DRAFT ◦ DECEMBER 2018

Environmental Impact Report for the Lower Klamath Project License Surrender Volume II

State Clearinghouse No. 2016122047



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Draft Environmental Impact Report for the Lower Klamath Project License Surrender

Volume II

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Prepared for:
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December 2018

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Appendix A

Notice of Preparation
and
Scoping Report
for
Lower Klamath Project License Surrender
Environmental Impact Report

The Notice of Preparation (Appendix A) for the Lower Klamath Project License Surrender Environmental Impact Report is available on the State Water Board's website at the following link (originally released on December 22, 2016):

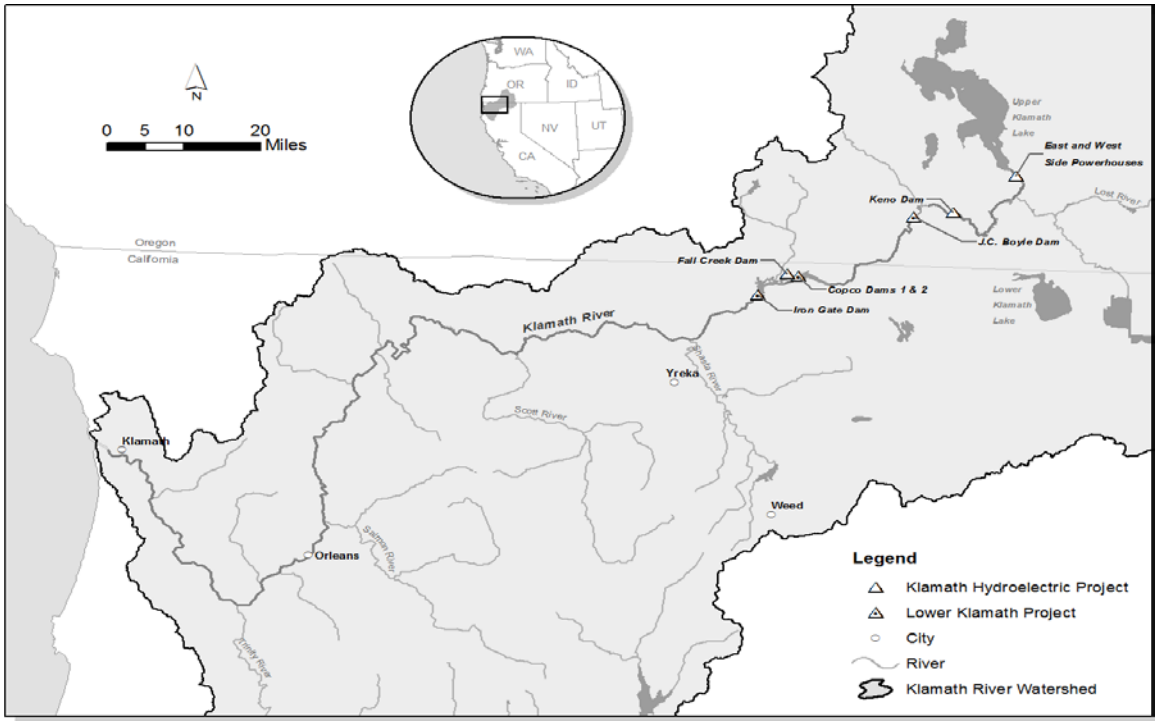
https://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/docs/lower_klamath_ferc14803/appxa_notice_of_preparation.pdf

The Scoping Report for the Lower Klamath Project License Surrender Environmental Impact Report is available on the State Water Board's website at the following link (originally released on April 28, 2017):

http://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/lower_klamath_ferc14803.shtml

01-10-2017: updated to reschedule Yreka scoping meeting, see page 4

NOTICE OF PREPARATION AND SCOPING MEETINGS FOR AN ENVIRONMENTAL IMPACT REPORT FOR THE LOWER KLAMATH PROJECT LICENSE SURRENDER



PROJECT AREA

To save paper, the State Water Resources Control Board (State Water Board) strongly encourages interested parties to subscribe to the State Water Board's Email Subscription List to electronically receive Lower Klamath Project specific information. Instructions on how to sign up for the State Water Board's Email Subscription List are outlined below:

1. Visit: http://www.waterboards.ca.gov/resources/email_subscriptions/swrcb_subscribe.shtml#rights
2. Provide your name and email in the required fields.
3. In the categories below the email and name fields, select "Water Rights," then "Lower Klamath Project."
4. Click on the "Subscribe" button.
5. An email will be sent to you. You must respond to the email message(s) to confirm your membership on the selected list(s).

Alternatively, you may request to be placed on the State Water Board's hard copy mailing list. Requests to receive information should be sent to:

Mr. Parker Thaler
parker.thaler@waterboards.ca.gov
(916) 341-5321
State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA 95812-2000

There will also be the opportunity to sign up for a mailing list at the scoping meetings.

Notice of Preparation **Form B**

TO: State Clearinghouse
Governor's Office of Planning and Research
P.O. Box 3044
Sacramento, CA 95812-3044

SUBJECT: **Notice of Preparation of an Environmental Impact Report for the Proposed Lower Klamath Project License Surrender**

Lead Agency:
Agency Name: State Water Resources Control Board
Address: P.O. Box 2000
City/State/Zip: Sacramento, CA 95812-2000
Contact: Mr. Parker Thaler

Consulting Firm:
Firm Name: Stillwater Ecosystem, Watershed and Riverine Sciences
Address: 2885 Telegraph Avenue, Suite 400
City/State/Zip: Berkeley, CA 94705
Contact: Ms. Maia Singer

INTRODUCTION

Pursuant to the California Environmental Quality Act (CEQA)[1], the State Water Resources Control Board (State Water Board) will prepare an environmental impact report (EIR) for removal of the Lower Klamath Project (LKP) facilities. The EIR will be prepared to support consideration of the Klamath River Renewal Corporation's (KRRC) LKP application for water quality certification[2]. The KRRC is proposing to remove sufficient portions of the LKP to create a free flowing Klamath River and provide for volitional fish passage through the Federal Energy Regulatory Commission (FERC) license surrender process. The EIR will evaluate potential impacts of the LKP to water quality and other resources within California as compared to the environmental baseline, and will also evaluate a range of alternatives.

The LKP (FERC Project No. 14803) is currently part of the Klamath Hydroelectric Project (FERC Project No. 2082), which is owned and operated by PacifiCorp. The Klamath Hydroelectric Project presently consists of seven dam developments: (1) East Side; (2) West Side; (3) Keno; (4) J.C. Boyle; (5) Fall Creek (located on Fall Creek, a Klamath River tributary); (6) Copco No. 1; (7) Copco No. 2; and (8) Iron Gate.

On September 23, 2016, PacifiCorp and the KRRC filed a joint license transfer application with FERC, which seeks to transfer the J.C. Boyle, Copco No. 2, Copco No. 1, and Iron Gate dam developments to the KRRC. If FERC approves the license transfer application, the LKP will consist of four dam developments: (1) J.C. Boyle; (2) Copco No. 2; (3) Copco No. 1; and (4) Iron Gate. Concurrent with the license transfer application, the KRRC filed a license surrender application with FERC to decommission the LKP.

The license transfer and license surrender applications are consistent with the April 6, 2016, Amended Klamath Hydroelectric Settlement Agreement (KHSA). The Amended KHSA is an agreement between PacifiCorp; several state, federal and local governmental agencies[3]; two Native American Tribes; several nongovernmental organizations; and individual stakeholders

[1] Public Resources Code, sections 21000 et seq.
[2] Clean Water Act, section 401.
[3] The State Water Board is not a signatory to, and is not bound by, the original or the Amended KHSA.

designed to remove sufficient portions of the four dam developments that comprise the LKP to create a free flowing Klamath River and provide for volitional fish passage.

The State Water Board is seeking comments from trustee agencies, responsible agencies, and other interested persons concerning the scope and content of the environmental information to be included in the EIR. Please send your comments to Mr. Parker Thaler at the address shown at the end of this Notice of Preparation (NOP).

The information in this NOP is divided into the following sections below:

- Project Title
- Project Location
- Scoping Meetings
- Brief Description of Existing LKP Dam Developments
- Brief Description of Proposed Project
- Federal Energy Regulatory Commission Process
- Klamath Settlement Agreements
- State Water Board's Water Quality Certification
- CEQA Information
- Submittal of Written Comments
- Questions and Additional Information
- Attachment 1 – Summary of Potentially Significant Impacts Associated with the Lower Klamath Project License Surrender

PROJECT TITLE: Lower Klamath Project License Surrender

PROJECT LOCATION
The LKP is located along the Klamath River, in Siskiyou County, California, and in Klamath County, Oregon. The California portion of the LKP includes: Copco No. 2, Copco No. 1, and Iron Gate dam developments. The Oregon portion of the LKP includes the J.C. Boyle dam development, which is located on the Klamath River approximately 16 river miles from Oregon's border with California. The general locations of LKP dam developments are shown in the map on the first page of this NOP.

The EIR will focus primarily on impacts related to the actions proposed for the LKP's dam developments in California. Actions at J.C. Boyle will be described, but impacts will only be addressed to the extent that such actions will adversely impact the California environment. Oregon's Department of Environmental Quality[4] is responsible for acting on a separate water quality certification application for the LKP that addresses the J.C. Boyle dam development.

SCOPING MEETINGS
The State Water Board will hold scoping meetings to provide information on the Lower Klamath Project License Surrender, the water quality certification process, and to receive written or oral comments from agency personnel and other interested persons concerning the range of alternatives, potential significant effects, and mitigation measures that should be analyzed in the EIR. The time allotted for each individual or organization to comment orally may be limited if the number of people in attendance so requires. Scoping meetings will be documented by transcript.

Date and Time	Location	Address
January 12, 2017 (5:00 pm – 7:00 pm)	Arcata	D Street Neighborhood Center 1301 D Street Arcata, CA 95521
January 20, 2017 (10:00 am – 12:00 pm)	Sacramento*	CalEPA Building Byron Sheet Auditorium 1001 I Street, 2nd Floor Sacramento, CA 95814
January 26, 2017 (5:00 pm – 7:00 pm)	Yreka**	Best Western Miner's Inn – Convention Center, Auditorium 122 E. Miner Street Yreka, CA 96097
* The Sacramento meeting will be webcast live on the California Environmental Protection Agency (CalEPA) website at: www.calepa.ca.gov/broadcast/. During the webcast, webcast participants can submit comments via electronic mail to: wr401program@waterboards.ca.gov. ** On January 9, 2017, the State Water Board canceled the January 10, 2017, scoping meeting in Yreka due to inclement weather and a strong advisory against travel from the National Oceanic and Atmospheric Administration's National Weather Service. On January 10, 2017, the State Water Board rescheduled the Yreka public scoping meeting for January 26, 2017.		

If you have additional questions concerning these meetings, or would like to make a request for reasonable accommodations for a disability, please contact Parker Thaler by phone at (916) 341-5321 or by email at parker.thaler@waterboards.ca.gov.

It is the policy of the State Water Board to provide a work environment that is free from threats or acts of violence. Threats or acts of violence committed by, or directed at, any employee or

[4] Oregon's Department of Environmental Quality's website: http://www.oregon.gov/deq/pages/index.aspx

contractor will not be tolerated. Any person who appears before the State Water Board has an obligation to represent their interests in a professional manner. The State Water Board requests that all persons in or near a State Water Board hosted meeting refrain from engaging in inappropriate conduct. Inappropriate conduct may include disorderly, contemptuous or insolent behavior, breach of peace, boisterous conduct, violent disturbance, or other unlawful interference in the proceedings.

It is possible that one or more members of the State Water Board will attend one or more of the scoping meetings. A quorum of the State Water Board may be present at the scoping meetings. However, no State Water Board action will be taken.

BRIEF DESCRIPTION OF EXISTING LKP DAM DEVELOPMENTS

California Dam Developments (described in order from downstream to upstream):

Iron Gate Dam Development: The Iron Gate dam development is located on the Klamath River between river mile (RM) 190 and RM 197 in Siskiyou County, California. The Iron Gate dam development primarily consists of: 1) 53,800 acre-feet (AF) reservoir (Iron Gate reservoir); 2) 189-foot tall earthen dam with a clay core on a basalt rock foundation (Iron Gate dam); 3) Iron Gate Hatchery, which includes warehouse, hatchery building, four fish rearing ponds, a fish ladder, visitor center, and four employee residences; 4) fish collection facility at Iron Gate dam; 5) ungated side-channel spillway capable of discharging 26,200 cubic feet per second (cfs); 6) reinforced concrete diversion tunnel capable of diverting 2,700 cfs from the reservoir to the Klamath River; 7) 45-foot tall freestanding intake structure; 8) 18 megawatt (MW) powerhouse; 8) 6.5 miles of transmission lines; and 9) recreation facilities, including Fall Creek, Jenny Creek, Wanaka Springs, Camp Creek, Juniper Point, Mirror Cove, Overlook Point, Long Gulch, and small unnamed dispersed shoreline recreation sites. Recreation sites include communication buildings, restrooms, and two residences. Iron Gate dam supplies cold water to Iron Gate Hatchery, which is located below Iron Gate dam and powerhouse. Iron Gate Hatchery raises steelhead, coho salmon, and chinook salmon.

Copco No. 2 Dam Development: The Copco No. 2 dam development is located on the Klamath River between RM 196 and RM 199 in Siskiyou County, California. The Copco No. 2 dam development consists primarily of: 1) 70 AF unnamed reservoir; 2) 33-foot tall concrete diversion dam with a gated spillway (Copco No. 2 dam); 3) water conveyance system consisting of a 3,550 feet of concrete lined tunnels, 1,313 feet of a wood-stave pipeline, an underground surge tank and two steel penstocks; 5) 27 MW powerhouse; 6) control center building; 7) maintenance building; 8) oil and gas storage building; and 9) a nearby village consisting of a cookhouse, bunkhouse, storage building, bungalow, three modular houses, four old style ranch houses, and a schoolhouse/community center. Copco No. 2 dam is located approximately 0.25 miles downstream of Copco No. 1 dam and has no associated recreation facilities. Water diversions for hydropower generation at Copco No. 2 create a 1.5-mile-long bypass reach.

Copco No. 1 Dam Development: The Copco No. 1 dam development is located on the Klamath River between RM 198 and RM 204 in Siskiyou County, California. The Copco No. 1 dam development primarily consists of: 1) 40,000 AF reservoir (Copco reservoir); 2) 135-foot tall concrete gravity arch dam with a gated spillway (Copco No. 1 dam); 3) diversion tunnel capable of diverting 5,179 cfs; 4) switchyard; 5) two 10- and one 14-foot diameter penstock pipes; 6) 20 MW powerhouse; and 7) reservoir-associated recreation facilities, including Mallard Cove and Copco Cove. There is no bypass reach for this dam development.

Oregon Dam Development:

J.C. Boyle Dam Development: J.C. Boyle Dam is located on the mainstem of the Klamath River, at RM 224.7. J.C. Boyle Dam is a 68-foot tall concrete dam that impounds approximately 2,629 AF of water in a narrow reservoir with approximately 420 surface-acres. J.C. Boyle supplies water through a 2.5-mile water conveyance system to a 98 MW powerhouse. Water diversions for hydropower generation at J.C. Boyle create a 4.3-mile bypass reach. The approximately 17 miles downstream of the J.C. Boyle powerhouse comprise the J.C. Boyle peaking reach. This 17-mile reach is where the LKP crosses from Oregon into California and ends at the Copco No. 1 reservoir.

BRIEF DESCRIPTION OF PROPOSED PROJECT

The KRRC is proposing to remove sufficient portions of the Iron Gate, Copco No. 2, Copco No. 1, and J.C. Boyle dam developments to create a free flowing Klamath River and provide for volitional fish passage in the Klamath River currently occupied by these dam developments. The hydroelectric facilities and associated structures will either be removed or decommissioned in place.

The LKP would require improvements to roads, construction of staging areas, and creation of onsite debris disposal sites. The LKP would also require changes to the city of Yreka's Fall Creek water supply. Yreka receives 15 cfs of water through a 24-inch diameter pipe that runs from the Fall Creek dam development, crosses the Klamath River near the upstream end of Iron Gate reservoir, to the City of Yreka's water distribution system.

The LKP would result in large sediment releases as water and sediment stored behind J.C. Boyle, Copco No. 2, Copco No. 1, and Iron Gate reservoirs are released during, and to a lesser extent, following decommissioning activities. Proposed post-decommissioning restoration activities include revegetation, invasive species control, and removal or modification of existing reservoir recreation facilities. The KRRC's water quality certification application proposes the following schedule in order to minimize sediment releases during the critical times and life stages of various sensitive species downstream:

Proposed Schedule for Lower Klamath Project	
Staging Activities	Beginning June 2019
Reservoir Drawdown	January 2020 – October 2020
Copco No. 1 Dam Development Removal	January 2020 – May 2020
J.C. Boyle Dam Development Removal	January 2020 – September 2020
Copco No. 2 Dam Development Removal	May 2020 – October 2020
Iron Gate Dam Development Removal	July 2020 – November 2020

A more detailed description of the Proposed Project is provided in the KRRC's application for water quality certification, which is available at: http://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/lower_klamath_ferc14803.shtml, and in the Final *Klamath Facilities Removal Draft Environmental Impact Statement/Environmental Impact Report* (2012 KHSA EIS/EIR), sections 2.4.3 and 2.4.4, available at: https://klamathrestoration.gov/Draft-EIS-EIR/download-draft-eis-eir.

FEDERAL ENERGY REGULATORY COMMISSION PROCESS

FERC is the federal agency that regulates the construction, operation, and decommissioning of most non-federal hydroelectric dams in the United States. The LKP (FERC Project No. 14803) is currently owned and operated by PacifiCorp as part of the Klamath Hydroelectric Project (FERC Project No. 2082).[5] On September 23, 2016, PacifiCorp and the KRRC filed a joint license transfer application with FERC, which seeks to transfer the J.C. Boyle, Copco No. 2, Copco No. 1, and Iron Gate dam developments to the KRRC. Concurrent with the license transfer application, the KRRC filed a license surrender application with FERC to decommission the LKP. The LKP license transfer and surrender processes are subject FERC's approval.

In September 2006, during PacifiCorp's Klamath Hydroelectric Project relicensing process, FERC released a draft Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA). FERC's draft EIS for the Klamath Hydroelectric Project examines the probable effects of a range of alternatives, including continued operations of the dam developments with or without fish passage improvements, and removal of some or all of the four dam developments that compromise the LKP. FERC received extensive comments from agencies and interested parties. FERC released its final EIS for the Klamath Hydroelectric Project in November 2007 and it is available online at: https://www.ferc.gov/industries/hydropower/enviro/eis/2007/11-16-07.asp.

KLAMATH SETTLEMENT AGREEMENTS

Concurrent with PacifiCorp's FERC relicensing of the Klamath Hydroelectric Project, the following three Settlement Agreements were executed by a number of parties with varying interests in the Klamath Basin: 1) KHSA (Klamath Hydroelectric Settlement Agreement); 2) Klamath Basin Restoration Agreement (KBRA); and 3) Upper Klamath Basin Comprehensive Agreement (UKBCA). These settlement agreements, among other things: 1) provided a decision-making framework and process for removal of J.C. Boyle, Copco No. 2, Copco No. 1, and Iron Gate dam developments; 2) addressed water supply and allocation issues; and 3) set forth substantial water quality improvement measures for the Upper Klamath Basin.

The original KHSA proposed federal legislation that would have halted PacifiCorp's FERC relicensing process and granted the Secretary of the United States Department of the Interior the authority to determine whether removing J.C. Boyle, Copco No. 2, Copco No. 1, and Iron Gate dam developments was in the public interest and would advance salmon restoration (Secretarial Determination).

In accordance with the original KHSA, the 2012 KHSA EIS/EIR was prepared to support Klamath Hydroelectric Project dam removal and to inform the Secretarial Determination. On September 22, 2011, the United State Department of Interior and the California Department of Fish and Game (now California Department of Fish and Wildlife) released the *Draft Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report*. The agencies circulated the Final 2012 KHSA EIS/EIR, but the United States Department of Interior never entered a Record of Decision and the California Department of Fish and Wildlife never certified the document.[6]

[5] The Klamath Hydroelectric Project was originally licensed in 1956 for a term of 50 years. On March 1, 2006, the original FERC license expired and since then PacifiCorp has continued to operate the Klamath Hydroelectric Project (including the LKP dam developments) under annual licenses issued by FERC while PacifiCorp pursued relicensing. On June 16, 2016, at PacifiCorp's request, FERC issued an order placing the Klamath Hydroelectric Project relicensing process in abeyance.

[6] The final 2012 KHSA EIS/EIR is dated December 2012, but was released in April 2013.

Similar to FERC's 2007 NEPA document, the 2012 KHSA EIS/EIR evaluated a range of project alternatives including continued operation of the dam developments, with and without fish passage improvements, as well as removal of some or all of the dams that make up the LKP. The 2012 KHSA EIS/EIR is available online at: https://klamathrestoration.gov/Draft-EIS-EIR/download-draft-eis-eir.

Federal legislation to enact the settlement agreements did not pass, and on December 31, 2015, the KBRA terminated. On April 6, 2016, the KHSA was amended to remove the need for Congressional authorization, and instead contemplates dam removal through the FERC license surrender process. Also on April 6, 2016, some of the parties to the KHSA and KBRA executed the Klamath Power and Facilities Agreement. The Klamath Power and Facilities Agreement addresses the disposition of specific Oregon facilities on the Klamath River, and expresses a commitment to continue negotiations regarding certain issues addressed in the KBRA. The State Water Board understands that the UKBCA remains in effect.

STATE WATER BOARD'S WATER QUALITY CERTIFICATION

The State Water Board's water quality certification process results from the KRRC's FERC license surrender application, filed in furtherance of the Amended KHSA. Section 401 of the Clean Water Act (33 U.S.C. § 1341) requires every applicant for a federal license or permit that may result in a discharge into navigable waters to provide the federal licensing or permitting agency with certification that the project will be in compliance with state water quality standards and other relevant requirements of state law. Section 401 provides that conditions of certification shall become conditions of any federal license or permit for the project. The State Water Board is the agency in California that is responsible for section 401 water quality certifications (Wat. Code, § 13160; Cal. Code Regs., tit. 23, § 3855, subd. (b)).

There are water quality impacts associated with both the operation and decommissioning of the LKP dam developments. The Klamath River and water bodies associated with the LKP dam developments are listed in the California's 2012 Clean Water Act Section 303(d) List of Impaired Water Bodies (2012 Integrated Report) as follows:

- The Klamath River from the Oregon border to the Pacific Ocean is listed for nutrients, organic enrichment/low dissolved oxygen, and temperature.
- Iron Gate and Copco No. 1 reservoirs are listed for mercury and for a liver toxin produced by blue-green algae, called microcystin.
- The Klamath River from Copco No. 1 reservoir to the Trinity River is listed for microcystin.
- The Klamath River from the Trinity River to the Pacific Ocean is listed for sediment.
- The Klamath River from Iron Gate Dam to the Scott River is listed for aluminum.

The State Water Board may issue a water quality certification if it determines that a project will comply with specific federal Clean Water Act requirements (including water quality standards and implementation plans) and with other relevant requirements of state law. The State Water Board will determine whether decommissioning the LKP dam developments adequately protects the beneficial uses and meets the water quality objectives for water bodies affected by the LKP, as defined in the *Water Quality Control Plan for the North Coast Region* (Basin Plan), as well as other relevant standards. Additional information concerning the Basin Plan and designated beneficial uses is available online at: http://www.waterboards.ca.gov/northcoast/water_issues/programs/basin_plan/basin_plan.shtml

CEQA INFORMATION

The issuance of a section 401 certification is a discretionary action subject to CEQA compliance. Because there are potentially significant environmental impacts associated with the LKP, the State Water Board has decided to prepare an EIR.

The State Water Board previously initiated CEQA review for PacifiCorp's continued operations of the Klamath Hydroelectric Project and associated LKP dam developments by issuing a NOP for an EIR in September 2008 and again in November 2015. During the 2008 and 2015 CEQA processes, the State Water Board held extensive scoping meetings.

Following issuance of the September 2008 NOP, on February 18, 2010, the original KHSA was executed. From May 18, 2010, to July 1, 2013, at the request of KHSA signatories, the State Water Board issued a series of time-limited abeyances holding PacifiCorp's 2008 water quality certification application in abeyance. The State Water Board's fourth and final water quality certification abeyance ended on July 1, 2013, and the State Water Board resumed processing PacifiCorp's Klamath Hydroelectric Project water quality certification application and issued a second NOP in November 2015, in light of significant new information developments.

On June 16, 2016, FERC issued an order to hold PacifiCorp's Klamath Hydroelectric Project relicensing process in abeyance. Following FERC's order, PacifiCorp withdrew its water quality certification application from the State Water Board. The withdrawal of PacifiCorp's water quality certification application suspended the November 2015 Klamath Hydroelectric Project's CEQA process.

In developing an EIR to support the State Water Board's consideration of a water quality certification for the LKP, the State Water Board will consider FERC's 2007 EIS and the 2012 KHSA EIS/EIR. The State Water Board plans to evaluate a range of alternatives from the No Project Alternative to removal of the four Lower Klamath Project dam developments (KRRC's Proposed Project). State Water Board staff encourages interested parties to provide input regarding which alternatives should be evaluated in the EIR and recommends parties reference existing alternatives in the 2007 FERC EIS and 2012 KHSA EIS/EIR, where applicable.

Attachment 1 provides a broad summary of potentially significant impacts identified by resource area. Additional information on potential impacts is available in the FERC 2007 EIS (summary included in Table ES-1, pp. xxxix – l.) and the 2012 KHSA EIS/EIR (summary included in Table 5-1, pp. 5-8 to 5-75).

SUBMITTAL OF WRITTEN COMMENTS

Please send written scoping comments to the address below. Please provide a contact person and contact information in case there are questions about the comments. **The comment deadline is 5:00 pm on February 1, 2017.**

State Water Resources Control Board
Division of Water Rights
Water Quality Certification Program
Attention: Mr. Parker Thaler
P.O. Box 2000
Sacramento, CA 95812-2000

Phone: (916) 341-5321
Fax: (916) 341-5400
Email: parker.thaler@waterboards.ca.gov

QUESTIONS AND ADDITIONAL INFORMATION
General questions should be directed to Mr. Parker Thaler at (916) 341-5321 or parker.thaler@waterboards.ca.gov.

Information related to the water quality certification for the LKP is available on the State Water Board's LKP webpage at:
http://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/lower_klamath_ferc14803.shtml

DEC 2 2 2016

Erin Ragazzi
Water Quality Certification Program Manager
Division of Water Rights

Date

Attachment 1: Summary of Potentially Significant Impacts Associated with the Lower Klamath Project License Surrender

Attachment 1: Summary of Potentially Significant Impacts Associated with the Lower Klamath Project License Surrender

The Lower Klamath Project License Surrender environmental impact report (EIR) will examine potentially significant impacts of the Lower Klamath Project License Surrender in a wide range of areas. Below is a list that provides a broad summary of potentially significant impacts anticipated with the Klamath River Renewal Corporation's Lower Klamath Project (LKP). A more detailed summary of potential impacts is available in the Federal Energy Regulatory Commission's 2007 *Environmental Impact Statement* (summary included in Table ES-1, pp. xxxix – l.) and the 2012 *Klamath Facilities Removal Draft Environmental Impact Statement/ Environmental Impact Report* (summary included in Table 5-1, pp. 5-8 to 5-75):

Aesthetics:

- Removal of dams and associated hydroelectric and recreational facilities, and restoration activities, could have short-term and long-term impacts on landscape aesthetics; and
- Sediment transport could change the appearance of the Klamath River.

Air Quality:

- Construction, dam removal and restoration activities will temporarily affect air quality, potentially increasing volatile organic compounds, dust, and criteria pollutant levels to significant levels.

Aquatic Resources:

- Reservoir draw-down and dam removal could cause short-term impacts to critical habitat for coho, bull trout, and Southern Resident killer whale populations;
- Dam removal activities could alter the quality of essential habitat for coho salmon, chinook salmon, groundfish, Southern Resident killer whales and pelagic fish;
- Suspended sediment concentrations, sediment deposition, and bedload sediment changes associated with dam removal could affect habitat for various species, including salmonids, Pacific lamprey, green sturgeon, eulachon, longfin smelt, freshwater mussels, and benthic macroinvertebrates; and
- Dam removal would eliminate reservoir habitat associated with the existing LKP dam developments.

Flood Hydrology:

- Reservoir drawdown could affect flood risk in the short-term;
- Downstream sediment deposition could change flood risk;
- Flow regime changes associated with dam removal activities could change the 100-year floodplain; and
- Realigning the City of Yreka's water supply pipeline could alter flood risk.

Geology, Soils, and Geologic Hazards:

- Draining the reservoirs and releasing sediment could cause short-term and long-term increases in sediment deposition that could alter geomorphological characteristics in the Klamath River and/or Klamath Estuary;
- Dam removal, construction and restoration activities may cause significant erosion in the LKP area and downstream;
- Draining the reservoirs may alter seismic and volcanic activity; and
- Drying of exposed reservoir bed sediments could affect future restoration and construction activities.

Attachment 1: Summary of Potentially Significant Impacts Associated with the Lower Klamath Project License Surrender

Greenhouse Gas Emissions:

- Removal of a very low-emission power source (i.e., hydroelectric projects) may result in increased greenhouse gas emissions from replacement sources; and
- Construction, dam removal and restoration activities will temporarily increase greenhouse gas emissions.

Historical and Archeological Resources:

- Removal of dams and associated hydroelectric facilities may affect hydroelectric structures and a potential historical district;
- Reservoir removal, changing sedimentation, flow and erosion patterns could affect submerged or riparian archeological resources; and
- Potential effects to tribal cultural resources may also be considered effects to historical and archeological resources.

Land Use, Agricultural and Forest Resources:

- The exposure of the reservoir bed, restoration activities, dam removal activities (including roads, staging areas, and debris disposal), and removal of recreational facilities could impact land use, and potentially result in the conversion of forest or farmland to other uses.

Noise and Vibration:

- Dam removal activities, and particularly dam blasting activities, could result in localized noise impacts and increased vibration levels; and
- Noise levels along haul routes could be increased.

Population and Housing:

- Employment for proposed activities may result in new jobs, including potential temporary housing needs for any non-local employees.

Public Health and Safety, Utilities and Public Services, Solid Waste, and Power:

- Dam removal activities could result in public safety risks and potentially increase fire risk;
- Dam removal could affect water availability and response times for wildfires and area residential fires;
- Dam removal activities could require new roads and temporarily affect traffic safety;
- The City of Yreka's water supply pipeline could potentially be more vulnerable to vandalism;
- Sediment releases associated with dam removal activities could result in short-term human exposure to contaminants from contact with exposed sediments;
- Dam removal activities could affect the need and response time for public services;
- Dam removal could temporarily affect available mosquito habitat and related disease transmission;
- Dam removal could result in significant amounts of debris; and
- Loss of hydroelectric power could impact the supply of electricity.

Recreation:

- Reservoir-based recreation would be affected by reservoir drawdown, dam removal, construction and restoration activities;
- Changes in water quality, sedimentation, floodplain and river channel could affect river-based recreational activities downstream of facilities, including fishing and contact recreation; and
- Whitewater boating opportunities would be changed under an altered flow regime.

Attachment 1: Summary of Potentially Significant Impacts Associated with the Lower Klamath Project License Surrender

Terrestrial Resources:

- Dam removal activities and associated flushing of sediments could result in loss of wetland habitat in the LKP area and downstream, as well as impacts to wildlife corridors;
- Dam removal activities could negatively impact special status and culturally important species; and
- Disturbed areas resulting from the LKP could provide habitat for invasive plants.

Toxic/Hazardous Materials:

- Dam removal activities could involve transport and handling of hazardous materials, including risk of release.

Traffic and Transportation:

- Traffic associated with dam removal activities could affect traffic flow and safety, including to public transit and non-motorized transportation (e.g., pedestrians, bicycles);
- Changes in land use could result in traffic changes; and
- Increased heavy vehicle traffic during construction could increase wear on roads and potentially exceed bridge weight limits.

Tribal Cultural Resources:[7]

- Construction and restoration activities could affect sites and landscapes with tribal cultural value;
- Reservoir dewatering and removal could affect items and areas with tribal cultural resources that are currently submerged;
- Changing sedimentation, flow and erosion patterns could affect tribal cultural resource areas downstream; and
- Landscapes, ecosystems and species that are tribal cultural resources could be affected by dam removal and restoration activities.

Water Quality:

- Dam removal activities could contribute to changes in water quality, including:
    - Short- and long-term changes to the water temperature regime;
    - Biological oxygen demand and daily dissolved oxygen variability;
    - Short-term increases in suspended sediment and sediment associated nutrients in the Klamath River from the California state line to the marine nearshore environment, and may affect long-term suspended sediment and sediment associated nutrients in the Lower Klamath River, Klamath Estuary, and marine nearshore environment;
    - Long-term summer time increases in pH downstream of Iron Gate Dam;
    - Short-term increases in inorganic or organic contaminant levels;
    - Changes in nutrient levels, biomass, and algal cycling, potentially from the state line through the Klamath Estuary;
    - Short- and long-term changes to algae populations and associated algal toxins in the Lower Klamath River from the California state line to the Klamath Estuary; and
    - Long-term increases in nutrient levels and periphyton biomass in the Klamath River downstream of Iron Gate Dam.

[7] This resource area was added to California Environmental Quality Act in 2014 (Assembly Bill 52; Statutes 2014, Chapter 532, Gatto), and has not been specifically evaluated in prior environmental documents. Tribal governments have been actively involved in issues surrounding the disposition of the Klamath Hydroelectric Project and associated LKP for many years. The State Water Board looks forward to working with California Native American Tribes to develop this analysis and any potential alternatives and mitigation measures.

- Restoration activities could involve application of herbicides that could cause short-term levels of organic contaminants in runoff that are toxic to aquatic biota in the LKP area.

Water Supply:

- Eliminating the reservoirs could impact groundwater wells near the reservoirs and the amount of groundwater recharge;
- Changes to the flow regime below Iron Gate Dam could affect water supply and water rights;
- Removal of Iron Gate Reservoir will require realignment of City of Yreka's water diversion pipeline from Fall Creek; and
- Sediment releases may affect Klamath River geomorphology, which can affect downstream water intake pumps.

Scoping Report

for

Lower Klamath Project License Surrender

Environmental Impact Report

California State Water Resources Control Board

April 2017

CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

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Abbreviations and Acronyms

BiOp	Biological Opinion
CalEPA	California Environmental Protection Agency
CCC	California Coastal Commission
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CDFW	California Department of Fish and Wildlife
CWA	Clean Water Act
DWR	California Department of Water Resources
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
GHG	Greenhouse Gas
IFR	Institute for Fisheries Resources
KBRA	Klamath Basin Restoration Agreement
KHP	Klamath Hydroelectric Project
KHSA	Klamath Hydropower Settlement Agreement
KRRC	Klamath River Renewal Corporation
LKP	Lower Klamath Project
North Coast Regional Board	North Coast Regional Water Quality Control Board
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOP	Notice of Preparation
PCFFA	Pacific Coast Federation of Fisherman's Associations
State Water Board	State Water Resources Control Board
TMDL	Total Maximum Daily Load
USFWS	United States Fish and Wildlife Service

1 INTRODUCTION

Pursuant to the California Environmental Quality Act (CEQA), the State Water Resources Control Board (State Water Board) will prepare an Environmental Impact Report (EIR) for removal of the Lower Klamath Project (LKP) dam developments. The EIR is being prepared to support consideration of the Klamath River Renewal Corporation's (KRRC) LKP application for water quality certification. The KRRC is proposing to remove sufficient portions of the LKP to create a free-flowing Klamath River and provide for volitional fish passage through the Federal Energy Regulatory Commission (FERC) license surrender process. The EIR will evaluate potential impacts of the LKP to water quality and other resources within California as compared to the environmental baseline, and will also evaluate a range of alternatives.

As part of the environmental review process, the State Water Board issued the *Notice of Preparation and Scoping Meetings for an Environmental Impact Report for the Lower Klamath Project License Surrender (NOP)* (Appendix A) for a 42-day public comment period and held three public scoping meetings to solicit public and stakeholder input. This Scoping Report documents the scoping process that occurred for the NOP, including the public scoping meetings and all comments received.

1.1 Scoping Purpose and Process

Scoping is generally defined as "early public consultation," and is one of the first steps of the CEQA environmental review process. The purpose of scoping is to involve the public, stakeholders, Native American Tribes, and other interested agencies early in the CEQA process to help determine the range of actions, alternatives, mitigation measures, and significant effects to be analyzed in depth in an EIR and to eliminate from detailed study, issues found not to be important (CEQA Guidelines Section 15083). Scoping has also been found to be "an effective way to bring together and resolve the concerns of affected federal, state, and local agencies, the proponent of the action, and other interested persons including those who might not be in accord with the action on environmental grounds" (CEQA Guidelines Section 15083).

As part of the scoping process, agencies often conduct public meetings. Public meetings allow interested persons to listen to information about a proposed project or action and express their concerns and viewpoints to the implementing agencies. During scoping meetings, the lead agency generally outlines the proposed project, identifies issues to be addressed in the environmental compliance document, and solicits public comments. Agencies also establish a scoping comment period to accept scoping comments submitted in writing. Scoping comments are considered by the agencies during the formulation of alternatives and are used to determine the scope of the environmental issues to be addressed in the environmental document. The State Water Board's NOP public scoping period began on December 22, 2016 and ended at 5:00 p.m. on February 1, 2017.

1.2 CEQA Scoping Requirements

After the lead agency determines an EIR is required for a project, the lead agency shall send a Notice of Preparation of an EIR to the Office of Planning and Research and each

responsible and trustee agency. This notice is also sent to every federal agency involved in approving or funding the project (CEQA Guidelines Section 15082 (a)).

For a project of statewide, regional, or area-wide significance, the lead agency must conduct at least one scoping meeting, and provide notice of the scoping meeting to all of the following[1]:

a) Any county or city that borders on a county or city within which the project is located, unless agreed otherwise;
b) Any responsible agency;
c) Any public agency that has jurisdiction by law with respect to the project; and
d) Any organization or individual who has filed a written request for the notice.

2 PROJECT OVERVIEW

This section describes the project location and background, and the alternatives introduced during scoping.

2.1 Project Location and Background

The LKP (FERC Project No. 14803) is located along the Klamath River, in Siskiyou County, California, and in Klamath County, Oregon (Figure 2-1). The LKP is currently part of the Klamath Hydroelectric Project (FERC Project No. 2082), which is owned and operated by PacifiCorp. The Klamath Hydroelectric Project (KHP) presently consists of seven dam developments: East Side, West Side, Keno, J.C. Boyle, Fall Creek (located on Fall Creek, a Klamath River tributary), Copco No. 1, Copco No. 2, and Iron Gate. On September 23, 2016, PacifiCorp and the KRRC filed a joint license transfer application with FERC, which seeks to transfer the J.C. Boyle, Copco No. 2, Copco No. 1, and Iron Gate dam developments to the KRRC. If FERC approves the license transfer application, the California portion of the LKP would include the Copco No. 2, Copco No. 1, and Iron Gate dam developments and the Oregon portion of the LKP would include the J.C. Boyle dam development. Concurrent with the license transfer application, the KRRC filed a license surrender application with FERC to decommission the LKP.

The State Water Board is the California State agency responsible for Clean Water Act (CWA) Section 401 water quality certifications that involve or are associated with a hydroelectric facility, and for which the proposed activity requires a FERC license or amendment to a FERC license (Wat. Code section 13160; Cal Code Regs., tit. 23, section 3855, subd. (b)(1)(B)(2)). On September 23, 2016, the KRRC submitted a water quality certification application to the State Water Board to decommission the LKP. Prior to the State Water Board taking a final action on the KRRC's water quality certification application, it must first comply with CEQA. The State Water Board has determined it is the CEQA lead agency for the KRRC's LKP, and an EIR will be prepared.

This EIR will focus primarily on impacts related to the actions proposed for the LKP's dam developments in California. Actions at J.C. Boyle will be described, but impacts will

[1] CEQA Guidelines Section 15082.

only be addressed to the extent that such actions will adversely impact the California environment. The Oregon Department of Environmental Quality (ODEQ) is responsible for acting on a separate water quality certification application for the LKP License Surrender that addresses the J.C. Boyle dam development.

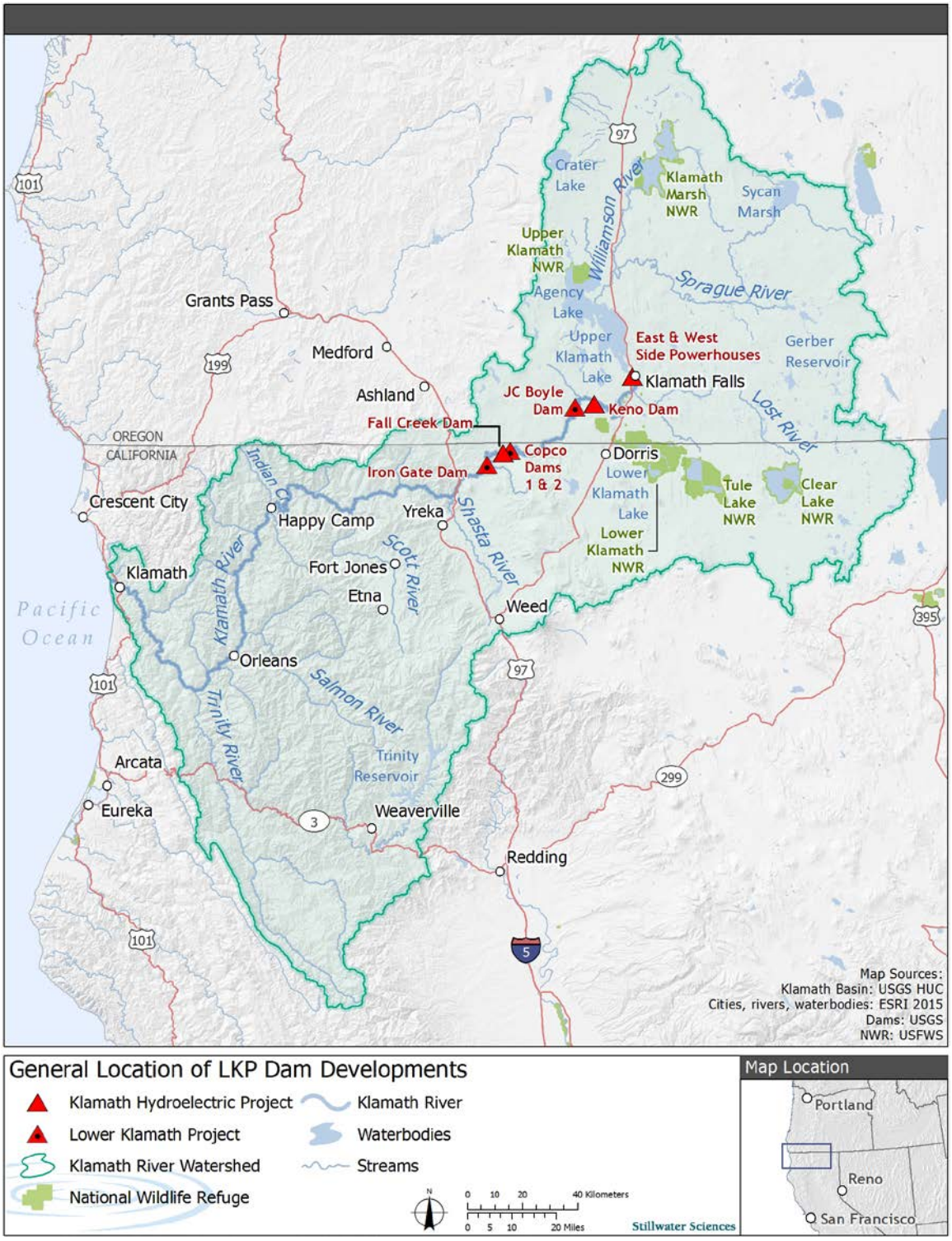


Figure 2-1. General Location of LKP Dam Development.

2.2 Alternatives Introduced During Scoping

As included in the NOP (Appendix A) and discussed at the public scoping meetings, the State Water Board will evaluate a range of alternatives from the No Project Alternative to removal of the four LKP dam developments (KRRC's Proposed Project). The State Water Board requested input from the public on the range of alternatives and any suggestions for specific alternatives to the KRRC's Proposed Project (see also Appendix B).

Per CEQA Guidelines 15126.6(f), "The range of alternatives required in an EIR is governed by a "rule of reason" that requires the EIR to set forth only those alternatives necessary to permit a reasoned choice. The alternatives shall be limited to ones that would avoid or substantially lessen any of the significant effects of the project. Of those alternatives, the EIR need examine in detail only the ones that the Lead Agency determines could feasibly attain most of the basic objectives of the project. The range of feasible alternatives shall be selected and discussed in a manner to foster meaningful public participation and informed decision making."

The NOP indicated that the EIR will evaluate environmental impacts associated with the KRRC's Proposed Project and alternatives to the KRRC's Proposed Project. The NOP included a summary of potentially significant impacts anticipated with the KRRC's Proposed Project in NOP Attachment 1: Summary of Potential Impacts Associated with the Lower Klamath Project License Surrender. (Appendix A).

3 NOTICE OF PREPARATON AND SCOPING MEETINGS

3.1 Scoping Meetings

This section provides summary information regarding the scoping meetings. The dates and locations of the scoping meetings are presented in Table 3-1.

The State Water Board recognizes the complex and controversial nature of the proposed LKP removal, that different communities along the Klamath River have different input to provide, and that travel for community members might be difficult. In this context, valuable community input may have been lost under CEQA's minimum requirement of one scoping meeting. To facilitate community input, the State Water Board conducted three scoping meetings during the NOP comment period.

Table 3-1. Public Scoping Meetings – Dates and Locations.

Arcata, CA
January 12, 2017 (5:00 pm–7:00 pm) D Street Neighborhood Center 1301 D Street Arcata, CA 95521
Sacramento, CA
January 20, 2017 (10:00 am–12:00 pm) CalEPA Building – Byron Sheet Auditorium 1001 I Street, 2nd Floor Sacramento, CA 95814
Yreka, CA
January 26, 2017 (5:00 pm–7:00 pm) Best Western Miner's Inn – Convention Center, Auditorium 122 E. Miner Street Yreka, CA 96097

The Sacramento public scoping meeting was recorded and webcast live on the California Environmental Protection Agency (CalEPA) website (www.calepa.ca.gov/broadcast/). During the webcast, participants were invited to submit comments via electronic mail to: wr401program@waterboards.ca.gov. One comment was submitted via email as part of the webcast meeting (Appendix C). A video recording of the CalEPA scoping meeting is available online at: http://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/scoping_meeting_2017.shtml.

The Yreka public scoping meeting was originally scheduled for January 10, 2017. On January 9, 2017, the State Water Board canceled the Yreka scoping meeting due to inclement weather and a strong advisory against travel from the National Oceanic and Atmospheric Administration's (NOAA's) National Weather Service.
On January 10, 2017, the State Water Board rescheduled the Yreka scoping meeting for January 26, 2017, providing an additional two weeks' notice for interested parties to make arrangements to attend.

3.1.1 Notice of Preparation

The State Water Board exceeded the CEQA notification requirements (CEQA Guidelines 15082 and 15083). On December 22, 2016, the State Water Board sent the NOP to the following entities:

- Governor's Office of Planning and Research (hand delivered)
- Forty-four letters to responsible, trustee, and federal agencies (certified mail)
- Siskiyou, Del Notre, Humboldt, Modoc, Shasta, Trinity, and Sacramento County Clerk offices (certified mail)

In addition, on December 22, 2016, State Water Board staff posted the NOP on its Lower Klamath Project webpage, and sent notification to all interested parties on the State Water Board's "Lower Klamath Project License Surrender" and "Water Rights Water Quality Certification" email subscription lists. Certified mail records indicate that County Clerk NOP notices were delivered between December 23, 2016 and

December 29, 2016, as follows: Sacramento (December 23, 2016); Siskiyou, Del Norte, Humboldt, Modoc, and Shasta (December 27, 2016); Trinity (December 29, 2016). Certified mail records indicate the responsible, trustee, and federal agencies were delivered between December 23, 2016 and December 28, 2016, with the exception of the Sierra Nevada Conservancy which was delivered on January 28, 2017[2].

In late December 2016, State Water Board staff was contacted by three individuals who had heard about the scoping meetings, but were requesting additional information regarding the scoping meetings or copies of the Notice of Preparation, as they had not received them directly. Based on those requests, State Water Board staff determined it would be beneficial to notify parties on PacifiCorp's KHP email and hard copy mailing lists[3].

On January 3, 2017, the State Water Board provided electronic notice to the KHP's email list, in addition to providing links to the NOP. This email provided information to interested parties about the water quality certification process and included directions on how to sign up for the "Lower Klamath Project License Surrender" email list, so that interested parties could continue to receive updates related to the LKP as it relates to the State Water Board's water quality certification process. On January 6, 2017, the State Water Board also sent the NOP to individuals on the KHP hard copy mailing list. The January 6, 2017, letter also directed interested parties to sign up for the Lower Klamath Project License Surrender email list or contact State Water Board staff to be added to the hard copy mailing list for the LKP.

Due to adverse weather conditions, the State Water Board canceled and rescheduled the Yreka public scoping meeting (see Scoping Report Section 3.1 – Scoping Meetings).

Shortly after rescheduling the Yreka public scoping meeting, on January 11, 2017, the State Water Board provided updated information to:

- Responsible, trustee, and federal agencies (certified mail)
- Siskiyou, Del Notre, Humboldt, Modoc, Shasta, Trinity, and Sacramento County Clerk offices (certified mail)
- FERC's eLibrary (electronic submission)
- Interested parties on the Lower Klamath Project email subscription list
- Interested parties on the Water Rights Water Quality Certification email subscription list
- Interested parties on the KHP email subscription list
- Interested parties on the Klamath Hydroelectric Project hardcopy mailing list
- State Water Board's Lower Klamath Project webpage

3.1.2 Newspaper Advertisements

To facilitate public input during the NOP public comment period, the State Water Board posted information regarding the scoping meetings in the following newspapers:

[2] Delivery attempted on December 24, 2016, but office was closed.
[3] PacifiCorp's Klamath Hydroelectric Project email and hard copy mailing lists were prepared for PacifiCorp's Klamath Hydroelectric Project, which is a separate FERC project than the KRRC's LKP.

- Eureka Times-Standard (January 6, 8, and 10, 2017)
- Sacramento Bee (January 6, 8, and 9, 2017)
- Siskiyou Daily News (January 6, 8, and 9, 2017)

Following the cancelation and rescheduling of the Yreka public scoping meeting, the State Water Board made the following additional newspaper postings to reflect the updated Yreka public scoping meeting:

- Eureka Times-Standard (January 22 and 24, 2017)
- Sacramento Bee (January 22 and 23, 2017)
- Siskiyou Daily News (January 23, 24, 25, and 26, 2017)

3.1.3 Website

As stated in the NOP, information related to the water quality certification for the LKP has been made available to the public since December 20, 2016, on the State Water Board's LKP webpage http://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/lower_klamath_ferc14803.shtml

3.2 Scoping Meeting Format and Content

This section describes the overall public scoping meeting format and content.

3.2.1 Agenda

The scoping meetings began with registration at the door, where attendees were asked to sign in and were provided a Scoping Meeting Information Sheet (see Appendix B). Sign-in sheets were provided to record the list of attendees. The State Water Board then gave a formal presentation (see Appendix B). After the presentation, attendees were given an opportunity to ask procedural questions, followed by a public oral comment period. Each scoping meeting continued until all public participants who wanted to provide oral comments had the opportunity to speak.

3.2.2 Meeting Materials

Meeting materials were made available to the public at each of the scoping meetings. These meeting materials included:

- Scoping Meeting Information Sheet (including online links to the NOP, the project website, email subscription instructions to receive project updates, a project location map, and other pertinent project-related information);
- Upon request copies of the visual (i.e., PowerPoint) presentation and NOP were available; and
- A speaker/comment card for individuals who wanted to provide written or oral comments during the scoping meetings.

A copy of all scoping meeting materials provided can be found in Appendix B of this Scoping Report.

3.3 Staff

A list of agency and consultant staff that attended the public scoping meetings is provided in Table 3-2.

Table 3-2. State Water Board and Consultant Staff that Attended Public Scoping Meetings.

Arcata, CA	
Erin Ragazzi	State Water Board
Parker Thaler	State Water Board
Marianna Aue	State Water Board
Kristen Gangl	State Water Board
Maia Singer	Stillwater Sciences
Lauren McClure	Stillwater Sciences
William Rich	William Rich & Associates
Jennifer Yang	KCW Court Reporters & Video Services
Sacramento, CA	
Erin Ragazzi	State Water Board
Parker Thaler	State Water Board
Marianna Aue	State Water Board
Alan Laca	State Water Board
Jeff Wetzel	State Water Board
Maia Singer	Stillwater Sciences
Lauren McClure	Stillwater Sciences
Kathryn Swank	Golden State Reporting & Video
Yreka, CA	
Erin Ragazzi	State Water Board
Parker Thaler	State Water Board
Marianna Aue	State Water Board
Kristen Gangl	State Water Board
Maia Singer	Stillwater Sciences
Lauren McClure	Stillwater Sciences
William Rich	William Rich & Associates
Carol Chase	Coleman Reporters

4 SCOPING COMMENT SUMMARY

This section presents a summary of all comments received by the State Water Board. As described in Section 1, the scoping comments are considered by the lead agency in determining the scope of the EIR analyses.

4.1 Scoping Comment Overview

The State Water Board received 83 oral and eight written comments during the public scoping meetings (Table 4-1), as well as 1,327 written comments submitted via email or letter, for a total of 1,418 comments. There were 1,321 written comments submitted via email or letter and received by February 1, 2017; seven comments were received after the close of the comment period. All comments referenced in this report will be considered in development of the EIR. Entities from the federal, state, local, and Native

American Tribal governments, organizations, and individuals who provided written comments are listed in Table 4-2 through Table 4-4. Individuals that provided oral and/or written comments during the scoping meetings are listed in Table 4-5 along with their affiliation, as appropriate. Oral and/or written comments received at the scoping meetings are presented in Appendix C in the order that they were received. Written comments are provided in Appendix D, organized alphabetically within each comment group (i.e., Federal Agencies, State Agencies, Native American Indian Tribes, Local Agencies, Organizations, Individuals, Klamath Riverkeepers).

Table 4-1. Number of Participants and Comments Received During Scoping Meetings.

	Number of Participants*	Number of Oral Comments	Number of Written Comments
Arcata—January 12, 2017	135	35	4**
Sacramento—January 20, 2017	6	5	0
Yreka—January 26, 2017	129	43	4**
Total	**270**	**83**	**8****

* The number of participants reflected in this table is based on the number of individuals that signed in for the meeting. Additional individuals who attended the meeting but did not sign-in are not reflected in the participant count.

** These meeting participants submitted written comments only and did not speak. Oral commenters who also submitted comments in written form are counted under Oral Comments with both the oral and written comments included in Appendix C.

Table 4-2. Written Comments Received from Governmental Entities.

Name	Affiliation
Federal	
John Hamilton	United States Fish and Wildlife Services (USFWS)
State	
Larry Simon	California Coastal Commission
Neil Manji	California Department of Fish and Wildlife (CDFW)
John Laird	California Natural Resources Agency
Clayton Creager	North Coast Regional Water Quality Control Board (North Coast Regional Board)
John Driscoll	Representative Jared Huffman
Native American Tribes	
Tahj Gomes	Etna Band of Indians
Robert Franklin	Hoopa Valley Tribe (Fisheries Department)
Leaf Hillman (and Craig Tucker)	Karuk Tribe
Crystal Robinson	Quartz Valley Indian Reservation
Janice Crowe	Shasta Indian Nation
Roy Hall and Betty Hall	Shasta Nation
Betty Hall	Shasta Nation
Thomas O'Rourke	Yurok Tribe
Local	
James Adams	Bogus Elementary School Board
Tom Mallams	Klamath County Commissioner
Mike Mallory	Siskiyou County Assessor-Recorder
Brandon Criss	Siskiyou County Board of Supervisors

Name	Affiliation
Ray Haupt	Siskiyou County Board of Supervisors
Michael Kobseff	Siskiyou County Board of Supervisors

Table 4-3. Written Comments Received from Organizations.

Name	Organization
Richard Roos-Collins, Steve Rothert, Curtis Knight, Mike Gerel, Brian Johnson	American Rivers, CalTrout, Sustainable Northwest, Trout Unlimited
Richard Gierak	Interactive Citizens United
Aaron Voit	Karuk-Berkeley Collaborative
Jaime Stephens, Sarah Rockwell	Klamath Bird Observatory
Konrad Fisher	Klamath Riverkeeper
Shari Tarantino	Orca Conservancy
Glen Spain	Pacific Coast Federation of Fishermen's Associations (PCFFA) and Institute for Fisheries Resources (IFR)
Marc Robbi & Corina Cohen	Rolling Rivers Farm
Kristen Sellmer	Salmon River Restoration Council
Regina Chichizola	Save the Klamath Trinity Salmon
John Livingston	Sierra Club
Rex Cozzalio	Siskiyou County Water Users Association
Richard Marshall	Siskiyou County Water Users Association
Joshua Strange	Sweet River Sciences
Jay Ziegler and Catherine Macdonald	The Nature Conservancy
Cindy Noble, Peter Mangarella, Eric Young, Derek Campbell, Bill Burden, Bill Templin, Christy Fischer, and Bob Blankenship	Trout Unlimited
Nell Scott	Trout Unlimited
Colleen Weiler	Whales and Dolphins Conservation

Table 4-4. Written Comments Received from Individuals.
(Affiliation information included in parentheses when provided as part of comment.)

Name	
Jim and Yvette Adams	Walt Levitus
Bo Adams	David Lipscomb
Alan Andersen	Trevor Lodence
Alan Andersen and Becky Davis	Pat Lunde
Jason Anderson	Eric Lwafuchi
Kurt Arens	Don Mackintosh
Kevin Ashbran	Mary Ann Madej
Jerry Bacigalupi	Peter Mangarella
Patrick Backer	Tressa Mannion
Jesse Bahm	Terry Mar
John Bair	Ken Martinez
Edward Barich	Vince Martino
K.L. Barton	Erik Mason

Name	
John and Loy Beardsmore	William Matchett
John Beardsmore	Kevin Mather
Cathy Beardsmore	Raymond Mattz
Ed Beardsmore	Nathan Mayl
Shaun Beardsmore	Stephen McCaffrey
Jeff Beardsmore	Mattheau McCreary
Chris Beath	Thomas McGee Sr.
Hal Beaver	Tom Menne
Trevor Beer	Wayne Merhoff
Craig Belden	Jay Mohahan
Jerry Bender	Mike Monroe
Ursula Bendix	Dave Moore
Grace Bennett (Former Supervisor for Siskiyou County)*	Warren Moorehead
Lisa Beranek	Tom Morehouse
John Bermel	Maxwell Morgan
Mark Bevans	Michael Morgan
Brian Bic	Jerry Mosier
Michael Bland	Mark Moskowitz
Paul and Margaret Boos	John Motlow
William Boosman	Nate Moylan
James Bowen	John Murphy
Steve Boyle	Dennis Murphy
Craig Bradshaw	James Naughton
John Bretl	Michael Nelson
Glen Briggs	Robert Nelson
Glen Briggs	Steve Netti
Gerald Brooks	Jerry and Linda Newton
Mark Brown	Thomas Nickelson
Brandon Bugge	Gail Nicola
Matt Burns	Nathan Niebergall
Adrian Cardenas	Craig Nielsen
WM Case	Susan Nolan
Tim Cate (University of Oregon)*	Kari Norgaard
Anthony Chacon Sr.	Cheryl and John Noutary
Paul Chua	Tom Obermeier
Rennie Cleland	Hugh O'Donnell
Jonathan Clifton	Rodney Oien
Brian Cochran	Niall O'Kane
Robert Cockcroft	Devin Olsen
Jim Cody	Vernon Olsen

Name	
Alex Corum	Buck and Judith Olson
Rex Cozzalio	Albert Olson
Earle Cummings	Jason Olson
Lisa Cutter	James Orosz
Brian Daniels (Penn Cultural Heritage Center/Museum)*	Jay Owen
Brett David	Patrick Owen
Brittany Davis	Dennis Pagones
Lori Day	Allen Parker
Timothy Devine	Mark Pastorius
Peter Douglas	George Paul
Michael Drais	Suzanne Perlick
Ann Duchi	Jeff Pierce
Anderson Dunn	Morgan Pierce
Elizabeth Earthman	Randal Pope
Linda Ebert	Ed Prather
Gordon Ehrman	Maymi Preston-Donahue
Paul Elkins	Errol Previde
David Enelow	Sam Rametta
Celio Enriquez	Michael Ream
Joshua Feltenberger	Joanna Reichhold
Miles Fidler	Chrissie Reynolds
Bruce Finney	Phil Reynolds
Richard Flynn	Matt Richardson
Linda-Marie Franks	Tom/Lee Rickard
Dan Frazier	Kevin Riddle
Christy Frenzen	Bob Rosenberg
Vince Fugina	Ed Rossi
Robert Fuller	Jim Rowland Jr.
Thomas Galindo	Tim Ryan
Joe Garoutte	Charles Salomon
Lawrence Gatt	Jim Sangster
Vanessa Gayton	Michael Sapunor
Robert Gearheart	Suzie Savoie
Miranda Geller	John Schaefer
Richard Gierak	Eric Schmidt
Brandon Gomez	Andrew Schneider
Michael Gonnella	Evan Sedlock
Juliet Grable	Mary Seeger
Jason Grant	Paul Sereno
Nora Grant	Vincent Sereno
Ben Halay	Bryan Shadden

Name	
Charles Hammerstad	Bill Sharp
Kris Hamrick	Daniel Shaw
Tim Harden	Jennifer Shrum
Ben Harris	Kay and Paul Shulz
Adam Hart	Judith Simmons
Jon Hazlett	Rich Slusser
Doug Heald	Chad Smith
Wilma Heiney	Mark Speer
Heather Hendrixson	Mike Spurlock
Danielle Hereford	Darek Staab
Steven Heron	Richard Stein
John Hewitt	Nita Still
Diane Higgins	Ivaylo Stoilov
John Hogan	Brian Stompe
Junko Hoshi	Jeff Stone
Jeff Howard	BJ Stone
Werner Hoyt	Arnold Strand
Danny Hull	Chris Stromsness
Timothy Hunt	Kenneth Stucki Sr.
Kyle Huntley	John Sullivan
Nancy Ihara	Steve Swadley
Mary Ingram	Stanley Swensen
Yadao Inong	Susan Terence
Aura Johnson	Erica Terence
Will Johnson	Brian Theriot
Dan Johnson	Jody Thompson
Matt Johnson	Licia Todhunter
Bobby and Michelle Jones	Tom Toretta
Chris Juanes	Robert Torre
Tim Kallas	Joshua Tracy
Patrick Kallerman	Daniel Trent
Austin Kamp	Steve Tubbs
Randy Kane	Mark Utter
Matt Kane	Ray Valencia
Alan Keller	Ron Van Fleet
Kevin Kennedy	Jim Vasquez
Lawrence Kenney	Todd Vick
Bart Kent and Mary Cunningham	Gary Vonderohe
Al Khartchenko	Yee Vue
Mary Ann King	Ken Wallace
Lydia King-Clegg	Susan Wallace
Kenneth Knight	Linda Wallace

Name	
Ryan Knoblock	Thomas Wargo
Joe Kopczynski	Wayne Watanabe
Daniel Kowalski	David Waterbury
Roger Krause	Dan Watson
Jacqui Krizo	Bernie Weisgerber
Donald Krueger	Ryan Willis
Matt Kurth	Tim Wilson
Steven Kwok	Michael Wilson
Michael Laing	Eric Wiseman
Chris Lang	Jami Witherspoon
Gavin Lantry	Edward Wolf
Maurice Ledoyen	Chris Yarnes
Michael Legrande	Randall Yates
Jack Lemein	Mark Zemke
Brian LeNeve	Robert Zimmerman
Maxine Levinson	

* Indicates people who wrote as an individual, but who identified themselves as having a current or past affiliation with the entity noted in parentheses.

Table 4-5. Written Comments Received from Klamath Riverkeeper Supports and Individuals.

Klamath Riverkeeper Supporters and Individuals			
Mary Abbott	Linda Evans	Seabrook Leaf	Mickelle Riley
Delia Aceves	Julie Evens	John Leary	Fred Rinne
Chris Ackerson	Michael Evenson	Jon Lee	Sharon Ritsch
Wanda Adams	Maggie Everett	Trisha Lee	Alex Robbi
Alicia Adrian	Douglas Eversole	Roslyn Lehman	Pauli Robinson
Gisele Albertine	Rayna Eyster	Anita Lemke	Michael Robinson
Susan Alexander	Elizabeth Eytchison	Adina Leone	Rod Rochambeau
Paul Alexander	Yassy Faal	Susan Leskiw	Maureen Roche
Tamara Alexander	Julia Farnum	Amber Lewis	Derrick Roffman
Carol Ampel	Dan Farquhar	Jason Lewis	Reina Rogers
Alison Anabal-Walker	Alexander Farrell	Zak Lieby	Doug Rohn
Carrie Anderson	Joanne Feinberg	Judith Lienhard	Tanya Roland
Gordon Anderson	Kai Ferrara	Rachel Lileet-Foley	David Rose
Donna Anderson	Sarah Fields	Ann Lindsay	Doug Rose
Paul Andrade	Ann Fiester	Elliott Linn	Patti Rose
Susan Andrews	Sarah Filer	Judith Little	Cee Roth
Cathy Anello	Beverly Filip	John Livingston	Mary Lynn Rounds
John Angus	Alice Finen	George Lloyd	Erin Rowe
Michele Antico	Oleg Finodeyev	Jim Lockhart	Annalisa Rush
Thea Appleton	Francine Fischl	Jamie Lockwood	Karen Rusiniak
Peter Aronson	Kimberly Fiscus	Wisteria Loeffler	Robert Rust
Michael Asher	Dylan Fitzwater	Hailee Lollar	Mark Rutherford
Tana Atchley	Janet Flanagan	Christine Long	Jeanette Rutherford

Klamath Riverkeeper Supporters and Individuals			
Debra Atlas	Robert Flasher	James Long	Lynn Ryan
Robert Attebery	Teanna Flippo	Dwight Long	Tim Ryan
April Atwood	Richard Flittie	Genevieve Long	JoEllen Ryan
Stephanie Aufdermaur	Sara Fogan	Paula Long	Lucy Ryan
Charlotte August	Jennifer Fogg	Pastor Lopez	Lucy Ryan
Kristine Avila	Ida Foo	Austen lorenz	Amber Ryno
K B	Jimmy Foot	Nicole Lorsong	Rick S
Chuck Bailey	Susie Foot	John Lovelace	Steph S
Deanna Bailey	Jennifer Forbes	Carol Lowe	Richard Salzman
Nancy Bailey	Joanne Fornes	Leslie Lowe	Marco Sanchez
Barbara Bailey	Cynthia Forsyth	Jim Lozano	Marco Sanchez
Sidney Bailey	Suzanne Forsyth	Sara Lucarelli	Aurora Sancoy
Ranie Baker	Michelle Foster	John Ludington	Shantara Sandberg
Kellie Barcelon	Diana Fox	Margaret Ludlow	Jason Sanger
Ginny Barker	Susan Fox	Nancy Lyles	Carrie Sanneman
Sheila Barnes	Irene Francis	Kitty Lynch	Dawne Santopietro
Melanie Barnett	Mitzi Frank	Michelle MacKenzie	Kim Savage
Ted Barone	Alessandro Freddi	Ericka Macy-Gustafson	Polly Savoie
Doug Barrett	Magali Frederic	Laura Madeline	John Schaefer
Stephanie Barron	Gary Freedman	Barry Madison	Cassandra Schafer
Deborah Baskette	Kristin Freeman	Ashton Maggetti	Kay Schaser
Nicolas Bauer	Luke Frey	Maya Makino	Noah Schillo
Madeline Bauman	Steve Frie	Liza Maltsberger	Nancy Schimmel
William Baumgartner	Kara Friedhaber	Lydia Mancilla	Claudia Schimmer
Sonia Baur	Adam Frohwein	Sacha Marini	Buffie Schmidt
Erin Bayer	Michael Frost	Jennifer Markman	Steve Schramm
Andrew Bear	Corinne Frugoni	Luan Marks	Judy Schriebman
Donald Beck	Thomas Frye	Tony Marks-Block	Rose Schwabe
Stacy Becker	Brian Fugler	Bill Marlett	Greg Schwaller
Candice Bell	Michelle Fuller	Brooke Marmolejo	Laurie Schwaller
Leslie Bellas	Andrew Fuller	Chris Martell	Meredith Seawell
Elisha Belmont	Ray Galbavy	Melissa Martin	Azra Sehic
Manuel Belmonte	Marie Garabedian	Tracy Martin	Raquel Selcer
Darcy Belshaw	Jennifer Garcia	Art Martin	Patrice Sena
Destiny Beltran	Betina Garsen	Bec Massell	Carolyn Serebreny
Greg Bennett	Lydia Garvey	Pamela Mattz	Linda Serrato
Joan Bennett	Marco Garza	Karen Mayer	George Sexton
Carol Bennett	Cynthia Gerard	Larry Mayfield	Margaret Shaffer
Victoria Bennington	Sue Ghilotti	Michael Mayne	Linda Shapeero
Rae Benson Jr.	Richard Gienger	Anne Mcavoy	Leslie Shapiro
John Bermel	Mariane Gilbert	Susan McCarthy	Katherine Sharp
Michael Beyer	Jax Gill	Kim McCary	Chip Sharpe
Lydia Biggs	Lauren Gill	Kate McClain	Corinne Shea
Petra Bingham	Richard Gillaspie	Nancy McClain	Elaine Shelley
Ray Binner	Nancy Gingrich.	Karen McClaskey	Therese Shere
Dustin Bispo	P. Givins	Melanie McCloskey	J. Sherfey

Klamath Riverkeeper Supporters and Individuals			
Marianne Bithell	Kathryn Glaessner	Sandra McColley	Deva Sherman
Jessica Black	Larry Glass	Robert McCombs	Beth Shipley
Carolyn Blackmon	Lin Glen	Bob McConachie	Cecile Shohet
Elissa Blair	Regina Glock	Claire McCoy	Emily Siegel
Rebecca Blanco	Janice Gloe	Maureen McCready	Dana Silvernale
Amanda Bloom	Anne Golden	Lou McDonald	RoxAnne Simon
Megan Bloom	David Gonzalez	Don McEnhill	Suzanne Simpson
Wendy Bloom	Laura Goodwin	C McFarland	Denise Sims
Harry Blumenthal	Bailey Gordon	Richard McFarland	Terry Slack
Sharon Bodman	Juliet Grable	Mashaw McGuinnis	Imants Slegelis
Pat Bognar	Margaret Green	Juanita McKinnon	Harold Sloane
Juliette Bohn	Keri Green	Angela McLaughlin	Charles Smith
Allen Bohnert	Iris Greenberg-Smith	Kelly McNeil	Sara Smith
Elizabeth Bonner	Elizabeth Greene	Paul McPhee	Stacy Smith
Miklos Bosarge	Solo Greene	Alicia McQuillen	Josine Smits
Heidi Bourne	Lacie Greenig	Charles McSweeney	Barbara Snell
Joseph Bower	Christine Griffin	Jackson Meadows	Donald Snow
Susan Bower	Suzanna Griffin	Melissa Medina	Ed Somers Jr.
Ashley Bowers	Laurel Grinnell	Loi Medvin	Monique Sonoquie
Donna Boyd	Suzanne Guerra	Joyce Meier	Madeleine Sosin-Rocha
Randall Boyd	Amy Gustin	Janine Melzer	Dennis Specht
Tod Boyer	Amber H.	Pam Mendelsohn	Richard Spicer
Sharon Bradbury	Christi Hadley	Lindsay Merryman	Pat Spray
Sarah Brandt	Deborah Hadley	Paul Merz	Katie Stalker
Leslee Bray	Barbara Haley	Dax Messett	Melissa Stansberry
Susan Breloff	Sue Hall-Goossen	Dax Messett	Ken Stanton
John Brennan	Randy Hamann	Colette Metz	Linda Stanton
Jorge Briceno	Patricia Hamilton	Sa Meyers	Donna Starnes
C Briggs	Kevin Hamilton	David Mierkey	Arlo Starr
John Brinkley	Mike Hanna	Kathleen Miller	Kemberlee Starritt
Carman Broderick	Joshua Hanna	Ken Miller	Melinda Stearns
Tiffany Brogdon	Kathryn Hannay	Doug Mishler	Barrie Stebbings
Allison Bronson	Carla Hara	Jackie Mix	Earl Steen
Carol Brooks	Wendy Harden	Gregory Monahan	Joella Steffenson
Deborah Brooks	Joy Hardin	Gregory Monahan	Kurt Stegen
Pamela Brown	Teresa Hardy	Shannon Mondor	Nicole Stephens
Jerome Brown	Celia Haro	Carol Mone	Nancy Stevens
Paul Brown	Forest Harpham	Marie Monrad	Fred Stevens
William Browning	Jennifer Harris	Christopher Monreal	Atta Stevenson
Jermaine Brubaker	Ronald Hart	Martin Monroe	Erin Stevenson
Allegra Brucker	Catlin Harvey	Greta Montagne	John Stewart
Donna Brucker	Tim Haskett	Melissa Moore	Jeff Stone
Ellen Bryant	Phillip Hayes	Matt Moreland	Richard Stout
Erin Buchan	Jenifer Hayes	Matt Moreland	Connie Stringer
Elizabeth Buitron	Michelle Hayward	Patricia Morey	Jasmine Stuverud
Keoki Burbank	Margaret Heberlin	Linda Morgan	Ilysea Sunderman
Patricia Burke	Charles Heberlin	Nicole Morgan	Sara Sunstein

Klamath Riverkeeper Supporters and Individuals			
Kristiana Burrow	Allene Hebert	Mariel Morison	Tami Swartz
Camille Bush	Karen Hefner	Julaine Morley	Anne Szostek
Lisa Butterfield	Ellyn Henderson	Emily Morris	Judith Talaugon
Charlotte Byrams	Cheryl Henley	Linda Mortenson	Bari Talley
Kimberly Cabot	Laura Hennings	Greg Movsesyan	Kristopher Tamburello
Christina Cafferata	Mark Hereford	Megan Mucioki	Pam Tate
Pamela Cahill	Rachel Hess	Casey Muhs	Diane Taudvin
Paul Cameron	Jessica Hewlett	James Mulcare	Jennifer Taylor
Heather Campbell	Phillip Hext	Robert Mulready	Monica Taylor
Paula Campbell	Elizabeth Hickman	Barbara Mumby	Norma Jean Taylor
Alex Cano	Cheryl Higgins	Robert Mumby	Allie Tennant
M Caputo	Brad Higgs	Jean Munsee	Susan Terence
Henry Carlile	Todd Hildebrandt	Janean Murdock	Ken Terrill
Tim Carlson	Connie Hill	Brennon Murdock	Tiffany Theden
JoAnne Carlson	Marla Hillman	Kenneth Nakazawa	Franklin Thom
Elissa Carlson	Sue Hilton	Mike Napolitano	Sandra Thomas
Brooke Carothers	Patricia Hine	Suzanne Neefus	Charles Thomas
Sydney Carothers	Tom Hinz	Daniel Nelson	Ann Thompson
Shelly Carpenter	Shane Ho	John Nettleton	Ronald Thompson
Marsha Carrino	Jessica Hobba	Rachel Neumann	James Thompson
Bianca Carroll	Susan Hobbs	Mark Newberger	Johannes Thrul
Dillon Castleton	Ray Hockaday	Gabriel Newton	Arthur Ticknor
Patt Causey	Matthew Hoffman	Dena Nickell	Stephanie Tidwell
Kim Chamberlain	Patricia Holcomb	Donald Nielsen	Sarah Tiller-Holman
Teri Chanturai	Nicole Holland	Val Nordeman	Kathleen Tillinghast
Veronica Chapman	Charles Horn	Kari Nordgaard	Julie Timmons
Anita Chapple	Terri Horn	Carolyn Norr	Holly Tomatis
Tanya Chapple	Susie Hoskie	Sherri Norris	Monica Tonty
Ronnie Chausse	Cheri Howard	Rosa Novak	Maxine Torres
Sheri Chenoweth	Peter Howland	Ciry Null	Mike Tout
Nat Childs	Sarah Hugdahl	Hugh Null	Nancy Tout
Michael Christian	Laura Hughes	Ed Nute	Lisa Townsend-Schmitt
Paul Cienfuegos	Ann Hunt	Helen Nutt	Gene Trapp
Amethyst Cilley	Matthew Hunter	Bridget O'Connor	Connie Turgon
Elizabeth Claman	Steve Huntley	Jean Okamura	Zachary Turner
Jennifer Clatty	Susan Hutchinson	Chris O'Keefe	Brendan Twieg
Mike Cleary	David Hyde	Dove Oldham	Samuel TwoBears
Aldonna Cloud	Pattie Hyde	Laureen Oliveira	Joe Tyburczy
Julie Coar	Nancy Ihara	Adel Olvera	Jacqueline Van Der Hout
Paulaanne Coburn	Leroy Ikerd	Heidi Oregon	Michael Van Devender
Ben Cochran	Marianne Itkin	Julie O'Rielly	Cyn Van Fleet
Thomas Cockle	Louisa J	Elaina ORourke	Robert Van Fleet
Mary Cody	Rita Jacinto	Jody Otolski	Melissa Van Scoyoc
Deborah Cogswell	Robert Jackson	Noemi Pacheco	Julie VandenBerg
Corrina Cohen	Verla Jackson-Robbins	Marilyn Page	Hilary Vander Veer
Joanne Cohn	Rebecca Jacobsen	Will Palmer	Lee Vandeveer
Lesa Coleman	Kathy Jacobson	Walter Paniak	Julie VanTilburg

Klamath Riverkeeper Supporters and Individuals			
Kathleen Commins	Kelly Jacobson	Ron Park	Irene Vasquez
Anessa Connor	Robert Jamgochian	Keith Parker	Mary Vedovi
Lynda Constable	Scott Jarvis	Mara Parker	Jean Vengua
Suzanne Cook	Leigh Anne Jasheway	Megan Parker	Maury Vezzolini
Fernando Cook-Morales	Lois Jean	Pamela Parsons	Megan Vierra
Morgan Corviday	Jessica Jiang	Christina Pasillas	Myra Villella
Todd Cory	Ophoff Joel	Jason Patton	Dale Visinaiz
Lindsay Corzine	Alissa Johnson	MaryAnne Paul	Sara Vitagliano
Sunny Cosce	Michael Johnson	Jean Paulson	Kristin Vogel
Jonnel Covault	Martha Johnson	Cynthia Peachey	Janet Voorhies
Ella Craig	Montanna Jones	Ted Pease	Kevin Vue
Johanna Creson	Mark Kacmarcik	Cris Pemberton	Jennifer W
Jason Crews	Eugene Kaczmarek	Ralph Penfield	Susan Waggoner
Earl Crosby	Donald Kalleck	Peg Pennington	Scott Wagner
Mack Cross	Patricia Kanzler	Bella Peralta	Micah Wait
Scott Crutcher	Kelly Karaba	Benjamin Perone	Wandalea Walker
Robert Cushman	Lyla Karolczuk	Claire Perricelli	Terri Walsh
L D	Jonathan Kastin	Joan Peter	Severin Walston
Jennifer Dadigan	Tracy Katelman	Tom Peters	Melvin Walter
Benjamin Dakota	Joel Kawahara	Davin Peterson	Rachelle Walters
Rose Dana	Lincoln Kaye	Vanessa Peterson	Pam Ward
Galaxy Dancer	Marria Kee	Eric Peterson	Jeff Wasielewski
Rachael Daniel	Laura Keenados	Leaanne Peterson	Susan waterman
Patricia Daniels	Robert Kehrig	Elaine Phillips	Rebecca Waters
Kimble Darlington	Heidi Keller	Adam Pickett	Virginia Waters
Julia Dashe	Jennifer Kellogg	Susan Piercy	Harriet Watson
Ellen Davidson	Mark Kennedy	William Piercy	Elizabeth Watts
Annette Davis	Kaetlin Kennedy	Paul Pitino	Jonathan Weber
Jim Davis	Lawrence Kenney	Angela Pittaluga	Sandy Webster
Shira Dawson	Bernadette Kero	Nicole Planchon	Kayte Wehinger
C Day	Mandi Kindred	Laura Porter	Debbi Weiler
Kim Day	Nancy King	Quinlan Porter	Courtney Weiler
Mark Day	Laura King	Barbara Poulsen	Michael Welch
Cesar De La Rosa	Nicole Kittersong	Jacob Pounds	Donald Wharton
Sylvia De Rooy	Linda Kjesbu	Charles Powell	Daniel White
Lacey Decker	Kim Klein	Mandy Powell	Edward White
Larry Dennis	Gregg Kleiner	Lauren Preston	Laura White
Erin Derden-Little	Brenda Kluhsman	Mark Pringle	Mani White
Tom Derry	Gail Knight	Kyle Pritchard	Carlotta Whitecrane
Patricia Deuter	Kenneth Knight	Kate Proctor	Carol Wiebe
Lee DeVeau	Carolyn Knoll	Peggy Pryor	Lynn Wilbur
Timothy Devine	Ande Kobek	Karuna Purcell	Chris Willis
Wilma Dibelka	Caroline Koch	April Quigley	Dave Willis
Margaret Dickinson	Jill Koch	Dana Quillman	Karen Wilson
Amy Diekmeyer	Elizabeth Kocher	Shelinda Quinland	John Wilson
Winchell Dillenbeck	Karl Koessel	Holly Quinn	Jan Windz

Klamath Riverkeeper Supporters and Individuals			
Caitlin Divine	Jessica Komaromy	Leslie Quinn	Sally Wise
Crystal Dobbs	Susan Kraft	Mary Raine	Lynn Wolf
Daniel Doble	Daniel Krall	Rudy Ramp	Kathleen Wolfberg
Yvonne Doble	Rachel Krasner	Joshua Ramsey	Paul Wolfberg
Sandra Dojcinovic	Linda Kutil	Rosa Rashall	Marcia Wolhandler
Michael Dotson	Cynthia Kuttner	Debie Rasmussen	Roberta Wong
Dennis Dougherty	Nancy Kuykendall	Amber Rau	Cheryl Wood
Patricia Dougherty	Rebecca Lacasse	Charles Ray	Leslie Wood
Joseph Dougherty	Zoe Lacoco	Terry Raymer	John Wood
Carla Douglas	Donna LaGraffe	Catherine Recinos	Cheryl Woodford
Emily Driskill	Denice LaGrassa	Lois Redelk	Linda Woodward
Iva Dubyak	Jennifer Lance	Kelsey Reedy	Lupine Wread
Norman Dyche	Kate Lancour	Lise Rehbock	Alfreda Wright
Tayla Ealom	Marilyn Lang	Jane Reid	Ashley Wright
Jeffery Eaton	Monalisa Langner	James Reid	Becca Wynne
Amy Eberwein	Ruth Lanton	Chris Rempel	Daphne Wysham
Douglas Edwards	J Lasahn	Angela Rex	R Y
Eve Marie Eells	Dona LaSchiava	Rebeka Reyes	Tammy Yazzie
Deborah Einbender	Cynthia Laughery	Brian Reynolds	Heidi Young
Kathy Eldredge	Logan LaVail	Rachel Rhinehart	Rebecca Younger
Love Electric	Brian Lavelle	Kristina Ribeiro	Sage Zanth
Jim Elferdink	Stephen Laviletta	Paul Richards	Lucas Zeeberg
Linda Elkins	Nicole Lawless	Laurie Richardson	Ron Zemel
Joe Ellrott	Laura Lawver	Miles Richardson	Gretchen Ziegler
Tyler Emerson	Casey Lay	Hilda Richey	Joel Ziegler
Livier Enciso	Bruce Lazar	Trisha Ridenour	George Zimninsky
Charles Erdman	Michael Le	Justin Riede	Leslie Zondervan-Droz

Table 4-6. Individuals Providing Oral and/or Written Comments at Public Scoping Meetings.

Name	Affiliation
David Aaron	Individual
James Adams	Individual
Dara Alexander	Individual
Jerry Bacigalupi	Individual
Jenna Bader	Individual
Mark Baird	Individual
Larry Bell	Individual
Grace Bennet	Siskiyou County Supervisor (retired)
Leo Bergeron	Individual
John Bermel	Klamath Riverkeeper
David Bitts	PCFFA/IFR
Glen Briggs	Individual
Regina Chichizola	PCFFA/IFR
Mark Coats	Individual
Amy Cordalis	Yurok Tribe
Rex Cozzalio	Individual

Name	Affiliation
Clayton Creager	North Coast Regional Water Quality Control Board
Brandon Criss	Siskiyou County Supervisor District 1
Robert Davis	Tea Party
Sami Jo Difuntorum	Shasta Indian Nation
John Driscoll	Representative Jared Huffman
James Dunlap	Individual
Linda Ebert	Individual
Mark Fischer	Individual
Konrad Fisher	Klamath Riverkeeper
Mahlija Florendo	Yurok, Selek, Hoopa, Wasco Tribes
John Foster	Individual
Jon-Luke Gensaw	Individual
Lena Belle Gensaw	Individual
Sammy Gensaw III	Individual
Richard Gierak	Interactive Citizens United
Larry Glass	Northcoast Environmental Center
William Glover	Individual
Betty Hall	Shasta Indian Nation
Roy Hall	Shasta Indian Nation
Ray Haupt	Siskiyou County Supervisor
Dave Hillemeier	Yurok Tribe
Annelia Hillman	Yurok Tribe
Allie Hostler	Individual
Joe James	Yurok Tribe
Joe James	Yurok Tribe
Brian Johnson	Trout Unlimited
Thomas Joseph	Hoopa Tribe
Thomas Joseph	Individual
Tracy Katelman	Individual
Colin Kerosky	Individual
Alexander Khartchenko	Individual
Javier Kinney1	Yurok Tribe
Paul Kinsey	Individual
Michael Kobseff	Siskiyou County Board of Supervisors
Greg Kuck	Individual
John Livingston	Sierra Club
Mark Lovelace	Individual
Don Mackintosh	Individual
Mike Mallory	Siskiyou County Assessor-Recorder
Cena Marin	Individual
Richard Marshall	Siskiyou County Water Users Association
Jack Mattz	Yurok Tribe
Raymond Matz	Individual
Jonathan McClelland	Klamath River Keeper, Mid Klamath Watershed Council (volunteer for both)
Lana McCovey	Yurok Tribe
John Menke	Individual

Name	Affiliation
Edward Nute	Individual
Linda Oliver	Copco Lake Fire Protection District
Andrew Orehoske	Individual
Ian Osipowitsch	Individual
Nathaniel Pennington	Salmon River Restoration Council
Steve Radford	Individual
Chrissie Reynolds	Individual
Cutcha Risling Baldy	Humboldt State University
Lindamood Robert	Individual
Erin Ryan	Congressman Doug LaMalfa
Zane Schoettgen	Individual
Greacen Scott	Friends of the Eel River
Kristen Sellmer	Salmon River Restoration Council
Daniel Simon	Individual
Nita Still	Individual
Joshua Strange	Individual
Lisa Sundberg	Trinidad Rancheria
Craig Tucker[1]	Karuk Tribe
Susan Wallace	Individual

[1] Attended and spoke at both Arcata and Yreka public scoping meetings.

4.2 Comment Summary

This section summarizes comments received in response to the LKP NOP. Comments are generally organized by subject area. Some comments are relevant to more than one subject area, and placing them in one area does not reflect a lack of recognition of a comment's relevance to other areas. If the comment was made by a governmental entity, a Native American Tribe, or an organization, the entity, Native American Tribe, or organization is often identified along with the comment, particularly for the broad categories of overall EIR scope (Section 4.2.1), environmental baseline (Section 4.2.2), the No Project alternative (Section 4.2.4), and other Project alternatives suggested during scoping (Section 4.2.5). All original comments are presented in *Appendix C Oral and/or Written Comments Received at the Scoping Meetings* (in the order that they were received) and *Appendix D Written Comments* (organized alphabetically within each comment group, i.e., Federal Agencies, State Agencies, Native American Tribes, Local Agencies, Organizations, Individuals, Klamath Riverkeepers).

4.2.1 Overall EIR Scope

Several comments were submitted on the overall scope of the EIR.

- The PCFFA/IFR made the following comments on the scope of the EIR:
  - The Project Area, for purposes of cumulative impacts analysis, should be the entire area from Upper Klamath Lake's Link River Dam (containing the first structures within the KHP), downstream to the estuary, and also including all impacts from salmon population and fisheries losses and declines that can be causally linked to the KHP and which occur within the coastal areas of the

Klamath Management Zone, which is consistent with the Project Area used in PacifiCorp's original Application for Relicensing.
  - Cumulative and other impacts should be analyzed using the same time scale as the Final Environmental Impact Statement for Hydropower License for the Klamath Hydroelectric Project, FERC Project No. 2082-027 (2007 FERC EIS) and the U.S. Bureau of Reclamation's Klamath Facilities Removal Final Environmental Impact Statement/Environmental Impact Report (2012 KHSA EIS/EIR) (i.e., 30 to 50 years).
  - The analysis should use the "Natural Baseline Conditions" that existed prior to the KHP dams.
- The Salmon River Restoration Council stated that the project area must include all impacts on salmon-dependent communities in the Klamath Management Zone. This area extends at least from Shelter Cove, CA to Humbug Mountain, OR and offshore out to 200 miles.
- The Siskiyou County Board of Supervisors commented that the area of analysis in the EIR must consider the entire Klamath River system, its tributaries (including the Trinity River), surrounding areas, and local communities, including Siskiyou County.
- The Siskiyou County Board of Supervisors stated that the LKP EIR should make clear that under the No Project alternative, and any other alternative, existing Klamath River total maximum daily loads (TMDLs) require that water quality standards must be attained. This comment is also listed in *Section 4.2.4 No Project* and *Section 4.2.8 Water Quality*.
- The Siskiyou County Assessor-Recorder stated that the valuation studies conducted by the Federal agencies to date have been inadequate. The commenter requested that the State Water Board conduct an objective analysis regarding the loss of property values and tax revenues for all impacted parcels due to dam removal, real or perceived loss of flood control, and removal of the hydroelectric facilities from the Assessment Roll. This comment is also listed in *Section 4.2.13 Economics.*
- Many commenters stated that there is uncertainty in past dam removal impact analyses because only five miles of river were analyzed. The commenters further stated that the LKP EIR should analyze the impacts of dam removal along the entire river.
- Many commenters requested that the State Water Board analyze the anticipated long-term benefits of dam removal for fisheries, water quality, public health and regional economy against the short-term impacts.
- Several commenters stated that consideration of Trinity River water management, including water transfers to the State Water Project, should be analyzed in the LKP EIR.
- One commenter stated that the Board should also analyze whether the removal, or changes to the operation of, the Keno Dam and reservoir is also necessary to achieve Basin Plan compliance.
- With respect to the potential for re-certification and relicensing of the KHP (i.e., dams remain in place), one commenter stated that the EIR should analyze issues of pollution that originates in Oregon, TMDL compliance, mandatory fish ladders, cumulative impacts, protective flows, Iron Gate hatchery pollution, economic impacts from dams, and ramping and bypass flows.

4.2.2 Environmental Baseline

The following comments were received regarding the environmental baseline for the LKP EIR analysis.

- One commenter asked for clarification regarding whether the current condition would be the environmental baseline for the EIR analysis.
- The Klamath Riverkeepers, PCFFA/IFR, and Salmon River Restoration Council stated that the "baseline" for EIR comparisons should be natural baseline conditions that existed before the Klamath Hydroelectric Project dams were constructed, and which would presumably exist without the dams in place today.

4.2.3 KRRC's Proposed Project

Numerous comments were made regarding KRRC's Proposed Project. These are presented by subject area in subsequent sections.

4.2.4 No Project

The following comments were made regarding consideration of the No Project alternative:

- The Klamath Riverkeepers and the Salmon River Restoration Council requested that the State Water Board consider a No Project alternative to be hypothetical since PacifiCorp has withdrawn its request to certify a new dam operation license.
- The Siskiyou County Board of Supervisors stated that the LKP EIR should make clear that under the No Project alternative, and any other alternative, existing Klamath River total maximum daily loads (TMDLs) require that water quality standards must be attained. This comment is also listed in *Section 4.2.1 Overall EIR Scope* and *Section 4.2.8 Water Quality*.
- One commenter stated that the LKP EIR should be clear in defining the meaning of No Project and that the only feasible No Project alternative is denial of CWA Section 401 certification.

4.2.5 Other Project Alternatives Suggested During Scoping

The following comments were made regarding consideration of alternatives to the KRRC's Proposed Project:

- CDFW stated that the State Water Board should analyze the effects of reservoir stratification on dissolved oxygen and water temperature for alternatives that maintain reservoirs, and any mitigation options. They referenced the Klamath River total maximum daily load (TMDL) analysis (North Coast Regional Board 2010) and noted that there are no depths at which salmonids could be supported and that no mitigations were identified in the 2007 FERC EIS to address this issue.
- CDFW recommended that the State Water Board include analysis of alternatives similar to Alternative 2 (Full Facilities Removal of Four Dams) and Alternative 3 (Partial Facilities Removal of Four Dams) presented in the 2012 KHSA EIS/EIR.

- The Klamath Riverkeepers and the Salmon River Restoration Council requested that the EIR analyze an alternative that includes removal of J.C. Boyle and Keno dams due to adverse impacts on water quality and beneficial uses of water.
- The PCFFA/IFR expressed concern that Oregon and California would not be analyzing the same range of alternatives for their respective permitting processes and they proposed the addition of "two additional alternatives":
  - *Additional Option A:* Removal of Iron Gate, Copco No. 1, Copco No. 2, and J.C. Boyle Dams: This would be a four-dam removal option that would leave Keno Dam (and Keno Reservoir) in place with appropriate fish passage prescriptions and water quality mitigation measures, but take out the four hydropower-producing components of the KHP below Keno.
  - *Additional Option B:* Removal of Iron Gate, Copco No. 1, Copco No. 2, J.C. Boyle and Keno Dams: In other words, this would be the removal of all KHP structures in the mainstem Klamath River, resulting in a free-flowing river from Link River all the way downstream to the estuary.
- The Save the Klamath-Trinity Salmon organization stated that the State Water Board should analyze an alternative which allows the continued operation of the Fall Creek Development while requiring removal of Iron Gate, Copco No. 1, Copco No. 2 and J.C. Boyle dams and reservoirs.
- The Siskiyou County Board of Supervisors and the Siskiyou County Water Users Association and several individual commenters stated that the CEQA document should consider a "dams-in" fish passage alternative that includes a variety of options including fish cannons, trap and haul, a Shasta Nation fish tunnel, and a Bogus Creek bypass.
- The Siskiyou County Board of Supervisors and the Siskiyou County Water Users Association proposed alternatives to dam removal including the construction of a Klamath River/Shasta Valley transfer canal and storage facility and/or the establishment of additional storage facilities in the Scott and Quartz Valleys as ways to address environmental issues in the Klamath watershed while keeping the Klamath dams in place.
- The Siskiyou County Board of Supervisors stated that the LKP EIR should make clear that under the No Project alternative, and any other alternative, existing Klamath River total maximum daily loads (TMDLs) require that water quality standards must be attained. This comment is also listed in *Section 4.2.4 No Project* and *Section 4.2.8 Water Quality*.
- The Klamath County Commissioner attached to his comment letter FERC's 2007 conclusion that the best alternative for the KHP would be to issue a new license consistent with the environmental measures specified in the Staff Alternative.

4.2.6 Incorporation of Findings from Past Studies

Many comments were received referencing past studies that were prepared to assess the potential impacts of Klamath River dam removal, including the following:

- Many commenters requested that the State Water Board incorporate the findings of the 2012 KHSA EIS/EIR and the U.S. Department of the Interior Secretarial Determination Report (2012 SDOR) into the LKP EIR, noting that these prior analyses adequately addressed environmental impacts related to facilities removal.

- One commenter indicated that the LKP EIR should incorporate the findings of the 2012 KHSA EIS/EIR but should remove Klamath Basin Restoration Agreement (KBRA) components of the prior analysis.
- Many commenters requested that the State Water Board *not* incorporate the findings of the 2012 KHSA EIS/EIR and the 2012 SDOR) into the LKP EIR, noting that these prior analyses were not exhaustive and reached incorrect conclusions.
- The North Coast Regional Board referred to a letter from Interior Secretary Jewell to Secretary Bose supporting the dam removal project.
- Several commenters recommended that the State Water Board incorporate the findings of the 2007 FERC EIS into the LKP EIR.

4.2.7 Fish/Fisheries

Many comments were related to fisheries issues.

EIR analysis related to fisheries

- One commenter stated that the (salmonid) "Recovery Strategy for California" should be referenced to guide future restoration and mitigation efforts. The commenter did not provide a reference to a specific document.
- Two commenters stated that the LKP assessment area should include the entire Klamath Management Zone in the ocean.
- One commenter stated that the EIR should evaluate the effects of the LKP on fish passage, salmonid populations, commercial and recreational fisheries in the river and the open ocean.
- One commenter stated the EIR should include hatchery operation requirements developed for the KHSA in the evaluation of any EIR alternative that includes dam removal.
- One commenter stated that the EIR should analyze how dam operations, including hatchery operations, have impacted spring-run Chinook salmon and salmon composition in the Klamath River, and how effective dam removal and other alternatives would be in reducing or eliminating these impacts.
- Two commenters suggested that the EIR look at the effects of sea lions and foreign and domestic fisheries on salmon populations.
- Two commenters stated that Southern Resident killer whales rely heavily on Chinook salmon as a food resource and this should be analyzed in the EIR.

General fisheries comments

- Many commenters stated that natural fish blockages downstream of Copco and/or J.C. Boyle preclude anadromous passage upstream to Upper Klamath Lake and its tributary rivers.
- One commenter indicated that the 1,191-foot elevation change in the 26 miles between Copco No. 1 and J.C. Boyle dams is too steep for salmon to pass and for gravel to deposit and create habitat features.
- One commenter noted that only eight miles of habitat would be opened up if the dams were to be removed.

- Several commenters stated that between 300 and 600 miles of historic habitat for salmon and steelhead would be accessible if the dams are removed.
- Several commenters stated and/or provided documentation that historically, anadromous salmonids did successfully migrate as far upstream as Upper Klamath Lake.
- One commenter supplied historical information indicating that some salmon did successfully move past the Keno barrier, but they were bruised and worthless for eating.
- One commenter has never seen a salmon in irrigation water.
- Several commenters indicated that coho salmon are not native to the Klamath River basin.
- Several commenters stated that coho salmon never occurred in the mid- to upper-Klamath basin.
- Several commenters stated that the dams provide in-river water storage for fish habitat and flow releases, and they are used to avoid major fish die-offs.
- One commenter stated that low water (due to dam removal) would kill smolts.
- Several commenters stated that salmon runs have been good and record runs have occurred with the dams in place.
- Several commenters indicated that the dams should be kept in place and have fish ladders installed, which should improve salmonid runs.
- One commenter indicated that trap and haul would not work because fish would be moved from one toxic part of the river to another.
- One commenter stated that 100 years of evidence shows that there has been no significant alteration in salmon returns due to dams.
- Another commenter stated that prior to European settlement, an estimated 660,000 to 1.1 million adult salmon returned to the Klamath River each year to spawn, of which 880,000 individuals were spring-run Chinook. Salmon returns are now only about 12% of what they once were, averaging only about 105,000 adults over the time frame of 1978–2007, but the majority of these are of hatchery origin.
- One commenter stated that dams change nutrient dynamics, which is negative for salmon.
- One commenter noted that salmon would not be able to navigate the shallow lake to arrive at Link River.
- Several commenters stated that fisheries and essential fish habitat will be decimated by the release of sediment associated with dam removal.
- Several commenters indicated that sediment release would have an immediate negative impact on fisheries and habitat, but would be beneficial in the long-term.
- Two commenters stated that removal of the lower Klamath dams had nothing to do with fish.
- Several commenters indicated that dams reduce habitat for disease organisms.
- Many commenters stated that dams exacerbate disease in downstream salmonids.
- Several commenters provided recent scientific studies linking the Klamath River dam operations and salmonid disease.

- Several commenters stated that perch (i.e., yellow perch) were in the lakes and releasing them would have adverse consequences on salmonids because of egg predation.
- Several commenters indicated that gill-netting occurs on the lower river and it affects salmon populations.
- One commenter noted that the Iron Gate Hatchery is essential for salmon runs.
- One commenter stated that the upper river tributaries would not produce the six million fingerlings produced by the Iron Gate Hatchery.
- Two commenters indicated that the Iron Gate Hatchery produces one million fingerlings.
- Over 200 commenters stated that anadromous fish populations are expected to rebound with dam removal.
- Two commenters noted that the EIR should include an analysis of water temperature impacts on salmonid migration.
- One commenter stated that releases from Trinity Lake artificially trigger upstream migration of salmon into the Klamath River during August and September.
- Two commenters indicated that existing cold water springs are currently inundated by the reservoirs, but if the dams were removed the springs would discharge to the river. These comments are also listed in *Section 4.2.9 Water Quality*.
- Two commenters stated that the dams changed the species composition of salmonids in the Klamath River (i.e., pink and chum salmon have been extirpated and spring Chinook populations have been severely depressed).
- One commenter stated that there have been no candlefish (i.e., eulachon) since the dams were built.
- Two commenters stated that the reservoirs have trapped gravel, which has reduced spawning and edge-water rearing habitat downstream of the dams.
- One commenter noted that the KHP has changed thermal processes in the river (i.e., cooling water in the spring and warming water in the fall).
- One commenter stated that the dams have vastly improved downstream cold and warm water fisheries.
- One commenter indicated that there should be more fish counting stations.
- One commenter stated that the CEQA analysis should consider the effect of J.C. Boyle Dam peaking flows on downstream fisheries if it were to remain in place after the lower three dams are removed.
- Several commenters stated that the dams have decimated native salmonid populations and that dam removal is the key to their recovery.
- A few commenters stated that the increase in sea lion populations since the passage of the Marine Mammal Protection Act is a major factor in the decline of salmon in the Klamath River.
- A few commenters stated that the Asian/foreign fishing fleets off the coast are a significant factor in the decline of salmon in the Klamath River.

4.2.8 Water Quality

Many comments were focused on the potential effects of dam removal on water quality in the Klamath River and the LKP reservoirs.

- The North Coast Regional Board stated the following:
  - Ongoing restoration actions and Total Maximum Daily Load (TDML) implementation efforts to restore the Klamath River cannot reach their full potential without also addressing the water quality limiting factors created by the four dams associated with the LKP.
  - Procedures for evaluating and authorizing temporary impacts due to restoration activities are detailed in the Regional Water Board's *Policy in Support of Restoration in the North Coast Region.*
- The Siskiyou County Board of Supervisors stated that the LKP EIR impacts analysis must consider the existing TMDLs and attainment of water quality standards under a range of conditions, for all alternatives (including the No Project alternative). This comment is also listed in *Section 4.2.1 Overall EIR Scope* and *Section 4.2.4 No Project*.
- The Hoopa Valley Tribe Fisheries Department noted that analyses in the EIR need to consider Hoopa Valley Tribe's water quality standards as well as those developed by the State of California.
- Several commenters stated that dam removal will result in temporary downstream water quality impacts that may be unavoidable. These impacts may cause temporary exceedances of water quality objectives.
- Several commenters stated that dam removal will alleviate the adverse temperature effects of the reservoirs (e.g., increased summer/low flow temperatures) on the downstream river.
- Several commenters stated that the dams and reservoirs and their operations exacerbate already significantly impaired water quality conditions in the Klamath River, and that dam removal would significantly improve water temperature, dissolved oxygen, and reduce algal toxins in the river.
- The Klamath County Commissioner indicated that the existing reservoirs improve water quality by serving as a sink for phosphorus laden sediment and cool the water in the river by providing a deep pool behind each dam.
- Two commenters indicated that existing cold water streams and springs are currently inundated by the reservoirs but if the dams were removed would discharge to the river. These comments are also listed in *Section 4.2.7 Fish/Fisheries: General fisheries comments*.
- Several commenters indicated that dam removal will minimize still and quiescent water that currently supports filamentous attached algae in the river and planktonic blue green algae (and the associated toxins) in the reservoirs.
- Several commenters stated that blue green algae growth will continue to occur in the Klamath River in the absence of the reservoirs.
- Two commenters noted poor water quality in Keno Reservoir and indicated that this should be considered in the EIR analyses.
- Two commenters noted that needed improvements to water quality in Lake Ewauna/Keno Reservoir should be considered in the EIR, including the potential

for mitigations for the East and West Side such as infiltration galleries and treatment wetlands.

- One commenter states that global warming impacts to water quality in the Klamath River will be extreme and impossible to mitigate without dam removal.
- One commenter noted that blue-green algal growth in the Klamath River is due to natural conditions and pollution in the Upper Klamath Basin.
- Several commenters noted that while other recent dam removal projects have resulted in short-term water quality impacts, the latter are outweighed by the long-term benefits of habitat restoration.
- Several commenters cited results indicating that the reservoirs improve water quality because water leaving Copco Reservoir is cleaner than when it entered.
- One commenter expressed concern that excess phosphorus, pesticides and fertilizers pollute the water in Oregon, which then flows into California.
- Several commenters noted that agricultural runoff is cleaner and contains lower phosphorous than natural water.
- One commenter noted that water from J.C. Boyle and Iron Gate reservoirs equilibrates to ambient conditions within a few miles or less of the dams.
- Several commenters expressed concern that release of toxic substances (i.e., metals, pesticides, chlorinated acid herbicides, polychlorinated biphenyls [PCBs], volatile organic compounds, cyanide, and dioxins) contained within reservoir sediment deposits could negatively impact aquatic life in downstream reaches when the dams are removed. Several of these commenters expressed concern that the 2012 KHSA EIS/EIR did not adequately address these effects. One of these commenters expressed concern that release of toxic substances contained within reservoir sediment deposits could result in human disease, citing poisoning of wells following dam removal in Oregon. These comments are also listed in *Section 4.2.11 Sediment*.
- One commenter noted that prior to the dams, local tribes moved away from the river in the summertime due to an offensive smell from low water.

4.2.9 Water Supply

Several comments were received regarding the potential for dam removal effects on water supply.

- Many commenters stated that the reservoirs provide water supply for fighting regional wildland fires, and therefore fire suppression would be negatively impacted by dam removal.
- Many commenters stated that the reservoirs provide water for additional summer instream flows to improve downstream water quality and prevent fish kills.
- Many commenters stated that the reservoirs provide agricultural irrigation supply to farmers in upper basin areas of both California and Oregon.
- One commenter expressed concern that Klamath dam removal will influence future water allocations from the Trinity River to water users in the California Central Valley.

- One commenter stated that the State of California will need to better manage water in the Trinity River so that the Klamath River water supply is not negatively impacted.
- Several commenters suggested analyzing the option of removing J.C. Boyle and Keno dams due to their adverse impacts on beneficial water uses, including irrigation and instream flow augmentation uses.
- Several commenters expressed concern about the threat to Yreka's municipal water supply and the need to realign the water line as part of dam removal.
- One commenter expressed concern about the loss of water storage that could be used in drought years.
- One commenter stated that dam removal would be a violation of the Reclamation Act of 1902 which authorizes "*the Secretary of the Interior to locate, construct, operate, and maintain works for the storage, diversion, and development of water for the reclamation of arid and semiarid lands in the western States*."
- One commenter stated that dam removal will provide more water for agricultural use (from Upper Klamath Lake), considering that less reservoir water will be needed to augment instream flows in support of improving downstream water quality.
- One commenter stated that dam removal will eliminate water supply for lake recreation.
- Several commenters expressed concern regarding the loss of well water as a result of draining the reservoirs.

4.2.10 Hydrology

Many comments were focused on the potential effects of dam removal on hydrology in the Klamath River and the LKP reservoirs.

- Several commenters cited benefits to fisheries and other resources due to a free-flowing river with increased flow should the dams be removed.
- Many commenters expressed concern that dam removal would take away the ability to regulate flow and would reduce flood control capability, resulting in increased downstream flooding. One of these commenters suggested that flood risk could be increased by the sediments from behind the dams. One of these commenters expressed concern regarding accidental catastrophic flooding during the dam removal process.
- One commenter stated that the Klamath's four major dams operate as a "run of the river" system that only slightly reduces peak flooding events.
- One commenter stated that the dams provide a 25% reduction in peak flows based on the 1964 flood hydrograph located near the Iron Gate hatchery. The commenter suggested conducting a major flood study.
- Several commenters questioned the validity of existing hydrologic studies, indicating that previous studies failed to consider hydrologic inputs from the entire Klamath watershed (i.e., tributaries such as the Trinity River), that the existing flood hydrology analysis is in error, and/or that the hydrologic outcomes of dam removal have not been modeled.

- One commenter stated that after dam removal, water for pulse flow releases will need to come from Upper Klamath Lake, which will negatively impact agriculture and wildlife refuge deliveries in the Klamath Basin.
- Several commenters stated that dam removal will cause groundwater wells around the reservoirs to go dry.
- One commenter noted that recent USFWS guidance memos "*recommend that dam removal is the key action to alleviate disease impacts but that increased* (instream) *flows are needed in the interim*."

4.2.11 Sediment

Many comments were focused on the Project's potential sediment-related effects.

- Many commenters cited the benefits of increased gravel supply and a natural flow regime for adult and juvenile salmonid habitats and other aquatic resources in downstream reaches of the Klamath River. Many commenters note that J.C. Boyle and Keno reservoirs trap sediment that would otherwise create and maintain spawning and rearing habitats in downstream reaches. Several of these commenters stated that the impacts of fine sediment release on fisheries habitat will be short-term.
- Two commenters stated that the EIR should include analysis of bedload and spawning gravel transport under each alternative. One of these commenters stated that the EIR should thoroughly evaluate the effects of dam removal on sediment transport downstream to the ocean. The evaluation should address how river flows and volumes may affect erosion of the river channel and adjacent areas, including areas of known and potential archaeological resources.
- One commenter stated that project facilities should be operated in a manner that provides flow releases sufficient to establish a geomorphically functional stream channel above and below project diversions.
- One commenter stated that KHP structures and operations that impact California waters should be considered under CEQA, including trapping of gravel in J.C. Boyle and Keno that would otherwise contribute to spawning and rearing substrates in downstream reaches. The commenter also stated that analysis of the "Retirement of Copco No. 1 and Iron Gate Developments" alternative in the 2007 FERC EIS failed to address sedimentation in the Copco No. 2 resulting from removal of the Copco No. 1 dam. The commenter regarded any alternative that included removal of Copco No. 1 but retention of Copco No. 2 dam as impractical, and recommends that the Copco Dams 1 and 2 be considered for removal together as part of every scenario. The commenter indicates that simultaneous dam removal and sediment discharges should be preferred over sequential releases in order to minimize the total number and duration of fish exposure times to high levels of sediment. The commenter requested that the State Water Board conduct a thorough analysis of both the short-term impacts and long-term benefits of dam removal, noting successful outcomes from recent dam removal projects and strategies for managing and mitigating risks associated with sediment release.
- Several commenters expressed concern about potential long-lasting negative impacts of sediment release on channel conditions (e.g., spawning gravels) in downstream reaches of the Klamath River. Several expressed concern that the

2012 KHSA EIS/EIR understated the amount of sediment that will be released into the environment, that the potential effects of sediment release from dam removal to salmon populations and other aquatic species were not studied in the entire downstream river and estuary, and/or that impacts from sediment release were incorrectly or inadequately addressed. Several of these commenters stated concern regarding the potential liabilities (i.e., costs) associated with sediment release. Several of these commenters recommend that a new and complete analysis of the effects of reservoir sediment release be performed for the entire river and estuary.

- Two commenters expressed concern that sediment release and/or altered hydrology from dam removal will negatively impact sediment deposits at the mouth of the Klamath River, and would reduce fish passage into the river as a concern.
- Several commenters expressed concern that release of toxic substances (i.e., metals, pesticides, chlorinated acid herbicides, polychlorinated biphenyls [PCBs], volatile organic compounds, cyanide, and dioxins) contained within reservoir sediment deposits could negatively impact aquatic life in downstream reaches when the dams are removed. Several of these commenters expressed concern that the 2012 KHSA EIS/EIR did not adequately address these effects. One of these commenters expressed concern that release of toxic substances contained within reservoir sediment deposits could result in human disease, citing poisoning of wells following dam removal in Oregon. These comments are also listed in *Section 4.2.8 Water Quality*.
- One commenter recommended addressing how much silt is trapped behind the dams and what the impact of increased fine sediment deposition in the reservoirs would be if dam removal is delayed.
- One commenter asked if dredging reservoir sediment could be addressed.
- One commenter expressed concern about what will happen to the Native American Indian grave sites currently buried under reservoir sediment deposits if the dams are removed.

4.2.12 Recreation

Several comments were received regarding the potential for recreation issues should the dams be removed.

- Several commenters noted that recreational activities, including fishing, and/or quality of life would be reduced due to dam removal, particularly at Copco Lake. General concerns regarding aesthetics were mentioned as part of recreational uses.
- Many comments were received regarding an anticipated increase in fishing-related recreation on the river following dam removal. .
- Several commenters stated that the Iron Gate Fish Hatchery was an important feature to keep because it enhances recreational fishing opportunities.
- One commenter questioned the future disposition of PacifiCorp properties within and adjacent to the former reservoirs.

4.2.13 Economics

Several comments were focused on the potential economic effects of dam removal in the Klamath Basin.

- Several commenters expressed concern that economic impacts would occur due to dam removal, including that ratepayers would have to pay for dam removal.
- Another concern expressed by several commenters included the potential that Klamath and Siskiyou counties would not be able to continue to provide services and would lose school district funding due to reduced tax base.
- Several commenters requested a thorough analysis of the economic impacts resulting from dam removal.
- The Siskiyou County Assessor-Recorder stated that the valuation studies conducted by the Federal agencies to date have been inadequate. The commenter requested that the State Water Board conduct an objective analysis regarding the loss of property values and tax revenues for all impacted parcels due to dam removal, real or perceived loss of flood control, and removal of the hydroelectric facilities from the Assessment Roll. This comment is also listed in *Section 4.2.1 Overall EIR Scope.*
- Many commenters noted the potential economic benefits of dam removal for recreational and commercial fishing.
- One commenter requested that only local contractors/suppliers be used in dam removal contracts.
- One commenter detailed the economic impacts on commercial fisheries in northern California and southern Oregon following completion of Iron Gate Dam.

4.2.14 Property Value

Several comments were focused on the potential for property value impacts related to dam removal.

- Many commenters expressed a concern that properties near the reservoirs have already experienced, and would continue to suffer a decrease in property value if the dams are removed, primarily due to the loss of the reservoirs. Many of these commenters indicated that they own property adjacent to Copco Lake.
- Several commenters expressed concern that the lack of a plan for restoration in reservoir areas following dam removal will lower property values in the vicinity of the reservoirs.
- Several commenters stated that property owners affected by dam removal should be compensated for their loss of property value.

4.2.15 Tribal Cultural and Historical Resources

Many comments provided a range of viewpoints regarding the effects of the dams and their proposed removal on cultural resources.

- Several commenters expressed profound personal and tribal connection to the Klamath River and its water quality. Specifically, members of the Yurok and Karuk

tribes indicated that the dams have threatened the health of the river and compromised their traditional subsistence, ceremonial, spiritual, recreational, and economic lifeways. One commenter indicated that dam restoration will allow for future generations to carry out their cultural practices and responsibilities. The Yurok Tribe specifically referred to its 2016 comments, with regard to the cultural significance of the Klamath River and the devastating impacts the dams have had on these cultural resources (see also *Section 4.2.7 Fish/Fisheries*).

- Several commenters expressed concern regarding dam removal and the potential for impacts to cultural resources associated with ancient Shasta tribal occupation of the landscape, a historical Shasta Indian community, as well as specific rock cairns marking civil war veteran burials and the internments at the Beaver Creek historical cemetery.
- Several commenters stated that the 2012 KHSA EIS/EIR does not properly address the concerns of the Shasta Tribes, which are recognized by the State of California, and that all affected tribes should be given equal weight. One commenter requests that certification not take place until consultation with the tribes is completed and potential impacts and mitigations are addressed.
- Several commenters indicated that the journal of George Gibbs (1851), early miners' notes, contemporary [California Department of Fish and Game] files, and family accounts provide a historical context for pre-dam river conditions that would support benefits of the dams today.
- The California Coastal Commission referenced Section 30244 of the Coastal Act and the responsibility of the applicant to evaluate how river flows and volumes may affect erosion of the river channel and adjacent areas, including areas of known and potential archaeological resources, and should provide reasonable mitigation measures where necessary.
- One commenter indicated that the decommissioning of the four dams will provide a rare opportunity for river restoration, which would be important for tribes, upper basin irrigators, and other communities.
- One commenter specifically notes that dam removal will result in low river flows that will preclude the Karuk Tribe from performing the canoe dance ceremony.
- One commenter requested that the Klamath River Basin be restored and that a traditional fishery be returned to the up-river Klamath Tribes.
- One commenter indicated that the construction of the Klamath River dams may have compromised the very identity of the Shasta tribes, and is likely associated with Shasta Tribe's lack of federal recognition today.
- One commenter indicated that quicksilver mining sites from the 19th century are in the general vicinity of the LKP.
- One commenter indicated that dam removal will benefit recreational fishing communities, which existed in the basin in the 1950s and 1960s.

4.2.16 Paleontological Resources

The California Coastal Commission indicated that the EIR is subject to the policies of Chapter 3 of Coastal Act, which requires review of paleontological resources.

4.2.17 Energy Production and Greenhouse Gases

Several comments were received regarding the potential for dam removal effects on energy production and greenhouse gas (GHG) generation.

- Several commenters expressed concern regarding the loss of existing hydroelectric power, noting that it is an environmentally safe and clean energy source. One commenter indicated that the replacement source for hydroelectric power has not been identified and suggested that dam removal would result in a loss of energy security.
- One commenter indicated that hydroelectric power could be replaced with less impactful sources if the dams are removed.
- Two commenters referenced recent studies on reservoir contributions to methane generation and other GHG impacts created by dams.

4.2.18 Wildlife

Several comments were focused on the potential effects of dam removal on wildlife species.

- One commenter encouraged integration of Partners in Flight conservation objectives into dam removal planning and evaluation, as focal bird species can be indicators of restoration for dam removal projects (e.g., Gold Ray Dam).
- Several commenters noted that unless the entire river is studied, all impacts to fish and birds from dam removal cannot be known.
- Several commenters stated that the existing reservoirs provide breeding and resting habitats for many wildlife species, and the impacts to these species should be studied. Species noted include: sucker fish, mallards, egrets, herons (blue and white), northern white pelican, Canada geese, golden eagles, bald eagles (seven nests around Copco Lake), raccoons, deer, cougars, bears, and species groups of frogs, toads, loons, swans, hawks, eagles, and migratory birds.
- One commenter stated: (1) the Southern Resident killer whale is dependent on the fishery in the Klamath watershed; (2) Chinook salmon is their main food source and is supported by the Klamath, Sacramento, Eel, and other rivers; and (3) the whale spends substantial time in coastal areas off Washington, Oregon, and California, which is currently under the consideration as designated critical habitat.
- One commenter stated that prey depletion is recognized as the top threat to the Southern Resident killer whales, and the four dams have contributed to the decline of the Chinook salmon. The commenter urged the State Water Board to consider long-term and ecosystem-wide impacts, including the positive effect of increased salmon abundance on the whale population.
- Two commenters noted that sea lion populations have grown considerably. Commenters also discussed evidence of sea lion pups starving due to inadequate fish stocks. One commenter noted that trends need to be developed and provided estimates of annual sea lion fish consumption.
- One commenter noted that their hunting club property is in the bed of what was once Lower Klamath Lake, and they hope that a dam removal decision will not prevent access to irrigation tailwater that is used downstream by aquatic and avian

species (e.g., bald eagles). They have restored their property to seasonal wetlands, which can reduce the nutrients that cause downstream toxic algae growth that poisons fish and wildlife.

- One commenter noted that humans should be considered only after fish and wildlife, specifically wild steelhead and wild salmon.
- One commenter indicated that the survival and rights of the wildlife (e.g., turtles, birds) currently using the ecosystem must be considered. For example, cattle and wildlife drink from the lake daily and do not die. The commenter questioned why we do not hear about how tribes allegedly net thousands of salmon at the mouth of the river, shoot the sea lions which prey on the salmon, and then waste half of the salmon.

4.2.19 Riparian Habitat

One commenter recommended that the best available science be used to inform dam removal and riparian restoration planning and that robust regional avian science and conservation objectives be integrated into planning and evaluation.

4.2.20 Agriculture

Several comments were received regarding the potential for dam removal effects on agriculture.

- One commenter stated that farms and ranches along the river rely upon flood control and a steady supply of irrigation water provided by the dams. That will not be possible with a post-dam water source that will be wildly fluctuating throughout the year.
- One commenter expressed concern that Scott and Shasta Valley farmers will be told to stop farming because irrigation water may be needed to benefit Klamath River fisheries if the dams are removed.
- One commenter stated that farmers and ranchers are paying a steep price for the presence of the KHP because they receive no benefits in the form of irrigation storage, flood control, or future discounted electrical rates.
- One commenter stated that dam removal will provide more water for agricultural use (from Upper Klamath Lake) considering less reservoir water will be needed to augment instream flows in support of improving downstream water quality (assuming dam removal will improve water quality in the river).

4.2.21 Public Health and Safety

Several comments were focused on the potential effects of dam removal on public health and safety.

- Several commenters expressed concern that water in the reservoirs would no longer be available for use in fire suppression and questioned whether there would be a replacement plan for ensuring public safety. This comment is also listed in *Section 4.2.9 Water Supply*.

- Several commenters expressed concern regarding the loss of well water as a result of draining the reservoirs. This comment is also listed in *Section 4.2.9 Water Supply*.
- Several commenters noted the potential for downstream flooding as a result of dam removal. This comment is also listed in *Section 4.2.9 Water Supply* and *Section 4.2.10 Hydrology*.
- Several commenters were concerned with the potential health effects of 'toxic' sediments behind the dams remaining on-site or being transported into the river system.
- One commenter indicated concern about there being a single access route to the Copco Dam area and the potential impacts of construction activities/traffic on the safety of other road users such as school busses, residents, pedestrians, livestock and dogs. The commenter also noted that the road could be damaged during construction activities.

4.2.22 Aesthetics

Several comments were received regarding the potential for dam removal effects on aesthetics.

- Several commenters noted the potential for negative aesthetic impacts related to loss of the reservoirs and the resulting denuded landscape, debris, sediment and mud.
- Several commenters noted a presumably extended lag time for restoration activities to take effect (see also *Section 4.2.14 Property Value*).
- One commenter stated that dam removal will adversely affect the Copco and Iron Gate community viability.

4.2.23 Environmental Law Compliance

Many comments focused on environmental law compliance related to dam removal.

- Several commenters stated that public notification of the original January 10, 2017 public scoping meeting in Yreka was very limited and notification was not accomplished in a transparent way.
- One commenter stated that in considering impacts to Tribal Cultural Resources it is important to note that the treatment of federally-terminated tribes differs under federal and state laws. CEQA and California Assembly Bill (AB) 52 (Chapter 532, Statutes of 2014) provide a procedural pathway for consultation with California Native American Tribes recognized under the applicable California state laws, while NEPA only considers impacts to tribal cultural resources or federally-recognized tribes; others are treated as "interested parties."
- Two commenters stated that the passage of AB 52 requires lead agencies to engage in meaningful consultation with California Native American Tribes regarding proposed projects.
- Once comment noted that under the ESA, only water and substrate can be managed.

- Several commenters expressed concern that the State of California/State Water Board does not have jurisdiction beyond California and questioned the legality of the State Water Board undertaking an impact analysis for dams located in Oregon and waters originating in Oregon. Commenters suggested that federal agencies (e.g., Army Corps of Engineers, U.S. Department of Interior) possess the relevant regulatory authority and cited various sections of CEQA, Supreme Court decisions *Rapanos v. United States* and *Carabell v. the U.S*., and Civiletti Memorandum (43 Opinion Attorney General 197, 1979).
- Many commenters expressed concern that dam removal is a premature and/or a pre-determined outcome, which would make the environmental document pre-decisional and in violation of existing laws.
- One commenter indicated that in order to approve the water quality certification, the State Water Board must thoroughly and transparently identify, analyze, and determine whether possible mitigation measures are feasible and would render identified impacts less than significant.
- One commenter suggested that the 2012 KHSA EIS/EIR has no legal standing and noted that it should not be used for tiering of an environmental decision.
- Two commenters asserted that the analysis must include the entire river under federal and state statute prior to the State issuing a water quality certification.
- Several commenters questioned the legal authority and/or standing of the KRRC as a private corporation and noted that FERC must recognize that KRRC is capable of fully carrying out all potential imposed requirements, mitigations, and responsibilities involved in dam removal.
- One commenter stated that before FERC can accept a license surrender application, PacifiCorp and the KRRC must obtain water quality certification under the (CWA) Section 401 from the State Water Board. The State Water Board must analyze the existing operations to determine compliance with the CWA.
- Two commenters asserted that the KHP has been operating in violation of the CWA, and potentially other State and Federal laws.
- Several commenters cited the CEQA Guidelines and various public codes, which relate to the following:
  - analysis of all reasonably foreseeable direct and indirect significant effects
  - analysis of short-term and longterm effects
  - balancing of the social and environmental benefits with the unavoidable adverse environmental effects
  - alternatives to the project
  - detailed information about the effect which a proposed project is likely to have on the environment
  - identification of ways in which the significant effect(s) of the project might be minimized
- One commenter stated that according to CEQA Guidelines an EIR may incorporate by reference all or portions of another document which is a matter of public record or is generally available to the public, and cited the 2012 KHSA EIS/EIR.
- The California Coastal Commission stated that the EIR should examine KRRC's Proposed Project for consistency with the policies of Chapter 3 of the Coastal Act,

and noted several key policies including: 1) Section 30231, Biological Productivity and Water Quality; 2) Section 30234.5, Economic, Commercial, and Recreational Importance of Fishing; 3) Section 30233(d), Movement of Sediment and Nutrients; 4) Section 30244, Archaeological or Paleontological Resources; and 5) Section 30253, Hazards.

- One commenter expressed concern that removal of the Klamath River dams would violate the National Wild and Scenic Rivers designation. The commenter expressed concern that any state that imposes a regulatory action on a navigable river would violate the Dormant Commerce Clause. The commenter also stated that removal of the dams would be in violation of Siskiyou County's water rights.
- Many commenters noted that a majority of voters in Siskiyou County voted to retain the dams and asserted that the environmental document must analyze all viable alternatives.
- One commenter stated CEQA requires that all portions of the same project be analyzed for their environmental impacts. In spite of the artificial divisions of a state line, the KHP is one single project, under one single FERC license, and all parts of the project are designed to interact in various ways. Analyzing California pollution and operations without a discussion of J.C. Boyle and Keno would lead to an incomplete analysis. This could possibly also impact Oregon's application or help to create a situation where only the California dams come down because no single analysis of dams' interactions on the receiving reservoirs' existed. See Calif. Farm Bureau Federation v. California Wildlife Conservation Board (App. 3 Dist. 2006, 49 Cal.Rptr.3d 169, 143 Cal.App.4th 173 ("Improper for an agency to divide a project into separate parts to avoid CEQA analysis"), and San Joaquin Raptor Rescue Center vs. County of Merced (App. 5 Dist. 2007), 57 Cal.Rptr.3d 663, 149 Cal.App.4th 654, as modified ("The entirety of a project must be described in an EIR, and not some smaller portion of it.").

4.2.24 Cumulative Impacts Analysis

- Several commenters stated that the EIR should analyze cumulative impacts of the various alternatives in the entire Klamath Management Zone. This is an area extending from the shores of California and Oregon offshore out to 200 miles, and which extends north to at least Humbug Mountain, Oregon and south to at least Horse Mountain (near Shelter Cove), California (see also Section X.x.x).
- One commenter stated
- that the EIR must consider all significant impacts of its proposed project, regardless of whether those impacts occur offsite, and regardless of whether those activities would be attributable solely to the permitted activity or to that activity in combination with other circumstances including, but not necessarily limited to other past, present, and reasonably expect[ed] future activities in the relevant area. The commenter also stated that if the lead agency determines that there are one or more significant potential cumulative effects, then it must carefully consider those effects in determining whether, and on what terms, to condition the proposed project.
- Several commenters stated that the cumulative impacts analysis needs to include analysis of the Oregon dams and Upper Klamath Basin irrigation project.

4.2.25 Source Data and Information

Several commenters submitted new studies or information for consideration during the development of the LKP EIR. All information submitted during the NOP public comment period will be considered during the development of the LKP EIR. Information and studies submitted by commenters for consideration in LKP EIR development included the following:

- Alexander, J. D., J. L. Bartholomew, K. A. Wright, N. A. Som, and N. J. Hetrick. 2016. Integrating models to predict distribution of the invertebrate host of myxosporean parasites. Freshwater Science Online Early. DOI: 10.1086/688342. http://onlinelibrary.wiley.com/doi/10.1002/rra.3067/epdf
- David, A. T., S. A. Gough, and W. D. Pinnix. 2016. Summary of abundance and biological data collected during juvenile salmonid monitoring on the mainstem Klamath River below Iron Gate Dam, California, 2014. Arcata Fisheries Data Series Report Number DS 2016-47. U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, California. http://www.fws.gov/arcata/fisheries/reports/dataSeries/KlamathOutmigrantReport2014.pdf
- David, A. T., S. A. Gough, and W. D. Pinnix. 2017. Summary of abundance and biological data collected during juvenile salmonid monitoring on the mainstem Klamath River below Iron Gate Dam, California, 2015. Arcata Fisheries Data Series Report Number DS 2017-48. U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, California.

  https://www.fws.gov/arcata/fisheries/reports/dataSeries/KlamathOutmigrantReport2015_final.pdf
- Deemer, B. R., J. A. Harrison, S. Li, J. J. Beaulieu, T. Delsontro, N. Barros, J. F. Bezerra-Neto, S. M. Powers, M. A. Dos Santos, and J. A. Vonk. 2016. Greenhouse gas emissions from reservoir water surfaces: a new global synthesis. BioScience Advance Access.
- Goodman, D. H., and S. B. Reid. 2015. Regional implementation plan for measures to conserve Pacific lamprey (*Entosphenus tridentatus*), California – North Central Coast Regional Management Unit. Arcata Fisheries Technical Report Number TR 2015-27. U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, California. https://www.fws.gov/arcata/fisheries/reports/technical/PLCI%20CA%202015_CA%20Implementation_North%20Central%20Coast_Final.pdf
- Goodman, D. H., S. B. Reid, N. A. Som, and W. R. Poytress. (In Press). The punctuated seaward migration of Pacific Lamprey (*Entosphenus tridentatus*): environmental cues and implications for streamflow management. Canadian Journal of Fisheries and Aquatic Sciences 72: 1,817–1,828. http://www.nrcresearchpress.com/doi/abs/10.1139/cjfas-2015-0063#.V6oypU1-ND8
- Gough, S. A., and N. A. Som. 2015. Fall Chinook salmon run characteristics and escapement for the mainstem Klamath River, 2012. Arcata Fisheries Data Series Report Number DS 2015-46. U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, California. http://www.fws.gov/arcata/fisheries/reports/dataSeries/2012%20klamath%20carcass%20survey%20report%20FINAL.pdf

- Harrison, J. A., B. R. Deemer, M. K. Birchfield, and M. T. O'Malley. 2016. Reservoir water-level drawdowns accelerate and amplify methane emission. Environmental Science & Technology 51: 1,267–1,277. http://pubs.acs.org/doi/abs/10.1021/acs.est.6b03185
- Hillemeier, D., M. Belchik, T. Soto, S. C. Tucker, and S. Ledwin. 2017. Measures to reduce *Ceratonova Shasta* infection of Klamath River salmonids: a guidance document. Disease Technical Advisory Team.
- Jones, E. C., R. W. Perry, J. C. Risley, N. A. Som, and N. J. Hetrick. 2016. Construction, calibration, and validation of the RBM10 water temperature model for the Trinity River, northern California: U.S. Geological Survey Open-File Report 2016–1056. http://dx.doi.org/10.3133/ofr20161056. http://www.fws.gov/arcata/fisheries/reports/technical/rbm10_trinity.pdf
- Shea, C., N. J. Hetrick, and N. A. Som. 2016. Response to request for technical assistance – sediment mobilization and flow history in Klamath River below Iron Gate Dam. Technical Memorandum. Arcata Fish and Wildlife Office, Arcata, California. https://www.fws.gov/arcata/fisheries/reports/technical/Maintenance%20Flow%20Tech%20Memo%20Final.pdf
- Som, N. A, N. J. Hetrick, and J. Alexander. 2016. Response to request for technical assistance – polychaete distribution and infections. Technical Memorandum. Arcata Fish and Wildlife Office, Arcata, California. https://www.fws.gov/arcata/fisheries/reports/technical/Polychaete%20Tech%20Memo%20Final.pdf
- Som, N. A. and N. J. Hetrick. 2016. Response to request for technical assistance – *Ceratonova shasta* waterborne spore stages. Technical Memorandum. Arcata Fish and Wildlife Office, Arcata, California. https://www.fws.gov/arcata/fisheries/reports/technical/Spores%20Tech%20Memo%20Final.pdf
- Som, N. A., N. J. Hetrick, S. Foott, and K. True. 2016. Response to request for technical assistance – prevalence of *C. shasta* infections in juvenile and adult salmonids. Technical Memorandum. Arcata Fish and Wildlife Office, Arcata, California. https://www.fws.gov/arcata/fisheries/reports/technical/Fish%20Infection%20Tech%20Memo%20AFWO%20Final.pdf
- USDI (U.S. Department of Interior). 2016. Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report – Supplemental Information Report. State Clearinghouse #2010062060.
- CEQA scope should analyze beneficial uses associated with historical Chinook Salmon migrations upstream from dams. This information is summarized in the SDOR report and the recent Oregon Historical Quarterly article - OHQ. http://ohs.org/research-and-library/oregon-historical-quarterly/browse-ohq-articles.cfm.
- The Siskiyou County Assessor-Recorder submitted a detailed comment letter containing new information regarding the economic analysis in relation to property valuation and taxes.
- A box of materials was submitted by former Siskiyou County Board of Supervisor Grace Bennett for inclusion in the CEQA administrative record. These materials consisted of a variety of items including old newspaper articles, maps, opinion

pieces, and other information (Appendix D). These materials will be considered during development of the LKP EIR.

- Richard Marshall submitted several documents for inclusion in the CEQA administrative record. These materials consisted of a variety of items from the Siskiyou County Water Users Association, including a history of ballot measures, resolutions by the Siskiyou County Board of Supervisors, Shasta Nation Anadromous fish passageway alternatives, scoping comments related to the KBRA/KHSA and dam removal, and other materials. These materials will be considered during development of the LKP EIR.
- Richard Marshall's submittals during the Yreka public scoping meeting included a petition to support a class action lawsuit (dated April 11, 2016). The petition was signed by 466 persons.
- The PCFFA/IFR submitted 17 documents for inclusion into the CEQA administrative record and consideration during development of the EIR. The documents date from 1980 to 2009.
- The County of Siskiyou provided a resolution (16-220) adopted by the Board of Supervisors on September 13, 2016 adopting the map labelled "The Traditional Homelands of the Shasta People." The map was attached to the resolution. The Shasta Nation requested that this map be referenced for all future consultation and cultural resource processes.

4.2.26 Other Comments

- One commenter suggested that the State Water Board prepare an index and update a publicly available searchable database for this project.
- Several commenters stated that the State Water Board should look at other dam removal projects for guidance on assessment of impacts and benefits.
- One commenter stated that dam removal is necessary but not sufficient for full recovery/restoration of the Klamath River.

4.2.27 Comments Not Relating to the Scope or Content of the EIR

Many comments were received that do not relate to the scope or content of the EIR, for example:

- Many comments were statements for or against the project.
- Many commenters urged the State Water Board to expedite the environmental review and Clean Water Act (CWA) Section 401 certification process to allow the dams to be removed by 2020.
- Several commenters objected to PacifiCorp assessing a surcharge on ratepayers to fund dam removal.
- Several commenters objected to the payment of State dollars to the KRRC.
- Two organizations volunteered their expertise in restoration planning and monitoring.
- One commenter would like to see the Klamath Hot Springs restored.

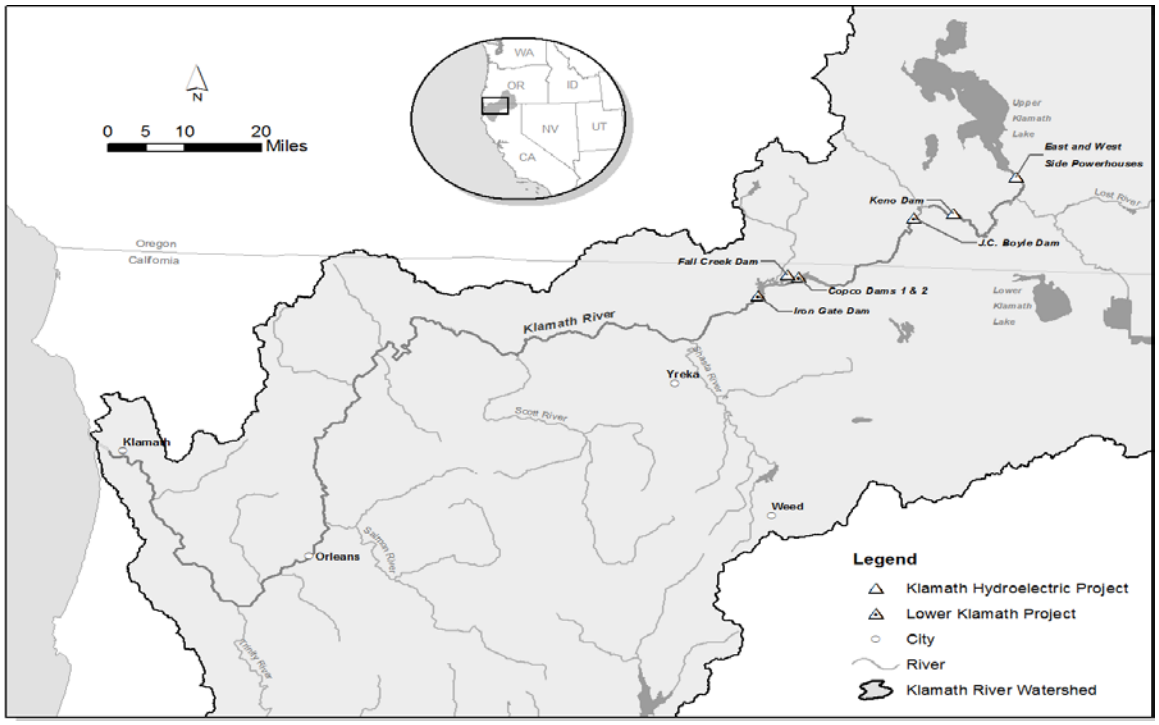
- One commenter indicated that the dams provide a remote and population-safe target, should the United States attack a foreign power and the latter decide to retaliate.
- Several commenters stated that ranchers and residents do not have a voice in this matter.
- One commenter stated that the system is rigged and benefits the one percent.
- One commenter stated that the health threats related to blue green algae blooms in the reservoirs and interest in dam removal are forms of ecoterrorism.
- One commenter stated that society faces a myriad of difficult situations.
- Once commenter stated that the analysis should weigh the good of the many over the good of a few.
- A few commenters stated that the State Water Board's actions are part of an illegal California government, and that these actions would never occur in the State of Jefferson.
- Several commenters expressed concerns about secret meetings by government agencies regarding this project.
- One commenter stated that President Trump is abolishing NEPA.
- One commenter stated that this project is part of a global initiative to control all of the people in the world.

Appendices

Appendix A

Notice of Preparation

NOTICE OF PREPARATION AND SCOPING MEETINGS FOR AN ENVIRONMENTAL IMPACT REPORT FOR THE LOWER KLAMATH PROJECT LICENSE SURRENDER



PROJECT AREA

To save paper, the State Water Resources Control Board (State Water Board) strongly encourages interested parties to subscribe to the State Water Board's Email Subscription List to electronically receive Lower Klamath Project specific information. Instructions on how to sign up for the State Water Board's Email Subscription List are outlined below:

1. Visit: http://www.waterboards.ca.gov/resources/email_subscriptions/swrcb_subscribe.shtml#rights
2. Provide your name and email in the required fields.
3. In the categories below the email and name fields, select "Water Rights," then "Lower Klamath Project."
4. Click on the "Subscribe" button.
5. An email will be sent to you. You must respond to the email message(s) to confirm your membership on the selected list(s).

Alternatively, you may request to be placed on the State Water Board's hard copy mailing list. Requests to receive information should be sent to:

Mr. Parker Thaler
parker.thaler@waterboards.ca.gov
(916) 341-5321
State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA 95812-2000

There will also be the opportunity to sign up for a mailing list at the scoping meetings.

Notice of Preparation **Form B**

TO: State Clearinghouse
Governor's Office of Planning and Research
P.O. Box 3044
Sacramento, CA 95812-3044

SUBJECT: **Notice of Preparation of an Environmental Impact Report for the Proposed Lower Klamath Project License Surrender**

Lead Agency:
Agency Name: State Water Resources Control Board
Address: P.O. Box 2000
City/State/Zip: Sacramento, CA 95812-2000
Contact: Mr. Parker Thaler

Consulting Firm:
Firm Name: Stillwater Ecosystem, Watershed and Riverine Sciences
Address: 2885 Telegraph Avenue, Suite 400
City/State/Zip: Berkeley, CA 94705
Contact: Ms. Maia Singer

INTRODUCTION

Pursuant to the California Environmental Quality Act (CEQA)[1], the State Water Resources Control Board (State Water Board) will prepare an environmental impact report (EIR) for removal of the Lower Klamath Project (LKP) facilities. The EIR will be prepared to support consideration of the Klamath River Renewal Corporation's (KRRC) LKP application for water quality certification[2]. The KRRC is proposing to remove sufficient portions of the LKP to create a free flowing Klamath River and provide for volitional fish passage through the Federal Energy Regulatory Commission (FERC) license surrender process. The EIR will evaluate potential impacts of the LKP to water quality and other resources within California as compared to the environmental baseline, and will also evaluate a range of alternatives.

The LKP (FERC Project No. 14803) is currently part of the Klamath Hydroelectric Project (FERC Project No. 2082), which is owned and operated by PacifiCorp. The Klamath Hydroelectric Project presently consists of seven dam developments: (1) East Side; (2) West Side; (3) Keno; (4) J.C. Boyle; (5) Fall Creek (located on Fall Creek, a Klamath River tributary); (6) Copco No. 1; (7) Copco No. 2; and (8) Iron Gate.

On September 23, 2016, PacifiCorp and the KRRC filed a joint license transfer application with FERC, which seeks to transfer the J.C. Boyle, Copco No. 2, Copco No. 1, and Iron Gate dam developments to the KRRC. If FERC approves the license transfer application, the LKP will consist of four dam developments: (1) J.C. Boyle; (2) Copco No. 2; (3) Copco No. 1; and (4) Iron Gate. Concurrent with the license transfer application, the KRRC filed a license surrender application with FERC to decommission the LKP.

The license transfer and license surrender applications are consistent with the April 6, 2016, Amended Klamath Hydroelectric Settlement Agreement (KHSA). The Amended KHSA is an agreement between PacifiCorp; several state, federal and local governmental agencies[3]; two Native American Tribes; several nongovernmental organizations; and individual stakeholders

[1] Public Resources Code, sections 21000 et seq.
[2] Clean Water Act, section 401.
[3] The State Water Board is not a signatory to, and is not bound by, the original or the Amended KHSA.

designed to remove sufficient portions of the four dam developments that comprise the LKP to create a free flowing Klamath River and provide for volitional fish passage.

The State Water Board is seeking comments from trustee agencies, responsible agencies, and other interested persons concerning the scope and content of the environmental information to be included in the EIR. Please send your comments to Mr. Parker Thaler at the address shown at the end of this Notice of Preparation (NOP).

The information in this NOP is divided into the following sections below:

- Project Title
- Project Location
- Scoping Meetings
- Brief Description of Existing LKP Dam Developments
- Brief Description of Proposed Project
- Federal Energy Regulatory Commission Process
- Klamath Settlement Agreements
- State Water Board's Water Quality Certification
- CEQA Information
- Submittal of Written Comments
- Questions and Additional Information
- Attachment 1 – Summary of Potentially Significant Impacts Associated with the Lower Klamath Project License Surrender

PROJECT TITLE: Lower Klamath Project License Surrender

PROJECT LOCATION
The LKP is located along the Klamath River, in Siskiyou County, California, and in Klamath County, Oregon. The California portion of the LKP includes: Copco No. 2, Copco No. 1, and Iron Gate dam developments. The Oregon portion of the LKP includes the J.C. Boyle dam development, which is located on the Klamath River approximately 16 river miles from Oregon's border with California. The general locations of LKP dam developments are shown in the map on the first page of this NOP.

The EIR will focus primarily on impacts related to the actions proposed for the LKP's dam developments in California. Actions at J.C. Boyle will be described, but impacts will only be addressed to the extent that such actions will adversely impact the California environment. Oregon's Department of Environmental Quality[4] is responsible for acting on a separate water quality certification application for the LKP that addresses the J.C. Boyle dam development.

SCOPING MEETINGS
The State Water Board will hold scoping meetings to provide information on the Lower Klamath Project License Surrender, the water quality certification process, and to receive written or oral comments from agency personnel and other interested persons concerning the range of alternatives, potential significant effects, and mitigation measures that should be analyzed in the EIR. The time allotted for each individual or organization to comment orally may be limited if the number of people in attendance so requires. Scoping meetings will be documented by transcript.

Date and Time	Location	Address
January 10, 2017 (5:00 pm – 7:00 pm)	Yreka	Best Western Miner's Inn – Convention Center, Auditorium 122 E. Miner Street Yreka, CA 96097
January 12, 2017 (5:00 pm – 7:00 pm)	Arcata	D Street Neighborhood Center 1301 D Street Arcata, CA 95521
January 20, 2017 (10:00 am – 12:00 pm)	Sacramento*	CalEPA Building Byron Sheet Auditorium 1001 I Street, 2nd Floor Sacramento, CA 95814
* The Sacramento meeting will be webcast live on the California Environmental Protection Agency (CalEPA) website at: www.calepa.ca.gov/broadcast/. During the webcast, webcast participants can submit comments via electronic mail to: wr401program@waterboards.ca.gov.		

If you have additional questions concerning these meetings, or would like to make a request for reasonable accommodations for a disability, please contact Parker Thaler by phone at (916) 341-5321 or by email at parker.thaler@waterboards.ca.gov.

It is the policy of the State Water Board to provide a work environment that is free from threats or acts of violence. Threats or acts of violence committed by, or directed at, any employee or contractor will not be tolerated. Any person who appears before the State Water Board has an obligation to represent their interests in a professional manner. The State Water Board

[4] Oregon's Department of Environmental Quality's website: http://www.oregon.gov/deq/pages/index.aspx

requests that all persons in or near a State Water Board hosted meeting refrain from engaging in inappropriate conduct. Inappropriate conduct may include disorderly, contemptuous or insolent behavior, breach of peace, boisterous conduct, violent disturbance, or other unlawful interference in the proceedings.

It is possible that one or more members of the State Water Board will attend one or more of the scoping meetings. A quorum of the State Water Board may be present at the scoping meetings. However, no State Water Board action will be taken.

BRIEF DESCRIPTION OF EXISTING LKP DAM DEVELOPMENTS

California Dam Developments (described in order from downstream to upstream):

Iron Gate Dam Development: The Iron Gate dam development is located on the Klamath River between river mile (RM) 190 and RM 197 in Siskiyou County, California. The Iron Gate dam development primarily consists of: 1) 53,800 acre-feet (AF) reservoir (Iron Gate reservoir); 2) 189-foot tall earthen dam with a clay core on a basalt rock foundation (Iron Gate dam); 3) Iron Gate Hatchery, which includes warehouse, hatchery building, four fish rearing ponds, a fish ladder, visitor center, and four employee residences; 4) fish collection facility at Iron Gate dam; 5) ungated side-channel spillway capable of discharging 26,200 cubic feet per second (cfs); 6) reinforced concrete diversion tunnel capable of diverting 2,700 cfs from the reservoir to the Klamath River; 7) 45-foot tall freestanding intake structure; 8) 18 megawatt (MW) powerhouse; 8) 6.5 miles of transmission lines; and 9) recreation facilities, including Fall Creek, Jenny Creek, Wanaka Springs, Camp Creek, Juniper Point, Mirror Cove, Overlook Point, Long Gulch, and small unnamed dispersed shoreline recreation sites. Recreation sites include communication buildings, restrooms, and two residences. Iron Gate dam supplies cold water to Iron Gate Hatchery, which is located below Iron Gate dam and powerhouse. Iron Gate Hatchery raises steelhead, coho salmon, and chinook salmon.

Copco No. 2 Dam Development: The Copco No. 2 dam development is located on the Klamath River between RM 196 and RM 199 in Siskiyou County, California. The Copco No. 2 dam development consists primarily of: 1) 70 AF unnamed reservoir; 2) 33-foot tall concrete diversion dam with a gated spillway (Copco No. 2 dam); 3) water conveyance system consisting of a 3,550 feet of concrete lined tunnels, 1,313 feet of a wood-stave pipeline, an underground surge tank and two steel penstocks; 5) 27 MW powerhouse; 6) control center building; 7) maintenance building; 8) oil and gas storage building; and 9) a nearby village consisting of a cookhouse, bunkhouse, storage building, bungalow, three modular houses, four old style ranch houses, and a schoolhouse/community center. Copco No. 2 dam is located approximately 0.25 miles downstream of Copco No. 1 dam and has no associated recreation facilities. Water diversions for hydropower generation at Copco No. 2 create a 1.5-mile-long bypass reach.

Copco No. 1 Dam Development: The Copco No. 1 dam development is located on the Klamath River between RM 198 and RM 204 in Siskiyou County, California. The Copco No. 1 dam development primarily consists of: 1) 40,000 AF reservoir (Copco reservoir); 2) 135-foot tall concrete gravity arch dam with a gated spillway (Copco No. 1 dam); 3) diversion tunnel capable of diverting 5,179 cfs; 4) switchyard; 5) two 10- and one 14-foot diameter penstock pipes; 6) 20 MW powerhouse; and 7) reservoir-associated recreation facilities, including Mallard Cove and Copco Cove. There is no bypass reach for this dam development.

Oregon Dam Development:

J.C. Boyle Dam Development: J.C. Boyle Dam is located on the mainstem of the Klamath River, at RM 224.7. J.C. Boyle Dam is a 68-foot tall concrete dam that impounds approximately 2,629 AF of water in a narrow reservoir with approximately 420 surface-acres. J.C. Boyle supplies water through a 2.5-mile water conveyance system to a 98 MW powerhouse. Water diversions for hydropower generation at J.C. Boyle create a 4.3-mile bypass reach. The approximately 17 miles downstream of the J.C. Boyle powerhouse comprise the J.C. Boyle peaking reach. This 17-mile reach is where the LKP crosses from Oregon into California and ends at the Copco No. 1 reservoir.

BRIEF DESCRIPTION OF PROPOSED PROJECT

The KRRC is proposing to remove sufficient portions of the Iron Gate, Copco No. 2, Copco No. 1, and J.C. Boyle dam developments to create a free flowing Klamath River and provide for volitional fish passage in the Klamath River currently occupied by these dam developments. The hydroelectric facilities and associated structures will either be removed or decommissioned in place.

The LKP would require improvements to roads, construction of staging areas, and creation of onsite debris disposal sites. The LKP would also require changes to the city of Yreka's Fall Creek water supply. Yreka receives 15 cfs of water through a 24-inch diameter pipe that runs from the Fall Creek dam development, crosses the Klamath River near the upstream end of Iron Gate reservoir, to the City of Yreka's water distribution system.

The LKP would result in large sediment releases as water and sediment stored behind J.C. Boyle, Copco No. 2, Copco No. 1, and Iron Gate reservoirs are released during, and to a lesser extent, following decommissioning activities. Proposed post-decommissioning restoration activities include revegetation, invasive species control, and removal or modification of existing reservoir recreation facilities. The KRRC's water quality certification application proposes the following schedule in order to minimize sediment releases during the critical times and life stages of various sensitive species downstream:

Proposed Schedule for Lower Klamath Project	
Staging Activities	Beginning June 2019
Reservoir Drawdown	January 2020 – October 2020
Copco No. 1 Dam Development Removal	January 2020 – May 2020
J.C. Boyle Dam Development Removal	January 2020 – September 2020
Copco No. 2 Dam Development Removal	May 2020 – October 2020
Iron Gate Dam Development Removal	July 2020 – November 2020

A more detailed description of the Proposed Project is provided in the KRRC's application for water quality certification, which is available at: http://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/lower_klamath_ferc14803.shtml, and in the Final *Klamath Facilities Removal Draft Environmental Impact Statement/Environmental Impact Report* (2012 KHSA EIS/EIR), sections 2.4.3 and 2.4.4, available at: https://klamathrestoration.gov/Draft-EIS-EIR/download-draft-eis-eir.

FEDERAL ENERGY REGULATORY COMMISSION PROCESS

FERC is the federal agency that regulates the construction, operation, and decommissioning of most non-federal hydroelectric dams in the United States. The LKP (FERC Project No. 14803) is currently owned and operated by PacifiCorp as part of the Klamath Hydroelectric Project (FERC Project No. 2082).[5] On September 23, 2016, PacifiCorp and the KRRC filed a joint license transfer application with FERC, which seeks to transfer the J.C. Boyle, Copco No. 2, Copco No. 1, and Iron Gate dam developments to the KRRC. Concurrent with the license transfer application, the KRRC filed a license surrender application with FERC to decommission the LKP. The LKP license transfer and surrender processes are subject FERC's approval.

In September 2006, during PacifiCorp's Klamath Hydroelectric Project relicensing process, FERC released a draft Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA). FERC's draft EIS for the Klamath Hydroelectric Project examines the probable effects of a range of alternatives, including continued operations of the dam developments with or without fish passage improvements, and removal of some or all of the four dam developments that compromise the LKP. FERC received extensive comments from agencies and interested parties. FERC released its final EIS for the Klamath Hydroelectric Project in November 2007 and it is available online at: https://www.ferc.gov/industries/hydropower/enviro/eis/2007/11-16-07.asp.

KLAMATH SETTLEMENT AGREEMENTS

Concurrent with PacifiCorp's FERC relicensing of the Klamath Hydroelectric Project, the following three Settlement Agreements were executed by a number of parties with varying interests in the Klamath Basin: 1) KHSA (Klamath Hydroelectric Settlement Agreement); 2) Klamath Basin Restoration Agreement (KBRA); and 3) Upper Klamath Basin Comprehensive Agreement (UKBCA). These settlement agreements, among other things: 1) provided a decision-making framework and process for removal of J.C. Boyle, Copco No. 2, Copco No. 1, and Iron Gate dam developments; 2) addressed water supply and allocation issues; and 3) set forth substantial water quality improvement measures for the Upper Klamath Basin.

The original KHSA proposed federal legislation that would have halted PacifiCorp's FERC relicensing process and granted the Secretary of the United States Department of the Interior the authority to determine whether removing J.C. Boyle, Copco No. 2, Copco No. 1, and Iron Gate dam developments was in the public interest and would advance salmon restoration (Secretarial Determination).

In accordance with the original KHSA, the 2012 KHSA EIS/EIR was prepared to support Klamath Hydroelectric Project dam removal and to inform the Secretarial Determination. On September 22, 2011, the United State Department of Interior and the California Department of Fish and Game (now California Department of Fish and Wildlife) released the *Draft Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report*. The agencies circulated the Final 2012 KHSA EIS/EIR, but the United States Department of Interior never entered a Record of Decision and the California Department of Fish and Wildlife never certified the document.[6]

[5] The Klamath Hydroelectric Project was originally licensed in 1956 for a term of 50 years. On March 1, 2006, the original FERC license expired and since then PacifiCorp has continued to operate the Klamath Hydroelectric Project (including the LKP dam developments) under annual licenses issued by FERC while PacifiCorp pursued relicensing. On June 16, 2016, at PacifiCorp's request, FERC issued an order placing the Klamath Hydroelectric Project relicensing process in abeyance.

[6] The final 2012 KHSA EIS/EIR is dated December 2012, but was released in April 2013.

Similar to FERC's 2007 NEPA document, the 2012 KHSA EIS/EIR evaluated a range of project alternatives including continued operation of the dam developments, with and without fish passage improvements, as well as removal of some or all of the dams that make up the LKP. The 2012 KHSA EIS/EIR is available online at: https://klamathrestoration.gov/Draft-EIS-EIR/download-draft-eis-eir.

Federal legislation to enact the settlement agreements did not pass, and on December 31, 2015, the KBRA terminated. On April 6, 2016, the KHSA was amended to remove the need for Congressional authorization, and instead contemplates dam removal through the FERC license surrender process. Also on April 6, 2016, some of the parties to the KHSA and KBRA executed the Klamath Power and Facilities Agreement. The Klamath Power and Facilities Agreement addresses the disposition of specific Oregon facilities on the Klamath River, and expresses a commitment to continue negotiations regarding certain issues addressed in the KBRA. The State Water Board understands that the UKBCA remains in effect.

STATE WATER BOARD'S WATER QUALITY CERTIFICATION

The State Water Board's water quality certification process results from the KRRC's FERC license surrender application, filed in furtherance of the Amended KHSA. Section 401 of the Clean Water Act (33 U.S.C. § 1341) requires every applicant for a federal license or permit that may result in a discharge into navigable waters to provide the federal licensing or permitting agency with certification that the project will be in compliance with state water quality standards and other relevant requirements of state law. Section 401 provides that conditions of certification shall become conditions of any federal license or permit for the project. The State Water Board is the agency in California that is responsible for section 401 water quality certifications (Wat. Code, § 13160; Cal. Code Regs., tit. 23, § 3855, subd. (b)).

There are water quality impacts associated with both the operation and decommissioning of the LKP dam developments. The Klamath River and water bodies associated with the LKP dam developments are listed in the California's 2012 Clean Water Act Section 303(d) List of Impaired Water Bodies (2012 Integrated Report) as follows:

- The Klamath River from the Oregon border to the Pacific Ocean is listed for nutrients, organic enrichment/low dissolved oxygen, and temperature.
- Iron Gate and Copco No. 1 reservoirs are listed for mercury and for a liver toxin produced by blue-green algae, called microcystin.
- The Klamath River from Copco No. 1 reservoir to the Trinity River is listed for microcystin.
- The Klamath River from the Trinity River to the Pacific Ocean is listed for sediment.
- The Klamath River from Iron Gate Dam to the Scott River is listed for aluminum.

The State Water Board may issue a water quality certification if it determines that a project will comply with specific federal Clean Water Act requirements (including water quality standards and implementation plans) and with other relevant requirements of state law. The State Water Board will determine whether decommissioning the LKP dam developments adequately protects the beneficial uses and meets the water quality objectives for water bodies affected by the LKP, as defined in the *Water Quality Control Plan for the North Coast Region* (Basin Plan), as well as other relevant standards. Additional information concerning the Basin Plan and designated beneficial uses is available online at: http://www.waterboards.ca.gov/northcoast/water_issues/programs/basin_plan/basin_plan.shtml

CEQA INFORMATION

The issuance of a section 401 certification is a discretionary action subject to CEQA compliance. Because there are potentially significant environmental impacts associated with the LKP, the State Water Board has decided to prepare an EIR.

The State Water Board previously initiated CEQA review for PacifiCorp's continued operations of the Klamath Hydroelectric Project and associated LKP dam developments by issuing a NOP for an EIR in September 2008 and again in November 2015. During the 2008 and 2015 CEQA processes, the State Water Board held extensive scoping meetings.

Following issuance of the September 2008 NOP, on February 18, 2010, the original KHSA was executed. From May 18, 2010, to July 1, 2013, at the request of KHSA signatories, the State Water Board issued a series of time-limited abeyances holding PacifiCorp's 2008 water quality certification application in abeyance. The State Water Board's fourth and final water quality certification abeyance ended on July 1, 2013, and the State Water Board resumed processing PacifiCorp's Klamath Hydroelectric Project water quality certification application and issued a second NOP in November 2015, in light of significant new information developments.

On June 16, 2016, FERC issued an order to hold PacifiCorp's Klamath Hydroelectric Project relicensing process in abeyance. Following FERC's order, PacifiCorp withdrew its water quality certification application from the State Water Board. The withdrawal of PacifiCorp's water quality certification application suspended the November 2015 Klamath Hydroelectric Project's CEQA process.

In developing an EIR to support the State Water Board's consideration of a water quality certification for the LKP, the State Water Board will consider FERC's 2007 EIS and the 2012 KHSA EIS/EIR. The State Water Board plans to evaluate a range of alternatives from the No Project Alternative to removal of the four Lower Klamath Project dam developments (KRRC's Proposed Project). State Water Board staff encourages interested parties to provide input regarding which alternatives should be evaluated in the EIR and recommends parties reference existing alternatives in the 2007 FERC EIS and 2012 KHSA EIS/EIR, where applicable.

Attachment 1 provides a broad summary of potentially significant impacts identified by resource area. Additional information on potential impacts is available in the FERC 2007 EIS (summary included in Table ES-1, pp. xxxix – l.) and the 2012 KHSA EIS/EIR (summary included in Table 5-1, pp. 5-8 to 5-75).

SUBMITTAL OF WRITTEN COMMENTS

Please send written scoping comments to the address below. Please provide a contact person and contact information in case there are questions about the comments. **The comment deadline is 5:00 pm on February 1, 2017.**

State Water Resources Control Board
Division of Water Rights
Water Quality Certification Program
Attention: Mr. Parker Thaler
P.O. Box 2000
Sacramento, CA 95812-2000

Phone: (916) 341-5321
Fax: (916) 341-5400
Email: parker.thaler@waterboards.ca.gov

QUESTIONS AND ADDITIONAL INFORMATION
General questions should be directed to Mr. Parker Thaler at (916) 341-5321 or parker.thaler@waterboards.ca.gov.

Information related to the water quality certification for the LKP is available on the State Water Board's LKP webpage at:
http://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/lower_klamath_ferc14803.shtml

DEC 2 2 2016

Erin Ragazzi
Water Quality Certification Program Manager
Division of Water Rights

Date

Attachment 1: Summary of Potentially Significant Impacts Associated with the Lower Klamath Project License Surrender

Attachment 1: Summary of Potentially Significant Impacts Associated with the Lower Klamath Project License Surrender

The Lower Klamath Project License Surrender environmental impact report (EIR) will examine potentially significant impacts of the Lower Klamath Project License Surrender in a wide range of areas. Below is a list that provides a broad summary of potentially significant impacts anticipated with the Klamath River Renewal Corporation's Lower Klamath Project (LKP). A more detailed summary of potential impacts is available in the Federal Energy Regulatory Commission's 2007 *Environmental Impact Statement* (summary included in Table ES-1, pp. xxxix – l.) and the 2012 *Klamath Facilities Removal Draft Environmental Impact Statement/ Environmental Impact Report* (summary included in Table 5-1, pp. 5-8 to 5-75):

Aesthetics:

- Removal of dams and associated hydroelectric and recreational facilities, and restoration activities, could have short-term and long-term impacts on landscape aesthetics; and
- Sediment transport could change the appearance of the Klamath River.

Air Quality:

- Construction, dam removal and restoration activities will temporarily affect air quality, potentially increasing volatile organic compounds, dust, and criteria pollutant levels to significant levels.

Aquatic Resources:

- Reservoir draw-down and dam removal could cause short-term impacts to critical habitat for coho, bull trout, and Southern Resident killer whale populations;
- Dam removal activities could alter the quality of essential habitat for coho salmon, chinook salmon, groundfish, Southern Resident killer whales and pelagic fish;
- Suspended sediment concentrations, sediment deposition, and bedload sediment changes associated with dam removal could affect habitat for various species, including salmonids, Pacific lamprey, green sturgeon, eulachon, longfin smelt, freshwater mussels, and benthic macroinvertebrates; and
- Dam removal would eliminate reservoir habitat associated with the existing LKP dam developments.

Flood Hydrology:

- Reservoir drawdown could affect flood risk in the short-term;
- Downstream sediment deposition could change flood risk;
- Flow regime changes associated with dam removal activities could change the 100-year floodplain; and
- Realigning the City of Yreka's water supply pipeline could alter flood risk.

Geology, Soils, and Geologic Hazards:

- Draining the reservoirs and releasing sediment could cause short-term and long-term increases in sediment deposition that could alter geomorphological characteristics in the Klamath River and/or Klamath Estuary;
- Dam removal, construction and restoration activities may cause significant erosion in the LKP area and downstream;
- Draining the reservoirs may alter seismic and volcanic activity; and
- Drying of exposed reservoir bed sediments could affect future restoration and construction activities.

Attachment 1: Summary of Potentially Significant Impacts Associated with the Lower Klamath Project License Surrender

Greenhouse Gas Emissions:

- Removal of a very low-emission power source (i.e., hydroelectric projects) may result in increased greenhouse gas emissions from replacement sources; and
- Construction, dam removal and restoration activities will temporarily increase greenhouse gas emissions.

Historical and Archeological Resources:

- Removal of dams and associated hydroelectric facilities may affect hydroelectric structures and a potential historical district;
- Reservoir removal, changing sedimentation, flow and erosion patterns could affect submerged or riparian archeological resources; and
- Potential effects to tribal cultural resources may also be considered effects to historical and archeological resources.

Land Use, Agricultural and Forest Resources:

- The exposure of the reservoir bed, restoration activities, dam removal activities (including roads, staging areas, and debris disposal), and removal of recreational facilities could impact land use, and potentially result in the conversion of forest or farmland to other uses.

Noise and Vibration:

- Dam removal activities, and particularly dam blasting activities, could result in localized noise impacts and increased vibration levels; and
- Noise levels along haul routes could be increased.

Population and Housing:

- Employment for proposed activities may result in new jobs, including potential temporary housing needs for any non-local employees.

Public Health and Safety, Utilities and Public Services, Solid Waste, and Power:

- Dam removal activities could result in public safety risks and potentially increase fire risk;
- Dam removal could affect water availability and response times for wildfires and area residential fires;
- Dam removal activities could require new roads and temporarily affect traffic safety;
- The City of Yreka's water supply pipeline could potentially be more vulnerable to vandalism;
- Sediment releases associated with dam removal activities could result in short-term human exposure to contaminants from contact with exposed sediments;
- Dam removal activities could affect the need and response time for public services;
- Dam removal could temporarily affect available mosquito habitat and related disease transmission;
- Dam removal could result in significant amounts of debris; and
- Loss of hydroelectric power could impact the supply of electricity.

Recreation:

- Reservoir-based recreation would be affected by reservoir drawdown, dam removal, construction and restoration activities;
- Changes in water quality, sedimentation, floodplain and river channel could affect river-based recreational activities downstream of facilities, including fishing and contact recreation; and
- Whitewater boating opportunities would be changed under an altered flow regime.

Attachment 1: Summary of Potentially Significant Impacts Associated with the Lower Klamath Project License Surrender

Terrestrial Resources:

- Dam removal activities and associated flushing of sediments could result in loss of wetland habitat in the LKP area and downstream, as well as impacts to wildlife corridors;
- Dam removal activities could negatively impact special status and culturally important species; and
- Disturbed areas resulting from the LKP could provide habitat for invasive plants.

Toxic/Hazardous Materials:

- Dam removal activities could involve transport and handling of hazardous materials, including risk of release.

Traffic and Transportation:

- Traffic associated with dam removal activities could affect traffic flow and safety, including to public transit and non-motorized transportation (e.g., pedestrians, bicycles);
- Changes in land use could result in traffic changes; and
- Increased heavy vehicle traffic during construction could increase wear on roads and potentially exceed bridge weight limits.

Tribal Cultural Resources:[7]

- Construction and restoration activities could affect sites and landscapes with tribal cultural value;
- Reservoir dewatering and removal could affect items and areas with tribal cultural resources that are currently submerged;
- Changing sedimentation, flow and erosion patterns could affect tribal cultural resource areas downstream; and
- Landscapes, ecosystems and species that are tribal cultural resources could be affected by dam removal and restoration activities.

Water Quality:

- Dam removal activities could contribute to changes in water quality, including:
    - Short- and long-term changes to the water temperature regime;
    - Biological oxygen demand and daily dissolved oxygen variability;
    - Short-term increases in suspended sediment and sediment associated nutrients in the Klamath River from the California state line to the marine nearshore environment, and may affect long-term suspended sediment and sediment associated nutrients in the Lower Klamath River, Klamath Estuary, and marine nearshore environment;
    - Long-term summer time increases in pH downstream of Iron Gate Dam;
    - Short-term increases in inorganic or organic contaminant levels;
    - Changes in nutrient levels, biomass, and algal cycling, potentially from the state line through the Klamath Estuary;
    - Short- and long-term changes to algae populations and associated algal toxins in the Lower Klamath River from the California state line to the Klamath Estuary; and
    - Long-term increases in nutrient levels and periphyton biomass in the Klamath River downstream of Iron Gate Dam.

[7] This resource area was added to California Environmental Quality Act in 2014 (Assembly Bill 52; Statutes 2014, Chapter 532, Gatto), and has not been specifically evaluated in prior environmental documents. Tribal governments have been actively involved in issues surrounding the disposition of the Klamath Hydroelectric Project and associated LKP for many years. The State Water Board looks forward to working with California Native American Tribes to develop this analysis and any potential alternatives and mitigation measures.

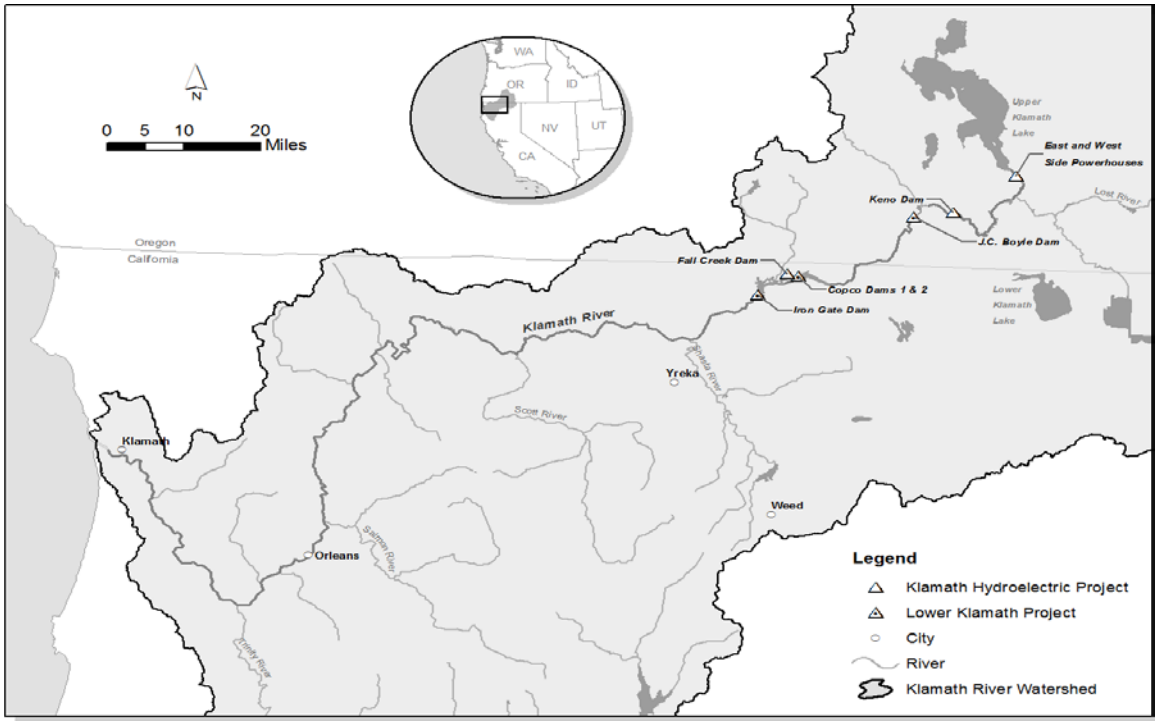
- Restoration activities could involve application of herbicides that could cause short-term levels of organic contaminants in runoff that are toxic to aquatic biota in the LKP area.

Water Supply:

- Eliminating the reservoirs could impact groundwater wells near the reservoirs and the amount of groundwater recharge;
- Changes to the flow regime below Iron Gate Dam could affect water supply and water rights;
- Removal of Iron Gate Reservoir will require realignment of City of Yreka's water diversion pipeline from Fall Creek; and
- Sediment releases may affect Klamath River geomorphology, which can affect downstream water intake pumps.

01-10-2017: updated to reschedule Yreka scoping meeting, see page 4

NOTICE OF PREPARATION AND SCOPING MEETINGS FOR AN ENVIRONMENTAL IMPACT REPORT FOR THE LOWER KLAMATH PROJECT LICENSE SURRENDER



PROJECT AREA

To save paper, the State Water Resources Control Board (State Water Board) strongly encourages interested parties to subscribe to the State Water Board's Email Subscription List to electronically receive Lower Klamath Project specific information. Instructions on how to sign up for the State Water Board's Email Subscription List are outlined below:

1. Visit: http://www.waterboards.ca.gov/resources/email_subscriptions/swrcb_subscribe.shtml#rights
2. Provide your name and email in the required fields.
3. In the categories below the email and name fields, select "Water Rights," then "Lower Klamath Project."
4. Click on the "Subscribe" button.
5. An email will be sent to you. You must respond to the email message(s) to confirm your membership on the selected list(s).

Alternatively, you may request to be placed on the State Water Board's hard copy mailing list. Requests to receive information should be sent to:

Mr. Parker Thaler
parker.thaler@waterboards.ca.gov
(916) 341-5321
State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA 95812-2000

There will also be the opportunity to sign up for a mailing list at the scoping meetings.

Notice of Preparation **Form B**

TO: State Clearinghouse
Governor's Office of Planning and Research
P.O. Box 3044
Sacramento, CA 95812-3044

SUBJECT: **Notice of Preparation of an Environmental Impact Report for the Proposed Lower Klamath Project License Surrender**

Lead Agency:
Agency Name: State Water Resources Control Board
Address: P.O. Box 2000
City/State/Zip: Sacramento, CA 95812-2000
Contact: Mr. Parker Thaler

Consulting Firm:
Firm Name: Stillwater Ecosystem, Watershed and Riverine Sciences
Address: 2885 Telegraph Avenue, Suite 400
City/State/Zip: Berkeley, CA 94705
Contact: Ms. Maia Singer

INTRODUCTION

Pursuant to the California Environmental Quality Act (CEQA)[1], the State Water Resources Control Board (State Water Board) will prepare an environmental impact report (EIR) for removal of the Lower Klamath Project (LKP) facilities. The EIR will be prepared to support consideration of the Klamath River Renewal Corporation's (KRRC) LKP application for water quality certification[2]. The KRRC is proposing to remove sufficient portions of the LKP to create a free flowing Klamath River and provide for volitional fish passage through the Federal Energy Regulatory Commission (FERC) license surrender process. The EIR will evaluate potential impacts of the LKP to water quality and other resources within California as compared to the environmental baseline, and will also evaluate a range of alternatives.

The LKP (FERC Project No. 14803) is currently part of the Klamath Hydroelectric Project (FERC Project No. 2082), which is owned and operated by PacifiCorp. The Klamath Hydroelectric Project presently consists of seven dam developments: (1) East Side; (2) West Side; (3) Keno; (4) J.C. Boyle; (5) Fall Creek (located on Fall Creek, a Klamath River tributary); (6) Copco No. 1; (7) Copco No. 2; and (8) Iron Gate.

On September 23, 2016, PacifiCorp and the KRRC filed a joint license transfer application with FERC, which seeks to transfer the J.C. Boyle, Copco No. 2, Copco No. 1, and Iron Gate dam developments to the KRRC. If FERC approves the license transfer application, the LKP will consist of four dam developments: (1) J.C. Boyle; (2) Copco No. 2; (3) Copco No. 1; and (4) Iron Gate. Concurrent with the license transfer application, the KRRC filed a license surrender application with FERC to decommission the LKP.

The license transfer and license surrender applications are consistent with the April 6, 2016, Amended Klamath Hydroelectric Settlement Agreement (KHSA). The Amended KHSA is an agreement between PacifiCorp; several state, federal and local governmental agencies[3]; two Native American Tribes; several nongovernmental organizations; and individual stakeholders

[1] Public Resources Code, sections 21000 et seq.
[2] Clean Water Act, section 401.
[3] The State Water Board is not a signatory to, and is not bound by, the original or the Amended KHSA.

designed to remove sufficient portions of the four dam developments that comprise the LKP to create a free flowing Klamath River and provide for volitional fish passage.

The State Water Board is seeking comments from trustee agencies, responsible agencies, and other interested persons concerning the scope and content of the environmental information to be included in the EIR. Please send your comments to Mr. Parker Thaler at the address shown at the end of this Notice of Preparation (NOP).

The information in this NOP is divided into the following sections below:

- Project Title
- Project Location
- Scoping Meetings
- Brief Description of Existing LKP Dam Developments
- Brief Description of Proposed Project
- Federal Energy Regulatory Commission Process
- Klamath Settlement Agreements
- State Water Board's Water Quality Certification
- CEQA Information
- Submittal of Written Comments
- Questions and Additional Information
- Attachment 1 – Summary of Potentially Significant Impacts Associated with the Lower Klamath Project License Surrender

PROJECT TITLE: Lower Klamath Project License Surrender

PROJECT LOCATION
The LKP is located along the Klamath River, in Siskiyou County, California, and in Klamath County, Oregon. The California portion of the LKP includes: Copco No. 2, Copco No. 1, and Iron Gate dam developments. The Oregon portion of the LKP includes the J.C. Boyle dam development, which is located on the Klamath River approximately 16 river miles from Oregon's border with California. The general locations of LKP dam developments are shown in the map on the first page of this NOP.

The EIR will focus primarily on impacts related to the actions proposed for the LKP's dam developments in California. Actions at J.C. Boyle will be described, but impacts will only be addressed to the extent that such actions will adversely impact the California environment. Oregon's Department of Environmental Quality[4] is responsible for acting on a separate water quality certification application for the LKP that addresses the J.C. Boyle dam development.

SCOPING MEETINGS
The State Water Board will hold scoping meetings to provide information on the Lower Klamath Project License Surrender, the water quality certification process, and to receive written or oral comments from agency personnel and other interested persons concerning the range of alternatives, potential significant effects, and mitigation measures that should be analyzed in the EIR. The time allotted for each individual or organization to comment orally may be limited if the number of people in attendance so requires. Scoping meetings will be documented by transcript.

Date and Time	Location	Address
January 12, 2017 (5:00 pm – 7:00 pm)	Arcata	D Street Neighborhood Center 1301 D Street Arcata, CA 95521
January 20, 2017 (10:00 am – 12:00 pm)	Sacramento*	CalEPA Building Byron Sheet Auditorium 1001 I Street, 2nd Floor Sacramento, CA 95814
January 26, 2017 (5:00 pm – 7:00 pm)	Yreka**	Best Western Miner's Inn – Convention Center, Auditorium 122 E. Miner Street Yreka, CA 96097
* The Sacramento meeting will be webcast live on the California Environmental Protection Agency (CalEPA) website at: www.calepa.ca.gov/broadcast/. During the webcast, webcast participants can submit comments via electronic mail to: wr401program@waterboards.ca.gov. ** On January 9, 2017, the State Water Board canceled the January 10, 2017, scoping meeting in Yreka due to inclement weather and a strong advisory against travel from the National Oceanic and Atmospheric Administration's National Weather Service. On January 10, 2017, the State Water Board rescheduled the Yreka public scoping meeting for January 26, 2017.		

If you have additional questions concerning these meetings, or would like to make a request for reasonable accommodations for a disability, please contact Parker Thaler by phone at (916) 341-5321 or by email at parker.thaler@waterboards.ca.gov.

It is the policy of the State Water Board to provide a work environment that is free from threats or acts of violence. Threats or acts of violence committed by, or directed at, any employee or

[4] Oregon's Department of Environmental Quality's website: http://www.oregon.gov/deq/pages/index.aspx

contractor will not be tolerated. Any person who appears before the State Water Board has an obligation to represent their interests in a professional manner. The State Water Board requests that all persons in or near a State Water Board hosted meeting refrain from engaging in inappropriate conduct. Inappropriate conduct may include disorderly, contemptuous or insolent behavior, breach of peace, boisterous conduct, violent disturbance, or other unlawful interference in the proceedings.

It is possible that one or more members of the State Water Board will attend one or more of the scoping meetings. A quorum of the State Water Board may be present at the scoping meetings. However, no State Water Board action will be taken.

BRIEF DESCRIPTION OF EXISTING LKP DAM DEVELOPMENTS

California Dam Developments (described in order from downstream to upstream):

Iron Gate Dam Development: The Iron Gate dam development is located on the Klamath River between river mile (RM) 190 and RM 197 in Siskiyou County, California. The Iron Gate dam development primarily consists of: 1) 53,800 acre-feet (AF) reservoir (Iron Gate reservoir); 2) 189-foot tall earthen dam with a clay core on a basalt rock foundation (Iron Gate dam); 3) Iron Gate Hatchery, which includes warehouse, hatchery building, four fish rearing ponds, a fish ladder, visitor center, and four employee residences; 4) fish collection facility at Iron Gate dam; 5) ungated side-channel spillway capable of discharging 26,200 cubic feet per second (cfs); 6) reinforced concrete diversion tunnel capable of diverting 2,700 cfs from the reservoir to the Klamath River; 7) 45-foot tall freestanding intake structure; 8) 18 megawatt (MW) powerhouse; 8) 6.5 miles of transmission lines; and 9) recreation facilities, including Fall Creek, Jenny Creek, Wanaka Springs, Camp Creek, Juniper Point, Mirror Cove, Overlook Point, Long Gulch, and small unnamed dispersed shoreline recreation sites. Recreation sites include communication buildings, restrooms, and two residences. Iron Gate dam supplies cold water to Iron Gate Hatchery, which is located below Iron Gate dam and powerhouse. Iron Gate Hatchery raises steelhead, coho salmon, and chinook salmon.

Copco No. 2 Dam Development: The Copco No. 2 dam development is located on the Klamath River between RM 196 and RM 199 in Siskiyou County, California. The Copco No. 2 dam development consists primarily of: 1) 70 AF unnamed reservoir; 2) 33-foot tall concrete diversion dam with a gated spillway (Copco No. 2 dam); 3) water conveyance system consisting of a 3,550 feet of concrete lined tunnels, 1,313 feet of a wood-stave pipeline, an underground surge tank and two steel penstocks; 5) 27 MW powerhouse; 6) control center building; 7) maintenance building; 8) oil and gas storage building; and 9) a nearby village consisting of a cookhouse, bunkhouse, storage building, bungalow, three modular houses, four old style ranch houses, and a schoolhouse/community center. Copco No. 2 dam is located approximately 0.25 miles downstream of Copco No. 1 dam and has no associated recreation facilities. Water diversions for hydropower generation at Copco No. 2 create a 1.5-mile-long bypass reach.

Copco No. 1 Dam Development: The Copco No. 1 dam development is located on the Klamath River between RM 198 and RM 204 in Siskiyou County, California. The Copco No. 1 dam development primarily consists of: 1) 40,000 AF reservoir (Copco reservoir); 2) 135-foot tall concrete gravity arch dam with a gated spillway (Copco No. 1 dam); 3) diversion tunnel capable of diverting 5,179 cfs; 4) switchyard; 5) two 10- and one 14-foot diameter penstock pipes; 6) 20 MW powerhouse; and 7) reservoir-associated recreation facilities, including Mallard Cove and Copco Cove. There is no bypass reach for this dam development.

Oregon Dam Development:

J.C. Boyle Dam Development: J.C. Boyle Dam is located on the mainstem of the Klamath River, at RM 224.7. J.C. Boyle Dam is a 68-foot tall concrete dam that impounds approximately 2,629 AF of water in a narrow reservoir with approximately 420 surface-acres. J.C. Boyle supplies water through a 2.5-mile water conveyance system to a 98 MW powerhouse. Water diversions for hydropower generation at J.C. Boyle create a 4.3-mile bypass reach. The approximately 17 miles downstream of the J.C. Boyle powerhouse comprise the J.C. Boyle peaking reach. This 17-mile reach is where the LKP crosses from Oregon into California and ends at the Copco No. 1 reservoir.

BRIEF DESCRIPTION OF PROPOSED PROJECT

The KRRC is proposing to remove sufficient portions of the Iron Gate, Copco No. 2, Copco No. 1, and J.C. Boyle dam developments to create a free flowing Klamath River and provide for volitional fish passage in the Klamath River currently occupied by these dam developments. The hydroelectric facilities and associated structures will either be removed or decommissioned in place.

The LKP would require improvements to roads, construction of staging areas, and creation of onsite debris disposal sites. The LKP would also require changes to the city of Yreka's Fall Creek water supply. Yreka receives 15 cfs of water through a 24-inch diameter pipe that runs from the Fall Creek dam development, crosses the Klamath River near the upstream end of Iron Gate reservoir, to the City of Yreka's water distribution system.

The LKP would result in large sediment releases as water and sediment stored behind J.C. Boyle, Copco No. 2, Copco No. 1, and Iron Gate reservoirs are released during, and to a lesser extent, following decommissioning activities. Proposed post-decommissioning restoration activities include revegetation, invasive species control, and removal or modification of existing reservoir recreation facilities. The KRRC's water quality certification application proposes the following schedule in order to minimize sediment releases during the critical times and life stages of various sensitive species downstream:

Proposed Schedule for Lower Klamath Project	
Staging Activities	Beginning June 2019
Reservoir Drawdown	January 2020 – October 2020
Copco No. 1 Dam Development Removal	January 2020 – May 2020
J.C. Boyle Dam Development Removal	January 2020 – September 2020
Copco No. 2 Dam Development Removal	May 2020 – October 2020
Iron Gate Dam Development Removal	July 2020 – November 2020

A more detailed description of the Proposed Project is provided in the KRRC's application for water quality certification, which is available at: http://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/lower_klamath_ferc14803.shtml, and in the Final *Klamath Facilities Removal Draft Environmental Impact Statement/Environmental Impact Report* (2012 KHSA EIS/EIR), sections 2.4.3 and 2.4.4, available at: https://klamathrestoration.gov/Draft-EIS-EIR/download-draft-eis-eir.

FEDERAL ENERGY REGULATORY COMMISSION PROCESS

FERC is the federal agency that regulates the construction, operation, and decommissioning of most non-federal hydroelectric dams in the United States. The LKP (FERC Project No. 14803) is currently owned and operated by PacifiCorp as part of the Klamath Hydroelectric Project (FERC Project No. 2082).[5] On September 23, 2016, PacifiCorp and the KRRC filed a joint license transfer application with FERC, which seeks to transfer the J.C. Boyle, Copco No. 2, Copco No. 1, and Iron Gate dam developments to the KRRC. Concurrent with the license transfer application, the KRRC filed a license surrender application with FERC to decommission the LKP. The LKP license transfer and surrender processes are subject FERC's approval.

In September 2006, during PacifiCorp's Klamath Hydroelectric Project relicensing process, FERC released a draft Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA). FERC's draft EIS for the Klamath Hydroelectric Project examines the probable effects of a range of alternatives, including continued operations of the dam developments with or without fish passage improvements, and removal of some or all of the four dam developments that compromise the LKP. FERC received extensive comments from agencies and interested parties. FERC released its final EIS for the Klamath Hydroelectric Project in November 2007 and it is available online at: https://www.ferc.gov/industries/hydropower/enviro/eis/2007/11-16-07.asp.

KLAMATH SETTLEMENT AGREEMENTS

Concurrent with PacifiCorp's FERC relicensing of the Klamath Hydroelectric Project, the following three Settlement Agreements were executed by a number of parties with varying interests in the Klamath Basin: 1) KHSA (Klamath Hydroelectric Settlement Agreement); 2) Klamath Basin Restoration Agreement (KBRA); and 3) Upper Klamath Basin Comprehensive Agreement (UKBCA). These settlement agreements, among other things: 1) provided a decision-making framework and process for removal of J.C. Boyle, Copco No. 2, Copco No. 1, and Iron Gate dam developments; 2) addressed water supply and allocation issues; and 3) set forth substantial water quality improvement measures for the Upper Klamath Basin.

The original KHSA proposed federal legislation that would have halted PacifiCorp's FERC relicensing process and granted the Secretary of the United States Department of the Interior the authority to determine whether removing J.C. Boyle, Copco No. 2, Copco No. 1, and Iron Gate dam developments was in the public interest and would advance salmon restoration (Secretarial Determination).

In accordance with the original KHSA, the 2012 KHSA EIS/EIR was prepared to support Klamath Hydroelectric Project dam removal and to inform the Secretarial Determination. On September 22, 2011, the United State Department of Interior and the California Department of Fish and Game (now California Department of Fish and Wildlife) released the *Draft Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report*. The agencies circulated the Final 2012 KHSA EIS/EIR, but the United States Department of Interior never entered a Record of Decision and the California Department of Fish and Wildlife never certified the document.[6]

[5] The Klamath Hydroelectric Project was originally licensed in 1956 for a term of 50 years. On March 1, 2006, the original FERC license expired and since then PacifiCorp has continued to operate the Klamath Hydroelectric Project (including the LKP dam developments) under annual licenses issued by FERC while PacifiCorp pursued relicensing. On June 16, 2016, at PacifiCorp's request, FERC issued an order placing the Klamath Hydroelectric Project relicensing process in abeyance.

[6] The final 2012 KHSA EIS/EIR is dated December 2012, but was released in April 2013.

Similar to FERC's 2007 NEPA document, the 2012 KHSA EIS/EIR evaluated a range of project alternatives including continued operation of the dam developments, with and without fish passage improvements, as well as removal of some or all of the dams that make up the LKP. The 2012 KHSA EIS/EIR is available online at: https://klamathrestoration.gov/Draft-EIS-EIR/download-draft-eis-eir.

Federal legislation to enact the settlement agreements did not pass, and on December 31, 2015, the KBRA terminated. On April 6, 2016, the KHSA was amended to remove the need for Congressional authorization, and instead contemplates dam removal through the FERC license surrender process. Also on April 6, 2016, some of the parties to the KHSA and KBRA executed the Klamath Power and Facilities Agreement. The Klamath Power and Facilities Agreement addresses the disposition of specific Oregon facilities on the Klamath River, and expresses a commitment to continue negotiations regarding certain issues addressed in the KBRA. The State Water Board understands that the UKBCA remains in effect.

STATE WATER BOARD'S WATER QUALITY CERTIFICATION

The State Water Board's water quality certification process results from the KRRC's FERC license surrender application, filed in furtherance of the Amended KHSA. Section 401 of the Clean Water Act (33 U.S.C. § 1341) requires every applicant for a federal license or permit that may result in a discharge into navigable waters to provide the federal licensing or permitting agency with certification that the project will be in compliance with state water quality standards and other relevant requirements of state law. Section 401 provides that conditions of certification shall become conditions of any federal license or permit for the project. The State Water Board is the agency in California that is responsible for section 401 water quality certifications (Wat. Code, § 13160; Cal. Code Regs., tit. 23, § 3855, subd. (b)).

There are water quality impacts associated with both the operation and decommissioning of the LKP dam developments. The Klamath River and water bodies associated with the LKP dam developments are listed in the California's 2012 Clean Water Act Section 303(d) List of Impaired Water Bodies (2012 Integrated Report) as follows:

- The Klamath River from the Oregon border to the Pacific Ocean is listed for nutrients, organic enrichment/low dissolved oxygen, and temperature.
- Iron Gate and Copco No. 1 reservoirs are listed for mercury and for a liver toxin produced by blue-green algae, called microcystin.
- The Klamath River from Copco No. 1 reservoir to the Trinity River is listed for microcystin.
- The Klamath River from the Trinity River to the Pacific Ocean is listed for sediment.
- The Klamath River from Iron Gate Dam to the Scott River is listed for aluminum.

The State Water Board may issue a water quality certification if it determines that a project will comply with specific federal Clean Water Act requirements (including water quality standards and implementation plans) and with other relevant requirements of state law. The State Water Board will determine whether decommissioning the LKP dam developments adequately protects the beneficial uses and meets the water quality objectives for water bodies affected by the LKP, as defined in the *Water Quality Control Plan for the North Coast Region* (Basin Plan), as well as other relevant standards. Additional information concerning the Basin Plan and designated beneficial uses is available online at: http://www.waterboards.ca.gov/northcoast/water_issues/programs/basin_plan/basin_plan.shtml

CEQA INFORMATION

The issuance of a section 401 certification is a discretionary action subject to CEQA compliance. Because there are potentially significant environmental impacts associated with the LKP, the State Water Board has decided to prepare an EIR.

The State Water Board previously initiated CEQA review for PacifiCorp's continued operations of the Klamath Hydroelectric Project and associated LKP dam developments by issuing a NOP for an EIR in September 2008 and again in November 2015. During the 2008 and 2015 CEQA processes, the State Water Board held extensive scoping meetings.

Following issuance of the September 2008 NOP, on February 18, 2010, the original KHSA was executed. From May 18, 2010, to July 1, 2013, at the request of KHSA signatories, the State Water Board issued a series of time-limited abeyances holding PacifiCorp's 2008 water quality certification application in abeyance. The State Water Board's fourth and final water quality certification abeyance ended on July 1, 2013, and the State Water Board resumed processing PacifiCorp's Klamath Hydroelectric Project water quality certification application and issued a second NOP in November 2015, in light of significant new information developments.

On June 16, 2016, FERC issued an order to hold PacifiCorp's Klamath Hydroelectric Project relicensing process in abeyance. Following FERC's order, PacifiCorp withdrew its water quality certification application from the State Water Board. The withdrawal of PacifiCorp's water quality certification application suspended the November 2015 Klamath Hydroelectric Project's CEQA process.

In developing an EIR to support the State Water Board's consideration of a water quality certification for the LKP, the State Water Board will consider FERC's 2007 EIS and the 2012 KHSA EIS/EIR. The State Water Board plans to evaluate a range of alternatives from the No Project Alternative to removal of the four Lower Klamath Project dam developments (KRRC's Proposed Project). State Water Board staff encourages interested parties to provide input regarding which alternatives should be evaluated in the EIR and recommends parties reference existing alternatives in the 2007 FERC EIS and 2012 KHSA EIS/EIR, where applicable.

Attachment 1 provides a broad summary of potentially significant impacts identified by resource area. Additional information on potential impacts is available in the FERC 2007 EIS (summary included in Table ES-1, pp. xxxix – l.) and the 2012 KHSA EIS/EIR (summary included in Table 5-1, pp. 5-8 to 5-75).

SUBMITTAL OF WRITTEN COMMENTS

Please send written scoping comments to the address below. Please provide a contact person and contact information in case there are questions about the comments. **The comment deadline is 5:00 pm on February 1, 2017.**

State Water Resources Control Board
Division of Water Rights
Water Quality Certification Program
Attention: Mr. Parker Thaler
P.O. Box 2000
Sacramento, CA 95812-2000

Phone: (916) 341-5321
Fax: (916) 341-5400
Email: parker.thaler@waterboards.ca.gov

QUESTIONS AND ADDITIONAL INFORMATION
General questions should be directed to Mr. Parker Thaler at (916) 341-5321 or parker.thaler@waterboards.ca.gov.

Information related to the water quality certification for the LKP is available on the State Water Board's LKP webpage at:
http://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/lower_klamath_ferc14803.shtml

DEC 2 2 2016

Erin Ragazzi
Water Quality Certification Program Manager
Division of Water Rights

Date

Attachment 1: Summary of Potentially Significant Impacts Associated with the Lower Klamath Project License Surrender

Attachment 1: Summary of Potentially Significant Impacts Associated with the Lower Klamath Project License Surrender

The Lower Klamath Project License Surrender environmental impact report (EIR) will examine potentially significant impacts of the Lower Klamath Project License Surrender in a wide range of areas. Below is a list that provides a broad summary of potentially significant impacts anticipated with the Klamath River Renewal Corporation's Lower Klamath Project (LKP). A more detailed summary of potential impacts is available in the Federal Energy Regulatory Commission's 2007 *Environmental Impact Statement* (summary included in Table ES-1, pp. xxxix – l.) and the 2012 *Klamath Facilities Removal Draft Environmental Impact Statement/ Environmental Impact Report* (summary included in Table 5-1, pp. 5-8 to 5-75):

Aesthetics:

- Removal of dams and associated hydroelectric and recreational facilities, and restoration activities, could have short-term and long-term impacts on landscape aesthetics; and
- Sediment transport could change the appearance of the Klamath River.

Air Quality:

- Construction, dam removal and restoration activities will temporarily affect air quality, potentially increasing volatile organic compounds, dust, and criteria pollutant levels to significant levels.

Aquatic Resources:

- Reservoir draw-down and dam removal could cause short-term impacts to critical habitat for coho, bull trout, and Southern Resident killer whale populations;
- Dam removal activities could alter the quality of essential habitat for coho salmon, chinook salmon, groundfish, Southern Resident killer whales and pelagic fish;
- Suspended sediment concentrations, sediment deposition, and bedload sediment changes associated with dam removal could affect habitat for various species, including salmonids, Pacific lamprey, green sturgeon, eulachon, longfin smelt, freshwater mussels, and benthic macroinvertebrates; and
- Dam removal would eliminate reservoir habitat associated with the existing LKP dam developments.

Flood Hydrology:

- Reservoir drawdown could affect flood risk in the short-term;
- Downstream sediment deposition could change flood risk;
- Flow regime changes associated with dam removal activities could change the 100-year floodplain; and
- Realigning the City of Yreka's water supply pipeline could alter flood risk.

Geology, Soils, and Geologic Hazards:

- Draining the reservoirs and releasing sediment could cause short-term and long-term increases in sediment deposition that could alter geomorphological characteristics in the Klamath River and/or Klamath Estuary;
- Dam removal, construction and restoration activities may cause significant erosion in the LKP area and downstream;
- Draining the reservoirs may alter seismic and volcanic activity; and
- Drying of exposed reservoir bed sediments could affect future restoration and construction activities.

Attachment 1: Summary of Potentially Significant Impacts Associated with the Lower Klamath Project License Surrender

Greenhouse Gas Emissions:

- Removal of a very low-emission power source (i.e., hydroelectric projects) may result in increased greenhouse gas emissions from replacement sources; and
- Construction, dam removal and restoration activities will temporarily increase greenhouse gas emissions.

Historical and Archeological Resources:

- Removal of dams and associated hydroelectric facilities may affect hydroelectric structures and a potential historical district;
- Reservoir removal, changing sedimentation, flow and erosion patterns could affect submerged or riparian archeological resources; and
- Potential effects to tribal cultural resources may also be considered effects to historical and archeological resources.

Land Use, Agricultural and Forest Resources:

- The exposure of the reservoir bed, restoration activities, dam removal activities (including roads, staging areas, and debris disposal), and removal of recreational facilities could impact land use, and potentially result in the conversion of forest or farmland to other uses.

Noise and Vibration:

- Dam removal activities, and particularly dam blasting activities, could result in localized noise impacts and increased vibration levels; and
- Noise levels along haul routes could be increased.

Population and Housing:

- Employment for proposed activities may result in new jobs, including potential temporary housing needs for any non-local employees.

Public Health and Safety, Utilities and Public Services, Solid Waste, and Power:

- Dam removal activities could result in public safety risks and potentially increase fire risk;
- Dam removal could affect water availability and response times for wildfires and area residential fires;
- Dam removal activities could require new roads and temporarily affect traffic safety;
- The City of Yreka's water supply pipeline could potentially be more vulnerable to vandalism;
- Sediment releases associated with dam removal activities could result in short-term human exposure to contaminants from contact with exposed sediments;
- Dam removal activities could affect the need and response time for public services;
- Dam removal could temporarily affect available mosquito habitat and related disease transmission;
- Dam removal could result in significant amounts of debris; and
- Loss of hydroelectric power could impact the supply of electricity.

Recreation:

- Reservoir-based recreation would be affected by reservoir drawdown, dam removal, construction and restoration activities;
- Changes in water quality, sedimentation, floodplain and river channel could affect river-based recreational activities downstream of facilities, including fishing and contact recreation; and
- Whitewater boating opportunities would be changed under an altered flow regime.

Attachment 1: Summary of Potentially Significant Impacts Associated with the Lower Klamath Project License Surrender

Terrestrial Resources:

- Dam removal activities and associated flushing of sediments could result in loss of wetland habitat in the LKP area and downstream, as well as impacts to wildlife corridors;
- Dam removal activities could negatively impact special status and culturally important species; and
- Disturbed areas resulting from the LKP could provide habitat for invasive plants.

Toxic/Hazardous Materials:

- Dam removal activities could involve transport and handling of hazardous materials, including risk of release.

Traffic and Transportation:

- Traffic associated with dam removal activities could affect traffic flow and safety, including to public transit and non-motorized transportation (e.g., pedestrians, bicycles);
- Changes in land use could result in traffic changes; and
- Increased heavy vehicle traffic during construction could increase wear on roads and potentially exceed bridge weight limits.

Tribal Cultural Resources:[7]

- Construction and restoration activities could affect sites and landscapes with tribal cultural value;
- Reservoir dewatering and removal could affect items and areas with tribal cultural resources that are currently submerged;
- Changing sedimentation, flow and erosion patterns could affect tribal cultural resource areas downstream; and
- Landscapes, ecosystems and species that are tribal cultural resources could be affected by dam removal and restoration activities.

Water Quality:

- Dam removal activities could contribute to changes in water quality, including:
    - Short- and long-term changes to the water temperature regime;
    - Biological oxygen demand and daily dissolved oxygen variability;
    - Short-term increases in suspended sediment and sediment associated nutrients in the Klamath River from the California state line to the marine nearshore environment, and may affect long-term suspended sediment and sediment associated nutrients in the Lower Klamath River, Klamath Estuary, and marine nearshore environment;
    - Long-term summer time increases in pH downstream of Iron Gate Dam;
    - Short-term increases in inorganic or organic contaminant levels;
    - Changes in nutrient levels, biomass, and algal cycling, potentially from the state line through the Klamath Estuary;
    - Short- and long-term changes to algae populations and associated algal toxins in the Lower Klamath River from the California state line to the Klamath Estuary; and
    - Long-term increases in nutrient levels and periphyton biomass in the Klamath River downstream of Iron Gate Dam.

[7] This resource area was added to California Environmental Quality Act in 2014 (Assembly Bill 52; Statutes 2014, Chapter 532, Gatto), and has not been specifically evaluated in prior environmental documents. Tribal governments have been actively involved in issues surrounding the disposition of the Klamath Hydroelectric Project and associated LKP for many years. The State Water Board looks forward to working with California Native American Tribes to develop this analysis and any potential alternatives and mitigation measures.

- Restoration activities could involve application of herbicides that could cause short-term levels of organic contaminants in runoff that are toxic to aquatic biota in the LKP area.

Water Supply:

- Eliminating the reservoirs could impact groundwater wells near the reservoirs and the amount of groundwater recharge;
- Changes to the flow regime below Iron Gate Dam could affect water supply and water rights;
- Removal of Iron Gate Reservoir will require realignment of City of Yreka's water diversion pipeline from Fall Creek; and
- Sediment releases may affect Klamath River geomorphology, which can affect downstream water intake pumps.

Appendix B

Scoping Meeting Materials

Scoping Meeting Information Sheet for Lower Klamath Project License Surrender

The State Water Resources Control Board (State Water Board) released the *Notice of Preparation and Scoping Meetings for an Environmental Impact Report for the Lower Klamath Project License Surrender* on December 22, 2016. **Comments in response to the Notice of Preparation are due by 5:00 pm on Wednesday, February 1, 2017**.

Written comments may be emailed to: **WR401program@waterboards.ca.gov,** or mailed to:

Parker Thaler
State Water Resources Control Board
Division of Water Rights – Water Quality Certification Program
P.O. Box 2000
Sacramento, CA 95812-2000

The State Water Board maintains a Lower Klamath Project website that provides information related to the State Water Board's water quality certification process, including compliance with the California Environmental Quality Act (CEQA). Additional information, including the Notice of Preparation, is available on the Lower Klamath Project webpage at:
http://www.swrcb.ca.gov/waterrights/water_issues/programs/water_quality_cert/lower_klamath_ferc14803.shtml

General Information

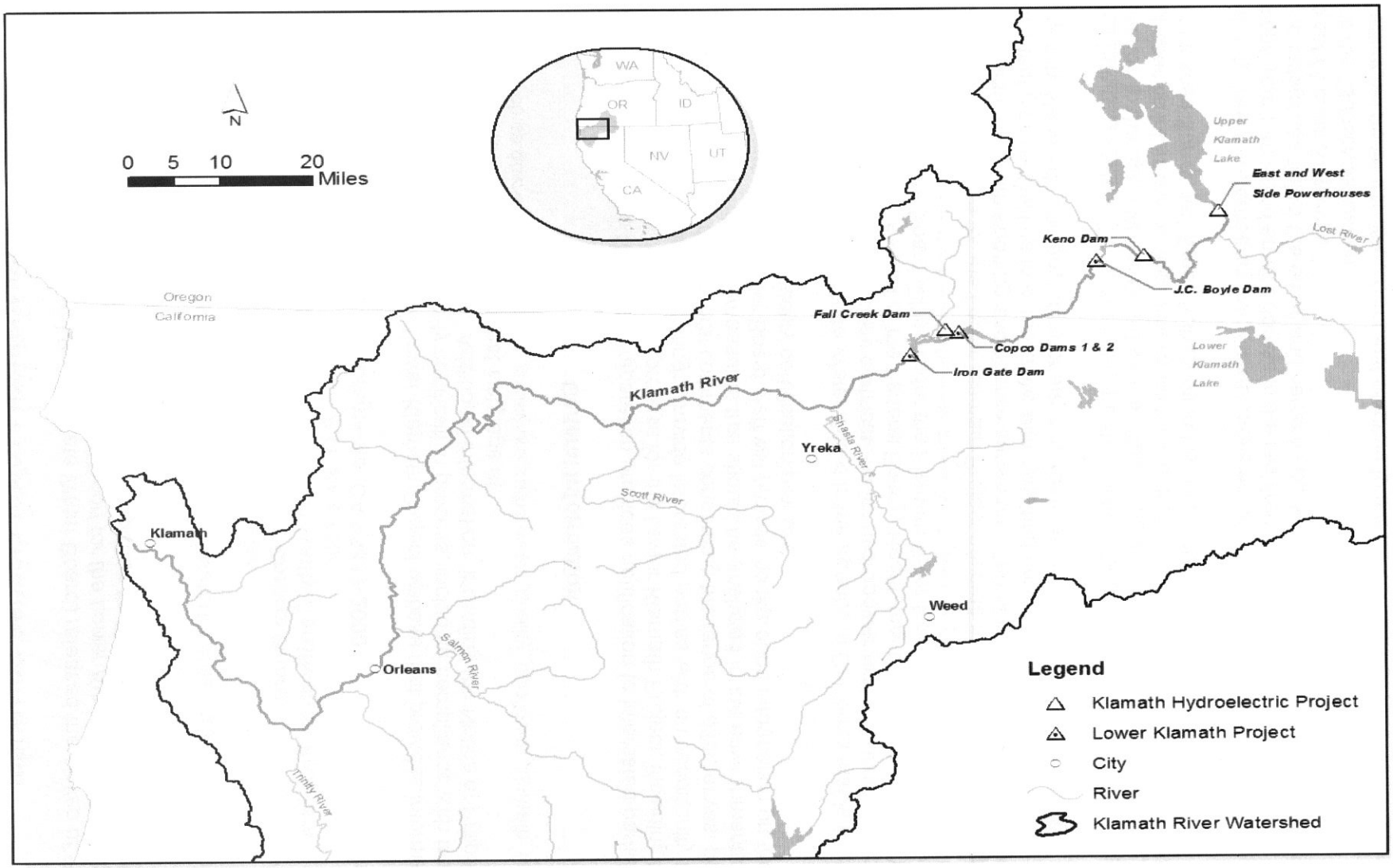
Notice of Preparation: The Notice of Preparation provides notification to interested parties and the public regarding the start of the CEQA process for the Lower Klamath Project, including information on scoping meetings. The scoping meetings provide interested parties with an opportunity to provide the State Water Board with written or oral comments concerning the range of alternatives, potential significant effects, and mitigation measures that should be analyzed in the environmental document. At the scoping meetings, State Water Board staff will provide background information on the Lower Klamath Project and the water quality certification process.

Water Quality Certification: The State Water Board is the agency in California that is responsible for acting on applications for water quality certifications for hydropower projects under section 401 of the federal Clean Water Act. As part of the Federal Energy Regulatory Commission (FERC) licensing process the State Water Board will consider the Klamath River Renewal Corporation's water quality certification application for the Lower Klamath Project. Conditions of a water quality certification issued by the State Water Board for the Lower Klamath Project become mandatory conditions of the FERC license for dam decommissioning and license surrender. The purpose of a water quality certification is to certify that a project will be in compliance with specified provisions of the Clean Water Act, including water quality standards and any appropriate requirements of state law.

Receive Future Updates: To save paper, the State Water Board strongly encourages interested parties to subscribe to the State Water Board's Email Subscription List to electronically receive Lower Klamath Project specific information. Instructions on how to sign up for the State Water Board's "Lower Klamath Project License Surrender" Email Subscription List are outlined below:

1. Visit: http://www.waterboards.ca.gov/resources/email_subscriptions/swrcb_subscribe.shtml#rights
2. Provide your name and email address in the required fields.
3. In the categories below the email and name fields, select "*Water Rights*," then "*Lower Klamath Project License Surrender*."
4. *Click the "Subscribe" button.*
5. An email will be sent to you. You must respond to the email message(s) to confirm your membership on the selected list(s).

Lower Klamath Project Area



Lower Klamath Project License Surrender

State Water Resources Control Board Staff Presentation – Soliciting Comments on the Notice of Preparation

January 2017

Arcata – January 12

Sacramento – January 20

Yreka – January 26

Scoping Meeting Overview

1. Review Meeting Logistics and Ground Rules

2. Presentation by State Water Board Staff

3. Comments by Attendees

4. Adjourn Meeting

Meeting Logistics

- Please sign-in on the attendance sheet
- If you wish to speak, please fill out a speaker card and provide it to a State Water Board staff person
- So that your comments may be correctly transcribed, please speak into microphone and provide your first and last name with spelling
- A handout is provided with information on submitting written comments or you can indicate “no oral comments” on the speaker card

Ground Rules

- Please silence electronic devices
- Please respect all speakers and points of view
- One person speaks at a time – all speakers must use a microphone
- Please hold questions/comments until end of presentation
- Recognize short time frame to receive oral comments, please respect time limits so we can hear from everybody
- Written comments are an alternative for those that would like to provide additional comments beyond the allotted time or those that do not wish to speak today

Why We Are Here

- The Klamath River Renewal Corporation (KRRC) submitted a water quality certification application for the Lower Klamath Project

- State Water Board conditions hydroelectric projects via water quality certifications to ensure protection of the state's waters (section 401 of Clean Water Act)

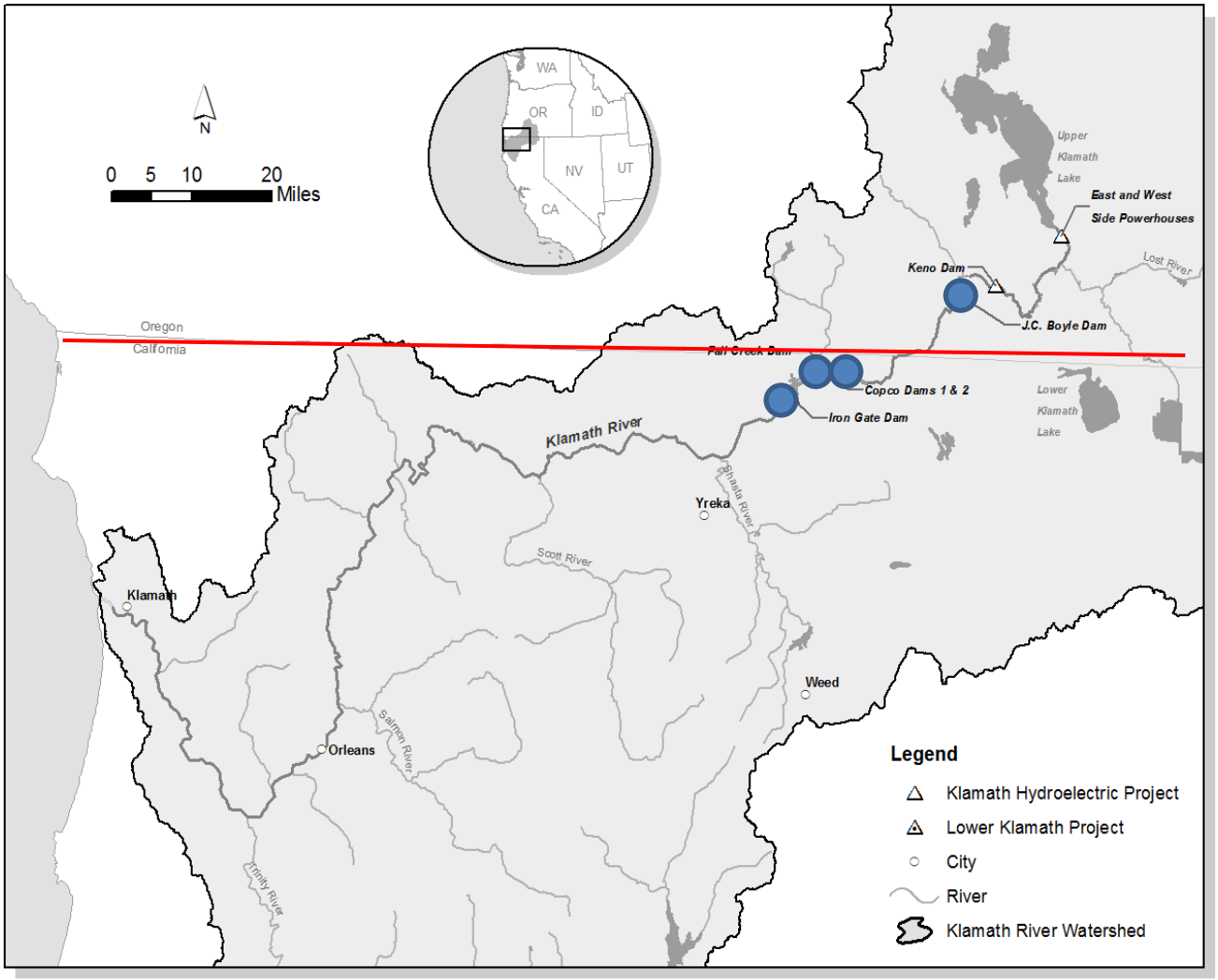
- California Environmental Quality Act requires an environmental impact report to inform the State Water Board and the public about the project's significant environmental effects and ways to reduce those impacts

Lower Klamath Project

- Overview of Lower Klamath Project dam developments
- Background on Lower Klamath Project Federal Energy Regulatory Commission (FERC) process
- Overview of California Environmental Quality Act (CEQA) process
- Discussion of Notice of Preparation (NOP)

Lower Klamath Project Overview

- East Side (OR)
- West Side (OR)
- Keno (OR)
- **JC Boyle (OR)**
- **Copco No. 1 (CA)**
- **Copco No. 2 (CA)**
- **Iron Gate (CA)**
- Fall Creek (CA)



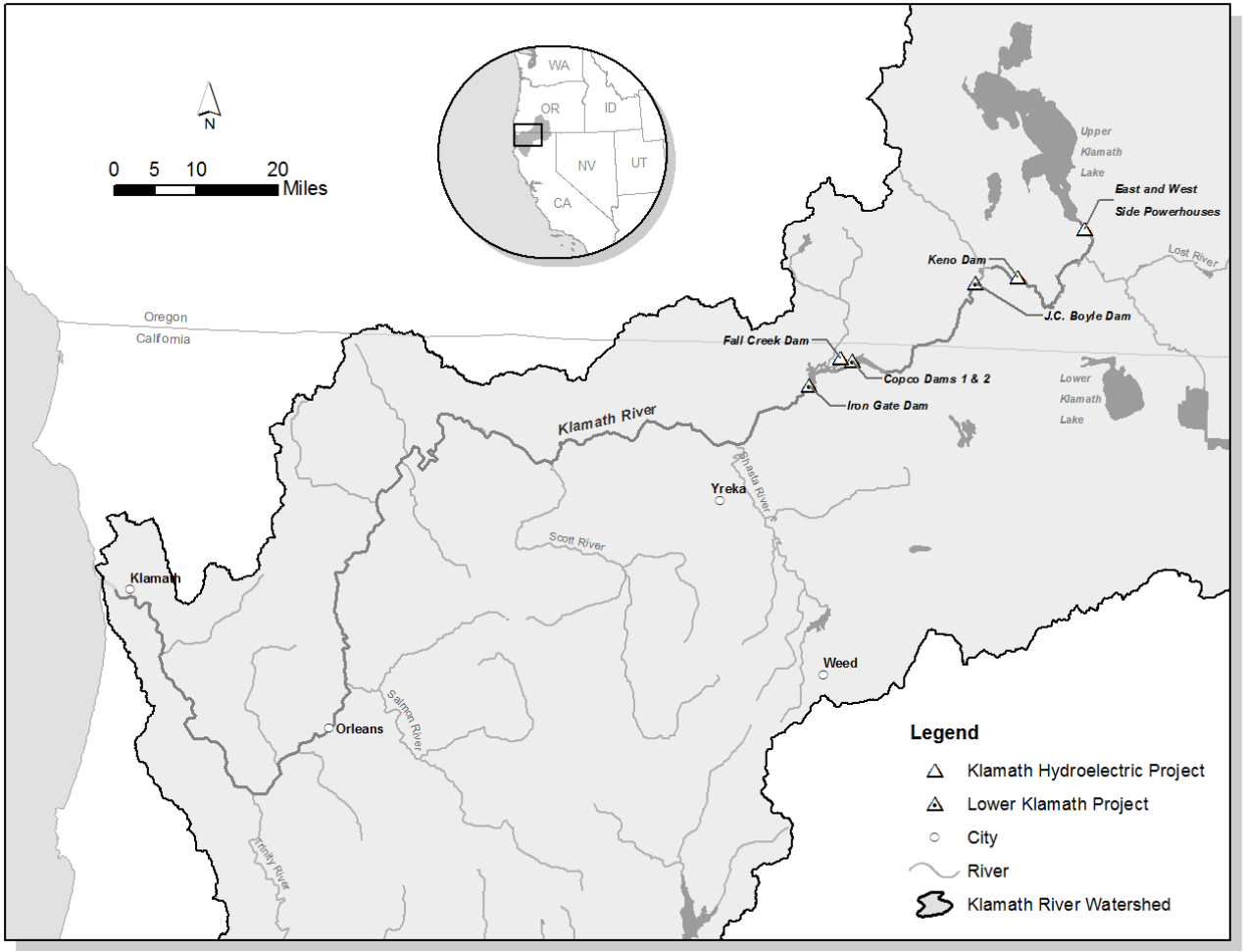
Background

- 1956, Federal Energy Regulatory Commission (FERC) licenses Klamath Hydroelectric Project
- February 2004, PacifiCorp applies for new license from FERC
- March 2006, PacifiCorp files water quality certification (certification) application with State Water Board
- November 2007, FERC issue its final Environmental Impact Statement for National Environmental Policy Act compliance

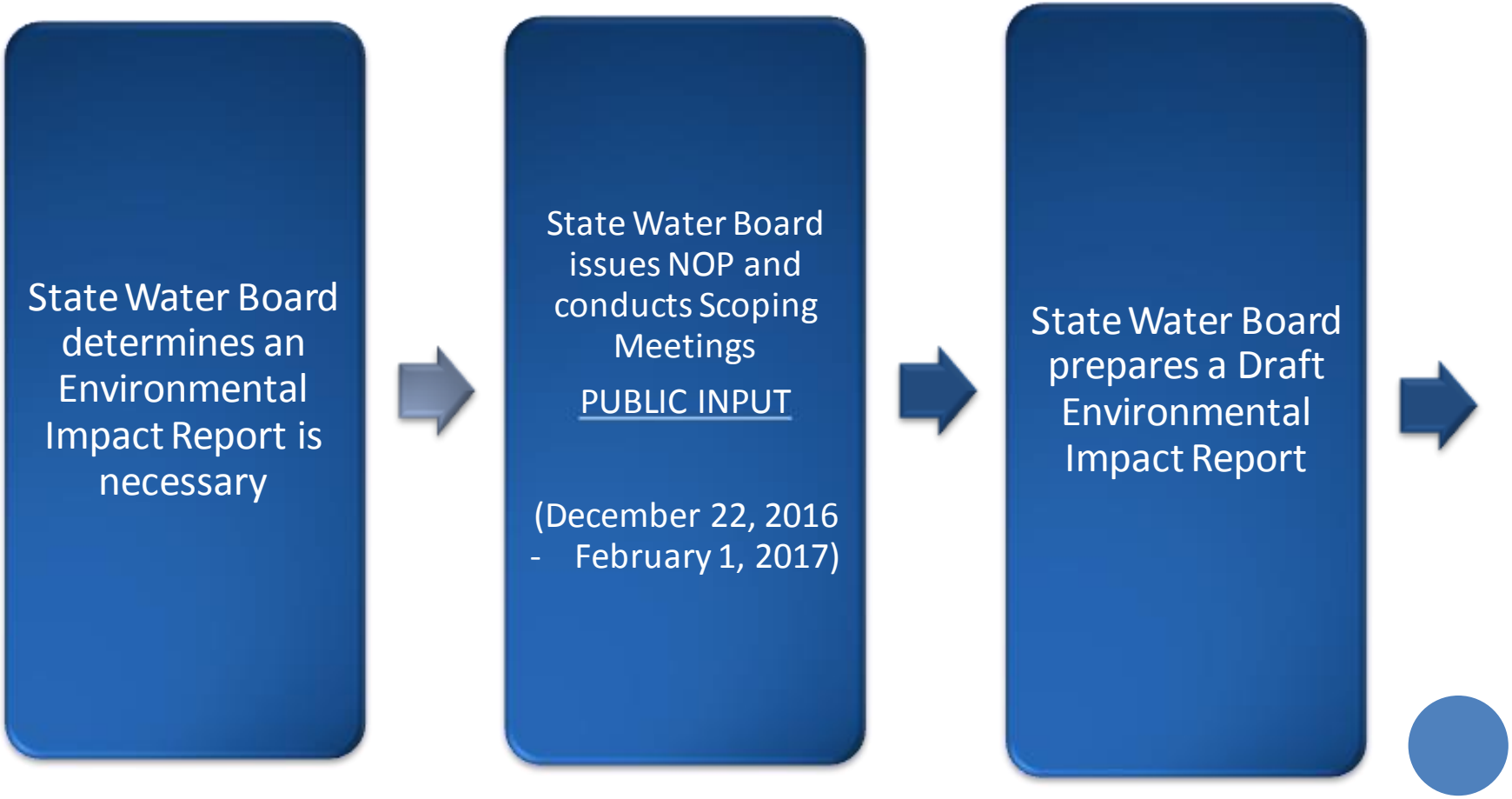
Background Continued…

- February 2010, original Klamath Hydroelectric Settlement Agreement executed, requires Federal Authorization and removes project from FERC process
- April 2016, Amended Klamath Hydroelectric Settlement Agreement executed, removes Federal Authorization and returns to FERC process
- June 2016, FERC grants abeyance for Klamath Hydroelectric Project
- September 2016, Klamath River Renewal Corporation (KRRC) and PacifiCorp jointly apply to FERC to transfer portions of the Klamath Hydroelectric Project to KRRC; and KRRC applies to FERC to for Lower Klamath Project to decommission four dam developments and surrender license

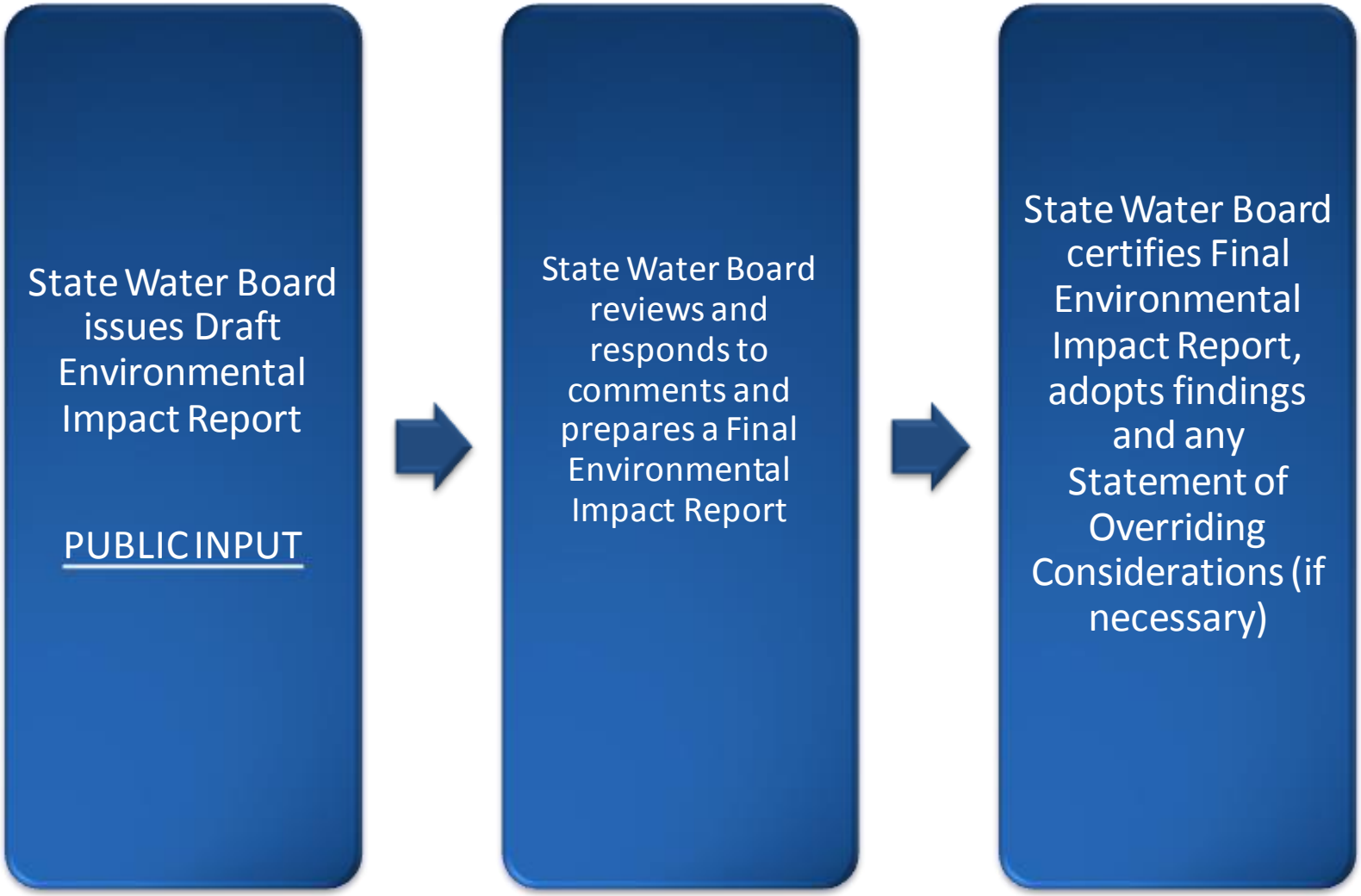
Background Continued…



CEQA Process Overview



CEQA Process Overview cont.



Approach to CEQA Analysis

- Focus on California portion of Lower Klamath Project
- Use FERC Environmental Impact Statement (EIS) and Klamath Facilities Removal EIS/Environmental Impact Report (EIR) in development of Lower Klamath Project EIR
- Use information gathered by the CEQA commenters, scientific community, settlement agreements, Tribes, and other sources

Project Alternatives

Project alternatives being considered for analysis in EIR range from:

- KRRC's Proposed Project of decommissioning sufficient portions of the Lower Klamath Project to provide for volitional fish passage and a free flowing Klamath River.

- No Project Alternative

Requested Input

- Adequacy of FERC EIS and Klamath Facilities Removal EIR/EIS. Do these documents address your comments/concerns?
- Range of alternatives, or specific alternatives
- Potential Impacts to evaluate
- Potential mitigation measures
- Other items

Submit Comments by 5:00 pm On February 1, 2017

Parker Thaler
State Water Resources Control Board
P.O. Box 2000
Sacramento, CA 95812-2000
Or
parker.thaler@waterboards.ca.gov

Lower Klamath Project Website:

http://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/lower_klamath_ferc14803.shtml

How to Stay Informed

- Refer to first page of Notice of Preparation
- Subscribe to "Lower Klamath Project License Surrender" Email List
  - Webpage: http://www.waterboards.ca.gov/resources/email_subscriptions/swrcb_subscribe.shtml#rights
  - 1. Provide name and email in required fields
  - 2. In categories below, select "Water Rights," then "Lower Klamath Project License Surrender"
  - 3. Click "Subscribe" button
  - 4. An email will be sent to you; you must respond to email message to confirm membership

Public Comment Reminders

- Please state and spell your first and last name for court report
  - You may also provide your affiliation, if desired
- Please use microphone
- Please respect time limits

Appendix C

Scoping Meeting Transcripts and Oral and/or Written Comments Submitted at Scoping Meetings

Scoping Meeting for an Environmental Impact Report for the Lower Klamath Project License Surrender

D Street Neighborhood Center – 1301 D Street, Arcata

January 12, 2017 (5:00 p.m. – 7:00 p.m.)

Sign-In Sheet

Sign-in Sheet for Scoping Meeting for an Environmental Impact Report for the Lower Klamath Project License Surrender

Location: D Street Neighborhood Center - 1301 D Street, ARCATA

Date and Time: January 12, 2017 5:00 p.m. to 7:00 p.m.

Name	Organization	Contact Information
Annelia Hillman	Yurok Tribe	ahillman@yuroktribe.nsn.us
Dell Angelesa	Yurok Tribe	(707) 502-7533
Ysabel Diaz	Local Citizen/Resident	ysadiaz@gmail.com
Graham Uemura	N/A	Maguro4u@gmail.com
Jeff Blaeke	HSU Wildlife	Jeff.Blaeke@humboldt.edu
Sylvia DeRosa	—	ofxthepoint@att.net
Jennifer Kalt	Humboldt Baykeeper	jkalt@humboldtbaykeeper.org
Craig Tucker	Karuk Tribe	ctucker@karuk.us
COURTNEY BROWN	HSU STUDENT	CMB1068@HUMBOLDT.EDU
RYAN KAPLAN	CITIZEN	RYAN.J.KAPLAN@GMAIL.COM
FRED KRISSMAN	HSU ANTH DEPT	fredkrissman@humboldt.edu

Sign-in Sheet for Scoping Meeting for an Environmental Impact Report for the Lower Klamath Project License Surrender

Location: D Street Neighborhood Center - 1301 D Street, ARCATA

Date and Time: January 12, 2017 5:00 p.m. to 7:00 p.m.

Name	Organization	Contact Information
WALT PANIAK	—	WPANIAK@GMAIL.COM
Dustin Brooks	—	
PAUL KINSEY		paulkinsey395@gmail.com
Jamie Bettaso	—	jamiebettaso@gmail.com
RICHARD ITRÉIS	SCNC / NEC	rgitreis@gmail.com
Sydney Stewart		SMS226@humboldt.edu
Becky Dutra		becky_dutra@hotmail.com
Trevor Lucas	BUFC	Trevor[illegible]@yahoo.com
Robert Shearer	—	rls511@humboldt.edu
Michelle Krall	—	michelle.krall4@gmail.com
DAVID BITTS	PCFFA	dbitts@suddenlink.net
Peter Carlson	—	pccarlson@gmail.com
JANICE KINNEY	YUROK TRIBE	jkinney@yuroktribe.nsn.us
Dave Hillemeier	Yurok Tribe	Dave@YurokTribe.nsn.us
Josh Strange	[illegible]	joshua@sweetriversciences.com
Onna Joseph	Yurok Tribe	

Sign-in Sheet for Scoping Meeting for an Environmental Impact Report for the Lower Klamath Project License Surrender

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Name	Organization	Contact Information
Mahlija florendo	yurok tribe	(541) 232-6850
Melinda Groom	—	(707) 668-4275
Emily Scott		eesi76@humboldt.edu
Cena Marino	Citizen	(707) 445-3603 (ID w/ yourself pam Removal)
Rosada Martin	citizen	(707) 223-3969
Emily Mahoney	citizen	530-514-8714
BILL BURTON	TRINITY COUNTY	Bburton@trinitycounty.org
Scott Greacen	Friends of the Eel River	scott@eelriver.org
Mirely Watt	yurok tribe	mwatt@yurok tribe.nsn.us
Nancy Ihara	citizen	nancyihara@gmail.com

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Name	Organization	Contact Information
Lauren McClure	Stillwater Sciences	lauren@stillwatersci.com
Clayton Creager	NCRWQCB	clayton.creager@waterboards.ca.gov
Bob Gearhart	Retired HSU	rag2@humboldt.edu
Katie Terhaar		Kbt38@humboldt.edu
Kay Schulz		khopschulz@hotmail.com
John Driscoll	Rep. Jared Huffman	john.driscoll@mail.house.gov
John Schaefer		jcschaef@igc.org
Konrad Fisher	Klamath Riverkeeper	Konrad@klamathriver.org
Richard Hanzis		rah14@humboldt.edu
Bob Brown	Streamline Planning	bob@streamlineplanning.net
Kate Selway	NA	Selwaykae@gmail.com
Brianna Walsh		brianna.r.walsh@gmail.com
TINA GARSON	—	tna626962@sbcglobal.net
Andreas Krause	Yurok Tribe	akrause@yuroktribe.nsn.us
Aaron Lervold	NIA	aal378@humboldt.edu
Terry Torgerson		torgomail@gmail.com
Nat Pennington	Klamath Riverkeeper	nathaniepennington@hotmail.com
Jacque + Bob Camm	Trinidad Rancheria	jhosterr@trinidadrancheria.com

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Name	Organization	Contact Information
Parker Thaler	State Water Resources Control Board	parker.thaler@waterboards.ca.gov
Maia Singer	Stillwater Sciences	maia@stillwatersci.com
NICK CUSICK	Regional WB 1	nicholas.cusick@waterboards.ca.gov
Callie Grant	Regional WB 1	callie.grant@waterboards.ca.gov
Dennis Halligan	Stillwater Sciences	dennis@stillwatersci.com
Mary Ann Murphy		maryann.murphy@gmail.com
Paul K Schulz	—	pkuner@live.com
Abel Brumo	Stillwater Sciences	abel@stillwatersci.com
Diane Ryerson		dryerson7@gmail.com
Tom Weseloh	Senator McGuire	tom.weseloh@sen.ca.gov
Tim Bailey	HCN	tim.bailey@humboldt.edu
Mark Mette	-	Nikkimatte@icloud.com
Raymond Mette	-	/
Diane Anderson	neighbor	[illegible]
Jason Hold		jah2584@gmail.com
John Stokes	Not much	gadumma@MSN.com
HEATHER SEARS	PRINCESS SEAFOOD LLC	Princessoftheboatsales@gmail.com
Evan Mahony-Moyer		emahonymoyer@gmail.com

Sign-in Sheet for Scoping Meeting for an Environmental Impact Report for the Lower Klamath Project License Surrender

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Name	Organization	Contact Information
Josh Fishbein		fishbein@gm.slc.edu
Erin Burke		burkeerin@gmail.com
Larry Glass	NorthCoast Environmental Center	larryglass71@gmail.com
Adam Wagschal	ICF	adam.wagschal@icf.com
Kalin Sinn		KSS46@humboldt.edu
Nancy Stivers	Stillwater Sciences	Nancy@stillwatersci.com
Joe Janes	Yurok Tribe	
Amy Cordalis	Yurok Tribe	acordalis@yuroktribe.nsn.us
Louisa McCovey	Yurok Tribe	lomccovey@ " "
Mary Ann Madej	Self	soilsave@hotmail.com
Shane Quinn	Yurok Tribe	squinn@yuroktribe.nsn.us
Brandon Bastros	Self	bcbastros@humboldt.edu
James Dunlap	SELF	YurokJames@SBCGLOBAL.NET
Gwa Laa Dee	ma-le'natura	emerald@pacific.net
Yvonne Everett	HSU	everett@humboldt.edu
Cristina Ruiz Burdy	HSU	Cristinaburdy@humboldt.edu
Anya Mettler		dryabary7@gmail.com
Grant Gilkison	Karuk Tribe	ggilkison@karuk.us

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Name	Organization	Contact Information
Carol Osborn	none	smartgrammie@gmail.com
Jenna Bader	Citizen	Jenna.bader@yahoo.com
Matt Lavis	Yurok Tribe	mlavis@yuroktribe.nsn.us
Angela Rex	none	westermaid@hotmail.com
Ian Sipowitsch	citizen	ian.sipowitsch@yahoo.com
SUSAN RHODES	SAVE THE HUMANS	bigfatsue@yahoo.com
Lee Dedini		dediniLee@gmail.com
D. BARACONI	CITIZEN	dbaraconi@gmail.com
JamesAdamTaylor	↑	JamesAdamTaylor@gmail.com
Verbena Lea	Peoples' Action for Rights + Community	peoplesarc@gmail.com
BAYLEY B. BROWN	KHUM	BAYLEY@KHUM.COM
Christopher Mettier	Resident	christophermettier@gmail.com
TRACY KATELMAN	resident	tracy@foreverlovefreshly.com
Aaron David		Aarondavid@yahoo.com
SUSAN NOLAN	—	BOX 115 BAYSIDE CA 95524
Lisa Sundberg	Trinidad Rancheria Member	Sundberg.Lisa888@gmail.com
Judith Mayer	citizen	jmayer@sonic.net
Nancy Kuykendall	citizen	nancelot9@gmail.com

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Name	Organization	Contact Information
Zane Schoettgen		zts4@humboldt.edu
Colin Kerosky	Rogue Climate	colin@rogueclimate.org
Chris Attias		chrisattias@yahoo.com
Jay Stallman	Stillwater Sciences	jay@stillwatersci.com
Oshun Drourke	Yurok Tribe	Odrourke@yuroktribe.nsn.us
Marisa Parish	Smith River Alliance	mmparish@gmail.com
Bob Borch	Humb Fishermens Marketing	rhbfishld@aol.com
Deja Malone-Perrha		Deja.malone@gmail.com
Jenny Curtis	U.S. Geological Survey	jcurtis@usgs.gov
Charlie Holthaus	Fisherman	clwhwts@suddenlink mail.com
Mark Lovelace	Citizen	marklovelace01@gmail.com
Lana M McCovey	Yurok	lamccovey@yuroktribe.nsn.us
Beau Quinta	Forest Service SRRC	Beaq747@icloud.com
Mary Ellen Anderson	NC	cstrep1@gmail.com
Maria Diaz	citizen	mdl53@humboldt.edu
Richard nelson	Yurok Tribe	Richard@Yuroktribe.nsn.us
Nate Harris	Yurok Tribe	njharris30@gmail.com
NED FORSYTH	SIERRA CLUB REDWOOD CHAPTER	[illegible]

Sign-in Sheet for Scoping Meeting for an Environmental Impact Report for the Lower Klamath Project License Surrender

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Name	Organization	Contact Information
LAVINA BROOKS	Yurok Tribal Member	lbrooks@yuroktribe.nsn.us
Ryan Arseneault		arsen747@gmail.com
Linda Evans		lindylou@suddenlink.net
Tim Hayden	YUROK TRIBE	thayden@yuroktribe.nsn.us
Genell Fitch		
Joanne McGarry		joannemmcgarry@yahoo.com

Sign-in Sheet for Scoping Meeting for an Environmental Impact Report for the Lower Klamath Project License Surrender

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Name	Organization	Contact Information
Bessie Shorty	Yurok Tribe	bshorty@yuroktribe.nsn.us
Keenan Hilton		keenan.a.hilton@gmail.com
Josh Koepke	Samara Restoration	josh@samararestoration.com

Speaker Cards and Written Comments

(1)

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
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January 2017

(Please Print Clearly)

John Driscoll

Rep. Jared Huffman -
Supportive of water quality cert

ARCATA **SACRAMENTO** **YREKA**

(2)

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

PAUL KINSEY

paulkinsey395@gmail.com

AS A STATE WATER RESOURCES LICENCEE (License Holder) I support the K.R. Licensee SURRENDER and the undaming of THE KLAMATH RIVER.

ARCATA **SACRAMENTO** **YREKA**

~~Good evening madam chair and members of the board.~~ I am John Driscoll, district representative for Congressman Jared Huffman. Thank you for taking the time to come to ~~Eureka~~ Arcata to hear the concerns of the congressman's constituents about the Klamath River.

The permit you are considering is of great interest to the congressman and to tribes, fishermen and communities up and down the West Coast. It's a key piece in the effort to remove the four dams on the Klamath to rebuild salmon runs and make the river healthy.

We have known for a long time that the reservoirs behind the four dams severely compromise water quality by heating up water and causing algae blooms. This has had disastrous effects on the Klamath River's important fisheries, to recreational uses of the river, and to ceremonial uses by the tribes that hold the river sacred.

As you know, the 2012 state and federal environmental study on this issue detailed these impacts. Studies since then have added more scientific weight to the joint EIR/EIS conclusions. Congressman Huffman asks that the findings of that joint study be rolled into the new state environmental study under consideration. He also asks that the expected long-term benefits of removing the Klamath's four dams be weighed carefully and thoroughly along with the possibility of short-term effects. It is especially important to take the long view, in which a restored river can rebuild itself.

Congressman Huffman asks that your board issue a water quality certification for dam removal that so many have worked to achieve for so long. The timely issuance of the certificate is imperative to allow the Federal Energy Regulatory Commission to authorize dam removal this year. Please give the water quality certification your full and fair consideration.

Congressman Huffman thanks your board for its long participation in Klamath River issues. Congressman Huffman asks you to take one more step, to help tear down these dams.

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LOWER KLAMATH PROJECT LICENSE SURRENDER
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January 2017

(Please Print Clearly)

JAVIER KINNEY

j.kinney@yuroktribe.nsn.us

YUROK TRIBE SUPPORTS REMOVAL OF ALL DAMS & FOR THE CONTINUOUS OF THE CULTURAL WAY OF LIFE FOR GENERATIONS TO COME.

ARCATA SACRAMENTO YREKA

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(Please Print Clearly)

Amy Cordalis

Yurok Tribe

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(Please Print Clearly)

Larry Glass

larryglass71@gmail.com

Northcoast Environmental Center

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(Please Print Clearly)

Nathaniel Pennington

nathanielpennington@hotmail.com

Klamath Riverkeeper Salmon River Restoration Council nature Rights council

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January 2017
(Please Print Clearly)

Mahlija Florendo
mahlija.florendo@yahoo.com
Yurok tribe
How us as a native tribe, and surrounding tribes are affected by the dams on the Klamath River

~~ARCATA~~ SACRAMENTO YREKA

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January 2017
(Please Print Clearly)

Annelia Hillman
ahillman@yuroktribe.nsn.us

Dam removal is needed for the health of our communities, our cultural restoration, and for our economies. Dam removal is the first step to restoration for the Klamath River. It is long over due.

~~ARCATA~~ SACRAMENTO YREKA

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(Please Print Clearly)

DAVID BITTS

dbitts@suddenlink.net

PCFFA

VALUE OF DAM REMOVAL TO
OCEAN SALMON FISHERIES

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(Please Print Clearly)

Mark Lovelace

markelovelace01@gmail.com

I urge the State Water Board to approve the 401 permit to allow KRRC to go forward with decommissioning of these dams.

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(Please Print Clearly)

Raymond Matz

Commercial fisherman on klamath
Dam Removal

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January 2017
(Please Print Clearly)

Craig Tucker

Karuk Tribe

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(Please Print Clearly)

James Durkan

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(Please Print Clearly)

Dave Hillemeier

Dave@Yurok.nsn.us

Yurok Tribe

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Ian Osipovitsch
ian.osipovitsch@yahoo.com

Please remove the Dams.
Thanks.

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SCOPING MEETING

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Dr. Joshua Strange
joshua@sweetriversciences.com

comments re WQ & fish disease
benefits of removal/surrender

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Clayton Creager

North Coast Regional Water Quality Control Board

provided

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Regina Chichizola

PCFFA

ARCATA SACRAMENTO YREKA

Good evening. My name is Clayton Creager and I am an Environmental Program Manager for the North Coast Regional Water Quality Control Board. I am here today to speak on behalf of our agency on the State Water Board's *Notice of Preparation of an Environmental Impact Report for the Lower Klamath Project* and to express our support for the Facilities Removal alternative that will lead to the decommissioning of the four lower-Klamath dams.

- The North Coast Water Board is employing a comprehensive basin-wide (above and below the Klamath dams) recovery strategy to restore water quality throughout the Klamath Basin. We are working collaboratively with many organizations, Tribes, and private landowners. We consider the entire Klamath River Basin to be one single, integrated watershed ecosystem composed of many diverse sub-basins. To facilitate this strategy we have developed the Klamath Basin Monitoring Program and the Klamath Tracking and Accounting Program to coordinate recovery actions and monitoring across the basin.

- The ongoing restoration actions and TMDL implementation efforts to restore the Klamath River cannot reach their full potential without also addressing the water quality limiting factors created by the four dams identified in the *Lower Klamath Project*. This understanding is widely accepted in the scientific community, as noted in Interior Secretary Jewell's summary of the Klamath Secretarial Determination Findings[1], which makes the selection of the Facilities Removal alternative a clearly preferred choice.

- The North Coast Water Board accepts that the Facilities Removal scenario is undoubtedly going to result in temporary downstream impacts that may be unavoidable. The procedures for evaluating and authorizing these temporary impacts from restoration projects, which at times can degrade water quality and cause temporary exceedances of water quality objectives, are detailed in the Regional Water Board's *Policy in Support of Restoration in the North Coast Region* (Restoration Policy) which was approved by the SWRCB and the Office of Administrative Law.

- The North Coast Water Board stands solidly behind the Facilities Removal alternative and believes that it is necessary to *restore* and maintain the chemical, physical, and biological integrity of the Klamath River.

[1]Letter from Interior Secretary Sally Jewell to Kimberly D. Bose (Secretary) Federal Energy Regulatory Commission (October 17, 2016) summarizing the findings of the Secretarial Determination supporting the applications submitted by PacifiCorp and the Klamath River Renewal Corporation on September 23, 2016, urging the Federal Energy Regulatory Commission (Commission) to approve these applications for dam removal as a critical step toward resolving the significant water-related issues in the Klamath Basin.

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(Please Print Clearly)

SCOTT GREACEN

Friends of the Eel River

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Aaron David

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Zane Schoettgen

If necessary

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(Please Print Clearly)

TRACY KATZMAN

Please issue a permit for the dam removal

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LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

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(Please Print Clearly)

NAME: LANA M McCOVEY

EMAIL (if desired): lamccovey@yurok tribe.nsn.us

ORGANIZATION (if applicable): YUROK TRIBE

REMARKS: ALL 4 DAMS Should be removed.
THE YUROK TRIBE HAS BEEN A PART OF THE REMOVAL PROCESS FROM THE BEGINNING. OUR ORGANIZATION HAS PROVIDED SCIENTIFIC INFORMATION AND CULTURAL INFORMATION AS TO HOW DAM REMOVAL IS THE BEST OPTION TO RESTORING THE WATER QUALITY OF THE KLAMATH RIVER.

LOCATION (circle one): (ARCATA) SACRAMENTO YREKA

POOR WATER QUALITY HAS HAD DETRIMENTAL AFFECTS TO THE FISHERY OF THE KLAMATH RIVER.

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(Please Print Clearly)

NAME: Dr. Cutcha Risling Baldy

EMAIL (if desired): Crislingbaldy@humboldt.edu

ORGANIZATION (if applicable): Humboldt State Dept. of Native American Studies

REMARKS:

LOCATION (circle one): **ARCATA** SACRAMENTO YREKA

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NAME: Lisa Sundberg

EMAIL (if desired):

→ Host of Sumeg Village Brush Dam.

ORGANIZATION (if applicable): Tribal Member Trinidad Rancheria

REMARKS: Other Yurok communities are also affected by the dams & as a member who was raised in Trinidad & Klamath River am in support of Dam Removal. The Yurok people are River & and Costal Indians who use the fish resources for Ceremonies & traditional Subsistence and Trinidad is a coast Yurok community →

LOCATION (circle one): (ARCATA) SACRAMENTO YREKA

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(Please Print Clearly)

NAME: Andrew Orehoske

EMAIL (if desired):

ORGANIZATION (if applicable):

REMARKS:

LOCATION (circle one): (ARCATA) SACRAMENTO YREKA

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(Please Print Clearly)

NAME: Jenna Bader

EMAIL (if desired): jenna.bader@yahoo.com

ORGANIZATION (if applicable): Citizen, Energy & Climate Scientist

REMARKS: I support un-damming the Klamath. Dams were created in a narrow framework to create energy, without considering the fact that we need water for other resources. These dams are choking the river of nutrients & minerals, and threaten the water quality, Salmon, and all local Tribes that rely on the River for survival.

LOCATION (circle one): (ARCATA) SACRAMENTO YREKA

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(Please Print Clearly)

Sammy GenSaw III

Sammy3Saw232@Gmail.com

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(Please Print Clearly)

Colin William Kerosky

Colin@roguechinook.org

Rogue Chinook

- If [redacted] there B time, I [redacted] will speak. [redacted]

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(Please Print Clearly)

Jon-Luke Gensaw

Gensaw22471@gmail.com

Ancestral Guard

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Joe James

Yurok Tribal Council

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(Please Print Clearly)

Lena Mann (~~do not need to speak~~)

cdmag1@sbcglobal.net

With the new administration it will be VERY important to show solidarity in all environmental concerns - getting out the word through whatever means you can - computer, newspaper, JPR + Democracy Now on radio, the Journal, etc., contacting all local + county + state + ~~federal~~ (Federal) people, completing petitions on line or at various group meetings, demonstrations, etc. Besides fish man and many other species (animal + plant) depend on clean water!

ARCATA SACRAMENTO YREKA

1/12/17

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(Please Print Clearly)

Lena Belle GenSaw

ARCATA SACRAMENTO YREKA

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(Please Print Clearly)

Dara Alexander

Please take down all dams so a core source of life life can be rejuvinated, revived, so that life can flourish and thrive once again endlessly.

ARCATA **SACRAMENTO** **YREKA**

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(Please Print Clearly)

Thomas Joseph

Hoopa Tribe

ARCATA **SACRAMENTO** **YREKA**

DID NOT SPEAK

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(Please Print Clearly)

NAME: Kristin Richter

EMAIL (if desired): kannichja@gmail.com

ORGANIZATION (if applicable):

REMARKS:

LOCATION (circle one): (ARCATA) SACRAMENTO YREKA

Do Not wish to speak

~~SPEAKER CARD~~

LOWER KLAMATH PROJECT LICENSE SURRENDER SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: Mary Ann Murphy

EMAIL (if desired): maryann.murphy@gmail.com

ORGANIZATION (if applicable):

REMARKS: From everything I've read + heard the dams should be removed from the Klamath River

LOCATION (circle one): (ARCATA) SACRAMENTO YREKA

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(Please Print Clearly)

NAME: Rob Gearheart

EMAIL (if desired): rg8@humboldt.edu

ORGANIZATION (if applicable):

REMARKS: Written remarks provided

LOCATION (circle one): ARCATA SACRAMENTO YREKA

My name is Bob Gearheart, Emeritus Humboldt State University Professor of Environmental Resource Engineering I have lived Arcata for 41 years and have been involved in water quality and wetland research for 48 years. I have support the removal of the dams on the Klamath River based on the science that shows the role it will play in improving water quality and fisheries populations. I have worked on various water quality and wetland projects on the upper Klamath Basin for 24 years. I was a member of the Upper Klamath Basin Science Team, contributed and reviewed the Undepleted Natural Flow report , and more recently was a member the Klamath Hydroelectric Settlement Agreement IM 10 technical review team. Dam removal will allow the lower Klamath River to process water, nutrients, gravels, and sediments which will promote and sustain fish population and reduce human impacts from blue green algae metabolites.

- Water temperature-reduce heat build in reservoir supporting BF algae
- Allow springs to discharge to rivers with cooler termperature without dilution into a reservoir
- Allow natural flows to synchronize with salomonid fish behavoir
- Allow winter and spring floodplain riparian development from sediments and nutrients (nitrogen and phosphorus)
- Allow for low flow natural wetlands to develop to produce habitat and to process and storge nutrients.
- Natural distribution of gravels and production of pools and riffles to support habitats for aquatic insects and fish species
- Minimize still and quiesent water that supports filamentous attached algae and planktonic bluegreen algae
- others

Removing the dams will allow the river to perfom its natural process for improving and maintaining water quality and supporting fisheries population. Dam removal is necessary but not sufficient from watershed standpoint to insure full recovery of the river.

Thank You
Robert Gearheart
613 Park Ave
Arcata, California 95521

no Speaking

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: Dan Ehresman

EMAIL (if desired): dan.ehresman@gmail.com

ORGANIZATION (if applicable):

REMARKS: As a long-time resident of the Humboldt Bay area & in standing with Tribes & other North Coast communities who depend on a healthy Klamath River, I am here to urge my strong support for moving forward with water quality certification →

LOCATION (circle one): (ARCATA) SACRAMENTO YREKA

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...towards removal of all four Klamath dams. For those who came before us & for those who follow - it is past time to Un-dam the Klamath River.

Thank you.

Court Reporter Transcript

STATE OF CALIFORNIA

STATE WATER RESOURCES CONTROL BOARD

LOWER KLAMATH PROJECT LICENSE SURRENDER

* * *

REPORTER'S TRANSCRIPT OF PROCEEDING

Thursday, January 12, 2017

5:09 P.M.

* * *

D Street Neighborhood Center

1301 D Street

Arcata, California 95521

Jennifer L. Yang, CSR 12367

A P P E A R A N C E S

FOR THE STATE WATER RESOURCES CONTROL BOARD:

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ARCATA, CALIFORNIA MONDAY, JANUARY 25, 2016

5:09 P.M.

* * *

MS. RAGAZZI: Good evening and welcome.

This is the first of three scoping meetings that the State Water Resources Control Board is going to be having on the Lower Klamath Project. I'm Erin Ragazzi with the State Water Resources Control Board and I'm here today with a couple of my colleagues. Parker Thaler and Christine Diego, in the back of the room, they're both with the Water Quality Certification Program with the State Water Board, and Marianna Aue is with our Office of Chief Counsel.

We're also joined today by our environmental consultants, Stillwater Sciences. We have Maia Singer and Barbara Clark, and then they subcontracted. The tribal lead for the project is William Rich.

So I'm going to do a little bit of logistics and ground rules here today and then I'm going to turn it over to Parker for a presentation.

First thing I want to do is just provide an update. So we were scheduled originally to have a scoping meeting in Yreka on June 6, but there was a lot of weather recently, pretty wet, and, unfortunately, we had to cancel that meeting. We were very fortunate that we could

reschedule that for Thursday, January 26, to the same location, the Miner's Inn, and same time, 5:00 to 7:00 p.m., as this meeting.

I did want to let folks know that should you leave here today and talk with other folks and they have an interest in hearing about this project, hearing about our process, they can either attend one of the future scoping meetings in Sacramento or Yreka, or the Sacramento meeting is actually being webcast, so you can always have them listen in and be at that webcast.

So the purpose of today's meeting is really for us to provide information, but, more importantly, for us to hear comments from folks about the Lower Klamath Project and specifically the State Water Board's process related to the water quality certification application that's before us.

So after I go through the logistics and ground rules, Parker's going to provide that presentation, a very brief presentation, and then we'll up open it up for comments. This meeting is scheduled to go up until 7:00 p.m. this evening and we'll see how many commenters we have.

The back of the room there's a sign-in sheet. Please be sure to sign in. There's also a one-page information sheet. Be sure to pick one of these up. It

provides the web page for the Lower Klamath Project. It also has information on signing up for the Lower Klamath Project email subscription list, so that you can receive future updates about the project, and on the back there's a map of the Lower Klamath Project which will help out.

If you want to speak tonight, please be sure to fill out one of these speaker cards and then hand it off to a State Water Board staffperson in the back of the room.

If you are not sure if you want to speak or not, please fill out a card and just write "if necessary," so that provides with us the opportunity to know how many people might want to speak so that we can figure out how much time we can allocate to each speaker.

Please note that we have Jennifer Yang over there. She's transcribing this meeting for us, and it's important that you state your first and last name and you spell it so that she can accurately transcribe that information for us.

Are we good on sound and everything? Great.

Little bit on ground rules. Typical ground rules: Please silence any electronic devices you have. Take a moment to do that. Please be sure to respect all speakers and all points of view this evening, and we want to make sure there's only one person speaking at a time

and that you do use the microphone so that everybody can hear the comments and, more importantly, so that we can get them accurately transcribed.

We ask that you hold any questions or comments until the end of the presentation. So we're really here tonight to listen to the comments that folks have, but there will be an opportunity at the end of the presentation for any procedural questions that you may have.

We do recognize there's a short time frame for us to receive all comments tonight, so please respect the time limits. If at the end of the oral comment period we have additional time, I'm more than happy to have people come up and provide additional oral comments or for other folks to come forward at that time and provide additional comments.

If you don't want to speak tonight, you can take one of these speaker cards, write on it whatever comments you want and put you don't want to speak tonight. We'll take those written comments and consider them equally to what we would consider as part of the oral comments, and if you aren't able to make all of your oral comments tonight, please feel free to submit written comments. The comment deadline is February 1st.

With that, I'm going to turn it over to Parker

to provide a presentation on why we're here and a little bit about the Lower Klamath Project.

MR. THALER: Hello. Thank you all for coming.

As Erin said, my name is Parker Thaler and I'm the lead technical staff assigned to the Lower Klamath Project, and as for why we are here, the Klamath River Renewal Corporation, otherwise known as the KRRC, submitted a water quality certification application to the State Water Board to decommission sufficient portions of the Lower Klamath Project for it to provide a free-flowing Klamath River and for volitional fish passage.

The State Water Board conditions hydroelectric projects via water quality certifications to ensure the protection of State's waters, and the California Environmental Quality Act requires an environmental impact report to inform the State Water Board and the public about the project's significant environmental affects and ways to reduce those impacts.

Now today I'll be providing an overview of the Lower Klamath Project dam developments; background on the Lower Klamath Project Federal Energy Regulatory Commission, or FERC, process, as well as the Lower Klamath Project's link to the Klamath Hydroelectric Project; an overview of the CEQA process, otherwise known as the California Environmental Quality Act; and a discussion of

our notice of preparation, and in advance, I apologize for all the abbreviations.

So shown in this slide is a map illustrating the general locations of Lower Klamath Project's dam developments. This is the same figure located on the cover of your notice of preparation that was sent out December 22, 2016, and is also located on the back page of the fact sheet at the back of the room.

For the purposes of easy viewing on the slide on the screen, I've added blue dots to generally locate the Lower Klamath Project's dam developments and a red line to delineate the State of California and Oregon's border.

The Lower Klamath Project is located along the Klamath River in Siskiyou County, California and in Klamath County, Oregon. The California portion includes Copco No. 1, Copco No. 2, and Iron Gate Dam developments.

J.C. Boyle is located in Oregon, approximately 16 miles north of the state line, and is subject to the State of Oregon's water quality certification process which is a separate action than what we are discussing today.

The Lower Klamath Project dam developments are currently part of the Klamath Hydroelectric Project which is owned and operated by PacifiCorp. For reference, the slide lists all Klamath Hydroelectric Project facilities

and from upstream to downstream include East Side and West Side, which are located adjacent to Link River Dam at Upper Klamath Lake, Keno and J.C. Boyle, which are both Oregon facilities; Copco No. 2, Copco No. 1, and Iron Gate, which are all located on the main stem Klamath River in California, and Fall Creek, which is located on Fall Creek that is a tributary to the Klamath River.

You can see on the slide in bold and underlined I've delineated the Lower Klamath Project dam developments from the Klamath Hydroelectric Project facilities, and off to the right of each name there is an abbreviation for which state that facility is located at.

Now that I've provided information on the Lower Klamath Project dam developments, I will briefly provide background information on the Lower Klamath Project's progress through the Federal Energy Regulatory Commission process. For context, FERC is the federal agency that issues orders for the construction, operations, and decommissioning of hydroelectric projects. FERC orders are often issued with conditions or measures that project operators must comply with to protect public and environmental resources.

So beginning in 1956, FERC issued the original license order for the construction and operation of the Klamath Hydroelectric Project, and in February of 2000,

the 1956 license for the Klamath Hydroelectric Project was issued on a 50-year term that expired in 2006.

Because the FERC license expired, the Klamath Hydroelectric Project is required to obtain a new license to operate from FERC, which requires a water quality certification as well as other authorizations from various state and federal agencies.

So in 2004, PacifiCorp, the owner of the Klamath Hydroelectric Project, and currently associated Lower Klamath Project dam developments applied to FERC to relicense the Klamath Hydroelectric Project, and shortly thereafter, in 2006, applied to the State Water Board for water quality certification.

In 2007, FERC completed its National Environmental Policy Act compliance by issuance of a final environmental impact statement analyzing PacifiCorps proposals for continued operations of the Klamath Hydroelectric Project as well as various alternatives.

Following that, in 2008, the State Water Board began CEQA process of evaluating the Klamath Hydroelectric Project for release of a notice of preparation and hosting of scoping meetings.

Following FERC's issuance of its final environmental impact statement, some Klamath Hydroelectric Project-affected parties began discussions for a

settlement agreement that resulted in the formation of the Klamath Hydroelectric Settlement Agreement in February 2010.

The Klamath Hydroelectric Settlement Agreement created a pathway for dam removal of J.C. Boyle, Copco No. 2, Copco No. 1, and Iron Gate Dam developments via federal authorization that would have removed these developments from the FERC process, and in September of 2012, the Klamath Hydroelectric Settlement Agreement, along with its companion agreement known as the Klamath Basin Restoration Agreement, resulted in the final Klamath Facilities Removal environmental impact statement and environmental impact report, and before I go any further, I would like to note here that the State Water Board is not a signatory to any of the settlement agreements and that the State Water Board maintains its independent authority to condition the Klamath Hydroelectric Project and the Lower Klamath Project for the protection of water quality standards, and in light of the substantial new information developed since the 2008 notice of preparation, in 2015 the State Water Board reinitiated the CEQA process by release of an updated notice of preparation and hosting the public scoping meetings.

Shortly thereafter, on April 6 of 2016, the Klamath Hydroelectric Settlement Agreement was amended to

remove provisions requiring federal authorization to proceed with dam removal and instead pursue dam removal through the FERC process.

Following the amendment of the Klamath Hydroelectric Settlement Agreement and at the request of PacifiCorp, on June 16, 2016, FERC placed the Klamath Hydroelectric Project relicensing process on hold for an abeyance and on June 24, 2016, PacifiCorp withdrew its water quality certification application from the State Water Board thereby ending the water quality certification and CEQA process associated with the Klamath Hydroelectric Project.

Following PacifiCorps' withdrawal of its water quality certification application, several events happened on September 23, 2016. A new entity, a 501(c)(3) non-profit known as the Klamath River Renewal Corporation, jointly filed with PacifiCorp an application to transfer a portion of the Klamath Hydroelectric Project to the Klamath River Renewal Corporation thereby dividing the Klamath Hydroelectric Project into two separate projects, the first being East Side and West Side, Keno, and Fall Creek, which would maintain the name Klamath Hydroelectric Project as well as FERC project number 2082.

The second would go to the Klamath River Renewal Corporation and would consist of J.C. Boyle, Copco No. 2,

Copco No. 1, and Iron Gate dam developments, otherwise known as the Lower Klamath Project. FERC has designated this project as project number 14803. I'd like to note that this transfer application is currently pending before FERC.

In addition to the transfer application, the Klamath River Renewal Corporation also, on September 23, 2016, filed with FERC a license surrender application seeking to decommission sufficient portions of the Lower Klamath Project to provide for a free-flowing Klamath River in the project-affected area as well as volitional fish passage, and also on September 23, 2016, the Klamath River Renewal Corporation submitted a water quality certification application to the State Water Board.

Now that we've covered the background, the State Water Board is proceeding with processing the Klamath River Renewal Corporation's water quality certification application, but before the State Water Board can take an action on the Lower Klamath Project's water quality certification application, it must first comply with CEQA as CEQA is a requirement of state law. Information developed in the CEQA process will be used to inform the State Water Board's future actions.

Today's scoping meeting is part of the notice of preparation public comment period that began on

December 22, 2016, and will end on February 1st of 2017.

Shown in the slide is an overview of the typical CEQA process in which the State Water Board has determined an environmental impact report is necessary. You can see following that determination the State Water Board will issue a notice of preparation and conduct public scoping meetings, which is currently where we are at.

You can see on the slide in bold and underlined I have noted this a formal public comment period under CEQA, and the dates for the comment period are listed. December 22 is when it began, and it will close on February 1 at 5:00 p.m.

Following the close of the comment period, the State Water Board will collect all the comments and take them into consideration as well as consider the existing environmental information that is available and use those to develop a draft environmental impact report.

The draft environmental impact report will then be released for a minimum 30-day public comment period, and again you can see that there's a formal public comment period associated with the environmental impact report.

The draft environmental impact report will include items like a detailed description of the project and project alternatives, mitigation measures to reduce impacts to resource areas and a description of

environmental baseline conditions.

Now, similar to the notice of preparation portion of the CEQA process, the State Water Board will consider all comments received and issue a final environmental impact report.

Following or concurrent with the issuance of the final environmental impact report, the State Water Board will take an action on the KRRC or Klamath River Renewal Corporation's water quality certification application.

Now, our CEQA approach is to focus on the California portion of the Lower Klamath Project because that is the portion of the project subject to the State Water Board's authority.

We plan to use FERC's environmental impact statement and the Klamath facilities removal environmental impact statement and environmental impact report in development of our CEQA document. We also plan to use information gathered by CEQA commenters, the scientific community, settlement agreement, tribes and other sources.

Our notice of preparation identified two project alternatives that we plan to include, and those were the Klamath River Renewal Corporation's proposed project to decommission sufficient portions of the Lower Klamath Project to provide for volitional fish passage and a free-flowing Klamath River and the known project

alternatives, and we recognize there is a range between these two alternatives and part of this public scoping period is to receive input on additional alternatives or specific alternatives that the public feels should be considered.

So to jump back to today's meeting, all public comments submitted by February 1st of 2017 will be considered. I consider all comments to be helpful, but there are a few key pieces of information that would be most helpful to us in development of our CEQA document, and those are the adequacy of FERC's environmental impact statement and the planned facilities removal joint CEQA-NEPA document.

In other words, do these documents address your concerns or is additional time needed; the range of alternatives or specific alternatives that should be considered, as well as potential impacts or mitigation measures, and, of course, any other items.

Now, there has been previous analysis done on alternatives, impacts, and mitigation measures, and those have been described today such as FERC's environmental impact statement and the Klamath Facilities Removal CEQA-NEPA document. To the extent that those documents address your concerns or comments, it would be beneficial for us to know of them, and we do understand there are

environmental impacts associated with the Klamath River Renewal Corporation's proposed project and potential other alternatives, including the release of large sediments from behind Copco and Iron Gate reservoirs, changes in ground water table and potential impacts to tribal cultural resources.

If you're planning on commenting on potential impacts, I encourage everyone to refer to attachment one in the notice of preparation for a list of impacts that we've identified which was developed using previous environmental information that we cited.

So with that, again, please submit your comments by 5:00 p.m. on February 1st of 2017. You can send them to the physical or email address shown up here, and there's a link also on the slide to our Lower Klamath Project web page where we post updated water quality certification information, and another slide here is how to stay informed, and on the front of our NLP there's instructions on how to subscribe to our Lower Klamath Project License Surrender email subscription system, and when we have updates such as release of a notice of preparation or draft CEQA document, we will be sending them out via that system, and if you're signed in, you'll automatically receive those updates, and we've also posted those instructions on the slide.

With that, I will turn it over to Erin to take over the questions relating to processes described today and then public comments. Thank you.

MS. RAGAZZI: So there's a bunch of folks standing over here. There are plenty of seats out here. Anyone with a seat next to them that's open, raise your hand and let folks know where they might want to come in and sit down, so if you'd like to, there's plenty of seats up front, and we are here until 7:00, potentially.

So second of all I want to find out does anybody have any comment cards out there. Anybody else that wants to comment today? If so, you can hand your comments to Christian. That would be great.

And then, are there any procedural questions? So not a comment, just where you have a question about how to submit a comment or something like that.

Okay, so we're going to dive right in to hear what you guys came here to tell us tonight, so first speaker -- I'm going to call out a couple names so folks know -- John Driscoll with representative Jared Huffman followed by Paul Kinsey and Javier Kinney.

And just so folks know, I'm going to give folks three minutes, so plan accordingly. If we have extra time at the end, I'm happy to give people an opportunity to come back and provide additional comments.

If you could state your name, first and last name, and spell it, that would be great.

JOHN DRISCOLL: My name is John Driscoll, J-o-h-n D-r-i-s-c-o-l-l. I'm the district representative for Congressman Jared Huffman. Do I need to spell that as well?

Thank you for coming to Arcata tonight and being here to listen to what all these folks have to say, and I think it's pretty clear that most people feel the same way about these dams.

The part that you're considering is of great interest to the Congressman and to tribes, fishermen, communities up and down the West Coast. It's a key piece in the effort to remove the four dams on the Klamath, to rebuild salmon runs and make the river healthy.

We've known for a long time that the reservoirs behind the four dams severely compromise water quality by heating up water and causing algae blooms. This has had disastrous effects on the Klamath River's important fisheries, recreational uses of the river, and the ceremony uses by the tribes that hold the river sacred.

As you know, the 2012 state and federal environmental study on this issue detailed those impacts, and the studies that have come since then have added more scientific weight to joint EIR/EIS conclusions.

Congressman Huffman asks that the findings of that joint study be rolled into the new state environmental study for consideration.

I also ask that the expected long-term benefits of removing the Klamath's four dams be weighed carefully and thoroughly along with any possibility of short-term impacts. It's especially important to take that long view in which a restored river can rebuild itself.

Congressman Huffman asks that your board issue a water quality certification for dam removal as so many, including many of the people in this room, have worked to achieve for so long. The timely issuance of the certificate is imperative to allow the Federal Energy Regulatory Commission to authorize dam removal this year.

Please give the water quality certification your full and fair consideration. Congress Huffman thanks you for your long participation in the Klamath River issues and Congressman Huffman also asks you take one more step to help tear down these dams.

MS. RAGAZZI: Thank you.

If you feel comfortable with leaving your written comments with Jenni, she'd probably really appreciate it.

So next speaker, Paul Kinsey.

If I mispronounce anyone's name, please don't

take offense and please correct me when you come up, so first name, last name, and please spell it.

PAUL KINSEY: You did a very good job.

My name is Paul Kinsey, P-a-u-l K-i-n-s-e-y, and I am in fact a water license holder in the State of California, one of the very few less than 7,000 license holders in California and I am one of those license holders, and I am here today to say that I support the unlicensing of the Klamath dams and encourage the State Water Resources Board to revoke the license and discontinue it. Thank you.

MS. RAGAZZI: Javier Kinney followed by Amy Cordalis followed by Larry Glass.

JAVIER KINNEY: Good evening. Javier Kinney, J-a-v-i-e-r K-i-n-n-e-y, and Yurok tribal member, director of the Office of Self Governance, Yurok Tribe.

So the Yurok Tribe formally and strongly supports the issuance of the 401 certification for the removal of all four dams for three reasons. The first, restoration, respect and recognition.

First, the removal of all four dams will assist not only the Yurok Tribe, indigenous people of the Klamath River, to restore and balance our ecosystem and our traditional ways of life, not only our economic, political, social, legal, and cultural ways of being.

Secondly, the removal of all four dams will respect the balance, the indigenous knowledge, as well as the contemporary way of life. The Yurok Tribe not only manages, but implements direct action to protect the waterways, the water quality, and the scientific foundation in order to continue the positive, as well as economic, foundation for generations to come.

Lastly, the removal of all four dams will rightly recognize the way of life of the Yurok Tribe, and its communities, the cultural ceremonies, the prayers, as well as traditional food types and sources, will continue to provide both sustenance for our communities, our children, our elders, as well as the rest of the region and the peoples along the Klamath River.

So in recap, the restoration, respect, and recognition of Yurok Tribe's tribal comments -- more will be coming this evening as well -- to remove all four dams and the approval, as well as strong support for the issuance of the 401 certification. Thank you.

MS. RAGAZZI: Thank you.

So Amy followed by Larry Glass followed by Nathaniel Pennington.

AMY CORDALIS: Aiy yu kwee. Nek now Amy Cordalis. My name is Amy Cordalis. I'm general counsel for the Yurok tribe. My family is from Requa. We've been

in Requa since the beginning of time, which for folks that don't know, that's right at the mouth of the Klamath River on the north side.

The Yurok Tribe has always resided on the Klamath River. Our current reservation straddles the lower 44 miles of the Klamath River a mile on either side of the river.

The river is the core of who we are as a people. Everything we do, from our economic livelihood to our culture, to our religion, to recreation depends on a clean, healthy river.

Ever since the dams have been in place since the 1950s, we have seen the gradual destruction of our fishery and our river. We have spent a considerable amount of our time and resources building a fisheries department that has studied the poor -- well, the effects of dams on our fisheries, and all of our reports, all of our work which has informed the 2012 EIS indicates that the dams have incredibly negative water quality impacts -- there's just no other way around it -- and so we strongly support removal of the dams.

We strongly support that this board move forward with the certification process. We hope that you can do that by at least 2019 so that we can stay on track for dam removal by 2020. We encourage you to inform your

environmental impact report with the 2012 EIS update, that by taking out the components that were related to the KBRA, because that's no longer valid; account for the last five years of drought; and then also consider the new fisheries or fisheries disease issues that we've had on the Klamath River. Those are in 2014 and 2015 the Endangered Species Act was violated because the incidental take permit was exceeded.

We had a disease, C. shasta, that killed what I call our baby fish. Eighty to 90 percent of our baby fish in 2014 and 2015 were killed as a result of the C. shasta disease, and so since then, our fisheries team has looked at the cause of that, those mortalities, and again it goes back to the poor water quality conditions caused by the dams, so I encourage you to incorporate the reports that we will submit later outlining those disease into your EIR. Thank you.

MS. RAGAZZI: Thank you.

Next speaker, Larry Glass followed by Nathaniel Pennington followed by Medilia Cordeno.

LARRY GLASS: Hi. Larry Glass, L-a-r-r-y G-l-a-s-s, representing the North Coast Environmental Center. The Environmental Center would like to restate its long-held position of all dams being removed from the Klamath River.

For our input for the Water Board, we'd like you to be sure to move expeditiously so that the permit certificate can be granted in a timely enough fashion so that the FERC can do their job in 2020. Those of us that deal with government all the time know how critical that timing issue can be. We may have missed our window of opportunity.

I want to encourage you to encompass the 2012 EIR/EIS, the State and the Fed's, in your document, and oh, yes, do not forget to thoroughly analyze the long-term benefits that will be accorded to the fish and the people who live along the Klamath River system by these dam removals.

NATHANIEL PENNINGTON: Hello. My name is Nathaniel Pennington, N-a-t-h-a-n-i-e-l P-e-n-n-i-n-g-t-o-n. I'm here representing the Salmon River Restoration Council. I'm also on the board of directors of Klamath Riverkeeper, Nature Rights Council. I've worked for the Department of Fish & Wildlife.

I'd like to encourage you guys -- I echo some of the earlier speakers -- to act with expedience and also, please, in development of the document, as you've heard, take into account the long-term benefits of dams out in the river and, of course, you know, also take into account the fact that there is absolutely no way to have a healthy

Klamath River with these four lower-most large dams in place, and so eventually they will be removed.

At the Salmon River Restoration Council, we have an imperilled run of salmon that once was predominant in the Klamath Basin and provided economy and traditional food sources for tribes, that is the Klamath River spring Chinook run, and with the dams in place, there is really no way that these fish are going to continue to exist in the Klamath.

As of now, there's, you know, anywhere between 90 and 1,600 wild fish that return on the Klamath side, and once numbering in the hundreds of thousands before the dams were put in place, so to wrap it up, just there's absolutely no way that the river will survive or the salmon will survive with the dams.

So please take into account the overall benefit and try to buffer your document against people that, for whatever reason, may be trying to doom it all, the good work that has happened. Thank you.

MS. RAGAZZI: So I'm going to -- I know I'm not getting this name right, so I can't -- Medilia. Sorry. I'll let you say it properly -- followed by Annelia Hillman followed by David Bitts.

MAHLIJA FLORENDO: Hello. My name is Mahlija Florendo, M-a-h-l-i-j-a F-l-o-r-e-n-d-o. I am part of the

Yurok, Selek, Hoopa, and Wasco tribes. I live in Orleans, California and my people are from the Rek-woy and the Hop-ew villages on the Klamath River and we have always depended on this river for years, for thousands and thousands of years of what we know.

This river is our food source, you know, it is our water source. It is everything to us. It's our lifeline, and the dams have a great affect on how we live and how we depend on this river. We have never been able to use it the way that our ancestors did before this dam was here, and I want in my future, I want my kids to be able to see what this river is like when it's natural and beautiful because it's -- it's our lifeline and it is everything, and I just want to say, regarding my future as well as everyone around it and who depends on it, undam the Klamath.

MS. RAGAZZI: Thank you.

ANNELIA HILLMAN: Aiy yu kwee. Nek now Annelia Hillman, A-n-n-e-l-i-a H-i-l-l-m-a-n. Here we are again. Hopefully, we won't have to do this too many more times, but I'm here, of course, today to support the certification to remove the four dams on the Klamath River. Again, dam removal is the most necessary and first step to restoration for our river that we, the Yurok people and the Karuk people, depend on so deeply for our

lifeways and our future.

I'd like you to consider, you know, we talk a lot about the environmental impacts. Well, our people are part of that environment. We are a species that depends on this river, and so I'd like you to consider our mental health and well-being that will be affected and renewed. Once our river is renewed and restored, our mental health and the well-being of our people will also be restored, so please consider that, and I thank you for coming and listening to us today.

MS. RAGAZZI: Thank you.

So David, I believe it's Fitts, followed by Christian Richard, Mark Lovelace.

DAVID BITTS: Thank you. My name is Dave Bitts, that's bravo, india, tango, tango, sierra, and I'm a ocean salmon fisherman and crab fisherman based in Eureka for the last 40 years. I'm also president of the Pacific Coast Federation of Fishermen's Associations, which we have been involved in the settlement talks that led to the agreement in 2010 since before those talks began, and I want to speak briefly on behalf of ocean salmon trollers because we are constrained by the abundance of Klamath fall Chinook from Point Sur, California to Cape Falcon in Oregon.

In good years we have not really a wonderful

opportunity, but many years of adequate opportunity to fish and do okay at that, but years like last year and this year, we don't. We were lucky to get a few days on the water and lucky to have a few fish to catch.

The parasite C. shasta has been mentioned. I believe that parasite is the primary cause of the situation we have on the Klamath River in years like last year and this year. As far as I can tell, some very smart people have been studying that parasite for at least 15 years, and as far as I know, the solution seems to be scouring the bottom of the river by high flows with lots of gravel, and one of the things the dams do is trap all that gravel so it can't scour the bottom of the river, and that allows the algae to flourish.

There's a worm that lives in the algae. The parasite lives in the worm when it's not out looking for salmon to kill. If the algae can be scoured by a free-flowing river, gravel rolling down in the wintertime flows, we should have better fishing in many more years than we currently do, so we would like to see these dams removed.

It's kind of funny that a project that, by every measure I know of, should vastly increase water quality has to get certified based on water quality standards compared to what it is now, but that's the way it is, so

thank you.

MS. RAGAZZI: Thank you.

Christian Richter, Mark Lovelace and Raymond Matz. Christian?

I'll move it to the back and we'll go with Mark.

MARK LOVELACE: Thank you. I'm Mark Lovelace. Until very recently, I was the Third District Supervisor for Humboldt County. I've worked on the Klamath River issue since 2006. Oh. L-o-v-e-l-a-c-e.

I've worked on the Klamath River issue since 2006, including eight years on behalf of County of Humboldt. While I no longer speak on behalf of the County, Humboldt is the signatory to the revised KHSA and to the regional KHSA and KVRA.

I urge you to approve the 401 permit and move forward with decommissioning in 2020 as proposed. The existing EIR/EIS addresses the full range of the issues, alternatives, and mitigations for this project and forms a sound basis for your own analysis. I wish I had forethought to bring the administrative record for that document here. It would stand about this tall, and that found conclusively that dam decommission and removal is by far the best path forward with the health of the river.

As with the previous speaker, David Bitts, I have to comment on the irony of having to do EIR,

environmental study, for removal of the dams when none was done for construction of the these dams over the 60-year period of their development. Had there been any kind of analysis of constructing these dams prior to that, I don't think there's any doubt these dams never would have been built in the first place.

We've seen over the 100 years that some of these dams have stood the impacts that they've created to water quality, to fish, to the river itself, to the fisherman, the tribes, downstream communities, the industries that depend upon this river. Clearly, that impact is very present. You've heard that and you will hear that for the rest of this evening from so many people.

I urge you to move forward on 401 certification to allow these dams to come down by 2020. Thank you.

MS. RAGAZZI: Thank you.

Raymond followed by Craig Tucker followed by James Dunlap. Raymond, you're next. You're up right now.

RAYMOND MATZ: Hello. Raymond Matz. I'm a Yurok Indian and I live down at the mouth of the river and, you know, I just heard the commercial fisherman get up here say about the algae. How about taking those four dams out and you won't have to scrub the bottom. They'd be clean in a year. It's the craziest thing I've heard in a long time, but that's important. You know, I'm a

commercial fisherman, so I know how they act.

Years ago I was fishing, swimming on the Klamath River -- folks had a place up the river -- and some boat pulled up and a bunch of guys got out and they had cameras in the boat and they asked us, "What you think of all of the bark coming down the river? Is it killing salmon?" And I spoke up, "Yeah, you see dead salmon, but you always see them in the summertime," and the friend where I was swimming, there was a plumb full of water and they say, "Where is that coming from," and I said, "The rafts coming down the river hit the bottom and knocking the bark off." No. She didn't know why she was even there. Just some people talking, you know?

The biggest thing I seen with hurt the Klamath River is the salmon kill. I cried on that. I went up four times with fishing people, showing up, and I said, "I can't go back." It's just a killing zone the way I felt about it, and I knew it was happening. I knew as soon as I heard they were dying up there what was happening.

I said, when they took the Trinity and put a dam on it, something's going to happen. The water, so much of it came out of the Klamath, out of the Trinity and just started -- the whole river started falling apart, and you know we don't get them dams out, the Klamath River's going

to die. You can see it. It's happening right now. It's happening. Okay. Thank you.

MS. RAGAZZI: Thank you.

CRAIG TUCKER: My name is Craig Tucker. I'm the net resources policy advocate for the Karuk Tribe. I've been working on this professionally for over 12 years, and there's a lot of people in this room that have spent a lot more years than that, they're whole lives, working on this issue.

I want to let you know the Karuk Tribe supports the issuance of the 401 water quality permit for the decommission of the lower four dams unequivocally. We think that you need to incorporate the bulk of the scientific analysis that went into the 2012 EIR/EIS. This is what's already been done. There's 3,000 pages of peer-reviewed, technical analysis that can be drawn on. The result of that analysis was a recommendation to remove these dam. We want you to do this in a timely manner. We want to remove these dams by 2020, so we hope your permitting process will be consistent with that time line.

We think that new information that should be included has to do with what we have learned in recent years about the fish diseases you've been hearing about, and the Karuk Tribe will be providing you guys, in coordination with Karuk, Yurok, and Hoopa tribes, a

technical report on these fish diseases.

I just want to say I appreciate you guys making the drive out here. I really appreciate -- seems like a little bit of a family reunion when we have these meetings now, and I really appreciate the people in this community. It makes me proud to live here where we can have these very similar meetings where we come out time and time again to make the exact same points about restoring our river.

We have kids out playing basketball right now, we have things going on at home, but people are in here. It makes really proud to live this in area and see all these familiar faces keep coming out and committed to this river. I really appreciate it. Thank you very much.

MS. RAGAZZI: Thank you.

James Dunlap followed by Dave Hilleman followed by Ian Ospowochi. Start with James.

JAMES DUNLAP: James Dunlap, D-u-n-l-a-p. I'd like to say I'm a Yurok tribal member, a father, grandfather and fisherman, and I would implore you to expediate the process.

I was sitting back there going over the mission statement of water quality of the resource board, and just follow through with the mission statement, that's to preserve and restore California water.

When kids and grandkids can't swim in the river because of the toxic green algae, because the quality of water that's coming out from behind those dams, it's a very deep and saddening affect on everyone, and, you know, I want to tell you to do your job, you know, and of course one of the things I'd like to see is that the newest dam -- I'd like to thank you for giving us this opportunity to give you the impact it's going to have on us, and it's about the quality of water that -- you guys are the water quality people.

How it's gotten to this point, how it's progressed to where we are today is a tragedy within itself, and I would hope that you take all the necessary steps to rectify this problem. Thank you.

MS. RAGAZZI: Thank you.

David, it could be Hillman. Hillemeier. Thank you. I apologize.

DAVID HILLEMEIER: Good evening. My name is David Hillemeier and I'm the fisheries director for the Yurok Tribe.

MS. RAGAZZI: Can you spell it for Jenni, please.

DAVID HILLEMEIER: H-i-l-l-e-m-e-i-e-r. It's hard to pronounce.

Yeah, so I'm the fisheries director for the

Yurok Tribe, and I want to reiterate what some of the Yurok residents have said previously, that we fully support the certification of the removal of the four Klamath dams.

It's a pretty exciting time for me. I've been working for the tribe for over 20 years, and we do a lot of stuff to try to improve fisheries habitat in the Klamath and Trinity Basins, and I think it's all really good stuff, but it's all pretty much work, from my perspective, relative to the prospect of getting the four dams out of the Klamath River. That's the one that would make a major difference in regards to restoring the fishery.

I encourage you to work as expeditiously as possible, try to rely upon some of the record that exists from previous EIS efforts because there's a lot of good information that was gathered at that time.

In regards to the timing of it, just this past year, Yurok Tribe received the lowest fall Chinook allocation that they've received since the early 1990s.

The river needs help. The river is very sick, and there are several reasons for that. One of the primary reasons is the dams.

In 2014 and 2015, we had over 80-90 percent of the juvenile fish that were sampled for disease were

infected with a parasite known as Ceratonova shasta, and high or low flows are a large component of that, but also the dams, they make it a very good polychaete habitat, which is a worm that is part of the life cycle of this of disease, and because the dams have interrupted the sediment budget in the Klamath River, the river has become very armored and stable, so these polychaetes stay in place rather than having sediments move them around, which is how the natural river would function each year, and also the algae in the reservoirs, every year they deposit that algae downstream. It's prime food for these polychaetes and it's really disrupted the balances of the Klamath Basin and it was a major contributor to the fact that there was almost no fish for the Yurok Tribe to harvest this past year.

MS. RAGAZZI: Ian.

IAN OSIPOWITSCH: My name is I-a-n O-s-i-p-o-w-i-t-s-c-h. Thank you.

I just want to say that I support the dam removal. I think it would behoove the local people and the ecology a lot and hopefully lead the way for more river restoration throughout the state and the country because it's a very large river. You can tell by the size of the watershed. And thank you.

MS. RAGAZZI: Thank you.

Dr. Joshua Strange followed by Clayton Creger followed by Regina Chichizola followed by Scott Greacen.

DR. JOSHUA STRANGE: Hello. Good evening. Appreciate the opportunity to speak here, yeah. So I also appreciate the Water Board's efforts here and the team that's invoked to help keep this on pace for 2020.

I do want to speak just a few brief comments about the effects analysis. As many speakers have already alluded to, it's going to be really important to add that we discussed the disease impacts, and that is relating --

MS. RAGAZZI: I think there's some reverb.

DR. JOSHUA STRANGE: Yeah, so many people have already spoken to the Myxosporidium disease and it's important to include the Parvicapsulum minibicornis, as well as the C. shasta, and there are some recent documents, as you know, that will be helpful on all that as well.

Also, I conducted research for the Yurok Tribe on the rivers of Washington related to the adult salmon migration in the lower Klamath River, and one of the conclusions of that research is that the dams are likely contributing to the disease risk to the adults as well through the Ick, and that's related to how it impacts their migration behavior, so I'd be happy to provide that publication reference. That is an important part.

In terms of mitigation, I would suggest that there are some additional mitigations that could work for the dam, in particular for allowing continuation of the East Side and West Side project on the Fall side, and I would suggest looking at the possibility of fish passage at Jenny Creek Falls and also opportunities to improve water quality in the Klamath River and the Link River through the East Side and West Side in filtration galleries, other approaches that could be tested and then scaled up if they showed promise as part of the mitigation for water quality.

In particular, as many of you are aware, Keno Reservoir is going to be a key water quality issue moving forward, and so as part of this process, whatever additional mitigation that could be done related to East Side and West Side as part of this transfer of those projects would be helpful, and that can include potentially transferring or ejecting clean water into the river or thereabouts. Thank you.

MS. RAGAZZI: Thank you.

Clayton, Regina, Scott.

CLAYTON CREAGER: Good evening. My name is Clayton Creager, C-r-e-a-g-e-r, and I'm an environmental program manager for the North Coast Regional Water Quality Control Board. I'm here tonight to speak on behalf of our

agency relative to this Lower Klamath Project and express our full support for the alternative of the four Lower Klamath Dams.

The North Coast Regional Water Board has been working on a comprehensive step throughout the basin, both above and below the dams to improve and restore water quality throughout the basin.

MS. RAGAZZI: We turned it up.

CLAYTON CREAGER: Through that strategy, we've been working with many organizations, many of the people in the room, the tribes, private landowners, environmental groups, and we consider the Klamath Basin in its entirety a single ecosystem, and towards that end, to support that adaptive management approach, we've developed the Klamath Basin Long-term Program, which could provide essential information on both current status and trends and future effects of dam removal, and the Klamath Tracking and Hunting Program, which provides information on restoration actions throughout the basin.

So the ongoing restoration action of -- the ongoing restoration actions of the TMVL implementation is not adequate to restore water quality to the Klamath River. It cannot restore the Klamath to its full potential without also addressing the water quality factors created by the four dams identified in the Lower

Klamath Project. This understanding is widely accepted in the scientific community as noted in Interior Secretary Jewell's summary of the Klamath Secondary Determination Findings which makes the selection of the facility removal alternative a clear choice.

The North Coast Board accepts that this facility removal scenario is undoubtedly going to result in temporary downstream impacts that may be unavoidable. The procedures for evaluating and authorizing these temporary impacts from restoration projects, which at times can degrade water quality and cause temporary exceeding of water quality objectives, are detailed in the Regional Board's policy in support of restoration in the North Coast Region Restoration Policy which when it's approved by the State Board and the Office of Administrative Law.

In short, we just want to express again our full support for the alternatives to decommission the dams. Thank you.

MS. RAGAZZI: Thank you.

REGINA CHICHIZOLA: Hello. My name is Regina Chichizola. This is my son, Malcom Fisher Chichizola. C-h-i, c-h-i again, z-o-l-a.

I have been working on this process, the 401 certification process, for 12 years and have been kind of a pain in the butt sometimes, so sorry for that, but it's

really nice to see you moving forward with the 401 certification to remove these dams.

I know that removing the dams are going to have this great impact. I have studied dam removal as to how it relates to water quality in other watersheds, and what we've seen is even in cases where there are major pollutants such as PCBs and lead and things like that, actually, dam removal has been beneficial and it has not released, in areas where there's been so many sediments way beyond the Klamath, those sediments have flushed out fast and they've actually created new beaches, new opportunities for fishermen, and so I think you should look at some of those dam removals in this process because they will show that the benefits far outweigh anything else that is possible.

That said, I'd also like to say that the Klamath River right now is so extremely important and the restoration is so extremely important because most of the other rivers on the West Coast have declining fish populations. A lot of the species are at risk of immediate extinction in the Sacramento and Columbia River, and this is the best chance we have to bring back a fishery in the West Coast, so I fully support this plan.

I'd like to bring up I hope that California engages in the Oregon process and makes sure that Keno

Reservoir is not a problem for fisheries and that water quality issues there are dealt with, and also, I would like to support what Josh said about the East Side and West Side power houses.

Other than that, I would also like to say that any of the claims that these dams help nutrient dynamics or temperatures are false. All they do is change nutrient dynamics and they greatly increase temperatures, and all of that is negative for salmon, on and on.

Just so you know who I represent, I work the Pacific Coast Federation Fishermen's Association and also work with a group called Save the Klamath Trinity Salmon, and I have been doing comments, also, for the California Sportfishing Protection Association. Thank you very much, and I'm going to see if Malcom wants to say anything.

Oh, yeah. The last thing is please have this process move as quickly as possible because everyone who depend on these fisheries need the dam removal to occur fairly soon so that everyone can be eating and communities can be restored upon the river.

And Malcom, do you want to say anything?

MALCOM CHICHIZOLA: I don't know.

REGINA CHICHIZOLA: You don't?

Well, he usually likes to say that he really likes orca whales and sharks and he thinks you should save

the salmon for the orca whales and the sharks.

This meeting's a little bigger than the one before, but thank you again so much and please move this process along quickly and take down these dams. Thank you.

MS. RAGAZZI: Scott Greacen, Friends of the Eel, Aaron David and Zane Schoettgen.

SCOTT GREACEN: Scott Greacen, Friends of the Eel River. G-r-e-a-c-e-n.

The Eel River has two dams on its outer main stem which should also be decommissioned and removed, which is part of the reason I'm here tonight.

We got a little too comfortable rebuilding the plumbing of a lot of westerns watersheds, and I see this process as a important step in getting more comfortable with the idea that many of these dams are going to need to come out during the lifetimes of people in this room. We do need to get started with these four Klamath dams, the removal of which, as you heard, is necessary to secure the restoration and protection of clean water and functioning ecosystem.

As others have said, I would encourage you to move as expeditiously as possible to issue this clean water permit, because this is going to help protect clean water; to use the analysis in the 2012 EIR/EIS because,

hey, it would be foolish not to use it, we paid for it; and to look again at the long-term benefits of dam removal, because they are very substantial and we really need to think about that stuff as we make these important decisions. Thank you very much.

MS. RAGAZZI: Thank you. Aaron David.

AARON DAVID: Aaron David. A-a-r-o-n D-a-v-i-d.

Thank you for the opportunity to speak, primarily an echo what other folks have already said tonight, that in regards to this process, please, I urge you to certify the water quality certification for removal of the dams, and as other folks have said, there's this tremendous scientific and regulatory literature, and all these reports have been published and I'm sure you don't want to start from scratch with this process and write a phone book-sized report, so use that literature out there, use the scientific and regulatory literatures as others have said.

The Department of Interior report, 2012 EIS/EIR said taking down the dams is the best thing we can possibly do for restoring the fisheries along the Klamath River also water quality and the communities along the Klamath River, so take that information into account. It is solid science.

Also echo what Regina had to say. Take a look

at the dam removals that have occurred in other places, the Elwha in particular and some other dam removals, where they have seen some short-term water quality impacts it's true, but they abate pretty quickly and that we have seen very rapidly a huge number of benefits from the removal of the dam. I encourage you, as you go through this process, to take a look at some of those results. Thank you.

MS. RAGAZZI: Thank you.

Zane followed by Tracy Katelman.

ZANE SCHOETTGEN: Zane Schoettgen, S-c-h-o-e-t-t-g-e-n. Most of what I had to say has been said tonight and in far better terms than I could have and far more versed in literature and scientific findings than I could have said; however, what I want to say is I want to see this dam removal happen as quickly as it can. Use the scientific findings and bureaucratic standards, but as expeditiously as possible I think would be best and make an impact. In an area where dam removal will get you a dirty look at the very least, it's refreshing to see this.

Thank you for your time.

MS. RAGAZZI: Thank you. Tracy Katelman.

TRACY KATELMAN: My name is Tracy Katelman, T-r-a-c-y K-a-t-e-l-m-a-n. I know a little about the impact. I've been gone for ten years out of the country. I'm back to Humboldt, glad to be back, and really

heartened that an idea that we talked about back then as a dream really is happening, so that's so exciting for me to see that.

In perspective, I want to share a couple of things with you. One is that the world is watching this process. I've been living in Southern Chile and we've been looking there at how to stop dams coming in, and it's been interesting to see the news about what's happening up here and the dam removal process down there and people looking at the environment to stop more dams coming in, so I wanted you to understand that international perspective happening.

And I'm looking down what the mission is the of the Water Board, which is to ensure the highest reasonable quality for waters of the State while allocating these waters to achieve the optimal balance of beneficial uses, and I think, from what I've heard today, people who have been working on this issue for the last ten or twenty years, there's a lot of really good science that's already happened that's clearly demonstrating that this is, without a doubt, the best thing for water quality.

Certainly we're going to see short-term impacts with the flushing of the dams, but the long-term impact, which is what I think this issue says, is that we're going to see an absolute increase in water quality, so I

encourage you to approve the permit as expeditiously as possible and thanks for providing this.

MS. RAGAZZI: Thank you.

LANA MCCOVEY: Hi. My name is Lana McCovey, L-a-n-a M-c-C-o-v, as in Victor, e-y. I'm a Yurok tribal member. I'm also a council member for the Yurok Tribe, and a lot has been said already about the science and you have received documentation on that, and I just want to reiterate that the Yurok Tribe supports the full removal of the four Upper Klamath River dams, but I did want to reflect, on a personal note, some of the things regarding the water quality of the Klamath.

I remember the first time that I was told, as a teenager, that I shouldn't swim in the river because it wasn't healthy, and I couldn't understand then, and being a council member, I'm slowly learning everything that has contributed to this, and the one thing I have learned is that the dams are in fact the contributing factor to the poor health of the river, and so that's sad to me that I have to put out notices -- and I put out several throughout this last year -- to the tribal membership that the river wasn't healthy to touch, you know, that elders and children and animals should not go into the water, and with the Yurok Tribe, that reservation is on both sides of the river going for 35 miles, you know, up from the mouth,

that that is a really sad thing to have happen, that you can't even touch the water that's in your backyard because you can get sick from it, and so it's just that, you know, if we're going to be -- if you're going to focus, you know, you really need to focus on the water quality and how it affects all species, not just the salmon, but the people that live on the river, the species that live on the river, and how just a simple contact with water that should be clean and pure you can't have. Thank you.

MS. RAGAZZI: Thank you.

Dr. Cutcha Risling Baldy.

CUTCHA RISLING BALDY: Hi. I'm Cutcha Risling Baldy, C-u-t-c-h-a R-i-s-l-i-n-g B-a-l-d-y. I'm a professor of Native American Studies at Humboldt State -- just started -- and I am here today specifically because I wanted to speak a little bit about the work that I do when talking about the work that you all do with the environment and water quality as not just being about the science, but about the way that it affects our people and our communities as a whole and the way that, when you look at studies coming out saying that the people who are most affected by the water issues there are happening when it comes to the Klamath dams are native people and that our native people have very high rates of suicide and very high rates of violence, and some of that comes out of the

things happening in our environment and the things we have to contend with as people on a regular basis.

So in 2002, there was a massive fish kill on the Klamath River, and I went to speak to my grandfather and talk to him about what that was like to see thousands upon thousands of dead fish, and he said to me, "What does this mean for our future and for our people? What does this mean for who we are as a people today?" and he was looking at it as what does it mean that this can be allowed to happen in our society, that we can be allowed to be faced with the dead carcasses of fish and the sort of sadness that comes with that and what will we carry with us now that we've had to live through that.

So what I have started to do as a researcher is to look at the way the environment impacts who we are as a people, and that's something that I want you to consider. The taking down of the dams is not just about the fact that the science supports it and it's not just about the fact that it is actually more economically beneficial for everyone in the state if we do it, it's that it is actually going to help us on a social level to be healthier individuals in our society.

I think a lot about a scholar who said one of the things about the society that we live in today is that we are taught that we live in a world with rights, not

responsibilities, and we start to think that things are our right -- we have a right to this water. We have a right to have dams -- rather than what is our responsibility to the world that we live in.

Native people have always looked at our responsibilities. Who are we responsible for and to? We do not fish just because it is our right. We fish because it is part of our responsibility to this earth. It's the things that we take care of.

So as we move forward, I urge you to think about what your responsibilities are for our future. It's not just now, but seven generations into the future. Think about the fact that there is no other alternative but dam removal for our children and our children's children and our great, great grandchildren. It's the only way that we're going to be able to start to heal all of the things that we see that are affecting us today. Thank you.

MS. RAGAZZI: Thank you.

Lisa Sundberry followed by Andrew Bocarowski followed by Christian Richer.

LISA SUNDBERG: Hi. My name is Lisa Sundberg.

MS. RAGAZZI: Spell your name.

LISA SUNDBERG: S-u-n-d-b-e-r-g.

I am a tribal member of the Trinidad Rancheria and I was raised on the Trinidad Rancheria. I'm Yurok.

I'm no other type of Indian, I'm just Yurok, and I was raised on the Yurok reservation and the Rancheria -- I spent my life growing up in both places -- and so I'm a descendant of villages Churey, which is Trinidad, as well as Big Lagoon and villages up and down the Klamath River as well. Yurok people are river and coastal Indians, and my rancheria is a coastal Yurok community predominantly and/or organized under the Hoopa, the 1906 Rancheria Act.

Our family -- I wanted to say also, you don't stop becoming a Yurok because you're from a different tribal organization, so we continue to practice our ceremonies, and so before the Yurok Tribe was organized, under the Hoopa/Yurok Settlement Act, which I won't get into all that, but anyway, before the Yurok Tribe was organized, my mom was a chairman of the Trinidad Rancheria for 28 years, and as a community activist, even when I was young, we stood in the gap where we could to support Yurok rights, even though there was no tribal government there at that time, and so some of the things that we worked on was protecting the salmon and the water wherever we could, because we're a government and it's always that government-to-government relationship that's so important, that gives people voices, but I'm glad to be here as an individual today talking to you about this and that we have a voice as individuals to be heard.

So I also worked on things like protecting traditional ways of the Yurok practices when it was tribe-based at that time, and we hosted some of the first discussions between the Native Americans and the commercial and sport fishermen to come together as a common body of people who are interested in the fisheries just in general and not continue to fight, because we didn't have anything to fight over if there's no fish, and so we do host the ceremonies at Sumig and so our ceremonies are being affected by these low runs as well.

Last year salmon festival and our ceremonies were affected by the fact there was no -- a low salmon run, and I echo the comments made earlier by the Yurok tribal councilman about the fact that, you know, you can't swim in the river and, you know, the social impacts.

There's other things that contributed to the low salmon runs besides, and it's the timber practices. The incremental things that happened to our land from the gold rush to the timber rush, the dams, all these things to undo.

I can only remember the stories of hearing that the salmon were so thick in the runs that you could walk across their backs. That's how plentiful they were when they came up the river. In my lifetime, I have not seen that because of these practices that have gone along.

They have affected that.

I hope that my grandchildren will be able to see those backs so plentiful again that they'll be able to walk across them, and I support the removal of the dams and to do it timely.

MS. RAGAZZI: Andrew, Christian, Jenna Bader.

ANDREW ORAHOSKE: Good evening. My name is Andrew Orahoske, O-r-a-h-o-s-k-e. Thank you for coming up to the North Coast to listen to everyone this evening, and I hope you come back, perhaps next time, to the Klamath River, the mouth of the Klamath, for some future meetings.

I've been living in the region for about 15 years and worked as a biologist, a conservationist, and more recently, in outdoor recreation as a river guide, and it's in that capacity I'm really excited about prospects on the Klamath River. Soon I'll be able to float from Oregon to the ocean on the Klamath. I'm really excited by that. I'd like to thank everyone for giving me that opportunity and to believe able to share it with others.

I've got four things to share specifically with you about this project. The first thing, the project area, I notice that the Trinity River, the South Fork Klamath River, is looks like it's outside of the project area, and I think in basically every decision on the Klamath River, the Trinity River and it's vantagement,

because a lot of that water is taken out of basin, as you know, to meet water quality standards on the Sacramento River, I think as this project moves forward, it's going to be really important for the State of California to better manage the Trinity River so that the Klamath River is not left short, as it has been.

The second thing is the duties of the State Water Board 401 certification on the Clean Water Act, and many view that as a very narrow responsibility, so narrow that it's been delayed for over a decade. It's primarily a federal process that we're understanding this entire dam removal process to be, and it may get more complicated, which relates to the second.

We've been very fortunate over the last eight years to have a relatively non-hostile federal agency administration that has helped the river out to a certain extent, and we haven't faced a hostile administration on the Klamath River, openly hostile. The last time that happened, tens of thousands of fish perished in one event, so that's something to look at going forward as well, because regardless of what these federal agencies may be doing in the next several years, the State of California has a duty under The Clean Water Act and 401 certification, but also under the Public Trust Doctrine, to rescue the Klamath River, to rescue the people that

depend on the Klamath River.

So please remember that regardless of what we may see ahead at a federal level that California needs to step up, and California can be in the driver's seat and see this process through and it can be successful. Thank you.

MS. RAGAZZI: Thank you.

So Christian Richer. Okay, that's the second time.

Jenna Bader, Sammy Genshaw III followed by Colin William Kerosky.

JENNA BADER: My name is Jenna Bader, J-e-n-n-a B-a-d-e-r. I'm just here as a citizen in support of undamming the Klamath River. I'm also an environmental science energy and climate graduate from HSU and I work as a certified energy analyst.

I have a few points to say. I'm really just echoing what people have said very well tonight. One is that dams are kind of a old creation. We're born into this system, but we don't necessarily have to abide by it. Dams were created with a very narrow framework that doesn't take into account the fact that we need water for other purposes, like our survival. With our climate being threatened, drought, all these things just mean we need to act quickly with the Klamath River.

The Klamath River is a life source for local tribes who rely on the river for clean water, rely on it for healthy salmon, for cultural purposes. The river also carries critical nutrients and minerals downstream. Dams are basically halting that stream. Dams completely interrupt the health of the entire watershed, and it's said best by Dr. Amana Shiva in a documentary called "Blue Gold". She explains it the rivers are like our veins distributing vital nutrients through our system. The dams are liked clogged arteries. They're choking us and choking our planet.

I want to mention not to forget about the devastating fish die-off that happened in 2002. Just reminding you we need to act quickly. And the Klamath also faces terrifying consequences with companies trying to build pipelines below it. Just worth a mention that there are many threats to the Klamath River, mainly caused by humans, so we need to act quickly to let the Klamath flow freely and get it back to its natural cycle. Thank you.

MS. RAGAZZI: Thank you.

SAMMY GENSAW III: Aiy yu kwee. Nek now Sammy Gensaw. I come from the village of Requa and have grown up in these type of meetings. I now understand the words of Chief Seattle from Washington and Rocks Baugh of Requa.

Creator may have brought your ancestors across this ocean so we could teach you, but the original American settlers did not have the patience for our knowledge. The original American settlers only had one thing on their mind, and they were willing to do anything to get it, including abandoning the base of their own religion, twisting the words of peace from their prophets, using the Bible as a weapon of genocide in this position. May you be the leaders of your generations to listen to the scientists of modern man who study the earth, as my people once did years ago.

Eighty percent of original indigenous California has been exterminated. They are still with us. They will always be my people. As an American, I feel the pain of your ancestors. Sorry. As an American, I feel the pain of your ancestors because they are now my ancestors as well. We may differ in many ways, but the shames and benefits of a colonized America are shared. Fortunately, my surviving ancestors had the patience to not only learn the American way of life, but build up the foundation indigenous societies stand on today. Fortunately, my people left the banks of the river to learn English language so your ancestors will no longer treat us as savage beasts, but instead listen to us as fellow Americans.

Living on the reservation, I see the stress of historical trauma on a daily basis. Although I strive to live a good life, every day is a struggle. My whole existence has been among these rivers as a fisherman, but now there are not enough salmon, not even for each of my people to have one fish.

My first boat had been burned and carved from the ancient wood of my peoples, but I cannot do the same for my nephews because most of our forests I cannot go. My favorite memories were formed deep within the Redwood forests or at the mouth of the Klamath River where my parents raised me. These are the same places I will spend the rest of my life.

I was brought up in a world of tradition values surrounded by the love and pain that come with being indigenous. Many people in this room have guided every step of my growth and support the work I do now.

Family lore states as a man of the river, when the river is sick, I am also sick. When a family member is sick, we do not leave them. We help them get better, and that's what I'm asking you to do is to help us be able to help our family make themselves better, because we have people coming back to our homeland, but we cannot support them without a healthy, thriving river, so I ask you guys, please, help make our rivers great again. Thank you.

MS. RAGAZZI: Colin William -- I think it's Kerosky followed by Jon-Luke Gensaw and Joe James.

COLIN WILLIAM KEROSKY: Colin William Kerosky, C-o-l-i-n W-i-l-l-i-a-m K-e-r-o-s-k-y.

I'd like to thank you all for bringing everybody together once again. I am a resident of Phoenix, Oregon. I've been watching this process very closely, and it's very inspirational to see such a large community support something that seems so obviously scientifically beneficial. We appreciate all the work you've been doing for these water quality committees, and I'd like to recommend that you expedite them and really be part of this process in Oregon.

On a final note, the last time I was down here, I was a young man and my mother had been working with the conservation movement. Sneaking off from their cricket game, I found an old man along the river. He was watching the salmon run which was the first one I had seen in my life. I didn't notice until I almost left that he was crying, and part of it was because he had seen me watching it and this was something he thought future generations would not be able to enjoy to the level the tribes had.

Even though it's not directly related to this permitting process, I'd like to urge you to expedite the removal of these dams so people have the right to enjoy

the salmon as well as I did for a short period. Thank you.

MS. RAGAZZI: Thank you.

JON-LUKE GENSAW: Aiy yu kwee. Nek now Jon Gensaw. I come from Requa, my village at the mouth of the Klamath. I personally know that the river is important -- let me start from the top.

I come tonight from Klamath. My ancestors lived along the banks since the world was created. I speak for them when I say the river is my mother, just as important as my biological. Although I never had too much, the river had moments in life. That's all I have every had. I come from a big family with six relatives -- two brothers, two sisters, and the river.

I may not be the most educated on the science of the river, but I do know that the river is very sick. I hear stories of the quality and the death of quantity, purity. My traditions are carried word-of-mouth, and when the river dies, so does my traditions and my religion and my spirit. I know that the knowledge is deep as my roots for this land.

I may not be the best public speaker, but I feel like this is very important. I personally know that the river is important to everybody, not just indigenous. Water is life, life is energy and currents and is what you

make it, and at the end of the day, being indigenous is a mind-set. Thank you.

MS. RAGAZZI: Joe James, followed by Mary Ann Murphy followed by Cena M-a-m, I think.

JOE JAMES: Good evening. My name is Joe James, J-o-e J-a-m-e-s. I'm a Yurok tribal member, Yurok tribal council member. I'm from the village of Srey-gon up there on the Klamath River, just upriver from the stream of Pek-won.

I wanted to comment that, from the tribal leadership, we fully support the removal of the dams, but also, too, I wanted to talk on the record, talk to the importance of the impacts on our culture it has for us.

As a couple of my young brothers have mentioned, lack of salmon this last year, there was more tribal members than we had fish to give out. That was a real huge impact on us. We rely on our salmon for our way of life. We are traditional people. We are hunters, we are gatherers, we are fisherman. We are strong Indian people that rely directly on the salmon that provides for us, and at the same time -- we mentioned respectfulness -- we respect the river and Mother Earth that has provided for us. But getting back to that culture component of it, this year it was really disheartening to provide not just our elders -- we were taught to give the fish to our

elders, our community members, during our ceremonies, and when we don't have that, that makes it really tough on the challenge. It doesn't stop the way we are, but it makes things more difficult, and it's a huge, huge red flag, not just this year, but has been for the last four, five-plus years, so I wanted to comment on that, on the cultural side of it.

And just a little bit, too, on the economic side of it, too, we have felt the impacts from an economic side that the lack of salmon, the lack of sports fishermen, the lack of business to our enterprises that have impacted to our business there in Klamath.

I also wanted to let the people know that Yurok Tribe has been on point and has been a lead, but at the same time, we couldn't have done it by ourselves, and we thank everybody that we continue to work with, our partners, our tribes, our local fisherman, people here on the North Coast, and again, we want to look forward to partnering, collaborating, and working with people in removing the dams and strongly consider using the existing resources to expedite. The Yurok would say "heemerks'ers", hurry up. Like I said, please utilize the existing resources so we break the dams down. Thank you for your time.

MS. RAGAZZI: Thank you. Mary Ann Murphy,

followed by Cena, followed by Lena Belle Gensaw.

CENA MARINO: My name is Cena Marino C-e-n-a M-a-r-i-n-o, and what I'd like to say tonight is the Indian people are awaiting us, as they have on the Dakota Access Project. They're closer to Mother Nature and closer to Mother Earth and we need to listen to them, but for all of us who are concerned with our environmental health, we have to stand together. We have to come out again and again, no matter whether it's the main focus of our concern or not. We have to get together because we have an administration and a cabinet that is not going to support us at all, so we have to work from the grassroots. We have to write letters. We have to make calls. We have to sign petitions whenever we can to get behind each other and to show support for the things we need, to save our planet, to save our earth.

It's getting close to the tipping point in a lot of areas, and we see it in the fish, we see it in other species, and we are a species that are at the top and can go down with the rest of them, and that's about all I wanted to say is we really need to stick together. Thank you guys for listening to us.

MS. RAGAZZI: Thank you.

Lena Belle Crenshaw followed by Dara Alexander.

At this point I'm going to -- Dara's the last

one I have here, so if there's any other speaker cards out there and you haven't heard your name called, let Christian know.

LENA BELLE GENSAW: Aiy yu kwee. Nek now Lena Belle Gensaw. I come here tonight to represent my people from the Yurok Tribe and the people from our lands. I have two young sons and I come here tonight to be able to ask you guys to further the dam removal so that they may have a plentiful future, so they can grow and learn our culture and be part of the land we live upon.

A Creator blessed us so we were able to live on the Earth, to live and not to damage the Earth and doing such things that put us in harm's way. I ask that you guys keep an open mind to be able to do what you can to represent the dam removal. Thank you.

MS. RAGAZZI: Thank you. Dara Alexander.

DARA ALEXANDER: Hello. I'm very nervous. I don't usually speak in front of people.

I just want to say I started coming to the Klamath River just on accident 10 or 15 years ago, and it's just an amazing river and I love the people that live on the river, even though I don't know them personally, and I can just -- I can't imagine how beautiful it once was because before it was dirty, became dirty.

I just want to say that I believe there are four

forces of unification that unify people. There may be more than four, but the ones I know of are the water, the forest, the fire, and the vibration, the rhythm, and the water helps, and the moons, all that help with the river.

I believe there's a rhythm to life and the rivers help, and I just believe that a part of the reason why there's war, in part, is because when the water is dirty and people cannot play in the water and they cannot unite in the water and cleanse and heal in the water, where once in summertime the water is like a main magnet and focus to cool off in, you know, that unify people and cleanse people and heal people so that they can be ready and cleaned out and ready to start the winter, and now we cannot go through this cycle. There is no cycle for this, and the native people cannot go through this so they can help heal the Earth, and to me, the indigenous people are like the old growths of the world and so we need to help them. We need to help them. They're trying to help the Earth, and we need to help them. We need to take down these dams and let the river flourish and flow and clean out and -- and so that we can all have more healing and there will be less distraction toward doing other things that are negative, that cause harm and war and violence and competition and just more unity.

So I hope we can help to -- to support the

people that are the keepers of -- the Earth keepers and that keep the rivers and to keep the sacred ceremonies and healing places and places for playing and flourishing in eternal life of planet Earth. Thank you.

MS. RAGAZZI: Thank you. And Thomas Joseph.

THOMAS JOSEPH: Good evening. I was late and so I apologize. Are you guys board members or representatives of the board?

MS. RAGAZZI: So we're staff.

THOMAS JOSEPH: Staff.

MS. RAGAZZI: Staff of the Board.

THOMAS JOSEPH: Okay, so you're taking this message to the board then.

I think most important message that I heard tonight, you know, there's a lot of science, and we all know that the science is correct and right for the removal of the dams. It is going to benefit the waters of California. When you go to Yreka, you'll have some scientists up there, but we have real scientists that have dedicated their lives, have worked hard, have proven this, that dam removal will be beneficial for not only the Klamath Basin, but for the waters of all California.

I want you guys to know that's here, that's going to take this message, that the most valuable message to take to the Board is the responsibility to protect and

honor indigenous rights and the tribes that have been living in this basin for thousands and thousands of years, and if you don't really, truly feel that or understand that, then you're not really able to take our message to that board.

You really have to believe the stories that these people have told are deeply rooted in the blood and the DNA that flows through them for thousands of years, and as representatives of the board that are supposed to look after the best interests of California water, it is your obligation and duty to deliver that message in a powerful way and so you may have to excuse yourself sometime in your personal life to really contemplate and understand what that means, to really dig deep and find the connection that you have with your Creator, that you have with your higher power or whatever you may look to spiritually to understand that the importance of this dam removal is in your hands quite a bit and that you really need to persuade those decision-makers to let them know with all your might, with your all your ability, with all the moves that you may carry that these dams need to come down, not because scientists say that it's correct and right, but because you dug deep within yourselves and found out and know that that's what's best for the State of California, that's what is best for California water.

And you're going to receive the same message and the same answers that we all receive, that all these scientists have done for a long time, for decades. You're going to receive a message we all say as indigenous people that have grown up here for thousands of years, that these dams need to come down, but how are you going to be able to deliver that message in a way that is going to move them emotionally for them to do their job in a respectful, honorable manner to protect the waters of California? That's a tricky task, and I applaud you if you do take these words seriously and dig deep and real that you may be able to deliver the message of these people here in a powerful way for the decision-makers for them to make the right decision. I mean, jeez, how many hearings have we been to? Your faces actually look familiar some of you.

So continue, continue, but really this is the responsibility of all of us living in this basin and it's the responsibility of your guys' job and task to deliver our message in a powerful way, in a spiritual way, in a meaningful way, that these dams can come down, that you are standing on the right side of history and that you are doing your obligation to protect all California water. Thank you.

MS. RAGAZZI: Thank you.

Okay, so if you weren't counting, that was 35

commenters that we got to hear from tonight, but I do want to say if there's anyone who felt like they didn't get enough time to make a comment, they can come up now, and if there's anyone who didn't put in a speaker card but would like to make a comment, now would be a good time as well.

Okay, I want to thank everyone for coming tonight. Again, written comments are due by 5:00 p.m. on February 1st. Thank you all for coming in tonight.

(Whereupon, the hearing concluded at 7:01 p.m.)

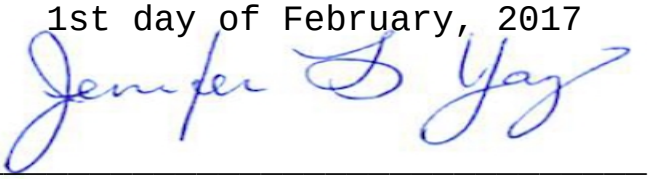
STATE OF CALIFORNIA)

COUNTY OF HUMBOLDT)

I, the undersigned, hereby certify that the foregoing hearing was taken in shorthand by me, a Certified Shorthand Reporter, at the time and place therein stated and that the testimony was thereafter reduced, by computer, to typewriting under my direction and supervision.

I further certify that I am not of counsel or attorney for either or any of the parties in the foregoing hearing and caption named, nor in any way interested in the event or outcome of this cause and that I am not related to any of the parties thereto.

IN WITNESS WHEREOF, I have hereunto set my hand this 1st day of February, 2017



Jennifer L. Yang, CSR No. 12367

Good evening. My name is Clayton Creager and I am an Environmental Program Manager for the North Coast Regional Water Quality Control Board. I am here today to speak on behalf of our agency on the State Water Board's *Notice of Preparation of an Environmental Impact Report for the Lower Klamath Project* and to express our support for the Facilities Removal alternative that will lead to the decommissioning of the four lower-Klamath dams.

- The North Coast Water Board is employing a comprehensive basin-wide (above and below the Klamath dams) recovery strategy to restore water quality throughout the Klamath Basin. We are working collaboratively with many organizations, Tribes, and private landowners. We consider the entire Klamath River Basin to be one single, integrated watershed ecosystem composed of many diverse sub-basins. To facilitate this strategy we have developed the Klamath Basin Monitoring Program and the Klamath Tracking and Accounting Program to coordinate recovery actions and monitoring across the basin.

- The ongoing restoration actions and TMDL implementation efforts to restore the Klamath River cannot reach their full potential without also addressing the water quality limiting factors created by the four dams identified in the *Lower Klamath Project*. This understanding is widely accepted in the scientific community, as noted in Interior Secretary Jewell's summary of the Klamath Secretarial Determination Findings[1], which makes the selection of the Facilities Removal alternative a clearly preferred choice.

- The North Coast Water Board accepts that the Facilities Removal scenario is undoubtedly going to result in temporary downstream impacts that may be unavoidable. The procedures for evaluating and authorizing these temporary impacts from restoration projects, which at times can degrade water quality and cause temporary exceedances of water quality objectives, are detailed in the Regional Water Board's *Policy in Support of Restoration in the North Coast Region* (Restoration Policy) which was approved by the SWRCB and the Office of Administrative Law.

- The North Coast Water Board stands solidly behind the Facilities Removal alternative and believes that it is necessary to *restore* and maintain the chemical, physical, and biological integrity of the Klamath River.

[1]Letter from Interior Secretary Sally Jewell to Kimberly D. Bose (Secretary) Federal Energy Regulatory Commission (October 17, 2016) summarizing the findings of the Secretarial Determination supporting the applications submitted by PacifiCorp and the Klamath River Renewal Corporation on September 23, 2016, urging the Federal Energy Regulatory Commission (Commission) to approve these applications for dam removal as a critical step toward resolving the significant water-related issues in the Klamath Basin.

~~Good evening madam chair and members of the board.~~ I am John Driscoll, district representative for Congressman Jared Huffman. Thank you for taking the time to come to ~~Eureka~~ Arcata to hear the concerns of the congressman's constituents about the Klamath River.

The permit you are considering is of great interest to the congressman and to tribes, fishermen and communities up and down the West Coast. It's a key piece in the effort to remove the four dams on the Klamath to rebuild salmon runs and make the river healthy.

We have known for a long time that the reservoirs behind the four dams severely compromise water quality by heating up water and causing algae blooms. This has had disastrous effects on the Klamath River's important fisheries, to recreational uses of the river, and to ceremonial uses by the tribes that hold the river sacred.

As you know, the 2012 state and federal environmental study on this issue detailed these impacts. Studies since then have added more scientific weight to the joint EIR/EIS conclusions. Congressman Huffman asks that the findings of that joint study be rolled into the new state environmental study under consideration. He also asks that the expected long-term benefits of removing the Klamath's four dams be weighed carefully and thoroughly along with the possibility of short-term effects. It is especially important to take the long view, in which a restored river can rebuild itself.

Congressman Huffman asks that your board issue a water quality certification for dam removal that so many have worked to achieve for so long. The timely issuance of the certificate is imperative to allow the Federal Energy Regulatory Commission to authorize dam removal this year. Please give the water quality certification your full and fair consideration.

Congressman Huffman thanks your board for its long participation in Klamath River issues. Congressman Huffman asks you to take one more step, to help tear down these dams.

Scoping Meeting for an Environmental Impact Report for the Lower Klamath Project License Surrender

CalEPA Building, Byron Sheet Auditorium – 1001 I Street, Sacramento, CA

January 20, 2017 (10:00 am – 12:00 pm)

Sign-In Sheet

Sign-in Sheet for Scoping Meeting for an Environmental Impact Report for the Lower Klamath Project License Surrender

Location: Cal/EPA Building, Byron Sher Auditorium - 1001 I Street, SACRAMENTO		
Date and Time: January 20, 2017 10:00 a.m. to 12:00 p.m.		
Name	**Organization**	**Contact Information**
Parker Thaler	State Water Resources Control Board	parker.thaler@waterboards.ca.gov
Jonathan McClelland	KRK	jonsonario@comcast.net
Timothy Ryan	US National Wildlife Research Center	tryanlve alumni.nd.edu
BRIAN MOSS	CNRA	—
Peter Olaszowski	KRRC	Peter@klamathrenewal.org
James Frolich	Hallmark Group	james.frolich@gmail.com
Steve Edmondson	NOAA	steve.

Speaker Cards and Written Comments

(1)

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: Ed Nute

EMAIL (if desired): e.nute@nute-engr.com

ORGANIZATION (if applicable): N/A

REMARKS: Would like to speak

LOCATION (circle one): ARCATA SACRAMENTO YREKA

(2)

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: Jonathan McClelland

EMAIL (if desired): jonsonario@comcast.net

ORGANIZATION (if applicable): Klamath River Keeper, Mid Klamath Watershed Council

REMARKS: I volunteer with both these orgs. I do not officially represent them

LOCATION (circle one): ARCATA (SACRAMENTO) YREKA

3

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: Brian Johnson

EMAIL (if desired):

ORGANIZATION (if applicable): Trout Unlimited

REMARKS: Use the existing CEQA doc.

LOCATION (circle one): ARCATA SACRAMENTO YREKA

4

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: W. Glover

EMAIL (if desired): william.d.glover@gmail.com

ORGANIZATION (if applicable):

REMARKS:

LOCATION (circle one): ARCATA (SACRAMENTO) YREKA

5

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: Allie Hostler

EMAIL (if desired): allie.riseup@gmail.com

ORGANIZATION (if applicable):

REMARKS:

LOCATION (circle one): ARCATA (SACRAMENTO) YREKA

ATTEN: Federal Energy Regulatory Commission

Subject: Jan.20th scooping meeting in Sacramento comments
From: Alan <alan@andersenjewelry.com>
Date: 1/20/2017 12:28 PM
To: wr401program@waterboards.ca.gov, parker.thaler@waterboards.ca.gov., Robert Davis <viking3135@hotmail.com>

I went to the webanar @ HTTP://video.calepa.ca.gov/ and watched it until you closed down the meeting unexpectedly at 10:42 after just a few comments were heard. I spent the time to be able to comment myself but could not since you did not provide me with a phone number so I could of call live and made my comments and you could of put me on speaker phone for the few people that showed up and the board to hear. You did not provide me with that oppertunity. All I have is this e-mail letter that I send with an attachment of the letter I have sent so it will be placed on the public record for today at that meeting.

I was surprised that you also at the very end changed the date for public comment about saving the dams in the upper and lower Klamath river Basin from Feb. 5th 2017 to Feb.1st . You didn't have enough people there to be able to vote that in. You canceled the Yreka meeting where most of the areas voters voted 78% to keep the dams in and not to remove Hydro Electric- clean energy Dam at Copco lake or Iron gate Dam. That meeting was the most important meeting since you would of had standing room only turn out against Dam removal. What is your hidden agenda to have a meeting in Sacramento where most are not even affected by what goes on in the Klamath river basin?? You need to hold a meeting In Yreka, CA and allow enough time on a agreed to time that way people who are affected by your proposed actions and attemp to go forward with Dam removal will have a chance to further comment . Not in a middle of a work day. You need to contact everyone who will be affected to come to the meeting and not just running a tiny ad in a newspaper. A well informed letter and contact for a front page news article - emails and other announcements to give fair chance for the residents to partisapate and come to the meeting. Again I am requesting you record this e-mail letter I am sending you as if I was at your meeting but not allowed to comment or talk since you did not have that available or post a phone number for all to see who watched the webenar; except what I have done by writing you this letter and read and post on record the attached 3 page letter from Alan R. Andersen and Rebecca Davis - property owners at Copco lake.

P.S. The only way I even heard about the canceled meeting up in Yreka or the webanar that started today Jan.20th , 2017 (right in the middle of the new President oath of office.) was from a relative who also lives at the Copco Lake.

-------- Forwarded Message --------
Subject: About the Copco Lake Dam Removal Oct. 2016
Date:

3 page letter Enclosed

20170124-0060 FERC PDF (Unofficial) 01/24/2017

Talking Waters

Siskiyou County Water Users Association

"SAVE THE DAMS SAVE THE SALMON"

347 North Main Street, Yreka CA 96097

Issue 7 ***Bob Rice Man of the Year 2016*** **Winter 2016**

Officers: President: Richard Marshall richard@marshall-ranch.com 468-4204 ; **Treasurer/Secretary** Kathy Bergeron bergeron@inreach.com 459-5266 **Board Members:** Rex Cozzalio, Jerry Bacigalupi, Louise Gliatto, Sam Jackson, Richard Marshall, Kathy Bergeron, Charlie Blackburn **Oregon**: Joe Watkins, Dennis Linthicum

Consultants: Bob Rice, George Webb **Emeritus:** Leo Bergeron and Mark Baird

The Board of Directors and its officers serve as volunteers with no remuneration.

MAJOR ISSUES

I. **FERC**—Recently the States of Oregon and California entered into an Agreement in Principle to destroy the Klamath Facilities. The above referred to agreement in principle was also signed by two federal agencies, Sally Jewell, Secretary of the Interior and Kathy Sullivan, Secretary of Commerce for NOAA. This despite the fact that the Congress over the past many years made it clear that they weren't in favor of removing the dams. The agreement spells out that despite the adverse impacts of dam removal they want to proceed by pursuing the transfer of the Hydro-facilities to a Dam Removal Entity located in New York City. This requires the approval of the Federal Energy Resource Commission (FERC).

The spotlight has shifted to the FERC process whose commissioners are appointed by the President. PacifiCorp filed a Petition with the commission to simultaneously transfer the dams and license to the Klamath River Renewal Corp (KRRC) and also filed with the CPUC (Public Utilities Commission) to transfer the trust assets (surcharge) funds of approx. $200 Million plus another $250 Million from the California Prop 1 (water bond funds) to the KRRC a newly formed non profit 501 c3 California Corporation instituted for the express purpose of taking over and destroying the four hydro electric facilities, thereby removing carbon free, clean energy production facilities, flood control, and water storage, and fish hatchery facility, to presumably raise the production of Salmon for the Pacific Coast Fisherman.

The PacifiCorp organization has no regard for the ratepayers or the County of Siskiyou or Klamath County or others who have all indicated in local voting that they are adamantly opposed to the removal of these dams. Warren Buffet owner of the PacifiCorp facilities has substantial financial interests in Mid West energy which will benefit by the removal of the Klamath Dams. The potential damage that could occur would **result in the**

agencies and NGO groups, tribes etc of liability for what could be an ecological disaster of enormous consequences.

The County Board of Supervisors on behalf of the County have also filed objections with the FERC on the dam removal process. This has been filed by the law firm of Nossaman et al a nationwide legal firm with offices in Washington DC.

A recent conversation with officials at FERC indicate that PacifiCorp may have been caught off guard by opponents by their filing incomplete documents. They have asked for additional time suggesting to the FERC that they will refile next year and asking that comments be held in abeyance until after March 2017. They still have before the CPUC a request to approve the process and agree to release the Trust Funds to KRRC.

II. **CPUC** — As mentioned earlier the CPUC has been Petitioned by PacifiCorp to accept the amended KHSA agreement which authorizes the formation of the KRRC and allows the transfer of the facilities and the Trust Funds to KRRC. They have been joined by the DOI and the Secretary of Commerce and California Dept. of Natural Resources in pushing the CPUC to accept the Petition. Meanwhile both the Siskiyou Water Users and the County of Siskiyou County Counsel have independently submitted challenges to the CPUC requesting a full hearing and analysis of the proposed transfer. PacifiCorp has suggested that the CPUC approve their request out of hand suggesting that in fact this was "only a ministerial action" and didn't deserve a full hearing process. At this time the Administrative Law Judge, an employee of the

WWW.WATERBOARDS.CA.GOV HTTPS://VIDEO.CALEPA.CA.GOV/
MR. PARKER T13

Talking Waters, Siskiyou County Water Users Assoc.

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WATERBOARDS.CA.GOV

river not to mention the amount of debris left in the river as a result. The Elwha was many hundreds of times smaller in size and the concomitant release of sediments and debris into the water.

The destruction of the Klamath Dams will be the largest dam removal project in the history of the United States yet the project has not yet received the proper EIR study of the seven reaches of the River. Because of this evident effort to not look at the full amount of damage that will result, we at SCWUA remind everyone that this is not about the fish or the water; ***this is about politics and money***.

IV. **COPCO** — Siskiyou County Citizens living in and around the COPCO Lake area have been affected by the proposed removal of Klamath Dams for some time but recently this came to a head with the letter sent to many of them by KRRC regarding the taking of a portion of their property rights namely their view and resultant substantial loss of property value. Many of these citizens have a substantial part of their retirement funds tied up in the properties. SCWUA conducted a meeting in COPCO with the support of the community association to review the letter from KRRC and share information regarding the inappropriate if not unlawful letter from KRRC. KRRC has no status at this point as the FERC has not reviewed and or agreed to put KRRC in the position of taking over from PacifiCorp who remains to this date the party in the chain of title of the dams and who is liable for any and all damages resulting from the removal of the hydro facilities.

It was recommended that the association on behalf of the group retain the services of a qualified attorney to file an inverse condemnation and damage suit against KRRC and PacifiCorp for their part in damaging the property values of the COPCO citizens without compensation being offered.

Many of those present also signed the class action Petition regarding the collusion of PacifiCorp and CPUC to deprive them of their property without compensation and charge them a surcharge for dam removal which is against their will.

Court Reporter Transcript

STATE WATER RESOURCES CONTROL BOARD

LOWER KLAMATH PROJECT LICENSE SURRENDER

CERTIFIED COPY

PUBLIC HEARING

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

BYRON SHER AUDITORIUM

1001 I STREET

SACRAMENTO, CALIFORNIA

FRIDAY, JANUARY 20, 2017

10:05 A.M.

KATHRYN S. SWANK, CSR, RPR, NO. 13061

APPEARANCES

CAL/EPA STAFF:

Parker Thaler

Erin Ragazzi

PUBLIC SPEAKERS:

William Glover

Allie Hostler

Brian Johnson

Jonathan McClellan

Edward Nute

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PROCEEDINGS

MS. REGAZZI: Good morning. And welcome to the second of three scoping meetings that the State Water Board is holding for the Lower Klamath Project in order to form the development of an environmental document for the application the State Water Board has before it for water quality certification.

I'm Erin Regazzi with the State Water Resources Control Board. I work in the Division of Water Rights, and I'm joined here today by some other state water board folks -- Parker Thayer works in the Water Quality Certification Program. He's going to be providing a presentation a little bit later today.

I'm also joined today by Alan Luca. He's going to be manning the computer because this is being broadcast today, so folks are able to listen in and hear the presentation, and if folks want to, they can also e-mail us their comments or questions. We'll be taking some procedural questions.

And then Marianna Aue is also with the State Water Board. She's in the Office of Chief Counsel.

And everyone should have signed in downstairs. If you didn't sign in downstairs, please be sure to sign, and in the back of the room, just so we know how many folks came today.

We're also joined today by our consultant, Maia Singer and Lauren McClure. They are both with Stillwater Sciences.

And our court reporter today is Kathy Swank. So Kathy is going to be transcribing the meeting so that we have a record of it. So that transcript will be posted to the Web once we get it back, following the meeting.

A little bit about general logistics here at the Cal/EPA building. So should there be an emergency -- alarms start flashing, that type of thing -- that means that we should gather our items and leave out the nearest exit door, go down the stairs, and we'll reconvene at Cesar Chavez Park. Hopefully it won't be raining at that time, if that were to occur. If you hang out with us, then you'll know when we get the "all clear" sign and we can all come back in and proceed with the meeting. Again, hopefully that does not happen.

If you need to use the facilities, restroom, out the door and to your left and then to your right; you can get to restroom facilities.

And everyone should be -- have a handout. There's a scoping meeting information sheet in the back of the room for folks that want to grab one. It has

some very general information. The key things I want to point out on it is, it has the Web page for the Lower Klamath Project. So if you want additional information after you leave here today, you can get that on the Lower Klamath Web page. The presentation is posted there.

Additionally, it says how to sign up for our e-mail subscription list. So if you want to receive e-mails, notifying you about things related to the Lower Klamath Project, follow the instructions there.

And then on the back, there's a nice map of the Lower Klamath Project area.

So this meeting is being broadcast today. So it is important to make sure everybody speaks into the microphones so that folks that are online can hear us. A little procedurally, we're going to have folks step up to that microphone right over there if they want to make any public comments later today.

And the purpose of today's meeting is really to provide information, but, more importantly, to solicit input and comments from folks about the water quality -- the environmental document we're preparing for the water quality certification related to the Lower Klamath Project.

And with that, I'm going to get into a couple

quick updates. So originally, the Yreka scoping meeting was scheduled to take place on January 10th. Unfortunately, we had to cancel it due to bad weather. But we were fortunate to be able to reschedule it for January 26th. So if you know folks in that area, and they are interested in the project, please be sure to pass on the information that we're having: The Yreka scoping meeting next Thursday, January 26th, at the Miner's Inn from 5:00 to 7:00 p.m. We did update the Notice of Preparation with that location change and date change, and that's also posted on the Lower Klamath Project Web page.

So a little bit about what we're going to be doing here today. Going to go through a little bit of the logistics and ground rules. Parker is going to provide a presentation that provides some background about the Lower Klamath Project. Then we'll have an opportunity for any procedural questions, but, like I said, we're really here to solicit comments, so we're going to open it up for public comments at that point in time. And then the meeting is scheduled to conclude by noon.

So hopefully folks have signed in, in the back of the room. If you wish to speak, please fill out a speaker card. That lets us know how many folks do want

to speak today. At any point in time you decide you want to speak, go grab a speaker card, fill it out, and then you can hand it to Lauren or any of us up here.

And so that Kathy can accurately get your name, please, when you come up, state your name, first and last name, and spell your first and last name for her, so she can get it in the record properly.

I will do my best to pronounce folks' names properly as well.

So at this time, I'm going to ask that everybody silence their electronic devices. So if you have got those, take them out, do a quick scan, make sure they are in the off position.

Some other general ground rules: We want to make sure that we respect all speakers and all points of views. Only one person speaks at a time. That's really important in any meeting, but especially important in this meeting because it's being broadcast, and we want to make sure that folks that are listening online get to hear what folks have to say.

I'm going to ask that folks hold any questions or comments until the end of the presentation. And again, we'll have that brief opportunity for any procedural questions, and then we'll really be getting into the comment period.

I think we'll have plenty of time for commenters today, given the number of folks we have here today, but when we have a lot of folks, we do have to limit comment time. So I anticipate we won't have to do that in this case today.

Written comments are an alternative to providing oral comments, so if you want to provide additional comments after you leave here today, or if folks didn't get enough time to provide their comments today, they are welcome to send them in.

And with that, I'm going to turn it over to Parker so that he can provide a presentation and more context to why we're here today.

MR. THAYER: Thanks, Erin.

So as Erin said, my name is Parker Thayer, and I'm the lead technical staff assigned to the Lower Klamath Project Water Quality Certification Application.

We're here today because the Klamath River Renewal Corporation, or KRRC, submitted a water quality certification application for the Lower Klamath Project. The State Water Board conditions hydroelectric projects via water quality certifications to ensure their protection of state waters.

The California Environmental Quality Act, or CEQA, requires an Environmental Impact Report to inform

the State Water Board and the public about the project's significant environmental effects and ways to reduce those impacts.

So today, I will be providing an overview of the Lower Klamath Project Dam Development; background on the Lower Klamath Project progress through the Federal Energy Regulatory Commission, or FERC, relicensing process; and a description about the link from the Lower Klamath Project to the Klamath Hydroelectric Project; as well as an overview of the CEQA process; and a discussion of our Notice of Preparation that was filed on December 22nd of 2016.

So shown in this slide is a map illustrating the general locations of the Lower Klamath Project dam development. For the purpose of easy viewing, I've put blue dots on top of the Lower Klamath Project dam development and a red line to delineate the border between California and Oregon. Other than that, this is the same figure that's located on the front page of the Notice of Preparation, and on the back page of the fact sheet, which is located at the back of the room.

The Lower Klamath Project is located along the Klamath River in Siskiyou County, California, and in Klamath County, Oregon. The Lower Klamath Project facilities include J.C. Boyle, Copco Number 1, Copco

Number 2, and Iron Gate Dam developments. J.C. Boyle is located approximately 16 miles north of the California/Oregon border and a subject of the state of Oregon's water quality certification process, which is a separate action than what we are discussing today.

The Lower Klamath Project Dam development are currently part of PacifiCorp's Klamath hydroelectric project, and those facilities are also included on this figure, and, from upstream to downstream, include East Side and West Side, which are located adjacent to Link River Dam on upper Klamath Lake; Keno and J.C. Boyle, which are both Oregon-based facilities; Copco Number 1, Copco Number 2, and Iron Gate, which are California-based facilities along the main stem of Klamath River; and Fall Creek, which is located on Fall Creek Tributary to the Klamath River. You can see them bold and underlined. I depicted the Lower Klamath Dam developments in relation to the Klamath Hydroelectric Project facilities. And off to the right of each name there is an abbreviation for the state that that facility is located in.

So now that I've provided a general description of the project's locations, I wanted to provide some background information on the Lower Klamath Project and its link to the Klamath Hydroelectric Project.

And that begins in 1956, when the Federal Energy Regulatory Commission, or FERC, issued the original license for the construction and operation of the Lower Klamath Project. And for context, FERC is the federal agency that issues orders to hydroelectric projects for the construction, operation, and decommissioning of those facilities. FERC's orders are often issued with conditions or measures that project operators must implement in order to protect public and environmental resources.

The 1956 FERC license order was issued on a 50-year term that expired in 2006. And because the FERC license expired, the Klamath Hydroelectric Project is required to obtain a new license from FERC, and that license requires a water quality certification, as well as other various state and federal authorizations.

So in 2004, the then and current owner of the Klamath Hydroelectric Project, PacifiCorp, and associated Lower Klamath Dam developments applied to renew the FERC license, and shortly after, in 2006, submitted a water quality certification application for continued operations of the Klamath Hydroelectric Project.

In 2007, FERC completed its National Environmental Policy Act compliance by issuance of a

Final Environmental Impact Statement that analyzed PacifiCorp's proposed project and continued operations as well as various alternatives.

So following FERC's issuance of its Final Environmental Impact Statement, some Klamath Hydroelectric parties began discussions for a settlement agreement that resulted in the formation of the Klamath Hydroelectric Settlement Agreement in February of 2010. The Klamath Hydroelectric Settlement Agreement created a pathway for dam removal of J.C. Boyle, Copco Number 2, Copco Number 1, and Iron Gate, via federal authorization that would have removed these facilities from the FERC process.

And in September of 2012, the Klamath Hydroelectric Settlement agreement and its companion agreement, known as the Klamath Basin Restoration Agreement, resulted in the final Klamath facilities removal, Environmental Impact Statement, and Environmental Impact Report.

Now, before I go any further, I would like to note here that the State Water Board is not a signatory to any of the settlement agreements and that the State Water Board maintains its independent authority to condition the Klamath Hydroelectric Project and the Lower Klamath Project for the protection of water

quality.

And in light of the substantial new information developed since the 2008 Notice of Preparation that the State Water had released to begin its CEQA process, in 2015, the State Water board reinitiated the CEQA process to analyze PacifiCorp's planned hydroelectric project by releasing a Notice of Preparation and hosting public scoping meetings.

Shortly thereafter, on April 6th of 2016, the Klamath Hydroelectric Settlement Agreement was amended to remove provisions requiring federal authorization and, instead, pursue dam removal through the FERC process.

Following the amendment of the KHSA, and at the request of PacifiCorp, on June 16th of 2016, the Federal Energy Regulatory Commission placed the Klamath Hydroelectric Project relicensing process on hold, or in abeyance.

And shortly after, PacifiCorp withdrew its water quality certification application from the State Water Board, thereby ending its water quality certification process for CEQA process for relicensing of the Klamath Hydroelectric Project.

Following the withdrawal of PacifiCorp's application, several things happened on

September 23rd of 2016: The first being, the new entity, a 501(c)(3) known as the Klamath River Renewal Corporation, or KRRC, jointly filed, with PacifiCorp, the license transfer application seeking to divide the Klamath Hydroelectric Project into two separate projects: The first being the Klamath Hydroelectric Project, which would be owned by PacifiCorp and consisted of East Side and West Side, Keno, and Fall Creek; while the second would be the Lower Klamath Project that would be owned by the Klamath River Renewal Corporation, and consisted of J.C. Boyle, Copco Number 1, Copco Number 2, and Iron Gate Dam developments.

The Klamath Hydroelectric Project will maintain its FERC project number of 2082 while the Lower Klamath Project has received a new FERC number of 14803.

I would like to note that the transfer application is pending before FERC.

So in addition to the transfer application, also on September 23rd, 2016, the Klamath River Renewal Corporation filed with FERC a license surrender application seeking to decommission sufficient portions of the Lower Klamath Project to provide for additional fish passage and a free flowing Klamath River.

And also, on September 23rd of 2016, the Klamath River Renewal Corporation submitted a water

quality certification application to the State Water Board for its proposed project of decommissioning.

So the State Water Board is proceeding with processing the KRRC's water quality certification application. Before the State Water Board can issue a water quality certification or take an additional action on the project, it must first comply with CEQA, as CEQA is a requirement of state law.

Information developed in the CEQA process will be used to inform future actions of the State Water Board on this project. And today's scoping meeting is part of the Notice of Preparation public comment period that began on December 22nd of 2016 and will end at 5:00 p.m. on February 1st, 2017.

So shown in the slide is an overview of the typical CEQA process in which the State Water Board is the leading agency and has determined an Environmental Impact Report is necessary.

Following that determination, the State Water Board issues a Notice of Preparation and conducts public scoping meetings. You can see on the slide, in cap locked and in underlined, I've noted this is a formal public comment period, and that comment period, again, began on November 22nd and will end on February 1st.

Following the close of that comment period, the

State Water Board will consider all comments received as well as existing environmental information and use that to prepare a Draft Environmental Impact Report.

The Draft Environmental Impact Report will include items like a detailed project description, as well as description of other alternatives, mitigation measures to reduce project impacts, and a discussion of environmental baseline.

After preparing the Draft Environmental Impact Report, the State Water Board will issue it for another formal public comment as shown on the slide -- sorry. There you go -- for a minimum of 30 days.

Similar to the Notice of Preparation public comment period, all comments received during the comment period will be considered and used to inform the development of the Final Environmental Impact Report. And following or concurrent with issuance of the Final Environmental Impact Report, the State Water Board will take an action on the KRRC's water quality certification application.

So our CEQA approach is to focus on the California portion of the Lower Klamath Project. We would like to use the FERC Environmental Impact Statement and Klamath Facilities Removal Environmental Impact Statement and Environmental Impact Report in

development of our CEQA document. And we would like -- we also plan to use information gathered by CEQA commenters, the scientific community, settlement agreements, tribes, and other sources.

Our Notice of Preparation identified two project alternatives, those being the Klamath River Renewal Corporation's proposed project to decommission sufficient portions of the Lower Klamath project, to provide for additional fish passage and a free flowing Klamath River, as well as a no-project alternative. And we recognize that there's a range of actions and alternatives in between both of those. And part of this comment period is to hear from the public on which alternatives you believe should be considered.

So jumping to today's meeting, as said earlier, all public comments received by February 1st of 2017 will be considered, and I consider all comments to be helpful. But there are a few key pieces of information that would be most helpful to us in our process, and I've listed those up here:

The first being the range of alternatives or specific alternatives the public feels should be included and analyzed in our CEQA document; any potential impacts that should be evaluated or mitigation measures; and of course any other items.

I would like to note that there was previous analysis done for the Klamath Hydroelectric Project, as discussed by FERC and the Klamath Facilities Removal CEQA document, and to the extent that that information exists, and if the public agrees or disagrees, it is beneficial for us to hear that.

We do understand that there will be environmental impacts associated with the KRRC's proposed project and other alternatives that we will be analyzing, including, but not limited to, items such as the large release of sediments from behind Copco and Iron Gate, groundwater table changes, and impacts to tribal cultural resources.

And if you are planning on commenting on any of those items, in our Notice of Preparation, there's an Attachment 1 that lists a summary of impacts that we anticipate, and I encourage everyone to look at that and let us know if there's any feedback that needs to be done.

So with that, please submit your comments by 5:00 p.m. on February 1st of 2017 to the physical or e-mail address shown there. Also on the slide is a link to our Lower Klamath Project Web page, where we post updated information, like this PowerPoint, the Notice of Preparation, the water quality certification

application. So it's a good source to check out.

And I will be turning it over to Erin to take any questions related to processes and then move into public comments.

Thank you.

MS. REGAZZI: Are there any procedural questions about the Water Board's CEQA process?

Great.

We'll move directly into public comment. That's what we're here for.

Given, I have four comment cards, I'm just going to put a five-minute timer over there so folks are aware of how much time they are using. And I'm going to have folks walk up to that podium over there and speak into the microphone.

When you walk up there, be sure to push the button. It will turn green. That means that it's on and folks should be able to hear you if you get close enough.

So I'm going to read off a couple names, just so folks know what order they are in.

So I have Ed Nute, Jonathan McClellan, Brian Johnson, and W. Glover.

Is there -- if anybody else wants to provide any comments, speaker comments, please fill out a

speaker card and you can hand it off, up here.

So Ed, if you want to take the podium. And just to help folks out, there's a little thing up there that says please remember, state your name, first and last, and spell it for Kathy, because I'm sure she would really appreciate it.

MR. NUTE: Thank you. I'm Edward Nute. I live in Marin County. I'm a civil engineer and an interested citizen.

And I encourage the state board to move forward with the certification to remove the Iron Gate, Copco 1 and 2, and J.C. Boyle Dams on the Klamath River, known as the Lower Klamath Project. And I strongly encourage the state board to move forward with the water quality certification.

For many years, I've been involved in restoration projects in Marin on the Lagunitas Creek, including removal of Roy's Dam and San Geronimo Valley. Lagunitas Creek is critically important to the passage of spawning endangered coho salmon on the Central California coast. It now has one of the largest coho runs on the Central California coast, although these rains are probably washing it all out.

I'm also aware, and have visited the highly successful dam removal up on the Elwha River in

Washington State; they now have restored the salmon runs far up into the Olympic Park.

The Klamath River is a major river in California on the West Coast. The four dams in the Lower Klamath Project are aging infrastructure. Their continued existence is untenable because of the adverse effects on downstream water quality and fisheries. They are anachronisms, and sooner or later, they will have to be removed. Otherwise, they will just continue to silt in and kill and weaken the downstream fishery. Further delay will just add silt that will have to be dealt with, when, eventually, they come down. And this should be quantified in the EIR.

Some scoping recommendations I have is, how much silt is being trapped each year behind these dams, and what's the impact of a delay on their removal?

What is the -- what improvement to the downstream fishery would result in the dam removal?

If the dams are gone, there could be a fly fishing potential for recreation use of that part of the river. There could also be some rafting recreation activities that ought to be quantified.

And in terms of power generation, it would be nice to quantify the amount of land that would be needed to replace the power that's generated with solar panels

or windmills.

Finally, as a personal note, my grandparents lived in Mount Shasta. My grandfather, Edward H. Kaupp, served on the board of supervisors for 12 years as well as on the Mount Shasta City Council, and he served on the Board of Trustees of Siskiyou Joint Union High School District for 21 years. He was a strong force in bringing high schools to rural communities of the county, including Happy Camp and Tulelake.

Edward Kaupp was a progressive thinker and took a keen interest in public works, particularly road improvements, which were sorely needed at the time, as well as public agent -- education.

I would hope that if he were alive today, he would have seen the benefits of dam removal; would greatly help the people of the Klamath by restoring the free flowing river and resulting in a healthy fishery and increased recreation opportunities. I would hate to think that 50 or a hundred years from now, these dams would still be in place as aging infrastructure, and still sickening and killing fish, degrading the downstream water quality. At some point, the dams will have to come out, and sooner better than later.

So thank you very much.

MS. REGAZZI: Thank you. If you want to leave

your written comment, I'm sure Kathy would appreciate them.

If you could state and spell your name, that would be great.

MR. McCLELLAND: My name is Jonathan McClelland, J-O-N-A-T-H-A-N, M-C-C-L-E-L-L-A-N-D.

And I'm a private citizen. I've been involved in what's going on in the Klamath since 2001, which was a couple of years before the FERC licensing process started, but it was apparent at that time, to pretty much anybody with any scientific information, that there was no feasible economic way to bring these four dams in the Lower Klamath Project into compliance for water quality and for fish passage.

There were numerous public groups that are frequently on opposite sides of the fence on anything that has to do with environmental concerns, that came together on this project, and worked out the Klamath Hydropower Settlement Agreement, and the Klamath -- the KBR, through a lot of years of work and just spreading the information to the affected communities as to how much of a benefit it would be if these dams came down.

The Klamath River was once the third largest salmon spawning river in the Western United States south of Alaska. And now all of the fish that spawn up the

Klamath River, aside from the ones that go into the Trinity, have -- are either endangered or threatened. So it's of utmost importance that the State Water Resources Control Board act as expediently as possible to move this process forward.

There was a good agreement in place, and it ran into a roadblock with the federal Congress. And I am thrilled that the Water Resources Control Board has provided another opportunity to move this process forward.

So thank you.

And I look forward to seeing those dams come down. I want to be able to fish for salmon in that river and eat them with my grandchildren. Time is running out.

MS. REGAZZI: Thank you.

So Brian Johnson and then W. Glover.

And then -- is there anybody else that wants to fill out a speaker card here today?

MR. JOHNSON: Hello. My name is Brian Johnson and I'm a California and Klamath director for Tribes Unlimited. We're a signatory to the KHSA and helping negotiate the original agreement and the amendments to the agreement. I will keep my remarks short.

We participated in the original scoping for the

relicensing project with FERC and the water quality certification, and through that process, and also through the NEPA and CEQA document, and we believe that the Water Board can and should use the CEQA document for this proceeding.

Our only other recommendation at this point, although we will submit written comments, is to continue to keep in mind the historic nature of this and the high priority that the State of California has put on this for close to 20 years now. And it's a priority in the State Water Action Plan. The Legislature has specifically called it out as something to move forward, and we would like to see a good timeline and being able to stick to it so that we can keep the project on track.

Thanks.

MS. REGAZZI: Thank you.

MR. GLOVER: Hi. My name is William Glover, G-L-O-V-E-R.

I want to remind you to include Native American stakeholders in whatever comes next. And there needs to be a viable alternative energy replacement for the lost hydro. It seems like it presents a good opportunity to expand salmon restoration, which is a good thing. And to remove these dams makes it possible for a possible -- to maybe in the future, have a possible state law in

scenic river declared out of the Klamath -- Klamath Watershed area.

Thank you.

MS. REGAZZI: Thank you.

Allie Hostler. I apologize if I mispronounced your name.

MS. HOSTLER: Hi. My name is Allie Hostler. My name is spelled A-L-L-I-E H-O-S-T-L-E-R.

I am a member of the Hoopa Tribe, and I've been in front of the Water Board several times over the past several years. Most of the time, it had been to beg you guys not to continue to grant abeyances for PacifiCorp to continue to operate their polluting dams.

But today, I'm happy to say, I encourage the Water Board to move forward with water quality permit -- with a water quality permit to decommission the four dams in question.

I believe you have done it before, in, like, 2011. It was the right decision then and it's the right decision now. All the science, up until this point and even since 2011, has only proven that decommissioning the dams is of great benefit. And as the gentleman stated earlier, there's a lot of movement and support for that. It's the right thing to do.

So back when I've been in front of the board

before, I advocated for the process to revert away from the settlement process and to the FERC process. So now that that's finally an option, I would say, move forward and -- on a tight timeline so that FERC can do what they need to do in the time frame that we have.

So I wasn't quite prepared for this hearing, but I'm glad I was able to be here, and I definitely support the Water Board moving forward with the process.

Thanks.

MS. REGAZZI: Thank you.

Anybody else interested in making a public comment today?

Anything online?

Okay. We all get an extra hour and 20 minutes in our day. That's always a nice thing to have happen.

So again, the public comment period ends on February 1st, at 5:00 p.m. So I encourage everyone to provide written comments, if they have any additional comments they would like to, before then.

Thank you.

(Proceedings concluded at 10:41 a.m.)

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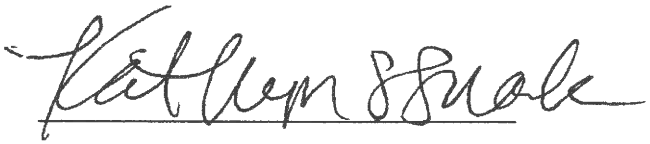
CERTIFICATE OF REPORTER

I, KATHRYN S. SWANK, a Certified Shorthand Reporter of the State of California, do hereby certify:

That I am a disinterested person herein; that the foregoing public hearing was reported in shorthand by me, Kathryn S. Swank, a Certified Shorthand Reporter of the State of California, and thereafter transcribed into typewriting.

I further certify that I am not of counsel or attorney for any of the parties to said public hearing nor in any way interested in the outcome of said public hearing.

IN WITNESS WHEREOF, I have hereunto set my hand this 1st day of February 2017.



KATHRYN S. SWANK, CSR, RPR
Certified Shorthand Reporter
License No. 13061

Scoping Meeting for an Environmental Impact Report for the Lower Klamath Project License Surrender

Best Western Miner's Inn – Convention Center Auditorium
122 E. Miner Street,
Yreka, CA 96097

January 26, 2017 (5:00 pm – 7:00 pm)

Sign-In Sheet

Sign-in Sheet for Scoping Meeting for an Environmental Impact Report for the Lower Klamath Project License Surrender

Location: Best Wetern Miner's Inn, Convention Center - 122 East Miner Street, YREKA		
Date and Time: January 26, 2017 from 5:00 p.m. to 7:00 p.m.		
Name	**Organization**	**Contact Information**
Mark Coats	CCA	
Sami Jo Difuntorum	Shasta Indian Nation	sami_jodif@yahoo.com
Kathy Warnell	Etna Band of Indians	Konomihoshasta@gmail.com
Linda Wallace	Coyote Valley Res	lwallace1952@gmail.com
Jack Mattz	Yurok Tribe	jmattz@yuroktribe.nsn.us
Bruce Ross	AFM Bear Table	Bruce.Ross@AFM.CA.GOV
Tom Menne	QWAC	HAYDUDE@SISQTEL.NET
Larry Bell	NONE	spud@Finestplanet.com
Marah Perryman	Tea Party	(530) 974-4408
Ann & Bob Noel	None	bobbnoel@yahoo.com
Don Wallace	—	Luke4@4feet.NET
Susan Wallace	—	" "
Jeanne Welch	—	chipmunkcourt@aol.com
Lisa L. Nixon	Siskiyou County Dist. 4 Supervisor	lnixon@co.siskiyou.ca.us
Nicholas Attill		
Kathy Tyler		
Dave Hyler		
Dusty Veale		

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Date and Time: January 26, 2017 from 5:00 p.m. to 7:00 p.m.		
Name	**Organization**	**Contact Information**
Sheila Davis	Copco Lake. Res	530-905-2068
KEITH MOLINE	"	541-761-2404
Richard Marchack	Siskiyou Water	530 468 4204
John Menke	Rancher	530-468-5341
Jenny O'Gorman	Resident	530-598-1961
Dr. Richard Gierak	Resident	530-475-3212
HERBERT DUERR	Concerned Citizen	530-467-3264
CAROLYN DUERR	Concerned Citizen	530-467-3264
Kiley Munoz	Concerned Citizen	
PHIL PORTER	" "	530-842-1534
Mark Fischer	Copco Lake Res	530 459 5988
Joe James	Yurok Tribe	707-482-1350
Thomas Mello	Big Spring	530 459-5069
Brandon Criss	Siskiyou County	530 859-3548
[illegible] Kuhl	Siskiyou County	530-905-2076
Susan M. Roden	Siskiyou County / Big Spring	714 322 0028
Justin B. Holmes	Rancher	414-801-1668
David White		davidwhite2015@protonmail.com

Sign-in Sheet for Scoping Meeting for an Environmental Impact Report for the Lower Klamath Project License Surrender

Location: Best Wetern Miner's Inn, Convention Center - 122 East Miner Street, YREKA

Date and Time: January 26, 2017 from 5:00 p.m. to 7:00 p.m.

Name	Organization	Contact Information
example: Parker Thaler	State Water Resources Control Board	parker.thaler@waterboards.ca.gov
Cindy Cable		Montague Ca
George Webb	State of Jefferson Rep.	
Susan B. Carowell		Montague, CA
JAVIER I. KINNEY	DIRECTOR YUROK TRIBE	JKinney@yuroktribe.nsn.us
YVETTE ADAMS		Jyadams@ootars.net
JAMES ADAMS		" "
Kaylee Starman		Kmstarman@outlook.com
Bob Rice		Consultant Water Rights
Anna Murvett	KRRC	
JERRY BACIGALUPI	P.E.	SCWUA
Mary L. O'Keefe	RE RE	
DEAN HARRIS	Citizen S.I.S Kepp Co.	twinedc61@att.net
Dave Montague		
Don Mackintosh		
Jim + Kim Hankins	Land owner	Lnd b.g blue@aol.com
Stanley Sorensen		
JOHN FOSTER	LAND OWER	

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Date and Time: January 26, 2017 from 5:00 p.m. to 7:00 p.m.		
Name	**Organization**	**Contact Information**
JOHN BERMEL	KLAMATH RIVERKEEPER	PILOTROCK@COPPER.NET (530) 475-3447
Sherrie Peery		530-842-6389
Leonard Ferguson		530-842-4731
CHRIS STINE	OREGON DEER	541-686-7810
Rex Corzolio		
ROBERT DAVIS	STAKE HOLDER	459 5042
Glen Briggs	STAKEHolder	530-496-3343
Demian Ebert	Pacific Power	
Elizabeth Nielsen	Siskiyou County	
DIETMAR KADLE		459-3084
Steve RADFORD	SOS1	598-0378
Carl and Linda Ebert	residents of Copco Lake	26834 Copco Road Montague, Calif 96064 530-459-5318
Jack Hemphill	Rancher	JRHemphill2000@yahoo.com
John Livingston	Sierra Club	Livingstonjohn@att.net
JOE SISK	PACIFIC POWER HYDRO	
Linda & Ken Oliver	Copco Lake Fire Protection Dist	Klamathbbq@aol.com
Annie Pedro	KID	
Candace Carter	BSID	

Sign-in Sheet for Scoping Meeting for an Environmental Impact Report for the Lower Klamath Project License Surrender

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Date and Time: January 26, 2017 from 5:00 p.m. to 7:00 p.m.		
Name	**Organization**	**Contact Information**
Myra Wilson	Home Owner	530-475-3304
Dave Wilson	Home Owner	" " "
BOB LINDWOOD	HOME OWNER	530-475-3314
DAVE RAUMAKER	HOMEOWNER	475-0634
Roy Hall	Shasta Motors	643-2339
Betty Hall	Shasta Motors	488-2287
Mike Mallory	Siskiyou County Assessor	842-8036
Liz Casson	City of Yreka	841-2324
Teresa Soares		530 964 4693
GRACE WARNER	RURAL ORGANIZING PROJECT	541 799 4314
GEORGE JENNINGS	ORE-CAL RC&D	530-643-6574
Margo Robbins	True North	(707) 502-8654
Greta Hardesty	Montague Water Conservation	530-459-3036
Steve Baker	City of Yreka	530-841-2321
Faye Wichern	None	
Dave Manker	None	
LORENZO CASTRO	NONE	530-925-1544
TOM O'GORMAN	N/A	530 842-4028

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Date and Time: January 26, 2017 from 5:00 p.m. to 7:00 p.m.		
Name	**Organization**	**Contact Information**
Ryan Nowakowski	Family of property owner on Copco Lake	415-706-0464
Doreen Reed	Citizen Taxpayer	
Kimberly Harkless	family Propertyowner	530-465-2033
CHRISSIE REYNOLDS	PROPERTY OWNER	530-459-1137
Danny Fontella	Property owner	530-459-3513
Jim Halpeaux	property owner	530-524-1203
Nancy & Larry Duff	property owner	530 905-5604
Carrie Rivers	UCE LIVESTOCK & NR adviser	530 842 2711
Celeste Fowler		
Lynne Hadsall	Property owner	604-5347
Josh Smith Freeman	City of Yreka	jfreeman@ci.yreka.ca.us
Jack Rogenbuck	Property owner	jrhvr@me.com

Sign-in Sheet for Scoping Meeting for an Environmental Impact Report for the Lower Klamath Project License Surrender

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Date and Time: January 26, 2017 from 5:00 p.m. to 7:00 p.m.

Name	Organization	Contact Information
Josh O'Faulkner	Grithersville Alpaca	JFRepa.@aol.com
Pat Kaula		
Michael Harris	CDFW	Michael.r.harris@wildlife.ca.gov
Pat Lunde	Klamath Irrigator	larry.pat09@yahoo.com
Dorothy Gaurlea		dggourl@msn.com
JON E. LOPEY	SHERIFF	jon.e.lopey@SISKIYOUSHERIFF.ORG

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Name	**Organization**	**Contact Information**
Jan Jackson	N/A	
Kenny Jacobsen	N/A	
DAVE MEURER	SENATOR TED GAINES	dave.meurer@sen.ca.gov
Wanda Laney	1038 So Pine Ln Mead	
JANNE SKVAGS	CDFW	
GraceBonnett	People of Siskiyou	
DENNIS L CAMPBELL		
Kristen Sellmer	SERC	
Will Johnson	Ashland Elks Lodge	will.flagsky@gmail.com
Sarah Rockwell	Klamath Bird Observatory	srw@klamathbird.org
KEITH POMEROY		
ALEXANDER KHARTCHENKO	N/A	akhartch@yahoo.com
Carol Dyer		Carol Dyer @gmail.com
Clifford Berry		
Carol Crabbin		
Colleen Alonez		
JIM MORRIS	SISKIYOU COUNTY FARM BUREAU	jim@brown-morristaxch.com
CARDINE BRASK	WOMEN IN BUS NETWORK	meme_brask@yahoo

Sign-up Sheet for Hard Copy Information Mailings

Name	Organization	Mailing Address
example: Parker Thaler	State Water Resources Control Board	1001 I Street Sacramento, California 95814
Carl and Linda Ebert	residents of Copco Lake	26834 Copco Road Montague, Calif. 96064
		Yreka

Speaker Cards and Written Comments

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

(1)

NAME: John Bermel

EMAIL (if desired): pilotrock@copper.net

ORGANIZATION (if applicable): Klamath Riverkeeper

REMARKS: Looking for worthy steward(s) to restore Klamath Hot Springs. Property is currently owned by Pacific Corp (Pacific Power)

LOCATION (circle one): ARCATA SACRAMENTO (YREKA)

(2)

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: Richard MARSHALL

EMAIL (if desired):

ORGANIZATION (if applicable): President Siskiyou Water Users

REMARKS:

LOCATION (circle one): ARCATA SACRAMENTO YREKA

Richard Marshall
Yreka
1/26/17

(2)

Siskiyou County Water Users

January 26, 2017

State Water Resources Control Board
Mr. Parker Thaler
PO Box 2000
Sacramento, CA 95812-2000

RE: California Water Board
KRRC/ Scoping Hearing
Klamath Dams

Dear Mr. Thaler,

My name is Richard Marshall and I am President of the Siskiyou County Water Users Association representing our organization of some 200 members as well as thousands of Siskiyou County citizens who indicated by voting nearly 80% their desire to keep the Klamath Dams in place. I would hasten to add that a recent vote in Klamath County, Oregon produced approximately the same result. In addition I am also a rancher in the Scott Valley.

Mr. Thaler, nearly exactly one year ago on January 26, 2016 we met in the same room on practically the same subject that is a scoping session regarding water quality and the Klamath Dams. There was a large crowd in attendance that evening again on short notice. At that time we registered the same concern regarding the seeming inability of the Water Board to properly notice the public regarding this most important meeting. Certainly it is important to us, if not to you and your associates that we participate in the process. It seems we are constantly finding out about these "public scoping" meetings at the last minute. Even though I am registered on two of the notice lists i.e. yours and the FERC. I never received notice from your organization and surprisingly did get notice until just prior to the proposed meeting of the 20th from the FERC. I don't know the rules that you follow but when I used to conduct public hearings it was required generally speaking to give 90 days' notice of an EIR scoping meeting so that the public could fully participate. I therefore question for the record the authenticity and legality of this meeting because of lack of proper public notice.

At that meeting of Jan. 26, 2016 we were asked to submit our concerns in writing which we did, thinking that our questions and opinions deserved some sort of response from your organization who is willing to take our tax dollars and spend without reserve. However, no such luck as a thank you letter for our thoughts or a response to our considered opinions.

CEQA vs NEPA

Our first issue with the project proposal is that this proposed project requiring an environmental study is not properly done by using CEQA. The Klamath River is a federally designated Wild and Scenic River and also qualifies under the navigable river federal waterway. The project as proposed impacts two states, Oregon and California. This alone demands that an environmental analysis concerning the destruction of the hydroelectric and associated storage facilities; the destruction of environmental protected fish species not the least of which includes the Coho Salmon and the Green Sturgeon; as well as the short and long nosed suckerfish; and much of the aquatic life in the river system; together with the pollution of the riverine system by toxic sediment demands that the EIR/ EIS be done under NEPA rules and prepared by the US Commerce Department and the Department of Interior.

Furthermore, one can't study just part of the Klamath River system in California especially when it comes to sediments and pollution. One must look to the headwater source of the Klamath in Oregon. The production of nitrogen and microcystin which is wrongly attributed to the presence of the hydroelectric facilities occurs naturally and by way of the byproduct of farming operations and particularly the bird life in the Oregon side of the River system. The studies done previously by the Bureau of Reclamation make this point very clear. Among others they concluded that the pollution problems could be substantially reduced or even eliminated by the installation at Keno Dam of a water quality treatment facility. Within this same study the removal of the hydro facilities and storage capability will dramatically impact the ability to modulate the river flow especially in low water times. The BOR estimates that replacing this flow capability may cost upwards of Eighteen Billion dollars.

Therefore we object strenuously to the proposed actions which absent a thorough analysis of the Pacific Decadal Oscillation as well as all seven reaches of the Klamath cannot determine the full impact of the effort to remove the hydroelectric facilities. The study should further include an examination of the impact of the destruction of the facilities will have on the economic well-being of the counties which are impacted. For example there will be an immediate destruction of property values particularly at Copco Lake where owners have already experienced a loss in value.

Finally in this section we raise an objection to the State of California spending tax payer dollars to benefit a private 501 (3) c non- profit corporation the KRRC which although recently filed as a California Corporation came out of New York. It is bad enough that we have been forced to pay an electric surcharge to remove the hydro facilities for many years now against our will and best interest for Siskiyou County. Either KRRC or PacifiCorp should be paying for the studies to be submitted to the State for review, analysis and potential approval. The KRRC has not been recognized by either the FERC or the CPUC to carry out the proposed activity. In fact the FERC

raised an objection to the KRRC both filing simultaneously the license transfer from PacifiCorp to KRRC and filing to terminate the license and remove the hydro power facilities.

Amended KHSA

On April 6, 2016 after the resounding failure of the previous KBRA and KHSA agreements, which had been pursued for many years by the Department of Interior, State of California, State of Oregon and numerous agencies and NGO'S, and rejection by Congress, despite numerous attempts by the environmental arms of California and Oregon reconstructed the previously failed KHSA calling it the amended KHSA. This is the underpinning of your organizations efforts to legitimatize the effort to destroy the hydroelectric facilities. It is our opinion that this document is illegal as the Governor of California had no legislative authority to bind the State in a potentially disastrous project without the benefit of appropriate studies and deliberations by the State Legislature. In short Governor Brown had no authority to enter into an abortive attempt to create a Federal Interstate Compact.

Klamath Bi State Compact

The Klamath Basin is governed by the 1957 Compact between the States of California, Oregon and the Federal Government. This governing doctrine is referred to as "the law of the River". It is a Federal Statute enacted by both legislatures of Oregon and California and codified by the US Congress by Statute enacted on August 30, 1957 (71 Stat. 497). This document arrived after many years of negotiation between the States and their representatives set forth the process for prioritization of beneficial uses of the Klamath River including the hydropower element which was negotiated at the time by COPCO the predecessor to PacifiCorp. The negotiating team included officials from both Oregon and California and the Federal government. The Compact is still in effect and is still the "law of the River". This magnificently versatile agreement arrived at by earnest and artful negotiations included a right to 60,000 acre feet of water to be taken from behind Iron Gate Dam and 200,000 acre feet from behind Keno Dam for the Butte Valley area. Amongst those at the table were members of the Siskiyou County Board of Supervisors under the guidance of Senator Collier. It also resulted in the development of the very successful fish hatchery at Iron Gate which draws cold water to stimulate the development of SIX MILLION FINGERLINGS (6,000,000) per year to keep the Salmon population well stocked. This process if the dams were destroyed would go with them. There will be no way to make up the difference.

Siskiyou County Flood Control and Water Conservation District

A unique piece of legislation flowed from the adoption of the Compact to the benefit of Siskiyou County. Through the legislative process in California Assemblywoman Pauline Davis authored a AB 1592 which was further codified under the California Water Code as Section 89-

1. This unique piece of legislation blessed the County of Siskiyou with special water rights to govern all waters of Siskiyou County including subterranean and surface water excluding the water controlled by the upper basin federal project. This was intended to insure that Siskiyou County would be the master of its own fate to provide for development of hydropower and water usage to benefit industry, agriculture and domestic. Again we would postulate that this unique water right conferred on the County of Siskiyou by the State of California trumps the efforts of the Water Board. These were "quid pro quo" for the County's spearheading the effort to develop the Federal Interstate Klamath Compact.

Conclusion

We reiterate our concerns over the legitimacy of the scoping session by the Water Board first because the notice period was exceedingly short and begs the question of the intent of the board in giving such short notice to the group most impacted by the potential destruction of the hydro facilities i.e. Siskiyou County in which three of the four facilities to be destroyed are located and which has the greatest river frontage to be impacted by the release of sediment and opening up the prospect of flooding and resultant damage. Secondly, we object to the use of state funding to conduct the EIR/EIS for the benefit of a private company, the KRRC, which is not even recognized by either the FERC or by the CPUC. The KRRC has no demonstrated capability to manage such a huge undertaking and they have no significant funding. Thirdly, we believe that the Governor of the State of California had no authority to enter into the Amended KHSA as it had never been reviewed or approved by the Legislature and by signing the agreement he has put the State of California and the citizens of Siskiyou County at great risk and peril. Fourthly, the Water Board planned action violates at least three Federal laws (NEPA, Federal Interstate Compact, Article 1 Sec. 10 US Constitution, and Endangered Species Act) and two State laws (Quo Warranto, and Water Code Sec. 5900-5901). Fifth, the proposed objectives of the project under the KRRC are physically and scientifically unattainable. Sixth, most importantly the existing Interstate Federal Compact has not been dealt with by Congress and therefore remains the law of the river.

Finally, we respectively demand that the Water Board respond in writing to the issues we have raised on or before February 15, 2017.

Sincerely yours

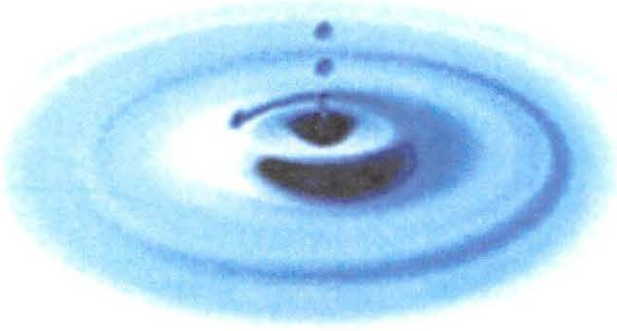
Siskiyou County Water Users

Richard Marshall
Richard Marshall
President

Richard Marshal Yreka 1/20/17

(2)

Siskiyou County Alternatives To Dam Removals



Submitted By S.C.W.U.A

SISKIYOU COUNTY WATER USERS ASSOCIATION

UPDATE 8/4/16

In late 2015 the KBRA came apart at the seams as it was unable to get Congress to agree to fund the destruction of the Klamath Hydro facilities. Although there were some in Congress who were allies of the environmentalists they were held in check by those who felt that it was an outrageous use of funds and subjected the government to potential monumental costs in restoring the Klamath after the dams were gone. They also felt that removing the water storage capability made no sense given the drought and the search for ways to conserve water.

In early 2016 the two governors of Oregon and California both "Browns" together with PacifiCorp and a number of Indian Tribes and representatives of the Federal agencies of the Dept. of Interior and the Dept. of Commerce met with other representatives of the environmental organizations that comprised parties to the KHSA agreement signing an Agreement in Principal to amend the KHSA agreement and circumvent Congress for the sole purpose of destroying the Klamath Hydro Dams. This would accomplish their stated goal of destruction of the dams.

In reviewing the revised KHSA it was clear that the strategy now would entail circumventing Congress by putting the process in the hands of the Federal Energy Regulatory Commission or FERC as it is commonly known. Hand in hand with this effort was to pass off the potential legal liability for damages to the newly created Dam Removal Entity (DRE). This would relieve the States, PacifiCorp and the agencies of any responsibility for the ecological damages that would inevitably result from the massive destruction (the largest dam removal project in the US). If a biological disaster ensued the burden would fall to the ratepayers and taxpayers ultimately. In addition the ratepayer surcharges in amount of $200 MM together with the tax payers $250 MM would be transferred with the dams to the DRE. Interesting to note is that those surcharges were actually supposed to be held in trust by PacifiCorp, meaning that the funds are those of the ratepayers. Also, interesting to recognize that the DRE is a hastily formed California 501 3c but the offices are on the 42nd floor of a building in New York City in the offices of an attorney. Now we find out weeks later that the board of this group which is just being formed is being composed of some KBRA members with others not yet named.

SCWUA is in the process of trying to establish a civil lawsuit to represent the public who have been disenfranchised in this process. The effort will be aimed at bringing an injunction against the FERC to move the matter to the EPA who has so far evaded its responsibilities with regard to the destruction of listed endangered species and the issue of the Clean Water Act which comes under both the State and Federal Water Boards. You can help by becoming a member of SCWUA or making a donation. Thanks for your help.

SCWUA Board of Directors

TABLE OF CONTENTS: Alternatives to Dam Removals

SISKIYOU COUNTY WATER USERS ASSOCIATION: (Mission & Objectives)
RESOLUTION 11-256 Submitting these Alternatives as comments to the Department of Interior EIR/EIS on Dam Removals
RESOLUTION: for the preservation of the Klamath R. and Hydro Elec. Facilities
MAPS: Klamath River Basin, Aboriginal Territory, Burial Sites, K.R. Dams,
KLAMATH RIVER PROFILE
REEFS & FALLS (precluding historic anadromous fish travel to Upper Basin)
U.S DEPARTMENT OF INTERIOR: Bulletin on HYDROPOWER
CHRONOLOGY: History ,developments and events in the Klamath Basin

I MEASURE "G" (November Ballot Measure) (No! to Dam Removals)

- SCWUA LETTER: to the Siskiyou Co. BOS to place Measure G on the ballot
- SCWUA LETTER: to voters and mailers
- SISKIYOU COUNTY BOS RESOLUTION: to place Measure G on the ballot
- RESULTS: (including maps of County and Precinct Districts)

II RESOLUTION BY SISKIYOU COUNTY BOS: to not be party to or sign the

- KBRA (Klamath Basin Restoration Agreement) or the KHSA (Klamath Hydro-Electric Settlement Agreement)

III SHASTA NATION ANADROMOUS FISH PASSAGEWAY ALTERNATIVES TO DAM REMOVALS: WITH A BRIEF HISTORY REVIEW OF THE KLAMATH RIVER, KLAMATH RIVER BASIN, AND THE CURRENT SITUATION.

IV SHASTA NATION ANADROMOUS FISH PASSAGEWAY ALTERNATIVES TO DAM REMOVALS: (PRELIMINARY ENGINEERING DRAWINGS AND COST ESTIMATES)
MEMO TO SCWUA: in reference to a meeting with the State Water Resources Control Board addressing Alternatives to Dam Removals.
2007: KLAMATH-SHASTA WATER SUBSTITUTION STUDIES by CDFG and SVRCD.

V SISKIYOU COUNTY SCOPING COMMENTS ON ENVIRONMENTAL IMPACT STATEMENT (E.I.S.) RELATED TO KBRA, KHSA, and DAM REMOVALS.

VI DATA, LETTERS AND REPORTS RELATED TO DAM REMOVALS AND ANADROMOUS FISH.

SCWUA

Siskiyou County Water Users Association

Making a Difference

Siskiyou County is faced with multifaceted attacks by the Federal Department of Interior and the State of California.

The SCWUA objectives are to provide substantial long term benefits to all of Siskiyou County by:

- **Protection of existing water and property rights.**
- **Retaining our Clean Hydro-Electric Reservoirs on the Klamath River.**
- **Preventing sky rocketing electricity cost and increase to our carbon foot print with replacement power.**
- **Increasing and sustaining property values.**
- **Adding irrigation waters to the Shasta Valley.**
- **Reducing the irrigation demands on Lake Shastina.**
- **Increasing instream flows in the Shasta and Klamath Rivers.**
- **Provide for additional anadromous fish habitat.**
- **Coordinate and Cooperate with Federal, State and County Agencies on projects that are beneficial to Siskiyou Co.**

The (SCWUA) began taking shape in Jan. 2008 when several community leaders in the Yreka area reviewed the Klamath Basin Restoration Agreement (KBRA). The KBRA settlement group represents 2 farming units, 3 tribes, 3 Federal Cabinet Secretaries, 3 Oregon State Depts., 1 CA State Dept., 2 of the 9 Basin counties, 8 environmental groups and 2 fishing associations. **(Siskiyou County is not represented)**

During the past 2 years the KBRA settlement group (in closed **secret** sessions) negotiated agreements contrary to the benefit of most citizens of Siskiyou County.

When the Siskiyou County Board of Supervisors first learned publicly that 3 of the 4 dams slated for removal were in Siskiyou County, they held public hearings which reflected an overwhelming majority of Siskiyou County's citizens' are opposed to the

Settlement Groups' agreement. The County passed a 4 page resolution supporting the County's citizen's feelings, and to obtain a more detailed look at the citizen's concerns. The County Board of Supervisors held 2 more Public Sessions that pointed out the adverse effects of the proposed actions, the lack of supporting scientific evidence, misrepresented use of historical records, and that sustaining the minimum mandatory flow of 1300 cfs for salmon cannot be met without the storage capacities of the dams. Soon afterward, countywide conversations and feelings exploded and several informal roundtable discussions were held amongst knowledgeable residents: scientists, engineers, educators, the Shasta Nation, property owners and pioneers of the river. Their collective understandings of KBRA impacts to the Klamath River's flows, flood potential, water quality issues, fish populations, habitat use, Tribal impacts, property values, clean hydro- power and understanding of the "Law of the River" (1957 Klamath River Compact) demanded a stand. The **SCWUA** took the position that whatever is done to the River **must be done right**, to the Klamath River Basin as a hole; as it will **forever** totally affect the livelihood of the residents of Siskiyou County, the largest county with the most River miles in the 10 million acre Klamath Basin.

In 2009 work began by the 10 volunteer organizers of the SCWUA to review authentic data and begin an organized effort to challenge the Klamath Settlement groups' (KBRA) provisions. (Frank Tallerico, Robert Rice, Leo Bergeron, Anthony Intiso, Betty Hall, Roy Hall sr, Roy Hall jr, Harry Lake, John Menke, Jerry Bacigalupi and Rex Cozzalio)

The volunteers (River Patriots) selected an organizational name of **Siskiyou County Water Users Association (SCWUA)** and Articles of Incorporation were filed as a tax-exempt status corporation as defined in the Internal Revenue Code 501 (c) (7).

Mission

Support and defend county-wide property rights, water rights, and water use priorities as they are identified in the "Law of the River" (1957 Klamath River Bi-State Compact and Appendixes A, B & C).

Objectives

Currently the **SCWUA** is pursuing 6 goals:

1. Protecting Our Water Rights; obtaining legal services when necessary to protect property and water rights held by Siskiyou County residents.

2. Pursue the Shasta Nation (anadromous fish by-pass) alternatives to dam removal within Siskiyou County and preserve the clean sustainable hydroelectric power to 70,000 homes, property values, warm water fisheries, recreation, flood protection, etc. provided by the dams.

3. Pursue the transfer of the annual 60,000 acre feet Klamath River storage adjudicated water right from the State of California Dept of Finance to Siskiyou County Flood Control & Water Conservation District for irrigation and in stream

enhancements in the Shasta Valley, as provided for in Appendix B of the Klamath Basin Compact.

4. Pursue grants and funding opportunities to engineer and develop the Shasta Nation Anadromous Fish By-Pass Alternatives to Dam Removals and the Klamath-Shasta River Canal System for water use within Siskiyou County and the Montague Irrigation District.

5. Pursue opportunities to examine and make repairs to Dwinnell Dam to increase its effective storage capacity to 50,000 acre feet.

6. Explore the possibilities of expanding Siskiyou County's current power supply at Box Canyon Dam to Irongate, Copco I, and Copco II hydro-electric facilities.

Membership in SCWUA

All citizens, property owners, ranchers, farmers, timber lands owners, irrigation districts, businesses, industries, organizations and anyone else using water within the county are membership candidates. Any one that turns on a faucet or flushes a toilet is a water user.

Application Fees & Dues

Annual Membership Dues:

Water user	$25.00
Property Owner	$50.00
Farm, Ranch, Timber Owner:	
Less than 100 acres	$100.00
Greater than 100 acres	$300.00
Commercial Businesses and industries	$500.00
Cities, Water agencies and Irr. Districts	

Siskiyou County Water Users Association, Inc

347 N. Main Street; Yreka, Ca. 96097

This instrument is a correct copy of the original on file in this office.
ATTEST:
COLLEEN SETZER
County Clerk
of the State of California
in and for the County of Siskiyou.
By _____ Deputy

RESOLUTION NO. 11-256

RESOLUTION OF THE BOARD OF SUPERVISORS OF THE COUNTY OF SISKIYOU SUPPORTING THE SISKIYOU COUNTY WATER USERS ASSOCIATION EIR/EIS COMMENTS

WHEREAS, the United States of America, Department of the Interior, has currently issued an EIR/EIS with respect to the removal of the Klamath hydroelectric facilities; and,

WHEREAS, three of the dams that are part of the Klamath hydroelectric facilities project are located in Siskiyou County; and,

WHEREAS, the Siskiyou County Water Users Association has prepared an alternative to removal of the dams; and,

WHEREAS, the Siskiyou County Water Users Association's support of the County effort in looking at alternatives to dam removal has constituted a meaningful voice of the people of the County of Siskiyou; and,

WHEREAS, the Siskiyou County Water Users Association was a major proponent for the placement of Measure G on the ballot which resulted in the citizens of Siskiyou County voting overwhelmingly to oppose dam removal; and,

WHEREAS, the Siskiyou County Water Users Association has prepared an in-depth and comprehensive study of the Shasta Nation Tunnel Unassisted Anadromous Fish Passage alternative to dam removal; and,

WHEREAS, the Siskiyou County Water Users Association's document entitled "Siskiyou County Alternatives to Dam Removals" constitutes an unprecedented effort by a private citizens group for the residents of this County that demonstrates the flaws in the United State's intention to remove the dams on the Klamath River,

NOW, THEREFORE, BE IT RESOLVED that the Board of Supervisors of Siskiyou County supports the Siskiyou County Water Users Association efforts and the filing of the "Siskiyou County Alternatives to Dam Removals" as comments to the EIR/EIS being circulated by the Department of the Interior.

SISKIYOU COUNTY
RESOLUTION
No. 11-256

PASSED AND ADOPTED by the Siskiyou County Board of Supervisors at a regular meeting of said Board, held on the 13th day of December, 2011, by the following vote:

AYES: Supervisors Cook, Bennett, Armstrong, Kobseff and Valenzuela
NOES: NONE
ABSENT: NONE
ABSTAIN: NONE

Jim Cook, Chair
Board of Supervisors

ATTEST:
COLLEEN SETZER,
County Clerk

By _____
Deputy

G:\Share\FERC_Draft EIR_EIS September 2011\Resolution Supporting SCWUA EIR_EIS Comments 12_13_11.wpd

RESOLUTION FOR THE PRESERVATION OF THE KLAMATH RIVER AND THE PRESERVATION OF THE KLAMATH RIVER BASIN WITH RESPECT TO THE HYDRO-ELECTRIC FACILITIES

Whereas: this document exposes the impacts that the Klamath Basin Restoration Agreement **(KBRA)** and the Klamath Hydro Settlement Agreement **(KHSA)** would have on the region **by removing four perfectly sound hydro-electric dams on the Klamath River and taking control of all Klamath Basin water through the creation of a Charter that would give control of the entire Klamath Basin Watershed to a select group of the signatories' of the KBRA & KHSA. And,**

Whereas: the **KLAMATH BASIN COMPACT** between the states of California and Oregon signed by both Governors, Congress, and the President in 1957 was enacted to control waters and water disputes in the Klamath River Basin has been ignored by the KBRA. The KBRA will exclude the public from participation in any decisions that impacts the Klamath Basin for 50 years. And,

Whereas: these agreements falsely propose to create an additional 420 miles of additional anadromous habitat above the dams for the benefits of the questionable ESA listing of the Coho salmon, the short nose and lost river suckers, and to resolve government and state sponsored water wars between Farmers, Ranchers and Indian Tribes, And,

Whereas: KRRA agreements, if implemented, would destroy the Klamath Basin, costing all citizens, communities, farmers, ranchers, ratepayers and taxpayers billions of dollars that will neither improve nor create additional anadromous fish habitat above the dams proposed for removals. The Department of Interior (DOI) National Scientific Review Officer stated in his findings that the KBRA & KHSA would be better termed an experiment rather than a restoration agreement that was doomed for failure. And,

Whereas: this document proposes to create additional water storage and ground water enhancement projects for the benefits of **all** the Klamath River Basin including the questionable ESA listings of the Coho salmon, the short nose sucker, and to resolve government sponsored water wars between Farmers, Ranchers, and Indian Tribes. And,

Whereas: this document presents the following impacts and proposals to address the problems created with the approvals of the KBRA and KHSA.

Resolved: **the Yreka Greenhorn Grange and the Siskiyou County Water Users Association, and the majority of Siskiyou and Klamath Counties Residents OPPOSE DAM REMOVALS (as resolved by MEASURE G where 80% of Siskiyou County voters oppose the removals of the Klamath River Hydro-Electric Facilities proposed for removal under the KBRA and KHSA), and presents the following ISSUES, OBJECTIVES, and PROPOSALS to address the position taken for this resolution.**

ISSUES and OBJECTIVES in THE KLAMATH RIVER BASIN:

1. **To Stop the Federal Department of Interior (DOI) and State Agencies' Scams, Conspiracies, Bribes, Grants and Blackmails** to gain support **to remove four perfectly sound hydro-electric dams** on the Klamath River and **take control of all Klamath Basin water** by over regulating, spinning, and promoting the following events: Over reaching FERC hydro-electric relicensing requirements; Endangered Species Act (EPA) questionable listings; North Coast Regional Water Control Board (TMDL) over reaching Klamath R. water quality regulations; DOI Klamath Project Irrigators electricity rate increases, water cutoffs and irresponsible regulated river flows; Upper Klamath Basin Tribal Water Right Wars against Farmers and Ranchers; Grants and Bribes to tribes, NGO's, Farmers and Ranchers to bring **Stakeholders** together to sign the KBRA. All signatories having to agree to one primary objective (**Dam Removals**). Note: the dams are downstream of Upper Basin Tribal water wars and the DOI Klamath Project and have no effect on either, except they were Federally approved to provide cheap power to the Project Irrigators.

2. **To Save Taxpayers and Ratepayers over one billion dollars in initial cost** associated with the Klamath River **GREEN** Hydro-electric Dams and facilities scheduled for removals ***(down played by the DOI to be less than the $450 million cap in the KBRA & KHSA)***, plus their replacement cost with **NON GREEN POWER.** This cost does not include **the additional long term billions of dollars** in cost associated with future Klamath R. sediment release restorations and secret undisclosed KBRA and KHSA agreements.

3. **To Save Iron Gate Fish Hatchery and the complete destruction of the Klamath River** aquatic and fishery habitat below **Iron Gate Dam and Fish Hatchery** by **PROHIBITING the DOI & CDFG irresponsibly washing 20+/- million cubic yards of contaminated sediments (equivalent to 3 feet deep by 150 feet wide by 190 miles long) retained behind the dams down river during dam removals.** ***(An intentional violation of the State and Federal clean water act to reduce dam removal cost below the $450 million KBRA & KHSA cap).*** Note, dredging the sediments prior to dam removal was considered by the DOI and would be the most environmental preferred alternative, however, it was cost prohibited under the $450 million cap.

4. **To Challenge the DOI claim that dam removals would create an additional 420 miles of anadromous fish habitat above the dams.** Whereas several historical reefs and falls existed on the Klamath River which prohibited anadromous fish to reach the Upper Klamath Basin above dams proposed for removals.

5. **To Achieve the overriding environmental objectives** set forth by the Federal Energy Regulatory Commission (FERC) and the North Coast Regional Water Control Board (NCRWCB) to restudy and negotiate **unreasonable** mitigation recommendations for relicensing the four hydro-electric dams on the Klamath River in Oregon and California

6. **To Restore Historic Water Rights** back to the Upper Basin Off Project Water Users prior to the ESA listings and the KBRA.

7. **To Restore Historic Water Diversions** back to the On Project Water Users prior to the ESA listings and the KBRA.

8. **To Introduce Other Water Development Proposals** to provide the Upper and Lower Klamath Basins with **MORE WATER STORAGE** (with beneficial controlled releases).

PROPOSED PROJECTS:

1. **Implement a trap and haul study** around the dams scheduled for removals to determine that anadromous fish habitat does or does not exists above the dams. If anadromous fish habitat exists, Implement the Shasta Nation Tunnel Unassisted Anadromous Fish Passageway around Iron Gate, COPCO 1 and COPCO 2 Reservoirs at a cost of $50million (1/6th the $300million cost estimated for installing fish ladders & 5% the $1billion cost of dam removals).

2. **Establish additional reliable storage facilities within the Upper Klamath Basin** to augment the Upper Klamath Basin farmer's and rancher's water rights, Klamath Project Water User's demands, instream flows, and to improve water quality in the Upper Klamath River. This will preclude another 2001 Yr. Episode of Federal Agencies' **inappropriate** allocation of water for raising Upper Klamath Lake levels for endangered species, depriving 1400 project irrigators their water and negatively affecting the short nose sucker. In 2013, another episode involving Tribes and Federal & State Agencies allocation of water for endangered species deprived Off Project Irrigators their water resulting in water cutoffs to over 100,000 acres of Upper Basin family farms and ranches.

3. **Establish additional reliable storage facilities within the Scott and Quartz Valleys,** including increasing storage capacities of high-elevation lakes as recommended in the October 1991 Department of Water Resources Study entitled: *SCOTT RIVER FLOW AUGMENTATION STUDY.* These storage facilities will augment late summer and fall instream flows, improve Klamath River water quality and supplement agricultural irrigation water.

4. **Implement the 60,000 ac.ft. (Klamath River, IronGate Reservoir, Shasta Valley) Reserved Water Right (A0169580), and storage facilities** to supplement Montague Irrigation District's irrigation water with Klamath River water at a cost of $500million (1/2th the $1billion cost of dam removals). This project augments current irrigation supplies, allows for additional irrigable lands, and replaces naturally impaired Upper Klamath River water with higher quality water. A portion of the reduced water demands (good water quality) can be released by the Montague Irrigation District from Lake Shastina or from their wells into the Shasta River, improving the

water quality in both the Shasta River and in the Klamath River below Iron Gate Reservoir per FERC recommended requirements for relicensing.

5. **Support and introduce Coho Salmon Restoration Programs on Klamath River tributaries below Iron Gate Fish Hatchery. Note: Coho are cold water fish with their most desirable habit within 30 to 40 miles of the coast.**

6. **Implement a US Forest Service supported Grant Program and a Juniper Removal Program** for wood energy and wood products markets, sustainable forest and wildfire management. These programs will provide local economy, wildfire protection, improved ground water infiltration, instream flow accretion, surface water runoff, and improved grass land production. These programs have the potential to provide several hundred thousand acre feet of surface, ground water, and instream flow to the entire Klamath Basin.

7. **California Establishment of a Joint Powers Authority (JPA)**, Public Utility District (PUD), or the Siskiyou County Flood Control and Water Conservation District's acquisition of Iron Gate, COPCO 1, and COPCO 2 Hydro-Electric Facilities. PaciCorp is a signatory to the KHSA agreement to decommission the Hydro-electric Dams. A **negative one billion dollar** 2020 yr. worth value has been established for the Klamath River Hydro-electric Dams scheduled for removals. The sale of this 65 MW green energy to the PP&L grid would generate an estimated $50 Million per year to a JPA, PUD, or Siskiyou County which could be used for project financing and to **reduce electricity rates to farming and ranching operations and to <u>all ratepayers</u> within the district.**
8. **Oregon Establishment of a Joint Powers Authority (JPA)** or Public Utility District (PUD) acquisition of J.C.Boyle Hydro-Electric Facilities. The sale of this 98 MW green energy to the PP&L grid would generate an estimated $75 Million per year to a JPA or PUD which could be used for project financing and to **reduce electricity rates to farming and ranching operations and to <u>all ratepayers</u> within the District**. Also, a Bi-State Joint Power Authority (JPA) or Public Utility District (PUD) could be formed to acquire all four hydro-electric facilities.

<u>These Proposals Will:</u>

- **Save farmers, ranchers, the public, and tax payers <u>billions</u> of dollars**
- **Save the Klamath River from complete destruction** by eliminating the release of 20 millon cubic yards of sediments.
- **Save the Hydro-electric Dams** which generate **<u>clean, green power</u>** to 70,000 homes, protect the lake habitat and homes values around the reservoirs and provide **<u>flood protection</u>** with a 25% reduction and a 9 hr.delay in peak flows. Given the condition of a complete Klamath River cutoff by the DOI or a severe drought **the dams can also easily protect the Upper and Lower Klamath Basin water demands by providing CDFG's 700 cfs minimum instream river flows for a three month period** with adequate storage retained for lake habitat..

- **Save IronGate Fish Hatchery,** which is dependent on cool low level water releases from Iron Gate Reservoir and releases over **six million salmon and steelhead fingerlings per year** into the Klamath River. **Note:** ***(It is impossible for the Klamath River Habitat above IronGate Dam to duplicate the production of IronGate Hatchery).***
- **Save relocating the City of Yreka's Fall Creek water supply system across Iron Gate Reservoir and prevent future demands on Fall Creek Water Rights under the KBRA.**
- **Save Klamath River water demands** by State and Federal Agencies from the **Upper and Lower Klamath Basins, the Rogue Valley,** and **the Scott and Shasta Rivers** to satisfy requirements proposed in the KBRA for **environmental waters**.
- **Save our forest from future catastrophic fires by proposing needed thinning projects and control present and future invasion of the evasive Juniper population in the entire Klamath River Basin.** This can provide hundreds of thousands acre feet of additional Klamath Basin ground water, surface waters, and instream flows.
- **Preserves the sacred Shasta Nation Villages and Burial Sites** beneath the waters of Iron Gate and COPCO Reservoirs.
- **Provide substantial additional water storage facilities within the Klamath Basin** which will benefit **all water users in the basin** including benefits to instream flows, ground water, fisheries, Tribes, NGO's and fishing interest.
- **Provide reduced electricity rates for On and Off Project irrigators and all rate payers.**
- **Provide Governmental Agencies with public supported alternatives** to maintain the economic and environmental sustainability of the Klamath River Basin.

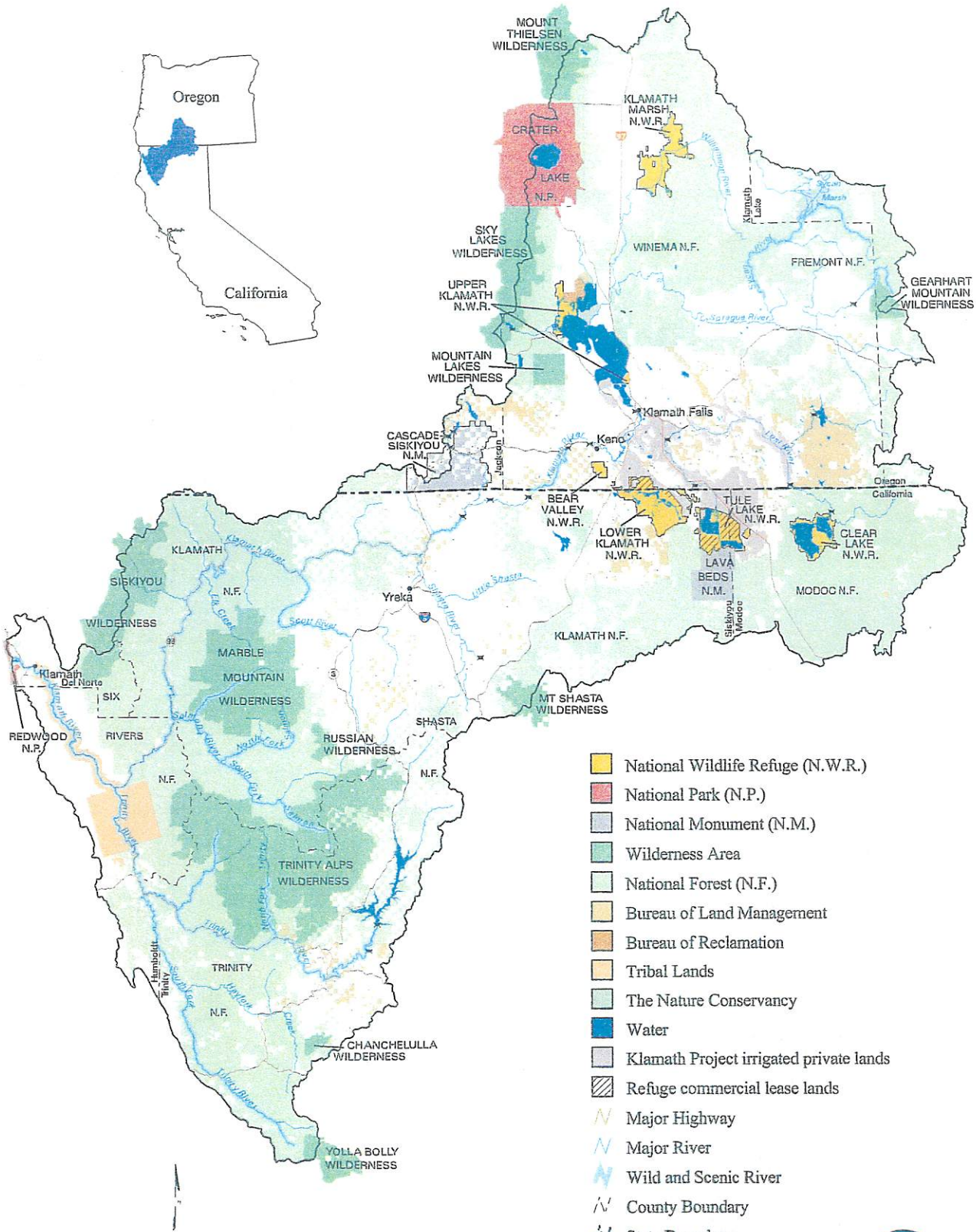
Anthony Intiso
Yreka Greenhorn Grange

Date 2, 2016

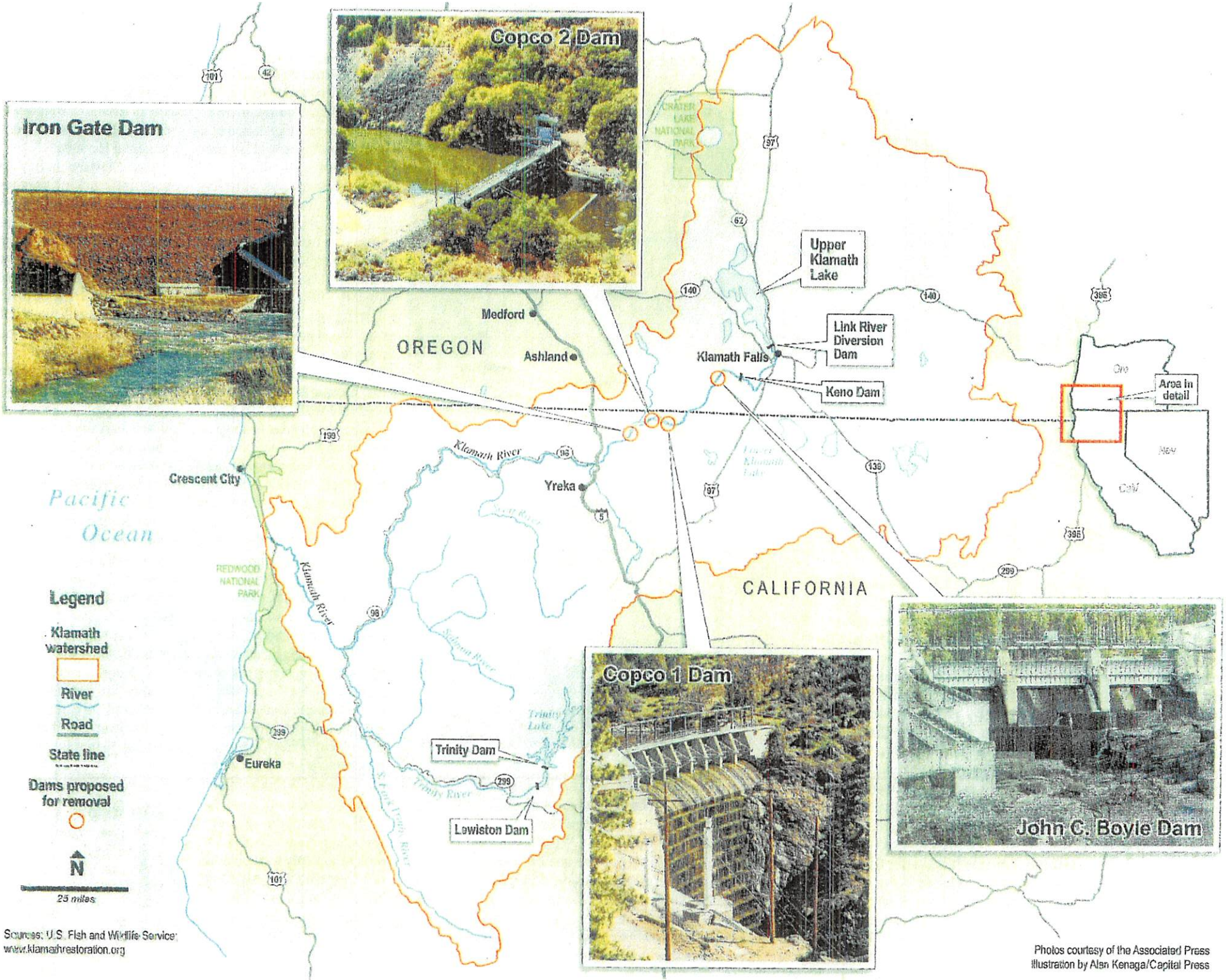
Richard Marshall
Siskiyou County Water Users Assoc.

Date 2-2-16

Klamath River Basin



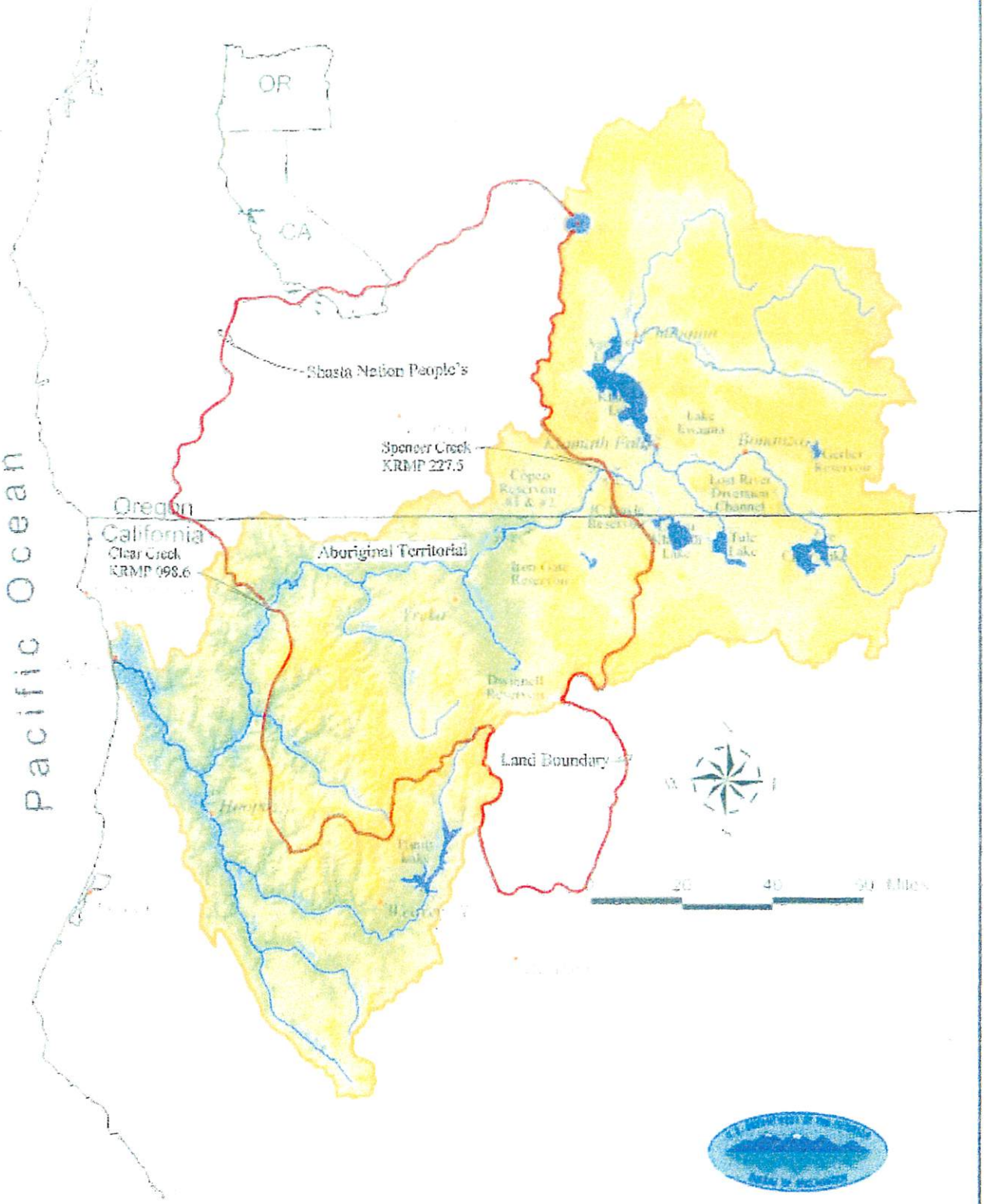
The Wilderness Society
Center for Landscape Analysis

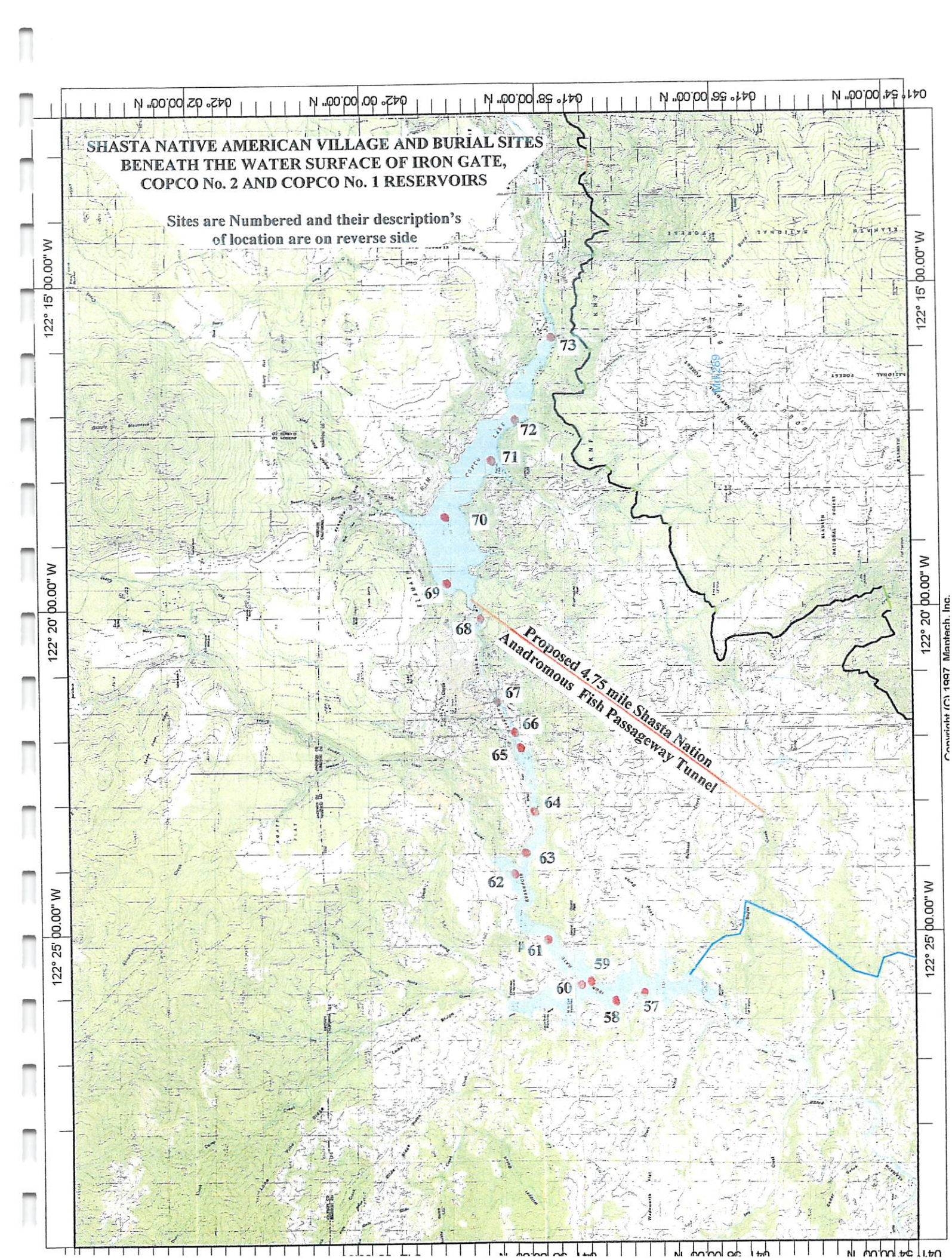


Sources: U.S. Fish and Wildlife Service; www.klamathrestoration.org

Photos courtesy of the Associated Press
Illustration by Alan Kenaga/Capital Press

Klamath River Basin




SHASTA NATIVE AMERICAN VILLAGE AND BURIAL SITES
BENEATH THE WATER SURFACE OF IRON GATE,
COPCO No. 2 AND COPCO No. 1 RESERVOIRS
Sites are Numbered and their description's
of location are on reverse side
Proposed 4.75 mile Shasta Nation
Anadromous Fish Passageway Tunnel
73
72
71
70
69
68
67
66
65
64
63
62
61
59
60
58
57
042° 02' 00.00" N
042° 00' 00.00" N
041° 58' 00.00" N
041° 56' 00.00" N
041° 54' 00.00" N
122° 15' 00.00" W
122° 20' 00.00" W
122° 25' 00.00" W
Copyright (C) 1997 Maptech, Inc.

57. Kwer'-re-bak'-kik'stok. Village on N. side of Klamath River about half a mile below Okwer'-ker-ram'-mah (Merriam, ms.).

58. O-kwer'-ker-ram'-mah. Village on N. side of Klamath River, half a mile below Camp Creek (Merriam, ms.).

59. Wahp'-pre-wa'-o. On S. side of Klamath River, nearly opposite the mouth of Camp Creek.

60. Id-doo'-kwi. A Shasta village on N. side of Klamath River on E. side of mouth of Camp Creek (Merriam, ms.).

61. Kwah'-tah-kah-pahk'. Village on N. side of Klamath River 1 mile below Koo-kwah-re'-kah (Merriam, ms.).

62. Koo-kwah-re'-kah. Village on N. side of Klamath River at the mouth of Jenny Creek (Merriam, ms.).

63. Enta'warahowa'xa. On N. side of Klamath River and west side of a creek, at its mouth (possibly Jenny Creek; Holt, 1946: map).

64. At-tik'-kah-ha-tat-so. Village on N. side of Klamath River at the old railroad crossing near mouth of Jenny Creek (Merriam, ms.).

65. Ah-soon-nah-ko-witch'-e-rah. Located on a pine flat on S. side of Klamath River a short distance below Copco Dam (Merriam, ms.).

66. Kutsastsus. Dixon (1907: map) and Kroeber (1925:286) refer to it as a Kammatwa settlement on N. side of Klamath River. Holt (1946: map) refers to it as Gu'jas Jas, and places it on the N. side of the Klamath above the village of Enta'warahowa'xa. Merriam (ms.) notes the village as Koo-ches'-ches, and locates it on the N. side of the Klamath at the mouth of Fall Creek.

67. Wah'-ah-ye. Village on Fall Creek (at location of present powerhouse) and on N. side of Klamath River (Merriam, ms.).

68. Ko-soo'-rah. Small Shasta village on N. side of Klamath River, close to Copco Dam and a round hill (Merriam, ms.).

69. Choo-pah'ch-took. Village on N. side of Klamath River below Ik'-kweek and now under water from Copco Dam (Merriam, ms.).

70. Ik'-kweek. Shasta village on N. side of Klamath River below Ho'-a'te-took', and also now under water.

71. Tah-her'-ruk-kwe. Small Shasta village on S. side of Klamath River at mouth of Deer Creek.

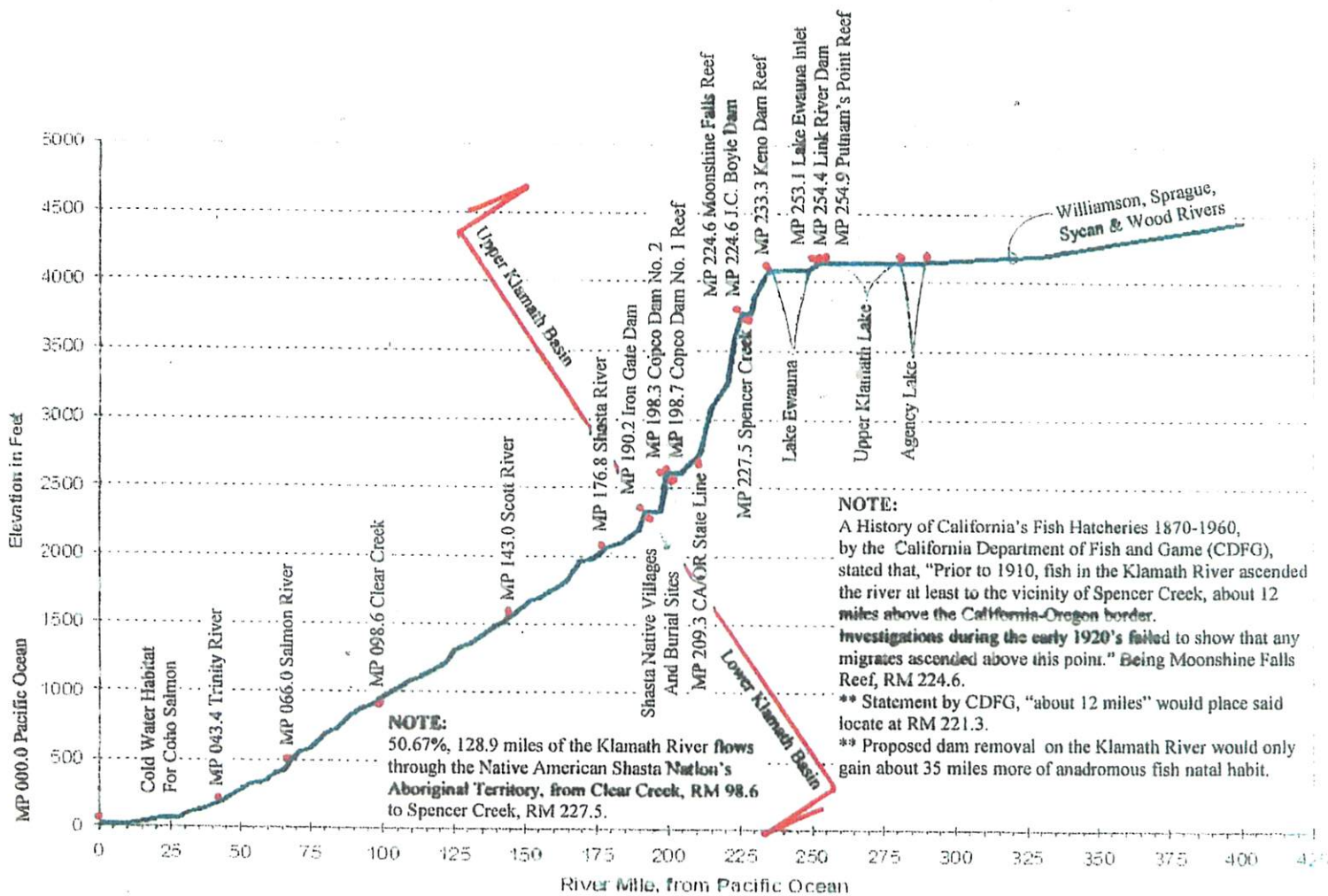
72. Ko-kwan'-nut. Small Shasta village on S. side of Klamath River about half a mile above mouth of Deer Creek (Merriam, ms.).

73. Ho'-a-te-took'. Village on N. side of Klamath River 6 miles below Beswick and 3 miles below wagon bridge (Merriam, ms.).

KLAMATH RIVER PROFILE

Water Surface Profile & Appurtenances Of The Klamath River
Profile excerpted from Technical Report No. SHR-2011-02, USDOI-BOR

Prepared By:
Siskiyou County Water Users Association
Yreka, Siskiyou County, California



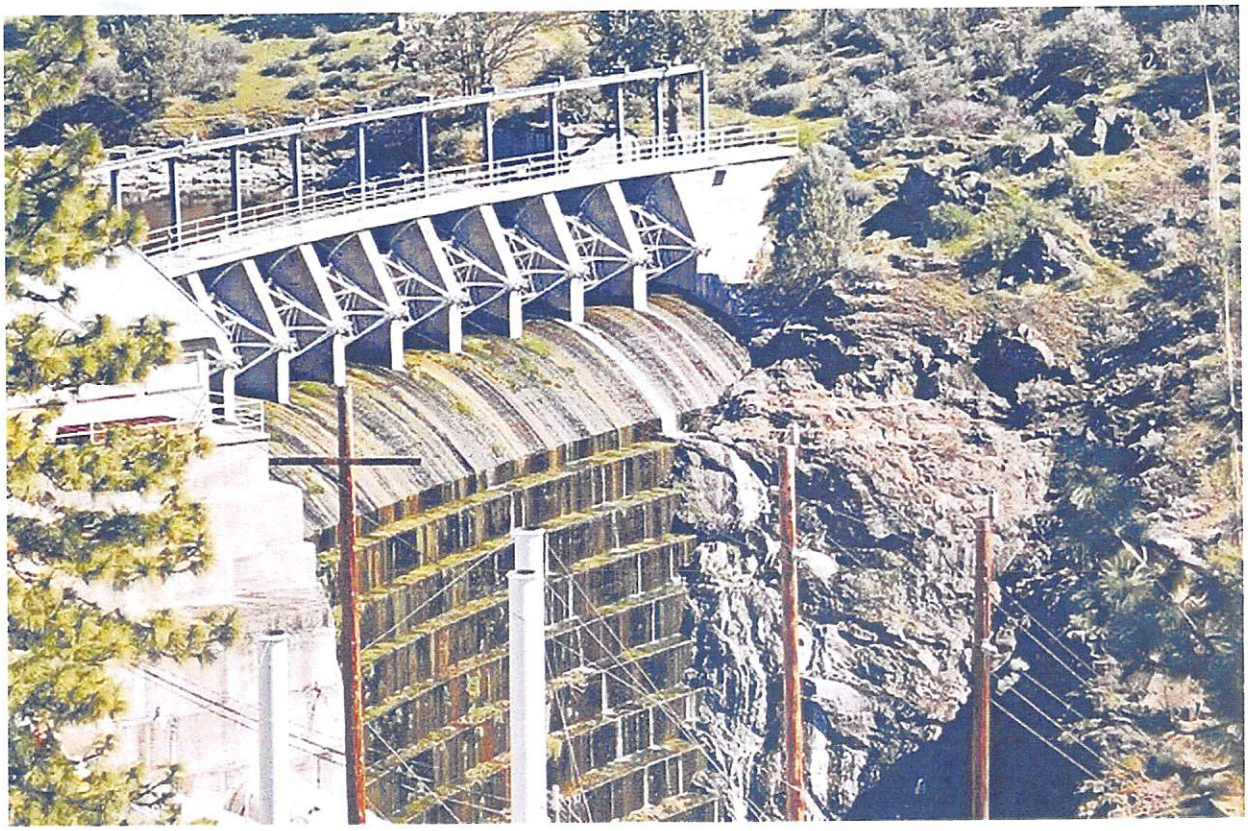
COPOC DAM No. 1 (1918) at an ANCIENT REEF

RM 198.7

The Klamath River Electrical Development Project, written in 1913 by John C. Boyle

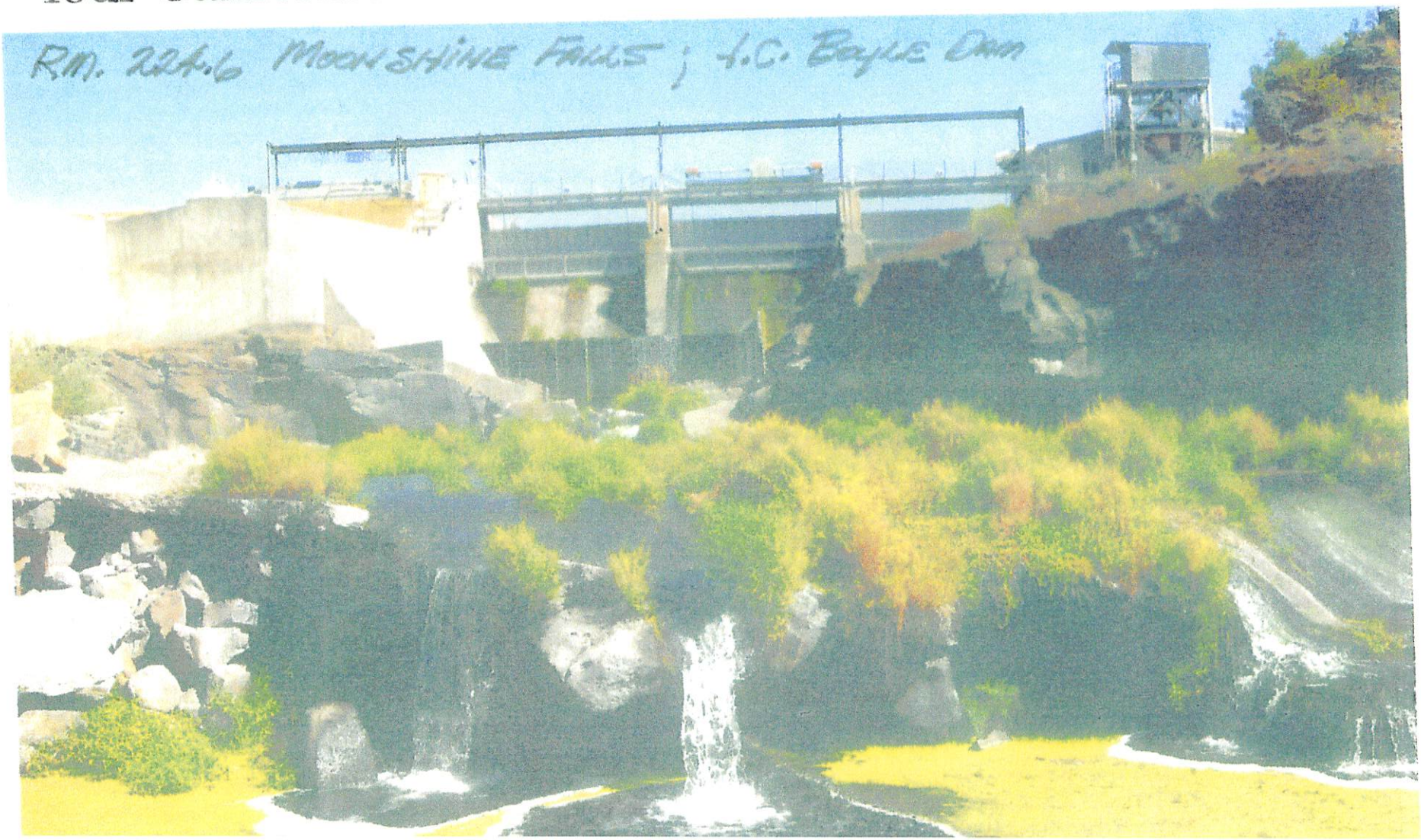
"The engineering structures--the dam, power plant, fore bay, and lake, are combined under the name of the Klamath River Dam No. One. They are located principally as a unit beginning at the head of a canyon formed by the Klamath River eroding five distinct lava flows. Although the surrounding country is principally lava formation, and the walls of the canyon, rising up to 250 feet high is lava rock, the river in its erosion has exposed at the site of the dam an ancient shelf, which was at one time approximately 130 feet high across the canyon, this reef is andesite, apparently continuous for a considerable distance on both sides of the canyon, and it is believed to be the oldest exposed formation in the country.

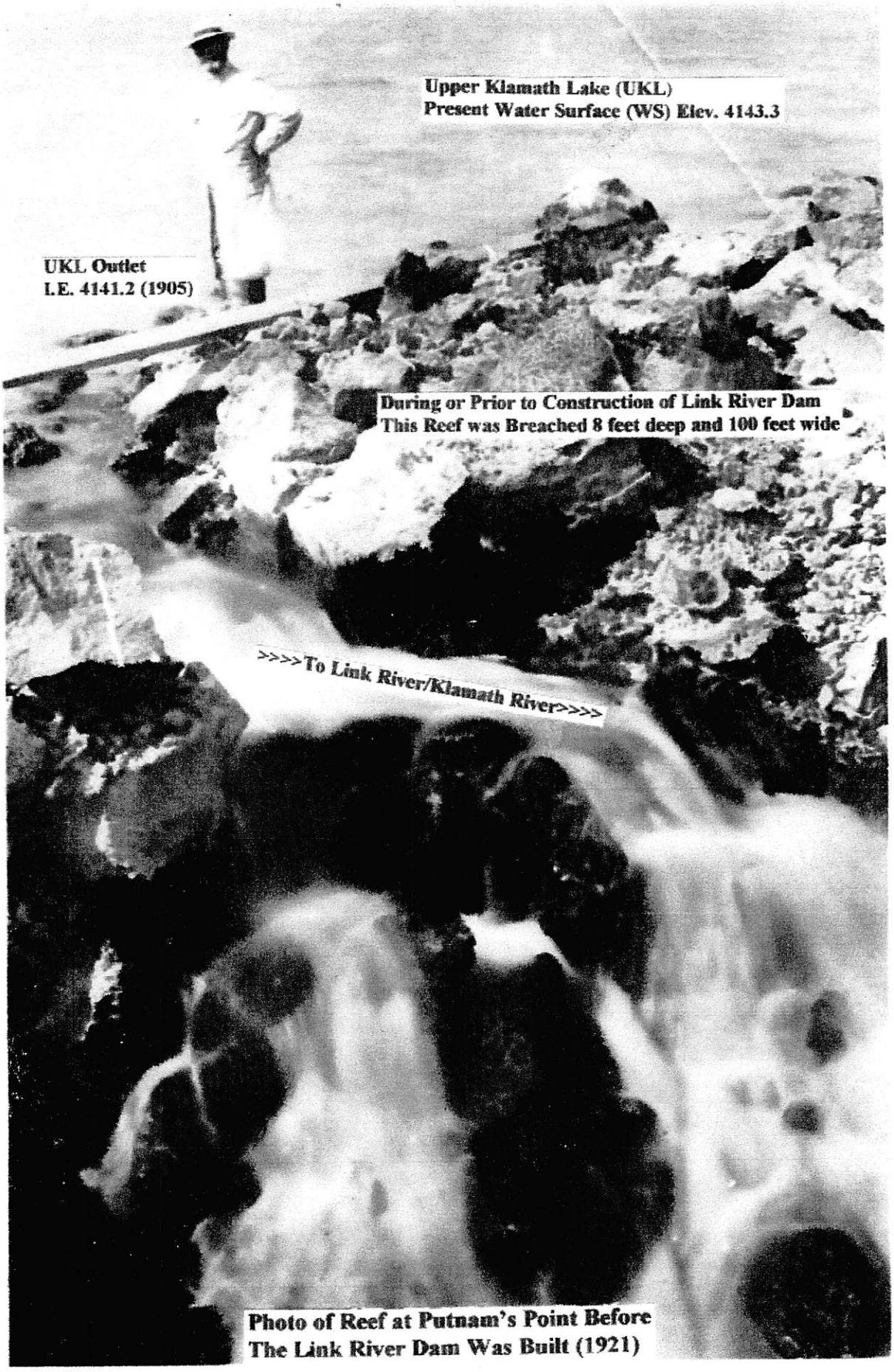
Geological conditions upstream from the site indicate that at one time the river ran over this reef 130 feet above its present bed, and at that period the waters were backed up about 5 miles and formed a lake about one mile in extent at its widest part."



Fish Win

It's Fish 1, People 0 in the fight to remove four California dams. When will the insanity stop? p. 16




Upper Klamath Lake (UKL)
Present Water Surface (WS) Elev. 4143.3
UKL Outlet
I.E. 4141.2 (1905)
During or Prior to Construction of Link River Dam
This Reef was Breached 8 feet deep and 100 feet wide
>>>>To Link River/Klamath River>>>>
Photo of Reef at Putnam's Point Before
The Link River Dam Was Built (1921)

Hydropower Program

Reclamation is the second largest producer of hydropower in the United States with 58 powerplants and an installed capacity of over 14 million Kilowatts.

These 58 powerplants generate more than 44 billion Kilowatt-hours annually. That is enough electricity to meet the annual needs of more than 9 million people and the energy equivalent of replacing more than 80 million barrels of crude oil or about 48.4 billion pounds of coal.

In 2006, Reclamation hydropower plants resulted in avoiding the release of over 31 million tons of carbon dioxide emissions.

When compared to all electric utilities on the basis of nameplate capacity, Reclamation ranks as the tenth largest "utility" in the United States.

Reclamation powerplants range in size from 350 kilowatts at Lewiston Powerplant to 6.8 million kilowatts at Grand Coulee Dam, the nations largest.

Revenues from the sale of Reclamation's power average over $700 million annually. Since 1909, power revenues have contributed over $10 billion in project repayment to the federal treasury.

Since Reclamation began installing hydroelectric powerplants at its dams in the early 1900's, the technology of the generators has evolved and improved. Reclamation has worked to maximize the generating capacity of its generators, increasing the generating capacity at one-third of the generators, increasing the capacity of those generators by an average of 48 percent.

Hydropower is Renewable

It is the primary generator of renewable energy in the United States. Hydropower generating units capture the power of the water as it falls through the penstocks. It does this all and does not generate atmospheric emissions.

The generation of hydropower is also the most efficient way to produce energy with each kilowatt-hour of hydroelectricity being produced at an efficiency of more than twice that of any other energy resource.

Hydropower is also extremely flexible and reliable compared to other energy resources. Hydropower can rapidly change its output to match needs, going from no power generation to maximum power output quickly and as expected. This flexibility makes hydropower a critical energy source to stabilize the electrical grid.

CHRONOLOGY
AND
HISTORY OF DEVELOPMENT ALONG THE KLAMATH RIVER

Pre-1850 Native American tribes lived along and deepened upon the Klamath River and it tributaries

1850 Gold is discovered in the Klamath River Basin

1850 Farms and ranches are established in Scott and Shasta Valleys

1851 Treaties are signed with the various tribes along the Klamath River

1855 November 16, Klamath River Reservation is established. This reservation was abandoned in 1861 after a disastrous flood and terminated in1864

1864 April 8, the president set aside land for four tribes in California, one of them being the Hoopa

1864 Klamath Tribes cede land to the U.S. government and a reservation is created

1868 Two farmers dig first irrigation ditch in the Upper Klamath Basin

1876 June 23, President Grant formally defines the boundaries of the Hoopa Valley Reservation

1878 February 6, The Yreka Journal, Siskiyou County, had 98 mining ditches of 600 miles in length and 20 irrigation ditches supplying 10,000 acres

1888 California court rules lower Klamath Reservation abandoned, opening the lower river to non-Indian commercial fishing and management by the State of California

1888 A large saw mill and a wooden splash dam were built on the Klamath River at Klamathon. The dam was destroyed by fire in 1902

1891 October 16, President Harrison enlarged the Hoopa Valley Reservation.

1895 Introduction of Coho Salmon to the Klamath River, a plant made on Supply Creek, a tributary to the Trinity R. Several out of basin import plantings were made since 1895

1905 Klamath Project is authorized

1907 First deliveries of water through the Klamath Project "A" Canal

1908 President Theodore Roosevelt creates the nation's first wildlife refuge, Klamath Lake Refuge—now called Lower Klamath National Wildlife Refuge

1910 The US Bureau of Sports Fisheries installed the Klamathon Racks as a salmon egg-taking station at the site of the old logging dam, blocking passage for Chinook and Coho salmon

1917 First Klamath Project lands are opened to homesteaders.

1918 COPCO 1 dam hydroelectric facilities become operational

1919 Salmon canning industry on the Klamath and in California were abolished by an act of the California Legislature.

1921 Link River Dam completed allowing control of water releases from Upper Klamath Lake

1922 COPCO 1 second generator becomes operational.

1925 COPCO 2 hydroelectric plant was put into commercial use

1927 Dwinell Dam (Lake Shastina) constructed on the Shasta River

1928 Tule Lake Bird Refuge (Now Tule Lake National Wildlife Refuge) is created

1932 Shasta River and tributaries adjudicated and Water Mastering established

1933/1934 Commercial fishing on Klamath River banned, tribal gillnet fishing prohibited

1954 Congress votes to terminate the Klamath Tribe's reservation

1956 Klamath Project farmers' electricity rate contract set for 0.6 cents per kilowatt-hour for 50 years. The Mid and Upper Basin Klamath farmers did not receive the rate break.

1957 Congress ratifies the Klamath Basin Compact between the states of California and Oregon

1958 J.C. Boyle or "The Bend" dam and power plant were built upstream from COPCO 1 dam in Oregon

1962 Iron Gate Dam is completed

1963 Lewiston dam on the Trinity River is completed diverting a majority of the Trinity River water to the Sacramento River

1964 Large flood on the Klamath River destroys several bridges, roads, and structures. All dams targeted for removal were in place, reducing and delaying peak flows

1964 Kuchel Act precludes homesteading on refuge land; provides for continued leasing of refuge land for farming

1966 Iron Gate hatchery which is dependent on Iron Gate Dam completed and operational

1966 Keno Dam (Lake Ewana) constructed to replace Needle Dam on the Klamath River

1971 Lost River shortnose suckers identified as a species of concern under California law

1972 California Wild and Scenic Rivers Act designates the Klamath River from 100 yards below Iron Gate to the ocean to the list

1973 U.S. Supreme Court rules that stretches of the Trinity and Klamath River flowing through the Hoopa and Yurok reservations is "Indian Country," effectively restoring tribal salmon fishing rights

1976 Oregon Water Resources Department begins the Klamath water rights adjudication process

1977-78 Tribal salmon fishing resumes on Lower Klamath River, but was quickly stopped by the Federal Government on conservation grounds

1980 Scott River Adjudication decree and partial Water Master service enacted

1981 Lower Klamath River federally designated as "wild and scenic" between its mouth and 3,600 feet below Iron Gate Dam

1983 *United States v. Adair* decision upholds Klamath Tribes' right to enough in-stream water to support fishing and hunting, but does not establish how much water is needed to support those activities

1985 California state court confirms limited tribal fishing rights for the Karuk at Ishi Pishi Falls

1986 Klamath River Basin Fishery Resource Restoration Act is passed. Funded at 1 million dollars per year

1986 Klamath Tribes reservation restored

1986 Klamath Tribes close sucker fishery on Upper Klamath Lake and its tributaries

1987 Indian salmon harvest on Klamath River reopened for five years

1988 The Hoopa Yurok Settlement Act; Public Law 100-580 102 Stat. 2924, partitioned certain reservation lands between the Hoopa Valley Tribe and the Yurok Indians

1988 Shortnose and Lost River Sucker listed as endangered under the Endangered Species Act

1988 Oregon State Scenic Waterways Act designated the Klamath Scenic Waterway from J.C. Boyle downstream to the California Oregon border

1990-1992 Severe declines in salmon runs close ocean salmon fishing

1993 Federal government sets Klamath tribal salmon fishing limit at 50 percent of the total available harvest

1994 The Klamath River from J.C. Boyle to the Oregon border is federally designated under the Wild and Scenic Rivers Act

1996-1998 Lost, Klamath, Salmon, Scott, and Shasta Rivers declared impaired under Federal Clean Water Act

1997 Federal EPA listing of the Southern Oregon, Northern California Coastal Coho as a "threatened" species

1997 Minor flood event below Iron Gate Reservoir

1997-2004 DFG killing of all unmarked (wild reared) Coho salmon returning to Iron Gate Fish Hatchery

1998 First of several unsuccessful negotiations undertaken among some Klamath Basin water interest

1999 Final submission of water rights claims (730) and contested (5,664) in Upper Klamath Basin adjudication

2000 PacifiCorp begins (FERC) federal relicensing process for the Klamath Hydroelectric Project dams

2001 In a drought year water deliveries to the Klamath Project were cut off in mid-irrigation season to preserve water for fish in Upper Klamath Lake and the Lower Klamath River, sparking protests and drawing national news media to Klamath Falls. This resulted in foreclosures and distress sales of 1200 family farms and homes.

2002 Klamath Project farmers receive full irrigation allocation while downstream water is cut back. An estimated 33,000 salmon die near the mouth of the Klamath River from undetermined causes, (disease, poisoning, and Trinity River ceremonial ramping), and worsened by the low flow and high temperature conditions

2004 California lists the Coho from San Francisco to the Oregon border as a "threatened" species

2004 Federal Agencies requested that 40 returning (wild reared) unmarked Coho Salmon be implanted with radio transmitters and returned to the river at Iron Gate Hatchery. 23 were accounted for and traveled down river as far as 50 miles and then up tributaries (3 up the Scott River)

2005 Private negotiations between Tribes, Non-Governmental Organizations, State & Federal Agencies, and Klamath Project farmers began KBRA negotiations.

2006 Projected weak runs of Klamath River Chinook Salmon force closure to ocean harvest

2006 PacifiCorp's license for the Klamath Hydroelectric Project expires. The relicensing process continues; the company faces major costs to meet new environmental standards demanded by state and federal regulators

2006, 2008, 2009 Draft Klamath Basin Restoration Agreement (KBRA) released; transfer of public forest to Klamath tribe; alternative sources of energy and some water certainty for the Klamath Project irrigators; idling of off-project farmlands; temporary assignment of salmon fishing rights for the Klamath tribes from the Shasta Indian territory; major fisheries restoration effort; **demands for dam removals.**

2008 PacificCorp agrees to dam removal, in exchange for a waiver of liability, most services costs, and ability to pass most costs to rate payers

2008 In January, Draft Klamath Restoration Agreement (KBRA) is released

2009 Draft Klamath Hydroelectric Agreement (KHSA) Settlement is released

2009 Siskiyou County passes Title 10, Chapter 13 of County Codes – regarding "Demolition, Decommissioning, Removal and Reclamation (applies to dam removals)

2010 Siskiyou County voters **vote NO! to dam removals** Measure G, (an advisory measure,) by an overwhelming 79.04%

2010 February 18 Final Klamath Restoration Agreement (KBRA) and Klamath Settlement Agreement (KHSA) **(demands for dam removals)** signed by several parties, pending funding allocations and review by the Secretary of the Interior

2011 Oct. 22 Defend Rural America Rally and 8 county Constitutional Sheriffs' Town Hall meeting held in Siskiyou County. Excess of 1,000 people in attendance protesting dam removal

2011 Dec. Siskiyou County submits comments on the EIR/EIS on dam removals being circulated by the Department of the Interior (DOI)

2012 March 30 Following a review by the Secretary of the Interior, **and in consideration of all viable alternatives,** a Secretarial Determination will be made whether the removal of the Klamath Hydroelectric Project Dams will help restore anadromous fisheries and is in the public interest

2012 Expected date for Oregon Water Resources Department's final determination on the Upper Klamath Basin water rights adjudication. The determination may be appealed in court

2015 Dec.31 KBRA/KHSA Agreements expire

2016 Dam Removals referred back to the FERC process

2016 DOI, States of California & Oregon in process of reviving the Klamath Hydro Settlement Agreement (KHSA) and forming a Dam Removal Entity (DRE) with little or no assets which will take liability away from Pacific Corp and the Governments

2020 Earliest year in which dam removal could begin under the KHSA

I

MEASURE "G" (November Ballot Measure) (No! to Dam Removals)

- SCWUA LETTER: to the BOS to place Measure G on the ballot
- SCWUA LETTER: to voters and mailers
- SISKIYOU COUNTY BOS RESOLUTION: to place Measure G on the ballot
- RESULTS: (including maps of County and Precinct Districts)

8/3/10 AF from Frank Tallerico

August 2, 2010

To: Members, Siskiyou County Board of Supervisors

From: Frank Tallerico, President
Siskiyou County Water Users Association

Subject: Advisory Measure regarding dam removal on Nov. 2, 2010 ballot

The proposed advisory ballot measure supports every public comment the Siskiyou County Board of Supervisors has made to date. Off the record, we all have heard that the majority of voters in Siskiyou County oppose dam removal. Now is the time to call upon those voters and let's set the record straight.

Whatever letter of the alphabet is assigned to this measure by our County Clerk, this measure is a **proactive approach** to this very serious problem facing our county, and yet has all of ingredients that Board of Supervisors has supported since this dam removal issue reared it's ugly head almost three years ago.

1. In 2008, the Siskiyou County Board of Supervisors passed a resolution opposing dam removal.
2. This ballot measure supports the scoping feedback you have obtained from the many people who attended the three sessions held by the Board and the Department of Interior in the last five months.
3. This ballot measure supports the proposed Shasta Nation/Siskiyou County Water Users Association's Alternative, and which the Board Supervisors has supported, with a logical bypass around Irongate and the two Copco dams.
4. This ballot measure builds upon initiative that there are projects in both the Shasta and the Scott River Basin's that can enhance habitat for migrating salmon and to expand the salmon's use of these two rivers.
5. This ballot measure will generate a county-wide position that can be included in grant applications for funds from bonds that already have been passed and future bonds.
6. The advisory ballot will give the voters of Siskiyou County a **VOICE** in something that will have a direct impact upon their lives and future generations.

MEASURE "W" SAVE OUR DAMS

PURPOSE: To place on the November Election Ballot a measure that will give the citizens of Siskiyou County the opportunity to express their opinion as to whether to retain or to remove the four dams on the Klamath River scheduled for removal by the KBRA and the KHSA.

CONCERN: With respect to the proposed removal of four dams on the Klamath River: Iron Gate, Copco No. 1, Copco No. 2, and the J C Boyle Dam, the Residents and Property Owners within the Klamath River Drainage Basin and all of Siskiyou County Residents have the following concerns related to their rights as Citizens and as Property Owners.

Siskiyou County Government has the Responsibility and Duty under the State Government Code to protect Private Property Rights and to protect the well being of its citizens from floodwaters, water quality, economic and other social and environmental concerns. Siskiyou County Government is our Lead Agency for any proposed changes in land use and for any proposed private property projects within the county such as the removal these dams.

DECLARATION: The removal of these dams will affect **all** of the County's Citizens and Property Owners.

Following list of some concerns that are directed to the Board of Supervisors with the request that they stand by and support the position of the citizens of Siskiyou County as to whether the Dams are to be Retained or Removed.

PARTIAL LIST OF CONCERNS:

- ☐ **Irresponsible expenditures during a national economic crisis**
- ☐ **Unnecessary loss of green hydro-electric power for 70,000 homes**
- ☐ **Cost to replace hydro-power**
- ☐ **Substantial increase in electricity cost**
- ☐ **Replacement of clean hydro- power with fossil fueled power**
- ☐ **Loss of wildlife habitat**
- ☐ **Loss of lake fisheries**
- ☐ **Loss of Iron Gate fish hatchery**
- ☐ **Loss of recreation**
- ☐ **Loss of esthetics**
- ☐ **Loss of property values**
- ☐ **Loss of roads and bridges from flooding**
- ☐ **Loss of emergency services during flooding (public safety)**
- ☐ **Loss of fire protection**
- ☐ **Loss of filtering down river flows**
- ☐ **Loss of sustained minimum river flows**
- ☐ **Irresponsible release of dam sediments down river**
- ☐ **Promised? power cost and water benefits to upper basin landowners**
- ☐ **Lack of any direct physical factual benefits to upper basin land owners**
- ☐ **Lack of factual evidence that dam removals will restore salmon runs**

Should our dams be removed? ☐ **Yes** ☐ **No**

on Measure G Committee
47 N. Main Street
eka, CA 96097

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SAVE THE DAMS, SAVE SISKIYOU COUNTY

VOTE ☑ NO ON MEASURE G

DON'T BE FOOLED BY THE LIES!

This is your only chance to be heard

DAM REMOVALS WILL NOT:

- Guarantee Yreka's water supply
- Give us long-term local jobs
- Improve coho habitat or water quality
- Provide enough river flow for fish without taking our water

DAM REMOVALS WILL:

- Increase everybody's electric and water bills
- Cause major flooding damage: roads, bridges, structures
- Decrease everybody's property values
- Eliminate **millions of tax dollars** from the County
- Make our farmers and ranchers **lose** water to a few favored special interests



VOTE ☑ NO ON MEASURE G

RESOLUTION NO. 10-185

RESOLUTION OF THE
SISKIYOU COUNTY BOARD OF SUPERVISORS
CALLING FOR AN ADVISORY ELECTION
WITH RESPECT TO THE
REMOVAL OF DAMS ON THE KLAMATH RIVER
TO BE HELD NOVEMBER 2, 2010

WHEREAS, the Siskiyou County Board of Supervisors wishes to provide the voters of this County with the opportunity to voice their opinion with respect to whether or not they support the removal of the Klamath River dams (Iron Gate, Copco 1, and Copco 2) and associated hydroelectric facilities;

NOW, THEREFORE, BE IT RESOLVED that the Siskiyou County Board of Supervisors hereby call an advisory election to be held on the same date and time as the next statewide regular election, Tuesday, November 2, 2010. At such election the issue to be presented to the voters of the County of Siskiyou shall be:

"SHOULD THE KLAMATH RIVER DAMS (IRON GATE, COPCO 1, AND COPCO 2) AND ASSOCIATED HYDROELECTRIC FACILITIES BE REMOVED?

YES _____ NO_____"

BE IT FURTHER RESOLVED that the Siskiyou County Board of Supervisors hereby authorizes and directs the County Clerk to provide all necessary election services and to canvas the results of the election and conduct such election as required by law as hereinabove requested.

SISKIYOU COUNTY
RESOLUTION
No. 10-185

BE IT FURTHER RESOLVED that the County Clerk is authorized and directed to include notice of the advisory election in any Notice of Election published pursuant to California Elections Code Section 10417 and 10418 as authorized or otherwise required by law respecting statewide elections to be held on the date set forth.

PASSED AND ADOPTED at a regularly scheduled meeting of the Siskiyou County Board of Supervisors, this 6th day of August, 2010, by the following vote:

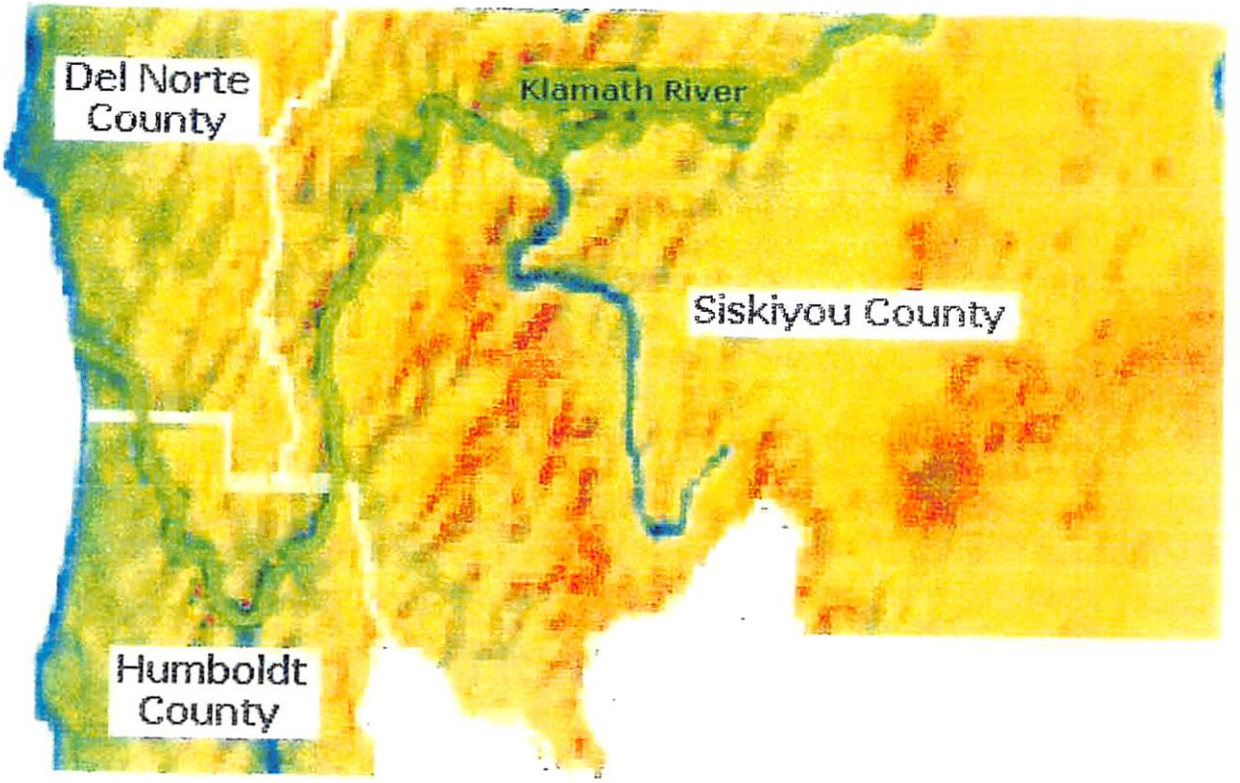
AYES: Supervisors Armstrong, Kobseff, Cook and Bennett
NOES: Supervisor Valenzuela
ABSENT: NONE
ABSTAIN: NONE

Márcia H. Armstrong
Chair, Board of Supervisors

ATTEST:
COLLEEN SETZER, Clerk
Board of Supervisors

By _____
Deputy

Course of Klamath River in California
Voter preference on retention of Dams



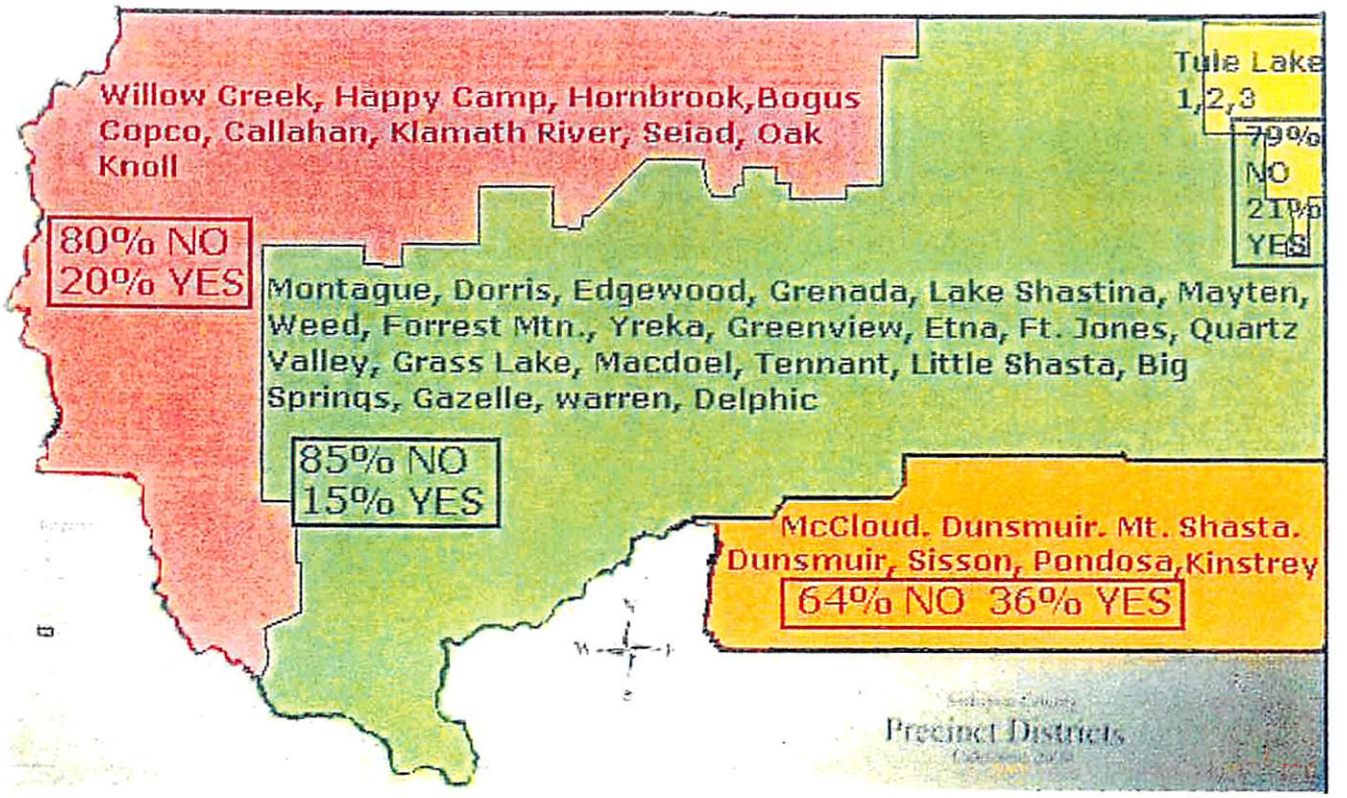
California hosts 195.5 miles of the Klamath River

Siskiyou County hosts 133 miles of the Klamath or 68%
Humboldt County hosts 51.5 miles of the Klamath or 26.4%
Del Norte County hosts 11 miles of the Klamath or 5.6%
There is also mileage in Klamath County, Oregon

79% of Siskiyou County Voters wish to retain the Dams

Sisikiyou County voting record on Dam Removal

Measure G Nov. 2010



There are 25,922 registered voters in Siskiyou County of which 59.73% of the voters cast ballots on this measure.

There were 14,206 votes for measure G
11,229 voted NO on removal of dams or 79.04%
2,977 voted YES on removal of dams or 20.96%

This is a clear mandate by the citizens of Siskiyou County on the issue of dam removal on the Klamath River.

II

RESOLUTION BY SISKIYOU COUNTY BOARD OF SUPERVISORS (BOS):

- RESOLUTION to not be party to or sign the KBRA (Klamath Basin Restoration Agreement)or the KHSA (Klamath Hydro- Electric Settlement Agreement)
  .
- LETTER TO SISKIYOU COUNTY BOS: advising them not to sign the KBRA, recent legislation passed for flood control, including an Inflow Outflow Hydrograph for the flood protection provided by the dams proposed for removals, and responses to and from the DOI

RESOLUTION OF THE
BOARD OF SUPERVISORS
OF THE COUNTY OF SISKIYOU
OPPOSING DAM REMOVAL AND THE CURRENT
"KLAMATH RIVER BASIN RESTORATION AGREEMENT"
AND EXPRESSING ITS WILLINGNESS TO PURSUE
ALL APPROPRIATE AVENUES TO PROTECT
THE INTERESTS OF ITS CITIZENS

WHEREAS, the County of Siskiyou is the area where three of the four dams slated for removal are situated and which will be most affected by dam removal; and,

WHEREAS, the County of Siskiyou wishes to insure that the public health and safety of its residents are fully protected; and,

WHEREAS, Siskiyou County, in order to accomplish the foregoing, has participated in good faith in the Klamath Settlement Group, a group which was ongoing at the time that Siskiyou County was allowed to participate and which had as its mission at the time that Siskiyou County was allowed to participate the exploration of dam removal as opposed to other potential options for fish health, fish restoration, and river health; and,

WHEREAS, the County of Siskiyou, as part of its ongoing efforts to insure that all is done to identify and protect against potential impacts, sought to have neutral, independent, peer-reviewed studies done to seek to articulate the potential impacts which might result and to attempt to identify potential alternate courses of action, which proposal was declined by the Settlement Group; and,

WHEREAS, the County of Siskiyou still seeks to explore options that would maximize fish recovery and river health without dam removal; and,

WHEREAS, the current draft proposal still continues to envision removal of all four PacifiCorp dams on the Klamath River, including three of which are located in Siskiyou County; and,

WHEREAS, the residents of Siskiyou County will suffer economically from lost tax revenues resulting from dam removal, including lost revenues from reduction of property values, which revenues provide a number of governmental services, including law enforcement and other health and safety services. In addition, Siskiyou County will suffer the loss of world class whitewater rafting, the loss of lake recreational and fishing opportunities, the loss of carbon neutral, inexpensive hydropower, the possible unleashing of large amounts of sediment of unknown properties currently lodged at the base of the

SISKIYOU COUNTY
RESOLUTION
No. 08-68

dams, and other possible degradation in the quality of the life of those residing in Siskiyou County; and,

WHEREAS, the County of Siskiyou and its citizens have displayed a strong commitment to river and fish health, as evidenced by the role they have and continue to play in promoting Coho salmon recovery, in concert with the California Department of Fish and Game; and,

WHEREAS, the County of Siskiyou has consistently maintained that the dam owners, PacifiCorp, should be required to undertake all reasonable measures which would promote Coho salmon recovery; and,

WHEREAS, there have been no neutral, independent, peer-reviewed studies conducted that have concretely demonstrated that dam removal would promote significantly greater fish recovery than fish ladders and other measures that PacifiCorp has agreed to install and implement; and,

WHEREAS, dam removal poses a significant threat to water quality in light of the release of many tons of potentially toxic sediment that has accumulated behind the dams; and,

WHEREAS, it does not appear that sufficient studies have been done to support dam removal prior to a commitment to such a course of action; and,

WHEREAS, the proposed restoration agreement would exclude representation from Siskiyou County and the Scott and Shasta Resource Conservation Districts from the group of "Fish Managers" designated to write a new Restoration Plan; and

WHEREAS, the proposed Restoration Agreement would exclude representation from the Scott and Shasta RCDs, farming and ranching communities, Upper Mid-Klamath Watershed Council and Copco landowners from the Klamath Basin Coordinating Council and from setting policies and making decisions regarding the allocation of restoration funding; and

WHEREAS, it appears that the dam owner, PacifiCorp, is hesitant to assume any legal liability for the consequences of dam removal and would desire protection against or limitation of liability for the consequences of dam removal; and,

WHEREAS, it does not appear that any entity, including the state and federal governments, is willing to come forth and assume liability for any consequences of dam removal if PacifiCorp is able to obtain a limitation or waiver of liability for the consequences of dam removal; and,

WHEREAS, the current proposal under review does not mitigate the adverse impacts of dam removal for the citizens of Siskiyou County; and,

WHEREAS, it continues to be indicated that any such mitigation would be part of any settlement agreement with the dam owner, PacifiCorp; and,

WHEREAS, there is presently no such agreement in place with PacifiCorp; and,

WHEREAS, there is no clear policy determination made by the participating states or the federal government regarding dam removal, nor does it appear from the proposed Agreement that all of these entities would be signatories to the Agreement; and,

WHEREAS, there currently is no agreement with the owner of the dams, which would allay the fears of an apprehensive citizenry in Siskiyou County that the reasonable risks and potential consequences of dam removal will be reasonably addressed; and,

WHEREAS, the preliminary review of the adverse consequences of dam removal gives Siskiyou County concerns about this potential course of action without in-depth, sound, scientific studies supporting such a decision to remove; and,

WHEREAS, there is no clear candidate who has emerged to assume the risk of the consequences of dam removal; and,

WHEREAS, while the federal government does possess the legal power to assume the responsibility for acquiring ownership of the dams and therefore the responsibility for removal if it wishes to do so, it has not chosen to do so; and,

WHEREAS, the Klamath River Basin Compact and the Siskiyou County Flood Control and Water Conservation District have powers and duties directly pertinent to ongoing disputes in the Klamath Basin and should be included in any process seeking solutions to those disputes; and

WHEREAS, these unaddressed concerns, including, but not limited to, the failure to satisfactorily address economic losses, loss of economic opportunity, loss of carbon neutral replacement power, the failure to clearly articulate a rehabilitation and restoration commitment, the unwillingness to address and reasonably restore infrastructure stress and serious damage which could occur from dam removal activity (including potential damage to the City of Yreka's water supply lines), lack of full due diligence and thorough economic environmental review and the commitment to not proceed in the face of identified impacts by use of the CEQA override process, the failure to make provision for reimbursement for property owners who can prove that they have been damaged from dam removal or dam removal activity, and because of the potential for yet unknown and unarticulated impacts

which might result from dam removal and dam removal activity, require the Board of Supervisors of the County of Siskiyou, at this time, to conclude and resolve that:

BE IT RESOLVED that the Board of Supervisors of the County of Siskiyou renews and restates its opposition to dam removal.

BE IT FURTHER RESOLVED that the Board of Supervisors of the County of Siskiyou is opposed to the present draft of the Klamath River Basin Restoration Agreement and Siskiyou County, although not willing to sign the agreement, will seek to open discussions in pursuit of actions to improve fisheries, water quality, and Upper Basin water surety, and will continue to work with and pursue all avenues other than dam removal to protect the interests of its citizens.

BE IT FURTHER RESOLVED that any resolution or potential settlement of the pending FERC application should involve license extensions for a period of time reasonably sufficient to allow all the due diligence efforts and public interest determinations required to fully illuminate and inform a possible decision to relicense dams in the longer term, including full exploration and evaluation of the following:

(1) The positive impacts of the Irongate Fisheries Hatchery upon salmonid populations;

(2) The viability of trap and haul methodology as a means of sustaining salmonid survivability above dams;

(3) All fish diseases, including the *C. Shasta* parasite, which currently decrease salmonid survival in the Klamath Basin, and the possible means to alleviate or eradicate these diseases;

(4) Algae ecology related to the dams, and the potential means by which algal concerns in the Klamath Hydro-project area can be alleviated;

(5) The negative impacts on salmonid survival related to conditions in the ocean habitat which can be reasonably influenced, and the potential ways in which these impacts can be alleviated or eradicated;

(6) Impacts of commercial ocean, Tribal, and in-river fishing and natural predators upon anadromous fish; and,

(7) Should dam removal be entertained as an option by any settlement process, a full comprehensive scientific exploration and evaluation of the impacts of sediment release on the physical and biological

environment, and human communities below the dams must be included with such consideration.

BE IT FURTHER RESOLVED that this Resolution be sent to:

(1) The Governor of the State of California.

(2) The Governor of the State of Oregon.

(3) The U.S. Department of the Interior.

(4) The U.S. Department of Agriculture.

(5) The Federal Energy Commission.

(6) The Bureau of Indian Affairs.

(7) The California Department of Water Resources.

(8) The Oregon Department of Water Resources.

(9) The State Water Resources Control Board.

(10) Senator Diane Feinstein.

(11) Senator Barbara Boxer.

(12) Congressman Wally Herger.

(13) Congressman Mike Thompson.

(14) Senator Sam Aanestad.

(15) Assemblyman Doug LaMalfa.

(16) Klamath County, Oregon.

(17) Trinity County, California.

(18) Humboldt County, California.

(19) Del Norte County, California.

(20) All newspapers of general circulation in this County.

(21) All newspapers of general circulation in Klamath County, Oregon.

(22) The Sacramento Bee.

PASSED AND ADOPTED this 15th day of April, 2008, by the following vote:

AYES: Supervisors Overman, Armstrong, Kobseff and Cook
NOES: NONE
ABSENT: Supervisor Erickson
ABSTAIN: NONE

W. R. Overman, Chair,
District 4

LaVada Erickson, Vice Chair,
District 2

Jim Cook, Supervisor, District 1

Marcia Armstrong, Supervisor, District 5

Michael Kobseff, Supervisor, District 3

ATTEST:
COLLEEN SETZER, Clerk
Board of Supervisors
By: _____
Deputy

G:\Share\FERC_KRB Restoration Agreement Resolution 2008\Resolution by Board Opposing Dam Removal and Current KRB Settlement Agreement 04_15_08 FINAL DOC.wpd

4/15/0

Additions to proposed Klamath Basin Restoration Agreement Resolution

Page 4 - 3rd paragraph down insert in second to last line between "and pursue all appropriate avenues" and "to protect the" - the phrase "other than dam removal" full section of sentence would read "and will continue to work with and pursue all appropriate avenues other than dam removal to protect the interests of its citizens."

Under the enumerated BE IT FURTHER RESOLVEDS add:

(6) Impacts of commercial ocean, tribal and in-river fishing and natural predators upon anadromous fish; and

(7) Should dam removal be entertained as an option by any settlement process, a full comprehensive scientific exploration and evaluation of the impacts of sediment release on the physical environment and human communities below the dams must be included with such consideration.

and biological added

APRIL 1, 2010

Jerry L. Bacigalupi, P.E.
P.O. Box 309
Montague, Ca. 96064
530 459 5546
916 768 5015

Siskiyou County Board of Supervisors (B.O.S.)
C/O County Clerk Office
510 North Main Street
Yreka, Ca. 96097

Subject: Written testimony for Proposed Klamath Basin Restoration Agreement (K.B.R.A.) Hearings at the Convention Center on April 1, 2010

As I stated in my letter to the B.O.S. on Nov. 12, 2009, it is time to give serious consideration to the proposed Klamath Basin Restoration Agreement **(DO NOT SIGN).** It is also time that the **B.O.S.** stand to the position that they were sworn to: to protect the property rights and the rights of the public, and to voice the will of the people of Siskiyou, County.

I am a Registered Professional Engineer with extensive experience in water resources engineering, FEMA Base Flood Elevation studies, bridge hydrology and hydraulic studies, bridge and highway design and construction. I am also a Siskiyou County property owner with over 4,800 acres of land in the County.

If this proposal is implemented, it is my opinion and fear that the consequences will be dire and harm many. The proposal is shortsighted with not all the stakeholders at the table. I cannot see one aspect of this proposal that would have a direct benefit to any property owner in our County. The proposed Agreement is a can of worms with no factual benefits to the public, and if allowed to go further, will decrease property values and only produce future problems for the majority of Siskiyou Co. property owners and citizens, with the County **B.O.S.** faced with **major law suits.**

Accordingly, it is imperative that County B.O.S. takes their Legal Position as the Lead Agency at this time.

Please take notice to my following observations and comments:

1. **Applicable Existing Laws and Regulations Need to be Followed.** Federal and State Agencies are proposing to erode (washing) 84% of the estimated 20.4 million cubic yards of the sediment deposits in the lakes down river as the reservoirs are drained. The State Water Quality Control Board and Department of Fish and Game, and the U.S. Corps of Engineers regulate all private construction

projects involving disturbed soil, within a drainage watercourse. How could anyone even consider such an irresponsible recommendation by public agencies? Moreover, the planning and zoning laws of the State of California, starting with Section 65000 of the Government Code, require that all lands be zoned appropriately with regard to their highest and best uses. All dams on the Klamath River subject to dam removal were constructed prior to the enactment of the California Planning and Zoning laws. The Siskiyou County Planning and Zoning Laws and the Land Use Element of the General Plan is required to designate the location and permitted uses of the land within and adjacent to these dam and reservoir areas, and identify **lands down stream which are subject to flooding.** The Conservation Element of the General Plan provides for the conservation, development, and utilization of natural resources including water and it's **hydraulic forces, flood management, water conservation, and the prevention, control and correction of soil erosion.**

The intent and purpose of the State Planning and Zoning Laws is to protect resources and property rights. Property owners adjacent to and downstream from the proposed dam removals expect their **property rights to be protected and upheld by State and Local Governments.**

Further, recent legislation passed in 2007, AB 70 (Ch. 367) and AB 162 (Ch. 369) expands the requirement for Cities and Counties to incorporate **flood control and management** and **provides that a city or county may be required to contribute its fair and reasonable share of the property damage caused by flooding,** & I might add, flooding caused by dam removal.

2. **Where are the Studies and Supporting Data related to Dam Removal?**
   a. Down Stream Flood Studies (FEMA Base Flood Elevation data)
   b. What to do with the bath rings around the dams? They will never be mitigated.
   c. Reducing river temperatures without low-level dam releases?
   d. Sustaining minimum flows with-out sustained dam releases.
   e. Washing dam sediment deposits down river.
   f. Replacing clean hydro-electric power.
   g. Rate increases to PP&L customers.
   h. Etc.

3. **Where are the Studies Supporting Coho Salmon Recovery if the dams are removed?** This appears to be a very controversial subject and one area that is not Supported by fact. **Can or will Coho Salmon migrate above Spencer Falls? Is the big picture being considered? Offshore foreign cannery factories, Protected Sea Lyons, Gill Netting, The killing of thousands of returning Coho Salmon at Iron Gate fish hatchery, etc.**

4. **Dams Provide Clean Energy.** At the present time California and the Nation is faced with three critical issues: a fiscal crisis, a water crisis and an energy crisis. Our state (and nation) should be trying to preserve and improve upon these dams and clean hydroelectric power generation facilities instead of removing them. The dams generate a substantial amount of clean renewable hydroelectric power. The

conditions and constraints being placed on Pacific Corp by Federal and State agencies are so extensive and costly and too "Dams Out" oriented. This is like raising rent so high the tenants are forced to move out.

5. **Dams Provide Critical Flood Protection.** The flood protection currently provided by the dams in place is notable. Without the dams much of the private property adjacent to the Lower Klamath River would be subject to severe flooding and erosion. Highway 96 may have to be relocated in several locations and many bridges replaced to provide the same level of service and protection that we currently enjoy.

   The 1964 flood destroyed many bridges on the Lower Klamath and washed out much of Highway 96. All of the dams that are proposed for removal were in place during the 1964 flooding. All roadways and bridges were re-located above the calculated Base Flood Elevation considering all existing dams in place. For public agencies to even consider removal of these dams without an in-depth study of the flood protection that they provide is very irresponsible.

   Attached is an Inflow / Outflow computer model of the Klamath River at Iron Gate using the 1964 Recorded Flood Data, which shows that there is a 22% reduction in peak flows and a peak delay of nine hours.

   The Board of Supervisors has the duty and is liable for any action, that they take or do not take to control flooding downstream of the Iron Gate Reservoir with the removal of these dams.

6. **Mother Nature Will Hit Hard.** Without the dams the Lower Klamath River peak flows and velocities will increase significantly during flood conditions, well in excess of these conditions experienced with dams in place. The increased velocity of the river will increase the bed load carrying capacity (boulders, rocks, gravel, sand, and silt) and increase the size of the rocks and boulders carried down stream. . With dams in, the tributaries have deposited their bed loads into the river, some of which were carried down stream and some of which (larger rocks and boulders) remain in the river because of reduced historic peak flows caused by the dams being in place and the river's inability to carry the larger bed loads. Most of these recent deposits will be carried down river during future flooding conditions without the dams in place, inevitably changing the river's course at several locations.

7. **The Dams Provide Controlled Necessary Cool Water.** Dams allow a controlled release of water on the Lower Klamath River, which maintains minimum flows and also contributes to filtering and cooling. This benefits fish and wildlife and allows fishing, rafting and other river recreation activities without the danger of sudden rises in river levels.

8. **The Dams Created Iron Gate Fish Hatchery.** The CDF Fish Hatchery at the base of Iron Gate Reservoir receives its water supply from low-level releases from

Iron Gate Reservoir. Without this cold filtered controlled water supply from Iron Gate, the fish hatchery's future operations will be dismal or non-existent.

9. **The K.B.R.A."Dams Out" Public Hearings have Ignored Well Established Science.** At one of the "Dams Out" meetings I pointed out that dams with deep water releases do provide cooling of the river below the dams. The U.S. Fish and Wild Life Service argued against this point stating that the dams are like a bathtub and have little or no effect on river temperatures below the dams. This is contrary to scientific fact.

At a later meeting the same point was raised; this time the U.S. Fish and Wild Life Service argued that the dams cause the river to be too cold at times for spawning fish and fry in the spring and fall.

When asked about the flood protection dams provide, their response was that the dams are like a wide spot in the river and provide little or no flood protection **(wrong! all dams provide some flood protection)**.

At a recent presentation by the State Water Resource Control Board a graph was presented to the public showing that the low-level releases from Iron Gate Reservoir were 10 degrees C or 20 degrees F above their estimated river temperatures with the dams removed **(this is an impossibility)**. I questioned this data and they responded that they did also. I then asked them why is this data being used? Their response was that this is the only data in this area that we have.

In short, the public has been presented with biased data that supports "Dams Out", much of which is contrary to well established and undisputed science in this area.

These are only some of the reasons why it is imperative that the B.O.S. take their sworn duty to Siskiou Co. property owners and citizens as LEAD AGENCY on this proposal at this time.

10. **FACTUAL AND HYPOTHETICAL DATA:**
    a. It is **FACTUAL** that the dams do provide clean electrical power to 70,000 homes; provide flood protection for down stream properties; provide cooler sustaining river flow releases; provide lake recreation; provide a safe pleasing natural looking front yard for several private property owners along the river and around the dams proposed for removal; provide for fish and wildlife habitat; maintains the Iron Gate Fish Hatchery; and much more.

    It is **HYPOTHETICAL** that the removal of 4 dams will provide any benefits what so ever to restore or improve coho salmon runs or provide any direct factual benefits to the Klamath River Basin.

Recommendations:

My recommendations to the Siskiyou County Board of Supervisors, the **PERMIT ISSUING AGENCY** for any proposed private land projects of Siskiyou County, is to:

1, **Demand and Take the Lead Position** on this proposed change in private land use.

2. **Require and Direct an unbiased study** addressing: flood protection, environmental impacts, recreation, costs, benefits, and a study addressing the replacement of clean renewable hydroelectric power, etc.

Removal of these dams without proper studies, environmental documents, and the involvement of the public will set the Federal, State and County Governments up for a **multitude of law suits.**

3. **Do not become signature to the K.B.R.A..**

Thank you for considering my opinions.

Respectfully submitted,

Jerry L. Bacigalupi P.E. (RCE 18063)

Attachment: Inflow/outflow K.R. Hydrograph at Iron Gate

J.L.B. Construction and
Engineering
3097 Sierra Blv.
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KLAMATH RIVER

INFLOW OUTFLOW COMPUTER MODEL FOR COPCO NO.1 & IRON GATE DAMS

USING 1964 FLOOD OUTFLOW DATA RECORDED 12/22/1964 @ GAGE 11516530 BELOW IRON GATE

OUTFLOW: IRON GATE DAM OF 29,400 cfs

CALCULATED INFLOW: Tc =24hr.; Q100 =35,700cfs

TIME hr.	INFLOW c.f.s.	OUT FL. c.f.s.	"Q"net ave c.f.s.	VOL. net Q(0.25) ac.ft.	AREA ac. (combined)	VOLUMN ac.ft. (V/7.407)*.5 combined	SURFACE EL. 2189.0ft.+ (V/7.407)*.5= 2,328.0+H	HEIGTH "H" (ft.) outflow	OUTFLOW Q=585(H)*1.5 +1000 c.f.s.
PEEK	35,700								
0	1000	1000	0	0	2000	135,000	2328.00	0.00	1000
3	4463	1000	1731	433	2003	135433	2328.22	0.22	1060
6	8925	1060	5633	1408	2014	136841	2328.92	0.92	1517
9	13388	1517	9639	2410	2031	139251	2330.11	2.11	2797
12	17850	2797	12822	3206	2055	142456	2331.68	3.68	5133
15	22313	5133	14948	3737	2081	146194	2333.49	5.49	8523
18	26775	8523	16020	4005	2110	150199	2335.40	7.40	12778
21	31238	12778	16229	4057	2138	154256	2337.31	9.31	17621
24	35700	17621	15848	3962	2165	158218	2339.15	11.15	22788
27	33469	22788	11796	2949	2185	161167	2340.51	12.51	26880
30	31238	26880	5474	1368	2195	162535	2341.13	13.13	28843
33	29006	28843	1279	320	2197	162855	2341.28	13.28	29307
36	26775	29307	-1417	-354	2194	162501	2341.12	13.12	28793
39	24544	28793	-3134	-783	2189	161717	2340.76	12.76	27665
42	22313	27665	-4237	-1059	2182	160658	2340.28	12.28	26160
45	20081	26160	-4963	-1241	2173	159417	2339.71	11.71	24429
48	17850	24429	-5463	-1366	2164	158052	2339.08	11.08	22564
51	15619	22564	-5829	-1457	2154	156594	2338.40	10.40	20623
54	13388	20623	-6120	-1530	2144	155064	2337.69	9.69	18643
57	11156	18643	-6371	-1593	2133	153472	2336.94	8.94	16647
60	8925	16647	-6607	-1652	2121	151820	2336.17	8.17	14654
63	6694	14654	-6845	-1711	2109	150109	2335.36	7.36	12676
66	4463	12676	-7098	-1775	2097	148334	2334.51	6.51	10726
69	2231	10726	-7379	-1845	2083	146490	2333.63	5.63	8818
72	1000	8818	-7202	-1801	2071	144689	2332.76	4.76	7084

INCREASE IN FLOW WITHOUT DAMS : 35,700-29,307= 6,400 c.f.s. OR 22% @ IRON GATE
DELAY OF PEAK FLOW: (33-24) = 9HR
NOTE:above quantities include 1,000 cfs sustained flows through power facilities

DATA:

1964 FLOOD OUTFLOW DATA RECORDED 12/22/1964 @ GAGE 11516530 BELOW IRON GATE DAM OF 29,400 cfs. & DEPARTMENT OF WATER RESOURCES BULLETIN 17-93

DAM	SURFACE AREA	VOLUMN	SPILLWAY ELEV.	FREEBOARD
COPCO NO.1	1,000 ac.	77,000 ac.ft.	2,464 ft.	20 ft.
IRON GATE	1,000 ac.	58,000 ac.ft.	2.328 ft.	15 ft.
COMBINED	2,000 ac.	135,000 ac.ft.		

To: Ms. Elizabeth Vasquez
Bureau of Reclamation
2800 Cottage Way
Sacramento, CA 95825

June 13, 2013

Gordon Leppig
California Department of Fish & Game
619 Second Street
Eureka, CA 95501

From: Jerry L. Bacigalupi
Professional Engineer (P.E.)
P.O. Box 309
Montague, CA. 96064 (530) 459-5546 (916) 768-5015c

Dear Ms. Vasquez and Mr. Leppig:

Following are my comments to the **Klamath Facilities Removal Final EIS/EIR** (dated December 2012, but not mailed to respondents until 04/05/13)

1) As a citizen and Professional Engineer I am disappointed at the professional integrity within the DOI and CDFG. In reviewing several of the EIS/EIR comments submitted to the DOI and the DOI responses, I am disturbed at the DOI's lack of professional knowledge, goal oriented responses, and spin **supporting dam removals**.

2) After reviewing my comments and the DOI responses, I feel that my comments were not addressed. **I would make the same comments again.** The point being that the EIR/EIS has not been properly completed because the **EIS/EIR process is flawed** with responses that lack professional and scientific integrity, and with probable misconduct, all supporting the KBRA / KHSA (Dam Removals). In addition viable alternatives with dams in place were not studied, and the facts that the Upper Basin Water Wars and the Klamath Hydro-Electric Facilities are not physically related. The KBRA & KHSA improperly mandate stakeholders agreeing to Hydro- Electric Dam Facility removals.

3) In particular I would like to address my highlighted comment #5 and DOI response **(Comment 6 Hydrology).** To quote my comment:
"In Chapter 3 - 3.6 Flood Hydrology of the EIR/EIS, data provided does not accurately represent current independent scientific or historical data. The data and conclusions presented was data that supports the Lead Agencies' desired outcomes and not supported by recognized engineering practices.

   a) Table 3.6-5 shows the 100-yr flows at Keno at 11,800cfs and Iron Gate at 31,460cfs. **A statistical analysis using data from Calif. Division of Dam Safety shows 100-yr. flows for Keno at 12,000cfs and Iron Gate at 30,600cfs. This is a close check, however;**
   Table 3.6-9 shows a 6.9% reduction in the flood attenuation of Iron Gate and COPCO Reservoirs combined.

This is in substantial disagreement with an engineered independent evaluation. Using the 1964 flood data for Gage 11516530 (29,400cfs peak flow at Iron Gate) an inflow out flow hydrograph combining both reservoirs shows a 22% reduction in peak flow and a 9 hour delay in peak discharge.

b) Table 3.6-9, the 100 yr. flood plain below Iron Gate Reservoir, and the write up needs to be recalculated and re-evaluated using properly engineered procedures for inflow/outflow analysis **based on historic hydrographs** to **show that the Dams Provide Critical Flood Protection."**

The DOI Response to my comment :

GP_LT_1230_1220-6 Master Response HYDG-1 Flood Protection. The comment author refers to an analysis of the 1964 flood documented in a memo delivered to Siskiyou County (Bacigalupi, 2010). In this analysis, it was concluded that Iron Gate Dam and Copco Dam reduce the 100-yr flood by 22 percent. However, a time step of 3 hours was used in Bacigalupi (2010), which is too large and this caused **errors** in the results. If the same analysis was performed with a time step of 15 minutes or smaller, the flood attenuation effects would be very similar to Reclamation (2D12b) and find that the attenuation of the 100-yr is near 7 percent as stated in the Draft EIS/EIR.

My comment to the DOI response:
The same analysis was performed using the same computerized program, same data, and varying the time steps of the inflow outflow hydrograph as suggested by the DOI. The results are as follows:

Time Step Hr.	Inflow cfs	Outflow cfs	Peak Flow Delay Hr.	Increase In Flow With Out Dams %	Remarks
3	35,700	29,400	9	22	Original
1	36,800	29,400	10	25	1Hr. Steps
.25(15min.)	37,250	29,400	10.25	26.7	15min. Steps

The above results show that the DOI makes rudimentary conclusion and statements that are in **error** and that have definite impacts on the decision of dam removals.
The Dams do provide substantial (26.7%) flood protection. Table 3.6-9, the 100yr. flood plain and write up needs to be revised.
The EIR/EIS process has not been completed. The EIS/EIR is flawed with responses that are in error, and lack professional and scientific integrity, all supporting the KBRA / KHSA (Dam Removals).

Respectfully submitted:

Jerry L. Bacigalupi 06/13/13
Jerry L. Bacigalupi

III

SHASTA NATION ANADROMOUS FISH PASSAGEWAY ALTERNATIVES TO DAM REMOVALS:

WITH A BRIEF HISTORY REVIEW OF THE KLAMATH RIVER, KLAMATH RIVER BASIN, AND THE CURRENT SITUATION

SHASTA NATION UNASSISTED VOLITIONAL ANADROMOUS FISH PASSAGEWAY ALTERNATIVES TO DAM REMOVALS

WITH A BRIEF HISTORICAL REVIEW OF THE KLAMATH RIVER, KLAMATH RIVER BASIN AND THE CURRENT SITUATION

The following data is presented to give a brief introduction to current conditions on the Klamath River, which will lead into the development of the Shasta Nation Unassisted Volitional Anadromous Tunnel Fish Passageway proposal as viable alternatives to the placement of fish ladders on three of the four dams targeted for removals, or the removals of the four dams: **J.C.Boyle, COPCO 1, COPCO 2, and Iron Gate.**

SHASTA NATION TRIBAL HISTORY

The Shasta Nation's First People occupied their aboriginal territorial lands in and around the four Klamath River Dams targeted for removal for centuries before their native way of life was disastrously disrupted by the intrusion of the Euro- American's lust for gold during the 1850's. The Shasta Nation's Aboriginal Territory is now known to be a portion of Southern Oregon and Northern California. The Shasta People were a forceful nation of six groups of Native Indians known as the Shastan Group, with each group speaking a variation associated with the Hokan Family Group language. The Shastan Group Indians were comprised of the Shasta, New River Shasta, Konomihu, Okwanuchu, Achomawi, and the Atsugewi Indians. The post Euro-American Shasta Nation is comprised of the Shasta Valley, Scott Valley, Okwanuchu, New River Shasta, Konomihu and Upper Klamath River Indians who lived downriver from Keno, Oregon.

The Shasta Nation's aboriginal territory, cultural heritage, and burial sites lie under and around the waters behind the dams proposed for removal.

Refer to Table of Contents: "MAPS" showing sites beneath these waters.

KLAMATH RIVER HISTORICAL REVIEW

The river has been the subject of much conversation and study going back to the 1800's. One story relates to General Freemont's expedition down the river. The report states that they tried to camp on its banks but could not because of the amount of dying fish caused by the lack of adequate water which created low flows and warm water temperatures. The conditions created a huge stench. It was so bad that the expedition's horses would not drink the water.
One of the first studies on the river was done in 1897 by Dr. Warren Barton Everman, a Federal Biologist. Some of the noteworthy comments in the report described the water as very warm and cloudy with difficulty seeing the fish occupants. They reported the cause being natural volcanic vents in the Upper Basin Lake (Upper Klamath Lake) emitting natural phosphorous and nitrate into the water. As the Everman team traveled west down River they noted that there were **no anadromous ocean going fish** in the River until they reached a point about where the present Iron Gate Reservoir is now located. They did observe a "species of land-locked salmon," then known as sockeye salmon. In their contacts with the Upper Klamath Lake Tribe, which inhabited the Upper Basin, they were told that the Upper Klamath Lake Indians traveled downriver to Shasta Tribe villages to trade for better quality fish. Evermam and his team were able to observe this trading.

KLAMATH BASIN OVERVIEW

The Klamath Watershed is a large geographical area with a land base of 11.4 million acres: 56% in California, 44% in Oregon, in a total of 9 counties, 5 in California and 4 in Oregon.
The local land use county authorities are:

California	Siskiyou	3,270,000 Acres
	Trinity	1,635,600 Acres
	Modoc	752,600 Acres
	Humboldt	600,000 Acres
	Del Norte	141,000 Acres
		6,399,200 Acres

Oregon	Klamath	3,113,100 Acres
	Jackson	1,600,000 Acres
	Lake	322,700 Acres
	Josephine	3,600 Acres
		5,039,400 Acres

The predominate feature of this watershed is the **Klamath River which originates in the lower one third of the Upper Klamath Basin at Link River Dam (base of Upper Klamath Lake in Klamath Falls, Oregon)** and flows west to the Pacific Ocean, a distance of 254 miles.
The Klamath River is physically located in 3 of the 9 watershed counties in which Siskiyou County has 56% of the River mileage.
The watershed is unique among all the major aquatic systems in the Western United States because of its upside down climatic and topographic conditions. Annual precipitation (snow and rain) amounts to approximately 90 inches in the coastal 1/3 of the river mileage, 15-30 inches in the central 1/3 of the river mileage, and less than 15 inches in the 1/3 that lies in the arid Upper Klamath Basin.
This low rainfall combined with the volcanic soils and shallow topography of the basin creates poor water quality conditions entering the Klamath River at Link Dam (River Mile 254). Water quality does improve moving towards the ocean starting at Iron Gate Dam (River Mile190).

THE KLAMATH PROJECT

In the 1850's, the discovery of gold in the Klamath River and its tributaries brought many people to select areas in the watershed seeking riches and to settle. The Upper Klamath Basin was found to be a hostile location and as a consequence was slow to develop.

The large, warm and shallow marshes of the Upper Klamath Basin were generally considered contaminated and toxic. These waters which were in contact with highly mineralized volcanic soils and geothermal conditions supported algae and disease carrying mosquito infestations. Between evaporation and infiltration in the upper basin marshes, the Klamath River waters between Keno and the Shasta River were frequently known by the locals to retreat subsurface in summer.

In the early 1900's, in cooperation with local landowners, the Bureau of Reclamation (BOR)proposed and engineered **The Klamath Project** for the Upper Basin (Klamath Falls-Tule Lake area) to consolidate a large portion of the marshes minimizing evaporation, infiltration, and mineral contamination. It would also expose rich bottomland for agricultural use, allow habitat and increase food availability for migratory waterfowl, minimize disease potential, and incorporate excess water from the normally landlocked Lost River to supplement Klamath River summer flows for the fisheries and irrigation.

Using an intricate system of canals, storage and diversion dams, and tunnels, electricity would be required to support the necessary pumping for the project. Research was performed and an agreement made for the locally formed Siskiyou Power and Electric Company (later to become COPCO – California Oregon Power Company, Pacific Power, and currently PacifiCorp) to finance a dam and provide power at cost for Project operation in exchange for augmented Klamath flows and Federal licensing. The lower dam (COPCO 1 at river mile 198) location was chosen in part due to consensus that salmon were never known in numbers above Spencer Creek due to impassability of the falls near Keno (river mile 230), generally depleted salmon physical conditions, and poor intermediate upper basin water quality.

Mitigation for the few blocked creeks normally accessible to salmon was accomplished by construction of the Fall Creek Hatchery.

Three dams were built prior to 1930 to satisfy the needs of the Klamath Project. **COPCO 1** in 1918, **Link River Dam** in 1921, and **COPCO 2** in 1925. Over the next forty years additional storage and stream flow maintenance structures were built to augment beneficial use of River and tributary waters for domestic, irrigation, flood protection, sediment control, fish and wildlife enhancement, recreational resources, industrial purposes, and hydro-electric power production. These improvements proved to be successful and concurrent with many of the largest salmon runs on record.

KLAMATH – SHASTA VALLEY RECLAMATION PROJECT

In 1923 the United States Reclamation Service (Horner J. Gault and Foster Towle) in cooperation with the State of California and the Klamath-Shasta Irrigation District investigated the feasibility of diverted water from the Klamath River one mile downstream from Keno, Oregon (at or near the present location of

Keno Dam) to the Shasta Valley via a gravity flow canal and tunnels flowing at 420 to 1100 cfs which would irrigate 25,000 to 65,000 acres. Several similar studies have been made since the 1923 investigation which are reported in this report.

KLAMATH BASIN BI-STATE COMPACT

Prior to 1955, after experiencing some major wet and dry years, representatives from Oregon and California began negotiations related to the water resources of the Klamath River Basin. Their interest was to facilitate and promote the orderly integrated and comprehensive development, use, conservation and control of water for various purposes. Five commissioners were selected representing two counties in Oregon (Klamath and Jackson) and four commissioners were selected representing California, (Modoc, Trinity, Humboldt, and Siskiyou) a 5th Commissioner (Director of Water Resources, State of California) became the 10th member. They developed a Bi-State Federal agreement called the **"Klamath Basin Compact".**
This document contains articles addressing controversial issues, equitable distribution and use between the two states and federal agencies, and for preferential rights for the use of water after 1957 for irrigation purposes in the Upper Klamath Basin in Oregon and California (The Klamath Project). The Compact was ratified by the Legislatures of both States and the U.S. Congress, and **signed into Law by the Governors of each State and the President of the United States on August 30, 1957.** This Act (Law), in conjunction with three appendixes that become a part of the Compact, was consented to by Congress.

Appendix B formed the **Siskiyou County Flood Control and Water Conservation District** (which is Appendix 89 to the California Water Code).
The Siskiyou County Flood and Water Conservation District is a district in politic with twenty-three powers. When Iron Gate Dam was completed in 1962, a provision in the aforementioned Appendix B not only set aside the District's **60,000 acre feet of reserved storage rights to be held for Shasta Valley water use,** it also gave latitude to carry out all works and improvements to make uses of water for any of the purposes authorized by the Bi-State Compact Act. (Articles: e, i, k, m, p, & q),
Including flood control.

MAJOR DAMS IN THE KLAMATH BASIN WATERSHED:

Within the River and its tributaries there are **twelve major water storage structures** from Upper Klamath Lake to the mouth.

Five are on tributaries:

Located in California: Dwinnell on the Shasta River, Trinity and Lewiston on the Trinity River which has a diversion to the Sacramento River.

Located in Oregon: Howard Prairie and Hyatt Prairie on Jenney Creek and Fourmile Lake on Fourmile Creek, all which have diversions to the Rogue Valley.

Seven structures are on the Klamath River main stem:

In addition to providing irrigation water and hydro-electric power, these dams collectively **provide flood control and maintain minimum prescribed water flows** in the River for fish, especially during drought conditions as the River has historically gone dry in the upper reaches during the late summer and early fall.

Located in Oregon:

Link River Dam (Upper Klamath Lake) (Head Waters of the Klamath River) (16'high) (Upper Klamath and Agency Lakes) (River Mile 254), **the largest natural lakes & storage structure,** a 66,000 ac., 400,000+ ac.ft., 30+ mile long shallow lake at the **head waters of the Klamath River,** constructed in 1921 by the Bureau of Reclamation. It has a fish ladder and provides storage for downstream flow maintenance, irrigation waters for the Klamath Project, and hydro-electric diversions for the East and West Side Developments (4 MW@1450 cfs) for PacifiCorp's power grid and the Klamath Project.

Keno Dam (25' high) (Lake Ewana) (River Mile 233), a 20 mile long narrow reservoir which backs up to the city of Klamath Falls, one mile downriver from Link River Dam, with construction completed in 1967. It is owned by PacifiCorp and operated under contract with B.O.R. It has a fish ladder and a storage reservoir. Its primary responsibility is to regulate down river flows on the Klamath River, based on the volume of water released to the River from Link River Dam and the Klamath Project canals.

J.C. Boyle Dam (68' high) (River mile 224), a 420 acre, 3,500 ac.ft., 3.6 mile long reservoir which backs up to 5 miles downriver from Keno Dam near the California/Oregon border, construction was completed in 1958. It is owned and operated by PacifiCorp. It has a fish ladder and conveys water to a penstock and

powerhouse through a two mile concrete canal parallel to the Klamath River. Its only purpose is to generate power (98 MW @1425 cfs).

Located in California:

COPCO #1 (126' high) (River Mile 198), a 1,000 acre, 77,000 ac.ft., 4.8 mile long reservoir which backs up to 21 miles downriver from the J.C. Boyle Dam, owned and operated by PacifiCorp, construction was completed in 1918. The purpose of COPCO #1 was to generate hydro-power (20 MW @1180 cfs, with provisions for additional generation) and sedimentation control for the Klamath Project. It also provides downstream flood protection and many recreational fishing and water sport opportunities for visitors from Oregon and California. There has been considerable land development around the reservoir with permanent and seasonal homes.

COPCO #2 (33' high) (River Mile 198), a small 5 acre, 55 ac.ft., 0.3 mile long reservoir which is directly downriver from COPCO #1 Dam. It is owned and operated by PacifiCorp. and was constructed in 1925. The dam was constructed for a hydro-electric diversion to a nearby penstock and powerhouse (27 MW @1338cfs) for the Klamath Project.

Iron Gate Dam (188' high) (River Mile 190), a 1,000 acre, 58,000 ac.ft., 6.5 mile long reservoir which backs up to one mile downriver from COPCO #2 Dam, owned and operated by PacifiCorp, constructed in 1962. It was designed to provide storage water for in-stream flow maintenance to support minimum flows for fall migration of salmon, down-river flood and surge control at the request of downstream residents, power generation (18 MW @1735 cfs), and cool summer water for Iron Gate Hatchery. It also provides many recreational fishing and water sport opportunities for visitors from Oregon and California.

Iron Gate Hatchery is directly down river and dependent on Iron Gate Dam. Constructed by Pacific Power in 1966 as an alternative mitigation measure to providing fish passage around the Dams to 25 miles of native river and to a few minor creeks which historically provided anadromous fish habitat. The hatchery is currently 80% financially supported by PacifiCorp. and receives its cool 59 degree summer water from two low level releases (20' & 70') from Iron Gate Reservoir, which allows blending to create desired water temperatures and dissolved oxygen. The Hatchery releases over six million fingerlings into the Klamath River a year: five million Chinook (King) Salmon released in the spring and one million released in the fall, 200,000 Steelhead, and 75,000 Coho Salmon.

Reserved Water Rights: Within the reservoir are several reserved water rights for storage and beneficial uses; the **Klamath-Shasta Valley Transfer** will utilize one. The Reservoir reserves a 60,000 acre feet water right that can be diverted to the Shasta Valley for various consumptive uses including irrigation, industrial, domestic, municipal, recreation, and fish and wildlife.

A 1964 study: The California Department of Water Resources (Bulletin No. 87) completed a study consisting of a pumping plant at Iron Gate Reservoir and a delivery system consisting of piping and canals to Northern Shasta Valley. The transfer plan proposed pumping 350 cfs to provide 122,000 ac.ft. of water to serve the Ager and Shasta Valley area. The 1964 estimated annual water cost for this proposal was $16+ per ac.ft.

A 2007 study: "Klamath-Shasta Water Substitution Preliminary Engineering Study", financed by the California Department of Fish and Game (CDFG) in cooperation with the Shasta Valley Resource Conservation District (SVRCD), was performed to consider the 60,000 ac.ft. water right transfer to the Shasta Valley to be used by the Montague Irrigation District's irrigators in exchange for in-stream flow releases from Lake Shastina to the Shasta River. This project proposed diverting Klamath River water from Keno Dam in Oregon to Lake Shastina via canals, tunnels and siphons, and another alternative pumping from Iron Gate Dam to Lake Shastina via piping and canals. There has been no follow up on this study by CDFG, DOI, or the SVRCD to SCWUA knowledge, probably because it does not support the KBRA or KHSA agreements (dam removals).

MID-UPPER KLAMATH RIVER WATER QUALITY

Because of the volcanic origin of the Upper Klamath Basin, the water quality of this basin is high in phosphates and nitrates creating impaired water conditions in the Klamath River. The water quality at the headwaters of the Klamath River (Link River Dam, at the outlet to Upper Klamath Lake) is impaired by having a low dissolved oxygen content and high nutrient loading. This is a naturally occurring phenomenon and is incurable. Early explorers of the River cited the water as being turbid, stinky and not fit to drink. Further, PacifiCorp completed a water quality study in Nov, 2006 for their Federal Energy Regulatory Commission (FERC) relicensing application No. 2082 showing that the nutrients traveling through the dams, proposed for removal, undergo an overall annual net reduction compared to inflow conditions. This study shows that the dams and reservoirs targeted for removal actually **improve** water quality contrary to commonly stated opinions.

COHO SALMON IN THE KLAMATH RIVER

Coho are not considered native to the inland River; CA. Department of Fish and Game (CDFG) records list the earliest record of Coho Salmon being stocked in the Klamath River Basin was of a plant made in 1895 in Supply Cr., a tributary to the Trinity River. Several out of basin import plantings have been made in the Klamath River and tributaries since 1895. Inland Klamath Coho stocks were never considered effective until after conditions improved as a result of Iron Gate Dam and Fish Hatchery. Only then was the planted Cascadia Coho return determined marginally successful.

U.S. Fish & Wildlife and Washington Fish & Game indicates that most Coho Salmon spawn in streams close to the Ocean. Distance from the Coast varies from 15 to 25 miles.

California Fish & Game "Finfish and Shellfish Identification Book" published in December 2006 does NOT list Coho Salmon as being present in California waters.

Karuk Tribal Council Meeting (12,27,2001) It was reported that not one member of the Council believed that Coho salmon were native to the Klamath River.

Current Historical Cyclic Ocean warming has caused the long term migration of the cold water anadromous fish (Coho Salmon) northerly along the California, Oregon, and Washington coast to Canada and Alaska. NOAA data shows that the salmon landings (catches) on the west coast are almost three times greater today than it was in 1970, with 97% of the landings in Alaska (refer to graph in section V). The ocean impacts on Coho Salmon have not been analyzed by Federal and State Agencies.

Trawlers and Ocean Cannery Impacts on Coho Salmon numbers have not been analyzed by Federal and State Agencies.

Predation by Pinnipeds and the Protected Sea Lions Impacts to Coho Salmon numbers have not been analyzed by Federal and State Agencies.

Gill Netting by Indian Tribes on the Klamath and Trinity Rivers has been permitted by agreement with DFG setting limits on the number of salmon takes. The tribes are allowed to monitor their own take. CDFG does not Police or monitor the takings. The gill netting impact on Coho Salmon numbers has not been analyzed by Federal and State Agencies.

1997 to 2003 killing of native Coho Salmon by DFG. During this period CDFG's practice was to kill all returning unmarked (wild reared) Coho Salmon returning to the Iron Gate Hatchery (IGH), which included those used for hatchery spawning purposes (1,791 Coho killings, 22% of all returning Coho Salmon). In 2004, at the request of Federal Agencies, 40 returning (wild reared) unmarked Coho Salmon

were implanted with radio transmitters and returned to the river at (IGH). 23 of the 40 were accounted for and traveled down river as far as 50 miles and up tributaries (3 up the Scott R.)

2002 September killing of 33,000 adult Salmon on the Lower Klamath River. NMFS and FWS attributed the fish killings to an epizootic disease with contributing factors being: 1. above average numbers of Ocean Chinook Salmon entering the Klamath River. 2. River flow in the fish-kill area was atypically low. 3. Water temperatures were very warm.

A Center For Disease Control study initiated in 2009 revealed that the waters released from Iron Gate Reservoirs had no toxic effects.

The Fish & Game report published in 2003 indicated the following: "The CDFG concludes that low flows and other flow related factors (eg, fish passage and fish density) caused of the 2002 fish kill on the Lower Klamath River. Furthermore, of the conditions that can cause or exacerbate a fish kill, flow is the only factor that can be controlled to any degree. Flow is regulated by upstream reservoirs controlled by the USBR on both the Klamath and Trinity Rivers."

The National Marine Science Academy found the Klamath River Iron Gate Dam flow releases not to be the cause of the kill. The most supported cause of the killings is a dumping of methamphetamines in the River upstream within the affected area, the Trinity River Ceremonial Ramping of flows which triggered early salmon runs, and seasonal hot temperatures, contrary to NMFS and FWS determinations.

Similar mysterious virus killings of huge numbers of Fraser River salmon off the west coast of Canada were studied and reported by Dr. Kristi Miller.

In spite of the kill, the healthy salmon return up river was one of the largest.

Iron Gate Hatchery (IGH) reared returning Coho Salmon were not included in the ESA Coho listing by DFG. Wild Reared Coho Salmon Returns to the IGH averaged 22% of all returning Coho during the period 1997 to 2004, 78% were not considered for the listing.

Recent Coho Studies (informed by CDFG personnel) Shasta River Wild Coho Salmon Studies revealed that there are no biological differences between Shasta River Wild Coho Salmon and Iron Gate Hatchery reared Coho Salmon. CDFG was negligent for not including I.G. Hatchery Coho Salmon Returns and the possible impacts of the 1791 native Coho killings before listing Coho as an Endangered Species.

There is little or no record of any of the above Coho information being considered before the listing of Klamath River Coho (a planted species) as an Endangered or Threatened Species.

Klamath Basin Restoration Agreement (KBRA)
and
Klamath Hydro-Electric Settlement Agreement (KHSA)

Nearly ten years ago (2001) a decision by **federal agencies** to allocate most of the useable water from the Upper Klamath Lake to in-stream flows for endangered sucker fish created a dire situation for hundreds of farming operations, resulting in the loss of over 1200 family homes and futures. Locals at the time said the devastating action to increase lake levels would prove counter to sucker fish due to their adapted advantage in low level conditions. Subsequent results revealed years later determined the **experiment** a complete failure. No just compensation was offered or considered for those who suffered.

After the DFG listing of the Coho Salmon as an endangered species and because PacifiCorp was in the process of relicensing their Hydro-electric facilities on the Klamath River, a group of nearly 30 **self described stakeholders** comprised of Federal, State, County, Tribal, Environmentalist, Fishing Organizations, and a minority of Irrigation interests who were **assured guaranteed water deliveries** to participate, organized in **secret** to create the **Klamath Basin Restoration Agreement** (KBRA). The majority of the group formed has no regional vested interest and little but beneficial individual consequence for failed determinations. They ostensibly assumed among themselves oversight and allocation of all regional water resources and of **required acceptance to dam removals** as a condition to sit at the table. Agreements were then made **allocating benefits** and position between and to participating members. Once in place, with the KBRA seated and the Department of Interior in the lead, the **Federal Klamath Working Group** was again formed in **secret** with governmental authority compelling PacifiCorp to negotiate compliance with KBRA provisions and implementation through the Agreement in Principle (later called **Klamath Hydroelectric Settlement Agreement** (KHSA). Key provisions of the KHSA **significantly impact** the assets and resources of many that were unrepresented, including Pacific Corp ratepayers.

The limited hydro-electric relicensing options given PacifiCorp under the **closed** Federal Energy Regulatory Commission Report were heavily influenced by **mitigation requirement recommendations** from many of the later seated KBRA members. PacifiCorp was further limited by the subsequent altered California Regional Water Quality Control Board 401 water quality permit **requirements** imposed after closing of the report, making relicensing too costly and essentially

unfeasible. These changed conditions effectively eliminated the only economically viable options for relicensing. FERC refused to reopen the report to consider newly available studies and alternatives which would have contradicted previous FERC opinions and offered additional far less costly and more effective options.

It is the opinion of the SCWUA that options unjustifiably dismissed under the FERC relicensing requirements, such as preliminary salmon truck and haul studies to ascertain their historically contradicted upper basin survival capabilities, were intentionally dismissed to develop a predetermined objective (removal of dams). Though PacifiCorp has now found it most expedient to secure **economic beneficial agreements** of compliance **at ratepayer and taxpayer expense,** the included implementation of the KBRA and potential removal of the dams greatly impacts the lives, resources, and assets of the unrepresented vested majority in opposition throughout the entire **closed agreement process.** Agencies and entities responsible for the creation of the KBRA and KHSA agreements regarding dam removals have failed to consider local public comments related to potential social and economic impacts on affected local communities; this defies credibility. **Siskiyou County, which will be impacted the most, was not a signing party to either agreement.**

SCWUA believes in the light of the above described proceedings and recent studies providing critical corrective information, that FERC should reopen its Relicensing Report to reconsider previously dismissed and newly advanced options **(Including the Shasta Nation Unassisted Anadromus Fish Passageway Alternatives).** Barring reconsideration of prior dismissed options demonstrating present success, the following alternatives to dam removals are presented outside the previously considered FERC options.

SISKIYOU COUNTY'S PROPOSALS:

It is within this historic and legal framework that we, the **Siskiyou County Water Users Association,** as a task force to the Board of Directors of the **Siskiyou County Flood Control and Water Conservation District,** submit the following studies and report for a proposed anadromous fish by-pass around Iron Gate and the COPCO dams as alternatives to fish ladders or dam removals. In addition, to expose potential spawning and rearing habitat for an additional 25 river miles of the native portion in the Upper 64 miles of Klamath River and adjacent tributaries below Keno Dam.

ALTERNATIVES TO DAM REMOVALS:

I

SHASTA NATION TUNNEL UNASSISTED ANADROMOUS FISH PASSAGEWAY

This study and option is introduced by the Shasta Nation, S.C.W.U.A. and others to offer an alternative to dam removals and to introduce salmon to an additional 25 river miles of native Upper Klamath River. The study was conducted by the Klamath River Advisory Council, a sub-committee of the Siskiyou County Water Users Association. The council consisted of people with backgrounds in Academics, Hydrology, Aquatic Biology, Geology, Surveying, Engineering, and members of the Shasta Nation. This report has several objectives:

1. To provide fish passage around Iron Gate and COPCO Dams. (All dams above the proposed Tunnel Passageway have fish ladders.)
2. To test and increase the use of 25 river miles of native Upper Klamath River habitat.
3. To prevent the destruction of the Shasta Nation's aboriginal cultural, heritage and burial sites under the waters behind the dams
4. Maintain sustained downstream 1,300 cfs. flow from Iron Gate Dam to the Klamath River.
5. Maintain clean Hydro-Electric Power for 70,000 homes.
6. Maintain flood protection for downriver cities, roads, bridges, and private property.
7. Protect property owners and property values adjacent to the river and reservoirs.
8. To redirect funding proposed for dam removals to this project, which will have positive economic and environmental benefits for Northern California and Southern Oregon and the Nation.

The following criterion has been considered:
Cost Benefit Ratio, Environmental Impact, Genetic Imprinting, Thermal Refugia Gradient of Route, Water Quantity, Water Temperature, Water Quality, Length of By-Pass, Tunnel Lighting, and Other Alternatives.

Cost Benefit Ratio: In the past, there have been other proposals offered to get salmon around the dams and up the remaining 64 miles (25 miles natural river) of the total river length of 254 miles. During the construction of the dams, fish ladders were studied and rejected and Iron Gate Fish Hatchery was built to mitigate the loss of the 25 river miles of natural habitat. Recently, under the FERC relicensing requirements, fish passage around 3 dams was required and fish ladders are again being considered with an estimated cost in excess of 300 million dollars. A study of trucking and release of the salmon around the dams was also proposed but rejected by state and federal agencies. Dam removal cost estimates are in excess of one (1) Billion dollars, not including the cost of replacing existing power facilities or mitigating the dams 20+ million cu. yds. of contaminated sediments behind the dams.
The cost of the Tunnel Passageway proposal is estimated to be 50 +/- million, or 1/6 (17%) the cost of fish ladders and 1/20 (5%) the cost of dam removals.

Environmental Impact: One of the most important considerations of these alternatives is the impacts to the existing environment in the Klamath River Watershed. The Tunnel Passageway will have significantly less environmental impact on the total watershed, being that a portion of the proposed Passageway on Bogus Creek is already being used by anadromous salmon and steelhead to migrate and spawn, and the tunnel portion will be below the ground surface. There will be very minimal impacts at the tunnel entrances; versus long term impacts associated with dam removals.
Dam removals will destroy an established 100 year old aquatic and waterfowl habitat in the river and reservoirs, not to mention the irresponsible long term sediment impacts being proposed by Federal and State Agencies **(allowing the 20+ million cubic Yards of contaminated sediments to naturally erode down the river).**

Thermal Refugia: Establishment of resting places ie: thermal refugia for spawning salmon is essential. By the time they get up the Klamath River to the Iron Gate Dam Hatchery they will have traveled nearly 200 miles from the ocean in an environment of water with many changes in the water quality and river conditions. Rest areas (refugia) enlarged areas off to one side of the tunnel) are needed and will be placed at 250' spacing throughout the tunnel.

Gradient Route: This route was selected in order to keep the average gradient at 1% or less. The Hart By-Pass, a previous conceptual proposal, would have had several, gradients that exceed 6% and required several fish ladders.

Water Quality: The water passing through the Tunnel Passageway will be Klamath River water from COPCO #1 Lake at 10 cfs. or greater and will be blended with Bogus Creek water from outlet of the Tunnel Passageway to the Klamath River (3.3 miles). Imprinting (Olfactory) will be accomplished because all waters will have a majority of Klamath River water.

Water Temperature: Water temperatures running through the tunnel should approach 50 to 60 degrees F. at the outlet irrespective of the surface temperatures at COPCO 1 Lake. This should be within the range of water temperatures on Bogus Creek, depending on weather conditions, and be well within range for good salmon habitat conditions

.

Length of Passageway: The entire length of the Passageway from the confluence of Bogus Creek (Iron Gate Fish Hatchery) and the main stem of the Klamath River to Copco 1 Lake is eight miles, 3.3 miles up Bogus Creek and 4.75 through the tunnel, **2 miles shorter** than the travel up the Klamath River to the tunnel inlet structure. Note: as compared to fish ladders, the Tunnel Passageway would also eliminate the predation across Iron Gate and COPCO 2 reservoirs.

Lighting: The Tunnel will be equipped with a programmable- automated lighting system throughout its entire length with a backup system. The entrances will be equipped with a unique designed system intended to attract by brightening and help camouflage the entrances as seen from the water.

Note: This proposal is estimated at about 1/6 (17%) the cost of fish ladders or 1/20 (5%) the cost of dam removals. It will have very little, if any, negative environmental short or long term impacts compared to dam removals. It will have several benefits to Siskiyou County and the Klamath River:

II

SHASTA NATION TUNNEL UNASSISTED ANADROMOUS FISH PASSAGEWAY INCLUDING THE GRAVITY FLOW: KLAMATH - SHASTA IMPORT PROJECT (JOHN C. BOYLE RESERVOIR TO THE SHASTA VALLEY)

SIMILAR TO THOSE STUDIES PERFORMED FOR THE SHASTA VALLEY R.C.D. & CDFG JUNE 2007 (CDFG PROJECT NO. P0310329)

This proposal incorporates the previously discussed Shasta Nation Unassisted Anadromous Tunnel Passageway with the import of the 60,000 ac.ft. Siskiyou County State Reserved Storage Water Right (A016958) from the Klamath River to the Shasta Valley. This alternative would consist of a diversion structure at J.C. Boyle reservoir and a 45 mile gravity flow canal, incorporating several environmentally friendly tunnels and inverted siphons, to a 50,000 ac.ft.+/- storage reservoir or reservoirs on or near Willow Creek. From Willow Creek a 7.6 mile canal would be constructed to the Montague Irrigation District (MID) main canal below the City of Montague diversion.

This proposal would divert water from the Klamath River during high flow periods or by direct diversion during irrigation season at up to 200 cfs, which can provide 400 ac.ft. a day or 12,000 ac.ft. a month. It would take five months, at this rate, to provide 60,000 ac. ft.

The tunnel and siphon entrances will be equipped with special designed gates which would allow water passage, but block the entrance of debris and preclude the entrance by humans and animals. The canal will be widened and the slopes flattened to provide animal friendly crossings at all game trails and at tunnel and siphon entrances.

This proposal will allow the City of Montague to continue receiving its water from Lake Shastina without blending with Klamath River water.

The benefits of this proposal: would provide irrigation water to the Ager area; allow MID to supply the majority of their irrigators with Klamath River water; reduce the demands on Lake Shastina, thereby allowing MID to dedicate a portion of the reduced demands to in-stream flow in the Shasta River, improve water quality and fish habitat in both the Shasta and Klamath Rivers, save the dams, and have minor environmental impacts compared to dam removals.

The cost of this proposal is estimated at $500,000,000 including the Tunnel Passageway, or 67% higher than installing fish ladders and 50% the estimated cost for dam removals.

III

SHASTA NATION TUNNEL UNASSISTED ANADROMOUS FISH PASSAGEWAY INCLUDING THE PRESSURIZED FLOW: KLAMATH - SHASTA IMPORT PROJECT (IRONGATE RESERVOIR TO THE SHASTA VALLEY)

SIMILAR TO THOSE STUDIES PERFORMED FOR THE SHASTA VALLEY R.C.D. & CDFG JUNE 2007 (CDFG PROJECT NO. P0310329)

This proposal is similar to the previous gravity flow import project transfer from J.C. Boyle Reservoir to the Shasta Valley; **however it requires pumping** with the point of diversion out of Iron Gate Reservoir instead of J.C.Boyle. It incorporates the previously discussed Unassisted Anadromous Tunnel Passageway with the transfer of the 60,000 ac.ft. Siskiyou County Reserved Storage Water Right from Iron Gate Reservoir to the Shasta Valley. It would consist of two 12,000 H.P. pumping plants, one at Iron Gate Reservoir (El. 2,343) and one at EL. 2680+/- ; a 6.2 mile 6' diameter pressurized pipeline; and a 5.1 mile gravity flow canal to a 50,000 ac.ft.+/- storage reservoir or reservoirs on or near Willow Creek. From Willow Creek a 7.6 mile canal would be constructed to the Montague Irrigation District (M.I.D.) main canal below the City of Montague diversion. This will allow the City of Montague to continue receiving its water from Lake Shastina without blending with Klamath River water.

The benefits of this proposal: It would provide irrigation water to the Ager area and allow MID to supply the majority of their irrigators with Klamath River water, thus reducing the demands on Lake Shastina, thereby allowing MID to dedicate a portion of the reduced demands to in-stream flow in the Shasta River, improve water quality and fish habitat in both the Shasta and Klamath Rivers, save the dams, and have minor environmental impacts compared to dam removals.

The cost of this proposal is estimated at $300,000,000 including the Tunnel Passageway, or equal cost to installing fish ladders, and 30% the estimated cost for dam removals.

Note: This proposal is estimated at the same cost of installing fish ladders or 30% the cost of dam removals. The estimated cost of this proposal does not consider power cost, which could be considerable ($60.00/ac.ft. at current electrical cost). It will have very little, if any, negative environmental short or long term impacts compared to dam removals. It will provide several benefits to Siskiyou County and the Klamath River; pumping cost may make this alternative prohibitive.

Other Unassisted Anadromous Passageway Alternatives Studied:

1. **Shasta Nation's Alternative to Dam Removals "PROPOSED SHASTA ANADROMOUS FISH PASSAGEWAY (Hart By-Pass)** a previous studied alternative to dam removals utilizing Bogus, Cold, and Deer Creeks, a total travel of 12miles with an elevation rise of over 1,000 feet to the pass between Cold and Deer Creeks and from there over 600 feet decline to Keaton Cove on COPCO 1 Reservoir. This alternative required a 1,500 H.P. pumping station on COPCO 1 Reservoir with a delivery pipe to the divide between the two drainages plus several regulating structures and several fish ladders, and for those reasons, this alternative was determined to be not environmentally or cost beneficial to the Tunnel Alternative. (Refer to original "PROPOSED SHASTA ANADROMOUS FISH BY PASS ROUTE").

2. **The Bogus Creek to J.C. Boles / Shasta Valley Transfer Canal Passageway** This conceptual alternative involved utilizing Bogus Creek up to its intersection with the 60,000 ac. ft. Klamath R.-Shasta Valley Transfer Canal. It would require a water transfer structure at Bogus Cr. to the canal and several flume structures to replace the proposed canal siphons. This alternative was also determined to be not environmentally or cost beneficial to the Tunnel Alternative.

SEE SECTION IV: **FOR PRELIMNARY DRAWINGS, DETAILS, AND ESTIMATES**

REASONS FOR THESE PROPOSALS AND KEEPING THE KLAMATH RIVER DAMS:

- **Irresponsible expenditures during a national economic crisis**
- **Unnecessary loss of green hydro-electric power for 70,000 homes**
- **Cost to replace hydro-with fossil fuel power falls on us, the rate payers**
- **Carbon foot print created to replace hydro-with fossil fuel**
- **Substantial increase in electricity cost**
- **Loss of lake fisheries and wildlife habitat**
- **Loss of Iron Gate fish hatchery**
- **Loss of recreation**
- **Substantial loss of property values**
- **Substantial loss of down river flood protection- FEMA flood insurance - move to high ground**
- **Loss of infrastructure during flooding such as loss of roads and bridges**
- **Loss of sustained 1300 cfs minimum river flows- will be replaced by the Upper Klamath, Scott and Shasta Valley irrigators**
- **Irresponsible release of dam sediments down river by State & Federal Agencies**
- **Promised??? power costs and water benefits to upper basin landowners without any direct factual benefits**
- **Impacts on Shasta Nation Burial Grounds and Yreka water supply are unknown and unstudied**
- **KRBA requirements will replace all water rights in the Klamath Basin Watershed with a Federal Charter in lieu of Constitutional guarantees**
- **The Klamath Lake Tribe and Karuk Tribes will exterminate the Shasta Nation within the KBRA requirements upon dam removals**
- **Lack of factual evidence that removing dams will restore salmon runs**

Respectively submitted by:

Siskiyou County Water Users Association

Board of Directors:

Frank Tallerico
President

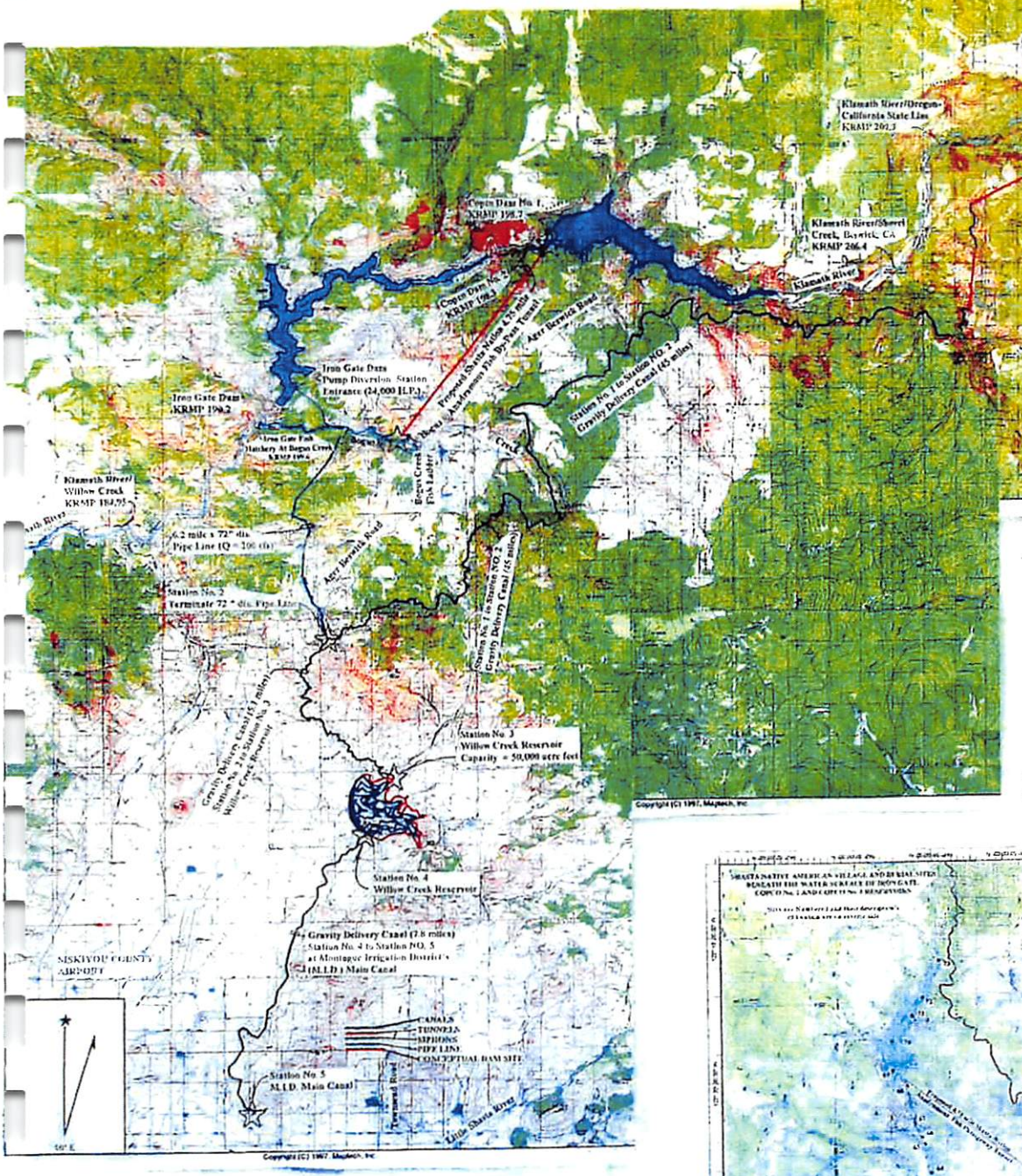
IV

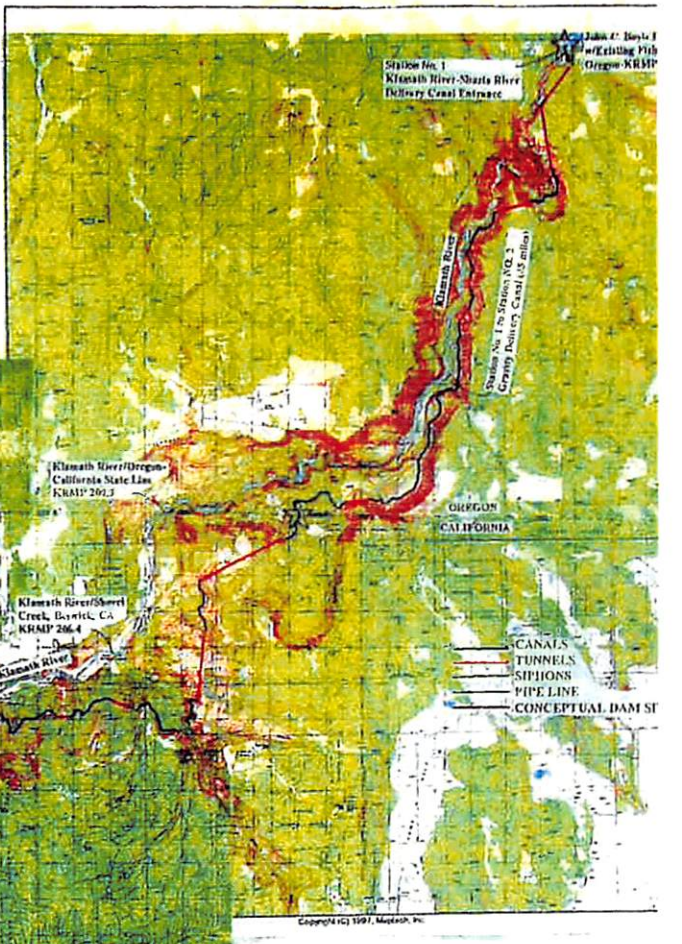
SHASTA NATION ANADROMOUS FISH PASSAGEWAY ALTERNATIVES TO DAM REMOVALS:

PRELIMINARY ENGINEERING DRAWINGS AND COST ESTIMATES

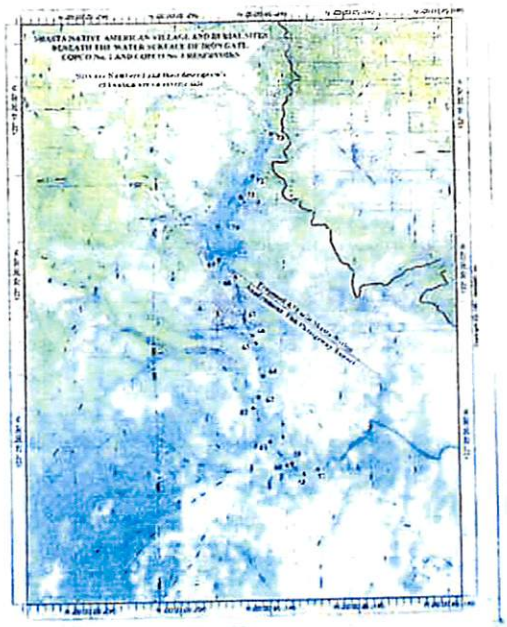
- MEMO T0 SCWUA: in reference to a meeting with the State Water Resources Control Board addressing Alternatives to Dam Removals.
- DOI analyze of Alternative I (TUNNEL BYPASS) THE BEST ALTERNATIVE FOR SISKIYOU COUNTY
- 2007: KLAMATH-SHASTA WATER SUBSTITUTION STUDIES by CDFG and SVRCD

S.C.W.U.A. Alternatives to Dam Removals





Shasta Nation Villages and Burial Sites beneath ~ Copco no.1, Copco no.2 and Iron Gate Reserviors.



ALTERNATIVE I

SHASTA NATION TUNNEL UNASSISTED ANADROMOUS FISH PASSAGEWAY

Via Bogus Creek/and a Proposed Tunnel to COPCO Lake No.1

By Jerry Bacigalupi, P.E. and Harry L. Lake, P.L.S.

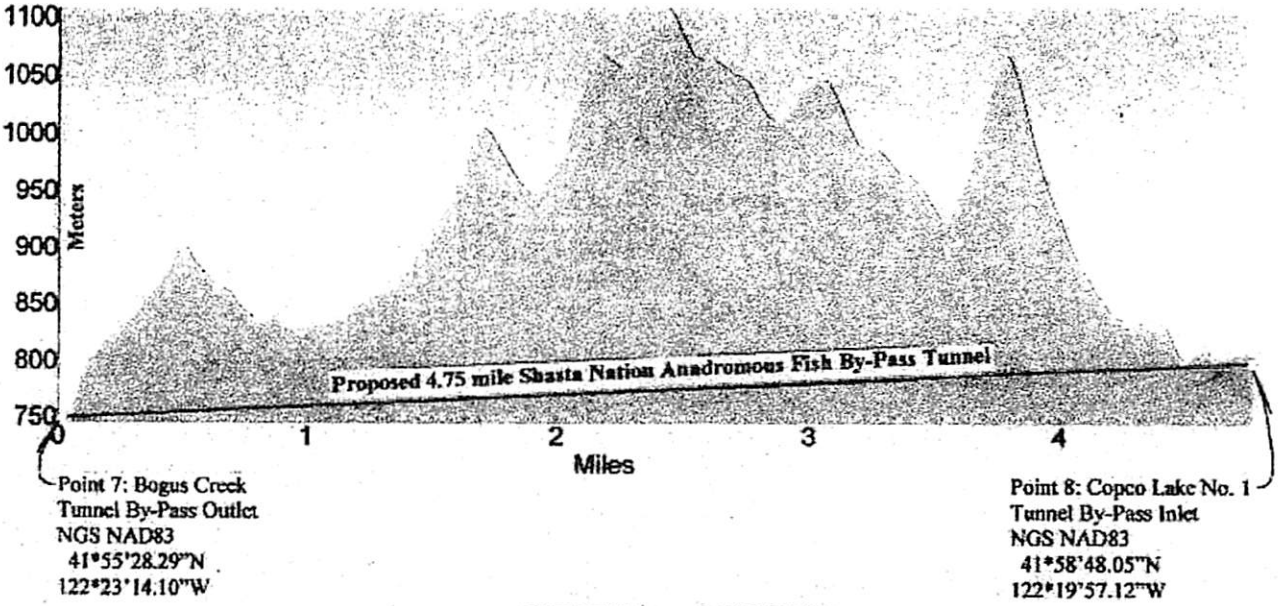
A viable preferred alternative to the previously proposed "Shasta Nation Anadromous Fish By-Pass" utilizing Bogus, Cold and Deer Creeks, is a tunnel passageway commencing 3.3 miles upstream from the Klamath River on Bogus Creek, below the existing falls and fish ladder, and terminating at the narrow portion of the lake just upstream from the dam on COPCO Lake No. 1 Reservoir.

This alternative would require a 4.75 mile lighted tunnel 16 ft. wide by 12 ft. high with a 4 ft. wide by 2 ft. deep concrete lined fish channel off to one side. Fish refugias (rest areas) will be placed at approximately 250 ft. intervals. The entrance structure to the tunnel will be constructed to float and take water from near the surface and allow for lake level fluctuations. The gradient of the tunnel will be less than 1% and the flow will be over 10 cfs.

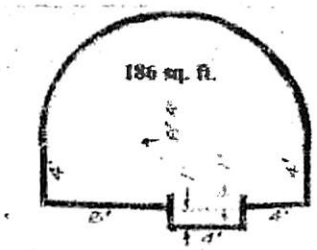
A computer mapping program, California Terrain Navigator by Maptech, Inc., was used as a cursory technical aid to review pertinent geographic features to ascertain horizontal and vertical control, to recommend an unassisted anadromous fish passageway from the Klamath River, around the Iron Gate Dam, COPCO Dam No. 2 and COPCO Dam No. 1 to COPCO Lake.
A final on site survey of said proposed fish passageway is recommended to ascertain pertinent ground feature information on the said proposed route, subject to acceptable design criteria for said project.

Point	Station	Elev. Feet	Lineal Feet	% Gradient	Remarks:
0	0+00	2165			Confluence Klamath River & Bogus Creek
			2833	+1.518	
1	28+33	2208			Bogus Creek (BC)
			3278	+1.403	
2	61+11	2254			BC
			2789	+0.717	
3	89+00	2274			BC
			2743	+2.370	
4	116+43	2339			BC
			2944	+2.345	
5	145+87	2408			BC
			1153	+1.127	
6	157+40	2421			BC
			1703	+1.585	
7	174+43	2448			BC/Tunnel Outlet
			25099	+0.606	
8	425+42	2600			Tunnel Inlet/COPCO Lake No.1/w.s. Elev. 2606'

The estimated cost of this alternative is approximately $50,000,000 or about 17% of the cost of installing fish ladders and about 5% of the estimated cost of dam removals.



TYPICAL TUNNEL PROFILE



TYPICAL TUNNEL DESIGN

INPUT VARIABLES

Depth

n = 0.025

Base Width = 4.0
Slope = 0.0055

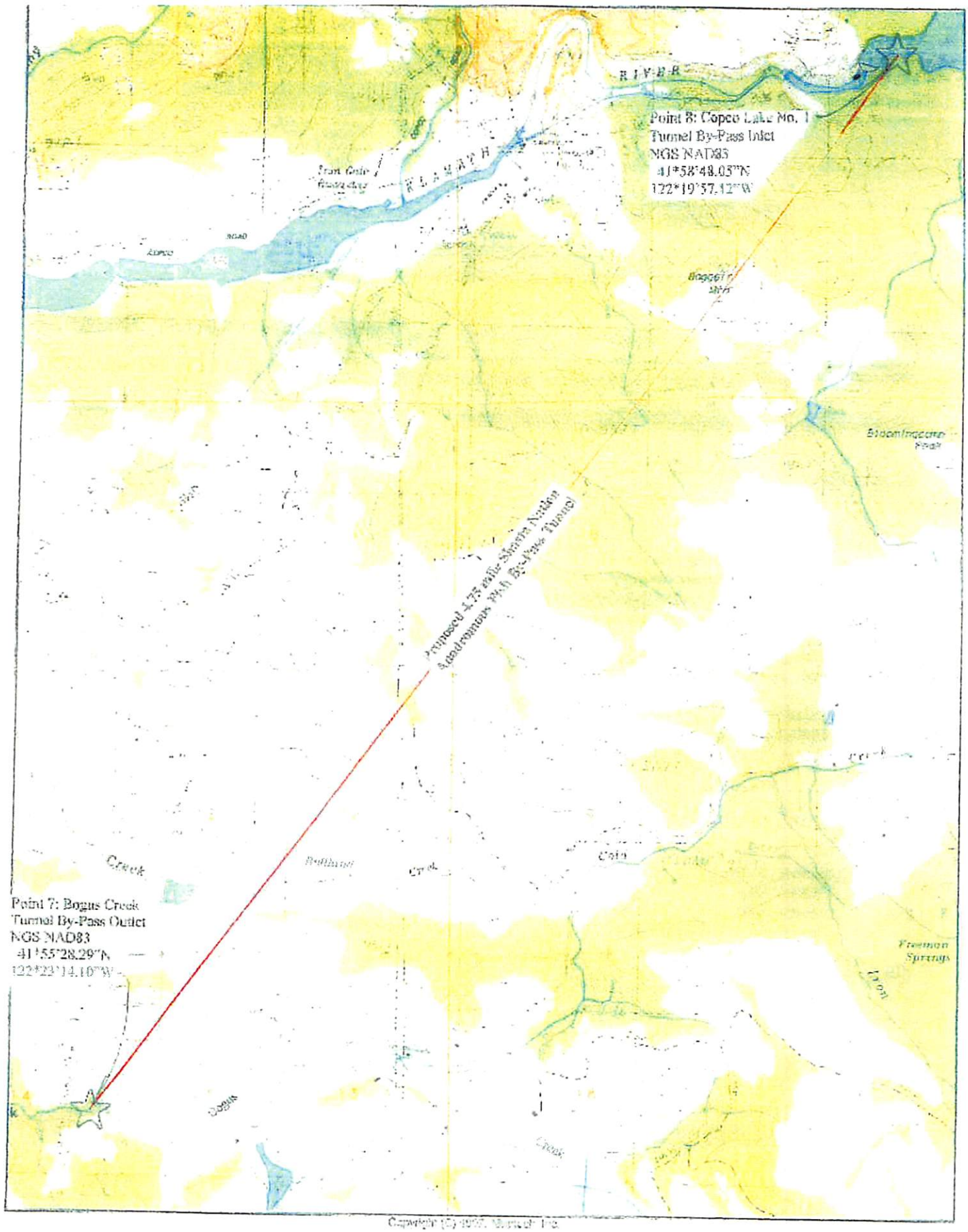
OUTPUT VARIABLES

Depth (ft)	1.00
Discharge (cfs)	13.5
Velocity (ft/s)	3.36
Top Width (ft)	4.0
Froude No.	0.59
Flow Type:	SUBCRITICAL

JLB Construction and Engineering
3097 Sierra Boulevard
Sacramento, CA 95864
916-768-5015, 916-484-7807

ALTERNATIVE I
SHASTA NATION TUNNEL ANADROMOUS FISH PASSAGEWAY
Planning Study
Engineering and Construction Cost Estimate

No.	Item	Quantity	Unit	Unit Price	Amount
	IMPROVEMENTS				
	ENGINEERING DESIGN &CONSTRUCTION ADMINISTRATION	1	LS	$4,000,000.00	$4,000,000
					$4,000,000
	MOBILIZATION	1	LS	$1,000,000.00	$1,000,000
					$1,000,000
	TUNNEL STRUCTURE				
3	Excavation (6.9cy/ft.)	25,000	LF	$ 1,400.00	$35,000,000
4	Refugia (Rest Area)(12'x12'x12')	100	EA	$ 10,000.00	$1,000,000
5	Linning (4" wire reinforced gunnite) (0.4 cy/ft)	25,000	LF	$ 400.00	$10,000,000
					$46,000,000
	INLET STRUCTURE				
1	FLOATING STRUCTURE (with intake control weir).	1	LS	$ 300,000.00	$300,000
2	RAMP STRUCTURE	1	LS.	$ 200,000.00	$200,000
					$500,000
	OUTLET STRUCTURE				
1	Outlet Structure	1	LS	$ 100,000.00	$100,000
2	Outlet Structure Refugia (Rest Area)	1	LS	$ 20,000.00	$20,000
					$120,000
	PLACEMENT OF EXCAVATED MATERIAL OFF SITE	180,000	CY	$ 10.00	$1,800,000
					$1,800,000
	CONSTRUCTION ACCESS				
1	Staging Areas	1	LS	$ 100,000.00	$100,000
2	Access Roads	1	LS	$ 150,000.00	$150,000
3	Erosion Control & Revegetation	1	LS	$ 50,000.00	$50,000
					$300,000
	ELECTRICAL				
1	Tunnel Lighting	1	LS	$ 375,000.00	$375,000
2	Inlet & Outlet Tunnel Lighting	1	LS	$ 50,000.00	$50,000
					$425,000
	R/W COST	1	LS	$ 25,000.00	$25,000
					$25,000
	TOTAL ESTIMATED CONSTRUCTION COST:				$54,170,000


Point 8: Copco Lake No. 1
Tunnel By-Pass Inlet
NGS NAD83
41°58'48.03"N
122°19'57.12"W
Proposed 4.75 mile Siphon Number
Supplemental With By-Pass Tunnel
Point 7: Bogus Creek
Tunnel By-Pass Outlet
NGS NAD83
41°55'28.29"N
122°23'14.10"W

ALTERNATIVE II

SHASTA NATION TUNNEL UNASSISTED ANADROMOUS FISH PASSAGEWAY INCLUDING THE GRAVITY FLOW KLAMATH - SHASTA IMPORT PROJECT (JOHN C. BOYLE RESERVOIR TO THE SHASTA VALLEY)

SIMILAR TO THOSE STUDIES PERFORMED FOR THE SHASTA VALLEY R.C.D. & CDFG JUNE 2007 (CDFG PROJECT NO. P0310329)

60,000 acre feet Siskiyou County Klamath River–Shasta Valley Import Project (John C. Boyle Reservoir to the Shasta Valley) Incorporating the Shasta Nation Tunnel Unassisted Anadromous Fish Passageway.

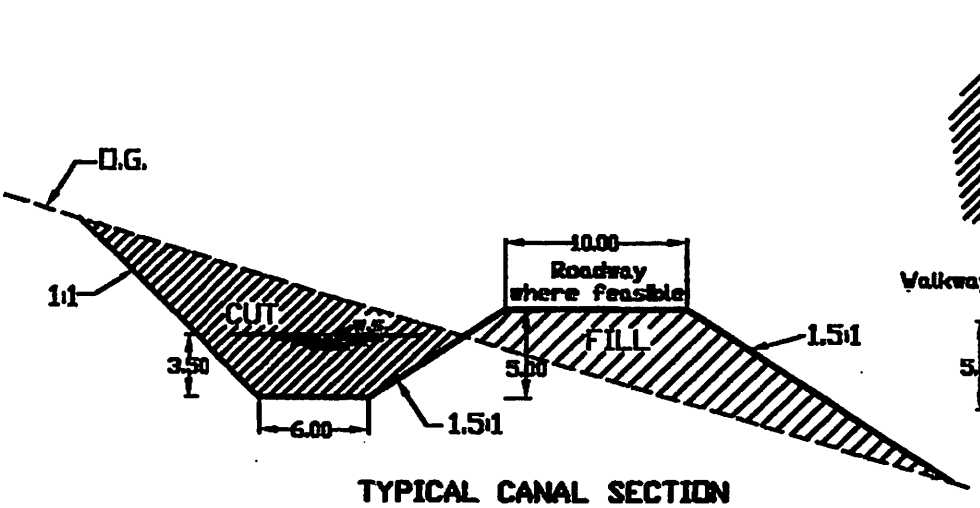
This viable alternative to dam removal proposes to import the 60,000 acre feet Siskiyou County **State Reserved Water Right A016958** from the Klamath River (John C. Boyle Reservoir to the Shasta Valley) via a 45 mile gravity flow canal with a -0.2% grade, flowing at 200 cfs. during the proposed months of December, January, February, March, and April depending on winter rainfall conditions to storage facilities at or near Willow Creek, or by direct application without storage during the irrigation season. A request will be required to move the point of diversion for this water right from Irongate Reservoir to J.C. Boyles Reservoir, and to request for off stream storage facilities.

This alternative proposes 50,000 to 60,000 acre feet storages facilities at or near Willow Creek and a 7.8 mile distribution canal from Willow Creek to the Montague Irrigation District's main canal. The Shasta Nation Tunnel Unassisted Anadromous Fish Passageway will be incorporated in this alternative.

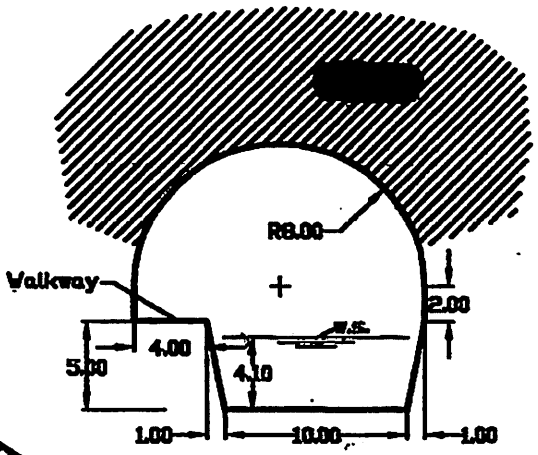
The transfer conduit would consist of a concrete grouted trapezoidal canal with a 6 foot bottom width for its major length and incorporate several 16 foot wide tunnels and 6 foot diameter inverted siphons to satisfy environmental concerns and provide for stream crossings.

The estimated construction costs is approximately $500,000,000 or 67% higher than the estimated cost of installing fish ladders and about 50% of the estimated cost of dam removal.

TYPICAL SECTIONS AND CHANNEL HYDRAULICS



TYPICAL CANAL SECTION

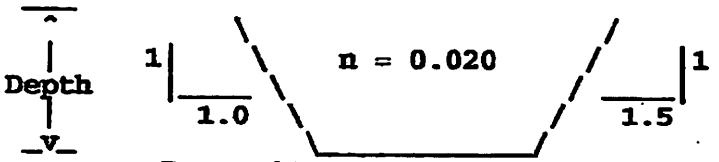


TYPICAL TUNNEL SECTION

CANAL HYDRAULICS:

QUICK - 2
CHANNEL CAPACITY
Trapezoidal Channel

INPUT VARIABLES



Base Width = 6.0
Slope = 0.0020

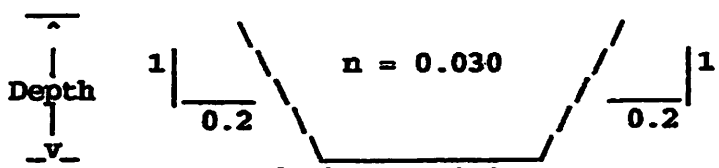
OUTPUT VARIABLES

Depth (ft)	3.50
Discharge (cfs)	198.2
Velocity (ft/s)	5.46
Top Width (ft)	14.8
Froude No.	0.61
Flow Type:	SUBCRITICAL

TUNNEL HYDRAULICS:

QUICK - 2
CHANNEL CAPACITY
Trapezoidal Channel

INPUT VARIABLES



Base Width = 10.0
Slope = 0.0025

OUTPUT VARIABLES

Depth (ft)	4.10
Discharge (cfs)	197.9
Velocity (ft/s)	4.46
Top Width (ft)	11.6
Froude No.	0.40
Flow Type:	SUBCRITICAL

JLB Construction and Engineering
3097 Sierra Boulevard
Sacramento, CA 95864
916-768-5015, 916-484-7807

ALTERNATIVE II
60,000 AC.FT. SHASTA VALLEY WATER RIGHT IMPORT
J.C.BOYLES RESERVOIR to M. I. D. MAIN CANAL
INCLUDING THE SHASTA NATION TUNNEL ANADROMOUS FISH PASSAGEWAY
Planning Study
Engineering and Construction Cost Estimate

IMPROVEMENTS No.	Item	Quantity	Unit	Unit Price	Amount
ENGINEERING DESIGN & CONSTRUCTION ADMINISTRATION		1	LS	$ 35,000,000.00	$35,000,000
					$35,000,000
MOBILIZATION		1	LS	$ 1,500,000.00	$1,500,000
					$1,500,000
TUNNEL STRUCTURES					
1	Inlet Outlet Structures (including grated gates)	22	EA	$ 30,000.00	$660,000
2	Excavation (6.9cy/ft.)	33,800	LF	$ 1,400.00	$47,320,000
3	Linning (4" wire reinforced gunnite) (0.4 cy/ft)	33,800	LF	$ 400.00	$13,520,000
4	Placement of tunnel excavation. materal	233,000	CY	$ 10.00	$2,330,000
					$63,830,000
SYPON STRUCTURES					
1	72 in. Dia. Welded Steel Pipeline	11,400	LF	$ 900.00	$10,260,000
2	Inlet Outlet Structures (incl. grated gates & thrust control)	48	EA	$ 20,000.00	$960,000
					$11,220,000
TRAPAZOIDAL CANAL					
1	6' Depth X 6' Bot. with 1:1 & 1.5:1 side slopes (exc.& emb.)	236,600	LF	$ 600.00	$141,960,000
2	Linning (4" wire reinforced gunnite) (0.4 cy/ft)	236,600	LF	$ 350.00	$82,810,000
3	J.C. Boyles Inlet Structure (including fish screen)	1	LS	$ 400,000.00	$400,000
					$225,170,000
STORAGE FACILITIES (RESERVOIRS 50,000+/- AC.FT COMBINED)					
1	Excavation / Embankment	1	LS	$ 96,000,000.00	$96,000,000
2	Outlet Structures	1	LS	$ 4,000,000.00	$4,000,000
					$100,000,000
CONSTRUCTION ACCESS					
1	Staging Areas	1	LS	$ 200,000.00	$200,000
2	Access Roads	1	LS	$ 500,000.00	$500,000
3	Erosion Control & Revegetation (All Const. Sites)	1	LS	$ 1,000,000.00	$1,000,000
					$1,700,000
R/W Cost					
1	Tunnels	6.4	Mi.	$ 5,000.00	$32,000
2	Sypons	2.15	Mi.	$ 10,000.00	$21,500
3	Canals	44.87	Mi.	$ 10,000.00	$448,700
4	Reservoirs	1,000	Ac.	$ 5,000.00	$5,000,000
					$5,502,200
SHASTA NATION TUNNEL ANADROMOUS FISH PASSAGEWAY					
1	Total cost from previous sheet	1	LS	$ 54,170,000.00	$54,170,000
					$54,170,000
TOTAL ESTIMATED CONSTRUCTION COST:					$498,092,200

ALTERNATIVE III

SHASTA NATION TUNNEL UNASSISTED ANADROMOUS FISH PASSAGEWAY INCLUDING THE PRESSURIZED FLOW KLAMATH - SHASTA IMPORT PROJECT (IRONGATE RESERVOIR TO THE SHASTA VALLEY)

SIMILAR TO THOSE STUDIES PERFORMED FOR THE SHASTA VALLEY R.C.D. & CDFG JUNE 2007 (CDFG PROJECT NO. P0310329)

60,000 acre feet Siskiyou County Klamath River Import Project **State Reserved Water Right A016958** (Irongate Reservoir to the Shasta Valley) Incorporating the Shasta Nation Tunnel Unassisted Anadromous Fish Passageway. This proposal is similar to **Alternative II** but requires pumping from Irongate Reservoir. A request for off stream storage facilities will be required. This viable alternative to dam removal would import the 60,000 acre feet Siskiyou County Reserved Water Right from Iron Gate Reservoir to the Shasta Valley via a 24,000 H.P. pumping system, a 6.2 mile, 72" diameter pipeline and a 5.1 mile gravity flow canal to the proposed 50,000 to 60,000 acre feet storage facilities near or on Willow Creek, and a 7.6 mile canal from Willow Creek to the Montague Irrigation District's main canal. The Shasta Nation Tunnel Unassisted Anadromous Fish Passageway will be incorporated in this alternative.

The estimated construction costs of this proposal is $300,000,000 plus pumping cost, or approximately the estimated cost of installing fish ladders and about 30% of the cost of dam removal.

CONCLUSION:

Either **Alternative II** ,the John C. Boyle or **III** ,the Iron Gate 60,000 acre feet import projects to the Shasta Valley under a Siskiyou County Reserved Water Right, including the Shasta Nation Tunnel Unassisted Anadromous Fish Passageway, has the potential of providing a win-win solution for all including the fish.

By allowing a portion of the Klamath River 60,000 acre feet diversion to storage (or by direct diversion during the irrigation season) to be released from Lake Shastina directly into the Shasta River, the in stream flows conditions and water quality will be improved in both the Shasta River and the Klamath River below Iron Gate Reservoir.

Note: The KBRA does not appear to show direct positive benefits to the Upper Klamath Basin farmers and ranchers except promises or agreements which will likely not be attainable or be broken in the future.

It is recommended that winter water storage facilities be studied and incorporated in the Upper Klamath Basin which can provide additional waters to the Klamath River for increased in stream flows, which will benefit on project and off project water users and benefit fish habitat.

By combining any one of these viable alternatives with new Upper Klamath Basin storage facilities, the money projected towards dam removals could be directed to projects that would have a direct positive benefit to the entire Klamath River Basin, including the fish, verses the hypothetical benefits projected in the KBRA. This Nation does not need to waste the taxpayer's and power ratepayers money on hydro-dam removal projects that 80% of the public does not support.

JLB Construction and Engineering
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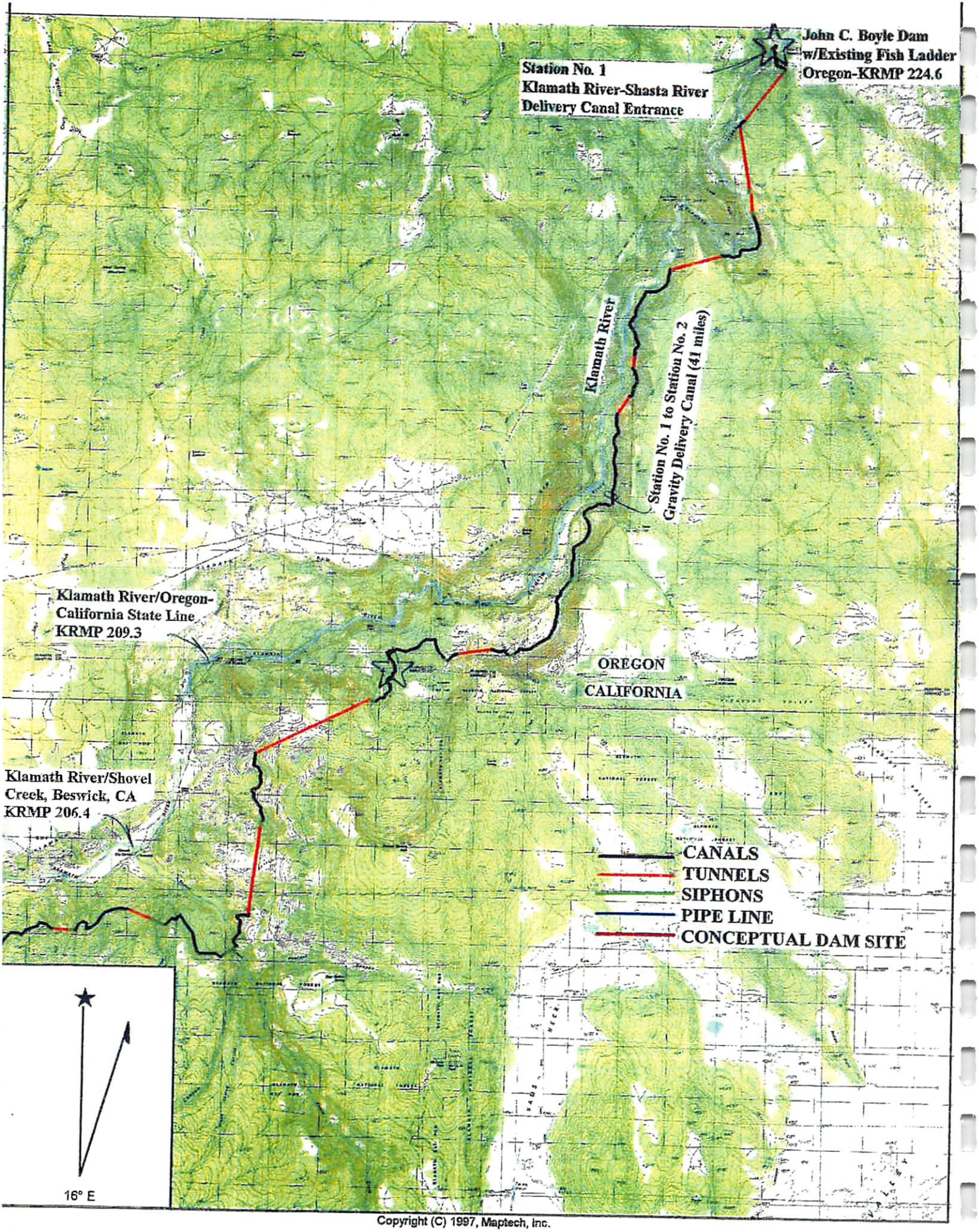
ALTERNATIVE III
60,000 AC. FT. SHASTA VALLEY WATER RIGHT IMPORT
IRON GATE RESERVOIR to M. I. D. MAIN CANAL
INCLUDING THE SHASTA NATION TUNNEL ANADROMOUS FISH PASSAGEWAY
Planning Study
Engineering and Construction Cost Estimate

IMPROVEMENTS No.	Item	Quantity	Unit	Unit Price	Amount
ENGINEERING DESIGN & CONSTRUCTION ADMINISTRATION		1	LS	$ 20,000,000.00	$20,000,000
					$20,000,000
MOBILIZATION		1	LS	$ 1,000,000.00	$1,000,000
					$1,000,000
PUMPING PLANTS (1@ I.G.Res. El.2,343 & 1@ El.2,680'+/-)					
1	Floating Inlet Structure (incl. grated gate and fish screen)	1	LS	$ 850,000.00	$850,000
2	2- 12,000 H.P. Pumping Plants.	2	LS	$ 2,400,000.00	$4,800,000
3	Pumping Plant Facilities	2	LS	$ 750,000.00	$1,500,000
					$7,150,000
PRESSURIZED STEEL PIPELINE					
1	72 in. Dia. Welded Steel Pipeline	32,800	LF	$ 900.00	$29,520,000
2	Thrust Control	250	EA	$ 6,000.00	$1,500,000
					$31,020,000
TRAPAZOIDAL CANAL					
1	6' Depth X 6' Bot. with 1:1 & 1.5:1 side slopes (exc.& emb.)	67,000	LF	$ 600.00	$40,200,000
2	Linning (4" wire reinforced gunnite) (0.4 cy/ft)	67,000	LF	$ 350.00	$23,450,000
3	Inlet Structure (including grate & gate)	1	LS	$ 50,000.00	$50,000
					$63,700,000
STORAGE FACILITIES (RESERVOIRS 50,000+/- AC.FT COMBINED)					
1	Excavation / Embankment	1	LS	$ 96,000,000.00	$96,000,000
2	Outlet Structures	1	LS	$ 4,000,000.00	$4,000,000
					$100,000,000
CONSTRUCTION ACCESS & EROSION CONTROL					
1	Staging Areas	1	LS	$ 50,000.00	$50,000
2	Access Roads	1	LS	$ 100,000.00	$100,000
3	Erosion Control & Revegetation	1	LS	$ 500,000.00	$500,000
					$650,000
R/W Cost					
1	Pipeline	6.2	Mi.	$ 5,000.00	$31,000
2	Canals	12.7	Mi.	$ 10,000.00	$127,000
3	Reservoirs	1,000	Ac.	$ 5,000.00	$5,000,000
					$5,158,000
SHASTA NATION TUNNEL ANADROMOUS FISH PASSAGEWAY					
1	Total cost from Tunnel Passageway Estimate	1	LS	$ 54,170,000.00	$54,170,000
					$54,170,000
TOTAL ESTIMATED CONSTRUCTION COST:					$282,848,000



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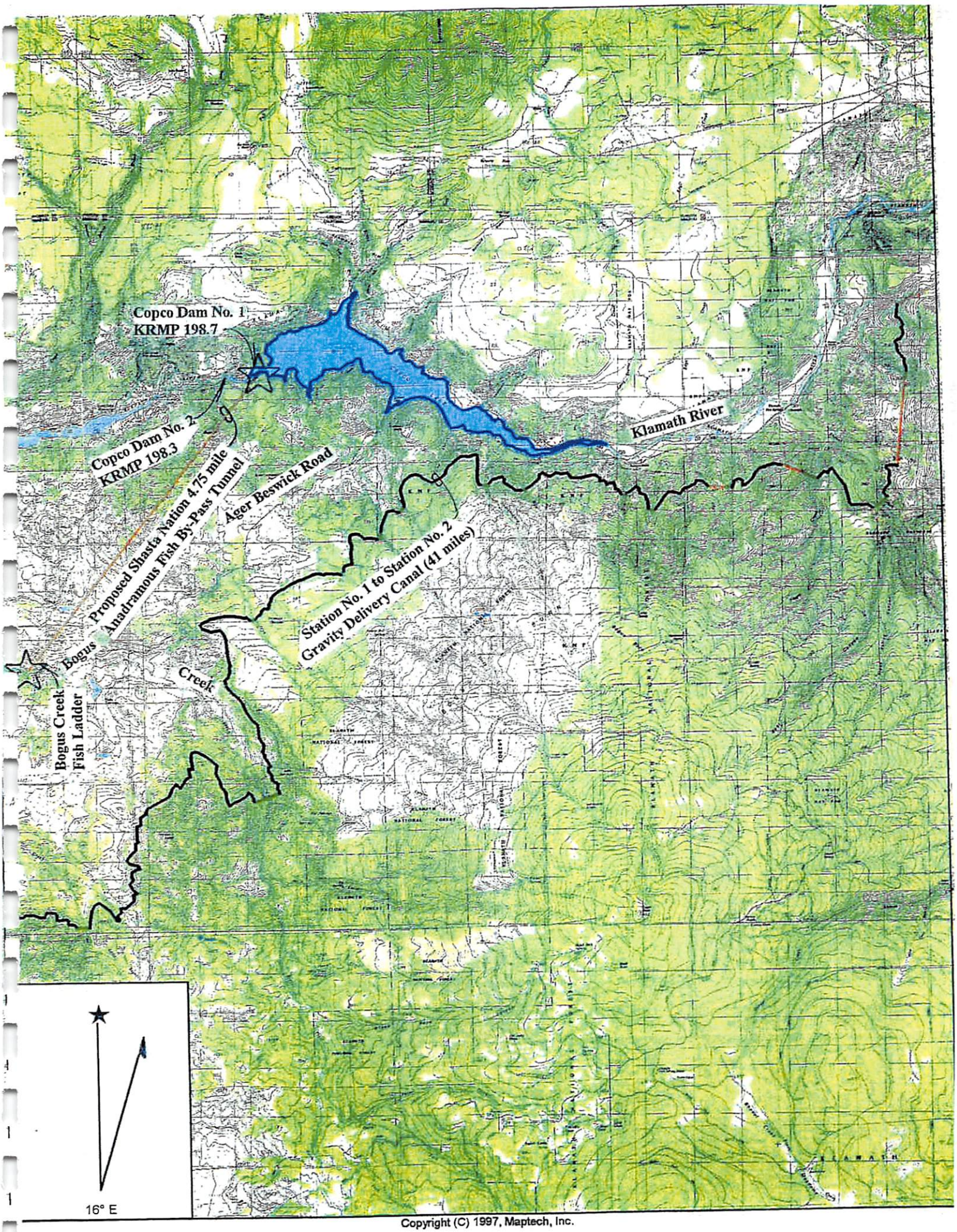

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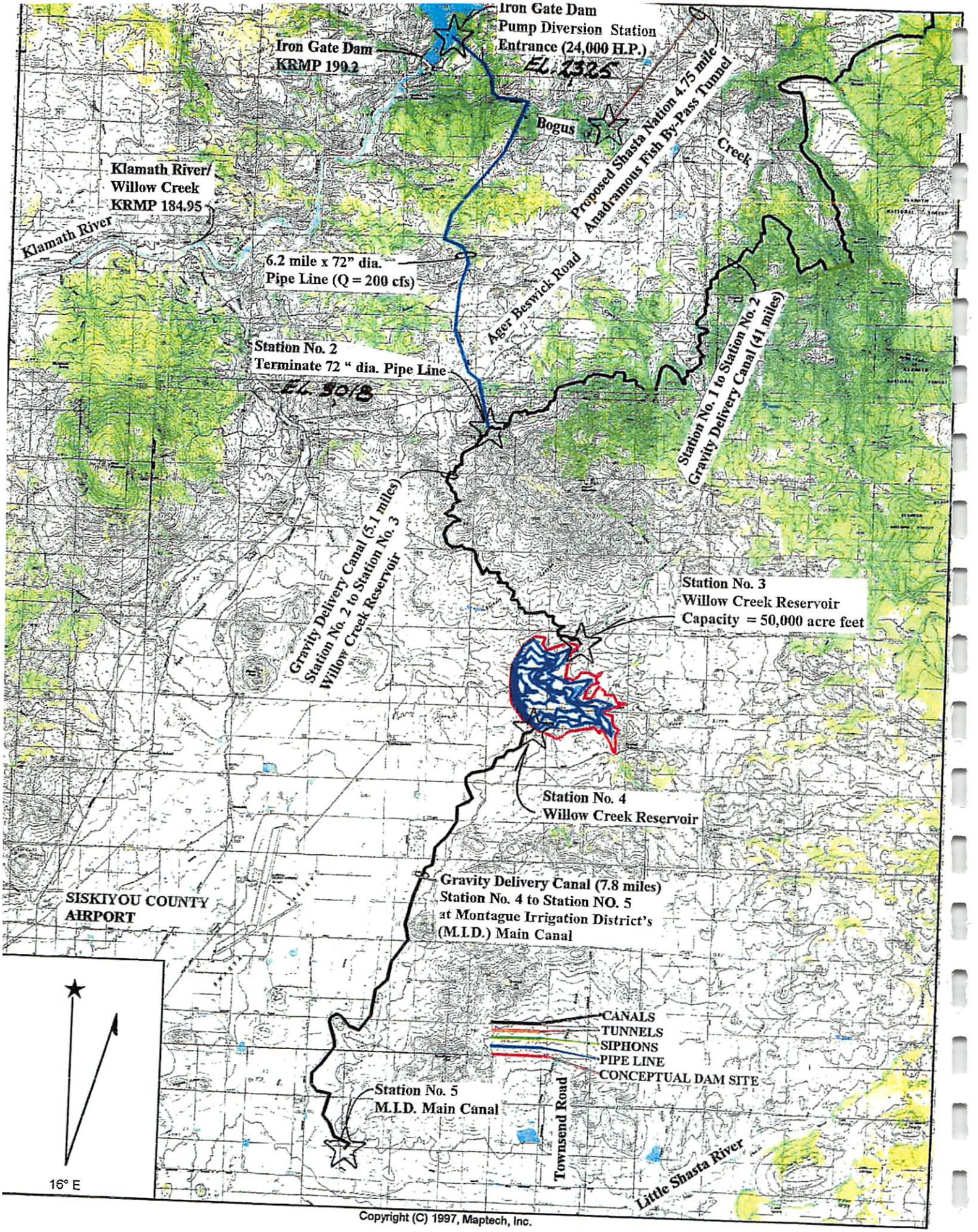

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Memo to: Siskiyou County Water Users Association (S.C.W.U.A.).
347 N. Main St.; Yreka, Ca. 96067

Subject: Meeting with the State Water Resources Control Board (S.W.R.C.B.)
1/20/11 1001 I St, P.O. Box 100 Sacramento, Ca. 95812

Present: Katherine Mrowka, P.E.; Charles Rich, P.E.; Mark Stretars, P.E., all with the (S.W.R.C.B.), and Jerry Bacigalupi, P.E. (J.L.B.), (S.C.W.U.A.)

Subjects:

1. Shasta Nation Fish Bypass Tunnel and the 60,000 Ac. Ft. Shasta Valley Water Right Transfer as a viable alternative to dam removal.
2. Transfer of the state 60,000 Ac. Ft. Klamath River – Shasta Valley storage reserved rights from the State of California to Siskiyou County Flood Control and Water Conservation District.

Subject 1: J.L.B. furnished the S.W.R.C.B. staff with copies of the following, for an open discussion session:

1. SCWUA's preliminary engineering maps and cost estimate for the tunnel bypass and 60,000 ac. ft. transfer to Shasta Valley.
2. Shasta Valley Resource Conservation District, Siskiyou County, California "Klamath-Shasta Water Substitution Preliminary Engineering Study", June 2007 Project No. 205013, California Department of Fish and Game Project No. P0310329.(similar to the S.C.W.U.A. proposal with the point of diversion at Keno Dam, Oregon)
3. March 31, 2004 report on legal issues Klamath-Shasta Water Transfer Study by Law Offices of Donald B. Mooney and Law Office of Marsha A. Burch.
4. Average Klamath River monthly flows for the years 1987 through 2006 (Appendix 30, Page 3 of 18); Measure "G" data; and an Article by Tom Mallams, from the Klamath Falls Herald and News, related to U.S. Rep's. Doc Hasting and Tom McClintok opposition to dam removals.

JLB pointed out that in addition to providing fish passage, this proposal would allow Montague Irrigation District to supply additional irrigation water to the Ager area and a majority of their water users with stored Klamath River winter water. Also, this proposal would allow dedication of a portion of this water to additional in-stream flow releases from Lake Shastina, which would improve water quality in the Shasta and Klamath Rivers. This proposal is supported by a majority in Siskiyou County to be a viable alternative to dam removals.

The S.W.R.C.B. staff had concerns over the spawning salmon and the returning smolt accessing the tunnel and the predatory take across Copco 1 Lake. After discussion, J.L.B. pointed out the following:

1. The Tunnel Bypass access for spawning salmon is located immediately below the Bogus Creek Falls and the CDFG Fish Ladder, and that the 10 CFS flow through

the bypass would be Klamath River water, and would normally be greater than the flow in Bogus Creek.

2. The tunnel would have dusk to dawn lighting with resting pools at 250' intervals.
3. The floating intake structure would be located at a shaded, very narrow portion of Copco #1 Lake, just upstream from the dam, and would provide the first moving surface water discharge on the lake and more than likely the only moving surface water discharge because the hydro-intake structures are located several feet below the surface.

Their initial responses were that the S.W.R.C.B. staff could not take a position on this proposal at this time; however, this alternative might very well be considered as an alternative to dam removals. They were also concerned that the tunnel bypass concept has not been tested to their knowledge.

They suggested that if local proponents wish to pursue this proposal they should see if the U.S. Bureau of Reclamation or the State Department of Water Resources would be willing to further evaluate the project and come up with a more detailed and defendable proposal; however, these agencies will generally not work with a citizens group. Therefore, the S.W.R.C.B. staff recommended that the County Board of Supervisors consider taking the lead to pursue obtaining the involvement of these agencies in defining the project.

The following possible actions were also discussed without the S.W.R.C.B. staff taking a position.

1. Introduce the Tunnel Bypass and 60,000 ac. ft. Klamath River Transfer with provisions to provide additional in-stream Lake Shastina releases into the Shasta and Klamath Rivers, as Siskiyou County's solution to coho salmon restoration, retaining Klamath River Dams for flood control and providing clean hydroelectric power for 70,000 homes.
2 Contact U.S. Rep's Tom McClintok and Doc Hastings to obtain their support along with Rep's Greg Walden and Wally Herger.
3 Contact Assemblyman Jim Nielson and Senator Doug LaMalfa to get their support and introduce a bill to remove the $250,000.000 California contribution for dam removal from the Water Bond. Governor Brown is looking for ways to reduce spending and also to get more support for the passage of the water bond.
4 Request an in-depth study of this alternative to dam removals by the California Dept. of Water Resources or the Bureau of Reclamation through our State and Federal Representatives.

Subject 2: J.L.B. furnished the S.W.R.C.B. staff copies of the following documents:

1. Klamath River Basin Compact
2. Appendix B: Siskiyou County Flood Control and Water Conservation District Act.
3. October 11, 1960, Board of Supervisors Resolution enacting the Siskiyou County Flood Control and Water Conservation District.
4. March 31, 2004 report on legal issues Klamath-Shasta Water Transfer Study by Law Offices of Donald B. Mooney and Law Office of Marsha A. Burch.

5. Average Klamath River Monthly Flows 1987-2006, Appendix 3D.

S.W.R.C.B. staff's response to the data furnished them was that they were familiar with most of the data, but not that the Siskiyou County Flood Control and Water Conservation District had been established. However, they felt that such an entity could be a good choice for the project proponent as a governmental agency that can enter into Joint Power Agreements and qualify for loans or grants as well as petition for assignment of a Status Filing for the transfer of the 60,000 ac. ft. Reserved Water Right.

Initially, because the proposed point of diversion is located in Oregon, they recommended that the State of Oregon be approached to determine if acquisition of a water right from Oregon would not be a problem.

J.L.B. brought up the fact that the 2007 R.C.D./CDFG Study proposed diverting water from Keno Dam, from which Oregon has irrigated land down river between that diversion and J.C. Boyles Dam. The S.C.W.U.A. alternative proposes to divert water from J.C. Boyles Dam, which is at the head of the Klamath River Canyon, and would have little to no impact on water use in the State of Oregon.

J.L.B. requested that the S.W.R.C.B. staff look at and respond to the S.C.W.U.A. alternative of pumping the 60,000 ac.ft. Shasta Valley Water Transfer from Iron Gate Reservoir and not involve the State of Oregon at this time. If no major problems are uncovered with the transfer in California, and because of high pumping cost, they could recommend that the gravity flow alternative from J. C. Boyles be explored through the State of Oregon at a later date.

The S.W.R.C.B. staff informed J.L.B. that the cost to file a petition for assignment of a State Filing for 60,000 ac.ft. water right from the Klamath River in California is $460,673 (including the $850 fee to the DF&G). Additional cost of processing such a petition could include cost for the preparation of a CEQA document, a water availability study, public trust evaluation, and technical/legal support.

J.L.B. was furnished with an informational document pertaining to "State Filing" and a "Petition for Assignment Form.

The Scott Valley Ground Water situation was also briefly discussed with a general consensus that streams and diverters in the valley might benefit if a Ground Water Recharge Program were to be initiated by the Siskiyou County Flood Control and Water Conservation District or some other local entity (ie: Off Stream Secondary Winter Storage Facilities which would recharge the ground water aquifer by infiltration and releasing flows in late spring to early fall, thus providing a higher water table and adding cooler water to the streams).

Jerry Bacigalupi
P.O. Box 309
Montague, Ca. 96064

THE BEST ALTERNATIVES
for the Community and the Environment

Klamath Settlement BEST alternatives for the community and environment, currently not being considered but reported in the Final Environmental Impact Statement/Environmental Impact Report in the Klamath Facilities Removal FINAL Alternatives Report

3.11 Alternative 11 – Fish Bypass: Alternative Tunnel Route

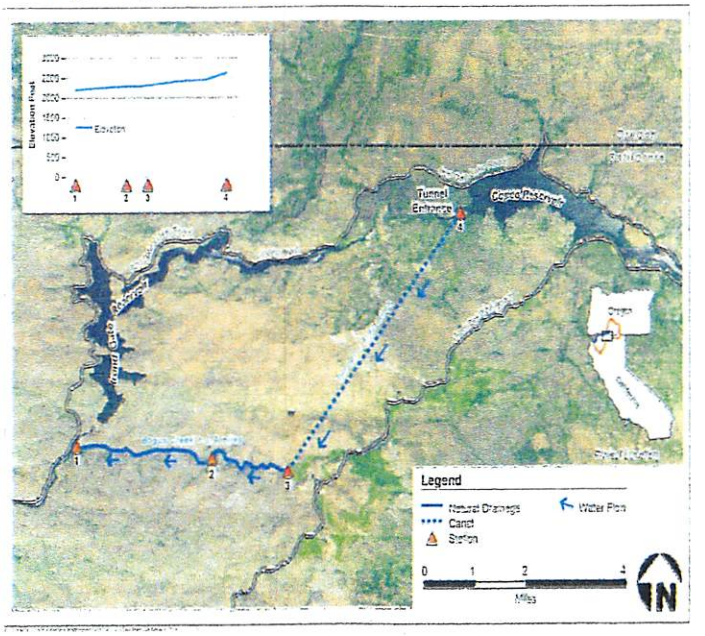
This alternative would use a combination of natural drainages and a constructed tunnel to provide a migratory passage for anadromous species around Copco 1, Copco 2, and Iron Gate Dams while leaving the dams in place. This alternative also includes improvements to fish passage facilities at J.C. Boyle Dam to allow upstream and downstream passage. This alternative would allow continued power generation at the Four Facilities, but the Hydropower Licensee would need to obtain a new FERC license to continue operations.

This alternative bypass would route upmigrating fish into Bogus Creek into an approximately five-mile tunnel that would connect Bogus Creek to Copco 1 Reservoir. The tunnel would connect to Bogus Creek at stream mile 2.9, well downstream of the existing fish ladder on the creek and the confluence with Cold Creek (Bacigalupi and Lake 2010) (Figure 3-8).

The proposed tunnel would be 16 feet wide by 12 feet high and would contain a 4 foot wide by 2 foot deep fish channel on one side. Larger —rest areas‖ for the migrating fish would be placed every 250 feet, and vertical shafts would be installed at regular intervals to provide natural light to the channel (Bacigalupi and Lake 2010). The proposed gradient of the channel would be less than one percent, and flow would be above 10 cfs. The proposed gradient of the channel would be less than one percent, and flow would be above 10 cfs.

A floating entrance structure at Copco 1 Reservoir would provide water and fish access to the tunnel. The structure would float with the level of the lake to provide a year round water supply regardless of the level of the reservoir, as well as serve as the access to the tunnel for anadromous species.

The proposal addresses some of the issues associated with Alternative 10, the Bogus Creek Bypass route: the tunnel would allow migrating salmonids to swim in a consistently upstream direction, as the tunnel would be drilled to connect the reservoir with the downstream tributary. In addition, it would not require a new water supply or negotiations, as would the bypass in the fully appropriated Cold Creek (in Alternative 10), because water for Alternative 11 would be supplied from Copco 1 Reservoir. Finally, the tunnel might provide more capacity for more capacity for the large numbers of migrating salmonids than the smaller drainages of Clear and Deer Creeks.



ES.7.3 Environmentally Preferable/Superior Alternative

NEPA requires the Lead Agency to identify the alternative or alternatives that are environmentally preferable in the Record of Decision (ROD) (40 CFR Part 1505.2(b)). The environmentally preferable alternative generally refers to the alternative that would result in the fewest adverse effects to the biological and physical environment. It is also the alternative that would best protect, preserve, and enhance historic, cultural, and natural resources. Although this alternative must be identified in the ROD, it need not be selected for implementation.

Section 15126.6(e)(2) of the CEQA Guidelines requires agencies to identify the environmentally superior alternative in a draft EIR. If the No Project Alternative is the environmentally superior alternative, an additional environmentally superior alternative must be identified among the other alternatives.

CDFG has identified Alternative 3 (Partial Facilities Removal of Four Dams) as the environmentally superior alternative. All of the alternatives evaluated in the EIS/EIR, including for the No Action/No Project Alternative, have significant unavoidable environmental impacts as identified in Section 5.5. Alternative 2 (Full Facilities Removal of Four Dams, the Proposed Action), Alternative 3, and Alternative 5 (Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate) would have the most short-term significant and unavoidable impacts among the alternatives. These impacts would largely be limited to the time frame of direct dam deconstruction actions and sediment release. After dam deconstruction, impacts would include the loss of reservoir recreation and local economic impacts. Alternatives 2, 3, and 5 would significantly improve water temperature, dissolved oxygen, and algal toxins for aquatic resources and reduce the incidence of fish disease in juvenile salmon by removing the two largest reservoirs—Copco I and Iron Gate. Alternatives 4 and 5 would maintain some power production and recreational benefits thereby reducing local economic impacts.

Although the No Action/No Project Alternative will have no change from existing conditions resulting from construction, this alternative is not the environmentally superior alternative when compared to the Proposed Action, which is intended to improve environmental conditions. Alternative 3 is the environmentally superior alternative when compared with the Proposed Action because it would:

Reduce the air quality impacts from emissions of volatile organic compounds (VOCs), nitrogen oxides (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter < 10 microns (PM_{10}), and particulate matter < 2.5 microns ($PM_{2.5}$) from reduced construction activities;

Reduce the contribution to greenhouse gas emissions from reduced construction activities;

Reduce noise and vibration from reduced construction activities;

Reduce impacts to terrestrial plants and wildlife from fewer truck trips;

Reduce disturbance to archaeological and historic sites from fewer truck trips;

Retain structures for roosting bats; and

Retain historically significant structures at Copco 1.

Alternative 3 would provide similar long-term benefits when compared with Alternative 2, but would reduce short-term impacts because it involves less construction. Alternative 3 would result in superior long-term beneficial environmental effects. In summary, Alternative 3 is considered the environmentally superior alternative among all the alternatives because it provides long-term beneficial environmental effects, while reducing some of the short-term significant effects of the Proposed Action (Alternative 2).

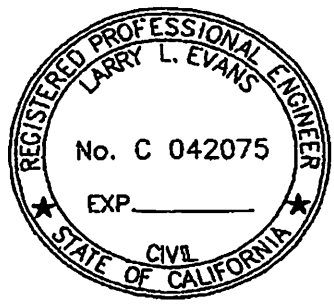
ES.6.3 Alternative 3 - Partial Facilities Removal of Four Dams

The Partial Facilities Removal of Four Dams Alternative would include removal of enough of each dam to allow free-flowing river conditions and volitional fish passage for all Klamath River anadromous species at all times. Under this alternative, portions of each dam facility would remain in place, including ancillary buildings and structures such as powerhouses, foundations, tunnels, and pipes (Figure ES-9). Some of these remaining features would require perpetual maintenance and security measures to prevent unauthorized entry and safety hazards. All tunnel openings would be sealed and all potentially hazardous materials found in powerhouses and machinery would be removed prior to final decommissioning and securing of buildings.

The schedule for Partial Facilities Removal of Four Dams would be the same as for the Proposed Action (the Full Facilities Removal of Four Dams Alternative). The Partial Facilities Removal of Four Dams Alternative also includes the transfer of Keno Dam to DOI and implementation of the KBRA (as in the Proposed Action).

SHASTA VALLEY RESOURCE CONSERVATION DISTRICT SISKIYOU COUNTY, CALIFORNIA

Klamath – Shasta Water Substitution Preliminary Engineering Study



June 2007

Project No. 205013
CDFG Project no. P0310329

FORSGREN ASSOCIATES / INC.

Boise, Idaho

Shasta Valley Resource Conservation District

TABLES

Table 1	Water User Flow Requirements
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Table 6	Alternative No. 1 / Option 2 for 125 cfs (Gravity Flow Conduit / Keno to Dwinnell Reservoir, Minimize Use of Tunnels)
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Table 8	Alternative No. 2 / Option 2 (Gravity Flow Conduit / Keno to Below Dwinnell Reservoir, Maximize Use of Tunnels)
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FIGURES

Figure 1	Location Map
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APPENDICES

Appendix A	Alignment and Topographic Information
Appendix B	Hydraulic Calculations
Appendix C	Cost Opinion Assumptions

1.0 INTRODUCTION

1.1 General

The Shasta River, located in Syskiyou County, California is a major tributary to the Klamath River. The demand on water resources in the Klamath River Basin has long been a challenging issue. The Shasta River in particular is a primary water supply resourse for agriculture, fisheries, and recreation in Siskiyou County.

In past years a variety of work has been done to investigate development of water resources in the Shasta Valley. These efforts were primarily focused on water resource development to stimulate the local economy and meet local agricultural, municipal, and industrial needs. In recent years the importance of the Shasta River for fisheries habitat has been more clearly recognized and documented. The Shasta River is recognized as one of the most important spawning tributaries in the Klamath Basin.

A concept investigated as early as 1923 to meet water resource demands in the Shasta Valley has been to import water from the Klamath River to the Shasta River Basin. In the past, the driver for considering such a concept has been development of water resources for agricultural, municipal, and industrial use. This study has been prepared to investigate a Klamath-Shasta water import concept within the current context of fisheries habitat restoration for anadromous fish. This study investigates the feasibility of transporting water from the Klamath River to the Shasta River basin to meet irrigation demands. If this were done, water currently being diverted from the Shasta River for irrigation could remain in the river resulting in improved fisheries habitat.

1.2 Project Objectives

The following objectives have been outlined for this particular investigation.

1. Review the feasibility of past-proposed import projects based on current engineering standards and economics.
2. Use information and data from these past studies to develop a minimum of two Klamath-Shasta water substitution alternatives and evaluate these based on current engineering standards. The alternatives will be evaluated from the prospective of salmon habitat restoration instead of water resources for development.
3. Develop preliminary opinions of probable project costs and estimates of annual operation and maintenance costs for each alternative. These costs will be for comparison purposes based on existing survey data, USGS topographic maps, and existing cost data for similar infrastructure.
4. Identify critical legal and environmental issues related to implementing a project of this scale. Issues will include, NEPA and CEQA compliance, easements, and right-of-way issues.
5. Present the findings and recommendations of this effort in a document that can be used to make an informed decision on the current feasibility of the concept and determine whether further investigation is warranted.

1.3 Authorization

Forsgren Associates has been authorized to prepare this report through an agreement with the Shasta Valley Resource Conservation District. Funding for this report has been provided by the California Department of Fish and Game.

1.4 Background

The Shasta River Valley is located in the central region of Siskiyou County in Northern California. A location map is provided in Figure 1. The Shasta Valley is formed by the Cascade Mountain Range to the east and the Klamath Mountain Range to the west. The Shasta River originates near the southern boundary of the valley on the northeastern slopes of Mount Eddy. Runoff from the northern slopes of Mount Shasta also contributes significantly to Shasta River flows. In addition several tributaries feed the river as it flows northwest to intersect the Klamath River west of Iron Gate Dam. A vicinity map of the Shasta River is provided in Figure 2.

A major feature along the Shasta River is Dwinnell Dam and reservoir (See Figure 2). Dwinnell is the largest impoundment along the Shasta River having a total storage capacity of approximately 72,000 acre-ft. However, due to seepage problems and structural stability, actual reservoir capacity is limited to approximately 34,000 acre-ft.

There are also several smaller irrigation diversions along the river diverting water ranging from 1 to 2 cubic feet per second (cfs) to as much as 40 plus cfs.

1.5 Current Water Delivery Requirements

Water delivery requirements for six current users in the Shasta Valley will be considered in this study. Water for these users come from ground water, the Shasta River and the Little Shasta River which is a tributary to the Shasta River. A summary of these users is provided in Table 1.

The Shasta-Klamath import concept being considered in this investigation would provide the water requirements for these users. The water currently being consumed by these users would be left in the Shasta River basin and result in overall higher flows in the Shasta River.

Table 1 Water User Flow Requirements

Irrigation District	Flow[1] (cfs)
Little Shasta Irrigation District	25
Big Springs Users	20
Shasta Water Association	35
Big Spring Irrigation District	20
Grenada Irrigation District (includes Hussman – 8cfs)	25
Montague Irrigation District	80
Total	205

Note:
[1]Flows shown are those anticipated following implementation of water conservation measures

Two water import scenarios have been considered in this study. The first scenario would import water to meet the needs of all the users listed in Table 1 except the Montague Irrigation District. This scenario would require importing 125 cfs from the Klamath River. The second scenario would import enough water to supply the Montague Irrigation district as well and would require a total flow of 205 cfs.

2.0 PREVIOUS INVESTIGATIONS

2.1 General

Two previous water resource studies of the Shasta River Basin that have investigated the concept of a Klamath-Shasta import project are reviewed in this report. These studies include:

1. Klamath-Shasta Valley Reclamation Project (1923) – Bureau of Reclamation
2. Bulletin No. 87 Shasta Valley Investigation (1964) – California Department of Water Resources

These studies present Klamath-Shasta import alternatives and evaluate the feasibility of the concept. When these studies were prepared, the focus of the investigations were on development of water resources for agricultural, municipal, and industrial use. A summary of the Klamath-Shasta import alternatives presented in these investigations are presented below.

2.2 Klamath-Shasta Valley Reclamation Project (1923)

In 1923, Homer J Gault and Forster Towle of the United States Reclamation Service, in cooperation with the State of California and the Klamath-Shasta Irrigation District, investigated the feasibility of reclamation of certain lands in the Shasta Valley by diverting waters from the Klamath River. This investigation considered not only the transmission of water from the Klamath River to the Shasta Valley, but also the distribution of water to individual irrigation districts. The concept consisted of a main conduit, several tunnels, a large siphon, branch canals and laterals supplying individual irrigation districts. Generation of hydroelectric power through the construction of a series of dams was also considered. The study assessed four different plans to provide irrigation for varying acreages and different arrangements of hydroelectric power generation. The four plans are summarized below.

2.2.1 Plan I

Plan I consisted of construction of a low diversion dam in the Klamath River approximately one mile downstream of Keno, Oregon. Under the proposed plan, the diversion dam fed a gravity delivery channel at a flow rate of 1,100 cubic feet per second (cfs). The diverted water would be transferred to the Shasta Valley utilizing lined and unlined canal sections, a concrete bench flume, a lined tunnel, and a steel pipe siphon.

The conduit for this plan included approximately 46 miles of canal and approximately 11 miles of tunnel. The siphon included in the plan was approximately 3,900 feet. At mile 46 the delivery system branched into approximately 68 miles of smaller canals and laterals serving the northern and southern portions of the Shasta valley. The plan included construction of six additional tunnels within the 68 miles of smaller canals and laterals. Under this plan approximately 65,000

acres of land would be irrigated. The construction of six power plants was also included in this plan. A cost of $29,674,465 was estimated for this plan in 1923.

2.2.2 Plan II

Plan II was essentially the same as Plan I except the power plants were not included. The 1923 cost for this plan was estimated at $21,392,640.

2.2.3 Plan III

Under Plan III only the northern portion of the Shasta Valley would be irrigated (approximately 32,000 acres). The diversion dam was located at the same point on the Klamath River. The cross section of the delivery channel was adjusted to reflect the lower water supply demand (approximately 550 cfs). Plan III included the 46 miles of canal and 11 miles of tunnel to reach the northern portion of the Shasta Valley and the smaller canals and laterals associated with the northern portion of the Valley. Plan III included construction of five power plants and had a 1923 estimated cost of $11,014,198.

2.2.4 Plan IV

Under Plan IV the location of the diversion point was changed in order to reduce the length of transmission canal to approximately 38 miles. The diversion point for Plan IV would have been located seven miles above Shovel Creek. This plan would have supplied 420 cfs of irrigation water to approximately 25,000 acres of the northern portion of the Shasta River Valley. The 1923 estimated project cost was $5,019,771.

2.3 Bulletin No. 87 Shasta Valley Investigation (1964)

In 1964 the California Department of Water Resources completed Bulletin No. 87 Shasta Valley Investigation to examine potential development of water resources in the Shasta Valley. The primary objective of the investigation was to examine possibilities for conserving waters of the Shasta River and its tributaries and to investigate the possibility of importing water to the Shasta River Valley from the Klamath River.

This investigation describes a Klamath-Shasta import concept sited in earlier Department of Water Resources Bulletins. The concept included Iron Gate dam and reservoir, an Iron Gate Pumping Plant, an Ager Pumping Plant, Red School Dam and Reservoir, and a Bogus Conduit. The project would have provided approximately 122,000 acre-feet of water to serve the Ager area and Shasta Valley. An estimated capital cost of $19,960,000 with annual operating costs of approximately $1,415,000 was cited from a 1959 Department of Water Resources Bulletin No.83. It was estimated that pumping costs would be approximately $522,000 per year for a total annual cost of $1,937,000. The project did not include costs for a local distribution system.

Since this investigation, Iron Gate Dam has been constructed and is in operation by the California Oregon Power Company (COPCO). The import portion of the project was not constructed at that time because initial reconnaissance studies suggested it would not be feasible.

Specific reasons as to why the import portion of the project was considered unfeasible are not given. Bulletin No. 87 suggests that local interests in the Northern Shasta Valley were unprepared economically. The project would have required approximately 23 miles of canal and a pumping plant capable of lifting nearly 350 cfs approximately 635 feet. Implementation of this

project would have required development of an agreement with COPCO for access to Iron Gate Dam and due compensation.

3.0 DEVELOPMENT AND EVALUATION OF POTENTIAL SHASTA-KLAMATH IMPORT PROJECTS

This section provides a summary of the Klamath – Shasta Import project alternatives investigated in this study. The potential projects investigated utilize information available from previous investigations and expand on the concept of a gravity flow conduit as presented in the 1923 Klamath-Shasta Valley Reclamation Project prepared by the Bureau of Reclamation. The concept of a pressurized transmission line originating from Iron Gate Reservoir as described in Bulletin No. 87 Shasta Valley Investigation prepared in 1964 has also been expanded.

These concepts have been adapted and geared toward meeting the specific need of providing water for the specific users summarized in Table 1. No attempt has been made to investigate the potential for water delivery beyond these specific users.

The following primary conceptual alternatives have been developed during this investigation:

1. Alternative 1: Gravity Flow Conduit, Keno to Dwinnell Reservoir
2. Alternative 2: Gravity Flow Conduit, Keno to below Dwinnell Reservoir
3. Alternative 3 : Pressure / Gravity Combination, Iron Gate Reservoir to Below Dwinnell Reservoir

Alternatives one and two above have been developed with two options. One option maximizes the use of tunnels through the alignment. The other option minimizes the use of tunnels. A detailed description of each alternative and option is presented in Sections 3.1 to 3.4. Alignment details and topographic information for each of the alternatives is provided in Appendix A.

3.1 Basic Design Criteria

Limited field reconnaissance was performed for this investigation. No field surveys were performed. Topography information was obtained from digital topographic maps. The alignments developed were reviewed in the field where access was possible. Data from previous investigations was used as appropriate to develop the alternatives.

For the purposes of this investigation, transmission canals were assumed to be trapezoidal open channel lined shotcrete. Use of a circular section pipeline was considered but did not compete economically with an open channel section.

The alignments investigated required a variation in slope at various locations. Slopes ranged from a minimum of 0.0003 ft/ft to a maximum of 0.0035 ft/ft. The overall average slope of the conduit for the alignments has a value of approximately 0.001ft/ft. This translates to a drop of approximately 5.30 feet per mile of conduit. The dimensions and parameters used in analysis of the open channel conduit are summarized in Table 2. A summary of the open channel flow calculations are provided in Appendix B.

Table 2 Open Channel Dimensions and Parameters

Parameter / Dimension	Flow Rate (Q) = 125 cfs	Flow Rate (Q) = 205 cfs
Manning's n (n)	0.016	0.016
Bottom Width (b)	4.5 ft	6.0 ft
Depth of Water (d)	3.5 ft	4.0 ft
Freeboard (f)	2.0 ft	2.5 ft
Side Slope (z)	1.0	1.0

3.2 Alternative 1 – Gravity Flow Conduit / Keno to Dwinnell Reservoir

Under this alternative, a gravity flow conduit would be constructed originating just below Keno, Oregon and terminating at Dwinnell Reservoir. The alignment for this alternative is similar to the one developed by the Bureau of Reclamation in 1923. An overall view of this alignment is provided in Appendix A on Figure 3. Figures 4, 5 and 6 in Appendix A show details of this alignment as well as the details of each of the alignments considered in this study.

This alternative will require an inlet structure at the Keno Reservoir. The inlet structure could be gravity fed or use low head pumps to lift water into the open channel canal. This alternative allows import water to be delivered to Dwinnell Reservoir. This is accomplished by maintaining elevation along the east side of the Shasta Valley along the foothills of the Cascade Mountains. (See Appendix A)

Two options for this alternative have been developed; one maximizing the use of tunnels and one minimizing the use of tunnels.

3.2.1 Option No.1 – Maximize Use of Tunnels

For this option the transmission conduit includes approximately 52 miles of trapezoidal open channel canal, eighteen lined tunnel sections totaling approximately 20.6 miles, and one siphon approximately 1.2 miles long. The location of the tunnels and siphon are shown in Figures 4, 5 and6. The use of tunnels has the advantage of greater safety in terms of potential obstruction from falling debris and lower ongoing maintenance cost due to in-channel vegetation. In some cases the use of tunnels will prove to be more cost effective due to the reduction in overall conduit length. Tunnels will be required at some sections of the conduit where construction of an open channel along steep or very rocky side slopes will be impractical.

The siphon is included in this Option to traverse a large canyon so a reasonable slope can be maintained and a final elevation above Dwinnell Reservoir be reached. Overall this Option traverses 74 miles from the Keno Reservoir through the eastern region of the Shasta River Valley to Dwinnell Reservoir (See Appendix A).

3.2.2 Option No.2 – Minimize Use of Tunnels

For this Option, the conduit includes approximately 90.3 miles of trapezoidal open channel canal, one 1.3 mile tunnel section, and two large siphons totaling 1.4 miles long. (see Appendix

A). The tunnel included in this Option is necessary to maintain gravity flow throughout the alignment. The two siphons are necessary to traverse two large canyons in order to maintain a reasonable slope to the final elevation at Dwinnell Reservoir. The overall length of this Option is 93 miles from the Keno Reservoir to Dwinnell Reservoir (See Figures Appendix A).

3.2.3 Alternative 1 Constructability Issues

Construction of the canals and tunnels described in this Alternative will present several challenges. These challenges will primarily include severe topography, excess rock excavation, and very limited site access. Other challenges will include hauling and disposal of excavated material, disposal of clearing and grubbing debris, and slope stabilization. Significant challenges will also be encountered during construction of the siphons. These challenges will also include site access, severe topography, and excessive anchoring and thrust control. These challenges have been considered when developing the opinions of probable project cost described in Section 4.0.

3.3 Alternative 2 – Gravity Flow Conduit / Keno to below Dwinnell Reservoir

Under this alternative a gravity flow conduit would be constructed originating at Keno Reservoir and terminating below Dwinnell Reservoir. The alignment for this alternative is similar to the one developed by the Bureau of Reclamation in 1923 for the first approximately 40 miles. The alignment then follows a course lower in the valley. This alignment is closer to potential users and would require less lateral canals to deliver water for service (see Figures Appendix A).

As with Alternative 1, Alternative 2 would require an inlet structure be constructed at Keno Reservoir. This alternative also has two options; one maximizing the use of tunnels and one minimizing use of tunnels.

3.3.1 Option 1 - Maximize Use of Tunnels

This option would consist of approximately 54 miles of trapezoidal open channel canal, fifteen tunnel sections totaling approximately 17 miles, and two large siphons totaling approximately 2.1 miles. The total length of the conduit would be approximately 73 miles from the Keno Reservoir to a region of the Shasta Valley just below Dwinnell Reservoir (see Figures Appendix A).

3.3.2 Option 2 – Minimize use of Tunnels

Under this option approximately 82.1 miles of trapezoidal open channel canal would be constructed. No tunnel would be constructed. Two siphons totaling approximately 1.9 miles would be required. The total length of conduit for this option would be approximately 84 miles (see Figures Appendix A).

3.3.3 Alternative 2 Constructability Issues

Construction of the canals, tunnels, and siphons described in this alternative will have construction challenges similar to those of Alternative 1. These challenges have been considered during the development of opinions of probable project costs as well.

3.4 Alternative 3 – Pressure / Gravity Combination, Iron Gate Reservoir to Below Dwinnell Reservoir

This alternative is similar to the concept discussed in Bulletin No.87 Shasta Valley Investigation prepared by the California Department of Water Resources in 1964. This alternative consists of the following major elements:

1. Iron gate pumping plant;
2. Pressurized transmission line from Iron Gate reservoir to Bogus Mtn.
3. Tie in to Alternative 2 alignment below Bogus Mtn.

Under this alternative a pumping plant would be constructed on the south shores of Iron Gate Reservoir near the Iron Gate Dam. An approximate location is shown in Appendix A on Figure 5. The pumping plant would require approximately 22,800 horsepower and consist of multiple pumps connected in parallel.

Water would be pumped south toward Bogus Mountain via a single 96-inch diameter spiral welded steel pipeline. The pipeline would be approximately seven miles long. A preliminary hydraulic and economic analysis of a series of pipeline sizes and configurations indicate that a single 96-inch conduit will be most economical. Spiral welded steel was the only material considered due to the need for durability at high pressures. The alignment of this pressure transmission pipeline is shown on Figure 5 in Appendix A.

At a location near Bogus Mountain, the pressure pipeline would discharge into the gravity alignment described in Alternative 2 above. An outlet structure would be constructed for control of discharge from the pressure pipeline and outlet into the gravity canal.

3.4.1 Alternative 3 Constructability Issues

Construction of the canals in this alternative will have construction challenges similar to those of Alternative 1. This alternative will also have challenges associated with installation of a large diameter pipeline over very rugged topography. Thrust control as well as anchoring will be critical components of planning and design for the pipeline. These challenges have been considered during the development of opinions of probable project costs as well.

It is important to note that power requirements for Alternative 3 will be significant. The most practical source of power would be from the Iron Gate Power Plant. However, it is likely that additional power generation capacity will need to be constructed to supply power for the pumping plant for Alternative 3. The feasibility of expanding power generation at Iron Gate was not investigated in the study. However, determining power supply expansion capacity and feasibility will be critical to further defining any proposed import project.

4.0 OPINION OF PROBABLE COST

In this section opinions of probable project cost for the alternatives described above have been developed. The opinions presented in this section are based on the preliminary data reviewed in this report as well as current (2006) cost information obtained from various material suppliers and vendors. These cost opinions provide a basis for comparison of the alternatives presented and will need to be updated with current cost information as they are referred to in future investigations and studies.

Cost opinions have been developed based on the basic design criteria presented in Section 3.1. A 25% contingency and a 25% legal, administrative, and engineering cost is included in each cost opinion. In Addition, a 10% environmental permitting cost has been included. Detail regarding development of the opinions of probable cost is provide in Appendix C.

A net present value for each alternative has also been provided. The net present value was determined by estimated annual operation and maintenance cost as well as power costs where applicable. The net present value for O&M and power costs were estimated using an inflation rate of 4.0% over fifty years. The net present value of the O&M and power costs were added to the estimated construction cost to develop an estimate of the total net present value for each alternative.

The opinions of probable project cost are provided in Tables 3 through 9. Assumptions and calculation details are provided in Appendix C.

5.0 ENVIRONMENTAL COMPLIANCE

5.1 National Environmental Policy Act (NEPA)

Implementation of a Klamath-Shasta import project will require compliance with both State and Federal environmental policies. A project of this magnitude will certainly involve federal funding and will required compliance with the National Environmental Policy Act (NEPA). The State of California has a similar policy with the California Environmental Quality Act.

NEPA establishes the Federal government's environmental policy. Its primary goal is to help public officials make decisions based on an understanding of the environmental consequences of their actions. In order to accomplish this, NEPA requires Federal agencies to prepare written assessments that describe:

1. The affected environment and environmental consequences of a proposed project;
2. Reasonable or practicable alternatives to the proposed project; and
3. Any mitigation measures necessary to avoid or minimize adverse environmental effects.

In accordance with NEPA, three levels of environmental review are established. These include the following listed in order of project complexity:

1. Categorical Exclusions,
2. Environmental Assessments, and
3. Environmental Impact Statements.

The magnitude and complexity of a Klamath-Shasta Import project will certainly require preparation of an Environmental Impact Statement.

Table 3 Alternative No. 1 / Option 1 for 205 cfs (Gravity Flow Conduit / Keno to Dwinnell Reservoir, Maximize Use of Tunnels)

Item	Description	Units	Quantity	Unit Price	Total
1.0	Trapazoidal Open Channel Conduit				
	Excavation/Fill	LF	274,300	$ 1,500	$ 411,450,000
	Lining	LF	274,300	$ 400	$ 109,720,000
2.0	Tunnel Sections (12-ft Diameter)				
	Excavation	LF	109,000	$ 1,920	$ 209,280,000
	Lining	LF	109,000	$ 720	$ 78,480,000
3.0	Siphon				
	Inlet Structure	EA	1	$ 1,500,000	$ 1,500,000
	Outlet Structure	EA	1	$ 1,500,000	$ 1,500,000
	Excavation / Backfill	LF	6,200	$ 1,100	$ 6,820,000
	Appurtenances / Thrust Control	LS	1	$ 5,000,000	$ 5,000,000
	Spiral Welded Steel Pipe (96-inch)	LF	6,200	$ 900	$ 5,580,000
4.0	Control Structures				
	Transfer Structures	EA	20	$ 100,000	$ 2,000,000
	Water Measurement	EA	7	$ 65,000	$ 455,000
5.0	Construction Access				
	Staging Areas	EA	10	$ 50,000	$ 500,000
	Access Roads	LF	120,000	$ 150	$ 18,000,000
6.0	Diversion Structure				
	Concrete	CY	150	$ 500	$ 75,000
	Mechanical	LS	1	$ 100,000	$ 100,000
	Earthwork	CY	400	$ 75	$ 30,000
	Site Work	LS	1	$ 150,000	$ 150,000

Construction Subtotal	$	850,640,000
Contingency (25%)	$	212,660,000
Legal, Administrative, Engineering (25%)	$	265,825,000
Environmental Permitting (10%)	$	106,330,000
Total Estimated Project Budget	$	1,435,455,000
Estimated Annual O&M	$	1,276,000
O&M Net Present Value	$	27,411,000
Total Net Present Value	**$**	**1,462,866,000**

Table 4 Alternative No. 1 / Option 1 for 125 cfs (Gravity flow Conduit / Keno to Dwinnell Reservoir, Maximize Use of Tunnels)

Item	Description	Units	Quantity	Unit Price	Total
1.0	Trapazoidal Open Channel Conduit				
	Excavation/Fill	LF	274,300	$ 1,000	$ 274,300,000
	Lining	LF	274,300	$ 320	$ 87,776,000
2.0	Tunnel Sections (12-ft Diameter)				
	Excavation	LF	109,000	$ 1,920	$ 209,280,000
	Lining	LF	109,000	$ 720	$ 78,480,000
3.0	Siphon				
	Inlet Structure	EA	1	$ 1,250,000	$ 1,250,000
	Outlet Structure	EA	1	$ 1,250,000	$ 1,250,000
	Excavation / Backfill	LF	6,200	$ 650	$ 4,030,000
	Appurtenances / Thrust Control	LS	1	$ 3,000,000	$ 3,000,000
	Spiral Welded Steel Pipe (72-inch)	LF	6,200	$ 650	$ 4,030,000
4.0	Control Structures				
	Transfer Structures	EA	20	$ 100,000	$ 2,000,000
	Water Measurement	EA	7	$ 65,000	$ 455,000
5.0	Construction Access				
	Staging Areas	EA	10	$ 50,000	$ 500,000
	Access Roads	LF	120,000	$ 150	$ 18,000,000
6.0	Diversion Structure				
	Concrete	CY	150	$ 500	$ 75,000
	Mechanical	LS	1	$ 100,000	$ 100,000
	Earthwork	CY	400	$ 75	$ 30,000
	Site Work	LS	1	$ 150,000	$ 150,000
				Construction Subtotal	$ 684,706,000
				Contingency (25%)	$ 171,177,000
				Legal, Administrative, Engineering (25%)	$ 213,971,000
				Environmental Permitting (10%)	$ 85,588,000
				Total Estimated Project Budget	$ 1,155,442,000
				Estimated Annual O&M	$ 1,027,000
				O&M Net Present Value	$ 22,062,000
				Total Net Present Value	**$ 1,177,504,000**

Table 5 Alternative No. 1 / Option 2 for 205 cfs (Gravity Flow Conduit / Keno to Below Dwinnell Reservoir, Minimize Use of Tunnels)

Item	Description	Units	Quantity	Unit Price	Total
1.0	Trapazoidal Open Channel Conduit				
	Excavation/Fill	LF	477,000	$ 1,500	$ 715,500,000
	Lining	LF	477,000	$ 400	$ 190,800,000
2.0	Tunnel Sections (12-ft Diameter)				
	Excavation	LF	6,800	$ 1,920	$ 13,056,000
	Lining	LF	6,800	$ 720	$ 4,896,000
3.0	Siphon				
	Inlet Structure	EA	1	$ 1,500,000	$ 1,500,000
	Outlet Structure	EA	1	$ 1,500,000	$ 1,500,000
	Excavation / Backfill	LF	7,500	$ 1,100	$ 8,250,000
	Appurtenances / Thrust Control	LS	1	$ 5,000,000	$ 5,000,000
	Spiral Welded Steel Pipe (96-inch)	LF	7,500	$ 900	$ 6,750,000
4.0	Control Structures				
	Transfer Structures	EA	4	$ 100,000	$ 400,000
	Water Measurement	EA	7	$ 65,000	$ 455,000
5.0	Construction Access				
	Staging Areas	EA	15	$ 50,000	$ 750,000
	Access Roads	LF	156,000	$ 150	$ 23,400,000
6.0	Diversion Structure				
	Concrete	CY	150	$ 500	$ 75,000
	Mechanical	LS	1	$ 100,000	$ 100,000
	Earthwork	CY	400	$ 75	$ 30,000
	Site Work	LS	1	$ 150,000	$ 150,000
				Construction Subtotal	$ 972,612,000
				Contingency (25%)	$ 243,153,000
				Legal, Administrative, Engineering (25%)	$ 303,941,000
				Environmental Permitting (10%)	$ 121,577,000
				Total Estimated Project Budget	$ 1,641,283,000
				Estimated Annual O&M	$ 1,459,000
				O&M Net Present Value	$ 31,342,000
				Total Net Present Value	$ 1,672,625,000

Table 6 Alternative No. 1 / Option 2 for 125 cfs (Gravity Flow Conduit / Keno to Dwinnell Reservoir, Minimize Use of Tunnels)

Item	Description	Units	Quantity	Unit Price	Total
1.0	Trapazoidal Open Channel Conduit				
	Excavation/Fill	LF	477,000	$ 1,000	$ 477,000,000
	Lining	LF	477,000	$ 320	$ 152,640,000
2.0	Tunnel Sections (12-ft Diameter)				
	Excavation	LF	6,800	$ 1,920	$ 13,056,000
	Lining	LF	6,800	$ 720	$ 4,896,000
3.0	Siphon				
	Inlet Structure	EA	1	$ 1,500,000	$ 1,500,000
	Outlet Structure	EA	1	$ 1,500,000	$ 1,500,000
	Excavation / Backfill	LF	7,500	$ 650	$ 4,875,000
	Appurtenances / Thrust Control	LS	1	$ 3,000,000	$ 3,000,000
	Spiral Welded Steel Pipe (96-inch)	LF	7,500	$ 650	$ 4,875,000
4.0	Control Structures				
	Transfer Structures	EA	4	$ 100,000	$ 400,000
	Water Measurement	EA	7	$ 65,000	$ 455,000
5.0	Construction Access				
	Staging Areas	EA	15	$ 50,000	$ 750,000
	Access Roads	LF	156,000	$ 150	$ 23,400,000
6.0	Diversion Structure				
	Concrete	CY	150	$ 500	$ 75,000
	Mechanical	LS	1	$ 100,000	$ 100,000
	Earthwork	CY	400	$ 75	$ 30,000
	Site Work	LS	1	$ 50,000	$ 50,000
				Construction Subtotal	$ 688,602,000
				Contingency (25%)	$ 172,151,000
				Legal, Administrative, Engineering (25%)	$ 215,188,000
				Environmental Permitting (10%)	$ 86,075,000
				Total Estimated Project Budget	$ 1,162,016,000
				Estimated Annual O&M	$ 1,033,000
				O&M Net Present Value	$ 22,191,000
				Total Net Present Value	**$ 1,184,207,000**

Table 7 Alternative No. 2 / Option 1 (Gravity Flow Conduit / Keno to Below Dwinnell Reservoir, Maximize Use of Tunnels)

Item	Description	Units	Quantity	Unit Price	Total
1.0	Trapazoidal Open Channel Conduit				
	Excavation/Fill	LF	284,400	$ 1,000	$ 284,400,000
	Lining	LF	284,400	$ 320	$ 91,008,000
2.0	Tunnel Sections (12-ft Diameter)				
	Excavation	LF	89,700	$ 1,920	$ 172,224,000
	Lining	LF	89,700	$ 720	$ 64,584,000
3.0	Siphon				
	Inlet Structure	EA	2	$ 1,500,000	$ 3,000,000
	Outlet Structure	EA	2	$ 1,500,000	$ 3,000,000
	Excavation / Backfill	LF	11,300	$ 650	$ 7,345,000
	Appurtenances / Thrust Control	LS	1	$ 6,000,000	$ 6,000,000
	Spiral Welded Steel Pipe (72-inch)	LF	11,300	$ 650	$ 7,345,000
4.0	Control Structures				
	Transfer Structures	EA	30	$ 100,000	$ 3,000,000
	Water Measurement	EA	7	$ 65,000	$ 455,000
5.0	Construction Access				
	Staging Areas	EA	20	$ 50,000	$ 1,000,000
	Access Roads	LF	156,000	$ 150	$ 23,400,000
6.0	Diversion Structure				
	Concrete	CY	150	$ 500	$ 75,000
	Mechanical	LS	1	$ 100,000	$ 100,000
	Earthwork	CY	400	$ 75	$ 30,000
	Site Work	LS	1	$ 50,000	$ 50,000
				Construction Subtotal	$ 667,016,000
				Contingency (25%)	$ 166,754,000
				Legal, Administrative, Engineering (25%)	$ 208,442,500
				Environmental Permitting (10%)	$ 83,377,000
				Total Estimated Project Budget	$ 1,125,589,500
				Estimated Annual O&M	$ 1,001,000
				O&M Net Present Value	$ 21,503,000
				Total Net Present Value	$ 1,147,092,500

Table 8 Alternative No. 2 / Option 2 (Gravity Flow Conduit / Keno to Below Dwinnell Reservoir, Minimize Use of Tunnels)

Item	Description	Units	Quantity	Unit Price	Total
1.0	Trapazoidal Open Channel Conduit				
	Excavation/Fill	LF	433,700	$ 1,000	$ 433,700,000
	Lining	LF	433,700	$ 320	$ 138,784,000
2.0	Siphons				
	Inlet Structure	EA	2	$ 1,500,000	$ 3,000,000
	Outlet Structure	EA	2	$ 1,500,000	$ 3,000,000
	Excavation / Backfill	LF	9,900	$ 650	$ 6,435,000
	Appurtenances / Thrust Control	LS	1	$ 6,000,000	$ 6,000,000
	Spiral Welded Steel Pipe (72-inch)	LF	9,900	$ 650	$ 6,435,000
3.0	Control Structures				
	Transfer Structures	EA	2	$ 100,000	$ 200,000
	Water Measurement	EA	7	$ 65,000	$ 455,000
4.0	Construction Access				
	Staging Areas	EA	15	$ 50,000	$ 750,000
	Access Roads	LF	156,000	$ 150	$ 23,400,000
5.0	Diversion Structure				
	Concrete	CY	150	$ 500	$ 75,000
	Mechanical	LS	1	$ 100,000	$ 100,000
	Earthwork	CY	400	$ 75	$ 30,000
	Site Work	LS	1	$ 50,000	$ 50,000
				Construction Subtotal	$ 622,414,000
				Contingency (25%)	$ 155,603,500
				Legal, Administrative, Engineering (25%)	$ 194,504,375
				Environmental Permitting (10%)	$ 77,802,000
				Total Estimated Project Budget	$ 1,050,323,875
				Estimated Annual O&M	$ 934,000
				O&M Net Present Value	$ 20,064,188
				Total Net Present Value	**$ 1,070,388,063**

Table 9 Alternative No. 3 (Pressure / Gravity Combination, Iron Gate Reservoir to Below Dwinnell Reservoir)

Item	Description	Units	Quantity	Unit Price	Total
1.0	Trapazoidal Open Channel Conduit				
	Excavation/Fill	LF	185,000	$ 1,000	$ 185,000,000
	Lining	LF	185,000	$ 320	$ 59,200,000
2.0	Iron Gate Pumping Plant / Force Main				
	Inlet Structure / Pumping Plant	LS	1	$ 7,500,000	$ 7,500,000
	Outlet Structure	EA	1	$ 1,500,000	$ 1,500,000
	Excavation / Backfill	LF	37,000	$ 650	$ 24,050,000
	Appurtenances / Thrust Control	LS	1	$ 15,000,000	$ 15,000,000
	Spiral Welded Steel Pipe (72-inch)	LF	37,000	$ 650	$ 24,050,000
3.0	Control Structures				
	Transfer Structures	EA	2	$ 100,000	$ 200,000
	Water Measurement	EA	7	$ 65,000	$ 455,000
				Construction Subtotal	$ 316,955,000
				Contingency (20%)	$ 63,391,000
				Legal, Administrative, Engineering (25%)	$ 95,087,000
				Environmental Permitting (10%)	$ 38,035,000
				Total Estimated Project Budget	$ 513,468,000
				Estimated Annual O&M	$ 15,848,000
				Estimated Annual Power Cost	$ 5,875,000
				O&M Net Present Value	$ 466,653,000
				Total Net Present Value	$ 980,121,000

5.2 Environmental Impact Statement (EIS)

Preparation of an EIS will require collection of relevant data on environmental resources that may be affected by the proposed project, a review of the project alternatives that have been evaluated, a description of any proposed mitigation measures, and a summary of correspondence and consultation with various concerned agencies.

The general format for an Environmental Impact Statement will include the following:

1. Purpose and Need of Project
2. Alternatives to the Project Action
3. Affected Environment/Environmental Consequences
4. Summary of Mitigation

5. Correspondence
6. Exhibits

A Klamath-Shasta Import project will affect multiple resources and require consultation with multiple agencies. When this is the case, the various agencies involved will agree upon who will be the Lead Agency in directing preparation of the EIS. Actual preparation of the EIS will be done in accordance with guidelines and requirements set forth by the Lead Agency.

Summarized below are the environmental resources that typically are addressed in preparation of an EIS. The level of effort required to address each of the resources affected and develop mitigation plans will be determined during consultation with the appropriate agency.

- Land Use
- General Land Use
- Important Farmland, Prime Range Land and Forest Land
- Formally Classified Lands
- Floodplains
- Wetlands
- Cultural Resources
- Biological Resources
- Water Quality
- Coastal Resources
- Socio-Economic/Environmental Justice
- Miscellaneous Issues
- Air Quality
- Transportation
- Noise

6.0 LEGAL ISSUES

A major legal issue will be addressing water rights associated with diverting water from the Klamath River to the Shasta Valley. In Bulletin No. 87 Shasta Valley Investigation it indicates that prior to construction of the Iron Gate Project by the California Oregon Power Company (COPCO) irrigation in the Shasta Valley and Ager area were considered higher uses than power production. Stipulations to diversion of water from the Klamath river for irrigation purposes in the Shasta Valley have existed up until March 1, 2006. Since this date has passed there would be more flexibility to implementation of an import project. The agreement between California Fish and Game and COPCO requires due compensation be provided to COPCO if water is diverted from the Iron Gate project for use in the Shasta Valley.

Other legal issues will include obtaining easements through private property and obtaining various permits associated with construction of the project. A more detailed review of legal issues and requirements will need to be performed before a Klamath-Shasta Import project is pursued further.

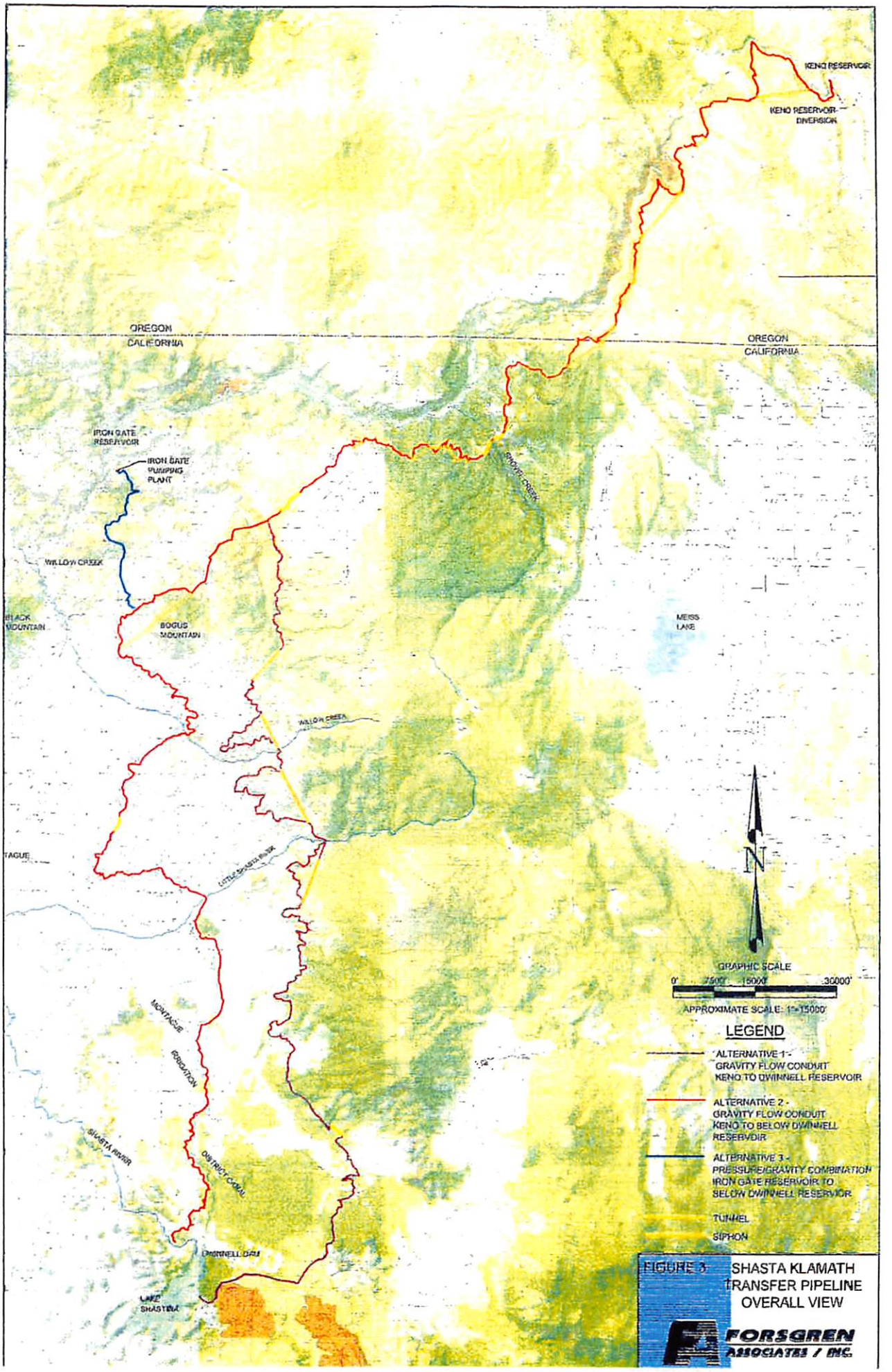


FIGURE 3 SHASTA KLAMATH TRANSFER PIPELINE OVERALL VIEW

FORSGREN ASSOCIATES / INC.

V

SISKIYOU COUNTY SCOPING COMMENTS ON ENVIRONMENTAL IMPACT STATEMENT (EIS)

RELATED TO KBRA, KHSA, and DAM REMOVALS

DAM REMOVAL

ENVIRONMENTAL IMPACT STATEMENT (EIS)

DEVELOPMENT

Federal Register Notice June 14, 2010

?ublic comments on the environmental impact study associated with the Klamath Basin estoration Agreement and the Klamath Hydroelectric Settlement Agreement must be submitted y July 21.

- Go online to www.KlamathRestoration.gov/contact-us/feedback and fill out an online form.
- Send comments by mail to the U.S. Bureau of Reclamation office, Tanya Sommer, 2800 Cottage Way MP-152, Sacramento, CA, 95825; via e-mail to klamathsd@usbr.gov ; or by fax to 916-978-5055.
- Send comments to the California Department of Fish and Game office to Caitlin Bean, 601 Locust Street, Redding, CA, 96001; via e-mail to KSDcomments@dfg.ca.gov or by fax to 530-225-2343.

Official website http://klamathrestoration.gov/

COUNTY TASK FORCE

COMMENTS/PROPOSALS

- May 4, 2010, **Klamath Dams Removal,** Dr. John W. Menke, (retired professor Department of Agronomy and Range Science, University of California, Davis)
- Shasta Nation's Alternative to Dam Removal and **Suggested Anadromous Fish By-Pass proposal; Map of bypass** and proposed diversion rotes for the County's 60,000 acre feet storage water use right;
  - **Proposed Alternate Tunnel Route** Shasta Nation Anadromous Fish Bypass
  - See **Deschutes Passage** - a successful dam bypass project
- Jerry Bacigalupi, (PE-Engineer) - **Flood Control capacity of the dam complex**

- Please do not Restore My Klamath River - Glen Briggs, Civil Engineer, retired, Dept. of Interior, Bureau of Reclamation, 1960 to 1987
- Concerns regarding downstream release of warm water fish from the reservoirs
  - Gierak letter to the editor
- Concerns U.C. Farm Advisor on spread of noxious weeds (paper on yellow starthistle)
- A-Red - an initiative of the Siskiyou County Board of Supervisors to increase salmon production; County to move forward with salmon propagation plans; This option has been dropped due to lack of cooperation and budgetary considerations
- Ocean conditions are driving salmon north to Alaskan waters where they are thriving
- Infrastructure (Roads and Bridges) that would likeley be affected by the impacts of dam removal
- Socio-economic (Cumulative Effects) Cover Letter
  - Demographics - Aging trends
  - Siskiyou County Business Characteristics and Growth 1998-2007
  - Major Employers in Siskiyou County (EDD)
  - Unemployment history 1990 - 2009
  - History of Income in Siskiyou County 1987-2008
  - Poverty in Siskiyou County 1989-2008
  - Number of Farm/nonfarm proprietors in Siskiyou County 1987-2008
  - Agricultural Profit 1987-2008
  - Trends in AG Census Data
  - Timber jobs 1988-2009
  - Timber Harvest Levels in the National Forests of Siskiyou Co.
  - Harvest levels to jobs
  - County Share of CA Timber Harvest and Value -Public and Private Lands
  - Timber Appeals 1998-2008
  - Economic impacts of suction dredge mining

COUNTY TASK FORCE

Citations/Studies of Particular Interest:

- **Final Eligibility and Suitability Report for the Upper Klamath Wild and Scenic River Study** (large file)

- **Klamath Project Operations Biological Assessment 2007** - The Effects of the Proposed Action to Operate the Klamath Project from April 1, 2008 to March 31, 2018 On Federally-Listed Threatened and Endangered Species Mid-Pacific Region; **Appendices**

- **Upper Klamath Lake Basin Nutrient-Loading Study—Assessment of Historic Flows in the Williamson and Sprague Rivers** Risley and Laenen;

- **Recent Water Temperature Trends in the Lower Klamath River, California,** Bartholow

- Committee on Hydrology, Ecology, and Fishes of the Klamath River, National Research Council (National Academy of Sciences) - **Hydrology, Ecology, and Fishes** of the Klamath River Basin - in the last portion of the report, the critiques the utility of the Natural Flow and Instream Flow studies, in conclusion stating: "... the study makes the implicit assumption that the primary limiting factor for the recovery of salmon is physical habitat, directly related to instream flows, but the study does not demonstrate when or even if physical habitat is a limiting factor in any of the life stages of the fishes of concern. The precise nature of any flow-related hydraulic-habitat "bottlenecks" in the population dynamics of the salmon is not demonstrated, so it is possible that temperature, dissolved oxygen, water quality, connectivity, disease, competition, or other factors are more critical to fish persistence than the hydraulic aspects of habitat are. In other words, suitable hydraulic-habitat conditions may be necessary but are not by themselves sufficient for fish persistence."

  "...the two studies do not allow for a detailed and practical analysis of trade-offs among various flow-management regimes with respect to benefits and costs to the anadromous fishes in the river and to the agricultural and other interests in the basin."

- Committee on Hydrology, Ecology, and Fishes of the Klamath River, National Research Council (National Academy of Sciences) **Endangered and Threatened Fishes** in the Klamath River Basin: Causes of Decline and Strategies for Recovery: **Recommendations:** "Actions intended to improve environmental conditions for the threatened coho salmon to date primnarily have involved hydrological manipulation of the main stem at Iron Gate Dam. Continual focus on hydrologic conditions in the main stem is an excessively narrow basis for recovery actions or for a recovery plan..."

- **Scientific Evaluation of Biological Opinions** on Endangered and Threatened Fishes in the Klamath River Basin: Interim Report (2002)
- Predicting the Thermal Effects of Dam Removal on the Klamath River, Bartholow, Flug
- Modeling Klamath River System Operations for Water Quantity and Quality. ASCE Journal of Water Resources Planning and Management
- Klamath River Basin Fisheries Resource Plan (DOI) CH2M Hill
- Water Quality Modeling in the Systems Impact Assessment Model for the Klamath Basin: Keno, OR to Seiad Valley, CA USGS 99-113
- Long Range Plan for the Klamath River Basin Conservation Area 1991 (Klam. River Task Force)
- Life Stage Periodicities of Anadromous Salmonids in the Klamath River Basin 1984, Leidy
- Klamath River Hydrological Conditions Prior to the September 2002 Die-Off of Salmon and Steelhead. USGS Water-Resources Investgative Rpt. 03-4099
- Pacific Salmon at the Crossroads: stocks at risk from CA, OR, ID and WA Fisheries 16(2):4-21 Nehlsen, Lichatowich
- Upper Klamath Basin Nutrient Loading Study - assessment of historic flows in the Williamson and Sprague Rivers: Report 98-4198 Risley, Laenen 1999
- Modeling of Climate Change Effects On Stream Temperatures and Fish Habitats Below Dams and Near Groundwater Inputs, Sinokrot, stefan, McCormick, Eaton Climatic Change 30:181-200
- Northwest Forest Plan - the First Ten Years (1994-2003) Socio-economic monitoring of the Klamath National Forest and Three Local Communities (Cumulative effects)
- Estimated Water Vlaues in the Shasta River Basin
- California Department of Fish and Game Suction Dredge Permitting Program Chapter 4.6
- The Impact of Regulatory Costs on Small Firms (SBA)





The National Environmental Policy Act of 1969; CEQ - Regulations for Implementing NEPA ;

- **Request for Preliminary Injunction** - Central Valley ESA Water Cut-off: **Summary** NMFS and Reclamation, as the consulting and action agencies, must take the hard look under NEPA at the draconian consequences visited upon Plaintiffs, the water supply of California, the agricultural industry, and the residents and communities devastated by the water supply limitations imposed by the RPA Actions. NEPA analysis must include comprehensive analysis of impact to humans and the human environment. **The Consolidated Salmonid Cases**, case 1:09-cv-01053-OWW- DLB, Document 347, U.S. District Ct. for the Eastern District of CA, Judge Wanger: (**Excerpts on NEPA**)
  - **Delta fish rulings could affect endangered species law**



EPA website on **NEPA compliance**; ; **NEPA.net**; A **Citizen's Guide** to NEPA; **Collaboration** and NEPA; Considering **Cumulative Effects** Under the National Environmental Policy Act; **Recent Trends** in Cumulative Impact Case Law Council on Environmental Quality (CEQ) NEPA regulations issued in 1973 and substantially revised in 1978 clearly stated a requirement to consider cumulative impacts for all projects undergoing NEPA analysis (Thatcher 1990), and provided the following definition of cumulative impacts in Section 1508.7:

"The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. "



CEQA website



Tulelake Irrigation District v. All Persons Having or Claiming to Have an Interest in the Validity of Agreements Entered Into by Tulelake Irrigation District Entitled "Klamath River Restoration Aghreement for the Sustainability for Public and Trust Resources and Affected Communities" and "Klamath Hydroelectric Settlement Agreement" Siskiyou County Superrior Court No. SC CV CV 10-0463. (Suit may perfect CEQA/NEPA and other flaws and quash any claims by parties whose interests are injured by the KBRA/KHSA.)



The Klamath Hydroelectric Settlement Agreement and Klamath Basin Restoration **Agreements**;



Hydro Relicensing ; Yreka USFWS site on Hydropower; USBR K-Falls **site**; USGS **site**; EPA

site; Siskiyou County site; FERC Relicensing **EIS documents**; Federal Energy Regulatory Commission. 2007. Final Environmental Impact statement for the Klamath Hydroelectric Project, Docket No. P-2082-027. 11/18/07. U.S. DOE, FERC, Washington D.C. **Download zipped document.** (22 separate files.); **National Marine Fisheries Service.** 2006. Comments, Recommended Terms and Conditions, and Preliminary Prescriptions for the Klamath Hydroelectric Project, FERC Project #2082. NMFS, SW Region, Long Beach, CA. 161 p.

CA Water Code 5900-5901; Klamath River Basin Compact;or here Appendix B - Siskiyou County Water Conservation and Flood Control District Boundaries: "All of that territory of the County of Siskiyou lying within the exterior boundaries thereof, exclusive of the area in Siskiyou County within the Upper Klamath River Basin, as delineated on the Official Map of the Upper Klamath River Basin approved September 6, 1956, and made a part of the Klamath River Basin compact between the States of Oregon and California, ratified by said states on April 17, 1957."

"(r) To control flood and storm waters within the district and the flood and storm waters or streams outside the district, which flow into the district; to conserve such waters by storage in surface reservoirs, to divert and transport such waters for beneficial uses within the district; to release such waters from surface reservoirs to replenish and augment the supply of water in natural underground reservoirs and otherwise to reduce the waste of water and to protect life and property from floods within the district; to commence, maintain, intervene in, defend or compromise, in the name of the district, on behalf of the landowners therein, or otherwise to assume the cost and expenses of any action or proceeding involving or affecting the ownership or use of waters or water rights within or without the district, used or useful for any purpose of the district or of the common benefit of any land situated therein, or involving the wasteful use of water therein; to commence, maintain, intervene in, defend and compromise and to assume the cost and expenses of any and all actions or proceedings now or hereafter begun; to prevent interference with or diminution of, or to declare the rights in natural flow of any stream or surface or subterranean supply of waters used or useful for any purpose of the district or of common benefit of the lands within the district or to its inhabitants; to prevent unlawful exportation of water from said district; to prevent contamination, pollution or otherwise rendering unfit for beneficial use the surface or subsurface water used or useful in said district, and to commence, maintain and defend actions and proceedings to prevent any such interference with the aforesaid waters as may endanger or damage the inhabitants, lands, or use of water in, or flowing into, the district provided, however, that said district shall not have power to intervene or take part in or to pay the costs or expenses of actions or controversies between the owners of lands or water rights which do not affect the interests of the district."

In addition, there is a reserved storage right of 60,000 acre feet per year in Iron Gate Reservoir to serve irrigation and other consumptive uses in the Shasta Valley.

Siskiyou County Code: **TITLE 10; Chapter 10** FLOOD DAMAGE PREVENTION; **TITLE 10: Chapter 12** COUNTY PARTICIPATION IN STATE AND FEDERAL AGENCIES LAND TRANSACTIONS; **TITLE 10: Chapter 13** DEMOLITION, DECONSTRUCTION, REMOVAL AND RECLAMATION

Siskiyou County Code: TITLE 10. PLANNING AND ZONING; CHAPTER 11. RIGHT TO FARM Section 10-11.01-.05 "No agricultural activity, operation or facility or appurtenances thereof, conducted or maintained for commercial purposes, and in a manner consistent with proper and accepted customs and standards and with all chapters of this code, as established and followed by similar agricultural operations, shall be or become a nuisance, public or private, pursuant to this code after the same has been in operation for more than three (3) years, if it was not a nuisance when it began."

Siskiyou County Resolution 93-284 Joint Environmental Planning

Correspondence (See also **County Coordination**)

Correspondence on KHSA/KBRA (dam removal):

- County March 17, 2009 letter to Secretary Chrisman and his March 10 response
- County letter 12/8/09 to Secretary Chrisman on unsatisfied CEQA requirements (similar letter to Governor Schwarzenegger
- County Letter of 12/14/09 to US Bureau of Reclamation regarding coordination requirements/PacificCorp's dams on the Klamath River. (2 MB PDF)
- County Letter of 2/17/09 to Secretary Salazar regarding coordination requirements and the Agreement In Principle for removal of PacificCorp's dams on the Klamath River. (73 KB PDF)
- 2/23/10 Letter from DOI regarding coordination
- County letter of 5/12/10 to John Bezdek (DOI, Mark Stopher (CA DFG) and Dennis Lynch (USGS) NEPA/CEQA and coordination
- County letter 6/8/10 to Secretary Salazar NEPA/CEQA process
- Letter from NOAA fisheries denying coordination
- Letter from US Department of the Interior
- DOI Secretary Salazar's **May 26, 2010 response** to Congressman Herger's letter of March 29, 2010
- 6/14 DFG letter (Stopher) "The Department does not have the resources or the capacity to commit to a separate coordination process with Siskiyou County in regard to the Comprehensive Land and Resource Management Plan, and as a matter of law this is not required."

ARTICLES

Technical Management Team briefing 5/6/10: Column **Part 1; Part 2**

Dr. Gierak - videos on dam removal at Savage Rapids Dam:

http://www.youtube.com/watch?v=rUeeHydjIs8

http://www.youtube.com/watch?v=cYAzsCUS8a4

http://www.youtube.com/watch?v=mK3lkqFt398&feature=related

Articles & Columns:

- The Klamath Basin Agreements: Who's Not at the Table?
- Delta fish rulings could affect endangered species law
- Help us fix the Klamath resource crisis
- Governor to try to push water bond vote to 2012
- Governor wants state water bond off Nov. ballot
- Governor pulls water bond off Nov. ballot; Wolk applauds move
- Public scoping, Web site announced for Klamath agreements
- Western Economists Question USGS Draft Klamath Recreational Study
- Study on Klamath Project recreation impact dead wrong
- County letter to Salazar alleges failure to meet dam settlement commitments
- Siskiyou County Board of Supes talk dam removal at meeting
- Judge lifts water pumping limits
- Fish Ruling in Fresno Sides with Farmers: Wanger found that the federal government "completely abdicated [its] responsibility" to consider other alternatives when it formulated the current biological opinion, decisions that should not only protect endangered salmon, but also "minimize the adverse impact on humans and the human environment."
- Judge sides with farmers in delta pumping lawsuit (Adequacy of NEPA analysis and action re impact to human environment)
- Board approves study of Shasta Nation fish bypass proposal
- Agencies, entities receive update on Klamath science review process
- Multiple studies underway on Klamath River dam removal question
- Jim Cook:Hart Bypass analysis 'insulting'
- County moves toward start of salmon restoration project
- Report identifies key Siskiyou County issues at Klamath science conference
- Science, engineering needs for dam removal decision discussed
- Science Conference looks at diverse perspectives in the Klamath Basin
- Science Conference Column
- Columns KBRA/KHSA: (1) ; (2); (3); (4); (5); (6); (7); (8); (9); (10); (11); (12)
- Deliberative Democracy -
    - **Environmental Dispute Settlement**

      Environmental Dispute Settlement, or Alternative Dispute Resolution, relies on a stakeholder model for organizing deliberation, rather than on open community meetings. A limited number of representatives from affected interests agrees upon rules that are conducive to mutual understanding of each other's interests and perspectives, and seeks common ground for action....The circle of deliberation can be extended considerably by communication of stakeholder representatives with their grassroots constituencies during the negotiations. This form of deliberative democracy has guided state legislatures in policy making and agency officials in rule making. It is often convened and facilitated by administrative officials in agencies such as EPA, the Army Corps of Engineers, and the U.S. Forest Service, leading some scholars to speak of "deliberative cultures" emerging within regulatory agencies. An increasing number of environmental officials, in fact, are aware not only of the practical techniques, but of the theoretical discussions of deliberative democracy. And policy analysts have begun to pay increasing attention to how policy designs can and should encourage citizen deliberation in confronting complex problems and tradeoffs. See the discussion of Environmental Dispute Settlement, and extensive references, in Civic Environmentalism, by

Carmen Sirianni and Lewis Friedland.

APPLICABLE REFERENCE & BACKGROUND

- Compilation of information to Inform USFWS Principals on the Potential Effects of the Proposed Klamath Basin Restoration Agreement (Draft 11) on Fish and Fish Habitat Conditions in the Klamath Basin, with Emphasis on Fall Chinook Salmon
- **Klamath Project Operations Biological Assessment 2007 - The Effects of the Proposed Action to Operate the Klamath Project from April 1, 2008 to March 31, 2018 On Federally-Listed Threatened and Endangered Species Mid-Pacific Region; Appendices**
- Fruit Growers (cumulative effects) **Draft Environmental Impact Statement** for Authorization for Incidental Take and Implementation of Fruit Growers Supply Company's Multi-Species Habitat Conservation Plan
- **Final eligibility and suitability report for the upper Klamath wild and scenic river study.** by United States. Bureau of Land Management. Klamath Falls Resource Area Office. Published in 1990, U.S. Dept. of the Interior, Bureau of Land Management, Klamath Falls Resource Area (Klamath Falls, Or) **Available at Yreka Public Library**
- **A Siskiyou County Perspective (Mid-River overview) Very large file**
- Committee on Hydrology, Ecology, and Fishes of the Klamath River, National Research Council (National Academy of Sciences) - **Hydrology, Ecology, and Fishes** of the Klamath River Basin; **Endangered and Threatened Fishes** in the Klamath River Basin: Causes of Decline and Strategies for Recovery ; **Scientific Evaluation of Biological Opinions** on Endangered and Threatened Fishes in the Klamath River Basin: Interim Report (2002); IFIM and PHABSIM
- **Hardy Phase II flows; NAS Review;** The Water Report - Klamath Basin Science **Dr. T. B. Hardy vs Dave Vogel, Wildlife Biologist; Klamath Watershed in Perspective** A review of historical hydrology of major features of the Klamath River Watershed and evaluation of Hardy Iron Gate Flow requirements. By Dr. K.A. Rykbost, Superintendent, Klamath Experiment Station, Oregon State University, and R. Todd, Klamath County Extension Office, Oregon State University. HERE for Power Point presentation
- **Lake Levels - River Flows**
- **Dam Removal and Klamath River Water Quality: A Synthesis of the Current Conceptual Understanding and an Assessment of Data Gaps (Stillwater)**
- **Long Range Plan For The Klamath River Basin** Conservation Area Fishery Restoration Program
- Ft. Collins USGS K-SIAM- **Quantifying the effect of dam removal on water temperatures** in the lower Klamath River, California, and implications for salmon recovery; **Predicting the thermal**

effects of dam removal on the Klamath River; **Drought allocation modeling** for the Klamath River; Evaluating water management strategies with the Systems Impact Assessment Model: **SIAM Version 4** (Revised October 2005); **SALMOD (1); SALMOD (2); SALMOD: Salmonid Young-of-Year Production Model for the Klamath**, Trinity, and Sacramento Rivers; **Application of the Systems Impact Assessment Model (SIAM) to fishery resource issues in the Klamath River**, California; **Reshaping the annual hydrograph at Iron Gate Dam** to benefit anadromous fish populations in the Klamath River, CA; SIAM - **Animation of Water Temperature Along the Klamath River ; SIAM v.4**

- **Klamath River Modeling Project** (Deas/Orlob)

- **Fish Health Monitoring Reports** (Arcata USFWS); **Ceratomyxa Shasta 2007** Study Summary Jerri Bartholomew ; FY2002 Investigational Report: **Ceratomyxosis resistance in juvenile Chinook Salmon and Steelhead Trout** from the Klamath River.; **Nichols, K. and J.S. Foott. 2005.** Health Monitoring of Juvenile Klamath River Chinook Salmon, FY 2004 Investigational Report. USFWS California-Nevada Fish Health Center, Red Bluff, CA. (77 Kb); **Nichols, K. and K. True. 2007.** Monitoring incidence and severity of Ceratomyxa shasta and Parvicapsula minibicornis infections in juvenile Chinook salmon (Oncorhynchus tshawytscha) and coho salmon (Oncorhynchus kisutch) in the Klamath River, 2006. USFWS California-Nevada Fish Health Center, Anderson, CA 23 p.; **Update on Juvenile Fish Mortalities** Observed in the Klamath River 2008

- **Sediment Management for Dam Removal** Jeffrey B. Bradley, P.E, Ph.D. President, WEST Consultants

- Watershed Condition, **Turbidity, and Implications for Anadromous Salmonids** in North Coastal California Streams

- **Salmon rearing habitats in the main stem Klamath River.** Natural Resource Scientists, Inc. Red Bluff, CA. 37 pp. [1.65Mb] Vogel 2003

- **CA DFG Hatchery EIR / EIS**

- Nutrient Loading: Power Point Presentation: **Nutrient loading in the Klamath Basin: Agriculture and Natural Sources.** Special Report 1023, , by K.A. Rykbost and B.A. Charlton, Oregon State University/Klamath Experiment Station. ; **Nutrient Loading of Surface Waters in the Upper Klamath Basin**: (paper) K.A. Rykbost and B.A. Charlton; **Historical information on Klamath Watershed Hydrology and water quality in the Upper Klamath Basin** Presented to the National Research Council Committee on Hydrology, Ecology and Fishes in the Klamath River Basin by Klamath Water Users Association, posted to KBC 10/13/06; **Farming practices and water quality in the Upper Klamath Basin,** by TID Manager Earl Donosky and UC Davis Agronomist Steven Kaffka, Final Report to the Ca. State Water Resources Control Board (4/16/02) posted to KBC 9/11/06; **Klamath River Nitrogen Loading and Retention Dynamics** 1996-2004 (Yurok Tribe); **Upper Klamath Lake Basin Nutrient-Loading Study—Assessment of Historic Flows in the Williamson and Sprague Rivers** Risley and Laenen; **Upper Klamath Basin Nutrient-Loading Study - Estimate of Wind-Induced Resuspension of Bed Sediment During Periods of Low Lake Elevation** (1996) Laenen, Letourneau and Eaton must be purchased; **Water Quality and Nutrient Loading in the Klamath River Between Keno, Oregon and Seiad Valley, California From 1996-1998** Open File Report 01-301;

- Information about the **Klamath Project**; A Selected Bibliography of Water-Related Research in the **Upper Klamath Basin**, Oregon, through 1994; **Ground-Water Hydrology of the Upper Klamath**

Basin ; Final Natural Flow study - upper Klamath River (Attachments)

- Klamath River Compact Commission: Investigation Into Methods to Control Algae in The Klamath River Basin, June 1962
- CDC Facts about Blue Green Algae; Results of 2007 study
- Distribution of Anadromous Fishes in the Upper Klamath River Watershed Prior to Hydropower Dams—A Synthesis of the Historical Evidence
- Water Allocation Alternatives for the Upper Klamath Basin (This costs out the economic value of water to ag. We need a similar report for comparison of the value of water for fish)
- Estimated Water Vlaues in the Shasta River Basin
- Peace on the River? Social-Ecological Restoration and Large Dam Removal in the Klamath Basin. USA - Gosnell , Kelly
- Northwestern California/Klamath Bioregion Environment Information Sources
- Klamath River Basin 2009 Report to Congress NOAA
- Klamath Basin Science Conference 2010; and Program
- American Rivers links to various studies
- Critique of Science by David Vogel: 8 peer-reviewed reasons for the decline in coho, according to the USFWS studies (VIDEO); Salmon Rearing Habitats in the Main Stem Klamath River.; Major Problems with the Department of Fish and Game (DFG) 'Fish Kill' Report.:. Document by fish-scientist David Vogel, directed to the Fish and Game's statements on the 2002 fish die-off. ; Assessment of Klamath River Water Temperatures Downstream of Iron Gate Dam During September and October 2002, by David Vogel.
- US DOI Modified Terms and Conditions and Prescriptions for Fishways FERC - Klamath River Hydro

SOCIAL and ECONOMIC CUMULATIVE EFFECTS

- Northwest Forest Plan - the First Ten Years (1994-2003) Socio-economic monitoring of the Klamath National Forest and Three Local Communities (Cumulative effects)
- Excerpts Fruit Growers EIS social and economic impacts Draft Environmental Impact Statement for Authorization for Incidental Take and Implementation of Fruit Growers Supply Company's Multi-Species Habitat Conservation Plan
- Assessing the Viability and Adaptability of Forest-Dependent Communities in the United States (USDA Haynes)
- Unemployment History Siskiyou County
- USDA Economic Research: 1990 and 2000 Census Poverty Data; County-Level Unemployment and Median Household Income;

- CAL EDD - Siskiyou County Profile; Enterprise Zone Application
- Siskiyou County Child Care Planning Council Needs Assessment 2010
- Siskiyou County: A Profile of Poverty, Hunger & Food Assistance
- 2007 Ag Census - Siskiyou County; Agriculture pages; Klamath Basin Crops, Products and Livestock
- Economic Impacts of 2001 Klamath Project Water Allocation - OSU
- Kruse, S., Scholz, A. (2006). "Prelminary Economic Assessment of Dam Removal: The Klamath River." Ecotrust. (Mar. 11, 2007)
- U.S. Bureau of Reclamation. (2006). "Economic Modeling of Relicensing and Decommissioning Options for the Klamath Basin Hydroelectric Project." California Energy Commission. (Mar. 20, 2007)
- Forest Management Impacts (Large file - power pt.)
- Forest Economics Research at the Pacific Northwest Research Station, to 2000
- Well-being Assement of Communities in the Klamath Region (Prep. for USFS)
- A business owner in Seiad in northern California discusses the local economic impact of the suction dredging ban
- Suction Dredge Economic Impact; 07/22/2009 Economic Impact of Suction Gold Dredging in California is Over $52 Million Per Year ; Excerpts DEIR
- PacifiCorp proposed rate increses - comment to PUC (Armstrong)

See also Social and Economic Information

VI

DATA, LETTERS AND REPORTS

RELATED TO DAM REMOVALS AND ANADROMOUS FISH

Record copies - Iron Gate Fish Hatchery office

Iron Gate Hatchery

Iron Gate Dam and the spawning facility were completed in 1962. The main hatchery area was completed in 1966. The hatchery and dam were built by Pacific Power & Light Company. The hatchery is operated by the California Department of Fish & Game and was built to handle salmon and steelhead that previously spawned above the dam.

Fish Runs:

Chinook (King) Salmon - Late September to early November
Coho (Silver) Salmon - Late October to early December
Steelhead - November to March

Production Goals:

Chinook Salmon -	5,100,000 smolts (released in May - June)
	900,000 yearlings (released in November)
Coho Salmon -	75,000 yearlings (released in April)
Steelhead -	200,000 yearlings (released April)

A few salmon come back as jacks or grilse (2 year olds), most Chinook come back as 3 or 4 year olds, a very few return as 5 year olds and most Coho return as 3 year olds.

A female Chinook Salmon at Iron Gate Hatchery usually averages about 3,100 eggs.

We give fillets from our adult salmon to various organizations (churches, senior groups, food banks, & etc.) after they are spawned and processed.

Usually we have yearling Steelhead in raceway A, yearling Coho in raceway B, and Chinook fry or yearlings in each raceway C-H.

Fish in the raceways are usually fed 4-8 times per day (depending on size and age). During peak periods we feed in excess of a ton of food per day.

During October adult salmon can be observed spawning in Bogus Creek (walk down the road behind houses to bridge). **THIS ROAD IS OPEN TO PUBLIC ONLY DURING OPEN HOUSE** (check with hatchery to view at other times).

The hatchery water comes from 70 feet down in Iron Gate Reservoir and varies from 39 degrees F (winter) to 58 degrees F (late summer).

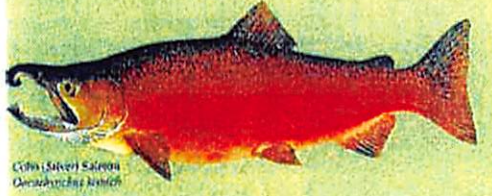
Most of the year, the river water comes through the powerhouse from the 20-foot level in Iron Gate Reservoir. The powerhouse can handle up to about 1,800 cfs. Any amount above that coming into the reservoir will cause the reservoir to fill and then spill.

If you have any questions about the hatchery call (530) 475-3420 (Monday - Friday: 7:00 AM to 3:30 PM).

7/2010

Male steelhead and salmon change colors during spawning season, as depicted below.



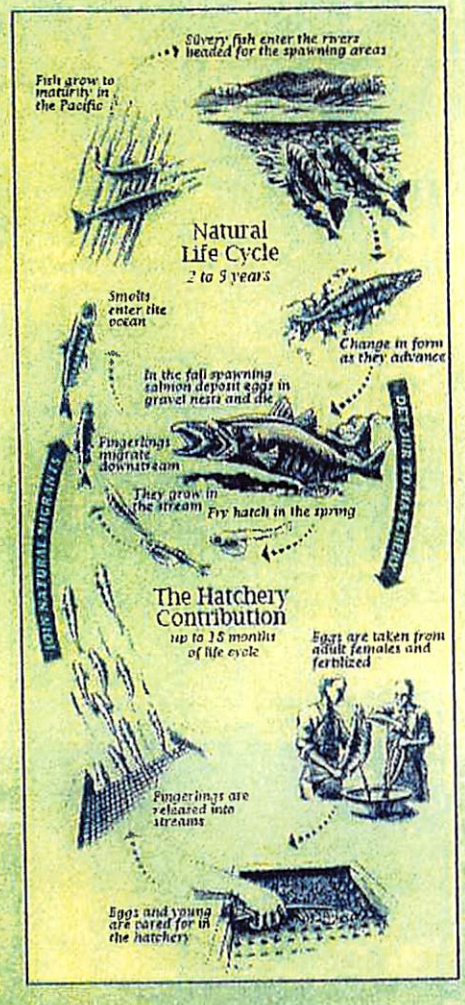


Coho (Silver) Salmon
Oncorhynchus kisutch

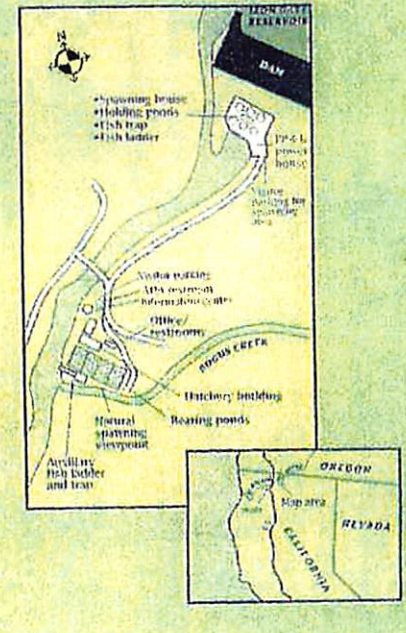


Chinook (King) Salmon
Oncorhynchus tshawytscha

Fish images copyright Windsor Nature Discovery
800-635-4194



Iron Gate Hatchery
8638 Lakeview Road
Hornbrook, California 96044

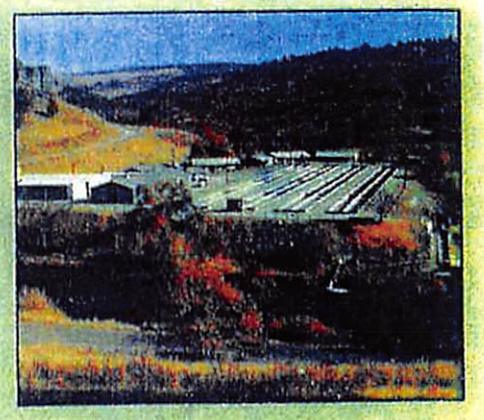


Iron Gate Hatchery is open to the public year-round. Visiting hours are 7 a.m. to dusk, seven days a week. October and early November are best for viewing.

Built by
Pacific Power and Light Company

Operated by
California Department of Fish and Game

Alternate communication methods are available upon request. If reasonable accommodation is needed, contact the Department of Fish and Game at (916) 653-6420 or the California Relay Service serving the deaf or hearing impaired from TDD phones at 1-800-735-2929.

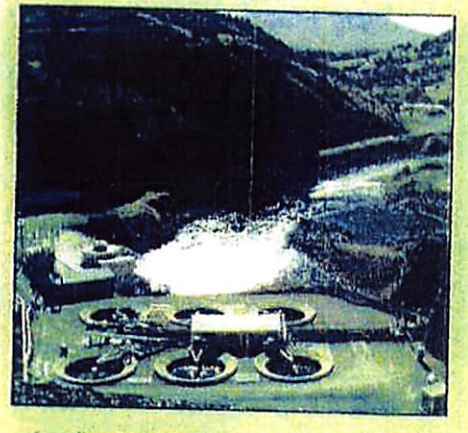


Iron Gate Hatchery









Iron Gate Hatchery is located on the Klamath River near Hornbrook, California. The hatchery, just downstream of Iron Gate Dam, was built in 1966 by Pacific Power as fulfillment of federal license requirements. Pacific Power continues to fund 80 percent of the operations and maintenance of the hatchery.

Iron Gate Hatchery spawns and rears three kinds of fish: chinook (king) salmon, coho (silver) salmon, and steelhead trout. All three species are *anadromous*, meaning the fish spend most of their lifetime in the ocean and swim up fresh water streams to spawn. Salmon die after spawning, but some steelhead return to spawn again.

The hatchery's goal is to raise about 6 million chinook per year. Five million chinook fingerlings are released in the spring and the remaining one million are released in the fall as yearlings. In addition, the hatchery produces 200,000 steelhead and 75,000 coho yearlings.



When they reach the hatchery, fish swim up the fish ladders toward the spawning facility, providing a spectacular sight for visitors.

The returning adult salmon make a 190-mile trip from the ocean to the hatchery. When they reach the hatchery site, fish enter either the 300-foot long fish ladder at the spawning facility below the dam or the smaller ladder and trap at the hatchery. Adults are held in circular holding tanks below the dam until they are ready for spawning.

Some fish enter Bogus Creek, which borders the south end of the hatchery, and spawn naturally in the creek. A viewing site on the north bank of Bogus Creek allows visitors a glimpse of these naturally spawning fish.

The hatchery contains eight standard concrete raceways, 400 feet long, for rearing fish; a hatchery building; an office; and four employee residences. The hatchery building houses 117 stacks of vertical, flow incubators with each stack having the ability to hold about 100,000 – 120,000 eggs. The eggs are collected in the fall and winter, and take approximately 40 to 60 days to incubate. The fry subsist on their own yolk sacs for about four weeks prior to feeding.

Fish are then placed in tanks or raceways and are fed various fish feeds until they are released into the Klamath River.

Iron Gate Hatchery contributes to commercial, sport and tribal fisheries in Northern California and Southern Oregon.

The Hatchery Cycle



1. Eggs are removed from the females and fertilized.



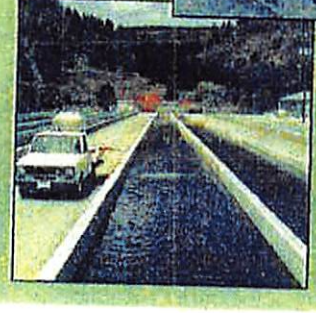
2. Eggs are checked for size and placed into incubation trays.



3. During the 40-60 day incubation period, a continuous supply of fresh water flows through the hatchery building.



4. Small fish, called fry, are moved from the hatchery building to the outdoor raceways.



5. Fry are fed a variety of fish food until they are ready to be released into the Klamath River.



6. Once released, the fish grow to a catchable size to provide recreation and food for California anglers.

Frank Tallerico

From: rgierak2 [rgierak2@hughes.net]
Sent: Tuesday, July 19, 2011 5:22 PM
To: Frank Tallerico
Subject: Fw: Possible lawsuit against CA ESA, NMFS & USF&WS
Sent: Saturday, July 16, 2011 5:52 PM
Subject: Fw: Possible lawsuit against CA ESA, NMFS & USF&WS

PETITION TO DELIST
Coho Salmon (Oncorhynchus kisutch)
Nomination for Delisting of a Taxon of Flora or Fauna (Endangered Species Act 1973)

Presented By
Siskiyou County Water Users Association



347 N. Main St.

Yreka, Ca. 96097

530 842-4400

Prepared By

Dr. Richard A. Gierak

Bachelors Degrees in Biology & Chemistry, Doctorate in the Healing Arts, Director of Interactive Citizens United, Director of New Frontiers Institute, Inc. Prior Participant of FERC and FPAT (Fish passage advisory team) and HET (Hatchery evaluation team) Prior Vice President of Greenhorn Action Grange, Prior California State Grange Spokesman for the Water Committee, Prior National Whip of the Property Rights Congress of America, Representative of the Grange States of California, Oregon, Washington and Idaho regarding EFH regulations, Science consultant to Siskiyou County Water Users Association.

Statement identifying the taxon

Coho Salmon, Silver Salmon, Oncorhynchus kisutch...a salmonid which is a vertebrate fish

Reasons for nominating the taxon for delisting

This petition refers to the listing of Coho Salmon in the Klamath Basin including the Klamath River, Trinity River and associated waterways that empty into the Klamath River.

Known distribution of the taxon.

Occupies the entire Pacific Coastal region is herein challenged. This petition specifically refers to Northern California and the present listing of Coho Salmon as endangered under the California Endangered Species Act on the Klamath River and the proposed Federal ESA listing of Coho Salmon..

Known threats which may affect the taxa.

Nature--Estuarine destruction--predation--over fishing--by catch--Ocean temperature--Climatic

changes

Endangered Species Act of 1973

There is no provision for listing a species that is not indigenous to the ESU. To this date there is no historical evidence indicating that Coho Salmon were ever indigenous to the Klamath Basin.

In 2001, Not one person on the Karuk Tribal Council believed that Coho salmon were native to the Klamath River.

Within the Tribe's jurisdiction between Bluff Creek and Clear Creek on the California portion of the Klamath River, which is approximately between 91 and 140 miles below the lowest slated dam, Iron Gate, for removal this statement is reflected for example, in the **minutes of the Karuk Tribal Council Meeting of December 27, 2001:** Discussion was held by the Tribal Council and whether or not they [Coho] were ever present in the main streams and tributaries… …"Council states it may be **easier to prove the Coho were never present**", and also the comment was made that if they were never here, then **"they should not be encouraged to come back.**". The tribe named the river the Klamath, which translated means "Stinky River" and would not support salmon. http://www.savethedams.com/?page_id=350

Karuk tribal history dates back to 1700 when there were an estimated 2,700 members present and there is no mention of Coho or Silver Salmon prior to plantings in 1895 and 1899.

http://www.fourdir.com/karuk.htm

1913 California Fish and Game Commission Report

(CFGC 1913) , W. H. Shebley, Superintendent of Hatcheries, writes "Strange as it may appear, the presence of the silver [Coho] salmon in the waters of this State remained unnoticed until Dr. Gilbert, Prof. of Zoology at Stanford University, a few seasons ago called attention to them. Heretofore, all the salmon taken in our rivers have been commercially classed as Quinnat [chinook]". Any reported Coho were as a result of plantings in the Klamath River in 1895 and 1899. "Most of the salmon and steelhead eggs were taken at the [Redwood Creek] substation, as there was **no run of either kind of Salmon in the Trinity River".**
http://www.dfg.ca.gov/fish/documents/SAL_SH/SAL_Coho_StatusNorth_2002/SAL_Coho_StatusNorth_2002_D.pdf

Records from History as stated by CA Department of Fish &Game:

Quotes; "The earliest record of Coho salmon being stocked in the Klamath Basin was of a plant made in 1895. Further examination of the original records from the U.S. Commission on Fish and Fisheries (1895) revealed those fish were raised in the Ft. Gaston facility in Hoopa and were stocked in the Trinity River and in Supply Creek, a tributary to the Trinity River. Those fish were reared from eggs taken at a facility in **Redwood Creek**… and also from eggs shipped from another **facility not identified** in the report (but were likely from **out of the basin**)."

http://www.dfg.ca.gov/fish/documents/SAL_SH/SAL_Coho_StatusNorth_2002/SAL_Coho_StatusNorth_2002_D.pdf

Coho Salmon were not native

Dr. Ken Gobalet Professor of Biology Ph.D. California State University, Bakersfield

"The rarity of salmonids in archaeological materials suggests that the ethnographic record overstated the importance of salmonids to the Native Americans of California

No salmon remains of any kind were found south of San Francisco. Chinook salmon were the most abundant salmonid in the Sacramento River drainage. **No salmonids were found in the archaeological record in the San Joaquin River** drainage south of San Joaquin County."

http://www.informaworld.com/smpp/content~db=all~content=a932170617

Dr. Gobalet performed the research on the San Lorenzo River in Santa Cruz and his archeaological evidence (ie

excavation of middens at village sites) that proved that Coho were not native to the Lorenzo river. It has been ignored by the agencies....but it has not been used as evidence in a court case....yet The study only applies south of Pescadero Creek. He was hired to do more work down here and **found no Coho Salmon remains**.
http://www.naturalprocess.net/np_pages/coho.html

Historical Coho sightings in Californaia

"Coho were recorded in 1936 and 1981 from streams in northern San Francisco Bay (Marin County) (Brown and Moyle 1991)".(Peter Moyle is a warm water inland fish person, not an anadromous trained or studied person) This was most likely as a result of multiple plantings in California Rivers by Fish and Game with the earliest plantings in 1895 and 1899 followed by massive plantings in the 1960's and 1980's. "Historically, Coho were reported from streams as far south as the Santa Ynez River (Santa Barbara County) (Bryant 1994)", Once again these are most likely as a result of the massive plantings in the 1960's and 1980's in Northern California. "With respect to the San Francisco Bay, no Coho populations are known to spawn in streams emptying into the bay. Although there are no historical records indicating spawning populations on the bayside of San Mateo County, Coho were recorded in 1936 and 1981 from streams in northern San Francisco Bay (Marin County) (Brown and Moyle 1991)". Plantings of Coho in Northern California rivers in 1895, 1899 and the 1960's and 1980's are indicative of the source of these recorded sightings considering their genetic signature is that of Coho Salmon from Cascadia, Oregon.

http://www.cfses.org/salmonid/html/salmonid/population.htm

FINAL Report_Coho Salmon-Steelhead_Klamath Expert Panels_04 25 11

http://www.dfg.ca.gov/fish/documents/SAL_SH/SAL_Coho_StatusNorth_2002/SAL_Coho_StatusNorth_2002_D.pdf

Genetic Analysis of Hatchery vs. Natural Salmon

The initial statement regarding the controversy between "natural" and "hatchery" fish was made in a report by Busack and Currens in 1995, wherein they stated, "Interbreeding with hatchery fish might reduce fitness and productivity of a natural population", and picked up by noted Ecologist Dr. Richard Primack and many Environmental Radicals and utilized in a listing petition for Cutthroat Trout in the Colorado River. Mr. Michael Rode of the California Department of Fish and Game at a Hatchery Evaluation meeting on September 19, 2002 at Iron Gate Hatchery disclosed that less than a 2% genetic survey has been taken to date and **no genetic differences have been noted between "hatchery" or "natural" Coho Salmon**. A 2011 report by the Expert Panel indicated that their genetic analysis indicated the Salmon in Northern California were from Cascadia, Oregon plantings.

California Fish & Game "Finfish and Shellfish Identification Book" published in December 2006 does NOT list Coho Salmon as being present in California waters.

Expert Science Panel 4-25-2011

"Weitkamp et al. (1995) suggested that natural origin Coho production in the SONCC ESU may not be currently sustainable. Further reduction in survival at sea in response to climate shifts has the potential to offset potential improvements in the freshwater environment, or it could cause further reductions or even extinction of natural origin Coho populations that are presently threatened with extinction."

It is also to be noted that upon genetic analysis of the Coho Salmon in the Klamath Basin appears to be from plantings from Cascadia, Oregon. This statement also verifies the statement that Coho Salmon were never indigenous to the Klamath Basin. "The final expert report on Coho and steelhead appears to indicate that the extinction of the Coho Salmon looks like it cannot be avoided. It does not appear that it is resource users (timber, farming, mining,) in the mid-Klamath is the reason, but is instead Ocean and climatic conditions."

FINAL Report_Coho Salmon-Steelhead_Klamath Expert Panels_04 25 11

Quote from 2009 Water Quality Klamath TMDL scoping comment responses -
"The Regional Water Board can not establish life cycle-based water quality objectives for the mainstem Klamath River because the DO concentrations associated with salmonid life cycle requirements **can not be met even under natural**

conditions- conditions in which there are no anthropogenic influences. As such, the Regional Water Board staff has proposed water quality objectives that protect natural DO conditions from further degradation."

1800's Explorers comments

Explorers noted when first visiting the Upper Klamath Basin that water quality was so undesirable that even their riding horses and pack animals would not drink let alone support salmon populations.

Summation:

Based on evidence presented in this petition Coho Salmon were never indigenous to the Klamath River and the listing of Coho Salmon by California ESA and Federal ESA should be considered unlawful, arbitrary and capricious. Concluding that Coho Salmon were not indigenous there is no provision in the Endangered Species Act to list a non-native species.

Respectfully Submitted;

Leo Bergeron

SCWUA President

PETITION TO DELIST
Coho Salmon (Oncorhynchus kisutch)
Nomination for Delisting of a Taxon of Flora or Fauna
(Endangered Species Act 1973)

Presented By
Siskiyou County Water Users Association





PRESS RELEASE

June 23, 2011

Siskiyou County Water Users Association has submitted a second Coho delisting petition to delist Coho Salmon in the Klamath Basin based on the following parameters.

1. There is no historical evidence that Coho Salmon were ever indigenous to the Klamath Basin.

http://www.dfg.ca.gov/fish/documents/SAL_SH/SAL_Coho_StatusNorth_2002/SAL_Coho_StatusNorth_2002_D.pdf

http://www.informaworld.com/smpp/content~db=all~content=a932170617

http://www.naturalprocess.net/np_pages/coho.html

http://www.cfses.org/salmonid/html/salmonid/population.htm

FINAL Report_Coho Salmon-Steelhead_Klamath Expert Panels_04 25 11

2. The Karuk tribal Council meeting of Dec. 27, 2001 indicated that Coho Salmon were never in the Klamath River and they should not try to bring them back.

http://www.savethedams.com/?page_id=350

3. In a 1913 California Fish & Game Commission report indicated there were no run of either kind of Salmon in the Trinity River even after Coho were planted in 1895 and 1899.

4. There is no provision in the Federal Endangered Species Act for listing a non- indigenous species.

http://www.nmfs.noaa.gov/pr/laws/esa/text.htm

5. California ESA and NMFS are in violation of the Endangered Species Act by listing Coho Salmon which is unlawful, arbitrary and capricious.

6. U.S. Fish & Wildlife service are in violation of their mandates which are restricted to freshwater species only. By being involved in the KBRA and KHSA regarding a saltwater species, ie: Salmon, their actions are unlawful, arbitrary and capricious.

http://www.fws.gov/endangered/

7. Based on these historical records and the violation of the Federal Endangered Species Act Coho Salmon must be removed from the endangered list in California.

Respectfully submitted;

Leo Bergeron

SCWUA president

Frank Tallerico

From: rgierak2 [rgierak2@hughes.net]
Sent: Tuesday, July 19, 2011 5:30 PM
To: Frank Tallerico
Subject: Fw: ESA, Historical & Ocean

Subject: ESA, Historical & Ocean
Frank: These are the latest condensed version of the above topics with graphs.

Re: Coho Salmon in the Klamath Basin and Commercial Fisheries in the Pacific Northwest

1. There is no historical evidence that Coho Salmon were ever indigenous to the Klamath Basin.

http://www.dfg.ca.gov/fish/documents/SAL_SH/SAL_Coho_StatusNorth_2002/SAL_Coho_Stat

http://www.informaworld.com/smpp/content~db=all~content=a932170617

http://www.naturalprocess.net/np_pages/coho.html

http://www.cfses.org/salmonid/html/salmonid/population.htm

FINAL Report_Coho Salmon-Steelhead_Klamath Expert Panels_04 25 11

2. The Karuk tribal Council meeting of Dec. 27, 2001 indicated that Coho Salmon were never in the Klamath River and they should not try to bring them back.

http://www.savethedams.com/?page_id=350

3. In a 1913 California Fish & Game Commission report indicated there were no run of either kind of Salmon in the Trinity River even after Coho were planted in 1895 and 1899.

http://www.dfg.ca.gov/fish/documents/SAL_SH/SAL_Coho_StatusNorth_2002/SAL_Coho_Stat

4. There is no provision in the Federal Endangered Species Act for listing a non- indigenous species.

http://www.nmfs.noaa.gov/pr/laws/esa/text.htm

5. California ESA and NMFS are in violation of the Endangered Species Act by listing Coho Salmon which is unlawful, arbitrary and capricious.

6. U.S. Fish & Wildlife service are in violation of their mandates which are restricted to freshwater species only. By being involved in the KBRA and KHSA regarding a saltwater species, ie: Salmon, their actions are unlawful, arbitrary and capricious.

http://www.fws.gov/endangered/

7. Based on data from NOAA, NMFS, NASA, WEBECS, UK Pacific Ocean Temperatures have driven cold water Salmon North into Alaskan waters.

http://www.google.com/search?
q=history+of+pacific+ocean+temperature&hl=en&prmd=ivns&sa=X&ei=sCYiTp6ZLIe2sAOx9Q9&ved=0CDwQpQI&tbm=&tbs=tl:1,tlul:1950,tluh:2010

http://earthobservatory.nasa.gov/Features/OceanCooling/page4.php

8. NMFS and NOAA data indicate that Commercial Salmon fisheries in the Pacific Northwest are 273% better today than it was in 1950 due to dams and hatcheries.

http://www.st.nmfs.noaa.gov/st1/commercial/landings/annual_landings.html

9. Dams and hatcheries are not the cause of Salmon decline in California and Oregon waters. In 1950 the total catch of Salmon in the Pacific Northwest was 149,000 metric tons with 80 % caught in Alaskan waters and in 2007 the total catch was 403,000 metric tons with 97% caught in Alaskan waters.

http://www.st.nmfs.noaa.gov/st1/commercial/landings/annual_landings.html

Based on these historical records and the violation of the Federal Endangered Species Act Coho Salmon must be removed from the endangered list in California.

Respectfully submitted;

Dr. Richard A. Gierak

Planetary Changes Noted



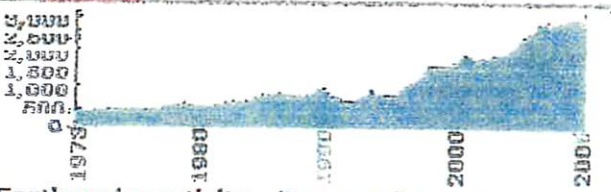
Pacific Ocean Temperature

http://www.google.com/#q=history+of+pacific+ocean+temperature&hl=en&sa=X&tbo=p&tbs=tl:1,tll:1950,tlh:1999&ei=XQL7S-zVJcL68AaJkPXXCg&oi=timeline_histogram_main&ct=timeline-histogram&cd=10&ved=0CGwQyQEoCg&fp=244bc79c41741c3



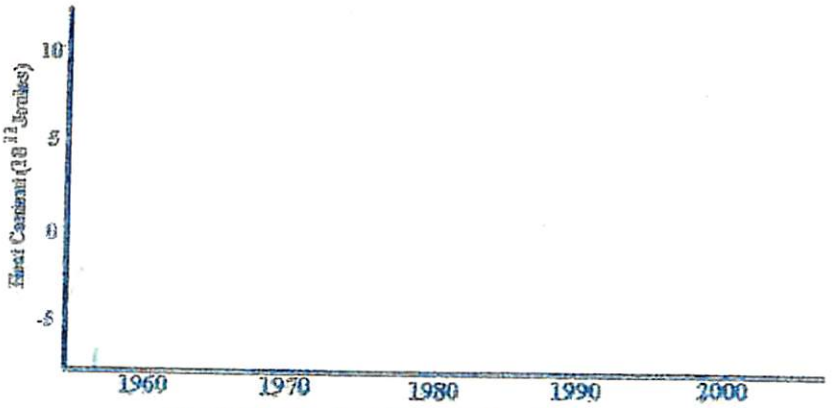
Volcanic activity in the Pacific Ring of Fire

http://www.google.com/search?q=volconic+history+of+eruptions+in+the+ring+of+fire&hl=en&sa=X&ei=K4PYTKWHHI7WtQPH4I8NCw&ved=0CGQQpQI&tbs=tl:1,tll:1700,tlh:2010



All Planetary Earthquake activity (Increased sensors add to increase)

http://www.earth.webecs.co.uk/



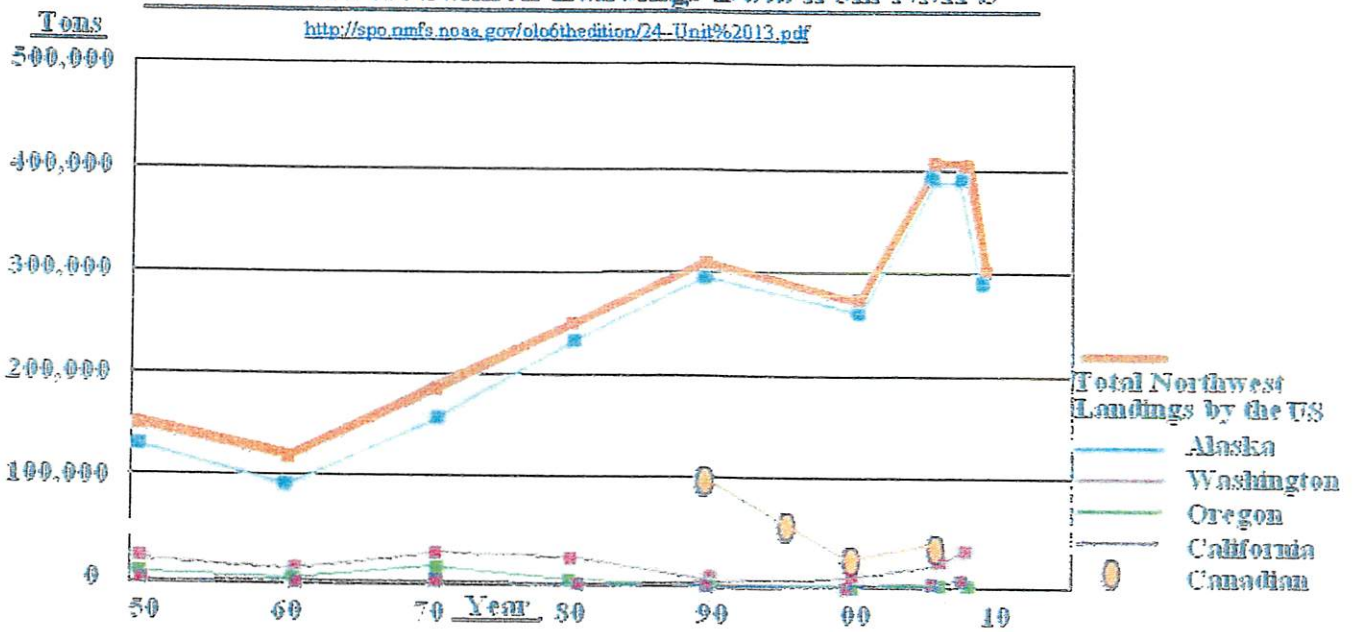
Heat Content of the Pacific Ocean

http://earthobservatory.nasa.gov/Features/OceanCooling/page4.php

Prepared by Dr. Richard Gierak 11-19-2010

U.S. Northwest Salmon Landings Data from NMFS

http://spo.nmfs.noaa.gov/olo6thedition/24-Unit%2013.pdf



NOTE: It is of interest to note that the largest landing of Salmon occurred in the year 2005 with over 400,000 tons. Compare that with the 1950 value of only 149,071 tons. That is an increase of a 273% increase in total Salmon catch. The decrease in 2008 to 300,000 tons is still a 201% increase over the 1950 value. We must assume from looking at the data that our Salmon fisheries are in great shape even though the landings in Oregon and California have dropped significantly. The overall Salmon landings are still healthy and would corroborate that Pacific Ocean warming has driven the Salmon North. It is apparent from NMFS data that landings in Oregon, California and Washington are but of small importance.

Of most importance is to note that increase in Pacific Ocean temperature has driven Salmon North as evidenced by the landing data.

Frank Tallerico

From: rgierak2 [rgierak2@hughes.net]
Sent: Tuesday, July 19, 2011 5:51 PM
To: Frank Tallerico
Subject: chinook halt listing

Frank;
This is the Halt Chinook Listing and associated press release. If you would like anything else feel free to ask.
Have fun.
Doc

Petition To Halt Listing Upper Klamath Chinook Salmon (Oncorhynchus Tshawytscha) As a Threatened Or Endangered Species



Prepared By
Siskiyou County Water Users Association



530 842-4400

May 18, 2011

Statement identifying the taxon

Chinook salmon, *O. tshawytscha* is an anadromous salmonid, the National Marine Fisheries Service has jurisdiction over this petition. Petitioner files this petition pursuant to § 553(e) of the Administrative Procedure Act ("APA"), 5 U.S.C. §§ 551-559 and § 1533(b)(3) of the Endangered Species Act, and 50 C.F.R. part 424.14, which grant interested party the right to petition for removal of a rule. This petition sets in motion a specific administrative process as defined by § 1533(b)(3) and 50 C.F.R. § 424.14(b), placing mandatory response requirements on the National Marine Fisheries Service.

Petitioner also requests the removal of future critical habitat for Upper Klamath-Trinity Rivers The spring run component of the Upper Klamath-Trinity Rivers ESU has seen dramatic declines from historic levels and is in danger of becoming extinct in the foreseeable future should hatcheries and dams be removed. Most known spring run populations have been extirpated and the few runs that do still exist have undergone severe declines as a result of historic rise in the temperature of the Pacific Ocean driving these cold water fish North into Alaskan waters. In the past 25 years, wild fish have consistently returned at much lower numbers and only when hatchery fish are included do numbers approach historical estimates in some years. However, Salmon and steelhead hatcheries have historically had the twin goals of (1) helping to recover and conserve Natural spawning populations, and (2) supporting sustainable commercial, recreational, subsistence, and ceremonial fisheries. Most hatcheries in the Pacific Northwest and Alaska have been operating for many decades and have generally been very successful in producing fish for harvest and compensating for declines in wild salmon populations. Hatcheries are critical to maintaining future recreational and commercial fishing in the Pacific Ocean and in meeting Treaty harvest obligations. Like it or not, hatchery populations now comprise a major component of Pacific salmon/steelhead species gene pools. This year (2001) for example, 60-80% of salmon that will be harvested originated in state, federal, and Tribal hatcheries. Given the additional 20-40 million in human population growth predicted for the Pacific Northwest in coming decades, it is almost certain that the downward trend in purely wild salmon populations will continue. For example, the east coast of the US, Europe, China, Japan, and Korea formerly supported large populations of purely wild salmon. They no longer do so and it is unlikely they will ever do so again (Lackey, 2001). At the present time, hatchery runs are thriving and must not be destroyed.

Historical habitat for Fall Chinook Salmon

Native tribes and environmental NGO's have claimed that prior to the dams on the Klamath river there were millions of Salmon that spawned in the river. However, the reality based on Division of Fish & Game 1930 report, fish bulletin #34, the total number of Salmon on the Klamath totaled between 30,000 and 45,000 prior to the dams being installed. After the dams the numbers went up to between 45,000 and 90,000 fish. They seem to forget that in a dry summer the Klamath River turned into swamps and marshes and could not support any kind of Salmon run.

Historically Chinook Salmon on the Klamath River sported a Spring Run and in wet years a Fall Run. Before the dams were built, during a dry summer, there would be no water for a Fall Run of Salmon and with the building of the dams there is now a significant Fall Run due to the storage of water behind the dams. It is clear that since 1950 the actual tonnage of Salmon off the California Coast has been rather

level through 2000.

Genetic analysis of wild vs. hatchery salmon

Not only did today's hatchery salmon originate from the eggs and sperm of naturally reproducing salmon populations, hatchery produced fish have been thriving and returning to Pacific Northwest Rivers in unprecedented numbers. Unfortunately, these same hatchery fish are now being labeled genetically inferior, hunted down and clubbed, and their eggs sold as fish bait. There is a very real danger that present anti-hatchery policies will, if pursued, reduce salmon/steelhead populations to the point that there will be no significant recreational or commercial fishing for decades to come. In addition, the deliberate destruction of these hatchery populations by natural resource management agencies may actually be destroying genetic material needed for the continued health of salmon populations in general. Once genetic material is lost from a species gene pool, it can never be recovered. The populations of some remaining "wild" fish are now so small that their genetic diversity has been reduced to the point that they may be unable to grow sufficiently without an infusion of genetic material from hatchery fish.

In 2002 there was a serious fish kill of 33,000 salmon on the lower Klamath River. Environmentalists sounded the alarm that the toxic algae above the hydroelectric dams was responsible for the kill. Indian tribes raised the cry that warm water and lower flows were the primary cause of the kill. Fish & Game did not sample the waters until a week after the kill was complete. As a result of the environmental alarm of toxic algae in the reservoirs above the hydro dams the lakes were posted as toxic and the public was warned. Because of this action it was deemed that the dams had to be removed to protect people and the Salmon runs and thus the cry to remove dams and hatcheries were born. A Center For Disease Control study was initiated in 2009 and the waters in the reservoirs found no health related detrimental evidence.

Of primary importance was the Fish & Game report published in 2003 which indicated the following: ***"The DFG concludes that low flows and other flow related factors (eg; fish passage and fish density) caused of the 2002 fish kill on the lower Klamath River. Furthermore, of the conditions that can cause or exacerbate a fish kill, flow is the only factor that can be controlled to any degree. Flow is regulated by upstream reservoirs operated by the USBR on both the Klamath and Trinity Rivers." "Fish and Game also determined that the floods of 1997 and 1998 caused deposition of material in the lower Klamath that reduced the depth for returning Salmon. In addition to this factor the Trinity River had 70% of its waters diverted to Southern California thereby reducing not only the depth of the river but the increase in the temperature of the Klamath River."***

The Hoopa tribe water/boat celebration called for a pulse flow into the river system which decoyed the Salmon into the river system and the flows were then decreased leading to low flow conditions trapping Salmon in a narrow part of the river with shallow water and increased temperatures.

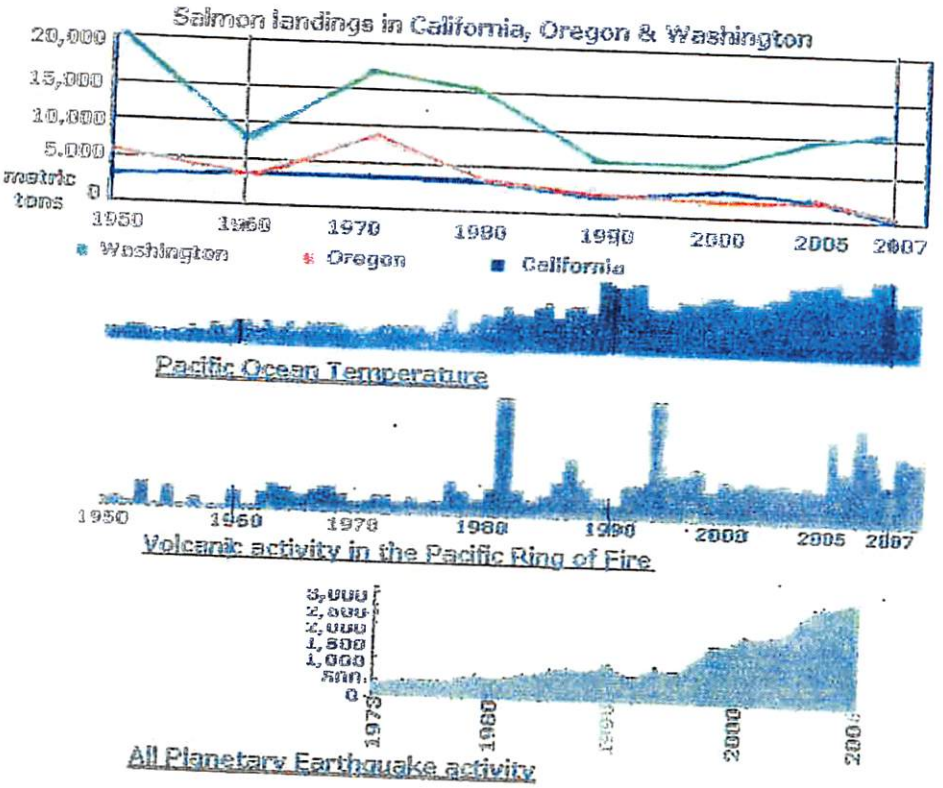
The initial statement regarding the controversy between "natural" and "hatchery" fish was made in a report by Busack and Currens in 1995, wherein they stated, "Interbreeding with hatchery fish might reduce fitness and productivity of a natural population", and picked up by noted Ecologist Dr. Richard Primack and many Environmental Radicals and utilized in a listing petition for Cutthroat Trout in the Colorado River. According to Mr. Michael Rode of the California Department of Fish and Game at a Hatchery Evaluation meeting on September 19 at Iron Gate Hatchery disclosed that less than a 2% genetic survey has been taken to date and no genetic differences have been noted between "hatchery" or "natural" Salmon. It should be noted that the NMFS listing of Coho Salmon in Northern California and Southern Oregon in 1997, (Federal Register: May 6, 1997 (Volume 62, Number 87, 50 CFR Part 227 [Docket No. 950407093-6298-03; I.D. 012595A]) Page 24588-24609) utilized the same data as in the coastal Oregon Coho listing. This listing also distinguishes "natural coho" from "hatchery coho" and they did not count "hatchery coho" even though there is no biological distinction between the two. Therefore, any listing affecting Northern California and Southern Oregon is also unlawful and should be set aside as arbitrary and capricious.

Recently an Appeal Court has set aside the 2001 ruling of the ninth District where the listing affecting Northern California and Southern Oregon Salmon is that "naturally spawned" and "hatchery spawned" argument for listing Oregon coastal Coho salmon The NMFS listing decision, contained at 63 Federal Register 42,587, is declared unlawful and set aside as arbitrary and capricious. United States District Judge, Michael R. Hogan stated the NMFS listing decision was arbitrary and capricious and thus unlawful under the Administrative Procedures Act 5 U.S.C. 706.

Understanding Salmon reduction in California Waters

In an attempt to understand the movement of commercial Salmon into Alaskan waters research found that there has been a historic rise in temperature of the Pacific Ocean which directly correlates with the historic increased activity in the Ring of Fire volcanoes. Since 1980 97% of all commercial Salmon in the Pacific Northwest have been caught in Alaskan waters. Although California, Oregon and Washington commercial fisheries are suffering there is scientific evidence that the Pacific Ocean temperature increase is the primary cause. In 1950 the total catch of all Salmon species in the Pacific Northwest totaled 149,000 metric tons with 80% caught in Alaskan waters. In 2007 the total catch in the Pacific Northwest was 403,000 metric tons with 97% caught in Alaskan waters. This scientific data clearly demonstrates that the commercial Salmon industry is in better shape than it has ever been. However, due to severe reduced landings of Chinook Salmon in California, Oregon and Washington have nothing to do with conditions on the Klamath River and its tributaries, but, is a direct result of the historic rise in Pacific Ocean temperatures.

Causative Factors in Salmon Decline



Prepared by Dr. Richard Glerak 11-19-2010

Pacific Ocean Temperature

http://www.google.com/search?q=history+of+pacific+ocean+temperature&hl=en&prmd=ivns&sa=X&ei=D_N3TbhSg4KxA7b61ccE&ved=0CHAQpQI&tbm=&tbs=tl:1,tlul:1970,tluh:2010

Pacific Northwest Salmon landings. http://www.st.nmfs.noaa.gov/st1/commercial/landings/annual_landings.html

Summary

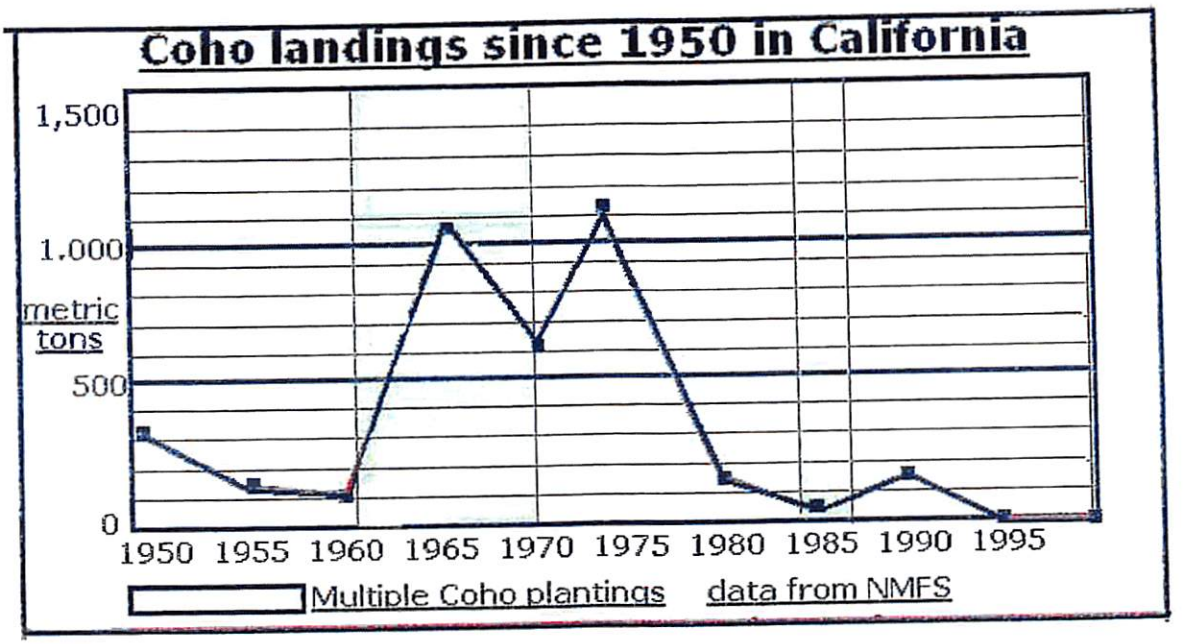
At this time NMFS and NOAA Fisheries has identified 17 evolutionarily significant units (ESUs) of Chinook salmon in Washington, Oregon, Idaho and California. Each ESU is treated as a separate species under the Endangered Species Act. Click the link below to get information about a specific ESU, its status, and other relevant information. Southern Oregon and Northern California Coastal in addition to the Upper Klamath and Trinity River ESU's are listed as NOT WARRENTED.

NMFS/NOAA data

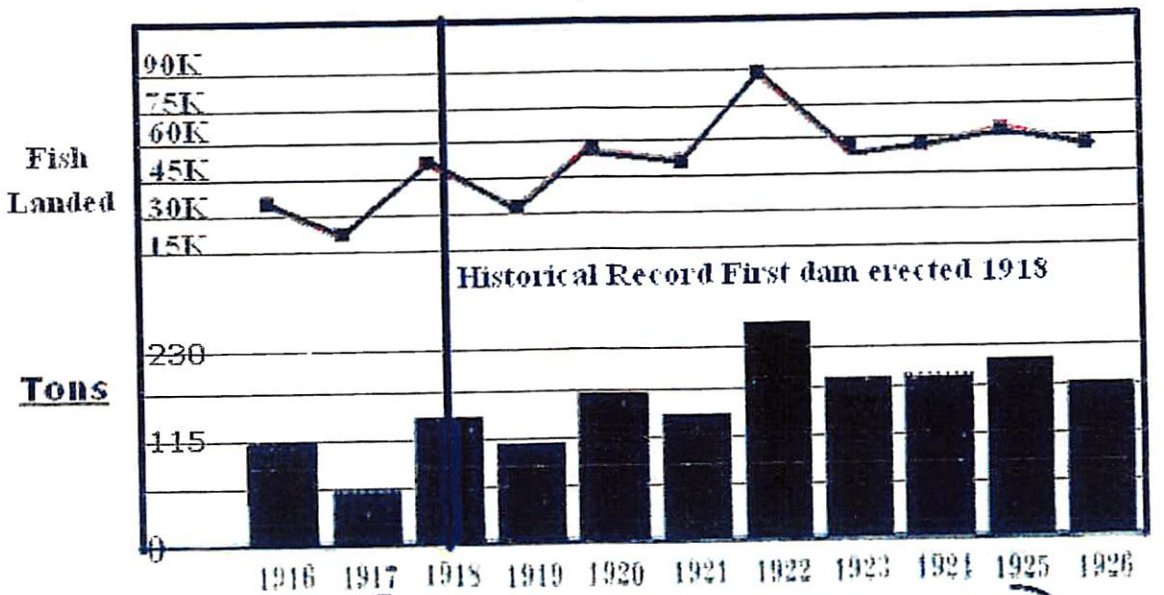
http://www.nwr.noaa.gov/ESA-Salmon-Listings/Salmon-Populations/Chinook/

Not only did today's hatchery salmon originate from the eggs and sperm of naturally reproducing salmon populations, hatchery produced fish have been thriving and returning to Pacific Northwest Rivers in unprecedented numbers. Unfortunately, these same hatchery fish are now being labeled genetically inferior, hunted down and clubbed, and their eggs sold as fish bait. There is a very real danger that present anti-hatchery policies will, if pursued, reduce salmon/steelhead populations to the point that there will be no significant recreational or commercial fishing for decades to come. In addition, the deliberate destruction of these hatchery populations by natural resource management agencies may actually be destroying genetic material needed for the continued health of salmon populations in general. Once genetic material is lost from a species gene pool, it can never be recovered. The populations of some remaining "wild" fish are now so small that their genetic diversity has been reduced to the point that they may be unable to grow sufficiently without an infusion of genetic material from hatchery fish. Listing Chinook in these ESU's is unwarranted and will not restore Chinook Salmon.

The year (2001) for example, 60-80% of salmon that will be harvested originated in state, federal, and Tribal hatcheries. Given the additional 20-40



Klamath History of Salmon Landings

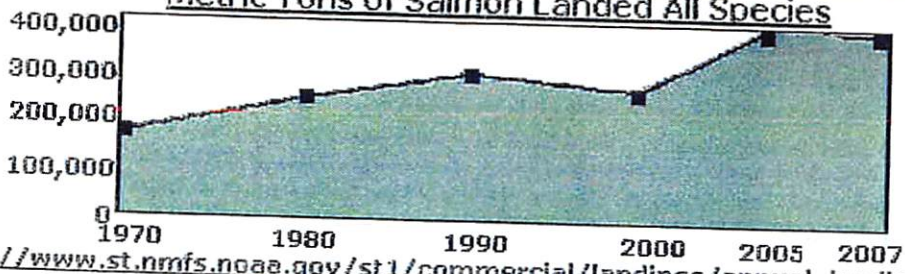


Fish caught numbers are based on an average of 14= per fish as per the 1930 Snyder report

http://content.cdlib.org/xtf/view?docId=kt538nb0tr&brand=calisphere&doc.view=entire_text

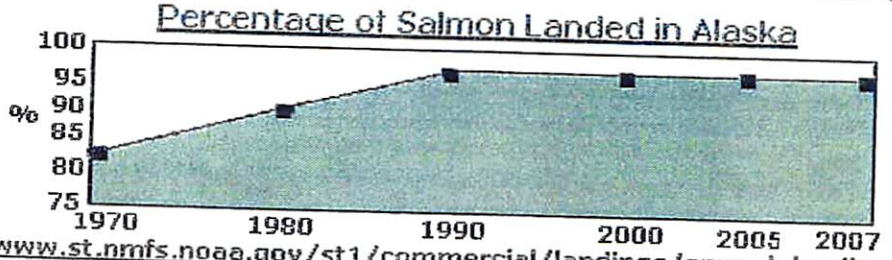
Division of Fish & Game 1930 Report
Fish Bulletin #34
The Salmon and the fishery of the Klamath River

Metric Tons of Salmon Landed All Species



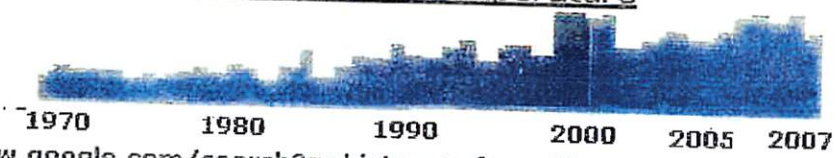
http://www.st.nmfs.noaa.gov/st1/commercial/landings/annual_landings.html

Percentage of Salmon Landed in Alaska

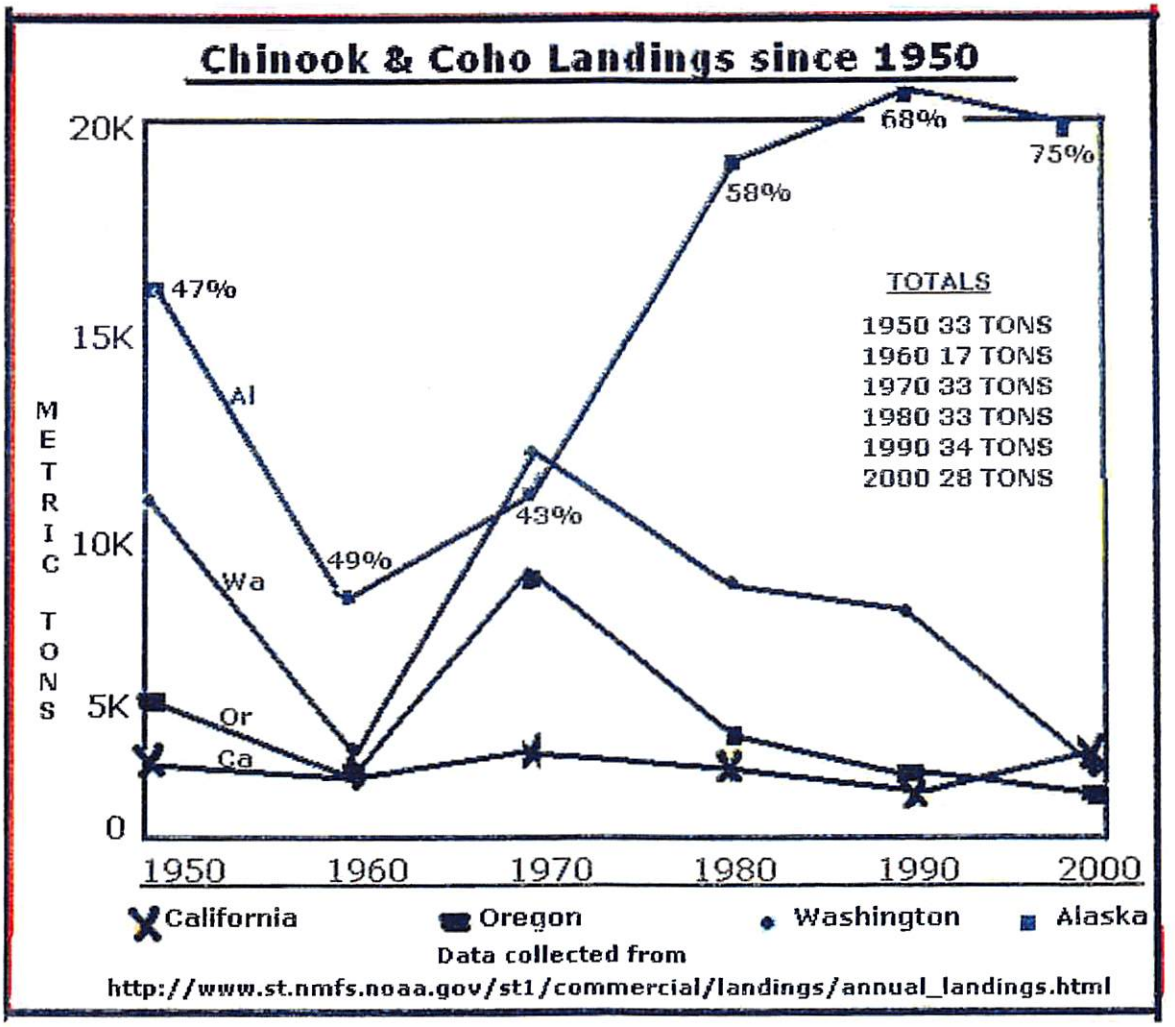


http://www.st.nmfs.noaa.gov/st1/commercial/landings/annual_landings.html

Pacific Ocean Temperature



http://www.google.com/search?q=history+of+pacific+ocean+temperature&hl=en&prmd=ivns&sa=X&ei=v5shTfjaLpKmsOPA6pTxAQ&ved=0CHoQpQI&tbs=tl:1,tlul:1970,tluh:2010


Chinook & Coho Landings since 1950
20K
15K
10K
5K
0
METRIC TONS
1950
1960
1970
1980
1990
2000
47%
49%
43%
58%
68%
75%
Al
Wa
Or
Ca
TOTALS
1950 33 TONS
1960 17 TONS
1970 33 TONS
1980 33 TONS
1990 34 TONS
2000 28 TONS
California
Oregon
Washington
Alaska
Data collected from
http://www.st.nmfs.noaa.gov/st1/commercial/landings/annual_landings.html

million in human population growth predicted for the Pacific Northwest in coming decades, it is almost certain that the downward trend in purely wild salmon populations will continue. For example, the east coast of the US, Europe, China, Japan, and Korea formerly supported large populations of purely wild salmon. They no longer do so and it is unlikely they will ever do so again (Lackey, 2001).

http://www.propertyrightsresearch.org/role_o.htm

Respectfully submitted;

SCWUA President;

Leo Bergeron

Dr. Richard Gierak D.C.
5814 Highway 96
Yreka, CA. 96096
530 475-3212
3-24-2011
Degrees in Biology, Chemistry and a Doctorate in the Healing Arts

Siskiyou County Water Users Association
Yreka, California

Re: Removal of hydroelectric dams on the Klamath River in Northern California to restore Salmon fisheries.

Are commercial fisheries in the pacific northwest in serious trouble?? Will removal of hydroelectric dams restore salmon fisheries?? These are the questions being asked about the dams on the Klamath River River. An opinion by National Marine Fisheries Service states clearly that removing dams on the Snake River will not help in restoring salmon. As to the dams on the Klamath River, radical environmental NGO's, tribal governments, commercial fisherman and governmental agencies believe that this action by the Klamath Basin Restoration Agreement and the **Klamath Hydroelectric Settlement Agreement "may" restore salmon runs.**

This presentation will investigate the reality of Salmon Fisheries in the Pacific Northwest. The primary premise for removing four dams on the Klamath River is to restore Salmon Fisheries. In 2002 there was a serious fish kill in the lower Klamath River that was attributed to toxic algae from the reservoirs above the dams. **A Center For Disease Control study was initiated and the waters in the reservoirs were deemed non-toxic.**

Recreational exposure to microcystins during algal blooms in two California lakes
Lorraine C. Backer a,*, Sandra V. McNeel b, Terry Barber c, Barbara Kirkpatrick d, Christopher Williams e, Mitch Irvin f, Yue Zhou f, Trisha B. Johnson g, Kate Nuremberg d, Mark Aubel e, Rebecca LePrell a, Andrew Chapman e, Amanda Foss e, Susan Corum h, Vincent R. Hill g, Stephanie M. Kieszak a, Yung-Sung Cheng Received 8 April 2009 Received in revised form 26 June 2009 Accepted 6 July 2009

It is of interest to note that Fish & Game did not sample the waters during the fish kill, but, waited over a week before sampling. Del Norte, Humboldt and Siskiyou County Sheriffs Departments in addition to the California Conservation Corps believed that the kill was caused by a metamphetamine dump into a stream which emptied into the Klamath.

FERC analysis of proposed re-licensing of Dams on the Klamath River

In their final report in 2006 FERC believed that the best option in considering the dams on the Klamath River was to leave them in place with mitigating factors.

What caused salmon deaths? Siskiyou Daily News (excerpted) ^ | February 16, 2003 | Barry Clausen

Salmon killed by illegal drug activities?

Journalist's findings challenge official explanation of cause of death

Posted: February 22, 2003 By Sarah Foster © 2010 WorldNetDaily.com

As a result the Coho Salmon were listed as endangered by the California Fish & Game and have instituted a plethora of regulations on the Klamath River in direct violation of the Magnusson Stevens Act and the Sustainable Fisheries Act. They are proposing fish ladders, TMDL regulations, algae control and a variety of other meaningless regulations. **It is a well known fact and the latest NorthCoast Water Board information states that the waters in the Klamath River have the largest amount of algae as it leaves Klamath Falls and that as the waters move downstream they become cleaner as a result of the reservoirs allowing sediments to settle out.** The latest report of the 2002 Salmon kill by U.S. Fish and Wildlife indicate that the kill was caused by unusually warm water, exceptionally large run of Salmon, Shallow waters due to 1997 flood depositing silt and debris, and 70% of Trinity River water being diverted South. **They have admitted that the reservoirs and dams did not cause the catastrophic salmon kill thereby negating the entire premise for removing the dams.** Under the Dormant Commerce Clause no State can impose regulatory actions on Waterways that are considered navigable or harbor commercial fisheries. Due to a loophole that was initiated in a lawsuit filed in 1970 is the premise for these actions.

Historic Salmon landings1916:

Native tribes and environmental NGO's have claimed that prior to the dams on the Klamath river there were millions of Salmon that spawned in the river. However, the actual numbers of Salmon during the years of 1916 to 1918 numbered an average of 34,000 fish per run. They seem to forget that in a dry summer the Klamath River turns into swamps and marshes and cannot support any kind of Fall Salmon run.

Between 1916 and 1918 prior to the dams being built it was noted that the Salmon catch on the Klamath River averaged 120 tons per run. After the first dam was built the next five years produced an average of 188 tons per run. This clearly demonstrates that the dam increased the tonnage by over 50%. The following link is a Fish and Game 1930 report.

http://content.cdlib.org/xtf/view?docId=kt538nb0tr&brand=calisphere&doc.view=entire_text

Not only will these actions not restore salmon fisheries in the Pacific Northwest but **Fish & Game cannot document that Coho Salmon were ever native to the Klamath River**. Plantings were made in the Klamath in 1895, 1899, the 1960's and the 1980's according to historical records. After plantings there was a rise in returning Coho for the following three years, however, without further plantings Coho levels again dropped to historical low levels. As a scientist I would classify these failed plantings as a failed experiment and that you cannot list a species that was never native to the River.

A REPORT UPON SALMON INVESTIGATIONS ON THE PACIFIC COAST IN 1896. By BARTON WARREN EVERMANN AND SETH EUGENE MEEK.

Predation by Pinnipeds

Both El Nino and the recent drought has been indicated as having an effect on the prey and predator species distribution. **Threatened California sea lions were porking out on threatened salmon.** Efforts to capture and relocate harbor seals exhibiting the same tendency have been unsuccessful in solving the problem. The (LRP) Ch4, pages 37-39, states that estimates of **mortality of anadromous salmonids from natural predators run as high as 98 percent (Fresh in Steward and Bjornn 1990)** Yuroks traditionally harvested marine mammals (McEvoy 1987), but today many of these species are protected by the Marine Mammals Protection Act." In the typical logic of fisheries scientists, the report proceeds to ignore its own stated facts in favor of the politically correct.

Chinook and Coho landings in California waters

It is clear that since 1950 the total landings of Coho and Chinook in California has dropped significantly. However, if we look at the total tonnage of these two species caught in the Pacific Northwest the total tonnage has not dropped significantly, but, the Coho and Chinook have moved North into Alaska. **In 1950 47% of these two species were caught in Alaskan waters and in 2000 the Alaska catch has gone up to 75%.** We will consider what has caused the movement of these two species North into Alaskan waters. http://www.st.nmfs.noaa.gov/st1/commercial/landings/annual_landings.html

Chinook landings in California waters

The most important Salmon in California is the Chinook which traditionally sported a Spring Run and in wet years a Fall Run. **Before the dams, during a dry summer, there would be no water for a Fall Run of Salmon** and with the building of the dams there is now a significant Fall Run due to the storage of water behind the dams. If we look at the data it is clear that since 1950 the actual tonnage of Salmon off the California Coast has been rather level through 2000, unlike the Coho which have basically disappeared. In 1950 the tonnage of Chinook caught off of California was 3,200 tons. In 2005 the total tonnage was 2,300 tons and the numbers continue to fall. However, in 2000 Alaska landed 34% of all Chinook in the Pacific Northwest and in 2009 Alaska landed 53% of all Chinook in the Pacific Northwest.

The **true cause of Salmon decline** in California, Oregon and Washington are **as a result of a historic rise in temperature of the Pacific Ocean driving these cold water fish North into Alaska. In 1950 the total catch of Salmon in the Pacific Northwest was 149,000 metric tons with 80% caught in Alaskan waters. In 2007 the total catch was 402,000 metric tons with 97% caught in Alaskan waters. This represents a 270% increase in commercial Salmon caught in the Pacific Northwest.**

Pacific Ocean Temperature
http://www.google.com/search?q=history+of+pacific+ocean+temperature&hl=en&prmd=ivns&sa=X&ei=D_N3TbhSg4KxA7b61ccE&ved=0CHAQpQI&tbm=&tbs=tl:1,tlul:1970,tluh:2010

Pacific Northwest Salmon landings.
http://www.st.nmfs.noaa.gov/st1/commercial/landings/annual_landings.html

This alone verifies that the intervention of man with dams and hatcheries has been a successful endeavor with a 270% increase in Salmon in the Pacific Northwest since 1950.

"Dr. Victor Kaczynski, a fish biologist and consultant on fishing issues in the pacific Northwest, says that per classical ecological theory, a 70 percent decline in zooplankton biomass results in a 70percent reduction in predators dependent on zooplankton. Since 1979, zooplankton levels have declined by an estimated 70 percent due to ocean warming. With a reduction in zooplankton levels by more than 70 percent over the past two decades, West Coast salmon have declined by at least 70 percent."

The Pacific Ocean has had an increase in temperature since 1970 that is historic in nature driving Salmon North into cooler waters.

It is also of interest to note that our planet is undergoing a historical rise in earthquake activity and Ring of Fire volcanic activity since 1973.

Volcanic Activity;
http://www.google.com/search?q=volcanic+history+of+eruptions+in+the+ring+of+fire&hl=en&prmd=ivns&sa=X&ei=Z_x3TfLGBo62sAP9_ozSBA&ved=0CGwQpQI&tbm=&tbs=tl:1,tlul:1970,tluh:2010

Earthquake Activity;
http://www.earth.webecs.co.uk/

Caspian Tern impact on salmonids

In recent months Fish & Wildlife, Fish & Game and environmental NGOs have theorized that **increases in the Caspian Tern in the Columbia Basin in the state of Oregon has been a causative factor in decreased salmonid production**, as they prey on salmonid smolts. **Rather than considering thinning of the tern population they are proposing relocating some of them throughout Washington, Oregon, Idaho, California and Nevada.** The rationale behind this proposal is insanity, as the relocation and building of new habitats for the tern would seriously affect present ecosystems in addition to allowing them to continue populating new areas for these predatory birds. As has already been presented, the causative factor in decreased commercial salmonid production in Washington, Oregon and California is the increased warming of the Pacific Ocean driving cold water Salmon North into Alaska. Refer to the following link:
http://www.fws.gov/pacific/migratorybirds/cate.htm

Impact on property owners residing on the Klamath River

Since the proposal of the KBRA and KHSA property values are plummeting on the property owners along the Klamath River. Specifically, the residents at Copco Lake are in such dire straits that realtors will not even list their properties. Not only are values being devastated, but, **Iron Gate Dam was built in the 50's for the primary function of reducing devastating floods downriver**. Iron Gate Dam allows for a 90 minute warning blanket to residents downriver in the event of an impending flood thereby saving property and lives.

Dam Removal on Salmon Fisheries

It becomes apparent from the preceding data that **dam removal will not restore Salmon Fisheries, but, will devastate it.** The Expert Panel in their conclusions indicated that dam removal will decrease Salmon production in the first years and **"MAY" increase Salmon production in 50 years**. Not only will we be looking at **Salmon spawning grounds upended and buried in silt and mud from the removal of dams, and it would release a "biomass" of yellow perch to feed on Salmon eggs and smolts. There is no scientific basis for assuming that dam removal will restore Salmon Fisheries** in the Klamath Basin as stated in the U.S. Fish & Wildlife report that the reservoirs and dams did not cause the 2002 Salmon Kill. .

Latest Pacific Northwest Fisheries data

Big Salmon Run spawns Profits: The Wall Street Journal Tuesday, February 8, 2011
http://online.wsj.com/article/SB10001424052748704124504576118462016940744.html
Dan Springer of Fox News reported that National Marine Fisheries Service indicated that removal of Snake River Dams would not restore Salmon Fisheries.

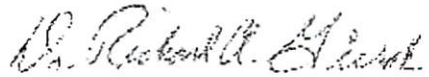
Conclusions

Should this dam removal proposal continue to move forward it would devastate property owners and subject those downriver of the dams to suffer inundating floods when you consider that Iron Gate Dam was specifically built to ameliorate the floods downriver by giving residents a 90 minute evacuation buffer in the event of a serious flood. This in addition to the fact that power rates will skyrocket and that Pacific Corps is pursuing "clean coal plants" to replace the most environmentally clean, green energy production. With the advent of electric cars we need more power, not less.

In the FERC analysis of the various options referring to dam removal their conclusion was that the dams should remain in place with mitigating factors.
http://www.ferc.gov/industries/hydropower/enviro/eis/2007/11-16-07.asp

For further information and references to these statements please go to the following you tube links.

Klamath Basin Salmon
http://www.youtube.com/watch?v=QOR8kBc0V6k
Historical Fisheries
http://www.youtube.com/watch?v=2-NkcLS68nw
global warming 7min.
http://www.youtube.com/watch?v=WffQhAOjVB8
Salmon bird 5min
http://www.youtube.com/watch?v=6a8Y-YEaMvo
Respectfully submitted;
Dr. Richard A. Gierak



An Engineers Quick Review and Analysis of the "Proposal to Remove the Klamath River Power Plants"

By

Werner F. Hoyt, PE (Mechanical/Marine Engineer)

31 March 2010

The National Science Foundation Review issued in March 2010 of the science behind decisions regarding water use cut off decisions. Driving these decisions were suppositions based on various ideas that certain activities were responsible for the collapse and subsequent listing of Delta Smelt and Longfin Smelt as threatened or endangered species. The foundation cited although the individual study science was good, they directed that the agencies go back and "Quantify the various elements of the situation. Spending 95% of your effort which attacks 5% or less of the global problem is bad science and bad management of scarce resources.

Subsequent to this Pacific Legal Foundation won their case *Stewart & Jasper Orchards, et al. v. United States Fish and Wildlife Service, et al.*). 18 May PLF statement **"Judge Wanger recognized that federal regulators had not taken account of how water cutoffs could damage the human environment, and they did not use the best available science," said PLF attorney Brandon Middleton.**

"This is a powerful, excellent ruling," said Middleton. "The judge is telling the feds that they can't ignore the harsh human and environmental impacts of cutting off water to farms, workers, businesses, and communities. The judge is also saying the feds can't get away with using slippery science to justify environmental restrictions that rob communities of their lifeblood – water."

We have a similar situation with the efforts from outside – The removal of the Klamath River Dams is an initiative largely on the part of individuals and agencies who do not have a personal stake in the issue. The impact of the changes imposed by these outsiders will fall on the residents of Siskiyou, Del Norte, Jackson, and Klamath Counties in the form of increased energy costs and reduced power reliability and security.

A quick review of the Parameters impacting the Klamath River Power Plant Removal Proposal

1 – What are the Major Factors Impacting Salmon and Steel Head Runs
- a) Marine Mammals/Predation
- b) International fishing
- c) Habitat
- d) Environmental Quality

e) What has changed that impact the Salmon and Steelhead Runs

2 – What are the Impacts of the alternatives
- a) Costs
- b) Reliability
- c) Environmental –clean vs CO2 emissions
- d) Security – Local power vs import from out of area
- e) Security – Trade Deficit/Dependence on foreign oil

The above all require quantification to determine where effort is to be applied.
The 5% solution yields 95% of the desired goal.

1a – Pinniped impact on fish populations

California Sea Lion Census 2007 – 238,000 Estimate by NOAA National Marine Fisheries
Current Population estimate extrapolated at 6%/yr. 1978 Census was 11,000 when the Marine Mammals Protection Act was established.

Year	Population
2007	238,000
2008	252,280
2009	267,417
2010	283,462

California Seal Population Census 2004 by NOAA National Marine Fisheries estimated West Coast Population at 31,000. Population growth per census appears to be starting to level. Assume declining growth rates at 1% per year from 2004 for extrapolation. Growth rate provided by Census was 9%/year

Year	Harbor Seal Population
1978	6,000
2004	31,000
2005	33,480
2006	35,824
2007	37,973
2008	39,872
2009	41,467
2010	42,711

Sea Lion/harbor seal Daily Food requirement ~ 16 kg (35 lb)/day equates to 3 ½ 10 lb fish per day = 35 lb x 365 = 12,775 lbs Estimated West coast population of pinapeds as of 2010 is approx 325,700 harbor seals and sea lions - equating to a food requirement of 4 billion lbs (2 million tons) of fish or 400 million 10lb sized fish.

Seal Pop	Pinniped Pop	Food Rqmt (lbs)	Food Rqmt(tons	Number of 10# fish
6,000	17,000	211,225,000	105,613	21,122,500
42,700	325,700	4,046,822,500	2,023,411	404,682,250

Pinnipeds are smart – they go where they can find food. In particular they congregate at the mouth of the rivers when the salmon and steelhead runs take place and compete with the Indian Tribes for what fish return. The have moved into the Columbia River as far as the Grand Coolee Dam, have been found as far inland as Stockton, California. Recently with the collapse of the fish stocks in the San Francisco Bay Estuary the resident population in SF Bay relocated for better hunting grounds.

1 b. Impact of Foreign Fish Trawlers and Fish Factories. Salmonoids range of migration is TransPacific in nature. Currently there is no management of take regarding populations originating from West Coast Spawning Areas. Drift net practices by Pacific Rim Countries result is a near complete take of Salmon Schools and steelhead when encountered by these fishing vessels. A quick look at total Pacific ocean take with National Marine Fisheries oversight indicates declining fish takes and collapses in fish stocks over the last 30 years. A rough estimate of current fish take all species by Commercial Fishing Trawlers is approximately 10% of that during the early 1970's. Current Data is not immediately available by web search. Best estimate base on trends is that the current take on the part of Commercial Fishing is similar to the impact on fish by marine mammals. The take in Alaskan waters in 1988 was 700,000 metric tons in a study regarding incidental take of marine mammals by the National Marine Fisheries Service. Best estimate without direct input from NMFS is that this number will be on the order of 2 million tons of fish.

Environmental Quality Trends Regarding West Coast Watersheds

Establishment of the Clean Water Act has resulted in -

1) substantially increased clarity of rivers and streams
    a. personal observation from having been diving in sections of the Klamath river below I-5 from 1970 to present, there is significantly less fine sedimentation and suspended clay fines. Summer visible distance has increased by several orders of magnitude. " inches to feet"
2) elimination of pesticides such as DDT
3) substantial reductions of pesticides entering the watershed
4) substantial reductions of phosphates entering the watershed
5) timber buffers on all streams/rivers prohibiting cutting w/in 50 to 100 ft – this has been in place since the early 1970's for private

companies/individuals. Believe this ha been s extended to publicly owned lands regarding timber harvest.

6) Substantially reduced timber harvest activity – on the order of 10% of the 1970 numbers on an annual basis for Northern California. We have seen the closure of
   a. Two mills in Mt. Shasta
   b. Two mills in Yreka
   c. Decrease in milling operations at Weed
   d. Two mills at Hilt
   e. Two mills in Dorris
   f. One mill in McCloud

Remaining Milling activity in Siskiyou Count of significant size
   a) 1 mill in Yreka
   b) 1 mill in Weed
   c) 1 mill in Dorris

Salmon Runs in the 1960's and Early 1970's – local fisher's were lining both sides of the Klamath River. Our family limited out routinely during both Chinook and Steelhead runs during the 60's.

Environmental Quality Trends – Need to Quantify
Annual Timber Harvest in the Klamath Basin from 1960 to present.
Annual Cattle production – as far back as we can go
Annual grain production – indicator of farming intensity/soils loss
Annual estimate salmon catch as far back as records go
- Various runs for both salmon and steelhead.

Klamath River water quality indicators
- As far back as records go
- TMDL records – into and out of the power plant system.
- Temperature of water released from iron gate vs the pre-dam river temperature profiles prior to construction of the power plants.

Build the case that the power plant system is beneficial to downstream water quality/beneficial to the health of the salmon/steelhead returning up

What has been a constant through this period – The Power Generation Facilities on the Klamath River (Iron Gate, Copco, etc)

What has changed.

1) Explosive growth of Sea Lion and Harbor Seal Populations - 20X based on National Marine Fisheries Data
2) Massive increased use of fishing trawlers and fish factories on the high seas by pacific rim countries from 1970 to present – 10X or greater.
3) Decreased environmental pressure on spawning stocks from human generated activity all across the North State. Reductions and quality

indexes need to be generated to quantify. But these numbers are on the order of 90% or more from the mid 60's.

Economic Impact of the Change

Current Power Rates for Siskiyou, Jackson, Klamath Counties 0.07/KWH vs 0.11/KWH from Pacific Power due to the Klamath River Hydroelectric Facilities.

Current Residential Billed Rate - May 2010 at Lake Shastina

KWH	Cost	unit price
1152	135	0.117188

Customers will face both the cost of the facility removal as well as increased power rates.

Alternative Clean Power – Suitability and Cost

Wind power – I believe that all attempts to permit wind generation in Siskiyou County have been blocked to date on the basis of "Visual pollution". Wind power although it has promise to contribute to the clean power in the county is only part of the solution to provide local energy security. Wind is not constant. There are a substantial number of days insufficient to generate power. The wind probability mapping for power suitability of wind generation indicates such installations are "marginal at best" Installed cost is $5.2 million per 2.5Mw turbine. Cost to replace the Klamath river Power system is 160/2.5x5.2= $322 Million dollars for 64 each 2.5Mw turbines.

Solar power – present cost $10,000/kW or higher. Replacement of power generated by the Klamath River Power by solar alone is

160 Mw peak gen capacity = 160,000 Kw = > $1.6 billion

Total annual Klamath river power generation =

Peak Power Output = 160 MW

Average Annual output = 80 MW to Siskiyou/Jackson/Klamath counties

Power output = 80MW*24*365/1000= 700 million KWH

Power Cap	Hrs	Days	Conv	KWH	Cost/k wh	Cost	Revenue/k wh	Revenue
80,000,000	24	365	1,000	700,800,000	0.07	49,056,000	0.018	12,614,400

Customer cost @ $0.07/KWH

Electric Generation from fossil fuel creates the following CO2 emissions.

955 g/kWh CO2 Coal
893 g/kWh CO2 Oil
599 g/kWh CO2 Natural gas

		lbs CO2/yr	ton CO2/yr	gallons/oil	Barrels/Oil	Import cost @ 50/Barrel	Import co 150/bar
2.101	lb/kWh Coal	1,472,380,800	736,190				
1.9646	lb/kWh Oil	1,376,791,680	688,396	62,581,440	1,862,543	$93,127,143	$279,381
1.3178	lb/kWh Nat Gas	923,514,240	461,757				
			49	100%			
			93	190%			
			279	569%			

Presently the cost of power produced by the Klamath river – assuming an average production of 80Mw

Is 49 million – local resource at $0.07/kWH

Removal and replacement by either oil or natural gas will result in pricing at

93 Million/year + generation and distribution cost – assuming $50/barrel of crude oil this is a 190% + increase over our current power

The bulk of this revenue will be exported overseas

279 million/year + generation and distribution cost – when prices return to $150/barrel as we previously experienced. This is 569% increase in cost the customers served.

Again this money is exported overseas as this is a new demand on fossil fuel sources where the United States is increasingly dependent on international markets for energy.

At $100/barrel over

$180 million/yr

$1.8 billion dollars over the next 10 years not indexing for inflation the cost

$18 billion dollars over the next 100 years not indexing for inflation

2010 Population Estimates

Siskiyou County 49,000 , Jackson County 201,000, Klamath County 68,000 Total Population Served ~ 338,000 -- estimated number of households assuming average household size of 3 = 113,000 households.

This equates to an additional **household burden of ~**

$1,000/household/year for $100 barrel oil

$2,000/household/year for $150 barrel oil

assuming that the change impacts the entire of each county if less that the entire then the burden proportionally increases.

1.8 billion – 0.49 billion = 1.31 billion => Cost/#households = 1.31 billion/113,000 = an increased cost of 12,000/household. ~ 1,000/household/year not indexed for inflation or likely energy cost increases for fossil fuels.

Existing Hyrdoelectric Power Plants Provide

1 – Clean Power

2 – Renewable resource

3 – Provides a power source locally

4 – Power is not subject to variability of weather or availability of the sun. Available based on demand by households and business.

5 – Does not contribute to global warming (no CO2 Emissions)

6 – Did not contribute to the decline of the Salmon/Steel head populations as evidenced by:

a. the explosive growth of the Pinnaped populations – establish a normalized trend line. Establish food demand trend line for population preying on salmonids at sea. Need NMFS to cough up their data on

- Sea Lion Population monitoring in the area from Humbolt to Coos Bay.
- Movements and behavior of the larger groups.
- Conflicts between fishermen and sea lions at the mouth of the Klamath River.

- Behavior and estimated take from the Sea Lions.

b. international fish trawler fish takes. – Establish trend lines
c. US fisher fish take – establish trend lines
c. improved water quality trends over the period of the decline
c. no evidence of decline as a result of the power plant construction

7 – Provides local jobs in the maintenance and generation of power.

Need to cite # of jobs – direct and indirect – indefinitely

Vs

No jobs in county provided by the facility removals. County resident construction companies will be unable to bond the size of the project $100+million. Outside companies will bring in their own workers.

Loss of the jobs currently provided.

8 – Provides an economical source of energy for local residents

Cost of power on the basis plants are maintained in current configurations. Including structural seismic upgrades if needed (No ladders)

Vs cost of power incorporating fish ladders

Vs cost of power with no power plants – note the cost of removal ultimately will be paid by the rate payers/tax payer – primarily the county residents.

9 – Power security independent of fluctuations in the fossil fuel markets

Power security that is local not subject to
- Major seismic events outside Siskiyou County
- Winter weather interruption of power grid outside of Siskiyou County
- Local power source allows for repair locally.

10 – Not subject to international events.

11 – Keeps local money here at home, in the county, in the country – does not add to the balance of trade deficit

12 – Does not increase our dependence on foreign energy sources.

13 – Flood protection

Define current flood boundaries as a result of the presence of the power plants.

Define the spring thaw snow melt flood event conditions – size and duration of flood event.

Define areas subject to that flood event – historical research of flood events, flood crests that took place on the Klamath as a result of spring snow melt/rain events in the upper Klamath Basin

Define the damage estimate of an uncontrolled flood event.

Define who would be affected from Iron Gate to the Coast based on the largest known flood event prior to the Construction the Power System Complex.

All presently protected residences, businesses in the new flood plain band would be required to obtain flood insurance. Note I believe current FEMA policy is to pay off and not rebuild in the flood plain if a business or residence is destroyed.

Conclusion based on sound analysis of the overall factors affecting fish populations.

1) **Predation** – Marine Mammals and Commercial Fisheries are the 95-99% portion of the equation affecting the Salmon and Pacific Fish Stock Populations. The **correlation** between Predation and fish stock collapse is **extremely strong.** Very strong impact versus rapid species decline.

2) **Habitat** – Environmental Quality has Steadily Improved for fish reproduction over the past 40 years. **Improving trend** while there has been a collapse in fish stocks indicating that habitat has not been a contributing factor to the species collapse. All indicator trends run **counter to the fish stock collapse.**

3) **Power Facilities** are not the source of the fish stock collapse – they have been a **constant factor** in the Habitat since construction. **No correlation.**

Ownership – Eminent Domain on the basis that FERC/Pacific Power have completely mismanaged the Resource???

How much of the income from the facilities is exported. How much infrastructure outside of our county are we paying for?

Recommendation –

(1) **Build fish ladders:** The cost of construction of fish ladders at each of these facilities is far less expensive proposition to the 3 counties than the future cost of energy and is the overall least damaging environmental solution to our energy needs.

1) Cost 90-300 million versus 1.8 Billion in increased costs to the county
2) It maintains our source of clean, reliable, low cost energy
3) Restores salmon access to the upper Klamath basin.
4) Prevents the creation of
    700,000 tons/year of CO2,
    7 million tons/next 10 years
    70 million tons/nest 100 years
5) Conserves fossil fuels oil or equivalent in coal/natural gas
    62 million gallons/year
    620 million gallons/next 10 years
    6.2 billion gallons/next 100 years
6) Maintains the recreation resource provided by the associate lakes behind the power facilities.

(2) **Seek assistance of the Pacific Legal Foundation** for assistance in this issue to force quantification of the sources causing the collapse. We will never restore Salomon Populations if the 95% portion of the problem is not addressed first.

Note: Detailed quantification is required to fully document the conclusions of this preliminary study of the Removal of the Kamath River Power Plants.

(3) **Full quantification** should be required of the agencies producing their studies as was recommended by the National Science Foundation in the case of the Delta Smelt calling for the removal of the Power Plants. The ESA requires that economic factors be considered in actions to be taken as well as an estimate of the effectivess of those proposed actions under the ESA. Does the proposed action really have a productive effect?

Known factors negatively contributing to species decline due to adverse fish management policy.

(1) Failure by NOAA/FWS to control take beyond the 200 mile limit by commercial fishers

(2) Adverse water releases from the trinity reservoir triggering fish movement when movement is not a normal event due to weather. Need to request records of water releases from the Trinity Reservoir

(3) Fish kill by agencies of reproductive adult fish at the Iron Gate facility that would otherwise migrate back downriver to another stream to reproduce.

County Government is the responsible agency for the CEQA review. As part of that review any or all of the NEPA accomplished by FERC can be called into question.

- Security analysis
- Energy analysis
- Cost of alternatives
- Economic impact on the 3 county area of Siskiyou, Jackson and Klamath
- Environmental quality trend analysis
- Population trend analysis
- Predator trend analysis
- Fish Take trend analysis by
  - Commercial Fishers
  - Tribes
  - Recreational anglers

Has FERC completed and issued their NEPA analysis regarding their imposition of requirements on Pacific Power.

KLAMATH RIVER DAMS REMOVAL: THE ISSUE IN BRIEF

(Prepared by Dr. John W. Menke, July 27, 2010)

Removal of four Klamath River dams as proposed in the KHSA and KBRA will result in unintended consequences that collectively add up to negative cost-benefit outcomes individually and collectively using scientific, engineering, economic, and Native American cultural criteria.

First and foremost, the dams provide flood protection for residences, businesses, agency offices, bridges, and other structures adjacent to reservoirs and within the floodplain of the Klamath River downstream from Iron Gate Dam (IGD) to the ocean. The railroad levee parallel to Highway 97, from approximately 4 miles north of Dorris, CA to Klamath Falls, OR restricts floodplain flows away from the river upstream of the geologically-formed Keno-divide and causes higher peak-flood-flows in the Klamath River today compared to pre-dam conditions (NRC 2008). If the dams are removed the levee must be removed or modified to provide the natural 'escape-valve' for the river above Keno. The Klamath River dams provide a minimum 9-hour peak-flood-delay below Iron Gate Dam which results in a significant reduction in risk to property loss. Additionally, the reservoirs provide local water supplies to helicopters used in fighting wildland fires that are threatening property.

Second, responsible federal and state fisheries management agencies and the Bureau of Reclamation have inappropriately devoted almost exclusive attention to natural and instream flow studies and agricultural flow-reduction strategies in the Klamath River watershed without studying, modeling and showing that Klamath River flow is the limiting factor or bottleneck to producing more salmon (NRC 2008). The studies and models that have been developed are too gross (monthly verses daily time step) and 'black-box' (not mechanistic) in design to accurately account for critical factors affecting fish abundance and health. In the case of the short-nosed sucker fish in Upper Klamath Lake, the agencies used a flawed Biological Opinion based on one naïve model to cut off irrigation water to farmers when that fish was not limited by lake levels according to vast amounts of empirical data. Until the true limiting factors are identified and justified with sound scientific studies and model demonstrations with sensitivity analysis to show causal mechanisms, it is premature to remove dams and hope that that action might help (see more on this below).

Third, only the freshwater life-stage portions of salmon and steelhead life-cycles have been discussed as affecting salmon abundance when we all know ocean temperatures and recent record harvest of Chinook salmon in Alaskan waters show ocean currents and food availability are affecting local fish abundance as well. The NOAA Fisheries component (ocean effects) of agency responsibility is never discussed in local meetings concerning salmon and steelhead in the Klamath River watershed. Likewise marine mammal depredation rates are never discussed. Now that large proportions of marine mammals have moved north to follow the salmon and steelhead, it is time for responsible agency officials to present their data and models concerning growth rates and harvest in the ocean where the vast majority of fish growth and harvest takes place.

Fourth, even though a vast majority of the freshwater fishery management agency workforce is devoted to surveys and monitoring studies including fish returns, spawning dates

and locations, live fish surveys, carcass surveys, juvenile escapement screw-trap-monitoring in the mainstem Klamath River and tributaries, disease incidences, coded-wire-tag marking and return information, harvest information: tribal netting, and sport-fishers catches, marine mammal predation studies, etc., no dynamic simulation models have been developed to allow prioritizing of possible limiting factors to salmonid productivity. Again it is time for this vast information database to be put to good use, and at least a freshwater component of the salmonid life-cycles be developed and demonstrated to the public. The NRC (2008) study stated that this process should precede any adaptive management program, after limiting factors or bottlenecks to improved salmonid production are identified—this has not been done.

In 1984, a Yreka sporting goods store owner put faith and hope in a $40,000,000, 20-year-long state funding commitment to California Department of Fish and Game to make improvements to the Klamath River fishery. Nothing of significance was shown or discussed with the public justifying the money spent during a review field trip to the river in 2004. During the partially concurrent 10-year Klamath Act and the NRCS EQIP Program efforts including the clearing of culverts and log-jams that restrict fish access to small tributary creeks, construction of fish screens to reduce incidental take, construction of pipe-lines to reduce ditch losses in agricultural diversions, and installing cost-shared pivot-irrigation systems to replace less efficient flood and wheel-line irrigation systems, no improvement in salmon and steelhead numbers can be demonstrated. With less flood irrigation, reduced ditch losses, and with 'efficient irrigation' systems, groundwater replenishment has most certainly been reduced and cold-water refugia have likely been reduced in effectiveness. Winter-time tributary stream temperatures have likely declined during egg incubation so that emergence has been delayed due to less groundwater accretion to tributaries. These are clear examples where hypotheses are not tested prior to implementation of un-educated guesses on what's broke about the system.

(Another 3-4 paragraphs will be added concerning water quality, sediment, and fish disease—the greatest risk of dam removal; and cultural issues of burial site disturbance and ?)

But agencies are in need of projects since most diversions have been screened, those wanting cost-share pivots have been satisfied, and seasonal monitoring needs are not year-round jobs. Why not develop a mega-restoration project even before the impact assessment is done?

Literature Cited

NRC (National Research Council). 2008. Hydrology, Ecology, and Fishes of the Klamath River Basin, National Academic Press, Washington, D.C., 249 pp.

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May 11, 2011

We live (since 1993) in rural Siskiyou County where cattle, hay, logs and gold sales are the economy. We have way too much government employment in our county. Since forestry has largely been shut down on public lands the number of employees on National Forests far exceeds the work load. It is basically a government welfare system going on in our area as far as the Federal agencies are concerned. To show Federal support (short-term local construction jobs) two new large buildings have and are being constructed for the US Forest Service at tremendous unnecessary expense to the federal taxpayer.

Currently we are fighting using civil disobedience to counter State Fish and Game and North Coast Regional Water Quality Control Board (NCRWQCB) efforts to take our irrigation water away. Fish and Game tried to implement an illegal ITP (incidental take permit) program and has violated landowners with extortion actions by armed game wardens committing color of authority violations in the process. They are now in the process of replacing the Fish and Game Director since they know he is liable for jail time having authorized an illegal method of forcing landowners to make decisions contrary to their will.

US Department of Interior, through the President, is illegally using the Antiquities Act to designate a new monument and expand an existing one from southern Oregon into north Siskiyou County, and is ignoring the Congress of the United States which is the only body legally able to designate wilderness. The Department of Interior is going to make a unilateral decision about hydroelectric dams removal which the citizens of Siskiyou County overwhelmingly voted (80%) to keep the dams in place producing green power. The NCRWQCB is in collusion with the US Department of Interior using their waiver program to stop grazing on part of the proposed monument area, and they have violated the Data Quality Act (EPA oversight) in giving the public the impression that Upper Klamath Lake water can be cleansed by bioremediation through extensive, expensive wetlands construction. Even the expert scientific panel on Chinook salmon related to dams removal doesn't buy their claims, but the government is 'MOVING FORWARD' on their efforts regardless.

Fish and Game has been practicing Federal take on coho salmon since 1995, to reduce the population initially get the fish listed in 2005, and now to take further property rights away from landowners via water controls. The NCRWQCB has used their EPA connections to force the dams owner, PacifiCorp, to agree to dams removal, and now the National Marine Fisheries Service has forced PacifCorp to secure an ITP and HCP, so that power rates will be raised again to further hurt agricultural irrigators' pocket books. In fact, all citizens (70,000 residences in northern California, southern Oregon, and as far away as Wyoming using power generated by the Klamath River dams) are being ripped

off with power rate increases to supposedly pay for dams removal, even though the decision has not been made or funded by California and Oregon nor the Federal governments.

Fish and Game has prepared suction gold dredge guidelines that essentially eliminates economical gold dredging on the Klamath River. In actuality gold dredging helps the river by dislodging an overly cemented armor bottom on the riverbed disallowing spawning salmon to dig their nests to deposit their eggs. Lack of sufficiently frequent flood events with more common drought cycles in the last several decades have caused abnormally cemented gravel materials to develop, disallowing good salmon reproduction. Fish and Game, like all their sister agencies, are part of a larger agenda to force people out of Siskiyou County because it is a rare place in an otherwise overpopulated state. These folks see the county as a park, given its relatively pristine/undisturbed state when comparing it to even the 'visited-to-death' Yosemite National Park. Agenda 21 has mapped the whole county as a corridor of organism movement for otherwise non-gene sharing segregated meta-populations of plants and animals that have 'human rights'.

Given the collusion that has been taking place among Federal and state regulatory agencies and coastal communities including Indian tribes to the west of Siskiyou County, it would be to Siskiyou County's detriment to be pooled with counties to the west from a representation standpoint. Siskiyou County shares custom, culture and economies with Modoc County and other counties to our south including Shasta, Lassen, Tehama, and Plumas counties. The proposal to make the dividing line Interstate 5 and pooling western Siskiyou County with Trinity, Humboldt and Del Norte counties would not be welcomed by Siskiyou County residents.

Sincerely, John and Jennifer Menke, Ranchers

KLAMATH RIVER ISSUES-PERSONAL INVOLVEMENT and OBSERVATION

I am fully aware of the Lower Klamath and Tule Lake Basin reclamation projects where shallow lakes and marshes were drained and manipulated into manageable farmland and made available to lottery winning American war veterans. I am also aware of the water issues of 2001 and the Endangered Species Act which have caused social unrest and division in our region. However, as a state wildlife officer I had no direct professional or personal involvement in any way, shape or form, other than monitoring media reports. My personal and professional views have not been publicly shared.

During and after my professional career I have been an active board member of the Collier Interpretive and Information Center (CIIC), located north of Yreka at the juncture of Interstate 5 and the Klamath River. CIIC provides the public with interpretation and information specific to the geographical region and the Klamath River watershed.

It is clear to me that the Klamath River drainage is a unique **"upside down watershed"**. Whereas many natural drainages of the Pacific Northwest originate high in the coastal mountains where precipitation levels are high and somewhat maintained through snow pack, this system originates in a high desert, plateau-like environment with sparse annual precipitation. As a result, the upper end of this system is typically a spring fed or artesian water supply with slight elevation changes and marginal water velocity variations as it flows from the high desert towards the ocean. In this case, where water velocity is low or relatively consistent, any sedimentation that occurs creates alluvial deposits locally over time. There are several regional examples of this process, called "succession", but a prime example is the shallow body of water called Upper Klamath Lake and Agency Lake. This is a relatively long and shallow mostly natural-impoundment in Klamath County, Oregon. Historically speaking, and I mean thousands and thousands of years ago, anadromous fish species undoubtedly traversed the watershed from the Pacific Ocean to the Williamson, Wood and Sprague River drainages. As a result of time, naturally occurring water flow scouring and water-caused sedimentation have produced the river-lake conditions that exist today. And, because of that historic anadromous access there are indigenous trout above present day Upper Klamath Lake; just as they exist in several closed watersheds in the region. Over time, warm water and cold water fish species have adapted to the current given environments, the carp or sucker fish are examples thereof.

As the watershed naturally drains towards the ocean it meets a sharp gradient change in the Keno, Oregon area and begins to flow through deeply carved canyons and the coast range where annual precipitation is comparatively high. Because of the elevation change the rapidly flowing water is cutting and filling the river's channel until it bluntly meets sea level which is a relatively consistent "plug" to the drainage system. This natural degradation and periodic flushing action of the river, during high flows especially, are uniquely tolerated by anadromous and catanadromous fish species and their life and cyclic movements are triggered as a result of the fluctuation.

Water quality above the John C. Boyles Dam near the California-Oregon state line is historically poor for anadromous fish species and has declined further since the farmland reclamation project in the early 1900s and settlement downstream from the Klamath Lake outlet at Link River.

Anadromous fish utilize the river system as a freeway-like route with a strong desire reach its headwaters and/or to enter the river's femoral feeder streams to spawn. Bogus Creek, near the current Iron Gate Fish Hatchery, is a good example of this where spawning salmon choke the spawn able gravels and then die. Each and every stream feeding the Klamath River system in those lower reaches will receive adult steelhead and salmon if that is where they originated

and other conditions are acceptable. I have seen very large steelhead trout spawning in femoral streams at the uppermost extremes of the drainage (or natural barrier) where their backs are out of the water and they can't turn around without considerable effort.

Shovel Creek, above the Iron Gate and two Copco Lake power generating dams, is a prime example of one of the last streams where anadromous fish were able to successfully spawn prior to the river being impounded for electrical production. The adult fish utilizing Shovel Creek spawning habitat went as far as the natural barrier at the confluence of Panther Creek, but indigenous, naturally reproducing trout exist above it simply because previous generations were able to maneuver beyond the barrier before it naturally became impossible to do so.

When Iron Gate Dam on the Klamath River was proposed every governmental agency involved had to know that there would be an anadromous fish passage issue above that point. Through studies and first hand knowledge they had to realize too that there was historically marginal spawning habitat and conditions for those migrating fish species above that point. Because of that knowledge the Iron Gate Hatchery was not only proposed, it was mandated by scientific based agreement with government agencies to maintain anadromous fish in the Klamath River into perpetuity.

That hatchery, placed at the base of the Iron Gate Dam, did not happen haphazardly. There were strong reasons for it and planning mandates that came with its construction design and long term maintenance. Cold water would be drawn from well below the surface level of water behind the dam so as to assure cold water temperatures for the hatchery's fish spawning byproduct and rearing. Though built by federal agency dollars the hatchery is professionally and capably managed by the California Department of Fish and Game personnel on a year round basis. The number of adult fish processed and eggs fertilized is mandated by oversight authorities based on several factors and those numbers serve to mitigate the permanent loss of spawn able habitat above the dam. In my opinion, there are more genetically strong fish being produced by this fish hatchery than what the watershed can produce in ocean-entering and river-returning individuals naturally on its own.

The vast ocean environment is a critical factor in the returning number of Klamath River Salmon and Steelhead and is yet an unknown influence on the population dynamics of Klamath River fish. When 100% enter the ocean at the mouth of the Klamath River on their outward migration into the ocean and more than 80% fail to return as adult spawners four years later, the loss is considerable and thus far unexplained. Commercial take of Klamath River fish is considerable in ocean waters as far north as Alaska and west towards International and Russian controlled waters.

OPINION and CONCLUSION

After serious deliberation, I am of the opinion that Alternative 1 (No Action/No Project) is the best alternative at this time in American history. We are in critical economic strife nationally and worldwide currently and I believe this is an unnecessary expenditure of tax payer dollars. The adverse impacts of dam removal to Siskiyou County are potentially disastrous and unacceptable and I feel the opinion and concerns of Siskiyou County were poorly addressed from the start.

I feel PacifiCorp, a privately held corporation, is being unduly regulated by the federal and California state re-licensing authorities and have been forced to destroy the electrical power facilities on the Klamath River simply because the regulations and political demands have become cost prohibitive to effectively and efficiently run their business. It's insane to regulate this clean energy source out of existence, absolutely insane here in America.

I also feel this public input process has been pre-conceived and determined to force any opinion options towards dam

removal. As such, I think all of the alternatives except Alternative 1 are unacceptable and have unfairly forced respondents into a box. Any input honestly offered is simply a forced reaction to the alternatives on the table. I think the whole process is a farce. The dams are not the problem with the Klamath River fish!! The ocean holds the answers and further knowledge should be obtained before money is wasted on dam and clean energy destruction.

And, regardless of what Native Americans upstream of the Klamath Lake impoundment believe, I do not think salmon or steelhead trout would navigate the shallow lake from its outlet into the Link River and find their way to the Wood, the Williamson or any other tributary on the north end of the lake even if they were trucked there and released. This whole project is ignorant from the start and to offer rebuttal to insanity is worthless and senseless from the start.

The rainbow trout that inhabit Klamath and Agency Lakes, and spawn in those river and stream systems, have adapted to this unique system and adequately provide any and all cultural opportunities for their Native People. The carp, or sucker fish, have been their staple fish source for many, many moons, not the ocean run salmon and steelhead that they are professing historical ownership to.

The Klamath Tribe has been fully compensated over the years by the US Government and the American public. There is absolutely no acceptable reason for US tax dollars be used to purchase the 92,000 acre "tree farm" that is currently being considered as part of the Klamath Basin Restoration Agreement. They are doing well with the corrupt casino businesses throughout the nation now and money is literally flowing into their pockets. If the property is for sale, they should have the opportunity to purchase it just like others throughout the world do.
The downriver tribes have little or no ground to stand on. They have all the Klamath River fish they want or could ever need. They have gill nets across the river that take upwardly migrating salmon and steelhead. Not for subsistence or cultural uses, but for commercially motivated reasons that are unlawful and unethical in today's world. They will soon introduce the California Condor into the Klamath River watershed and it too will become a cultural icon to them that will again adversely affect current civilization and spawn conflict with other Americans.

In conclusion, I am critical of the process used in this KBRA/KHSA. I believe we are catering to a second generation of privileged farmers that for fifty-years enjoyed bargained power rates offered only to the American war veterans who literally won a once in a lifetime lottery to own and work potential farmland in the Tulelake, California area of the Klamath Basin. When that time frame was over, they were to assume the power rates that everyone else in the region was paying. They are now complaining that their power costs have gone up two thousand percent (2,000%) literally over-night. Welcome to the real world, now they're finally paying exactly what everyone else has been paying for the last fifty years.

Bottom line, keep the Dams in place. Re-license the PacifiCorp dam operation on the Klamath River and keep the rogue individuals working in Government out of the way. Sensible oversight for the overall public good is one thing. This is incredibly insane in America.

Sincerely yours,

Rennie D. Cleland
Dorris, Siskiyou County, California

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17 Nov 2008, 9:10pm
Homo sapiens Salmon and other fish
by admin

Sophie's Choice on the Klamath

The following letter is from Ric Costales. Ric has lived and worked on the land and in the woods in the Klamath Basin for 35 years. He is currently the Natural Resource Policy Specialist for Siskiyou County. This letter represents his personal opinions and is not an expression on behalf of the County of Siskiyou.

Dear Green River friends:

I understand from a friend of mine in Rock Springs that there was a recent forum having to do with water issues and the matter of the Klamath Basin was brought up as a solution in progress. Apparently an image was conveyed of happy stakeholders awaiting a New Day. Well, yeah, the Tribes are probably happy for numerous reasons. And, yeah, the big irrigators are probably content thinking they have secured the amount of water that is positively the absolute minimum they can economically live with. And, yeah, environmentalists are thinking they have taken a small step, but a first great step for mankind in "freeing" all the rivers. But that is it. It is not any sort of a rosy picture for the majority of people in the Klamath Basin, especially the small irrigators who are so far left out in the cold. Nor does it come without impact on the future of renewable hydropower and irrigated agriculture in America.

The position of Siskiyou County has been and still is that a decision to take the dams out is premature. Given the magnitude of the irrevocable step being proposed, no compelling argument based on fish or water quality science or economic feasibility has been presented. Neither has sufficient effort been made to investigate the mitigation for negative impacts. This is a shameful rush to judgment for political reasons, plain and simple. Any other analysis of the situation is self-serving, ignorant or both.

We in Siskiyou County are well aware of the flow characteristics of the Klamath River. People are going to be shocked when they see how little water comes down the river in dry years. The dams are the only thing mitigating the flow in those years. They are the last thing between the irrigated agriculture in the Upper Basin and losing the water completely. When (not if!) the salmon fail to rebound if the dams are decommissioned, there will be immense pressure to end irrigated agriculture in the entire Klamath Basin. The farmers who have sold out thinking that supporting decommissioning will somehow guarantee their way of life will have only bought themselves time to live out their lives on their farms. It will be the next generation who will have to live with the final round of "takings."

To be fair, the big irrigators were faced with "Sophie's Choice," having to choose which "child" was "killed." The dams weren't in their backyard, so it was easiest to cut them loose. I think they know what they did, and the futility of the bargain they made. Honestly, I don't know that I would have done differently had I been in their shoes. But the point is, this is not a rosy scenario by any stretch.

I heard that "intrinsic value" was mentioned as something taxpayers were willing to subsidize to some significant extent. How much are the American people willing to pay for that? Was this pitch made before or after the economic meltdown that is in the process of making the world reassess the limits of governments' abilities to make everyone's dreams come true? I can flat guarantee you that people are pretty soon going to pick commodity production and renewable energy over amorphous things like "intrinsic value" of "wild" rivers. This is particularly true when the difference in "intrinsic value" is the difference between one of the most picturesque, productive and ecologically diverse agricultural landscapes in America and what the landscape will turn into in the absence of irrigation. The only way this "intrinsic value" will ever be actually paid for is if the government pays, and the Federal Reserve printing presses are already working overtime. It is tragic that one has to visit the Klamath Basin to dispel the images of ecological abuse portrayed in the media and thus understand what is at stake in all this nonsense.

I also heard that logging was again referenced as a scapegoat for the problems of the Klamath River. The timber industry in the Klamath Basin in California has almost been extirpated since the spotted owl issue came to town. Siskiyou County is the 5th largest of California's 58 counties, and we have never been less than the 3rd largest timber producing County annually and often have been Number 1. There is now not a single board sawn in our County. We have two veneer mills but no one is sawing any boards. There are a handful of logging contractors left struggling to survive. The sediment alluded to in all the finger pointing on the dams is a relic of long bygone days. Timber harvest regulations in coho salmon watersheds in California are so strict that the season is so short that it is almost impossible to retain skilled employees. At least in a few locations the ground does freeze and some winter operations can take place. That is if the snowfall is not too severe and the haul roads freeze or are rocked.

What sediment issues that do exist and are tied to logging are legacy issues. The culprits are almost exclusively roads on USFS land, because the Forest Service can't log to pay for the infrastructure investment required by redesigning roads, resizing culverts, rocking roads, etc. This past summer, over 200,000 acres have burned in Siskiyou County, probably greater than 30% catastrophically. The

USFS has been told by local environmental groups that, "You won't salvage a stick!" because they will appeal and litigate until all value is lost. Being continuously victimized by such ideological demagoguery and senseless waste, it should be obvious that the Klamath National Forest's ability to generate any funding for infrastructure through timber projects is non-existent.

And this is logging's problem? Just like nature but exponentially faster, industries change and adapt. The forestry and wood products industries of today have experienced a similar evolution in technology over the past 30 years as has happened in the computer industry. But still, we hear the hue and cry of days gone by....

As to the $100+ million on permitting and $100+ million in fish ladder mitigation that was mentioned as an argument as to why decommissioning was the right choice. The analysis and process required by the California Environmental Quality Act (CEQA) for dam removal including the 20,000,000 cubic yards of sediment (perhaps toxic) behind the dams is going to approach the money spent on permitting, so there may be no appreciable savings on "bureaucratic paper." The best solution to mitigation for fish passage has not even been looked at adequately. There is an alternative that connects two creeks (Bogus Creek and Cold Creek) by a short canal that would bypass the three dams that don't have fish ladders and cost far less than the exorbitant figure seized on to make fish passage appear prohibitive.

And, finally, there has been absolutely no credible investigation on what decommissioning is going to cost. There have been some people in the know who are throwing around a figure of $1 billion total. However, virtually nothing official has been done to yield something that would give us the ability to assess feasibility or generate some sort of Cost/Benefit analysis. In other words, the figures being bandied around are not comparing apples to oranges, they are comparing apples to.....nothing!!!!

There is absolutely no denying that mitigation of dam impact is challenging. It may, in fact, be prohibitive and decommissioning the least bad alternative. At this point, however, the Powers-That-Be have decreed that America shall experiment with dam decommissioning in an effort to set America's rivers "free." And the Klamath River has been selected as the guinea pig. Viewed in the light of experimentation, our area probably is the best place to try this idea out. No large urban populations, with money, lawyers and political horsepower to combat the iniquity. No one here but us poor people, and damn few of us to boot (read: the local uproar is manageable). And the watershed is probably in excess of 60% federal ownership. For good or ill, Siskiyou County will almost inevitably be the poster child of America's return to "wild" rivers.

So, this whole thing is fraught with political hardball, uncertainty and hardship. Portraying it as anything less is irresponsible. But then again, personal responsibility has been vanishing from the American character at an alarming rate since my generation (Baby Boomers) came of age... .

26 Feb 2010, 2:54pm
by Leo "T" Bergeron

A great piece, could not have done it any better myself!!!!!! My hat is off to Mr. Costales.

The shame of it all is that the supporters of this movement to remove these dams are stupid. They accept fantasy and hype for facts and feel good about it. Get real, check it out!!!!!!!

*name

Outline for Todd Neeley meeting 5/18/11 by the Siskiyou County Water Users Association

- Overview of KBRA –

- 1820s to 1850s. Explorers such as Ogden, Abbott, Kroeber, and Freemont documented references to the upper Klamath Basin as a difficult region for both them and Indian tribes to survive having extensive marshlands of contaminated non potable warm odorous waters conducive to disease. Statements to them by tribes was that anadromous salmon were not known above the current Keno (Spencer Creek/Copco dam) area.

- 1850s to 1880s. Gradual 'settlement' of upper basin region contended with difficulties of extremes of climate and environmental conditions and investigated options to optimize and stabilize those conditions. Chronicles were written by authors such as Gibbs regarding lower Klamath conditions, its naturally extremely poor river water quality, diseased condition of salmon, and the lower Klamath Indian built fish dams blocking the river to trap migrating salmon.

- 1890s to 1920s. Studies such as those by Evermann, Lietretz, and Boyle documented conditions and supported the movement by locals in conjunction with Bureau of Reclamation to consolidate marsh waters to reduce contamination which reduced high volcanic phosphorous absorption, expose inundated areas as productive agricultural lands using a fraction of the previous water lost to percolation and evaporation, assure waterfowl refuge area with reliable forage from surrounding agricultural production, and use that saved previously closed basin water plus man-made accessible water storage from the Upper Klamath Lake to augment flows in the Klamath River frequently going subsurface in the canyon below in late summer before the Project. Electricity to support the Project pumping was to be supplied at cost by agreement with Siskiyou Power Company (later Copco) in exchange for the advantage of increased summer water flows making generation feasible. A hatchery at Fall Creek was built at the time to supplement the few affected salmon habitat areas immediately above Copco Lake. The Project was considered extremely successful on all counts. Copco Lake comprised a fraction of the surface area with much deeper and colder water provision than the shallow (0 – 6 feet deep) much larger warm bodied Upper Klamath Lake immediately above, and sequestered much of the nutrients natural to it. Many of the greatest salmon runs occurred long after dams were in place.

- 1930s to 1960s. Concern over sudden salmon decline in the late 30s was determined due to gill netting by Yurok on the lower Klamath which was curtailed resulting in salmon numbers rebounding. The Klamath Tribe sold their reservation, petitioned to have it given back, only to sell it again. During this time and with little opposition, Government agencies were known to have tried several times to eradicate sucker fish in upper basin but failed.
Though locals experienced dams greatly reduced riparian flood damage in the erosion prone upper river, repetitive flood damage still occurred due to yet insufficient storage capacity to fully moderate incoming flows. Locals supported addition of Iron Gate Dam immediately below Copco to give added capacity to

moderate the spring floodwaters, summer John Boyle pulses, and help with late summer Klamath flows. Locals below the dam saw tremendous success and improvement in riparian stability, water quality and flows. In sequestering naturally high nutrients, the far more consistent late summer flows below the dams also saw far less periphyton (moss, algae, and aquatic plants harboring indigenous polychaete worm hosting Ceratomyxa Shasta salmon parasite). Iron Gate Hatchery was then built to mitigate both the handful of salmon blocked Fish and Game designated 'marginal' habitat creeks and those at Copco formerly mitigated by Fall Creek Hatchery. Much 'colder than natural' lower lake water as a result of the dam allowed one of the most productive hatcheries in the state. The region realized improved separated fisheries both above and below the dam. The benefits on all counts were hailed for decades as a tremendous unquestioned success, all managed under the openly negotiated equally based legislated into law Klamath Basin Compact.

- 1970s to 1990s. Environmentalists take aim with an agenda focused on the Klamath region where mining, timber, and agriculture formed the ongoing economic base of a relatively stable community living closely with their environment. With mining the smallest fraction due to increasing impediments on state and federal lands comprising over 60% of regional property, mining was shut down through lawsuits and fear driven by media highlighting any 'abuses' as the norm. Agenda implementing environmentalists later funded operatives, such as Felice Pace founding the Klamath Forest Alliance, to shut down logging through repetitive lawsuits using the locally known and subsequently proven fabrication of spotted owl 'declines' in a region based upon sustainable harvest for nearly one hundred years. Effectively destroying that industry devastated those unheeded regional people who stated that forest harvest management shutdown would see their precious environment and timber resources lost to repetitive cycles of burning brush. (30 years of unmanaged fuel growth later in a county still economically reeling have seen surviving residents lose precious forests, homes, and sustainable environment to uncontrollable massive fires. Those fires have likely caused far greater massive killing of species, erosion, sedimentation, contaminated water and air pollution than any 'human caused' impacts. In spite of a study confirming that increased wildfires are primarily due to forest shutdowns, environmentalists now simply claim the destruction is 'good for the environment' and the fault of nonexistent regional 'climate change' and 'prior forest management' curtailed over 30 years earlier. Those and additional personally benefiting 'environmental' groups now with even greater funding have simply moved their broken prior promises of benefit 'to the mouth of the Klamath' as their 'next step' lucrative cause).

In the late 1970s, after a armed and media supported standoff with Yurok Tribes when Fish and Game attempted to enforce laws against their renewed illegal gill netting and commercial salmon take on the Klamath, secret negotiations were conducted and 'legal decisions' resulting in Department of Fish and Game backing off enforcement and 'aligning' with and funding 'environmental' Tribal interests. (The renewal of extensive and unregulated salmon gill netting banned since the 1930s, perhaps coincidentally, coincides with the recent 'decline' in Klamath salmon in an ecosystem remaining virtually unchanged except for decreased human impacts over the prior hundred years). In 1991 many of those Agencies, groups, and Tribes created the Dept of Interior's 'Long Range Klamath Plan' setting the assumptions and format for dams' removals and resource reallocation using the then pending FERC

Klamath Dam's relicensing. (In the first dams' relicensing event 50 years prior, approval was easily made as many of the regional residents familiar with the pre and post Project Klamath conditions were still alive). Dams were constructed to enhance the environment and water quality as well as create farmland from reclaimed naturally contaminated marshes, which proved very successful. Prior to the Project, naturally occurring mercury was panned from the marsh banks and often toxic geothermal springs were used to heat Klamath Falls. However, the pending Dams' relicensing by FERC was seen as opportunity by environmentalists/media/government agencies to force a precedent resource and asset reallocation agenda upon the region's area and people using Pacific Power's (PP&L) coerced 'cooperation'.

Funded by Interior and Environmentallsts, Klamath Tribes filed constant litigation against ag for 'water rights' sold along with their reservation, seeking to once again restore the reservation and have authority over water usage. Karuk and Yurok Tribes filed lawsuits suddenly claiming 'impacts' to Klamath water 160 miles downstream from dams accounting for less than 15% of the water below.

National Marine Fisheries launched a campaign to both obtain ostensible takeover of 600 feet (300 feet on either side) of every stream and river in the Klamath Basin, along with 'authority' over every square foot of ground that drains into any stream or river, based upon constructed 'threatened' salmon status. Under their 'review', 1996 studies showing protected compounded predation of up to 80% salmon stocks, exponential international ocean harvesting of 2 million tons, and cyclical ocean conditions, were determined of little impact. However, the less than 2% assessed Trinity 'human impact' and the unquantified but greatly reduced Klamath 'human impacts' compared to those existing during claimed historical 'salmon runs' were considered 'unacceptable'. Their overstepping position and illegal basis eventually resulted in withdraw of the 600 foot taking, but effective oversight of all ground was assumed. NMFS (aka NOAH) was a federal lead on the 'Long Range Klamath Plan' and a seated member of the subsequent KBRA.

At the same time, the Scott Valley in Siskiyou County was targeted by ESA driven CA Fish and Game and CA Water Quality TMDL (Total Maximum Daily Loads) 'research and recommendation' programs. Seeing the pending massive expansion of regulatory intent, locals responded with showing their voluntary initiatives already taken and continuing through locally created Resource Conservation Districts. Claiming benign 'cooperation' and offering funding through RCDs to 'aid' in 'projects' and staffing, RCDs soon became an enforcement arm of the two agencies dependent upon funds for operation and later agency determined 'necessary' projects.

- 2001 - Pushed by environmentalists and the Klamath Tribe asserting water control, the agencies required 'shutdown' of upper Klamath Basin ag water to 'save' sucker fish by raising lake levels, claiming suckers were 'endangered' and facing imminent extinction. Locals said if they wanted to benefit suckers, raising water was the worst thing to do and they rather should lower water levels to allow suckers their natural competitive advantage. Unheeded, over 1200 of those homes, lives, and futures were lost. Only 8 years later did Fish and Wildlife acknowledge that they knew little about suckers and were now spending taxpayer millions to build a hatchery to 'study' sucker needs. It also was discovered

that the 'endangered numbers' were intentionally or incompetently flawed and there were actually many times more suckers than cited for 'endangered' status.

At same time, Bruce Babbitt working in conjunction with a group formed under the World Wildlife Fund created the Soda Mountain Monument originally slated to include portions of southern central Oregon and extending into California to the Klamath River east of Interstate-5, but after much opposition the monument was retracted back to the Oregon border before executed by executive order of Clinton. The following year BLM attempted to 'expand' their California 'Horseshoe Ranch' to encompass the same exact previously intended California Soda Mountain Monument territory, stating their sudden 'need to preserve the biodiverse region'. Only after additional extensive opposition exposing falsified documents and failed 'Horseshoe Ranch' mandates, BLM withdrew the proposal. In 2010 secret documents were leaked of Interior Salazar's plan to create many new monuments by executive order including the 'Siskiyou Cascade Monument', effectively greatly expanding the current monument encompassing an area west of I-5 to the coast range and from well within Southern Oregon south to the Klamath River. The secret papers also included the 'extension' of the Soda Mountain Monument to once again include the area south of the Oregon border to the Klamath River. That fully developed 'unacknowledged' document is currently engendering opposition but remains pending, during which time Salazar released his 2011 'changes' to Interior's mandates defining himself the power to 'administer' lands in a new direction 'for the people' and creating a new 'designation' of regions 'requiring protection' as 'Wildlands', which as of this writing is pending.

- 2002 – Occasionally happening throughout Klamath history, a combination occurred of a salmon run concurrent with high day and night temperatures in the lower Klamath. A salmon kill happened nearly 160 miles downstream from the dams. Initially reported as 13,000 fish in a specific stretch of river, over the years those 'most massive fish kill' numbers have escalated to over 80,000 reported in media and rhetoric, with most unsupported 'generous' formal accounts actually estimating it at around 33,000. A known methamphetamine dump had also occurred immediately above and just prior to the kill but the kill was well over by the time water was tested. In spite of the incessant media repeated 2002 farmer caused low flow 'salmon kill' rhetoric, reports seldom include the fact that the run still realized one of the best overall returns, and the National Research Council found it not a result of upper Klamath water releases. In fact, the flows at the Klamath dams had long been kept unnaturally high at the time of the kill.

Using money from international environmental groups and 'grants' from Dept of Interior's BIA and Federal and State Environmental agencies, select profiting tribes and NGOs (non-governmental organizations) supplied 'directed' studies and 'mitigation wish lists' often unrelated to dams' operation, to FERC pushing to make PP&L operation conditions economically unfeasible while simultaneously filing repeated litigations against PP&L for 'water quality impairment'. FERC accepted those 'mitigation recommendations' rejecting all other alternatives and thereby proposed 6 extortive 'relicensing' options with only 2 being remotely economically feasible short of dams' removals including the one

'recommended' at PPL breakeven at best and one at substantial PPL loss compelling 'economic' decision.

Coincident with Agencies' 'scoping' and permit revisions, the Karuk Council launched a grant funded public media campaign with NGOs alleging 'toxicity' from dams without a single reported health related case occurring in a hundred years of existence, but nonetheless filing litigations, media campaigns, and 'posting' the lakes and Klamath in conjunction with Water Quality and CDC and against local county findings. A subsequent CDC 'study', while spending the vast majority of its report on the potential 'dangers' of microcystin, could report no found evidence of health impairment.

To bypass the well functioning 50+ year legislated and equally based Klamath Basin Compact, the majority of those same described players including Federal and State agencies/tribes/environmental groups orchestrated the 'KBRA' (Klamath Basin Restoration Agreement) secret meetings requiring agreement to dams removals and the taking and reallocation of assets to sit at the table. To bring agriculture beleaguered by ESA and environmentalist litigation to the table, a promise was made of 'consensus agreements' and 'assurance of water' to seated agriculture in exchange for publically supporting requirement of dams' removals and a new hierarchy (federal, state, environmentalist taking of resources for 'fish first', tribes second, seated agriculture 3rd, and the Klamath Wildlife Refuge fourth, later to change placing Refuge 3rd and ag 4th) A number of upper basin ag districts attended but upon exposed KBRA corruption, broken promises of 'consensus', Board manipulation, and the obvious intent for attrition of majority agriculture, most could not accept conditions they knew would be destructive to the environment and region. Given preferential position, the KWUA (Klamath Water Users Association) and TID (Tule Lake Irrigation District in California) agreed to publically 'represent' agriculture. Actually representing less than 10% of agriculture, that effectively made the vast majority of ag unrepresented and intentionally subject to indeterminate shutdowns. The self created KBRA terms enjoy a self appointed Board, will have legislated charted 50 years of funding (a minimum of 2 billion dollars initially, one before dam removals and one after), and protected unaccountable authority with the only recourse of affected individuals being 'presentation' of their 'grievance' to the Council. Not requiring their own decisions to be successful, scientifically supported, or historically proven, they grant themselves (26 benefitting special interest groups at signing) the right to unhindered 'adaptive management' without consequence.

Several of the lead seated federal agencies (BOR, Fish and Wildlife, etc) instrumental in creating the KBRA are under direction of the Secretary of Interior (then Kempthorne). Upon that preconditioned exclusionary KBRA creation in secret, the Secretary of Interior also created and administered the AIP (Agreement In Principle) (later called KHSA – Klamath Hydroelectric Settlement Agreement). Held in the same exclusionary Interior mandated secrecy as the KBRA, seating was allowed only to those accepting all terms and dams removal objective coercing PPL 'cooperation'. Governors Kulongoski and Schwarzenegger seeking environmental political standing included the complying threat and benefits of the resident States.

Further 'prompting' PPL, CA Water Quality suddenly 'decided' to revise long standing CEQA 401 permitting 'standards' ignoring 'public input' to make 'lake' water unacceptable and effectively eliminating the only 'break-even' option allowed under the closed FERC Report. In addition to threat of 401 permit refusal demanding dam removals and the promise of continued 'litigation liability' if 'negotiations' failed, both of which are legislated away if PP&L 'cooperates', Interior also offered PP&L extensive financial concessions placed upon the unrepresented backs of ratepayers and the regionally affected majority. Presenting PP&L with absolutely no viable alternatives, a great many far less costly of which have been presented throughout the entire 'process' and rejected out of hand, Interior and other KBRA seated members now pontificate to the public how they support Pacific Power's right to make a 'business decision' in its best economic interest

Upon 'signing' of the KHSA and adopting the absolutely least estimated cost of dams' removals of close to half a billion (see CDM Report), a 'proposal' was sponsored by Oregon Governor Kulongoski for SB 76 legislated ratepayer bypass of PUC funding paying not only the 'capped' portion for dams' removals but also the 'unreported' majority of KHSA PP&L 'concessions' and 'mitigations'. SB 76 senate committee, ignoring much public input against, still passed 'in support of a politically expeditious agreement', but only after undisclosed behind closed door concessions to the Oregon Manufacturers as the only powerful and well funded entity in opposition apparently warranting political concern.

With KBRA projections of a taxpayer funded minimum 2 billion dollars to be funneled through the seated members, the Secretary of Interior presented the already signed KHSA 'agreement' for 'public process' 'administered' by his own agency (USGS) and aiming for eventual 'congressional approval'. 'Studies' to be 'reviewed' by USGS for 'recommendation' still leaves the ultimate 'determination' to be made by the Secretary alone. His terms mandate only 'fisheries', and 'in his opinion', whether removals would 'harm' salmon and suckers, and whether 'in his opinion' it would be in the best 'public interest', 'considering but not limited to regional impacts'. While the Secretary and KHSA acknowledged KHSA/KBRA being intrinsically tied together and the intention for KBRA to be also implemented upon 'approval' of KHSA' under limited KHSA 'review' criteria, the KBRA 'agreement' is not directly being 'assessed' for legality, self appointed authority, Constitutional compliance, equity, or consequence for damages to community and environment beyond any 'actual harm' to salmon and sucker fish. Interestingly, the KHSA validates the KBRA requiring dams' removals and the associated asset reallocations and hierarchy overriding the Klamath Basin Compact, regardless of final Secretarial 'determination' concerning dams' removals. In the unlikely event the Secretary instrumental in creating the prerequisite of dams' removals would find against dams' removals, the exorbitant ratepayer/taxpayer costs would still be incurred by requiring implementation of KBRA seated member 'wish lists' demanded under the closed FERC relicensing requirements.

In the meantime CA Water Quality staff working with 'memorandums of understanding' are creating mutually compatible TMDLs reinforcing KBRA reallocating positions. Catherine Kuhlman, head of North Coast Regional Water Quality and also simultaneous employee of US EPA stated her intention in public to see the Klamath dams removed long before research had been assigned or 'scoping' performed. The original 'research and recommendation' begun by North Coast Regional Water Quality in Scott Valley

TMDLs was transformed by them into 40 years of unaccountable judicial enforcement under the 'progressive' Shasta Valley TMDL, with those authorities made retroactive to the Scott. The Klamath TMDL now being finalized expands Shasta TMDL unaccountable subjective authority and self determined requirements and fees to include even greater restrictions and KBRA 'MOU' agreements, making all retroactive to the Shasta and Scott.

Also, CA Department of Fish and Game (DFG), as a seated KBRA creating 'member' independently launched their drastically onerous newly 'interpreted' 1602 and created ITP (Incidental Take Permit) requirements, along with a DFG proposed legislated passage of 'agencies' ability to charge 'permitees' for generating a 'fully funded budget'. After a group exposed DFG's illegal threats, intimidation, and abuses used in attempting implementation of 1602 'permits', DFG publically replaced the regional head, Mark Stopher identified as responsible. In spite of that proven abuse, Mark Stopher was and continues to be the lead 'creator' and seated negotiator for the State of California on both the KBRA/KHSA 'agreements'. His then 'assistant', Neil Manjii, stepped into his '1602' public position, with a recent judicial decree that the permits aren't restrictive enough and to virtually ignore private property rights. Throughout this time, DFG has practiced killing of <u>all</u> hatchery harvested marked and unmarked returning coho and Chinook salmon known able to spawn instream, have routinely 'marked' salmon by clipping off the upper jawbone greatly reducing survivability, and have required 'diversion removals' increasing temperature, destroying refugia, and reducing salmon populations. Agencies working with NGOs are coercing 'purchases' of primary water rights throughout the region, and the demanding those unused water rights normally available to downstream users be untouchable as 'environmental' water. Claiming purchases such as the Big Springs Ranch in Montague would 'relieve' ranchers from increasing fisheries' burdens, shortly after the Big Springs purchase a call was made to extend 'habitat' designation well above Dwinell Dam.

NMFS, a seated founding KBRA lead, is the primary responsible agency requiring unnaturally high flows down the Klamath for over 10 years resulting in severe manmade water shortages and human hardship and loss with <u>no</u> corresponding statistical salmon improvement. In 2011, NMFS newly demanded even <u>greater</u> suddenly increased life and property threatening flows with virtually no public warning to flush 'disease carrying periphyton' exclusively for the area immediately below the dams. Insanely, there was almost no periphyton prior to the flush in that reach which another study recently found to have the highest salmon survivability in the Klamath from the dams to the coast range a hundred miles downstream. That continued unsustainable release will likely create future precedent oppression in the upper basin beyond one of the greatest snowpack years on record. All agencies and members of the KBRA hailed the action as an example of the 'cooperation' attained under the terms of the KBRA (which by law should have no legal authority at the time).

Throughout this entire so called 'process', the Shasta Tribe in opposition to removal of dams within aboriginal ground have been completely shut out. Against the loss of improvements to environment, loss of clean power, and the exposing of now underwater burial sites, their ignored pleas under the KBRA terms instead divide 'fishing rights' between seated Klamath and Karuk Tribes to aboriginal grounds they historically never held. In effect, the Shasta culture is being erased by KBRA special interest decree.

The majority of above regulatory actions and 'requirements' are based upon the 'determination' that the indistinguishable DNA identical hatchery spawned salmon are 'different' from so called 'wild stocks', thus artificially creating a 'threatened' species. It is well proven that a large percentage of hatchery spawned salmon as well as salmon from other watersheds repopulate the Klamath mainstem and tributaries and are indistinguishable from, and counted as, 'wild' stocks. In fact, coho salmon were never known native to the upper mid stem Klamath and failed attempts at planting coho had occurred since the 1800's. Only after 3 additional attempts under the improved Klamath conditions from Iron Gate was the 3rd attempt considered marginally successful using Cascadia stocks and from which returns the 'threatened' coho status is based. With Klamath DNA identical hatchery salmon mitigating natural cycles and human harvest since the late 1800s, a large portion of 'justification' from benefitting interests demanding 'dams removals' is to eliminate hatcheries and hatchery spawned salmon from the 'gene pool'. Hypocritically, it is anticipated by the same promoting groups that dams' removals will likely extirpate all indigenous salmon from the Klamath which can only be replaced years later by hatchery reared stocks. With removal of Iron Gate dam providing the 'unnaturally' cold water allowing successful hatchery operation, the KHSA imposes upon unrepresented PP&L ratepayers, among a multitude of other costs, the burden of 'providing alternate cold water' not known to exist in the area or constructing an entire hatchery elsewhere.

With contradictory 'cold water' salmon upper basin 'warm water' sucker fisheries being the only two considered, all other world class local fisheries upon dams' removals stand a high chance of extirpation, such as the bass and brown trout, through competition, predation, habitat alteration, and introduction of disease.

Recent studies (ie 2008 Columbia Sockeye Salmon Study) confirm that 'riparian conditions' have had virtually no effect upon returning salmon populations, but are rather an effect of ocean conditions. While likely cyclic increased ocean temperatures have driven much salmon habitat northward, Pacific fisheries' harvests are over 250% greater than in the 1950s. With virtually all Klamath Basin 'human impacts' tremendously reduced over the past hundred years, the only recent 'significant' changes have been international offshore fishing, shifting ocean conditions, exponentially increased protected species' salmon predation, and resumed Tribal gill netting. With those being the only significant quantitative increases during claims of salmon decline, then maintaining an optimized hatchery augmented population is the only reasonable way to assure sustainable returns.

Funded rhetoric is assuring residents of governmental competence and financial benefit from future 'environmental money' 'offsetting' regional financial devastation and uncompensated asset reallocation. However, that 'competence' is frequently regionally revealed as in the recent spending of over 4 million taxpayer dollars to build 3 'islands' in the upper Klamath Basin. In an area being ravaged to create historically non-existent habitat for salmon, the islands were built to transplant tens of thousands of Caspian terns from the Columbia River. The 'reason' for transplant is due to the severe pressure on the Columbia fisheries from the terns consuming millions of salmon smolts. The local 'economic benefit' of those contracted Agency administered funds was the temporary hiring of 4 resident laborers and 'attendance at a charity BBQ'. Dams' removal and 'mitigation' contracts will produce the same results, particularly since funding is 'only' to be provided correcting damages affecting salmon or sucker fish.

Even before being completed or determined legal, the unrepresented Pacific Power ratepayers are already being burdened with KHSA 'agreed' tremendous cost increases just beginning to be imposed for 'mitigations' often totally unrelated to PP&L operation. Due to just the possibility of dams' removals and the locally known consequential regression to environment and property rights, property values along the Klamath have already plummeted far beyond the current real estate downturn with properties by the lakes being virtually unsalable at any price, causing many to suffer the loss of their homes. Obvious opposition, in the face of well funded rhetoric claiming otherwise, prompted a vote in Siskiyou County to determine the opinion of people whose region maintains 3 of the 4 dams proposed for removal. With virtually no money to fund opposition and tens of thousands of outside dollars promoting 'jobs for removals' in an economically distressed county, nearly 80% voted against dams' removals. Concurrently in Klamath County unaffected by the dams a vote was held to determine simply whether the county should remain at the then yet unfinished KBRA table. Reportedly hundreds of thousands of dollars were directed at the public also promising many jobs and a 'final agreement benefitting all'. Even with that campaign and vague directive, the vote was barely a majority to continue sitting at the table. Interestingly, the money funding the promotion in both counties was from California Trout, deriving a portion of its funds from Ca Department of Fish and Game, and a 'formed for the purpose' group called PROSPER, who though not publically disclosed were found to be formed of several seated KBRA benefitting members, with funding appearing to involve agency and NGO grant monies targeted for 'education'.

In spite of current science refuting KBRA oppressive failed theory basis and many ignored far less expensive and more effective presented alternatives, as of now the KBRA/KHSA creators are already implementing the previously failed 'agreement' 'policies'. By mutual agreement carried on in contradiction to the legally established Klamath Compact authority while waiting for the Secretary to 'objectively determine' approval of the plan and the objectives he was instrumental in creating, those policies even now being implemented are proving the progression towards inevitable elimination of the vested majority. Escalating power costs, decreasing property values, uncertain water for the 90% unrepresented ag, insurmountable permits/EIR/fees to pay for increasing agencies and programs and time delays incurred, vacillating 'adaptive management' requirements, and the inability to make timely, responsive, experienced, and knowledgeable decisions regarding vested interests upon which quality of life and environment depend, can only lead to eventual attrition for all but the unaccountable seated few, the wealthy, and corporate agriculture able to pass on uncertainties and increased costs to the public.

Conclusion: Klamath history was historically worse pre project, salmon were never known in numbers above Spencer Creek (in the vicinity of Copco), the Klamath Project and Dams were in place for nearly a hundred years and considered extremely successful and beneficial for all uses including fisheries until 'dams effects' claims of arguable recent salmon 'decline'. Regional 'human impacts' during this 'decline' are a mere fraction of what they were during the often repeated 'huge salmon runs' with many of the greatest runs actually occurring long after dams were in place, Half a billion dollars in 'restoration' based on asset reallocation 'theories' over the last 20 years have produced 0 statistical benefits and increased declines. Increased Klamath River flows for over 10 years for salmon have resulted in 0 statistical benefits and increased declines. Sucker fish 'estimates' justifying 'endangered' status were fabricated and later discovered faulty with no change in authoritative designation (Vogel). Higher Upper Klamath Lake levels occurring for 10 years at tremendous loss to the regional community has resulted in 0 statistical sucker fish benefit. The KBRA is advancing those failed theories and historically unattainable goals into unaccountable chartered 50 year 2 billion dollar funded authority, 'governed' by a minority of self appointed special interests. Their rules leave little recourse to the unrepresented affected majority in opposition. The grossly minimized stated costs (see CDM Report) of dams' removals to assure public and congressional acceptance places that understated burden on the unrepresented taxpayer/ratepayers/region landowners and guarantees underfunded environmental Klamath disaster and unattainable KBRA/Agencies' goals. Unattained goals will greatly escalate already devastating regulatory oppression. KBRA protected special interest minority mandates accelerated by the likely 'determination' for dams' removals carries no assurances and has less than zero history of success posing tremendous potential for environmental unrecoverable disaster.

Under current KBRA/KHSA terms it is those seated on the KBRA, corporate agriculture picking up prime lands for cents on the dollar, and NGOs 'administering' acquired remaining lands, who will profit mightily.

TMDLs, 1602s, ITPs, 401s and many more interrelated requirements implement costly already regionally failed boilerplate mandates eliminating the input and judgment of the experienced vested knowledgeable in the region suffering the greatest consequence of decisions. Subjective and arbitrary 'adaptive management' requirements by all of the Agencies involved assessing self supporting fees and EIRs to force an unattainable 'agenda' will destroy the very environment and peoples which support them. Those conditions have already cost the lives, homes and futures of many, and unless stopped now, will invariably cause the attrition of most of us here today.

PETITION

CLASS ACTION LAWSUIT

We the undersigned hereby declare our support to carry out a Class Action lawsuit for recovery of funds which have been taken from us against our will by actions of PacifiCorp and the California Public Utilities Commission for the removal of the Klamath Dams providing clean hydropower to Siskiyou and other northern California counties. A referendum known as Measure G was approved by nearly 80% of Siskiyou voters to keep the Klamath Dams in place. Yet, a cabal of State and Federal Agencies, various Tribal groups together with a number of so called environmental groups have conspired to destroy the Klamath Dams no matter the environmental damage to the eco system, to ranchers, farmers, businesses and the general populace. Removal of the dams amounts to a substantial threat to the health, safety and welfare of our area.

These same parties as part of a newly revised KHSA agreement are now trying to remove all potential liability to themselves and their cohorts by creating a third party shadow group to be called the Dam Removal Entity, a faceless group in New York City being given title to the dams with a requirement to destroy them. In addition the DRE is being given the money held in trust collected from the consumers of PacifiCorp together with a promise of TWO HUNDRED FIFTY MILLION DOLLARS ($250,000,000) of taxpayer money. No regard is being given to the ultimate destruction that will result to the Klamath River or those who depend on it. The U.S. Department of Interior has attested in the EIR EIS to significant damage to the eco system that will result from removal of the hydropower facilities. No one can assure the return of the Klamath or its fish to its natural beauty. It is our belief that damage in Siskiyou County alone may exceed ONE BILLION DOLLARS ($1,000,000,000). We are therefore advocating that a bond in the amount of FIVE BILLION DOLLARS ($5,000,000,000) be created by the State of California and PacifiCorp to be held by a neutral third party naming the County of Siskiyou and its citizens and PacifiCorp consumers as beneficiaries of said bond. In addition should damage occur the perpetrators of the amended KHSA shall be held accountable jointly and severally for damage to the eco system, businesses and land value impacts.

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RICHARD K. MASON		21236 AGER BESWICK CA 96064	"
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Pamela Andrews	Pamela Andrews	5029 Hartford Rd Etna 96027	467-3727
Jim Frisbee	Jim Frisbee	POB 277 Greenview	468-5385
Rodney J. Sheldon	Rodney J. Sheldon	P.O. Box 172 Greenville, Ca 96037	468-2168
Lee Gish	Lee Gish	Box 145 Greenview, Ca	925-9067
Cicely Muelrath	Cicely Muelrath	9410 Azalea Dr Etna, Ca-96027	(530) 905-2036
Paul Muelrath	Paul Muelrath	9410 Azalea Dr. Etna, Ca. 96027	(530) 905-0710
Christopher Muelrath	Christopher Muelrath	9410 Azalea DR Etna Ca 96027	(530) 467-3356
CHERYL HENDER	Cheryl Hender	PO Box 206 Greenview, CA	530-598-8076
Donald P Gutherie	Donald P Gutherie	15432 Valley Rd 96037	468-2066
Diane Olson	Diane Olson	B471 Forest Lane Etna	530-598-2781
Ken Johnson		PO Box 876 Fort Jones CA	562-458-2214
Peggy Arton	Peggy Arton	890 Sawyers Bar RD Etna, CA	530-467-3762
Elida Pelayo	Elida Pelayo	P.O Box 818 Etna, C.A 96027	530-905-2316
Tani Duerr	Tani Duerr	P.O. Box 88 Greenview CA 96037	530-468-2869
Joe Duerr	Joe Duerr	P.O. Box 88 Greenview CA 96037	530-468-2869
Isobel Anderson	Isobel Anderson	PO BOX 179 Etna, CA 96027	949-351-4546
Deborah Jacobsen	Deborah Jacobsen	14123 Quartz Valley Fort Jones, Ca	530-468-2868
T Downey	T Downey		5706432244
D A Rego	D A Rego	10938 Quartz Valley Rd Fort Jones	530 468 2822
John Anderson	John Anderson	PO Box 5 Greenview CA	530 468 4033
LEE Johnson		13327 Dangel Ln. Ft Jones Ca	530-598-2855
KEVIN GOSS		4930 Cy Rd Fort Jones 96032	530 227 1783

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Lisa Hayden	Lisa Hayden	4901 NHW 43	530 467 3034
Mark Johnson	Mark Johnson	4722 - Scott Valley Rd	Etna Co.
Margaret Johnson	Margaret Johnson	460 Scott Valley Rd	Etna Ca 530-598-4508
Charles Kelly	Charles Kelly	Box 28	Greenview, CA 96037
Heather Whitchurch	Heather Whitchurch	4121 French Creek Etna	530-598-0796
Bridgette Crews	Bridgette Crews	521 Sturgeon Etna	530-467-5925
Bill Parry	Bill Parry	424 Main Dr Etna	530-598-5983
Dennis Thomas	Dennis Thomas	613 Yreka Ty Yreka CA	530-310-4489
Roy Besosin	Roy Besosin	424 Kidder Ck	—
Wm Wise	Wm Wise	1535 Shasta View dr	5419731657
Kaydee Watkins	Kaydee Watkins	Etna Ca	—
Nick Kraus	Nick Kraus	Po. Box 1086 Fortuna	(530) 598-1857
Jeremy Ravenscroft	Jeremy Ravenscroft	9100 Belgian Ln. Ft. Jones	(530) 510-1770
James Kurtz	James Kurtz	5447 Scott Rv	530 340-2670
Jarrett Airhart	Jarrett Airhart	3622 North Kidder	530(410) 7042
CAEG PETTIS	Craig Pettis	763 S Weed Blvd	801-691-3423
GREG LEITNER	Greg Leitner	240 STARROS RD #60	(530) 340-2718
ALAN LABRIERE	Alan Labriere	10409 QUARTZ MT. LO RD	4682925
Mary STREETER	Mary Streeter	10409 Quartz Hill	468-0945
CAROL SILICZ	Carol Silicz	415 Dale Etna	916-645-8893
Gordon Thomas	Gordon Thomas	1837 Sawyers Bar Rd	530-467-5727
RICK Gephart	Rick Gephart	9521 ORO Fino Rd	530 598 0948
BARBARA EASTLICK	Barbara Eastlick	12070 OAK MILL DR	530 905 2763

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Theresa Naylor		Etna 96027 4210 Scott Valley Rd	
William Lampert Jr		12717 Dangel Ln Ft. Jones Ca 96032	468-2894
Gary Kooyman		840 Buyan	598-4349
Robert Cousineau		No 1309 CST Greenview 96037	469-3059
Kyle Cousineau		104 Scott St Etna Ca	5305982076
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Jodi King		Etna	467-5639
Tammy McEwen		319 Island Rd Etna Ca	467-3350
Jay Love		bedrock	295-5205
Elizabeth Lockhart		11708 Quartz Valley Rd Ft J	8508303303

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William Brandon	William Brandon	P.O Box 371 Fort Jones	530-340-7098
JESSICA CUDZILO		337 Callahan St	530-566-5609
Dylan Berryhill	Dylan Berryhill	6917 Myrtle St	598-9612
Edward Patrick Johnson	Edward Patrick Johnson	400 High Street Fort Jones CA 96032	(530)598-2566
	PETE MORRILL	2006 SOUTH KIDDER CREEK RD GREENVIEW	570 598-1527
Michael MARTIN		4001 S.V. Rd. Etna	467-5174
CAROL MUNSON	Carol Munson	HORSE Creek, CA 30130 WALKER RD	530-598-2992
Shirley Gilmore	Shirley Gilmore	530 McKeen Rd CALLAHAN CA	530-467-3620
Karen Gilmore	Karen Gilmore	715 South Fork Rd Callahan CA 96014	530-467-5681
Rhonna Sanders	Rhonna Sanders	535 Main Street Etna CA	530-65-2829
Antonia Ryder	Antonia Ryder	9015 Quartz Rm Rd	530-468-5326
Tina BUCHTER	Tina Buchter	401 Mtn. View Rd Greenview	468-2083
Dennis Jervey	Dennis Jervey	6904 Shackleford LN	468-4758
Trevor Dunay	Trevor Dunay	14447 McAdams Cr Rd Ft Jones CA	468-2789
Linda M. Berry	Linda M Berry	6928 Main St. Greenview	468-5385
Anne Bradley	Anne Bradley	15432 Otter Valley FJ	468 2066
John Bauer	John N Bauer	1907 Sawyers Bar Rd ETNA	530 467 4237
RANDALL HABERMAN		5728 SCOTT RIVER RD	FORT JONES 530 598 6141
John Mokes		12322 Dwight Way (FJ)	570 643 2491
MIKE WALTERS		5960 NOKES Valley Rd	5304675764

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Todd Nelson		1515 RJ Street	925 301-5454
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DENNIS HOYT		223 HARRISON ETNA	530-467-3969
Ted Knox	Ted Knox	9202 old Eng. Rd F.J.	468-2486
Patty Goss		11930 Quartz Valley Rd	598-0385
Bob LAPOINTE		5309 NTS#3	831-359-1841
Chris Mueller	Chris Mueller		530 598-7831
Alex Vargas			530-468-2541
Karen Paula	Karen Paula	PO Box 263 Greenview, CA	530-468-5263
Sean Tarkington		PO Box 157 96037 Greenview 96037	(501) 318-8414
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Nancy Niles	Nancy Niles	15013 Fernway Fort Jones, CA	530-468-5476
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Willie Monson	Willie Monson	PO 381	530 468-5720
Heather Ford		4017 S.V. Road	530-467-3193

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Charleen Dale	Charleen Dale	Etna	
Darla Miller	Darla Miller	Ft. Jones	468-2238
Beverly Lodge	Beverly Lodge	Fort Jones	— " —
D. A. Ross		Fort Jones	468 2822
Leon Eisley		CV	— " —
Robert Roberts		PO Box 62 Oregon View	468-5636
MARSHA ANDERSON	M L Anderson	11924 MAIN ST FORT JONE CA	530 468 2110
LORI Conklin	Lori Conklin	711 Howell Ave Etna CA	530 467 3760
Donna Willox	Donna Willox	3829 N Hwy 3 ~~ETNA~~, CA	530-598-4526
ANSELMO GARCIA	Anselmo J. Garcia	9525 OLD. ENGLISH. P.O. FORT JONES	530 468 5373.
Jim Balmer	J Bl	4220 White oak ct Etna	530-467-3145
DUANE DOWNIE	Duane V. Downie	371 S. 14th	530-492-9473
Betty Lou Hall	BETTY LOU HALL	468-2387 10736 Quartz Valley Rd	Fort Jones, CA. 96032
Gordon Thomas	Gordon Thomas	1837 Sawyers Bar Rd Etna Ca	530.467.5727

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Keith Wood	Keith Wood	217 North Adams Mt. Shasta CA 96067	530-941-7431
Gene Kutzer	Gene Kutzer	P.O. Box 44 Greenview CA 96037	530 468-5969
ROBERT RODRIGO	Robert Rodrigo	4612 LOCH DR SHASTA LAKE 96019	RODRIGO ROB63@GMAIL.CO
Josh York	Josh York	598-6646	→
Ted Rivers	Ted Rivers	3521 Scala Ln Montague CA	530-261-0659
Logan Rock	Logan Rock	1025 5th Street Yreka OR	541.840-6872
Wilma Kellmer	Wilma Kellmer	354 N. Rock Creek Rd - Greenview, Ca	530-468-2447
Victor Kwasniewski	Victor Kwasniewski	1034 Clapper Rd	Fort Jones 598-8954
Julie McQuoid	Julie McQuoid	4620 Eastside Rd Etna	(530) 467-5379
Herbert Bunker	—	216 Southside Ln	

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Rick Gourley	Rick Gourley	5231 Klamath River Rd Yreka	530-475-3147
Linda Zoller	Linda Zoller	9026 Ager Beswick Montague CA 96064	530-459-5054
Charles Zoller	Charles Zoller	9026 Ager Beswick Montague CA 96064	530-459-5054
Debbie Kulpa	Debbie Kulpa	5339 Klamath River Rd	530-475-3537
Charles D Kulpa	C D Kulpa	5339 Klamath River Rd. Yreka	530-475-3537
Della Frost	Della Frost	917 Ridge	5308420801
Dean Harris	Dean Harris	504 Woodridge Ct	530-859-0758
Mike Adams	Mike Adams	1209 Cleary Maple Horse Cir	530 496 3346
Gerald Benton	Gerald Benton	659 Burke St Yreka	530-842-4426
Dave Somerlot	Dave Somerlot	5334 Agerro	530-459-5358
Della Somerlot	Della Somerlot	Montague 5334 Ager Rd	530-459-5358
Richard Dews	Richard Dews	17033 Darigold Ln Fort Jones Ca	5304682502
Tonya Dews	Tonya Dews	17033 Darigold Ln Fort Jones	
Mary Craddock	Mary Craddock	18800 N Hwy 99 Gazelle, CA 96034	530-435-2306
Alma M Gois	Alma M Gois	25105 Gazelle Callahan Rd Gazelle CA 96034	5303482883
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Dell Grissen	DELWIN GRISSEN	2526 Owens Way Hornbrook CA	530-475-0625
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Steve Ludes	Steve Ludes	Gen Delivery Yreka CA	598 6070
Linda Krahn	Linda Krahn	21216 Dry Creek Rd Montague CA 96064	459 7486
IRMA VORBECK	Irma Vorbeck	1737 Shastaview Rd. Mt. Shasta	530-926-6809
SELMA Schantz	Selma Schantz	514 Sunset Ct Yreka	841-1031
Andrea Carson	Andrea Carson	5112 Whitworth Etna	598-7643
Linda Ebert	Linda Ebert	26834 Copco Rd. Montague Ca. 96064	459-5318
STEVE EBERT	STEVE EBERT	26834 Copco Rd. Montague Ca. 96064	459-5318
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DAVID TYLER	David Tyler	1874 Fairlane	842-3652
DAVID MARSH	David Marsh	15629 Klamath River Hwy	475-3700
DON BAIRD	Don Baird	PO Box 887 YREKA CA	842-7252
Debra A Ohlund	Debra Ohlund	81351 Ja Ct Yreka	530-842-2350
Cindy Fraga		3115 Fairlane Ct Yreka CA	530 643-3154
Mary Henry		3115 Fairlane Rd Spc #33 Yreka	(530) 598-3805
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Francis Gill		20820 Ager Beach Montague Ca 96064	(530) 459-5629

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Bill Schmidt		8721 Hwy 96 Yreka	
Harlowe Kittle		13747 Rattlesnake Cr Rd Fort Jones CA	
Robert Downs	ROBERT DOWNS	13731 Rattlesnake	
CHARLES R. KITTLE		13747 RATTLESNAKE	FORT JONES, CA
Lynn Wright		13731 Rattlesnake	" " "
Scot Lee		P.O. Box Greenview CA	
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RICHARD OBER	Richard Ober	Grenada, CA	
John McGee	John McGee	YREKA	
George Gleason	George Gleason	Yreka Ca	
Jack Cowley	Jack Cowley	Montague Ca.	
CLIFF MUNSON		GTNA, CA	
Michael Eiler	Michael Eiler	YREKA. CA	
WILLIAM BAKER	W.L. Baker	YREKA, CA	
CAROL BAKER	Carol Baker	YREKA, CA.	
Jerry Reed & Pearl		Yreka Ca	
Mary Pearl	Mary Pearl	Yreka Ca	
Howard Wells	Howard Wells	Yreka CA.	
Audrey Wells	Audrey Wells	YREKA, CA.	
CHARLOTTE RICE	Charlotte Rice	YREKA, CA	
Barbara Hardy	Barbara E Hardy	Yreka, CA	
Brenda Evans	Brenda E Evans	Montague, CA	
Sunday Bogart	A Bogart	Dunsmuir CA	
Douglas Langford	Douglas Langford	Montague Ca.	
MICHAEL P. NEWS	Michael P News	Yreka, Calif.	
KAREN L. Shipman	Karen L Shipman	Yreka, CA	
ALBERT H. Newton	Albert H Newton	Yreka Ca	
Alan Dyar	Alan L Dyar	Happy Camp CA - 493-5262	

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Carol Cupp	Carol Cupp	4870 E Ridge	530 938 3166
Gregory C Hamma	Gregory C Hamma	4707 Harbstreet Rd Eureka CA 95503	(530) 598-7107
Nancy Miller	Nancy Miller	433 Bel Air Ave Willow CA 96094	(530) 925.4470
Todd Scott		801 E Hirschey St Mt Shasta 96067	530-938-5901
Dwight L Roberts	Dwight L Roberts	410 Green Haven Yreka Cal.	842 530 4818
John Richter	JOHN RICHTER	1018 Quarry Ct. Y	530-842-6106
Steven Thornburg		800 South Street Eureka CA	530 842-2815
Matt Osborn		748 Meadowlark Eureka CA 96097	530-842-3873
Linda Thornburg		800 South St Yreka	530-842-2815
Michelle Hogue		16813 Middlecoff Ct Weed	530-938-1608
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Al Knudsen		315 3rd #7, Yreka	530 9050473
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Richard Keiser	Richard Keiser	3115 Fairlane #49	
Patricia Ferguson	Patricia Ferguson	Gazelle Ca	
Donna Phillips	Donna Phillips	Grenada Ca.	
patricia keyes	patricia Keys	Gazelle, Ca.	
John Elsner	John Elsner	21001 Gazelle/Callahan Rd. 96034	
Jennifer Burleigh	Jennifer Burleigh	21001 gazelle Callahan Rd Gazelle 96034	
Roger Bridwell	Roger Bridwell	5515 Mark Gavich Rd Gazelle Ca.	
Patricia Cates	PATRICIA CATES	Gazelle Ca 96034	
Carl Cates	Carl Cates	Gazelle Ca	
Harry Shelvock		GRENADA CA	
Ken Mouw	Ken Mouw	Montague	
Nancy Mouw	Nancy Mouw	Montague	
Linda Campbell	Linda Campbell	Yreka	
Elaine Taylor	Elaine Taylor	Yreka	
Berta Rowe	Berta Rowe	GAZELLE	
Beverly M Hooper	Beverly M Hooper	Gazelle	
Mary Cameron	Mary Cameron	Mt Shasta Vista	
Kathy Davis	Kathy Davis	montague	
Tom Davis	Tom Davis	MONTAGUE	
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Sally Rapoza	Sally Rapoza	2825 Balaton Ave.	Redding 96001
~~Marjorie Baugh~~			
Marjorie Baugh	Marjorie Baugh	1614 Verda Street Redding CA 96001	
FRANCES WILKINSON	Fred Wilkinson	3187 SARREL CT REDDING, CA 96002	530-246-9131
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Daniel Kincade		240 N 16th Montague CA	530 643 3957
Jerome webb	Jerom webb	16731 friar place weed CA 96094	530 710 1952
ALAN Blackenship		16725 Friar Pl. Weed CA 96094	530- 925-7990
Diana Simmons	Diana Simmons	16725 Friar Pl. Weed, CA 96094	530-938-1908
Melissa Webb	Melissa webb	16731 friar place weed CA 96094	530 710 1952
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Caleb Webb	Caleb Webb	805 South St Yreka Ca 96097	
SARAH WEBB	Sh	618 FRENCH ST. YREKA, CA 96097	(530) 643-8047
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Stacy Lashyon	Stacy Lashyon	4524 Pine Co Rd	467-7636
Richard Marshall	Richard Marshall	11720 Eastside	468-4204
Dorothy Gourley	Dorothy Gourley	5231 Klamath River Rd	475-3147
Kut Marshall	Kut Marshall	1008 Sugar Creek Callahan	530/467-3020
Judy Mackintosh	Judy Mackintosh	5322 Hwy Rd Weed	530 938-9648
Della Frost	Della Frost	917 Ridge Yreka	530-842-0804
Pamela S Gabrielson	Pamela S Gabrielson	2542 SALMON CT Hornbrook	530-475-3213
Richard G Gabrielson	Richard G Gabrielson	2542 SALMON CT	530-475-3213
Renee Young	Renee Young	21893 Squaw Gulch Trl	530-949-2260
ALEX ROBERTS	Alex Roberts	P.O. Box 427 Merrill	
Carolyn Dueer	Carolyn L. Dueer	P.O. Box 176 Etna 96027	530 467-3264
Sheila Meamber	Sheila Meamber	5800 Reservoir Rd	(530) 459-3379
Linda Wallace	Linda Wallace	Montague, CA 11001 Patricia Ave Montague Co	530-459-1321

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PRINTED NAME	SIGNATURE	ADDRESS	EMAIL OR PHONE
Herbert Duerr	Herbert Duerr	880 Saigen Park Rd Etna	467-3264
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Brad Eslinger	Brad Eslinger	203 Terry Lynn Ave Mt. Shasta, CA 96067	926-2319
Kathleen Eslinger	Kathleen Eslinger	203 Terry Lynn Ave MS CA 96067	926-2319
Candice Slette	Candice Slette	15330 Mc Adams Ck Rd Fort Jones CA 96032	468-2601
ADRIANA DeRose	Adriana DeRose	YREKA CA 96097	842-2482
Sel Schantz	Sel Schantz	Yreka	841-1031
John Jolley	John Jolley	P.O Box 1435 Rogue River OR	541 601 1001
DAVID BAUDET	David Baudet	6504 COPCO RD HORNBROOK CA 96044	530 598 4408
DAVE WEILER		816 S. OREGON ST YREKA 96097	530-340-1718
Lani DeRose	LANI DeROSE	3211 Greenhorn Yreka CA	530-842-2482
JEROME SCHUMACHER	Jerome Schumacher	500 SUMMIT CT YREKA CA	530-842-3630
Kim Foster	Kim Foster	1412 OAK V DR Yreka, CA	530-459 4162
Shirley Bigelow	Shirley Bigelow	18620 Antler Ct Yreka Ca	530-598-6387
SUSAN ORLAND	SUSAN ORLAND	P.O. Box 705 YREKA CA	530-842-5264
JOHN T. ELLIOTT	John T. Elliott	417 S. OREGON ST YREKA	530-340-0031
J. Harkless	J. Harkless	11531 Klamath River rd KR	530. 465-2033
Tom Reese	Tom Reese	14424 Quartz Valley Dr. Ft Jones, Ca	468-2414
LAWRENCE A BELL	Lawrence A. Bell	2538 Pinegrove Rd Mt Shasta CA 96067	530-926-2141
Sarah J. McCoy	Sarah J. McCoy	217 Wetzel Way Yreka	530-340-0516
MASON McCOY	Mason McCoy	217 WETZEL WAY YREKA	530. 340-0515
JOHN DOYLE	John Doyle	14004 Hwy A-12 Montague	530-921-2953
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Deanne Terry	Deanne Terry	520 Holcomb Rd Montague CA	530 598-8078

PRINTED NAME	SIGNATURE	ADDRESS	EMAIL OR PHONE
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JAMES BEAUCHAMP	J B	13701 COUGAR Cy	530 475-3626
Debra A. Ohlund	Debra Ohlund	813 Silva Ct. Eureka, Ca 95503	530-442-2350
Tom Richard	Tom R. Richard	21036 Agger Bosworth	530-458-1002
Lee Richards	Lee R. Richards	21036 Agger Bosworth	530-458-1002
Linda Oliver	Linda Oliver	20820 Agger Bosworth	530-459-5623
Kenneth E Oliver	Kenneth E Oliver	20820 Agger Bosworth Rd	530 459-5623
LINDA JO YAWN	Linda Jo Yawn	544 N. Main St, Yreka CA	842-1100
John W. Menke	John W. Menke	10935 Quartz Valley Rd Ft Jones	468-5341
[illegible]			
Bethany Elliott	B Elliott		530 340-0680
Ted Knox	Ted Knox	9202 Old English Rd F.J.	468-2486

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SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: Sami Jo Difrantorum

EMAIL (if desired): samijodif@yahoo.com

ORGANIZATION (if applicable): Shasta Indian Nation

REMARKS:

LOCATION (circle one): ARCATA SACRAMENTO YREKA

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

4

NAME: Brandon Criss

EMAIL (if desired):

ORGANIZATION (if applicable): Siskiyou County Supervisor District 1

REMARKS:

LOCATION (circle one): ARCATA SACRAMENTO (YREKA)

(4)

Brandon Criss, Siskiyou County Supervisor District 1
Comments regarding 401 certification for the Klamath River Hydropower Dams.

At 10 pm on August 1st, 2014 I received a phone call from Sheriff Lopey advising me that constituents were being evacuated from their homes due to a rapidly spreading fire north of Copco Lake. I drove over to the evacuation center and spent the night their getting feedback of what was happening. Constituents witnessed helicopter bucket load after helicopter bucket load of water being drawn out from behind Copco Dam. The water behind the dam was used to save homes and lives. When you consider this issue, we demand that public health and safety be given priority. Do not take away this fire protection tool that the Dams provide.

We ask that you also consider the health of the migrating salmon. Also in 2014 there was a chance of another fish kill similar to 2002 on the Klamath River. At the North Coast Regional Water Quality Control Board meeting of October 9th, 2014 the Karuk Tribal spokesman Craig Tucker stated, that "increasing flows and the velocity of flows disperses disease on the Klamath. … We averted a fish kill because of Trinity Flows, then the Karuk Tribe observed disease above the Trinity confluence. A lot of credit to PacifiCorp's collaboration with the Bureau of Reclamation 16,000 acre/ft was released with 1700 cubic feet per second"

In total 20,000 acre/feet was released by these dams. Without the dams this 20,000 acre/ft of water would not have been available to save the salmon.

We find it ironic that some claim these dams impair water for fish, yet a release of an extra 20,000 acre/feet of this same water is credited with being pivotal in helping to prevent a fish kill. Please do not take this tool away from us.

The Bureau of Reclamation struck a deal with PacifiCorp to release this 20,000 acre/feet from behind these dams so this water would not have to be taken from farmers in the Klamath Basin. In the BOR August 8, 2014 press release stated that the water released from behind the lower dams would "assist Reclamation by extending the Klamath Project's available water supplies from Upper Klamath Lake to help close the irrigation season." Please for the benefit of those farmers, do not take this tool away from us.

Lastly, do not view agriculture as harming the river, view it as a tool to benefit the river. For example, the State Fish and Game quickly blamed Klamath Basin Agriculture for the 2002 fish kill, yet the National Academy of Sciences made clear in their study that agriculture did not cause the fish kill. It's a proven fact as well that agricultural water run off from the Klamath and Tulelake Basins is cleaner and has less phosphorous loading than natural conditions would give this river. Don't just demand cleaner water, respect and honor that you are already receiving cleaner water due to agriculture.

We request that you allow us to continue to use the dams as a tool, a proven tool to benefit the Klamath River system in whole.

With the dams in place, we are seeing record runs of Klamath River salmon. Tearing out existing hydropower dams that have proven benefits for fish, Klamath and Tulelake Basin agriculture, and firefighting efforts, is no solution, it's instead the start of many problems.

Best Regards,

Brandon A. Criss MPA'
Siskiyou County Supervisor District 1

(5)

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: Grace Barnett

EMAIL (if desired): gben@snowcrest.net

ORGANIZATION (if applicable):

REMARKS: Don't take out Dams

LOCATION (circle one): ARCATA SACRAMENTO (YREKA)

(5)

History of the Klamath River
People I have talked to
1. Tribal moves away from the River in the Summer to stinky
2. George Gibbes report Horses wouldn't drink the water
3. People who have lived on the River Floods stinky water river very low in summer
4. Klamath River Compact Commission in 1962
Alga in upper Klamath River bad water quality
5. CDM report
This is the only report that can be trusted because after this was released Mr. Salazar from the Dept of Interior said in his public speeches that the dams would come out, after that reports, studies and models were then written to reflexes this pre-determined decision.
6. Expert Panels in their report they stated that dam removal would only open 8 miles of new habitat and they were very concerned about the induction of a listed species and the loss of the trout that have been able to develop in the area above the Dams.
7. Work that Farmers, Ranchers, Loggers, County have done
Erosion work to stop sediment, Beaver dams, removal of weir dams, new pumping stations, lined ditches. Replace culvert replaced with bridges. water storage to provide cold water, Major changes in irrigation practices. Very little logging with many changes logging regulation Suction dredge Mining has stopped. Water banks, and many many hours of volunteer work provide by the people that live and work here.
8. Two of the biggest ranches along the Shasta River were purchased and are operated by the Nature Conservancy, water right sold to Cal Fish and Wildlife to put more water in the Shasta River.
9. Water releases from Iron Gate Dam to flush the system when the spawning season starts and maintain year round flow
10. We have learned how to grow fish and we do it well. We send million upon millions of little fish out to the ocean every year, Only to have them die from the C Shasta disease when they reach the Klamath River. In 2013-14 we had over half of the entire counts of Coho salmon return to the Scott and Shasta rivers, these were drought years and as much as we tried to save fingerling, it has shown up this year with very few returning adults.
11. If you allow the 20 to 30 million tons of sediment and fish behind the dams to be sweep down the river will destroy it for a very long time and all of the effort and money that has already been spent to improve this system will have been wasted.
12. The other thing that must be watched very carefully is the City of Yreka Water supply this must not be put in any jeopardy.
13 . I am appalled and the California tax payers should all be upset that in the last 2 years, this water board has spent $400,000 in Oregon to improve water quality. The water quality in Oregon is not the responsibility of the California Taxpayer, that bill should be paid for the Oregon taxpayer. It is their nasty water.
I am tired of hearing that you and other agencies think that they can make the WARM Klamath River system Cold at the expense Siskiyou County residents.

13. FIXES

Leave the Dams In the sediment behind them will sterilize the entire River for years
Put a water filtration system at the state line between Oregon and California
Stop the Fish Disease in River
Investigate what is happening with Ocean conditions
Currently there are only 3 counting stations on the entire river install a
Counting station at the Mouth of the Klamath report Tribal catch
Expansion of water storage in wilderness areas to provide more water in the fall
Let our people get back to work so they can support their families and enjoy life in our Beautiful Siskiyou County

My Name is Grace Bennett I am a retired Siskiyou County Supervisor serving 8 years on the Board. I am also a 5th generation Siskiyou County resident, my family settled on the Klamath River in the 1850's. Living there mining, ranching and building a good life on the river.

I have been to many many meeting about the Klamath River, water quality, and quantity, Dam removal and have studied the river for many years. I have talked to many people who to have lived on the river. From the Spannus family in the Copco area to the Andersen Family at the middle to Tribal members in Happy Camp, In these discussions one this is very apparent Dam removal is not the answer to the problems on the Klamath.

Has this Board ever consulted with the Shasta Tribe, I already know this answer. No! the area where the dams are located in their Historical Homeland. There are many burial sites and ceremonial sites under these lakes, a full investigation of these sites and what will happen to them, if the dams come out must be made. And they must have input in this matter.

The water that comes from Oregon is the problem. This water is naturally polluted when it come from the Upper Klamath Lake. The Klamath River is a warm water system and no amount of money, wishful thinking or regulation will ever change that.

It disturbs me greatly and it should all California residents that the State of California Water Board has spent $400,000 dollars in the State of Oregon, in the last two years. for an experiment to see it the flooding of wetlands would help improve the water quality in Oregon: The muckie water in Oregon is their problem not ours, Oregon Tax payers should be the ones footing the bill to pay for the research to improve their water quality. The only way to fix that muckie water for us is to put a filtration plant at the State line.

Now let's look at the reports and Documents that have already been prepared. The only one that I fell is accurate is the CDM report it was the first. After that in public speeches from Mr. Salazar, the then Secretary of the Interior said that the Dams would be removed, from then on every report pointed to that pre-determined conclusion that the Dams would be removed. One of the last meetings that I attended was with a group of agency folks that were just gittie about the prospect of the Dams being removed. This grand experiment will be the destruction of the once productive river system on the West Coast.

Letting Millions upon Millions of Muck and sediment will sterilize the river for many year. Even in some of the study say that it will be 50 years before anyone knows if this experiment is working.

I have written many letters and attended many meeting about the river and it's problems. I keep hoping that someone some where will stop this insanity and let our people go back to work on their farms ranches and in the woods making a living a taking care of their families, we live here because we love the land and what the way of life here provides. Who has taken care of this land for many years we have and we will continue to do so.

Water Quality in the Klamath River

Many people believe that if the Klamath River Dams are removed all of this clear, clean cold water will suddenly appear and go rushing down the Klamath River, this is not the case. The water that comes from Oregon to California is a problem: This water is the source of much pollution. The Upper Klamath Lake is shallow; warm in the summer, has many nutrients, phosphorus and organic matter in it. To increase storage, they are talking about flooding the wetlands around the Upper Klamath Lake however this will only add more phosphorus because the phosphorus is in the soil. Phosphorous causes algae to grow in slow moving water there has been a major algae bloom this summer already. Once the water leaves the Upper Klamath Lake it picks up more impairments as it continues down to the Klamath project and a series of canals to help farmers irrigate in the Klamath and Tulelake basins then travels to the Lower Klamath Wildlife Refuge, this untreated, unfiltered water flows through a canal back into the Klamath River. This stretch of the River from Keno to Copco Lake has been identified as the most impaired water in the system. (Page 141 of the Endangered and Threatened Fish in the Klamath River)

The J.C. Boyle, Copco and Irongate Dams allow these nutrients, organic matter and phosphorous to settle and the water is cleaner when it leaves the Irongate Dam than when it comes in, (this is documented in a Pacific Corp study.) There are 84 creeks and rivers below Irongate Dam, to dilute this impaired water. These 84 creeks and rivers provide 471 miles of great habitat for spawning fish, (identified in a 1989 study compiled by the U.S. Forest Service.) plus the 196 miles of Klamath River. Surely this is enough area for the fish to use as spawning grounds.

For the past 30 years there has been a concentrated effort to improve the habitat and restore the Klamath River. The people of Siskiyou County have been working very hard since 1986 to improve water quality and quantity in the Scott and Shasta Valleys. Weir dams have been replaced, new pumping stations installed, ditches have been lined to improve water supplies, fish screens added to ditches and irrigation practices have been analyzed and changed to improve crop production and use less water. Logging practices have been drastically changed to protect water sheds. Streams have been fenced off so cattle aren't in them thus making streams narrower and lowering temperatures.

It is estimated that the Siskiyou County Road Department has completed over 62 projects since 2008 to improve fish access to these streams, removing culverts and installing bridges. The Scott Valley RCD has completed over 1,200 projects and the Shasta Valley RCD started in 1986 completing over 1,500 projects. This doesn't include the work that has been done by our farmers, ranchers and loggers who have voluntarily undertaken to improve land conditions to improve water quality. All suction dredge mining has ceased in the Klamath River.

Fish populations are improving and water quality has also improved. In 2013 the California Fish and Wildlife reported that over half of the total counts of returning Coho

salmon for the State of California were counted in the Scott River. With the returning Chinook salmon counts in the Shasta improving as well.

In the documents that have been prepared for dam removal it says that the fish will have to be trapped and hauled around the Keno section of the river because in the summer the river will be low and warm in that area. Why not do that now to see if the fish will even survive in the upper basin. At the resent scoping meeting in Yreka, a man from Klamath Falls addressed the Water board stating that there is no extra water in the upper basin to help flush the river in the fall of the year to help prevent the fish disease that happen in the lower reaches of the river, the last 2 years Iron gate Dam has provided the water to flush the river. The river and lake's water has also been used for Fire protection when 200,000 acres burnt in Siskiyou County, without the Dams this wouldn't have been possible.

Siskiyou County has researched and developed several plans and projects to increase water quality and quantity in the Klamath River. With two thirds of the Klamath River flowing through Siskiyou County we are committed to making the river work for all of our citizens. These plans include the repair of holding pond below the many lakes in the Marble Mountain wilderness area. (The U.S. Forest Service were the first to build these ponds before the Wilderness Act was implemented,) To hold the winter run off until it was needed to increase the flows in the Scott River, thus increasing the flow with clean cold water. There are also leaks in Dwinnell Dam if these leaks are repaired, it would provide more water for the Shasta River and it would not be hard to put in a fish ladder at the same time as the repairs were being made.

Siskiyou County has proven that we can grow fish: along with the hatchery we send millions and millions of smolts back to the ocean. There is a disease in the river that affects these small fish, the California Fish and Wildlife has of yet to fully address this problem. The fish returns from the ocean each year are not counted properly, with the tribes having commercial fishing agreement and no count of the fish that are taken, who really knows what the actual return numbers are. There are only 3 counting stations on the river, these being on the Scott, Shasta and Bogus Creek, for the 84 creeks and rivers below the dams there is really no way of knowing just how many fish return to the Klamath River system.

There is another very important item that people seem to forget about, it is the fact that the Shasta Tribe has many documented ceremonial and burial site throughout Siskiyou County, especially under the reservoirs behind the dams. If these Dams are removed these sites will be exposed and unearthed. There are provisions in both State and Federal documents/laws that prohibit the disturbance of such sites. This must be addressed.

I recently attended a meeting and spoke to Diane Messina Supervising Engineer Division of Water Quality who works for the State Water Resource Control Board about this very problem of point source water quality and the water crossing of State lines. She advised that this should be very carefully investigated and studied to see what impacts it has on

the Klamath River. Impaired water that crosses State lines is not the responsibility of the State that it flows into.

I have taken this paragraph from the Environmental Species Act section 7 A 2 of the ESA requires 16 USC 1536 A 2 202 that each federal agency shall, in consultation with and with the assistance of US Fish and Wildlife Service and National Marine Fisheries Service insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species. If the dams are removed there will be consequences to the endangered salmon and the destruction of habitat.

I will close with one more thought: If you take nothing else from my comments please remember this. In the TMDL's for the Klamath River and its tributaries there are many listing for sediment? Some of these very streams come directly from wilderness areas that have no roads, where no logging has occurred and they is very little human contact. There seems to be a great interest in this small amount of sediment while on the other hand if the dams are removed there will be 20 to 30 million tons of sediment released from behind the dams into the Klamath River. This sediment will suffocate and sterile the River for years, the fish will disappear and the millions of dollars spent to restore this habitat will have been spent for nothing. One thing that our neighbors on the coast should really think about is what happens when this sediment gets to the coast will it fill up Eureka and Crescent City's harbors? Will it close the mouth of the Klamath River or fill up the estuary?

There is a disaster waiting to happen and another experiment gone astray, I sure hope that the super funds don't run out before this happens, because the Klamath River will be destroyed.

Grace Bennett

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

(6)

January 2017

(Please Print Clearly)

NAME: ROBERT DAVIS

EMAIL (if desired): VIKING3135@HOTMAIL.COM

ORGANIZATION (if applicable): T-PARTY

REMARKS: PROPERTY OWNER

LOCATION (circle one): ARCATA SACRAMENTO (YREKA)

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SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: Jack Matz

EMAIL (if desired): yurok tribe

ORGANIZATION (if applicable):

REMARKS:

LOCATION (circle one): ARCATA SACRAMENTO (YREKA)

(8)

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: Erin Ryan

EMAIL (if desired):

ORGANIZATION (if applicable): Congressman Doug LaMalfa

REMARKS:

LOCATION (circle one): ARCATA SACRAMENTO YREKA

9

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: Rex Cozzalio

EMAIL (if desired):

ORGANIZATION (if applicable):

REMARKS:

LOCATION (circle one): ARCATA SACRAMENTO (YREKA)

We are 4 generations at the same location on the Klamath directly below where Iron Gate Dam now exists, before and after, at what is described in all rhetoric as the 'focal point' of dams impacts. I am in the Klamath I love over 50 times a year for nearly 60 years, before and after Iron Gate, as my grandfather before me.

1 The majority of salmon reaching our location are depleted and dying, before and after dams. In combination with multiple impassable upstream reefs, a river often going subsurface in the canyon late summer before dams, and the naturally non-conducive upper basin salmon habitat, salmon were never historically known resident above Spencer Creek near present Copco Dam or to populate the upper Klamath Basin. Historical documentation, experiential testimony, and now a recent proponent study intended to confirm the opposite, referenced and submitted to this Agency many times in the past, have been consistently ignored in pursuit of Agency agenda.

2 Our area has witnessed the dam related dramatic improvements to water quality, late summer quantity, fisheries habitat, riparian stability, drastically reduced flood damage, and environmental improvements. Dams vastly improved the fisheries above and below for optimized and sustainable resident warm and cold water species. Iron Gate Dam artificially creates 'unnaturally' cold downstream water resources for one of the best producing hatcheries in California, far exceeding prior known upstream production. Statistics for nearly a hundred years evidence NO significant alteration in salmon returns occurring at our location as a result of the first dam. The addition of Iron Gate Dam and Hatchery INCREASED averaged returns by well over 100%, and averaged a 200% increase during proponents' media cited so-called 'recent catastrophic declines'. Incoming data now confirms the locally submitted historic documentation, empiric declarations, and studies regarding the environmental benefits of the hydroelectric and storage facilities. However, NONE of that data is allowed to modify failed Biological Opinions until AFTER the dams are scheduled for irreversible removals. Hatchery and cold water resources, along with clean hydroelectric power for 70,000 homes, major holistic ecosystem enhancements, non-reproducible regional recreational opportunities, optimized downstream benefits, property use and valuations, public safety, and both area and downstream public/private infrastructure will be lost as a result of dams removals.

3 Chinook are not endangered, negating any rhetoric for wide spread dams removals devastation. Spending countless billions forcing a naturally non-conducive upper basin square peg into a profiting special-interest round hole, pushing for the return and compounding of detrimental conditions existing prior to the dams, destroying watershed-wide beneficial and irreplaceable resources for a science cited 'chance' of perceptible benefit bears no transparent reason.

4 Coho salmon, which 'endangered' status this KBRA/KHSA special-interest agenda helped create and manipulate, are listed by Fish and Game as a 'coastal fish generally occurring within 20 miles of the ocean; were never known indigenous to the upper Klamath; were unsuccessfully repeatedly planted since the 1890's; never saw a 'marginally sustainable' return until the 1960's 3rd attempt using coho imported from Cascadia AFTER Iron Gate Dam and Hatchery enhanced Klamath conditions; approximately 60% of coho returning to the Hatchery have been found to relocate and spawn in downstream tributaries and mainstem; not surprisingly, so called 'wild' coho are DNA identical to hatchery coho; and from the 1990s to this day ALL coho returning to Iron Gate Hatchery have been systematically killed, upon which exclusion of hatchery numbers from 'wild' salmon allowed the CREATION of 'endangered' status.

5 Sucker Fish, upon which 'endangered' status this KBRA/KHSA special-interest agenda helped create and manipulate, forced upper basin irrigators to agree with predetermined agenda terms of dams removals

and regional water confiscation without compensation before being allowed to even 'sit at the table' of selective secretly held meetings. Those suckers; had previously been subjected to multiple failed earlier attempts at intentional eradication by the same seated KBRA/KHSA Agencies; had been later listed as 'endangered' by those same agencies based upon their hypothesized 'dead zones' and numbers; were later proven in gross error by their own scientist studies but which rather than resulting in 'endangered' status removal instead resulted in the firing of those 7 scientists and court sealing of the records; have been the excuse for decades of oppression and extortion for additional water confiscations raising Upper Klamath Lake to historically unprecedented levels exclusively for sucker fish benefit against the recommendations of local residents, and as a result were found in 2012 to have actually DECLINED in Upper Klamath Lake by up to 86%, but which lake levels and confiscation have not been restored; were a 'modeled' reason calling for removal of John Boyle Dam as being one of those 'dead zones', but which latter study has found one of the most viable populations of suckers in the region which will be lost with dam removals; and are directly incompatible with the species requirements of salmon which the dams removals intend to superimpose upon a historically salmon nonconducive region.

6 A billion dollars spent and 17 years of KHSA/KBRA hypothetically modeled Biological Opinion implementations and confiscated flows destroying thousands of families' futures have resulted in ZERO attributable statistical increase to coho and an imposed 'restored-area' DECLINE in sucker fish.

7 Recent 'KHSA Interim Agreement' ratepayer funded data is now confirming the locally submitted historic documentation, empiric declarations, and studies regarding the environmental benefits of the hydroelectric and storage facilities. However, there appears NO intent to formalize or incorporate that data into the Biological Opinions until years AFTER the dams are scheduled for irreversible removals.

8 The Department of Water Resources Board (DWR) is unelected, appointed by the governor to serve at the governor's pleasure. That unelected Board is there to execute the policy directives of the governor. The governor's self-determined policy directives are subject to legislative review, but NOT to legislative revision. The governor has stated in the California Water Crisis Management Plan that ALL California Agencies are ordered to support and promote the removal of Klamath River Dams. On the 22 of December the DWR Board, without a vetting or determination of validity by FERC on the submitted recently formed and unfunded Klamath River Renewal Corporation (KRRC), took upon itself to initiate an Environmental Impact Report at taxpayer expense on behalf of that private corporation 'in support' of Klamath Dams Removals. The KRRC is a private 'non profit' corporation largely made up of the same KBRA/KHSA profiting special-interest parties, which members under their own created Bylaws are allowed to personally profit by virtue of their positions 'as long as the remaining Board gives its permission'. The October minutes for that KRRC Board showed 'non-member' Water Resources seated on the panel, but as of the 26th of January, no minutes were posted for the December 14th meeting which would reveal funding transfers. Notification of DWR's expedited intent and the 3 scheduled 2 hour long 'Scoping' meetings soliciting 'public input' wasn't received until January 6th. The one meeting scheduled within the most affected region, which 'may or may not' have a DWR Board member in attendance, was to be held 4 days later on the 10th. On the morning of the 10th, the announcement was made that the meeting was canceled 'due to weather' and 'may or may not be rescheduled', but that 'comments could be submitted at the other meetings'. Only upon fervent local protest did DWR announce a rescheduled meeting for the 26th, with ALL PUBLIC COMMENTS to be closed 4 working days later on February 1st, for the largest proposed dams removals in the history of the world. The DWR paid contractor (Stillwater) overseeing the EIR is the same paid 'scientific consultant' previously employed to support dams removals by ALL KBRA/KHSA seated special interest parties. EVERY relevant prior 'determination' the DWR Board has

made at every 'scoping' juncture, without exception, has been in support of confiscatory, regulatory, and administrative authority designed to compel and facilitate Klamath Dams removals. The Boards predicated limiting conditions relegates primary consideration to the prior 2007 FERC and 2012 KHSA EIS. Current science and experimentation refuting prior 2007 FERC EIS assumptions, options, and alternatives have rendered that document completely inapplicable. The KBRA demise was also the demise of KBRA associated promised unknown, uncertain, and unfunded 'restorations and mitigations' held 'intrinsic' to the KHSA. The KHSA EIR conditionally predicated that EVERY KHSA EIR scientific evaluation of removals be based upon the assumed successful implementation of those KBRA 'mitigations' which no longer exist, rendering the 2012 KHSA EIR totally irrelevant. As such, a new EIR MUST be performed that is based upon currently known conditions, fully comprehensive, holistic, transparent, and inclusive of ALL current data, ecosystem interactions, and regional impacts. The DWR Board has initiated this EIR at public expense for a private corporation which FERC has yet to vet, an act likely unprecedented in regulatory permitting history. It is impossible under the projected FERC timeframes for a DWR comprehensive EIR to be produced or for the Board to reasonably evaluate the information. The DWR Board proposes to render a supportive determination regarding dams' removal to influence FERC, inferring a 'comprehensive' evaluation, when DWR internally limits that EIR to considering ONLY conditions occurring in California, effectively disenfranchising an interdependent ecosystem. Given the manipulated and constructed past, it appears unlikely that DWR is capable of or considers producing any 'determination' other than a policy directed recommendation for Klamath Dams removals, regardless of the evidence or the multicounty official supermajority most knowledgeable and impacted citizens voting against Klamath Dams removals. Therefore it MUST fall to a fully comprehensive and inclusive NEPA EIS executed through FERC, encompassing the entire watershed impacts, options, alternatives, and required mitigations, to fulfill the public trust. Only AFTER that NEPA EIS and FERC evaluation would DWR be procedurally called upon or capable of producing a California EIS necessarily conditioned upon and subject to the options and mitigations considered by FERC.

Rex Cozzalio

10

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: Glen Briggs

EMAIL (if desired): glenb@sisqtel.net

ORGANIZATION (if applicable): Self

REMARKS:

LOCATION (circle one): ARCATA SACRAMENTO (YREKA)

11

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: Mark Coats

EMAIL (if desired):

ORGANIZATION (if applicable):

REMARKS: Unknown

LOCATION (circle one): ARCATA SACRAMENTO YREKA

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

12

January 2017

(Please Print Clearly)

NAME: John Menke

EMAIL (if desired): jmenke@sisqtel.net

ORGANIZATION (if applicable): —

REMARKS:

LOCATION (circle one): ARCATA SACRAMENTO (YREKA)

13

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: DR. Richard Gierak

EMAIL (if desired): rgierak2@hughesnet.com

ORGANIZATION (if applicable):

REMARKS: Re Klamath Hydro Project

LOCATION (circle one): ARCATA SACRAMENTO YREKA

Dr. Richard Gierak
5814 Hwy. 96
Yreka, Ca. 96097
530 475-3212

Re: Proposed Kalath Hydroelectric Project

Coho & Chinook Salmon listing history

~1992 Federal ESA listed Coho as endangered
~1994 ESA attempted to change regulation of water & substrate rule to be expanded to up 300 feet from the rivers high water mark.
~1995 Coalition of Idaho, Washington, Oregon and California State Granges fought this ruling and were successful in maintaining the Federal ruling of water and substrate only. It is of interest to note that the Karuk tribal records indicated Coho were never native to the Klamath River.
~1997 California & Southern Oregon Granges engaged PLF who won their case and all listings for Coho in California and Southern Oregon were removed as they were not an indigenous species.
2002 Major fish kill in the Klamath blamed on bacterial contamination
Reality: Tribes called for water release for ceremonial water boat dance while salmon were in the estuary. This enticed them to move upstream to spawn and then the water was turned off leaving them high and dry causing a serious salmon kill. Note that prior to any dams on the Klamath at this time of the year the river was nothing but swamps and mud holes. Could not have been traditional Indian ceremony.
2004 National Research Council researched the fish kill and determined Coho were from Cascadia, Oregon proving they are not indigenous to the Klamath and could not be listed.
2005 Based on fish kill Coho were re-listed illegally as they have been proven not to be indigenous species in 2000
2009 CDC investigated the reservoir at Iron Gate and determined it was not the cause of the 2002 fish kill.
~2006 Environmental organizations filed a listing petition for Chinook Salmon in the upper Klamath and I filed a de-listing petition. I received a call from Washington and was told that there was no provision for filing a de-listing petition prior to a species being listed, however, he would evaluate my petition when he reviewed their listing petition. A few weeks later it was announced that their petition to list was denied.

Submitted by;
Dr. Richard Gierak
Bachelors Degrees in Biology, Chemistry, Doctorate in the Healing Arts, Director of Interactive Citizens United, Director of New Frontiers Institute, Inc. Prior Participant of FERC and FPAT (Fish passage advisory team report) and HET (Hatchery evaluation team) Prior Vice President of Greenhorn Action Grange, Prior California State Grange Spokesman for the Water Committee, Prior National Whip of the Property Rights Congress of America, Representative of the Grange States of California, Oregon, Washington and Idaho regarding EFH regulations, Prior member of the SCWUA.

(13)

Dr. Richard Gierak
5814 Highway 96
Yreka, Ca. 96097
530 475-3212

Illegal infractions regarding Klamath dam removals

Violation of the Reclamation Act of 1902

The Reclamation Act of 1902 (43 U.S.C. 391 et seq.) authorized the Secretary of the Interior to locate, construct, operate, and maintain works for the storage, diversion, and development of water for the reclamation of arid and semiarid lands in the western States.

Congress facilitated development of the Klamath Project by authorizing the Secretary to raise or lower the level of Lower Klamath and Tule Lakes and to dispose of the land uncovered by such operation for use under the Reclamation Act of 1902. Starting around 1912, construction and operation of the numerous facilities associated with Reclamation's Klamath Project significantly altered the natural hydrographs of the upper and lower Klamath River. Reclamation's Klamath Project consists of an extensive system of canals, pumps, diversion structures, and dams capable of routing water to approximately 200,000 ac (81,000 ha) of irrigated farmlands in the upper Klamath Basin. Water diversions from from UKL for the Klamath Project affects river flows downstream of Link River and Iron Gate dams.

The headwaters of the Klamath River originate in Southern Oregon and flow through the Cascade Mountain Range to the Pacific Ocean south of Crescent City, California. The river extends nearly 250 miles and is just one of three waterways that pass through the Cascades to the Pacific. It is named after a native American name - klamet - meaning swiftness.

Violation of the 1981 National Wild & Scenic Rivers Designation

The Klamath River was designated a Recreational River within the National Wild & Scenic Rivers System in 1981. The Klamath River enters California from Oregon just north of the Goosenest Ranger District. Heading west it is impounded by two dams forming Copco Lake and Iron Gate Reservoir. Nine miles further west it turns south and follows Interstate 5 for a few miles before again turning west and entering the Happy Camp/Oak Knoll Ranger District. The next 85 miles provide many opportunities for recreation and scenic vistas before the river enters the Six Rivers National Forest. Dam removal would release toxic material that would destroy the habitat for all species in addition to physically changing the course of the Klamath River in direct violation of the National Wild & Scenic Rivers designation.

Violation of the Dormant Commerce Clause

No State may impose any regulatory action against navigable rivers in the US of which the Klamath River is considered a navigable river. This would also prohibit removal of any dams located on a navigable river in the US by States.

Violation of the Federal Endangered Species Act

Under the Federal ESA only indigenous species can be listed and under the Final report of Coho Salmon by the Klamath Expert Panel Coho Salmon were planted from Cascadia, Oregon and are not indigenous to the Klamath. The present listing of Coho in the Klamath River is illegal and was determined in the courts in the early 2000's.

Violation of Rogue Valley Oregon Irrigation Rights

Removal of these dams would reduce approximately 40% of water from the Klamath River that now goes to Southern Oregon for agriculture which would result in serious loss of agriculture that now stabilize the economy of Southern Oregon

Serious impact on power costs in Northern CA and Oregon

At this time these hydroelectric dams supply Northern California and most of Oregon homes and businesses with the least expensive power available. The average homeowner is liable for approximately $200 per month and with the proposed natural gas power supply it would increase their costs to approximately $600 per month.

Violation of Shasta Indian burial rights

At the present time Shasta Indian Tribe burial grounds are protected by Iron Gate Reservoir and removal of this dam their burial grounds could be exposed, plundered and desecrated.

Violation of Siskiyou Counties water rights

Removal of these dams would be in serious loss of existing water rights as proposed solutions to avoiding this problem would be in serious possibility of failure and exposed to vandalism.

Possible loss of life and property to all adjoining the Klamath River

Due to occasional flooding Iron Gate Dam was constructed to serve to protect all that lived on the banks of the Klamath River from catastrophic flooding events. Without this dam property values would fall and expose all with the possibility of loss of life and property.

Serious fire danger to all in Siskiyou County

At the present time the dams supply fire helicopters access to water supply to fight forest fires. Removal of these dams would force said fire helicopters to much longer time delays to fill their buckets and thereby expose all to longer wait times and possibility of loss of lives and property.

Violation of the Constitution of the United States

Elections in Siskiyou County California and Klamath County Oregon voted 80% to retain the dams and removal of these dams would be in direct violation of the will of the people and the Constitution.

Prior law decisions

In the late 90's proposal was made to change the definition of Federal ESA regulations regarding endangered salmon to Ecological Society of America regulations which means that instead of regulations applying only to water and substrate would be changed to allow them regulations up to a mile from the banks of a river. Through the States of Idaho, Washington, Oregon and California State Granges we defeated this change.

In the early 2000's the Granges engaged Pacific Legal Foundation and listings of Coho in Northern California and Southern Oregon were cancelled as the Coho were not indigenous to these waters and rivers.

In the mid 2000's an attempt was made by environmental groups to list Chinook Salmon in the upper Klamath and the Siskiyou County Water Users Association filed a de-listing petition which was successful and the Chinook listing was denied.

Submitted by;
Dr. Richard Gierak
Bachelors Degrees in Biology, Chemistry, Doctorate in the Healing Arts, Director of Interactive Citizens United, Director of New Frontiers Institute, Inc. Prior Participant of FERC and FPAT (Fish passage advisory team report) and HET (Hatchery evaluation team) Prior Vice President of Greenhorn Action Grange, Prior California State Grange Spokesman for the Water Committee, Prior National Whip of the Property Rights Congress of America, Representative of the Grange States of California, Oregon, Washington and Idaho regarding EFH regulations, Prior member of the Siskiyou County Water Users Assoc.

(13)

Dr. Richard Gierak
5814 Hwy. 96
Yreka, Ca. 96097

Re: Salmon in the Klamath River

1. Navigable rivers in the United States fall under the Federal Government and not the States. The Klamath River is considered a navigable river.

2. Under the Federal regulations any salmon listed under the Federal guidelines the only remedy is to water and substrate only.

3. Regarding Coho Salmon the first formal planting in the Klamath was in 1895 and was only partially successful. Multiple planting were made without success until the series of plantings from the Cascadia river in Oregon during the 1960's which was successful. Therefore the Coho Salmon is not a native species in the Klamath and therefore does not require any regulatory action under the Federal ESA. FINAL Report_Coho Salmon-Steelhead_Klamath Expert Panels_04 25 11

4. There are two primary reasons why Coho are considered endangered at this time:

A. The hatchery at Iron Gate originally took Coho at the beginning, middle and end of the Coho run. This allowed the bulk of Coho to spawn in natural streams. Due to complaints by property owners the Coho that spawned naturally died after spawning and their carcasses created a smell and sickened pets and livestock that ate them, so, for decades they now capture all the returning Coho diminishing the run considerably.

B. Their present practice is to tag all Coho raised at the hatchery and when they return to the hatchery they are not counted, thereby creating a very small return of Coho.

5. Regarding Chinook Salmon there was an attempt to list them in the upper Klamath River in 2011 and due to historical data regarding the Chinook's spawning grounds this listing was rejected by USFWS after I sent a de-listing petition.

In conclusion it is obvious that there is no legitimate cause to remove the dams as neither species qualifies to be listed as in the case of Coho the species is not native and does not qualify for any consideration and as to the Chinook USFWS rejected listing them above Iron Gate Dam based on considerable research.

Bachelors Degrees in Biology, Chemistry, Doctorate in the Healing Arts, Director of Interactive Citizens United, Director of New Frontiers Institute, Inc. Prior Participant of FERC and FPAT (Fish passage advisory team report) and HET (Hatchery evaluation team) Prior Vice President of Greenhorn Action Grange, Prior California State Grange Spokesman for the Water Committee, Prior National Whip of the Property Rights Congress of America, Representative of the Grange States of California, Oregon, Washington and Idaho regarding EFH regulations, Prior member of the Siskiyou County Water Users Assoc.

(13)

Dr. Richard Gierak
5814 Highway 96
Yreka, Ca. 96097
530 475-3212

Truth about Salmon in Southern Oregon & Northern California

It is of interest to note that all battles over listing of Salmon in Southern Oregon and Northern California has been over the Coho Salmon. As has been stated earlier Coho Salmon are native to the Cascadia River in Central Oregon and under the ESA only a native species can be listed. Any listing in Southern Oregon and Northern California for Coho Salmon is illegal under the ESA.

In the 1990's there was a serious diminution of Coho Salmon in both Southern Oregon and Northern California which was blamed on the dams of the Klamath River. The reality was that the Ring of Fire volcano's were highly active raising the temperature of the Pacific Ocean and since Coho are a cold water species they migrated north into Washington and Alaskan waters. Data going back to the 1700's never demonstrated a rise in temperature of the Pacific as happened in the 1990's.

Of interest is to note that NMFS data appeared to indicate that the Pacific temperature never had a large temperature increase. What was found was that at the end of the first year of temperature rise they reported an increase of 1.6 degrees. However, when they started their survey the next year they started at 0 degrees of change. This continued throughout the 90's and in reality the total rise in temperature of the Pacific Ocean was approximately 10 degrees Fahrenheit This is the reason Coho migrated North into Washington and Alaskan waters.

It becomes apparent that the government would manipulate data to promote the cause of dam removal.

Bachelors Degrees in Biology, Chemistry, Doctorate in the Healing Arts, Director of Interactive Citizens United, Director of New Frontiers Institute, Inc. Prior Participant of FERC and FPAT (Fish passage advisory team report) and HET (Hatchery evaluation team) Prior Vice President of Greenhorn Action Grange, Prior California State Grange Spokesman for the Water Committee, Prior National Whip of the Property Rights Congress of America, Representative of the Grange States of California, Oregon, Washington and Idaho regarding EFH regulations, Prior member of the Siskiyou County Water Users Assoc.

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

14

January 2017
(Please Print Clearly)

NAME: Larry Bell

EMAIL (if desired): Sqdg Finest planet. Com

ORGANIZATION (if applicable): None

REMARKS:

LOCATION (circle one): ARCATA SACRAMENTO YREKA

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

15

January 2017

(Please Print Clearly)

NAME: SUSAN WALLACE

EMAIL (if desired):

ORGANIZATION (if applicable):

REMARKS:

LOCATION (circle one): ARCATA SACRAMENTO YREKA

(16)

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: Linda Ebert (husband, Carl Ebert)

EMAIL (if desired): 26834 Copco Road 530-459-5318

ORGANIZATION (if applicable): Montague, Calif. 96064

REMARKS: We live on Copco Lake and wish to express our concerns

LOCATION (circle one): ARCATA SACRAMENTO (YREKA) Montague, Copco Lake

(16)

Mr. Parker Thaler
State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, California 95812-2000

My name is Linda Ebert. My husband, Carl Ebert, and I retired to Copco Lake around sixteen years ago, settling on its north shore. We have enjoyed the pleasures of residing on a lake filled with perch, crappie, bass, trout, sucker and catfish. Aside from experiencing many memorable fishing and boating outings on the lake, we have been visually rewarded while viewing the many moods of the lake, whether sparkling in sunshine, bathed in moonlight, iced over, surging with waves or mirroring the hills. Now, all of that enjoyment is threatened by dam removals on the Klamath to which we strongly object.

We also object to the following consequences of Klamath dam removals:

1. The release of both coarse and fine sediments, some of which have been shown to contain toxic pesticides in core samples that will endanger the fish on whom they are released because of their toxic nature and because they will deoxygenate the water, causing fish to die. Furthermore, large debris material will litter the landscape in front of our homes now on the lake.
2. The potential for flooding will become a reality for ourselves and our neighbors downriver. Floodplains will be re-drawn,

having implications for insurance coverage.
3. The cloud of uncertainty surrounding potential dam removals that pushed our property values downward will darken as values plummet with dam removals while our visual paradise disappears.
4. Our sense of security that comes with knowing there's a huge reservoir of water that can be drawn upon when there's a fire emergency threatening our homes will be gone in the event of Klamath dam removals. We experienced such an emergency in 2014 when those of us living on the north shore of Copco Lake were placed under mandatory evacuation for four days. We have witnessed helicopters dip into the lake many times during fire fighting in our area and just over the Oregon border.

Lastly, we also object to the tactics used by proponents of dam removals, namely the following:

1. We, the property owners living on the Klamath, many of us also rate payers, were never given a seat at the table in determining the fate of the Klamath dams. We are true stakeholders.
2. Instead, reasonable advance notice of the times and places of "official" dam determination

meetings, has seldom been forthcoming to those opposed to dam removals, including old Siskiyou County Supervisors.

3. There has been a dismissive attitude toward, and an unwillingness to consider seriously, viable alternatives for fish passage on the Klamath verses dam preservation which would save valuable hydropower infrastructure. Such alternatives for fish passage include:
   a. Fish tunnel passage, as proposed by Shasta Ardiene
   b. Trap and haul
   c. Fish cannons as available from the company, "Whooshh Innovations"

4. There has been an unwillingness to achieve a compromise with the Copco Lake Fire Protection District through the government to government process of Coordination which was abandoned by government dam removal proponents.

Carl and Linda Ebert
26834 Copco Road
Montague, California 96064
530-459-5318

17

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: Steve RADFord

EMAIL (if desired):

ORGANIZATION (if applicable):

REMARKS: Go Away!

LOCATION (circle one): ARCATA SACRAMENTO (YREKA)

18

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: Mark Fischer

EMAIL (if desired):

ORGANIZATION (if applicable):

REMARKS:

LOCATION (circle one): ARCATA SACRAMENTO (YREKA)

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

(19)

January 2017

(Please Print Clearly)

NAME: Nita Still

EMAIL (if desired): nitastill@snowcrest.net

ORGANIZATION (if applicable):

REMARKS: Read from letter

LOCATION (circle one): ARCATA SACRAMENTO YREKA

19

Nita Still

In the year of 2009, we voted to keep our three dams by 80%; the people in Oregon also voted to keep their one dam. There is great manipulation and conniving going on here with those who want to take out the dams holding secret meetings with some of our Representatives and the two governors named "Brown." These NGO-Stakeholder-Environmentalists will do anything to have our dams removed. The KBRA expired and now they have made a KRRC. They are involving every agency in hopes they will get their way. There is also another problem, the Klamath river is flowing over the burial grounds of the Shasta tribe. It was covered by water, and now they want to expose it, all against the Antiquities Act. There has been no courtesy or respect shown to the Shasta Tribe, so you should not be cooperating with these "killers of dams!" You should not cooperating with these NGO-Stakeholder-Environmentalists!
The TMDL's will not be what you want them to be, because the Klamath river runs through a volcanic area, and there are hot springs running from tributaries near the Keno Dam. A company named, "Quick Silver Mining," mined mercury in that area in the 19th century. Mercury is also called quicksilver. Besides, it is the truth that the water, after if goes through the dams is much cleaner.
If the dams are removed there will be much less water in the river so the TMDL's will be worse.
In 1851, George Gibbs went with another man who was having the Indians along the Klamath river to sign treaties. He told about one area, possibly, sometime in October, maybe near the Hamburg community, where there were thousands of dead salmon, possibly because the water was low and or some of them had spawned. They had to move their camp way up a tributary to get away from the bad odor.
The Karuk tribe in the 1970's took the Shasta "R Treaty" and became a recognized tribe; they are also claiming Shasta Territory, as well as claiming there is not enough fish for them when there has been more than enough fish. But, if the dams come out, there will not be enough water for the salmon to spawn or available water to do their "canoe dance." And the Coho Salmon is NOT indigenous to this area!
Please, do not involve yourselves in something that is as conniving, mean and unjust, as is this plot to ~~remove~~ destroy our dams! We would like you to respect our Rights as well as to be Honest!
Thank you, Sincerely, Nita Still

Nita

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

20

NAME: LEO T. BERGERON

EMAIL (if desired): BERGERON@INREACH.COM

ORGANIZATION (if applicable):

REMARKS: CLEAN WATER IN THE KLAMATH

LOCATION (circle one): ARCATA SACRAMENTO YREKA

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

21

January 2017

(Please Print Clearly)

NAME: JOHN LIVINGSTON

EMAIL (if desired): LIVINGSTONjohn@att.net

ORGANIZATION (if applicable):

REMARKS: ~~Klamath~~ Dam removal will increase recreational revenue.

LOCATION (circle one): ARCATA SACRAMENTO YREKA

SIERRA CLUB
FOUNDED 1892

(21)

Shasta Group
Mother Lode Chapter
P.O. Box 491554
Redding, CA 96049-1554
www.motherlode.sierraclub.org/shasta

January 26, 2017

Parker Thaler
State Water Resources Control Board
P.O. Box 2000
Sacramento, CA 95812-2000

Subject: Scoping Meeting Input for Environmental Impact Report for Dam Removal on the Klamath River

Thank you for accepting input to the Environmental Impact Report for dam removal on the Klamath River associated with PacifiCorp's FERC license Surrender. The Shasta Group of the Sierra Club is located in northeastern California and consists of approximately 800 members. Most members have visited the Klamath River for recreation such as rafting, canoeing, sightseeing or fishing. The Sierra Club supports the Klamath River Renewal Corporation (KRRC) proposed project of decommissioning sufficient portions of the Lower Klamath Project to provide for volitional fish passage and a free flowing Klamath River. Only removal of the dams will accomplish the objective of unrestricted fish passage and improvement of water quality. The CEQA process should proceed as quickly as possible and therefore existing documents should be used where appropriate. We look forward to providing comments on the Draft Environmental Impact Report.

Respectfully,

John Livingston

John Livingston
Chair of the Executive Committee, Shasta Group

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

(22)

January 2017
(Please Print Clearly)

NAME: Greg Kuck

EMAIL (if desired):

ORGANIZATION (if applicable):

REMARKS: ? what is the (trump) Administration going to say about this project.

LOCATION (circle one): ARCATA SACRAMENTO (YREKA)

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

23

NAME: JAVIER I. KINNEY, DIRECTOR OFFICE OF SELF GOV.

EMAIL (if desired):

ORGANIZATION (if applicable): YUROK TRIBE

REMARKS: F/I SUPPORT FOR DAM REMOVAL BY 2020 FOR CULTURAL, ECONOMIC, LEGAL, SOCIAL & ENVIRONMENTAL REASONS.

LOCATION (circle one): ARCATA SACRAMENTO (YREKA)

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

29

NAME: Linda Oliver

EMAIL (if desired): Klamathbbg@aol.com

ORGANIZATION (if applicable): Copco Lake Fire Protection Dist

REMARKS: No one seems to care about the vote or Continuing Coordination w/ Copco Lake Fire Protection District

LOCATION (circle one): ARCATA SACRAMENTO YREKA

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

25

NAME: JAMES ADAMS

EMAIL (if desired):

ORGANIZATION (if applicable):

REMARKS:

LOCATION (circle one): ARCATA SACRAMENTO YREKA

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

26

January 2017

(Please Print Clearly)

NAME: Kristen Sellmer

EMAIL (if desired):

ORGANIZATION (if applicable): Salmon River Restoration Council

REMARKS:

LOCATION (circle one): ARCATA SACRAMENTO YREKA

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

27

January 2017

(Please Print Clearly)

NAME: Mark Baird

EMAIL (if desired):

ORGANIZATION (if applicable):

REMARKS: Dam Removal

LOCATION (circle one): ARCATA SACRAMENTO YREKA

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: Don Mackintosh

EMAIL (if desired):

ORGANIZATION (if applicable):

REMARKS:

LOCATION (circle one): ARCATA SACRAMENTO YREKA

29

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: JERRY BACIGALUPI

EMAIL (if desired): dbaci@surecrest.net

ORGANIZATION (if applicable): J.L.B. CONST. & ENGR.

REMARKS:

LOCATION (circle one): ARCATA SACRAMENTO (YREKA)

29

State Water Resources Control Board Scoping Meeting
Notice of Preparation (NOP)
For the Environmental Impact Report (EIR) for the Lower Klamath Project (LKP) License Surrender by Pacific Corp to the Klamath River Renewal Corporation (KRRC) with the intent of decommissioning in place or removing four Hydroelectric Dams on the Klamath River

Best Western Miners Inn Convention Center
122 E. Miner St, Yreka, Calif.

January 26, 2017

State Water Resources Control Board
Division of Water Rights
P.O. Box 2000; Sacramento, Calif. 95812

Attention: Mr. Parker Thaler

As a Professional Engineer, if Responsible for moving the Proposed Action forward, I would propose the following actions PRIOR TO THE PREPARATION OF AN EIR:

1. Because of the controversy over the Department Of Interior's (DOI) statements' that the proposed action would provide 420 miles of additional Anadromous Fish Habitat above the dams proposed for removal, **insist** that a 5 year **Truck and Haul Study** be initiated utilizing at least 50 tagged migrating female Coho Salmon with corresponding males per year captured at the Iron Gate Hatchery (R.M.190) and transported to the head waters of the Klamath R. (R.M.254). Note: the beginning of the Klamath R. coincides with the end of Link River which drains from Upper Lake and the inlet waters of Lake Ewanna in the city of Klamath Falls.

   This controversy exists because historically several reefs and dikes were present above Iron Gate Reservoir that precluded anadromous fish travel to Upper Lake. Currently because of the steep River gradient between Copo 1 Reservoir and J.C. Boyle's Dam, coupled with the environmental negatives of Upper Lake and Agency Lake (30+ miles length, shallow, high predation, high in nitrates and sulfates) it appears that it would be almost impossible for Anadromous fish to traverse to the five river tributaries above Upper Lake, spawn, and the Juveniles return to the point of release. Former employees of the Dept. of F&WL made the comment that it is impossible for the river habitat above Iron Gate Dam to produce the 6 million fingerlings produced by the Hatchery and It is impossible for this portion of the Rived to ever be Anadromous Fish Habitat. **DO THE STUDY**
2. As a matter of State Law, submit the Dam Removal Proposals to the **Division of Dam Safety** for their Statuary Requirements and Approvals.

   Recognizing that the Dams are currently in good condition and provide a 25% reduction in peak flows, based on the 1964 flood hydrograph gage located near the Iron Gate Hatchery. I would recommend that a major flood study is necessary to address

potential damage and protect private properties and the Public Roads and Bridges along Hwy 96.

3. As a matter of State Law, require the preparation of a **Storm Water Pollution Prevention Plan (SWPPP)** submitted to the State Water Resources Control Board. Currently the Board requires a SWPPP be prepared and approved for **all projects** disturbing more than 1 acre of soil.

   The proposed Dam Removal Project exposes upwards of 3,000 acres of exposed soils with the potential of eroding 20 million cubic yards of contaminated sediments down the Klamath R. These sediments equate to a mass 150 feet wide by 190 miles down the Klamath R. below Iron Gate Dam to the estuary. In my opinion it would be an impossibility to meet SWRCB and Environmental Requirements without removing contaminated sediments prior to Dam breaching or removals.

4. As a matter of County Regulations, submit the Dam Removal Proposals to the **Siskiyou Co. Flood Control and Water Conservation District (SCFCWCD)** and **Klamath Co. Ore.** for their Requirements and Recommendations.

   Siskiyou County and Klamath County has the statutory responsibility to provide public safety to all citizens and protect the environment for present and future generations. Before any Dams are breached or removed, the Proposed Project must be submitted to Siskiyou County and Klamath County for approvals under existing statutes and regulations as required by the **SCFCWCD** and in the **Klamath Basin Compact.**

As a Professional Engineer, Responsible for <u>THE PREPARATION OF AN EIR</u>, I would propose the following after the above recommended studies were completed and State and County Agencies have been consulted and made their recommendations and requirements. The Calif. Environmental Quality Act (CEQA) requires the following:

1. **Sec. 21000 Legislative Intent:** (d) *The capacity of the environment is limited, and it is the intent of the Legislature that the government of the state take immediate steps to identify any critical thresholds for the health and safety of the people of the state and take all coordinated actions necessary to prevent such thresholds being reached.*
2. **Sec. 21001 Additional Legislative Intent:** (c) *Prevent the elimination of fish or wildlife species due to man's activities, insure that fish or wildlife populations do not drop below self-prepetuating levels etc.*
3. **Sec. 21002 Approval of projects: feasible alternatives or mitigation measures:** *The Legislature finds and declares that it is the policy of the state that public agencies should not approve projects as proposed if there are feasible alternatives or feasible mitigations measures available which would substantially lessen the significant environmental effects of the project etc.*
4. **Sec. 21003.1 Environmental effects of projects; comments from public and public agencies to lead agencies; availability of information:** (b) *Information relevant to the significant effects of a project, alternatives, and mitigation measures which substantially reduce the effects shall be made available as soon as possible by lead agencies, etc.*

The release of a potential 20 million cubic yards of contaminated sediments down river, the removal of flood protection structures, and the absence of viable studies and alternatives such as those proposed by Siskiyou County and the Siskiyou County Water Users Association violates the Legislative Intent of CEQA.

Siskiyou County and the SCWUA supports and recommends to the NCRWCQB the following projects which will mitigate water instream flow, water quality, retain Iron Gate Hatchery and promote fish passage:

1. Implement the Shasta Nation Tunnel Unassisted Anadromous Fish Passageway around Iron Gate, Copco 1 and Copco 2 Reservoirs at a cost of $50 million (1/6th the $300 million cost estimated for installing fish ladders). This will provide anadromous fish passage around Iron Gate, Copco 1, and Copco 2 reservoirs to the pre dam 20 miles of native river habitat above Copco 1 Reservoir. Moonshine Falls, directly below J.C. Boyles Reservoir, is cited by CFW to be the upper most habitats for anadromous fish. **Note: 1.**The downstream Dams have absolutely nothing to do with the Upper Basin water wars or the DOI Klamath Project regulated flows to farmers and ranchers. **2.** The California dams have been recently inspected by the Division of Dam Safety and are in good condition. These dams provide considerable down river flood and surge protection and provide an average yearly water quality improvement. **3.** Given the condition of a complete Klamath River cutoff by the DOI or a severe drought. The dams can also **easily provide CDFG's (CFW) 700 cfs minimum instream river flows for a three month period** with adequate storage retained for Lake Habitat.
2. Implement the 60,000 ac.ft. Klamath River/Shasta Valley Reserved Water Right (A0169580), transfer canal and storage facilities to supplement Montague Irrigation District's irrigation water with Klamath R. water (poor water quality containing high nutrients). This project augments current irrigation supplies, allows for additional land to become irrigable, and replaces naturally impaired upper Klamath R. water with higher quality water. A portion of the reduced water demands (good water quality) can be released by the District from Lake Shastina or from their wells into the Shasta River, improving the water quality in both the Shasta River and in the Klamath River below Iron Gate Reservoir per FERC recommended requirements for relicensing. The Shasta Valley RCD & CDFG contracted a similar augmentation study in 2007 that has since been shelved. *(Because it depends on retaining the dams scheduled for removals)* Ref: (CDFG Project No. P0310329)

3. Establish additional reliable storage facilities within the Scott and Quartz Valleys, including increasing storage capacities of high-elevation lakes as recommended in the October 1991 Department of Water Resources Study entitled: *SCOTT RIVER FLOW AUGMENTATION STUDY.* These storage facilities will augment late summer and fall instream flows and supplement agricultural irrigation water.

These Proposals Will:

- **Save the Hydro-electric Dams** which generate clean, green power to 70,000 homes and protect the lake habitat and homes in and around the reservoirs by removing dam removals from the KBRA and eliminating the KHSA.
- **Save IronGate Fish Hatchery,** which is dependent on cool low level water releases from Iron Gate Reservoir, that releases over **six million salmon and steelhead fingerlings per year** in to the Klamath River. **Note: (** It is *impossible for the Klamath River Habitat above IronGate Dam to duplicate the production of IronGate Hatchery).*
- **Save the Klamath River from complete destruction** by eliminating the **irresponsible** releasing of 20 million cubic yards of sediments retained the dams.
- **Save future Klamath River water demands** by State and Federal Agencies from the **Upper and Lower Klamath Basins and the Scott and Shasta Rivers** to satisfy requirements proposed in the KBRA for **environmental waters**.
- **Preserves the sacred Shasta Nation Villages and Burial Sites** beneath the waters of Iron Gate and CopCo Reservoirs.
- **Provide additional instream flows** which will enhance fisheries and benefit the Tribes, NGO's and fishing interest.
- **Provide reduced electricity rates for On and Off Project irrigators and all ratepayers** within the creation of a Bi-State Alliance JPA or PUD.
- **Provide Governmental Agencies common sense and engineered alternatives** to maintain the economic and environmental sustainability of the Klamath River Basin.

This proposed over reach by State and Federal Agencies to remove structural sound Hydro Dams on the Klamath River will impact the environment, local economy, and lives of the local citizens and for those reasons the above alternatives must be studied to comply with CEQA requirements and existing laws and regulations, including Coordination between County, Federal, and State Governments.

Respectfully submitted:

Jerry L. Bacigalupi

Jerry L. Bacigalupi PE 1/26/17

PO Box 309 Montague, Calif. 96064

Attachments: Comments on the Klamath Facilities Removal, Public Draft, EIR

Comments on the Klamath Facilities Removal, Final EIS/EIR

Nov, 18, 2011

Jerry L. Bacigalupi, P.E.
P.O. Box 309
Montague, CA. 96064
530 459 5546 916 768 5015

Ms. Elizabeth Vasquez
Bureau of Reclamation
2800 Cottage Way
Sacramento, CA 95825

Gordon Leppig
California Department of Fish & Game
619 Second Street
Eureka, CA 95501

Dear Ms. Vasquez and Mr. Leppig:

The following are comments to the **Klamath Facilities Removal, Public Draft, EIS/EIR**

1) **The DOI and DFG are improperly committed to dam removals such that they will not and cannot consider feasible alternatives and mitigation measures because they have already committed to the KBRA and KHSA settlement agreements which will become invalid if dams are not removed.**

The California Supreme Court in *Save Tara v. City of West Hollywood* (2008) 45 Cal.4th 116 (*"Save Tara"*) cautioned lead agencies that CEQA compliance should occur before committing to a particular project so that environmental review does not devolve into a *post hoc* rationalization of a decision already made. "A fundamental purpose of an EIR is to provide decision makers with information they can use in deciding *whether* to approve a proposed project, not to inform them of the environmental effects of projects that they have already approved." (*Laurel Heights Improvement Assoc. v. Regents of the University of California* (1988) 47 Cal.3d 376, 394 [emphasis in original]). Accordingly, "before conducting CEQA review, agencies must not 'take any action' that significantly furthers a project 'in any manner that forecloses alternatives or mitigation measures that would ordinarily be of CEQA review of that public project.'" (*Save Tara, supra*, 45 Cal.4th at 138).

a) Page ES-17 states "This EIR/EIS is being prepared in compliance with NEPA and CEQA." This Statement is intentionally misleading since these actions were reached in secret meetings, with a pre-determined out-come as expressed by the Secretary of the Interior in his speech to the Commonwealth Club in San Francisco, California on September 9, 2011 (prior to the comment period for this document).

2) **The Environmental Impact Report/Environmental Impact Statement (EIR/EIS) fails to follow the law as required by the National Environmental Policy Act of 1969 :**
(Pub. L. 91-190, 42 U.S.C. 4321-4347 January 1, 1070, as amended, and Pub. L. 94-52, July 3, 1975, Pub. L. 94-83, August 9, 1975, and Pub. L. 97-258, sec. 4(b), Sept. 13, 1982).

Title 42 of the United States Code 4331, Section 101 (b) states: Section 101 (42 USC 4331) states:

" In order to carry out the policy set forth in this Act, it is the continuing responsibility of the Federal Government to use all practicable means, consistent with other essential considerations of national policy, to improve and **coordinate** federal plans, functions, programs, and resources to the end that the nation may:

1. Fulfill the responsibilities of each generation as trustee of the environment to succeeding generations;
2. Assure for all Americans safe, healthful, productive, and for an aesthetically and culturally pleasing surroundings;
3. Attain the widest range of beneficial uses of the environment without degradation, risk to health and safety, or other undesirable and unintended consequences;
4. Preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment that supports diversity, and variety of individual choices;
5. Achieve a balance between population and resource which will permit high standards of living and a wide sharing of life's amenities;
6. Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources."

3) **The "Lead Agencies", as defined in the EIR/EIS, have been and continue to violate applicable existing federal, state, and local laws and regulations.**

a) The planning and zoning laws of the State of California, starting with Section 65000 of the Government Code, require that all lands be zoned appropriately with regard to their highest and best uses. The Siskiyou County Planning and Zoning Laws and the Land Use Element of the General Plan is required to designate the location and permitted uses of the land within and adjacent to these dam and reservoir areas, and identify **lands downstream which are subject to flooding.** The Conservation Element of the General Plan provides for the conservation, development, and utilization of natural resources including water and its **hydraulic forces, flood management, water conservation,** and **the prevention, control and correction of soil erosion.**

b) Recent legislation passed in 2007, AB 70 (Ch. 367) and AB 162 (Ch. 369) expands the requirement for Cities and Counties to incorporate **flood control and**

management and provides that a city or county may be required to contribute its fair and reasonable share of the property damage caused by flooding, including State and Federal Government caused flooding by dam removal. As such, it is a critical legal and budgetary matter of the local city and county governing bodies to not only be included in this process, but to also weigh in on the final decisions in this matter. The Siskiyou County Board of Supervisors did not sign the KBRA & KHSA for such matters and the Lead Agencies have failed to consider this and other important matters addressed herein and by other stakeholders.

c) The State Planning and Zoning Laws gave authority to the local governing body (The Siskiyou County Board of Supervisors) for controlling land uses and to protect resources and property rights.

d) The Secretary of the Interior does not have proper legal jurisdiction over private land use in Siskiyou County to make a determination to remove 3 privately owned dams with out coordination and approvals by Siskiyou County.

4) **The Lead Agencies and this EIR/EIS have failed to identify and properly weigh and consider the benefits of alternatives that do not support the KBRA & KHSA No. 11 (Siskiyou County's environmentally preferable and superior alternative).**

Per EIR/EIS section ES.7.3 Environmentally Preferable/Superior Alternative:
"NEPA requires the Lead Agency to identify the alternative or alternatives that are environmentally preferable in the Record of Decision (ROD) (40 CFR Part 1505.2(b)). *to quote*
"**The environmentally preferable alternative generally refers to the alternative that would result in the fewest adverse effects to the biological and physical environment. It is also the alternative that would best protect, preserve, and enhance historic, cultural, and natural resources.** Although this alternative must be identified in the ROD, it need not be selected for implementation."
Section 15126.6(e)(2) of the CEQA Guidelines requires agencies to identify the environmentally superior alternative in a draft EIR. If the No Project Alternative is the environmentally superior alternative, an additional environmentally superior alternative must be identified among the other alternatives.

a) **<u>Alternative 3</u> (Partial Facilities Removal of Four Dams) has been identified as the environmentally superior alternative:** *to quote*
"Alternative 3 would provide similar long-term benefits when compared with Alternative 2*(complete removals),* but would reduce short-term impacts because it involves less construction. Alternative 3 would result in superior long-term beneficial environmental effects. **In summary, Alternative 3 is considered the environmentally superior alternative among all the alternatives because it provides long-term beneficial environmental effects, while reducing some of the short-term significant effects of the Proposed Action (Alternative 2)."**

b) **The following environmentally preferable and superior alternative was not properly considered; Alternative 11 (Fish Bypass: Alternative Tunnel Route) on page 4-11 (4.2.11)** clearly states that it does not meet consideration because it is not consistent with the requirements of the KBRA and KHSA as it would not remove any of the four dams. Under NEPA and CEQA **THIS ALTERNATIVE MUST BE RECONSIDERED and must not be dependent on the predetermined, undisclosed KBRA/KHSA agreements.**

c) **Alternative 11 (Fish Bypass: Alternative Tunnel Route) is identified by Siskiyou County as the "environmentally preferable alternative that would result in a cost of 1/6 the cost of installing fish ladders, 5% the cost of dam removals, and the fewest adverse effects to the biological and physical environment." THIS ALTERNATIVE IS SUPPORTED BY 80% OF THE COUNTY AND MUST BE RE-CONSIDERED under CEQA and NEPA requirements not dependent on secrete KBRA/KHSA agreements.**

5) **In Chapter 3 - 3.6 Flood Hydrology of the EIR/EIS, data provided does not accurately represent current independent scientific or historical data. The data chosen for the study was that the data that supports the Lead Agencies desired outcomes.**

a) Table 3.6-5 shows the 100-yr flows at Keno at 11,800cfs and Iron Gate at 31,460cfs. **However, a statistical analysis using data from 1961 provides flows at Keno at 12,000cfs and Iron Gate at 30,600cfs** (close).

b) Table 3.6-9 shows a 6.9% reduction in the flood attenuation of Iron Gate and Copco Reservoirs combined. **This is in substantial disagreement with an engineered independent evaluation.** By using the 1964 flood data for Gage 11516530 and a t/c in of 24 hr, t/c out of 48 hr. an inflow out flow hydrograph shows a 22% reduction in peek flow and a 9 hour delay in peek discharge.

c) Table 3.6-5, the 100 yr. flood plain below Iron Gate Reservoir, and the write up needs to be revised to **show that the Dams Provide Critical Flood Protection.**

6) **The EIR/EIS fails to weigh basic risks associated with Flood Hydrology.** The flood protection currently provided by the dams in place is notable. Without the dams much of the private property adjacent to the Lower Klamath River would be subject to severe flooding and erosion. Highway 96 may have to be relocated in several locations and many bridges may need to be replaced to provide the same level of service and protection that we currently enjoy.

a) The 1964 flood destroyed many bridges on the Lower Klamath and washed out much of Highway 96. All of the dams that are proposed for removal were in place during the 1964 flooding. All roadways and bridges were re-located above the calculated **B**ase **F**lood **E**levation considering all existing dams in place. DOI

determined the existing floodplain by computing the 100 year flood and then mapping the extent of that floodplain on the existing topography. The existing floodplain may be different than that proposed by FEMA because it is based upon more current information.

b) DOI determined the 100-yr floodplain after dam removal. Based upon the most current inventory of structures downstream of Iron Gate Dam to Humbug Creek over 24 residences are within the existing 100 year flood plain. Less than 6 residences and other structures such as garages are outside of this flood plain, but may be put into the 100 year floodplain after removal of the dams. However, the final determination of the future 100-yr floodplain after dam removal will be made by FEMA. The purpose of the analysis was to estimate the costs to mitigate the increase in flood risk. The existing bridges are within the 100-year floodplain; however, these structures would need to be evaluated to determine if they would still maintain enough clearance to not be inundated by flooding. Not all of the structures that could be exposed to increased flooding risks are permanent..

7) The EIR/EIS Mitigation Measures downplay real risks presented and put the public and environment at severe risk. **The EIR/EIS change to the 100-year floodplain inundation area downstream from Iron Gate Dam would increase the risks of flooding structures; therefore, the impact on flood hydrology would be significant. Mitigation Measures H-1 and H-2 assign and thereby reduce the impact to flood hydrology to less than significant.** This conclusion is, at best, irresponsible. By definition, an increase in risk to one habitable structure or bridge is to be considered significant according to the significance criteria.

8) **Statements made in the EIR/EIS about current dam conditions and impacts of removing the dams are unsupported and dishonest.** These dams are in very good condition according to the Ca. Div. of Dam Safety. The primary benefits and reasons for building dams is for water conservation and management, clean energy production and flood control. For example;

a) The EIR/EIS states; *"removing the Four Facilities could reduce the risks associated with a dam failure.* The Four Facilities, collectively, store over 169,000 acre-feet of water when they are full. The dams are inspected regularly, and the probability for failure has been found to be low. However, if a dam failed, it could inundate a portion of the downstream watershed (Siskiyou County website 2011). **Removing the Four Facilities would eliminate the potential for dam failure and subsequent flood damages.** Therefore, eliminating the dam failure risk associated with the Four Facilities would have a beneficial effect on flood hydrology."

b) The EIR/EIS states; **"Therefore, it is anticipated that implementation of the Emergency Response Plan would generate no change in flood risk when compared to existing conditions, although it would likely help to reduce damage to property or loss of life due to a flood event which would be a beneficial effect to flood risks. Implementing the Emergency Response Plan will likely require**

the analysis of changes to flood risks in future environmental compliance investigations as appropriate."

9) The EIR/EIS Mitigation Measures downplay real risks presented, offer inadequate mitigation measures and put the public and environment at severe risk ***For example;***

   a) ***Per EIR/EIS section 3.6.4.4 Mitigation Measures, Mitigation Measure H-1:*** "Prior to dam removal, the **DRE will inform the National Weather Service, River Forecast Center, of a planned major hydraulic change (removal of four dams)** to the Klamath River that could potentially affect the timing and magnitude of flooding below Iron Gate. **The River Forecast Center is the federal agency that provides official public warning of floods.** As needed, the River Forecast Center would update their hydrologic model of the Klamath River to incorporate these hydraulic changes so that changes to the timing and magnitude of flood peaks would be included in their forecasts. As currently occurs, flood forecasts and flood warnings would be publicly posted by the River Forecast Center for use by federal, state, county, tribal, and local agencies, as well as the public, so timely decisions regarding evacuation or emergency response could be made. Prior to dam removal, the DRE will inform FEMA of a planned major hydraulic change to the Klamath River that could affect the 100-year flood plain. The DRE will ensure recent hydrologic/hydraulic modeling, and updates to the land elevation mapping, will be provided to FEMA so they can update their 100-year flood plain maps downstream of Iron Gate Dam (as needed), so flood risks (real-time and long-term) can be evaluated and responded to by agencies, the private sector, and the public.

10) The EIR/EIS Mitigation Measures display the agencies force of will over residents, fail to offer adequate mitigation plans to the potentially affected inhabitants and put the public and environment at severe risk ***For example;***

   a) ***Mitigation Measure H-2:*** The **DRE will work with willing landowners to move or relocate permanent, legally established, permitted, habitable structures in place before dam removal.** The DRE will move or elevate structures where feasible that could be affected by changes to the 100-year flood inundation area as a result of the removal of the Four Facilities.
   b) **Effectiveness of Mitigation in Reducing Consequence** These mitigation measures will be effective as they will identify the extent of the increased flood risks and take measures which will reduce the risks for loss, injury or death from flooding.
   c) **Agency Responsible for Mitigation Implementation.** The DRE would be responsible for implementing mitigation measures H-1 and H-2.

   These are not "Mitigation Measures"... a telephone call or radio broadcast to tell you that you are about to be flooded. As stated above, the EIR/EIS fails to present and weigh sound scientific data and make conclusions that are in the best interest of the environment, community and lives of humans and species downstream of the dams.

11) **The sediment removal proposal is a scientific impossibility. The Lead Agencies failed to demonstrate adequate scientific knowledge to perform and make scientifically sound decisions.**
Per the EIR/EIS; 3.2 Sediment Removal: Dam removal would release some of the accumulated sediments downstream. The Proposed Action includes the use of erosion from river flows to flush the sediment behind the dams downstream during facility removal. Reservoir drawdown would focus on the wet season in order to flush the sediment downstream with the natural seasonal high flows. Modeling studies indicate that drawdown would erode and flush 41 to 65 percent of the stored sediment downstream (DOI 2011). The initial drawdown would begin slowly, to minimize riverbank erosion, with the rate increasing as water levels drop to maximize the amount of sediment flushed down stream. Most of the sediment remaining on the riverbank slopes would stabilize and would not erode downstream in subsequent years.

a) **As an engineer of dams and bridges, formerly with Cal Trans, I can attest that the standing water behind the dam will not transport sediments to the breached area of the dam during drawdown. The only sediment transport will be within the remaining river after the reservoirs are drained.**

12) **The EIR/EIS fails to consider logical scientifically supported impacts and mitigation measures related to the removal the sedimentation during and after dam removal.** This failure leads to an unnecessary risks presented to the public and the environment.

Per the EIR/EIS section3.2.1 Option: Sediment Removal, "If analysis indicates that the release of sediment could result in significant effects, the EIS/EIR may include consideration of dredging sediments out of the reservoirs before removing the dams if this measure is determined to be feasible. Dredging would focus on the area within the new river area; sediment remaining above the new stream level would only require removal if the slopes would not be stable."

a) Surveys to date have shown water content in the sediments behind the reservoir to average 80 percent by volume (Eilers and Gubala 2003). Once dredging began, the spoils would be pumped to a detention area near the reservoir for the sediments to dry. Dredging and the mechanical removal of sediment from the reservoirs would require equipment in addition to that needed for dam removal. This additional equipment would include barges, dredges, and pumps.

b) Storing the spoils after removal from the reservoirs would require an area of sufficient size to allow the sediment to be spread and dried

c) **This option, being the only viable option to mitigate sediment impacts upon dam removals is not on the table because of predetermined conclusions that funding would not be approved or available to support actual projected cost. This is the reason that Alternative 3 (Partial removal of 4 dams) was selected as the:**

i) **Initial sediment study:** 20.4 million cubic yards with 84% washing down river

ii) **Recent sediment analysis:** 13.1 million cubic yards with 41 to 65% washing down river

iii) **Analyses:** Sediment depth below Iron Gate to the ocean assuming a river bottom width of 150'and a length of 190 miles
Initial sediment study: 3.1 feet depth
Recent sediment analysis: 1.0 to 1.5 feet depth

d) The recent study appears to be in line with recent attempts to reduce cost in support to dam removals with limited funding. The State Water Quality Control Board and Department of Fish and Game, and the U.S. Corps of Engineers regulate all private construction projects involving disturbed soil, within a drainage watercourse. **How could public agencies (for and by the peope), even consider such an irresponsible action?**

13) The Lead Agencies failed to present a truthful and logical cost/benefit analysis for the Secretary or any reviewer to make a logical determination. **The cost proposals for all the alternatives are either intentionally omitted or were not conducted. How could you make a decision on a project without accurate detailed cost estimates?**

CONCLUSION:

This document is riddled with bias conclusions and inappropriate mitigation measures which are not supported by fact, respected science or properly engineered studies. **This document was prepared supporting a predetermined goal (Removing 4 dams on the Klamath River) and needs major revisions to comply with NEPA and CEQA regulations.**

Thank you for considering my opinions.

Respectfully submitted,

Jerry L. Bacigalupi

Jerry L. Bacigalupi P.E. (RCE 18063)

To: Ms. Elizabeth Vasquez
Bureau of Reclamation
2800 Cottage Way
Sacramento, CA 95825

June 13, 2013

Gordon Leppig
California Department of Fish & Game
619 Second Street
Eureka, CA 95501

From: Jerry L. Bacigalupi
Professional Engineer (P.E.)
P.O. Box 309
Montague, CA. 96064 (530) 459-5546 (916) 768-5015c

Dear Ms. Vasquez and Mr. Leppig:

Following are my comments to the **Klamath Facilities Removal Final EIS/EIR** (dated December 2012, but not mailed to respondents until 04/05/13)

1) As a citizen and Professional Engineer I am disappointed at the professional integrity within the DOI and CDFG. In reviewing several of the EIS/EIR comments submitted to the DOI and the DOI responses, I am disturbed at the DOI's lack of professional knowledge, goal oriented responses, and spin **supporting dam removals.**

2) After reviewing my comments and the DOI responses, I feel that my comments were not addressed. **I would make the same comments again.** The point being that the EIR/EIS has not been properly completed because the **EIS/EIR process is flawed** with responses that lack professional and scientific integrity, and with probable misconduct, all supporting the KBRA / KHSA (Dam Removals). In addition viable alternatives with dams in place were not studied, and the facts that the Upper Basin Water Wars and the Klamath Hydro-Electric Facilities are not physically related. The KBRA & KHSA improperly mandate stakeholders agreeing to Hydro- Electric Dam Facility removals.

3) In particular I would like to address my highlighted comment #5 and DOI response **(Comment 6 Hydrology).** To quote my comment:
"In Chapter 3 - 3.6 Flood Hydrology of the EIR/EIS, data provided does not accurately represent current independent scientific or historical data. The data and conclusions presented was data that supports the Lead Agencies' desired outcomes and not supported by recognized engineering practices.

   a) Table 3.6-5 shows the 100-yr flows at Keno at 11,800cfs and Iron Gate at 31,460cfs. **A statistical analysis using data from Calif. Division of Dam Safety shows 100-yr. flows for Keno at 12,000cfs and Iron Gate at 30,600cfs. This is a close check, however;**
   Table 3.6-9 shows a 6.9% reduction in the flood attenuation of Iron Gate and COPCO Reservoirs combined.

This is in substantial disagreement with an engineered independent evaluation. Using the 1964 flood data for Gage 11516530 (29,400cfs peak flow at Iron Gate) an inflow out flow hydrograph combining both reservoirs shows a 22% reduction in peak flow and a 9 hour delay in peak discharge.

b) Table 3.6-9, the 100 yr. flood plain below Iron Gate Reservoir, and the write up needs to be recalculated and re-evaluated using properly engineered procedures for inflow/outflow analysis **based on historic hydrographs** to **show that the Dams Provide Critical Flood Protection."**

The DOI Response to my comment :

GP_LT_1230_1220-6 Master Response HYDG-1 Flood Protection. The comment author refers to an analysis of the 1964 flood documented in a memo delivered to Siskiyou County (Bacigalupi, 2010). In this analysis, it was concluded that Iron Gate Dam and Copco Dam reduce the 100-yr flood by 22 percent. However, a time step of 3 hours was used in Bacigalupi (2010), which is too large and this caused errors in the results. If the same analysis was performed with a time step of 15 minutes or smaller, the flood attenuation effects would be very similar to Reclamation (2D12b) and find that the attenuation of the 100-yr is near 7 percent as stated in the Draft EIS/EIR.

My comment to the DOI response:
The same analysis was performed using the same computerized program, same data, and varying the time steps of the inflow outflow hydrograph as suggested by the DOI. The results are as follows:

Time Step Hr.	Inflow cfs	Outflow cfs	Peak Flow Delay Hr.	Increase In Flow With Out Dams %	Remarks
3	35,700	29,400	9	22	Original
1	36,800	29,400	10	25	1Hr. Steps
.25(15min.)	37,250	29,400	10.25	26.7	15min. Steps

The above results show that the DOI makes rudimentary conclusion and statements that are in **error** and that have definite impacts on the decision of dam removals.
The Dams do provide substantial (26.7%) flood protection. Table 3.6-9. the 100yr. flood plain and write up needs to be revised.
The EIR/EIS process has not been completed. The EIS/EIR is flawed with responses that are in error, and lack professional and scientific integrity, all supporting the KBRA / KHSA (Dam Removals).

Respectfully submitted:

Jerry L. Bacigalupi 06/13/13
Jerry L. Bacigalupi

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SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: SUPERVISOR MICHAEL KOBSEFF

EMAIL (if desired): mkobseff@co.siskiyou.ca.us.

ORGANIZATION (if applicable): CHAIRMAN SISKIYOU COUNTY BOARD of SUPERVISORS

REMARKS:

LOCATION (circle one): ARCATA SACRAMENTO YREKA

COUNTY OF SISKIYOU
Board of Supervisors

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Tuesday, January 17, 2017

SISKIYOU COUNTY BOARD OF SUPERVISORS STATEMENT TO THE STATE WATER RESOURCES CONTROL BOARD REGARDING THEIR *NOTICE OF PREPERATION AND SCOPING MEETINGS FOR AN ENVIRONMENTAL IMPACT REPORT FOR THE LOWER KLAMATH PROJECT LICENSE SURRENDER*

The Siskiyou County Board of Supervisors would like to provide the following oral and written statement regarding the Water Boards notice of public scoping meetings in preparation of the Environmental Impact Report (EIR). In addition, the Board of Supervisors will be providing formal written comments by February 1st, 2017, in response to the *proposed* Notice of Preparation.

First, it seems that public notification of the original January 10th meeting was very limited, even within the County in which it is taking place. The Board of Supervisors was informed of the meeting by an individual who read about it on a local environmental group's webpage in late December 2016. We did not receive official notice from the Water Board until January 4, 2017, although it appears the notice was first sent out to certain people and groups on December 22, 2016. This short notice and limited communication violates, if not the letter, then certainly the spirit, of the law intended to notify and engage the public and solicit active participation. Unfortunately, this is not the first time situations like this have occurred. The County of Siskiyou deserves and demands adequate notice, at the earliest possible date, of all future public meetings.

Siskiyou County is concerned with the economic and environmental consequences that would impact the County if the four Lower Klamath River Dams were transferred to and removed by the Klamath River Renewal Corporation. To address a few of these concerns, the County continues to reiterate that the 20-30 million cubic yards of sediment that has collected behind the Dams, and would be released down the Klamath River after dam removal, has not been adequately evaluated to address the adverse local and environmental impacts. Over the last several years, water has been released from behind Copco Dam to initiate Klamath River pulse flows to help improve water quality and fisheries habitat during the summer months. If the Dams are removed, this water would not be available at the critical time needed, and would have to come from Upper Klamath Lake storage, which would impact agricultural and wildlife refuge deliveries in the Klamath Basin. Other issues include the potential for catastrophic floods, either during dam removal activities, or thereafter; and property value loss in the areas around Iron Gate and Copco Dams, which Siskiyou County estimates would be several million dollars. As part of the environmental process, it is the

Brandon Criss	Ed Valenzuela	Michael N. Kobseff	Lisa Nixon	Ray Haupt
District 1	*District 2*	*District 3*	*District 4*	*District 5*

Water Board's responsibility to fully address these issues, impacts to Siskiyou County and impacts to Klamath River water quality.

In the past, when the Klamath Basin Restoration Agreement and Klamath Hydroelectric Settlement Agreement were being developed, environmental documents limited the analysis area to a five mile stretch of the Klamath River, which was inadequate and in no way addresses the total effects and consequences of Dam removal. During any environmental process concerning the Klamath River, the area of analysis needs to consider the entire river system, surrounding areas, and local communities, including Siskiyou County. We also raise the issue that this would be difficult to do as the Water Board does not have any jurisdiction beyond California, which raises the question as to the legal ability of the Board to analyze impacts for a Dam located in Oregon, and waters originating in Oregon. Nevertheless, any deviation from full analysis would be in violation of *Title 14, Chapter 3 of the California Code of Regulations, Guidelines for Implementation of the California Environmental Quality Act.* In relation to this, the Water Board's documents outlining the process for water quality permit certification seem to assume that Dam removal is the determined outcome, which would make the environmental document pre-decisional, and would again violate the Code of Regulations. We are requesting that you not make this assumption, and that you meet the needs of all impacted environmental and natural resources, and give due diligence to the people, livelihood, and economy of Siskiyou County.

To reiterate, it is Siskiyou County's expectation that there will be a fair and complete analysis of all environmental consequences of the proposed Section 401 Certification, for the entire impacted Klamath River system. O*nly* if the Water Board thoroughly and transparently identifies, analyzes and determines whether possible mitigation measures are feasible, and would render identified impacts less than significant – and we submit that this is not possible - can the Water Board approve the requested 401 water quality certification. The California Environmental Quality Act, and interpreting case law, makes clear that proceeding without meeting these requirements would be an improper abuse of the Water Board's discretion in acting on this proposed project.

Thank you for the opportunity to make this statement on behalf of Siskiyou County. As indicated, we will submit more formal and detailed comments, particularly concerning the significant adverse environmental impacts to occur, as the *proposed* EIR progresses.

Michael N. Kobseff, Chairman
Siskiyou County Board of Supervisors

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

31

January 2017
(Please Print Clearly)

NAME: JOE JAMES

EMAIL (if desired):

ORGANIZATION (if applicable): YUROK TRIBE

REMARKS: Support Dam Removal by 2020.

LOCATION (circle one): ARCATA SACRAMENTO (YREKA)

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

32

January 2017
(Please Print Clearly)

NAME: ROBERT LINDAMOOD

EMAIL (if desired): BOB@LIBUSTERS.COM

ORGANIZATION (if applicable):

REMARKS: SALMON PROTECTION

LOCATION (circle one): ARCATA SACRAMENTO (YREKA)

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

33

January 2017

(Please Print Clearly)

NAME: Craig Tucker

EMAIL (if desired):

ORGANIZATION (if applicable): Karuk Tribe

REMARKS:

LOCATION (circle one): ARCATA SACRAMENTO YREKA

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

34

January 2017

(Please Print Clearly)

NAME: Konrad Fisher

EMAIL (if desired):

ORGANIZATION (if applicable): Klamath RiverKeeper

REMARKS:

LOCATION (circle one): ARCATA SACRAMENTO (YREKA)

85

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: John FOSTER

EMAIL (if desired):

ORGANIZATION (if applicable):

REMARKS:

LOCATION (circle one): ARCATA SACRAMENTO YREKA

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

36

January 2017
(Please Print Clearly)

NAME: Betty Hall – Shasta Nation

EMAIL (if desired):

ORGANIZATION (if applicable):

REMARKS: Save Native american sites

LOCATION (circle one): ARCATA SACRAMENTO YREKA

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

37

January 2017

(Please Print Clearly)

NAME: Roy Hall Shasta Nation

EMAIL (if desired):

ORGANIZATION (if applicable):

REMARKS: Dam Removal

LOCATION (circle one): ARCATA SACRAMENTO YREKA

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

38

January 2017

(Please Print Clearly)

NAME: Mike Mallory

EMAIL (if desired): mmallory@co.siskiyou.ca.us.

ORGANIZATION (if applicable): Siskiyou County Assessor-Recorder

REMARKS: Assessed value loss & corresponding loss in revenue if dams are removed

LOCATION (circle one): ARCATA SACRAMENTO YREKA

MIKE MALLORY, ASSESSOR - RECORDER
County of Siskiyou

Courthouse • 311 Fourth Street • Room 108 • Yreka, CA 96097-2984
Assessor (530) 842-8036 • Recorder (530) 842-8065 • FAX (530) 842-8059

38

January 26, 2017

California State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA 95812-2000
Parker.thaler@waterboards.ca.gov

Attn: Mr. Parker Thaler

Re: Scoping Comments Relating to EIR – Proposed Lower Klamath Project License Surrender

Dear Mr. Thaler:

As Siskiyou County Assessor-Recorder I submit the following comments and requests as provided for in the public scoping process. I will be presenting this information at tonight's Yreka Public Scoping Meeting, to be held at the Best Western Miner's Inn – Convention Center.

- Valuation studies to date at the Federal level have been woefully inadequate, as the Department of Interior has carefully crafted the Scope of Work to arrive at a predetermined outcome of minimal value impact in the event of dam removal ($2M to $2.5M total value loss). Appraisals to date have been based on the hypothetical assumption that the land underlying the lakes has been restored to its native condition with full access to a free-flowing river; structural and site improvements have been intentionally excluded from the analysis; and an estimate of nearly 1,500 "Potentially Impacted Parcels" has been grossly understated at just under 700 "Impacted Parcels." ***REQUEST:*** *Completely disregard any valuation study relating to Klamath Dam removal as commissioned by the Department of Interior. Provide an objective analysis of the loss in property values and tax revenues to all impacted parcels in the event of dam removal, with consideration of the mud flats and denuded landscape which will remain for years after dam removal.*

- The Klamath River dams, while not constructed specifically for flood control, are utilized to "temper" flows and reduce flooding. Moreover, there is a perception from the general public that the dams do, in fact, provide flood control, and that removal of the dams will increase flooding. Perception is reality when it comes to property values. This issue has been blatantly ignored thus far. ***REQUEST:*** *Analyze the impacts to property values and tax revenues along the Klamath River below Iron Gate Dam due to the real and/or perceived loss of flood control in the event of dam removal. In addition, silt deposition may change the river course and lead to more severe flooding, which must also be considered in the analysis.*

- Valuation of PacifiCorp's assets for property tax purposes is accomplished by the California State Board of Equalization (SBE) and assessed on the Board Roll of State Assessed Property (also known as the Unitary Roll). These values are transmitted to the County annually, and taxes are collected locally by the Siskiyou County Tax Collector. While PacifiCorp's total valuation at $162.6 Million is publically available, the underlying classification by property type is confidential, even to County Assessors. In the event of dam removal, all assets associated with the hydroelectric facilities will be removed along with corresponding assessments. Once represented by PacifiCorp as upwards of 20% of its total assessment, removal of these assets has the potential to reduce the Tax Roll by $32.5 Million in value. The corresponding loss of approximately $370,000 per year in taxes will have a big impact on the County of Siskiyou as well as the Hornbrook Elementary School District (which is the only basic aid school districts in Siskiyou County). ***REQUEST:*** *Analyze the impacts to property values and tax revenues caused by removal of the hydroelectric facilities from the Assessment Roll.*

Thanking you in advance for your attention to my concerns as outlined above. In the event that you should require any additional information and/or clarification, please do not hesitate to contact me.

Sincerely,



Mike Mallory
Siskiyou County Assessor-Recorder

MM:ss

cc: Michael Kobseff, Chair Siskiyou County Board of Supervisors
Elizabeth Nielsen, Siskiyou County Natural Resource Specialist

(397)

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: CHRISSIE REYNOLDS

EMAIL (if desired): littleeaglewomanseeing@gmail.com

ORGANIZATION (if applicable):

REMARKS: I WANT A HARD COPY OF THE EIR

LOCATION (circle one): ARCATA SACRAMENTO (YREKA)

39

Never be afraid to do what's right, especially if the well-being of a person or animal is at stake. Society's punishments are small compared to the wounds we inflict on our soul when we look the other way. -Martin Luther King

To the State Water Control Board,

My name is Chrissie Reynolds and I live at Copco Lake. I am a resident of Siskiyou County and a mom. First of all, I am outraged that the first I heard about the public meeting that was supposed to be held last Tuesday was from a facebook post from a part time resident to Copco ~~via Santa Barbara~~ and NOT FROM ANY OFFICIAL either from your organization or from my own elected government representative. I now understand that the latter is due to late notice from YOU. I am a property owner and stakeholder of what happens at Copco Lake. I received no notice of your intent to provide me with the opportunity to speak. And apparently you have received a letter from our Board of Supervisors also voicing their anger and displeasure at the lack of consistent notice with regards to some people (in favor of dam removal) being informed early and some people (not in favor of dam removal) being informed without much notice. I agree almost whole heartedly with what our Board wrote in response to you except that in regards to their statement on transparency, I feel that it is truly transparent that the residents of Siskiyou County are again being purposefully misled and that our due process is again being subverted by government agencies that are supposed to be looking out for the welfare of their citizenry but instead these citizens are having to speak up and out against the agencies with which their responsibilities are about furthering policies that are not in the public interest but in maintaining policies that benefit a certain agenda and not on the welfare of the People or the fish. It is absolutely absurd to me that when 80% of the residents of Siskyou County have voted NO on dam removal and spoken, written, and commented for over a decade now against dam removal, the false and misleading science of the last environmental impact study that was done which resulted in the firing of Dr Paul Houser who was THE Scientific Integrity Officer, and began a whistle blower case that ended up being settled out of court, to the lack of continued Coordination with the Copco Lake Fire Board and those meetings being satisfactory, to disregard of our Board of Supervisors and their expressed feelings and needs that we are undergoing this process again under these conditions are simply unacceptable. We the People are being denied due process by having our State Governors decide on their own that they want the dams out, ~~they will~~ set up a non profit entity with no accountability to anyone, and the state agencies now have an agenda to follow regardless of what laws either legally, morally or ethically with which they violate. In Siskiyou County's history there are harsh reminders of what governmental policies were with regards to the indigenous people who were here before our government was. They gathered the leaders of the Shasta people (who in 2017 are STILL NOT A FEDERALLY RECOGNIZED TRIBE) and under the

pretext of a feast were given tainted food and blankets with small pox in a genocidal attempt. It simply boggles the mind that these people are still not recognized with the proper respect or sovereignty that they inherently deserve. I myself am Japanese American with parents and grandparents that were stripped of their Constitutional Rights and had their homes, businesses and belongings taken from them while they were sent to first horse stables and then shipped out of state to be held in concentration camps in tar paper shacks in a barren desert landscape simply because that was the policy at the time. Now it seems, we are in times just as dark and incomprehensible because that is how we are being treated. Our rights are being ignored, denied and completely disrespected. The current agenda will be to lock us up and out from the lands on which we hold ownership through our property rights and for which we pay taxes, but no matter if we lose out property values, no matter that we don't want dam removal, no matter that we are being extorted by having to PAY FOR DAM REMOVAL on our power bills, some of us with properties in both Oregon and California so they have to pay for it twice and still lose on their property value, it all just dosen't seem to matter to these agencies that are simply "doing their job". You know, people who do their jobs without thinking of the people or the lives that they are impacting really ought to really KNOW what it feels like to robbed of the freedom and their Constitutional rights. They should lose their jobs if they are guilty of being complicit while these agendas are being carried out against the will and rights of American people who have an inherent and inalienable right to live where they want to live, in manners that they have self determined bring about their right to life and the pursuit of happiness and NO Government agency should be allowed to use policy to carry out eco terrorism against it's own people. The People have spoken. They said NO. You are not listening and you are using our tax money against us and furthering to cause pain and suffering to people with this constant nonsense. We want our Tribal People given the respect and recognition they deserve. We want our lake and reservoirs to continue to provide clean, green renewable energy to over 70,000 homes, we want to be able to hunt, fish and recreate in these areas, we want to keep these waters available for fire suppression, we want an end to geoengineering our weather and causing increased loss of life, we our property values back to where they were before the whole blue green algae lie and the beginning of this farce and we want no release of sediment down the river that would decimate life of all kinds. I hope you will see what is so transparent for all of us, we will not give up our lands, our water or our rights and we will hold accountable those who would lie, cheat, deceive and disregard us. Thank you. Chrissie Reynolds

Plant our food

NO

Past adequacy

John Bemel

range of alternatives

Hot Springs

Impacts to evaluate

- groundwater

Dam Removal

For | Against

road -

Dec 22nd

Feb 1st

mitigation

30-

1954 50 yrs

2006

Transfer Application

Be denied

45 miles

To the

Ocean

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

40

January 2017
(Please Print Clearly)

NAME: Ray Haupt

EMAIL (if desired):

ORGANIZATION (if applicable): Siskiyou County Supervisor

REMARKS:

LOCATION (circle one): ARCATA SACRAMENTO YREKA

40

California State Water Board
Re; Klamath Hydroelectric Facilities License Transfer

Comments regarding proposed Federal Clean Water Act and CA Porter Cologne Act Water Quality Certifications

CEQA/NEPA Comments

The Action of the Board is premature and attempts to sidestep federal processes and use former processes not vetted by Public Review and Appeal Processes or legal scrutiny through the courts.

In your previous Yreka public meeting the water board has stated their intent was to use the environmental analysis of preceding environmental analysis included in the 2012 Klamath Dam Removal EIS. This document has no legal standing and prevents tiering under federal statutes or agreements as outlined in; Council on Environmental Quality document, NEPA and CEQA: Integrating Federal and State Environmental Reviews February 2014.

Legal sufficiency for NEPA analysis is defined in law. CEQA Decisions may not tier to a NEPA Decision when the EIS has not concluded in a Record of Decision; CFR Title 40 section §1506.1 sub-part a; Limitations on actions during NEPA processes.

As recent as November 2016 the Federal Energy Regulatory Commission formally stated they have postponed the analysis of License Transfer until Mid-March 2017. This in part, due to incomplete application appendices from which to properly analyze the action before the commission. What action is the water board undertaking when the action has not been accepted by the body that is responsible for determining whether or not to proceed with License Transfer and subsequent Dam removal?

Using the former EIS Documents for Klamath Dam removal does not meet the thorough and complete look for effects found in NEPA and CEQA Statutes. Those previous documents had as a premise a federally funded mitigation list found in the expired KBRA/KHSA Agreements. Those mitigations were part of the analysis of environmental effect designed to lessen impacts to fisheries, the public and water quality on the Klamath River. The ESA determinations and Environmental Conclusions in those documents are now referred to as "stale" and must be rejected and analysis reinitiated as both NEPA and ESA require when there is a significant change in the proposal.

The former analysis is incomplete. In the ten years of analysis that took place every one of them eliminated the flows of the Trinity River as the analysis was narrowed to 5 miles within the reaches below Iron Gate Dam. Any analysis must include the entire river under federal and state statute prior to any Clean Water Certifications the state may make.

Jurisdictional Comments

Does this State Agency have the jurisdiction to analyze and make a Clean Water Act Certification regarding the Transfer of 4 Dams on the Klamath River under the Clean Water Act?

There is no authority for the State of California to make determinations outside its Sovereign Borders nor do its laws extend beyond them. One of the Dams in the Transfer Application and a large segment of the Klamath River affecting the Lower Klamath are within the Sovereign Borders of Oregon. Several Dams within Oregon have the potential to significantly affect California's water quality with their operations. The flows from Upper Klamath Lake are well outside this states influence and cannot be predicted with any certainty and therefore makes a state level analysis for water quality tenuous at best. The Porter Cologne Act from which the State Water Boards authority originates has no regulatory influence over another state and is the wrong authority at the wrong scale to make an informed water quality determination.

In The Supreme Court Decision, Rampos v. United States & Carabell v. United States clarify the Authority and Jurisdiction of the Clean Water Act for Navigable Waters and is to be under the Army Corps of Engineers and the Federal EPA the court directs them to exert their regulatory authority over them. This jurisdiction is further clarified in the "Civilettii Memorandum at 43 Opinion Attorney General 197(1979).

The NPDES Memorandum between the United States and the state of California defines when a state may take Clean Water Certifications. The states independent certification process is limited to waters not reserved by the EPA for review. Those classifications of discharges reserved to EPA regulation under federal statute include; Discharges to territorial seas, Discharges which may affect the water quality of another state and Discharges from any other source which exceeds a daily average discharge of 1/2 million gallons.

In summary, to properly analyze any action on the Klamath River I urge the Board to start over on all processes using Federal and State Statutes respecting the federal agencies responsible for all interstate actions. To do otherwise and to continue to side step a complete and thorough scientific analysis in full participation of the public will likely lead to severe damage of our river, extirpation of listed Salmon, devastate our local economy and lead our state into years of costly litigation.

January 26, 2017

Ray A. Haupt
Siskiyou County Supervisor, District 5
P.O. Box 750
1312 Fairlane Rd.
Yreka, CA 96097

41

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: Thomas Joseph

EMAIL (if desired):

ORGANIZATION (if applicable):

REMARKS: Wanna speak

LOCATION (circle one): ARCATA SACRAMENTO YREKA

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

42

January 2017

(Please Print Clearly)

NAME: Daniel F. Simon, PE

EMAIL (if desired): DanielFSimon@yahoo.com / 530-598-9671

ORGANIZATION (if applicable):

REMARKS: ARSENIC SEDIMENT BEHIND THE DAMS. ~~THE~~ W Fall Creek HATCHERY HAD KILL-OFFS FROM SEDIMENT W/ ARSENIC. DAMS HAVE ACCUMULATED THIS SEDIMENT.

LOCATION (circle one): ARCATA SACRAMENTO (YREKA)

43

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: AL KHART (ALEXANDER KHARTCHENKO)

EMAIL (if desired): alkhart@YAHOO.COM

ORGANIZATION (if applicable):

REMARKS: THE PROJECT OF DAMS REMOVAL HAS NO SCIENTIFIC AND HUMANITARIAN GROUNDS, HENCE IT MAY TURN TO BE AN ECOLOGICAL CRIME. DAMS ARE ONE HUNDRED YEARS OLD DURING ALL THOSE YEARS HELPED TO FIGHT FIRE, DROUHTS.

LOCATION (circle one): ARCATA SACRAMENTO (YREKA)

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017
(Please Print Clearly)

44 DID NOT SPEAK

45

NAME: Susan Mallott Rodgers / Jack Judy Roggenbuck

EMAIL (if desired): Hidden Valley Ranch

ORGANIZATION (if applicable): jrhvr@me.com

REMARKS: We support the Siskiyou Co. Board of Supervisors statement + Mike Mallory's statement

LOCATION (circle one): ARCATA SACRAMENTO YREKA

46 DID NOT SPEAK

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: Margo Robbins

EMAIL (if desired): footstepsunltd@yahoo.com

ORGANIZATION (if applicable): True North

REMARKS: Klamath River dams deteriorate water quality.

LOCATION (circle one): ARCATA SACRAMENTO (YREKA)

47 DID Not SPEAK

SPEAKER CARD
LOWER KLAMATH PROJECT LICENSE SURRENDER
SCOPING MEETING

January 2017

(Please Print Clearly)

NAME: Sarah Rockwell

EMAIL (if desired): smr@klamathbird.org

ORGANIZATION (if applicable):

REMARKS: will submit written letter

LOCATION (circle one): ARCATA SACRAMENTO (YREKA)

Court Reporter Transcript

STATE WATER RESOURCES CONTROL BOARD STAFF PRESENTATION

SOLICITING COMMENTS ON THE NOTICE OF PREPARATION

LOWER KLAMATH PROJECT LICENSE SURRENDER)
PUBLIC COMMENTS.)
)
)
)
~~~~~~

Date: THURSDAY, JANUARY 26, 2017

Time: 5:00 p.m.

Place: Best Western Miner's Inn
122 East Miner Street
Yreka, California 96097

Reporter: Carol J. Chase, CSR No. 13538
COLEMAN REPORTERS
510 Fourth Street, Suite A
P.O. Box 7
Yreka, California 96097
(530) 842-1455
e-mail: colemanreporters@earthlink.net
~~~~~~

A P P E A R A N C E S:

For State Water Resources Control Board:

PARKER THALER, Environmental Scientist, Lead Tech
ERIN RAGAZZI, Environmental Program Manager
MARIANNA AUE, Office of Chief Counsel, Legal Support
KRISTEN GANGL, Environmental Scientist
TIM MURAN, Office of Public Affairs
WILLIAM RICH, Tribal Tribal Cultural Resources Leader

For Stillwater Sciences:

MAIA SINGER, Stillwater Sciences Senior Scientist/Water Quality Specialist, Consultant
LAUREN McCLURE, Stillwater Sciences, Consultant

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(filled out speaker card but did not speak)

- Susan Mallett Rodgers
- Jack & Judy Roggenbuck
- Margo Robbins
- Sarah Rockwell

---oOo---

PROCEEDINGS

---oOo---

WATER BOARD MEETING

Thursday, January 26, 2017

---o0o---

MS. ERIN RAGAZZI: Thank you. I want to welcome everyone here tonight. This is the third and final scoping meeting that we're holding as part of the Lower Klamath Project Environmental Impact Report Scoping Meeting.

I'm Erin Ragazzi with the State Water Resources Control Board and I want to introduce a couple of other folks here this evening.

So Kristen Gangl is out there helping people get checked in and she's with the State Water Board and the Water Quality Certification Program.

Also here from the program tonight is Parker Thaler and he's going to be providing a presentation.

We have Marianna Aue with the Office of Chief Counsel with the State Water Board.

And then our environmental consultants that are going to help us prepare the environmental document for the Lower Klamath Project and they're with Stillwater Sciences. That's Maia Singer and Lauren McClure.

They have subconsulted with William Rich on the cultural resources and tribal -- he's the tribal

cultural resources lead.

And then also here this evening, we have Carol Chase. She's our court reporter. Who has as a very vital role today. And we have a couple of key points to make sure that she's able to transcribe the meeting accurately this evening.

So a little bit on logistics. If you need to use the restroom, out the main door. The women's restroom to your right and the men's to the left.

There are handouts out there. There are speaker cards. And then there is a scoping meeting information sheet. The important thing about the scoping meeting information sheet is that it has the Lower Klamath Project Web page, which has a bunch of information about our process and the project. And at the bottom, it has information about how to sign up for our e-mail subscription list. So if you want to remain informed moving forward, that's a great way to sign up for that list and you'll get e-mails as we move forward. On the back of that information sheet is a map of the project area.

So the purpose of tonight's meeting is to provide a little bit of information about the Lower Klamath Project but, more importantly, it's to solicit comments from folks about the water quality

certification application that the State Water Board has before it for the Lower Klamath Project.

So a little bit logistics, Parker's going to provide a brief presentation about the Lower Klamath Project, and then we'll have comments by attendees.

And logistics, there's a sign-in sheet out there. If you want to speak, please make sure that you fill out that white speaker card and you hand it to Kristen or just bring it up front here and we'll grab it from you that way, too.

And so that we can get all of the comments transcribed correctly, please make sure you use the microphone. And I'm going to ask you to state your first name, your last name, spell it for Carol. And then, also, I had a request from someone that if you could state where you're from, they would appreciate that, and your affiliation if you feel comfortable.

We'll have a slide up at the end of the presentation to remind you about that because, when you come to speak, sometimes you don't remember all those things. And then we've got that handout. So if you haven't got one, I suggest you grab one of those.

A little bit on ground rules. Typical ground rules, please silence these electronic devices so we don't have interruptions. Take a moment to do that.

Also, make sure that we respect all speakers and all points of view this evening. We're going to have one person speak at a time, make sure that you do use that microphone, not only so that Carol can make sure she gets things transcribed but also so that everybody can hear those comments.

If you have any questions or comments, we'll do that at the end of the presentation. Questions and comments -- or questions that we're looking for are procedural questions, because we're not responding to comments tonight. We're really soliciting and listening to your comments this evening, so we're really looking for any procedural questions that you may have.

We recognize that we do have a short time frame this evening, so this meeting is scheduled from 5:00 to 7:00. It's possible it will run late depending on the number of commenters, so we're going to have a three-minute limit on comments. And I ask that everybody respect that time limit so that we can hear from everybody.

If someone feels that they want to say more after their three minutes, once everybody has had an opportunity to provide their comments, you're welcome to come back up and provide more comments or additional comments at that time. You can also send us a comment

letter.

The comment decline is 5:00 p.m. on February 1st, so that's next week. So you can also provide us with written comments by that time.

And with that, I'm going to turn it over to Parker to get into the meat and potatoes of why we're here and a little brief overview of the Lower Klamath Project.

MR. PARKER THALER: Hello. Thank you all for coming.

My name is Parker, and I'm the lead technical staff assigned to the Lower Klamath Project Water Quality Certification application.

As for why we are here, the Klamath River Renewal Corporation or KRRC has submitted a water quality certification application for the Lower Klamath Project.

The State Water Board conditions hydroelectric projects via water quality certifications to ensure the protection of the State's waters. And the California Environmental Quality Act requires an Environmental Impact Report to inform the State Water Board and the public about the project's application and the environmental effects and ways to reduce those impacts.

So jumping into today's portion of the

presentation -- I'm sorry, Erin -- I'll be providing an overview of the Lower Klamath Project dam development, a brief background on the Lower Klamath Project dam development, and progress through the Federal Energy Regulatory Commission or the FERC licensing process, as well as the link between The Lower Klamath Project and the Klamath Hydroelectric Project, an overview of the CEQA process, and discussion of the Notice of Preparation that was released on December 22nd of 2016 with a comment period that ends on February 1st of 2017.

Next slide. So shown in this map is the figure illustrating the general location of The Lower Klamath Project dam development. This is the same figure that is located on the front page of the Notice of Preparation and is also included on the back page of the fact sheet which, again, is located at the back of the room.

For the ease of viewing and today's presentation, we have these blue dots on top of the Lower Klamath Project dam development and a red line to delineate the border between the states of Oregon and California.

The Lower Klamath Project dam development consists of Copco No. 1, Copco No. 2, and Iron Gate, which are all located in California, and J. C. Boyle dam

development which is located approximately 16 miles north of the California-Oregon border.

The J. C. Boyle dam development is subject to the State of Oregon's water quality certification process, which is a separate action than what we are discussing today as we are focused on the California portion of the project.

The Lower Klamath Project dam development are located in Klamath County, California -- or Siskiyou County, California, and Klamath County, Oregon.

For reference, I've included the Klamath Hydroelectric Project facilities in relation to the Lower Klamath Project and development. And from upstream to downstream, those include:

East Side and West Side which are located adjacent to Link River Dam, Keno, and J. C. Boyle which are both Oregon-based facilities located along the main stem Klamath River;

Copco No. 1 and Copco No. 2 and Iron Gate, which are all located on the main stem Klamath River;

And Fall Creek which is located on Fall Creek, a tributary to the Klamath River;

In bold and underlined and delineated, the Lower Klamath Project dam development from the Klamath Hydroelectric Project facilities. And, off to the

right, you can see an abbreviation for the state that that facility's located in.

Next slide. So now that I've provided information on the general facility location, I would like to discuss the background of the Klamath Hydroelectric Project and as it proceeds to the Federal Energy Regulatory Commission or FERC process.

And for reference, FERC is the federal agency that issues license orders for the construction, operation, and decommissioning of hydroelectric facilities. FERC's orders are issued usually with terms or conditions that project operators must implement in order to protect public and environmental resources.

So beginning in 1956, FERC issued the original license order for the construction and operations of the Klamath Hydroelectric Project. The 1956 license was issued on a 50-year term that expired in 2006. And because the FERC license expires, the Klamath Hydroelectric Project was required to obtain a new license from FERC which requires a water quality certification as well as other state and federal authorization.

So in 2004, Pacificorp, the owner of the Klamath Hydroelectric Project applied to renew the FERC license and, in 2006, submitted a water quality

certification application to the State Water Board. And in 2007, FERC completed it's National Environmental Policy Act compliance by issuance of a final Environmental Impact Statement that analyzed PacifiCorp's then proposed project for continued operations of the Klamath Hydroelectric Project as well as various alternatives.

Shortly after that in 2008, the State Water Board began it's California -- California Environmental Quality Act or CEQA process by release of a Notice of Preparation and hosting public scoping meetings.

So following FERC's issuance -- next slide.

Following FERC's issuance of its Environmental Impact Statement, some Klamath Hydroelectric Project affected parties began discussions for a Settlement Agreement that resulted in the formation of the Klamath Hydroelectric Settlement Agreement or KHSA in February of 2010.

Now, the KHSA created a pathway for a dam removal of J. C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Dam development in federal authorization that would have removed these dam developments from the FERC process.

And in September of 2012, the KHSA and its companion agreement known as the Klamath Basin

Restoration Agreement resulted in the final Klamath Facilities Removal Environment Impact Statement and Environment Impact Report.

And before I go any further in today's presentation, I would like to note here that the State Water Board is not a signatory to any of the Settlement Agreement and that the State Board maintains its independent authority to condition the Klamath Hydroelectric Project and the Lower Klamath Project for the protection of water quality.

And in light of the substantial new information that have been developed since the 2008 Notice of Preparation, in 2015, the State Water Board reinitiated the CEQA process by release of a Notice of Preparation in hosting a public scoping meeting, they analyzed PacifiCorp's Klamath Hydroelectric Project. And shortly thereafter, on April 6th of 2016, the Klamath Hydroelectric Settlement Agreement was amended to remove provisions requiring federal authorization and, instead, pursue dam removal through the FERC process.

Following the amendment of the Klamath Hydroelectric Settlement Agreement and, at the request of Pacificorp on June 16th of 2016, FERC placed the Klamath Hydroelectric Project relicensing process in abeyance. And on June 24th of 2016, Pacificorp withdrew

its water quality certification application from the State Water Board effectively endings its water quality certification and CEQA process for the Klamath Hydroelectric Project.

Following the withdrawal of PacifiCorp's application, several items happened on September 23rd of 2016, the first being a new entity of 501(c)(3) nonprofit, known as the Klamath River Renewal Corporation or KRRC, jointly filed with Pacificorp the license transfer application seeking to divide the Klamath Hydroelectric Project into two separate projects.

Next slide. The first project being the Klamath Hydroelectric Project would consist of East Side and West Side, Keno, and Fall Creek. The second project would be titled the Lower Klamath Project and would consist of J. C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate dam development. The Klamath Hydroelectric Project would maintain its ownership of PacifiCorp and be known as -- and would maintain its first project number of 2082.

The Lower Klamath Project would go to the Klamath River Renewal Corporation and would have a new FERC number of project number 14803, which has been designated by FERC. I would like to note here, though,

that the transfer application is currently pending before FERC.

Next slide. In addition to the transfer application filed by both PacifiCorp and KRRC also on September 23rd of 2016, the KRRC filed with FERC a license surrender application seeking to decommission sufficient portions of the Lower Klamath Project to provide for a free-flowing Klamath River and volitional fish passage.

And, finally, also on September 23rd of 2016, the Klamath River Renewal Corporation submitted a water quality certification application to the State Water Board. Now, the State Water Board is proceeding with processing the Klamath River Renewal Corporation's water quality certification application. But before the State Water Board can issue a water quality certification or take an additional action for the Lower Klamath Project, it must first comply to CEQA as CEQA is a process required by state law. Information developed in the CEQA process will be used to inform future actions on the State Water Board on the Lower Klamath Project.

Today's scoping meeting is part of the public comment period that began with the issuance of the Notice of Preparation on December 22nd of 2016 with comments due of February 1st of 2017.

So shown in the slide here is an overview of the typical CEQA process in which the State Water Board is the CEQA lead agency and has determined an Environmental Impact Report is necessary. Following that determination, the State Water Board will issue a Notice of Preparation and conduct scoping meetings.

You can see in the slide I have cap-locked and underlined that this is a formal public comment period. And as we discussed, the comment period began on December 22nd with comments due by 5:00 p.m. on February 1st of 2017.

Following the close of the comment period, the State Water Board will take all comments into consideration and use those in preparation of its draft Environmental Impact Report. The draft Environmental Impact Report will include items such as a detailed description of the proposed project as wells as alternatives, mitigation measures to reduce impact to resource areas and a description of environmental baseline.

Next slide. Following the preparation of the draft Environmental Impact Report, the State Water Board will issue it as dictated here for another formal public comment period. That's a minimum 30-day comment period on the draft EIR, and the State Water Board will review

and respond to all comments and use those comments as well as other scientific information or information submitted to prepare a final Environmental Impact Report.

Following or concurrent with the issuance and certification of a final Environmental Impact Report, the State Water Board plans to take an action on the Klamath River Renewal Corporation Lower Klamath Project.

Next slide. So our CEQA approach is to focus on the California portion of the Lower Klamath Project, because that is the portion subject to the State Water Board's water quality certification process. And we plan to use past environmental information such as FERC's Environmental Impact Statement and the Klamath Facilities Removal Final Environmental Impact Statement and Environmental Impact Report in preparation for our CEQA document. And we also plan to use the information gathered by CEQA commenters such as those provided at today's meeting, Settlement Agreement, tribes, scientific community, and other sources.

Next slide.

Our Notice of Preparation identified two project alternatives, those being the no project alternative and the Klamath River Renewal Corporation's proposed project to decommission sufficient portions of

the Lower Klamath Project dam development to provide for volitional fish passage and a free-flowing Klamath River.

We recognize that there is a range of alternatives between those two proposed plans. And part of what we'd like to hear in our scoping meeting today and our scoping period is if there's any thoughts on specific alternatives or actions that should be considered in our final environmental -- or in our draft environmental document.

Next slide. So to jump back to today's meeting, all public comments submitted by February 1st of 2017 will be considered. I consider all comments to be helpful, but there are a few key pieces of information that would be most helpful to us in our process. And those are listed on this slide and include the adequacy of past environmental documents developed in relation to this project.

And two examples here is FERC's Environmental Statement and the Klamath Facilities Removal EIR/EIS. In other words, do these documents address your concerns? In addition, a range of alternatives or specific alternatives that you feel should be analyzed in our Environmental Impact Report as well as potential impacts to evaluate and mitigation measures, and as well

as any other items that you feel is relevant to this process.

Next slide. I'd like to note though that, as discussed today, there's been a lot of previous analysis done on alternative, impact, and mitigation measures. To the extent that you agree or disagree with that past information, we would like to hear about it.

We do understand that there will be environmental impacts associated with the Klamath River Renewal Corporation's project and various alternatives, such as the large amount of sediment behind Copco and Iron Gate Reservoirs, impacts to groundwater table and tribal cultural resources.

If you're planning on commenting on any of these, I encourage everyone to please refer to attachment 1 of the Notice of Preparation as we did our best to identify the summary of potential significant impacts.

And with that, I ask that you please submit your comments by February 1st of 2017 at 5:00 p.m. You can submit them to the physical address or e-mail address listed on the screen. And also on the screen, I've included a link to our Lower Klamath project's Web site, which is a useful Web site that includes information such as today's presentation, the Notice of

Preparation that we released, and other relevant information that developed related to the water quality certification process.

I'll be turning it over to Erin for questions related to processes described in our presentation and then public comments.

Thank you.

MS. ERIN RAGAZZI: Thank you, Parker.

So the other thing that I did want to point out on that slide right there, it says, how to stay informed. So I don't expect you to copy down that Web page while you were looking at that slide.

So if you can grab this handout, they're outside. You can pick one up already. It's a one-page summary. On it, it has that Web page address and you can go directly there.

It also has this information up here about how to sign up for the Lower Klamath Project e-mail subscription list. So please make sure you grab one of those before you leave because it will make it a lot easier. When you leave here today, make sure you sign up for the e-mail lists and that you can get to the Web page.

So before we move into the comment period, are there any procedural questions that folks have about the

water quality certification process?

UNIDENTIFIED WOMAN: My question is, if we make a comment tonight, can we still make a written comment?

MS. ERIN RAGAZZI: So the question was, if you make an oral comment tonight, can you still provide written comments? Yes. We welcome both types of comments and I anticipate lots of folks will say something here tonight that may have additional thoughts or they may just want to put them in writing as well. And we would appreciate you providing comments in whatever way you feel most comfortable.

UNIDENTIFIED MAN: Is anyone here from the KRRC?

MS. ERIN RAGAZZI: So the question is whether or not anybody is here from the Klamath River Renewal Corporation if they feel comfortable. Anybody here? Or over there, there's a hand up. That gentleman right over there has his hand up.

How about other people who have their hand up, are you with the Klamath River Renewal Corporation? No. Okay.

Are you as well? Okay. So there's three people here with the Klamath River Renewal Corporation.

Any other procedural questions? I don't know if that was procedural, but any more questions with more

informational as opposed to comment questions? All right.

I've got a handful of comment cards. If you want to make a comment, please fill out a comment card. They're in the back of the room. You can hand them to Kristen, who is probably out there waiting for more comment cards. Walking in right there (indicating) if you can hand them to Kristen or you can bring them directly up to us as well.

So, first speakers of the evening, I'm going to ask folks to come up to this microphone right here. I'm also going to have a slide up here to remind people, state your name, first and last name, spell it for us. If you fee like giving your affiliation, that would be great as well.

And please stick to that three-minute time limit. As we get close to the three-minute time limit, you'll see I start walking closer to you to let you know that you should wrap it up.

So this gentleman showed up really early so John Bermel. So do you want to come up and make a comment?

MR. JOHN BERMEL: Well, hi, everybody.

MS. ERIN RAGAZZI: I needed to turn on the monitor.

Hello. And my name is John, J-O-H-N, Bermel, B-E-R -- can you hear me back there?

MS. ERIN RAGAZZI: Can you hear me? They can hear me. Okay.

MR. JOHN BERMEL: My name, again, is John, J-O-H-N, Bermel, B-E-R-M-E-L.

I am a resident of Hornbrook, California. And I am for having the dams emptied, so that the salmon can live and so other people can have water.

I have an unrelated comment. Perhaps I am looking to see Klamath Hot Springs become restored, perhaps not like it was in -- 100 years ago, but I'm looking for somebody or some group to become a working steward of this place with very light development on it and sensitive -- sensitivity to the environment and beauty of the development of it. I think this is too good of a place to leave as it is.

Currently, it is being leased by a rancher and his wife and there is a very good probability that a parcel within the 460 acres that -- I believe that's what it is -- could be created for the springs and have the ranching, grazing going on around it.

And I'm very optimistic about this. I think that it is not a matter of if this will ever become developed but when. And I would appreciate people

giving their response to me. I will leave my name and phone number and e-mail address and -- and you know, please let me get it in here.

Thank you.

MS. ERIN RAGAZZI: Thank you.

Next speaker -- and I'm going to go through a couple of speakers so folks know when they're in line. So Richard Marshall followed by Sami Jo followed by Brandon Criss followed by Grace Bennett.

MR. RICHARD MARSHALL: Well, good evening. Can you hear me? I don't hear it coming -- there we go.

UNIDENTIFIED WOMAN: We can't hear that very well at all.

UNIDENTIFIED MAN: He needs your microphone.

UNIDENTIFIED WOMAN: It happened the last time we had the meeting as well. Yours works better.

MS. ERIN RAGAZZI: Well, I can hear myself. Can you guys hear me?

MR. RICHARD MARSHALL: My name is Richard Marshall.

I'm the president of the Siskiyou Water Users Association. I'm also a rancher out at Fort Jones, California. And we are in California, thank goodness. Things are going to change in California pretty soon.

In any case, I want to start off by admonishing

this committee that you have before me because the last time I was here -- it was almost a year to this date -- we never received any comments. I know other people were here, too. Nobody got any comments back or feedback from this meeting. I hope it's different this time. We would like to have you respond to our comments by February 15th. I think that's an appropriate time for you to respond.

In any case, we just found out about the meeting late. That's why I'm admonishing you, because I'm on all your mailing lists and I just got the information. And speaking now of the 20th when it was supposed to be on the 20th the day before for the FERC, which I understand the FERC which we're going to submit all this to, is now a defunct commission for the time being until Trump signs -- President Trump signs new people into the commission.

So I would like to start off by saying that when we're talking about water quality, we really have to talk about Oregon, because that's where the problem with the water is in Oregon. And even the Bureau of Reclamation recommended in its report that Keno Dam, there should be placed a water purification facility before the water even gets into California.

There's no reason to take the dams out to

improve the water quality. That has nothing to do with the water quality. It's Oregon where you have to start with the process.

Next, I'd like to refer to the fact that the group here is here to do a CEQA study, I understand. And in the announcement they lay out, you start off by saying you're going to support the KRRC's comments, basically, that you're supporting their effort to get the water quality control certification.

I don't think taxpayer money -- we certainly don't want to spend our money here for their bill to take care of the KRRC. The KRRC was formed in New York City by a law firm and it was then codified in California as a corporation. Certainly, to be here as part of this process because it's --

THE COURT REPORTER: One moment. Stop.

I can't hear him.

UNIDENTIFIED WOMAN: I can't either. That's why --

THE COURT REPORTER: I mean, I have other people talking so, please, one at a time.

UNIDENTIFIED WOMAN: But we can't hear in the back, Richard.

(Heavy overtalk of the audience.)

MR. RICHARD MARSHALL: How's this? Is that

better? All right. I'm glad to hear it.

As I was saying, it's in Oregon where the water needs to be cleaned out. Even the Bureau of Reclamation recommended a clean-up facility to be placed at Keno Dam to clean up the water before it came into this area.

And then my next question I rose was, why are our tax dollars, the people who are here in this room and in this area, being spent to support the KRRC?

KRRC was formed in New York City at the law firm there, and then it was codified as a corporation, 501(3)(c) [sic] here in California. It wasn't put together until June of this last year. And they didn't fill their board spots until later.

The next thing I want to raise is the issue of CEQA versus NEPA. You're talking about doing a CEQA designation, but this is a federal interstate navigable waterway. Two states can't join together to do work on that as a project without the Congress intervening because -- in the process, because it's a federal interstate waterway.

And right now, there's already a compact that exists. It's the only one that exists, Klamath compact which controls both the water quality -- supposed to control the water quality and the way the water is used for beneficial use.

MS. ERIN RAGAZZI: I did give you extra time.

(Multiple people speaking over each other.)

MR. RICHARD MARSHALL: I had a lot of interference. Let me just do this.

MS. ERIN RAGAZZI: And like I said, you can come up at the end.

UNIDENTIFIED MAN: I give all of my time to him.

MR. RICHARD MARSHALL: Okay. I'm just going to read my last conclusion letter, which I'm going to turn in. We reiterate our concerns over the legitimacy of this scoping session by the Water Board.

First, because the notice period was extremely short, as I said, and begs the question of the intent of the Board in giving such short notice to the group most impacted by potential destruction of hydro facilities, which is Siskiyou County in which three of the four facilities are located which has the greatest river frontage to be impacted by the release of sediment and opening up the prospect of flooding as a result of the damage.

Secondly, we come to the initial state funding to conduct this EIS for the benefit of a private company, 501(3)(c) of the KRRC which is not even recognized by either the FERC or the CPUC at this time.

In fact, the money is frozen, the surcharge money at the CPUC right now.

The KRRC has no demonstrated capability to manage such a huge undertaking and they have no significant funding. Further, the governor of the State of California had no authority to enter into the KHSA as it's never been reviewed or approved by the legislature. And by signing the agreement, he put the State of California and citizens of California and Siskiyou County at great risk and peril.

And, finally, the water board planned action violates three federal laws --

THE COURT REPORTER: Pull it away, please. Thank you.

MR. RICHARD MARSHALL: Three federal laws. Is that better? I'm just ready to finish up.

Three federal laws -- and including the Federal Interstate Compact, Article 1, Section 10, U.S. Constitution, and the Endangered Species Act; and two state laws, Quo Warranto and the Water Code Section 5900 to 5901.

And, finally, we feel that the existing interstate compact, as I said before, it is the law of the river, it's still the law of the river, and will continue to be the law of the river.

MS. ERIN RAGAZZI: Thank you, Richard.

(Applause.)

MS. SAMI JO DIFUNTORUM: Okay. Good evening.

My name is Sami Jo Difuntorum, D-I-F, as if Frank, U-N-T-0-R-U-M, just like it sounds.

So I'm here to represent the interests of the Shasta Indian Nation. And welcome to the traditional homelands of the Shasta people.

I see my colleague, Roy Hall, in the audience, and I hope he's going to share comments on behalf of the Shasta Tribe as well. We don't support dam removal, and there's a reason for it.

Our state in the area is a little bit different than other people's. So my mother's family specifically lived in the Indian village where Iron Gate is right now. Right? It was my mother's, great grandmother, and her brother. They were removed at gunpoint. Right?

And so they moved up it to Copco and, later, the lands were taken from them -- well, oh -- can you hear me? Can you hear me?

And so our interest in the area is a little bit different. It isn't really about the water quality or any of those things. It's a very personal story to us. We have family graveyards underneath the sediment. We have our villages there. So when the dams come out and

the water is drawn down and the sediment starts moving, what happens to -- I won't start crying -- to our people -- to our people that are buried there?

I know anybody in the room that -- every native person gets this, and I think everybody gets this. One of the things that people really hold very sacred and personal is where we lay our people to rest. And it's for that reason that we object to dam removal. We appreciate that you've implemented the CEQA process.

Under NEPA, we're considered just another public group, because we're not a federally-recognized tribe and, under CEQA, we actually have standing. And so I'm going to respectfully request, maybe insist if that's appropriate, that you hold off on the certification until such time as consultation with our tribes is concluded and issues have been addressed.

I've not heard a single solitary person or group or entity, anybody come forward with a plan to mitigate our concerns. I don't know how you would mitigate those issues. But, you know, it's important that the story is told because that part of the dialogue is often left out.

People talk about a lot of issues and, you know, we don't want to make light of anybody's issues or anybody's concerns. I just know for us and for Shasta

people, it's a very different -- very different state, very different issue.

We are not signatories to any of the agreements for obvious reasons. Actually, I don't think we were asked to sign them, but I don't think we would have anyway. So when you start thinking about dam removal and all of these things flowing downriver, imagine how you would feel if that was your family. That's how we feel.

So, what else do I want to say? That's it. Three minutes. Thank you.

(Applause.)

MS. ERIN RAGAZZI: Thank you.

We've got Brandon Criss followed by Grace Bennett followed by Robert Davis and then Jack Mattz. Again, I don't think it's the microphone. If you could state your name and spell it, that would be great.

MR. BRANDON CRISS: My name is Brandon Criss -- sorry.

My name is Brandon Criss, B-R-A-N-D-O-N, last name, C-R-I-S-S.

At 10:00 p.m. on August 1st, 2014, I received a phone call from Sheriff Lopey advising me that constituents were being evacuated from their homes due

to a rapidly spreading fire north of Copco Lake. I drove over to the evacuation center and spent the night there getting feedback of what was happening.

Constituents witnessed helicopter bucket load after helicopter bucket load of water being drawn out from behind Copco Dam. Water behind the dam helped save these people's homes and lives. When you consider this issue, we demand that public health and safety be given priority. Do not take away this fire protection tool from -- that the dams provide.

We also ask that you would also consider the health of the migrating salmon. Also, in 2014, there was a chance of another fill kill as occurred in 2002 on the Klamath River.

At the North Coast Regional Water Quality Control Board meeting on October 9th, 2014, the Karuk tribal spokesman stated that, quote, "Increasing flows and the velocity of flows disperses disease on the Klamath...we averted a fish kill because of Trinity flows then the Karuk tribe observed disease above the Trinity confluence. A lot of credit to PacifiCorp's collaboration with the Bureau of Reclamation, 16,000 acre feet was released with 1700 cubic feet per second."

In total, 20,000 acre feet was released from behind these dams. Without the dams, this 20,000 acre

feet would not have been available to save the salmon.

We find it ironic that some claim these dams impair water for fish, yet a release of an extra 20,000 acre feet of this exact same water that's credited with being pivotal in helping to prevent a fish kill. Please do not take this tool away from us.

The Bureau of Reclamation struck a deal with PacifiCorp to release this 20,000 acre feet from behind these dams so this water would not have to be taken from farmers in the Klamath basin. In the BOR August 8, 2014, press release stated that the water released from behind these dams would "assist reclamation by extending the Klamath Project's available water supplies from Upper Klamath Lake to help close the irrigation season." Please, for the benefit of these farmers, do not take that 20,000 acre feet of water away from them.

(Applause.)

MR. BRANDON CRISS: All right. Lastly -- I get the shakes and I do that myself, even at a young age.

Lastly, do not view agriculture in the Klamath Basin as being the one that impairs the water. Actually, the water that goes through Tulelake Basin --

UNIDENTIFIED MAN: Hold the mic down.

MR. BRANDON CRISS: Oh, sorry.

That goes through Tulelake Basin agriculture

and Klamath Lake agriculture is less phosphorous loaded than the water that actually comes down Klamath River. The water is cleaner after it's being used for irrigation than it is when it actually comes down. So please give that benefit to the farmers. And we ask that all these benefits be considered and that you keep the dams in place.

Thank you.

(Applause.)

MS. GRACE BENNETT: Good evening. Thank you for coming to Yreka for this meeting.

And I am Grace Bennett, B-E-N-N-E-T-T. I just retired from 20 years being in public service and a county supervisor for the last eight years. I've been cleaning out my library of interesting information. I have boxes and boxes and boxes of studies, reports, everything that has happened in the whole Klamath River.

Going through these, I found some things that are very interesting. In my notes, when I talked to tribal elders, they informed me that they have to move away from the river in the summertime because of the smell of the river and it was so low.

In George Gibbs' report, horses that were in the 1850s that came on the exploration of Siskiyou County would not drink the water in the Klamath River.

People who lived on the river also talked -- and these people are long-time residents, generations that have lived on the river. They talk about the floods, the stink of water, how low the water is in the summer and it's muckiness and other reports.

The Klamath Basin Compact which Mr. Marshall just talked about, in a report that they did in 1962 talked about the algae in the Upper Klamath Lake and the bad water quality in Oregon. Then the next thing that I thought was very interesting was the CDM report, Camp Dresser Report.

In this report -- it's the only thing that can be trusted. Because after that report was done, Mr. Salazar from the Department of Interior talked about, in public speeches, that the dams would come out. He was very adamant that these dams would come out no mater what anybody did or said. After that, the reports, studies, and models that were produced were written to reflect this predetermined decision. And that was noted when Paul Houser was the integrity officer for the Department of Interior and he was fired and -- because he brought this -- he was a whistle-blower.

The expert panels that came and reviewed all the documents, they were very, very concerned about dam

removal. They -- in their reports, they said that only eight miles of new habitat would be expanded and they were very concerned about a listed species being introduced to the Upper Klamath where the redband trout have a great deal of influence.

Our work in Siskiyou County with the farmers, ranchers, and the loggers, we have stopped sediment, we've done beaver dams, removed weir dams, pumping stations, lined ditches, replaced culverts with bridges. Water storage has been provided for cold water and major irrigation practices. And there's very little mining that -- or very little logging that happens and suction dredge mining has been completely stopped.

Two of the biggest ranches on the Shasta River were purchased by the Nature Conservatory and the water was sold to -- the water right was sold to Fish and Game.

I have some other things but I'm going to -- to say a couple more things.

I am totally appalled that the California taxpayers and the Water Board have been -- in this last year, spent 400,000 in Oregon trying to improve the water quality up there. It is not the -- it is not the responsibility of the California taxpayers to pay the bill for the nasty water that's in Oregon. The Oregon

taxpayers should pay for that.

I have -- and I'm tired of hearing that you and other agencies think that they can make warm water of the Klamath River system cold at the expense of the Siskiyou County residents. It is a warm water system. It has been for 150 years or more, a million years probably. It cannot be made warm -- cold. It is warm.

(Applause.)

MS. ERIN RAGAZZI: Robert. Again, lower that so people should hear you. Okay.

MR. ROBERT DAVIS: Good morning [sic]. I'm Robert Davis. I live on Copco Lake. My name is R-O-B-E-R-T, last name, D-A-V-I-S.

You said you were going to have a scientific study for this Environmental Impact Statement. There has been a scientific study that has been going on for years and it was conducted by Ken Salazar and Dennis Lynch.

And then Paul Houser came on the scene. And when he came on, he wanted to know why all the studies showed that dams should be removed. There was never anything that showed anything about a dam being of any benefit. So he was called a whistleblower and they gave him a bad name, told him he was not a team player.

Now, is that the kind of a study that we are

going to have again, or are we going to have some honest people come in and make an honest study? That's what was supposed to be done in the first place. If that had been done, they would have submitted the study to Congress so that the Congress people would know what they were voting on and there would have been a vote depending on what they found out.

The way it's been, there has been no fairness in anything. And I've been living there for 30 years and I don't know -- what have you done to clean up the water?

We've been waiting for a clean water permit from the water resources board but they never could get it. The water was always dirty. Now, the water is suddenly clean when you have somebody else that you want to report to. The whole thing don't add up.

You should go back and start from square one and get some honest people to get some honest results.

(Applause.)

MS. ERIN RAGAZZI: So Jack Mattz followed by Erin Ryan followed by Rex Cozzalio.

MR. JACK MATTZ: Good evening, everybody.

My name is Jack Mattz, J-A-C-K, M-A-T-T-Z. I'm a Yurok tribal member. I'm also on the tribal council. I'm here to speak for dam removal.

Our -- our history goes back time tomorrow [phonetic]. We've always depended on fish, salmon mainly, but there's another fish that used to be in the river was called candlefish. It used to go up the river by the boatloads. And since the dam's been put in, now they're gone.

And our salmon seem to be following the same route. Last year, we didn't have enough fish to feed every member in our tribe. There wasn't enough fish to give one fish to every tribal member. There's over 6,000 members. We got 5,000 fish.

So dam removal is contingent on a lot of things. Temperature -- water temperature in the fall, the water's so hot, it affects our fish. And in the summer, the water -- the water affects our -- while it affects -- excuse me there. It affects our fish where the smolt that are getting ready to go downstream, they're -- it makes it more susceptic [sic] to Shasta Sea.

And what's the other one there? Make it -- it makes 'em more susceptible to get and -- especially in Shasta Sea.

In 2014, we lost 81 percent of our juveniles. In 2015, we lost 91 percent of our juveniles born downriver to Shasta Sea. Now, last year, that's what we

got. We don't know what we're going to get this year if we even get that amount or what we're going to get next year. It's just -- we don't know. We won't know if later on in the year when the scientists come out and say "this is what you're going to get."

And it all depends on dam removals. There should have been some way to get them fish above them dams when the dams were put in but that got pushed aside and everybody just let it go. And, now, it's cheaper to take the dams out than it is to keep the dams in and build the ladders around them.

To build a ladder around Iron Gate, $250 million. Now, it's -- they can take out all four of 'em for 250 million or 400 million so -- that's the way it's got to go. We're -- I'm here to request that dams be taken out. And that's -- that's the point of the Yurok people.

Thank you.

(Applause.)

MS. ERIN RAGAZZI: Thank you.

So we've got Erin Ryan followed by Rex.

I'm going to just ask that everybody respect each speaker and don't make comments while other people are trying to speak, so that we can accurately transcribe the meeting and we can give everybody the

respect while they're speaking.

MS. ERIN RYAN: Hi, I'm Erin Ryan, last name R-Y-A-N, pretty straightforward.

I'm with the office of Congressman Doug LaMalfa. And the word I kept hearing was the "gill netting" during that last comment that was the unintelligible word. So maybe try not gill netting and see what happens. Just a thought.

So anyway, the congressman had a little message for you from Ryan Zinke who is -- I -- I don't know what's happening with the Secretary of the Interior, but it's kind of on hold or something. So, without all the inside baseball, he did have a message for you, quote -- Zinke told me, quote, "We don't pull down dams, we put 'em up."

I told him I'd be short and succinct, but I think it would be a good point so there you go.

(Applause.)

MS. ERIN RAGAZZI: Thank you.

UNIDENTIFIED WOMAN: Thanks, Rex.

MR. REX COZZALIO: Hi. My name is Rex Cozzalio, R-E-X, C-O-Z-Z-A-L-I-O.

Is that better?

We're four generations at the same location on the Klamath directly below where Iron Gate dam now

exists, before and after. It was described as a focal point of dams impacts.

I'm in the Klamath I love for over 50 times a year fore nearly 60 years before and after Iron Gate, as my grandfather before me.

The majority of salmon reaching our location are historically depleted and dying from -- dying from multiple impassable upstream reefs, a river often going subsurface in the canyon late summer before the dams and a naturally non conducive Upper Basin salmon habitat. Salmon were never historically a known resident above Spencer Creek near present Copco Dam or to populate the Upper Klamath Basin. Historical documentation, experiential testimony and recent studies have been submitted many times but have been consistently ignored in pursuit of agency agenda.

Our area has witnessed dam-related dramatic improvements to water quality, the late summer quantity, fisheries habitat, riparian stability, drastically reduced flood damage, and environmental improvements. Dams vastly improved the fisheries above and below for optimized and sustainable resident warm and cold water species.

Iron Gate Dam artificially creates unnaturally cold downstream water resources for one of the best

producing hatcheries in California, far exceeding prior known upstream production. Statistics for nearly 100 years evidence no significant alteration in salmon returns occurring at our location as a result of the dams.

The addition of Iron Gate Dam and Hatchery increased average returns by well over 100 percent and averaged a 200 percent increase during proponent's cited so-called "recent catastrophic declines." Incoming data now confirms the locally submitted historic documentation, empiric declarations and studies regarding the environmental benefits of the hydroelectric and storage facilities. However, none of that data is allowed by profiting KHSA special interests to modify failed biological opinions until after the dams are scheduled for irreversible removals.

Hatchery and cold water resources, along with clean hydroelectric power for 70,000 homes, major holistic ecosystem enhancements, nonreproducible regional recreational opportunities, optimized downstream benefits, property use, valuations, public safety, and both area and downstream public/private infrastructure will be lost as a result of the dams removals.

The 2007 FERC EIR and 2012 KHSA EIR are

predicated upon now just proven unavailable and unfunded criteria. The DWR Board serves at the pleasure of the governor. In the California Water Crisis Management Plan, the governor ordered all California agencies to facilitate the removal of the Klamath dams.

DWR is limited to its EIR scope to only consider conditions within California effectively disenfranchising an interdependent ecosystem from a comprehensive EIR assessment. Therefore, it must fall to a fully comprehensive and inclusive NEPA EIS executed through the FERC, encompassing entire watershed impacts, options, alternatives, and required mitigations to fulfill the public trust. Only after that NEPA EIS and FERC evaluation would DWR be procedurally called upon or capable of producing a California EIS necessarily conditioned upon and subject to the options and mitigations considered by FERC.

Thank you.

(Applause.)

MS. ERIN RAGAZZI: The next speaker is Glen Briggs followed by Mark Coats followed by John Menke.

Glen Bridges -- or Glen Briggs?

MR. GLEN BRIGGS: Thank you.

Can you hear me? This is coming out all right?

I have one question before I get going. Reading this project description, it refers to the environmental -- the environmental condition that you're going by to evaluate the releases from the dam. Is that the current condition that is being used as a guideline?

UNIDENTIFIED WOMAN: The current EIR?

MS. ERIN RAGAZZI: Are you asking what baseline would be?

MR. GLEN BRIGGS: It calls for -- it says -- just a minute -- the environmental baseline.

MS. ERIN RAGAZZI: Yeah. So we have --

MR. GLEN BRIGGS: The current -- the current existing condition?

MS. ERIN RAGAZZI: The final baseline is defined in CEQA as the current condition.

MR. GLEN BRIGGS: Okay.

MS. ERIN RAGAZZI: Typically around the time of the NOP -- it's not exactly right, but the Klamath River as it is basically today.

MR. GLEN BRIGGS: My name is Glen Briggs, G-L-E-N --

MS. MARIANNA AUE: One more thing about that, if there's a reason that you think that using the current conditions isn't a good idea, that's just -- it's normally what's used. But if that would be

confusing to people about, you know, if there's an impact that you don't get from using that, we would love to know about that.

MR. GLEN BRIGGS: I asked that question to your office and I got a response the very same way. What I was asking is, which is applied to this project?

MS. MARIANNA AUE: Right. So the --

MR. GLEN BRIGGS: The current conditions.

MS. ERIN RAGAZZI: So, currently, the baseline is existing conditions at the time of the Notice of Preparation. If for some reason you think that is not an appropriate baseline, that is something that you can comment on and we would like to hear from you about that.

MR. GLEN BRIGGS: Okay. Okay.

My name is Glen Briggs, G-L-E-N, B-R-I-G-G-S.

I am a retired engineer from the Bureau of Reclamation. My experience was construction on dams and irrigation facilities. I have been associated with the Klamath River since 1931. My mother was associated with the Klamath River from 1909 until 2009. My grandmother was associated with the Klamath River from 1875 to 1970.

So I know of that period of time does not add up to what the native tribes can account for, but it is long enough that we've gained some opinions. And I

won't take very long here once we get started. If I can find the right page, we'll get there. Okay.

You put out as a notice of project a summary of the potential significant impacts. And reviewing those -- in reviewing those, it occurs to me from my experiences and knowledge about the Klamath River where we live which is 60 miles downstream from here.

The first water quality note here -- and I think water quality is primarily what you're interested in. The water quality, short term, does not matter that much because it takes care of itself. Long term, water quality a going to be a disaster if you remove the dams. There is no question about that.

All you have to do is go back, look at early literature, start with George Gibbs' journal about the treaty expedition up the Klamath River, look at miner's notes, look at the Fish and Game files on their check of the river years ago. You will find that the dams have improved the quality of the water in the river tremendously. There's no comparison. Water in the late fall on low rainfall years gets very, very dry without supplementing flows from the dams.

Now, the fisheries people that require that the dam out -- the power dam operation has been modified so that releases are -- can be made for fish survival

coming up the river. If you take out the dams, there's going to be no more water for that, but there will be a drive to get the water from Upper Klamath Dam which currently is used for irrigation and will be -- on normal years, will be pretty well used up before the fall salmon season. Okay.

MS. ERIN RAGAZZI: Thank you.

MR. GLEN BRIGGS: That is the extent of my comments I have. Thank you.

MS. ERIN RAGAZZI: Thank you. So Mark Coats, John Menke, and Dr. Richard Gierak.

MR. MARK COATS: I'm Mark Coats. I'm here and just briefly want to say I oppose the dams being removed. Shut down quick so you guys can move forward.

MS. ERIN RAGAZZI: I'll pass it on.

MR. JOHN MENKE: Thanks for the Shasta talk.

I'm John Menke, M-E-N-K-E, J-O-H-N.

I'm retired professor of agronomy and range science and forestry at Berkeley for 25 years with the university and then for training for ten years before I became a professor for 25.

I've now lived up here for 24 years. And I tell you, I'm hoping with Trump we can end the NEPA process. I am appalled at all the idiots that think they know something -- [applause] -- education. I took

all the soils, all the water science, all the animal science courses at Davis. I went to college for ten years. My dad was a surgeon in Sacramento. I didn't need to have a job so I studied all my life.

Now, I raise prime Red Angus cattle. We're making so damn much money, I'm paying too much taxes, I hate to see the money thrown away on outfits like this.

I never thought I'd do this, but this is the picture of a colleague of mine at Davis, Dr. Peter Moyle. You probably know the crooked state of California has already approved the damn tunnels across the Bay Delta. You talk about a disaster. Peter Moyle and I are really ticked at you people in Sacramento for ever even going for this.

But the reason I refer to Peter, in 2007, he and Jeff Mount at Watershed Sciences at Davis -- UC Davis submitted about a four-page letter to the resources secretary of the -- in Sacramento and the Fish and Wildlife Service. Let me just -- item No. 1: No entities including Pacificorp, federal and state agencies and stakeholder interest groups has provided sufficient modeling and analysis to demonstrate the water quality impacts associated with removal of the dams.

Peter has been too busy to come up here and

spend a lot of time on the dams, but he's had his agent here, John Menke, for 25 years. I've read all the Stillwater sciences reports for the first FERC assessment and they're an absolute joke -- [applause] -- an absolute joke. Today, we call that type of analysis semi-science. It's not true science. They haven't tested any hypotheses.

Do you realize in 2020, the oldest dam when it goes out, you're going to be flushing about 43 percent, is the estimate of materials that accumulated there for 98 years, down a wild and scenic river? You people have to have your head examined. [Applause.]

Because I happened to buy a fabulous ranch in Quartz Valley that has a dam in the Marble Mountain Wilderness Area called Campbell Lake Dam for which was built in 1896, I have to have the Division of Safety of Dams Department of Water Resources in Sacramento every year come up and look at that dam because it exceeds the height required and inspected by an engineer.

Russ Bowlus, who is a current engineer with the Division of Safety of Dams about three years ago, walked in with me. It's about two and a half hours each way. And I had lots of time to talk with him. He inspects the Klamath River dams four times a year or his agent does. The dams are in as good a shape today as the day

they were built.

Copco 1 and Copco 2, because it did not have rebar at the time, this is -- I quoted Russ Bowlus, a professional engineer with Division of Safety of Dams in Sacramento -- "could take a direct hit by a bomb and they would not go out."

Finally, I have one last item. Another colleague of mine at Davis, Dr. Steve Kaffka, did an analysis of -- under the 205(j) program -- 205(j) of the Water Resources Board, this board that's doing this process. This is the final report of the California State Water Resource Control Board, April 16th, my birth date, of 2002. Mine was many years earlier.

"Farming practices and water quality in the Upper Klamath Basin, the final conclusion in this, the Lost River, water that comes into Tulelake compared to the water that goes out the drains, it is much improved after agriculture has exported the nutrients."

So all this effort recently to take agriculture away from the Upper Basin is actually doing harm to the water quality.

Thank you.

DR. RICHARD GIERAK: Dr. Richard Gierak, G-I-E-R-A-K.

I wanted to start out by indicating basically

that removal of these dams is, first of all, in violation of four federal laws. Second of all, in violation of Oregon and California water rights.

These are things that we need to look at. But, primarily, all this has been premised on the backs of coho salmon. Now, in 1992, the Federal Endangered Species Act listed coho salmon. And under the Federal Endangered Species Act, the only thing you can really take care of is the water in substrate of the river.

Two years later, a Federal Endangered Species Act group wanted to change that so they could get 300 feet from the edge of the river. That means that every individual that lives along the river now would have to get a federal permit to go ahead and put gravel on your road, a roof on your house, et cetera.

Well, I went ahead and joined with the granges. We have Idaho, Washington, Oregon, and California state granges. And in that process, we stopped that terrible thing from happening.

But it's also interesting to note that, at that time, the Karuk Tribal Council made it very clear at one of their meetings that coho salmon were never native to the Klamath River.

Then, as we continued on and, in '97, the California and Oregon granges came together and they

filed a lawsuit with Pacific Legal Foundation. And what they founded and won was that coho salmon were not an indigenous species to the Klamath River and could not be listed under any Endangered Species Act.

Then, in 2002, came the big fish kill. And right away, they blamed it on bacteria from the dams. Well, what happened was they immediately listed the salmon again in violation of the laws.

And in 2009, the CEC came up here and evaluated our dams and lakes and they said, "gee, they didn't cause the problem."

And then the Northern Research Council did an evaluation of the 2000 fish kill, et cetera. And what they discovered was that, "gee, the coho salmon that were killed in that big 2002 mess were from Cascadia, Oregon," again, proving they are not an indigenous species to the Klamath Basin and, therefore, cannot be listed under any federal laws.

In 2006, an environmental group tried to list chinook salmon in the Upper Klamath Basin. Well, we found out about it before it got listed and then we filed a delisting petition. And that was really interesting because, a few weeks later, got a call from DC and the gentleman indicated that we can't go ahead and use a delisting petition on something that's being

listed. So I will use that material when I look at the listing. Two weeks later, they denied the petition. But this is all about a ruse to remove our dams.

Thank you.

(Applause.)

MS. ERIN RAGAZZI: Next, Larry Bell followed by Susan Wallace followed by Linda Ebert.

MR. LARRY BELL: Oh, my name is Larry Bell. I'll spell it, L-A-R-R-Y, B-E-L-L.

I am a person who -- whose father who homesteaded in the Klamath Basin 70 years ago. I've never seen such a mess as you people are making over some fish. I've never seen a salmon in the irrigation water in the Klamath Basin. I don't know where all this got started but it's crazy.

And I'm for what the people have stated here that want to keep the dams in. I see no reality to tear something out that is doing good for human kind.

Okay. Thank you.

MS. ERIN RAGAZZI: Susan Wallace.

MS. SUSAN WALLACE: Susan Wallace, S-U-S-A-N, W-A-L-L-A-C-E.

I am a resident of Hornbrook area. I overlook the Klamath River from my house. I watch all the fisherman fish every year, and we have quite a lineup at

the Klamathon Bridge constantly.

I have to say that I don't trust anything you people are doing. This has just been a ruse to remove dams. We have renewable electric resources that we've used for years.

We have never seen anything other than good coming out of these dams. Taking them out is going to release the sediment that we've already spoken to earlier that has more than likely chromium-6 involved.

I have a sister-in-law who has a steel rod through her spine right now because of chromium-6. I have a brother-in-law who is dying of cancer because of it. It is a group thing when you turn this stuff loose.

You have evidence of this activity in the sediment in the Oregon dam removals of which there were two. They have -- the stuff in that sediment has poisoned dams -- or excuse me -- poisoned wells all along the river's edge in Oregon. So it's not like it's a surprise. It's already out there.

We have so much information people have brought here that exists. The reason for another fake -- I will say "fake" -- study is just to promote the removal of the dams. They have nothing to do with truth, honestly, and I think it stinks.

Thank you.

(Applause.)

MS. ERIN RAGAZZI: So Linda Ebert followed by Steve Radford followed by Mark Fischer.

MS. LINDA EBERT: Hello. My name is Linda Ebert, E-B-E-R-T.

My husband and I are private residents on Copco Lake. Around 16 years ago, we settled on its north shore. We've enjoyed the pleasures of residing on a lake filled with perch, croppie, bass, trout, sucker, and catfish.

And aside from experiencing many memorable fishing and boating outings on the lake, we have been visually rewarded while viewing the many moods of the lake, whether sparkling in sunshine, bathed in moonlight, iced over surging with waves or mirroring the hills. And all that enjoyment is threatened by dam removal on the Klamath to which we strongly object.

We also object to the following consequences of dam removals:

The release of both coarse and fine sediments, some of which have been shown to contain toxic pesticides in core samples that will endanger the fish on whom they are released because of their toxic nature and because they will deoxygenate the water causing fish to die. Furthermore, large debris material will litter

the landscape in front of our houses now on the lake.

Number 2, the potential for flooding will become a reality for ourselves and others downriver. Floodplains will be redrawn having implications for insurance coverage.

Number 3, the cloud of uncertainty surrounding potential dam removals that pushed our property values downward will darken as values plummet with dam removals while our visual paradise or what once was disappears.

Number 4, our sense of security that comes with knowing that there's a huge reservoir of water that can be drawn upon when there's a fire emergency threatening our homes will be gone in the event of Klamath dam removals.

We experienced such an emergency in 2014 when those of us living on the north shore of Copco Lake were placed under mandatory evacuation for four days. We witnessed helicopters dip into the lake many times during firefighting in our area and just over the Oregon border.

Lastly, we also object to the tactics used by proponents of dam removals; namely, the following:

Number 1, we, the property owners living on the Klamath, many of us also rate payers, were never given or sent or -- a seat, I'm sorry, at the table in

determining the fate of the Klamath dams. We are the true stakeholders. We live on the Klamath.

Number 2, instead, reasonable advance notice of the times and places of the official dam determination meetings, that has seldom been forthcoming to those opposed to dam removals, including our Siskiyou County supervisors.

Number 3, there's been a dismissive attitude toward, and an unwillingness to consider seriously, viable alternatives for fish passage on the Klamath versus dam preservation which would save valuable hydropower infrastructure, which has been previously mentioned serves at least 70,000 households.

Such alternatives for fish passage include, (a), fish tunnel passages as proposed by Shasta Indians; two, trap and haul; and, number 3, fish cannons as available from the company Whoosh Innovations; and number 4, there has been an unwillingness to achieve a compromise with the Copco Lake Fire Protection District through the government-to-government process of coordination which was abandoned by government dam removal proponents.

Thank you.

MS. ERIN RAGAZZI: Thank you.

MR. STEVE RADFORD: Hi, I'm Steve Radford,

resident of Siskiyou County.

God, it's amazing. I'm a little bit appalled that you guys are so young and -- I'm a little bit appalled that you guys are so young and think you have a voice up here. You don't live up here? You have no idea what life up here is like as I didn't.

(Applause.)

MR. STEVE RADFORD: I had no idea what life up here was like until I moved up here seven years ago. I was from your part of the country, had no idea how these people live up here and what they're up against.

They lost their logging due to lobbyists and money. If you follow the money, that's what's going on here. You guys aren't educated enough. You're not old enough. You haven't been on this earth long enough to understand how this government works, how corrupt our government is, the federal and now Governor Brown follows -- you know, his hands, you know, are in the pockets of all the federal criminals.

I'm a Vietnam veteran, combat veteran, and I've witnessed how corrupt our government is. I've been fighting it ever since. I'm 67 years old.

The global initiative to control all of the people in this world today is so big and that's what's going on here. It's not about the fish. It's really --

it's about controlling the people and taking the people out of the environment, the rural areas, and putting us all in these stack-and-pack communities that you guys are living in down there.

We don't live like you guys doe down there. We live completely different. If you moved up here, if you spent a month or a year up here and lived up here and witnessed these people, these intelligent people, scientists, and ranchers and farmers that have been living here for generations.

You know, where's the study about the dams that -- that put those dams in in the first place? You know, they studied those -- the initiative to put the dams in for years before they went in. And then the clean hydropower and clean energy that comes from those dams, plus the fresh water that goes to the cattle that you guys are enjoying down there in Sacramento.

You know, there's a lot of reasons for these people to be here. This is the heart of the land right here and the farming and the ranching.

What goes on down there in those cities is pollution. This is clean, environmental property up here. I'm an environmentalist. I want to sees the dams stay.

Thank you.

(Applause.)

MS. ERIN RAGAZZI: So Mark Fischer followed by Nita Still followed by Leo T. Bergeron.

MR. MARK FISCHER: Mark Fischer, F-I-S-C-H-E-R.

And I am a resident of Copco Lake, been for eight years. In those eight years, I've only heard twice from anybody about these meetings, once from Elizabeth Vasquez and one by a lawyer firm, Cable Hut- -- Huddon [phonetic].

Anyway, and you guys just bring these on last minute like we can just drop everything. And I think it's all in a game to try to get these dams out without any of us around.

And I'd like to give the rest of my time to this gentleman right here (indicating) if he'd like, because he knows more about it than I do.

MR. RICHARD MARSHALL: Thank you very much.

But I think you can see the issue here is this process of taking dams out. You are going to have to be independent thinkers, because the people behind you who are telling you what to do, having a plan, which is to take these dams out -- we want to keep the dams. There's good reasons to keep the dams.

And as you heard from one gentleman, the water quality has been improved, actually, by having the dams

in place. That's proven. But you won't find that in the stuff that DOI has prepared, because they have an agenda.

That's all I have to say.

(Applause.)

MS. NITA STILL: I want a -- I'll get it. I want to put my crutch on a chair.

UNIDENTIFIED MAN: I'll get it up there.

MS. ERIN RAGAZZI: And I think we have copies of --

MS. NITA STILL: Thank you for being here. I appreciate it. And we're being hard on you but that's okay.

In the year 2009, we voted to keep the dams by 80 percent. The people in Oregon also voted to keep their one dam. There is a manipulation and a conniving going on here, and those who want to take out our dams are holding secret meetings with some of our representatives and the two governors named Brown. These NGO stakeholders will do anything to have our dams destroyed basically.

The KBRA expired and now they have made the K- -- now they have made a KRRC. They are involving every agency in hopes that they will get their way.

There is another problem. The Klamath River is

flowing over the burial grounds of the Shasta tribe. And it was covered by water and now they want to expose it. This is all against the Antiquities Act. There has been no courtesy or respect shown to the Shasta tribe or even to the common people here. So you should not get -- you should not be coordinating with these killers of dams.

I got to relax a minute.

MS. ERIN RAGAZZI: Do you want to sit down? I completely understand.

MR. RICHARD MARSHALL: You can sit down.

MS. NITA STILL: That's okay. I won't sit down.

You should not be cooperating with these NGO stakeholder environmentalists. The TMDLs will not be what you want them to be because the Klamath River runs through a volcanic area.

And there are hot springs running from tributaries near Keno Dam. A company named Quicksilver Mining mined mercury in that area in the 19th century. Mercury --

MS. ERIN RAGAZZI: Let me hold the microphone.

MS. NITA STILL: Mercury is also called "quicksilver." Besides, it is the truth that the water after it goes through the dams is much cleaner. If the

dams are removed, it will be much less water in the river, so the TMDLs will be worse.

In 1851, George Gibbs went with another man who was having the Indians along the Klamath River to sign treaties. He told about one area, possibly sometime in October maybe near Hamburg community, where there were thousands of dead salmon possibly because the water was low and/or some of them had spawned since it was October. They had to move their camp up the tributary to get away from the bad odor.

The Karuk tribe, in the 1970s, took the Shasta R Treaty and became a recognized tribe. They're also claiming Shasta territory as claiming there's not enough fish for them when there are enough fish. And I do believe they are supposed to get their fish at Ishi Pishi Falls. I may not be pronouncing that right.

UNIDENTIFIED WOMAN: You are correct.

MS. NITA STILL: Oh, dear. If the dams -- oh, there's another thing when -- the ocean also affects the amount of fish -- the amount of salmon that return. And Mr. Gierak, he didn't mention that but he knows all about that.

Did I say my name? Okay.

But if the dams come out, there will not be enough water for the salmon to spawn or available water

to do their Karuk canoe dance. And the coho salmon is not indigenous to this area.

Since the fish stay out in the -- and they come to be adults when they're out in the ocean, that's what can affect 'em because, sometimes, there's lots of fish and, sometimes, there are no fish.

Please do not involve yourselves in something that is as conniving, mean, and unjust as is this plot to destroy our dams. We would like you to respect our rights and be honest.

Thank you sincerely.

(Applause.)

MS. ERIN RAGAZZI: Can we get the spelling of your last name?

MS. NITA STILL: S-T-I-L-L. Nita.

MS. ERIN RAGAZZI: Leo Bergeron. Leo. Come back. After you, we will have John then.

MR. LEO BERGERON: Leo Bergeron, B-E-R-G-E-R-O-N.

And there was reference made to some activities of the grange and the salmon was concerned. And I've been a member of the grange for over 55 years.

And don't you just love that woman? Can you imagine? Can you imagine what she had to go through to get up here and do that? Right? God, that was

beautiful.

First, I just had a birthday and it's caused me some anxieties, because I'm getting closer to 100. And some of these things kind of disturb me now where, in the past, I was a little bit more understanding shall we say.

But right off the bat, I took exception to your title. It says "dam development." That's a bunch of bull. We're talking about dam removal. Why the hell won't you say it?

And good water quality -- water quality. Good water quality does not exist in the Klamath. Polluted water comes into California from Oregon. California cleans it up so that, by the time it gets to the ocean, it's almost decent.

How does this happen? A coastal range with streams that are fed by fresh rain and dams, dams on the river. The water comes into the dams dirty and it goes out cleaner. Now, you've got a number of dames each time. I mean, it gets a little bit cleaner so.

This is not a real thing. Everybody knows this. I mean if you have any sense whatsoever, you know this, but science -- there have been tests made and surveys made and studies made and it says, "this is what the truth is, it's dirty coming in, clean coming out."

So, you know, this same thing we experienced here a whole year ago. I made reference to that. The same thing, the same things was said, the same people talked. Nobody listened. Nobody listened. Now, you people -- all educated people, hi, listen, check out the information and then do something. Do something intelligent this time.

Thank you.

(Applause.)

MS. ERIN RAGAZZI: John Livingston and Greg -- I think it's Kuck followed by Javier Kinney.

MR. JOHN LIVINGSTON: I'm John Livingston, J-O-H-N, L-I-V-I-N-G-S-T-O-N.

I was born and raised in Northern California over in Eureka and I reside in Redding and I came up here to give my testimony tonight.

I'm a recreationist. I'm a canoer, a rafter, a hiker. And I would like to see the dams removed, so that the economy of Siskiyou County can be improved through increased recreational opportunities.

Thank you.

I also have a letter from the Sierra Club.

(Applause.)

MS. ERIN RAGAZZI: So we have a Greg K-U-C --

UNIDENTIFIED WOMAN: "Cook."

MS. ERIN RAGAZZI: Cook [phonetic], okay, followed by Kinney.

MR. GREG KUCK: Well, almost all the people in this room probably know me. I'm a sixth-generation rancher -- cattle rancher living in the watershed of the Klamath. We have the Shasta River -- a mile of Shasta River.

And what I kind of want to talk to you folks about -- you guys all have families? You all got kids?

Well, we've been doing this on the same ranch for six generations raising our families. We have cattle in that drainage. We spent a lot of time fencing the rivers out for this whole watershed. We have some of the cleanest water in the world that runs into the Klamath. We developed one of the nicest fisheries in the world in California or on the West Coast to bring those fish back up, rear 'em and send 'em back down.

And I sat in a lawsuit and I heard Leif Garrett say that he'll never let those fish come back up. Well, after I heard that, I gave up on you guys. And I went through a bunch of you people over the last 30 years. We've jumped through every hoop that we could do to get these fish back up here for you guys. And it isn't getting done by taking the dams out.

Thank you.

MS. ERIN RAGAZZI: Javier Kinney followed by Linda Oliver followed by James Adams.

MR. JAVIER KINNEY: We are the Klamath River; the Klamath River are us.

My name is Javier Kinney. I'm the director of the south governance for the Yurok tribe, comes from the village of the Pekw-tuehl, Weych-pues, Rugger [phonetic], the villages that we originate, you know, the traditional and indigenous peoples of the Klamath River.

And I just wanted to share with you, first off, we strongly support the removal of all four dams by 2020. We also support a successful certification of the 401 certification process by 2019 in order for the four dams to be removed by 2020.

There's three things I'd like to provide for the record on behalf of the Yurok tribe: Respect, recognition, and understanding. First, as the traditional and indigenous people of the Klamath and Trinity Rivers, we want to make sure that the respect is given to the traditional life ways and cultural ways for ceremonial purposes and the food/security that is required of the Yurok tribe and communities and peoples that live along our traditional ancestral territory.

We're provided the knowledge as well as

technical expertise and fisheries, a natural resource protection, since the beginning of time. We also understand the importance of the continuance of that knowledge to protect the water and the way of life that we know.

Recognition of including that knowledge in the management of not only our waterways but of the natural resources to ensure that the health and welfare and the prayers are carried on prior to anybody coming to what we know of as California. We have traditional government systems that have been put in place before the State of California and the United States, and we're going to continue that.

Lastly, understanding. We understand the changing times and the importance to have inclusive of not only scientific fact but old is new again. Governments across the world are looking at indigenous peoples and the way that we manage our resources in a sustainable way. We're going to continue that, because we are those caretakers.

A lot of times our elders share with us the ways to carry on and, many ways, your kids will may be at some type of meeting 50 years from now and we'll have the same conversation but we'll come with that respect, recognition, and understanding because we're not going

anywhere.

So we support the four dams to be removed by 2020. We support the 401 certification to be approved by 2019 in order to make that happen.

Thank you.

(Applause.)

MS. ERIN RAGAZZI: Linda Oliver, James Adams, and then Kristen Sellmer.

MS. LINDA OLIVER: My name is Linda Oliver, L-I-N-D-A, O-L-I-V-E-R. I am a chairman of the Copco Lake Fire Protection District.

A few years ago, I teamed to coordinate with the Federal Government of this land. All I got from them was we agree to disagree. It is against the law to take something away from people and not either make it better or best when you leave.

We will not tolerate these dams coming out. If we become the State of Jefferson, then what are you going to do? And I hope we do because I am tired.

I've been up here for 14 years. I have met people here and they've got far more education than I've ever seen in any place that I've ever lived in the State of California and I can call 'em my friend. But to have to go through this year after year after year, this is ridiculous. And all the scientific study that is bogus;

I know more science from the seventh grade than people do. It's not about degrees. It's about common sense.

And as far as respect? What about the Shasta Nation? Do they not deserve the respect of their tribes? Their burial grounds? And they are allowed to come on our property to investigate those areas. Are they allowed to go on your property? Think about it.

Thank you.

(Applause.)

MS. ERIN RAGAZZI: James.

MR. JAMES ADAMS: Good evening. I'm Jim Adams, J-I-M, A-D-A-M-S like the second president. Thank you.

I've been in state service, my wife and I, almost 60 years. I retired after 37. I've been on that side of the Board. I've been on this side of it. I'm now currently always on this side. And I understand your positions, and I would just like to have you hear me out and a couple of things that I have to say.

Get my specticators on here. And I'm chasing some hay fever so just have to deal with that.

My wife and I have worked for a government agency, so we sort of have an idea of how some of this works. We do feel that this is a waste of time, as we feel in political power has an agenda of their own and we really don't care and they, the government, really

don't care what the citizens of Siskiyou County want.

However, we will say our piece. Thank you for the opportunity. We are against the dams coming out.

First, they keep our power bills down and produce clean energy better than buying it from another state or an entity that will charge more.

Secondly, it provides small towns below the dams with flood production.

Thirdly, we have water storage for drought years of which we have experienced in the last six -- which we have experienced the last six or seven years and which out of -- as without the water storage -- excuse me -- John C. Boyle, Copco, Iron Gate, the fish would have suffered greatly. The state has just cast a disgust adding four more reservoirs from Colusa to Red Bluff and another near Colfax on Bear River. Why in the world during a drought have -- why in the world, during a drought or otherwise, would you remove existing dams?

Since DWR takes water from the Trinity system to send down to the Delta, John C. Boyle, Copco, and Iron Gate can supplement water to the Lower Klamath to enable to send water from Trinity down to the Delta. So does this mean that you will no longer send water from the Trinity to the farmers in the Delta if the water in

the Klamath is not enough?

It is -- was truly getting the -- if it was truly about getting the fish up and over the dams, this could be done using the natural topography of the area and create an additional waterway around the dams.

Americans have created some of the most wonderful things: Mt. Rushmore, put a person on the moon, enormous bridges. Well, you know where this is going. I believe it can be done. If the word "compromise" was only in a politician's or government worker's vocabulary.

I'll just to give you a little impromptu background. I probably had my hands on about a billion eggs and fry and salmon and trout in 37 years. They need water. Fish need water. So in '14 and '15 when the drought was at its most severe, those dams, with water in reserve like a bank account, were able to flow to the ocean and keep the 2002 die-off from being -- happening again. The additional flow, lower water temperatures, less pathogens, and they were able to keep fish. And the ones at Iron Gate dam were able to complete their cycle.

I could go on and on about fish and their life cycles but you get my idea that, if you don't have water, you don't have fish. And believe me, without the

dams, Klamath River will become pretty small come September and October.

Thank you.

(Applause.)

MS. ERIN RAGAZZI: So Kristen followed by Mark Baird followed by Don McIntosh.

MS. KRISTEN SELLMER: Hello. My name is Kristen Sellmer, K-R-I-S-T-EN, S-E-L-L-M-E-R.

I'm a resident of Etna, California, and I coordinate the fisheries program for the Salmon River Restoration Council.

Concerning the scope and content of the environmental information to be included in the new EIR, I ask the State Water Board to incorporate the Klamath facilities removal 2012 EIS/EIR analysis as well as new scientific findings such as those that have emerged in the wake of our nation's largest in the state of Washington on the Elwha River, which has been met with unprecedented success.

To know that specifically that the unavoidable impacts to water quality and aquatic resources due to dam removal will be short term and that the removal of the four PacifiCorp dams provides the highest long-term benefits for salmonid restoration and the water quality of the Klamath River.

The costs of any alternatives besides dam removal outweighs the benefits as dam removal has been proven to be an effective way to restore watershed ecosystems, revive wild and sustainable fisheries and associated jobs, protect coastlines, and improve water quality.

Therefore, despite the difficult challenges in changing, it just -- that this project poses, I sincerely request that the Water Board, with the advocation of the best available science, issue water quality certification for dam removal and to issue it in time for FERC to approve dam removal by 2020.

Thank you.

(Applause.)

MS. ERIN RAGAZZI: Thank you.

So we have Mark.

MR. MARK BAIRD: Mark Baird, B-A-I-R-D.

I'm from the Scott Valley Protect Our Water and the Jefferson Declaration Committee.

So far, we have spent in excess of a quarter billion dollars of the taxpayers' money to save the coho salmon in this watershed. And by the admission of Mark Stouffer, the head of the Fish and Game and lead agent for this mess prior to you guys coming this time with a new plan -- according to him, we haven't saved a

damn one of 'em.

So I don't know. I'm an airplane pilot and a rancher but, if I do something that doesn't work for 25 years, the last thing on my mind is to keep doing it for another 25 and spend another quarter billion or 500 million or 2 billion and hope it turns out different the next time.

And also, in addition to that, Stouffer also said, "Well, this is just an experiment. We have to try to see if it works." We've heard that before about ObamaCare. But he had no idea how long this will poison the river, 200 million cubic yards of sediment.

And you guys are really interested in doing the right thing, there's an easy way to do it. Just take a water sample in the Upper Basin and take a sample again below the last dam and see which one is cleaner. And that would be the science -- the best emerging science I think our opponents say to find out whether those dams clean the river or destroy the river. I think you would probably be pretty surprised because your agenda is to take it out.

Just remember that article 1, section 10, clause 3 of the United States Constitution prohibits states from making agreements with one another without the consent of Congress. You have no consent from

Congress. Which means that if you cooperate in any way, shape, or form, you personally on the Water Board are acting outside the scope of your agency and your training which puts you in jeopardy of being prosecuted under title 18, section 242 of the United States Code.

And also, the civil penalty for acting outside of the scope of your agency is title 42, section 1983, and that applies civil penalties for acting under color of authority to deprive anyone of privileges, rights, or immunities. And we fully intend to prosecute every single one of you if you participate in this scam. Dam removal is nothing more than the biggest environmental scam of the century.

And I keep reminding our people in the water rights group this has nothing to do with the fish. It never did. This is about money and power and they want it. And it's taxpayers' money.

Now, finally, I will leave you with this thought. I was invited to a secret meeting in Yreka. I remember a couple of other people in the room that were there. And just raise your hand if you were there. And you know the meeting that I'm talking about.

So Rich, you were there, I think. Is Rich still here?

Anyway, there were a couple of people there and

they can testify to what I'm about to tell you. An emissary of the Yurok tribe was there and he sat on the stage with somebody from the Klamath Irrigation District, and he said to us, "We don't care what you think, we don't care what you want, we don't care what you do, we're not asking your permission or telling you what's going to happen. These dams are going to come out because we want control of the flow of the Klamath River and we want that money." And I was there and that's a quote and there were other people there, too.

MR. JAVIER KINNEY: Not true. I was there.

MR. MARK BAIRD: Well, I heard it and so did other people.

Thank you.

MS. ERIN RAGAZZI: Don followed by Jerry Bac- --

UNIDENTIFIED PARTICIPANTS: Bacigalupi.

MS. ERIN RAGAZZI: Followed by supervisor Michael Kobseff.

MR. DON MACKINTOSH: I'm Don Mackintosh, M-A-C-K-I-N-T-O-S-H.

I'm a rancher but, before that, I was with PG&E for 28 years. I retired as a grid operations -- in grid operations. I controlled the power including, you know, hydroelectric hydro power.

And what I wanted to talk about here is just to -- the -- to talk about these dams being removed which is -- there is -- these dams are a business. It's a beautiful business. It has revenue that is in excess of $40 million annual. And the cost of producing that at 12 percent, plus or minus, which is quite a return on your pock- -- money. But it is a beautiful thing. It's the cleanest, cheapest power that there is and the -- I was -- it's got so many benefits you just couldn't -- the benefits for power, the power system itself.

But let's go over the steps that's going to happen when they take 'em out. First of all, they'll blow the dams and then that destroys this business that produces 40 billion -- million dollars. And so then -- and then when you take this out -- these dams out, you're going to have to replace 'em, the power, and that's going to be possibly a billion dollars.

So then the -- just the cost of removing these, you know, I've seen a $2 billion price tag on it. So then it's -- it's awful. This is what is happening because I spent my whole life in this business and there's nothing nicer and does more -- more good things. Everything can pre- -- can -- it benefits from hydroelectric power. And so then -- but then the bad thing about it, when they do take this out, you have

nothing and the whole -- the bottom line of it is complete cost. Everything is cost.

So then -- and then on top of that, you have -- you know, the people -- the people are going to end up paying for this liability, the cost of moving it out because they -- the way this is set up, the company that's taking -- wants to take 'em out is a worthless company that isn't creditable to handle power or doesn't have the money, doesn't have the experience to deal with it. And, you know, when I was in the power business, you know, the FERC was for, you know, power and for hydroelectric.

You are saying I'm done? Well, it's a sad thing and this should not happen. So -- so -- and then I'm also a rancher now, but I loved what I did and I was good at what I did. And then so I just -- this is an awful thing to take 'em out.

(Applause.)

MS. ERIN RAGAZZI: Thank you.

Are you Jerry?

MR. JERRY BACIGALUPI: I'm Jerry Bacigalupi.

And I'm a former state employee with Caltrans and the Department of Conservation and I was a resident engineer on Interstate 5 for the bridges.

And Siskiyou County, to me, was the last

frontier in California. So my wife and I, we bought a ranch up here, and now I'm up here full time. So, basically, on my input to you, I'll try to highlight some of the things --

MS. ERIN RAGAZZI: A little bit higher.

MR. JERRY BACIGALUPI: Okay. Basically, as a professional engineer, I would like to highlight some of the things that I would propose if I were responsible for moving this project forward. And number 1 is, because of the controversy of the anadromous fish habitat in the Upper Basin where Salazar claimed that it would provide an additional 425 miles of anadromous fish habitat if the dams are removed.

This has created a tremendous controversy. And what I would propose is that we need to do a truck and haul study. And I would say, without a doubt if I was involved as an engineer, there would be no doubt that's what we would do.

So Iron Gate Dam is at mile 190. The headwaters to the Iron Gate Dam which is the headwaters for Lake Ewauna and the outlet of Link River which is just below the Upper Bas- -- Upper Klamath Lake is at mile 254.

So what I would -- what I would propose is to take the fish from Iron Gate Dam, collect them at Iron

Gate, dispose of them at the headwaters of the Klamath River, and I would propose probably, you know, somewhere between 50 and 100 female salmon with corresponding males and make a five-year study out of it.

And the problem is that Upper Lake and Agency Lake, they are probably -- they are over 30 miles long and the fish would have to traverse a shallow lake that is high in nitrates and high in sulphates, very shallow, very warm in the summertime, and to be able to traverse to the upper five rivers that contribute to the upper lake.

And so let me read -- let me read an article here that is by a former game warden and wildlife biologist that worked for Department of Fish and Game. He says, "Regardless of what Native Americans upstream of Klamath Lake impound believe, I do not think salmon or steelhead trout would navigate the shallow lake from its outlet into the Link River or find their way to the Woods, the Williams, or any other tributary to the north end of the lake, even if they were trucked there and released."

The whole project is ignorant from the start and to offer rebuttal to insanity is worthless and senseless from the start. So this comes from a wildlife man and I respect -- am I done already?

MS. ERIN RAGAZZI: Yes.

MR. JERRY BACIGALUPI: Okay. What else I would like to do is Siskiyou County has several alternatives in here. Siskiyou County has several alternatives to dam removal and there's a lot of other evidence.

Did you present them at the --

MR. RICHARD MARSHALL: Yeah, I gave them one.

MR. JERRY BACIGALUPI: Okay. So a few items above there, it shows the reefs along the river. It would preclude that salmon from ever getting into Upper Basin and, basically, I would like to have you guys review that thoroughly.

MS. ERIN RAGAZZI: Thank you.

(Applause.)

MS. ERIN RAGAZZI: So Joe James followed by Robert Lindi- -- I think it's an I -- Lindamood.

MR. MICHAEL KOBSEFF: Michael Kobseff, K-O-B-S-E-F-F.

I'm the current chairman of the Siskiyou County Board of Supervisors. And I'll be reading a statement that was a unanimous statement from the Siskiyou County Board of Supervisors.

The Siskiyou County Board of Supervisors would like to provide the following oral and written com- -- statement regarding the Water Board's note of public

scoping meetings in the preparation for the EIR for the Lower Klamath Project license surrender.

In addition, the Board of Supervisors will be providing formal written comments by February 1st of 2017 in response to the proposed Notice of Preparation.

First, it seems that the public notification of the original January 10th meeting was very limited, even within the county in which it's taking place. The Board of Supervisors was informed of the meeting by an individual who read it -- read about it on her local environmental group's Web page in late of December 2016.

We did not receive official notice from the Water Board until January 4th of 2017, although it appears that the notice was first sent out to certain people in groups on December 22nd, 2016. This short notice and limited communication violates, if not the letter, then certainly the spirit of the law intended to notify and engage the public and solicit active participation. Unfortunately, this is not the first time situations like this have happened.

The County of Siskiyou deserves and demands adequate notice at the earliest possible date of all future meetings. Siskiyou County is concerned with the economic and environmental consequences that would impact the county if the four Lower Klamath River dams

were transferred to and removed by the Klamath River Renewal Corporation.

To address a few of these concerns, the county continues to reiterate that the 20 to 30 million cubic yards of sediment that has been collected behind the dams and would be released down the Klamath River after dam removal has not adequately been evaluated to address the averse local and environmental impacts.

Over the last several years, water has been released from behind Copco Dam to initiate Klamath River pulse flows to help improve water quality and fisheries habitat during the summer months. If the dams were removed, this water would not be available at a critical time needed and would have to come from Upper Klamath Lake storage which would impact agriculture and wildlife refuge deliveries in the Klamath Basin.

Other issues include the potential for catastrophic flood, either during dam removal activities or after or -- and property loss values in the areas surrounding Iron Gate and Copco dams which Siskiyou County estimates would be several million dollars.

As part of the environmental process, it is the Water Board's responsibility to fully address these issues, impacts to Siskiyou County, and the impacts to the Klamath River water quality. In the past when the

Klamath Restoration Agreement and the Klamath Hydro Settlement Agreement were being developed, environmental documents limited the analysis of the area to a five-mile stretch of the Klamath River which is inadequate and, in no way, addresses the total effects of dam removal.

During any environmental process concerning the Klamath River, the area of analysis needs to consider the entire river systems surrounding the areas and the and local communities including Siskiyou County. We also raised the issue that it would be difficult to do as the Water Board does not have any jurisdiction beyond California which raises the question as to the legal ability this board the Water Board to analyze impacts for the dams located in Oregon and waters originating in Oregon.

Nevertheless, any deviation from full analysis would be in violation of Title 14, Chapter 3 of the California Code of Regulations, Guidelines for Implementation of the California Environmental Quality Act. In relation to this, the Water Board's documents outlining the process for the water quality permit certification seem to assume that dam removal is -- is a determined outcome, which would make the environmental document predecisional and would, again, violate Code of

Regulations.

We were requesting that you not make this -- almost there -- assumption and that you meet the needs of all impacted environmental and natural resources and give due diligence to the people, livelihood, and economy of Siskiyou County.

To reiterate, it is Siskiyou County's expectation that there would be a fair and complete analysis of all environmental consequences of the proposed section 401 certification for the entire impacted Klamath River system. Only if the Water Board thoroughly and transparently identifies, analyzes, and determines whether possible mitigation measures are feasible and would render identified impacts less than significant and we would submit that this is not possible, can the Water Board approve the requested 401 Water Certification.

The California, oh, Environmental Quality Act and interpreting case law makes clear that proceeding without meeting these requirements would be an improper abuse of the Water Board's discretion in acting on this proposed project.

Thank you for the opportunity to make this statement. And we'll follow up with more comments.

Thank you.

(Applause.)

MS. ERIN RAGAZZI: Joe James, Robert Lindemann, Craig Tucker, and Konrad Fisher.

MR. JOE JAMES: I agree now. Joe James, J-O-E, J-A-M-E-S.

I'm a Yurok tribal member. I'm also a Yurok tribal elected official to the Yurok tribe. The Yurok tribe is the largest populated tribe in the State of California.

Since time immemorial, the Yurok tribe, and its indigenous people have been stewards of the land. I'm a resident -- full time resident of the Indian country. The Yurok Tribe fully supports the removal of the Klamath River dams and it's associate -- facility structures. We encourage the environmental process to show, as it did in the 2012 EIS, that ben- -- that the impacts of dam removal due to social, cultural, and illogical [phonetic] amount of features were the strongest and most lasting with the full removal of the dams.

Also encourage the State Water Control Board Certificate Program purchase -- the board to issue the certificate for dam removal by 2019 so the dams can be fully removed.

Also, in closing, we understand the issues. We

agree to disagree. But for us as a people -- as people, as river people -- as people that utilize the river since time for a number of things for our cultural, economic, our social, the river is a vital and key component of the rier for the Yurok tribe.

And in closing, not only do we urge the removal of the dams, but we also consider utilizing the Yurok tribe labor force to remove -- when the dams do come down to remove -- to utilize our labor force and resources as the dams come down.

Thank you.

(Applause.)

MS. ERIN RAGAZZI: Robert followed by Craig by followed by Konrad.

Can you please spell your name for --

MR. ROBERT LINDAMOOD: Robert, you know how spell that, L-I-N-D-A-M-O-O-D, not Lindawood.

Hi, my name is Bob Lindamood. And thank you for coming today finally.

First thing I want to go ahead and say is thank you -- Richard? You still here? Richard Wallace -- Marshall. I'm sorry. And also Erin, my good friend from the Congressman's office, thank you for what you said. I want to amplify these people and what they said. I'd definitely say, there is no way in hell they

want that dam tore down.

Now, let me ask you a question -- actually, let me not ask you question, just make a statement about that. We're talking about quality. There's one thing about quality that we have. There's also consumer impact. Now, consumer impact, we're talking about water quality. And also how many fees we're paying to the power company already to tear the dams down. Why are we paying that? I don't know. When I first came here, I said, "Why are you all paying that?" Nobody knew.

But here's your job as far as quality -- water quality goes is for recreation. And, yes, I ran up here from Sacramento to make that statement. Recreation also includes the peaceful enjoyment of your property in the area.

Now, if you would like to go fishing for salmon, what happens when the dam's tore down? Let me explain that part for you. I've done a lengthy study myself. In 2009, salinity was higher further upriver we went, lower as we went down past each dam. Now, what does that tell us? You tear the dams down, you're going to kill all the damn salmon, and there won't be no fishing for nobody.

Thank you.

(Applause.)

MS. ERIN RAGAZZI: Craig Tucker.

MR. CRAIG TUCKER: My name is Craig Tucker. I'm the natural resources policy advocate for the Karuk tribe.

I just bought a t-shirt. I wish I'd worn it. It says, "science doesn't care what you think." And I say that because there's been a lot of anecdotal stories and a lot of vague references to science. But what I'm asking you guys to do is look at the technical record that's been built.

This is probably the most studied dam project in the world. Over 3,000 pages of technical reports went into the 2012 EIS/EIR. The United States went through the exceptional step of putting all of that data through three levels of peer review -- did the peer review by a committee with the National Academy of Sciences.

The National Academy of Sciences is the most prestigious scientific organization in America. It's America's best scientists. They concluded that removing the dams was safe. They concluded that removing the dams was the best way to address water quality concerns, and that removing the dams is the best way to restore fish in the Klamath Basin.

It is really bizarre to me to come to Siskiyou

County and hear people want to force a private company to maintain an asset that it loses them money. So Pacificorp, for their part, have a legal obligation to pursue this relicensing process in a way that leaves the cheapest possible power rates to their customers.

The Public Utility Commission of Oregon and California agree the PacifiCorp that removing these dams through this agreement achieves the lowest possible power rate for their customers.

(Audience overtalk.)

MR. CRAIG TUCKER: That's not my opinion. That's not my opinion.

Hey, you know what, you guys bully people that you don't agree with off a stage, but not you're not going to bully me off the stage. All right.

So this is not my opinion. This is what these regulatory agencies have decided. So I urge you guys to look at the existing public record, the existing record for the 2012 EIR/EIS in the decision by the Public Utility Commissions.

The Karuk tribe strongly supports the 401 permit to decommission these dams as soon as possible.

Thanks.

(Applause.)

MS. ERIN RAGAZZI: Thank you.

Konrad Fisher followed by John Foster followed by Sarah Rockwell.

MR. KONRAD FISHER: Thank you. My name is Konrad.

I live on the Klamath River in southwest Siskiyou County. My family has been here for four generations. And so it's always interesting to come upriver and meet my fellow Siskiyou County residents. My grandparents came, in part, to log and, in part, to build a pipe to takes water out of the Klamath Basin and sell it to Central Valley, California.

But it's interesting to hear from people who live in Scott and Shasta Valley about their opinions about dam removal. Many of you do not live on the Klamath River so that's interesting but just the sheer -- it's hard to know where these facts come from. And it's critical to base opinions on actual facts rather than alternative facts.

And I think the irony of all of this is that we all kind of want the same thing. I assume you all believe in private property rights. I assume you all want clean water and economic recovery and more salmon and health for your kids. So we all want the same things. We just don't really agree on how to get there. And I'm not sure we ever will agree so the question is

what to do about that.

For three summers in a row, I had to tell my niece and nephew, "you can't come to the Klamath." We set a date. "You can't come because the river is too toxic green." The preponderance of scientific evidence suggests that we can fix that according to the plan that's being presented here.

So really -- we're not going to agree on -- we can agree on what we want. We're never going to agree on facts, so I urge the state agencies to continue doing what you did in the past. Good job analyzing all of the evidence. In 2012, you reached the correct conclusion.

So the only new evidence that has come out since the last EIR further supports your conclusion. So I urge you to issue a water quality certification for dam removal in time to remove them by 2020.

Thanks.

(Applause.)

MS. ERIN RAGAZZI: John Foster, Sarah Rockwell, Betty Hall.

MR. JOHN FOSTER: Hello. John Foster, J-O-H-N, F-O-S-T-E-R.

MS. ERIN RAGAZZI: A little closer, sir.

MR. JOHN FOSTER: My family has been on Bogus Creek which is the last live stream below Iron Gate Dam

for since -- I think it was 1869 or something like that. As a kid, I remember lots of salmon. And it seems like the more we've done to improve the habitat, the less salmon. The more things done to make things better, the less salmon.

And I know the Klamath River is what they consider a back-ridge river. It starts out warm and gets colder as it goes down. So where you take out the dams, deep water makes colder water, so salmon like cold water, so the dams are improving the salmon habitat in my opinion.

And I still haven't heard anything what -- all that I know if we put in -- we used to put in flashboard dams. We're getting rid of them and now doing other things. But those dams would only be in for a summer and we had to wait until there was some good rains before we pulled 'em because there was so much sediment just after a summer that you killed the stream, you know, for it to flush on through.

So how many years of high water is it going to take to flush all that sediment behind them dams? I don't even venture to guess. And just going to lock up the gravel and spawning beds and definitely not good for the salmon.

(Applause.)

MS. ERIN RAGAZZI: Thank you.

Sarah Rockwell. Sarah. Is Sarah here?

Here, I'll move it to the back. Betty Hall followed by Roy Hall followed by Mike Mallory.

Here you go, ma'am.

MS. BETTY HALL: Just a minute. How am I going to do this and do that, too?

MS. ERIN RAGAZZI: I can hold it for you.

MS. BETTY HALL: Okay. I am Betty Hall. I am a liaison for the Shasta Nation.

And if these dams come out, they will flush out our village sites, sacred sites, burial grounds, hundreds of 'em from John Boyle clear on down, clear down to Clear Creek on the Klamath River. That's all Shasta Nation aboriginal homelands.

Ancestors -- my ancestors bones will be floating down the river. Would you like to see yours doing that? You know, it's hard to think about.

And I have a statement here. A document that was written by State of California Resource Agency Department of Parks and Recreation continuance sheet. There are 41 cairns listed here. Resource name, Shasta Civil War cairns.

We have Shasta Indians that were Civil War veterans buried on the Klamath River. They must be

protected by NEPA, CEQA, whatever. And if these come out, they're going to be gone. That's criminal. That's a crime.

Now, I have a letter here I'm going to read from the Native American Heritage Commission. I think it says a lot. It's written to the Shasta Nation. It says, on December 28th, 2016:

> "Dear tribal leaders, on behalf of the commissioners and staff of the Native American Heritage Commission, I would like to thank you for support in celebrating the 40th anniversary of the NAHC. The celebrating culminated with the 40th anniversary date on October 21st, 2016.
>
> The gala was an overwhelming success and we continue to receive very positive feedback for those who were in attendance. Since its inception in 1976, the NAHC has been charged with protecting Native American religious and sacred sites, assisting Native Americans in obtaining access to religious and in sites on public lands and bringing

legal action to prevent severe or irreparable damage to sacred sites or the ceremonial places as they have served as a momentous forum to celebrate all that has been accomplished over the last 40 years, an offer to look forward to the future, challenges and opportunities to protect California tribal cultural resources.

Most importantly, the gala served as an opportunity for the NAHC to show its appreciation to you and your tribal community and leaders for your unwavering commitment to culture resource protection.

To show our appreciation, please find the following items enclosed with a letter and certificate honoring your tribal commitment to the protection of California's tribal culture resources.

Signed by myself and NAHC Chairman James Raymond and a flash

drive containing all of the photographs and videos taken of the gala, including a short highlight video and digital copies of the printed materials distributed at the gala.

I would also like to take this opportunity to thank you for your continued support, and I look forward to working with you in the future.

Signed by Cynthia Gomez. Cynthia, Executive Secretary, Native American Heritage Commission."

I think that's powerful. I think that says a lot coming from our state official. And in this right here is all the cairns -- pictures of the Civil War cairns. Think about it. You have to save them.

MS. ERIN RAGAZZI: Are you leaving that with us?

MS. BETTY HALL: No. I'll send it to you.

MS. ERIN RAGAZZI: Thank you.

(Applause.)

MS. ERIN RAGAZZI: Roy Hall followed by Mike Mallory followed by Chrissie Reynolds.

MR. ROY HALL: I am Roy Hall, H-A-L-L.

I'm the Chief of the Shasta Nation. That's the local tribe right here.

The coho salmon is a tool for dam removal. There are natural blockages on the -- there are numerous natural blockages on the Klamath River from Iron Gate on up which the fish have never passed. We have documentation that the Shastas gave the Klamath tribe periodic permission to come down and gather salmon on the Shasta River. The fish never went up here. No one listens to this.

We have the documentation. If you want to see it, we've got it.

And what really bothers me about this -- this new deal -- this new corporation, the State of California and Oregon signing a bilateral contract. They're trying to say they didn't by creating this new corporation, but this is illegal and you are partly responsible.

And -- and this dam removal, what bothers me the most is Endangered Species Act. Species that are native and non native will be introduced upon our land and will be managed thereof. So there goes all our property rights.

We have nothing. We will be totally

controlled. They can introduce anything they want anywhere they want. And they've already proved that by introducing the Canadian gray wolf. It's here now.

And they are limiting our private property rights. And this is a violation of the Constitution. And I want you folks to know that you will be in court if this proceeds.

Thank you.

(Applause.)

MR. MIKE MALLORY: Good evening. My name is Mike Mallory. I'm the Siskiyou County Assessor Recorder. That's Mike, M-I-K-E, M-A-L-L-O-R-Y.

I've been involved in the valuation process of the -- to determine negative value impacts of dam removal for probably a dozen years now. I have a statement, a couple of concerns that I have -- three, in fact -- and some requests upon the Water Board to address those concerns.

Valuation studies to date at the federal level have been woefully inadequate, as the Department of Interior has carefully crafted the scope of work to arrive at a predetermined outcome of minimal value impact in the event of dam removal.

The figures so far are -- in the update, and I believe it was 2012 was 2 to $2-and-a-half million in

value lost to the properties around Copco and Iron Gate. And that is just totally ludicrous. That's just such a low number that it's hard to fathom that somebody could put that down on paper.

Appraisals to date have been based on the hypothetical assumption that the land underlying the lakes has been restored to its native condition with full accesses to a free-flowing river. It also excludes structural and site improvements from the process, so none of that value has been included. That's the largest portion of a property's value.

And an estimate of nearly 1500 impacted parcels has been grossly underestimated at just 700 impacted parcels, so less than half of what were originally targeted were analyzed.

For you, as the Water Board, I make this request that you completely disregard any valuation study relating to Klamath dam removal as commissioned by the Department of Interior, provide an objective analysis of the loss in property values and tax revenues to all impacted parcels in the event of dam removal, with consideration of mud flats and denuded landscape which will remain for years after dam removal.

My second observation is the Klamath River dams were not constructed specifically for flood control.

They are utilized to temper flood -- river flows to reduce flooding. Moreover, there's a perception that they provide flood control, and perception is reality in real estate valuation.

I ask that you analyze the impacts to the property values and tax revenues along the Klamath River below Iron Gate dam due to real and/or perceived loss of flood control in the event of dam removal. In addition, silt deposition may change the river course and lead to more severe flooding, which also must be considered in this analysis.

And, lastly, valuation of PacifiCorp's assets for property tax purposes are accomplished by the State Board of Equalization in Sacramento. And they insist on the State Board role also known as a unitary role. These values are transmitted to the county annually and are collected locally by the Siskiyou County tax collector.

These PacifiCorp's values currently are at 162 million in the county and the -- but the underlying classification by property type are not available even to the county assessor in the county.

At one time, we learned from Pacificorp representatives that hydroelectric assets represented about 20 percent of the total assessment which would --

so removal of these assets would be reducing the tax roll by about 32.5 million. That's $370,000 per year. That will be a big impact to the County of Siskiyou as well as the Hornbrook School District, which is a basic aid district, one of only of its type in the North State.

So I ask you to analyze the impacts to property values and tax revenues caused by removal of the hydroelectric facilities from the assessment roll. And I have a written statement.

(Applause.)

MS. ERIN RAGAZZI: Thank you.

So Chrissie.

MS. CHRISSIE REYNOLDS: Will you hold that for me?

MS. ERIN RAGAZZI: Yeah. And Ray --

MS. CHRISSIE REYNOLDS: Haupt, H-A-U-P-T.

MS. ERIN RAGAZZI: Haupt and then Thomas Joseph.

MS. CHRISSIE REYNOLDS: First -- first of all, a couple comments. The Elwha that was referenced, it's only 45 miles from the river to where the dam was, so you cannot compare what happened on that system to this system.

Second of all, it's never been mentioned in any

of those documents from the DOI on the EIR before about the roads. There's only one road going into the Copco and out. And Linda Ebert who spoke, her house is the last place that's paved. Beyond that, it's unpaved.

So as a daughter that has a kid that goes on the school bus with one way in and one way out, and I'm thinking of machinery and equipment for dam removal and the destruction of that road and people walking on that road and livestock and deer and my dog on that road, that's, you know -- that needs to be taken into consideration. Very small road, one way in, one way out for a project of this size, and it's never been mentioned in any EIR. I don't know. That needs to be looked at.

My name is Chrissie Reynolds, C-H-R-I-S-S-E, Reynolds, R-E-Y-N-O-L-D-S.

"Never be afraid to do what's right, especially if the well-being of a person or an animal is at stake. Society's punishments are small compared to the wounds we inflict on our soul when we look the other way," Martin Luther King.

I live at Copco Lake. I'm a resident of Siskiyou County and I'm a mom.

First of all, I'm outraged that the first I heard about this public meeting that was supposed to

happen before was from a Facebook post from a part-time resident and not from any official, either from your organization or even my own elected government representative. I now understand that the latter is due to late notice from you.

I'm a property owner and a stakeholder of what happens at Copco Lake. I received no notice of your intent to provide me the opportunity to speak. And apparently you received a letter from our Board of Supervisors also voicing their anger and displeasure at the lack of consistent notice with regards to some people in favor of dam removal being informed early and some people not in favor of dam removal being informed without much notice.

I agree almost wholeheartedly with the letter our Board wrote in response to you, except that in regards to their statement on transparency. I feel it's truly transparent that the residents of Siskiyou County are again being purposefully misled and that our due process is, again, being diverted by government agencies that are supposed to be looking out for the welfare of their citizenry. But, instead, these citizens are having to speak up and out against the agencies with which their responsibilities are about furthering policies that are not in the public interest but in

maintaining policies that benefit a certain agenda and not on the welfare of the people or the fish.

It's absolutely absurd to me that when 80 percent of the residents of Siskiyou County have voted no on dam removal and spoken and written and commented for over a decade now against dam removal, the false and misleading science of the last environmental impact study that was done which resulted in the firing of Dr. Paul Houser who was the scientific integrity officer and began a whistle-blower case that ended up being settled out of court due the lack of continued coordination with the Copco Lake Fire Board and those meetings being satisfactory to disregard our board of supervisors and their expressed feelings and needs that we are undergoing this process again under these conditions is simply unacceptable.

We the people are being denied due process by having our state governors decide on their own that they want the dams out. They set up a nonprofit entity with no accountability to anybody and the state agencies now have an agenda to follow regardless of what laws, either legally, morally, or ethically with which they violate.

In Siskiyou County's history, there are harsh reminders of what governmental policies were with regards to the indigenous people who were here before

our government was. They gathered the leaders of the Shasta people who, in 2017, are still not a federally-recognized tribe and, under the pretext of the feast were given tainted food and blankets with smallpox in a genocidal attempt. It simply boggles the mind that these people are still not recognized with the proper respect with the sovereignty they inherently deserve.

I, myself, am Japanese American. With parents and grandparents that were stripped of their constitutional rights and had their homes, business, and belongings taken from them while they were sent to, first, horse stables and then shipped out of state to be held in concentration camps the tar paper shacks in a barren desert landscape simply because that was the policy at the time.

Now, it seems we are in times just as dark and incomprehensible because that's how we are being treated. Our rights are being ignored, denied, and completely disrespected. The current agenda will be to lock us up and out from the lands which we hold ownership through our property rights and for which we pay taxes.

But no matter if we lose property values, no matter that we don't want dam removal, no matter that we are being extorted by having to pay for dam removal on

our power bills, some of us with properties in both Oregon and California so they have to pay for it twice and still lose their property value, it just all doesn't seem to matter to these agencies that are simply doing their job.

You know, people who do their jobs without thinking of the people or the lives that they are impacting really ought to know what it feels like to be robbed of the freedoms and their constitutional rights. They should lose their jobs if they're guilty of being complicit while these agendas are being carried out against the will and the rights of the American people who have an inherent and inalienable right to live where they want to live, in manners that they have self determined, bring about their right to life and the pursuit of happiness. And no government agency should be allowed to use policy to carry out eco terrorism against its own people.

The people have spoken. They said "no." You are not listening, and you are using our tax money against us and furthering to cause pain and suffering to people with this constant nonsense. We want our tribal people given the respect and the recognition they deserve. We want our lakes and our reservoirs to continue to provide clean, green, renewable energy to

over 70,000 homes. We want to be able to hunt, fish, and recreate in these areas.

We want to be able to keep these waters available for fire suppression. I was evacuated. I know how important these waters are. They've been dipped out of every year since I lived here.

MS. ERIN RAGAZZI: You need to wrap it up or you can come back up, that's fine.

MS. CHRISSIE REYNOLDS: We want an end to the geoengineering of our weather and our food and causing increased loss of life. We want our property values back to where they were before you started posting the blue-green algae scare, which is what the perceptional value was that started the deadline in our property values. This was even before dam removal.

I would hope that you will see what is so transparent for all of us. We will not give up our land, our water, or our rights and we will hold accountable those who will lie, cheat, deceive, and disregard us.

(Applause.)

MS. ERIN RAGAZZI: So Ray followed by Thomas Joseph followed by Daniel F. Simon followed by Margo Robbins followed by Sarah Rockwell if you're here.

MR. RAY HAUPT: Thank you. Almost thought you

forgot me back there. It's been a long evening.

My name is Ray Haupt, H-A-U-P-T. I'm the Siskiyou County Supervisor, Vice Chair of the Chair -- the Board and represent District 5, the bulk of the Klamath River.

You know, I -- we've listened to a lot in the room. And some things come to mind, certainly, that I could bring forward. I'm not going to dwell on the science, because they've been studied in great detail for over ten years. And I am trained in those areas to be able to look at it.

The question I would have as a former decisionmaker in the Federal Government is, why weren't mitigation measures looked at for dam removal?

You know, you've heard the controversy with all the sediment being flushed down the river. Why wasn't dredging an option prior to dam removal? It certainly fits the Clean Water Act. It certainly fits a better fit for the river. I suspect probably because it didn't fit the benefit-to-cost ratio and the economic analysis which I'm not allowed to see.

So I'm going to focus on a couple of procedural things in CEQA and NEPA. And those -- those come to mind to me as well as some of the jurisdictional comments I might have.

The action of the board, I think, is premature because of attempts to sidestep federal processes and use former processes that were not vetted by public review and appeal process or legal scrutiny through the courts.

In your previous meeting when you were here, someone made the statement that the intent was to use the environmental assessments from the 2012 Klamath dam EIS. The document really has no legal standing, as it is mentioned, and it prevents tiering under federal statutes or agreements outlined in the Council on Environmental Quality document.

I'm going to need a podium here.

The document I refer to is a federal document that says "integrating federal and state environmental reviews dated February 2014."

Legal sufficiency for NEPA analysis is defined in law. CEQ decisions may not tier to a NEPA decision when the EIS has not concluded in the record of decisions. CFR title 40, section 1506.1 subpart A --

THE COURT REPORTER: Slow down a little, please.

MR. RAY HAUPT: Pardon?

THE COURT REPORTER: Slow down a little, please. I'm getting a little tired.

MR. RAY HAUPT: I'm trying to speed up so these folks can go get some dinner.

THE COURT REPORTER: That's not working.

MR. RAY HAUPT: Those actions are outlined in that subpart that places some limitations on actions during the NEPA process.

This recent -- as recent as November 2016, the Federal Energy Regulatory Commission formally stated that they postponed the analysis of the license transfer until mid March 2017. And that's -- at least what they conveyed to our county. This, in part, due to incomplete application appendices from which to properly analyze the action before the commission.

What action is the board undertaking right now when the action is not clearly accepted or identified?

Using the former EIS documents for Klamath dam removal does not meet the thorough and hard look for effects found in NEPA and CEQA statutes. Those previous documents had, as a premise, a federally funded mitigation list found in the expired KBRA/KHSA agreements. Those no longer exist. Those mitigation measures are now -- are now not part of the analysis that you're predicating this decision on.

Am I getting --

MS. ERIN RAGAZZI: (Indicating.)

MR. RAY HAUPT: Those mitigations were part of this analysis and they helped reduce the effect designed to lessen impacts on fisheries, the public and water quality on the Klamath River. The ESA determinations environmental conclusions in those documents are now referred to as "stale" and must be rejected and analysis reinitiated as both NEPA and ESA require them when there is a significant change in this proposal.

The former analysis is -- was incomplete. In the ten years of analysis that took place, every one of them eliminated the flows of the Trinity River as the analysis was narrowed to five miles below the Iron Gate Dam. So any analysis must include the entire river under federal and state statute prior to any clean water certification the state may undertake.

Judicial comments I have: Does the state agency have the jurisdiction to analyze and make a Clean Water Act determination regarding the transfer of four dams when one of them is in Oregon? There's no authority for the State of California to make determinations outside its sovereign borders, nor do its laws extend beyond them. One of the dams, like I said, is in Oregon and it affects both the Lower Klamath and flows on the Trinity.

I'm going to speed this up a little bit.

In the Supreme Court decision Rampos versus United States and Carabell versus the U.S. clarify the authority and jurisdiction of the Clean Water Act for navigable waters and is to be under the Army Corps of Engineers and the Federal EPA, and it directs them to exert their regulatory authority over them. This jurisdiction is further clarified in the Civilettii Memorandum at 43 Opinion Attorney General 197, 1979. So that memorandum between the United States and the State of California defines when the state may make clean water certifications.

There are a number of things that are reserved to the EPA. Those are discharges to territorial seas, discharges which may affect the water quality of another state, and discharges from any other source which exceeds a daily average discharge of a 100 [sic] million gallons.

In summary, I think we all want a process but we want a fair process. We want one that looks at both -- all of the lawsuits that govern this process as well as the best available science to make this decision.

Thank you.

(Applause.)

MS. ERIN RAGAZZI: Thomas Joseph.

MR. THOMAS JOSEPH: Thank you. My name is Thomas Joseph, T-H-O-M-A-S, J-O-S-E-P-H.

I can feel the frustration and anger if it be for foreigners coming into our land and dictating what you're going to do or what is best for your land. And I think that's the sediment that a lot of these people in here may feel and they're worried about what may happen. That happened to us quite a long time ago when they said they were going to come in here and the build these dams. "We don't care what you're going to do or what you're going to say. We're going to build them anyways."

Listening to the people speak, they go back as far as, I think, an elderly gentleman here said 1850 was as far back as his people went. That's about the same amount of time here on this land as you guys being here for an hour in Northern California to these people that have been here for may be a few generations.

It doesn't take too much science to realize that these dams cause grave harm for the water quality and everybody downstream, affecting everybody upstream as well. And you can hear all the alternative facts or lies that these people have said that try to prove it wrong but, as we know, alternative facts are lies.

The facts state that when these dams come out,

the water quality will get better. As evidence of that happens, in Washington, the removal of that dam and the sediment that came down actually created large amounts of space at the mouth of that river for additional animals to live in and to prosper.

There's no way that these farms clean the water as you heard tonight. That's -- it's just -- that's another alternative fact. The fact is the sediment and the junk they put into the farm and foods that goes into the river pollutes the river. And then we know that when these dams are removed, the water quality will greatly repair itself as it has throughout the rest of the nation.

I don't really know what else to say besides these dams need to come down. And I know that it's not your guy's fault that they're coming down. They point the finger to you guys. We know it's the company that says, "Hey, we don't want to build these fish ladders. It's cheaper for us to take 'em down. How can we take 'em down?"

Over 50 years ago, the United States people, its citizens agreed to have an Environmental Protection Agency with EPA regulations protecting its natural waters and natural rivers. But because of the privilege that these people receive in this area that that was not

abided by for over 50 years on the Klamath River.

Because of the privilege and the ancestors of the people in this room, the water quality on the Lower Klamath Basin was never fixed and that those families and that those communities downstream had to continue to suffer because of those dams. And the privilege that the people here didn't want to comply with national guidelines and national standards of water quality.

I'm asking you, let's follow federal law. Let's follow rural law. Let's protect our natural streams and rivers. Let's protect our water quality.

I know you're here to take the mic, but I just figured that you guys had open mic for like -- someone took five -- well, someone took, like, ten minutes.

(Overtalk by audience.)

MR. THOMAS JOSEPH: What's that?

Okay. Thank you.

MS. ERIN RAGAZZI: Thank you.

So now we have Daniel F. Simon and Margo Robbins, and Sarah Rockwell. If there's any other additional folks that want to provide comments tonight, if you could fill out a comment card.

Kristen will grab it from you right there, sir.

MR. DANIEL SIMON: Hello, Board. I'm Daniel Simon, D-A-N-I-E L, Simon, S-I-M-O-N.

I'm a licensed professional civil engineer. I hold a master's degree in civil engineering focusing on environmental engineering.

I did want to communicate that I speak for the assurance of aquatic life in the Klamath River downstream of the dam removal. I wish for assurance as with the public as with the Karuk and Shasta and Yurok tribes here today. The assurance I seek is that sediment and arsenic -- arsenic-laden sediment will not kill aquatic life when the dams are removed. Has arsenic been thoroughly studied in the sediment?

Years ago, the Fall Creek Fish Hatchery suffered repeat kill-offs of hatchery fish after heavy rains. This was reported in another meeting years ago by Christopher Lyles, the former mayor of Etna. And the investigation yielded surface soils containing arsenic-laden soils.

And so during the heavy rains, the arsenic-laden soils, by erosion, went into the Fall Creek Hatchery killing the fish repeatedly. Years ago, I informed you folks of this. And I'm just kind of curious if this has been fully addressed.

Let's look at some numbers here. Okay. Twenty the 30 million yards of sediment -- of course, obviously, that's not all impacted at toxic levels. But

if you happen to find, say, a half a million yards, it's 200 bucks a yard to remove. It is a very expensive project, about a billion dollars, give or take. It's a lot cheaper just to flush it down the river.

So here's the question, had the various EIS considered this historical occurrence, what happened at Fall Creek? Have appropriate tests for arsenic-laden soil been performed and in specific locations? Are the dams presently holding sediment containing arsenic?

If this is released when the dams are removed, there is a great potential of another fish kill down the Klamath River, not just coho salmon, but arsenic can impact all aquatic life down the Klamath, as it repeatedly occurred at the Fall Creek Hatchery. So, again, has arsenic been properly considered?

I've done environmental reports, phase I and the phase II, remedial plans, process plans, et cetera, et cetera, et cetera. Okay. It is a professional standard to investigate any sign historically or any historical hint or tip for environmental impacts. When we do a phase I, we go to the hot spots. When you find a problem, you get into phase II and start sampling.

I'm giving you this significant historical tip on the Fall Creek Hatchery. So, again, have the various EIRs considered this historical occurrence, what

occurred at the Fall Creek Hatchery?

We are in a mining area and you get, of course, gold, silver, but you also get platinum, chromium. You get arsenic, other heavy metals, lead, mercury, et cetera, et cetera, et cetera. And it's pretty common in mining areas. Any geologist will tell you this. So I'm talking about testing in a precise location near the Fall Creek Hatchery, not tests like every quarter mile which I've seen in the EIR years ago.

So then I want to make a short political statement. I mean, if you do want to kill the coho salmon and aquatic life in the Klamath River, then just remove the dams, kill 'em with a flood of arsenic. And if that happens and it impacts the Yurok's food supply, then I would guess that they would probably sue alphabet agencies -- alphabet-soup agencies for hurting their way of life.

And if you wanted your job professionally, which I'd hope you would, I would hope you're not scared of the present administration. They have two words that are quite scary for those not being professional, and those two words are "you're fired."

MS. ERIN RAGAZZI: Margo Robbins, Sarah Rockwell, and Al Khart.

Margo? Okay.

Sarah Rockwell?

Al.

MR. AL KHART: My name is A-L, K-H-A-R-T, Al Khart.

So I am resident of Copco Lake for five years. I bought property five years ago and I was very happy and I am happy now.

So Copco Lake saved my house couple years ago. It was fire. So because of taking water from Copco Lake, they stopped fire and my house is still alive, so I like Copco Lake.

Have you been at Copco Lake, guys? So do you know anything about Copco Lake? And you want this lake to disappear? All right.

And I'm American citizen for 27 years. I got my citizenship because I work in science, so it gave me a special right. I'm alien who's admission is beneficial for the United States of America so I'm very beneficial alien. That's what immigration told me 27 years ago.

So I work in mathematics. I did modeling simulation. So did you model the impact of dams removal? You know, what is modeling? You know, what simulation? No. I don't see any scientific grounds for removal dams.

By the way, I have scientific grounds for removal Internet. Would you like me to remove Internet? No, I'm really -- it's bad for kids.

So you are young people. I am 69 year old. I'll be 70 in couple months, so I know a lot. I lived in Germany and Germans do not remove dams which are hundred years old. Don't give me trouble because German. I know a lot of people don't like Germans but, you know, they're not stupid because these dams created new environment.

Copco Lake and Iron Gate Lake created new environment, very positive in that environment by the way. And you know, I'm -- okay, you know, I am foreigner, so I look at different point of view but it's beauty. It's beautiful.

So I would never vote for removal dams. It's bad for anybody. It's scientifically not grounded -- grounded. It's not economically grounded. It's not humanitarian grounded for this. Look for removal of the dams, young people.

So do you respect old people, guys? You don't. And you don't respect me as well. So I vote for keeping dams for the rest of the life of the river.

(Applause.)

MS. ERIN RAGAZZI: Do you want to come back up,

Grace, and make another comment?

MS. GRACE BENNETT: Yes.

In the document that I gave you had fixes for the river. And one of those was to put a filtration plant on where the water comes out of Oregon. We will never have a healthy river with the water that comes from Oregon. It's just nasty.

The other one was to fix -- and this hasn't been addressed. We have learned how to grow fish. We've learned that because we've worked really hard at growing fish. We put millions and millions of small fish back in the river.

When they get to the river, the disease kills those baby fish. That has to be addressed. It's -- it's just unconscionable to put our farmers and ranchers through all of the things that they've had to do to grow more fish and then they get to the river and they die. And that's not fair to our citizens.

The other thing was -- I don't remember -- to improve what happens at the fish-counting stations. Currently, there are three fish-counting stations, one at the Scott, one at the Shasta, one on Bogus Creek. We have no idea how many fish the tribes take. We have no idea how many fish go up the other 84 creeks and rivers that go into the Klamath below Iron Gate Dam.

There's 471 miles of spawning habitat in those creeks and rivers, so we don't know how many fish come, actually, into the Klamath River. We need to have a counting station at the mouth of the Klamath River so we have accurate counts of the fish.

By the time they get here, they are black with sores and ready to spawn and die, but we don't know how many are in those 84 creeks and rivers before they get here. That's very, very important to all of this.

We need to thank our people that live here for all the work that they've been doing for the last -- well, since 1986. We've done thousands and thousands and thousands of dollars worth of projects. We've done thousands and thousands of voluntary hours to improve the health of the river.

Our greatest fear is that there won't be enough water in the river, then they'll tell our Scott and Shasta River farmers that they cannot farm anymore because that water has to go in the river for the fish. And that is not justice for our hard-working people.

I want you to really, really think about those things when you're discussing and going over those studies. I -- while sitting here, I decided to go through my box -- my box of wonderful things. I'm going to send you a box of wonderful things for you to look

at. So enjoy your mission through the -- through the miles and miles of documents that are out there.

Thank you.

(Applause.)

MS. ERIN RAGAZZI: Thank you. Okay. Okay. I just want to do a check really quick. I don't know what time it is, but I'm sure it's past 7:00.

So how many people still would like to say something? If people could just raise your hands. Two people. Three people. I'm going to give each of you two minutes.

MS. GRACE BENNETT: Okay. Thank you. I'll make mine fast.

I want to talk about the City of Yreka's water supply. Fall Creek, too. We've had that water supply since 1969. We're very, very nervous about what will happen to that water supply. That is the only water supply that the City of Yreka has, and it's very, very important to us.

There are 7,500 people that live here. We need that water. And if there isn't enough cold water for the fish hatchery at Iron Gate, there is a fish hatchery at Fall Creek, but we don't want the water supply for the City of Yreka to be endangered.

Thank you.

(Applause.)

MR. RICHARD MARSHALL: Are there any actual members of the Board here representing your group, or are you all staff?

MS. ERIN RAGAZZI: We're staff.

MR. RICHARD MARSHALL: All staff.

How many of you were in the Sacramento meeting? Actual board members?

MS. ERIN RAGAZZI: No board members were in the room. It was webcast.

MR. PARKER THALER: Correction, I'm not staff.

MR. RICHARD MARSHALL: Okay. Mr. Thayer, you're the head guy in this group here?

MR. PARKER THALER: No.

MR. RICHARD MARSHALL: Senior --

MR. PARKER THALER: No, I'm the lead technical staff.

MR. RICHARD MARSHALL: Who is the senior person in this room?

MS. ERIN RAGAZZI: I'm the program manager and Marianna is the attorney.

MR. RICHARD MARSHALL: All right. So I have here a petition signed by about 500 people in Siskiyou County for a class action lawsuit regarding these issues that we're talking about this evening and the surcharges

that we've been billed for that we don't want to pay.

MS. ERIN RAGAZZI: And just so it's on the record, can you state your name?

MR. RICHARD MARSHALL: Richard Marshall, Siskiyou Water Users.

(Applause.)

MS. ERIN RAGAZZI: Thank you.

MR. JOHN MENKE: John Menke, M-E-N-K-E.

One more item real quickly. I served for one year as a volunteer for Siskiyou County on the Klamath Fisheries Task Force Technical Work Group. Peter Brucker from Salmon River was the chair.

I got to know Tom Shaw very well, a fisheries biologist with the Arcata U.S. Fish and Wildlife Service. He handed me a document by Robert T. Milhous, M-I-L-H-O-U-S, Fort Collins Science Center, U.S. Geological Survey, Fort Collins, where I did my Ph.D. That's irrelevant, though, in this case.

In this document Milhous reports, from 1962 through 2006, 81 percent of the Trinity River water was diverted to Southern California.

UNIDENTIFIED WOMAN: What?

MR. JOHN MENKE: I consider everything south of Sacramento Southern California.

81 percent. This effort by Sacramento is a

cover for the theft of the water of one of the finest rivers in North America, the Trinity. They've been stealing that water all these years.

This is Chinatown once again. If you ever enjoyed it like I did, the Jack Nicholson Chinatown, it's theft of the water.

If the State of Jefferson gets enacted, I'm going to push very hard for ceasing any diversion at Lewiston down to Whiskeytown and down the Sacramento River. Look what the recent election has done, brought all the illegal people from Mexico into Southern California.

I was trained a little bit in land use planning during my natural resources career. You don't continue to create more and more demand for water when you're stealing it.

Thank you.

(Applause.)

MS. ERIN RAGAZZI: Okay. I want to thank everybody for coming out tonight. The comment period is 5:00 p.m. on February 1st. And I really appreciate you all sticking around and providing your comments. We really appreciate it.

(The proceedings concluded at 8:11 p.m.)

CERTIFICATE OF REPORTER

I, Carol J. Chase, CSR 13538, hereby certify that the proceedings in the within-entitled cause was taken down in shorthand by me, a Certified Shorthand Reporter and a disinterested person, at the time and place herein stated, and that the proceedings were thereafter reduced to typewriting, by computer, under my direction and supervision;

I further certify that I am not of counsel or attorney for either or any of the parties to the said proceedings, nor in any way interested in the outcome of this cause, and that I am not related to any of the parties thereto.

I hereto declare under penalty of perjury that the foregoing is true and correct. I have hereunto set my hand on February 5, 2017.

_____
Carol J. Chase, CSR #13538

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Appendix D

Written Comments

WRITTEN COMMENTS FROM FEDERAL AGENCIES

Thaler, Parker@Waterboards

From: Hamilton, John <john_hamilton@fws.gov>
Sent: Wednesday, February 01, 2017 8:38 AM
To: Thaler, Parker@Waterboards
Cc: Dennis D Lynch; Matt Baun; Singer, Maia@stillwatersci.com; Nick Hetrick; Mark Hampton - NOAA Federal; Carey, Robert@FWS; Jenny Ericson
Subject: CEQA Scoping
Attachments: SIR v3.0 09022016 (1).pdf; Deemer et al. BioScience-2016_biw117 (1).pdf; Harrison Deemer et al 2016.pdf

Mr. Thaler:

In regard to California State Water Resources Control Board (CSWRCB) request for CEQA scoping comments dated December 22, 2016, we recommend that the CSWRCB refer to the 2012 Department of the Interior and the California Department of Fish and Wildlife analysis of Klamath River dams-in and dams-out scenarios completed for the Secretarial Determination.

Also, the *Secretarial Determination Overview Report (SDOR): an Assessment of Scientific and Technical Information* was completed by the Departments of the Interior and Commerce in 2012. The Final Secretarial Determination Overview Report provides a single, convenient, peer reviewed summary of key findings from the Federal technical studies that were undertaken to address each of the four questions of the Secretarial Determination, and a summary of findings from other reports and data sources relevant to these questions. This is a stand alone technical document analyzing natural resources benefits, risks, and uncertainties associated with the removal of the lower four Klamath River dams. Both these documents are available at https://klamathrestoration.gov/.

The update of the analysis of Klamath River dams-in and dams-out scenarios completed for the Secretarial Determination should be incorporated into the CEQA information. It was drafted in September 2016 as the Supplemental Impact Report (SIR) (attached).

Additional Relevant Aquatic Reports

Additional Relevant Aquatic Reports and Publications include the following:

Citation Posted (Y/N) Link

Pacific Lamprey (applic to Klamath)

Goodman, D.H., S.B. Reid, N.A. Som and W.R. Poytress. (In Press). The punctuated seaward migration of Pacific Lamprey (Entosphenus tridentatus): environmental cues and implications for streamflow management. Can. J. Fish. Aquat. Sci. 72(12): 1817-1828, 10.1139/cjfas-2015-0063 N http://www.nrcresearchpress.com/doi/abs/10.1139/cjfas-2015-0063#.V6oypU1-ND8

Goodman, D.H. and S.B. Reid. 2015. Regional Implementation Plan for Measures to Conserve Pacific Lamprey (Entosphenus tridentatus), California – North Central Coast Regional Management Unit. U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, Arcata Fisheries Technical Report Number TR 2015-27, Arcata, California. Y https://www.fws.gov/arcata/fisheries/reports/technical/PLCI%20CA%202015_CA%20Implementation_North%20Central%20Coast_Final.pdf

Various Data Series and Tech Reports on Juvenile Abundance and Adult Escapement in Klamath and Trinity (several others posted on website)

Gough, S.A., and N.A. Som. 2015. Fall Chinook Salmon Run Characteristics and Escapement for the Mainstem Klamath River, 2012. U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report Number DS 2015-46, Arcata, California. Y
http://www.fws.gov/arcata/fisheries/reports/dataSeries/2012%20klamath%20carcass%20survey%20report%20FINAL.pdf

David, A.T., S.A. Gough, and W.D. Pinnix. 2016. Summary of Abundance and Biological Data Collected During Juvenile Salmonid Monitoring on the Mainstem Klamath River Below Iron Gate Dam, California, 2014. U.S. Fish and Wildlife Service. Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report Number DS 2016-47, Arcata, California. Y
http://www.fws.gov/arcata/fisheries/reports/dataSeries/KlamathOutmigrantReport2014.pdf

David, A.T., S.A. Gough, and W.D. Pinnix. 2017. Summary of Abundance and Biological Data Collected During Juvenile Salmonid Monitoring on the Mainstem Klamath River Below Iron Gate Dam, California, 2015. U.S. Fish and Wildlife Service. Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report Number DS 2017-48. N

RBM10 Klamath Basin Water Temp Model

Jones, E.C., R. W. Perry, J. C. Risley, N. A. Som, and N. J. Hetrick. 2016. Construction, calibration, and validation of the RBM10 water temperature model for the Trinity River, northern California: U.S. Geological Survey Open-File
Report 2016–1056, 46 p., http://dx.doi.org/10.3133/ofr20161056. " Y http://www.fws.gov/arcata/fisheries/reports/technical/rbm10_trinity.pdf

Diseaase Tech Memos

The scope should update the past analyses of fish disease. There are four very recent technical memos from the U.S. Fish and Wildlife Service, Arcata Office. These memos should be added to the fish disease section of the SIR:

Shea, C., N. J. Hetrick, and N. A. Som. 2016. Response to Request for Technical Assistance – Sediment Mobilization and Flow History in Klamath River below Iron Gate Dam. Arcata Fish and Wildlife Office Technical Memorandum. Arcata, California. Y
https://www.fws.gov/arcata/fisheries/reports/technical/Maintenance%20Flow%20Tech%20Memo%20Final.pdf
Som, N. A, N. J. Hetrick, and J. Alexander. 2016. Response to Request for Technical Assistance – Polychaete Distribution and Infections. Arcata Fish and Wildlife Office Technical Memorandum. Arcata, California. Y
https://www.fws.gov/arcata/fisheries/reports/technical/Polychaete%20Tech%20Memo%20Final.pdf
Som, N. A. and N. J. Hetrick. 2016. Response to Request for Technical Assistance – Ceratonova shasta Waterborne Spore Stages. Arcata Fish and Wildlife Office Technical Memorandum. Arcata, California. Y
https://www.fws.gov/arcata/fisheries/reports/technical/Spores%20Tech%20Memo%20Final.pdf
Som, N. A., N. J. Hetrick. S. Foott, and K. True. 2016. Response to Request for Technical Assistance – Prevalence of C. shasta Infections in Juvenile and Adult Salmonids. Arcata Fish and Wildlife Office Technical Memorandum. Arcata, California. Y
https://www.fws.gov/arcata/fisheries/reports/technical/Fish%20Infection%20Tech%20Memo%20AFWO%20Final.pdf

Polychaetes (Disease related)

Alexander, J. D., J. L. Bartholomew, K. A. Wright, N. A. Som, and N. J. Hetrick. 2016. Integrating models to predict distribution of the invertebrate host of myxosporean parasites. Freshwater Science Online Early. DOI: 10.1086/688342. Y
http://onlinelibrary.wiley.com/doi/10.1002/rra.3067/epdf

Greenhouse Gasses

We recommend that the CEQA scope also update analyses of the contributions of reservoirs to methane - there are two very recent publications on contributions of reservoirs to methane and other greenhouse gasses (attached). Two Oregon reservoirs on the Klamath River (J.C. Boyle and Keno) are among the reservoirs studied. This information is not in Appendix N of the SD.

Coho Habitat Upstream from Iron Gate Dam (IGD)

In the discussion of coho salmon historical habitat, we recommend caution in using the conclusion that 76 miles of habitat would be created under a dams out scenario. In the ALJ ATTACHMENT D RULINGS ON PROPOSED FINDINGS OF FACT is the following:

7.4 The boundaries of historical habitat of the Upper Klamath population of Coho salmon extended from Portuguese Creek upstream to Spencer Creek, NMFS/FWS Issue 7-Williams-Exhibit 14 at 41, and approximately 40% of the historical habitat of this population is upstream of IGD. NMFS/FWS Issue 7-Williams-Exhibit 1 at 6:7-11.

RULING: ACCEPTED IN PART, REJECTED IN PART. The record evidence is inconclusive as to whether Coho salmon's historical distribution
extended upstream to Spencer Creek. The evidence definitively shows that Coho salmon used habitat in Fall Creek. (Aug. 24, 2006 Tr. at 273:11-274:8;
NMFS/FWS-Issue 2A-Garza-Ex. 7 at 7-8;NMFS/FWS-Issue 8-Hamilton-Ex. 1 at 4:3-13; NMFS/FWS-Issue 8-Hamilton-Exhibit 6 at 6-7;NMFS/FWS-Issue 8-
Hamilton-Ex. 11 at 236; Yurok-Steward 8 Direct at 3:20- 4:8; Yurok Tribe- Steward 8 Rebuttal at 4:12 to 5:8; KTr.-CWH-Ex. 4 at 216; KTr-CWH-Ex. 5 at
16; NMFS/FWS-Issue 7-Simondet-Ex. 5 at 117; NMFS/FWS-Issue 7-Simondet- Ex. 1 at 4:7-18; NMFS/FWS-Issue 7-Williams-Ex. 1 at 5:8-6:4; KTr-CWH-Ex. 4
at 216-224; Indian Tribes PFF 7.1).

Whether Coho Salmon are Native to the Klamath River

We recommend that scoping consider responses AQU-3, AQU-4, and AQU-5 in the Secretarial Determination.

Historical Chinook Salmon Migrations Upstream From IGD

CEQA scope should analyze beneficial uses associated with Historical Chinook Salmon Migrations upstream from dams. This information is summarized in the SDOR report and the recent Oregon Historical Quarterly article - OHQ.http://ohs.org/research-and-library/oregon-historical-quarterly/browse-ohq-articles.cfm.

Thank you for the opportunity for input. Please contact me if you have questions.

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Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report

Supplemental Information Report

State Clearinghouse

#2010062060

DRAFT

U.S. Department of the Interior

March 2016

Mission Statements

U.S. Department of the Interior

The U.S. Department of the Interior protects America's natural resources and heritage, honors our cultures and tribal communities, and supplies the energy to power our future.

Executive Summary

This supplemental information report documents the findings of a team of staff technical reviewers familiar with the *Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report* (EIS/EIR) from the Bureau of Reclamation (Reclamation), US Fish and Wildlife Service(USFWS), National Marine Fisheries Service(NMFS), US Geological Survey(USGS), Department of Interior (DOI), State of Oregon, and State of California regarding new information relevant to facilities remove of J.C. Boyle, Copco 1, Copco 2, and Iron Gate dams (Figure 1).

The Klamath Hydroelectric Settlement Agreement (KHSA), executed in February 2010, has two related agreements: the Klamath Basin Restoration Agreement (KBRA) and the Upper Klamath Basin Comprehensive Agreement (UKBCA). The KBRA expired in December 2015, without Congressional authorization. The UKBCA is still in effect, though the agreement is not capable of being fully implemented without Congressional authorization. Dam removal can proceed without Congressional authorization via the Federal Electrical Regulatory Commission's (FERC) process for dam decommissioning as authorized by the Federal Power Act. Parties to the KHSA made amendments to that agreement, which became effective on April 6, 2016. Those amendments shift the decision on whether to remove the dams to the FERC rather than the Secretary of the Interior as originally agreed in 2010.

A team of staff technical reviewers familiar with the EIS/EIR has reviewed the EIS/EIR in light of the amendments to the KHSA. The team analyzed the Amended KHSA and expired KBRA to determine if the changes affected the utility of the environmental document for incorporation by reference or adoption by other entities as permitted by the NEPA implementing regulations. With the KBRA's expiration in 2015, some benefits provided by the KBRA are no longer a part of the Proposed Action, but overall the changes in approval authority were not relevant to the environmental impact analysis or determinations. The team also reviewed relevant technical information that may have not been available at the time the EIS/EIR analysis was completed; however, none of that technical information materially changes interpretations or conclusions about the effects of dam removal described in the EIS/EIR. Thus, the existing Klamath Facilities Removal EIS/EIR adequately addresses environmental impacts related to facilities removal and could provide a sufficient basis for decision-making by another federal agency.

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List of Abbreviations and Acronyms

µg/L	micrograms per liter
AASHTO	American Association of State Highway Transportation Officials
AB 32	Assembly Bill
ACHP	Advisory Council on Historic Preservation
Amended KHSA	Amended Klamath Hydroelectric Settlement Agreement
APE	Area of Potential Effect
Basin Study	Klamath River Basin Study
BEA	Bureau of Economic Analysis
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
BMP	Best Management Practices
BOE	Board of Equalization
CA	State of California
Caltrans	California Department of Transportation
CEQA	California Environmental Quality Act
cfs	cubic foot per second
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CPUC	California Public Utility Commissions
DDT	dichlorodiphenyltrichloroethane
DFG	California Department of Fish and Game (prior to January 1, 2013)
DFW	California Department of Fish and Wildlife (after January 1, 2013)
DO	dissolved oxygen
DOC	Department of Commerce
DOI	Department of Interior
DPS	Distinct Population Segment
DRE	dam removal entity
EDD	Employment Development Department
EDR	Environmental Data Resources
EDRRA	Evaluation of Dam Removal and Restoration of Anadromy
EFH	Essential Fish Habitat
EIS/EIR	Environmental Impact Statement/Environmental Impact Report
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
GHG	greenhouse gases

HABS/HAER	Historic Architectural Building Survey/Historic Architectural Engineering Report
HALS	Historic American Landscape Survey
HCP	Habitat Conservation Plan
HGMP	Hatchery and Genetics Management Plan
HTRW	hazardous, toxic, and radiological waste
IGH	Iron Gate Hatchery
IMPLAN	Impact analysis for PLANning
ITP	Incidental Take Permit
KBRA	Klamath Basin Restoration Agreement
KHSA	Original Klamath Hydroelectric Settlement Agreement
KHHD	Klamath Hydroelectric Historic District
KHP	Klamath Hydroelectric Project
KPFA	Klamath Power and Facilities Agreement
KRRC	Klamath River Restoration Corporation
KMZ	Klamath Management Zone
KMZ-CA	Klamath Management Zone – California
KMZ-OR	Klamath Management Zone - Oregon
LWD	large woody debris
mg/L	milligrams per liter
mm	millimeters
$MMTCO_2e$	million metric tons carbon dioxide equivalent
NCRWQCB	North Coast Regional Water Quality Control Board
NBER	National Board of Economics
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO_x	Nitrogen dioxide
NRDC	Natural Resources Defense Council
NWR	National Wildlife Refuge
NWS	National Weather Service
O_3	ozone
ODFW	Oregon Department of Fish and Wildlife
OEHHA	Office of Environmental Health and Hazard Assessment
O&M	operation and maintenance
OPCC	An Opinion of Probably Construction Costs
OPUC	Oregon Public Utility Commission
OR	State of Oregon
PA	Programmatic Agreement
PCEs	Primary Constituent Elements
PFMC	Pacific Fishery Management Council
$PM_{2.5}$	Particulate Matter <2.5 microns
PM_{10}	Particulate Matter <10 microns

Reclamation	United States Department of the Interior, Bureau of Reclamation
RED	Regional Economic Development
RM	river mile
ROD	Record of Decision
SHPO	State Historic Preservation Office
SO_X	sulphur oxide
SONCC	Southern Oregon Northern California Coast
SWRCB	State Water Resources Control Board
TAC	Technical Advisory Committee
THPO	Tribal Historic Preservation Officers
TM	Technical Memorandum
TMDL	Total Maximum Daily Load
TN	total nitrogen
TP	total phosphorous
TPI	Total Personal Income
UKBCA	Upper Klamath Basin Cooperative Agreement
UKL	Upper Klamath Lake
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VOC	Volatile Organic Carbon
VRM	Visual Resource Management Methodology
WRD	Water
WSR	Wild and Scenic Rivers
WSRA	Wild and Scenic Rivers Act
YTEP	Yurok Tribe Environmental Program
YTFP	Yurok Tribe Fishery Program

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1.0 Introduction and Background

This document, *Klamath Facilities Removal Environmental Impact Statement/ Environmental Impact Report* (EIS/EIR) - *Supplemental Information Report* (SIR), has been developed to reexamine the potential impacts to the environment of the proposed removal of four PacifiCorp Dams (J.C. Boyle, Copco 1, Copco 2, and Iron Gate, collectively referred to herein as the Four Facilities or Facilities) on the Klamath River (Figure 1). Since the publication of the Final Klamath Facilities Removal EIS/EIR in December 2012 the Klamath Hydroelectric Settlement Agreement (KHSA), which described the proposed Facilities removal has been amended (Amended KHSA) (KHSA 2010; KHSA 2016). In this document, the term "KHSA" refers to the original KHSA, signed in 2010, and "Amended KHSA" refers to the amended document signed in 2016. The Amended KHSA remains a vital step to address continuing unresolved problems that impact natural resources and communities in the Klamath Basin.

The KHSA is linked to two related agreements—the Klamath Basin Restoration Agreement (KBRA) and the Upper Klamath Basin Comprehensive Agreement (UKBCA). When negotiated, these three agreements sought to comprehensively resolve long-standing, complex, and intractable conflicts over natural resources in the Klamath Basin. These agreements, however, required or continue to require Congressional authorization to be fully implemented as contemplated. To date, Congress has not enacted authorizing legislation. As a result, the KBRA expired on December 31, 2015. The UKBCA did not expire and currently remains in effect, although the agreement is not capable of being fully implemented as contemplated without Congressional authorization.

The parties to the KHSA in 2010 negotiated a settlement in which the Secretary of the Interior, Secretary of Commerce and the Governors of Oregon and California would make a determination as to whether removal of Klamath River dams would advance salmonid fisheries as well as be in the public interest. Authorization from Congress was required to permit the Secretary of the Interior to make such a determination. However, as the Parties have agreed in the Amended KHSA, the decision process for dam removal would occur through the Federal Electrical Regulatory Commission (FERC) process for dam decommissioning.

In this SIR and the Klamath Facilities Removal EIS/EIR, the Full Facilities Removal of Four Dams Alternative (Proposed Action) includes the removal of the Four Facilities during a 20-month period, which includes an 8-month period of site preparation and partial drawdown at Copco 1 and a 12-month period for full reservoir drawdown and removal of the Four Facilities. This alternative would include the complete removal of the dams, power generation facilities, water intake structures, canals, pipelines, ancillary buildings, and dam foundations to create a free-flowing river. Preparation for dam removal would begin in May 2019 for Iron Gate Dam and June 2019 for Copco 1 Dam. Deconstruction efforts for the J.C. Boyle and Copco 2 facilities would commence after January 1, 2020, and all four dams would be completely removed (or at least to an extent

that supports volitional fish passage) by December 31, 2020. This alternative would also include the transfer of Keno Dam to the Department of Interior (DOI) and the decommissioning of PacifiCorp's Eastside/Westside facilities. The deconstruction described in the Klamath Facilities Removal EIS/EIR remains the same in this reexamination of the Proposed Action –only the institutional process has changed under which removal of the Four Facilities would occur.

While executing the Amended KHSA, some stakeholders also executed the Klamath Power and Facilities Agreement (KPFA)(KPFA 2016). The KPFA includes some components of the KBRA such as regulatory protections and attribution of costs related to the transfer of Keno Dam and the operation and maintenance of Keno and Link River Dams. The KPFA also commits its signatories to develop agreements for the remainder of the bargained-for benefits of the KBRA, namely fisheries, water resources, regulatory assurances, tribal, and counties programs. However, the Amended KHSA does not describe an inextricable link between actions called for in the KPFA and those needed for facilities removal. For this reason the KPFA is addressed for this reexamination in Cumulative Effects Section 3.4.



Figure 1. The Klamath Basin.

Table 1. Hydroelectric Dams (Four Facilities) on the Mainstem Klamath River

Dam	Year Operational		Maximum Power Generation Capacity (megawatts)	Annual Average Generation Rate (megawatts)	Dam Height (feet)
J.C. Boyle	1958		98	38	68
Copco 1	1918		20	12	126
Copco 2	1925		27	15	33
Iron Gate	1962		18	13	194
Total	--		**163**	**78[1]**	--

Source: FERC 2007

Notes: [1] This annual average generation rate is only for the Four Facilities and does not include the Fall Creek or Eastside and Westside Facilities. Under the agencies' mandatory prescriptions and conditions, along with FERC's required conditions, average annual generation for the entire project would drop by approximately 20 megawatts.

Figure 2. JC Boyle Reservoir, Dam, and Facilities





Figure 3. Copco 1 Reservoir, Dam and Facilities



Figure 4. Copco 2 Dam and Facilities



Figure 5. Iron Gate Reservoir, Dam and Facilities

2.0 Guidance and Summary Results of Reexamination and Analysis

2.1 Guidance for NEPA Evaluation

The Council on Environmental Quality (CEQ) regulations provides direction regarding the review of an EIS and preparation of supplemental statements before a proposal has been implemented. The CEQ regulations (Section 1502.9(c)) state:

> *Agencies shall prepare supplements to either draft or final EIS's if:*
>
> *1. The agency makes substantial changes in the proposed action that are relevant to environmental concerns; or*
>
> *2. There are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts.*

A supplemental EIS is prepared under the above circumstances to ensure the agency has the best possible information to make any necessary substantive changes in its decisions regarding the proposal. In evaluating the present day adequacy of the Klamath Facilities Removal Final EIS/EIR, the criteria in Section 1502.9(c) of the CEQ regulations were employed to determine: (1) if substantial changes have been made to the Proposed Action since completion of the Klamath Facilities Removal Final EIS/EIR in December 2012 that are relevant to environmental concerns, and (2) if significant new circumstances or information relevant to environmental concerns and bearing on the Proposed Action or its impacts have occurred since completion of the Klamath Facilities Removal Final EIS/EIR in December 2012.

2.2 Approach to the Klamath Hydroelectric Settlement Agreement in the Final Klamath Facilities Removal EIS/EIR and in this Reexamination

2.2.1 Overview of the KHSA in the Klamath Facilities Removal Final EIS/EIR

The KHSA established the process and circumstances under which facilities removal would proceed. The KHSA detailed additional studies, including the development of a "Detailed Plan for Facilities Removal" (Detailed Plan) and environmental review to support a Secretarial Determination as to whether removal of the four downstream-most PacifiCorp owned dams on the Klamath River (1) will advance restoration of the salmonid fisheries of the basin, and (2) is in the public interest, which includes, but is not limited to, consideration of the potential impacts on affected local communities and Indian Tribes.

2.2.2 Overview of the Amended KHSA in this Reexamination

Under the Amended KHSA, the signatory parties agreed to change the process under which facilities removal would occur. The primary change in process alters the nature of the Secretarial Determination to a policy evaluation using the relevant science and expert opinion to answer the KHSA questions, specifically whether dam removal (1) will advance restoration of the salmonid fisheries of the basin, and (2) is in the public interest. Furthermore, the Amended KHSA identifies a non-federal Dam Removal Entity (DRE).

Whether DOI would have or FERC now approves dam removal does not change how the dams would be removed. The Detailed Plan describes the reservoir drawdowns, deconstruction activities, and restoration of the affected areas and remains unchanged since publication of the Klamath Facilities Removal Final EIS/EIR in December of 2012. The amendment of the KHSA, such that FERC now will have final approval of dam removal, is not a change that is relevant to or produces changes to environmental concerns or impacts previously analyzed.

2.2.3 Overview of the Klamath Basin Restoration Agreement and Upper Klamath Basin Comprehensive Agreement in the Klamath Facilities Removal Final EIS/EIR

As a result of the Klamath Basin issues surrounding the limited availability of water to support agricultural, tribal, environmental, and fishery needs in many years, the United States[1], the States of California and Oregon, the Klamath, Karuk, and Yurok Tribes, Klamath Water Users Association, and other Klamath Basin stakeholders negotiated the KBRA to resolve the water conflicts among the many users, restore stressed fisheries, provide regulatory assurances, provide economic benefits to counties and tribes, and identify reliable and affordable power supplies for water management. The KBRA parties viewed the KBRA as an important part of the resolution of long-standing, complex, and difficult-to-resolve concerns over resources in the Klamath Basin.

The Klamath Facilities Removal EIS/EIR analysis treated the KBRA as a connected action because the Secretarial Determination as described in the KHSA was one of the early key milestones toward full implementation of KBRA. However another key milestone required for full implementation, federal authorizing legislation, failed to materialize prior to expiration of the KBRA agreement. On December 31, 2015, the KBRA expired and the prospects of passing federal legislation to authorize a new, similar agreement are unknown. If a new KBRA-replacement agreement is negotiated by basin parties, and is later authorized by Congress, it will not be considered a KHSA connected action under NEPA, as was done in the Klamath Facilities Removal Final EIS/EIR published in December 2012. Any impacts from a new agreement that may be negotiated would need to be analyzed prior to implementation of such agreement.

[1] Agencies involved in KBRA negotiations include: NOAA Fisheries Service, U.S. Forest Service, U.S. Department of the Interior (including, the Bureau of Indian Affairs, Bureau of Land Management, Bureau of Reclamation, and Fish and Wildlife Service).

Development of the UKBCA, which was signed in 2014, occurred after publication of the Klamath Facilities Removal EIS/EIR and was not specifically included in the Klamath Dam Removal EIS/EIR analysis. The UKBCA contains the detailed approach for ensuring 30,000 acre feet of additional water enters Upper Klamath Lake (UKL) on an annual average basis (primarily through water use retirements), protection of riparian areas, fish habitat, stream flows and water quality above UKL, all of which were key provisions in the KBRA.

2.2.4 Overview of the Klamath Basin Restoration Agreement and Upper Klamath Basin Comprehensive Agreement in this Reexamination

As a milestone in all three settlement agreements, the Secretarial Determination on dam removal influenced timing and implementation in the KBRA and UKBCA. With expiration of the KBRA, limited implementation of UKBCA, and amendment of the KHSA, the connections among the Klamath agreements has effectively been decoupled. However, because KBRA and UKBCA did not dictate the process to remove dams or mitigate the effects of dam removal, expiration of KBRA and particle implementation of the UKBCA does not change the Proposed Action considered in the Klamath Facilities Removal EIS/EIR as it relates to impacts of facilities removal on the environment. The synergistic effects of implementation of the three agreements in concert, however, have been lost and some benefits in this reexamination of facilities removal have been tempered due to the expiration of KBRA.

Specifically in the EIS/EIR, many effects of KBRA Programs were described as beneficial to the environment (primarily water quality and aquatic resources). Because KBRA is no longer an action connected to the Proposed Action, the environmental benefits of these programs are not included in the reexamination analysis. Below is a summary of the environmental benefits from KBRA Programs that were described in the EIS/EIR and actions that might be implemented in the absence of KBRA to achieve similar outcomes. KBRA would have:

- Accelerated the rate at which the Klamath River and tributaries would be expected to meet Oregon and California water temperature, nutrient, dissolved oxygen (DO), pH, and chlorophyll-a standards and goals through implementation of the Fisheries Restoration Program. Both California and Oregon have ongoing, long-term TMDL programs to meet water quality goals in the Klamath Basin, but KBRA funding would have achieved those goals more quickly.
- Expanded opportunities to create springtime flushing flows and stream-bed movement with water "reserved" in the Environmental Water Program, which is predicted to help reduce juvenile salmon disease below Iron Gate Dam. The 2013 Biological Opinion on Operation of the Klamath Reclamation Project, however, includes a similar Environmental Water Account with provisions for flow alterations to protect ESA-list species, including the release of dilution/flushing water from Upper Klamath Lake to reduce juvenile Coho Salmon disease below Iron Gate Dam.
- Improved base flows for salmonids, particularly in drought years, through the KBRA Water Resources Program, which would have improved fish health and survival. The 2013 Biological Opinion on Operation of the Klamath Reclamation Project, however,

provides minimum flows that are protective of fish especially in low flow years and supersedes the flows described in the EIS/EIR.

- Increased the pace of funding for basin-wide habitat restoration actions, coordination, monitoring, and adaptive management in the Klamath River Watershed, which would have accelerated improvements to fish habitat and populations including certain Endangered Species Act (ESA) listed fish. Restoration actions are continuing in the basin, but KBRA funding would have accelerated basin restoration actions prior to and following dam removal.
- Accelerated the effective use of the Upper Basin habitat by salmonids through the KBRA Fisheries Reintroduction and Management Plan, which would have advanced improvements to fish habitat and populations more quickly. Reintroduction of salmonids above Iron Gate Dam would occur naturally following dam removal, and the states of Oregon and California would likely institute additional measures to facilitate reintroduction as resources become available.

2.3 Summary Result of the Reexamination and Conclusions

This SIR provides a reexamination and section-by-section analysis of the Klamath Facilities Removal Final EIS/EIR in light of the renewed interest in the Klamath Facilities Removal under a FERC process. The results of this evaluation are summarized in Table 2. Overall, this reexamination concludes no significant new circumstances or release of information relevant to the Proposed Action or any of the environmental impacts addressed in the Klamath Facilities Removal Final EIS/EIR have occurred since completion of the document in December 2012. It is the opinion of the interdisciplinary technical team that performed the reexamination that a supplemental EIS/EIR is not warranted or required.

Table 2. Summary of New Information and Conclusions

Final EIS/R Section	New Information	Conclusion
Chapter 1: Introduction, Section KHSA and KBRA	Amendment of the KHSA; KBRA has expired;	The Amended KHSA now describes a FERC process to approve dam removal; however KHSA goals remain unchanged. With KBRA expiration, benefits would be reduced compared to those evaluated in the Klamath Facilities Removal EIS/EIR.
Chapter 1: Introduction, Section Purpose and Need	Amendment of the KHSA; KBRA has expired	The Amended KHSA now describes a FERC process to approve dam removal; however KHSA goals remain unchanged. Though KBRA has expired, the Proposed Action remains consistent with the goals described in that document.
Chapter 2: Proposed Action and Description of Alternatives	Dam Removal through an administrative FERC Process; Amendment of the KHSA; KBRA has expired; Continued Interim Measures Implementation; Implementation of the 2013 Joint Biological Opinion	The Detailed Plan that describes the deconstruction activities, drawdown, and restoration of the Four Facilities remains unchanged since publication of the Klamath Facilities Removal Final EIS/EIR in December of 2012. With KBRA expiration, benefits would be reduced compared to those evaluated in the EIS/EIR. The relatively small flow differences between KBRA Flows and

		2013 Joint Biological Opinion flows do not alter the conclusions drawn in the EIS/EIR for water quality, aquatic resources, flood risk, and recreation
In addition to the conclusions described above resource specific conclusions include the following:		
Chapter 3: Water Quality	New research; KBRA has expired; 2013 Joint Biological Opinion	Additional research reinforces conclusions made in the Klamath Facilities Removal EIS/EIR. Expiration of KBRA lessens the benefits to water quality. The relatively small flow differences between KBRA Flows and 2013 Joint Biological Opinion flows do not alter the conclusions drawn in the EIS/EIR.
Chapter 3: Aquatic Resources	New research; KBRA has expired; Designation of critical habitat for coho salmon; Coho Habitat Conservation Plan (HCP); Sucker HCP; Hatchery and Genetic Management Plan (HGPM) for Iron Gate Hatchery; 2013 Joint Biological Opinion	Additional research reinforces conclusions made in the Klamath Facilities Removal EIS/EIR. Expiration of KBRA lessens the benefits to lower basin fisheries and results in no benefits to suckers. Impacts to aquatic resources remain unchanged in regard to new aquatic resource protections (critical habitat, HCPs, and HGMP). The relatively small flow differences between KBRA Flows and 2013 Joint Biological Opinion flows do not alter the conclusions

		drawn in the EIS/EIR.
Chapter 3: Algae	Genotyping study completed	Additional research reinforces conclusions made in the Klamath Facilities Removal EIS/EIR.
Chapter 3: Terrestrial Resources	Grey wolf occurrences in southern Oregon and northern California; Listing of Oregon Spotted Frog	Grey wolf and Oregon Spotted frog are not known to occur in the hydroelectric reach. Detailed Plan has not changed, therefore effects to terrestrial wildlife characterized in the EIS/EIR has not changed.
Chapter 3: Flood Hydrology	2013 Joint Biological Opinion	The relatively small flow differences between KBRA Flows and 2013 Joint Biological Opinion flows do not alter the conclusions drawn in the EIS/EIR.
Chapter 3: Groundwater	Expiration of KBRA	No groundwater effects are expected above Keno Reservoir. Additional research reinforces conclusions made in the Klamath Facilities Removal EIS/EIR.
Chapter 3: Water Supply/Water Rights	KBRA has Expired; 2013 Joint Biological Opinion	No water supply/water rights effects will occur in the upper Klamath Basin. The relatively small flow differences between KBRA Flows and 2013 Joint Biological

		Opinion flows do not alter the conclusions drawn in the EIS/EIR.
Chapter 3: Air Quality	No change	Detailed Plan has not changed, therefore emissions characterized in the EIS/EIR have not changed.
Chapter 3: Greenhouse Gases/Global Climate Change	No change	Detailed Plan has not changed, therefore effects to activity emissions characterized in the EIS/EIR has not changed even given reinterpretation of emissions related to Assembly Bill (AB) 32.
Chapter 3: Geology, Soils, and Geologic Hazards	No change	Detailed Plan has not changed, therefore effects to activity emissions characterized in the EIS/EIR has not changed.
Chapter 3: Tribal Trust	KBRA expiration	With the expiration of KBRA, there will be fewer benefits to fisheries and other resources traditionally used by tribes.
Chapter 3: Cultural and Historic Resources	Change in NHPA Process	With a change in lead agency, the NHPA process has changed. The mitigation measures and agreement by Tribal Preservation Officers, State Preservation Officers and Federal agencies will still be required to resolve adverse effects.

Chapter 3: Land Use, Agricultural and Forest Resources	KBRA expiration	Expiration of KBRA reduces nearly all benefits to agricultural and forest resources.
Chapter 3: Socioeconomics	KBRA expiration; Updated economic data	Expiration of KBRA reduces socioeconomic benefits to irrigated agricultural. Changes in the regional economy have generally improved since 2012 (i.e. lower unemployment and increased total personal income) thereby improving the socioeconomic conditions under which dam removal would occur.
Chapter 3: Environmental Justice	KBRA expiration; Updated economic data	Expiration of KBRA slow the realization of environmental justice benefits as fisheries and water quality will improve more slowly. Changes in the regional economy have generally lead to a stronger regional economy (i.e. lower unemployment and increased total personal income) improving the socioeconomic conditions under which dam removal would occur.
Chapter 3: Population and Housing	Updated census data	Population demographics remain similar to those reported in the Klamath Facilities

		Removal EIS/EIR
Chapter 3: Public Health and Safety, Utilities and Public Services, Solid Waste, Power	No change	
Chapter 3: Scenic Quality	No change	
Chapter 3: Recreation	2013 Joint Biological Opinion	The relatively small flow differences between KBRA Flows and 2013 Joint Biological Opinion flows do not alter the conclusions drawn in the EIS/EIR.
Chapter 3: Toxic/Hazardous Materials	No change	
Chapter 3: Traffic and Transportation	No change	
Chapter 3: Noise and Vibration	No change	
Chapter 4: Cumulative	UKBCA signed but future speculative without legislation; Signing of the KPFA in April 2016	Without federal authorization, implementation of the UKBCA is too speculative and therefore it will not be include in this reexamination. No actions described in the KPFA will occur in the Klamath Basin below Keno Reservoir and the benefits to aquatic species would not lead to additional cumulatively

		considerable effects.
Chapter 5: Other Required Disclosures	Amendment of the KHSA; KBRA has expired;	The amended KHSA now describes an administrative FERC process to approve dam removal; however KHSA goals remain unchanged. With KBRA expiration, benefits would be reduced compared to those evaluated in the EIS/EIR.
Chapter 6: Compliance with Applicable Laws Policies, and Plans	No change	
Chapter 7: Consultation and Coordination	No additional consultation or coordination has occurred regarding dam removal and NEPA, ESA, or NHPA since publication of the Klamath Facilities Removal Final EIS/EIR	No additional consultation or coordination has occurred regarding dam removal and NEPA, ESA, or NHPA since publication of the Klamath Facilities Removal Final EIS/EIR

3.0 Reexamination and Analysis

3.1 Chapter 1: Introduction

3.1.1 Amended Klamath Hydroelectric Settlement Agreement

Information in the Klamath Facilities Removal Final EIS/EIR

The 2010 KHSA established the process and circumstances under which Facilities removal would proceed. The 2010 KHSA provided details about additional studies, including the development of a Detailed Plan and environmental review to support a Secretarial Determination as to whether removal of the four downstream-most PacifiCorp owned dams on the Klamath River: (1) advance restoration of the salmonid fisheries in the Klamath Basin; and (2) be in the public interest, which includes but is not limited to, consideration of the potential impacts on affected local communities and Indian Tribes. Under the 2010 KHSA process, Congressional authorization was needed before a Secretarial Determination on Facilities removal could be issued.

New Information

Under the amended KHSA, signed in April 2016, the signatory parties agreed to change the process under which Facilities removal would be implemented. The primary change in process alters the nature of the Secretarial Determination to a policy evaluation that uses the relevant science and expert opinion to answer the above two questions. Further, the amended KHSA identifies a non-federal DRE that will be a signatory of the amended KHSA, which would proceed with Facilities Removal following the FERC process for decommissioning hydroelectric dams.

Conclusion

Whether DOI or FERC approve dam removal does not change how the dams would be removed. The Detailed Plan that describes the deconstruction activities, drawdown, and restoration of the Four Facilities remains unchanged since publication of the Klamath Facilities Removal Final EIS/EIR in December of 2012. The amendment of the KHSA, such that FERC has final approval over Facilities removal, is not a change that is relevant to environmental concerns or impacts previously analyzed.

3.1.2 Expiration of Klamath Basin Settlement Agreement

Information in the Klamath Facilities Removal Final EIS/EIR

The Klamath Facilities Removal EIS/EIR analysis treated the KBRA as a connected action because the Secretarial Determination as described in the KHSA was one of the early key milestones toward full implementation of KBRA. However, another key milestone required for full implementation, federal authorizing legislation, failed to occur prior to expiration of the KBRA agreement. As of December 31, 2015, the KBRA has expired and the prospects of passing federal legislation for a subsequent agreement are unknown. For additional context see Sections 2.2.3 and 2.2.4.

New Information

As a milestone in all three settlement agreements, the KHSA, KBRA, and the UKBCA, the Secretarial Determination on dam removal influenced timing and implementation in the KBRA and UKBCA. With expiration of the KBRA, limited implementation of UKBCA, and amendment of the KHSA, the three settlement agreements have been delinked. However, as KBRA and UKBCA did not dictate the process to remove dams nor mitigate the effects of dam removal, expiration of KBRA and the less than full implementation of the UKBCA does not change the proposed action considered in the Klamath Facilities Removal EIS/EIR or the impacts of that removal. The synergistic effects of implementation of the three agreements in concert have been lost and some benefits in this reexamination have been tempered due to the expiration of KBRA. In particular, the expiration of KBRA influences the benefit of dam removal to aquatic resources, water quality, water supply/water rights, tribal trust, and socioeconomics. The effect of expiration of KBRA is examined in more detail in those corresponding sections in this reexamination.

The Klamath Power and Facilities Agreement (KPFA) was executed in April 2016. Explicit linkages between the KPFA and the Amended KHSA were not part of the new agreement. Additionally, all the actions considered part of KPFA occur upstream of the hydroelectric reach above Keno Dam. Given the lack of connection between KPFA and the Amended KHSA and the difference in location, this reexamination is considering the KPFA in Section 3.4 Cumulative Effects.

Conclusion

The expiration of the KBRA delinks KBRA and KHSA. Though to some degree the overall benefits expected have been limited by expiration of the KBRA, no discernible adverse environmental consequence has been identified due to the expiration of the KBRA as an action connected to the Proposed Action of Facilities Removal in the EIS/EIR.

3.1.3 Purpose and Need

Information in the Klamath Facilities Removal Final EIS/EIR

The following is the Purpose and Need from the Klamath Facilities Removal EIS/EIR (Section 1.5.2.1) :

> *The Proposed Action is to remove the four lower PacifiCorp dams on the Klamath River. The need for the Proposed Action is to advance restoration of the salmonid fisheries in the Klamath Basin consistent with the KHSA and the connected KBRA. The purpose is to achieve a free flowing river condition and full volitional fish passage as well as other goals expressed in the KHSA and KBRA. By the terms of the KHSA, the Secretary will determine whether the Proposed Action is appropriate and should proceed. In making this determination, the Secretary will consider whether removal of the Four Facilities will advance the restoration of the salmonid fisheries of the Klamath Basin, and is in the best interest of the public, which includes but is not limited to consideration of potential impacts on affected local communities and Tribes.*

New Information

The Amended KHSA now provides for an existing administrative FERC process, rather than a separately congressionally authorized process, to approve Facilities removal. The primary purpose of the 2010 KHSA remains unchanged in the Amended KHSA, which is to achieve a free-flowing river and full volitional passage of fish into the upper Klamath Basin. Because KBRA was considered a connected action in the EIS/EIR, its goals were included in the Purpose and Need statement. Though KBRA has expired, the Proposed Action remains consistent with the associated KBRA goals in the EIS/EIR. The main goal of KBRA was to address long-standing natural resource issues and conflicts in the Klamath Basin. This goal will still be partially met by Klamath Facilities Removal.

Conclusion

Because there is no change to the Purpose and Need since publication of the Klamath Facilities Removal EIS/EIR, there is no change relevant to environmental concerns.

3.2 Chapter 2: The Proposed Action

3.2.1 Changes to the Proposed Action

Information in the Klamath Facilities Removal Final EIS/EIR

The KHSA established the process for additional studies, including development of the Detailed Plan and environmental review to support the removal of the four downstream-most PacifiCorp owned dams on the Klamath River. This plan and associated reports also addressed whether dam removal (1) will advance restoration of the salmonid fisheries of the basin, and (2) is in the public interest, which includes, but is not limited to, consideration of the potential impacts on affected local communities and Indian Tribes. The KHSA also included provisions for the

interim operation of the Four Facilities by PacifiCorp and the process to transfer, decommission, and remove the dams. Those interim measures remain unchanged in the Amended KHSA.

For more details related to the deconstruction of the Four Facilities see the Detailed Plan and Klamath Facilities Removal EIS/EIR, Section 2.3 Proposed Action and Alternatives. The information presented here is a summary of those more exhaustive reports.

Detailed Plan and Other Studies

The Parties[2] to the KHSA agreed further studies were needed to determine if the actions specified under the KHSA were feasible. These studies included analysis of the regional impacts of the KHSA on water quality, economics, real estate, recreation, and biology. The findings of these studies are summarized in the *Final Klamath Dam Removal Overview Report for the Secretary of the Interior – an Assessment of Science and Technical Information* (DOI and DOC [NOAA Fisheries Service] 2012). For more details related to the deconstruction of the Four Facilities see the Detailed Plan and Klamath Facilities Removal EIS/EIR, Section 2.3 Proposed Action and Alternatives. The Detailed Plan also describes the following:

- Physical methods to remove the dams and achieve a free-flowing condition.
- As necessary and appropriate, plans for management, removal, and/or disposal of sediment, debris, and other materials.
- A plan for site remediation and restoration.
- A plan for measures to avoid or minimize adverse downstream impacts.
- A plan for compliance with all applicable laws, including anticipated permits and permit conditions.
- Estimated costs for Facilities Removal and various measures to mitigate and minimize adverse impacts.

In addition to the decommissioning and removal of the Four Facilities, KHSA and the Amended KHSA call for the transfer of Keno Dam ownership from PacifiCorp to DOI.

KHSA Implementation

KHSA described the process under which PacifiCorp would transfer ownership of each facility when the DRE provides notice that all necessary permits and approvals have been obtained for removal of a facility, all contracts necessary for facility removal have been finalized, and facility removal is ready to commence. After the transfer, the DRE would remove the facilities. The target date to begin deconstruction was January 1, 2020. The Amended KHSA contemplates transfer of the Four Facilities to the DRE as soon as possible which could be within the next year. PacifiCorp will execute an operations agreement with the DRE and will continue to operate the Facilities, but will no longer be the licensee. The Amended KHSA holds the target date for decommissioning as January 1, 2020.

[2] Parties: Signatories to the Klamath Hydroelectric Settlement Agreement.

KHSA Interim Measures

The KHSA included interim measures for the operation of the Klamath Hydroelectric Project by PacifiCorp from the effective date of the agreement (February 18, 2010) or as otherwise specified for each interim measure. If the Secretary makes an Affirmative Determination, as defined in the 2010 KHSA, PacifiCorp would continue to perform the interim measures until decommissioning. These measures include the implementation of measures included as part of PacifiCorp's Interim Conservation Plan (ICP).[3] Measures from the ICP (see Appendix C of the KHSA) are included in the Habitat Conservation Plan (HCP). The HCP requires PacifiCorp to fund projects to enhance the survival and recovery of ESA-listed Coho Salmon, turbine venting to improve DO concentrations downstream from Iron Gate Dam, funding for the development and implementation of a Hatchery Genetics Management Plan for Iron Gate Hatchery, increased flow variability at Iron Gate Dam, and studies on fish disease. On March 13, 2012, National Oceanic and Atmospheric Administration (NOAA) issued an Incidental Take Permit (ITP) that authorizes potential take associated with Klamath Hydroelectric Project operations and Interim Measure implementation. In accordance with the ITP, PacifiCorp is required to implement a HCP that contains measures to minimize and mitigate Project effects on coho salmon. The HCP was developed by PacifiCorp over a period of several years with involvement from NOAA, the California Department of Fish and Wildlife (DFW), and other stakeholders in the basin.

Appendix D of the KHSA provides additional measures to be implemented during the interim period. These measures include the funding of restoration activities, water quality research, the Bureau of Land Management for the land management measures in Appendix C of the KHSA, and Iron Gate Hatchery operations and maintenance (including funding for an 8-year period after removal of Iron Gate Dam). They also include an increase in monitoring activities, the removal of the J.C. Boyle bypass barrier, and the possible removal of three diversions on Shovel and Negro Creeks.

Under the Amended KHSA, PacifiCorp shall continue to perform the Interim Measures in accordance with the terms an schedule set forth in Appendices C and D until Decommissioning. Decommissioning is defined as when PacifiCorp has physically removed any equipment and personal property that PacifiCorp determines has salvage value, and physical disconnection of the facility from PacifiCorp's transmission grid.

Decommissioning of the Four Facilities

The Full Facilities Removal of Four Dams Alternative includes the removal of the Four Facilities as described in the KHSA. This alternative would include the complete removal of the Four Facilities in 2020, including dams, power generation facilities, water intake structures, canals, pipelines, and ancillary buildings. During reservoir drawdown and Facilities deconstruction, the reservoirs would be closed to recreation. This alternative would include the transfer of Keno Dam to the DOI and decommissioning of PacifiCorp's Eastside/Westside facilities. This

[3] As described in the KHSA, the Interim Conservation Plan was developed by PacifiCorp through technical discussions with the NOAA Fisheries Service and the USFWS describing measures for the enhancement of coho salmon and suckers listed under the ESA (see KHSA Appendix A). The Interim Conservation Plan was submitted to FERC on November 25, 2008 and can be found online through the FERC Web site (http://ferc.gov).

alternative, as originally described in the Klamath Facilities Removal EIS/EIR, also included the implementation of the KBRA as a connected action as defined under NEPA. The DRE would begin preparatory work for Facilities removal in May 2019. The initial schedule for this alternative would stop power generation at the Iron Gate and J.C. Boyle facilities on December 31, 2019. Power generation would stop at Copco 2 Powerhouse in April 2020 and would cease at Copco 1 in October 2019. The Detailed Plan designed drawdown rates to protect slope stability, public safety, and structures near the reservoirs.

The result of the Proposed Action would be that the Klamath River would have no dams downstream from Keno Dam. This alternative, as originally described in the Klamath Facilities Removal EIS/EIR, also included the operation of Reclamation's Klamath Project and the decision that river flows would be modeled using hydrologic assumptions in KBRA (Reclamation 2012). These assumed flows are referred to as "KBRA Flows."

Removing the Four Facilities would release sediment currently stored behind the dams into the downstream river system. Reservoir drawdown schedules were selected to minimize release of sediment during critical times for sensitive species. Multiple drawdown timing scenarios were analyzed to avoid or minimize impacts to aquatic species, especially anadromous fishes. The challenge in selecting a drawdown period was to avoid impacts to migrating adult fish (salmonids, sturgeon, and lamprey), migrating juvenile smolts, and rearing of juveniles. During the summer months, juveniles are rearing while green sturgeon adults and spring-run Chinook salmon are migrating. During the fall, adult Coho salmon, steelhead, and fall-run Chinook salmon are migrating while smolts are out-migrating. During the spring, smolts are out-migrating; adult green sturgeon, steelhead, and spring-run Chinook adults are migrating. Drawdown would primarily occur during winter because it would be the least harmful season; however, there are still species and life stages that may be affected, such as adult migrating steelhead and lamprey. The Detailed Plan calls for all four reservoirs to be drawn down in a single year to minimize the number of months and years fish are exposed to high sediment concentrations in the mainstem Klamath river.

J.C. Boyle Dam and Powerhouse

Full removal of the J.C. Boyle Dam and Powerhouse would include removal of the dam, spillway and gates, powerhouse, powerhouse equipment, and concrete fish ladder. This alternative would also include removal of ancillary facilities, such as the canal and pipeline that convey water to the powerhouse. The extensive head cut downstream from the fore bay overflow discharge canal would be filled and stabilized with a portion of the material removed from the dam structure. Further, the DRE would fill the tailrace (where the powerhouse discharges water) to restore natural river conditions in this area. In order to access the dam for deconstruction, the DRE would perform a controlled reservoir drawdown using the spillway gates, conveyance pipeline and canal, and diversion conduit.

The deconstruction process would begin by gradually drawing down the reservoir. Reservoir drawdown would release water into the concrete canal (the power generation intake), the

spillway, and the bypass conduit through the dam depending on the water surface elevation in the reservoir. Water would flow through the Bypass Reach throughout reservoir drawdown. As the reservoir is drawn down, the DRE would remove facilities from the top down. The DRE would start by removing the spillway gates, the spillway bridge, and the upstream concrete intake structure for the powerhouse canal. The DRE would use cranes and excavators for removal; blasting may also be required to remove concrete facilities.

Copco 1 Dam and Powerhouse

The DRE would remove the entire Copco 1 Dam from canyon wall to canyon wall and 5 feet below the existing streambed (a total of 130 feet from the top of the dam). Removing all facilities would include removal of the concrete water intake structure, concrete gate houses, penstock pipes and supports, powerhouse, power generation support facilities, switchyard, and unused transmission lines.

The deconstruction process would begin by gradually drawing down the reservoir. Reservoir drawdown would release water through three primary locations: over the spillway; through the penstock pipes; and through the diversion tunnel. Use of the diversion tunnel would require the removal of three gates, three valves, and a concrete plug to make it operable. Three new gates would be placed on the diversion tunnel; these could be remotely operated. The concrete dam could safely allow flows that overtop the dam crest during dam removal without dam safety or flood concerns. The DRE would construct multiple "notches" in the dam to allow the reservoir to drain; the notches would be 20-foot wide openings that would be a minimum of 16 feet deep.

As the reservoir is drawn down, the DRE would remove facilities from the top down. This process will begin by removing the spillway gates and the spillway deck bridge, using cranes and excavators. The concrete dam will then be removed in 8-foot-high sections using drilling and blasting. Dam removal would be challenging because the dam has large boulders embedded in the concrete and is reinforced with steel rails.

The DRE would construct a cofferdam to isolate one side of the dam and remove water from the working area once the concrete dam is moved down to the water level. The dry portion of the dam would be removed to 5 feet below the existing riverbed and the river would be diverted through the new opening. The other side of the dam would be isolated and removed. The DRE would use mechanical means (such as hydraulic shears that break concrete by shearing it like scissors or an excavator with a hoe-ram attachment) to excavate the reinforced concrete in deck, wall, and floor slabs for remaining features (including powerhouse and diversion intake structure).

Copco 2 Dam and Powerhouse

At Copco 2 Dam, full facilities removal would include removal of the dam, spillway and gates, water intake structure, pipelines, penstock, power generation equipment, and unused transmission lines. The DRE would also reshape the embankment on river right to create a stable slope that blends into the natural hillslopes and river channel. Restoration would include

filling in the tailrace channel between the powerhouse and the river to restore natural river conditions. The Copco 2 substation at the powerhouse and a switchyard on a bluff north of the river would remain in service following dam removal.

Because of the small reservoir size, a river diversion and work area isolation plan would be sufficient for dam removal. The DRE would start by removing the spillway gates and the spillway bridge using cranes and excavators. Next, the river flow would be lowered and routed through the spillway gates while a cofferdam would be constructed to isolate the left half of the dam. The river flow would be routed through the two spillway gates on the right; the two spillway gates on the left and the spillway would be removed using mechanical techniques. The techniques would include use of hydraulic shears or hoe-ram attached to a track-hoe. The shears would be able to cut, or shear through the concrete like scissors while the hoe-ram is able to jackhammer the concrete into small pieces that can be removed. After the left spillway is removed, the river would be diverted through the vacated structure and the right portion of the dam would be removed using similar mechanical techniques. The remaining reinforced concrete walls and water intake structure on the side of the river would be removed after the dam is removed. The power generation water conveyance pipes and powerhouse would be removed using conventional track-hoes and off-road dump trucks.

Iron Gate Dam and Powerhouse

Removal of Iron Gate Dam and Powerhouse would include removal of the earthen dam, diversion tunnel gate structure, concrete water intake structure, powerhouse generation facility, penstock and its concrete supports, unused transmission lines, and the switchyard. The DRE would bury the concrete spillway to restore the pre-dam appearance of the right abutment bedrock canyon. Further, the DRE would fill the tailrace (where the powerhouse discharges water) to restore natural river conditions in this area.

Facilities Removal at Iron Gate Dam would include removal of the fish handling facilities at the base of the dam, but the Iron Gate Fish Hatchery would remain in place. PacifiCorp would need to identify and secure an alternate water source for the fish hatchery to remain operational because the water supply pipe from the penstock intake structure to the fish hatchery would be removed with the dam. PacifiCorp would fund eight years of hatchery operations after the decommissioning of Iron Gate Dam, after which the parties will be responsible for identifying funding for continued operation if necessary.

The DRE would draw down the reservoir by releasing water through the diversion tunnel and into the power generation facilities. The DRE would begin excavation of the embankment on the very narrow top section, which would be a slow process because of the confined work area. As the excavation is worked down from the top, the width of the excavation footprint would be wider and additional equipment could be used. The DRE would remove the riprap during embankment excavation. The DRE would then remove reinforced concrete from remaining structures (including intake structures, fish handling facilities, and powerhouse) using mechanical methods if possible (or drilling and blasting if necessary). The construction of

temporary cofferdams would be necessary to divert water and create isolated work areas for removing the base of of some dams. These cofferdams would be built using materials from the dam removal process and removed upon completion of the work.

Reservoir Restoration following Drawdown

Under the Proposed Action, there would be substantial erosion of the reservoir sediment while the reservoirs are being drawn down. The eroded sediment would then be transported downstream. Following drawdown of the reservoirs, the DRE would complete restoration actions including revegetation, recreation area maintenance, and recreation area decommissioning as described in this section.

Following drawdown of the reservoirs, revegetation efforts would be initiated to support establishment of native wetland and riparian species on newly exposed reservoir sediment. Access for ground application equipment is expected to be limited immediately following drawdown due to terrain, slope, and sediment instability. Upper areas would be reseeded from a barge until the reservoir levels become too low to operate and access the barge. As the reservoirs are drawn down, trucks will be used to apply hydroseed to all accessible areas. Aerial application would be necessary for precision applications of material near the sensitive areas and the newly established river channel, as well as in the remaining areas that are inaccessible by barge or truck.

Additional fall seeding may be necessary to supplement areas where spring hydroseeding was unsuccessful. In cases where mulch moved/degraded or otherwise exposed bare soil, aerial hydroseeding would be used again for the fall re-seeding. In other cases, where establishment failed, yet the mulch remained intact, new seed material applications may need to be incorporated in order to re-establish seed/soil contact sufficient for germination.

City of Yreka Water Supply

The city of Yreka has a municipal water supply intake on Fall Creek and a pipeline that crosses Iron Gate Reservoir; the pipeline would be affected if the Iron Gate Dam were removed. The KHSA addressed the possible impacts that facilities removal would have on the water supply pipeline for the city of Yreka and provides provisions for mitigation of impacts on this supply system. Signatories agreed not to prevent use of the city of Yreka's Water Rights permit and will study the potential risks to the water supply system from facilities removal. Necessary actions for the continued use of the City of Yreka water supply infrastructure would be funded and implemented as part of implementation of the KHSA (KHSA 2010 Section 7.2.3). Final design for a replacement pipeline, if needed, will be done in consultation with the City of Yreka. These commitments remain the same in the Amended KHSA.

Keno Facilities Transfer

The KHSA called for transferring ownership and operation of Keno Dam from PacifiCorp to DOI. The Secretary and PacifiCorp are negotiating the proposed transfer of Keno facilities (the Keno Transfer). Further, transfer of title shall be subject to completion of any necessary

improvements to the facility to meet the DOI directives and standards for dam safety identified by the DOI through a safety inspection of the Keno facility. The Klamath Facilities Removal EIS/EIR analyzed the impacts associated with the Keno Transfer as a connected action. There were no changes to the Keno Facilities Transfer provisions in the Amended KHSA.

Eastside and Westside Powerhouse Decommissioning

PacifiCorp's Eastside and Westside Facilities were proposed for decommissioning in PacifiCorp's 2004 relicensing application. Their decommissioning through the FERC process is described in the KHSA (KHSA 2010 6.4.1(B)). Removing the two facilities would result in the loss of 3.8 megawatts of generating capacity and the removal of the generating infrastructure. The Link River Dam, which is the point of diversion for the two generating facilities, is already owned by Reclamation. Link River Dam was built in 1921, and the power facilities were constructed separately later. Relicensing of the Eastside and Westside facilities would likely require upgrading the power facilities to remain in compliance with FERC standards. This would include the installation of fish screens on the power facilities, potentially requiring major construction and associated maintenance changes.

As noted above, the decommissioning of the Eastside and Westside facilities would be carried out through application to the FERC. FERC will conduct any necessary environmental analysis and make a FERC determination. The Klamath Facilities Removal EIS/EIR used a programmatic analysis to evaluate the impacts associated with the decommissioning of the Eastside and Westside Facilities.

KBRA

The Klamath Facilities Removal EIS/EIR analysis treated the KBRA as a connected action because the Secretarial Determination as described in the KHSA was one of the early key milestones toward full implementation of KBRA. The KBRA included a mix of programs including Fisheries Programs, Water Storage Projects, Water and Power Programs, Regulatory Assurances Programs, and County and Tribal Programs. The KBRA's Fisheries Program was more expressly linked to dam removal rather than the Secretarial Determination, as other programs were.

KBRA Fisheries Program

The Fisheries Program of the KBRA assisted the recolonization of fish habitat made accessible through dam removal and had three main goals:

A. Restore and maintain ecological functionality and connectivity to historic habitat.

B. Re-establish and maintain naturally sustainable and viable populations of fish to the full capacity of the restored habitats.

C. Provide for full participation in harvest opportunities by Tribes

Fisheries Restoration Plans

Implementation of the Fisheries Restoration Plan could include actions for restoration of existing fisheries in the upper basin, as well as actions necessary to prepare for reintroduction of anadromous

fish upstream of Iron Gate Dam. Specific elements could include restoration and protection of riparian vegetation, water quality improvements, restoration of stream channel functions, measures to prevent excessive sediment inputs, remediation of fish passage blockages, and prevention of entrainment into diversions (KBRA Section 10.1.2). See Klamath Facilities Removal EIS/EIR, Table 2-17, for a geographic breakdown of when and where restoration activities would occur.

Restoration activities similar to the general classes of actions described in the KBRA currently occur throughout the basin as funding is available. It was expected that the Restoration Plan would build upon existing activities.

Fisheries Reintroduction Plans

Under the KBRA, the states of California and Oregon would each have prepared separate Fisheries Reintroduction Plans that would have identified the facilities and actions that would be necessary to start reintroduction of anadromous fish upstream of Iron Gate Dam (KBRA Section 11). The Phase I Reintroduction Plans would have been prepared if there was an Affirmative Determination and each state concurred with that Determination. Reintroduction activities specifically would have excluded the Trinity River watershed upstream of the confluence with the Klamath River; Lost River and its tributaries; and Tule Lake Basin.

The Oregon Phase I Reintroduction Plan, would have been prepared by the Oregon DFW and the Klamath Tribes, and would have identified the facilities and actions necessary to start reintroduction and would be adaptable in order to incorporate information gained from the monitoring program. Oregon DFW, the Klamath Tribes, and other fish managers would have been responsible for implementation of the Phase I Reintroduction Plan.

Under the KBRA, Phase I reintroduction upstream of Iron Gate Dam would have included active intervention and movement of Chinook salmon into suitable habitats (KBRA Section 11.3). Following dam removal seasonal trap and haul operations, primarily for fall-run Chinook salmon, may have occurred around Keno Dam until water quality conditions was sufficiently improved. Activities would have been prioritized under the Reintroduction Plan and additional funding that might have become available under the KBRA would have allowed greater improvements to be realized than would occur without the KBRA.

New Information

As a milestone in all three settlement agreements (KHSA, KBRA, and UKBCA), the Secretarial Determination on dam removal influenced timing and implementation of programs in the KBRA and UKBCA. With expiration of the KBRA and limited implementation of UKBCA, the three agreements are currently unlinked. However, because KBRA and UKBCA did not dictate the process to remove dams or mitigate for the impacts of dam removal, expiration of KBRA and the less than full implementation of the UKBCA does not change the proposed action considered in the Klamath Facilities Removal EIS/EIR or the impacts of that removal. The synergistic effects of implementation of the three agreements in concert have currently been lost and some benefits in this reexamination of the EIS/EIR have been tempered due to the expiration of KBRA,

including reduced benefits to aquatic resources, water quality, water supply/water rights, tribal trust, and socioeconomics.

The KBRA included several measures focused on fish reintroduction and aquatic restoration of the upper Klamath Basin. While not strictly mitigation for removal of dams, the Fisheries Reintroduction Plan and the Fisheries Restoration Plan included actions that were primarily aimed at advancing salmonid fisheries as fish passage into the upper basin was reopened. In this reexamination, it is anticipated that the DOI, the tribes, and fish and wildlife resource management agencies will implement some actions that would have been supported by the KBRA programs (i.e. stream restoration action and some fish reintroduction actions), although implementation of these programs may not occur as rapidly as envisioned in the KBRA. Specifically, Oregon DFW has indicated that Oregon would implement actions that would have been included in the KBRA Phase I Restoration and Reintroduction Plan as resources become available for these activities (T. Wise, pers. comm. February 4, 2016).

Additionally, under the Proposed Action described in the Amended KHSA, DOI will operate and maintain Keno Dam and Link River Dam. After Facilities Removal, the operation and maintenance of Keno Dam and Link River Dam will need to be protective of anadromous fish. Those protections have been described in detail by the fish and wildlife resource agencies and it is the expectation of DOI that operation of Keno and Link River Dam will need to be consistent with *United States Department of the Interior's Filing of Modified Terms, Conditions, and Prescriptions (Klamath Hydroelectric Project, No. 2082)* (DOI 2007) and from the *National Marine Fisheries Service Modified Prescriptions for Fishways and Alternatives Analysis for the Klamath Hydroelectric Project (FERC Project No. 2082)* (NMFS 2007). All action alternatives included in the Klamath Facilities Removal EIS/EIR included explicit measures in the project description or described as part of a connected action such that all alternatives are consistent with DOI 2007 and NOAA Fisheries Service 2007. The Interim Trap and Haul Programmatic measure that was described as part of the Klamath Facilities Removal EIS/EIR remains a connected action to dam removal as part of operation and maintenance of Keno Dam and Link River Dam by DOI (See Klamath Facilities Removal EIS/EIR p. 2-90).

The expiration of KBRA and the issuance of a joint biological opinion (2013 Joint Biological Opinion) for the Reclamation's Klamath Irrigation Project (NOAA and USFWS 2013) change the likely hydrologic condition in the Klamath River during dam removal. Reclamation's Klamath Irrigation Project proposed action for 2013 to 2023 includes operation of the Klamath Project for the delivery of water for irrigation purposes consistent with historic operations, subject to water availability, while maintaining lake and river hydrologic conditions that avoid jeopardizing the continued existence of listed species and adverse modification of designated critical habitat (NOAA and USFWS 2013). Klamath Irrigation Project's proposed action was designed to optimize limited water supplies to provide greater certainty for Project Supply, and to provide Upper Klamath Lake (UKL) elevations and Klamath River flows representative of real-time hydrologic conditions. Klamath Irrigation Project's proposed action includes two

distinct operational approaches for water management for the fall/winter (October through February) and spring/summer (March through September) time periods.

Fall/winter water management implements a formulaic management approach based on current hydrologic indicators (UKL storage, UKL inflows, Klamath River accretions, and snowpack conditions) to ensure adequate water storage and sucker habitat in UKL in the fall/winter, while meeting the needs of coho almon downstream and providing fall/winter water deliveries to the Project and Lower Klamath National Wildlife Refuge (NWR). The fall/winter approach prioritizes refill of UKL to provide adequate Project supply, sucker habitat and enhanced river flows in the spring/summer period, while providing opportunity for increasing variability in daily flows that more closely mimic natural hydrology and provides ecological benefits, based on real-time hydrologic conditions in the upper Klamath Basin. Spring/summer water management implements a water supply account approach to determine a volume of water reserved in UKL for ESA-listed suckers (UKL Reserve), the amount of water available for the Klamath River Environmental Water Account (EWA), and the available water supply for Project irrigation (Project Supply). The division of the total available UKL water supply between UKL Reserve, EWA, and Project Supply was based on an analysis of the ecologic needs of ESA-listed species. The formulaic distribution of EWA in spring/summer is based on real-time hydrologic indicators in the upper Klamath Basin, primarily the Williamson River and inflows (accretions) between Link River and Iron Gate Dams, and was designed to achieve key ecological objectives for UKL and the Klamath River. The spring/summer operational approach remains consistent with historic operations by maintaining full irrigation deliveries in accordance with existing contracts, contingent upon available water supplies. To ensure Klamath Irrigation Project operations do not jeopardize listed coho salmon, Reclamation's proposed action included the minimum flows below Iron Gate Dam described in Table 3.

Month	Iron Gate Dam Average Daily Minimum Target Flows (cfs)
March	1,000 (28.3 m^3/sec)
April	1,325 (37.5 m3/sec)
May	1,175 (33.3 m3/sec)
June	1,025 (29.0 m3/sec)
July	900 (25.5 m^3/sec)
August	900 (25.5 m^3/sec)
September	1,000 (28.3 m^3/sec)

Table 3. Minimum Klamath River discharge below Iron Gate Dam (2013 Joint Biological Opinion).

The Klamath Irrigation Project's proposed action incorporates a real-time management concept into current Project operations to lessen the impacts of Project operations on ESA-listed species. A key driver and benefit of this concept is greater water supply certainty for the irrigation project and the flexibility to meet real-time species needs. This real-time management approach for UKL and the Klamath River attempts to optimize the ecologic benefit of the available water supply, resulting in the ability to maximize the amount of remaining water available for the Project. In some instances, dry hydrologic conditions characterized by limited precipitation, runoff, and inflows to UKL may create shortages in the total available UKL water supply, which can result in Project Supply that is less than the full irrigation demand.

Summary of the Effects of Changing the Proposed Action Flows

The EIS/EIR evaluated and analyzed the potential environmental impacts of the Proposed Action (removal of J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate dams) on multiple Klamath Basin resources. To evaluate impacts to some resources (e.g. aquatic biota, water quality, flood plains, among others), assumptions were made about likely flow conditions before, during, and after dam removal in the EIS/EIR and other technical studies. These studies were completed using flow assumptions based on proposed operations under the KBRA (Reclamation 2012) because implementation of the Proposed Action was connected to KBRA. The KBRA expired on December 31, 2015, due to a lack of Congressional authorization, and the KHSA (and the amended KHSA signed on April 6, 2016) are no longer treated as connected actions under NEPA or CEQA. Consequently, for purposes of NEPA and CEQA, it is now appropriate to analyze the effects of the Proposed Action using flows that are defined by the NMFS and USFWS 2013 Joint Biological Opinion.

Reclamation's Proposed Action for 2013 Joint Biological Opinion was developed collaboratively by biologists and hydrologists with NOAA, USFWS, Klamath Basin Tribes, and Reclamation, and it is currently the standard to which the Klamath Irrigation Project operates. The flows under this 2013 Joint Biological Opinion are different flows than those proposed under the KBRA. This section of the SIR describes the relatively small flow differences between KBRA and 2013 Joint Biological Opinion flows, and how these flow differences do not alter major conclusions drawn in the EIS/EIR regarding environmental impacts of the Proposed Action on several resources that are closely tied to hydrology, such as aquatic resources, water quality (including sediment transport), flood hydrology, water supply/water rights, and geology, among others. The sections covering these resource areas refer back to this section in order to avoid excessive repetition of explanations, figures, and tables.

KBRA and 2013 Joint Biological Opinion flows are nearly identical when examined on an average annual basis, with flows below Iron Gate Dam averaging about 1,920 and 1,932 cubic feet per second (cfs), respectively. Similarly, KBRA and 2013 Joint Biological Opinion average annual flows are nearly identical below Keno Dam, averaging about 1,413 and 1,434 cfs, respectively. While on an average annual basis the flows above and below the Hydroelectric Reach are within a few percent of each other, average monthly flows do differ between KBRA

and 2013 Joint Biological Opinion, as evident in Tables 4 and 5. The most prominent difference is the 2013 Joint Biological Opinion requires greater flows in the fall months (October through December) and allows lesser flows in the summer months (June through August) in many years when compared to KBRA Flows, but particularly during wetter-than-average years. Below Iron Gate Dam, 2013 Joint Biological Opinion fall flows average about 216 cfs more than KBRA Flows; 2013 Joint Biological Opinion summer flows average about 114 cfs less than KBRA Flows (Table 4). These seasonal differences in 2013 Joint Biological Opinion versus KBRA Flows reflect the joint goal of NMFS and USFWS to collectively protect ESA listed fish that rely on a shared and finite aquatic resource (most notably two endangered sucker species in Upper Klamath Lake and threatened coho salmon in the Klamath River below Iron Gate Dam).

Figures 6 and 7 show the monthly flow exceedances for the 2013 Joint Biological Opinion and KBRA Flows below Iron Gate Dam and Keno Dam, respectively. Monthly flow exceedance plots are particularly useful for comparing differences between 2013 Joint Biological Opinion and KBRA Flows for different year types (e.g. wet, median, and dry years). For example, the first panel in Figure 6 shows that flows in the Klamath River below Iron Gate Dam in October under the 2013 Joint Biological Opinion are always 150 to 400 cfs greater than under the KBRA Flows, regardless of whether it is a wet year (e.g. 10 percent exceedance), a median year (50 percent exceedance), or a dry year (e.g. 90 percent exceedance). Figures 6 and 7 allow one to analyze whether the assumption of KBRA Flows versus 2013 Joint Biological Opinion flows would affect conclusions in the EIS/EIR regarding the environmental effects of the Proposed Action.

Suspended Sediment Concentrations and Effects on Aquatic Resources:
The Detailed Plan for dam removal (Reclamation 2011a) assumed that the natural release of sediment to the Klamath River from the three larger reservoirs (J.C. Boyle, Copco, and Iron Gate) would be initiated on or soon after January 1, 2020, by regulated releases from available gated spillways, powerhouse bypass facilities, and modified low-level outlets, in order to draw down the reservoirs in a controlled manner. Facilities Removal, as defined by the KHSA to produce a free-flowing river at all four facilities, would be completed prior to December 31, 2020. Drawdown of the three largest reservoirs would be completed in March 2020 (Reclamation 2012).

Based on a sediment transport model (Reclamation 2012a), which assumes KBRA Flows, the largest loads and concentrations of suspended sediment will erode downstream from January through March 2020, but significant loads and high concentrations of suspended sediment would continue through May (Figure 8). Concentration of suspended sediment would peak at about 7,000 to 14,000 mg/L during drawdown, depending on water year type (Table 6). By late spring 2020, however, the sediment transport model predicts that suspended sediment concentrations would be approaching 100 mg/L below Iron Gate Dam (Figure 5) regardless of whether drawdown occurred in a wet, median, or dry year (Reclamation 2012). Because KBRA and 2013 Joint Biological Opinion flows for January through May are nearly identical for all water year types below Keno and Iron Gate dams (generally within a few percent for the 5-month period --

see monthly exceedance Figures 6 and 7), it is reasonable to conclude that the sediment transport model would produce nearly identical suspended sediment concentrations for this January through May time period if it were run with 2013 Joint Biological Opinion flows. Small differences in flows would have negligible impacts on suspended sediment concentrations. It is also reasonable to conclude that the predicted mortality of fish due to the release of high concentrations of suspended sediment (Stillwater 2011), regardless of whether 2013 Joint Biological Opinion or KBRA Flows were assumed in the sediment transport modeling, would be the same and would remain a significant adverse impact of the Proposed Action.

Suspended Sediment Concentrations and Effects on Water Quality:
The Proposed Action would have a short term (< 2 years) adverse impact on water quality relative to suspended sediment standards regardless of whether KBRA Flows or 2013 Joint Biological Opinion flows are assumed in sediment transport model predictions (Reclamation 2012). KBRA Flows and 2013 Joint Biological Opinion flows are nearly identical on an annual basis (within 2 percent), and differ by only 0 to 21 percent for individual months below Iron Gate Dam (Table 4). These differences between KBRA and 2013 Joint Biological Opinion annual and monthly flows are small compared to the water-year types analyzed to provide a broad range of likely impacts of the Proposed Action on suspended sediment concentrations. Three representative water year types were modeled to cover a range of hydrologic conditions during and after reservoir drawdown, including a relatively dry year (in the lower quartile of flows), a more average flow year, and a very wet year. Average annual measured flows below Iron Gate Dam (USGS gage 11516530) for the three representative years ranged from 1,340 cfs (water year 2001), 2,063 cfs (water year 1976), and 3,477 cfs (water year 1984) respectively. Regardless of water year type, with their wide annual and monthly flow differences, peak suspended sediment concentrations for all water-year types were very high during reservoir drawdown (7,000 to 14,000 mg/L), concentrations were greater than or equal to 1,000 mg/L for 2 to 3 months, concentrations were greater than or equal to 100 mg/L for 5 to 7 months, and concentrations were greater than or equal to 30 mg/L for 6 to 10 months (Table 6).

Although differences in suspended sediment concentrations and durations were observed among water year types, they all would produce a significant adverse impact on water quality as concluded in the EIS/EIR. If the sediment transport model was run assuming slightly different 2013 Joint Biological Opinion flows rather than KBRA Flows, it is reasonable to conclude the effects of the Proposed Action would be bracketed by the EIS/EIR analysis, the intensity, magnitudes, and durations of high suspended sediment concentrations would be very similar, and the same conclusion of a significant adverse impact of the Proposed Action on water quality would be reached.

Effects on Flood Hydrology:
The differences between the KBRA and 2013 Joint Biological Opinion will also not affect the flood operations in Upper Klamath Lake or Keno Reservoir. The KBRA flow simulation only computes monthly average flows downstream of Keno so it is not possible to directly compare the predicted flood peaks between the KBRA and 2013 Joint Biological Opinion. However, there

are two factors that indicate that there will be no significant difference in flood conditions between the two operations. First, downstream of Iron Gate Dam, the peak flows are largely determined by the rainfall and runoff that occurs in the watershed between Keno Dam and Iron Gate Dam (Reclamation 2012), which is unaffected by Reclamation's Klamath Project. There is no new evidence that suggests the frequency of large storms has changed significantly since the analysis of KBRA Flows in 2012. Second, the maximum monthly average flows at Iron Gate Dam for the 2013 Joint Biological Opinion are less than those assumed under KBRA Flows (Figure 9) for all the months when flooding has historically occurred (December through May).

Therefore, it is reasonable to conclude that because the flood operations under the 2013 Joint Biological Opinion flows versus the KBRA Flows have not changed, and because the frequency and magnitude of large storms has not changed, the likely adverse impacts to structures in the 100-year flood plain downstream of Iron Gate, and the timing of downstream flood peaks, would be similar for both flow scenarios, with the adverse impacts being significant but reduced to less than significant with implementation of Mitigation Measure H-1 and H-2.

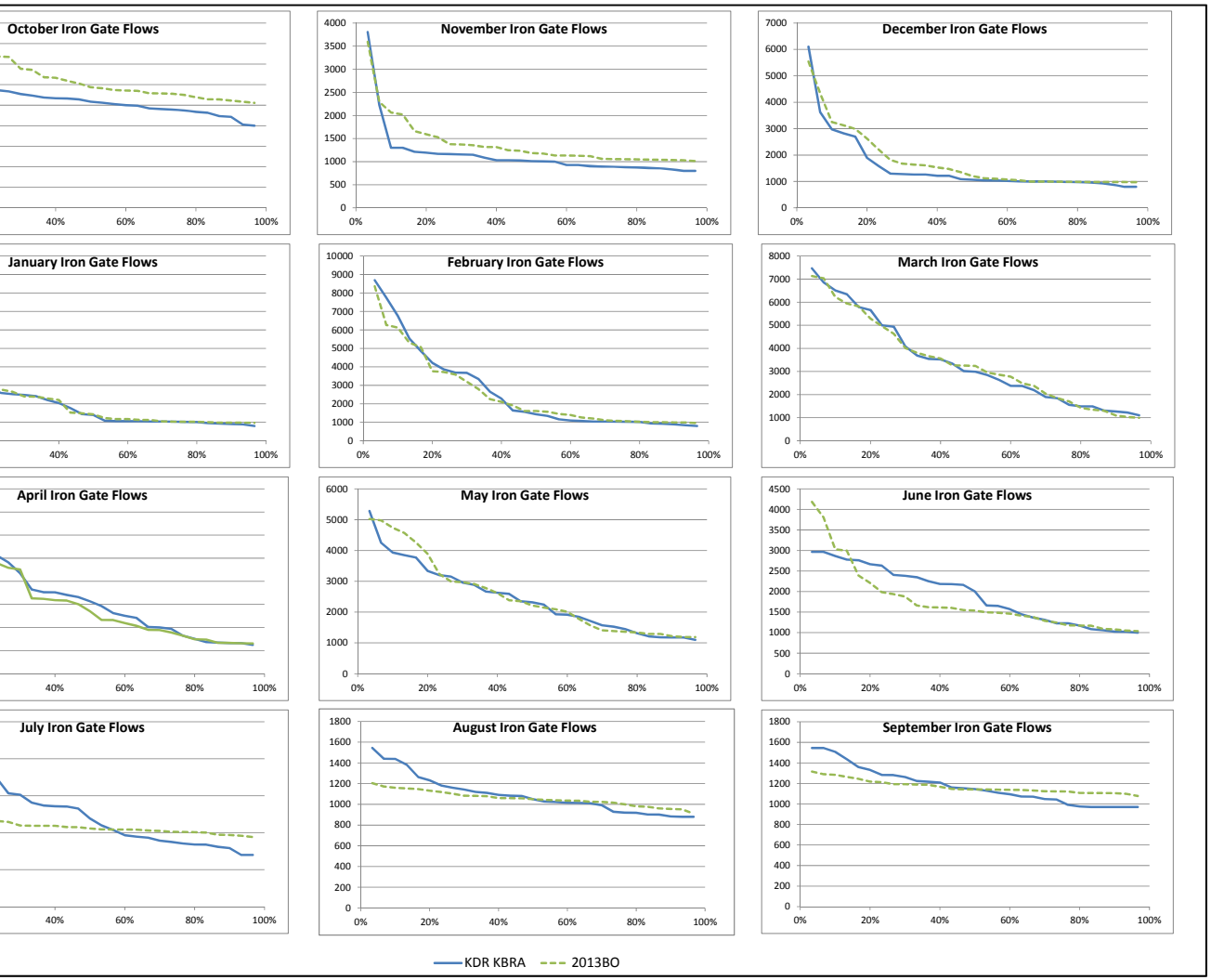
The expected hydrology in the Klamath River remains similar in magnitude and timing of flood peaks to that used in the Klamath Facilities Removal EIS/EIR analysis. New information and the slight change in flood hydrology under the Proposed Action do not result in a change relevant to environmental concerns.

Effects on Flood Risk during Reservoir Drawdown Prior to Dam Removal:
Because of the similarities in flow between the 2013 Joint Biological Opinion and KBRA for the months of January through March, there is expected to be no significant difference between the impacts of dam removal for the dry and average water year types. During the wetter water year types in May and June (Figure 9), there may be a slight increase in the amount of refilling of Iron Gate Reservoir under the 2013 Joint Biological Opinion, but by July the flows for the 2013 are below the low level outlet capacity of Iron Gate Dam. Additionally the flood capacity within the reservoirs increases as drawdown proceeds. If in May or June the very remote possibility of a major hydrologic event occurred, the flood water would be retained within the Four Facilities and drawdown would only resume once the risk of flood had ended. The possibility and impacts of refilling Iron Gate Reservoir is adequately analyzed in the previous work documented in Reclamation (2012) and in the Klamath Facilities Removal EIS/EIR. Therefore, the reservoir drawdown process associated with dam removal described in the Detailed Plan and the Klamath Facilities Removal EIS/EIR would not change and there is no change relevant to environmental concerns.

Effects on Water Supply/Water Rights:
The very minor changes to the hydrology between KBRA Flows and 2013 Joint Biological Opinion flows can be seen when evaluating the average monthly flows and monthly flow exceedances below Iron Gate Dam (Table 4 and Figure 6). The 2013 Joint Biological Opinion slightly increases the annual average water supply by about 9 thousand acre feet when compared with the KBRA Flows. Moreover, when compared to the KBRA Flows, the 2013 Joint

Biological Opinion maintains higher minimum summer months (July and August) during very dry years, when water demands by downstream users are greatest and tributary inputs and groundwater discharges to the river are lowest. In the Klamath Facilities Removal EIS/EIR, a 90 percent exceedance flow of 824 cfs was used to represent a dry year at Iron Gate Dam under KBRA Flows. The flow rate of 824 cfs was once the seasonal low flow during the month of July, when irrigation and livestock demands were very high. Because the 2013 Joint Biological Opinion requires the higher minimum flows of 900 cfs in July and August (Table 3), the 2013 Joint Biological Opinion increases the downstream supply of water to satisfy water rights, and for biological purposes, during the most critical months of dry years.

Effects on Recreation:
The implementation of the 2013 Joint Biological Opinion would have similar effects on the number of recreation days for white-water boating and fishing in the Klamath River as would KBRA Flows. Major trends such as significant losses of flat water fishing opportunities on the hydroelectric reservoirs and the loss of the Hell's Corner peaking flows would be similar in magnitude. However the 2013 Joint Biological Opinion does have slightly increased flows in dry water year types in July and August (Table 3). This would lead to slightly more recreational days for white water boating in the Klamath River under the 2013 Joint Biological Opinion.



3 Joint Biological Opinion Monthly Flow Exceedance at Iron Gate Dam

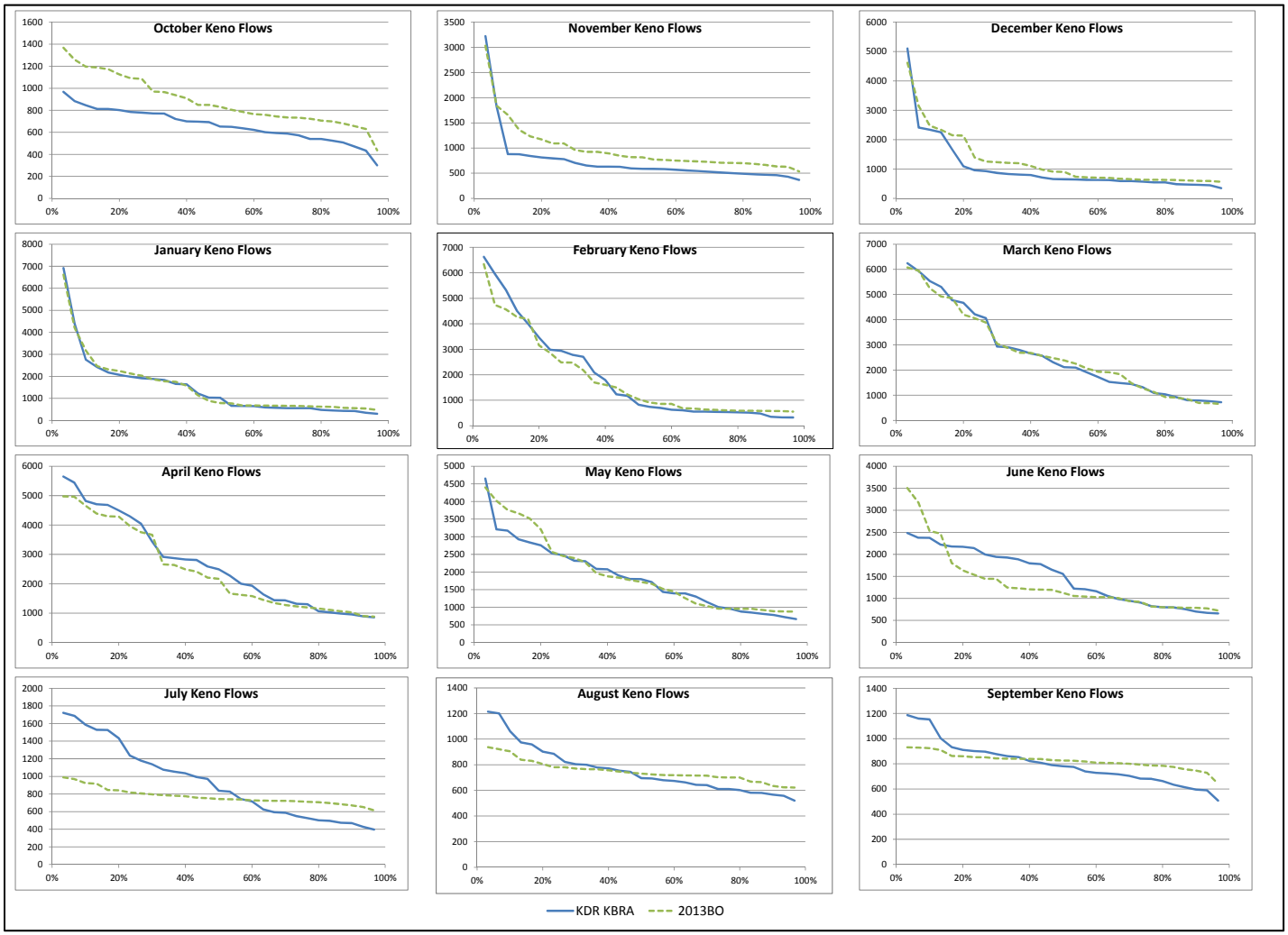


Figure 7. **KBRA** and **2013 Joint Biological Opinion** Monthly Flow Exceedance at Keno

Table 4. Monthly Average Iron Gate Flow for KBRA Flows and 2013 Joint Biological Opinion Flows

	Avg Monthly Flow		Differences (2013 BO versus KBRA)		
	KDR KBRA (cfs)	2013 Joint Biological Opinion (cfs)	(cfs)	(taf)	(%)
oct	1050	1263	213	13.1	20%
nov	1149	1387	239	14.2	21%
dec	1546	1744	197	12.1	13%
jan	2061	2131	70	4.3	3%
feb	2628	2545	-83	-4.6	-3%
mar	3390	3381	-9	-0.6	0%
apr	3340	3119	-222	-13.2	-7%
may	2431	2523	92	5.6	4%
jun	1910	1777	-132	-7.9	-7%
jul	1272	1096	-177	-10.9	-14%
aug	1090	1056	-34	-2.1	-3%
sep	1174	1167	-7	-0.4	-1%

Table 5. Monthly Average Keno Flow for KBRA Flows and 2013 Joint Biological Opinion Flows

	Average Monthly Flow		Differences (2013 BO versus KBRA)		
	KDR KBRA (cfs)	2013 BO (cfs)	(cfs)	(taf)	(%)
oct	664	885	220	13.5	33%
nov	743	980	237	14.1	32%
dec	1023	1245	222	13.7	22%
jan	1455	1510	55	3.4	4%
feb	1925	1850	-74	-4.1	-4%
mar	2644	2639	-6	-0.3	0%
apr	2661	2448	-213	-12.7	-8%
may	1858	1960	102	6.3	5%
jun	1489	1354	-135	-8.1	-9%
jul	929	770	-159	-9.8	-17%
aug	758	748	-10	-0.6	-1%
sep	803	822	19	1.2	2%

Table 6. Summary of Model Predictions (Reclamation 2012) for SSCs in the Klamath River Downstream from Iron Gate Dam for the Proposed Action (assumes KBRA Flows)

Water Year Type	Peak SSC (mg/L)	SSC≥1,000 mg/L		SSC≥100 mg/L		SSC≥30 mg/L	
		Duration (Months)	Time Period	Duration (Months)	Time Period	Duration (Months)	Time Period
Dry (WY2001)	13,600	3	January–March 2020	6	January–June 2020	10	January–October 2020
Median (WY1976)	9,900	2	January–February 2020	5	January–May 2020	6	January–June 2020
Wet (WY1984)	7,100	2	January–February 2020	7	November 2019–February 2020 and April– June 2020	9	November 2019–July 2020

Source: Reclamation 2012
Key:
WY = Water Year
SSC = suspended sediment concentration
mg/L = milligrams per liter

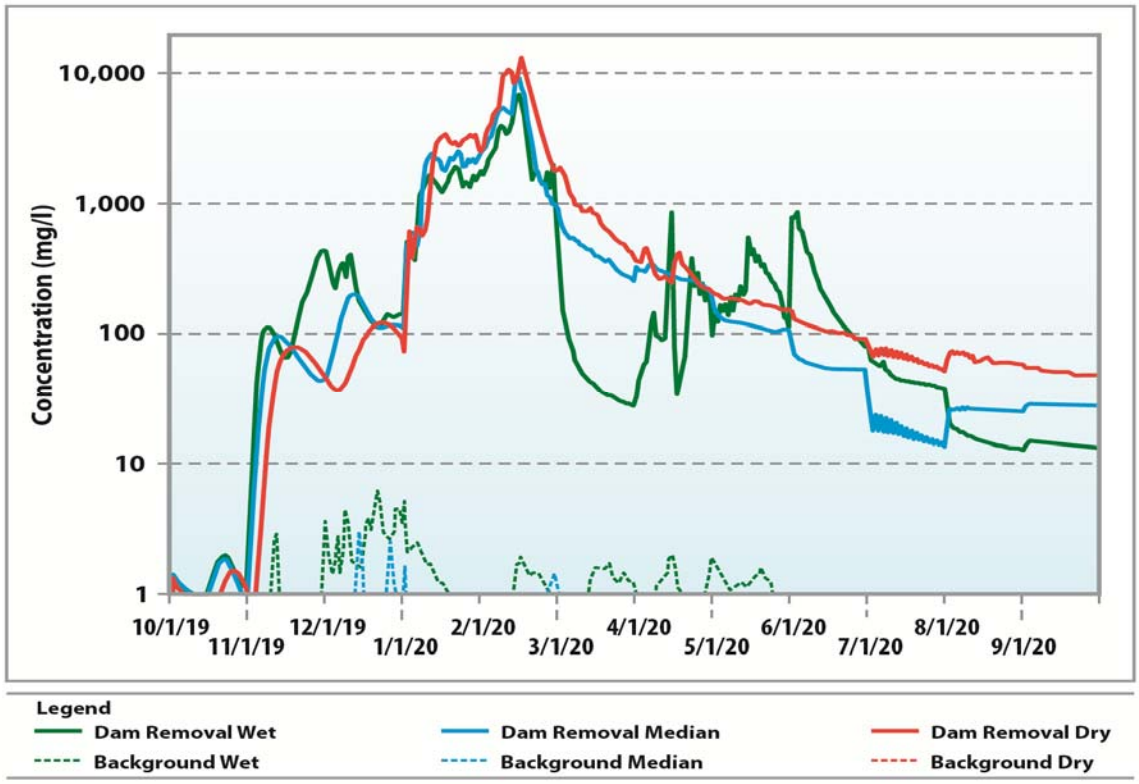


Figure 8. Modeled suspended sediment concentrations (SSC) immediately downstream of Iron Gate Dam for dam removal in dry, median, and wet water years. Background concentrations are modeled using data from all water year types for 1961–2008.

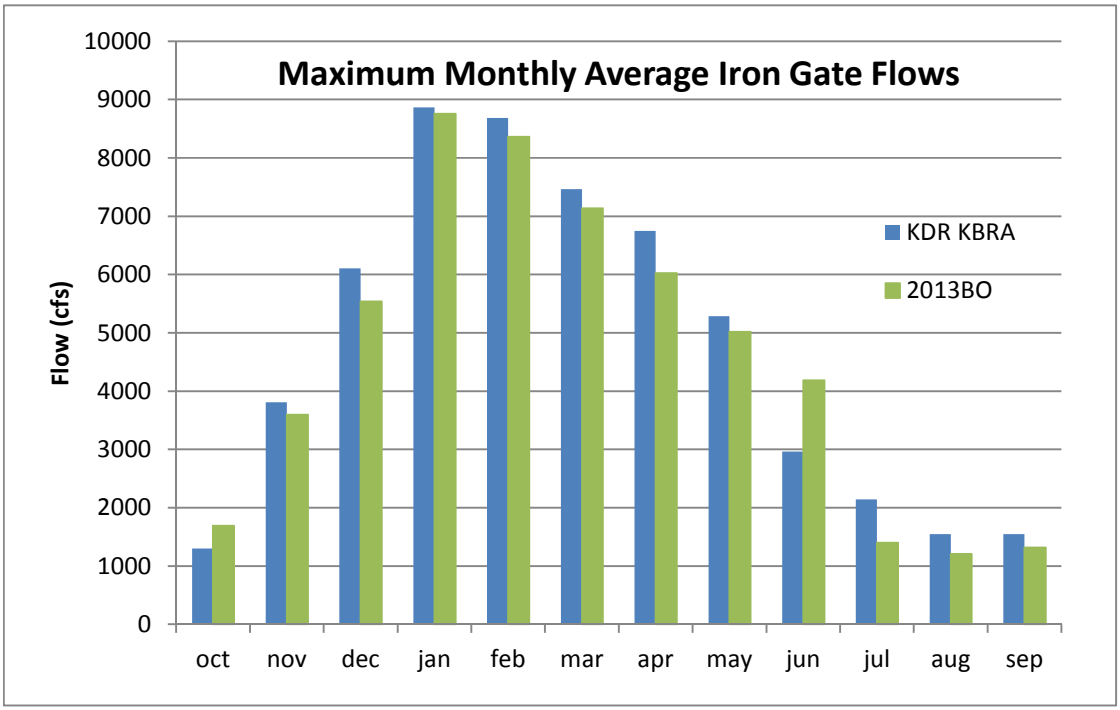
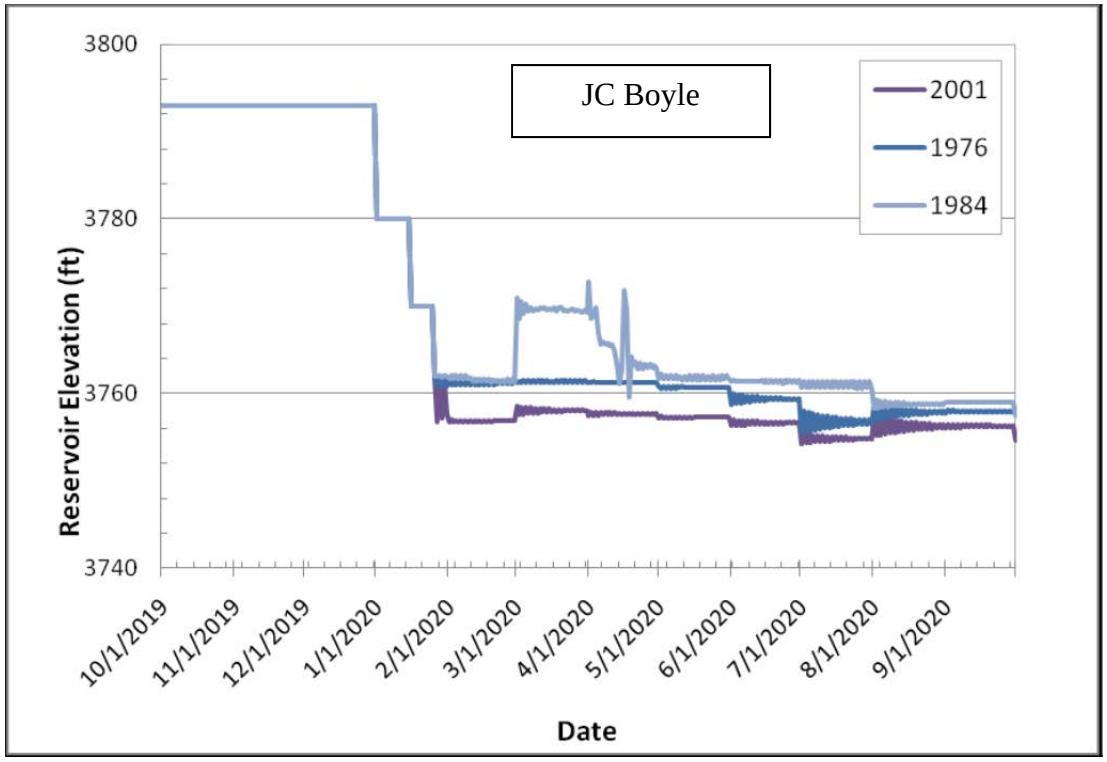


Figure 9. Maximum monthly average flows at Iron Gate Dam for KBRA Flows and 2013 Joint Biological Opinion flows.


JC Boyle
2001
1976
1984
3800
3780
3760
3740
Reservoir Elevation (ft)
10/1/2019
11/1/2019
12/1/2019
1/1/2020
2/1/2020
3/1/2020
4/1/2020
5/1/2020
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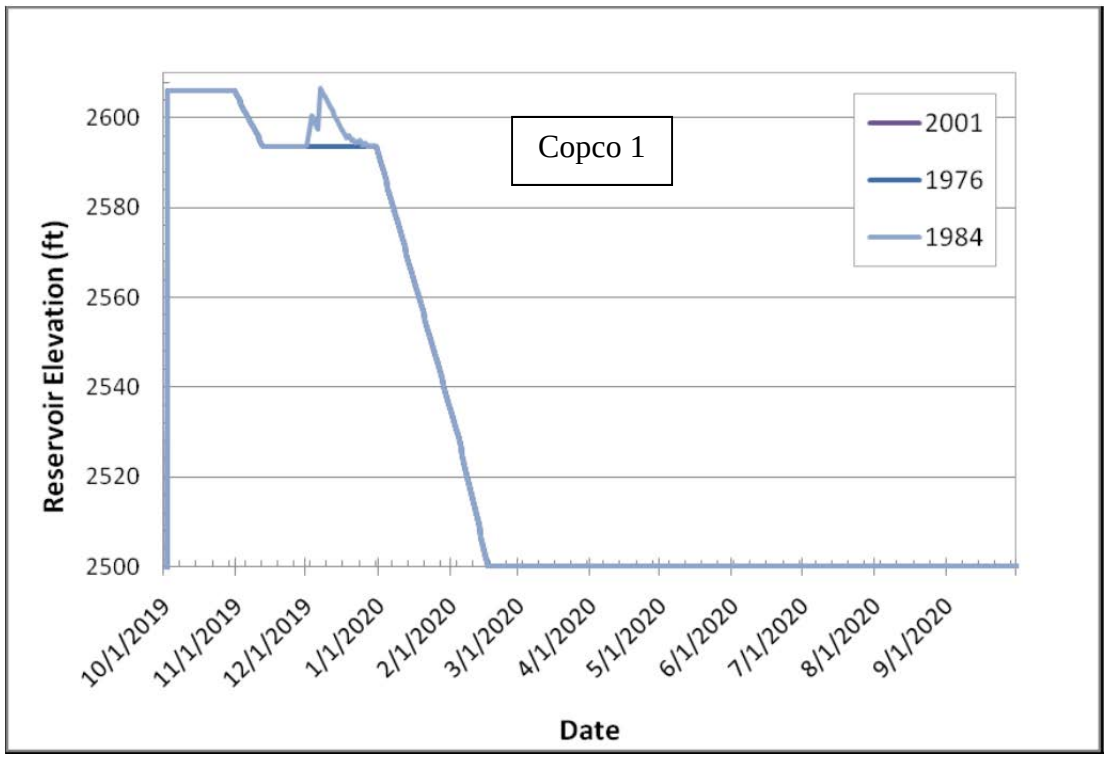
Date


Copco 1
2001
1976
1984
2600
2580
2560
2540
2520
2500
Reservoir Elevation (ft)
10/1/2019
11/1/2019
12/1/2019
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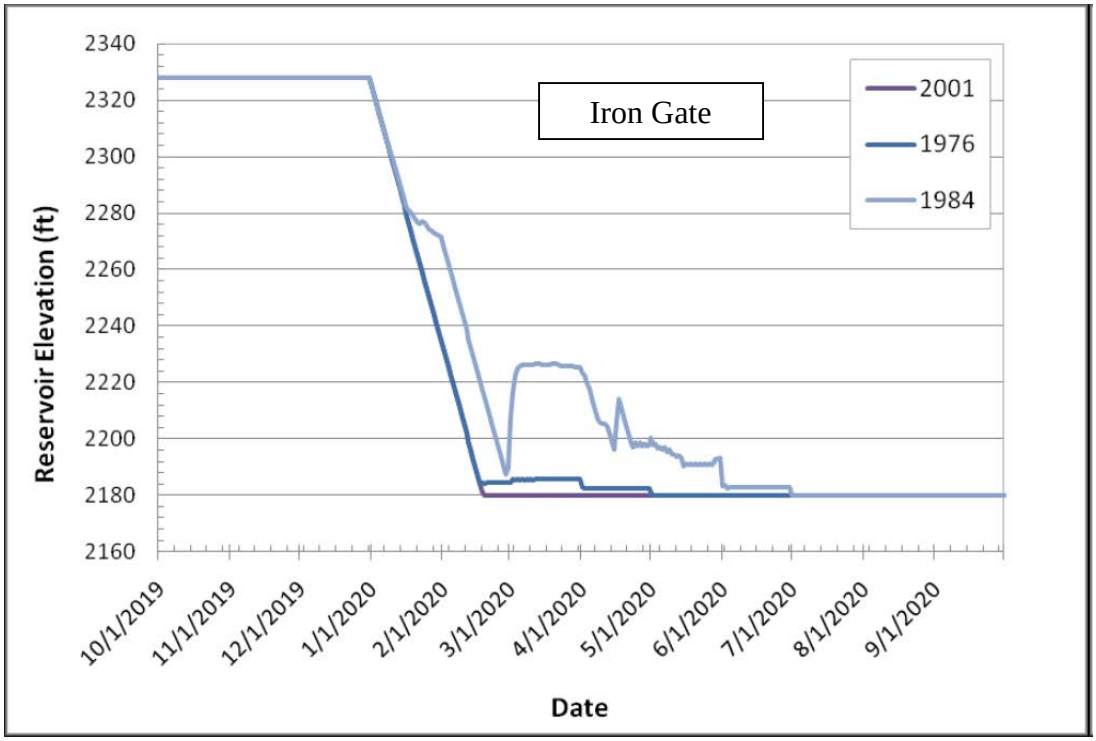

Figure 10. Reservoir elevations of JC Boyle, Copco 1, and Iron Gate reservoirs during reservoir drawdown as computed by Reclamation (2012) assuming KBRA Flows in 3 example water years, 2001 is a dry year, 1976 is an average year and 1984 is a wet year.

3.3 Chapter 3: Environmental Consequences

3.3.1 Water Quality

Environmental Setting

This section describes the effects of the Proposed Action on water temperature, suspended sediments, nutrients (total phosphorus (TP), total nitrogen (TN), ortho-phosphorus, nitrate, and ammonium), DO, pH, and inorganic and organic contaminants within the area of analysis. Effects of the Proposed Action on algae and algal toxins are covered in Section 3.4 (Algae). The Water Quality section of the EIS/EIR analyzed potential effects of the Proposed Action on water quality in Klamath Basin, excluding the Lost River watershed, Tule Lake watershed, and most of the Trinity River watershed. In the EIS/EIR some areas upstream of Link River Dam (e.g. Upper Klamath Lake and its tributaries) were included because implementation of the connected KBRA Programs could have affected water quality in these areas. These areas are not included in the analysis of the Proposed Action without KBRA because dam removal alone would not affect water quality in these parts of the Klamath Basin. The areas downstream of Link River Dam and to the top of the Hydroelectric Reach are still included in the analysis of the Proposed Action

because water quality could potentially be impacted by Eastside and Westside Facilities decommissioning and the transfer of Keno Dam.

The area of analysis also includes the Hydroelectric Reach, which extends from the upstream end of J.C. Boyle Reservoir to Iron Gate Dam, including all sections categorized as mainstem, bypass, and peaking reaches. It also includes the Lower Klamath River downstream from Iron Gate Dam, through the Klamath Estuary, and including the Pacific Ocean marine nearshore environment. Tributaries to the Klamath River in the Hydroelectric Reach and below Iron Gate Dam are not included in the analysis of the Proposed Action (without KBRA as a connected action) because dam removal alone would not affect water quality in these parts of the basin.

Impacts

Suspended Sediment:
Within the general uncertainty of the model predictions (Reclamation 2012), the Proposed Action would result in suspended sediment concentrations (SSCs) below Iron Gate Dam with peak values of 7,000–14,000 mg/L occurring sometime in the first few months of reservoir drawdown, depending on water year type (dry, average, or wet) and the timing of storm events. SSCs in excess of 1,000 mg/L would occur on a timescale of weeks to months. Predicted SSCs would remain greater than or equal to 100 mg/L for 5–7 months following drawdown, and concentrations would remain greater than or equal to 30 mg/L for 6–10 months following drawdown. Model results also indicate that while dilution in the lower river would decrease SSCs to 60–70 percent of their initial value downstream from Seiad Valley (RM 129.4) and to 40 percent of their initial value downstream from Orleans (≈RM 59), it can be conservatively assumed that SSCs in the Lower Klamath River would be sufficient (≥30 mg/L) to substantially adversely affect beneficial uses throughout the lower River and the Klamath Estuary for 6–10 months following reservoir drawdown. A more detailed analysis of the anticipated suspended sediment effects on key fish species in the lower river is presented in the Aquatic Resources section.

The sediment model (Reclamation 2012) used to predict the effects of the Proposed Action on suspended sediment concentration assumed KBRA Flows because KBRA was treated as connected action in the EIS/EIR. Because KBRA expired on December 31, 2015, it is now appropriate to analyze the effects of the Proposed Action using flows that are defined by the 2013 Joint Biological Opinion for Bureau of Reclamation's (Reclamation) Klamath Project (NMFS and USFWS 2013a). Reclamation's Proposed Action for 2013 Joint Biological Opinion was developed collaboratively by biologists and hydrologists with NMFS USFWS, Klamath Basin Tribes, and Reclamation, and it is currently the standard to which the project operates.

The Proposed Action would have a short term (< 2 years) adverse impact on water quality relative to suspended sediment standards regardless of whether KBRA Flows or 2013 Joint Biological Opinion flows are assumed in sediment transport models predictions (Reclamation 2012). KBRA Flows and 2013 Joint Biological Opinion flows are nearly identical on an annual

basis (within 2 percent), and differ by only 0 to 21 percent for individual months below Iron Gate Dam (Table 4). These differences between KBRA and 2013 Joint Biological Opinion annual and monthly flows are small compared to the water-year types analyzed to provide the full range of likely impacts of the Proposed Action on suspended sediment concentrations. Three representative water year types were modeled to bracket likely hydrologic conditions during and after reservoir drawdown, including a dry year, a median year, and a wet year. Average annual measured flows below Iron Gate Dam (USGS gage 11516530) for the three representative years ranged from 1,340 cfs for a dry year (water year 2001), 2,063 cfs for a median flow year (water year 1976), and 3,477 cfs for a wet year (water year 1984). Regardless of water year type, with their wide annual and monthly flow differences, modeled peak suspended sediment concentrations for all water-year types were very high during reservoir drawdown (7,000 to 14,000 mg/L), concentrations were greater than or equal to 1,000 mg/L for 2 to 3 months, concentrations were greater than or equal to 100 mg/L for 5 to 7 months, and concentrations were greater than or equal to 30 mg/L for 6 to 10 months (Table 6).

Although differences in suspended sediment concentrations and durations were observed among water year types, they all would produce a significant adverse impact on water quality as concluded in the EIS/EIR. If the sediment transport model was run assuming slightly different 2013 Joint Biological Opinion flows rather than KBRA Flows, it is reasonable to conclude the effects of the Proposed Action would produce a similar range of suspended sediment concentrations that were analyzed in the EIS/EIR, with similar magnitudes and durations of high concentrations, and the same conclusion of a significant adverse impact of the Proposed Action on water quality would be reached. Overall, sediment release associated with the Proposed Action of drawing down JC Boyle, Copco 1, and Iron Gate reservoirs would cause short-term (<2 years following dam removal) increases in suspended material (≥30 mg/L for 6–10 months following drawdown) that would result in non-attainment of applicable North Coast Basin Plan water quality objectives for suspended material in the Lower Klamath River and the Klamath Estuary. And as stated in the previous paragraph, for 2 to 3 months concentrations would be greater than 1,000 mg/L.

Due to the relatively small magnitude of sediment released to the nearshore environment, the anticipated rapid dilution of the sediment plume as it expands in the ocean, and the relatively low rate of deposition of sediments to the marine nearshore bottom substrates, the short-term impact of this sediment in the marine nearshore environment under the Proposed Action would be a less-than-significant impact. The long-term (2–50 years following dam removal) increases in suspended sediment in the Lower Klamath River, the Klamath Estuary, and the marine nearshore environment would be a less-than significant impact because the majority of erodible reservoir sediment is fine-grained material that would be transported to the ocean in the first two years following reservoir drawdown.

No mitigation measures are planned to reduce sediment concentrations under the Proposed Action during the period of reservoir drawdown. Dredging reservoir bottom sediments prior to dam removal to decrease loads of suspended sediments was deemed infeasible (Lynch 2011)

based on a number of factors, including the relatively small reductions in mortality of fish it would achieve, the land disturbance that would occur for sediment-containment structures, the potential disturbance of cultural resources, and the high cost of the dredging operation. In lieu of dredging, mitigation measures (e.g. trapping and relocating potentially affected fish, lamprey, and mussels during reservoir drawdown; increasing fall flows prior to reservoir drawdown; and delaying release of hatchery yearlings in the spring following reservoir drawdown) were identified to potentially minimize effects to aquatic species from sediment release associated with dam removal and to be significantly more cost effective. In addition, the planned reservoir drawdown during the winter months of a single year (2020) was timed and designed to minimize adverse impacts on key aquatic resources, such as ESA listed juvenile and adult coho salmon. Longer term mitigations (following reservoir drawdown) include replanting and reseeding newly exposed reservoir surfaces to minimize their erosion in subsequent years (Reclamation 2012).

Nutrients:
Under the Proposed Action, the short-term (<2 years following dam removal) increase in nutrients associated with eroded reservoir bottom sediments would be a less-than-significant impact in the Hydroelectric Reach, the Lower Klamath River, estuary, and the marine nearshore environment. The majority of the nutrients associated with reservoir bottom sediments is not readily bioavailable and would not significantly increase the growth of algae. Further, reservoir drawdown under the Proposed Action would occur during winter months when rates of primary productivity and microbially mediated nutrient cycling are expected to be low because of limited ambient light and cold water temperatures.

The Four Facilities, and primarily the two largest reservoirs (Copco 1 and Iron Gate Reservoirs), intercept and retain suspended material behind the dams, including phosphorus and nitrogen originating from the upper basin (Asarian et al 2010). Under the Proposed Action, these additional nutrients currently being retained in the reservoirs would be transported downstream and potentially be available for uptake (e.g., by nuisance algae species) over the long term (2-50 years). Based on available information, the slight nutrient increases in the Hydroelectric Reach would not be expected to result in exceedances of either Oregon water quality objectives for nuisance algae growth, or California North Coast Basin Plan water quality objectives for biostimulatory substances, beyond levels currently experienced. While periphyton colonization would likely increase in the Hydroelectric Reach under the Proposed Action, the increases would be due to the increased habitat for the growth of periphyton as reservoir environments are converted to riverine habitat, rather than increases in nutrient concentrations. Further, the lacustrine environment that supports the current growth of nuisance and toxic algae blooms, such as *M. aeruginosa* in Copco 1 and Iron Gate reservoirs, would be eliminated under the Proposed Action and thus these blooms would be reduced or eliminated, regardless of any increase in nutrient concentrations. Under the Proposed Action, the long-term (2–50 years following dam removal) increase in nutrients in the Hydroelectric Reach would be a less-than-significant impact.

Under the Proposed Action, the long-term increase in nutrients in the Lower Klamath River and the Klamath Estuary would also be a less-than-significant impact. Concentrations of both nitrogen and phosphorus are high enough in the river from Iron Gate Dam (RM 190.1) to approximately Seiad Valley (RM 129.4) (and potentially further downstream) that nutrients are not likely to be limiting primary productivity (i.e., periphyton growth) in this portion of the Klamath River (Asarian and others 2010). In addition, N-fixing species dominate the periphyton communities in the lower reaches of the Klamath River where inorganic nitrogen concentrations are low. Because these species can fix their own nitrogen from the atmosphere, and because dam removal will only cause a minor increase in total phosphorus concentration, the increases in total nitrogen due to dam removal would likely only result in minor increases in periphyton biomass.

Temperature:
A primary effect of the Proposed Action is still anticipated to be the return of approximately 160 miles of the Klamath River, from J.C. Boyle Reservoir (RM 224.7) to the Salmon River (RM 66), to a natural thermal regime. The effects of the Proposed Action on water temperature along this 160-miles reach varies spatially and temporally, but the temperature effects range from less-than significant to beneficial.

Current operations at J.C. Boyle Powerhouse divert relatively warm reservoir discharges around the J.C. Boyle Bypass Reach, leaving large groundwater discharges (springs) to dominate the flows in this reach. This maintains water temperatures between 5-15°C (41-59°F) in this short bypass reach throughout the year, and provides summer and fall cold-water refugia for fish. Under the Proposed Action, which includes removing J.C. Boyle Dam, all flows would be returned to the main channel (currently the bypass reach) and would mix more upstream surface water with the groundwater discharges, locally producing warmer water temperatures from spring to fall than currently exists. Adding this additional water to the bypass reach, however, would not eliminate or overwhelm the benefits of groundwater discharges to water temperatures, particularly during the warm, low-flow summer months. The summer flows in the bypass reach would be comprised of 30 to 40 percent cool groundwater (Buchanan and others 2011) and would continue to have a positive effect on water quality and temperature, and continue to enhance rearing and harvest of redband/rainbow trout. In addition, areas adjacent to the coldwater springs in the bypass reach would continue to serve as thermal refugia for aquatic species in the summer months because the springs themselves would not be affected by the Proposed Action.

Further downstream in the Klamath River, water temperatures are currently influenced by the presence of the two largest reservoirs, Copco 1 and Iron Gate, which delay the natural warming and cooling of riverine water temperatures on a seasonal basis (PacifiCorp 2005, NCRWQCB 2010b). Temperature modeling (Perry and others 2011) results (including climate change) indicate that the annual temperature cycle just downstream of Iron Gate Dam would shift earlier by approximately 18 days within the first year following dam removal, with 1–2°C warmer temperatures in spring and early summer and up to approximately 4°C cooler temperatures in late summer and fall. The return of cooler water

temperatures during the late summer and early fall will more closely mimic natural daily and seasonal conditions and would benefit and support rearing, migration, and earlier spawning and incubation of anadromous salmonids, particularly fall-run Chinook salmon (Bartholow 2005). Analyses suggests that re-establishment of a natural thermal regime with diel fluctuation in the springtime would result in faster growth and earlier outmigration of rearing juvenile salmon, thereby decreasing potential exposure to the comparatively high water temperatures that are experienced in late spring and early summer. This shift in thermal conditions is hypothesized to decrease the frequency and magnitude of large-scale outbreaks of disease in juvenile salmon populations that have occurred for many years in the Klamath River below Iron Gate Dam. At the confluence with the Scott River (RM 143), the differences from dam removal would be diminished, but there would still be a slight warming (<1°C) in the spring and beneficial cooling (1–2°C) in the late summer and fall. Further downstream, at the confluence with the Salmon River (RM 66), water temperature changes associated with the Proposed Action would be small or not discernable (Perry et al 2011).

Based on modeling results and other studies, under the Proposed Action, the short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) increases in springtime water temperatures and diel temperature variation in the Hydroelectric Reach and the Klamath River down to the confluence with Salmon River would be less than significant. Decreases in late summer/fall water temperatures and restoring the natural pattern of wider diel variations in water temperatures (Huntington and Dunsmoor 2006) would be beneficial below Iron Gate Dam to the Salmon River. There would be no change from existing conditions on water temperatures for Klamath River downstream from the Salmon River, the Klamath Estuary, and the marine nearshore environment.

The temperature model used to predict the effects of the Proposed Action on water temperatures assumed KBRA Flows because KBRA was treated as connected action in the Klamath Facilities Removal EIS/EIR. Because KBRA expired on January 1, 2016, it is now appropriate to analyze the effects of the Proposed Action using flows that are defined by the 2013 Joint Biological Opinion for Bureau of Reclamation's (Reclamation) Klamath Project (NMFS and USFWS 2013a). KBRA Flows and 2013 Joint Biological Opinion flows are nearly identical on an annual basis (within 2 percent) and differ by only 0 to 21 percent for individual months below Iron Gate Dam. These flow differences may slightly alter the predicted benefits of the Proposed Action on water temperatures in the Hydroelectric Reach and downstream to the confluence with Salmon Creek, but they do not change the overall conclusion in the EIS/EIR that removal of Copco and Iron Gate dams will benefit water quality by reducing the elevated water temperatures in the late summer and fall.

Dissolved Oxygen:
Under the *Proposed Action*, long-term (2–50 years following dam removal) elimination of seasonal extremes in dissolved oxygen (DO) (i.e., super saturation in surface waters and oxygen depletion in bottom waters of reservoirs) in the river reaches replacing Copco 1 and Iron Gate reservoirs would be beneficial. In addition, modeling of DO under the Proposed Action indicates

that dam removal would increase seasonal DO concentrations in the Klamath River downstream of Iron Gate Dam (PacifiCorp 2005; NCRWQCB 2010a), as compared with current conditions, which would also be beneficial. Under current conditions, thermal stratification of the reservoirs (particularly Iron Gate Reservoir) results in severe oxygen depletion in the bottom waters (hypolimnion) due to microbial decomposition of settling algae. As a result, the dams can release water downstream with low DO concentrations by entraining hypolimnetic water in the summer when the reservoirs are stratified and in the fall when thermal stratification breaks down and the oxygen-depleted deeper water mixes with the entire water column. With the Proposed Action, DO concentrations immediately downstream of Iron Gate Dam during July through November would be greater than those under existing conditions. This condition would result from the lack of stratification and oxygen depletion in bottom waters in the upstream reservoirs, combined with the improved reaeration that occurs in a free-flowing river. As with the river downstream of J.C. Boyle Reservoir, modeling also predicts that daily fluctuations in DO just downstream of Iron Gate Dam during June through October would be greater under the Proposed Action because periphyton communities would become established in the free-flowing reaches of the river that are currently occupied by reservoirs.

Sediment release from reservoirs associated with the Proposed Action would cause short-term (<2 years following dam removal) increases in oxygen demand and reductions in DO in the Hydroelectric Reach as well as downstream from Iron Gate Dam to the confluence with Clear Creek (Stillwater Sciences 2011b). Models show that the duration of decreased DO concentrations will be up to 3 months following dam removal. This oxygen deficit will have a significant adverse impact on DO levels; however, drawing reservoirs down in the cold, high-flow winter months, which maximizes dilution and minimizes rates of biological oxygen demand, will minimize the magnitude and duration of the oxygen deficit caused by the Proposed Action. No other measures or mitigations are planned to reduce this short-term adverse impacts. These significant adverse impacts to DO levels would not extend to Klamath Estuary or the marine nearshore environment in the months following dam removal.

Chemicals in Reservoir Sediments:
Monitoring studies of reservoir bottom sediments (Shannon and Wilson Inc 2006; Reclamation 2012) generated multiple lines of evidence that were used collectively to evaluate the chemistry of trapped reservoir sediments and their potential to affect the environment and human health under the Proposed Action. Multiple potential exposure pathways were analyzed for both humans and aquatic biota for the Proposed Action, including short-term exposure to sediments flushing downstream during dam removal, long-term exposure to exposed reservoir sediments and river-bank deposits, long-term exposure to sediments deposited in the river channel, and long-term exposure to sediments deposited in the marine and near-shore environment (CDM 2011).

No chemicals were detected in sediment at concentrations exceeding available human health screening levels and the Dredge Materials Management Levels, and no other preclusions to releasing the reservoir sediments to the freshwater or marine environment were identified for

human or aquatic biota exposure. A number of chemicals and common classes of chemicals were detected; however, the results were neither surprising nor unusual. Many of the detected compounds have natural sources or are broadly distributed around the earth (e.g., arsenic, trace metals, legacy organochlorine insecticides like dichlorodiphenyltrichloroethane (DDT), and dioxins and furans), and are known to be present at trace or background concentrations in soils, streams and biota across the United States. Absolute concentrations of most chemicals in the reservoir sediments were generally relatively low compared to the screening levels, with no consistent pattern of elevated chemical composition observed within a given reservoir or between reservoirs. No chemicals were identified at levels associated with significant adverse effects (CDM 2011). However, some chemicals were identified at levels "unlikely to cause adverse effects" or with "potential to cause minor or limited adverse effects" for humans or aquatic biota under the Proposed Action.

Under the Proposed Action, the effects of reservoir sediment on human exposure to sediment-associated inorganic and organic contaminants in the Hydroelectric Reach and in the Lower Klamath River would be a less-than-significant impact. Similarly, under the Proposed Action, the effects of sediment release, transit, and deposition on aquatic species due to exposure to sediment-associated inorganic and organic contaminants in the Lower Klamath River, Klamath Estuary, and marine nearshore environment would be a less-than-significant impact.

New Information

Water-quality monitoring in the Klamath Basin has continued to be a high priority for a number of groups since the EIS/EIR was published, including basin tribes, PacifiCorp and its contractors, and government agencies, among others. The goal of the majority of this monitoring and research is focused on documenting the current conditions (water quality in the river and reservoirs with the dams in place); although this new information offers some new insights it primarily reinforces the conclusions in the EIS/EIR regarding how the system would likely change under the Proposed Action of dam removal. There is no new information to suggest adverse environmental impacts would occur beyond those identified in the EIS/EIR. For additional information, the monitoring information including monitoring of water quality constituents (e.g. nutrients, physical parameters, cyanobacteria, etc) required as part of Interim Measure 15 are available on the KBMP.net website. Areas of new (continued) monitoring and research include measurement of nutrient concentrations and loads in the Klamath River and reservoirs (Yurok Tribe Environmental Program (YTEP), 2013a and 2014; Karuk Tribe of California, 2012 and 2013; Hoopa Tribal Environmental Protection Agency, 2013), and real-time continuous monitoring of parameters such as water temperature, DO, pH, specific conductance, and turbidity, among others (Asarian, E. and J. Kann 2013; YTEP, 2013b; Karuk Tribe of California, 2012 and 2013).
In a 2012 water temperature modeling report (Risley and others, 2012), two dam scenarios were simulated: "dams in" and "dams out." The dams out scenario, which is similar to the Proposed Action, analyzed temperature changes that could be attributed to removing the dams, but using

flow conditions from the 2010 Klamath Biological Opinion rather than flows assumed flows if KBRA was implemented. The authors report:

> *Simulated water temperatures from January through June at almost all locations between J.C. Boyle Reservoir and the Pacific Ocean were higher for the "dams out" scenario than for the "dams in" scenario. The simulated mean monthly water temperature increase was highest [1.7–2.2 degrees Celsius (°C)] in May downstream of Iron Gate Dam. However, from August to December, dam removal generally cooled water temperatures. During these months, water temperatures decreased 1°C or more between Copco Lake and locations 50 miles or more downstream. The greatest mean monthly temperature decrease was 4°C in October just downstream of Iron Gate Dam. Near the ocean, the effects of dam removal were small (less than 0.2°C) for most months.*

The results from this study were very similar to the water temperature studies used to draw conclusions regarding the benefits of the Proposed Action on water temperatures in the Hydroelectric Reach and the Lower Klamath River.

Relative to the potential environmental effects of chemicals in reservoir bottom sediments, EPA Region 9 (Nancy Woo, written communication, 2015) reached the following overall conclusions: (1) the levels of chemical contaminants in sediments behind the dams largely fell below screening thresholds used to assess sediment disposition; (2) the sediments likely to be released by the Proposed Action are not likely to have significant contaminant-related effects on downstream fish, wildlife, or human receptors, especially after mixing and dilution; and (3) fish, wildlife, and human exposure to sediment contaminants would actually be reduced overall with the Proposed Action when compared to the alternative of leaving the dams in place.

Conclusion

An analysis of new information since the publication of the EIS/EIR does not change any of the conclusions regarding the environmental effects of the Proposed Action on water quality in the Klamath Basin. As identified in the EIS/EIR: (1) sediment release from reservoirs associated with the Proposed Action would cause short-term (< 2 years) increases in DO demand and adverse reductions in DO in the Hydroelectric Reach and downstream to the confluence with Clear Creek; (2) sediment release associated with the Proposed Action would cause short-term (< 2 years) increases in suspended material (≥30 mg/L for 6–10 months following reservoir drawdown) that would result in non-attainment of applicable North Coast Basin Plan water quality objectives for suspended material in the Lower Klamath River and the Klamath Estuary. The adverse impacts and the non-attainment of water quality objectives associated with the Proposed Action are predicted to occur regardless of whether KBRA or 2013 Joint Biological Opinion flows are assumed in the analysis.

3.3.2 Aquatic Resources

Environmental Setting

The area of analysis includes aquatic communities, fish health, and habitats of the Klamath River watershed currently influenced by the presence of the Four Facilities proposed for removal. The proposed removal of the four dams would provide anadromous fish with access in a free-flowing river from the Pacific Ocean to upstream fish ladders at Keno Dam and Link River Dam. Thus, the total increase in access to historical habitat upstream from Iron Gate Dam for both steelhead and salmon would be approximately 420 miles (including the Sprague, Williamson, and Wood rivers and tributaries in the Hydroelectric Reach).

In addition, these four dams and associated reservoirs influence water quality, water quantity, bedload transport, and disease downstream. Thus, the project area includes the Klamath River from Keno Dam to the Pacific Ocean. This would include areas potentially affected by changes in water supply patterns caused by removal of the Four Facilities.

Impacts

Dam removal would provide for a free-flowing river below Keno Dam to the Pacific Ocean. At Keno and Link Dams, fishways would then complete the migratory connection to the Upper Basin. With the habitat in the Hydroelectric Reach, this would re-establish migration to at least 420 stream miles of historical habitat above Iron Gate Dam for anadromous fish. Anadromous fish would also access low gradient historical habitat of critical importance to spawning and rearing under Copco 1 and Iron Gate Reservoirs. Consequently, the size and diversity of these populations is expected to increase. In addition, fish would gain access to cold water springs in the Hydroelectric Reach and the Upper Basin, offering improved winter growth opportunities for rearing and some protection against future warming water temperatures associated with climate change. Dam removal would renew bedload transport and the recruitment of gravel within and below the Hydroelectric Reach, which would benefit fish spawning and rearing.

Under the Proposed Action, the occurrence of *C. shasta*, a fish parasite known to cause high mortality in juvenile salmon in the Klamath Basin, is anticipated to be reduced as a result of changes in the overall dispersal of adult salmon carcasses, increases in bedload and sediment transport, and reductions in food resources for the intermediate host of the parasite. While there is some uncertainty associated with the causative factors of infection of *C. shasta* in juvenile salmon, a reduction in the prevalence of the disease is likely under the proposed action as it would create better conditions for fish migration, rearing, and spawning. Given the elimination of large congregations of adult salmon carcasses near Iron Gate Hatchery coupled with the release of large numbers of hatchery fry/smolts in late spring when infection rates are often high, we hypothesize that the establishment of a *C. shasta* "hot spot" above the current location of Iron Gate Dam would have a low probability of occurrence. .

Cooler fall water temperature and improvements in water quality that would result from removal of the Four Facilities are also predicted to reduce the stress and disease experienced by returning

adults. The adverse effects of peaking and entrainment in the Hydroelectric Reach on resident species such as redband trout would also be eliminated. Disease risks to resident fish would not be expected to increase in response to the proposed action; native Klamath River trout are generally resistant to *C. shasta*. Also, KHSA includes implementation of all Interim Measures funded by PacifiCorp for the period 2012 through 2020 to improve fish habitat, water quality, and to fund monitoring and critical research.

The release of sediments stored behind Copco 1 and Iron Gate dams would have negative impacts on fish and water quality in the short term (< 2 years) but would provide longer term benefits in the form of increased habitat complexity and increased movement of larger sediment substrate along the river bed (bedload transport), reductions in fish disease, and the nearly complete elimination of toxic algal blooms in the Hydroelectric Reach and the downstream transport of algal toxins. Some chemicals are present in reservoir sediments but at concentrations below critical screening levels for freshwater and marine disposal and do not preclude sediments being released downstream. Based on multiple lines of evidence, long-term adverse effects for biota would be unlikely from the chemicals present in the new river channel and downstream areas as a result of the Proposed Action (CDM 2011).

Dam removal would eliminate the recreational benefits of project reservoirs such as fishing and some white water recreation opportunities related to peaking flows in the Hydroelectric Reach; however the removal of the Four Facilities would create new recreational opportunities (rafting and fishing) in a free-flowing Hydroelectric Reach, including improved flow conditions and recreational opportunities in the J.C. Boyle and Copco 2 bypass reaches.

The Iron Gate Hatchery was originally designed to mitigate for 16 miles of habitat from IGD upstream to the Copco dams (FERC 1963). The Interim Measures of the KHSA require that PacifiCorp propose an Iron Gate Dam Mitigation Hatchery Plan that would ensure hatchery mitigation goals are met for 8 years following dam removal. After 8 years, continued hatchery operations would depend largely on: 1) realized and projected benefits of restored access to historical habitat above the current location of Iron Gate Dam; 2) the success and timeliness of habitat restoration; and 3) the timeliness and success of fish reintroduction (natural and assisted) above Iron Gate Dam.

Suspended Sediment

Downstream from Iron Gate Dam

Under the Proposed Action, full facility removal would result in the release of 5.3 to 8.6 million yd^3 (1.2 to 2.3 million tons) of sediment stored in the reservoirs into the Klamath River downstream from Iron Gate Dam (Reclamation 2012), temporarily resulting in higher suspended sediment concentrations (SSCs) than would normally occur under existing conditions (Figure 3.3-9 of the EIS/EIR). Reservoir drawdown is expected to commence in November 2019 for Copco Reservoir and in January 2020 for J.C. Boyle and Iron Gate Reservoirs.

Based on a sediment transport model (Reclamation 2012), which assumes KBRA Flows, the largest loads and concentrations of suspended sediment will erode downstream from January through March 2020, but significant loads and high concentrations of suspended sediment

would continue through May (Figure 8). Concentration of suspended sediment would peak at about 7,000 to 14,000 mg/L during drawdown, depending on water year type (Table 6). By late spring 2020, however, the sediment transport model predicts that suspended sediment concentrations would be approaching 100 mg/L below Iron Gate Dam (Figure 5) regardless of whether drawdown occurred in a wet, median, or dry year (Reclamation 2012). The SSCs will be near background conditions for all water year types within the first year following removal. At Iron Gate Dam, where SSCs are artificially low under current conditions (because of sediment trapping by the dam), SSCs would remain elevated above existing conditions throughout the first 2 years. At Orleans (Figure 3.3-10 of the EIS/EIR), where event-based SSCs under existing conditions are higher than downstream of Iron Gate Dam because of inputs of many tributaries, under a most-likely-to-occur scenario the effects of the Proposed Action would be similar to existing conditions by late April when SSCs at baseflow from the Proposed Action are predicted to decrease. Under a worst case scenario, namely reservoir drawdown in a relatively dry year, SSCs at baseflow are projected to remain somewhat elevated above existing conditions until October.

Klamath River Estuary and Pacific Ocean

Under the Proposed Action, suspended sediment would be released from reservoirs in the Hydroelectric Reach but concentrations would decrease in the downstream direction as a result of dilution by tributary inputs unaffected by dam removal and deposition of some sediment. The SSCs in the estuary under the most-likely-to-occur scenario would be similar to those that occur during existing high-flow years (e.g. a 10-year high-flow event) owing to large sediment loads entering the river from tributaries below Iron Gate Dam during the winter months. Under the worst-case simulation, SSCs concentrations would only be marginally higher than those that occur during a 10-year high flow event. Therefore, effects on aquatic species from SSCs within the estuary are not anticipated to be distinguishable from existing conditions.

Bedload Sediment

Under existing conditions, the reach below Iron Gate Dam is gravel-starved and the substrate is dominated by bedrock and large cobbles, similar to other reaches immediately downstream of dams in western rivers (Collier et al., 1996). Dam removal would release a mix of fine sediment, sands, and gravel. In the short term (within 2 years), the fines are expected to be mostly transported well downstream and into the Pacific Ocean; sand percentage in the river bed downstream of Iron Gate is expected to increase to 30-35 percent initially and reduce to 10 to 20 percent by September. Meanwhile gravels are expected to deposit largely in the reach below Iron Gate Dam, with mediate substrate size decreasing from the current condition (diameter ~100 mm) to about 50 to 55 mm within about year 5. Over the long term, the effect of the proposed action will be a more dynamic and mobile bed downstream from Iron Gate Dam, with an increased sediment supply (including spawning gravel) to channels below Iron Gate Dam that are currently sediment starved due to the presence of the Four Facilities.

Water Quality

J.C. Boyle to Iron Gate Dam - As described in the subsection of Klamath Facilities Removal EIS/EIR, Section 3.2.4.3.2, Water Quality, the Proposed Action would cause long-term increases in DO in the Hydroelectric Reach. DO in the current river reaches and the free-flowing river reaches replacing the reservoirs would no longer be affected by hydropower peaking flows or the extreme conditions of super-saturation (i.e., >100% saturation) in surface waters and hypolimnetic oxygen depletion in bottom waters of Copco 1 and Iron Gate Reservoirs during the April/May through October/November period. This would increase the likelihood of consistently supporting beneficial uses, including aquatic biota, during this time period. Some degree of diurnal fluctuation caused by photosynthesis of periphytic (attached) algae is expected because of the shift from lacustrine to riverine habitats, with continued influx of nutrient rich waters from the Klamath River upstream of the Hydroelectric Reach. However, conditions for dissolved oxygen and pH would be more consistent on a day-to-day basis and the diel extremes would decrease in a downstream direction.

Downstream from Iron Gate Dam Site–

Facilities Removal under the Proposed Action would cause long-term overall increases in DO during late summer and fall, as well as increased diel variability in DO, in the Lower Klamath River, particularly for the reach immediately downstream from Iron Gate Dam. Effects would diminish with distance downstream from Iron Gate Dam, such that no effects on DO would occur by the confluence with the Trinity River. The Proposed Action would increase the likelihood of consistently supporting beneficial uses, including aquatic biota, particularly in the summer and fall months.

Sediment release associated with the Proposed Action would cause short-term increases in oxygen demand and reductions in DO. Accounting for predicted short-term increases in oxygen demand under the Proposed Action, DO concentrations are generally expected to be greater than 5 mg/L. Exceptions to this would occur four to eight weeks following reservoir drawdown (i.e., in February 2020) for median and dry year hydrologic conditions, when DO would drop to levels below 5 mg/L from Iron Gate Dam to near the confluence with the Shasta River (RM 176.7). Recovery to the North Coast Basin Plan water quality objective of 90 percent saturation (i.e., 10–11 mg/L) would occur in the reach from Seiad Valley to the mainstem confluence with Clear Creek, and therefore DO would not be affected in the estuary or the nearshore environment.

Water Temperature

The thermal lag caused by the storage of water in J.C. Boyle, Copco 1 and Iron Gate reservoirs would be eliminated in the Lower Klamath River under the proposed action. Eliminating this thermal lag would return water temperatures to a more natural condition (seasonally, monthly, daily, and hourly) similar to pre-dam conditions, warming earlier in the spring and cooling earlier in the fall compared to current conditions, and returning natural diel (hourly) fluctuations (Hamilton et al. 2011). These more natural temperatures are better synchronized to the historical migration and spawning patterns to which Klamath River salmonids evolved.

Disease

The Proposed Action is expected to reduce fish disease impacts on salmon *C. shasta* and *Parvicapsula minibicornis* are responsible for most of the disease-related mortality of juvenile salmonids in the Lower Klamath River downstream from Iron Gate Dam. Among all salmon lifestages, juvenile are generally the most susceptible to *P.minibicornis* and *C. shasta*, particularly during their outmigration in the spring months (Beeman et al. 2008). The main factors contributing to risk of infection by *C. shasta* and *P. minibicornis* include availability of habitat (pools, eddies, and sediment) for the polychaete intermediate host; artificially stable microhabitat characteristics (static flows and low velocities); polychaete proximity to spawning areas; increased planktonic food sources from Project reservoirs; and water temperatures greater than 15°C (Bartholomew and Foott 2010).

Adult salmonids are also currently impacted by fish diseases, with improvements predicted under the Proposed Action. Adult salmonids also become infected with *C. shasta*, when they return to the Klamath River to spawn. Although there is no evidence that these infections negatively impact the adult population, these infected adults complete the *C. shasta* disease cycle by releasing spores to infect the intermediate host polychaete worms. Cooler fall water temperatures associated with the Proposed Action are also predicted to reduce the infection prevalence of adults and may reduce the transport of *C. shasta* back into upper reaches of the river.

Though not as common as the frequent annual *C. shasta* outbreaks that impact juvenile salmonids, the fall of 2002 was marred by the large-scale fish adult salmonid mortality event caused by Ich and columnaris. Cooler fall water temperature and improvements in water quality that would result from removal of the Four Facilities are predicted to reduce the stress experienced by upstream migrant pre-spawn adults. Additional reductions in disease are anticipated from increased dispersal of returning adult salmonids into the newly created upstream spawning habitat.

Algal Toxins

Removal of the Four Facilities under the Proposed Action would eliminate the reservoirs that promote the growth of toxin-producing nuisance algal blooms (e.g. *Microsystis aeruginosa*) in the Hydroelectric Reach, thereby alleviating high seasonal concentrations of algal toxins and the bioaccumulation of microcystin in fish tissue in Copco 1, Iron Gate reservoirs and in the river below Iron Gate Dam. While some microcystin may be transported downstream from algal blooms in Upper Klamath Lake, the levels would not be as high as those currently experienced due to the prevalence of seasonal in-reservoir blooms in Copco 1 and Iron Gate reservoirs. Overall, bioaccumulation of algal toxins in fish tissue would be expected to decrease in the Hydroelectric Reach and downstream, and would be beneficial to aquatic biota.

Critical Habitat

Coho Salmon

Under the Proposed Action, elevated levels of SSCs would occur for 3 to 4 months during and after reservoir drawdown, which would temporarily degrade critical habitat for coho salmon. Bedload movement following dam removal would increase supply of gravel downstream from Iron Gate Dam as far downstream as Cottonwood Creek. In the long-term, this bedload movement would potentially improve critical habitat for coho salmon by reducing median substrate to a size more favorable for spawning and increasing the suppy of gravel for spawning (Reclamation 2012).

The Proposed Action would increase the amount of habitat available to coho salmon upstream of, and improve water quality within, the currently designated critical habitat in the mainstem Klamath River within current critical habitat. NOAA Fisheries Service may consider whether to designate the newly available habitat as critical habitat as part of its 5-year status review or as a separate reconsideration of the critical habitat designation for coho salmon (J. Simondet, NMFS, pers. comm., 2011). The Proposed Action would restore access for upper Klamath River population of coho salmon into habitat within the Hydroelectric Reach, expanding their distribution to include historical habitat along the mainstem Klamath River and in Jenny, and Fall Creeks (Hamilton et al 2005). In addition, coho salmon could find suitable temperatures for holding in pockets within the J.C. Boyle Bypass Reach, although the average and maximum temperatures in this reach are seasonally expected to exceed optimal temperatures for coho salmon. On an annual basis, access to this habitat would increase the availability of spawning sites, result in additional food resources, and provide access to areas of better water quality. Water quality conditions would also improve within the mainstem river downstream from the J.C. Boyle Powerhouse. As discussed in detail in the EIS/EIR, the thermal lag caused by water storage in Copco 1 and Iron Gate reservoirs would be eliminated in the Lower Klamath River. Water temperatures would have more natural seasonal and daily variations, and would become better synchronized with historical coho migration and spawning periods in the Klamath River. Overall, these changes would result in water temperature more favorable for coho salmon in the mainstem. After the initial negative impacts, removal of the Four Facilities would also improve long term DO concentrations and the conversion of Copco 1 and Iron Gate reservoir habitat to restored river habitat would greatly reduce or eliminate the growth of toxic algae. These changes would be beneficial for coho salmon critical habitat.

Based on reductions in habitat quality during reservoir drawdown, which would be detrimental to Primary Constituent Elements (PCEs), the Proposed Action would have a significant short term adverse impact on coho salmon critical habitat. Based on benefits to the PCEs, the Proposed Action would have long-term beneficial effect on critical habitat for coho salmon.

Bull Trout
Based on the restricted distribution of bull trout, implementation of the Proposed Action would not affect the physical or chemical components of critical habitat. However, the Proposed Action would allow Chinook salmon and steelhead to access areas they have not been able to access since the construction of the Copco 1 Dam. These species would potentially compete with and prey upon bull trout fry and juveniles; however, bull trout would also be expected to consume the eggs and fry of Chinook salmon and steelhead. These species co-evolved in the watershed and as such, it is anticipated that they would co-exist in the future.

The Proposed Action would have a less-than-significant or minor impact on critical habitat for bull trout in the short and long term.

Southern Resident Killer Whale
Klamath River salmon are anticipated to provide less than 1 percent of the diet of Southern Resident Killer Whales in most months. The Proposed Action would not be likely to materially affect the food supply of Southern Resident Killer Whales.

Based on small influence of the Klamath River on PCEs of Southern Resident Killer Whale, the Proposed Action would have a less-than-significant impact on critical habitat for Southern Resident Killer Whales in the short and long term.

Eulachon
Under the Proposed Action, PCEs of critical habitat supporting eulachon would be degraded in the short term, including adverse effects of suspended sediment on spawning and egg incubation habitat, and adult and larval migration habitat for southern Distinct Population Segment (DPS) eulachon. Critical habitat for the Southern DPS eulachon includes approximately 539 miles of riverine and estuarine habitat in California, Oregon, and Washington. In the Klamath River, critical habitat only comprises a small portion (<2%) of the Klamath River and is designated from the mouth of the Klamath River upstream to the confluence with Omogar Creek at approximately river mile (RM) 10.5 from the mouth; however, critical habitat does not include any tribal lands of the Yurok Tribe or the Resighini Rancheria. With the removal of the Four Facilities, along with continued implementation of TMDLs, water quality improvements in the estuary are expected, which would be beneficial to eulachon. Although the Proposed Action would result in short-term reductions in habitat quality detrimental to PCEs, a very small proportion (< 2%) of eulachon critical habitat would be affected, and thus the Proposed Action would have a less-than significant effect on eulachon critical habitat. Based on water-quality benefits to the PCEs, the Proposed Action would likely have a beneficial effect on critical habitat for eulachon in the long term.

Essential Fish Habitat (EFH)

Chinook and Coho Salmon EFH

The short-term release of sediment from the dams under the Proposed Action would be detrimental to Chinook and coho salmon EFH during the months when SSC concentrations are elevated. In the long term, the Proposed Action would increase habitat for Chinook and coho salmon (upstream of currently designated EFH) by providing access to habitats upstream of Iron Gate Dam. EFH quality would be affected by improved water quality, and decreased prevalence of disease, as described above for coho salmon critical habitat. Improved access to habitats (upstream of currently designated EFH), improved water quality, increased sediment transport, and decreased prevalence of disease, would provide a benefit to EFH for Chinook and coho salmon. Based on a substantial reduction in EFH quality during reservoir drawdown, the Proposed Action would have a significant effect on EFH for Chinook and coho salmon in the short term. Based on improvements to habitat quality, the Proposed Action would have a beneficial effect on EFH for Chinook and coho salmon in the long term.

Groundfish and Pelagic Fish EFH

Under the Proposed Action, impacts to the nearshore environment are not anticipated to be distinguishable from existing conditions, based on a relatively small magnitude of SSCs released to the nearshore environment, an anticipated rapid dilution of the sediment plume as it expands in the ocean, and a relatively low rate of deposition of sediments to the marine nearshore bottom substrates (subsection of Section 3.3.4.3.2). EFH in the Klamath River Estuary could be affected by elevated suspended sediment from sediment releases during dam removal for about 3 months. After this time, SSCs would return to levels similar to existing conditions.

In the long term, SSCs would be similar to that under existing conditions. Natural bedload transport processes would resume, as the dams would no longer trap sediments upstream of Iron Gate Dam. Bedload in the estuary and ocean would not be appreciably affected, because of the relatively small contribution of bedload from above Iron Gate Dam compared to the total bedload carried by the Klamath River. With the exception of algal toxins, water quality benefits resulting from dam removal would largely have dissipated upstream of the estuary, and therefore, water quality in the estuary would be expected to remain similar to existing conditions. Based on the small proportion of groundfish EFH and Pelagic Fish EFH affected, and short duration of poor water quality during reservoir drawdown in the near-shore environment and estuary, the Proposed Action would have a less-than-significant effect on EFH for groundfish and Pelagic fish in the short and long term.

Species Specific Impacts

Fall-Run Chinook Salmon

Fall-run Chinook salmon use the mainstem Klamath River for spawning, rearing, and as a migratory corridor downstream from the four dams proposed for removal. Direct mortality is predicted for fall-run Chinook salmon incubating eggs in redds and for some smolts. However, the effect of SSC from the Proposed Action on the fall-run Chinook salmon population, under both most-likely and worst-case scenarios, is expected to be relatively minor because of variable

life histories, the age 0 juveniles that remain in tributaries until later in the spring and summer, and because many of the fry that outmigrate to the mainstem come from tributaries in the mid-or Lower Klamath River, where SSCs resulting from the Proposed Action are expected to attenuate due to dilution from tributaries. Based on substantial reduction in the abundance of a year class in the short term, the effect of the Proposed Action would be significant for fall-run Chinook salmon in the short term.

Mitigation Measures AR-1 through AR-4 (see Klamath Facilities Removal EIS/EIR, Section 3.3.4.4) could be implemented to reduce the short-term effects of SSCs on fall-run Chinook salmon incubating eggs and smolts. There would still be short-term effects for fall-run Chinook salmon, including some direct mortality, but no one-year class would suffer a substantial decrease in abundance. Based on minimal reduction in the abundance of a year class in the short term, the Proposed Action would be a less-than-significant effect on fall-run Chinook salmon after mitigation.

As stated above, dam removal would also restore connectivity to hundreds of miles of potentially usable habitat in the Upper Klamath Basin and would create additional spawning and rearing habitat within the Hydroelectric Reach. By providing an unimpeded migration corridor, the Proposed Action would provide the greatest possible benefit related to fish passage, hence, the highest survival and reproductive success. It is anticipated that the Proposed Action would increase the abundance, productivity, population spatial structure, and genetic diversity of fall-run Chinook salmon in the Klamath River watershed. In general, free flowing conditions as per the Proposed Action, would likely provide optimal efficiency, decrease outmigrant delay, and increase concomitant adult escapement (Buchanan et al. 2011b). As discussed in detail in the Klamath Facilities Removal EIS/EIR Section 3.2 Water Quality, dam removal would also cause water temperatures to become warmer earlier in the spring and early summer and cooler earlier in the late summer and fall, and have diurnal variations more in sync with historical migration and spawning periods (Hamilton et al. 2011). These changes would result in water temperature more favorable for salmonids in the mainstem. In addition, under the Proposed Action diminished disease conditions and improved water quality in the mainstem Klamath River will likely improve the survival of smolts outmigrating from tributaries downstream from Iron Gate Dam (e.g., Scott and Shasta rivers), thus increasing the likelihood of successful restoration actions in those watersheds. Based on increased habitat availability and improved habitat quality, the effect of the Proposed Action would be beneficial for fall-run Chinook salmon in the long term.

Spring-Run Chinook Salmon

The overall short term effect of suspended sediment from the Proposed Action on the spring-run Chinook salmon population is not anticipated to differ much from existing conditions and the No Action/No Project Alternative. There is very little difference from existing conditions and the No Action/No Project Alternative for adult migrants, all of which is predicted to be sublethal, and no effects are anticipated for the spawning, incubation, and fry stages because they do not spawn in the mainstem. Type I and II outmigrants are expected to experience very similar conditions

under the Proposed Action as under existing conditions and the No Action/No Project Alternative. However, direct mortality is predicted for some Type III smolts (< 1 percent of production). Based on minimal reduction in the abundance of a year class in the short term, the effect of the Proposed Action would be less-than-significant for spring-run Chinook salmon in the short term.

Implementation of Mitigation Measures AR-2 (see Klamath Facilities Removal EIS/EIR, Section 3.3.4.4) could reduce the short-term effects of SSCs on spring-run Chinook salmon Type III smolts. With implementation of mitigation measures, there would still be short-term effects for spring-run Chinook salmon including some potential direct mortality, but there would not be a substantial reduction in the abundance of a year class. Based on minimal reduction in the abundance of a year class in the short term, the Proposed Action would be a less-than-significant effect on spring-run Chinook salmon after mitigation.

Dam removal would restore connectivity to hundreds of miles of potentially usable habitat in the Upper Klamath Basin, including additional habitat within the Hydroelectric Reach. Access to additional habitat would provide a long-term benefit to spring-run Chinook salmon populations. The expansion of habitat opportunities would allow maximum expression of life-history variation and the restoration of an additional population of spring-run Chinook salmon population to strengthen resiliency in the Klamath Basin, particularly because passage upstream of Iron Gate Dam would provide access to groundwater thermal refugia during summer and fall, as well as providing slightly warmer winter water temperatures conducive to the growth of salmonids (Hamilton et al. 2011). By providing an unimpeded migration corridor, the Proposed Action would provide the greatest possible benefit related to fish passage, hence, the highest survival and reproductive success (Buchanan et al. 2011b). As discussed in detail above, dam removal would also cause water temperatures to become warmer earlier in the spring and early summer and cooler earlier in the late summer and fall, and have diurnal variations more in sync with historical migration and spawning periods (Hamilton et al. 2011). These changes would result in water temperature more favorable for salmonids in the mainstem. In addition, with large scale hydraulic mining operations now outlawed, spring-run Chinook salmon would no longer be subject to one of their most significant threats in the Klamath River (as discussed in Klamath Facilities Removal EIS/EIR, Section 3.3.3.1.1.).

Current fisheries management also minimizes overharvest. It is anticipated that as a result of the Proposed Action the spring-run Chinook salmon population within the Klamath River watershed would have an increase in abundance, productivity, population spatial structure, and genetic diversity. Based on increased habitat availability and improved habitat quality, the effect of the Proposed Action would be beneficial for spring-run Chinook salmon in the long term.

Coho Salmon

In general, the wide distribution and use of tributaries by both juvenile and adult coho salmon will likely protect the population from the worst effects of the Proposed Action. However, direct mortality is anticipated for redds and smolts from the upper Klamath River, mid-Klamath River,

Shasta River, and Scott River population units. No mortality is anticipated for the Salmon River, Trinity River, and Lower Klamath River populations under the most likely or worst-case scenarios. All population units would be expected to recover from these losses within one or two generations. Based on substantial reduction in the abundance of a year class in the short term, the effect of the Proposed Action would be significant for the coho salmon from the Upper Klamath River, Mid-Klamath River, Shasta River, and Scott River population units in the short term. Based on no reduction in the abundance of a year class, the effect of the Proposed Action would be less-than-significant for the coho salmon from the three Trinity River population units, Salmon River and the Lower Klamath River Population Unit in the short term.

Steelhead

In general, the effects of suspended sediment resulting from the Proposed Action on steelhead are likely to be much higher than under existing conditions and the No Action/No Project Alternative, particularly for the portion of the population that spawns in tributaries upstream of the Trinity River. For that portion of the population, effects are anticipated on adults, run-backs, half-pounders, any juveniles rearing in the mainstem, and outmigrating smolts. However, the broad spatial distribution of steelhead in the Klamath Basin and their flexible life history suggests that some will avoid the most serious effects of the Proposed Action by (1) remaining in tributaries for extended rearing, (2) rearing farther downstream where SSC should be lower due to dilution (e.g., the progeny of the adults that spawn in the Trinity River Basin or tributaries downstream from the Trinity River), and/or (3) moving out of the mainstem into tributaries and off-channel habitats during winter. In addition, the life-history variability observed in steelhead means that, although numerous year classes will be affected, not all individuals in any given year class will be exposed to the effects of the Proposed Action. In addition, some portion of the progeny of those adults that spawn successfully would rear in tributaries long enough to not only avoid the most serious impacts of the Proposed Action in 2020, but may also not return to spawn for up to two years, when any suspended sediment resulting from the Proposed Action should be greatly reduced. The high incidence of repeat spawning among summer-run steelhead (ranging from 40 to 64 percent, Hopelain 1998) should also increase that population's resilience (including all year classes) to effects of the Proposed Action. Based on substantial reduction in the abundance of a year class in the short term, the effect of the Proposed Action would be significant for summer and winter steelhead in the short term.

Implementation of Mitigation Measures AR-2 and AR-3 (see Klamath Facilities Removal EIS/EIR,Section 3.3.4.4.2 and 3.3.4.4.3) could be implemented to reduce the short-term effects of SSCs on steelhead adults and outmigrating juveniles. With implementation of mitigation measures there would still be short-term effects on summer and winter steelhead, including sublethal and lethal effects. Based on substantial reduction in the abundance of a year class in the short term, the Proposed Action would be a significant effect on summer and winter steelhead in the short term after mitigation.

Dam removal would restore connectivity to hundreds of miles of historical habitat in the Upper Klamath Basin and would create additional habitat within the Hydroelectric Reach. FERC

(FERC 2007) concluded that implementing fish passage would help to reduce adverse effects to steelhead associated with lost access to upstream spawning habitats. Hamilton et al. (2011) also concluded that access to additional habitat in the upper Klamath River watershed would benefit steelhead runs. In general, dam removal would likely result in the restoration of more reproducing populations, increased abundance, higher genetic diversity, and the opportunity for variable life histories and use of new habitats (Hamilton et al. 2011). In general, free flowing conditions as per the Proposed Action, would likely provide optimal efficiency, decrease outmigrant delay, and increase concomitant adult escapement (Buchanan et al. 2011b). By providing an unimpeded migration corridor, the Proposed Action would provide the greatest possible benefit related to fish passage, hence, the highest survival and reproductive success (Buchanan et al. 2011b). As discussed in detail above, dam removal would also cause water temperatures to become warmer earlier in the spring and early summer and cooler earlier in the late summer and fall, and have diurnal variations more in sync with historical migration and spawning periods (Hamilton et al. 2011). These changes would result in water temperature more favorable for salmonids in the mainstem. Based on increased habitat availability and improved habitat quality, the effect of the Proposed Action would be beneficial for summer and winter steelhead in the long term.

Pacific Lamprey

The Proposed Action would have short-term effects related to SSCs, bedload sediment transport and deposition, and water quality (particularly DO). Overall, because multiple year classes of lamprey rear in the mainstem Klamath River at any given time, and since adults will migrate upstream over the entire year, including January 2020 when effects from the Proposed Action will be most pronounced, effects on Pacific lamprey adults and ammocoetes could be much higher in the mainstem Klamath River than under existing conditions and the No Action/No Project Alternative. However, because of their wide spatial distribution and varied life history, most of the population would likely avoid the most severe suspended sediment pulses resulting from the Proposed Action. In addition, Pacific lamprey are considered to have low fidelity to their natal streams (FERC 2006), and may not enter the mainstem Klamath River if environmental conditions are unfavorable in 2020. Migration into the Trinity River and other Lower Klamath River tributaries may also increase during 2020 because of poor water quality. Low fidelity also increases the potential that lamprey can recolonize mainstem habitat if ammocoetes rearing there suffer high mortality. Based on substantial reduction in the abundance of a year class in the short term, the effect of the Proposed Action would be significant for Pacific lamprey in the short term.

Implementation of Mitigation Measures AR-2 and AR-5 (see Klamath Facilities Removal EIS/EIR, Sections 3.3.4.4.2 and 3.3.4.4.5) could reduce the short-term effects of DO and SSCs on lamprey ammocoetes. With implementation of mitigation measures there could still be short-term effects for lamprey including sublethal and lethal effects. Based on substantial reduction in the abundance of a year class in the short term, the Proposed Action would be a significant effect on Pacific lamprey in the short term after mitigation.

The Proposed Action would provide access to habitat upstream of Iron Gate Dam. It is anticipated that as a result of the Proposed Action the Pacific lamprey population within the Klamath River watershed would have an increase in abundance, productivity, population spatial structure, and genetic diversity. Based on increased habitat availability and improved habitat quality, the effect of the Proposed Action would be beneficial for Pacific lamprey in the long term.

Green Sturgeon

Overall the effects of the Proposed Action are most likely to include physiological stress, inhibited growth, and high mortality for some portion of the age-0 2020 cohort and age 1 2019 cohort. To summarize, green sturgeon in the Klamath Basin have the following traits likely to enhance the species' resilience to impacts of the Proposed Action:

- Most of the population (subadult and adult) would be in the ocean during the year of the Proposed Action (2020) and would be unaffected (Appendix E).
- The approximately 30 percent of the population that spawn and rear in the Trinity River would be unaffected.
- Much of the spawning and rearing of green sturgeon occurs downstream from the Trinity River, where sediment concentrations would be similar to existing conditions and the No Action/No Project Alternative.

Green sturgeon are long-lived (>40 years) and are able to spawn multiple times (~8 times) (Klimley et al. 2007), so effects on two year classes may have little influence on the population as a whole.

Based on substantial reduction in the abundance of a year class in the short term, the effect of the Proposed Action would be significant for green sturgeon in the short term.

Implementation of Mitigation Measure AR-3 (see Klamath Facilities Removal EIS/EIR, Section 3.3.4.4.3) could be implemented to reduce the short-term effects of SSCs on green sturgeon adults post-spawning. With implementation of mitigation measures there would still be short-term effects for green sturgeon including sublethal and sublethal effects. Based on substantial reduction in the abundance of a year class in the short term, the Proposed Action would be a significant effect on green sturgeon in the short term after mitigation.

It is anticipated that as a result of the Proposed Action, the green sturgeon population within the Klamath River watershed would have increased long term productivity. Based on improvements in habitat quality within part of their range, the effect of the Proposed Action would be less-than-significant for green sturgeon in the long term.

Lost River and Shortnose Suckers
Based on reduction in abundance of suckers within the Hydroelectric Reach reservoirs, the effect of the Proposed Action would be significant for Lost River and shortnose sucker populations in the short term. Implementation of Mitigation Measure AR-6 (see Klamath Facilities Removal EIS/EIR, Section 3.3.4.4.6) could be implemented to reduce the impact to individuals within reservoirs by rescuing fish prior to reservoir drawdown. Based on small numbers of individuals affected after mitigation, the effect of the Proposed Action would be beneficial for Lost River and shortnose sucker populations in the short term after mitigation.

The Klamath Facilities Removal EIS/EIR concluded that the effect of the Proposed Action with implementation of the connected KBRA would be beneficial for Lost River and shortnose sucker populations in the long term. The long-term benefits ascribed to the Proposed Action resulted from Upper Basin water quality improvements and restoration. The removals of facilities downstream of the known viable populations of lost river and shortnose suckers have no effect on suckers or their habitat.

Redband Trout
Based on a small proportion of the population with a potential to be exposed to short-term effects, the effect of the Proposed Action would be less-than-significant for redband trout in the short term. With long term increased habitat availability and improved habitat quality, the effect of the Proposed Action would be beneficial for redband trout.

Bull Trout
Based on the co-evolution of bull trout with anadromous salmonids, the potential change in the food web that supports the bull trout was found to have a less-than-significant impact in the short and long term.

Eulachon
The Proposed Action would have short-term effects related to SSCs and bedload movement. Based on no substantial reduction in the abundance of a year class, the Proposed Action would have a less-than-significant effect on eulachon in the short term. Due to the short duration of poor water quality in the estuary due to dam removal, the Proposed Action would have a less-than-significant effect on eulachon in the long term.

Longfin smelt
The Proposed Action would have short-term effects related to SSCs and bedload movement. Based on no substantial reduction in the abundance of a year class, the Proposed Action would have a less-than-significant effect on longfin smelt in the short term. Due to the short duration of poor water quality in the estuary due to dam removal, the Proposed Action would have a less-than-significant effect on eulachon in the long term.

Introduced Resident Species
The Proposed Action would eliminate habitat for introduced resident species in the Hydroelectric Reach. Because these species were introduced and they occur in other nearby water bodies, their loss would not be considered significant from a biological perspective, and their elimination would benefit native species. Their loss would, however, decrease opportunities for recreational fishing for these species, as discussed in Section 3.20 of the EIS/EIR.

Interactions Among Species
There are many examples from nearby river systems in the Pacific Northwest that show how wild anadromous steelhead trout and resident rainbow/redband trout can co-exist successfully and maintain abundant populations without adverse consequences. The Deschutes River in Oregon, the Yakima River in Washington, and the river systems in Idaho are examples (Administrative Law Judge 2006). As noted by Buchanan et al. (2011a), existing trout and colonizing anadromous steelhead are expected to co-exist, as they do in other watersheds, although there may be shifts in abundance related to competition for space and food.

Freshwater Mussels
Based on substantial reduction in the abundance of multiple year classes in the short term and the slow recovery time of freshwater mussels, the effect of the Proposed Action would be significant for mussels in the short term. Implementation of Mitigation Measure AR-7 (see Klamath Facilities Removal EIS/EIR, Section 3.3.4.4.7) could be implemented to reduce the short- and long-term impacts of the Proposed Action on freshwater mussels. With implementation of mitigation measures there would still be impacts to a portion of the freshwater mussel population, and there could still be a substantial reduction in the abundance of at least one year class. Based on substantial reduction in year classes, the Proposed Action would have a significant effect on freshwater mussels after mitigation in the short term.

Based on increased habitat availability and habitat quality in the long term, the effect of the Proposed Action would be beneficial for mussels in the long term.

Benthic Macroinvertebrates
The Proposed Action would have short-term effects related to SSCs and bedload movement. Based on substantial reduction in the abundance of a year class in the short term, the effect of the Proposed Action would be significant for macroinvertebrates downstream from Iron Gate Dam in the short term.

While a large proportion of macroinvertebrate populations in the Hydroelectric Reach and in the mainstem Klamath River downstream from Iron Gate Dam would be affected in the short term by the Proposed Action, their populations would be expected to recover quickly because of the many sources for recolonization and their rapid dispersion through drift or aerial movement of adults. Habitat quality would also be improved in the Hydroelectric Reach by the ending of deleterious Klamath Hydroelectric Project peaking operations (Administrative Law Judge 2006).

Dam removal would restore riverine connectivity among the Lower Klamath Basin, the Hydroelectric Reach and its tributaries, and the Upper Klamath Basin, and would rehabilitate and increase availability of riverine habitat within the Hydroelectric Reach. Based on increased habitat availability, increased riverine habitat connectivity, and improved habitat quality, the effect of the Proposed Action on macroinvertebrates would be beneficial in the long term.

New Information

Hydrology

Hydrology Changes without KBRA as a Connected Action:
The EIS/EIR evaluated and analyzed the potential environmental impacts of the Proposed Action (removal of J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate dams) on multiple Klamath Basin resources. To evaluate impacts to some resources (e.g. aquatic biota, water quality, flood plains, among others), assumptions were made about likely flow conditions before, during, and after dam removal in the EIS/EIR and other technical studies. These studies were completed using flow assumptions based on proposed operations under the Klamath Basin Restoration Agreement (KBRA) (Reclamation 2012) because implementation of this agreement was connected to the Klamath Hydroelectric Settlement Agreement (KHSA), the Proposed Action.

Reclamation's Proposed Action for the 2013 Joint Biological Opinion was developed collaboratively by biologists and hydrologists with NOAA, USFWS, Klamath Basin Tribes, and Reclamation, and it is currently the standard to which the project operates. The flows under this 2013 Joint Biological Opinion are different from the KBRA Flows. This section of the SIR describes the relatively small flow differences between KBRA and 2013 Joint Biological Opinion flows, and how these flow differences do not alter major conclusions drawn in the EIS/EIR regarding environmental impacts of the Proposed Action on several resources that are closely tied to hydrology, such as fish health, sediment transport and effects on fish, water quality, and flood impacts.

KBRA and 2013 Joint Biological Opinion flows are nearly identical when examined on an average annual basis, with flows below Iron Gate Dam averaging about 1,920 and 1,932 cubic feet per second (cfs), respectively. Similarly, KBRA and 2013 Joint Biological Opinion average annual flows are nearly identical below Keno Dam, averaging about 1,413 and 1,434 cfs, respectively. While on an average basis the flows above and below the Hydroelectric Reach are within two percent of each other, average monthly flows do differ between KBRA and 2013 Joint Biological Opinion, as seen in Tables 1 and 2. The most prominent difference is that the 2013 Joint Biological Opinion requires greater flows in the fall months (October through December) and allows lesser flows in the summer months (June through August) in many years when compared to KBRA Flows, but particularly during wetter-than-average years. Below Iron Gate Dam, 2013 Joint Biological Opinion fall flows average about 216 cfs more than KBRA

Flows; 2013 Joint Biological Opinion summer flows average about 114 cfs less than KBRA Flows (Table 1). These seasonal differences in 2013 Joint Biological Opinion versus KBRA Flows reflect the joint goal of NMFS and USFWS to collectively protect ESA fish that rely on a shared and finite aquatic resource (most notably two endangered sucker species in Upper Klamath Lake and threatened Coho Salmon in the Klamath River below Iron Gate Dam).

Figures 1 and 2 show the monthly flow exceedances for the 2013 Joint Biological Opinion and KBRA Flows below Iron Gate Dam and Keno Dam, respectively. Monthly flow exceedance plots are particularly useful for comparing differences between 2013 Joint Biological Opinion and KBRA monthly flows for different year types (e.g. wet, median, and dry years). For example, the first panel in Figure 1 shows that October 2013 Joint Biological Opinion flows are always 150 to 400 cfs greater than KBRA Flows below Iron Gate Dam, regardless of whether it is a wet year (e.g. flow 10 percent exceedance), a median year (50 percent exceedance), or a dry year (e.g. 90 percent exceedance). These figures allow one to analyze whether the assumption of KBRA Flows versus 2013 Joint Biological Opinion flows would affect conclusions in the EIS/EIR regarding the environmental effects of the Proposed Action.

Suspended Sediment Concentrations and Effects on Fish:
The Detailed Plan for dam removal (Reclamation 2011a) assumes that the release of sediment to the Klamath River from the three larger reservoirs (J.C. Boyle, Copco, and Iron Gate) would be initiated on or soon after January 1, 2020 by regulated releases from available gated spillways, powerhouse bypass facilities, and modified low-level outlets, in order to draw down the reservoirs in a controlled manner. Facilities Removal as defined by the KHSA to produce a free-flowing river at all four facilities would be completed prior to December 31, 2020. Drawdown of the three largest reservoirs would be completed in March 2020 (Reclamation 2011a).

Based on a sediment transport model (Reclamation 2012), which assumes KBRA Flows, the largest loads and concentrations of suspended sediment will erode downstream from January through March 2020, but significant loads and high concentrations of suspended sediment would continue through May (Figure 8). Suspended sediment concentrations would peak at about 7,000 to 14,000 mg/L during drawdown, depending on water year type (Table 6). By late spring 2020, however, the sediment transport model predicts that suspended sediment concentrations would be approaching 100 mg/L below Iron Gate Dam (Figure 5) regardless of whether drawdown occurred in a wet, median, or dry year (Reclamation 2012). Because KBRA and 2013 Joint Biological Opinion flows for January through May are nearly identical for all water year types below Keno and Iron Gate dams (generally within a few percent for the 5-month period -- see monthly exceedance Figures 6 and 7), it is reasonable to conclude that the sediment transport model would produce nearly identical suspended sediment concentrations for this January through May time period if it were run with 2013 Joint Biological Opinion flows. Small differences in flows would have negligible impacts on suspended sediment concentrations. It is also reasonable to conclude that the predicted mortality of fish due to the release of high concentrations of suspended sediment (Stillwater 2011), regardless of whether 2013 Joint

Biological Opinion or KBRA Flows were assumed in the sediment transport modeling, would be the same and would remain a significant adverse impact of the Proposed Action.

An Opinion of Probable Construction Cost (OPCC) (CDM 2011b) for a reservoir dredging operation to reduce impacts of released sediment on fish from the Proposed Action would result in an estimated cost of $165 million (in 2020 dollars), after including estimated costs for engineering design, construction oversight, site restoration, among other costs. Reductions in basin-wide fish mortality associated with dredging would be relatively small, remaining unchanged at 8 percent for fall-run adult Chinook, decreasing from 3 percent to negligible for juvenile coho salmon, remaining unchanged for adult steelhead at 14 percent, and decreasing from 14 percent to 9 percent for juvenile steelhead. Mortality of the other life stages of Chinook and coho salmon are less than one percent and would not be influenced by sediment dredging. Based on a number of factors, including the relatively small reductions in mortality of fish, the land disturbance that would occur for sediment containment structures, the potential disturbance of cultural resources, and the high cost of the dredging operation, dredging reservoir bottom sediments prior to dam removal was deemed infeasible for protection of fish (Lynch 2011).

In lieu of dredging, mitigation measures were identified in the EIS/EIR to minimize effects to fish from sediment release associated with the Proposed Action that would be more cost effective. EIS/EIR mitigation measures AR-1 (protection of mainstem spawning), AR-2 (protection of outmigrating juveniles), AR-3 (fall flow pulses), and AR-4 (hatchery management) would minimize adverse impacts of the Proposed Action to fish species. These mitigation measures, however, would not make these adverse impacts less than significant in the short term for coho salmon, steelhead, Pacific lamprey, and green sturgeon.

Disease

Since the publication of the Klamath Facilities Removal EIS/EIR, the USFWS has completed additional monitoring and analyses to evaluate late-summer/early-fall augmentation flows and their efficacy in minimizing risk of an adult fish die-off such as the one that occurred in 2002. The September 2002 adult fish die-off is the most widely known fish health event in the Klamath Basin. Minimum estimates of lower river fish mortalities include 32,533 fall Chinook Salmon, 629 steelhead, and 344 Coho Salmon (Guillen 2003a). Flows leading up to the 2002 fish kill event were historically low, ranging from about 1,900 to 2,020 cfs in the lower Klamath River, including about 760 cfs being released from Iron Gate Dam (Guillen 2003b; Belchik et al. 2004). The USFWS (Guillen 2003b) concluded:

> *Low river discharges apparently did not provide suitable attraction flows for migrating adult salmon, resulting in large numbers of fish congregating in the warm waters of the lower River. The high density of fish, low discharges, warm water temperatures, and possible extended residence time of salmon created optimal conditions for parasite proliferation and precipitated an epizootic of Ich and columnaris.*

Turek et al. (2004) reported that "At least 33,000 adult salmon died during mid to late September 2002 in the lower 36 miles of river" and further stated that "*The total fish-kill estimate of 34,056 fish was conservative and DFG analyses indicate actual losses may have been double that number*" and that estimates from the USFWS mortality report "*should be viewed as a minimum number of fish killed*", as described by Guillen (2003a). While mortality of adult salmon was significant in 2002, the population level effects from a relatively rare epizootic Ich (*Ichthyophthirius multifiliis)* and columnaris (*Flavobacterium columnare)* event such as the 2002 Klamath fish kill are much less than the disease losses of juvenile fish from myxozoan parasites like *C. shasta* that occur annually in the Klamath River (Klamath Facilities Removal Final EIS/EIR 2012).

Following the 2002 epizootic, Reclamation has augmented late-summer/early-fall flows in the Trinity and lower Klamath River with cold-water flow releases from Lewiston Dam on the Trinity River (USFWS and YTFP 2015) to reduce the risk of another major fish kill. Supplemental fall flow releases from Lewiston Dam were implemented in 2003, 2004, 2012, 2013, 2014, and 2015 and from Iron Gate Dam on the Klamath River in 2014 (Magneson and Chamberlain 2015). There are several intended benefits of these augmented flow releases, including decreasing water temperatures in the lower Klamath River, flushing non-encysted and free-swimming forms of the parasite from the hosts and the system, diluting parasite concentrations, eliminating thermal barriers to upstream fish migration, and decreasing densities and residence time of adult salmon by dispersing fish (USFWS and NMFS 2013; USFWS and YTFP 2015).

While a major adult fish kill has not occurred since 2002, a large-scale outbreak of Ich in Chinook occurred in 2014 (Belchik 2015), and to a much lesser degree in 2015 (YTFP 2015). In September and early October 2014, high prevalence and severity of adult fall-run Chinook Ich infections prompted supplemental fall flow releases reported to have improved fish habitat conditions and aid in preventing an adult salmon fish die-off (Belchik 2015). In late summer/fall 2015, a low prevalence and severity of Ich infection was documented in adult upstream migrant salmon and steelhead (YTFP 2015), and in resident speckled dace (*Rhinichthys osculus*) in the Lower Klamath River (Foott et al. 2015). Foott et al. (2015) hypothesized that high densities of resident fish exhibiting a low prevalence of Ich infection could be the source of Ich parasites infecting adult salmon and steelhead returns to the Klamath River. While endemic to the Klamath Basin, epizootic outbreaks of Ich can occur when presented with conditions such as those previously described and that were documented leading up to and during the 2002 Klamath fish die off.

While it is not possible to define the extent that the past preventative and emergency flow augmentation releases from Lewiston Dam have prevented fish kills, they have resulted in significant reductions in water temperatures in the lower Klamath River, albeit delayed due to travel time (Figure 11; Zedonis 2004; Zedonis 2005; Magneson 2013; Magneson 2014; Magneson 2015; Magneson and Chamberlain 2015). Augmented flow releases from Lewiston Dam on the Trinity and Klamath Rivers in 2014 and 2015 were also documented to disperse

large congregations of adult salmonids that had been holding for extended periods of time in thermal refugia of the lower Klamath River (USFWS 2015; Belchik 2015). A key benefit of flow augmentation from Lewiston Dam is a reduction of water temperatures in the lower Klamath River, which functions to minimize or eliminate thermal migration barriers and reinitiate upstream migration behaviors of adult fish. This, in turn, lessens the already extended residence time of adult fish holding in thermal refugia and positively disrupts conditions conducive to fish-to-fish and fish-to-substrate-to-fish disease transmission and associated fish kills (e.g., Ich transmissions).

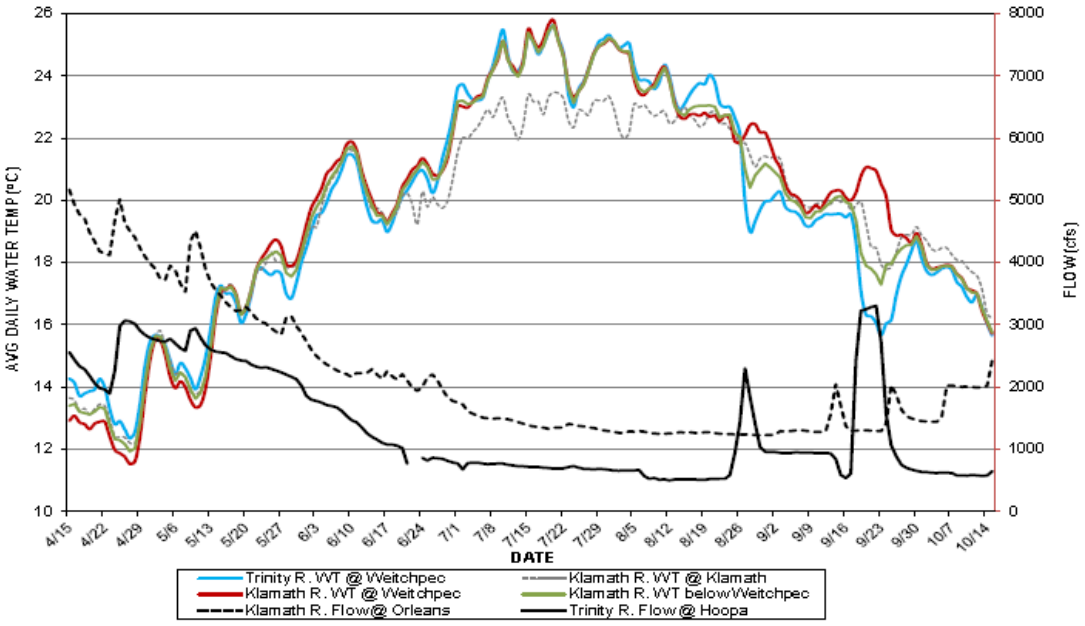

Figure 11. Comparison of water temperatures of the Trinity River at Weitchpec (rkm 0.1) and the Klamath River above (rkm 70.2) and below (rkm 62.0 and rkm 13.0) the confluence of the Trinity River relative to stream flow in 2014. Augmented flow releases from Lewiston Dam occurred from August 23 to September 14 (Reclamation 2014a) and from September 16 to 23, 2014 (Reclamation 2014b) and from Iron Gate Dam October 4 to 15, 2014 (Reclamation 2014c) (taken from Magneson and Chamberlain 2015).

Since planning for the initial fall flow augmentation release from Lewiston Dam in 2003, Reclamation has continued to seek input from fish health experts and basin science partners to refine measures for protecting salmonids in the lower Klamath River (Reclamation 2015). Reclamation is currently developing a long-term plan for protecting late summer adult salmon in the lower Klamath River. This plan will include triggers to guide implementation of preventative and emergency flow augmentation releases from Lewiston Dam in future years, with a goal of reducing the risk of an adult fish kill in the Trinity and lower Klamath rivers. As such, the positive results of past late-summer early fall flow augmentations and the development of a long-term plan to guide future supplemental flow augmentations provide additional support

for a reduction in the risk of an adult salmonid fish kill. The anticipated benefits of augmented flow releases, when conditions indicate a need for them, leads to better conditions in the lower Klamath River than originally considered in the EIS/EIR.

Comparisons of river flows at Iron Gate Dam with modelled values anticipated under KBRA and the 2013 Biological Opinion show them to be similar. California Department of Fish and Wildlife (Turek et al. 2004) concurred with the findings of the USFWS's and Yurok Tribe's reports on the causative factors of the 2002 Klamath fish kill, adding that, "*flow is the only controllable factor and tool available in the Klamath Basin… to manage risks against future epizootics and major adult fish kills.*" With regard to flows in the Klamath River, the 2013 Joint Biological Opinion (NMFS and USFWS 2013a) established minimum flow release requirements from Iron Gate Dam of 900, and 1000 cfs for August and September. These minimum flow values are similar to the ecological base flow values as defined by Hardy (880 cfs August and 970 cfs September) and to the Alt X Yurok (WRIMS R-32 Refuge) Iron Gate flow targets established for a 90% exceedance (895 cfs August and 1010 cfs September) that were incorporated into the hydrology model that was foundational to the flow simulations presented in the KBRA (Hetrick et al. 2009). Note, however, that the Alt-X flow targets reported in the hydrology section of the KBRA are recommendations only, and that modelled flow outputs for August and September in extreme drought years under the KBRA were lower than the targets and the 2013 Biological Opinion minimum values.

We do not anticipate any increased risk of adult fish die-off events given similarities in the anticipated flows below Iron Gate Dam between those presented in the KBRA and those identified in the 2013 Joint Biological Opinion. Improvements in water quality that would result from removal of the Four Facilities as previously described, are predicted to reduce the stress experienced by staging and upstream migrant pre-spawn adults. In addition, flow management described in the 2013 Joint Biological Opinion incorporates real time daily flow variability that is based on natural hydrologic conditions present in the upper basin. The resulting daily fluctuations in flow that respond to seasonal climatic changes and weather events are anticipated to positively influence the pattern of upstream migration of fish holding and moving in response to the ascending and descending limbs of the hydrograph under which the species evolved.

Species Specific Effects

Fall Run Chinook Salmon

Since the 2012 Klamath Facilities Removal EIS/EIR, there are now published recommendations for salmon restoration given the reality of a changing climate. The authors' conclusions are that restoring connectivity between cold-water tributaries and main stem habitats via fishways or barrier removals should be one of the highest restoration priorities (Beechie, Imaki et al. 2013).

In 2014, an assessment method was published to examine the relationship between proposed dam removals and salmonid conservation benefits. About half the dams evaluated had scores

indicating at least moderate benefits. For the Klamath River, scores indicated that removal of the four dams is warranted for salmonid conservation (Quinones, Grantham et al. 2014).

There have been a number of recently published (Anderson, Pess et al. 2013; Burton, Lowe et al. 2013; Engle, Skalicky et al. 2013; Weigel et al. 2013; Pess, T. P. Quinn et al. 2014; Anderson, Faulds et al. 2015; Hatten, Batt et al. 2015; Allen, Engle et al. 2016) and unpublished reports (McHenry, Pess et al. 2015; Moses, McMillan et al. 2015) of anadromous fish response to dam or barrier removals in the Pacific Northwest. All of these have reported a positive response of salmon populations following dam or barrier removals. In one case, redds upstream from the former dam site initially made up ~10 percent of the Chinook salmon observations but they declined to zero percent. At the same time spawning habitat below the former dam site increased 46 percent (Hatten et al. 2015). In particular, the response of populations to the removal of two dams on the Elwha River, in Washington State, has been monitored closely. In all years following the removal of Elwha Dam in 2012, surveyors found the majority of Chinook salmon redds in the river upstream from the former dam site (McHenry, Pess et al. 2015).

On the Elwha River, despite the exposure of 21 ± 3 million m^3 (~30 million tonnes) of stored reservoir sediment due to the removal of Elwha dams between 2011 and 2014 (Warrick, Bountry et al. 2015), by 2014 and 2015 smolt outmigration of Chinook salmon for the river recovered quickly and was estimated to be within the range of the pre-dam removal period (2006-2011) (McHenry, Elofson et al. 2015) (George Pess, personal communication March 2016). In addition to the erosion of sediment particles, dam removal added woody debris, ranging from millimeter-size particles to old-growth trees and stumps, to fluvial and coastal landforms during the dam removals. The volume of sediment stored behind the Elwha Dams was significantly greater than the approximately 11.5 million m^3 that is expected to be stored by the dams in the hydroelectric reach of the Klamath River if they are removed in 2020 (Reclamation 2012). Comparisons with other Pacific Northwest dam removals suggest that these steep, high-energy rivers have enough stream power to export the vast majority of the reservoir sediment out of the river system in only months to a few years (Warrick, Bountry et al. 2015).

In 2014 a comprehensive summary of anadromous fish recolonization following dam or barrier removals was published. The authors concluded that salmon and other anadromous fishes have the capacity to rapidly re-colonize newly available habitats, though the life history patterns of each species, the proximity to source populations in the same or nearby river systems, and the diversity of habitats available may control the patterns and rates of colonization. The authors found that salmon populations generally increased to self-replacing levels (usually without active reintroduction) within 5 and 30 years with most populations responding between 10 and 20 years once fish passage was restored (Figure 12). Colonizing salmon populations often showed an exponential growth phase of ~ 18 to 100 percent per generation (Pess, T. P. Quinn et al. 2014). During this exponential growth phase the estimated annual rate of increase after barrier removal for Chinook salmon was ~1.6 or 60 percent/year (Pess, T. P. Quinn et al. 2014).

For the Klamath River, an update of the historical record of salmon upstream from the current location Iron Gate Dam confirms the conclusions of the EIS/EIR that Chinook salmon runs were abundant, as well as seasonally diverse, and likely consisted of various life histories (Hamilton, Rondorf et al. In Press).

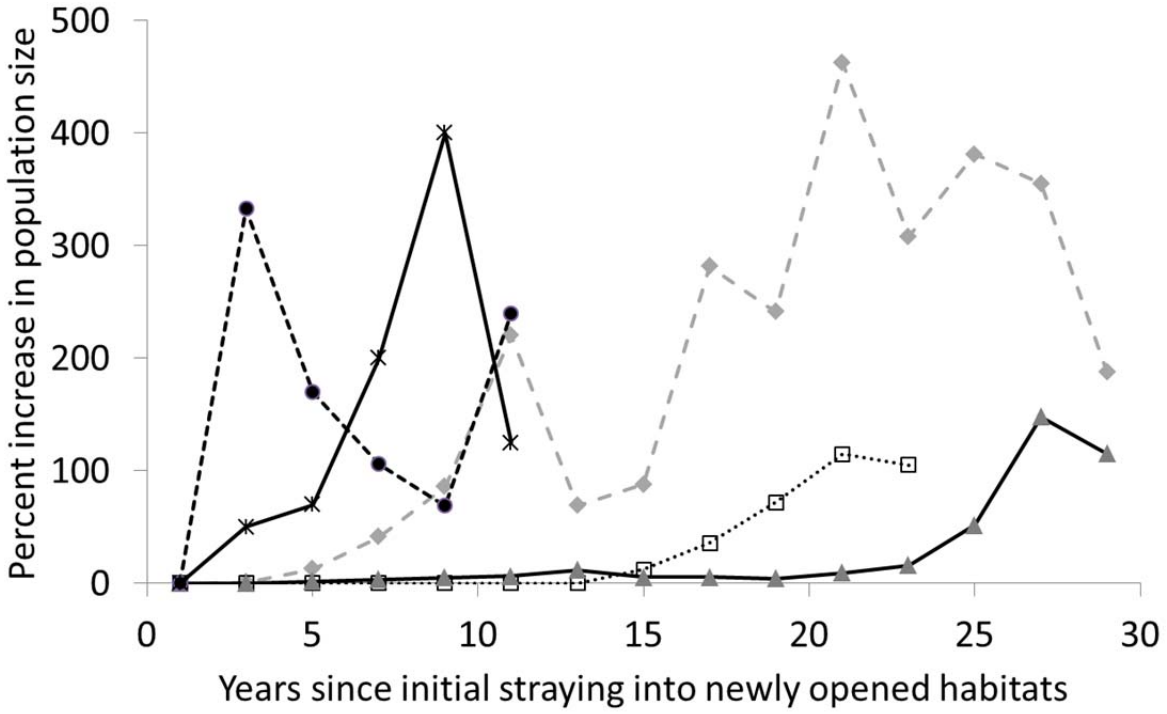

Figure 12. Percent increase in population size of several salmon populations over time along the Eastern Pacific Rim. Sold black dots with hashed black line represent Cedar River, Washington State Coho Salmon (Kiffney, Pess et al. 2008). Solid black line with stars represent Cedar River, Washington State Chinook salmon (Kiffney, Pess et al. 2008). Solid grey diamonds with grey hashed line represent Fraser River, British Columbia pink salmon (Pess, Hilborn et al. 2012). Open dark squares dark hashed line represent Glacier Bay, AK pink salmon (Milner, Fastie CL et al. 2007). Solid grey triangles with solid black line represent percent increase in South Fork Skykomish pink salmon above Sunset falls, Washington State. Population size of the Cedar Coho and Chinook salmon is 100s; 100,000s for Fraser River pink salmon; 10,000s for South Fork Skykomish pink salmon, and 1,000s for Glacier Bay, AK pink salmon (Figure from Pess, T. P. Quinn et al. (2014)).

For the Klamath River Klamath Facilities Removal, the Evaluation of Dam Removal and Restoration of Anadromy (EDRRA) model projected impacts for Chinook salmon associated with dam removal for the 2012 EIS/EIR. There were no EDRRA model runs for Chinook

salmon productivity and harvest that compare the effects of dam removal with KBRA to the effects of dam removal without any elements of KBRA (e.g. habitat restoration and an active salmon reintroduction plan). However the modeler was asked to quantify the effects of dam removal without the KBRA improvements in productivity for Alternative 2, but with the effects of KBRA hydrology remaining (Hendrix 2012, see Appendix B). The results of this projection were that dam removal alone, after the direct effects of an active reintroduction program ended in 2032, still showed significant increases in Chinook productivity (71 percent), tribal harvest (46 percent), and ocean commercial/recreational harvests (39 percent) for the modeled years of 2033 to 2061. The Hendrix analysis was completed after the Chinook Expert Panel completed their review and was therefore unavailable to the panel.

Active reintroduction and Mitigation Measure AR-1 (Protection of Mainstem Spawning), would accelerate occupation of habitat opened by dam removal. However, while the Oregon Department of Fish and Wildlife indicates that Oregon would implement the reintroduction actions that would have been included in the KBRA Phase I Restoration and Reintroduction plan, as resources become available for these activities (T. Wise, pers. comm. February 4, 2016), given some uncertainties, active reintroduction upstream from Upper Klamath Lake may be more limited than projected in the EDRRA model runs.

Following dam removal seasonal trap and haul operations, primarily for fall-run Chinook salmon may occur around Keno Dam and Keno Impoundment/Lake Ewauna until water quality conditions are sufficiently improved to allow for year round passage. A variety of release and rearing strategies could be utilized to optimize success. However, if salmon reintroduction efforts occur at a lower intensity than envisioned under KBRA, it would likely take longer to achieve the increases in Chinook productivity and harvest projected by the EDRRA model runs and the 2012 Klamath Facilities Removal EIS/EIR.

For the Klamath River, the 2013 BO would mean that effects downstream from Iron Gate Dam would likely increase production of Chinook salmon due to more favorable flows and improved habitat condition. In particular, these alternatives would also improve survival of smolts emigrating from downstream tributaries, such as the Scott and Shasta rivers, due to improved Klamath River flows and disease conditions. Restoration of runs in these two tributaries is the goal of extensive restoration programs and investment.

The new published information on Fall run Chinook Salmon remains consistent with the long term impact disclosures of the Klamath Facilities Removal EIS/EIR, which indicates that dam removal would be beneficial.

Spring Run Chinook Salmon
Since the publication of the Klamath Facilities Removal EIS/EIR, much of the new information on Fall run Chinook salmon would also apply to spring run Chinook. One account has been published that is specific to the response of Spring run Chinook to dam removal. After dam removal on the White Salmon River in Washington State, Spring run Chinook Salmon spawning surveys indicated a positive trend for the river, with more than two times as many spawning in 2014 as in 2013 (the first year of surveys) (Allen, Engle et al 2016).

Another recent publication found that the timing of Klamath–Trinity spring-run Chinook salmon tended to prevent fish exposure to adversely high river temperatures and demonstrated the unexpected ability of adult Chinook salmon to migrate successfully through surprisingly warm temperatures and endure acute thermal stress if sufficiently large volumes of cold water await them at their destination (Strange 2012).

Since the publication of the Klamath Facilities Removal EIS/EIR, the update of the historical record of salmon upstream from the current location Iron Gate Dam confirms the conclusions of the EIS/EIR that runs were abundant, as well as seasonally diverse, and likely consisted of various salmon life histories, including Spring run Chinook salmon (Hamilton, Rondorf et al. In Press).

The new published information on Spring run Chinook Salmon remains consistent with the impact disclosures of the Klamath Facilities Removal EIS/EIR, which indicates that dam removal would be beneficial in the long term.

Steelhead
Since the publication of the Klamath Facilities Removal EIS/EIR, there has been one published study of barrier removal devoted only to effects to steelhead. In this study on Beaver Creek, in Washington State, steelhead migrated into the study area during the first spawning season after passage was established. Parr that were tagged in the stream returned as adults, indicating establishment of the anadromous life history. Colonization and expansion of steelhead occurred more slowly than expected due to the low number of wild adults migrating into the study area (Weigel, Connolly et al 2013). On the White Salmon River, also in Washington State, after the removal of Condit Dam steelhead have recolonized into expected tributaries and mainstem reaches, but the extent and source of the recolonizing fish remains unknown until biologists are able to conduct additional surveys

In an unpublished report for the Elwha River, in 2014-2015 naturally colonizing winter run steelhead were documented in the mainstem and tributaries upstream from the former of Elwha and Glines Canyon Dam sites (McMillan et al 2015). In 2015, surveyors observed summer run steelhead for the first time since the 2012 dam removal, indicating the beginning of this life history strategy (George Pess, personal communication March 2016).

The information on steelhead remains consistent with the impact disclosures of the Klamath Facilities Removal EIS/EIR, which indicate that dam removal would be beneficial in the long term.

Lamprey

Since the publication of the Klamath Facilities Removal EIS/EIR, the USFWS has completed a Regional Implementation Plan for Measures to Conserve Pacific Lamprey (*Entosphenus tridentatus*) in California and the Klamath River Watershed (Plan)(Goodman and Reid 2015). While there remains some uncertainty about the historical extent of Pacific lamprey in the upper Klamath Watershed, the Plan concludes that removal of the dams and restoration of natural hydrologic flow regimes to the Klamath River would have a great positive influence on Pacific Lamprey in the upper Klamath River drainage (Goodman and Reid 2015). The analysis in the Klamath Facilities Removal EIS/EIR indicated that the effect of opening significant portions of the Klamath River to anadromous fish species such as Pacific Lamprey would be beneficial. The new information is consistent with the analysis in the Klamath Facilities Removal EIS/EIR that increasing the range of the Pacific Lamprey would be positive and long term impacts would be beneficial.

Green Sturgeon (Northern DPS)

In 2014 the NMFS completed an informal status review (Doukakis 2014) for the Northern DPS of green sturgeon (*Acipenser medirostris*) to assess whether its current status on the NMFS Species of Concern List is still appropriate. The information presented in the review indicated that Northern DPS green sturgeon should remain a Species of Concern based on data about their abundance and productivity, distribution, and threats. Current potential threats to Northern DPS green sturgeon include water and land-use management practices, chemical applications, and climate change. Understanding of the species status and biology has increased substantially and threats to the population, such as fisheries harvest have been reduced. However, the limited geographic occupancy during some life stages, remaining uncertainty about abundance, and persistent threats indicate that a Species of Concern classification is still warranted. The information provided in the status review is consistent with the information contained in the Klamath Facilities Removal EIS/EIR and does not provide any new information that would change the outcome of the analysis of impacts to this species described in the Klamath Facilities Removal EIS/EIR.

Redband Trout

Since the publication of the Klamath Facilities Removal EIS/EIR**,** we have found little new information on Redband trout. Riparian corridor improvements and protections would remain under the dams out proposed action, impacts would be consistent with the EIS/EIR and would be beneficial in the long term for redband trout.

Introduced Resident Species
The information on Introduced Resident Species remains consistent with the impact disclosures of the Klamath Facilities Removal EIS/EIR, which indicates that dam removal would decrease opportunities for recreational fishing for these species.

Interactions Among Species
Since the publication of the Klamath Facilities Removal EIS/EIR, researchers investigated competitive interactions in laboratory streams to determine the potential for competition in reaches of the Elwha River after dam removal between coho salmon and non-native brook trout. Coho salmon were competitively dominant over brook trout regardless of size difference or group size, and will likely outcompete brook trout in the wild if resources become limited (Thornton 2015).

Our review herein remains consistent with the impact disclosures of the Klamath Facilities Removal EIS/EIR, which indicates that dam removal would be beneficial in the long term.

Freshwater Mussels
The information on Freshwater Mussels remains consistent with the impact disclosures of the Klamath Facilities Removal EIS/EIR, which indicates that dam removal would have beneficial effects in the long term.

Benthic Macroinvertebrates
The information on benthic macroinvertebrates remains consistent with the impact disclosures of the Klamath Facilities Removal EIS/EIR, which indicates that dam removal would have beneficial effects in the long term.

Listed Species

Coho salmon
The NMFS published the Final Recovery Plan for the Southern Oregon/Northern California Coast Evolutionarily Significant Unit of Coho Salmon (*Oncorhynchus kisutch*) in 2014. The Recovery plan identifies reasonable actions that may be necessary for the conservation and survival of SONCC (Southern Oregon Northern California Coast) coho salmon based upon the best scientific and commercial data available at the time. For the Upper Klamath River population unit the key limiting stresses to the recovery of SONCC coho salmon include barriers, altered hydrologic function and impaired water quality associated with the hydroelectric facilities on the main stem Klamath River. The loss of approximately 76 miles of habitat upstream of Iron Gate Dam, much of which is high quality spawning and rearing habitat, severely limits the spatial structure and natural productivity of the population. The operation of the Klamath Project and hydroelectric project has led to additional limiting stresses related to the loss of flow variability and impaired water quality. The findings and recommendations in the Recovery Plan are consistent with the findings in the Final EIS/EIR.

On October 21, 2014, NMFS issued a Scientific Research and Enhancement Permit under Section 10(a)(1)(A) of the Endangered Species Act to the California Department of Fish and Wildlife for implementation of a Hatchery and Genetic Management Plan (HGMP) for the SONCC coho salmon program at Iron Gate Hatchery (IGH). The HGMP covers activities related to the artificial production of coho salmon at IGH for the period 2014-2024. This includes the interim period until mainstem Klamath River dams of the Klamath Hydroelectric Project (Federal Energy Regulatory Commission Project No. 2082) are anticipated to be removed (2020) pursuant to the Klamath Hydroelectric Settlement Agreement (KHSA) and a new HGMP would be developed for any new or revised programs at IGH or other hatchery facilities in the area. The potential removal of Iron Gate Dam would eliminate the current cold-water source for IGH and will likely create a situation in which salmon and steelhead can no longer be produced at this facility. Continuation of artificial production of coho salmon following removal of IGH will depend on whether future studies identified in the KHSA identify a viable alternative source of water. After 2020, it may be necessary to maintain hatchery production elsewhere in the basin. The measures and facilities necessary for ongoing coho salmon production following potential removal of Iron Gate dam are uncertain and the subject of ongoing study the details of which are described under Interim Measure 19 in Appendix D of the KHSA. Therefore, based upon the results of studies under Interim Measure 19 and the development of reintroduction plans by the State of Oregon, the HGMP may be amended in the future to ensure hatchery operations during the term of the HGMP are consistent with the most current plans for species conservation and reintroduction efforts that will benefit SONCC coho salmon under the KHSA.

In an evaluation of the 2012 removal of Elwha Dam, the release of coho salmon upstream from the former dam site was effective in increasing adult coho salmon. Coho salmon were also noted to naturally recolonize upstream tributaries (Moses, McMillan et al. 2015).

Our review herein remains consistent with the impact disclosures of the Klamath Facilities Removal EIS/EIR, which indicates that dam removal would be beneficial in the long-term.

Eulachon

In June of 2013 NMFS released a federal recovery plan outline (outline) for southern DPS of Pacific eulachon. The outline is not a regulatory document and is intended primarily for internal use by NMFS as a pre-planning document. The outline is meant to serve as interim guidance for recovery efforts and recovery planning for the southern DPS of Pacific eulachon until a full recovery plan is developed. The major threats to eulachon recovery that are described in the outline are climate change related impacts to ocean and freshwater habitats, vulnerability to by-catch, dams and water diversions, and predation. In July of 2013 NMFS posted a Federal Register Notice of Intent to prepare a recovery plan for the southern DPS of Pacific eulachon and requested additional information to help inform development of the recovery plan (Federal Register Vol. 78, No. 1128, 40104). A public draft of the recovery plan is anticipated to be released by NMFS for review in the spring of 2016.

In October of 2015 the Northwest Power and Conservation Council hosted a science/policy forum focused on the current state of scientific knowledge on the biology and biological requirements of Pacific eulachon including abundance and productivity, spatial distribution, genetic characteristics, and life history diversity (Anchor QEA, LLC 2015). The findings would help identify key information gaps necessary to help develop research and monitoring actions that may be incorporated into the draft recovery plan currently being written by NMFS. Although most of the information presented was focused on populations in Oregon and Washington, some new information was presented for the Klamath River by Mr. Robert Anderson of the Yurok Tribal Fisheries Department. The Yurok Tribe began sampling for adult and juvenile eulachon through a Protected Species Conservation and Recovery Grant Program to Tribes and observed seven adult eulachon in 2011. Adult eulachon numbers have increased since, with a collection of 40 adults in 2012, 112 in 2013, and approximately 1,000 in 2014.

The state of knowledge for the Southern DPS of Pacific eulachon has not changed appreciably from the description and analysis of environmental effects findings presented in the Klamath Facilities Removal EIS/EIR.

Green Sturgeon (Southern DPS)

The Southern DPS of North American green sturgeon is listed as a threatened species, and includes all green sturgeon spawning populations south of the Eel River, with the only known spawning population being in the Sacramento River (71 FR 17757; April 7, 2006). Sub-adult and adult southern DPS of North American green sturgeon enter coastal bays and estuaries north of San Francisco Bay, California, during the summer months to forage (Lindley et al. 2008). As described in the Klamath Facilities Removal EIS/EIR, the southern DPS of North American green sturgeon's potential occurrence in the lower Klamath River is limited to only the sub-adult and adult life stages, only during the summer and fall, and only in the Klamath River estuary.

The new published information on green sturgeon remains consistent with the impact disclosures of the Klamath Facilities Removal EIS/EIR, which indicates that dam removal would be less-than-significant in the long term.

Bull Trout

Since the publication of the Klamath Facilities Removal EIS/EIR, the Klamath Recovery Unit Implementation Plan for Bull Trout has been finalized (USFWS 2015). A Conservation Recommendation in this plan is: *"Support actions to reintroduce anadromous species. Anadromous species, such as Chinook salmon and steelhead, were historically present in the upper Klamath River basin and their reintroduction would support bull trout recovery by increasing prey base and providing marine derived nutrients. Feasibility of restoration of spawning Chinook salmon and steelhead populations should be evaluated and implemented where feasible and biologically supportable."*

Based on this analysis and information, we conclude that the effects to bull trout would be revised to beneficial, rather than less-than-significant, in both the short term and long term.

Lost River and Shortnose Suckers
Since the publication of the Klamath Facilities Removal EIS/EIR, the USFWS has designated Critical Habitat (CH) for Lost River and shortnose suckers (USFWS 2012). Because Sucker CH had been proposed again by the USFWS, but not yet finalized when the Klamath Facilities Removal EIS/EIR was published, CH was not formally addressed in the Klamath Facilities Removal EIS/EIR. However, the Klamath Facilities Removal EIS/EIR disclosure was consistent with habitat already established for suckers and habitat now in the finalized designation.

Critical Habitat designation did not affect populations in Project Reservoirs proposed for removal. While dam removal would result in the loss of limited habitat for suckers in the Project reservoirs, these populations do not contribute to recovery of the species (USFWS 2006).

Given the reduction in abundance within the reservoirs, dam removal would have significant effects in the short term. However, Mitigation Measure AR-6 could be implemented to reduce the impact to individuals within reservoirs by rescuing fish prior to reservoir drawdown. Based on small numbers of individuals affected after mitigation the effect of dam removal would be consistent with the impact disclosures of the Klamath Facilities Removal EIS/EIR, and remain less-than-significant after mitigation for shortnose and Lost River suckers in the short term.

In the long term, with our analysis of effects of dam removal now limited to the Hydroelectric Reach, our conclusion regarding dam removal effects for suckers would be revised to no-effect.

Conclusions
Our conclusions on the dam removal proposed action (Alternative 2: Full Facilities Removal of Four Dams) are based upon new information and analyses since the publication of the Klamath Facilities Removal EIS/EIR.

For bull trout, new information in the USFWS Klamath Recovery Unit Implementation Plan indicates that effects of dam removal for bull trout would be beneficial, rather than less-than-significant, for bull trout in both the short term and long term.

For Lost River and shortnose suckers, the effects in the short term are consistent with those analyzed in the EIS/EIR, and would remain significant, but mitigatable (Mitigation Measure AR-6, Sucker Rescue and Relocation). In the long term, based on new information, including the USFWS' recent designation of CH for Lost River and shortnose suckers, and with our analysis of effects of dam removal now limited to the Hydroelectric Reach, our conclusion regarding dam removal would have no effect on suckers.

Our conclusions for Alternative 2: Full Facilities Removal of Four Dams would be consistent with the Klamath Facilities Removal EIS/EIR and there is no change relevant to environmental concerns.

3.3.3 Algae

Environmental Setting

This section of the EIS/EIR analyzed potential effects of the Proposed Action on algal communities (phytoplankton and periphyton) in the Klamath Basin, excluding the Lost River watershed, Tule Lake watershed, and most of the Trinity River. In the EIS/EIR some areas upstream of the influence of J.C. Boyle Reservoir (e.g. Upper Klamath Lake and its tributaries, and the Klamath River from Link River Dam to J.C. Boyle Reservoir, including the Keno Impoundment/Lake Ewauna), were included because implementation of the connected KBRA Programs could have affected algal communities in these areas. These areas are now excluded in the analysis of the Proposed Action without KBRA because dam removal alone would not affect their periphyton or phytoplankton communities.

The area of analysis includes the Hydroelectric Reach, which extends from the upstream end of J.C. Boyle Reservoir to Iron Gate Dam, including all sections categorized as mainstem, bypass, and peaking reaches. It includes the Lower Klamath River downstream from Iron Gate Dam, through the Klamath Estuary, and including the Pacific Ocean marine nearshore environment. Tributaries to the Klamath River in the Hydroelectric Reach and below Iron Gate Dam are not included in the analysis of the Proposed Action (without KBRA as a connected action) because dam removal alone would not affect these algal communities.

Impacts

Two types of algal communities, phytoplankton and periphyton, are predominant in the Klamath Basin, with peak biomass occurring primarily during summer and fall months. Copco 1 and Iron Gate reservoirs are dominated by phytoplankton, small algae that float in the water column. Particular phytoplankton species (i.e., blue-green algae or cyanobacteria) frequently reach nuisance levels within these reservoirs in the summer and fall, often producing toxins at levels potentially harmful to both humans and animals (Watercourse Engineering, Inc. 2011; Kann 2008; Kann and others 2010). Peak levels of microcystin in Copco 1 and Iron Gate Reservoirs exceeded the California State Water Resources Control Board (SWRCB)/Office of Environmental Health and Hazard Assessment (OEHHA) public health threshold of 8 μg/L (SWRCB et al 2010) by over 1000 times in Copco 1 Reservoir during 2006–2009 and extremely high concentrations (1,000–73,000 μg/L) were measured during summer algal blooms in both Copco 1 and Iron Gate Reservoirs during 2009 (Watercourse Engineering, Inc. 2011).

In addition, there are portions of the Klamath River below Iron Gate Dam (e.g., backwater eddies and near shore shallows) that regularly accumulate and can become inoculated with phytoplankton from the hydroelectric reservoirs, which can also support nuisance levels of blue-green algae under certain conditions. The riverine portions of the Klamath River are dominated by periphyton (i.e., attached algae), primarily including diatoms, cyanobacteria, and green algae (Asarian et al., 2014; Gillett et al., 2016).

The stable lacustrine environment created by impounding water in the Copco 1 and Iron Gate reservoirs, coupled with warm, high nutrient water from the upper basin in the summer and fall months, provides conditions for phytoplankton growth, including the growth of blue-green algal species, most notably the toxin producing *M. aeruginosa*. While blue-green algae can be found in a variety of environments, these species tend to thrive under warm water temperature, high nutrient, and stable water column conditions where they can out-compete other algal species. Under the Proposed Action, the elimination of these two reservoirs would result in the immediate and long-term reduction in the growth of nuisance, toxin producing phytoplankton blooms, which would be beneficial to the environment and would substantially reduce the risk to human health of those currently exposed to water in the reservoirs. In addition, elimination of these two reservoirs would reduce or eliminate the transport of nuisance phytoplankton blooms and their associated toxins (e.g. microcystin) into the Klamath River below Iron Gate Dam and into the Klamath Estuary, which would also be beneficial.

Under the Proposed Action, conversion of the reservoir areas to a free-flowing river, and the elimination of hydropower peaking operations, could cause long-term slight increases in nutrients and increases in low-gradient channel margin habitat available for nuisance periphyton growth in the Hydroelectric Reach downstream from the upper extend of the J.C. Boyle Reservoir, which would be a significant impact. Removing the reservoirs and creating a free-flowing river that is no longer conducive to the growth of phytoplankton would likely return these river reaches to periphyton-dominated algal communities similar to what likely existed prior to the construction of dams in the Hydroelectric Reach. No mitigation measures were proposed for this impact under the Proposed Action. However, long term reductions in nutrient concentrations in the Klamath River upstream of Keno Dam are anticipated over a period of years as a result of multiple regulatory and restoration processes independent from the Proposed Action. Most notably, continued implementation of the TMDLs in the Lost River and Upper Klamath basins will ultimately reduce periphytic algal accumulations in the free flowing reaches of the Klamath River downstream of Keno Dam following dam removal under the Proposed Action,

Under the Proposed Action, dam removal and conversion of the reservoir areas to a free-flowing river could also cause long-term increases in river nutrient concentrations (primarily nitrogen) and biomass of nuisance periphyton in the Klamath River downstream of Iron Gate Dam, on a seasonal basis. This impact, however, would likely be less than significant because the concentrations of nutrients (nitrogen and phosphorus) are already high enough in the river from Iron Gate Dam (RM 190.1) to approximately Seiad Valley (RM 129.4) (and potentially further downstream) that they do not limit periphyton. Periphyton communities further downstream, and into the Klamath Estuary, are dominated by nitrogen-fixing species because inorganic nitrogen concentrations are relatively low in these reaches due to nutrient uptake by upstream periphyton (including the Hydroelectric Reach) during the summer-fall growing season, and from tributary dilution. Because certain species in these reaches can fix their own nitrogen from the atmosphere, seasonal increases in total nitrogen due to dam removal may alter the assemblage of the periphyton community but they may not significantly increase periphyton

biomass in these lower reaches and the estuary. Only minor seasonal increases in total phosphorus would occur due to dam removal in the lower river and therefore would have little impact on periphyton community biomass.

New Information

Algae and algal toxins in Copco 1 and Iron Gate Reservoirs, and in the Klamath River below Iron Gate Dam, continue to be topics of extensive monitoring and research by the lower basin tribes (Yurok, Karuk, and Hoopa Valley), PacifiCorp, academia, and government agencies, among others. The goal of the majority of this monitoring and research is focused on documenting the current conditions (the algal dynamics with the dams in place); however, this new information offers some insights and reinforces the conclusions in the EIS/EIR regarding how the system would likely change under the Proposed Action of dam removal.

Areas of new (continued) monitoring and research include periphyton growth patterns (temporal and spatial) below Iron Gate Dam (Asarian and others, 2014 and 2015; Gillett and others 2016); ecosystem metabolism of various Klamath River reaches below Iron Gate Dam (Genzoli and others 2015); monitoring the levels of toxic algae and toxins (most notably *M. aeruginosa* and microcystin) within and downstream of Copco 1 and Iron Gate reservoirs (Kann 2014; Kann and Bowman 2012); tracking the source of toxic algae found in the Klamath River below Iron Gate Dam (Otten and others 2015); exploring engineering solutions to reduce the release of algae and associated toxins from Iron Gate dam (Miao and Deas, 2014); and testing the efficacy and feasibility of using algaecides to control toxic algae in isolated areas of Iron Gate and Copco 1 reservoirs (Watercourse Engineering, 2013, 2014, and 2015). Overall, this new information does not change any of the conclusions in the EIS/EIR about the existing ecosystem or environmental impacts under the Proposed Action. It does, however, strengthen conclusions in the EIS/EIR by lengthening the record of similar observations that serious algal problems continue to develop in these two reservoirs (e.g. nuisance blooms of phytoplankton and production of high concentrations of algal toxins in the summer and fall) under current conditions, and that some of the algal biomass and toxins are transported downstream into the Lower Klamath River and its estuary. For example, the reservoirs have now been listed every year since 2008, including 2013-2015, for *M. aeruginosa* and microcystin levels that exceeded California health advisory levels, often by a factor of 100 or more. As a result of this sampling, health advisories for the reservoirs and the Klamath River below Iron Gate Dam were posted in the summer of 2014 and the advisories were not lifted from the two reservoirs until December. During the period of analysis for the original EIS/EIR (2000 to 2012), health advisory postings were common place, and this more recent data shows this trend is continuing.

One new study (Otten and others 2015) used a variety of genetic approaches to assess the connectivity of *Microcystis* populations found throughout the Klamath River. In 2012, samples were collected bi-weekly from 16 sites spanning the entire system, including all five reservoirs and Upper Klamath Lake. The authors concluded: "Overall, *Microcystis* was a minor constituent of the phytoplankton community above Copco and Iron Gate Reservoirs, although it was highly

prolific within these reservoirs and our data indicate that most of these populations originate internally. Spatiotemporal variations in the proportional abundances of a single nucleotide polymorphism was used to fingerprint Iron Gate Reservoir as the source of downriver *Microcystis* assemblages. Throughout the study period, the *Microcystis* populations remained highly toxic, with total microcystin concentrations ranging from 165 mg/L in Copco Reservoir to 3.6 mg/L within the lower estuary (0.8 km from the Pacific Ocean)." These results support the EIS/EIR conclusion that *Microcystis* blooms largely develop internally in Copco 1 and Iron Gate reservoirs and are not primarily imported from upstream sources. These results also support the EIS/EIR conclusion that sources of *Microcystis* in the lower river and estuary primarily originate from the Hydroelectric Reach reservoirs. In short, this 2015 study confirms that dam removal under the Proposed Action would eliminate the two reservoirs in the Hydroelectric Reach that promote the growth of toxic algae, which would greatly reduce the transport of algal toxins in the Klamath River below Iron Gate Dam, reaching at times to the Klamath Estuary.

New studies are also providing insights into the feasibility of controlling algae problems if the dams are left in place. For example, studies have been completed to test the efficacy of using algaecides to reduce algal blooms and toxins in small areas of a reservoir (e.g. a recreational cove) that has been isolated from the main reservoir with a curtain (Watercourse Engineering, 2013, 2014, and 2015). Results show some promise, but further testing is needed to determine its season-long efficacy in these isolated areas. No studies have been done at a reservoir-wide scale for either reservoir. Similarly, there are ongoing studies to assess if an intake barrier on Iron Gate dam can be configured to entrain water from greater depths and thereby reduce the release of algae and algal toxins to the Klamath River below the dam (Miao and Deas 2014). Tests done in 2012 showed some promise, but for less than 24 hours, after which the downstream benefits diminished as changing hydraulics in the vicinity of the intake began to entrain more water near the surface of the reservoir. The results to date suggest more development and testing are needed before a conclusion can be reached about the efficacy of this technology to reduce algae and algal toxin issues downstream of Iron Gate Dam.

Conclusion

An analysis of new information since the publication of the EIS/EIR does not change any of the conclusions regarding the environmental effects of the Proposed Action on algae and algal toxins in the Klamath Basin.

3.3.4 Terrestrial Resources

Environmental Setting

The area of analysis includes vegetation communities and habitats of the Klamath River watershed currently influenced by the presence of the Four Facilities. Both the riparian vegetation communities downstream from these dams and the associated reservoirs upstream are influenced by the presence of the dams and have the potential to be affected by their removal. Thus, the project area extends along the Klamath River from Keno Dam to the Pacific Ocean and includes the river channel and riparian zone. Upland habitats occurring in construction areas are

also included in the area of analysis. This would include areas potentially affected by changes in land use and water supply patterns associated with dam removal.

Impacts

Significant impacts on terrestrial resources would occur if the project resulted in substantial adverse effects, either directly or through habitat modifications, on any special-status terrestrial species, any riparian habitat, federally protected wetlands, on species considered significant to Indian Tribes, caused substantial interference with the movement of any native resident or migratory wildlife species, or caused a substantial adverse effect on natural communities through the introduction or spread of invasive plants.

Dam deconstruction and restoration activities would result in changes to the amount and distribution of habitat types and consequently to the species that depend on them. In addition, removal of the dams would enable salmon and other fish species to migrate upstream to reaches of the Klamath River that are currently inaccessible to them. These salmon would provide nutrient-rich food for terrestrial species, including bald eagles, osprey, and many other species of birds and mammals. These consumers would subsequently deposit these marine-derived nutrients into terrestrial habitats, increasing productivity of riparian vegetation and benefiting terrestrial ecosystems as a whole (Hilderbrand et al 2004, Merz and Moyle 2006, Moore et al 2011).

Following drawdown of the reservoirs to facilitate dam removal, existing upland vegetation is expected to remain unchanged and contribute to successional processes on newly exposed reservoir areas. Wetland-dependent vegetation currently along the margins of the reservoirs is expected to die out and transition to upland communities. Wetland species that occur near confluences would remain unchanged if the hydrology is unaltered, and could expand down to the river channel at reconnected tributaries. Passive restoration of wetland vegetation in areas along the restored river channel is considered feasible, given the densities of viable wetland vegetation seeds that are present in reservoir sediments based on seedbank analysis (Reclamation 2011b). Disturbances associated with construction areas and haul roads where clearing, grading, and staging of equipment would occur would have less than significant impacts on wetlands along reservoirs and river reaches. Long-term impacts to wetlands in the form of the permanent loss of existing wetland habitat along the reservoir fringes is a potentially significant impact that would be mitigated to a less than significant level through the development and implementation of a Compensatory Wetland Mitigation Plan and Clean Water Act Section 404 Permit that would require the development of compensation wetlands that meet or exceed the functions and quality of the wetland habitat lost at the reservoirs.

Active restoration would however be needed for riparian areas. The newly exposed reservoir areas will be re-seeded with various herbaceous species (primarily grasses) following drawdown in the spring. Seeding is expected to occur via aerial application of hydromulch, as access to newly drawn down reservoir areas would be limited. Hydroseeding would occur prior to full drawdown, likely in stages as reservoir sediments are newly exposed, and ultimately covering

the entire area of exposed sediment following drawdown. It would be necessary to hydroseed before the reservoir sediment desiccates so that there is residual soil moisture for seed germination. Following hydroseeding, grasses would quickly germinate and grow on the exposed reservoir surfaces to stabilize the surface of the sediment, minimizing erosion. Riparian restoration activities would include planting of various woody species along the channel margins to stabilize the river banks and provide habitat for fish and other species. Incorporation of impact avoidance measures into project design along with the implementation of mitigation measures including Protocol-level vegetation surveys, sensitive habitat exclusion fencing, construction equipment maintenance, and construction scheduling to avoid sensitive periods, and habitat restoration and substitution would reduce potential impacts from disturbances associated with construction areas and haul roads where clearing, grading, and staging of equipment to a less than significant level. In this document, protocol-level surveys are considered standardized methods approved by the USFWS or other resource agencyfor establishing the presence or absence of special status species. Long-term effects to riparian habitat would be less than significant and would include the generation of approximately 272 acres of riparian wetland habitat in the restored reservoir areas.

Construction would require heavy machinery to move through construction areas, staging areas, and haul roads where special-status invertebrate, amphibian, and reptile species could occur. Contact with construction vehicles could result in direct mortality or injury to special-status invertebrate, amphibian, and reptile species including tailed frog, southern torrent salamander, northern red-legged frog, foothill yellow-legged frog, Siskiyou (Chace) sideband, western toad, western pond turtle, California mountain kingsnake, and common kingsnake. In addition, increased suspended sediment concentrations in the river during reservoir drawdown has the potential to adversely affect or cause mortality to sensitive life stages of amphibians and reptiles occurring in the Lower Klamath River mainstem. Dam demolition, clearing of access and haul roads, upload staging and disposal sites, and restoration activities could also generate impacts on migratory birds, and other special-status species including northern spotted owl, bald eagle, golden eagle, osprey, willow flycatcher, peregrine falcon, and greater sandhill crane, through nest abandonment due to noise and human activity during construction periods. Incorporation of impact avoidance measures into project design along with the implementation of mitigation measures including protocol-level wildlife surveys, sensitive habitat exclusion fencing, construction equipment maintenance, and construction scheduling to avoid sensitive periods, and habitat restoration and substitution would reduce potential impacts to a less than significant level. Long-term effects on special-status invertebrate, amphibian, and reptile species, migratory birds, and other special-status avian species, and other mammals would all be less than significant following the restoration of riparian, grassland and wetland habitat at the former reservoir sites.

New Information

Since the publication of the Klamath Facilities Removal EIS/EIR, a lone male grey wolf and later two adults and five pups (now known as the Shasta Pack) were observed in northern California prompting a petition for and approval of listing of the grey wolf as endangered under the California ESA. Evaluations of potential grey wolf habitat in California identified the

Klamath Mountains as a potential area where wolves might disperse (California Department of Fish and Game 2012). The Shasta Pack is not, however, currently including the Hydroelectric Reach of the Klamath River in its range.

In addition to the listing of the grey wolf as endangered under the California ESA, the Oregon spotted frog was listed as threatened under the federal ESA. The Oregon spotted frog's historical habitat range includes sections of Klamath and Jackson counties in Oregon and Siskiyou County in California (USFWS 2016). The Oregon spotted frog typically inhabits large, warm perennial marshes and is not currently known to exist in Siskiyou County (USFWS 2016). The Klamath Facilities Removal EIS/EIR noted that no Oregon spotted frogs were detected during 2003 surveys, or during surveys conducted in 1994 at locations of historic occurrence based on the Oregon Natural Heritage Program database (PacifiCorp 2004a). The presence of non-native bullfrog throughout the study area may indicate that predation has led to the extirpation of Oregon spotted frogs from the study area (PacifiCorp 2004a). Habitat degradation and poor water quality are other likely reasons why the Oregon spotted frog does not occur in the study area (PacifiCorp 2004a).

Conclusion

The grey wolf was not specifically considered in the Klamath Facilities Removal EIS/EIR. Long-term improvements to wildlife corridor function for large mammals was described, but analysis of potential impacts specific to grey wolf habitat was not included. Since the listing of the grey wolf as endangered under the California ESA and the establishment of the Shasta Pack near Mt. Shasta, no grey wolves have been observed in the Hydroelectric Reach of the Klamath River. The Protocol-level Wildlife Surveys that would be completed prior to any dam removal activity would include surveys for grey wolves and any warranted avoidance measures incorporated into project design. Mitigation measures identified in the Klamath Facilities Removal EIS/EIR for wildlife in the study area would reduce any potential impact on grey wolves to a less than significant level.

The listing of the Oregon spotted frog as threatened under the Federal ESA would not change the effects determinations in the Klamath Facilities Removal EIS/EIR. The Oregon spotted frog has not been observed in the Hydroelectric Reach of the Klamath River and as noted above, the presence of non-native bullfrog throughout the study area is likely to prevent their reestablishment.

3.3.5 Flood Hydrology

Environmental Setting

The area of analysis for flood hydrology includes the Klamath River and tributaries that define the Klamath Basin. Upper Klamath Lake is in Oregon. The downstream outlet of Upper Klamath Lake is Link River Dam which releases water into the Link River. About one mile below the Link River Dam, the Link River flows into Keno Impoundment/Lake Ewauna. The Keno Impoundment/Lake Ewauna water level is controlled by the Keno Dam near Keno, Oregon. The Klamath River flows

approximately 250 miles from the outflow of Lake Ewauna, through Keno Dam, through the Klamath Hydroelectric Project, and into the Pacific Ocean near Klamath, California.

The Upper Klamath Basin is upstream of Iron Gate Dam and includes Upper Klamath Lake and its tributaries, Link River, the Keno Impoundment/Lake Ewauna, and the Hydroelectric Reach (from J.C. Boyle Dam to Iron Gate Dam). Several facilities control water management in the Upper Klamath Basin, including the Klamath Hydroelectric Project and Reclamation's Klamath Project via several diversions from the Klamath River (FERC 2007).

The Lower Klamath Basin includes the areas of the Klamath Basin downstream from Iron Gate Dam to the Klamath Estuary. Major tributaries to the Lower Klamath Basin include the Shasta, Scott, Salmon, and Trinity Rivers. The Klamath Estuary, on the northern California coast, completes the system and discharges to the Pacific Ocean (FERC 2007).

Historical Hydrologic Conditions

Major hydrologic changes to the Klamath Basin were triggered construction of Reclamation's Klamath Project, following its authorization in 1905, including Link River Dam, several hundreds of miles of irrigation ditches, large diversion and conveyance canals, and pumping plants to divert water from the Klamath River watershed for agricultural use (FERC 2007) and to return excess water to the Klamath River. This infrastructure supported the agricultural community, which was already established to some extent in the Upper Klamath Basin, and allowed for reclamation of additional wetlands for homesteading purposes (FERC 2007).

Development of hydroelectric plants in the Klamath Basin began as early as 1891 in the Shasta River Canyon to provide electricity for the City of Yreka. Klamath Hydroelectric Project facilities were constructed by Copco beginning with Copco 1 (1918), followed by Copco 2 (1925), and reconstruction of the old Eastside facility in 1924. After World War II, regional population growth prompted a new round of hydroelectric power expansion highlighted by Copco's Big Bend project (J.C. Boyle Dam and powerhouse) in 1958 and the construction of the Iron Gate facilities in 1962.

General Basin Hydrology

Precipitation, Runoff and Springs

The headwaters of the Klamath River, unlike most other watersheds in the Pacific Northwest, originate in relatively flat open valleys before descending into a steep river canyon that intercepts inputs from multiple groundwater inflows in the upper basin and the Shasta, Scott, Salmon, and Trinity Rivers, among others, in the lower basin, prior to emptying into the Pacific Ocean. The upper basin contains large, porous aquifers that store precipitation falling throughout the year and steadily release cool water into stream channels. Consequently, seasonal stream flow fluctuations in upper basin streams are relatively small. In contrast, the lower basin does not contain large, porous aquifers that temporarily store precipitation. As a result, precipitation tends to runoff more quickly in the lower basin, creating relatively "flashy" streams (U.S. Department of the Interior and U.S. Department of Commerce 2012).

Precipitation in the watershed varies widely, ranging from an annual average of 15 to 25 inches in the open valleys in the headwaters, which are in the rain shadow of mountains to the west, to approximately 80 inches of rainfall near the river's mouth. Consequently, the amount of water running off from the upper basin, even though it is nearly equal in size to the lower basin, is relatively small, averaging less than 20 percent of the total runoff on an annual basis. The steadier groundwater discharge from the upper basin, however, does provide an important source of water for the lower basin and for fish during the dry summer and early fall months when flows in the lower basin tributaries are low (U.S. Department of the Interior and U.S. Department of Commerce 2012). One large spring complex below J.C. Boyle Dam discharges 220 to 250 cubic feet of regional groundwater year round (FERC 2007).

At its higher elevations (above 5,000 feet), the Upper Klamath Basin receives rain and snow during the late fall, winter, and spring. Peak stream flows in the upper basin (above Upper Klamath Lake) generally occur during snowmelt runoff in winter and spring. Peak runoff events in the lower basin tend to occur from November through March, when rainfall is highest, or when rain-on-snow events occur.

Reclamation's Klamath Project

Operation of Reclamation's Klamath Project affects Klamath River flows and Upper Klamath Lake water surface elevations. Link River Dam, which is owned by Reclamation but operated by PacifiCorp under the direction of Reclamation, is the primary structure controlling the level of Upper Klamath Lake and releases of water to the Klamath River. Upper Klamath Lake water levels typically range about 4 to 5 feet annually, reaching a maximum (about 4143 feet above sea level, Reclamation datum) near the beginning of the irrigation season in April, and often dropping below 4139 feet above sea level, Reclamation datum, at the end of the irrigation season in October. The range of water levels in Upper Klamath Lake depends on many factors, including hydrologic conditions, flood risk management, agricultural demands for irrigation deliveries, and ESA requirements for lake-level management for endangered suckers and downstream flows for threatened Coho salmon.

Klamath Facility Removal EIS/EIR, Section 3.8, Water Supply/Water Rights, describes the scope of Reclamation's Klamath Project in more detail, including the water supply diversions and amount of water diverted. As a Federal agency, Reclamation is required to comply with the ESA. To meet ESA requirements, Reclamation operates the Klamath Project in compliance with the most recent biological opinion. To comply with ESA, Reclamation operation of the Klamath Projects targets Klamath River flows measured below Iron Gate Dam and water surface elevations in UKL. Flow requirements changed with implementation of the 2013 Joint Biological Opinion. Please refer to the Flood Hydrology, New Information section below, for additional information.

The Four Facilities and the Hydroelectric Reach

J.C. Boyle Reservoir is approximately 5 miles downstream from Keno Dam. PacifiCorp operates J.C. Boyle Reservoir to produce hydroelectric power. Current operations of the reservoir follow Interim Measures from the Interim Conservation Plan effective as of February 2010. Water is spilled from

the dam during high flow months of January through May and when inflow "exceeds the capacity of the J.C. Boyle powerhouse and low flow requirements" (FERC 2007).

The J.C. Boyle Bypass Reach is a 4.3-mile section of the Klamath River between the Boyle Dam and its Powerhouse; it flows at a steep grade. At 0.5 miles downstream from the dam, flows are increased by groundwater entering the bypass reach. There is currently a 100 cfs minimum required release from J.C. Boyle Reservoir into the Boyle Bypass Reach (NOAA Fisheries Service 2010). The average accretion due to groundwater inflow/spring inflow is an additional 220 to 250 cfs and varies seasonally and from year to year (FERC 2007).

The J.C. Boyle Peaking Reach is downstream from the J.C. Boyle Powerplant, so flows vary based on releases from the powerplant. Typically, the reach has high flows during the day as a result of powerhouse flows used to provide peak energy demand. The powerhouse flows may be reduced to zero at night when J.C. Boyle Reservoir is refilled for the following days peaking operations.

PacifiCorp operates Copco 1 Reservoir for hydroelectric power generation through Copco 1 Dam. With the most active storage volume behind the Four Facilities of 6,235 acre feet for power production, Copco 1 Reservoir has a total storage capacity of 46,867 acre feet (Reclamation 2012). This reservoir is deeper than both Keno Impoundment/Lake Ewauna and J.C. Boyle Reservoir (FERC 2007).

Copco 2 Reservoir, a small impoundment, receives discharge from Copco 1 Reservoir through Copco 1 Dam. Copco 2 dam diverts water to Copco 2 Powerhouse through a combination of two tunnels and pipeline. Spillage from the dam is rare and typically only happens from November through April in wet years. PacifiCorp releases between 5 and 10 cfs into the bypass reach under normal conditions. Copco 2 Powerhouse discharges and water from the bypass reach discharges into Iron Gate Reservoir (FERC 2007).

Iron Gate Reservoir is downstream from the Copco 2 Dam and also receives water from Jenny and Fall Creeks, which are tributaries to the Klamath River downstream from Copco 2 Dam and upstream of Iron Gate Reservoir. PacifiCorp operates Iron Gate Dam and Reservoir as a re-regulating facility for peaking operations at the other three hydroelectric power dams. Iron Gate Reservoir is the deepest of the four reservoirs in the Hydroelectric Reach. The total storage at this reservoir is approximately 58,794 acre feet of which 3,790 acre feet is available for power production (Reclamation 2012). Iron Gate Powerhouse, at the base of the dam, has a maximum hydraulic capacity of 1,735 cfs. Cool water is diverted from the reservoir to the Iron Gate Fish Hatchery, downstream from the dam (FERC 2007).

Lower River Basin

The Lower Klamath Basin includes the river area downstream from Iron Gate Dam, which includes 190 miles of river flowing to the Klamath Estuary and then to the Pacific Ocean. The major tributaries entering the river include the Shasta, Scott, Salmon and Trinity Rivers. The hydrology of

the Lower Klamath Basin is heavily influenced by these four rivers because they provide 44 percent of the Klamath River's flow (FERC 2007).

Flood Hydrology and River Flood Plain

The active storage capacity in UKL is approximately 560,000 acre-feet and includes areas newly reconnected to UKL by levee and dike breaches at Agency Lake, Barnes Ranch, Tulana Farms, and Goose Bay (Reclamation, 2011). UKL alone provides about 98 percent of the active storage for the Upper Klamath Basin (upstream of Iron Gate Dam); this active storage is managed for seasonal storage of irrigation and flood control. In contrast, active storage in Keno, J.C. Boyle, Copco 1, Copco 2 and Iron Gate reservoirs totals about 12,200 acre-feet of water (FERC 2007), or about 2 percent of the total active storage above Iron Gate Dam. The five dams below Link River Dam were not constructed to be flood control structures, nor are the operated by PacifiCorp as flood-control structures. These dams are operated continuously at or near full pool to optimize hydropower generation and revenue. As a result, other than UKL, these reservoirs do not seasonally store water for downstream irrigation purposes.

During extremely wet years, UKL's flood-storage capacity can be exceeded while downstream tributaries between Link River Dam and Iron Gate Dam are also flooding. Because there is little surplus active storage in the Four Facilities and Keno Dam, flooding downstream from Iron Gate Dam periodically occurs. During peak floods, the Klamath River overtops its banks and inundates the floodplain downstream of Iron Gate Dam. Federal Emergency Management Agency (FEMA) has prepared flood risk mapping for portions of the Klamath River in Siskiyou, Del Norte and Humboldt Counties.

Impacts

There are two major potential impacts related to the removal of the Four Facilities. The first is during the drawdown of the reservoirs there will be a short term increase in the downstream surface water flows. The second potential impact will be that the removal of the dams causes permanent changes to the downstream floodplain elevations (e.g. changes to the 100-year floodplain).

Regarding the first impact, reservoir drawdown activities would begin on November 1, 2019 at Copco 1 Dam, and on January 1, 2020 at J.C. Boyle and Iron Gate Dams, at which times hydroelectric power generation would cease. The timing of drawdown of the three larger reservoirs in the winter of a single year was optimized to protect downstream species and to facilitate the movement of erodible sediment during winter high flows. At Copco 2 Dam, because of its small impoundment, drawdown would not begin until June 1, 2020, to allow for continued hydroelectric power generation at this site until dam removal began. Reservoir drawdown periods would be in accordance with Dam Removal Plans developed by the DRE and with applicable biological opinions and operation plans. The DRE would control the releases that would vary by reservoir depending on the type of dam, discharge capacity, safe drawdown rates to avoid slumping, water year type, and the volume of water and sediment within a reservoir.

The reservoir drawdown plans were made with consideration for minimizing flood risks downstream. The DRE would carefully control drawdown to maintain flows that would not cause flood risks.

Drawing down the reservoirs would increase storage availability in J.C. Boyle, Copco 1, and Iron Gate Reservoirs. If a flood event occurred during drawdown, the DRE would retain flood flows using the newly available storage capacity and continue drawdown after flood risks have ended. Existing conditions do not allow these reservoirs to assist in flood prevention in this manner. For specific details on the sequence and timing of drawdown at each reservoir, see Klamath Facilities Removal EIS/EIR Section 3.6.4.

The reservoir drawdown release rates at Iron Gate Dam were the focus of this analysis because Iron Gate Dam has the largest reservoir for storage of floodwater during drawdown and because it is the most downstream dam. The release rates that would occur during drawdown of the reservoir would be in significantly less than the historical flow during an extremely wet year (1- percent exceedance capacity). Klamath Facilities Removal EIS/EIR Figure 3.6-5 shows historical and maximum flows at Iron Gate Dam under wet year, average year and dry year types. While the release rates that would occur during reservoir drawdown would be greater than would have occurred with the dams in place, these releases would be considerably lower than the historical peak flows below Iron Gate Dam. Because the flows would stay below historical peak flows, they would not create a flood risk to downstream structures or communities.

The second potential impact is related to the reduction of flood attenuation due to the removal of the reservoirs. This impact was quantified and Appendix J of the Klamath Facilities Removal EIS/EIR includes model results that show flood maps for the river reaches below Iron Gate Dam to Happy Camp. The series of figures show the 100-year floodplain under the current condition and the Proposed Action; the differences between the two floodplains are very minor. The mapping includes the effects of the increase in the 100-year flood peak flow rate and the small amounts of sediment deposition in the channel following removal of the Four Facilities.

Hydrologic modeling of changes shows that removal of the Four Facilities could alter the 100-year floodplain inundation area downstream of Iron Gate Dam between RM 190 and 172 (from Iron Gate Dam to Humbug Creek) (Reclamation 2012). Modeling of flood flows downstream of Iron Gate Dam shows that the Four Facilities provide a slight attenuation of peak flood flows. Current estimates are that the discharge rate of the 100-year peak flood immediately downstream of Iron Gate would increase by up to 7 percent following dam removal (Reclamation 2012) and flood peaks would occur about 10 hours earlier. This increased discharge rate would result in approximately 1.5 feet higher flood elevations on average from Iron Gate Dam (RM 190) to Willow Creek (RM 185). The impact of dam removal on flood peak elevations would decrease with distance downstream of Iron Gate Dam, and Reclamation (2012) estimated that there would be no significant effect on flood elevations downstream of RM 172 because of attenuation effects in the channel and tributary peak flows would not coincide with the peak flow below Iron Gate Dam.

Decommissioning of the Eastside and Westside canals and hydropower facilities by PacifiCorp as a part of the KHSA would eliminate the need for diversions at Link River Dam into the two canals. Following decommissioning of the facilities there would be no change in outflow from Upper Klamath Lake or inflow into Lake Ewauna. It was assumed in the hydrologic modeling that

decommissioning of the Eastside and Westside facilities would not change conditions related to the existing conditions as operation of those facilities would not change flood hydrology. Similarly, transferring the ownership and operation of Keno Dam from PacifiCorp to Reclamation under the amended KHSA would also not change flood hydrology.

Changes in flood peak elevations and changes to the floodplain could affect properties and structures along the river downstream of Iron Gate Dam during a flood event. The Klamath Basin is subject to flooding and the FEMA has developed flood insurance risk maps that Siskiyou County has recognized in regulations concerning development along the river.

An estimate of the number of residences and structures potentially affected from Iron Gate Dam downstream to Humbug Creek was provided by Reclamation (2012). This estimate was based on photo interpretation and field visits. Structures in the Klamath Basin were categorized according to whether they are within the existing 100-year floodplain or would be in the 100-year floodplain after dam removal. The structures were further classified as either residences or garages (including buildings such as equipment sheds and horse barns). With the Four Facilities in place, approximately two dozen residences and two dozen garages are located in the existing 100-year floodplain between RM 190 and RM 172. Given the current plans for removal of the Four Facilities, less than six additional structures (including residences and garages) are projected to be within the modeled 100-year flood plain. Any new information developed to assess likely impacts to the flood plain and nearby habitable structures would be shared with the appropriate authorities and the public. The DRE would work with willing landowners to develop and implement a plan to address any increased flood threat caused by dam removal for permanent, legally established, permitted, habitable structures prior to dam removal. Such a plan could include measures to move, modify, or elevate structures where feasible.

All the bridges over the Klamath River from Iron Gate Dam to Humbug Creek were evaluated to determine the effects of the increase in the 100-year flood (Reclamation, 2012). All the bridges intended for vehicle traffic (cars and trains) have more than 3 ft of freeboard for the 100-year flood under the Proposed Action. CalTrans requires that there is 2 ft of clearance below the low cord for the 50-year flood and that the 100-year flood passes under the low cord. The potential for increasing scour at the bridge piers was also evaluated. In all cases, except the Rail Bridge (RM 183.3), the scoured bed elevation will not decrease more than 0.2 ft if the Four Facilities are removed. This is not considered a significant change in scour elevation considering the uncertainty associated with scour computations and the conservatism used in scour computations. The largest change to the scour elevation is at the Rail Bridge where it is expected to decrease approximately 1.2 ft. The change in scour elevation is not considered to affect significantly the structural integrity of the piers considering likely presence of bedrock near the riverbed that will limit scour at this location. Therefore, no improvements to the existing bridges should be necessary to convey slightly higher peak flows under the Proposed Action.

When a large flood event is predicted, the National Weather Service provides river stage forecasts for the Klamath River for the USGS gages at Seiad Valley, Orleans and Klamath. They currently do not publish a forecast for river stage at Iron Gate gage. However, they work with PacifiCorp to issue

flood warnings to Siskiyou County. After removal of the Four Facilities, it is likely that National Weather Service will publish a forecast at the Iron Gate gage location (Reclamation 2012) to help alleviate issues with peak flows arriving downstream earlier than if the Four Facilities remained in place.

The change to the 100-year floodplain inundation area downstream from Iron Gate Dam would increase the risks of flooding structures; therefore, the impact on flood hydrology would be significant. Mitigation Measures H-1 and H-2 would reduce the impact to flood hydrology to less than significant. Mitigation Measure H-1 describes how, after the removal of the Four Facilities, the DRE will work with NWS to allow it to forecast floods at Iron Gate gage as well, located just downstream from Iron Gate Dam. Shifting the analysis point upstream will help increase the warning time available to respond to flood conditions. Mitigation Measure H-2 describes how the DRE will work with willing landowners to develop and implement a plan to address any increased flood threat generated by changes to the 100-year flood inundation area as a result of the removal of the Four Facilities; such a plan could include measures to move, modify, or elevate structures where feasible.

New Information

The 2013 Joint Biological Opinion changed the flow regime in the Klamath River and under which dam removal would likely occur. The 2013 Joint Biological Opinion includes operation of the Klamath Project, for the delivery of water for irrigation purposes consistent with historic operations, subject to water availability, while maintaining lake and river hydrologic conditions that avoid jeopardizing the continued existence of ESA listed species and adversely modifying designated critical habitat. The 2013 Joint Biological Opinion was designed to optimize limited water supplies to provide greater certainty for Project Supply, and to provide UKL elevations and Klamath River flows representative of real-time hydrologic conditions. The 2013 Joint Biological Opinion includes two distinct operational approaches for water management for the fall/winter (October through February) and spring/summer (March through September) time periods.

Fall/winter water management implements a formulaic management approach based on current hydrologic indicators (UKL storage, UKL inflows, Klamath River accretions, snowpack conditions) to ensure adequate water storage and sucker habitat in UKL in the fall/winter, while meeting the needs of coho salmon downstream and providing fall/winter water deliveries to the Irrigation Project and Lower Klamath NWR. The fall/winter approach prioritizes refill of UKL to provide adequate Project supply, sucker habitat and enhanced river flows in the spring/summer period, while providing variable river flows that mimic natural hydrology, based on real-time hydrologic conditions in the upper Klamath Basin.

Spring/summer water management implements a water supply account approach to determine a volume of water reserved in UKL for ESA-listed suckers (UKL Reserve), the amount of water available for the Klamath River EWA, and the available water supply for Project irrigation (Project Supply). The division of the total available UKL water supply between UKL Reserve, EWA, and Project Supply was based on an analysis of the ecologic needs of ESA-listed species.

The formulaic distribution of EWA in spring/summer is based on real-time hydrologic indicators in the upper Klamath Basin, primarily the Williamson River and local inflows (accretions) from Link River through Iron Gate Dam, and was designed to consider and account for key ecological objectives for UKL and the Klamath River. The spring/summer operational approach remains consistent with historic operations by maintaining full irrigation deliveries in accordance with existing contracts, contingent upon available water supplies. To ensure Klamath Irrigation Project Operations do not jeopardize listed coho salmon, the 2013 Joint Biological Opinion included minimum flows below Iron Gate Dam described in Table 3.

The 2013 Joint Biological Opinion incorporates a real-time management concept into current Project operations to lessen the impacts on ESA-listed species. A key driver and benefit of this concept is greater water supply certainty for the Klamath Irrigation Project and the flexibility to meet real-time species needs. This real-time management approach for UKL and the Klamath River attempts to optimize the ecologic benefit of the available water supply, resulting in the ability to maximize the amount of the remaining water available for the Klamath Irrigation Project. In some instances, dry hydrologic conditions characterized by limited precipitation, runoff, and inflows to UKL may create shortages in the total available UKL water supply, which can result in a Project Supply that is less than the full irrigation demand.

This new hydrological regime influences flows in the Klamath River however the difference in flow during reservoir drawdown is very minimal. The simulated drawdown under KBRA for each of the three reservoirs is shown in Figure 10 for three example year types. A dry year is represented by water year 2001, an average water year is represented by 1976 and a wet water year is represented by water year 1984. Drawdown of the three significant reservoirs will begin Jan 1 and will be complete by mid-February, except for a wet year in which there may be some refilling of the reservoirs because of the limited outlet capacity at the dams low elevation outlets. The refilling during wet years is most pronounced at Iron Gate because it is the most downstream reservoir and because its low level outlet capacity is slightly smaller than Copco 1.

Because of the similarities in flow between the 2013 Joint Biological Opinion and KBRA for the months of January through March, there is expected to be no significant difference between the impacts of dam removal for the dry and average water year types. During the wetter water year types in May and June, there may be a slight increase in the amount of refilling of Iron Gate Reservoir under the 2013 Joint Biological Opinion, but by July the flows for the 2013 are below the low level outlet capacity of Iron Gate Dam. Additionally the flood capacity within the reservoirs increases as drawdown proceeds. If in May or June the very remote possibility of a major hydrologic event occurred, the flood water would be retained within the Four Facilities and drawdown would only resume once the risk of flood had ended. The possibility and impacts of refilling Iron Gate Reservoir is adequately analyzed in the previous work documented in Reclamation (2012) and in the Klamath Facilities Removal EIS/EIR. The drawdown associated with dam removal would not change the floodplain or flood risk.

The differences between the KBRA and 2013 Joint Biological Opinion will also not affect the flood operations in Upper Klamath Lake or Keno Reservoir. The KBRA flow simulation only computes monthly average flows downstream of Keno so it is not possible to directly compare the predicted flood peaks between the KBRA and 2013 Joint Biological Opinion. However, there are two factors that indicate that there will be no significant difference in flood conditions between the two operations. First, downstream of Iron Gate Dam, the peak flows are largely determined by the rainfall that occurs in the watershed between Keno Dam and Iron Gate Dam (Reclamation, 2012a), which is unaffected by the project. There is no evidence that suggest the frequency of large storms has changed significantly since the analysis in 2012. The second reason is that the maximum monthly average flows for 2013 Joint Biological Opinion are less than those under KBRA for the months when flooding has historically occurred (December through May).

Therefore, it is reasonable to conclude that because the flood operations under the 2013 Joint Biological Opinion flows versus the KBRA Flows have not changed, and because the frequency and magnitude of large storms has not changed, the likely adverse impacts to structures in the 100-year flood plain downstream of Iron Gate, and the timing of downstream flood peaks, would be similar for both flow scenarios, with the adverse impacts being significant but reduced to less than significant with implementation of Mitigation Measure H-1 and H-2.

No new information relevant to dam failure, Keno Transfer or Eastside/Westside decommissioning for flood hydrology has been identified since the Final Klamath Facilities EIS/EIR was issued.

Conclusion

Hydrologic differences between the KBRA Flows and those implemented under the 2013 Joint FWS and NMFS Biological Opinion for the Klamath Project would have negligible differences relevant to the effects of dam removal, Keno Transfer and Eastside/Westside Decommissioning on flood hydrology. The expected hydrology in the Klamath River remains similar in magnitude and timing of flood peaks to that used in the Klamath Facilities Removal EIS/EIR analysis. New information on flood hydrology does not result in a change relevant to environmental concerns.

3.3.6 Ground Water

Environmental Setting

The EIS/EIR's area of analysis, or "project area," for groundwater as related to the KHSA included the area within 2.5 miles of J.C. Boyle, Copco 1, Copco 2, and Iron Gate reservoirs. The project area lies within Klamath County, Oregon, and Siskiyou County, California. This continues to be the area of analysis for the Proposed Action of facilities removal but without KBRA as a connected action.

The EIS/EIR also included the project area for the KBRA with respect to groundwater in the Klamath basin upstream of Copco 1 Dam. This is the area covered by a USGS-Oregon Water Resources Department (WRD) groundwater model designed to determine effects on groundwater from pumping water for irrigation purposes. Because implementation of KBRA is no longer a connected action, the area of analysis more than 2.5 miles upstream of J.C. Boyle Reservoir is now outside the area of analysis for groundwater impacts associated with the Proposed Action.

Impacts

The Proposed Action is not expected to reduce the amount of groundwater recharge to aquifers by removing the reservoirs. The Proposed Action would result in the same relative volume of water flowing through the project area in the Klamath River irrespective of changes in groundwater levels near existing reservoirs.

Under the Proposed Action, groundwater levels in existing wells adjacent to the reservoirs could decline in response to the drop in surface water elevation when the reservoirs are removed. The water-bearing units from which most of the existing domestic or irrigation wells obtain water are either below the elevation of the original river channel, are exposed along reservoir walls, or are above the reservoir stage. A number of existing domestic or irrigation wells lie close to the reservoir shorelines (wells within 2.5 miles). These wells may be influenced by the dropping reservoir water levels following facilities removal when they are hydraulically connected to a reservoir (directly or indirectly). However, all but three of the locatable shoreline wells tap water-bearing units with elevations below the bottom of a reservoir.

There are existing domestic and irrigation groundwater wells that could not be located reliably based on the information in the Oregon Water Resources Department or California Department of Water Resources databases. In addition to the non-locatable wells in the databases, there are likely other existing wells in the vicinity of the reservoirs. Among those could be wells associated with the 176 improved parcels near Copco 1 and Iron Gate Reservoirs. The extent of improvements on these parcels is not known, but it could have included the installation of domestic wells.

The degree of impact on wells near the reservoirs will be controlled by the degree of hydraulic connectivity between the reservoirs and the water bearing units below and adjacent to the reservoirs. Some of the water-bearing units tapped by existing domestic or irrigation wells lie above the reservoir water surface elevation and are at elevations similar to those of mapped springs. These springs are likely fed by the same water-bearing units supplying the wells and neither are expected to be significantly impacted by the removal of the reservoirs. Wells that pump from water-bearing units that are directly connected to the reservoirs will likely be affected by reservoir removal and the impacts could be significant. Wells which tap water-bearing units below the bottom of a reservoir are assumed to be maintained by regional groundwater flow systems and would not be effected by localized changes in groundwater associated with draining the reservoirs under the Proposed Action. Ultimately however, the potential impacts at specific

wells will partly depend upon local hydrogeologic conditions at a well site and the well construction characteristics.

A decline in groundwater levels in some existing nearby wells adjacent to the reservoirs in response to the drop in surface water elevation when the reservoirs are removed would be a significant impact, but implementation of mitigation measure GW-1 would reduce this impact to less than significant. Mitigation measure GW-1 provides for the deepening (or replacement) of an existing affected domestic or irrigation groundwater well so the groundwater production rate from the well is returned to conditions prior to implementation of the Proposed Action

New Information

No new information has been identified related to the effects of dam removal on groundwater levels near J.C. Boyle, Copco 1, Copco 2, and Iron Gate Reservoirs. Additional groundwater studies have been completed in the upper basin, but these are not relevant to an analysis of the Proposed Action without KBRA as a connected action.

In 2014, UKBCA was signed. This agreement includes a Water Use Program designed to permanently increase stream flows into Upper Klamath Lake by at least 30,000 acre feet through reductions in water use (surface water and groundwater) while providing a stable, sustainable basis for the continuation of irrigated agriculture in the Upper Klamath Basin. It also provides the means for meeting specified instream flows on various streams above Upper Klamath Lake and establishing permanent riparian restoration actions along many of these streams. The potential impacts of the UKBCA on groundwater are not within the area of analysis for the Proposed Action (i.e. facilities removal without KBRA as a connected action) and thus are not relevant irrespective of its uncertain future.

Conclusion

No additional information has been identified on groundwater relevant to the effects of dam removal, Keno Transfer, and Eastside/Westside Decommissioning that was not already included in the groundwater analysis published in the Klamath Facilities Removal Final EIS/EIR.

3.3.7 Water Supply/Water Rights

Environmental Setting

The area of analysis for water supply/water rights includes the Klamath River and tributaries that define the Klamath Basin. The downstream outlet of Upper Klamath Lake is Link River Dam, which releases water into Link River. About one mile below the Link River Dam, Link River flows into Keno Impoundment/Lake Ewauna. The Keno Impoundment/Lake Ewauna water level is controlled by the Keno Dam near Keno, Oregon. The Klamath River flows approximately 250 miles from the old outfall of Lake Ewauna, through Keno Dam, through the Klamath Hydroelectric Project into the Pacific Ocean near Klamath, California.

The Upper Klamath Basin is upstream of Iron Gate Dam and includes Upper Klamath Lake and its tributaries, Link River, the Keno Impoundment/Lake Ewauna, Klamath River between Keno Dam J.C. Boyle Dam, and the Hydroelectric Reach (from J.C. Boyle Dam to Iron Gate Dam). Several facilities control water management in the Upper Klamath Basin, the Klamath Hydroelectric Project, and Reclamation's Klamath Project via several diversions from the Upper Klamath River Basin (FERC 2007).

The Lower Klamath River Basin includes the areas of the Klamath Basin downstream from Iron Gate Dam to the Pacific Ocean. Major tributaries to the Lower Klamath River include the Shasta, Scott, Salmon, and Trinity Rivers. The Klamath Estuary, on the northern California coast, completes the system and discharges to the Pacific Ocean (FERC 2007).

The EIS/EIR also included the project area for the KBRA with respect to water supply/water rights in the Klamath basin upstream of Link River Dam. Because implementation of KBRA is no longer a connected action, the area of analysis upstream of Link River Dam is now outside the area of analysis for water supply/water rights associated with the Proposed Action.

Klamath Hydroelectric Project

Multiple dams are associated with the Klamath Hydroelectric Project, which is in both Klamath County, Oregon and Siskiyou County, California. The Klamath Hydroelectric Project includes eight facilities, all owned and operated by PacifiCorp. The Eastside and Westside powerhouses, which are downstream from Link River Dam, represent the upstream boundary of the Klamath Hydroelectric Project; the Iron Gate Development represents the downstream boundary. Link River Dam, which controls the water level in Upper Klamath Lake, is not part of the Klamath Hydroelectric Project; this dam is owned by Reclamation and is currently operated by PacifiCorp. Keno Dam, about 20 miles downstream from Link River Dam, is part of the Klamath Hydroelectric Project (FERC License 2082), but it has never been outfitted or operated as a hydroelectric facility. Further downstream, the J.C. Boyle, Copco No.1, Copco No. 2, and Iron Gate facilities (Four Facilities, see Table 1) generate the majority of the power produced by the Klamath Hydroelectric Project. The Fall Creek facility, located on a tributary to Iron Gate Reservoir, is the eighth facility in this Project.

Flows through the Hydroelectric Reach (J.C. Boyle Dam to Iron Gate Dam) are related to flow releases from Upper Klamath Lake, tributary inputs between Upper Klamath Lake and Iron Gate Dam, flows diverted to and returned from Reclamation's Klamath Project, relatively small storage capacities of the Klamath Hydroelectric Project facilities, and the releases out of Iron Gate Dam (FERC 2007). Upper Klamath Lake holds 83 percent of the total storage capacity of the reservoirs on the Klamath River (FERC 2007) and approximately 98 percent of active storage (Greimann 2011). Associated reservoirs for J.C. Boyle, Copco 1, Copco 2, and Iron Gate Dams contain 14 percent of the total storage capacity and only 2 percent of the active storage on the river. However, these dams were not designed for, nor are the operated for, downstream irrigation purposes or drinking water supplies, maintenance of instream flows for fish, or providing flood control. The primary purpose of the Four Facilities is to generate

hydroelectricity. As such, the Four Facilities are primarily operated as run-of-the river facilities, with some daily reservoir fluctuations for peaking operations. In contrast, Upper Klamath Lake (and Link River Dam) provides the majority (98 percent) of active storage in the Upper Klamath Basin, with the ability to capture flood peaks in the winter and spring months when lake levels are relatively low from the previous irrigation season, and the ability to provide irrigation water and augment instream flows for fish in the summer and fall with water stored from the previous year's runoff.

Klamath River Water Rights

Downstream from the California State line, the mainstem of the Klamath River flows through Siskiyou, Del Norte, and Humboldt Counties to the Pacific Ocean. A query on California's Electronic Water Rights Information Management System provided 38 water right listings with the Klamath River as the water source. Six of these water rights listings are upstream of Iron Gate Dam and 32 of these listings are on the mainstream of the Klamath River downstream from Iron Gate Dam. Appendix L of the EIS/EIR contains the query results and has a map that displays the documented locations.

The City of Yreka receives its water supply from Fall Creek, a tributary to the Klamath River in the Upper Klamath Basin that is approximately 23 miles northeast of the city. California State Water Rights Permit 15379 allocates the City of Yreka up to 15 cubic feet per second (cfs) or 9.7 million gallons per day (mgd) from this source. The city's current demand, however, is less than the permitted amount (City of Yreka 2010). The City of Yreka's diversion was completed in 1969 and the public water systems facilities at Fall Creek include two impoundments; an intake structure with fish screens, a pump, and pre-treatment facility; a cathodic protection field at the Fall Creek Campground and Day Use Boat Ramp; and a 24-inch pipeline that crosses on the eastern (upstream) end of Iron Gate Reservoir. Water diverted from Fall Creek for the City of Yreka is mainly returned through subsurface drains, infiltration, and irrigation runoff to a tributary of the Shasta River (City of Yreka 2010). The DFW possesses a 10 cfs non-consumptive water right (SWRCB License 11681) for fish propagation at Fall Creek Hatchery between March 15 and December 15 each year, not to exceed 5,465 acre-feet per year.

Impacts

With a major change in the water that is impounded in the hydroelectric reach, dam removal had the potential to change surface water flows available for diversion downstream of Iron Gate Dam. The Klamath Facilities Removal EIS/EIR compared the modeled flow rate at Iron Gate Dam under a scenario with dam removal, assuming KBRA Flows, to that of the No Action/No Project Alternative. The results showed either a slightly higher or slightly lower flow rate on the Klamath River downstream from Iron Gate Dam when compared to the No Action/No Project Alternative. This was an expected result because the Four Facilities were not designed as, nor are the operated as, seasonal storage reservoirs for maintaining downstream flows for irrigation or drinking water withdrawals. These Facilities are primarily operated as run-of-the-river reservoirs and thus have only a small effect on daily, monthly, seasonal, or annual flow

conditions. The modeling results showed that at Seiad Valley, approximately 62 miles downstream from the Iron Gate Dam, the flow rates would be nearly identical after removal of the Four Facilities. Because the flow rates at Seiad Valley would be nearly identical between the Proposed Action and the No Action/No Project Alternative, the dam removal activities and KBRA are not likely to affect water supply downstream from Seiad Valley.

The monthly diversion flow rate associated with all of the active and inactive water rights, aside from the four reserved State filings and the PacifiCorp power diversion water right,[4] is approximately 64 cfs (based on water right information in Appendix L of the EIS/EIR). During peak summer months (e.g. July and August), usage typically doubles. Assuming usage doubles between Iron Gate Dam and Seiad Valley during July and August, the peak short term diversion flow rate that would be diverted is 128 cfs if all users doubled their water diversion rate during the same period. This represents the maximum diversion rate, which would likely be lower during wetter water years and other months. The Proposed Action would slightly change the flows in the river, but the flows would still be substantially greater than the maximum diversion rate. The most conservative comparison is just downstream from Iron Gate Dam, where the flows would be the lowest in the potentially affected reach. Comparing the maximum potential diversion with low flow conditions, the diversions would be approximately 16 percent of the Klamath River flows during a dry year[5]. A 90 percent exceedance flow of 824 cfs was used to represent a dry year. The flow rate of 824 cfs was once the seasonal low during the month of July, when irrigation and livestock demands are the greatest. (These low flows were used to develop a conservative impact evaluation, but they are less than what was acceptable under the 2010 NMFS Biological Opinion.)

Because the amount of flow diverted for water right users between Iron Gate Dam and Seiad Valley would be less than 20 percent of the flow in the Klamath River in the upstream portions of this reach during a dry year, water right users are not likely to experience decreased supplies at any time of the year because of the slight changes in flows associated with removal of the Four Facilities.

Release of stored sediment during drawdown of the reservoirs could change Klamath River geomorphology and affect water intake pumps downstream from Iron Gate Dam. Reservoir drawdown activities would begin on November 1, 2019 at Copco 1, on January 1, 2020 at J.C. Boyle and Iron Gate Dams, and on June 1, 2020 at Copco 2 Dam. During this period, individual downstream water intake facilities could be impacted by suspended sediment or sediment deposits, causing operational problems. Reclamation conducted modeling of the reservoir drawdown and erosion of reservoir sediment. The released sediment would likely exceed the

[4] The four State filings with the SWRCB were not included because the water right is associated with a storage amount to preserve water for future use with no indication of the period of time during which the flow volume will be drawn. The PacifiCorp water right is associated with power generation at Iron Gate Dam and does not result in reduction of flows. For the diversion amount given in cubic feet per year (ID: WR-6), a diversion period of six months was assumed.

[5] The increase during July and August is an average based on reported values on Statement Diversion and Use forms available on California Electronic Water Rights Information Management System for the Klamath River.

carrying capacity of the river during some water year types, and would result in sedimentation and particle settling in slow-moving downstream areas. The fine fraction of the released sediment (silts, clays, and organics) would not be expected to deposit in substantial amounts in the river channel. The majority of this material would be transported to the ocean and would not interact substantially with the river bed. The amount of fine deposition would also decrease with distance downstream. If drawdown occurred in a dry year, a substantial deposition of sands would be expected in the reach from Iron Gate Dam to as much as eight miles downstream from the dam, around Cottonwood Creek. There are 14 water rights registered on this reach; five are listed as inactive, two are State filings with the SWRCB, and two are associated with PacifiCorp's Iron Gate Dam facility and fish hatchery. The remaining water rights are associated with domestic, irrigation, and/or fire protection use. Sediment deposition in the eight miles downstream from Iron Gate Dam could affect diversion facilities that deliver water to users. Under the Proposed Action, impacts to water intake pumps downstream from Iron Gate Dam would be significant. Implementation of mitigation measure WRWS-1, would reduce this impact to a less than significant level. WRWS-1 calls for the DRE to assess each pump location at legitimate points of diversion. Following dam removal, the DRE would investigate intake and pump sites at the request of the water user. If effects on water supply intakes occur as a result of dam removal, the DRE will complete modifications to intake points as necessary to reduce effects such that the water right holder can divert water on the same pattern (including amounts and timing) as before the project.

Implementation of the interim trap and haul could require water rights to divert water for the fish handling facilities. Fish handling facilities to collect fish downstream from Keno Dam and at Link River Dam would require water sources. The facilities would not consumptively use the water; the water would pass through the facilities for release back into the system. Trap and haul is likely to be an exempt use under Oregon Revised Statutes 537.141(d) and Oregon Administrative Rules 3400010(2)(c)(B) if it causes no injury to existing water rights and if it is found to be not harmful to fish or wildlife after consultation with Oregon Department of Fish and Wildlife (ODFW). Changes in water diversions near Keno and Link River Dams would not contribute to any changes in water supply or water rights associated with removal of the Four Facilities because the actions are in different parts of the watershed. Because the fish handling facility would not increase consumptive use on the Klamath River system, the impacts of the trap and haul operations on water supply/water rights would be less than significant.

New Information

The 2013 Joint Biological Opinion changed the likely flow regime in the Klamath River under which dam removal would occur in 2020. In the 2013 Joint Biological Opinion for 2013 to 2023 includes, delivery of water for irrigation purposes consistent with historical operations, subject to water availability, while maintaining lake and river hydrologic conditions that avoid jeopardizing the continued existence of listed species and adverse modification of designated critical habitat. The 2013 Joint Biological Opinion was designed to optimize limited water supplies to provide greater certainty for Project Supply and to provide UKL elevations and Klamath River flows that are more protective of three ESA listed species. The 2013 Joint Biological Opinion includes two

distinct operational approaches for water management for the fall/winter (October through February) and spring/summer (March through September) time periods.

Fall/winter water management implements a formulaic management approach based on current hydrologic indicators (UKL storage, UKL inflows, Klamath River accretions, snowpack conditions) to ensure adequate water storage and sucker habitat in UKL in the fall/winter, while meeting the needs of coho salmon downstream and providing fall/winter water deliveries to the Irrigation Project and Lower Klamath NWR. The fall/winter approach prioritizes refill of UKL to provide adequate Project supply, sucker habitat and enhanced river flows in the spring/summer period, while providing variable river flows that mimic natural hydrology, based on real-time hydrologic conditions in the upper Klamath Basin.

Spring/summer water management implements a water supply accounting approach to determine a volume of water reserved in UKL for ESA-listed suckers (UKL Reserve), the amount of water available for the Klamath River (EWA), and the available water supply for Project irrigation (Project Supply). The division of the total available UKL water supply among UKL Reserve, EWA, and Project Supply was based on an analysis of the ecological needs of ESA-listed species. The formulaic distribution of EWA in spring/summer is based on real-time hydrologic indicators in the upper Klamath Basin, primarily flows in the Williamson River, and was designed to consider and account for key ecological objectives for UKL and the Klamath River. The spring/summer operational approach remains consistent with historical operations by maintaining full irrigation deliveries in accordance with existing contracts, contingent upon available water supplies. To ensure Klamath Irrigation Project Operations do not jeopardize listed coho salmon, the 2013 Joint Biological Opinion included minimum flows below Iron Gate Dam described in Table 3.

The 2013 Joint Biological Opinion incorporates a real-time management concept into current Project operations to lessen the impacts on ESA-listed species. A key driver and benefit of this concept is greater water supply certainty for the Klamath Irrigation Project and the flexibility to meet real-time species needs. This real-time management approach for UKL and the Klamath River attempts to optimize the ecologic benefit of the available water supply, resulting in the ability to maximize the amount of the remaining water available for the Klamath Irrigation Project. In some instances, dry hydrologic conditions characterized by limited precipitation, runoff, and inflows to UKL may create shortages in the total available UKL water supply, which may result in a Project Supply that is less than the full irrigation demand.

The very minor changes to the hydrology between KBRA Flows and 2013 Joint Biological Opinion flows can be seen when evaluating the average monthly flows and monthly flow exceedances below Iron Gate Dam (Table 4 and Figure 6). The 2013 Joint Biological Opinion slightly increases the annual average water supply by about 9 thousand acre feet when compared with the KBRA Flows. Moreover, when compared to the KBRA Flows, the 2013 Joint Biological Opinion maintains higher minimum summer months (July and August) during very dry years, when water demands by downstream users are greatest and tributary inputs and

groundwater discharges to the river are lowest. In the Klamath Facilities Removal EIS/EIR, a 90 percent exceedance flow of 824 cfs was used to represent a dry year at Iron Gate Dam under KBRA Flows. The flow rate of 824 cfs was once the seasonal low flow during the month of July, when irrigation and livestock demands were very high. Because the 2013 Joint Biological Opinion requires the higher minimum flows of 900 cfs in July and August (Table 3), the 2013 Joint Biological Opinion increases the downstream supply of water to satisfy water rights, and for biological purposes, during the most critical months of dry years.

Conclusion

The expected hydrology in the Klamath River under the Proposed Action remains similar in magnitude to that used in the Klamath Facilities Removal EIS/EIR analysis. Hydrologic differences between the KBRA Flows and those implemented under the 2013 Joint Biological Opinion for the Klamath Project are small. The Proposed Action with either set of assumed flow conditions would have similar, less than significant effects, on water supply and water rights. The Keno Dam transfer and Eastside and Westside decommissioning would have no impact on water supply and water rights. New information on water supply and water rights does not result in a change relevant to environmental concerns.

3.3.8 Air Quality

Environmental Setting

The area of analysis includes multiple counties in northern California and southern Oregon. Air quality impacts from the dam demolition and restoration actions would be limited to Siskiyou County, California and Klamath County, Oregon for dam removal activities, while additional impacts could occur in Jackson County, Oregon and Shasta County, California from haul truck or construction worker travel.

Impacts

Significant impacts on air quality would be generated if the dam demolition and restoration actions cause a cumulatively considerable net increase in ozone (O_3) or inhalable particulate matter (PM_{10}); release emissions that exceed 250 pounds per day for nitrogen dioxide (NOx), volatile organic compounds (VOC), PM_{10}, fine particulate matter ($PM_{2.5}$), or sulfur oxides (SOx); or 2,500 pounds per day for carbon monoxide (CO); expose sensitive receptors to substantial pollutant concentrations; or generate emissions inconsistent with the California and Oregon Regional Haze plans.

Dam demolition would generate a significant impact on air quality from NOx and PM_{10} emissions, but with the implementation of mitigation measures requiring the use of on road construction equipment model year 2000 or newer, off road construction equipment model year 2015 or newer, off site transport trucks model year 2010 or newer, and implementation of a dust control plan, the NOx emissions would be reduced to a less than significant level. However, the PM_{10} emissions would remain significant and unavoidable. Impacts from the implementation of restoration actions in the dewatered reservoir, the relocation of recreation facilities and the

Eastside/Westside decommissioning on air quality, and potential dust emission effects on visibility in the study area would all be less than significant. The transfer of Keno Dam from PacifiCorp to the federal government would result in no change from existing conditions.

New Information

No new information has been identified related to the effect of dam removal, Keno Transfer and Eastside/Westside Decommissioning on air quality.

Conclusion

No additional information has been identified regarding air quality relevant to the effects of dam removal, Keno Transfer and Eastside/Westside Decommissioning that was not already included in the analysis published in the Klamath Facilities Removal Final EIS/EIR. New information on air quality does not result in a change relevant to environmental concerns.

3.3.9 Greenhouse Gases/Global Climate Change

Environmental Setting

The area of analysis is the Klamath Basin, which includes multiple counties in northern California and southern Oregon. The area of analysis was further subdivided to support the quantitative analysis of KHSA generated greenhouse gases (GHG) emissions from dam removal activities and construction-related vehicle trips (e.g., trucks and construction worker commuting). This focused area of analysis included Siskiyou and Shasta Counties in California and Klamath and Jackson Counties in Oregon. A qualitative analysis of how global climate change could affect the Proposed Action was completed for the aforementioned counties, as well as Del Norte, Humboldt, Modoc, and Trinity Counties in California and Curry County in Oregon.

Impacts

Significant impacts on GHGs and global climate change would occur if the project resulted in substantial increases in GHG emissions as compared to the existing environmental setting, generate emissions that exceed a threshold of significance that the lead agency determines applies to the project, or substantially obstruct compliance with the GHG emission reduction regulations or requirements adopted to implement a statewide, regional, or local plan for the reduction or mitigation of GHG emissions.

Increases in GHG emissions when compared to the existing environmental setting were measured as an indirect effect from the replacement of power produced at the PacifiCorp hydroelectric facilities under existing conditions with power produced in the PacifiCorp Power Control Area. This indirect effect, along with the direct effect of construction emissions during dam deconstruction and restoration, were evaluated in comparison to numeric thresholds of significance developed by the South Coast Air Quality Management District and the Bay Area Air Quality Management District that were adopted by the lead agencies. A threshold of 10,000 million metric tons carbon dioxide equivalent ($MMTCO_2e$) per year is applied by both districts to evaluate the significance for industrial stationary source emissions, and by the South Coast Air

Quality Management District to evaluate construction emissions. Evaluation of the Proposed Action's compliance with GHG emission reduction regulations or requirements compared emissions from dam deconstruction and restoration actions against the GHG emission reduction goals in California Assembly Bill (AB 32) and California Executive Order S-3-05. A substantial obstruction of these goals would result from project emissions that would prevent the State's achievement of the AB 32 required reductions in GHG emissions to 1990 levels when compared to the business-as-usual emissions projections calculated by the California Air Resources Board for the year 2020 (a 29 percent reduction) or California Executive Order S-3-05 requirement for the reduction of emissions to 80 percent below 1990 levels by 2050.

The indirect effect of removing the dams that provide a renewable source of power that would be replaced in part by non-renewable sources would increase GHG emissions and would result in a significant and unavoidable impact on the State's efforts to reduce GHG emissions as required by AB 32. Impacts from dam demolition, the implementation of restoration actions in the dewatered reservoir, the relocation of recreation facilities, and the Eastside/Westside decommissioning on GHG emissions would all be less than significant. The transfer of Keno Dam from PacifiCorp to the federal government would result in no change from existing conditions.

New Information

The qualitative analysis of how global climate change could affect the Proposed Action completed in the Klamath Facilities Removal EIS/EIR relied on the results from climate studies and reports completed across a range of geographic scales from regional to state to basin levels. Since the publication of the Klamath Facilities Removal EIS/EIR, Reclamation has been evaluating potential changes in water supply and demand in the Klamath River Basin under future climate change scenarios as a part of the ongoing Klamath River Basin Study (Basin Study). The analysis underway in the Basin Study includes evaluation of potential changes in precipitation volumes, river flows and temperature, runoff timing and changes in the ratio of Upper Basin snowfall to rainfall. Coordination within Reclamation to determine how the results from the ongoing Klamath Basin Study might be different than the studies considered in the Klamath Facilities Removal EIS/EIR determined that while the projections of changes in water supply/demand and river conditions had been refined, they still fell within the range of potential conditions evaluated in the Klamath Facilities Removal EIS/EIR.

Since the publication of the Klamath Facilities Removal EIS/EIR, the California Air Resources Board has completed its first update to the Scoping Plan required under AB 32 to describe California's approach to reducing GHGs to 1990 levels by 2020. In this updated Scoping Plan, CARB adjusted the estimated 1990 emissions levels slightly higher based on new understanding of the global warming potentials of greenhouse gases (CARB 2014). In addition, adjustments were made to the business-as-usual emissions estimates for 2020 as a result of the economic downturn along with two reduction measures adopted by the legislature since the publication of the first Scoping Report in 2008 (CARB 2015). These adjustments combine to reduce the total percent reduction in emissions required to meet the AB 32 goal of cutting GHG emissions to

1990 levels. In addition to the modifications to AB 32, Executive Order B-30-15 established in 2015 further extends the GHG emissions targets to meet a 40% reduction below 1990 levels by 2030 (Office of Governor Edmund G. Brown 2015).

In 2015, the California State Supreme Court determined in its decision on the *Center for Biological Diversity v. California Department of Fish and Wildlife (Newhall Ranch Project)* has resulted to a change in the analysis of compliance with AB 32. The Court held in its opinion that use of compliance with AB 32 as a significance threshold was appropriate but determined that the use of a comparison of a project's reduction in GHG emissions to the AB 32 percent reductions required to lower GHG emissions to 1990 levels to measure compliance with this threshold was inappropriate (Center for Biological Diversity v. CDFW 2015).

Conclusion

The climate change analysis under development by Reclamation in the Klamath Basin Study and the recent changes to the AB 32 significance threshold used in the Klamath Facilities Removal EIS/EIR are not likely to change the magnitude or severity of effects identified for the Proposed Action. As noted above, the refined climate change projections under development by Reclamation for the Klamath River Basin are not inconsistent with the analysis completed in the Klamath Facilities Removal EIS/EIR. The changes to AB 32 and how compliance with AB 32 can be analyzed in an EIS/EIR would not change the determination made in the Klamath Facilities Removal EIS/EIR that emissions generated by the dam deconstruction and restoration activities under Proposed Action would result in a significant and unavoidable impact on the State's efforts to reduce GHG emissions as required by AB 32.

3.3.10 Geology, Soils, and Geologic Hazards

Environmental Setting

The analysis of Geology, Soils, and Geologic Hazards assesses the changes to geomorphology and the potential for shoreline landslides and erosion due to sediment transport processes within the Klamath River watershed. This analysis also assesses the potential for local sedimentation in eddies and other "dead" zones in the Klamath River channel, as well as the effects on the estuary both during and following dam removal activities. Finally, this section discusses the potential for impacts from geologic hazards such as seismology and volcanology in the project area.

The area of analysis includes the riverbed and reservoir banks at the sites of the Four Facilities as well as the riverbed and adjacent banks along the Klamath River downstream from Iron Gate Dam to its mouth at the Pacific Ocean.

The Klamath Basin lies at or near the convergence of three tectonic plates that influence the geologic setting of the region: the Pacific, Juan de Fuca, and North American Plates. Consequently, the Klamath River flows through four distinct geologic provinces, each of which changes the character of the river's channel morphology and its tributary watersheds, varying the supply of inputs such as water, sediment, nutrients, and wood (FERC 2007). The Upper Klamath Basin lies in the transition zone between the Modoc Plateau and Cascade Range physiographic

provinces, with the Klamath River cutting west through the Klamath Mountain province and then the Coast Range province where it reaches the Pacific Ocean near Requa, California (California Department of Conservation 2002).

In many ways the Klamath River is the reverse of most river systems. The headwaters flow through relatively flat, open country, and then flow through mountainous areas with input of water from the major tributaries. Accordingly, the river and major tributaries have less gradient and less velocity and energy upstream of Keno Dam, while downstream river reaches and major tributaries tend to have a steeper gradient and higher velocities and energy. The Klamath River from the Oregon-California State line to downstream from Iron Gate Dam is a predominantly non-alluvial, sediment supply-limited river flowing through mountainous terrain. Downstream from the dam and for most of the river's length to the Pacific Ocean, the river maintains a relatively steep, high-energy, coarse-grained channel frequently confined by bedrock. Much of the course of the river in the Klamath Hydroelectric Reach is bedrock controlled, interspersed with relatively short alluvial reaches; thus, the influence of the Four Facilities on river geomorphology within the project area and downstream is limited. Floodplain development is minimal, and wider valleys allowing alluvial channel migration processes are rare.

Impacts

The analysis looked at the erosion effects of construction activities on erosion. These effects were all found to be minor sources of erosion with the implementation of Best Management Practices (BMPs) that minimize construction erosion. Similarly the removal of recreational facilities would not affect sediment supplies, contribute substantially to erosion, or expose people or populations to geologic hazards.

Another impact of dam removal, the effects of drawdown on reservoir erosion and landslides, was found to be a temporary minor adverse impact due to the hardening of sediments left in the drained reservoirs and the revegetation of the reservoir area. Both hardening and revegetation would in the long-term stabilize the former reservoir sites and minimize future erosion.

The drawdown during dam removal could also increase erosion downstream of the Four Facilities. This erosion is expected to be minor and temporary because the proposed drawdown rates are consistent with the historical discharge rates from the reservoirs and would be adjusted depending on the water year; therefore, flow rates downstream from the dams are not anticipated to increase substantially above median historical rates, if at all. Discharges from the reservoirs would be similar to seasonal 10-year flood flows within the Hydroelectric Reach and below Iron Gate Dam.

Following dam removal, the reservoir sediment remaining would dry and could affect restoration activities and/or future road construction activities. Following dam removal an estimated 44 to 62 percent of the sediment in the reservoirs would remain and is expected to settle on the terraces of the new river channel. Initial sampling conducted on the sediment indicates that once dry, it has a tendency to crack and substantially decrease in porosity. With implementation of GEO-1,

dam removal would require geotechnical analysis of any proposed operation site or staging area within the old reservoir area by a qualified geologist to determine capability of the sediment. The sediment would be removed if necessary to produce acceptable sites. With implementation of this mitigation measure, this effect would be minor and less than significant.

New Information

Hydrology Changes without KBRA as a Connected Action:
The EIS/EIR evaluated and analyzed the potential environmental impacts of the Proposed Action (removal of J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate dams) on multiple Klamath Basin resources. To evaluate impacts to some resources (e.g. aquatic biota, water quality, flood plains, among others), assumptions were made about likely flow conditions before, during, and after dam removal in the EIS/EIR and other technical studies. These studies were completed using flow assumptions based on proposed operations under the KBRA (Reclamation 2012) because implementation of this agreement was connected to the KHSA, the Proposed Action.

Reclamation's Proposed Action for the 2013 Joint Biological Opinion was developed collaboratively by biologists and hydrologists with NMFS, USFWS, Klamath Basin Tribes, and Reclamation, and it is currently the standard to which the project operates. These relatively small flow differences are discussed in detail in *Changes to the Proposed Action* found in Section 3.2.1 of this document. The flows under this 2013 Joint Biological Opinion are slightly different from the KBRA Flows (Tables 4 and 5). Peak flows under the 2013 Joint Biological Opinion are similar to or less than peak flows under KBRA (Figure 9) during the winter and spring months when high-flow events are most likely and sediment/bedload transport is most active.

The Detailed Plan for dam removal assumes that the natural release of sediment to the Klamath River from the three larger reservoirs (J.C. Boyle, Copco, and Iron Gate) would be initiated on or soon after January 1, 2020. Based on a sediment transport model (Reclamation 2012) which assumes KBRA Flows, the largest loads and concentrations of suspended sediment will erode downstream from January through March 2020, but significant loads and high concentrations of suspended sediment would continue through May (Figure 8). Concentration of suspended sediment would peak at about 7,000 to 14,000 mg/L during drawdown, depending on water year type (Table 6). Because KBRA and 2013 Joint Biological Opinion flows for January through May are nearly identical for all water year types below Keno and Iron Gate dams (see monthly exceedance Figures 6 and 7), it is reasonable to conclude that the sediment transport model would produce nearly identical suspended sediment concentrations for this January through May time period if it were run with 2013 Joint Biological Opinion flows. Small differences in flows would have negligible impacts on suspended sediment concentrations.

Under wet, median and dry simulations, sand within the bed below Iron Gate Dam would increase to 30 to 35 percent by March to June following drawdown, gradually decreasing to

10 to 20 percent by September of the following year, while median substrate size (D50) would fluctuate slightly before finally stabilizing to approximately the initial condition with a D50 of 100 mm (Klamath Facilities Removal EIS/EIR, Appendix F). Longer-term (5, 10, 25, and 50 years) simulations show increases in the proportion of sand to 5 to 22 percent below the location of Iron Gate Dam and decreases in D50 to approximately 50 to 55 mm (Klamath Facilities Removal EIS/EIR, Appendix F) after 5 years and continuing through to year 50. In general, the effect of the Proposed Action will be a more dynamic and mobile bed downstream from Iron Gate Dam, with increased transport of sediment, and increased sediment supply, including an increased supply of spawning gravel. Because KBRA and 2013 Joint Biological Opinion flows for January through May are nearly identical for all water year types below Keno and Iron Gate dams, it is reasonable to conclude that the sediment transport model would produce nearly identical bedload sediment transport for this January through May time period if it were run with 2013 Joint Biological Opinion flows. Small differences in flows would have negligible impacts on bedload transport.

Conclusion

New hydrology remains similar in magnitude to that used in the Klamath Facilities Removal EIS/EIR. New information on Geology, Soils, and Geologic Hazards does not result in a change relevant to environmental concerns.

3.3.11 Tribal Trust

Environmental Setting

The federally recognized tribes in the study area include The Klamath Tribes, Quartz Valley Community, Karuk Tribe, Hoopa Valley Tribe, Yurok Tribe, and Resighini Rancheria. These tribes live along different reaches of the Klamath River and in different areas of the Klamath Basin. Each tribe has a unique history of its long-term occupation and use of the study area and establishment of its tribal government, reservations, rancherias, or other tribal lands. Each tribe has specific water supply, aquatic resources, and terrestrial resources considered Indian trust resources and/or traditionally used resources.

The Klamath Tribes

Among the anadromous fish The Klamath Tribes used as staple foods are fall and spring Chinook salmon, steelhead, Pacific lamprey, and possibly coho and sockeye salmon. These fish entered the Klamath Reservation along the drainages of the Sprague, Williamson, and Wood Rivers and were also found in the open waters of Upper Klamath Lake. Historically, The Klamath Tribes also depended on a variety of other resident fish species, primarily the adfluvial and resident rainbow trout, *c'waam* or Lost River sucker, and *koptu* or shortnose sucker, cutthroat trout, Klamath smallscale sucker, Klamath largescale sucker, Pit-Klamath brook lamprey, blue chub, tui chub, and speckled dace. Although the exact quantity of fish historically consumed by The Klamath Tribes is difficult to establish, anadromous salmonids were staple foods. Anadromous salmonids were the focus of extended multifamily fishing operations often lasting weeks or months, and were an important source of wealth and stability to The Klamath Tribes prior to the construction of Copco 1 Dam in 1918.

The construction of Copco 1 Dam blocked anadromous fish runs into the Upper Klamath Basin and abruptly ended The Klamath Tribes' access to all anadromous fish. Two other major fisheries, adfluvial and resident salmonids (trout) and Catostomids (suckers), could still be used by The Klamath Tribes after the demise of the anadromous fisheries. The catostomid fishery consisted primarily of *c'waam* (Lost River sucker) and *koptu* (shortnose sucker) until the Tribes closed their fishery in 1986 to protect it in the face of severe population declines.

Water quality and flows in the Klamath River and its tributaries associated with current dam operations are an important issue to The Klamath Tribes. Water conditions affect the ability of anadromous fish species to survive. The Klamath Tribes retain a right to instream water quantities at levels that are sufficient to support fishing and other harvest rights on former reservation lands, as affirmed in 1984 with the 9th Circuit Court of Appeals' decision in United States v. Adair, 723 F.2d 1394. A number of ritual traditions of The Klamath Tribes depend on access to clean water from natural sources, which is used in ritual purification of people, places, and objects, as well as in rituals associated with drought abatement and other environmentally restorative activities. However, the water of the Klamath River is widely viewed as inappropriate for these ritual uses because of the effects of the dams on water temperature, algae development, and other variables of water quality.

The current operations of the Klamath River dams have had a range of secondary effects on The Klamath Tribes. Among these effects are the decline of fish and wildlife in addition to the loss of cultural and social practices, diminished economic opportunity, and negative health effects resulting from dietary changes that became necessary with the loss of traditional food sources.

The Quartz Valley Community

The Quartz Valley Community does not have a reserved right to the Klamath River fishery. The tribe is not reliant on Klamath River water, nor does it retain Klamath River reserved water rights. The tribe's land base is not along the Klamath River but on a tributary to the Scott River, which is a tributary to the Klamath. Therefore, there are no primary effects on Quartz Valley trust resources although there are effects on Quartz Valley resources traditionally used by the tribe, health, and cultural values and wellbeing.

Traditionally used fish resources of the Scott River include Chinook salmon, coho salmon, steelhead and Pacific lamprey. The Quartz Valley Indian Reservation relies on these fish for sustenance and their spiritual well-being. These fish need to survive their migration through the Klamath River to and from the ocean. Therefore, the tribe has an interest in Klamath River health.

Karuk Tribe

Most of the Karuk Tribe's aboriginal lands lie along the Klamath River, upstream of the confluence with the Trinity River. Any fishing and concomitant water rights to which the Karuk Tribe may be entitled have not yet been determined. Regardless, the Karuk assert that an inability to use traditional resources affects their general health and well-being and cultural values.

Hoopa Valley Tribe
Current operations of the four Klamath dams likely affect resources traditionally used by the Hoopa Valley Indian Tribe. The Tribe's fishing rights are adversely affected to the extent that migrating fish must pass through approximately 42 miles of the Klamath River before turning up the Trinity River on their way to Hoopa Valley, where Hoopa tribal members participate in a subsistence fishery.

Yurok Tribe
A government-to-government consultation meeting concerning Yurok trust resources affected by current dam operations held on September 28, 2010, the Yurok Tribe asserted the following as Yurok trust resources: water, fish, land, wildlife, minerals, and timber. The Yurok Tribe asserted that the United States has a trust responsibility to protect such resources and ensure that such resources are managed for the beneficial use of the Tribe and its membership. The Yurok further assert that the Federal Government has other trust responsibilities to the Yurok in the areas of social welfare, education, and health. For example, Yurok believe that limited access to water, aquatic, and terrestrial resources has restricted the ability of Yurok to practice of some of their most important traditions. This includes freely fishing the once-prolific semi-annual salmon runs and participating in the cycle of ceremonies initiated concurrently. In the past, the Yurok were not inclined to leave their territory; currently, several factors, including an inability to meet subsistence needs from the fishery and a perception that the rivers are dirty, prompt younger tribal members to leave the area to find work (DOI 2011; DOI 2012).

The Yurok tribal chairperson, when asked if such trust resources were affected by the current dam operations, responded "Yes" and went on to relate that the Yurok understand that their resources are intricately interconnected to multiple ecosystems. The Yurok World Renewal Ceremonies, recently completed at the time of the meeting, were provided as an example of how Yurok understand and pray for the integrity of such ecosystems. The United States does not necessarily agree that all of the above resources are in trust (and therefore form the basis of a trust relationship), but the resources are important to the Yurok (and thus to the United States) for their traditional and ceremonial use.

Resighini Rancheria
In a government-to-government consultation meeting concerning Resighini Rancheria trust resources affected by current dam operations held on September 29, 2010, the Resighini Rancheria asserted the following as Rancheria trust resources: gravel (minerals); water as it relates to ground water for domestic, agricultural, and recreational (campground) uses; riparian plants; wetlands; fish; land; and wildlife. The Resighini Rancheria asserted that the United States has a trust responsibility to protect such resources and ensure that such resources are managed for the beneficial use of the Rancheria and its membership. The Rancheria further asserted that the Federal Government has trust responsibilities to the Rancheria in the areas of social welfare, education, and health. The United States does not necessarily agree that all of the above resources are trust resources but the resources are important to the Rancheria (and thus to the United States) for their traditional ceremonial use.

Any Klamath River salmonid fishing rights and concomitant water rights to which the Resighini Rancheria may be entitled have not yet been determined [Solicitor's Opinion M-36979 October 4, 1993]. Regardless, the general health and well-being and cultural values of the members of the Rancheria are affected by a lack of fish in the local economy and overall water quality. The lack of fish in the local economy also has secondary effects on general tribal health and cultural well-being. The Rancheria tribal council person, when asked during consultation if such resources were affected by the current dam operations, responded, "Yes" and went on to relate that water quality has declined, erosion of lands occurs at a higher rate, replenishment of gravel extraction beds has diminished, and fish returns are low. In addition, as a tribe that lives alongside the river, their aesthetic quality of life has diminished. The Rancheria people are at risk when they bathe in the river, tourists are less interested in visiting the Klamath River and staying in the campground, and in an area with fewer available fish, tribal members are likely to consume fewer traditional food resources. This has led to related impacts on tribal health such as higher rates of obesity, diabetes, heart disease, and stroke (DOI 2011; DOI 2012).

Impacts
Water, aquatic resources, and terrestrial resources which were and are used by The Klamath Tribes, Quartz Valley Community, Karuk Tribe, Hoopa Valley Indian Tribe, Resighini Rancheria, and Yurok Tribe occur in the Klamath River watershed. These resources are considered tribal trust assets. Implementation of the dam removal would, in the long term, benefit the trust resources and rights identified by the federally recognized tribes in the Klamath Basin.

New Information
The salmonid population modeling and water quality analysis completed for the Klamath Facilities Removal EIS/EIR included simulation of some of the effects of KBRA related to habitat restoration and water quality improvements. The benefits described in the tribal trust analysis included identification of the benefits of increased access to more abundant fish and cleaner water for tribal communities. The benefits to tribal communities would remain even if

the water quality improvements and fish populations increase more slowly due to a more limited fish reintroduction and stream restoration program.

Conclusion

Expiration of the KBRA reduces some benefits to tribal trust resources identified in the Klamath Facilities Removal EIS/EIR, as compared to the implementation of the KBRA and KHSA together. However implementation of KHSA and dam removal continues to provide benefits, albeit at a lesser degree, to water quality and fisheries. These benefits will improve the condition of water, aquatic, and terrestrial trust resources and rights identified by the federally recognized tribes. New information on tribal trust does not result in a change relevant to environmental concerns.

3.3.12 Cultural and Historic Resources

Regulatory Framework

For the Secretarial Determination, DOI elected to integrate compliance with Section 106 of the National Historic Preservation Act (NHPA) through the NEPA process, pursuant to 36 CFR Section 800.8(c)(1)-(4). Consequently, the preparation of the Klamath Facilities Removal EIS/EIR was used to evaluate and resolve the potential adverse effects of the Secretarial Determination possibly resulting in the removal of the four PacifiCorp dams. The mitigation measures presented in the EIS were developed for potential future use in a Programmatic Agreement to fulfill Section 106 compliance requirements for removal of the four PacifiCorp dams.

Area of Analysis

The area of analysis for cultural and historic resources was defined broadly as DOI elected to utilize the NEPA process to meet the requirements of Section 106 of the National Historic Preservation Act (NHPA) as allowed under 36 CFR Section 800.8(c). An area of potential effects (APE) was defined pursuant to Section 106 to represent the largest potential impact areas of all alternatives. The APE for the Secretarial Determination was defined as the Klamath River from the outlet at Keno Dam to the river's outlet at the Pacific Ocean (approximately 250 miles long), and extending outward for 0.5 miles from each bank of the river, plus a 0.5-mile-wide corridor from the high water mark surrounding each of the four reservoirs, and all four dams and associated facilities.

Prehistoric Resources

The history of human occupation along the Klamath River extends as far back as 12,000 years ago, based on archaeological evidence and Indian tribes' beliefs, traditions, and ceremonies (Cardno Entrix 2012). Relationships, interactions, and use of resources along the Klamath River, with salmon of high importance, are reflected in the documentation of cultural sites (approximately 650 sites), as well as in traditional and current use of the river and the area immediately surrounding it. Prehistoric cultural resources sites show evidence of short-term and long-term use in artifact scatters, camping and fishing sites, ceremonial sites, and village sites,

some with human burials. One large and several other Traditional Cultural Properties (a property with traditional cultural significance derived from the role it plays in a community's historically rooted beliefs) customs, and practices (Parker and King 1998), are identified as associated with the Klamath River (Cardno Entrix 2012). A "riverscape" is identified along the entire length of the Klamath River as a potential Traditional Cultural Property composed of cultural and natural (salmon) resources of historical importance to the Indian tribal communities who live along the river (Gates 2003, King 2004). Through consultations for this study, continued ceremonial and traditional use of places along the Klamath River were identified as of great importance to all Indian tribes who use the river.

Historic Resources

Euroamerican exploration of the Klamath Basin began in the early 19th century with a dramatic influx of Euroamericans in the 1850s due to the discovery of gold in California (Cardno Entrix 2012). Trails and roads were developed as travelers passed through or settled in the area. Communities sprang up, requiring supporting services such as farming, ranching, and logging. As mining proved less lucrative, logging and agriculture grew in importance. The Bureau of Reclamation's Klamath Project was authorized in 1905, and was developed to provide irrigation for farmlands in the Klamath Basin. With Upper Klamath Lake and storage created by Link River Dam as the principle water source, Reclamation's Klamath Project provides water to the Upper Klamath Basin, up river of the Four Facilities.

Initial hydroelectric development began in the Klamath Basin in 1891 to provide electricity to Yreka (Klamath Hydroelectric Project 2004). Four years later, the Klamath Falls Light & Water Company built a generating facility on the east bank of the Link River, known as Eastside Powerhouse, to supply power to Klamath Falls. These ventures soon attracted competitors. By 1912, the California-Oregon Power Company (Copco) consolidated hydroelectric development in the region. Subsequently, Copco built hydroelectric facilities Copco 1 and Copco 2 in 1918 and 1925, respectively. After World War II, regional population growth prompted new hydroelectric power expansion such as Copco's Big Bend (now J.C. Boyle) (1958) and Iron Gate (1962) developments. While Iron Gate was under construction, Copco was merged with Pacific Power & Light to become PacifiCorp, the current owners and managers of the Four Facilities. The Klamath Hydroelectric Project was identified as a historic district due to its association with the industrial and economic development of southern Oregon and northern California (Kramer 2003a and 2003b).

Known Cultural and Historic Resources in the APE

Record searches and archival research were conducted for the vicinity of the APE. Previously, 191 cultural resources surveys were conducted covering 30,746 acres (approximately 36 percent of the APE) and more than 680 sites were identified (Cardno Entrix 2012). Most of the surveys were conducted around Upper and Lower Klamath Lakes and on Yurok lands with very little survey coverage along the river itself. The majority of the sites within the APE are prehistoric sites associated with Indian occupation and use of the area. These sites include small lithic scatters, traditional fishing sites, ceremonial sites, and large village sites. The

historic sites within the APE are mostly related to the development of agriculture and hydroelectric power.

Impacts

The Proposed Action would result in direct effects/impacts to J.C. Boyle Dam, Copco 1 Dam, Copco 2 Dam, and Iron Gate Dam, their associated hydroelectric facilities, and on the Klamath Hydroelectric Historic District (KHHD), which is considered eligible for inclusion on the National Register and California Register. The Proposed Action would include removal of J.C. Boyle Dam, Copco 1 Dam, Copco 2 Dam, and Iron Gate Dam and their associated hydroelectric facilities on the Klamath River (refer to Klamath Facilities Removal Final EIS/EIR, Chapter 2 Proposed Action and Description of Alternatives for additional details). These four dams and a majority of their associated facilities are assumed to contribute to the KHHD, which is considered eligible for inclusion on the National Register and the California Register due to its role in early development of electricity and economy of the southern Oregon and northern California regions. All associated and related structures have yet to be evaluated but are likely to include such properties as miscellaneous structures that are associated with construction of the dams and transmission lines that may be eligible for listing on the National Register individually or as contributing to the KHHD. Under the Proposed Action all of the dams and associated facilities would be removed.

For the purpose of NEPA and CEQA, mitigation measures that include Historic Architectural Building Survey/Historic Architectural Engineering Report/Historic American Landscape Survey (HABS/HAER/HALS) documentation could be implemented for the removal of dams under the Proposed Action. However the intent of Proposed Action is to fully remove the dams, the KHHD, and much of the context for these historic resources. Therefore documentation such as HABS/HAER/HALS is the only feasible form of mitigation because avoidance and minimization measures would not be possible. As part of a conservative analysis, it has been determined that implementation of mitigation measures would not reduce impacts to historical resources to a less than significant level.

Under NEPA and CEQA, the Full Facilities Removal of Four Dams would cause a significant impact to J.C. Boyle Dam, Copco 1 Dam, Copco 2 Dam, and Iron Gate Dam, their associated hydroelectric facilities, and on the KHHD. After implementation of Mitigation Measure CHR-1, CHR-2, CHR-3, and CHR-4 impacts to the four dams and hydroelectric facilities and to the KHHD would remain significant and unavoidable. Mitigation Measures CHR-1broadly described would outline an approach for identifying, evaluating, and, where possible, minimize adverse effects to the KHHD. Mitigation Measure CHR-2 broadly described would outline an approach for identifying, evaluating, and, where possible, minimize adverse effects to other historic properties. Mitigation Measure CHR-3 calls for an approach for identifying, evaluating, and, where possible, minimize adverse effects to Traditional Cultural Properties (TCPs) and cultural landscapes for eligibility for listing on the National Register and/or California Register and Mitigation Measure CHR-4 requires development of stipulations and appendices in the PA to cover exposure, management, disposition, and treatment of human remains. Refer to Klamath

Facilities Removal Final EIS/EIR Section 3.13 Cultural and Historic Resources for additional mitigation measure information.)

The DRE or the designated lead Federal agency if the DRE is a non-Federal entity with authority over particular aspects of the detailed plans for the action alternatives, would continue consultation with Advisory Council on Historic Preservation (ACHP), SHPOs, THPOs, Indian Tribes and other consulting parties. In the event that the designated DRE is a non-Federal entity, the designated lead Federal agency will assume all responsibility to carry out the measures articulated herein. Up to and immediately following a decision on the proposed undertaking analyzed in this EIS, consultation will continue and in the short-term focus primarily on the development and preparation of a Programmatic Agreement (PA). The DRE will seek to execute the PA within one year from the issuance of a decision or as soon thereafter as is practicable. The purpose of the PA is to establish a process for the continued compliance with Section 106 of the NHPA wherein the DRE or lead Federal agency will carry out consultation for the definite plan on how to implement the action alternative. Such consultation, which will be established by the PA, prior to the approval of any activities that may directly or indirectly adversely affect historic and cultural resources, shall undertake planning and actions as may be necessary to avoid, minimize or mitigate adverse effects.

Reservoir drawdown associated with the Proposed Action could affect/impact archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register and/or California Register and possibly prehistoric and historic human remains. The Proposed Action includes a drawdown of the reservoirs behind the dams. The deconstruction process would begin by gradually drawing down the reservoirs through a controlled process using existing spillway gates, conveyance pipelines and canals, and diversion conduit (refer to additional details in Klamath Facilities Removal EIS/EIR, Chapter 2 Proposed Action and Description of Alternatives). Modeling studies indicate that drawdown would erode and flush stored sediment downstream during the three-month drawdown period. Afterwards, the river bed in the reservoir reaches is expected to stabilize. Once eroded from the reservoir, the fine sediment would continue to be suspended in the river water during the short term following dam removal, flowing downstream to the ocean. Large quantities of sediment would remain in place in the reservoirs after dam removal, primarily on areas above the active river channel. The remaining sediments would consolidate by drying out, resulting in a decrease in thickness. Following drawdown of the reservoirs, revegetation efforts would be initiated to support establishment of native wetland and riparian species on newly exposed reservoir sediment. Impacts from the drawdown potentially affecting cultural resources include erosion, changes in sediment, and changes in river flows. Cultural resource surveys to identify cultural resources were not conducted prior to inundation so, very little is known regarding the extent of cultural resources that would have been along the river and that would now be under water.

Few cultural resource surveys have been conducted along the Klamath River below Iron Gate Dam to Yurok lands at the mouth of the river. Sites identified along the river between Iron Gate Dam to its confluence with Shasta River include: one prehistoric artifact scatter; one prehistoric

camp site; one prehistoric fishing locale; one prehistoric burial; one historic habitation debris site; one historic structural and landscaping remains site; and one historic bridge. Traditional use locations for ceremonies, fishing, and other purposes were identified along the river during consultations. Due to the controlled release of water flows during reservoir drawdowns, impacts to these sites are not expected, particularly below the confluence with the Shasta River, as increased river elevations will be minimal and these sites have been exposed to historic flows since their original use. Indirect impacts may result afterwards from changes in the water flows.

The riverscape, a potentially eligible or significant cultural landscape, includes villages, hunting, gathering, fishing, and spiritual locations on terraces and benches along the river, as well as the river itself and its natural resources. The overall riverscape/cultural landscape would likely benefit from dam removal by restoring the river more closely to its original setting and facilitating the practice of important Indian traditional customs, ceremonies, and economic activities. However, sites associated with it could be adversely affected through erosion, sediment changes, artifact displacement, exposure, and vandalism. Relationships between the elements of the riverscape would change as the environmental and cultural setting changes from one of dams and reservoirs back to one of a free-flowing river. The impacts of these changes are not easily assessed and will likely require surveys, research and consultations with Federal agencies, Indian tribes, Native Americans, and other interested parties to determine the effects. The same can be said of other TCPs and cultural landscapes, prehistoric or historic, which have been identified in general terms but not yet specifically identified or recorded.

Under NEPA and CEQA, reservoir drawdown would cause a significant impact to archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register and/or California Register and possibly Native American and non-native human remains. After implementation of Mitigation Measures CHR-1, CHR-2, CHR-3, and CHR-4 impacts to archaeological and historic sites, TCPs, and cultural landscapes would be mitigated to a less than significant impact.

Construction activities including use of haul roads and disposal sites for demolition debris, removal and relocation of recreational facilities, relocation of the City of Yreka water supply line, under the Proposed Action could affect/impact archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register or California Register. Ground disturbing activities associated with construction activities will likely have both direct and indirect effects/impacts on historic properties/historical resources. The debris from the demolition of the dams and facilities would be hauled to disposal sites. Modifications of the proposed haul roads and use of disposal sites could affect/impact sites that are located along the haul roads and/or at the disposal sites.

Under NEPA, construction activities would cause a significant impact to archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register and/or California Register and possibly prehistoric and historic human remains. After implementation of Mitigation Measures CHR-1, CHR-2, CHR-3, and CHR-4 impacts to

archaeological and historic sites, TCPs, and cultural landscapes would be mitigated to a less than significant impact.

The Transfer of Keno Dam to the DOI would likely be a beneficial effect because the facilities would be subject to Federal regulation**.**

The decommissioning of the East and Westside Facilities could have adverse effects on historic resources or historic properties. Decommissioning of the Eastside and Westside canals and hydropower facilities by PacifiCorp as a part of the KHSA would eliminate the need for diversions at Link River Dam into the two canals. Following decommissioning of the facilities there would be no change in outflow from Upper Klamath Lake or inflow into Keno Impoundment/Lake Ewauna. Decommissioning does not typically involve deconstruction of the facilities. Instead, buildings and equipment that are too large to easily remove or fixed in place are usually fenced to prevent entry. Any deconstruction and removal of facilities would be analyzed in future environmental analyses. For this reason there would be a de minimus adverse effect on cultural resources.

New Information

Cultural and historic resources were identified through archival research and record searches and Native American consultations for the entirety of the APE. In addition, through archival and background research, consultations, and knowledge of known resources, the types of historic properties likely present in unsurveyed and inaccessible areas (primarily areas currently inundated by the reservoirs) were characterized. No new information is known that would add to or change the types of historic properties known or expected to be present in the APE. No new information regarding cultural resources has been identified related to the effect of dam removal, Keno Transfer, Eastside/Westside Decommissioning, and City of Yreka's Water Supply Pipeline Relocation and Cultural and Historic Resources.

Conclusion

No additional information has been identified cultural and historic resources relevant to the effects of dam removal, Keno Transfer and Eastside/Westside Decommissioning that was not already included in the analysis published in the Klamath Facilities Removal Final EIS/EIR. New information on cultural and historic resources does not result in a change relevant to environmental concerns.

3.3.13 Land Use, Agricultural and Forest Resources

Environmental Setting

The land use area was defined as lands encompassed by the FERC boundary identified in the FERC EIS (2007), surrounding lands that could be affected by implementation of the Amended KHSA and private lands adjacent to the reservoirs and the Klamath River downstream from the reservoirs to the estuary that would be affected by the removal of the dams and loss of the reservoirs.

The Four Facilities that would be removed are in two counties, Siskiyou in California and Klamath in Oregon, and are not within any incorporated cities. The area of analysis includes the areas adjacent to the Four Facilities. The City of Yreka is included because its water supply facilities would be affected by the Proposed Action. In addition, lands downstream from the Iron Gate Dam that may be subject to flooding with or without the dams were identified (see Klamath Facilities Removal Final EIS/EIR Appendix J, "Modeled Changes to the 100 Year Flood Plain" for maps).

PacifiCorp also owns approximately 8,000 acres in Klamath County and Siskiyou County that are associated with the Klamath Hydroelectric Project and/or included within the FERC project boundary. The Amended KHSA describes this property as Parcel B lands. Of these lands, approximately 2,000 acres are currently inundated by the reservoirs.

According to the Amended KHSA, Parcel B lands would be transferred to the respective States (Oregon or California) or a designated third party, before facility removal. Lands owned by the State and Federal Government would not be subject to local zoning laws and regulations. The transferred lands would be managed for public interest purposes such as fish and wildlife habitat restoration and enhancement, public education, and public recreational access. The Amended KHSA provides an option that would invoke the "meet and confer" provisions to allow for other uses. The States have no detailed plans but indicate that the approximately 2,000 acres of inundated lands would be restored to natural conditions consistent with the intent of improving fisheries in the Klamath Basin.

In addition to the above categories of lands, the Amended KHSA identifies three parcels (Eastside/Westside generating facilities lands) that may be transferred to DOI, near Klamath Falls, Oregon upon decommissioning.

Impacts

Activities defined in the Proposed Action would change current uses of the Parcel B lands in the vicinity of J.C. Boyle Dam from rural industrial to non-resource. Land use designations around the other reservoirs would not be changed as existing designations would be consistent with potential future land uses. Activities defined in the Proposed Action would not conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project adopted for the purpose of avoiding or mitigating an environmental effect.

Applicable plans and policies would not be affected by the Proposed Action, because the inundated lands in Siskiyou County already have zoning and land use designations that would not change once they are no longer inundated (Plucker 2011). In Klamath County, formerly inundated lands would require new land use designations and zoning, the designation of which would likely not conflict with any adopted plans or policies (Gallagher 2011). Private lands adjacent to the reservoirs would not have a land use change; however, those lands would no longer be adjacent to inundated land with reservoir views and that is currently used for water-based recreational purposes. In the future other land-based recreational uses could occur on the

publicly owned property. Although the land use designations and zoning would not change *per se*, the functional use of the area would change and would be noticeable to the private property owners.

Implementation of the Proposed Action would not involve directly converting farmland to non-agricultural uses, would not conflict with existing zoning or Williamson Act contracts, or convert forest land or forest uses surrounding the reservoir.

Dam decommissioning and removal would require the creation of temporary roads, staging areas and construction sites. Although existing roads provide access to the Klamath Hydroelectric Project facilities, new roads would be needed during deconstruction activities. Temporary construction roads and staging sites would also be required during dam removal activity (see Chapter 2). Permanent disposal sites would be needed near the dams on lands currently designated open space and/or conservation. Site access for restoration activities would require construction of temporary gravel access roads and storage pads. Because these temporary roads would be built on lands designated for industrial (dam) or open space use or on currently inundated lands, and could be returned to their original or alternate use following deconstruction, construction of the roads would not conflict with applicable plans and policies or otherwise cause a significant land use impact.

Permanent roads associated with achieving public access to the river would be addressed as part of the recreation plan (mitigation measure REC-1). REC-1 describes the development of new comparable recreational facilities and supporting infrastructure near the banks of the Klamath River after dam removal. However, those roads would not constitute a significant land use impact because they would not take agricultural or forest lands out of production.

New Information

No new information has been identified related to the effect of dam removal, Keno Transfer and Eastside/Westside Decommissioning on land use, agricultural, and forest resources.

Conclusion

No additional information has been identified relevant to land uses and the effects of dam removal, Keno Transfer and Eastside/Westside Decommissioning that was not already included in the analysis published in the Klamath Facilities Removal Final EIS/EIR. New information on land use, agricultural, and forest resources does not result in a change relevant to environmental concerns.

3.3.14 Socioeconomics

Environmental Setting

The modeling package used to assess the regional economic impacts from the expenditures associated with each alternative was IMPLAN (IMpact analysis for PLANning). IMPLAN is a commonly used, industry accepted economic input-output modeling system that estimates the effects of economic changes in a defined analysis area. MIG, Inc. developed the

IMPLAN modeling system. This analysis in the Klamath Facilities Removal EIS/EIR used the Version 3.0 system, which was released in November 2009.

The Klamath Facilities Removal EIS/EIR reports regional economic total effects in terms of employment, labor income, and output. IMPLAN defines these parameters as follows:

- Employment – Number of jobs, a job can be full-time, part-time, or temporary.
- Labor Income -All forms of employment income, including employee compensation (wages and benefits) and proprietor income.
- Output -Value of industry production. In IMPLAN these are annual production estimates for the year of the data set.

Using IMPLAN, the evaluation of the proposed action in the Klamath Facilities Removal EIS/EIR presented quantified results for regional economic effects from changes in expenditures or revenues associated with:

- Dam decommissioning, operation and maintenance (O&M), mitigation
- Commercial fishing
- Reservoir recreation
- Ocean sport fishing
- In-river sport fishing
- Whitewater recreation

Dam Decommissioning, Operation and Maintenance (O&M), Mitigation

Deconstruction of the dams would result in economic effects in Siskiyou and Klamath Counties. Deconstruction or construction activities would create jobs and generate additional economic activity within the region during the period of construction. Direct effects represent equipment rentals, purchase of materials, and payment for labor.

An important consideration in evaluating regional economic effects is how much money is spent within the region for construction supplies and equipment, and how many workers are employed that originate from the region. Costs for dam decommissioning were divided into expenditures that would be made inside and outside of Siskiyou and Klamath counties. The expenditures assumed to be spent within the counties were used in IMPLAN to estimate employment, labor income, and output from dam decommissioning. Dam decommissioning expenditures made outside the analysis area would have no impact on the local economy.

Reclamation estimated total dam decommissioning costs and allocated the costs associated to within-region expenditures. Dam decommissioning costs assumed to be spent within the region are described in more detail in the Benefit Cost and Regional Economic Development (RED)

Technical Report (Reclamation 2012a).The analysis assumed that the onsite construction workforce would be hired from within the region. Some workers would be brought into the region from outside areas. Money from out-of-region workers spent on goods and services within Siskiyou and Klamath Counties contributes to regional economy, while money that originates from in-region workers is much less likely to generate regional economic effects because spending from sources within the region represents a redistribution of income and output.

Commercial Fishing

The estimates of gross revenue used in this analysis are based on relative projections of Klamath River Chinook salmon harvest provided by the Evaluation of Dam Removal and Restoration of Anadromy (EDRRA) model (Hendrix 2011). The EDRRA model is a simulation model that provides 50-year projections of Klamath River Chinook salmon escapement and harvest under the alternatives. The EDRRA harvest projections pertain to Klamath River Chinook salmon and do not distinguish between spring and fall runs. Harvest is estimated for each simulated year on the basis of a new Klamath River fall Chinook salmon harvest control rule recommended by the PFMC to the NOAA Fisheries Service in June 2011. The model allocates total Klamath River Chinook salmon harvest among fisheries as follows: 50 percent to tribal fisheries, 7.5 percent to the in-river recreational fishery (up to a maximum of 25,000 fish – with any surplus above 25,000 allocated to escapement), 34 percent to the ocean commercial fishery, and 8.5 percent to the ocean recreational fishery. The 50/50 tribal/non-tribal split is a "hard" allocation specified by the United States Department of the Interior (DOI) (1993). The remaining allocations are "soft" allocations as they represent customary practice rather than mandatory conditions.

Recreation

Depending on the recreation activity, visitors typically spend money on guide fees, food, hotels, restaurants, gasoline, equipment rentals, and/or other supplies required for outdoor activities. Any change to recreation opportunities that would result from implementation of the Proposed Action or alternatives would affect visitor spending and the region's economy. Increases in recreation spending would be considered a positive effect and decreases would be an adverse effect. This recreation economic impact analysis evaluates potential changes in direct visitor spending for recreation activities and subsequent, secondary economic effects. Estimates for changes in number of visitors and daily visitor spending are needed to calculate total reduction in recreation expenditures. IMPLAN is used to evaluate secondary effects in the regional economy. The recreation activities considered included reservoir recreation, ocean sport fishing, in-river sport fishing, and whitewater recreation.

Reservoir Recreation

Within region reservoir recreation expenditures per visit were obtained from the recreation survey presented in the PacifiCorp (2004) report. The expenditure information was gathered by expenditure category such as accommodations, food, gas, supplies and guide fees. This analysis assumes an average of $15.35 per visit. Changes to average annual within region, nonlocal

visitor expenditures were run through IMPLAN to estimate regional economic effects associated with the Full and Partial Facilities Removal Alternatives.

Ocean Sport Fishing

The ocean sport fishing information is taken directly from analyses contained in Reclamation (2012b) and NOAA Fisheries Service (2012h). This analysis focuses on economic effects of expenditures for ocean sport fishing in the KMZ-CA and KMZ-OR (where the effects of Klamath River fall Chinook salmon abundance are largely felt). Expenditures within the region by resident and nonresident anglers generate economic activity measured in terms of industry output, labor income, and employment. A basic assumption underlying this analysis is that any increase in expenditures by resident anglers associated with expanded fishing opportunities would be accommodated by reducing expenditures on other locally purchased goods and services, with no net change in local economic activity. For nonresident anglers, however, increases in local expenditures associated with increases in local fishing opportunities would be accomplished by diverting money that they would otherwise spend in their area of residence. Thus the economic analysis focuses on nonresident angler expenditures, which represent 'new money' whose injection serves to stimulate the local economy.

In-river Sport Fishing

The in-river sport fishing information is taken directly from analyses contained in Reclamation (2012b) and NOAA Fisheries Service (2012g). For the in-river salmon fishery, the affected area includes Klamath, Siskiyou, Humboldt, and Del Norte Counties. The three California counties cover the current location of the in-river salmon and steelhead fisheries; Klamath County covers the area above the dams where salmon and steelhead could potentially recolonize under the action alternatives. Details regarding the methods, assumptions, and conclusions underlying this analysis are in the In-River Sport Fishing Economics Technical Report (NOAA Fisheries Service 2012g).

Whitewater Recreation

The affected area for whitewater boating is defined as Jackson, Klamath, Siskiyou, and Humboldt Counties. Klamath River users that engage in whitewater boating recreation spend money in the region purchasing gas, food and drink, lodging, guide services, and other items. The expenditures associated with these trips generate economic activity measured in terms of total industry output, labor income, and employment within the four county economic region.

Expenditures per user day are differentiated by private and commercial users, where commercial use is associated with the use of a whitewater boating outfitter. Whitewater boating outfitter fees vary among upper Klamath River and lower Klamath River trips and private and commercial trips. Expenditures other than outfitter fees (e.g., accommodations, food, gas, supplies, and shuttle services) were based on Johnson and Moore (1993) and inflated to 2012 dollars.

Property Values
All else equal, the removal of the Four Facilities including loss of the reservoirs could impact real estate values of parcels surrounding Copco 1 and Iron Gate Reservoirs in Siskiyou County. Dam removal could also potentially affect the value of parcels near and adjacent to the Klamath River downstream from Iron Gate Dam due to improved water quality and more robust runs of anadromous fish. The discussion in this EIS/EIR considers potential effects on reservoir and riverine property values qualitatively. Studies have shown that amenities provided by proximity to a lake have a positive correlation with land values (See Klamath Facilities Removal EIS/EIR Section 3.15.3.6). Thus, the loss of reservoirs could result in declines in private land values. The net value of these changes, and the time over which such changes might be observed in market prices, is uncertain.

In concept, to evaluate impacts on real estate values, one would collect market sales data for different properties with different characteristics, which would include "view amenities." This data would include market values for land that had reservoir views, river views, and no views. All else equal, the difference in the land values for properties with different amenities would represent the impacts of such amenities on real estate values. This is a challenging exercise in thin markets, where limited data inhibit revelation of market preferences, and where other external factors affecting real estate markets may mask or overwhelm the effects of dam removal.

PacifiCorp Property Taxes
This analysis discusses effects to county property tax revenues qualitatively. PacifiCorp pays property taxes to Siskiyou and Klamath counties. After dam removal, the States of California and Oregon would assume payment of property tax assessments in the form of in-lieu fees for the lands underneath and adjacent to the reservoirs that will come under State management. In-lieu fees would be equivalent to the current assessment paid by PacifiCorp for hydroelectric properties, as defined by California Fish and Game Code Section 1504 and Oregon Revised Statutes Section 496.340.

Impacts

Dam Removal
Construction activities associated with dam removal would increase economic output, employment, and labor income during the construction period in Klamath and Siskiyou counties. Effects from dam decommissioning expenditures would occur for one year in 2020. The costs for full facility removal would be approximately $178.4 million[6] in 2012 dollars. Not all dollars

[6] Dam removal as described in this EIS/EIR would occur from May 2019 through December 2020. For this socioeconomic analysis, all effects have been described in 2012 dollars to compare economic effects of alternatives. These costs for facilities removal should not be considered a most probable cost estimate for dam removal in 2020. For a more detailed analysis of the cost of dam removal please see Detailed Plan for Dam Removal – Klamath River Dams, July 2012.

would be spent within the region. Approximately $114.3 million of $178.4 million would be spent in Klamath and Siskiyou Counties. Dam decommissioning would support approximately 1,400 jobs and generate approximately $60 million in labor income and $163 million in output. Most economic effects would be in the sector where the direct impact occurs. For dam deconstruction expenditures, this analysis assumes direct effects would mostly occur in the construction sector.

Employment created in this sector would be full and part time jobs and include contractors and subcontractors directly engaged in construction operations (such as equipment operators, drillers, carpenters, electricians, mechanics, apprentices, skilled and unskilled laborers, truck drivers, on-site record keepers and security guards), and any of their related office or administrative staff (in executive, purchasing, accounting, personnel, professional, technical activities and routine office functions, and supervisory employees). The Proposed Action would result in short term positive effects to output, employment, and labor income in the region relative to the No Action/No Project Alternative. Effects would only occur during the construction period.

Operations and Maintenance of Hydroelectric Facilities

The Proposed Action would not require any long term annual O&M expenditures for operation of hydroelectric facilities. As a result, there would be a decrease in expenditures in the region under the Proposed Action relative to the No Action/No Project Alternative. The regional economy would lose 49 jobs, $2.05 million in labor income and $5.19 million in output relative to the No Action/No Project Alternative. For reduced O&M expenditures, this analysis assumes direct effects would occur in the construction sector. Employment created in this sector could be full time or part time and include various types of jobs, such as engineer, management, and administrative jobs. Reduction of O&M associated with the Four Facilities under the Proposed Action would result in adverse, long-term economic effect on employment, labor income, and output in the regional economy relative to the No Action/No Project Alternative.

Dam Removal Mitigation

Mitigation spending after the deconstruction period could increase economic output, employment, and labor income in the regional economy. Spending on mitigation would occur within the region after construction is complete. Mitigation would generally include repaving roads, replanting vegetation, restoring river banks, and monitoring. Not all mitigation dollars would be spent within the region. Klamath County has highway, street, and bridge construction companies that provide asphalt and asphalt products for road construction. Siskiyou and Klamath counties also have county road crews. Much of the roadwork could be done by local workers and businesses. Local workers could also provide much of the replanting and habitat restoration required for mitigation.

Mitigation spending would be temporary and would vary year by year from 2018-2025. Spending would increase employment, labor income and output in the region. Approximately 220 jobs, $10 million in labor income, and $31 million in output between the years 2018-2025 would be generated by mitigation expenditures for the Proposed Action. For mitigation

expenditures, this analysis assumes direct effects would occur in the construction sector. Employment created in this sector could be full time or part time and include construction, management, administrative and other types of jobs. The Proposed Action would result in positive, temporary effects to employment, labor income, and output during the mitigation period (2018-2025) relative to the No Action/No Project Alternative.

After construction and mitigation activities are complete, there would no longer be increased spending or employment in the region as a result of the Proposed Action. Some longer term monitoring activities would continue, but it would be substantially less than spending during the construction period. Output, employment, and labor incomes within the region would largely return to levels prior to construction. Some wholesale suppliers, retail businesses, hotels, motels, and restaurants that served the influx of construction workers would have increased profits for potential investments, but sales would return to pre-construction levels. Mitigation activities would return most resources, such as roads and public utilities, to at least pre-construction conditions.

Commercial Fishing

Increases in commercial fishing harvests would increase fishing revenues and associated jobs, labor income, and output in the regional economy. The Proposed Action would restore a more natural Klamath River flow regime and improve and expand spawning and rearing habitat for salmon on the Klamath River, which would benefit salmon populations. Commercial fishing landings would increase because of increased salmon abundance, which would increase fishing revenues. The differences range from about $114,000 in KMZ-OR to $3.9 million in San Francisco (Reclamation 2012b, NOAA Fisheries Service 2012a).

Additional employment would range from 11 to 218 jobs, labor income would increase between $0.06 million to $2.56 million, and output would increase from $0.13 million to $6.6 million compared to the No Action/No Project Alternative. Most employment, labor income, and output effects would occur in the agricultural sector of the regional economy. Employment created in this sector could be full time or part time and include various types of services, such as fishing, provision of fuel, bait, and ice, and other supporting jobs. Increases in fish landings and revenues under the Proposed Action would have a long term, positive impact on employment, labor income and output in the regional economy relative to the No Action/No Project Alternative. It is also important to note that the Proposed Action would reduce the incidence of low abundances and associated adverse economic impacts on the troll fishery.

Reservoir Recreation

Dam removal would eliminate in-reservoir recreation activities, which could reduce recreational expenditures and affect employment, labor income, and output in the regional economy. Under the Proposed Action, dam removal would eliminate reservoir recreation activities in the short and long term. This analysis assumes the loss of recreation at Copco 1, Iron Gate, and J.C. Boyle Reservoirs under the Proposed Action relative to the No Action/No Project Alternative.

This analysis assumes an average annual reduction of 40,901 visits under the Proposed Action relative to the No Action/No Project Alternative. The change in average annual expenditures would be a reduction of $627,838. Most employment, labor income, and output effects would occur in the services sector. Employment affected in this sector could be full time or part time. Lost reservoir recreation would be a long term adverse effect to the regional economy under the Proposed Action relative to the No Action/No Project Alternative.

Ocean Sport Fishing

Changes to ocean sport fishing recreation opportunities could affect recreational expenditures in the regional economy. Increased salmon populations would attract more ocean recreational fishing effort, which would increase spending in the regional economy. Klamath Facilities Removal EIS/EIR summarizes annual salmon fishing effort (in total and by nonresident anglers) and nonresident angler expenditures for the Proposed Action (Reclamation 2012b, NOAA Fisheries Service 2012h).

The Proposed Action would support and increase in regional activity because of increased angler expenditures. Most employment, labor income, and output effects associated with ocean sport fishing would occur in the services sector. Employment created in this sector could be full time or part time. Recreational expenditures for ocean sport fishing would increase under the Proposed Action relative to the No Action/No Project Alternative, which would increase employment, labor income and output in the region. Effects would be long term.

In-River Sport Fishing

Changes to in-river sport fishing opportunities associated with dam removal could affect recreational expenditures in the local economy. Annual salmon fishing effort on the Klamath River is estimated at 26,578 angler days under the Proposed Action. The portion of this effort attributable to nonresident anglers is 17,036 angler days. Expenditures in the region by nonresident anglers are estimated at $1.789 million (2012 dollars). The annual increase in nonresident expenditures under the Proposed Action relative to Alternative would be $127,000.

The Proposed Action would result in increased numbers of steelhead spawners and provide conditions conducive to establishment of a steelhead fishery above Iron Gate Dam (Hamilton et al. 2010). However, because these changes were not quantified, it is not possible to quantify the effects of the Proposed Action on the steelhead fishery. However, expansion of that fishery would likely generate additional expenditures, jobs, labor income, and output in the regional economy.

The Proposed Action would result in increased abundance and distribution of redband trout in Upper Klamath Lake and its tributaries and a potential seven-fold expansion of the fishery below Keno Dam (Buchanan et al. 2011). The effects of this increase could not be quantified with available data but would likely yield a notable increase in economic impacts, given the size of the potential increase in the fishery noted.

Whitewater Boating

On the upper Klamath River, the average number of days with acceptable flow conditions for whitewater boating in the Hell's Corner Reach would decrease under the Proposed Action. The Hell's Corner Reach is somewhat unique in the project area in that it provides Class V rapids during the late summer months. Analysis of predicted hydrology modeling shows that the average number days with acceptable flows for primarily commercial whitewater boating on the Hell's Corner Reach are estimated to decline significantly. The combination of the decline in the number of days with acceptable flows, particularly during the three months when most of the use is observed (June, July, and August), and the lack of consistency and predictability of days with acceptable flows could make it more challenging for outfitters to continue offering trips for this reach of the Upper Klamath River in the future, and to a lesser extent also make it more challenging for private users to engage in whitewater boating activities. Therefore, it is assumed whitewater boating activity on the upper Klamath River would be negatively affected under the Proposed Action for the long term.

The economic analysis for the lower Klamath River assumes that there would not be a measurable change in visitation levels for whitewater boating on the lower Klamath River after dam removal. Whitewater boaters would continue to spend money in the local economy. Expenditures would be similar to existing levels described for the No Action/No Project Alternative.

The loss of whitewater boating activity on the upper Klamath River (primarily the Hell's Corner Reach) would result in losses in expenditures and regional economic activity in the local region as compared to the No Action/No Project Alternative. Annual losses would begin in 2020. The difference in total average annual user days between the Proposed Action and the No Action/No Project Alternative was estimated at 2,706 user days. The difference in average annual lost expenditures between the Proposed Action and the No Action/No Project Alternative was estimated as $701,170. Most employment, labor income, and output effects associated with whitewater boating would occur in the services sector. Employment created in this sector could be full time or part time. Reduced whitewater boating expenditures would result in long term adverse effects to the regional economy under the Proposed Action relative to the No Action/No Project Alternative.

Indian Tribes

Dam removal would increase the harvest of fish for subsistence purposes, cultural practices, and commercial uses by Indian Tribes residing on the Klamath River (and perhaps by the Hoopa Valley Tribe, which resides on the Trinity River). Tribal harvest opportunities for Chinook, Pacific lamprey and steelhead are expected to increase in varying degrees under the Proposed Action relative to the No Action/No Project Alternative. Removal of the reservoirs behind the dams would reduce or eliminate the incidence of late-summer, toxigenic phytoplankton blooms that have prompted postings of public health advisories in the Hydroelectric Reach and further

downstream on the Klamath River. These water quality improvements would have beneficial effects on tribal cultural practices in the affected areas.

PacifiCorp Hydroelectric Service

Removal of the Four Facilities could result in increased energy rates for PacifiCorp customers. PacifiCorp has added an approximately 2 percent surcharge to customer rates in Oregon and California to cover costs of dam removal. Under the Klamath Hydroelectric Settlement Agreement (KHSA), ratepayer liability is capped at $200 million, prorated between PacifiCorp's customers in Oregon (up to $184 million) and California (up to $16 million). The Oregon Public Utility Commission and California Public Utility Commission issued rulings that approved dam removal surcharges for PacifiCorp customers in Oregon and California (OPUC 2010, CPUC 2011). Under the Proposed Action, customer rates would not likely increase above the existing surcharges as a direct result of dam removal costs.

Property Values and Local Government Revenues

Removal of the Four Facilities could affect property values of parcels near Copco 1 and Iron Gate Reservoirs. Private parcels with partial reservoir views, frontage/access or with river views subsequent to the action could be affected by the Proposed Action.

To address issues specific to the Proposed Action, the two valuation impact studies for private parcels at Copco 1 and Iron Gate reservoirs were completed, one in March 2011 (Bender Rosenthal Inc. 2011) and a second in June 2012 (Bender Rosenthal Inc. 2012). The studies looked at three baseline dates of property values; the June 2012 study reported on December 2004 and December 2006 dates of value and the March 2011 study reported on an April 2008 date of value.

The studies included private parcels with reservoir views of Iron Gate Reservoir and private parcels with reservoir views and frontage on Copco 1 Reservoir. These two groups of properties could be affected by dam removal due to a change in either reservoir view or frontage after the dams are removed. Parcels were excluded from the initial list of potentially impacted properties if they were (1) publicly owned; (2) PacifiCorp owned; (3) had no assessed value; (4) in an area influenced by river (i.e., had river views prior to dam removal, and would therefore not be impacted by losing a reservoir view); and/or, (5) above the reservoir ridge (i.e., too far from the reservoirs to be affected by dam removal). Based on these criteria, the study identified 1,467 parcels that potentially could be affected by the removal of Iron Gate and Copco 1 reservoirs (Bender Rosenthal Inc. 2011). Of the 1,467 parcels, about 46 percent (668) were determined to have a measurable effect from dam removal. Parcels determined not to have a measurable impact from dam removal included those that were larger than 50 acres, located east of Copco Bridge (i.e., parcels with river frontage under existing conditions), determined unbuildable, or had no view of the reservoirs. Table 3.15-52 shows potentially affected private parcels by land use category. A majority of the applicable private parcels are vacant residential land and single-family residential. The assessed land value of the potentially affected parcels was about $9.0 million (Bender Rosenthal Inc. 2011).

While the Bender Rosenthal Inc. reports (2011, 2012) used data from individual parcels, the appraisal was completed for groups of parcels based on common attributes and/or physical characteristics. Parcels were grouped according to water-frontage, access (property access by paved road as well as to utilities), and location. To evaluate the impact of dam removal on private properties around Iron Gate and Copco 1 reservoirs, this study used a before dam removal condition and a hypothetical after dam removal condition. The after dam removal condition assumed that the dams were removed and the river had returned to its original channel with the land under the reservoirs restored to its native condition. It is anticipated that land values would reach a low point soon after the reservoirs were drained and that they would progressively increase in value over time until the terraces above the river are revegetated and the river channel is fully recovered. The differences in land value through time in this interim period could not be quantified, and the amount of time it would take for a fully recovered river channel to develop is unknown, but would likely take years.

The valuation assessment considered reservoir frontage in the before dam removal condition to change to river view in the after dam removal condition. Similarly, reservoir view in the before dam removal condition was assumed to change to no reservoir view or river view in the after dam removal condition. Each of these comparisons was completed for 2004, 2006, and 2008. The study identified a discount in land value based on reservoir view to no view and reservoir frontage to river view. However there was only a very limited amount of data for the three years examined.

Riverine water quality improvements are likely to have little effect on the value of reservoir parcels, which are not generally expected to become riverfront properties after dam removal. Available data are insufficient to quantify such short-and long-term effects. Riverine parcels in areas downstream from Iron Gate Dam that experience detectable improvements in water quality and/or fish availability may experience positive changes in value. However, available data are insufficient to quantify such effects (DOI 2012a).

Reservoir real estate values are expected to decline in the short term due to adverse landscape changes associated with dam removal. This loss in value may be partially offset over the long term as barren landscape becomes revegetated open space. However, some of this loss would be permanent as a shift from reservoir view to no view or from reservoir frontage to river view would make a parcel less desirable.

Changes in real estate values around Copco 1 and Iron Gate Reservoirs and downstream from Iron Gate Dam could affect property tax revenues to Siskiyou County. In the short term, if reservoir property values decline, there could be adverse effects on property tax revenues to Siskiyou County. In the long term, if some reservoir land values permanently decline, Siskiyou County property tax revenues might decline relative to the No Action/No Project Alternative, assuming nothing else changes that might impact property tax revenues (e.g., tax rates). If riverine property values downstream from Iron Gate Dam increase in the long term, tax revenues

to Siskiyou County could increase and at least partially offset the loss of tax revenues associated with the decline in reservoir property values. Effects on property values are uncertain in the long term; therefore, it is unknown how property tax revenues would be affected.

Removal of the Four Facilities could affect property tax revenues to Siskiyou and Klamath Counties from PacifiCorp. PacifiCorp owns property around the reservoirs and pays property taxes annually to Siskiyou and Klamath Counties. PacifiCorp pays in the range of $290,000 to $305,000 in property taxes on land attributable to hydroelectric facilities at Copco and Iron Gate Dams and about $132,000 in property taxes for land attributable to hydroelectric facilities at J.C. Boyle Dam. Under the Proposed Action, the States would assume ownership of these lands and PacifiCorp would not pay property taxes on the relinquished land to the counties.

The States of California and Oregon would pay in-lieu payments on the transferred land. In California, in-lieu fees would be equivalent to the current assessment paid by PacifiCorp for hydroelectric properties, as required by California Fish and Game Code Section 1504. To make in-lieu payments to counties, the California legislature has to authorize payments. It is unknown if the California legislature would authorize payments in future years. Lost tax revenues to Siskiyou County would be an adverse economic effect. Similar to California, Oregon law (State Wildlife Fund Section 496.340) requires the State to pay the current assessed value on transferred lands. The State Department of Revenue can review and revise assessed values if it is determined substantially incorrect.

The loss in tax revenue from PacifiCorp owned lands would impact the regional economy. However, if Siskiyou and Klamath Counties receive in-lieu payments of equal value to PacifiCorp property tax payment, there would be no net effect to county revenues under the Proposed Action relative to the No Action/No Project Alternative.

Construction worker spending could increase sales and use tax receipts in Siskiyou and Klamath Counties. Construction crews for dam removal in Siskiyou County would purchase goods and services from local restaurants and stores, which would increase sales tax revenues for the county. Sales and use tax revenues are an important receipt for Siskiyou County to fund general government, health, and social programs. In 2010, sales tax in Siskiyou County was 8.25 percent (BOE 2010a). Some workers that are brought to the area would stay in hotels, motels, or campgrounds, which could also produce additional sales tax for the county. For workers staying in hotels or motels, the county could receive additional hotel-motel tax. From 2000 through 2010, hotel-motel tax made up an average of 2.7 percent of Siskiyou County tax receipts. As a result of construction worker spending, county tax revenues would increase during the construction period. Oregon has a hotel-motel tax but does not have a general sales tax, so effects on tax receipts would be more limited in Klamath County. Construction worker spending would be a temporary and positive effect to Siskiyou County and to a lesser extent Klamath County under the Proposed Action relative to the No Action/No Project Alternative.

Changes in visitation for recreation activities could affect sales tax revenues. Similar to construction worker spending, increased visitation to the counties offering recreation activities would increase sale tax revenues within the counties. Any adverse effects on visitation expenditures would decrease sales tax revenues. Changes in sales tax revenues would affect funding for county programs, such as health, education, social services and other programs funded through sales taxes. For increases in in-river recreation activities and ocean fishing, increases in sales tax revenues would be a long-term and positive effect. Decreases in reservoir recreation in Siskiyou County could reduce sales tax revenues, which would be a long-term and adverse effect of the Proposed Action relative to the No Action/No Project Alternative. Reductions in whitewater boating expenditures would also be a long term, adverse effect to county sales tax. The net effect to sales tax revenues from changes in recreation expenditures is unknown.

Eastside and Westside Facilities – Programmatic Measures
Minor construction would be required to decommission the facilities; therefore, there would not likely be any regional economic effects. PacifiCorp would no longer need to operate the facilities, which would reduce some employee hours required for operations and maintenance. This would not be a substantial effect.

City of Yreka Water Supply Pipeline Relocation – Programmatic Measures
Construction activities associated with the City of Yreka Water Supply Pipeline could increase economic output, employment, and labor income during the construction period in Siskiyou County. Construction of the City of Yreka Water Supply Pipeline would temporarily increase employment, labor income and output in Siskiyou County. Local construction firms would likely have the skills available for this construction effort; therefore, the majority of the regional economic effects would occur in the county. Increased employment and spending would have secondary impacts as inputs are purchased locally and construction workers spend a portion of their income in the region. This would be a temporary effect.

New Information

The economies of Siskiyou and Klamath counties have improved somewhat since the Klamath Facilities Removal EIS/EIR analysis. For the most part, the analysis in the EIS/EIR was based on economic data from 2009. According to the National Bureau of Economic Research, the Great Recession ended in June of 2009 (NBER 2010). Since the end of the Great Recession, indicators such as unemployment and total personal income by county have improved.

Unemployment rates in 2009 and 2010 were the highest that Siskiyou County has experienced in the past 20 years (California Employment Development Department [EDD] 2010). Klamath County has also had consistently higher unemployment rates than the State. The 2009 unemployment rate was the highest of the 12-year period (Oregon Employment Department 2010). Since that time, the unemployment rate in Siskiyou County improved from a high of 16.8% in December of 2009 to approximately 11.4% in March of 2016 (Bureau of Labor Statistics 2016). The unemployment rate for Siskiyou County still trends higher than California

overall; the California unemployment rate was 5.4% in March of 2016 (Bureau of Labor Statistics 2016). Similarly, the Klamath County unemployment rate decreased from a high of 13.9% in December of 2009 to 8.1% in December of 2015 (Bureau of Labor Statistics 2016). Similarly in Klamath County the unemployment rate still trends higher than Oregon overall; the Oregon unemployment rate was 4.5% in March of 2016 (Bureau of Labor Statistics 2016).

Table 7. Unemployment Rates

Location	Unemployment[7]	
	December 2009	March 2016
Oregon	11.0%	4.5%
Jackson County, OR	11.9%	6.0%
Klamath County, OR	13.9%	7.6%
California	12.4%	5.4%
Siskiyou County, CA	16.8%	11.4%
Humboldt County, CA	11.1%	5.3%

Another broad measure of economic strength for a county is total personal income (TPI). TPI for a county consists of the income that persons in that county from labor, land, and capital used in current production and personal current transfer receipts[8]. In 2004, the TPI of Siskiyou was $1,219,635,000[9] and ranked 45th in the state (BEA 2015b). In 2014, Siskiyou had a total personal income of $1,614,315,000 (Bureau of Economic Analysis (BEA) 2015b). This TPI ranked 45th in the state and accounted for 0.1 percent of the state total. In 2004, Klamath County had a TPI of $1,667,336,000 (BEA 2015a). This TPI ranked 16th in the state and accounted for 1.3 percent of the state total. In 2014, the TPI of Klamath was $2,183,329,000 and ranked 16th in the state (BEA 2015a). Both Siskiyou County and Klamath County have improved TPIs since 2004 and have maintained the relative TPI ranking to the other counties in their respective state. This suggests that the economies maybe improving similarly to the other counties in their region and state.

[7] Unemployment rate from March 2015 as reported at Bureau of Labor Statistics (BLS 2016).
[8] According to Bureau of Economic Analysis, personal current transfer receipts are benefits received by persons for which no **current** services are performed. They are payments by governments and businesses to individuals and nonprofit institutions serving individuals (Bureau of Economic Analysis 2016) .
[9] TPI have not been adjusted for inflation.

The economic indicators in the primary areas of analysis for dam removal, Siskiyou County, California and Klamath County, Oregon suggest improvement or similar conditions exist in the regional economy when compared with the 2009 economic data used for the Klamath Facilities Removal EIS/EIR analysis. This suggests that the Klamath Facilities Removal analysis related to loss of jobs and loss of tax revenue is still applicable and that the impacts enumerated in the economic analysis for loss of dam operation and maintenance activities at the hydrologic facilities, reservoir recreation, decrease in property values near the reservoirs, and loss of local government revenues can now be more readily absorbed by the regional economy. The economic gains from construction jobs related to dam removal and mitigation remain beneficial to the same extent as described in the Klamath Facilities Removal EIS/EIR.

Commercial fishing and in-river fishing remain beneficial however the expiration of KBRA the fish focused restoration and reintroduction actions planned for the upper basins may be reduce somewhat. The fish population modeling done without KBRA restoration actions indicates that the increase of Chinook salmon with dam removal will likely be 10 to 12% less. Similarly the economic benefit expected in the commercial and in-river fishery will be more modest.

In addition to Siskiyou County and Klamath County some white water recreation occurs in Jackson County, Oregon and Humboldt County, California. These counties have also experienced improving employment. (Table 3). The region as a whole has experienced some recovery from the recession that ended in 2009.

Conclusion

New economic data for the four counties most likely to experience some economic effects remains similar in magnitude or improved compared to the baseline economic data used in the Klamath Facilities Removal EIS/EIR. New information on economics does not result in a change relevant to environmental concerns.

3.3.15 Environmental Justice

Environmental Setting

Four factors were used to determine if there were a disproportionate number of low-income individuals in the area of analysis: income, poverty, substandard housing, and unemployment. It was found that the area of analysis does not have disproportionately more substandard housing than Oregon or California; therefore no low income individuals were identified on this basis. Data does show that there are disproportionately more individuals with low incomes, living in poverty, or unemployed at a county level relative to the State(s). The counties in the area of analysis all have greater percentages of American Indians than California and Oregon as a whole. Data indicate that any impacts from the Proposed Action could disproportionately affect Indian Tribes and low income and minority residents of Siskiyou County, California and Klamath County, Oregon in the area of analysis.

Impacts

The construction activities related to dam removal for the area of analysis could impact environmental justice communities. Residents of Siskiyou and Klamath counties and tribal people could experience increased traffic, noise and air emissions. As such, county residents and tribal people would be disproportionately affected by construction activities.

The sediment release and short-term water quality impacts could have human health implication for those practicing subsidence fishing and traditionally practices such as religious ceremonies and basket making in the Klamath River. Due to the limited time and the constituents likely to be mobilized during drawdown, the analysis concluded that the sediment release would not cause increases in concentrations of inorganic and organic contaminants that would adversely affect beneficial uses, be toxic to humans, or result in bioaccumulation in the Lower Basin. As such, county residents and tribal people would not be disproportionately affected by the release of sediment in the short term.

Also related to environmental justice, the removal of facilities could eliminate certain jobs related to operation and maintenance of the PacifiCorp facilities (49 jobs), reservoir recreation (4 jobs) and whitewater boating operation (14 jobs). Dam removal would also create jobs within the in-river fishing industry (3 jobs) and construction related jobs (1,400 jobs). On balance, the loss of jobs associated with the Proposed Action would not be a disproportionately high and adverse impact on low income populations.

The Facilities Removal analysis also looked at the impact to social programs caused by the potential reduction in tax revenue from real estate adjacent to the reservoirs and the taxes collected for PacifiCorp operations. It is speculative to quantify short-and long-term impacts on county social programs because many of these programs receive funding from the State and Federal Governments in addition to county funds. If funding to social programs is reduced, effects would disproportionately affect low income county residents.

The Klamath Facilities Removal EIS/EIR also looked at the long-term effect to environmental justice communities from improved water quality and increased numbers and access to salmon. These benefits provided local environmental justice communities improved access to subsistence fishing as well as provided tribal communities better quality water in which to practice traditional activities.

New Information

The small changes in the hydrology related to the flow regime expected under the Joint 2013 Biological Opinion may change the drawdown expected during dam removal. However these slight changes in the sediment release downstream would not alter the likely chemical composition of the sediment as characterized through sediment testing. Even given this new information, the release of sediment in the short term from dam removal would not disproportionately affect tribal or county residents.

The 2014 American Communities Data for Siskiyou County and Klamath Counties has come available and is provided below:

Table 8. 2014 Demographic Information for Siskiyou and Klamath Counties

Geographic Area	Total Population	White (percent)	Black or African American (percent)	American Indian and Alaska Native (percent)	Asian (percent)	Native Hawaiian and Other Pacific Islander (percent)	Some Other Race (percent)	Two or More Races (percent)	Hispanic or Latino (of any race) (percent)
California	**37,253,956**	**57.6**	**6.2**	**1.0**	**13.0**	**0.4**	**17.0**	**4.9**	**37.6**
Siskiyou County	44,900	84.7	1.3	4.0	1.2	0.2	3.3	5.3	10.3
Oregon	**3,831,074**	**83.6**	**1.8**	**1.4**	**3.7**	**0.3**	**5.3**	**3.8**	**11.7**
Klamath County	66,380	85.9	0.7	4.1	0.9	0.1	4.1	4.1	10.4

Source: U.S. Census Bureau 2010, U.S. Census Bureau 2014.

For the most part, the demographic composition of these counties remains very similar to the characteristics used in the Klamath Facilities EIS/EIR. The American Indian and Alaska Native population increased slightly in 2014 in Siskiyou and Klamath Counties and remains higher than the percentage represented in the states of California and Oregon.

The economy of Siskiyou and Klamath counties has improved somewhat since the Klamath Facilities Removal EIS/EIR analysis. Please see Section 3.3.14 Socioeconomics for a robust discussion on New Information relevant to economics.

The economic indicators in the primary areas of analysis for dam removal, Siskiyou County, CA and Klamath County, OR suggest improvement or similar conditions exist in the regional economy when compared with the 2009 economic data used for the Klamath Facilities Removal EIS/EIR analysis. This suggests that the Klamath Facilities Removal analysis related to loss of jobs and loss of tax revenue is still applicable and that the impacts enumerated in the environmental justice analysis can now be more readily absorbed by the regional economy. The economic gains from construction jobs and in-river recreation remain beneficial and may to some extent offset some of the adverse effects.

The salmonid population modeling that was completed for the Klamath Facilities Removal EIS/EIR incorporated some of the effects of habitat restoration related to the KBRA. The benefits described in the environmental justice analysis included the benefits that increased access to more abundant fish populations would have for tribal communities. These benefits to tribal communities would still occur if the fish populations increase more slowly due to a more limited fish reintroduction and stream restoration program.

Conclusion

New hydrologic data, demographic data, economic data, and fisheries data for the area of analysis most likely to experience effects from dam removal and which also contains environmental justice communities remain similar in magnitude to that used in the Klamath Facilities Removal EIS/EIR. New information on environmental justice does not result in a change relevant to environmental concerns.

3.3.16 Population and Housing

Environmental Setting

The area of analysis includes a combination of urban and rural communities. The area of analysis also includes the residential rural areas immediately near the Copco 1 and 2 Dams and just upstream of the J.C. Boyle Dam. Effects considered for this resource area would be related to availability of housing for non-local construction workers and whether the use of housing by construction workers would impact the local housing market.

Impacts

Significant impacts on population and housing would result if the project resulted in substantial population growth in the area of analysis. Population growth in a community is "substantial" if it would result in housing needs exceeding the number of housing units projected to be available and affordable. The housing in the area analyzed, Hornbrook and the City of Yreka in California and Klamath Falls and Medford in Oregon and the unincorporated near Copco 1 and 2 Dams and just upstream of the J.C. Boyle Dam, was shown to have adequate available rental housing.

New Information

Since the publication of the Klamath Facilities Removal EIS/EIR, 2010 to 2014 American Community Survey 5-Year Estimates has been made available. Table 4 contains the key demographic data for the population centers most likely to house construction workers for 2014 and the original 2010 data. The housing inventory slightly increased in Klamath Falls, Oregon and Yreka, California and slightly decreased in Medford, Oregon. Overall the vacancy rate for rental properties slightly increased since the analysis presented in the Klamath Facilities Removal EIS/EIR. The inventory and the occupancy rates are very similar to that found in the 2010 census data.

Table 9. Housing Inventory and Vacancy Rate

Location	Housing	Housing	Percent	Vacancy	Vacancy	Change

	Units 2014	Units 2010	Change	Rates 2014	Rates 2010	
Klamath Falls, OR	10,248	9,595	+6.8%	11.1%	11%	+.1%
Medford, OR	32,279	32,430	-0.5%	8%	7.2%	+.8%
Yreka, CA	3,589	3,394	+5.7%	9.6%	7.6%	+2.0%

Conclusion

New demographic data for the three communities most likely to house construction workers remains similar in magnitude to that used in the Klamath Facilities Removal EIS/EIR. New information on population and housing does not result in a change relevant to environmental concerns.

3.3.17 Public Health and Safety, Utilities and Public Services, Solid Waste, Power

Environmental Setting

The analysis of public health and safety, utilities and public services, solid waste, and power focuses on public services in region of the hydroelectric reach included Klamath County, Oregon and Siskiyou County, California.

Impacts

The analysis of the alternatives on public health and safety included evaluation of the impact to police, fire, and other emergency response times and effectiveness; whether the alternatives and construction activity would restrict access to emergency centers or evacuation routes, and whether the project or its construction would directly create or increase the risk posed by an existing hazard.

The analysis of utilities and public services include potential impacts on electricity, natural gas, water supplies, stormwater management, wastewater, solid waste, telecommunications, public roads, police, and fire services. The power analysis examines the potential impacts on existing power facilities and the resulting loss of power production.

New Information

No new information has been identified related to the effect of dam removal, Keno Transfer and Eastside/Westside Decommissioning on recreation.

Conclusion

No additional information has been identified on public health and safety, utilities and public services, solid waste, and power relevant to the effects of dam removal, Keno Transfer and Eastside/Westside Decommissioning that was not already included in the analysis published in the Klamath Facilities Removal Final EIS/EIR. New information on public health and safety, utilities and public services, solid waste, and power does not result in a change relevant to environmental concerns.

3.3.18 Scenic Quality

Environmental Setting

In terms of scenic quality, BLM's VRM methodology classifies public land as either Class A, B, or C scenic quality (inherent scenic attractiveness), with A being the most distinctive and Class C being the most common, in terms of variety of key factors such as; color, water, vegetation, landform, influence of adjacent scenery, scarcity, and cultural modifications (BLM 2007). Analysis by the Lead Agencies concluded that all of the project area would be contained within Class A landscapes or a highly distinctive scenic landscape. The VRM analysis also classified the action area as an area of high visual sensitivity because recreational sightseers are highly sensitive to changes in visual quality, public interest and controversy created in response to proposed activities, portions of the area of analysis are within the viewshed of residential areas, and most of the Klamath River has been designated under the National WSRA.

Impacts

The analysis primarily entails the identification and description of changes to scenic resources in the landscape. Scenic quality is the essential resource that supports the recreational activity of "sightseeing" recreation. Other potential aesthetic impacts associated with odor, noise and physical contact.

The impact analysis looked at the short-term and long-term effect of dam removal. In the short-term prior to revegetation of the reservoir sites adverse effects were expected to view-sheds and recreational vantage points. In the long-term return of the area to a free-flowing river and removal of facilities that do not blend with the surrounding natural environment could have beneficial effects however the loss of some historical structures could have adverse effects to the visual landscape.

New Information

No new information has been identified related to the effect of dam removal, Keno Transfer and Eastside/Westside Decommissioning on recreation.

Conclusion

No additional information has been identified on scenic quality relevant to the effects of dam removal, Keno Transfer and Eastside/Westside Decommissioning that was not already included in the analysis published in the Klamath Facilities Removal Final EIS/EIR. New information on

public health and safety, utilities and public services, solid waste, and power does not result in a change relevant to environmental concerns.

3.3.19 Recreation

Environmental Setting

Rivers, streams, and lakes are common throughout the mountainous landscape, and grasslands exist in the high plateau areas of the region. A large number of public lands are in the region, including five national forests, five National Wildlife Refuges, one national park, one joint national and State park, and two national monuments. These areas provide sightseeing, camping, hiking, fishing, wildlife viewing, and other recreational opportunities. In addition, a number of the lands have rivers or river segments designated as Wild and Scenic Rivers (WSRs).

A number of rivers cross the region, including four rivers designated as WSRs, Sycan River, Smith River, and Trinity River. Portions of the Klamath River, are designated as Wild and Scenic under Section 2(a)ii of the Wild and Scenic Rivers Act. Other rivers in the Klamath Basin include the Salmon River, Scott River, and Clear Creek. These rivers provide a variety of recreational opportunities, including sightseeing, fishing, and whitewater boating.

Impacts

This discussion of environmental effects considers the implications of the Proposed Action on the potential changes to river-and reservoir-based recreation opportunities, activities, and settings within the area of analysis. The analysis assessed both short-term and long-term effects on access, flow-dependent recreational activities, recreational fishing, and other recreational activities associated with the existing Klamath River corridor and reservoir recreational facilities within the study area.

The impacts analyzed temporary construction impacts related to dam removal from restricted access and increased noise and dust. General construction activities would temporarily impact recreation use in the action area.

The analysis also looked at permanent effects to reservoir recreation facilities, reservoir and lake-based recreation, white water rafting, and water-contact-based recreation. With the loss of the reservoirs, recreation associated with these waterbodies was negatively impacted. White water rafting in the action area especially in the Hell's Corner reach would also be permanently impacted as the flow regime would permanently impact that reach such that Class IV+ rapid in late summer would not occur. Another permanent change to the nature of recreation would be that water-contact-based recreation would likely benefit from the reduce instances of certain algae that produce microcystin toxin which has been associated with public health risks for recreational water use.

Additionally, this section included a Wild and Scenic River that provided an assessment of the effects of full facilities removal on each of the four resources specified in the WSR Act Section 7(a) (fish, wildlife, scenery, and recreation river values).

New Information

The implementation of the 2013 Joint Biological Opinion would have a similar effect on the number of recreation days for white water boating and fishing in the Klamath River as would KBRA Flows. Major trends such as significant losses of flat water fishing opportunities on the hydroelectric reservoirs and the loss of the Hell's Corner peaking flows would be similar in magnitude. However the 2013 Joint Biological Opinion does have slightly increased flows in dry water year types in July and August (Table 3). This would lead to slightly more recreational days for white water boating in the Klamath River under the 2013 Joint Biological Opinion.

Conclusion

The implementation of the 2013 Joint Biological Opinion would have similar effects on recreational days as KBRA Flows. No additional information has been identified on recreation relevant to the effects of dam removal, Keno Transfer and Eastside/Westside Decommissioning that was not already included in the analysis published in the Klamath Facilities Removal Final EIS/EIR. New information on recreation does not result in a change relevant to environmental concerns.

3.3.20 Toxic/Hazardous Materials

Environmental Setting

This section describes impacts related to the presence and/or use of hazardous, toxic, and radiological waste (HTRW) within the area of analysis for the Proposed Action and alternatives. A database search and research of any information related to the PacifiCorp facilities were conducted by consultant Environmental Data Resources (EDR) of sites within a 1-mile radius of the area of analysis where there is potential concern for the presence of HTRW (EDR 2010a and 2010b). Potential HTRW sites included spill sites, sites with leaking underground storage tanks, emergency response to releases sites, brownfields (urban development sites previously built upon), hazardous material incidents, and voluntary cleanup sites, among others.

Impacts

The analysis considered whether dam removal activities created a significant hazard to the public or the environment through the transport, use, or disposal of hazardous materials. The analysis of significant hazards also considered reasonably foreseeable accidents and existing known sites of contamination.

New Information

No new information has been identified related to the effect of dam removal, Keno Transfer and Eastside/Westside Decommissioning on toxic/hazardous materials.

Conclusion

No additional information has been identified on toxic/hazardous materials relevant to the effects of dam removal, Keno Transfer and Eastside/Westside Decommissioning that was not already included in the analysis published in the Klamath Facilities Removal Final EIS/EIR. New information on toxic/hazardous materials does not result in a change relevant to environmental concerns.

3.3.21 Traffic and Transportation

Environmental Setting

The area of analysis for the KHSA includes roadways in Siskiyou and Shasta Counties in California and Klamath and Jackson Counties in Oregon. The area of analysis for the KHSA is rural with very low-density development. Most of the private property is undeveloped and/or used as grazing land for cattle with the exception of several small communities in the vicinity of Copco 1 and Iron Gate Reservoirs.

Impacts

Construction related traffic could cause temporary traffic flow effects which would delay other motorists, safety effects by increasing the possibility for a vehicular or pedestrian accident, and impacts to regional transit by delaying transit vehicles.

New Information

No new information has been identified related to the effect of dam removal, Keno Transfer and Eastside/Westside Decommissioning on traffic and transportation.

Conclusion

No additional information has been identified on traffic and transportation relevant to the effects of dam removal, Keno Transfer and Eastside/Westside Decommissioning that was not already included in the analysis published in the Klamath Facilities Removal Final EIS/EIR. New information on traffic and transportation does not result in a change relevant to environmental concerns.

3.3.22 Noise and Vibration

Environmental Setting

The area of analysis for noise and vibration effects associated with the KHSA includes areas near the Four Facilities and the haul routes in Klamath and Jackson counties, Oregon, and Siskiyou and Shasta counties, California. These are predominately rural residential areas. Siskiyou County presents in the average noise levels for various land use categories in the Noise Element of their General Plan (Siskiyou County 1978). Because noise and vibration impacts would not occur without a receptor, the Affected Environment includes the rural residential areas closest to the proposed construction sites. Existing outdoor ambient noise levels at affected sensitive

receptor locations were estimated using published average ambient noise levels for various land uses.

Impacts

Potential sources of noise from implementation of the Amended KHSA include construction equipment and construction-related traffic noise.

New Information

No new information has been identified related to the effect of dam removal, Keno Transfer and Eastside/Westside Decommissioning on noise and vibration.

Conclusion

No additional information has been identified on noise and vibration relevant to the effects of dam removal, Keno Transfer and Eastside/Westside Decommissioning that was not already included in the analysis published in the Klamath Facilities Removal Final EIS/EIR. New information on noise and vibration does not result in a change relevant to environmental concerns.

3.4 Chapter 4: Cumulative Effects

3.4.1 Changes to Cumulative Effects

Information in the Klamath Facilities Removal Final EIS/EIR

This cumulative analysis considers adverse effects of the project identified in the Klamath Facilities Removal EIS/EIR that are less than significant or significant. The adverse impacts described remain the same since publication of the Klamath Facilities Removal EIS/EIR. As there are no additional adverse effects that have been identified during this reevaluation the only potential new information that would lead to changes relevant to environmental concerns would result from new projects or actions in the area of interest that are reasonably certain to occur.

New Information

To identify whether new projects or actions may have been initiated since completion of the Klamath Facilities Removal EIS/EIR analysis, the key agencies were contacted again in February and March of 2016. These included federal, state, county, and local agency offices to establish if any new projects or actions had been approved that were not included in the Klamath Facilities Removal EIS/EIR. The following information was generated during that effort:

Table 10. Additional Projects

Author	Document Title	Coverage Area	Resource Topic(s) Addressed	Date Published	Timeframe Covered
City of Klamath Falls, and Klamath County, Oregon	Urban Area Transportation System Plan Update	Klamath Falls, OR	Transportation	August 2012	2037
City of Klamath Falls, and Klamath County, Oregon	Klamath Falls Urban Trail Master Plan (Update to the Current Comprehensive Plan)	Klamath Falls, OR	Transportation	April 2016	2037

No additional information has been identified on traffic and transportation relevant to the effects of dam removal, Keno Transfer and Eastside/Westside Decommissioning that was not already included in the analysis published in the Klamath Facilities Removal Final EIS/EIR. For the most part the update to the Transportation Comprehensive Plan targets a plan area upstream of the deconstruction haul routes and activities. The exception to this would be the haul trucks required to relocate anadromous fish species around Keno Impoundment/Lake Ewauna and Link River. Haul trucks may travel on OR66, US97, access roads, and on-site roads. Seasonal trap and haul operations would occur during periods of poor water quality. Hauling activities would occur after the peak traffic-generating period of facility removal because fish cannot access Keno Dam until after removal of the Four Facilities; however, some construction traffic associated with completing removal activities and reservoir restoration may occur at the same time as hauling operations. The Trail Master Plan and the TSP update to the transportation system in the Klamath Falls area such that the traffic flow and access to multiple modes of transportation is improved. The impacts from traffic and transportation remain an **i**ncremental contribution to the significant cumulative effects associated with traffic the Trail Master Plan and TSP update would not change this evaluation.

Also, the Klamath Power and Facilities Agreement was signed in April 2016. This agreement settled several outstanding issues for the Klamath Project water users. In particular the agreement dealt with three topics: whether the operation of Keno was to be paid by the Reclamation Klamath Project water users; screening of Reclamation's Klamath Project intakes in Keno Reservoir for fish; and the cost of power to be borne by Klamath water users. The effects of screening Klamath Project intakes for fish could potentially be relevant to the cumulative analysis in the Klamath Facilities EIS/EIR however the details of how this project would be executed have not yet been developed or disclosed. Therefore this project is not ripe for analysis at this time and the impacts too speculative to be effectively addressed in this reexamination.

Conclusion

New information on traffic and transportation does not result in a change relevant to environmental concerns. Additional information related to traffic and transportation projects that are reasonably certain to occur would not be cumulatively considerable. The KPFA is too

speculative to be effectively addressed at this time. New information on cumulative effects does not result in a change relevant to environmental concerns.

3.5 Chapter 5: Other Required Disclosures

3.5.1 Changes to Other Required Disclosures

Information in the Klamath Facilities Removal Final EIS/EIR

This chapter of the Final EIS/EIR includes discussion of Irreversible and Irretrievable Commitment of Resources, Relationship between Short-term Uses and Long-term Uses, Growth Inducing Impacts, Summary of Impacts, Listing of Significant and Unavoidable Impacts, Adverse Environmental Effects After Mitigation, NEPA Environmentally Preferable Alternative, and CEQA Environmentally Superior Alternative, and Controversies and Issues Raised by Stakeholders.

New Information

As a milestone in all three settlement agreements the KHSA, KBRA, and the UKBCA, the Secretarial Determination on dam removal would have influenced timing and implementation in the KBRA and UKBCA. With expiration of the KBRA, limited implementation of UKBCA, and amendment of the KHSA the three settlement agreements has been decoupled. However as KBRA and UKBCA, did not dictate the process to remove dams nor mitigate the effects of dam removal, expiration of KBRA and the less than full implementation of the UKBCA does not change the proposed action considered in the Klamath Facilities Removal EIS/EIR or the impacts of that removal. However the synergistic effects of implementation of the three agreements in concert have been lost and some benefits in this reexamination have been tempered due to the expiration of KBRA. In particular the expiration of KBRA influences the benefit of dam removal to aquatic resources, water quality, water supply/water rights, tribal trust, and socioeconomics.

The other required disclosures in Chapter 5 of the EIS/EIR include information for the complete range of alternatives including dam removal and KBRA. No new information has been identified that would change the analysis provided in sections Irreversible and Irretrievable Commitment of Resources, Relationship between Short-term Uses and Long-term Uses, Growth Inducing Impacts, NEPA Environmentally Preferable Alternative, CEQA Environmentally Superior Alternative, and Controversies and Issues Raised by Stakeholders. Within Chapter 5 several long lists of impacts and benefits are reported in sections Summary of Impacts, Listing of Significant and Unavoidable Impacts, Adverse Environmental Effects After Mitigation. The lists of impacts remain unchanged. As described in this SIR, some benefits have been tempered.

Conclusion
The expiration of the KBRA decouples the KBRA from KHSA. Though to some degree the overall benefits expected have been moderated by the loss of KBRA, no discernible adverse environmental consequence has been identified.

3.6 Chapter 6: Compliance with Applicable Laws, Policies, and Plans

3.6.1 Changes to Compliance with Applicable Laws, Policies, and Plans

Information in the Klamath Facilities Removal Final EIS/EIR
This section describes the applicable Federal, State, and local laws, policies, and regulations.

New Information
No new information related to applicable laws, policies, and plans and dam removal has been identified.

Conclusion
As there is no change to the applicable laws, policies, or plans since publication of the Klamath Facilities Removal EIS/EIR, there is no change relevant to environmental concerns.

3.7 Chapter 7: Consultation and Coordination

3.7.1 Consultation and Coordination

Information in the Klamath Facilities Removal Final EIS/EIR
This section of the Klamath Facilities Removal EIS/EIR described Government-to-Government coordination, public outreach, and communication on specific permits and regulation.

New Information
Regarding the Endangered Species Act, FERC has statutory responsibility to consult with the FWS and NMFS.

Regarding Section 106 of the National Historic Preservation Act, FERC will assume the responsibility to fulfill its requirements of the NHPA.

The document distribution for this SIR will include electronic notification via e-mail and post card mailing to the Klamath Facilities Removal mailing list.

Conclusion

No additional consultation or coordination has occurred regarding dam removal and NEPA, ESA, or NHPA since publication of the Klamath Facilities Removal Final EIS/EIR. New information on consultation and coordination does not result in a change relevant to environmental concerns.

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Greenhouse Gas Emissions from Reservoir Water Surfaces: A New Global Synthesis

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Collectively, reservoirs created by dams are thought to be an important source of greenhouse gases (GHGs) to the atmosphere. So far, efforts to quantify, model, and manage these emissions have been limited by data availability and inconsistencies in methodological approach. Here, we synthesize reservoir CH_4, CO_2, and N_2O emission data with three main objectives: (1) to generate a global estimate of GHG emissions from reservoirs, (2) to identify the best predictors of these emissions, and (3) to consider the effect of methodology on emission estimates. We estimate that GHG emissions from reservoir water surfaces account for 0.8 (0.5–1.2) Pg CO_2 equivalents per year, with the majority of this forcing due to CH_4. We then discuss the potential for several alternative pathways such as dam degassing and downstream emissions to contribute significantly to overall emissions. Although prior studies have linked reservoir GHG emissions to reservoir age and latitude, we find that factors related to reservoir productivity are better predictors of emission.

Keywords: reservoir, methane, greenhouse gas, eutrophication, ebullition

The construction and operation of over 1 million dams globally (Lehner et al. 2011) has provided a variety of services important to a growing human population (e.g., hydropower, flood control, navigation, and water supply), but has also significantly altered water, nutrient, and ecosystem dynamics and fluxes in river networks. Much attention has been paid to negative impacts of dams on fish and other riverine biota, but the indirect effects on biogeochemical cycling are also important to consider. Although reservoirs are often thought of as "green" or carbon-neutral sources of energy, a growing body of work has documented their role as greenhouse gas (GHG) sources. Artificial reservoirs created by dams are distinct from natural systems in a number of key ways that may enhance GHG emissions from these systems. First, the flooding of large stocks of terrestrial organic matter may fuel microbial decomposition, converting the organic matter stored in above and below ground biomass to carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Second, reservoirs often experience greater fluctuations in water level than natural lakes. Drops in hydrostatic pressure during water level drawdowns can enhance CH_4 bubbling (e.g., ebullition) rates at least over the short term (Maeck et al. 2014). This enhanced ebullition may then decrease the fraction of CH_4 that is oxidized to CO_2, a less potent GHG, by methane oxidizing microbes (Kiene 1991). Finally, the high catchment area–to–surface area ratios and close proximity to human activities (Thornton et al. 1990) characteristic of many reservoirs are likely to increase the delivery of organic matter and nutrients from land to water (relative to natural lakes), potentially fueling additional decomposition.

St. Louis and colleagues (2000) raised the possibility that reservoir GHG emissions contribute significantly to global budgets (table 1). Since that influential review appeared, and in part because of the attention it generated, researchers have quantified GHG fluxes from more than 200 additional reservoirs, and have synthesized regional emissions (Demarty and Bastien 2011, Li et al. 2015) and emissions from particular types of reservoirs (i.e., hydroelectric; Barros et al. 2011, Hertwich 2013) paving the way for a new synthesis of global reservoir GHG emissions. In the sections that follow, we revisit the global magnitude and controls on reservoir GHGs presented by St. Louis and colleagues (2000). This includes (a) explicit incorporation of reservoir CH_4 ebullition measurements, (b) updated global estimates of the magnitude of GHG emissions from reservoir water surfaces including the first global estimates of reservoir N_2O emissions, (c) a discussion of the environmental controls on CO_2, CH_4, and N_2O emissions

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Table 1. The global surface area and GHG flux estimates from reservoirs compared with those of other freshwater ecosystems and other anthropogenic activities.

System Type	Surface Area (x 10^6 km^2)	Annual teragrams (Tg) C or N (Tg per year)			Areal Rates (milligrams per square meter per day)			Annual CO_2 Equivalents (Tg CO_2 Eq per year)			
		CH_4-C	CO_2-C	N_2O-N	CH_4-C	CO_2-C	N_2O-N	CH_4	CO_2	N_2O	Total
All Reservoirs (This Study)	0.31[a]	13.3	36.8	0.03	120	330	0.30	606.5	134.9	31.7	773.1
All Reservoirs (Other Work)	0.51–1.5[b,c]	15–52.5[b,d]	272.7[b]	–	82–96	498	–	680–2380	1000	–	
Hydroelectric Reservoirs	0.34[e]	3–14[e,f]	48–82[e,f]	–	24–112	386–660	–	136–635	176–301	–	
Lakes	3.7–4.5[c,g,h]	53.7[d]	292[g]	–	40	216	–	2434	1071	–	
Ponds	0.15– 0.86[i]	12[i]	571[i]	–	27[i]	422[i]	–	544	2094	–	
Rivers	0.36–0.65[d,g]	1.1–20.1[d,j]	1800[g]	–	6–98[j]	7954	–	50–911	6600	–	
Wetlands	8.6–26.9[k]	106–198[k]	–	0.97[l]	15–63[k]	–	0.1–0.31	4805–8976		908	
Other Anthropogenic Emissions (2000s)	N.A.	248[m]	9200[m]	6.9[m]	–	–	–	11243	33733	6462	51438

Note: The values presented are mean estimates; the ranges of mean values are reported when there are multiple relevant models. In cases in which the areal rates are not referenced, they were derived from dividing annual teragrams (Tg) of C or N by the global surface-area estimate. The annual CO_2 equivalents were calculated by multiplying the mass-based flux (in units of Tg CH_4, CO_2 or N_2O per year) by the 100-year global warming potential of each gas (1 for CO_2, 34 for CH_4 and 298 for N_2O). [a] (Lehner et al. 2011). [b] (St. Louis et al. 2000). [c] (Downing and Duarte 2009). [d] (Bastviken et al. 2011) . [e] (Barros et al. 2011). [f] (Li and Zhang 2014). [g] (Raymond et al. 2013). [h] (Verpoorter et al. 2014). [i] (Holgerson and Raymond 2016). [j] (Stanley et al. 2016). [k] (Melton et al. 2013). [l] (Tian et al. 2015). [m] (Ciais et al. 2013).

from reservoir water surfaces, (d) a discussion of the policy implications of these new findings, and (e) recommendations regarding fruitful avenues for future research. Although this synthesis focuses on GHG emissions from reservoir water surfaces, we also describe and discuss several important alternative pathways that can contribute significantly to reservoir GHG budgets (figure 1, supplemental table S1). Given the limited number of studies characterizing these pathways, we do not include them in this global analysis, but stress the need for additional study and eventual incorporation of relevant sources in future global analyses. Finally, we stress that the GHG emissions from reservoir water surfaces synthesized here represent gross fluxes such that CO_2 and CH_4 emissions should be considered alongside estimates of reservoir carbon burial for the purposes of carbon budgeting exercises.

From a GHG-management perspective, it is crucial to understand the relative role of CO_2, CH_4, and N_2O emissions as CH_4 and N_2O are more powerful GHGs than CO_2 (34 and 298 times the global warming potential on a 100-year timescale, respectively; Myhre et al. 2013). To describe the relative contribution of various GHG emissions to global warming, emissions were converted to CO_2 equivalents, a metric that relates the radiative forcing caused by 1 mass unit of trace GHG to that caused by the emission of 1 mass unit of CO_2 over a given time span. Although CH_4 emissions from reservoirs have been implicated as a particularly important source of CO_2 equivalents (Giles 2006), constraining and modeling these fluxes is complicated by the fact that common methodological approaches, which are effective for CO_2 and N_2O emissions, do not capture an important fraction of overall CH_4 flux: bubble-based (ebullitive) CH_4 emissions. Our synthesis confirms that CH_4 emissions are responsible for the majority of the radiative forcing from reservoir water surfaces (approximately 80% over the 100-year timescale and 90% over the arguably more policy-relevant 20-year timescale) and that modeling approaches that ignore ebullitive CH_4 flux may fail to accurately quantify the magnitude of fluxes. We find that more productive, nutrient-rich reservoirs tend to emit more CH_4 than their less productive, nutrient-poor counterparts. Our global estimates support previous assertions (e.g., St. Louis et al. 2000) that GHG fluxes from reservoirs are globally important (approximately 1.3% of anthropogenic CO_2 equivalent emissions over the 100-year timespan), with CH_4 emissions from reservoir water surfaces comparable to those from rice paddies or from biomass burning. Therefore, we suggest the utility of incorporating reservoir CH_4 emissions into Intergovernmental Panel on Climate Change (IPCC) budgets.

Why methods matter

Aquatic GHG fluxes are measured using a variety of techniques (e.g., floating chambers, thin boundary methods, eddy covariance towers, acoustic methods, and funnels; supplemental figure S1) that provide varying degrees of spatial and temporal coverage and accuracy (St. Louis et al. 2000). Many commonly employed techniques for measuring aquatic GHG emissions focus on quantifying the diffusive flux of gases across the air–water interface. For CO_2 and N_2O, which are

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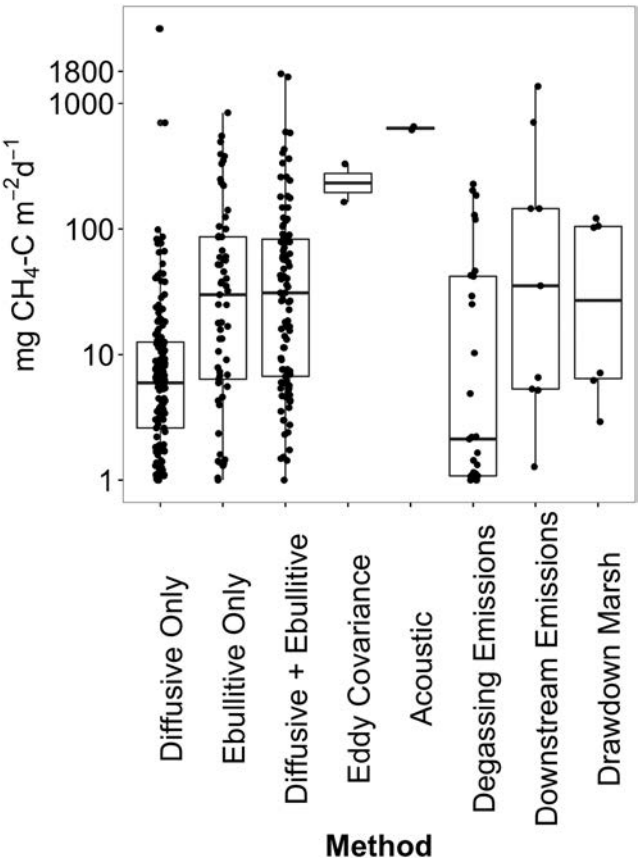

Figure 1. Areal CH_4 fluxes associated with reservoir: diffusive-only fluxes (via thin boundary layer and floating chamber with R^2 cutoff values > 0.85, n = 151), ebullitive-only fluxes (via funnels and floating chamber by subtraction, n = 58), diffusive + ebullitive fluxes (via traditional methods n = 89), total CH_4 emission via eddy covariance (n = 2), ebullitive emissions via acoustic measurements (n = 2), degassing emissions (n = 22), downstream emissions (n = 6), and drawdown marsh fluxes (n = 6, 5 from Three Gorges Reservoir). Each dot represents the mean flux from a single published paper. The lines within the boxes indicate median fluxes. The boxes demarcate the twenty-fifth and seventy-fifth percentiles; the whiskers demarcate the 95% confidence intervals.

quite soluble in water (mole fraction solubility of 7.07×10^{-4} and 5.07×10^{-4} respectively at 20°C), this is the dominant flux pathway, moving gasses to the atmosphere across the air–water interface. In contrast, CH_4 is relatively insoluble in water (mole fraction solubility of 2.81×10^{-5} at 20 °C), and is often emitted in the form of bubbles that rise directly from the sediments (Kiene 1991, Bastviken et al. 2004). Several common measurement methods do not capture ebullition (e.g., combining estimates of air–water gas exchange with measurements of dissolved GHG concentrations), whereas others may exclude ebullition events because they interfere with the linear accumulation of CH_4 within a sampling chamber (e.g., floating chambers; supplemental figure S2). A second important challenge for accurate measurements of aquatic CH_4 ebullition is that fluxes are often highly variable in both time and space (Wik et al. 2016). Ebullition is most commonly measured using inverted funnel traps, which float beneath the surface of the water and capture bubbles as they rise through the water column. These funnel traps are typically deployed for relatively short periods of time (minutes to hours) in a relatively small number of locations (generally fewer than 10 sites per reservoir), making it difficult to capture the spatial and temporal variability of fluxes (see the Hot Spots and Hot Moments section below).

Several recent method developments improve the spatial and/or temporal resolution of CH_4 ebullition measurements in lakes and reservoirs. Modified funnel trap designs can support longer-term, temporally resolved data by (a) incorporating an airtight housing equipped with a differential pressure sensor or optical bubble size sensor for automated, high temporal resolution measurements of ebullition fluxes (Varadharajan et al. 2010, Delwiche et al. 2015), and (b) installing an electronic unit to empty the trap once it reaches full capacity so that traps don't fill faster than they can be sampled (cited in Maeck et al. 2014). Acoustic techniques can support higher spatial and temporal resolution ebullition measurements without the cumbersome and invasive field deployments associated with funnel traps. Following calibration of acoustic signal with bubble size (Ostrovsky et al. 2008), an echosounder can be mounted to a boat to estimate ebullition flux at a greater spatial resolution, or mounted to a stationary object for greater temporal resolution. Repeat daily or subdaily echosounder surveys provide a much higher degree of spatiotemporal coverage than that achieved via traditional methods, allowing for more accurate ebullitive flux estimates in survey zones (DelSontro et al. 2015). Still, echosounders are only effective within a certain depth range that depends on transducer frequency, beam angle, and survey boat speed (but generally ranges from 1 to 100 meters), provide no information about bubble CH_4 concentrations without ancillary measurements, and can also be cost prohibitive and challenging to calibrate (Ostrovsky et al. 2008, DelSontro et al. 2015). Eddy covariance techniques, which calculate GHG fluxes on the basis of mean air density and instantaneous deviations in vertical wind speed and gas concentrations, can also overcome some of the difficulty of capturing spatially and temporally variable emissions although they cannot zero in on hot spots for release unless combined with other methods. Currently, the use of eddy covariance systems over lakes and reservoirs is relatively new and poses several challenges. These challenges include (a) high instrument cost, (b) poor sensor performance during wet conditions, and (c) difficulty associated with estimating measurement footprints, especially in small, heterogeneous areas (Fassbinder et al. 2013, Peltola et al. 2013).

Of the studies compiled here, ebullition was measured in only 52% of cases in which reservoir CH_4 emissions were reported (figure 1). In the majority of cases, ebullition was measured with funnels or was lumped with diffusive flux via

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floating chamber measurements; however, in two studies, researchers estimated methane fluxes via eddy covariance (Eugster et al. 2011, Deshmukh et al. 2014), and in another two studies, researchers estimated ebullitive flux via acoustic methods (DelSontro et al. 2011, 2015). Mean ebullition + diffusion fluxes were over double that of diffusion-only fluxes (103 versus 43 mg CH_4-C per square meter, m^2, per day) and CH_4 fluxes varied significantly on the basis of whether or not ebullition was included (Kruskal Wallis test, $\chi^2 = 52.7$, $p < .001$; figure 1, supplemental table S2). On average ebullition contributed 65% of total diffusive + ebullitive flux ($n = 56$, standard deviation [SD] = 33.5). This is consistent with natural lakes where between 40% and 60% of CH_4 flux generally occurs via ebullition (Bastviken et al. 2004). The relative contribution of CH_4 ebullition to overall CH_4 flux was also highly variable, constituting anywhere from 0% to 99.6% of total CH_4 flux. This highlights how crucial it is to measure both types of CH_4 emission in order to estimate the total flux from reservoir surface waters. Although we did not explicitly address the temporal or spatial resolution of emission data from each system, it is notable that the few published acoustic and eddy covariance-based reservoir CH_4 flux estimates are quite high compared to the median CH_4 flux estimates from less temporally and/or spatially integrated measurement techniques (figure 1). Given the importance of CH_4 ebullition to overall CH_4 fluxes, we only use CH_4 emission estimates that incorporate both ebullition and diffusion in further sections of this article (i.e., to estimate the magnitude and controls on fluxes).

As with CH_4, many studies of CO_2 and N_2O emissions from reservoir water surfaces also suffer from low spatial and temporal resolution (therefore reducing the accuracy of emission estimates). Of the GHG estimates synthesized here, less than 25%, 3%, and 26% of temperate reservoir CH_4, CO_2, and N_2O emission estimates covered 6 months or more of the year. The majority of studies also had fewer than 10 sampling sites and measured fluxes over short periods of time (minutes to hours), often neglecting night sampling in favor of daytime measurements. A more extensive characterization of the spatial and temporal resolution of reservoir GHG sampling was beyond the scope of this analysis, but the role of sampling bias in upscaling efforts is discussed further below (see the section on Hot Spots and Hot Moments).

Patterns in areal fluxes

In total, we assembled areal CH_4, CO_2, and N_2O flux estimates from 161, 229, and 58 systems respectively, although only 75 reservoirs with CH_4 data met the methodological criteria for inclusion in our analyses (figure 2). In contrast to other recent reservoir GHG syntheses (Barros et al. 2011, Demarty and Bastien 2011, Hertwich 2013, Li et al. 2015), we include both hydroelectric and nonhydroelectric systems such as those used for flood control, irrigation, navigation, or recreation. Whereas previous synthesis efforts have lacked measurements from temperate and subtropical systems, our data set addresses this gap by including a number of recent GHG flux estimates from US, European, Australian, and Asian temperate and subtropical reservoirs (figure 2, table 2). This is important given a large number of dams that are either planned or under construction in temperate and subtropical zones (Zarfl et al. 2015). Several alternative flux pathways were not included in the areal flux estimates or the regression analysis, but are reported when available (see supplemental discussion and the Alternative Flux Pathways section below).

Here, we report mean areal (per unit surface area) CH_4 fluxes from reservoir water surfaces that are approximately 25% larger than previous estimates (120.4 mg CH_4-C per m^2 per day, SD = 286.6), CO_2 flux estimates that are approximately 30% smaller than previous estimates (329.7 mg CO_2-C per m^2 per day, SD = 447.7), and the first-ever global mean estimate of reservoir N_2O fluxes (0.30 mg N_2O-N per m^2 per day, SD = 0.9; table 1). The mean areal N_2O emissions reported here are approximately an order of magnitude less than those estimated for US reservoirs (Baron et al. 2013) and are consistent with the areal fluxes reported by Yang and colleagues (2014). 16% of reservoirs were net CO_2 sinks and 15% of reservoirs were net N_2O sinks, whereas all systems were either CH_4 neutral or CH_4 sources (figure 2). The average areal CH_4 emissions that we report from reservoirs are higher than average fluxes from natural lakes, ponds, rivers, or wetlands (table 1). On the basis of the mean areal GHG fluxes in our data set, the majority (79%) of CO_2 equivalents from reservoirs occurred as CH_4, with CO_2 and N_2O responsible for 17% and 4% of the radiative forcing, respectively, over the 100-year timespan.

The higher mean CH_4 emissions reported here are likely due to the exclusion of diffusive-only estimates and a preponderance of high CH_4 flux estimates in the recent literature. Particularly high CH_4 flux estimates have been reported for some temperate reservoirs (Maeck et al. 2013, Beaulieu et al. 2014) and subtropical reservoirs (Grinham et al. 2011, Sturm et al. 2014) that were not included in previous global estimates (St. Louis et al. 2000, Barros et al. 2011, Bastviken et al. 2011), indicating that midlatitude reservoirs can emit as much CH_4 as tropical systems. In fact, we found that CH_4 fluxes from Amazonian reservoirs were statistically indistinguishable from reservoir CH_4 fluxes in other regions (Mann Whitney test, $p = 0.25$; supplemental figure S3). These findings run counter to the common view that low latitude reservoirs (and Amazonian reservoirs in particular) support greater CH_4 emission rates than temperate systems (Barros et al. 2011), but are consistent with the recent influx of higher emission estimates from subtropical and temperate ecosystems mentioned above.

Previous efforts to identify predictors of reservoir GHGs

Reservoir age (Barros et al. 2011, UNESCO–IHA 2012, Hertwich 2013) and latitude (Barros et al. 2011) have been suggested as predictors of CO_2 and CH_4 flux from hydroelectric reservoirs. Elevated GHG emissions from young (less than 10 years) reservoirs are commonly observed

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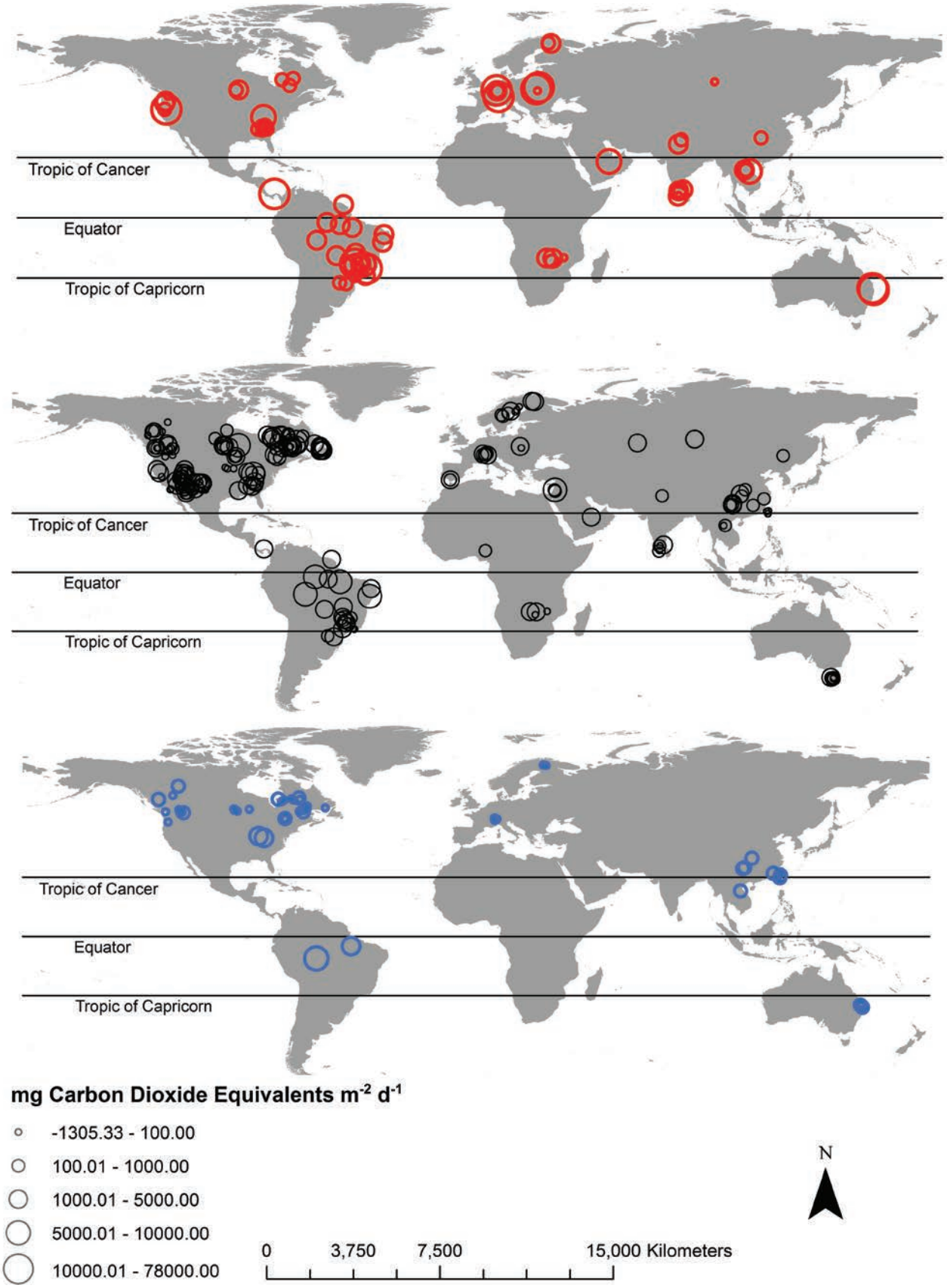

Figure 2. Diffusive + ebullitive methane (top), carbon dioxide (middle), and nitrous oxide (bottom) emissions from reservoirs on a CO_2-equivalent basis (100-year horizon). Few reservoirs had measurements for all three gases.

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Table 2. The number of reservoirs with surface water GHG emission estimates by continent, as well as a break down of the number of CO_2, ebullitive + diffusive (E+D) CH_4, diffusive only (D) CH_4, and N_2O emission estimates by continent.

Continent	CO_2	CH_4 (E +D)	CH_4 (D)	N_2O	Total number of reservoirs with any GHG emission estimates
North America	144	23	56	37	158
South America	22	21	1	2	23
Africa	5	4	0	0	5
Europe	18	11	10	7	31
Asia	30	14	6	8	36
Australia	10	2	12	4	14
World	**229**	**75**	**85**	**58**	**267**

(Abril et al. 2005, Bastien et al. 2011, Teodoru et al. 2012) and are thought to be due to rapid decomposition of the most labile terrestrial organic matter, although some reservoirs may continue to have elevated GHG emissions at least 20 years after flooding (Kemenes et al. 2011). Measurements in an oligotrophic system in Canada's boreal zone have shown that heterogeneity in preflood carbon stocks can affect young reservoir CO_2 fluxes, with greater rates of sediment CO_2 production in higher carbon sediments (Brothers et al. 2012). However, the experimental flooding of high, medium, and low carbon boreal forests yielded no discernible relationship between the soil or sediment carbon stock and GHG production over a 3-year time span (Hendzel et al. 2005, Matthews et al. 2005). Reservoir GHG emissions can also be positively correlated with temperature (DelSontro et al. 2010, UNESCO–IHA 2012). Consequently, the negative correlation between latitude and hydroelectric GHG emissions reported in previous work could reflect higher average water temperatures at low latitudes. In addition, lower latitude regions typically experience higher rates of terrestrial net primary production (NPP), a factor that has been positively correlated with GHG emissions from hydroelectric reservoirs (Hertwich 2013). High rates of NPP may promote enhanced leaching of dissolved organic matter (DOM), fueling additional decomposition of terrestrial organic matter within tropical reservoirs.

A growing body of work highlights the role that nutrient status and associated primary productivity may play in determining overall reservoir GHG dynamics. For example, Li and colleagues (2015) reported a negative correlation between both nutrient enrichment and primary production and CO_2 fluxes, and at least one study has argued that increasing primary production can shift lentic ecosystems from CO_2 sources to sinks (Pacheco et al. 2013). This occurs when additional nutrients promote atmospheric carbon sequestration via enhanced photosynthesis leading to accelerated rates of organic carbon sedimentation and burial. At the same time, eutrophication may promote larger CH_4 emissions, both by reducing O_2 concentrations in reservoir bottom waters and by increasing organic matter quantity (as described below). In wetland ecosystems, NPP has been posited as a "master variable" that integrates several important environmental factors influencing CH_4 emission (Whiting and Chanton 1993). Some of these factors are likely to be more important in wetlands than in reservoirs (i.e., rooted plants as conduits for CH_4 exchange), whereas others are applicable across systems (i.e., increased substrate availability associated with elevated rates of carbon fixation). Regionally, positive correlations between chlorophyll *a* concentrations and both dissolved CH_4 concentrations (Indian reservoirs; Narvenkar et al. 2013) and CH_4 fluxes (north temperate lakes; West et al. 2015a) have been found in lakes and reservoirs. Although less is known about the controls on reservoir N_2O flux, strong positive correlations between NO_3^- concentrations and both N_2O concentration and flux have been observed across aquatic ecosystems (Baulch et al. 2011, McCrackin and Elser 2011).

Overall, better predictive tools are needed for identifying environmental controls on reservoir GHGs. Some progress has been made toward accomplishing these tasks through the modeling of hydroelectric CO_2 and CH_4 emissions (Barros et al. 2011, IEA Hydropower 2012, UNESCO–IHA 2012, Hertwich 2013). Still, we are not aware of any modeling efforts that have explicitly incorporated ebullition; instead, existing efforts have used either diffusive-only emissions or a combination of diffusive-only and ebullitive + diffusive emissions. In the section that follows, we explicitly consider ebullition by categorizing CH_4 fluxes on the basis of collection methods and considering the extent to which environmental controls differed on the basis of CH_4 flux pathway (ebullitive versus diffusive). In particular, we explore the hypothesis that nutrient loading and the resulting increase in primary production stimulates GHG emissions from reservoir water surfaces, primarily via enhanced CH_4 production.

Synthesis findings: Productivity predicts the radiative forcing capacity of reservoir GHG emissions

We collated system characteristics likely to covary with, or control, GHG fluxes. These characteristics included

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Table 3. The least squared regression statistics for a subset of the best models relating reservoir CO_2, CH_4, and N_2O fluxes to potential predictor variables. All the significant linear regressions ($p < .05$) with $R^2 > 0.1$ are shown. **Sign** ***indicates whether the slope of the regression line was positive (+) or negative (–). Note that reservoir CO_2 fluxes are inverse transformed such that a negative regression correlation indicates a positive relationship between the predictor variable and the CO_2 flux. * Indicates modeled predictor. Complete regression statistics can be found in supplemental tables S4 and S5.***

Gas	Predictor	Transformation	df	*p* value	R^2	Sign
Ln (CH_4 + 1) Bubble + Diffusion n = 75	[Chlorophyll *a*]	Ln	29	<.001	0.50	+
	[DIP]*	Ln	31	0.02	0.18	+
1/(CO_2 + 1000) n = 229	Mean Annual Precipitation	none	31	0.04	0.11	–
Ln (N_2O + 1) n = 58	[NO_3^-]	Ln	16	<.001	0.49	+
	Latitude	none	56	<.001	0.46	–
	Mean Annual Air Temperature*	Sqrt	55	<.001	0.33	+
	Mean Annual Precipitation*	Sqrt	54	<.001	0.30	+

morphometric, geographic, and historical properties of study reservoirs (i.e., depth, residence time, volume, surface area, age, and latitude), biologically significant water column solute concentrations (i.e., NO_3^-, total phosphorus, and dissolved organic carbon), and metrics of ecosystem primary productivity (i.e., trophic status and mean or modeled surface water chlorophyll *a* concentrations; see the supplemental materials for a complete list of the tested variables).

Of the factors examined, CH_4 emissions were best predicted by chlorophyll *a* concentrations (positive correlation, $p < 0.001$, $R^2 = 0.50$, $n = 31$); CO_2 emissions were best predicted by reported mean annual precipitation (positive correlation, $p = 0.04$, $R^2 = 0.11$, $n = 33$); and N_2O emissions were most strongly related to reservoir NO_3^- concentrations (positive correlation, $p < 0.001$, $R^2 = 0.49$, $n = 18$, table 3, supplemental figure S6). Although latitude was also a strong predictor of N_2O flux ($p < 0.001$, $R^2 = 0.47$, $n = 55$), latitude and NO_3^- were weak covariates (–0.29 Pearson correlation), and latitude was not a significant predictor of N_2O ($p = 0.10$) in a multiple linear regression model with NO_3 ($p = 0.01$). CH_4 emissions were only weakly related to latitude ($p = 0.05$, $R^2 = 0.04$), and CO_2 emissions were not significantly related to latitude. Whereas CO_2 emissions were weakly related to reservoir age ($p = 0.003$, $R^2 = 0.04$), CH_4 and N_2O fluxes were not (supplemental table S4). The positive, albeit weak, relationship between CO_2 fluxes and mean annual precipitation is consistent with observations in boreal lakes where precipitation has been observed to flush terrestrial carbon into surface waters and enhance CO_2 concentrations and emissions via organic matter degradation (Rantakari and Kortelainen 2005). The relationship between N_2O fluxes and NO_3^- concentrations is consistent with observations from small streams (Baulch et al. 2011) as well as observed positive relationships between concentrations of N_2O and NO_3^- in reservoirs (Beaulieu et al. 2015) and in lakes receiving atmospheric nitrogen deposition (McCrackin and Elser 2011).

The controls on reservoir CH_4 flux deserve particular attention because our analysis suggests that CH_4 emissions are responsible for 79% of the radiative forcing from reservoirs over the 100 year timespan. Chlorophyll *a* and air temperature were significant predictors of CH_4 emissions from reservoir water surfaces regardless of flux type (i.e., diffusive only, ebullitive only, diffusive + ebullitive; supplemental tables S4 and S5). Mean reservoir depth and chlorophyll *a*, both of which have been reported to control lake and reservoir CH_4 emissions, were weakly correlated in this analysis (Pearson correlation 0.46). Depth was not a significant predictor of CH_4 flux for the whole data set ($p = 0.14$, $R^2 = 0.02$) or for the subset of the data for which chlorophyll *a* concentrations were available ($p = 0.19$, $R^2 = 0.02$), indicating that chlorophyll *a* is a better predictor of system-wide CH_4 emissions than mean depth. Depth has been found to exert an important control on the spatial variability of CH_4 fluxes from lakes, particularly with respect to ebullition (Bastviken et al. 2004, West et al. 2015a). In the marine environment, ebullition-based emissions to the atmosphere are thought to be negligible in waters deeper than 100 meters because of the dissolution of bubbles en route from sediments to the atmosphere (McGinnis et al. 2006), and a recent study of north temperate lakes reported that ebullition rarely occurred at sites deeper than 6 meters (West et al. 2015a). Although both depth and age (discussed above) may be important predictors of carbon emissions in individual reservoir systems,

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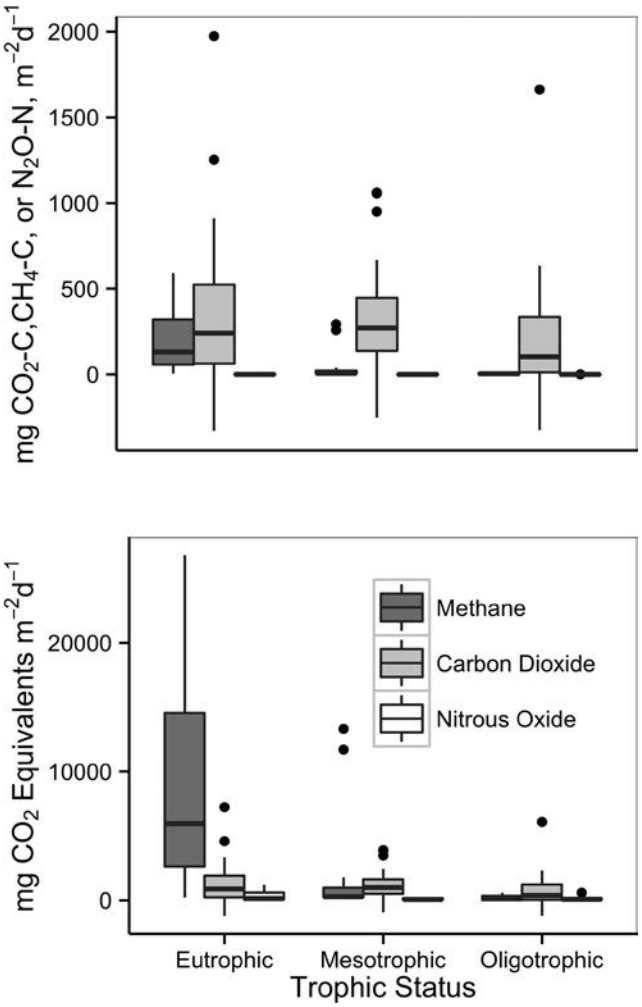

Figure 3. Average reservoir GHG fluxes by trophic status. The top panel shows areal flux rates; the bottom panel shows fluxes converted to CO_2 equivalents. The legend is for both panels. The lines within the boxes indicate median fluxes. The boxes demarcate the twenty-fifth and seventy-fifth percentiles, the whiskers demarcate the 95% confidence intervals, and the dots plot data outside this range. One methane flux from a eutrophic reservoir is removed from the bottom panel (78,000 milligrams CO_2 equivalents per m^2 per day from the Rsezów Reservoir) to improve readability.

these relationships do not appear to scale up in the global model, which only considers mean values for individual reservoirs (e.g., mean reservoir depth or the mean age of the reservoir when carbon emissions were measured).

The strong positive correlation between reservoir CH_4 flux and chlorophyll *a* is also reflected in the significantly different CH_4 emissions found in systems of different trophic statuses (Kruskal Wallis test, $\chi^2 = 16.8$, $p < .001$). Specifically, eutrophic systems emitted approximately an order of magnitude more CH_4 than oligotrophic ones (figure 3). This pattern has been observed regionally in North American, Swedish, and Canadian lakes (Bastviken et al. 2004, Rasilo et al. 2015, West et al. 2015a) as well as Finnish lakes and reservoirs (Huttunen et al. 2003), and is consistent with recent findings from shallow lake mesocosms where CH_4 emissions were best predicted by factors related to primary production (i.e., nutrient concentrations and primary producer abundance; Davidson et al. 2015). This suggests that the low oxygen and high dissolved organic carbon conditions that often develop in eutrophic systems promote elevated CH_4 production relative to lower nutrient systems. In addition to increasing the quantity of organic carbon and reducing the availability of oxygen, eutrophication may also affect the overall quality of organic matter for fueling CH_4-producing archaea. Algae-derived organic matter has been found to fuel higher rates of CH_4 production than land-based "terrestrial" carbon (West et al. 2012), and may even stimulate the enhanced incorporation of recalcitrant terrestrial carbon into bacterial biomass (i.e., priming effect; Guillemette et al. 2015). Thus, increasingly high fractions of algae-derived organic matter will likely support more methane production.

Global surface area of reservoirs

Global-scale estimates of reservoir GHG emissions are dependent on estimates of both areal fluxes (discussed above) and global reservoir surface area. There have been a number of recent efforts to improve global reservoir (and lake) surface-area estimates (Downing and Duarte 2009, Lehner et al. 2011, Verpoorter et al. 2014). Although St. Louis and colleagues (2000) estimated global reservoir surface area by multiplying the surface area of reservoirs in the *World Register of Dams* by a factor of four, more recent reservoir surface-area estimates were made assuming that reservoir surface areas follow a pareto distribution (Downing et al. 2006, Lehner et al. 2011). Downing and colleagues (2006) used data from the International Commission on Large Dams together with pareto-based extrapolations to estimate that reservoirs more than 0.01 square kilometers (km^2) cover 258,570 km^2 of the earth's surface. Following this, Lehner and colleagues (2011) used the Global Reservoir and Dam Database (GRAND) together with pareto-based extrapolations to estimate that reservoirs more than 0.00001 km^2 cover 507,102 km^2 of earth's surface. These reservoir surface-area estimates are one-sixth to one-third the value used by St. Louis and colleagues (2000). For our best estimate of global reservoir GHG fluxes, we use 305,723 km^2 of reservoir surface area (table 1). This estimate is based on GRAND and excludes the original surface area of natural lakes that have been modified with water regulation structures (this includes Lakes Victoria, Baikal, and Ontario; Lehner et al. 2011). The 267 reservoirs whose CO_2, CH_4, and/or N_2O emission estimates we synthesize here cover a collective surface area of over 77,287 km^2 (28 reservoirs with unknown surface area), and therefore represent 25% of global reservoir coverage.

In addition, reservoir surface area is likely to increase substantially in coming decades given the 847 large hydropower

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projects (more than 100 MW) and 2853 smaller projects (more than 1 MW) that are currently planned or under construction (Zarfl et al. 2015). In this synthesis, reservoirs with more than 1MW installed capacity had a median surface area of 226 km^2. Assuming each of the 847 large hydropower projects that are planned or under construction has an equivalent surface area, this would constitute 225,691 km^2 of additional reservoir surface area, nearly doubling current reservoir surface-area estimates. Although there is a net trend toward dam decommissioning in the United States, most of these removals have been small dams, and the global number of removals is more than offset by recent increases in dam construction (O'Connor et al. 2015).

Global magnitude of reservoir GHG emissions

We report global GHG emissions from reservoir water surfaces on the low end of previously published values (table 1), but stress that these emissions still contribute significantly to global budgets of anthropogenic CO_2 equivalent emissions. CH_4 constituted the majority of CO_2 equivalent emissions from reservoirs, and the per area reservoir CH_4 fluxes reported in this synthesis are higher than per area fluxes for any other aquatic ecosystem (table 1). We estimate that reservoirs emit 13.4 Tg CH_4-C per year (5th and 95th confidence interval: 8.9–22.2 Tg CH_4-C per year), 36.8 Tg CO_2-C per year (5th and 95th confidence interval: 31.8–42.8 Tg CO_2-C per year), and 0.03 Tg N_2O-N per year (5th and 95th confidence interval: 0.02–0.07 Tg N_2O-N per year; table 1). The estimate of global reservoir GHG emissions presented here is calculated on the basis of the product of bootstrapped estimates of mean areal GHG fluxes and best estimates of global reservoir surface area (as was done in a recent estimate of global methane emissions from streams and rivers, Stanley et al. 2016). See the supplemental materials for information about the bootstrapping technique used. Given the dominant controls on GHG emissions from reservoir water surfaces identified in this study and given the current availability of relevant predictor variables at the global scale, we do not see an advantage to segmenting our upscaling efforts at this point in time. Still, identifying regional differences in reservoir GHG emissions remains a needed area of future research (see below section on Uncertainties and Future Research Directions).

Although the global mapping of reservoir trophic status (and associated upscaling of CH_4 emissions) is beyond the scope of this article, recent progress in the mapping of chlorophyll *a* in medium and large-sized lakes and reservoirs shows that about 60% of systems have more than 10 micrograms per liter chlorophyll *a* (Sayers et al. 2015), and would therefore be considered eutrophic by most classification schemes (Cunha et al. 2013). Similarly, a comparison of large reservoir locations (Lehner et al. 2011) with model-predicted dissolved inorganic phosphorus (DIP) yields (Harrison et al. 2010) indicates that most large reservoirs occur in phosphorus enriched regions (figure 4a) that may promote eutrophication of reservoirs. To illustrate, the average DIP yield (per 0.5 degree grid cell) in grid cells with dams is over threefold higher than the global average DIP yield (45 versus 13 kilograms P per km^2 per year). Given this pattern and the high fraction of nutrient enriched, productive reservoirs in our GHG database (of systems where trophic status data were available, 38% and 24% were eutrophic and mesotrophic respectively), it is likely that a large fraction of reservoirs are highly productive and therefore support high CH_4 emission rates. However, overlaying a map of the hydroelectric projects that are currently planned or under construction (Zarfl et al. 2015) on a map of average DIP yield (Harrison et al. 2010) suggests that newer hydroelectric projects will be more evenly distributed between phosphorus enriched and relatively phosphorus poor regions (Figure 4b). Further research is needed to better understand how much P will be *routed through* current and future reservoirs to support large-scale models of reservoir trophic status and associated CH_4 emissions. Specifically, models of riverine DIP yield would need to be downscaled to quantify how much DIP individual reservoirs are intercepting.

Emissions from alternative flux pathways

There are several emission pathways that are either nonexistent or of marginal importance in natural lakes, but that may contribute significantly to reservoir GHG budgets. These include: drawdown emissions, downstream emissions, emissions from decomposing wood, and emissions from dam spillways and turbines (e.g., "degassing" emissions). Drawdown emissions occur when fluctuating water levels cause large changes in hydrostatic pressure and create sediments that are periodically inundated with water and then exposed to the atmosphere. Although all aquatic systems experience natural fluctuations in water level, the amplitude and/or frequency of these fluctuations is likely more pronounced in reservoir ecosystems (Zohary and Ostrovsky 2011). Drawdown zones (that are periodically dry and then inundated) may contribute disproportionately to systemwide GHG emissions because of the shifting redox conditions they experience (Lu et al. 2011, Yang M et al. 2014). Drawdown may also be a hot moment for systemwide CH_4 release because reductions in hydrostatic pressure can stimulate ebullition events (Maeck et al. 2014). These events may constitute significant components of annual reservoir-wide CH_4 emission budgets and are the subject of ongoing work, but are not included in the analyses presented here. Degassing emissions from turbines and spillways occur when reservoir water undergoes rapid depressurization and/or aeration resulting in rapid emission of dissolved gasses. GHGs that remain in solution after water passes through a dam either diffuse into the atmosphere or are consumed by microbes (e.g., methane oxidation) downstream of the dam. Downstream emissions refer to GHGs that are produced within the reservoir and emitted from the river channel below a dam. The spatial footprint of these emissions is generally defined as the river reach for which GHG emissions are elevated above background (Kemenes et al. 2007). Finally, the decomposition of standing woody material was found to constitute a large fraction

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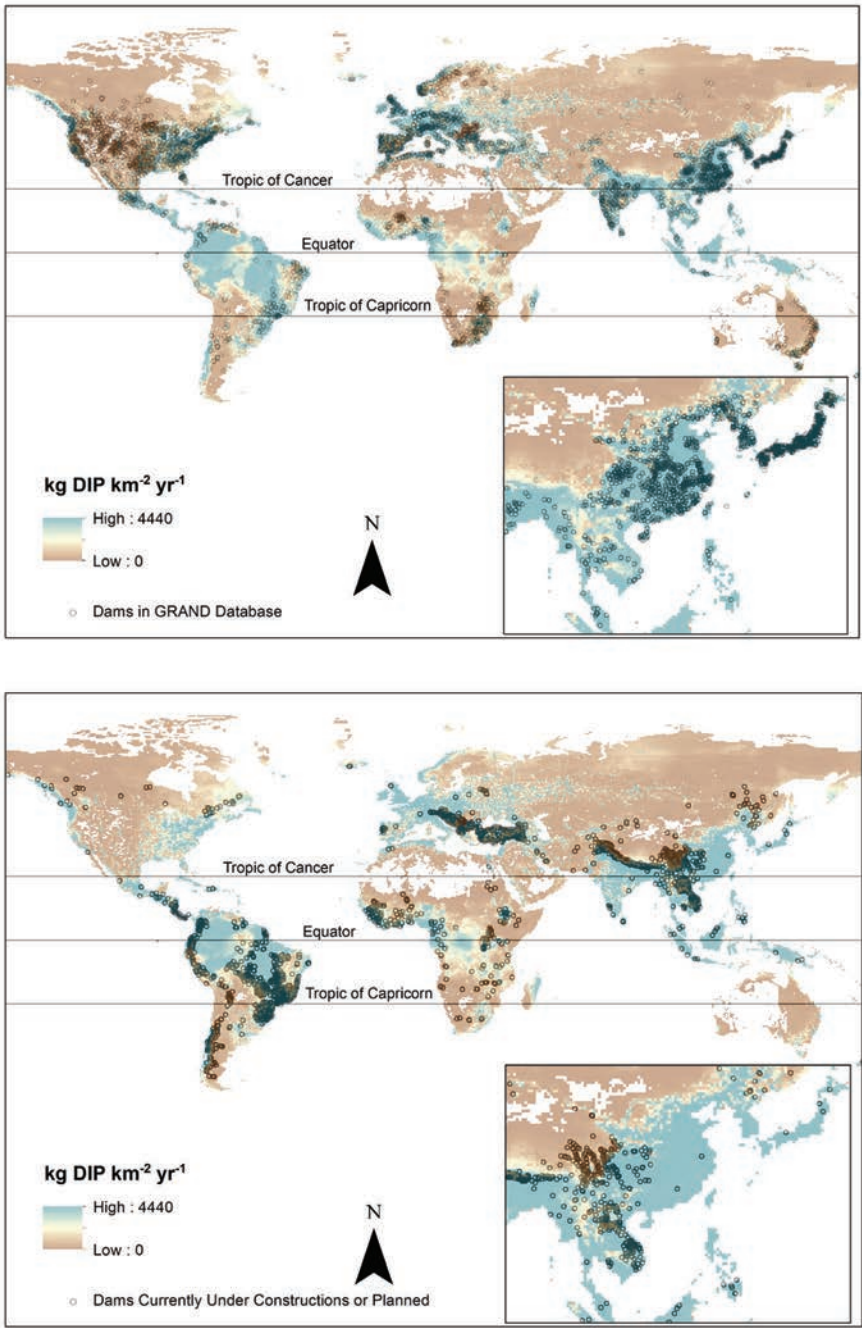

Figure 4. Global NEWS half-degree dissolved inorganic phosphorus (DIP) yield (Harrison et al. 2010) overlaid on existing reservoirs from the GRAND database (Lehner et al. 2011) and hydropower reservoirs currently either under construction or planned (bottom panel; Zarfl et al. 2015). The inset maps show Southeast Asia, a region of rapid dam construction. China is projected to remain the global leader in hydropower dam construction, producing approximately one-fourth of global hydropower (Zarfl et al. 2015).

of total GHG emissions in a tropical reservoir (26%–45% of CO_2 equivalents over a 100-year time frame; Abril et al. 2013), but this GHG source remains to be studied in reservoirs from other regions.

Both downstream and degassing emissions are likely highly dependent on reservoir GHG concentrations, dam engineering, spill practices and downstream biogeochemistry. Larger degassing and downstream emissions are expected when the spilled reservoir water is high in GHGs (Guérin et al. 2006). This generally occurs in systems in which the water is withdrawn from the lower portion of the reservoir (hypolimnetic release), because this water is typically highly pressurized and is also enriched in GHGs relative to surface waters (Kemenes et al. 2007). These emissions may also depend on dam-specific engineering. For example, an aerating weir at Petit Saut reservoir was installed to optimize CH_4 degassing immediately below the dam to avoid problems associated with methane-oxidation-induced hypoxia (Abril et al. 2005). Finally, the environmental controls on methane consumption (e.g., methane oxidation; Abril et al. 2005, Kemenes et al. 2007) and air–water gas exchange rates downstream of a dam may also play an important role in determining the magnitude of downstream emissions.

Measurements of GHG emissions from drawdown zones, downstream river reaches, wood decomposition, as well as spillways and turbines are currently too limited and/or too poorly constrained to meaningfully include in analyses of the controls and magnitude of reservoir GHGs. Still, these pathways may contribute significantly to overall ecosystem fluxes, particularly in the case of CH_4 (figure 1). For a more detailed summary of reservoir GHG fluxes via alternative flux pathways, see the supplemental discussion and table S1.

Uncertainties and future research directions

In developing this synthesis, we identified a number of areas that are beyond the scope of our analysis but that certainly deserve additional attention and research. Although the spatial coverage of GHG flux measurements has improved in recent years, there are still few measurements from many regions, including Africa, Australia, and Russia (table 2, figure 2). With respect to the forms of GHGs measured, there are currently threefold and fourfold more reservoirs with CO_2

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emission estimates than for CH_4 (ebullitive + diffusive) and N_2O emissions, respectively (table 2). In addition, there is a crucial need to better constrain GHG emissions from boreal reservoirs, especially the relative role of diffusive versus ebullitive CH_4 emission pathways. The roles of reservoir typology, spatiotemporal variability, and ecosystem productivity in determining GHG emissions all deserve further analysis. In the sections that follow, we highlight some significant research needs that will improve our ability to model and potentially manage reservoir GHG emissions.

Reservoir typology. Currently, there are relatively few GHG flux estimates from nonhydroelectric systems. Although hydroelectric dams are estimated to constitute 30%–62% of global impoundments (Lehner et al. 2011, Varis et al. 2012), 82% of reservoirs with known uses in our GHG database had the capacity to generate hydroelectricity (supplemental figure S7). Although we did not detect any significant difference between the areal emission of CH_4, CO_2, or N_2O from hydroelectric versus nonhydroelectric systems (Mann Whitney test, $p = .83$, .27, and .87 respectively; figure S3), we also did not consider degassing, downstream, or drawdown zone emissions, all of which are likely to vary on the basis of reservoir typology. Better characterization of reservoir outlet structure (e.g., proportion of surface versus bottom water withdrawals by reservoir type) and associated turbine and downstream GHG emissions would aid our understanding of how different types of reservoirs (hydroelectric, flood control, irrigation etc.) contribute to overall GHG emissions. In addition, small farm impoundments were not included in this data set because of lack of data, but these systems clearly deserve more attention because they are often located in eutrophied areas and are disproportionately active with respect to carbon cycling (Downing et al. 2008). In fact, natural ponds less than 0.001 km^2 are estimated to make up less than 10% of global lake and pond surface area but constitute more than 15% of CO_2 emissions and more than 40% of diffusive CH_4 emissions (Holgerson and Raymond 2016).

Hot spots and hot moments. Lake and reservoir GHG emissions are often highly variable in both space and time. The flux estimates presented in previous sections use available estimates from every reservoir where GHG emissions have been reported (and mean estimates from reservoirs where multiple studies or years of data have been collected), but it is important to note that the spatial and temporal coverage of these emission estimates are highly variable. Reservoir GHG emission estimates are often made at temporal scales ranging from minutes to hours even though lake and reservoir GHG emissions can vary over single day–night cycles (Morales-Pineda et al. 2014, Podgrajsek et al. 2014, 2015), seasonally with changes in productivity and/or river inflow (Knoll et al. 2013, Morales-Pineda et al. 2014, Pacheco et al. 2015), and episodically because of water-level fluctuations (Maeck et al. 2014) or water-column mixing dynamics (Jammet et al. 2015). The spatial coverage of reservoir GHG emission measurements is also often limited; many studies measure emissions at fewer than 5 sites and very few studies have more than 10 sites. Recent spatial analyses of reservoir CH_4 dynamics highlight the disproportionate importance of inlets and other depositional zones toward overall flux (DelSontro et al. 2011, Maeck et al. 2013) as well as from seasonally flooded and downstream zones (see the Emissions From Alternative Flux Pathways section).

Despite the considerable uncertainty associated with the reservoir-specific GHG emission estimates synthesized here, we argue that these data provide a low-end estimate of global emissions. A recent study quantified the effects of spatial and temporal sampling resolution on diffusive and ebullitive CH_4 emission estimates from 3 shallow boreal lakes and found that low sampling coverage is more likely to lead to underestimates of flux than overestimates (72% chance of flux underestimation when bubble trap sampling is limited to 1–3 days; Wik et al. 2016). The authors estimate that diffusive and ebullitive CH_4 fluxes should be measured from a minimum of 3 and 11 depth stratified sites on at least 11 and 39 days (respectively) to achieve ±20% of the emissions estimated from sampling more intensively (Wik et al. 2016). More work is needed to characterize sampling bias in other types of systems, and to understand how sampling bias scales up. In this analysis, we treated system-specific estimates of GHG flux equally despite a large range in the degree of sampling effort represented by each study.

The development of methods and protocols that effectively capture spatial and temporal variation in GHG fluxes is crucial for improving our ability to compare "apples to apples" between different reservoir systems. Efforts are already being made in this direction (UNESCO–IHA 2010, Bastviken 2015).

Seasonality and ice cover. The seasonality of reservoir GHGs is a major frontier. Future research should aim to quantify both seasonal patterns in emission and the extent to which water-column mixing and other short-term events contribute to annual-scale GHG emissions. Although warmer temperatures have been correlated with higher rates of CH_4 production across a range of ecosystems (Yvon-Durocher et al. 2014), annual-scale reservoir GHG data are currently too limited to make inferences on how seasonal biases may either under or overestimate annual-scale fluxes. Spring (ice melt) and fall (destratification) turnover events can result in pulse emissions wherein gasses that have accumulated under the ice or thermocline are suddenly mixed upward and vented to the atmosphere as a lake circulates. Although turnover data from reservoir systems is extremely sparse (but see Bastien et al. 2011, Demarty et al. 2011, Beaulieu et al. 2014), in lakes, turnover flux may account for an average of 35% (and a range of less than 1% to 70%) of annual CH_4 emissions, with the highest contribution from small systems (Michmerhuizen et al. 1996, Bastviken et al. 2004, Jammet et al. 2015).

Currently, the role of CH_4 oxidation (a microbial process that consumes methane) in mediating atmospheric CH_4

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fluxes during lake turnover events is also not well understood. Commonly employed methods for estimating turnover flux use hypolimnion storage (i.e., the gasses that have accumulated under the ice or thermocline) to estimate emissions and assume that there is no significant CH_4 oxidation during turnover (Michmerhuizen et al. 1996). Research in boreal and temperate lakes has found that anywhere between 60 and 94% of the CH_4 stored in the water column can be oxidized during turnover (Rudd and Hamilton 1978, Utsumi et al. 1998) but the environmental controls on turnover-related methane oxidation rates are not well known. Given current uncertainties, our global-scale estimate of reservoir GHG flux does not account for ice cover, but see the supplemental materials for an estimate of the extent to which ice cover could reduce annual-scale emissions (assuming no turnover emissions).

The role of boreal systems. Results from this synthesis suggest that biases in the application of different measurement techniques have led to spurious assignment of age as a significant control on reservoir CH_4 fluxes. In addition, this sampling bias may have overemphasized the significance of latitude as a predictor of CH_4 fluxes. The majority of measurements from old systems and high latitude systems have been diffusive only (supplemental figures S4 and S5), which may underestimate true CH_4 fluxes. It is possible, however, that ebullition is limited in boreal systems. Large-scale monitoring efforts in Canadian hydroelectric reservoirs suggests that CH_4 bubbling constitutes less than 5% of total emissions in many boreal systems (Tremblay pers. comm.). Still, we are aware of only a handful of published studies that report both diffusive and ebullitive emissions from boreal systems, and the fraction of bubbling in these systems covers a broad range (0%–20% in Eastmain reservoir, 18% in Porttipahta reservoir, 61% to 75% in Canadian experimental reservoirs, and 87% in Lokka reservoir [Huttunen et al. 2002, Matthews et al. 2005, Teodoru et al. 2012]). Unfortunately, CH_4 flux measurements from permafrost reservoirs and nonhydroelectric boreal reservoirs are currently lacking. Future study of boreal reservoir GHG fluxes should target these underrepresented systems and incorporate more comprehensive ebullition rate measurements.

The role of reservoir productivity. Recent work has suggested that eutrophication might "reverse" the carbon budget of lakes and reservoirs (i.e., shifting the ecosystem from net heterotrophy to net autotrophy) by converting large amounts of CO_2 to organic matter via elevated primary production (Pacheco et al. 2013). Our analysis does not support this idea. A comparison of CO_2 and CH_4 fluxes from eutrophic reservoirs suggests that eutrophication does little to change the net carbon balance of reservoirs, but greatly increases the atmospheric radiative forcing caused by these systems through the stimulation of CH_4 production (figure 3). This suggests a potential positive feedback loop wherein a warming climate supports larger algal populations, larger algal populations provide more organic matter to support more methane production, and a portion of the methane produced escapes to the atmosphere, where it functions to further warm climate. The relationship between organic matter quality and methane production is an active area of research that may reduce the strength, or possibly even negate, the feedback loop proposed above. A recent laboratory study revealed that algal biomass quality, in terms of lipid content, enhanced rates of methane production (West et al. 2015b). Because algae grown under nutrient rich conditions tend to be relatively lipid poor, the authors posit that this resource quality feedback reduces the strength of the positive feedback between eutrophication and methane production (West et al. 2015b). Developing our understanding of these feedbacks should help inform quantitative modeling efforts.

The larger context. In this study, we have discussed only gross carbon emissions from existing reservoirs, ignoring other stages or factors of a reservoir's carbon cycle that are important to consider. For example, it will be necessary to eventually place gross fluxes in context by comparing them with (a) the GHG balance of the land prior to flooding, (b) the rates of reservoir carbon fixation and storage, (c) the GHGs associated with reservoir creation and decommissioning (e.g., life-cycle-analysis perspective), and (d) the long-term fate of carbon buried in reservoirs that are decommissioned. Few studies have placed reservoir GHG emissions into such a context, but those that have find that reservoirs result in a net carbon footprint that exceeds that of the preflooded landscape and that they are net emitters of CO_2 equivalents (Jacinthe et al. 2012, Teodoru et al. 2012, Faria et al. 2015). A recent analysis of CH_4 fluxes from hydroelectric reservoirs showed that 10% of reservoirs have emission factors (gCO_2e per kilowatt hour) larger than the CO_2 emissions from natural gas combined cycle plants (Hertwich 2013), although the authors did not consider carbon burial offsets. Although dams are responsible for high rates of carbon burial (Clow et al. 2015), it has been argued that at least a portion of this burial would still be occurring farther downstream, perhaps even in coastal waters, in the absence of dams (Mendonça et al. 2012). The role of dams in re-locating sediment carbon pools may be significant in determining total carbon burial (Mendonça et al. 2012) as well as the fraction of carbon that is emitted as CH_4. For example, faster-moving, more oxygenated "lotic" waters typically support more rapid decomposition and CO_2 production but less CH_4 production. Similarly, at the coast, high concentrations of SO_4^{2-} generally prohibit high CH_4 emissions. Accounting for the short and long-term fate of carbon in reservoir sediments is an important next step in global carbon budgeting exercises.

Policy implications

When CH_4, CO_2, and N_2O emissions are combined, our synthesis suggests that reservoir water surfaces contribute 0.8 Pg CO_2 equivalents per year over a 100-year time span (fifth and ninety-fifth confidence interval: 0.5–1.2 Pg CO_2 equivalents

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per year), or approximately 1.5% of the global anthropogenic CO_2-equivalent emissions from CO_2, CH_4, and N_2O reported by the IPCC (table 1; Ciais et al. 2013) and 1.3% of global anthropogenic CO_2-equivalent emissions from well mixed GHGs overall (Myhre et al. 2013). Therefore, we argue for inclusion of GHG fluxes from reservoir surfaces in future IPCC budgets and other inventories of anthropogenic GHG emissions. The reservoir-based CH_4 emissions reported here (8.9–22.2 Tg CH_4-C per year) are similar in magnitude to estimates of CH_4 emissions from rice paddies and to those from biomass burning (which includes biofuel emissions) by the IPCC (21–30 and 18–29 Tg CH_4-C per year respectively; Ciais et al. 2013). Reservoir CO_2 and N_2O fluxes, however, are lower than other anthropogenic or natural sources as reported by the IPCC (Ciais et al. 2013).

Although global-warming potentials for CO_2-equivalent calculations are often reported for a 100-year time span, the selection of time span is somewhat arbitrary (Myhre et al. 2013). CH_4 is relatively short-lived in the atmosphere (atmospheric lifetime on the order of a decade) relative to CO_2 (atmospheric lifetime on the order of centuries) and therefore has a higher global warming potential over the shorter 20-year time horizon (86 versus 34; Myhre et al. 2013). Policymakers should carefully consider the timescales that are relevant to GHG mitigation efforts, especially given the recent international push to maintain average global temperatures within 1.5–2°C of the pre-industrial mean (Fearnside 2015). Over shorter timescales (decades), and given the exclusion of several important alternative emission pathways (i.e., degassing, downstream and drawdown zone emissions; see section above), reservoirs are almost certainly contributing more than the 0.8 Pg CO_2 equivalents per year calculated here. In fact, when looking over the 20-year time horizon, CO_2 equivalent emissions from reservoir surface waters are estimated at double the flux presented here (1.7 Pg CO_2 equivalents per year , 5th and 95th confidence interval: 1.1 to 2.7 Pg CO_2 equivalents per year). With the current boom in global dam construction (Zarfl et al. 2015), reservoirs will represent an even larger fraction of anthropogenic CO_2 equivalent emissions in the coming years. Therefore, policymakers and water managers that are siting new dams or decommissioning old ones should weigh the multiple services that reservoirs provide against their GHG-related costs in planning to either construct or decommission a dam. A number of papers compare reservoir GHG emissions to those of the natural gas combined cycle (see the Larger Context section above), but many reservoirs do not produce energy at all.

Conclusions

Sixteen years ago, the first global review of reservoir GHG emissions highlighted the potential significance of reservoir surfaces as GHG sources and postulated that factors such as age, water temperature, and organic carbon inputs could regulate fluxes (St. Louis et al. 2000). At that time, there were GHG flux estimates from only 22 reservoir systems and potential controlling factors could not be quantitatively assessed. Here, we discuss a more comprehensive set of reservoir GHG flux estimates than has previously been analyzed, and use that data set to develop new insight into the rates and controls of reservoir GHG fluxes. Specifically, this work highlights the dominant contribution of CH_4 emissions to total reservoir carbon emissions, and the importance of including ebullitive CH_4 emissions in modeling efforts. Furthermore, it appears that reservoir nutrient loading and associated eutrophication leads to increased radiative forcing by reservoirs because of increased CH_4 emissions. The relationship between reservoir eutrophication and GHG emissions presented here provides a crucial first step in identifying potential management opportunities for the reduction of reservoir GHGs. Specifically, watershed nutrient reduction strategies aimed at preventing reservoir eutrophication may also mitigate both CH_4 and N_2O emissions (specifically via reduction of P and NO_3^- loading). In addition, when possible new reservoirs could be strategically sited upstream from anthropogenic nutrient sources. With the need for better global water management and the push for expanded global hydropower capacity, careful siting of new reservoirs, and revising management of existing ones may help balance the positive ecosystem services that reservoirs provide against the GHG emission costs.

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Supplemental material

The supplemental material is available online at *http://bioscience.oxfordjournals.org/lookup/suppl/doi:10.1093/biosci/biw117/-/DC1*.

There is also an accompanying supplementary spreadsheet available via Dryad (doi:10.5061/dryad.d2kv0) that contains the complete data set used in this synthesis and accompanying references.

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Reservoir Water-Level Drawdowns Accelerate and Amplify Methane Emission

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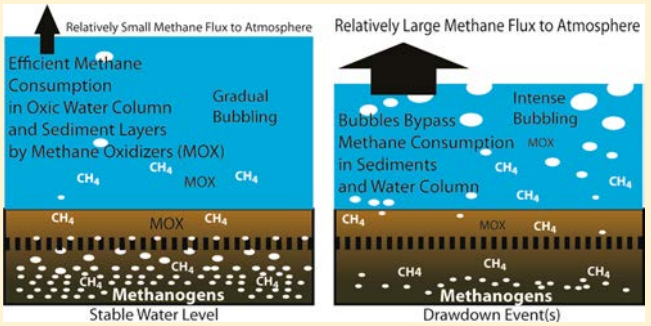
Supporting Information

ABSTRACT: Water-level fluctuations due to reservoir management could substantially affect the timing and magnitude of reservoir methane (CH_4) fluxes to the atmosphere. However, effects of such fluctuations on CH_4 emissions have received limited attention. Here we examine CH_4 emission dynamics in six Pacific Northwest U.S. reservoirs of varying trophic status, morphometry, and management regimes. In these systems, we show that water-level drawdowns can, at least temporarily, greatly increase per-area reservoir CH_4 fluxes to the atmosphere, and can account for more than 90% of annual reservoir CH_4 flux in a period of just a few weeks. Reservoirs with higher epilimnetic [chlorophyll *a*] experienced larger increases in CH_4 emission in response to drawdown (R^2 = 0.84, p < 0.01), suggesting that eutrophication magnifies the effect of drawdown on CH_4 emission. We show that drawdowns as small as 0.5 m can stimulate ebullition events. Given that drawdown events of this magnitude are quite common in reservoirs, our results suggest that this process must be considered in sampling strategies designed to characterize total CH_4 fluxes from reservoirs. The extent to which (and the mechanisms by which) drawdowns short-circuit connections between methanogenesis and methanotrophy, thereby increasing net CH_4 fluxes to the atmosphere, should be a focus of future work.



INTRODUCTION

Collectively, at the global scale, reservoirs constitute a major anthropogenic source of atmospheric CH_4, emitting 12−70 Tg y^{-1} of CH_4, roughly as much as other major anthropogenic CH_4 sources such as rice cultivation or biomass burning.[1−4] In lakes and reservoirs, CH_4 is produced primarily in anoxic sediments and can be released to overlying water via diffusion, ebullition (bubbling),[5] or, when emergent vegetation is present, via plant-mediated transport. Emissions of CH_4 from reservoirs can also occur via degassing at turbines and spillways.[3] The pathway for CH_4 emission (diffusion vs ebullition) matters because the fate of CH_4 diffusing out of sediments is quite different from that of CH_4 bubbling out of sediments. CH_4 diffusing out of sediments is generally subject to remarkably efficient microbial CH_4 oxidation (methanotrophy), a process which converts CH_4 to CO_2, a much less potent greenhouse gas on a per-molecule basis.[6] In fact, a recent review of nine lakes with both CH_4 production and oxidation measurements conservatively estimated that methanotrophs consume 50−95% (median: 90%) of all CH_4 produced in lakes and an even greater fraction of the nonebullitive CH_4 flux.[7] In contrast, CH_4 bubbling out of sediments largely bypasses methanotrophs, especially in shallow systems/sites where water column bubble dissolution is limited.[8] Hence, processes that increase the fraction of CH_4 released via ebullition (versus diffusion) can increase the magnitude of atmospheric CH_4 flux. Furthermore, although ebullition is frequently the dominant emission pathway for CH_4 emission from reservoirs, it is infrequently measured relative to diffusive emissions.[3] Hence there is a great need to better quantify and understand the drivers of CH_4 ebullition.

Methane is produced in anoxic lake sediments via microbial decomposition of organic matter, and production rates depend on organic carbon availability, redox conditions, and temperature.[9,10] If the partial pressure of all dissolved gases in porewater exceeds ambient pressure and water surface tension, free gas is formed.[11−13] Continuous CH_4 production causes bubbles to form, grow and create fractures or disc-shaped cavities within sediments.[13,14] With continuing gas production in sediments, these gas bubbles can grow further, coalesce, and migrate vertically through the sediment until they are released into the water column and, subsequently, to the atmosphere.[11,13] Decreases in hydrostatic pressure (or other physical disturbances) can lower compressive sediment stress and cause bubbles to overcome their confinement, expand by deforming

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Table 1. Characteristics of Study Reservoirs

reservoir name	surface area (ha)	max depth (m)	drawdown description	magnitude of drawdown (m)	average pace of drawdown (m d^{-1})	average surface[Chl a] (mg m^{-3})	trophic status[a]
Cle Elum	1940	101	large summer drawdown	25	0.45	0.24	oligotrophic[36]
Kachess	1837	125	large late-summer drawdown	7	0.12	0.40	oligotrophic
Foster	425	33	fall drawdown + hydropower reregulation	6	0.30	1.35	mesotrophic[37]
Lacamas	127	17	short late-summer drawdown	2	0.14	5.38	eutrophic[38]
J. C. Boyle	154	14	hydropower peaking	0.5	0.66	6.27	eutrophic[39]
Keno	634	10	constant water level	0	na	12.03	eutrophic[39]

[a]Trophic status was taken as reported by system-specific studies when available (citations included in table) or, otherwise, based on U.S. EPA National Lakes Assessment chlorophyll a criteria and data from this study.[61]

the surrounding sediments, and hasten their rise to the surface.[11] The cohesive strength of sediments, and hence their sensitivity to changes in hydrostatic pressure, is thought to vary as a function of organic content and pore pressure, with greater organic matter content generally associated with greater sediment cohesive strength.[15]

On their way upward through sediments (and the water column), bubbles are subject to diffusive exchange with the surrounding environment. There is a widely reported positive relationship between ebullition rates and bubble CH_4 concentrations, which is generally attributed to N_2 stripping by CH_4 bubbles.[16,17] The idea here is that bubbles moving through sediments can strip out N_2 (the most abundant of the dissolved gases at atmospheric equilibrium) from pore waters, leaving CH_4 to make up a large fraction of the partial pressure in remaining bubbles. Although the flattened bubbles thought to occur in cohesive sediments[12] are likely to exhibit more efficient diffusive exchange than spherical bubbles would, larger bubbles generally have lower surface area:volume ratios and therefore result in less efficient gas exchange. In addition, longer residence times for bubbles in sediments would result in lower emission efficiencies for CH_4 produced in sediments as greater time in sediments provides greater opportunity for methanotrophy to occur.

Prior studies of factors controlling ebullition events from aquatic sediments have highlighted many potential drivers, including wind events and associated bottom shear,[15,18] variations in atmospheric pressure,[19−21] oxygen concentrations, water temperature, organic matter input,[22−24] and seasonal[22,25] and tidal[26] decreases in water level. The trophic status of reservoirs also should influence sediment CH_4 production and atmospheric emissions.[27] The theory here is that higher nutrient loads support higher rates of primary production, which in turn provide the organic carbon substrate and favorable (hypoxic) conditions necessary to support rapid rates of CH_4 production. Trophic status also influences the availability of autochthonous carbon, which has been found to promote higher rates of methanogenesis than allocthonous carbon.[27] Recent studies of single systems, as well as regional and global syntheses, suggest an important link between primary production and CH_4 emission in lakes and reservoirs,[3,5,28−30] with more nutrient enriched systems generally exhibiting higher rates of CH_4 emission.

Although fluctuations in pressure (either barometric or hydrostatic) can clearly influence the timing of methane release from sediments,[19,31,32] and researchers have argued that reservoir drawdowns should affect CH_4 ebullition,[11,33,34] there have been very few studies of this phenomenon in reservoirs. In fact, an extensive literature search yielded only two studies investigating the relationship between reservoir water level and ebullition, both of which focused on a single reservoir with a small (<0.5 m in both cases) range of stage height fluctuation. The first study reported synchronous bubble releases across multiple sites within a single, slightly regulated kettle-hole lake that were linked equally to variations in atmospheric pressure and reservoir water level via time series analysis.[22] This study measured cumulative bubble volume, but CH_4 concentrations in bubble gases were not measured, so CH_4 fluxes could not be directly computed. The second, more recent study reported pulsed releases of CH_4-rich bubbles from sediments in a regulated portion of the Saar river (Germany), which correlated with navigation-associated water level fluctuations (total range in water level <0.3 m).[35] Neither study examined the potential interactive effects of water level drawdown and trophic status on atmospheric CH_4 emissions, but it stands to reason that more eutrophic systems may have larger sediment CH_4 stores to be released during drops in hydrostatic pressure.

Here, we take a multireservoir comparative approach to investigate how reservoir management and characteristics affect CH_4 emissions by examining CH_4 ebullition dynamics in several reservoirs subject to a variety of drawdown types (flood prevention, hydropower peaking, and maintenance-related) and spanning a range of trophic statuses. This allows us to examine how reservoir management and characteristics affect CH_4 emissions. Second, we directly compare two adjacent (in-series) reservoirs that differ primarily with respect to water-level management, allowing us to examine the impact of drawdowns on CH_4 flux magnitude, in addition to timing. Third, three full years of data from one of our study reservoirs allowed us to quantify the contribution of drawdown-associated CH_4 fluxes relative to annual CH_4 emissions, a result with important implications for efforts to quantify CH_4 emissions from reservoirs.

MATERIALS AND METHODS

To examine the relationship between water level drawdown and CH_4 ebullition we monitored water column CH_4 concentrations, CH_4 ebullition fluxes, and variables likely to control CH_4 ebullition in six Pacific Northwest U.S. reservoirs, spanning a range of management regimes, trophic statuses, and morphologies (Table 1, Supporting Information (SI) Figures S1 and S2). Two of the study reservoirs (Cle Elum and Kachess) are oligotrophic systems[36] located high in the Yakima River Basin (~700 m elevation), and are managed primarily as irrigation storage reservoirs, with pronounced summer drawdowns that occur over periods of approximately two months (7 and 25 m drawdowns for Kachess and Cle Elum reservoirs, respectively; Table 1). Foster Reservoir is located in the

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Santiam River drainage, is mesotrophic,[37] and is managed as a hydropower reregulation reservoir, a reservoir designed to reduce the impact of flow disturbance caused by hydropower operations at an upstream dam. During this study, Foster Reservoir experienced a 6 m drawdown over a 20 day period in late autumn. Lacamas Lake is a small (127 ha), relatively shallow (8 m average depth), eutrophic reservoir which is managed primarily for recreation.[38] This reservoir experiences an annual September drawdown of 1.5−2.0 m over a 7−12 day period so that dam owners can perform dam maintenance. Finally, Keno and J. C. Boyle reservoirs are adjacent eutrophic systems,[39] situated in series, with Keno located just upstream of J. C. Boyle. These two eutrophic reservoirs differ primarily with respect to their water level management regime, allowing us to examine the effect of drawdowns on CH_4 emissions in two otherwise similar reservoirs. Keno reservoir is managed to maintain a constant water level all year with no drawdowns, whereas J. C. Boyle experiences a daily ∼0.5 m drawdown in order to provide hydropower during periods of peak energy demand. The measurement period for most of these reservoirs ranged from weeks to months, but in Lacamas Lake CH_4 fluxes were measured during multiple drawdown events spanning five years (Table 2).

Table 2. Number of Sampling Sites and Sampling Dates for Each Study Reservoir

reservoir name	no. of sampling sites	dates of trap deployment and associated CH_4 sampling	period between sampling events
Cle Elum	4	May 14, 2013 to Oct 22, 2013	20−30 days
Kachess	4	Jun 5, 2013 to Sept 24, 2013	27−29 days
Foster	4	Aug 6 to Nov 12, 2013	2−16 days
Lacamas	4−13*	Aug 9, 2011 to Oct 7, 2011, Sept 1, 2012 to Oct 26, 2012, and May 31, 2013 to Jan 7, 2016	<1 day during drawdown) - 55 days (winter); (every 5 min for volume)
J. C. Boyle	4	Aug 12−19, 2013	0.05−2 days (every 5 min for volume)
Keno	4	Aug 13−18, 2013	0.2−1.3 days (every 5 min for volume)

In each reservoir, we estimated ebullition using at least 4 inverted funnel traps (SI Figure S3)[22] deployed for extended periods, hanging 1.5 m below the water surface at profundal, intermediate depth, inlet littoral, and noninlet littoral sites. In Lacamas Lake, 6 and 13 traps were deployed in 2013 and 2014−2015, respectively. Gases were sampled at regular intervals (hours to weeks; Table 2) determined by the rate of bubbling within each reservoir, and concentrations were subsequently measured on a Hewlett-Packard 5890 gas chromatograph equipped with a flame ionization (FID) detector.[38] Ebullition fluxes (mg CH_4 m^{-2} y^{-1}) were calculated as the product of accumulated gas volume and concentration, divided by funnel aperture cross-sectional area, and sampling interval. Control traps injected with 130 mL of 50% CH_4 standard were deployed along with sampling traps in each reservoir to account for potential diffusive loss of gas from traps left out over extended periods. These control traps were identical to sampling traps except that a plexiglass sheet was hung below control trap funnels to prevent bubbles from diluting or enriching the control gas.

These control traps were sampled every time the noncontrol traps were sampled. Measured concentrations of standards held for up to 55 days in control traps demonstrated no detectable loss of CH_4 (SI Figure S4), perhaps due to the high volume of standard (generally >70 mL) relative to the surface area in contact with reservoir waters (3.98 cm^2) and the low solubility of CH_4. It is possible that small volumes of gas held in traps would be subject to greater proportional dissolution and oxidation, but we did not observe this effect for the volumes tested (40−100 mL). Sampling events where gas volume in traps was greater than zero and less than 40 mL accounted for just 2.1% of total gas volume collected during this study. At the deepest point in each reservoir (SI Figure S2), vertical profiles were sampled for dissolved [CH_4], temperature, dissolved oxygen, and [chl *a*]. Dissolved [CH_4] was estimated via headspace equilibration as in Harrison and Matson (2003),[40] with gas concentrations measured on a GC equipped with an FID, as described above for bubble fluxes.[38] Temperature, dissolved O_2, and [Chl *a*] were measured using a Hach DSX Sonde. Chl *a* measurements were cross calibrated with acetone-extracted Chl *a*, measured on a Turner Designs AU Fluorometer. Hypolimnetic CH_4 accumulation for Lacamas Lake, Cle Elum Reservoir, and Kachess Reservoir was estimated from profile data as the change in volume-weighted CH_4 mass over time as in Deemer et al. (2011).[41] Diffusive CH_4 flux was estimated using a standard thin boundary layer model that predicted gas flux (F; for example, mmol CH_4 m^{-2} d^{-1}) according to

$$F = k(C_{sur} - C_{eq})$$

where k is the piston velocity (m d^{-1}) and C_{sur} and C_{eq} are measured surface water concentration and calculated air-equilibrium concentration, respectively, for CH_4.[42] Piston velocity (k) was estimated to vary as a function of surface water temperatures measured at the same time as surface water CH_4 concentrations and mean daily windspeed as in Musenze et al. (2014)[43] and similar to Cole and Caraco (1998)[44] according to

$$k = \left(\frac{S_c}{600}\right)^{-0.5}\left[2.07 + 0.215\left(\frac{\ln\left(\frac{10}{Z_0}\right)}{\ln\left(\frac{Z}{Z_0}\right)}\right)^{1.7} U_z^{1.7}\right]$$

where S_c is the Schmidt number for CH_4 at measured surface water temperature calculated as in Waninkhof et al., (1992),[45] Z_0 is the roughness height (taken as 0.1 m), Z is the height at which wind speed was measured, and U_z is the average daily wind speed during the day when surface water concentration was measured.

Lake-wide ebullition fluxes were estimated by area-weighting fluxes from two zones (profundal and littoral, defined as greater and less than 4 m depth, respectively) in each reservoir, using a minimum of 2 traps in each zone for each reservoir. In Lacamas Lake, diffusive and ebullitive CH_4 fluxes as well as hypolimnetic accumulation were measured biweekly over two and a half years (June 2013 to January 2016) and both prior to and during two additional annual drawdown events (in 2011 and 2012). In addition to funnel trap estimates, we also performed hydroacoustic transects in each reservoir using a 120 Hz, split-beam transducer to develop qualitative insight into temporal and spatial distribution of bubbles[34] (see Supplement for additional detail). These transects were executed before and during drawdown in each study reservoir in 2013.

Sampling density and duration in this study were comparable to those in many recent published studies. For example,

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Kemenes et al. (2007)[46] quantified ebullition over 20 min periods at monthly intervals using 10−14 sites, and Maeck et al. (2014)[35] had funnel traps deployed at three sites over a 6 month duration. Similar to Maeck and colleagues (2014),[35] we deployed gas traps for a much greater period of time than is common (weeks-to-months as opposed to the typical minutes-to-hours) and in a variety of habitat types. Sampling and flux calculations were designed to avoid overemphasis of inlet hotspots. Ebullition traps in each reservoir were intentionally placed so as to maximize both the variability captured and sample representativeness. For example, in each reservoir, we utilized at least one shallow site near the inlet, one shallow outlet site, and two comparatively deep (>4 m depth) sites. From traps with pressure transducers (deployed in Keno, J. C. Boyle, and Lacamas) we collected hundreds of observations of gas volume. We present data from only traps with a minimum of five sampling events apiece, but most traps were sampled much more frequently, with collection events (instances when gas samples were collected from traps and returned to the lab for subsequent concentration measurements) occurring at intervals ranging from 0.05 days to several weeks and total sampling time ranging from 5 days up to several calendar years (Table 2).

RESULTS AND DISCUSSION

Drawdown Affects Timing of CH_4 Emission. Several lines of evidence implicate water level drawdown as a crucial control on timing of CH_4 emissions in our study reservoirs. First, there was a strong temporal correspondence between drawdown events and increases in ebullition rates across all study reservoirs experiencing drawdowns ≥0.5 m (i.e., five of the six study systems). In all reservoirs (and in all years for Lacamas Lake, the one system in our study which was monitored for multiple years) we observed pulses of total ebullition, CH_4 emission via ebullition, CH_4 emission via diffusion, and total CH_4 emission (ebullition plus diffusion) associated with water level drawdown (Figures S5, 1, 2, and 3). In every case, simple average and area-weighted-mean whole-lake ebullition rates at least tripled between predrawdown and drawdown periods, and, in the most extreme case (Lacamas in 2013), increased by more than a factor of 6000 (Figure 1a). Furthermore, there were no instances where ebullition rates decreased in any of our study reservoirs (or even individual traps) during drawdown events.

We also observed increases in average surface water CH_4 concentrations in all study reservoirs during reservoir drawdown ($P < 0.05$ in all cases by one-way ANOVA; SI Figure S6), and increases ($P < 0.1$ in all cases) in average hypolimnetic CH_4 concentrations during drawdown in all but one study reservoir (Foster Reservoir; SI Figure S6), which showed no significant change. In reservoirs where it was possible to calculate dissolved CH_4 mass and dissolved CH_4 accumulation rates during predrawdown and drawdown periods (Lacamas, Kachess, and Cle Elum Reservoirs), we observed increases in hypolimnetic CH_4 mass during drawdowns (SI Figure S7). One explanation for these observed increases is that bubbling events load the water column with CH_4 as gases in bubbles exchange with the water column during ascent. An alternative explanation for observed patterns in hypolimnetic CH_4 loading during drawdowns is that increased bubble densities in sediments enhanced diffusion of sparingly soluble gases from sediments into the water column, as has been suggested could occur by at least one core incubation study.[47] Regardless of mechanism,

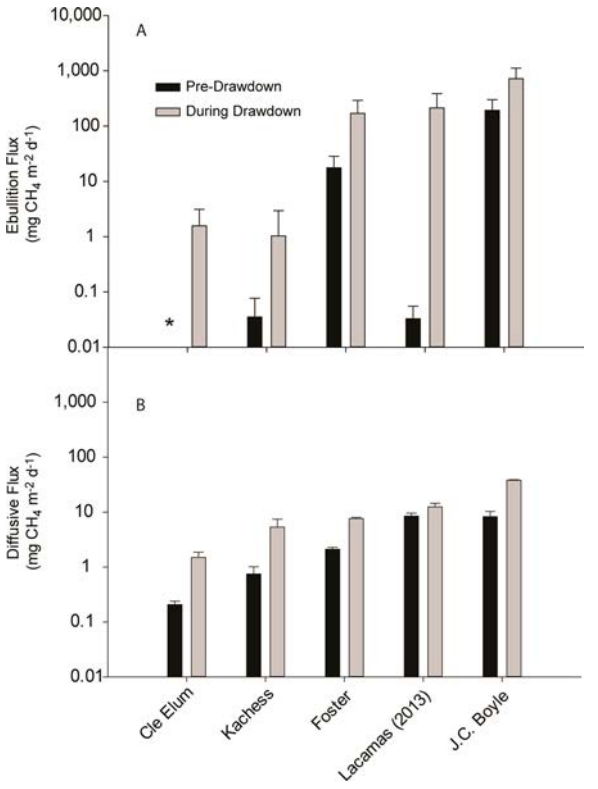

Figure 1. Average CH_4 ebullitive (A) and diffusive (B) fluxes (mg CH_4 m^{-2} day^{-1}) from 5 reservoirs during predrawdown versus during-drawdown conditions. For Panel A, $n = 4$ funnel traps in all cases except Lacamas, where $n = 6$, and error bars represent one standard error of measurements between all traps. For Panel B, $n = 2$−14 time points, depending on the system, and error bars represent one standard deviation of modeled fluxes. * denotes zero flux during the predrawdown period in Cle Elum Reservoir.

hypolimnetic CH_4 accumulation rates in Lacamas increased 250−4,200% during drawdown events, compared to predrawdown accumulation rates during the five years for which we have data (SI Figure S7). Diffusive CH_4 losses to the atmosphere were also elevated during drawdown periods (Figure 1b). Thin boundary layer model-estimated diffusive fluxes were smaller than ebullition fluxes during drawdown periods in all reservoirs, but were larger than ebullition fluxes during nondrawdown periods in oligotrophic reservoirs and in Lacamas Lake (Figure 1a and b). When both ebullition and diffusive fluxes are considered (ignoring hypolimnetic CH_4 accumulation), all reservoirs in this study experienced at least a 3.6-fold increase in CH_4 emissions during drawdown. In all reservoirs, CH_4 accumulation measurements from traps were qualitatively consistent with hydroacoustic data. Bubble densities in the hydroacoustic surveys were much greater following drawdowns than prior to drawdown events, and the highest bubble densities in the hydroacoustic surveys occurred at locations where the greatest gas volumes were collected in traps (SI Methods and Figures S8 and S9).

Ebullition rates varied substantially between traps in each reservoir. During predrawdown periods, coefficients of variation (CVs) for mean rates of CH_4 ebullition between traps ranged from zero in Cle Elum Reservoir, where no ebullition was detected, to 200% in Kachess Reservoir. During drawdown CVs for mean CH_4 ebullition rates ranged from 117% (in J. C. Boyle Reservoir) to 200% (in Kachess Reservoir). A Monte Carlo

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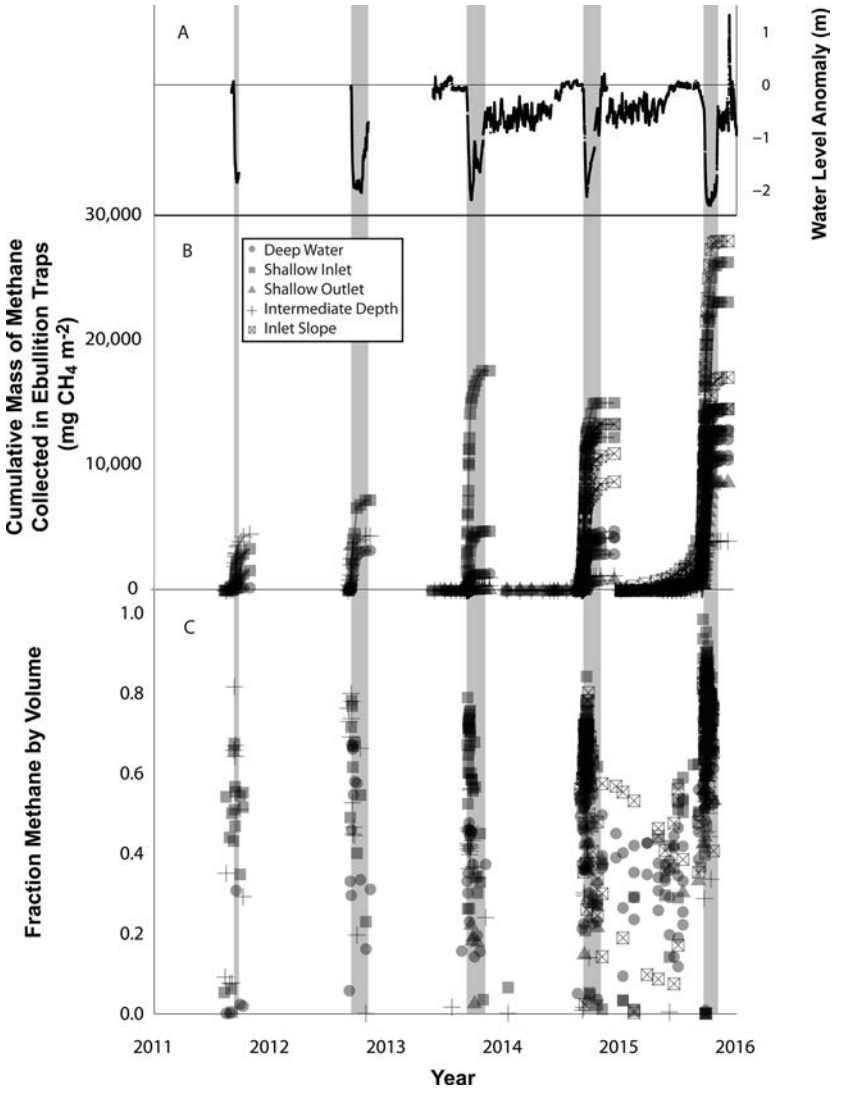

Figure 2. Time series showing (A) change in the water surface elevation anomaly in Lacamas Lake (secondary *Y*-axis and black lines; annual reservoir drawdown events are also indicated by shaded gray bars), (B) cumulative bubbled mass of CH_4 in traps located at four sites in Lacamas Lake in 2011 and 2012, six in 2013, and 13 sites in 2014−2016; lines represent individual bubble traps, and points represent sampling events where traps were emptied and gas concentrations were measured, and (C) the fraction of sampled gas as CH_4 for each time a trap was sampled (n = 717).

subsampling analysis of subsequent additional, higher density sampling in Lacamas Lake (Figure 2) allowed us to determine that sampling with two shallow and two deep ebullition traps (the design implemented in most reservoirs in this study) yields rate estimates within ±60% of rates calculated using 13 traps >95% of the time. Hence, it appears that the large signal due to drawdown made it possible to detect a significant drawdown effect in Lacamas Lake despite substantial spatial variation between traps. If spatial variability of ebullition rates in other study reservoirs is similar to (or less than) that observed in Lacamas Lake, then the sampling density employed in this study was sufficient to reliably detect the large and consistent observed drawdown effect, which was greater than 3-fold in all study reservoirs.

Drawdowns and Magnitude of Ebullition Events. A comparison of two reservoirs differing primarily in water level management suggests that drawdowns affect not just the timing but also the *magnitude* of CH_4 ebullition (J. C. Boyle vs Keno; Figure 3). These reservoirs occur in series, within 9 river km of each other and experience very similar levels of nutrient loading.[39] In J. C. Boyle reservoir, daily drawdowns timed to meet hydropower demand were associated with pulsed release of CH_4-rich bubbles from sediments. In contrast, over the same period, just upstream in Keno reservoir (which is managed to maintain a constant water level), no such pulsed bubbling events were observed. Instead, where ebullition was measured in Keno, rates were fairly constant over the duration of our experiment (Figure 3). The net effect of drawdowns over the period of measurement was to increase total CH_4 ebullition by a factor of 3.5 in J. C. Boyle relative to Keno (Figure 3). During the experimental period bubble CH_4 concentrations averaged 54% in Keno Reservoir and 74% in JC Boyle reservoir, so differences in CH_4 concentration of bubbles only accounted for a small portion of the total difference in ebullition between the two reservoirs. The remainder of the difference in observed ebullition between the two reservoirs was due to differences in bubbling rates, which averaged 341 mL $m^{-2}d^{-1}$ in Keno and 445 and 1624 mL m^{-2} d^{-1} during nondrawdown and drawdown periods in JC Boyle, respectively. It is conceivable that differences in short-term whole-reservoir ebullition rates

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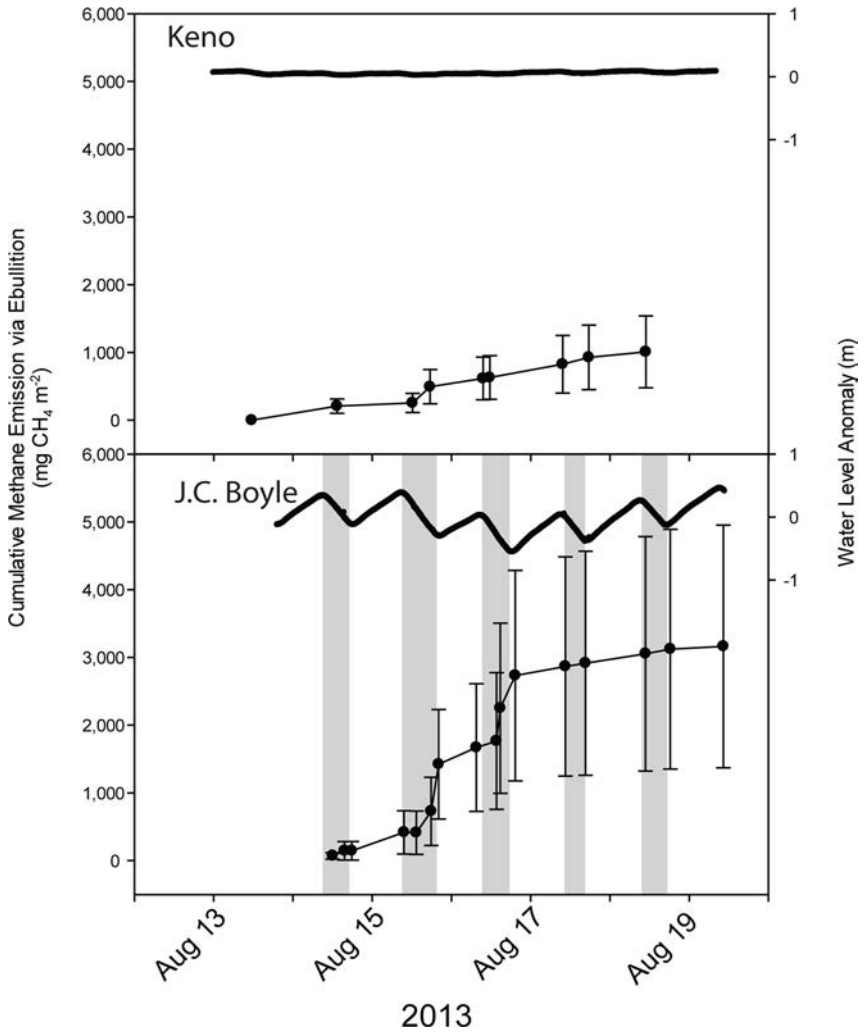

Figure 3. Time series showing average cumulative bubbled mass of CH_4 in traps located at sites in Keno (A) and J. C. Boyle (B) Reservoirs (n = 4 traps in each reservoir). Reservoir drawdown events are represented by shaded gray bars and are also visible as the change in the water surface elevation anomaly (secondary Y-axes and lines). Panels show a contrast between cumulative CH_4 ebullition in two reservoirs positioned in series (i.e., receiving the same water), experiencing different water level management. Error bars represent ±1 SE.

between Keno and J. C. Boyle were due to differences in factors other than drawdown. However, the available data suggest that, if anything, CH_4 emission rates should be greater in Keno than in J. C. Boyle, the opposite of what we observed. Turbidity and [Chl a], both of which would be associated with higher rates of CH_4 production, were higher in Keno than J. C. Boyle. During our study, turbidity was more than 3-fold higher in Keno Reservoir (mean: 28 NTU) than in J. C. Boyle Reservoir (mean: 8 NTU), and [Chl *a*] was roughly 2-fold higher in Keno than in J. C. Boyle (12.03 μg L^{-1} in Keno vs 6.27 μg L^{-1} in J. C. Boyle). Sediment percent organic C at the most active sites for ebullition was comparable between the two reservoirs (6.42% in Keno vs 7.40% in J. C. Boyle). Bottom water temperatures were slightly higher in Keno (21.24 °C) than in J. C. Boyle (19.71 °C), and average bottom water O_2 concentrations were higher in J. C. Boyle (2.41 mg O_2 L^{-1}) than in Keno (0.64 mg O_2 L^{-1}). Hence temperature and O_2 conditions should both favor greater rates of CH_4 production in Keno than in J. C. Boyle, the opposite of what we observed. Although these measurements were carried out over just a short period of time (5 days), they are consistent with longer-term monitoring data for the two reservoirs, which show very similar water chemistry (i.e., no detectable differences in mean annual concentrations of total nitrogen, dissolved organic nitrogen, nitrate, ammonium, total phosphorus, and soluble reactive phosphorus), and a similar difference in [Chl *a*] between the two reservoirs to that observed during our study.[39] Temperatures in the two reservoirs are generally within 1 °C of each other (http://www.kbmp.net/maps-data/links-data-reports). In addition, a long-term (8-year) record of barometric pressure fluctuations for the region shows that for the 8 years prior to our study, daily barometric pressure fluctuations never exceeded the pressure changes due to 0.5 m daily water level drawdowns in J. C. Boyle, and barometric pressure was quite stable for weeks prior to our experiment. Hence, it is unlikely that barometric pressure fluctuations occurring beyond the end of our experiment in Klamath River reservoirs would cause net CH_4 fluxes from Keno to catch up to those from J. C. Boyle.

Data from Lacamas Lake also suggest that by enhancing ebullition rates, even temporarily, drawdowns might increase CH_4 emissions. This is due to a strong ($P < 0.001$; $R^2 = 0.5$), positive relationship between ebullition rates and bubble CH_4 concentrations in Lacamas Lake, with concentrations peaking during drawdown events (Figure 2b). During drawdowns in

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Lacamas Lake, average bubble CH_4 concentrations were roughly 2-fold higher than those during nondrawdown periods ($P < 0.001$), averaging 61% CH_4 during drawdown periods and 30% during nondrawdown periods (Figure 2b). There was also a significantly ($P < 0.001$) strong ($R^2 = 0.5$) and positive log−linear relationship between ebullition rate and bubble CH_4 concentrations. This relationship may be due simply to bubble aging and the effect of N_2 stripping from sediments that has been observed previously in other systems,[16,17] but it is also consistent with increased sediment-to-atmosphere transfer efficiency for CH_4 in bubbles emitted during drawdown (due to larger bubble sizes and/or higher sediment or water column CH_4 concentrations). Future efforts should aim to characterize differences in bubble size prior to and during drawdown as well as pore water chemistry and groundwater exchange rates during water level drawdown events. ^{13}C may also be a useful tool to help determine the degree to which CH_4 emitted as bubbles during drawdown events is oxidized compared to CH_4 emitted as bubbles during nondrawdown periods, as in Walter et al. (2008).[48]

Although one might argue that the CH_4 emitted during drawdown events would simply build up in sediments and that the same amount of CH_4 would ultimately be released to the atmosphere, there are several reasons this is probably not the case. It is likely that drawdowns short-circuit the CH_4 oxidation that normally is quite an efficient process in lakes and reservoirs, typically converting 50−95+% of CH_4 to CO_2 before it ever reaches the atmosphere.[7] Although some recent work has shown that some methanogenesis can occur under aerobic conditions,[49−51] the great majority of methanogenesis in lentic systems is thought to occur under highly reduced (O_2-poor) conditions whereas methanotrophy requires the presence of oxygen, or at least an electron acceptor.[52] This means that methanogenesis and methanotrophy generally require different chemical environments and mainly occur in different locations. Hence, any process that interrupts the transfer of CH_4 from methanogens (via diffusion or advection) to methanotrophs must decrease the efficiency of CH_4 oxidation, and thus increase CH_4 "leakage" to the atmosphere. It is also possible that bursts of bubbles associated with drawdowns enrich the water column with CH_4 so that the diffusive exchange of gas between bubbles and the water column is not as efficient as at other times of year. Finally, it is possible that by causing an ebullition event, drawdowns bring CH_4 to the surface that would otherwise be oxidized following fall lake turnover, when well-oxygenated water comes into contact with sediments that have been sitting in an anoxic environment during summer stratification.

Drawdown-Associated Ebullition Events Can Dominate a Reservoir's Annual CH_4 Emission. We were able to estimate the impact of drawdown on CH_4 fluxes in Lacamas Lake, the best-characterized of our study systems. During the 2.5 years over which bubble traps were deployed continuously at Lacamas Lake (2013−2016), 83−91% of total annual CH_4 flux to the atmosphere (ebullition plus diffusion) occurred during the period of drawdown and recovery (56−76 days, or 15−21% of the year). A large fraction (46−70%, depending on the year) of total annual hypolimnetic CH_4 accumulation in Lacamas Lake also occurred during reservoir drawdown. Across all reservoirs in our study, average predrawdown rates of ebullition were not especially high (0.0−192.6 mg CH_4 m^{-2} d^{-1}; mean of all reservoirs: 42.0 mg CH_4 m^{-2} d^{-1}), but rates observed during drawdown (0.09−719.0 mg CH_4 m^{-2} d^{-1}; mean: 223.0 mg CH_4 m^{-2} d^{-1}) fell toward the high end of reported CH_4 ebullition rates for reservoirs and lakes. In fact, the mean ebullition rate we observed during drawdowns was higher than 92.5% of reported reservoir CH_4 flux rates,[3] SI Table S1.).

Together, these results and those presented in previous sections constitute the first evidence that (1) water level drawdowns stimulate CH_4 emissions from reservoir sediments across a range of different types of reservoirs experiencing different management regimes and (2) that the magnitude of ebullition events associated with drawdowns can constitute a large fraction of the total annual CH_4 flux from reservoirs. These insights highlight a need to explicitly consider drawdown events in efforts to quantify CH_4 fluxes, both from individual reservoirs and, where possible, in regional and global CH_4 budgeting efforts.

Controls on Drawdown-Related Ebullition Events. We also examined controls on CH_4 fluxes. Of the factors examined, chlorophyll *a* concentrations [chl *a*] most strongly correlated with CH_4 emissions across reservoirs in this study. CH_4 ebullition, CH_4 diffusion, and the change in CH_4 emissions between predrawdown and drawdown periods all scaled strongly and positively with surface water [chl *a*] ($R^2 = 0.88$, 0.95, and 0.84; $P < 0.0005$, 0.0001, and 0.01, respectively; Figure 4). Although some of the observed relationship between

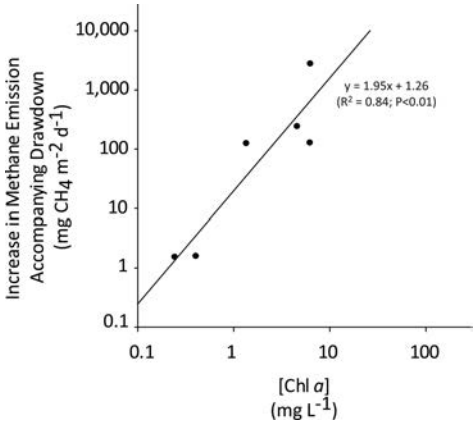

Figure 4. Relationship between average surface (top 3 m) chlorophyll *a* concentrations and increase in CH_4 ebullition accompanying drawdown in each of our study reservoirs. Best fit least-squares regression models and associated statistics are shown.

[chl *a*] and CH_4 emission may be explained by depth ([chl *a*] and depth were inversely correlated in our data set ($r = -0.59$)), the relationship between [chl *a*] and CH_4 ebullition was stronger than the relationship between depth and CH_4 emission ($R^2 = 0.87$ using [chl *a*] as an independent variable and $R^2 = 0.68$ using depth as an independent variable). This is consistent with a recent analysis, showing a relationship between [chl *a*] and CH_4 emission globally.[3]

The J. C. Boyle case suggests that magnitude of drawdown may affect CH_4 emissions within a single reservoir. During a two day experiment in this reservoir, (August 16−17), diel water level drawdowns were extended 0.19 m (first day) and 0.26 additional m (second day) below the standard operating range. CH_4 emissions were larger during these deeper drawdown events (August 16−17, Figure 3) than during standard water level operation (August 15) and during subsequent days (when water levels were not allowed to fall

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as low as they had the previous day, August 17−19). Although depth of drawdown appeared to affect ebullition within J. C. Boyle, there was no detectable relationship between drawdown magnitude and CH_4 emissions when all reservoirs were considered ($P > 0.05$). This suggests that once a critical pressure threshold is crossed (possibly related to recent pressure variation), the magnitude of drawdown ceases to matter, or, alternatively, that other factors (e.g., trophic status) are more important than drawdown magnitude in controlling CH_4 emissions when multiple reservoirs are considered. The magnitude of drawdown that will cause an ebullition event is also likely to vary as a function of CH_4 production rates, reservoir geomorphology, sediment cohesiveness, and reservoir management history. Characterizing these relationships so that predictive models can be developed remains a critical challenge for future research efforts. Similar to drawdown magnitude, there was no detectable relationship between drawdown velocity and any metric of CH_4 production or release, including overall average and during-drawdown ebullitive, diffusive, and total CH_4 fluxes and hypolimnetic CH_4 accumulation ($P > 0.05$ in all cases) across all study reservoirs. Nor was there any significant relationship between drawdown duration and total drawdown-associated CH_4 ebullition, either within a single reservoir across years in the case of Lacamas or across reservoirs ($P > 0.05$ in all cases).

We also tested for correlations between ebullition and alternative potential controlling factors such as near-sediment water temperature, wind speeds (and gusts), wind direction, and changes in atmospheric pressure. To accomplish this, we used high temporal frequency data (one pressure measurement every 5 min) from nondrawdown periods in 2013 at deep water and shallow inlet sites in Lacamas Lake and at a shallow inlet site in Keno Reservoir. Each site was analyzed separately, using ∼4 months of data for Lacamas sites and 3 days of data for the Keno site. At all three sites, all correlations between CH_4 ebullition rates and potential physical drivers of CH_4 ebullition were weak ($r < 0.3$) or statistically insignificant.

Although drawdowns consistently resulted in elevated CH_4 emission across our study reservoirs, there was considerable spatial variability in CH_4 emission both between traps within a single reservoir (e.g., Figures 2 and 3) and between reservoirs (Figure 1). Reservoir mean fluxes spanned 3 orders of magnitude (0.5−465 mg CH_4 m^{-2} d^{-1}), and time-averaged within-reservoir fluxes varied substantially between traps (e.g., 0−952 mg CH_4 m^{-2} d^{-1} in J. C. Boyle, the reservoir with the greatest variation between sampling sites). Bubble dissolution models predict that the importance of ebullition declines as water depth increases,[8] with little ebullition occurring from waters deeper than ∼8 m[5], but others have seen substantial CH_4 bubbling from depths greater than 8 m.[53] Depth was significantly correlated with CH_4 ebullition across all traps in all study reservoirs, with higher fluxes generally occurring at shallower sites ($P < 0.001$, adj. $R^2 = 0.66$). However, we observed some of the highest rates of ebullition at 11 m depth and substantial time-averaged CH_4 ebullition fluxes (3.7 mg CH_4 m^{-2} d^{-1}) in water up to 42 m deep. It has also been suggested that reservoir inlets are especially active sites for CH_4 production and emission, perhaps due to elevated rates of carbon input to these regions.[54,55,43] In our study, inlet sites had the highest average CH_4 fluxes in five out of six reservoirs and the most pronounced response to drawdown in four of the five reservoirs experiencing drawdowns. In J. C. Boyle, the reservoir where the inlet site(s) was not the most active site for CH_4 ebullition, the highest average CH_4 fluxes occurred at a site located near the reservoir's outlet.

Implications and Future Directions. The strong response of eutrophic reservoirs to water level drawdown forcing we report here adds a twist to a recently posited conceptual framework[35] wherein higher CH_4 production rates push systems from a "forcing controlled regime" where forcing mechanisms such as barometric or hydrostatic pressure control CH_4 emissions to a "CH_4 production controlled regime", where CH_4 production rates overwhelm the sediment's capacity to modulate CH_4 emissions. In our study, higher CH_4 emission rates appear to correlate with *greater* sensitivity to physical forcing events, not less (Figure 4), even when drawdown events occur daily, as in J. C. Boyle. This may be due to the fact that sediments can store a large amount of CH_4 relative to what is released to the atmosphere. Of course, if sediment CH_4 storage capacity is far exceeded by CH_4 accumulation, then drawdowns are likely to exert a small relative effect on the timing of CH_4 release because they are likely bubbling at near maximum rates. However, if sediments are capable of holding a large proportion of the CH_4 produced by reservoir sediments in a given year, then drawdowns could increase CH_4 emissions to the atmosphere substantially. This is particularly likely in cases where periodic mixing events "reset" the sediments by bringing terminal electron acceptors (e.g., O_2, NO_3^-, etc.) down to the sediment−water interface, thereby stimulating rapid periodic methane oxidation. In Lacamas Lake, we used the ratios of CH_4 released during drawdowns to CH_4 released during predrawdown periods (Figure 2) to calculate that Lacamas sediments can (conservatively) hold 50−700% of the annual nondrawdown ebullition flux. Lacamas was one of most active emitters of CH_4 in this study, and CH_4 emission rates in Lacamas are high compared to many other lakes and reservoirs globally (higher than 83% of reservoirs in a recent synthesis).[1,3] Hence, Lacamas produces a lot of CH_4 relative to other reservoirs, yet its sediments can hold as much or more CH_4 than it emits to the atmosphere on an annual basis. Although the size of the CH_4 pool held in sediments is likely vary substantially between reservoirs, our results from Lacamas suggest that there could be many systems where within sediment accumulation of CH_4 is substantial relative to annual CH_4 fluxes. In such systems, reservoir water level management could play an important role in controlling CH_4 emissions. The sensitivity of reservoirs to drawdowns is likely to be a function of sediment characteristics (e.g., sediment cohesiveness and, especially, organic matter content[13]), reservoir average depth, the frequency of drawdowns, rates of methanogenesis, and CH_4 oxidation, and is a topic meriting further attention in future work.

Given the diversity of reservoirs and the current lack of information regarding reservoir bathymetry and biogeochemistry at large spatial scales, it is not currently possible to credibly extrapolate from our observations to continental or global scales. However, reservoir drawdowns are quite common, suggesting that this CH_4 release mechanism has potential to affect timing and magnitude of CH_4 emissions significantly at landscape or larger scales. For example, stage height data from 157 U.S. reservoirs showed 95% of reservoirs experienced at least one annual drawdown ≥0.5 m, and 70% experienced multiple drawdown events of this magnitude (median: two events per reservoir[56]). Thus the potential role of reservoir drawdowns as a control on large scale estimates of CH_4 emission from reservoirs deserves further attention. In addition, the potential impact of drawdown-related CH_4 releases on past

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efforts to quantify CH_4 fluxes should be evaluated. Short-term CH_4 ebullition measurements in reservoirs (typical deployments lasting only hours to days) have almost certainly missed pulsed CH_4 bubbling events associated with water-level drawdowns, resulting in substantial underestimates of reservoir CH_4 emissions. The strong effect we observed across all of the reservoirs in this study, the ubiquity of reservoir drawdown events, and the absence of drawdown-associated CH_4 flux estimates from other reservoir CH_4 emissions studies all suggest that CH_4 emission from reservoirs has been substantially underestimated. In addition, as a major increase in the number and cumulative surface area of reservoirs is anticipated globally,[57] the importance of these issues is likely to increase.

Finally, given the importance of water level manipulation in controlling CH_4 fluxes, it is possible that altered reservoir water level management could reduce reservoir greenhouse gas emissions. Data from Keno and J. C. Boyle reservoirs suggest that decreasing the number (and possibly the magnitude) of drawdowns could reduce CH_4 emissions, highlighting a potential trade-off between power generation and greenhouse gas fluxes. It is also possible that altering timing of reservoir drawdown (e.g., by delaying drawdown from the end of the stratified summer period to a period when lake waters are better mixed) might decrease the effect of drawdowns on CH_4 emissions by stimulating rapid methanotrophy at the sediment−water interface, but this hypothesis requires further testing. Furthermore, the observed relationship between eutrophication status and the effect of drawdown on CH_4 emissions (Figure 4) indicates that, in addition to the well-characterized benefits of reducing nutrient loading to aquatic ecosystems,[58,59] this strategy may also mitigate greenhouse gas emissions. This possibility certainly merits further investigation. More specifically, researchers should investigate how reservoir greenhouse gas emissions respond to increases and decreases in nutrient loading and how reservoir characteristics, including management, affect the relationship between eutrophication and greenhouse gas emission. In addition, there is a need to better understand (1) rates and controls of methanogenesis and methanotrophy in reservoir sediments, and particularly the availability of "free" CH_4 (CH_4 in bubbles) to methanotrophs (e.g., through the use of process rate measurements or isotopic indicators of oxidation such as the ^{13}C signature of CH_4), (2) the role of reservoir and sediment characteristics such as geomorphology, temperature, sediment organic matter content, and sediment texture, in determining a sediment's tendency to retain (or release) CH_4 via ebullition, and (3) the physics governing the migration of bubbles upward through sediments as a function of water level fluctuations (i.e., whether upward migration and eruption simply result from increased buoyancy or whether groundwater flushing resulting from a decrease in pressure head or more complex sediment physics (e.g., fracture dynamics) are at play[11,13,60]). Addressing these unknowns would both help address important knowledge gaps and provide management-relevant information that could help reservoir managers to mitigate greenhouse gas emissions.

■ ASSOCIATED CONTENT

Supporting Information

The Supporting Information is available free of charge on the ACS Publications website at DOI: 10.1021/acs.est.6b03185.

Nine figures and one table (PDF)

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The authors declare no competing financial interest.

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Environ. Sci. Technol. XXXX, XXX, XXX−XXX

Thaler, Parker@Waterboards

From: Hamilton, John <john_hamilton@fws.gov>
Sent: Tuesday, January 10, 2017 10:37 AM
To: Thaler, Parker@Waterboards
Subject: Fwd: Graves under Copco Reservoir
Attachments: Hessig 1979 Looking back.pdf

Parker: Good talking with you this AM.

FYI - this movement of graves to Hornbrook prior to filling Copco 1 probably is not in the SD supporting info.

It may or may not apply only to Native American graves.

John Hamilton
Fisheries and Hydropower Branch Chief
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Yreka Field Office
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Yreka, California 96097
(530) 842-5763 Office
(530) 841-3114 Direct
(530) 340-2391 Cell
(530) 842-4517 Fax
John_Hamilton@fws.gov

---------- Forwarded message ----------
From: **Hamilton, John** <john_hamilton@fws.gov>
Date: Fri, Nov 22, 2013 at 11:02 AM
Subject: Graves under Copco Reservoir
To: ELIZABETH VASQUEZ <evasquez@usbr.gov>

Liz: Hope all is well.

The SD is probably an ancient memory. However, Indian and other burials under the Reservoirs were an issue. The attached historical account states that bodies from the cemetery near Beaver Creek (now a tributary of Copco 1 reservoir) were moved to the Hornbrook cemetery when the dam was built.

Who should this information go to?

Thank you much.

John Hamilton
Assistant Field Supervisor/Hydropower Branch Chief/Biological SubGroup co-chair for the Klamath Secretarial Determination
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TRACING BACK

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perhaps the distance of one-eighth mile apart. Negro Creek is a smaller stream than Shovel Creek and heads from an unbelievable spot of beauty on a rocky mountainside south of the head waters of Shovel Creek. The water is ice cold, the banks covered with wild columbine and yellow cowslips as well as other vegetation. The head waters of Shovel Creek originate near a stream called Bear Creek.



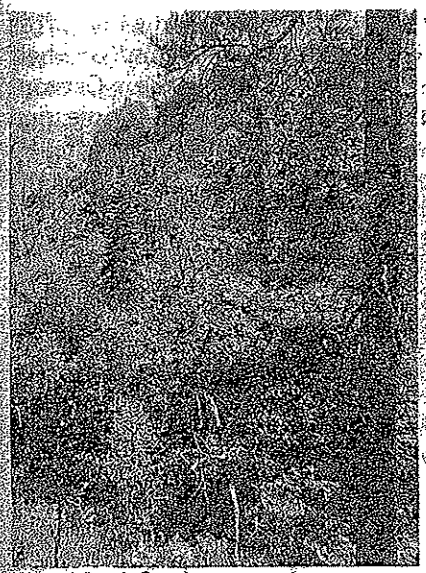


Henry and Annie Spannus with sons Buddy and Albert in front of the ranch home where they lived for many years.

One could take no more a nostalgic trip than to ride horseback to see this beautiful sight for one's self. The name Negro Creek originated from families of Negro people who came in by team and wagon to fish for salmon which were taken to Yreka and sold to the miners. Shovel Creek was so named by the finding of a gold pan and shovel on the stream bank. This information was given to me by Fred C. Stocksiager, a former ward of the Richard Beswicks. It is hard to visualize the grandeur of the canyons these creeks traverse, slides of lava rock, huge rocky walls on either side. However, there is a clear path along the creek banks for either hiker or horseman. The fall cottonwood trees, black alder, ash trees and wild plum and oak trees that are scattered over the rocky hillsides make this a riot of flaming fall colors during the autumn season.

As we come over a little rise in the road we can see some remains of Indian camps which are distinguished by the large round depressions in the earth. Now we come to the sight of the old Whalen Saloon. In approaching the river's edge one can see many beautiful pieces of broken glass. The empty bottles from the saloon were no doubt thrown into the river. Across the road we see the line fence between the Klamath Hot Springs property and the Hessig Ranch.

Within a few minutes we see the site of the first school in the area. It was located on the upper side of the road. Nothing remains of the small building. We walk up the hill about one-quarter mile from the road. Here we find an unusual site of seven small craters. They show that in some time in history they had been active. They are known as the Beswick Craters.

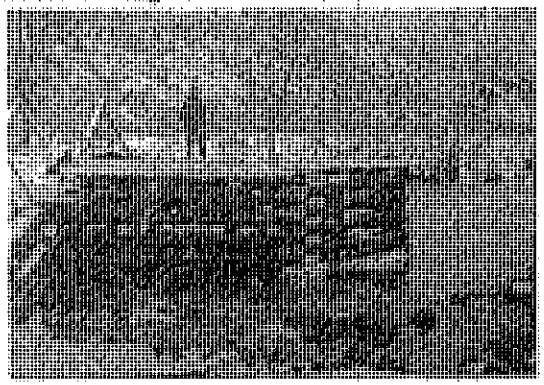


Shovel Creek Canyon.



State Line Spring.

Back to the main road we go down a hill and through a lane with buildings on the east side and green meadows along the Klamath River. Having described this historical old Hessig Ranch in my chapter on the cattle industry, we will wend our way along the very rough road. We pass the graves of the three men who died such tragic deaths on the Klamath and see the bridge crossing the river. These river bridges have to be built very strong to withstand the turbulent waters of the Klamath. Large cribs are first built and filled with tons of rock. Long log stringers are laid from one side to the other. Huge braces are fastened onto the cribs with iron clamps. Then the heavy boards are laid on the bridge. There are several of these bridges built on the river. William G. Hoover planned and did most of the building of the river bridges.



River Bridge.

THE CEMETERY NEAR BEAVER CREEK

There are quite a few whites and Indians alike buried in this cemetery. I have been told by old timers that the bodies were moved to Hornbrook Cemetery when Copco Dam was built to avoid leaving the graveyard under water.

Kitty Ward's brother, Olum, was buried there. Bill Hoover's brother, Henry Hoover, was also laid to rest there. There may be many graves there that are unknown to anyone. As the verse goes, "It matters not, so I've been told, where the body lies when the heart grows cold."

INDIANS OF THE KLAMATH RIVER NEAR BESWICK

Before the coming of the white man, the Indians were free to roam a large area which extended from the Oregon border to the Bogus Mountain area. They were a tribe known as the Shasta Indians. They had their homes (rancherias) along the Klamath River on both sides and on the north and south sides of Shovel Creek. Since there were no dams on the river or no white men to hamper their lives, it was an Indian's Paradise.

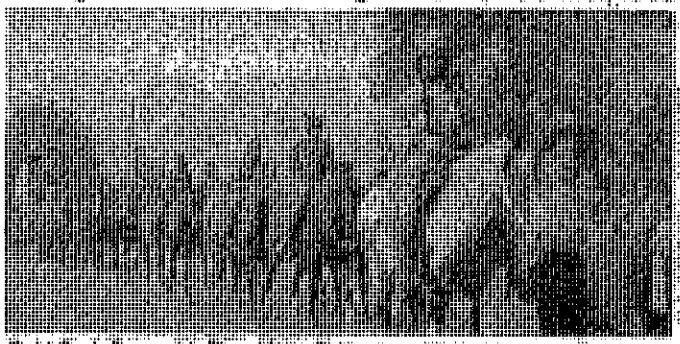
The Indians always had their rancherias on high ground near water or springs. The river and creek abounded with salmon and steelhead. The fish were caught in traps they made by weaving willows together to cross the entire stream. They would then spear the fish, throw them out onto the banks. The women would clean and split them and place them on racks to dry.

Wild plums, blackberries and service berries were dried and stored for winter use. Deer were plentiful at that time, however, they wasted none. The hides were tanned for bedding and articles of clothing. Warm clothing was needed in this area as winters were quite cold. Summers were mild and warm. The Indian boys and men simply wore breech cloths for their summer apparel.

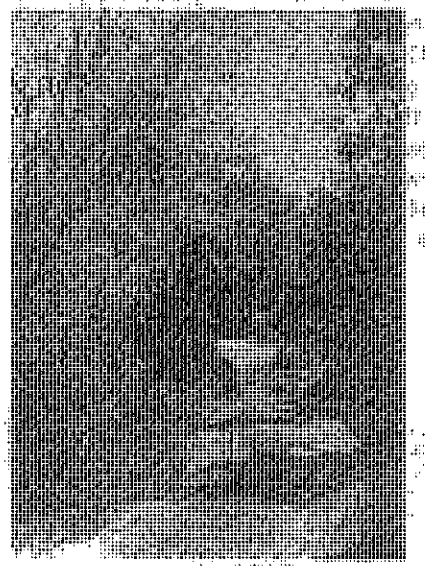
Acorns were plentiful most years. They were greatly valued as a source of food. They used mortars and pestals to pound the acorn seeds into meal. They made a soup called acorn soup. In addition to the acorns they included meat and fish to make a palatable dish.

Another food was Apo. The apos grew in open places. They are something like a small potato. Indian women carried large baskets on their backs to collect the apos in as they dug them. They used a stick with a little spoon shaped on the end of it. They would get the stick under the apo, give the stick a flip, and on to the next one.

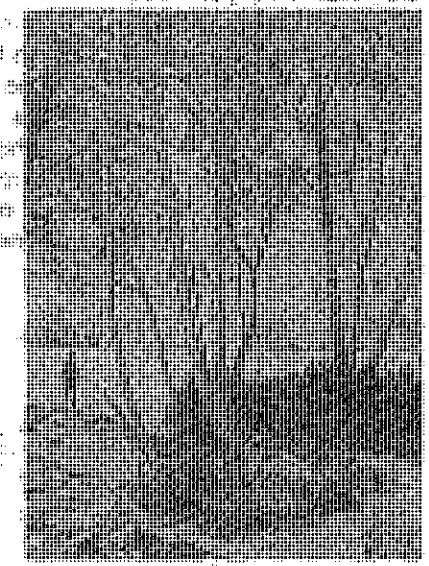
They also enjoyed another plant food called icknish. The tender sprouts of icknish taste very much like celery. They smell quite strong. The roots were dug and dried to flavor food and for med-



The following beautiful photos by Charles Harwell Edson, son of Ephraim Wadsworth Edson, are the courtesy of Edson Faulke, Jr. Ephraim, born in 1884 in Los Angeles, California, was the younger brother of Joe and Lyle Edson.

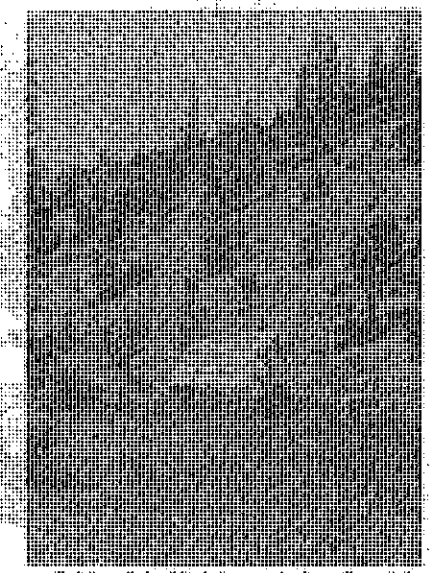


On the road to Klamath and the site of the Oak Grove School.

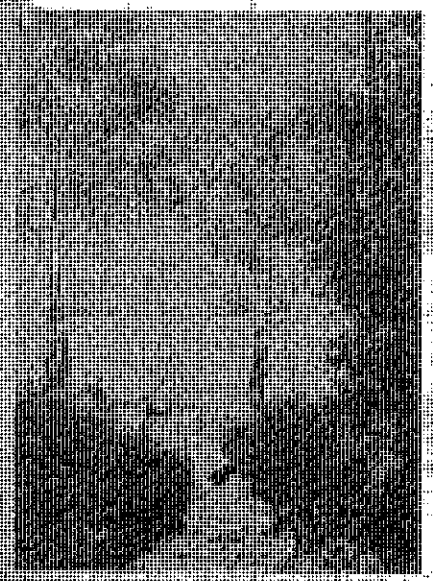


Waiting for a boat at the mouth of Hayes Creek.



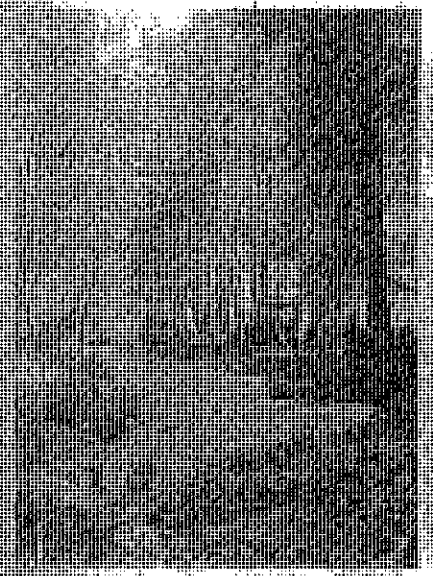


Cabin of A. M. Johnson before [illegible] owned Hayes Klamath Hot Springs previously.





Edson's Boat on Hayes Creek.



Edson Johnson Resort Cabin.



Trestle Bridge, ... a landmark today.

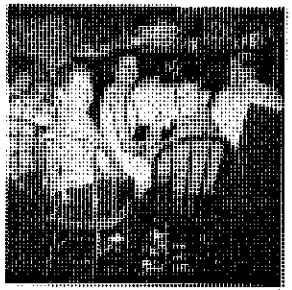
Hessig 1979 Looking back

RECREATION



The reader may wonder what the folks living along the Oregon-California State Road from Ager to Topsy did for recreation. In the days of the 1800's and early 1900's neighbors used to visit one another. It wasn't unusual for one family to spend a day with another family. They would stay for dinner, as the noon meal was called. The ladies always found something of interest to talk about while they kept their hands busy with crochet work or knitting needles. The children played games outdoors or indoors acording to the weather conditions. The men usually walked around the place looking at the livestock or crops.

Dancing was enjoyed by most all of the country folk. When a dance was to be held at the Klamath Hot Springs, Oak Grove Schoolhouse or Bogus Schoolhouse, word seemed to get around. It spread as far as Butte Valley, Pokegama and Fall Creek. Some came horseback. The ladies carried their dresses and dancing shoes in a flour sack and changed once they arrived. Others came by buggy or spring wagon depending upon the condition of the weather and the roads. Sometimes three or four ladies of the community would prepare a chicken or ham supper. Most generally, great hampers of food would be brought along with each family who attended the festivities. Musicians like Wren Frain, Lee Varnum, Bert Hessig, Fred Stockslager and Inez Spannus would furnish the waltz, two-step and quadrille music. Mage Spencer was a fine caller, and could call all the different changes for a quadrille without using the same one twice. There was one called Dan Tucker. Participants had to be on their toes or find themselves Old Dan Tucker. My stepbrother, Bill Hoover, and I used to do a pretty fancy heel and toe polka.



At midnight the food was placed on a table which was made with sawhorses and long boards and covered with tablecloths. Thirty-five cents each was usually charged for the supper and to pay the musicians and the caller. The supper was always delicious and usually consisted of home-cured ham, fried chicken, salads, pies and cakes by the dozens.

After supper the food would be cleared away, the tables dismantled and the musicians would prepare to start the dancing again. "Turkey In The Straw," "Irish Washer Woman," "Soldiers Joy," and "Arkansas Traveler" were some of the tunes for quadrilles. Some of the favorite waltzes were "The Black Hawk Waltz," "Rosy O'Grady," "Sweet Betsy From Pike," and "Shamus O'Brien." There were many other lovely old tunes. Dances never broke up before four in the morning. I've crawled into bed many a time with the screeching of fiddles and the tune of "Shamus O'Brien" ringing in my ears. I would sleep the greater part of the day and hope there would be another dance soon. These were nights to remember, never to return.

The Klamath Hot Springs was a metropolis for the surrounding communities. There were picnics on Sundays, horseshoe pitching for the men, games for the children. Beswick also boasted a baseball team with competition from Butte Valley, Pokegama and Montague. Montague's brass band often came to the resort to entertain guests on Sunday afternoons. There was a Sunday School at the resort for the children. This writer has in her possession a little hymn book. Inside the fly leaf is written, "Property of the Klamath Hot Springs."

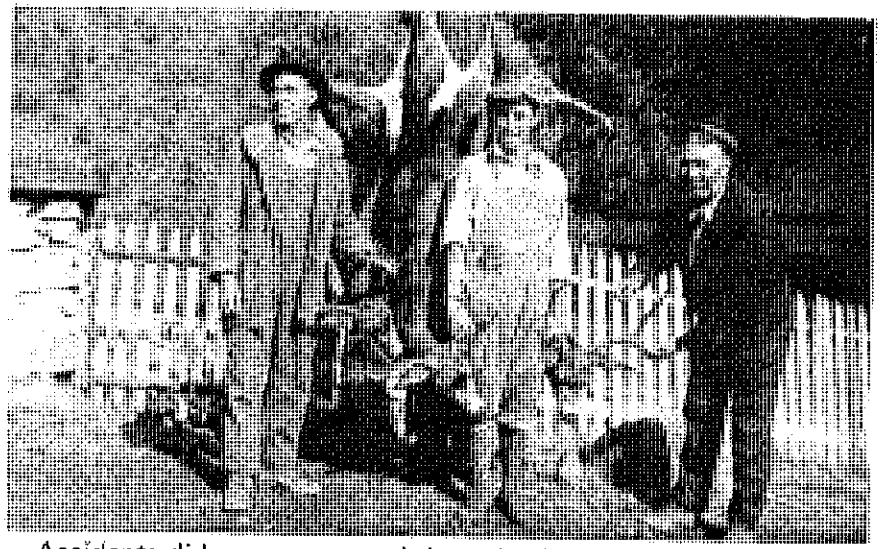
Before the building of the first dam on the Klamath, there was no better fly fishing for rainbow trout anywhere in the west. Shovel Creek and Spencer Creek in Oregon were great spawning areas for these fine game fish.

Ethel Hoover, wife of William Hoover, and Mrs. Bessie Edson, owner of the Klamath Hot Springs, used to ride up the Shovel Creek Trail to count the herds of deer in the late afternoon. They could count hundreds. At the time of this writing one would be lucky to see one or two.

There were some fine trackers and hunters in the Beswick area. Among them were George Cook who worked as a guide to hunting parties sent out by the Edsons and the Frain brothers, Rod and Wren. There was Bill Hoover and Frank Woods who seldom let a big buck get away from them once they had come across a fresh track. They could pack a 200-pound field-dressed buck for miles on their backs.

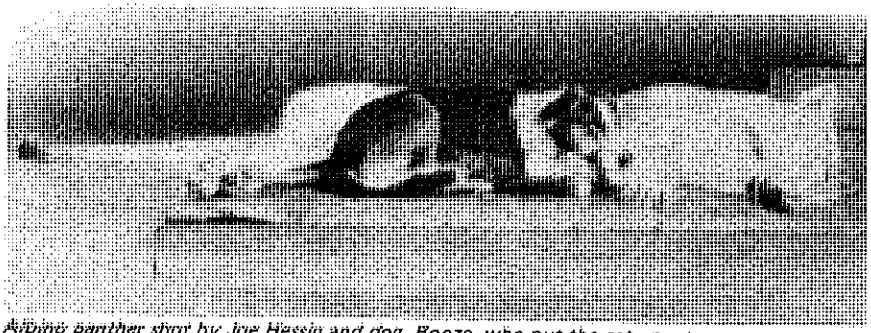


Will Blasse of Napa, Cal., with 11 pound rainbow trout caught in Klamath River near Shovel Creek.



Accidents did occur now and then. Dr. Wyburn and George Cook were hunting along the rims above the Butler Place on the Klamath. Dr. Wyburn spotted a large buck and ran along the rim to get a shot. He was not watching his step and fell and broke his leg. Luckily, they had horses. Cook rode to the Hessig ranch and with the help of Joe Hessig, lifted Wyburn on a horse and brought him back to the Klamath Hot Springs Hotel where a doctor was summoned from Yreka to set the leg. Those rocky rims are dangerous to walk around. Watching your step and watching for game was quite a feat.

A beautiful white panther was killed by Joe Hessig after being treed by his hunting dogs. The large cat was killed in Panther Canyon. This canyon has a small creek at its base which runs into Shovel Creek. The canyon walls are almost perpendicular. This white panther was stuffed and sent to the exposition fair in San Francisco in 1915. It was thought to be the only albino panther ever killed. There is a picture that shows the old hunting dog, Booze, that put the panther up the tree.

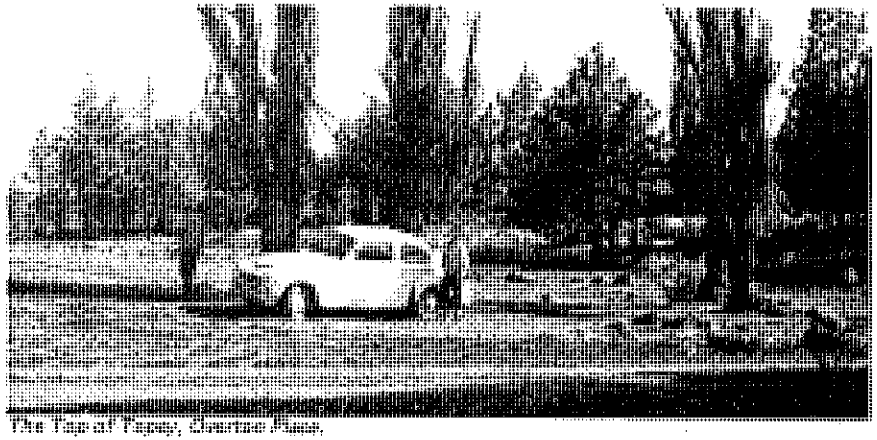


Albino panther shot by Joe Hessig and dog, Booze, who put the cat up a tree.

TOPSY GRADE

The first road up this mountain was built by Frank Picard, grandfather of William G. Hoover. The second grade was built by George Chase, father of Ray V. Chase, Carroll Chase and the late Mrs. John Boyle. The last road up the steep grade was built by Bob Emmett, possibly in the year 1890.

My father, Major Watson Overton, had a homestead at the top of the grade. Previous to homesteading he worked for John Fairchild breaking horses. Mr. Fairchild raised many fine horses. When my father was twenty-one years old he married the sister of his boyhood friend. Her name was Dora Rambeau. At the top of Topsy they built a house and other buildings and kept travel, as it was called in those years. My father was also postmaster at Topsy. All this is hard to imagine now as there are only a few old poplar trees and the scant remains of an old building site.



The Top of Topsy, Overton Place.

My father told me that Mr. Fairchild gave him the pick of any of the fine horses he owned for a team. My father passed away in 1932. Before his passing, I asked him how Topsy got its name, as I had heard many versions. My father's seemed the most realistic and likely to me. To quote him, "The old freighters that traveled the long steep rough road from the bottom to the top, on arriving at the utmost top called it Topsy, thence Topsy Grade."

In spite of the rocks, sharp turns and switch backs, it is well worth a trip over this road to look down on the Old Frain Ranch from the Big Bend and to see the rough water of the Klamath roaring through the rugged canyon. One should stop for a little rest at the top of Topsy where Topsy Creek crosses the road. Maybe one can find an arrowhead or bits of purple glass. While there, one might reminisce, as I do, of the young man who built a home there and of his dreams.





WRITTEN COMMENTS FROM STATE AGENCIES

STATE OF CALIFORNIA – NATURAL RESOURCES AGENCY EDMUND G. BROWN, JR., GOVERNOR

CALIFORNIA COASTAL COMMISSION
45 FREMONT, SUITE 2000
SAN FRANCISCO, CA 94105-2219
VOICE (415) 904-5200
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TDD (415) 597-5885

January 31, 2017

Mr. Parker Thaler
Division of Water Rights
State Water Resources Control Board
P.O. Box 2000
Sacramento, CA 95812-2000

Subject: Notice of Preparation of an EIR for the Lower Klamath Project Licensing Surrender

Dear Mr. Thaler:

The Coastal Commission staff has reviewed the above-referenced Notice of Preparation of an Environmental Impact Report published by the State Water Resources Control Board (Board) for the Klamath River Renewal Corporation's (KRRC) proposed Lower Klamath Project (LKP) Licensing Surrender project. The Board is seeking comments concerning the scope and content of the environmental information to be included in the EIR.

The California Coastal Act includes specific policies that address the protection of public access and recreation, terrestrial and marine habitat, visual resources, commercial and recreational fisheries, water quality, archaeological resources, and other coastal resources (Division 20 of the Public Resources Code). The policies of the Coastal Act constitute the statutory standards applied to regulatory decisions made by the Commission pursuant the Coastal Act. The coastal zone, which was specifically mapped by the California Legislature, varies in width on land from several hundred feet in highly urbanized areas up to five miles in certain rural areas; offshore the coastal zone includes a three-mile-wide band of ocean. The coastal zone includes the lower reaches of the Klamath River upstream to a point approximately three-fourths of a mile east of the Highway 101 bridge near the community of Klamath.

The operation of four dams on the Klamath River affects coastal resources along the lower reaches of the Klamath River, in particular water quality and fisheries. The proposed removal of sufficient portions of the Iron Gate, Copco No. 2, Copco No. 1, and J.C. Boyle dam developments also hold the potential to affect coastal resources. As such, the Commission staff appreciates the opportunity to comment on the scoping process for the environmental document to be prepared for the proposed LKP Licensing Surrender project. The Commission may also have a direct role in reviewing the project pursuant to the federal Coastal Zone Management Act (CZMA). The Coastal Commission is one of California's two designated coastal management agencies for the purposes of administering the CZMA. The CZMA gives state coastal management agencies certain federal consistency review authority over federally licensed, permitted, or assisted activities, wherever they may occur (i.e., landward or seaward of the

respective coastal zone boundaries fixed under state law) if the activity affects coastal resources. Based on the information contained in the above-referenced Notice of Preparation, the Commission staff believes that that the KRRC's proposed LKP Licensing Surrender project, which will require the approval of the Federal Energy Regulatory Commission (FERC), would affect the coastal zone and will require Commission review of a federal consistency certification.

The proposed LKP Licensing Surrender project is a non-federal agency activity. As noted in KRRC's license surrender application to FERC, one or more federal agencies, including FERC, the U.S. Army Corps of Engineers, and the National Marine Fisheries Service, would issue a permit or license or authorization to KRRC, which would then be responsible for CZMA compliance (i.e., prepare and submit to the California Coastal Commission a consistency certification). Because the project is located inland of the coastal zone, the Commission would first need to obtain permission from NOAA's Office for Coastal Management (OCM) to review a federal permit/license/authorization under the CZMA.[1] If such permission were granted, federal agencies could not issue a permit/license/authorization until the Commission has concurred with the consistency certification submitted by KRRC. This permission would be sought once the Commission receives notice that an application has been made to a federal agency by KRRC for the LKP Licensing Surrender project. The federal consistency certification should include a finding that the project is consistent with the California Coastal Management Program (CCMP), and should contain sufficient information for the Commission to assess the activity's effect on the coastal zone and its consistency with the CCMP (see Section 930.58 of the NOAA Federal Consistency Regulations for additional details on information requirements for federal consistency submittals).

The EIR should examine the proposed project for consistency with the policies of Chapter 3 of the Coastal Act, which are the enforceable policies of the aforementioned California Coastal Management Program. Several key policies of Chapter 3 of the Coastal Act that are especially pertinent to the review of the proposed project include: (1) Section 30231, Biological Productivity and Water Quality; (2) Section 30234.5, Economic, Commercial, and Recreational Importance of Fishing; (3) Section 30233(d), Movement of Sediment and Nutrients; (4) Section 30244, Archaeological or Paleontological Resources; and (5) Section 30253, hazards. The EIR should examine the project's consistency with the applicable Chapter 3 polices of the Coastal Act, with particular attention to the above-listed policies.

The Klamath River basin has enormous importance as habitat for threatened salmonid species. The salmon fishery of the river is of tremendous economic and cultural significance for the Yurok Tribe and also of great importance for commercial and recreational fishing and the economies of all the communities along the North Coast of California. As habitat for threatened salmonid species, the Klamath River and its tributaries are critical to the health of coastal resources under a number of Coastal Act policies. Section 30231 of the Coastal Act provides in applicable part that the biological productivity and the quality of coastal waters, streams, wetlands, and estuaries appropriate to maintain optimum populations of marine organisms shall be maintained and, where feasible, restored. Furthermore, Section 30234.5 of the Coastal Act

[1] Note: This step in the process can be skipped if the applicant agrees to submit a consistency certification directly to the Commission – See 15 CFR § 930.54(f).

provides that the economic, commercial, and recreational importance of fishing activities shall be recognized and protected. The EIR should thoroughly evaluate the effects of the LKP Licensing Surrender project, including the effects on fish passage, salmonid populations, volume of river flows, water quality, sediment and nutrient transport down the river to the shoreline and ocean, and commercial and recreational fisheries in the river basin and open ocean from removal of LKP dams and associated developments.

The downstream portions of the Klamath River basin have been the home of the Yuroks, Hoopas, Karuks, and other native peoples for thousands of years. As a result, significant archaeological resources exist throughout the basin. Section 30244 of the Coastal Act states that where development would adversely impact archaeological resources, reasonable mitigation measures shall be required. Implementation of the proposed project may affect the quantity and timing of river flows, and as a result may affect erosion patterns downstream of the existing dams and possibly into the coastal zone. Such changes in erosional patterns may lead to greater erosion of buried archaeological resources, causing their destruction. The EIR should thoroughly evaluate how river flows and volumes may affect erosion of the river channel and adjacent areas, including areas of known and potential archaeological resources.

Thank you for the opportunity to comment on the EIR scoping process. Please contact me at larry.simon@coastal.ca.gov or at (415) 904-5288 should you have questions regarding the federal consistency process.

Sincerely,

LARRY Simon

Larry Simon
Federal Consistency Coordinator

cc: CCC – North Coast District

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Region 1 – Northern
601 Locust Street
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EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

February 1, 2017

Parker Thaler
State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA 95812-2000

Subject: Notice of Preparation for an Environmental Impact Report for the Proposed Lower Klamath Project License Surrender State Clearinghouse Number 201622047

Dear Mr. Thaler:

In response to the December 22, 2017 Notice of Preparation (NOP) of an Environmental Impact Report (EIR) for the proposed Lower Klamath Project (LKP) License Surrender (Project) distributed by the State Water Resources Control Board (State Board), the California Department of Fish and Wildlife (Department) respectfully submits the following comments.

General Comments

The Department offers the following comments and recommendations on the Project in our role as the State's trustee for fish and wildlife resources. Pursuant to Fish and Game Code (FGC) section 1802, the Department has jurisdiction over the conservation, protection, and management of California's fish, wildlife, native plants, and the habitat necessary for biologically sustainable populations of those species.

The State Board previously released a NOP on November 30, 2015 of an EIR for the Klamath Hydroelectric Project Relicensing. The Department provided comments for that NOP on January 29, 2016 (Attachment 1). The Department understands that this is a new NOP and the EIR will be prepared to support the Klamath River Renewal Corporation's (KRRC) application to remove sufficient portions of the Iron Gate, Copco No. 2, Copco No. 1, and J.C. Boyle dam developments to create a free flowing Klamath River and provide for volitional fish passage. The hydroelectric facilities and associated structures will either be removed or decommissioned in place.

The Department was the California Environmental Quality Act (CEQA) Lead Agency for the 2012 Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report (2012 Klamath EIS/EIR, Department of Interior 2012). The 2012 Klamath EIS/EIR's alternatives included Alternative 2 (Full Facilities Removal of Four Dams) and Alternative 3 (Partial Facilities Removal of Four Dams). The Department recommends the State Board include alternatives similar to these two in your EIR. As a signatory to the Klamath Hydroelectric Settlement Agreement (KHSA), the Department remains supportive of either alternative (i.e. Partial Facilities Removal of Four Dams and Full Facilities Removal of Four Dams).

The Department is not aware of any new information to suggest any new or increased significant environmental impacts would occur beyond those identified in the 2012 Klamath EIS/EIR. The Department also believes the analysis in the 2012 Klamath EIS/EIR adequately addressed environmental impacts related to facilities removal.

Detailed Plan

The Detailed Plan was developed as part of the KHSA and describes the reservoir drawdowns, deconstruction activities, and the restoration of affected areas. The Department recommends the State Board use the Detailed Plan, and any updates to it, in the State Board's analyses and Alternatives.

Hatchery Operations

The NOP correctly identifies that substantially new information has been developed under the KHSA process including the development of the 2012 Klamath EIS/EIR. We understand the State Board will use the information developed as part of their analysis. The Department recommends the State Board specifically include the requirements developed in the KHSA for hatchery operations in their evaluation of any EIR alternative that includes dam removal.

Conclusion

The Department appreciates the opportunity to provide comments on this important and historic project. We support the State Board's efforts to analyze and mitigate impacts to water quality and fish and wildlife resources through the 401 Certification process. If you have any questions concerning these comments, please contact Senior Environmental Scientist Specialist, Matt Myers at (530) 225-3846 or matt.myers@wildlife.ca.gov.

Sincerely,

Neil Manji
Regional Manager

Attachment 1

ec: State Clearinghouse
state.clearinghouse@opr.ca.gov

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California Department of Fish and Wildlife
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References:

Department of the Interior. 2012. *Klamath Facilities Removal Final Environmental Impact Statement/Environmental Impact Report*

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EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

January 29, 2016

Parker Thaler
State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA 95812-2000

Subject: Notice of Preparation for an Environmental Impact Report for the Klamath Hydroelectric Project Relicensing State Clearinghouse Number 2015122002

Dear Mr. Thaler:

The California Department of Fish and Wildlife (Department) has reviewed the Notice of Preparation (NOP) of an environmental impact report (EIR) for the Klamath Hydroelectric Project Relicensing (Project), which would involve modifications and the continued operation of the hydroelectric facilities (State Clearinghouse Number 2015122002). The Department appreciates this opportunity to comment on the above-referenced Project relative to impacts to biological resources.

The Department must begin this comment letter, however, acknowledging certain developments. In February 2010, the Governor of California and the Department signed the Klamath Hydroelectric Settlement Agreement (KHSA) and the Klamath Basin Restoration Agreement (KBRA). The KHSA lays out a process for removal of four PacifiCorp dams (J.C. Boyle, Copco 1, Copco 2, and Iron Gate) on the Klamath River to serve the public's interest and restore depressed fisheries in the Klamath River watershed. The KHSA and two related agreements – the Klamath Basin Restoration Agreement (KBRA) and the Upper Klamath Basin Comprehensive Agreement (UKBCA) – were developed to resolve long-standing resources challenges in the basin comprehensively and collaboratively.

The Department is a signatory to the KHSA and remains committed to working with those parties to maintain the benefits of that agreement. The Department also remains committed to achieving a comprehensive and collaborative resolution with Tribes, the power company, conservation groups, commercial fishing interests, and agricultural and water user communities.

The Department provides comments in this letter because the Board's process requires us to do so. However, the comments that the Department provides in this letter should be viewed against our preference for continued resolution of problems through collaboration. In the event that the relicensing proceeding for this Project continues, and given that the Board requests comments under that scenario pursuant to the NOP, the Department submits comments responsive to that scenario.

The Department offers the following comments and recommendations on the Project in our role as the State's trustee for fish and wildlife resources and as a Responsible Agency under the California Environmental Quality Act (CEQA), California Public Resources Code section 21000 et seq. Pursuant to Fish and Game Code (FGC) section 1802, the Department has jurisdiction over the conservation, protection, and management of California's fish, wildlife, native plants, and the habitat necessary for biologically sustainable populations of those species.

The Department's primary concerns involving the Project include impacts to salmonids due to: (1) inadequate fish passage up and downstream, (2) inadequate flow regimes, and (3) degraded water quality conditions.

The Department has been actively participating in the relicensing process for the Project since December 2000 when we received PacifiCorp's *"First Stage Consultation Document"* and we continue to participate to date. The Department filed a Federal Power Act (FPA) section 10(j) (16 U.S.C. § 803(j)) on March 27, 2006.[1]

The Department was also the CEQA Lead Agency for Klamath Facilities Removal Environmental Impact Statement/ Environmental Impact Report (Klamath EIS/EIR) that analyzed the potential impacts to the environment from removing the four PacifiCorp dams as contemplated in the KHSA. Finally, the Department is responsible for the management and operation of the Iron Gate Hatchery, which provides mitigation for the Project located just below Iron Gate Dam. The production goals that drive Iron Gate Hatchery operations are only intended to mitigate for the loss of habitat between Iron Gate Dam and Copco 2 dam (FERC, 1963).

Authority

The following policies and State statutes regarding water, fish, and terrestrial resources guide the Department's authorities and should be considered in the EIR.

- The California Fish and Game Commission's policy on water provides: *"The quantity and quality of the waters of the state should be apportioned and maintained respectively so as to produce and sustain maximum numbers of fish and wildlife."*

- The California Endangered Species Act (CESA), FGC section 2080 et seq., establishes the policy of the State to conserve and restore any threatened or endangered species and their habitat. Coho salmon were listed as threatened pursuant to CESA in 2006. PacifiCorp does not currently have State coverage for the

[1]Section 10(j) of the FPA requires the Commission to include in any license fish and wildlife measures for the protection, mitigation of damages to, and enhancement of fish and wildlife resources potentially affected by the Project based on recommendations from the National Marine Fisheries Service, the U.S. Fish and Wildlife Service, and state fish and wildlife agencies.

take of State-threatened coho salmon due to their operations from the State of California. CESA sections 2080.1 and 2081 describe the processes for an entity to receive take coverage under CESA.

- FGC section 5515 states that fully protected fish may not be taken or possessed at any time. Shortnose sucker (*Chasmistes brevirostris*) and Lost River sucker (*Catostomus luxatus*) are fully protected fish species that occur in the Klamath River watershed and are impacted by the Project.

- FGC section 5901 states that it is unlawful to construct or maintain in any stream any device or contrivance that prevents, impedes, or tends to prevent or impede, the passing of fish up and down stream.

- FGC section 5931 requires the owner of a dam to furnish a suitable fishway in consultation with the Department where the Fish and Game Commission determines that the dam does not allow free passage for fish.

- FGC section 5937 reads, in part: *"The owner of any dam shall allow sufficient water at all times to pass through a fishway, or in the absence of a fishway, allow sufficient water to pass over, around or through the dam, to keep in good condition any fish that may be planted or exist below the dam."* FGC section 45 defines "fish" as *"wild fish, mollusks, crustaceans, invertebrates, or amphibians, including any part, spawn or ova thereof."*

- FGC section 5980 et seq. requires installation of screens approved by the Department on all conduits to hydropower facilities if, in the opinion of the Department, such a screen is necessary to prevent fish from passing into the conduit. This section specifically notes that conduits to power devices *"tend to destroy fish in a greater degree"* than other conduits.

- The Salmon, Steelhead Trout, and Anadromous Fisheries Program Act (Act) (FGC § 6900 et seq.) requires the Department to undertake major efforts to restore the State's salmon, steelhead trout, and anadromous fisheries. Specifically, the Act directs the Department to develop a plan and program to double the current natural production of salmon and steelhead trout resources in the State (FGC § 6902, subd. (a)), and to consult with public agencies whose policies or decisions affect the goals of such a program to determine if there are feasible means for those public agencies to assist the Department in achieving the goals of the program (FGC § 6920, subd. (b)). The waters and lands impacted by the Project represent major components in the Department's efforts to maintain and restore anadromous fish populations in accordance with the Act.

- The Act also provides: *"Reliance on hatchery production of salmon and steelhead trout in California is at or near the maximum percentage that it should occupy in the mix of natural and artificial hatchery production in the State. Hatchery production may be an appropriate means of protecting and increasing salmon and steelhead in specific situations; however, when both are feasible alternatives, preference shall be given to natural production."* (FGC § 6901, subd. (f))

Project Description and Scoping

The NOP provides the project title as "Klamath Hydroelectric Project Relicensing," along with a description of project location, objectives and existing facilities, but does not provide a detailed description of the Project the State Water Resources Control Board (State Board) is proposing to analyze in the EIR. The NOP states the EIR will evaluate potential impacts of proposed modifications and continued operation of the Project to water quality and other resources within California as compared to the environmental baseline. Since the Federal Energy Regulatory Commission (FERC) chose and analyzed the Staff Alternative, it is one potential alternative that could be analyzed as the CEQA project. Regardless of which alternative is the CEQA project, the Department recommends the EIR provide a clearly defined project description from which to analyze impacts.

To enable the Department to adequately review and comment on the EIR, we recommend the following scoping information be included:

1. A complete assessment of the flora and fauna within and adjacent to the Project area should be conducted, with particular emphasis upon identifying special-status species that may be impacted by the project including fully-protected, rare, threatened, and endangered species. This assessment should also address locally unique species, rare natural communities, and wetlands. The assessment area for the Project should be large enough to encompass areas potentially subject to both direct and indirect Project effects. Both the Project footprint and the assessment area (if different) should be clearly defined and mapped in the EIR.

2. A thorough discussion of direct, indirect, and cumulative impacts expected to adversely affect biological resources with specific measures to offset such impacts should be included.

3. Mitigation measures for adverse Project-related impacts to sensitive plants, animals, and habitats should be developed and thoroughly discussed. Mitigation measures should first emphasize avoidance and reduction of Project impacts. For unavoidable impacts, compensatory mitigation measures should be identified.

Geographic Scope

The Project's boundary includes approximately 20 miles of the Klamath River within the State starting at the Oregon-California border and continuing downstream to Iron Gate Dam. This stretch of the Klamath River includes a 6-mile riverine reach upstream of Copco reservoir which is designated as a wild trout area and managed under the Department's Wild Trout Program. It also includes three reservoirs, Copco 1 and 2 and Iron Gate, as well as approximately 1.5 miles of Fall Creek, a tributary just upstream of Iron Gate reservoir. Iron Gate Dam serves as the lower limit of the FERC boundary and the upper limit of the anadromous fishery on the mainstem Klamath River. However, the Project affects temperature downstream to the confluence of the Salmon River, about 124 miles downstream of Iron Gate Dam. The FERC Final Environmental Impact Statement (FERC EIS, FERC 2007) concludes that the Project modifies the temperature regime downstream of Iron Gate Dam in a manner that at times adversely affects salmon.

Upstream of the California section, the current Project boundary includes approximately 50 miles of the Klamath River in the State of Oregon. The Oregon section starts at Link River Dam in Klamath Falls and continues down to the Oregon/California border. Although this portion of the Project falls outside of California, ecological processes do not segregate along jurisdictional boundaries. The Project blocks access for anadromous fish to over 400 miles of habitat upstream from Iron Gate Dam, well beyond the Project's upstream most dam. We recommend that an evaluation of Project components in Oregon that affect resources within California be conducted in the EIR.

The Project features and operations affect the Klamath River fish and wildlife resources at a fundamental level. The Project alters basic ecological processes such as fluvial geomorphology and hydrology while fragmenting and degrading aquatic and terrestrial habitats. The anadromous fishery resources of the Klamath River have undergone a major decline during the past century. Estimates from the commercial fishing industry place the current salmon and steelhead populations in the Klamath River at eight percent or less of their historic abundance (Institute of Fisheries Resources 2004). Degradation of habitat and the subsequent decline in fisheries resources has led to the listing of coho salmon under both the federal Endangered Species Act and CESA, as well as curtailment of fisheries along the Pacific Coast from the Columbia River to south of San Francisco to protect Klamath Basin origin Chinook salmon. In 1999, the Pacific Fishery Management Council identified the mainstem Klamath River and its tributaries from its mouth to Iron Gate Dam as essential fish habitat for Chinook and coho salmon.

Many different land and water management activities have contributed to the decline of the Klamath River fishery and habitat. Construction of the Project stands out as one of the most direct and detrimental activities. Completion in 1918 of Copco 1 dam

blocked access to hundreds of miles of anadromous habitat including primary Chinook and steelhead spawning and rearing grounds upstream. Impassable Project facilities also block access to thermal refugia. Completion in 1962 of the lowermost dam (Iron Gate) blocked access to known thermal refugia remaining in tributaries and mainstem springs. Subsequent to this final phase of Project construction, the spring-run Chinook population downstream of the dam underwent serious decline. Today, the mouth of the Salmon River (over 130 miles downstream of Iron Gate Dam) marks the upper limit of a remnant spring-run population in the Klamath River. The lack of fish passage at Project facilities is a direct, unequivocally adverse impact of the Project on the anadromous fish resources of the Klamath Basin.

Analyses indicate Project facilities and operations have shifted the timing of two critical and interrelated phenomena—water temperature and disease transmission. These shifts in temperature and disease risk below Iron Gate Dam occur at vulnerable life stages for out-migrating juveniles and spawning adults. These disruptions of natural cycles exacerbate already challenging conditions for Klamath River resources and compound Project impacts on the downstream fishery.

Water Quality and Instream Flow

In addition to altering Klamath River flow regimes, the Project contributes to the degradation of water quality in the Klamath River. Preliminary water quality modeling results indicate that Project dams such as Keno, J.C. Boyle, Copco No. 1 and Iron Gate impact water quality by slowing and storing water, increasing retention time and solar exposure, and shifting thermal regimes and nutrient cycling. The Project facilities and operations exacerbate already significantly impaired water quality conditions in the Klamath River.

The Project's continual degradation of water quality, specifically high water temperatures, in the Klamath River impacts fishery resources. The extension of high water temperatures into August and September due to Project dams likely postpones spawning migration, delaying spawning and egg development. In addition, elevated water temperatures in August and September increase adult mortality through stress and crowding (Schreck and Li, 1991; Matthews and Berg, 1997).

Cyanobacteria, also known as blue-green algae, are a family of single-celled algae. Cyanobacteria proliferate in water bodies such as ponds, lakes, reservoirs, and slow-moving streams that lack vertical mixing and when the water is warm and nutrients are available. They generally occur in areas of poor water quality. Many cyanobacteria species produce a group of toxins known as microcystins, some of which are toxic. The species most commonly associated with microcystin production is *Microcystis aeruginosa*. Upon ingestion, toxic microcystins are actively absorbed by fish, birds, and mammals. Microcystins primarily affect the liver, causing minor to widespread damage, depending on the amount of toxin absorbed. Microcystins have

been measured in several water bodies in California, including the Klamath River and its reservoirs.

Fish and wildlife mortalities have been linked to microcystin poisoning. Pets and livestock have died after drinking water contaminated with microcystins. In the *"Revised Recovery Plan for the Lost River Sucker and Shortnose Sucker,"* the U.S. Fish and Wildlife Service identifies microcystin as an algal toxin that affects the liver of these species and is one of the factors in the suckers decline (USFWS 2012). A wild roe deer in Norway was necropsied and the cause of death was acute cyanobacterial hepatotoxicosis (Handeland, K. and O. Ostensvik 2010). In 2014, the California Animal Health and Food Safety Laboratory necropsied a black-tailed deer from Siskiyou County and cause of death was microcystins (Shirkey et al. 2015).

Restoration of flows to more natural conditions will help to improve water quality conditions in each reach. Sufficient water should be released from each of the Project facilities and operations in order to:

1. Provide a flow regime of sufficient quantity to allow native aquatic and riparian species to establish and flourish within the Project.

2. Provide a flow regime to support a diverse native coldwater fishery in good condition, and with controlled flow transitions that avoid stranding, stressing, or displacement of native aquatic species.

3. Provide safe, timely and effective up and downstream passage for native fish at Project facilities that meets or exceeds relevant federal and State criteria.

4. Provide water of sufficient quantity and quality within and downstream of the Project to meet or exceed the North Coast Regional Water Quality Control Board Basin Plan (2001) (Plan) water quality objectives including temperature. The temperature objective reads, in part: *"At no time or place shall the temperature of any cold water be increased by more than 5°F above natural receiving water temperature. . ."* (Plan, p. 3-4).

5. Provide water of sufficient quantity and quality within and downstream of the Project to mitigate for Project impacts contributing to the incidence of fish disease in the mainstem Klamath River.

6. Establish a geomorphically functional stream channel above and below Project diversions.

The Project facilities and operations exacerbate already significantly impaired water quality conditions in the Klamath River. Even with fish passage, the project affects aquatic and

riparian habitat due to modified or reduced flow regimes. The State Board should analyze impacts and propose mitigation. Restoration of flows to more natural conditions will help to improve water quality conditions and aquatic and riparian habitat in and downstream of the Project.

Fish Passage

Existing Project operations and facilities drastically disrupt native anadromous and resident fish migration. The Project completely precludes the passage of anadromous species above Iron Gate Dam at River Mile 190. The three Project dams in California on the mainstem Klamath River lack any passage facilities and block access to more than 400 miles of migration, spawning, and rearing habitat for native salmon, steelhead, and Pacific lamprey (Hamilton et al. 2005 and Huntington 2004 and 2006). The Department recommends that the State Board's Alternatives should either evaluate dam removal or an Alternative that includes mandatory conditions to provide fish passage facilities. Although fish ladders would allow for fish passage, they would also require continual maintenance, and outmigration success of juveniles is unknown. Alternatives which require dam removal would provide 100 percent passage; therefore, the Department prefers dam removal as an alternative to fish passage to address existing effects on fish migration.

Beyond precluding the restoration of anadromy, the Project facilities also disrupt seasonal migration patterns of resident salmonids. These facilities also diminish access to refugia and spawning habitats important for all native fish. This fragmentation is compounded by potentially lethal entrainment risks including risks to Lost River and Shortnose suckers, which are fully protected under FGC section 5515. The California facilities lack screens and other exclusionary devices to prevent entrainment and mortality to resident fish. The J.C. Boyle facility does have a screen, but it is inadequate and does not conform to current fishway criteria. Therefore, any alternative which contemplates the continued operation of the J.C. Boyle facility should update fishway criteria in consultation with the Department.

Disease

Disease of fish and fish-kills in the lower Klamath River downstream from the Project are a serious management concern. Fish disease among anadromous fish has increased in recent years in both adults and outmigrating juveniles in the lower Klamath River (Williamson and Foott 1998; Foott et al. 1999, 2002, 2003, Nichols and Foott 2005). The primary pathogens implicated in the disease outbreaks and fish-kills are the myxozoan parasites *Ceratomyxa shasta* and *Parvicapsulum minibicornis* (Williamson and Foott 1998; Foott et al. 1999; Foott et al. 2002; Foott et al. 2003).

The life cycles of the parasites endemic to the lower Klamath River are complex and require development in both a vertebrate and invertebrate host. For *C. shasta* the invertebrate host is the freshwater polychaete *Manayunkia speciosa* (Bartholomew et al. 1997). Fish become infected by contact with actinospores that are produced within *Manayunkia*. Following fish mortality, myxospores are released into the water where they are then taken up by the polychaete. The invertebrate host for *P. minibicornis* has not yet been identified, but new information suggests that its host may also be *Manayunkia*.

Algal buildup on substrate in the Klamath River is believed to increase the suitability of habitat for *Manayunkia* (Stocking and Bartholomew 2004). By increasing the number of myxozoan spores in the water column, the algal buildup contributes to higher infection rates. Project operations reduce the magnitude and duration of peak flows below Iron Gate Dam, exacerbating algal buildup and provide stable habitat for the polychaetes downstream of the Project (McKinney et al. 1999).

Beyond creating suitable conditions for the polychaetes, the Project contributes to higher water temperatures, further increasing the suitability for algal growth and disease risk in fish.

Outmigrating juvenile salmonids within the Lower Klamath River Basin experience significant mortality from infectious disease, with recent estimates of disease-related mortality in downstream migrants as high as 90 percent (Scott Foott, USFWS, personal communication). In the spring months of March through May, juvenile salmonids need temperatures above 10 to 13 degrees Celsius for optimal growth (EPA, 2003). The Project significantly delays the onset of these temperatures in the spring, slowing salmonid juvenile growth rates. By slowing juvenile growth rates, juvenile outmigration is likely delayed, subjecting juvenile Chinook to higher disease risk conditions. Outmigration of juvenile fall-run Chinook salmon would, under a more natural thermal regime occur before the summer months, in part, to avoid warmer temperatures. In the late summer and fall, the return of cooler water temperatures would more closely mimic natural daily and seasonal conditions favorable for rearing, migration, spawning, and incubation for anadromous salmonids, particularly fall-run Chinook salmon.

Bedload Transport

Project dams have diminished bedload sediment transport and gravel recruitment in the Hydroelectric Reach and downstream of Iron Gate Dam. Quantitative modeling and multiple studies indicate that dam removal would improve stream-bed mobility and gravel transport, creating better salmonid spawning and rearing areas, and decreasing juvenile salmon disease. The FERC EIS analyzed bed mobility for each reach using with- and without-project hydrology. Those results indicate that, except for the Link River and Keno reaches,

the project consistently increases the estimated discharge required to mobilize the bed. Project operations reduce the frequency of bed-mobilizing events from roughly an annual or semi-annual basis to about two times less frequent. This indicates that, without project operations, spawning gravels would be more frequently mobilized, flushed, and replenished from upstream. In the river reaches immediately downstream of Iron Gate Dam, results indicate that the bed is only mobilized on average every 4 to 9 years. More-frequent seasonal high flow events would refresh spawning gravels and disperse sediment across the channel (and potentially onto the floodplain, depending on the magnitude of the flow), benefiting aquatic and riparian habitats (FERC, 2007). The EIR should include analysis of bedload and spawning gravel transport under each alternative.

Hatchery Operations

The NOP correctly identifies that substantially new information has been developed under the KHSA process including the development of an environmental review document evaluating the impacts of dam removal (Klamath Facilities Removal Final Environmental Impact Statement/Environmental Impact Report, December 2012, State Clearinghouse No. 2010062060). We understand the State Board will use the information developed as part of their analysis. The Department recommends the State Board specifically include the requirements developed during the KHSA process for hatchery operations in their evaluation of any EIR alternative that includes dam removal. The hatchery and other artificial propagation can be utilized and contribute to the overall restoration efforts in the Klamath Basin.

Alternatives Analysis

The NOP notes the State Board staff has determined the FERC EIS does not fully comply with the requirements of CEQA, and therefore has determined it is necessary to prepare a separate EIR in conformance with CEQA Guidelines. The Department also agrees with the State Board staff regarding the FERC EIS that alternatives analyzed in the EIR should include mandatory conditions provided by the Department and the U.S. Departments of the Interior and Commerce.

The State Board's NOP mentions a possible range of alternatives (Alternatives) for consideration. In addition to the No Project Alternative, alternatives may include but are not limited to:

- PacifiCorp's Project as proposed in its August 2014 water quality certification application, updated with mandatory conditions;
- the FERC staff alternative with mandatory conditions;
- removal of the three mainstem Project facilities in California;

- removal of some or all of the California mainstem dams; and

- implementation of the KHSA measures to the extent that they affect California's environmental resources.

The Department supports the evaluation of these Alternatives. Specifically, the Department supports the State Board addition of the mandatory conditions to both PacifiCorp's Project proposal and the FERC staff alternative.

The FERC EIS identifies numerous, significant positive effects of decommissioning two or four Project facilities. These benefits include water quality improvements below Iron Gate Dam, restoration of historical anadromous fish habitat, elimination of fish passage barriers, and net annual power benefits when compared to installation of fishways. Negative and uncertain effects of dam removal regarding anadromous fish are described as generally short term and manageable. Indeed, from the analysis provided in the FERC EIS, dam removal appears to be the most beneficial course of action with regards to most significant issues.

To alleviate any concerns that may exist related to the economic costs of decommissioning and loss of power generation, the State Board should consider a report by the California Energy Commission (CEC), *"PacifiCorp's Klamath Hydroelectric Project: Transmittal of Economic and Energy Information from the California Energy Commission to Assist Public Utilities Commissions in Identifying the Least-Cost Project Alternative for Ratepayers."* The CEC provided this information to FERC and the California and Oregon public utility commissions to assist development of options that provide optimum benefits to ratepayers at lowest cost. Specifically, the CEC recommended:

> *"Based on the scientific, energy and economic evidence provided in this letter, the FERC proceeding administrative record, and in our reports, Energy Commission staff recommends that the California Public Utilities Commission authorize cost recovery only for the decommissioning scenario, which is the least-cost, environmentally superior project option for the Klamath Hydro Project."*

In light of the high cost and low benefit ratio presented in the FERC EIS and detailed in the CEC report, it appears that any issues related to high economic costs of decommissioning and loss of power generation would be less compared to the continued operation of the Project.

The Department would also like to clarify that although the Klamath EIS/EIR identifies Partial Facilities Removal of Four Dams as the environmentally superior alternative, the Department also supports the Four Dam Removal alternative. Although retirement of

Copco 1 and Iron Gate or four dam removal alternatives would have the most short-term significant and unavoidable impacts, these impacts would largely be limited to the time frame of direct dam deconstruction actions and sediment release (see Klamath EIS/EIR). Dam removal alternatives would significantly improve water temperature, dissolved oxygen, and algal toxins for aquatic resources, and reduce the incidence of fish disease in juvenile salmon.

The State Board should analyze the effects of reservoir stratification on dissolved oxygen and water temperature for alternatives that maintain reservoirs, and any mitigation options. The analysis for the Klamath River Total Maximum Daily Load (North Coast Regional Water Quality Control Board 2010), determined Iron Gate and Copco reservoirs have significant impacts on dissolved oxygen and temperature, and there are no depths at which salmonids could be supported. No mitigations were identified in the FERC EIS to address this issue.

In summary, the Department determined Alternative 3 (Partial Facilities Removal of Four Dams) to be the environmentally superior alternative among all the alternatives because it provides many of the long-term beneficial environmental effects while reducing some of the short-term significant effects of the Proposed Action. Still, the Department remains supportive of the Department EIS/EIR Proposed Action: Alternative 2 (Full Facilities Removal of Four Dams) because it would also result in the most long-term beneficial environmental effects.

Conclusion

The Klamath Hydroelectric Project is causing irreparable harm to the State's fish and wildlife resources. The State Board should use information presented in the FERC EIS and Klamath EIS/EIR. Based on current information and analysis, the Department's position is that dam removal alternatives are superior for conservation of fish and wildlife resources.

The Department appreciates the opportunity to provide comments on the NOP. If you have any questions concerning these comments, please contact Senior Environmental Scientist (Specialist) Matt Myers at (530) 225-3846 or matt.myers@wildlife.ca.gov.

Sincerely,

Neil Manji
Regional Manager

ec: Page 13

References: Page 13

ec: State Clearinghouse
state.clearinghouse@opr.ca.gov

Curt Babcock, Curtis Milliron, Tony LaBanca, Donna L. Cobb, Matt Myers, Caitlin Bean, Suzanne Turek, Jennifer Bull, Wade Sinnen, Morgan Knechtle, Kevin Takei
California Department of Fish and Wildlife
Curt.babcock@wildlife.ca.gov, Curtis.milliron@wildlife.ca.gov, tony.labanca@wildlife.ca.gov, donna.cobb@wildlife.ca.gov, matt.myers@wildlife.ca.gov, Caitlin.bean@wildlife.ca.gov, Suzanne.turek@wildlife.ca.gov, Jennifer.bull@wildlife.ca.gov, wade.sinnen@wildlife.ca.gov, morgan.knechtle@wildlife.ca.gov, kevin.takei@wildlife.ca.gov

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PT

CALIFORNIA natural resources AGENCY

EDMUND G. BROWN JR., Governor
JOHN LAIRD, Secretary for Natural Resources

STATE WATER RESOURCES CONTROL BOARD
2017 FEB -1 PM 2:39
DIV OF WATER RIGHTS SACRAMENTO

January 30, 2017

Parker Thaler
State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA 95812-2000

Subject: Notice of Preparation of an Environmental Impact Report for the Proposed Lower Klamath Project License Surrender

Dear Mr. Thaler:

Thank you for the opportunity to comment on the scope and content of the environmental information to be included in the environmental impact report for the removal of four Klamath River dams and associated facilities.

The California Department of Fish and Wildlife, one of the departments within the California Natural Resources Agency, will submit separate comments on the project scope, including recommendations on information to be included in the EIR.

I write to express on a broader level the strong support of the California Natural Resources Agency for the revitalization of the Klamath River.

When the Klamath River flows relatively free again from the Cascades to the coast, we can expect salmon, steelhead, sturgeon, eulachon, and lamprey to rebound, bringing back jobs in commercial fishing and recreation and directly nourishing tribes that evolved over thousands of years to depend physically and spiritually on these sea-going fish. Gone will be the toxic algae blooms and lethally warm flows that slack reservoirs exacerbate. More than 420 miles of historic spawning and rearing grounds for salmon will open, including cold-water habitat that can help protect the river ecosystem from the warming effects of climate change. Healthier salmon runs mean more jobs, more food, and more stable water deliveries to communities in the basin.

Restoration in the Klamath Basin is among the priorities of the Brown administration's Water Action Plan. Removal of these outdated dams will help recover fish populations and improve water quality and water reliability for all users.

Despite decades of strife over the dividing of the river and its resources, Klamath communities learned and listened to one another and together planned a future. That future does not include these four dams, the oldest built in 1916, that cause irreparable damage to river ecology and water quality but provide no significant water storage, flood control, or hydroelectric benefits.

The circumstances of the Klamath Basin are unique, including the interrelationship of tribal rights, the resolution of water disputes, the engagements of two states, and the agreement of the private owner of the dams. These circumstances make restoration through dam removal the best long-term approach for California's second-largest river and the people who depend upon it. But, removal of dams alone is not the complete picture. We ask the State Water Resources Control Board to make expeditious progress on the environmental review and Board approvals. At the same time, our Agency, including the Department of Fish and Wildlife, will remain actively engaged with the State of Oregon, the federal government, tribes, farmers, ranchers, and others to find common ground on water use, restoration, and stability for local communities.

Thank you again for the opportunity to comment. We look forward to working with the State Water Resources Control Board as it analyzes the environmental effects of dam removal and ways to mitigate those effects.

Sincerely,

John Laird

John Laird
Secretary for California Natural Resources

Good evening. My name is Clayton Creager and I am an Environmental Program Manager for the North Coast Regional Water Quality Control Board. I am here today to speak on behalf of our agency on the State Water Board's *Notice of Preparation of an Environmental Impact Report for the Lower Klamath Project* and to express our support for the Facilities Removal alternative that will lead to the decommissioning of the four lower-Klamath dams.

- The North Coast Water Board is employing a comprehensive basin-wide (above and below the Klamath dams) recovery strategy to restore water quality throughout the Klamath Basin. We are working collaboratively with many organizations, Tribes, and private landowners. We consider the entire Klamath River Basin to be one single, integrated watershed ecosystem composed of many diverse sub-basins. To facilitate this strategy we have developed the Klamath Basin Monitoring Program and the Klamath Tracking and Accounting Program to coordinate recovery actions and monitoring across the basin.

- The ongoing restoration actions and TMDL implementation efforts to restore the Klamath River cannot reach their full potential without also addressing the water quality limiting factors created by the four dams identified in the *Lower Klamath Project*. This understanding is widely accepted in the scientific community, as noted in Interior Secretary Jewell's summary of the Klamath Secretarial Determination Findings[1], which makes the selection of the Facilities Removal alternative a clearly preferred choice.

- The North Coast Water Board accepts that the Facilities Removal scenario is undoubtedly going to result in temporary downstream impacts that may be unavoidable. The procedures for evaluating and authorizing these temporary impacts from restoration projects, which at times can degrade water quality and cause temporary exceedances of water quality objectives, are detailed in the Regional Water Board's *Policy in Support of Restoration in the North Coast Region* (Restoration Policy) which was approved by the SWRCB and the Office of Administrative Law.

- The North Coast Water Board stands solidly behind the Facilities Removal alternative and believes that it is necessary to *restore* and maintain the chemical, physical, and biological integrity of the Klamath River.

[1]Letter from Interior Secretary Sally Jewell to Kimberly D. Bose (Secretary) Federal Energy Regulatory Commission (October 17, 2016) summarizing the findings of the Secretarial Determination supporting the applications submitted by PacifiCorp and the Klamath River Renewal Corporation on September 23, 2016, urging the Federal Energy Regulatory Commission (Commission) to approve these applications for dam removal as a critical step toward resolving the significant water-related issues in the Klamath Basin.

~~Good evening madam chair and members of the board.~~ I am John Driscoll, district representative for Congressman Jared Huffman. Thank you for taking the time to come to ~~Eureka~~ Arcata to hear the concerns of the congressman's constituents about the Klamath River.

The permit you are considering is of great interest to the congressman and to tribes, fishermen and communities up and down the West Coast. It's a key piece in the effort to remove the four dams on the Klamath to rebuild salmon runs and make the river healthy.

We have known for a long time that the reservoirs behind the four dams severely compromise water quality by heating up water and causing algae blooms. This has had disastrous effects on the Klamath River's important fisheries, to recreational uses of the river, and to ceremonial uses by the tribes that hold the river sacred.

As you know, the 2012 state and federal environmental study on this issue detailed these impacts. Studies since then have added more scientific weight to the joint EIR/EIS conclusions. Congressman Huffman asks that the findings of that joint study be rolled into the new state environmental study under consideration. He also asks that the expected long-term benefits of removing the Klamath's four dams be weighed carefully and thoroughly along with the possibility of short-term effects. It is especially important to take the long view, in which a restored river can rebuild itself.

Congressman Huffman asks that your board issue a water quality certification for dam removal that so many have worked to achieve for so long. The timely issuance of the certificate is imperative to allow the Federal Energy Regulatory Commission to authorize dam removal this year. Please give the water quality certification your full and fair consideration.

Congressman Huffman thanks your board for its long participation in Klamath River issues. Congressman Huffman asks you to take one more step, to help tear down these dams.

WRITTEN COMMENTS FROM NATIVE AMERICAN TRIBES

Thaler, Parker@Waterboards

From: Tahj Gomes <dauntlesslawyer@gmail.com>
Sent: Wednesday, February 01, 2017 7:16 AM
To: Thaler, Parker@Waterboards
Subject: Etna Band of Indians & Klamath Hydroelectric Project (FERC Project 14803)
Attachments: Thaler_1 Dam Removal.pdf; Thaler_1 Dam Removal.docx

Mr. Thaler,

Attached please find the Etna Band of Indians' comments on the above - referenced matter, in various formats.

Very truly yours,

Tahj Gomes

Dear Mr. Thaler:

Thank you for the opportunity to provide comments for the record regarding the impact to Tribal Cultural Resources on the project known as FERC Project 14803. Shasta Indian people have resided in the Upper Klamath River Canyon since time immemorial. The ancestors of the present Etna Band of Indians intermarried with and maintained social, cultural, and trade relations with Shasta Indian people living in the Upper Klamath River Canyon, now represented under California State law by the Shasta Indian Nation.

The Etna Band of Indians represents a Federally-terminated Tribe under the California Rancheria Termination Act, Public Law 85-671 (72 Stat. 619), and, as a consequence, has not been a party to any of the negotiations surrounding the Klamath Hydroelectric Settlement Agreement as a Tribe. As a result, we believe that our views as Tribal stakeholders have been marginalized in the process to date.

It is our understanding that, pursuant to the California Environmental Quality Act (CEQA), the State Water Resources Control Board will prepare an environmental impact report (EIR) for the proposed removal of the Lower Klamath Project. The EIR will be used in considering the Klamath River Renewal Corporation's (KRRC) application for water quality certification. The KRRC is formed for the purpose of removing four dams on the Klamath River, three of which are located in California. The license transfer and license surrender applications are made in accordance with the April 6, 2016, Amended Klamath Hydroelectric Settlement Agreement (KHSA).

The Etna Band of Indians was not a signatory to the original or amended KHSA. In considering impact to Tribal Cultural Resources it is important to note the treatment Federally-terminated tribes differs under Federal and state laws. The assessment of project impacts on Tribal Cultural Resources under the CEQA Section 15064.5 and California AB 52 provides a procedural pathway for consultation with Native American Tribes recognized under the applicable California state laws. The National Environmental Policy Act (NEPA) only considers impacts to tribal cultural resources or Federally-recognized tribes; others are treated as "interested parties."

As noted in the Water Resource Control Boards notice, the 2012 KHSA EIS/EIR was prepared to support Klamath Hydroelectric Project dam removal, in accordance with the amended KHSA. The United States Department of Interior never entered a Record of Decision and the California Department of Fish and Wildlife never certified the document.

The Etna Band of Indians concurs with the Shasta Indian Nation that the 2012 EIS and EIR does not properly consider the impact to Shasta Indian cultural sites and landscapes with tribal cultural value. The Etna Band of Indians requests that a new EIS be developed that gives due consideration to the Shasta Indian descendants whose gravesites, historic villages, and cultural sites will be affected by this process. The Etna Band of Indians supports additional consultation to be undertaken by the California State Water Resources Control Board with Shasta Indian Nation, and we will monitor the outcome carefully.

Respectfully,

Tahj Gomes

Chairman, Etna Band of Indians

Law Office Of

Tahj Gomes

DauntlessLawyer@gmail.com

315 Wall Street, Suite 2
Chico, CA 95928-7800
Phone: (530)387-5150
Fax: (530) 350-2607

February 1, 2017

Mr. Parker Thaler
State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA 95812-2000

Re: Klamath Hydroelectric Project (FERC Project 14803)

Dear Mr. Thaler:

Thank you for the opportunity to provide comments for the record regarding the impact to Tribal Cultural Resources on the project known as FERC Project 14803. Shasta Indian people have resided in the Upper Klamath River Canyon since time immemorial. The ancestors of the present Etna Band of Indians intermarried with and maintained social, cultural, and trade relations with Shasta Indian people living in the Upper Klamath River Canyon, now represented under California State law by the Shasta Indian Nation.

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Respectfully,

Tahj Gomes
Chairman, Etna Band of Indians

Via Electronic Mail

February 1, 2017

State Water Resources Control Board
Division of Water Rights
Water Quality Certification Program
Attention: Mr. Parker Thaler
P.O. Box 2000
Sacramento, CA 95812-2000

E-mail: parker.thaler@waterboards.ca.gov

Comments of the Hoopa Valley Tribe - Scope of Environmental Impact Report for Federal Energy Regulatory Commission (FERC) Project No. 14803 Project Name: Lower Klamath Project

Dear Mr. Thaler:

On behalf of the Fisheries Department of the Hoopa Valley Tribe, I am providing the following comments on the scope of the Board's Environmental Impact Report for FERC Project # 14803.

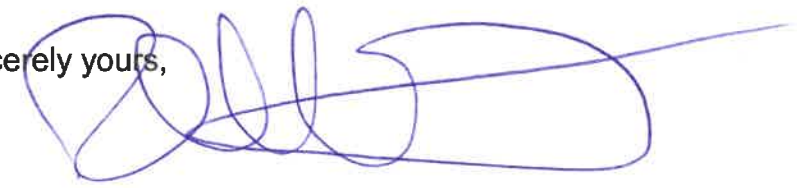
The Hoopa Valley Tribe is a native sovereign nation with federal recognition of its fully-vested fishing rights and "standing as a state" under the federal Clean Water Act. The Tribe's resource agencies are directly involved in management of fish habitat, instream flows and annual harvest of native anadromous fishes including: chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey. Pertinent to management of Klamath River water quality, the Tribe wields authority via EPA-approved water quality standards for that portion of the River that flows into and through the Reservation along its northern border.

Information regarding the need for mitigation of Klamath River water quality problems and the ways in which mitigation can and cannot be achieved is documented extensively in environmental compliance documents prepared over the past several years in support of deliberations by the Federal Energy Regulatory Commission and the Secretary of the Interior.

The Tribe has long participated in dam removal negotiations, and has written to the State Board on the need for its exercise of related Clean Water Act authorities. The Tribe's past comments are incorporated by this reference. Our position has remained throughout: 1) the mitigation is a must. We support removal of Lower Klamath Project facilities because the data show it is otherwise impossible to comply with applicable water quality requirements; and 2) Analyses in the EIR need to consider Hoopa water quality standards as well as those developed by the State of California.

Timely completion of the DEIR in synchrony with the present Klamath Renewal Corporation schedule for onset of dam removal activities as early as 2019, is fundamentally important.

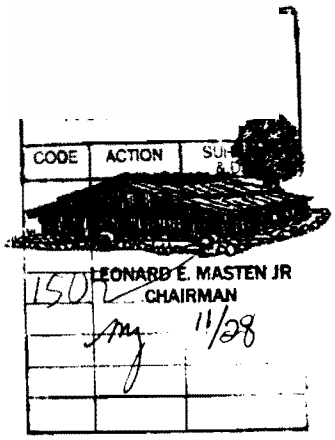
Sincerely yours,



Robert Franklin, Division Lead
Hoopa Tribal Fisheries, Water Division

Hoopa Valley Tribal Council

P.O. Box 1348 • Hoopa, California 95546
PH: (530) 625-4211 • Fax: (530) 625-4594
website: www.hoopa-nsn.gov



November 18, 2011

Via E-Mail to: KlamathSD@usbr.gov
and Overnight Delivery

Ms. Elizabeth Vasquez
U.S. Bureau of Reclamation
2800 Cottage Way
Sacramento, CA 95825

Re: Comments of Hoopa Valley Tribe on DEIS/DEIR for Klamath Facilities Removal

Dear Ms. Vasquez:

SCANNED

The Hoopa Valley Tribe submits the following comments on the Department of the Interior and California Department of Fish and Game's Draft EIS/EIR regarding Klamath Facilities Removal (the "DEIS"). The Tribe has previously submitted comments, dated July 14, 2010, on the Department of Interior's Notice of Intent to Prepare an EIS/EIR (the "Scoping Notice"). The Tribe also submitted extensive comments on the cooperating agency draft of the DEIS dated June 22, 2011. The Tribe incorporates those prior comments by reference, because the DEIS fails to incorporate or adequately address the vast majority of the Tribe's comments.

Interest of the Hoopa Valley Tribe

Since time immemorial, the fishery resources of the Klamath and Trinity Rivers have been the mainstay of the life and culture of the Hoopa Valley Tribe. The fishery was "not much less necessary to the existence of the Indians than the atmosphere they breathed." *Blake v. Arnett*, 663 F.2d 906, 909 (9th Cir. 1981) (quoting *United States v. Winans*, 198 U.S. 371, 381 (1905)). The salmon fishery is integral to the customs, religion, culture, and economy of the Hoopa Valley Tribe and its members. The lower twelve miles of the Trinity River and a stretch of the Klamath River flow through the Hoopa Valley Reservation.

NOTICE: IF YOU DETACH ENCLOSURE PLEASE INSERT
CODE NO.
INITIAL
DATE

The federal government established the Hoopa Valley Reservation in 1864. The Hoopa Valley Reservation is located in the heart of the Tribe's aboriginal lands; lands the Tribe has occupied since time immemorial. The Hoopa Valley Tribe has fishing and water rights in the Klamath River with a priority date of 1864, as recognized by the United States in the Memorandum from Solicitor of the Department of the Interior to the Secretary of the Interior (Oct. 4, 1993); and the Memorandum from Regional Solicitor, Pacific Southwest Region to the Regional Director, Bureau of Reclamation, Mid-Pacific Region (July 25, 1995) (collectively, "Solicitors' Opinions"); and by federal courts in, for example, *Parravano v. Babbitt*, 70 F.3d 539 (9th Cir. 1995). Congress has recognized and confirmed, for example in the Central Valley

Project Improvement Act, Public Law 102-575, Section 3406(b)(23) (Oct. 30, 1992), that the United States has a federal trust responsibility to restore and maintain the fishery trust resources of the Hoopa Valley Tribe to specified standards. Those standards are recognized in federal law and have become a legal mandate. The Hoopa Valley Tribe's rights are unique. This is unlike the situation where several tribes signed a single treaty reserving rights in common. While other tribes in the Klamath Basin also have water and fishing rights, our rights are distinct in scope, derive from different authorities, and must be treated separately.

The fish and water resources of the Klamath River Basin have been severely and adversely affected by the federal authorization, construction, and operation of the Klamath Reclamation Project and the Klamath Hydroelectric Project upstream of the Hoopa Valley Reservation. The impacts associated with blocked fish passage, nutrient enrichment, loss of habitat, and inadequate instream flows due to the authorization, construction, and operation of the Klamath Reclamation Project and the Klamath Hydroelectric Project have contributed to the listing of the Southern Oregon/Northern California coast (SONCC) coho salmon and its critical habitat under the Endangered Species Act.

The Tribe has actively participated in all proceedings relating to the re-licensing of the Klamath Hydroelectric Project before the Federal Energy Regulatory Commission (FERC), and proceedings to enforce operation of the Klamath Reclamation Project in compliance with the Endangered Species Act and other applicable law. Protection of the Klamath and Trinity Rivers and the aquatic resources therein is of vital importance to the Hoopa Valley Tribe.

The Tribe participated in settlement negotiations leading to the Klamath Hydroelectric Settlement Agreement (KHSA) and Klamath Basin Restoration Agreement (KBRA). Although the Tribe favors the removal of the dams of the Klamath Hydroelectric Project for the purposes of improving water quality and restoring fish passage on the Klamath River, the Tribe did not sign, and enacted a resolution in opposition to the KHSA. The Tribe opposes the KHSA as drafted because it does not require the removal of any dams, but instead establishes an uncertain planning process that could potentially lead to commencement of dam removal in 2020 subject to the achievement of numerous contingent events that include, but are not limited to: (a) enactment of federal legislation; (b) California voter approval of a $250 million bond package; (c) an affirmative determination by the Secretary of Interior that dam removal is in the public interest; and (d) separate concurrences by the states of California and Oregon that dam removal is in the public interest. To date, none of these contingencies have occurred.

The Tribe also opposes the KHSA because it suspends the FERC re-licensing proceeding, suspends the State of California and Oregon water quality certification proceedings, and permits the licensee PacifiCorp to continue operation of the Klamath Hydroelectric Project on terms of annual licenses until at least 2020. The KHSA also fails to provide for interim license measures that will bring the Project into compliance with current state, federal, tribal environmental laws, or applicable water quality standards, or that will adequately mitigate fishery impacts associated with operation of the Project.

The Tribe also did not sign, and enacted a resolution in opposition to, the KBRA because the KBRA conflicts with tribal sovereignty, violates trust duties owed to the Hoopa Valley Tribe by the United States, subordinates tribal water and fishing rights in favor of junior non-Indian irrigation interests without tribal consent, provides inadequate flows for the protection of tribal trust resources, offers a speculative and unfunded program for fishery restoration and water conservation, encourages unsustainable use of groundwater in the Upper Klamath Basin, fails to abate acute nutrient pollution problems and is not based on best available, peer reviewed science. The Tribe also objects to the linkage of the KHSA and the KBRA.

Here, as in all other proceedings related to protection of the Klamath and Trinity Rivers, the Tribe is committed to ensuring that the United States and its respective departments and agencies fulfill their duties to the Tribe and to the Klamath and Trinity Rivers in accordance with applicable law, including NEPA, the Endangered Species Act, Clean Water Act, Federal Power Act, and the federal government's trust responsibility to the Hoopa Valley Tribe.

Comments on Draft EIS/EIR

I. The DEIS Contains An Incomplete Evaluation of Alternatives, Fails to Evaluate the Impacts of the KBRA, and Ultimately Fails to Meet the Purpose of NEPA and CEQA to Facilitate Informed Decision-Making and Public Participation.

The purpose of the NEPA and CEQA environmental review process is two-fold: "First, it places upon [the action] agency the obligation to consider every significant aspect of the environmental impact of a proposed action. Second, it ensures that the agency will inform the public that it has indeed considered environmental concerns in its decision-making process." *Kern v. United States Bureau of Land Management*, 284 F.3d 1062, 1066 (9th Cir. 2002). *See also Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 349 (1989) (NEPA "ensures that the agency, in reaching its decision, will have available, and will carefully consider, detailed information concerning significant environmental impacts; it also guarantees that the relevant information will be made available to the larger audience that may also play a role in both the decisionmaking process and the implementation of that decision."); *Idaho Sporting Congress v. Thomas*, 137 F.3d 1146, 1149 (9th Cir. 1997) (same); *Columbia Basin Protection Ass'n v. Schlesinger*, 643 F.2d 585, 592 (9th Cir. 1981) ("[T]he preparation of an EIS ensures that other officials, Congress, and the public can evaluate the environmental consequences independently."). Ultimately, an EIS does not satisfy NEPA unless "its form, content, and preparation substantially (1) provide decision-makers with an environmental disclosure sufficiently detailed to aid in the substantive decision whether to proceed with the project in light of its environmental consequences, and (2) make available to the public, information of the proposed project's environmental impacts and encourage participation in the development of that information." *Trout Unlimited v. Morton*, 509 F.2d 1276, 1283 (9th Cir. 1974).

The DEIS here fails to meet the standards set forth above primarily through its failure to adequately disclose and evaluate the impacts associated with the KBRA. As the DEIS confirms, the KBRA is a connected and interdependent action. Yet, the DEIS does not adequately disclose the impacts of the KBRA. Nor does the DEIS consider or evaluate alternatives to the KBRA.

The DEIS misleads the public and the decision-makers to believe that the KBRA is an agreement that will result in fishery protection and environmental restoration. The DEIS continually makes the incorrect statement that the KBRA "limits" irrigation water diversions below levels currently allowed by law. In fact, the KBRA will result in inadequate (and unlawful) flows for fish at critical times of dry water years, will result in a historic termination of the United States responsibilities to Indian tribes in the Klamath basin, will turn Western water law on its head by subordinating senior tribal water rights to junior irrigation interests, and will support otherwise unsustainable consumptive agricultural practices through hundreds of millions of dollars in public subsidies. In addition, the DEIS fails to inform the public and the decision-makers that any benefits that could derive from the KBRA for fish are speculative at best, given the need for congressional authorization and appropriations of funding that are not likely to occur.

The Tribe believes that dam removal is necessary and in the public interest. Improvements in water quality, volitional fish passage, and a free-flowing Klamath River are critical to support the Tribe and the river that runs through its homeland. However, the benefits of dam removal will not be achieved if tied to the KBRA. The proposed action may lead to a river without dams, but with the KBRA it will also lead to a river without sufficient water in the river for fish at critical times of the year. The impacts of the KBRA's guaranteed diversions and associated tribal trust violations will not be evaluated in subsequent NEPA processes. The public, the Governors, the Departmental decision-makers, and Congress need to be made fully aware of the consequences of, and alternatives to, the KBRA. The DEIS fails in that regard.

II. The Purpose and Need Statement Should Delete Reference to Consistency with the KBRA.

CEQ Regulation 1502.13 requires that an EIS "briefly specify the underlying purpose and need to which the agency is responding in proposing the alternatives including the proposed action." As stated in the DEIS, the purpose and need statement "is a critical part of the environmental review process because it helps to set the overall direction of an EIS/EIR, identify the range of reasonable alternatives, and focus the scope of analysis." Final Alternatives Report, p. 2-1.

The DEIS describes the purpose of the Proposed Action as follows: "to achieve a free flowing river condition and full volitional fish passage as well as other goals expressed in the KHSA and KBRA." The need is described as: "to advance restoration of the salmonid fisheries in the Klamath Basin consistent with the KHSA and the connected KBRA." The Department should delete the references to consistency with the KHSA and KBRA. This EIS is being prepared to inform the Secretary of the Interior and the Governors of the States of Oregon and California whether "Facilities Removal (i) will advance restoration of the salmonid fisheries of the Klamath Basin, and (ii) is in the public interest, which includes but is not limited to consideration of potential impacts on affected local communities and Tribes." KHSA, Sec. 3.3.1; DEIS, p. ES-2. Consistency with the KBRA is not a factor in the Secretarial Determination or the Governors' concurrence and should not guide the selection of alternatives here.

As the Tribe warned in its July 14 scoping comments, tying the purpose and need of the Proposed Action to KBRA implementation has resulted in an unreasonably narrow, and unlawful, alternatives analysis. As discussed in more detail below, an alternative that removes all four facilities without execution and implementation of the KBRA would achieve the purpose of "a free flowing river condition and full volitional fish passage" and would "advance restoration of the salmonid fisheries" and would be in the public interest. In addition, such an alternative would be feasible. However, by requiring consistency with the KBRA in the purpose and need statement, the Department was unable or unwilling to consider a no-KBRA alternative. *See* Final Alternatives Report, Section 2.3, Chapter 4 (establishing consistency with KBRA as factor for screening alternatives).

III. The Alternatives Analysis Fails to Comply With Requirements of NEPA and CEQA.

The alternatives analysis is the "heart of the environmental impact statement." 40 C.F.R. § 1502.14. The EIS must "rigorously explore and objectively evaluate all reasonable alternatives," and "devote substantial treatment to each alternative . . . so that reviewers may evaluate their comparative merits," including "reasonable alternatives not within the jurisdiction of the lead agency. 40 C.F.R. § 1502.14(a),(b),(c); *see also* 43 C.F.R § 46.420(c) (defining "range of alternatives").

The CEQ publication "NEPA's Forty Most Asked Questions" confirms that in establishing a reasonable range of alternatives, "the emphasis is on what is 'reasonable' rather than on whether the proponent or applicant likes or is itself capable of carrying out a particular alternative." Question 2a. The CEQ publication adds that "an alternative that is outside the legal jurisdiction of the lead agency must still be analyzed in the EIS if it is reasonable. . . . Alternatives that are outside the scope of what Congress has approved or funded must still be evaluated in the EIS if they are reasonable, because the EIS may serve as the basis for modifying the Congressional approval or funding in light of NEPA's goals and policies." Question 2b.

For the reasons discussed below, the alternatives analysis in the DEIS is deficient:

A. The Description of the No-Action Alternative Is Inaccurate and Misleading and Does Not Facilitate Informed Decision-Making.

The alternatives analysis in an EIS is required to evaluate a No-Action Alternative. 40 C.F.R. § 1502.14(d). The No-Action Alternative is required to discuss both the existing conditions "as well as what would be reasonably expected to occur in the foreseeable future if the project were not approved." CEQA Guidelines Section 15126.6(e)(2). The DEIS states that "[f]or the purposes of this analysis, the No Action/No Project Alternative will continue current operations with the Four Facilities remaining in place and PacifiCorp operating under the current annual license." DEIS, at ES-21. This is an inaccurate and misleading description of what would happen in the event of no-action, or a negative Secretarial Determination. As a result, the decision-makers and the public have not been presented with an accurate No-Action Alternative to compare with the other alternatives.

In the event of a negative Secretarial Determination or adoption of the "No-Action" alternative the FERC licensing process will resume. All events in the FERC licensing process have been completed except for the completion of the Section 401 water quality certification (which is currently contractually barred from completion under the KHSA). If the KHSA and KBRA terminate, the States would resume the certification process and a new FERC license would issue "in the foreseeable future." Indeed, the California State Water Resources Control Board Resolution No. 2011-0038, adopted August 16, 2011, makes clear that the Water Board expects that the environmental review process here "will facilitate completion of the State Water Board's 401 certification process for the relicensing proceeding should that become necessary because the Secretarial Determination does not occur by April 30, 2012."

The Departments of Interior and Commerce have already prescribed final and binding conditions pursuant to Section 4(e) and 18 of the Federal Power Act (including volitional fishway prescriptions) which must be included in the new license. *Escondido Mut. Water Co. v. La Jolla Band of Mission Indians*, 466 U.S. 765 (1984) (FERC must include the Departments mandatory conditions and prescriptions); *City of Tacoma v. FERC*, 460 F.3d 53 (D.C. Cir. 2006) (same).

It is not correct that the Klamath Hydroelectric Project would continue operating on annual licenses, with no protective terms and conditions, for "the foreseeable future" in the event that the KHSA terminates. The foreseeable No-Action scenario is not perpetual operation of the Klamath Hydroelectric Project under a long-expired license. Instead, the foreseeable No-Action scenario is one in which the Klamath Project is re-licensed, subject to the Departments mandatory Section 4(e) and 18 conditions and fishway prescriptions, as well as any conditions imposed under the authority of Section 401 of the Clean Water Act for compliance with water quality standards of the States of Oregon and California, and the Hoopa Valley Tribe.

By failing to describe the reasonably foreseeable No-Action scenario, the DEIS artificially makes the proposed action (dam removal plus KBRA implementation) seem more attractive than it really is. A properly framed No-Action alternative would describe issuance of, and project operations under, a FERC license that provided volitional passage and compliance with state and tribal water quality standards. In addition, the KBRA and its guaranteed water diversions and tribal claim waivers would not occur. Thus, the Klamath Reclamation Project would continue to be managed in accordance with existing and future limitations on diversion required by the Endangered Species Act and other applicable law.

The problems associated with the No-Action Alternative, as currently framed, are evident in the discussion of water quality impacts. The evaluation of the No-Action Alternative, in Section 3.2's discussion of water quality repeatedly states that the "continued impoundment of water at the Four Facilities under the No Action/No Project alternative would result in no change from existing conditions." This statement rests on the erroneous premise that the Project would be allowed to continue operating out of compliance with state and tribal water quality standards. In fact, under a properly framed No-Action Alternative, the FERC process would resume and the States of Oregon and California, and the Hoopa Valley Tribe, would impose conditions on continued operation designed to ensure compliance with the applicable standards. Under

existing federal and state law, the Project could not be permitted to continue operating in a manner that violated the applicable water quality standards.

In summary, continued un-mitigated operation of the Klamath Hydroelectric Project is not likely, foreseeable, or reasonable if Facilities Removal fails to occur pursuant to the KHSA process. The No-Action Alternative should be modified to reflect the likely outcome of a resumption of the FERC licensing process.

B. Analysis of the Proposed Action Alternative Is Inadequate Because It Fails to Evaluate the Effects of the KBRA's Guaranteed Minimum Irrigation Diversions on the Fishery.

The Proposed Action is described as Facilities Removal (i.e., decommissioning and removal of Iron Gate Dam, Copco Dams 1 and 2, and J.C. Boyle Dam). The Department considers the KBRA to be connected to the Proposed Action; however, the DEIS and its supporting documents confirm that less water will be available for flows at Iron Gate Dam under the Proposed Action (i.e. Reclamation (2011), pages 6-9 and 6-10; Figure 1) but do not actually evaluate or disclose the adverse consequences to water flow and the fishery that will result from federal execution and implementation of the KBRA. Hydrology modeling in Reclamation (2011) shows that flows under the Proposed Action will be 200 - 400 cfs less than what would otherwise be available under the No Action alternative. Additionally, both the Proposed Action and the No Action alternative fall consistently short of the instream flow recommendations in Hardy et al. (2006), except during extremely wet hydrologic conditions (Figure 2). The DEIS must fully disclose to the decision-makers and to the public that dam removal tied to the KBRA will not achieve the goals of fishery restoration, because there will not be water of sufficient quantity and quality left in the river for the fish at critical times in dry water years.

Both before the KBRA and KHSA were signed, and throughout this NEPA process, the Hoopa Valley Tribe has urged that modeling be completed which compares the water flows needed for fish restoration to those projected to become available under the KBRA. For example, in Additional Modeling and Analytical Work Needed (February 5, 2008), the Hoopa Valley Tribe and others urged modeling "that will achieve modified Hardy II Iron Gate flow targets. . . . [and determine] the Project diversions allowable while meeting April 1 through September 30 Hardy II Iron Gate flow targets." The document further requested "a written procedure for operationalizing the Hardy II flows. . . . intended to help determine the amounts that will be available for diversion in time steps throughout the summer and winter months."

On June 16, 2009, Hoopa Tribal Fisheries Director, Mike Orcutt, wrote to Associate Deputy Secretary of the Interior, Laura Davis, urging the Department "to conduct the additional analyses discussed . . . to illuminate the feasibility of KBRA water management schemes . . . .in advance of final federal decision-making and before KBRA legislation is introduced in Congress." On July 2, 2009, Hoopa Tribal Chairman Leonard E. Masten also wrote to Associate Deputy Secretary of the Interior, Laura Davis, urging completion of modeling and noting that "[s]uch modeling was also requested in the February 5, 2008, list of studies that we previously sent you." In response, Associate Deputy Secretary Laura Davis, on September 11, 2009, reported that work had been done "to identify additional scientific analyses that may better

inform review of the draft KBRA." Ms. Davis referred to the February 5, 2008, request and said "[o]ther issues will be addressed by additional modeling described above." Nevertheless, the DEIS fails to disclose any modeling of implementation of the Hardy II flows recommended for fish restoration and does not examine how such flows could be operationalized to permit continued water diversions for the irrigation project.

The DEIS also misrepresents the facts, unsuccessfully attempting to claim the KBRA will be better for fish. For example, page 3.3-99 references Hetrick et al. (2009), citing that fall-run Chinook under "KBRA type flows showed the greatest benefits in years when production was low." This summary conclusion in Hetrick et al. 2009 is stated in the Anadromous Fish Production section under PRE-DAM results. Modeling results for POST-DAM removal did not state the same result regarding the ratio of benefits to production in low production years (Hetrick et al. 2009).

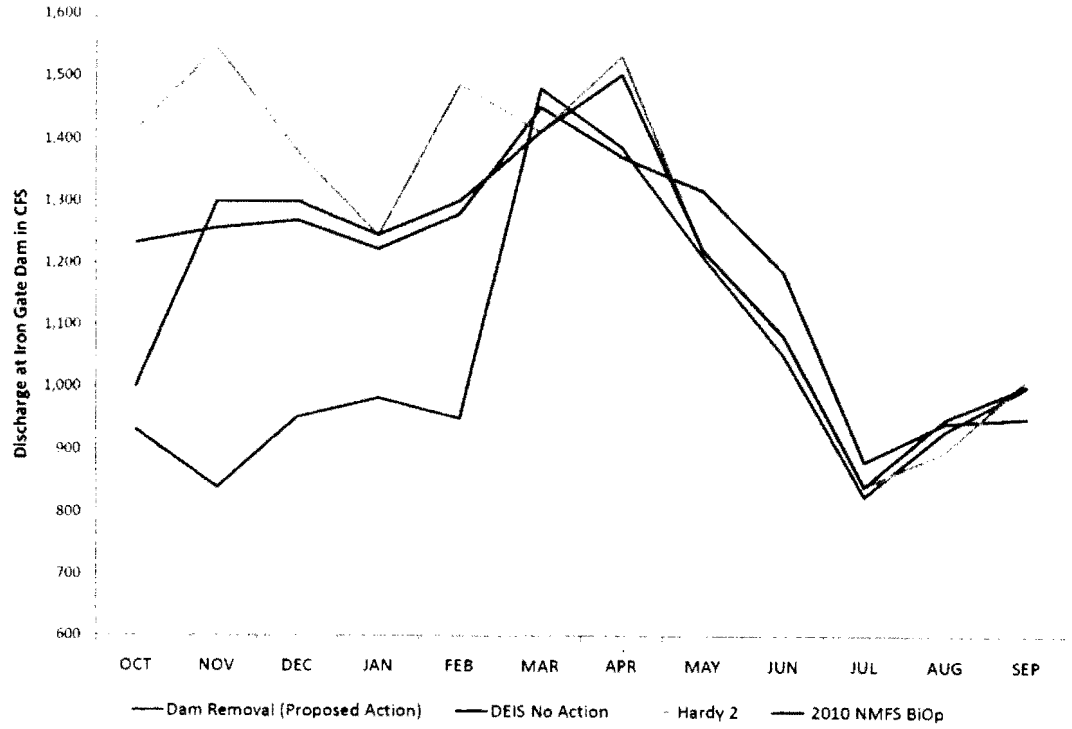


Figure 1. Comparison of 90% exceedance discharge at Iron Gate Dam for the DEIS Proposed Action, DEIS No Action, Hardy et al. (2006) and the NMFS Biological Opinion (2010). Note dry year Proposed Action flows are well below thresholds established in the NMFS Biological Opinion (2010) and Hardy et al. (2006) during most months, and especially during November through February. Chinook fry emerging beginning in December (Hardy et al. 2006) will be affected by insufferably low winter flows.

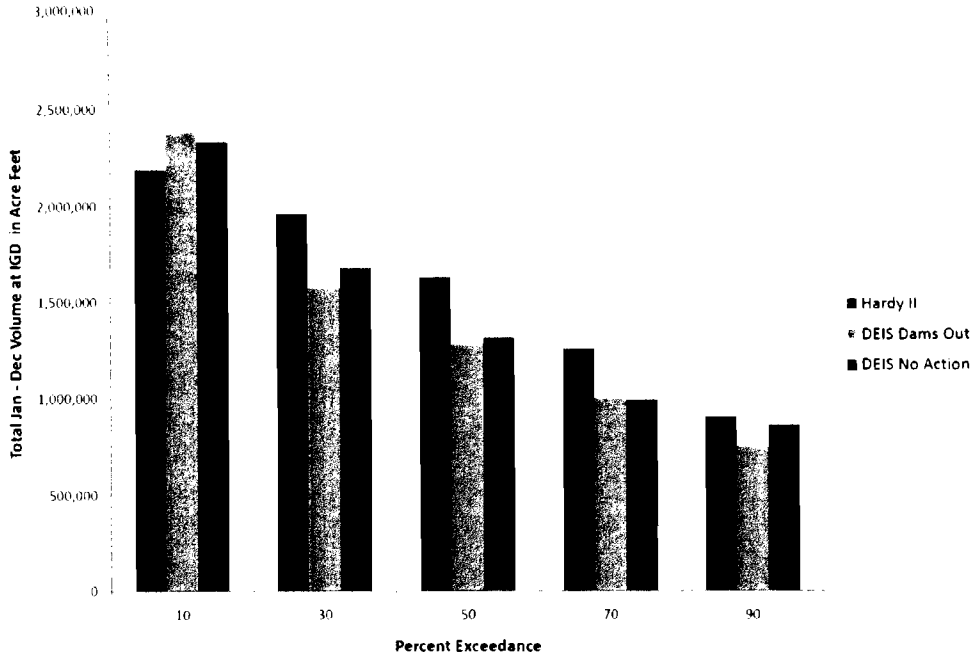


Figure 2. Hardy et al. (2006) Iron Gate Dam instream flow recommendation water volumes compared to both DEIS alternatives. Both the Proposed Action and No Action are well below Hardy et al. (2006) recommendations for instream fisheries needs in all exceedance year types except during extremely wet annual hydrologic conditions.

Throughout the DEIS, the effect of the KBRA Water Diversion "Limitation" is inaccurately described. For example, page ES-19 states that a key outcome of the KBRA is that the Klamath Reclamation Project's water users have agreed to "accept reduced water deliveries." At page 3.7-19, the DEIS states that "the Water Diversions Limitations program (KBRA Section 15.1) would reduce the availability of surface water for irrigation on Reclamation's Klamath Project to 100,000 acre-feet less than the demand in the driest years to protect mainstem flows." Similarly, page 3.8-20 states "Water Diversions Limitations would be implemented during dry years to increase flows for fisheries by reducing Reclamation's Klamath Project Diversion up stream of approximately 100,000 acre-feet."[1] Both of these statements are completely false. Not only is 100,000 acre-feet not reduced from current demand, the DEIS's Proposed Action's modeled water volume falls well below ESA requirements established in the 2010 National Marine Fisheries Service (NMFS) Biological Opinion (Figure 3) for dry water year types. A comparison of required versus available water volume totals for the January through December time period reveals water volumes established in the 2010 NMFS Biological Opinion would not be met in four out of six water year types (66%). None of the sections referring to the mythical 100,000 acre-feet or any other part of the DEIS, reveals that the existing legal limitations in the

[1] We find it unusual that the reference to this mysterious 100,000 acre feet water volume savings first appears in an earlier draft of Hetrick, et al. (2009) but is not included in the Final version of the same report.

applicable Biological Opinions independently prevent the Project from satisfying irrigation demand in dry years. The analysis of the KBRA flows in the DEIS appears to rely on irrigator water usage from years *prior to* BiOp implementation. The large irrigation diversions noted in the DEIS occurred prior to the BiOp and are illegal now under the ESA. The KBRA would change that by guaranteeing a minimum diversion for irrigators to the detriment, not the benefit, of fish.

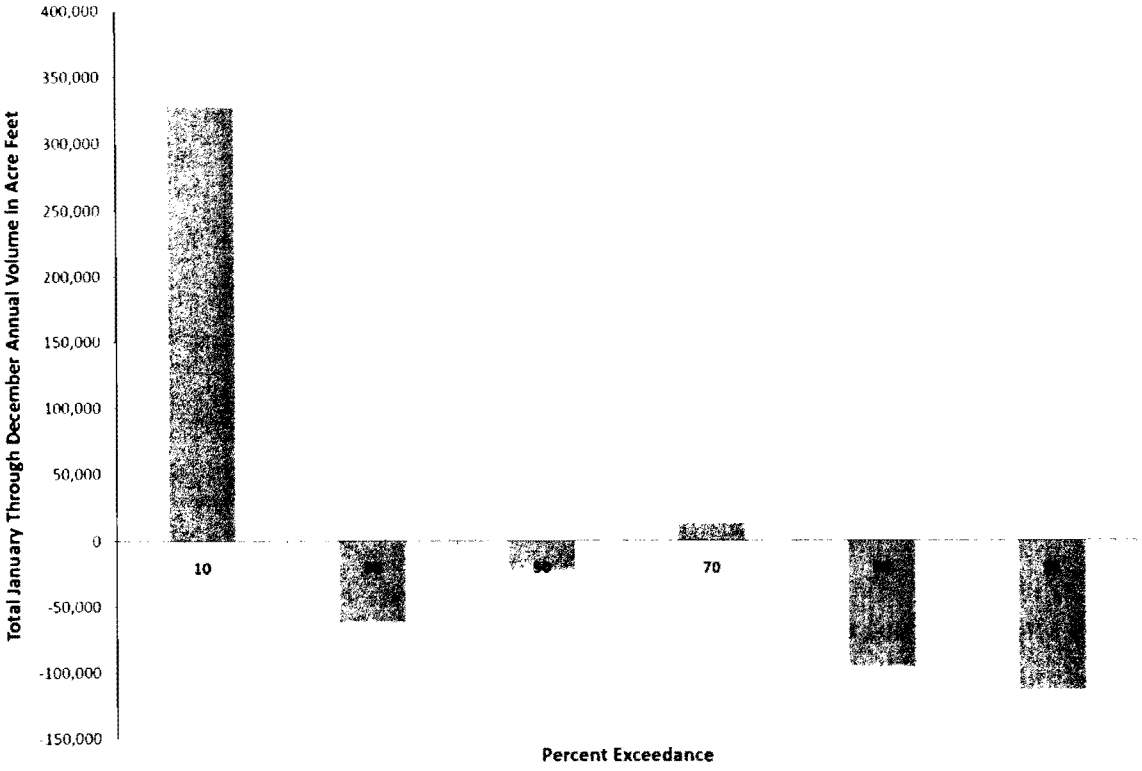


Figure 3. DEIS Proposed Action water volume[2] shortages when compared to volumes required to satisfy the 2010 NMFS Biological Opinion[3] for January through December volumes. Volumes are calculated from Iron Gate Dam releases.

The purported "limitation" on diversions in the KBRA is nothing of the kind and will actually work to negate benefits of dam removal. The purpose of the KBRA is not to limit diversions, but to guarantee a firm minimum amount of water for irrigation diversions that exceeds currently legal levels. Those diversions, which under the KBRA would be 330,000 to

[2] DEIS Proposed Action water volumes were calculated from exceedance tables presented in Appendix F of (Reclamation 2011).

[3] 2010 NMFS Biological Opinion water volumes were calculated from Table 18 of (NMFS 2010).

385,000 acre-feet per year, would trump the in-stream flow needs of fish and other aquatic organisms, especially in drier water years (Figure 4). DEIS hydrology model results indicate that the Proposed Action will result in a buffering of Agricultural Supply water volumes in dry years above what would otherwise be available. Meanwhile, the river suffers a penalty of a volume reduction that violates the 2010 NMFS Biological Opinion (Figure 3). While the DEIS states ESA compliance will continue, it fails to describe *how* this will be achieved given the clear shortage of water volume under the KBRA. The United States would be legally obligated to defend the irrigators' diversion rights against the interests of fish and Indian tribes in the Klamath Basin. The KBRA thus subordinates senior tribal rights to water for fish in favor of junior irrigation interests. In the case of the Hoopa Valley Tribe, this subordination occurs without the Tribe's consent – effectively terminating Interior's trust obligation to the Tribe in this context. The DEIS leaves the wrong impression that the KBRA limits irrigation diversions below the level that can lawfully occur under the existing BiOp.

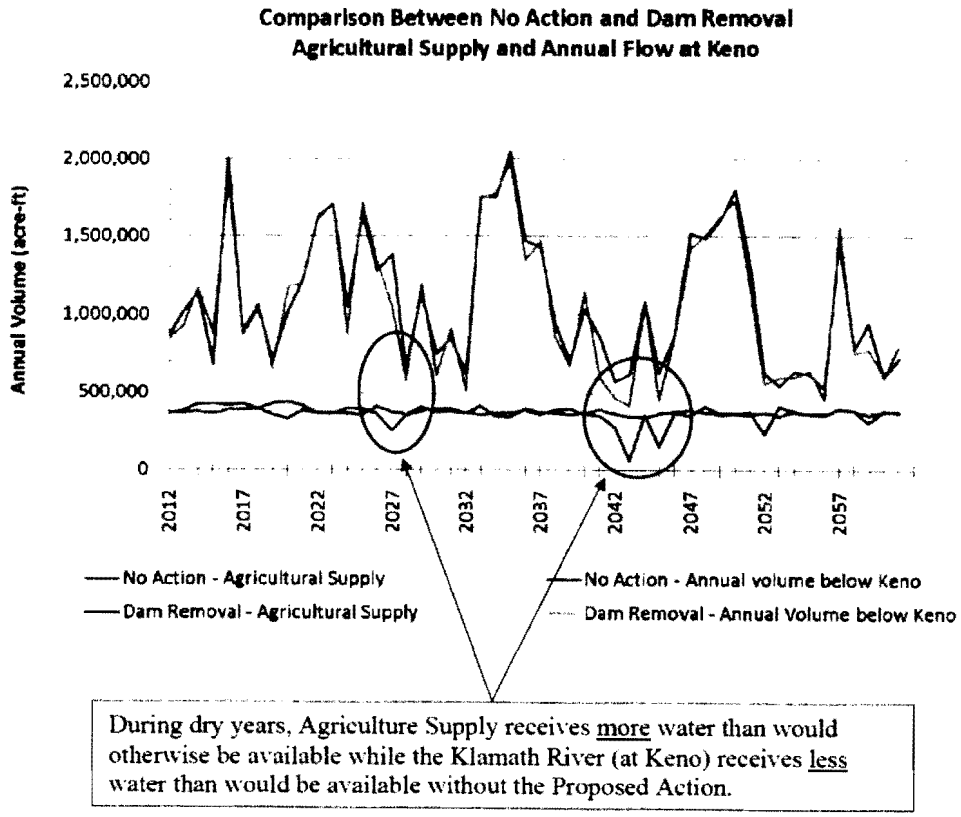


Figure 4. The DEIS Proposed Action favors Agricultural Supply in dry years, providing a guarantee of more water than would be available under the No Action Alternative, which includes the flow requirements established in the 2010 NMFS Biological Opinion. Conversely, the river is penalized by a decrease in available water under the Proposed Action. Adapted from Reclamation (2011), page 6-18. This modeling comparison does not indicate irrigation will be reduced by 100,000 acre feet from current demand, as erroneously represented in the DEIS (i.e. page 3.7-19).

Analysis of the KBRA's guaranteed diversions shows that water flows in the vicinity of Iron Gate Dam would frequently fail to meet the requirements of the NMFS Biological Opinion for protection of salmon in the mainstem Klamath River (Figure 3). The flows in the BiOp are those necessary to avoid placing the fish in jeopardy of extinction. The guaranteed diversion of 330,000 acre-feet for irrigators will, in 66% of water years, leave too little water in the Klamath River to meet the requirements of the Coho Salmon BiOp flow requirements (Figure 3). Flows under the KBRA (Appendix E-5) will fall to below 450 cfs if water years similar to 1992 occur in the next 50 years. During the massive fish die-off in 2002 (in which 70,000 adult salmon died), flows in the river were 750 cfs. (Guillen 2003, CDFG 2004).

The Department cannot avoid analyzing the impacts of the diversion limitations in this EIS. The commitments related to the diversion limitations will become binding once the Secretary of the Interior signs the KBRA. Since the Secretary will be bound to honor the water balance and diversion guarantees prescribed in the KBRA upon signing, there will be no point in the future at which to analyze the effect of the diversion guarantees under NEPA. The Secretary will lack discretion to not honor the diversion guarantees once the necessary conditions are met.

The Department must analyze the effect of the KBRA and its diversion guarantees now. The Department concedes that the KHSA and KBRA are interdependent. The Department cannot tout the benefits of dam removal while ignoring the harm that will result from the associated KBRA. Nor can the Department fail to examine the KBRA water diversion impacts by analyzing the KBRA at a "programmatic" level. Examination of the KBRA at a programmatic level does not excuse the Department from analyzing and disclosing the known impacts associated with the program. The minimum diversions guaranteed by the KBRA are known now, will be non-discretionary once the KBRA is executed, have significant impacts associated with them, and therefore must be evaluated now.

C. The Alternatives Analysis is Incorrect in Concluding a The Proposed Action Will Result in a Positive Geomorphic Effect

Fluvial geomorphic function is critical for habitat creation and maintenance for rearing and spawning anadromous salmonids. Geomorphic function is also essential for naturally functioning physical processes (i.e. bar development, scour) in a dynamic river system. Reclamation (2011) cites the existing condition median bed mobilization flows for Slight and Significant Bed Mobilization flows as 9,800 and 15,900 cfs respectively (Table 1). That is, to significantly mobilize the bed of the Klamath River below Iron Gate Dam, a median flow of 15,900 cfs is required.

Slight Mobilization is defined by Reclamation (2011) as "a small, but measurable, sediment transport rate. Armor layer is only minimally disturbed and there may be flushing of sand to a depth of the D_{90}." Reclamation (2011) also defines Significant Mobilization as "many particles are moving and there is a significant sediment transport rate. Sand is mobilized in the interstitial spaces of the bed and to a depth of twice the D_{90}. The armor layer is significantly disturbed. Given these definitions, we believe a Significant Mobilization is required in river downstream of Iron Gate Dam to recover geomorphic function and mitigate bed armoring caused by Iron Gate Dam, constructed in 1962. While the geomorphic effect of Iron Gate Dam clearly

extends beyond the first ten miles downstream, Table 1 includes only mobilization flows for the first ten river miles, for discussion purposes.

Reach	River Mile	Slight Bed Mobilization Flow (cfs)			Significant Bed Mobilization Flow (cfs)		
		Low	Median	High	Low	Median	High
Bogus Creek to Willow Creek	190.33-185.83	7,000	**9,800**	13,100	11,500	**15,900**	21,300
Willow Creek to Cottonwood Creek	185.23-182.95	7,700	9,800	13,100	12,500	17,200	22,900
Cottonwood Creek to Shasta River	182.95-179.17	5,900	8,400	11,300	9,700	13,800	18,400

Table 1. Bed mobilization flow requirements for the ten miles of river below Iron Gate Dam (Bogus Creek to the Shasta River). Mobilization flows reported in Reclamation (2011). River miles reported in Ayers (1999). Median discharge required for the first 4.5 miles downstream of Iron Gate Dam in bold for discussion purposes (see text).

The modeled hydrology for the period between 2011 and 2061 does not meet the flow threshold for a Significant Bed Mobilization flow (15,900 cfs) even once (Figure 5). As a result, the reaches downstream of Iron Gate Dam will suffer in their ability to recover from the harmful effects caused by sediment starvation and bed armoring over the past fifty years. Because neither the Proposed Action nor No Action Alternatives meet the geomorphic needs of the Klamath River downstream of Iron Gate Dam, additional flow management provisions will be required to ensure adequate geomorphic recovery. The additional coarse sediment provided by the upstream Iron Gate Reservoir will not be a benefit if there is not sufficient flow to mobilize it downstream over time.

Reclamation (2011) is incorrect when it concludes, "It is expected that the reach between Iron Gate and Cottonwood Creek will have improved habitat function under the Dam Removal Alternative than under the No Action Alternative." Reclamation (2011) bases this future-condition geomorphic assessment off the Slight and not Significant Mobilization threshold. Given a Slight Mobilization event will do little more than flush sand (as defined by Reclamation), we find this conclusion in error.

Reclamation (2011) also asserts that the return period for future sediment mobilization flows will decrease – sediment is predicted to mobilize more frequently. We also find this conclusion incorrect. Reclamation's (2011) model results for reach average D_{50} (coarse sediment) for the short distance between Iron Gate and Bogus Creek actually coarsens post-dam removal, while the Willow Creek to Bogus Creek reach does decrease in grain size slightly. The Cottonwood Creek to Willow Creek reach shows the greatest shift in grain size, but the Shasta to Cottonwood reach indicates no change in grain size. Given grain sizes for these reaches are not consistently (or significantly) trending downward, we find it dubious that the modeled return

period (for a Slight Mobilization event) would actually decrease, as predicted by Reclamation (2011) and the DEIS. Model results for the Significant Mobilization return period would have been far different, resulting in a longer return period likely only to be met during extreme flood conditions (i.e. 100-year floods).

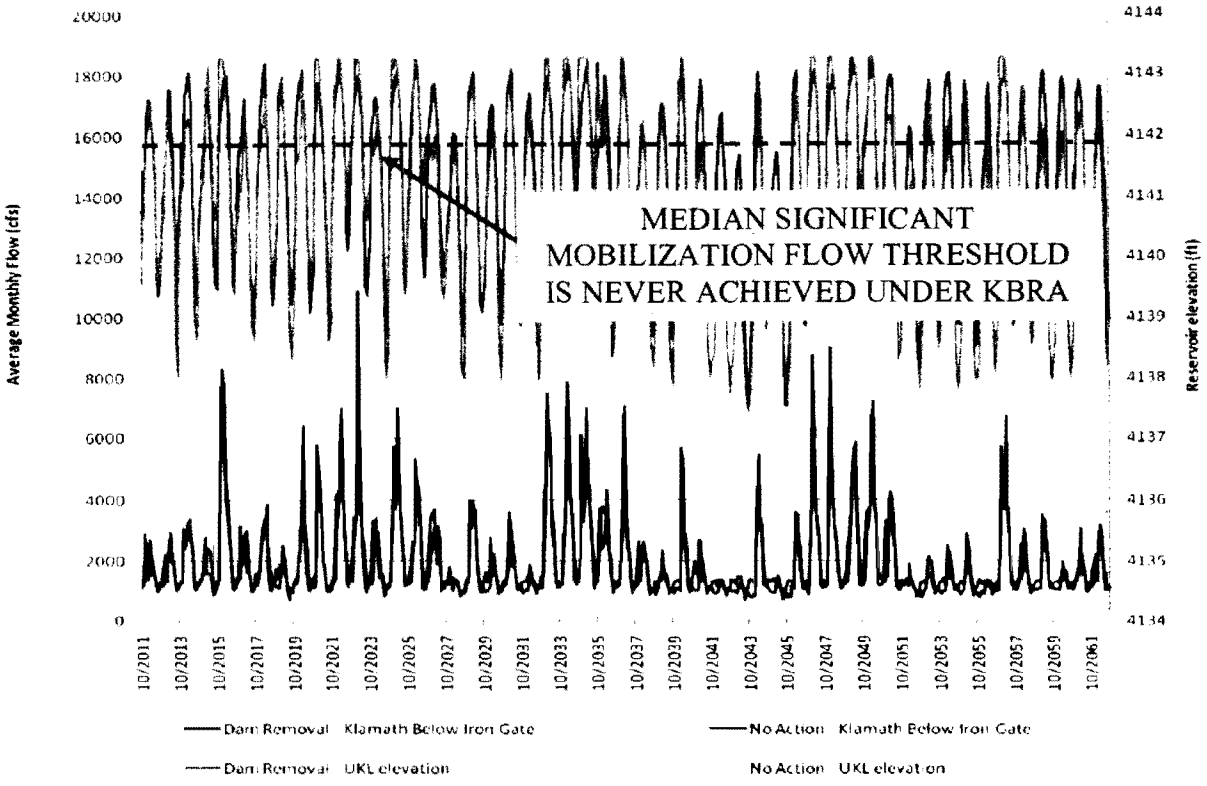


Figure 5. Modeled Iron Gate Discharge 2011-2061 contrasted with the median threshold (15,900 cfs) for Significant Bed Mobilization, which is never achieved. The low threshold for Significant Bed Mobilization (11,500 cfs) and the median threshold for Slight Bed Mobilization (9,800 cfs) is met only once in the fifty year forecast. Adapted from Reclamation (2011).

D. The Alternatives Analysis Is Inadequate Because It Fails To Evaluate A No-KBRA Alternative.

The EIS must evaluate an alternative of full Facilities Removal without execution or implementation of the KBRA. The omission of a Facilities Removal/No-KBRA alternative in the EIS renders it out of compliance with NEPA, because the No-KBRA alternative is both feasible and would be the alternative most likely to result in restoration of the fishery. Under this scenario, Klamath Hydroelectric Project dams would be removed, but diversions to the Klamath Reclamation Project would continue to be managed under currently applicable laws, such as the ESA, without the guaranteed diversions prescribed by the KBRA. The purpose of volitional

passage and a free flowing river would be achieved and the flows would continue to be managed for the fish first, and irrigation second.

It is clear that the failure to analyze a No-KBRA alternative violates NEPA and CEQA requirements. The No-KBRA is both a reasonable and a feasible alternative. The Department's own analysis concedes that the No-KBRA alternative would (i) remove dams to allow the river to flow freely; (ii) provide for full volitional fish passage; (iii) provide access to more of the watershed; (iv) create a free-flowing river, which would reduce quality concerns within existing reservoirs; and (v) is technically feasible. Final Alternatives Report, Section 4.2.8.

The DEIS contends that it is reasonable to not evaluate the no-KBRA alternative because that alternative "does not meet the purpose and need under NEPA." But, as stated above, it is improper to tie the KBRA to dam removal. The purpose of the EIS evaluation is to determine what is best for the fish and the health of the river. Agricultural subsidies and guaranteed irrigation diversions have little to do with that analysis. Also, the failure to evaluate a no-KBRA alternative deprives the decision-makers and the public of the information needed to determine if the no-KBRA alternative would better achieve the fishery and river-restoration goals, and without the need for $1 billion in subsidies, fundamental changes in existing law, and termination of tribal trust interests. The need to evaluate a no-KBRA alternative is especially important in light of the fact that the KBRA and KHSA require Congressional authorizations. Evaluation in this EIS of dam removal without the KBRA and its associated problems would assist the decision-makers in determining the best course of action.

E. The Alternatives Analysis is Inadequate Because It Fails to Evaluate a Federal Takeover Alternative.

The EIS must evaluate an alternative in which the Secretary does not render a Determination pursuant to the terms of the KHSA, but rather exercises authority to takeover the Klamath Hydroelectric Project pursuant to Section 14 of the Federal Power Act, 16 U.S.C. § 807 and/or supplemental Congressional authorization. Like the dam removal/no-KBRA alternative, this alternative would achieve the goals of volitional fish passage, improved water quality, and a free-flowing river without the harmful consequences and expense of the KBRA. The Final Alternatives Report, Section 4.2.13, contends that the Federal Takeover alternative is not superior to the Proposed Action because dam removal would occur on generally the same time-frame under both alternatives. There is no support for this statement. The KHSA artificially delays commencement of dam removal until 2020 or later solely to benefit the private hydropower licensee that has been operating on the terms of an expired 1950's era-license since 2006. There is simply no justifiable basis to allow PacifiCorp to continue its unmitigated operation of the Klamath Project for another decade. A federal takeover alternative, similar to that successfully implemented on the Lower Elwha River in Washington State, could disregard the KHSA terms solely designed to benefit the private licensee and commence dam removal years earlier for the benefit of the river and its resources.

F. The Alternatives Analysis Is Inadequate Because It Fails to Evaluate, or Even Consider Evaluation of the Water Quality Improvement Strategy Alternative Recommended by the Tribe in Scoping, or Any Alternative That Will Ensure Compliance With Hoopa Valley Tribe Water Quality Standards.

In its July 2010 scoping comments, the Tribe recommended evaluation of a Dam Removal/Water Quality Improvement Strategy alternative that would replace the KBRA measures with an alternative approach consisting of refilling Lower Klamath Lake using Lost River winter water, somewhat expanding the footprint of Tule Lake, and restoring riparian zones along the entire lower Lost River and Keno Reach of the Klamath River. The Tribe's scoping comments referenced the Klamath Basin Trial Water Quality Work Group comments on the Klamath River TMDL, found at http://www.schlosserlawfiles.com/~hoopa/LostRiverTMDL.pdf. The DEIS fails to address this proposed alternative or provide any explanation for why it was not evaluated.

The DEIS, as drafted, fails to evaluate any alternative that will result in full compliance with Hoopa Valley Tribe water quality standards. Section 3.2 notes the existence of applicable water quality standards enacted by the Hoopa Valley Tribe, but fails to adequately address whether the Proposed Action of dam removal with associated implementation of KBRA flows, (or some other alternative) will ensure compliance with the tribal standards. We attach the Patrick Higgins, "KHSA and KBRA Likelihood of Meeting Hoopa Valley Tribe Klamath River Water Quality Standards" (October 6, 2011), which details this problem. In fact, certain statements in the EIS confirm that the Proposed Action will continue to result in violations of Hoopa standards. *See* page 3.2-103 (stating that Total Nitrogen (TN) levels will continue to exceed Hoopa objectives).

G. The Alternatives Analysis Is Inadequate Because It Fails to Evaluate Any Alternatives to the KBRA.

The proposed action assumes that the KBRA will be executed and implemented. The proposed action assumes that the KBRA is an interdependent component of a comprehensive program to restore the Klamath River. Yet, in addition to failing to consider an alternative in which dams are removed without the KBRA, the DEIS also fails to consider or evaluate any substantive alternatives to the KBRA. The execution of the KBRA, as argued throughout these comments, is a major federal action with significant known environmental impacts. The failure to fully evaluate the impacts of, and alternatives to, the KBRA is a violation of NEPA.

Assertions that the impacts of the KBRA will be evaluated at a later time are incorrect given the non-discretionary nature of many of those programs, such as the diversion guarantees. In addition, the proposed legislation attached as an Exhibit to the KBRA and KHSA would exempt the KBRA execution from NEPA review. Of course, that legislation has not been enacted (or even introduced) and thus the Department has a currently binding obligation to review the KBRA under NEPA. The public, Congress, and decision-makers in the Department must receive the benefit of a thorough alternatives analysis which considers the pros and cons of the KBRA and whether there are alternative approaches that would achieve the river restoration goals with less impact.

IV. The EIS Fails to Evaluate the Impacts of the Proposals for Legislation, Which Are An Express Prerequisite of the KBRA and KHSA.

NEPA requires that federal agencies prepare an environmental impact statement for "every recommendation or report on proposals for legislation . . . significantly affecting the quality of the human environment." 42 U.S.C. § 4332(C). In this case, the action being analyzed is specifically tied to and dependent on enactment of federal legislation containing specific elements proposed by the Department and other parties to the KHSA and KBRA. Pursuant to Section 3.3.4 of the KHSA, the Secretary will be barred from rendering any determination on dam removal unless Congress first enacts "federal legislation, which . . . is materially consistent with Appendix E [of the KHSA]." Appendix E of the KHSA is entitled "Elements for the Proposed Federal Legislation" and contains a detailed list of specific proposed elements for legislation related to both the KBRA and the KHSA. Even if the Secretary determines that dam removal is clearly in the public interest, will restore fisheries, and provide for a free-flowing river, the Secretary cannot, consistent with the KHSA, make any public determination about the benefits of dam removal unless the proposed legislation is enacted.

There are significant environmental consequences that will flow from the enactment of the KHSA and especially the KBRA that require complete analysis in the EIS. Of most significance are the effects associated with the guaranteed minimum diversions of the KBRA, the impacts of the $1 billion in subsidies that encourage unsustainable agricultural practices, impacts on the Trinity River Restoration Program, and the historic termination of tribal trust rights. Given that the enactment of the proposed legislation is a direct prerequisite to the Secretary's determination in this proceeding, the EIS must fully evaluate the impacts associated with the proposals for legislation that would authorize implementation of the KHSA and KBRA.

The proposed legislation, and execution of the KBRA, would also undermine enforcement and compliance with the Endangered Species Act. Although the EIS repeatedly states that the KBRA programs, and the irrigation diversions by the Klamath Reclamation Project, would need to comply with the ESA, this is clearly inconsistent with the text of the KBRA, which is designed to constrain NMFS and USFWS ability to protect threatened and endangered species. *See* KBRA, Sections 21.3.1 and 22.4. The objective of the parties under the KBRA is that reductions in flows to irrigators below those prescribed in the KBRA "will be a last and temporary resort to prevent jeopardy under the [ESA]." KBRA, § 21.3.1.B.ii.c. This objective is plainly inconsistent with the science (which shows flow to be the most significant factor affecting fish health) and the law (which mandates that the agencies protect endangered and threatened species based on the best available science).

Since Congress is not limited by the terms of the KBRA and KHSA, an EIS that accurately and completely describes and evaluates the full suite of reasonable and feasible alternatives, including a dam removal/no-KBRA alternative and a federal takeover and decommissioning alternative, is critical.

V. The DEIS Fails To Adequately Evaluate and Disclose the Impacts of the KBRA, and Overstates Its Potential Benefits, Precluding Informed Public Participation and Decision-Making.

The DEIS states that the KBRA is a connected action requiring analysis under NEPA. It is true that the KHSA and KBRA have been drafted as interdependent components of a larger plan relating to Klamath Basin restoration. Although the DEIS states that the KBRA is a connected action, the DEIS then fails to adequately describe or evaluate its impacts. Even if the KBRA is evaluated at a more general, programmatic, level, the EIS still must evaluate those aspects of the KBRA that have known or foreseeable impacts, in addition to any components that will not be evaluated under NEPA in the future. Describing the KBRA as "programmatic" does not excuse the Department from actually evaluating the known impacts of the KBRA that are ripe for evaluation.

Some of the key elements of the KBRA that are not adequately described and evaluated are the minimum guaranteed water diversions, the potential impacts on the Trinity River Restoration Program, and the unconsented subordination and waiver of trust obligations relating to tribal water rights. There will not be any future NEPA analysis of the impacts of the guaranteed water diversions because implementation of those diversions will be non-discretionary; therefore, a full analysis must occur now prior to approval and execution of the KBRA. The DEIS also improperly assumes that the various fisheries restoration and other programs are likely to occur when, in fact, those programs depend entirely on funding from Congress that is unlikely to materialize. In summary, the impacts of the KBRA are either not evaluated or minimized, while the benefits of the KBRA are made to appear more certain than they actually are. The public and decision-makers need to be made aware that approval of the KBRA could result in a scenario in which dam removal occurs, but there is insufficient water left in the river for fish to survive and the promised programs for fisheries fail to materialize.

Due to the need for substantial Congressional appropriations, the purported benefits of the KBRA are highly speculative, especially in today's political climate. The DEIS fails to adequately discuss the likely scenario in which the purported benefits from the KBRA are not achieved due to lack of Congressional funding. The KHSA and KBRA were signed in early 2010 and their implementation expressly depends on the enactment of federal legislation. Yet, we now approach the end of 2011 with no legislation even introduced. With good reason, there simply is not support from any member of Congress to propose spending nearly $1 billion on needless subsidies for unsustainable agricultural practices. Nor is there support in Congress to introduce legislation that unilaterally terminates Indian trust obligations. The DEIS needs to more fully explain that the purported environmental benefits of the KBRA are highly speculative and may not ever occur to offset the impacts of the guaranteed diversions for irrigation.

Even if funding does occur, the DEIS fails to adequately explain that the KBRA does not contain any fish restoration goals. It establishes no target salmon sizes or harvest goals. The KBRA simply calls for funding without any definition of success. The failure to connect the funding to any defined performance measures is likely another obstacle to obtaining Congressional funding in the current economic and political environment.

Numerous sections of the EIS require additional comprehensive discussion of the impacts of the KBRA on water, aquatic resources, and tribal trust rights, especially including Sections 3.2 (water quality), 3.8 (water supply/water rights), 3.12 (tribal trust) and 3.16 (environmental justice). These sections fail to openly disclose the negative consequences that will result from the KBRA's guaranteed minimum diversions and un-consented subordination of tribal trust rights, presenting only a one-sided view of the KBRA to the public and decision-makers.

VI. The DEIS Fails To Disclose That Execution and Implementation of the KBRA Would Result in a Historic Termination of the United States Trust Relationship With Klamath Basin Indian Tribes With Respect to Protection of Reserved Water and Fishing Rights and Would Unlawfully Result in an Un-consented Subordination of Senior Tribal Water Rights to Junior Water Rights of Non-Indian Irrigators.

In the KBRA, the United States provides assurances, without the consent or approval of the Hoopa Valley Tribe, that the United States will not assert the Hoopa Valley Tribe's tribal water, fishing, or trust rights, in a manner that will interfere with the Klamath Reclamation Project's annual diversion of 330,000 acre-feet of water from the Klamath River (the "Assurances"). These Assurances in favor of the Klamath Reclamation Project, once effective, are permanent regardless of: (a) whether federal appropriations are provided for anticipated fishery restoration and reintroduction programs; (b) the success or failure of anticipated fishery restoration and water quality improvement efforts; (c) future effects of climate change, or other environmental conditions, on water quality and quantity in the Klamath River; (d) the future fishery harvest needs of the Hoopa Valley Tribe; or (e) other unknown or unforeseeable events.

The Assurances in the KBRA effectively terminate the United States' fiduciary obligation to the Hoopa Valley Tribe by permanently subordinating the Tribe's senior water and fishing rights in the Klamath River to junior non-Indian irrigation interests in the Upper Klamath Basin, regardless of future impacts on tribal trust resources, and without the consent or approval of the Hoopa Valley Tribe. The Assurances become permanent if the Klamath dam facilities are removed pursuant to an Affirmative Secretarial Determination.

Although this issue has been a highly publicized area of controversy, the Draft EIS fails to mention it. Section 3.12 purports to discuss impacts on tribal trust resources. Yet, that section says nothing about the fact that the United States, in the KBRA, has agreed to subordinate tribal water rights to junior irrigation interests. Section 3.12 asserts that the Hoopa Valley Tribe will be eligible for KBRA funding "upon becoming a party" but fails to mention that the Tribe would be required to enact claim waivers and take other acts inconsistent with its trust resources in order to obtain those "benefits." The DEIS fails to mention that the Tribal Council of the Hoopa Valley Tribe enacted a resolution in February 2010 that finds in relevant part:

> WHEREAS: The Assurances in the *Klamath Basin Restoration Agreement* effectively terminate the United States' fiduciary obligation to the Hoopa Valley Tribe by permanently subordinating the Hoopa Valley Tribe's senior water and fishing rights in the Klamath River to junior non-Indian irrigation interests in the Upper Klamath Basin, regardless of future impacts on tribal trust resources, and without the consent or approval of the Hoopa Valley Tribe; and

> WHEREAS: The Assurances in the *Klamath Basin Restoration Agreement* conflict with the National Congress of American Indians (NCAI) Resolution #PSP-09-051 (October 2009), and Affiliated Tribes of Northwest Indians (ATNI) Resolution #09-63 (September 2009) in which the NCAI and ATNI each resolved to oppose "any policy of the United States to terminate the rights of, or impose adverse consequences upon, a tribe that chooses to retain its water rights instead of settling on terms desired by the federal government"; and
>
> WHEREAS: The *Klamath Basin Restoration Agreement* requires the Hoopa Valley Tribe, as a condition of the Tribe's participation and receipt of funding and benefits in the Agreement, to relinquish and release claims against the United States relating to water management in the Klamath Basin and associated impacts on Hoopa Tribe water, fishing, and trust rights; and . . .
>
> WHEREAS: The *Klamath Basin Restoration Agreement* thus conflicts with tribal sovereignty, violates trust duties owed to the Hoopa Valley Tribe by the United States; subordinates tribal water and fishing rights in favor of junior non-Indian irrigation interests without tribal consent; provides inadequate flows for the protection of tribal trust resources; offers a speculative and unfunded program for fishery restoration and water conservation; encourages unsustainable use of groundwater in the Upper Klamath Basin; and is not based on the best available, peer reviewed science; and . . .
>
> NOW, THEREFORE BE IT RESOLVED: The Hoopa Valley Tribal Council, acting under its sovereign authority on behalf of the Hoopa Valley Tribe, hereby rejects, opposes, and disapproves of the *Klamath Basin Restoration Agreement* and the *Klamath Hydroelectric Settlement Agreement* . . . .

If the priority given by the KBRA to Klamath River surface diversions has the effect of preventing fish restoration (which is likely), the United States will not only be unable to protect Indian fishing rights under the terms of the KBRA, but it will be legally required to defend the irrigation interests against the tribes and trust resources. In other words, the United States would be enforcing the priority for water diversions even if that leaves too little water to restore the fish on which the Indian tribes rely. By contrast, under existing law "Reclamation is obligated to ensure that project operations not interfere with the Tribes' senior water rights. This is dictated by the doctrine of prior appropriation as well as Reclamation's trust responsibility to protect tribal trust resources. . . . Reclamation must, pursuant to its trust responsibility and consistent with its other legal obligations, prevent activities under its control that would adversely affect [the Tribes' fishing] rights." Memorandum of Regional Solicitor (July 25, 1995). The KBRA would preclude the trustee United States from preventing such adverse effects to tribal trust resources. The KBRA changes the tribal right (enforceable by the federal trustee) from a right to sufficient water to produce the fish on which the Tribes rely, into a right to water left over after diversion per Appendix E-1 of the KBRA, regardless of what the habitat results may be. The effect is thus similar to termination provisions such as the one for the Klamath Tribes of Oregon, which provided "statutes of the United States which affect Indians because of their status as Indians shall no longer be applicable to the members of the Tribes." 25 U.S.C. § 564q(a). The

KBRA will abridge the Government-to-Government relationship between the United States and the Hoopa Valley Tribe.

In the DEIS, the public and decision-makers learn nothing about the impacts on Hoopa Valley Tribe's trust rights and resources. The Executive Summary asserts that there are no impacts to tribal trust flowing from the Proposed Action. This is patently false. The DEIS simply accentuates the "positives" in order to promote the KBRA and KHSA in accordance with the interests of the Department, while setting aside the anticipated termination and subordination of tribal trust rights. This also implicates environmental justice impacts. The failure to properly and fully disclose the impacts to the Tribe's rights results in an unlawfully deficient EIS.

VII. Conclusion.

The Tribe supports dam removal; however, the linkage of dam removal to the KBRA will result in non-achievement of the desired fish restoration goals. Thus, the Tribe requests that the EIS evaluate alternatives that do not include execution and implementation of the KBRA. We thank you for your consideration to these comments. We will continue to work with the Department to achieve a solution that will protect the Trinity River, restore the Klamath fishery, remove the dams of the Klamath Hydroelectric Project, and preserve Hoopa water and fishing rights.

Sincerely,

HOOPA VALLEY TRIBAL COUNCIL

Leonard E. Masten, Jr., Chairman

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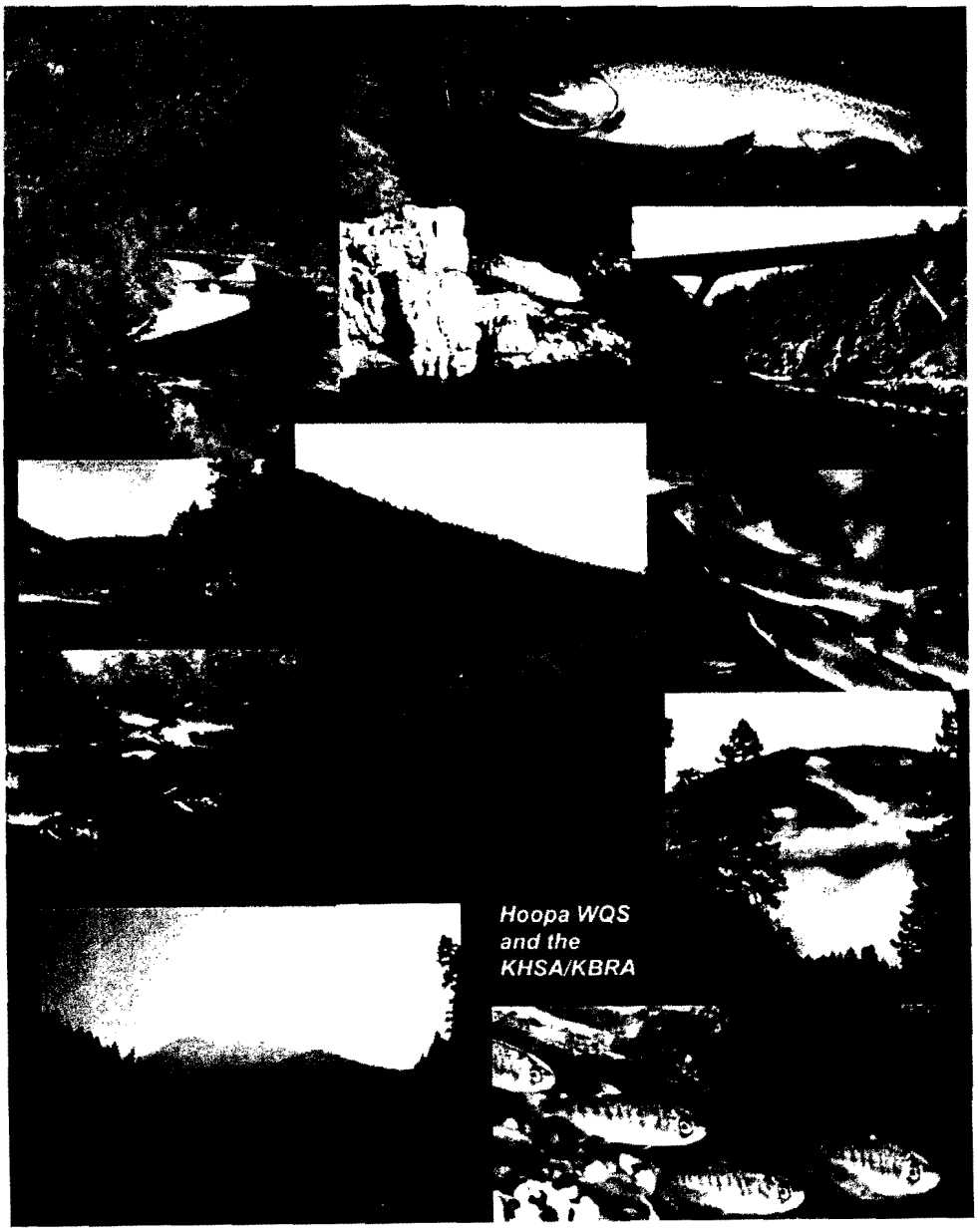
KHSA and KBRA Likelihood of Meeting Hoopa Valley Tribe Klamath River Water Quality Standards



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Prepared for:
Hoopa Tribal Environmental Quality Agency

October 6, 2011

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Foreword

The purpose of this report is to provide the following information for the Hoopa Tribal Environmental Protection Agency (TEPA) in response to their request:

- Provide a clear over view of whether water quality management under the Klamath Hydropower Settlement Agreement (KHSA) and Klamath Basin Restoration Agreement (KBRA will attain Hoopa Valley Tribe (2008) Klamath River Water Quality Standards (WQS),

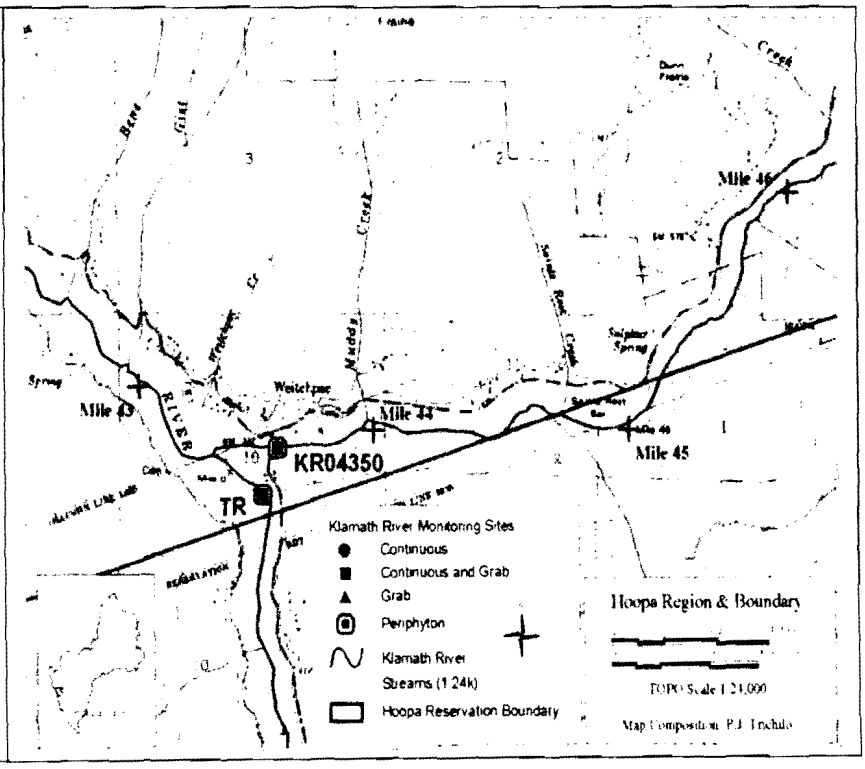
- Provide recommendations for exercising the Hoopa Valley Tribe's WQS authority under the KHSA/KBRA water quality management process, and

- Identify options other than the KHSA/KBRA for the Hoopa Valley Tribe that achieve dam removal.

These are section headers in the report below, but sections on the origin of the KHSA/KBRA and using ecological restoration to attain Hoopa WQS are also included.

The Hoopa Indian Reservation includes a segment of the mainstem Klamath River just upstream of its confluence with the Trinity River (Figure 1 at right).

Hoopa Valley Tribe water quality authority that allows them to create water quality standards (WQS) for the Klamath River is based on U.S. EPA (2002) approval.



Origin of the KHSA and KBRA

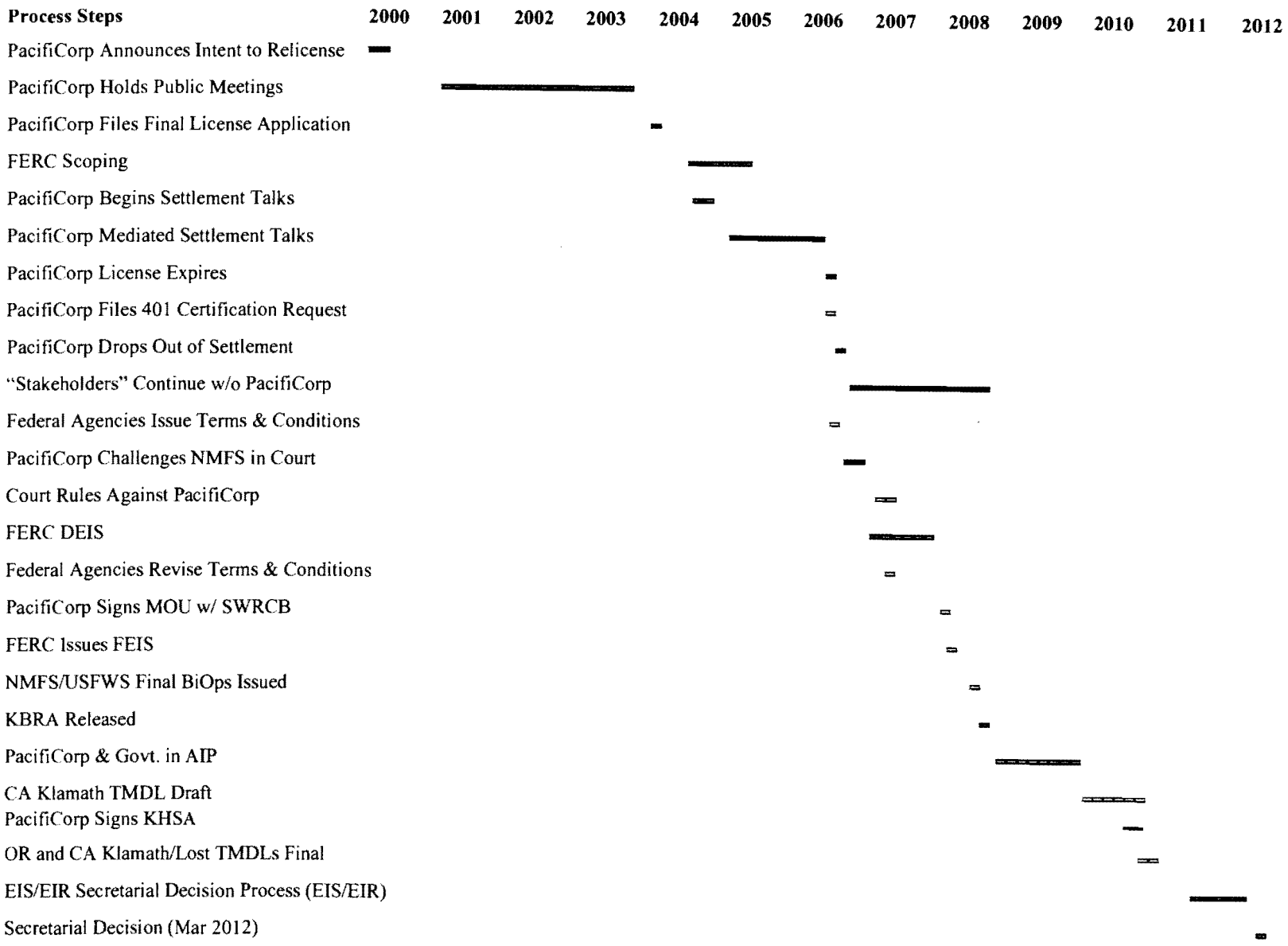
The KHSA is a negotiated settlement in lieu of following the Federal Energy Regulatory Commission (FERC, 2007) relicensing process for the Klamath Hydroelectric Project (KHP) (FERC #P-2082). The KHP is owned and operated by PacifiCorp and the company has pursued settlement because the outlook of their relicensing process did not look favorable (Brockbank 2010). The deposition of PacifiCorp Executive Vice President Dean Brockbank (2010) supplies much of the information in this section about the chronology of settlement talks (see also Alternatives for KHP Dam Removal).

PacifiCorp first announced its intention to relicense the KHP in December 2000 and held a series of public meetings before filing its Final License Application in February 2004. Table 1 provides a time line that chronicles steps in relicensing, other processes that have bearing on relicensing (i.e., 401 certification) and KHSA and KBRA development. Red highlights in the table indicate unfavorable components of relicensing of the KHP from PacifiCorp's perspective. In particular, PacifiCorp was apprehensive about obtaining necessary State water quality certification (SWRCB 2007) and the cost of fish passage facilities for Pacific salmon species mandated by the National Marine Fisheries Service (NMFS 2006).

PacifiCorp began informal settlement talks in October 2004 that became a "mediated" settlement in January 2005. The settlement process took over five years to complete and ironically PacifiCorp dropped out of talks in mid-2006 as other "stakeholders" crafted the KBRA. The Energy Policy Act of 2005 (Public Law 109-58) allowed entry into settlement at any time within the licensing process for PacifiCorp. This new law also allowed PacifiCorp to challenge NMFS' authority to require KHP fish passage but their challenge was rejected by an administrative law judge (McKenna, 2006). PacifiCorp's KHP license expired on March 1, 2006 and FERC has been issuing 1 year extensions since. The company reengaged with state and federal agencies regarding potential decommissioning through an Agreement in Principal (AIP) in July 2008 (CA, OR, USDOI and PacifiCorp 2008) that was superseded by their signing the KHSA in February 2010. PacifiCorp is not a signatory to the KBRA, but all Parties signing the KBRA also signed the KHSA.

The creation of the KBRA involved dozens of meetings spanning several years, all behind closed doors with participants bound by a confidentiality agreement. Although the process involved several counties, Tribes, environmental organizations and government agencies, key participants were excluded from participation, including Del Norte County and the federally recognized Resighini Rancheria and the Quartz Valley Indian Reservation. The Hoopa Valley Tribe participated in the Settlement, but declined to sign the final KBRA or KHSA because they would require giving up water rights and the ability to take legal action to abate water quality problems to protect fisheries (KBRA 15.3.9). The KBRA and KHSA are arcane documents written by lawyers with tedious cross references and a myriad of contradictions. Ultimately important decisions regarding public trust and Indian Treaty Rights and Trust responsibilities are embodied in these documents that were made out of public view and excluded legitimate stakeholders.

Table 1. Time Line for Klamath Settlement Process



In April 2007 during the Settlement that preceded the KBRA, Klamath Project irrigators made an ultimatum with regard to their continuing participation; any Settlement would have to include farming in the Lease Lands of Tule Lake and Lower Klamath National Wildlife Refuges. Oregon Water Watch (OWW 2010) and Oregon Wild (OW) were expelled from Settlement talks because they would not agree to this condition. Talks continued without OWW and OW, but their expulsion sent a clear message and restricted subsequent consideration of viable ecological restoration options under the KBRA.

Although the KBRA is separate from the KHSA and deals with issues largely unrelated to KHP relicensing, the agreements are intertwined due to KBRA (7.2.1 C) and KHSA (8.1) "severability" clauses that state that neither can be implemented separately. Therefore, both the KHSA and KBRA are discussed below with regard prospects of meeting Hoopa TEPA (2008) WQS. The *Klamath River and Lost River Total Maximum Daily Load (TMDL)* (NCRWQCB 2010) and *Upper Klamath and Lost River TMDL and Water Quality Management Plan* (ODEQ 2010) are integral to improving water quality, so their potential to improve conditions is also considered.

KHSA and KBRA Actions Insufficient to Meet Hoopa TEPA WQS

The KHSA has to do with dam decommissioning and pollution associated with KHP operation while the KBRA would deal with fishery restoration and potential remediation of water quality problems. Both the KHSA and KBRA will require federal authorizing legislation, including $1 billion or more in funding. Legislation has not been passed. Pollution associated with KHP dam operation will continue under the KHSA until 2020, but there is also a question as to whether measures taken under the KBRA after dam removal will be sufficient to abate nutrient pollution and meet Hoopa TEPA (2008) WQS. Interim Measures to abate water quality problems under the KHSA are pertinent to the Klamath River TMDLs and are discussed in that section below. Table 2 lists beneficial uses recognized by the NCRWQCB (2007) *Basin Plan* and Hoopa TEPA (2008) and their likelihood of being met under the KBRA/KHSA before and after 2020.

Table 2. Likelihood of meeting Klamath River beneficial uses under the North Coast Basin Plan (NCRWQCB 2007) or Hoopa TEPA (2008) WQS before and after 2020 under the KBRA/KHSA. Green indicates beneficial uses are restored and red indicates that they are not.

Beneficial Use	Key	Before 2020	After 2020
COLD	Cold freshwater habitat		
SPAWN	Fish spawning		
MIGRATION	Fish migration		
RARE	ESA and CESA Fish		
COMM	Commercial & Sport Fishing		
FISH	Subsistence Fishing		
CUL	Cultural Use		
REC-1	Recreational Contact		
REC-2	Recreational Boating		

KHSA

The KHSA does not directly call for KHP dam removal but rather sets up a March 2012 Secretary of Interior Decision as to whether decommissioning is in the public interest and will benefit the environment, including Klamath River native fish species. A major effect of the KHSA is to delay the 401 processes of California (PacifiCorp 2008, SWRCB 2008) and Oregon that had the potential to force expeditious dam decommissioning (Brockbank 2010), if either State withheld certification. The serious nuisances caused by KHP reservoirs is justification for swift dam removal (SWRCB 2007), but instead under the KHSA the project will operate until 2020 on a year to year extension of its 1956 FERC license (Brockbank 2010). Numerous problems have been identified with regard to KHP operation that lead to major negative impacts on salmonids and other beneficial uses (Hoopa TEPA 2008), and to a large extent these cannot be mitigated without dam removal (SWRCB 2007, FERC 2007).

Fish Passage: Fish passage for anadromous species is considered as part of the COLD beneficial use according to the SWRCB (2007), and migration for Pacific salmon species (MIGR) will continue to be blocked until at least 2020 under the KHSA and KBRA (see Alternatives for Dam Removal). Coho salmon that are affected by the KHP are listed as Threatened under the federal Endangered Species Act (ESA); therefore, the RARE beneficial use is also compromised. The impediment to migration also continues to compromise the commercial and sport fishing beneficial use (COMM) and tribal subsistence fisheries (FISH).

Thermal Problems Created by Iron Gate Reservoir: The mass of water within Iron Gate Reservoir creates thermal problems that delay Chinook salmon spawning (SPAWN) in fall and impair juvenile rearing conditions (COLD) in spring. This will continue until drawdown of the reservoir or Iron Gate Dam removal. Klamath River fall temperatures remain above suitable for spawning three weeks later than if the river were free flowing (Figure 4). The KBRA Chinook Expert Panel (Goodman et al. 2011) noted high "pre-spawning mortality documented in the mainstem river may be related to high water temperature and moderately low dissolved oxygen", which are both side effects of reservoir operation. Increased fall water temperatures and associated stress are also likely to reduce fecundity. Fry from eggs laid later in the season emerge later in spring and their growth is then suppressed by artificially depressed Klamath River temperatures. Smaller fry migrate more slowly as the Klamath River water temperature rises and water quality becomes adverse. With their resistance compromised by water quality related stress, these fish also face much greater exposure to the disease organisms (see below). The thermal lag at Iron Gate appears to have shifted spawn timing of fall Chinook later and the losses of juveniles are sometimes in the hundreds of thousands (USFW 2001, Nicholas and Foott 2005). While temperature effects of Iron Gate Reservoir do not extend downstream to the Hoopa Reservation, maintaining Iron Gate Dam through 2020 leads to unacceptably high risk to the Klamath River fall Chinook population. Continued depressed Chinook populations blocks attainment of commercial and sport fishing (COMM) and tribal subsistence fishing (FISH) beneficial uses.

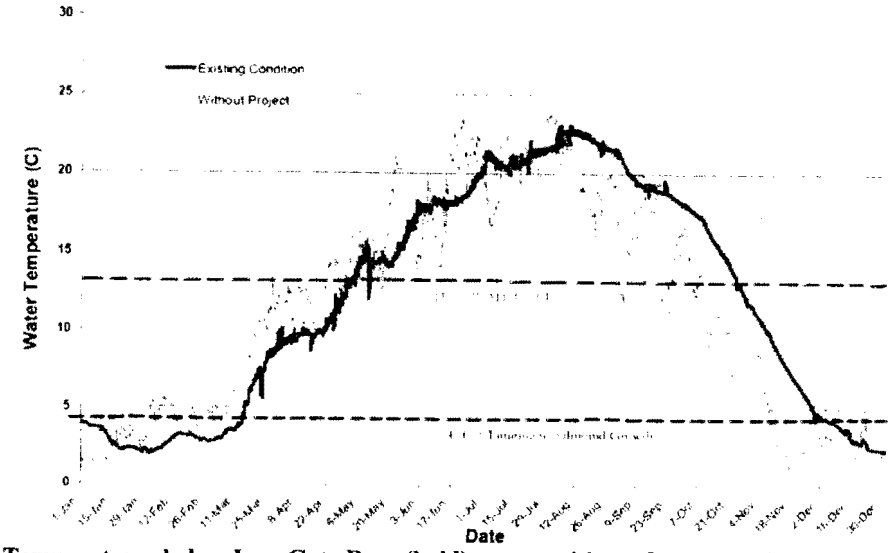


Figure 2. Temperatures below Iron Gate Dam (bold) versus without dam scenario (grey). Warmer fall temperatures create a three week lag for suitability of spawn timing and rearing temperatures remain below optimal for a month. Reference thresholds from U.S. EPA (2003).

Fish Disease Cycles: One of the main impediments to restoring COLD, COMM, RARE and FISH beneficial uses of Pacific salmon in the Klamath River, particularly Chinook salmon and coho salmon, is the extremely high prevalence of disease organisms below Iron Gate Dam (Foott et al. 2003, Stocking and Bartholomew 2004, Nichols and Foott 2005, Nichols and True 2007, Nichols et al. 2008, Bartholomew 2008, Stocking et al 2006, Stone et al. 2007). Two myxozoan disease organisms, *Ceratomyxa shasta and Parvicapsula minibicornis*, are endemic to the Klamath River and the Pacific salmon species have co-evolved with them and have developed substantial resistance. However, nutrient enrichment from the Upper Klamath Basin and from within Iron Gate Reservoir sets up conditions that cause extraordinarily high production of disease organisms that can overwhelm otherwise healthy fish (Nichols and Foott 2005).

The green algae species *Cladophora* is recognized as an indicator of nutrient pollution and there are areas below Iron Gate Dame where this species is dominant (Stocking et al. 2006). A polychaete worm, *Manayunkia speciosa*, which thrives in Cladophora beds also serves as an intermediate host for the deadly diseases. Fall Chinook spawning is concentrated below Iron Gate Dam and adults carry myxospores that cause a vicious cycle as *M. speciosa* captures them and then releases actinospores when Chinook juveniles are migrating downstream (Stocking et al. 2006, Bartholomew 2008). Stocking et al. (2006) concluded that actinospores remain viable during the 5 days required for water to pass from Iron Gate Dam to the Klamath estuary. Therefore, it is likely that disease problems will continue for fish migrating through the Hoopa Reservation portions of the Klamath River until at least 2020. Disease effects can extend downstream of the Trinity River and there indications of major impacts to juvenile Chinook from that river (Figure 3); therefore, Hoopa Valley Tribe Trinity River fish harvest is also directly impacted.

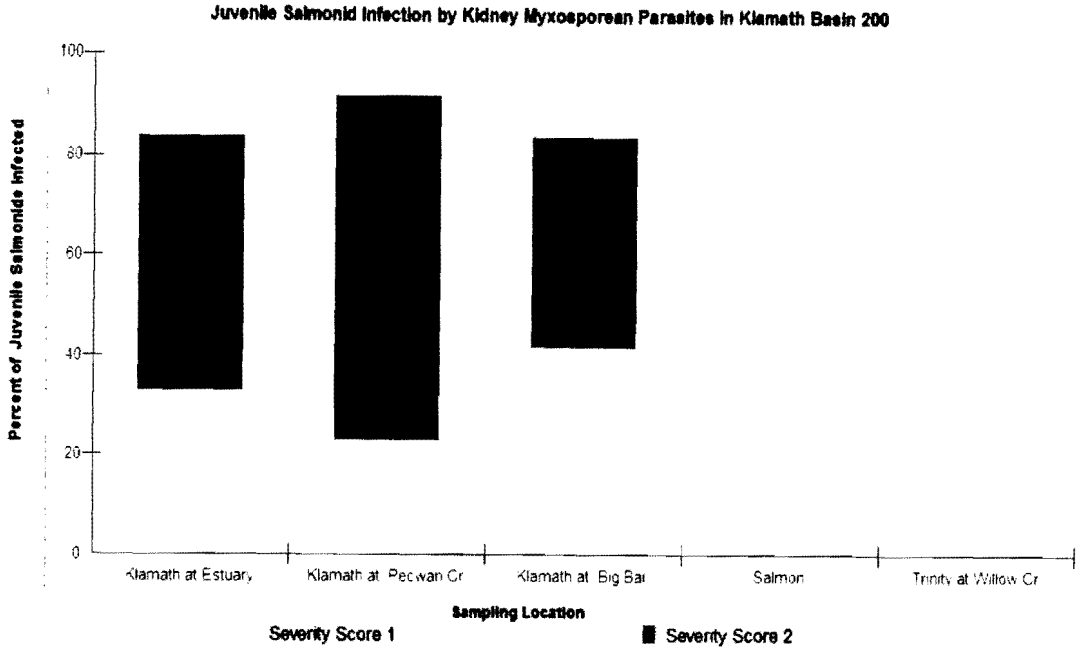


Figure 3. Chart shows the percentage of juvenile salmonids infected by kidney myxosporean parasites. High severity (2) score indicates likely mortality. While Trinity River infection is low, Pecwan and estuary high disease incidence suggests Trinity fish are becoming infected. Most of the juvenile salmonids sampled were Chinook salmon. Data from Foott et al. (2003).

Water Quality Stress: Fish susceptibility to disease is a function of cumulative stress caused by multiple water quality factors (Hoopa TEPA 2008). In addition to temperature, impairment below Iron Gate Dam can include elevated pH, algal toxins and dissolved ammonia as well as depressed dissolved oxygen (D.O.), all of which are linked to KHP dam operation (SWRCB 2007, FERC 2007). These conditions will continue to cause impairment until at least 2020 as a result of KHP operation and lack of attainment of the COLD, FISH, COMM, and RARE beneficial uses. The manifestation of nutrient pollution and associated problems for fish health may remain after dam removal, but that prospect is more fully explored under the KBRA section below.

Toxic Algae: Kann (2006) found the toxic algae species *Microcystis aeruginosa* to be prevalent within Copco and Iron Gate reservoirs but in low abundance or absent from the outlet of Upper Klamath Lake to below J.C. Boyle Reservoir within the Klamath Project. The SWRCB (2007) points out that there is little chance for remediation of toxic algae in the lower two KHP reservoirs before 2020; therefore, NCRWQCB (2011) staff do not recommend PacifiCorp carry out Interim Measures within the reservoirs aimed at treating algae problems (see TMDL discussion).

Kann and Corum (2009) found evidence of *Microcystis* downstream at Orleans and samples from the Yurok Reservation indicate it is present downstream to the estuary (Yurok 2009). Kann (2008) also reported bioaccumulation of microcystin toxin in Iron Gate Hatchery Chinook salmon juveniles. Yellow perch from Copco and Iron Gate

Reservoirs and mussels downstream of the KHP had such high levels due to bioaccumulation that they would pose a human health risk, if consumed. Emerging epidemiological evidence suggests that the substance BMAA (beta-methylamino-L-alanine) that is prevalent in toxic blue-green algae species may be linked to neurological disorders, such as Amyotrophic Lateral Sclerosis (ALS) (Lou Gehrig's disease), Parkinson's disease and Alzheimer's disease (Caller et al. 2009). Impairment of Hoopa Reservation waters on the Klamath River from toxic algae will continue through at least 2020 with the recreational (REC-1) beneficial use compromised and ceremonial use (CUL) in certain seasons inadvisable.

Keno Reservoir Operation: The KHSA (7.5.4, 7.5.5) stipulates that the U.S. Bureau of Reclamation (BOR) will assume ownership of the Keno Reservoir and will continue to operate it in the same way that PacifiCorp has since 1968. Keno Reservoir has major problems with seasonal anoxia (Deas and Vaughn 2006, Sullivan et al. 2009, 2010) and riparian marsh restoration needed to combat this problem will, therefore, be prevented. Historically a lava bedrock sill at the location of Keno Dam caused the Klamath River to back up and form a vast connected wetland with Lower Klamath Lake. Diking off of wetlands and farming up to the margin of the reservoir has disrupted river processes that could otherwise assist with nutrient processing and reduction, similar to the findings of Bernot and Dodds (2005). Dredging of the reservoir to increase water storage capacity circa 1968 likely contributed to a decreased ability for ecological function and an increased propensity for anoxia.

Goodman et al. (2011) call attention to persistent problems of prolonged anoxia in Keno Reservoir (Figure 4) that they believe will not be alleviated under the KBRA. Figure 5 shows a map from PacifiCorp (2004) of riparian vegetation of the Keno Reservoir just above Keno Dam and Figure 6 is an aerial photo of the same area showing the pattern of land use. Continuing this land use and pattern of operation of Keno Reservoir under the KHSA will prevent improved ecosystem function by riparian marshes that could otherwise assist with clean up of nutrient pollution (Lytle 2000, Mayer 2005).

The ODEQ (2010) TMDL found that the suspended load from Upper Klamath Lake is a major driver of anoxia in Keno Reservoir; however, they also found the waste load from the Straits Drain to be a major source of pollution. ODEQ (2010) provided a schematic of flow diversions from the Klamath River and flow contributions to Keno Reservoir (Figure 7). Waste water from the Klamath Straits Drain in August 2002 constituted 48% of flows to the reservoir, which is similar to NRC (2004) findings. The Lost River and Tule Lake were originally a sink and did not discharge into the Klamath River; therefore, the high level of nutrients contributed by them today help push the river past the tipping point where ecosystem processes are insufficient for the river to clean itself. This results not only in anoxia within the Keno Reservoir but also in very adverse water quality impacts in the lower Klamath River.

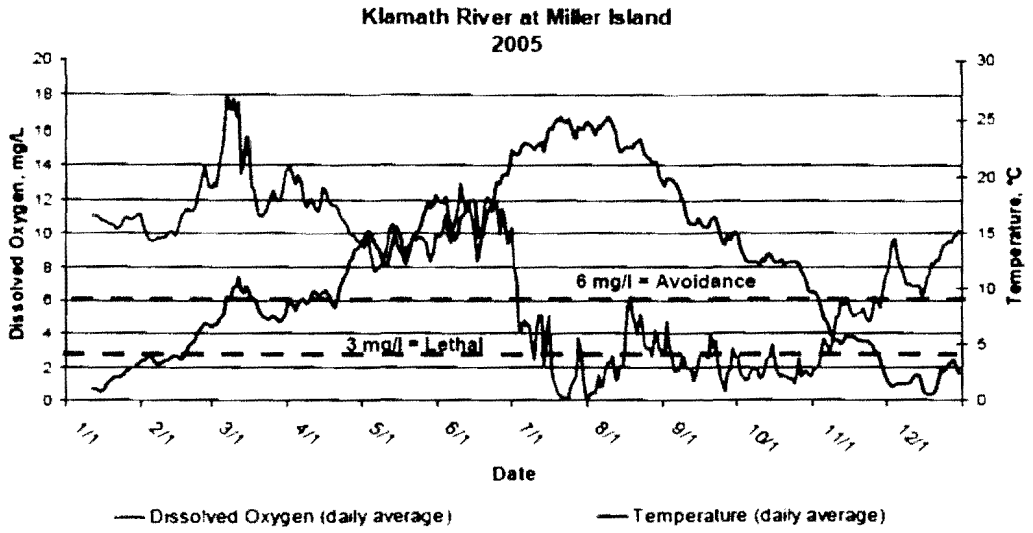


Figure 4. This chart shows fluctuations of water temperature and dissolved oxygen in Keno Reservoir in 2005 with lethal levels extending from July through October. Taken from Goode et al. 2011 where it appears as Figure 4. Threshold reference annotations added based on WDOE (2002).

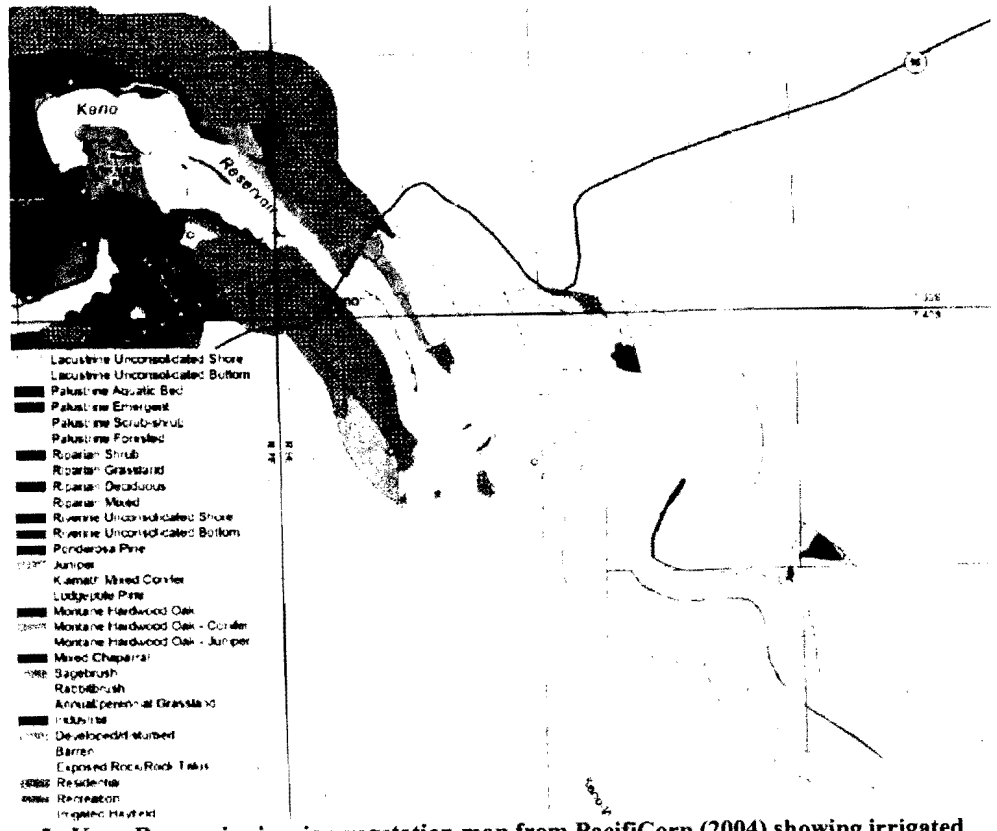


Figure 5. Keno Reservoir riparian vegetation map from PacifiCorp (2004) showing irrigated hayfields right up to the margin with no marsh buffer to help absorb nutrients and to provide other ecosystem services.

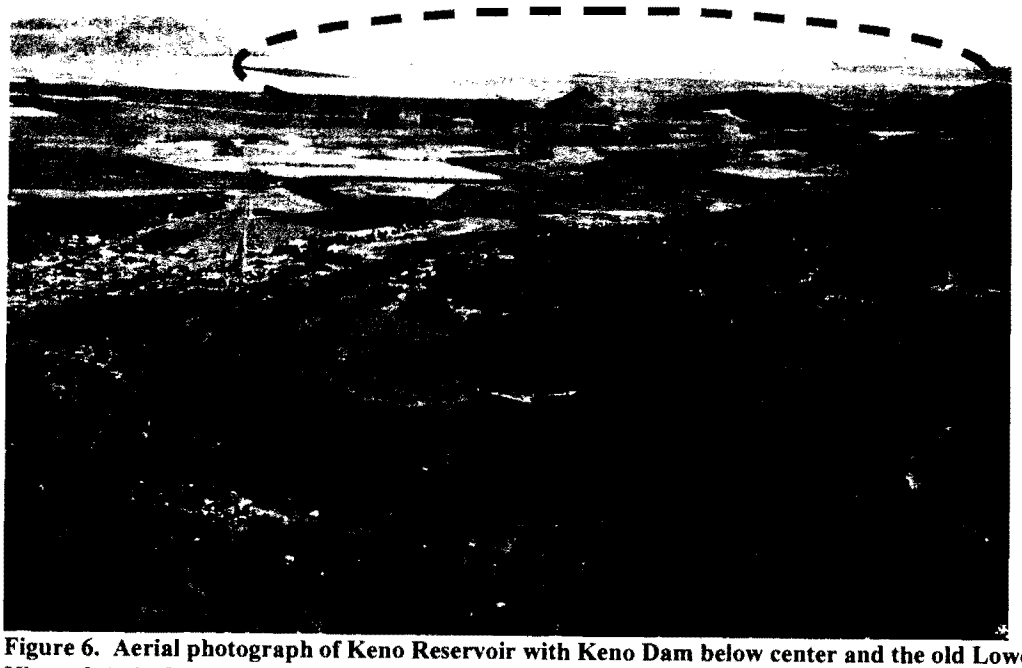


Figure 6. Aerial photograph of Keno Reservoir with Keno Dam below center and the old Lower Klamath Lake bed in the distance (red oval).

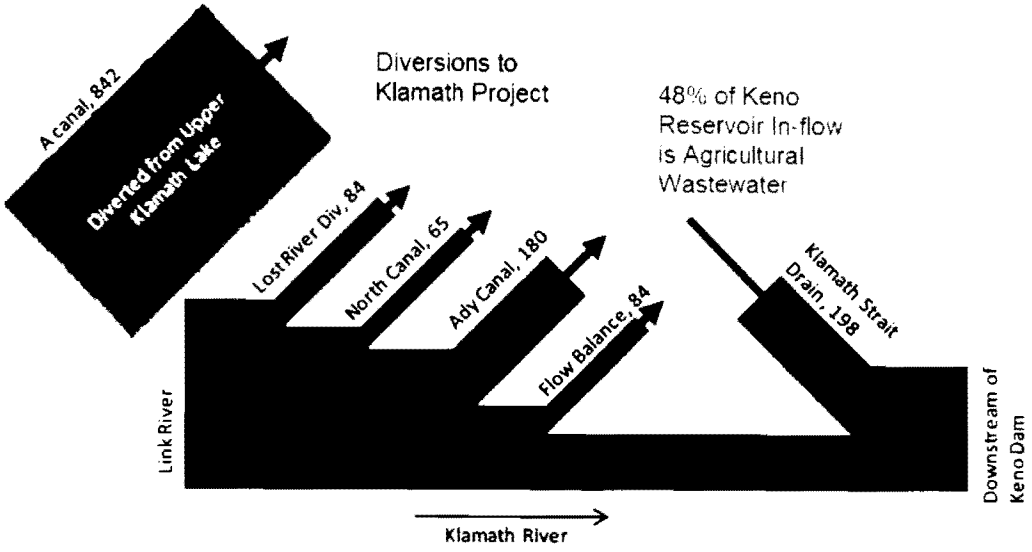


Figure 7. Average daily flow in August 2002 into the Klamath Project and Keno Reservoir. From ODEQ (2010) where it appears as Figure 2-21.

Agricultural discharges from the Lost River through the Lost River Diversion (LRD) canal are known to occur in winter (Deas and Vaughn 2006); however, ODEQ (2010) also found substantial nutrient contributions from that source in summer and fall of 2000 and 2008. ODEQ (2010) model runs of D.O. depletion in Keno Reservoir (Figure 9) show that the contributions from the LRD in September and October 2008 had substantial impacts in addition to discharges from the Klamath Project through the Straits Drain.

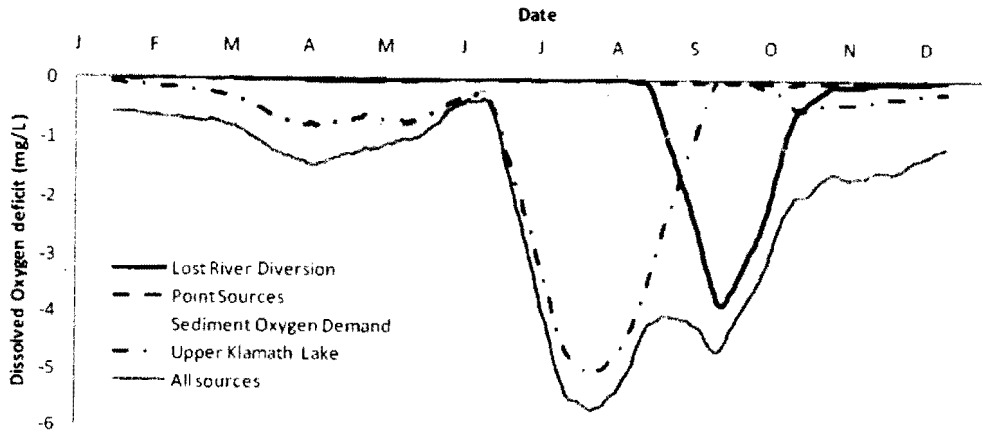


Figure 8. This chart is taken from ODEQ (2010) and shows model results of the D.O. deficits in Keno Reservoir by month in 2008 with a substantial contribution from the LRD Canal in fall, which likely extended conditions lethal to salmonids for two months.

KBRA

The KBRA does not have a water quality plan and has a very broad and ill defined strategy for clean up of nutrient pollution in the Upper Klamath Basin (Dunne et al. 2011, Goodman et al. 2011). Flows under the KBRA (Appendix E-5) will drop further from historic norms (Dunne et al. 2011), which will cause water pollution and fish health problems to persist or even worsen (Goodman et al. 2011). Lost River surface flows are likely to also be reduced under the KBRA resulting in direct impacts to ESA listed suckers and increased nutrient concentrations in waste discharges sent to the Keno Reservoir. The greatest KBRA effect on water quality, however, is that it guarantees continued agricultural land use over vast areas, including sites critically needed for ecological restoration. Major subsidy for maintaining low cost power for Upper Basin water users is also part of the KBRA, when the footprint of agriculture might otherwise shrink due lack of profitability (Jaeger 2004) helping to lower water demand and nutrient pollution.

Klamath River KBRA Flows to Increase Water Quality Problems: The KBRA convened Expert Panels (Dunne et al. 2011, Goodman et al. 2011) to judge the sufficiency of action in restoring conditions favorable for different fish species in the Klamath Basin. The Coho Salmon and Steelhead Expert Panel (Dunne et al. 2011) expressed concern that there would be no consideration under the KBRA of trying to restore historic flows in the Klamath River. Before the Klamath Project was created, Lower Klamath Lake (LKL) would fill in winter and then augment Klamath River flows from May through July (Weddell 2000). Dunne et al. (2011) charted flows before and after Klamath Project construction to show the departure from historical patterns (Figure 9). A return to historic flows would reduce water temperature and nutrient concentrations, which in turn would reduce algae blooms and fish diseases. Figure 9 is annotated to show where departures from the natural flow regime of the Klamath River since the construction of the Klamath Project increase water temperatures and water quality problems as well as

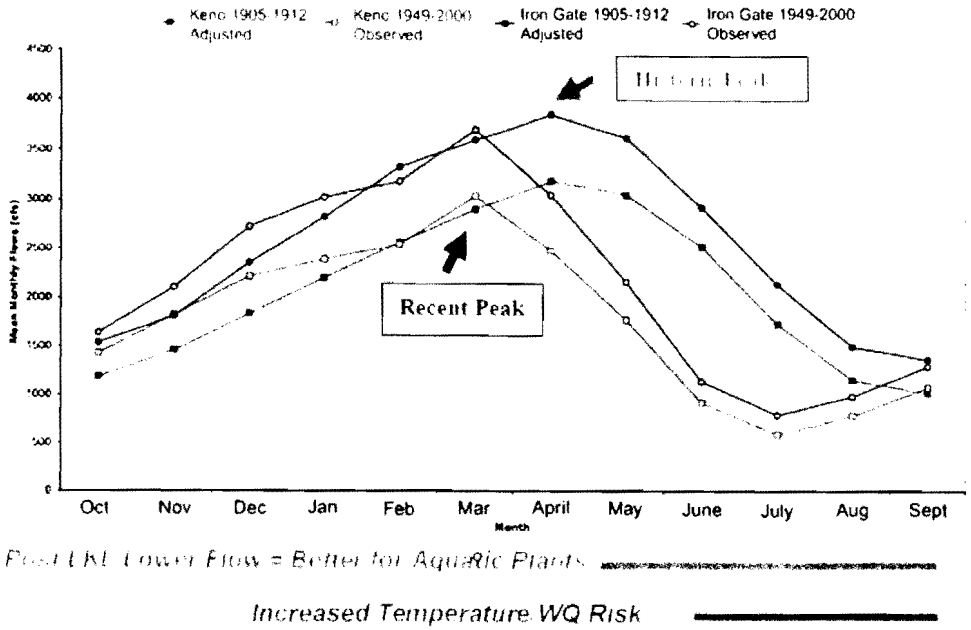


Figure 9. Chart of historic seasonal flows versus those after the construction of the Klamath Project and the disconnection of Lower Klamath Lake. Annotations include historic and recent peaks as well as periods likely to increase algal growth, temperature and nutrient pollution (WQ) added. Taken from Dunne et al. (2011) where it occurs as Figure 3.

promoting conditions that favor growth of algae beds. Continued agricultural activity in the Lower Klamath National Wildlife Refuge (LKNWR) under the KBRA forecloses the option of refilling the lake and increasing spring and early summer flows; instead KBRA flows will depart even further from historic norms.

Flows under the KBRA will be less than those called for under the Klamath Project operations NMFS (2010) Biological Opinion (B.O.) for coho salmon and Hardy et al. (2006). Figure 10 shows Klamath River flows at Iron Gate Dam for the 90% exceedance (very dry) water year with the KBRA WRMS R32 model run, the NMFS (2010) Biological Opinion (B.O.) flows and minimums recommended in the Hardy et al. (2006) Phase II study (Hoopa Tribe Fisheries Department 2011). Annotations once again show periods when very low flow conditions will foster increased algae growth and trigger more adverse water quality. Algae build up has the potential to be most injurious during prolonged droughts when there is insufficient water for flushing flow releases in spring.

Table 3 captures KBRA model (Appendix E-5) projections for Klamath River flows at the location of Iron Gate Dam Flows during extreme drought years similar to 1992 and 1994. Flows could fall as low as 442 cubic feet per second (cfs) (Figure 11) while the adult salmon kill of September 2002 was triggered by flows of 758 cfs (Guillen 2003, CDFG 2003). Reduced flow decreases the volume of water which in turn increases water temperature and nutrient concentration. Although the KBRA states that the Drought Plan would define higher flows for fish needs, the draft Drought Plan circulated in May 2011 does not have alternative levels to those in Appendix E-5 (Resighini Rancheria 2011a).

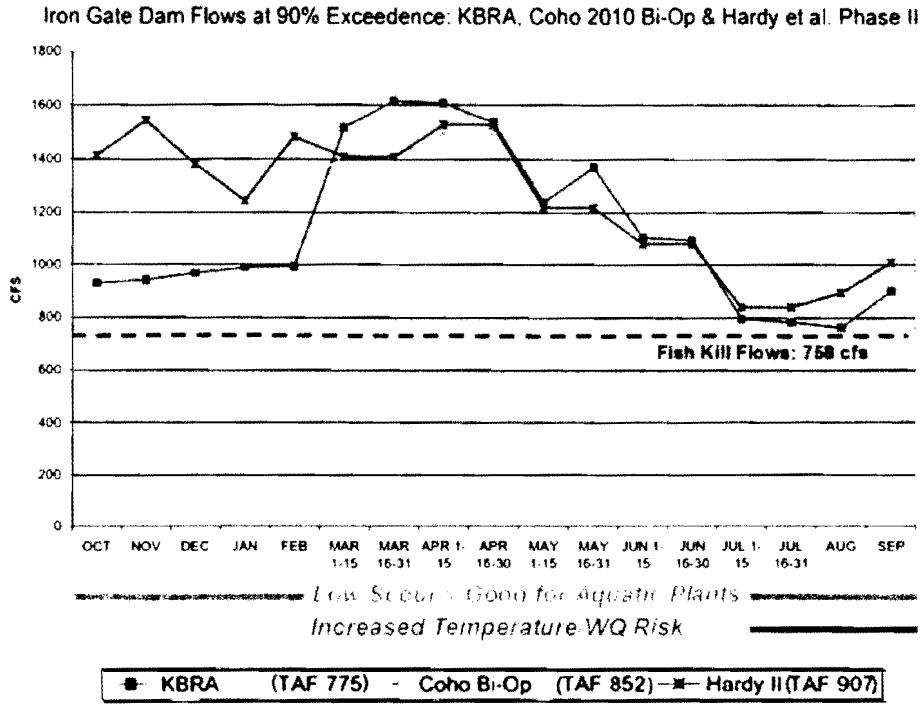


Figure 10. Flows at Iron Gate Dam in a 90% exceedance flow year comparing the KBRA WMRS R32 model flows, NMFS (2010) BO flow levels and Hardy et al. (2006) Phase II. Data from the Hoopa Fisheries Department. Reference is USGS Iron Gate September 2002 fish kill flow release.

Table 3. KBRA WRMS model flow simulations at Iron Gate Dam for years similar to 1992 and 1994 under KBRA flow allocations. R32 = primary run. R33 = with additional storage. R34 = with additional storage and climate change. Yellow indicates lower than September 2002 fish kill flows (758 cfs).

Period	R32_1992	R32_1994	R33_1992	R33_1995	R34_1992	R34_1994
Jan	854	959	819	1106	846	1106
Feb	809	928	800	1025	809	1025
Mar_1_15	1022	1239	800	996	800	996
Mar16_31	1021	1151	800	860	826	924
Apr_1_15	1063	1184	800	824	786	847
Apr_16_31	1022	1125	800	821	767	813
May_1_15	807	924	800	813	701	798
May_16_31	843	1069	800	812	668	823
Jun_1_15	698	913	800	811	581	773
Jun16_30	646	873	800	809	610	753
Jul_1_15	509	629	700	706	515	607
July15_30	524	574	700	705	537	561
August	442	485	800	804	533	548
Sept	512	577	800	808	519	552
Oct	549	582	800	811	800	811
Nov	647	690	829	800	829	800
Dec	774	762	914	800	914	800

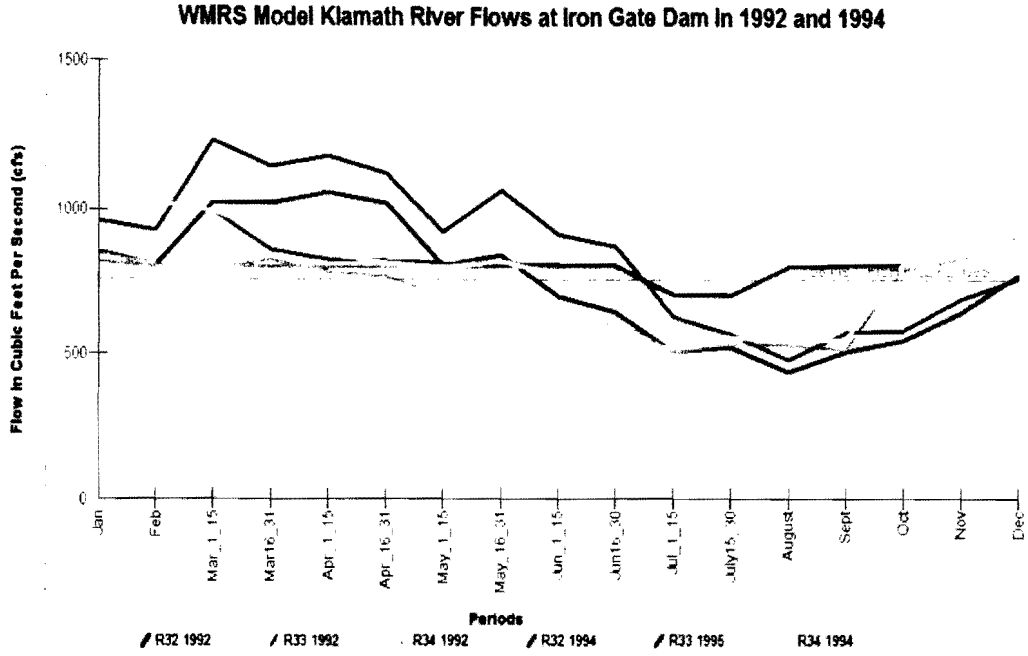


Figure 11. KBRA WRMS model run for flows at the location of Iron Gate Dam in years of Extreme Drought, with similar Upper Klamath Lake in-flow to 1992 and 1994. Data from KBRA (E-5, Tables 2, 4, 6).

Moving flows further away from their historic range of variability poses greater risk due to processes described in the FERC (2007) Final Environmental Impact Statement (FEIS) for the KHP relicensing:

> "Over time, the overall limitations on water availability and dynamic hydrographs contribute to conditions that result in a channel that becomes stable and prone to other undesirable consequences to water quality and aquatic resources."

Although nutrient concentrations are reduced by greater water volume (Asarian et al. 2010), the KBRA (Section 25.1.4) states that increasing flows will be the last option for improving water quality:

> "The Parties shall support all reasonably available alternative or additional water quality measures before considering any action for the purpose of water quality compliance that would reduce water supplies beyond the limitations provided in this Agreement."

Restricted Klamath River flows under the KBRA in and of themselves substantially lower chances of attaining Hoopa TEPA (2008) WQS, especially during drought or extreme drought years even after dams are removed.

Lost River Flow Reduction Impacts Under KBRA: The KBRA will likely reduce surface flows in the Lost River, which will have a direct impact on Lost River and shortnose suckers but will also increase nutrient concentrations in Straits Drain and LRD waste water sent to Keno Reservoir. The KBRA provides substantial resources that allow irrigation districts to bind together and create an On-Project Plan for water and power. This publicly funded document may not undergo public review and yet it will govern Lost River flows for the life of the KBRA. Lost River surface and groundwater have been used to make up for Klamath River shortfalls since 2001 through the U.S. Bureau of Reclamation (BOR) water bank. According to USGS (2005) "Water bank activities have resulted in an approximately eight-fold increase in ground-water pumping in the vicinity of the Klamath Valley and Tule Lake sub-basins." Gannett et al. (2007) measured water table drops from 2001-2004 of greater than 15 feet in the lower Lost River in California and stated that this was likely reducing surface flows. California State agencies and Siskiyou County do not actively manage groundwater and are not likely to prevent future adverse Lost River drought impacts. Increased nutrient concentrations in tail waters sent to Keno reservoir will promote continuing acute water pollution there with radiating negative impacts downstream.

KBRA Nutrient Reduction Insufficient: The U.S. EPA (2000) notes that "restoration should reestablish in so far as possible the ecological integrity of degraded aquatic ecosystems." A restored system would meet the following criteria: "Its key ecosystem processes, such as nutrient cycles, succession, water levels and flow patterns, and the dynamics of sediment erosion and deposition, are functioning properly within the natural range of variability" (U.S. EPA 2000). As noted above, the KBRA will cause flows to depart further from their historic range of variability and the amount of functioning marsh and area of shallow lakes that formerly helped improve water quality will remain at just a fraction of their historic extent.

Dunne et al. (2011) pointed out that the KBRA has no assured strategy for reducing nutrient pollution (emphasis added):

> "Experience from other locations where eutrophication is a major problem suggests that, at a minimum, drastic reductions in loading from the watershed must accompany local amelioration. These reductions must account for the apparently high natural nutrient inputs from the local watersheds, and the unavoidable leakage occurring in watersheds heavily altered for urban and agricultural use. *Thus, it would be premature to conclude that any problems caused by these blooms, including low dissolved oxygen, will be substantially reduced by KBRA*" (p. 39).

Goodman et al. (2011) urge consideration of more extensive wetland and lake restoration to recover the Klamath River's limnological balance:

> "Evaluate reductions in irrigated agriculture for lands draining to UKL and the Lost River for their feasibility to reduce summer and fall nutrient additions from those waters. Consider managing the refuges to further emphasize their benefits

> for fish and wildlife, which can be in contrast to their agricultural objectives." (Page 12, Section 2.1)

Goodman et al. (2011) also express doubt that problems with extremely low D.O. in Keno Reservoir will be resolved by KHSA and KBRA measures and as result that "a fully self-sustaining run of Chinook salmon to the upper basin is unlikely" even with KHP dam removal.

Asarian et al. (2010) project that available nitrogen at the location of Iron Gate Dam after removal of KHP reservoirs will increase in the months of July through September by 45-58%. Asarian et al. (2010) note that nutrient assimilation of periphyton and macrophytes will increase in the Klamath River below the location of Iron Gate Dam in response to increased nitrogen availability and state that "These increased retention rates downstream would then partially offset the effects of increased Iron Gate load on nitrogen concentrations in reaches farther downstream." The problem is that the process of photosynthesis associated with assimilating a 50% increase in nitrogen will continue to cause water quality perturbations that create stressful conditions for salmonids and disease rates similar to those experienced in the recent past (Halstead 1997, USFWS 2001, Nichols and Foott 2005).

Goodman et al. (2011) acknowledged the potential significance of the increased nutrient load in the Lower Klamath River:

> "Releasing these excessive amounts of nutrients to the Klamath River in the absence of the four lower dams means that the river, versus the reservoirs, will process the nutrients, perhaps in the form of excessive *Cladophora* biomass or increased periphyton production down river. These changes could elevate pH, lower night time dissolved oxygen, and cause gas supersaturation during afternoons in local areas."

The FERC (2007) FEIS also poses the same hypothesis as Goodman et al. (2011) with regard to nutrient surpluses and fish disease risk:

> "Continued high nutrient levels in the Klamath River that create ideal colonization conditions for *Cladophora*, at sites with favored flow and substrate conditions, would enable the host polychaete to become reestablished, and *C. shasta* and *P. minibicornis* would likely continue to pose a serious threat to downstream salmon for the foreseeable future."

As pointed out in the Fish Disease Cycles section above, no matter where the new fish disease node is below Keno Reservoir after dam removal, actinospores will be viable and increase exposure to *C. shasta* and *P. minibicornis* downstream to the estuary even after dam removal. Thus, Hoopa TEPA (2008) WQS beneficial uses will not likely be met and the Hoopa Valley Tribe will also likely continue to suffer fisheries losses both at Klamath River and Trinity River fishing sites.

Reservoir reach to help improve water quality, the importance of which is discussed above.

Agricultural water supply from Upper Klamath Lake through the A Canal continually inoculates the Lost River and Tule Lake with *A. flos-aquae* and marsh complexes there need to be re-expanded to stifle its growth. Neither the U.S. EPA (2008) Lost River TMDL or the NCRWQCB (2010) Klamath and Lost River TMDL implementation recognize the need for these restored ecosystem functions and processes. The KBRA guarantees water delivery and continued agricultural use of the Lease Lands within the TLNWR (15.1.2 B i) and LKNWR (15.1.2 B i), which constitutes 21,000 acres (Figure 12) and is the only such arrangement on any wildlife refuge in the nation. Tule Lake was originally 110,000 acres whereas Tule Sump occupies between 10,000-14,000 acres and Lower Klamath Lake was 95,000 acres and is now only 4,000 to 7,000 acres depending on the water year (Figures 13-14). This essentially blocks ecological recovery of both areas; therefore, confounds successful abatement of pollution.

Dam removal will help ecosystem function of the Klamath River in the restored KHP reach, including elimination of toxic algae. However, the huge excess of nutrients from Keno Reservoir will continue to overwhelm the river's capacity for assimilation causing major algae blooms downstream. As noted above, this has consequences for fish diseases as well as exceedance of water quality standards. Lower Klamath River recovery also requires that flows and ecosystem function of the Shasta and Scott rivers also be restored, but conditions there have not improved since adoption of those TMDLs (Higgins 2011).

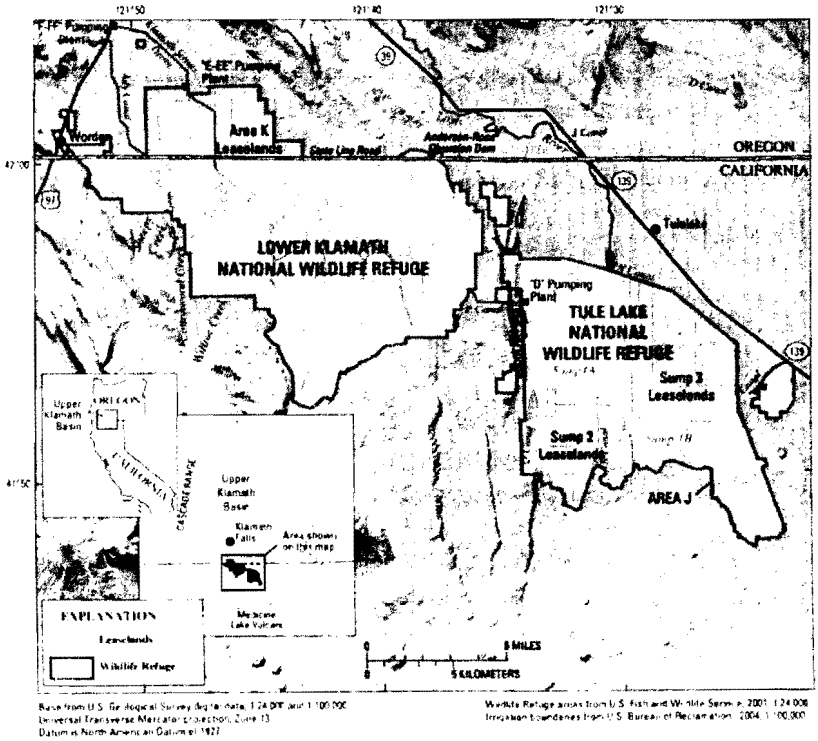


Figure 13. USFWS and BOR map of TLNWR and LKLNWR Lease Lands occupy 21,000 acres.

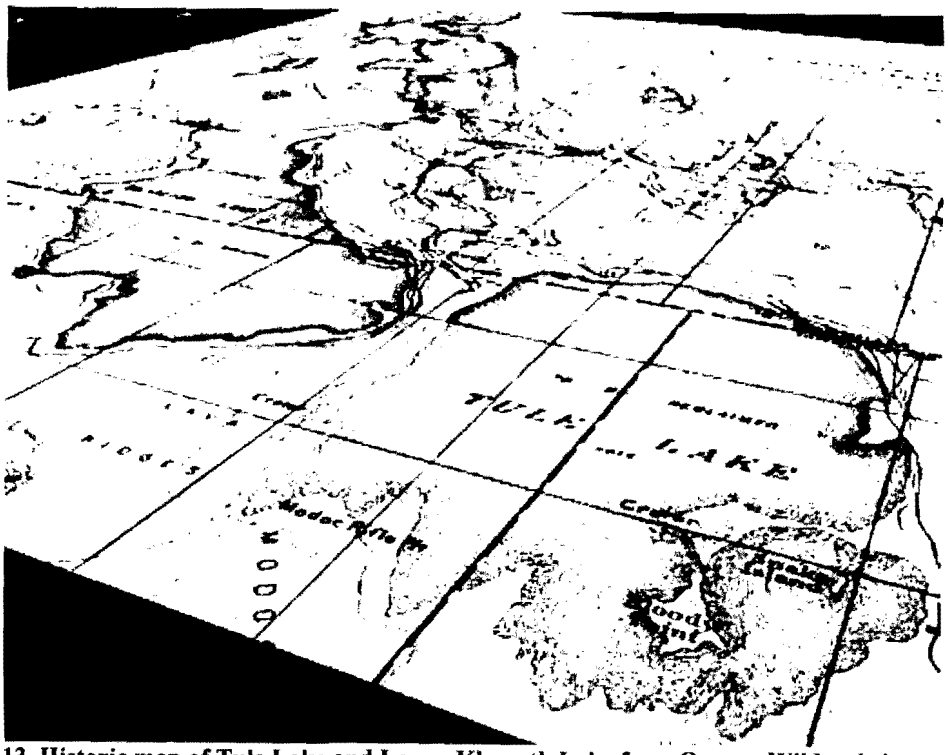


Figure 13. Historic map of Tule Lake and Lower Klamath Lake from Oregon Wild website at www.oregonwild.org/waters/klamath/klamath-photos-and-maps/interactive_maps



Figure 14. Aerial photo of Tule Lake and Lower Klamath Lake from Oregon Wild website.

The Tule Lake basin also has the highest use of pesticides in Siskiyou County (Figure 15) with up to 7,500 pounds per acre in use within the TLNWR on the Lease Lands.

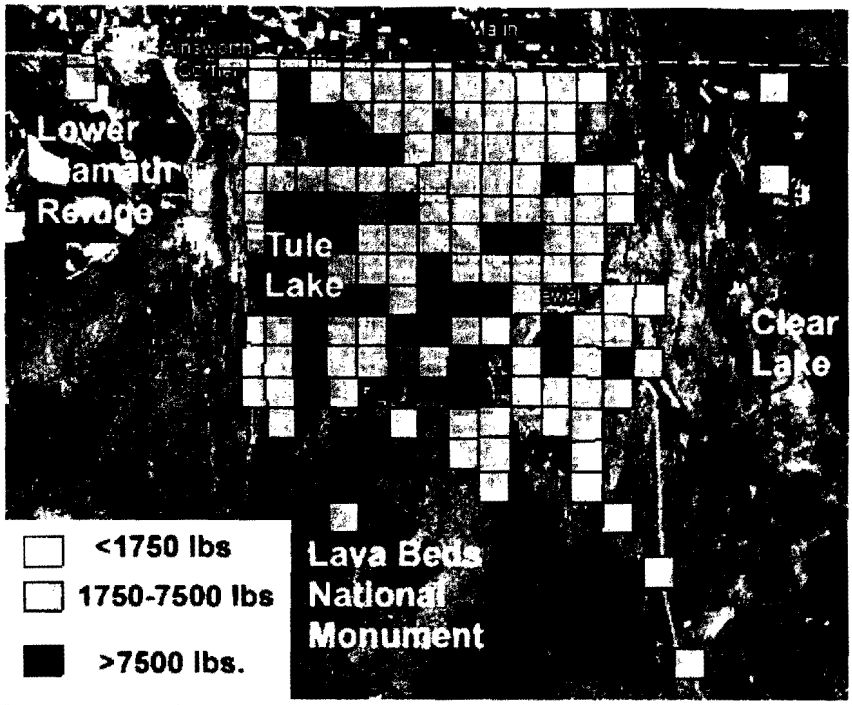


Figure 15. Tule Lake pesticides in pounds per year, including within the TLNWR Lease Lands adjacent to Tule Lake. Data from CA Department of Pesticide Regulation (DPR).

Recent studies have shown that even low levels of some chemicals can be injurious to coho salmon when acting together (Laetz et al. 2009). The KHSA and KBRA do not even mention the topic of pesticides but high contributions to the Keno Reservoir reach could be another factor that could impede Upper Basin salmon recovery. Laetz et al. (2009) found combinations of diazinon, malathion, chlorpyrifos, carbaryl and carbofuran in many Pacific Northwest rivers and exposing coho salmon juveniles to equivalent levels in a lab induced mortality. All of these chemicals are used in Siskiyou County where in 2007 an estimated 1,287,800 pounds of pesticides were applied to 187,595 acres, most of them within the Klamath Basin (CDPR 2008). Conversion to organic farming techniques needs to be pursued as part of any final settlement, especially on Lease Lands if farming there continues.

Technical Fix of Water Quality Problems is Experimental and Unlikely to Succeed

The NCRWQCB (2010) frames the strategy for nutrient pollution as follows:

> "Explore engineered treatment options such as treatment wetlands, algae harvesting, and package wastewater treatment systems to reduce nutrient loads to the Klamath River and encourage implementation of these options where feasible."

These technical approaches to nutrient pollution all require intensive capital investments for implementation and also have substantial on-going costs for electricity for water pumping or purification. It is very unlikely with the current budget crisis that funds will be available for construction and availability of capital for operation and maintenance in the future casts doubt on the ability of this approach to succeed. Furthermore, harvest of algae at the outlet of Upper Klamath Lake in perpetuity makes far less sense economically than abating algae blooms through ecological restoration. Similarly, operating a waste water treatment plant at the Keno Reservoir is not cost-competitive with reducing nutrient loads by eliminating farming on the TLNWR and LKNWR and expanding marshes to clean the water.

Meyer (2005) found that water passed through the LKNWR marsh complex had a 55-77% reduction in total nitrogen (N) and 19-51% reduction in total phosphorous with permanent wetlands having a much greater retention rate than seasonal wetlands. Lytle (2000) assessed the potential for use of a treatment wetland to reduce nutrient loads from the Klamath Straits Drain:

> "With an estimated wetland treatment area ranging between 1,633 and 3,114 acres, according to the Kadlec and Knight Model, the wetland could achieve a 61% reduction in total P concentration (0.41 to 0.16 mg/L) and a 90% reduction in total nitrogen including NH_3-N."

The problem with operation of such a treatment wetland is that it requires a flow rate of 70-130 cubic feet per second, which would require additional water storage. Thus, even operation of a treatment wetland at the Straits Drain would require expansion of Lower Klamath Lake or Tule Lake, both of which are blocked by the KBRA. The report from Lytle (2000) remains in draft and there has been no action with regard to its implementation.

TMDLs Rely on Voluntary Cooperation and Have No Timelines for Compliance

Both the California (NCRWQCB 2010) and the Oregon (ODEQ 2010) TMDLs are overly reliant on voluntary measures for compliance. TMDLs from both States lack any projections for when water quality compliance will occur or when beneficial uses will be fully restored. The Final KHP EIS (FERC 2007) expressed the following concern with regard to potential for success of TMDLs in the Upper Klamath to remediate pollution:

> "The TMDL program relies on voluntary involvement for loads identified from non-point sources; therefore, nutrient load reductions to the allocated size may not be fully realized as farmers and ranchers choose between converting portions of their land to best management practices or maximizing their property's agricultural potential." (3.3.2.3)

ODEQ (2010) states the TMDL "does not attempt a timeline addressing the many ongoing and voluntary efforts."

The prospect of enforcement in Oregon is more remote than in California because ODEQ (2010) must delegate authority for implementation to designated management agencies (DMAs). The lead DMA is the Oregon Department of Agriculture (ODA), which is charged with both promoting agriculture and regulation of agricultural activities that affect water quality. Other DMAs include the U.S. BOR and irrigation districts. A program that relies on polluters to oversee abatement of pollution has a very low likelihood of success.

Interim Measures for KHP Will Not Improve Reservoir or Lower Klamath River Water Quality Conditions

PacifiCorp has complied with Section 6.3.2 of the KHSA and submitted a TMDL implementation plan to the NCRWQCB. Appendix C and D of the KHSA lay out the 21 Interim Measures and they are reflected in PacifiCorp's (2011) *Plan for Implementing Management Strategies and Water Quality-Related Measures*. The NCRWQCB (2010b) response to the proposed measures states that in-reservoir actions will not abate nutrient pollution or toxic algae problems there. The PacifiCorp (2011) actions pursuant to TMDL implementation relevant to this report are as follows.

Interim Measure 2 requires that PacifiCorp provide $500,000 per year for coho salmon habitat restoration or acquisition, but these measures will have small water quality benefits and will target projects below the KHP. The improvement of cold water refugia at the mouths of Klamath River tributaries is very laudable and worthwhile, but it does not fully mitigate impacts of the operation of KHP dams as PacifiCorp (2011) claims: "The thermal refugia actions to be implemented under the Coho Enhancement Fund will mitigate the continuing effect of the reservoirs on water temperature during the interim period." This measure will help coho salmon, but the major impact to fall Chinook of reservoir operation described above will remain huge as long as Iron Gate Dam remains. Also, increased flows in the Shasta and Scott rivers is needed to restore coho salmon habitat there, which has much greater potential to increase carrying capacity for these fish (Higgins 2011)

Interim Measure 3 calls for turbine venting at Iron Gate Dam to improve dissolved oxygen (D.O.) levels that may improve lower Klamath River conditions within a short distance of the dam. Even if such measures were implemented, excess nutrients from the reservoir will continue to be released that stimulate profuse algae growth leading to D.O. sags stressful for salmonids downstream, when algae respires nocturnally.

Interim Measure 5 calls on PacifiCorp to consult with agencies and tribes and to carry out experiments with different flow levels in fall and early winter to benefit salmonids. In February 2011 5,000 cfs was released for one day under the theory that such a peak would increase scour and potentially reduce algae beds. These short term events are aimed at offsetting potential problems from low fall and winter flows planned under the KBRA as described above. No experimental design is in place, so whether this isolated action had any benefit is unknown.

Interim Measure 10 requires that PacifiCorp provide $100,000 to hold a conference "that focuses on the design and implementation of nutrient and organic matter reduction projects. The conference should assess the appropriateness and feasibility of various centralized pollutant removal technologies, including wetland treatment systems, wastewater treatment systems with energy recovery capabilities, aquatic plant harvesting, as well as agricultural best management practices" (NCRWQCB 2010). Planning for this event has been restricted to Parties to the KBRA and KHSA.

Interim Measure 11 is entitled Interim Water Quality Improvements, but there will be no significant improvements to Lower Klamath River that result. PacifiCorp is to spend $250,000 a year on one or more of the following: 1) developing a water quality accounting framework, 2) constructing pilot treatment wetlands for evaluation, 3) assessing in-reservoir water quality control techniques, and 4) improving J.C. Boyle D.O.

The NCRWQCB (2011) is asking that PacifiCorp increase resources to fully develop the water quality accounting framework that will help evaluate TMDL implementation, which is good. In lieu of reservoir projects, the NCRWQCB staff recommends pilot projects for nutrient reduction that could be expanded and implemented under the KBRA. While treatment wetlands have the potential to reduce nutrient contributions (Lytle 2000), they are unlikely to be able to offset continuing high contributions of nutrients (see Ecological Restoration).

The KHSA would set up an Interim Measures Implementation Committee (IMIC) to work with PacifiCorp comprised only of signatories or "Parties" to the settlements. The committee would also appoint and oversee a Fisheries Technical Working Group and a Water Quality Technical Working Group. These processes would prevent involvement of the Hoopa Tribe and other legitimate stakeholders who did not sign onto the KHSA and KBRA. The Hoopa Tribe has used government-to-government consultations and Freedom of Information Act requests to try to keep abreast of activities within the IMIC. Exclusion of the Hoopa Tribe and other non-Parties will lead to a continuing bias against any solutions to water quality problems that require more land retirement or higher flows than agreed to in the KBRA.

Sucker "Beneficial Use" Recovery Required by TMDLs Unlikely Under KBRA

Both the Lost River and shortnose suckers are endemic to the lower Lost River, Tule Lake and Lower Klamath Lake and they are, thus, both considered beneficial uses under the Clean Water Act and the Lost River TMDL (U.S. EPA 2008). Both species have been extirpated in Lower Klamath Lake (LKL)(USFWS 2001b). The NRC (2004) recommended consideration of refilling LKL to re-establish sucker populations to reduce regional extinction risk and to improve ecological function of the Klamath River. As noted above, this option is precluded by KBRA provisions that guarantee farming in the lake bed and the LKNWR Lease Lands. Therefore, this aspect of TMDL implementation is not likely to occur within the 50 year life of the program.

Shortnose suckers are no longer present in the lower Lost River (Delineas et al. 1996). Although there is an adult population of Lost River suckers in Tule Lake, there is no viable spawning habitat for them in the lower Lost River (Delineas et al. 1996, Shively et al. 2000). The source population for Tule Lake may be partially supplied by Upper Klamath Lake larvae entrained in the A Canal (Scoppettone et al. 1995), and colonists will likely decrease as fish screens are improved. Consequently, with no ability to reproduce and a diminishing source of colonists, the Tule Lake Lost River sucker population is also likely to be lost over time. Marsh and lake restoration in the lower Lost River, Tule Lake and LKL basins would not only allow re-establishment of sucker populations to lessen species extinction risk, it would help attain algae suppression and nutrient reduction that will likely prove elusive otherwise.

Ecological Restoration Approach to Restoring the Klamath River

An ecosystem based approach to resolving Klamath River water quality impairment is in keeping with current best-science principles: "Management of the freshwater habitat of Pacific salmon should focus on natural processes and variability rather than attempt to maintain or engineer a desired set of conditions through time" (Bisson et al. 2009). Major Upper Klamath Basin anthropogenic alteration and reengineering have overwhelmed ecosystem function and caused the Klamath River to develop acute water pollution. Ecosystem services that stifle algae blooms, absorb nutrients and provide water storage need to be regained, which will then allow Pacific salmon and sucker species recovery. The U.S. EPA (2000) gives similar guidance with regard to restoration:

- "Restoration strives for the greatest progress toward ecological integrity achievable within the current limits of the watershed, by using designs that favor the natural processes and communities that have sustained native ecosystems through time.

- Restoring the original site morphology and other physical attributes is essential to the success of other aspects of the project, such as improving water quality and bringing back native biota."

Despite naturally high phosphorous levels because of volcanic activity in its headwaters, the Klamath River was known as the "river of renewal" because of its ability to clean itself (NCRWQCB 2010). Marshes filtered run off, trapped nutrients and suppressed blue-green algae as described above. Lower Klamath Lake acted as the water storage system capturing winter flows and releasing them in late spring. The river bed itself, in a free-flowing condition, helped capture nitrogen from the water and release it back into the atmosphere similar to processes described by Sjodin et al. (1997). None of these ecological functions can be substituted for through technical fixes.

The Klamath River has passed its tipping point in terms of nutrient balance due to several changes:

- Changes within Upper Klamath Lake leading to A. flos-aquae domination,
- Blocking the connection to Lower Klamath Lake and drying it up,
- Pollution of the Lost River and Tule Lake and artificial connection to the Klamath River in the Keno Reservoir, and
- Keno Reservoir reach alteration that stopped denitrification and added to eutrophication.

The goal of ecological restoration as applied to the Klamath River is not to return the watershed to pristine conditions but rather to take strategic actions to restore the natural balance so that beneficial uses as defined by the Clean Water Act can be attained. If the natural system is restored to a level where its ecosystem processes clean the water, then it will be largely powered by gravity and far less expensive than technological fixes.

Studies are needed that go beyond those of Lytle (2000) and Mayer (2005) to determine quantitatively how strategic, large scale marsh and lake restoration would reduce water demand, increase water storage and resolve nutrient pollution as a result of improved ecosystem function. The current state of knowledge would suggest priorities include re-establishment of a marsh perimeter around Upper Klamath Lake, restoring the riparian marsh in the Keno Reservoir and in the lower Lost River, and expansion of Tule Lake and Lower Klamath Lake. The KBRA has hundreds of millions of dollars earmarked for restoration, which could be used for acquisition of wetlands for restoration. However, the obvious solution is to restore wetland and lake functions in TLNWR and LKNWR since there are 21,000 acres of wetlands there in public ownership. Costs of easements and acquisitions for areas in addition to the Lease Lands would be one time investments that lead to ecosystem function that has modest or no need for on-going maintenance.

Hoopa Valley Tribe Alternatives to KHSA/KBRA for Dam Removal

The two most promising avenues for promoting KHP dam removal are to return to the FERC relicensing process and by pressing for a speedy decision by the California SWRCB regarding 401 certification.

The Hoopa Valley Tribe challenged continuing operation of the KHP on a year to year basis without implementation of mitigation measures (HVT vs. FERC 2010). While the challenge was rejected (U.S. Court of Appeals District of Columbia 2010), trying to re-initiate the FERC licensing process should provide benefits with regard to promoting decommissioning. PacifiCorp felt imminent KHP decommissioning and loss of their power generating facility was a possibility under the relicensing process (Brockbank 2010):

> "Throughout these negotiations, the federal government and the states of Oregon and California have expressed a strong policy preference that PacifiCorp's dams on the Klamath River be removed."

If the KHP relicensing process re-opens, NMFS' (2006) fish passage requirements at dams will be part of terms and conditions. Administrative Law Judge Parlen McKenna

(2006) upheld NMFS authority and PacifiCorp (2008) estimates that fish passage at all KHP dams would cost $267 million, which is far more than project revenue justifies. This will likely throw the project into the "uneconomic" category. Brockbank (2010) explains PacifiCorp's options: "The applicant may accept the uneconomic license, decommission and remove the facility, or pursue litigation and challenge the mandatory conditions."

The California SWRCB (2008) suspended the 401 certification process after entering into an Agreement in Principal with PacifiCorp and subsequently signing the KHSA. The Hoopa Valley Tribe (2011a) pointed out that the most recent SWRCB Resolution (2010-0024), which held the KHP 401 process in abeyance, required federal KBRA/KHSA legislation be enacted by May 17, 2011, which it was not. Therefore, the SWRCB should re-start its 401 certification process. Oregon and northern California environmental groups (Cascadia Wildlands et al. 2011) and the Resighini Rancheria (2011d) also made similar requests to the SWRCB, which is likely to consider the matter at its August 2011 meeting.

If the relicensing and 401 process restart, the SWRCB will likely prevent FERC from issuing a new KHP license by withholding 401certification because water pollution problems associated KHP reservoirs cannot be remedied (SWRCB 2006). The inability of PacifiCorp to acquire a new license would also force abandonment and decommissioning.

Hoopa TEPA (2008) WQS for the Klamath River must be considered by the SWRCB in the 401 certification process. When the 401 process is reopened, the Hoopa Valley Tribe should continue to provide the SWRCB with evidence that shows the need for immediate removal of KHP dams due to toxic algae problems and alarming continuing impacts to salmon resources, particularly in drier years.

Conclusion

There is substantial concern that the lack of nutrient reduction at the source in the Upper Klamath Basin under the KBRA will cause a failure to remediate water quality problems even after dam removal (Dunne et al. 2011, Goodman et al. 2011). The chances that Hoopa WQS standards will be met appear low and all fisheries-related beneficial uses will continue to be compromised under the KBRA even after dams are removed. As noted above, a rigorous testing and reporting program to measure compliance with Hoopa WQS will be essential.

There is urgent need for action in promoting an ecologically sound restoration alternative. Current conditions have lead to a fish kill of 33,000-70,000 adult Chinook salmon (CDFG 2004) and the level of mortality of juvenile Chinook salmon in some recent years has had an equivalent impact (Nichols and Foott 2005). High levels of fish disease threaten the existence of remnant runs of spring Chinook and coho salmon and these problems are not likely to be remedied either before dam removal or afterward. Continuing operation of the KHP without mitigation poses high risk to these at-risk fish

populations and insufficient actions under the KBRA to abate nutrient pollution virtually assure the extirpation of these species before 2062.

A critical consideration is the urgent need for action given short term climate regime known as the Pacific decadal oscillation cycle (Hare et al. 1999, Collison et al. 2003) that affects Pacific salmon species:

> "If current patterns prevail, with shifts in the PDO occurring every 20 to 30 years (Hare et al. 1999), the next negative shift in the PDO for California is likely to occur in the 2015 to 2020 timeframe ..... If fresh water habitats have not recovered by that time, the fish will simultaneously face both degraded freshwater habitats and an unproductive ocean. The result could shift the stocks to endangered status or result in extinctions" (Collison et al. 2003).

This suggests that dam removal needs to be in advance of 2020 for the highest potential of success. Toxic algae from reservoirs will also continue to pose unacceptably high health risk for recreational or ceremonial use of the Klamath River until at least 2020, and this condition in and of itself should be sufficient cause for speedy KHP dam decommissioning.

"We must restore impaired ecosystems if we are ever to regain the natural capital necessary to prevent continued economic and social decay and to approach economic and ecological health and sustainability" (Society for Ecological Restoration 2004).

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From: Craig Tucker <ctucker@karuk.us>
Sent: Tuesday, January 31, 2017 3:00 PM
To: Thaler, Parker@Waterboards
Subject: Karuk 401 Scoping comments
Attachments: 17-01-30 Scoping Comments EIS dam removal.pdf

Mr. Thaler:

Please accept the attached comment letter from Karuk on the State Board's scoping in the Klamath Dam removal 401 certification process.

Yootva,

S. Craig Tucker, Ph.D.
Natural Resources Policy Advocate
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January 31, 2017

Parker Thaler
State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA 95812

RE: Karuk Tribe Scoping Comments on the EIR related to the Clean Water Act Section 401 Permitting of a Surrender Application, FERC Project 14803

Ayukii Mr. Thaler:

The Karuk Tribe appreciates the opportunity to comment on the scope of the Environmental Impact Report related to the Clean Water Act permitting of PacifiCorp's Klamath Hydroelectric Project.

On December 22, 2016, the State Water Resources Control Board (State Water Board) issued a Notice of Preparation of an Environmental Impact Report for the surrender of the Lower Klamath Hydroelectric Project (LKHP). Under the California Environmental Quality Act (CEQA) a Lead Agency is required to solicit comments on a Notice of Preparation (NOP) from interested parties. The Karuk Tribe is submitting comments as a long term participant in the Klamath Hydroelectric Project relicensing process and a signatory to the amended Klamath Hydroelectric Settlement Agreement (KHSA). Reduced fish populations and poor water quality resulting directly from the operation of the Klamath Hydroelectric Project have had profound impacts on the traditional cultural practices and the health of Tribal members.

On September 23, 2016, PacifiCorp and the Klamath River Renewal Corporation (KRRC) filed a joint license transfer application with the Federal Energy Regulatory Commission (FERC). Pursuant to the amended KHSA, PacifiCorp and the KRRC seek to transfer the lower four dams (J.C. Boyle; Copco No. 1; Copco No. 2; and Iron Gate) to the KRRC for the purpose of decommissioning and removal.

Before FERC can accept a license surrender application, PacifiCorp and the Klamath River Renewal Corporation must obtain water quality certification under Section 401 of the Clean Water Act (33 U.S.C. § 1341) from the State Water Board. Under Section 401, conditions of a water quality certification become conditions of any federal license or permit for the project. The State Water Board is the agency authorized to issue certification of any potential discharge from an activity that requires a FERC license or amendment. The State Water Board adopted the Water Quality Control Plan for the North Coast Region (Basin Plan). The Basin Plan includes the Beneficial Uses and Water Quality Objectives necessary to project the Beneficial Uses. Together these constitute the Water Quality Standards that must be met before the State Water Board can issue Water Quality Certification. Issuance of a water quality

certification is a discretionary action subject to CEQA compliance. The State Water Board has correctly chosen to prepare an Environmental Impact Report (EIR) because there are potentially significant impacts associated with dam transfer and removal.

California Environmental Quality Act

CEQA requires a lead agency to analyze the impacts of a project as defined in the CEQA Guidelines. In the case of an existing hydroelectric project that has been in operation before the adoption of the Clean Water Act and Endangered Species Act the ongoing impacts of the project will not register as significant. While CEQA considers the existing conditions as the baseline for analysis of project impacts the State Water Board must analyze the existing operations to determine compliance with the Clean Water Act. We assert that the LKHP has been operating in violation of the Clean Water Act, and potentially other State and Federal Laws, for decades and this must disclosed in a discussion of the baseline conditions.

We assert that the LKHP cannot be brought into compliance with State and Federal Laws without being removed. Clearly, dam removal and the expected discharge of sediments will have an immediate negative impact on water quality downstream of the LKHP; however, the expected long term benefits are enormous and have been thoroughly researched and described in the 2012 EIR/EIS on Klamath Facilities Removal and further expanded on in the Klamath Dam Removal Overview Report for the Secretary of Interior (October 2012).

Rely on Existing Technical Analyses

As you know the California Department of Fish and Wildlife and the United States Department of Interior prepared a joint Environmental Impact Statement (EIS)/ Environmental Impact Report (EIR) in 2012. Over 3,000 pages worth of peer reviewed technical reports informed the joint EIR/EIS. The peer review process used in the preparation of this document exceeded what is legally required by state or federal statutes and included a final review by a series of expert panels made up of members of the National Academy of Sciences. We strongly urge the State Board to rely heavily on the information in these documents. As noted above, in addition to the EIR/EIS the Department of Interior went one step further and developed a Klamath Dam Removal Overview Report for the Secretary of Interior in anticipation of congressional approval of a package of agreements which included the KHSA. Had this package of agreements been approved by congress, the Secretary of Interior would have made a public interest determination regarding dam removal. The Overview Report thus went above and beyond typical requirements of the National Environmental Policy Act to better inform the Secretary. We urge the Water Board to draw on this report to inform the pending EIS document.

Impacts to Karuk Tribe

The impact of the LKHP on Karuk culture as well as the health of Tribal members is well described in the 2012 EIR/EIS. Generally, loss of fish impairs our members' ability to fully participate in traditional cultural and religious activities. In addition, denied access to traditional foods has direct effects on the health of Tribal members. Karuk Tribal members have been adversely impacted by poor water quality and high levels of cyanotoxins resulting from operation of the LKHP. A more detailed description of these impacts was included in previous scoping comments on the previous FERC application to relicense the LKHP submitted to the Water Board January 29, 2016.

Timeliness

The Amended KHSA calls for dam removal to be completed in 2020. It is imperative that the Water Board act in accordance with this timeline and approve a 401 permit for facilities removal in time for FERC to act on the pending transfer and surrender applications.

Additional Information

Recently, the Yurok, Karuk, and Hoopa Tribes jointly produced a review and recommendations related to managing effects of *Ceratonova shasta* (*C. shasta*) infections of juvenile salmonids. This document, *Measures to Reduce Ceratonova shasta Infection of Klamath River Salmonids: A Guidance Document*, is included. This document discusses the role dams play in the high infection rates of salmonids and how the Bureau of Reclamation may better manage flows to mitigate the problem. This new information should inform the EIS.

Conclusions

The Karuk Tribe appreciates the diligent efforts of State Water Board staff to develop the required environmental review documents necessary to meet state and federal laws and best inform the decision over granting a permit for dam removal. We urge the state board to remain focused on the best available peer reviewed science available and to act in a timely manner.

Pursuant to Governor Brown's executive order B-10-11 regarding Tribal consultation and the new CEQA requirments of AB 52, we look forward to government to government consultation in the near future as you make progress on developing the EIS.

Yootva,

Leaf Hillman
Director
Karuk Department of Natural Resources

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January 29, 2016

Parker Thaler
State Water Resources Control Board
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RE: Karuk Tribe Scoping Comments on the California Water Resources Control Board's Notice of Preparation of an Environmental Impact Report for the Klamath Hydroelectric Project Relicensing

Ayukii Mr. Thaler:

The Karuk Tribe appreciates the opportunity to comment on the scope of the Environmental Impact Report related to the Clean Water Act permitting of PacifiCorp's Klamath Hydroelectric Project.

The Karuk Tribe remains disappointed by Congress' failure to resolve the issues surrounding the Klamath Hydroelectric Project by enacting legislation that would implement a trio of settlement agreements negotiated by Klamath Basin stakeholders. Implementation of those agreements would have mooted out this proceeding entirely. Although we remain cautiously optimistic that an opportunity to resolve the fate of the Klamath dams through a negotiated settlement remains, we will now urge the Water Board to move forward with the Clean Water Action section 401 permitting process.

The State Water Resources Control Board (State Water Board) issued a Notice of Preparation of an Environmental Impact Report for the Klamath Hydroelectric Project Relicensing in November of 2015. Under the California Environmental Quality Act (CEQA) a Lead Agency is required to solicit comments on a Notice of Preparation (NOP) from interested parties. The Karuk Tribe is submitting comments as a long term participant in the Klamath Hydroelectric Project (KHP) relicensing process and a signatory to the Klamath Hydro Settlement Agreement (KHSA). Reduced fish populations and poor water quality resulting directly from the operation of the Klamath Hydroelectric Project (KHP) have had profound impacts on the traditional cultural practices and the health of Tribal member.

Clean Water Act

Before the Federal Energy Regulatory Commission can issue a new license for the KHP, PacifiCorp must obtain water quality certification under Section 401 of the Clean Water Act (33 U.S.C. § 1341) from the State Water Board. Under Section 401 conditions of a water quality certification become conditions of any federal license or permit for the project. The State Water Board is the agency authorized to issue

certification of any potential discharge from an activity that requires a FERC license or amendment. The State Water Board adopted the Water Quality Control Plan for the North Coast Region (Basin Plan). The Basin Plan includes the Beneficial Uses and Water Quality Objectives necessary to project the Beneficial Uses. Together these constitute the Water Quality Standards that must be met before the State Water Board can issue Water Quality Certification. Issuance of a water quality certification is a discretionary action subject to CEQA compliance. The State Water Board has correctly chosen to prepare an Environmental Impact Report (EIR) because there are potentially significant impacts associated with the KHP.

California Environmental Quality Act

CEQA requires a lead agency to analyze the impacts of a project as defined in the CEQA Guidelines. In the case of an existing hydroelectric project that has been in operation before the adoption of the Clean Water Act and Endangered Species Act the ongoing impacts of the project will not register as significant. While CEQA considers the existing conditions as the baseline for analysis of project impacts the State Water Board must analyze the existing operations to determine compliance with the Clean Water Act. The KHP has been operating in violation of the Clean Water Act, and potentially other State and Federal Laws, and this must be disclosed in a discussion of the baseline conditions. Mitigation measures necessary to bring the KHP into compliance with State and Federal Laws must also be evaluated in the EIR. Dam removal is an alternative that must be considered and may be the only alternative that can bring the KHP into compliance with the Clean Water Act. The process of removing dams may result in short term impacts which must be weighed against the long term benefits of improved water quality and increased fish populations resulting from the opening of between 300 and 700 miles of habitat. These short term impacts should be evaluated consistent with natural river processes, and the State Water Board should gather information from other dam removal projects to inform this EIR. In the EIR the State Water Board should provide a separate analysis of the impacts to, or compliance with, the Water Quality Standards. Baseline conditions, the proposed project, and project alternatives must all be evaluated for compliance with the Water Quality Standards.

Environmental Impact Statement

As you know the Federal Energy Regulatory Commission (FERC) prepared an Environmental Impact Statement (EIS) for the KHP in 2007. As required by CEQA the State Water Board will use this EIS as the basis for developing the EIR. There are several issues of concern using the EIS as the basis for the EIR. First, the EIS was developed nine years ago and new information is now available concerning the impacts of the project. Second, FERC staff concluded in the EIRS that "Based on our detailed analysis of the environmental benefits and costs associated with the four alternatives considered in detail in this EIS, we conclude that the best alternative for the Klamath Hydroelectric Project would be to issue a new license consistent with the environmental measures specified in the Staff Alternative." While continued operation may be best for the KHP and PacifiCorp, we disagree that the continued operation can comply with the Clean Water Act, the Endangered Species Act, restore tribal cultural practices, and restore fisheries to historic sustainable levels. We believe, based on years of study, that the best and only alternative that can restore water quality and fisheries, is the removal of the four lower dams.

The National Environmental Policy Act does not require that impacts be identified based on thresholds of significance as required by CEQA. In the EIS FERC staff describe the project and project effects, but only provide vague analysis of the impacts that are often not supported by evidence. State Water Board staff will need to establish thresholds of significance and make clear determinations when and if mitigation is required.

Impacts to Karuk Tribe

CalEPA has developed an Environmental Justice (EJ) Program that is designed to reduce the impacts to "individuals disproportionately impacted by pollution in decision making processes". Karuk Tribe members have been adversely impacted by the loss of salmon, poor water quality, and high levels of cyanotoxins resulting from operation of the KHP. Continued operation of the KHP combined with the impacts of climate change will likely worsen the impacts to Tribal members. The Karuk Tribe has been impacted more than any other group from the operation of the KHP. State Water Board staff should consider EJ and ensure consistency with State Law when developing the Draft EIR. Finally, please be aware the Karuk Tribe participated in the development of a CalEPA EJ pilot project for the Klamath River. State Water Board staff should review the results of the pilot project.

Following are comments submitted by the Karuk Tribe to the North Coast Regional Water Quality Control Board in 2007 addressing the Cultural (CUL) and Subsistence Fishing (FISH) Beneficial Uses. These comments provide detailed information about the ongoing impacts to the Karuk Tribe, and will help guide in the development of thresholds of significance in the EIR.

The Water Quality Control Plan for the North Coast Region (Basin Plan) includes two Native American Cultural Beneficial Uses; Native American Culture (CUL) and Subsistence Fishing (FISH). The CUL beneficial use covers "uses of water that support the cultural and/or traditional rights of indigenous people such as subsistence fishing and shellfish gathering, basket weaving and regalia material collection, navigation to traditional ceremonial locations, and ceremonial uses"; FISH encompasses "uses of water that support subsistence fishing" (NCRWQCB 2007). CUL is designated as an "Existing" use in the Ukonom, Happy Camp, Seiad Valley, Klamath Glen, and Orleans Hydrologic Subareas of the Klamath River. Due to a lack of available information at the time of the last update of the Basin Plan, no waterbodies in the North Coast have been designated as "Existing" or "Potential" use for FISH. Based on the available information, however, Regional Water Board staff consider FISH an existing use within the same Hydrologic Subareas of the Klamath River as those designated CUL.

The CUL beneficial use in the Klamath River in California is currently impaired due to the decline of salmonid populations and degraded water quality resulting in changes to or the elimination of ceremonies and ceremonial practices and risk of exposure to degraded water quality conditions during ceremonial bathing and traditional daily activities. The FISH beneficial use is currently impaired in the Klamath River basin in California due to the decline of salmonid populations and other Tribal Trust fish populations resulting in decreased use, abundance, and value of subsistence fishing locations, altered diet and associated health issues, and increased poverty. Further, it is important to note that other beneficial uses, such as COLD and MUN, are linked to the support of the CUL and FISH beneficial uses throughout the year.

Decline in Salmonid and Other Fish Populations

Salmon are food, culture, and religion to the Klamath River tribes (Reed 2005). Religion, lore, law, and technology all evolved from the Tribal People's relationship with the salmon and other fish of the Klamath River basin (Pierce 2002, p.7-2). The Supreme Court has recognized the importance of salmon to Northwest tribes such as those in the Klamath River basin, concluding that access to the fisheries was "not much less necessary to the existence of the Indians than the air they breathed" (Pierce 2002, p.7-2).

The decline of salmon populations, as well as the decline of other Tribal Trust fish species of the Klamath River basin in California including sturgeon, eulachon (candlefish), and lamprey (eel), has impaired the CUL and FISH beneficial uses. Sufficient numbers of trust species must be maintained in the river to sustain the primary dietary needs of the Klamath River Basin Tribes. The federal government has allocated 50% of the total available harvest of salmonids in the Klamath River basin to the Tribes, as required by 50 CFR Part 661 (NOAA 1993). The elimination of the spring Chinook run above the Salmon River has resulted in the elimination of cultural ceremonies associated with the migration of this species through the length of the Klamath River. Declines in fish populations, especially salmonids, has also resulted in decreased use, abundance, and value of subsistence fishing locations, an altered daily diet that has been linked to health issues for Tribal Members, and increased poverty.

An elaborate ceremony called the First Salmon Ceremony, marks the passing of the first spring Chinook salmon up the Klamath River. This migrating salmon was allowed to pass all the way up the Klamath River to its spawning ground. It was believed that the first spring Chinook migrating upstream would leave its scales at each spawning location for the rest of the salmon run to follow (Roberts 1932 as cited by Sloan 2003, p. 25). This first migrating salmon of the year was considered taboo, and if eaten would cause convulsions and death. Thus, the First Salmon Ceremony allowed this fish to pass safely upstream, thereby lifting the taboo, and allowing the Native People to fish for salmon in the river (Waterman and Kroeber 1938 as cited by Sloan 2003, p.25). The dramatic decline in the spring Chinook run has made it impossible for the Klamath Tribes to conduct the First Salmon Ceremony. "And how do you perform the Spring Salmon Ceremony, how do you perform the First Salmon Ceremony, when the physical act of going out and harvesting that first fish won't happen?"(Leaf Hillman 2004 as cited by Norgaard 2005, p.35).

The Karuk Tribe historically depended on the abundant populations of fish found in the mainstem Klamath River for subsistence. However, as fish populations have declined the Karuk have shifted their reliance to other food source (Reed 2007). Ron Reed (2005), traditional fisherman and cultural biologist for the Karuk Tribe, states that there is only one remaining tribal fishery location that provides any level of subsistence fishing to the Karuk Tribe, Ishi Pishi Falls. According to Reed (2005), in 2002, about 1,500 fish were caught at Ishi Pishi Falls, in 2003 approximately 1,000 fish were caught, and in 2004 only 100 fish were harvested at this location. The limited harvest of fish at Ishi Pishi Falls has meant that even ceremonial salmon consumption is limited (Ron Reed Pers. Comm. as cited by Norgaard 2005, p.4). According to Norgaard (2006), in addition to declining salmonid numbers, the fishery at Ishi Pishi Falls is negatively affected by low flows. When flows are too low the ability to perform dip net fishing is limited and fewer fish are caught (Norgaard 2006).

The importance of fishing to Tribal Members is reflected by the fact that fishing locations are a form of real property (Pierce 2002, p.7-2; Sloan 2003, p.17). They can be owned by individuals, families, or a group of individuals, and can be borrowed, leased, inherited, and bought and sold (Sloan 2003, p.17, 18). The quality, use, and value of these fishing locations has been reduced as factors including increased siltation

and decreased salmonid abundance have occurred in the Klamath River and its tributaries (Sloan 2003, p.18, 28).

Historically, the Karuk Tribe had a platform fishery associated with each of their 100 Tribal village sites (Reed 2006). These fisheries were located near the tops of riffles, where eddies were created along the margins of the Klamath River. These areas of low velocity were where the salmon would hold. According to Reed (2006) these 100 platform fishery locations are no longer as productive as they once were, or are gone. Tribal elders convey that the riffles near these fishing areas have been filled in and flattened out by sediment, contributing to the decline in overall fish populations (Reed 2006), as well as contributing to the loss of a culturally significant way of life.

The decline of salmonids and other Tribal Trust fish populations in the Klamath River basin has altered the diet of each of the tribes along the river and its tributaries. Historically, traditional consumption of fish by the Karuk Tribe was estimated at 450 pounds per person per year, while in 2003 the Karuk People consumed less than 5 pounds of salmon per person, and in 2004 less than ½ pound per person was consumed (Norgaard 2005, p.13). In 2005 over 80% of Karuk households surveyed reported that they were unable to harvest adequate amounts of eel, salmon or sturgeon to fulfill their family needs (Norgaard 2005, p.4). Furthermore, 40% of Karuk households reported that there are fish species that their family historically caught, which are no longer harvested (Norgaard 2005, p.7).

The decrease in abundance and availability of traditional foods, including salmon, trout, eel, and sturgeon, is responsible for many diet related illnesses among Native Americans including diabetes, obesity, heart disease, tuberculosis, hypertension, kidney troubles and strokes (Joe and Young 1993 as cited by Norgaard 2003, p.9, 39). These conditions result from the lack of nutrient content in foods consumed in place of the traditional foods such as salmon, as well as from the decrease in exercise associated with fishing and gathering food (Norgaard 2003, p.40). The estimated diabetes rate for the Karuk Tribe is 21%, nearly four times the U.S. average, and the estimated rate of heart disease for the Karuk Tribe is 39.6%, three times the U.S. average (Norgaard 2003, p.40).

In addition to altered diet and increased health issues, declines in fish populations have resulted in a documented increase in poverty rates for some Klamath tribes.

> The destruction of the Klamath River Fishery has led to both poverty and hunger. Prior to contact with Europeans and the destruction of the fisheries, the Karuk, Hupa and Yurok Tribes were the wealthiest people in what is now known as California. Today they are amongst the poorest. This dramatic reversal is directly linked to the destruction of the fisheries resource base.
>
> The devastation of the resource base, especially the fisheries, is also directly linked to the disproportionate unemployment and low socio-economic status of Karuk people today. Before the impacts of dams, mining and over fishing the Karuk People subsisted off salmon year round for tens of thousands of years. Now poverty and hunger rates for the Karuk Tribe are among the highest in the State and Nation. The poverty rate of the Karuk Tribe is between 80 and 85% (Norgaard 2005 Exec Summary).

Degraded Water Quality

Degraded water quality in the Klamath River basin in California, including the seasonal presence of algal toxins in the Klamath River and Reservoirs (see section 2.X), has impaired the CUL beneficial use. Known and/or perceived health risks associated with degraded water quality have resulted in the alteration of cultural ceremonies to exclude or limit ingestion of river water. Additionally, known or perceived risk of exposure to degraded water quality conditions during ceremonial bathing and traditional cultural activities such as bathing, gathering and preparing basket materials, and collecting and using plants has resulted in an impairment of CUL.

The Native American Tribes practice their culture through their ceremonies, such as the White Deer Skin Ceremony, the Brush Dance Ceremony, First Salmon Ceremony, Second Salmon Ceremony, and the World Renewal Ceremony (Reed 2005). All of these ceremonies require tribal members to be in close proximity to the Klamath River and the ceremonies are integrally linked to the river and its health (Sloan 2003 p.18).

According to Karuk Cultural Biologist Ron Reed (2006), the World Renewal Ceremony is held on the Klamath River at Clear Creek, Somes Bar, and Orleans during July, August, and September of each year. The Medicine Man, who leads the ceremony, walks 14 miles through the ridges and hills along the Klamath River and is joined halfway through his journey by children and adults of the Tribe who follow him the rest of the way for good luck. Upon reaching the Klamath River at the end of this walk, it was historically tradition to drink water from the river to complete the ceremony. This is no longer done due to health concerns about drinking water directly from the river, though children are still known to jump in and drink the water (Reed 2006).

Ceremonial bathing in the river is an important part of most ceremonies (Curtis 1924 as cited by Sloan 2003, p.28). For example, bathing in the Klamath River and its tributaries is a requirement for participants in the Brush Ceremony (Sloan 2003, P.16). "During the Fish Dam Ceremonies at *Kepel*, young girls were selected by the Medicine Man to participate in the ceremonies. Once selected, they were sent to the river to bathe and then were dressed in full regalia which they would wear during the ceremonies. Then they were sent home to their families, and were required to fast and bathe in the river every day" (Van Stranlen 1942 as cited by Sloan 2003, p. 28). During the World Renewal Ceremony, the Medicine Man and other participants bathe in the Klamath River for up to 10 days (Reed 2006).

Bathing is also associated with funeral services, subsistence practices, recreational swimming, courtship, and for individual hygiene (Reed 2007). Bathing associated with funeral rituals occurs year round and includes preparation for burial, and purification after burial (Curtis 1924 as cited by Sloan 2003, p.28). The Karuk Tribe historically bathed in the Klamath River, however in more recent years degraded water quality conditions during the summer have forced them to take precautionary steps and avoid contact with the water (Reed 2007). The Yurok Tribe has reported that detached algae have been present in the Klamath River in amounts high enough to prevent access and negatively affect the spirituality associated with bathing areas (McKernan 2006).

Willow roots, wild grape, Cottonwood, and Oregon Grape are collected by Tribal Members in the riparian zone of the Klamath River and used to make baskets (Reed 2007). Traditional collection of these basketry materials often involved wading in the water (Sloan 2007a), and further contact occurs when the material is washed and cleaned in the water (Reed 2007). Additionally, willow roots are peeled by mouth following cleaning with river water (Reed 2006). In addition, plants are collected for food, medicine, materials, and other cultural functions (Reed 2007). Gathering plants or plant materials involves wading and contact with

the Klamath River (Sloan 2007a; Reed 2007). Ingestion of water can occur because plants are often cleaned in the river water and water is consumed with medicinal plants (Sloan 2007a). Given degraded water quality conditions, ingestion of water may pose a potential health risk.

Table 1.a provides a summary of the activities that are encompassed by the CUL and FISH beneficial uses. Table 1.a also denotes when those activities occur during the year, and the footnotes identify the amount of physical contact with the water associated with each of these activities. This table is not comprehensive, but conveys the magnitude and diversity of activities that are covered under these uses. Based on the information presented, Regional Water Board staff find that the CUL and FISH beneficial uses of the Klamath River in California are not being fully supported.

Table 1.a: Karuk, Yurok, and Quartz Valley Tribes Cultural Beneficial Uses (CUL and FISH) of the Klamath River and Tributaries[4]

RESOURCE	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CUL												
Plants[1,3]	■	■	■	■	■	■	■	■	■	■	■	■
Fish[1]	■	■	■	■	■	■	■	■	■	■	■	■
Fishing[1,2]	■	■	■	■	■	■	■	■	■	■	■	■
Water-drinking, steaming, cooking[1,3]	■	■	■	■	■	■	■	■	■	■	■	■
Rocks[1]	■	■	■	■	■	■	■	■	■	■	■	■
Bathing[2]	■	■	■	■	■	■	■	■	■	■	■	■
Boating[1,2]	■	■	■	■	■	■	■	■	■	■	■	■
Wildlife[1]	■	■	■	■	■	■	■	■	■	■	■	■
Hunting & Trapping[1]	■	■	■	■	■	■	■	■	■	■	■	■
River & Trail Access[1]	■	■	■	■	■	■	■	■	■	■	■	■
Training[2]	■	■	■	■	■	■	■	■	■	■	■	■
Swimming[2]				■	■	■	■	■	■	■		
Prayer & Meditation[1]	■	■	■	■	■	■	■	■	■	■	■	
Fish Dam[1,2]							■	■	■			
Washing[1]	■	■	■	■	■	■	■	■	■	■	■	■
Meditation[1]	■	■	■	■	■	■	■	■	■	■	■	■
Wood Gathering[1]	■	■	■	■	■	■	■	■	■	■	■	■
Tanning Hides[1]	■	■	■	■	■	■	■	■	■	■	■	■
Roots[1,3]	■	■	■	■	■	■	■	■	■	■	■	■
Sticks, Shoots & Bark[1]	■	■	■	■	■	■	■	■	■	■	■	■
Weaving[1]	■	■	■	■	■	■	■	■	■	■	■	■
Shells[1]	■	■	■	■	■	■	■	■	■	■	■	■
First Salmon Ceremony[2,3]				■	■							
World Renewal Ceremony[2,3]							■	■	■			

FISH												
Plants[1,3]												
Fishing[1,2]												
Eeling[1,2]												
Shellfish[1,2]												
Water-drinking, steaming, cooking[1,3]												
Rocks[1]												
Bathing[2]												
Boating[1,2]												
Wildlife[1]												
River & Trail Access[1]												

Sources: Bowman 2006; Norgaard 2006; Reed 2007; Sloan 2007a, Sloan 2007b

Indicates time of use.

1-Wading, 2-Full submersion, 3-Ingestion of water
4-Tributaries utilized by the tribes of the Klamath river for cultural purposes include many of those from the Scott River down to the mouth of the Klamath river. Additionally, the Quartz Valley tribe utilized all tributaries which flow into the Scott and Shasta Rivers.
Note: This table is not an exhaustive list of all activities covered under the CUL and FISH beneficial uses.

Geographic Scope/Cumulative Impacts

The State Water Board should ensure the geographic scope of the project is large enough to encompass the impacts of the KHP. The impacts of reduced salmon populations from the KHP extend well beyond the mouth of the Klamath River. West coast salmon fisheries are managed based on populations of Klamath River fish. Low escapement numbers have resulted in the curtailment of commercial salmon fishing. The Southern Resident Killer Whales, which predate on salmon, are listed as endangered under the Federal Endangered Species Act. Sturgeon tagged in the Klamath River have been located in the Frazier River in British Columbia. These examples show the geographic scope of the project, and the impacts of the KHP, extend well beyond the mouth of the river.

The NOP states the water quality impacts of the portions of the KHP in Oregon "...will be addressed only to the extent that discharges from Oregon KHP facilities adversely impact the California environment". This approach may not address the cumulative impacts of actions taken by the Oregon Department of Environmental Quality and the actions of the State Water Board in California. For example, if the lower three dams in California are removed, and if J.C. Boyle Dam is not altered to provide adequate fish passage, the full benefits of fish passage provided by California may be achieved. The actions of both water quality agencies are cumulative and must be addressed. The same concern applies to Keno Dam. PacifiCorp has proposed removing Keno Dam from the FERC license, and the KHSA proposed to transfer the dam to the Bureau of Reclamation (who would operate the dam for the benefit of irrigators). The impact of these actions in combination with the actions taken by the State Water Board must be evaluated.

Water Quality Impacts

The effects of PacifiCorp's Klamath Hydroelectric Project (KHP) on water quality have been assessed in several previous efforts including by the Federal Energy Regulatory Commission (FERC 2007) and the U.S. Department of the Interior and California Department of Fish and Game (US DOI and CDFG 2012). Overall, the water quality information presented in those two documents is of high quality and provides a solid foundation to inform SWRCB's development of an Environmental Impact Report (EIR) for a Clean Water Act section 401 water quality certification for the relicensing or decommissioning of the KHP. The US DOI and CDFG (2012) document was prepared more recently and is more comprehensive so we recommend that SWRCB reply on it more heavily than the FERC (2007) document in cases where different conclusions are reached (e.g., the effect of the reservoirs on nutrient dynamics).

The Klamath Hydroelectric Project (KHP) has an overall negative effect on Klamath River water quality, and is causing violations of California's water quality standards including the Klamath River TMDL (NCRWQCB 2010). SWRCB's obligation under section 401 of the Clean Water Act (CWA) is to determine how the operation of the KHP can be modified in order to comply with California's water quality standards. The menu of experiments and water quality improvement measures described in PacifiCorp's

(2014) Reservoir Management Plan fall far short of what would be needed to comply with California's water quality standards. Despite a decade of experimentation and study, PacifiCorp has yet to offer a specific plan for how a combination of techniques could be jointly implemented to actually meet water quality standards. The lack of such a plan is extremely revealing. There are no feasible means besides dam removal for mitigating the KHP's two most consequential water quality impacts: alteration of water temperature and promotion of toxic cyanobacterial blooms.

The Klamath Hydroelectric Project (KHP) has an overall negative effect on Klamath River water quality. These effects include increased water temperatures in late summer/fall, cyanotoxins, substrate armoring, and release of water from Iron Gate reservoir with high ammonia, low dissolved oxygen, and high pH; however, the KHP also has some potentially positive effects including reduced nitrogen concentrations and cooling water temperatures in spring. These positive and negative effects generally diminish with increasing distance downstream of Iron Gate (although due to bioaccumulation of cyanotoxins transported from the reservoirs, effects on public health and biota continue to the river mouth and potentially to the costal margin). The river immediately below Iron Gate is very important due to high spawning use by chinook salmon, so effects in that reach are of particular concern.

All negative water quality effects of the reservoirs can be eliminated by dam removal. Nitrogen concentrations would likely increase long-term following dam removal (due to loss of nutrient retention within the reservoirs and more rapid downstream transit of water), but this is not likely to deleteriously affect D.O. and pH because downstream periphyton (algae attached the riverbed) communities are comprised of nitrogen-fixing species that can flourish even when nitrogen concentration is low. Thus, the effects of increased nitrogen are not likely to be outweighed by other effects of dam removal that would favor lower periphyton biomass, such as a more dynamic flow regime and restored sediment transport.

In this section we present a brief summary, including references, of the impacts of the Klamath Hydroelectric Project (KHP) on Klamath River water quality. For additional details, we refer to the following documents that Tribes have previously placed into the FERC record (KTOC 2006a, 2006b; QVIR 2006; QVIC 2006; Yurok Tribe 2006a, 2006b; HVT 2006a, 2006b; Resighini Rancheria 2006a, 2006b), as well as the references cited herein.

KHP Effects on Specific Aspects of Water Quality

Cyanobacteria and cyanobacterial toxins

► Microcystin toxins produced by the toxic cyanobacteria (blue-green algae) *Microcystis aeruginosa* represent a substantial threat to human and animal health (OEHHA 2005; Kann 2006; Kann and Corum 2006, 2007; OEHHA 2012). The Klamath River is listed as impaired by microcystin toxins from Stateline to its confluence with the Trinity River[1]. Microcystin concentrations generally decline with distance downstream of

[1] Final 2012 California Integrated Report (Clean Water Act Section 303(d) List / 305(b) Report) http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2012.shtml

Iron Gate Dam (US DOI and CDFG 2012) but frequently exceed public health guidelines between Iron Gate and Orleans, and occasionally exceed public health and water quality criteria as far downstream as the Klamath Estuary (HVTEPA 2013, YTEP Annual Blue-Green Monitoring Reports[2]). More recent genetic fingerprinting research showed that Iron Gate Reservoir is the source of downriver *Microcystis* assemblages and that Iron Gate Reservoir was determined to be the principal source of *Microcystis* found throughout the lower 300 km of river separating the reservoir from the Pacific Ocean (Otten et al. 2015).

► In the presence of abundant nutrients, the transformation from river to reservoir environment leads to massive blooms (Kann 2006; Kann and Corum 2006, 2007). Although nutrients are necessary for bloom proliferation, such concentrations alone are not sufficient to cause the magnitude of blooms observed in Copco and Iron Gate reservoirs. As a consequence, despite similar nutrient loads, *Microcystis* is uncommon in the free-flowing river reach above Copco.

► There are higher levels of microcystin toxin and *Microcystis* cell density below the Copco-Iron Gate reservoir complex than above the reservoirs (Kann and Asarian 2007; Kann and Corum 2006, 2007; CH2MHill 2008; Asarian and Kann 2011).

► PacifiCorp's KHP provides ideal habitat for *Microcystis* by transforming turbulent free-flowing river reaches into stagnant thermally-stratified impoundments that favor cyanobacterial proliferation. For example, US DOI and CDFG (2012) concluded: "Removal of the dams would eliminate the lacustrine environment that currently supports ideal growth conditions for toxin-producing nuisance algal species such as M. aeruginosa." and "Under a dam removal with KBRA implementation scenario, the production of algal toxins in Copco 1 and Iron Gate reservoirs would be eliminated. The algae producing these toxins do not grow in a free flowing river." In addition, as concluded by Otten et al. (2015), there was no evidence of endemic *Microcystis* populations in the flowing regions of the Klamath River, both upstream and downstream of Copco and Iron Gate Reservoirs, indicating that the river itself does not represent good cyanobacterial habitat.

► Samples collected in 2007 indicate microcystin bioaccumulation in freshwater mussels from the Klamath River below Iron Gate, and in yellow perch from Iron Gate and Copco Reservoirs. Concentrations of microcystin in the organisms indicated that consumption of such organisms would exceed established public health advisory values (Kann 2008, OEHHA 2008). In 2009, freshwater mussels collected from the Klamath River between Iron Gate Dam and the Yurok Reservation also showed microcystin levels above public health advisory values (Kann et al. 2010). Such bioaccumulation in the lower river occurred despite very low ambient microcystin concentrations indicating that even when ambient concentrations do not exceed public health guidelines that shellfish may be unsafe for consumption. Furthermore, as demonstrated in Monterey Bay, microcystin exported from upstream lakes can be bioaccumulated in marine animals (e.g., sea otters) that consume shellfish containing algal toxins (Miller et al. 2010). Although yet to be monitored for in the Klamath system there is great potential for algal toxin bioaccumulation in sea mammals, sea birds, and other biota in the estuary and near-coastal environment.

► Although only limited data are available regarding the concentrations of microcystin toxins in tissues of Klamath Basin salmonids, data from 2007 indicate microcystin

[2] Yurok Tribe Environmental Program: http://www.yuroktribe.org/departments/ytep/water_reports.htm

bioaccumulation in juvenile salmonids reared in Iron Gate hatchery (Kann 2008). In addition, trace concentrations of microcystin were found in Klamath River steelhead livers in 2005 (Fetcho 2006). Analysis of salmonid tissue samples collected by the Karuk Tribe also showed that Klamath River salmonids (chinook salmon and steelhead) were exposed to microcystin and that bioaccumulation in liver tissue occurred with concentrations in several fish livers exceeding public health guideline values (Kann et al. 2013). Although histopathological results were inconclusive, the measured toxins in livers point to the potential for recurring microcystin exposure and subsequent bioaccumulation of microcystins in Klamath River Salmonids

► Laboratory and field studies from elsewhere have demonstrated toxic effects of microcystin on salmonids (Andersen et al. 1993, Bury et al. 1997, Landsberg 2002) and other fish (Smith et al. 2008). Based on these studies, and the documented prevalence of microcystin the Klamath River, the potential clearly exists for sublethal (e.g., stress and disease) effects on salmonids from exposure to algal toxins.

► Other than dam removal, PacifiCorp has yet to demonstrate mitigations likely to effectively remedy the *Microcystis* problem. For example, Solar Bee circulators deployed in Copco Reservoir by PacifiCorp in 2008 did not appear to be effective at reducing microcystin concentrations (CH2MHill 2008), and a plastic curtain installed at the Iron Gate log boom did not prevent a pulse of *Microcystis* cells from moving downstream in September of 2008.

Temperature

Primarily due to the thermal mass of Iron Gate and Copco reservoirs, the KHP significantly alters water temperatures in the Klamath River (FERC 2007, PacifiCorp 2004, PacifiCorp 2005c) in ways that are detrimental to the various runs of anadromous fish in the Klamath River.

► The KHP causes warm temperatures in the fall, negatively impacting fall Chinook salmon spawning success and egg survival, and resulting in a delay in spawning run-timing of several weeks.

► The KHP cools the river in early spring, which depresses the growth and survival of juvenile salmonid during this critical life history stage because it keeps water temperature below the optimum growth temperatures for juvenile salmonids. The resulting smaller-sized Chinook salmon juveniles migrate downstream more slowly than would larger individuals (PFMC 1994) and are less likely to survive to maturity and to spawn (Nicholas and Hankin 1988). This increased transit time exposes them to prolonged stress, increasing their likelihood of becoming infected with parasites.

► PacifiCorp has acknowledged that adjustment in operation (e.g. using selective withdrawals, curtains, or flow augmentation) cannot effectively mitigate for these temperature impacts (PacifiCorp 2005a, 2005b; Scott 2005).

► The Klamath River TMDL requires that water released from Iron Gate and Copco Reservoirs cause "Zero temperature increase above natural temperatures"(NCRWQCB 2010). Dam removal is the only method that is likely to reverse these KHP impacts to water temperatures.

Nutrients

► By replacing a formerly free-flowing river with a series of reservoirs, peaking reaches, and bypass reaches, the KHP has greatly altered the hydrologic, physical, chemical, and biological processes of the Klamath River.
► To provide a range of estimates for how total phosphorus (TP) and total nitrogen (TN) concentrations at Iron Gate Dam might change under a dam removal scenario for the months of June through October, Asarian et al. (2010) compared relative retention rates in river reaches with results from a study of the Copco-Iron Gate Reservoir complex by Asarian et al. (2009). The results indicated that dam removal will result in only a very small increase in TP concentration in the Klamath River between Iron Gate and Turwar. TN concentrations will increase 37-42% at Iron Gate, with the magnitude of the increase diminishing with increasing distance downstream. The effect on TN is substantially diminished by Orleans and quite small at Turwar. The implications of this increase is discussed in the "Dissolved oxygen and pH" sub-section below.
► As PacifiCorp itself (2005d) has acknowledged, peaking and bypass operations inhibit the river's capacity to assimilate nutrients within the KHP area. Bypass operations also inhibit the decomposition of organic matter, passing on a greater oxygen demand to downstream river reaches. Due to insufficient data, such effects were not included in predictions of nutrient concentration by Asarian et al. (2010) cited above.

Dissolved oxygen and pH

► Photosynthesis and respiration by periphyton (algae attached the riverbed) and aquatic plants in the Klamath River can degrade dissolved oxygen and pH conditions, resulting water quality that is chronically stressful to fish (HVTEPA 2008, NCRWCB 2010, Asarian and Kann 2013).
► The KHP has a direct effect on D.O. and pH levels in the Klamath River immediately below Iron Gate Dam (FERC 2007). During the summer season the reservoir often releases water with high pH and low D.O. (Asarian and Kann 2013), which could harm salmonids in the vicinity of the dam. Phytoplankton blooms from KHP reservoirs tend to decrease daily minimum dissolved oxygen concentrations in the Klamath River, presumably by reducing light availability and rates of production from periphyton (Genzoli 2013, Genzoli and Hall, in review, Genzoli et al. 2015).
► The KHP dams interrupt the downstream transport of gravel, resulting in more coarse stream substrates (Biggs 2000). The Klamath Hydroelectric Project has had this effect on the Klamath River below Iron Gate Dam (FERC 2007). Larger substrate materials like cobble and boulder require higher flows to scour them than smaller substrates like gravel and sand. These coarse substrates are more stable, increasing the amount of periphyton and aquatic macrophytes than can grow (Biggs 2000, Anderson and Carpenter 1998), which in turn increases diel fluctuations in pH and D.O.
► Although nitrogen concentrations are predicted to increase in the mainstem Klamath River downstream of the dams following dam removal (Asarian et al. 2010), this is not likely to deleteriously affect D.O. and pH because periphyton communities are comprised of nitrogen-fixing species that can convert abundant atmospheric nitrogen into biologically available forms and flourish even when nitrogen concentrations are low (Asarian et al. 2014, Asarian et al. 2015, Gillett et al. 2016). Thus, increased nitrogen is not likely to increase periphyton biomass and would actually likely be outweighed by other effects of dam removal that would likely reduce periphyton biomass, such as a more dynamic flow regime and restored sediment transport.

Ammonia toxicity

► Data clearly show that ammonia concentrations are often substantially higher below Iron Gate Dam than above Copco Reservoir (Asarian et al. 2009, Kann and Asarian 2007, FERC 2007, Asarian and Kann 2011). These higher concentrations represent a localized toxicity risk to fish in the river below Iron Gate.

Fish parasites

The KHP promotes infection of salmonids by the myxosporean parasites *Ceratonova shasta* and *Parvicapsula minibicornis* in the Klamath River through:

► Providing habitat for the polychaete *M. speciosa* by:

- Increasing substrate stability below Iron Gate Dam (see "Dissolved oxygen and pH" sub-section above)(FERC 2007)
- Increasing the stability of the hydrograph below Iron Gate Dam by regulating flow of tributaries from Keno to Iron Gate Dam.

► Increasing salmon spawning density below Iron Gate Dam by blocking fish passage, delivering massive loads of myxospores in an area with high polychaete populations, which results in high infection prevalence of polychaetes in an area of salmon crowding (FERC 2007, Stocking 2006, Stocking and Bartholomew 2007).

► Deteriorating pH and D.O. conditions and increasing ammonia, which are conditions created by the KHP cause stress and immunosuppression in salmonids, increasing the likelihood that they will become infected and diseased (FERC 2007).

Evaluation of Pacificorp's Interim Measure 11 Studies and Reservoir Management Plan

With the stated goal to improving water quality within Copco and Iron Gate Reservoirs and the Klamath River downstream, PacifiCorp has conducted a series of activities under the Klamath Hydroelectric Settlement Agreement (KHSA) Interim Measures 10 and 11 and developed a Reservoir Management Plan (RMP) and (PacifiCorp 2014). Although PacifiCorp correctly states that the source of nutrient enrichment for the reservoirs is the result of upstream nutrient and organic matter loads, they do not directly acknowledge that the dams create the lacustrine habit required for the large and toxic cyanobacteria blooms that currently dominate (see above discussion). The RMP then proposes to implement management techniques that are aimed at improving reservoir water quality conditions related to nutrients, algae, dissolved oxygen and pH[3].

However, despite the aim of the RMP and the statement that the RMP "will also help to improve water quality in the Klamath River below the Project reservoirs" and "The implemented techniques, particularly when combined with implementation of appropriate TMDLs to control and reduce nutrient loads upstream of the Project, are expected to provide appreciable and sustained water quality enhancements in and below Copco and Iron Gate reservoirs" (PacifiCorp 2015a), no data or evidence are provided for how the proposed techniques will reduce toxic cyanobacteria blooms to meet Clean Water Act and public health thresholds. Rather, for those techniques that relate to cyanobacteria reduction, the RMP references ongoing evaluation of the

[3] (1) constructed treatment wetlands; (2) reservoir and tailrace aeration and oxygenation systems; (3) epilimnion (surface water) mixing and circulation; (4) selective withdrawal and intake control; (5) reservoir drawdown and fluctuation; and (6) algaecide treatment.

techniques, many of which have not moved past the modelling phase (e.g., surface mixing and circulation and reservoir drawdown), and for those that have, some have been discounted (e.g., destratification, solar powered circulators, phosphorus inactivation), and others have only undergone small scale testing. Those in the latter category (chiefly application of algaecide and implementation of an intake barrier to reduce algal entrapment downriver), have either been shown to be completely ineffective (algaecide) or existing studies have yet to show improvement in downstream conditions (intake barrier). Moreover, PacifiCorp has not provided information on how any of the proposed projects would be scaled to the size necessary to improve water quality on a reservoir-wide basis (even assuming water quality could be improved on a small scale basis such as in an isolated cove), let alone what the cost of such full-scale implementation would be.

The water quality improvement measures described in the RMP fall far short of what would be needed to comply with California's water quality standards. The current RMP is really more a menu of options or a study plan than it is a management plan. The RMP described various techniques, including conceptual ideas for how the techniques could be applied in Iron Gate and Copco Reservoirs, but there are no details provided regarding at what scale the techniques would be applied, what capital and maintenance costs would be, and what expected water quality outcomes would be. Despite a decade of experimentation and study, PacifiCorp has yet to offer a specific plan for how a combination of the techniques could be jointly implemented to meet water quality standards. There are no feasible means besides dam removal for mitigating the KHP's two most consequential impacts to water quality: alteration of water temperature and promotion of toxic cyanobacterial blooms.

The various Klamath River Tribes (as well as other federal and state agencies) have been evaluating and commenting on the management techniques proposed in the RMP as part of PacifiCorp's Interim Measure 11 studies (which consist of testing, design, or modelling) to address water quality conditions (Table 1)[4]. Those comments support our statement above that none of the proposed RMP projects have been demonstrated to improve cyanobacterial related water quality violations or public health. In the following sub-sections, we provide an overview of the major components of PacifiCorp's Interim Measure 11 studies and the Reservoir Management Plan.

[4] The list in Table 1 may not be exhaustive and therefore we request that SWRCB contact the Klamath Basin Tribes and other members of the Interim Measures Implementation Committee to obtain other relevant documents.

Table 1. List of 1) PacifiCorp IM11 study plans, 2) Tribal comments on PacifiCorp's IM11 study plans and draft reports, and 3) PacifiCorp responses to Tribal comments. Check boxes on left side of table indicate which topics/approaches are addressed in each document. Documents are sorted by date. Some of the dates are approximate (i.e., within a month). All documents listed were organized into folders according to Document Type and uploaded to an online archive accessible at: https://www.dropbox.com/s/exc6fkhmaiz7sw3/IM11_docs.zip

In-reservoir		Nutrient Reduction				Other				
Algaecides	Oxygenation/ Mixing	Iron Gate Outlet	Wetlands	Algae/OM remove	Chem. sequestration	KTAP	Approx. Date	Document Type	Document Filename(s)	Document Title and/or Citation
x	x	x	x	x		x	8/10/10	PacifiCorp IM11 study plan	PC Interim Measure 11 Plan - Draft.doc	Klamath Hydroelectric Settlement Agreement Implementation: Proposed Activities Related to Interim Water Quality Improvements (Interim Measure 11), preliminary draft
x	x	x	x	x			8/23/10	Tribal comment on PacifiCorp IM11 study plan	kier_imic_wq_study_plan_comments_2010 08 24.doc	Asarian, Eli. 2012. Comments regarding Klamath Hydroelectric Settlement Agreement Implementation: Proposed Activities Related to Interim Water Quality Improvements (Interim Measure 11). From: Eli Asarian, Kier Associates. Date: August 23, 2010.
x	x	x	x	x		x	10/18/10	PacifiCorp IM11 study plan	IM 11 Studies Cost Summary _Oct 18 2010_.pdf, IM 11 Study Plan Copco Algaecide _Oct 18 2010_.pdf, IM 11 Study Plan Iron Gate Intake _Oct 18 2010_.pdf, IM 11 Study Plan JC Boyle DO _Oct 18 2010_.pdf, IM 11 Study Plan Keno OM Removal _Oct 18 2010_.pdf, IM 11 Study Plan Treatment Wetlands _Oct 18 2010_.pdf, IM 11 Study Plan WQ Accounting _Oct 18 2010_.pdf	[final IM11 study plans for 2010, separate document for each study plan]
x			x	x			11/16/10	Tribal comment on PacifiCorp IM11 study plan	Yurok Comments on IM 11 Final Plans 111610.docx	Fetcho, Ken. Yurok Tribe Comments prepared with assistance from Eli Asarian on 3 Final Study Plans. Yurok Tribe, November 16, 2010.

In-reservoir		Nutrient Reduction				Other				
Algaecides	Oxygenation/ Mixing	Iron Gate Outlet	Wetlands	Algae/OM remove	Chem. sequestration	KTAP	Approx. Date	Document Type	Document Filename(s)	Document Title and/or Citation
x			x	x		x	5/13/11	PacifiCorp's response to comments on IM11 study plan	IMIC_IM11 Comment_Table_5-13-2011.pdf	PacifiCorp. 2011. PacifiCorp Responses to IMIC Comments on Interim Measure 11 Study Plans.
							4/27/12	Tribal comment on PacifiCorp IM11 report	2012.04.27 Yurok_PC Comments Draft Wetland Rpt.pdf	Fetcho, Ken. 2012. Comments letter to Tim Hemstreet, PacifiCorp. Subject: Yurok Tribe Comments on the draft document "Approaches to Water Quality Treatment by Wetlands in the Upper Klamath Basin". From: Ken Fetcho, Yurok Tribe. Date: April 27, 2012.
x	x	x	x	x		x	6/25/12	PacifiCorp IM11 study plan	IM11-WQStudyProgressRpts_June 2012.pdf	PacifiCorp. 2012. Klamath Hydroelectric Settlement Agreement Interim Water Quality Improvements (Interim Measure 11) Water Quality Study Progress Reports June 25, 2012
x		x		x			10/31/12	Tribal comment on PacifiCorp IM11 study plan	kier_imic_wq_study_plans_comments_20121031.doc	Asarian, Eli. 2012. Memo to Klamath Basin Tribal Water Quality Work Group. RE: Comments regarding Klamath Hydroelectric Settlement Agreement (KHSA) Interim Measure 11 water quality studies for 2012-2013. From: Eli Asarian, Kier Associates. Date: October 31, 2012. [note: header has incorrect date 9/31/2012]
x		x		x			12/31/12	PacifiCorp's response to comments on IM11 study plan	IM 11 Study Comment Response (Dec 31 2012) F.pdf	PacifiCorp. 2012. PacifiCorp Responses to Comments from IMIC Members on Interim Measure 11 Studies (Received October 29 to November 9, 2012).
x		x	x	x			2/28/13	Tribal comment on PacifiCorp IM11 study plan	Yurok comments 2013 IM 11 022813.pdf	Fetcho, Ken. 2013. Comments letter to Tim Hemstreet, PacifiCorp. Subject: Yurok Tribe Comments and Recommendations for 2013 IM 11 Water Quality Studies. From: Ken Fetcho, Yurok Tribe. Date: February 28, 2013.
x		x	x	x			3/4/13	Tribal comment on PacifiCorp IM11 study plan and reports	Karuk IM 11 Comments_3.04.13.pdf	Bowman, Crystal. 2013. Memo to Tim Hemstreet, PacifiCorp. RE: Review and recommendations for Klamath Hydroelectric Settlement Agreement (KHSA) Interim Measure 11 water quality studies. From: Crystal Bowman, Karuk Tribe. Date: March 4, 2013.
x		x	x	x	x	x	5/9/13	Tribal comment on PacifiCorp IM11 study plan and reports	IMIC IM 11 2013 Project Comments Karuk Tribe 05.09.13.pdf	Bowman, Crystal. 2013. Memo to Tim Hemstreet, PacifiCorp. RE: Review and recommendations for Klamath Hydroelectric Settlement Agreement (KHSA) Interim Measure 11 water quality studies 2013-2014. From: Crystal Bowman, Karuk Tribe. Date: May 9, 2013.

In-reservoir		Nutrient Reduction				Other				
Algaecides	Oxygenation/ Mixing	Iron Gate Outlet	Wetlands	Algae/OM remove	Chem. sequestration	KTAP	Approx. Date	Document Type	Document Filename(s)	Document Title and/or Citation
x		x	x	x	x	x	5/10/13	Tribal comment on PacifiCorp IM11 study plan	Yurok comments 2013-2014 IM 11 Study Plan 051013.pdf (and identical MS Word version: Yurok comments 2013-2014 IM 11 Study Plan 051013.pdf)	Fetcho, Ken. 2013. Comments letter to Tim Hemstreet, PacifiCorp. Subject: Yurok Tribe comments and recommendations for Klamath Hydroelectric Settlement Agreement (KHSA) Interim Measure 11 water quality studies 2013-2014 . From: Ken Fetcho, Yurok Tribe. Date: May 10, 2013.
x		x		x			5/16/13	Tribal comment on PacifiCorp IM11 report	Karuk Comments_ IM 11 Project Reports 2012.pdf	Bowman, Crystal. 2013. Memo to Tim Hemstreet, PacifiCorp. RE: Comments of PacifiCorp 2012 Draft Reports. From: Crystal Bowman, Karuk Tribe. Date: May 16, 2013.
x		x		x			5/17/13	Tribal comment on PacifiCorp IM11 report	Yurok comments 2012 IM 11 Draft Reports 051713.pdf	Fetcho, Ken. 2013. Memo to Tim Hemstreet, PacifiCorp. Subject: Yurok Tribe comments and recommendations for Klamath Hydroelectric Settlement Agreement (KHSA) Interim Measure 11 water quality studies 2013-2014. From: Ken Fetcho, Yurok Tribe. Date: May 17, 2013.
x							9/6/13	PacifiCorp's response to comments on IM11 study plan	Activity 5 Karuk Comment Response (Sep 6 2013).pdf	PacifiCorp. 2013. Responses to Comments of the Karuk Tribe on the Implementation and Monitoring Plan for the 2013 Environmentally-Safe Algaecide Application in Long Gulch Cove, Iron Gate Reservoir September 6, 2013
					x		1/30/14	Tribal comment on PacifiCorp IM11 study plan	IMIC Karuk Comments_Activity 7 Bench Testing IM 11 Draft Study Plan 02.03.14.pdf	Bowman, Crystal. 2014. Memo to PacifiCorp and Interim Measures and Interim Conditions Committee. RE: Review and comment on Interim Measure 11 Study Activities for 2013-2014, Activity : Pilot Study of Nutrient Reduction Methods in Klamath Basin Waterbodies, Initial Testing Approach and Prodeedures (Review Draft). From: Crystal Bowman, Karuk Tribe. Date: January 30, 2014.
					x		3/12/14	PacifiCorp's response to comments on IM11 study plan	IM Activity 7 Comments Responses f _Mar 12 2014_.pdf	PacifiCorp. 2014. Table B-1. Responses to Comments on the Activity 7 Draft Study Plan. March 12, 2014.
		x					3/24/14	Tribal comment on PacifiCorp IM11 report	KHSA IM 11 Iron Gate Intake Comments_Karuk Tribe 3.24.14.pdf	Bowman, Crystal. 2014. Memo to Tim Hemstreet and Linda Prendergast, PacifiCorp. RE: Review and comment on Assessment of an Intake Barrier for Water Quality Control at Iron Gate Reservoir - 2013 Study Results (Draft). From: Crystal Bowman, Karuk Tribe. Date: March 24, 2014.

In-reservoir		Nutrient Reduction				Other			
Algaecides	Oxygenation/ Mixing	Iron Gate Outlet	Wetlands	Algae/OM remove	Chem. sequestration	KTAP	Approx. Date	Document Type	Document Filename(s)	Document Title and/or Citation
x							5/6/14	Tribal comment on PacifiCorp IM11 report	Karuk_algaecide report comments_2013.docx	Corum, Susan. 2014. Karuk Tribe comments on: "2013 Localized Treatment of Long Gulch Cove in Iron Gate Reservoir Using Environmentally Safe Algaecide, Draft Technical Report, April 2014. Prepared for PacifiCorp by Watercourse Engineering Inc."
			x				5/20/14	Tribal comment on PacifiCorp IM11 report	Kier_IM11_Wetlands_20140520_draft.doc	Asarian, Eli. 2014. Memo: to Klamath Basin Tribal Water Quality Work Group. RE: Review and comments on (Draft) Demonstration Wetland Facility Preliminary Research and Implementation Plan Klamath River, Oregon. From: Eli Asarian. Date: May 20, 2014
			x				10/20/14	Tribal comment on PacifiCorp IM11 report	Kier_IM11_Wetlands_20141021_draft.doc	Asarian, Eli. 2014. Memo to: Klamath Basin Tribal Water Quality Work Group. Review and comments on (Final Draft) Demonstration Wetland Facility Preliminary Research and Implementation Plan Klamath River, Oregon. From: Eli Asarian. Date: October, 2014 [note: header has incorrect date 5/13/2014]
				x			11/18/14	Tribal comment on PacifiCorp IM11 report	Karuk_IM11_OrgRemove_11.18.14.doc	Corum, Susan. 2014. Memo to: Pacificorp and Interim Measures Implementation Committee. Re: Review and comments on (Draft) Conceptual Design Evaluation for Full-Scale Particulate Organic Matter Removal from Klamath River Source Water Using Stormwater Treatment Technology, 2013. From: Susan Corum, Karuk Tribe. Date: Nov 18, 2014.
				x			11/21/14	Tribal comment on PacifiCorp IM11 study plan	KHSA_IM11_AlgalRemoval_20150121.docx	Corum, Susan. 2014. Conceptual Proposal for Removal of Algae Near Outlet of Upper Klamath Lake and Evaluation of Options for Re-Use. November 21, 2014.
	x	x	x	x		x	2/5/15	Tribal comment on PacifiCorp IM11 study plan	Karuk.studyplancomments.2015.020515.doc	Corum, Susan. 2015. Memo to: PacifiCorp and Interim Measures Implementation Committee. Re: Review and comment on Draft Study Plan Klamath Hydroelectric Project Interim Measure 11 Study Activities for 2015. From: Susan Corum, Karuk Tribe. Date: February 5, 2015.
				x			2/23/15	Tribal comment on PacifiCorp IM11 study plan	Karuk.2015.7.8.Comments.022315.pdf	Corum, Susan. 2015. Memo to: PacifiCorp and Interim Measures Implementation Committee. Re: Review and comment on Proposed IM11 study plans 7 (Algae Biomatter Utilization) and 8 (Algae Harvesting/Processing Methods and Removal Rates). From: Susan Corum, Karuk Tribe. Date: February 23, 2015.

In-reservoir		Nutrient Reduction				Other			
Algaecides	Oxygenation/ Mixing	Iron Gate Outlet	Wetlands	Algae/OM remove	Chem. sequestration	KTAP	Approx. Date	Document Type	Document Filename(s)	Document Title and/or Citation
x							2/25/15	Tribal comment on PacifiCorp IM11 report	Karuk_2014_Algaecide Report_comments.pdf	Corum, Susan. 2015. Memo to: Pacificorp and Interim Measures Implementation Committee. Re: Review and comment on Draft Technical Report: 2014 Localized Treatment of Long Gulch Cove in Iron Gate Reservoir Using Hydrogen Peroxide Based Algaecide. From: Susan Corum, Karuk Tribe. Date: February 25, 2015.
						x	4/9/15	PacifiCorp's response to comments on IM11 study plan	2014.04.16 Algaecide 2014 Comment Response.pdf	PacifiCorp. 2015. PacifiCorp Responses to Comments on the Draft Technical Report "Draft Technical Report - 2014 Localized Treatment of Long Gulch Cove in Iron Gate Reservoir Using Hydrogen Peroxide Based Algaecide". April 9, 2015.
	x	x	x	x		x	5/29/15	PacifiCorp IM11 study plan	IM 11 2015 WQ Study Plan F (May 29 2015).pdf	PacifiCorp. 2015. Study Plan Klamath Hydroelectric Project Interim Measure 11 Study Activities for 2015, May 29, 2015.
		x					6/10/15	Tribal comment on PacifiCorp IM11 study plan	2015.06.10 Karuk Comments-IM11-Study Activity 5.pdf	Corum, Susan. 2015. Memo to: PacifiCorp and Interim Measures Implementation Committee. Re: Review and comment on Proposed IM11 Study Plan for 2015: Study Activity 5. From: Susan Corum, Karuk Tribe. Date: June 10, 2015.

Comments on components of PacifiCorp's Interim Measure 11 studies and Reservoir Management Plan

Reduce nutrient load delivered to KHP reservoirs

As part of implementing the KHSA and in cooperation with other interested parties, PacifiCorp has been evaluating methods for reducing the amount of nutrients delivered from Upper Klamath Basin down the Klamath River into the KHP reservoirs. Activities have included convening a water quality workshop to evaluate various technologies (Stillwater Sciences et al. 2012, 2013) as well as funding a series of technical investigations of the potential to reduce nutrient loads using treatment wetlands (Lyon et al. 2009; CH2M HILL 2012, 2014), chemical application (CH2M HILL 2015), removal of algal biomass near Link Dam using stormwater technology (hydrodynamic separators, Watercourse Engineering, Inc. 2013b, 2014b, 2014c,) or other methods (PacifiCorp 2015).

Reducing nutrient loads is an important endeavor and specific reductions are prescribed in Total Maximum Daily Loads (TMDLs) for Upper Klamath Lake (ODEQ 2002), the Lost River (ODEQ 2010), and the Klamath River (NCRWCB 2010, ODEQ 2010). PacifiCorp's assessments have provided useful information which could assist in informing future development of projects to reduce the nutrient loads coming from the Upper Klamath Basin. However, most of the assessments lack cost estimates for full-scale deployment, and the one study that did provide a cost estimate (organic matter removal near Link Dam, Watercourse Engineering Inc. 2014b) indicated the cost per units of phosphorus removed was quite high relative to other approaches previously considered in other assessments (Corum 2014b).

We are a long way from having the comprehensive strategy and sufficient resources that would be required to substantially reduce nutrient loads. Numerous scientific, economic, political, and cultural obstacles remain, but with intensive effort and substantial investment over several decades, it may be possible to obtain the major reductions in nutrient load called for in the TMDLs. Even if such reductions were eventually achieved, they would at best only reduce the magnitude of the harmful algal blooms within KHP reservoirs, not eliminate them. Given that, the project location is relatively low in the watershed, the reservoirs would continue to receive nutrients from the upper basin including its agricultural lands, and will continue to foster cyanobacterial blooms by creating lacustrine habitat required for the massive planktonic blooms of toxigenic cyanobacteria currently observed. Meeting water quality standards within Iron Gate and Copco Reservoirs will be exceedingly difficult as long as the reservoirs remain in place.

Algaecide control of cyanobacteria

PacifiCorp has been evaluating various algaecides as a potential tool to locally improve water quality conditions in high public use areas of its reservoirs since 2008 (Deas et al. 2009, 2012; Watercourse 2013a, 2014a, 2015). While PacifiCorp acknowledges that algaecide treatment is likely not economic or feasible for fully addressing algal concerns in Project Reservoirs (which alone implies that the technique will not allow the hydro project to be water quality compliant) they go on to state that preliminary study results indicate that algaecide can be successful in reducing algal concentration while also reducing microcystin concentrations (see PacifiCorp's 2014 Application for Water Quality Certification; KHSA Implementation Report p. 23). This statement is strongly overstated and inconsistent with results of the pilot algaecide studies on which the tribes have submitted extensive comments (PacifiCorp 2012, Bowman 2013, Fetcho 2013a, Corum 2014b, Corum 2015a). For example, in comments provided on PacifiCorp's Draft Technical Report: 2014 Localized Treatment of Long Gulch Cove in Iron Gate, we demonstrated that when consideration was given to the control dynamics and when actual concentrations were compared through the course if the experiment, it was apparent that the algaecide

treatment was ineffective at controlling the toxic blooms in Copco Cove in 2012 (Corum 2015a). Specifically, the surface level of microcystin was higher post-event compared to pretreatment, and microcystin levels remained well above public health guideline values. Similarly for 2013, two out of three Post-Event samples in the integrated September sample from the treated area increased and showed much higher microcystin than all samples from the non-treated area showing that the treatment was not effective at reducing microcystin toxin (Corum 2014b). Finally regarding the 2014 study results, we also noted that algaecide treatment had little to no effect on microcystin or even increased it some instances, and in some cases algal biomass (chlorophyll) increased after some algaecide treatments (Corum 2015). It is clear from the IM 11 algaecide studies that algaecide application was not effective at controlling cyanobacterial blooms and toxins (in fact toxins often increased) in a small cove area, let alone on any scale that would allow the project to meet water quality criteria and public health objectives either in the reservoirs or downstream in areas of concern to the Tribes.

Selective withdrawal from Iron Gate Reservoir

PacifiCorp has pilot tested several configurations of selective withdrawal systems designed to reduce the amount of water withdrawn from the surface of Iron Gate Reservoir where algae are concentrated, with the goal of reducing the amount of *Microcystis* and associated toxins entrained into the Klamath River downstream. The initial design was a cover on the intake tower which did not work because after the cover was installed, the hydraulics adjusted to the presence of the intake (Miao and Deas 2014). In 2014 and again in 2015, a geotextile curtain was deployed upstream of the intake (PacifiCorp 2015).The Tribes have submitted extensive comments (Bowman 2013, 2014; Fetcho 2013a, 2013b, 2013c; Corum 2015b) on this IM 11 measure, and data to date do not show that the barriers tested were able to prevent cyanobacterial entrainment and prevent downstream public health exceedances of cyanobacteria and toxins. While results of the latest 2015 study are not yet available, previous testing showed the various barriers to be ineffective or not assessable due to poor study design. For example, comparisons of conditions in the reservoir vs. in the river downstream were not made on the same parcel of water in either 2012 or in 2013, and results were also confounded by diel patterns in the algae, patterns which PacifiCorp did not incorporate in their comparisons (Bowman 2014). Although they may be informative, study results for the 2015 intake barrier experiment will not provide the means to assess barrier efficacy due to very low algal and toxin levels above the barrier. Such a test would need to be performed in a year when algal concentrations are high (as often occurs) in order to evaluate whether the intake barrier might reduce downstream entrainment of cyanobacteria and toxins. Moreover, even low levels of toxins from Iron Gate Reservoir are associated with bioaccumulation in Klamath River mussels downstream (Kann et al. 2010), so marginal reductions in the amount of Microcystis released from Iron Gate Reservoirs will not be sufficient to meet all beneficial uses downstream.

Mixing

PacifiCorp is current conducting modelling to determine whether mixing water within reservoir coves could reduce cyanobacterial blooms (PacifiCorp 2015). This technology is yet another example in which the goal is only to improve water quality in localized areas (e.g., reservoir coves), not to meet Clean Water Act and public health thresholds. Mixing could also potentially be used to destratify reservoirs rather than just coves (PacifiCorp 2014), but PacifiCorp has not

proposed to attempt this in Iron Gate and Copco Reservoirs. As noted in the RMP "PacifiCorp does not propose to conduct further evaluation of potential destratification of Copco and Iron Gate reservoirs under this RMP" (PacifiCorp 2014).

Oxygenation

It is conceptually possible to use mechanical oxygenation to increase oxygen levels enough to meet dissolved oxygen criteria (MEI 2007, PacifiCorp 2014); however, it would be quite expensive and would not solved the reservoirs' other water issues (e.g., promotion of cyanobacteria blooms and alteration of water temperature).

Upcoming Documents Relevant to Klamath River Water Quality

In this section, we provide a list of recent and upcoming documents relevant to Klamath River water quality that were not included in the Secretarial Determination EIS/EIR (US DOI and CDFG 2012), plus a few of the most relevant documents that were not included in the FERC (2007) EIS but were included in the Secretarial Determination EIS/EIR[5]. These and other relevant documents can be found on the websites for Karuk Tribe (http://www.karuk.us/index.php/departments/natural-resources/somes-bar-water-quality), Yurok Tribe (http://www.yuroktribe.org/departments/ytep/index.htm), and the Klamath Tribal Water Quality Consortium's website (http://klamathwaterquality.com/documents.html)

In addition, we would like to take this opportunity to inform SWRCB of some studies/analyses that are currently in progress and therefore are not cited in the Specific Documents listed below, which include: 1) Klamath Tribal Water Quality Consortium's analysis of continuous phycocyanin probe data, 2) Karuk Tribe's analysis of 2011-2015 harmful algal bloom (HAB) monitoring, 3) Karuk and Yurok Tribes' analysis of diel patterns in cyanobacteria and microcystin.

We also request that SWRCB obtain all documents within the following categories, which we do not list individually in the Specific Documents list:

- All public health HAB memos through 2015 (both weekly and seasonal summaries) from PacifiCorp, the Karuk Tribe, and the Yurok Tribe.
- All Tribal annual reports on KHSA monitoring (e.g., continuous YSI data and nutrients).

Specific Documents

Asarian, E. and J. Kann. 2011. Asarian, E. and J. Kann. 2011. Phytoplankton and Nutrient Dynamics in Iron Gate and Copco Reservoirs 2005-2010. Prepared by Kier Associates and Aquatic Ecosystem Sciences for the Klamath Basin Tribal Water Quality Work Group. 60p + appendices. http://www.klamathwaterquality.com/documents/asarian_kann_2011_CopIG_res_2005_2010_rpt.pdf

Asarian, E. and J. Kann. 2013. Synthesis of Continuous Water Quality Data for the Lower and Middle Klamath River, 2001-2011. Prepared by Kier Associates and Aquatic Ecosystem Sciences for the Klamath Basin Tribal Water Quality Work Group. 50 p. + appendices.

[5] The Secretarial Determination EIS/EIR presents a quite comprehensive compilation of the water quality documents that were available at the time it was written, and including all the relevant documents cited there would overwhelm this list, which we intend to focus on the most recent information.

http://www.klamathwaterquality.com/documents/Klamath_2001_2011_sonde_rpt_20130502_final.pdf

Asarian, E. and J. Kann. 2014. Justification for Revisions Proposed in the Karuk Tribe's 2014 Water Quality Control Plan. Prepared by Riverbend Sciences and Aquatic Ecosystem Sciences for Karuk Tribe of California Department of Natural Resources, Orleans, California. 19 p. + appendices.

Asarian, J.E., Y. Pan, N.D. Gillett, and J. Kann. 2014. Spatial and Temporal Variation of Periphyton Assemblages in the Klamath River, 2004-2012. Prepared by Kier Associates, Portland State University, and Aquatic Ecosystem Sciences LLC. for the Klamath Basin Tribal Water Quality Work Group. 50p. + appendices. http://www.klamathwaterquality.com/documents/KlamPeriphyton_Phase1Final_20140623.pdf

Asarian, J.E., Y. Pan, N.D. Gillett, and J. Kann. 2015. Periphyton Assemblages and Associated Environmental Conditions in the Klamath River 2004-2013. Prepared by Riverbend Sciences, Portland State University, and Aquatic Ecosystem Sciences LLC. for the Klamath Basin Tribal Water Quality Work Group. 48p. + appendices. http://www.klamathwaterquality.com/documents/KlamPeriphyton_Phase2_20150819final.pdf

Genzoli, L. 2013. Shifts in Klamath River metabolism following cyanobacterial bloom. MS thesis. University of Wyoming, Laramie, Wyoming. 53 p. http://search.proquest.com/docview/1494791470

Genzoli, L. and R. O. Hall. *In review*. Shifts in Klamath River metabolism following a reservoir cyanobacterial bloom.

Genzoli, L., R.O. Hall, J.E. Asarian, and J. Kann. 2015. Variation and Environmental Association of Ecosystem Metabolism in the Lower Klamath River: 2007-2014. Prepared by the University of Wyoming, Riverbend Sciences, and Aquatic Ecosystem Sciences LLC. for the Klamath Tribal Water Quality Consortium. 44p. + appendices. http://www.klamathwaterquality.com/documents/Genzoli_2015KlamathMetabolism_final20151215.pdf

Gillett, N.D., Y. Pan, J.E. Asarian, and J. Kann. 2016. Spatial and temporal variability of river periphyton below a hypereutrophic lake and a series of dams. Science of the Total Environment 541: 1382–1392. https://www.researchgate.net/profile/Yangdong_Pan/publication/283013280_Spatial_and_temporal_variability_of_river_periphyton_below_a_hypereutrophic_lake_and_a_series_of_dams/links/5643935f08aef646e6c6b913.pdf

Hillman, L. 2014. Letter to Victoria Whitney (State Water Resources Control Board) and Charles Andrews (California Department of Pesticide Regulation). RE: Withdraw Permit for Algaecide Application. From: Lead Hillman, Karuk Tribe. Date: July 16, 2014.

Hoopa Valley Tribal Environmental Protection Agency (HVTEPA). 2013. Water Quality Monitoring by the Hoopa Tribal Environmental Protection Agency 2008-2012. Prepared by the Hoopa Tribal Environmental Protection Agency in cooperation with Kier Associates. 21p.

http://www.klamathwaterquality.com/documents/hoopa_2013_WQreport20082012_final.pdf

Kann, J. 2015. Evaluation of Cyanobacteria and Cyanobacterial toxins with reference to Selection of Water Quality Criteria for the Karuk Tribe of California. Technical Memorandum prepared for the Karuk Tribe Natural Resources Department, Orleans, CA. June 2014. 40 p.

Kann, J., L. Bowater and S. Corum. 2010. Middle Klamath River Toxic Cyanobacteria Trends, 2009. Aquatic Ecosystem Sciences LLC. and Karuk Tribe Department of Natural Resources. 25 pp.

Kann J, L. Bowater, S. Raverty, G. Johnson, and C. Bowman. 2013. Microcystin bioaccumulation and histopathology in Klamath River salmonids; 2010 study results. Technical Memorandum. Prepared by Aquatic Ecosystem Sciences LLC for the Karuk Tribe Department of Natural Resources, Orleans California. 52 p.

Kann, J. and C. Bowman. 2012. Middle Klamath River Toxic Cyanobacteria Trends, 2010. Aquatic Ecosystem Sciences LLC. and Karuk Tribe Department of Natural Resources. 42 pp. http://www.klamathwaterquality.com/documents/Karuk_Public_Health_Cyano_2010_Report_2_9_12_final.pdf

Karuk Tribe of California. 2011. Water Quality Assessment Report 2010. Karuk Tribe Department of Natural Resources, Orleans, CA. 23 p. http://www.klamathwaterquality.com/documents/Karuk_2011_WQ_Report_2010.pdf

Karuk Tribe of California. 2012. Water Quality Assessment Report 2012. Karuk Tribe Department of Natural Resources, Orleans, CA. 35 p. http://www.klamathwaterquality.com/documents/2012%20Karuk%20Water%20Quality%20Annual%20Report_FINAL.pdf

Karuk Tribe of California. 2013. Water Quality Assessment Report 2013. Karuk Tribe Department of Natural Resources, Orleans, CA. 33 p. http://www.klamathwaterquality.com/documents/2013WQAR.pdf

Yurok Tribe Environmental Program. 2011. Final 2010 Klamath River Continuous Water Quality Monitoring Summary Report. Prepared by Scott Sinnott. YTEP Water Division, Klamath, CA. 54 p.

Yurok Tribe Environmental Program. 2011. Final 2010 Klamath River Nutrient Summary Report. Prepared by Scott Sinnott. YTEP Water Division, Klamath, CA. 54 p.

Yurok Tribe Environmental Program. 2013. Draft 2012 Klamath River Continuous Water Quality Monitoring Summary Report. Prepared by Matthew Hanington. YTEP Water Division, Klamath, CA. 69 p.

Yurok Tribe Environmental Program. 2013. Final 2012 Klamath River Nutrient Summary Report. Prepared by Matthew Hanington and Kathleen Torso. YTEP Water Division, Klamath, CA. 56 p.

Karuk Tribe members and staff have unique knowledge of the Klamath River, fisheries, and water quality. The Karuk Tribe has conducted a number of studies related to water quality, cyanobacteria/cyanotoxins, and fisheries that are important to consider when preparing the Draft EIR. The Karuk Tribe will be directly affected by any changes to the operation of the KHP proposed by the State Water Board. Consistent with CEQA Guidelines section 15083 and the Karuk Tribe's Consultation Policy, we expect State Water Board staff to consult with Karuk Tribe members and staff during preparation of the Draft EIR.

Please contact Craig Tucker, ctucker@karuk.us, (916) 207-8294, with any questions regarding scheduling meetings with Tribal Council and staff regarding these comments.

Yootva,

Leaf G. Hillman
Director of Natural Resources and Environmental Policy

Additional References

Andersen RJ, Luu HA, Chen DZ, Holmes CF, Kent ML, Le Blanc M, Taylor FJR, and DE Williams. 1993. Chemical and biological evidence links microcystins to salmon netpen liver disease. Toxicon 31(10):1315-1323.

Anderson, C.W. and K.D. Carpenter. 1998. Water-Quality and Algal Conditions in the North Umpqua River Basin, Oregon, 1992–95, and Implications for Resource Management. Water-Resources Investigations Report 98–4125. U.S. Geological Survey, Portland, Oregon. Accessed online 11/4/20008 at <http://or.water.usgs.gov/pubs_dir/Pdf/98-4125.pdf>

Asarian, E. and J. Kann. 2011. Phytoplankton and Nutrient Dynamics in Iron Gate and Copco Reservoirs 2005-2010. Prepared by Kier Associates and Aquatic Ecosystem Sciences for the Klamath Basin Tribal Water Quality Work Group. 60p + appendices.

Asarian, E. and J. Kann. 2013. Synthesis of Continuous Water Quality Data for the Lower and Middle Klamath River, 2001-2011. Prepared by Kier Associates and Aquatic Ecosystem Sciences for the Klamath Basin Tribal Water Quality Work Group. 50 p. + appendices. http://www.klamathwaterquality.com/documents/Klamath_2001_2011_sonde_rpt_20130502_final.pdf

Asarian, E. J. Kann, and W. Walker. 2009. Multi-year Nutrient Budget Dynamics for Iron Gate and Copco Reservoirs, California. Prepared by Riverbend Sciences, Kier Associates, Aquatic Ecosystem Sciences, and William Walker for the Karuk Tribe Department of Natural Resources, Orleans, CA. 55pp + appendices.

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January 17, 2017

Measures to Reduce *Ceratanova shasta* Infection of Klamath River Salmonids: A Guidance Document

Prepared by the following members of the Disease Technical Advisory Team:

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Introduction and Purpose of Document

In recent years, high infection rates of the parasite *Ceratonova shasta* (*C. shasta)* have been linked to population declines in Klamath River salmonids. *C. shasta* is a metazoan parasite with a complex life cycle, and it infects both salmonids and the freshwater water polychaete worm *Manayunkia speciosa* (*M. speciosa*). Infected *M. speciosa* produce actinospores which infect salmonids. Infected salmonids produce myxospores which in turn infect *M. speciosa*. Clinical signs of the disease state exhibited by infected salmonids include necrosis of intestinal tissue that can be accompanied by a severe inflammatory reaction (enteronecrosis) and subsequent death (Bartholomew et al. 1989).

In the 2013 Biological Opinion (BiOp) regarding Klamath Project (KP) operations, National Marine Fisheries Service (NMFS) determined that KP activities exacerbated the impacts of *C. shasta* on listed Coho Salmon. NMFS subsequently developed an incidental take statement that established an infection threshold of 49% of sampled juvenile Chinook Salmon. Because Coho are in such decline, not enough individuals could be captured to directly determine Coho infection rates and thus Chinook served as a surrogate to determine rate of Coho infection.

Observed infection rates of Chinook Salmon sampled between the Shasta River confluence and the Trinity River confluence in May through July of 2014 and 2015 were 81% and 91% respectively – considerably exceeding the take threshold established in the Biological Opinion (True et al. 2016, NMFS and USFWS 2013). In order to propose guidance for science-based measures intended to mitigate the effects of *C. shasta* disease infection rates in coho and Chinook salmon below Iron Gate Dam, the Disease Technical Advisory Team (DTAT) was formed, and existing information was summarized into a series of four technical memoranda by the Arcata Fish and Wildlife Office (AFWO) of the United States Fish and Wildlife Service (USFWS).

The four memoranda are:

1. Sediment Mobilization and Flow History in Klamath River below Iron Gate Dam (Conor et al 2016-Geomorphic Memo);

2. Polychaete Distribution and Infections (Som et al 2016-Polychaete Memo);
3. *Ceratonova shasta* Waterborne Spore Stages (Som and Hetrick 2016-Spore Memo);
4. Prevalence of *C. shasta* Infections in Juvenile and Adult Salmonids (Som et al 2016-Fish Infection Memo).

Research described in these four technical memoranda (summarized in Appendix A and attached in full in Appendices B-E), indicate that disease rates are largely a function of flow regimes, water temperature, adult salmonid carcass densities, sediment regimes, and are potentially exacerbated by hatchery production goals and fish release strategies. The operation of the Bureau of Reclamation's (BOR's) KP affects the total volume of flow in the Klamath River, the hydrograph, and generally alters the geomorphological features of the Klamath River (NMFS and USFWS 2013, Geomorphic Memo). A consequence of the impaired natural flow is the elevated rate of *C. shasta* infection of the Southern Oregon Northern California Coho (SONCC) Salmon which is listed as threatened on the federal endangered species list (NMFS and USFWS 2013).

The purpose of this document is to synthesize information contained in these memoranda and other information sources and to provide management guidance intended to lower the incidence of *C. shasta* in the Klamath River mainstem for both Chinook and Coho Salmon. Management guidance means identifying conditions or actions below Iron Gate Dam that will help alleviate disease conditions.

The DTAT considered actions that might contribute to lessening the prevalence and/or severity of *C. shasta* in juvenile salmonids, including both flow and non-flow related measures. The DTAT considered physical possibility, safety, and a reasonable timeline for implementation in its review of possible guidance actions. In other words, guidance provided by the DTAT must be physically possible and achievable. Furthermore, the guidance provided in this document is intended for the period between now through 2023, which is the duration of the 2013 BiOp or dam removal, whichever comes first[1]. Measures described below are intended to be implemented in addition to the measures and management actions described in the 2013 BiOp. It is acknowledged that implementation of these measures is complex and will involve policy considerations that are not examined in this document.

[1] Dam removal is expected to change the physical nature of the river bed and it is assumed that this issue will be re-examined at that point in light of new conditions.

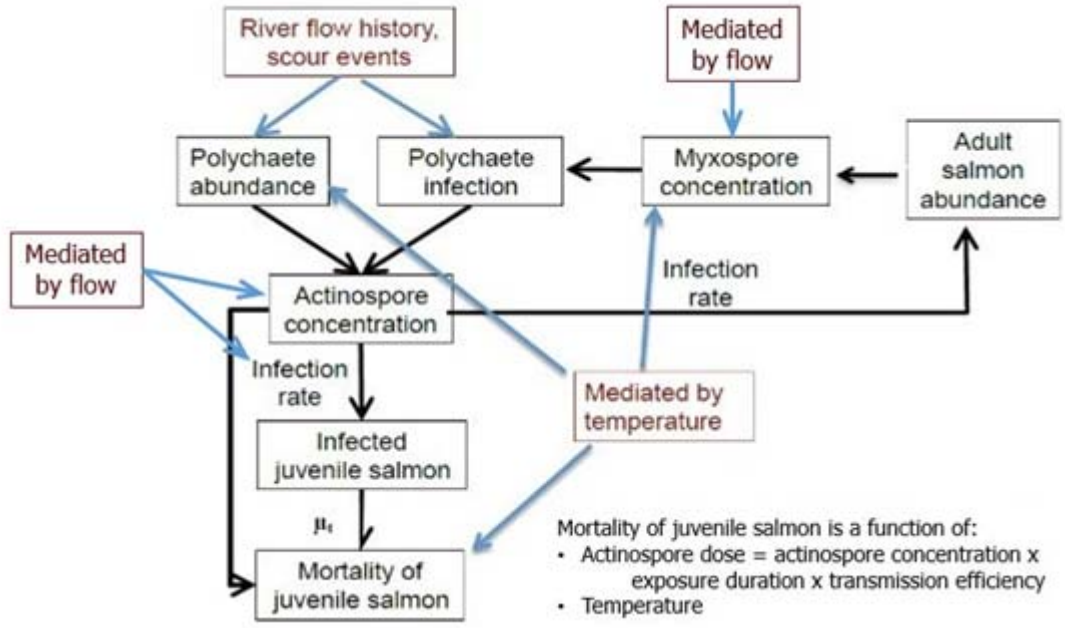

Figure 1: Conceptual model for variables that influence infection and mortality of juvenile Chinook salmon with μ_t being the mortality rate of infected juvenile salmon, estimated from weekly actinospore concentrations in water samples. Taken from Foot et al. (2011) and as cited in each of the four technical memoranda discussed below. (Figure from USFWS Memoranda). NOTE: Added "Mediated by flow" box to the conceptual model as supported by information contained in all four Technical Memoranda.

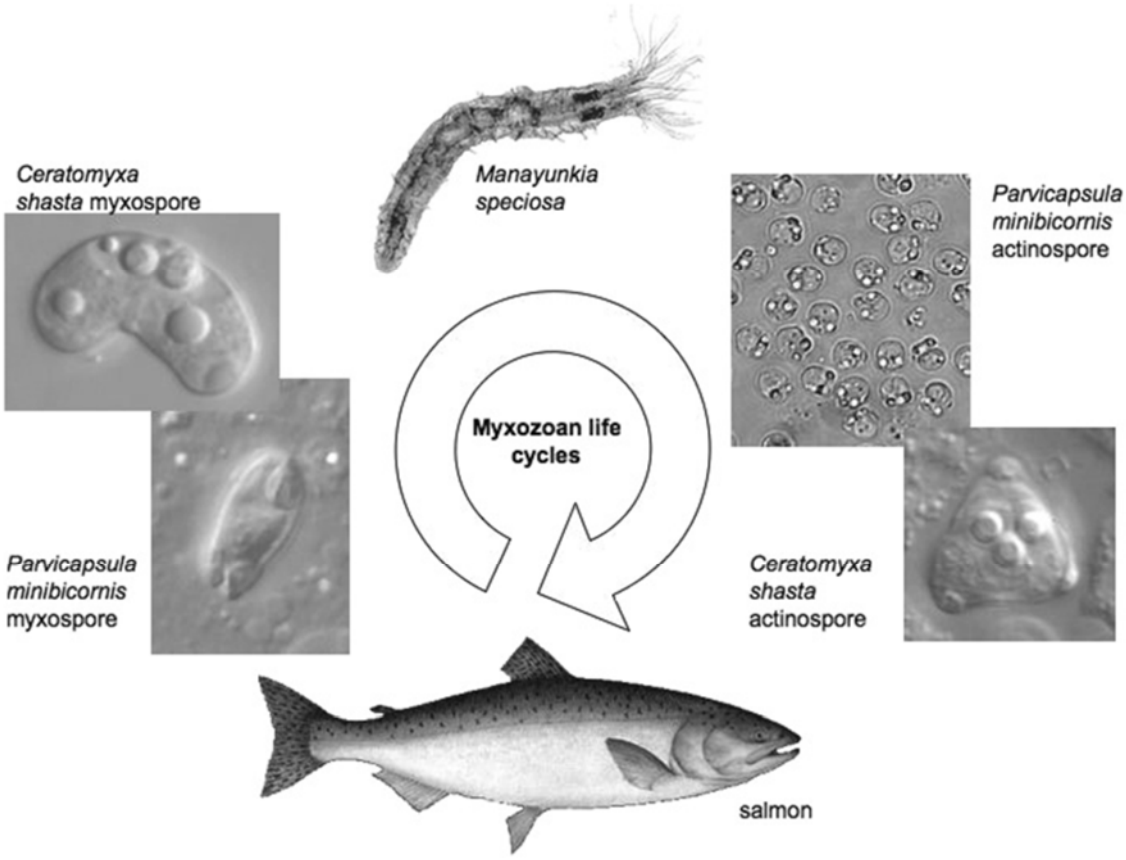

Figure 2 The life cycle of Ceratanova shasta and Parvicapsula minibicornis. Manayunkia speciosa is a small freshwater polychaete worm (3-5 mm in length) and intermediate host of both parasites. (Figure from USFWS)

Summary of Information Available to the DTAT

As discussed above, the USFWS in cooperation with other investigators and subject to peer-review, produced a series of four technical memoranda related to the issue of *C. shasta* in the Klamath River. Although the memoranda are an excellent summary of existing information on the subject, they do not contain guidance on specific management decisions to control the prevalence and severity of *C. shasta*.

The four memoranda are:

1. Sediment Mobilization and Flow History in Klamath River below Iron Gate Dam (Geomorphic Memo);
2. Polychaete Distribution and Infections (Polychaete Memo);
3. *Ceratonova shasta* Waterborne Spore Stages (Spore Memo);
4. Prevalence of *C. shasta* Infections in Juvenile and Adult Salmonids (Fish Infection Memo).

Each memorandum has a summary page of important facts presented in bullet-list form. These are presented in Appendix A.

Additional relevant scientific literature was reviewed and utilized.

Members of the DTAT also had personal communication with Scott Foott, Sascha Hallett and Julie Alexander, all of whom have relevant expertise with regard to *C. shasta*.

Adaptive Management Considerations

The DTAT recognizes the importance of applying a formalized Adaptive Management component to the implementation of any management action. The lifecycle of *C. shasta* is complex and the hydrology of the Klamath River is highly dynamic. Thus, to the extent practicable, any management actions should be carried out in such a manner as to allow for scientific observations to determine if predicted outcomes of the action are realized. These observations will in turn inform future management decisions.

We recommend that the Bureau assemble a technical group from fish management agencies and Tribes to ensure that studies are developed and appropriately funded such that field observations can be made before and after management actions are implemented, and technical memoranda published to inform future management decisions. In this manner we can constantly test our conceptual model and better understand the flow thresholds necessary to disrupt the various stages of the *C. shasta* lifecycle.

Overview of Disease Control Measures

A control measure is an action or condition that leads to the objective of reducing the prevalence and severity of *C. shasta* infections in the mainstem Klamath. The DTAT discussed a number of control measures, and considered all reasonable options, not just flow related options, to reduce the incidence and severity of *C. shasta* infections. However, some were considered physically impossible, ineffective, costly, or a combination of these factors.

Short Term Disease Control Measures

The team found several types of actions that could be implemented immediately that would have a high likelihood of reducing the infection prevalence and severity of *C. shasta* in the Klamath River. If this occurred, these actions would mitigate the disease impacts associated with the operations of the KP. These fall under the following broad categories each of which will be discussed more fully in the Management Guidance Sections.

1. Flow management
    a. Sediment flushing and/or geomorphic flows to control infected polychaete populations and promote a more functional hydrologic and geomorphic regime in the Klamath River;
    b. Spore dilution and disruption flows during juvenile outmigration in the spring;
    c. Pulse flows to redistribute and strand myxospores and possibly carcasses in late fall/winter.
2. Hatchery management
    a. Alter hatchery management practices to reduce abundance of juvenile fish during times of peak actinospore concentrations.

Longer Term Control Measures

These are measures which may yield long-term benefits to the *C. shasta* disease situation on the Klamath, but will not likely yield measureable results in the shorter term.

1. Large-scale nutrient reduction and eutrophication control. Excessive nutrient inputs to the Klamath River results in impaired water quality, but also contributes fine organic sediments

through algal production. These fine organic sediments are hypothesized to be a major food source for polychaete worms. High concentrations of nutrients alter the food chain of the river, which could be a factor in producing high numbers of polychaete worms.

2. Removal of Iron Gate, Copco I, Copco II, and J.C. Boyle Dams. The removal of the lower four Klamath River dams has been thoroughly evaluated in an Environmental Impact Statement on Facilities Removal (USDOI and CDFG 2012) and a Secretarial Determination Overview Report (USDOI and USDOC 2013). Both of these evaluations conclude that dam removal would provide opportunities to reduce juvenile salmon disease. Dam removal would reduce *C. shasta* disease rates by creating a more natural fish spawning distribution, a more natural carcass redistribution, improving water quality, and restoring some of the natural hydrological and geomorphic functions in and below the hydroelectric project reach. Substrate mobility would be significantly increased, which would reduce polychaete densities (Malakauskas et al. 2013). Dam removal has been proposed to the Federal Energy Regulatory Commission for consideration.
3. Integration of *C. shasta* control measures and application of the principles of Adaptive Management. Control of the *C. shasta* disease situation in the Klamath River will take many individual actions. Care should be taken such that the actions will be integrated together into a coherent disease control plan and that sufficient monitoring is conducted to gage progress. Even after dam removal, it is important to track how the ecology and disease processes of the river adapt to the new situation on the river.

Control Measures Considered but Eliminated from Further Consideration

1. Dewatering. The team considered dewatering as a means to control polychaete populations. This would involve reducing the flow in the Klamath River at Iron Gate Dam to a point where a significant proportion of the polychaete population are killed through desiccation. This idea was rejected for the following reasons: 1) the flow would have to be reduced by a very large amount (i.e. to less than 300 cfs) in order to affect a large number of polychaete worms, which would cause damage to other important ecological functions of the river, such as macroinvertebrate populations which are an important food source for juvenile salmonids, 2) recent work (see polychaete memorandum) indicates that polychaete worms infected with *C. shasta* are found in deeper portions of the river (Polychaete Memo Figure 4, page 8).
2. Manual carcass removal: The team considered the removal of adult salmon carcasses as a means to limit myxospore production, thus interrupting the life cycle of *C. shasta*. However, this idea was rejected because of logistic, ecological and safety concerns. Recent publication by Foote et al (2011) also suggests that carcass removal is neither technically feasible nor an effective strategy (Spore Memo page 11). This is not to be confused with carcass redistribution, which we recommend below.
3. Direct sediment introduction: Although the Geomorphic Memo demonstrates the importance of sediment movement in controlling the polychaetes as well as the effects that dam construction has had on the sediment budget of the upper Klamath River, the imminent

prospect of dam removal precludes this option on more than an experimental, small-scale basis[2].

4. Channel restoration – Process based channel rehabilitation would provide an improved channel planform that may result in dynamics that reduce *C. shasta* prevalence. However, with the imminence of dam removal and associated expected changes in river function and the significant investment and time required to alter the channel form through mechanical channel restoration, this was removed from further consideration.

Overview of Specific Guidance for *C. shasta* Disease Control Measures

The information that describes the *C. shasta* lifecycle (Spore, Polychaete, and Fish Infection Memos) indicates that: increased river flows at certain times of years can initiate the physical, geomorphic, and ecological changes that result in less disease in juvenile salmonids including Coho Salmon. However, flows are not just a function of irrigation diversions and BOR management, but of highly variable hydrologic conditions from year to year.

Based on the science summarized in the technical memos, the following measures can be reasonably hypothesized to aid in the control of *C. shasta*:

1. Initiation of surface flushing flows
2. Initiation of deep flushing flows and armor layer disturbance
3. Initiation of geomorphically effective flood flows
4. Fall flow variability to disrupt transmission of myxospores from salmon carcasses to polychaete[3] worms.
5. Spring dilution flows to address high spore concentrations.
6. Changes in Iron Gate Hatchery practices to reduce infection rates.

The data summarized in the four technical memoranda shows that the loss of dynamic high flow events have led to river channel conditions that favor the proliferation of *M. speciosa*, *C. shasta*, and high rates of fish disease. As stated in the Geomorphic Memo:

> *"Development of flow releases from Iron Gate Dam that are intended to adversely impact the C. shasta life cycle by targeting the disruption of the obligate invertebrate host as suggested by Alexander et al. (2016) should identify specific physical objectives. The specification should identify the desired form of bed modifications (e.g., sand mobilization or gravel mobilization) and the extent of the mobilization (e.g., from riffles, from channel margins, from pools, etc.). The frequency and seasonal timing of environmental flows should also be specified. Seasonal timing should be based on biological objectives and constraints. Seasonal timing might also be based on physical objectives such as sequencing flows to occur simultaneously or following unregulated tributary peak flows.*

The first three Management Guidance Actions are designed to mobilize sediments to reduce polychaete densities and abundance, thus lowering spore production, and the last three are intended to address

[2] If it becomes apparent that dam removal will not occur, or if it becomes significantly delayed, this option should be re-examined.

[3] "Polychaete worms" or "polychaetes" refers to the species *Manayunkia speciosa* throughout this document.

acute spore concentrations and hatchery practices that are thought to lead to *C. shasta* proliferation. Implementation of the geomorphically oriented management guidance actions may significantly reduce the need for the other management guidance actions such as spring dilution, fall variability, and hatchery changes.

Management Guidance 1: Provide Surface Flushing Flows to the Mainstem Klamath River Below Iron Gate Dam

Objective: The objective of this management guidance measure is to induce the movement of fine sediments below Iron Gate Dam in order to reduce the populations of the polychaete host of *C. shasta*, thus reducing the incidence and severity of *C. shasta* in the future.

Description: Implement flows sufficient to move surface sediments as described in the Geomorphic Memo in Table 3 during the winter period (Nov 1-April 30). Specifically, provide a flow of at least 6,030 cfs from Iron Gate Dam for a 72 hour period. Given the recent scarcity of these types of flows, this action should be implemented every winter until dam removal or the end of the 2013 BiOp. Existing guidelines contained in the 2013 BiOp should be followed with regard to downramping rate unless modified by the Technical Team or FASTA as necessary and supported by scientific information. As explained in the support and uncertainties section, the descending limb is important for the river to sort and distribute fine sediments.

Support: Although the Geomorphic Memo specifies a range of flows for the mobilization of surface sediment (5,000-8,700 cfs), 6,030 cfs is recommended because as indicated in the Geomorphic Memo, that magnitude of flow would mobilize fine sediment. . This management action would increase the number of days that the Klamath River below Iron Gate Dam is in a mobile surface substrate state and therefore increase frequency, magnitude and duration of fine sediment moving flows compared to 2014 and 2015, which had high disease incidence. The Polychaete Memo describes how populations of polychaetes can be kept in check by mobilizing sediments, and the Geomorphic Memo describes what flows are needed to accomplish various geomorphic objectives.

With regard to the magnitude of discharge necessary for a surface flushing flow, the Geomorphic Memo notes different estimates from three different studies in the Klamath River. However, the Geomorphic Memo uses the flow thresholds as described in Holmquist-Johnson and Milhous (2010) in describing the thresholds for later analysis (Geomorphic Memo Tables 3 and 4, Figure 4, 5). The recommended flow of 6,030 cfs falls within the range of flows for mobilization of surface sediments.

With regard to frequency of the discharge necessary for a surface flushing flow, the guidance provides for this flow to occur every year because low winter flow conditions since 2000 (Geomorphic Memo Figure 3) have resulted in overly stable river bed conditions which in turn have caused very high mortality rates from *C. shasta*. Therefore, the guidance is for this flow to occur each year for the duration of the BiOp. Additionally, the annual occurrence of in-reservoir phytoplankton blooms in PacifiCorp Project Reservoirs, primarily in Copco I and Iron Gate, results in a large amount of dead algae that is then released into the Klamath River (NCRWQCB 2010). Dead and decaying algal materials released down the Klamath River, including from cyanobacteria species, settle out and become a potential food source to support high-density polychaete colonies. The extent of this settling out of fine

organic sediments in the bed of the Klamath River is elevated during drought conditions due to the extended retention time and turn-over rate of water in PacifiCorp Project reservoirs, warmer water temperatures, and a corresponding increase in algal blooms in the PacifiCorp reservoirs (U.S. DOI and NMFS 2013).

The reduction in surface flushing flows experienced since the year 2000, relative to the 35 years prior, has resulted in fine sediment and suspended sediments accumulating on the bed of the river. This is a concern because high densities of *M. speciosa* have been observed in such deposits (Polychaete Memo). These sediments may provide prime feeding grounds for *M. speciosa*, given that in addition to being sessile suspension feeders they likely also have the flexibility to feed on organic matter in deposited sediments (Polychaete Memo).

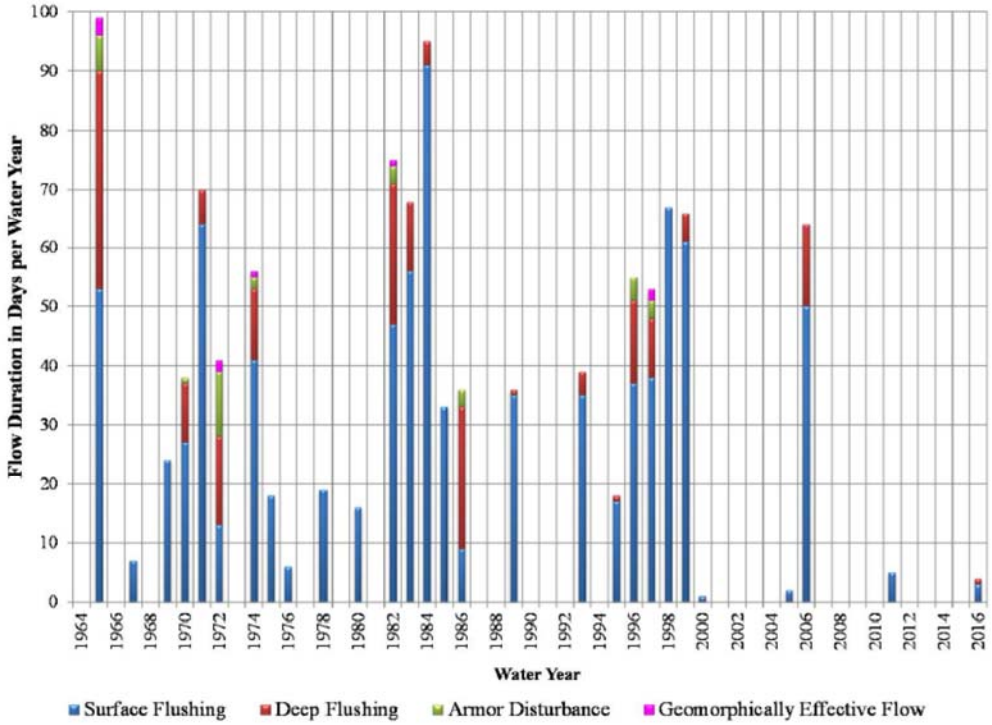

Figure 3: (Figure 5 in Geomorphic Memo), Duration of sediment mobilization flows in days per Water Year in the Klamath River below Iron Gate Dam for Water Years 1964-2016.

Uncertainties: The Geomorphic Memo provides a range of flows (5,000 cfs to 8,700 cfs) that will accomplish surface sediment mobilization (Geomorphic Memo Table 4). The estimated two year recurrence interval (Geomorphic Memo page 6) of 6,030 cfs was selected. It is uncertain exactly which sediments from which habitats will be mobilized from this magnitude and duration of flow, but indications are that at least some surface sediment will move.

In general, a longer duration event will accomplish more of the objective than a shorter duration, because more of the suspended sediments flush out of the river system, rather than being re-deposited further downstream. It is also preferable to have a gradual descending limb to the hydrograph, so that sediments can be sorted as they are deposited on the river bed. Thus it is recommended to follow the

existing guidelines for downramping as contained in the 2013 BiOp unless modified by the technical team or FASTA as necessary and supported by scientific information.

The response of the polychaete worm populations to surface flushing flows is also not known with complete certainty. However, there is strong evidence to suggest that frequent surface flushing flows minimizes available habitat for polychaetes (Polychaete Memo page 4, 5).

Adaptive Management Considerations and Monitoring Guidance: The central hypothesis behind this control measure is that surface flushing flows will induce sediment movement that will decrease polychaete densities to the point where spore production and therefore disease incidence will be less. Thus appropriate monitoring of all of these factors should be done within the availability of funding and personnel resources. The ongoing work on predictive modeling of polychaete presence, polychaete infection rates and distribution should continue to be funded because it allows understanding of the effectiveness of this control measure. In addition, appropriate geomorphic monitoring should be initiated to confirm that the flows provided achieved the sediment movement objectives identified.

Management Guidance 2: Provide Deep Flushing Flows and Armor Disturbing Flows to the Mainstem Klamath River Below Iron Gate Dam

Objective: Move sediment from deeper layers of the armored bed layer to remove polychaete worms attached to the armored bed layer in order to reduce polychaete density and reduce spore production of *C. shasta*.

Description: Provide a daily average flow of at least 11,250 cfs as measured in a 24 hour period in the Klamath River at Iron Gate Dam. This should be done at least once during the period of February 15 to May 31 in 2017 and thereafter at least every other year unless precluded by drought conditions. This action should be timed with peak releases from other tributaries such as the Scott River. This flow should occur after Feb 15th if possible to avoid scouring salmon redds and disrupting incubating salmon eggs because some level of gravel movement is expected.

Downramping rates as described in the 2013 BiOp should be adhered to in order to minimize stranding and facilitate the depositional sorting of mobilized bedload unless modified by a Technical Team or FASTA team and supported by scientific information.

This management action may need to occur during times of high accretion between Link River Dam and Iron Gate Dam due to outflow limitations at Link River Dam.

NOTE: if the deep flushing event as described in Management Guidance 2 results in flows above 6,030 cfs for at least 72 hours, it will fulfill the surface sediment management guidance action (#1). In this circumstance, there would be no need for separate implementation of Management Guidance 1.

Support: In addition to the surface flushing flows described above, the Klamath River has also experienced a significant reduction in deep flushing flows and armor disturbing flows (Geomorphic Memo, see also Figure 3 this document). Deep flushing flows are described as having a magnitude of 8,700 cfs to 11,250 cfs, and armor disturbing flows have a magnitude of 11,250 cfs to 15,000 cfs (Geomorphic Memo Table 4). The management guidance here is to provide flows at the top end of the range for deep flushing and the beginning of the armor disturbing flow threshold.

Deep flushing events have become rare over the course of the past 16 years (2000 to 2016) (Figure 3). Only twice in the last 10 years (2006 and 2016) were deep flushing flows observed with only one year, 2006, having a significant number of days (>10days)where the river was in a deep flushing state. While the event in 2016 briefly exceeded the deep flushing threshold in magnitude, it had a short duration substantially less than 24 hours. Armor disturbing flows have experienced an even more significant decline.

Despite the short duration of the March 2016 deep flushing flow event (peak discharge of 11,100 cfs) this event appeared to have a significant effect on the density of *M. speciosa* (Polychaete Memo), therefore the management guidance provided herein calls for a repeat of that flow magnitude based on past success. Of all the management action prescriptions, this appears to have the most demonstrated success at significantly reducing polychaete density.

Given the extremely high levels of C. shasta experienced in recent years, as well as the lack of high flows in recent years, it is recommended that this guidance occur in the winter of 2016-2017.

Uncertainties: The provision of flows of this magnitude entails a great deal of uncertainty primarily having to do with infrastructure capacity, safety, and hydrologic support. What is far more certain is that flows of this magnitude will have a significant effect on *M. speciosa* densities and abundance. While the implementation uncertainty is high, the uncertainty regarding the effect to polychaetes is very low. In other words, if this action is implemented, past monitoring has showed that there will be a negative effect on polychaete density.

The prescribed amount (11,250 cfs) is at the upper end of the deep flushing flow criterion (Geomorphic Memo Table 4), but at the bottom of the Armor Disturbance criterion. This prescription is intended to address both needs.

With regard to ecosystem effects of this guidance action, re-establishment of a more natural flow regime that includes high flows such as called for in this management guidance is expected to restore flows that are closer to the unimpaired natural flow regime. Please see discussions on page 2 of Geomorphic Memorandum regarding importance of high flows to riverine systems and also page 3 of the Fish Infection Memo regarding parasite-host imbalances resulting from ecosystem alteration.

Adaptive Management Considerations and Monitoring Guidance: Sediment movement as well as polychaete density and abundance should be monitored as well as monitoring in support of USFWS' and OSU's polychaete predictive habitat model.

Management Guidance 3: Provide Geomorphically Effective Flows on an Opportunistic Basis.

Objective: Provide high magnitude flows that move significant quantities of gravel and large-scale disruption of polychaete colonies in a wide variety of habitats.

Description: The Bureau of Reclamation, in cooperation with PacifiCorp and other fisheries co-managers including the Tribes, and taking public safety into account, shall look for opportunities to provide safe, short-term peak flows of higher magnitudes than 11,250 cfs whenever possible. Because of the

inherent unpredictability and public safety factors inherent in this recommendation, no specific flow magnitude or duration is named.

Support: The Geomorphic Memo describes in detail how flows above 11,250 cfs have declined in frequency and duration. The Polychaete Memo infers how these stable flow conditions have led to a proliferation of *M. speciosa*, and additionally show that unstable bed conditions (i.e. mobile sediment) dislodge polychaete worms (Polychaete Memo pg. 4). Provision of these flows will likely reduce the abundance and density of these worms, which will presumably lead to a reduction in spore production and a decrease in fish infection rates and severity.

Uncertainties: While there is little doubt about the effectiveness of high flows if the magnitude described above to reduce polychaete abundance, implementation of these types of flows has considerable uncertainty with regard to infrastructure capacity, public safety, future weather conditions, PacifiCorp facility operations, and other factors.

Adaptive Management Considerations and Monitoring Guidance: Ideally, it would be desirable to monitor sediment movement as well as polychaete density and abundance. In particular, it would be desirable to conduct monitoring in support of USFWS' and OSU's polychaete predictive habitat model.

Management Guidance 4: Emergency provision of flow in the spring to dilute spore concentrations of *C. shasta*.

Objective: Reduction of spore density and disease transmission through the provision of flows in the spring period (April 1 through June 15 or when 80%of the juvenile Chinook Salmon outmigration is estimated to have occurred).

Description: Hold in reserve 50 thousand acre feet (TAF) of water for the purposes of implementing spring disease dilution and disruption flows if the following thresholds are met:

1. Spore concentrations exceed 5 spores (non-specified genotype) per liter for the preceding sample based on qPCR from water filtration samples at any sampling station;

OR

2. The prevalence of infection (POI) of all captured fish (both wild and hatchery) exceeds 20% in aggregate for the preceding week at the Kinsman Rotary Screw Trap.

This guidance action should not be implemented if the juvenile catch at the Kinsman rotary screw trap is estimated to have exceeded 80% of the expected wild run. This can be based on the cumulative catch at Kinsman, Shasta, and Scott Rivers, historic averages, temperature units, and/or any other predictive tools developed in the upper Basin.

When disease levels begin to climb to detectable levels, initiate a state of readiness to prepare for higher releases through coordination of FASTA and PacifiCorp and Bureau of Reclamation personnel. If critical disease and fish presence thresholds described above are met, release water from Iron Gate Dam to achieve 3,000 cfs immediately at Iron Gate Dam.

Maintain flows at 3,000 cfs until spore or POI at Kinsman Trap sampling indicates a decrease in disease levels. If disease levels are still elevated, increase flows to 4,000 cfs after 7 days of 3,000 cfs until sampling indicates a change in disease levels. If disease levels become reduced below critical thresholds, reduce flows slowly and monitor changes in disease levels to ensure flows result in disease measurements below critical thresholds. Maintain elevated flows at the level required to abate disease below critical thresholds, as determined through monitoring and adaptive management, until 80% of wild juvenile fish are predicted to have out migrated past the Kinsman trap. After initiating this action, evaluate the efficacy of specific flow targets and durations and adjust flow thresholds and durations for subsequent years as directed by the Disease Management Team to account for learning and specific within year environmental conditions.

Support: Altered Klamath River flow regimes have enhanced the reproductive success of *C. shasta* at every stage of its lifecycle. Reduced spring flows exacerbate the transmission of actinospores to rearing and migrating juvenile fish, contributing to significant population level impacts. Flow increases can play an important role in mitigating the impacts of *C. shasta*, with greater water volumes and velocities resulting in reduced disease transmission (Bjork et al. 2010; Hallett et al. 2012; Ray and Bartholomew 2013). The Spore Memo provides some insights into how resource managers can use spring flow increases to dilute actinospore concentrations and disrupt infection in juvenile salmonids.

The concentration of actinospores in the Klamath River is a function of the total number of spores and the volume of water into which they are discharged (Spore Memo page 6-8). The effective dilution capacity of the river increases with increasing flows. Infection of juvenile salmonids is a function of water temperature, exposure, duration, and spore concentration (modified with volume and velocity).Therefore, simply diluting spore concentration by increasing flows can reduce infection. This is consistent with the observation of reduced disease infection rates and mortality estimates in wetter years with higher flows as opposed to drier years and lower flows although water temperature plays a role also. Increased flows also increase water velocity and have been shown to reduce transmission rates (Fish Infection Memo).

The Fish Infection and Spore Memos discuss the efficacy of high spring releases in reducing spore density. These memos concluded that previously planned discharges for spore dilution objectives (e.g. 1900 cfs) were likely too small to be biologically effective, with larger events likely needed to effectively reduce spore concentrations. Flows in low disease years like 2012, which were approximately 3000 cfs and 4000 cfs during the critical spring periods, provide some evidence of potential magnitudes required to reduce spore concentrations meaningfully.

Despite limited examples of higher flows in the spring that coincide with high disease periods due to altered flow management, information from 2005 and 2014 provide the best insight into how dilution of actinospores through sudden flow increases can provide a means to influence infection rates. In 2005, an uncontrolled spill event of 6,000 cfs was coincident with a decrease in infected fish and non-detection of spores in water samples (Spore Memo). The 2005 event lasted several weeks. In 2014, a planned flow increase to 1,900 cfs that lasted less than a day resulted in a modest decrease in spore concentrations (Spore Memo). Spore concentrations of 5 spores per liter (Hallett et al., 2012) and prevalence of infection (POI) of 20% (True et al. 2016) are strong indicators of impending and realized high disease rates. For example Hallett et. al (2012) found that a lethality threshold of 40% mortality

was reached with 10 spores per liter for Chinook and 5 spores[4] liter for Coho Salmon. These high levels of mortalities support using 5 spores per liter as a threshold to initiate this Management Guidance Action.

Both outmigration timing and pattern of POI levels in natural-origin juvenile Chinook salmon can vary between years, and the more these distributions overlap, the greater the adverse effect on the population.

For emergency flow releases to be effective, dilution flows need to occur as disease is worsening but before lethal doses are occurring in juvenile fish. Actinospores are generally released when temperatures are above 10°C and remain viable (able to infect salmon) at temperatures ranging from 11 to 18ºC (Foott et al. 2011). Given the lag time for analysis of samples of at least a week and trajectories of disease progression in past years, this recommendation was thought to be a prudent precautionary approach to avoid excessive mortality rates. Reclamation in the 2013 BiOp proposed flow increases for the Klamath River downstream of IGD to dilute actinospore concentrations within 24 hours of receiving information that disease thresholds have been met and used 5 spores per liter of Type II as a threshold (NMFS and USFWS 2013 page 41) so while this was only implemented once and with meager flows, this is a previously contemplated action. The unspecified genotyping referenced in the memo is in part to allow for much more rapid turnaround time for results (reduction of 2-4 days of process time), which would allow for more effective implementation for fish and water conservation. It is not disputed that there is sufficient information to assess C. Shasta through genotyping and that data would still be collected. Chinook salmon are the disease surrogate for coho in the Incidental Take Statement[5] (ITS) and incredibly important to tribal fisheries so they should be protected during these actions along with ESA listed Coho Salmon.

Uncertainties: As discussed briefly above, spring flows have been provided (whether deliberately or due to hydrologic conditions), but a direct cause and effect link is hard to establish. Part of the uncertainty is due to the effect of temperature. Low temperatures inhibit transmission of *C. shasta* (Fish Infection Memo), and low temperatures often coincide with higher flows. There is also inherent uncertainty regarding when 80% of the juvenile outmigration has been completed.

Adaptive Management Considerations and Monitoring Guidance: The implementation of this measure requires an investment in real-time data on spore concentrations and POI of fish at the Kinsman Trap. At present time, water samples are collected from various locations on the Klamath River ranging from Beaver Creek to Tully Creek once per week. *C. shasta* spores are filtered from the water and express shipped to OSU for DNA processing. Due to shipping time and logistics, the fastest turnaround time is approximately 7 days. Although it may not be possible to compress this timeline any further, it is recommended that water samples be filtered two times per week instead of one, and an alternate DNA analysis facility be employed if necessary. This will yield results twice per week instead of once. Degree days or Accumulated Thermal Unit analysis and other techniques provide promise for use in helping predict disease prevalence and outmigration timing. Tools of this type should be utilized to help maximize the efficacy of this action.

[4] Chinook and Coho are infected by different genotypes of C. shasta. The thresholds described are for type 1 genotype for Chinook Salmon and type 2 genotype for Coho Salmon.

[5] An incidental take statement (ITS) is a statement defining the allowable amount of take of an endangered species as a result of implementation of a proposed action.

Management Guidance 5: Provide flow in the late fall and early winter to redistribute salmon carcasses and myxospores.

Objective: Provide variable fall flows to redistribute salmon carcasses and move myxospores downstream.

Description: Provide a fall/early winter flushing flow of between 1500 and 2500 cfs for a period of 3-5 days between November 15th and January 15th to redistribute salmon carcasses and myxospores. Timing should coincide with tributary elevated flows during storm events when possible. Existing ramping requirements as described in the BiOp should be followed unless a Technical Team (i.e. FASTA, or DTAT) decides otherwise.

Support: The decaying carcasses of a small percentage of adult salmon post-spawn can emit large numbers of myxospores. The reduced frequency of late fall flow increases allows these carcasses to concentrate in slow velocity pools and reside within the active river channel for an extended period of time where they then release myxospores into the water column. Fall flow increases can redistribute carcasses downstream.

Modeling of polychaete habitat suggests that low velocity/ moderately (2-3m depth) deep pools have the highest concentration of infected polychaetes (Polychaete Memo). These types of slow pool habitats are presumed areas where carcasses, myxospores, and polychaetes will be in close contact resulting in higher infection rates of polychaetes, especially during times of low/stable flows (Spore Memo).

Uncertainties: While not much is known about the actual mechanisms involved in infection of polychaetes by myxospores, most experts agree that distributing carcasses further downstream or removing them from the stream channel would reduce infection rates of *M. speciosa*. QPCR methods do not distinguish between myxospores and actinospores present in the water sample, but water sampling should also occur during the time period before and after or ideally all year.

Adaptive Management Considerations and Monitoring Guidance: Real-time monitoring of the run and spawn timing and carcass counts would inform the timing of this fall pulse flow. Research and monitoring should be conducted to determine a peak flow target necessary to achieve carcass movement.

Carcass surveys already occur within the Iron Gate to Shasta Reach, but additional monitoring work load for those crews may or may not be feasible depending on year to year carcass abundances. Additional work may include more time marking carcasses, walking river banks looking for carcasses, snorkeling deep pools and taking photos. There may be a need for an additional monitoring crew in the event the carcass crews are not available.

Monitoring carcass movements could be achieved by attaching highly visible flagging and uniquely identifiable jaw tags to carcasses in variable locations (deep pools, riffles, and margins) prior to the pulse flow event. After the event, make an equal effort to re-encounter previously marked carcasses to determine new locations, travel distance, carcass condition and infection status.

In addition, gut samples from salmon carcasses should be collected to determine infection status. A sub sample of carcasses would be sampled to determine proportion of infected vs non-infected, specifically

carcasses removed from the river to estimate the pulse flow effect on myxospore load. It is unclear if level of infection on individual carcasses can be measured.

Management Guidance 6: Iron Gate Hatchery Release Strategy

Objective: Minimize:

1) the perpetuation of *C. Shasta* in the Klamath River that may be caused by infected hatchery juveniles carcasses
2) the infection, and subsequent mortality, of IGH Chinook from *C. Shasta*
3) negative interactions between hatchery/natural fish in the Klamath River, while meeting the two objectives listed above

Description: Implement release strategies based on real-time conditions for Iron Gate Hatchery fall Chinook that are timed to minimize overlap with peak *C. Shasta* infection levels in the Klamath River, while minimizing negative interactions between hatchery and natural fish in the Klamath River. Such strategies could include a combination of the following:

1. Release more yearlings (typically in mid-November) and fewer fingerlings in the spring
    a. May need to increasing rearing capacity for yearlings by installing circular tanks at the Fall Creek facility or making infrastructure improvements at IGH.
2. Continue to increase fingerling releases during May, rather than during June, as has happened since 2013, to minimize overlap with high disease prevalence in the river.
    a. May require heating of water for incubation/early life stage rearing at the hatchery so more fingerlings reach minimum size requirements for release during May, especially for eggs taken late in the spawning season.
    b. This should be balanced with consideration to minimize competition with natural rearing fish.
3. Consider reduction of fingerling releases relative to natural run size, especially during times that disease rates are expected to be high (e.g. drought conditions).

Support: Iron Gate Hatchery (IGH) has a production goal to release 6,000,000 juvenile Chinook salmon annually. This production goal includes the release of 5.1 million fingerlings at 90 fish per pound (fpp) between May 1 and June 15 and the release of 900,000 yearlings at 10 fpp between October 15 and November 20 (HSRG 2012). Fish are released when two of the following criteria are met (HSRG 2012):

- Achieve target release size (fingerlings at 90 fpp, or yearlings at 10 fpp)
- Release period (May 1 to June 15 (fingerlings). October 15 to November 20 (yearlings)
- River temperatures less than 65°F

Prior to 2012, fingerling releases occurred during the month of June (personal communication and data from Keith Pomeroy, IGH Manager), occasionally not until the third week of June. Since 2013, the hatchery began releasing fingerlings during May, annually averaging a release of 65% of the fingerlings during May. The remaining annual average 35% of fingerling releases has extended through mid-June. Table 1 shows the proportion of fish released during May vs. June since 2013.

Release Year	% Fingerlings May	% Fingerlings June
2016	46%	54%
2015	68%	32%
2014	62%	38%
2013	82%	18%
% of Total Release	65%	35%

There is considerable inter-annual variation in the timing of the peak POI rate of juvenile Chinook salmon in the reach of the Klamath River from the Shasta to Scott River (Fish Infection Memo, Figure 5). However, as noted in the Fish Infection Memo, the release period for fingerlings from IGH is substantially later than when the majority of natural origin Chinook fingerlings have emigrated from the upper river, and generally aligns with the highest weekly POI estimates for each year. Summaries of the weekly POI samples over the hatchery outmigration period suggest that a high proportion of the IG hatchery stock may become infected with *C. shasta*.

It is worth noting that relatively low levels of infection by *C. Shasta* have been detected in IGH fall Chinook fingerlings prior to release. Estimated infection rates ranged from 0% to 18% from 2011 – 2015 (average = 6.5%).

Substantial mortality of IGH fingerlings from *C. shasta* is a concern in regard to the loss of mitigation production for the benefit of fisheries. However, another substantial concern is that IGH fingerlings that die from *C. shasta* may perpetuate the life cycle of *C. shasta* in the Klamath River. Just as adult carcasses infected with *C. shasta* release myxospores that infect polychaetes, juvenile carcasses also release myxospores that can infect polychaetes. These infected polychaetes may then release actinospores that infect adult Chinook while migrating up the Klamath River en-route to spawning grounds. The actinospores within the adult salmon may then develop into myxospores, thereby increasing the magnitude of myxospores released by rotting adult salmon carcasses on the spawning grounds.

As summarized in the Fish Infection Memo, True et al. (2012) noted the development of myxospores in both Chinook and Coho salmon at 15-16 days post exposure, and hypothesized that juvenile salmonids in the Klamath River could contribute spores to the system and may contribute to polychaete infections in years with high disease severity. The development and release of myxospores in juveniles was further studied by Benson (2014), who found releases from fish occurring generally at or soon (within several weeks) after mortality. Benson (2014) also suggests the potential for juvenile hatchery Chinook Salmon to contribute more myxospores to the system than spawning adults, but notes the timing and spatial overlap of myxospore release from adults likely better aligns with the distribution of the polychaete hosts.

Uncertainties:

- The timing in regard to thermal units and the infection of adults by actinospores initiated by the release of myxospores from juvenile carcasses has not been assessed (but could potentially be done with existing data).
- The number of hatchery fish that can be released per time period during May without having excessive impacts upon natural rearing fish is unclear.

Adaptive Management and Monitoring Considerations: The hypothesis inherent to this management guidance action is that disease prevalence and severity can be affected by altering release strategies from Iron Gate Hatchery. The percentage and health of hatchery fish should continue to be monitored as implementation of alternative release strategies occurs.

CONCLUSION

In 2014 and 2015 extremely high rates of *C. shasta* infection exceeded the thresholds established in the NMFS incidental take statement associated with the BiOp on the Bureau of Reclamation plan for operating the Klamath Project. These high rates of infection play a major role in the population declines of Klamath River salmonids, including ESA listed SONC Coho Salmon.

A fruitful collaboration between USFWS and disease researchers yielded a series of technical memoranda that collectively describe the current understanding of the life cycle of the fish disease causing metazoan *C. shasta* and its response to changes in river flows at various times of year. From these memoranda, we have developed this guidance document to inform the federal agencies responsible for water management and ESA compliance in the Klamath Basin on what specific measures should be taken to reduce *C. shasta* infection rates.

Although much of this effort has been couched as necessary to meet agency obligations pursuant to the Endangered Species Act, we note here that Agencies' have a further obligation as trustees of Tribal resources. This Tribal Trust obligation extends beyond ESA listed species such as coho salmon to fall and spring run Chinook salmon as well as steelhead trout, all of which suffer from *C. shasta* infections.

The technical memoranda developed by the DTAT clearly demonstrate that disease rates can best be controlled by disrupting the habitat of *M. speciosa* and diluting *C. shasta* spores with increased flows. Perfecting the magnitude, duration, and intervals of these increased flow releases will be achieved over time through adaptive management practices; however, Klamath fisheries are in dire need of measures to alleviate high disease rates immediately.

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Appendix A. – Summary of Summary of Important Facts From USFWS *C. shasta* Technical memos published in October 2016.

This is summarized information from each of the four technical memoranda prepared in support of identifying management guidance actions to address high disease levels of *C. shasta* in the mainstem Klamath River below Iron Gate Dam. Each memo had a bulleted list of important conclusions which are presented here for convenience.

Sediment Mobilization and Flow History in Klamath River below Iron Gate Dam (Geomorphic Memo)

- Environmental flows are developed by river managers to mitigate the detrimental impacts of dams and water diversions on river form and ecological functions. Environmental flow regimes designed to induce geomorphic changes are broadly divided into two categories, sediment maintenance or "flushing flows" used to modify substrate composition and channel maintenance flows intended to maintain channel form and floodplains.
- In developing environmental flow regimes, it is important to recognize conflicts in objectives and constraints on flow releases.
- There are three contemporary studies that estimated sediment transport thresholds in the Klamath River below Iron Gate Dam
- The sediment entrainment threshold estimates reported in the three studies varied due to differences in study methods employed and the dates when channel substrate and channel conditions were evaluated.
- Ayres Associates (1999) concluded that floods of approximately 10-year return period magnitude rejuvenate the Klamath River channel by reworking gravels on riffles, eroding channel banks, re widening the channel, and removing substantial amounts of aquatic vegetation in the reach between Iron Gate Dam and the Scott River.
- The 1.5-, 2-, and 10-year return period for the Klamath River below Iron Gate Dam was estimated by Reclamation (2011) to be 4,389, 6,030, and 15,610 cfs, respectively.
- The 10-year return period of 15,610 cfs reported by Reclamation (2011) is consistent with the findings of Holmquist-Johnson and Milhous (2010) who estimated the threshold for general Armor Layer Movement to be 15,000 cfs and that of Ayres Associates (1999) who estimated the gravel mobilization on riffles to occur between 9,800 and 16,500 cfs for the reach between Iron Gate Dam and Seiad Valley.
- We classify discharges that exceed 15,000 cfs in the Klamath River below Iron Gate Dam as geomorphically effective flows, which are occasional high flows required to maintain channel form and reduce riparian encroachment.
- Other important considerations in flow include ramping rates, timing, duration, and monitoring and calibration.
- From 1964 to 1999, the average cumulative duration of Surface Flushing flows exceeded 22 days per water year. From 2000 to 2016, the average cumulative duration of Surface Flushing flow exceeded five days in only one water year and no sediment mobilization flows occurred in 12 of the 17 water years.

- At flow releases less than 2,500 cfs below Iron Gate Dam, Immobile Bed conditions exist that allow suspended sediments to settle and accumulate on the bed, which are not resuspended until flows that generate Surface Flushing occur.
- Growth of fine sediment deposits on the bed and channel margins is a concern because high densities of M. speciosa have been observed in such deposits. In addition, riparian and aquatic vegetation can colonize fine sediments, further narrowing the channel and degrading fish habitat conditions such as what has been documented on the Trinity River.

Polychaete Distribution and Infection (Polychaete Memo)

- The polychaete M. speciosa has been documented as the obligate intermediate host for the parasite *C. shasta*.
- Polychaetes in the Klamath River have been documented to be sessile suspension feeders and may also have flexibility to feed on organic matter in deposited sediments.
- Polychaete reproduction typically peaks in spring to early summer, coinciding with increasing water temperatures.
- Studies indicate that dislodgement of M. speciosa increases with increasing water velocities and decreasing substrate stability.
- Results of 2-D hydrodynamic model runs predict decreasing WUA (weighted usable area) of suitable polychaete habitat with increasing discharge.
- Results of repeat samples at specific locations in the Klamath River indicate a decrease in M. speciosa following the March 2016 peak discharge event of 11,200 cfs.
- Evidence suggests that the prevalence of *C. shasta* infection in polychaetes is negatively correlated with the peak flow regime.
- Preliminary results indicate that infected polychaetes are more likely to occur within a smaller range of peak-flow depths and velocities than the general population, with infected polychaetes more associated with deeper and lower-velocity depositional habitats.

Ceratonova shasta Waterborne Spore Stages (Spore Memo)

- A DNA assay allows for the quantification of spore concentrations in water samples.
- Spore genotypes have been shown to associate with salmonid species-specific mortality.
- Myxospores are hardier than actinospores, and likely survive for a longer period after release from their host organism.
- The majority of myxospore load to the system is likely via adult salmon carcasses in the fall.
- Generally, actinospore spore concentrations increase with increasing water temperatures in the spring and then decrease as water temperatures further increase during summer.
- The location of peak actinospore concentrations varies among years, but most frequently occurs near the confluence of Beaver Creek.
- It is not uncommon for actinospore concentrations to peak as far downriver as the Tully Creek confluence. However, the magnitude of the difference between the peak spore concentrations downriver and at Beaver Creek was much higher in 2016 than for any other year since water monitoring began.
- Annual peak actinospore concentrations vary by several orders of magnitude.
- Actinospore development within polychaetes is likely a function of accumulating thermal units, and likely takes between 100 and 115 days.

- Though managed discharge events have not produced dramatic reductions in spore concentrations, the planned discharge increases were likely too small to be biologically effective. An unplanned discharge increase in 2005 likely demonstrates the potential for larger discharges to effectively reduce spore concentrations.

Prevalence of *C. Shasta* Infections in Juvenile and Adult Salmonids (Fish Infection Memo)

- Temperature and spore concentrations are positively correlated with infection and mortality of both Chinook and Coho salmon.
- Carcasses of juvenile salmon infected with *C. shasta*, particularly hatchery-produced Chinook Salmon due to their timing of release and associated water temperatures, may be contributing significantly to the total myxospore load.
- Mortality predictions based on 3-day sentinel trial exposures likely underestimate the population-level impacts of ceratomyxosis.
- Both outmigration timing and pattern of POI levels in natural-origin juvenile Chinook salmon can vary between years, and the more these distributions overlap, the greater the adverse effect on the population.
- Carcass removal is not a viable method for reducing myxospore levels, in addition to being contrary to natural ecological processes.
- The majority of myxospores contributed to the system are most likely released by adult carcasses during a typically stable hydraulic period of managed water years.

Appendices B, C, D, E, F:

B. Geomorphic Memo
C. Polychaete Memo
D. Spore Memo
E. Fish Infection Memo
F. Comments and response to comments.

United States Department of the Interior

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In Reply Refer To:
AFWO

Technical Memorandum

TO: Dave Hillemeier, Yurok Tribal Fisheries, and
Craig Tucker, Karuk Department of Natural Resources

FROM: Conor Shea, Nicholas J. Hetrick, and Nicholas A. Som, Arcata Fish and Wildlife Office

SUBJECT: Response to Request for Technical Assistance – Sediment Mobilization and Flow History in Klamath River below Iron Gate Dam

DATE: September 29, 2016

Purpose. The Arcata Fish and Wildlife Office (AFWO) Fisheries Program is working with its scientific co-investigators to develop a series of four technical memorandums that summarize recent findings of studies that contribute to our current understanding of *Ceratanova shasta* (syn *Ceratomyxa shasta)* infections in the Klamath River, in response to requests for technical assistance from the Yurok and Karuk tribes. Each of the topics addressed in the four technical memorandums: 1) sediment mobilization review and streamflow history for the Klamath River below Iron Gate Dam, 2) polychaete distribution and infections, 3) actinospore and myxospore concentrations, and 4) prevalence of *C. shasta* infections in juvenile and adult salmonids, are identified in a conceptual model diagram (Figure 1) taken from Foott et al. (2011) and as discussed with the requesting tribes. The intent of the technical memorandums is to provide managers with a contemporary understanding of the state of the science with regard to the *C. shasta* in the Klamath River, and to provide a scientific basis to inform and support resource management decisions. The focus of this technical memorandum is to summarize the state of knowledge regarding environmental flow releases from the Iron Gate Dam to achieve specific objectives for channel form and ecological function. Other memorandums in this series will address how achieving these objectives will potentially influence various aspects of the *C. shasta* life cycle and population.

In this technical memorandum, we first summarize the state of knowledge regarding environmental flows to achieve specific objectives for channel form and ecological function. Then, the memorandum reviews estimates of flows necessary for achieving several channel substrate movement states in the Klamath River below Iron Gate Dam that were developed by three different research teams. The final section of the memorandum examines the frequency, magnitude, and duration of sediment mobilization flows for the Klamath River below Iron Gate Dam that have occurred since dam construction.

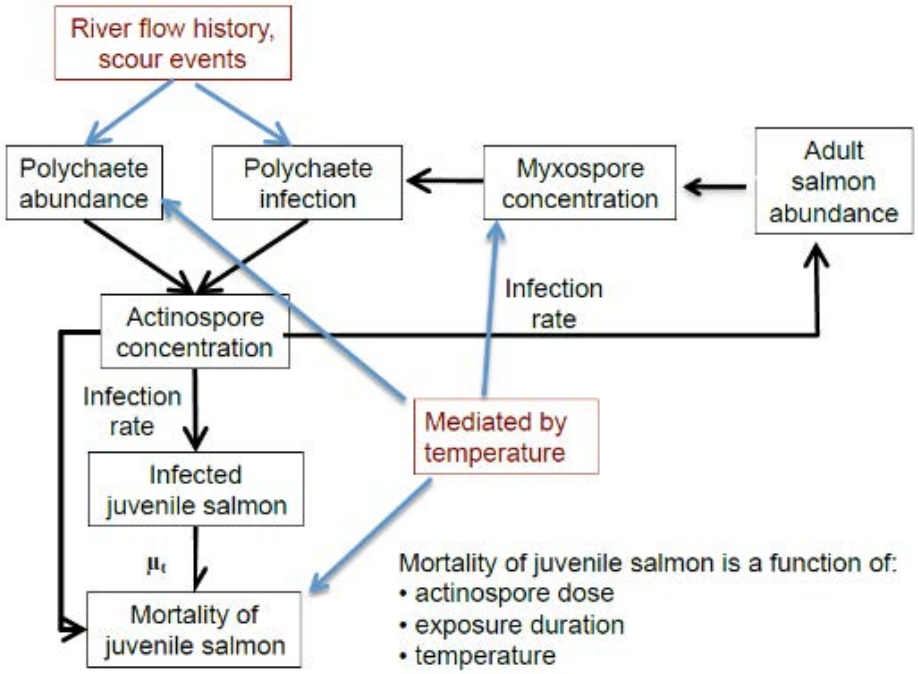

Figure 1. Conceptual model for variables that influence infection and mortality of juvenile Chinook Salmon, with μ_t being the mortality rate of infected juvenile salmon, estimated from weekly actinospore concentrations in water samples. (taken from Foot et al. 2011).

Environmental Flows. The physical and ecological responses of a river to construction of a dam or diversion of flow have been recognized for many years (Rathburn et al. 2009). A river's planform and cross section are formed in response to the flow that the river receives, the character and rate of sediment supplied to and transported by the river, and the characteristics of the vegetation, sediment, and substrate comprising the channel through which the river flows (Leopold, 1994). Similarly, a river's ecosystem is regulated and maintained by the temporal distribution, duration, and magnitude of floods and low flows (Karr 1991). The construction of dams and/or the creation of water diversions alter the natural hydrologic and geomorphic processes that maintain river form and habitat for aquatic and riparian species. Physical responses to dam construction or diversions can include downstream channel erosion and coarsening of bed substrate due to reduced sediment supplies, deposition of sediment on the bed due to reduced transport capacities, decreases in channel width and depth, and floodplain disconnection due to reduced magnitude and frequency of high flows (Kondolf and Wilcock, 1996, Williams and Wolman, 1984). Alterations to the flow regime likewise change the timing and movement of sediment, biological materials, and energy within rivers and between rivers and their floodplains, which disrupts the life cycles of riparian and aquatic species adapted to an undisturbed regime (Poff et al. 1997).

Definition. Environmental flows are developed by river managers to mitigate the detrimental impacts of dams and water diversions on river form and ecological functions. The term *environmental flow* as used in this memorandum is defined as the water regime in a river implemented to maintain geomorphic form, riparian and aquatic ecosystems, and their related benefits where flows are regulated. Environmental flows mimic components of natural flow

variability including the magnitude, frequency, duration, timing, and sequencing of both high and low flow events (Arthington et al. 2006). Environmental flow regimes can include diverse components designed to meet specific physical objectives such as maintaining aquatic habitat; removal of accumulated fine sediments; maintaining sediment balance, remobilization of gravels and formation of bars, scouring of vegetation, overtopping riverbanks with flow and sediment to augment floodplain development (Whiting 2002).

Environmental flow regimes designed to induce geomorphic changes can be broadly divided into two categories: (1) *sediment maintenance flows* (also commonly called *flushing flows*) that are made with the objective of removing sediment from a channel or otherwise modifying substrate composition; and (2) *channel maintenance flows* which are flow regimes intended to maintain channel form and floodplains (Kondolf and Wilcock 1996).

Identifying Physical Outcomes. River restoration activities often have poorly defined goals and fail to specify desired project outcomes (Bernhardt et al. 2005). Similarly, environmental flow releases are often made without a clear statement of desired physical outcomes and with insufficient consideration of the physical changes that a particular environmental flow regime will create (Kondolf and Wilcock 1996). To be effective, environmental flow objectives need to be specified in terms of desired physical responses. Table 1 presents a list of common geomorphic goals with corresponding physical objectives and required environmental flow parameters.

Development of flow releases from Iron Gate Dam that are intended to adversely impact the *C. shasta* life cycle by targeting the disruption of the obligate invertebrate host as suggested by Alexander et al. (2016) should identify specific physical objectives. The specification should identify the desired form of bed modifications (e.g., sand mobilization or gravel mobilization) and the extent of the mobilization (e.g., from riffles, from channel margins, from pools, etc.). The frequency and seasonal timing of environmental flows should also be specified. Seasonal timing should be based on biological objectives and constraints. Seasonal timing might also be based on physical objectives such as sequencing flows to occur simultaneously or following unregulated tributary peak flows.

In developing environmental flow regimes, it is important to recognize conflicts in objectives and constraints on flow releases. Wilcock et al. (1996b) describes the conflict in developing flushing flow recommendations for the Trinity River below the Lewiston Dam. Optimizing the removal of fine sediment from channel would result in loss of supply limited gravel. Flushing flows were set to balance competing objectives. Constraints on flow releases may involve limits in the water available for flow due to drought or competing uses, concerns over lost power generation, and undesirable flooding or channel adjustments for downstream landowners.

Table 1. Flushing flow and channel maintenance flow goals, objectives, and requirements (adapted from Kondolf and Wilcock 1996).

Flow Regime	***Management Goal***	***Specific Objective***	***Flow Requirement***
Flushing Flow	Restore riffle habitat	Remove surficial fine sediment[1] from riffles	Generate shear stress (τ_0) sufficient to transport sand particles on riffles
		Remove interstitial fine sediment	Generate shear stress (τ_0) sufficient to entrain surface gravels
	Improve spawning gravels	Increase gravel porosity (i.e. loosen gravel)	Generate shear stress (τ_0) sufficient to entrain surface gravels
	Improve pool habitat	Scour accumulated fine sediments	Transport net sand out of pools
Channel Maintenance Flow	Maintain/Restore Channel Width, Depth and Topographic Diversity	Mobilize surface gravel layer throughout cross section	New projects[2]: Release flow equivalent to the pre-project effective (channel forming) discharge
			Old projects: Generate shear stress (τ_0) sufficient to entrain on bar surfaces
	Reduce riparian encroachment	Uproot seedlings on bar surfaces	Generate shear stress (τ_0) sufficient to entrain gravel on bar surfaces
		Remove established vegetation	May require large flow on order of 10-20 year return period
	Create/build floodplain habitat	Create vertical accretion on floodplains	Produce muddy over-bank flow (requires source of suspended sediment)
	Create diverse multiage riparian habitat	Induce channel migration and create diverse geomorphic surfaces	Flow sufficient to erode banks, deposit point bars, and create overbank deposits

Notes:
(1) Fine sediment refers to sediment where the particle diameter along the intermediate axis is less than or equal to 2 mm. Coarse sediment refers to sediment where the particle diameter along the intermediate axis is greater than 2 mm.
(2) The term new projects refers to new dams or diversions where the river retains its original form. The term old projects refers to locations where the river has undergone long-term adjustments in form in response to a dam or diversion.

Analysis Methods. Kondolf and Wilcock (1996) characterize three methods for estimating flushing flows and channel maintenance flows:

- Self-adjusted channel methods employ the assumption that the flushing flows should mimic the pre-project effective discharge (e.g., Andrews and Nankervis, 1995). Use of self-adjusted channel methods requires the assumption that the river was previously in an equilibrium condition.

- Sediment entrainment methods employ sediment transport relationships to estimate the thresholds for sand and gravel entrainment. Local observations of stream sediment and hydraulic properties are used to develop estimates. Use of these methods does not require the assumption that the river is in an equilibrium condition.

- Direct calibration methods require extensive monitoring during pilot environmental flow releases. Observations are made of flow velocity, total discharge, bed movement and sediment transport for flow events that mobilize sediment. Direct calibration methods allow for estimates of volume of sand and gravel that are mobilized (Wilcock et al. 1996a), which are critical to developing a balanced sediment regime (Wohl et al. 2015; Schmidt and Wilcock 2008).

The Role of Adaptive Management. Environmental flows should be implemented within an adaptive management framework (e.g., see Williams and Brown 2012). Projecting the responses of environmental systems to management actions often involves uncertainties. Developing environmental flows targeted at disrupting M. speciosa will involve uncertainties in the biological response, sediment transport relationships, and meteorological and channel conditions prior to releases. Development of environmental flows should be seen as an iterative process of developing flow regimes, implementing and monitoring the environmental flow, followed by assessment of sediment transport, biological response, and sediment storage on a reach by reach basis in downstream areas.

Klamath River Sediment Entrainment Analyses. There are three recent studies that developed estimates of sediment transport thresholds in the Klamath River below Iron Gate Dam (Ayres Associates, 1999; Holmquist-Johnson and Milhous, 2010; and Reclamation, 2011). These studies employ uncalibrated sediment transport relationships to develop estimates of discharge required to initiate various stages of sediment mobilization. Local observations of stream sediment and hydraulic properties are used to develop the estimates.

Although terminology and methods differs slightly between the three studies, each of the studies characterizes the channel substrate as consisting of several sediment layers:

- a mobile surface layer of fine sediment (sand, silt, and clay sized particles having median grain diameters less than 2 mm);
- an armor layer consisting of sorted coarse sediment (gravel, cobbles and boulders having median grain diameters greater than 2 mm) 1-2 grain diameters in thickness; and
- an underlying substrate layer, less coarse than the armor layer, and containing a mixture of coarse and fine sediment.

The actual composition of the channel substrate material varies with location relative to dams and tributaries. There are areas directly below Iron Gate Dam, which have reduced coarse grain

material input due to sediment trapping behind the dam, where the armor layer has been winnowed out and a pavement layer has developed that consists of large coarse sediment (cobbles and boulders) that are several grain diameters in thickness. In other areas where fine sediment supplies are high and entrainment flows low, the armor layer has infilled with fine sediment.

The three studies develop estimates of the discharge required to achieve several sediment mobilization states. Again, terminology differs slightly between the three studies. In this memorandum, we employ the terms listed in Table 2 to describe differing degrees of sediment mobilization. The discharges ranges established by the three studies for the sediment mobilization states should be understood to be approximate values and that transitions between sediment mobilization states occur gradually, not with sudden jumps when a threshold value is exceeded.

Table 2. Sediment mobilization state definitions.

Immobile Bed	No movement of surface sediment, armor layer or substrate. Deposition of suspended sediment absorbed into voids (until full).
Stable Bed	No movement of surface sediment, armor layer or substrate. Suspended sediment in water column remains in transport.
Surface Flushing	Movement of surface fine layers on 20-30% of bed.
Depth Flushing	Removal of in-filled fine sediment from armor layer.
Armor Disturbance	Movement of individual armor layer particles.
Armor Layer Movement	Reworking of armor and substrate layers

Ayres Associates (1999). Ayres Associates prepared a geomorphic and sediment evaluation of the Klamath River from Iron Gate Dam to the ocean for the U.S. Fish and Wildlife Service (Ayres Associates, 1999). Much of the study report covers the geomorphic assessment of the river and the report provides substantive descriptions of the geomorphic controls shaping the river.

Ayres Associates (1999) conducted their field work for the report in 1997. In the period from fall 1992 to spring 1997, there were six flow events in which the daily-mean flows at Iron Gate Dam exceeded 6,030 cubic feet per second (cfs), which Reclamation (2011) estimates is the two-year return period discharge for the Klamath River below Iron Gate Dam. Daily-mean flow reached 18,500 cfs on January 1, 1997, the second highest flow since dam closure. Ayres Associates (1999) observed that neither aggradation nor channel degradation (downcutting) was apparent in the reach of the Klamath River between Iron Gate Dam and the Shasta River. They also observed that pools did not appear to be infilling with sediment and that there was minimal infilling of coarse bed substrate with fine sediment.

Ayres Associates (1999) surveyed a series of cross sections at each of six study sites. Three of the study sites were located between Iron Gate Dam and Seiad Creek. Ayres Associates used the cross sections and water surface elevation measurements to develop and calibrate 1-D hydraulic models of the study sites using Version 2.0 of the U.S. Army Corps of Engineers HEC-RAS computer program.

Ayres Associates (1999) conducted an incipient motion analysis using the hydraulic analysis to determine critical shear stress and critical discharge necessary to initiate movement of sediment from riffles and pools. The incipient motion analysis used the Shields' relationship:

$$\tau_c=\theta(\gamma_s-\gamma)D_c \quad (1)$$

where:

- τ_c is the critical shear stress required to initiate sediment transport
- θ is the Shield's parameter
- D_c is the representative sediment size
- γ is the specific weight of water
- γ_s is the specific weight of sediment

Ayres Associates (1999) set the value of D_c to the value of the median grain size (D_{50}) found on pools and riffles during site investigations. Ayres Associates (1999) set the value of the Shield's parameter to 0.047 for fine sediment and 0.035 for coarse sediment.

Ayres Associates (1999) used the U.S. Army Corp of Engineers HEC-RAS model to determine the critical discharge (Q_c) that would generate the critical shear stress calculated in equation (1) to mobilize sediment from pools and from riffles at the six study sites. Boundary shear stress was calculated using:

$$\tau_o = \frac{\rho V^2}{\left[5.75 \log\left[12.27\frac{y_o}{k_s}\right]\right]} \quad (2)$$

where:

- τ_o is the cross section average hydraulic shear stress on the bed
- ρ is water density
- V is the cross section average flow velocity
- y_o is the cross section average flow depth
- k_s is the equivalent roughness height of the substrate

Ayres Associates (1999) set the equivalent roughness height to $3.5*D_{84}$ for coarse sediment (surface $D_{50} > 2$ mm) and to D_{84} for fine sediment (surface $D_{50} < 2$ mm). They identified the critical discharge (Q_c) required to initiate sediment motion as the mean discharge where the boundary shear stress equaled the critical shear stress ($\tau_0 = \tau_c$).

In addition to the incipient motion analysis for pools and for riffles, Ayres Associates conducted a flushing flow analysis to estimate the discharge required to flush surface sediment from pools. They assumed that the D_{84} of pool sediment was 2 mm and assumed a shear stress of twice the critical shear stress for the D_{84} would result in pool flushing. Their assumption for pool flushing flows was based on previous experience.

Results of the Ayres Associates analysis are only shown for the three most upstream sites (Sites 4 – River Mile[1] (RM) 128), 5 –RM 161, and 6 - RM 187) because the influence of Iron Gate Dam (RM 190) flows on bed conditions diminishes moving downstream from Iron Gate Dam as tributary accretions increase total flow (Table 3).

USGS – Holmquist-Johnson and Milhous (2010). The U.S. Geological Survey (USGS) conducted a study for the U.S. Fish and Wildlife Service to determine flushing flows required to improve and maintain quality spawning and rearing habitats for salmon, and to reduce the abundance of preferred habitats of *M. speciosa* (Holmquist-Johnson and Milhous, 2010). Field work for the Holmquist-Johnson and Milhous (2010) study was conducted in 2007. Just prior to data collection, three flow events occurred in 2006 where daily-mean flows at Iron Gate Dam exceeded 6,030 cfs (the two-year return period flow), but daily-mean flows in the previous six years (2000 – 2005) did not exceed 6,030 cfs.

Holmquist-Johnson and Milhous (2010) resampled sediment at the six study sites established by Ayres Associates (1999). Holmquist-Johnson and Milhous (2010) segregated samples into surface sediment, armor layer, and substrate (under the armor layer). The surface sediment was composed of silt-, clay- and sand-size sediment (i.e., fine sediment). The armor layer was composed of gravel-, cobble-, and boulder-size sediment (i.e., coarse sediment). The substrate was composed of a mix of sand-, gravel-, and cobble-size sediment.

Table 3. Ayres Associates (1999) incipient motion analysis results.

Incipient Motion Condition	Sediment Mobilization State (from Table 2)	Quantity	Site 4 RM 128	Site 5 RM 161	Site 6 RM 187
Pools Incipient Motion	Stable Bed	D_{50} – Median Grain Diameter (mm)	0.50	0.070	1.00
		τ_c – Critical Shear Stress (lbs/ft^2)	.00794	0.01100	0.0159
		Q_c – Critical Discharge (cfs)	2,300	2,600	2,500
Pool Flushing Flow	Surface Flushing	Q_c – Critical Discharge (cfs)	6,600	6,000	5,400
Riffles Incipient Motion	Armor Disturbance	D_{50} – Median Grain Diameter (mm)	86	86	86
		τ_c – Critical Shear Stress (lbs/ft^2)	1.01	1.01	1.01
		Q_c – Critical Discharge (cfs)	9,800	13,200	16,500

[1] Positions on the Klamath River are referenced by the distance in river miles measured from the river mouth and as shown on U.S. Geological Survey topographic maps.

Holmquist-Johnson and Milhous (2010) developed sediment entrainment discharge estimates using methods described by Milhous (1998). They defined four sediment mobilization states: Immobile Bed, Stable Bed, Surface Flushing, and Depth Flushing (Table 4). They estimated the sediment mobilization state for individual site conditions and discharges using the movement parameter β calculated using equation 3:

$$\beta = \frac{n^2 v^2}{1.492^2 d^{1/3}(G-1)D_{50}} = \frac{RS_e}{D_{50}(G-1)} \quad (3)$$

where:

β	is the dimensionless shear stress (movement parameter)
n	is Manning's n roughness coefficient
v	is cross section average velocity (ft/sec)
d	is cross section average depth (ft)
G	is the specific gravity of sediment (taken as 2.65)
D_{50}	is the median grain size (feet) of the bed armor later
R	is the hydraulic radius in feet
S_e	is the energy slope

The movement parameter (β) has the form of dimensionless shear stress and is analogous to the Shield's relationship. Increasing values of β imply increasing levels of shear stress applied to the river bed.

Sediment mobility states were then related to ranges of the movement parameter β (Table 4). The relationship between values of the movement parameter (β) and sediment mobility states are the same as employed in Milhous (1998). Values used to define sediment mobility states in Milhous (1998) are based on data collected at Oak Creek, Oregon in the early 1970's.

Holmquist-Johnson and Milhous (2010) employed the U.S. Army Corps of Engineers HEC-RAS hydraulic models developed by Ayres Associates (1999) and the sediment data they collected in 1997 to calculate movement parameter (β) values for discharges ranging from 1,000 to 50,000 cfs at each of the six Ayres Associates (1999) study sites. They fit a linear relation between movement parameter (β) and discharge at the Klamath River below Iron Gate Dam to estimate upper and lower discharge limits for Immobile Bed, Stable Bed, Surface Flushing, and estimate a lower discharge limit for Armor Disturbance.

Holmquist-Johnson and Milhous (2010) left a gap in their table between the upper limit of Surface Flushing (β = 0.035) and the initiation of Armor Disturbance (β = 0.045). Milhous (1998) defines Depth Flushing as the removal of fine material from within the substrate without Armor Disturbance and defines the value of the movement parameter (β) required to initiate Depth Flushing as 0.035. We adapted the Milhous (1998) study to set the range of the movement parameter (β) for Depth Flushing as 0.035 to 0.045.

Holmquist-Johnson and Milhous (2010) also computed the ratio between bed shear stress and critical shear stress required to initiate general movement of the armor layer for the range of discharges at the six study sites. They defined general movement of the armor layer as occurring when the boundary shear stress (τ_0) exceeds the critical shear stress for incipient motion of the armor layer (τ_c). Results of the Holmquist-Johnson and Milhous (2010) study found that the average critical discharge at Ayres Associates (1999) sites 4 (RM 128), 5 (RM 161), and 6 (RM

Table 4. Substrate movement state, movement parameter, and discharge limits for Klamath River below Iron Gate Dam (adapted from Holmquist-Johnson and Milhous 2010).

Substrate Movement State	Substrate Movement State Description	Movement Parameter β		Discharge (cfs)	
		Lower Limit	Upper Limit	Lower Limit	Upper Limit
Immobile Bed	No movement of surface sediment, armor layer or substrate. Deposition of suspended sediment absorbed into voids (until full).	0.000	0.009	0	2,500
Stable Bed	No movement of surface sediment, armor layer or substrate. Suspended sediment in water column remains in transport.	0.009	0.021	2,500	5,000
Surface Flushing	Movement of surface fine layers on 20-30% of bed.	0.021	0.035	5,000	8,700
Depth Flushing	Removal of in-filled fine sediment from armor layer.	0.035	0.045	8,700	11,250
Armor Disturbance	Movement of individual armor layer particles.	0.045	----	11,250	15,000
Armor Layer Movement	Reworking of armor and substrate layers ($\tau_0 > \tau_c$ of armor layer)	----	----	15,000	

187, the point at which $\tau_{0=}\tau_c$) was 15,000 cfs. Note that the average is based on ratio values of τ_0/τ_c that ranged between approximately 0.65 and 1.45.

We combined the Holmquist-Johnson and Milhous (2010) estimates for discharges thresholds for Immobile Bed, Stable Bed, Surface Flushing, and Armor Disturbance with the estimates for discharge required to produce Depth Flushing (Milhous 1998), and with estimates for Armor Layer Movement to develop estimates for six sediment mobilization states for the Klamath River below Iron Gate Dam (Table 4).

Reclamation (2011). The U.S. Bureau of Reclamation evaluated sediment mobilization below Iron Gate Dam (Reclamation, 2011) as one component of numerous studies conducted to support the Secretarial determination process for the Klamath Basin Restoration Agreement and Klamath Hydroelectric Settlement Agreement (Department of Interior et al. 2013).

Reclamation (2011) developed a U.S. Army Corps of Engineers HEC-RAS model of existing conditions for the reach of the Klamath River from Iron Gate Dam (RM 190) to Happy Camp (RM 105). Model geometry was based on bathymetric surveys conducted in 2009 supplemented by LIDAR surveys conducted in 2010. Reclamation used the survey data to develop a triangulated irregular network (TIN) terrain model. Reclamation (2011) extracted 692 HEC-RAS cross sections from the TIN to develop a hydraulic model of existing conditions. Reclamation (2011) calibrated the HEC-RAS model using observed water surface elevation data and to gage data from Iron Gate Dam and at Seiad Valley (USGS 11516530, 11520500).

Reclamation (2011) analyzed stream gage records to develop flood frequency relationships for the USGS gages on the Klamath River below Iron Gate Dam (RM 190) and the Klamath River near Seiad Valley (RM 128) (Table 5).

Reclamation (2011) defined sediment mobilization states as follows:

- Under *Slight Mobilization*, there is a small, but measurable, sediment transport rate. The armor layer is only minimally disturbed and there maybe flushing of sand to a depth of the armor layer D_{90}.
- Under *Significant Mobilization,* there are many particles in motion and there is a significant sediment transport rate. Sand is mobilized from the interstitial spaces of the bed to a depth of twice the D_{90}. The armor layer is significantly disturbed.

Table 5: Flood frequency analysis for Klamath River below Iron Gate Dam (USGS Gage 11516530) and near Seiad Valley (USGS Gage 11520500 (Source: Reclamation, 2011).

Gaging Station		Klamath River below Iron Gate Dam	Klamath River near Seiad Valley
River Mile		190	128
Period of Record Used in Analysis		1961- 2009	1913 -1925 1952 -2009
Drainage Area (mi^2)		4,630	6,940
Discharge (cfs)	Median Flow	1,370	2,700
	Average Flood	7,978	28,569
	1.5 year return period	4,380	11,000
	2-year return period	6,030	17,600
	5-year return period	10,980	39,960
	10-year return period	15,610	56,540
	25-year return period	21,460	93,400
	50-year return period	26,280	131,000
	100-year return period	31,460	179,300

Reclamation (2011) developed a methodology to estimate the discharge required to generate *Slight Mobilization* and *Significant Mobilization.* Reclamation (2011) used hydraulic data from the HEC-RAS model and sediment data from their surveys to compute the Shield's parameter using equation (4), which is a re-arranged form of the Shield's relationship shown in equation (1):

$$\theta = \frac{\tau_g}{(\gamma_s - \gamma) D_{50}} \quad (4)$$

where:

τ_g is the grain shear stress

Reclamation (2011) computed the grain shear stress using results from the hydraulic modeling and methods that are detailed in Appendix J of their report.

Reclamation (2011) used the Parker Reference Transport method (Parker, 1990) to evaluate sediment mobility:

$$W^* = \frac{(s-1) g q_q}{\rho_s \left(\tau_g / \rho\right)^{1.5}} \quad (5)$$

where:

s	is the relative specific density
q_s	is the sediment transport rate
τ_g	is the grain shear stress
ρ_s	is the sediment density
ρ	is the fluid density
W*	is the dimensionless sediment transport rate.

The Parker (1990) method replaced incipient motion with a small, but measurable transport rate, where W* = 0.002. The Shield's number that yields W* = 0.002 is called the reference Shield's stress (θ_r).

Reclamation (2011) characterized *Slight Mobilization* as occurring when hydraulic conditions produced a Shield's parameter equivalent to the reference Shield's stress ($\theta = \theta_r$). Reclamation characterized *Significant Mobilization* as occurring when hydraulic conditions produced a Shield's parameter equivalent to 1.3 times the reference Shield's stress ($\theta = 1.3\theta_r$).

The value of 1.3 is equivalent to the ratio between the Holmquist-Johnson and Milhous (2010) movement parameter value of 0.045 (Armor Disturbance) and 0.035 (Surface Flushing). Thus, Reclamation's (2011) slight mobilization is equivalent to the Holmquist-Johnson and Milhous (2010) Surface Flushing and Reclamation's (2011) significant mobilization is equivalent to the Holmquist-Johnson and Milhous (2010) Armor Disturbance. Reclamation (2011) notes importantly that sediment transport increases as a continuous function, not a step function. There is a continuum of sediment transport movement between conditions where $\theta=\theta_r$ and $\theta=1.3\theta_r$ rather than an abrupt change in transport states.

Combining the HEC-RAS results with measured substrate characteristics, Reclamation (2011) developed estimates of the range of discharges required to achieve *Slight Mobilization* and *Significant Mobilization* in nine reaches of the Klamath River below Iron Gate Dam. Reclamation (2011) allowed for uncertainties in the value of the reference shear stress, creating a

spread in discharge estimates. The median mobilization flow estimates are shown in Table 6. Reclamation (2011) related the discharge to return period using their frequency analysis (Table 5). Figures 2 and 3 replicates Reclamation (2011) figures showing the discharge and return periods estimates with error bars for initiating *Slight Mobilization* and *Significant Mobilization.*

Reclamation (2011) flow estimates for significant and slight mobilization vary considerably between the nine reaches defined in the study. The median flow estimate of 19,100 and 20,000 cfs required to produce slight mobilization in the reaches from Shasta River to Beaver Creek far exceed the median flow estimates for significant bed material mobilization from Bogus Creek to the Shasta River. The much higher flow required to initiate sediment mobilization between Shasta River and Beaver Creek might be undesirable because they would transport gravels out of the reaches located directly below the dam that are sediment starved due to trapping of sediment upstream of Iron Gate Dam. Development of environmental flow objectives should account for differences in geomorphic controls and sediment transport capabilities between reaches.

Reclamation (2011) states that the sediment entrainment analysis is not sufficient to predict the fraction of sand remaining after an environmental flow event. Such predictions would require more information about the surface and subsurface sand fractions as well as the sand supply in the reach and would require simulation of the sand budget and bed mixing during the event. Reclamation (2011) suggests that future studies of mobilization could be done to quantify the flows necessary to accomplish a certain level of sand mobilization in the Klamath River.

Table 6. Median discharges for slight and significant mobilization for Klamath River between Bogus Creek and Indian Creek (adapted from Reclamation 2011).

Reach	Slight Bed Material Mobilization Median Flow Estimate (cfs)	Significant Bed Material Mobilization Median Flow Estimate (cfs)
Bogus Creek (RM 189.6) to Willow Creek (RM 185.0)	9,800	15,900
Willow Creek (RM 185.0) to Cottonwood Creek (RM 182.1)	10,700	17,200
Cottonwood Creek (RM 182.1) to Shasta River (RM 176.7)	8,400	13,800
Shasta River (RM 176.7) to Humbug Creek (RM 171.5)	20,000	33,900
Humbug Creek (RM 171.5) to Beaver Creek (RM 161.0)	19,100	32,900
Beaver Creek (RM 161.0) to Dona Creek (RM 152.8)	5,800	10,100
Dona Creek (RM 152.8) to Horse Creek (RM 147.3)	5,900	9,700
Horse Creek (RM 147.3) to Scott River (RM 143.0)	6,500	10,400
Scott River (RM 143.0) to Indian Creek (RM 106.8)	15,300	25,500

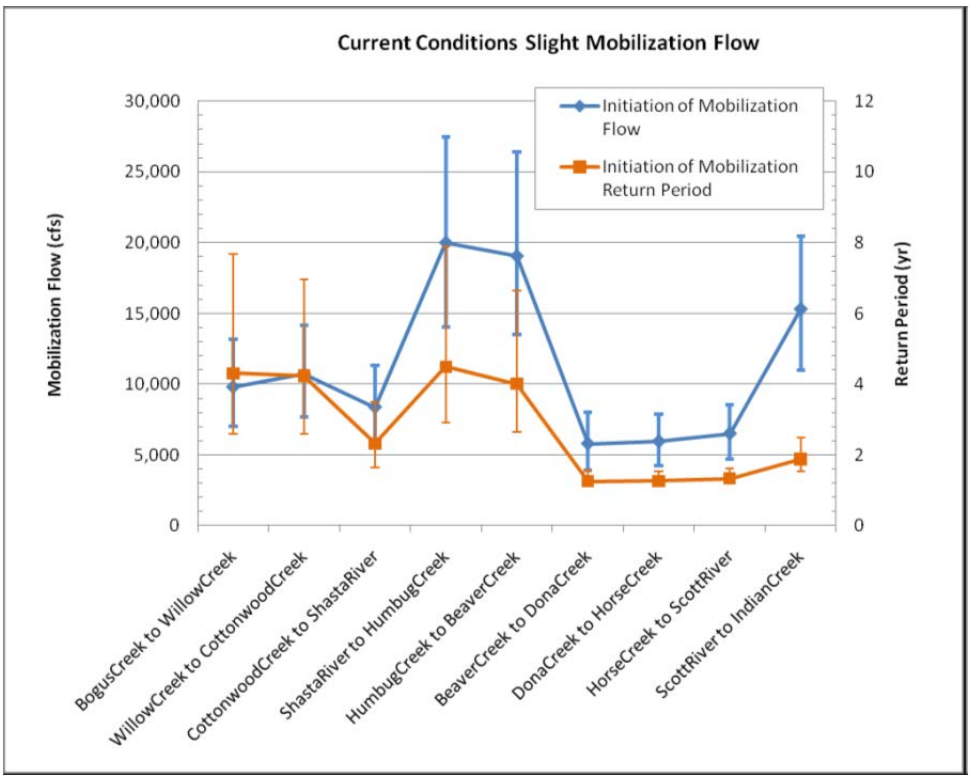

Figure 2: Slight bed material mobilization flow and return period for reaches downstream of Iron Gate Dam. (Reproduced from Figure 5-24, Reclamation, 2011).

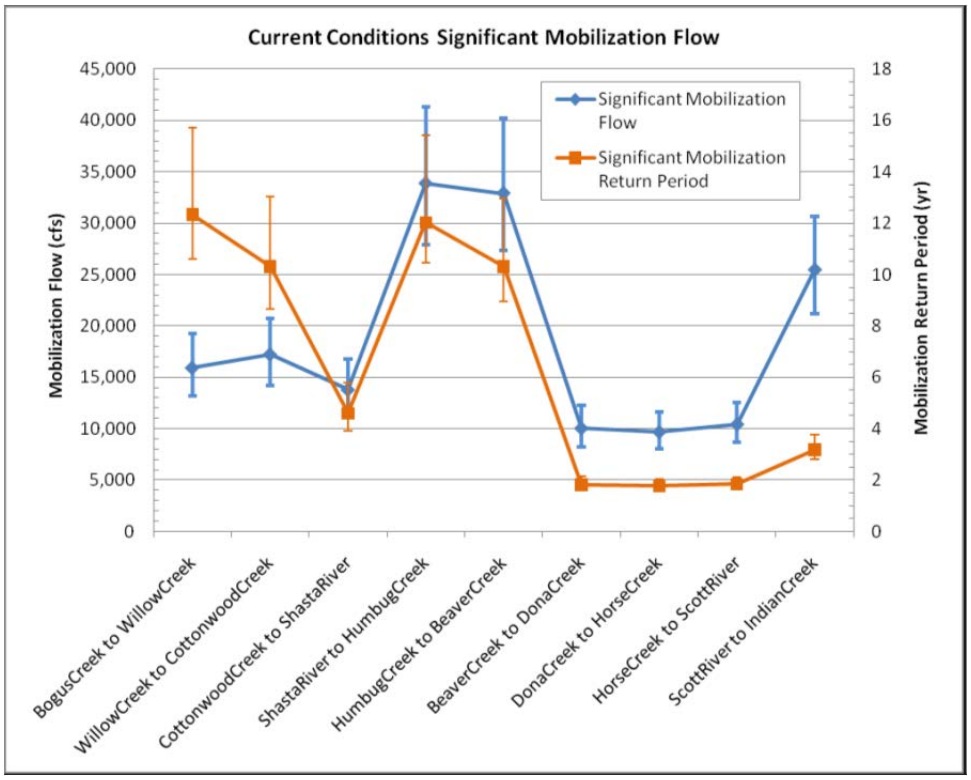

Figure 3: Significant bed material mobilization flow and return period on a reach averaged basis for reaches downstream of Iron Gate Dam. (Reproduced from Figure 5-25, Reclamation, 2011).

Comparison of Sediment Entrainment Analyses. Ayres Associates (1999), Holmquist-Johnson and Milhous (2010), and Reclamation (2011) used differing approaches to develop estimates of sediment entrainment. For purposes of comparison, we equate the Ayres Associates (1999) pool flushing flow with Holmquist-Johnson and Milhous (2010) Surface Flushing and Reclamation (2011) Slight Mobilization and we equate Ayres Associates (1999) riffle incipient motion with Holmquist-Johnson and Milhous (2010) Armor Disturbance and Reclamation (2011) Significant Mobilization (Table 7). We show the mean minimum Reclamation (2011) estimates for the Klamath River between Iron Gate Dam and the Shasta River confluence. Discharge thresholds in the Klamath River increase significantly downstream in the reach between the Shasta River and Beaver Creek reach because of its steep gradient, armor layer composed of immobile large cobbles and boulders, and occurrence of bedrock outcrops.

There is a spread in the estimates due to variances in the methods employed and the dates when channel substrate and channel conditions were evaluated, and the specific channel conditions at study locations.

Study Limitations. The three studies summarized in this technical memorandum provide useful estimates of the discharges required to mobilize bed sediment in Klamath River below Iron Gate Dam. There are some limitations resulting from the scale and scope of the studies:

- The Ayres Associates (1999) and Holmquist-Johnson and Milhous (2010) estimates are based on a hydraulic analyses that employed a limited number of stream cross sections collected at six sites that extended over 171 river miles. Only sites 4, 5, and 6 were used to evaluate conditions below Iron Gate Dam.
- All three studies developed sediment transport estimates using general sediment mobilization formulations. The estimates are not calibrated to direct observations of sediment transport in the Klamath River below Iron Gate Dam.
- All three studies used one-dimensional hydraulic models to develop estimates of hydraulic variables. The hydraulic variables extracted from the one-dimensional models are cross section averages and do not reflect the variability in flow velocities and depth across a river cross section, or across a river reach.
- The studies do not identify the mode of sediment transport (suspended or bedload).

Table 7: Comparison of sediment entrainment discharge estimates

Sediment Entrainment State	Discharge Estimate (cfs)					
	Ayres Associates (1999)		Holmquist-Johnson and Milhous, (2010)	Reclamation (2011): Bogus Creek to Shasta River		
	Low	High	Threshold Limit	Mean Minimum	Mena Median	Mean Maximum
Surface Flushing	5,400	6,600	5,000	6,900	9,600	12,900
Armor Disturbance	9,800	16,500	11,250	11,200	15,600	20,900

Additionally, the three sediment entrainment studies do not provide sufficient information to fully specify environmental flows to manage channel sediment. Wohl et al. (2015) and Schmidt and Wilcock (2008) recommend managing flow regimes below dams to produce a balanced sediment regime. Wohl et al. (2015) defines a balanced sediment regime as present when the energy of flow available to transport sediment is balanced by the sediment supply. Schmidt and Wilcock (2008) characterize a balance as occurring when the long-term transport of sediment out of a reach is equivalent to the long-term supply into the reach. Environmental flows developed to achieve a balanced sediment regime require information on sediment supply to a reach, sediment storage within a reach, and the effect of flow regimes on moving sediment out of a reach.

Additional Studies. Two additional studies bear mention because they provide the basis for further investigations into sediment mobility and developing environmental flow recommendations.

The U.S. Fish and Wildlife Service Arcata Fish and Wildlife Office (AFWO) and Oregon State University developed two-dimensional hydraulic models for three study sites in the Klamath between the Shasta and Scott Rivers (Wright et al. 2014; Alexander et al. 2016). The models are well calibrated and have been combined with statistical modeling for the purpose of analyzing distribution of *M. speciosa*. Modeling was combined with biological and physical observations made prior to and following major flows. These models could be adapted to calibrate sediment transport estimates and to tie physical outcomes of flushing flows to biological outcomes. Direct calibration of the flow required to achieve environmental flow objectives would improve the efficiency of potential water releases.

Malakauskas et al. (2013) performed flume experiments to evaluate flow requirements for dislodging *M. speciosa*. Their results identified shear velocity thresholds for dislodgement. This is another opportunity to directly relate measurable physical flow requirements to biological goals for disrupting *M. speciosa*.

Vegetation Disturbance and Geomorphically Effective Flow. Wolman and Gerson (1978) defined geomorphic effectiveness in terms of the ability of an event to alter the shape or form of the landscape. With respect to rivers, geomorphically-effective floods are described as creating a disturbance in the equilibrium river form (e.g., channel widening) that is followed by a recovery period where the channel readjusts to an equilibrium condition. Costa and O'Connor (1995) defined the energy produced by geomorphically-effective floods as a function of stream power (the product of the unit weight of water, discharge and energy slope) and flood duration for discharges above the incipient motion threshold for bed movement.

Floods are important mechanisms for maintaining channel form on rivers, including the Klamath River. During extended low-flow periods, riparian vegetation encroaches onto bar surfaces. Once riparian vegetation is established, it repeats a cycle of sediment trapping and channel narrowing and further encroachment of riparian vegetation into the channel (Ayres Associates 1999). Large, less-frequent floods of approximately a 10-year return period magnitude rejuvenate the Klamath River channel by reworking gravels on riffles, eroding channel banks and re-widening the channel, and removing substantial amounts of aquatic vegetation in the reach between Iron Gate Dam and the Scott River (Ayres Associates, 1999).

Holmquist-Johnson and Milhous (2010) estimated the threshold for general Armor Layer Movement at 15,000 cfs. Ayres Associates (1999) estimated the discharge required to rework

gravel on riffles at between 9,800 and 16,500 cfs in the Klamath River between Iron Gate Dam and Seiad Valley. Ayres Associates (1999) suggested that discharges of approximately ten-year return period were required to rejuvenate the channel. Reclamation (2011) reported the ten-year return period discharge of 15,610 cfs as the approximate discharge needed to rejuvenate the river bed in the Klamath River below Iron Gate Dam.

We classify discharges that exceed 15,000 cfs in the Klamath River below Iron Gate Dam as geomorphically effective flows. This is an approximate estimate, but one which provides a general order of magnitude for a flow that will induce channel migration and create diverse geomorphic surfaces. Geomorphically effective flows remove accumulated riparian and aquatic vegetation, widen the channel where vegetation encroachment has narrowed the channel, and sort the gravel armor layer and substrate layer. The amounts of work done by geomorphically effective flows are dependent on duration and magnitude of discharges above the threshold value where Armor Disturbance occurs. After a geomorphically effective flow event, vegetation recovery, vegetation encroachment, and channel narrowing occur until the next geomorphically effective flow occurs.

Other Environmental Flow Considerations. There are several features of environmental flow releases for the Klamath River that require analysis.

Ramping Rates. Ramping rate is the rate of change in water flow released from a dam. Whiting (2002) notes than implementation of ramping rates in environmental flows are poorly addressed. Ramping rates that drop too rapidly can cause fish stranding and bank failures. Ramping rates that rise too quickly can create safety issues. Ramping rates can also be adjusted to meet other environmental flow objectives. For example, the Trinity River Restoration Program adjusts their ramping rates on environmental flow releases to encourage development of riparian vegetation.

Timing of Flows. Timing of environmental flows should consider how to minimize impacts to fish populations while identifying optimal times that flow may provide benefits, such as disrupting *M. speciosa,* in the case of the Klamath River. Timing should also consider how dam releases can interact to augment unregulated flood flows on local tributaries to cleanse fan deposits at tributary mouths to improve access by upstream migrant fish.

Duration of Flows. More analysis is required to evaluate the duration and shape of an environmental flow hydrograph. The duration should address how much sediment is available for transport and how much flow is required to cleanse the system. Specifying flow duration requires developing better information for implementing a balance sediment regime (Wohl et al. 2015) in the reaches of the Klamath River below Iron Gate Dam.

Need for Calibration. Monitoring and observation of bed mobility during flow releases are required to calibrate sediment and hydraulic assessments. Direct calibration methods allow for estimates of volume of sand and gravel that are mobilized (Kondolf and Wilcock (1996). Calibration work should be combined with monitoring observations of biological responses similar to the work of Alexander et al. (2016).

Sediment Mobilization Flows at Klamath River below Iron Gate Dam. In this section, we examine the occurrence of sediment mobilization flows for the Klamath River below Iron Gate Dam since construction of the dam in 1962. We downloaded daily-mean flow records from the USGS National Water Information System for USGS gage 11516530 Klamath River below Iron

Gate Dam for the period October 1, 1964 to September 28, 2016. Data are reported on a Water Year (WY) basis, which extends from October 1 to September 30 for all calendar years.

Occurrence of Sediment Mobilization Flows. We plotted the long-term hydrograph for the Klamath River below Iron Gate Dam from WY 1964 through WY 2016 with the discharge limits for the six substrate mobilization states defined in Table 2, as shown in Figure 4. The discharge limits are based on the sediment mobilization limits developed using the Holmquist-Johnson and Milhous (2010) and Milhous (1998) studies (Table 6). Although, the discharge estimates presented in Table 6 are at the lower range of the three sets of sediment mobilization estimates previously discussed, we chose to use the Holmquist-Johnson and Milhous (2010) and Milhous (1998) set because it is the only set that establish discharge ranges for all sediment mobilization states listed in Table 6. These should be seen as a conservative estimate of the flows required to mobilize sediment.

A visual analysis of Figure 4 shows that geomorphically-effective flow events (i.e., discharge > 15,000 cfs) are rare, occurring only five times between WY 1964 and WY 1997. Armor disturbing events are slightly less rare, occurring ten times between WY 1964 and WY 1997. The Klamath River below Iron Gate Dam has not experienced a geomorphically-effective or armor-disturbing event since the January, 1997 spill event. Surface Flushing and Depth Flushing events were common prior to WY 2000. Since WY 2000, Depth Flushing events occurred only during high runoff events in winter 2006 and during a controlled spill event in March 2016 (Figure 3).

Duration of Sediment Mobilization Flows. Because the effectiveness of sediment mobilization flows are a function of both sediment mobilization capability and the duration of flows capable of mobilizing sediment (Costa and O'Connor 1995), we evaluated the duration of sediment mobilization flows over time. We plotted the number of days per Water Year that daily-mean flows in the Klamath River below Iron Gate Dam fell in the range of a substrate mobilization state that transported sediment (Figure 4). We observed that the pattern of sediment mobilization can be split into two periods: (1) the period WYs 1964 to 1999, when sediment mobilization flows were common and (2) the period WYs 2000 to 2016 when sediment mobilizations flows were rare. From WYs 1964 to 1999, the average cumulative duration of Surface Flushing was greater than 22 days per water year. From 2000 to 2016, sediment mobilization flow occurred in only five of the 17 water years; and the cumulative duration of Surface Flushing flow exceeded five days in only one water year. We conclude that the effectiveness of sediment mobilization flows in the period WYs 2000 to 2016 substantially dropped from the period WYs 1964 to 1999.

Frequency of Immobile Bed Conditions. The *Immobile Bed* sediment mobility state is estimated to occur for flow rates of 2,500 cfs or less at the Klamath River below Iron Gate Dam. Flows released from the Iron Gate Dam carry suspended materials consisting of mineral content and organic material originating from in-reservoir algal blooms (U.S. Department of Interior and California Department of Fish and Game, 2012). During Immobile Bed conditions, suspended mineral sediment and organic materials released from Iron Gate Dam can settle and accumulate on the bed and are not re-suspended until the occurrence of flushing flows. Increase in the areas of fine-grain sediment and organic material deposits on the bed and channel margins is a concern because high densities of *M. speciosa* have been commonly observed on fine sediments that are most prone to mobilization. In addition, riparian and aquatic vegetation can colonize fine sediments, further narrowing the channel and degrading fish habitat conditions (USFWS and HVT 1999).

Immobile Bed conditions persisted during WYs 2000-2016, while immobile conditions were less frequent in WYs 1964-1999 (Figure 5). For 10 of the 17 years in the period WYs 2000-2016, Immobile Bed conditions persisted for over 90% of the year. In the period WYs 1964 -1999, Immobile Bed conditions persisted over 90% of the year in only eight of the 36 years.

Sequencing of Sediment Mobilization Flows. The occurrence of Surface Flushing flows in natural rivers is a frequent event. Flows that reach or exceed the top of bank (i.e., the bankfull flow) occur on a frequency of one to two years (Leopold, 1994). Dunne and Leopold (1978) define bankfull stage as the stream level that corresponds to the discharge at which channel maintenance is most effective. Schmidt and Potyondy (2004) employed 80% of the 1.5 year return period discharge as a first approximation of the Surface Flushing flow. Robinson (2007) recommended a two-year return period discharge as a first approximation of the Surface Flushing flow for sediment supply limited streams in Oregon. Note that the two-year return period discharge for the Klamath River below Iron Gate Dam (6,030 cfs) is in the range of estimates for sediment flushing flows listed in Table 7.

Effective channel maintenance flow regimes possess flows of sufficient duration and frequency to maintain channel morphology (Schmidt and Potyondy, 2004). Lack of sufficient flows causes loss of channel capacity. The lack of sufficient duration and frequency of flows in managed systems is also detrimental to system ecology (Annear et al 2004). Poff et al. (1997) attributes flow stabilization (i.e., maintenance of a stable flow without interruption by flooding events) as a cause of overall reduction of biological diversity and increases in presence of invasive species.

In the period WYs 1964 to 1999, the duration between Surface Flushing events below Iron Gate Dam was typically one to two years (Figure 6). There were two occasions, corresponding to a drought periods in the late 1980s and early 1990s, when the duration between Surface Flushing events reached almost three years and four years. The frequency of Surface Flushing events in the period WYs 1964 to 1999 is consistent with channel maintenance needs of natural streams. Since 2000, however, there have been three occasions when the duration between flushing events was approximately five years.

Between WYs 1964 and 2000, there were five geomorphically effective events (including the December 1964 flood) for the Klamath River below Iron Gate Dam (Figure 7). Duration between events ranged between two and 14 years. As of the end of WY 2016, there has not been a geomorphically effective event since 1997, a period approaching 20 years. Geomorphically effective flow events that remove vegetation encroachment and rejuvenate the channel used to be common, but are now rare.

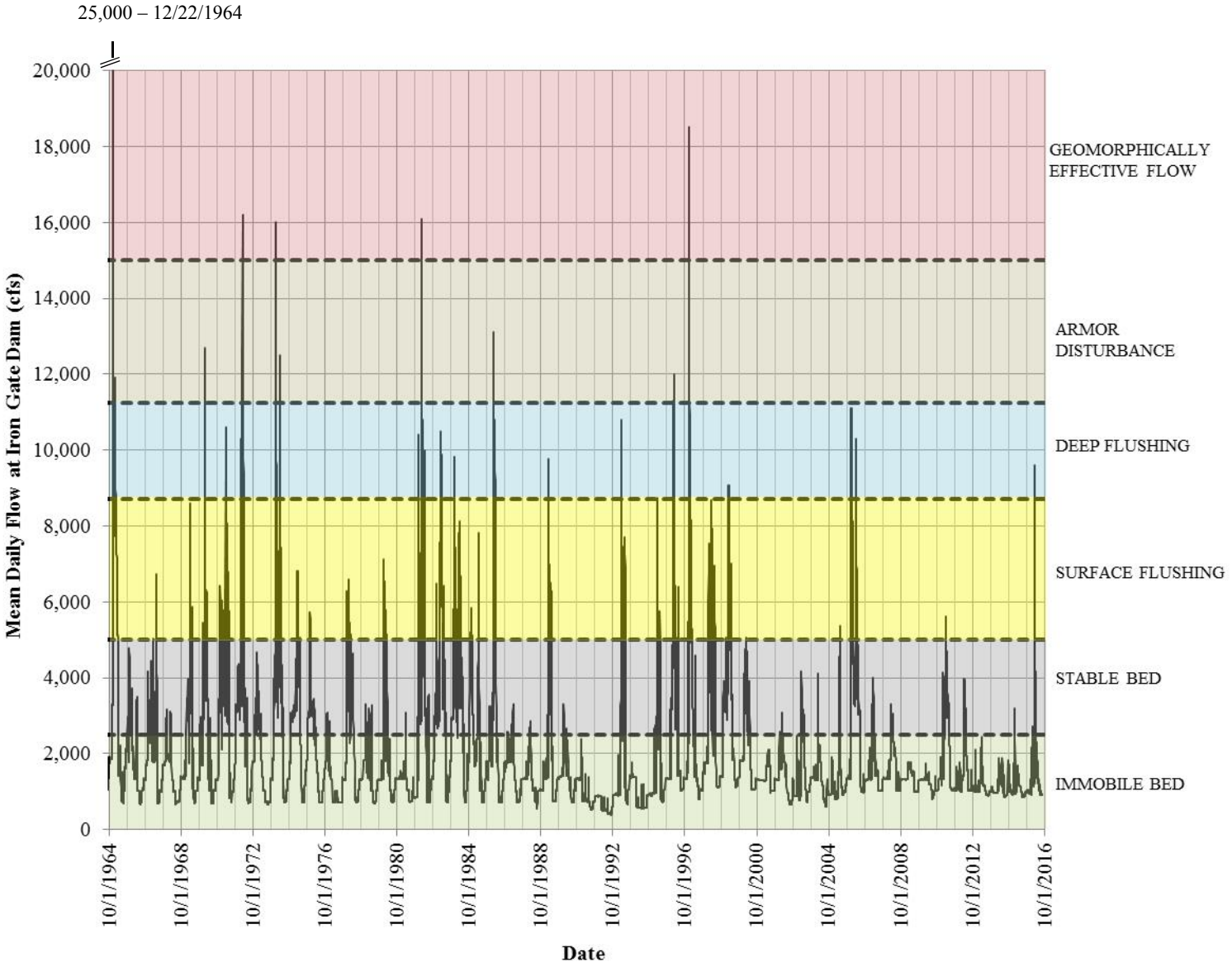

Figure 4: Daily-mean flow in cfs for Klamath River below Iron Gate Dam with substrate mobilization states. See Table 3 for definition of substrate mobilization states, Water Years 1964-2016.

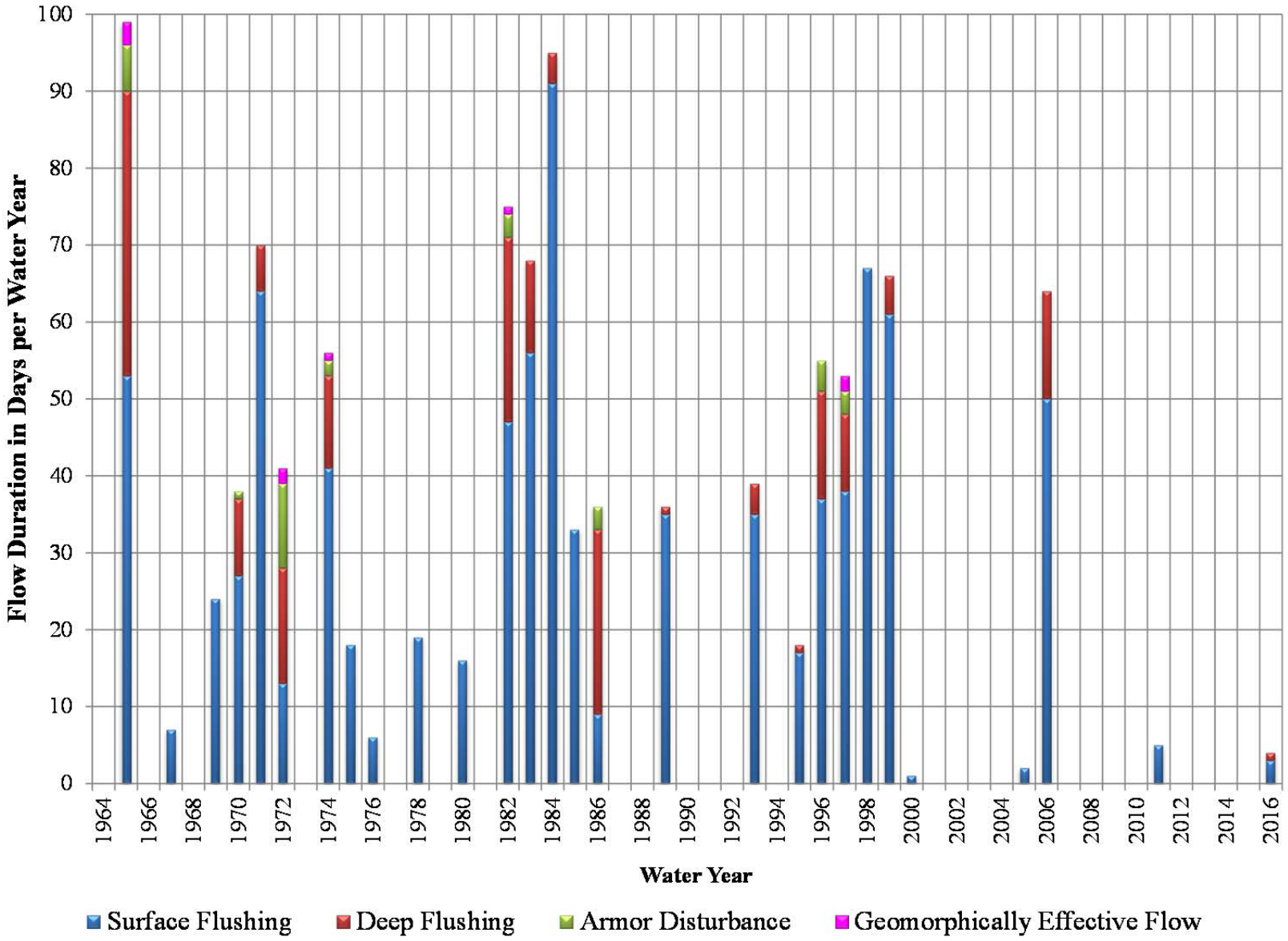

Figure 5: Duration of sediment mobilization flows in days per Water Year in the Klamath River below Iron Gate Dam Water for Water Years 1964-2016.

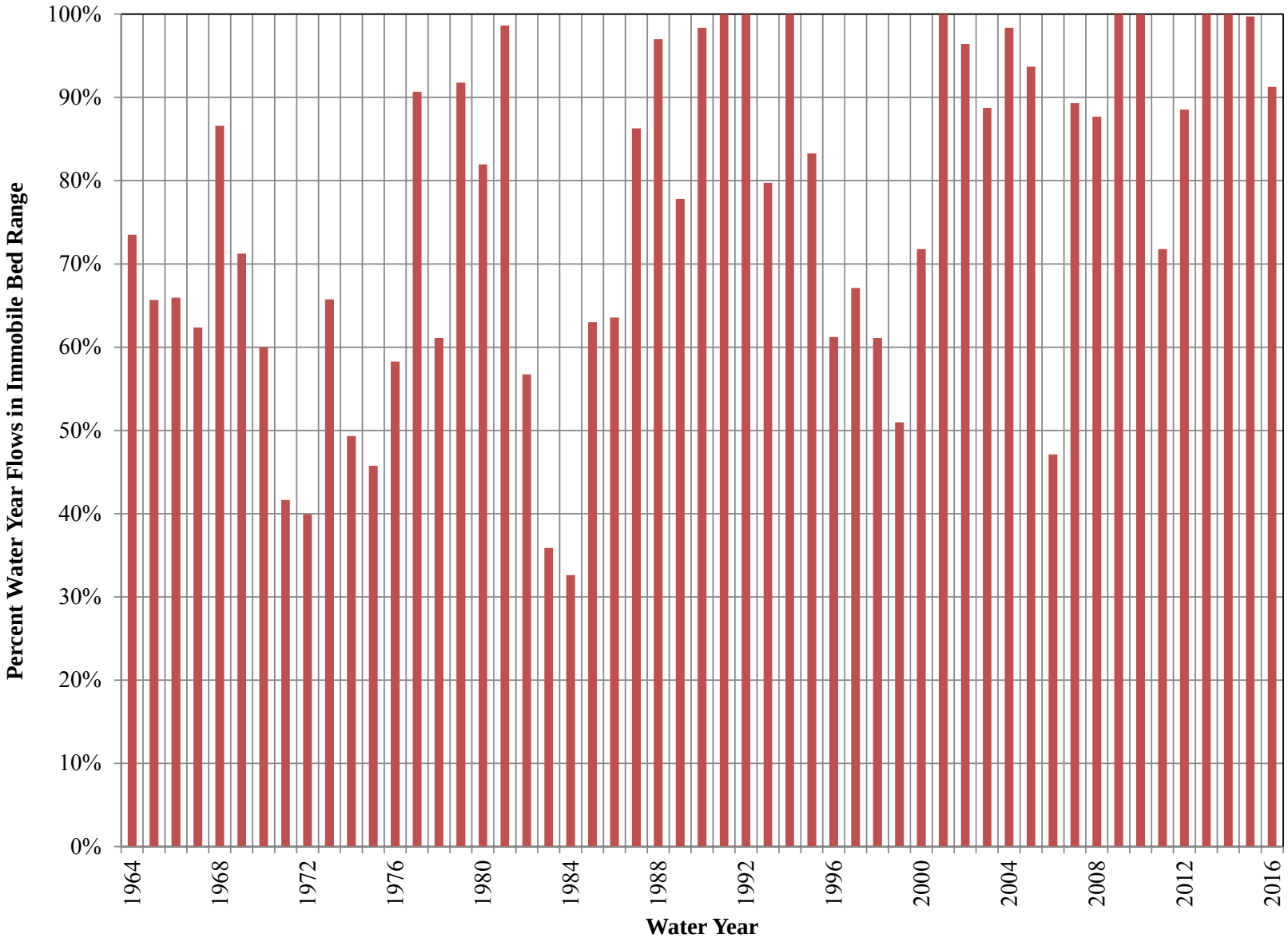

Figure 6: Percentage of Water Year Immobile Bed conditions occur in the Klamath River below Iron Gate Dam for Water Years 1964 -2016.

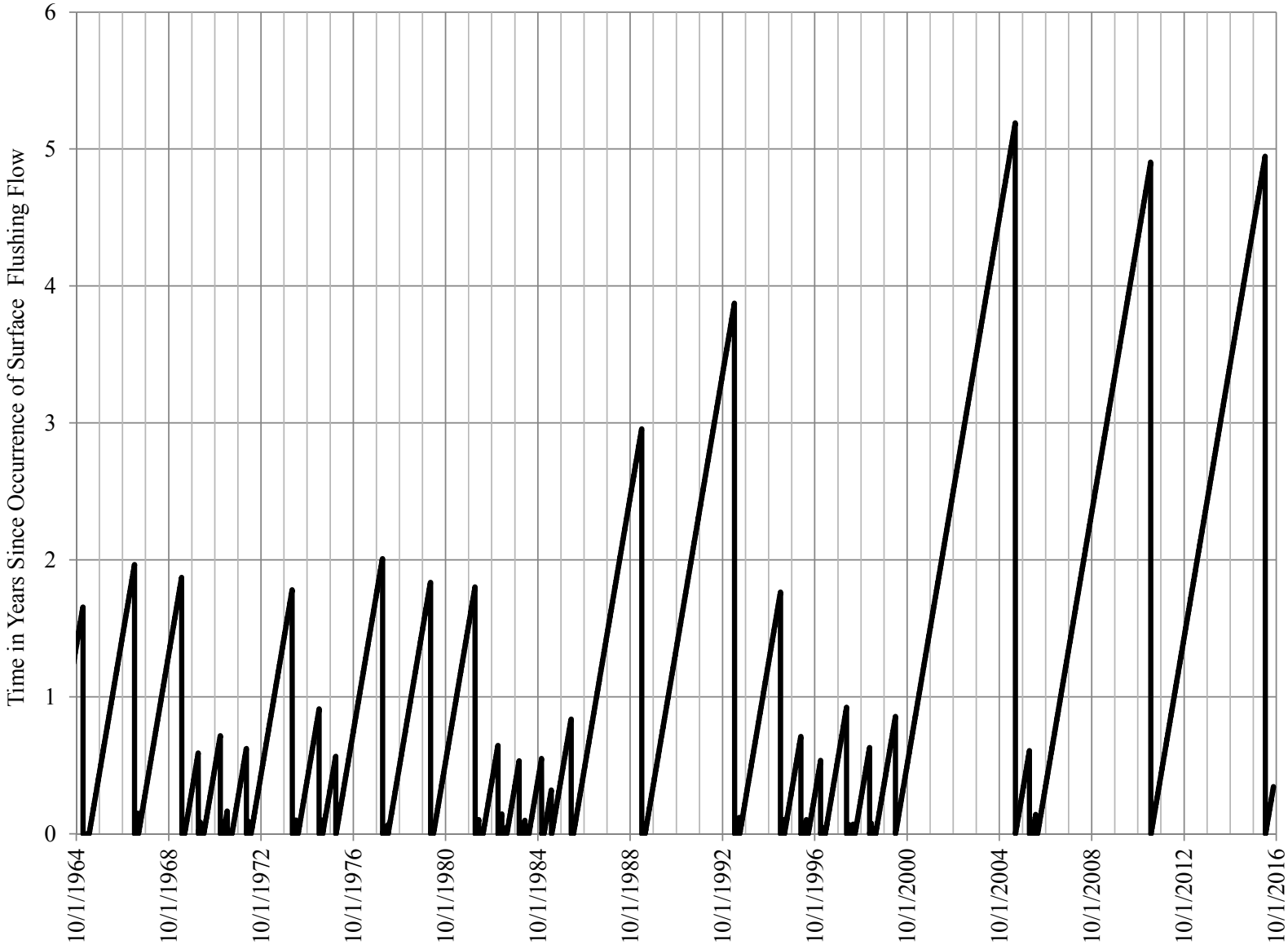

Figure 7: Time in years since occurrence of Surface Flushing flows in the Klamath River below Iron Gate Dam, Water Years 1964-2016.

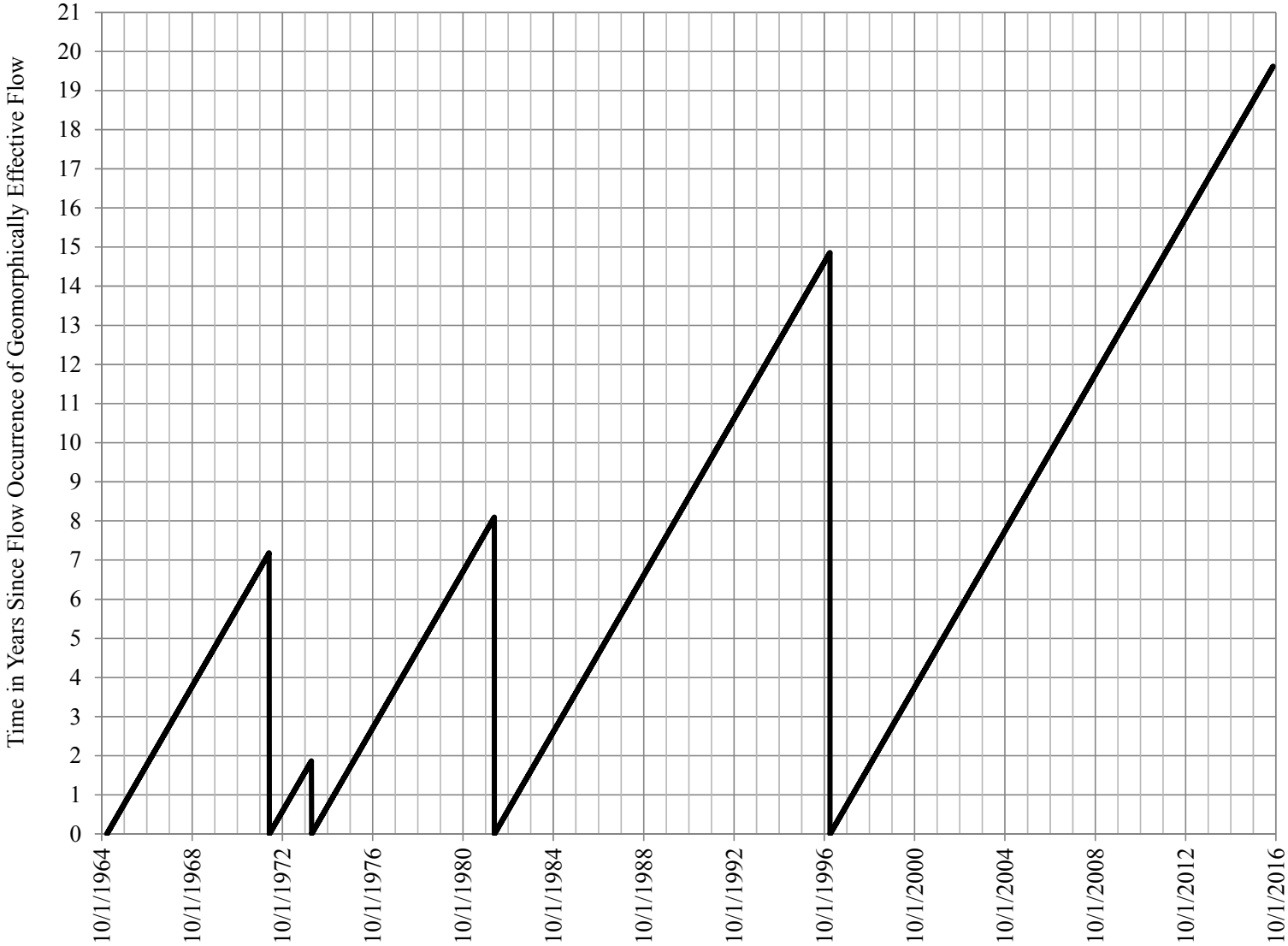

Figure 8: Time in years since occurrence of geomorphically effective flows in the Klamath River below Iron Gate Dam, Water Years 1964-2016.

Summary Guidelines.

- Environmental flows are developed by river managers to mitigate the detrimental impacts of dams and water diversions on river form and ecological functions. Environmental flow regimes designed to induce geomorphic changes are broadly divided into two categories, sediment maintenance or "flushing flows" used to modify substrate composition and channel maintenance flows intended to maintain channel form and floodplains.
- In developing environmental flow regimes, it is important to recognize conflicts in objectives and constraints on flow releases.
- There are three contemporary studies that estimated sediment transport thresholds in the Klamath River below Iron Gate Dam
- The sediment entrainment threshold estimates reported in the three studies varied due to differences in study methods employed and the dates when channel substrate and channel conditions were evaluated.
- Ayres Associates (1999) concluded that floods of approximately 10-year return period magnitude rejuvenate the Klamath River channel by reworking gravels on riffles, eroding channel banks, re widening the channel, and removing substantial amounts of aquatic vegetation in the reach between Iron Gate Dam and the Scott River.
- The 1.5-, 2-, and 10-year return period for the Klamath River below Iron Gate Dam was estimated by Reclamation (2011) to be 4,389, 6,030, and 15,610 cfs, respectively.
- The 10-year return period of 15,610 cfs reported by Reclamation (2011) is consistent with the findings of Holmquist-Johnson and Milhous (2010) who estimated the threshold for general Armor Layer Movement to be 15,000 cfs and that of Ayres Associates (1999) who estimated the gravel mobilization on riffles to occur between 9,800 and 16,500 cfs for the reach between Iron Gate Dam and Seiad Valley.
- We classify discharges that exceed 15,000 cfs in the Klamath River below Iron Gate Dam as geomorphically effective flows, which are occasional high flows required to maintain channel form and reduce riparian encroachment.
- Other important considerations in flow include ramping rates, timing, duration, and monitoring and calibration.
- From 1964 to 1999, the average cumulative duration of Surface Flushing flows exceeded 22 days per water year. From 2000 to 2016, the average cumulative duration of Surface Flushing flow exceeded five days in only one water year and no sediment mobilization flows occurred in 12 of the 17 water years.
- At flow releases less than 2,500 cfs below Iron Gate Dam, Immobile Bed conditions exist that allow suspended sediments to settle and accumulate on the bed, which are not re-suspended until flows that generate Surface Flushing occur.
- Growth of fine sediment deposits on the bed and channel margins is a concern because high densities of *M. speciosa* have been observed in such deposits. In addition, riparian and aquatic vegetation can colonize fine sediments, further narrowing the channel and degrading fish habitat conditions such as what has been documented on the Trinity River.

- From 1964 to 1999, the time between Surface Flushing events below Iron Gate Dam was typically 1-2 years, which is consistent with channel maintenance needs of natural streams reported in the literature. Since 2000, there have been three occasions when the duration between Surface Flushing events approached or exceeded 5 years.
- Between 1964 and 2000, 5 geomorphically-effective events occurred on the Klamath River below Iron Gate Dam, with the duration between events ranging between 2 to 14 years. There has not been a geomorphically-effective flow event, the events that remove vegetation encroachment and rejuvenate the channel, since 1997, in a period approaching 20 years.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

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In Reply Refer To:
AFWO

Technical Memorandum

TO: Dave Hillemeier, Yurok Tribal Fisheries, and

Craig Tucker, Karuk Department of Natural Resources

FROM: Nicholas A. Som and Nicholas J. Hetrick, Arcata Fish and Wildlife Office, and

Julie Alexander, Oregon State University

SUBJECT: Response to Request for Technical Assistance – Polychaete Distribution and Infections

DATE: September 20, 2016

Purpose. The Arcata Fish and Wildlife Office (AFWO) Fisheries Program is working with its scientific co-investigators to develop a series of four technical memorandums that summarize recent findings of studies that contribute to our current understanding of *Ceratanova shasta* (syn *Ceratomyxa shasta)* infections in the Klamath River, in response to requests for technical assistance from the Yurok and Karuk tribes. Each of the topics addressed in the four technical memorandums: 1) geomorphic channel conditions and flow, 2) polychaete distribution and infections, 3) actinospore and myxospore concentrations, and 4) prevalence of *C. shasta* infections in juvenile and adult salmonids, are identified in a conceptual model diagram (Figure 1) taken from Foott et al. (2011), and as discussed with the requesting tribes. The intent of the technical memorandums is to provide managers with a contemporary understanding of the state of the science with regard to the *C. shasta* in the Klamath River, and to provide a scientific basis to inform and support resource management decisions. In this technical memorandum, we summarize the state of the science regarding the infection and mortality experience of salmonids exposed to *C. shasta* in the Klamath River.

Background. High infection rates by the myxozoan parasite *C. shasta* have been documented in emigrating juvenile salmon populations during spring and early summer in the Klamath River (Foott et al. 1999; Nichols and Foott 2006; True et al. 2016; among others), which have been linked to population declines in fall Chinook Salmon (Fujiwara et al. 2011, True et al. 2013). While native salmonids exposed to low doses of the parasite exhibit some degree of resistance (Ching and Munday 1984; Bartholomew et al. 2001), they can become overwhelmed by high infectious doses that result in a diseased state and cause mortality (Ratliff 1981; Ching and Munday 1984; Bartholomew 1998; Stone et al. 2008). Fish that display clinical signs of *C. shasta* infection are also likely to be more prone to mortality because of increased susceptibility to other pathogens such as *Parvicapsula minibicornis* (Figure 2*)*, to predation, and as a result of a compromised osmoregulatory system that is essential for successful ocean entry (S. Foott personal communication).

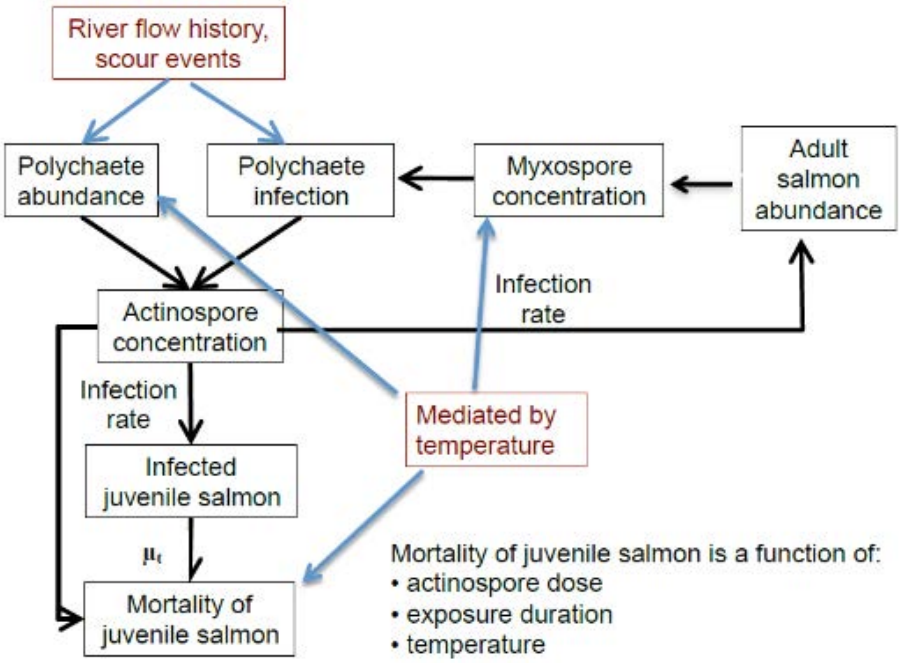

Figure 1. Conceptual model for variables that influence infection and mortality of juvenile Chinook Salmon. with μ_t being the mortality rate of infected juvenile salmon, estimated from weekly actinospore concentrations in water samples. (taken from Foot et al. 2011).

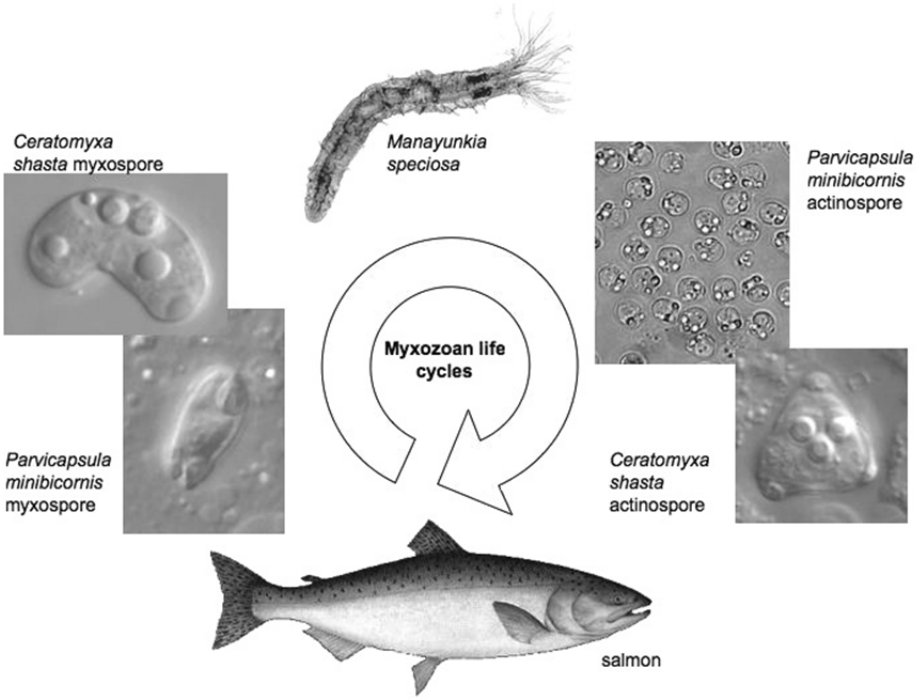

Figure 2. The life cycle of *Ceratomyxa shasta* and *Parvicapsula minibicornis* (graphic provided with permission from J. Bartholomew, Oregon State University). *Manayunkia speciosa* is a small freshwater polychaete worm (3-5 mm in length) and intermediate host of both parasites.

The parasite *C. shasta* is endemic to the Klamath Basin and is assumed to have co-evolved with the different species of salmonids it infects. Coevolution results in parasites that are in dynamic equilibrium with their hosts and low virulence, assuming continued environmental variation under which this equilibrium evolved (Toft and Aeschilimann 1991; Esch and Fernandez 1993). When environmental conditions are significantly altered, however, the change will most often favor the parasite because of its shorter generation time and greater genetic variation as compared to the host (Webster et al. 2007). In general, the parasite adapts more quickly to environmental change than the host, causing the parasite-host equilibrium to shift out of balance (Thompson 1994). This imbalance can be expressed as an elevated prevalence of host infections over naturally-occurring background or equilibrium levels, which is consistent with the abnormally high infection levels observed in juvenile salmon in the Klamath River during some years.

The life cycle of *C. shasta* is complicated and involves salmonids and a freshwater polychaete *Manayunkia speciosa* as alternate hosts, and two microscopic waterborne spore stages (Bartholomew et al. 1997, Meaders and Hendrickson 2009, Figure 2). Actinospores develop within infected polychaete worms that are later released into the water column where they may encounter and infect adult and juvenile salmonids. Clinical signs of the disease state exhibited by infected salmonids include necrosis of intestinal tissue that can be accompanied by a severe inflammatory reaction (enteronecrosis) and subsequent death (Bartholomew et al. 1989). The polychaete invertebrate host is necessary for completion of the life cycle and neither horizontal (fish to fish), or vertical (fish to egg) transmissions have been documented under laboratory conditions. Myxospores develop within infected salmonids and are released into the environment. After release, myxospores may be consumed by and infect polychaete worms, thus completing the life cycle.

The complexity of the *C. shasta* life cycle may lend itself to a variety of management approaches because actions can be tailored to target the different hosts or parasite spore stages, thus arresting the life cycle. Of particular interest, are aspects of the *C. shasta* life cycle that are susceptible to alteration via management alternatives (Figure 1). Given the nature of the parasite's life cycle, disruption of even a single element of the cycle could have profound impacts on survival of juvenile salmonids in the Klamath River.

Polychaete Ecology. Morhpological (e.g., body shape, structures for attachment), physiological and behavioral adaptations enable aquatic invertebrates to feed, grow, reproduce, and maintain productive populations in a constantly moving environment (Vogel, 1996). The polychaete worm *M. speciosa* is specifically adapted to life as a semi-sessile benthic invertebrate. Morphology consists of three body regions including the anterior end composed of the branchial crown, prostomium and peristomium, the thoracic region composed of 8 serially-repeated segments, and the posterior end composed of the pygidium (Thorp and Rogers 2015). *Manayunkia speciosa* inhabit flexible tubes which they construct from mucus, sand, and silt. The tubes are attached to substrate, allowing *M. speciosa* to suspension feed in the flowing water column by extending its branchial crown structure ("tentacles") out of the tube in order to contact and ingest food particles. A series of hooks on the posterior end of the organism facilitates attachment of the worm to the inside of the tube.

Three types of feeding behavior have been reported for the genera *Manayunkia*: deposit feeding, suspension feeding, and secondary suspension feeding (Lewis 1968). *M. speciosa* has been reported in the literature as being suspension-type feeders (Stocking and Bartholomew 2007). Additionally, Stocking and Bartholomew (2007) observed populations of *M. speciosa* "freely roaming the sediment" at the mouth of the Williamson River in the Upper Klamath River Basin. This diversity in habitat use and flexibility in feeding behaviors contribute to *M. speciosa* being

able survive under various environmental and nutrient availability conditions (Hendrickson et al. 2008), found in still-water depositional habitats, slow flowing habitats such as lake reservoir inflows and outflows, and lotic habitats including pools, eddies, riffles, and runs).

Knowledge of the reproduction and development of *M. speciosa* is fairly limited. The sexes are separate (dioecious) and non-feeding larvae are brooded in the maternal tube with the adult worm (Leidy 1883). Males have a dorsal sperm duct and females have a sperm storage structure located in the radiolar crown (Holmquist 1973, Rouse 1995). Eggs develop in females asynchronously in the coelem (Eckelbarger 2005) and reproduction typically peaks in spring to early summer as temperatures increase (Hendrickson et al. 2008, Willson et al. 2010, Alexander et al., personal communication). *Ceratonova shasta* infections are not commonly observed in sexually mature individuals (male or female) and infection is not thought be transmitted either vertically or horizontally among polychaetes. Progeny are reared in the maternal tube until they reach approximately 1 mm (Willson et al. 2010, Schloesser et al. 2016), which suggests they are not feeding independently (and thus not susceptible to infection by *C. shasta*) until they abandon the maternal tube (Alexander et al., personal communication).

Distribution and Habitat. Though previous work suggested that the distribution of *M. speciosa* is influenced by substrate (Stocking and Bartholomew 2007, Malakauskas and Wilzbach 2012) and a limited range of flow conditions (Jordan 2012), several recent studies have attempted to isolate how hydraulics and substrate may interact to influence the distribution of M. speciosa. Malakauskas et al. (2013) performed a series of laboratory flume experiments in which the stability and texture of substrates were varied across flume water velocities. They observed that dislodgement of *M. speciosa* increased with increasing water velocities and decreasing substrate stability, and concluded that higher flows could directly influence the distribution of polychaetes by restricting habitat use to stable substrates. They also concluded that altered flows targeting mobile substrates could effectively dislodge *M. speciosa* from readily entrained substrates, but noted that the polychaetes exhibited attachment abilities similar to taxa found in higher-gradient, rapidly-flowing environments, and that *M. speciosa* could potentially move to lower velocity sections of stable substrates (e.g., behind rock outcroppings) during high flow events. The ability of some polychaetes to persist after high flow events (Alexander et al. 2014) complicates our ability to predict the effectiveness of pulse flow events that may be targeted to scour polychaetes.

Alexander et al. (2016) implemented a designed study to assess how hydraulic conditions interact with substrate and relate to the distribution of *M. speciosa* in the Klamath River. This work coupled field sampling (measurements taken during summer base-flow periods when sampling was feasible) with the development of 2-dimensional hydrodynamic models (2DHMs, Wright et al. 2014) that allowed predictions of depth and velocity at discrete riverine locations over a range of discharges. Results of this study showed that the distribution of polychaetes is correlated with hydraulic variables occurring during the water year's winter or spring peak discharge event. Applications of the 2DHM to peak flows occurring each in 2012, 2013, 2014, and 2016 all show a consistent pattern: increasing peak discharge is associated with decreases in predicted weighted-useable area (WUA) as shown in Table 1. We note, however, that 2DHM predictions at the peak discharges of 2016 should be taken cautiously as the 2DHMs were calibrated and validated to discharges near 8,500 cfs (Wright et al. 2014). Predictions made under discharges above 12,000 cfs represent a considerable extrapolation beyond the calibration bounds of the model.

Table 1. Weighted-usable-area (WUA) for *M. speciosa* habitat at 3 sites in the Klamath River as predicted by coupling the peak discharge (Q) model of Alexander et al. (2016) with depth and velocity predictions from the 2DHM of Wright et al (2014). "T" represents the Tree of Heaven site (river kilometer (rkm) 281; 350 m in length), "B" represents the site just upstream of Beaver Creek (rkm 264; 550 m in length), and "C" represents the site near the Community Center grange (rkm 259; 850 m in length). Discharge values are in cubic feet per second, and WUA values are units of probability-weighted square-meters.

Site	Year	Peak Q (cfs)	WUA
T	2014	2154	2867
	2013	2755	2797
	2012	4520	2543
	2016	12,148	1979
B	2014	2225	6717
	2013	2825	6551
	2012	4697	5975
	2016	12,395	4552
C	2014	2331	6277
	2013	2931	6009
	2012	5015	5491
	2016	12,960	3633

The sampling design utilized by Alexander et al. (2016) also lent to the investigation of polychaete distribution dynamics by re-sampling specific geo-referenced locations in subsequent years. The main data for fitting the predictive statistical model was collected in 2012. In 2013, a largely independent (i.e., compared to the 2012 locations) data set was collected to evaluate the predictive performance of the statistical model, and so very few locations were resampled. However, many of the 2013 sample locations were resampled in 2014 and again in 2016. Of specific the locations sampled in 2013, 208 were again sampled in 2014. Of the locations sampled in 2014, 286 were again sampled in 2016. These repeated sampling locations allow us to look at changes in the density of polychaetes over time, and potentially relate changes to hydraulic conditions. Although the repeat sampling data are currently under analysis and write-up, we provide a summary of their results here. Between the 2013 and 2014 sampling period the peak discharge out of Iron Gate Dam (IGD) was 1,890 cfs, and annual peaks in 2015 and 2016 were 3,580 cfs and 11,200 cfs, respectively.

At each sampling location, a relative measure of polychaete density was assessed and recorded, with ordinal values of 0 (no polychaetes), 25, 50, 75, and 100 representing percent polychaete cover. To evaluate potential changes over each time period, we took the difference between the percent cover values recorded at the beginning and end of the period such that a larger percent cover at the end of the time period would indicate an increase. We note that our sampling was initially designed to capture the full range of hydraulic conditions at the Klamath River sites where data was collected. As such, there were a large number of samples taken and replicated at locations learned to be well outside the bounds of suitability for *M. speciosa*. Therefore, many sampling locations that were initially observed as having zero percent cover remained void of

polychaete cover across the sample periods, resulting in no change in percent cover (Table 2). Between the 2013 and 2014 samples, with an IGD peak discharge of only 1,890 cfs, locations more frequently increased than decreased in percent cover across all substrate types. The opposite was observed for samples collected in 2014 and again in 2016, where decreases were more commonly observed than increases across all substrate types (Table 2), as shown visually in Figure 3. A likely mechanism for the higher frequency of observed decreases in percent cover across sampled locations is scour and bed mobility resulting from the peak discharge event of 11,200 cfs that occurred in March 2016. Notably, increases detected from 2014 to 2016 were largely limited to shallow, marginal sand habitat (sandy deposits near river banks). One explanation for this result is that polychaetes disturbed during the high discharge event of March 2016 had settled in these areas by July when sampling occurred. Polychaetes were no longer observed in these locations during subsequent sampling (August 2016, J Alexander OSU pers. comm.).

Infection Prevalence. The infection prevalence of polychaetes in the Klamath River is less understood than polychaete distribution. However, several studies and ongoing monitoring efforts (conducted by Oregon State University, Yurok Tribal Fisheries) have measured incidence of infection among sampled polychaetes. Spatial and temporal (within and among years) variation in prevalence of infection among polychaete host assemblages creates a very context dependent picture that requires further study. Variation may be explained in part by spawning adult salmon abundance, known to bring *C. shasta* to the sections of river directly downstream of Iron Gate Dam, and other unknown factors contributing to myxospore production, survival and availability for infecting polychaetes.

Table 2. Change in percent cover over two different time periods summarized across sampling sites and within each substrate type. “B/B” represents bedrock and boulder substrates, and “S/S” represents sand and silt substrates. Numbers represent, for each substrate, the proportion of locations that decreased, did not change, or increased in percent cover of polychaetes between the beginning and end of the specified time period. Peak flow between sampling periods is parenthetically noted.

Time Period (peak discharge cfs)	Change	Substrate			
		B/B	Cobble	Gravel	S/S
2013-2014 (1,890 cfs)	Decrease	15%	6%	0%	0%
	No Change	36%	75%	78%	78%
	Increase	49%	19%	22%	22%
2014-2016 (11,200 cfs)	Decrease	59%	20%	29%	25%
	No Change	38%	78%	71%	59%
	Increase	3%	2%	0%	16%



Figure 3. Split screen picture of an identical rock in the mainstem Klamath River taken in 2014 (left) and in 2016 (right) following the March 2016 peak release of 11,200 cfs from Iron Gate Dam.

Generally, myxozoan infection prevalence tends to be very low (0.1-2.0%) in naturally exposed invertebrate host populations (Zendt and Bergersen 2000, Ozer et al. 2002). Prevalence of *C. shasta* infection is also typically low in Klamath River polychaetes, but zones or patches of high infection prevalence have been described. For example, Stocking and Bartholomew (2007) reported 8.24% in one population sampled near the I-5 rest area, downstream from Iron Gate Dam. If factors resulting in these potential focal centers of infection could be identified, then management actions could potentially be targeted.

The sampling associated with Alexander et al. (2016) may provide some insight into the distribution of polychaetes prone to infection. To validate the relative abundance measure recorded at all sampling locations, a subset of locations were selected as validation samples, whereby all benthic material was collected and a more precise enumeration of polychaetes was conducted, as well as an assessment to diagnose the prevalence of *C. shasta* infections among the subsampled polychaetes. Though these data are still under preparation and formal analysis, graphical evidence suggests that infected polychaetes exhibit a smaller range of peak-flow discharge depths and velocities than the general population of polychaetes distributed throughout the infectious zone of the Klamath River (Figure 4). The preliminary findings of this on-going study also suggest that management actions targeted to reduce the impact of *C. shasta* on native salmonids of the Klamath River may not need to target the hydraulic habitat preferences of all polychaetes.

There is evidence from sampled polychaetes that the prevalence of infection is correlated with peak flow regime. Following the 2006 peak flow event (12,400 cfs at IGD), Alexander (2014) reported maximum prevalence of infection in polychaetes of 0.17-0.35% in populations sampled from June-September. Following moderate peak discharges (4,380 cfs in 2004; 5,700 cfs in 2011; measured at IGD), maximum infection prevalence reached 4.96% (Stocking and Bartholomew 2007) and 5.38% (Jordan 2012), respectively. Additionally, preliminary data shows that the highest polychaete prevalence of infection on record (10%, Alexander in prep.) was observed in drought years of 2014 and 2015 (peak IGD discharges of 1,890 and 3,580, respectively).

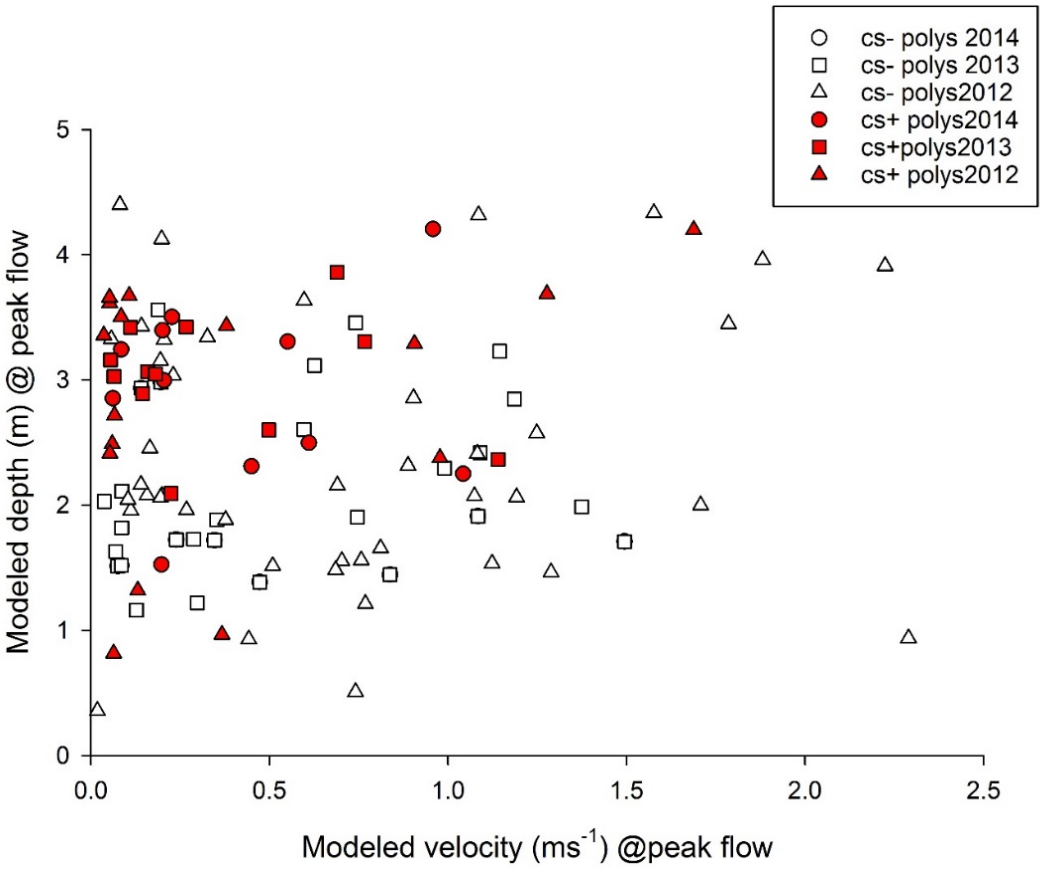

Figure 4. Infected (filled shapes) and uninfected (open shapes) polychaete host assemblages related to the peak-flow water depths and velocities as predicted by the 2-dimensional hydrodynamic model of Wright et al. (2014), and assessed under the sampling design of Alexander et al. (2016). Note that symbols in this figure reference only locations of polychaete presence and do not represent the full suite of depth and velocity combinations considered in the sampling design of Alexander et al. (2016).

Summary Guidelines.

- The polychaete *M. speciosa* has been documented as the obligate intermediate host for the parasite *C. shasta*.
- Polychaetes in the Klamath River have been documented to be sessile suspension feeders and may also have flexibility to feed on organic matter in deposited sediments.
- Polychaete reproduction typically peaks in spring to early summer, coinciding with increasing water temperatures.
- Studies indicate that dislodgement of *M. speciosa* increases with increasing water velocities and decreasing substrate stability.
- Results of 2-D hydrodynamic model runs predict decreasing WUA of suitable polychaete habitat with increasing discharge.
- Results of repeat samples at specific locations in the Klamath River indicate a decrease in *M. speciosa* following the March 2016 peak discharge event of 11,200 cfs.

- Evidence suggests that the prevalence of *C. shasta* infection in polychaetes is negatively correlated with the peak flow regime.
- Preliminary results indicate that infected polychaetes are more likely to occur within a smaller range of peak-flow depths and velocities than the general population, with infected polychaetes more associated with deeper and lower-velocity depositional habitats.

Key Questions. There are several aspects regarding the role of *M. speciosa* in the life-cycle of *C. shasta* that remain unknown, and that could help inform how the disease cycle is completed in the Klamath River. For instance, exactly when and how the infections occur, and if infection differs by parasite genotype, via suspension or deposit feeding, etc. would help inform the transmission mechanism and could help evaluate the potential efficacy and timing of pulse flow events/managed flow events. Additionally, how infection and genotype may affect the life span and survival of *M. speciosa* remains a key question.

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In Reply Refer To:
AFWO

Technical Memorandum

TO: Dave Hillemeier, Yurok Tribal Fisheries, and

Craig Tucker, Karuk Department of Natural Resources

FROM: Nicholas A. Som and Nicholas J. Hetrick, Arcata Fish and Wildlife Office

SUBJECT: Response to Request for Technical Assistance – *Ceratonova shasta* Waterborne Spore Stages

DATE: September 23, 2016

Purpose. The Arcata Fish and Wildlife Office (AFWO) Fisheries Program is working with its scientific co-investigators to develop a series of four technical memorandums that summarize recent findings of studies that contribute to our current understanding of *Ceratanova shasta* (syn *Ceratomyxa shasta)* infections in the Klamath River, in response to requests for technical assistance from the Yurok and Karuk tribes. Each of the topics addressed in the four technical memorandums: 1) geomorphic channel conditions and flow, 2) polychaete distribution and infections, 3) actinospore and myxospore concentrations, and 4) prevalence of *C. shasta* infections in juvenile and adult salmonids, are identified in a conceptual model diagram (Figure 1) taken from Foott et al. (2011). The intent of the technical memorandums is to provide managers with a contemporary understanding of the state of the science with regard to the *C. shasta* in the Klamath River, and to provide a scientific basis to inform and support resource management decisions. In this technical memorandum, we summarize the state of the science regarding the waterborne spore stages of the parasite and how they infect the salmonid (via actinospores) and benthic invertebrate (via myxospores) hosts in the Klamath River.

Background. High infection rates by the myxozoan parasite *C. shasta* have been documented in emigrating juvenile salmon populations during spring and early summer in the Klamath River (Foott et al. 1999; Nichols and Foott 2006; True et al. 2016; among others), which have been linked to population declines in fall Chinook Salmon (Fujiwara et al. 2011, True et al. 2013). While native salmonids exposed to low doses of the parasite exhibit some degree of resistance (Ching and Munday 1984; Bartholomew et al. 2001), they can become overwhelmed by high infectious doses that result in a diseased state and cause mortality (Ratliff 1981; Ching and Munday 1984; Bartholomew 1998; Stone et al. 2008). Fish that display clinical signs of *C. shasta* infection are also likely to be more prone to mortality because of increased susceptibility to other pathogens such as *Parvicapsula minibicornis* (Figure 2*)*, to predation, and as a result of a compromised osmoregulatory system that is essential for successful ocean entry (S. Foott personal communication).

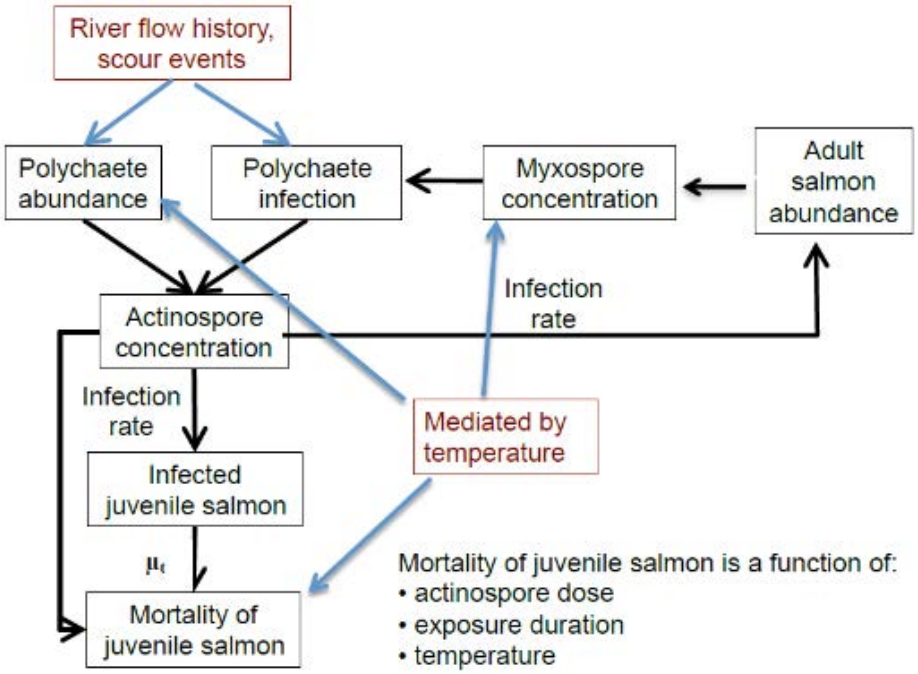

Figure 1. Conceptual model for variables that influence infection and mortality of juvenile Chinook Salmon. with μ_t being the mortality rate of infected juvenile salmon, estimated from weekly actinospore concentrations in water samples. (taken from Foot et al. 2011).

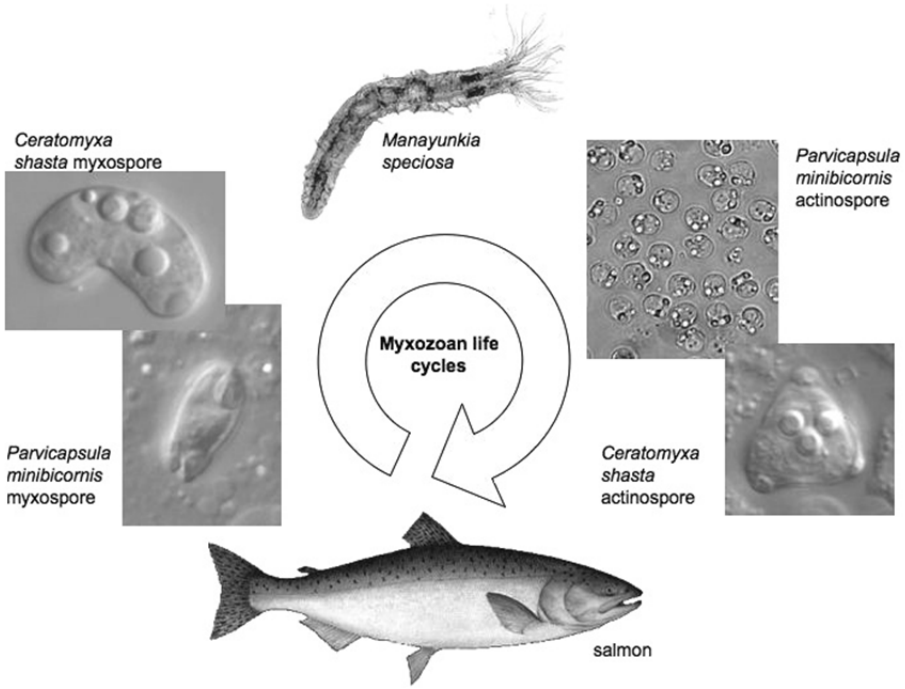

Figure 2. The life cycle of *Ceratomyxa shasta* and *Parvicapsula minibicornis* (graphic provided with permission from J. Bartholomew, Oregon State University). *Manayunkia speciosa* is a small freshwater polychaete worm (3-5 mm in length) and intermediate host of both parasites.

The parasite *C. shasta* is endemic to the Klamath Basin and is assumed to have co-evolved with the different species of salmonids it infects. Coevolution results in parasites that are in dynamic equilibrium with their hosts and low virulence, assuming continued environmental variation under which this equilibrium evolved (Toft and Aeschilimann 1991; Esch and Fernandez 1993). When environmental conditions are significantly altered, however, the change will most often favor the parasite because of its shorter generation time and greater genetic variation as compared to the host (Webster et al. 2007). In general, the parasite adapts more quickly to environmental change than the host, causing the parasite-host equilibrium to shift out of balance (Thompson 1994). This imbalance can be expressed as an elevated prevalence of host infections over naturally-occurring background or equilibrium levels, which is consistent with the abnormally high infection levels observed in juvenile salmon in the Klamath River during some years.

The life cycle of *C. shasta* is complicated and involves salmonids and a freshwater polychaete *Manayunkia speciosa* as alternate hosts, and two microscopic waterborne spore stages (Bartholomew et al. 1997, Meaders and Hendrickson 2009, Figure 2). Actinospores develop within infected polychaete worms that are later released into the water column where they may encounter and infect adult and juvenile salmonids. Clinical signs of the disease state exhibited by infected salmonids include necrosis of intestinal tissue that can be accompanied by a severe inflammatory reaction (enteronecrosis) and subsequent death (Bartholomew et al. 1989). The polychaete invertebrate host is necessary for completion of the life cycle and neither horizontal (fish to fish), or vertical (fish to egg) transmissions have been documented under laboratory conditions. Myxospores develop within infected salmonids and are released into the environment. After release, myxospores may be consumed by and infect polychaete worms, thus completing the life cycle.

The complexity of the *C. shasta* life cycle may lend itself to a variety of management approaches because actions can be tailored to target the different hosts or parasite spore stages, thus arresting the life cycle. Of particular interest, are aspects of the *C. shasta* life cycle that are susceptible to alteration via management alternatives (Figure 1). Given the nature of the parasite's life cycle, disruption of even a single element of the cycle could have profound impacts on survival of juvenile salmonids in the Klamath River.

Environmental Detection. The waterborne spore stages of the parasite alternatively infect the salmonid (via actinospores) and benthic invertebrate (via myxospores) hosts. Prior to the work of Hallett and Bartholomew (2006), detection of infectious actinospores in water relied on the fates of exposed sentinel fish. Hallett and Bartholomew (2006) developed a DNA-based method for water samples that quantifies abundance of *C. shasta* by a quantitative polymerase chain reaction (qPCR) assay. This qPCR assay provides evidence of waterborne *C. shasta* spores much more quickly than exposed sentinel fish. Although this method cannot distinguish between the actinospore or myxospore stages, or between viable and non-viable (dead or partial) spores, DNA collected in water samples can be further processed to quantify the different genotypes of spores present in the Klamath River (Atkinson and Bartholomew 2010). Of most management concern in the Klamath Basin are Type I, which is associated with mortality in Chinook Salmon, and Type II, which is associated with mortality in Coho Salmon. The detection assay has been used to monitor the temporal and spatial distribution of spores in the Klamath River, and help evaluate the effectiveness of naturally occurring or prescribed experimental flows aimed to reduce the concentration of spores in water during periods of juvenile salmonid outmigration.

The J. L. Bartholomew Laboratory began monitoring spore concentrations in 2005 and added long-term monitoring index sites in 2006. In 2007, the sampling calendar was modified to begin

earlier in the water year to capture the initial rise of spore concentrations associated with warming water temperatures. Over time, the sampling calendar and spatial extent of sampling have increased to address various research and monitoring needs. Currently, weekly water samples are collected and processed at five sites during the months of April through October, and year-round at two of those sites. The sampling effort at each site consists of four 1-liter samples extracted from an automatic sampler that pulls 1-liter riverine samples every 2 hours over the prior 24-hour period. The collection and filtration of water samples is coordinated with the Karuk Natural Resources Department and Yurok Tribal Fisheries Program.

Temporal and Spatial Distribution. From late winter to early summer, which encapsulates a single outmigration period, actinospore concentrations (confirmed via sentinel exposures) increase with increasing water temperatures, and then decrease forming a curvilinear pattern (Hallett et al. 2012, Hurst et al. 2012). The timing of spore release (i.e., when spore levels increase to the point of detectability in water samples) usually coincides with the descending limb of the spring hydrograph, and is likely dependent on accumulating thermal units. Meaders and Hendrickson (2009) infected polychaetes with Type II myxospores and tracked actinospore development within a laboratory. Actinospores were generated after 49 days averaging 17.3°C (approximately 850 degree days). Recent laboratory experiments suggest that Type I spores may develop more quickly (approximately 735 degree days) in polychaetes, with actinospores generated after 35 days averaging 21°C (J. Alexander, personal communication).

Actinospore and myxospore viability are both affected by water temperatures, but myxospores are more resilient to higher water temperatures (Chiaramonte 2013). At temperatures near 20°C in a controlled laboratory setting, 50% survival was observed after approximately 25 days, and the hardiest myxospores survived approximately 50 days (Chiaramonte 2013). At 15°C, 50% survival was observed as late as 100 days and the hardiest myxospores lasted 150 days. This is in stark contrast to laboratory-monitored actinospores held in 20°C water, where only 20% survival was observed after 3 days, the most robust of which lasted only 9 days (Bjork 2010). Actinospore survival also related to temperature, and at temperatures near 12°C approximately 50% survival was observed at 3 days and the hardiest spores survived 15 days.

The current hypothesis is that myxospores released from adult salmon carcasses contribute the bulk of myxospore to the system (Foott et al. 2016). The release of myxospores from adults likely occurs within several weeks of pre- or post-spawn mortality. Hence, the timing of myxospore contribution closely aligns with the timing of salmon spawning, which in recent years coincides with a stable hydraulic period below Iron Gate Dam (Figure 3). Recent laboratory studies estimate the settling rate of *C. shasta* myxospores at 0.35—0.45 m/day (Miao and Deas 2015). This rate suggests that suspended myxospores could settle in riverine locations quite distant from entry location under turbulent high-flow conditions. The settling characteristics and relative resiliency of myxospores suggests that they could be prone to redistribution and potential infection of polychaetes at spatial locations and time periods distant from their initial release time and location.

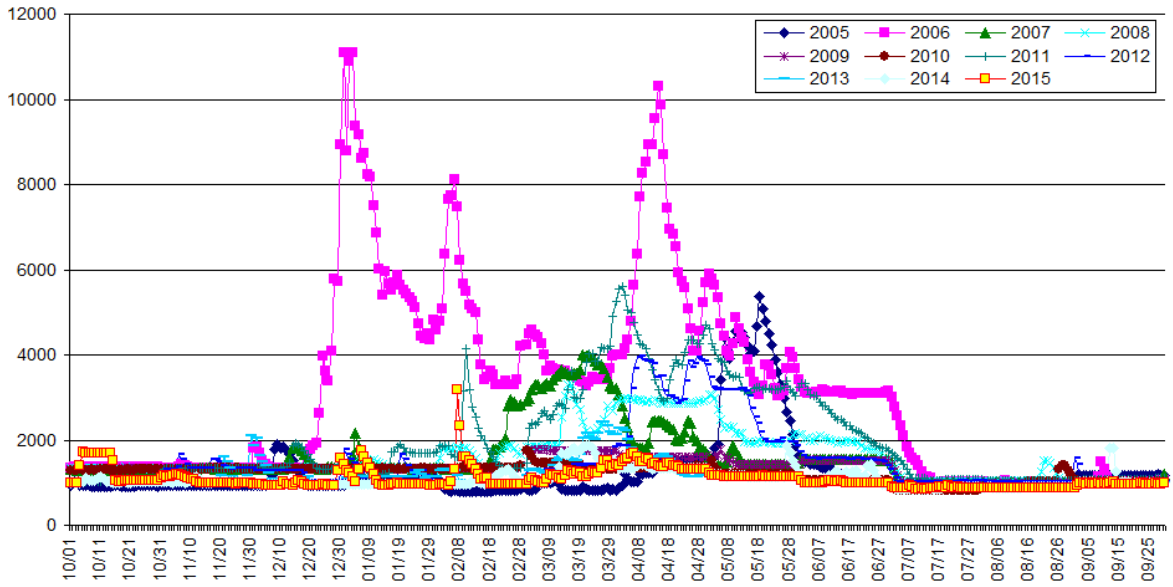

Figure 3. Daily discharge from Iron Gate Dam as measured by U.S. Geological Survey gauge 11516530 for water years 2005 – 2015. Reported discharge values are in units cubic feet per second. http://waterdata.usgs.gov/ca/nwis/uv?format=gif&period=10&site_no=11516530

The concentration of spores varies spatially within the mainstem river, with the highest spore concentrations typically detected near the confluence of Beaver Creek (Hallett et al. 2012). However, the spatial peak has occurred downstream of Beaver Creek (e.g., near confluences of Seiad Creek or Tully Creek) in some years (Bartholomew 2010, 2011, Table 1). In 2016, the index water sampling sites near Orleans and Tully Creek had much higher peak spore concentrations than any of the upstream locations, which has not previously been observed (http://microbiology.science.oregonstate.edu/content/monitoring-studies). Further, the difference between the peak spore concentrations at the Orleans index site and the upriver sites was of a much higher magnitude than observed in previous years. One hypothesis for the unique spatial pattern of spore concentrations observed in 2016 relates to the 11,200 cfs Iron Gate Dam discharge event occurring March 2016. This event could have dislodged and moved high numbers of polychaete worms downstream in the drift and these redistributed worms, if infected, may have contributed to the relatively high spore concentrations observed in the lower river (J. Alexander, pers. comm).

The annual peak concentration of actinospores varies considerably, with observed differences of several orders of magnitude among years. (Table 1). Predicting annual peak actinospore concentration levels remains elusive. The difficulty in prediction is likely attributable to the currently unavailable population-level estimates of both myxospores released by adult salmon, and abundances of infected polychaetes in each year. Further, knowledge of the exact timing or dynamics of infection and parasite transmission to polychaetes is still not well understood under riverine conditions.

Table 1. Annual maximum actinospore concentrations recorded at the Beaver Creek ("BC Peak") water monitoring index site during the Chinook Salmon outmigration period (spring and early summer). Values provided are approximations of spores per liter based on a standard curve transformation of detection assay readings, and include the totals pooling over all genotypes. In years where the system maximum value occurred at another site, the location and maximum value are indicated ("Alt. Peak"), where KTC represents Tully Creek, KSV represents Seiad Valley, and KOR represents the Orleans water monitoring index sites. Data provided by the J. L. Bartholomew Laboratory, Oregon State University.

Year	BC Peak	Alt. Peak
2005	75	
2006	8	
2007	250	
2008	300	
2009	150	
2010	20	KTC: 100
2011	10	
2012	1	KSV: 5
2013	5	KTC: 8
2014	100	
2015	1200	
2016	50	KOR: 250

Effects of Discharge on Spore Concentrations. Due to water management concerns impacting the entire Klamath Basin, experimental discharge increases have not generally been available to assess the effects of within-year discharge changes on spore concentrations. There have been several years where elevated discharges from Iron Gate Dam have occurred between April and June, the time of year when actinospore levels are rising or at their highest. During high flows events occurring in spring 2006 (10,300 cfs) and 2011 (5,700 cfs), spore concentrations were below the detection limit prior to the increases in discharge. Hence, it is not possible to assess the dilution potential of elevating discharge in those years. Some insight into the dilution potential of elevated flows may be gained from two additional events that occurred over the last decade. The first event was an unplanned discharge increase occurring in May of 2005, and associated fish-health and water monitoring data may demonstrate an effect of discharge on spore concentrations. A planned pulse event occurred in 2014, and this event was well monitored. Both are described below.

By 2005, the impacts of *C. shasta* on salmonids in the Klamath Basin had risen to the point that fish health and water monitoring programs were being implemented throughout the basin. Weekly-stratified fish-health surveys began in March of 2005. Water monitoring assays adept at quantifying spore concentrations in water samples had just been developed (Hallett and Bartholomew 2006), and water sampling began in May of 2005.

In April, the weekly-stratified prevalence of infection estimates began to quickly rise, and eventually reached 100% of sampled fish at the beginning of May (Figure 4). Despite no water sampling occurring during this time of year in 2005, the estimated prevalence of fish infections undoubtedly demonstrates the presence of actinospores in the water. Further, given the relatively

high estimated prevalence of fish infections, once could safely assume concentrations well above 10 spores/L threshold reported by Hallett et al. (2012) for infectioning Chinook Salmon.

Towards the end of April, releases from Iron Gate Dam increased slightly, but in early May discharge spiked sharply and remained elevated for nearly a month (Figure 4). Soon after the spike in discharge, weekly prevalence of infection values began to decrease. One explanation for a decrease in the weekly prevalence of infection estimates could be the addition of hatchery-released fish that were not in the river long enough to become infected. This influx of uninfected fish would dilute the weekly samples, resulting in lower prevalence of infection estimates. However, the first Iron Gate Hatchery release in 2005 occurred on May 15, several weeks after the observed decrease in weekly prevalence of infection estimates. Additionally, the first water monitoring sample was collected when discharge was elevated and resulted in a non-detection (equivalent to an estimate of ~ zero spores/L). After flows had receded to base levels, subsequent water monitoring samples revealed detectable levels of spore concentrations (Figure 4).

In 2014, water monitoring samples indicated that spore densities had reached levels of concern for Coho Salmon. To prevent or reduce a disease outbreak in juvenile fish, federal agencies and partners agreed to increase discharge as a possible solution to dilute spore concentrations or otherwise disrupt the *C. shasta* life cycle. For this event, discharge was increased to approximately 1,900 cfs on May 27, and held for 24 hours. Flows were reduced approximately 200 cfs each subsequent day until a base discharge of 1,000 cfs was reached on June 2 (Figure 5).

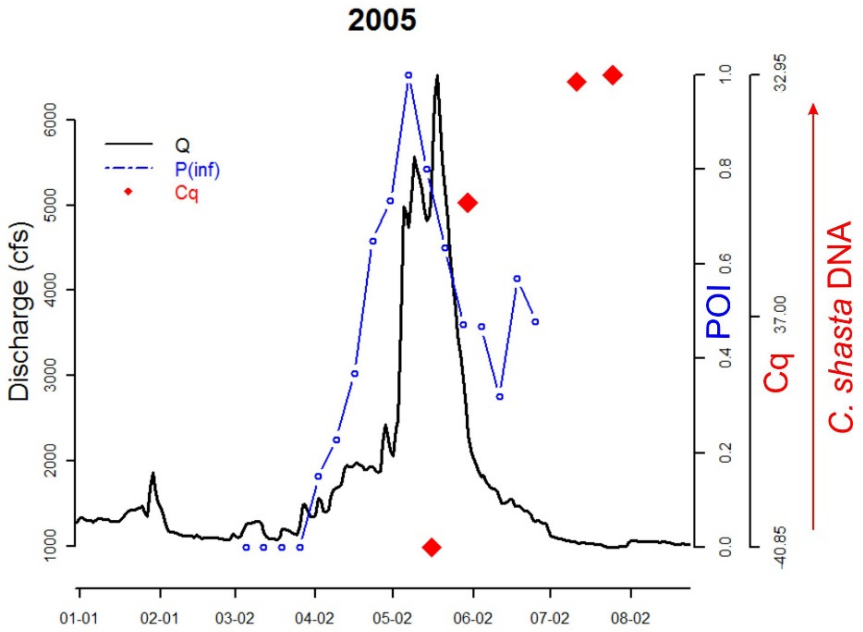

Figure 4. Daily river discharge (solid black line), weekly-stratified prevalence of *C. shasta* infection among sampled Chinook Salmon (open blue circles connected by blue lines), and Cq scores for water monitoring samples (solid red diamonds), all estimated for an area of the mainstem Klamath River between the Shasta and Scott confluences. The inset right axis represents the range of prevalence of infection values in fish, and the outset right axis represents Cq values that reflect quantities of *C. shasta* DNA; these are scaled so that increasing values correspond to increases in spore concentrations.

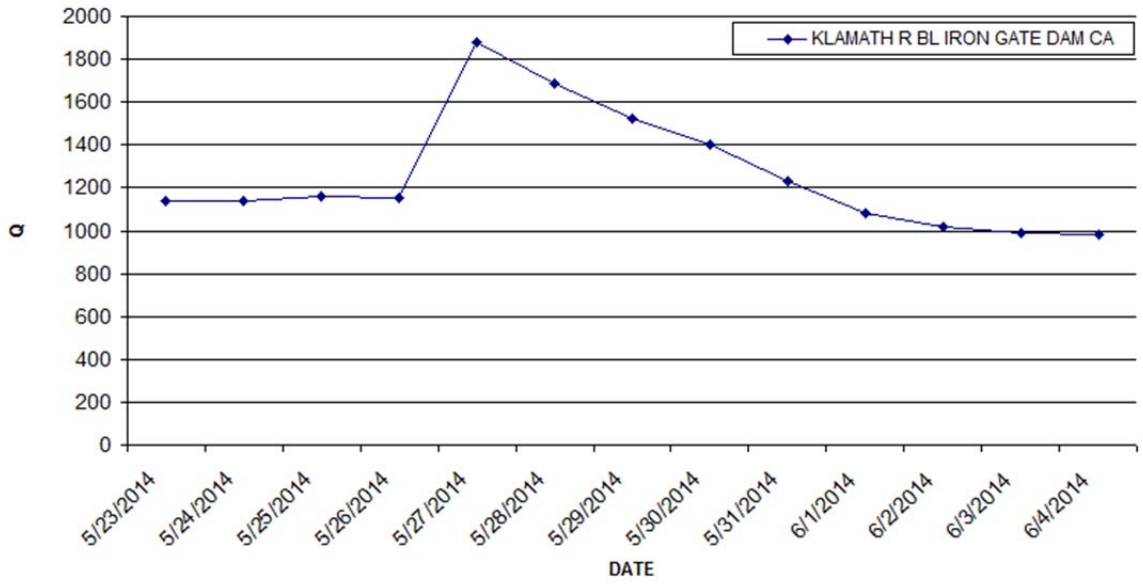

Figure 5. Daily discharge (Q) from Iron Gate Dam as measured by U.S. Geological Survey gauge 11516530 for May 23, 2005 – June 4, 2005. Reported discharge values are in units cubic feet per second.
http://waterdata.usgs.gov/ca/nwis/uv?format=gif&period=10&site_no=11516530

As a planned event, monitoring to evaluate the effectiveness of the increased discharge was coordinated. In particular, Oregon State University monitored spore concentrations at two locations. Water samples were collected daily at Beaver Creek and Seiad Valley index sites, beginning three days prior to the event and ending on May 30. Samples were collected every 2 hours using automated samplers, and pooled to make a 6-hour composite sample that was assayed using a *C. shasta*-specific qPCR. Data were more complete for Seiad Valley (Figure 6). At both sites there was a noticeable decrease in spore concentrations immediately following the increase in discharge. This reduction in spore concentrations, however, did not persist, and spore concentrations increased with decreasing discharge (Figures 5 and 6). The continued rise in spore concentrations may have been amplified by increasing temperatures.

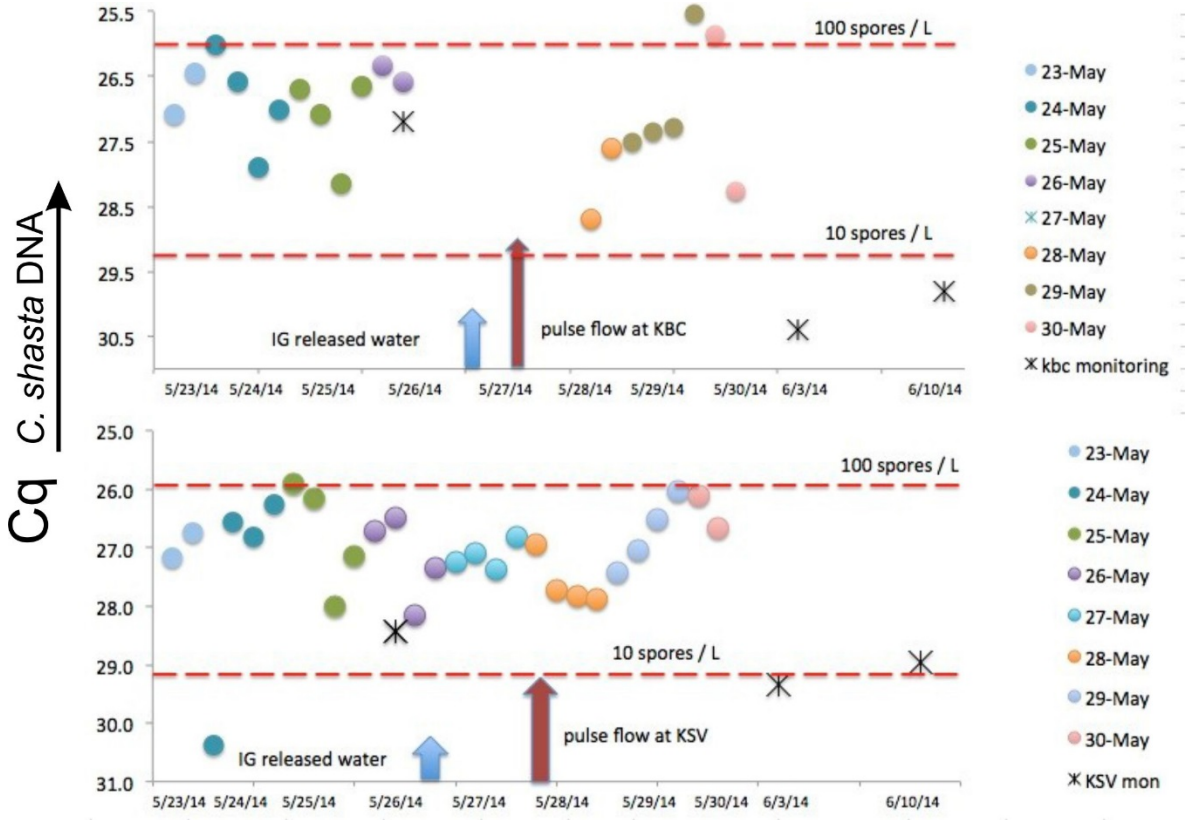

Figure 6. Quantitative PCR results, also expressed as *C. shasta* spores/L, at the Beaver Creek (top) and Seiad Valley (bottom) index water monitoring locations. Each data point is the average Cq of 3 x 1L water samples (6h composite). A lower Cq value indicates more parasite is present. Blue arrows mark the date of increasing discharge from Iron Gate Dam, and red arrows mark the arrival of the increased discharge at each index location. Figure provided by the J. L. Bartholomew Laboratory, Oregon State University.

Summary Guidelines.

- A DNA assay allows for the quantification of spore concentrations in water samples.
- Spore genotypes have been shown to associate with salmonid species-specific mortality.
- Myxospores are hardier than actinospores, and likely survive for a longer period after release from their host organism.
- The majority of myxospore load to the system is likely via adult salmon carcasses in the fall.
- Generally, actinospore spore concentrations increase with increasing water temperatures in the spring and then decrease as water temperatures further increase during summer.
- The location of peak actinospore concentrations varies among years, but most frequently occurs near the confluence of Beaver Creek.
- It is not uncommon for actinospore concentrations to peak as far downriver as the Tully Creek confluence. However, the magnitude of the difference between the peak spore

concentrations downriver and at Beaver Creek was much higher in 2016 than for any other year since water monitoring began.

- Annual peak actinospore concentrations vary by several orders of magnitude.
- Actinospore development within polychaetes is likely a function of accumulating thermal units, and likely takes between 100 and 115 days.
- Though managed discharge events have not produced dramatic reductions in spore concentrations, the planned discharge increases were likely too small to be biologically effective. An unplanned discharge increase in 2005 likely demonstrates the potential for larger discharges to effectively reduce spore concentrations.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

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In Reply Refer To:
AFWO

Technical Memorandum

TO: Dave Hillemeier, Yurok Tribal Fisheries, and

Craig Tucker, Karuk Department of Natural Resources

FROM: Nicholas A. Som and Nicholas J. Hetrick, Arcata Fish and Wildlife Office,

J. Scott Foott and Kimberly True, USFWS California-Nevada Fish Health Center

SUBJECT: Response to Request for Technical Assistance – Prevalence of *C. shasta* Infections in Juvenile and Adult Salmonids

DATE: September 20, 2016

Purpose. The Arcata Fish and Wildlife Office (AFWO) Fisheries Program is working with its scientific co-investigators to develop a series of four technical memorandums that summarize recent findings of studies that contribute to our current understanding of *Ceratanova shasta* (syn *Ceratomyxa shasta)* infections in the Klamath River, in response to requests for technical assistance from the Yurok and Karuk tribes. Each of the topics addressed in the four technical memorandums: 1) geomorphic channel conditions and flow, 2) polychaete distribution and infections, 3) actinospore and myxospore concentrations, and 4) prevalence of *C. shasta* infections in juvenile and adult salmonids, were identified in a conceptual model diagram (Figure 1) taken from Foott et al. (2011), and as discussed with the requesting tribes. The intent of the technical memorandums is to provide managers with a contemporary understanding of the state of the science with regard to the *C. shasta* in the Klamath River, and to provide a scientific basis to inform and support resource management decisions. In this technical memorandum, we summarize the state of the science regarding the infection and mortality experience of salmonids exposed to *C. shasta* in the Klamath River.

Background. High infection rates by the myxozoan parasite *C. shasta* have been documented in emigrating juvenile salmon populations during spring and early summer in the Klamath River (Foott et al. 1999; Nichols and Foott 2006; True et al. 2016; among others), which have been linked to population declines in fall Chinook Salmon (Fujiwara et al. 2011, True et al. 2013). While native salmonids exposed to low doses of the parasite exhibit some degree of resistance (Ching and Munday 1984; Bartholomew et al. 2001), they can become overwhelmed by high infectious doses that result in a diseased state and cause mortality (Ratliff 1981; Ching and Munday 1984; Bartholomew 1998; Stone et al. 2008). Fish that display clinical signs of *C. shasta* infection are also likely to be more prone to mortality because of increased susceptibility to other pathogens such as *Parvicapsula minibicornis* (Figure 2*),* to predation, and as a result of a compromised osmoregulatory system that is essential for successful ocean entry (S. Foott personal communication).

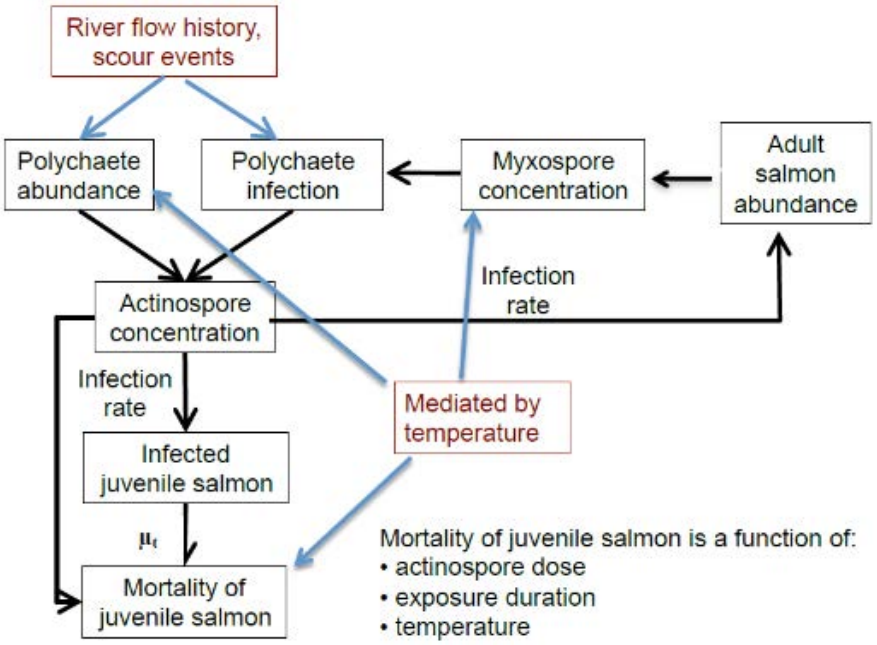

Figure 1. Conceptual model for variables that influence infection and mortality of juvenile Chinook Salmon. with μ_t being the mortality rate of infected juvenile salmon, estimated from weekly actinospore concentrations in water samples. (taken from Foot et al. 2011).

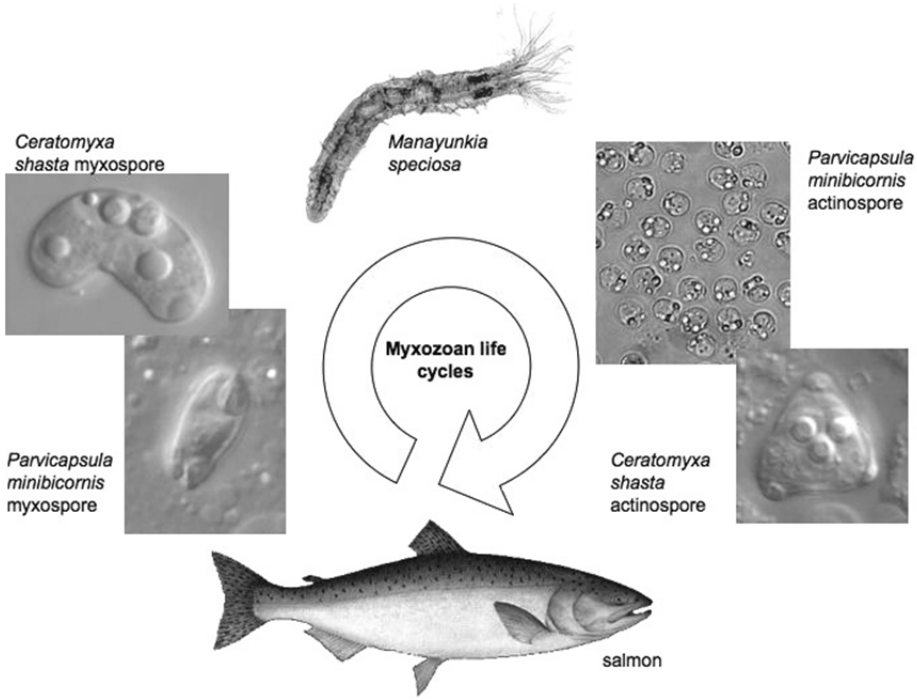

Figure 2. The life cycle of *Ceratomyxa shasta* and *Parvicapsula minibicornis* (graphic provided with permission from J. Bartholomew, Oregon State University). *Manayunkia speciosa* is a small freshwater polychaete worm (3-5 mm in length) and intermediate host of both parasites.

The parasite *C. shasta* is endemic to the Klamath Basin and is assumed to have co-evolved with the different species of salmonids it infects. Coevolution results in parasites that are in dynamic equilibrium with their hosts and low virulence, assuming continued environmental variation under which this equilibrium evolved (Toft and Aeschilimann 1991; Esch and Fernandez 1993). When environmental conditions are significantly altered, however, the change will most often favor the parasite because of its shorter generation time and greater genetic variation as compared to the host (Webster et al. 2007). In general, the parasite adapts more quickly to environmental change than the host, causing the parasite-host equilibrium to shift out of balance (Thompson 1994). This imbalance can be expressed as an elevated prevalence of host infections over naturally-occurring background or equilibrium levels, which is consistent with the abnormally high infection levels observed in juvenile salmon in the Klamath River during some years.

The life cycle of *C. shasta* is complicated and involves salmonids and a freshwater polychaete *Manayunkia speciosa* as alternate hosts, and two microscopic waterborne spore stages (Bartholomew et al. 1997, Meaders and Hendrickson 2009, Figure 2). Actinospores develop within infected polychaete worms that are later released into the water column where they may encounter and infect adult and juvenile salmonids. Clinical signs of the disease state exhibited by infected salmonids include necrosis of intestinal tissue that can be accompanied by a severe inflammatory reaction (enteronecrosis) and subsequent death (Bartholomew et al. 1989). The polychaete invertebrate host is necessary for completion of the life cycle and neither horizontal (fish to fish), or vertical (fish to egg) transmissions have been documented under laboratory conditions. Myxospores develop within infected salmonids and are released into the environment. After release, myxospores may be consumed by and infect polychaete worms, thus completing the life cycle.

The complexity of the *C. shasta* life cycle may lend itself to a variety of management approaches because actions can be tailored to target the different hosts or parasite spore stages, thus arresting the life cycle. Of particular interest, are aspects of the *C. shasta* life cycle that are susceptible to alteration via management alternatives (Figure 1). Given the nature of the parasite's life cycle, disruption of even a single element of the cycle could have profound impacts on survival of juvenile salmonids in the Klamath River.

Sentinel Trials. The infection and mortality experience of juvenile Klamath River salmonids has received substantial research and monitoring attention over the last decade. Most of the work has focused on sentinel exposure experiments, where groups of fish are caged in the river and exposed for several (typically 3) days, and then moved to laboratory tanks where they are reared for an extended period of time. Fish in these trials are exposed *in situ* to Klamath River water concentrations of actinospores and temperatures, with the subsequent laboratory holding temperatures often varied across trials to isolate the effects that temperatures may play in the infection and mortality experienced by exposed fish. Experimental variation in actinospore levels is achieved by conducting the experiments at different times of the year, and by natural variation in actinospore levels that occur across years.

The most comprehensive summary of Klamath River sentinel exposures to-date was conducted by Ray et al. (2014), who analyzed the *C. shasta* mortality experience of juvenile Chinook and Coho salmon in trials conducted between 2006 and 2010. They found that increasing parasite (species-specific) concentrations and water temperatures were positively associated with the proportion of individuals succumbing to disease and to the rate at which mortality occurred. A positive relationship between discharge and mortality was also estimated, but the authors noted

several key caveats. First, the effects of temperature and spore concentration were estimated to be much stronger influences on mortality than the discharge variable, and consistent among both Chinook and Coho salmon. Second, discharge was measured at a nearby gauge and was applied as a coarse-level proxy for water velocity (and hence, potential dose) experienced by fish held in fixed-position cages, which are a weak proxy for cage-specific water velocities. Cage placement also prevented sentinel fish from seeking velocity shelter, a behavior commonly observed in the wild. Further, a separate study aimed to investigate the transmission dynamics of actinospores found that increasing velocities decreased parasite transmission and that transmission stopped above 0.2 – 0.3 m/s (Ray and Bartholomew 2013).

In addition to studying how environmental factors relate to the proportion and rate of fish mortalities, True et al. (2012) expanded on these sentinel experiments to track the progression of disease among exposed individuals. After 3-day river exposures, juvenile Chinook and Coho salmon were held at 18 °C water and groups were tested for parasite DNA levels daily for 35 days. Riverine exposure temperatures averaged 16.8 °C, and the water concentration of spores averaged 147 spores/L over the 3 days. Onset of enteronecrosis (syn. with ceratomyxosis; the disease caused by *C. shasta)* occurred at a range of 10-15 days post exposure for both species. The mean day to death was slightly (3 days) shorter for Chinook Salmon than for Coho Salmon, but a higher percentage of Coho Salmon succumbed to disease. We note that the spore concentration data were not processed for genotypic differences, which may help explain some of the small differences in the observed mortality experiences between Chinook (87%) and Coho (96%) Salmon in this study.

True et al. (2012) also noted the development of myxospores in both Chinook and Coho salmon by 15-16 days post exposure, and hypothesized that juvenile salmonids in the Klamath River could contribute spores to the system and may contribute to polychaete infections in years with high disease severity. The development and release of myxospores in juveniles was further studied by Benson (2014), who found releases from fish occurring generally at or soon (within several weeks) after mortality. Benson (2014) does note the potential for pre-spore stages (i.e., not fully developed myxospores) to be detected. The DNA assay method does not distinguish parasite developmental stage and could hinder precise timing and quantity of myxospore release. Bension (2014) also suggests the potential for hatchery Chinook Salmon to contribute more myxospores to the system than spawning adults, but notes the timing and spatial overlap of myxospore release from adults likely better aligns with the distribution of the polychaete hosts.

Extended Sentinel Trials. Building on the foundational knowledge laid down by the sentinel exposure experiments, several recent studies have attempted to address the hypothesis that 3-day exposures may underestimate the disease experience of natural and hatchery fish in the wild. These fish populations are continuously exposed to riverine conditions, and during periods of high actinospore concentrations, these extended duration exposures may lead to higher levels of infection and mortality than previously reported in the literature.

The first examination of extended exposures includes the analyses of Russell et al. (in prep). This work utilized the known exposure duration of hatchery-released fish to examine the effects of continuous, and potentially changing, temperatures and actinospore concentration levels on the prevalence of infection (POI) of juvenile Chinook Salmon. The analysis included 252 hatchery fish collected between the years of 2007 and 2011 in the “infectious zone” (Shasta River to

Salmon River confluences), and included a broad range of spore concentrations (range = 0.14 – 227 spores/L), water temperatures (range = 14.6 – 22.5°C), and exposure durations (range = 1 – 32 days). This work again demonstrated the positive association between increasing

temperatures and spore concentrations on the probability of fish becoming infected, but also captured an interaction among the physical variables (Figure 3). At higher temperatures, the model estimates a slower rate of increasing POI with increasing spore concentrations, and likely reflects the known degradation of actinospores at higher temperatures (Hurst et al. 2012). As the assay to detect spore concentrations relies on DNA content, it cannot distinguish among viable actinospores, degraded actinospores, or even myxospores. The results of this work could be applied to predict the infection prevalence given time series of spore levels and water temperatures over any specified duration.

The second examination of extended exposures is a multi-year effort jointly conducted by AFWO-fisheries, the OSU Aquatic Animal Health Laboratory, and USGS Western Fisheries Research Center – Cook, WA in 2014, 2015, and 2016 (publication in preparation). These sentinel exposures mirrored the traditional 3-day exposure experiments with regard to the times of year and river locations of application. However, instead of only implementing 3-day caged exposures, simultaneous exposures of 1, 3, 5, and 7 days were conducted. Daily water temperatures across all trials ranged from 9.6 °C to 22.8 °C, and daily spore concentrations ranged from 4.8 to 900 spores/L. The formal analysis of these experiments is pending new model development for applications to a fish production model. However, summaries of the rates and percentages of mortality suggest that in addition to the influence that temperature and spore concentration play (i.e., described by Ray et al. 2014) additional days of exposure result in further increased levels and rates of mortality (e.g., Figure 4). Results from this study suggest that mortality predictions based on 3-day exposures may underestimate the population-level impact of disease.

Impacts of Disease on Outmigrant Juvenile Salmonids. Since 2005, the California-Nevada Fish Health Center has partnered with AFWO-Fisheries Program, Yurok Tribal Fisheries Program, and the Karuk Natural Resources Department to monitor the prevalence of *C. shasta* infections in outmigrating fish of the mainstem Klamath River. Though the number of sampling weeks per year has varied over time, sampling has generally occurred in a weekly-stratified fashion designed to align with Chinook Salmon population estimates generated over a comparable number of years. To summarize the weekly infection rates at an annual level, the weekly rates of infection are averaged over the period of sampling in each year. The well-designed and long-term nature of this monitoring program lead to its adoption as a metric of annual *C. shasta* infection severity and incidental take of federally listed Coho Salmon in the Klamath River (NOAA and USFWS 2013). More information on the methods and implementation of this monitoring program can be found in, for example, True et al. (2013, 2015, 2016). Between the years of 2005 and 2015, annual estimates of wild or unknown-origin juvenile Chinook Salmon POI range between 0% and 96% (Table 1).

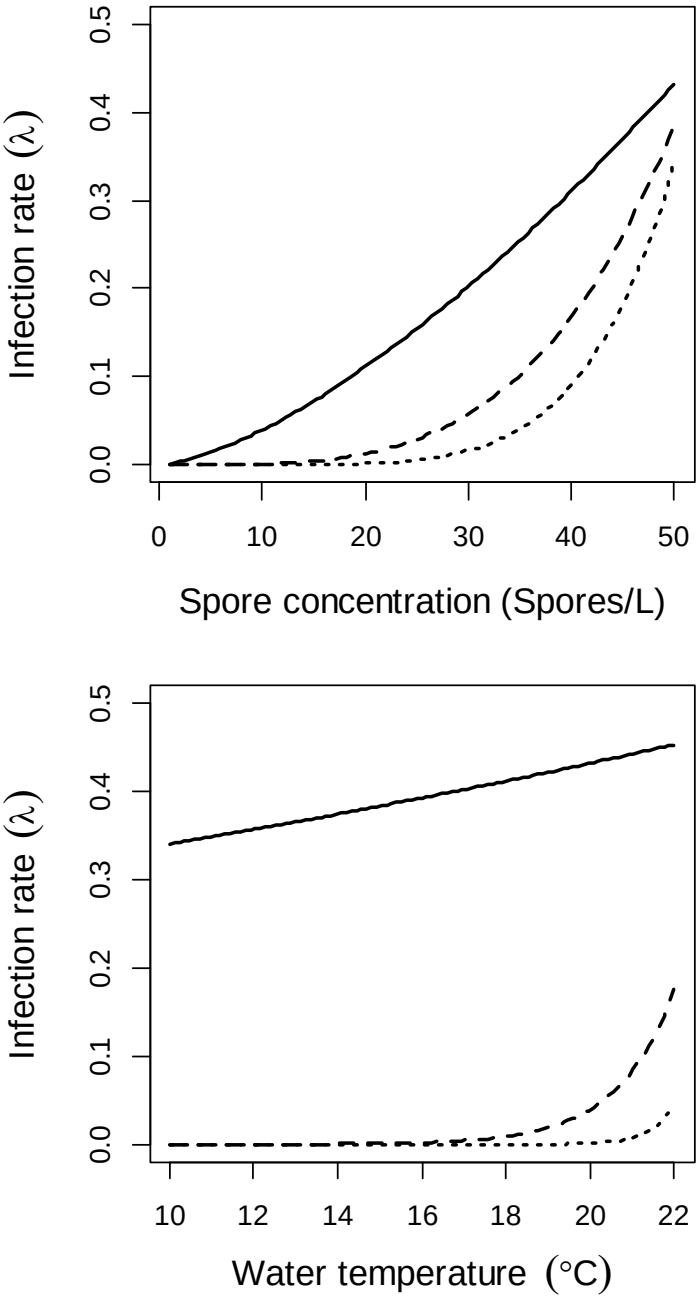

Figure 3. Effect of spore concentration and water temperature on infection rate of juvenile Fall Chinook Salmon with *C. shasta*. In the top panel, infection rates are shown as a function of spore concentration at 10 °C (dotted line), 15 °C (dashed line), and 20 °C (solid line). In the bottom panel, infection rates are show as a function of water temperature at spore concentrations of 1 spore/L (dotted line), 10 spores/L (dashed line), and 50 spores/L (solid line). Prevalence of infection is plotted using the posterior medians of the parameter values for the effect of water temperature and spore concentration on infection rate.

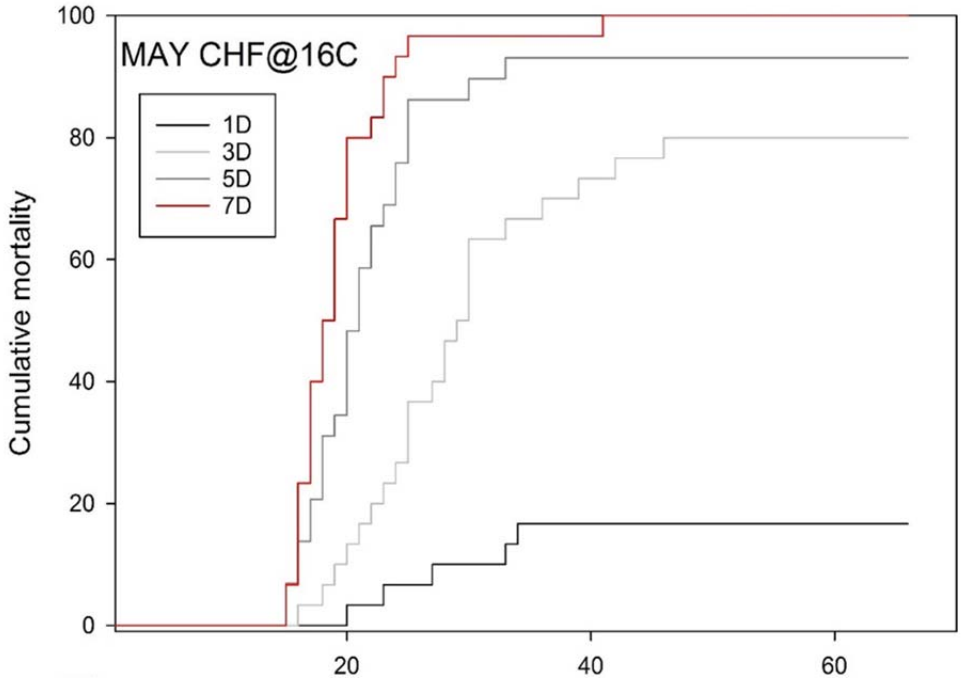

Figure 4. Cumulative percent mortality for trials of Chinook Salmon exposed for 1 day (black), 3 days (light gray), 5 days (dark gray), and 7 days (red). Each trial consisted of 30 fish exposed *in situ* to riverine conditions and then reared in disease-free laboratory water at a constant temperature for the duration of the experiment. For this set of trials, water temperatures averaged 16°C and spore concentration levels averaged 660 spores/L during the riverine exposure period. Numbers on the x-axis represent days since exposure.

Table 1. Summaries of estimates of annual-level infection prevalence for wild and/or unknown (non-adipose fin clipped) origin Chinook Salmon passing the Kinsman rotary screw trap site. "POI" references annual summaries of weekly prevalence of infection collections aimed to monitor weekly disease rates. "PoP" references estimates for the prevalence of *C. shasta* infections in the population of juvenile Chinook Salmon. "LCL" and "UCL" reference the lower and upper confidence limits, respectively, of the infected population that account for the estimation uncertainty in abundance and weekly prevalence of infection estimates. The 2006 estimates are omitted because river discharge conditions prevented the computation of reliable weekly abundance estimates.

Year	Origin	POI	Pop. LCL	Pop. Est	Pop. UCL
2005	All	0.41	0.26	0.38	0.47
2007	All	0.28	0.07	0.1	0.15
2008	All	0.60	0.43	0.51	0.58
2009	All	0.50	0.50	0.58	0.66
2010	Wild/Unknown	0.12/0.15	0.02	0.04	0.07
2011	Wild	0.20	0.07	0.11	0.17
2012	Wild/Unknown	0.06/0.00	0.04	0.08	0.14
2013	Wild	0.18	0.03	0.06	0.09
2014	Wild	0.67	0.12	0.18	0.26
2015	Wild/Unknown	0.66/0.96	0.20	0.29	0.39

The stratified POI sampling described above is designed to track the progression of disease rates over the outmigration period, but is not aimed to estimate the impact of *C. shasta* disease at the population level. To estimate the annual impact of disease on the outmigrating population of juvenile Chinook Salmon, an analysis was recently completed that coupled the POI sampling data with weekly estimates of juvenile Chinook Salmon. Population estimates for fish passing the Kinsman rotary screw trap site (Gough et al. 2015) were selected because that site is the most downstream location of weekly abundance estimates, is located within the often referenced "infectious zone" of the mainstem Klamath River upstream of the Scott River confluence, and is spatially aligned with POI sampling (K4 reach between the Shasta and Scott Rivers, True et al. 2015). Using methods described in Appendix A to this memorandum, we estimated the number of infected and non-infected individuals passing by the Kinsman site for each week. We then summarized these estimates over the entire monitoring period to estimate the proportion of the monitored population infected with *C. shasta*. The methods employed to conduct this analysis allowed us to propagate all estimation uncertainty (regarding weekly infection rates and weekly abundance estimates) to the annual population impact estimates. We note that the estimates of population impact of *C. shasta* should be considered conservative as they are based on apparent survival. As such, fish succumbing to *C. shasta* before passing the Kinsman trap site are not accounted for in the weekly abundance or prevalence of infection estimates.

Estimates of the annual proportion of infected Klamath River Chinook Salmon range from 4% to 58%, and acknowledging estimation uncertainty, range between 2% and 66% (Table 1). Annual variation in the estimated percentage of infection is not only attributable to variation in weekly disease prevalence in sampled fish, but also to the temporal overlap of the migrating population and weekly disease prevalence estimates (Figure 5).

Although the progression of disease rates within a year can vary substantially in overlap with the natural population of juvenile salmon (Figure 5), the California-Nevada Fish Health Center's weekly POI samples likely do overlap well with Iron Gate (IG) hatchery-origin fish. These fish are generally released in late May and have a contracted outmigration period. The hatchery release period generally aligns with the highest weekly POI estimates of each year, and summaries of the weekly POI samples over the hatchery outmigration period suggest that a high proportion of the IG hatchery stock can become infected with *C. shasta* (Table 2). Hatchery estimates akin to those labeled as "Pop" in Table 2 cannot be generated because the Kinsman rotary screw trap is removed before the brunt of the hatchery population passes the trap site, and hatchery-specific population estimates are not available for this section of the Klamath River.

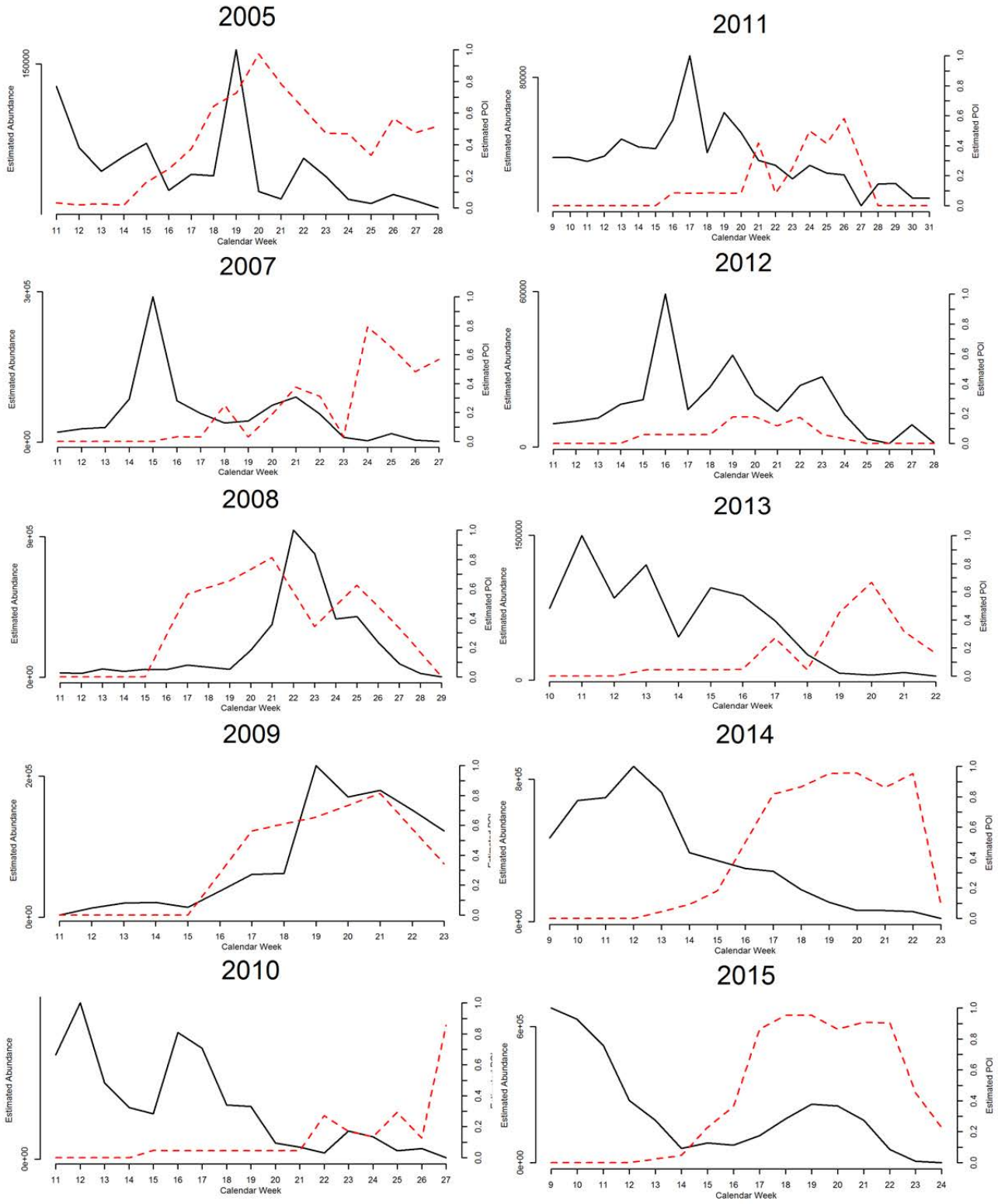

Figure 5. Weekly-stratified abundance estimates of juvenile Chinook Salmon (solid black lines) and *C. shasta* prevalence of infection (POI, dashed red line), by year. Abundance estimates reference the Kinsman rotary screw trap location (Gough et al. 2015) and prevalence of infection estimates reference the K4 reach of the mainstem Klamath River (True et al. 2016). The 2006 estimates are omitted because river discharge conditions prevented the computation of reliable weekly abundance estimates.

Table 2. Summaries of estimates of annual-level infection prevalence for hatchery origin Chinook Salmon passing the Kinsman rotary screw trap site. "POI" references annual summaries of weekly prevalence of infection collections aimed to monitor weekly disease rates. Years not included in the table reflect years where either sampling didn't extend far enough into the hatchery migration period or adipose-fin clip rates were too small to effectively differentiate the hatchery population.

Year	Origin	POI
2008	Hatchery	69%
2010	Hatchery	7%
2011	Hatchery	6%
2012	Hatchery	15%
2013	Hatchery	2%
2014	Hatchery	45%
2015	Hatchery	83%

Adult Salmonids. The current hypothesis is that adult salmon carcasses, above the confluence with the Shasta River (rkm 285), contribute the bulk of myxospores that continue the parasite's life cycle within the "infectious zone." A decade of monitoring has demonstrated that myxospore transmission is sufficient to continue the *C. shasta* lifecycle to a degree that juvenile salmon are at risk of disease in the Klamath River. A recent publication (Foott et al. 2016) has summarized the findings from surveys of adult salmon carcasses in the Klamath River basin, and we note the highlights of that work in the paragraphs below.

IG hatchery (via homing returns) and IG Dam (via migration barrier) influence the current concentration of adult carcasses to the river reach above the Shasta River confluence. While the majority of spawned Klamath River salmon are infected with *C. shasta*, myxospore development occurs predominately in decomposed carcasses rather than recently post-spawned adults. There is no evidence to suggest that myxospore detection is associated with fish size (age), sex, spawn timing (death), or carcass site. This data together with logistic, ecological, and safety concerns precludes carcass removal as a viable management technique to reduce *C.shasta* infectivity in the Klamath R.

Prevalence of myxospore detection from carcasses range from 22 – 52%, however, $\leq$13% are considered significant contributors (produce $\geq$ 500,000 spores). These high myxospore carcasses contribute an average of 89% of the total estimated myxospore input to the river per spawning season. This suggests that billions of myxospores are produced annually from adult carcasses in the Klamath River, and myxospores are associated with sediments on the spawning grounds after carcass decomposition. Myxospore viability is rapidly lost in temperatures greater than 18°C and limits the transmission period to the winter and early spring, and it is likely that myxospore enter the water column over the winter. There is tremendous variation in the viability of myxospores (ranging from 7 – 100%) and this has hampered efforts to model the population impact of infection based on estimated myxosore inputs.

Summary Guidelines.

- Temperature and spore concentrations are positively correlated with infection and mortality of both Chinook and Coho salmon.
- Carcasses of juvenile salmon infected with *C. Shasta,* particularly hatchery-produced Chinook Salmon due to their timing of release and associated water temperatures, may be contributing significantly to the total myxospore load.
- Mortality predictions based on 3-day sentinel trial exposures likely underestimate the population-level impacts of ceratomyxosis.
- Both outmigration timing and pattern of POI levels in natural-origin juvenile Chinook Salmon can vary between years, and the more these distributions overlap, the greater the adverse effect on the population.
- Carcass removal is not a viable method for reducing myxospore levels, in addition to being contrary to natural ecological processes.
- The majority of myxospores contributed to the system are most likely released by adult carcasses during a typically stable hydraulic period of managed water years.

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Appendix A. Methods for Annual Population Impact Assessment

Our analysis goal was to estimate the proportion of the natural juvenile Chinook Salmon population infected with *C. shasta* each year that comparable data have been collected. We relied on abundance estimates generated for the Kinsman rotary screw trap location because that site sits within the so-called "infectious zone" (Shasta River to Salmon River confluences), and the trapping occurs during a period of the year aimed to capture as much of the passing natural population as possible (Steven Gough, pers. comm). Due to weather and discharge constraints, as well as natural variation in immergence timing, the Kinsman trap can miss a portion of the outmigrant run in some years. Hence, in some cases our estimates refer to a percentage of the measured population, rather than strictly referring to the entire population of natural juvenile Chinook Salmon passing the Kinsman trap site. We also note that if sections of the natural run are missed by the trapping schedule, they are more prone to miss early portions of the run that occur when C. shasta conditions in the river are always benign (both in terms of temperature and spore concentrations). Hence, we are unlikely to miss a substantial portion of the infected run of natural juvenile fish in any year. Additionally, the discharge conditions in 2006 were so extreme that they prevented sufficient implementation of the mark-recapture experiments necessary to construct reliable abundance estimates.

To estimate the annual proportion infected in each year, we started with estimates of weekly abundances and weekly prevalence of infection (POI), each obtained via Bayesian methods. Abundance estimates were generated via the methods of Bonner et al. (2009), which apply Bayesian p-splines to generate weekly-stratified abundance estimates that account for potentially missed sampling weeks. This method also accounts for the capture probability of the rotary screw trap via a series of mark-recapture experiments that occur during each trapping season. More details on the abundance estimates can be found in David et al. (2016). After burn-in and thinning, 6000 posterior distribution draws were retained for each weekly-stratified abundance. Convergence of chains was assessed via Bayesian p-values and visual assessment. In all cases Bayesian p-values were less than 1.1 and no traceplots indicated issues related to convergence.

Prevalence of infection estimates were generated by summarizing the weekly samples collected over the course of a fish health survey jointly implemented by the California-Nevada Fish Health Center, the AFWO-Fisheries Program, the Yurok Tribal Fisheries Program, and the Karuk Natural Resources Department. This survey generally calls for weekly collections of at least 20 fish in designated reaches of the Klamath River. For this analysis we focused on the section of river labeled "K4" which corresponds with the previously noted infectious zone and lies above the Kinsman trapping location. In the event, either planned or conditions permitting, that sampling was not conducted in a given week, we estimated a missed week's POI by averaging the POI for the weeks directly before and after the missed week. For all weeks where abundance estimates commenced before the onset of fish health sampling, we imputed POI values in two ways. If the number of infected individuals in the first week(s) of fish health sampling was zero, then the POI for all weeks prior to the onset of fish health sampling were all set to zero. If the number of infected individuals in the first week of fish health sampling was non-zero, then the POI estimate for the week immediately prior to the onset of fish health sampling was set to the average of zero and the first week's POI value, and all previous weeks' POI values were set to zero.

Weekly-stratified POI estimates were generated using JAGS software, implemented with the R statistical computing environment. Vague priors were specified for all parameters. After burn-in and thinning, 6000 posterior distribution draws were retained for each weekly-stratified POI sample. Convergence of chains was assessed via Bayesian p-values and visual assessment. In all cases Bayesian p-values were less than 1.1 and no traceplots indicated issues related to convergence.

By applying Bayesian methods and estimating the weekly abundance and POI values via Markov Chain Monte-Carlo methods, we were able to compute the weekly number of infected individuals as derived parameters in a broader Bayesian implementation. We next summed the number of infected and non-infected individuals annually, and propagated all estimation uncertainty in order to compute estimates and credible intervals for the annual POI in the natural (or measured natural) population of juvenile Chinook Salmon.

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DTAT Guidance Document Comments and Responses					
Submitting Party	**Comment Location**			**Comment**	**Disposition**
	Page #	**Paragraph**	**Sentence**		
AFWO			General	Our understanding is that the draft "Guidance Document" was prepared by the Tribes to provide science-based actions for consideration by managers that would lower the incidence of C. shasta in juvenile Chinook and Coho salmon in the Klamath River, independent of consideration of other demands on the Basin's limited water resources and/or agency obligations. Given the intended purpose of the document, we believe the authors present recommendations that capture key information and scientific findings presented in the Service's four Technical Memos, with exceptions detailed below.	
AFWO	4	3	General	Here and throughout document: we believe the language regarding monitoring and evaluation of hypotheses prompting the flow augmentation recommendations is too weak. The monitoring and evaluation efforts should be required, not optional, and need to be well designed and incorporate an adaptive management approach.	It is beyond the perview of the Guidance Document to require any action (see Guidance Scoping document). Existing language in the document regarding Adaptive management and associated monitoring already indicates the desire that such monitoring be well-designed.
AFWO	4	6, item 1.c	Pulse flows to redistribute and strand carcasses and myxospores in late fall/winter.	The flow magnitudes specified during the fall are not sufficient to strand carcasses. This observation is compounded by the findings of Foott et al. (2010) that showed that about 5-9% of carcasses in Bogus Creek were categorized as being "high spore contributors" (>1 million spores/carcass), which account for about 90% of the total myxospore load to the river. As a result, a relatively high proportion of total carcasses would need to be removed from the channel to result in a correspondingly large decrease in "high spore contributor" carcasses and therefore, spore loads. However, spore development in carcasses in relation to disturbance events is one area of research that should be conducted to test they hypothesis that carcass stability, in relation to movement and temperature, is linked to spore production within carcasses.	"possibly" added to carcasses wording regarding stranding. An additional goal is to redistribute carcasses and that is reflected in the wording.
AFWO	7	2	Given the recent scarcity of these types of flows, this action should be implemented every winter until dam removal or the end of the 2013 BiOp.	We believe the document would benefit if the authors could provide a brief description as to why a Q of 6,030 cfs below Iron Gate Dam, the flood frequency 2-yr return period presented in the Geomorphic Technical Memo, was selected to occur for a 72-hr interval annually. We further suggest that the justification be, in part, based on the annual occurrence of in-reservoir phytoplankton blooms in PacifiCorp Project Reservoirs, primarily in Copco I and Iron Gate, that are released into the Klamath River (NCRWQCB 2010). Dead and decaying algal materials released down the Klamath River, including from cyanobacteria species, settle out and become a potential food source to support high-density polychaete colonies. The extent of this settling out of fine organic sediments in the bed of the Klamath River is elevated during drought conditions due to the extended retention time and turn-over rate of water in PacifiCorp Project reservoirs, warmer water tempertures, and a corresponding increase in algal blooms in the PacifiCorp reservoirs (U.S. DOI and NMFS 2013). Also important to note that in the period WYs 1964 to 1999, the duration between Surface Flushing events below Iron Gate Dam, as calculated on a daily-mean discharge basis, was typically one to two years (Figure 6 in Geomorphic Technical Memo). The 1-2 yr. return period for Q>6,030 below Iron Gate Date is consistent with the modelled outputs of discharge from Iron Gate Dam as presented in the 2013 Joint Biological Opinion (see attached "BiOP Model Output at IGD" sheet), with mean weekly Q >6,030 cfs occurring during 35% of the modelled years and mean weekly Q >4,000 cfs occurring in 52% of the modelled years. It is assumed that a modelled mean weekly Q >4,000 cfs would likely result in a spill event that would result or could be configured to result in a spill event equating to over 6,030 cfs for 3 of the 7 days in the mean weekly value.	Language and citations added, as follows: NCRWQCB. 2010. Final staff report for the Klamath River Total Maximum Daily Loads (TMDLs) addressing temperature, dissolved oxygen, nutrient, and Microcystin impairments in California, the proposed site-specific dissolved oxygen objectives for the Klamath River in California, and the Klamath River and Lost River implementation plans. State of California North Coast Regional Water Quality Control Board, Santa Rosa, California. http://www.swrcb.ca.gov/northcoast/water_issues/programs/tmdls/klamath_river/ (U. S. Department of Interior and U. S. Department of Commerce, National Marine Fisheries Service, 2013. Interior U. S. Department of Interior Klamath Dam Removal Overview Report for the Secretary of the Interior AN ASSESSMENT OF SCIENCE AND TECHNICAL INFORMATION Version 1.1, March 2013.
AFWO	7	3	The Polychaete Memo describes how populations of polychaetes can be kept in check by mobilizing sediments.	Technically, the Polychaete Memo does not explicitly link polychaete population size to sediment mobility. The Memo does discuss modeled relationships between the probability of polychaete presence with hydraulics and substrate, and also documents reductions in polychaete occurrence associated with larger flow events.	language added to address this issue
AFWO	9	2	Provide a flow of at least 11,250 cfs in the Klamath…May 31 for a period of at least six hours…	The 6-hour duration presented by the authors is not consistent with daily-mean discharge values presented in the Geomorphic Technical Memo.	guidance changed to average 11,250 cfs for a day.
AFWO	10	4	...should look for opportunities to provide safe, short-term peak flows of higher magnitudes than 11,250 cfs whenever possible	We suggest the author's mention the importance of synching the timing of deep flushing flows to coincide with high-flow events in tributaries. Important to also establish ramp down rates that it will minimize stranding of fishes as well as facilitate the depositional sorting of mobilized bedload. We assume that during a "geomorphically-effective flow event, both the duration and ramp rates would occur as a run-of-the-river event and therefore, outside of the control of management.	language added to address this issue

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AFWO	10	5	The Polychaete Memo describes how these stable flow conditions have contributed to a proliferation of M. speciosa.	"Describes" is too strong of a word, as the Polychaete Memo did not present any estimates of population proliferation. Perhaps one could infer this idea from the contents of the Polychaete Memo, but the language should reflect that inference.	language added to address this issue
AFWO	11	top 1/3 of page	The 4-step logical statement	The current logic of the and/or progression would trigger MG #4's augmented flows in almost every year (for instance, 8 of the last 9 years). In addition to potential issues with the and/or progression, the 5 s/L in step 1 and 13 digress C in step 4 are likely too low.	5 spores/liter was kept, due to high mortalities observed in sentinel studies; the 13C temperature threshold was eliminated.
AFWO	13	3	Fall flow increases …carcasses downstream or entrain them on the river banks and in willows.	The flow magnitudes suggested in this Management Guidance (#5) are not large enough to entrain carcasses on banks. See response in row 5.	language added to address this issue
AFWO	15	2	Continue to increase fingerling releases during May, rather than during June, as has happened since 2013, to minimize overlap with high disease prevalence in the river.	Unclear sentence as to what "has happened since 2013". Our understanding is that fingerling releases have typically been initiated in May. As written, we are concerned that in years having cooler winter and spring water temperatures that result in a late outmigration of natural fish (see 2012 Klamath Outmigrant Monitoring Summary), the overlap between natural and hatchery fish in May could be significant. For example, in colder years such as 2012, hatchery fish were not released until June 6 and yet experienced a moderate (15%) estimated infection rate (Table 2, Fish Infection Technical Memo). As such, we suggest the authors consider recommending management triggers used to adjust the timing of fingerling hatchery releases based on real-time environmental conditions, with the goal of reducing the overlap of occupancy of hatchery and natural fish in the mainstem river while minimizing the risk of high levels of infection in hatchery fish. These real-time metrics could include the timing and pattern of the natural outmigrant catch (preferably abundance or relative abundance) at the Kinsman trap and a water temperature/developmental degree day metric.	added "based on real-time conditions" to description.
USFWS Klamath Falls Office	1	3	Observed infection rates of Chinook Salmon sampled between the Shasta River confluence and the Trinity River confluence in May through July of 2014 and 2015 were 81% and 91% respectively – considerably exceeding the take threshold established in the Biological Opinion (True et al. 2016, 2013 BiOp).	Add "May through July" into sentence	Will fact-check and do so if appropriate.
USFWS Klamath Falls Office	1	3		extra "the" in sentence	Corrected; thank you.
USFWS Klamath Falls Office	2	3	The only limitations the DTAT placed on the guidance provided herein, were physical possibility, safety, and a reasonable timeline for implementation.	change limitations to limitation	Rejected; "limitations" grammatically correct.
USFWS Klamath Falls Office	4	2	Members of the DTAT also had personal communication Scott Foote, Sascha Hallet, and Julie Alexander, all of whom have relevant expertise with regard to C. shasta.	multiple errors	Changed to "Members of the DTAT also had personal communication with Scott Foott, Sascha Hallett, and Julie Alexander, all of whom have relevant expertise with regard to C. shasta."
USFWS Klamath Falls Office	4	4		extra space	extra space removed
USFWS Klamath Falls	4	6	The team found several types of actions that could be implemented immediately that would have a high likelihood of reducing the infection prevalence and severity of *C.*	Would suggest that success in reducing infection prevalence will be dependent on monitoring. It is likely that these short term control measures will have some effect on infection rates, but “high likelihood” may be too strong given the myriad factors at play here, both from a biological and hydrological perspective.	Do not agree that success in reducing infection prevalence will be dependent on monitoring. Maybe "determination of success" in which case, see section on Adaptive Management. By "high likelihood" the DTAT interprets that to mean greater than a 50/50 chance, and we stand by that conclusion based on the information provided in the memoranda and the integration of this information as presented in this memorandum.
USFWS Klamath Falls	5	2		no space	Corrected; thank you.
USFWS Klamath Falls	5	4		wrong verb tense	Corrected; thank you.
USFWS Klamath Falls	5	6		no space	Corrected; thank you.
USFWS Klamath Falls	6	3	The primary means of controlling *C. shasta* were identified as:	These were not explicitly stated in the tech memos. Suggest a modification to language such as, “Based on the science summarized in the technical memos, the following measures can be reasonably presumed to aid in the control of C. shasta:”	Sentence changed to: “Based on the science summarized in the technical memos, the following measures can be reasonably hypothesized to aid in the control of C. shasta:”

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USFWS Klamath Falls	6	6	The DTAT has determined, based on the weight of the evidence provided in the Technical Memos and the collective expertise of the team members that implementation of the geomorphically oriented management guidance actions ~~is expected to~~ may significantly reduce the need for the other management guidance actions such as spring dilution, fall variability, and hatchery changes.	Suggest changing "is expected to" to "may".	The DTAT believes that the scientific evidence supports the likelihood that improved geomorphic function as provided for in recommendations 1-3 will in fact result in improved conditions with regard to C. shasta and thus will in fact reduce the need for other corrective actions such as spring flows. The original wording was left intact.
USFWS Klamath Falls	7	1	Management Guidance 1: Provide Surface Flushing Flows to the Mainstem Klamath River Below Iron Gate Dam	Combining these flows essentially narrows the window to Feb 15 – April 30. This is not in the spirit of the guidances, but more importantly, it leaves us with a severely hydrologically limited system. Conducting a high flow in fall and a high flow in spring makes more sense in the hydrologic function of the system. Flexibility should be sought in the frequency of these flows rather than the annual timing, so that the system can function appropriately given the availability of water in a given year.	It is unclear what this comment is referring to. Recommendation 2 (flow of 11,250 cfs) did contain a statement where it was suggested that thobjective of proficing surface flushing flows could also be met if the provision of 11,250 cfs provided a flow of 6,030 cfs that lasted longer than 24 hours). This was not required, and thus the recommendation did not narrow the window to Feb 15-April 30.
USFWS Klamath Falls	7	2	Specifically, provide a flow of at least 6,030 cfs from Iron Gate Dam for a 72 hour period	How was this time period for elevated flows determined? Please reference the technical memos or otherwise give justification for this time period.	Please see Uncertainties in this section: "In general, a longer duration event will accomplish more of the objective than a shorter duration, because more of the suspended sediments flush out of the river system, rather than being re-deposited further downstream."
USFWS Klamath Falls	7	2	Existing guidelines contained in the 2013 BiOp should be followed with regard to downramping rate	Suggest that ramping rates should be adjusted based on the seasonal situation and review by the FASTA team, as has been done in previous flows. Flexibility in ramp rates is going to be key, especially in the fall. We should look for a mechanism to streamline this process within the FASTA.	Text changed to: Existing guidelines contained in the 2013 BiOp should be followed with regard to downramping rate unless modified by the Technical Team or FASTA as necessary and supported by scientific information. As explained in the support and uncertainties section, the descending limb is important for the river to sort and distribute fine sediments.
USFWS Klamath Falls	7	3		typo: replace "an" with "a"	Corrected; thank you.
USFWS Klamath Falls	8	1	The estimated two year recurrence interval (Geomorphic Memo page 6) of 6,030 cfs was selected	Please justify making a flow with a 50/50 chance of occurring in any given year into an annual flow. This does not seem to be supported by the technical memos, nor is it within the nature of a two year recurrence interval flow	Supporting language added to support subsection of this proposed action. "With regard to frequency of the discharge necessary for a surface flushing flow, the guidance provides for this flow to occur every year because low winter flow conditions since 2000 (Figure 3) have resulted in overly stable river bed conditions which in turn have caused very high mortality rates from C. shasta. Therefore, the guidance is for this flow to occur each year for the duration of the BiOp. Additionally, the annual occurrence of in-reservoir phytoplankton blooms in PacifiCorp Project Reservoirs, primarily in Copco I and Iron Gate, results in a large amount of dead algae that is then released into the Klamath River (NCRWQCB 2010). Dead and decaying algal materials released down the Klamath River, including from cyanobacteria species, bsettle out and become a potential food source to support high-density polychaete colonies. The extent of this settling out of fine organic sediments in the bed of the Klamath River is elevated during drought conditions due to the extended retention time and turn-over rate of water in PacifiCorp Project reservoirs, warmer water tempertures, and a corresponding increase in algal blooms in the PacifiCorp reservoirs (U.S. DOI and NMFS 2013). "
USFWS Klamath Falls	8	1	However, there is strong evidence to suggest that frequent surface flushing flows minimizes available habitat for polychaetes	Please cite either technical memos or other relevant documentation to support this statement.	Citation added (Polychaete tech memo pages 4 and 5 support this statement)
USFWS Klamath Falls	8	4	However, there is strong evidence to suggest that frequent surface flushing flows minimizes available habitat for polychaetes	Monitoring the movement of fines and tying this movement, if it can be quantified, to a reduction in polychaete density will be extremely difficult. Please consider and make some reference to the difficulty in proving that these flows are having measurable positive effects outside of increased "natural" hydrologic function in the river.	Please see recent research by Alexander et al. 2016 in which polychaete distribution is correlated with hydraulic conditions during high flows. (Alexander, J. D., J. L. Bartholomew, K. A. Wright, N. A. Som, and N. J. Hetrick. 2016. Integrating models to predict distribution of the invertebrate host of myxosporean parasites. Freshwater Science. Online Early. doi: 10.1086/688342). This analysis, when combined with laboratory observations of polychaete dislodging under unstable substrates in high velocities (Polychaete Memo page 4, 5) places this hypothesis on firm footing. Therefore, the wording will remain unchanged in Guidance Document.
USFWS Klamath Falls	8	5	Adaptive management (generalized)	As a general comment on monitoring guidance in this document, the authors need to commit to greater specificity in this guidance as the measures are developed. I understand that it is difficult at this point to lay out specifics on monitoring, but this document should address that specificity in monitoring procedures, timing, and personnel should be and will be addressed before any of these management actions are implemented	The Guidance Document expresses strong support for a robust Adaptive Management aspect including hypothesis testing, monitoring and response to new information. It is beyond the scope of the document to outline a full and complete monitoring plan for each of the identified management guidance actions. The authors of the report look forward to working with fisheries co-managers to create and implement such a plan.

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USFWS Klamath Falls	9	3	Description of guidance (2)	What other potential ecosystem level effects may happen with this type of regime? Please address, with appropriate citation, the science supporting a net benefit from these flows to the overall ecosystem, as an imbalanced ecosystem could create unforeseen difficulties for the very species which we are trying to protect	Text added in "uncertainties" section of described management guidance #2. "With regard to ecosystem effects of this guidance action, re-establishment of a more natural flow regime that includes high flows such as called for in this management guidance is expected to restore flows that are closer to the unimpaired natural flow regime. Please see discussions on page 2 of Geomorphic Memorandum regarding importance of high flows to riverine systems and also page 3 of the Fish Infection Memo regarding parasite-host imbalances resulting from ecosystem alteration."
USFWS Klamath Falls	9	3	This action should be timed with peak releases from other tributaries such as the Scott River or other tributaries.	Add "if possible" to end of sentence.	Paragraph already says"should" and "unless precluded by drought conditions". Addition of "if possible" would therefore be redundant, because current wording captures it already.
USFWS Klamath Falls	9	4	NOTE: if the deep flushing event as described in Management Guidance 1 does not result in flows above 6,030 cfs for at least 72 hours, it will not fulfill the fine sediment management guidance action (#1)	This note has been the source of consternation in discussions with other reviewers. I read this as saying is that we can kill two birds with one stone (i.e. guidance 1 and 2), but if the ramping rates for guidance 2 preclude a flow exceeding 6030 cfs for 72 hours, the peak flow of guidance 2 will not fulfill guidance 1. Suggest clarification of this note and the purpose for its insertion here	Commentor was correct in assertion that the meaning of the note was to clarify the "kill two birds with one stone" but an unfortunate typographical error has contributed to confusion. The wording has been changed to clarify using a positive assertion. "NOTE: if the deep flushing event as described in Management Guidance 2 does result in flows over 6,030 cfs for at least 72 hours, it will also fultill the surface flushing as described in Management Guidance 1.
USFWS Klamath Falls	10	4	Management Guidance 3 (general comment)	Who will determine when these flows are available and the timing in which they should occur? Suggest clarifying within the body of this guidance as to potential decision-making process and if further hydrological modeling will be needed to define this decision-making process. Further, suggest addressing "inherent unpredictability and public safety factors" further. Are these flows intended to manifest as flood releases in wet springs, a la 2016? If so, this should be stated. Otherwise, this guidance is very similar to #3.	The Guidance 3 description states that it is the Bureau of Reclamation and PacifiCorp that would "look for opportunities" to implement this action. Have added "and other fisheries co-managers" after PacifiCorp to clarify that they should reach out to a broader technical audience. Specifying the exact circumstances for each case where this might be implemented is (as noted in the Guidance Document) complex and should be handled on a case-by-case basis.
USFWS Klamath Falls	12		Management Guidance 4 (general comment)	This entire management guidance effectively sets a new minimum in the river for a given period each spring. It will expend a great deal of water and may or may not result in the desired outcome. There is little evidence in the tech memos to support the need or effectiveness of this action. Suggest either further clarification of this guidance, with appropriate documentation, or removal of this guidance altogether.	For emergency flow releases to be effective, dilution flows need to occur as disease is worsening but before excessive levels of lethal doses are occurring in juvenile fish. Hallet (2012) found the lethality threshold of 40% was reached at 10 spores per liter for Chinook (type 1 genotype) but only 5 spores per liter (type 2 genotype) for coho salmon. Actinospores are generally released when temperatures are above 10°C, and remain viable (able to infect salmon) at temperatures ranging from 11 to 18ºC (Foott et al. 2006). A lethal combination of spores and temperatures is occurring at the trigger threshold of 5 spores per liter and 13 degrees C and given lag times of sampling of a week and likely trajectories given an examination of past trends, this was thought to be a prudent precautionary approach to avoid excessive mortality rates. Reclamation in the 2013 BiOp proposed flow increases for the Klamath River downstream of IGD to dilute actinospore concentrations within 24 hours of receiving information that disease thresholds have been met and used 5 spores per liter of Type II as a threshold (2013 BiOp page 41) so while this was only implemented once and with meager flows, this is a previously contemplated action. The unspecified genotyping referenced in the memo is in part to allow for much more rapid turnaround time for results (reduction of 2-4 days of process time), which would allow for more effective implementation for fish and water conservation. It is not disputed that there is sufficient information to assess C. Shasta through genotyping and that data would still be collected. Chinook salmon are the disease surrogate for coho in the ITS and incredibly important to tribal fisheries so should be protected during these actions along with ESA listed coho salmon.
USFWS Klamath Falls	11	1	Hold in reserve 50 TAF…	It is highly unlikely that 50 TAF can be "held in reserve" at any time in the year, much less the period annually in which water is at its most over-allocated in this system. This effectively means that 50 TAF can be requested and must be made available if the below criteria are evident, regardless of other obligations or needs. This would coopt all inflows to the lake at a critical time. Suggest a reduction in the amount requested for "reserve," which would also require adjustment of flow schedule below	Added statement in the Introduction section explaining that the purpose of this management guidance was to identify conditions in the mainstem river that would alleviate the high mortalities experienced due to disease in juvenile salmonids. The question of "how" to make these things happen is beyond the perview and scope of the document. We acknowledge that the system is complex, and variables interact with each other in unpredictable ways. none the less, we believe it is physically possible to deliver this quantity of water in the specified time period.
USFWS Klamath Falls	11	2	Spore concentrations exceed 5 spores (non?specified genotype) per liter for the preceding sample based on qPCR from water filtration samples at any sampling station;	Non-specified genotype is worrisome, given Sascha Hallett's work on genotypic specificity of C. shasta infection in a given species of salmon. There is obvious and universal interest in protecting the tribal trust species (i.e. Chinook), but the primary focus currently is on the listed Coho. Dr. Hallett's work should not be disregarded in this document. Suggest allowing specification of genotype so that species-specific threat may be more effectively evaluated, given other factors at play in the river.	We are recommending flows when the spore count reaches 5/L of any type, on the premise that 1) 5/L is indicative of a rising trend, 2) distinguishing DNA type takes precious extra days, and (?) 3) high concentrations of type 1 can mask detection of type 2. Wording as to such was added to the support section.

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USFWS Klamath Falls	11	2	Spore concentrations exceed 5 spores (non?specified genotype) per liter for the preceding sample based on qPCR from water filtration samples at any sampling station;	These criteria will be met in 9/10 years, effectively creating a new minimum flow for the river for much of the spring/summer. This appears to set the bar quite low for justification of these flows. Suggest reevaluating the criteria upon which these flows are based.	These criteria are based on the conclusion in the BiOp that 5 spores/L of type 2 and 10 spores/L of type 1 cause an estimated 40% mortality in Coho and Chinook juvenile salmon respectively (BiOp at 341-342). While it is acknowledged that this is a significant amount of water, it is also apparent that mortalities from this disease are a "key factor limiting salmon recivery in the Klamath River" (BiOp at 341). Furthermore, given the restrictions placed on implementation of this measure (less than 80% of the outmigration complete), it is not at all clear that 9/10 years would require additional flows. Language added under Support section: "For example Hallett et. al found that a lethality threshold of 40% mortality was reached with 10 spores per liter for Chinook and 5 spores liter for Coho Salmon. These high levels of mortalities support using 5 spores per liter as a threshold to initiate this Guidance Action. "
USFWS Klamath Falls	11	last	The concentration of actinospores in the Klamath River is a function of the total number of spores and the volume of water into which they are discharged.	While this makes sense, this does not seem to be supported by the Spore technical memo. The conceptual diagram (figure 1) suggests that actinospore concentration is a function of polychaete prevalence and infection rate. The effect of dilution, discussed in the body of the memo, is uncertain with the current science. Suggest removing these sentences.	We believe this statement is correct and is supported by analysis in the spore memo presented on pages 6-8 of the Spore Memo (Effects of Discharge on Spore Concentrations). We believe this discussion supports an alteration of the conceptual diagram to include flows and releases from Iron Gate Dam as a significant factor that affects spore concentrations. Added citation to Spore Memo to document.
USFWS Klamath Falls	12	1	Increased flows also increase water velocity and have been shown to reduce transmission rates.	This also seems to be a tenuous connection, given the current science outlined in the tech memo. Please cite with the appropriate support or remove.	Citation added to document (Ray et al.)
USFWS Klamath Falls	12	5	low temperatures often coincide with higher flows	This is anecdotal. I've not seen hydrologic research to support this, though I'd imagine there is likely some correlation. Perhaps a study should be commissioned to demonstrate the veracity of this statement in the Klamath River?	The statement says that low temperatures "often" correlate with higher flows. This is true because the higher flows come from precipitation, snowpack, and also are associated with decreased travel time from colder high elevation sites. Language remains unaltered.
USFWS Klamath Falls	13	1	Management guidance 5	Redistributing carcasses will be very difficult, and even if redistribution is successful, Foote's work shows that a single infected carcass can introduce millions of spores into the system, effectively negating the positive effect of moving carcasses about. Further, implementing guidance 1 will accomplish this goal, obviating the need for inclusion of this measure. Suggest removal or revision of this guidance.	Added statement in the support section regarding objectives. In addition to moving carcasses to different locations, it is also hypothesized that the myxospores themselves will be advected to less advantageous locations further downstream and some may become stranded on floodplains and subsequently dessicated. Management Guidance 1 (6,030 cfs flow for 72 hours), if performed during the myxospore release season (Nov-Dec) may achieve this objective, but it is more likely that if Management Guidance 1 is implemented it will be later in the year.
USFWS Klamath Falls	14	1	Management guidance 6	I agree that this should be implemented for disease control. However, this is not within Reclamation's purview, nor should it be tied in to BiOp obligations that may ultimately open the Services up to litigation in the future.	The guidance document identifies management actions that may alleviate C. shasta conditions on the Klamath without regard to implementation. This Guidance Document does not demand that Bureau of Reclamation implement any of these actions. Text will remain unaltered.
USFWS Klamath Falls	14	2	negative interactions between hatchery/natural fish in the Klamath River, while meeting the two objectives listed above	What are these negative interactions? Are they disease related? Is that disease something other than C. shasta?	This concept has been accepted in fisheries science for quite some time. No change to the text.
USFWS Klamath Falls	16	3	Adaptive Management and Monitoring Considerations for (MG6)	Perhaps language could be added here to the effect of, "The disease management team recognizes that these measure are outside of the purview of BoR and the Services. However, given the need for implementation of these measures, we strongly suggest a concerted effort between CDFW and the Yurok, Karuk, and Hoopa Tribes; with input from Reclamation, the Services, and the Klamath Tribes; to see these measures implemented at the IGD hatchery	The guidance document identifies management actions that may alleviate C. shasta conditions on the Klamath without regard to implementation. This Guidance Document does not demand that Bureau of Reclamation implement any of these actions. Text will remain unaltered.
Bureau of Reclamation	General			While the four technical memos present a science based discussion of possible factors and results, the Guidance Document does not conprehensively summarize the conclusions in the tech memos.	Disagree. Please see appendices for comprehensive summaries of each of the four tech memos as well as the memos themselves.
Bureau of Reclamation	General			The Guidance Document should be more science-based and provide recommended disease control actions independent of Klamath Project operations.	It was not focused on Klamath Project Operations, but on measures that could be implemented to minimize disease. The Klamath project is the entity tha has an Incidental Take Statement under the Federal Endangered Species Act regarding take in the Klamath River associated with Klamath Project water diversions; this ITS was substantially violated in 2014/2015, so to the extent water management is part of measures to address disease issues, the Klmath Project may be involved.
Bureau of Reclamation	General			Additional detail needs to be provided for the scientific bases of timing, duration, and frequency intervals of events for *all* management options. For example, if a management action is recommended every year, please more closely tie the recommended timing, duration, and frequency back to the technical memoranda.	Language was added in various parts of the document bolstering scientific support for implementation of various management guidance actions.

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Bureau of Reclamation	General			The most probable disease control measures proposed in the Guidance Document would involve use of flow releases to reduce polychaete densities and possibly disperse salmon carcasses downstream of IGD. However, high flow conditions (≥ 10% exceedence flows) are needed to produce an appreciable impact on polychaete and salmon carcass densities. Whether these high flows can be consistently achieved at the frequency needed is a major uncertainty, especially during moderate and dry water years (see Hardy et al. 2006, figures 5, 7, and 9). For example, how much would the frequency of high flow events >6,000 cfs increase if irrigation water was no longer stored and diverted? Instituting operational measures that rely heavily on factors outside management control, such as runoff, will not produce the desired outcome.	We agree that flow management is the most probable proposed measure to control diesease, and associated densities of infected polychaetes. There are multiple factors that affect the ability to increase flows in the Klamath River, especially for relatively short periods of time, including: end of year lake levels, management of winter flows, managing for flood control curve of the lake, management of reservoir levels, management of flows when lake is nearing full capacity, and timing associated with hydrologic events. As you are likely aware, water is naturally stored in Upper Klamath Lake. The hydrology of the Klamath River would be substantially different if it didn't have several hundred thousand acre feet of water diverted from it. However the intent, and effect even if all control measures were fully implemented, of this docment is not to eliminate agriculture and return to the pre-development hydrograph, our intent is to manage in a manner that minimizes the extremely high disease rates the river has experienced during recent years (i.e. we are not suggesting that ag diversions be halted).
Bureau of Reclamation	General			The link between coho salmon life-history events (e.g. emigration) and timing of the recommended flow management measures is not provided in the Guidance Document. Our understanding is that most of the juvenile coho emigrating through reaches proximate to IGD will have passed through the area prior to the annual onset of high C. shasta spore concentrations. These types of relationships are important to understanding the magnitude of potential benefits of some of the proposed measures (e.g. Management Guidance 4) to coho salmon population viability.	Depending on the year, disease levels can vary substantially during April - June. The years when disease levels are elevated relatively early would likely impact juvenile coho smolts prior to their emigration to the ocean. As noted in the BiOp (page 243), coho salmon migrating downstream have been found to have infection rates as high as 50% (Bartholomew and Foote, 2010). Juvenile young of year coho that are utilizing the mainstem Klamath, whether for rearing or re-distribution, would be affect by high disease levels throughout the April - June time period.
Bureau of Reclamation	General			The four USFWS C. shasta technical memos provide a logical basis to conclude that regulation of the Klamath River, particularly storing water during winter and spring, may exacerbate C. shasta infection rates for outmigrating salmon downstream of Iron Gate Dam (IGD) during some years. These impacts would be most pronounced in the first 15-20 river miles downstream of IGD where flow conditions are principally driven by IGD water releases. However, a functional relationship between IGD discharge and disease conditions (i.e. fish infection or mortality rates) in the Lower Klamath River, which would be necessary to quantify the impact of KP operations on disease-induced fish mortality, has not been developed. Therefore, the outcome of the flow management measures proposed in the Guidance Document is highly uncertain, and these measures should be regarded as investigational.	It is likely that disease conditions in the Upper Klamath River affect disease conditions in the Lower Klamath River, whether it be from dislodged/infected polychated worms, free floating actinospores, or fish that become infected in the Upper Klamath and die to release myxospores downstream. We recognize that there is still much to learn regarding the dynamics of C. shasta in the Klamath River, which is why adaptive management is highlighted as being so important in the Synthesis Memo
Bureau of Reclamation	General			The relationship between coho salmon smolt survival and flow has been quantified (Beeman et al. 2012), but this relationship includes all sources of fish mortality, not just disease. Beeman et al. (2012) did not quantify latent effects of disease that may occur after fish reach the ocean, but water temperature is the primary determinant of disease-induced mortality, and ocean temperatures are much cooler, suggesting that survival rates of infected fish would likely increase upon ocean arrival. Though latent effects of disease infection are a concern, it was generally believed that in-river survival conditions between IGD and the ocean were adequately described by the Beeman et al. (2012) study. One interpretation of the study findings is that small operational changes should not be expected to significantly reduce juvenile coho mortality. Instead, large flow events, such as those associated with large storms, were the most influential throughout most of the Lower Klamath River. The information described in the four USFWS disease technical memos also supports the idea that large flow events are needed to meaningfully alter disease conditions and subsequent fish mortality.	Of the flow related control measures identified in the Synthesis Memo to minimize *C. shasta* levels in the Klamath River, four of five measures are focused on interrupting the life cycle of C. shasta, primarily by disrupting polychaete worms (an obligate part of C. shasta life cycle), polychaete habitat, or infection of polycaetes by myxospores released from rotting carcassess. The effectiveness of these control measures to impact polychaetes was not been assessed by the Beeman study. The control measure that consist of the provision of emergency spring dilution flows if certain criteria are met, could somewhat be related to the findings of the Beeman study. Whether increasing flows to 3,000 cfs (and then going to 4,000 cfs if necessary) is considered a "small operational change" or "large flow event" is up to interpretation, however the amount of water required to meet these levels during the April/May time period can vary substantially, depending upon hydrologic conditions. During some wetter water years, these flow levels would be met without any flow augmentation.
Bureau of Reclamation	General			Please consider assessing the potential role of increasing flows from key tributaries of the Klamath River below IGD in reducing C. shasta POI. Although outside of Reclamation's jurisdiction, we feel that increasing cool water flows from key tributaries could reduce spore production and improve upstream passage into the tributaries. Concentrating efforts on increasing flows from IGD ignores the potential role tributaries could play at reducing actinospore concentrations in the mainstem Klamath River and increasing usage of those habitats by juvenile coho salmon.	It is not clear what time of year is being recommending for increasing flows in tributaries, given the reference to fish passage, however we agree that cool water accretions from Klamath River tributaries are critical for the health of the Klamath River ecosystem and could help to ameliorate disease conditions in the Klamath River to some extent. However, the magnitude of water diverted within tributaries downstream of Iron Gate Dam is relatlively small compared to IGD discharge - while the impact of these diversions is extreme within the tributaries, the impact to the mainstem Klamath flow is much less (but still important).

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Bureau of Reclamation	1	2	General	There are inaccuracies in this paragraph. For example, in the BiOp, NMFS concluded that they "cannot quantify the magnitude of the increased disease risk to coho salmon under the proposed action" (2013 BiOp, page 376). As such, to the extent statements such as those in paragraph 2 are needed, they should be limited to factual statements. Please verify the accuracy of other statements in this paragraph.	Page 349 of the BiOp: "The proposed action is likely to adversely affect coho salmon fry by reducing habitat availability and increasing susceptibility to diseases." AND NMFS believes the high incidence of disease in certain years within the mainstem Klamath River results largely from the reduction in magnitude, frequency, and duration of mainstem flows from the natural flow regime under which coho salmon evolved. The proposed action's effects on spring flows and channel maintenance flows and their relationship to disease are discussed below. Research on the effects of C. shasta on coho salmon juveniles is applicable to coho salmon fry because the parasite targets species not life stages (Hallett et al. 2012). (page 341 of the BiOp) AND: "Therefore, when environmental conditions are conducive to actinospore release in the spring (e.g., elevated water temperature), the proposed action will likely result in hydrologic conditions in the mainstem Klamath River that contribute to high C. shasta actinospore concentrations (e.g., ≥5 spores/L actinospore genotype II), which will likely increase the percentage of disease-related mortality to coho salmon fry in the mainstem Klamath River between Trees of Heaven (RM 172) and Seiad Valley (RM 129) in May to mid-June (Foot et al. 2008, Hallett et al. 2012, Ray et al. 2012). The proposed action will also likely increase the percentage of coho salmon fry in the mainstem Klamath River between Klamathon Bridge (RM 184) and Orleans (RM 59) that will experience sublethal effects of C. shasta infections during April to mid-June. Sublethal effects include impaired growth, swimming performance, body condition, and increased stress and susceptibility to secondary infections (Hallett et al. 2012)." (page 343). It seems that all of the statements in this paragraph are accurate. Please be more specific if you don't agree.
Bureau of Reclamation	1	2	General	Please refer to the Klamath Project as the Klamath Reclamation Project or Klamath Project throughout document.	Done
Bureau of Reclamation	1	3		The third paragraph on p. 1 of the Guidance Document does not seem to be directly related to the purpose of the Guidance Document. There is no reference to the ITS in the scoping document, rather the purpose of the exercise was to provide scientific information as to possible controls of the disease that could be implemented by Reclamation. Please remove first full sentence. Additionally, revise second sentence to be consistent with Scoping Document as follows: "In order to propose guidance for science-based measures intended to mitigate the effects of Ceratanova shasta (C. shasta) disease infection rates in coho and Chinook salmon below Iron Gate Dam, ...the disease technical advisory committee.....".	The first sentence of paragraph 3 gives context for the document. While the scoping document doesn't specifically refer to the ITS, it does refer to the BiOp and the fact that the Synthesis Memo (referred to as Guidance Document in the Scoping memo) is intended for consideration and implementation for the duration of the 2013 BiOp.
Bureau of Reclamation	2	1		What are the specific mechanisms and empirical evidence linking KP to C. shasta infection in fish? The reviewer is concerned that operation of the Klamath Project may be less influential than other factors like meteorological conditions. Yes, the Klamath Project changes the hydrograph, but what is the relative contribution as compared to meteorological conditions, etc? There is a large amount of uncertainty whether the types of flows needed for disease control can be reliably, artificially produced. Figure 3 in the DTAT Guidance Document shows the flow duration for various types of high flow events in the Klamath River, 1964-2016. During the last 16 years there was one very wet water year (2006) and that's the year that produced the types of flows desired for disease control. The Geomorphic Memo stated that "From 2000 to 2016, the average cumulative duration of Surface Flushing flow exceeded five days in only one water year and no sediment mobilization flows occurred in 12 of the 17 water years." Due to water storage limitations, the Klamath Project may not be able to artificially create high flow conditions during dry or moderate water years, which indicates that the quantity and duration of the requested flow management measures may not be implementable.	The comment states: "There is a large amount of uncertainty whether the types of flows needed for disease control can be reliably, artificially produced". In regard to reliability, it depends upon which flows are being referenced, and, of course, the hydrologic conditions. However, surface flushing flows could be provided in most years, and deep flushing flows in many years. In regard to "artificially produced", we would argue that in many years the lack of higher flows, especially surface flushign flows), is "artificially" prevented from happening. Your reference to the minimal amount of high flows during the past 16 years,especially relative to the prior 26 years, is what we are trying to remedy. We think that part of the solution is management of the project, lake levels, and river flows. The driest yeaers will be the most challenging, however the surface flushing flows would consume approximatley 30,000 - 35,000 acre ft. of water (depending upon details), which should be technically feasible in all water years.
Bureau of Reclamation	2	3	3	On page 2, the document states "the only limitation the DTAT placed on the guidance provided herein, were physical possibility, safety, and a reasonable timeline for implementation". The limitation criteria described on page 2 is not followed in Page 5 list of control measures considered but elimiated (ie. Dewatering and Direct Sediment Introduction). The reasons for rejecting these control measures should reflect this list, or the list should be revised to include the reasons noted for each eliminated control measure starting on page 5.	Clarifying language added on page 2.
Bureau of Reclamation	2			The discussion in the first full paragraph of page 2 regarding operation of the Klamath Project is not relevant to the task of determining possible science-based controls of disease. Also, the reference to the impaired natural flow is an oversimplification of a more detailed discussion of the BiOp. Also, there is no explanation on how the Klamath Project affects water quality that relates to the disease issue at hand.	Language re: WQ deleted, reference to 2013 BiOp and Geomorph memo added
Bureau of Reclamation	3			The underlined text on p. 3 of the Guidance Document does not seem necessary as the Tech Memos were not for the purpose of suggesting management decisions.	The tech memos were developed, at the Yurok and Karuk Tribes request, so we could draft the synthesis memo which is based upon the information from the tech memos.
Bureau of Reclamation	4	2	1	typo, should be Sascha Hallett not Sasha Hallet	Thank you

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Bureau of Reclamation	4	3	3	Predicted outcomes are a key element of adaptive management. As such, to be able to meaningfully carry out the adaptive management considerations described on page 4, clear definition is needed in each of the management options. Please include.	This will be a task for technical group identified in the 2nd paragraph under "Adaptive Management Considerations".
Bureau of Reclamation	4	3	General Comments	In the Adaptive Management Considerations section (page 4), the authors recommed that 'Reclamation assemble a techncial group from fish management agencies and Tribes to ensure that studies are developed and appropriately funded such that field observations can be made before and after management actions are implemented and monitored.' The FASTA team, comprised of technical experts from the Tribes, fish management agencies, and universities already exists and has been developing and carrying out adaptive management activities; hypotheses are often discussed prior to implementation of management actions, monitoring plans are coordinated, and results are conveyed. As an example, the FASTA team recently agreed to deviate from the formulaic approach to implement a pulse flow capable of displacing carcasses and limiting myxospore load. Do the authors envision the need for an additional technical group? How often would this group convene and what would they discuss. Reclamation believes the composition and forum is captured with the existing FASTA team and does not recommed the forming of an additional and largely redundant group.	The relationship between the disease technical group and the Fasta team should be discussed among Co-Managers to determine the most efficient/effective way to meet the adaptive management needs associated with measures to minimize disease issues.
Bureau of Reclamation	4	4	2	typo, should be thresholds not thresh holds	Thank you
Bureau of Reclamation	4	5		"Spore dilution" is mentioned as an objective of one of the DTAT's flow management recommendations. However, spore dilution via flow augmentation has not been shown to appreciably decrease infection rates in Klamath River salmon (2014, tech memo). Infection rates are most strongly correlated with water temperature, especially in cases where spore concentrations are high. Lab studies have also shown that temperature is the key factor for predicting mortality of infected fish, which means releasing more warm water above the tubine capacity at IGD may not appreciably (if at all), affect mortality rates.	We believe that the rationale behind the spore dilution management guidance is adequately explained and backed up with appropriate scientific literature
Bureau of Reclamation	4	6	1 & 2	The sentences noted below contradict each other, and the text in page 2, paragraph 2, sentence 2. Page 4, Paragraph 6, Sentence 1 states "high likelihood" whereas sentence 2 states "would" - a positive assurance of results while Page 2, paragraph 2, sentence 2 implies considerable uncertainty. Change "would" to "could" since the outcomes of all management guidance are not fully understood at this time.	language changed for clarification
Bureau of Reclamation	6	3	General Comments	The authors state that implemention of the geomorphically oriented management guidance actions is expected to reduce the need for other management guidance (dilution, fall carcass, and hatchery changes etc.). The observation of polychaete distribution/density and C. shasta POI in juenvile Chinook and coho after the 2016 'deep flushing flow' event supports the statement that geomporhically active flows can disrupt the C. shasta lifecycle. However, it's unclear how the authors anticipate managers will make decisions on whether or not management actions in addition to, or other than, geomorphically oriented events are also needed for disese abatement. Please provide specific instruction and/or criteria that provides for the decision making process on when and how management guidance 4-6 are implemented (or not). Do the authors anticipate that these decisions will be necessary on an annual basis. If so, what are the criteria and who will make them (FASTA?)?	The guidance document identifies management actions that may alleviate C. shasta conditions on the Klamath without regard to implementation. This Guidance Document does not demand that Bureau of Reclamation implement any of these actions. Text will remain.

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Bureau of Reclamation	7	2		IGD discharges of 6,030 cfs flow was noted to have a two-year recurrence interval, but the recommendation is for this to occur every year until dam removal. What is the rationale for a recommendation that exceeds the frequency of high flow events observed over the period of record? This point is especially valid given climate change projections and the already reduced frequency of these events observed over the last 16 years.	With regard to the climate change portion of the document, the BiOp says the current drought cycle is an anomaly. (source is: USBR [U.S. Bureau of Reclamation]. 2011. SECURE Water Act Section 9503(3) - Reclamation Climate Change and Water, Report to Congress. U.S. Dept. of Interior, Denver, Colorado.) "Reclamation also projects annual increases in runoff during the 2020s compared to the 1990s, based on the global climate models. The annual volume of flow in the Williamson River is expected to increase by approximately 8 percent, with increases of approximately 22 percent during December through March and decreases of approximately 3 percent during April through July (Reclamation 2011). The Klamath River below Iron Gate Dam is expected to experience an approximate 5 percent increase in annual flow volume, with increases of approximately 30 percent during December through March and decreases of approximately 7 percent during April through July (Reclamation 2011)." (BiOp at 67)(source is: USBR [U.S. Bureau of Reclamation]. (same source as cited above). Now with regard to frequency being more than historic: The first reason we have asked for 6,030 more frequently than every other year is because of the dire situation with regard to disease in the Klamath River. The frequency of flow in the Geomorphic memo is a description of how frequently a given flow occurred over the specified period of record. The flow magnitude of 6,030 was selected because it does initiate movement of fine sediments and surface layer sediment (Geomorphic Memo). The polychaete memo, combined with the spore and fish infection memo describe what are the ecological results of the lack of these flows (see Figure 5 of Geomorphic Memo on page 21).
Bureau of Reclamation	7	last	last	typo, should be Polychaete not Polycheate	Thank you
Bureau of Reclamation	7,8	6	Management Guidance 1: Provide Surface Flushing Flows	The authors recommend that Reclamation follow the 2013 BiOp ramp up and ramp down rates during the implementation of the fall surface flushing flows of 6,030 cfs in November-December. Reclamation, when implementing the fall carcass displacement in November 2016 did not need to follow the downramping rate in the BiOp because, as individuals on the FASTA noted, 'there were very few, if any juvenile salmon in the mainstem Klamath River at that time and stranding was not a significant concern'. Also, the surface flushing flow time period overlaps with Recommendation #5 (carcass displacement flow). Reclamation seeks clarification on whether the fine flushing flows and carcass displacement flow could be combined into one event. And, if combined into one event, and given the need to remove carcasses from the wetted channel, the authors should clarify whether they feel the BiOp ramping rates should be adhered to (as recommended) or whether there's more benefit than risk associated with steeper ramp up and ramp down rates.	NOTE: we don't refer to "fall surface flushign flows", but "surface flushing flows". The surface flushing flow does not necessarily overlap with the carcass displacement flow - see response to comment in row 29 below. In regard to ramping rates, this should be considered by technical experts, such as the potential Disease Management Recommendations Team mentioned by BOR in the Scoping Document.
Bureau of Reclamation	7,8	6	Management Guidance 1: Provide Surface Flushing Flows	It is unclear whether the recommended surface flushing flow of 6,030 cfs can be incorporated on the beginning or end of a larger geomorphic flow event in the spring months (Feb-April) or a carcass displacement flow in the fall (Novemeber - December). The authors should clarify whether these events can be combined into one singular flow event. If the authors recommend two discrete flow events, justification and rationale should be provided.	As noted on page 9 of the Synthesis Memo, "if the deep flushing event as described in Management Guidance 1 does not result in flows above 6,030 cfs for at least 72 horus, it will not fulfill the fine sediment managemetn guidance action (#1)." Therefore, deep flushing events and surface flushing flow events can be piggy backed on top of each, as long as flows are above 6,030 cfs for at least 72 hours. Potential concerns with piggy-backing the surface flushing flows with the fall carcass/myxospore redistribution flows include: 1) scouring of redds in the Upper Klamath, 2) effectiveness of the flows at reducing polychaete densities for the spring/early summer. Our opinion is that the spring time, especially during an ongoing hydrologic event, is likely the best time for the surface flushing flows. However, this would be a good topic for the experts to consider, such as the Disease Management Recommendation Team that is described by BOR in the Scoping Document.
Bureau of Reclamation	8	3		While there is considerable discussion to support the 6,030 cfs flow, the true target is the reduction in the host population where the scientific basis included in the Guidance Document is that there is "strong evidence to suggest". This does not provide the "predicted outcome" assumed in the adaptive management consideration section on page 4. Clear definition is needed. Please include.	Not clear what this comment is asking or recommending. The predicted outcome of the surface flushing flows is the mobilization of surface sediments, reduction in available polychaete habitat, and resultant reduction in polychate densities.

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Bureau of Reclamation	9	6	General Comment	Since there has been a demonstrated successful reduction in polychaete density at a much shorter duration than suggested in the management guidance, recommend including a component in the adaptive management strategy that provides for testing and success of various flow management alternatives that include scenarios with a magnitude/duration/frequency less than suggested in the Guidance Document that may result in similar successes.	These recommendations are intended for the period from now through 2023, when the BiOp expires and after dam removal has occurred; six years is not enogh time to explore several paramters (i.e. magnitude/duration/frequency). Furthermore, our intent is provide management actions that prevent high *C. shasta* infections, such as occurred in 2014 and 2015, between now and 2023. We fully support an adaptive management approach, however it must be implemented with an eye toward minimizing the risk of high *C. shasta* infection rates. We do not recommend exposing the the fish to additional high risk of *C. shasta* infections for the sake of science or for the sake of conserving a relatively small amount of water.
Bureau of Reclamation	9		Management Guidance 2: Provide Deep Flushing Flows and Armor Disturbing Flows	Given that Reclamation enacted a large deep flushing flow in the spring of 2016 (March) of 11,200 CFS and the recommendation is to have these events occur every other year, what is the justfication and scientific basis for requiring this flow to occur in water year 2017?	language supporting implementation in 2017 added to support section
Bureau of Reclamation	10		Management Guidance 3: Opportunistic Geomorphic Flows	This recommendation seems redundant with recommendation number 2. Reclamation and NMFS will seek to maximize the magnitude of geomorphically active flows within the inherent constraints of infrastructure and public safety.	This recommendation is for flows higher than deep flushing flows, so it is not redundant with recommendation #2. We agree that such flow events need to be done wtihin constraints of infrastructure and public safety.
Bureau of Reclamation	10	9		From the Spore memo: "Though managed discharge events have not produced dramatic reductions in spore concentrations, the planned discharge increases were likely too small to be biologically effective. An unplanned discharge increase in 2005 likely demonstrates the potential for larger discharges to effectively reduce spore concentrations." "Actinospore development within polychaetes is likely a function of accumulating thermal units…" The Fish Infection Memo, Figure 3 shows that infection rates will be between 35% and 45% across a range of water temperatures (10-22°C) when spore concentrations reach 50 spores/L. Monitoring sites in the lower Klamath River show spore concentrations regularly exceeding 50 spore/L even following experimental flow releases. Taken together, these observations would lead to the thought that a small dilution effect associated with Guidance Measure 4 would have little effect on fish infection rates. Please clarify.	Agreed, the flows (1,900 cfs) provided in 2014 indicate that minimal flow increases (which result in minimal dilution effect) would have little effect on prevalence of infection rates. However, the natural hydrologic event that occurred in May 2005 (briefly > 6,000 cfs) indicates that prevalence of infection dropped substantially from this event. These two flow levels set the side boards, as we suspect the "sweet spot" for reducing spore levels lies somewhere in between them. We propose starting with 3,000 cfs and if that is not effective, then increasing to 4,000 cfs. The text will remain unchanged.
Bureau of Reclamation	11	1	Mangement Guidance 4: Emergency Provision Flow to dilute spores	In general, Reclamation believes the thresholds listed for detemining whether to implement a diluting flow are difficult to quantify, especially given the dynamic nature of natural systems. This has the potential to make implementation of a diluting flow incredibly difficult. For example what tool or approch is available and accepted as a means to estimate whether 80% of the expected wild run has passed the Kinsman, Scott and Shasta? It doesn't seem like this threshold is easily quantifiable, especially in real time (i.e., how do we know what 80% is until we get to the end?). Looking back at past data, water temperature and prevalance of infection are also highly dynamic, leading to the possibility of an on-again/off-again management action.	USFWS staff (operators of the Kinsman trap) have indicated that they can develop a method for estimating when 80% of the run has passed the trap site - this would be independent of real-time trapping information. Dynamic flows in the spring time would not necessarily be a bad thing. Management Guidance Action will remain the same.
Bureau of Reclamation	11		Mangement Guidance 4: Emergency Provision Flow to dilute spores	The scientific support and mechanism for the diluting flow recommendation is less robust and direct than the other recommendations. Increasing spring flows to dilute actinospores likely leads to complex biotic interactions, including altered habitat use by juvenile coho and Chinook salmon (increased time in margin habitats with slower water velocities). Given Adam Ray's dissertation, which describes the effect of water velocity on the likelihood of actinospores finding and attaching to a host, and the compounding effects of increasing flow on fish behavior and habitat use, there seems to be a lot of uncertainty surrounding the actual benefits of a diluting flow. The authors also do not provide a justification for the thresolds listed; how did the authors identify 5 spores and 20% POI as the thresholds and how are those thresholds related to population level mortality? Given the inherent uncertainty regarding the efficacy of this action based on past events and the complex interactions between flow, fish behavior, and infectivity rates, Reclamation recommends that this guidance be removed from the Guidance Document.	The flows identified in the Synthesis Memo (3,000 cfs initially, followed by 4,000 cfs if necessary) for spore dilution provide improved habitat conditions for coho fry (see 2013 BiOp, Figure 11.17) and coho juveniles (see 2013 BiOp, Figure 11.18), relative to flows below these levels. See next response (row 37) in regard to justification for the criteria. No change to Management Guidance Action.

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Bureau of Reclamation	11		Management Guidance 4: General Comment	It's clear that the authors selected conservative thresolds for implementing the diluting flow. As such, please provide the scientific basis for reduced disease management thresholds (ie. 5 spores per liter, irrespective of genotype, and 13 degrees celsius water temperature at Seiad Valley) from those identified in the BiOp. Daily average water temperature of 13 deg C at Seiad ran from about May 1 through Oct 15 in 2016 and 5 spores per liter (no genotype req's) happened by mid April in 2016 and continued through October. Furthermore, please provide the scientific basis for using unspeciified genotyping as part of the criterion. Consistent with Scoping Document, the strategies or actions are being proposed in an effort to reduce infection rates of juvenile coho and Chinook salmon, to the extent such information on Chinook salmon is relied on to address measures for coho salmon. Since there is sufficent information to assess the risk of C. Shasta infection in coho salmon through genotyping, this data should be relied on to indicate the need for implementation of this management action. Disregarding the genotyping ignores the effects specific to ESA listed coho, the subject of this exercise.	The following language was added to document: "For emergency flow releases to be effective, dilution flows need to occur as disease is worsening but before excessive levels of lethal doses are occurring in juvenile fish. Hallet (2012) found the lethality threshold of 40% was reached at 10 spores per liter for Chinook but only 5 spores per liter for coho salmon. This level of mortality is extremely high with small changes in mortality rates translating to a large difference in overall survival rates (Fujiwara 2014). Actinospores are generally released when temperatures are above 10°C, and remain viable (able to infect salmon) at temperatures ranging from 11 to 18ºC (Foott et al. 2006). A lethal combination of spores and temperatures is occurring at the trigger threshold of 5 spores per liter and 13 degrees C and given lag times of sampling of a week and likely trajectories given an examination of past trends, this was thought to be a prudent precautionary approach to avoid excessive mortality rates. Reclamation in the 2013 BiOp proposed flow increases for the Klamath River downstream of IGD to dilute actinospore concentrations within 24 hours of receiving information that disease thresholds have been met and used 5 spores per liter of Type II as a threshold (2013 BiOp page 41) so while this was only implemented once and with meager flows, this is a previously contemplated action. The unspecified genotyping referenced in the memo is in part to allow for much more rapid turnaround time for results (reduction of 2-4 days of process time), which would allow for more effective implementation for fish and water conservation. It is not disputed that there is sufficient information to assess C. Shasta through genotyping and that data would still be collected. Chinook salmon are the disease surrogate for coho in the ITS and incredibly important to tribal fisheries so should be protected during these actions along with ESA listed coho salmon.
Bureau of Reclamation	11		Mangement Guidance 4: Emergency Provision Flow to dilute spores	The thresold criteria for Kinsman rotary screw trap is specific to wild fish (to not exceed 80%), but the criteria number 2 regarding overall POI does not specify whether the POI is all fish captured, or just wild? Please clarify.	The 80% is specific to wild fish emigration, the POI level pertains to all fish sampled prior to when 80% of the wild run is estimated to have passed the Kinsman trap site. Clarifying language added to document in description of Management Guidance Action.
Bureau of Reclamation	11		Mangement Guidance 4: Emergency Provision Flow to dilute spores	Just as there are inherent infrastructure limitations with providing a 11,250 cfs geomorphic flow, there are also inherent infrastructure limitations and public safety risk limitations to the amount of storage in UKL during the spring months when UKL is at or near full pool. In other words, there are safety limitations associated with storage operations and UKL will not have the capacity to store an additional 50K AF for this purpose in many years.	Understood, we did not anticipate there would be additional water stored in UKL. No change made to document.
Bureau of Reclamation	11		Mangement Guidance 4: Emergency Provision Flow to dilute spores	The temperature benefit from increasing flows at Iron Gate Dam are uncertain and overstated - spring flows at Iron Gate Dam, especially above turbine capacity have the potential to increase water temperatures between Iron Gate and the confluence with the Shasta River.	We could not find corroborating evidence that increases in flow during the time period specified would increase water temperatures by any significant degree. Even if that occurred (which we doubt), the effects would be very limited in geographic scope, based on temperature modeling from the Sec Determintaiton report and observation. No change to text.
Bureau of Reclamation	11	1		There may be an important tradeoff between potential benefits from diluting spore concentrations and increasing water temperature. Artificial increases in spring flows from IGD have been shown to increase water temperature, particularly upstream of the Shasta River, which would cause spore concentrations and fish infection rates to increase as well. Therefore, this management measure could reduce fish survival. The authors should utilize existing predictive tools such as the S3 temperature submodel to better understand the multiple effects of increasing flows form IGD on water temperatures and fish POI.	See previous comment response.
Bureau of Reclamation	11	1		Smolt trapping data at Bogus Creek (USFWS 2002-2005) showed that coho salmon smolts migrated through the most upstream reach of the Lower Klamath River between March 1 and May 1, nearly a month prior to the increase in C. shasta spore concentrations recorded in 2005 (Spore Memo, Figure 4). If coho emigration regularly precedes spore concentration increases, dilution strategies would not be effective.	In addition to some coho smolts being in the Upper Klamath River during May, there are also young of year coho in the Upper Klamath at this time; rearing and/or re-distributing from one area to another. For example see USFWS report titled *Arcata Fisheries Data Series Report DS 2016-47 Summary of Abundance and Biological Data Collected During Juvenile Salmonid Monitoring on the Mainstem Klamath River Below Iron Gate Dam, California, 2014* (David et al, 2016) - available on USFWS Arcata web site. No change to text.
Bureau of Reclamation	11	7	1	The authors state that 'Altered Klamath River flow regimes have enhanced the reproductive sucess of C. shasta at every stage of its lifecyle'. The authors mention reduced spring flows as one aspect of the annual hydrograph that has been altered and contributed to the reproductive success of C. shasta. However, the authors should also note that reduced variability throughout the year, inclulding stable base flows during the summer months may also be contributing to C. shasta's reproductive success.	Noted
Bureau of Reclamation	12	3	5	Add (POI) after "prevalence of infection"	Thank you

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Bureau of Reclamation	13		Mangement Guidance 5: Provide flow in the late fall and early winter to redistribute salmon carcasses and myxospores	The mechanism the authors provide for disrupting the production and contribution of mxyospores is intuitive. However, it's unclear how the authors arrived at the specific magnitude, duration, and timing recommended. Also, the discussion does not indicate what amount/kind/extent of carcass redistribution is needed to meet an undefined goal. The benefit in terms of reduced infection rates is unclear. Is there also the potential to just move the myxospore load downstream, or are there fewer or less dense polychaete beds below Beaver Creek? Please justify. Monitoring conducted before/after the fall 2016 flow (and future years) may provide additional information for the range of magnitudes and durations needed to redistribute and remove carcasses from the channel. Additionally, the authors should specify whether BiOp ramp up/ramp down rates will be required?	We had little data to base this recommendation upon, however the concept appears to be supported by the scientific evidence (TechMemos) and relatively speaking, it does not require a large volume of water. We agree that the efficacy of this measure, along with the magnitude, duration, and timing of flow should be investigated through an adaptive management process. Clarifying language re: ramping rates has been added.
Bureau of Reclamation	14		Mangement Guidance 6: Iron Gate Hatchery Release Strategy	Although this management guidance is outside of Reclamation's control, authority, and discretion, Reclamation supports this management guidance and recommends that appropriate parties coordinate immediately and prior to the upcoming season to determine ways that hatchery management could be modified to reduce their contribution to the disease incidence in the Klamath River during the critical spring time period. However, as the authors note, infected and dying fingerlings released from Iron Gate Hatchery are likely contributing myxospores to the Klamath River. Given the high production goals (up to 5.1 million annually) and late releases (compared to wild fish outmigration), there is reason to believe that hatchery fish are contributing myxospores to the system and perpetuating the C. shasta lifecycle. This is especially true in years of drought or above average temperatures (e.g., 2014 and 2015) when the vast majority of hatchery fish showed clinical signs of the disesase (and likely died) within days of release. What is unknown is the relative contribution of myxospores between adult and juvenile fish and future monitoring should attempt to clarify the reletive contribution between lifestages.	See response in row 25 above.
Bureau of Reclamation	14	2		The second objective of this measure is to reduce hatchery fish exposure during peak spore concentration periods. This appears to be a logical basis for this management action. Additionally, juvenile hatchery fish could also be released in coordination with river operations to push fish through the IGD reach more quickly and potentially increase smolt survival.	There are complexities associated with release of IGH fish, such as size of fish due to incubation/rearing temperatures, infrastructure limiations, etc…., however we agree that such strategies should be considered amongst Co-managers.
Bureau of Reclamation	36	Table 7		typo, Mena should be Mean	Thank you
Bureau of Reclamation	52	3	1	typo, Morhpological should be Morphological	Thank you
Bureau of Reclamation	76	1	1	The effects of water temperature and actinospore concentration are estimated to be much stronger influences on mortality than discharge (especially when increased flows come from the hydropower reach). The authors should examine ways to increase shading, hyporheic inflows, or expanding the influence of cold water tributaries.	Actinospore concentration is related to discharge, however more data regarding this relationship would be beneficial. Ways to increase shading, hyporheic inflows, and expanding the influence of cold water tributaries are worthy of consideration, however they are better fit for the bin of "Longer Term Control Measures". No change made to text.
Klamath Water Users Association	General			Respectfully, some aspects of the Draft Guidance appear to contemplate a reversion to the failed paradigm of looking to the Klamath Irrigation Project to attempt to address and solve all issues of concern in the basin.	We have added language under the "purpose of the document" section to clarify that this Management Guidance simply describes conditions necessary below Iron Gate Dam to alleviate acute disease mortality issues that affect both Coho and Chinook salmon. We do not agree that this document points directly at the Klamath Reclamation Project.
Klamath Water Users Association	General			The Draft Guidance should be reviewed for consistency and objectivity. Various alternatives are rejected because of cost, safety considerations, or effects on certain resources (e.g., invertebrates). Yet there has been no consideration of the potential consequences of any of the retained Management Guidance actions for irrigation water supplies and related communities, national wildlife refuges, endangered suckers, or other resources that could be affected. Nor has there been sufficient consideration of legal authority to implement any or all of the actions.	We have added language under the "purpose of the document" section to clarify that this Management Guidance simply describes conditions necessary below Iron Gate Dam to alleviate acute disease mortality issues that affect both Coho and Chinook salmon. While it is acknowledged that any departure from current water management will have implications to other parts of the system including farmers, such analysis is beyond the scope of this document. Same applies to any analysis or discussion of legal authority to implement any or all of the actions.
Klamath Water Users Association	General			As noted above, the Draft Guidance, or at least portions, appears to target the Klamath Project as the only factor related to disease in the Klamath River.	Disagree with this statement. The guidance document identifies management actions that may alleviate C. shasta conditions on the Klamath without regard to implementation. This Guidance Document does not demand that Bureau of Reclamation implement any of these actions. To the extent that Klamath Project operations are identified or mentioned, it is because it is the 2013 BiOp that is at the center of this analysis.

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Klamath Water Users Association	General			In addition, KWUA had understood that various flow-related actions that might be considered would only be proposed for an interim period, with an emphasis on opportunistic approaches that would avoid adverse water supply consequences for other parties. This appears to have been abandoned.	As stated in the "Purpose of Document" section of the Guidance Document, the purpose of this document was to identify flow and/or other conditions in the river below Iron Gate Dam that would alleviated acute disease mortality currently being experienced in the Klamath River. It was, and still is, beyond the perview of the Guidance Document to discuss impacts to other users from implementation of any of the guidance actions identified.
Klamath Water Users Association	General			We do observe, however, that in some locations the Draft Guidance refers to "hydrologic support" or similar concepts. We recommend that it be made clear what this means.	noted: will add clarifying language as appropriate. In general, hydrologic support means not trying to implement large flows during extreme drought. There is much room for flexibility in this concept.
Klamath Water Users Association	General			Also, KWUA's general concerns can be mitigated if the Guidance Document makes clear, as we believe it should, that the implementation of any measure would: be accomplished through, or affect only, the Environmental Water Account (EWA) established in the Klamath Project biological assessment and opinions; or provide offsetting adjustment of fall-winter flows. This also, however, has not been made clear.	It is beyond the scope of this Guidance Document to identify specific ways in which flow conditions could be achieved. The Guidance Document does not specify any source for identified additional flows.
Klamath Water Users Association	General			The Draft Guidance appears to include multiple actions directed to the same end. It would be helpful if there were a clear prioritization.	Noted. The Management Guidance is presented in a generalized prioritized order in that the first three Guidance Actions focus on prevention, the fourth one (spring dilution flows) is an emergency response. The fifth and sixth actions are additional actions the DTAT believed would also help.
Klamath Water Users Association	General			The Draft Guidance describes the 2014 and 2015 situation as critical, and refers to an immediate dire need. We believe parties would benefit from a more complete understanding of the consequences of C. shasta for overall populations of coho or other species through time and over the range of conditions that exist in the river, and the relative role of disease and other factors affecting populations, including at the present time.	Please see Fujiwara et al. 2011, True et al. 2013 as cited in the Fish Infection Memo (attached as appendix to the Guidance Document) for a peer-reviewed fully developed analysis of population effects. Although this does not include the most recent data, it discusses population level effects to chinook and coho salmon.
Klamath Water Users Association	General			We also recommend a more fully-developed discussion of post-2015 disease rates and any significance to be assigned. Some of this information may be lacking, and KWUA would support work to improve our understanding.	Noted. In general the 2016 data was not available to our knowledge as we were drafting the Guidance Document.
Klamath Water Users Association	General			We also are interested to work with DTAT parties who are willing to engage in collaborative approaches.	We welcome your technical participation.
Klamath Water Users Association				Affected communities in the upper basin have not been included in this process. This approach is not consistent with progress in addressing Klamath basin issues that has been achieved over the past 10 years. We recommend immediate efforts to include potentially affected parties in any consideration of the Draft Guidance.	The identification of Management Guidance was a thoroughly technical exercise. The next steps, which will include discussion on whether, and if so, how to implement any of these actions is another process and will address concerns you have raised. The DTAT is not involved in that process.
Klamath Water Users Association	Page 1	Third paragraph:			
Klamath Water Users Association				The focus here falls to the operation of the Klamath Project; KWUA encourages a broader perspective. The flows affected by Klamath Project operations also supplement natural flow conditions in certain times of year. Additionally, the last sentence in the paragraph makes an assumption regarding infection rates in coho salmon. We are not aware of data on this issue and ask that it be provided if it exists and is available.	Citations added for clarity. Again, this document identifies conditions downstream of Iron Gate Dam that could help alleviate high disease mortality and does not specify management actions needed to achieve those conditions. Thus, we do not believe we targeted the Klamath Project.
Klamath Water Users Association					
Klamath Water Users Association	Page 2	First full paragraph:			
Klamath Water Users Association	Page 2	Second paragraph:		The term "management guidance" should be defined.	Noted: will add.
				It has been stated by fish biologists that less water will be needed if dam removal occurs. There should be an acknowledgement that any guidance considerations or recommendations would be expected to change.	The Guidance document clearly states that the Management Guidance provided is valid until the BiOp concludes or is superceded. Presumably dam removal would trigger reconsultation on this BiOp.
Klamath Water Users Association	Page 2	Second paragraph:			
Klamath Water Users Association	Page 2	Last Sentence		"Measures described below are intended to be implemented <u>in addition</u> to the measures and management actions described in the 2013 BiOp." This statement is not consistent with KWUA's understanding. It was explained to us that these measures were being identified but implementation of any measures is to be discussed among the affected parties (i.e. Reclamation, irrigators, Klamath Tribes, USFWS (including Refuges)) and Reclamation would decide how to proceed.	The Guidance document rationale for this statement is that the acute disease conditions that have caused high mortality have resulted from implementation of the BiOp. Therefore, any proposed management guidance should be in addition to that on the premise that we don't want to create new problems as we solve others. Text remains unaltered.
Klamath Water Users Association	Page 4	Second full paragraph:		We recommend the document identify anticipated sources of funding including whether there is any expectation it would be reimbursable by Project Contractors?	This is beyond the scope of this document.
				The dewatering alternative is dismissed summarily, and it appears that reasons 1 and 2 for dismissal may be the same. The alternative that was considered is not thoroughly described, but the potential benefits of any alternative should be fully analyzed. Natural variability of the river system involved very low flows. Variations of the alternative could also be considered in combination with other actions.	Our technical information, as discussed in the Guidance Document, indicated that dewatering would be ineffective and entail high risk to existing ecosystem function. In particular (as noted in the Guidance Document in the dewatering discussion) newer work has shown that infected polychaetes reside in deeper pools due to the settling rate of the spores. See polychaete memo Figure 4 Page 8).
Klamath Water Users Association		Control Measures Eliminated - #1			

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Klamath Water Users Association	Page 5	Control Measures Eliminated - #3		This measure is too readily dismissed. The prospect of dam removal may or may not be "imminent.	If it becomes apparent that dam removal will either 1) not happen, or 2) be delayed for a significant period of time; then yes, we agree this option should be re-examined. Footnote added.
Klamath Water Users Association	Page 6	First full paragraph		KWUA appreciates the acknowledgement of variable hydrologic conditions here. We think that acknowledgement is lost in other areas of the document.	The Guidance document makes many references to this, in particular in discussion around implementation of Management Guidance #2 and 3 which involve releases of high flows from Iron Gate Dam.
Klamath Water Users Association	Page 7	Management Guidance 1 - "Description"		Acknowledgement of hydrologic conditions should be made here. The unprecedented consecutive years of drought could be a factor in the "recent scarcity of these types of flows". Also, flow conditions in 2016, and their current relevance, has not been considered here. It is also difficult to understand how the logic supporting that this action should be implemented every single winter, and more so because there is apparently uncertainty about effectiveness.	The Guidance Document did not attempt to attribute low flows to any single cause, but rather to link the lack of high flows with high numbers of polychaetes and then high mortalities of C. shasta. As discussed in the document, we believe there is a solid link between flow, polychaetes, C shasta spore density and finally fish mortality.
Klamath Water Users Association	Page 7	Management Guidance 1 - Last full paragraph		Given the Draft Guidance's frequent reference to the Klamath Project, we believe it is important here to recognize that the period since 2000 has seen curtailments and constriction on irrigation diversion that were not characteristic of the 35 years prior to 2000.	This is beyond the scope of the document and inconsistent with the fact that we are not targeting any specific source or group for water needed downstream.
Klamath Water Users Association	Page 8	Figure 3		The Draft Guidance appears to support that pre-2001 river management was beneficial to the system. This should be discussed and evaluated in the document.	Specifically, the Guidance Document notes the higher frequency of high flows in that time period and combines that knowledge with 1) the high densities of polychaete worms in the upper Klamath River below Iron Gate Dam, and 2) recent polychaete habitat modeling that clearly links hydraulic conditions during periods of high flow to subsequent polychaete distribution. (see Polychaete Memo).
Klamath Water Users Association	Page 9	Management Guidance 2		KWUA appreciates the acknowledgement here of how hydrology could be relevant to this recommendation. Potential implications for other stakeholders in the system of this and any other recommendation should be described. KWUA also notes that the occurrence of flows described as deep flushing flows is strongly related to natural conditions? Biological Opinions have dictated micromanagement of the system (and provided less water for Project operations) over the last 16 years.	Potential implications for other stakeholders in the system cannot be described, because it is not known how (or if) the Bureau of Reclamation will implement this recommendation.
Klamath Water Users Association	Page 10	Management Guidance 3		In the "Support" discussion, the Draft Guidance alludes to decreased flows in recent history without mention to natural hydrologic conditions (i.e. drought). The document implies that these decreased flows are the result of management decisions rather than natural hydrologic conditions. Figure 3 helps illustrate that drought plays a major role.	We believe that both changed management and drought conditions are responsible for lower winter flows. For example, the flood control curve at Upper Klamath Lake has changed significantly in recent years. Text remains unaltered.
Klamath Water Users Association	Page 11	Sixth full paragraph		Klamath Project contractors should be part of FASTA and should be consulted.	This is a topic to take up with the Bureau of Reclamation who runs the FASTA process
Klamath Water Users Association	Page 11	Seventh full paragraph		This action is not legal, feasible, or prudent in most or all years. Also, as noted elsewhere, effects on other interests and resources has not been considered.	The difficulties of implementation are clearly acknowledged in the Guidance Document which only calls for the Bureau of Reclamation and PacifiCorp to "look for opportunities" to implement high flows.
Klamath Water Users Association	Page 11	Eighth full paragraph, first sentence "support"		There is a lack of documentation that this is fact. What role has natural hydrology played in the reproductive success of *C. shasta* ?	The 2013 BiOp has a detailed section that discusses how fish disease is affected by flows and how flows are affected by the operation of the Klamath Project. Clearly the Guidance Document does not lay blame for the disease situation at the feet of any user group, but does identify low flow conditions caused in part by drought conditions that have lead to high infection rates of sampled fish. Text remains unaltered.
Klamath Water Users Association	Page 12	"Uncertainties"		The expressed uncertainty is significant. The potential cost to Upper Klamath Lake, the Klamath Project, Upper Basin irrigators, and the refuge is not uncertain.	Noted
Klamath Water Users Association	Page 16	Conclusion		The Conclusion, particularly the last two paragraphs, is obviously direct advocacy, and does not square with characterizations of the process as only technical or informational in nature.	The penultimate paragraph discusses Tribal trust, and is simply a statement of fact; the Federal Agencies to have a responsibility in that regard. The last paragraph simply speaks to the necessity of acting quickly due to ongoing high mortality rates. Both of these are well supported, and the authors of the Guidance Document do not agree that re-stating well supported factual information is advocacy.
Klamath Water Users Association		General Comment		There appears to not have been an opportunity for the Klamath Tribes to engage or have a seat at the table in developing this document. What is the role or position of the Klamath Tribes regarding this Guidance Document?	The Klamath Tribes did provide comments on this document.
Klamath Water Users Association		General Comment		There are considerable reference to altered flow regimes, including over the last 16 years. Klamath Project contractors have had decreased certainty and generally less water over that same period of time than they have had historically.	Noted

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Klamath Water Users Association		General Comment		The Draft Guidance does not explain the process for creation of the DTAT or any subgroup that prepared the Draft Guidance Document. We believe this should be provided. There is reference on the first page to potential "[Others]" as authors. This apparent "sign on" process does not seem consistent with the concept of this paper as the product of a strictly technical analysis. Nor do several statements throughout the document.	noted
Klamath Water Users Association		General Comment		Overall we find the document incomplete. We understand the document specifically and purposefully did not discuss other socio-economic factors, affects on other stakeholders or species. Still, to conclude that some of these flow regimes are "physically possible and achievable" is not correct.	We disagree, and believe we completely addressed the purpose of the document, which was to identify Management Guidance to address severe disease conditions below Iron Gate Dam.
Klamath Water Users Association		General Comment		Any meaningful Guidance document must be based on a feasibility evaluation with a cost benefit analysis. This document does not include that information and therefore should be retitled to something like "Disease Management Concepts Assessment."	The term "Guidance" was a result of discussions with Federal Fish Management Agencies.
NMFS	1	2		Replace: "……served as a surrogate to determine rate of Coho infection." WITH "….served as the best surrogate available at the time for determining the estimated degree of Coho infection."	It seems to be the best surrogate currently as well. Text remains unaltered.
NMFS	1	2	1	Add "May through July" before 2014	Agree
NMFS	2	1	1 "Research described……."	add "adult salmonid" in front of carcass densities	Agree
NMFS	2	1	last of paragraph	add "salmon" after "(SONCC)"	Agree
NMFS	4	2	"Members of the DTAT….."	add "with" in front of Scott Foote	Agree
NMFS	5	1st under "Control Measures……" heading	1. Dewatering……	put "are" before killed	Agree
NMFS		2nd under "Control Measures……" heading	2. Manual carcass remvoval…… - 2nd to last word of paragraph	"recommended below" instead of "recommend below"	Do not agree.
NMFS	6	1	General comment	1. Seems there may be a reliance on faster in-season turn-around time on POI and spore monitoring, and this may not be possible to mobilize soon. Also could be issues with 'preliminary data' being used for 'if/then' water management decisions?	Our discussions with OSU researcher indicates that timing would be consistent with that outlined in our document.
NMFS	6	1	General comment	2. Might want to review polychaete habitat discussions and check for consistency with the associated Tech. Memo.?	Text remains; we believe it is supported by Tech Memos and BiOp.
NMFS	6		5……	typo - change Dilution to dilution	agree
NMFS	6	The data summarized……	1st sentence	Change M. speciose to M. speciosa	
NMFS	6	The first three……	last sentence of paragraph	Change "….guidance actions significantly…." to "guidance actions may significantly….."	ok
NMFS	7	Description:……	last sentence	recommend considering downramping rates on a case by case basis	Clarifying language added
NMFS	7	Support:……	2nd to last sentence	replace "recent years" with 2014 and 2015	ok
NMFS				replace "The Polychaete Memo describes how populations of polychaetes can be kept in check by mobilizing sediments, and the Geomorphic Memo describes what flows are needed to accomplish various geomorphic objectives." WITH "The Polychaete Memo describes how polychaetes distribution is related to substrate and hydraulics, and the Geomorphic Memo describes what flows are needed to accomplish various geomorphic objectives"	Text changed and clarified.
NMFS	9	under Management Guidance 2:	NOTE: If the deep…..	This is a bit confusing and could use clarificaiton	Text changed and clarified.
NMFS	9			There are three minor typos in the rest of recommendation	Text changed and clarified.
NMFS	10	Management Guidance 3		Comments include: "Uncertain if flows of this magnitude can be engineered due to infrastructure and safety constraints." AND "Unclear to me how #3 is different than #2" AND "Agree that it may be dependent on accretions as the hydraulic capacity at Link dam may be ~ 10 K cfs. Also, this may be duplicative with Management Guidance 2. It is probably realistic to consider when drought conditions may preclude implementation of both 2 and 3."	A sentence can be added at end of Description: "Furthermore, such an event may need to occur during times of high accretion between Link River Dam and Iron Gate Dam, due to outflow limitations at Link River Dam".
NMFS		Management Guidance 3	Support: 2nd and 3rd sentences	Change: "The Polychaete Memo describes how these stable flow conditions have contributed to a proliferation of M. speciosa. Provision of these flows will reduce……" TO "The Polychaete Memo describes how these stable flow conditions leads to increased polychaete habitat Provision of these flows will likely reduce…."	Text changed and clarified.
NMFS	10	Management Guidance 3	Adaptive management section:	Recommend deleting first part of first sentence: "Ideally, it would be desirable to monitor"	Text changed and clarified.
NMFS	10	Management Guidance 4	Objective: 1st sentence	Should change "….when 80% of the juvenile outmigration is …." TO "…when 80% of the juvenile Chinook outmigration is …."	Text changed and clarified.

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NMFS	11	Description: 1……	1…..	Not sure what the basis is for the 5 spores/l threshold. Seems that in the past this threshold has been related to coho salmon. ALSO The influence of IGD releases often diminishes further downstream.	The following language was added to document:"For emergency flow releases to be effective, dilution flows need to occur as disease is worsening but before excessive levels of lethal doses are occurring in juvenile fish. Hallet (2012) found the lethality threshold of 40% was reached at 10 spores per liter for Chinook but only 5 spores per liter for coho salmon. This level of mortality is extremely high with small changes in mortality rates translating to a large difference in overall survival rates (Fujiwara 2014). Actinospores are generally released when temperatures are above 10°C, and remain viable (able to infect salmon) at temperatures ranging from 11 to 18ºC (Foott et al. 2006). A lethal combination of spores and temperatures is occurring at the trigger threshold of 5 spores per liter and 13 degrees C and given lag times of sampling of a week and likely trajectories given an examination of past trends, this was thought to be a prudent precautionary approach to avoid excessive mortality rates. Reclamation in the 2013 BiOp proposed flow increases for the Klamath River downstream of IGD to dilute actinospore concentrations within 24 hours of receiving information that disease thresholds have been met and used 5 spores per liter of Type II as a threshold (2013 BiOp page 41) so while this was only implemented once and with meager flows, this is a previously contemplated action. The unspecified genotyping referenced in the memo is in part to allow for much more rapid turnaround time for results (reduction of 2-4 days of process time), which would allow for more effective implementation for fish and water conservation. It is not disputed that there is sufficient information to assess C. Shasta through genotyping and that data would still be collected. Chinook salmon are the disease surrogate for coho in the ITS and incredibly important to tribal fisheries so should be protected during these actions along with ESA listed coho salmon.
NMFS	11	Description 2….. (in regard to "….exceeds 20% in aggregate for the preceding week at the Kinsman Rotary Screw Trap."		Not sure that POI estimates can be provided in real time.	Per discussions with Kim True, USFWS CA-NV Fish Health Center, a week is tight, but possible, especially, if a process is implemented that gets the samples to the fish health lab sooner.
NMFS	11	3. (in regard to 80% of the expected wild run)	The juvenile catch at the Kinsman rotary screw trap is estimated to have not exceeded 80% of the expected wild run	Not sure that this can be currently estimated in real time.	USFWS Biometrician thinks this can be estimated, without relying upon real-time downstream migrant trap data.
NMFS	11	criteria #4	"The daily average water temperature has reached 13C at Seiad Valley".	Recommend deleting criteria #4	done
NMFS	11	When disease……		replace "….readiness prepare" with "…..readiness to prepare"	done
NMFS	11	"Maintain flows….."	Maintain flows at 3,000 cfs until spore or POI at Kinsman Trap sampling indicates a decrease in disease levels .	Given sample turn-around time, this would always be at least a week, perhaps more.	TRUE
NMFS	11	"Maintain flows….." (last sentence)	"After initiating this action, evaluate the efficacy of specific flow targets and adjust….."	May want to consider duration also.	text added
NMFS	11	"Support:…… "	2nd sentence	Replace: "to rearing and migrating juvenile fish, causing significant population" WITH "to rearing and migrating juvenile fish, contributing to significant population"	change made
NMFS	11	"Support:…… "	last sentence of first paragraph "Spring flows similar to average natural flow conditions are required to make meaningful reductions in C. shasta transmission during critical outmigration periods."	This statement could use a support citation?	sentence deleted
NMFS	12	"The concentration of….."	2nd sentence of paragraph	"….(modified with velocity)". REPLACE with "….(modified with volume and velocity)".	text changed
NMFS	12	"The concentration of….."	This is consistent with the observation of reduced disease infection rates and mortality estimates in wetter years with higher flows as opposed to drier years and lower flows	Add to this sentence: "…., although water temperature plays a role also".	done
NMFS	12	"The concentration of….."	Increased flows also increase water vilocity and have been shown to reduce transmission rates.	This statement could use a supporting citation. Is this based on lab studies, or river studies?	Citation added
NMFS	12	"Despite limited……"	Spore concentrations of 5 spores per liter (Hallett et al., 2012) and prevalence of infection of 20% (True et al., 2016) are strong indicators of impending and realized high disease rates.	Is this a quote from the previous citations?	Citations are provided
NMFS	12	Both outmigration…..	Both outmigration timing and pattern of POI levels in natural-origin juvenile Chinook salmon can vary between years, and the more these distributions overlap, the greater the adverse effect on the population.	Is this being proposed for in-season managemetn considerations?	Yes, prior to 80% of the estimated natural run having migrated from the Upper Basin and 20% of prevalence of infection of captured fish exceeding 20% in aggregate for the preceeding wad at the Kinsman trap.
NMFS	12	"Uncertainties:…."	…..low termperatures often coincide with higher flows……	Not necessarily true, not certain but not aware of any correlation between low temps and higher flows AND Is this generally true for releases above turbine capacity?	Text remains; modified by the word "often", which is true in rainy, wet spring periods, or times of abundant snowmelt runoff.
NMFS	13	Management Guidance 5:	General	It may make sense to combine Management Guidance 1 and 5	This should be conidered by disease experts, such as the Disease Management Recommendations Team, things to consider include: 1) potential scour of redds, 2) time of the year that the polychaetes are most vulnerable, 3) time of year that would minimize recolonozation by polychaetes prior to spring
NMFS	13	Support:…..	last of 1st paragraph	delete "entrain" and replace with "strand"	text changed
NMFS	13	Uncertainties	2nd sentence	replace decipher with discriminate	text changed to "distinguish"
NMFS	13	Adaptive Management…… 3rd paragrpah	1st sentence	replace "identified" with "identifiable"	done
NMFS	13	Adaptive Management…… 4th paragrpah	2nd sentence	estimate "quantify" with "estimate the"	done
NMFS	14	Managemetn Guidance 6	Description: #3 "Consider reduction……"	Manage this season?	Need to consider in collaboration with Co-managers, however it is worth noting that the release in 2017 is likely to be < 2,000,00 due to low egg take of brood 2016.
NMFS	15	Support section. Paragraph 5	3rd	replace: "…myxospores that likley infect polychaetes" with "….myxpspores that can can infect polychaets"	done

DTAT Guidance Document Comments and Responses					
Submitting Party	**Comment Location**			**Comment**	**Disposition**
	Page #	**Paragraph**	**Sentence**		
NMFS	15	Support section. Paragraph 5	2	Replace "…..myxospores from juveniles…." with "…….myxospores in juveniles….."	done
NMFS	15	Support section. Paragraph 6	last sentence	"Benson (2014) also suggests the potential for hatchery Chinook Salmon to contribute" Insert "juvenile" in front of Chinook Salmon	done
NMFS	16	Conclusion	first paragraph	insert "incidental" in between "NMFS take statement"	done
NMFS	16	Conclusion - first paragraph	first paragraph	Replace "These high rates of infection play a major….." WITH "These high rates of infection likely play a major….."	don't agree; supported by citation (Fujiwara et al.) as noted in introduction.
Klamath Tribes	General			cooler water temperatures, higher late spring and summer flows, and a more typical substrate distribution prior to dam construction helped keep C. shasta at bay historically	Agreed; see "long term measures" section regarding dam removal on page 5.
Klamath Tribes	General			the recommended high flows are much higher than they would have been historically (pre-dam)	Do not agree. Guidance measures 1-3 call for flows consistent with high flow years in the past (see Geomorphic Memo for full analysis). Dilution flows (Guidance measure 4) calls for a reinitiation of high snowmelt flows which may or may not be higher than natural flows in the past. This Guidance Measure is an emergency action to alleviate acute disease conditions in real time as they are occurring.
Klamath Tribes	General			Some may argue that dams allow for higher flows for diseased salmon and are therefore essential, we do not agree with this assessment and this should be explained in the document.	We agree; the Secretarial Determination reports show unequivocally that the dams have only limited ability to change flows. See dam removal section on Page 5 of the Guidance Document.
Klamath Tribes	General	guidance measures 1-5		are these presented in order of priority?	The Guidance Measures are not presented in order of priority, although it should be noted that measures 1-3 and 5 are preventative measures intended to prevent diesase conditions to become acute in the first place.
Klamath Tribes	General	Guidance 1		How was a 72 hour flow duration arrived at? The geomorphic tech memo? Figure 3 indicates that past years saw several days of sediment mobilizing flows, so is 72 hours sufficient?	The management guidance is to provide for surface flushing. It is assumed that longer periods of time will provide more complete movement and sorting of sediment. 72 hours was selected as a reasonable amount of time in which these processes are given time to occur.
Klamath Tribes	General			calling for a single 72 hour surface flushing flow of ~6,000 cfs despite "strong evidence to suggest that frequent surface flushing flows minimize available habitat for polychaetes" (emphasis added). Based on this statement, shouldn't this guidance be recommending more than a single surface flushing flow? If I am misunderstanding the recommendation (i.e., the guidance is recommending several surface flushing flows), perhaps clarifying this point in the document would be helpful.	Management Guidance 1 is called for at least once per year. Will add language clarifying that it is acceptible to have more than one event per year. It is assumed that, in wetter years, flows greater than 6,030 will occur more frequently than once per year.

	Disease Management Planning Effort - Guidance Document Comments USFWS Comments				*AFWO Review of our initial response to comments. Some responses by the DTAT changes subsequently.*	
Submiting Party	**Page #**	**Paragraph**	**Sentence**	**Reviewer Comment**	**Original DTAT Response**	**AFWO Comment**
USFWS Klamath Falls	7	2	Specifically, provide a flow of at least 6,030 cfs from Iron Gate Dam for a 72 hour period	How was this time period for elevated flows determined? Please reference the technical memos or otherwise give justification for this time period.	Please see Uncertainties in this section: "In general, a longer duration event will accomplish more of the objective than a shorter duration, because more of the suspended sediments flush out of the river system, rather than being re-deposited further downstream."	We further suggest the authors cite page 5 of the Spore Technical Memo as it relates to a justification for events of longer duration... "*One hypothesis for the unique spatial pattern of spore concentrations observed in 2016 relates to the 11,200 cfs Iron Gate Dam discharge event occurring March 2016. This event could have dislodged and moved high numbers of polychaete worms downstream in the drift and these redistributed worms, if infected, may have contributed to the relatively high spore concentrations observed in the lower river (J. Alexander, pers. comm).*"
USFWS Klamath Falls	8	1	The estimated two year recurrence interval (Geomorphic Memo page 6) of 6,030 cfs was selected	Please justify making a flow with a 50/50 chance of occurring in any given year into an annual flow. This does not seem to be supported by the technical memos, nor is it within the nature of a two year recurrence interval flow	Supporting language added to support subsection of this proposed action. "We have recommended this flow to occur every year until the end of the BiOp or dam removal occurs for two reasons: 1)The reduction in surface flushing flows experienced since the year 2000, relative to the 35 years prior, has resulted in fine sediment and suspended sediments accumulating on the bed of the river and 2) the polychaete memo explains how higher flows and increased substrate instability (such as that caused by higher flows) dislodges polychaete worms and decreases polychaete Weighted Usable Area. The reduction in high flow occurrence and subsequent accumulation of fine sediments is a concern because high densities of M. speciosa have been observed in such deposits (Polychaete Memorandum page 3). These sediments may provide prime feeding grounds for M. speciosa, given that in addition to being sessile suspension feeders they likely also have the flexibility to feed on organic matter in deposited sediments (Polycheate Memo)."	See AFWO Comments on Synthesis Report
USFWS Klamath Falls	8	1	However, there is strong evidence to suggest that frequent surface flushing flows minimizes available habitat for polychaetes	Please cite either technical memos or other relevant documentation to support this statement.	Citation added (Polychaete tech memo pages 4 and 5 support this statement)	Also see AFWO Comments on Synthesis Report
USFWS Klamath Falls	9	3	Description of guidance (2)	What other potential ecosystem level effects may happen with this type of regime? Please address, with appropriate citation, the science supporting a net benefit from these flows to the overall ecosystem, as an imbalanced ecosystem could create unforeseen difficulties for the very species which we are trying to protect	See discussion on page 2 of Geomorphic Memo for thorough discussion on this topic complete with references. This information, combined with the analysis proving that the past 15 years has lacked these high flows supports the premise that flows of this magnitude (i.e. 11,250 cfs), and provided at least every other year for the duration of the BiOp or until dam removal will place the system in balance, rather than in a state of imbalance as asserted in the comment.	The reviewer infers that the current highly-altered and often over-allocated water system in the upper basin is in balance and raises concern that deviation from current water management practices could result in an "imbalanced ecosystem". We suggest referencing page 3 of the Fish Technical Memo in your response, which states that "*When environmental conditions are significantly altered... the change will most often favor the parasite...compared to the host (Webster et al. 2007)*" and that "*the parasite adapts more quickly to environmental change than the host, causing the parasite-host equilibrium to shift out of balance (Thompson 1994).*" The Fish Technical Memo also states that "*This imbalance can be expressed as an elevated prevalence of host infections over naturally-occurring background or equilibrium levels, which is consistent with the abnormally high infection levels observed in juvenile salmon in the Klamath River during some years",*
USFWS Klamath Falls	9	4	NOTE: if the deep flushing event as described in Management Guidance 1 does not result in flows above 6,030 cfs for at least 72 hours, it will not fulfill the fine sediment management guidance action (#1)	This note has been the source of consternation in discussions with other reviewers. I read this as saying is that we can kill two birds with one stone (i.e. guidance 1 and 2), but if the ramping rates for guidance 2 preclude a flow exceeding 6030 cfs for 72 hours, the peak flow of guidance 2 will not fulfill guidance 1. Suggest clarification of this note and the purpose for its insertion here	Commentor was correct in assertion that the meaning of the note was to clarify the "kill two birds with one stone" but an unfortunate typographical error has contributed to confusion. The wording has been changed to clarify using a positive assertion. "NOTE: if the deep flushing event as described in Management Guidance 2 does result in flows over 6,030 cfs for at least 72 hours, it will also fultill the surface flushing as described in Management Guidance 1.	Important comment and clarification.

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USFWS Klamath Falls	10	4	Management Guidance 3 (general comment)	Who will determine when these flows are available and the timing in which they should occur? Suggest clarifying within the body of this guidance as to potential decision-making process and if further hydrological modeling will be needed to define this decision-making process. Further, suggest addressing "inherent unpredictability and public safety factors" further. Are these flows intended to manifest as flood releases in wet springs, a la 2016? If so, this should be stated. Otherwise, this guidance is very similar to #3.	The Guidance 3 description states that it is the Bureau of Reclamation and PacifiCorp that would "look for opportunities" to implement this action. Have added "and other fisheries co-managers" after PacifiCorp to clarify that they should reach out to a broader technical audience. Specifying the exact circumstances for each case where this might be implemented is (as noted in the Guidance Document) complex and should be handled on a case-by-case basis.	Our understanding is that the draft "Guidance Document" was prepared by the Tribes to provide science-based actions for consideration by managers that would lower the incidence of C. shasta in juvenile Chinook and Coho salmon in the Klamath River, independent of consideration of other demands on the Basin's limited water resources and/or agency obligations. Consistent with our understanding, we suggest the Tribes refer to the document titled Final_Revised Disease Technical Advisory Team Scoping Document_092916.pdf prepared by BOR, the Klamath Falls Fish and Wildlife Office, and NMFS which states " *Once the Guidance Document is completed, the Bureau of Reclamation will coordinate with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service to determine how to best apply the information presented in the Guidance Document to Klamath Project operations...*".
USFWS Klamath Falls	11	1	Hold in reserve 50 TAF…	It is highly unlikely that 50 TAF can be "held in reserve" at any time in the year, much less the period annually in which water is at its most over-allocated in this system. This effectively means that 50 TAF can be requested and must be made available if the below criteria are evident, regardless of other obligations or needs. This would coopt all inflows to the lake at a critical time. Suggest a reduction in the amount requested for "reserve," which would also require adjustment of flow schedule below	Added statement in the Introduction section explaining that the purpose of this management guidance was to identify conditions in the mainstem river that would alleviate the high mortalities experienced due to disease in juvenile salmonids. The question of "how" to make these things happen is beyond the perview and scope of the document. We acknowledge that the system is complex, and variables interact with each other in unpredictable ways. none the less, we believe it is physically possible to deliver this quantity of water in the specified time period.	We concur with the authors' response and suggest they add the reference Final_Revised Disease Technical Advisory Team Scoping Document_092916.pdf prepared by BOR, the Klamath Falls Fish and Wildlife Office, and NMFS which states " *Once the Guidance Document is completed, the Bureau of Reclamation will coordinate with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service to determine how to best apply the information presented in the Guidance Document to Klamath Project operations...*".
USFWS Klamath Falls	11	2	Spore concentrations exceed 5 spores (non?specified genotype) per liter for the preceding sample based on qPCR from water filtration samples at any sampling station;	Non-specified genotype is worrisome, given Sascha Hallett's work on genotypic specificity of C. shasta infection in a given species of salmon. There is obvious and universal interest in protecting the tribal trust species (i.e. Chinook), but the primary focus currently is on the listed Coho. Dr. Hallett's work should not be disregarded in this document. Suggest allowing specification of genotype so that species-specific threat may be more effectively evaluated, given other factors at play in the river.	We are recommending flows when the spore count reaches 5/L of any type, on the premise that 1) 5/L is indicative of a rising trend, 2) distinguishing DNA type takes precious extra days, and (?) 3) high concentrations of type 1 can mask detection of type 2.	There is no potential for TI masking TII at the concentration levels being discussed here. Dr. Hallett's work is extensively utilized in this document.
USFWS Klamath Falls	11	2	Spore concentrations exceed 5 spores (non?specified genotype) per liter for the preceding sample based on qPCR from water filtration samples at any sampling station;	These criteria will be met in 9/10 years, effectively creating a new minimum flow for the river for much of the spring/summer. This appears to set the bar quite low for justification of these flows. Suggest reevaluating the criteria upon which these flows are based.	These criteria are based on the conclusion in the BiOp that 5 spores/L of type 2 and 10 spores/L of type 1 cause an estimated 40% mortality in Coho and Chinook juvenile salmon respectively (BiOp at 341-342). While it is acknowledged that this is a significant amount of water, it is also apparent that mortalities from this disease are a "key factor limiting salmon recivery in the Klamath River" (BiOp at 341). Furthermore, given the restrictions placed on implementation of this measure (water must be >13C, less than 80% of the outmigration complete), it is not at all clear that 9/10 years would require additional flows.	Has the guidance document and/or logic progression been clarified? NOTE: Yes
USFWS Klamath Falls	12	1	Increased flows also increase water velocity and have been shown to reduce transmission rates.	This also seems to be a tenuous connection, given the current science outlined in the tech memo. Please cite with the appropriate support or remove.	Citation to be added.	Ray, R.A., and J. L. Bartholomew. 2013. Estimation of transmission dynamics of the Ceratomyxa shasta actinospore to the salmonid host. Journal of Parasitology 140:907–916. doi: 10.1017/S0031182013000127.

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USFWS Klamath Falls	12	5	low temperatures often coincide with higher flows	This is anecdotal. I've not seen hydrologic research to support this, though I'd imagine there is likely some correlation. Perhaps a study should be commissioned to demonstrate the veracity of this statement in the Klamath River?		As reported by Dettinger et al. (2015) "Lower flows can concentrate pollutants, increase stream temperatures, and reduce dissolved oxygen" which they attribute to, in part, increased air temperatures that result in increased ET, decreased soil moisture, increase demand, a lower thermal capacity (mass) and therefore increased diurnal temperature fluctuations, etc. Van Vliet at al. 2012 reported a high sensitivity of water temperature to discharge of large rivers during warm, dry conditions. The authors reported that decreases in discharge of 25% and 50% resulted in significantly lower maximum water temperatures in the winter and significantly higher maximum water temperatures during the summer, which they attribute to decreased thermal capacity and increased sensitivity to atmospheric warming and cooling.
USFWS Klamath Falls	14	2	negative interactions between hatchery/natural fish in the Klamath River, while meeting the two objectives listed above	What are these negative interactions? Are they disease related? Is that disease something other than C. shasta?		My opinion is that the negative interactions of hatchery/wild populations is common knowledge and does not require citation.
USFWS Klamath Falls	16	3	Adaptive Management and Monitoring Considerations for (MG6)	Perhaps language could be added here to the effect of, "The disease management team recognizes that these measure are outside of the purview of BoR and the Services. However, given the need for implementation of these measures, we strongly suggest a concerted effort between CDFW and the Yurok, Karuk, and Hoopa Tribes; with input from Reclamation, the Services, and the Klamath Tribes; to see these measures implemented at the IGD hatchery	The guidance document identifies management actions that may alleviate C. shasta conditions on the Klamath without regard to implementation. This Guidance Document does not demand that Bureau of Reclamation implement any of these actions. Text will remain unaltered.	We agree with the authors' response and further suggest they cite the Final Disease Technical Advisory Team Scoping Document prepared by BOR, the Klamath Falls Fish and Wildlife Office, and NMFS which states " Once the Guidance Document is completed, the Bureau of Reclamation will coordinate with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service to determine how to best apply the information presented in the Guidance Document to Klamath Project operations...".
Bureau of Reclamation	General			Additional detail needs to be provided for the scientific bases of timing, duration, and frequency intervals of events for *all* management options. For example, if a management action is recommended every year, please more closely tie the recommended timing, duration, and frequency back to the technical memoranda.	The technical memos did not, nore were they intended to, contain specific details regarding recommendations to address juvenile disease issues in the Klamath. The memos were to provide the scientific basis of current knowledge regarding *C. shasta*, from which guidance recommendations could be developed. If addtional details are needed to further refine management measures to minimize C. shasta, then that should be considered by a Disease Managemetn Recommendations Team comprised of Co-Managers.	The response does not appear to address the review comment. For example, in our comments on the report we suggest the authors provide a more through explanation as to why a 2-yr return period flow would be recommended every year, and suggest a justification.
Bureau of Reclamation	General			The four USFWS C. shasta technical memos provide a logical basis to conclude that regulation of the Klamath River, particularly storing water during winter and spring, may exacerbate C. shasta infection rates for outmigrating salmon downstream of Iron Gate Dam (IGD) during some years. These impacts would be most pronounced in the first 15-20 river miles downstream of IGD where flow conditions are principally driven by IGD water releases. However, a functional relationship between IGD discharge and disease conditions (i.e. fish infection or mortality rates) in the Lower Klamath River, which would be necessary to quantify the impact of KP operations on disease-induced fish mortality, has not been developed. Therefore, the outcome of the flow management measures proposed in the Guidance Document is highly uncertain, and these measures should be regarded as investigational.	It is likely that disease conditions in the Upper Klamath River affect disease conditions in the Lower Klamath River, whether it be from dislodged/infected polychated worms, free floating actinospores, or fish that become infected in the Upper Klamath and die to release myxospores downstream. We recognize that there is still much to learn regarding the dynamics of C. shasta in the Klamath River, which is why adaptive management is highlighted as being so important in the Synthesis Memo	We suggest the authors add that the prevalence of infection has been most pronounced during drier water years such as 2005 (prior to the May spill event), 2009, 2014, and 2015. During these dry water years, the discharge of the Klamath River below Iron Gate accounts for a greater proportion of the mainstem Klamath River discharge and therefore, has an increased influence on the total discharge of the mainstem Klamath River at locations located downriver as compared to wetter water years. Also important to note that contributions of Iron Gate Releases to of the overall Q of the Klamath River located at sites downriver varies considerable with date. As an example, see attached figure (10) from Beeman et al. 2008.

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Bureau of Reclamation	General			The relationship between coho salmon smolt survival and flow has been quantified (Beeman et al. 2012), but this relationship includes all sources of fish mortality, not just disease. Beeman et al. (2012) did not quantify latent effects of disease that may occur after fish reach the ocean, but water temperature is the primary determinant of disease-induced mortality, and ocean temperatures are much cooler, suggesting that survival rates of infected fish would likely increase upon ocean arrival. Though latent effects of disease infection are a concern, it was generally believed that in-river survival conditions between IGD and the ocean were adequately described by the Beeman et al. (2012) study. One interpretation of the study findings is that small operational changes should not be expected to significantly reduce juvenile coho mortality. Instead, large flow events, such as those associated with large storms, were the most influential throughout most of the Lower Klamath River. The information described in the four USFWS disease technical memos also supports the idea that large flow events are needed to meaningfully alter disease conditions and subsequent fish mortality.	Of the flow related control measures identified in the Synthesis Memo to minimize *C. shasta* levels in the Klamath River, four of five measures are focused on interrupting the life cycle of C. shasta, primarily by disrupting polychaete worms (an obligate part of C. shasta life cycle), polychaete habitat, or infection of polycaetes by myxospores released from rotting carcassess. The effectiveness of these control measures to impact polychaetes was not been assessed by the Beeman study. The control measure that consist of the provision of emergency spring dilution flows if certain criteria are met, could somewhat be related to the findings of the Beeman study. Whether increasing flows to 3,000 cfs (and then going to 4,000 cfs if necessary) is considered a "small operational change" or "large flow event" is up to interpretation, however the amount of water required to meet these levels during the April/May time period can vary substantially, depending upon hydrologic conditions. During some wetter water years, these flow levels would be met without any flow augmentation.	We suggest the authors also mention the Coho Salmon survival study the Service initiated in 2005 and summarized in the Beeman et al. 2012 multi-year report. This study addressed survival for outmigrating natural and hatchery-produced Coho Salmon smolts and not for Coho Salmon fry. These two life history stages of development are likely to have a much different migration pattern and therefore, exposure history and parasite dose in the mainstem Klamath River.
Bureau of Reclamation	General			Please consider assessing the potential role of increasing flows from key tributaries of the Klamath River below IGD in reducing C. shasta POI. Although outside of Reclamation's jurisdiction, we feel that increasing cool water flows from key tributaries could reduce spore production and improve upstream passage into the tributaries. Concentrating efforts on increasing flows from IGD ignores the potential role tributaries could play at reducing actinospore concentrations in the mainstem Klamath River and increasing usage of those habitats by juvenile coho salmon.	It is not clear what time of year is being recommending for increasing flows in tributaries, given the reference to fish passage, however we agree that cool water accretions from Klamath River tributaries are critical for the health of the Klamath River ecosystem and could help to ameliorate disease conditions in the Klamath River to some extent. However, the magnitude of water diverted within tributaries downstream of Iron Gate Dam is relatlively small compared to IGD discharge - while the impact of these diversions is extreme within the tributaries, the impact to the mainstem Klamath flow is much less (but still important).	Note that while generally true, not all tributaries provide "cool water flows" at all times of the season. For example, the Shasta River near its confluence can, at times, be warmer than the mainstem Klamath River just upstream of its confluence with the Shasta River (see graph from 2016).
Bureau of Reclamation	4	5		"Spore dilution" is mentioned as an objective of one of the DTAT's flow management recommendations. However, spore dilution via flow augmentation has not been shown to appreciably decrease infection rates in Klamath River salmon (2014, tech memo). Infection rates are most strongly correlated with water temperature, especially in cases where spore concentrations are high. Lab studies have also shown that temperature is the key factor for predicting mortality of infected fish, which means releasing more warm water above the tubine capacity at IGD may not appreciably (if at all), affect mortality rates.	In the spring time, is there an inverse relationship between water flow from IGD and water temperature? Data is not as plentiful to assess the relationship between IGD Q and disease levels as we would like, however the spore technical memo did show a substantial decline in prevalence of infection from C. shasta from a substantial flow event in 2005 (Figure 4), and there was a moderate decline in C. shasta spore levels from an increase in Q to 1,900 cfs in 2014 (Figure 6).	In addition to the spore data the authors refer to in their response, we suggest the Tribes discuss the abrupt increase in disease-induced mortality of young-of-year Chinook Salmon that was observed in juvenile outmigrant trap catches at the Bogus, I-5, and Kinsman fish trap sites below IGD beginning on April 29, 2004 (Chamberlain and Williamson 2006) as reported by Hetrick et al. (2009). By early May 2004, mortality approached 50% for unclipped young-of-year Chinook salmon captured at the Kinsman, Happy Camp, and Persido Bar trap sites located further downstream. From June 2 to June 18, mortality observed in daily catches of Chinook Salmon at the Kinsman site ranged between 51% and 88%. During this period, flows below IGD averaged 1,810 cfs for April, 1,290 cfs for May and dropped to 942 cfs for June, with daily mean values ranging from 2,060 - 802 cfs.
Bureau of Reclamation	8	3		While there is considerable discussion to support the 6,030 cfs flow, the true target is the reduction in the host population where the scientific basis included in the Guidance Document is that there is "strong evidence to suggest". This does not provide the "predicted outcome" assumed in the adaptive management consideration section on page 4. Clear definition is needed. Please include.	Not clear what this comment is asking or recommending. The predicted outcome of the surface flushing flows is the mobilization of surface sediments, reduction in available polychaete habitat, and resultant reduction in polychate densities. (Why didn't we include infected polychaetes?)	A strict focus on infected polychaetes is probably not required as justification for the flow recommendation.
Bureau of Reclamation	11	1	Mangement Guidance 4: Emergency Provision Flow to dilute spores	In general, Reclamation believes the thresholds listed for detemining whether to implement a diluting flow are difficult to quantify, especially given the dynamic nature of natural systems. This has the potential to make implementation of a diluting flow incredibly difficult. For example what tool or approch is available and accepted as a means to estimate whether 80% of the expected wild run has passed the Kinsman, Scott and Shasta? It doesn't seem like this threshold is easily quantifiable, especially in real time (i.e., how do we know what 80% is until we get to the end?). Looking back at past data, water temperature and prevalance of infection are also highly dynamic, leading to the possibility of an on-again/off-again management action.	USFWS staff (operators of the Kinsman trap) have indicated that they can develop a method for estimating when 80% of the run has passed the trap site - this would be independent of real-time trapping information. Dynamic flows in the spring time would not necessarily be a bad thing.	USFWS staff have indicated that they will investigate the development of a method for estimating when 80% of the run has passed the trap site, and have suggested that the results of this investigation are likely to be successful.
Bureau of Reclamation	11		Mangement Guidance 4: Emergency Provision Flow to dilute spores	The thresold criteria for Kinsman rotary screw trap is specific to wild fish (to not exceed 80%), but the criteria number 2 regarding overall POI does not specify whether the POI is all fish captured, or just wild? Please clarify.	The 80% is specific to wild fish emigration, the POI level pertains to all fish sampled prior to when 80% of the wild run is estimated to have passed the Kinsman trap site.	The authors response is correct.

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Bureau of Reclamation	11	1		Smolt trapping data at Bogus Creek (USFWS 2002-2005) showed that coho salmon smolts migrated through the most upstream reach of the Lower Klamath River between March 1 and May 1, nearly a month prior to the increase in C. shasta spore concentrations recorded in 2005 (Spore Memo, Figure 4). If coho emigration regularly precedes spore concentration increases, dilution strategies would not be effective.	In addition to some coho smolts being in the Upper Klamath River during May, there are also young of year coho in the Upper Klamath at this time; rearing and/or re-distributing from one area to another. For example see USFWS report titled *Arcata Fisheries Data Series Report DS 2016-47 Summary of Abundance and Biological Data Collected During Juvenile Salmonid Monitoring on the Mainstem Klamath River Below Iron Gate Dam, California, 2014* (David et al, 2016) - available on USFWS Arcata web site.	Observed timing at the most upstream portion of the river does not estimate mainstem rearing or migration timing.
Klamath Water Users Association	General			The Draft Guidance describes the 2014 and 2015 situation as critical, and refers to an immediate dire need. We believe parties would benefit from a more complete understanding of the consequences of C. shasta for overall populations of coho or other species through time and over the range of conditions that exist in the river, and the relative role of disease and other factors affecting populations, including at the present time.	Please see Fujiwara et al. 2011, True et al. 2013 as cited in the Fish Infection Memo (attached as appendix to the Guidance Document) for a peer-reviewed fully developed analysis of population effects. Although this does not include the most recent data, it discusses population level effects to chinook and coho salmon.	We suggest the authors also refer to Tables 1 and 2 in the Fish Technical Memo.
Klamath Water Users Association	Page 2	First full paragraph:		The focus here falls to the operation of the Klamath Project; KWUA encourages a broader perspective. The flows affected by Klamath Project operations also supplement natural flow conditions in certain times of year. Additionally, the last sentence in the paragraph makes an assumption regarding infection rates in coho salmon. We are not aware of data on this issue and ask that it be provided if it exists and is available.	The language and conclusions in this paragraph are largely drawn from the 2013 BiOp. (NOTE: should we include language addressing this issue?	Exact quotes might not be necessary, but instead a more directed citation (page, section, paragraph numbers, etc.).
NMFS				replace "The Polychaete Memo describes how populations of polychaetes can be kept in check by mobilizing sediments, and the Geomorphic Memo describes what flows are needed to accomplish various geomorphic objectives." WITH "The Polychaete Memo describes how polychaetes distribution is related to substrate and hydraulics, and the Geomorphic Memo describes what flows are needed to accomplish various geomorphic objectives"	see comments above	USFWS suggested a similar change.
NMFS	11	Description: 1.....	1.....	Not sure what the basis is for the 5 spores/l threshold. Seems that in the past this threshold has been related to coho salmon. ALSO The influence of IGD releases often diminishes further downstream.	see comments above	The authors could copy/paste responses provided above to other reviewers here. USFWS has also noted concerns about threshold levels.
NMFS	11	3. (in regard to 80% of the expected wild run)	The juvenile catch at the Kinsman rotary screw trap is estimated to have not exceeded 80% of the expected wild run	Not sure that this can be currently estimated in real time.	USFWS Biometrician thinks this can be estimated, without relying upon real-time downstream migrant trap data.	USFWS statistician has agreed to investigate a method, but the investigation could include using real-time downstream migrant trap data (but cannot rely upon detection probability reliant population estimates).
NMFS	12	"The concentration of....."	Increased flows also increase water vilocity and have been shown to reduce transmission rates.	This statement could use a supporting citation. Is this based on lab studies, or river studies?	we should cite the study that found this or delete	Here is the citation for velocity vs transmission: Ray, R.A., and J. L. Bartholomew. 2013. Estimation of transmission dynamics of the Ceratomyxa shasta actinospore to the salmonid host. Journal of Parasitology 140:907–916. doi: 10.1017/S0031182013000127.

February 1, 2017

Mr. Parker Thaler
State Water Resources Control Board
Division of Water Rights
Water Quality Certification Program
parker.thaler@waterboards.ca.gov
Via e-mail

BerkeleyLaw
UNIVERSITY OF CALIFORNIA

Student-Initiated Legal
Services Projects (SLPS)

RE: Scoping Comments on Application for Water Quality Certification Pursuant to Section 401 of the Federal Clean Water Act for the Relicensing of the Klamath Hydroelectric Project (FERC No. 2082)

Dear Mr. Thaler:

The Karuk-Berkeley Collaborative Legal (KBC) is a student-run organization at Berkeley Law. We have served the Karuk Tribe for more than five years, providing legal research and analysis in support of the Tribe's natural resource goals. In that time, we have gained a tremendous respect for the Tribe's stewardship of the Klamath River and an appreciation for the role of SWRCB in protecting California's water resources. KBC respectfully submits these comments on scoping for the Environmental Impact Report (EIR) for the issuance of a Water Quality Certification for the Relicensing of the Klamath Hydroelectric Project (FERC No. 2082).

We urge the State Water Resources Control Board to prepare an Environmental Impact Review that:

1. **Analyzes long-term beneficial impacts**, not just near-term adverse impacts, of license surrender,
2. **Relies on the 2012 KHSA EIS/EIR** analysis, findings, and record of comments/responses, and
3. **Establishes a schedule for this proceeding**, including a set date for SWRCB's final decision on whether to certify the license surrender application.

CEQA compels SWRCB to analyze the reasonably foreseeable long-term beneficial impacts of license surrender

California's CEQA Guidelines require that EIRs analyze all direct and indirect significant effects of a proposed project that are reasonably foreseeable. CAL. CODE REGS. tit. 14, § 15064. The Guidelines direct State agencies preparing an EIR to consider both "short-term and long-term effects." *Id.* at § 15126.2. Moreover, the Guidelines mandate that the lead agency balance the social and environmental benefits of a proposed project with the unavoidable adverse environmental effects. *Id.* at § 15093(a)–(c). If these and other benefits outweigh the unavoidable adverse environmental effects, "the adverse environmental effects may be considered 'acceptable.'" *Id.* at § 15093(a).

As such, the EIR for the Lower Klamath Project (LKP) must consider not only the near-term adverse impacts of license surrender, but also the long-term beneficial impacts that are sure to come from a free flowing Klamath River. Myriad studies, including FERC's 2007 NEPA document and the 2012 KHSA EIS/EIR, outline the long-term benefits of the LKP. Specifically, the 2012 KHSA EIS/EIR found that:

> Reversing the consequences of barriers to fish passage, degraded fish habitat, and degraded water quality throughout the basin could result in great benefit to tribal communities relying on fish, shellfish, riparian plants, clean water, and other resources for their subsistence, ceremonies, physical health, way of life, and spiritual well-being. While sediment release and other construction related activities during dam removal could cause short-term (1 to 2 years) adverse impacts on fisheries downstream from the Hydroelectric Reach, salmon and other aquatic resources would be expected to return to population levels observed prior to dam removal (in 2010 when the Notice of Preparation was issued) within 5 years, and would provide long-term benefits to Indian Tribes for 50 years and beyond." U.S. DEP'T OF THE INTERIOR & CAL. DEP'T OF FISH & GAME, Klamath Facilities Removal Final EIS/EIR, ES-39 (2012).

SWRCB is right to consider FERC's 2007 EIS and the 2012 KHSA EIS/EIR in its current EIR

As per the CEQA Guidelines, an EIR "may incorporate by reference all or portions of another document which is a matter of public record or is generally available to the public." CAL. CODE REGS. tit. 14, § 15150. The U.S. Department of the Interior and the California Department of Fish and Wildlife have already analyzed the environmental impacts of the LKP in its 2012 KHSA EIS/EIR. Their analysis is extensive and in line with the demands of NEPA and CEQA. SWRCB is right to rely on that analysis, findings, and record of comments/responses to inform its current review. STATE WATER RES. CONTROL BD., Notice of Preparation and Scoping Meetings for an Environmental Impact Report for the Lower Klamath Project License Surrender 9 (2016).

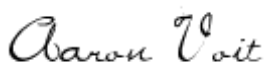
SWRCB should establish a schedule for this proceeding

The Karuk Tribe has been a steward of the Klamath River since time immemorial. Since first becoming aware of the harmful environmental, social, and cultural impacts of the dams on the lower Klamath River, the Tribe has advocated tirelessly for their removal. It has participated in the KBRA/KHSA talks in good faith since as early as 2005. However, in the time that has elapsed without a final resolution on dam removal, there has been further degradation of water quality in the Klamath, additional major fish kills, and more obstruction of the Tribe's traditional lifestyle and sacred rituals. It's time to have a final resolution in this matter. We urge SWRCB to establish a schedule for this proceeding and set a date for its final decision on whether to certify the license surrender application.

Conclusion

As students of the law, we learn that legal processes express our societal values and goals. Through our work with the Karuk Tribe, we have been inspired by the Clean Water Act's mission to ""restore and maintain the chemical, physical, and biological integrity of the Nation's waters." 33 U.S.C. § 1251(a) (2012). We were also moved by the passage of AB 52, which requires lead agencies to engage in "meaningful consultation" with California Native American Tribes regarding proposed projects. 2014 Cal. Legis. Serv. Ch. 532 (West). In these turbulent times, it is more important than ever for California to uphold our values to protect our natural resources and take tribal interests into account. The LKP is an opportunity to put those values into action. Thank you for the opportunity to submit these comments.

Sincerely,



Aaron Voit
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The views and opinions expressed in this comment represent those of the Karuk-Berkeley Legal Collaborative, a student pro bono project, and do not necessarily reflect the views, official policy, or position of the Karuk Tribe, the University of California, the University of California, Berkeley School of Law, or Berkeley Law's Student-Initiated Legal Services Projects (SLPS) Program.

To: State Water Resources Control Board
From: Quartz Valley Indian Reservation
Date: February 1, 2017
Re: Comments on *Notice of Preparation and Scoping Meetings for an Environmental Impact Report for the Lower Klamath Project License Surrender*

INTRODUCTION/SUMMARY

The "*Notice of Preparation and Scoping Meetings for an Environmental Impact Report for the Lower Klamath Project License Surrender*" (NOP) was issued by California's State Water Resources Control Board (SWRCB) in December 2016. To assist the Tribe in the development of their comments on the NOP, our consultants, Kier Associates, have reviewed the documents and prepared the comments provided. These comments focus almost exclusively on water quality issues. The Tribe's cultural resources are greatly impacted by the water quality issues the dams create. Migrating salmonids returning to the Reservation must endure both the water quality impacts of the mainstem Klamath and the impacts imposed on the Scott River and tributaries.

COMMENTS

We agree with the approach proposed in the NOP, including the range of alternatives to be assessed and the reliance on previous evaluations.

As stated in the NOP, the effects of removing PacifiCorp's Klamath Hydroelectric Project (KHP) have been evaluated in several previous efforts, including by the Federal Energy Regulatory Commission in 2007 and the U.S. Department of the Interior and California Department of Fish and Game's Environmental Impact Statement/Environmental Impact Report (EIS/EIR) in 2012. Given the ample previous syntheses of information, we see no need to re-invent the wheel. Scientific understanding of the Klamath River is increasing over time in response to new data and research, but progress since 2012 has been incremental rather than revolutionary, and we are not aware of any new information that would warrant changing overall conclusions regarding the net effects of the dam removal.

We encourage the SWRBC to move as rapidly and as is reasonably possible to develop the EIR. If new (i.e., post-2012) information can be included in the EIS without delaying the project timeline, we would welcome that. *However, given the high quality of information in the 2012 EIR and the fact that newly available information is unlikely to meaningfully alter overall conclusions about the effects of dam removal, our top priority is that the EIR be timely.* For inclusion of post-2012 information, we refer SWRCB to the detailed comments on the topic submitted to SWRCB in January 2016 by many entities, including the Quartz Valley Tribe. Some additional information that we would like to call SWRCB's attention to are field

measurements of greenhouse gas emissions from J.C. Boyle Reservoir and Keno Reservoir (Harrison et al 2017 http://pubs.acs.org/doi/abs/10.1021/acs.est.6b03185 and Deemer et al. 2016 http://onlinelibrary.wiley.com/doi/10.4319/lo.2011.56.4.1189/pdf).

In assessing the environmental impacts of the proposed license surrender and decommissioning, we recommend that SWRCB evaluate not just short-term effects but also long-term effects, and not just negative impacts but also positive impacts. Previous assessments have shown clearly that over the long-term, the environmental benefits of reducing toxic algal blooms, restoring a free-flowing river and volitional passage for anadromous fish outweigh the short-term pulse of negative effects. Rivers are naturally dynamic ecosystems and the species that reside in the Klamath River have survived many short-term disturbances over their evolution. While it is important to carefully plan the dam removal process to minimize deleterious short-term effects, we are confident that the long-term effects on water quality and fisheries would be positive.

If there are any questions regarding these comments, please contact me at 530-468-5907 ext 318 or crystal.robinson@qvir-nsn.gov.

Sincerely,

Crystal Robinson

Crystal Robinson
Environmental Director
Quartz Valley Indian Reservation

Quartz Valley Indian Reservation
13601 Quartz Valley Road
Fort Jones, CA 96032
ph: 530-468-5907 fax: 530-468-5908

To: State Water Resources Control Board
Attn: Mr. Parker Thaler

From: Quartz Valley Indian Reservation
Contact: Crystal Robinson, Environmental Director 530-468-5907 ext 318

Date: January 29, 2016

Re: Comments on *Notice of Preparation and Scoping Meetings for an Environmental Impact Report for the Klamath Hydroelectric Project Relicensing*

INTRODUCTION/SUMMARY

The "*Notice of Preparation and Scoping Meetings for an Environmental Impact Report for the Klamath Hydroelectric Project Relicensing*" (NOP) was issued by California's State Water Resources Control Board (SWRCB) in December 2015. To assist the Tribe in preparation of their comments on the NOP, our consultants have reviewed the documents and prepared the comments provided. These comments focus almost exclusively on water quality issues.

The effects of PacifiCorp's Klamath Hydroelectric Project (KHP) on water quality have been assessed in several previous efforts including by the Federal Energy Regulatory Commission (FERC 2007) and the U.S. Department of the Interior and California Department of Fish and Game (US DOI and CDFG 2012). Overall, the water quality information presented in those two documents is of high quality and provides a solid foundation to inform SWRCB's development of an Environmental Impact Report (EIR) for a Clean Water Act section 401 water quality certification for the relicensing or decommissioning of the KHP. The US DOI and CDFG (2012) document was prepared more recently and is more comprehensive so we recommend that SWRCB reply on it more heavily than the FERC (2007) document in cases where different conclusions are reached (e.g., the effect of the reservoirs on nutrient dynamics).

The Klamath Hydroelectric Project (KHP) has an overall negative effect on Klamath River water quality, and is causing violations of California's water quality standards including the Klamath River TMDL (NCRWQCB 2010). SWRCB's obligation under section 401 of the Clean Water Act (CWA) is to determine how the operation of the KHP can be modified in order to comply with California's water quality standards. The menu of experiments and water quality improvement measures described in PacifiCorp's (2014) Reservoir Management Plan fall far short of what would be needed to comply with California's water quality standards. Despite a

decade of experimentation and study, PacifiCorp has yet to offer a specific plan for how a combination of techniques could be jointly implemented to actually meet water quality standards. The lack of such a plan is extremely revealing. The simple truth is that there are no feasible means besides dam removal for mitigating the KHP's two most consequential water quality impacts: alteration of water temperature and promotion of toxic cyanobacterial blooms.

We organize our comments below into three sections:

- Section 1: Overview of Klamath Hydroelectric Project (KHP) Effects on Water Quality
- Section 2: Evaluation of PacifiCorp's Interim Measure 11 Studies and Reservoir Management Plan
- Section 3: Recent and Upcoming Documents Relevant to Klamath River Water Quality That Were not Included in FERC EIS or Secretarial Determination EIS/EIR

We have also provided a separate list of references cited for each section rather than a single comprehensive list.

References Cited in Introduction/Summary Section

Federal Energy Regulatory Commission (FERC). 2007. Final Environmental Impact Statement for Hydropower License. Klamath Hydroelectric Project. FERC Project No. 2082-027. Oregon and California. Federal Energy Regulatory Commission, Office of Energy

North Coast Regional Water Quality Control Board (NCRWQCB). 2010. Final Staff Report for the Klamath River Total Maximum Daily Loads (TMDLs) Addressing Temperature, Dissolved Oxygen, Nutrient and Microcystin Impairments in California, the Proposed Site Specific Dissolved Oxygen Objectives for the Klamath River and California, and the Klamath River and Lost River Implementation Plans. NCRWQCB, Santa Rosa, CA

PacifiCorp. 2014. Application for Water Quality Certification Pursuant to Section 401 of the Federal Clean Water Act for the Relicensing of the Klamath Hydroelectric Project (FERC No. 2082) in Siskiyou County, California, Klamath Hydroelectric Project. (FERC Project No. 2082). PacifiCorp, Portland, Oregon.

U.S. Department of Interior (US DOI) and California Department of Fish and Game (CDFG). 2012. Klamath Facilities Removal, Environmental Impact Statement/ Environmental Impact Report (EIS/EIR). State Clearinghouse # 2010062060. Sacramento, California.

SECTION 1: OVERVIEW OF KLAMATH HYDROELECTRIC PROJECT (KHP) EFFECTS ON WATER QUALITY

Summary of KHP Effects on Water Quality

As summarized in the following section, the Klamath Hydroelectric Project (KHP) has an overall negative effect on Klamath River water quality. These effects include increased water temperatures in late summer/fall, cyanotoxins, substrate armoring, and release of water from Iron Gate reservoir with high ammonia, low dissolved oxygen, and high pH; however, the KHP also has some potentially positive effects including reduced nitrogen concentrations and cooling water temperatures in spring. These positive and negative effects generally diminish with increasing distance downstream of Iron Gate (although due to bioaccumulation of cyanotoxins transported from the reservoirs, effects on public health and biota continue to the river mouth and potentially to the costal margin). The river immediately below Iron Gate is very important due to high spawning use by chinook salmon, so effects in that reach are of particular concern.

All negative water quality effects of the reservoirs can be eliminated by dam removal. Nitrogen concentrations would likely increase long-term following dam removal (due to loss of nutrient retention within the reservoirs and more rapid downstream transit of water), but this is not likely to deleteriously affect D.O. and pH because downstream periphyton (algae attached the riverbed) communities are comprised of nitrogen-fixing species that can flourish even when nitrogen concentration is low. Thus, the effects of increased nitrogen are not likely to be outweighed by other effects of dam removal that would favor lower periphyton biomass, such as a more dynamic flow regime and restored sediment transport.

In this section we present a brief summary, including references, of the impacts of the Klamath Hydroelectric Project (KHP) on Klamath River water quality. For additional details, we refer to the following documents that Tribes have previously placed into the FERC record (KTOC 2006a, 2006b; QVIR 2006; QVIC 2006; Yurok Tribe 2006a, 2006b; HVT 2006a, 2006b; Resighini Rancheria 2006a, 2006b), as well as the references cited herein.

KHP Effects on Specific Aspects of Water Quality

Cyanobacteria and cyanobacterial toxins

► Microcystin toxins produced by the toxic cyanobacteria (blue-green algae) *Microcystis aeruginosa* represent a substantial threat to human and animal health (OEHHA 2005; Kann 2006; Kann and Corum 2006, 2007; OEHHA 2012). The Klamath River is listed as impaired by microcystin toxins from Stateline to its confluence with the Trinity River[1]. Microcystin concentrations generally decline with distance downstream of Iron Gate Dam (US DOI and CDFG 2012) but frequently exceed public health guidelines between Iron Gate and Orleans, and occasionally exceed public health and water quality criteria as far downstream as the Klamath Estuary (HVTEPA 2013, YTEP Annual Blue-Green Monitoring Reports[2]). More recent genetic fingerprinting research showed that Iron Gate Reservoir is the source of downriver *Microcystis* assemblages and that Iron Gate Reservoir was determined to be the principal source of *Microcystis* found throughout the lower 300 km of river separating the reservoir from the Pacific Ocean (Otten et al. 2015).

► In the presence of abundant nutrients, the transformation from river to reservoir environment leads to massive blooms (Kann 2006; Kann and Corum 2006, 2007). Although nutrients are necessary for bloom proliferation, such concentrations alone are not sufficient to cause the

[1] Final 2012 California Integrated Report (Clean Water Act Section 303(d) List / 305(b) Report) http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2012.shtml

[2] Yurok Tribe Environmental Program: http://www.yuroktribe.org/departments/ytep/water_reports.htm

magnitude of blooms observed in Copco and Iron Gate reservoirs. As a consequence, despite similar nutrient loads, *Microcystis* is uncommon in the free-flowing river reach above Copco.

► There are higher levels of microcystin toxin and *Microcystis* cell density below the Copco-Iron Gate reservoir complex than above the reservoirs (Kann and Asarian 2007; Kann and Corum 2006, 2007; CH2MHill 2008; Asarian and Kann 2011).

► PacifiCorp's KHP provides ideal habitat for *Microcystis* by transforming turbulent free-flowing river reaches into stagnant thermally-stratified impoundments that favor cyanobacterial proliferation. For example, US DOI and CDFG (2012) concluded: "Removal of the dams would eliminate the lacustrine environment that currently supports ideal growth conditions for toxin-producing nuisance algal species such as M. aeruginosa." and "Under a dam removal with KBRA implementation scenario, the production of algal toxins in Copco 1 and Iron Gate reservoirs would be eliminated. The algae producing these toxins do not grow in a free flowing river." In addition, as concluded by Otten et al. (2015), there was no evidence of endemic *Microcystis* populations in the flowing regions of the Klamath River, both upstream and downstream of Copco and Iron Gate Reservoirs, indicating that the river itself does not represent good cyanobacterial habitat.

► Samples collected in 2007 indicate microcystin bioaccumulation in freshwater mussels from the Klamath River below Iron Gate, and in yellow perch from Iron Gate and Copco Reservoirs. Concentrations of microcystin in the organisms indicated that consumption of such organisms would exceed established public health advisory values (Kann 2008, OEHHA 2008). In 2009, freshwater mussels collected from the Klamath River between Iron Gate Dam and the Yurok Reservation also showed microcystin levels above public health advisory values (Kann et al. 2010). Such bioaccumulation in the lower river occurred despite very low ambient microcystin concentrations indicating that even when ambient concentrations do not exceed public health guidelines that shellfish may be unsafe for consumption. Furthermore, as demonstrated in Monterey Bay, microcystin exported from upstream lakes can be bioaccumulated in marine animals (e.g., sea otters) that consume shellfish containing algal toxins (Miller et al. 2010). Although yet to be monitored for in the Klamath system there is great potential for algal toxin bioaccumulation in sea mammals, sea birds, and other biota in the estuary and near-coastal environment.

► Although only limited data are available regarding the concentrations of microcystin toxins in tissues of Klamath Basin salmonids, data from 2007 indicate microcystin bioaccumulation in juvenile salmonids reared in Iron Gate hatchery (Kann 2008). In addition, trace concentrations of microcystin were found in Klamath River steelhead livers in 2005 (Fetcho 2006). Analysis of salmonid tissue samples collected by the Karuk Tribe also showed that Klamath River salmonids (chinook salmon and steelhead) were exposed to microcystin and that bioaccumulation in liver tissue occurred with concentrations in several fish livers exceeding public health guideline values (Kann et al. 2013). Although histopathological results were inconclusive, the measured toxins in livers point to the potential for recurring microcystin exposure and subsequent bioaccumulation of microcystins in Klamath River Salmonids

► Laboratory and field studies from elsewhere have demonstrated toxic effects of microcystin on salmonids (Andersen et al. 1993, Bury et al. 1997, Landsberg 2002) and other fish (Smith et al. 2008). Based on these studies, and the documented prevalence of microcystin the Klamath River, the potential clearly exists for sublethal (e.g., stress and disease) effects on salmonids from exposure to algal toxins.

► Other than dam removal, PacifiCorp has yet to demonstrate mitigations likely to effectively remedy the *Microcystis* problem. For example, Solar Bee circulators deployed in Copco

Reservoir by PacifiCorp in 2008 did not appear to be effective at reducing microcystin concentrations (CH2MHill 2008), and a plastic curtain installed at the Iron Gate log boom did not prevent a pulse of *Microcystis* cells from moving downstream in September of 2008.

Temperature

Primarily due to the thermal mass of Iron Gate and Copco reservoirs, the KHP significantly alters water temperatures in the Klamath River (FERC 2007, PacifiCorp 2004, PacifiCorp 2005c) in ways that are detrimental to the various runs of anadromous fish in the Klamath River.

► The KHP causes warm temperatures in the fall, negatively impacting fall Chinook salmon spawning success and egg survival, and resulting in a delay in spawning run-timing of several weeks.

► The KHP cools the river in early spring, which depresses the growth and survival of juvenile salmonid during this critical life history stage because it keeps water temperature below the optimum growth temperatures for juvenile salmonids. The resulting smaller-sized Chinook salmon juveniles migrate downstream more slowly than would larger individuals (PFMC 1994) and are less likely to survive to maturity and to spawn (Nicholas and Hankin 1988). This increased transit time exposes them to prolonged stress, increasing their likelihood of becoming infected with parasites.

► PacifiCorp has acknowledged that adjustment in operation (e.g. using selective withdrawals, curtains, or flow augmentation) cannot effectively mitigate for these temperature impacts (PacifiCorp 2005a, 2005b; Scott 2005).

► The Klamath River TMDL requires that water released from Iron Gate and Copco Reservoirs cause "Zero temperature increase above natural temperatures"(NCRWQCB 2010). Dam removal is the only method that is likely to reverse these KHP impacts to water temperatures.

Nutrients

► By replacing a formerly free-flowing river with a series of reservoirs, peaking reaches, and bypass reaches, the KHP has greatly altered the hydrologic, physical, chemical, and biological processes of the Klamath River.

► To provide a range of estimates for how total phosphorus (TP) and total nitrogen (TN) concentrations at Iron Gate Dam might change under a dam removal scenario for the months of June through October, Asarian et al. (2010) compared relative retention rates in river reaches with results from a study of the Copco-Iron Gate Reservoir complex by Asarian et al. (2009). The results indicated that dam removal will result in only a very small increase in TP concentration in the Klamath River between Iron Gate and Turwar. TN concentrations will increase 37-42% at Iron Gate, with the magnitude of the increase diminishing with increasing distance downstream. The effect on TN is substantially diminished by Orleans and quite small at Turwar. The implications of this increase is discussed in the "Dissolved oxygen and pH" sub-section below.

► As PacifiCorp itself (2005d) has acknowledged, peaking and bypass operations inhibit the river's capacity to assimilate nutrients within the KHP area. Bypass operations also inhibit the decomposition of organic matter, passing on a greater oxygen demand to downstream river reaches. Due to insufficient data, such effects were not included in predictions of nutrient concentration by Asarian et al. (2010) cited above.

Dissolved oxygen and pH

► Photosynthesis and respiration by periphyton (algae attached the riverbed) and aquatic plants in the Klamath River can degrade dissolved oxygen and pH conditions, resulting water quality that is chronically stressful to fish (HVTEPA 2008, NCRWCB 2010, Asarian and Kann 2013).
► The KHP has a direct effect on D.O. and pH levels in the Klamath River immediately below Iron Gate Dam (FERC 2007). During the summer season the reservoir often releases water with high pH and low D.O. (Asarian and Kann 2013), which could harm salmonids in the vicinity of the dam. Phytoplankton blooms from KHP reservoirs tend to decrease daily minimum dissolved oxygen concentrations in the Klamath River, presumably by reducing light availability and rates of production from periphyton (Genzoli 2013, Genzoli and Hall, in review, Genzoli et al. 2015).
► The KHP dams interrupt the downstream transport of gravel, resulting in more coarse stream substrates (Biggs 2000). The Klamath Hydroelectric Project has had this effect on the Klamath River below Iron Gate Dam (FERC 2007). Larger substrate materials like cobble and boulder require higher flows to scour them than smaller substrates like gravel and sand. These coarse substrates are more stable, increasing the amount of periphyton and aquatic macrophytes than can grow (Biggs 2000, Anderson and Carpenter 1998), which in turn increases diel fluctuations in pH and D.O.
► Although nitrogen concentrations are predicted to increase in the mainstem Klamath River downstream of the dams following dam removal (Asarian et al. 2010), this is not likely to deleteriously affect D.O. and pH because periphyton communities are comprised of nitrogen-fixing species that can convert abundant atmospheric nitrogen into biologically available forms and flourish even when nitrogen concentrations are low (Asarian et al. 2014, Asarian et al. 2015, Gillett et al. 2016). Thus, increased nitrogen is not likely to increase periphyton biomass and would actually likely be outweighed by other effects of dam removal that would likely reduce periphyton biomass, such as a more dynamic flow regime and restored sediment transport.

Ammonia toxicity

► Data clearly show that ammonia concentrations are often substantially higher below Iron Gate Dam than above Copco Reservoir (Asarian et al. 2009, Kann and Asarian 2007, FERC 2007, Asarian and Kann 2011). These higher concentrations represent a localized toxicity risk to fish in the river below Iron Gate.

Fish parasites

The KHP promotes infection of salmonids by the myxosporean parasites *Ceratonova shasta* and *Parvicapsula minibicornis* in the Klamath River through:
► Providing habitat for the polychaete *M. speciosa* by:
- Increasing substrate stability below Iron Gate Dam (see "Dissolved oxygen and pH" sub-section above)(FERC 2007)
- Increasing the stability of the hydrograph below Iron Gate Dam by regulating flow of tributaries from Keno to Iron Gate Dam.

► Increasing salmon spawning density below Iron Gate Dam by blocking fish passage, delivering massive loads of myxospores in an area with high polychaete populations, which results in high infection prevalence of polychaetes in an area of salmon crowding (FERC 2007, Stocking 2006, Stocking and Bartholomew 2007).
► Deteriorating pH and D.O. conditions and increasing ammonia, which are conditions created by the KHP cause stress and immunosuppression in salmonids, increasing the likelihood that they will become infected and diseased (FERC 2007).

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SECTION 2: EVALUATION OF PACIFICORP'S INTERIM MEASURE 11 STUDIES AND RESERVOIR MANAGEMENT PLAN

Summary of PacifiCorp's Interim Measure 11 studies and Reservoir Management Plan

With the stated goal to improving water quality within Copco and Iron Gate Reservoirs and the Klamath River downstream, PacifiCorp has conducted a series of activities under the Klamath Hydroelectric Settlement Agreement (KHSA) Interim Measures 10 and 11 and developed a Reservoir Management Plan (RMP) and (PacifiCorp 2014). Although PacifiCorp correctly state that the source of nutrient enrichment for the reservoirs is the result of upstream nutrient and organic matter loads, they do not directly acknowledge that the dams create the lacustrine habit required for the large and toxic cyanobacteria blooms that currently dominate (see above discussion and references). The RMP then proposes to implement management techniques that are aimed at improving reservoir water quality conditions related to nutrients, algae, dissolved oxygen and pH[3].

However, despite the aim of the RMP and the statement that the RMP "will also help to improve water quality in the Klamath River below the Project reservoirs" and "The implemented techniques, particularly when combined with implementation of appropriate TMDLs to control and reduce nutrient loads upstream of the Project, are expected to provide appreciable and sustained water quality enhancements in and below Copco and Iron Gate reservoirs" (PacifiCorp 2015a), no data or evidence are provided for how the proposed techniques will reduce toxic cyanobacteria blooms to meet Clean Water Act and public health thresholds. Rather, for those techniques that relate to cyanobacteria reduction, the RMP references ongoing evaluation of the techniques, many of which have not moved past the modelling phase (e.g., surface mixing and circulation and reservoir drawdown), and for those that have, some have been discounted (e.g., destratification, solar powered circulators, phosphorus inactivation), and others have only undergone small scale testing. Those in the latter category (chiefly application of algaecide and implementation of an intake barrier to reduce algal entrapment downriver), have either been shown to be completely ineffective (algaecide) or existing studies have yet to show improvement in downstream conditions (intake barrier). Moreover, PacifiCorp has not provided information on how any of the proposed projects would be scaled to the size necessary to improve water quality on a reservoir-wide basis (even assuming water quality could be improved on a small scale basis such as in an isolated cove), let along what the cost of such full-scale implementation would be.

The water quality improvement measures described in the RMP fall far short of what would be needed to comply with California's water quality standards. The current RMP is really more a menu of options or a study plan than it is a management plan. The RMP described various techniques, including conceptual ideas for how the techniques could be applied in Iron Gate and Copco Reservoirs, but there are no details provided regarding at what scale the techniques would be applied, what capital and maintenance costs would be, and what expected water quality outcomes would be. Despite a decade of experimentation and study, PacifiCorp has yet to offer a specific plan for how a combination of the techniques could be jointly implemented to meet

[3] (1) constructed treatment wetlands; (2) reservoir and tailrace aeration and oxygenation systems; (3) epilimnion (surface water) mixing and circulation; (4) selective withdrawal and intake control; (5) reservoir drawdown and fluctuation; and (6) algaecide treatment.

water quality standards. The lack of such a plan is extremely revealing. The simple truth is that there are no feasible means besides dam removal for mitigating the KHP's two most consequential impacts to water quality: alteration of water temperature and promotion of toxic cyanobacterial blooms.

The various Klamath River Tribes (as well as other federal and state agencies) have been evaluating and commenting on the management techniques proposed in the RMP as part of PacifiCorp's Interim Measure 11 studies (which consist of testing, design, or modelling) to address water quality conditions (Table 1)[4]. Those comments support our statement above that none of the proposed RMP projects have been demonstrated to improve cyanobacterial related water quality violations or public health. In the following sub-sections, we provide an overview of the major components of PacifiCorp's Interim Measure 11 studies and the Reservoir Management Plan.

[4] The list in Table 1 may not be exhaustive and therefore we request that SWRCB contact the Klamath Basin Tribes and other members of the Interim Measures Implementation Committee to obtain other relevant documents.

Table 1. List of 1) PacifiCorp IM11 study plans, 2) Tribal comments on PacifiCorp's IM11 study plans and draft reports, and 3) PacifiCorp responses to Tribal comments. Check boxes on left side of table indicate which topics/approaches are addressed in each document. Documents are sorted by date. Some of the dates are approximate (i.e., within a month). All documents listed were organized into folders according to Document Type and uploaded to an online archive accessible at: https://www.dropbox.com/s/exc6fkhmaiz7sw3/IM11_docs.zip

In-reservoir		Nutrient Reduction				Other				
Algaecides	Oxygenation/ Mixing	Iron Gate Outlet	Wetlands	Algae/OM remove	Chem. sequestration	KTAP	Approx. Date	Document Type	Document Filename(s)	Document Title and/or Citation
x	x	x	x	x		x	8/10/10	PacifiCorp IM11 study plan	PC Interim Measure 11 Plan - Draft.doc	Klamath Hydroelectric Settlement Agreement Implementation: Proposed Activities Related to Interim Water Quality Improvements (Interim Measure 11), preliminary draft
x	x	x	x	x			8/23/10	Tribal comment on PacifiCorp IM11 study plan	kier_imic_wq_study_plan_comments_2010 08 24.doc	Asarian, Eli. 2012. Comments regarding Klamath Hydroelectric Settlement Agreement Implementation: Proposed Activities Related to Interim Water Quality Improvements (Interim Measure 11). From: Eli Asarian, Kier Associates. Date: August 23, 2010.
x	x	x	x	x		x	10/18/10	PacifiCorp IM11 study plan	IM 11 Studies Cost Summary _Oct 18 2010_.pdf, IM 11 Study Plan Copco Algaecide _Oct 18 2010_.pdf, IM 11 Study Plan Iron Gate Intake _Oct 18 2010_.pdf, IM 11 Study Plan JC Boyle DO _Oct 18 2010_.pdf, IM 11 Study Plan Keno OM Removal _Oct 18 2010_.pdf, IM 11 Study Plan Treatment Wetlands _Oct 18 2010_.pdf, IM 11 Study Plan WQ Accounting _Oct 18 2010_.pdf	[final IM11 study plans for 2010, separate document for each study plan]
x			x	x			11/16/10	Tribal comment on PacifiCorp IM11 study plan	Yurok Comments on IM 11 Final Plans 111610.docx	Fetcho, Ken. Yurok Tribe Comments prepared with assistance from Eli Asarian on 3 Final Study Plans. Yurok Tribe, November 16, 2010.

In-reservoir		Nutrient Reduction				Other			
Algaecides	Oxygenation/ Mixing	Iron Gate Outlet	Wetlands	Algae/OM remove	Chem. sequestration	KTAP	Approx. Date	Document Type	Document Filename(s)	Document Title and/or Citation
x			x	x		x	5/13/11	PacifiCorp's response to comments on IM11 study plan	IMIC_IM11 Comment_Table_5-13-2011.pdf	PacifiCorp. 2011. PacifiCorp Responses to IMIC Comments on Interim Measure 11 Study Plans.
							4/27/12	Tribal comment on PacifiCorp IM11 report	2012.04.27 Yurok_PC Comments Draft Wetland Rpt.pdf	Fetcho, Ken. 2012. Comments letter to Tim Hemstreet, PacifiCorp. Subject: Yurok Tribe Comments on the draft document "Approaches to Water Quality Treatment by Wetlands in the Upper Klamath Basin". From: Ken Fetcho, Yurok Tribe. Date: April 27, 2012.
x	x	x	x	x		x	6/25/12	PacifiCorp IM11 study plan	IM11-WQStudyProgressRpts_June 2012.pdf	PacifiCorp. 2012. Klamath Hydroelectric Settlement Agreement Interim Water Quality Improvements (Interim Measure 11) Water Quality Study Progress Reports June 25, 2012
x		x		x			10/31/12	Tribal comment on PacifiCorp IM11 study plan	kier_imic_wq_study_plans_comments_20121031.doc	Asarian, Eli. 2012. Memo to Klamath Basin Tribal Water Quality Work Group. RE: Comments regarding Klamath Hydroelectric Settlement Agreement (KHSA) Interim Measure 11 water quality studies for 2012-2013. From: Eli Asarian, Kier Associates. Date: October 31, 2012. [note: header has incorrect date 9/31/2012]
x		x		x			12/31/12	PacifiCorp's response to comments on IM11 study plan	IM 11 Study Comment Response (Dec 31 2012) F.pdf	PacifiCorp. 2012. PacifiCorp Responses to Comments from IMIC Members on Interim Measure 11 Studies (Received October 29 to November 9, 2012).
x		x	x	x			2/28/13	Tribal comment on PacifiCorp IM11 study plan	Yurok comments 2013 IM 11 022813.pdf	Fetcho, Ken. 2013. Comments letter to Tim Hemstreet, PacifiCorp. Subject: Yurok Tribe Comments and Recommendations for 2013 IM 11 Water Quality Studies. From: Ken Fetcho, Yurok Tribe. Date: February 28, 2013.
x		x	x	x			3/4/13	Tribal comment on PacifiCorp IM11 study plan and reports	Karuk IM 11 Comments_3.04.13.pdf	Bowman, Crystal. 2013. Memo to Tim Hemstreet, PacifiCorp. RE: Review and recommendations for Klamath Hydroelectric Settlement Agreement (KHSA) Interim Measure 11 water quality studies. From: Crystal Bowman, Karuk Tribe. Date: March 4, 2013.
x		x	x	x	x	x	5/9/13	Tribal comment on PacifiCorp IM11 study plan and reports	IMIC IM 11 2013 Project Comments Karuk Tribe 05.09.13.pdf	Bowman, Crystal. 2013. Memo to Tim Hemstreet, PacifiCorp. RE: Review and recommendations for Klamath Hydroelectric Settlement Agreement (KHSA) Interim Measure 11 water quality studies 2013-2014. From: Crystal Bowman, Karuk Tribe. Date: May 9, 2013.

In-reservoir		Nutrient Reduction				Other			
Algaecides	Oxygenation/ Mixing	Iron Gate Outlet	Wetlands	Algae/OM remove	Chem. sequestration	KTAP	Approx. Date	Document Type	Document Filename(s)	Document Title and/or Citation
x		x	x	x	x	x	5/10/13	Tribal comment on PacifiCorp IM11 study plan	Yurok comments 2013-2014 IM 11 Study Plan 051013.pdf (and identical MS Word version: Yurok comments 2013-2014 IM 11 Study Plan 051013.pdf)	Fetcho, Ken. 2013. Comments letter to Tim Hemstreet, PacifiCorp. Subject: Yurok Tribe comments and recommendations for Klamath Hydroelectric Settlement Agreement (KHSA) Interim Measure 11 water quality studies 2013-2014 . From: Ken Fetcho, Yurok Tribe. Date: May 10, 2013.
x		x		x			5/16/13	Tribal comment on PacifiCorp IM11 report	Karuk Comments_ IM 11 Project Reports 2012.pdf	Bowman, Crystal. 2013. Memo to Tim Hemstreet, PacifiCorp. RE: Comments of PacifiCorp 2012 Draft Reports. From: Crystal Bowman, Karuk Tribe. Date: May 16, 2013.
x		x		x			5/17/13	Tribal comment on PacifiCorp IM11 report	Yurok comments 2012 IM 11 Draft Reports 051713.pdf	Fetcho, Ken. 2013. Memo to Tim Hemstreet, PacifiCorp. Subject: Yurok Tribe comments and recommendations for Klamath Hydroelectric Settlement Agreement (KHSA) Interim Measure 11 water quality studies 2013-2014. From: Ken Fetcho, Yurok Tribe. Date: May 17, 2013.
x							9/6/13	PacifiCorp's response to comments on IM11 study plan	Activity 5 Karuk Comment Response (Sep 6 2013).pdf	PacifiCorp. 2013. Responses to Comments of the Karuk Tribe on the Implementation and Monitoring Plan for the 2013 Environmentally-Safe Algaecide Application in Long Gulch Cove, Iron Gate Reservoir September 6, 2013
					x		1/30/14	Tribal comment on PacifiCorp IM11 study plan	IMIC Karuk Comments_Activity 7 Bench Testing IM 11 Draft Study Plan 02.03.14.pdf	Bowman, Crystal. 2014. Memo to PacifiCorp and Interim Measures and Interim Conditions Committee. RE: Review and comment on Interim Measure 11 Study Activities for 2013-2014, Activity : Pilot Study of Nutrient Reduction Methods in Klamath Basin Waterbodies, Initial Testing Approach and Prodeedures (Review Draft). From: Crystal Bowman, Karuk Tribe. Date: January 30, 2014.
					x		3/12/14	PacifiCorp's response to comments on IM11 study plan	IM Activity 7 Comments Responses f _Mar 12 2014_.pdf	PacifiCorp. 2014. Table B-1. Responses to Comments on the Activity 7 Draft Study Plan. March 12, 2014.
		x					3/24/14	Tribal comment on PacifiCorp IM11 report	KHSA IM 11 Iron Gate Intake Comments_Karuk Tribe 3.24.14.pdf	Bowman, Crystal. 2014. Memo to Tim Hemstreet and Linda Prendergast, PacifiCorp. RE: Review and comment on Assessment of an Intake Barrier for Water Quality Control at Iron Gate Reservoir - 2013 Study Results (Draft). From: Crystal Bowman, Karuk Tribe. Date: March 24, 2014.

In-reservoir		Nutrient Reduction				Other			
Algaecides	Oxygenation/ Mixing	Iron Gate Outlet	Wetlands	Algae/OM remove	Chem. sequestration	KTAP	Approx. Date	Document Type	Document Filename(s)	Document Title and/or Citation
x							5/6/14	Tribal comment on PacifiCorp IM11 report	Karuk_algaecide report comments_2013.docx	Corum, Susan. 2014. Karuk Tribe comments on: "2013 Localized Treatment of Long Gulch Cove in Iron Gate Reservoir Using Environmentally Safe Algaecide, Draft Technical Report, April 2014. Prepared for PacifiCorp by Watercourse Engineering Inc."
			x				5/20/14	Tribal comment on PacifiCorp IM11 report	Kier_IM11_Wetlands_20140520_draft.doc	Asarian, Eli. 2014. Memo: to Klamath Basin Tribal Water Quality Work Group. RE: Review and comments on (Draft) Demonstration Wetland Facility Preliminary Research and Implementation Plan Klamath River, Oregon. From: Eli Asarian. Date: May 20, 2014
			x				10/20/14	Tribal comment on PacifiCorp IM11 report	Kier_IM11_Wetlands_20141021_draft.doc	Asarian, Eli. 2014. Memo to: Klamath Basin Tribal Water Quality Work Group. Review and comments on (Final Draft) Demonstration Wetland Facility Preliminary Research and Implementation Plan Klamath River, Oregon. From: Eli Asarian. Date: October, 2014 [note: header has incorrect date 5/13/2014]
				x			11/18/14	Tribal comment on PacifiCorp IM11 report	Karuk_IM11_OrgRemove_11.18.14.doc	Corum, Susan. 2014. Memo to: Pacificorp and Interim Measures Implementation Committee. Re: Review and comments on (Draft) Conceptual Design Evaluation for Full-Scale Particulate Organic Matter Removal from Klamath River Source Water Using Stormwater Treatment Technology, 2013. From: Susan Corum, Karuk Tribe. Date: Nov 18, 2014.
				x			11/21/14	Tribal comment on PacifiCorp IM11 study plan	KHSA_IM11_AlgalRemoval_20150111 21.docx	Corum, Susan. 2014. Conceptual Proposal for Removal of Algae Near Outlet of Upper Klamath Lake and Evaluation of Options for Re-Use. November 21, 2014.
	x	x	x	x		x	2/5/15	Tribal comment on PacifiCorp IM11 study plan	Karuk.studyplancomments.2015.02051 5.doc	Corum, Susan. 2015. Memo to: PacifiCorp and Interim Measures Implementation Committee. Re: Review and comment on Draft Study Plan Klamath Hydroelectric Project Interim Measure 11 Study Activities for 2015. From: Susan Corum, Karuk Tribe. Date: February 5, 2015.
				x			2/23/15	Tribal comment on PacifiCorp IM11 study plan	Karuk.2015.7.8.Comments.022315.pdf	Corum, Susan. 2015. Memo to: PacifiCorp and Interim Measures Implementation Committee. Re: Review and comment on Proposed IM11 study plans 7 (Algae Biomatter Utilization) and 8 (Algae Harvesting/Processing Methods and Removal Rates). From: Susan Corum, Karuk Tribe. Date: February 23, 2015.

In-reservoir		Nutrient Reduction				Other			
Algaecides	Oxygenation/ Mixing	Iron Gate Outlet	Wetlands	Algae/OM remove	Chem. sequestration	KTAP	Approx. Date	Document Type	Document Filename(s)	Document Title and/or Citation
x							2/25/15	Tribal comment on PacifiCorp IM11 report	Karuk_2014_Algaecide Report_comments.pdf	Corum, Susan. 2015. Memo to: Pacificorp and Interim Measures Implementation Committee. Re: Review and comment on Draft Technical Report: 2014 Localized Treatment of Long Gulch Cove in Iron Gate Reservoir Using Hydrogen Peroxide Based Algaecide. From: Susan Corum, Karuk Tribe. Date: February 25, 2015.
						x	4/9/15	PacifiCorp's response to comments on IM11 study plan	2014.04.16 Algaecide 2014 Comment Response.pdf	PacifiCorp. 2015. PacifiCorp Responses to Comments on the Draft Technical Report "Draft Technical Report - 2014 Localized Treatment of Long Gulch Cove in Iron Gate Reservoir Using Hydrogen Peroxide Based Algaecide". April 9, 2015.
	x	x	x	x		x	5/29/15	PacifiCorp IM11 study plan	IM 11 2015 WQ Study Plan F (May 29 2015).pdf	PacifiCorp. 2015. Study Plan Klamath Hydroelectric Project Interim Measure 11 Study Activities for 2015, May 29, 2015.
		x					6/10/15	Tribal comment on PacifiCorp IM11 study plan	2015.06.10 Karuk Comments-IM11-Study Activity 5.pdf	Corum, Susan. 2015. Memo to: PacifiCorp and Interim Measures Implementation Committee. Re: Review and comment on Proposed IM11 Study Plan for 2015: Study Activity 5. From: Susan Corum, Karuk Tribe. Date: June 10, 2015.

Comments on components of PacifiCorp's Interim Measure 11 studies and Reservoir Management Plan

Reduce nutrient load delivered to KHP reservoirs

As part of implementing the KHSA and in cooperation with other interested parties, PacifiCorp has been evaluating methods for reducing the amount of nutrients delivered from Upper Klamath Basin down the Klamath River into the KHP reservoirs. Activities have included convening a water quality workshop to evaluate various technologies (Stillwater Sciences et al. 2012, 2013) as well as funding a series of technical investigations of the potential to reduce nutrient loads using treatment wetlands (Lyon et al. 2009; CH2M HILL 2012, 2014), chemical application (CH2M HILL 2015), removal of algal biomass near Link Dam using stormwater technology (hydrodynamic separators, Watercourse Engineering, Inc. 2013b, 2014b, 2014c,) or other methods (PacifiCorp 2015).

Reducing nutrient loads is important endeavor and specific reductions are proscribed in Total Maximum Daily Loads (TMDLs) for Upper Klamath Lake (ODEQ 2002), the Lost River (ODEQ 2010), and the Klamath River (NCRWCB 2010, ODEQ 2010). PacifiCorp's assessments have provided useful information which could assist in informing future development of projects to reduce the nutrient loads coming from the Upper Klamath Basin. However, most of the assessments lack cost estimates for full-scale deployment, and the one study that did provide a cost estimate (organic matter removal near Link Dam, Watercourse Engineering Inc. 2014b) indicated the cost per units of phosphorus removed was quite high relative to other approaches previously considered in other assessments (Corum 2014b).

We are a long way from having the comprehensive strategy and sufficient resources that would be required to substantially reduce nutrient loads. Numerous scientific, economic, political, and cultural obstacles remain, but with intensive effort and substantial investment over several decades, it may be possible to obtain the major reductions in nutrient load called for in the TMDLs. But even if such reductions were eventually achieved, they would at best only reduce the magnitude of the harmful algal blooms within KHP reservoirs, not eliminate them. Given the mainstem location relatively low in the watershed, the reservoirs would continue to receive nutrients from the upper basin including its agricultural lands, and will continue to foster cyanobacterial blooms by creating lacustrine habitat required for the massive planktonic blooms of toxigenic cyanobacteria currently observed. Meeting water quality standards within Iron Gate and Copco Reservoirs will be exceedingly difficult as long as the reservoirs remain in place.

Algaecide control of cyanobacteria

PacifiCorp has been evaluating various algaecides as a potential tool to locally improve water quality conditions in high public use areas of its reservoirs since 2008 (Deas et al. 2009, 2012; Watercourse 2013a, 2014a, 2015). While PacifiCorp acknowledges that algaecide treatment is likely not economic or feasible for fully addressing algal concerns in Project Reservoirs (which alone implies that the technique will not allow the hydro project to be water quality compliant) they go on to state that preliminary study results indicate that algaecide can be successful in reducing algal concentration while also reducing microcystin concentrations (see PacifiCorp's 2014 Application for Water Quality Certification; KHSA Implementation Report p. 23). This statement is strongly overstated and inconsistent with results of the pilot algaecide studies on which the tribes have submitted extensive comments (PacifiCorp 2012, Bowman 2013, Fetcho

2013a, Corum 2014b, Corum 2015a). For example, in comments provided on PacifiCorp's Draft Technical Report: 2014 Localized Treatment of Long Gulch Cove in Iron Gate, we demonstrated that when consideration was given to the control dynamics and when actual concentrations were compared through the course if the experiment, it was apparent that the algaecide treatment was ineffective at controlling the toxic blooms in Copco Cove in 2012 (Corum 2015a). Specifically, the surface level of microcystin was higher post-event compared to pretreatment, and microcystin levels remained well above public health guideline values. Similarly for 2013, two out of three Post-Event samples in the integrated September sample from the treated area increased and showed much higher microcystin than all samples from the non-treated area showing that the treatment was not effective at reducing microcystin toxin (Corum 2014b). Finally regarding the 2014 study results, we also noted that algaecide treatment had little to no effect on microcystin or even increased it some instances, and in some cases algal biomass (chlorophyll) increased after some algaecide treatments (Corum 2015). It is clear from the IM 11 algaecide studies that algaecide application was not effective at controlling cyanobacterial blooms and toxins (in fact toxins often increased) in a small cove area, let alone on any scale that would allow the project to meet water quality criteria and public health objectives either in the reservoirs or downstream in areas of concern to the Tribes.

Selective withdrawal from Iron Gate Reservoir

PacifiCorp has pilot tested several configurations of selective withdrawal systems designed to reduce the amount of water withdrawn from the surface of Iron Gate Reservoir where algae are concentrated, with the goal of reducing the amount of *Microcystis* and associated toxins entrained into the Klamath River downstream. The initial design was a cover on the intake tower which did not work because after the cover was installed, the hydraulics adjusted to the presence of the intake (Miao and Deas 2014). In 2014 and again in 2015, a geotextile curtain was deployed upstream of the intake (PacifiCorp 2015).The Tribes have submitted extensive comments (Bowman 2013, 2014; Fetcho 2013a, 2013b, 2013c; Corum 2015b) on this IM 11 measure, and data to date do not show that the barriers tested were able to prevent cyanobacterial entrainment and prevent downstream public health exceedances of cyanobacteria and toxins. While results of the latest 2015 study are not yet available, previous testing showed the various barriers to be ineffective or not assessable due to poor study design. For example, comparisons of conditions in the reservoir vs. in the river downstream were not made on the same parcel of water in either 2012 or in 2013, and results were also confounded by diel patterns in the algae, patterns which PacifiCorp did not incorporate in their comparisons (Bowman 2014). Although they may be informative, study results for the 2015 intake barrier experiment will not provide the means to assess barrier efficacy due to very low algal and toxin levels above the barrier. Such a test would need to be performed in a year when algal concentrations are high (as often occurs) in order to evaluate whether the intake barrier might reduce downstream entrainment of cyanobacteria and toxins. Moreover, even low levels of toxins from Iron Gate Reservoir are associated with bioaccumulation in Klamath River mussels downstream (Kann et al. 2010), so marginal reductions in the amount of Microcystis released from Iron Gate Reservoirs will not be sufficient to meet all beneficial uses downstream.

Mixing

PacifiCorp is current conducting modelling to determine whether mixing water within reservoir coves could reduce cyanobacterial blooms (PacifiCorp 2015). This technology is yet another example in which the goal is only to improve water quality in localized areas (e.g., reservoirs

coves), not to meet Clean Water Act and public health thresholds. Mixing could also potentially be used to destratify reservoirs rather than just coves (PacifiCorp 2014), but PacifiCorp has not proposed to attempt this in Iron Gate and Copco Reservoirs. As noted in the RMP "PacifiCorp does not propose to conduct further evaluation of potential destratification of Copco and Iron Gate reservoirs under this RMP" (PacifiCorp 2014).

Oxygenation

It is conceptually possible to use mechanical oxygenation to increase oxygen levels enough to meet dissolved oxygen criteria (MEI 2007, PacifiCorp 2014); however, it would be quite expensive and would not solved the reservoirs' other water issues (e.g., promotion of cyanobacteria blooms and alteration of water temperature).

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SECTION 3: RECENT AND UPCOMING DOCUMENTS RELEVANT TO KLAMATH RIVER WATER QUALITY THAT WERE NOT INCLUDED IN FERC EIS OR SECRETARIAL DETERMINATION EIS/EIR

In this section, we provide a list of recent and upcoming documents relevant to Klamath River water quality that were not included in the Secretarial Determination EIS/EIR (US DOI and CDFG 2012), plus a few of the most relevant documents that were not included in the FERC (2007) EIS but were included in the Secretarial Determination EIS/EIR[5]. These and other relevant documents can be found on the websites for Karuk Tribe (http://www.karuk.us/index.php/departments/natural-resources/somes-bar-water-quality), Yurok Tribe (http://www.yuroktribe.org/departments/ytep/index.htm), and the Klamath Tribal Water Quality Consortium's website (http://klamathwaterquality.com/documents.html)

In addition, we would like to take this opportunity to inform SWRCB of some studies/analyses that are currently in progress and therefore are not cited in the Specific Documents listed below, which include: 1) Klamath Tribal Water Quality Consortium's analysis of continuous phycocyanin probe data, 2) Karuk Tribe's analysis of 2011-2015 harmful algal bloom (HAB) monitoring, 3) Karuk and Yurok Tribes' analysis of diel patterns in cyanobacteria and microcystin.

We also request that SWRCB obtain all documents within the following categories, which we do not list individually in the Specific Documents list:

- All public health HAB memos through 2015 (both weekly and seasonal summaries) from PacifiCorp, the Karuk Tribe, and the Yurok Tribe.
- All Tribal annual reports on KHSA monitoring (e.g., continuous YSI data and nutrients).

Specific Documents

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[5] The Secretarial Determination EIS/EIR presents a quite comprehensive compilation of the water quality documents that were available at the time it was written, and including all the relevant documents cited there would overwhelm this list, which we intend to focus on the most recent information.

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If there are any questions or comments regarding these comments please contact me at the following: crystal.robinson@qvir-nsn.gov or 530-468-5907 ext 318.

Thank you for this opportunity to provide additional comments regarding the Klamath Hydroelectric Project and associated water quality.

Sincerely,

Crystal Robinson

Crystal Robinson
Environmental Director
Quartz Valley Indian Reservation

Update on Adenovirus Infection in Mule Deer (*Odocoileus hemionus*) 2014-2015 as of 7/30/15

Nicholas Shirkey, Ben Gonzales, Leslie Woods

Wildlife Investigations Lab, California Department of Fish and Wildlife and the California Animal Health and Food Safety Laboratory

History of Adenovirus in California

In 1993 and 1994 a significant mortality event impacted California's mule deer population across eighteen counties of Northern and Central California. Crude estimates at the time put the number of mortalities at over a 1000, primarily impacting fawns (Swift 1997, Woods et al. 1996). Necropsy findings in carcasses from the affected regions were similar to hemorrhagic disease caused by bluetongue virus (BTV) or epizootic hemorrhagic disease virus (EHDV). However, microscopic examination and transmission electron microscopy conducted by the California Animal Health and Food Safety Laboratory (CAHFS) discovered that a previously unrecognized adenovirus infection was the cause (Woods et al. 1996). The adenovirus was detected in carcasses from Siskiyou, Shasta, Tehama, Lake, Yuba, Nevada, Sacramento, Sonoma, Tuolumne, San Mateo, and Marin counties, and was suspected to be the cause of mortalities in Modoc, Trinity, Calaveras, Santa Clara, Monterey, San Luis Obispo, and El Dorado counties as well. It was also demonstrated in historical tissues dating as far back as 1987 in Sonoma County.

Description of the Disease

During the 1993/1994 and subsequent outbreaks, fawns were most impacted by the disease, though yearlings and adults were also affected. In inoculation studies, 80% of black-tailed fawns exposed to adenovirus developed the disease compared to 16% of yearlings (Woods et al., 1999; Swift, 1997). Because of the increased susceptibility of fawns, rehab centers that specialize in the care of abandoned fawns have been the site of adenovirus mortalities in Sonoma County in 1987, Nevada County in 1990, Nevada & Placer County in 1993, and Nevada County in 1994.

In contrast to BTV and EHD which spread via an insect vector, inoculation studies on adenovirus show that the disease spreads via direct contact (Woods et al., 1999, 2001). It also appears to be highly contagious with signs of infection appearing almost simultaneously in the inoculated animals and the animals they are in contact with. The incubation period of the disease ranges from 4-16 days post exposure with death occurring acutely afterwards (Woods et al., 1999). It is associated with high levels of mortality; 60% of fawns housed in a Nevada County rehab facility died during a 1994 outbreak (Swift, 1997). Typical symptoms found in infected animals included; excess salivation, diarrhea, regurgitation, seizures, and an affinity for sources of water (Woods et al., 1996, 1999; Swift 1997).

The deer adenovirus infection can take the form of both a systemic and localized infection. In both cases the primary impact of the virus is vasculitis or inflammation of the blood vessels. Inflammation of the endothelial cells lining the vessels can lead to necrosis or cell death and can result in leakage of fluid into the tissues, and loss of flow of oxygenated blood to regions of tissue.

In the systemic form of the infection the respiratory and digestive tracts are most affected by the disease. Vasculitis caused by the adenovirus is responsible for interstitial edema in the lungs, or a buildup of

fluid, and in many cases can result in pneumonia (Woods et al., 1996). In the intestines the vasculitis can cause hemorrhage into the lumen or internal space (Woods et al., 1996). In both cases systemic infection by adenovirus can lead to acute death.

The localized form of the infection results in focal lesions throughout the upper alimentary tract and can cause infarcts with secondary bacterial infection and abscess formation (Woods et al., 2001b). Abscesses resulting from adenovirus have been noted in the lips, tongue, gingiva, hard palate, nasal cavity, pharynx, esophagus, and abomasum (Woods et al., 1999, 2001a). These lesions can also be present in animals showing signs of systemic infection. While the lesions themselves are unlikely to be life-threatening, they can lead to starvation or septicemia and therefore result in death.

Current Update

Adenovirus has been ruled as the cause of death in black-tailed deer (*Odocoileus hemionus columbianus*), and other subspecies of mule deer (*Odocoileus hemionus ssp*.) in several California counties starting in the summer of 2014 and continuing throughout the winter and spring of 2015. Adenovirus has been identified in eight of the seventeen deer that have been submitted to CAHFS in 2015 as of the 30th of July. This marks a substantial jump from the four deer, out of forty-eight, in which adenovirus was determined to be the cause of death in 2014, and the one deer from 2013. The twelve diseased deer from the 2014/2015 period were submitted from nine unique events spanning from June of 2014 to July of 2015 and came from Amador, El Dorado, Fresno, Marin, Mariposa, Shasta, Siskiyou, and Yolo counties.

As in past mortality events fawns have been most affected by the adenovirus with six of the twelve animals coming from this group. However, the fact that the majority of the deaths thus far in 2015 have occurred outside of the fawning season and that three of the four adults were reported to be in fair to good body condition with reasonable stores of fat is a reminder of the high morbidity and mortality associated with this disease.

For all twelve animals in 2014 and 2015 where adenovirus was positively identified in tissues, it was also determined to be the cause of death. All animals showed signs of the systemic infection with widespread vasculitis. Nine of the twelve animals had pulmonary edema characterized by an enhanced lobular pattern and ten had hemorrhagic enteropathy. Bloody diarrhea was noted in eight of the animals submitted for necropsy, but lesions associated with the localized form of the infection were not mentioned in any of the reports.

For the fifty-three deer submitted to CAHFS where adenovirus was not found, diagnoses varied widely (See Table 1 for full list). Animals were submitted from nineteen counties. Thirty of the animals had some pathology of the lung including; mild edema (9/53), abscesses, hemorrhage, and pneumonia (20/53). Other common findings were nutritional deficiencies (21/42 had a selenium deficiency and 18/41 had low tissue copper levels), encephalitis (7/53), myopathy (4/53), gastrointestinal disorder (12/53), and trauma (11/53). Though the agent of disease was not always identified, after adenovirus the bacterium *Trueperella pyogenes*, a common cause of secondary infection, was the greatest cause of pathology in the submitted deer (5/53). Other infectious agents included *Clostridium* sp., *Enterobacter* sp., EHD, Listeria encephalitis, Bibersteinia, and various endoparasites (*Parelaphostongylus odocoilei*, *Setaria*, Trichostrongyles, etc). Chronic wasting disease (CWD) samples were submitted from ten counties: El Dorado, Fresno, Kern, Madera, Sacramento, San Luis Obispo, Shasta, Siskiyou, Trinity, and Yolo. CWD was not found in any of the 17 deer

tested, and was also negative in the obex and retropharyngeal lymph nodes of an additional 4 deer that were not included in this report from the 2014-2015 period. Adenovirus was the most common definitive cause of death, particularly in 2015 in which it accounted for 47% of the submissions.

Field Investigation

Current evidence indicates that we are in the middle of a significant period of adenovirus mortality, which may have begun in the summer of 2014. The factors resulting in increased adenovirus mortality in a given year remain as elusive today as they were in 1993, though the continued severity of the drought may very well play into the epidemiology of the disease as groups of deer congregate to acquire water and food resources. Deer may also congregate around artificial feeding sites and increase their exposure to infected deer. Biologists should keep an eye out for deer showing the following symptoms; excess salivation, diarrhea, regurgitation, and seizures (Woods et al., 1996, 1999; Swift 1997). Increased mortality of fawns should also be monitored, and fresh carcasses should be considered for necropsy.

Currently, we have a scattering of reports from around Northern and Central California, but past outbreaks of adenovirus indicate that we are now in the time of year where peak mortalities should be occurring. While estimating the impact of adenovirus mortality in herds across the state may be a difficult endeavor, accurate records should be maintained by local biologists to the extent possible to at least gauge the impact to local herds and to monitor the spread of the virus. Any indication of a mortality event taking place in your region should be reported to the big-game veterinarian for the Wildlife Investigations Laboratory, Ben Gonzales, (916) 358-1464, Ben.gonzales@wildlife.ca.gov. Members of the public should be advised to report deer mortalities to both their local biologist, and the Wildlife Investigations Lab via our online mortality reporting form.

https://www.wildlife.ca.gov/Conservation/Laboratories/Wildlife-Investigations/Monitoring/Mortality-Report

Keep in mind that the deer adenovirus is a pathogen specific for white tail and mule deer including black tail deer and does not affect domestic livestock, nor is it a human health risk. However, as is true with any dead animal, people should wear gloves when handling carcasses and domestic dogs should be prevented from scavenging the remains of deer.

References

Swift, P. 1997. Update on Systemic Adenovirus Infection in Mule Deer (*Odocoileus hemionus*). Report CDFW.

Woods, L., H. Lehmkuhl, P. Swift, P. Chiu, R. Hanley, R. Nordhausen, M. Stillian, M. Drew. 2001a. Experimental Adenovirus Hemorrhagic Disease in White-Tailed Deer Fawns. *Journal of Wildlife Diseases*. 37: 153-158.

Woods L. 2001b. Infectious Diseases of Wild Mammals, Third Edition Chapter 9: Adenoviral Diseases. *Iowa State University Press* 202-213.

Woods, L., R. Hanley, P. Chiu, H. Lehmkuhl, R. Nordhausen, M. Stillian, P. Swift. 1999. Lesions and Transmission of Experimental Adenovirus Hemorrhagic Disease in Black-tailed Deer Fawns. *Veterinary Pathology* 36: 100-110.

Woods, L. P. Swift, B. Barr, M. Horzinek, R. Nordhausen, M. Stillian, J. Patton, M. Oliver, K. Jones, N. MacLachlan. 1996. Systemic Adenovirus Infection Associated with High Mortality in Mule Deer (*Odocoileus hemionus*) in California. *Veterinary Pathology* 33: 125-132.

Deer Mortality CAHFS Submissions
2014-2015 as of 7/30/15

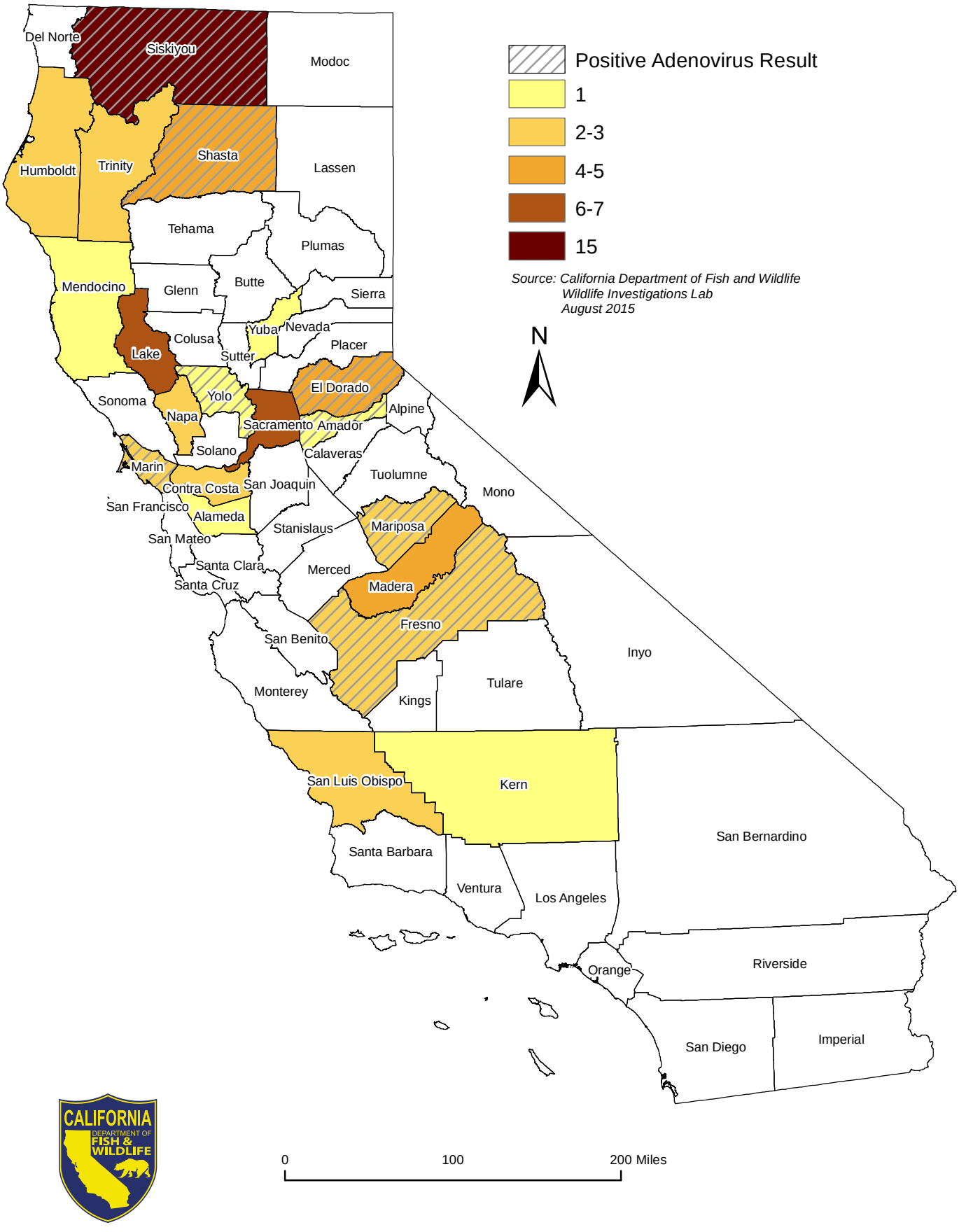

Table 1: Deer Mortalities Submitted to CAHFS (2014-2015) by County with Findings as of 7/30/15								
CAHFS #	**Date**	**Age**	**Sex**	**County**	**Findings**	**Cause of Death**	**AV**	**AV Test**
D1415744	12/23/2014	A	F	Alameda	Pericarditis, endometritis, lung worm infection	Clostridium infection	NT	NA
D1407575	6/19/2014	A	M	Amador	Vasculitis, pulmonary edema	Adenovirus	P	IHC, FA, PCR
D1403672	3/27/2014	J	U	Contra Costa	Pneumonia	Meconium aspiration	NT	NA
D1403672	3/28/2014	J	U	Contra Costa	Alveolitis	Meconium aspiration	NT	NA
D1401770	2/11/2014	A	F	El Dorado	No significant findings due to autolysis	Unknown	NT	NA
D1407790	6/24/2014	A	M	El Dorado	Dermatitis, encephalitis, pneumonia, gunshot	Euthanasia	NT	NA
D1413423	10/28/2014	J	F	El Dorado	Pneumonia, hemorrhagic enteritis	Adenovirus	P	IHC, FA, PCR
D1501183	1/10/2015	J	F	El Dorado	Pneumonia, hemorrhagic enteritis	Adenovirus	P	IHC, FA, PCR
D1505318	3/21/2015	J	F	El Dorado	Pneumonia	Adenovirus	P	FA, IHC
D1400993	1/23/2014	A	F	Fresno	Peritonitis, abomasal abscesses	Cysticercus	NT	NA
D1400997	1/23/2014	A	F	Fresno	Pneumonia, rumenitis, gunshot	Euthanasia	NT	NA
D1412030	9/25/2014	J	F	Fresno	Systemic vasculitis	Adenovirus	P	FA, PCR
D1410922	9/5/2014	J	F	Humboldt	Emaciated	Nutritional	N	FA
D1410922	9/5/2014	J	U	Humboldt	Emaciated	Nutritional	N	FA
T1500057	1/8/2015	A	M	Kern	Pulmonary abscesses, meningeal abscess, dermatitis	Trueperella pyogenes	N	PCR
D1412031	7/4/2014	J	U	Lake	No significant findings due to autolysis	Unknown	N	IHC, PCR
D1412031	7/4/2014	A	F	Lake	Cu deficiency	Unknown	N	FA, PCR
D1409243	7/30/2014	J	F	Lake	Pneumonia, subcutaneous edema	EHD	N	IHC, FA, PCR
D1412288	10/1/2014	A	F	Lake	Meningoencephalitis, pneumonia	Unknown	N	FA, PCR
D1413416	10/27/2014	J	M	Lake	Pulmonary thrombosis, myocardial necrosis, myopathy	Unknown	N	PCR
D1509213	6/26/2015	A	M	Lake	Pleuritis, epicarditis, pneumonia	Trueperella pyogenes	N	FA, PCR
D1407708	6/24/2014	A	F	Madera	Interstitial pneumonia, encephalitis, gunshot	Euthanasia	N	FA
D1411917	9/25/2014	A	M	Madera	Rumen acidosis, encephalitis, gunshot	Euthanasia	N	FA
D1503456	1/14/2015	J	F	Madera	Fractured Skull, fractured Tibia, pneumonia, gunshot	Euthanasia	NT	NA
D1503457	2/5/2015	J	F	Madera	Hepatocellular degeneration, pneumonia	Poss. Heart Failure	N	FA, PCR
D1506855	5/12/2015	J	F	Marin	Colitis	Bacterial	NT	NA
D1509325	7/6/2015	A	F	Marin	Pneumonia	Adenovirus	P	FA, PCR
D1413993	11/10/2014	U	F	Mariposa	Rectal hemorrhage, peritonitis	Trueperella pyogenes	N	FA
D1509811	7/15/2015	J	U	Mariposa	Vasculitis, pulmonary edema, hemorrhagic enteritis	Adenovirus	P	IHC, FA, PCR
D1507833	6/3/2015	A	F	Mendocino	Hemorrhagic enteritis, bronchiolitis, gunshot	Euthanasia	N	FA,IHC
D1410710	8/22/2014	A	M	Napa	Pneumonia, gunshot	Euthanasia	N	FA, PCR
D1410170	9/29/2014	J	M	Napa	Meningoencephalitis, hemothorax, pneumonia	Poss. EHD	N	FA, PCR

CAHFS #	Date	Age	Sex	County	Findings	Cause of Death	AV	AV Test
D1404727	4/22/2014	A	F	Sacramento	Euthanasia drug, dermatitis and poor nutrition	Euthanasia (IV)	NT	NA
D1412431	10/7/2014	A	M	Sacramento	Renal lymphoma, rumen acidosis	Acidosis	N	PCR
D1415529	12/18/2014	J	F	Sacramento	Gunshot	Euthanasia	NT	NA
D1415529	12/18/2014	J	F	Sacramento	Gunshot	Euthanasia	NT	NA
D1415529	12/18/2014	A	F	Sacramento	Gunshot	Euthanasia	NT	NA
D1415529	12/18/2014	A	F	Sacramento	Gunshot	Euthanasia	NT	NA
D1415529	12/18/2014	A	M	Sacramento	Gunshot	Euthanasia	NT	NA
D1402998	3/14/2014	J	M	San Luis Obispo	Pneumonia, nephritis, adrenal hemorrhage	Euthanasia	NT	NA
D1410687	8/28/2014	J	F	San Luis Obispo	Meningitis, adrenal hemorrhage, thrombosis	Listeria encephalitis	N	FA
D1408087	7/2/2014	A	M	Shasta	Pneumonia, pharyngitis, tonsilitis, Se Deficiency	Trueperella pyogenes	N	FA, PCR
D1409795	8/12/2014	A	F	Shasta	Hemothorax, pneumonia, regional vasculitis	Adenovirus	P	FA, PCR
D1410926	9/5/2014	J	U	Shasta	Aspiration pneumonia	Enterobacter cloacae	N	FA
D1410924	9/5/2014	A	M	Shasta	Myocardial necrosis, aspiration pneumonia	Result of aspiration	N	PCR
D1411758	9/10/2014	U	U	Shasta	Myocarditis, myopathy, bronchopneumonia	Hemolytic crisis	N	FA, PCR
D1413566	8/27/2014	U	F	Siskiyou	Peritonitis	Microcystins	NT	NA
D1413568	9/3/2014	U	M	Siskiyou	Interstitial pneumonia, nephritis, hepatopathy	Unknown	N	IHC
D1413564	9/8/2014	U	U	Siskiyou	Bronchopneumonia	Trueperella pyogenes	N	IHC
D1413565	9/10/2014	A	F	Siskiyou	Interstitial pneumonia, tracheitis	Unknown	N	IHC
D1414296	9/26/2014	J	U	Siskiyou	Pharyngitis, esophagitis, glossitis, gunshot	Euthanasia	N	IHC, FA, PCR
D1412723	10/7/2014	A	M	Siskiyou	Encephalitis, kidney edema, gunshot	Euthanasia	N	PCR
D1412728	10/9/2014	J	M	Siskiyou	Nephrosis, rumenitis, myocarditis, gunshot	Euthanasia	N	IHC, PCR
D1413567	10/18/2014	U	M	Siskiyou	Myopathy, pneumonia, gunshot	Euthanasia	N	IHC
D1413563	10/30/2014	A	M	Siskiyou	Pneumonia, rumenitis, mandibular abscess	Unknown	N	IHC, FA, PCR
D1502819	2/19/2015	A	F	Siskiyou	Generalized inflammation, pneumonia, Cu/Se Deficiency	Poss. nutritional	N	PCR
D1502819	2/19/2015	J	F	Siskiyou	Pleuritis, epicarditis, myopathy, Cu/Se Deficiency	Poss. nutritional	N	PCR
D1505165	3/11/2015	A	F	Siskiyou	Emaciated, Cu/Se Deficiency	Nutritional	NT	NA
D1509860	7/16/2015	J	F	Siskiyou	Vasculitis, hemorrhagic enteritis	Adenovirus	P	FA, PCR
D1509860	7/16/2015	J	M	Siskiyou	Vasculitis, hemorrhagic enteritis	Adenovirus	P	FA, PCR
D1509860	7/16/2015	J	U	Siskiyou	Vasculitis, hemorrhagic enteritis	Adenovirus	P	FA, PCR
D1411759	9/23/2014	A	M	Trinity	Myocarditis, rumenitis, hemorrhagic enteritis	Hemolytic crisis	N	FA, PCR
D1412729	10/2/2014	J	F	Trinity	Rumenitis, gunshot	Euthanasia	N	PCR
D1500084	1/5/2015	A	F	Yolo	Vasculitis, pneumonia, hemorrhagic enteritis	Adenovirus	P	IHC, FA
D1400168	1/6/2014	J	M	Yuba	Hepatitis, pneumonia, nephritis, enteritis, trauma	Predation	NT	NA

	A = Adult (>2)		M = Male		IHC = Immunohistochemistry	NT= Not Tested		
	J = Juvenile (<2)		F = Female		PCR = Polymerase Chain Reaction	P = Positive		
	U = Unknown				FA = Fluorescent Antibody	N= Negative		

SHASTA INDIAN NATION

P.O. Box 195 Macdoel, CA 96058

January 29, 2017

Mr. Parker Thaler
State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA 95812-2000

Dear Mr. Thaler:

Subject: Klamath Hydroelectric Project (FERC Project 14803)

Thank you for the opportunity to provide comments for the record regarding the impact to Tribal Cultural Resources on the project known as FERC Project 14803. The Shasta people resided in the Upper Klamath River Canyon since time immemorial. We are the original inhabitants of the Upper Klamath River Canyon and thus have a unique place in the history of the region.

Pursuant to the California Environmental Quality Act (CEQA), the State Water Resources Control Board will prepare an environmental impact report (EIR) for the proposed removal of the Lower Klamath Project. The EIR will be used in considering the Klamath River Renewal Corporation's (KRRC) application for water quality certification. The KRRC is formed for the purpose of removing four dams on the Klamath river, three of which are located in California.

The license transfer and license surrender applications are made in accordance with the April 6, 2016, Amended Klamath Hydroelectric Settlement Agreement (KHSA).

The Shasta Indian Nation is not a signatory to the original or amended KHSA.

In considering impact to Tribal Cultural Resources it is important to note the treatment of non-federally recognized tribes differs in federal and state laws. The assessment of project impacts on Tribal Cultural Resources under the CEQA Section 15064.5 and California AB 52 acknowledge the Shasta Indian Nation as an Indian tribe in the state of California. The National Environmental Policy Act (NEPA) only considers impacts to tribal cultural resources for Federally recognized tribes; others are treated as "interested parties".

Janice A. Crowe , Chairman
Candice Difuntorum Vice Chairperson
19349 Kinene Ct. Redding, CA 96003
530-244-2742 twocrowes63@att.net
530-204-7283 candie5150@hotmail.com

As noted in the Water Resource Control Boards notice, the 2012 KHSA EIS/EIR was prepared to support Klamath Hydroelectric Project dam removal, in accordance with the amended KHSA. The United States Department of Interior never entered a Record of Decision and the California Department of Fish and Wildlife never certified the document.

The Shasta Indian Nations strongly believes the 2012 EIS/EIR does not properly consider the impact to Shasta cultural sites and landscapes with tribal cultural value.

There is no doubt the proposed undertaking will negatively impact Shasta sites. For these reasons, the Shasta Indian Nation implores you to develop a new EIS/EIR that gives proper weight and consideration to the irreversible damage to Shasta sacred sites.

Respectfully,

Janice Crowe

Janice Crowe, Chairman

Janice A. Crowe , Chairman
Candice Difuntorum Vice Chairperson
19349 Kinene Ct. Redding, CA 96003
530-244-2742 twocrowes63@att.net
530-204-7283 candie5150@hotmail.com

Thaler, Parker@Waterboards

From: Roy hall Jr <shastanation@hotmail.com>
Sent: Wednesday, February 01, 2017 3:03 PM
To: Wr401program
Subject: DO NOT TRANSFER THE KLAMATH DAMS/LICENSE TO THE NON-PROFIT
Attachments: IMG_3076.JPG; IMG_3077.JPG; IMG_3078.JPG; IMG_3079.JPG; IMG_3080.JPG; IMG_3081.JPG

WR401program@waterboards.ca.gov
February 1, 2017
Mr. Parker Thaler
State Water Resources Control Board
Division of Water Rights-Water Quality Control Program
PO Box 2000
Sacramento CA 95812-2000

Dear Mr. Thaler,
I am mailing hard copies of the complete documents listed in the attachments.
There is no reason to take out clean inexpensive hydro power. This whole process is a power play and a money, land and cultural grab. It was designed to circumvent the failure of the KBRA and KHSA.
Salmon did not go above the lower dams. After over 150 miles of treacherous travel the fish are not in any condition to do more than spawn at the hatchery.
There are several rock reefs that the fish cannot breach.
There are hotspring above the reefs that heat the water to temps no fish can withstand.
Any fish getting that far up the river are inedible. That is why the Shasta allowed the Klamath people to come to Shasta Valley and catch fish on the Shasta river, well below the dams.
Shasta Nation is opposed to the transfer of the Klamath dams to the non-profit. There is no guarantee that any Shasta sites will be protected if this transfer takes place. Laws are in place to protect our lands from these kinds of situations.
Shasta Nation is opposed to dam removal. Our sacred lands, burials, village sites, hunting, fishing and gathering areas and invaluable cultural sites are in danger if the transfer takes place.
Because previously, Shasta Nation Burial Cairns have been destroyed by Federal Agencies in the past, The Shasta Nation does not want similar occurrences to happen on the Klamath.
The burials along the Klamath between the dams are Civil War Burial Cairns and must be protected. Dam removal would endanger the burial cairns and the burials would be washed away.
1st document is a map approved by the Siskiyou County Supervisors showing Shasta Nation Homelands with the area of the Dams indicated.
2nd document is a letter from Native American Heritage Commission in Sacramento thanking tribes for protecting our cultural sites.
3rd document is from California Dept of Parks and Recreation documenting the Civil War Cairns on the Klamath River.

4th is a typed letter explaining the history of the California Treaties and that the Karock tribe is over 100 miles down river from the dam sites. The dams lie wholly within the Shasta Nation Aboriginal Homeland Boundaries.

Please do not tranfer these lands to the non-profit. Do not allow the dams to be removed.
Help protect a vital part of the Shasta Homeland from total destruction.
thank you
Roy Hall Chairman Shasta Nation
Betty Hall Historian/Keeper of Records Shasta Nation
530-643-3339
530-468-2387
PO Box 1054
Yreka CA 96097

This is the Support Docs to go with the ERPT
Email Letter/Docs sent on Feb 1 from shastanation@hotmail.com
February 1, 2017

Betty Hall
SNAT Historian
(19 Pages total)

Mr. Parker Thaler
State Water Resources Control Board
Division of Water Rights - Water Quality Cert. Program
P.O. Box 2000
Sacramento, CA. 95812-2000



Dear Mr. Thaler,

I am just sending the letter head of the:
"State of California - The Resources agency
Dept. of Parks and Recreation -
Continuation Sheet.
Resource name or # Shasta Civil War. Carins.

Because previously Shasta Native Carins have been destroyed by a Federal ~~Agency~~ agency and the rocks had to be packed back up the mountain and Carins restored. Shasta Nation does not want to take that chance again. But there is enough here to show you that the Civil war Carins are on the Klamath River. and must be protected! And not washed away by taking out

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the Klamath River Dams.

The State Water Resource Board needs to respond to the Shasta Nation in writing to set up a meeting ~~to~~ regarding the Shasta Civil War Caves.

As you know there are hundreds of Shasta village sites, burial grounds and sacred sites below these dams, all the way to Clear Creek on the Klamath River.

Sincerely

Betty L. Hall
~~Secretary~~ for
Shasta Nation Tribal Council

Respond to Shasta Nation
P.O. Box 1054
Yreka, CA. 96097

Encl: 1. Scoping Meeting Information Sheet - 1-page
2. Letter to Shasta Nation from Native American Heritage Commission - 12-28-2016 1-1/2 page
3. Confidential Material re: Shasta Civil War Caves - 13 Pages
Hi The Klamath River - "Its People + Fish"
by Betty L. Hall - (Second submission) 13 Pages

Letter to Shasta Nation

2/19
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SHASTA

Continued from 1

Specialist Elizabeth Nielsen stated at the meeting that the county took the initiative to work with the Shasta People on documenting their homeland and territorial boundaries.

Nielsen mentioned that she also plans to send out letters to Siskiyou County's other tribes requesting their territorial maps. The maps will aid in consultation with tribes and will provide state agencies with additional information when they work with tribal populations as well.



The Siskiyou County Board of Supervisors discusses a map of the traditional homeland of the Shasta people.

DAILY NEWS PHOTO/DANIELLE JESTER

The resolution states that the designated boundary of the "Traditional Homelands of the Shasta People" map "is the archaeological, cultural, and sacred places significant in tribal cultural traditions, heritages, and identities of the Shasta People."

The Shasta People have requested that the map be referenced "for all future consultation and cultural resource processes."

The resolution details that the map will be on file with the Native American Heritage Commission in Sacramento, the California Historical Resources Information System in Chico, California, and the Klamath National Forest in Yreka.

District 3 Supervisor Michael Kobseff added that he wanted the map to be sent to the Rural County Representatives of California, the California State Association of Counties, federal and state representatives, the Bureau of Indian Affairs and the Department of the Interior.



2017 FEB -3 PM 2:18
SACRAMENTO

December 28, 2016

Dear Tribal Leaders,

On behalf of the Commissioners and staff at the Native American Heritage Commission, I would like to thank you for your support in celebrating the 40th anniversary of the NAHC. This celebration culminated with our 40th Anniversary Gala on October 21, 2016. The Gala was an overwhelming success and we continue to receive very positive feedback from those who were in attendance.

Since its inception in 1976, the NAHC has been charged with protecting Native American religious and sacred sites, assisting Native Americans in obtaining access to religious and sacred sites on public lands, and bringing legal action to prevent severe or irreparable damage to sacred sites or ceremonial places. The Gala served as a momentous forum to celebrate all that has been accomplished over the last forty years and offered a look forward to the future challenges and opportunities to protect California's tribal cultural resources. Most importantly, the Gala served as an opportunity for the NAHC to show its appreciation to you, our tribal community and leaders, for your unwavering commitment to cultural resources protection.

To show our appreciation, please find the following items enclosed with this letter: A certificate honoring your Tribe's commitment to the protection of California's tribal cultural resources signed by myself and NAHC Chairman James Ramos, and a flash drive containing all of the photographs and video taken at the Gala, including a short highlight video and digital copies of the printed materials distributed at the Gala.

I would also like to take this opportunity to thank you for your continued support and I look forward to working with you in the future.

Respectfully,

Cynthia Gomez, Executive Secretary
Native American Heritage Commission

4/19
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Native American Heritage Commission
1550 Harbor Blvd, Suite 100
West Sacramento, CA 95691
(916) 373-3710
nahc@nahc.ca.gov

Tues. Jan. 26, 2016 Presented to: CA. WATER RESOURSES CONTROL BOARD, at Yreka, California

THE KLAMATH RIVER--It's PEOPLE and FISH

Peter Skene Ogden, Hudson Bay Fur Trapper, and party were the first white people to contact the Klamath Tribe in southern Oregon. Ogden's party consisted of about 44 people, and 100 horses. Ogden roamed around the Klamath Basin, going to the Tule Lake area, and back to what he called the Klamath River at Beswick. He describes the river there as being ¼ mile wide and enters into a lake just down stream. Ogden/Davies,ed. Introduction xixiii. 1961. Here after referred to as Davies,ed. 1961.

RECEIVED 2017 FEB -3 PM 2:18 STATE WATER RESOURCES CONTROL BOARD

Jeff LaLande, author of First Over The Siskiyous, 1987, retraced the route of Ogden and concluded that Ogden had indeed arrived at the Link River, which entered a lake just below his camp. Ogden's description matched this area. LaLande,p.28.1987.

Ogden had not reached the Klamath River at Beswick.

Ogden observed that the Klamath Indians did not bury their dead. And the fish they ate were the most miserable food..

January 17, 1827 . Ogden crossed the Link river and camped for a few days, and he asked the Klamath chief to get him a guide to take him down the Klamath River. The Chief told him "that there was only one Indian in the tribe that knew the river". Davies,ed.p.54. 1961. A guide was found, and they proceeded down the Klamath River, crossing two points of land, and coming to a natural rock barrier in the river near Keno, Oregon. The Klamath guide told Ogden salmon could not get over it

Also at this place there was a destroyed Shasta village, Ogden's Klamath guide explained that the Klamath Tribe was at war with the Shasta Indians, and they had recently attacked and destroyed their village. Davies,ed.p57, 1961.

January 24, 1827. Ogden continued on down the river, and coming to a place where

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he could look to his rear, and in advance for some distance there was one continued rapid fall and cascade, his guide informed him beyond this salmon do not ascend.

February 1, 1827. Ogden travels on down the Klamath river and makes camp. But the day before this he visited an Indian hut with his Klamath chief, and guide. He found three Indian women and a boy, the women became very alarmed and began to cry, and were very distressed. Upon leaving the hut the chief told Ogden that he had killed their husbands last summer in a War excursion. Davies,ed.p 63. 1961.

After this Ogden acquired Shasta Indian guides, and continued on down the Klamath River, according to Jeff LaLande he came to Cottonwood Creek, and there turned to go over the Siskiyou mountain range.

JOURNAL OF THE EXPEDITION OF COLONEL REDICK M'KEE, UNITED STATES INDIAN AGENT, by George Gibbs. 1853/

August 11, 1851, Redick McKee and party escorted by Major Wessells, and a detachment of thirty five riflemen and about one hundred head of cattle for sustenance, left Sonoma, going to Santa Rosa. The planned route was up the Russian River, down the Eel River to Humboldt bay, and then over to the Klamath River.

September 29, 1851. Colonel McKee arrived at the junction of the Klamath River and Trinity River. A Mr. Durkee kept a ferry here to cross the Klamath. Mr. Gibbs speaks of the Trinity River's waters are of transcendent purity; contrasting with the Klamath that never lose the taint of their origin. Gibbs.p30.1853.

There are three distinct tribes, speaking different languages up to the mouth of the Shasta. Gibbs.p31.1853.

Mr. Gibbs does not elaborate on the Treaty at the confluence of the Trinity River

9/19
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So I will refer to : INDIAN AFFAIRS: LAWS AND TREATIES. Compiled and Edited by Charles J. Kappler, Washington: Government Printing Office. 1929. Part IV. (http://digital.library.okstate.edu/kappler/Vol4/HTML_files/v4p1i7.html)

TREATY WITH THE POHLIK OR LOWER KLAMATH, ETC., 1851
October 6, 1851. / Unratified.

TREATY MADE AND CONCLUDED AT CAMP KLAMATH, AT THE JUNCTION OF KLAMATH AND TRINITY RIVERS, STATE OF CALIFORNIA, OCTOBER 6, 1851, BETWEEN REDICK MCKEE, INDIAN AGENT ON THE PART OF THE UNITED STATES, AND THE CHIEFS, CAPTAINS AND HEAD MEN OF THE POHLIK OR LOWER KLAMATH, &c., TRIBES OF INDIANS.

A treaty of peace and friendship made and concluded at Camp Klamath, at the Junction of the Klamath and Trinity rivers, between Redick McKee, one of the Indian agents specially appointed to make treaties with the various Indian tribes in California, on the part of the United States, and the chief, captains, and head men of the tribes or bands of Indians now in council at this camp, representing the Poh-lik or lower Klamath, the Peh-tsick or upper Klamath, and the Hoo-pah or Trinity river Indians; containing also stipulations preliminary to future measures to be recommended for adoption, on the part of the United States. (Peh-tsick or upper Klamath-AKA. Karuk). Kappler.p1117.1929.

October 9, 1851. Business of the Treaty concluded, Colonel McKee broke camp and crossed to the west side of the Klamath River, continuing upstream a couple of miles there was a large fish dam; a work exhibiting an extraordinary degree both of enterprise and skill. Similar dams exist on the Klamath, a few miles below the forks, and about fifteen above this one; and another on the Trinity thirteen or so miles from its mouth. Water ways were opened at times for the passage of fish for tribes upstream. Gibbs.p.38.1853.

October 10, 1851. They crossed Mr. Durkee's toll bridge across Bluff creek, reputed to be the Aboriginal Territorial Boundary between the Yurok and Karuk tribes. They arrive at Orleans Bar, crossing another branch the Ocketch, at the mouth of which there was another fish dam similar to the one below.

October 11, 1851. McKee goes over another mountain, coming down to a small flat

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about a mile above the entrance of the Salmon River. Gibbs, p.41.1851.

October 12, 1851. McKee remained in camp here for the purpose of treating with the rest of the bands belonging to this division they refer to themselves as "Kahruk" meaning up, and "Yourruk" meaning down. The language extends on the Klamath from Bluff Creek to a considerable distance above here, according to some reports to the Eenah-met, or Clear Creek. Gibbs also mentions that the Kahruk extends to the forks on the Salmon River. Gibbs.p.42.1851.

(Due to the extensive genealogy I have done regarding the Indians on the Salmon River, I believe that the Karuk Indians only went up as far as Wolley Creek).

October 12, 1851. "It was proposed to bring the whole of these into the reserve on the Trinity; leaving the Shasta, upper Klamath and upper Trinity Indians to fall within that intended to be established above;"

A TREATY SUPPLEMENTARY TO THE FOREGOING TREATY

The undersigned chiefs, captains and head men of the Si-wah, op-pe-o, , He-ko-neck and In-neck tribes or bands of Indians, residing at and near to the mouth of the Cor-a-tem or Salmon river, having had the terms and stipulations of the foregoing treaty, concluded at Durkee's ferry on the 6th instant, fully explained to them by Redick McKee, Indian agent of the United States, having expressed an earnest desire to become parties to the said treaty in all its articles and stipulations, it s therefore agreed by and between the said agent and the said chiefs, &c., that the said bands be and hereby are admitted as parties to the same, and to the advantages thereof, and become bound by the stipulations therein contained as fully in all respects as if they had been parties thereto originally.

In testimony whereof the parties have hereunto signed their names and affixed their seals at Camp Cor-a-tem, near mouth of Salmon river, this twelfth day of October, anno Domini, 1851.

October 15,1851. McKee camped at the confluence of Clear Creek, the furthest upstream village of the Karuk Tribe. Clear Creek is reputed to be the aboriginal territorial boundary between the Karuk and Shasta Indians.

A Karuk World-Renewal Ceremony At Panaminik, by Philip Drucker. 1936.

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APPENDIX: THE INAM CEREMONY. These are notes obtained by Kroeber from Old Ned in 1923 on the Inam, or Clear creek ceremony, the farthest upstream of the Karuk. Drucker.p.28.1936. Old Ned a respected Karuk elder lived at Clear Creek.

October 17, 1851. This morning they had to search for a mule, Major Wessells with the command moved on, and Mr.Kelsey and Colonel Sarshel Woods, were sent forward to Scott Valley to call the Indians in. Messrs. T.J. Roach and W.J. Stevens came down today from "Murder's Bar, (Happy Camp) a short distance above. These men explained the terrain of the area to McKee. They told him that the Indians of Illinois Valley are said to spead the language of this part of the Klamath, (the Shasta). Gibbs.p.45.1851.

October 18, 1851. They arrived at Murder's Bar, and found that the majority of the Shasta (aka Shasta Nation) people had disappeared due to their ranches having been burned by the whites, and it was supposed they moved to either the valleys above, or to the Illinois River area. The Shasta population between Clear Creek and the mouth of the Shasta River appeared to be 300 to 400 Shasta People. George Gibbs wrote that they had very little information of the Shasta people living up the Klamath River from the mouth of the Shasta River to the foot of the Cascade Range.

October 19, 1851. They crossed a large brook or creek, (aka Thompson Creek) which was afterwards fixed upon as part of the Boundary of the "Reservation" and as such is referred to in the Treaty made in Scott's Valley, on November 4, 1851 with the Shasta and Upper Klamath people, (both groups (aka The Shasta Nation).

October 21, 1851. They arrived at the confluence of the Scott's River with the Klamath River, journeying up the Scott's River canyon to a rendezvous at Major Wesselll's camp at the confluence of Scott River and Shackleford Creek along the

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western area of Quartz Valley.

October 26, 1851. They rode to Shasta Butte City, (aka Yreka) a place of some 300 houses built on two streets in the form of an L and numbering about 1,000 souls, including the immediate vicinity.

October 28, 1851. That evening the Chiefs of the Shasta and Scott's River Tribes with some of their headmen arrived at camp. We learned from every quarter, that apprehensions existed among the Indians that the object of assembling them was to kill the whole together, and this fear had prevented the Chief of the Klamaths from coming.

October 29, 1851. In regard to the location and limits of a reserve to place the Native American People on the Whit, (European descendants) Citizens Committee members decided that no conclusion could be arrived at, so Messrs. Charles McDermit and Alva Boles were chosen by the Citizens Committee to accompany George Gibbs, Mr. Kelsey and Colonel Woods as detailed by Colonel McKee to further investigate a suitable locate for the proposed Native American Indian Reservation, knowing that time of the essence was critical due to the winter season coming on.

October 30,1951. After a hard rain fell during the night the appointed Reservation locate Committee departed about 11 a.m. in their quest to find a suitable Reservation.

November 3, 1851. The day was spent in arranging the details of the Treaty. Our exploring party united in a report to the Agent, stating the result of the journey, and our belief that Scott's Valley would afford the only resource for the agricultural part of the reserve. Colonel MdKee, upon consideration, accordingly decided to set apart the lower, or northern end of the valley, for that purpose. In determining the other limits, it was held important to embrace, in as compact a space as possible, a tract which would

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afford sufficient hunting and fishing grounds for the expected populations, and which should leave the most valuable mineral lands to the whites. Into this reservation it was proposed to collect all the tribes on the Klamath, Scott's and Shasta Rivers, speaking the Shaste (Shasta) tongue, and also those of the upper Trinity River.

November 4,1851. In the Morning at Camp, in Scott's Valley, Shasta County, (now Siskiyou County) State of California, the Treaty was explained carefully as drawn up, and the bounds of the Reservation pointed out on a plat. In the afternoon it was signed in the presence of a large concourse of Whites and Indians, with great formality. Concluded between Reddick MdKee, one of the Commissioners on the part of the United States, and the Chiefs, Captains and Head Men of the Shasta, Scott's River and Upper Klamath Indian Tribes. There were no representatives from the upper Trinity River.

IN TESTIMONY WHEREOF, the parties have hereunto signed their names and affixed their seals, this fourth day of November, anno Domini eighteen hundred and fifty-one, REDICK McKee ,United States Indian Agent, [Seal]. For and in behalf of the I-KA-RUCK Tribe or band in Shasta Valley, Chief TSO-HOR-GIT-SKO, his X mark, [Seal], CHE-LE-NA-TUK, his X mark, [Seal]. For and behalf of the KO-SE-TAK Tribe or band in Shasta Valley, Chief ADA-WAR-HOW-IK, his X mark, [Seal], QUAP-SOW-A-Ha, his X mark, [Seal]. For and in behalf of the IDA-KAR- I-WAKA- HA Tribe or band in Shasta Valley, Chief IDA-KAR-I-WAK-A-HA, his mark, [Seal], A-LAK-SE-WAK-A-NA, his X mark, [Seal]. For and in behalf of the WAT-SA-He-WA Tribe or band in Scott's Valley, Chief AR-RATS-A-CHO-I-CA, his mark, [Seal]. For and in behalf of the E-EH Tribe or band in Scott's Valley, Chief AN-NA-NIK-A-HOK, his X mark, [Seal]. SUN-RISE, his X mark, [Seal]. For and in behalf of the O-DE-I-LAH Tribe or band from The upper Klamath River, Chief I-SHACK, his X mark, [Seal], E-EH-NE-QUA, his X Mark [Seal], PI-O-KUKE, his X mark, [Seal], SA-NAK-A-HA, his X mark, [Seal]. Signed and delivered, after being fully explained, in presence of : John McKee, Secretary, George Gibbs, Interpreter, Lindley Abel, Interpreter, W.T. Smith, F.H. Mckinney, C. McDermit, Samuel Fleming, Walter McDonald, C. Fulton, Wm. H. Burgess, Edward Hicks, William Dain, Liry Swan, and Geo. W. Tait. The usual presents were then distributed and they separated to go their own way.

November 6, 1851. Their mission completed, about noon Colonel Redick McKee, George Gibbs, Walter McDonald with three men started their return trip, arriving in

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San Francisco, California , on December 28, 1851. Gibbs.p.63.1851.

July 8, 1852. The United States Senate in executive session refused to ratify Eighteen Treaties made with the California Tribes, and ordered the said eighteen Treaties to be filed under injunction of secrecy which was not removed until January 18, 1905. The Shasta Nation, which included the Scott's Valley , and the Upper Klamath River Indians was one of the ungratified eighteen Treaties.

January 19, 1905. The texts of the eighteen ungratified Treaties were made public at the order of the United States Senate, which met in executive session on that day in the Thirty-second Congress, First Session. The Treaties were published subsequently several times in connection with hearings held by the Subcommittee of the Committee on Indian Affairs.

EVENING HERALD, September 24, 1908.

MILLIONS OF SALMON Cannot Reach Lake on Account of Rocks in the River at Keno. River Below Keno Rapids Is One Mass of Fish Trying to Reach Spawning Grounds --An Opening Needed or Else a Fish Ladder Should Be Constructed.

" Parties coming in from Keno state that the run of salmon in the Klamath River this year is the heaviest it has ever known". The article also states that there is a natural rock barrier below Keno, which it is almost impossible for the fish to get over, should some succeed they are spotted, bruised, and are worthless.

Evidently salmon getting to Link River was not a common occurrence, as to the statement made above.

May 1910, COPCO NO. 1 and NO. 2.

At this time surveys were started for two power plants, this was a location of

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beautiful farms engaged in cattle raising, and gardening. A dam site was planed for the head of Ward canyon. Boyle,p.8,1986.

The land owners here did not want to sell, but realized it was progress. Boyle,p,8,86.

This site was where a Shasta Indian Jake Smith, AKA, Moffett Creek Jake, was known to spear fish for hours.

Some of the owners were: William Lennox, Henry Keaton, Maurweza Aquada, Kitty Ward, Mary Ward, William Raymundo, Stone and Edwards, Henry and Herman Spannas, George Chase, D.D. Hahn, Erskine Parks, and Manuel Corvelle. Boyle,8,86.

I mention these people because Henry Keaton, Kitty Ward, and Mary Ward, were Shasta Indian people living on the Upper Klamath River.

The family members of these Shasta people that were buried in local historical Cemeteries were removed to the Henely cemetery. Other Shasta Indian families living in the Klamath canyon were that of the Griffith, Raymond, Frain, and Hoover. Tom and Isabell (John) Smith lived on an Indian allotment on Shovel Creek. Some Shasta Indians are buried in the Way Cemetery. One was Missouri Ann Owens, the Grand daughter of Chief Ida-kar-i-wak-a-ha, who signed the Shasta Treaty at Fort Jones on November 4, 1851.

50 Years On The Klamath. By John C. Boyle. 1982.

When in the process of constructing Copco l, and Copco 2, and 1-A, a fish ladder was considered by the Klamath Sportsman's Association, the U.S. Bureau of Indian Affairs, and the Fish and Game Commission. The Klamath Indians investigated often, along with other agencies. Boyle,21,86.

March 7, 1918. Evening Herald, Klamath Falls, Oregon. Hatchery For Streams of

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Klamath Over Copco Dam Found to be Impracticable. . New Hatchery in California will Supply Stock for Streams Here. "Thousands of fish at different varieties will be planted in the streams adjacent to the Klamath Lakes, which will make this section an anglers paradise.

California-Oregon Power company has agreed to the erection of a hatchery on its property on Fall Creek, which on account of clear and even temperature of water, a perfect condition is found for hatching and caring for little fish, and the California Fish Commission agree to take spawn and hatch varieties of fish native to the coast streams, and to deliver to the Oregon fish Commission and the game wardens of Klamath County all the little fish necessary to stock abundantly the numerous lakes, rivers and creeks in the vicinity.

The Oregon Fish and Game Commission is particularly pleased, as a much felt want is being supplied without cost, other than transportation to the people of Oregon and this locality. The Commission was represented by the project Engineer H.W. Hicks of the Modoc Point project in this matter. Boyle,22,82.

It is apparent that the Interior Department representing the Klamath Indians, and the Oregon Fish Commission were well pleased with the Fish Hatchery at Fall Creek.. In all of my research the Coho Salmon are not mentioned prior to constructing the dams on the Klamath River. The Coho Salmon were planted in the Klamath River just prior to 1900, they do not do well here because they like colder water and are not native to the Klamath.

So why the big fuss by the Klamath, Karuk, Hoopa, and Yurok Indians to remove the

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Dams? And I suppose the Fish and Game have forgotten how delighted they were to have a fish hatchery at Fall Creek.

Now a huge concern for the Shasta Nation and myself are the ancient villages, sacred sites, and burial grounds under these reservoirs. I have read that the sediment is expected to flush out quickly when the dams are removed. I fear that the human remains of my ancestors will be washed down the river. These sites need to be protected according to the guidelines of NEPA. Have appropriations been made for this, should it happen? I don't believe the Karuk, Hoopa, and YurokIndians will quickly stretch their nets across the Klamath River to catch the bones of Shasta Indians. The dams are there, leave them in place, please.

Aboriginal Use of Fishery Resources in Northwestern North America, by Gordon Winant Hewes. 1938. Klamath Lake: "Salmon were not present in the Klamath Lakes and adjacent districts". "Fish was the major animal food of all these groups, but salmon were available only in the Klamath River and its tributaries below Copco Marsh to which a few ascended". Hewes.p.96.1938.

Suckers were abundant in the Klamath Lakes region. The Lost River Sucker fish were the most important to the Klamath Indians. Some were 3 feet long. They were cured for winter, and oil was also extracted from them.

The Klamath Indians did take salmon and steelhead when spawning near the outlet to Copco Marsh. The Shasta Indians employed A-frame nets from platforms along the Klamath river and its tributaries. Hewes.p.97.1938.

About The Klamath Tribe, by Gordon Bettles, Cultural and Heritage Specialist. 1995.

On page five under the heading: What are Natural Resources and Who Manages

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Them?

A "natural resource" is anything the Earth provides us to help us live. Air, water and food are natural resources. For the Klamath Tribes, some of their most important natural resources are water, minerals, muledeer, /c'wam/ (a bottom feeding fish in the water systems)''. Bettles,p.5.1995.

"What are some of the ceremonies the Tribes practice"?

"The Klamath Tribes continue to hold the /na . as c'wam hoot 'at gat bambli/ ceremony along the banks of the Sprague River near Chiloquin. This ceremony is to celebrate the return of / c' wam/ a bottom feeding fish, also known as the Lost River Sucker". Bettles,p.5.1995.

"Many years ago, a dam was built on the Sprague River. The / c'wam/ could not go further upstream any more to spawh. They could only go as far as the foot of the dam. the Klamath Tribes began to hold the ceremony at the new place in the 1920's. This happens every year in March. Elders present the first /c'wam/ with prayers to the Creator on behalf of the Tribes". Bettles,p.5.1995.

The most important fish to the Klamath Tribes is the Lost River Sucker Fish! Not once does Mr. Bettles mention the use of Salmon. And remember he wrote his article as the Klamath Tribes Culture and Heritage Specialist. I believe he said it best By omission..

Betty L. Hall

Betty L. Hall
Historian, Author, Researcher, Founder, Owner.
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YUROK TRIBE

190 Klamath Boulevard • Post Office Box 1027 • Klamath, CA 95548

Via Electronic Mail

February 1, 2017

State Water Resources Control Board
Division of Water Rights
Water Quality Certification Program
Attention: Parker Thaler
P.O. Box 2000
Sacramento, CA 95812-2000

Email: parker.thaler@waterboards.ca.gov

Re: Yurok Tribe's Scoping Comments on the Environmental Impact Report for the Klamath Hydroelectric Project License Surrender

Aiy-ye-kwee':

The Yurok Tribe ("the Tribe") respectfully submits the following written comments to the State Water Resources Control Board ("the Board") for consideration in its certification, pursuant to the Clean Water Act, of the Klamath Hydroelectric Project (KHP) license surrender by the Federal Energy Regulatory Commission (FERC).

The Yurok people have lived on the Klamath River since immemorial. The River is the central bloodline of the Tribe. Our oral history teaches us that our way of life is dependent on the River; if the River dies there will be no need for the Yurok People. The health of the Yurok People, our culture, subsistence, spirituality, and very identity are completely dependent on the health of the River. As the most downstream inhabitants of the Klamath River Basin, the Yurok people feel the impacts – positive and negative – of all upstream activity. Our fishery resources, confirmed as trust assets by federal courts, are the single most important resource to the Tribe. We will continue to work tirelessly to bring a healthy salmon population back to the entire Klamath basin.

For over a decade, the Tribe has been advocating for complete facilities removal because it is only way to restore the health of the Klamath River. In that time the exhaustive analysis, studies, and reports leave no question that the presence of the dams on the Klamath River has impaired the health of the River and our downstream communities. Last year, the Tribe submitted comments to the Board through the KHP relicensing certification process echoing these long held sentiments, and urging the Board to fully analyze complete facilities removal as a solution to the ongoing water quality issues caused by the dams.

With this current water quality certification process, the Tribe is heartened by the fact that the Water Board will be conducting the certification of the surrender application of the KHP license, an action that is largely supported by the affected tribes, states, federal agencies, and

supplemental information on the key cultural, biological, and environmental impacts of the KHP addressed herein.

1. The Tribe Strongly Urges the Board to Expedite the Completion of the EIR

The Tribe urges the Board to establish a schedule for this proceeding, including its final decision on whether to certify the license surrender application, that is consistent with the project purpose of completing facilities removal by 2020. To meet this deadline the Board will need to finalize the EIR and issue its certification by mid-2019.

To assist in expediting this current certification proceeding, the Tribe recommends relying on the 2012 *Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report* (SDFEIS). The SDFEIS was based on a comprehensive and exhaustive set of engineering and environmental studies analyzing a wide range of impacts. This analysis is largely still relevant (with notable exceptions identified below), and should be used as a basis for the Board's current EIS analysis. In this current EIR, the Board should utilize the SDFEIS range of alternatives, scope of affected resources, analysis, findings, and record of comments and update them to reflect that the Klamath Basin Restoration Agreement has terminated.

2. The Current EIR Should be Updated to Incorporate the Technical Disease Memorandums

Ceratanova shasta (C. shasta) is a lethal parasitic disease that has plagued juvenile salmon in the Klamath River during recent years. Of the Chinook salmon sampled for the disease in May through July of 2014 and 2015, 81% and 91% respectively were infected with *C. shasta*. In addition to the impacts to the Tribe's Chinook fishery, his disease is a major source of mortality for juvenile coho salmon, which are listed as threatened under the Endangered Species Act.

The proliferation of *C. shasta* levels in the Klamath River has been exacerbated by an ecosystem that is out of balance relative to conditions under which salmonids evolved. The presence of the dams and associated reservoirs, along with flow reductions due to upstream diversions, have led to conditions that favor *C. shasta* and it's obligatory host, a polychaete worm (*Manayunkia□speciosa□- M.□speciosa*) that lives on the substrate of the Klamath River. Effects from the KHP that have contributed to excessive C. shasta levels include the following:

- An altered sediment regime downstream of Iron Gate Dam caused by the reservoirs retaining bedload that would naturally route through this area. The reduced sediment load has resulted in a stable substrate that has become armored, thereby, minimizing the alluvial nature of the upper reaches of the river. This stable substrate is prime habitat for the polychaete worms, as they are disturbed less frequently from the flushing of sediments, scouring of substrate, and re-deposition of sediments relative to conditions in a naturally flowing river.
- The reservoirs annually have phytoplankton blooms, especially in Copco and Iron Gate reservoirs. These blooms result in large amounts of dead algae being released in the to Klamath River. This dead and decaying algal material, including from cyanobacteria

species, settle out and become a potential source of food for the polychaete colonies inhabiting the river.

In response to the high disease levels encountered during recent years, especially during 2014 and 2015, a technical team of federal, tribal, and academic scientist was formed to develop technical recommendations to address disease issues. The team developed four technical memorandums and a guidance document that outlines measures necessary to reduce *C. Shasta* rates in the Klamath River. These documents provide extensive current information about the negative effects of an altered sediment and flow regime, algal blooms from the reservoirs, poor water quality and high water temperatures have on juvenile disease levels in the Klamath River. The four memorandums and guidance documents are attached herein for the Board's review.

3. The Current EIR should Incorporate the Analysis Findings of the SDFEIS with Some Additional Consideration

As stated above, and in our January 2016 comments, the Tribe generally supports the analysis and conclusions of the SDFEIS. There are, however, some areas of the SDFEIS in which we believe the analyses to be flawed or lacking. As our 2016 comments relay these items in detail we simply list them below:

- The SDFEIS understates the impacts of the "No Action" alternative on fish populations
- The SDFEIS overstates the worst-case impacts of sediment flush from dam removal.
- The SDFEIS does not accurately reflect the impacts of toxic algae by omitting the unique risks faced by tribal members.
- The Board's EIR should include an analysis on the KHP's impacts on water temperature and subsequent impacts on fish migration.
- The EIR should include an analysis of KHP's effects on fisheries, including geomorphic effects, that have led to increased fish disease below Iron Gate Dam.
- The EIR should include an analysis of climate change impacts that are exacerbated by the presence of the dams.
- The 2017 EIR must also consider to a greater degree the impacts to tribal trust species and how those trust resources are affected by dam removal. The SDFEIS has only a cursory explanation of these impacts.

The Tribe urges the Board to incorporate these items in its current environmental analysis.

4. The EIR Must Include a Comprehensive Analysis of the Cultural Impacts of KHP

The recent amendment to CEQA, AB 52, imposes a commitment on the Board to incorporate and evaluate potential negative impacts to Tribal Cultural Resources and to avoid and mitigate those impacts whenever possible. The Tribe has detailed the cultural significance of the Klamath River and its resources, as well the devastating impacts of the KHP on these cultural resources, in its 2016 comments. We ask that the Board refer to these comments for a detailed discussion and supplemental documents regarding Yurok Tribal cultural resources. We are confident that when the impacts to our cultural resources are given sufficient weight, it will be

clear that facilities removal is the only viable option. We, therefore, urge the Board to honor its commitment to incorporate the impacts to Yurok Tribal cultural resources into its EIR analysis.

The Tribe appreciates the opportunity to provide comments on the Board's certification of the KHP application for licenses surrender and removal to FERC. The Tribe looks forward to continuing to work with the Board to accomplish facilities removal by 2020. Should you have any questions regarding the Tribe's comments, please contact Amy Cordalis, General Counsel, at (707) 482-1350.

Wok-hlew',

Thomas P. O'Rourke, Sr.
Chairman

YUROK TRIBE

190 Klamath Boulevard • Post Office Box 1027 • Klamath, CA 95548

Via Electronic Mail

January 29, 2016

State Water Resources Control Board
Division of Water Rights
Water Quality Certification Program
Attention: Mr. Parker Thaler
P.O. Box 2000
Sacramento, CA 95812-2000

E-mail: parker.thaler@waterboards.ca.gov

Re: Yurok Tribe Scoping Comments on the Klamath Hydroelectric Project EIR

Aiy-ye-kwee':

The Yurok Tribe (the Tribe) respectfully submits the following written comments to the State Water Resources Control Board (the Board) for consideration in its certification pursuant to Clean Water Act Section 401 of the Klamath Hydroelectric Project (KHP) relicensing by the Federal Energy Regulatory Commission (FERC).

The Yurok People have always been stewards of the Klamath Basin. Yurok culture is centered on maintaining the balance between the River and everything that depends on it. In the early 2000's as scientific information on the ongoing effects of the dams became more readily available, the Yurok Tribe began to advocate for complete facilities removal in a timely fashion. In 2006, when the first relicensing application and coinciding state water quality certification processes commenced, the Yurok Tribe formalized its position. Since 2006, the Yurok Tribe has strongly advocated for complete facilities removal as the only effective means of fully mitigating for the KHP. After more than ten years of exhaustive analysis, studies, and reports, there is no question that the presence of the dams has impaired the health of the Klamath River and downriver communities. Over the course of the last decade, state and federal agencies, and PacifiCorp itself have also acknowledged that dam removal is appropriate. The Tribe stays committed in its call for complete facilities removal to address water quality impacts caused by KHP.

In this current water quality certification process the Board is once again faced with the task of analyzing and prescribing mitigation for the wide range of negative water quality impacts of the KHP. The Tribe urges the Board, in its certification of the KHP relicensing,

fully analyze complete facilities removal as a comprehensive and long term solution to the ongoing water quality issues caused by the dams.

The following comments provide the Tribe's key issues and supporting data, which reinforce the need for dam removal, and which must be considered when assessing the water quality impacts of the KHP.

1. The Board is Obligated under CEQA to Evaluate Project Alternatives that Avoid and Mitigate Impacts to the Tribe's Cultural Resources

Since time immemorial Yurok people have lived along the Klamath River. The ancestral territory of the Yurok Tribe is centered on the Klamath River. Today, the Yurok Reservation is just a fraction of the Yurok ancestral territory, extending for a mile on each side of the Klamath River from the Pacific Ocean to just upstream of the confluence of the Klamath and Trinity Rivers. The Klamath River flows for 45 miles directly through the heart of the Yurok Reservation.

The importance of the Klamath River to the Yurok way of life cannot be overstated. The Tribe, its history, subsistence, culture, identity, spirituality and economic survival have always relied upon the Klamath River. The River is the central bloodline of the Yurok People and the health of the people are connected to the health of the River. Non-Indian settlement in the 1800s began a long history of land management decisions beyond the control of the Tribe that altered the River, its ecosystems, and the presence of the Yurok people on the surrounding lands. The Tribe had no say in the decision to construct the Klamath Project when it occurred and received no benefit from the power it produced, but is now suffering disproportionately from its consequences. The water quality conditions created by the dams have had devastating impacts on fish populations in the River, the focal point of Yurok subsistence, spirituality, ceremony, and economy. The increased presence of toxic algae in the River, caused by the lacustrine effect of the dams, occurs during the peak time for commercial and subsistence fishing and ceremonial practice for Yurok people, exposing those who practice these traditional activities to increased health risks. Yurok basket weavers collect materials (willow sticks and roots) in riparian areas of the Klamath River, traditionally using their teeth to help strip and clean the freshly harvested materials that have been continually exposed to the toxins in the River. Ceremonial bathing in the river following sweathouse cleansing places the practitioner at risk due to elevated toxin levels. It is unacceptable that because of water quality problems created by the KHP our people are now forced to compromise their health to practice their way of life.[1]

Yurok people have struggled to maintain cultural, economic, and spiritual ties to the Klamath River through ceremonial practices, subsistence and traditional uses of local natural resources, but that way of life we have fought so hard to preserve is at risk as long as the KHP continues to impact River health.

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[1] The Yurok Tribe Heritage Preservation Officer (THPO), Robert McConnell, has provided separate comments to the Board further explaining the significant cultural impacts of the KHP. They are incorporated herein by reference.

The State has expressed a commitment in adopting AB 52, an amendment to CEQA incorporating impacts to tribal cultural resources into its environmental review, to respect and protect tribal cultural resources like those of the Yurok Tribe in the Klamath Basin that have been too long overlooked by state and federal management decisions. The Tribe encourages the Board to honor this commitment by incorporating the devastating cultural impacts into its EIR for 401 certification. These impacts, when given weight, make the necessity of facilities removal very clear.

For an in-depth analysis of the connection between the River and the Yurok People please see the attached report, *Yurok and the Klamath River: Yurok Historical Context and Data for Assessing Current Conditions and the Effects of the Proposed Klamath Restoration Project on Yurok Tribal Trust Assets and Yurok Resources of Cultural and Religious Significance* (Sloan February 2011), which was compiled by Yurok Tribal staff for the 2011 Secretarial Determination EIS/EIR. The Tribe urges the Board to weigh the information in the report heavily in its assessment of impacts of the KHP to tribal cultural resources.

2. The Board Must Consider How KHP Water Quality Impacts Affect the Tribe's Federally Protected Rights to a Healthy Fishery

The Yurok people are totally reliant on the Klamath River salmon fishery for survival. The courts have acknowledged that the Klamath River Indian fishery is "not much less necessary to the existence of the [Yurok] Indians than the atmosphere they breathed."[2] Prior to the arrival of non-Indians in the 19th century, the Klamath River fishery provided significant economic value such that Yurok Indians were self-sufficient and considered to be people of wealth. In fact, noted anthropologist Alfred Kroeber labeled Yurok as "Salmon People of the Northwest Coast."

The fishing rights of the Yurok Tribe are well-established as a matter of federal law. The Yurok Reservation was created pursuant to an 1855 Act of Congress with the specific purpose of providing a territory in which the Tribe's fishing-based culture and way of life could persist. This fact has been recognized repeatedly since the Reservation was established, by the Department of the Interior, the United States Supreme Court, the lower federal courts and the California Courts.[3] The Ninth Circuit has confirmed that the Executive Orders that created the present-day Yurok Reservation vested the Yurok Tribe with "federally reserved fishing rights."[4]

The KHP has contributed to significant detrimental impacts to the Tribe's federally reserved fishing rights. It has blocked hundreds of miles of once viable salmon habitat, altered geomorphic and hydrologic processes in a manner that compromises downstream habitats, and deteriorated water quality to a point that threatens existing fish populations. In

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[2] *Mattz v. Arnett,* 633 F.2d 906, 909 (9th Cir. 1981), 412 U.S. 481 (*quoting United States v. Winans,* 198 U.S. 371, 381 (1905)).

[3] *See, e.g., United States v. Eberhardt*, 789 F.2d 1354 (9th Cir. 1986); *United States v. Wilson*, 611 F. Supp. 813 (N.D. Cal. 1985), *rev'd on other grounds sub. nom., Eberhardt*, 789 F.2d 1354; *Pacific Coast Federation of Fishermen's Assoc. v. Sec'y of Commerce,* 494 F. Supp. 626 (N.D. Cal. 1980); *Mattz v. Arnett*, 412 U.S. 481, 487 (1973); Memorandum Opinion of the Solicitor, John D. Leshy ("Solicitor's Opinion"), M-36979 (October 4, 1993).

[4] *Parravano v. Masten,* 70 F.3d 539, 541 (9th Cir. 1996), *cert. denied*, 518 U.S. 1016, (1996).

its review, the Board must carefully examine how KHP water quality impacts jeopardize the fishery that is central to Yurok existence.

3. The Tribe Largely Supports the Conclusions from the Secretarial Determination EIS/EIR with a Few Notable Exceptions the Board Should Address in its EIR

In general, we support the analyses and conclusions of the Klamath Facilities Removal EIS/EIR prepared for the Secretarial Determination of the KHSA and its analyses (SDFEIS), and urge the SWB to use this information as appropriate as a basis for the 401 water quality certification and associated EIR. There are, however, several substantial areas in the SDFEIS in which we believe the analyses were flawed or the SDFEIS understated the water quality impacts of the continued presence of the dams to fish. Many of the SDFEIS analyses contemplates all TMDL's being met in the near future, which may or may not be the case in this EIR process. This causes a systematic underestimation in the SDFEIS of the ongoing water quality impacts. However, many of the analyses contained in the SDFEIS are still useful.

a. The SDFEIS Understates Impacts of "No Action" Alternative on Fish Populations

A recurring theme in the SDFEIS is that under the "no action" alternative the status of the fisheries resources on the Klamath River would remain static and at current depressed levels. While we concur that the dams are depressing fish populations, we believe that the KHP has been contributing to the decline of the fishery for quite some time, and that it is possible for the fishery to decline further and for certain species (i.e. coho salmon) and runs (i.e. spring Chinook salmon) to descend to extinction. The Board must ensure that the analysis of the no action alternative in the current EIR reflects this possibility.

b. SDFEIS Overstates Worst-Case Impacts of Sediment Flush from Dam Removal

The SDFEIS makes an attempt to characterize "most likely" and "worst-case scenario" suspended sediment concentrations (SSC's), resulting from facilities removal, but this attempt is insufficient. The method used in the SDFEIS leads to erroneously overstated effects to the river from suspended sediments mobilized by dam removal. The method used runs each year of the 48 year period of record through a sediment model to estimate corresponding SSC's. Each day's results are then rank-ordered, and the top 10% is selected. Each day's 10 percentile flow is then used to construct a "worst case" estimate. Such an analysis is statistically indefensible. Using independently derived estimates of exceedance probabilities and joining them together is deeply flawed and is not scientifically defensible. Although it is useful to analyze a worst-case scenario, the analysis must be accurate, and in the SDFEIS, due to the statistical treatment of the data, the worst case scenario analysis is not accurate.

In addition, a "best case" scenario should be added if a "worst case" scenario is evaluated. This will allow for a proper risk-management decision. It is not proper to be "conservative" toward one outcome or another, but the document and analysis should simply present a range of possibilities and their likelihoods according to the best available information.

A remedy for this error might be to determine for each year in the period of record (for the sediment model output) the duration of SSI over a given threshold. From those durations, you could then calculate a 10% exceedance for time spent over that threshold. For example: calculate the number of days for every year in the modeled period of record that the river at point X spends over 1000 ppm. Sort the number of days over the threshold of interest in each year high to low, and from there, select the 10%, 50%, 80%, time durations over the threshold that would represent best, most likely, and worst-case scenarios. Repeat process for other thresholds of interest or relevant to sediment exposure model for fisheries.

The Yurok Tribe raised this point in the administrative draft of the SDFEIS and the public release draft, but no corrective action has been taken with regards to this point. The statistical analysis remains deeply flawed. We urge the Board to adopt a more defensible approach to assessing the impacts of dam removal. If SWB staff have questions on this important point, please contact the Yurok Tribe for clarification.

4. The Board must carefully evaluate the KHP Impacts on Toxic Algae, and the Unique Risk Faced by Tribal Members Because of Its Presence in the River

The Tribe urges the Board to carefully evaluate the impacts of the KHP on the presence of microcystin in the River, and more importantly the feasibility of suggested mitigation measures to remedy the problem. It is the Tribe's opinion that there are no alternatives, besides dam removal, that will effectively reduce the prevalence of toxic algae in the lower Klamath to meet water quality standards, and mitigate the health risk caused by its presence.

The concern that cyanobacterial diseases may be contributing to stress levels in adult fish and shellfish is addressed in the SDFEIS on page 3.3-45.

> *Algae produced in Upper Klamath Lake and the reservoirs in the Klamath Hydropower Reach (Copco 1 and Iron Gate Reservoirs) may be deleterious to the health of aquatic organisms in Upper Klamath Lake and the Klamath River. Some cyanobacteria species, such as M. aeruginosa, produce toxins that can cause irritation, sickness, or in extreme cases, death to exposed organisms (see Section 3.2.3.7 and Appendix C, Section C.6). While direct links to fish health are still somewhat unclear, recently collected data from the Klamath Basin indicates that algal toxins bioaccumulate in tissue from fish and mussels at concentrations that may be detrimental to the affected species (Fetcho 2011).*

For the Yurok People, it's not just the animals themselves, but the people who rely on them that are at risk. Samples collected in 2007 and again in 2009 indicate microcystin bioaccumulation in traditionally significant freshwater mussels from the Klamath River below Iron Gate at levels that exceed established public health advisory values for consumption. (Kann 2008, OEHHA 2008, Kann et al. 2010). Such bioaccumulation levels in the lower river occurred despite very low ambient microcystin concentrations, indicating that even when ambient concentrations do not exceed public health guidelines, shellfish may still be unsafe for consumption. Although only limited data are available regarding the concentrations of microcystin toxins in tissues of Klamath Basin salmonids, tissue samples collected by the Karuk Tribe also showed that Klamath River salmonids (chinook salmon

and steelhead) were exposed to microcystin and that bioaccumulation in liver tissue occurred with concentrations in several fish livers exceeding public health guideline values (Kann et al. 2013).

Yurok Tribal members face additional exposures and adverse impacts in ways not accounted for in most risk assessments, which model exposures largely received in mainstream, urban and suburban settings and do not consider the extent of tribal environmental contact through extended length of daily contact time and the cumulative exposure throughout their lifetime. Tribal members are at risk in all aspects of daily life: during recreational, subsistence, cultural, ceremonial and commercial fishing use of the River; from inadvertently inhaling aerosolized toxins; ingesting contaminated water; absorption of toxins through their skin and through the ingestion of contaminated fowl, fish, shellfish and other subsistence foods. Recent studies also indicate cyanotoxins can bioaccumulate in terrestrial plants (Corbel 2014), creating health risks for Tribal members harvesting riparian plant materials through traditional methods. Choosing not to go to the River or using river resources when toxins are present is simply not an option for the Yurok People.

With the goal of improving water quality within Copco and Iron Gate Reservoirs and the Klamath River downstream, PacifiCorp has conducted a series of interim measures under the Klamath Hydroelectric Settlement Agreement (KHSA) and developed a Reservoir Management Plan (RMP) (PacifiCorp 2014). These measures focus on issues external to the dam operations, rather than the significant contribution of the dams themselves in creating the lacustrine habitat required for the large and toxic cyanobacteria blooms that currently dominate. Despite the purpose of the RMP to help to improve water quality in the Klamath River below the Project reservoirs by reducing nutrient loads upstream (PacifiCorp 2015), no data or evidence are provided for how the proposed techniques will reduce toxic cyanobacteria blooms to meet water quality standards and public health thresholds.

The menu of experiments and water quality improvement measures fall far short of what would be needed to comply with California's water quality standards. Despite a decade of experimentation and study, PacifiCorp has yet to offer a specific plan for how a combination of techniques could be jointly implemented to actually meet water quality standards. There are no feasible means besides dam removal for mitigating toxic cyanobacterial blooms, one of the KHP's most consequential water quality impacts for Yurok Tribal members. The Board should take special consideration of the daily exposure risk of Yurok Tribal members when assessing the KHP impacts on toxic algae.

5. Additional Issues for the Board's Consideration

In addition to the issues identified above, the Board should incorporate the following issues into its environmental review:

a. KHP Impacts on Temperature

The KHP raises temperatures significantly at Iron Gate Dam, Copco 1 and Copco2 during the fall migration period for Chinook salmon due to the thermal inertia of the dams as they retain summer heat through the fall release period. One of the effects of raised

temperatures during the fall migration is a shift in run timing for fall-run Chinook salmon. A comparison of the peak of fall Chinook salmon entry timing into the Klamath River estuary from the 1920's until today (Yurok Tribal harvest data, Snyder 1931, Strange 2012) shows that the run currently peaks about three weeks later than it used to, which coincides nearly exactly with the phase shift of high temperatures due to the presence of the reservoirs.

This shift in run timing in turn causes a "pause" in fish migration through the lower Klamath River in most years (Strange 2012). This pause in migration is hypothesized to lead to higher fish densities as later returning fish and Trinity River fish join in the lower river, which then leads to higher risk of fish disease outbreaks in the lower river. The risk of outbreaks of ich and columnaris such as happened during the catastrophic fish kill event of 2002, and again in 2014 and 2015, are thus increased due to the altered temperature regime in the area of Iron Gate Dam and its selective effect on migration rates.

In addition, because the fish now spawn later, they also hatch later, which leads to later outmigration and rearing. Juvenile salmonids, especially fall-run Chinook salmon, now outmigrate during a time of rapidly rising water temperatures. When combined with high spawning densities due to the migration barrier at Iron Gate Dam, overly stable geomorphology from the presence of the dams, and steady-state flow management, this creates the "perfect storm" for disease conditions on the Klamath River. It is very likely that the fall temperature increase leads to a "domino effect" situation which exacerbates an already serious disease condition on the Klamath.

PacifiCorp, in its FERC license application, determined that the cold water pool in Iron Gate Dam was insufficient to provide for cold water releases for any appreciable period of time, and that the deeper, colder water was deficient in dissolved oxygen. Thus there is no mitigation for the temperature-related water quality impact to the river, besides dam removal.

b. KHP Impacts on Disease Below Iron Gate Dam

Cold water fisheries are a beneficial use of the waters of the Klamath River below Iron Gate Dam. Therefore, the overall effects of the dams' presence on fisheries, including geomorphic effects, must be incorporated into the Board's water quality analysis. The presence of the dams contributes to a stable geomorphic environment with stable winter flows. Stable geomorphic conditions have led to an increase in the polychaete host for two diseases that affect Chinook and coho salmon, *Ceratonova shasta* and *Parvicapsula minibicornis.*

In 2015, over 90% of juvenile fish from the upper portion of the Klamath River were infected with these lethal diseases (Bartholomew 2016 unpublished data). The losses to the 2015 year class are not known exactly, but are presumed to be significant if not catastrophic.

We agree with FERC's assessment of the dam's contribution to the fish diseases in the mainstem Klamath River below Iron Gate Dam (FERC 2007 as quoted on page 3.3-44 of SDFEIS)

> *FERC (FERC 2007) concluded that Klamath Hydroelectric Project has likely contributed to conditions that foster disease losses in the Lower Klamath River by (1) increasing the density of*

spawning adult fall Chinook salmon downstream from Iron Gate Dam; (2) promoting the development of attached algae beds that provide favorable habitat for the polychaete alternate host for C. shasta, with P. minibicornis; and (3) contributing to water quality conditions that increase the stress level of juvenile and adult migrants and increase their susceptibility to disease. The water quality conditions that may increase stress levels include: (1) increased water temperatures in the late summer and fall; (2) elevated ammonia concentrations and swings in DO and pH associated with algal blooms in project reservoirs; and (3) effects of exposure to elevated levels of microcystin produced from microcystis blooms in Project reservoirs, which may also result in direct mortality.

As is the case for all issues raised in our comments, there is no mitigation measure available besides dam removal to adequately address the water quality impacts of the dams' effects on geomorphic conditions.

c. Climate Change

The Yurok Tribe is very concerned about the potential impacts of climate change on Yurok lands and the Klamath River and its resources, specifically to culturally significant species and the habitats and ecosystems that support them.

In spite of being located in a region that receives significant precipitation, changes in hydrology, temperatures and precipitation type (rain or snow), timing and intensity have the potential to disrupt the availability and reliability of key resources upon which many tribal members still rely for drinking water, subsistence foods, cultural and ceremonial activities. The lack of adequate infrastructure, and heavy reliance on Reservation surface waters and vulnerable aquatic resources, puts the Yurok Tribe at significant risk of adverse tribal health outcomes resulting from changes in temperature and water quality; changes that are exacerbated by KHP operations. Impacts include the potential loss of safe and reliable subsistence foods, exposures to water-borne pathogens through surface waters, increased exposure to toxic algae, and increased community health risks associated with an increase in extreme weather events such as floods, tidal surges, erosion from sea level rise, landslides, droughts and wildfire. The Yurok Tribe asks the Water Board to consider the effects of climate change on an ecosystem wide level as they relate to Klamath River water quality and meeting the objectives of prescribed beneficial uses.

For fisheries resources, dam removal is a key strategy to ensure the long term survival of the anadromous fish runs of the Klamath River. Substantial cold water resources lie upstream of Iron Gate Dam, including springs at Fall Creek, Copco, Big Springs near JC Boyle, Spencer Creek, Upper Klamath Lake, Wood River, the Williamson including Spring Creek, and more. These areas will remain cold during the summer period even as snowpack dwindles from the effects of climate change (Tague 2008). Access to these areas, and the ability for this cold water to make its way downriver without interceding reservoirs is crucial for the long term survival of the fisheries resources of the Klamath River.

6. Conclusion

The Tribe appreciates the opportunity to provide input on the Board's water quality certification of the KHP FERC relicensing, and looks forward to working with the Board to

fully mitigate the effects of the KHP to meet state water quality standards. The Tribe is happy to provide any additional data and information you may find useful in your review. If you have any questions please contact Rebecca McMahon, Deputy General Counsel for the Yurok Tribe at (707) 482-1350.

Wok-hlew',



James Dunlap,
Chairman

Water Quality & Other Relevant Reports

There are several reports the Tribe would like the Water Board to review while drafting their Environmental Review. Several have been included in these written comments as attachments. Relevant water quality documents from the Yurok Tribe can be found on YTEP's portion of the Tribal website at: http://www.yuroktribe.org/departments/ytep/index.htm, and on the Klamath Tribal Water Quality Consortium's website http://klamathwaterquality.com/documents.html. Any report listed below that is not attached or available online is available upon request of Yurok Tribal staff.

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Review

Cyanobacterial toxins: Modes of actions, fate in aquatic and soil ecosystems, phytotoxicity and bioaccumulation in agricultural crops

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HIGHLIGHTS

- Phytotoxic effects of cyanotoxins on agricultural plants have been updated.
- We report mechanisms of cyanotoxins and target molecules in vegetable organisms.
- The effects of cyanotoxins in the terrestrial environment is particularly scarce.
- We describe fate of cyanotoxins in aquatic and soil ecosystems.
- We examine bioaccumulation of cyanotoxins in vegetable foods.

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ABSTRACT

The occurrence of harmful cyanobacterial blooms in surface waters is often accompanied by the production of a variety of cyanotoxins. These toxins are designed to target in humans and animals specific organs on which they act: hepatotoxins (liver), neurotoxins (nervous system), cytotoxic alkaloids, and dermatotoxins (skin), but they often have important side effects too. When introduced into the soil ecosystem by spray irrigation of crops they may affect the same molecular pathways in plants having identical or similar target organs, tissues, cells or biomolecules. There are also several indications that terrestrial plants, including food crop plants, can bioaccumulate cyanotoxins and present, therefore, potential health hazards for human and animals. The number of publications concerned with phytotoxic effects of cyanotoxins on agricultural plants has increased recently. In this review, we first examine different cyanotoxins and their modes of actions in humans and mammals and occurrence of target biomolecules in vegetable organisms. Then we present environmental concentrations of cyanotoxins in freshwaters and their fate in aquatic and soil ecosystems. Finally, we highlight bioaccumulation of cyanotoxins in plants used for feed and food and its consequences on animals and human health. Overall, our review shows that the information on the effects of cyanotoxins on non-target organisms in the terrestrial environment is particularly scarce, and that there are still serious gaps in the knowledge about the fate in the soil ecosystems and phytotoxicity of these toxins.

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1. Introduction

In light of global climate change, and particularly measurable rises in global temperature, as well as increased fluxes of certain nutrients (i.e., nitrates, phosphates) brought either by agricultural run-off or by sewage treatment plants and other anthropogenic sources, it has been suggested that cyanobacteria, including toxin-producing taxa, may be increasing in abundance, and thus represent an emerging human and environmental health concern (For review see in O'Neil et al., 2012). The presence of such toxins has been reported throughout the world and it appears that liver-toxic microcystins are more commonly found in 40–75% cyanobacterial blooms (Sivonen and Jones, 1999). The contamination of surface waters by these cyanotoxins can cause water quality problems for fisheries, aquaculture, farming, and sanitary hazard for human and animals. Humans are exposed to cyanobacteria toxins through many routes, including drinking water, recreational contact, and health food products made from cyanobacteria, and food chain. In recent years, several cyanobacterial toxins were investigated in regard to their ability to enter the food chain *via* freshwater seafood (Ibelings and Chorus, 2007; Ettoumi et al., 2011), however, their ability to enter the food chain *via* agricultural crops has not been thoroughly investigated to date. Although no case of poisoning by these products has been reported in the literature, this eventuality must not be ignored. Indeed, a recent epidemiological study showed that the excessive incidence of amyotrophic lateral sclerosis in the population of the islands of Guam in the Pacific was linked to a consumption of the seeds of cycas contaminated by a neurotoxin, β-methylamino-L-alanine (BMAA), produced by a species of cyanobacteria of the genus *Nostoc* living in symbiosis in the roots of this plant (Banack and Cox, 2003; Cox et al., 2003; Murch et al., 2004; Steele and McGeer, 2008). This last cited fact is gaining importance since plants could in a direct or indirect manner contribute to food chain cyanotoxin's transfer, and by the way constitute a potent health risk source. Indeed, numerous studies reported that both submerged and emergent aquatic plants have been shown to absorb microcystins from low external concentrations (Pflugmacher et al., 1998, 2001; Yin et al., 2005; Saqrane et al., 2007). In terrestrial plants, Codd et al. (1999) reported that spray irrigation of commercial lettuce (*Lactuca sativa*) plants with water containing *Microcystis* resulted in colonies and single cells of the cyanobacterium being lodged on the leaves 10 d after the last irrigation. MC-LR was present at 2.5 mg kg^{-1} dry weight (DW) in the central leaves, 0.833 mg kg^{-1} (DW) in the distal zone of mature leaves, and 0.094 mg kg^{-1} (DW) in the basal zone of mature leaves. The last study indicated that toxins were absorbed by the plant as the central leaves would have been protected from irrigation. Similar conclusions were reached for rice (*Oryza sativa*) and rape (*Brassica napus*) by Chen et al. (2004). Therefore, the accumulation of cyanotoxins in the terrestrial food chain is at present remains more worrying and the proposed quality limits are rare, indeed, many aspects concerning these toxins are particularly scarce, notably those relative to the fate of cyanotoxins in the soil ecosystems and their toxicity and bioaccumulation on agricultural crops.

There have been several reviews of the intensification and global expansion of harmful cyanoabcterial blooms in terms of abundance, geographic extent, factors that may be promoting this expansion, and prevention and management of cyanobacteiral blooms and their toxins, as well as effects on aquatic ecosystem health and transfer on food webs (Wiegand and Pflugmacher, 2005; Ibelings and Chorus, 2007; Paerl and Huisman, 2009; Aráoz et al., 2010; Kinnear, 2010; Merel et al., 2010; Jančula and Maršálek, 2011; O'Neil et al., 2012). However, the purpose of this review is to: (1) Highlight important findings of the last decade of modes of actions of cyanotoxins in humans and mammals and occurrence of target biomolecules in vegetable organisms; (2) Describe the fate of cyanotoxins in aquatic and soil ecosystems and focus in their phytotoxicity; and (3) Emphasize bioaccumulation of these toxins in vegetable foods and its consequences on animals and human health.

2. Cyanotoxins and their producers

Recent research suggests that eutrophication and climate change are two processes they may promote the proliferation and expansion of harmful cyanobacterial blooms in freshwater, estuarine, and marine ecosystems. These microorganisms are known to biosynthesize a wide range of chemical classes of secondary metabolites such as peptides, macrolides, and glycosides (Patterson et al., 1994; Namikoshi and Rinehart, 1996) possessing a number of bioactivities: antiviral (Patterson et al., 1993, 1994), antifungal (Patterson et al., 1994), cytotoxic (Patterson et al., 1991), enzymatic inhibitor (Honkanen et al., 1995), antineoplastic (Moore, 1996), and allelopathic (Pushparaj et al., 1998). However, some of these cyanobacterial secondary metabolites encompass a diversity of alkaloid and peptide cyanotoxins which have been suggested to both pose threats to human and environmental health worldwide (Hawkins et al., 1985; Carmichael and Falconer, 1993; Kuiper-Goodman et al., 1999; Sivonen and Jones, 1999; Hitzfeld et al., 2000; Ettoumi et al., 2011). Toxic cyanobacteria that have been involved in such incidents belong essentially to the genera *Microcystis*, *Anabaena, Aphanizomenon, Planktothrix, Oscillatoria, Cylindrospermopsis* and less often *Gomphosphaeria*, *Coelosphaerium, Gloeotrichia*, *Nodularia* and *Nostoc* (Hawkins et al., 1985; Sivonen and Jones, 1999). The cyanotoxins are essentially endotoxins which can be released in the environment following a cellular lyse (Codd et al., 1989) or following treatment of cyanobacterial blooms with algaecides (Kenefick et al., 1993). They can be classified into four families according to the organs on which they act: neurotoxins (nervous system), hepatotoxins (liver), cytotoxins (several organs: liver, kidneys, adrenal glands, small intestine), and dermatotoxins (irritant toxins).

Cyanobacterial neurotoxins are divided in three groups: anatoxins (anatoxin-a, homoanatoxin-a, and anatoxin-a(s)), saxitoxins,

and the neurotoxic amino acid L-beta-N-methylamino-L-alanine (BMAA). Anatoxins and the BMAA are specific of cyanobacteria, while, saxitoxins are also synthesized by some marine dinoflagellates and associated with the human disease paralytic shellfish poisoning or PSP (Falconer, 1991; Carmichael, 1994; Kaebernick and Neilan, 2001). By contrast to the other neurotoxins which production depends on the phylogeny of the species, the BMAA can be produced by almost all groups of cyanobacteria from freshwater, brackish, and marine environments (Cox et al., 2005; Banack et al., 2007). Hepatotoxins are divided into two groups: Microcystins (MCs), cyclic heptapeptide hepatotoxins (MW 900–1200), that are regarded as the most frequently occurring and widespread of the cyanotoxins with more than 80 MC variants already reported (Sivonen and Jones, 1999; Cox et al., 2005; del Campo and Ouahid, 2010); and nodularins (MW 800–900) composed of five amino acids with only nine different natural analogs have been characterized (De Silva et al., 1992; Namikoshi et al., 1993; Rinehart et al., 1994; Codd et al., 2005). The hydrophilic alkaloid cytotoxin, cylindrospermopsin (MW 415) has been identified in the freshwater cyanobacteria *Cylindrospermopsis raciborskii* (Ohtani et al., 1992), *Umezakia natans* (Harada et al., 1994), *Aphanizomenon ovalisporum* (Sivonen and Jones, 1999), *Anabaena* sp. (Schembri et al., 2001), and *Raphidiopsis* sp. (Li et al., 2001). Today, only two congeners of cylindrospermopsin have been identified: 7-epicylindrospermopsin and deoxycylindrospermopsin. The freshwater cyanobacterial irritant toxins such as lipopolysaccharides (LPS), or endotoxins as they are commonly called, are major components of the cell wall in most Gram-negative bacteria including cyanobacteria (Jann and Jann, 1984; Mayer and Weckesser, 1984; Kaya, 1996; Stewart et al., 2006).

3. Modes of actions in humans and mammals and occurrence of target biomolecules in vegetable organisms

3.1. Neurotoxins

Anatoxin-a is a potent postsynaptic depolarizing neuromuscular blocking agent that affects both nicotinic and muscarinic acetyl cholineacetylcholine receptors (Carmichael et al., 1979; Spivak et al., 1980). It acts as a depolarizing neuromuscular blocking agent mimicking the action of acetylcholine. However, this neurotoxin is not degraded by the acetylcholinesterase, and consequently its action on the muscular cells does not stop and, due to being stimulated, these cells are blocked and thereby resulting to muscle paralysis (Carmichael, 1994; Lilleheil et al., 1997). When the respiratory muscles are affected, the insufficient oxygenation of the brain engenders convulsions and the oppression (Carmichael, 1994; Humpage et al., 1994). The LD_{50} (lethal dose resulting in 50% deaths) of this neurotoxin is 200 μg kg^{-1} (mouse, i.p.) (Carmichael et al., 1979; Skulberg et al., 1992). Homoanatoxin-a is a homologue of anatoxin-a, that was reported to be a potent nicotinic agonist (Wonnacott et al., 1992). It enhances the release of acetylcholine from peripheral cholinergic nerves through opening of endogenous voltage dependent neuronal L-type calcium channels (Aas et al., 1996; Lilleheil et al., 1997). Despite the similarity in their names, anatoxin-a(s) and anatoxin-a are not structurally related and exhibit different physiological properties. Anatoxin-a(s) belongs to the organophosphate class of neurotoxins and it acts as an irreversible inhibition of acetylcholinesterase at the nerve synapse (Mahmood and Carmichael, 1986, 1987). The LD_{50} (mouse, i.p.) of this toxin is about 20–40 μg kg^{-1} (Mahmood and Carmichael, 1987; Matsunaga et al., 1989; Carmichael et al., 1990). In animals, the mechanisms of action of PSP toxins (saxitoxins) are based on the blockage of sodium conductance in axons (Kao et al., 1967; Henderson et al., 1973). They so inhibit the transmission of the electric activity and prevent the liberation of the acetylcholine (Nishiyama, 1968). Their toxicity is more important than that of anatoxins with a LD_{50} (mouse, i.p.) in the same conditions for the saxitoxin of 10 μg kg^{-1} (Gorham and Carmichael, 1988). Saxitoxins can also bind to calcium (Ca^{+2}) and K^+ channels, interfering with the speed of opening and closing of these channels, which can in turn lead to alteration in the influx of ions to the cell (Wang et al., 2003; Su et al., 2004). In addition, the Na^+-channel blockage may alter the selective permeability of the membrane and may change the flow of ions, leading to damage to cellular homeostasis (Hille, 1992; Jablonski et al., 2007). Concerning the neurotoxic amino acid (BMAA), it acts in mammals as a glutamate agonist at AMPA, kainite and NMDA receptors (Spencer et al., 1986, 1987; Andersson et al., 1997; Seawright et al., 1999). Consequently, it increases the intracellular concentration of calcium in neurons and induces neuronal activity by hyperexcitation (Brownson et al., 2002). To our knowledge, no data regarding the toxicity of cyanobacterial neurotoxins in higher plants have been reported. However, interfering of some of them such as saxitoxins with the speed of opening and closing of Na^+, Ca^{2+} and K^+ channels could modify ions transport in plant cells. For example, a modification of sodium signals can modify osmotic pressure in cells or the assimilation of CO_2 for C4 plants (Brownell and Crossland, 1972). While sodium extrusion in animal cells and microorganisms (including yeast) is directly energized by ATP hydrolysis (Na^+-ATPases), these Na^+ pumps are absent from higher plants (Horie and Schroeder, 2004).

3.2. Hepatotoxins

Cyanobacterial hepatotoxins type microcystin-LR are generally not able to penetrate vertebrate cell membranes and therefore, require uptake via the bile acid transport system present in hepatocytes and cells lining the small intestine (Runnegar et al., 1991). As a result of this, toxicity of these cyanotoxins is restricted to organs expressing the organic anion transporter on their cell membranes such as the liver (Fischer et al., 2005). However, in vegetable cells one relatively unexplored question regarding these toxins concerns the mechanism of uptake, particularly the variants that would be predicted to be membrane impermeable based on polarity. They may cross cell membranes of plants by other mechanisms, including diffusion or by root absorption. Pflugmacher et al. (2001) have been reported that when the emergent reed plant *P. australis* was exposed to 0.5 μg of ^{14}C-labeled microcystin-LR L^{-1} for 3 d, it demonstrated a rapid uptake (since 0.5 h) of the toxin. The main uptake route appeared to be in the stem and rhizome, from which the toxin is transported into the higher parts of the plant to the leaves. Uptake directly through the leaves may also occur by direct contact of small plants or by the lowest leaves of a plant with surface water and with upper leaves by wave and spray contact (Pflugmacher et al., 2001). Once in both vertebrate and vegetable cells, microcystins and nodularins have been shown to be potent and specific inhibitors of protein phosphatases 1 and 2A, and this inhibition accounts for their extreme toxicity (MacKintosh et al., 1990; Kurki-Helasmo and Meriluoto, 1998; Hastie et al., 2005). Those proteins are involved in several physiological and molecular processes in higher plants (Sheen, 1993; Takeda et al., 1994). Indeed, numerous studies reported that microcystins have several perturbatory effects on plant physiology and metabolism, when sufficient levels of toxin enter the plant cells (MacKintosh et al., 1990; Siegl et al., 1990; Sheen, 1993; Yamasaki, 1993; Smith et al., 1994; Takeda et al., 1994; Abe et al., 1996; Smith, 1996; Kurki-Helasmo and Meriluoto, 1998; Weiss et al., 2000; McElhiney et al., 2001; Pflugmacher, 2002; Romanowska-Duda and Tarczyńska, 2002; Gehringer et al., 2003; Chen et al., 2004, 2011; Mitrovic et al., 2005; Saqrane et al., 2007, 2008; Stüven and Pflugmacher, 2007; Järvenpää et al.,

2007; Jang et al., 2007; Peuthert et al., 2008; Máthé et al., 2009; Huang et al., 2009; El Khalloufi et al., 2011, 2012; Jámbrik et al., 2011; Perron et al., 2012). On the other hand, several studies have also reported that these hepatotoxins induce oxidative stress in mammal cells (Žegura et al., 2003; Botha et al., 2004; Bouaïcha and Maatouk, 2004; Puerto et al., 2010). Therefore, their toxicity on aquatic plants seems to be also more linked to the induction of oxidative stress manifested by elevated reactive oxygen species (ROS) production and malondialdehyde (MDA) content (Lefevre et al., 1950; Pflugmacher, 2004; Hu et al., 2005; Leflaive and Ten-Hage, 2007).

3.3. Cytotoxins

The alkaloid cylindrospermopsin (CYN) is known as a general cytotoxin that blocks protein synthesis in mammal cells (Runnegar et al., 1995; Froscio et al., 2001, 2003). Implications of this effect can be also observed in vegetable cells. In fact, Froscio et al. (2008) reported that CYN was shown to inhibit the eukaryotic protein synthesis apparatus with similar potency in plant and mammalian cell extracts, IC50 of 334 nM in wheat germ extract and 110 nM in reticulocyte lysate. Metcalf et al. (2004) also showed that CYN inhibited pollen germination in tobacco plants (*Nicotiana tabacum*), with partial inhibition of protein production in the germinating pollen tubes following exposure to 138 μg mL^{-1} of toxin.

4. Environmental concentrations of cyanotoxins in freshwaters and fate in aquatic and soil ecosystems

4.1. Environmental concentrations of cyanotoxins

The occurrence of cyanobacterial toxins was reported throughout the world in surface waters, where hepatotoxic microcystins are more commonly found in 50–75% cyanobacterial blooms (Ettoumi et al., 2011). Data on environmental concentrations of cyanotoxins have been compiled and reviewed in numerous papers (Sivonen and Jones, 1999; Falconer and Humpage, 2006; Van Apeldoorn et al., 2007; Messineo et al., 2009). In this review, we give a summary on environmental concentrations focusing on irrigation waters with the ultimate aim to relate them to phytotoxicological data. Cyanotoxins are intracellular toxins contained within living cells, depending on both the nature of the toxin and the growth stage (Jungmann et al., 1996; Orr and Jones, 1998; Park et al., 1998a,b; Sivonen and Jones, 1999). They are only released into the water, to form dissolved toxin, during cell senescence or cell death and lysis or through water treatment processes such as algaecide application, rather than by continuous excretion (James and Fawell, 1991; Gupta et al., 2001; Babica et al., 2006). The highest total (intracellular plus dissolved) cyanotoxin levels have been found in blooms and scums. For example, total MC concentrations in surface waters vary from trace to several milligrams per liter, being strongly influenced by the occurrence of these forms of cyanobacterial biomass. In surface waters used as irrigation source, total MC concentrations of 4–50 μg L^{-1}, up to 6500 μg L^{-1}, have been reported in multiple locations, including but not limited to the Morocco (Oudra et al., 2001), Tunisia (El Herry et al., 2008), India (Prakash et al., 2009), Turkey (Gurbuz et al., 2009), and Finland (Spoof et al., 2003), but much higher levels up to 29 000 μg L^{-1} in Algeria (Nasri et al., 2008) (Table 1). It should be noted, however, that these very high concentrations of cyanotoxins would be from scums or from very dense cyanobacterial biomass. In the field, water samples with more than 1 μg L^{-1} total MCs, dissolved fraction did not comprise more than 10% of the combined intra and extracellular pool (Lindholm and Meriluoto, 1991; Jones and Orr, 1994; Tsuji et al., 1996; Ueno et al., 1996; Lahti et al., 1997). As well in some laboratory studies, where both intracellular and extracellular cyclic peptide toxins and STXs have been measured, it is generally the case that in healthy log phase cultures, less than 10–20% of the total toxin pool is dissolved in the culture medium (Sivonen et al., 1990; Lehtimaki et al., 1997; Negri et al., 1997; Rapala et al., 1997). On the contrary, CYN may often be found at higher levels in dissolved form than within cells, as it readily leaks from cells under normal growth conditions (Norris et al., 2001; Falconer and Humpage, 2006; Wörmer et al., 2008). For example, Shaw et al. (1999) found that in two instances of *A. ovalisporum* blooms around 80% of the total toxin content of the water was in free solution. Recently, Messineo et al. (2009) reported that in several Italian lakes of different characteristics and human uses, extracellular concentrations of total CYN varied from non-detectable values up to 126 μg L^{-1}. However, limited or no information is available about the proportion of dissolved form with respect to the total level for the cyanobacterial neurotoxins.

4.2. Fate in aquatic and soil ecosystems

Once they enter in aquatic and soil ecosystems, cyanotoxins can be removed according to various processes such as photochemical degradation by UV, adsorption in particles in suspension or onto sediments, and biodegradation (Tsuji et al., 1994; Rapala et al., 1994; Lahti et al., 1996; Chiswell et al., 1999; Welker and Steinberg, 1999; Kaebernick and Neilan, 2001; Mazur-Marzec et al., 2006; Wörmer et al., 2008; Burns et al., 2009; Klitzke et al., 2010, 2011; Thirumavalavan et al., 2012). However, the four groups of cyanotoxins: hepatotoxins, neurotoxins, cytotoxins, and dermatotoxins, exhibit quite different chemical stabilities in these ecosystems. Hepatotoxin cyclic peptide cyanotoxins, microcystins and nodularins, are extremely stable compounds and may persist in aquatic systems for weeks after being released from the cells (Jones and Orr, 1994; Chen et al., 2008; Edwards et al., 2008). According to other studies, these toxins in natural conditions could persist for several months or years (Harada et al., 1996; Sivonen and Jones, 1999). However, numerous studies reported that photochemical degradation by sunlight UV and exposure to degrading bacteria may speed up their removal from the water (Bourne et al., 1996; Heresztyn and Nicholson, 1997; Sivonen and Jones, 1999; Park et al., 2001; Song et al., 2009; Ho et al., 2012). The photodegradation of MCs in full sunlight can take as little as two weeks or longer than six weeks, depending on the presence of water-soluble cell pigments (Tsuji et al., 1994; Welker and Steinberg, 2000). More recently, Thirumavalavan et al. (2012) showed in a laboratory experiment that the presence of humic acid and turbidity affected the photo-degradation process. Additionally, in sea water the rate of nodularin photolysis can be accelerated by the presence of some cell components and humic substance (Welker and Steinberg, 1999). Conversely, during the benthic phase, the photodegradation of these cyanotoxins is expected to be almost negligible due to low radiation penetration (Wörmer et al., 2010). In fact, Welker and Steinberg (2000) found that the half-life of MCs in the deep lakes is longer than the season of cyanobacteria growth, what suggests that the photolysis is significant only for shallow lakes. The alkaloid cytotoxin, CYN, is relatively stable in the dark; however, in sunlight and in the presence of cell pigments degradation occurs quite rapidly with more than 90% within 2–3 d (Chiswell et al., 1999). The neurotoxin, anatoxin-a, is also relatively stable in the dark, but it undergoes rapid photochemical degradation in sunlight particularly in alkaline conditions, even in the absence of cell pigments (Stevens and Krieger, 1991; Smith and Sutton, 1993). However, no data are available for other cyanobacterial neurotoxins and LPS dermatotoxins.

Cyanotoxins can also be retained on suspended particles or onto sediments in aquatic systems. Wörmer et al. (2011) showed the

Table 1
Overview of some published cyanobacterial toxin concentrations from various countries. Concentrations are presented in μg g^{-1} dry weight (DW) or else in μg L^{-1} as indicated.

Country	Location	Use	Type	Concentrations (μg L^{-1} or μg g^{-1} dw*)	Reference
Algeria	L. Oubeira	¤	microcystin-LR	3–29,163	Nasri et al. (2008)
Argentina	R. San Roque	$, £	microcystin-LR	920	Conti et al. (2005)
	–	–	microcystin-LR	48.6	Giannuzzi et al. (2011)
Australia	R. of drinking water	$	saxitoxin	30	Orr et al. (2004)
	L. Julius	$, £, ¤	cylindrospermospin	2×10^6	Saker and Griffiths (2001)
	R. Cania	$, £, ¤	cylindrospermospin	18.9	McGregor and Fabbro (2000)
	L. Cobaki Village	$, £, ¤	cylindrospermospin	101.4	Everson et al. (2011)
	Narrung Channel	$	nodularin-R	1.6	Heresztyn and Nicholson (1997)
	L. Coolmunda	£	microcystin-LR	12	Stewart et al. (2006)
	L. Wivenhoe	£	cylindrospermospin	1–2	
Brazil	L. Bolonha	$	microcystin	1.25	Vieira et al. (2005)
	Sao Paulo	$, £	microcystin	0.5–100	Nobre (1997)
	Parana	$	microcystin	0.2–6.6	Hirooka et al. (1999)
	D. Itaipu	£	microcystin	6,4–10	
	R. Tapacura	$	saxitoxin	52	Molica et al. (2005)
	R. Armando Ribeiro Goncalves	$	microcystin-LR	8.8	Costa et al., 2006
			saxitoxin	3.14	
China	R. Haimen	$	microcystin-LR	1,556	Ueno et al. (1996)
	L. Taihu	$, £, ¤	microcystin-LR	34.2	Liu et al. (2011)
Denmark	L. Knud so	–	homoanatoxin-a	2,300*	Henriksen (1996)
		–	homoanatoxin-a	800*	
		–	homoanatoxin-a	60*	
	L. Ravn so	–	homoanatoxin-a	2,300*	
	L. Salten Langso	–	homoanatoxin-a	20*	
	L. Agerso	–	saxitoxin	37*	Kaas and Henriksen (2000)
	L. Bastrup so	–	saxitoxin	6.4*	
	L. Hvideso	–	saxitoxin	85.1–182.5**	
	L. Vissiggaard so	–	saxitoxin	224.1*	
Finland	Prästträsket	$, £, ¤	microcystin-LR	42	Spoof et al. (2003)
	Södra Slemmern	$, £, ¤	nodularin-R	0.2	
	Högskär	$, £, ¤	nodularin-R	0.5	
France	La Loue	£	anatoxin-a	8,000*	Gugger et al. (2005)
	L. Champs-sur-marne	£	saxitoxin	4.8–6.7	Ledreux et al. (2010)
Germany	20 water bodies	£	anatoxin-a	0.39–6.7	Bumke-Vogt et al. (1999)
	55 water bodies	–	microcystin-LR	10	Fastner et al. (1999)
	–	£	microcystin-LR	36	Ueno et al. (1996)
	Berlin water bodies	£	microcystin-LR	0.14–119	Fromme et al. (2000)
Greece	33 water bodies	–	microcystin-LR	50–1,600*	Cook et al. (2004)
Ireland	L. Caragh	$, £	anatoxin-a	112–444	James et al. (1997)
		$	homoanatoxin-a	1.4	Furey et al. (2003b)
	L. Lough Sillan	$	homoanatoxin-a	24	Furey et al. (2003a,b)
	R. Innincarra	$	homoanatoxin-a	34	Furey et al. (2003b)
	L. Lough Key	$	homoanatoxin-a	12	
	L. Corbally	$, £	anatoxin-a	60–100*	James et al. (1997)
Italy	R. Monteleone	$	microcystin	226	Messineo et al. (2009)
	L. Albano	£	cylindrospermospin	126	
Japan	L. Inbanuma	$, £	microcystin	52	Ueno et al. (1996)
	L. Suwa	–	microcystin	3.61	Park et al. (1998a,b)
Kenya	L. Baringo	¤	anatoxin-a	0.05–0.21	Ballot et al., 2004
	L. Nakuru	–	anatoxin-a	5–223*	
	L. Baringo	¤	anatoxin-a	0.05–0.21*	Ballot et al. (2003)
	L. Bogoria	–	anatoxin-a	10–18*	Krienitz et al. (2003)
		–	anatoxin-a	0.3–9*	Ballot et al. (2004)
	L. Simbi	–	microcystin-LR	19.7–39	Ballot et al. (2005)
	L. Sonachi	–	microcystin-LR	1.6–12*	
	L. Norivasha	$, ¤	microcystin-LR	0.041	Krienitz et al. (2013)
Morocco	R. Lalla takerkoust	$, £, ¤	microcystin	73*	Oudra et al. (2001)
		¤	microcystin	95.4	El Ghazali et al. (2011)
Netherlands	L. 't Joppe	$, £	microcystin-LR	2.5	Kardinaal et al. (2007)
	L. Volkerak	$, £	microcystin-LR	7	
	L. Kinselmeer	$, £	microcystin-LR	18	
New Zealand	L. Waitawa	–	microcystin-LR	28,000	Wood et al. (2006b)
	L. Horowhenua	–	microcystin-LR	16,291	
	L. Ngaroto	–	microcystin-LR	1,535	
	L. Taupo	–	microcystin-LR	708	
	Neuma Pond	–	microcystin-LR	22,58	
	L. Rotoiti	¤	microcystin-LR	10–760	Wood et al. (2006a)
	L. Rotoehu	¤	microcystin-LR	23	
Portugal	–	$, £	microcystin	13.7	Ueno et al. (1996)
Poland	R. Sulejow	$, £	microcystin-LR	1.17	Gagala et al. (2010)
	L. Bninskie	£	microcystin-LR	1.87	
S. Africa	D. Nhanganzwane	–	microcystin	23,718	Oberholster et al. (2009b)
	D. Makhohlolo	–	microcystin	0.317	
	L. Krugersdrift	–	microcystin	43.7	Oberholster et al. (2009a)

(*continued on next page*)

Table 1 (*continued*)

Country	Location	Use	Type	Concentrations (μg L^{-1} or μg g^{-1} dw*)	Reference
S. Korea	R. Younglang	£	anatoxin-a	417*	Park et al. (1998b)
	Jangsong	$	anatoxin-a	1444*	
Serbia	L. Ludös	$, £	microcystin-LR	362.68	Svirčev et al. (2007)
	R. Celije		microcystin-LR	650	Svirčev et al. (2009)
Spain	R. Santillana	$	microcystin	9.99–55.02	Carrasco et al. (2006)
	R. Valmayor	$	microcystin	1.2	
	R. Picadas	$	microcystin	1.3	
	R. Oros	$, ¤	microcystin	1.6*	Aboal and Puig (2005)
	R. Cenajo	¤	microcystin	3*	
Tunisia	D. Lebna	¤	microcystin-LR	5.485	El Herry et al. (2008)
Turkey	L. Kovada	$, £, ¤	microcystin-LR	0.73–48.5	Gurbuz et al. (2009)
United States	L. Pinto	£	microcystin-LR	100	Miller et al. (2010)
	San Francisco estuary	¤	microcystin-LR	0.02	Lehman et al. (2007)
	L. Doctors	£	microcystin-LR	1	Stewart et al. (2006)
	L. Seminole	£	anatoxin-a	1	
	–	–	cylindrospermospin	100	Falconer and Humpage 2006
	St Johns river	£	microcystin-LR	0.1–31	Williams et al. (2007)
			cylindrospermospin	0.07–1.6	
	L. Bufalo Springs	£	microcystin-LR	0.41–1.78	Billam et al. (2006)
	L. Ransom Canyon	£	microcystin-LR	0.44–1.08	

About location: L. for lake, R. for reservoir, D. for dam. About use of water: ($) for drinking supply, (£) for recreational activities, and (¤) for agriculture (irrigation and pasture) and aquaculture. "–" absence of information.
* Concentrations are presented in μg g^{-1} dry weight.

great importance of sedimentation processes in the fate of MCs in freshwaters with an amount of toxin associated to settling particles to be in the range of mg d^{-1} m^{-2}. But other studies reported that no more than 20% of toxins can be adsorbed on sediments (Rapala et al., 1993; Lahti et al., 1996). Furthermore, it was suggested that the removal of cyanotoxins in this process was the result of both adsorption and biodegradation (Lahti et al., 1996). Therefore, biodegradation would appear to be the main fate for most cyanotoxins in aquatic systems and the relative performance of this process would be very site specific and dependent upon local sediment characteristics and microbial activity. It was recently reported that the data generated in laboratory and field studies strongly indicate that, in shallow lakes, low persistence and natural eliminations of MCs are due to biodegradation; suggesting that sediments play a crucial role in biodegradation by continuously supplying toxin-degrading bacteria to the water column (Chen et al., 2008, 2010; Mazur-Marzec et al., 2009). However, in deep sediments, biodegradation might be limited due to anoxic conditions (Holst et al., 2003; Grützmacher et al., 2002, 2010) and sediments only bring nutrients for bacteria responsible of cyanotoxins biodegradation. Degradative heterotrophic bacteria of hepatotoxic cyanotoxins (MCs and NOD), and cytotoxins (CYN) have been found in various media, such as water columns (Jones and Orr, 1994; Cousins et al., 1996; Christoffersen et al., 2002; Hyenstrand et al., 2003; Lemes et al., 2008; Mazur-Marzec et al., 2009; Chen et al., 2010), sediments (Rapala et al., 1994; Holst et al., 2003), sewage effluents (Lam et al., 1995) or soils (Miller et al., 2001; Grützmacher et al., 2002), with specific enzymatic pathways well characterized (Bourne et al., 1996; Okano et al., 2009; Zhang et al., 2010). Several previous studies have been indicated that MCs can be degraded by aquatic bacteria identified as pertaining especially to the genus *Sphingomonas* (Bourne et al., 1996; Harada et al., 2004; Ishii et al., 2004; Maruyama et al., 2006; Manage et al., 2009). Therefore, a microcystin-degrading gene cluster, *mlr*A, B, C and D was identified in these microorganisms, sequenced and the degradation process was proposed (Bourne et al., 2001; Saito et al., 2003; Imanishi et al., 2005). In the last two decades, several other species of bacteria capable of degrading peptidic cyanotoxins were identified, *Sphingomonas* sp. strain ACM-3962 (Jones et al., 1994), *Paucibacter toxinivorans* (Rapala et al., 2005), *Sphingosinicella microcystinivorans* (Maruyama et al., 2006), *Burkholderia* sp. (Lemes et al., 2008). The most toxic congener, Microcystin-LR, was also found susceptible to breakdown by *Sphingomonas*, which initiated ring-opening and the production of a linear compound 200 times less toxic (Bourne et al., 1996). Recently, Ho et al. (2012) identified another bacterium strain (TT25) whose genome is similar to *Sphingopyxis* sp. that it is able to degrade MCs. The ability of these all species to degrade other congeners of MCs and NODs was investigated and revealed that peptides with the Adda–Arginine bond were successfully degraded while MC-LF, with Adda–Phenyalanine bond and 6(z)-Adda-MC-LR and 6(z)-Adda-MC-RR were not significantly degraded (Imanishi et al., 2005). Another Japanese *Sphingomonas* isolate, 7CY, was shown to degrade a wider range of MCs, including MC-LR, -RR, -LY, -LW, and -LF but it was unable to degrade NOD-Har a NOD analog where arginine is replaced by homoarginine (Ishii et al., 2004). Biodegradation has also been shown to be an important process for the removal of the alkaloid cytotoxin, CYN, from contaminated water (Chiswell et al., 1999; Senogles et al., 2002). By contrast, a laboratory study investigating biodegradation of CYN with bacterial communities from two water bodies in Spain, one having frequent exposure to CYN, the other rarely, has been shown that biodegradation of this toxin by an active microbial community does not take place during a 40-d (Wörmer et al., 2008). A recent study demonstrated that CYN was degraded by indigenous microbial flora in waters with a history of *Cylindrospermopsis* blooms (Smith et al., 2008). Despite isolation of many bacteria from CYN enriched cultures, only a single isolate (*Delftia* sp.) capable of degrading CYN has been obtained (Smith, 2005). However, for cyanobacterial neurotoxins there are few reports on their persistence and biodegradation compared to cyanobacterial heptotoxins, although the increasing occurrence of these toxins in surface waters. A recent study indicated that saxitoxins (STXs) are predisposed to bacterial degradation during passage through bioactive treatment plant (Kayal et al., 2008). However, this study showed that structural modification during the biological treatment resulted to decrease of the predominant C-toxins variants and an increase in GTX2 and GTX3 which are more toxic than the C-toxins. Early work by Kiviranta et al. (1991) reported the isolation of a *Pseudomonas* sp. capable of rapid degradation of anatoxin-a, with a rate of 6–30 mg mL^{-1} per 3 d. A later study reported by Rapala et al. (1994) has been shown the removal of anatoxin-a by microbial populations isolated from water and sediments of a eutrophic, oligotrophic, and humic lake. In conclusion, the period of photodegradation of cyanotoxins is relatively long in

comparison to the degradation caused by the microbial activity. Recently, Hu et al. (2012) found that the *Bacillus* sp. strain EMB is able to completely remove 2.99 mg L^{-1} of MC-RR and 2.15 mg L^{-1} of MC-LR within 24 h. However, the biodegradation speed of cyanotoxins in aquatic ecosystems can be influenced by the initial concentration and nature of toxins (Edwards et al., 2008; Ho et al., 2012) and by additional factors such as the water temperature (Park et al., 2001; Ho et al., 2007a,b; Smith et al., 2008; Hoefel et al., 2009) and the bacterial community composition within the water body; not only the types of organisms present, but also their abundance (Hoefel et al., 2009; Ho et al., 2012). Hoefel et al. (2009) have demonstrated a direct relationship between the abundance of degrading organisms and the rate of degradation of MC-LR. Furthermore, although MCs are degraded by most of bacteria species, it seems that a lasting day's delay or weeks are necessary before the degradation is introduced. This result was in agreement with the conclusion of Hyenstrand et al. (2003) indicating that bacteria species have to adapt themselves at first to the cyanobacteria metabolites before the degradation of MCs becomes effective. Indeed, the results of this last study indicate a weaker degradation of the MC-LR in May compared with September where the occurrence of cyanobacteria is higher. Similarly, Smith et al. (2008) found that CYN was degraded by indigenous microbial flora in waters with a history of *Cylindrospermopsis* blooms.

The physicochemical fate and the environmental concentrations of cyanotoxins in soil have been the subject of a range of recent studies. Several classes of these toxins have been detected in field soils, and the sorption behavior and degradation and transfer to vegetables have been studied to a large extent (Morris et al., 2000; Miller et al., 2001; Chen et al., 2006b; Bibo et al., 2008; Sathishkumar et al., 2011). The use of water from sources containing cyanobacterial blooms and toxins for spray irrigation of terrestrial plants, including food crop plants presents both a harmful effect on growth and development of plants and on soil ecosystems and potential health hazards through several exposure routes, including uptake into the food chain and accumulation of toxins on the external surfaces of edible plant material. Questions, therefore, arise about the persistence of total cyanotoxins (dissolved and within the cyanobacterial cells) when reach the soil ecosystem to produce phytotoxic effects. Once reach the soil ecosystem, cyanotoxins persist in the environment, depending on the efficiency of degradation (i.e., photolysis, hydrolysis and bacterial degradation). Microcystins can persist in agriculture soils for relatively long times, with a half-life ranging between 6 and 17.8 d (Chen et al., 2006b). Jones et al. (1995) reported that scums of *M. aeruginosa* that dry on the shores of lakes may contain high concentrations of MCs for several months. Recently, Metcalf et al. (2012) found that MCs were detected in herbarium specimens of cyanobacteria which had been collected from aquatic and terrestrial environments in 11 countries throughout the world, dried, and stored at ambient temperatures in the dark for up to 170 years. Microcystins were also detected by HPLC and ELISA assays in desert crust samples from Qatar at concentrations between 1.5 and 53.7 ng g^{-1} dry weight (Metcalf et al., 2012). Thus, the persistence of these toxins within dried cyanobacterial cells for long period suggests that they will be released back into the soil when re-immersed by irrigation water, particularly when cyanobacterial blooms are used in some countries as an organic fertilizer (Chen et al., 2006a,b). However, as mentioned above for aquatic ecosystems, adsorption on sediments and specially exposure to degrading bacteria may also speed up their removal from the soil.

The information on the adsorption of cyanotoxins in agriculture soil ecosystems is particularly scarce. However, adsorption of cyanobacterial hepatotoxins was measured in several batch studies to determine the applicability of bank filtration as an efficient removal strategy of these toxins from drinking water. For example, in batch experiments Miller et al. (2001) studied the adsorption of cyanobacterial hepatotoxins, MC-LR and NOD, in five soils with different physicochemical properties collected from regions around South Australia. They found that the soils with the high clay and/or organic carbon contents had the higher toxins adsorption coefficients. In similar experiments, Miller and Fallowfield (2001) found that the soils with the highest organic carbon content (2.9%) and the highest clay content (16.1%) were the most effective at removing these toxins in batch experiments. However, the sandy soil (98.5% sand) was incapable of the removal of cyanotoxins. This finding was supported by Morris et al. (2000) who reported that the clay content and its quality may be more important for the adsorption than other soil characteristics. However, Eynard et al. (2000) suggested that soil was unable to protect groundwater from cyanotoxins that originated from surface waters. Thus, it seems that cyanotoxins sorption in soils is low and could potentially result in their high bioavailability to soil organisms and plants. In several studies, it seems that the major dissipation process for cyanotoxins in soil ecosystems is mainly via microbial degradation (Miller and Fallowfield, 2001; Chen et al., 2006b). In fact, numerous soil bacteria as *Arthrobacter* sp., *Brevibacterium* sp. and *Rhodococcus* sp. are able to breakdown MCs (Manage et al., 2009). Bourne et al. (2001) observed the same thing with *Sphingomonas* sp. that possesses a gene cluster involved in the degradation of MC-LR. Furthermore, Falconer et al. (1983) and Lambert et al. (1996) conclude that sand filtration alone is unable to remove dissolved cyanotoxins. However, slow sand filters can be expected to remove 99% of dissolved cyanotoxins (Keijola et al., 1988; Grützmacher et al., 2002). This can be explained by the formation of a biofilm on top of the filter that it allows for some biodegradation of cyanotoxins in slow sand filtration. No data are available for other cyanoabcterial toxins such as neurotoxins and dermatotoxins, but some degradation may be expected, again depending on the chemical conditions of soil. In conclusion, the scarce results on the fate of cyanotoxins in soil ecosystems are very variable, which do not allow affirming with certainty the necessary time for a complete disappearance of these toxins. This variability ensues partially from used methods (e.g. studies led in laboratory with non environmental concentrations of toxins and in free-soil systems). Therefore, the fate of cyanotoxins in soil ecosystems will require more studies before we are capable to formulate an opinion on their persistence and uptake into the food chain.

5. Phytotoxicity effects of cyanotoxins

The information on the effects of cyanotoxins on non-target organisms in the terrestrial environment is particularly scarce. However, despite the impressive amount of information on their toxicity on mammals compiled during the last two decades, there are still serious gaps in the knowledge about the phytotoxicity of these toxins. The phytotoxic effects of cyanotoxins on higher plants were firstly focused on aquatic photoautotrophic organisms (algae and macrophytes) that are naturally exposed to cyanotoxins (Harper, 1992; Papke et al., 1997; Weiss et al., 2000; Yu et al., 2000; Ikawa et al., 2001; Pietsch et al., 2001; Mitrovic et al., 2004; Ha and Pflugmacher, 2013). Since few years, scientists were also interested by the effect of these toxins on terrestrial plants because, irrigation waters from sources containing cyanobacterial blooms and toxins are generally used without treatment for spraying agricultural crops and plants that might, therefore, induce a food chain contamination with a considerable health risk and potential economic losses.

5.1. Neurotoxins

The cyanobacterial neurotoxins have not received more research attention than have cyanobacterial hepatotoxins. This is a consequence of the many livestock deaths caused by cyanobacte-

rial species producing hepatotoxic microcystins and their more widespread occurrence rather than species producing neurotoxins (Ettoumi et al., 2011). In addition, the recent inclusion of microcystin-LR as a toxic chemical in the World Health Organisation (WHO) drinking water guidelines has further accelerated investigation of the toxic effects of microcystins on mammals and vegetables rather than cyanobacterial neurotoxins. Therefore, there are only few studies reported in the literature on the effects of cyanoabcterial neurotoxins on crops and plants. Mitrovic et al. (2004) were exposed the free-floating aquatic plant *L. minor* and the filamentous macroalga *Chladophora fracta* to anatoxin-a at 0.1–25 μg L^{-1} under laboratory conditions for 4–7 d. They found in both organisms significantly increase of peroxidase activity after 4 d exposure at 25 μg L^{-1} but not at lower concentrations. After 7 d exposure to this neurotoxin significant increase of GST activity and reduction of photosynthetic oxygen production were observed at 5 and 20 μg L^{-1} but not at lower concentrations in *L. minor*. In addition, Ha and Pflugmacher (2013) reported that this alkaloid neurotoxin at an environmentally relevant concentration (15 μg L^{-1}), induced phytotoxic effects on the submerged aquatic macrophyte *Ceratophyllum demersum*, mediated by oxidative stress. Recently, Esterhuizen-Londt et al. (2011) investigated in *in vitro* study the effect of BMAA at different environmentally concentrations (0.5, 1, 5, 50 and 100 μg L^{-1}) for 24 h on the oxidative stress responses of the macrophyte *C. demersum*. The most pronounced effects found were activity-inhibiting effects on all the oxidative stress response enzymes at all exposure concentrations. However, enzymes not related to oxidative stress response were not affected by the BMAA in these experiments. For other neurotoxins, the literature search did not yield any results.

5.2. Hepatotoxins

The effects of cyanoabcterial toxins on photoautotrophic organisms have been most intensively studied for MCs, in line with their abundance and their mode of action. First experiments were focused on the ability of these hepatotoxins to act as general allelopathic compounds against planktonic microalgae, macroalgae and macrophytes in aquatic ecosystems. The allelopathic effects of *Aphanizomenon* and other cyanobacteria bloom formers on chlorophyte species are early documented in several studies (Lefevre et al., 1950; Tassigny and Lefevre, 1971; Boyd, 1973). Subsequently, Ikawa et al. (2001) and Papke et al. (1997) observed that cyanobacterial metabolites can induce the growth inhibition of the green alga *Chlorella pyrenoidosa* and the photosynthesis of other cyanobacteria species, respectively. Similarly, Sukenik et al. (2002) found that *Microcystis* sp., a MCs producer, severely inhibited the growth of the freshwater dinoflagellate *Peridinium gatunense* in mixed laboratory cultures which was attributed to the excretion of allelopathic substances rather than to successful competition for nutrients. Hu et al. (2005) found that the growth of *Synechococcus elongatus* was reduced by 53.6% after 6 d of exposure to 100 μg L^{-1} of MC-RR suggesting that oxidative stress manifested by elevated ROS levels and MDA contents might be responsible for the toxicity of MC-RR to this species. Moreover, Singh et al. (2001) demonstrated that MCs are strongly algicidal and point to the possibility that they may have an important role in establishment and maintenance of toxic blooms of *M. aeruginosa* in freshwater ecosystems. Valdor and Aboal (2007) demonstrated the inhibitory effect of both cyanobacterial extracts and pure MCs on the growth of microalgae. Bártová et al. (2010) examined effects of semipurified *Microcystis* extract containing MCs (0.2–20 nM) on age-induced cell differentiation of the filamentous cyanobacterium *Trichormus variabilis* and they found that heterocyst and akinete formation was significantly decreased after exposure to extract containing 2 or 20 nM of MCs within 10 d of exposure. Recently, Perron et al. (2012) evaluated the effect of four microcystins standards (variants MC-LF, -LR, -RR, -YR) at different concentrations (0.01–10 μg mL^{-1}) and 0.01, 0.1, and 1 μg mL^{-1} equivalent microcystins extracted from *Microcystis aeruginosa* (CPCC299), which is known to produce mainly MC-LR, on the fluorescence of four green algae (*Scenedesmus obliquus* CPCC5, *Chlamydomonas reinhardtii* CC125, *Pseudokirchneriella subcapitata* CPCC37 and *Chlorella vulgaris* CPCC111) and how they can affect the flow of energy through photosystem II. Their results showed that MCs affect the photosynthetic efficiency and the flow of energy through photosystem II from 0.01 μg mL^{-1} within only 15 min and that MC-LF was the most potent variant, followed by MC-YR, -LR and -RR.

It was also noticed that in eutrophic freshwaters dominated by cyanobacteria, a decrease in species diversity and in the growth of macrophytes often occurs (Harper, 1992; Weiss et al., 2000; Yu et al., 2000; Pietsch et al., 2001). Casanova et al. (1999) found that the abundance and the variety of macrophytes are reduced in the presence of cyanobacterial blooms. In 1986, Kirpenko showed for the first time the inhibition growth of water plants *Elodea* and *Lemna* by MCs isolated from a natural bloom. This allelopathic action was recently confirmed by Weiss et al. (2000) further to the coculture of the plant *Lemna minor* with the cells of *M. aeruginosa.* Moreover, Pflugmacher (2002) revealed that MC-LR induces allelopathic effects on the aquatic macrophytes such as *C. demersum* and *Myriophyllum spicatum*, resulting in growth inhibition, reduction in photosynthetic oxygen production, and changes in pigment pattern. Jang et al. (2007) found by examining cyanobacterial toxin production in response to direct exposure to an axenically cultured aquatic plant (*Lemna japonica* Landolt) using two toxic monoclonal strains of *M. aeruginosa* Küzing (NIES strains 103 and 107) that reciprocal allelopathic responses have been observed between these two species *Microcystis* and *Lemna*. In several other studies, it occurred that MCs have the potential to exert toxic effects on growth and physiological processes, which all might be related to the inhibition of protein phosphatase activity or oxidative stress in aquatic moss (Wiegand et al., 2002) and in higher aquatic plants such as *Lemna gibba* (Saqrane et al., 2007), *Lemna genus* (Mitrovic et al., 2005), *L. japonica* (Jang et al., 2007), *Spirodela oligorrhiz* (Romanowska-Duda and Tarczyńska, 2002), *Phragmites australis* (Yamasaki, 1993; Máthé et al., 2009; Jámbrik et al., 2011), and *C. demersum* (Pflugmacher, 2004).

There are also several indications that terrestrial plants, including food crop plants, can be altered by MCs present in irrigation waters, resulting principally to their serine/threonine phosphatases inhibition and reactive oxygen species (ROS) production. Sheen (1993) found that the marine phycotoxin okadaic acid, a potent inhibitor of serine/threonine protein phosphatases like MCs, efficiently blocks chlorophyll accumulation induced by light in etiolated maize leaves. It seems also that this phycotoxin blocks root hair growth and alter cortical cell shape of *Arabidopsis thaliana* L. at 3 nM (Smith et al., 1994). Takeda et al. (1994) found that okadaic acid and MC-LR, inhibitors of protein phophatases type 1 and 2A block the sugar-inducible gene expression in petioles of sweet potato *Ipomoea batatas*. Similarly, Siegl et al. (1990) reported that in *in vivo* these toxins prevented the light-induced activation of sucrose-phosphate synthase (SPS) that is generally activated by dephosphorylating by protein phosphatase 2A, and decreased sucrose biosynthesis and CO_2 fixation in spinach leaves. Yin et al. (2005) reported that MC-LR at 5 mg L^{-1} is able to cause oxidative damage resulting in lipid peroxidation and decrease of glutathione GSH content and increases of superoxide dismutase (SOD) and catalase (CAT) activities on *A. thaliana* cells. Later, Stüven and Pflugmacher (2007) provide further evidence that cyanobacterial toxins as well as cyanobacterial crude extract containing MC-LR induce oxidative stress response in *Lepidium sativum* seedlings, manifested by lipid peroxidation, elevation of alpha- and beta-

tocopherol concentrations and elevated activities of antioxidative enzymes like the glutathione peroxidase, glutathione S-transferase and glutathione reductase. El Khalloufi et al. (2012) showed that 30 d exposure of *Lycopersicon esculentum* to a cyanobacterial crude extract containing 2.22–22.24 μg MCs mL^{-1} caused enhancement on peroxidase activity and phenolic content indicated that the extract caused an oxidative stress. The exposure of rice plants (*Oriza sativa*) to toxic *M. aeruginosa* cyanobacterial extracts containing 50 μg MC-LR L^{-1} resulted in a significant increase in the GST activity in leaves of this plant (Prieto et al., 2011). Therefore, by acting as protein phosphatase inhibitors and inducers of ROS production, MCs could be involved in several physiological and molecular processes in higher terrestrial plants.

5.3. Cytotoxic alkaloids

Cylindrospermopsin, a protein synthesis inhibitory cyanoabcterial cytotoxin also led to a clear growth inhibition and anatomy modification through the alteration of microtubules organization of the common reed *P. australis* at concentrations 0.5–40 μg mL^{-1} (Beyer et al., 2009). Previous study demonstrated that CYN inhibited the growth of *Sinapsis alba* mustard seedlings at 18.2 μg mL^{-1} (Vasas et al., 2002). Short term exposure of rice plants (*Oriza s.*) to toxic *A. ovalisporum* cyanobacterial extracts containing 0.13 μg CYN L^{-1} can lead to an increase of oxidative stress (increase in GST and GPx activities). Moreover, longer exposure periods can lead to tissue necrosis (loss of tissue fresh weight) concomitant with the oxidative stress. In addition, the plant exposure to a mixture of *A. ovalisporum* and *M. aeruginosa* cell extracts containing 0.13 μg CYN L^{-1} and 50 μg MC-LR L^{-1}, respectively, resulted in a significant increase in the GST and GPx activities, suggesting a synergistic effect of both extracts (Prieto et al., 2011).

6. Bioaccumulation of cyanotoxins in vegetable foods and consequences on animals and human health

In aquatic ecosystems, several studies have been reported the bioaccumulation of cyanotoxins in common aquatic vertebrates and invertebrates, including zooplankton, mollusks and crustaceans, and fish, which pose a potential risk to both animal and human health if such aquatic animals are consumed (Ibelings and Chorus, 2007; Ettoumi et al., 2011). However, their ability to enter the food chain *via* agricultural crops has not been thoroughly investigated to date. Questions, therefore, arise about the health significance of spray irrigation of crops with water from sources containing cyanobacterial blooms and toxins. Nevertheless, several studies have been shown the accumulation potential of cyanotoxins in aquatic vegetable organisms, suggesting that terrestrial plants, including food crop plants, can also take up these toxins. Mitrovic et al. (2005) reported that the filamentous alga *C. fracta* accumulates MC-LR at a rate of 8 ng g^{-1} d^{-1}. In addition, few amounts of MCs were detected in *C. vulgaris* and *Scenedesmus quadricauda* cells only during the first 3 d of exposure, but not during the remaining period of the experiment, suggesting a possible biotransformation of MCs in these algae (Mohamed, 2008). The emergent reed plant *P. australis* showed an apparent distribution of MC-LR in the different parts of the plant, after exposure to this toxin at 0.5 μg L^{-1} with highest uptake was detected in the stem and then the rhizome (Pflugmacher et al., 2001). In addition, *Lemna minor* has also been shown to accumulate MC-LR up to a concentration of 0.2887 ± 0.009 ng mg^{-1} wet wt plant material, after 5 d of exposure to this toxin at 20 μg L^{-1} with an accumulation rate equivalent to 58 ng g^{-1} d^{-1} (Mitrovic et al., 2005). However, Saqrane et al. (2007) reported that *L. gibba* could take up and biotransform microcystins. The chronic exposure of plant led to dose-dependent MCs accumulation which reached 2.24 μg g^{-1} dry weight after being exposed to 0.3 μg mL^{-1} of MCs (Saqrane et al., 2007). Recently, it has been shown that collected water chestnut (*Trapa natans*) from Lake Tai accumulated MCs at highest level up to 7.02 ng g^{-1} dw (Xiao et al., 2009).

Terrestrial plants could be exposed to cyanobacterial toxins via the use of eutrophic water that may contain cyanobacterial blooms and toxins from irrigation and, therefore, they can take up cyanotoxins. Peuthert et al. (2007) have been reported that MC-LR could be absorbed by roots and be translocated from roots to shoots in seedlings of eleven agricultural plants. A second study by Crush et al. (2008) that used different species too, revealed a high level of MCs accumulation in lettuce (*L. sativa*) exceeding the tolerable daily intake of 0.04 μg kg^{-1} of body weight d^{-1} recommended by the World Health Organization (Sivonen and Jones, 1999). However, the most of these studies have been performed in hydroponic conditions where the roots have been in direct contact with the toxin solutions and can, therefore, overestimate the bioaccumulation rate. In our knowledge the only study reported in the literature that was realized in soil showed that MC concentrations in roots did not exceed the tolerably limit, however, the concentration of MCs in aerial parts of the plant are not determined (Järvenpää et al., 2007). Both the roots and shoots of rice were reported to accumulate MC-LR in a laboratorial study (Chen et al., 2004). In addition, a recent study by Chen et al. (2012) reported for the first time the accumulation of MC-LR in rice grains harvested from Lake Taihu in China. However, the concentration of MC-LR detected in rice grains was very low and thus may not pose a threat to human health currently. In addition to the possibility of internal accumulation of MCs, irrigation may lead to accumulation of toxins on the external surfaces of edible plant materials when the contaminated water dries on the plant surface between irrigation periods or when the water becomes trapped in the centers of, for example, salad plants. In fact, Codd et al. (1999) have been reported that colonies and single cells of *M. aeruginosa* and microcystins were retained by salad lettuce after growth with spray irrigation water containing the microcystin-producing cyanobacteria. Recently, Kittler et al. (2012) reported that treatment of *Brassica oleracea* var. *sabellica*, *Brassica juncea*, and *S. alba* under varying experimental conditions showed significant CYN uptake, with CYN levels ranging from 10% to 21% in the leaves compared to the CYN concentration applied to the roots (18–35 μg L^{-1}). These results suggest that crop plants irrigated with CYN-containing water may represent a significant source of this toxin within the food chain. However, further research is needed into the uptake and fate of microcystins and other cyanobacterial toxins by food plants and the persistence of these toxins in the edible plant materials.

7. Conclusion and future directions

This review has established that cyanobacterial cells and toxins can be associated with crop plants after spray irrigation with water containing these agents. Therefore, the use of water from sources containing cyanobacterial blooms and toxins for spray irrigation of crop plants may not only inhibit growth of plants, but also can induce a food chain contamination with a considerable health risk and potential economic losses. Several studies have been shown that cyanotoxins could be absorbed by roots, transported to shoots, and then be translocated to grains and/or fruits. Nevertheless, the concentration of MC-LR detected, for example, in rice grains was very low and thus may not pose a threat to human health currently. Cyanotoxins could be partially metabolized during the long distance transportation from roots to grains or fruits, which may resulted in the lower level of cyanobacterial hepatotoxins type

microcystins detected in rice grains. In addition, MCs could bind to serine/threonine phosphatases during transport and thus could also affect their accumulation in grains and fruits. Therefore, further investigations are needed into the uptake and fate of microcystins and other cyanobacterial toxins by food plants during the totally period of vegetative and fruit development.

However, there are gaps remaining concerning information on the future of cyanotoxins in soil in term of speciation, persistence, mode of degradation and impact on biological life in soils. The results of many existing tests and particularly laboratory studies on phytotoxicity of cyanotoxins are done in soil-free systems and using non realistic environmental concentration of toxins. Therefore, they are difficult to compare to field studies because both abiotic (*e.g.*, soil conditions) as well as biotic (composition of the degrading biological community) factors can influence the outcome of such studies. In order to assess the relevance of phytotoxicity of cyanotoxins and their bioaccumulation in crop plants in the terrestrial environment, further research seems thus appropriate.

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Yurok and the Klamath River:

Yurok Historical Context and Data for Assessing Current Conditions and the Effects of the proposed Klamath Restoration Project on Yurok Tribal Trust Assets and Yurok Resources of Cultural and Religious Significance

Report Prepared for the
Department of the Interior
Bureau of Indian Affairs
For Use in the Secretarial Determination Overview Report and NEPA/CEQA Analysis
Under Grant # 81333AG053 from US Fish and Wildlife Service

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- **A. 1851 Treaty with the Poh-lik-lah**
- **B. 1973 USC 412 US 481 Mattz v. Arnett**
- **C. 1993 DOI Solicitors Opinion: Fishing Rights of the Yurok and Hoopa Valley Tribes**
- **D. 2006 DOI Cooperative Agreement: Cooperative Management of Tribal and Federal Lands and Resources in the Klamath River Basin in California**

I. Introduction: Purpose of Report

This report has been prepared under contract with the US Fish and Wildlife Service for the purpose of providing information to the Department of the Interior (DOI), the Secretary of the Interior, the Bureau of Indian Affairs (BIA) and all federal agencies involved in the Secretarial Determination and compliance with the National Environmental Policy Act (NEPA) and California Environmental Policy Act (CEQA) currently underway for the purposes of evaluating the proposed action of removing four Klamath River dams and implementing provisions set forth in the Klamath Basin Restoration Agreement (KBRA) and the Klamath Hydroelectric Settlement Agreement (KHSA). The primary focus of this report is the impact of the current conditions of continued operations of the Klamath Hydroelectric Project on Yurok trust resources and implications regarding the federal government's trust responsibility to the Yurok Tribe.

Much of the contents of this report are historical in nature due to the fact that historic context is required to adequately assess the direct and cumulative impacts of current conditions and current operations of the Klamath Hydroelectric Project on tribal trsut resources and the Klamath River ecosystem and its fishery.

The Yurok Tribe, its history, culture, identity, spirituality and economic survival have always relied upon the Klamath River. For Yurok people, the Klamath River is "the Bloodline: the life blood of the people". The dependence and interdependence of the Yurok on the River and its resources cannot be overstated. It has always been and remains the central feature in Yurok life, ceremony and traditions. Reliance on the Klamath River fishery is not simply for economics, but most importantly for subsistence and cultural survival. Prior to the arrival of non-Indians into the region, the Yurok Tribe was considered one of the most prosperous and wealthy tribes in the area. This wealth was a result of an abundant year-round fishery that provided the basis for the entire Klamath River tribal economic system. Fish were traded and sold to neighboring tribes for a range of resources used in daily and ceremonial life. Abundant food provided by the year-round fishery allowed for the development of a highly developed social and economic system that was reinforced through a highly structured ceremonial and cultural cycle that still persists today.

Klamath River fish are irreplaceable to the Yurok Tribe's culture, religion and economy. From time immemorial, Yurok people have depended on the Klamath River. The River is central to Yurok society by providing food, transportation, commercial trade, and numerous other activities essential to Yurok life. Throughout history and today, the identity of the Yurok people has been intricately woven into natural environment including the Klamath Basin watershed. Tribal religious and ceremonial practices focus on the health of the world; the Klamath River and its fisheries are a priority. The Yurok Tribe's obligation to protect the fishery has always been understood by Yurok people. The ancestral territory of the Yurok Tribe included coastal lagoons, marshes, ocean waters, tidal areas, redwood and other ancient forests, prairies and the Klamath River. The Preamble of the Constitution of the Yurok Tribe identifies:

Our people have always lived on this sacred and wondrous land along the Pacific Coast and inland on the Klamath River, since the Spirit People, *Wo'qe'* made things ready for us and the Creator, *Ko-won-no-ekc-on Ne ka-nup-ceo*, placed us here. From the beginning, we have followed all the laws of the Creator, which became the whole fabric of our tribal sovereignty. In times past and now Yurok people bless the deep river, the tall redwood trees, the rocks, the mounds, and the trails. We pray for the health of all the animals, and prudently harvest and manage the great salmon runs and herds of deer and elk. We never waste and use every bit of the salmon, deer, elk, sturgeon, eels, seaweed, mussels, candlefish, otters, sea lions, seals, whales, and other ocean and river animals. We also have practiced our stewardship of the land in the prairies and forests through controlled burns that improve wildlife habitat and enhance the health and growth of the tan oak acorns, hazelnuts, pepperwood nuts, berries, grasses and bushes, all of which are used and provide materials for baskets, fabrics, and utensils.

(Yurok Tribe Constitution 1993)

Because of the rivers' importance, one of the Tribe's highest priorities is to protect and preserve the resources of the rivers, and in particular, to restore the anadromous fish runs to levels that can sustain Yurok people. When the original Klamath Reservation was established in 1855, the rivers were filled with abundant stocks of salmon, steelhead, eulachon, lamprey, and green sturgeon. Today, the abundance of fish in the Klamath River and its tributaries are only a small fraction of their historic levels. Many species of fish have gone extinct, many other species, such as fall Chinook, are in serious trouble. Nonetheless, anadromous fish continue to form the core of the Yurok Tribal fishery. The Yurok Tribe is pursuing its fishery restoration goals through a fish management and regulatory program, participation in various forums to reach long term solutions to Basin problems and when necessary, litigation. The Tribe has devoted a large share of scarce funding resources to budgets for fishery management and regulation. The Tribe has enacted a fisheries ordinance to ensure that the fishery is managed responsibly and in a sustainable manner and has a longstanding record of resource protection. The Tribe's fisheries department is well respected and recognized as a knowledgeable and experienced fisheries entity in the Klamath Basin. The Yurok Tribal Council and the Tribal members they represent are well known for taking and supporting responsible actions to protect fisheries resources.

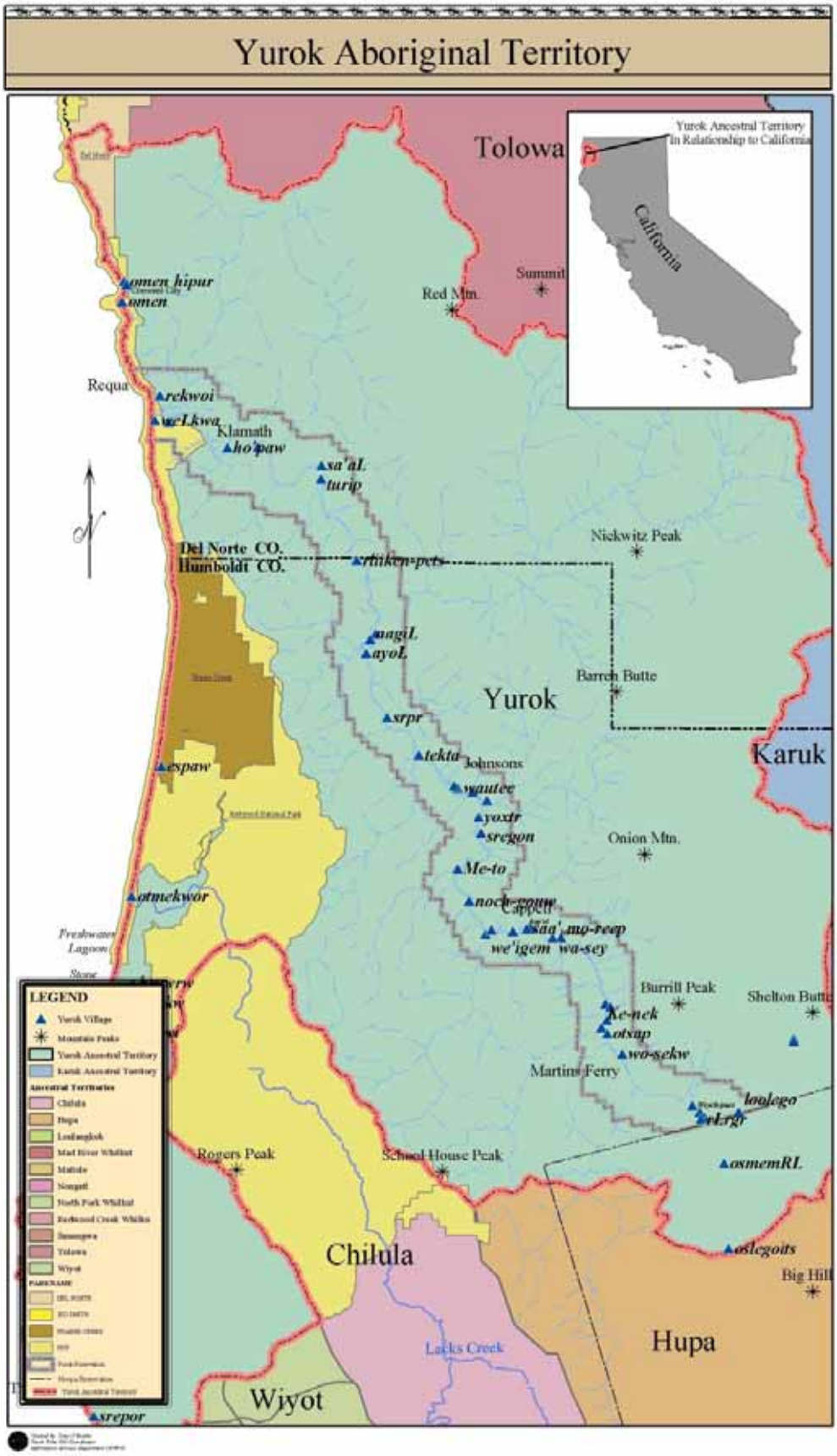
The management of the Klamath River and its ecosystem was radically altered due to historical events that led to the dispossession of lands and resources from Yurok and other Tribal people in the Basin during the settlement and expansionist era of American society, starting in the mid 1800s. Loss of lands and political autonomy resulted in the loss of management authority by Yurok and other Tribes over the River and the resources on which they relied upon since time immemorial. Subsequent management decisions regarding commercial fisheries, the establishment and abolition of canneries, and the construction of a series of dams in the upper basin have had a cumulative impact on tribal society, economy, culture and traditional lifeways. The Yurok Tribe had no say in these

decisions when they occurred, yet have born the disproportionate burden of the ecological and socio-economic impacts of these management decisions over time. During the Reservation Era, the Termination Era and prior to the Self-Determination Era the Tribe has suffered the consequences of these short-sighted management decisions by state and federal managers and agencies with regards to the Klamath River and its resources. These management decisions have resulted in extirpation of numerous runs and species of culturally significant anadromous and riverine species that were relied upon by Yurok and other tribes. Today, Candlefish (once an important subsistence food) no longer exist in the Klamath River. Coho Salmon and Green Sturgeon are on the Endangered Species list. Pacific Lamprey have experienced dramatic decreases and Chinook Salmon have declined to such numbers that only a short commercial fishing season can be practiced for the fall run, and all other runs have diminished to the extent that they are no longer viable for economic harvest.

Impairments to Klamath River water quality as a result of the ecological impacts of the Klamath River dams and their artificial reservoirs have resulted in recurring annual blooms of toxic blue green algae that exceed World Health Organization and state and county public health standards resulting in the posting of closures throughout the basin on an annual basis, always during the peak time for commercial and subsistence fishing and ceremonial practice for Yurok people. All of these adverse impacts not only effect the natural resources on which Yurok people rely, but also the cultural and ceremonial lifeways.

Numerous Yurok Trust Resources exist within the Klamath Basin and many are directly associated with the Klamath River ecosystem. These resources include fish and aquatic species: various species of salmon, pacific lamprey, sturgeon, candlefish, freshwater mussels, steelhead trout, amphibians and others. Additional resources include the water itself, waterfowl, plants and medicines, and numerous Traditional Cultural Properties including fishing places, prayer places, gathering places and cultural activity areas. All of these resources are resources of cultural and religious significance to the Tribe and its members. All of theses resources are Trust Resources and must be protected by the federal government as part of its Trust Responsibility to the Tribe and its members.

It is the opinion of the Yurok Tribe that the current conditions (ie: the current operations of the Klamath Hydroelectric Project and its dams) result in adverse and devastating impacts on these irreplaceable Yurok Trust Resources. It is also the opinion of the Yurok Tribe that only the removal of the four Klamath dams currently under review and the implementation of the Klamath Basin Restoration Agreement (KBRA) and Klamath Hydroelectric Settlement Agreement (KHSA) can restore and redress the longstanding issues and adverse impacts on these Yurok Trust Resources. These issues are, at their core, fundamental issues of Environmental Justice and must be adequately evaluated as such per Executive Order 12898. It is the responsibility of the Department of the Interior, the BIA, and all the federal agencies involved in the Secretarial Determination and the ongoing NEPA and CEQA process to acknowledge and resolve these Environmental Justice issues during this process.


Yurok Aboriginal Territory
Yurok Ancestral Territory In Relationship to California
California
Tolowa
Summit
Red Mtn.
omen hipur
omen
Requa
rekwoi
Klamath
ho'paw
sa'aL
turip
Nickwitz Peak
Del Norte CO.
Humboldt CO.
rtiken-pets
nagiL
ayoL
Barrel Butte
Yurok
srpr
Karuk
tekta
Johnsons
espaw
yautee
yoxtr
sregon
Onion Mtn.
Me-to
otmekwor
noch-eguw
Capt'n
sag' mo-reap
we'igem wa-sey
Freshwater Lagoon
Burrill Peak
Shelton Butte
ke-nek
otxap
wo-sekw
Martins Ferry
loolego
rkrgr
Rogers Peak
School House Peak
oxmemRL
oslegoits
Chilula
Big Hill
Hupa
Lacks Creek
Wiyot
srepor
LEGEND
Yurok Village
Mountain Peaks
Yurok Ancestral Territory
Karuk Ancestral Territory
Ancestral Territories
Chilula
Hupa
Lodmaglok
Mad River Wiyhot
Mattole
Nongatl
North Fork Wiyhot
Redwood Creek Whilkut
Sinsangwa
Tolowa
Wiyot

Yurok Tribe – Overview of Yurok History

"The Ach (the People) are river people. Have been since time began. If the river dies, we are no more. Without salmon in the river, I don't believe our culture can survive."
(Yurok Tribal Member Survey Respondent 2006)

Yurok Overview

The Yurok Tribe Dependence on Klamath River Basin Fish

Klamath River fish are irreplaceable to the Yurok Tribe's culture, religion and economy. From time immemorial, Yurok people have depended on the Klamath River. The River is central to Yurok society by providing food, transportation, commercial trade, and numerous other activities essential to Yurok life. Throughout history and today, the identity of the Yurok people has been intricately woven into natural environment including the Klamath Basin watershed. Tribal religious and ceremonial practices focus on the health of the world; the Klamath River and its fisheries are a priority. The Yurok Tribe's obligation to protect the fishery has always been understood by Yurok people. The ancestral territory of the Yurok Tribe included coastal lagoons, marshes, ocean waters, tidal areas, redwood and other ancient forests, prairies and the Klamath River.

Yurok people have resided within their ancestral lands, including the Lower Klamath River since time immemorial. Yurok people have always utilized a large and diverse cultural landscape that extended along the northern California coast and inland up the Klamath River and surrounding mountains.

The traditional names for the Yurok people living on the upper region of the Klamath River, lower region of the Klamath River, and the coast within Yurok Ancestral Territory are the Petch-ik-lah, Pohlik-la, and Nr'r'nr people, respectively. However, they have come to be known as the Yurok, which is the Karuk name meaning "downriver." The ancestral territory of the Yurok people is comprised of a narrow strip along the Pacific Ocean stretching north from the village on the Little River (Me'tsko or Srepor) in Humboldt County to the mouth of Damnation Creek in Del Norte County.

In addition to the Yurok coastal lands, Yurok ancestral territory extends inland along the Klamath River from the mouth of the river at Requa (Re'kwoi) to the confluence of Slate Creek and the Klamath River (Constitution of the Yurok Tribe Art. 1, Sec. 1). Within this ancestral territory there are approximately seventy known villages, which are situated along the banks of the Klamath or along the ocean streams and lagoons (Kroeber 1925:8, Waterman 1920, Pilling 1978). Many of these villages were permanent settlements, particularly the villages where ceremonial dances were held while others were only temporarily inhabited. Each village had its own geographical boundaries, as well as its own leaders who governed various sites and activities within the village. These sites

included fishing and hunting spots, permanent home sites, seasonal sites, gathering areas, training grounds, and spiritual power sites (Lindgren 1991).

Although there were villages all along the river and coast, a village of great importance would have several other villages in close proximity in a concentrated area. An example of this is at the confluence of the Klamath and Trinity Rivers where there were three villages, which in the 1850s had a population of about 200 (Bearss 1969:1). The largest of these three villages was We'itspus, meaning "confluence." This village was of extreme importance because it held a World Renewal Ceremony, also known as the White Deerskin Dance. This is one of several important ceremonial dances in the Yurok religion because its purpose is to renew or maintain the health of the world. The location of the village of We'itspus is on the north bank of the Klamath River and directly across from We'itspus, on the other side of the river was the village of Rlrgr. The third village in this close proximity was located across the Trinity River from Rlrgr and that village was known as Pek-tul.

Similarly in the middle course of the river is the village of Pecwan, located just downstream of Pecwan Creek from where the creek flows into the Klamath River. This is a village of great importance and wealth because Pecwan was a location for another major ceremony, the Jump Dance, which continues to be performed there today. The other villages in close proximity to Pecwan moving downstream on the northern bank are Qo'tep, Woxtek, and Woxhkero.

The final example of a concentration of villages is at the mouth of the Klamath River. On the northern slope of the hill ascending above the mouth is the largest Yurok settlement of Re'kwoi. In 1852, Re'kwoi had 116 residents and is another location for a Jump Dance (Bearss 1969:2). Just across the river on the southern side is the village of Welkwa. This village is the site of the annual Salmon Ceremony, which is performed to remove the effect of the taboo on the run of spring salmon (Waterman 1920:228). The last village in close proximity to the village of Re'kwoi is Tse'kwel.

There are many other Yurok villages residing along the Klamath River, which provides a means for transportation. Redwood dugout canoes are used on the River to access the villages lining the riverbanks. The river is also a primary source of sustenance, providing salmon, sturgeon, eels, and steelhead. Salmon, or nepū'i, meaning "that which is eaten" is one of the primary food sources for the Yurok, the other being acorns. Salmon is obtained during the annual runs by erecting a fish weir across the river, which provides salmon for people in surrounding villages. One location where fish weirs are erected include near the village of Kepel. The other primary food source for the Yurok is acorns. Acorn gathering grounds are found throughout the hills surrounding the villages. Acorns are processed into a soup-like mush, which is cooked in large baskets with hot stones.

Although the river was the primary means of transportation, an elaborate trail system was also utilized. Trails were to be treated with respect and travelers were to stay within the trail. Heavily utilized trails or trails deemed important had many resting spots where one

may stop and catch their breath. If a traveler stopped somewhere along the trail other than the resting place, they could bring themselves bad luck (Waterman 1920:185).

Redwood canoes were primarily used on the river, however, they were also used in the ocean to gather mussels and hunt sea lions. The Yurok, however, primarily stay away from open water. Other ocean food sources include surf fish and smelt, which are caught from the beach with throw nets. Seaweed, eels, and abalone are also important food sources for Yurok people. The latter is also used for regalia for ceremonial purposes.

The villages on the coast are primarily concentrated around lagoons and ocean streams. A prime example of such a concentration is the many villages that are located around Big Lagoon. Beginning to the north and continuing south along the eastern shore of the lagoon were the villages of Pa'ar, Oslokw, Keihkem, Maats, Pinpa, and Opyuweg, which is sometimes referred to as Ok'eto. Opyuweg means, "where they dance" because this is another village where a Jump Dance was held (Waterman 1920:266).

Although all the villages within Yurok Ancestral Territory are culturally and jurisdictionally Yurok, there is a distinction between those Yuroks residing within river villages and those along the coast. Coastal Yuroks living south of the mouth of Redwood Creek (Orek) are commonly referred to as Nr'r'nr, which describes a slight difference in dialect extending from Redwood Creek in the north to Tsurai and Me'tsko in the south. The other villages that comprise the Nr'r'nr area, beginning to the north are Orek, Orau, Tsahpekw, Hergwer, Tsotskwi, Pa'ar, Oslokw, Keikem, Ma'ats, Opyuweg, Pinpa, and Sumeg. Prehistorically, the largest concentration of occupants were located in the villages along the river, while the total number of houses in the coast villages were approximately one-third the number in river villages (Waterman 1920:184).

Historical documents record that the coastal Yurok had initial contact with Europeans as a result of Spanish expeditions spanning the mid 1500s to the late 1700s (McBeth 1950:2; Bearss 1969). Various Spanish-led expeditions and ships came up to northern California along the coast, followed later by American vessels as early as 1803 and 1805 (McBeth 1950:2: Bearss 1969). By 1828, the Klamath River had been documented and visited by ships from Britain, Spain, Russia and America (McBeth 1950:3; Bearss 1969).

First contact between Europeans and Yurok people on the upper Klamath River was documented to have occurred in 1827 when traders for the Hudson's Bay Company traveled downriver in search of furs and trade (Murray 1943:21-24; Bearss 1969). First contact within the project vicinity occurred in February 1827, when men from Peter Skene Odgen's party encountered Yurok in the Martins Ferry area. While these are the first documented encounters by non-Indians within the upriver areas of Yurok territory, the Hudson's Bay Company party documented the presence of European trade goods being used and sought by Yurok people, indicating prior interaction through trade or travel by Yurok people (Murray 1943:21-24; Bearss 1969; Pilling 1978:140).

In 1828, Jedediah Smith led an American party of beaver trapping men down the Trinity River, to the Klamath and the up the Pacific Coast (Goddard 1904; Bearss 1969). As a

result of the discovery of gold in the Trinity River, gold prospectors inundated the region by 1848. Upriver Yurok settlements were severely impacted by the incursion of gold prospectors in the 1850s, resulting in displacement and relocation away from some Yurok traditional villages along the Klamath River (Bearss 1969; Pilling 1978:140).

In 1851 a "Treaty of Peace and Friendship" was signed between the United States Government and the Klamath River Indians under the direction of U.S. Indian Agent Col. Reddick McKee (See Appendix A). The United States Congress did not ratify this treaty. Non-Indian incursions and resultant conflict continued and an Indian Agency and military fort were established on the River to mediate the conflict. The Agency was located on the south bank of the Klamath River, in the area known as *Waukel* (also spelled *Wo'kel* and Waukell) across the River from the military fort, Fort Terwer. In spite of the creation of these government posts, gold prospectors, miners, farmers, and settlers continued to encroach on Indian lands, often resulting in conflicts and violence. On November 16, 1855, the Klamath River Reserve (also known as the Klamath Indian Reservation) was created by Executive Order (pursuant to the Act of March 3, 1853, 10 Stat 226,238). This Order designated the reservation lands from the mouth of the Klamath River, one mile on each side extending approximately 20 miles upriver to Tectah Creek. The Klamath Reserve was established for several tribes because the treaty of 1851 was not ratified and the military was increasingly called to intervene between miners, settlers and Indians. It was the U.S. intent to move the Tolowa and Yurok onto it, but the Tolowa left soon after they were relocated (Bearss 1969).

The United States' original recognition of the central importance of rivers and fish to the Indian people of the Klamath-Trinity region is exemplified by the very shape and location of the lands first set aside for their reservations. The Secretary of Interior's own instructions at the time were, "to select these reservations from such tracts of land adapted as to soil, climate, water privileges, and timber, to the comfortable and permanent accommodation of the Indians." In 1855, Indian Agent S. Whipple's, when speaking of the Yurok, noted that "The river is abundantly supplied with Salmon. A fine large fish quite easily taken by the Indians and which is very properly regarded by the Indian as his staff of life."

In the letter was written to the Commissioner of Indian Affairs by Special Agent Whipple, the first Indian Agent on the Klamath River Reserve. This letter is important because it clearly describes several aspects of Yurok land use and their relationship to the River. In recommending the reservation boundaries extend five miles away from the River, Whipple recognized the Yurok use of the entire watershed associated with the River. He also describes the Lower Klamath as the best salmon fishing grounds in northern California. Whipple describes large alluvial terraces along the floodplain of the River that were used to gather a wide variety of plants, roots, and berries for food and supplies (Whipple 1855).

In that same year, President Pierce established the Klamath River Reservation. The Reservation (not to be confused with the Klamath Reservation in Oregon) was designated as a strip of territory commencing at the Pacific Ocean and extending one mile in width

on each side of the Klamath River for a distance of approximately 20 miles. This reservation lied entirely within the aboriginal territory of the Yurok.

While it was the Federal Government's intent to eventually move all the region's Indians onto the Klamath River Reservation, only the Yurok and some Tolowa did so. Both Fort Terwer and the Indian Agency at Waukel were destroyed in the floods of 1861 and 1862. Flooding along the Klamath River in 1862 led to the closing of the area's Indian Bureau office and the erroneous belief that the Reservation had been "abandoned", though it was still occupied by the Yurok. The Smith River Reservation, occupied primarily by Tolowa, was created in 1862 to supplement the loss of agricultural lands as a result of the floods. In 1865 the Hoopa Valley Indian Reservation was established with the intent of relocating all northwestern California Indians to this reservation (Bearss 1969).

Escalating conflict between Indians and non-Indians over encroachment onto the Klamath Indian Reserve resulted in the gradual displacement of Lower Klamath Indians further upriver during the 1860s and 1870s (Bearss 1969; McBeth 1950:44). In spite of the area being within the boundaries of the Klamath River Reserve, the area was occupied by non-Indians in defiance of the 1855 Executive Order and an 1877 order by the Department of the Interior that explicitly ordered non-Indian settlers off the reservation (McBeth 1950:46; Bearss 1969). Squatters resisted government attempts to remove them from the reservation and even when evicted by United States soldiers under orders in 1879, they quickly returned to the homes and farms they had established on Indian lands (McBeth 1950:53; Bearss 1969).

Soon after, on August 21, 1864, the Federal Government issued a proclamation and instructions from the Interior Department that established the Hoopa Valley Reservation on the Trinity River. The Trinity River flows north through Hoopa Valley to its confluence with the Klamath River. The Reservation is 12 miles square and is bisected by the last 12 miles of the Trinity River (it has often be called the Square or the 12 mile Square). In 1876 President Grant issued an Executive Order formally establishing the boundaries of the Hoopa Valley Reservation and provided that the land contained within those boundaries, "be withdrawn from public sale, and set apart in California by act of Congress approved April 8, 1864."

Efforts soon began to provide a single contiguous homeland for the region's Indian people by connecting the Klamath River Reservation (considered "abandoned" but not formally "extinguished") to the Hoopa Valley Reservation. Paris Folsom, a Special Agent for Interior proposed that the two reservations be connected in his "Report of Special Agent on Conditions and Needs of Non-Reservation Klamath Indians," sent to the Commissioner of Indian Affairs in 1885. In that report Mr. Folsom wrote:

> "Nature seems to have done her best here to fashion a perfect paradise for these Indians .... She filled the mouth of the Klamath river with a sand-bar and huge rocks, rendering ordinary navigation impossible, and pitched the mountains on either side into such steep and amazing confusion that the river has a hard struggle to drive its way through the wonderful gorges ... Tremendous bowlders (sic) and

> cragged points jut into the river and change its course, forming innumerable eddies and back currents, where salmon seek to rest, to be taken in large numbers by means of Indian nets" (Folsom 1885).

Nonetheless, it was not for another six years, until 1891, that the Klamath River Reservation was extended 20 miles up River to connect with the Hoopa Valley Reservation and made part of that Reservation in "an effort to better protect the region's Indians." By that time, as a result of the Dawes act of 1887, much of the Klamath River Reservation and extension lands (the 20 mile strip which connected the two reservations is commonly referred to as the "Connecting Strip" or "Extension") not already claimed as allotments by resident Indians had been opened up to non-Indian settlement. This led to checkerboard ownership of the Yurok portions of both the Extension and former Klamath River Reservation. Through various means, several timber companies had quickly consolidated and heavily logged much of this land.

In 1891, President Harrison issued an order to expand the existing Hoopa Valley Indian Reservation to include lands one mile on either side of the Klamath River from the Pacific Ocean to the Hoopa Valley, thereby including the Klamath Indian Reserve (Bearss 1969). In order to do this, he created the "extension", extending the Klamath River Reserve upriver until it reached the Hoopa Square. The "extension" was established in relation to the Dawes Act as a ploy to open up much of the land that was not claimed as allotments by resident Indians. Thus began the history of checkerboard ownerships of the Yurok portions of the Klamath Reservation and Extension. The result of Harrison's order was the essentially the creation of a new reservation by combining two existing ones. The new reservation consisted of the old Klamath River Reserve, the "extension", and the Hoopa Square and was referred to in its entirety as the Hoopa Valley Indian Reservation. On June 25, 1892, President Harrison singed a bill passed by Congress to open the reservation for non-Indian settlement. The bill declared all surplus lands open to settlers, "reserving to the Indians only such land as they require for village purposes" (McBeth 1950:48; Bearss 1969). The process of assigning Indian allotments within the reservation took two years. After decades of conflict, the Klamath Indian Reservation was legally opened up for non-Indian settlement on May 21, 1894 for homesteading (McBeth 1950:48; Bearss 1969). As a result, many Yurok people were displaced from their traditional villages along the Klamath River. Many Yurok relocated to the Hoopa Valley Indian Reservation and continue to live there today.

In the early 1900s the commercial fishery was overtaken by non-Indians and numerous canneries were established within Yurok territory near or at the mouth of the Klamath River. The resulting over harvest resulted in a complete closure of the Lower Klamath fishery by California Department of Fish and Game in the 1933. During this time, Yurok and other Indians were prohibited from fishing for subsistence or commercial purposes. The recreational fishery was restored for non-Indians in subsequent years, but the practice of subsistence and commercial fishing by Yurok people was prohibited and criminalized. Nonetheless, Yurok continued to fish the river as they always have, but the activity was deemed by state regulators as a criminal act, rather than a subsistence right.

In the 1970s enforcement actions for these unjust policies by the State of California Department of Fish and Game resulted in what is commonly referred to as the "Fish Wars" on the Klamath River. During this time Yurok fishers engaged in acts of civil disobedience, known as "Fish Ins" often resulting in the battery and arrest of those participating in these peaceful acts. After escalating violence and confrontations over Yurok exercising their fishing rights, one Yurok fisherman, Raymond Mattz was arrested and charged by the California Department of Fish and Game. The result was a court battle the went all the way to the US Supreme Court and the now-famous ruling that affirmed Yurok fishing rights: Mattz vs Arnett, 412 US 481 decided in 1973 (See Appendix B).

From 1891 through 1988 the Hoopa Valley Reservation was comprised of the Hoopa Valley Square, the Extension and the original Klamath River Reservation. In 1988 Congress, under the Hupa-Yurok Settlement Act, separated the Hoopa Valley Reservation into the present Yurok Reservation (a combination of the original Klamath River Reservation and Extension) and Hoopa Valley Reservation (the Reservation as proclaimed in 1864).

After decades of struggle to regain their traditional homelands, the Yurok Tribe was re-organized and granted its own reservation in 1988. As a result of the 1988 Hoopa-Yurok Settlement Act (PL-100-580), the Yurok Indian Reservation was established, comprised of the old Klamath Reserve of 1855 and the "extension" of 1891. The current reservation is comprised of trust land, tribal allotments, fee land, and privately owned land.

In 1993, the Department of the Interior further clarified Yurok fishing rights in the Solicitor's Opinion (See Appendix C). In this opinion, the Solicitor concluded that the Yurok Tribe has a reserved right to "harvest quantities of fish on their reservations sufficient to support a moderate standard of living" with an entitlement of 50% of the harvest in any given year. This decision enabled the Yurok Tribe to resume its traditional commercial harvest for economic purposes.

In spite of the restored rights for subsistence and commercial fishing, Yurok people continued to suffer the cultural and economic impacts of a declining fishery. The reasons for the decline are complex and a result of cumulative impacts of numerous management decisions within the Klamath Basin, but the dams and water diversions in the upper Basin have had a direct and adverse effect on the water quality and the health of the fishery throughout the Klamath watershed. In 2002, a drought, low flows and water diversions for agriculture in the upper Basin resulted in dire consequences on the Lower Klamath. Increased water temperatures and low flows resulted in the mass die off of over 30,000 adult returning Fall Chinook salmon within the Yurok Reservation. This tragedy is known as the "Klamath Fish Kill". The effect was devastating to Yurok people and resulted in the determination by the Yurok Tribe to save the fishery and actively engage in negotiations and efforts to protect their resources, their River and their salmon for not only this generation, but future generations of Yurok People.

***"Never in our time have we, the elders of the Yurok Culture Committee, seen such a mass destruction of our salmon resource."* (October 2, 2002)**

In 2006, the Yurok Tribe entered into a Cooperative Agreement with the Department of the Interior for the Cooperative Management of the Klamath River with federal agencies.(See Appendix D) The Agreement was the result of a settlement agreement with the Tribe over the 2002 Klamath Fish Kill. It is important to note that the Yurok Tribe refused to take a financial settlement for this loss of an irreplaceable resource, consistent with a Yurok philosophy of refusing to assign a dollar value to a resource that is irreplaceable.

COOPERATIVE AGREEMENT
between
UNITED STATES DEPARTMENT OF THE INTERIOR
and
YUROK TRIBE
for the
COOPERATIVE MANAGEMENT OF TRIBAL AND FEDERAL LANDS AND RESOURCES IN THE KLAMATH RIVER BASIN OF CALIFORNIA

I. STATEMENT OF JOINT OBJECTIVES:

A. Purpose. This Cooperative Agreement (Agreement) is made and entered into between the United States Department of the Interior (DOI) and the Yurok Tribe (Tribe) to coordinate and cooperatively manage Federal and Tribal lands and resources within the Klamath Basin in California, both within the Yurok Reservation as well as the related basin, upstream river, and Pacific Ocean resources subject to the jurisdiction or authorities of various DOI agencies and bureaus. This Agreement will provide more consistent, economical, effective, and collaborative management of Federal and Tribal lands and natural resources while furthering the Trust relationship that exists between DOI and the Tribe. This Agreement will also greatly expand the resources available to address the shared goals of DOI and the Tribe to improve our collective understanding of the river system and its dynamics, improve the health and vitality of the fishery, and identify and develop programs for natural resource management and service delivery in order to provide long-term benefits to the Tribe, local communities, and the general public and to improve the condition of the basin's natural resources. DOI and the Tribe anticipate that this Agreement will be the foundation for subsequent, continuing, and specific collaborative programs in natural resource management, including but not limited to land and water management, fisheries management, water quality monitoring, land use planning, data gap analysis, interpretation and outreach, and Tribal-interagency management initiatives which will enhance the opportunity to identify and resolve issues critical to the success and survival of a healthy river-based ecosystem in the lower Klamath Basin.

B. Objective. DOI and the Tribe intend to establish an ongoing collaborative government-to-government relationship for management of land, water and other natural resources which will inure to the benefit of DOI, the Tribe, and the communities, as well as the ecosystem and economy of the Klamath River Basin. This Agreement provides a

mechanism to coordinate natural resource management programs, develop joint planning and management initiatives, and coordinate program and budget priorities through the cooperative allocation of resources and the development of long-term resource management and programmatic goals between the signatories. The Agreement will improve DOI and Tribal services to the Tribal and local communities and the general public by improving Klamath River resources management, addressing the health of the fishery, and establishing related programs for restoration and management of natural resources. The Agreement will provide an opportunity for the Tribe to bring to bear its acknowledged scientific expertise, its knowledge of the basin, and the wealth of its culture and traditions to its collaborative relationship with DOI. The Agreement will provide a mechanism by which the Tribe and DOI may further the protection and preservation of Tribal cultural values and practices while collaborating on management of basin natural resources. The Agreement will accomplish these objectives by developing mechanisms for increasing the potential contribution and participation in federal programs by the Tribe while also realizing broader benefits to Klamath Basin communities, the general public, federal agencies and the scientific community.

Under re-organization the Yurok tribe has emerged as the largest tribe in California, with over 5,600 enrolled tribal members, and over 200 tribal government employees. The Yurok Tribe has a growing tribal population and is actively pursuing economic development and resource management both on the reservation and Yurok ancestral lands. The Yurok Tribe has a Natural Resources Department with the largest governmental fisheries program in the state of California. Other programs include the Yurok Tribe Watershed Restoration Program, devoted to restoring fish habitat, the Yurok Tribe Environmental Program, devoted to establishing and monitoring clean air, water, and land, and the Yurok Tribe Culture Department devoted to preserving Yurok culture. These departments assist the Tribal Council in its work to protect and maintain Yurok values as articulated in the Preamble Objectives of the Yurok Constitution (Yurok Tribe 1993). The River continues to be the foundation of Yurok culture, economy, and tradition.

Yurok Timeline – Contact to Present

- **1775** – Spanish explorer Juan Francisco de Bodega arrives in Trinidad Bay at Patrick's Point in order to lay claim to Spanish territory for the King of Spain.
- **1822** – Peter Skeene Ogden a fur trapper from the Hudson Bay Company arrives in Weitchpec.
- **June 8, 1828** – Jedidiah Smith on his intended exploration of the Sacramento River ended up in the Pacific Northwest. After hitting the south fork of the Trinity River, Smith and his men followed the river through the reported rough terrain to the Pacific Ocean at the mouth of Wilson Creek in Requa.
- **1848** – Josiah Gregg on a botanical expedition to collect specimens entered the Klamath River territory.
- **1849** – The beginning of the Gold Rush; settlers and miners first enter the Klamath River area for its rich natural resources (redwoods, fish etc.). These miners and settlers, in seeking the Klamath's resources, tried to force the Yuroks out of their ancestral land through practices such as hunting them down, ridicule, rape or enslavement. They would attack villages and in some cases slaughter men, women and even infants. Upon their return, the men would be treated as heroes and would also be paid by the state's government for their successful work.
- **September 4, 1851** – California became the 31st state.
- **1851** – Klamath River Peace Treaty was made at Camp Klamath at the junction of the Klamath and Trinity Rivers. The treaty was between Indian Agent Redick McKee and the tribes of the Yurok (Poh-lik or Lower Klamath), as well as the Hupa (Hoo-pah) and Karuk (Pen-tsick or Upper Klamath). For the tribes that agreed and acknowledged to keep peace under the U.S. government, they were to have a large Reservation set aside for them; the tribes requested that they be allowed to stay within their traditional territories. The treaty was never fully ratified by Congress due to the political pressure from the non-Indian residents of California and California's Governor James Douglas and Lieutenant Governor John Bigler. Almost all of the villages along the Klamath had been burned by miners; those villages that did survive were infested by disease outbreaks such as small pox, measles and tuberculosis.
- **November 16, 1855** – President Franklin Pierce, acting pursuant to the Act of March 3, 1853, amended on March 3, 1855, authorizing the creation of the Klamath River Military Reserve. The reservation started at the Pacific Ocean and extended one mile in width on each side of the Klamath River for a distance of approximately 20 miles, positioned about 25 miles north of the Klamath-Trinity confluence, setting aside a total of 25,000 acres.
- **1857** – Fort Terwer was established at Terwer Creek to keep peace between the Indians and the growing number of miners and traders trying to move onto the Klamath River Military Reserve.
- **1861** – The Klamath River Military Reserve was flooded and many of the homes were destroyed included Fort Terwer.
- **1864** – Congress enacted legislation that authorized the President to establish 4 Reservations in California, 13 Stat. 39. The Hoopa Valley Reservation was

provisionally created and became the supervising agency over the Lower Klamath River Indians. Indian Superintendent Wiley negotiated a "treaty" with Hupa and other tribes to establish a reservation that encompassed the Square. This "treaty" was never submitted to Congress and was never ratified. Nevertheless "The Yuroks were beneficiaries of the 1864 Treaty (never ratified) that called for the creation of the Reservation".

- **June 23, 1876** – An Executive Order was approved by Ulysses S. Grant, establishing the Hoopa Valley Reservation and it's boundaries for sixteen local area tribes and bands in their ancestral territories; including the Lower Klamath River people. The Hoopa Valley Reservation encompassed the Square and was established "in part for the Yuroks".
- **Fall 1876** – Martin V. Jones and George Richardson came to the Klamath to engage in the business of catching and salting for the first fishery market on the Klamath River
- **November 21, 1877** – By order from the Department of Interior… "All the WHITE men living on the KLAMATH RIVER MILITARY RESERVE have been ordered to move off, forthwith." War Department, General Irwin McDowell ordered Captain Parker to notify the settlers on the reservation to leave immediately. The evicted settlers left their homes, but returned as soon as the soldiers left the lower Klamath and returned to Fort Gaston in Humboldt County.
- **June 3, 1878** – The Timber and Stone Act allowed settlers to receive a timber lot which was to be used in conjunction with homesteading. It was only to be applied to unoccupied, unimproved, unreserved, surveyed, non-mineral lands unfit for cultivation with the maximum allowable of 160 acres per person. It was widely abused, particularly in dealing with the Redwood forests by various lumber companies in the 1880's.
- **March 3, 1883** – 22 Stat. 582 provided that the proceeds of timber sales should go into the treasury for the benefit of the members of the tribe.
- **1885** – Commercial and sports fisheries started to flourish due to the Klamath-Trinity salmon runs. R.D. Hume's "floating cannery" entered the mouth of the Klamath and began harvesting the salmon that the Yurok's relied on for subsistence.
- **February 8, 1887** – 24 Stat. 388-391 The Dawes or General Allotment Act allowed for the breakup of tribal lands into parcels or allotments. These allotments were to be held by individual allottees that were then granted citizenship upon receiving their allotments. Allotments allowed the Indian land to be held in trust with the U.S. Government for a period of 25 years. Allotment trust land could neither be taxed nor alienated. At the end of the 25 year period, the land was to be delivered to the allottees in fee patent (i.e. become private property) free of any encumbrance.
- **June 1889** – Nearly all the soldiers on the Lower Klamath had been removed. Squatters were appearing on the Klamath; nearly every foot of land from the mouth inland for twenty miles had been settled on.
- **1890's** – Four Klamath allotments were used for a cannery established by A. Bomhoff near the mouth at Requa. In exchange for the land, he agreed to hire only Indian fishermen and workers in the cannery.

- **October 16, 1891** – By Executive Order, President Harrison extended the Hoopa Valley Reservation to include the tract of land one mile in width on each side of the Klamath River from the confluence of the Trinity River to the mouth at the Pacific Ocean. The extension included not only the Klamath River Military Reserve but also the connecting strip between the Klamath River Military Reserve and the Hoopa Valley Reservation, known as the "addition" or "extension", creating an enlarged single Reservation of approximately 155,000 acres.
- **June 17, 1892** – Pursuant to the Dawes Act, Congress allowed for "surplus" unoccupied land upon the Reservation to be sold to the general public.
- **1892** – Congress enacted allotment legislation affecting only the former Klamath reserve portion of the Reservation. Ambrose H. Hill was appointed to make the individual allotments on the original Klamath River Military Reserve. Each Indian was to be allotted either 80 acres of agricultural land or 160 acres of grazing land. Indians on the Lower Klamath Reservation had to apply for these lands, while those on the "connecting "strip" received their allotments automatically.
- **February 13, 1893** – Ambrose H. Hill submitted a schedule of 161 allotments on the original Klamath River Military Reserve. These allotments varied from 8 to 160 acres, averaging 60 acres and totaling 9,762 acres. Three traditional villages of Requa, Hoppaw and Scaath totaling 70 acres, were set aside as reserves for the Klamath People. The remaining 15,321 acres of the Klamath River Military Reserve were returned to public domain for disposal via homesteading or sale under the Timber and Stone Act. Other lands were threatened for removal under the authority of Congress' Swamp Act of 1850 which enabled states to reclaim lands that were considered "swamp land" and could be traversed by a flat bottom boat.
- **February 1894** – Charles W. Turpin took over and completed the allotment process. Hill had made 246 allotments on the **"**connecting strip**"** while Turpin had made the final 253 allotments upon the "connecting strip". The allotments ranged from 5 to 160 acres, averaging 40 acres and totaling 19,330 acres.
- **April 1894** – Public notice was published:

  TO WHOM IT MAY CONCERN
  "The Klamath Indian Reservation opened
  May 21, 1894, at 9 a.m. Now prepared
  to receive application for homesteads."
- **June 23, 1898** – Within the "connecting strip" the Hill schedule had been approved for 9,215 acres and the Turpin schedule was approved for 10,115 acres four days later. The total allotted acres for the whole Klamath River Military Reserve was then 29,095 acres, containing approximately 641 separate allotments. About 320 acres on the "connecting strip" were for Village Reserves at Notchko, Mettah, Waseck, Kanick, Mareep, Moreck, Cawtep, Surgone, Wauteck, Pecwan, Cappell and Weitchpec.
- **May 8, 1906** – 43 Stat. 182 - The Burke Act authorized the Secretary "whenever he shall be satisfied that any Indian allottees is competent and capable of managing his or her own affairs" to issue a patent in fee simple to such allottees

and it allowed the trust period to be extended for those Indians found to be "not competent".

- **1910** – There was an estimated 688 Klamath River Indians, a decrease of about 73% of their original population in 1848 before white contact.
- **June 25, 1910** – 36 Stat., 885 authorized the Secretary of the Interior to sell land of allottees who died before their 25 year expiration of their trust period without the consent of all their heirs, upon showing that one or more of the heirs were deemed "incompetent" to manage their own affairs. 307 parcels were sold in this manner with only 213 cases that had obtained consent from all of the owners. An Indian was seen as competent if they had greater than one-half white blood, had received a year or more of white schooling or if they were able to read or write English and were 21 years of age or older.
- **October 8, 1910** – Bids for allotted Indian lands were advertised and were opened up for sale on September 30th, 1910. They were advertised in the *Blue Lake Advocate,* a local Humboldt County newspaper.
- **March 28, 1914** – H.R. 10848 – A bill was re-introduced to Congress after having first been introduced in 1911, to allow for the disposition of $25,000 in funds resulting from the sale of "surplus" Indian lands on the Lower Klamath Reservation. The funds from the sale of lands were originally to be used for the "maintenance and education of the Indians now residing on said lands and their children". H.R. 10848 provided for the $25,000 to be used to build a road along the Klamath River, connecting a road from Requa to the "extension" portion of the reservation.
- **1917** – The Trinidad Rancheria was established for landless Indians in the Trinidad area including Indians from three local tribes of the Yurok, Wiyot and Tolowa.
- **October 15, 1917** – Commissioner of Indian Affairs announced the "policy of greater liberalism". This allowed the Secretary of Interior to issue fee patents to allottees, resulting in allotted lands being removed from trust status whether the allottees had requested the removal or not. Subsequently, many allotments taken out of trust were subject to taxation by Humboldt and Del Norte Counties. Shortly thereafter, allottees began losing allotments for non-payment of back taxes, real estate fraud and the need for cash.
- **1918** – Copco 1 Dam was created on the Klamath River. It permanently blocked more than 75 miles of steelhead and salmon habitat in the main stem of the Upper Klamath and its tributaries. In 1925 Copco 2 Dam was constructed a quarter-mile downstream to regulate flows from Copco 1 Dam.
- **July 10, 1918** – The Big Lagoon Rancheria was established by Executive Authority by the Secretary of the Interior.
- **March 7, 1919** – A large number of allotments go out of trust along the Klamath River due to the pressures from white settlers and timber interests. The competency Commissioner had instructed the Superintendents of the various Indian reservations to submit a list of those allottees who were deemed competent along with a description of their allotments, resulting in 6,278 acres or 22% of the allotted lands passing into fee status.

- **1925** –The BIA in Washington DC sent instructions to Superintendent Montsorf to draw up a list of "competent" Indians on the "connecting strip" in anticipation of the expiration of their allotment trust periods. Another large group of allotments were then taken out of trust.
- **1931** – The Forest Service, in creating the "Redwood National Forest", established a Redwood forest acquisition program targeting reservation lands, including 780 acres of the Klamath River Military Reserve and 2,110 acres of Indian allotments for acquisition.
- **1933** – The State of California bans all forms of tribal traditional burning practices. The California Department of Fish and Game bans all commercial fishing and closes the canneries on the lower Klamath River.
- **1934** – Indian Reorganization Act, the Government extended the trust period for allotments from 25 years to indefinitely, stopped the issuing of Indian allotments and annulled their authority to sell surplus reservation lands, and instead move towards efforts of returning these lands back to the Indian People. The Klamath River Indians were banned from all of their traditional practices of commercial fishing and gill-netting. Yurok fishermen are given jobs building a road from the Klamath Glen to Blue Creek in exchange for gill nets.
- **1950** – With the assistance of the B.I.A., some Hupas organized as the Hoopa Valley Business Council. Prior to this time, from time immemorial, none of the Indian Tribes of the area had been formally organized.
- **1952** – The Secretary of the Interior approved the Hoopa Valley Tribe's Constitution and by-laws.
- **1953** – Public Law 280 enacted by Congress imposed State of California jurisdiction over criminal and civil cases committed by or against Indians in Indian Country. This failed to recognize tribal sovereignty and tribal self-determination. House Concurrent Resolution 108 encouraged the termination of Indian Reservations and the idea of relocating Indians off their reservations. Many Indians were encouraged to sell their allotted lands through questionable and forced fee patents, resulting in at least 60% of the lands being taken out of trust and sold to logging companies, primarily to support the plywood industry that was booming after WWII.
- **1955** – The Trinity River Act allowed the construction of the Trinity River Dam along the Trinity River that flows into the Klamath; to be completed by 1963. The B.I.A. approved timber sales for communally held timber in the Square and as the request of the Hoopa Valley Business Council; the B.I.A. began disbursing per capita payments to individual Hoopa Valley tribal members.
- **1958** – Solicitor's opinion provided that it is legal to distribute revenues from the unalloted trust timberlands of the Square in per capita payments to Hoopa Tribal members (later determined to be erroneous in Short).
- **May 19, 1958** – The Indian Land Restoration Act allowed the return of previously disposed of land restored back to tribal trust, most of which were exceptionally steep or frequently flooded, thus unsuitable for habitation. The 20 acres of Village Reserve at Requa was returned to public domain and allotted to four individual Indians.

- **1960** – Logging upon the North Coast had consumed nearly 90% of the original Redwood forest.
- **1962** – 173-foot high Iron Gate Dam was constructed in order to regulate the flows of the Copco Dams and to run 20 mega-watt's for Pacific Power's power plant. With the construction of Iron Gate Dam another 7 miles of salmon and steelhead spawning habitat disappeared.
- **1963** - A legal suit was filed against the United States on behalf of 16 named Yurok's. Later 3,222 additional claimants and descendants were added in a 1967 modification. The suit asserted that the Yurok Indians should share equally in the proceeds derived from the selling of timber resources on the area comprising the original Hoopa Valley Reservation. Jesse Short, et al v. United States.
- **1964** – The worst flood in recorded history occurred on the Klamath River wiping out the town of Klamath and many low-lying houses.
  The Lewiston dam is built on the Trinity River.
- **1968** – Redwood National Park was created by Congress and later expanded in 1978. The National Parks Service took over the possession of three individual allotments that were along the south end of the Lower Klamath. In all, 1,300 acres of Yurok Tribal land were included in the new Parks boundaries.
- **1973** – Jessie Short Et. Al. v. The United States, Court of Claims held that the Yurok Reservation was not a separate entity but actually an extension of the Hoopa Valley Reservation and was therefore entitled to equal rights to income from timber sales on unalloted trust land.
- **1973** – Mattz v. Arnett, was decided; it upheld the "Indian Country" status of the Reservation. The case involved the State of California trying to assert jurisdiction to regulate Indian fishers on the Klamath River; The Court determined that California had no such jurisdiction.
- **1974** – The U.S. Supreme Court declined to review Short v. United States. The Short court embarked on the task of determining which of the 3,800 plaintiffs were bona fide Indians of the Reservation and therefore entitled to damages. The U.S. and the Hoopa Valley Tribe vigorously contested the status of many of the plaintiffs and litigation continued for two decades. Eventually, in 1994 plaintiffs were certified and received Treasury checks for damages for the period of 1955 to 1974.
- **1974** – The Secretary of the Interior established the 70% escrow account for timber revenues. "Upon the denial of certiorari to the court's decision…The Secretary of the Interior ceased to distribute revenues exclusively to members of the Hoopa Valley Tribe. On the theory that all of the 3,800 plaintiff's could eventually be entitled to 70 percent of annual timber revenues in escrow pending a final decision on the number of plaintiffs in Short qualifying as Indians of the Reservation entitled to per capita distributions of timber revenues." Hoopa Valley Tribe v. United States.
- **1976** – Arnett v. 5 Gill Nets held that the state of California lacked jurisdiction to regulate the Indian fishing on a reservation and that the Yurok Indians had a reserved right to commercial fishing dating back to their aboriginal times and are protected by the governments trust responsibility.

- **1979** – The Hoopa Valley Tribe's suit for damages against the United States for breach of trust and otherwise for failing to protect the Hoopa Valley Reservation was decided adversely to the Tribe.
- **1974-1987** – The Hoopa Valley Tribe unsuccessfully urged Congress to over-turn Short.
- **April 1988** – Puzz v. United States affirmed the previous decision for the Hoopa Valley to receive consent from the Yurok's in the distribution of the escrowed timber sale proceeds. The Yurok's continued to refuse to form a separate tribal roll from that of the Hoopa Valley Tribe as well as participate in any "joint-management" schemes that would allow them to govern themselves. That the Department of the Interior would no longer recognize the Hoopa Valley Tribe as the exclusive government of the Hoopa Valley Reservation.
- **October 31, 1988** – 102 Stat. 2924 The Hoopa-Yurok Settlement Act (P.L. 100-580) divided the land into two separate Reservations: the "square" became the Hoopa Valley Reservation and the "extension" (including the original Klamath River Military Reserve) became the Yurok Reservation; excluding the Resighini Rancheria. This bill reversed the previous court decisions of the Short and Puzz cases and directed the Yurok Tribe to form a tribal council to handle their reservation responsibilities; they also had to establish a tribal roll as well as criteria for sharing the proceeds of the decision. Persons eligible by the criteria of the Short cases who elected not to pursue Yurok Tribal membership were entitled to a buyout payment of $15,000. The Short escrow accounts, plus some small Yurok escrow accounts, are transformed into a Hoopa-Yurok Settlement Fund; and a ten million dollar federal contribution to the Settlement fund was authorized (and appropriated). The Yurok Tribe, subject to adopting a waiver of claims, was given several small land tracts, the authority to organize, and an authorization of not less that 5 million dollars for land purchases. The Settlement Fund was to be allocated to the Hoopa Tribe and the Yurok Tribe based on their relative enrolled population at time of distribution. Both Tribes were to provide waives of claims against any takings of land or assets affected by the Act. This act specifically vest to the Yurok Tribe the fishery. The Yurok allocation of fish is 80% of the total Tribal allocation.
- **1990** – Water division due to the upriver dams has led to a 90% decline in the Klamath and Trinity Rivers fisheries.
- **1991** – The tribe becomes organized under the adoption of the Constitution of the Yurok Tribe and establishes their first Yurok Tribal Council.
- **1991** – In Heller, Ehrman v. Lujan, the Short claims attorneys sued the Secretary of Interior for attorney's fees of up to 25% of the Settlement Fund. They asserted that 70% escrow account was derived from their litigation efforts and that the Settlement Fund was in fact the escrow account. Yuroks, Jesse Short, Susan Masten, and Valerie Reed intervened as co-defendants with the consent of the United States to protect the Settlement Fund. The Yurok and United States defendants were successful when the federal court of appeals determined that the plaintiffs could not sue the United States for money damages in federal district court.

- **1991** – The Department of the Interior allocated the Hoopa-Yurok Settlement Fund based on Hoopa and Yurok tribal enrollments. From the $85,979,348.37 Fund balance, the Hoopa Tribe's share is determined to be 39.5% or $34,006,551.87. This amount has been provided to the Hoopa Valley Tribe. The balance of the Fund, after withdrawals for payments for buy-outs, and enrollments are made, was placed in a Yurok Tribe Trust Fund. The balance after the Hoopa withdrawals and the individual buy-out and enrollment (payment) withdrawals in 1991-93 in the Yurok Trust Account was $37,819,971.79. Each individual Yurok who received as enrollment check had to waive his/her rights to sue the United States for money damages for an unconstitutional taking under the Settlement Act
- **1993** – Twenty acres of the former Weitchpec Bar Mining Claim near Weitchpec was returned to tribal trust due to a surveying problem near Cappell and the end of the Reservation line at Weitchpec.
- **1993** – The Yurok Tribe formally organized and adopted a Constitution under its inherent powers of self-governance. The Department of the Interior recognized the Constitution and the Yurok Tribal Council as the governing body of the Yurok Tribe.
- **1994** – The Yurok Tribe assumed responsibility over the management of their fisheries from the Bureau of Indian Affairs and the U.S. Fish and Wildlife Service.
- **1996** – Parravano v. Masten affirmed the right of the Yurok and Hoopa Valley Tribes to 50% of the harvestable surplus of Klamath River Chinook.
- **1997**- Coho salmon are listed under the Endangered Species Act.
- **2002** – Klamath Fish Kill. Over 30,000 returning adult fall Chinook salmon die in the Lower Klamath River, within the Yurok Reservation as a result of diseases caused by low flows and increased water temperatures. The Yurok Culture Committee statement on the mass die off: The Yurok Tribe files suit against the United States as a result.
- **2006** – The Yurok Tribe, in a settlement agreement over the 2002 Klamath Fish Kill enters into a co-management agreement with the Department of the Interior. The Congress set aside funding for disaster relief due to the low populations of Klamath River fall Chinook for this year.
- **Today** - The Yurok Tribe is currently the largest tribe in California with over 5,600 members. The Yurok currently have approximately 3,400 acres of unalloted trust land, 350 acres of village reserves and 1,900 acres of trust allotments left on the reservation. This represents less than 10% of the original reservation land set-aside for the Yurok people. Billions of dollars in timber, water, fish and minerals have been removed from the lands within the Yurok Reservation with little or no support returned to the original inhabitants of the land. (petition was filed to list Chinook salmon in the Klamath River noting low populations of natural spring and fall Chinook in the Klamath)

III. Yurok Traditional Knowledge and the Klamath River

PREAMBLE OF THE CONSTITUTION OF THE YUROK TRIBE

Approved by the Interim Council on November 24, 1993

Our people have always lived on this sacred and wondrous land along the Pacific Coast and inland on the Klamath River, since the Spirit People, *Wo'ge'* made things ready for us and the Creator, *Ko-won-no-ekc-on Ne ka-nup-ceo*, placed us here. From the beginning, we have followed all the laws of the Creator, which became the whole fabric of our tribal sovereignty. In times past and now Yurok people bless the deep river, the tall redwood trees, the rocks, the mounds, and the trails. We pray for the health of all the animals, and prudently harvest and manage the great salmon runs and herds of deer and elk. We never waste and use every bit of the salmon, deer, elk, sturgeon, eels, seaweed, mussels, candlefish, otters, sea lions, seals, whales, and other ocean and river animals. We also have practiced our stewardship of the land in the prairies and forests through controlled burns that improve wildlife habitat and enhance the health and growth of the tan oak acorns, hazelnuts, pepperwood nuts, berries, grasses and bushes, all of which are used and provide materials for baskets, fabrics, and utensils.

For millennia our religion and sovereignty have been pervasive throughout all of our traditional villages. Our intricate way of life requires the use of the sweathouse, extensive spiritual training, and sacrifice. Until recently there was little crime, because Yurok law is firm and requires full compensation to the family whenever there is an injury or insult. If there is not agreement as to the settlement, a mediator would resolve the dispute. Our Indian doctors, *Keg-ae*, have cared for our people and treated them when they became ill. In times of difficulty village headmen gather together to resolve problems affecting the Yurok Tribe.

Our people have always carried on extensive trade and social relations throughout our territory and beyond. Our commerce includes a monetary system based on the use of dentalium shells, *Terk-n-term*, and other items as currency. The Klamath River was and remains our highway, and we from time beginning utilized the river and the ocean in dugout canoes, *Alth-wayoch*, carved from the redwood by Yurok craftsmen, masterpieces of efficiency and ingenuity and have always been sold or traded to others outside the tribe. Our people come together from many villages to perform ceremonial construction of our fish dams, *Lohq-en*. Our traditional ceremonies -- the Deerskin Dance, Doctor Dance, Jump Dance, Brush Dance, Kick Dance, Flower Dance and others -- have always drawn hundreds, and sometimes thousands, of Yuroks and members of neighboring tribes together for renewal, healing, and prayer. We also have always traveled to the North

and East to the high mountains on our traditional trails to worship the Creator at our sacred sites, -- Doctor Rock, Chimney Rock, *Thklamah* (the stepping stones for ascent into the sky world), and many others.

This whole land, this Yurok country, stayed in balance, kept that way by our good stewardship, hard work, wise laws, and constant prayers to the Creator.

Our social and ecological balance, thousands and thousands of years old, was shattered by the invasion of the non-Indians. We lost three-fourths or more of our people through unprovoked massacres by vigilantes and the intrusion of fatal European diseases. The introduction of alcohol weakened our social structure, as did the forced removal of our children to government boarding schools, where many were beaten, punished for speaking their language, and denied the right to practice their cultural heritage. After goldminers swarmed over our land we agreed to sign a "Treaty of Peace and Friendship" with representatives of the President of the United States in 1851, but the United States Senate failed to ratify the treaty. Then in 1855, the Unites States ordered us to be confined on the Klamath River Reserve, created by Executive Order (pursuant to the Act of March 3, 1853, 10 Stat. 226, 238) within our own territory.

In 1864 a small part of our Ancestral land became a part of the Hoopa Valley Indian Reservation which was set apart for Yuroks and other Indians in Northern California. This became known as the 12-mile "Square." In 1891, a further small part of our Ancestral land was added when "The Extension" to the Hoopa Valley Indian Reservation was set aside by executive order authorized by the 1864 statute, which created the Hoopa Valley Indian Reservation. This statutory reservation extension extended from the mouth of the Klamath River, including the old Klamath River Reserve, about 50 miles inland and encompassed the river and its bed, along with one mile of land on both sides of the river.

But even this small remnant of our ancestral land was not to last for long. In the 1890's, individual Indians received allotments from tribal land located in the Klamath River Reserve portion of the Hoopa Valley Reservation and almost all of the remainder of the Reserve was declared "surplus" and opened for homesteading by non-Indians. The forests were logged excessively and the wildlife was depleted. Even the great salmon runs went into deep decline due to over-fishing and habitat destruction. In the mid 1930's the State of California attempted illegally to terminate traditional fishing by Yurok people, the river's original --and only -- stewards from Bluff Creek to the Pacific Ocean. Our fishing rights were judicially reaffirmed in the 1970's and the 1980's after many legal and physical battles.

Throughout the first 140 years of our tribe's dealings with the United States, we never adopted a written form of government. We had not needed a

formal structure and were reluctant to change. The United States had decimated the Yurok population, land base, and natural resources and our people were deeply distrustful of the federal government. Yet we, the Yurok people, know that this is the time to exercise our inherent tribal sovereignty and formally organize under this Constitution. We do this to provide for the administration and governance of the modern Yurok Tribe that has emerged, strong and proud, from the tragedies and wrongs of the years since the arrival of the non-Indians into our land. Our sacred and vibrant traditions have survived and are now growing stronger and richer each year.

The Yurok Tribe is the largest Indian tribe in California, and, while much land has been lost, the spirit of the Creator and our inherent tribal sovereignty still thrives in the hearts and minds of our people as well as in the strong currents, deep canyons, thick forests, and high mountains of our ancestral lands.

Therefore, in order to exercise the inherent sovereignty of the Yurok Tribe, we adopt this Constitution in order to:

1) Preserve forever the survival of our tribe and protect it from forces which may threaten its existence;

2) Uphold and protect our tribal sovereignty which has existed from time immemorial and which remains undiminished;

3) Reclaim the tribal land base within the Yurok Reservation and enlarge the Reservation boundaries to the maximum extent possible within the ancestral lands of our tribe and/or within any compensatory land area;

4) Preserve and promote our culture, language, and religious beliefs and practices, and pass them on to our children, our grandchildren, and to their children and grandchildren, on and on, forever;

5) Provide for the health, education, economy, and social well being of our members and future members;

6) Restore, enhance, and manage the tribal fishery, tribal water rights, tribal forests, and all other natural resources; and

7) Insure peace, harmony, and protection of individual human rights among our members and among others who may come within the jurisdiction of our tribal government.

(Yurok Tribe Constitution 1993)

Yurok Culture and the Klamath River

From time immemorial Yurok people have lived along the Klamath River from the mouth of the river up to the Karuk boundary. Nearly every aspect of Yurok life, language, ceremonies, society, and economy, was, and continues to be, bound by the river. The River, being so basic that it has no specific Yurok word designation, is euphemistically referred to in its lower stretch as the "Yurok highway". At the mouth of the River, Yurok also refer to the Klamath River as *HeL kik a wroi* or "watercourse coming from way back in the mountains." It is not surprising that Yurok culture reflects a strong connection to the riverine environment. In contemporary times the Klamath River is referred to as "the main vein" or "blood line" of Yurok People, emphasizing the vital importance of the River to Yurok health and survival.

With the steep terrain and temperate rainforest climate of the Klamath-Trinity basin, the sun's rising and setting are not an accurate means of tracking time and direction. Thus, the Yurok have always based time and direction on the Klamath's flows. As one Yurok elder said, "without this river we would not know who we are, where we're from or where we're going" (Gates 1996). Under natural conditions, the rates and sounds of the River's flow tell the Yurok both the season and time of day. The skill of the Yurok fisherman has always been measured by his ability to navigate the Klamath River in the dark. Navigation is not done by the stars or landmarks, but by correlating the location and swiftness of the current and back eddy of the River with the sounds that are unique to each bend, slick and riffle. Every feature of water's movement and characteristics are named by the Yurok. Even when the Yurok are away from the River, they remain acutely aware of their location in relation to it, always measuring direction by the River's flow. For example, it is not uncommon to refer to the burners on a kitchen stove as up or down-river burners depending on their position in relation to the River's flow.

The Yurok's connection to rivers (particularly the Klamath), and their flows, go far beyond time and direction. Through a long history of observation and inter-generational education they have developed an extensive knowledge of rivers, an ability to astutely interpret what changes in the river's flows and ecosystem mean for the Yurok people. For example, it is known that the Spring run of salmon will come soon after the budding of the thimble berry that grows along the Klamath River. It is known that willow-root basket materials are best gathered in a straight narrow section of the River where a flood's raging waters have scoured the roots. The Yurok people have developed numerous ceremonies that officiate this human connection and communication with all these river processes.

A Yurok elder recalls in the 1920's going down the Klamath River in a traditional Yurok dugout canoe powered by an outboard motor and guided by his father. As they approached within five miles of the coast they noticed that the River was backed up and stagnant because the sand buildup prevented it from flowing out to the ocean. Prayers and offerings were made on the sandbar. A day later, a spirit guardian represented as a large rock granted the request, and the River broke through the sand bar, allowing fish to once again enter.

The majority of the Yurok cultural sites on the Klamath and Trinity Rivers are traditional fishing spots owned by Yurok families. Fishing spots are locations where there are deep holes, significant back eddies and ideal spots to set a net or erect a platform out over the river. Fishing spots can be given, inherited, loaned, leased, hawked and bought and sold and were central to the Yurok economy. Over time, as the rivers' flows have changed, so have the locations of these cultural sites. With nearby mining activity and dam-impeded river flushing, many of these sites have been filled with sediment and are no longer viable for fishing.

The Yurok Tribe, and Yurok people prior to the formal organization of the Tribe, fought hard to preserve the ability of Yurok Tribal members fish. The Tribe's dependence upon fish is recognized throughout is history and by the United States when the Yurok and prior reservations were created. The Yurok's dependence upon fish is well established applicable law and reflected by the fact that approximately 90% of Klamath River fish is harvested by the Yurok Tribe. The Yurok Tribe's allocation of Klamath River fish is 80% of the total Klamath River tribal allocation.

Yurok Oral History and the Klamath River

There are Yurok stories that reinforce the Yurok belief that the river was created in a distinct way in order to provide Yurok people with the best of worlds. For example, Wohpekumeu said "let the river run downstream" and that is how the river came to flow the direction it does. In the story No'ots, a young man went out on the river and took his paddle and rode about on the river. That is why it is crooked at Olege'l.

It is clear from Yurok oral history that the River is such an integral part of the Yurok way of life that without it the traditions of the Yurok people would be perceived in a radically different perspective. Practically every function of the Yurok way of life is associated to the river: The origination of fish, proper methods for taking fish, how the river is to flow, death passage ceremonies, locations for fish dams and ceremonies all reflect the bond between the river and the Yurok people. It is essential that the river be maintained at a level that provides relevance to the young Yurok mind that hears these stories.

The anthropologist Alfred Kroeber traveled throughout the Yurok's territory in the early 1900's interviewing Yurok people and documenting the tribe's way of life. Of the 169 stories which Mr. Kroeber presents in his book Yurok Myths (Kroeber 1978), 77 make direct reference to the river.

Among those stories, there are tales of the construction of the fish dams, locations and origins of ceremonies held along the river, bad places in the river, where the first salmon was created, what one must do with salmon caught at certain locations, how the river came to flow the way it does, and death passage on the river. Much of Yurok knowledge and belief about the river and its resources are held in their stories.

When the creator, *Wohpekumeu*, first came to the Klamath and Trinity Rivers, he saw that there was no food for the people. There were only two women who had salmon. *Wohpekumeu* took the salmon from the women and let them go into the River. *Wohpekumeu* said the people would never catch the Great Salmon. When the Great Salmon comes up, he will swim in the middle of the river so he isn't caught with the nets. The Immortals (*Woge*) only wanted salmon to go up on one side of the river to make sure they knew where they could get salmon. But they never caught anything so they made it so the salmon would come up both sides. A man from the village of *Welkwau* wanted to learn how to fish at the mouth of the River so he went to *Kowetsek* (the home of the salmon) and asked the headman to show him how to harpoon fish. The headman agreed to show the man from *Welkwau*. When *'Nepwo'* (the Great Fish) came through the mouth of the river, the headman acted as if he was going to spear it. He would make thrusting motions with his spear but not actually spearing it, at the same time, he was praying for more salmon to come up the river. More salmon came up the river. The headman speared some salmon and the man from *Welkwau* saw that he handled the fish in a particular way. The headman explained that if salmon was caught at the mouth, a man was not to use a wooden club to kill it; he was to use a stone to hit it in the head. But upstream from the mouth everyone else would use wooden clubs. If a salmon is caught at the mouth it must be buried with only its tail sticking out. People who use a spear to catch fish at the mouth must practice certain medicine before catching salmon. The lamprey eel was also made at *Kowetsek* and there are certain rules one must follow when catching them at the Mouth. This story, as recorded by Kroeber (1978), tells of how the reverence for fish and creator provided the Yurok not only with abundance of salmon, a place for salmon and people to inhabit (the River), that explains the proper etiquette and moral responsibilities of salmon and people.

Among the oral traditions are accounts how the River came to flow the way it does, of Yurok ocean travel to the home of salmon, construction of the fish dams, locations and origins of ceremonies held along the River, where the first salmon was created, what is supposed to be done with salmon when caught at certain locations, and in the proper method for transporting a corpse up the River. There are Yurok stories that reinforce the Yurok belief that the River was created in a distinct way in order to provide Yurok people with the best of worlds. For example, *Wohpekumeu* said, "let the river run downstream" and that is how the River came to flow the direction it does. In the story *No'ots*, a young man went out on the River and took his paddle and rode about on the River. That is why it is crooked at *Olege'l*.

When the world was made ready for Yurok to inhabit, immortals (*woge*) who occupied the land and River came together for discussion. There was indecision as to whether the Yurok people should be taught the knowledge of immortality. It was decided that instead the people should know mortality. Those *woge* who felt sorry for Yurok decided to transform into rocks along the River that would help Yurok with the suffering of death. The last journey of the deceased involves a boat trip up-river with ritual stops at various rocks at the River's edge.

The anthropologist Alfred Kroeber traveled throughout the Yurok territory in the early 1900's interviewing various Yurok people and documenting a Yurok way of life. In *Yurok Myths* (Kroeber, 1978), it is obvious that the River was as important to the people from that era as it is to Yurok people now. Out of the 169 stories in Yurok Myths, there are 77 that make direct reference to the River. Yurok words that name places, plants, animals, and things associated with the River are detailed throughout Yurok stories.

When *Wesona-me'getoL* (the one up-above) created the world, the homes of the supernatural and the people were segregated. The ocean *Pish kaL* separated the two homes. The region on the other side is further divided into *tsi'k-tsik-oL* the home of money, culture hero *Wopekamaw's* home, *Pulekuk,* home of gambling, and the home of *Koowetsik*, the dwelling place of Salmon. Salmon and humans were created to interact with one another and accordingly the River was created to provide a zone of interaction. There are Yurok stories that reinforce the Yurok belief that the River was created in a distinct way in order to provide Yurok people with the best of worlds. For example, *Wopekamaw* said, "let the River run downstream" and that is how the River came to flow the direction it does (Kroeber 1978).

The story *The Salmon and Koowetsik* depicts the location of where the first salmon originated (Kroeber 1978). When *Wohpekamaw* first came to the Klamath River, he saw that there was no food for the people. There were only two women who had salmon. *Wohpekamaw* took the salmon from the women and let them go. *Wohpekamaw* said the people would never catch the Great Salmon (*Nepwo*). When *Nepwo* comes up, he will swim in the middle of the River so he isn't caught with the nets. The Immortals (*woge*) only wanted salmon to go up on one side of the River to make sure they knew where they could get salmon. But they never caught anything so they made it so the salmon would come up both sides. A man from the village of *Welkwau* (south side of the mouth of the Klamath River) wanted to learn how to fish at the mouth of the River so he went to *Koowetsik* and asked the headman to show him how to harpoon fish. The headman agreed to show the man from *Welkwau*. When *Nepwo* came through the mouth of the River, the headman acted as if he was going to spear it. He would make thrusting motions with his spear but not actually spearing it, at the same time, he was praying for more salmon to come up the River.

These ritual actions demonstrated to *Nepwo* that Yurok were sincere in the proper treatment of salmon and *Nepwo* informed the other salmon that it was good to come into the Klamath River. More salmon came up the River. The lamprey eel was also made at *Koowetsik* and there are certain rules one must follow when catching them. This Yurok story is the explanation for the origin of the first fish ceremony.

In the story *Cappel fish dam or Tsurau man,* a young man from *Tsurai* (a Yurok village near the present day coastal town of Trinidad) longed to be around people (Kroeber 1978). He made a place where he could get woodpecker crests and money *'OL we-tsik'*. In order to get those things he would need to wash his hands in certain springs. While he was sitting near the springs, a stick spoke to him and informed the man to build a sweathouse. After the man built the sweathouse, he came back and the stick had turned

into a man whose name was *Tohstek*. *Tohstek* told the man to follow certain rules and he would become rich and would be able to do anything else he desired. The man slept in the sweathouse and began to dream. He dreamed of the Deerskin, Jumping, and Brush ceremonies and he thought that these are the types of things he wants to see. He went to get wood and when he came back to the sweathouse there were ten wooden trunks. Inside the trunks, were all of the things he would need to hold the ceremonies he dreamed about. He traveled up the Klamath River stopping along the way to hold the ceremonies. His final destination was *Cappell*. When he arrived, the people were in the process of building the fish dam but they did not have the proper medicine to finish the dam. *Tsurau* man conducted a ceremony there and the people were able to finish the dam. The headman from *Cappell* gave *Tsurau* man his best boat (*yoch*) so he could return home. Every autumn when the Fish Dam was built, *Tsurau* man traveled up the Klamath River to help the people conduct the ceremony.

Fish dams *?umyo?* were built to make sure there was enough fish for everybody. The Cappell Dam was of utmost importance because it signified the beginning of the dance cycle. Many stories center around the fish dam and the importance of proper ceremony and medicine in its construction and the taking of fish. One such tale, The Salmon and *Kowetsek*, tells about the time that the Creator, *Wohpekumeu*, fist came to the Klamath and Trinity Rivers, and saw there was no food for the people. There were only two women who had salmon. Wohpekumeu took the salmon from the women and let them go into the river. He said the people would never catch the Great Salmon. When the Great Salmon comes up the river, he will swim in the middle so he isn't caught with nets. The immortals (*Woge*) only wanted salmon to go up on one side of the river to make sure they knew where they could catch them. But they never caught anything so they made it so the salmon would come up both sides. A man from the village of *Welkwau* wanted to learn how to fish at the mouth of the river so he went to *Kowetsek* (the home of the salmon) and asked the headman to show him how to harpoon fish. The headman agreed to show the man from *Welkwau*. When *Nepwo* (The Great Fish) came through the mouth of the river, the headman acted as if he was going to spear it. He made thrusting motions with his spear without actually spearing it. At the same time, he prayed for more salmon to come up the river and more salmon came up the river. The headman speared some salmon and the man from *Welkwau* saw that he handled the fish in a particular way. The headman explained that if salmon was caught at the mouth, a man was not to use a wooden club to kill it, he was to use a stone to hit it in the head. But upstream from the mouth everyone else would use wooden clubs. If a salmon is caught at the mouth it must be buried with only its tail sticking out. People who use a spear to catch fish at the mouth must practice certain medicine before catching salmon.

Another Yurok story depicts a place on the river named *Akierger* where the immortals who used to fish there established a rule that any fish caught in that spot must have its eyes taken out and thrown away. In yet another story, a young man from *Tsurau* longed to be around people. He made a place where he could get woodpecker crests and money, *Ol we-tsik*. In order to get those things he would need to wash his hands in certain springs. While he was sitting near the springs, a stick spoke to him and informed the man to build a sweat house. After the man built the sweat-house, he came back and the stick

turned into a man whose name was *Tohstek*. *Tohstek* told the man to follow certain rules and he would become rich and would be able to do anything else he desired. The man slept in the sweat-house and began to dream. He dreamt of the deerskin, Jumping, and Brush dances and he thought that these are the types of things he wants to see. He went to get wood and when he came back to the sweat-house there were ten wooden trunks. Inside the trunks were all of the things he would need to hold the ceremonies that he had dreamt about. He traveled up the Klamath River stopping along the way to hold the ceremonies. His final destination was Cappell. When he arrived, the people from Cappell were in the process of building the fish dam but they did not have the proper medicine to finish the dam. The headman from Cappell gave *Tsurau* man his best boat (or *yoch*) so he could return home. It is said that *Tsurau* man travels every year to help the people dance.

In the story of the *Lo'olego* Ceremony, a young man from *Lo'olego* sought to build a fish dam, but when asked, the *Weitspus* people would not help. They thought he wanted to have a ceremony but lacked the regalia to do so. There was a rock with a hole in it located on the river. The young man went into the hole and didn't come out for a year. When the young man returned, the *Weitspus* people came to help him build the fish dam. When the dam was built, the *Weitspus* people went downstream to perform the White Deerskin Ceremony. The *Lo'olego* people had their own deerskin ceremony at *Lo'olego*. This story helps to show that personal sacrifice is respected and is rewarded.

In another story, *Kerenit* (Chicken Hawk) built his house on top of a large boulder by the river at *Knetkenolo*, which translates as "arrowhead-where fish-weir." He built a fish dam near the boulder and made a water fall so high that the salmon couldn't jump over. There are holes in the rock that held the posts that can still be seen today.

Several stories with translated titles such as, "Origin of Death" and "Death and Purification," indicate the location of eighteen rocks along the Klamath River which are central to the death purification ceremony of the *Woge*. Specifically, when the Yurok transport a corpse along the River they must speak to the *Woge* spirits that live in these rocks.

There are Yurok stories that reinforce their belief that the River was created in a distinct way to provide for the Yurok people. *Wohpekumeu* said "let the river run downstream" and that is how the River came to flow in the direction it does. In the Yurok story *No'ots*, a young man went out on the River and took his paddle and rode about the River near *Olege'l*. This is why it is believed the river is crooked at *Olege'l*.

It is evident from Yurok oral history that rivers are such an integral part of their way of life that without them, their traditions and culture would have little meaning. The stories from which young Yurok learn of their people depend on healthy and vibrant river ecosystems for much of their context. These selected oral traditions and corresponding ritual practices, of which there are many more, tell of the Yurok reverence for fish and creator and if adhered to, provide the Yurok with abundance of salmon, and a place for salmon and people to inhabit.

How Fish Came to be in the River (as told by Florence Shaughnessy, Yurok and documented by Perry 1988):

> In the beginning, there was an Indian goddess. They sent her with the first Indians to be settled here. They told her to stock the world with whatever she thought our people were going to need. So they got all kinds of animals- deer, elk, bear, and all the others. Then she took her people down to the beach, and she talked to the god there.
>
> "I have brought the children here because that is going to be their home. This is where they shall live."
>
> "Now" she said, " I will need help, because along the shore here there is food."
>
> And he said, "Yes, there is food, but there shall be proper help at the proper time. The food that is in the ocean is so delicate that it cannot be exposed for hours like the food that goes on land. They are different. You shall have a helper."
>
> And she said, "Who will my helper be?"
>
> "The moon, The moon shall control the tides."
>
> And so it was settled who should control the tides. They put the fish down at the mouth, the sturgeon and every known fish.
>
> And she said, "The sturgeon shall go far, far up the River until he is trapped, but he shall be a strong swimmer. And the salmon, there shall be four kinds of salmon coming in over the year. There shall be different species that survive the winter rains. And steelhead. And there shall be smaller fish that are seasonal, like the candlefish and surfish. And the lamprey eels, they are for variety of the diet."
>
> Then the sea foods were promised. So we got seaweed, seaboots, crabs, mussels, China slippers, clams of all sizes and others.
>
> And so it was that all the fish were named and sent as far as they could go up the river to feel the people all along the way. And the people were to follow and have their own fishing rocks. They were to look for a place with and eddy and claim that rock. Then they would build homes nearby because their food rock would be there, and then they can take care of their families. (Perry 1988:15)

The Yurok people are named and live in relation to the rivers and the sustenance that those quality flows provide. Residency, natural and cultural resource sites, ceremonial practices, oral history, transportation route, economic and sociological dependence, indeed the Yurok identity, are all intricately woven into the ecosystems of the Trinity and Klamath Rivers. Of 72 village sites in Yurok ancestral lands, the Yurok continue to live upon many of the 44 village sites that line the Klamath and Lower Trinity Rivers. These are places where Yurok have been born, lived, fished, gathered, prayed and have been buried.

Each generation was taught the appropriate respect for each other and everything in the Yurok World. Respect for the River was of particular importance because Yurok and the River are intertwined with sustaining the balance of life. The River is the main stem of Yurok life ways. Nearly every aspect of Yurok life was and continues to be bound to the River and surrounding landscapes that are defined by the actions of these waters. Yurok people and the River provide important roles in Yurok ceremonies, in defining proper methods for treating the deceased, religiously sanctified methods for taking fish at certain locations, gathering the necessary plant products for the manufacture of Yurok material culture and in maintaining the central transportation route.

A Yurok elder said, "without this river we would not know who we are, where we're from or where we're going." Other Native Americans track directionality based on cardinal directions. In a steep riverine environment with a temperate rainforest climate, the suns' rising and setting points are not accurate ways of tracking time and direction. Instead, the flow of the river is most essential for telling time and direction. River flow rates under natural conditions indicate both seasonality and time of day. The capability to estimate time of day and year is enhanced in the estuary where the river is subject to tidal fluctuations. A good Yurok boatman is rated by his ability to navigate the River in the dark. The boatman does this by correlating the location and swiftness of the current and the back eddy of the river in relation to the sound of the river that is uniquely created in each bend, slick and riffle of the riverine environment. Every type of unique feature of the water's movement and characteristics are named. Even when away from the water directionality is measured by the river flow, requiring people to always know where they are in relation to the river. For example it is not uncommon to refer to burners on one side of a kitchen stove as up or down-river burners.

Not only are the Rivers' fluctuations known by characteristics of water content but is also know by what the water flows additionally provide Yurok people. For example it is known that the spring run of salmon will come soon after the budding of the thimbleberry that grows along the Rivers' courses. It is know that after a good flooding willow-root basket materials are best gathered in a straight narrow section of the river where a flood's raging waters have scoured the roots. After a flood event, specific gravel bars are searched for new deposits of granite boulders used for porch rocks in Yurok traditional homes. It is known that in a drought year, flooding occurs in the lower portions of the River because of sandbar buildup at the mouth of the River. And for all of these natural occurrences Yuroks know of appropriate ceremonies that officiate the human communication with these river processes.

Various ethnographic sources show a wide diversity and abundance of cultural sites located along the River. For example in 1909 the anthropologist Thomas Waterman documented 82 various cultural places, 41 rocks of cultural significance, 97 fishing spots, and 44 villages all located in the river channel, river flood-plane or just above the high water mark. The 82 places are places significant to Yurok history (both historic and legendary), ceremony, gathering, and hunting. In addition to these 264 sites, the Yurok Tribe Heritage Preservation Office has documented approximately 100 additional sites

that were either missed by Waterman or have been established since his early century visit to the territories of the Yurok people.

Yurok Traditional Law and the River

Yurok political organization is and has always been very organized. Traditional political organization and the accompanying judicial system was established by Creator's Law, is institutionalized in the Yurok ceremonial system, and the determination of fault and compensation occurs in very exacting ways. Yurok Traditional Law operates on principles of payment rather than punitive penalty for damages or wrong-doing. This traditional system of jurisprudence is interrelated with the harvesting of fish through both individual fishing places as well as the annual community construction of the fish dam. As these traditional forms of communal fishing, traditional use of the river and traditional forms of jurisprudence were disrupted by non-Indian intervention so also did Yuroks become involved in the Indian wars of the 1860s and the Yurok fish wars of the1970s. Likewise, the traditional and stabilized living patterns were disrupted and Yuroks began to shift from permanent dwelling lifestyles (with bi-annual migrations) to multiple and migratory dwelling lifestyle. These new lifestyles also led to a change of traditional life ways but core Yurok values, particularly in relation to the River and Yurok Traditional Law persist:

The Creator placed Yurok people and fish together for reasons of balance and longevity. The Yurok have a responsibility for assuring the fish get up the River. These reasons are codified as Indian Law, first instructions from the Creator to the Yurok People. When the Law is not followed, the balance is not maintained and the fish do not return, the River dries up and the Yurok people dwindle away.

(Yurok Culture Committee 2003)

Traditional Yurok Fishing Law is as follows:

1. **Know your family relations. Know where you are related along the river. Know the River and its locations, particularly the village name that your family is from.**

2. **Not every Yurok family had/has a fishing place right.**

3. **Every Yurok has a fishing place right through permission.**

4. **Permission is gained by asking and being granted the right, with terms and conditions.**

5. **Permission given once is not permission given forever.**

6. **One standard condition is to offer some fish caught at the place where permission was granted.**

7. **Some fishing places are "open" and anyone can fish there. They are open on a first-come, first-serve basis. If someone is fishing in an open place then the latercomer informs the first party that they want to fish, and then they politely wait a day unless they have already caught enough fish, then they should make ready to leave. It is polite for the first party to provide some fish to those waiting.**

8. **No fighting on the River, particularly no fighting over fishing places. The River is a place to show respect.**

9. **Do not waste fish; do not take more than what is needed. It is not what the River will do for you, it is what you will do for the River.**

10. **Drift netting can occur anywhere as long as it doesn't disturb anyone else's fishing place or net set.**

(Yurok Culture Committee 2003)

Yurok Language and the Klamath River

The Yurok language reflects the intimate connection and relationship between Yurok People and the Klamath River. Yurok words that name places, plants, animals and other things they associate with the river are detailed throughout their stories. The importance of river resources to their people are captured in Yurok names. As discussed previously, rivers are the mainstream of the Yurok people. Nearly every aspect of Yurok life, their ceremonies, society and economy, was and continues to be bound by the river. Therefore, it is not coincidental that the Yurok language and oral history reflect a strong connection to the riverine environment. Yurok knowledge and tradition is handed down and preserved from generation to generation in stories. Stories and the Yurok language are an important part of the education received by younger generations.

There are numerous words for all aspects of the River's characteristics, rate of flow, back flows, eddies, boils, riffles and slicks, and color. Locations and directions are linguistically identified in relation to the river. For example, *poh* refers to 'down river' and *pech* refers to 'up river'. This is why the original Yurok word denotating the Yurok people is '*Poh lik lah*' or "down river people." Even places away from the river, such as the high country, are referenced as "way back from" the River or "*heL kau*." It has been reported that an elderly Yurok woman referred to her stove burners and knobs as the up-river and down river burners, effectively aligning the cook, stove, and house in relation to the directional flow of the river (Hinton 1994).

Waterman (1920) documents only three cardinal directions in Yurok Geography: 'up river', 'down river', and 'away from river'. This use of language in Yurok concepts of

geography underscores the central role the Klamath River has played in Yurok culture, history and cosmology. It also supports the Yurok view of the River as the central bloodline for Yurok People.

Language analysis can show the long-term values and emphasis of a people. For example while there is no specific name word for the Klamath River, the word for 'river' is *la yoh*, and translates as "to run" in reference to liquids. Another word for river, *?ume?wo* is in reference to the fish dams that are placed across the river. The English word 'salmon', denoting several types of anadromous fish does not readily translate into the Yurok word '*ne po y*', "that which is eaten." '*Ne po y'* denotes more than 'fish', but also includes connotations of Yurok reverence for a creature that provides sustenance to a people and way of life. Thus, *ne po y* reflects the Yurok reverence for a creature of the river and an explicit recognition that it sustains their people and way of life.Yurok places are sometimes named after the way the river moves in a particular stretch.

Place Names Associated with River

Yurok people have place names for numerous features and locations on the River and within their landscape. Yurok places are sometimes named after the way the river moves in a particular stretch. For example the town of '*Rekwoi*" denotes the mouth of the river; the town of '*AyoL*' denotes a wide curve in the River and the town of '*Olegel*' denotes a particularly twisty stretch of the River.

Many of these place-names were documented in T.T. Waterman's geographical research (Waterman 1920). Fishing places had names, rock out crops had names, villages, trails, and gathering areas all had Yurok names. Place names were often descriptive, others were references to creation stories, or stories about events that had occurred there. The number of place names given to locations on and around the river and surrounding landscape speak to the intimate relationship between Yurok and their environment, as well as their long-term presence within it.

Various ethnographic sources show a wide diversity and abundance of cultural sites located along the rivers. For example in 1909 the anthropologist Thomas Waterman documented eighty-two various cultural places, forty-one rocks of cultural significance, ninety-seven fishing spots, and forty-four villages all located in the river channel, river flood-plane or just above the high water mark. The eighty-two places locate places significant to Yurok history (both historic and legendary), ceremony, gathering and hunting. In addition to these two hundred and sixty-four sites, the Yurok Tribe Heritage Preservation Office has documented approximately one hundred additional sites that were either missed by Waterman or have been established since his early century visit to the territories of the Yurok people.

Many of these place names reflect geographic placement in relation to the River. For example the Yurok center of the world is named *Kenek*. A place immediately down-river from the town of *Kenek* is named *Kenek-pul*; '*pul*' translates as 'down-river'. A place up

the hill from *Kenek-pul* is named *Kenek-pul hi-won*; '*hi-won'* translates as 'little way up hill'. Another town, named *Ayolth*, denotes a sweeping bend in the River. The village is named after that type bend. The Yurok Village of *Rekwo*i, located at the mouth of the Klamath River, translates as "Mouth of the river." Other examples abound. The word 'Yurok' is a Karuk word for 'down river'. The Yurok people call them selves *Poh-lik Lah*; translated as 'down-river people'. Whether the Karuk or Yurok words are used, it is very clear that a people are named and identify with the river and its particular place in the world.

Yurok Traditional Fishing Technology and Use

The technological expertise of Yurok people presents a direct link to how and why tools were made. Specific types of implements or devices were made to fit a particular environment and type of fishing. For example, specific types of nets were made for river fishing and other types were made for ocean fishing. Tools or devices were not made simply to take river or ocean resources, but some were created specifically to signify the time of sacred ceremonies. The fixed weir is one such example. The most important Yurok fish weir (dam) is known as the Cappell Fish Dam, which signified the time to hold the Deerskin and Jump ceremonies, which in turn insured the abundance of health and resources for all the people. As described in *Fishing Among the Indians of Northwestern California* (Kroeber & Barrett, 12:1960):

> The weir was an elaborate structure built in ten named sections by ten groups of men, all working under the actual, as well as the ceremonial, direction of one formulist. Each section was built with an enclosure provided with a gate, which could be closed when the fish entered. The fish were then easily removed with dip nets.... All told, the full ceremonial cycle connected with the Kepel dam covered some fifty to sixty days. It was the most elaborate undertaking of any kind among the tribes of this Northwestern California region.

While the Fish Dam allowed for community fishing activities, Yurok fishing technology also allows for individual fishing activities. Landing, lifting, flat, and cylindrical nets are used to take a variety of fish. Trap baskets are used to catch eels. Mesh size was determined by the size of fish taken. Some nets were equipped with trigger mechanisms that trapped incoming fish. River & ocean going boats, nets hooks, lines, rope, sinkers, bait, harpoons, clubs fishing baskets and carrying baskets are just some of the technological adaptations employed by the Yurok to assist in the taking of fish.

One of the most important technological advancements of Yurok culture is the construction of river and ocean goings canoes. Canoes, or *yoch*, were carved from selected redwood trees. The ocean going Yurok canoe was from 30 to 40 feet in length, six to eight feet in width and three feet deep. It could haul up to five tons of cargo (usually seal carcasses) and was customarily paddled by five to 20 paddlers and an oarsman who steered the boat from the back. The oarsman was also the headman or,

poyweson, who had the financial and persuasive background to coordinate ocean-going expeditions. There are historic accounts of expeditions traveling 180 miles along the coast (Powers 1871, Gould 1968). Canoes were also used for gathering, fishing, and hunting and general travel along the River. River canoes average from 16 to 20 feet in length and are three to four feet in width. Canoes were customarily paddled and/or pushed with a long pole.

In proto-historic times canoes were also rigged with sails. The double ender canoe was introduced for travel on the estuary near the mouth of the River. Double ender canoes introduced by Yurok carvers in the early 20th century are easier to make and could be adapted to the outboard motor. As redwood logs and access to suitable logs for making a traditional Yurok canoe decreased, the Yurok utilized non-traditional boats to continue their use of and travel on the River. As the motorboat was introduced to the Klamath River, motors were also adapted to fit onto traditional canoes. More recently, modern aluminum boats have been designed specifically for use on the Klamath River, these are often referred to as "Klamath River Sleds" because their design allows them to travel well in various River depths and currents. Today the best boatmen of the Lower Klamath River, utilizing various watercraft, are predominately Yurok.

Specialized methods for harvesting fish and eel from the River were utilized to maximize the success of fishing at different localities on the river. Specific attributes of the river, riffles, shallows, eddies, falls, deep pools, and creeks each had unique attributes for which the Yurok developed specialized equipment or fishing methods to ensure a successful harvest:

> Riffles: harpoons and gaffs were used along with specialized traps.
>
> Shallows: fish weirs were often built in these areas, with impounding pens for spearing, dip netting, gaffing and trapping. Kepel fish dam was in one of these areas on the Klamath.
>
> Eddies: platform fishing with triggered lifting nets were used in these areas.
>
> Falls or cascades: plunge nets, traps, harpoons, and gaffs were used to harvest fish that were trapped below these natural river features.
>
> Deep pools: diving, bow and arrow, snaring, poisoning and sturgeon riding were used in these still and deep areas of the river.
>
> Creeks, streams and tributaries: short fish weirs, basket traps, and hook and line fishing techniques were common in these areas.
>
> Lamprey were harvested by use of lifting nets, dip nets, and basketry eel traps, gaffs and hand catching in certain areas. (Kroeber and Barrett 1960:8)

Fishing techniques were highly specialized to take advantage of specific characteristics of river morphology, as well as species behavior in their annual migration up the Klamath River. The importance of these river resources for Yurok people, and other Klamath River tribes is evident in the complex fishing methods, schedules, rituals and the use of specialized equipment and technique for each species. (Kroeber and Barrett 1960:8)

Traditional Fishing and Gathering

The river is lined with numerous fishing and gathering sites. A detailed discussion of Yurok Fishing Places is provided in Chapter V. The river is also lined with numerous gathering areas associated with plants adapted to flow levels of the river. Various plants are used as food and material to make ceremonial regalia, baskets, cloths, houses, boats, nets, and other everyday household utensils. For example it is well known that a specific type of willow root is best gathered in long narrow stretches of the river where the rivers scouring effect exposes the material sought. There are also places along the river where weavers traditionally meet to avoid the hot summer sun and weave together.

A wide variety of plants, for food, materials, and medicines were gathered along the riparian zone of the Klamath. Numerous species of berries grew along the banks of the River. Plants and roots used for basketry were collected along the River and along tributaries. Plants used for medicines and ceremonies grew along the riparian zone and were gathered for specific purposes by medicine women and ceremonialists (Curtis 1924). Resource areas used for gathering plants for food and materials were often owned by families or individuals. Driftwood along the river, root-gathering areas, seed gathering areas, tobacco plots were resources that were owned by families and individuals (Pilling 1978:147).

The Lower Klamath River, and most of Yurok ancestral territory occupies a discrete botanical niche, commonly referred to as the Oregon Biotic Province. In addition to containing unique species which do not occur anywhere else in North America (for example, California coastal redwoods), the groups that occupy this unique botanical niche share a common culture, and traditional subsistence pattern that is not shared with their neighbors who reside outside of this biotic region. Culturally significant plants for foods, medicines and arts are shared by the distinct Indian tribes that occupy this region and are part of the common culture that is defined by the Klamath River (Mead 1971:48-49). Yurok share a common forest type with their Karuk and Hupa neighbors, primarily mixed evergreen forest and coniferous forest even if the range and percentage of this type varies between groups (Mead 1971:97).

According to Mead, Yurok used over 13 species of plants in basketry, both in the construction and design of a basket. Four plants were used as dyes for basket materials (Mead 1971:64). Mead further identifies six different stems, and kinds of roots, and one type of leaf used in Yurok basketry (Mead 1971:66). Many of these roots and stems were gathered within the floodplain of the River, along the shore or from the exposed banks. Based upon the common use of plants for medicines, food and materials, Mead

concluded that the common culture areas for the region included a grouping of Yurok, Hupa and Karuk even though each group represented a different language family (Mead 1971:71).

Willow was used for many purposes and was often collected along the river. It's roots and shoots were used for basketry. It's leaves were used as medicine in myth times (Curtis 1924:174). Willow was used as a primary basketry material, particularly up river. It can be used interchangeably with hazel for the foundation of the basket. High quality willow shoots were generated every year within the floodplain of the river due to the fact that peak flows would remove the previous year's growth and stimulate new shoots in the spring, which are the most desirable for basketry (O'Neale 1995:16)

Spruce roots were primarily gathered near the mouth of the River and along the coast. They were traded upriver for basketry material for bear grass, black fern, and hazel (O'Neale 1995:17). The primary body material for a basket is spruce root (*Picea sitchensis*). This was gathered by digging out the root and cutting it in lengths of two to three feet. They are then split, while still soft, into broad, flat bands, and then split again to the desired size. These are woven over a frame of hazel (*Corylus*) sticks to form the basket (Merriam 1967:170). Spruce roots are often gathered on exposed riverbanks.

Traditional Trade and Exchange

Trade between upriver and downriver Yurok and between River Yurok and Coastal Yurok was a common practice that enabled the exchange of desired food items between localities. Shellfish, seaweed and surf fish from the coast were traded for salmon, sturgeon, and lamprey from the river. Salmon caught and dried near the mouth of the River were sought by upriver Yurok because of the better flavor provided by the extra fat, which the fish lose as they migrate upstream. These patterns of trade and exchange existed prior to European contact, and persist in present day Yurok society (Perry 1988:13).

One of the primary indicators of trade and exchange both on the River, and up the coast, was the importance of shell money, or dentalia in Yurok society. Yurok men would often have a special tattoo on their forearm for the sole purpose of measuring lengths of dentalium. These shells are indicative of wide trade and exchange because they originated offshore of Vancouver Island. The use of dentalia as currency on the Klamath River beyond Yurok territory indicates the trade networks along the river were quite extensive (Davis 1963:7).

Other common trade goods exchanged between Yurok and their upriver neighbors, the Karuk and the Shasta included obsidian, coastal shells such as Olivella, clam, mussel and abalone, tobacco seeds, juniper beads, white deerskins, woodpecker scalps, sugar pin nuts, elk antler, baskets, redwood canoes, acorns, salt, and seaweed (Davis 1963:49-50).

IV. Yurok Resources of Cultural and Religious Significance

"The River is the lifeline of the Indian people. We depend on the fish, depend on eels, sturgeon. In his lifetime, as an Indian person, going to school, come out to our freedom. River is medicine to him. He can feel lousy as hell and go out on the River and come back feeling good. Gives strength, knowing this is mine; this is where I live, where I'm born. This is where my roots are."

(Yurok Elder Walt McCovey Jr. 2003)

All the natural resources associated with the Klamath River have cultural significance to Yurok People. The fish, aquatic life, water and numerous riparian plant and riverine species are relied upon for a range of uses: subsistence, economic, ceremonial, medicinal and recreational. All are aspects of Yurok culture and lifeways. Most of these traditional practices are still practiced today, even if by a fewer number of Yurok than in pre-Contact times. Previous sections of this report have already documented many of the traditions and uses of the River and its resources and the importance of these uses and traditional practices for cultural identity, transmission and survival. As stated n the quote above, and by numerous Yurok: the River is the "Blood line" of the Yurok People. For this reason all the resources it provides remain resources of cultural and religious significance to the Yurok Tribe.

That the River remains integral to Yurok Culture and life ways is reflected in many aspects of contemporary Yurok life. Traditional ceremonies, that either never stopped or were restored in recent decades, are the Brush Dance, Jump Dance, White Deerskin Dance, and Boat Dance Ceremonies. All four ceremonies must be conducted in close proximity to the River and the cultural and ceremonial significance of these Ceremonies are linked directly to the River and include practices within the Ceremony that require direct exposure to the River, including bathing and drinking of River water. The First Salmon ceremony and the Cappell Fish Dam are currently not practiced but there is interest within the ceremonial community in restoring all Yurok Ceremonies. The Yurok ritual of taking the deceased up river to the death purification rocks is still practiced for those Yurok buried in the traditional fashion.

Yurok culture has recently had a resurgence of the traditional stick games, a ceremonial sport that combines aspects of wrestling and lacrosse. The playing fields are constructed on sandy beaches along the river during the summer months and often in conjunction with the Brush dance ceremony. Aspects of all Yurok ceremonies require interaction and even immersion in the River and require high water quality to be practiced with integrity and also the health and wellbeing of ceremonial practitioners.

Traditional gathering continues, primarily by contemporary basket weavers and medicine people and despite the increasingly difficult task of finding adequate plant population of good quality. Increased restrictions on accessing private and federal properties, increased timber production, and increased use of herbicides and pesticides have all limited the

traditional gatherers' access to suitable and desired species and have impeded efforts to revitalize traditional weaving. Willows, alders, ferns and other cultural plants used for basketry and medicines were traditionally harvested along the river bar where the materials were considered to be of highest quality for use. Decreased flows have impaired and adversely impacted many traditional gathering areas due to low flows, less scouring, and build up of gravel and cobbles along the Lower Klamath. Traditional users still access these areas for these plants and materials, but the availability of suitable materials has declined since the dams were constructed.

Yurok Ceremonial Uses of the Klamath River

This previous chapter of this report has already documented some of the rich Yurok ceremonial and cultural traditions associated with the Klamath River. All Yurok ceremonies involve the River and require high water quality as part of ceremonial activities.

As previously reported in Chpater V, Yurok oral history identifies a time before the world is as it is. In this time, the *wo'gey* lived in Yurok lands. There was a constant struggle to keep the world balanced upon the water. "Knowing that this would be so, before they left the *wo'gey* instructed certain people in what to do to put the world back in balance when the weight of human violations grew too great for it" (Buckley 2002:214). These instructions are the world renewal ceremonies that are held between villages on ceremonial grounds of Yurok, Karuk and Hupa alike. It is a common culture and a common ceremonial cycle that connect the people along the River in the past, present and future (Buckley 2002). Traditional Yurok Ceremonies included the First Salmon Ceremony, The Cappell Fish Dam Ceremony, the Brush Dance Ceremony, the White Deerskin and Boat Dance Ceremonies, and the Jump Dance Ceremony. Of these Ceremonies the Brush Dance Ceremony, the White Deerskin and Boat Dance Ceremonies, and the Jump Dance Ceremony are still practiced today. There is growing interest within the tribal community to restore all traditional Yurok ceremonies as part of cultural revival and cultural restoration efforts undertaken to heal the spiritual, social and psychological trauma experienced during the past 160 years.

Many of the items made and used in Yurok Ceremonies come from the River environment. Baskets made of plant materials collected at the water's edge are used to hold food and ceremonial medicine. Acorns, cooked in the baskets, are converted to a nourishing mush that is rendered by placing several hot rocks (cooking rocks), gathered off of specific river bars, into the acorn flour and water that is placed into the baskets. Regalia that adorn the ceremonialists is constructed out of various plant and animal products that the riverine environment provides. Ceremonial bathing in the River and its tributary creeks is a requirement for some of the participants. Ceremonialists also prepare themselves by listening to the River's sounds. While many guests today arrive by car, many more arrive by traditional transportation: boats.

In the early Spring, the first salmon to enter the Klamath River was speared and ritually eaten by medicine men. This event traditionally signified the beginning of the fishing season for the Yurok. The ritual also marked the scheduling of the construction of the fish dam at Cappell located thirty-three miles from the river's mouth on the Pacific. The fish dam was constructed in conjunction with ceremony and sanctified the taking, distribution and consumption of salmon. Salmon are ritually managed to assure that the Yurok people are all provided for, that up-river people are assured a percentage of the fishery and that enough fish are allowed to re-populate the species. While there still remains a general reverence for salmon, without proper ceremony a strong belief prevails that the salmon will not return in sufficient numbers. All other ceremonies were scheduled after the fish dam construction ceremony took place. The Yurok have many ceremonies in common with the Hupa such as the Jump ceremony and the White Deerskin ceremony. An integrated part of the White Deerskin Ceremony is the Boat Dance Ceremony. The River is central to all these ceremonies.

The Brush Dance held in many of the traditional village sites along the Klamath River, requires the proper scenic river qualities and the availability of river resources. As a brush dance unfolds over a four day period it attests to the wealth that the riverine environment provides. Baskets made of plant materials collected at the water's edge are used to hold food and ceremonial medicine. Acorns, cooked in the baskets, are converted into a nourishing mush that is rendered by placing special hot rocks gathered off of specific river bars into the acorn flour and water placed in the baskets. Regalia that adorns the dancers are constructed out of the various plant and animal products that the riverine environment provides. Ceremonial bathing in the River and its tributary creeks is a requirement for some Dance participants. Ceremonialists also prepare themselves by listening to the River's sounds. While many guests today arrive by car, many more arrive by the traditional transportation method: boats.

Just as children coming into the Yurok world are introduced in various ways to the rivers and the culture that surrounds their people's riverine way of life, so do the elderly depart from this world via the river and its features. Rocks located in the Klamath and Trinity Rivers and at their edges are seen as spirit people who guide Yurok knowledge concerning proper burial procedures. The deceased's last worldly journey is a boat ride up-river. At each of eighteen rocks from the mouth up to Slate Creek and up the Trinity, various burial rites and proscriptions are observed to assure the best departure for the deceased as well as those that remain in this world. There are several rocks in the mid-section of the rivers that contain rare petroglyphs giving instructions from the Creator to the Yurok people. One such instruction is a warning that when the rivers stop flowing it will mark the end of the Yurok world. Accordingly, some elders have prophecised that the manipulation of flows by damming represents the beginning of the end for the Yurok.

The White Deerskin Ceremony is held to thank the Earth and Creator for continued sustenance. An important component of Yurok Ceremonial life is the Boat Dance. In this ceremony, several boats filled with ceremonialists in full regalia traveled down river,

making a ceremonial crossing. The ceremonialists thank the River for continuing to flow and providing the pulse of life that sustains the Yurok world. The Boat Dance requires adequate flows of water in the River at particular times of the year. This is still true today. Therefore, diverting the water chokes the life out of the Klamath River environment. Currently the Tribes have to call the Bureau of Reclamation (BOR) and request an increase in water flows in order to have the Boat Dance during the White Deerskin Ceremony.

Klamath River Water

The Klamath River has always been the central feature of Yurok identity, cultural, spiritual and economic life. Integral to that relationship is water quality. Traditional Yurok ceremonial activities require high water quality due to ritual practices requiring immersion and even ingestion of Klamath River water. A healthy river is required for a healthy Tribe, as articulated by multiple respondents in the Yurok Tribe's 2006 Healthy River, Healthy People Traditional Foods Survey (Yurok Tribe Environmental Program 2006). Water quality issues on the Klamath River, including toxic algal blooms, have severely impacted many Yurok activities on and around the River, with many respondents indicating they stayed away from the River the summers of 2005-2010 out of concerns over public health warnings on recurring annual toxic algal blooms within the watershed. Water from the River is central to many traditional Yurok activities and ceremonies. Gathering of basketry plants and medicine plants is done along the shores, requiring one to wade in the river while following the shoreline. Similarly fishing, accessing fishing places, gillnetting, and dipnetting expose fishers to splashing water and frequent immersion. Eeling is done from the shoreline near areas of high, splashing water and rapid currents. In all cases the possibility and frequency of exposure to River water is extremely high. As a result, Native American people who utilize the River for harvesting or gathering resources have a higher risk of exposure to any toxins in the water than many other users of the same watershed. Tribal members remain very concerned about the toxic algae and other persistent toxins that may be entering the watershed from upstream sources. Degrading water quality not only has a disproportionate adverse impact on downstream tribes and tribal trust resources, but also on cultural activities. The River plays a central role in Yurok ceremonial life and as such water quality and quantity have a direct and significant impact on Yurok ceremonial and religious practices.

V. Yurok Fishing Sites and Fishing Rights

"Most Indian people had fishing spots. They have a right to fish, sometimes it's handed down through relations. You can give a fishing place to someone else….Tradition gives people the right to do things. They can say this is what we've done for years and years. Tracing back generations and generations, this is what makes us strong culturally. Hold onto the old ways. Stick with family fishing holes"

(Yurok Elder Glenn Moore Sr. 2003)

Fishing Places

Fishing places have always been considered real property in Yurok culture. The primary form of fishing was using a dip net in a deep hole or eddy that would form naturally behind a large rock or boulder in the River. A scaffold or platform would be built to access the fishing hole, and are called in Yurok, "*kworl*". Fishing places were considered to be owned by individuals or families. They could be sold, traded, or passed on to others. Agreements for fishing places were not made in writing, but were all verbal. The person giving would let it be known that the person could fish there. The owner of a fishing place could grant permission to others, families and others, to fish there. People were allowed to use the fishing hole of someone else as long as they offered it to you. The value of the fishing hole would be based upon its productivity, how many fish could be caught there in terms of Indian money (dentalia). The value of the fishing place would fluctuate depending on its condition as it would be impacted by annual river flows that could cause gravel or silt to alter its productivity (Waterman 1920:219). Several individuals might own a fishing place, which they used in rotation for one or more days according to their share of ownership in the site. Establishing a new fishing place, or fishing below an existing hole was not allowed. Ownership of existing fishing places was an economic matter, allowing for sale, trade or inheritance. This strict management of fishing places guaranteed the value and the viability of existing fishing places owned by individuals, groups, or families (Bearss 1969:3).

A fishing place can be a place where there is good river access, a deep hole, or good back eddy allows for fish to rest on the way up-river. Fishing places are designated fishing areas on the river, a pool, a rock, and eddy. Often times large projecting river rocks both provide such a place for fish and a place where Yurok fishermen can build scaffolds that allow for the establishment of fish netting areas. Fishing places are a form of real property in Yurok culture. Fishing places can be owned; by individuals, families, or a group of individuals. Fishing places are borrowed, leased, inherited and bought and sold. If shared, each owner has a right to fish there. Some ownership rights at fishing places depend on species of fish caught, salmon, eels, or sturgeon. Others depend on the water level, with individuals owning the right to fish at that place if the River is below or above a certain level. Ownership of a fishing place is not necessarily linked to ownership of

adjacent property, as individuals who live away from the River can have ownership in a fishing place. Some fishing places are abandoned during times when the productivity of a particular place was poor (Waterman 1920:219). Yurok people still recognize this traditional form of resource management and use on the River. Families and individuals continue to use and own rights to fishing places on the River. An entire traditional etiquette and jurisprudence has been developed to regulate the orderly taking of fish.

Fishing places could be shared between individuals who negotiated turns and shared equipment. A very good fishing place might be owned by five to ten men, who would rotate days and times of day to fish. Others fishing places were owned by one person for salmon, and another person for eel or sturgeon. Another fishing place might be owned to a certain water level, with one owning the right to fish when the water was above or below a certain level. Some fishing places might be abandoned due to siltation or some other factor that made it undesirable. If left abandoned so long that the owner was forgotten it could be claimed by a new owner. The Yurok word for that kind of fishing place is "*weq sisiik*". It was generally accepted in Yurok culture that all fishing places along the river were owned by individuals, families or groups of individuals who had the primary right fish there (Waterman 1920:220).

Waterman (1920) documented a total of 94 Yurok fishing places on the Klamath River. Each of these sites had a name and an identified owner or owners. The distribution of these sites on Waterman's maps indicate a gap in his own field data as he notes only one fishing site existing down river of *Turip*, near the mouth at *Rekwo*i. Contemporary ethnographic information, as well as oral history indicates that there are numerous Yurok fishing sites between *Rekwoi* and *Turip* that were not included in Waterman's inventory. Instead his field data appears to have been collected for areas upriver from *Turip* with the majority recorded between Cappell Creek and *Weistpus* at the mouth of the Trinity River.

While fishing places were owned, those who did not have a fishing place could work for the owner in exchange for some of the fish caught there. In this way it was possible for all Yurok to participate in the annual fishing season, and receive a share of the harvest, even if they did not possess a fishing place of their own (Roberts 1932:287).

The best fishing places on the River were privately owned by single individuals, or a group of individuals who rotated fishing at a specific location. Fishing places were recognized as personal property and could be sold, given away or passed on by inheritance. Fishing rights on the River extended beyond the Yurok who lived in river villages. For instance, Yurok who lived in coastal villages away from the River were still recognized as having ownership of fishing sites on the river. (Kroeber and Barrett 1960:3)

Fish Camps

Fish camps on the Klamath River are necessary in order for Indian fishers to take advantage of their fishing rights at the mouth of the River during the commercial fishing season. Many Yurok travel from upriver villages to participate in the annual commercial fishing season. Fish camps are temporary campsites where families stay during this time. Fish camps are places for people to gather, socialize, share stories, and prepare for the next day's catch (Perry 1988:14).

When Indian commercial fishing resumed on the Klamath in 1987, Indian fishing could only occur between 7:00 pm to 7:00 am. This meant nets had to be checked, and fishers had to stay up all night in order to pull in nets and clean and prepare their catch. Once7:00 am came around, Indian fishers had to remove their nets to allow for recreational fishing. When the night's work was complete, Indian fishers would sleep during the day and then prepare for the next night's work (Perry 1988:14-15).

Yurok fish camps on the Klamath continue to be both a social and economic enterprise. Fish camps are temporary camps that are used annually for the purpose of commercial and subsistence fishing on the river. They are strong indicators of a river-based economy. During the salmon runs on the river, these places are utilized by individuals and families. Yurok fish camps are primarily located near the most productive fishing locations, such as Dad's Fish Camp on the south bank, near the mouth of the River (Bearss 1969:14).

Historic Commercial Fishery

The first non-Indian commercial fishery for Klamath and Trinity chinook was established in 1876 on the lower Klamath River. The first cannery was started at Requa in the late 1880's. While non-Indian settlement and commercial fishing in the region began to erode the Yurok's ability to live in their traditional ways, they adapted as best as they could to the new economic opportunities that were created (Bearss 1969). The canneries themselves were not owned by the tribes; however, all of the fish reaching the canneries was being supplied by Indians since they were the only ones permitted access to the in-river fishery.

The peak of salmon canning on the Klamath took place in 1912 - 1915. In 1912 it is estimated that 141,000 salmon were canned. Local Indians were not only employed to harvest the fish but also performed most of the work at the canneries. With little regulation or coordination of in-River and particularly, ocean fishing activities, the Klamath and Trinity River stocks were fished to the limit during the first several decades of the 20th century. In 1933, the State of California, opting to halt the precipitous decline of both rivers' fisheries as a result of fishing, mining, logging, and farming, banned the use of gill-nets on the lower 20 miles of the Klamath (even for subsistence fishing), closed the canneries and prohibited the sale of river-caught salmon. This had severe implications for the tribes, as they were increasingly dependent on the economic opportunities provided by their fishery resources. The tribes resisted the Fish & Game

restrictions, the issue coming to a head in the 1960s and 70s when on several occasions Hupa and Yurok tribal members were cited for violations of the Code and armed confrontations narrowly averted (USFWS et al 2000).

Indian Reserved Rights

By first creating reservations "for Indian Purposes," the United States sought to provide the Hoopa Valley and Yurok tribes with the opportunity to remain mostly self-sufficient, exercise their rights as sovereigns and maintain their traditional ways-of-life.[1] Implicit in this objective was an expectation that the federal government would protect the tribes and the resources they retained (a protection that extended beyond reservation borders). The prerogative of tribes to continue to utilize resources as did their ancestors has long been recognized as an application of their inherent sovereign powers and aboriginal rights, not a privilege bestowed upon them by the Federal Government; an Indian treaty is "not a grant of rights to the Indians, but a grant of rights from them."[2] Therefore, any right not explicitly terminated by treaty or federal statue is considered reserved for a tribe. This basic principle of Indian law is called the "reserved rights" doctrine and has important implications in any action, such as the proposed Trinity River Restoration, which may affect tribal access to resources (USFWS et al 2000).

Yurok Fishing Rights

The fishing rights of the Yurok Tribe are well-established as a matter of federal law. The Yurok Reservation, created pursuant to an 1855 act of Congress, was established within the Yurok Tribe's aboriginal homeland primarily to provide a territory in which the Tribe's fishing-based culture and way of life could thrive and continue to exist. This fact has been recognized repeatedly since the Reservation was established -- by the Departments of the Interior and Commerce, the United States Supreme Court, the lower federal courts, and the California courts. *See, e.g., Mattz v. Arnett*, 412 U.S. 481, 487 (1973); *Donnelly v. United States*, 228 U.S. 243, 259 (1913); *Parravano v. Masten*, 70 F.3d 539, 545-46 (9th Cir. 1995), *cert. denied*, 116 S. Ct. 2546 (1996); *Blake v. Arnett*, 663 F.2d 906, 909 (9th Cir. 1981). As Justice Blackmun observed in *Mattz v. Arnett*, the original Klamath River Reservation, the precursor to the current Yurok Reservation, "abounded in salmon and other fish" and was in all ways "ideally suited for the Yuroks." 412 U.S. at 487.

The Yurok Tribe's right to take fish on the Klamath River is protected and guaranteed by federal law. The Ninth Circuit Court of Appeals confirmed that the executive orders that created the Yurok Reservation vested the Yurok Tribe with "federally reserved fishing rights." *Parravano v. Masten*, 70 F.3d 539, 541 (9th Cir. 1995), *cert, denied*, 518 U.S. 1016

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1 Pevar, Stephan L., The Rights of Indians and Tribes, Second Edition, 1992. Chapter 2.

2 U.S. v. Winans,198 U.S. 371 (1905).

(1996). The same court has aptly observed that the salmon fishery of the Yurok Tribe is "not much less necessary to the existence of the Indians than the atmosphere they breathed." *Blake v. Arnett, supra*, at 909. The Solicitor of the Department of the Interior has determined that the Yurok Tribe is entitled to a sufficient quantity of fish to support a moderate standard of living, or 50% of the Klamath fishery harvest in any given year, whichever is less. Memorandum from Solicitor to Secretary of the Interior, No. M-36979, October 4, 1993. The right includes fishing for subsistence, commercial and cultural purposes. As the court in *Parravano* noted, the purpose of the Yurok Reservation was to enable the Yurok people to continue their fishing way of life. The River and its fish are undeniably the cultural heart of the Yurok people.

In 1969, the State of California's jurisdiction over Indian fishing was challenged in court by Raymond Mattz a Yurok fisherman who had his gill nets taken from him by State officials when he tried to fish on the lower Klamath. Mr. Mattz asserted that as an enrolled member of the Yurok Tribe, State law does not apply since he was fishing in "Indian Country". While he lost his case in two lower courts, the Supreme Court reversed the decision in Mattz v. Arnett, 412 US 481 in 1973 (See Appendix B).

Nonetheless, it was not until 1977, that the Department of Interior reaffirmed the right of Indians of the reservations to sell fish and reopened the lower Klamath to Indian gill-net subsistence and commercial fishing. Interior's action was based in large part on the First District Court's decision in *Arnett v. 5 Gill Nets* that effectively overturned state regulation of on-Reservation Indian fishing. Shortly thereafter, in August of 1978, Interior placed a "Conservation Moratorium" on the Indian commercial fishery (in an effort to satisfy spawner escapement goals in the Klamath River drainage during anticipated low run years).

In 1977 and early 1978 more than 140 Indian fishermen sold salmon harvested from the Klamath River (includes Trinity River stock). Following implementation of the Moratorium a relatively small number of Indian's continued to sell fish, claiming the Moratorium infringed upon their fishing rights and unfairly and inequitably allocated the Rivers' fishery resources between ocean-based and Indian fisheries. This led to several armed confrontations (USFWS et al 2000).

During the nine years that Indian in-river commercial fishing was restricted for "conservation" purposes, 1978 through 1986, both in-river and off-shore non-Indian fishermen landed an average of 140,130 Klamath origin chinook per year for commercial and recreational purposes, while the Indians harvested an average of 20,660 chinook annually (Pierce, 1990).

Once the Moratorium was lifted in 1987, the tribes increased their fishing in accordance with stock abundance projections made in that year and the following two years, 1988 and 1989. More recently, tribal subsistence fishing has been severely limited, and commercial operations mostly non-existent, due to low numbers of fish. This has had a significant impact on the economic situation of the tribes. In 1993, the Department of the Interior concluded that the Pacific Fishery Management Council's ocean harvest

regulations had not met fishery conservation requirements and thus adversely impacted the tribes' in-river fisheries. During that same year, Interior's Solicitor's's office reaffirmed the fishing rights of the tribes and fixed their share of the harvestable Klamath-Trinity basin salmon fishery at an amount, sufficient to support a moderate standard of living or 50% (Solicitor 1993) (See Appendix C).

Ocean commercial fisherman subsequently sued the Secretaries of Commerce and Interior claiming that the Solicitor's decision had forced them to reduce their harvest, and thus, that their harvest rights under the Magnuson Fishery Management and Conservation Act had been violated. This suit was settled in 1995, when the U.S. 9th Circuit Court of Appeals ruled in Commerce's favor, finding that under the Magnuson Act the government can implement regulations which affect coastal fishing if the objective is to meet the purposes of other applicable law, such as its trustee obligation to protect tribal fishing rights.

Salmon, steelhead, sturgeon and lamprey that spawn and migrate up the Klamath river, pass through the Yurok Reservation and are harvested in tribal fisheries. The fishing traditions of these tribes stem from practices that far predate the arrival of non-Indians. Accordingly, when the U.S. established what are today the Hoopa Valley and Yurok Indian Reservations on the Trinity and lower Klamath Rivers, it reserved for the benefit of the Indian tribes of those reservations a right to the fish resources in the rivers running through them (Whipple, Cannery, 1933). The U.S. has long recognized the right of the tribes of the Klamath-Trinity basin to fish. To protect those rights, the Federal Government has a responsibility to ensure that sufficient fish are produced and available to meet certain of its trust obligations to the respective tribes (USFWS et al 2000).

Today, the reserved fishing right includes the right to harvest quantities of fish that the Indians require to maintain a moderate standard of living. It is a vested property right held in trust by the United States for the benefit of the Indians that has been acknowledged and confirmed by the executive, legislative and judiciary branches of the Federal Government in a number of authorities including: 1) Opinion of the Solicitor of the Department of the Interior (Opinion M-36979 (October 4, 1993, see Appendix); 2) The Central Valley Project Improvement Act, Public Law 102-575 3406 (b) (23); and 3) Parravano v. Babbitt and Brown, 837 F. Supp. 1034 (N.D. Calif. 1993); 861 F. Supp. 914 (N.D. Calif. 1994); affirmed 70 F.3d 539 (9th Cir. 1995); cert. Denied 1996 WL 79843 116 S.Ct 2546 (June 24, 1996). It cannot be supplanted by state or Federal regulation.

The above referenced 1993 Solicitor's opinion: 1) reaffirm the historic and legal basis of the reserved fishing rights of the tribes of the Klamath-Trinity region, 2) acknowledge the Federal Government's cognizance of the importance of fish to these Indians at the time it first established reservations on their behalf, 3) fixes the tribes' salmonid fishing rights at 50% of the harvestable surplus of salmonid stocks, 4) recognizes that under the current depleted condition of the fishery, a 50% allocation does not adequately meet the tribes' needs, and 5) argues that it is the degree of the Hoopa Valley and Yurok dependence on fisheries at the time their reservation's were first created or expanded, and not the tribes'

specific uses of the fish, that is relevant in determining their present day fishing rights (USFWS et al 2000).

The Yurok Tribe, and Yurok people prior to the formal organization of the Tribe, fought hard to preserve the ability of Yurok Tribal members fish. The Tribe's dependence upon fish is recognized throughout is history and by the United States when the Yurok and prior reservations were created. The Yurok's dependence upon fish is well established applicable law and reflected by the fact that approximately 90% of Klamath River fish is harvested by the Yurok Tribe. The Yurok Tribe's allocation of Klamath River fish is 80% of the total Klamath River tribal allocation.

Reserved Water Rights

In addition to fish, the tribes have reserved rights to water. The concept of reserved rights in general, and Indian reserved water rights specifically, originated just after the start of the 20th century with *Winters v. United States, 207 U.S. 564 (1908)*. The ruling in this case, commonly referred to as the *Winters* Doctrine, states that when the Federal Government established a reservation, it implicitly reserved a quantity of water necessary to fulfill the purposes of said reservation (that the government would not create a reservation, and Indians accept a permanent area for their home that would be useless without sufficient water). Generally, all original documents related to the establishment of reservations -- treaty, executive order or statute -- indicate, at a minimum, that the purpose of the reservation is to provide a "permanent home" for the tribe(s) in question. Some reservations were established with the general objective that the Indians become civilized. In cases where reservations have been created with specific language stating or implying reserved fishing, gathering or other rights, Winters has been interpreted to mean that adequate water supplies for these purposes have been reserved (even in addition to more general uses -- see *U.S. v. Adair, 723 F.2dd 1410 [9th Cir. 1983]).*

The Department of Interior Solicitor's office and the Courts have continuously reaffirmed these rights with respect to Bureau of Reclamation activities, stating that, "Reclamation is obligated to ensure that project operations not interfere with the Tribes' senior water rights. This is dictated by the doctrine of prior appropriations as well as Reclamation's trust responsibility to protect tribal trust resources" (Solicitor's Opinion, July 25, 1995,). Furthermore, the Solicitor notes that the Secretary of Interior, "through Reclamation, must operate reclamation projects consistent with vested, fairly implied senior Indian water rights" (Solicitor's Memorandum Jan 9,1997) (USFWS et al 2000)

The Salmon Resource

Salmon far exceeds other resources in its importance to the diet and cultures of the Hoopa Valley, Yurok and other tribes who have historically lived in the Klamath-Trinity basin (Swezey & Heizer, 1977; Warburton & Endert, 1966). The Supreme Court in U.S. v. Winans, 198 U.S. 371, 381 (1905) recognized the primary importance of salmon to these

tribes when they concluded that access to the fisheries was "not much less necessary to the existence of the Indians than the atmosphere they breathed" (Kroeber, 1960). The abundance of salmon has always been an important measure of tribal well-being -- where feasting is not simply an exercise in eating, but has deep rooted connections to the vitality of the Earth and a traditional connotation of community health (Gunther, 1926). The timing and cycle of many tribal societal, religious and economic activities were made to closely coincide with the seasonal and geographic variations in fish runs, particularly the arrival of the first salmon (USFWS et al 2000).

Despite variations in the size of the semi-annual runs, in times past, the tribes could typically procure enough salmon for their people. The abundance of fish once supported by the region's rivers is well documented, with stories that recount the challenge of fording the Trinity, and even Klamath River, because the salmon runs were so thick. It is estimated that prior to non-Indian settlement along California's North Coast, the region's Indians consumed over 2 million pounds of salmon annually from runs which are believed to have exceeded ½ a million fish (EIS Indian Fishing Regulations, 1985). Fishing by the Hupa and Yurok had one of the highest yield-to-effort ratios (i.e. was the most efficient) of any subsistence undertaking in all of North America (Swezey & Heizer, 1977). This was due not only to the abundance of fish, but the various fishing techniques developed by both tribes (USFWS et al 2000).

The continual bounty of salmon (as well as steelhead, sturgeon, lamprey and other fish species) available to the region's tribes prior to European settlement, has not been attributed to sparse human population or poor fishing technology, but management. These cultures have always recognized the potential humans have for damaging ecosystems. They also strongly believe that man can be sustained by nature if properly stewarded and revered by him; that nature's health is ultimately expressed through the resources it provides. Consequently, the tribes developed remarkably sophisticated and environmentally sensitive fishery management practices and shared a strong spirit of cooperation in their use of the region's fishery resources. In this manner, they minimized their impact on the fishery, and in some cases, enhanced its productivity. For example, salmon runs historically were protected by a very strict series of laws and traditional mores prohibiting over fishing and ensuring that only the amount needed by tribal communities was taken. Laws also served to guarantee that upstream people received a fair share of the salmon, and most importantly, that weir gates (e.g., fish dams) were kept opened for extended periods during harvest time to insure that adequate numbers of salmon could reach their spawning grounds. Other management activities included the clearing of smaller tributaries to facilitate fish migration. Furthermore, the tribes heeded tales that warn against eating too much and wasting food lest it run out and a belief system that states the salmon will be withheld if abused or mistreated (Lewis 1994). Such proscriptions continue to be voiced today by tribal elders (USFWS et al 2000).

During the pre-Euro-American contact period, fisheries were an essential part of the economy of the region's tribes. The sharing, trading, and consumption of fish was so important that fishing places were acquired as property. Fish were also used for commercial purposes, and were traded in substantial volume. Northwest California

Indians have been catching salmon for trade with other tribes since time immemorial.[3] Trade enabled them to acquire food, raw materials, and manufactured goods. The trade, which involved both necessities and luxuries of native life, existed because of the variation in available local resources. Food preservation methods were developed which allowed fish to be stored throughout the year and transported over great distances. It was tribal custom to take fish for food and commerce efficiently and without damaging the continued existence of the species. Today still, salmon continues to represent an important economic resource for the Klamath River tribes (USFWS et al 2000).

Yurok Cultural Resources

The inseparable relationship of the Yurok people with the environment and resources provided by the rivers of the Klamath-Trinity basin cannot be overemphasized. The Klamath River is a vital natural resource which is the foundation of Yurok social and cultural way of life. At its most basic level, the River has always been a source for food and other necessities of daily life. The River also provides basket materials, fish net materials, and a means of transportation. Even rocks from the river are used by Yurok people to practice their cultural ways. The Yurok River is traveled during religious ceremonies and in recreational activities, it is integral to the Yurok language and its oral tradition and truly represents the binding force of their community. Yurok use of the River developed over a long period of time as evidenced by the complexity of their religious ceremonies and practices. In aboriginal times, religious practices were integrated with fisheries management.

The Yurok have many traditional dances and ceremonies which they have long practiced along the banks of the Klamath and Trinity Rivers. The Yurok's ceremonial way-of-life has greatly suffered with the deterioration of the region's rivers. The Yurok have always depended on the Klamath and Trinity Rivers and the sustenance that their flows provide, they name themselves after the rivers and much of their universe is defined in terms of their physical relation to rivers. Residency, natural and cultural resource sites, ceremonial practices, oral history, transportation routes, economic and sociological resources, indeed the Yurok identity, are all intricately woven into the ecosystems of the Klamath and Trinity Rivers. Yurok continue to live upon some of the forty-four village sites that line the Klamath and lower Trinity Rivers. These are places where Yurok have lived, fished, gathered, prayed and have been buried for countless centuries (USFWS et al 2000).

[3] U.S. v. McCovey reaffirmed Yurok Fisherman's rights to sell fish off the reservation.

VI. Yurok Beneficial Uses of the Klamath River and Tributaries

"The River is part of life. No river, no life. God put it there for us, the people, to use. If people don't use it right, it's gone. It was a place for everyone. The River is there to supply food to the people who need it. We wouldn't be here without the River. I don't know how they figure the are going to get the water back [in the river system]. Who has the water? It is natural to have high water in the winter. I can't see anything bad about it. It is an act of nature".

(Yurok Elder Billy Wilson, 2003)

"The River is our life. Our life revolved around the River. For our own subsistence, our own person, later for business, kept our families for year round. We depended on the River for survival. Without the River, you don't have the fish. The River needs to be taken care of".

(Yurok Elder Fawn Morris, 2003)

"The Klamath River has provided the River Yurok people with food salmon, eels, candle fish, sturgeon and also transportation, eels, roots for basket materials and also willow sticks for basket materials."

(Yurok Tribal Member Survey Respondent 2006)

"I grew up and lived in and around the Yurok Reservation (ceremonial – social – cultural) for the first 31 years of my life. I have hunted with my family for deer and other wildlife, all of my life. I have gathered everything: acorns, berries, teas, plants/medicine mushrooms, all the resources I have used throughout my life time, Basked materials – ferns, willow, Redwood and spruce roots, bear grass, hazel stick, mosses, chitum bark. Salmon is our family's life blood – it provides (food) nourishment all year round. We fresh canned, smoked and canned smoked fish, even the heads and tails, heart and other inner parts are eaten. The backbone is dried and used for soup in the winter. Fish guts used to fertilize (food) gardens. The Redwood trees that grow on my family allotments depend on the Klamath River for water. The Klamath River is the heart and veins of our watershed – the web of life on which the tribe depends and for what we our, Yurok! Down River People! It is what our circle is: What we live, we eat, and sing songs about."

(Yurok Tribal Member Survey Respondent 2006)

The California North Coast Regional Water Quality Control Board has established both Native American Cultural and Subsistence Beneficial Uses for the Klamath River and its tributaries. In 2006, Klamath River tribes participated in an Environmental Justice Pilot Project with the State Water Resources Control Board that served to help provide data on these Beneficial Uses in terms of types of uses and also times of the year during which these Beneficial Uses occur. In 2006 a proposal prepared by the Tribes (Karuk, Yurok, Hoopa) stated:

> The Klamath Basin Tribes working with the State Water Resources Control Board propose an Environment Justice Pilot Project for the Klamath River Watershed. This project seeks to restore Klamath River water resource health for the protection, restoration, and enforcement of Native American Cultural and Traditional Subsistence Beneficial Uses.

The need for such a pilot project is clear. Water quality- based Environmental Justice issues of special concern are:

(1) that the tributaries, lakes, wetlands and the main stem of the Klamath River continue to benefit the Klamath River Basin tribes through traditional economic, subsistence, commercial, and ceremonial uses;
(2) that Native American Cultural and Traditional Subsistence Beneficial Uses, including ceremonial and religious uses of the river, subsistence fishing and other continued traditional cultural uses can and must be restored and protected.
(3) that tribal cultural, social, and physical health can be improved through State Water Board programs designed to restore water quality within the Klamath River Basin.

In order to address the significant water quality issues, the Klamath Basin Tribes have determined that the primary goal of this EJ Pilot Project is to uphold all regulatory parameters for Native American Cultural and Traditional Subsistence Beneficial Uses per the SWRCB North Coast Region Basin Plan:

> The basis for the discussion of beneficial water uses, which follows, is Section 13050(f) of California's Porter-Cologne Water Quality Control Act, which states:
>
> "Beneficial uses" of the waters of the state that may be protected against water quality degradation include, but are not necessarily limited to, domestic, municipal, agricultural, and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves. An essential part of a water quality control plan is an assessment of the beneficial uses, which are to be designated and protected….

> Protection will be afforded to the present and potential beneficial uses of waters of the North Coast Region as designated….The beneficial uses of any specifically identified water body generally apply to all its tributaries….
>
> Water quality standards are adopted to protect public health or welfare, enhance the quality of water, and serve the purposes of the Clean Water Act (as defined in Sections 101(a)(2), and 303(c) of the Act). Water quality standards consist of 1) designated beneficial uses; 2) the water quality objectives to protect those designated uses; 3) implementation of the Federal and State policies for antidegradation; and 4) general policies for application and implementation….

Established and adopted Beneficial Uses for the SWRCB North Coast Region that are of particular importance to Klamath Basin Tribes include but are not limited to:

> **Native American Culture (CUL)** Uses of water that support the cultural and/or traditional rights of indigenous people such as subsistence fishing and shellfish gathering, basket weaving and jewelry material collection, navigation to traditional ceremonial locations, and ceremonial uses.
>
> **Subsistence Fishing (FISH)** Uses of water that support subsistence fishing.

The SWRCB EJ Pilot Project for Klamath Basin Tribes should be devoted to assisting each Tribe in asserting regulatory enforcement of tribally-determined water quality criteria for these Beneficial Uses as they relate to SWRCB policies and actions for the Klamath River Basin.

It is important to recognize that each tribe has its own unique history, culture, and status relative to federal recognition, retained rights, and sovereignty. Participation in this project does not represent a waiver of sovereignty or any rights for any tribe, nor does it establish any additional rights for any tribe.

In a final 2006 Scope of Work prepared by the California State Water Quality Control Board as part of the pilot project the tribes stated:

> The State and Regional Water Boards are engaged in a number of activities to prevent further degradation to the Klamath River and its tributaries and to restore the health, habitat and beneficial uses of the river.
>
> The Klamath River and its tributaries are listed as impaired on the Federal Clean Water Act (CWA) Section 303(d) list. The Regional Water Board has adopted

Total Maximum Daily Loads (TMDLs) including Action Plans to restore the water quality and beneficial uses of Scott, Shasta, and Salmon River watersheds, and is in the process of developing TMDLs for the main stem Klamath River.

A TMDL is a framework for assessing the condition of a watershed, evaluating the factors that contribute to water quality problems in the watershed, and for developing a plan to restore healthy water quality conditions. There are five general objectives of a TMDL:

1. To assess the condition of a waterbody, and determine/confirm cause(s) / source(s) of stress.
2. To quantify the sources of the pollutant or stressor.
3. To determine how much of a particular pollutant or stressor a waterbody can handle and still meet desired conditions.
4. To identify whether and how much the different sources need to be reduced in order to support desired conditions.
5. To develop a plan which, when implemented, will restore waterbody health.

The Klamath River is listed as impaired due to low dissolved oxygen, high water temperature and nutrient concentrations. The Water Quality Control Plan for the North Coast Region (Basin Plan) designates the following beneficial uses to one or more hydrologic areas or sub-areas of the Klamath River:

- Municipal Water Supply (MUN)
- Water Contact Recreation (REC-1)
- Non-Contact Water Recreation (REC-2)
- Cold Freshwater Habitat (COLD)
- Spawning, Reproduction or Early Development (SPWN)
- Migration of Aquatic Organisms (MIGR)
- Rare, Threatened or Endangered Species (RARE)
- Commercial and Sport Fishing (COMM)
- Native American Cultural (CUL)
- Subsistence Fishing (FISH)
- Wildlife Habitat (WILD)
- Marine Habitat (MAR)
- Navigation (NAV)
- Shellfish Harvesting (SHELL)
- Aquaculture (AQUA)
- Agricultural Supply (AGR)
- Industrial Supply (IND)
- Industrial Process Supply (PRO)
- Groundwater Recharge (GWR)
- Freshwater Replenishment (FRSH)
- Hydropower Generation (POW)

In addition to beneficial uses related to the cold water fishery (COLD, SPAWN, MIGR) and drinking water (MUN); the Native American Cultural (CUL) use and the Subsistence Fishing (FISH) use are extremely important to the Klamath Basin Tribes (Tribes). The Regional Water Board added the CUL and FISH beneficial uses during a Basin Plan update in June 2003. This was done to specifically acknowledge reliance by the Tribes on fish to provide most of the protein in their diet and the extreme importance of high-quality water to their culture, spirituality and their economy.

The North Coast Basin Plan defines the Native American Cultural (CUL) and Subsistence Fishing (FISH) uses as follows.

Native American Culture (CUL) Uses of water that support the cultural and/or traditional rights of indigenous people such as subsistence fishing and shellfish gathering, basket weaving and jewelry material collection, navigation to traditional ceremonial locations, and ceremonial uses.

Subsistence Fishing (FISH) Uses of water that support subsistence fishing.

At the time the CUL use was added to the Basin Plan, the Regional Water Board staff did not have adequate information with which to support the designation of the use for all of the waterbodies in the region as existing or potential. Thus, staff did the best they could with the designations using the information submitted by approximately five tribes in the Region. For this reason the CUL designations are not complete in the beneficial use table found within the Basin Plan. There are many other waterbodies where the CUL use very likely exists or existed historically (potential). The Regional Water Board plans to update these beneficial use designations at their earliest opportunity.

In addition, Regional Water Board staff had originally proposed to add subsistence fishing to the Commercial and Sport Fishing use definition. However, at the adoption hearing for the Beneficial Use Amendment, the State Water Board stated that they preferred not to change the statewide definition of this use, but instead agreed to add a separate beneficial use entitled “Subsistence Fishing” (FISH). Because this use was adopted separately, the Regional Water Board was unable to designate this use to any specific waterbody at the time of adoption. This use is known to exist or existed historically (potential) in many waterbodies, including the Klamath River, and will be designated during the next update of the Beneficial Use Chapter of the Basin Plan.

Existing uses are those uses, which were attained in a waterbody on or after November 28, 1975. Existing uses cannot be removed or modified unless a use requiring more stringent criteria is added. However, a use requiring more stringent criteria can always be added because doing so reflects the goal of further

improvement of water quality. Biological data, human use statistics, and/or professional experience is used to document the existing uses.

Waterbodies may have potential beneficial uses established for any of the following reasons: 1) the use existed prior to November 28, 1975, but is not currently being attained; 2) plans already exist to put the water to that use; 3) conditions make such future use likely; 4) the water has been identified as a potential source of drinking water based on the quality and quantity available (see *Sources of Drinking Water Policy*, in Appendix 7); 5) existing water quality does not support these uses, but remedial measures may lead to attainment in the future or 6) there is insufficient information to support the use as existing, however, the potential for the use exists and upon future review, the potential designation may be re-designated as existing.

The CUL use is designated as an existing as well as a potential beneficial use in the Basin Plan and as such, must be protected and if impaired, must be restored. As stated above, existing uses cannot be removed using a use attainability analysis (UAA).

It is imperative that the beneficial use designations in the Basin Plan be updated to reflect existing and potential CUL and FISH beneficial uses so that water quality necessary to protect these uses can be restored and maintained as required by the federal Clean Water Act and the state Porter Cologne Water Quality Control Act.

Under the project described above, the Yurok Tribe Environmental Program (Sloan and McConnell 2007) collected data on Yurok Beneficial Uses of the Klamath River and its tributaries. This work continued in 2008 under a California Environmental Justice Grant (Sloan and McConnell 2009) and documented that Yurok traditional uses of the Klamath River and its tributaries is extensive and continual, spanning through most months of the year. The following tables present information both on types of uses and times of year during which these uses occur within the Yurok community.

YUROK TRIBE CULTURAL USES OF THE KLAMATH RIVER & TRIBUTARIES

Codes used in table: 1 = Main stem Klamath only, 2 = Tributaries only, 3 = Main stem AND Tributaries

USES:

CEREMONIAL	January	February	March	April	May	June	July	August	September	October	November	December
Plants	3	3	3	3	3	3	3	3	3	3	3	NO
Fish	3	3	3	1	1	1	1	1	1	1	1	NO
Fishing	3	3	3	3	3	3	3	3	3	3	3	NO
Water-drinking, steaming, cooking	2	2	2	2	2	2	2	2	2	2	2	2
Rocks	3	3	3	3	3	3	3	3	3	3	3	NO
Bathing						3	3	3	3	3	3	
Boating	3	3	3	3	3	3	3	3	3	3	3	3
Wildlife	3	3	3	3	3	3	3	3	3	3	3	3
River & Trail Access	3	3	3	3	3	3	3	3	3	3	3	3
Training	3	3	3	3	3	3	3	3	3	3	3	3
Swimming						3	3	3	3	3		NO
Prayer/Meditation	3	3	3	3	3	3	3	3	3	3	3	NO

YUROK TRIBE CULTURAL USES OF THE KLAMATH RIVER & TRIBUTARIES

Codes used in table: 1 = Main stem Klamath only, 2 = Tributaries only, 3 = Main stem AND Tributaries

USES:

ACTIVITIES	January	February	March	April	May	June	July	August	September	October	November	December
Plants	3	3	3	3	3	3	3	3	3	3	3	NO
Water-drinking, steaming, cooking	2	2	2	2	2	2	2	2	2	2	2	2
Rocks	3	3	3	3	3	3	3	3	3	3	3	NO
Bathing	3	3	3	3	3	3	3	3	3	3	3	3
Boating	1	1	1	1	1	1	1	1	1	1	1	1
River & Trail Access	3	3	3	3	3	3	3	3	3	3	3	3
Training	3	3	3	3	3	3	3	3	3	3	3	3
Swimming						3	3	3	3	3		
Washing	3	3	3	3	3	3	3	3	3	3	3	3
Meditiation	3	3	3	3	3	3	3	3	3	3	3	3
Wood Gathering	3	3	3	3	3	3	3	3	3	3	3	3

YUROK TRIBE CULTURAL USES OF THE KLAMATH RIVER & TRIBUTARIES

Codes used in table: 1 = Main stem Klamath only, 2 = Tributaries only, 3 = Main stem AND Tributaries

USES:

BASKETRY	January	February	March	April	May	June	July	August	September	October	November	December
Roots	3	3	3	3	3	3	3	3	3	3	3	NO
Sticks	3	3	3	3	3	3	3	3	3	3	3	NO
River & Trail Access	3	3	3	3	3	3	3	3	3	3	3	NO
Plants				3	3	3	3	3	3	3		NO

JEWELRY	January	February	March	April	May	June	July	August	September	October	November	December
			3	3	3	3	3	3	3	3	3	

YUROK TRIBE CULTURAL USES OF THE KLAMATH RIVER & TRIBUTARIES

Codes used in table: 1 = Main stem Klamath only, 2 = Tributaries only, 3 = Main stem AND Tributaries

USES:

SUBSISTENCE	January	February	March	April	May	June	July	August	September	October	November	December
Plants				3	3	3						NO
Fishing	3	1	1	1	1	1	1	1	1	1	1	NO
Eeling	1	1	1	1	1							NO
Shellfish						1	1	1				NO
Water-drinking, steaming, cooking	2	2	2	2	2	2	2	2	2	2	2	2
Wildlife	3	3	3	3	3	3	3	3	3	3	3	NO
River & Trail Access	3	3	3	3	3	3	3	3	3	3	3	3
Food Preparation	2	2	2	2	2	2	2	2	2	2	2	2

Yurok Tribe Cultural Uses of the Klamath River & Tributaries

CEREMONIAL	Pathways of Exposure
Plants	Gathering, walking in streams & river side, cooking, cleaning, soaking, exposure to water when dispensing of medicinal plants, water often taken to ceremonies and used with plants for medicine
Fish	Catching is the same as subsistence, fish for ceremonial use is fresh, contact with fish during preparation
Fishing	Same as subsistence, contact with water nearly constant
Water-drinking, steaming, cooking	Water often taken to the site of ceremony and used in various ways including cleansing, cooking, preparation, drinking, landscaping (packing sand down),
Rocks	Steaming, sweating, cooking, gathering on river and creek banks, exposure to water while walking to pick up rocks.
Bathing	Bathing before, during and after ceremonies and sweats, exposure to water while immersed.
Boating	Getting in and out of boat, splashing, paddling, accidentally falling in, boat capsizing
Wildlife	Walking during hunting for wildlife, cleaning, wildlife drank the water, otter, sea lion, ducks
River & Trail Access	Splashing while walking near and in waterways, trail often cross tributaries or run along side waterways.
Training	Swimming, diving, bathing after training
Swimming	Immersion in waterways, splashing, possibly swallowing water during swimming
Prayer/Meditation	Sitting on riverbank, feet in water
Fish dam	Full body immersion during construction, use of dam after construction, and deconstruction

Yurok Tribe Cultural Uses of the Klamath River & Tributaries

ACTIVITIES	Pathways of Exposure
Plants	Gathering in and near waterways, walking to gather plants, cleaning, cooking, steaming, rinsing, wading in waterways to gather plants,
Water-drinking, steaming, cooking	Drinking water from tributaries, using water to cook and clean, steaming, used to rinse food and eating utensils, water used in camps for multiple purposes
Rocks	Rocks gathered from banks of waterways, often time coming in contact with the water while gathering, either by splashing or wading. The rocks gathered have been in contact with the water, as well as rinsed in the water. Rocks are then used to cook and prepare either medicine or food.
Bathing	Daily bathing in river or tributaries, either by immersion, rinsing or splashing. Direct contact with skin and body
Boating	Getting in and out of boat, splashing while moving and paddling, putting in and taking boat out of water. As a result of being on the water there is constant contact with the water. Bailing of water from boat.
River & Trail Access	The trails often cross paths with waterways or are around, run along side. Contact by wading, splashing. Also when traveling the trails the waterway is used for cooling down and drinking
Training	Swimming, immersion in water, bathing, and diving.
Swimming	Full body immersion, splashing, wading, playing near and in the waterways
Washing	Washing of baskets, utensils, food, rocks, and plants. Washing hands, face, feet, and other body parts. Water used through out the day to wash various things, constant contact with water.
Meditation	Same as ceremonial
Wood Gathering	Gathering wood from the banks of the river, splashing. Traveling to gather wood, having to go through or wade in the shallows of the water to get to the wood. Also possibility that wood has been exposed to the water at some point. Winter gathering involvesthe use of a boat to gather wood that is floating downstream
Tanning hides	Placing of hides in creek

Yurok Tribe Cultural Uses of the Klamath River & Tributaries

BASKETRY	Pathways of Exposure
Roots	Having to dig near the water for roots. Wading in water to get the roots. Constant exposure of water on hands to gather. Also the cleaning and preparing the roots for use. Soaking the roots for flexibility
Sticks	Gathering near tributaries and river could possibly put one in contact with the water. Cleaning and soaking of the sticks to make them usable.
River & Trail Access	Wading to get to the resource. Crossing tributaries and river while gathering basket materials.
Plants	Gathering plants near waterways, having to travel to the plant location puts one in contact with waterways. Also the preparation and cleaning of plants uses water from river and tributaries. The soaking of plant material for flexibility uses water from the river and tributaries.
Weaving	Women would often gather in groups near a tributary. The placing of a wet stick or root in the mouth while weaving.

JEWELRY	Pathways of Exposure
Shells	Gathering from the streams and river. Wading to gather resource. Also preparation of use of the shells requires them to be cleaned in the waterways. Dipping of shell (abalone) in water while grinding

Yurok Tribe Cultural Uses of the Klamath River & Tributaries

SUBSISTENCE	Pathways of Exposure
Plants	The gathering plants in and near streams and rivers, cleaning and rinsing. Preparation, cooking, soaking, steaming…
Fishing	Getting in and out of the boat, Setting and pulling the net. Hands and arms continuously in the water while checking the net and removing fish. Cleaning the fish with water, using the water for slush tanks for storage, wading in the water, splashing from fish, boat moving and dropping the anchor. Trigger net for salmon and sturgeon
Eeling	Setting and checking eel baskets in the water ways. Hooking eels by wading and exposing feet, legs, hands and arms to the water. `Scraping' eels from rocks at Coon Creek and Smokers Falls. Trigger net and dip net. Cleaning eels and preparing them.
Shellfish	Immersion in the water to gather, cleaning and preparation of freshwater clams.
Water- drinking, steaming, cooking	Drinking water directly from tributaries, using water to cook and clean food and items used for food preparation. Water used for multi purposes in the kitchen with preparing all foods.
Wildlife	Wildlife caught in and near waterways. Water used to clean and prepare wildlife for consumption. Geese, ducks, mudhens
River & Trail Access	The trails used to gather and prepare subsistence food are in direct or indirect contact with the waterways.
Food Preparation	Water is used directly and indirectly with food preparation. Used for gathering, cooking, steaming, boiling, cleaning, and multiple uses in all food preparation.

VII. Environmental Justice

"I was born and raised on the River. My life is woven with the river and its fish and people. If the River is sick, so am I. So are we all, because it is our spirit and strength. Even though I live in town, I still live and choose to live close enough so I can go to the River whenever I choose. I participate in ceremonies on the River. If it were possible, I would live on the River, to see it and hear it and smell it every day and every night. I will not be completely healthy again until I can look out my front door at night and see the salmon moving up the River as they did when I was a child. It is not the simple fact of eating healthy food from the River that is important… It is the knowing in my mind, heart and spirit that the River itself is whole and healthy. We are merely a reflection of the river, and will never be healthy again until it is."

(Yurok Tribal Member Survey Respondent 2006)

"Over the years, the river got smaller and smaller. The color has gradually gotten darker. At first, (60's, 70's, 80's) the Klamath only looked unhealthy at the end of summer. Now the River always looks too dark in color and low. At the end of summer now, the Klamath looks dark, low, slow, dirty, slimy and too unhealthy to get into or eat anything coming from it. We used to be able to tell which salmon were not from the mouth, because they would sometimes have a muddy taste. Now I don't eat any salmon that aren't from the mouth for fear of eating toxins and diseased fish."

(Yurok Tribal Member Survey Respondent 2006)

"If something is not done to improve the river water temp – there will be no fish. As a people we are still dancing, without the fish there will be no ceremonies. Without the ceremonies we will be <u>NO MORE</u>. Something is going to have to be done about the damns on the Klamath and Trinity Rivers. Especially the Klamath River. Fish will not travel in hot water – the old holes where fish could find cool water, have filled in giving the fish no place to go – but belly up. I heard Calvin Rube speak before the Senate Committee 45 years ago. He said that we (younger generation) would see fish kills, because of the water temp., which would also cause algae to grow – making river unhealthy."

(Yurok Tribal Member Survey Respondent 2006)

"I am trying to teach my children how to fish on the River and have been very disappointed with the numbers of fish available. I do believe that a lot of traditional foods are being lost and becoming unavailable. Beach fishing is almost impossible to gather surf fish, clams and others. Gathering herbs for teas is becoming a lost art. There is very little if any big game available for food which could provide a lot for the people. Salmon is really the only thing we have left and it is hurting."

(Yurok Tribal Member Survey Respondent 2006)

"The Klamath River is considered a big pool of pesticides flowing to the ocean to do more damage. There will be <u>NO</u> chance that my children will swim in this pool of pesticide run off. I cannot see seven generations ahead on this River. I have had three family members die from cancer. They lived at Notchko. I pray for the River to come back and show my children the way of life. As it did for me."

(Yurok Tribal Member Survey Respondent 2006)

No single minority population in the US experiences higher rates of unemployment, poverty, diabetes, heart disease, cancer, or high-school drop out rates than Native Americans, and those statistics are starkly higher for on-reservation communities. EO 12898 was signed with the intent of finally recognizing, considering, and where possible mitigating the disproportionate adverse impacts on low-income and minority populations in federal actions. Presidential Executive Order 12898 issued a directive to all federal agencies on Environmental Justice:

> "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations."

The Yurok People remain intrinsically tied to the Klamath River and the resources it provides the community through the fishery. For the Yurok Tribe, the river is the foundation of tribal culture, spirituality, transportation, subsistence, as well as the traditional and contemporary economy. In pre-Contact times, the Yurok villages along the Klamath managed and utilized the fishery, as their primary source of sustenance and the fishery was the basis of the Klamath River economy. During the cannery period, tribal people continued making their livings of the fish that the river provided. Even with significant declines in anadromous fish populations in recent decades, the fishery remains a primary source of the tribal economy and subsistence of the tribe.

Environmental justice issues for the Yurok Tribe with regards to the Klamath River include: loss of traditional subsistence, lack of benefit from hydro-electric power generated by Klamath River dams, increased health risks as a result of degraded water quality and increase of toxic algae blooms, and the lack of funding to actively participate in the Pacificorp and dam re-licensing efforts or in the Secretarial Determination and NEPA/CEQA process currently underway.

The Yurok Tribe has been a long-time advocate for the protection of the Klamath River and the health of the fishery. The Yurok Tribe has been actively engaged in tribal and inter-tribal efforts to protect and restore the fishery for many decades. Since it's re-organization in 1988, the Yurok Tribe has developed several departments to help promote the Tribe's goals on the management of both natural and cultural resources. The Yurok Tribe has established and active programs in Forestry, Fisheries, Watershed Restoration, and the Yurok Tribe Environmental Program (YTEP). YTEP is an ongoing and current recipient of EPA funding for several programs in several media. All of these departments have demonstrated numerous successes in obtaining and managing grant funded programs, achieving grant objectives and deliverables, and utilizing grant funding to further enhance technical capacity within the Tribe.

Klamath River Tribes and California EJ Pilot Project

In a 2006 proposal to the State Water Quality Control Board for an Environmental Justice Pilot Project, the six federally recognized Klamath Basin Tribes stated:

> The Klamath River is a valuable ecological resource to the states of California and Oregon. The Klamath River and the resources it provides serve as a common cultural, spiritual, and social link between all Klamath Basin Tribes.
>
> In pre-Contact times, the tribes on the Klamath managed and utilized the fishery as a primary source of sustenance and the fishery was the basis of the Klamath River economy. Even the location of tribal communities was determined by the significance of salmon and the fishery to these tribes. The federal government considered the significance of the subsistence fishery in determining the location of reservations and rancherias.
>
> During the cannery period, tribal people continued to make their living from the fish that the River provided. Even with significant declines in salmon populations returning to the Klamath since the construction of the Klamath Project dams, the fishery remains a primary part of the tribal economy and source of sustenance for the tribes that still have access to fish.
>
> It is significant to note that some Klamath Basin Tribes have lost their entire tribal salmon fishery. The primary reason for the loss is the construction of dams that completely block fish access to the upper Klamath, once a prime salmonid spawning area.
>
> The dams also degrade Klamath River water quality resulting in a major impact to the health of the watershed. The cumulative impacts of the dams has caused a significant decrease in the number of salmon that return each year. California Klamath Basin Tribes have experienced a dramatic decline in their subsistence and commercial fisheries as a result of degraded water quality, including increased water temperature, algae and bacteria growth, high pH, and deadly dissolved oxygen levels.

In order to better manage the Klamath River and the resources that it provides, this proposal will rely on Government Code § 65040.12, which describes "Environmental Justice".

Environmental justice is defined by California statute as,

> "The fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies." (Gov. Code. §65040.12).

Given the mandates of this Section, it is critical that any environmental justice project for the Klamath River address the significance of salmon and other river resources to the traditional life ways and contemporary cultures of Klamath Basin Tribes. This should be accomplished through the identification and development of criteria to protect, restore, and enforce Native American Cultural and Subsistence Fishing Beneficial Uses for the Klamath Basin Tribes.

The tribal governments located in the Klamath Basin take the position that the issues of water quality and the impacts of dams on the traditional diet, traditional subsistence, and the continuation of tribal culture (spiritual, ceremonial, and resource uses)of the Klamath River and its tributaries must be a priority for this project if the mandates of Section 65040.12 are to be heeded and established Beneficial Uses are to be protected, restored, and enforced. A meaningful environmental justice project must address the cumulative impacts of degraded water quality not only on Native American Cultural and Subsistence Fishing Beneficial Uses, but also on the physical health of tribal people due to the decline of salmon and steelhead, and the loss of these fish in their daily diet.

The tribal governments and their people are united in their commitment and determination to protect what remains of the fishery and restore to historic levels river health, biodiversity, and the fishery (salmon, steelhead, sturgeon, lamprey, and suckers).

Given the language of Gov. Code § 65040.12 it is important that the Klamath Basin Tribes, through their respective tribal governments, take a lead role in developing the research design, methods, and implementation strategies for any pilot project proposal for environmental justice being proposed by the SWRCB for the Klamath River watershed.

The Klamath Basin Tribes agree that the Klamath River is an excellent choice for an environmental justice pilot project by Cal/EPA and the SWRCB. In order for this project to adequately identify and design both a methodology and implementation strategy for meeting the stated goals of the Cal/EPA environmental justice policy, then it must enable tribes to take the lead in the process, particularly in identifying needs, goals, methods, and implementation of any such project.

The Klamath Basin Tribes have historically been at a disadvantage while participating in the process surrounding the re-licensing of the Klamath Hydroelectric Project. Internal

capacity, lack of funding, limitation in staff numbers, and travel expenses are all factors that inhibit fair participation by the tribes. In contrast, federal, state, and local agencies have staff and funding for their representatives to participate in these processes. Industry and special interest groups also have more resources and expertise at their disposal during this process.

Furthermore, while other interest groups have benefited greatly from the development of the Klamath River, the tribes have not realized an economic benefit, nor have they realized a benefit from the energy generated by the hydro-electric operations, or agriculture. In fact, the negative impacts of these developments have proven to be detrimental to tribal interests.

It is important to note the social, cultural, economic and health issues that impact these tribal communities as a direct result of the loss and/or decline of their traditional fisheries, degraded water quality, and the disruption of a naturally functioning watershed and ecosystem by the construction of the Klamath dams.

It is important to recognize that the Klamath Basin Tribes have all paid the highest socio-economic, cultural, and related health costs resulting from land and water management decisions that have led to adverse cumulative impacts on water quality and watershed health.

Klamath Basin Tribes have suffered the highest impacts as demonstrated in the loss or decline of their fisheries, their traditional diet, and their ability to conduct ceremonies and practice traditional culture and spirituality in harmony with nature and the historic Klamath Basin ecosystem.

There is an intrinsic relationship between the overall ecological health of the Klamath River and the physical, cultural, and economic health of the Klamath Basin Tribal communities. The fundamental goal of this project must be the overall restoration of Tribal-specific Beneficial Uses of Klamath River Basin and related fisheries and cultural resources.

California State Water Resources Control Board

The proposal from the Tribes resulted in a final scope of work for the EJ project prepared by the State Water Resources Control Board:

Scope of Work for Klamath River Watershed

Environmental Justice Pilot Project

August 16, 2006

The Klamath River is a valuable ecological resource to the states of California and Oregon. For the tribes of the Klamath, the river is the foundation of tribal culture, spirituality, subsistence, and traditional and contemporary economy. The Klamath River

Basin also provides important spawning habitat for Chinook Salmon and other fish species.

The Klamath River is in a state of decline, in which impaired flows, disease, toxic algal blooms and diminished habitat have led to loss of the anadromous fishery and significant impact to the lives, economy, health and traditions of the Klamath River tribes.

These impacts to the Klamath River have also had a significant affect on salmon fishing and have led Governor Schwarzenegger, on June 6, 2006, to declare a state of emergency for Chinook Salmon in the Klamath River Basin. The disaster declaration states, in part:

> WHEREAS Klamath River Basin Chinook Salmon have been significantly impacted by poor ocean conditions, drought, water management, water quality, water flows, disease, and the elimination of access to historical spawning habitat; and
>
> WHEREAS restoration of habitat and improved water quality and flows are critical to restoring an environment suitable to the long-term sustainability of the Klamath River Basin Chinook Salmon and other anadromous fish species; and
>
> NOW, THEREFORE, I, ARNOLD SCHWARZENEGGER, Governor of the State of California, find that conditions of disaster or of extreme peril to the safety of persons and property exist within the California counties of Monterey, Santa Cruz, San Mateo, San Francisco, Marin, Sonoma, Mendocino, Humboldt, Del Norte, and Siskiyou due to the poor ocean conditions, drought, water management, water quality, water flows, disease, and the elimination of access to historical spawning habitat and resulting from the significant restrictions that have been imposed on the State's salmon fisheries. Because the magnitude of this disaster will likely exceed the capabilities of the services, personnel, and facilities of these counties, I find these counties to be in a state of emergency, and under the authority of the California Emergency Services Act, I hereby proclaim that a State of Emergency exists in these counties.

The decline of the salmonid fishery in the Klamath River has altered the diet of each of the tribes along the river and its tributaries. For example, traditional consumption of fish by the Karuk tribe was historically estimated at 450 pounds per person per year, while in 2003 the Karuk people consumed less than 5 pounds of salmon per person, and in 2004 less than ½ pound per person was consumed.

The Klamath River Basin is home to the largest population of Native Tribes in California. Tribal groups depend on the Tribal Trust species of the Klamath River for subsistence fishing purposes. The Trust species include, but are not limited to: Coho Salmon, Chinook Salmon, Steelhead Trout, Pacific and non-anadramous Lamprey Eel, Sturgeon, and Eulachon. Sufficient numbers of Trust species must be maintained to sustain the primary dietary needs of the Klamath Basin Tribes. The federal allocation of salmon fishery to the Klamath Basin Tribes is 50% of the total available harvest. (50 CFR 661).

Sufficient habitat and suitable water quality is necessary to provide numbers of Tribal Trust species adequate to support the dietary needs of the Klamath River Basin tribal members.

The decrease in abundance and availability of traditional foods, including the Tribal Trust species, is responsible for many diet related illnesses among Native Americans including diabetes, obesity, heart disease, tuberculosis, hypertension, kidney troubles and strokes. These conditions result from the lack of nutrient content specific to traditional foods such as salmon, as well as from the decrease in exercise associated with fishing and gathering food. The estimated diabetes rate for the Karuk Tribe is 21%, nearly four times the U.S. average and the estimated rate of heart disease for the Karuk Tribe is 39.6%, three times the U.S. average.

The destruction of the Klamath River fishery has led to both poverty and hunger. Prior to contact with Europeans and the destruction of the fisheries, the Karuk, Hoopa and Yurok tribes were the wealthiest people in what is now known as California. Today they are amongst the poorest. This dramatic reversal is directly linked to the destruction of the fisheries resource base.

The devastation of the resource base, especially the fisheries, is also directly linked to the disproportionate unemployment and low socio-economic status of Karuk people today. Before the impacts of dams, mining and over fishing the Karuk people subsisted off salmon year round for tens of thousands of years. Now poverty and hunger rates for the Karuk Tribe are amongst the highest in the State and Nation. The poverty rate of the Karuk Tribe is between 80 and 85%. The poverty rate is even higher for tribal members living in Siskiyou County (Norgaard 2005 Exec Summary).

The degradation of these uses threatens the very existence of these tribes. Restoration and protection of these uses is essential to preserve the health and culture of the Tribes.

Pierce, 2002 (p.7-2) states:

Salmon are food, culture, and religion to the Klamath River tribes. Religion, lore, law, and technology all evolved from the Indians relationship with the Salmon and other fish of the Klamath River Basin. The Supreme Court has recognized the importance of salmon to the Northwest Tribes such as those in the Klamath River Basin, concluding that access to the fisheries was not much less necessary to the existence of the Indians than the air they breathe.

Dr. Thomas King and Klamath Riverscape

In 2004, anthropologist Thomas King conducted a study of the Klamath Riverscape in a report entitled *First Salmon.* This study evaluated the Klamath River as a Traditional Cultural Property and Cultural Riverscape for its potential eligibility for inclusion on the National Register of

Historic Places for the Klamath River Inter-Tribal Fish and Water Commission. In this report, Dr. King also evaluates the proposed re-licensing of the Klamath Hydro-Electric Project under a range of federal environmental laws. In his evaluation of Environmental Justice Executive Order 12898 he concludes:

> Executive Order 12898 on "environmental justice" calls upon Federal agencies to do what they can to prevent disproportionate adverse environmental impacts on low income and minority populations. The tribes – both those that are federally recognized and those that are not – constitute such populations.
>
> Guidance from the Council on Environmental Quality, Environmental Protection Agency, and Department of Justice indicates that agencies are to comply with Executive Order 12898 by identifying low income and minority communities that might be affected by their actions, by involving such communities in their environ mental review work, and by working with such communities to identify and, if possible, avoid or mitigate disproportionate adverse effect on aspects of the environ ment that affect or are important to low income and minority people. In the case of the Klamath Riverscape, all the tribes (both federally recognized and non-recognized) are minority communities, and probably low-income as well.
>
> It is evident from the preceding discussion that the dams contribute to a pattern of cumulative effects on the cultural values and interests of the tribes – aspects of the environment that are of great importance to them. This would be the case even if the Klamath Riverscape were found ineligible for the National Register, because whatever the significance of the riverscape in the eyes of the National Register, to the tribes it is utterly central to their cultural identity.
>
> This being the case, it is equally evident that the effects of the dams, together with the other contributors to the Klamath's plight, fall disproportionately on the tribes. While others live within the riverscape, travel through it, fish in it and hunt in it, only the tribes have an intimate cultural connection to the riverscape going back to time immemorial. Only to the tribes is the riverscape the core of their cultural identity. Maintaining and reinforcing this association is particularly important today, as the tribes work to reestablish their traditional belief systems and ways of life.

Yurok Comments on FERC EIS

In 2006 the Yurok Tribe provided extensive data and comments on the Draft EIS prepared by the Federal Energy Regulatory Commission (FERC) on the Klamath Hydro-Electric Project Relicensing Application filed by Pacificorp. Portions of these formal comments filed by the Yurok Tribe related to Environmental Justice issues and the inadequacy of the socio-economic analysis in the DEIS. Excerpts from these comments are provided in the remaining pages of this Chapter.

Socioeconomic Resources

A legitimate socioeconomic impact assessment of the Klamath Hydroelectric Project and current conditions must determine how the proposed *federal action* affects the lives of current and future residents of the impacted area. PacifiCorp selected a 5-mile and 50-mile corridor as the study areas identifies for analysis under the National Environmental Policy Act (NEPA), which effectively diluted the representation of Tribes that live on the Klamath River and its tributaries and distorted the impact the Klamath Hydroelectric Project has on those Tribes. A socioeconomic impact assessment must evaluate the impacts of the proposed *federal action* on low-income and minority populations. The analysis of impacts on low-income and minority populations must address both specific/direct and cumulative effects of the project on the populations' demographics, employment, income levels, aesthetic environments and community-specific social, health, and economic conditions. The FERC EIS failed to adequately assess or consider any of those criteria, particularly for their impacts on the Yurok Tribe, Yurok Indian Reservation, or other Native American tribes within the basin and watershed.

The National Environmental Policy Act mandates that the Lead Agency follow a valid, established, and legitimate scientific assessment and process for insuring NEPA compliance and considering the impacts and cumulative effects of the proposed federal action and any alternatives. Section 4332 of NEPA states:

The Congress authorizes and directs that, to the fullest extent possible: (1) the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this chapter, and (2) all agencies of the Federal Government shall -

(A) utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decisionmaking which may have an impact on man's environment;

(B) identify and develop methods and procedures, in consultation with the Council on Environmental Quality established by subchapter II of this chapter, which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decisionmaking along with economic and technical considerations;

(C) include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on -

(i) the environmental impact of the proposed action,
(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,
(iii) alternatives to the proposed action,
(iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

The NEPA process is intended to promote excellent decision-making by federal agencies. It is intended to be interdisciplinary in scope. It requires compliance with all applicable federal and state laws. The Lead Agency cannot make any determination concerning compliance with federal and state laws if the necessary data have not been collected, and the necessary studies have not been conducted. The FERC EIS was fatally flawed because it did not contain the data necessary to identify and assess compliance with state and federal laws based on the Klamath Hydroelectric Project's effects on Native American tribes, reservation communities, and tribal trust resources.

The federal government, specifically those federal agencies involved in the preparation of the Secretarial Determination Overview Report and the associated NEPA analysis being conducted for the current proposed action, must fulfill its responsibilities under NEPA and to federally recognized Indian Tribes, especially to the Yurok Tribe; a tribe that has been undergoing active social, cultural, economic, and political restoration as a result of the Tribe's reorganization following the Hoopa-Yurok Settlement Act of 1988.

In 2006, out of concern over the lack of a legitimate socioeconomic analysis of the dams' impacts on Native American communities, the Yurok Tribe conducted a preliminary socioeconomic survey. The Tribe performed this survey as a preliminary way of identifying some of the potential socioeconomic impacts of the Project on the Yurok people. Because the Tribe recognizes the significance of these issues and understands the need for the Department of the Interior to have sufficient reliable information necessary to make a balanced and informed analyses under NEPA and for the Secretarial Determination Overview Report, the Tribe is providing key data and findings from this 2006 study in this report. Some of the key findings of this study, The Yurok Tribe's *Healthy River, Healthy People Traditional Foods Survey* are presented in the following comments. As these data and analyses will show, the FERC's socioeconomic data and analyses as presented in the Final EIS were biased and misrepresented or ignored socioeconomic impacts of the Klamath Hydroelectric Project on the Yurok Tribe, and Native American communities in general. This analysis was also submitted to the FERC in formal comments submitted by the Yurok Tribe on the Draft EIS to the formal FERC record in a separate filing. This 2006 study and the following data and findings have direct bearing on the Secretarial Determination Overview Report and the NEPA analysis currently underway. It is being submitted to the Bureau of Indian Affairs (BIA) due to its relevance and bearing on issues of tribal trust responsibilities of the federal government and its agencies.

Executive Order 12898 on Environmental Justice requires all federal agencies to consider the impacts of their actions on low-income and minority populations. Native American communities and Tribes are by all definitions low-income and minority populations. Federal and state laws, statutes, and government policies on Environmental Justice (EJ) that must be considered in the current NEPA and CEQA analysis and the Secretarial Determination Overview Report also include:

Federal Environmental Justice:

- Constitution of the United States;
- Title VI of the Civil Rights Act of 1964 (42 USC sec. 2000 et seq.) -Non discrimination in programs with Federal Funds;
- 40 CFR 7.35 (No disparate impacts from programs with Federal funds); and
- Executive Order 12898 (Established Federal EJ program).

State Environmental Justice:

- California State Constitution;
- Government Code section 65040.12 (Definition of EJ and designation of OPR as coordinating agency for EJ);
- Government Code section 65040.2 (requiring OPR to develop EJ guidance for General Plan); and
- Public Resources Code § 71110 et seq. (Established CA EJ program).

California Public Resources Code § 71110 et seq:

> 71110. The California Environmental Protection Agency, in designing its mission for programs, policies, and standards, shall do all of the following:
>
> (a) Conduct its programs, policies, and activities that substantially affect human health or the environment in a manner that ensures the fair treatment of people of all races, cultures, and income levels, including minority populations and low-income populations of the state.
>
> (b) Promote enforcement of all health and environmental statutes within its jurisdiction in a manner that ensures the fair treatment of people of all races, cultures, and income levels, including minority populations and low-income populations in the state.
>
> (c) Ensure greater public participation in the agency's development, adoption, and implementation of environmental regulations and policies.
>
> (d) Improve research and data collection for programs within the agency relating to the health of, and environment of, people of all races, cultures, and income levels, including minority populations and low-income populations of the state.
>
> (e) Coordinate its efforts and share information with the United States Environmental Protection Agency.
>
> (f) Identify differential patterns of consumption of natural resources among people of - different socioeconomic classifications for programs within the agency.

The socioeconomic analysis in the FERC EIS failed to present any evidence of tribal consultation in the NEPA process by the FERC on Project impacts on the Yurok Tribe. The relationship between the United States and Indian tribes is defined by treaties, statutes, and

judicial decisions. Indian tribes have various sovereign authorities, including the power to make and enforce laws, administer justice, and manage and control their lands and resources. Through several Executive Orders and a Presidential Memorandum, departments and agencies of the Executive Branch have been directed to consult with federally recognized Indian tribes in a manner that recognizes the government-to-government relationship between these agencies and tribes. In essence, this means that consultation should involve direct contact between agencies and tribes, in a manner that recognizes the status of the tribes as sovereign governments. Some applicable statutes on the federal responsibility regarding government-to-government consultation with Tribes include:

- Executive Order 13175, Consultation and Coordination with Indian Tribal Governments (issued November 6, 2000);
- Executive Order 13084, Consultation and Coordination with Indian Tribal Governments (issued May 14, 1998);
- Presidential Memorandum, Government-to-Government Relations with Native American Tribal Governments (issued April 29, 1994), reprinted at 59 Fed. Reg. 22,951; and
- Executive Order 12875, Enhancing the Intergovernmental Partnership (issued October 26, 1993).

In order for the Lead Agency, the BIA, or the Secretary of the Interior to make an accurate and valid determination of the current conditions on tribal trust resources, it must engage in meaningful consultation with Tribes, particularly on the design and implementation of research used to identify and assess Project impacts on tribal communities, tribal governments, tribal economies, and reservation communities. As the final FERC EIS illustrates, this consultation has yet to occur. Further, the socioeconomic analysis in the EIS makes it evident that PacifiCorp failed to make a valid or defensible effort to assess Project impacts on the Yurok Tribe, the YIR, and the Yurok People who have born the disproportionate costs of the Klamath Hydroelectric Project in the loss of many tribal trust resources, tribal trust species, cultural, traditional and ceremonial resources, traditional subsistence resources, and other significant tribal trust resources on which the Yurok Tribe relies for its survival, restoration, and recovery from more than one hundred years of cultural genocide, racism, oppression, and injustice that continues to affect the Tribe through the present-day.

Restoration of the Klamath River, its species and its fishery is an appropriate first step to begin to mitigate the decades of trauma and injustice inflicted upon Klamath River tribes, and the Yurok Tribe in particular. In fact, the Klamath Watershed is one of the few areas where that which was taken from the Yurok people can be restored. Klamath River and Basin Tribes have historically paid, and continue to pay the highest, and most adverse social, cultural, and economic costs for the Project. The failure of the FERC EIS to address these disproportionate impacts on tribal communities invalidates some of the conclusions in the FEIS. Therefore, the BIA cannot simply rely upon the FERC EIS findings specific to Environmental Justice and Tribal Trust issues.

Affected Environment

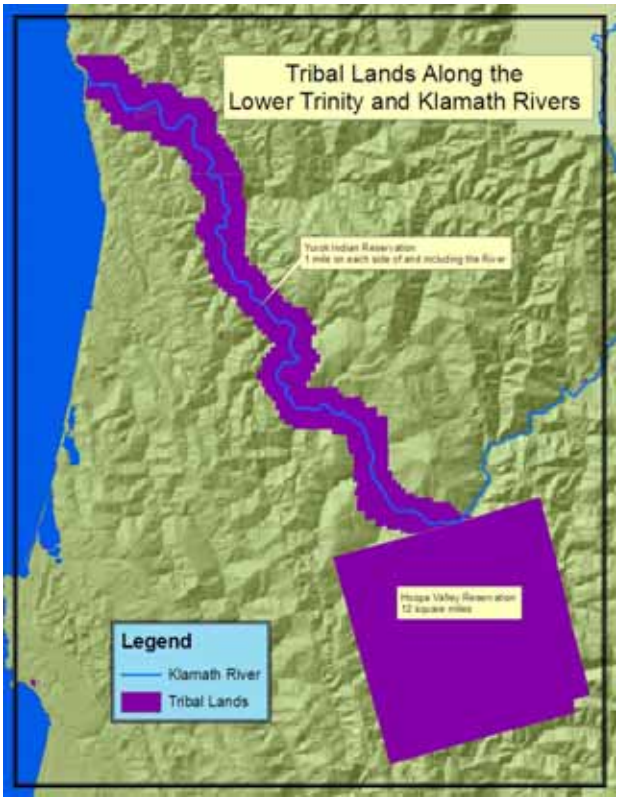
Yurok ancestral territory lies entirely within Humboldt and Del Norte Counties. The aboriginal territory used by the Yurok Tribe extended into adjacent counties. Today, the Yurok Indian Reservation (YIR) encompasses one mile on either side of the Klamath River from the Mouth at the Pacific Ocean upstream 45 miles, extending though both Del Norte and Humboldt counties. As demonstrated in the previous Yurok Tribe submissions (Sloan 2003, Gates 2003, King 2004) to the FERC, the center of Yurok culture and life has always been, and continues to be, the Klamath River. The Klamath River is the common thread that unites and connects all Klamath River Basin Tribes, in spite of distinct histories, cultures, languages, and governments.

The Yurok relationship to the Klamath River has been well-documented for the purposes of evaluating current conditions and potentially effected tribal trust resources (Sloan 2003). Abundant data exist within peer reviewed and published literature that document the Yurok reliance on the Klamath River and its abundant resources for their cultural, spiritual, economic, and political survival and for their prosperity and well-being. Information on this data (archival, historical, primary, and ethnographic documents as well as academic studies and peer-reviewed literature) have already been provided to PacifiCorp and the FERC, yet none of this information was utilized in the Final EIS. The FERC EIS failed to adequately acknowledge the previous submissions to the FERC that address the socioeconomic and cultural impacts on the Yurok Tribe resulting from the operations of the Klamath Hydroelectric Project, particularly the impacts on those tribal members who live within Yurok ancestral territory. Furthermore, the EIS mischaracterized the demographic and economic realities of Native American communities within the Klamath River Basin and watershed, the impact of the loss of the Tribe's subsistence and commercial fishery on the tribal and reservation communities and economies, and the significance of the Klamath River and the health of the Klamath River ecosystem to the past, present, and future of Yurok People.

The BIA and the Secretary of the Interior need to address the fact that the current conditions of the Klamath Hydroelectric Project have had a disproportionate and adverse impact on those Native American communities that have always relied, and continue today to rely upon the Klamath River. Executive Order 12898 on Environmental Justice directs all federal agencies to consider the impacts of their actions on low-income and minority populations. Furthermore, California Environmental Justice law requires that California agencies consider the impacts on differential rates of consumption for low-income and minority communities. The FERC EIS failed to accurately portray or assess the impacts and cumulative effects of the Project on Native American tribes, low-income and minority communities that rely upon the Klamath River and its resources for their subsistence, culture, spiritual traditions and practices, and local economies. These tribal communities experience significantly higher rates of food insecurity, poverty, and unemployment than non-Indian communities within the counties included in the study area (Fig.1-5). The FERC must consider the impacts of the Project, and any application for continued operations, on the Yurok Tribe, especially the impacts on Tribal Members

residing on the Reservation and within the two counties (Humboldt and Del Norte, CA) that contain the Yurok Ancestral Territory.

PacifiCorp did not provide adequate data or analysis for the FERC to make an accurate assessment on the determination of the affected environment. It is the position of the Yurok Tribe that PacifiCorp and the FERC did not adequately fund or conduct the necessary socioeconomic impact assessments, environmental justice analyses, cultural resources studies, or cumulative effects analyses and as a result, the information provided to the FERC by PacifiCorp was both flawed and misleading and resulted in inadequate analysis in the Final FERC EIS. It is the responsibility of the Department of the Interior, specifically the Secretary of the Interior to consider these omissions and following data in the final assessment that will lead to the Secretarial Determination for the current proposed action to remove the dams and implement the Klamath Basin Restoration Agreement (KBRA) and the Klamath Hydroelectric Settlement Agreement (KHSA).



The BIA is evaluating the effects of current conditions and the proposed Action (to remove the dams and implement the KBRA and KHSA) on tribal trust resources and the federal government's trust responsibility to the effected federally recognized Indian Tribes. The Yurok Tribe has maintained and continues to maintain that impacts of the Klamath hydroelectric Project dams extend downstream of the dams to the Klamath River mouth at the Pacific Ocean and beyond. For the Yurok Tribe, the affected environment is the Tribe's ancestral territory as well as those areas within the external boundaries of the YIR. The federal government has a trust responsibility for reservation and non-reservation trust lands; all of which are lands held in trust for the Tribe by the US Department of Interior. The FERC EIS and PacifiCorp failed to recognize the unique status of the Yurok Tribe, whose reservation occupies both sides of the Lower Klamath River (part of PacifiCorp's 'downstream subregion'), a region that suffers the cumulative adverse effects of everything that occurs upstream in the watershed. The FERC EIS failed to assess these impacts, or even acknowledge the overwhelmingly disproportionate adverse effects upon Yurok Tribe and its members. The FERC EIS not only failed to do this, but relied entirely on information provided by PacifiCorp that appears to be presented in an attempt to deliberately mask the socioeconomic realities of the YIR and

the Yurok Tribe and to avoid addressing the Project impacts on the Tribes within the region. The economic conditions on the Reservations in the downstream subregion are significantly worse compared to those in the downstream counties; likewise, Tribes suffer significantly greater poverty and food insecurity than the surrounding non-Indian communities in the downstream subregion. Thus, economically disadvantaged Native American communities have born the disproportionate socioeconomic costs of the Project resulting in the decline of the fishery and the decline or loss of numerous traditional cultural species resulting from altered riparian conditions caused by the Klamath Hydroelectric Project dams and current conditions.

Demographic Characteristics

The FERC EIS failed to consider the historical, cultural and economic geography of *tribal lands* within the Klamath Watershed. By using five- and fifty-mile corridors, the analysis offered by PacifiCorp diluted the representation of Tribes. Further by using county, city and census-designated-place data to describe the economic context of the project, the FERC EIS grossly underestimated the levels of unemployment, poverty and food insecurity in Indian Country—conditions that increased abundance of salmon and other fish species would *directly* ameliorate through increased subsistence and commercial harvests. The FERC EIS did not include data that included the socioeconomic and cultural impacts of the Klamath Hydroelectric Project on Tribes and Tribal Lands within the PacifiCorp-designated downstream five-mile corridor, nor was any economic, social or cultural justification given for using a five-mile corridor in their socioeconomic analysis. Given that both downstream and upstream Reservations are immediately adjacent to the Klamath River and its tributaries, it difficult to understand why an analysis of the socioeconomic impacts of the Klamath Hydroelectric Project on the Tribes, Reservations and Trust Lands was missing from the FERC EIS, even though it was provided to the FERC in formal comments on the Draft EIS in 2006.

The earliest historic accounts of non-Indian encounters with the *Poh-lik-lah*, the Down-River-People, the name the Yurok People used for themselves, document in great detail the elaborate cultural, spiritual, subsistence, and economic importance of the Klamath River and its abundant species of salmon, steelhead, pacific lamprey, eulachon, and sturgeon to the Tribe. As previously summarized in the Sloan (2003) Ethnographic Inventory, the Klamath River has always been the center of Yurok life and culture. This traditional life and culture continues today, in spite of the economic, social and cultural dislocation that the Tribe has experienced over the past 150 years. Yurok People continue to live, pray, practice, fish, and rely upon the Klamath River. The Yurok culture or Tribal Members' desire to continue a traditional way of life persist, but the loss of economic viability as a result of dramatically declining fish populations threatens the ability of the Yurok Tribe to continue practicing their traditions.

The FERC EIS failed to adequately address the socioeconomic impacts of the loss of the commercial fishery on the Yurok Tribe, but also fails to adequately assess the socioeconomic impacts resulting from the decline of a viable subsistence fishery. The Yurok Tribe is submitting this data to illustrate the importance of the subsistence fishery

to the Yurok Tribe, particularly for those living on the YIR and within Humboldt and Del Norte Counties. Loss of an abundant and reliable subsistence harvest compounds the extremely high levels of food insecurity experienced within these Yurok communities (Fig. 10).

Employment data and analysis used in the Secretarial Determination Overview Report and associated NEPA and CEQA analysis currently underway must clearly identify the data specific to the Yurok Tribe, the YIR, and other Native American communities within the Klamath River Basin. Tribe-specific data should then be compared against the county and state employment data. Because county-specific data for Tribes is not available in the US 2000 Census[4], these county-specific data will need to be collected before any appropriate analysis can be performed. Using available Tribal, BIA Labor Force, and Census data, the Yurok Tribe Environmental Program performed a preliminary analysis of the economic conditions of Tribes and reservations in the downstream subregion to illustrate the disparity between tribal communities and non-Indian sectors within the 5-mile corridor. Although the Yurok Tribe experiences adverse and disproportionate impacts from the current operations, data and analysis fail to address the impacts of the Project on downstream tribal communities who rely on a healthy fishery for their subsistence, cultural, spiritual, and economic survival and prosperity. The FERC EIS used county, city and census-designated-place data while ignoring the cognate 2000 census data available for reservations and non-reservation trust lands. There is no excuse for excluding sources of data on affected Tribes, such as the data from the 2000 US Census, from this analysis or any analysis currently underway for determining the effects of current conditions on the Yurok Tribe or Yurok trust resources. The Secretary and the BIA must consider the data submitted in the following sections in its analyses and reports. The current analysis must accurately capture and evaluate the very real and cumulative adverse impacts of the Klamath Hydroelectric project on Yurok Trust resources and the Yurok people.

Population, Race and Ethnicity

The 2000 Census data on demography, race and ethnicity for the 'downstream' Reservations (Yurok Indian Reservation or YIR and Hoopa Valley Indian Reservation or HVIR) paint a very different portrait than the one offered by the FERC in the final EIS for the downstream subregion. Not surprisingly, 75% of the population living within these lands is designated by the 2000 U.S. Census as "American Indian alone or in combination with one or more other races"[5]. Population growth rates for the region are also distinct; based on data from the 1990 and 2000 US Census, the population of the two reservations grew by an average 46%—a significantly higher growth rate than those cited for the downstream subregion within the EIS[5,6].

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[4] US Census Bureau, 2006 Letter, Question Reference #061117-000054, copy available upon request

5 U.S. Census Bureau, Census 2000 American Indian and Alaska Native Summary Profile of Selected General Demographic Characteristics 2000 http://factfinder.census.gov/servlet/QTTable?_bm=y&-reg=DEC_2000_SFAIAN_DP1:20A|69A;&-qr_name=DEC_2000_SFAIAN_DP1&-ds_name=DEC_2000_SFAIAN&-geo_id=01000US&-_lang=en&-format=&-CONTEXT=qt

6 U.S. Census Bureau, Census 1990 Census Summary Tape File 1 (STF 1) – 100 percent data; http://factfinder.census.gov/servlet/DatasetMainPageServlet?_lang=en&_ts=182194946578&_ds_name=DEC_1990_STF1_&_program=

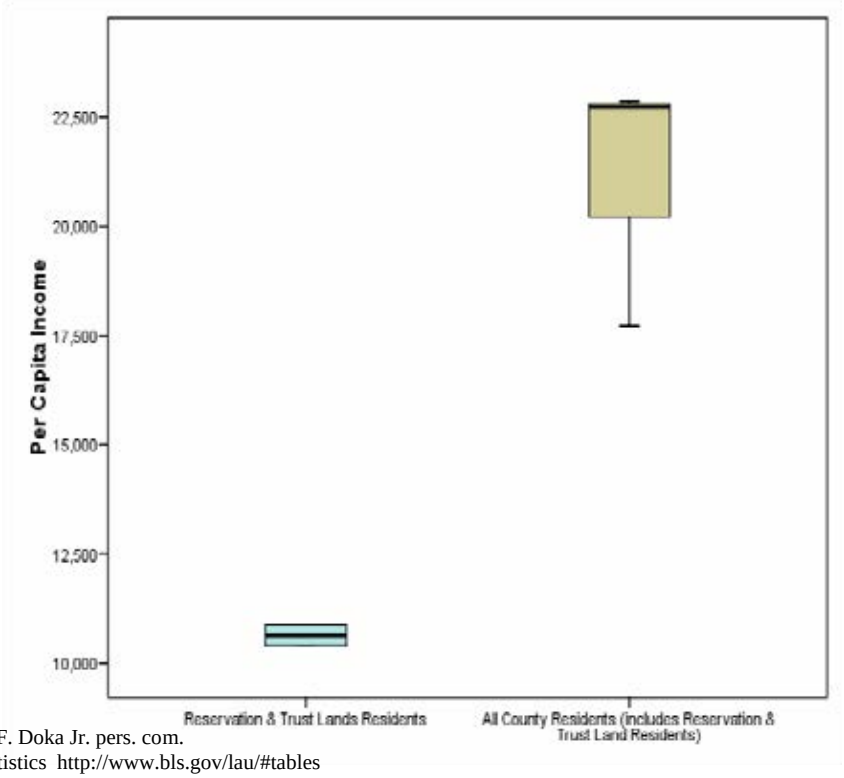
Economic Sectors

The FERC EIS failed to accurately portray the political and economic realities of tribal governments and Indian reservations. Tribal and reservation economies are unique and specific to each tribe, often operating as closed or semi-closed economic entities independent of state or county economic trends. PacifiCorp and the FERC failed to evaluate the socioeconomic impact of the Project on tribal and reservation communities within the 5- and 50-mile corridors even though there are six (i.e. Klamath Tribes, Quartz Valley Indian Tribe, Karuk Tribe, Hoopa Tribe, Yurok Tribe and Resighini Rancheria) federally recognized Indian Tribes with recognized tribal governments and within these corridors. Socioeconomic impacts of the Project on the Yurok Tribe and other federally recognized Indian Tribes must be evaluated using accurate demographic, economic, social, cultural and epidemiological data for both the YIR and the Tribe as a whole.

The following preliminary analysis was submitted as evidence that the data provided to the FERC by PacifiCorp was incomplete and misleading and resulted in a flawed analysis in the FEIS.

Employment and Income

The Tribes that live on the Klamath River have suffered and continue to suffer major losses of cultural, subsistence and commercial resources. Despite the net job growth cited by the DEIS the unemployment rate of Tribes in the downstream subregion is extremely high and significantly greater than that experienced by the counties in the downstream subregion ($G=66.77$, $p<0.001$). Employment data for 2001 from the BIA[7] indicate that the unemployment rate is 75% for Yurok and 40% for Hoopa Tribal Members. Comparable data for the downstream three counties in 2001 are much lower; Humboldt and Del Norte and Curry County Oregon having 6%, 8.1% and 6.9% unemployment respectively.[8] Likewise, there is significant disparity in the median per capita income between the downstream Reservations and the counties in the downstream subregion (Fig. 3).[9]



7 Unemployment figures for Tribes (not reservation) BIA 2001 F. Doka Jr. pers. com.
8 2001 Unemployment figures for counties Bureau of Labor Statistics http://www.bls.gov/lau/#tables

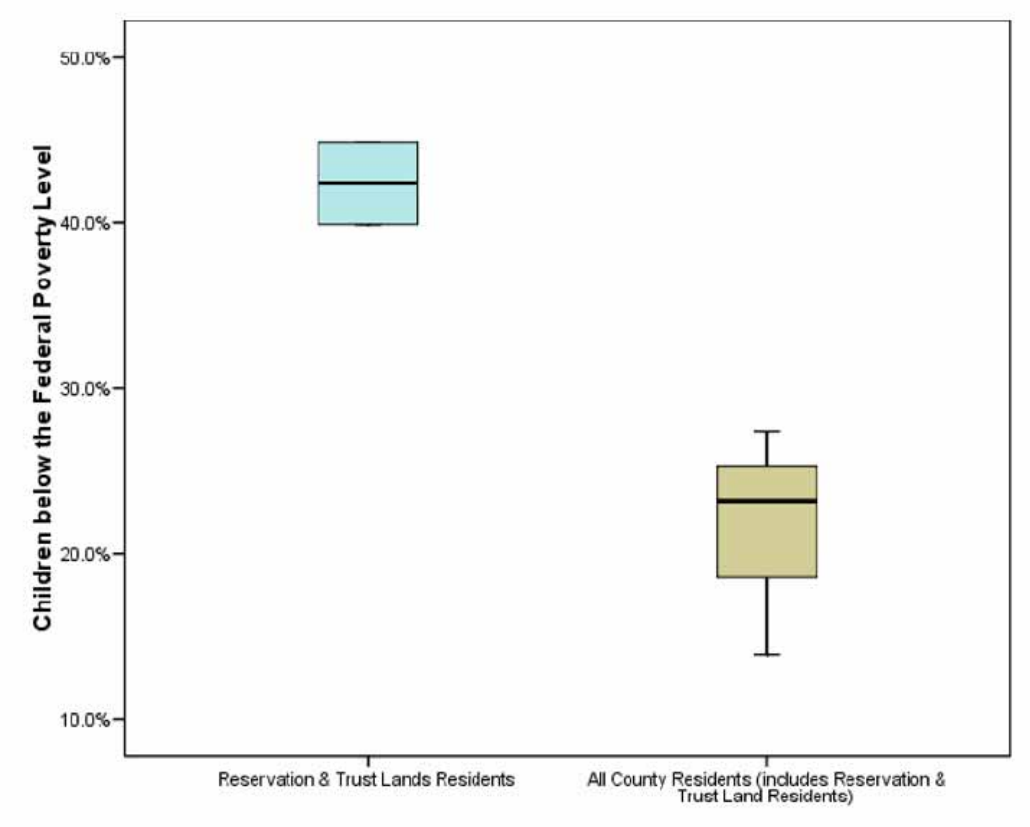
In contrast to the figures reported in the FERC EIS, between 1990 and 2000 people living on the YIR experienced a *net increase* of 59% in employment in the agriculture, forestry, fishing, hunting and mining sector, while the HVIR saw a net decrease of 7% in the same sector comparing data in the 1990 and 2000 US Census. In 2000 this sector employed 10.7% and 6.7% of Yurok and Hoopa Reservation residents respectively. Contrary to the statement in the DEIS that "employment related to recreation and tourism is not separately reported in the census" (p. 3-474), data on employment in the "arts, entertainment, recreation, accommodation and food services" sector are reported for both Reservations in the 2000 US Census. For the YIR this sector provided 18.1% of all employment in 2000, whereas for the HVIR the proportion was lower, at 3.8%.[10]

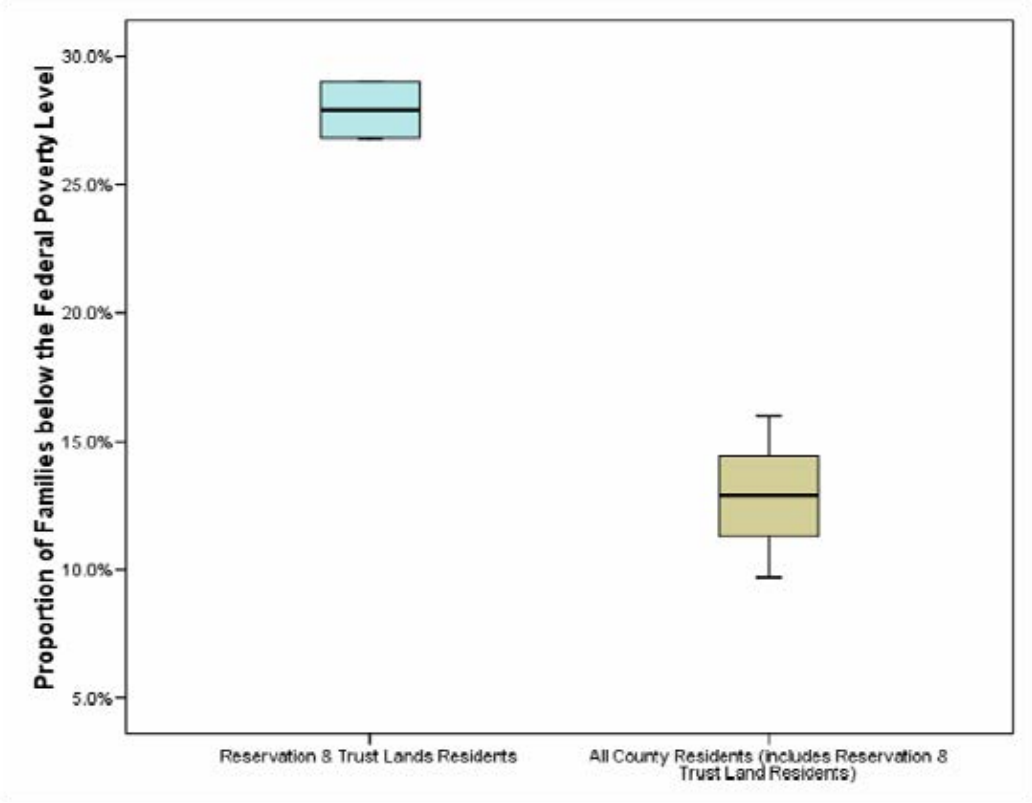
Declining fish stocks have affected all aspects of Yurok life. All the species on which Yurok People depend upon are in decline; largely because of effects the Klamath River Hydro-electric Project has had upon the fishery resource. As noted in Table 3-55 of the DEIS, the Yurok Tribe has had only minimal levels of fall Chinook commercial harvest during four of the past fifteen years. During the remaining 11 years the Yurok Tribal Council determined that the projected abundance of Klamath fall Chinook was insufficient to support a commercial fishery. For the past 15 years, the Yurok Tribe has also forgone commercial harvest of species other than fall-run Chinook (with the exception of minimal numbers of spring Chinook that were harvested during the beginning of the fall Chinook fishery). The Yurok Tribal Council has chosen not to have any commercial fisheries for other species such as spring-run Chinook salmon, Coho salmon, steelhead, lamprey, eulachon and sturgeon because of their concern regarding the status of these other species.

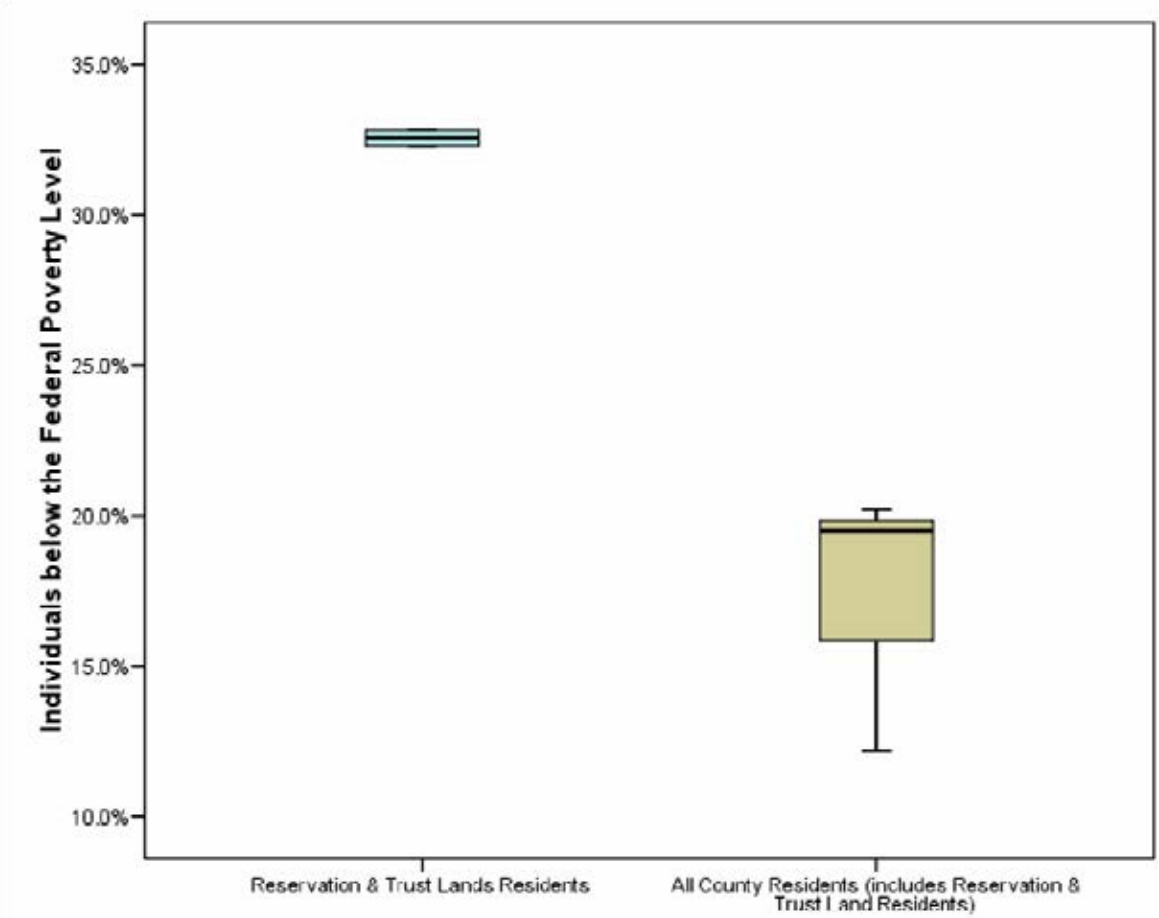
Poverty, inadequate access to traditional foods and resources, high unemployment rates and lack of food security are critical problems for the Yurok Tribe. The 2000 US Census indicates that 27% of families and 33% of individuals living on the Yurok Indian Reservation (YIR) fell below the federal poverty level in 1999[10]. For the Tribe as a whole, irrespective of residence location, the 2000 census data suggest that 20% of families, 25% percent of individuals and 26% of children fell below the federal poverty level[10]. For families with children the situation is worse: 26% of families with children under the age of eighteen and 32% of families with children under the age of five were below the federal poverty level in 1999 and 38% of Yurok families with a female head of household and no husband present fell below the federal poverty level in that year[10].Figures four through six, compare the proportion of children, families and individuals living on the downstream Reservations with children, families and individuals living in the surrounding counties the downstream subregion living below the federal poverty level in 1999; in all cases, significantly greater proportion of children, families

9 U.S. Census Bureau Census 2000 DP-3: Profile of Selected Economic Characteristics: 2000 Data Set: Census 2000 Summary File 3 (SF 3) - Sample Data, Geographic Areas: Humboldt & Del Norte County, California, Curry County, Oregon.
10 U.S. Census Bureau, Census 2000 American Indian and Alaska Native Summary Profile of Selected General Economic Characteristics 2000 http://factfinder.census.gov/servlet/QTTable?_bm=y&-reg=DEC_2000_SFAIAN_DP3:20A|69A;&-qr_name=DEC_2000_SFAIAN_DP3&-ds_name=DEC_2000_SFAIAN&-geo_id=01000US&-_lang=en&-format=&-CONTEXT=qt

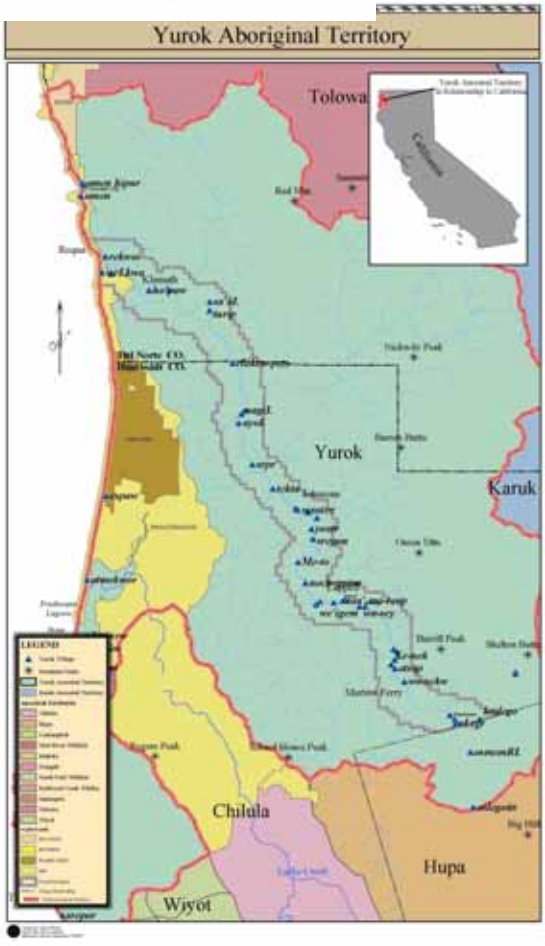
and individuals living on the downstream Reservations fall below the federal poverty limit than do the children families and individuals living in the downstream counties (chi-square, $p<0.001$, in all cases).[9,10]




Proportion of Families below the Federal Poverty Level
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
Reservation & Trust Lands Residents
All County Residents (includes Reservation & Trust Land Residents)



In 2006 the Yurok Tribe circulated a survey to determine the impact of the deteriorating health of the Klamath River on the health and wellbeing of Tribal Members. The *Healthy River, Healthy People, Traditional Foods Survey* collected data on access to traditional resources, economic status, medical conditions and the influence of water quality on Tribal Members health and wellbeing. The survey was only sent to adults (i.e. individuals 18 years of age or older) and response rate was >12%. 56% of respondents lived within the Ancestral Territory (Fig. 7) and 44% lived elsewhere. There were no significant differences in age or sex between the respondents living in the Ancestral Territory and those living elsewhere



(F=0.99, p=0.32, G=0.44, p=0.51, respectively). Regardless of where they live, the majority of respondents consider the Ancestral Territory in general, and the Klamath River in particular, home. It has been less than two hundred years since the Yurok Tribe was displaced from the Ancestral Territory and the Yurok continue to rely on the Klamath River and its abundant resources for their cultural, spiritual, economic, and political survival and for their prosperity and wellbeing and so the Klamath River is home.

I was born and raised on the River. My life is woven with the river and its fish and people. If the River is sick, so am I. So are we all, because it is our spirit and strength. It is not the simple fact of eating healthy food from the River that is important… It is the knowing in my mind, heart and spirit that the River itself is whole and healthy. We are merely a reflection of the river, and will never be healthy again until it is.

(Yurok Tribal Member Survey Respondent 2006)

Preliminary analyses of household income data from the *Healthy River, Healthy People, Traditional Foods Survey* are broadly congruent with census data for the Reservation and the Tribe. Data from both the Tribe's Survey and the 2000 US Census indicate that Yurok Tribal members living in Humboldt & Del Norte Counties suffer significantly greater poverty and unemployment compared to the populations of the three counties taken as a whole. A greater proportion of Yurok Tribal Members living within the Ancestral Territory earn less than $10,000 per anum compared to the three counties in the downstream subregion taken as a whole ($G=10.25$, $p<0.01$) (Fig. 8). Significant economic disparities also exist between Tribal Members who remain within the Ancestral Territory and those who reside outside of the Ancestral Territory ($G=23.69$, $p<0.005$) (Fig. 9). The data presented here support the common assertion by Tribal Members that they are forced by economic circumstances to move away from home.

Even though I live in town, I still live and choose to live close enough so I can go to the River whenever I choose. I participate in ceremonies on the River. If it were possible, I would live on the River, to see it and hear it and smell it every day and every night. I will not be completely healthy again until I can look out my front door at night and see the salmon moving up the River as they did when I was a child.

(Yurok Tribal Member Survey Respondent 2006)

Figure 8. Comparison of individuals earning less than $10,000PA in the counties in the downriver subregion with Yurok Tribal Members living in the Ancestral Territory within those two counties who earn less than $10,000 PA.

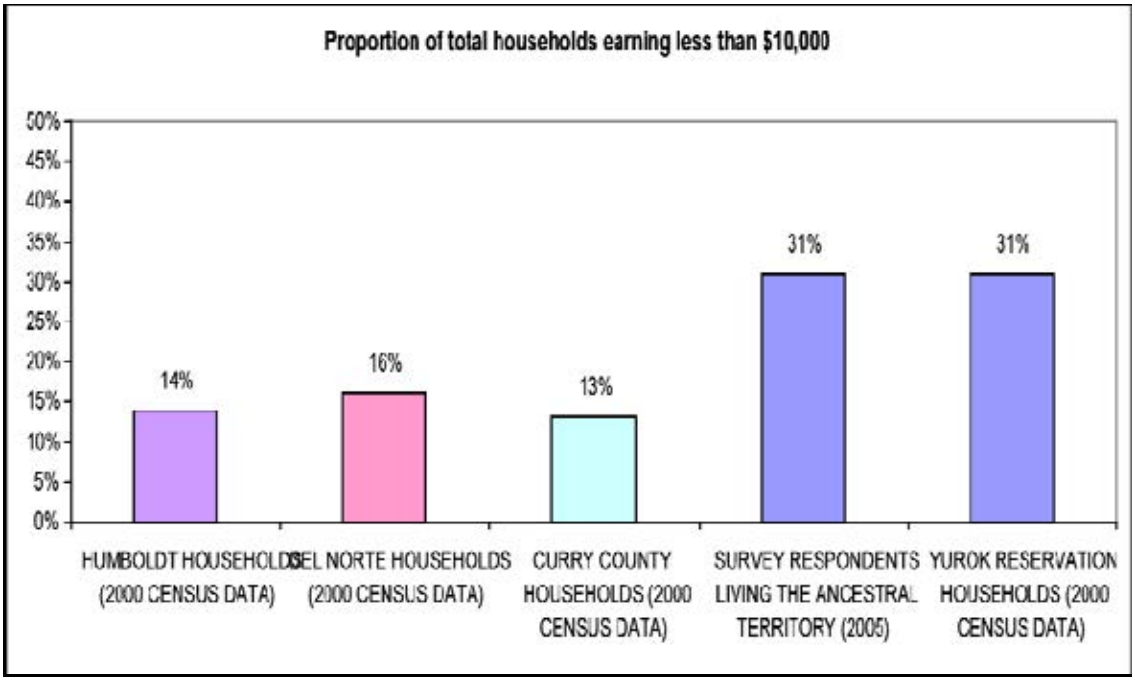
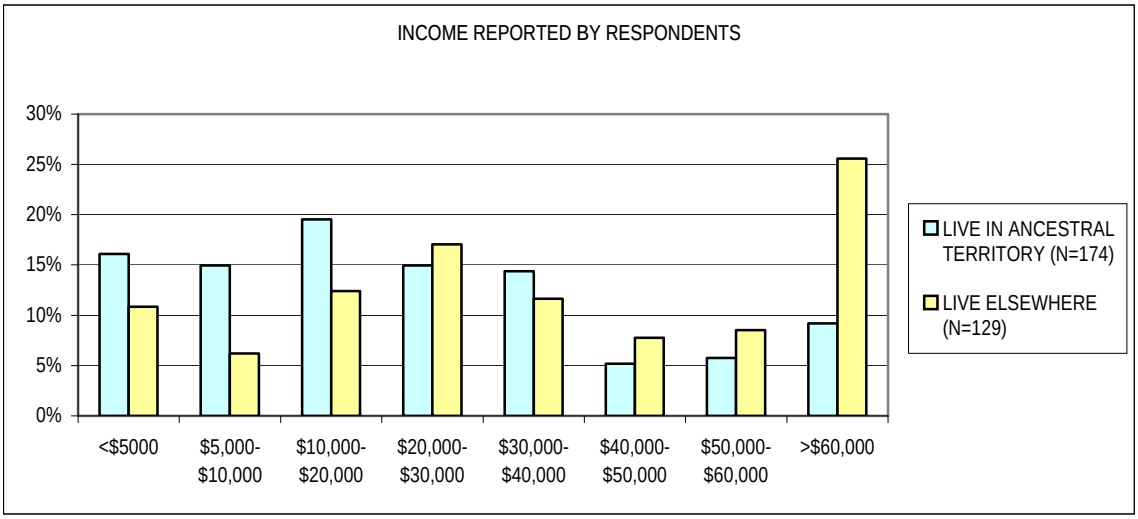


Figure 9. Comparison of income reported by survey respondents living within and outside of the Yurok Ancestral Territory



Similarly, food security continues to pose a significant problem for Tribal members. As defined by Harrison *et al.* in their 2002 UCLA Health Policy Research Brief, families and households in California are food insecure if their income is <200% of the federal poverty level[11]. According to the 2000 US Census, the average size of a Yurok family or household is three persons.[12] If we assume that the 'average' Yurok family or household in 2006 also consisted of three people, the federal poverty level for that family/household in 2006 is $16,600[13] and 200% of the poverty level for an 'average' Yurok family/household is $33,200. By the definition of food insecurity used by Harrison *et al.* (2002) 57% of Yurok families/households lack basic food security.

Respondents living within the Ancestral Territory are even more at risk: *80% lack basic food security*. The 2000 Census reports that 68% of individuals living on the YIR were below 200% of the Federal Poverty Level in 1999, the survey data suggest that poverty, and with it, food insecurity has increased within the Ancestral Territory during the six years since the census was performed.

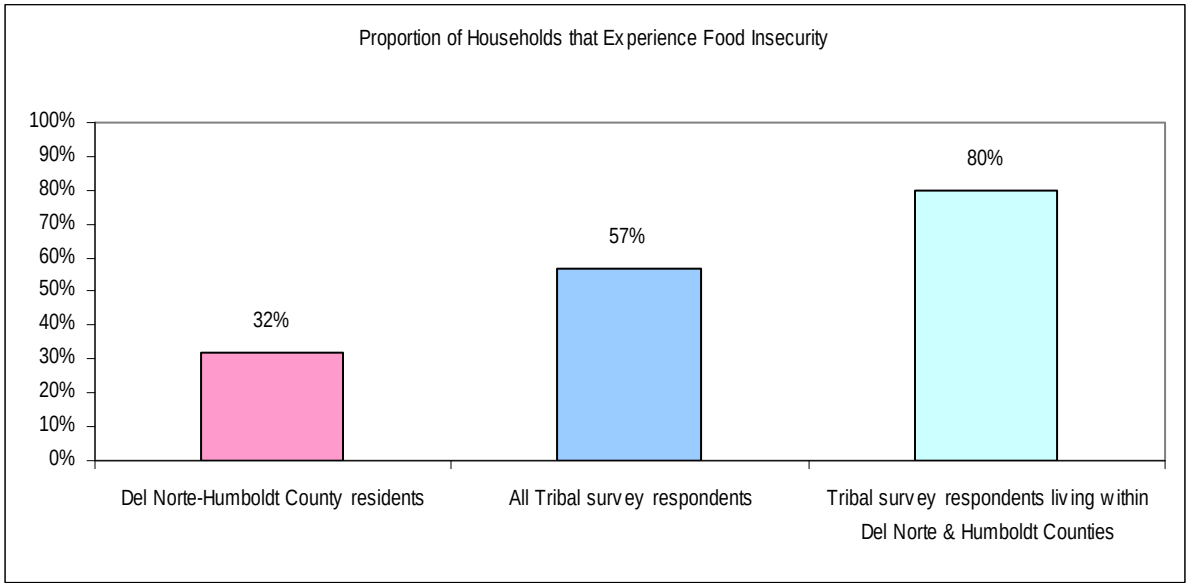
How do Tribal Members compare with the general population living within the Ancestral Territory? The UCLA study analyzed Del Norte and Humboldt Counties, together and found that, as of 2002, 32% of residents were food insecure (Fig. 10). The prevalence of hunger and food insecurity among Yurok Tribal Members residing within the Yurok Ancestral Territory in 2006 is almost three times that reported for the general population of Humboldt and Del Norte Counties in 2002.

11 Harrison, G.G. C.A. Disogra, G. Manalo-Leclair, J. Aguayo, W. Yen. 2002. Over 2.2 Million Low-Income California Adults Are Food Insecure; 658,000 Suffer Hunger. Policy Brief, UCLA Center for Health Policy Research, November 2002. Available online at http://www.healthpolicy.ucla.edu/pubs/files/FoodInsecurity.pdf

12 U.S. Census Bureau, Census 2000 American Indian and Alaska Native Summary Profile of Selected General Demographic Characteristics 2000 http://factfinder.census.gov/servlet/QTTable?_bm=y&-reg=DEC_2000_SFAIAN_DP1:20A|69A;&-qr_name=DEC_2000_SFAIAN_DP1&-ds_name=DEC_2000_SFAIAN&-geo_id=01000US&-_lang=en&-format=&-CONTEXT=qt

13 Federal Register, Vol. 71, No. 15, January 24, 2006, pp. 3848-3849

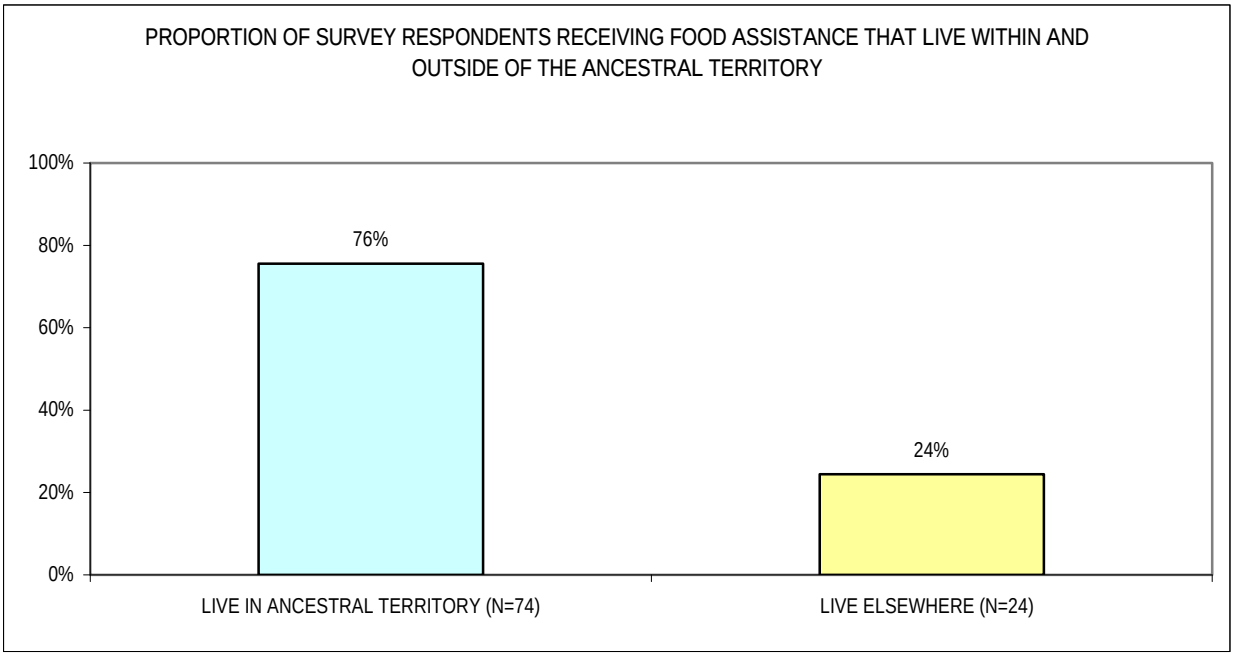
Figure 10. Proportion of households that experience food insecurity, data for Del Norte & Humboldt County residents from Harrison *et al.* 2002[11].



These estimates of food insecurity correlate well with the results of the survey regarding food assistance programs. Survey results indicate that 31% of the 305 respondents who answered the survey questions regarding food security receive some form of food assistance on a regular basis (compared to 57% classified as food insecure above), with the majority of aide going to respondents living within the Ancestral Territory ($G=21.12$, $p<0.001$) (Fig. 11).

This document uses respondents' reports of participation in the federal food assistance programs (Food Stamps, WIC and Commodity Supplemental Foods Program) as a surrogate variable for low income status since eligibility is directly linked to income (130%-185% of the federal poverty level). Because all individuals who are eligible for food assistance do not apply, the numbers used here undoubtedly underestimate the number of low income households within our pool of respondents. Harrison *et al.* (2002) report that, of income eligible persons in California who report hunger, less than 20% of adults participate in the Food Stamp Program and only 66% of hungry, eligible, pregnant women participate in WIC.[11]

Figure 11. Comparison of food assistance between respondents living within and outside the Ancestral Territory.



Historically, Yurok People were able to harvest fish from the Klamath River all year-round. People harvested fall Chinook and Coho salmon during the late summer/fall; steelhead, lamprey and candle fish during the winter and spring Chinook, sturgeon and lamprey during the spring and summer. The decline in these and other river species means that the Yurok People can no longer sustain themselves from the river on a year-round basis. In any community where 80% of the people lack basic food security this loss is ruinous. For the Yurok People who are recovering from more than one hundred years of cultural genocide the loss is catastrophic. Any assessment of the impact of the current conditions on the Yurok Tribe, the federal government's trust responsibility and any impacts of current conditions on tribal trust resources must consider these facts.

Dependence on food assistance and lack of traditional foods have been implicated in the development of a range of medical conditions. [14][15] Preliminary results from the Healthy River, Healthy People, Traditional Foods Survey suggest that similar patterns may exist within the Yurok Tribe. For example, the prevalence of diabetes among survey respondents 65 years and older is significantly greater among those who receive food assistance than those who do not ($G=5.64$, $p<.0.05$) (Fig. 12). In contrast, the prevalence of obesity, hypertension and heart disease and other related disorders show no significant differences between those who receive food assistance and those who do not.

14 Dillinger, Teresa L. et al. 1999. Feast or famine? Supplemental food programs and their impats on two American Indian communities in Calfiornia. Intl. J. Food Sci and Nutr. 50:173-187.
15 Norgaard K. 2005. The Effects of altered diet on the health of the Karuk People. A Report prepared for the Karuk Tribe of California

The prevalence of diabetes among American Indians and Alaska Natives is 2.3 times greater than that of non-Hispanic Whites and as of 2002, diabetes prevalence for American Indian and Alaska Natives as a whole was 15.3%[16]. Yurok Tribal Members report comparable levels of diabetes by and large, although they do report higher levels of diabetes among younger (25-30 year olds) and older (65 and older) age classes compared to the diabetes levels reported for American Indian and Alaska Natives as a whole (Fig. 13)[16]. Further research is needed to determine if these differences are significant and to determine the underlying factors associated with these high-than-average rates of diabetes among Yurok Tribal Members. Comments concerning the prevalence and incidence of diabetes within the FERC EIS indicate a lack of familiarity with the medical literature: Native American populations experience a disproportionately higher prevalence of diabetes than the overall US population. Contrary to statements within the FERC EIS, the increased prevalence and incidence of diabetes among the Native American population is statistically and epidemiologically distinct from that in the general US population (Fig. 14).[17] These preliminary findings suggest that further investigation into the health affects associated with loss of traditional foods and other river-based resources is warranted.

16 Acton, K.J et al. 2003. Diabetes prevalence among American Indians and Alaska Natives and the overall population---United States, 1994-2002. Morbidity and Mortality Weekly Report, August 1, 2003, 52(30): 702-04.

17 Diabetes prevalence among American Indians and Alaska Natives and the overall population--United States, 1994-2002. MMWR. Morbidity and Mortality Weekly Report - 2003 - Aug 1;52(30):702-4. NB According to the Editor, this report probably underestimates prevalence of Diabetes among AN/AN population;

Figure 12. Dependence on food assistance and prevalence of diabetes among respondents 65 years and older

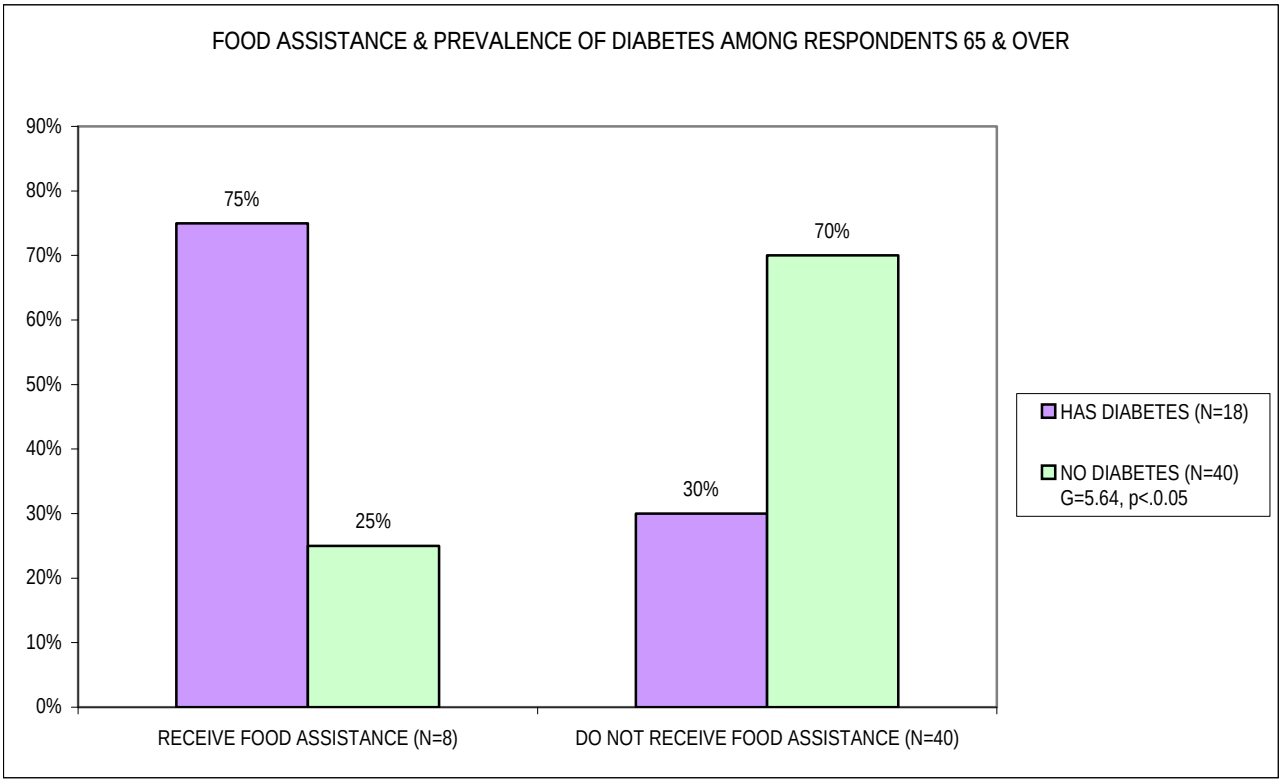


Figure 13. Prevalence of Diabetes among three populations compared within age groups. Data for AI/AN and US Population from Morbidity & Mortality Weekly Report, all differences significant (95%CI).

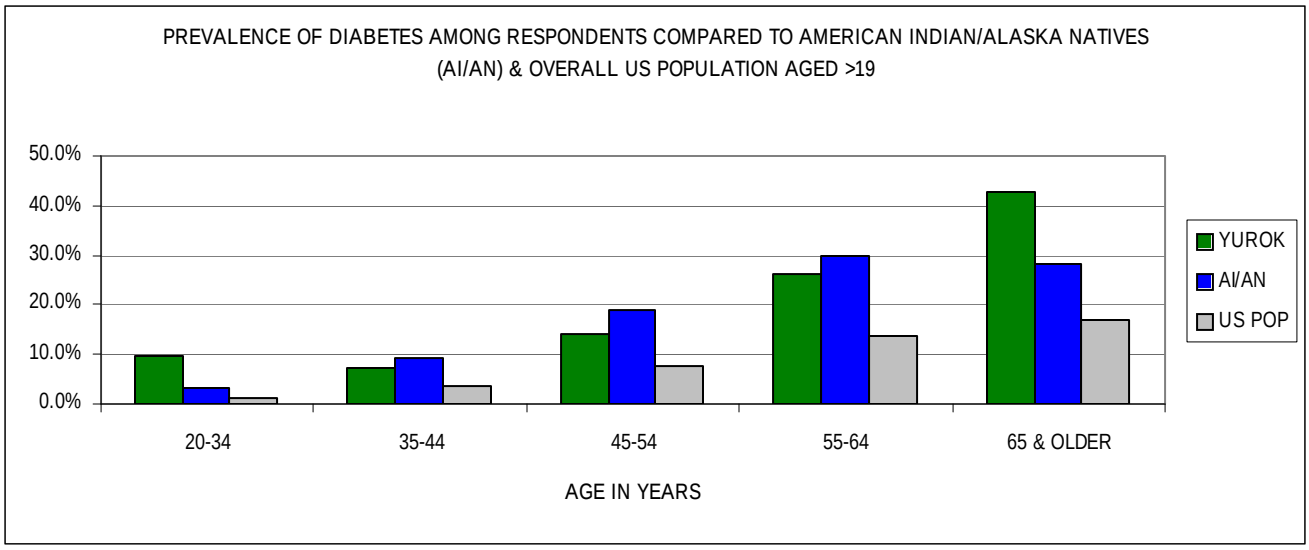
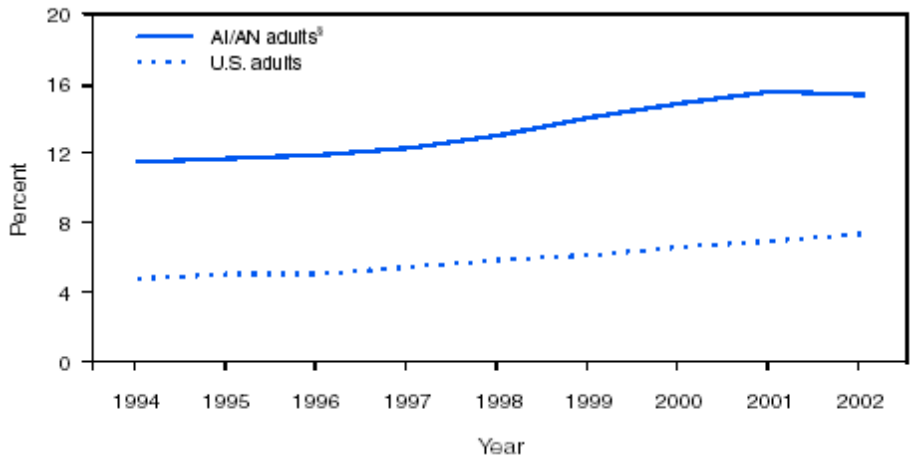


Figure 14. Prevalence of Diabetes among AI/AN and US Population taken from Morbidity & Mortality Weekly Report[17]

FIGURE. Age-adjusted prevalence* of diagnosed diabetes among American Indian/Alaska Native (AI/AN) and U.S. adults aged ≥20 years, by year — United States, 1994–2002†



* Based on the 2000 U.S. population.
† Based on Indian Health Service ambulatory patient-care data and the Behavioral Risk Factor Surveillance System.
§ Although the rate of increase in diabetes prevalence among AI/ANs slowed during 2001–2002, additional data are needed to assess recent trends.

Commercial and Subsistence Fisheries

Although subsistence and commercial fishing rights have been restored for the Yurok Tribe in recent decades, fish populations in the Klamath River have declined precipitously over this same period due to the operations of the dams, water diversions for agriculture, and other management decisions made by federal agencies within the Klamath Basin. Many of these adverse effects on tribal trust resources, specifically the fishery, are largely a result of effects the Klamath River Hydro-electric Project, or current conditions. The Yurok Tribe has had only minimal levels of fall Chinook commercial harvest during four of the past fifteen years. During the remaining 11 years the Yurok Tribal Council determined that the projected abundance of Klamath fall Chinook was insufficient to support a commercial fishery. For the past 15 years, the Yurok Tribe has also forgone commercial harvest of species other than fall-run Chinook (with the exception of minimal numbers of spring Chinook that were harvested during the beginning of the fall Chinook fishery). The Yurok Tribal Council has chosen not to have any commercial fisheries for other species such as spring-run Chinook salmon, Coho salmon, steelhead, lamprey, eulachon and sturgeon because of their concern regarding the status of these other species. Reduced abundance of these species has also affected subsistence harvest patterns.

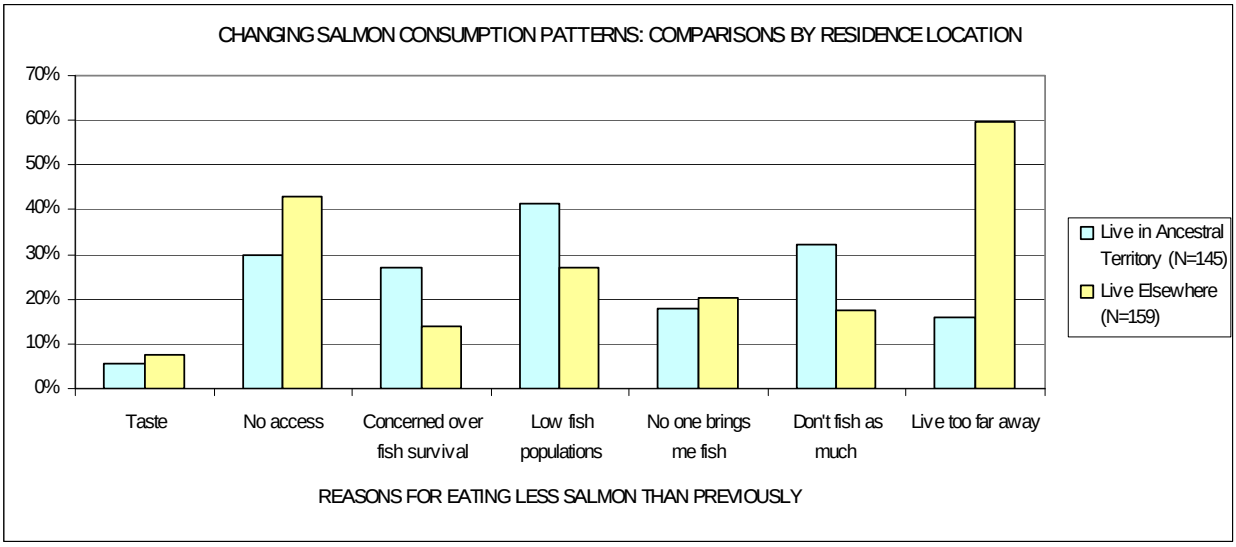
As a kid there were abundant salmon because you could see the salmon thick in the river from the bridges. You had to row your boat out to rocks that you can walk out to now…..In my lifetime I have watched the salmon, sturgeon, and eels become depleted. Salmon, eels, and sturgeon were our main food. We ate one of the three daily. We only ate meat on payday. The rest of the week we ate fish. Now we get fish only occasionally. This year we have not had any fish. My children may not have any salmon in the future.

(Yurok Tribal Member Survey Respondent 2006)

Because long-term data on fish numbers in the Klamath River do not exist for the periods prior to the construction of the first dams, respondents were asked about lifetime consumption patterns as way to document changes in the availability of particular species to Tribal Members over time. Where comparing respondents' diets growing up as a function of age, reported consumption of Coho, Lamprey and Candlefish declined significantly ($G=18.34$, $p<0.01$, 19.00, $p<0.01$, $G=37.9$, $p<0.001$ respectively). A similar trend exists for Spring Chinook, Steelhead, Fall Chinook, and Sturgeon.

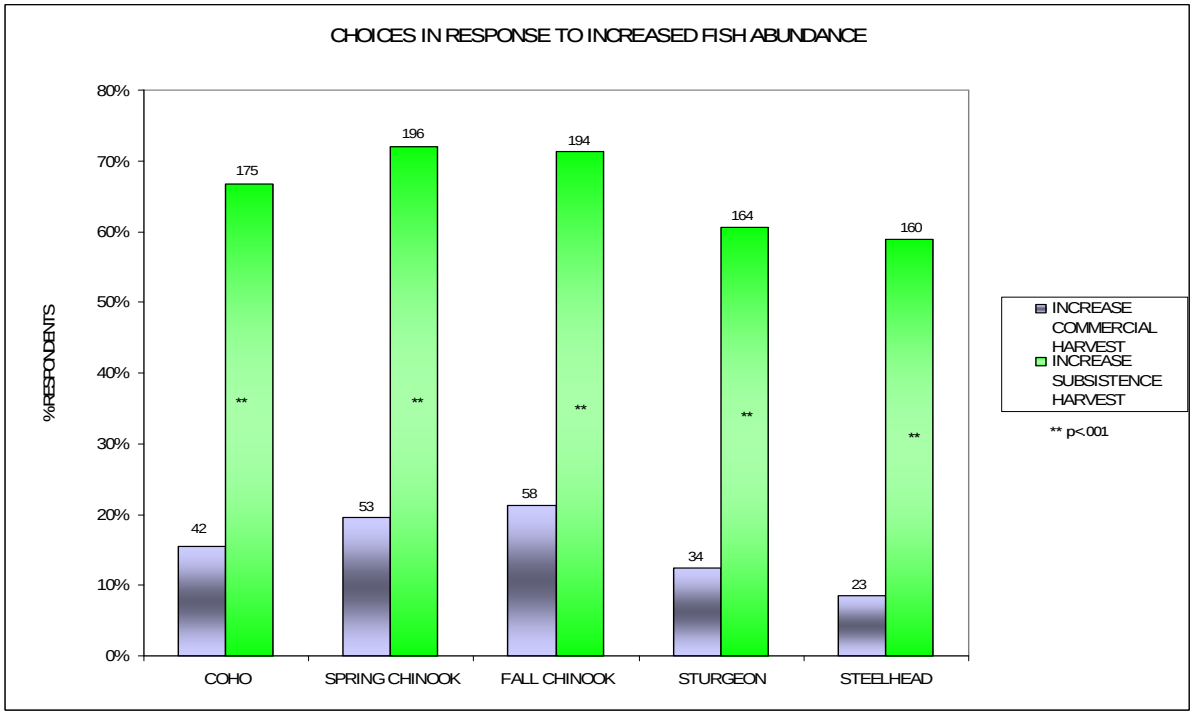
To determine whether decreased consumption was a reflection of changing tastes, respondents were asked to identify the reasons they consumed less salmon. For respondents residing within the Ancestral Territory the most influential factor was reduced fish populations, whereas those living outside the Ancestral Territory cited lack of access and distance from the Klamath River as the major factors responsible for reduced salmon consumption by other Tribal Members (Fig 15).

Figure 15. Changing consumption patterns



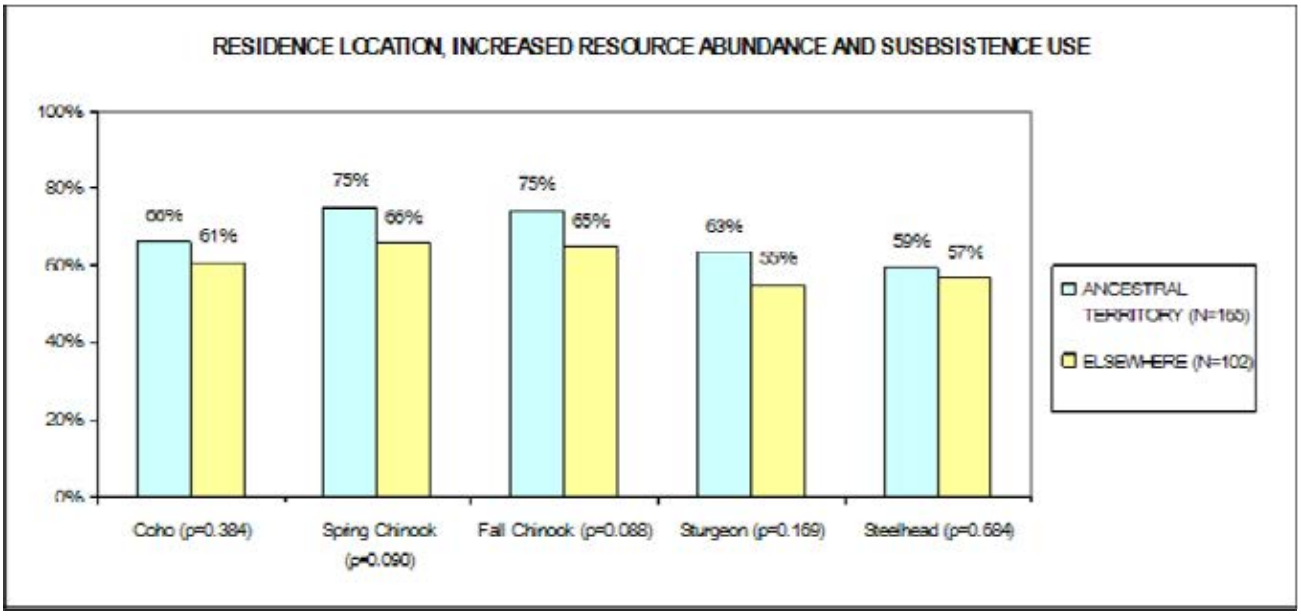
Respondents were asked whether they would increase subsistence and/or commercial harvest if fish were more abundant. In all cases, the majority of respondents indicated that they would increase subsistence fishing if the fish resource were more abundant. A significantly smaller number of individuals indicated that they would be interested in commercial harvests given increased resource availability (Fig. 16).

Figure 16. Choices in responses to increased fish abundance comparing subsistence and commercial interests of all respondents.

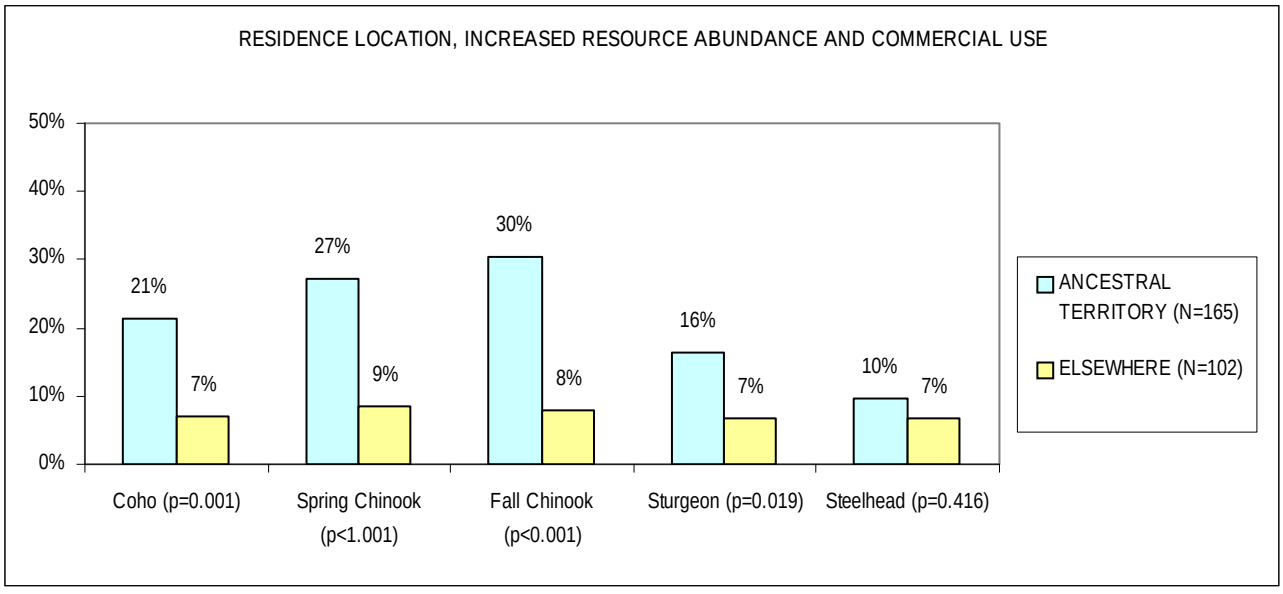


Interest in increased subsistence activity transcends geography: the majority of respondents living within and outside the Ancestral Territory indicated that they would increase subsistence activities in response to increased fish abundance (Fig. 17).

Figure 17 Comparison of responses to increased resource abundance among respondents living with the Ancestral Territory and those living elsewhere, showing the proportion of respondents who would increase subsistence harvest in response to increased resource abundance.



In contrast, interest in commercial use of most fish stocks is greater among those living within the Ancestral Territory (Fig. 18).



Fish are not commodities and their importance cannot be quantified using the usual economic measures; however the loss of these traditional resources, the closures and reduced harvests of the Tribal Commercial Fishery have had an economic impact on Tribal Members. As might be expected, the survey data suggest that the hardships associated the Commercial Fishery closures have had a greater impact on respondents living within the Ancestral Territory than those living elsewhere and in some cases these losses have disproportionately affected those respondents who receive food assistances (Table 1)

Table 1. Losses associated with Tribal Commercial Fishery closures

LOSSES ASSOCIATED WITH CLOSURE OF TRIBAL FISHERY	PROPORTION OF RESPONDENTS REPORTING LOSSES	PROPORTION OF RESPONDENTS ON FOOD ASSISTANCE REPORTING LOSSES	TOTAL RESPONDING
Loss of income	22% (61)	33%* (30)	280
Increased food expenses	28% (78)	39%* (38)	280
Reduction in social & cultural activities	24% (66)	32%* (29)	280
Loss of goods & services received through barter & trade	18% (49)	28%* (25)	280
Increased financial stress	18% (51)	30%* (27)	280
Reduced income from secondary business	8% (21)	13%* (12)	280
Applied for public assistance due to closure	8% (22)	21%*(19)	280

*Significantly greater proportion of respondents on food assistance affected, Chi-square test, $p<0.05$

Tribal Members who choose to remain within the Ancestral Territory experience higher levels of poverty and food insecurity than Tribal Members who live elsewhere. In spite of these conditions, Tribal Members choose to live in the Ancestral Territories because their culture and identity are inextricably bound to these lands and resources, and specifically the Klamath River. Economically forced relocation is perceived as another of the inequalities visited on the Tribe as a result of denied access to traditional resources, particularly the resources of the river.

I no longer live or work along the Klamath River. I had to leave due to financial reasons. I can no longer fish or gather, my children are not learning the culture like they should. They are not experiencing all that the Klamath River has to offer.

(Tribal Member Survey Respondent 2006)

Traditional Activities

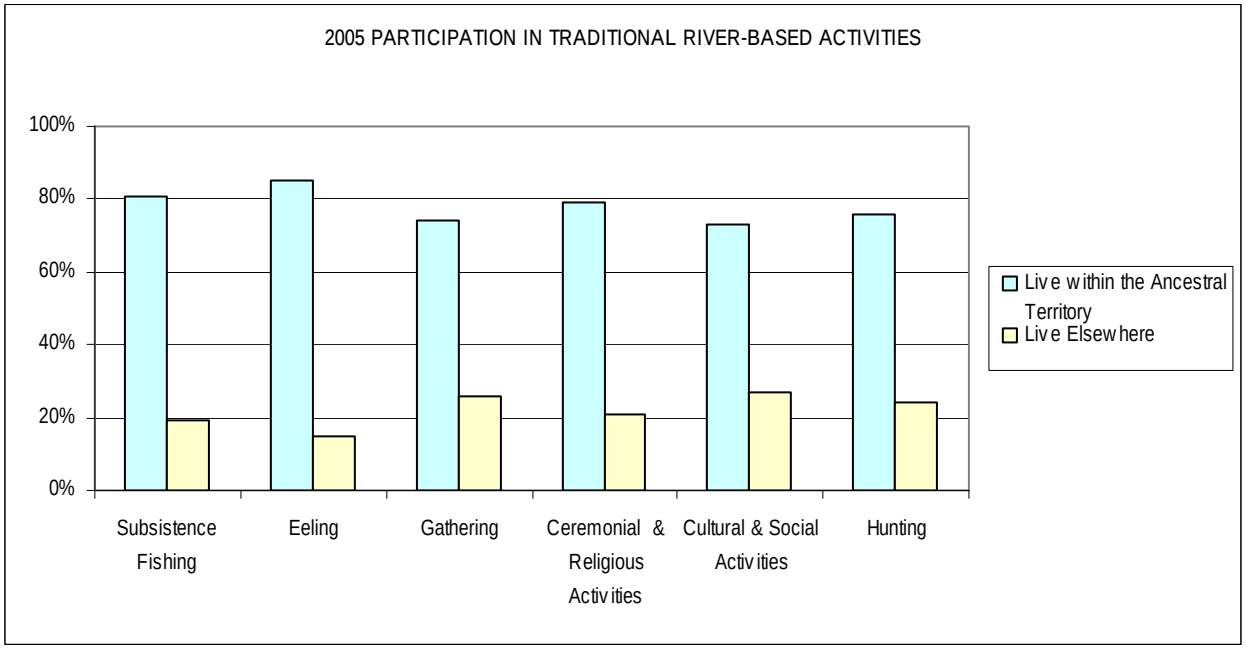
Fish plays a variety of roles in Yurok households. According to respondents, 86% use fish as food, 72% share fish with friends and family, for 34% fish fills ceremonial and religious roles and in 45% of households fish is part of cultural and social activities. In contrast, 21% of households report using fish in barter or trade and only 16% of households sell fish. This underscores the important *meanings* of fish for the Tribe. The Klamath River Hydroelectric Project has altered the river in ways that are destructive for all parts of Yurok life:

"[T]he dams contribute to a pattern of cumulative effects on the cultural values and interests of the tribes – aspects of the environment that are of great importance to them… to the tribes [the Klamath River] is utterly central to their cultural identity. This being the case, it is equally evident that the effects of the dams, together with the other contributors to the Klamath's plight, fall disproportionately on the tribes. While others live within the riverscape, travel through it, fish in it and hunt in it, only the tribes have an intimate cultural connection to the riverscape going back to time immemorial. Only to the tribes is the riverscape the core of their cultural identity. Maintaining and reinforcing this association is particularly important today, as the tribes work to reestablish their traditional belief systems and ways of life."[18]

Preliminary analyses of survey data indicate that a greater proportion of individuals who participate in traditional activities as children are more likely to continue those activities as adults. A similar pattern exists when those who live within the Ancestral Territory are compared to those who live elsewhere. In 2006, respondents who lived within the Ancestral Territory participated in traditional activities in significantly greater numbers than Tribal Members who lived elsewhere Territory (Fig. 20).

18 King, T.F. 2004. First Salmon. Prepared for Klamath River Intertribal Fish and Water Commission

Figure 20. Respondents involved in traditional activities in 2006 compared by residence location. In all cases Chi-square, $p<0.05$.



In spite of more than one hundred years of concerted attempts to destroy the Yurok Tribe's cultural and spiritual integrity, the language and the culture survived. For the Yurok Tribe, the health of the Klamath River, its fish runs and other traditional resources are essential for cultural survival.

Denied access to the river and the salmon is tantamount to denied access to essential cultural and spiritual resources. In these circumstances, poor water quality and unhealthy conditions constitute denied access. Respondents have indicated that poor water quality has had a detrimental affect on many aspects of their lives not just during the 2005 cyanobacterial bloom but various times during the past five years (Tables 2 and 3).

Table 2. Proportion of respondents who changes their use of the Klamath River in response to concerns over water quality during 2000-2004

ACTIVITY	PROPORTION REPORTING CHANGED USE	NUMBER REPORTING CHANGED USE	TOTAL RESPONDING
Fishing	52.9%	148	280
Eeling	33.2%	89	268
Hunting	19.5%	52	267
Gathering	21.2%	55	259
Ceremonial & Religious Activities	16.6%	43	258
Cultural & Social Activities	20.8%	54	260
Recreational	46.0%	126	274
Transportation	20.9%	53	254
Bathing & Drinking	49.8%	134	269

Table 3. Proportion of respondents who changes their use of the Klamath River in 2005 in response to the Microcystin Public Health Notice for the Klamath River

ACTIVITY	PROPORTION REPORTING CHANGED USE	NUMBER REPORTING CHANGED USE	TOTAL RESPONDING
Fishing	46.1%	113	245
Hunting	24.7%	59	239
Gathering	26.8%	64	239
Ceremonial & Religious Activities	22.5%	53	236
Recreational	45.8%	110	240
Transportation	22.6%	53	235
Bathing & Drinking	44.1%	104	236

When people are denied access to the River, they are cut off from these essential activities. Poor water quality has changed peoples' use of the River and interfered with many aspects of Tribal Members' lives.

> ***"Over the years, the river got smaller and smaller. The color has gradually gotten darker. At first, (60's, 70's, 80's) the Klamath only looked unhealthy at the end of summer. Now the River always looks too dark in color and low. At the end of summer now, the Klamath looks dark, low, slow, dirty, slimy and too unhealthy to get into or eat anything coming from it. We used to be able to tell which salmon were not from the mouth, because they would sometimes have a muddy taste. Now I don't eat any salmon… for fear of eating toxins and diseased fish."***
>
> **(Tribal Member Survey Respondent 2006)**

This analysis, while preliminary, clearly demonstrates the inadequate and flawed data and analyses submitted by PacifiCorp to the FERC for the DEIS. The Yurok Tribe has managed to provide a more comprehensive and accurate analysis than PacifiCorp provided or the FERC itself offered, but this is hardly sufficient to remedy the deep structural and substantive defects in the FERC analysis. A more thorough, representative evaluation of the cultural, social and economic analysis of the affects of the Project on Tribes within the region must be undertaken before any determination can be made by the FERC.

Environmental Effects

Data compiled by the Yurok Tribe and submitted in formal comments to the FERC DEIS in 2006 indicate that the Project's immediate and long-term, cumulative impacts on the socioeconomic conditions of the Yurok Tribe are actually severe and disproportionate. The impacts of the current conditions are particularly onerous on Native American Tribes in the Klamath basin and watershed, Tribes who are dependent upon the River and its fishery for not only subsistence but also their cultural, spiritual, economic way of life. Again, impacts on the Yurok Tribe, the YIR, and tribal trust resources must be accurately and meaningfully considered and evaluated in the Secretarial Determination Overview Report in addition to the NEPA and CEQA analysis currently underway.

The FERC EIS was completely inadequate in its consideration of Project effects on low-income and minority populations. Executive Order 12898 mandates that all federal agencies must consider the impacts of their actions on low-income and minority populations. California also has an Environmental Justice law that mandates all state agencies not only to consider impacts of actions on low-income and minority populations, but also examine disproportionate effects on differential rates of consumption of resources. The FERC EIS provides inadequate analysis of the impacts of the loss of a traditional diet on Klamath River tribes. Comments within the FERC EIS indicate a lack of familiarity with the evidence indicating that Native American populations experience disproportionately higher prevalence of diabetes than the overall US population. Contrary to statements within the FERC EIS, this increased prevalence is statistically and epidemiologically distinct from that in the general US population.[19]

The fact remains that the impacts of the current conditions on the Yurok Tribe, a low-income and minority population and a federally recognized Indian Tribe, are extensive. It is important to note that the FERC EIS failed to acknowledge or assess the health benefits of a traditional diet or the impact of food insecurity and

[19] Diabetes prevalence among American Indians and Alaska Natives and the overall population--United States, 1994-2002. MMWR. Morbidity and Mortality Weekly Report - 2003 - Aug 1;52(30):702-4. NB This report probably underestimates prevalence of dDiabetes among AN/AN population; also see figure below

poverty on the health of Native Americans in the affected areas. A preliminary analysis of poverty, food insecurity and tribal health data are being submitted as supporting documentation on this issue in the following comments. Peer reviewed and published medical studies support both the health benefits of a traditional Yurok diet, and the disproportionate rates of diabetes in Native American communities.[11,14,15,16,17,19]

The FERC EIS failed to address Environmental Justice (EJ) issues resulting from Project impacts on the Yurok Tribe, particularly in the area of disproportionate impacts on the health to Tribal and reservation communities, and the health of individual tribal members. The Klamath Hydroelectric project, current conditions and its continued operations, as well as the biased and discriminating treatment of Native Americans by PacifiCorp and the FERC in the previous NEPA process, as demonstrated in the flawed, insufficient and indefensible assessment of Project impacts in the FERC EIS are examples of what can only be defined as environmental racism and examples of blatant environmental injustice. The Yurok Tribe has provided ample testimony and evidence to PacifiCorp and the FERC that the Klamath Hydroelectric Project has had and continued to have significant, adverse, and disproportionate impacts on the Yurok Tribe and other tribal communities, which are low-income and minority populations. Unlike other stakeholders within the Basin, the Yurok Tribe receives no economic benefit as a result of the Project, yet the Project has resulted in the near-destruction of the River, its anadromous and resident species, numerous culturally significant resources, ie: tribal trust resources and as a result, the complete Yurok tribal fishery. The Klamath Hydroelectric Project and current conditions have had, and continue to have significant disproportionate adverse impacts on the Yurok Tribe because of its position in the watershed and its continued reliance on both subsistence and commercial fisheries. The basic and fundamental tenets of federal and state EJ laws suggest that the Department of the Interior and all federal agencies involved in the current analysis must consider the very real effects of these disproportionate impacts on a range of tribal trust resources.

The Department of the Interior and all federal agencies involved in the current Secretarial Determination and NEPA/CEQA analysis must consider the impacts of all aspects of the Klamath Hydroelectric Project and current conditions on low-income and minority communities, particularly on individual Klamath River Basin Tribes including the Yurok Tribe. The FERC EIS only provided a superficial assessment of the data submitted by the Karuk Tribe.[15] The Klamath Hydroelectric Project has had significant adverse effects on all aspects of Yurok cultural and traditional life and on numerous tribal trust resources. These impacts have been documented and submitted to the FERC, in written and verbal testimony by hundreds of Yurok tribal members, yet they are not included or reflected in the FERC EIS or the assessment of the impacts of current conditions on low-income and minority populations.

Cumulative Effects

In general this section of the DEIS fails to follow the Council for Environmental Quality's (CEQ) (1997) guidance on conducting cumulative effects analysis under NEPA. The Department of the Interior and all federal agencies involved in the current Secretarial Determination and NEPA/CEQA process should follow the CEQ guidance for identifying, evaluating, and assessing the cumulative effects of the current conditions on all types of environmental resources. Cumulative Effects analyses should be conducted for all natural and cultural resources within the study area for all alternatives under evaluation..

If the Klamath Hydroelectric Project is relicensed and current conditions continue without dam removal and implementation of the KBRA and KHSA, populations of traditionally and culturally and economically significant food sources species will continue to decline, possibly to extinction. Water quality would continue to deteriorate, toxic algal blooms would continue and possibly increase, culturally significant tribal trust resources and species would continue to suffer significant declines, diseases, and Project-related impacts that in turn would have a continuing significant adverse effect on the Yurok Tribe and YIR residents. The adverse socioeconomic impacts on the Yurok Tribe would continue and compound if current conditions continue. Only the removal of the four dams, and a fully restored River and fishery can uphold the federal government's tribal trust responsibility to the Yurok Tribe and protect these irreplaceable tribal trust resources.

The Department of the Interior and the BIA have a responsibility to ensure the protection of tribal trust resources because it acts as the primary branch of the US federal government responsible for tribal trust matters. The FERC EIS failed to acknowledge or adequately assess the impacts of the Project on tribal trust resources of the Yurok Tribe for which the federal government has a fiduciary responsibility. The status quo, or current conditions, would result in the eventual extirpation of all culturally significant tribal trust resources within the Klamath River watershed upon which Yurok culture has evolved, been sustained, and continues into the present day. If the current conditions continue they will result in severe socioeconomic and cultural costs, and continued losses, to the Yurok Tribe. These impacts must assessed by the Department of the Interior and all federal agencies involved in this current analysis and these assessments must accurately evaluated the federal trust responsibility to the Yurok Tribe and its members. The Secretarial Determination process provides for the first ever comprehensive assessment of these tribal trust issues and the environmental, economic, social and cultural impacts of the Klamath Hydroelectric Project, current conditions, and the proposed action of dam removal and implementation of the KBRA and KHSA. The further future decline of the fishery and the health of the Klamath River watershed, and its dependent tribal communities, is not an "unavoidable adverse effect". Rather, the adverse effects are only unavoidable if the federal government, its departments and agencies, fail in their trust responsibilities and the current conditions are allowed to continue, the dams are not

removed and the KBRA and KHSA are not implemented. The Department of the Interior, specifically the BIA and the Secretary of the Interior should not follow the FERC's mistake of ignoring the best possible science, the law, the needs of effected Tribes and the status quo (ie: current conditions) are maintained at the cost of a healthy river, restored watershed, sustainable economies, and tribal communities.

The Klamath Hydroelectric Project has literally destroyed, or nearly destroyed, the entire Klamath Basin ecosystem and all the abundant resources that the Tribe has relied upon for countless generations. And that near-destruction has happened within one generation or lifetime. Downstream tribal communities have received no benefit from the Klamath Hydroelectric Project, but have paid an overwhelming and disproportionate cost for the profit and benefit of PacifiCorp and a handful of upstream users. The Yurok Tribe has not even received the benefit of electricity generated from the Project, yet the Project has severely impacted the reservation economy, which relied upon the River primarily for food, and less as a commercial and recreational fishery. The lack of ability to make a living wage on the YIR has led to a Yurok diaspora, or displacement into surrounding areas or further in search of economic stability, yet Yurok who leave often return or wish to return to live on the reservation, if only they could make a living. These are profound Environmental Justice issues that have yet to be adequately addressed but must be addressed meaningfully in the Secretarial Determination and the ongoing NEPA and CEQA analysis for removing the four dams and implementing the KBRA and KHSA. Only the full removal of all four dams and the restoration of the Klamath River ecosystems and its once abundant fishery can begin to redress and resolve these Environmental Justice issues. It is imperative that the Department of the Interior, the Secretary, the BIA and all federal agencies involved in the current analysis acknowledge these long-standing Environmental Justice issues and address them in their final analysis and determinations on the proposed action and any alternatives and the Secretarial Determination Overview Report currently underway.

VIII. Tribal Trust and Potentially Impacted Trust Assets

"The River is the lifeline of the tribe. It needs to be clean and full so the salmon can come back and nourish the people. The salmon is like the miner's "canary" – if it is sick or dying it is a sign that our people are sick and dying too. If it is abundant and thriving – so are the people. It is the responsibility of the tribe and other government agencies to ensure this life line is healthy and abundant for the future generation."

(Yurok Tribal Member Survey Respondent 2006)

"There seem to be only memories of long and not so long ago when the fish were so plentiful to our kitchen tables or just catching, cleaning, hanging 20 fish in one day. Now it seems like you can go fishing all day or just to catch the tides and you come back home with 1 or 2 fish and moss and mud and plenty of sticks in your net. Not too many of us who traditionally live on eating sticks. None of the boys bring eels to you anymore cause they caught so many they don't know what to do with them. When your drifting at the mouth, you have to fight the sealions for one fish and sometimes he even takes the belly. The sealions chase you for a fish if you clean it too close to the waters edge. When I was a little girl my uncles used to bring the fish to Gram's house and we would spend all day hanging that fish and she would can it up and even share a jar or 2 for a gift every once in a while, now we can barely feed Gram and our own mouths and spirits.

Maybe we need to feed our elders and children – let them acquire a taste for that good real "CANDY" as Gram used to call it. When good fish used to run plentiful, Gram would make baked fish, fried fish, salmon patties, dried fish, canned fish, kippered fish. Cooked on sticks and even fish soup. Now we have to go buy a fish at the local market or eat burgers, pizza, Mexican food, hamburger helper, or any of the other processed foods full of all that stuff our elders wouldn't have dreamed of eating 20 to 30 years ago – Our elders don't even know what some of that stuff is.

When we have ceremonies and cultural gatherings we should not only be thankful for what we put in our mouth and cherish every bite, but pray for that fish to come back again and make us strong and keep our elders healthy and make our children healthy too with its strong vibrations. – We should ask that our fish and berries be made plentiful again. Let our youth and little Indian babies experience the love we have for the fish too and learn to harvest it the way Gram used to and feed us dried fish in the winter with her hot baked "Injun" Bread and jam. We are and always will be the fish people. May we be the ones the fish come back to."

(Yurok Tribal Member Survey Respondent 2006)

"As a kid there were abundant salmon because you could see the salmon thick in the river from the bridges. You had to row your boat out to rocks that you can walk out to now. Before I went to Vietnam in 1967 the River was high; when I came back after the Dam was built the water had dropped. In my lifetime I have watched the salmon, sturgeon, and eels become depleted. Salmon, eels, and sturgeon were our main food. We ate one of the three daily. We only ate meat on payday. The rest of the week we ate fish. Now we get fish only occasionally. This year we have not had any fish. My children may not have any salmon in the future."

(Yurok Tribal Member Survey Respondent 2006)

"My Yurok elders have always talked about the loss our natural resources and how this impacts our life way. The Tribe itself, the employees need to understand and advocate for both (ceremony and natural resources). When we do our Jump Dance we are praying for these things to return to abundance state. The Yurok people cannot survive without fish, acorns, language, and ceremonies."

(Yurok Tribal Member Survey Respondent 2006)

The Yurok have always inhabited California's northwestern coastline from Little River to Damnation Creek. Yurok Ancestral Territory also extends along the Klamath River from the mouth of the river up past the Klamath – Trinity confluence to Slate Creek. Yurok Territory continues six miles up the Trinity River. The Yurok language (and the neighboring Wiyot language) is affiliated with the Algonquin linguistic stock. Algonquin languages are primarily spoken by Tribes residing in the Great Lakes and New England areas. While the Yurok language is spoken fluently by several dozen Yurok people, a Tribal language program is in place to increase the fluency of its tribal members. Traditional subsistence animal species include salmon, ocean fish, sturgeon, sea lion, whale, elk, deer and duck. Acorns, berries, bulbs and grass seed are staple plant foods.

Yurok life is defined by extended families affiliated with villages and represented by head spokespersons. Ceremonial wealth and rights to subsistence resource areas determine familial standing within Yurok social structure. Yurok are recognized for their skills making redwood canoes, weaving fine baskets, highly stylized art forms, hunting, and specifically riverine salmon fishing. The ancient traditions are continued through contemporary times.

The traditional homeland of the Yurok Tribe extends from the Pacific Ocean along the lower Klamath River and into the Trinity River Basin. While Yurok culture and tradition centers on the Klamath River, their people have always lived along the lower Trinity and depended on its fish, water and other resources. The traditional and present territories of the Karuk and Klamath (Oregon) Tribes are located along the upper Klamath River, above the River's confluence with the Trinity. Both these tribes also depend on the

resources of the Trinity River, primarily as it influences the Klamath River ecosystem (USFWS et al 2000).

Natural resources hold significant cultural, ceremonial, spiritual and other non-economic values for all the Indian tribes of the Klamath region (the term cultural refers to the cultural anthropology of the tribes not their archaeologically significant artifacts and monuments which are addressed elsewhere in this document). Thus, standard economic methods of accounting and valuation cannot adequately measure the consequences of any action that may affect these tribes' trust assets. In fact, in previous EIS analysis processes, representatives of the Klamath River tribal governments have voiced concern over the utility and validity of attempts to quantify and express the benefits of natural resources, such as salmon, to their people in economic or dollar terms. Accordingly, the trust analysis does not focus simply on economics; instead, it evaluates the anticipated impacts of the Restoration in terms that are more meaningful and of primary importance to the potentially affected tribes. Specifically, the trust section endeavors to characterize the fundamental role of the region's rivers and river health in tribal history. It is in this context that the Restoration alternatives are evaluated in terms of their anticipated impact on the health of the Klamath River (USFWS et al 2000).

Healthy alluvial river ecosystems are ultimately the resource of greatest importance to the region's tribes. Continued tribal access to many trust resources such as fish, wildlife, water and plants depends on the condition of the rivers which transect their lands. Riverine health itself is a function of many fluvial and geomorphic attributes, including rates of sediment loading, flow variability, channel migration and riparian plant life-cycles, among others. Therefore, it is necessary to evaluate the influence the proposed project may have on these physical attributes of the Klamath River to understand the potential tribal trust impacts.

Trust Responsibility

From their earliest contact with the Indians of North America, the European powers and the United States have dealt with Indians on a government to government, or tribal basis. In principle, all treaties, statutes, and executive orders implementing Federal Indian policy are premised upon this political relationship.

From 1787 to 1871, the United States entered into hundreds of treaties with Indian nations in which Indian tribes gave up land in exchange for reservations, safety, and the well being of their people. The Supreme Court has held that treaties create a trust relationship between the Federal Government and Indian tribes. This relationship is "marked by peculiar and cardinal distinctions which exist nowhere else" and "resembles that of a ward to his guardian". The U. S. has a "duty of protection" toward the Indians. [See: Cherokee Nation v. Georgia, 30 U.S. 1 (1831); Worcester v. Georgia, 31 U.S. 515 (1832); U.S. v. Kagama, 118 U.S. 375, 384 (1886); Seminole Nation v. U.S., 316 U.S. 286 (1942)]. In U.S. v. Mitchell [463 U.S. 206, 225 (1983)], the Supreme Court reaffirmed the principle of "the undisputed existence of a general trust relationship

between the United States and the Indian people." The Federal Government's obligation to honor the trust relationship and to fulfill its treaty commitments is the trust responsibility. The Federal Government has extended the trust responsibility through federal statutes, agreements, and executive orders. These documents can create trust obligations in the same way that a treaty does. [See Antoine v. Washington, 420 U.S. 194 (1975) and Oneida Indian Nation v. County of Oneida, 414 U.S. 661 (1974); U.S. v. Mitchell, 463 U.S. 206, 225 (1983)]. The trust responsibility imposes an independent obligation upon the Federal Government to remain loyal to Indians and to advance their interests, including their interest in self-government. [See: Manchester Band of Pomo Indians v. U.S., 363 F. Supp. 1238 (N.D. Cal. 1973)]. The American Indian Policy Review Commission's, *Final Report* stated "The purpose behind the trust doctrine is and always has been to ensure the survival and welfare of Indian tribes and people. This includes an obligation to provide those services required to protect and enhance Indian lands, resources, and self-governance, and also includes those economic and social programs which are necessary to raise the standard of living and social well-being of the Indian people to a level comparable to the non-Indian society" (USFWS et al 2000).

Indian Natural and Cultural Resources

The Trust Doctrine requires, in part, that Indian tribes have continued access to natural resources if they are to preserve their cultural and traditional ways of life. Therefore, in order to fully characterize the potential impacts of any action that may affect a tribe's trust resources, it is necessary to examine the role of those resources in tribal cultures and societies.

Like all peoples, Native Americans depend on natural resources for the necessities of life, food, housing, and clothing. However, tribes have not traditionally regarded those resources simply as commodities to be bought, sold, or indiscriminately exploited. "The landscape itself…is seen as sacred and quivering with life. It is inscribed with meaning regarding the origins and unity of all life, rather than seen as mere property to be partitioned legally into commercial real-estate holdings" (USFWS et al 2000).

When non-Indians first began settling in North America, what they perceived as a wild and uninhabited land, had in many places been managed and utilized by Indian people. Over the millennia, many Native American peoples observed and learned to recognize, rely upon, and even emulate natural processes as part of their ceremonial and religious ways-of-life. In this manner, they enhanced the richness and productivity of the land and other resources on which they depended, and developed an intimate connection to the order and cycles of the natural world (Salter, 1996). The spiritual and practical environmental knowledge they amassed over time was passed orally from one generation to the next through story and language, and includes many what are today considered highly refined and enlightened techniques for eco-system management (USFWS et al 2000).

The significance of the Native American reliance on and veneration for nature is evident in all facets of their cultures, traditions, religions, and resource management. Consequently, increasing resource scarcity over the last century and a half has had a profound effect on Indian tribes. Tribal cultures across North America, such as those of the Klamath-Trinity region, are no longer in a position to fully embrace their traditional ways of life (USFWS et al 2000). This is not to suggest that Indian culture has disappeared. Rather, that the declining availability of resources critical to Native American traditional and spiritual practices has rendered some of those resources even more precious as a means of sustaining their cultures and made additional losses of their resource base increasingly difficult to accept (USFWS et al 2000).

Any tribal trust impact analysis must focus on the potential affect on the health of the Klamath River, as the River's overall health is a primary factor determining not only the availability of fish, but many trust assets including water, wildlife, and vegetation. Thus, increased numbers of chinook salmon and Pacific lamprey, just as other trust assets, represents an expected beneficial by-product of riverine health. The potential tribal trust impacts were not evaluated on a trust asset by trust asset basis because such an analysis would not only require a level of effort well beyond the scope of the EIS but it is unlikely to produce scientifically valid results or results readily interperable with respect to the overall implications for the region's tribes and the U.S.'s trust responsibility to those tribes (USFWS et al 2000)..

In the case of tribal trust resources however, a focus on present and future conditions may fail to adequately represent the true nature of the potential impacts on the region's tribes and its implications for the U.S.'s trust responsibility to those tribes. As the Tribal Trust -- *Existing Conditions* must evaluate the cultures, traditions, religions, languages and perspectives of the Indian tribes of the Klamath-Trinity region that are rooted to the area's once healthy rivers and the associated abundance of salmon, elk, vegetation, and other natural resources. Thus, while the tribes' access to natural resources and their socio-economic and cultural situations under existing and projected environmental conditions are relevant to the analysis of tribal trust impacts, it is far more meaningful to consider the impacts in the context of the tribes' traditional reliance upon rivers as well as the once pristine condition of those rivers relative to their currently degraded state.

Tribal Trust Resources

In his 2004 analysis, anthropologist Thomas King concluded:

> Another law that is pertinent to tribal use of the Klamath Riverscape is the American Indian Religious Freedom Act (AIRFA), which articulates a policy of respect for and protection of tribal rights to the practice of traditional religion. Although AIRFA provides little direction about how agencies are to carry out this policy, it has generally been interpreted to require consultation with tribes when planning actions that might affect religious practice, and actions to avoid impact to such practice where feasible.

The tribes obviously use the Klamath River, its water, its fish, and other elements of the Klamath Riverscape for religious purposes. It is not at all to much to say that the river is central to the tribes' religious practice. The Klamath Hydroelectric Project and other projects in the Klamath Basin have changed the river, and continue to change it, in ways that are deleterious to tribal religious practice. They do this by altering the quality of the river's water, which is traditionally used for purification rituals. They do this by altering the habits and habitats of the fish that play central roles in religious belief. They do this by causing the erosion of locations where key spiritual activities must take place. They do this by fundamentally altering the character of the river as an environment in which people can touch the immortal.

Under AIRFA, FERC and other Federal agencies are obligated to consult with the tribes and try to make decisions about actions affecting the river in such a way as to avoid doing further injury to religious practice. The logic of AIRFA would also suggest that FERC should seriously consider doing what it can to undo damage done in the past, in order to help the tribes regain the ability to practice their religion in traditional ways.

Effects on Indian Sacred Sites

Executive Order 13007 directs Federal agencies to try to avoid physical impact to "Indian sacred sites" on Federal and Indian land, and to avoid blocking tribal access to such sites. Sites like *Paniminik*, owned by the Karuk Tribe and recognized as a place of great spiritual importance, qualify as such sites; there may be sites meeting the executive order's definition on other tribal land or on land managed by the Forest Service, Bureau of Land Management, or Bureau of Reclamation. A site need not be eligible for the National Register to be a "sacred site" in terms of the executive order. FERC[20] and other agencies need to consider this possibility in making decisions about the Klamath Hydroelectric Project and other actions along the river.

Trust Responsibility for the Riverscape

Beyond the requirements of any specific law or executive order, the federal government has a broad trust responsibility toward federally recognized Indian tribes, derived from the Constitution, a great many treaties, laws and policies extending back to the earliest days of the nation, and a massive corpus of case law. The trust responsibility has most recently been articulated in a government-wide manner in Executive Order 13175.

[20] The applicability of executive orders to independent agencies like FERC is uncertain, but FERC's *Tribal Policy Statement* promulgated July 23, 2003 includes Executive Order 13175 among its authorities, suggesting that FERC views itself as obligated to be responsive to such orders.

Partly in response to this executive order, FERC has acknowledged in official polity that—

--as an independent agency of the federal government, it has a trust responsibility to Indian tribes and this historic relationship requires it to adhere to certain fiduciary standards in its dealings with Indian tribes[21].

FERC goes on to pledge itself to working with tribes on a government-to-government basis to address the effects of proposed projects on tribal rights and resources. Thus FERC has committed itself to exercising the Federal government's trust responsibilities toward tribes

Depending on its context, the term "trust responsibility" with respect to Indian tribes and the United States government is usually taken to connote either the relatively narrow responsibility to protect tribal interests in "trust assets" to which a tribe has rights by treaty, statute, or outright ownership (timber, minerals, fish)[22], or the more general responsibility to be sensitive to and represent tribal interests vis-à-vis other parties.

Taking the narrow definition first, it is well established that the Yurok and Hupa Tribes have federally recognized rights to fish in the Klamath River and its tributaries[23]. The Karuk have not been held to possess such rights, apparently because the tribe lacks a treaty explicitly reserving them. However, one of the central tenets of Indian law is that tribes retain all rights not explicitly ceded[24], so arguably the Karuk have retained rights to the Klamath's fish as well.

Apparently using a broader definition, the Trinity River EIS identifies not only anadromous fish but "non-anadromous fish, water, wildlife, and vegetation" as "trust-protected assets"[25].

FERC must understand itself to have a trust responsibility toward at least tribal rights to anadromous fish in the Klamath Riverscape, and arguably toward a broad array of the riverscape's other contributing elements.

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[21] FERC *Tribal Policy Statement:* 18 CFR 2.1c(b)

[22] 25 CFR 900.6

[23] Trinity River EIS:3-208; The primary Hupa rights are to fish in the Trinity, one of the Klamath's main tributaries.

[24] The "Reserved Rights Doctrine," see *U.S. v. Winans*, 198 U.S. 371 (1905).

[25] Trinity River EIS: 3-205

Yurok on Federal Government's Trust Responsibility

In 2009, the Yurok Tribe drafted core principles on the Tribe's position on Klamath River and Yurok Trust Resources in a White Paper presented to the US Fish and Wildlife Service.

The Yurok Tribe has developed this white paper to provide a description of the Tribe's interest in Klamath River Basin fish, water and related issues. The Klamath River Basin includes the Trinity, Scott, Shasta, Salmon, Williamson, Wood and Sprague Rivers including all connected tributaries.

The following principles must be applied when the United States is involved in any issue that affects Klamath River Basin fish, water or other resource issues:

1) That the United States fully and properly protect and restore all trust resources of the Yurok Tribe. This principle includes the need to manage Klamath River Basin resources such that the Yurok Tribe can fully participate in the subsistence, commercial and ceremonial harvest of all species and races of anadromous and other fish;
2) That the United States abide by and honor the commitments made in the Cooperative Agreement between United States Department of the Interior and Yurok Tribe for the Cooperative Management of Tribal and Federal Lands and Resources in the Klamath River Basin of California;
3) That any activities which affect fish and/or water resources within the Klamath River Basin affect the Yurok Tribe Reservation and the Yurok Tribe whether such activities occur in California or not;
4) That the United States, including the Department of the Interior, must provide the Yurok Tribe with any proposal, initiative or other concept that affects the interests and resources of the Yurok Tribe;
5) That the United States, including the Department of Interior, pursuant to the cooperative management agreement mentioned above, principles of the government-to-government relationship, and in proper recognition of the dependence of the Yurok Tribe upon Klamath River Basin fish, water and other resources, will not take any action affecting Yurok interests without the full, timely, and meaningful participation of the Yurok Tribe in all decision and other processes;
6) That the United States and the Department of the Interior recognize that the Yurok Tribe harvests the vast majority of Klamath River Basin fish as demonstrated by the Tribe's past harvest;
7) That the United States recognize and respect the Yurok Tribe fishery interests as specifically recognized by the 1993 Opinion of the Solicitor, the 1988 Hoopa Yurok Settlement Act and its legislative history and other appropriate sources.

What follows is a description of the Yurok Tribe's dependence upon the Klamath River and its fisheries, including attached rights.

The Yurok Tribe's message is that there is a continuing and substantial impact to the Yurok Tribe's fisheries and other resources. That impact has dire social and economic consequences on the lives of Tribal members, their families and Tribal communities. Any process regarding the management of Klamath River Basin fish, water or other resources must include the Yurok Tribe. The United States, including the Department of Interior, must properly share all information in its possession as it such relates. Any decisions regarding tribal resources must be based upon the Tribe's unique circumstances and strengthen Tribal culture and related priorities.

The Yurok Tribe Dependence on Klamath River Basin Fish

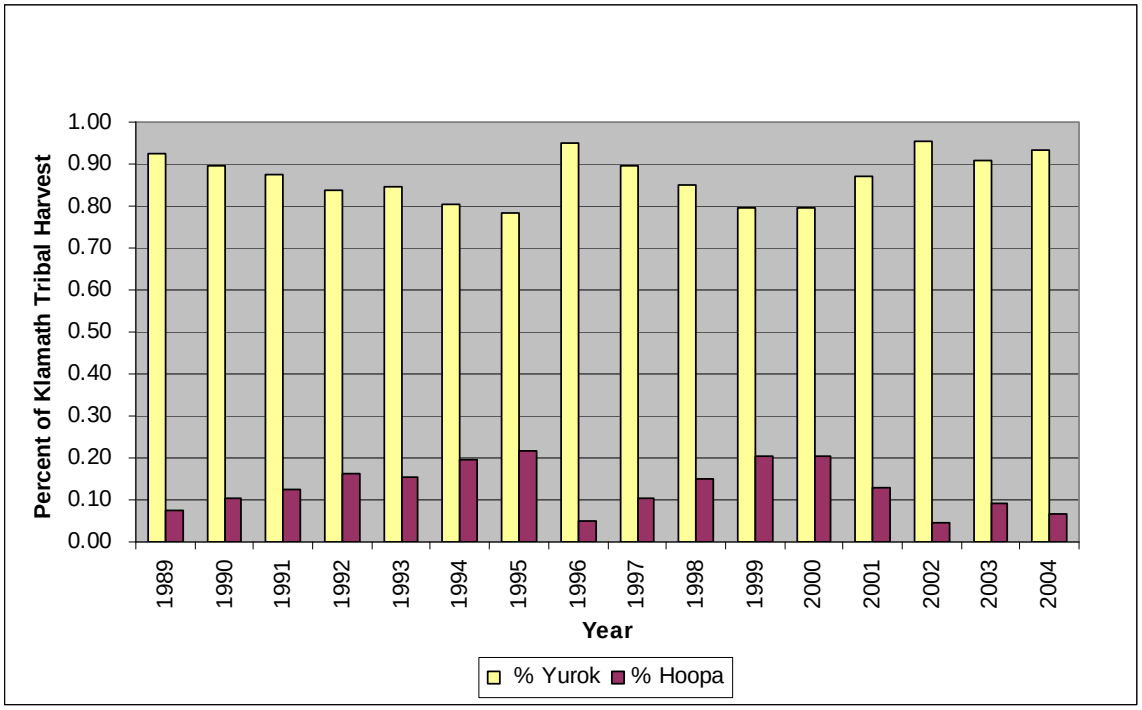
Klamath River fish are irreplaceable to the Yurok Tribe's culture, religion and economy. From time immemorial, Yurok people have depended on the Klamath River and all of its streams and tributaries. The River is central to Yurok society by providing food, transportation, commercial trade, and numerous other activities essential to Yurok life. Throughout history and today, the identity of the Yurok people has been intricately woven into natural environment including the Klamath Basin watershed. Tribal religious and ceremonial practices focus on the health of the world; the Klamath River and its fisheries are a priority. The Yurok Tribe's obligation to protect the fishery has always been understood by Yurok people. The ancestral territory of the Yurok Tribe included coastal lagoons, marshes, ocean waters, tidal areas, redwood and other ancient forests, prairies and the Klamath River.

Because of the rivers' importance, one of the Tribe's highest priorities is to protect and preserve the resources of the rivers, and in particular, to restore the anadromous fish runs to levels that can sustain Yurok people. When the original Klamath Reservation was established in 1855, the rivers were filled with abundant stocks of salmon, steelhead, eulachon, lamprey, and green sturgeon. Today, the abundance of fish in the Klamath River and its tributaries are only a small fraction of their historic levels. Many species of fish have gone extinct, many other species, such as fall Chinook, are in serious trouble. Nonetheless, anadromous fish continue to form the core of the Yurok Tribal fishery. The Yurok Tribe is pursuing its fishery restoration goals through a fish management and regulatory program, participation in various forums to reach long term solutions to Basin problems and when necessary, litigation. The Tribe has devoted a large share of scarce funding resources to budgets for fishery management and regulation. The Tribe has enacted a fisheries ordinance to ensure that the fishery is managed responsibly and in a sustainable manner and has a longstanding record of resource protection. The Tribe's fisheries department is well respected and recognized as a knowledgeable and experienced fisheries entity in the Klamath Basin. The Yurok Tribal Council and the Tribal members they represent are well known for taking and supporting responsible actions to protect fisheries resources.

The Yurok Tribe dependence upon Klamath River fish is supported by Tribal harvest information. Since the passage of the Hoopa Yurok Settlement Act in 1988, the Yurok

Tribe harvest of Klamath River fall Chinook represents approximately 87% of the 50% Tribal allocation (see Figure 1.). In terms of the overall allocation of Klamath River fall Chinook, comprised of Tribal and non-Tribal fishing groups, the allocation of fall Chinook for the Yurok Tribe is the largest single allocation of any group, Tribal or non-Tribal, harvesting Klamath River fall Chinook. The Tribe's allocation is 80% of the Tribal allocation or 40% of the total allocation of harvestable surplus of Klamath fish.

Figure 1. Percent of Klamath Tribal allocation harvested by the Yurok and Hoopa Valley Tribes, 1989 – 2004.



The Tribe's dependence on Klamath River fish and the expectation that the Tribe would have significant economic opportunities from the fishery was identified by Congress during passage of the 1988 Hoopa Yurok Settlement Act. Unfortunately, the lack of Klamath River fish has prevented the Yurok Tribe from realizing the benefits of the Klamath fishery as intended by Congress. The legislative history confirms that Congress intended to vest in the Tribe property rights to the fishery on the Klamath River. The Committee noted that the Act "will also establish and confirm the property interests of the Yurok Tribe in the Extension, including its interest in the fishery. Senate Report No. 564, 100 Cong., 2d sess. (1988).

IX. Conclusions and Recommendations

For the Yurok it is difficult to discuss the traditional and contemporary culture in two distinct life ways. Instead Tribal presence throughout the Klamath River Basin is a continuum running from time immemorial into the future generations yet to come. While this continuum can be marked by periods of change (creator, *woge*, culture heroes, oral tradition of prehistory, oral tradition of proto history, oral and written 20th century history, and 21st century contemporary occurrences.) the basic relationship remains the same: for Yurok People, social and physical health, culture and economy continue to rely on the Klamath River and its fishery. Further, the Yurok fishery depends on a healthy river ecosystem that includes as a necessary requirement adequate flows of high quality water to sustain the abundant trust resources that Yurok depend on to maintain their way of life.

The relationship between indigenous people, fish, and rivers with water is fundamentally a cultural relationship. The cultural relationship encompasses all other ways of defining the relationship and thus includes relationships of economics, politics, ecology and environment, and religion. In addition archeological or historical perspective for understanding cultures, while yielding important information, are limited in scope by the requirements of objectivity, evidence and a chronological ordering that may be radically different than that of the cultures to be understood. The River is of such great importance that there is no particular unique word that names the river. Instead, the River is named as 'river'. Yurok words for 'river' are *'la yoh'*, *'ra yoy'*, and are translated 'to run' or to 'run past' in reference to a liquid.

Yurok interaction and emulation of the environment is a spiritual - ceremonial activity. More than environmental management, for Yurok interaction and emulation are a religious right. This is important for linking Native American environmental practices to additional laws, regulations, policy orders, and policy that acknowledge Native American religious rights (American Indian Religious Freedom Act 1978, Executive Order 12898, Executive Order 13007).

Oral traditions, the spoken word that links people, cultural practices and place are critical to understanding the environment from the perspective of the Yurok and other Klamath River Tribes. The Klamath River as a cultural environment important to indigenous people is more than a collection of individual historic properties or sites. Instead it is the whole of the River considered as a single entity that best frames the meanings and relationships between Indigenous people, fish and water. It is clear from Yurok oral history that the River is such an integral part of the Yurok way of life that without it the traditions of the Yurok people would be perceived in a radically different perspective. Practically every function of the Yurok way of life is associated to the River: The origination of fish, proper methods for taking fish, how the River is to flow, death passage ceremonies, locations for fish dams and ceremonies all reflect the bond between the River and the Yurok people. It is essential that the River be maintained at a level that provides relevance to the young Yurok mind that hears these stories.

The condition of the Klamath River, it's health and quality, is of grave concern to Yurok people. Healthy habitat, adequate and high quality water flows, sustainable and abundant fish populations are of critical importance to Yurok culture. This concern is due to dependence on the River for all aspects of Yurok life, the directives handed to the People by the Creator as Indian Law, and a responsibility for good stewardship of the River and the resources it provides. The role and significance of the River in Yurok life and ceremony, from birth to death, cannot be overstated. The River is the bond that unifies Yurok culture. It is also the bond that unites Yurok with their upriver neighbors in a common life way that has persisted through time.

In a 2004 report evaluating the eligibility of the Klamath Riverscape for inclusion on the National Register of Historic Places, anthropologist Thomas King reported:

> Effects of the Project downstream from Iron Gate Dam are less straightforward than those within the Project area itself. Such effects must be understood as parts of a complex of cumulative effects – contributions to the overall transformation of the river from its natural condition to the way it is at present. This complex of effects is the result of a variety of forces. Besides the PacifiCorp Project, contributors include the dams managed by the Bureau of Reclamation (BOR), farming practices, particularly in the Klamath Basin upstream from the Project, logging, mining, sewage disposal, and other modern human activities along the river, and offshore commercial and recreational fishing that depletes salmon and steelhead runs in the river. To these contemporary impacts must be added the past impacts of hydraulic mining, which tore down riverbanks, altered streamflow, and filled in fishing holes. It is beyond the scope of this report to detail all the effects of all these sources, but it may be helpful to characterize them in general and then to consider what contribution the PacifiCorp Project may itself have to the overall pattern of effects.
>
> The culturally significant character of the riverscape is fundamentally controlled by the character of the river, which in turn is controlled by the quantity and quality of water flowing down it and the manner in which flows are regulated, whether by natural or human agent. Insufficient water, or water that has been polluted, obviously affects direct human consumption and other uses, but it also has a variety of damaging effects on the riverscape's cultural values. Effects discussed in the ethnographic reports and elsewhere, and by tribal consultants, include:
>
> - Impediments to Tribal River access, particularly just downstream from Iron Gate Dam.
>
> - Blocking the passage of anadromous fish up the river – resulting from the simple presence of the dams[26].

[26] See KRITFWC 2003. Karuk and Yurok consultants disparage the extent to which hatcheries can make up for this blockage, reporting that hatchery fish are very different from wild fish – softer, spongier. Shasta

- Other impacts on fish – ranging from catastrophic effects like the massive 2002 fish kill to a general decline in the populations of both anadromous and resident fish, and including the complete or near elimination of particular fish runs[27]., resulting from such factors as:

    - Release of insufficient water down the river, or releases at the wrong times, or in the wrong amounts, to meet the biological needs of all fish species, at all life stages.

    - Release of water that has been warmed (or cooled) by being held in reservoirs, creating an unnatural and detrimental temperature regime for fish.

    - Release of water that is polluted by agricultural runoff from above the reservoirs, full of chemical foam and algae, making it unhealthy not only for fish but also for people to drink or bathe in.

    - Deposition of sediment in cold-water holes where fish congregate.

    - Creation of a flow regime in which periodic flushing flows ("freshets") are replaced by a flat flow punctuated by flood events[28], failing to clear away sand and gravel bars at the mouths of tributaries and thus sealing off spawning ground and fish refugia.

- Through the same alterations in flow regime, causing erosion of culturally important areas along the river, such as the World Renewal site *Katamin*.

- Through flow alterations, temperature changes, and pollution, causing damage to the health of plants required for basketry and other cultural purposes.

Such effects have obvious implications for the relationships of the tribes to the river, the fish, special places along the river, and other elements that contribute to the significance of the riverscape. If the salmon do not run, the First Salmon Ceremony becomes meaningless. If the priest's sweatlodge washes away, the priest cannot use it during the World Renewal Ceremony. If the river is too polluted to bathe in, important purification rituals cannot be performed. If people cannot get enough salmon, or steelhead, or lampreys, their connection with the riverscape is diminished.

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consultants did not make this distinction but reported similar differences between wild and farmed salmon, and all consultants commented on the problem of competition between hatchery-raised fish and wild fish, arguing that the wild population is endangered by the release of hatchery fish.

[27] For summary statistics from Federal government sources, see Karuk ethnographic report:77-8

[28] See, for instance, Karuk ethnographic report:57-8

Further, interviews with Yurok tribal elders have made it clear that for Yurok, there is a direct cause and effect between the dams and the conditions on the River and impairments to the fishery and Yurok way of life:

> ***I think Iron Gate has a lot to do with the Klamath River because what it's doing is during these slack years when there is less water, that algae builds up in the bottom of swimming ponds, well that's the same thing that's happening up there now and we're getting this fertilizer and stuff from them farms building up on the floor of these little reservoirs. It is building up thick and then we get a little high water and they hold the water back. They hold the water back because they're trying to keep their water level in the reservoirs which cuts it short from going into the ocean. Then it just builds up and finally we get our weather and they say, 'Okay, we hit our level,' and they turn it loose. Then they open the gates and all we get is that slush and cow shit and debris from them reservoirs and it's pouring into our water and there is that white foamy stuff on the top of the water and this algae that is so thick you can't even walk in it and it's no good for the fish. It's no good for the wildlife. It's no good for nothing. And anymore even if we do have a high water it doesn't flush it. It goes down the little channels where the water is supposed to be and all this algae is on the sides and it floats up and goes down to where the fish are and never goes away. There it is. That has a lot of effect on our river.***
>
> ***The River used to have high winter flows. People would move around in the winter. The River would rise 40-50 feet every year in peak flows. Walt recalls high water and flood events in 1955, 1964, and 1974. High water events removed silt and sediments and large woody debris from the river. Now the flows are not high enough to float out the big logs over the riffles or clear out the gravel and sediments that pile up at the mouths of the creeks. The construction of dams on the Klamath and the Trinity Rivers had a big impact on the River and its annual flow. Walt stated that a significant decline in fish population was evident after the construction of the dams.***
>
> **(Walt McCovey Jr., 2003)**

In his 2004 analysis, Thomas King concludes the following:

> The Klamath Riverscape *is* the physical cultural environment of the tribes, and that its health is intimately related to the health of their less tangible cultural institutions. The Klamath Riverscape, the river itself, and its fish would be key cultural resources for the tribes even if they were not eligible for the National Register. To the extent the dams contribute to the pattern of cumulative impacts on the riverscape, they have an adverse effect on the integrity of these resources, which must be considered in project review under NEPA.

It remains the position of the Yurok Tribe that the only resolution of these long standing violations of Yurok sovereignty, the depletion and degradation of Yurok Trust Resources and the actual fulfillment of the federal government's Trust Responsibility to the Yurok

Tribe and its members requires the full removal of the 4 Klamath River dams and the implementation of the KBRA and KHSA all leading to the restoration of the Klamath River its ecosystem and its fishery. This report has been prepared for the purposes of providing citations, references, data and evidence that will assist the Department of the Interior, the Secretary of the Interior and all federal agencies engaged in the Secretarial Determination Process and the ongoing NEPA/CEQA process in making a sound and informed decision on these important matters of vital interest to the Yurok Tribe.

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XII. Attachments

A. 1851 Treaty with the Poh-lik-lah
B. 1973 USC 412 US 481 Mattz v. Arnett
C. 1993 DOI Solicitors Opinion: Fishing Rights of the Yurok and Hoopa Valley Tribes
D. 2006 DOI Cooperative Agreement: Cooperative Management of Tribal and Federal Lands and Resources in the Klamath River Basin in California

A. 1851 Treaty with the Poh-lik-lah

In testimony whereof, the parties have hereunto signed their names and affixed their seals this eighteenth day of September, in the year of our Lord one thousand eight hundred and fifty-one.

O. M. WOZENCRAFT,
United States Indian Agent.

For and on behalf of the Cu-lu:

MI-ON-QUISH, his x mark. [SEAL.]

For and in behalf of the Tan-ok:

SAN-TEA-GO, his x mark. [SEAL.]

For and in behalf of the Loc-lum-ne:

POL-TUCK, his x mark. [SEAL.]

For and in behalf of the Wo-pum-nee:

HIN-COY-E, his x mark. [SEAL.]
MAT-TAS, his x mark. [SEAL.]
HOL-LOH, his x mark. [SEAL.]
BOY-ER, his x mark. [SEAL.]

Signed, sealed and delivered, after being fully explained, in presence of—
FLAVEL BELCHER.
J. B. McKINNEY.
WILLIAM REDAR.

TREATY WITH THE POHLIK OR LOWER KLAMATH, ETC., 1851.

TREATY MADE AND CONCLUDED AT CAMP KLAMATH, AT THE JUNCTION OF KLAMATH AND TRINITY RIVERS, STATE OF CALIFORNIA, OCTOBER 6, 1851, BETWEEN REDICK MCKEE, INDIAN AGENT ON THE PART OF THE UNITED STATES, AND THE CHIEFS, CAPTAINS AND HEAD MEN OF THE POHLIK OR LOWER KLAMATH, &C., TRIBES OF INDIANS.

October 6, 1851.
Proclaimed

A treaty of peace and friendship made and concluded at Camp Klamath, at the junction of the Klamath and Trinity rivers, between Redick McKee, one of the Indian agents specially appointed to make treaties with the various Indian tribes in California, on the part of the United States, and the chiefs, captains, and head men of the tribes or bands of Indians now in council at this camp, representing the Pah-lik or lower Klamath, the Pah-taick or upper Klamath, and the Hoo-pah or Trinity river Indians; containing also stipulations preliminary to future measures to be recommended for adoption, on the part of the United States.

ARTICLE 1. The said tribes or bands acknowledge themselves, jointly and severally under the exclusive jurisdiction, authority and protection of the United States; and hereby bind themselves to refrain hereafter from the commission of all acts of hostility or aggression towards the government or citizens thereof, and to live on terms of peace and friendship among themselves, and with all other Indian tribes which are now or may hereafter come under the protection of the United States.

ART. 2. Lest the peace and friendship established between the United States and the said tribes should be interrupted by the misconduct of individuals, it is expressly agreed that, for injuries received on either side, no private revenge or retaliation shall take place or be attempted; but instead thereof, complaints shall be made by the party aggrieved to the other, through the Indian agent of the United States in their district, whose duty it shall be to investigate, and, if practicable, adjust the difficulty; or, in case of acts of violence being committed upon the person or property of a citizen of the United States by an Indian or Indians belonging to or harbored by either of said tribes or bands, the party or parties charged with the commission of the crime shall be promptly delivered up when demanded, to the civil authorities of the State of California for trial; and in case the crime has been committed by a citizen or citizens of the United States upon the person or property of an Indian or Indians of either of said tribes, the agent shall take all proper measures to bring the offender or offenders to trial in the same way.

ART. 3. The said tribes or bands hereby jointly and severally relinquish, cede, and forever quit claim to the United States, all their right, title, claim or interest of any kind which they or either of them have to lands or soil in California.

ART. 4. To promote the settlement and improvement of said tribes or bands, it is hereby stipulated and agreed, on the part of the United States, that the following tract or district of land shall be appropriated and set apart as an Indian reservation, and the use and possession thereof forever guaranteed to the said tribes, their successors, and to such other tribes as the United States may hereafter remove from other parts of the valleys of the Trinity or Klamath rivers, or the country adjacent, and settle thereupon, to wit: commencing at the mouth of a stream called John's creek, emptying into Trinity river on the north side thereof, about fourteen miles above this camp; thence running up the middle of the same with its windings, to a distance of five miles; thence north to the summit of the dividing ridge between the waters of the Trinity and Klamath rivers; thence northwestwardly in a straight line to a point on said Klamath river opposite the lower end of what is now known as "Red Cap's" bar; thence due west to the summit of the first ridge lying beyond the Klamath river; thence southwestwardly along the summit of said ridge to a point due north of the mouth of Pine creek; thence south to the mouth of Sand creek; thence up Pine creek with its windings, to a point due south of the place of beginning; and thence north to said place of beginning. The said reservation including, by estimation, a tract twenty miles in length by twelve miles in width, and containing in all six or seven square miles of farming land. It is, however, understood and agreed that the United States reserves the right of way over said lands, and of using for farming purposes any quantity thereof not exceeding one thousand acres; also the right to establish such military posts, erect such buildings, and make such improvements for the accommodation of their agent and other officers or servants as the President may direct; also that said tribes or bands shall never sell or alienate their right or claim to any part thereof, except to the United States, nor shall they ever lease to or permit white men to settle, work or trade upon any part thereof without the written permission of the United States Indian agent for the district.

ART. 5. It is further stipulated and agreed that the said tribes or bands shall, within three years from the date hereof, or sooner, if thereto required by the United States, remove to and settle upon said reservation; and that whenever said removal and settlement shall be ordered by the United States or made by said tribes, such farmers, mechanics, and school teachers to instruct them in the language, arts, and agriculture of the whites as the President may deem expedient and proper, shall be assigned, provided for, and settled among them, so as to place the Indians on said reservation in a situation as favorable for their improvement (being in like manner supplied with facilities for farming, stock-raising, &c.,) as by the treaty of La-qui-yu-ma on the 20th day of August, 1851, is stipulated to be assigned to and provided for the *Clear Lake Indians*. It is understood, however, that if upon examination by the Indian agent it is found that any of the articles or supplies provided in said treaty for the Clear Lake Indians shall be unnecessary for or unsuited to the Indians on the Trinity and Klamath, the President may in his discretion withhold the same, and invest the value thereof in other and more suitable goods. And it is further expressly agreed and understood that if either of said tribes or bands, or other Indians harbored by them shall be guilty of theft, robbery or murder, either upon the persons and property of Indians or whites, the United States may exclude such tribe or band from all the benefits of this treaty.

ART. 6. As early as convenient after the ratification of this treaty by the President and Senate, the United States will deliver to the said Klamath and Trinity Indians, through their agent, during each of the years 1852 and 1853, viz: five hundred pairs two and a half point Mackinaw blankets, five hundred pairs strong cotton pantaloons, five hundred cotton (hickory) shirts, five hundred red flannel shirts, five hundred strong cotton or linsey gowns, three thousand yards of calico, three thousand yards of four-fourths brown sheetings, thirty pounds Scotch thread, five thousand needles, six dozen pairs scissors, two gross thimbles, ten pounds pins, ten dozen nine-inch flat files, thirty-five dozen large size butcher knives, ten mattocks, one hundred garden or corn hoes, two hundred chopping axes, handled, common size, two hundred chopping axes, handled, small size; one hundred shortiron camp kettles, large size; one hundred sheet-iron camp kettles, second size.

It is understood, however, that the agent shall use a sound discretion as to the time when, and the tribes or persons to whom the said goods shall be distributed, having reference to their peaceful disposition and good conduct.

ART. 7. In consideration of the premises, the United States, in addition to the numerous presents of beef, bread, sugar, blankets, shirts, &c., &c., made to said tribes at this camp, will, within sixty days from the date hereof, furnish them free of charge at the ferry of C. W. Durkee, in Klamath river, to enable them to rebuild the houses recently destroyed by the whites, with four dozen chopping axes, handled, ten sacks of hard bread, and four bullocks, sixteen pairs heavy blankets, to be distributed among them by said Durkee, according to their respective losses.

ART. 8. These articles to be binding upon the contracting parties when ratified by the President and Senate of the United States.

In testimony whereof the parties have hereunto signed their names and affixed their seals this sixth day of October, anno Domini 1851.

[SEAL.] REDUCK McKEE,
United States Indian Agent for California.

For and in behalf of the Welch-pack tribe, living at mouth of Trinity:

WUCK-UG-GEA, his x mark. [SEAL.]
WA-PE-SHAW, his x mark. [SEAL.]
SA-SA-MICH, his x mark. [SEAL.]
ES-QUA or AMOS, his x mark. [SEAL.]

For and in behalf of Wah-si tribe, living three miles below mouth of Trinity river:

MO-KU-KUS, his x mark. [SEAL.]

For and in behalf of the Cap-pel tribe:

MAH-ON, his x mark. [SEAL.]

For and in behalf of the Mor-si-ahs:

MAH-ON, his x mark. [SEAL.]
WUS-SUK, his x mark. [SEAL.]
UP-PER-GASH, his x mark. [SEAL.]

For and in behalf of the Sor-a-points:

UP-LA-GO-PUS, his x mark. [SEAL.]
MOO-ROO-KUS, his x mark. [SEAL.]
SA-ET-MA-GRIL, his x mark. [SEAL.]

For and in behalf of the Pak-wan tribe:

CAP-PEL-LA-WAH, his x mark. [SEAL.]

For and in behalf of the Ut-cha-pah tribe, living near the mouth of Bluff creek:

E-NE-NUCK, his x mark. [SEAL.]
MOW-WE-GUET, his x mark. [SEAL.]

For and in behalf of the Up-pa-goines, living near "Red Cap's" bar, on Klamath river:

KEE-CHAP, his x mark. [SEAL.]
RED CAP or MIK-KU-KEE his x mark. [SEAL.]

For and in behalf of the Sa-von-ra tribe:

SA-VON-RA, his x mark. [SEAL.]
UP-PA-GRAH, his x mark. [SEAL.]
EX-FIN-E-FAH, his x mark. [SEAL.]

For and in behalf of Cham-sucks-nee tribe:

KA-TOP-KO-RISH, his x mark. [SEAL.]

For and in behalf of the Coc-kes-nan tribe:

PA-NA-MO-NEE, his x mark. [SEAL.]

For and in behalf of the Chee-nah tribe, living ten miles below mouth of Salmon river:

AK-KA-REE-TA, his x mark. [SEAL.]

For and in behalf of the Hoo-pahs or Trinity river Indians, residing in twelve rancherias or villages:

Principal chief, AH-SOOK-KOS, his x mark. [SEAL.]
TE-NAS-TE-AH or JOHN, his x mark. [SEAL.]
MET-POOKA-TA-MAH, his x mark. [SEAL.]
NIC-A-WA-EN-NA, his x mark. [SEAL.]
WASH-TEN, his x mark. [SEAL.]

Signed, sealed and delivered, after being duly explained, in presence of—

JOHN MCKEE, *Secretary.*
C. W. DUNBAR,
GEORGE GIBBS,
Interpreters.
H. W. WESSELLS, *Brevet Major, U. S. A., commanding escort.*
WALTER VAN DYKE,
GEO. W. KELLOGGETT,
MORRIS S. THOMPSON,
WALTON MCDONALD,
Interpreters.

ARTICLE SUPPLEMENTARY TO THE FOREGOING TREATY.

The undersigned chiefs, captains and head men of the Si-wah, Op-po-o, He-ko-nook and In-nook tribes or bands of Indians, residing at and near to the mouth of the Cor-a-tem or Salmon river, having had the terms and stipulations of the foregoing treaty, concluded at Durken's ferry on the 6th instant, fully explained to them by Redick McKee, Indian agent of the United States, having expressed an earnest desire to become parties to the said treaty in all its articles and stipulations, it is therefore agreed by and between the said agent and the said chiefs, &c., that the said bands be and hereby are admitted as parties to the same, and to the advantages thereof, and become bound by the stipulations therein contained as fully in all respects as if they had been parties thereto originally.

In testimony whereof the parties have hereunto signed their names and affixed their seals at Camp Cor-a-tem, near mouth of Salmon river, this twelfth day of October, anno Domini, 1851.

[SEAL.] REDICK MCKEE,
United States Indian Agent.

For and in behalf of the Si-wah band:

ESSE-PISH-I-A, his x mark. [SEAL.]
RES-SOW, his x mark. [SEAL.]
CHEE-FEE-CHA, his x mark. [SEAL.]
PI-RA-TEEM, his x mark. [SEAL.]

For and in behalf of the Op-po-o band:

CA-POH-U-PUCK, his x mark [SEAL.]
PECK-NEETS, his x mark. [SEAL.]

For and in behalf of the He-ko-nook band:

YAH-FEE-PAH, his x mark.
HOSS-A-PUCK-IP-MA his x mark [SEAL.]

For and in behalf of the In-nook band:

SISH-KAH, his x mark. [SEAL.]

Signed, sealed and delivered after the foregoing treaty of 6th instant, and this addenda had been fully explained in presence of—

JOHN MCKEE, *Secretary.*
C. W. DUNBAR, *Interpreter.*
GEORGE GIBBS.
H. W. WESSELLS, *Brevet Major U. S. A., commanding escort.*
JOHN S. GRIFFIN, *Assistant Surgeon U. S. A.*
WALTER MCDONALD.

Klamath River Reserve.

DEPARTMENT OF THE INTERIOR,
Office of Indian Affairs, November 10, 1855.

SIR: Referring to your communication of the 8th of August last to the Acting Commissioner of Indian Affairs, advising him of the approval by the President of the United States of the recommendation of the Department that it was expedient to expend the money appropriated on the 3rd of March last for removing the Indians in California to two additional military reservations, I have the honor now to make the following report:

On the 15th of August last the Acting Commissioner inclosed a copy of your letter of the 8th of that month to the superintendent of Indian affairs in California, with directions to select these reservations from such "tracts of land adapted as to soil, climate, water-privileges, and timber, to the comfortable and permanent accommodation of the Indians, which tracts should be unincumbered by old Spanish grants or claims of recent white settlers," limiting the dimensions of the reserves to within 25,000 acres each, and to report to this office a description of their geographical position in relation to streams, mountain ranges, and county lines, etc., and indicating the same upon a map. A copy of that letter is herewith, marked A. By the last mail from California, I have received from Superintendent Thomas I. Henley a report upon this subject, dated the 4th ultimo (a copy of which is herewith, marked B), by which it appears he recommends as one of the reservations aforesaid "a strip of territory one mile in width on each side of the (Klamath) river, for a distance of 20 miles." The superintendent remarks upon the character of the country selected, and incloses an extract from a report (also herewith, marked C) to him of the 19th of June last, by Mr. S. G. Whipple, which contains in some detail a description of the country selected, habits and usages of the Indians, etc., but no map is furnished.

It will be observed from this report of the superintendent that he has deemed it important to continue the employ of an agent and to prepare for raising a crop in order to assure the Indians of the good faith of the Government and to preserve the peace of the country. Considering the great distance of this reserve from the seat of Government and the length of time it necessarily requires to communicate with an agency at the Klamath, it is desirable that some definite action be taken, if practicable, before the sailing of the next steamer, to leave New York on the 20th instant.

I, therefore, beg leave to ask your attention to the subject, and if you shall be of the opinion from the representations made by the superintendent in California and Mr. Whipple that the selection at the mouth of the Klamath River is a judicious and proper one, that it be laid before the President of the United States for his approval, but with the provision, however, that upon a survey of the tract selected that a sufficient quantity be cut off from the upper end of the proposed reserve to bring it within the limitation of 25,000 acres, authorized by the act of 3d March last.

I also inclose herewith a copy of another letter from Superintendent Henley, of 4th ultimo (marked D), in which he states, in relation to the other reserve, that it is intended to locate it "between the headwaters of Russian River and Cape Mendocino." In reference to both of these proposed reserves, and as connected with the means to be used to maintain peacable relations with the Indians, the superintendent is of opinion that it is of great importance to provide for crops, and that to do so an agent in each instance is necessary. As this last-named selection has not been defined by any specific boundaries, and no sufficient description is given as to soil, climate, and suitableness for Indian purposes, to enable the Department to determine the matter under-

standingly, of course nothing definite can now be done. But it may not be improper to consider the subject in connection with the general intent as to the particular locality in which it is proposed to make the location.

The reserve proposed on the Klamath River and Pacific coast does not appear from the map of the State of California to be very far removed from Cape Mendocino, or a point between that and Russian River; and as provision is made only for two reserves in the State other than those already in operation, the question arises whether it should not be situated farther in the interior, or perhaps eastern part of the State, than the point referred to. The Noome Lacke Reserve is situated in one of the Sacramento valleys, at about the latitude of 40 degrees north and 122 degrees of longitude west, about the center of that portion of the State north of the port of San Francisco. As, therefore, the proposed Klamath Reserve, being northwest from the Noome Lacke Reservation, would appear to be adapted to the convenient use of the Indians in that direction, the question is suggested whether the other reserve should not be located farther east and north, say on the tributaries of either Pitt or Feather Rivers. As in the case of the proposed reserve of the Klamath, I am desirous of obtaining your opinion and that of the President of the United States, with such decision as may be arrived at under the circumstances, in season to communicate the same by the next California mail, for the government of the action of superintendent Henley.

Very respectfully, your obedient servant,

GEO. W. MANYPENNY,
Commissioner.

Hon. R. MCCLELLAND,
Secretary of the Interior.

DEPARTMENT OF THE INTERIOR,
Washington, D. C., November 12, 1855.

SIR: I have the honor to submit herewith the report from the Commissioner of Indian Affairs of the 10th instant, and its accompanying papers, having relation to two of the reservations in California for Indian purposes, authorized by the act of 3d March last.

The precise limits of but one of the reservations, viz, a strip of territory commencing at the Pacific Ocean and extending 1 mile in width on each side of the Klamath River, are given, no sufficient data being furnished to justify any definite action on the other.

I recommend your approval of the proposed Klamath Reservation, with the provision, however, that upon a survey of the tract a sufficient quantity be cut off from the upper end thereof to bring it within the limit of 25,000 acres authorized by law.

Respectfully, your obedient servant,

R. MCCLELLAND,
Secretary.

The PRESIDENT.

Let the reservation be made, as proposed.

FRANKLIN PIERCE.

NOVEMBER 16, 1855.

Mendocino Reserve.

DEPARTMENT OF THE INTERIOR,
Office of Indian Affairs, April 16, 1856.

SIR: Referring to the report I had the honor to submit for your consideration on the 10th of November last, relative to the establishment

B. 1973 USC 412 US 481 Mattz v. Arnett

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Supreme Court of the United States Cases

MATTZ v. ARNETT, 412 U.S. 481 (1973)

412 U.S. 481
Case Number: 71-1182
Decided: 01/01/1900
United States Supreme Court

Cite as: 1973 US, 412 U.S. 481, ___ ___

U.S. Supreme Court

MATTZ v. ARNETT, 412 U.S. 481 (1973)

412 U.S. 481

MATTZ v. ARNETT, DIRECTOR, DEPARTMENT OF FISH AND GAME
CERTIORARI TO THE COURT OF APPEAL OF CALIFORNIA, FIRST APPELLATE DISTRICT

No. 71-1182.

Argued March 27-28, 1973
Decided June 11, 1973

Petitioner, a Yurok, or Klamath River, Indian, intervened in a forfeiture proceeding, seeking the return of five gill nets confiscated by a California game warden. He alleged that the nets were seized in Indian country, within the meaning of 18 U.S.C. 1151, and that the state statutes prohibiting their use did not apply to him. The state trial court found that the Klamath River Reservation in 1892 "for all practical purposes almost immediately lost its identity," and concluded that the area was not Indian country. The State Court of Appeal affirmed, holding that since the area had been opened for unrestricted homestead entry in 1892, the earlier reservation status of the land had terminated. Indian country is defined by 1151 as including "all land within the limits of any Indian reservation under the jurisdiction of the United States Government, not withstanding the issuance of any patent." The Klamath River Reservation was established by Executive Order in 1855 and included the area in question. In 1891, by Executive Order, the Klamath River Reservation was made part of the Hoopa Valley Reservation. The Act of June 17, 1892, provided that "all of the lands embraced in what was Klamath River Reservation" reserved under the 1855 Executive Order, are "declared to be subject to settlement, entry, and purchase under the laws of the United States granting homestead rights . . . Provided, That any Indian now located upon said reservation may, at any time within one year . . . apply to the Secretary of the Interior for an allotment of land . . . . And the Secretary of the Interior may reserve from settlement, entry, or purchase any tract . . . upon which any village or settlement of Indians is now located, and may set apart the same for the permanent use and occupation of said village or settlement of Indians." The Act further provided that proceeds from the sale of the lands "shall constitute a fund . . . for the maintenance and education of the Indians now residing on said lands and their children." Held: The Klamath River Reservation was not [412 U.S. 481, 482] terminated by the Act of June 17, 1892, and the land within the reservation boundaries is still Indian country, within the meaning of 18 U.S.C. 1151. Pp. 494-506.

(a) The allotment provisions of the 1892 Act, rather than indicating an intention to terminate the reservation, are completely consistent with continued reservation status. Seymour v. Superintendent, 368 U.S. 351 . Pp. 496-497.

(b) The reference in the Act to the Klamath River Reservation in the past tense did not manifest a congressional purpose to terminate the reservation, but was merely a convenient way of identifying the land, which had just recently been included in the Hoopa Valley Reservation. Pp. 498-499.

(c) The Act's legislative history does not support the view that the reservation was terminated, but by contrast with the final enactment, it compels the conclusion that efforts to terminate by denying allotments to the Indians failed completely. Pp. 499-504.

(d) A congressional determination to terminate a reservation must be expressed on the face of the statute or be clear from the

surrounding circumstances and legislative history, neither of which obtained here. Pp. 504-505.

(e) The conclusion that the 1892 Act did not terminate the Reservation is reinforced by repeated recognition thereafter by the Department of the Interior and by the Congress. Congress has recognized the reservation's continued existence by extending, in 1942, the period of trust allotments, and in 1958, by restoring to tribal ownership certain vacant and undisposed-of ceded lands in the reservation. P. 505.

20 Cal. App. 3d 729, 97 Cal. Rptr. 894, reversed and remanded.

BLACKMUN, J., delivered the opinion for a unanimous Court.

Lee J. Sclar argued the cause and filed briefs for petitioner.

Roderick Walston, Deputy Attorney General of California, argued the cause for respondent. With him on the briefs were Evelle J. Younger, Attorney General, and Carl Boronkay, Assistant Attorney General.

Harry R. Sachse argued the cause for the United States as amicus curiae urging reversal. With him on the brief [412 U.S. 481, 483] were Solicitor General Griswold, Assistant Attorney General Frizzell, Carl Strass, and Glen R. Goodsell.

MR. JUSTICE BLACKMUN delivered the opinion of the Court.

Our decision in this case turns on the resolution of the narrow question whether the Klamath River Indian Reservation in northern California was terminated by Act of Congress or whether it remains "Indian country," within the meaning of 18 U.S.C. 1151. [1] When established, the reservation was described as "a strip of territory commencing at the Pacific Ocean and extending 1 mile in width on each side of the Klamath River" [412 U.S. 481, 484] for a distance of approximately 20 miles, encompassing an area not exceeding 25,000 acres. This description is taken from President Franklin Pierce's Executive Order issued November 16, 1855, pursuant to the authority granted by the Act of March 3, 1853, 10 Stat. 226, 238, and the Act of March 3, 1855, 10 Stat. 686, 699. [2]

Petitioner Raymond Mattz is a Yurok, or Klamath River, Indian who, since the age of nine, regularly fished, as his grandfather did before him, with dip, gill, and trigger nets, at a location called Brooks Riffle on the Klamath River. On September 24, 1969, a California game warden confiscated five gill nets owned by Mattz. The nets were stored near Brooks Riffle, approximately 200 feet from the river, and within 20 miles of the river's mouth.

The respondent Director of the Department of Fish and game instituted a forfeiture proceeding in state court. Mattz intervened and asked for the return of his nets. He alleged, among other things, that he was an enrolled member of the Yurok Tribe, that the nets were seized within Indian country, and that the state statutes prohibiting the use of gill nets, Cal. Fish & Game Code 8664, 8686, and 8630, therefore were inapplicable to him. The state trial court, relying on Elser v. Gill Net Number One, 246 Cal. App. 2d 30, 54 Cal. Rptr. 568 (1966), found that the Klamath River Reservation in 1892 "for all practical purposes almost immediately lost its identity," [3] and concluded that the area where the [412 U.S. 481, 485] nets were seized was not Indian country. The court thereby disposed of petitioner's primary defense to the forfeiture. It did not reach other issues bearing upon the application of the California statutes to Indian country and the existence of Indian fishing rights there.

On appeal, the State Court of Appeal affirmed, holding that, inasmuch as the area in question had been opened for unrestricted homestead entry in 1892, the earlier reservation status of the land had terminated. 20 Cal. App. 3d 729, 97 Cal. Rptr. 894 (1971). The Supreme Court of California, one judge dissenting, denied a petition for hearing. See 20 Cal. App. 3d, at 735, 97 Cal. Rptr., at 898. We granted certiorari, 409 U.S. 1124 (1973), because the judgments of the state courts appeared to be in conflict with applicable decisions of this Court.

We now reverse. The reversal, of course, does not dispose of the underlying forfeiture issue. On remand, the questions relating to the existence of Mattz' fishing rights and to the applicability of California law notwithstanding reservation status will be addressed. We intimate no opinion on those issues.

I

While the current reservation status of the Klamath River Reservation turns primarily upon the effect of an 1892 Act of Congress which opened the reservation land for settlement, the meaning and effect of that Act cannot be determined without some reference to the Yurok Tribe and the history of the reservation between 1855 and 1892.

The Yurok Indians apparently resided in the area of the lower Klamath River for a substantial period before 1855 when the Klamath River Reservation was established. Little is known of their prior history. There are sources, however, that provide us with relatively [412 U.S. 481, 486] detailed information about the tribe, its culture, living conditions, and customs for the period following 1855. [4] That the tribe had inhabited the lower Klamath River well before 1855 is suggested by the name. Yurok means "down the river." The

names of the neighboring tribes, the Karok and the Modok, mean, respectively, "up the river" and "head of the river," and these appellations, as would be expected, coincide with the respective homelands. Powers 19; Kroeber 15. [5] [412 U.S. 481, 487]

By the Act of March 3, 1853, 10 Stat. 238, the President was "authorized to make five military reservations from the public domain in the State of California or the Territories of Utah and New Mexico bordering on said State, for Indian purposes." The Act of March 3, 1855, 10 Stat. 699, appropriated funds for "collecting, removing, and subsisting the Indians of California . . . on two additional military reservations, to be selected as heretofore . . . Provided, That the President may enlarge the quantity of reservations heretofore selected, equal to those hereby provided for." President Pierce then issued his order of November 16, 1855, specifying the Klamath River Reservation and stating, "Let the reservation be made, as proposed." Kappler 817.

The site was ideally selected for the Yuroks. They had lived in the area; the arable land, although limited, was "peculiarly adapted to the growth of vegetables," 1856 Report 238; and the river, which ran through a canyon its entire length, abounded in salmon and other fish. Ibid.; 1858 Report 286. [6]

In 1861 nearly all the arable lands on the Klamath River Reservation were destroyed by a freshet, and, upon recommendation of the local Indian agent, some of the Indians were removed to the Smith River Reservation, established for that purpose in 1862. Only a small number of Yuroks moved to the new reservation, however, and nearly all those who did move returned within a few [412 U.S. 481, 488] years to the Klamath River. Crichton v. Shelton, 33 I. D. 205, 208 (1904); Kappler 830; 1864 Report 122. The Smith River Reservation was then discontinued. Act of July 27, 1868, 15 Stat. 198, 221.

The total Yurok population on the Klamath River Reservation in the 1860's cannot be stated with precision. In 1852, based in part on a rough census made by a trader, it was estimated at 2,500. Kroeber 16-17. [7] [412 U.S. 481, 489] The effect of the 1861 flood cannot be firmly established; but it is clear that the tribe remained on the Klamath thereafter. [8] For later years, Kroeber estimated that the population in 1895 was 900, and, in 1910, 668. Kroeber 19. From this it would appear that the flood at least did not cause a dissolution of the tribe; on the contrary, the Yuroks continued to reside in the area through the turn of the century and beyond.

The Act of April 8, 1864, 13 Stat. 39, designated California as one Indian superintendency. It also recited that "there shall be set apart by the President, and at his discretion, not exceeding four tracts of land, within the limits of said state, to be retained by the United States for the purposes of Indian reservations." It further provided that "the several Indian reservations in California which shall not be retained . . . under . . . this act, shall . . . be surveyed into lots or parcels . . . and . . . be offered for sale at public outcry, and thence afterward shall be held subject to sale at private entry." Id., at 40.

At the time of the passage of the 1864 Act there were, apparently, three reservations in California: the Klamath River, the Mendocino, and the Smith River. It appears, also, that the President did not take immediate [412 U.S. 481, 490] action, upon the passage of the Act, to recognize reservations in California. It was not until 1868 that any formal recognition occurred, and then it was the Congress, rather than the President, that acted. In that year Congress discontinued the Smith River Reservation, 15 Stat. 221, and restored the Mendocino to the public lands. Id., at 223. No similar action was taken with respect to the Klamath River Reservation. Crichton v. Shelton, 33 I. D., at 209. Congress made appropriations for the Round Valley Reservation, 15 Stat. 221, and for it and the Hoopa Valley Reservation in 1869, 16 Stat. 37, although neither of these, apparently, had been established theretofore by formal Executive Order. [9]

The Klamath River Reservation, although not reestablished by Executive Order or specific congressional action, continued, certainly, in de facto existence. Yuroks remained on reservation land, and the Department of Indian Affairs regarded the Klamath River Reservation as "in a state of reservation" throughout the period from 1864 to 1891. [10] No steps were taken to sell the reservation, or parts thereof, under the 1864 Act. Indeed, in 1879, all trespassers there were removed by the military. In 1883 the Secretary of the Interior directed that allotments of land be made to the Indians on the reservation. [11] In February 1889, the Senate, by [412 U.S. 481, 491] resolution, directed the Secretary of the Interior "to inform the Senate what proceedings, if any, have been had in his Department relative to the survey and sale of the Klamath Indian reservation . . . in pursuance of the provisions of the act approved April 8, 1864." 20 Cong. Rec. 1818. In response, the Commissioner of Indian Affairs, by letter dated February 18, 1889, to the Secretary disclosed that no proceedings to this effect had been undertaken. [12] An Assistant Attorney General for the Department of the Interior expressed a similar view in an opinion dated January 20, 1891. [13] [412 U.S. 481, 492]

In 1888, in a forfeiture suit, the United States District Court for the Northern District of California concluded that the area within the Klamath River Reservation was not Indian country, within the meaning of Rev. Stat. 2133, prescribing the penalty for unlicensed trading in Indian country. The court concluded that the land composing the reservation was not retained or recognized as reservation land pursuant to the 1864 Act and that, therefore, it no longer constituted an Indian reservation. United States v. Forty-eight Pounds of Rising Star Tea, 35 F. 403 (ND Cal. 1888). This holding was expressly affirmed on appeal to a circuit judge. 38 F. 400 (CCND Cal. 1889). The Assistant Attorney General, in the opinion referred to above, conceded the probable correctness of the judgment but was not convinced that his own views were erroneous, and he could not assent to the reasoning of the court. He felt that the court's comments as to the abandoned status of the reservation "were dicta and not essential to the decision of the case before the court."

Crichton v. Shelton, 33 I. D., at 215.

Thus, as of 1891, it may be fair to say that the exact legal status of the Klamath River Reservation was obscure and uncertain. The petitioner in his brief here, [412 U.S. 481, 493] p. 14, states that the reservation "ceased to exist in 1876, at the latest."

Any question concerning the reservation's continuing legal existence, however, appears to have been effectively laid to rest by an Executive Order dated October 16, 1891, issued by President Benjamin Harrison. [14] By the specific terms of that order, the Hoopa Valley Reservation, which, as we already have noted, was located in 1864 and formally set apart in 1876, and which was situated about 50 miles upstream from the Klamath River's mouth, was extended so as to include all land, one mile in width on each side of the river, from "the present limits" of the Hoopa Valley Reservation to the Pacific Ocean. The Klamath River Reservation, or what had been the reservation, thus was made part of the Hoopa Valley Reservation, as extended.

The reason for incorporating the Klamath River Reservation in the Hoopa Valley Reservation is apparent. The 1864 Act had authorized the President to "set apart" no more than four tracts for Indian reservations in California. By 1876, and certainly by 1891, four reservations already had been so set apart. These were the Round Valley, referred to above, the Mission, [15] the Hoopa [412 U.S. 481, 494] Valley, and the Tule River. Kappler 830-831. Thus, recognition of a fifth reservation along the Klamath River was not permissible under the 1864 Act. Accordingly, the President turned to his authority under the Act to expand an existing, recognized reservation. He enlarged the Hoopa Valley Reservation to include what had been the Klamath River Reservation as well as an intervening riparian strip connecting the two tracts. [16] The President's continuing authority so to enlarge reservations and, specifically, the legality of the 1891 Executive Order, was affirmed by this Court in Donnelly v. United States, 228 U.S. 243, 255 -259 (1913), reh. denied, 228 U.S. 708 , and is not challenged here.

II

This general background as to the origin and development of the Klamath River Reservation is not contested by either party. The reservation's existence, pursuant to the Executive Order of 1891, is conceded. The present controversy relates to its termination subsequent to 1891, and turns primarily upon the effect of the Act of June 17, 1892, 27 Stat. 52, entitled "An act to provide for the [412 U.S. 481, 495] disposition and sale of lands known as the Klamath River Indian Reservation." This Act provided:

> "That all of the lands embraced in what was Klamath River Reservation in the State of California, as set apart and reserved under authority of law by an Executive order dated November sixteenth, eighteen hundred and fifty-five, are hereby declared to be subject to settlement, entry, and purchase under the laws of the United States granting homestead rights and authorizing the sale of mineral, stone, and timber lands: Provided, That any Indian now located upon said reservation may, at any time within one year from the passage of this act, apply to the Secretary of the Interior for an allotment . . . . And the Secretary of the Interior may reserve from settlement, entry, or purchase any tract or tracts of land upon which any village or settlement of Indians is now located, and may set apart the same for the permanent use and occupation of said village or settlement of Indians. . . . Provided further, That the proceeds arising from the sale of said lands shall constitute a fund to be used under the direction of the Secretary of the Interior for the maintenance and education of the Indians now residing on said lands and their children."

The respondent Director argues that this statute effected the termination of the Klamath River Reservation. The petitioner urges the contrary. It is our task, in light of the language and purpose of the Act, as well as of the historical background, outlined above, to determine the proper meaning of the Act and, consequently, the current status of the reservation. [412 U.S. 481, 496]

The respondent relies upon what he feels is significant language in the Act and upon references in the legislative history. He contends, "The fact that the lands were to be opened up for settlement and sale by homesteaders strongly militates against a continuation of such reservation status." Brief for Respondent 3.

We conclude, however, that this is a misreading of the effect of the allotment provisions in the 1892 Act. The meaning of those terms is to be ascertained from the overview of the earlier General Allotment Act of 1887, 24 Stat. 388. That Act permitted the President to make allotments of reservation lands to resident Indians and, with tribal consent, to sell surplus lands. Its policy was to continue the reservation system and the trust status of Indian lands, but to allot tracts to individual Indians for agriculture and grazing. When all the lands had been allotted and the trust expired, the reservation could be abolished. [17] Unallotted lands were made available to non-Indians with the purpose, in part, of promoting interaction between the races and of encouraging Indians to adopt white ways. See 6 of the General Allotment Act, 24 Stat. 390; United States Department of the Interior, Federal Indian Law 115-117, 127-129, 776-777 (1958). [18] [412 U.S. 481, 497] Under the 1887 Act, however, the President was not required to open reservation land for allotment; he merely had the discretion to do so.

In view of the discretionary nature of this presidential power, Congress occasionally enacted special legislation in order to assure that a particular reservation was in fact opened to allotment. [19] The 1892 Act was but one example of this. Its allotment provisions, which do not differ materially from those of the General Allotment Act of 1887, and which in fact refer to the earlier Act, do not,

alone, recite or even suggest that Congress intended thereby to terminate the Klamath River Reservation. See Seymour v. Superintendent, 368 U.S. 351, 357-358 (1962). Rather, allotment under the 1892 Act is completely consistent with continued reservation status. This Court unanimously observed, in an analogous setting in Seymour, id., at 356, "The Act did no more [in this respect] than open the way for non-Indian settlers to own land on the reservation in a manner which the Federal Government, acting as guardian and trustee for the Indians, regarded as beneficial to the development of its wards." See United States v. Celestine, 215 U.S. 278 (1909); United States v. Nice, 241 U.S. 591 (1916). See also Wilbur v. United States, 281 U.S. 206 (1930); Donnelly v. United States, 228 U.S. 243 (1913).

III

The respondent further urges, however, that his view of the effect of the 1892 Act is supported by the Act's reference [412 U.S. 481, 498] to "what was [the] Klamath River Reservation." According to the respondent, this reference, and other references in the legislative history, compel the conclusion that Congress intended to terminate the reservation in 1892.

The 1892 Act, to be sure, does refer to the Klamath River Reservation in the past tense. But this is not to be read as a clear indication of congressional purpose to terminate. Just a few weeks before the bill (H. R. 38, 52d Cong., 1st Sess.), which eventually became the Act, was reported out of committee on February 5, 1892, H. R. Rep. No. 161, 52d Cong., 1st Sess., the President had formally extended the Hoopa Valley Reservation to include the Klamath River Reservation. And only that portion of the extension which had been the Klamath River Reservation was the subject of the 1892 Act. The reference to the Klamath River Reservation in the past tense seems, then, merely to have been a natural, convenient, and shorthand way of identifying the land subject to allotment under the 1892 Act. [20] We do not believe [412 U.S. 481, 499] the reference can be read as indicating any clear purpose to terminate the reservation directly or by innuendo.

The respondent also points to numerous statements in the legislative history that, in his view, indicate that the reservation was to be terminated. We need not refer in detail to the cited passages in H. R. Rep. No. 161, supra, or to the debates on the bill, 23 Cong. Rec. 1598-1599, 3918-3919 (1892), for there is no challenge here to the view that the House was generally hostile to continued reservation status of the land in question. In our estimation, however, this very fact, in proper perspective, supports the petitioner and undermines the respondent's position.

As early as 1879, there were efforts in Congress to abolish the Klamath River Reservation. From that date to 1892 strong sentiment existed to this effect. But it does not appear that termination ever commanded majority support. The advocates of termination argued that the reservation, as of 1879, long had been abandoned; that the land was useless as a reservation; and that many white settlers had moved on to the land and their property should be protected. See H. R. Rep. No. 1354, 46th Cong., 2d Sess., 5 (1880). That whites had settled there is clear, but the view that no Indians remained after the flood of 1861 appears to have been a gross misconception on the part of those who sought termination. [21] [412 U.S. 481, 500]

The first bill providing for public entry and sale of the Klamath River Reservation was introduced in the Senate on May 28, 1879. S. Res. 34, 46th Cong., 1st Sess.; 9 Cong. Rec. 1651. The resolution referred to the reservation's having been "abandoned" in 1855 "and the tribe removed to another reservation established for its use." No action was taken on the bill, and another, of the same purport, was introduced on January 12, 1880, in the House. H. R. 3454, 46th Cong., 2d Sess.; 10 Cong. Rec. 286. This bill provided that the reservation "be, and the same is hereby, abolished," and authorized and directed the Secretary of the Interior to survey the lands and have them made subject to homestead and preemption entry and sale "the same as other public lands." It is clear from the report on this second bill, H. R. Rep. No. 1354, supra, at 1-5, that the establishment of the reservation in 1855 was viewed as a mistake and an injustice. According to the Report, the reservation had been abandoned after the 1861 freshet, and the Indians had moved to the Smith River and, later, the Hoopa Valley Reservations. White settlers had moved in and wished to exploit the lumber and soil of the area which, some said, "has no equal in California as a fruit and wine growing country." Id., at 5. Inasmuch as the reservation blocked access to the river, the resources of the area could not be developed. Although unmentioned in that Report, the Office of Indian Affairs opposed the bill. See H. R. Rep. No. 1148, 47th Cong., 1st Sess., 1 (1882). The bill as reported was recommitted and no further action was taken. 10 Cong. Rec. 3126 (1880).

An identical bill was introduced in the following Congress. H. R. 60, 47th Cong., 1st Sess.; 13 Cong. Rec. 90 (1881). The Commissioner of Indian Affairs opposed the bill as introduced, but stated that he would not opposed it if provision for prior allotments to the Indians was made. H. R. Rep. No. 1148, supra, at 2. The [412 U.S. 481, 501] Commissioner's proposed amendment was approved by the Committee, 13 Cong. Rec. 3414 (1882), but no action on the bill was taken by the full House.

In 1883 and 1884 three more bills were introduced. It is of interest to note that each acceded to the request of the Commissioner that provision be made for prior allotments to resident Indians. H. R. 112, 48th Cong., 1st Sess.; 15 Cong. Rec. 62 (1883); S. 813, 48th Cong., 1st Sess.; 15 Cong. Rec. 166 (1883); H. R. 7505, 48th Cong., 1st Sess.; 15 Cong. Rec. 5923 (1884). Each bill would have "abolished" the reservation and would have made the land subject to homestead and pre-emption entry. None of the bills was enacted, although passage must have been generally regarded as likely, for the Indian Bureau in 1883 began the work of allotment and survey, perhaps in anticipation of passage.

In 1885 two bills were introduced in the House. Each was substantially identical to those introduced in 1883 and 1884. H. R. 158 and H. R. 165, 49th Cong., 1st Sess.; 17 Cong. Rec. 370 (1885). No action was taken on either bill.

No further bills, apparently, were introduced until 1889. During the intervening period, however, the General Allotment Act of 1887, 24 Stat. 388, was passed and thereafter amended, 26 Stat. 794. The Rising Star Tea case, 35 F. 403, was also decided.

In 1889 a bill providing for the allotment of the Klamath River Reservation was introduced. The allotments, however, were to be made in a manner inconsistent with the General Allotment Act. H. R. 12104, 50th Cong., 2d Sess.; 20 Cong. Rec. 756 (1889). And after affirmance of the Rising Star Tea case by the circuit court, 38 F. 400 (1889), identical bills were introduced in the House and the Senate providing, without mention of allotment, that "all of the lands embraced in what was Klamath River Reservation . . . are hereby declared [412 U.S. 481, 502] to be subject to settlement, entry, and purchase" under the land laws. H. R. 113, 51st Cong., 1st Sess.; 21 Cong. Rec. 229 (1889); S. 2297, 51st Cong., 1st Sess.; 21 Cong. Rec. 855 (1890). The Indian Office opposed the bills, recommending that they be amended to provide for allotments to the Indians under the General Allotment Act, that surplus lands be restored to the public domain, and that the proceeds be held in trust for the Klamath River Indians. See Short v. United States, No. 102-63, pp. 44-45 (Report of Commissioner, Court of Claims, 1972). H. R. 113 was reported out of committee with certain amendments, including one to the effect that proceeds arising from the sale of lands were to be used for the "removal, maintenance, and education" of the resident Indians, the Hoopa Valley Reservation being considered the place of removal. Allotments to the Indians on the Klamath Reservation, however, were emphatically rejected. H. R. Rep. No. 1176, 51st Cong., 1st Sess., 2 (1890). The bill was so amended and passed the House. 21 Cong. Rec. 10701-10702 (1890). It died in the Senate.

In light of the passage of this last bill in the House and the presence of the Rising Star Tea opinions, the Indian Department moved to have the Klamath River Reservation land protected for the Indians residing there. The details of this effort, including the opinion of the Assistant Attorney General, referred to above, are outlined in the Commissioner's report in Short v. United States, supra, at 45-50. These efforts culminated in President Harrison's Executive Order of October 1891 expanding the Hoopa Valley Reservation to include the Klamath River Reservation.

It is against this background of repeated legislative efforts to terminate the reservation, and to avoid allotting reservation lands to the Indians, that the 1892 Act was introduced. H. R. 38, 52d Cong., 1st Sess.; 23 Cong. [412 U.S. 481, 503] Rec. 125 (1892). The bill provided for the settlement, entry, and purchase of the reservation land and specified that the proceeds should be used for the "removal, maintenance, and education" of the resident Indians. No allotments were provided for, as the Indians were "semicivilized, disinclined to labor, and have no conception of land values or desire to cultivate the soil." H. R. Rep. No. 161, 52d Cong., 1st Sess., 1 (1892). The House Committee on Indian Affairs amended the bill by changing the word "and" to "or" in the proviso relating to the use of proceeds. Id., at 2.

The bill passed the House without change. 23 Cong. Rec. 1598-1599 (1892). It was struck out in the Senate, however, and another version was substituted deleting reference to the removal of the Indians and providing that before public sale the land should be allotted to the Indians under the General Allotment Act of 1887, as amended. Id., at 3918-3919. This substitute measure had the support of the Interior Department. Id., at 3918. The Senate called for a conference with the House, id., at 3919, and the conference adopted the Senate version with amendments. Sen. Misc. Doc. No. 153, 52d Cong., 1st Sess. (1892). The bill was then passed and became the 1892 Act.

IV

Several conclusions may be drawn from this account. First, the respondent's reliance on the House Report and on comments made on the floor of the House is not well placed. Although the primary impetus for termination of the Klamath River Reservation had been with the House since 1871, this effort consistently had failed to accomplish the very objectives the respondent now seeks to achieve. Likewise, the House in 1892 failed to accomplish these objectives, for the Senate version, supported by the Interior Department, was substituted for that of [412 U.S. 481, 504] the House. The Senate version, ultimately enacted, provided for allotments to the Indians and for the proceeds of sales to be held in trust for the "maintenance and education," not the removal, of the Indians. The legislative history relied upon by the respondent does not support the view that the reservation was terminated; rather, by contrast with the bill as finally enacted, it compels the conclusion that efforts to terminate the reservation by denying allotments to the Indians failed completely.

A second conclusion is also inescapable. The presence of allotment provisions in the 1892 Act cannot be interpreted to mean that the reservation was to be terminated. This is apparent from the very language of 18 U.S.C. 1151, defining Indian country "notwithstanding the issuance of any patent" therein. More significantly, throughout the period from 1871-1892 numerous bills were introduced which expressly provided for the termination of the reservation and did so in unequivocal terms. Congress was fully aware of the means by which termination could be effected. But clear termination language was not employed in the 1892 Act. This being so, we are not inclined to infer an intent to terminate the reservation. [22] The Court stated in United States v. Celestine, 215 U.S., at 285, that "when Congress has [412 U.S. 481, 505] once established a reservation all tracts included within it remain a part of the reservation until separated therefrom by Congress." A congressional determination to terminate must be expressed on the face of the Act or be clear from the surrounding circumstances and legislative history. See Seymour v. Superintendent, 368 U.S. 351 (1962);

United States v. Nice, 241 U.S. 591 (1916). [23]

Finally, our conclusion that the 1892 Act did not terminate the Klamath River Reservation is reinforced by repeated recognition of the reservation status of the land after 1892 by the Department of the Interior and by Congress. In 1904 the Department, in Crichton v. Shelton, 33 I. D. 205, ruled that the 1892 Act reconfirmed the continued existence of the reservation. In 1932 the Department continued to recognize the Klamath River Reservation, albeit as part of the Hoopa Valley Reservation, [24] and it continues to do so today. And Congress has recognized the reservation's continued existence by extending the period of trust allotments for this very reservation by the 1942 Act, described above, 25 U.S.C. 348a, and by restoring to tribal ownership certain vacant and undisposed-of ceded lands in the reservation by the 1958 Act, supra. [25] [412 U.S. 481, 506]

We conclude that the Klamath River Reservation was not terminated by the Act of June 17, 1892, and that the land within the boundaries of the reservation is still Indian country, within the meaning of 18 U.S.C. 1151.

The judgment of the Court of Appeal is reversed, and the case is remanded for further proceedings.

It is so ordered.

Footnotes

[Footnote 1] Title 18 U.S.C. 1151 defines the term "Indian country" to include, inter alia, "all lands within the limits of any Indian reservation under the jurisdiction of the United States Government, notwithstanding the issuance of any patent . . . ." Title 18 U.S.C. 1162 (a) provides that, with respect to Indian country within California, that State "shall have jurisdiction over offenses committed by or against Indians in the areas of Indian country . . . to the same extent that such State . . . has jurisdiction over offenses committed elsewhere within the State . . ., and the criminal laws of such State . . . shall have the same force and effect within such Indian country as they have elsewhere within the State . . . ." Section 1162 (b) provides, however, "Nothing in this section . . . shall deprive any Indian or any Indian tribe, band, or community of any right, privilege, or immunity afforded under Federal treaty, agreement, or statute with respect to hunting, trapping, or fishing or the control, licensing, or regulation thereof." Finally, the California Fish & Game Code 12300 (Supp. 1973), reads: "Irrespective of any other provision of law, the provisions of this code are not applicable to California Indians whose names are inscribed upon the tribal rolls, while on the reservation of such tribe and under those circumstances in this State where the code was not applicable to them immediately prior to the effective date of Public Law 280, Chapter 505, First Session, 1953, 83d Congress of the United States [18 U.S.C. 1162]."

[Footnote 2] The Executive Order is reproduced in 1 C. Kappler, Indian Affairs - Laws and Treaties 817 (1904) (hereinafter Kappler). At the end of this opinion, as the Appendix, is a map of the Klamath River Reservation. The area described in the text is indicated as the "Old Klamath River Reservation."

[Footnote 3] See Pet. for Cert., App. B 4-5.

[Footnote 4] A. Kroeber, Handbook of the Indians of California, cc. 1-4, published as Bulletin 78, Bureau of American Ethnology 1-97 (1925) (hereinafter Kroeber); S. Powers, Tribes of California, cc. 4 and 5, published as 3 Contributions to North American Ethnology 44-64 (1877) (hereinafter Powers). Various Annual Reports of the Commissioner of Indian Affairs provide further information; see, for example, the 1856 Report of the Commissioner of Indian Affairs 249-250 (hereinafter Report).

[Footnote 5] Kroeber, in the preface to his work, suggests that the factual material contained in Powers' manuscript is subject to some criticism. Kroeber's reference to Powers deserves reproduction in full here: "I should not close without expressing my sincere appreciation of my one predecessor in this field, the late Stephen Powers, well known for his classic `Tribes of California,' one of the most remarkable reports ever printed by any government. Powers was a journalist by profession and it is true that his ethnology is often of the crudest. Probably the majority of his statements are inaccurate, many are misleading, and a very fair proportion are without any foundation or positively erroneous. He possessed, however, an astoundingly quick and vivid sympathy, a power of observation as keen as it was untrained, and an invariably spirited gift of portrayal that rises at times into the realm of the sheerly fascinating. Anthropologically his great service lies in the fact that with all the looseness of his data and method he was able to a greater degree than anyone before or after him to seize and fix the salient qualities of the mentality of the people he described. The ethnologist may therefore by turns writhe and smile as he fingers Powers's pages, but for the broad outlines of the culture of the California Indian, for its values with all their high lights and shadows, he can still do no better than consult the book. With [412 U.S. 481, 487] all its flimsy texture and slovenly edges, it will always remain the best introduction to the subject." Kroeber ix.

[Footnote 6] Of this area one agent stated, "No place can be found so well adapted to these Indians, and to which they themselves are so well adapted, as this very spot. No possessions of the Government can be better spared to them. No territory offers more to these Indians and very little territory offers less to the white man. The issue of their removal seems to disappear." 1885 Report 266.

[Footnote 7] It is interesting to note that Powers believed the Yurok population at one time far exceeded 2,500 and perhaps numbered over 5,000. This was, as Powers stated, "before the whites had come among them, bringing their corruptions and their maladies . . . ." Powers 59. The renowned Major John Wesley Powell, who was then in charge of the United States Geographical and Geological Survey of the Rocky Mountain Region, Department of the Interior, placed little faith in Powers' figures and requested that he modify his estimates. Powers expressed his displeasure at this in a letter to Major Powell stating, in characteristic fashion, "I have the greatest respect for your views and beliefs, and, with your rich fund of personal experience and observation; if you desire to cut out the paragraph and insert one under your own signature, in brackets, or something of that kind, I will submit without a murmur, if you will add this remark, as quoted from myself, to wit: `I desire simply to ask the reader to remember that Major Powell has been accustomed to the vast sterile wastes of the interior of the continent, and has not visited the rich forests and teeming rivers of California.' But I should greatly prefer that you would simply disavow the estimates, and throw the whole responsibility upon me. "This permission I give you; but I have waded too many rivers and climbed too many mountains to abate one jot of my opinions or beliefs for any carpet-knight who yields a compiling-pen in the office of the - or - . If any critic, sitting in his comfortable parlor in New York, and reading about the sparse aboriginal populations of the cold forests of the Atlantic States, can overthrow any of my conclusions with a dash of his pen, what is the use of the book at all? As Luther said, at the Diet of Worms, `Here I stand; I cannot do otherwise.' "I beg you, my dear major, not to consider anything above [412 U.S. 481, 489] written as in the slightest degree disrespectful to yourself; such is the farthest remove from my thoughts." Powers 2-3. Powers' estimates were not altered, and the above-quoted letter was placed sympathetically by Major Powell in the introductory section of Powers' published study.

[Footnote 8] 1864 Report 122; Opinion dated Jan. 20, 1891, of the Assistant Attorney General for the Department of the Interior, quoted in Crichton v. Shelton, 33 I. D. 205, 210 (1904); Kroeber 19. Another source estimates that in 1871 the Indian population along the Klamath was 2,500. Report of D. H. Lowry, Indian Agent, Sept. 1, 1871, noted in Short v. United States, No. 102-63, p. 35 (Report of Commissioner, Court of Claims, 1972).

[Footnote 9] The Hoopa Valley Reservation was located August 21, 1864, but formally set apart for Indian purposes, as authorized by the 1864 Act, by President Grant only by Executive Order dated June 23, 1876. Kappler 815. See Appendix map. The area is that described as the "Original Hoopa Valley Reservation."

[Footnote 10] Letter dated Apr. 4, 1888, from the Commissioner of Indian Affairs to the Secretary of the Interior, quoted in Crichton v. Shelton, 33 I. D., at 211.

[Footnote 11] The allotments, however, were postponed "on account of the discovery of gross errors in the public surveys." Ibid.; 1885 Report XLVIII.

[Footnote 12] "In response to said resolution, I have to state that I am unable to discover from the records or correspondence of this office that any proceedings were ever had or contemplated by this Department for the survey and sale of said reservation under the provisions of the act aforesaid; on the contrary, it appears to have been the declared purpose and intention of the superintendent of Indian affairs for California, who was charged with the selection of the four reservations to be retained under said act, either to extend the Hoopa Valley Reservation (one of the reservations selected under the act), so as to include the Klamath River Reservation, or else keep it as a separate independent reservation, with a station or subagency there, to be under control of the agent at the Hoopa Valley Reservation, and the lands have been held in a state of reservation from that day to this (Ex. Doc. 140, pp. 1, 2)." Quoted in Crichton v. Shelton, 33 I. D., at 212.

[Footnote 13] "Pushing aside all technicalities of construction, can any one doubt that for all practical purposes the tract in question constitutes an Indian reservation? Surely, it has all the essential characteristics of such a reservation; was regularly established by the proper authority; has been for years and is so occupied by Indians now, and is regarded and treated as such reservation by the executive branch of the government, to which has been committed the management of Indian affairs and the administration of the public land system . . . . It is said, however, that the Klamath River reservation was abolished by section three of the act of 1864. Is this so? . . . . . "In the present instance, the Indians have lived upon the described tract and made it their home from time immemorial; and [412 U.S. 481, 492] it was regularly set apart as such by the constituted authorities, and dedicated to that purpose with all the solemnities known to the law, thus adding official sanction to a right of occupation already in existence. It seems to me something more than a mere implication, arising from a rigid and technical construction of an act of Congress, is required to show that it was the intention of that body to deprive these Indians of their right of occupancy of said lands, without consultation with them or their assent. And an implication to that effect is all, I think that can be made out of that portion of the third section of the act of 1864 which is supposed to be applicable." Quoted in Crichton v. Shelton, 33 I. D., at 212-213.

[Footnote 14] "It is hereby ordered that the limits of the Hoopa Valley Reservation in the state of California, a reservation duly set apart for Indian purposes, as one of the Indian reservations authorized to be set apart, in said State, by Act of Congress approved April 8., 1864, (13 Stats., 39), be and the same are hereby extended so as to include a tract of country one mile in width on each side of the Klamath River, and extending from the present limits of the said Hoopa Valley reservation to the Pacific Ocean; Provided, however, That any tract or tracts included within the above described boundaries to which valid rights have attached under the laws

of the United States are hereby excluded from the reservation as hereby extended." Kappler 815.

[Footnote 15] Kappler 819-824. It is noteworthy that the boundaries of the Mission Reservation were altered repeatedly between 1870 and 1875, [412 U.S. 481, 494] and even thereafter. These actions were taken under the President's continuing authority to set apart and add to or diminish the four reservations authorized under the 1864 Act. Donnelly v. United States, 228 U.S. 243 and 708 (1913). In its final form, the Mission Reservation consisted of no less than 19 different and noncontiguous tracts. Kappler 819-824; Crichton v. Shelton, 33 I. D., at 209-210.

[Footnote 16] See Appendix map. The strip of land between the Hoopa Valley Reservation and the Klamath River Reservation is referred to there as the "Connecting Strip." Under the 1891 Executive Order the Hoopa Valley Reservation was extended to encompass all three areas indicated on the map. The connecting strip and the old Klamath River Reservation frequently are referred to as the Hoopa Valley Extension.

[Footnote 17] The trust period on allotments to Indians on the Klamath River Reservation expired in 1919, but was later extended by Congress by the Act of Dec. 24, 1942, 56 Stat. 1081, 25 U.S.C. 348a. See S. Rep. No. 1714, 77th Cong., 2d Sess. (1942). And in 1958 Congress restored to tribal ownership vacant and undisposed-of ceded lands on various reservations, including 159.57 acres on the Klamath River Reservation. Pub. L. 85-420, 72 Stat. 121.

[Footnote 18] For an extended treatment of allotment policy, see D. Otis, History of the Allotment Policy, in Readjustment of Indian Affairs, Hearings on H. R. 7902 Before the House Committee on Indian Affairs, 73d Cong., 2d Sess., 428-440 (1934). The policy of allotment and sale of surplus reservation land was repudiated in 1934 by the Indian Reorganization Act, 48 Stat. 984, now amended and codified as 25 U.S.C. 461 et seq.

[Footnote 19] See, for example, the Act of Mar. 2, 1889, 25 Stat. 888 (Sioux Reservations), and United States v. Nice, 241 U.S. 591 (1916); the Act of Mar. 22, 1906, 34 Stat. 80 (Colville Reservation), and Seymour v. Superintendent, 368 U.S. 351 (1962); the Act of May 29, 1908, 35 Stat. 460 (Cheyenne River and Standing Rock Reservations), and United States ex rel. Condon v. Erickson, 478 F.2d 684 (CA8 1973), aff'g 344 F. Supp. 777 (SD 1972).

[Footnote 20] The respondent argues, however, that Congress, perhaps unacquainted with the Executive Order of October 1891, intended this language to convey the view expressed in the House Report, H. R. Rep. No. 161. supra, 23 Cong. Rec. 1598-1599 (1892), that the Klamath River Reservation had long been abandoned and, in fact and in law, had already been terminated. It is clear from the text, infra, that there were efforts in certain quarters of the House to terminate the reservation and open it for white settlement. See Short v. United States, supra, n. 8, at 34-52. While the respondent's interpretation of the phrase is plausible, it is no less plausible to conclude, in light of the repeated and unsuccessful efforts by the House to terminate the reservation, that the Senate proponents of the legislation were not inclined to make their cause (of requiring allotments) less attractive to the House by amending the bill to refer to the "former Klamath River Reservation, now part of the Hoopa Valley Reservation" rather than "what was [the] Klamath River Reservation."

[Footnote 21] The Department of the Interior took issue with the Committee's population estimates. H. R. Rep. No. 1148, 47th Cong., 1st Sess., 1-3 (1882). In a letter transmitted to the Committee on Indian Affairs in 1881, an infantry lieutenant, acting as Indian Agent, suggested that the Committee's population estimates were "gleaned principally from civilians, who are, I believe, somewhat inclined to lessen the number, thinking doubtlessly that the smaller the number the greater the likelihood of its being thrown open to settlers." Id., at 2.

[Footnote 22] Congress has used clear language of express termination when that result is desired. See, for example, 15 Stat. 221 (1868) ("the Smith River reservation is hereby discontinued"); 27 Stat. 63 (1892) (adopted just two weeks after the 1892 Act with which this case is concerned, providing that the North Half of the Colville Indian Reservation, "the same being a portion of the Colville Indian Reservation . . . be, and is hereby, vacated and restored to the public domain"), and Seymour v. Superintendent, 368 U.S., at 354; 33 Stat. 218 (1904) ("the reservation lines of the said Ponca and Otoe and Missouria Indian reservations be, and the same are hereby, abolished").

[Footnote 23] In United States ex rel. Condon v. Erickson, 478 F.2d 684 (1973), the United States Court of Appeals for the Eighth Circuit reached a similar conclusion in a case presenting issues not unlike those before us. The court concluded, id., at 689, that "a holding favoring federal jurisdiction is required unless Congress has expressly or by clear implication diminished the boundaries of the reservation opened to settlement" (emphasis in original).

[Footnote 24] Hearings before a Subcommittee of the Senate Committee on Indian Affairs, Survey of Conditions of the Indians in the United States, pt. 29, California, 72d Cong., 1st Sess., 15532 (1934).

[Footnote 25] Although subsequent legislation usually is not entitled to much weight in construing earlier statutes, United States v.

Southwestern Cable Co., 392 U.S. 157, 170 (1968), it is not always without significance. See Seymour v. Superintendent, 368 U.S., at 356 -357. [412 U.S. 481, 507]

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C. 1993 DOI Solicitors Opinion: Fishing Rights of the Yurok and Hoopa Valley Tribes

United States Department of the Interior

OFFICE OF THE SOLICITOR
Washington, D.C. 20240

October 4, 1993

M-36979

Memorandum

To: Secretary

From: Solicitor

Subject: Fishing Rights of the Yurok and Hoopa Valley Tribes

You have asked for an opinion concerning the rights of the Yurok and Hoopa Valley Indian Tribes to an allocation or quantified share of the Klamath River Basin anadromous fishery resources. The request arises from the need of this Department for definitive legal guidance in setting yearly tribal harvest allocations. The Department of Commerce, although it does not have authority to regulate in-river Indian fisheries, has also requested a legal determination from this Department on the Tribes' rights because of the impact on decisions that the Commerce Department must make concerning ocean fisheries that harvest Klamath basin fishery resources.[1]

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[1] By memorandum dated September 16, 1991, the Assistant Secretary - Indian Affairs, originally requested this opinion. On March 10, 1993, in a letter to the Secretary of Commerce, you stated the position that in the absence of a formal legal determination, the most reasonable and prudent course for the United States, as trustee for the Tribes, would be to set aside at least a 50 percent share of the harvestable surplus of Klamath River stocks for the Indian in-river fishery. As a temporary resolution of differences between your recommendation and concerns expressed by the Department of Commerce, which has jurisdiction over ocean fisheries, this Department set the in-river tribal harvest ceiling in 1993 at 18,500, and both Departments agreed that additional conservation measures for 1993 were appropriate. The Secretary of Commerce directed a 1993 ocean fishing season that conformed to the in-river tribal harvest constraint, and provided a natural spawner escapement floor of 38,000 for 1993. See "Commerce and Interior Departments Set Chinook Salmon Management Measures," April 29, 1993 (U.S. Department of Commerce Press Release NOAA 93-R117); Ocean Salmon Fisheries Off the Coasts of Washington, Oregon, and California, 58 Fed. Reg. 26922 (May 6, 1993) (emergency interim rule); Ocean Salmon Fisheries Off the Coasts of Washington, Oregon, and California, 58 Fed. Reg. 31664 (June 4, 1993) (amendment to emergency interim rule).

During the past twenty-two years, numerous court decisions have confirmed that when the United States set aside in-. the nineteenth century what are today the Yurok and Hoopa Valley Indian Reservations along the Klamath and Trinity Rivers, it reserved for the Indians federally protected fishing rights to the fishery resource in the rivers running through the reservations.[2] This Department, through legal opinions and policy statements, also has acknowledged the fishing rights of the Yurok and Hoopa Valley Indians, and the Department's corresponding obligations.[3] None

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[2] See, e.g., United States v. Eberhardt, 789 F.2d 1354, 1359 (9th Cir. 1986); Pacific Coast Federation of Fishermen's Ass'n v. Secretary of Commerce, 494 F. Supp. 626, 632 (N.D. Cal. 1980); Mattz v. Superior Court, 46 Cal. 3d 355, 758 P.2d 606 (1988); People v. McCovey, 36 Cal. 3d 517, 685 P.2d 687, cert. denied, 469 U.S. 1062 (1984); Arnett v. 5 Gill Nets, 48 Cal. App. 3d 454, 121 Cal. Rptr. 906 (1975), cert. denied, 425 U.S. 907 (1976); Donahue v. California Justice Court, 15 Cal. App. 3d 557, 93 Cal. Rptr. 310 (1971).

[3] The Solicitor's office, through the Associate Solicitor, Division of Indian Affairs, has issued a variety of legal opinions since 1976 concerning the nature, extent, and scope of federal reserved Indian fishing rights in the Klamath River basin. See, e.g., Memorandum from Acting Associate Solicitor, Indian Affairs, to Director, Office of Trust Responsibilities (November 4, 1976) (regulation of on-reservation Indian fishing on the Klamath River); Memorandum from Associate Solicitor, Division of Indian Affairs, to Assistant Secretary., Indian Affairs (May 4, 1978) (rights of the Klamath and Hoopa Reservation Indians to fish for commercial purposes); Memorandum from Associate Solicitor, Division of Indian Affairs, to Assistant Secretary - Indian Affairs (March 14, 1979) (Indian legal considerations with respect to Trinity River diversions at Lewiston Dam).

In addition, as a matter of policy this Department has acknowledged the existence of Indian fishing rights on the Klamath and Trinity Rivers and the Department's corresponding obligations. See, e.g., Letter from Assistant Secretary - Indian Affairs to Secretary of Commerce, May 19, 1992; Letter from Secretary of the Interior to Acting Chairperson, Yurok Transition Team, August 23, 1991; Letter from Assistant Secretary - Indian Affairs to Secretary of Commerce, July 25, 1991; Letter from Secretary of the Interior to Secretary of Commerce, May 1, 1991; Trinity River Flows Decision (May 8, 1991) (Decision of the Secretary of the Interior) (adopting recommendation for 1992 through 1996 flow releases, based in part on Department's trust responsibility to the Hoopa Valley and Yurok Tribes); Secretarial Issue Document on Trinity River Fishery Mitigation (approved by Secretary, January 14, 1981) (flow releases of water in the Trinity River); Memorandum from Assistant Secretary for Fish and

of the court decisions, however, have decided whether the Tribes' fishing rights entitle them to a specific allocation or quantified share of the Klamath and Trinity River fishery resources.

I conclude that the fishing rights reserved for the Tribes include the right to harvest quantities of fish on their reservations sufficient to support a moderate standard of living. I also conclude that the Tribes' entitlement is limited to fifty percent of the harvest in any given year unless varied by agreement of the parties.

I have reached my conclusions by examining the history of the reservations, the Indians' dependence on the Klamath and Trinity River fisheries, the United States' awareness of that dependence, and the federal intent to create the reservations in order to protect the Indians' ability to maintain a way of life, which included reliance on the fisheries. I have conducted this examination in the context of the now-substantial body of case law examining the history of the present-day Hoopa Valley and Yurok reservations and confirming the reservation Indians' fishing rights,[4] and the variety of cases involving other tribes' reserved fishing rights.

I. BACKGROUND

A. The Fishery Resource

The Klamath River originates in Oregon and flows southwesterly into California to its juncture with the Trinity River. The lower 40-50 miles of the Klamath River lie within the Yurok Reservation. From the point of confluence, the Klamath River flows northwesterly to discharge into the Pacific Ocean. The lower 12 miles of the Trinity River flow through the Hoopa Valley

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Wildlife and Parks to Assistant Secretary for Land and Water Resources, October 24, 1979.

The Department of Commerce also has recognized that the tribes of the Klamath River basin have federal reserved fishing rights. Letter from Director, National Marine Fisheries Service, Department of Commerce, to Assistant Secretary - Indian Affairs, Department of the Interior, October 16, 1992.

[4] In addition to the cases cited in footnote 2, see Crichton v. Shelton, 33 I.D. 205 (1904) (history of Klamath River and Hoopa Valley Reservations); Partitioning Certain Reservation Lands Between the Hoopa Valley Tribe and the Yurok Indians, S. Rep. No. 564, 100th Cong., 2d Sess. 2-9 (1988) (same); and Partitioning Certain Reservation Lands Between the Hoopa Valley Tribe and the Yurok Indians, H. Rep. No. 938, pt. 1, 100th Cong., 2d Sess. 8-15 (1988) (same).

Reservation, before discharging into the Klamath River near the boundary between the Hoopa and Yurok Reservations.

The Klamath and Trinity Rivers provide habitat for runs of salmon and other anadromous fish. Anadromous fish hatch in fresh water, migrate to the ocean, and complete their life cycles by returning to their freshwater places of origin to spawn. Because of the regular habits of the fish, it is possible to some extent to forecast stock abundance and to control harvesting throughout their range in order to maintain appropriate spawner escapement numbers for conservation and regeneration. However, different species have different life cycles, and different stocks intermix in the ocean before sorting themselves out and returning to the rivers of their origin. See generally Washington v. Washington State Commercial Passenger Fishing Vessel Ass'n, 443 U.S. 658, 662-64 (1979) (discussion of anadromous fish). As such, it is more difficult to regulate the numbers of particular stocks harvested in mixed-stock ocean fisheries, than to regulate stock-specific harvests by ocean terminal or in-river fisheries.

B. The Reservations[5]

1. Klamath River Reservation

The reservations which today constitute the Hoopa Valley and Yurok Reservations originally were created by executive orders issued pursuant to statutes authorizing the President to create Indian reservations in California. The Act of March 3, 1853, authorized the President "to make . . . reservations . . . in the State of California . . . for Indian purposes." 10 Stat. 226 238. On November 10, 1855, the Commissioner of Indian Affairs submitted a report to the Secretary of the Interior, recommending a reservation that would encompass "a strip of territory one mile in width on each side of the (Klamath) river, for a distance of 20 miles." I Kappler, Indian Affairs Laws and Treaties 816 (1904) ("Kappler"). The Commissioner's report noted that the proposed reservation had been selected pursuant to the Secretary's instructions "to select these reservations from such 'tracts of land adapted as to soil, climate, water-privileges, and timber, to the comfortable and permanent accommodation of the Indians.'" Id. The report also noted in particular the representations of the federal Indian officials in California

[5] Attached as Appendix A is a copy of a map of the former Hoopa Valley Reservation appended to the Supreme Court's decision in Mattz v. Arnett, 412 U.S. 481 (1973). The map pre-dates the more recent partition of the reservation but generally speaking, the Hoopa Valley Reservation today includes what the map refers to as the "Original Hoopa Valley Reservation," and the Yurok Reservation today encompasses the "Old Klamath River Reservation" and the "Connecting Strip" shown on the map.

"that the selection at the mouth of the Klamath River is a judicious and proper one." Id. On November 12, 1855, the Secretary of the Interior recommended the proposed reservation to the President, and four days later President Pierce signed the proclamation establishing the Klamath Reservation. Id. at 817.[6] The lands were mostly occupied by Yurok Indians, and the reservation encompassed what is today the lower portion of the Yurok Reservation.

2. Original Hoopa Valley Reservation

The original Hoopa Valley Reservation is a 12-mile square extending six miles on each side of the Trinity River. The Superintendent of Indian Affairs for California located and proclaimed it in 1864, pursuant to legislation enacted that same year. The legislation authorized the President to set apart up to four tracts of land in California "for the purposes of Indian reservations, which shall be of suitable extent for the accommodation of the Indians of said state, and shall be located as remote from white settlements as may be found practicable, having due regard to their adaptation to the purposes for which they are intended." Act of April 8, 1864, § 2, 13 Stat. 39, 40 ("1864 Act"); see I Kappler at 815; see also Donnelly v. United States, 228 U.S. 243, 255-57 (1913); Mattz v. Superior Court, 46 Cal. 3d 355, 758 P.2d 606, 610 (1988). The reservation was mostly inhabited by Hoopa Indians. Although Congress itself thereafter recognized the existence of the Hoopa Valley Reservation as early as 1868, Donnelly, 228 U.S. at 257, it was not until 1876 that President Grant issued an executive order formally setting aside the reservation "for Indian purposes, as one of the Indian reservations authorized . . . by Act of Congress approved April 8, 1864." I Kappler at 815.

3. Extended Hoopa Valley Reservation

Between 1864 and 1891, the legal status of the Klamath River Reservation as an Indian reservation came into doubt. Although the Klamath Reservation had been created pursuant to the 1853 statute, the subsequent 1864 Act limited to four the number of reservations in California, and contemplated the disposal of reservations not retained under authority of the 1864 Act. See 1864 Act, § 3, 13 Stat. at 40. By 1891, the Round Valley, Mission, Hoopa Valley, and Tule River reservations had been set apart pursuant to the 1864 Act. Mattz v. Arnett, 412 U.S. at 493-94. Still, the Department of the Interior continued to recognize that the Klamath Reservation was critical for protecting the Indians who lived there and for protecting their access to the fishery, and continued to regard it as a

[6] See also Mattz v. Arnett, 412 U.S 481, 487 (1973); Mattz v. Superior Court, 46 Cal. 3d 355, 758 P.2d 606, 610 (1988).

reservation throughout the period from 1864 to 1891. As the Court noted in Mattz v. Arnett, the reservation "continued, certainly, in de facto existence," during that time. Id. at 490.

Finally, in 1891, in order to eliminate doubt, to expand the existing reservation, and to better protect the Indians living there from encroachment by non-Indian fishermen, President Harrison issued an executive order under the authority of the 1864 Act. The order extended the Hoopa Reservation along the Klamath River from the mouth of the Trinity River to the ocean, thereby encompassing and including the Hoopa Valley Reservation, the original Klamath River Reservation, and the connecting strip in between. Thereafter, the original Klamath Reservation and connecting strip have been referred to jointly as the "Extension" or the "Addition," because they were added to the Hoopa Valley Reservation in the 1891 Executive Order. See I Kappler at 815 (Executive Order, October 16, 1891); Mattz v. Arnett, 412 U.S. at 493-4; Donnelly, 228 U.S. at 255-259. The validity of the 1891 addition and the continuing existence of the area included within the original Klamath Reservation were subsequently upheld by the Supreme Court in the Donnelly and Mattz v. Arnett decisions.[7]

4. Partition into the Yurok and Hoopa Valley Reservations

In 1988, Congress enacted the Hoopa-Yurok Settlement Act, which partitioned the extended Hoopa Valley Reservation into the present Hoopa Valley Reservation, consisting of the original 12-mile square bisected by the Trinity River and established under the 1864 Act, and the Yurok Reservation, consisting of the area along the Klamath River included in the 1891 Extension (excluding Resighini Rancheria).[8] Hoopa-Yurok Settlement Act of 1988, Pub.

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[7] In Donnelly v. United States, 228 U.S. 243, modified and rehearing denied, 228 U.S. 708 (1913), the Court affirmed the federal conviction of the defendant for murdering an Indian within the boundaries of the 1891 Extension. The Court concluded that the Extension had been lawfully established and constituted Indian country. In Mattz v. Arnett, 412 U.S. 481 (1973) the Court rejected California's argument that the Act of June 17, 1892, 27 Stat. 52, opening the original Klamath Reservation to non-Indian settlement, had diminished the boundaries of the extended reservation. The Court struck down a state forfeiture proceeding against gill nets confiscated from a Yurok Indian, holding that the act opening the reservation to settlement did not alter the boundaries of the extended Hoopa Valley Reservation.

[8] For the history and background of the 1988 Settlement Act, see S. Rep. No. 564 and H. Rep. No. 938, pt. 1, supra note 4. You asked for an opinion addressing the rights of the Hoopa and

L. No. 100-580, 102 Stat. 2924, 25 U.S.C.A. § 1300i-1300i-11 (Supp. 1993).

The congressional partition "recognized and established" each area as a distinct reservation, and declared that "[t]he unallotted trust land and assets" of each reservation would thereafter be held in trust by the United States for the benefit of the Hoopa Valley and Yurok Tribes, respectively. 25 U.S.C.A. § 1300i-1(b)&(c). Both the House and Senate committee reports accompanying the legislation make specific mention of the Yurok Tribe's interest in the fishery. See S. Rep. No. 564, supra note 4, at 2, 14; H. Rep. No. 938, pt. 1, supra note 4, at 20.[9]

Although there are now two distinct reservations for the Yurok and Hoopa Valley Tribes, the events most relevant to your inquiry occurred prior to the 1988 partition. For purposes of this opinion, the various reservation areas will be referred to as the original Klamath River Reservation, the Hoopa Valley Reservation (original 12-mile square), and the extended Hoopa Valley Reservation (the post-1891 reservation, consisting of the Hoopa Square, the original Klamath River Reservation, and the connecting strip).

Yurok Tribes. We do not address the fishing rights of the Coast Indian Community of the Resighini Rancheria or other tribes in the Klamath River basin in California.

[9] Both House and Senate committee reports refer to the substantial economic value of the Yurok Reservation fishery. The Senate Committee Report on the Settlement Act states:

> Tribal revenue derived from the "Addition" [now the Yurok Reservation] recently has totalled only about $175,000 annually. However, the record shows that individual Indian earnings derived from the tribal commercial fishing right appurtenant to the "Addition" is also in excess of $1,000,000 a year. The Committee also notes that because of the cooperative efforts of the Hoopa Valley Tribe and other management agencies to improve the Klamath River system, and because the Fisheries Harvest Allocation Agreement apportioning an increased share of the allowable harvest to the Indian fishery, the tribal revenue potential from the "Addition" is substantial.

S. Rep. No. 564, supra note 4, at 14-15; see H. Rep. No. 938, pt. 1, supra note 4, at 20. See also Central Valley Improvement Act, Pub. L. No. 102-575, Title XXXIV, § 3406(b) (23), 106 Stat. 4706, 4720 (1992) (reference to federal trust responsibility to protect the fishery resources of the Hoopa Valley Tribe).

C. Historic Dependence of the Yurok and Hoopa Indians on the Salmon Fishery

Since prehistoric times, the fishery resources of the Klamath and Trinity Rivers have been a mainstay of the life and culture of the Indians residing there.[10] See Mattz v. Arnett, 412 U.S. 481, 487, (1973); Blake v. Arnett, 663 F.2d 906, 909 (9th Cir. 1981). One-estimate is that prior to settlement along the coast by non-Indians, the Indians in the Klamath River drainage "consumed in excess of 2 million pounds . . . of salmon annually from runs estimated to have exceeded 500,000 fish." U.S. Department of the Interior, Environmental Impact Statement - Indian Fishing Regulations 2 (Hoopa Valley Reservation, California) (April 1985).

The Indians' heavy dependence on the salmon fishery for their livelihood has been well-documented.[11] "The salmon fishery permitted the [Klamath-Trinity basin] tribes to develop a quality of life which is considered high among native populations." AITS

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[10] The Indians' reliance on fishing continues. As the court noted in United States v. Wilson:

> To modern Indians of the [pre-1988] Hoopa Valley Reservation, fishing remains a way of life, not only consistent with traditional Indian customs, but also as an eminently practical means of survival in an area which lacks the broad industrial or commercial base which is required to provide its population, Indian or otherwise, with predictable, full-time employment and income adequate to provide sufficient quantities and qualities of the necessities of life.

611 F. Supp. 813, 818 n.5 (N.D. Cal. 1985) (citing National Park Service, Environmental Assessment: Management Options for the Redwood Creek Corridor. Redwood National Park (1975)), rev'd and remanded on other grounds sub nom., United States v. Eberhardt, 789 F.2d 1354 (9th Cir. 1986).

[11] See, e.g., Anthropological Study of the Hupa, Yurok, and Karok Indian Tribes of Northwestern California: Final Report 10, 22, 67-68, 101, 107 (American Indian Technical Services, Inc. January 1982) (Prepared for the U.S. Department of the Interior) ("AITS (1982)"); Edwin C. Bearss, History Resource Study - Hoopa-Yurok Fisheries Suit - Hoopa Valley Reservation 60 (U.S. Department of the Interior 1981); see also Ethnohistorical Data on the Klamath-Trinity Tribes of Northwestern California With Particular Emphasis on the Yurok (Klamath) Indians of the Lower Klamath Area (American Indian Technical Services, Inc. June 1984) (prepared for the U.S. Department of the Interior) ("AITS (1984)").

(1982) at 10. The salmon resource was the primary dietary staple of the tribes, and was the center of their subsistence economy. As the court noted in Blake v. Arnett, 663 F.2d at 909, the fishery was "not much less necessary to the existence of the [Yurok] Indians than the atmosphere they breathed") (quoting United States v. Winans, 198 U.S. 371, 381 (1905)).

During the pre-contact period, the salmon fishery also held significant commercial and economic value in Yurok and Hoopa culture and economy. Both tribes appear to have held firm concepts of property rights associated with the fishery. Fishing rights were considered personal property and part of an individual's wealth. Rights to fishing sites could be owned privately, fractionally, or communally, and could be inherited, sold, or transferred to pay debts.[12] Ownership of fishing sites gave owners the right to do what they wished with the fish taken, including sale or trade.[13] Access to the fishery was the subject of trade and barter, and use of fishing sites not one's own might be paid for by providing a portion of the catch. Virginia Egan-McKenna, Persistence with Change: The Significance of Fishing to the Indians of the Hoopa Valley Reservation in Northwestern California 74-75 (Unpublished M.A. Thesis, University of Colorado 1983). Ownership of fishing rights associated with particular sites also may have given the owner control over downstream activities. Id. at 69.

According to one source:

> A key factor in [trading of fishing rights between tribes] appears to have been the number of salmon runs a tribe received each year. For example, the Chilula received only one run a year and they often either traded with the Hupa for fish or bartered for temporary fishing rights (Curtis 1924:4). The Chimariko "sometimes paid the Hupa for the privilege of fishing at the falls near Cedar Flats" (Nelson 1978: 25-26).

AITS (1982), supra note 11, at 73; see Egan-McKenna at 76.

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[12] AITS (1982) at 23, 49, 57, 72-73, 99, 105; Testimony of Dr. Arnold Pilling, Transcript of Proceedings at 55, California v. Eberhardt, No. 76-051-C (Cal. Super. Ct., County of Del Norte) (May 18, 1977).

[13] Declaration of Arnold R. Pilling at 3, People v. McCovey, No. A012716 (Cal. Ct. App., 1st App. Dist., Div. 3) (Dec. 10, 1982) (Exhibit 25 to State's Brief).

Although experts have disagreed on the extent that harvested salmon was used in trade,[14] the above example and other evidence indicate that such trading did occur. In years when salmon were plentiful throughout the Klamath-Trinity river system, there was little or no need to trade salmon to support the Indians' standard of living.[15] Salmon were dried and stored, however, and were used in trading partnerships in years when other Indians in the basin did not have access to salmon because of river blockage or low flows. Pilling Testimony, supra note 12, Transcript at 56, 102-03 ("[I]f you have lots of stored salmon [when the Klamath was blocked], why, you're in a position to make very good bargains with your trading partners."), 106-09. Gourmet items such as salmon cheeks were "great trade items." Id. at 58-59. The trading partnerships were part of a complex economic, social, and ceremonial system within the tribal society. Id. at 109-115; see also George Gibbs, Journal of the Expedition of Colonel Redick McKee. United States Indian Agent. Throush North-Western California, Performed in the Summer and Fall of 1851, in Henry R. Schoolcraft, Information Respecting the History. Condition and Prospects of the Indian Tribes of the United States 146 (1853) ("Some understanding, however, seems to exist as to opening

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[14] The ethnographic and archeological documentation appears somewhat limited on the issue of trade, although it has been asserted that the sale and trade of harvested salmon was not extensive among the tribes of the Klamath-Trinity basins. See AITS (1982) at 117, 173. In declarations introduced by the State of California in 1982 in People v. McCovey, Drs. William Wallace and Arnold Pilling criticized the AITS (1982) study. See Declaration of William J. Wallace, People v. McCovey, No. A012716 (Cal. Ct. App., 1st App. Dist., Div. 3) (Dec. 10, 1982) (Exhibit 24 to State's Brief); Declaration of Arnold Pilling, supra note 13; see also William J. Wallace, Detailed Account of Yurok Aboriginal Fishing Practices 17-18, attached as Exhibit 2 to Declaration of William J. Wallace, supra. In 1977, in California v. Eberhardt, Dr. Pilling had testified as a defense witness, and Dr. Wallace testified as a witness for the prosecution. In their declarations in 1982, both Wallace and Pilling criticized the AITS (1982) study's conclusion concerning the extent to which trade or sale of salmon played a role in aboriginal Yurok and Hoopa culture. Although a subsequent AITS study responded to that criticism, AITS (1984), at 45-46, determining the extent of the Tribes' legal rights does not require resolving that dispute, which focuses on a specific form of use rather than the degree of dependence as a source of livelihood and culture.

[15] See Pilling Testimony, supra note 12, Transcript at 106; Testimony of William J. Wallace, Transcript of Proceedings at 276, California v. Eberhardt, No. 76-051-C (Cal. Super. Ct., County of Del Norte) (May 19, 1977).

portions of [fish dams] at times, to allow the passage of fish for the supply of those above.").

In California v. Eberhardt,[16] the trial court relied on the testimony of Drs. Pilling and Wallace to recognize that "[i]t is probably true that there was some degree of mutual exchange between and among Yuroks themselves and with other tribes in which fish was one of the items of exchange." The court also stated that "the anthropological testimony is not persuasive that the nature of the aboriginal custom of the Yurok Indians in 'commercial fishing' as that term might have been considered in aboriginal times, is anything like the concept of commercial fishing in present times." Id. As discussed below,[17] the legal quantification of the reserved right depends not so much on the degree to which historic uses of salmon parallel modern uses, but on the degree of dependence on the salmon fishery.

Following non-Indian settlement in the area, the Indians of the Klamath-Trinity basin adapted to the new trading and economic opportunities presented. When non-Indians entered the area, there is some evidence that the Indians sold salmon to them. Pilling Testimony, supra note 12, Transcript at 61-62; Wallace Testimony, supra note 15, Transcript at 279. As the commercial fishing industry developed in the late 19th century, the Indians played an important role in supplying fish to and working at local canneries. See AITS (1982), supra note 11, at 119-21.

When the canneries developed, according to Dr. Pilling, the basic ownership right of access to the fishery seemed to be viewed by the cannery owners "as in Indian hands, and this was something that had to be negotiated. You had to meet specific contractual relationships, especially with the Spott family, to participate as canners on the lower Klamath, because it was essentially Indian territory. This is my understanding of the mercantilism." Pilling Testimony, supra note 12, Transcript at 69-70. The salmon cheeks were recognized as a luxury cut, which "[t]he cannery didn't get . . . unless the Indians waived [their] right" to keep the salmon heads. Id. at 58.

In 1876, the first commercial fishery was established on the Klamath by Martin V. Jones and George Richardson. Bearss, supra note 11, at 159-60. In 1879, in order to protect the Indian fishery from outside interference, the U.S. military sent a force to the Klamath Reservation with orders "[t]o suppress all fishing by whites and require all citizens residing on the Reservation to leave without delay." Id. at 146. The military construed this

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[16] Ruling on Motion to Dismiss for Lack of Jurisdiction, at 2, No. 76-051-C (July 18, 1977).

[17] See infra, at 18 to 22.

as extending to the expulsion of non-Indian fisheries from the river, even if they did not land on the shore, because under no circumstances were the Yuroks to be "deprived of the Salmon as it is their main subsistence." Id. at 148-49. After the expulsion of the Jones and Richardson commercial fishery from the Klamath reservation, a small military outpost was maintained at Requa "to protect the Yuroks in the enjoyment of their only industry--salmon fishing." Id. at 151. Jones then erected a cannery nearby. "The Indians would catch and deliver the salmon for so much a head. . . . As the cannery was off the reservation and the Indians were benefitted by its presence, the military took no action to interfere with its operation." Id. at 160-61.

In 1883, R.D. Hume sought to lease the Klamath fisheries from the United States. Because it considered the fishery to be within the Klamath Reservation and subject to federal protection of the Indians' access to their fishery, the Department of the Interior declined Mr. Hume's request.[18] The Indians apparently opposed R.D. Hume's efforts to establish a cannery operation because Hume's activities interfered with Yurok fishing and Hume wasn't interested in purchasing fish from the Indians but instead brought his own men to fish. AITS (19841, supra note 11, at 46.

By contrast, in 1886, John Bomhoff contracted with a number of Yuroks to supply his cannery with salmon. "By this agreement the Yuroks were not to fish for any other person nor give any other white the right to fish in the Klamath." Bearss at 163 (emphasis added); see AITS (1982), supra note 11, at 131. Bomhoff apparently also employed some Indians for wages. Bearss at 164. The Indian Bureau sanctioned Bomhoff's arrangement to purchase fish from the Indians. Id. at 186.

Eventually additional canneries were established in the area, and at the turn of the century, most of the commercial fishermen were Indians, some fishing at night and taking employment in the canneries during the day. See Bearss at 348; AITS (1982) at 121 & 131.

II. EXISTENCE AND CHARACTER OF YUROK AND HOOPA FEDERAL RESERVED INDIAN FISHING RIGHTS

The power of the United States to create or reserve fishing rights for Indian tribes is derived from its plenary power over

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[18] Appendix B to this opinion recounts the conflict that developed between the Government and Hume. After a court upheld Hume's resistance to expulsion, the United States expanded the Hoopa Valley Reservation to ensure that the original Klamath Reservation would have Indian reservation status. See Appendix B at 7-18.

Indian affairs, grounded in the Indian Commerce Clause,[19] and from the Interstate Commerce Clause.

In Mattz v. Superior Court, 46 Cal. 3d 355, 758 P.2d 606, 617 (1988), the Supreme Court of California squarely rejected the State's assertion that the Federal Government lacked the authority to reserve Indian fishing rights in the Klamath River fishery when it created the reservation. Notwithstanding the substantial body of case law recognizing the extended Hoopa Valley Reservation Indians' federally reserved fishing rights,[20] the State contended otherwise, arguing specifically that the Indians had no federally reserved right to fish commercially. The Supreme Court of California rejected the State's contention based on federal and state court precedent and upon its own substantive legal review of the merits of the State's argument. As the Court noted, the State's theory in essence sought a repudiation of the well-established federal reserved rights doctrine recognized by the Supreme Court in Arizona v. California, 373 U.S. 546 (1963). Mattz v. Superior Court, 758 P.2d at 617; see id. at 616 (right to take fish from the &math River was reserved for the Indians when the reservation was created).[21]

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[19] See Montana v. Blackfeet Tribe, 471 U.S. 759, 764 (1985) ("Constitution vests the Federal Government with exclusive authority over relations with Indian tribes); McClanahan v. Arizona State Tax Comm'n, 411 U.S. 164, 172 n.7 (1973); Hughes v. Oklahoma, 441 U.S. 322 (1979) (overruling Geer v. Connecticut, 161 U.S. 519 (1896)); Douglas v. Seacoast Prods., Inc., 431 U.S. 265, 281-82 (1977) (Congress' power under the Commerce Clause to regulate taking of fish in state waters where there is some effect on interstate commerce); Sohappy v. Smith, 302 F. Supp. 899, 912 (D. Or. 1969) ("Statehood does not deprive the Federal Government of the power to enter into treaties affecting fish and game within a state, especially migratory species.") (citing Missouri v. Holland, 252 U.S. 416 (1920)); see also Arizona v. California, 373 U.S. 546, 596-601 (1963) (post-statehood executive order reservations included federally reserved water rights); Toomer v. Witsell, 334 U.S. 385, 399-402 (1948).

[20] See note 2, supra.

[21] A few years earlier, the State had made a similar argument in another case. See Respondent's Supplemental Memorandum of Points and Authorities and Brief on Appeal, at 29-30, People v. McCovey, Crim. 23387 (Cal.) (Nov. 28 1983). The State contended that the federal power to appropriate or reserve proprietary interests, including Indian fishing rights, was limited to the pre-statehood period. That argument was implicitly rejected in the California Supreme Court's decision in that case. People v. McCovey, 36 Cal. 3d 517, 685 P.2d 687, 697,

In 1940, one of my predecessors issued an opinion concerning the right of the Indians of the extended Hoopa Valley Indian Reservation to fish in the Klamath River within the boundaries of the reservation. See Right of Hoopa Valley Indians to Fish in Klamath River Without California State Interference, I Op. Sol. (Indian Affs.) 945 (March 13, 1940). It assumed without much consideration that the Indians' rights depended on a determination of whether the United States owned the bed of the Klamath River, suggesting that if the State of California owned the bed, the Indians' fishing rights were subject to plenary state regulation. That opinion rested on the same mistaken premise unsuccessfully asserted by the State in People v. McCovey and Mattz v. Superior Court.[22] In light of subsequent federal and state court decisions confirming the Indians' federal reserved fishing rights,[23] that opinion must be overruled. Both the Commerce Clause and the Indian Commerce Clause provide constitutional authority for the United States to reserve fishing rights for Indians in migratory fishery resources, regardless of state ownership of a riverbed passing through the reservation. Therefore, this opinion does not address questions of navigability and title to the Klamath River.[24]

In short, it is now well-established that the Yurok and Hoopa Valley Indians have federal reserved fishing rights,[25] created in

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205 Cal. Rptr. 643 ("rights were granted by Congress when it authorized the President to create the reservation for Indian purposes"), cert. denied, 469 U.S. 1062 (1984).

[22] In Mattz v. Superior Court, the State specifically cited the 1940 opinion to support its argument. See 758 P.2d at 616 & n.8.

[23] See note 2, supra.

[24] The 1940 opinion did not determine whether the Klamath River was in fact navigable at statehood.

[25] A federally reserved fishing right is not one of ownership in particular fish, but a right to an opportunity to obtain possession of a portion of the resource, which can best be expressed by either the numbers of fish taken or an allocation of the harvestable resource. See United States v. Washington, 520 F.2d 676, 687 (9th Cir. 1975), cert. denied, 423 U.S. 1086 (1976); see also Puget Sound Gillnetters Ass'n v. U.S. Dist. Ct., 573 F.2d 1123, 1129 n.6 (9th Cir. 1978), vacated and remanded, Washington v. Washington State Commercial Passenger Fishing Vessel Ass'n, 443 U.S. 658 (1979) (vacating judgments of Ninth Circuit and state supreme court and remanding for further proceedings not inconsistent with the U.S. Supreme Court's opinion).

the nineteenth century when the lands they occupied were set aside as Indian reservations. Numerous court decisions have recognized that the United States intended to reserve for the Indians the rights and resources necessary for them to maintain their livelihood.[26] As the Ninth Circuit has stated the right includes "fishing for ceremonial, subsistence, and commercial purposes." United States v. Eberhardt, 789 F.2d 1354, 1359 (9th Cir. 1986).[27]

Appendix B to this opinion recounts and summarizes the history of the Klamath River and Hoopa Valley Reservations, reviewing in particular the Annual Reports of the Commissioner of Indian Affairs. As described there, at the time the reservations were created, the United States was well aware of the Indians' dependence upon the fishery. A specific, primary purpose for establishing the reservations was to secure to the Indians the access and right to fish without interference from others.[28] As

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[26] See cases cited supra, note 2; see also Menominee Tribe v. United States, 391 U.S. 404, 406 (1968); United States v. Adair, 723 F.2d 1394, 1408-10 (9th Cir. 1983) (reservation of water rights to accompany reserved rights to hunt, fish, and gather).

[27] See also Memorandum from Associate Solicitor, Division of Indian Affairs, to Assistant Secretary, Indian Affairs (May 4, 1978) (Indian fishing on Klamath and Trinity Rivers); United States v. Wilson, 611 F. Supp. 813, 817-18 (N.D. Cal. 1985), rev'd on other grounds sub no., United States v. Eberhardt, 789 F.2d 1354 (9th Cir. 1986) (same); People v. McCovey, 36 Cal. 3d 517, 685 P.2d 687, 690 (same), cert. denied, 469 U.S. 1062 (1984); and see Arnett v. 5 Gill Nets, 48 Cal. App. 3d 454, 458, 121 Cal. Rptr. 906, 909 (1975) (Indian commercial fishing early in 20th century), cert. denied, 425 U.S. 907 (1976).

[28] See Mattz v. Arnett, 412 U.S. 481, 487-88 (1973); Donnelly v. United States, 228 U.S. 243, 259, modified on other Grounds and rehearins denied, 228 U.S. 708 (1913); United States v. Eberhardt, 789 F.2d at 1360 (9th Cir. 1986) (Hoopa Valley Reservation Indian fishing rights were granted by Congress when it authorized President to create reservations for Indian purposes) (citing McCovey, 36 Cal. 3d at 534, 685 P.2d at 697; Wilson, 611 F. Supp. at 817-18 & n.5; Mattz v. Superior Court, 46 Cal. 3d 355, 758 P.2d 606, 618 (1988) (river and Indian fishing played a primary role in the 1891 extension of the Hoopa Valley Reservation to include the old Klamath Reservation and connecting strip); 5 Gill Nets, 48 Cal. App. 3d at 459-62, 121 Cal. Rptr. at 909-911 (Klamath); Donahue v. California Justice Court, 15 Cal. App. 3d 557, 562; 93 Cal. Rptr. 310, 313 (1971) (Hoopa Valley Reservation); Crichton v. Shelton, 33 I.D. 205, 217 (1904) ("the prevailing motive for setting apart the [Klamath River] reservation was to secure to the Indians the fishing privileges

against third parties, the Indians' reserved fishing rights were of no less weight because they were created by executive orders pursuant to statutory authority rather than by treaty.[29] Courts have uniformly rejected a "treaty vs. non-treaty" distinction as a basis for treating Hoopa and Yurok fishing rights differently from the treaty-reserved fishing rights of tribes in other areas of the United States.[30]

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of the Klamath river"); cf. Fishing Vessel Ass'n, 443 U.S. at 665 n.7, 666 n.8 (dependence of Stevens Treaty tribes on fishing); Colville Confederated Tribes v. Walton, 647 F.2d 42, 48 (9th Cir.) (executive order reservation for Indian purposes included purpose of preserving tribal access to fishing grounds and acted to reserve water rights necessary to maintain the fishery), cert. denied, 454 U.S. 1092 (1981); Quechan Tribe v. Rowe, 350 F. Supp. 106, 111 (S.D. Gal. 1972) (executive order reservation for "Indian purposes" necessarily included right to hunt, trap, and fish on the reservation).

[29] The congressional committee reports accompanying the 1988 Hoopa-Yurok Settlement Act concluded that, as against the plenary power of Congress to make further dispositions of the reservation property and resources; no constitutionally protected property rights had vested in any particular tribes or individuals when the reservation areas were established by executive order. S. Rep. No. 564, supra note 4, at 12; H. Rep. No. 938, pt. 1, supra note 4, at 18-19. That conclusion was based on "peculiar facts and law" relevant to the extended Hoopa Valley Reservation. S. Rep. No. 564, at 14. The same conclusion had been reached in the Court of Claims-more than a decade earlier. Short v. United States, 202 Ct. Cl. 870, 486 F.2d 561 (1973), cert. Denied, 416 U.S. 961 (1974).

This conclusion does not affect the present analysis. Short and related court decisions, as well as the legislative history of the 1988 Act, confirm that the Hoopa Valley Reservation was created for Indian purposes. See S. Rep. No. 564, at 12; H. Rep. No. 938, pt. 1, at 18. The absence of a compensable vested property interest as against congressional authority to allocate reservation resources among the tribes or tribal members settled thereon is not inconsistent with the history of the reservation demonstrating that the United States granted rights of use and occupancy to the Indians, including fishing rights, which were protected against third party or state interference while reserved for federal purposes. See Arnett v. 5 Gill Nets, 48 Cal. App. 3d 459, 121 Cal. Rptr. 906 (1975), cert. denied, 425 U.S. 907 (1976); People v. McCovey, 36 Cal. 3d 517, 685 P.2d 687 (Cal. 1984).

[30] See Blake v. Arnett, 663 F.2d 906, 909-910 (9th Cir. 1981); Wilson, 611 F. Supp. at 817-18; McCovey, 685 P.2d at 696-97; 5 Gill Nets, 48 Cal. App. 3d at 459-62, 121 Cal. Rptr. at

III. QUANTIFICATION OF THE FISHING RIGHT AND ALLOCATION OF HARVEST

A. Introduction

The legal measure of the Tribes' fishing rights depends primarily on the purpose of the United States in reserving such rights when it created the Klamath River, Hoopa Valley, and extended Hoopa Valley Reservations. See United States v. Walker River Irrigation Dist., 104 F.2d 334, 336 (9th Cir. 1939) (statute or executive order setting aside a reservation may be equally indicative of intent as treaty or agreement; intent is discerned by taking account, of the circumstances and needs of the Indians and the purpose for which the lands had been reserved); cf. Arizona v. California, 373 U.S. 546, 596-600 (1963).[31]

910-11. See also Antoine v. Washinston, 420 U.S. 194, 200-03 (1975). In response to California's petition for Supreme Court review of Arnett v. 5 Gill Nets, Solicitor General Bork's brief for the United States noted:

> That executive orders played a prominent role in the creation of the Reservation does not change this result [that the United States reserved to the Indians the right to fish on the Reservation without state interference]. Regardless of the manner in which a reservation is created the purpose is generally the same: to create a federally-protected refuge for the tribe. . . .
>
> With respect to fishing rights we see no reason why a reservation validly established by executive order should be treated differently from other reservations.

Memorandum for the United States as Amicus Curiae, at 5, Arnett v. 5 Gill Nets, (U.S. No. 75-527), cert. denied, 425 U.S. 907 (1976).

[31] The legal quantification of non-treaty federally reserved on-reservation Indian fishing rights to a specific share of an anadromous fishery resource appears to be a matter of first impression. It is well-settled, however, that non-treaty federally reserved rights, recognized when an Indian reservation is created, can affect off-reservation use of a natural resource. See, e.g., Arizona v. California, 373 U.S. at 596-600. In addition, the cases adjudicating the treaty fishing rights of the Northwest tribes have recognized that location-specific Indian reserved rights affect fishing taking place outside those locations. See, e.g., U.S. v. Washington, 459 F. Supp. 1020, 1070 (W.D. Wash. 1978); Sohappy v. Smith, 302 F. Supp. 899, 911 (D. Ore. 1969). As such, while the precise issue addressed in this opinion may be one of first impression, many of the principles applied are well-established.

The fishing rights now established in the Yurok and Hoopa Valley Tribes were reserved when the reservations were set aside for Indian purposes. See Act of April 8, 1864, § 2, 13 Stat. 39, 40 (reservations to be set aside "for the accommodation of the Indians," with "due regard to their adaptation to the purposes for which they are intended."). Because the rights arose by implication rather than by express language, the purposes of the reservation are discerned by examining the historical record and circumstances surrounding creation of the reservation.[32] Therefore, we must consider the evidence of the dependence of the Indians on the fishery "as a source of food, commerce, and cultural cohesion," Washington v. Washington State Commercial Fishing Vessel Ass'n, 443 U.S. 658, 686 (1979), and the Federal Government's awareness of the Indians' reliance on the fishery. The inquiry must also include recognition of the Indians' "need to maintain themselves under changed circumstances." Colville v. Confederated Tribes v. Walton, 647 F.2d 42, 47 & n.10 (9th Cir.), cert. denied, 454 U.S. 1092 (1981). Finally, the United States is presumed to have intended to deal fairly with the Indians. Arizona v. California, 373 U.S. at 600.

B. Quantification

The history of the creation of the Klamath River and Hoopa Valley Reservations, and the extension of the Hoopa Valley Reservation to include the Klamath River Reservation and connecting strip, plainly shows a purpose by the United States to reserve for the Indians what was necessary to preserve and protect their right to obtain a livelihood by fishing on the reservation. As discussed earlier, the Indians were highly dependent upon the fishery resource. As recounted in Appendix B, the United States was well aware of the importance of the fishery to the Indians and created the reservations to preserve their access to an adequate supply of fish. The historical record demonstrates the importance of the reservations to achieving the Federal Government's objectives of creating and maintaining peaceful relations between the Indian tribes and non-Indians, protecting the Indians from further encroachment and displacement by non-Indians, and obtaining the resources necessary for the Indians to maintain their livelihood and be self-sufficient on the reservation.[33] The United States

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[32] Indian hunting and fishing rights generally arise by implication when a reservation is set aside for Indian purposes. See, e.g., Ouechan Tribe v. Rowe, 350 F. Supp. 106, 111 (S.D. Cal. 1972). The precise extent of the right, however, is determined by examining the facts and circumstances of each case.

[33] As the court in United States v. Wilson, noted, "[i]n establishing the Hoopa Valley Reservation, Congress reserved those rights necessary for the Indians to maintain on the land ceded to them their way of life, which included hunting and

sought to isolate and protect the Indians from non-Indians who would otherwise appropriate the lands and the fishery resource upon which the Indians were so dependent for their livelihood.

The physical locations of the reservations --one mile on each side of the Klamath, six miles on each side of the Trinity--plainly demonstrate the United States' awareness of the centrality of the rivers and the fisheries to the purposes for which the reservations were created. As the Supreme Court noted in Mattz v. Arnett, 412 U.S. 481 (1973), the Klamath River Reservation was ideal for the Indians because of the river's abundance of salmon and other fish. The United States was well aware of the Indians' dependence on the fishery resource and of the need to protect the Indians' use of the fishery from non-Indian encroachment. Id. at 487 & n.6; Crichton v. Shelton, 33 I.D. 205, 216-18 (1904).

While the United States also sought to introduce agriculture to the Indians, see, e.g., Appendix B at 4 & 7, it anticipated that the Indians would continue to rely on the reservation fishery. Thus, the fishery and agriculture may be said to be twin primary purposes for creating the reservation. cf. Walton, 647 F.2d at 47-48 (reserved water right for agriculture and fishing, based on primary purposes of reservation).[34]

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fishing." 611 F. Supp. 813, 817-18 (N.D. Cal. 1985), rev'd and remanded on other grounds sub nom., United States v. Eberhardt, 789 F.2d 1354 (9th Cir. 1986); see Blake v. Arnett, 663 F.2d 906, 909 (9th Cir. 1981).

[34] In his journal of the 1851 expedition visiting Indian tribes in Northwestern California, George Gibbs recognized the value of protecting the Indian fisheries within a reservation, even while pursuing other assimilationist objectives:

> The Indians of the Klamath and its vicinity afford a field for a new experiment. Their country furnishes food of different kinds and in quantity sufficient to supply their absolute wants. . . . If collected as occasion may offer, and its advantage be shown to them, upon reservations, where their fisheries can still be carried on, where tillage of the soil shall be gradually introduced, and where the inducements to violence or theft will be diminished or checked they may possibly be made both prosperous and useful to the country.

George Gibbs, Journal of the Expedition of Colonel Redick McKee, United States Indian Agent, Through North-Western California. Performed in the Summer and Fall of 1851, in Henry R. Schoolcraft, Information Respecting the History, Condition and Prospects of the Indian Tribes of the United States 142-43 (1853).

Upon establishment of the original Klamath Reservation in 1855, the Commissioner of Indian Affairs contemplated that the inclusion of the fishery would eliminate any need to provide the Indians with rations of beef, as was common on other Indian reservations. See Appendix B at 1. Between 1855 and 1891, when the Hoopa Valley Reservation was extended to ensure the reservation status of the lower Klamath area, the annual reports of the Commissioner are replete with references to the importance of the fishery for the continued livelihood and welfare of the Indians. See, e.g., id. at 3-4, 8-9.

In short, the fishery here, no less than the water in the arid southwest, was deemed "essential to the life of the Indian people" for whom the reservation was created. Arizona v. California, 373 U.S. 546, 599 (1963). The inclusion within the reservation of the fishery at the mouth of the Klamath within the boundaries of the reservation demonstrates the purpose to prevent non-Indians from establishing commercial fisheries there to supplant the Indian fishery. Thus here, no less than with the Pacific Northwest treaty tribes, the Government "recognized the vital importance of the fisheries to the Indians and wanted to protect them from the risk that non-Indian settlers might seek to monopolize their fisheries." Washington v. Washington State Commercial Passenger Fishing Vessel Ass'n, 443 U.S. 658, 666 (1979).

At the time the reservation was created, ocean trolling was of little commercial consequence and was not of sufficient magnitude to interfere with the in-river fishery. Bearss, supra note 11, at 235. Only with subsequent technological advances did the ocean fishery begin to have a significant impact on salmon runs. As a practical matter then, the reservation boundaries as established were substantially equivalent to protecting the Indian fishery from significant non-Indian encroachment.

The standard for determining the extent of the Pacific Northwest treaty tribes' fishing rights has been stated by the Supreme Court as one which will "assure[] that the Indians' reasonable livelihood needs [will] be met." Fishing Vessel Ass'n, 443 U.S. at 685 (citing Arizona v. California, 373 U.S. at 600; Winters v. United States, 207 U.S. 564 (1908)). The "central principle here must be that Indian . . . rights to a natural resource that once was thoroughly and exclusively exploited by the Indians secures so much as, but no more than, is necessary to provide the Indians with a livelihood--that is to say, a moderate living." Fishing Vessel Ass'n, 443 U.S. at 686.

With respect to the reserved fishing right, I can find no meaningful difference between the federal purpose in creating the reservations for the Yurok and Hoopa Valley Indians, and the bilateral intent in the treaties with the Pacific Northwest tribes to guarantee to the tribes "an adequate supply of fish."

United States v. Washington, 506 F. Supp. 187, 197 (W.D. Wash. 1980), aff'd in relevant part, 759 F.2d 1353 (9th Cir.), cert. denied, 474 U.S. 994 (1985). Although the circumstances of this case may differ in certain respects from those of the Pacific Northwest treaty tribes,[35] they are not relevant to the outcome. Therefore, I conclude that the Government intended to reserve for the tribes on the Hoopa and Yurok Reservations a fishing right which includes a right to harvest a sufficient share of the resource to sustain a moderate standard of living.

There is, as discussed earlier, some uncertainty over the extent to which salmon was traded or sold "commercially" in aboriginal Hoopa and Yurok culture. But the focus of the inquiry into the Tribes' legal rights is on the degree of dependence on the fishery resource at the time the reservation was created or expanded, rather than on what particular uses were made of the fish, which may or may not approximate patterns of use or trade in non-Indian culture. As the Court in Fishing Vessel Ass'n noted with respect to the tribes in western Washington, it is not possible to compare Indian uses of fish for trade in aboriginal times with the volume of present day commercial use of salmon. 443 U.S. at 665 n.7. The same could be said of comparisons of the uses of salmon in aboriginal times to support a "reasonable livelihood," as compared with modern-day uses to the same end.[36] Present-day tribal needs to support the livelihood of members may be more or less than the volume utilized in aboriginal times. Cf. Fishing Vessel Ass'n, 443 U.S. at 687. In short, the United States Supreme Court has rejected the notion that prehistoric patterns or volumes of use must mirror modern economic uses of salmon in order to find sufficient Indian dependence on the

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[35] For example, while the importance of salmon to the diet and cultural cohesion appears similar,' historical evidence more extensively documents the use of harvested salmon for trade by the Pacific Northwest treaty tribes than by the Yurok and Hoopa Tribes. Cf. AITS (1984), supra note 11, at 45 ("trade patterns of the Northwestern California tribes in general have received little attention from anthropologists and historians"). The Yurok and Hoopa Indians' concepts of private ownership of fishing access sites also appear to contrast with the culture of the Northwest tribes, which viewed fishing rights as more communal. See United States v. Washington, 384 F. Supp. 312, 353 (W.D. Wash. 1974), aff'd, 520 F.2d 676 (9th Cir. 1975), cert. denied, 423 U.S. 1086 (1976).

[36] Indeed, a "subsistence" right limited to quantities based on aboriginal consumption levels might well equal or exceed modern-day notions of moderate living needs as satisfied by both consumptive and commercial uses.

salmon fishery sufficient to justify application of the moderate living standard.[37]

The Yurok and Hoopa Indians had a "vital and unifying dependence on anadromous fish," compare Fishing Vessel Ass'n, 443 U.S. at 664, which the historical evidence demonstrates was well-known to the-united States. As with the Northwest treaty tribes, salmon was the great staple of their diet and livelihood. Although the anthropological evidence does not clearly demonstrate the use of dried fish -for trade in the same manner as was shown for the Northwest treaty tribes, it does demonstrate that anadromous fish constituted the primary means for the Indians' livelihood, and that fishing rights and the fishery were an integral part of the diet, economy, and culture of the tribes. Cf. United States v. Washington, 384 F. Supp. 312, 350-58, 406-07 (W.D. Wash. 1974), aff'd, 520 F.2d 676 (9th Cir. 1975), cert. denied, 423 U.S. 1086 (1976). There is some evidence of the Indians' readiness to capitalize on the economic value of the fishery by selling or bartering dried fish with non-Indians passing through the area, and certainly the Indians adapted their utilization of the fishery to provide fish to the non-Indian canneries.

In this case, considering the nature of the right, which the courts have already confirmed, and considering the Indians' historic dependence on the fishery and the federal purposes of the reservation, the "reasonable livelihood" needs must satisfy ceremonial, subsistence, and commercial fishing needs. See Fishing Vessel Ass'n, 443 U.S. at 686-88.

C. Allocation of the Harvest

While the moderate standard of living generally has been identified as the benchmark for identifying the quantity of tribal reserved fishing rights, see United States v. Washington, 506 F. Supp. 187, 198 (W.D. Wash. 1980), aff'd in relevant park, 759 F.2d 1353 (9th Cir.), cert. denied, 474 U.S. 994 (1985) various Indian fishing rights cases have also limited tribal

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[37] As the amicus brief for the United States in Arnett v. 5 Gill Nets stated,

> Petitioner cites no authority, and we know of none, that would limit an Indian's on-reservation hunting or fishing to subsistence. The purpose of a reservation is not to restrict Indians to a subsistence economy but to encourage them to use the assets at their disposal for their betterment.

Memorandum for the United States as Amicus Curiae 8, Arnett v. 5 Gill Nets (U.S. No. 75-527) (on petition for certiorari), cert. denied, 425 U.S. 907 (1976).

harvest rights by an allocation ceiling of no more than 50% of the harvestable numbers of fish, thus providing that the tribes share the resource with non-tribal fishers. The 50% allocation has been based on express treaty language in some cases. Even where a specific treaty does not refer to sharing of the resource, at least one court has reached the same result based on the intent of the parties.

In the Pacific Northwest treaties, the tribes reserved off-reservation fishing rights at their usual and accustomed fishing places "in common with" the citizens of the Territory. The courts held that this language justified limiting the tribes' entitlement for allocation purposes to 50% of the harvestable catch. See id., 506 F. Supp. at 195-98. Thus, even though the treaties were designed to guarantee the tribes an adequate supply of fish and even though the starting point for apportionment is assuring that the Indians' reasonable livelihood needs will be met, Fishing Vessel Ass'n, 443 U.S. at 685, the tribes' agreement to share the resource with non-Indian users justified limiting the tribes to a percentage allocation. See United States v. Washington, 384 F. Supp. 312, 343 (W.D. Wash. 1974), aff'd, 520 F.2d 676 (9th Cir. 1975), cert. denied, 423 U.S. 1086 (1976).[38] That is, the treaties protected and recognized the treaty-derived rights of both the tribes and the non-Indians to a share of the available fish. Fishing Vessel Ass'n, 443 U.S. at 684-85.

In Sohappy v. Smith, 529 F.2d 570 (9th Cir. 1976), the court of appeals refused to set aside the district court's 50% allocation 'formula, adopted to reflect the Columbia River treaty tribes' right to a fair share of the salmon harvest. In United States v. Oregon, the-parties agreed to a Columbia River Management Plan that allowed in-river harvesting on a 60% treaty/40% nontreaty basis, an allocation which deviated from the 50%-50% starting point in order to compensate for ocean fishing by non-Indians. 718 F.2d 299,, 301-02 & n.2 (9th Cir. 1983).

In United States v. Michigan, the district court contrasted treaty rights explicitly held "in common with" other citizens with the treaties of the Indian tribes in Michigan, which had no

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[38] Limiting the tribal allocation to a 50% share of the harvestable resource in any given year is distinct from determining 'whether the moderate standard of living component of the right is being satisfied. Given the current depressed condition of the Klamath basin fishery, this opinion need not address how to calculate the quantities of fish needed to support the Tribes' moderate living needs. Until the fishery resource is substantially restored to the point that the evidence establishes that a 50% share is more than is needed to support the Tribes' moderate living needs, the 50% allocation is the appropriate quantification of the Tribes' rights.

such language. See 505 F. Supp. 467, 472-73 (W.D. Mich. 1980), remanded, 623 F.2d 448 (6th Cir. 1980) (to consider preemptive effect of new federal regulations), modified, 653 F.2d 277 (1981), cert. denied, 454 U.S. 1124 (1981) Although not deciding the allocation issue itself, the district court observed:

> [T]he Indians of Michigan presently hold an unabridged, aboriginal, tribal right to fish derived from thousands of years of occupancy and use of the fishery of the waters of Michigan. That aboriginal right arose from the tribes' reliance upon the fishery for its livelihood, that is, from its dependence upon this fishery for food and trade. That right was confirmed in its entirety by the Treaty of Ghent and left whole by the Treaties of 1836 (7 Stat. 459) and 1855 (11 Stat. 621). Thus, today the Michigan tribes retain the right to fish Michigan treaty waters to the full extent necessary to meet the tribal members' needs.
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> This 50% maximum [for the Washington treaty tribes] arises directly from the "in common with" language in the Washington treaties. [Fishing Vessel Ass'n,] 443 U.S. 686. The 50% ceiling is suggested, if not necessarily dictated by, the word "common" as it appears in the Washington treaties. No such language is present in the Michigan treaties. 443 U.S. at 686 n.27.
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> The general principle in Fishing Vessel is that Indian treaty rights to scarce natural resources are defined by what is necessary to assure that the Indians' reasonable livelihood expectations are met. 443 U.S. at 686. Where, as here, there was no negotiation resulting in a right held in common and the Indians implicitly reserved their aboriginal right in its entirety, this principle might, over time, mandate that the Indians have access to the entire available resource.

Id., 505 F. Supp. at 472-73.

In the lengthy Lac Courte Oreilles Band of Lake Superior Chippewa Indians v. Wisconsin litigation, the court also addressed Indian treaties with language different from those in the Pacific Northwest. The Treaty of 1837 with the Chippewas provided that the "privilege of hunting, fishing and gathering the wild rice [in the ceded area] is guarantied to the Indians, during the pleasure of the President of the United States.' Lac Courte Oreilles Band v. Wisconsin, 653 F. Supp. 1420, 1425 (W.D. Wisc. 1987) ("LCO III"). The Treaty of 1842 provided that "[t]he Indians stipulate for the right of hunting on the ceded territory, with the other usual privileges of occupancy, until required to remove by the President of the United States." Id. at 1425. Both treaties were silent concerning whether the Off-reservation reserved harvesting rights would be exclusive or in

common with other citizens. Lac Courte Oreilles Band v. Wisconsin, 686 F. Supp. 226, 232 (W.D. Wisc. 1988). Because of the absence of treaty language limiting the tribes" right as one "in common with" other users, the court was reluctant to follow the 50% allocation formula adopted in the Pacific Northwest treaty cases, focusing instead on the moderate living standard. Id.

Ultimately, however, when forced to allocate the harvest, the court concluded that "[t]he only reasonable and logical resolution is that the contending parties share the harvest equally." Lac Courte Oreilles Band v. Wisconsin, 740 F. Supp. 1400, 1417-18 (W.D. Wisc. 1990). The court noted that the treaties did not reserve to the Indians an exclusive right of harvesting in the ceded area. The court also found, though, that when the treaties were made, the Indians understood that the presence of non-Indian settlers would not require that the Indians forego the level of hunting, fishing, gathering, and trading necessary to provide them with a moderate living. Id. at 1415 (citing LCO III, 653 F. Supp. at 1426). The court then stated:

> This unexpected scarcity of resources makes it impossible to fulfill the tribes' understanding that they were guaranteed the permanent enjoyment of a moderate standard of living, whatever the harvesting competition from the non-Indians. It also makes it necessary to try to determine how the parties would have agreed to share the resources had they anticipated the need for doing so.

Id. at 1415. Based on the treating parties' understanding that there would be competition for the resource and the fact that the Chippewa Tribe did not retain exclusive-harvesting rights in the ceded territory, the court concluded

> that the parties did not intend that plaintiffs' reserved rights would entitle them to the full amount of the harvestable resources in the ceded territory, even if their modest living needs would otherwise require it. The non-Indians gained harvesting rights under those same treaties that must be recognized. The bargain between the parties included competition for the harvest.
>
> How to quantify the bargained-for competition is a difficult question. The only reasonable and logical resolution is that the contending parties share the harvest equally.

Id. at 1416 (emphasis added). While the court emphasized its view that the Chippewa treaties differed in significant respects from those of the Pacific Northwest tribes, it concluded that the

equal division was the "fairest" and "inevitable" result. Id. at 1417-18.

In United States v. Adair, 723 F.2d 1394 (9th Cir. 1983), in the context of addressing the relationship between reserved Indian fishing rights and federal reserved Indian water rights, the Ninth Circuit affirmed the district court's holding that the Klamath Tribe was "entitled to as much water on the Reservation lands as they need to protect their hunting and fishing rights . . . as currently exercised to maintain the livelihood of Tribe members." Id. at 1414. The court explained:

> Implicit in this "moderate living" standard is the conclusion that Indian tribes are not generally entitled to the same level of exclusive use and exploitation of a natural resource that they enjoyed at the time they entered into the treaty reserving their interest in the resource, unless, of course, no lesser level will supply them with a moderate living.

Id. at 1415 (citing Fishing Vessel Ass'n, 443 U.S. at 686) (emphasis added). Thus, the Ninth Circuit suggested, tribal fishing rights are not necessarily accompanied by a 50% allocation ceiling.

The Klamath River and Hoopa Valley reservations and accompanying federal rights were created by executive action pursuant to congressional statutory authorization, rather than through a bilateral, bargained-for agreement, as in the Pacific Northwest and the Great Lakes Tribes' fishing rights cases. Because the operative documents creating the reservation do not expressly reserve fishing rights, neither do they expressly limit the implied rights reserved for the Indians of the reservation. Thus, an argument could be made that the tribal moderate standard of living needs should be satisfied first, before other user groups can be afforded fishing privileges. Cf. State v. Tinno, 94 Idaho 759, 497 P.2d 1386 (1972) (unqualified treaty language contrasted with "in common with" treaty language, denoting a qualified right).

At the time the reservations were created, the United States doubtless contemplated that the reservation resources, and in particular the fishery, would be sufficient for the Indians to continue to be self-supporting, see Appendix B at 8, or in other words, to support a moderate standard of living. Furthermore, although there was competition for the fishery, the United States sought to reduce it by including what was then the location most desired by the early non-Indian fishing industry--the area at the mouth of the river--inside the reservation boundaries. The historical evidence does not indicate that either the United States or the Indians contemplated scarcity of the resource as a whole.

On the other hand, the Tribes' right to fish in this case does not extend beyond the reservation.' Moreover, the doctrine of implied reserved fishing rights has not been extended to provide an exclusive on-reservation right to a fishery resource such as anadromous fish that migrates off the reservation. To do so. could totally deprive off-reservation users of access until tribal rights are fully satisfied. The historical evidence that I have examined is not sufficient to infer that the United States, in creating the extended Hoopa Valley Reservation, contemplated that in times of scarcity, fishing by other user groups, wherever located, could be completely cut off until the Indians' total ceremonial, subsistence, and commercial needs are satisfied.[39]

While reservation purposes should be construed broadly, after considering the relevant history, I conclude that the United States did not intend to reserve for the Indians a right to the full amount of the harvestable resource, to the complete exclusion of non-Indian fishing off the reservation until the moderate living standard could be satisfied. Instead, the case law indicates that there should be a ceiling on the tribes' right to ensure that the resource is shared. In summary, the tribes are entitled to a sufficient quantity of fish to support a moderate standard of living, or 50% of the Klamath fishery harvest in any given year, whichever is less.[40]

The Tribes' fishing right is a "right to take a share of each run of fish that passes through tribal fishing areas." Fishing Vessel Ass'n, 443 U.S. at 679; Washington State Charterboat Ass'n v. Baldridge, 702 F.2d 820 (9th Cir. 1983), cert. denied, 464 U.S. 1053 (1984); Hoh Indian Tribe' v. Baldridge, 522 F. Supp. 683, 686-87, 689 (W.D. Wash. 1981). Thus, in the present case, it applies to Klamath River basin stocks that, absent interception, would pass through the Tribes' reservations. See U.S. v. Washington, 520 F.2d 676, 688-89 (9th Cir. 1975) (affirming 384 F. Supp. at 344), cert. denied, 423 U.S. 1086 (1976). In calculating the allocation, the numbers of fish harvested or intercepted by each user group is counted against

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[39] This is not to say, however, that in times of severe shortage, certain tribal ceremonial and subsistence needs may not take priority over the privileges of other user groups. This issue was left open by the Supreme Court in Fishing Vessel Ass'n, 443 U.S. at 688.

[40] This rule is not inflexible, and may be varied by agreement of the parties. See Hoh Indian Tribe v. Baldridge, 522 F. Supp. 683, 690 (W.D. Wash. 1981); United States v. Oregon, 699 F. Supp. 1456, 1463 (D. Ore. 1988), aff'd, 913 F.2d 576, 585 (9th Cir. 1990).

the respective party's share, regardless of where they are taken or for what purposes. Fishing Vessel Ass'n, 443 U.S. at 687-89.

Although the Tribes' rights in this case are geographically limited-to the on-reservation fishery, it is well-settled that tribal fishing rights have a geographical component that requires that fishing outside of those areas be managed in such a way to permit tribalaccess to their share of the fishery at those geographical locations. See Hoh Indian Tribe v. Baldridge, 522 F. Supp. at 687; SOhappy v. Smith, 302 F. Supp. 899, 910-911 (D. Ore. 1969) (state cannot so manage the fishery that little or no harvestable portion of the run reaches the Indian fishing areas).

Indian reserved fishing rights have both a geographical and a "fair share" aspect. Muckleshoot Indian Tribe v. Hall, 698 F. supp. 1504, 1511-14 (W.D. Wash. 1988). The right is not only one to harvest a particular share, but also to be able to harvest that share on the reservation or at other geographical locations linked to the reserved right. Thus, although the Northwest treaty tribes have fishing rights that attach both to reservations and to "usual and accustomed" locations, while the Yurok and Hoopa Valley Tribes' rights geographically are linked to their reservations, the underlying principle is the same. In each case, the tribal fishing rights are linked to specific geographic areas, and other fishing must not interfere with the Tribes' right to have the opportunity to catch their share.

IV. FEDERAL FISHERY REGULATION AND ACTIONS AFFECTING INDIAN FISHING RIGHTS

A. Federal Trust Responsibility

The United States is the trustee of Indian reserved rights, including fishing rights.[41] The role of the United States as trustee of Hoopa and Yurok Indian fishing rights has been recognized in various court decisions. See United States v. Eberhardt, 789 F.2d 1354, 1359-62 (9th Cir. 1986); id. at 1363 (Beezer, J., concurring); People v. McCovey, 36 Cal. 3d 517, 685 P.2d 687, 694, 205 Cal. Rptr. 643, cert. denied, 469 U.S. 1062 (1984). As recently as 1992, Congress explicitly acknowledged a trust responsibility in connection with the Indian fishery in the Trinity River. "[F]or the purposes of fishery restoration, propagation, and maintenance," and "in order to meet Federal trust responsibilities to protect the fishery resources of the Hoopa Valley Tribe, and to meet the fishery restoration goals of

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[41] See, e.g., Joint Bd. of Control v. United States, 862 F.2d 195, 198 (9th Cir. 1988); United States v. Michigan, 653 F.2d 277, 278-79 (6th Cir.), cert. denied, 454 U.S. 1124 (1981); Muckleshoot Indian Tribe v. Hall, 698 F. Supp. 1504, 1510-11 (W.D. Wash. 1988).

the Act of October 24, 1984, Public Law 98-541," Congress directed an instream release of water to the Trinity River of not less than 340,000 acre-feet per year. Central Valley Improvement Act, Pub. L. No. 102-575, Title XXXIV, § 3406(b) (23), 106 Stat. 4706, 4720 (1992).

The obligation of the United States as trustee of Indian resources and rights extends to all agencies and departments of the Executive Branch. See Pyramid Lake Paiute Tribe v. Department of the Navy, 898 F.2d 1410, 1420 (9th Cir. 1990); Covelo Indian Community v. FERC, 895 F.2d 581, 586 (9th Cir. 1990). As such, the Department; of Interior and Commerce, as well as other federal agencies whose actions affect the fishery resource, must ensure that their actions are consistent with the trust obligations of the United States to the Tribes.

Proper allocation of the harvest of Klamath River basin stocks is only part of the effort needed to protect the reserved fishing rights of the Tribes. The Secretary of the Interior has acted in the past to increase flows in the Trinity River, in part to improve-the fishery for the benefit of the Indians.[42] This was a recognition that protection of the fishery itself is necessary to make the tribal fishing right meaningful.

In order for both the purpose of the reservations and the objectives of the Magnuson Act[43] to be fulfilled, the fishery resource here must be rebuilt to sustain a viable fishery for all user groups, consistent with sound conservation practices. Cf. Hoh Indian Tribe v. Baldridge, 522 F. Supp. 683, 691 (W.D. Wash. 1981). The Trinity River Basin Restoration Act of 1984, Pub. L. No. 98-541, 98 Stat. 2721; the Klamath River Basin Fishery Resources Restoration Act of 1986, 16 U.S.C. § 460ss; and section 3406(b)(23) of the Central Valley Improvement Act of 1992, 106 Stat. at 4720; all reflect congressional intent to restore and protect the anadromous fishery in the Klamath and Trinity River basins.

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[42] See 1991 Trinity River Flows Decision, supra note 3; 1981 Secretarial Issue Document, supra note 3; see also Memorandum from the Associate Solicitor, Division of Indian Affairs to the Assistant Secretary - Indian Affairs, March 14, 1979 (quoted in 1981 Secretarial Issue Document).

[43] Magnuson Fishery Conservation and Management Act, Pub. L. No. 94-265, 90 Stat. 331, codified as amended at 16 U.S.C. §§ 1801 - 1882 (1988).

B . Regulation of the Klamath Fishery

The regulation of the Klamath River basin anadromous fishery resource is divided among a number of governments and agencies.[44] Within the three-mile territorial sea off the coast, the states have jurisdiction. Federal jurisdiction over management of the Klamath fishery resource is split between the Interior and Commerce Departments. The Tribes and the Department of the Interior have the authority to manage the in-river on-reservation tribal fishery.[45] See 25 C.F.R. Part 250. In the exclusive economic zone, generally three to two hundred miles offshore, the Department of Commerce has exclusive management and regulatory jurisdiction. See Magnuson Act, 16 U.S.C. §§ 1801 - 1882; Washington Crab Producers Inc. v. Mosbacher, 924 F.2d 1438, 1439 (9th Cir. 1991).

As a general matter, all parties that manage the fishery, or whose actions affect the fishery, have a responsibility to act in accordance with the fishing rights of the Tribes. This may go beyond safeguarding their right to an appropriate share of the harvest on their reservations, cf. U.S. v. Washington, 459 F. Supp. 1020, 1070 (W.D. Wash. 1978), to include a viable and adequate fishery from which to fulfill the Tribes' rights, whether those rights are fulfilled by a 50% share or by a lesser amount, if a lesser amount will satisfy fully the moderate living standard to which the Tribes are entitled. Cf. United States v. Washington, 506 F. Supp. 187, 197 (W.D. Wash. 1980) ("treaties were designed to guarantee the tribes an adequate supply of fish"), aff'd in relevant part, 759 F.2d 1353 (9th Cir.), cert. denied, 474 U.S. 994 (1985).

Because of the migratory nature of anadromous fish, ocean fishing has a direct impact on the available harvest in the Klamath and Trinity Rivers within the Tribes' reservations. The Magnuson Act provides:

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[44] The complicated jurisdictional- scheme for managing anadromous fishery resources was described in Washington Crab Producers. Inc. v. Mosbacher, 924 F.2d 1438, 1442 (9th Cir. 1991). The disjuncture between ocean and in-river fishing regulation authority over the Klamath basin fishery resource was noted with concern by Judge Beezer in his concurring opinion in United States v. Eberhardt, 789 F.2d 1354, 1363 (9th Cir. 1986) (Beezer, J., concurring).

[45] As a general matter, reasonable, necessary, and nondiscriminatory conservation measures may be imposed by the Federal Government or the states, as appropriate, on the exercise of tribal fishing rights in the absence of adequate tribal regulation. See Antoine v. Washington, 420 U.S. 194, 207 (1975); United States v. Eberhardt, 789 F.2d 1354 (9th Cir. 1986).

> Any fishery management plan which is prepared by any Council, or by the Secretary [of Commerce], with respect to any fishery, shall . . . contain the conservation and management measures, applicable to foreign fishing and fishing by vessels of the United States, which are . . . consistent with . . . any other applicable law.

16 U.S.C. § 1853(a)(1)(C) (1988) (emphasis added).

The Yurok and Hoopa Tribes' fishing rights are "applicable law" within the meaning of the Magnuson Act, because regardless of whether they were created by treaty or pursuant to statutory authority, they are rights that arise under federal law.[46] See Pacific Coast Federation v. Secretary of Commerce, 494 F. Supp. 626, 632 (N.D. Cal. 1980) ("It cannot be doubted that the Indians have a right to fish on the reservation. Congress has carefully preserved this right over the years, and the courts have consistently enforced it."); see also Washington State Charterboat Ass'n v. Baldridge, 702 F.2d 820, 823 (9th Cir. 1983) (treaty fishing rights as "applicable law"), cert. denied, 464 U.S. 1053 (1984); Hoh Indian Tribe v. Baldridge, 522 F. Supp. 683, 685 (W.D. Wash. 1981) (same). Furthermore: nowhere in the Magnuson Act has Congress stated an intent to interfere with Indian rights in the Klamath River area. Pacific Coast Federation, 494 F. Supp. at 633. Therefore, fishery management plans and ocean fishing regulations must be consistent with those rights. The Act, however, provides no authority to either the Pacific Fishery Management Council, see 16 U.S.C. § 1852(a)(6), or the Secretary of Commerce over in-river Indian fishing or in-river tribal harvest levels. Pacific Coast Federation, 494 F. Supp. at 632. Thus, in managing the ocean fisheries, the Secretary of Commerce must rely on management by the Department

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[46] The Magnuson Act expressly refers to Indian treaty fishing rights. Specifically, 16 U.S.C. § 1853(a)(2) requires that fishery management plans contain a description of "Indian treaty fishing rights, if any." Because the plans themselves are limited to management of the ocean fishery, however, this provision refers to Indian treaty fishing rights existing in ocean fishing areas, and not to in-river tribal fishing rights--treaty or otherwise. See Washington Troller's Ass'n v. Kreps, 466 F. Supp. 309, 313 (W.D. Wash. 1979) (description of in-river fishery not required by Magnuson Act). Section 1853(a)(2)'s failure to refer explicitly to other federally reserved Indian fishing rights does not affect our conclusion that § 1853(a)(1)(C) is the relevant provision requiring that fishery management plans substantively conform to Indian reserved rights. The status, scope, and character of those rights is determined by looking to their source--not to the Magnuson Act.

of the Interior or the Tribes of the in-river fishery. Cf. Washington Crab Producers, 924 F.2d at 1443.

Except for the general Magnuson Act requirement that ocean fishery plans be consistent with any other applicable law, the Act's provisions governing regulation of the ocean fishery do not extend to in-river Indian fisheries. Arguments to the contrary by both ocean fishermen and inland tribes have been rejected. Compare Washington Trollers Ass'n v. Kreps, 466 F. Supp. 309 (W.D. Wash. 1979) (rejecting ocean fishing association's argument that the fishery plan must describe inland fisheries); with Hoopa Valley Tribe v. Baldridge, No. C-82-3145, slip op. at 43-45 (N.D. Cal. June 25, 1984) (rejecting Tribe's argument that alleged discriminatory regulation of in-river tribal fishing violated the Magnuson Act's prohibition against discrimination in allocating the harvest).

V. CONCLUSION

I conclude that when the United States set aside what are today the Hoopa Valley and Yurok Reservations, it reserved for the Indians of the reservations a federally protected right to the fishery resource sufficient to support a moderate standard of living. I also conclude, however, that the entitlement of the Yurok and Hoopa Valley Tribes is limited to the moderate living standard or 50% of the harvest of Klamath-Trinity basin salmon, whichever is less. Given the current depressed condition of the Klamath River basin fishery, and absent any agreement among the parties to the contrary, the Tribes are entitled to 50% of the harvest.

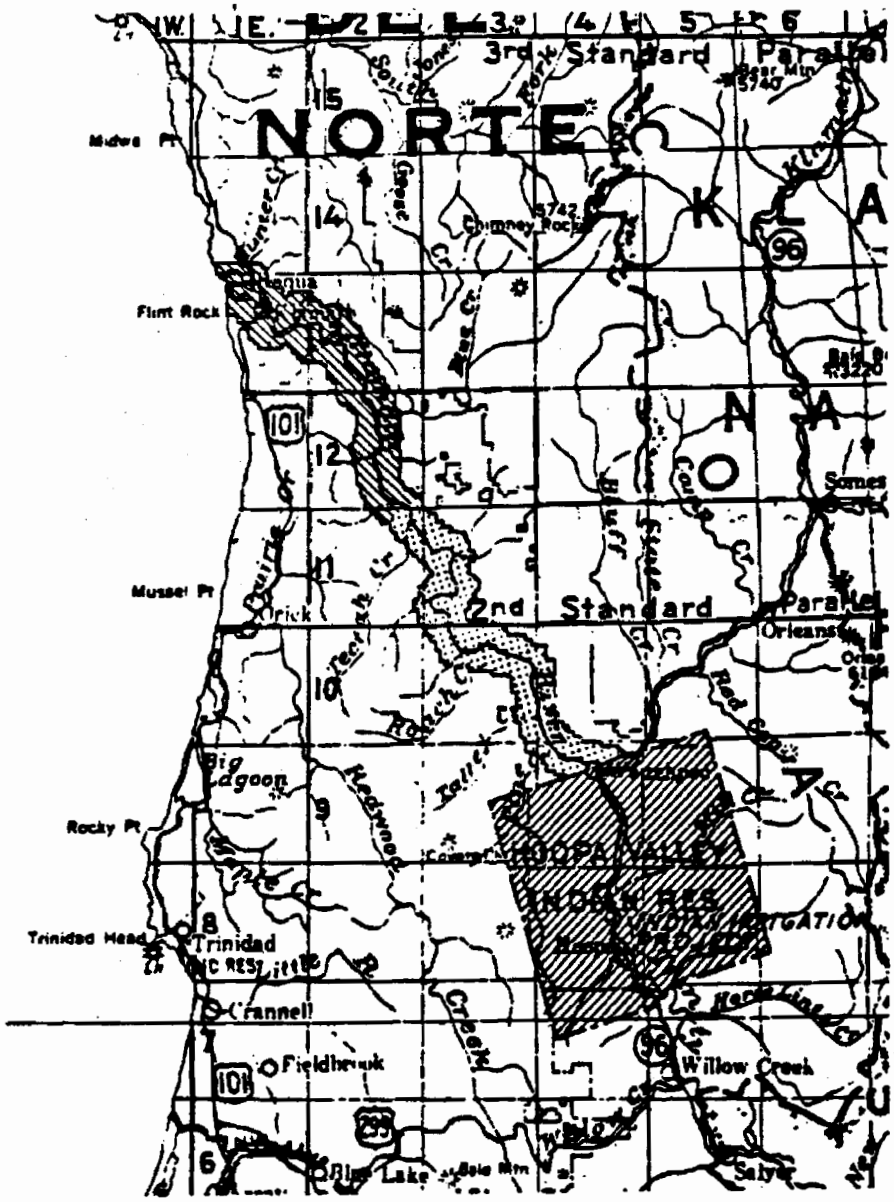


John D. Leshy
Solicitor

APPENDIX TO OPINION OF THE COURT

MAP OF HOOPA VALLEY INDIAN RESERVATION, CALIFORNIA*

Scale: 1 inch = 12 miles



LEGEND:
- Old Klamath River Reservation.
- Connecting Strip.
- Original Hoop Valley Reservation.

*United States Department of Interior, General Land Office 1944.

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APPENDIX B

Overview of the History of the
Klamath River and Hoopa Valley Reservations

The original Klamath River Reservation was established in 1855. The location had been selected pursuant to "directions [from the Secretary of the Interior] to select . . . reservations [in California] from such 'tracts of land adapted as to soil, climate, water-privileges, and timber, to the comfortable and permanent accommodation of the Indians, which tracts should be unincumbered by old Spanish grants or claims of recent white settlers.'" I Kappler, Indian Affairs: Laws and Treaties 816 (1904) ("Kappler") (Letter from Commissioner of Indian Affairs to Secretary of the Interior, Nov. 10, 1855). In creating the reservation, President Pierce accepted the Interior Department's recommendation to set aside a strip of territory one mile wide on each side of the Klamath River, for a distance of twenty miles. See id. at 816-17.

In the 1856 Annual Report of the Commissioner of Indian Affairs, the Klamath reservation is described as follows:

> Klamath reservation is located on the river of that name, which discharges its waters into the Pacific ocean twenty miles south of Crescent city.
>
> The Indians at this place number about two thousand. They are proud and somewhat insolent, and not inclined to labor, alleging that as they have always heretofore lived upon the fish of the river, and the roots, berries, and seeds of their native hills, they can continue to do so if left unmolested by the whites, whose encroachments upon what they call their country they are disposed to resist. . . . The land on this river is peculiarly adapted to the growth of vegetables, and it is expected that potatoes and other vegetable food, which can be produced in any abundance, together with the salmon and other fish which abound plentifully in the Klamath river, shall constitute the principal food for these Indians. It is confidently expected in this way to avoid the purchase of beef, which forms so expensive an item at those places where there is no substitute for it. The establishment of the Klamath reserve has undoubtedly prevented the spread of the Indian wars of Oregon down into northern California.

Annual Report of the Commissioner of Indian Affairs ("Annual Report") 238-39 (1856).

The next year, the Government agent at the Klamath Reservation described the importance of the fishery to the Indians on both the Klamath and Trinity Rivers. Because of the harm caused to the fishery on the Trinity, he recommended relocation of those Indians to the Klamath Reservation:

> Salmon has been very abundant this season, and in the different villages upon the reservation there has not been less than seventy-five tons cured for winter use. . . .
>
> We are now engaged in clearing, with Indian labor, one hundred acres of land, which will be ready for crop by the middle of October. . . .
>
> The Indians are located at different points upon the Klamath river, which runs through the reservation, . . . for the convenience of fishing . . . . On this river, above Marippe Falls, the eastern boundary of the reserve, there are probably about fourteen hundred Indians; they subsist upon fish, game, and the natural products of the earth. Some few of them work **for** the settlers.
>
> In Hoopa valley, on Trinity river, there are about seven hundred Indians; they subsist by hunting, fishing, grass seeds, and acorns. Many of them work for the white settlers in the valley, and are well paid for their labor.
>
> On the Trinity river and its tributaries, above Hoopa, there are about five hundred Indians; their resources for fishing and gaining a livelihood have been destroyed by mining in the vicinity; . . . I would recommend their removal to this agency.

Annual Report 391 (1857) (Letter from Indian Sub-Agent Heintzelman to Sup't of Indian Affairs, July 13, 1857).

In 1858, the California Superintendent reported:

> It is proper to remark, that in almost every locality in California there is a sufficiency of the natural products of the country for the subsistence of Indians residing there, and they could support themselves quite well, were it not for the encroachments of the whites, and the consequent destruction of their food by the settlement of the country.
>
> * * * *

> Klamath reservation is progressing steadily and quite satisfactorily. The crop is good, and with the yield of salmon at the fisheries the Indians are contented and happy.

Annual Report 283, 285 (1858) (Letter from Sup't of Indian Affairs to Comm'r of Indian Affairs, Sept. 4, 1858).

The Klamath Reservation sub-agent reported on the "abundance of [the Indians'] natural food," and also indicated the unlikelihood of extensive agricultural production on the Klamath reservation:

> One great difficulty this reservation labors under is the small amount of land that can be brought under cultivation. The Klamath river runs through a canon, the entire length, and the reservation being located upon each side of it, the only land suitable for cultivation is in the bottoms, ranging in size from one acre to seventy.

Id. at 286 (Letter from Indian Sub-agent Heintzelman to Sup't of Indian Affairs, July 1, 1858).

In 1859, the Klamath Reservation's Indian agent reported about two thousand Indians "on this reservation proper" and about four thousand more "who inhabit the mountain streams, and subsist principally on fish and game, which are very abundant, and seem inexhaustible." Annual Report 437 (1859) (Letter from Indian Agent Buel to Jas. Y. McDuffie, Esq. (undated)).

The agent's report in 1861 continues to reflect the importance of the reservation and its fishery to the Indians:

> [The Klamath] reservation is well located, and the improvements are suitable and of considerablevalue. There is an abundance of excellent timber for fencing and all other purposes, and at the mouth of the Klamath river there is a salmon fishery of great value to the Indians. The number **of** Indians here is not far from' eighteen hundred.
>
> * * * *
>
> I suggest, as this reservation has never been surveyed, that it should be so laid out as to embrace the island and fishery at the mouth of the Klamath, and extend a mile in width each side of the river, to a point one mile above Wakel, and a half a mile in width each side of the river, from that point to the mouth of the Trinity river.

Annual Report 147 (1861) (Letter from Superintending Agent Geo. M. Hanson to Comm'r of Indian Affairs, July 15, 1861).

In December, 1861, the Klamath agent reported the entire loss of the agricultural developments on the Klamath Reservation by an "unparalleled freshet." Annual Report 313 (1862) (Letter from Agent Hanson to Comm'r of Indian Affairs Dec. 31, 1861). As a result of the 1861 flood, the Superintendent and one group of the Indians moved to the Smith River reservation. Most, however, remained on the Klamath Reservation or in an area up the river. Nearly all eventually returned to the Klamath River and vicinity. See Letter from Comm'r of Indian Affairs to Secretary of the Interior, April 4, 1888, reprinted in S. Exec. Doc. No. 140, 50th Cong., 2d Sess. 19-22 (1889); Mattz v. Arnett, 412 U.S. 481, 487 (1973); Short v. United States, 202 Cl. Ct. 870, 887 (1973), cert. denied, 416 U.S. 961 (1974).

By 1862, the Indian Superintendent was recommending the sale of the Klamath Reservation and relocation of the Indians to another suitable reservation. See Annual Report 40-41 (1862). While Government officials now spoke of the Klamath Reservation as "almost worthless," and as "almost entirely abandoned by the Indians," it sought to relocate the Indians to another reservation which would continue to provide the Indians with a fishery, in addition to agricultural lands. See Annual Report 8-10 (1863). The 1863 Commissioner's report referred to the "abundance of fish" on the Round Valley reservation and noted that the Smith River valley, a recommended site, was isolated from non-Indians and would furnish the "best of fisheries" from the Pacific Ocean. Id. at 9-10.

As part of an effort to consolidate and reduce the number of Indian reservations in California, Congress in 1864 passed an act authorizing the President to set apart up to four tracts of land in California for the purposes of Indian reservations.. See Act of April 8, 1864, § 2, 13 Stat. 39, 40; Donnelly v. United States, 228 U.S. 243, 257, modified and rehearsing denied, 228 U.S. 708 (1913); Mattz v. Superior Court, 46 Cal. 3d 355, 758 P.2d 606, 610, 250 Cal. Rptr. 278 (1988).

In 1864, the Klamath, Redwood, and Trinity Indians were reported to still be at war with the forces of the United States. Annual Report 13 (1864); see Short, 202 Ct. Cl. at 889. Austin Wiley, an attorney, was appointed Superintendent of Indian Affairs- for California. In order to restore and establish peaceful relations with the tribes, Superintendent Wiley entered into negotiations and concluded a treaty with the Indians, which provided for locating the Indians in the Hoopa Valley. See Annual Report 12-14 (1864); Short, 202 Ct. Cl. at 891. Although the treaty was. never ratified, and there is doubt whether the Indians really

understood the terms of Wiley's treaty, see id. at 895, Wiley proceeded, consistent with the proposed treaty, to locate the Hoopa Valley Reservation. Id. at 891-92. By treating with the Indians and establishing the reservation, Superintendent Wiley "thereby brought to an end the war with the Indians of Humboldt, Klamath and Trinity counties." Id. at 896.

By 1865, the Government's original intention to remove the Klamath River Indians to the Smith River reservation had changed and refocused on use of the Klamath Reservation:

> It was intended to remove the Indians from the Smith River reservation, and place them at the old Klamath reservation, still owned by government, but to place the occupants under the charge of an employee of the Hoopa Valley agency. No definite suggestions were made as to the selection of the other two permanent reservations.

Annual Report 11 (1865).

Superintendent Maltby, who had replaced Superintendent Wiley, reported on the newly located Hoopa Valley reservation, and expressed his expectation that the "Klamath Indians in the vicinity, numbering eighteen hundred, will . . . most of them move to the [Hoopa Valley] reservation." Id. at 113 (Letter from Sup't of Indian Affairs to Comm'r of Indian Affairs, Sept. 15, 1865). The same year, the Government surgeon living on the Hoopa Valley reservation along the Trinity River reported on the Indians' reliance on the salmon fishery, and the difficulties resulting from harm to, the resource caused by local mining:

> They no longer sport on the banks of clear streams literally alive with salmon and other fish, but gaze sadly into the muddy waters, despoiled almost of -their finny prey by the impurities from the sluice-boxes of the miners at the head of the stream. In this consists one of the greatest calamities inflicted upon the Indians of recent years. Their salmon fishing is destroyed to a very great extent, and with it one of their chief means of subsistence. Those who saw the Klamath and Trinity rivers in early days say that during the summer months they ran as clear as crystal, and thronged with salmon from the sea; now they are muddy streams and almost deserted by this fish.

Id. at 116-17. The Government surgeon nonetheless noted that the Indians continued to secure "all the fish they can," id. at 117, and remarked at "the large quantity of fish oil they consume as food," id. at 118.

In 1866, Robert J. Stevens was appointed special commissioner to investigate and report on Indian affairs in California. His report dated January 1, 1867, and addressed to the' Commissioner of Indian Affairs, is contained in the 1867 Annual Report 117-48. Commissioner Stevens reported on continuing difficulties in maintaining peace between the Indians and non-Indians, and of the need for reservations for the exclusive use and occupancy of the Indians. He discussed the Hoopa Valley reservation in connection with Superintendent Wiley's "treaty," and the establishment of peaceful relations with the Indians. Commissioner Stevens travelled from the Hoopa Valley reservation down the Trinity to the Klamath River, making the following report:

> On the banks of the Klamath the villages were more numerous. . . .
>
> The salmon fisheries of the river have been very much injured by the former mining operations. Only now and then one of their ingenious weirs is seen. . . .
>
> * * * *
>
> The count of Indians on the Klamath, made officially, but little over a year previous to my visit, gave a census of 2,217 below the mouth of the Trinity.
>
> At this point I wish to submit my observations as to the character of the country through which flows the Klamath river. For 10 miles or more on each side to a point about 30 miles above its mouth, following its course, it is unsettled and wild, peopled almost exclusively by Indians, to whose wants and habits it is well adapted, supplying wild food and fish in abundance. Very little of it is tillable land, and whites will never care to settle upon it.
>
> My attention had been particularly directed to this region by Major Bowman while with him at Fort Humboldt. The following is his suggestion:
>
> "Extend the Hoopa reservation on its northern boundary, so as to include not less than six miles along the northern bank of the Klamath to the sea-shore, thence down the sea-shore to the mouth of Redwood creek, thence up Redwood creek to the point nearest to the head of Willow creek, thence down Willow creek to the boundary of the Hoopa reservation."
>
> He adds:
>
> "Very little of this tract is suitable for cultivation, and consequently not desirable for the settlements of white men, but will furnish sufficient tillable land, I think, for the wants of all the Indians that may be placed there, and range for necessary stock. . . ."

> "The miners engaged on the river banks within the described limits are but few, and are daily diminishing in numbers."

Id. at 127-29. Commissioner Stevens recommended the withdrawal for Indian use, "not only the tract on the Klamath, . . . but an enlargement thereof." Id. at 145.

In 1868, the Indian agent at the Hoopa Valley Reservation remarked in his report that establishment of the reservation "was right and its location good," and that "it would be almost impossible to remove [the Indians] to any other locality, and then only by a great expense, endangering the peace of this section while it was being done." Annual Report 133 (1868) (Letter from Indian Agent Pratt to Comm'r of Indian Affairs, July 20, 1868).

For a number of years, the reports from the Hoopa Valley Reservation discussed the attempts to begin agriculture livestock raising, and ranged from the optimistic to the pessimistic. Compare Annual Report 16 (1869) (Hoopa Valley reservation "under. a fine state of cultivation and highly prosperous"), with Annual Report 78 (1870) (Letter from Sup't of Indian Affairs to Comm'r of Indian Affairs, July 13, 1870) (Hoopa Valley reservation "has but a poor prospect of becoming self-sustaining;" "the soil at Hoopa is so poor that it is incapable of raising produce sufficient to feed 1,000 Indians").

In 1882, the Commissioner's report, while noting that "Indian farming has increased satisfactorily," noted that the salmon fishery still comprised one-third of the subsistence of Indians located on the Hoopa Valley reservation. Annual Report 10 (1882).

In 1883, a commercial fisherman named Hume contacted the Secretary of the Interior and proposed to lease the salmon fisheries of the Klamath River, within the Klamath River Reservation. The Acting Commissioner of Indian Affairs replied:

> [N]o such proposition can be entertained. It would be against usage and at variance with the policy of the Department in the control and management of Indian affairs.
>
> The permanent settlement of the Indians residing upon said reservation, and the disposal of so much of the reservation as may not be needed for that purpose, are matters engaging the attention of the Department at this time. . . .

> The reservation is still in a state of Indian reservation, and must so remain, uninterfered with, until otherwise ordered by competent authority.

Letter from Acting Comm'r of Indian Affairs to D.B.[1] Hume (July 23, 1883), reprinted in S. Exec. Doc. No. 140, 50th Cong., 2d Sess. 11 (1889).

Two years later, Special Agent Paris Folsom investigated and reported on the "Condition and Needs of Non-Reservation Klamath Indians in California," noting the particular suitability of the Klamath River fisheries for satisfying the needs of the Indians:

> The distance from the line of the Hoopa Valley Reservation, at the juncture of the Klamath and Trinity Rivers, to the Klamath River Reservation, upper line, by way of the river, is some 18 miles, and it is within these limits that the non-reservation Klamath Indians are located.
>
> Nature seems to have done her best here to fashion a perfect paradise for these Indians, and to repel the approach of the white man. She filled the mouth of the Klamath River with a sand-bar and huge rocks, rendering ordinary navigation impossible, . . .
>
> . . . [The Indians] form a very respectable peasantry, supporting themselves without aid from the Government by fishing, hunting, raising a little stock, cultivating patches of soil, and by day's labor at the Arcata lumber-mills. . . .
>
> * * * *
>
> . . . . Fisheries, staging for holding the fishermen and their nets, are dotted along the river. Indians have had general and actual, though unrecorded, possession and occupation of the whole river line here for years and years. Their dwellings are scattered and permanent. They wish to remain here; here they are self-supporting --actually self-sustaining. This is their old home, and home is very dear to them-- treasured above everything else. No place can be found so well adapted to these Indians, and to which they themselves are so well adapted, as this very spot. No possessions of the Government can be better spared to

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[1] This appears to be an error. Hume's initials apparently were "R.D." For historical works about Hume, see A Pygmy Monopolist: The Life and Doings of R.D. Hume Written by Himself and Dedicated to His Neighbors (Gordon B. Dodds, ed.) (Univ. of Wisconsin 1961); Gordon B. Dodds, The Salmon King of Oregon. R.D. Hume and the Pacific Fisheries (Univ. of North Carolina 1959).

them. No territory offers more to these Indians and very little territory offers less to the white man.

* * * *

I have the honor to further recommend that these same provisions be extended to the Indians on the Klamath River Reservation immediately adjoining the land here considered, and that the lower and remaining portion of that reservation be thrown again with the public lands, providing security and protection to the fisheries of the Indians above the mouth of the Klamath River.

Report of Special Agent on Condition and Needs of Non-Reservation Klamath Indians in California (June 25, 1885), reprinted in S. Exec. Doc. No. 140, 50th Cong., 2d Sess. 7-11 (1889).

In 1886, the Acting Agent for the Hoopa Valley Reservation reported on the "Klamath Reservation:"

My duties, as both agent and commanding officer, require me to exercise a supervision over the reservation on the Klamath. A small outpost is maintained at the mouth of that river to prevent intrusion on the Indian lands, and protect the Indians in their only industry-- that of fishing for salmon.

Those Indians are also anxious for a subdivision of their lands, but before this can be done the lines of the reservation must be fixed determinately. . . .

The people, like the Hoopas, are friendly and well disposed, and maintain amicable relations with the white people about them, but should the military power of the Government be removed from this valley, both reservations would soon be overrun, and the Indians dispossessed. The Klamaths live almost exclusively on the salmon, though a few plant a little.

Annual Report 43 (1886) (Letter from Acting Agent Wm. E. Dougherty, Capt. First Infantry, to Comm'r of Indian Affairs, Aug. 15, 1886).

The following year, in 1887, Acting Agent Dougherty reported on a controversy that had arisen with the commercial fisherman Hume at the mouth of the Klamath:

There are believed to be on the Klamath river about 1,200 Indians of that name. The live in villages on the river bank, a few miles apart, from far up it to its mouth, and have always been self-sustaining, relying to a great extent for subsistence upon the salmon. . . .

* * * *

> In May last, R.D. Hume, of Ellenburgh, Oreg., entered the mouth of the Klamath river, with a light-draft steamboat and a gang of fishermen brought from the north, and established a floating cannery on the fishing grounds near the mouth of the river. The Indians along the river are much disturbed at what they deem to be an intrusion that will deprive them to a great extent of their means of subsistence, and I think that unless some remedial measure is applied by the Government necessity will actuate them to seek a remedy in their own way.

Annual Report 9 (1887) (Letter from Acting Agent Wm. E. Dougherty, Captain U.S. Army, to Comm'r of Indian Affairs, July 5, 1887).

Concerned about the intrusion of R.D. Hume's steamer into the Klamath River within the Klamath Reservation, the Interior Department sought to obtain relief for the Indians and protection for their fishery. In June, 1887, the Secretary of the Interior, sought an opinion from the Attorney General concerning the Government's power to protect the Indians and their unimpaired access to the fishery within the boundaries of the reservation. The Secretary's inquiry prompted exchanges between the Interior and Justice Departments on the authority of the United States to exclude Hume from the Indian fishery at the mouth of the Klamath River. Much to the consternation of the Interior Department, the Justice Department took a narrow 'view of the Federal Government's power to protect the Indians.

The Attorney General concluded that "so long as the acts of persons resorting to these waters to take fish fall short of invading the right of Congress to regulate commerce with foreign nations or among the several States, no case for Federal interference can be said to exist." Letter from Attorney General to Secretary of the Interior, June 11, 1887, reprinted in S. Exec. Doc. No. 140, 50th Cong., 2d Sess. 13 (1889). In reaching his conclusion, the Attorney General discussed principles of state ownership of the beds of tide-waters and of fish running in them, noted that the State had declared the Klamath River to be navigable, and found that power over the fisheries had not been granted to the United States and thus remained under the exclusive control of the State.

The Interior Department continued to press its case to establish and protect the rights of the Indians. On June 21, 1887, the Commissioner of Indian Affairs submitted a brief setting forth arguments supporting the Indians' right to the fishery, see S. Exec. Doc. No. 140, supra, at 14-16, which the Secretary

submitted to the Attorney General. Interior's brief contended that the Indians,

> have had exclusive use of the fisheries in the Klamath River, from which they have supported themselves, entirely unaided by the Government, at least since the freshet of 1861.
>
> * * * *
>
> Have not the Indians acquired private rights in their fisheries by prescription?
>
> * * * *
>
> Can the legislature of the State of California by declaring the Klamath River navigable, when in fact it is not navigable, deprive the Indians of the exclusive use of fisheries?
>
> * * * *
>
> The Klamath Reservation having been declared by the President, in pursuance of an act of Congress, for Indian purposes exclusively, can the State of California so far defeat the purposes of said act of Congress as to grant liberty to any and all of her citizens to enter within its boundaries and engage in the business of catching and curing fish, to the injury of the Indians for whom the reservation was created?
>
> * * * *
>
> By seining near the mouth of the river the whites would obstruct the passage of the salmon and cut the Indians off from their accustomed supply.
>
> Section 2149 of the Revised Statutes provides as follows:
>
> "The Commissioner of Indian Affairs is authorized and required, with the approval of the Secretary of the Interior, to remove from any tribal reservation any person * * * within the limits of the reservation whose presence may, in the judgment of the Commissioner, be detrimental to the peace and welfare of the Indians."
>
> The presence of Hume and his party within the limits of the Klamath River Reservation is manifestly detrimental to the peace and welfare of the Klamath River Indians, in that it is likely to provoke open hostilities between them; and if they are permitted to remain the whites will deprive the Indians of their means of support. Certainly nothing could be more detrimental to their peace and welfare.
>
> The right to navigate the river is not denied, but anchoring floats with a view to erecting buildings thereon for the accommodation of extensive business operations during an entire season is another thing.

> Captain Dougherty, the acting agent in charge, is an Army officer of large experience amongst the Indians, and good judgment.
>
> He asks that "the highest power be invoked to protect the Indians in the possession of their only (food) resource."
>
> * * * *
>
> A small military force has for a long time been stationed at the mouth of the Klamath to protect the Indians in their fishing privileges.

Id.

Two days after submitting the brief to the Secretary, the Commissioner sent him another letter discussing the similarity of the Klamath case with a court decision issued concerning Pyramid Lake:

> Referring to my letter . . . and accompanying paper relative to the Klamath River Reservation in California, and the attempted dispossession of the resident Indians of their fishing grounds by a gang of white men under one Hume, I have the honor to draw your attention to a case [concerning the Pyramid Lake Reservation.]
>
> [The non-Indian defendants in the case were charged with trespass for fishing on Pyramid Lake, and contended that the taking of fish inside the reservation was not unlawful], upon which the court said:
>
> "If this argument is sound the whole purpose of the law, in setting apart lands for the separate use of the Indians, is defeated . . . . We know that the lake was included in the reservation that it might be a fishing ground for the Indians. . . . It is plain that nothing of value to the Indians will be left of their reservation if all the whites who choose may resort there to fish. In my judgment those who thus encroach on the reservation and fishing ground violate the order setting apart for the use of the Indians, and consequently do so contrary to law."
>
> It can be said with equal truth . . . that the Klamath River was included in the reservation, "that it might be a fishing ground for the Indians." True, the executive order does not so state in terms, neither does the order setting apart the Pyramid Lake Reservation. But it is manifest from the description of the boundaries of the Klamath Reservation that it was the purpose and intention to exclude white people

from fishing in the river, from its mouth to the upper extremity of the reservation.

Should the whites be permitted to enter the river to fish, but little if anything of it will be left of the reservation and the whole purpose of the law will be defeated.

Letter from Comm'r of Indian Affairs to Secretary of the Interior, June 23, 1887, reprinted in S. Exec. Doc. No. 140, supra, at 16.

On June 23, 1887, the Attorney General asked for a more precise statement of the case and the question for which Interior was soliciting an opinion. The Commissioner of Indian Affairs then wrote the Secretary of Interior stating the case and questions he recommended be sent to the Attorney General:

> So far as we can ascertain the Klamath River Indians in California have held and enjoyed exclusive fishery privileges in the Klamath River from time immemorial, and were in full possession of them at the date of the Guadalupe Hidalgo treaty, by which the territory embracing the Klamath River and the State of California was acquired by the United States.
>
> This exclusive possession has never been disturbed, and until recently never challenged.

Letter from Comm'r of Indian Affairs to Secretary of the Interior, July 6, 1887, reprinted in S. Exec. Doc. No. 140, supra, at 17. The Commissioner posited five questions for the Attorney General:

> (1) Did not the Klamath River Indians acquire by prescription and hold at the date of the Guadalupe Hidalgo treaty, title or property in the fisheries of the Klamath River?
>
> (2) Was not such title or property recognized and guarantied by the provisions of said treaty?
>
> (3) Was not the legislative and executive action which fixed the present reservation on either side of the Klamath River a recognition of the Indians' right and title to the exclusive fishery privileges of Klamath River within the boundaries thereof?
>
> (4) If the Indians have rights under the Guadalupe Hidalgo treaty, or have acquired rights by prescription since the date of that treaty, can the State of California by direct or indirect means divest them of those rights?
>
> (5) If the Indians have the exclusive right to fish in the Klamath River within the boundaries of

> their reservation, can not the Department, through this Bureau and its agents, protect those rights within said boundaries by the enforcement of the laws and regulations made in pursuance thereof for the maintenance of peace and order on Indian reservations?

Id.

The Attorney General replied that he deemed Interior's questions "clearly justiciable" and more properly presented to a court than to him. Letter from Attorney General to Secretary of the Interior, July 11, 1887, reprinted in S. Exec. Doc. No. 140, supra, at 17-18. On October 4, 1887, the Acting Commissioner of Indian Affairs recommended to the Secretary of the Interior that the United States bring suit on behalf of the Indians to judicially determine their rights in the fisheries. Letter from Acting Comm'r of Indian Affairs to Secretary of the Interior, Oct. 4, 1887, reprinted in S. Exec. Doc. No. 140, supra, at 18. The lawsuit against Hume followed, and the Interior Department's position that the Klamath River Reservation remained an Indian reservation was set forth in a letter from the Commissioner to the Secretary of the Interior, dated April 4, 1888. See S. Exec. Doc. No. 140, supra, at 19-22 (1889).

In 1888, even while the controversy with Hume continued, Acting Agent Dougherty reported that the Indians had negotiated a commercial agreement to supply a non-Indian cannery operation with fish:

> The question of the prescriptive rights of the Lower Klamaths to the fisheries of the Klamath River is still in abeyance, and I do not think that any action has yet been taken on the instructions given by the honorable the Attorney-General, in October last, to institute proceedings in this case.
>
> Meantime the Indians have made a co-operative partnership with Mr. John Bornhoff[2] of Crescent City, who has supplied them with boats, nets, etc., and the plant for a cannery, which is now in operation at the mouth of the Klamath. This enterprise gives occupation to all the Indians at that place, and for some distance up the river, ...
>
> Mr. Hume's party from Oregon is again in the river fishing. The Indians complain as before, of this intrusion, and are awaiting with some anxiety the decision that will

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[2] Bearss, supra note 11 in Opinion, at 163, gives the name as John Bomhoff, which is consistent with Dodds, The Salmon King of Oreaon, supra note 1 in Appendix B, at 180.

determine whether the exclusive right claimed by them will be sustained or not."

Annual Report 10 (1888) (Letter from Acting Agent Wm. E. Dougherty, Captain U.S. Army, to Comm'r of Indian Affairs, Sept. 20, 1888).

The action eventually brought against Hume was prosecution of libel against his goods, for unlicensed trading in Indian country in violation of Revised Statutes § 2133, as amended. 22 Stat. 179 (1882).[3] The court rejected the claim that the area in question was within an Indian reservation. While the court agreed that the area was still a federal reservation not open to public entry, it also concluded that the Government had abandoned it as an "Indian reservation." Therefore, notwithstanding its federal reservation status, the court held that it did not qualify as an Indian reservation or as Indian country for purposes of R.S. § 2133. United States v. Forty-Eight Pounds of Rising Star Tea, 35 F. 403, 406 (D.C.N.D. Cal. 1888), aff'd, 38 F. 400 (C.C.N.D. Cal. 1889); see Short v. United States, 202 Ct. Cl. 870, 912-16 (1973) (description of controversy and decision) cert. denied, 416 U.S. 961 (1974). The court never addressed or

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[3] Revised Statutes § 2133, as amended, provided:

> Any person other than an Indian of the full blood who shall attempt to reside in the Indian country, or on any Indian reservation, as a trader, or to introduce goods, or to trade therein, without [an Indian traders] license, shall forfeit all merchandise offered for sale to the Indians or found in his possession, and shall moreover be liable to a penalty of five hundred dollars.

Act of July 31, 1882, ch. 360, 22 Stat. 179.

Much to the consternation of the Indian agent, Captain Wm. Dougherty, when the case against Hume came to trial in district court, "[t]he United States attorney did not appear . . . and the Government was not represented. His honor stated that it was the sixth time the case had been set for hearing, and decided to go on with it, and hear the Government's argument later." Letter from Agent Wm. E. Dougherty to Comm'r of Indian Affairs, May 29, 1888, reprinted in S. Exec. Doc. No. 140, 50th Cong., 2d Sess. 23 (1889).

adjudicated the questions raised by the Interior Department to the Attorney General.[4]

After losing in district court, the Secretary of the Interior requested an appeal and reported that in order to protect the Indians, authority was needed at once "to set apart these lands as a reservation and thus remove all doubt." Short, 202 Ct. Cl. at 914. On April 1, 1889, the circuit court affirmed the district court's decision, and concurred in the district court's analysis. 38 F. 400 (C.C.N.D. Cal. 1889).

Soon thereafter, Congress took up the question whether to open the reservation lands to non-Indian settlement. In 1890, the House of Representatives passed a bill rejecting allotments for the Indians on the Klamath River Reservation, and providing for public sale of the reservation lands. See Short, 202 Ct. Cl. at 917-18. Although a similar bill was introduced in the Senate, the Senate took no action on either the House-passed bill or the Senate bill. Id.

The setback in the courts and the activity in Congress prompted the Interior Department immediately to review its authority for establishing Indian reservations in California to determine whether it could better protect the Indians along the Klamath. The Department sought a legal opinion from the Assistant Attorney General. On January 20, 1891, the Assistant Attorney General replied that in his view, under the special circumstances of the case, the Department had retained the Klamath River Reservation under the 1864 four reservations Act and that it was a part of the Hoopa Valley Reservation. Letter from Assistant Attorney-General to Secretary of the Interior, January 20, 1891 (copy on file in Office of the Solicitor, U.S. Department of the Interior). In response to the decision in Forty-Eight Pounds of

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[4] The district court did note the Indians' involvement in commercial fishing:

> At the proper season, [Hume] proceeds with his vessel to the river, and employs the Indians to fish for him, supplying them with seines and other appliances. He pays them 'in trade,' furnishing them with various articles composing the cargo of his vessel.

United States Forty-Eisht Pounds of Rising Star Tea, 35 F. 403, 406 (D.C.N.D. Cal. 1888), aff'd, 38 F. 400 (C.C.N.D. Cal. 1889).

Rising Star Tea, the Assistant Attorney-General noted his disagreement with the reasoning,[5] but concluded that

> [t]his difficulty may yet be removed by the President issuing a-formal order, out of abundant caution, setting apart the Klamath river reservation, under the act of 1864, as part of the Hoopa Valley reservation, or extending the lines of the latter reservation so as to include, within its boundaries, the land covered by the former reservation, and the intermediate lands, if the title to the last be yet in the United States.

Letter from Assistant Attorney-General, supra, at 28-29.

On January 21, 1891, the Secretary requested the Commissioner to prepare the necessary orders for extension of the Hoopa Valley Reservation, and on October 16, 1891, President Harrison signed the executive order extending the boundaries of the Hoopa Valley Reservation to include the Klamath River Reservation and the Connecting Strip between the two reservations. I Kappler 815; see also Mattz v. Arnett, 412 U.S. 481, 493 (1973), Donnelly v. United States, 228 U.S. 243, 255-59, modified and rehearing denied, 228 U.S. 708 (1913); Short, 202 Ct. Cl. at 920-23.

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[5] The Assistant Attorney-General did agree with the result. Following the reasoning adopted by the Attorney General in his June 11, 1887, letter, the Assistant Attorney General considered the Klamath River as not within the Klamath Reservation, and therefore beyond the authority of the United States to exclude persons fishing on the waters of the Klamath River. Letter from Assistant Attorney-General to the Secretary of the Interior, January 20, 1891, at 24-27.

In Mattz v. Superior Court, the State of California submitted this letter to establish that the Federal Government lacked the authority to reserve Indian fishing rights in the Klamath River or at least lacked the intent to reserve fishing rights for the Indians of the reservation. The Supreme Court of California rejected those arguments. 46 Cal. 3d 355, 758 P.2d 606, 616-18, 250 Cal. Rptr. 278 (1988).

D. 2006 DOI Cooperative Agreement: Cooperative Management of Tribal and Federal Lands and Resources in the Klamath River Basin in California

COOPERATIVE AGREEMENT
between
UNITED STATES DEPARTMENT OF THE INTERIOR
and
YUROK TRIBE
for the
COOPERATIVE MANAGEMENT OF TRIBAL AND FEDERAL LANDS AND RESOURCES IN THE KLAMATH RIVER BASIN OF CALIFORNIA

I. STATEMENT OF JOINT OBJECTIVES:

A. Purpose. This Cooperative Agreement (Agreement) is made and entered into between the United States Department of the Interior (DOI) and the Yurok Tribe (Tribe) to coordinate and cooperatively manage Federal and Tribal lands and resources within the Klamath Basin in California, both within the Yurok Reservation as well as the related basin, upstream river, and Pacific Ocean resources subject to the jurisdiction or authorities of various DOI agencies and bureaus. This Agreement will provide more consistent, economical, effective, and collaborative management of Federal and Tribal lands and natural resources while furthering the Trust relationship that exists between DOI and the Tribe. This Agreement will also greatly expand the resources available to address the shared goals of DOI and the Tribe to improve our collective understanding of the river system and its dynamics, improve the health and vitality of the fishery, and identify and develop programs for natural resource management and service delivery in order to provide long-term benefits to the Tribe, local communities, and the general public and to improve the condition of the basin's natural resources. DOI and the Tribe anticipate that this Agreement will be the foundation for subsequent, continuing, and specific collaborative programs in natural resource management, including but not limited to land and water management, fisheries management, water quality monitoring, land use planning, data gap analysis, interpretation and outreach, and Tribal-interagency management initiatives which will enhance the opportunity to identify and resolve issues critical to the success and survival of a healthy river-based ecosystem in the lower Klamath Basin.

B. Objective. DOI and the Tribe intend to establish an ongoing collaborative government-to-government relationship for management of land, water and other natural resources which will inure to the benefit of DOI, the Tribe, and the communities, as well as the ecosystem and economy of the Klamath River Basin. This Agreement provides a

mechanism to coordinate natural resource management programs, develop joint planning and management initiatives, and coordinate program and budget priorities through the cooperative allocation of resources and the development of long-term resource management and programmatic goals between the signatories. The Agreement will improve DOI and Tribal services to the Tribal and local communities and the general public by improving Klamath River resources management, addressing the health of the fishery, and establishing related programs for restoration and management of natural resources. The Agreement will provide an opportunity for the Tribe to bring to bear its acknowledged scientific expertise, its knowledge of the basin, and the wealth of its culture and traditions to its collaborative relationship with DOI. The Agreement will provide a mechanism by which the Tribe and DOI may further the protection and preservation of Tribal cultural values and practices while collaborating on management of basin natural resources. The Agreement will accomplish these objectives by developing mechanisms for increasing the potential contribution and participation in federal programs by the Tribe while also realizing broader benefits to Klamath Basin communities, the general public, federal agencies and the scientific community.

C. Authority. The Federal Land Policy and Management Act of 1976, 43 U.S.C. § 1737(b); Endangered Species Act, 16 U.S.C. § 1531 *et seq.*; Fish and Wildlife Coordination Act, 16 U.S.C. § 661 *et seq.*; National Park Service Organic Act, 16 U.S.C. 1 *et seq*; and Klamath River Basin Fisheries Resource Restoration Act , 16 U.S.C. § 460ss *et seq.*, among others, provide that the Secretary of the Interior may undertake programs of resource management through Cooperative Agreements.

D. Benefits. Cooperative undertakings withing the scope of this agreement will result in increased public management effectiveness, enhancement of natural resource program coordination, opportunity for joint public outreach, and a greater level of consistency and effectiveness in public and Tribal land use planning. This cooperative relationship provides DOI with access to resources and services not otherwise available, as well as the benefit of continued contributions by and involvement of Tribal officials, planners, resource specialists and the general Tribal membership in public land management. This broader partnership to further the federal-Tribal relationship is critical to providing a higher level of public service and to involving the Tribal government and the public in the development and coordination of resource management programs and cooperative land-use planning and management opportunities.

II. DEFINITIONS:

A. DOI: Means United States Department of the Interior, including its agencies, offices, and bureaus.

B. TRIBE: Means the Tribal Government, the Executive Offices, and/or authorized staff and agents of the Yurok Tribe.

C. AGREEMENT: Means this Cooperative Agreement.

III. SCOPE:

A. DOI agrees to:

Coordinate and consult with the Tribe, as frequently as required by DOI agencies and at least annually, through the Assistant Secretary, Policy Management and Budget or his/her designee and/or appropriate regional and other officials to identify opportunities for the development of land and resource management programs and coordination of resource program priorities and initiatives.

Identify opportunities for development of cooperative initiatives for coordinated management of land and water resources, beneficial data collection, fisheries or other natural resource management programs, land management initiatives, public outreach and such other programs which may offer opportunities for more efficient resource management.

Seek specific opportunities to involve the Tribe in DOI land and resource management activities in a more active role in furtherance of the federal-Tribal relationship and the partnership established under this Agreement.

Coordinate, organize, and assure appropriate government professional and management involvement in programs within the scope of this Agreement.

B. The TRIBE agrees to:

Coordinate and consult with the DOI, as often as necessary and at least annually, to identify Tribal land management priorities, resources and opportunities for joint Tribal-DOI program development.

Coordinate, organize, and assure appropriate Tribal governmental, Tribal member, professional, and executive involvement in programs within the scope of this Agreement.

Seek to identify opportunities for governmental partnerships and cooperative programs, including the identification of Tribal resources available for such initiatives.

Identify and provide appropriate staff and other resources for planning and implementation of initiatives developed pursuant to this Agreement.

C. DOI and the TRIBE agree to:

Establish an on-going joint management group to cooperate in identifying opportunities for collaborative projects pursuant to this Agreement, including program development, budget preparation, planning, and all other aspects necessary to make effective the purposes and objectives of this Agreement.

Conduct and collaborate on specific programs to further the goals and objectives of this Agreement and improve resource conditions, and in doing so: identify and achieve managerial efficiencies; identify and cooperatively address data gaps on fisheries, land, water and other natural resources and systems; involve where appropriate other parties to achieve critical resource management; and accomplish Tribal and agency program priorities and address comprehensive program issues.

Meet as necessary and at least annually to identify specific resource management, planning, scientific, economic, and other appropriate joint management opportunities.

Enter into separate agreements ("Task Orders") with respect to specific resource management projects, identifying the project goals, contributions of both parties, tasks to be performed, completion dates, and related matters as appropriate to the project; comply with the terms of the Task Orders developed in accordance with this Agreement; enter into initial task orders simultaneous with the signing of this Agreement; and identify, prepare, and carry out future task orders as the parties and circumstances determine.

Cooperatively seek additional partnerships, and where appropriate funds, and authorities to achieve shared Tribal and DOI management goals and work to identify additional resources, agencies, and authorities that can facilitate the goals of the parties set forth in this Agreement.

IV. TERM OF THE AGREEMENT:

This Agreement shall become effective on the date of signature (a) by the Secretary of the Interior or his authorized representative and (b) by the Tribal Chairman or his designee. This Agreement shall remain in effect until canceled or modified as provided in Section VI.

V. FINANCIAL SUPPORT:

This document does not authorize the transfer of funds or anything of intrinsic monetary value, nor does it confer upon any of the signatories the authority to commit the federal government or the Tribe to the expenditure of funds. Nothing in this Agreement shall be construed to commit a federal official to expend funds not appropriated by Congress. To the extent that the

expenditure or advance of money or the performance of any obligation of the United States under this Agreement is to be funded by appropriation of funds by Congress, the expenditure, advance, or performance shall be contingent upon the appropriation of funds by Congress that are available for this purpose and the apportionment of such funds by the Office of Management and Budget. No breach of this Agreement shall result and no liability shall accrue to the United States in the event that funds are not appropriated or apportioned.

It is anticipated by the signatories that, at a future date, the transfer of funds, dedication of equipment, delegation or assignment of personnel, and other tangible commitment of fiscal, labor and non-labor resources will be necessary to implement the intent of this Agreement. Such commitments and transfers shall be specifically developed and described through individual task orders or other appropriate instruments implementing this Agreement, and transfers shall be accomplished by separate procurement, financial assistance, or other appropriate instruments, which will be approved and issued by appropriate officials of the Tribe and DOI and be subject to the standard terms and conditions for such instruments.

VI. MODIFICATION AND TERMINATION:

This Agreement may be modified, amended, or supplemented by mutual consent of the parties. Either party may propose modification by notifying the other in writing. Termination may be requested by either party through notification of the other signatory. The notified party shall respond within 30 days. The parties agree to seek a mutually acceptable schedule to negotiate any modifications in the Agreement. In the event that this Agreement is terminated by either or both of the parties, the parties shall have a continuing obligation to comply with the terms of task orders or other instruments covering existing or ongoing specific collaborative projects.

VII. GENERAL PROVISIONS:

Nothing in this Agreement shall modify or abrogate the statutory or other authorities of either party signatory to this Agreement.

Each of the signatories warrants that he or she is authorized to enter into this Agreement on behalf of the party for whom the signatory has executed the Agreement.

VIII. COUNTERPARTS:

This Agreement may be executed in counterpart originals and each copy will have the same force and effect as if signed by all parties.

IN WITNESS WHEREOF, the parties have executed this Agreement:

APPROVALS:

U.S. DEPARTMENT OF THE INTERIOR

By: _____

Assistant Secretary-Policy, Management and Budget Date

YUROK TRIBE

By: Howard McConnell 6-16-06

Tribal Chairman Date

IN WITNESS WHEREOF, the parties have executed this Agreement:

APPROVALS:

U.S. DEPARTMENT OF THE INTERIOR

By: R. Thomas Weimer 6/12/06
Assistant Secretary-Policy, Management and Budget Date

YUROK TRIBE

By: _____
Tribal Chairman Date

U.S. Department of Justice

Environment and Natural Resources Division

JAB
90-8-6-05335

Appellate Section
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June 19, 2006

Scott W. Williams
Curtis G. Berkey
Alexander, Berkey, Williams & Weathers LLP
2030 Addison Street, Suite 410
Berkley, CA 94704

Re: Pacific Coast Federation of Fishermen's Associations et al., v. U.S. Bureau of Reclamation, et al., 9th Cir. Nos. 05-15856, 05-16027

Dear Mr. Williams and Mr. Berkey,

This letter will memorialize the agreement between your client, the Yurok Tribe, plaintiff-intervenor-appellant in the above captioned case in appeal No. 05-15856, and the United States Bureau of Reclamation, defendant-appellee, regarding the disposition of your client's appeal.

In consideration of the execution on this same date of the "Cooperative Agreement between United States Department of the Interior and Yurok Tribe for the Cooperative Management of Tribal and Federal Lands and Resources in the Klamath River Basin of California," and in consideration of the agreement on principles for consultation between the Department of the Interior and the Yurok Tribe regarding Klamath Irrigation Project Operations set out in ¶ A below, the Yurok Tribe and the United States Bureau of Reclamation agree that on or before October 15, 2006 and upon satisfaction of conditions set forth below in ¶ B, counsel for the Yurok Tribe will file, under Rule 42(b), Fed. R. App. P., a motion to dismiss the appeal in No. 05-15856, reciting that each party will bear its own costs and attorney's fees for the litigation of the Yurok Tribe's Fourth Claim for Relief in the Complaint in Intervention, filed in this case October 22, 2002. The

motion shall be in substantially the same form as Attachment A to this letter agreement. Alternatively, in the event the Klamath Water Users Association will join in a stipulated dismissal under Rule 42(b), Fed. R. App. P., of the appeal in No. 05-15856 and the cross-appeal in No. 05-16027, counsel for the Yurok Tribe and the Bureau of Reclamation will execute and file such a dismissal in substantially the same form as Attachment B to this letter agreement.

A. Principles for consultation on Klamath Irrigation Project Operations. – The Department of the Interior and the Yurok Tribe agree that the following principles shall be used to establish a structure for consultation on Klamath Irrigation Project Operations. The Department of the Interior and the Yurok Tribe further agree to seek agreement on such a structure in good faith and that satisfactory progress on such an agreement shall not be a condition precedent for dismissal of the Yurok Tribe's appeal as provided for above.

1. Consistent with its responsibilities to carry out the government-to-government relationship with Indian tribes, the Department of the Interior will consult with the Yurok Tribe in a timely and meaningful manner with regard to any planning, operational or management actions concerning the Klamath Irrigation Project that affect the Tribe's fishery within the Klamath River Basin.

2. The Department of the Interior and the Yurok Tribe understand timely and meaningful consultation in this context to mean that the Department of the Interior will seek information, analysis and comments from the Tribe at the earliest reasonable time in order to ensure that such information, analysis and views are considered before decisions affecting the Tribe's Klamath River fishery are made. The Department of the Interior and the Yurok Tribe understand that the creation of a joint technical committee is necessary to carry out these principles.

B. Conditions precedent to dismissal. – The only conditions precedent to dismissal of the Tribe's lawsuit and appeal are as set forth here:

1. The signing simultaneously with the "Cooperative Agreement" and this letter agreement of agreements on specific collaborative projects ("task orders") previously identified and to which the parties have previously agreed;

2. The signing of additional task orders on or before September 30, 2006;

3. The convening of a joint management group (Cooperative Agreement at ¶ III.C.) within 30 days of the signing of the Cooperative Agreement and that has met and discussed budgeting further collaborative projects for the fiscal year 2007 budget (to the extent feasible), the 2008 budget and out years; and

4. A meeting between designated representatives of the Yurok Tribe and designated representatives of the Bureau of Reclamation and its contractor for the study known as "Life History Model for Coho Salmon in the Klamath Basin" for the Yurok Tribe to present scientific and technical information for consideration by the Bureau of Reclamation and its contractor. The meeting will take place within 30 days of the signing of the Cooperative Agreement or the award of the contract, whichever is later.

Each signatory to this agreement certifies that he is authorized to enter into the terms and conditions of this agreement and to bind legally the party represented by him.

Please indicate your client's agreement by countersigning in the space designated below on the two counterparts of this agreement and return one original to me.

Sincerely yours,

John A. Bryson

John A. Bryson
Environment and Natural Resources Division
Counsel for the defendant-appellee
United States Bureau of Reclamation

Scott W. Williams
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Attorneys for plaintiff-appellant Yurok Tribe

ATTACHMENT A

IN THE UNITED STATES COURT OF APPEALS
FOR THE NINTH CIRCUIT

Nos. 05-15856, 05-16027

PACIFIC COAST FEDERATION OF
FISHERMEN'S ASSOCIATIONS, ET AL.,

Plaintiffs,

and

YUROK TRIBE,

Plaintiff-Intervenor-Appellant and Cross-Appellee.

v.

UNITED STATES BUREAU OF RECLAMATION , ET AL.,

Defendants-Appellees-Cross-Appellees,

and

KLAMATH WATER USERS ASSOCIATION, ET AL.,

Defendants-Intervenors-Appellees and Cross-Appellants.

MOTION FOR VOLUNTARY DISMISSAL

Pursuant to Fed. R. App. P. 42(b), the Yurok Tribe, plaintiff-intervenor-

appellant, hereby moves for dismissal of its appeal in No. 05-15856. The United States Bureau of Reclamation, defendant-appellee, does not oppose this motion. The Yurok Tribe and the United States Bureau of Reclamation, defendant-appellee, have agreed that each of them will bear its own costs and attorneys' fees on appeal and for the litigation of plaintiff-intervenor-appellant's Fourth Claim for Relief in the Yurok Tribe's Complaint in Intervention, filed in this case October 22, 2002.

WHEREFORE, plaintiff-intervenor-appellant Yurok Tribe requests that the motion be granted and its appeal in No. 05-15856 be dismissed.

Respectfully submitted,

SCOTT W. WILLIAMS
CURTIS G. BERKEY
Alexander, Berkey, Williams & Weathers LLP
2030 Addison Street, Suite 410
Berkley, CA 94704

Attorneys for the Yurok Tribe, plaintiff-intervenor-appellant.

DATED this _____ day of _____, 2006.

ATTACHMENT B

IN THE UNITED STATES COURT OF APPEALS
FOR THE NINTH CIRCUIT

Nos. 05-15856, 05-16027

PACIFIC COAST FEDERATION OF
FISHERMEN'S ASSOCIATIONS, ET AL.,

Plaintiffs,

and

YUROK TRIBE,

Plaintiff-Intervenor-Appellant and Cross-Appellee.

v.

UNITED STATES BUREAU OF RECLAMATION , ET AL.,

Defendants-Appellees-Cross-Appellees,

and

KLAMATH WATER USERS ASSOCIATION, ET AL.,

Defendants-Intervenors-Appellees and Cross-Appellants.

STIPULATION FOR DISMISSAL PURSUANT TO RULE 42(b),
FEDERAL RULES OF APPELLATE PROCEDURE

Pursuant to Fed. R. App. P. 42(b), the Yurok Tribe, plaintiff-intervenor-

appellant, the United States Bureau of Reclamation, et al., defendants-appellees, and the Klamath Water Users Association, et al., defendants-intervenors-appellees and cross-appellants, stipulate to the dismissal of the appeal and cross-appeal in Nos. 05-1585 and 05-16027. The parties have agreed that each party will bear its own costs and attorneys' fees on appeal and for the litigation of plaintiff-intervenor-appellant's Fourth Claim for Relief in the Yurok Tribe's Complaint in Intervention, filed in this case October 22, 2002.

DATED this _____ day of _____, 2006.

JOHN A. BRYSON
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Attorneys for the Yurok Tribe, plaintiff-intervenor-appellant.

Water Quality Data

YTEP has collected a significant amount of water quality, habitat, and physical data (parameters listed in table below) within the Yurok Reservation over many years (several parameters starting in 2003) which will be made available to the Water Board. YTEP will coordinate with the Board to share and transfer data (raw or analyzed) as needed. Please contact Louisa McCovey, Environmental Director (lomccovey@yuroktribe.nsn.us) or Micah Gibson, YTEP Assistant Director for the Water Division (Micah@yuroktribe.nsn.us) for more information.

Probes	Conventional WQ	Algae	Bacterial	Habitat	Sediment	Weather	Flow	Other
Temp H2O (hobo)	Ammonia	Phytoplankton	E coli	Fish Disease	Turbidity	Air Temp	Storage	Pesticides
Temp H2O (sonde)	Nitrite	Chlorophyll-a	Enterococcus	Fish Studies	TSS	Relative Humidity	Inflow	Herbicides
Conductivity	Nitrite+Nitrate	Phaeophytin	Coliform	Macroinverts	VSS	Wind	Outflow	SUVA
pH	Nitrate	Periphyton		Zooplankton	Total Dissolved Solids	Rain	Discharge	Other
DO	Particulate Nitrogen	Antoxin-a			Secchi	Snow	Gauge Height	
Turbidity (sonde)	Total Nitrogen	Microcystis			Sediment			
BGA (sonde)	Total Phoshate	Microcystin			Subsurface Sediment			
Chlorophyll (sonde)	SRP				Surface Sediment			
PAR	PO4							
Other Probes	TOC							
	DOC							
	Particulate Carbon							
	BOD							
	Alkalinity							
	Calcium							
	Magnesium							
	Silica							
	Iron Filtered							

KLAMATH HYDROELECTRIC PROJECT FERC NO. P-2082-027

ETHNOGRAPHIC RIVERSCAPE: KLAMATH RIVER
YUROK TRIBE ETHNOGRAPHIC INVENTORY

(Contract #P13342 – FERC Project No. 2082)

Prepared by: Yurok Tribe Culture Department
Prepared for: PacifiCorp

Kathleen Sloan, M.A.I.S
Yurok Tribal Archeologist

Draft
November 2003

CONFIDENTIALITY STATEMENT

Archaeological and traditional property locations are considered confidential and public access to such information is restricted by law (Section 304 of the National Historic Preservation Act; Section 9(a) of the Archaeological Resources Protection Act; Executive Order 13007; Section 6254.10 of the California State Government Code).

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Bibliography

1. Introduction

This section provides the context for this document, the purpose and scope of work for the project and an overview of the project participants, and the relevance of this document for the evaluation of the Klamath River as a Traditional Cultural Landscape (Riverscape).

1.0 Project Description

1.1 Scope of Work

This ethnographic inventory has been conducted by the Yurok Tribe Culture Department under contract with PacifiCorp as part of a federal relicensing application for the Klamath Hydroelectric Project (FERC Project No. 2082) for a series of hydroelectric dams on the Klamath River. As part of the relicensing process with the Federal Energy Regulatory Commission (FERC), PacifiCorp is required to assess the potential environmental and social effects of the Project on the surrounding environment. FERC requires that Exhibit E of the license application include surveys, inventories, impact assessments, management plans, and agency correspondence for cultural resources within the FERC boundary in order for it to meet its responsibilities under NEPA and NHPA.

The information provided in this ethnographic document will be used in the development of Exhibit E of the FERC license application, Cultural Resources Final Technical Report, and the Historic Properties Management Plan (HPMP) for the Klamath Hydroelectric Project. The information provided in this document will be integrated with other resource study results to address concerns the Cultural Resources Working Group has identified regarding the potential impacts of the Project on culturally significant resources.

1.2 Cultural Resources Working Group

The Cultural Resources Working Group for this project was organized by PacifiCorp for the purposes of identifying potential effects on cultural resources within the Project area as required under Section 106 of the National Historic Preservation Act (NHPA) and the National Environmental Policy Act (NEPA). Participants in this group included the five Klamath River Native American Tribes (Klamath Tribes, Shasta Nation, Karuk Tribe, the Hupa Tribe, and the Yurok Tribe), the California State Historic Preservation Office, the Oregon State Historic Preservation Office, the Yurok Tribe Heritage Preservation Office, the Bureau of Indian Affairs (BIA), the Bureau of Reclamation (BOR), the Bureau of Land Management (BLM), the Klamath River Inter-Tribal Fish and Water Commission, US Fish and Wildlife Service, Oregon Department of Fish and Wildlife, Oregon Parks and Recreation, Oregon Water Resources Department, Humboldt County Public Works, FERC, CH2Mhill, Kearns and West, and others. The Cultural Resources Working Group has worked to identify and define the Project‟s Area of Potential Effect (APE) on cultural resources within the 500 year flood plain of the Klamath River.

1.3 Native American Participants

Five Klamath Basin Native American Tribes have been included in the Cultural Resources Working Group: The Klamath Tribes of Oregon, the Shasta Nation of California, the Shasta Nation, Inc. of California, the Karuk Tribe of California, and the Yurok Tribe of California. PacifiCorp has contracted each of these Tribes to conduct an ethnographic study on their respective ancestral territories as it relates to the development of a HPMP and the preparation of

Exhibit E of the FERC license application. The five Tribes were contracted by PacifiCorp for the purposes of identifying cultural resources within the Klamath Hydroelectric Project including Traditional Cultural Properties (TCPs) and /or Sensitive Cultural Resources (SCRs) within the Project‟s APE. The tribal studies evaluated the following cultural components: water, fish, gathering areas, transportation, habitation, and sacred/ceremonial areas associated with the River.

1.4 Document Purpose: Synthesis

This document has been prepared by the Yurok Tribe Culture Department for the purpose of identifying ethnographic sources and information to be used in the creation of a final synthesis document for the preparation of Exhibit E of the FERC license application as previously described. It is not to be considered a read-through or stand-alone document, but rather a component of a larger document to be created upon the completion of the ethnographic inventories by each of the five of the participant Tribes. This document will be integrated with the other four tribal studies into a final synthesis document that will be used to identify cultural resource concerns within the Project‟s APE for the purpose of evaluating the Klamath River as a Traditional Cultural Landscape.

1.5 Regulatory Analysis

The regulatory analysis is a document that will be used in the preparation of the synthesis document for the purposes of assessing the Klamath River‟s eligibility to the National Register as a Cultural Landscape, or Ethnographic Riverscape. An Ethnographic Landscape (Riverscape) is defined as:

> A land (river)-scape containing a variety of natural and cultural resources that associated People define as heritage resources. Examples are contemporary settlements, religious sacred sties, and massive geological structures. Small plant communities, animals (fish), subsistence and ceremonial grounds are often components (NPS Preservation Brief 36).

The cultural components of the Klamath Ethnographic Riverscape include: water, fish, gathering, transportation, human habitation and ceremonial resources. The regulatory analysis is the framework provided for the purpose of evaluating the significance and integrity of the Klamath Riverscape and has provided the format for the individual tribal reports on cultural resources within the River corridor. It includes nomenclature and information on defining, identifying, and evaluating Cultural Landscapes under the NHPA.

1.6 Methodology

This document was prepared following an outline shared between the five Tribes conducting ethnographic studies and inventories for this process. The outline is based upon the criteria for defining the Klamath Riverscape as a Cultural Landscape as detailed in the Regulatory Analysis. This document includes ethnographic information on Yurok traditional and contemporary culture, archival and published literature, and Yurok oral histories and interviews with tribal elders on the Yurok relationship with the River. The information was reviewed and relevant passages and excerpts have been selected as they relate outline for the Riverscape analysis.

1.7 Document Organization

The format used in this document is based upon the outline developed to provide uniformity to the content and information provided for use in the generation of the final synthesis document.

The sections in this document provide information on various aspects of Yurok Culture in relation to the River. The sections in this document are presented in the following order:

- 1. Introduction. Scope of work, participants, and purpose.
- 2. Yurok Culture. A brief summary of Yurok traditional and contemporary culture as it relates to the Klamath River.
- 3. Ethnographic Literature. A literature review of historic and archival sources on Yurok traditional culture and the Yurok relationship to the River for the purposes of evaluating and defining the Klamath Riverscape.
- 4. Interviews with Yurok Elders. Excerpts from six interviews conducted with Yurok elders on personal experiences on and recollections about the River.
- 5. Conclusion. A brief summary of the relationship between Yurok and the River based upon the sources reviewed for this document.
- Bibliography. A list of reference used to compile this document.

This document should not be considered an authoritative or exhaustive document on Yurok Culture or the Yurok relationship with the River. Rather, it should be considered a cursory overview of published and unpublished sources, oral history, personal experiences, and archival literature as it relates to the scope of this Project, and the limitations in resources (funding and time) allotted for this study under the terms of the contract with PacifiCorp. The Yurok relationship with the River is well established in the information provided in this document, but in reality, the relationship between Yurok and the River is so profound that it cannot be encapsulated or adequately reflected in a document of this nature.

2. Yurok Cultural Values

This section provides an overview of the history of the Yurok Tribe, and examples of the traditional and contemporary relationship between Yurok and the River. It includes information on the political organization and history of the Yurok Tribe, aspects of Yurok language, oral traditions, ceremonial life, traditional life ways, Yurok geography, and contemporary resource use and subsistence as it relates to the River.

2.0 Traditional and Contemporary Culture

2.1 Yurok Culture

PREAMBLE OF THE CONSTITUTION OF THE YUROK TRIBE
Approved by the Interim Council on November 24, 1993

> Our people have always lived on this sacred and wondrous land along the Pacific Coast and inland on the Klamath River, since the Spirit People, *Wo'ge"* made things ready for us and the Creator, *Ko-won-no-ekc-on Ne ka-nup-ceo,* placed us here. From the beginning, we have followed all the laws of the Creator, which became the whole fabric of our tribal sovereignty. In times past and now Yurok people bless the deep river, the tall redwood trees, the rocks, the mounds, and the trails. We pray for the health of all the animals, and prudently harvest and manage the great salmon runs and herds of deer and elk. We never waste and use every bit of the salmon, deer, elk, sturgeon, eels, seaweed, mussels, candlefish, otters, sea lions, seals, whales, and other ocean and river animals. We also have practiced our stewardship of the land in the prairies and forests through controlled burns that improve wildlife habitat and enhance the health and growth of the tan oak acorns, hazelnuts, pepperwood nuts, berries, grasses and bushes, all of which are used and provide materials for baskets, fabrics, and utensils.

For millennia our religion and sovereignty have been pervasive throughout all of our traditional villages. Our intricate way of life requires the use of the sweathouse, extensive spiritual training, and sacrifice. Until recently there was little crime, because Yurok law is firm and requires full compensation to the family whenever there is an injury or insult. If there is not agreement as to the settlement, a mediator would resolve the dispute. Our Indian doctors, *Keg-ae*, have cared for our people and treated them when they became ill. In times of difficulty village headmen gather together to resolve problems affecting the Yurok Tribe.

Our people have always carried on extensive trade and social relations throughout our territory and beyond. Our commerce includes a monetary system based on the use of dentalium shells, *Terk-n-term*, and other items as currency. The Klamath River was and remains our highway, and we from time beginning utilized the river and the ocean in dugout canoes, *Alth-wayoch*, carved from the redwood by Yurok craftsmen, masterpieces of efficiency and ingenuity and have always been sold or traded to others outside the tribe. Our people come together from many villages to perform ceremonial construction of our fish dams, *Lohg-en*. Our traditional ceremonies -- the Deerskin Dance, Doctor Dance, Jump Dance, Brush Dance, Kick Dance, Flower Dance and others -- have always drawn hundreds, and sometimes thousands, of Yuroks and members of neighboring tribes together for renewal, healing, and prayer. We also have always traveled to the North and East to the high mountains on our traditional trails to worship the Creator at our sacred sites, -- Doctor Rock, Chimney Rock, *Thklamah* (the stepping stones for ascent into the sky world), and many others.

This whole land, this Yurok country, stayed in balance, kept that way by our good stewardship, hard work, wise laws, and constant prayers to the Creator.

Our social and ecological balance, thousands and thousands of years old, was shattered by the invasion of the non-Indians. We lost three-fourths or more of our people through unprovoked massacres by vigilantes and the intrusion of fatal European diseases. The introduction of alcohol weakened our social structure, as did the forced removal of our children to government boarding schools, where many were beaten, punished for speaking their language, and denied the right to practice their cultural heritage. After goldminers swarmed over our land we agreed to sign a "Treaty of Peace and Friendship" with representatives of the President of the United States in 1851, but the United States Senate failed to ratify the treaty. Then in 1855, the Unites States ordered us to be confined on the Klamath River Reserve, created by Executive Order (pursuant to the Act of March 3, 1853, 10 Stat. 226, 238) within our own territory.

In 1864 a small part of our Ancestral land became a part of the Hoopa Valley Indian Reservation which was set apart for Yuroks and other Indians in Northern California. This became known as the 12-mile "Square." In 1891, a further small part of our Ancestral land was added when "The Extension" to the Hoopa Valley Indian Reservation was set aside by executive order authorized by the 1864 statute, which created the Hoopa Valley Indian Reservation. This statutory reservation extension extended from the mouth of the Klamath River, including the old Klamath River Reserve, about 50 miles inland and encompassed the river and its bed, along with one mile of land on both sides of the river.

But even this small remnant of our ancestral land was not to last for long. In the 1890"s, individual Indians received allotments from tribal land located in the Klamath River Reserve portion of the Hoopa Valley Reservation and almost all of the remainder of the Reserve was declared "surplus" and opened for homesteading by non-Indians. The forests were logged excessively and the wildlife was depleted. Even the great salmon runs went into deep decline due to over-fishing and habitat destruction. In the mid 1930"s the State of California attempted illegally to terminate traditional fishing by Yurok people, the river"s original --and only -- stewards from Bluff Creek to the Pacific Ocean. Our fishing rights were judicially reaffirmed in the 1970"s and the 1980"s after many legal and physical battles.

Throughout the first 140 years of our tribe"s dealings with the United States, we never adopted a written form of government. We had not needed a formal structure and were reluctant to change. The United States had decimated the Yurok population, land base, and natural resources and our people were deeply distrustful of the federal government. Yet we, the Yurok people, know that this is the time to exercise our inherent tribal sovereignty and formally organize under this Constitution. We do this to provide for the administration and governance of the modern Yurok Tribe that has emerged, strong and proud, from the tragedies and wrongs of the years since the arrival of the non-Indians into our land. Our sacred and vibrant traditions have survived and are now growing stronger and richer each year.

The Yurok Tribe is the largest Indian tribe in California, and, while much land has been lost, the spirit of the Creator and our inherent tribal sovereignty still thrives in the hearts and minds of our people as well as in the strong currents, deep canyons, thick forests, and high mountains of our ancestral lands.

Therefore, in order to exercise the inherent sovereignty of the Yurok Tribe, we adopt this Constitution in order to:

1) Preserve forever the survival of our tribe and protect it from forces which may threaten its existence;

2) Uphold and protect our tribal sovereignty which has existed from time immemorial and which remains undiminished;

3) Reclaim the tribal land base within the Yurok Reservation and enlarge the Reservation boundaries to the maximum extent possible within the ancestral lands of our tribe and/or within any compensatory land area;

4) Preserve and promote our culture, language, and religious beliefs and practices, and pass them on to our children, our grandchildren, and to their children and grandchildren, on and on, forever;

5) Provide for the health, education, economy, and social well being of our members and future members;

6) Restore, enhance, and manage the tribal fishery, tribal water rights, tribal forests, and all other natural resources; and

7) Insure peace, harmony, and protection of individual human rights among our members and among others who may come within the jurisdiction of our tribal government.

(Yurok Tribe Constitution 1993)

From time immemorial Yurok people have lived along the Klamath River from the mouth of the river up to the Karuk boundary. Nearly every aspect of Yurok life, language, ceremonies, society, and economy, was, and continues to be, bound by the river. The River, being so basic that it has no specific Yurok word designation, is euphemistically referred to in its lower stretch as the "Yurok highway". At the mouth of the River, Yurok also refer to the Klamath River as *HeL kik a wroi* or "watercourse coming from way back in the mountains." It is not surprising that Yurok culture reflects a strong connection to the riverine environment. In contemporary times the Klamath River is referred to as "the main vein" emphasizing its comparison to a blood vessel that provides the main flow of sustenance.

The Yurok people are named and live in relation to the rivers and the sustenance that those quality flows provide. Residency, natural and cultural resource sites, ceremonial practices, oral history, transportation route, economic and sociological dependence, indeed the Yurok identity, are all intricately woven into the ecosystems of the Trinity and Klamath Rivers. Of 72 village sites in Yurok ancestral lands, the Yurok continue to live upon many of the 44 village sites that line the Klamath and Lower Trinity Rivers. These are places where Yurok have been born, lived, fished, gathered, prayed and have been buried.

Each generation was taught the appropriate respect for each other and everything in the Yurok World. Respect for the River was of particular importance because Yurok and the River are intertwined with sustaining the balance of life. The River is the main stem of Yurok life ways. Nearly every aspect of Yurok life was and continues to be bound to the River and surrounding landscapes that are defined by the actions of these waters. Yurok people and the River provide important roles in Yurok ceremonies, in defining proper methods for treating the deceased, religiously sanctified methods for taking fish at certain locations, gathering the necessary plant products for the manufacture of Yurok material culture and in maintaining the central transportation route.

A Yurok elder said, "without this river we would not know who we are, where we're from or where we're going." Other Native Americans track directionality based on cardinal directions. In a steep riverine environment with a temperate rainforest climate, the suns' rising and setting points are not accurate ways of tracking time and direction. Instead, the flow of the river is most essential for telling time and direction. River flow rates under natural conditions indicate both seasonality and time of day. The capability to estimate time of day and year is enhanced in the estuary where the river is subject to tidal fluctuations. A good Yurok boatman is rated by his ability to navigate the River in the dark. The boatman does this by correlating the location and swiftness of the current and the back eddy of the river in relation to the sound of the river that is uniquely created in each bend, slick and riffle of the riverine environment. Every type of unique feature of the water's movement and characteristics are named. Even when away from the water directionality is measured by the river flow, requiring people to always know where they are in relation to the river. For example it is not uncommon to refer to burners on one side of a kitchen stove as up or down-river burners.

Not only are the Rivers' fluctuations known by characteristics of water content but is also know by what the water flows additionally provide Yurok people. For example it is known that the spring run of salmon will come soon after the budding of the thimbleberry that grows along the Rivers' courses. It is know that after a good flooding willow-root basket materials are best gathered in a straight narrow section of the river where a flood's raging waters have scoured the roots. After a flood event, specific gravel bars are searched for new deposits of granite boulders used for porch rocks in Yurok traditional homes. It is known that in a drought year, flooding occurs in the lower portions of the River because of sandbar buildup at the mouth of the River. And for all of these natural occurrences Yuroks know of appropriate ceremonies that officiate the human communication with these river processes.

A Yurok elder recounts how as a boy in the 1920's he assisted in a propitiating ceremony held at the mouth of the River during the summer. He recalls going down river in a traditional Yurok dugout canoe powered by an outboard motor and guided by his father. As they approached within five miles of the coast they noticed that the River was backed up and stagnant because the sand buildup prevented the River from flowing out to the ocean. Prayers and offerings were made on the sandbar. A day later a spirit guardian represented as a large rock granted the request and the

River broke through the sand bar, alleviate flooding, and allowed fish to once again enter the River.

Various ethnographic sources show a wide diversity and abundance of cultural sites located along the River. For example in 1909 the anthropologist Thomas Waterman documented 82 various cultural places, 41 rocks of cultural significance, 97 fishing spots, and 44 villages all located in the river channel, river flood-plane or just above the high water mark. The 82 places are places significant to Yurok history (both historic and legendary), ceremony, gathering, and hunting. In addition to these 264 sites, the Yurok Tribe Heritage Preservation Office has documented approximately 100 additional sites that were either missed by Waterman or have been established since his early century visit to the territories of the Yurok people.

Yurok political organization is highly defined. It was in the past and has been additionally organized by the recently established Yurok Tribal government. It is just that in its traditional forms it is not defined according to the political systems of the clan based tribes to the north or according to U.S. governmental organization. Traditional political organization and the accompanying judicial system is established by Creator‟s Law, is institutionalized in the Yurok ceremonial system, and the determination of fault and compensation occurs in very exacting ways. Traditional Law operates on principles of payment rather than punitive penalty. It is because this is such an efficient means of political jurisprudence, sanctified by religion that the Yurok people are considered to be the least warlike. In addition, this system of jurisprudence is interrelated with the harvesting of fish through both individual fishing places as well as the annual community construction of the fish dam. As these traditional forms of communal fishing, traditional use of the river and traditional forms of jurisprudence were disrupted by non-Indian intervention so also did Yuroks become involved in the Indian wars of the 1860s and the Yurok fish wars of the1970s. Likewise, the traditional and stabilized living patterns were disrupted and Yuroks began to shift from permanent dwelling lifestyles (with bi annual migrations) to multiple and migratory dwelling lifestyle. These new lifestyles also led to a change of traditional life ways.

2.2 History of the Yurok – European Contact

Historical documents record that the coastal Yurok had initial contact with Europeans as a result of Spanish expeditions spanning the mid 1500s to the late 1700s (McBeth 1950:2; Bearss 1969). Various Spanish-led expeditions and ships came up to northern California along the coast, followed later by American vessels as early as 1803 and 1805 (McBeth 1950:2: Bearss 1969). By 1828, the Klamath River had been documented and visited by ships from Britain, Spain, Russia and America (McBeth 1950:3; Bearss 1969).

First contact between Europeans and Yurok people on the upper Klamath River was documented to have occurred in 1827 when traders for the Hudson‟s Bay Company traveled downriver in search of furs and trade (Bearss 1969). First contact within the project vicinity occurred in February 1827, when men from Peter Skene Odgen‟s party encountered Yurok in the Martins Ferry area. While these are the first documented encounters by non-Indians within the upriver areas of Yurok territory, the Hudson‟s Bay Company party documented the presence of European trade goods being used and sought by Yurok people, indicating prior interaction through trade or travel by Yurok people (Murray 1943:21-24; Bearss 1969; Pilling 1978:140).

In 1828, Jedediah Smith led an American party of beaver trapping men down the Trinity River, to the Klamath and the up the Pacific Coast (Goddard 1904; Bearss 1969; Eidsness 2001:7). As a result of the discovery of gold in the Trinity River, gold prospectors inundated the region by 1848 (Eidsness and McConnell 2001). Upriver Yurok settlements were severely impacted by the

incursion of gold prospectors in the 1850s, resulting in displacement and relocation away from some Yurok traditional villages along the Klamath River (Bearss 1969; Pilling 1978:140).

In 1851 a "Treaty of Peace and Friendship" was signed between the United States Government and the Klamath River Indians under the direction of U.S. Indian Agent Col. Reddick McKee. The United States Congress did not ratify this treaty. Non-Indian incursions and resultant conflict continued and an Indian Agency and military fort were established on the River to mediate the conflict. The Agency was located on the south bank of the Klamath River, in the area known as *Waukel* (also spelled *Wo'kel* and Waukell) across the River from the military fort, Fort Terwer. In spite of the creation of these government posts, gold prospectors, miners, farmers, and settlers continued to encroach on Indian lands, often resulting in conflicts and violence. On November 16,1855, the Klamath River Reserve (also known as the Klamath Indian Reservation) was created by Executive Order (pursuant to the Act of March 3, 1853, 10 Stat 226,238). This Order designated the reservation lands from the mouth of the Klamath River, one mile on each side extending approximately 20 miles upriver to Tectah Creek. The Klamath Reserve was established for several tribes because the treaty of 1851 was not ratified and the military was increasingly called to intervene between miners, settlers and Indians. It was the U.S. intent to move the Tolowa and Yurok onto it, but the Tolowa left soon after they were relocated (Bearss 1969).

In 1855, a letter was written to the Commissioner of Indian Affairs by Special Agent Whipple, the first Indian Agent on the Klamath River Reserve. This letter is important because it clearly describes several aspects of Yurok land use and their relationship to the River. In recommending the reservation boundaries extend five miles away from the River, Whipple recognized the Yurok use of the entire watershed associated with the River. He describes the salmon as "the staff of life" for the Yurok Indians. He also describes the Lower Klamath as the best salmon fishing grounds in northern California. Whipple describes large alluvial terraces along the floodplain of the River that were used to gather a wide variety of plants, roots, and berries for food and supplies (Whipple 1855).

Both Fort Terwer and the Indian Agency at Waukel were destroyed in the floods of 1861 and 1862. As a result of the flood damage the U.S. government abandoned these facilities. The Smith River Reservation, occupied primarily by Tolowa, was created in 1862 to supplement the loss of agricultural lands as a result of the floods. In 1865 the Hoopa Valley Indian Reservation was established with the intent of relocating all northwestern California Indians to this reservation (Bearss 1969; Eidsness 1988:29).

Escalating conflict between Indians and non-Indians over encroachment onto the Klamath Indian Reserve resulted in the gradual displacement of Lower Klamath Indians further upriver during the 1860s and 1870s (Eidsness 1988: 29; Bearss 1969; McBeth 1950:44). In spite of the area being within the boundaries of the Klamath River Reserve, the area was occupied by non-Indians in defiance of the 1855 Executive Order and an 1877 order by the Department of the Interior, that explicitly ordered non-Indian settlers off the reservation (McBeth 1950:46; Bearss 1969). Squatters resisted government attempts to remove them from the reservation and even when evicted by United States soldiers under orders in 1879, they quickly returned to the homes and farms they had established on Indian lands (McBeth 1950:53; Bearss 1969).

In 1891, President Harrison issued an order to expand the existing Hoopa Valley Indian Reservation to include lands one mile on either side of the Klamath River from the Pacific Ocean to the Hoopa Valley, thereby including the Klamath Indian Reserve (Bearss 1969; Eidsness 1988:29). In order to do this, he created the "extension", extending the Klamath River Reserve upriver until it reached the Hoopa Square. The "extension" was established in relation to the

Dawes Act as a ploy to open up much of the land that was not claimed as allotments by resident Indians. Thus began the history of checkerboard ownerships of the Yurok portions of the Klamath Reservation and Extension. The result of Harrison‟s order was the essentially the creation of a new reservation by combining two existing ones. The new reservation consisted of the old Klamath River Reserve, the "extension", and the Hoopa Square and was referred to in its entirety as the Hoopa Valley Indian Reservation. On June 25, 1892, President Harrison singed a bill passed by Congress to open the reservation for non-Indian settlement. The bill declared all surplus lands open to settlers, "reserving to the Indians only such land as they require for village purposes" (McBeth 1950:48; Bearss 1969). The process of assigning Indian allotments within the reservation took two years. After decades of conflict, the Klamath Indian Reservation was legally opened up for non-Indian settlement on May 21, 1894 for homesteading (McBeth 1950:48; Bearss 1969). As a result, many Yurok people were displaced from their traditional villages along the Klamath River.

After decades of struggle to regain their traditional homelands, the Yurok Tribe was re-organized and granted its own reservation in 1988. As a result of the 1988 Hoopa-Yurok Settlement Act (PL-100-580), the Yurok Indian Reservation was established, comprised of the old Klamath Reserve of 1855 and the "extension" of 1891. The current reservation is comprised of trust land, tribal allotments, fee land, and privately owned land.

Under re-organization the Yurok tribe has emerged as the largest tribe in California, with over 4,500 enrolled tribal members, and over 200 tribal government employees. The Yurok Tribe has a growing tribal population and is actively pursuing economic development and resource management both on the reservation and Yurok ancestral lands. The Yurok Tribe has a Natural Resources Department with the largest governmental fisheries program in the state of California. Other programs include the Yurok Tribe Watershed Restoration Program, devoted to restoring fish habitat, the Yurok Tribe Environmental Program, devoted to establishing and monitoring clean air, water, and land, and the Yurok Tribe Culture Department devoted to preserving Yurok culture. These departments assist the Tribal Council in its work to protect and maintain Yurok values as articulated in the Preamble Objectives of the Yurok Constitution (See page 3). The River continues to be the foundation of Yurok culture, economy, and tradition.

2.3 Traditional Yurok Language

The Yurok language is adapted to the riverine environment. There are numerous words for all aspects of the River‟s characteristics, rate of flow, back flows, eddies, boils, riffles and slicks, and color. Locations and directions are linguistically identified in relation to the river. For example, *poh* refers to „down river‟ and *pech* refers to up river. This is why the original Yurok word denotating the Yurok people is „*Poh lik lah*‟ or "down river people." Even places away from the river, such as the high country is referenced as "way back from" the River or "*heL kau*." It has been reported that an elderly Yurok woman referred to her stove burners and knobs as the up-river and down river burners, effectively aligning the cook, stove, and house in relation to the directional flow of the river (Hinton 1994).

Language analysis can show the long-term values and emphasis of a people. For example while there is no specific name word for the Klamath River, the word for „river‟ is *la yoh,* and translates as "to run" in reference to liquids. Another word for river, *?ume?wo* is in reference to the fish dams that are placed across the river. The English word „salmon‟, denoting several types of anadromous fish does not readily translate into the Yurok word „*ne po y*‟, "that which is eaten." „*Ne po y*‟ denotes more than „fish‟, but also includes connotations of Yurok reverence for a creature that provides sustenance to a people and way of life. Yurok places are sometimes named

after the way the river moves in a particular stretch. For example the town of „*Rekwoi*" denotes the mouth of the river; the town of „*AyoL*‟ denotes a wide curve in the River and the town of „*Olegel*‟ denotes a particularly twisty stretch of the River.

2.4 Yurok Oral Traditions

Among the oral traditions are accounts how the River came to flow the way it does, of Yurok ocean travel to the home of salmon, construction of the fish dams, locations and origins of ceremonies held along the River, where the first salmon was created, what is supposed to be done with salmon when caught at certain locations, and in the proper method for transporting a corpse up the River. There are Yurok stories that reinforce the Yurok belief that the River was created in a distinct way in order to provide Yurok people with the best of worlds. For example, *Wohpekumeu* said, "let the river run downstream" and that is how the River came to flow the direction it does. In the story *No'ots*, a young man went out on the River and took his paddle and rode about on the River. That is why it is crooked at *Olege'l*.

When the world was made ready for Yurok to inhabit, immortals (*woge*) who occupied the land and River came together for discussion. There was indecision as to whether the Yurok people should be taught the knowledge of immortality. It was decided that instead the people should know mortality. Those *woge* who felt sorry for Yurok decided to transform into rocks along the River that would help Yurok with the suffering of death. The last journey of the deceased involves a boat trip up-river with ritual stops at various rocks at the River‟s edge.

The anthropologist Alfred Kroeber traveled throughout the Yurok territory in the early 1900‟s interviewing various Yurok people and documenting a Yurok way of life. In *Yurok Myths* (Kroeber, 1978), it is obvious that the River was as important to the people from that era as it is to Yurok people now. Out of the 169 stories in Yurok Myths, there are 77 that make direct reference to the River. Yurok words that name places, plants, animals, and things associated with the River are detailed throughout Yurok stories.

When *Wesona-me'getoL* (the one up-above) created the world, the homes of the supernatural and the people were segregated. The ocean *Pish kaL* separated the two homes. The region on the other side is further divided into *tsi'k-tsik-oL* the home of money, culture hero *Wopekamaw's* home, *Pulekuk,* home of gambling, and the home of *Koowetsik*, the dwelling place of Salmon. Salmon and humans were created to interact with one another and accordingly the River was created to provide a zone of interaction. There are Yurok stories that reinforce the Yurok belief that the River was created in a distinct way in order to provide Yurok people with the best of worlds. For example, *Wopekamaw* said, "let the River run downstream" and that is how the River came to flow the direction it does (Kroeber 1978).

The story *The Salmon and Koowetsik* depicts the location of where the first salmon originated (Kroeber 1978). When *Wohpekamaw* first came to the Klamath River, he saw that there was no food for the people. There were only two women who had salmon. *Wohpekamaw* took the salmon from the women and let them go. *Wohpekamaw* said the people would never catch the Great Salmon (*Nepwo*). When *Nepwo* comes up, he will swim in the middle of the River so he isn‟t caught with the nets. The Immortals (*woge*) only wanted salmon to go up on one side of the River to make sure they knew where they could get salmon. But they never caught anything so they made it so the salmon would come up both sides. A man from the village of *Welkwau* (south side of the mouth of the Klamath River) wanted to learn how to fish at the mouth of the River so he went to *Koowetsik* and asked the headman to show him how to harpoon fish. The headman agreed to show the man from *Welkwau*. When *Nepwo* came through the mouth of the River, the

headman acted as if he was going to spear it. He would make thrusting motions with his spear but not actually spearing it, at the same time, he was praying for more salmon to come up the River.

These ritual actions demonstrated to *Nepwo* that Yurok were sincere in the proper treatment of salmon and *Nepwo* informed the other salmon that it was good to come into the Klamath River. More salmon came up the River. The headman speared some salmon and the man from *Welkwau* saw that he handled the fish in a particular way. The headman explained that if salmon was caught at the mouth, a man was not to use a wooden club to kill it; he was to use a stone to hit it in the head. But upstream from the mouth everyone else would use wooden clubs. If a salmon is caught at the mouth it must be buried with only its tail sticking out. People who use a spear to catch fish at the mouth must practice certain medicine before catching salmon. The lamprey eel was also made at *Koowetsik* and there are certain rules one must follow when catching them. This Yurok story is the explanation for the origin of the first fish ceremony.

In the story *Cappel fish dam or Tsurau man*, a young man from *Tsurai* (a Yurok village near the present day coastal town of Trinidad) longed to be around people (Kroeber 1978). He made a place where he could get woodpecker crests and money *„OL we-tsik"*. In order to get those things he would need to wash his hands in certain springs. While he was sitting near the springs, a stick spoke to him and informed the man to build a sweathouse. After the man built the sweathouse, he came back and the stick had turned into a man whose name was *Tohstek*. *Tohstek* told the man to follow certain rules and he would become rich and would be able to do anything else he desired. The man slept in the sweathouse and began to dream. He dreamed of the Deerskin, Jumping, and Brush ceremonies and he thought that these are the types of things he wants to see. He went to get wood and when he came back to the sweathouse there were ten wooden trunks. Inside the trunks, were all of the things he would need to hold the ceremonies he dreamed about. He traveled up the Klamath River stopping along the way to hold the ceremonies. His final destination was *Cappell*. When he arrived, the people were in the process of building the fish dam but they did not have the proper medicine to finish the dam. *Tsurau* man conducted a ceremony there and the people were able to finish the dam. The headman from *Cappell* gave *Tsurau* man his best boat (*yoch*) so he could return home. Every autumn when the Fish Dam was built, *Tsurau* man traveled up the Klamath River to help the people conduct the ceremony.

These selected oral traditions and corresponding ritual practices, of which there are many more, tell of the Yurok reverence for fish and creator and if adhered to, provide the Yurok with abundance of salmon, and a place for salmon and people to inhabit.

2.5 Traditional Yurok Ceremonies

Fish dams *„?umyo?"* were built in order to make sure there was enough fish for everybody. The *Cappell* fish dam was constructed annually in the early to mid-fall contingent upon the success of the first fish ceremony held in the spring. The dam, built 33 miles up river from the mouth, stretched across the entire width of the River. The dam was constructed with much ceremony, cultural taboo, and inter-village effort. Pens on the weir dam trapped salmon that were then selected for by Yurok fisherman. Fish were selected for subsistence take or allowed to continue up river for the purpose of giving up-river people the chance at the fishery and for allowing spawning to occur. Fish were also procured for trade. The right to take fish from the dam was held by affluent families who then allowed less wealthy people to fish.

After the fish dam was installed and prior to the onset of late fall rains the Jump and Deerskin ceremonies were held. The same affluent and religious people conducted these ceremonies partially to give thanks for the abundance as well as to assure the continuance of that abundance for the next year. As part of the ceremonies, wealthy people were expected to feed salmon to all that attended.

Canoes are important elements in Yurok ceremonial life. An important component of Yurok Ceremonial life is the Boat Ceremony. The boat ceremony is part of the Deerskin ceremony held to thank the Earth and Creator for continued sustenance. In this ceremony, several boats filled with ceremonialists in full regalia traveled down river, making a ceremonial crossing. The ceremonialists thank the River for continuing to flow and providing the pulse of life that sustains the Yurok world. The Boat Ceremony required adequate flows of water at particular times of the year. This is still true today. Therefore, diverting the water chokes the life out of the Klamath River environment. As a result, the Boat Ceremony becomes a hollow ceremony. Currently the Tribes have to call the Bureau of Reclamation (BOR) in order to get increased water flows for holding a Boat Ceremony. This disconnect between nature and ceremony underscore this sense of hollowness. To many it appears that the BOR has placed itself in the role of Creator.

The Brush Ceremony, still held in several of the traditional villages along the Klamath River requires the proper scenic river qualities and the availability of river resources. As a Brush Ceremony unfolds over a four-day period it attests to the wealth that the riverine environment provides. Baskets made of plant materials collected at the water‟s edge are used to hold food and ceremonial medicine. Acorns, cooked in the baskets, are converted to a nourishing mush that is rendered by placing several hot rocks (cooking rocks), gathered off of specific river bars, into the acorn flour and water that is placed into the baskets. Regalia that adorn the ceremonialists is constructed out of various plant and animal products that the riverine environment provides. Ceremonial bathing in the River and its tributary creeks is a requirement for some of the participants. Ceremonialists also prepare themselves by listening to the River‟s sounds. While many guests today arrive by car, many more arrive by traditional transportation: boats.

2.6 Traditional Technology and Use

The technological expertise of Yurok people presents a direct link to how and why tools were made. Specific types of implements or devices were made to fit a particular environment and type of fishing. For example, specific types of nets were made for river fishing and other types were made for ocean fishing. Tools or devices were not made simply to take river or ocean resources, but some were created specifically to signify the time of sacred ceremonies. The fixed weir is one such example. The most important Yurok fish weir (dam) is known as the Cappell Fish Dam, which signified the time to hold the Deerskin and Jump ceremonies, which in turn insured the abundance of health and resources for all the people. As described in *Fishing Among the Indians of Northwestern California* (Kroeber & Barrett, 12:1960):

> The weir was an elaborate structure built in ten named sections by ten groups of men, all working under the actual, as well as the ceremonial, direction of one formulist. Each section was built with an enclosure provided with a gate, which could be closed when the fish entered. The fish were then easily removed with dip nets.... All told, the full ceremonial cycle connected with the Kepel dam covered some fifty to sixty days. It was the most elaborate undertaking of any kind among the tribes of this Northwestern California region.

While the Fish Dam allowed for community fishing activities, Yurok fishing technology also allows for individual fishing activities. Landing, lifting, flat, and cylindrical nets are used to take a variety of fish. Trap baskets are used to catch eels. Mesh size was determined by the size of fish taken. Some nets were equipped with trigger mechanisms that trapped incoming fish. River & ocean going boats, nets hooks, lines, rope, sinkers, bait, harpoons, clubs fishing baskets and carrying baskets are just some of the technological adaptations employed by the Yurok to assist in the taking of fish.

One of the most important technological advancements of Yurok culture is the construction of river and ocean goings canoes. Canoes, or *yoch,* were carved from selected redwood trees. The ocean going Yurok canoe was from 30 to 40 feet in length, six to eight feet in width and three feet deep. It could haul up to five tons of cargo (usually seal carcasses) and was customarily paddled by five to 20 paddlers and an oarsman who steered the boat from the back. The oarsman was also the headman or, *poyweson,* who had the financial and persuasive background to coordinate ocean-going expeditions. There are historic accounts of expeditions traveling 180 miles along the coast (Powers 1871, Gould 1968). Canoes were also used for gathering, fishing, and hunting and general travel along the River. River canoes average from 16 to 20 feet in length and are three to four feet in width. Canoes were customarily paddled and/or pushed with a long pole.

In proto-historic times canoes were also rigged with sails. The double ender canoe was introduced for travel on the estuary near the mouth of the River. Double ender canoes introduced by Yurok carvers in the early 20th century are easier to make and could be adapted to the outboard motor. As redwood logs and access to suitable logs for making a traditional Yurok canoe decreased, the Yurok utilized non-traditional boats to continue their use of and travel on the River. As the motorboat was introduced to the Klamath River, motors were also adapted to fit onto traditional canoes. More recently, modern aluminum boats have been designed specifically for use on the Klamath River, these are often referred to as "Klamath River Sleds" because their design allows them to travel well in various River depths and currents. Today the best boatmen of the Lower Klamath River, utilizing various watercraft, are predominately Yurok.

The skill of the Yurok fishermen can be measured by the ability to navigate the Klamath in the dark. Navigation is not done by the stars or cardinal directions, but by correlating the location and swiftness of the current and back eddy of the River with the sounds that are unique to each memorized bend, slick or riffle.

2.7 Traditional Fishing and Gathering

The river is lined with numerous fishing and gathering sites. The river is also lined with numerous gathering areas associated with plants adapted to flow levels of the river. Various plants are used as food and material to make ceremonial regalia, baskets, cloths, houses, boats, nets, and other everyday household utensils. For example it is well known that a specific type of willow root is best gathered in long narrow stretches of the river where the rivers scouring effect exposes the material sought. There are also places along the river where weavers traditionally meet to avoid the hot summer sun and weave together.

A fishing place can be a place where there is good river access, a deep hole, or good back eddy allows for fish to rest on the way up-river. Fishing places are designated fishing areas on the river, a pool, a rock, and eddy. Often times large projecting river rocks both provide such a place for fish and a place where Yurok fishermen can build scaffolds that allow for the establishment of fish netting areas. Fishing places are a form of real property in Yurok culture. Fishing places can be owned; by individuals, families, or a group of individuals. Fishing places are borrowed, leased,

inherited and bought and sold. If shared, each owner has a right to fish there. Some ownership rights at fishing places depend on species of fish caught, salmon, eels, or sturgeon. Others depend on the water level, with individuals owning the right to fish at that place if the River is below or above a certain level. Ownership of a fishing place is not necessarily linked to ownership of adjacent property, as individuals who live away from the River can have ownership in a fishing place. Siltation and changes in the River have always affected the quality and use of fishing places. Some fishing places are abandoned during times when the productivity of a particular place was poor (Waterman 1920:219). Yurok people still recognize this traditional form of resource management and use on the River. Families and individuals continue to use and own rights to fishing places on the River. An entire traditional etiquette and jurisprudence has been developed to regulate the orderly taking of fish.

2.8 Place Names Associated with River

That the River is integral to Yurok Culture and life ways is reflected in the following site estimates compiled from the Yurok Tribe Heritage Preservation files. The Yurok Heritage Preservation Office does not make a distinction between Archeological sites and Traditional Cultural Properties. Instead all places that are important to the continuation of Yurok culture are called sites. Those sites that have archeological components are not those that have artifacts or other evidence of human occupation but rather have evidence of archeological excavation.

Yurok people have place names for numerous features and locations on the River and within their landscape. Many of these place-names were documented in T.T. Waterman‟s geographical research (Waterman 1920). Fishing places had names, rock out crops had names, villages, trails, and gathering areas all had Yurok names. Place names were often descriptive, others were references to creation stories, or stories about events that had occurred there. The number of place names given to locations on and around the river and surrounding landscape speak to the intimate relationship between Yurok and their environment, as well as their long-term presence within it.

Many of these place names reflect geographic placement in relation to the River. For example the Yurok center of the world is named *Kenek*. A place immediately down-river from the town of *Kenek* is named *Kenek-pul*; „*pul*‟ translates as „down-river‟. A place up the hill from *Kenek-pul* is named *Kenek-pul hi-won*; „*hi-won*‟ translates as „little way up hill‟. Another town, named *Ayolth*, denotes a sweeping bend in the River. The village is named after that type bend. The Yurok Village of *Rekwo*i, located at the mouth of the Klamath River, translates as “Mouth of the river.” Other examples abound. The word „Yurok‟ is a Karuk word for „down river‟. The Yurok people call them selves *Poh-lik Lah*; translated as „down-river people‟. Whether the Karuk or Yurok words are used, it is very clear that a people are named and identify with the river and its particular place in the world.

2.9 Contemporary Culture and History

Traditional ceremonies, either never stopped or recently reintroduced, are the Brush, Jump, Deerskin, and Boat ceremonies. All four ceremonies require a close proximity to the River and the ceremonial meanings integrally link to aspects of riverine health. The First Fish ceremony and the Cappell Fish Dam are currently not held. The death ritual of taking the deceased up river in respect to the death purification rocks still continues for those buried in the traditional fashion. Yurok culture has recently had a resurgence of the traditional stick games, a ceremonial sport that combines aspects of wrestling and lacrosse. The playing fields are constructed on sandy beaches along the river during the summer months and often in conjunction with the Brush dance ceremony.

Traditional gill nets, woven of iris fibers, have been replaced with more durable nylon filament gillnets. Despite the materials that make up nets, the strategies by which fish are taken remain the same with the exception that scaffolds with dip nets are no longer constructed. Fish is the primary food source for those Yurok living along the River. While the Cappell fish weir has not been constructed since the early 1900"s, traditionally minded Yurok talk of the possibility of bringing the ceremony and dam construction back as part of the larger movement to revitalize Yurok religion.

Traditional gathering continues, primarily by contemporary basket weavers and despite the increasingly difficult task of finding adequate plant population of good quality. Increased restrictions on accessing private and federal properties, increased timber production, and increased use of herbicides and pesticides have all limited the traditional gatherers" efforts to revitalize traditional weaving.

The River remains the main transportation thoroughfare of the Yurok Reservation. Vehicular travel from one end of the reservation to the other routinely takes two hours. By boat the trip is reduced to one hour. Most Yurok who live along the River own powerboats and pride themselves as keen river navigators and boat mechanics. There is still existent knowledge of traditional boat carving and traditional river-going canoes continue to be produced.

In contemporary times older traditions continue in ways that allow Yurok to maintain lives as participants in dominant social life yet maintain connections to Yurok Culture and the River. Today Yurok speech on and about the River is predominately conducted in English. A Yurok language Immersion Camp is annually held at a campground adjacent to the River and the river provides a basis for the cultural activities conducted that require the participants to engage in traditional Yurok language speech.

Many place names along the River and throughout Yurok ancestral lands continue to retain traditional Yurok names. In addition many old places and newer contemporary places are referred to by contemporary English names that uniquely reference a solely Yurok identity with place. For example the traditional place along the river called *Ha wok* by older Yurok is also referred to as the McCovey Ranch and named after one lineage of a very largeYurok McCovey family. Many non–Yurok people however refer to the same place as the "mouth of Omogar Creek."

3. Ethnographic Literature

The following section is a summary of ethnographic sources on the Yurok relationship with the Klamath River. The categories are thematic (natural features, cultural features, and other features) and the excerpts and summaries tend to be written in the past tense, as they were originally recorded. This section is not intended to be a read-through document, but rather a summary of ethnographic sources to be used in the final synthesis document. The citations are listed in chronological order and at times may be redundant. The redundancy is a reflection of the emphasis placed upon particular aspects of Yurok culture by the ethnographers and anthropologists who documented and published these accounts. It is important to note that not all accounts are accurate, some are in fact contradictory, but they are included as originally published by the authors. Differences in the spelling of Yurok place names and words are due to differences in published accounts, as written by the authors. What is consistent in the ethnographic literature is the significance of the River in Yurok life, and the intimate relationship between the Yurok and the River throughout time.

3.0 Klamath River Ethnographic Landscape (Riverscape)

3.1 Natural Features

3.1.1 Water

Gibbs (1853 reprinted in 1973)
Early accounts by George Gibbs, recorded in the 1800s provide a detailed description of Klamath River and surrounding valley and forests. Gibbs recorded a mixed wood forest of oak, madrone, maple, bay, alder, and near the coast, redwoods that covered the steep slopes leading down to the River. These were broken by broad river terraces on which Yurok settlements were located, separated from the River by extensive gravel bars with very few trees, and no vegetation. He also explained that the natural cycle of the River included periodic high water events in the winter rainy season (up to 100 feet), and partial rises in the spring (runoff), which did not subside until late July (Gibbs 1973:5).

Waterman (1920)
The traditional Yurok belief at the time of European Contact was that the world is a flat extent surrounded by ocean and bisected by the River. The role of the River to Yurok culture was not limited to transportation, but was an integral part of the social network both within Yurok and between their neighbors. Extensive visiting between villages, families and outside villages occurred via the river. Travelers would come from up and down river to participate or attend various ceremonies and gatherings so much that the primary Yurok ceremonial sites include houses for visitors from Hupa and Karok communities. Likewise the Karok and Hupa have houses for visiting Yurok for similar ceremonies. Although each group had its own unique aspects of ritual, language and material culture, the river provided a common cultural framework that was integrated in socioeconomic and spiritual life for all three groups (Waterman 1920:186).

Waterman reported that the Yurok had no name for the River because in Yurok terms, it is the only river. Streams and creeks are often named descriptively, after a character, story or nearby village, or not at all (Waterman 1920:196). (Note: Waterman‟s conclusion that there was no Yurok name for River is not accurate. The Yurok word for the River is *HeL kik a wroi* or “watercourse coming from way back in the mountains.”)

The River is a force to be respected. There were prayers or formulas that were used to speak with the river and with one‟s boat to perform well in those areas of the river commanding respect (Waterman 1920).

Merriam (1967)
The significance of the River in Yurok culture extends beyond the living to the imagery and beliefs related to the dead. According to Merriam, Yurok believe that the dead travel across the River before arriving at *Cher-rik-kuk*. The spirit travels across the river of the dead in a half-canoe. At the opposite shore, the spirit is met by the other spirits of the dead who check to see if the spirit belongs with them. If the spirit is recognized, it is accepted in *Cher-rik-kuk* (Merriam 1967:176)

Beals and Hester (1974)
In addition to being the primary source of food, the primary means of trade, travel and social networks was the River. Yurok preferred traveling by canoe. They also had a greater knowledge of their upriver neighbors, even those far away, than of their nearer coastal neighbors, in part due

to the rugged landscape, but also due to the fact that the River was the primary route of all trade and communication (Beals and Hester 1974:48-49).

Kroeber (1976)
The significance of the River to Klamath culture and thought is illustrated in Yurok geography. The Yurok had no cardinal directions (north, south, east or west) but instead oriented themselves in terms of the River and flow of water.

"*Pul*" means up river or up stream, "*pets*" means downriver or downstream, "*hiko*" means across the stream, "*won*" means away from the stream and "*wohpe*" means across the ocean (Kroeber 1976:15). The word "*Yurok*" is the Karok word for "downstream". All features of homes and landscape are described in terms of their relationship to the River, either upstream or downstream, towards or away.

The River was considered the center of the Yurok universe, both practically and spiritually. The River provided access to the primary food, salmon. It also served as the primary route for transportation, communication, and trade in an area known for its rugged terrain and dense forests. Trade and social networks between coastal Yurok and River Yurok allowed for the distribution of food and resources between the two groups. Coastal Yurok relied on the River Yurok for salmon, eels, and sturgeon in exchange for shellfish and seaweed. The River connected people between upstream and downstream villages for social and ceremonial gatherings. Yurok culture shares many common features with upriver neighbors, the Karok, Hupa and Klamath River tribes into Oregon. The commonality of culture, art and adaptations indicate that the River was the central unifying feature for these groups. The River provided a common way of life and worldview that existed cross-culturally in spite of linguistic differences, and geographic distance.

3.1.2 Fish

Gibbs (1853 reprinted 1973)
Salmon is the most important item of subsistence. Spring runs would begin in May, and were distinguished by being very rich and fatty. The Klamath River posed no insurmountable obstacles to fish in their annual migration up the river. Salmon runs in the late summer and fall were less rich and fatty, and were often smoked or dried for winter food supply. The fall runs would spawn in the creeks and streams while the spring runs spawned primarily within the main stem of the river (Gibbs 1973:6).

Waterman (1920)
The word for salmon is "*nepu*ʻ" which literally means, "that which is eaten".
(Waterman 1920:185)

Kroeber and Barrett (1960)
Two species of Pacific Salmon dominated the salmon population on the Klamath river, *Oncorhychus tschawytscha*, commonly known as King or Chinook, and *Oncorhynchus Kisutch,* known as Coho or Silver salmon. In addition, steelhead trout were common in the Klamath River, and its tributaries up to Klamath Lake. (Kroeber and Barrett 1960:4-5).

Two annual salmon runs were normal on the Klamath River, in the spring and fall. Yurok called the spring run of Chinook salmon "numi nepui" or true salmon, named after their mythical leader "*nepewo*". This spring run of Chinook is commemorated by the Yurok in their First Salmon ceremony, held in April at the mouth of the Klamath.

The Yurok name for the late summer/fall run of Chinook is "*ohpes*" or summer salmon. This later run could begin as early as July.

The Yurok name for Silver or Coho salmon is "*tsegwun*" or "*tsegun*", meaning silversides, and traditionally ran from September to November on the Klamath. (Kroeber and Barrett 1960:5)

Two species of steelhead were common on the Klamath. The Yurok name for both rainbow and cutthroat was "*tskwol*" and ran in the winter and summer on the Klamath. (Kroeber and Barrett 1960:5)

Sturgeon were limited to the lower Klamath, below the rapids and were not known to occur beyond Ike‟s Fall, a mile below the mouth of the Salmon River on the Klamath in Karuk territory. Two species of sturgeon, *Acipenser transmontanus,* or white sturgeon and *Acipenser medirostris*, or green sturgeon, were fished extensively by Yurok as they occurred primarily within their portions of the river. (Kroeber and Barrett 1960:5)

The Pacific lamprey eel, *Entosphenus tridentatus*, also migrated up the Klamath all the way to Klamath Lakes. Yurok harvested eel every year and had specialized baskets and nets for catching eel during their annual migration. (Kroeber and Barrett 1960:5).

Bearss (1981)
Numerous accounts by Indian Agents, military officers traveling through the Klamath River area between the mid 1800s through the 1930s reported that Yurok people were self-sustaining due to their reliance on river resources, primarily salmon. Even though they were considered poor, they were not dependent on government commodities and support, as many other Native communities had become. This was attributed to their ability to maintain their subsistence practices of gathering and fishing. The annual reliance on bountiful salmon runs, and the ability to harvest for storage, and trade for other necessities enabled Yurok people to maintain their traditional way of life in spite of many disruptions and loss of land. In the late 1800s commercial fisheries were established at the mouth of the Klamath River. Although the tribe challenged the legality of these fisheries, the fisheries and canneries persisted. Eventually the commercial canneries near the mouth of the Klamath provided jobs and income for Yurok people. The 1934 U.S. government‟s decision to ban all fishing on the Klamath river, and closure of the canneries were devastating to Yurok people who relied on the annual salmon runs for their subsistence needs as well as their economic survival (Bearss 1981).

Perry (1988)
Trade and exchange within Yurok territory relied on fish, and they type of fish and where they were caught. For instance, fish caught near the mouth of the River had a higher fat content than those caught upriver. For this reason, the dried fish from the mouth of the River are considered to taste better and are a desired trade item for people who live upriver (Perry 1988:13).

3.1.3 Gravel bars

Gibbs (1853 reprinted 1973)
Early accounts by Gibbs of the River corridor, describe extensive gravel bars along the flood plain of the river separating the broad terraces where the Yurok villages were located from the river. Gibbs describes these gravel bars as devoid of vegetation, apparently stripped away during the peak flows of the winter (Gibbs 1973:5).

3.1.4 Rock promontories/rock canyon walls

Gates (personal communication 2003)
Just as children are born into the Yurok world by being introduced in various ways to the River and the culture that surrounds the riverine way of life, so do the elderly depart from this world via the River and it‟s features. Rocks located in the River and at its edge are spirit people who guide Yurok knowledge concerning proper burial procedures. The deceased last worldly journey is a boat ride up-river. At each of eighteen rocks from the mouth up to Slate Creek and up the Trinity, various burial rites and proscriptions are observed to assure the best departure for the deceased as well as those that remain in this world. There are several rocks in the mid section of the River that contain rare petroglyphs that indicate instructions from the Creator to the Yurok people. One such instruction is a warning that when the River stops flowing it will mark the end of the Yurok world. Some elders have prophesied that the manipulation of water flows through the dams is the beginning of the end for Yurok culture.

3.1.5 Willow/riparian

Kroeber (1976)
New shoots of willow were gathered every year from the riparian areas of the River for basketry materials. The normal cycle of the river would wash out the willow in the high water periods and allow for new shoots to grow every year.
(Kroeber 1976:90).

3.1.6 Riverside vegetation

Gibbs (1853 reprinted 1973)
The banks of the Klamath River were used by Yurok as gathering areas for various edible plants such as berries, and grass seeds that were gathered and stored for winter foods (Gibbs 1973:9).

Kroeber (1976)
Wild tobacco, *Nicotianas*, occurs naturally on sandy bars adjacent to the River but was not utilized by Yurok for smoking for fear that it had grown in association with burials (Kroeber 1976:88)

The riparian zone of the River is the source of many materials used for Yurok basketry. Young willow shoots were harvested along the riverbank. Many roots were collected from the banks of the river, which allowed access to the roots without harmful digging and damage to the trees. Pine, redwood, and spruce roots, in addition to willow and grapevine are basic basketry materials used in basket weaving (Kroeber 1976:90).

O'Neal (1995)
Tree roots for basketry were gathered and prepared along the River. Near the coast, redwood and spruce roots were gathered. Upriver, primary roots collected were sugar pine, alder, will, cottonwood and wild grape (O‟Neale 1995:17).

3.1.7 Upslope vegetation

Gibbs (1853 reprinted 1973)
Many berry bushes grow on the banks of creeks and tributaries flowing into the Klamath River. These include salmon berry, huckleberry, gooseberry, sallal, currant, and grapes. Further upslope,

filberts and acorns could be gathered, along with several species of fungus, and edible roots (Gibbs 1973:9)

Beals and Hester (1974)
Gathering areas located near Yurok villages were not privately owned, but hunting and snaring places were. Beyond a one-mile distance from villages, most areas were not owned but were open to use by anyone. Plants that were gathered for food in areas above the River included "Indian potatoes" or bulbs (*hr'Lkr and otoi'*), grass seed (*legeL*), wild sunflower (*petso'lo*), clover (*kla'po*) as well as acorns (Beals and Hester 1974:58)

Kroeber (1976)
Hazel shoots are the primary basketry material used for the warp of a Yurok basket. Traditional burning of hillsides containing hazel patches occurred annually and the new shoots would be harvested and used for basketry. Other upslope vegetation used for basketry includes bear grass, black maidenhair fern, giant fern, and woodwardia for color and designs created by twining techniques.

3.2 Cultural Features

3.2.1 Ceremonial

Curtis (1924)
Yurok held an annual ceremony for the purpose of "cleaning off the earth". They also held a salmon ceremony at the beginning of the spring run. People traveled from far and wide, often on the river to attend and participate in these ceremonies. Some of the Brush, Deerskin and Jump Ceremonies were conducted on the shores of the Klamath River. In these instances, the river bar was a vital feature of the ceremony (Curtis 1924:61-63).

Yurok settlements along the River fell into three ceremonial clusters. From Bluff Creek down to Tule Creek (*Atsepar* to *Kenek*), the confluence of the Trinity and Klamath Rivers at *Weitspus* was considered the central location for ceremonial matters. Similarly, from *Merip* to *Erner*, *Kepel* was the central ceremonial location. *Rekwoi* was the ceremonial center for villages from *Turip* to the Pacific Ocean (Curtis 1924:40)

Bearss (1969)
Yurok ceremonies were designed and performed with the intent of restoring, renewing and maintaining world order. General George Crook, stationed at Fort Terwer, recorded a yearly ceremony associated with the construction of the Kepel fish weir, at which all wealth was displayed publicly and all past feuds and conflicts of those in attendance would be erased (Bearss 1969:5).

Kroeber (1976)
The ceremonial calendar of the Yurok was tied to the River. The First Salmon ceremony occurred at *Welkwau* and the Fish Weir at *Kepel*. The ceremonial calendar for Yurok began with the first salmon run in April and concluded in late September near the end of the fall salmon run. The ceremonial cycle of the Yurok was for the purposes of world renewal or purification to ensure good health, prosperity, and abundant food for the people (Kroeber 1976:53). In each of the world renewal ceremonies, the Brush, the Deerskin, and the Jump ceremonies, the River served an important function, either for transportation, or purification.

The River played an important role in Yurok funeral rites and purification rituals associated with death and the dead. Certain rock features in the river were associated with the proper handling of a corpse and require strict adherence. At some localities, mourners purified themselves after burial, a custom that is still practiced today (Kroeber 1976:68-69)

Kroeber (1978)
Out of the 169 stories in *Yurok Myths*, there are 77 that make direct reference to the River. For example the Yurok word *‚ne po y"* is loosely translated as "salmon." Closer linguistic analysis shows that the word is more accurately translated as "that which we eat." *‚ne po y"* denotes more than „fish", but also includes connotations of Yurok reverence for a creature that provides sustenance to a people and way of life. Yurok words that name places, plants, animals, and things associated with the river are detailed throughout Yurok stories.

3.2.1.1 Grounds

Waterman (1920)
Yurok ceremonies were held only in certain towns. The Deer-skin Ceremony was only held at *We'ĭtspus* (Weitchpec) and *Pe'k̆wan* (Pekwan), and the Jump Ceremony was only held at *We'ĭtspus*, *Wo'x̆tek* (Wautec), *Re'k̆woi* (Requa), *Ore'q̆* (Orick) and *Oke-to* (Waterman 1920:203-204).

3.2.1.2 Boat ceremony

Bearss (1969)
The River has a vital role in both Jump and the Deerskin ceremonies. In the Jump Ceremony, two large canoes are used for a boat dance that marks the climax of the ceremony. In the Deerskin Ceremony held at *Wetlkwau*, ceremonialists from *Turip*, *Rekwoi* and *Wetlkwau* would dance in several canoes as they approached *Rekwoi* (Bearss 1969:6). Boat ceremonies are still practiced today.

Gates (personal communication 2003)
The Yurok Tribe re-introduced the Boat Ceremony on the Klamath River at Weitchpec in 2002. The water level and river flow are critical elements of this ceremony. If there is not enough water in the River, it disrupts the ceremony by causing an unpredictable current. This occurred in 2202 and was attributed to low water causing a centering problem for the boats when they hit the rocky bottom and went off course. The Boat Ceremony in many ways represents the significance of the River in Yurok Ceremonial life and world view.

3.2.1.3 First Fish

Roberts (1932)
An elaborate ceremony marked the passing of the first salmon up the Klamath River. This salmon was allowed to pass all the way up the River to its spawning ground. It was believed that this fish would leave its scales at each spawning location for the fish that would follow it up stream. It was believed that by allowing the first salmon to pass through the River, an abundance of salmon would follow (Roberts 1932:286).

Waterman and Kroeber (1938)
The first salmon in the River each year was considered taboo and would cause convulsions and even death if eaten. The purpose of the first salmon ceremony was to lift the taboo from the fish passing upstream allowing them to be eaten without harm.

Spott and Kroeber (1942)
The first salmon rite held at the Yurok village of *Welkwau* is associated with the Yurok story of *helku wenekuni ne'pui* "the salmon spearing from shore".

> This rite concerned the spearing of the first spring salmon (*ne'pe'wo*) in the seventh month (*tserwerh'šik*); as the year began with the winter solstice, this would be about June-July. Beginning with the first month until this seventh month no salmon caught at the mouth of the River were allowed to be eaten. They said that if one ate them he would bleed to death. Only the aged, men and women of sixty or sixty-five or older, might eat them. The rule applied only to salmon; sturgeon, lamprey eels, surf fish and candlefish could be caught and eaten at all times.
>
> The mouth of the River was defined as ending at *Tmeri Wroi* (Cannery Creek), between the Indian town of *Rekwoi* an the modern American town of Requa. If a salmon came ashore right across the mouth of Cannery Creek, its upriver portion, whether head or tail, might be eaten but the down river half of it was not touched. This law, however, did not mean that people in *Rekwoi* and *Welkwau* had to do entirely without fresh salmon during the first six months. They could eat them, provided they had been caught above Cannery Creek and then brought down to the settlements at the mouth
>
> (Spott and Kroeber 1942:172)

The first salmon rite is a complex ritual surrounding the start of the salmon run. In this ritual the first salmon is allowed to pass up the River unharmed. The ritual spearing of the next salmon up the river, and the ceremony that follows marks the beginning of the fishing season at the mouth of the river (Spott and Kroeber 1942).

Bearss (1969)
General George Crook reported that those who attended the annual ceremony at Kepel Fish Dam would have all past blood feuds erased. The weir was built in ten named sections by designated groups of ten men (Bearss 1969:5).

Morris (n.d.)
Salmon defined the Yurok relationship to nature and life. The First Salmon ceremony is a common feature of all salmon based cultures in the Pacific Northwest, and was an important aspect of Yurok ceremonial life. A single salmon in the River was considered "proof of Nature trying to fulfill an agreement that was made in the beginning of time between the River, the Ocean, the People and the Creator" (Morris n.d.: 1)

> In the very beginning of time, the ocean, the River, the salmon, the original people of this land, and the True Creator, all agreed to something. The Ocean, the River, the salmon, and the True Creator all agreed the salmon should come up the river and feed the people. Human beings agreed to do our part, with our First Salmon Ceremony. The void we create in the world when we take these salmon from the River to feed the people, we fill with our respect. This salmon, lying here, is proof that Nature is still abiding by that original agreement. It is up to you to decide if you will carry out your part. You can never say you don"t have proof of Nature"s commitment to do Its" part. We will build a fire and cook this fish. It will become a part of you.
>
> (Doc Thompson as retold by Calvin Rube, Morris, n.d.: 1-2).

The bones of the fish that were eaten in the First Salmon Ceremony were thrown back into the River where they turned back into fish, and swam away (Morris n.d.: 4).

3.2.1.4 Fish Dam ceremony

Gunther (1928)
A ceremony marking the arrival of the first salmon of the year is a common cultural practice in the Pacific Northwest. The ceremony is not, however, practiced everywhere where salmon is caught. When the first salmon comes upstream the catch of this fish is ritually celebrated through ceremony, although not all ceremonies are alike (Gunther 1928:135). The knowledge of the salmon ceremony is similar between the Karuk, the Hupa and the Yurok indicating a shared ceremonial pattern. The Shasta did not hold the same ceremonies as the Yurok, Hupa and Karuk but they did participate in these activities even if they did not conduct them (Gunther 1928:144).

The ceremonial eating of the first caught salmon is a common feature in all first salmon ceremonies. In Yurok, Hupa and Karuk cultures the first salmon caught was eaten by the medicine man (or formulist) and his assistant (Gunther 1928:148). Throughout the Pacific Northwest, salmon are believed to be people, who live similar lives to those on land, while out at sea. The salmon have a chief or leader who leads them upriver and it is this being that is honored in the ceremony. Proper respect for these beings must be demonstrated in preparing and conducting the ceremony in order to insure an abundance of salmon in the annual run (Gunther 1928:150). In the Yurok ceremony, the story of the salmon leader, and his return to the sea is recounted (Gunther 1928:152).

Van Stralen (1942)
"To dance in the fish dam ceremony you must go through awful hardships" (Van Stralen 1942:81).

"The fish dam used to be made every year. It is part of the White Deerskin Dance and is always built before the dance" (Van Stralen 1942:81).

"Every year when it is time to build the dam and hold the dances (White Deerskin, Jumping and Brush dances) they would send word up and down the river, even as far as Trinidad, for all the people to settle their quarrels and come and take part in the ceremonies and dances. Some of the people would camp at *Kepel* and some at *Sa'a*, where the chief, who had charge of the ceremonies would stay" (Van Stralen 1942:81).

"There were many people camped all around where we were, five different kinds of Indians. They all wanted to join in the big time we had. All the different people at the camps were asked to join in the dancing. It did not matter what village they came from nor what kind of Indians they were" (Van Stralen 1942:83).

"They all visited from camp to camp, and some from far off could not speak one another's language, so they talked with their hands, sign talk. The visiting Indians brought with them great baskets heaped full of good things to eat-acorns, hazelnuts, berries, dried fish, seaweed and lots of other things" (Van Stralen 1942:83).

The fish dam was allowed to operate for ten days and people could take as much fish as they wanted. After ten days the people assembled at the dance ground and the strict rules were lifted. The fish dam ceremonies followed. The next day, the ceremonial grounds were cleaned off and prepared for the White Deerskin ceremony to begin. The Fish Dam ceremonialists remained in

the fish camp and were allowed to eat and play without restrictions. They remained at the camp until the next heavy rain washed the fish dam away (Van Stralen 1942:85-86).

3.2.1.5 Bathing

Curtis (1924)
Ritual bathing in the River is an integral part of most Yurok ceremonies and is particularly important in the handling of a corpse, preparation for burial, and purification after burial (Curtis 1924:43). The purification through bathing in the river of those who have handled a corpse and prepared it for burial is still an important practice in Yurok tradition.

Van Stralen (1942)
During the fish dam ceremonies at *Kepel*, young girls were selected by the medicine man to participate in the ceremonies. Once selected, they were sent to the river to bathe and then were dressed in full regalia they would wear during the ceremonies. Then they were sent home to their families, and were required to fast and bathe in the river every day (Van Stralen 1942:83-84).

3.2.1.6 Visual

Gates (personal communication 2003)
Visual components of the River are related to traditional Yurok forms of meditation. Medicine women would meditate on specific locations on the river, at specific points in the river, at certain times of the day. In this way both water quality and flow pattern were important aspects of this meditation.

3.2.2 Fishing Places

Waterman (1920)
Fishing places were considered real property. The primary form of fishing was using a dip net in a deep hole or eddy that would form naturally behind a large rock or boulder in the River. A scaffold or platform would be built to access the fishing hole, and are called in Yurok, "*kworl*". Fishing places were considered to be owned by individuals or families. They could be sold, traded, or passed on to others. The value of the fishing hole would be based upon its productivity, how many fish could be caught there in terms of Indian money (dentalia). The value of the fishing place would fluctuate depending on its condition as it would be impacted by annual river flows that could cause gravel or silt to alter its productivity (Waterman 1920:219)

Fishing places could be shared between individuals who negotiated turns and shared equipment. A very good fishing place might be owned by five to ten men, who would rotate days and times of day to fish. Others fishing places were owned by one person for salmon, and another person for eel or sturgeon. Another fishing place might be owned to a certain water level, with one owning the right to fish when the water was above or below a certain level. Some fishing places might be abandoned due to siltation or some other factor that made it undesirable. If left abandoned so long that the owner was forgotten it could be claimed by a new owner. The Yurok word for that kind of fishing place is "*weq sisiik*". It was generally accepted in Yurok culture that all fishing places along the river were owned by individuals, families or groups of individuals who had the primary right fish there (Waterman 1920:220).

Waterman (1920) documented a total of 94 Yurok fishing places on the Klamath River. Each of these sites had a name and an identified owner or owners. The distribution of these sites on Waterman‟s maps indicate a gap in his own field data as he notes only one fishing site existing

down river of *Turip*, near the mouth at *Rekwo*i. Contemporary ethnographic information, as well as oral history indicates that there are numerous Yurok fishing sites between *Rekwoi* and *Turip* that were not included in Waterman‟s inventory. Instead his field data appears to have been collected for areas upriver from *Turip* with the majority recorded between Cappell Creek and *Weistpus* at the mouth of the Trinity River.

Roberts (1932)
While fishing places were owned, those who did not have a fishing place could work for the owner in exchange for some of the fish caught there. In this way it was possible for all Yurok to participate in the annual fishing season, and receive a share of the harvest, even if they did not possess a fishing place of their own (Roberts 1932:287).

Kroeber and Barrett (1960)
The best fishing places on the River were privately owned by single individuals, or a group of individuals who rotated fishing at a specific location. Fishing places were recognized as personal property and could be sold, given away or passed on by inheritance. Fishing rights on the River extended beyond the Yurok who lived in river villages. For instance, Yurok who lived in coastal villages away from the River were still recognized as having ownership of fishing sites on the river. (Kroeber and Barrett 1960:3)

Specialized methods for harvesting fish and eel from the River were utilized to maximize the success of fishing at different localities on the river. Specific attributes of the river, riffles, shallows, eddies, falls, deep pools, and creeks each had unique attributes for which the Yurok developed specialized equipment or fishing methods to ensure a successful harvest.

Riffles: harpoons and gaffs were used along with specialized traps.

Shallows: fish weirs were often built in these areas, with impounding pens for spearing, dip netting, gaffing and trapping. Kepel fish dam was in one of these areas on the Klamath.

Eddies: platform fishing with triggered lifting nets were used in these areas.

Falls or cascades: plunge nets, traps, harpoons, and gaffs were used to harvest fish that were trapped below these natural river features.

Deep pools: diving, bow and arrow, snaring, poisoning and sturgeon riding were used in these still and deep areas of the river.

Creeks, streams and tributaries: short fish weirs, basket traps, and hook and line fishing techniques were common in these areas.

Lamprey were harvested by use of lifting nets, dip nets, and basketry eel traps, gaffs and hand catching in certain areas. (Kroeber and Barrett 1960:8)

Fishing techniques were highly specialized to take advantage of specific characteristics of river morphology, as well as species behavior in their annual migration up the Klamath River. The importance of these river resources for Yurok people, and other Klamath River tribes is evident in the complex fishing methods, schedules, rituals and the use of specialized equipment and technique for each species. (Kroeber and Barrett 1960:8)

Bearss (1969)
Several individuals might own a fishing place, which they used in rotation for one or more days according to their share of ownership in the site. Establishing a new fishing place, or fishing below an existing hole was not allowed. Ownership of existing fishing places was an economic matter, allowing for sale, trade or inheritance. This strict management of fishing places guaranteed the value and the viability of existing fishing places owned by individuals, groups, or families (Bearss 1969:3).

Lampreys, sturgeon and salmon were staples of the Yurok diet. Lamprey eels were prized for their grease. Lampreys and salmon were slit for drying. Most were smoked and stored in baskets. Specialized nets were made for each type of fish, with each requiring a specific web and strength. Fishing techniques included netting and harpooning depending on the species and the water conditions on the River (Bearss 1969:9).

Perry (1988)
Yurok fishing practices were severely impacted by several historical events following white settlement. In the late 1800s commercial fisheries and canneries opened at the mouth of the Klamath River. Many Yurok relocated in order to work at these canneries. The harvesting practices of these commercial fisheries resulted in the depletion of the resource so that the commercial fishing, and the use of gill nets were outlawed in 1934. This included Indian fishing, and literally blocked access to a traditional source of food, as well as the core of the Yurok economy. In 1970 a federal court ruling allowed for Indians to once again use their gill nets and sell their fish, but the Bureau of Indian Affairs (BIA) defied the order and banned Indian fishing in 1978. When Indians protested the illegal closure, conflicts and violence between Indian fishers and the BIA followed. The BIA closure lasted ten years, during which time traditional Indian fishing practices were deemed illegal and subject to arrest, fines and punishment by the BIA. In 1987 commercial fishing near the mouth of the Klamath resumed. Traditional Indian fishing is now regulated at the mouth, and the commercial fishing season is relatively brief (Perry 1988:13-14).

3.2.2.1 Net setting

Kroeber and Barrett (1960)
Specialized nets were designed and used by Yurok to take advantage of unique features in river morphology, flow and current on the Klamath.

Conical nets, or lifting nets, were constructed by attaching a woven conical net, or pouch onto a large A-frame of poles and was usually operated from a platform or scaffold built over an eddy or backwater where salmon would congregate, or rest, before proceeding with their upstream migration (Kroeber and Barrett 1960:32). These types of nets were used to catch salmon, lamprey and sturgeon. The weave of the net was specifically designed for each type.

The construction of a large, A-frame dip net was ritualized, requiring special songs and prayers as well as technique. The singing that accompanied the making of such a net was called "*Rekwoi*" (the same name as the Yurok village at the mouth of the River), translated by Kroeber as "entering from the ocean". The setting of the net in the River is also ritualized and if done improperly, is assumed to have a negative result on the harvest at that site (Kroeber and Barrett 1960:35).

Other types of traditional fishing nets were conical dragnets, drifting nets, plunge nets, scoop nets, arc nets, seine, gill nets, drift nets, and hoop nets. Each were designed and constructed to work with a specific feature of river morphology or current, or species.

Net making was also highly specialized, with specific types of nets and uses determining the materials to be used in construction, as well as the type of weaving technique used to make them. Coarse ropes were traditionally made by twisting grapevine and strips of willow bark and hazel withes. The finer netting was traditionally made from iris leaves, *Iris macrosiphon*. The individual leaf of an iris would produce only two fibers approximately one to two feet in length. The fibers were extracted from the leaf by women and rolled and twisted into a strong cord. The thickness of the cord was determined by the type of net being made and the appropriate number of fibers were used to obtain the desired thickness. The iris used to make these nets was harvested from high elevation sites in mountainous areas away from the river (Kroeber and Barrett 1960:57).

Traditionally, men were responsible for weaving and making nets used for fishing. This was considered a winter activity. The making of a net was also ritualized, and care was taken not to pass behind a weaver or speak loudly in the presence of a net being made, lest the salmon hear it and avoid the net (Kroeber and Barrett 1960:58).

Net making was a complex undertaking and required a specialized tool kit for various aspects of construction. Shuttles used for weaving were made from elk antler. Mesh measures were used to ensure that the weave was uniform and consistent throughout the net and were also made from elk antler. Some wood and bone meshes have been observed, but elk antler was considered to be the most desirable material (Kroeber and Barrett 1960:63).

3.2.2.2 Scaffolding

Kroeber and Barrett (1960)
The platform of scaffold built for fishing was a "combination gangplank and operating platform built out over the River". They were usually constructed from one or two planks and the necessary number of poles that extended from a rocky shoreline. Fishing platforms were specifically designed for a particularly fishing place, varying in size and construction (Kroeber and Barrett 1960:33).

Bearss (1969)
Scaffolds were built and used to support lift nets and dip nets used by Yurok fisherman on the river. Scaffolds were built out over the river, usually over an eddy or backwater. Fisherman would sit on a small wooden stool and operate the net from the scaffold (Bearss 1969:8).

3.2.2.3 Eel basket

Kroeber and Barrett (1960)
Basketry traps were primarily used for catching eels. These "eel pots" were woven from undressed withes of hazel or willow in a plain-twine technique. These large open weave baskets have a small opening for the eel to fit through. Bait would be set inside the trap and it would be placed and secured in the stream using a stake and rope to hold it in place. Historic records indicate that the Yurok use of an eel basket or eel pot was adapted after observing their use by displaced Wiyot who settled in *Weitspus* (Kroeber and Barrett 1960:71).

3.2.2.4 Fish weirs/dams

(Gibbs 1853 reprinted 1973)
The fish weir at *Heyomu* or *Lo"ɬego* was described by George Gibbs, a member of the McKee treaty expedition in 1850. Gibbs described a large fish weir, of elaborate construction crossing the entire width of the river at a village called "*Hai am mu*". Gibbs recorded that the fish weir was in use between June-July in 1850.

Curtis (1924)
The building of a fish weir was overseen by a Yurok ceremonialist. He conducted no physical work in the construction of the weir, but conducted ceremonies and offered prayers while it was being constructed by others. Two fish weirs were built by the Yurok on the River; one at *Lo"oɬego*, located two miles above the Trinity, and one at *Kepel.* The ceremonies at Kepel included visitors and participants from *Wa'ş'ai"* down river to *Wakhtek*. People from villages up river of the weir were allowed to come down to watch the ceremonies and to harvest as many fish as they needed (Curtis 1924:40)

Roberts (1932)
Salmon were allowed to pass up stream for half a moon before they were caught. The fish weirs were built at the peak of the salmon run, after many had already passed upstream to spawn (Roberts 1932:290). Most of the entire spring run was allowed to pass upstream, with fishing limited to what was needed. The late summer or fall sun was the one that was extensively harvested for drying and storing for winter months (Roberts 1932:290)

Fish weirs were considered community projects in which entire villages were entitled to a share of the harvest. Small fish weirs were made on streams and creeks by constructing a barrier made of green poles and filled with brush and rocks, leaving an opening to allow fish passage. The two Yurok fish weirs, at *Lo'ogelo* and *Kepel* were major feats of construction, ceremony and cooperation. The families that had primary fishing rights at these locations were allowed to take their share of fish each morning, and then the rest was open to those who had no fishing privileges to share the rest. People came from all villages up and down river to take part in the *Kepel* Fish weir harvest every year (Roberts 1932:288)

Waterman and Kroeber (1938)
The Kepel Fish Dam was a weir that was constructed every year near the mouth of Kepel Creek. People would begin gathering at *Kepel* and *Sa'a* in the early summer. In a collective effort they would build a complex fish weir of poles, logs and small stakes that extended across the entire width of the River. It was an effort that required many men and great skill to complete. The fish weir consisted of a fence of poles and stakes set into the bed of the stream and supported to hold up against the strong current of the river. A series of openings were left in the fence in order to allow fish to pass through and into holding pens where they could be easily removed with hand nets. The entire endeavor was a combination of ceremony and ritual, being built in ten days and operated only for ten days before being torn down (Waterman and Kroeber 1938:49-50).

The construction of the weir was highly ritualized, ceremonial and symbolic blending the mythological, the spiritual and practical aspects of its construction and the ceremony leading up to its completion and use. Traditional tools of stone pounders and elk horn wedges were used to make and set the stakes and construct the weir. Each day"s work was closely monitored and each day a specific amount of supplies was ordered for use in the next day"s work. It was taboo for travelers to see the unfinished structure, and they were told not to look upon it or else it would spoil it. The entire construction could take ten days, not more or less. At the end of each workday

the people would return home in their canoes. On the trip home a men would conduct a Boat Ceremony and songs of the fish dam would be sung "*wi lo'gonewol*" (Waterman and Kroeber 1938:60). When finally completed the two sections of the weir was pushed out from either shore and joined in the middle of the River. The two sections extended diagonally upstream in a V-shaped form and were secured together completing the structure. This event was celebrated by the a collective cheer of "We are so glad!" (Waterman and Kroeber 1938:58)

Ten gates were built into the dam, each one leading to a pen or corral for the fish on the upstream side of the structure. The men who participated in building a pen shared the fish that were trapped in it. The final day was marked by many ceremonies, dances and singing. The final ceremony at the fish weir was a Deerskin Ceremony. People came from all over the region to participate in these ceremonies and activities at *Kepel* (Waterman and Kroeber 1938:61).

Kroeber and Barrett (1960)
In historic times, the Yurok constructed two elaborate fish weirs, or fish dams, on the Klamath River. Prior to non-Indian contact four fish weirs (presumably the *Turip*, *Kepel*, and *Hyeomu* or *Lo'lego and Kererni*t fish weirs), were constructed annually by the Yurok on the Klamath River. (Kroeber and Barrett 1960:10)

The *Kepel* (Cappell) fish weir was built annually just above the mouth of Cappell Creek, three or four miles down river from Kanick Rapids (*Kenek*). This fish weir was constructed as part of an elaborate Yurok ceremony, and marked the start of a Deerskin Ceremony and Jump Ceremony. The weir was built in later summer, between August and September. (Kroeber and Barrett 1960:11).

Yurok tradition tells of the first fish weir being built at *Turip*, about 20 miles downriver from *Kepel*. The story says that the people from *Kepel* came and took the fish weir and the ceremony from *Turip*. *Turip* people traveled up to *Kepel* with the intent of reclaiming both, but after witnessing the *Kepel* ceremony decided instead to transform into redwoods and watch over the ceremony and the fish weir. This story is incorporated into the *Kepel* Fish Weir ceremony and the Guardian Trees remain important cultural and ceremonial figures in Yurok tradition. (Kroeber and Barrett 1960:11)

The cultural significance of the *Kepel* Fish Weir demonstrates several key features of Yurok culture and Yurok identity in relationship to the Klamath River. The construction of the *Kepel* Fish Weir integrated traditional ecological knowledge, spiritual belief, and social organization into a single, elaborate world-renewal ceremony (Kroeber and Barrett 1960:12). The weir was an elaborate structure built by ten men over ten days under the direction of a spiritual leader, or formulist. Yurok people from numerous villages came to participate in the Kepel Fish Weir including: *Tekta, Woxkero, Kootep, Pekwon, Yoxter, Sregon, Meta, Nohtskum, Murekw and Kepel*. Curtis (1924:40) noted that the villagers from *Was'ai* to *Wohtek* participated in building the weir, but people living above it were allowed to come and harvest all the salmon they wanted while the fish weir was in operation. (Kroeber and Barrett 1960:12-13).

The fish weir, once finished, was operated for ten days during which large quantities of salmon were harvested. After ten days, the fish weir was dismantled, allowing the remaining salmon to continue their migration upriver. The *Kepel* Fish Weir illustrates the Yurok integration of ceremonial and practical aspects of the harvesting of river resources (Kroeber and Barrett 1960:12).

The fish weir at *Heyomu* or *Lo"ɬego* was last constructed and used in 1868, but was discontinued due to the damage done to the area by hydraulic gold mining methods (Kroeber and Barrett 1960:17).

In both the *Kepel* and *Lo'lego* fish weirs, river morphology was important. A wide, shallow portion of the river, and a gravel bottom that allowed for the setting of stakes for construction were considered to be the primary features of river morphology needed to create a fish weir. Fish weirs were designed and constructed to block fish passage up river and instead route fish into holding pens where they could be easily harvested by using nets or spears (Kroeber and Barrett 1960:17)

Kroeber (1978)
In the story of The *Lo'olego* Ceremony, a young man from *Lo"oɬego* wanted to build a fish dam, but when asked, the *Weitspus* people would not help. They thought he wanted to make a ceremony although he didn"t have the regalia to make one. There was a rock with hole in it located on the River. The young man went into the hole and didn"t come out for a year. When the young man returned, the *Weitspus* people came to help him build the fish dam. When the dam was built, the *Weitspus* people went downstream to perform the White Deerskin ceremony. The *Lo"oɬego* people had their own Deerskin ceremony at *Lo"oɬego*. This fish weir was known as the *Lo"oɬego* Fish Dam.

In another story *Kerernit* (Chicken hawk) built his house on top of a large boulder by the river at *Knetkenolo*, which translates as "arrowhead-where fish-weir". He built a fish dam near the boulder and made a water fall so high that the salmon couldn"t jump over. There are holes in the rock that held posts for his dam. The rock is still there and the holes are visible. This structure was known as the Chickenhawk Fish Dam.

3.2.3 Gravel/Rock

Gibbs (1853 reprinted 1973)
Early accounts by George Gibbs, recorded in the 1800s describe the lower Klamath River as a steep valley where the forest came down to the river, separated only by wide gravel bars void of trees or grass. The Yurok villages were located on the banks of the river, occupying large terraces of rich fluvial soils.

3.2.3.1 Cooking rocks

(Curtis 1924)
Rocks were heated in fire and used inside baskets to heat and cook food. They were stirred inside the basket with a wooden paddle to prevent the rock from burning through the basket.

Gates (personal communication 2003)
Cooking rocks were used to prepare food in hearths and heat food in cooking baskets. Because they were used in fire, they needed to be free of inclusions or moisture that could cause them to explode when heated. Gravel bars along the river were formed as the annual peak flows receded. People would gather suitable cooking rocks from select gravel bars along the River. Not all gravel bars produced suitable cooking rocks, so specific areas in the floodplain at certain gravel bars were used to gather these types of rocks.

3.2.3.2 Porch rocks

Curtis (1924)
Rocks were used to pave the ground in front of a house. A narrow wall of stone was built on either side of the entrance to a Yurok house.

Kroeber (1976)
Large, flat rocks were used to line the outside of dwellings, residences, ceremonial houses and sweathouses. These rocks were usually of granite and were collected from select areas along the floodplain of the River. The size and distribution of these large rocks was likely a result of high water events that deposited these particular type and shape of stone in the River. Porch rocks were a regular feature in the traditional Yurok home. A functional aspect of this feature is that it would reduce moisture and mud from being brought into the dwelling. They were also used as porches where people would sit and visit outside the home.

3.2.4 Rock Promontories/Rock Canyon walls

3.2.4.1 Death rocks

Kroeber (1978)
The *Woge* made it so when people died they would have to use a prescribed formula. The *Woge* made the death purification ceremony. There are eighteen rocks that the *Woge* spirits live in along the rivers that must be spoken to when transporting a corpse. The stories "Origin of Death" and "Death and Purification" detail the locations of the eighteen rocks along the rivers.

3.2.4.2 Petroglyphs or Pictographs

Gates (personal communication 2003)
There are no petroglyphs or pictograph sites documented in the published literature in Yurok territory. There are however, four known sites on the Klamath River on the Yurok Reservation. In all cases these are elaborate forms of petroglyphs. Each location has numerous pecked designs in the faces of large rock outcroppings on the River. One such location is nearly buried by accumulated debris and sand, with only to upper portion of the outcrop and the glyph visible. The location of these petroglyphs is significant as they are along the River terrace at the confluence with important creeks.

3.2.5 Gathering/Botanical

Curtis (1924)
A wide variety of plants, for food, materials, and medicines were gathered along the riparian zone of the Klamath. Numerous species of berries grew along the banks of the River. Plants and roots used for basketry were collected along the River and along tributaries. Plants used for medicines and ceremonies grew along the riparian zone and were gathered for specific purposes by medicine women and ceremonialists.

3.2.5.1 Willow

(Curtis 1924)
Willow was used for many purposes and was often collected along the river. It‟s roots and shoots were used for basketry. It‟s leaves were used as medicine in myth times (Curtis 1924:174).

Kroeber (1976)
Willow was often gathered and used as a basketry material. Roots of willow were split for woofs, and used for fine design work, or as substitutes for spruce root (Kroeber 1976:90).

O'Neale (1995)
Willow was used as a primary basketry material, particularly up river. It can be used interchangeably with hazel for the foundation of the basket. High quality willow shoots were generated every year within the floodplain of the river due to the fact that peak flows would remove the previous year's growth and stimulate new shoots in the spring, which are the most desirable for basketry (O'Neale 1995:16)

3.2.5.2 Spruce roots

Merriam (1967)
The primary body material for a basket is spruce root (*Picea sitchensis*). This was gathered by digging out the root and cutting it in lengths of two to three feet. They are then split, while still soft, into broad, flat bands, and then split again to the desired size. These are woven over a frame of hazel (*Corylus*) sticks to form the basket (Merriam 1967:170). Spruce roots are often gathered on exposed riverbanks.

O'Neale (1995)
Spruce roots were primarily gathered near the mouth of the River and along the coast. They were traded upriver for basketry material for bear grass, black fern, and hazel (O'Neale 1995:17)

3.2.5.3 Tobacco

Kroeber (1976)
Tobacco of the same variety as found in the wild was cultivated by Yurok in high elevation sites for smoking and trade. Logs were burned on a hillside to produce a suitable soil and seeds were cultivated in these locations. Tobacco growing outside the cultivation sites was not harvested or used by Yurok for fear that it had grown in association with a cemetery or burials. Wild tobacco, *Nicotianas*, occurs naturally on sandy bars adjacent to the river but was not utilized by Yurok for smoking for fear that it had grown in association with burials (Kroeber 1976:88).

3.2.6 Habitation

3.2.6.1 Village sites

Waterman (1920)
Waterman recorded 31 Yurok villages or settlements located near or within the 100 year floodplain of the Klamath River. A few permanent villages occupy ancient river terraces more than one hundred feet above the river, Prior to the dams, in a high water event the River level could rise up to seventy feet (Waterman 1920:204).

Curtis (1924)
The Yurok ancestral villages extended from Bluff Creek, a few miles above the confluence with the Trinity River along the Klamath River to the Pacific Ocean, then south along the coast to Little River and north along the coast approximately six miles. While their villages tend to be concentrated on the river terraces and on coastal beaches, the Yurok claimed the entire Klamath watershed on both sides as ancestral lands and resource areas (Curtis 1924:37)

Yurok traditional lifestyles persisted in part due to the rugged terrain, the remote nature of the villages, and the lack of impact by non-Indians on the up river areas of Yurok territory. In the early 1900s the River was still the primary means of transportation and exchange between the up river villages and those down river and along the coast. At the time of Curtis‟ study with the Yurok, he reported nearly 700 living in villages on the River. The largest villages at that time were *Weitspus* (Weitchpec), *Pekwan*, *Wakhtek*, and *Rekwoi* (Requa). Many Yurok lived on allotments along the River, within these villages (Curtis 1924:38).

Thirty-four permanent Yurok villages on the Klamath River and the coast were recorded by Curtis. Of these 34, a total of 27 were on the banks of the Klamath River extending from Bluff Creek to the mouth. These villages were named (upriver to downriver) as follows: *Atsepar, Loolego, Weitspus, Pekwuteu, Ertlerger, Wakhshek, Kenek, Merip, Wa'ʂai, Kepel, Murek, Nakhtskum, Meta, Shregegon, Yohkter, Pekwan, Kootep, Wakhtek, Tekta, Serper, Erner, Turip, Sa'aihl, Hapau, Wahkel, Rekwoi*, and *Weltko* (Curtis 1924:221).

Merriam (1967)
Merriam recorded a total of 35 Yurok villages on the Klamath River from Weitchpec to the mouth. Twenty-two were located on the north side of the River and 13 on the south side (Merriam 1967:171). Most of the Yurok villages on the Klamath River are within the floodplain, just above the high water mark for the river (Merriam 1967:174).

Bearss (1969)
According to Bearss, there were 55 villages in Yurok ancestral lands. Most of these villages occupied ancient river terraces, increasing in elevation as they moved up river; *Wahkel* at 20 feet above mean sea level (amsl), *Turip* at 25 feet amsl, *Ko'otep* at 35 feet amsl, *Kepel* at 75 feet amsl, *Kenek* at 100 feet amsl, and Wahsekw at 200 feet amsl (Bearss 1969:1). Important villages were clustered together and were also the sites of ceremonial activities. Such villages were *Weitspus, Kepel, Sa'a, Pekwan, Rekwoi, Wetlkwau, Orckw*, and *Opyuweg*. Each of these villages had a sweat house (Bearss 1969:1).

In 1852, a trader recorded 17 Yurok villages between *Kepel* and the mouth of the River. A survey in 1895 recorded the same villages but with a declining population from over 1,000 residents in 1852 to less than 400 in 1895.

Traditional Yurok houses were constructed from large puncheon boards of split redwood planks. House pits were excavated to a depth of three to four feet below the ground surface and the remaining structure was constructed with the redwood planks. The roof was designed to allow for smoke to escape from the fire pit located in the center of the dwelling. The door was usually set to the upriver side, and was a small round or oval entryway. Yurok houses were built in alignment with the River (Bearss 1969:7).

Sweathouses were smaller in size and excavated deeper than a residential house. The walls were lined with redwood planks, but did not extend above the ground. The roof was constructed with redwood planks and the door facing the ocean or the River (Bearss 1969:7)

Pilling (1978)
There were seventy-three Yurok villages in Yurok ancestral territory, 50 villages or settlements were located along the Klamath River. Fifteen of those villages have been identified as having been occupied by Yurok people from before 1850 to present day. Those 15 villages are: *Rekwoi* (Requa), *Tmri, Welkew, Wo'kel* (Waukel), *Turip, Wohtek* (Wautec), *Pekwon* (Pekwan), *Sreyon*

(Sregon), *Metah, Murek, Kepel, Kenek, Wahsek, Weitspuc* (Weitchpec), and *Pek'ťul* (Pilling 1979:139).

3.2.6.2 Fish camps

Bearss (1969)
Yurok fish camps on the Klamath continue to be both a social and economic enterprise. Fish camps are temporary camps that are used annually for the purpose of commercial and subsistence fishing on the river. They are strong indicators of a river-based economy. During the salmon runs on the river, these places are utilized by individuals and families. Yurok fish camps are primarily located near the most productive fishing locations, such as Dad‟s Fish Camp on the south bank, near the mouth of the River (Bearss 1969:14).

Perry (1988)
Fish camps on the Klamath River are necessary in order for Indian fishers to take advantage of their fishing rights at the mouth of the River during the commercial fishing season. Many Yurok travel from upriver villages to participate in the annual commercial fishing season. Fish camps are temporary campsites where families stay during this time. Fish camps are places for people to gather, socialize, share stories, and prepare for the next day‟s catch (Perry 1988:14).

When Indian commercial fishing resumed on the Klamath in 1987, Indian fishing could only occur between 7:00 pm to 7:00 am. This meant nets had to be checked, and fishers had to stay up all night in order to pull in nets and clean and prepare their catch. Once7:00 am came around, Indian fishers had to remove their nets to allow for recreational fishing. When the night‟s work was complete, Indian fishers would sleep during the day and then prepare for the next night‟s work (Perry 1988:14-15).

3.2.6.3 Cemeteries

Curtis (1924)
The dead were buried in cemeteries and were placed in the ground in relation to the river, with the head of the deceased always pointed up stream. In times of famine, if a person died of starvation, their body was put in the river, instead of the ground (Curtis 1924:42)

3.3 Other Features

3.3.1 Up-slope

3.3.1.1 View shed/coverage

Gates (personal communication 2003)
Viewshed and the aesthetics of the viewshed in Yurok lands is an important aspect of Yurok spiritual life. Many ceremonies and spiritual activities incorporate the landscape and viewshed into the prayers and meditations associated with these activities. In this way, the appearance and condition of the landscape and river are important and integral aspects of ceremonial life.

In addition, there is an economic and social value in maintaining an aesthetic viewshed within the river corridor. Yurok economic development plans include the creation of an eco-tourism lodge and the development of a guided tourism program to promote the Klamath River and its ecological value for recreational visitors. This program is being developed in conjunction with the

River‟s national designation as a Scenic and Recreational river. In this plan the condition, the aesthetic quality and the viewshed within the river corridor is an integral component of the plan. Yurok people wish to share the experience of this riverscape with visitors so that they too will learn to appreciate the natural beauty and importance of the River.

3.2.3.2 Botanical gathering, subsistence medicinal

Mead (1971)
The Lower Klamath River, and most of Yurok ancestral territory occupies a discrete botanical niche, commonly referred to as the Oregon Biotic Province. In addition to containing unique species which do not occur anywhere else in North America (for example, California coastal redwoods), the groups that occupy this unique botanical niche share a common culture, and traditional subsistence pattern that is not shared with their neighbors who reside outside of this biotic region. Culturally significant plants for foods, medicines and arts are shared by the distinct Indian tribes that occupy this region and are part of the common culture that is defined by the Klamath River (Mead 1971:48-49). Yurok share a common forest type with their Karuk and Hupa neighbors, primarily mixed evergreen forest and coniferous forest even if the range and percentage of this type varies between groups (Mead 1971:97).

According to Mead, Yurok used over 13 species of plants in basketry, both in the construction and design of a basket. Four plants were used as dyes for basket materials (Mead 1971:64). Mead further identifies six different stems, and kinds of roots, and one type of leaf used in Yurok basketry (Mead 1971:66). Many of these roots and stems were gathered within the floodplain of the River, along the shore or from the exposed banks. Based upon the common use of plants for medicines, food and materials, Mead concluded that the common culture areas for the region included a grouping of Yurok, Hupa and Karuk even though each group represented a different language family (Mead 1971:71).

Pilling (1978)
Resource areas used for gathering plants for food and materials were often owned by families or individuals. Driftwood along the river, root-gathering areas, seed gathering areas, tobacco plots were resources that were owned by families and individuals (Pilling 1978:147).

3.3.2 Transportation

3.3.2.1 River- boat

Gibbs (1853 reprinted 1973)
Yurok dugout canoes were traded up and down the coast as far as Cape Mendocino and Port Orford. They were built thick and heavy and designed to withstand the rocky waters of the Klamath River. The stern had a raised step carved into it, which enabled the steersman to stand and remain stable in the boat. The paddle was designed for two purposes, upriver and downriver travel, which could be used alternately as a paddle or a pole to steer the boat. Yurok canoes were uniquely suited for traveling lightly on rapidly moving water (Gibbs 1973:9).

Waterman (1920)
Traveling by canoe on the River was the preferred mode of travel for Yurok. The River was the primary source for travel, communication, trade and commerce. The Yurok were more familiar with their upriver neighbors than they were with their coastal neighbors, such as the Tolowa. Canoe travel onto the open ocean was not common, instead they traveled close to shore to gather

shellfish and coastal resources (Waterman 1920:184). The River was the primary travel corridor and also the source of most food.

Boats were highly regarded in spiritual terms and many taboos were associated with boat etiquette. For instance, if a person was careless in landing his boat, or allowed it to bump into rocks, it was believed he would not live long. Canoes were asked for help in dangerous waters and encouraged to make a safe trip. Songs and formulas were known for keeping a canoe out of danger, especially on the ocean (Waterman 1920:186).

Curtis (1924)
Canoes were made exclusively of redwood logs. Gunwales were undercut on the inside, giving the effect of a rail, and the stern seat was shaped by carving out the log. The traditional Yurok canoe is known as a single ender, or blunt end canoe. It is carved this way because it is more stable on the River, and less likely to tip over. (Curtis 1924:39).

Bearss (1969)
Yurok canoes were designed for the River rather than ocean travel. Yurok would paddle canoes out to sea, but tended to stay close to the coastline and only to travel between coastal villages (Bearss 1969:1) Yurok canoes were dugout canoes made exclusively of redwood. Yurok canoes were symmetrical and carefully finished to enable safe passage on the River and out onto the ocean. Two types of paddles were used to steer a canoe on the River. One was a long pole to be used while standing, and the other was a true canoe paddle, used by the seated helmsman. Yurok canoes varied in length, but the standard length was 18-20 feet. A canoe of any greater length was not considered to be safe or controllable on the River (Bearss 1969:7-8).

Kroeber (1976)
Yurok boats were canoes carved exclusively from redwood. The traditional canoe was carved out of half of a redwood log and was designed specifically for use on the River, being sturdy and stable, with a square prow and wide bottom that allowed for quick pivoting in rapid river currents. Paddles and poles were used to steer and navigate on the River. Canoes were used almost exclusively on the River and rarely taken out on the open ocean. The average length of a Yurok canoe was about 18 feet, and varied considerably in width and thickness (Kroeber 1976:83)

Heffner (1986)
The harvesting of redwood logs for the purposes of making a canoe was highly ceremonial. Great care was taken in selecting a tree for a canoe or for planks to be used to build a ceremonial sweathouse or dance house. The procurement of redwood for ceremonial purposes required specific formulas. Selected redwood logs were then transported down river to be used to build a ceremonial structure at a specific location (Heffner 1986:25-26)

Cunningham (1989)
Yurok canoes were made from fallen redwood and were products of fire technology (Cunningham 1989:49). Fire was used to cut the log to its desired length, and to hollow out the center. The style of dugout canoe made by Yurok is called a "*yutch*". This type of canoe has several features that make it suitable to use on a rapidly moving river. These features include a round belly, rocker bottom, spoon-ended riverine hull without keel, cutwater or sharp ends. This is the most complex dugout canoe found in California. Early accounts of Yurok canoe making documented that such a canoe could be made in several days using iron tools, but prior to European trade tools, it took several months to burn, chisel and carve with stone adzes (Cunningham 1989:58-59).

Ortiz (1991)
Traditional Yurok redwood dugout canoes were made on the Lower Klamath, in the redwood forests and then traded or sold upriver (Ortiz 1991:13)

Yurok dugout canoes were designed for use on the River. They were designed to catch rough water in riffles and rise above it without tipping, staying on top of the water, designed to navigate the Klamath River specifically (Ortiz 1991:13).

All Yurok dugout canoes are considered to have a living spirit. They are carved to reflect the human body, and have eyes, a nose, lings, a heart, a belly, and kidneys. A traditional Yurok canoe has these physical elements in it, reflecting the belief that it is a living being (Ortiz 1991:15).

Beasely and Mount (n.d.)
The traditional Yurok dugout canoe was used to harvest coastal shellfish, salmon, lingcod, seals, sea lions, and sea otter. It was used on the coast, and on the Klamath, Little River, and Redwood Creek estuaries. The Yurok canoe was unique in that it could be used on the ocean as well as on the rapids of the Klamath River.

3.3.2.2 Riverside trails

Waterman (1920)
Trails were extensive throughout Yurok territory often connecting coastal villages and river villages with gathering areas away from the river. Some trails followed the river and provided an alternate route between river villages.

Davis (1963)
Indian trails in Yurok ancestral territory followed the river, and extended uphill to connect with prairies, coastal villages, and ceremonial areas. It appears that many Indian trails are now roads through these same areas first developed as military roads, then postal routes, and later improved roads for wagons, and automobile traffic (Davis 1963:8). Yurok trails were considered to be special places and were often marked with piles of twigs, rocks or arrows at junctions and "resting places (Davis 1963:11). Trails were often routes of exchange as well as ways to visit other villages, particularly if the river was too dangerous for travel (Davis 1963:14).

Beals and Hester (1974)
"Yurok country was intersected by numerous trails, many of them very ancient; but those trails were not nearly as important in commerce and social intercourse as the river" (Beals and Hester 1974:48)

Heffner (1986)
Traditional Yurok trails represent heavily utilized trade routes that enable trade, exchange and visiting between Yurok coastal villages and those along the Klamath River. These trade networks included the exchange of salmon, lamprey and sturgeon caught in the river for shellfish, seaweed, and surf fish caught along the coast. Trails followed the course of the river, from upstream to downstream villages, as well as connecting these villages with upland ceremonial and gathering sites and coastal villages within Yurok lands (Heffner 1986:18-19)

Gates (1995)
Trails served many purposes in Yurok life. They were used to travel and visit between villages along the river and the coast, connecting people with the greater world beyond their village or home. Trails were used for communication, to send messages via messengers, or *wego*, who

could travel the trails quickly. Trails connected villages with gathering areas, such as acorn grounds which were visited and used by people from different villages who would travel to the same gathering sites annually via the trail system. Hunters would talk on the trails to help them succeed in their hunt, and would offer thanks to a trail when the hunt was successful. Trails were natural routes for trade and exchange within Yurok territory and beyond it. Trails had many social and ceremonial aspects for Yurok life. Trails provided an alternate route to travel up and down river when river travel was not possible due to lack of a boat, or flooding (Gates 393-418).

3.3.3 Communication

Gates (personal communication 2003)
Verbal communication between villages and tribes up and down the River were a traditional form of exchanging information, such as during the First Fish Ceremony. Specific locations along the river corridor provided the right acoustics for sending a verbal message, by shouting, to the next message station either up or down the river. This form of communication, "the Indian telephone" relied upon the acoustics of the natural river corridor, with only specific locations capable of projecting the message to the next station.

3.3.4 River morphology

USFW (1999)
Many Yurok stories about the River and the land correlate to geological phenomena that occur in the Lower Klamath. Landslides, earthquakes and other tectonic activities have indeed formed the river as it is today. This natural morphology has been changed by human activity in historic times. Mining and logging activities dramatically impacted the water quality and the watershed in past decades. Likewise, the construction and operation of hydroelectric dams have significantly altered and disrupted the natural flow and physical aspects of the River. Geomorphic studies suggest that the impact of the dams is significant and has radically changed the natural flows within the River. These in turn have impacted fish habitat, and surrounding vegetation and resources, all vital to Yurok culture.

Buckley (2002)
The Klamath River has a history of regular and periodic flood events, some catastrophic. The dynamic processes of the River, floods, slides, and even the occasional earthquake or tsunami have altered the shape and landscape of the River over time (Buckley 2002:213)

3.3.5 Oral History

3.3.5.1 How the River (or associated features) came to be

Curtis (1924)
Yurok believe in the existence of spirit beings, or *wo'ge*, who occupied the earth and prepared it for the Yurok people. These *wo'ge* provided not only the world the Yurok lived in, but also the rules and ceremonies to keep it in order. Three primary characters are identified in Yurok stories, the transformer, who improved the natural features of the land and River, a hero who destroyed, drove out or made harmless the monsters that formerly inhabited the earth, and Coyote, the trickster (Curtis 1924:221).

Gunther (1928)
Yurok tradition tells of the origin of salmon in the story of how they are brought to the people. In this story, the main character is Coyote, who tricks the woman who owns the salmon and liberates

them for the people by breaking the fish dam. This story is relevant to the activities associated with the construction of the annual fish dam at *Kepel* (Gunther 1928:162).

Merriam (1967)
There is a story that tells of the arrival of the *Po-lik'-lah* on the Klamath River at a time when the river was occupied by *wo'ge*. The main village of the *wo'ge* was near *Wokero*. The *wo'ge* were kind to the new people from the north and left the country, promising to return someday (Merriam 1967:171).

Kroeber (1976)
Yurok stories include tales about how the world became to be as it is. One such character in these stories is *Wohpekumeu*, "widower across the ocean" who is said to have been the one to make things as they are. He was born at *Kenek*, where he lived until he left to join the other *wo'ge* who departed from this world. At *Amaikiara*, in Karuk territory, he tricked the woman who kept all the fish and liberated them for the future use of mankind. From the sky, he stole acorns for the people to eat. He pursued women everywhere, and as a result of his activities either created or ruined good fishing places. He also recovered the dentalia, or shell money, horded by his son and released it back to the world (Kroeber 1967:73).

"The world is believed to float on water. At the head of the river in the sky, where the Deerskin Dance (Ceremony) is danced nightly, are a gigantic white coyote and his yellow mate, the parents of all coyotes on earth" (Kroeber 1976:74)

Kroeber (1978)
When the creator, *Wohpekumeu*, first came to the Klamath and Trinity Rivers, he saw that there was no food for the people. There were only two women who had salmon. *Wohpekumeu* took the salmon from the women and let them go into the River. *Wohpekumeu* said the people would never catch the Great Salmon. When the Great Salmon comes up, he will swim in the middle of the river so he isn't caught with the nets. The Immortals (*Woge*) only wanted salmon to go up on one side of the river to make sure they knew where they could get salmon. But they never caught anything so they made it so the salmon would come up both sides. A man from the village of *Welkwau* wanted to learn how to fish at the mouth of the River so he went to *Kowetsek* (the home of the salmon) and asked the headman to show him how to harpoon fish. The headman agreed to show the man from *Welkwau*. When *„Nepwo"* (the Great Fish) came through the mouth of the river, the headman acted as if he was going to spear it. He would make thrusting motions with his spear but not actually spearing it, at the same time, he was praying for more salmon to come up the river. More salmon came up the river. The headman speared some salmon and the man from *Welkwau* saw that he handled the fish in a particular way. The headman explained that if salmon was caught at the mouth, a man was not to use a wooden club to kill it; he was to use a stone to hit it in the head. But upstream from the mouth everyone else would use wooden clubs. If a salmon is caught at the mouth it must be buried with only its tail sticking out. People who use a spear to catch fish at the mouth must practice certain medicine before catching salmon. The lamprey eel was also made at *Kowetsek* and there are certain rules one must follow when catching them at the Mouth. This story tells of how the reverence for fish and creator provided the Yurok not only with abundance of salmon, a place for salmon and people to inhabit (the River), that explains the proper etiquette and moral responsibilities of salmon and people.

Perry (1988)
How Fish Came to be in the River (as told by Florence Shaughnessy, Yurok)

> In the beginning, there was an Indian goddess. They sent her with the first Indians to be settled here. They told her to stock the world with whatever she thought our people were going to need. So they got all kinds of animals- deer, elk, bear, and all the others. Then she took her people down to the beach, and she talked to the god there.
>
> "I have brought the children here because that is going to be their home. This is where they shall live."
>
> "Now" she said, " I will need help, because along the shore here there is food."
>
> And he said, "Yes, there is food, but there shall be proper help at the proper time. The food that is in the ocean is so delicate that it cannot be exposed for hours like the food that goes on land. They are different. You shall have a helper."
>
> And she said, "Who will my helper be?"
>
> "The moon, The moon shall control the tides."
>
> And so it was settled who should control the tides. They put the fish down at the mouth, the sturgeon and every known fish.
>
> And she said, "The sturgeon shall go far, far up the River until he is trapped, but he shall be a strong swimmer. And the salmon, there shall be four kinds of salmon coming in over the year. There shall be different species that survive the winter rains. And steelhead. And there shall be smaller fish that are seasonal, like the candlefish and surfish. And the lamprey eels, they are for variety of the diet."
>
> Then the sea foods were promised. So we got seaweed, seaboots, crabs, mussels, China slippers, clams of all sizes and others.
>
> And so it was that all the fish were named and sent as far as they could go up the river to feel the people all along the way. And the people were to follow and have their own fishing rocks. They were to look for a place with and eddy and claim that rock. Then they would build homes nearby because their food rock would be there, and then they can take care of their families. (Perry 1988:15)

3.3.5.2 Traditional etiquette/river (or associated features) management

(Yurok Culture Committee)
"The Creator placed Yurok people and fish together for reasons of balance and longevity. The Yurok have a responsibility for assuring the fish get up the River. These reasons are codified as Indian Law, first instructions from the Creator to the Yurok People. When the Law is not followed, the balance is not maintained and the fish do not return, the River dries up and the Yurok people dwindle away."

“Traditional Yurok Fishing Law is as follows:

1. Know your family relations. Know where you are related along the river. Know the River and its locations, particularly the village name that your family is from.

2. Not every Yurok family had/has a fishing place right.

3. Every Yurok has a fishing place right through permission.

4. Permission is gained by asking and being granted the right, with terms and conditions.

5. Permission given once is not permission given forever.

6. One standard condition is to offer some fish caught at the place where permission was granted.

7. Some fishing places are “open” and anyone can fish there. They are open on a first-come, first-serve basis. If someone is fishing in an open place then the latercomer informs the first party that they want to fish, and then they politely wait a day unless they have already caught enough fish, then they should make ready to leave. It is polite for the first party to provide some fish to those waiting.

8. No fighting on the River, particularly no fighting over fishing places. The River is a place to show respect.

9. Do not waste fish; do not take more than what is needed. It is not what the River will do for you, it is what you will do for the River.

10. Drift netting can occur anywhere as long as it doesn‟t disturb anyone else‟s fishing place or net set.”

3.3.6 Relations with up or down river neighbors

Curtis (1924)
The name “Yurok” was derived from the name given them by their upriver neighbors, the Karok. To the Karok, they were known as “*Yuruq-arar*” which means, “down stream people” (Curtis 1924:38)

Relations between the Yurok and their neighbors, the Hupa on the Trinity River were known to be friendly. Many aspects of culture, ornamentation, subsistence, and apparel were nearly identical to those of the Hupa (Curtis 1924:39).

The Yurok name for their upriver neighbors, the Koruk was “*Petsikla*”, meaning “up river people”. The Yurok name for the Shasta who lived further upriver beyond the Karuk, was “*Siyaau*” (Curtis 1924:222).

Davis (1963)
One of the primary indicators of trade and exchange both on the River, and up the coast, was the importance of shell money, or dentalia in Yurok society. Yurok men would often have a special tattoo on their forearm for the sole purpose of measuring lengths of dentalium. These shells are

indicative of wide trade and exchange because they originated offshore of Vancouver Island. The use of dentalia as currency on the Klamath River beyond Yurok territory indicates the trade networks along the river were quite extensive (Davis 1963:7).

Other common trade goods exchanged between Yurok and their upriver neighbors, the Karuk and the Shasta included obsidian, coastal shells such as Olivella, clam, mussel and abalone, tobacco seeds, juniper beads, white deerskins, woodpecker scalps, sugar pin nuts, elk antler, baskets, redwood canoes, acorns, salt, and seaweed (Davis 1963:49-50).

Merriam (1967)
The Yurok were self-identified as two groups, the *Ner-er-ner*, or coastal Yurok and the *Po-lik'-lah* or River Yurok (Merriam 196: 167-169).

Perry (1988)
Trade between upriver and downriver Yurok and between River Yurok and Coastal Yurok was a common practice that enabled the exchange of desired food items between localities. Shellfish, seaweed and surf fish from the coast were traded for salmon, sturgeon, and lamprey from the river. Salmon caught and dried near the mouth of the River were sought by upriver Yurok because of the better flavor provided by the extra fat, which the fish lose as they migrate upstream. These patterns of trade and exchange existed prior to European contact, and persist in present day Yurok society (Perry 1988:13).

Buckley (2002)
The name "Yurok" is a recent name derived from the word "down river" by the "up rivers", or the Karuk. The word "*puliklah*" means down river and is a word that is used to identify the Yurok living on the Klamath.

Yurok oral history identifies a time before the world is as it is. In this time, the *wo'gey* lived in Yurok lands. There was a constant struggle to keep the world balanced upon the water. "Knowing that this would be so, before they left the *wo'gey* instructed certain people in what to do to put the world back in balance when the weight of human violations grew too great for it" (Buckley 2002:214).

These instructions are the world renewal ceremonies that are held between villages on ceremonial grounds of Yurok, Karuk and Hupa alike. It is a common culture and a common ceremonial cycle that connect the people along the River in the past, present and future.

3.3.7 River language

Gibbs (1853 reprinted 1973)
The Yurok used no specific name for themselves, but rather identified themselves and each other by the name of their village, which would also distinguish them as "above" or "below". The Klamath River had no special name, but was referred to as "the water" or the "big water" (Gibbs 1973:7).

Curtis (1924)
The name "Yurok" was derived from the name given them by their upriver neighbors, the Karok. To the Karok, they were known as "*Yuruq-arar*" which means, "down stream people" (Curtis 1924:38)

The Yurok name for their upriver neighbors, the Karuk was "*Petsikla*", meaning upstream (Curtis 1924:222)

Kroeber (1976)
Yurok directionality was related to the River as indicated by the use of Yurok terminology. "*Pul*" means downstream; "*pets*" means upstream; "*hiko*" means across the stream; "*won*" means up hill or away from the stream; "*wohpe*" means across the ocean. In terms of English, east means upriver. Features in villages and Yurok houses are described in relationship to the River, for instance, a house would not have its door on the western corner, but rather the downriver corner. Right and left are directions that are designated by their person"s relation to the River, either upstream or downstream. At the confluence with the Trinity River, the Trinity is considered to by up a side stream, while the Klamath continues upstream (Kroeber 1976:15).

4. Contemporary Yurok Views of the River

4.0 Interviews with six Yurok elders.

4.1 Desmond "Merkie" Oliver

Merkie Oliver was born in the Yurok village of *Rekwoi* (Requa) in 1929. He was raised in Yurok Indian culture "dancing and fishing". Culture is his whole life. He got through by fishing and trading. He has fished for many different types of fish in the River: salmon, steelhead, perch, bull head, suckers, and candlefish. Merkie was always around the River. His father and uncles all guided tours. Merkie also spent a good part of his life guiding tours for recreational fishers, hook and line fishers. River resources were never wasted; everything they caught was brought home and used. During the depression, and the World Wars, and during the relocation era, subsistence fishing on the River maintained the Yurok way of life and provided food for Yurok people.

Salmon run in the spring and fall. Steelhead runs in the summer and winter. Sturgeon run once a year. Merkie attributes some of the decline in fish populations to over fishing in the open ocean. Trolling boats are allowed to catch as many fish as they can take without a limit. The decision to ban the 40 miles trolling nets has had a beneficial impact on the salmon, resulting in larger runs and bigger fish in the River.

Candlefish (eulachon) used to be a major fish species in the River. There used to be millions that come up the River. Merkie recounts that the last good run of candlefish happened in 1986. Since then a few trickle through between December and February. He is not sure what has caused the decline in the Candlefish population. They used to catch them in dip nets and they would haul in a full catch. In 1996, he reported seeing only two candlefish.

Eel populations appear to be declining. The conditions at the mouth of the River are part of the problem. The River flow is not what it used to be and as a result, the current is not good enough. Perhaps the eels now migrate by traveling up the center of the River channel. Eel hooks were the traditional means for catching eels in the River. Each eel hook has a name, and they are decorated with special designs. Merkie started eeling when he was 6 or 7 years old. At that time the mouth of the River was very narrow. Merkie commented that eels would migrate up river and often got up inside the turbines of the dams. He stated that eels were poisoned in the reservoirs to keep them out of the turbines. Eel hooks are specialized equipment for a special use, catching eels, he commented that they are not the same as a gaff or snag hook. Eel hooks are used for one purpose

and need to be appreciated as such. Eels were not caught in the summertime because they were wormy. “When you see the *Perna-keesh* coming down the River, don‘t eat eels”.

The BIA attempted to regulate eeling on the River and start up commercial eeling. Merkie said that selling eels is okay, the Yurok have always traded and bartered. But commercial eeling is not the same; many Yurok do not want it. Once eeling is commercial, rules and regulations follow. The cultural rights of Yurok to harvest resources needs to be protected to allow for traditional fishing and eeling on the River. The BIA has previously closed theRriver for months, and banned the use of eel hooks and even dip nets. Merkie defied this ban and went to the River and caught 4 fish with an eel hook. The BIA came and cited him for it. At the same time tourists were allowed to keep fishing. Merkie stated that all of his life, he is a fisherman. “Fishing is a god-given right”. Yurok subsistence fishing is a way of life, a god-given right, and should not have imposed rules and regulations for using an eel hook or a gill net. Fishing is a means of Yurok survival before government commodities and social security. “Who has the right?” “Whose reservation is it?”

4.2 Walt McCovey, Jr.

Walt was born at Haa-wok on the Klamath River in July 1931. He lived on the River most of his life. His father was a commercial fisherman. Commercial fishing on the river was banned when he was about 2 or 3, but his family kept on fishing. “Fishing is a tribal resource. If we don‘t utilize the resource someone else will”. In the 1970s Walt became involved in the Indian fishing rights issue. He wanted to fish to make a living and to exercise his rights as a Yurok Indian. Commercial fishing was a way of life for the old people. Indians continued to fish, even after it was banned, often coming up river to do it.

Fish runs on theRiver included winter steelhead, springer, summer and winter salmon. Many of the salmon spawned in the creeks feeding into the Klamath. He remembers the creeks had a lot of fish in them. He recalled fishing in the creeks when he was around 6-7 years old. Now the creeks are silted in, full of gravel piling up at the mouths, just like cement. Winter salmon used to run in November, December, and January. These runs have disappeared.

The River used to have high winter flows. People would move around in the winter. The River would rise 40-50 feet every year in peak flows. Walt recalls high water and flood events in 1955, 1964, and 1974. High water events removed silt and sediments and large woody debris from the river. Now the flows are not high enough to float out the big logs over the riffles or clear out the gravel and sediments that pile up at the mouths of the creeks. The construction of dams on the Klamath and the Trinity Rivers had a big impact on the River and its annual flow. Walt stated that a significant decline in fish population was evident after the construction of the dams.

The traditional fishing season ran from summer to fall. Fish were harvested and prepared for storage to be used in the winter months. Salmon ran in the spring, but it was dangerous to fish for them because of the high water. When commercial fisheries and canneries were opened near the mouth of the river, many Yurok worked as fishermen and in the canneries. People working in the commercial fisheries and canneries made good money, but it was cut off in the 1930s. Then fishing was banned on the River until the 1970s. Old people told Walt during that time that Indians were supposed to have net and commercial fishing rights. Indian people continued to fish on the River, even though it was illegal.

When the mulberry bush blooms, there is supposed to be sturgeon in the River. When the dogwood blooms there is spring salmon in the River and it is the end of eel season.

The primary species caught in the River were eels, suckers, catfish, bullheads, and candlefish in addition to steelhead and salmon.

Candlefish (eulachon). There used to be a lot of candlefish in the River. They were caught in dip nets. In the late 1970s surrounding forests were heavily sprayed and Walt attributes the decline in the candlefish population to this activity.

Sturgeon. Two types of sturgeon were caught in the Klamath River, Green sturgeon and White sturgeon. The White has gray colored skin and a pointed snout. The Green sturgeon has green skin and is better for eating. Sturgeon run in mid-December, but not in the summer. Sturgeon would break a trigger net because they were so strong. Walt guessed they must have used older style nets for catching sturgeon.

Eels. Catching eels required intense concentration on the water. "If you're not thinking eel, you won't get one". Eels were caught with an eel hook, made of madrone or oak, with a hook and notch on the end. Dip nets were also used for catching eels, but would easily escape from the net.

The mouth of the River changes because it is supposed to be a lady. She takes a position for a while, and when she gets tired, she changes position and moves her legs. The two rocks at the mouth are sentinels. The one on the upper side (north) is *Or egos* (Tucker Rock). It looks like a woman carrying a burden basket.

"Tribes fight for fishing rights to make a living. One time people fished for subsistence. Not all people are fishing people. I was always a fisherman. Once you have your rights, you don't have to beg to have a fishing season each year".

"The River is the lifeline of the Indian people. We depend on the fish, depend on eels, sturgeon. In his lifetime, as an Indian person, going to school, come out to our freedom. River is medicine to him. He can feel lousy as hell and go out on the River and come back feeling good. Gives strength, knowing this is mine; this is where I live, where I'm born. This is where my roots are."

4.3 Glenn Moore, Sr.

Glenn is from the Yurok village of Sregon on the Klamath River. Glenn fished at Moore's Rock on the River ever since he can remember. When the River was high, they fished off a small rock near where they lived. His parents fished in other spots along the River, but he always fished at the same spot. Glenn recalls that the basic foods for Yurok were salmon and acorns. As long as the River provided a good run of salmon, there was enough food for the people.

"Most Indian people had fishing spots. They have a right to fish, sometimes it's handed down through relations. You can give a fishing place to someone else". Agreements for fishing places were not made in writing, but were all verbal. The person giving would let it be known that the person could fish there. The owner of a fishing place could grant permission to others, families and others, to fish there. People were allowed to use the fishing hole of someone else as long as they offered it to you."

Traditional Yurok fishing is the best way to manage fishing on the River. "Tradition gives people the right to do things. They can say this is what we've done for years and years. Tracing back generations and generations, this is what makes us strong culturally. Hold onto the old ways. Stick with family fishing holes".

Glenn recalled camping near the mouth in 1932-33 on a family fishing trip at Safford Island. The camped on the Island between August and September. Some people fished all night and then took their fish to the cannery. When the commercial fishing season was over, they would pack up and move back up river where they would fish for themselves. They would catch enough fish to last until the next season. Fish were smoked like jerky. So were eels. They were stored near the stove to keep them dry through the winter months. Glenn remembers their smokehouse was always full.

4.4 Billy Wilson

Billy was born at Martin‟s Ferry along the Klamath River. He remembers fishing every summer on the River at his grandfather‟s fishing place. His grandfather was Ben Billy. That is their fishing hole. They would catch sturgeon, salmon, ells, and steelhead. They would build a scaffold and set trigger nets to fish. When the gill net came along, this made fishing easier. He recalls the nets were made by hand. Old timers sat and rolled Iris fibers on their legs to make the cords used to make a net.

“The River is part of life. No river, no life. God put it there for us, the people, to use. If people don‟t use it right, it‟s gone. It was a place for everyone. The River is there to supply food to the people who need it. We wouldn‟t be here without the River. I don‟t know how they figure the are going to get the water back [in the river system]. Who has the water? It is natural to have high water in the winter. I can‟t see anything bad about it. It is an act of nature”.

“Fish came to visit you. If you don‟t treat them right, they won‟t come visit you anymore. If you catch them at the wrong time. If the sturgeon goes up and you miss it, when it comes back down, if you catch it, you let it go”.

Fishing is part of Yurok culture. Indian people used fish for food and for trade or sale. When they needed money, they could sell their fish. Indian people have always had the right to fish.

Eels. Billy never noticed if there were two annual runs of eels. He recalled eels came up river once a year. Old Indians would eat eels until after the first of the year. Eels were caught in nets during the same time as the spring salmon run. Eels, sturgeon and salmon all began their annual runs after the first of the year. Eels declined after they started poisoning the eels in the dams because they got inside the turbines. Dead eels would float down the River because they had been poisoned. Billy said there are not many eels that come up the River anymore.

Salmon. Spring salmon are the best tasting fish. The have better flavor. High water did not make the salmon more difficult to catch up river. The low water is keeping the fish out of the creeks now. The fish can‟t get into the creeks anymore. They want to get in there. Billy believes that the declining salmon population is due to the hatcheries. Too many fish in the estuary are stripping the habitat so that the native salmon cannot survive. Dams on the River also hurt the fish. If there is not enough water in the River, the fish will die.

Candlefish: Billy does not recall catching candlefish up River. He remembers going to the mouth to dip net for them. They did not go fishing for candlefish very often, but when they did would bring a lot back.

4.5 Aileen Figueroa

Aileen was born in 1912 in Klamath. She remembers gathering along the River for huckleberry, sallal berry, and willow. Willow was used to make eeling baskets. She also recalled her

grandfather raising Indian tobacco down on the river bar. Mint tea used to be gathered on the river bar, but it does not grow there anymore.

4.6 Fawn Morris

Fawn was born on the south side of the River, near the mouth at *TsekweL* and grew up on the beach and on the River. She traveled with her brothers and learned to fish, trap, duck hunt, and even eel. She also commercial fished when they reopened the cannery at Requa. She remembers always fishing at night. She remembers catching eels, salmon, candlefish, and sturgeon.

Eels. Eels were caught in the winter months and at nighttime. She does not remember eeling during the day. They would take gas lanterns over the water so they could see the eels reflecting in the water. Winter eels were the best. They would be split, flattened, and then smoked or baked in an oven.

Sturgeon. Fawn recalls catching sturgeon at the mouth of the River. She remembers when they were endangered and they were not allowed to catch them.

Candlefish. Fawn recalls that these fish ran in the summertime. They used dip nets and would catch a lot in a short time. The candlefish died out in the 1970s.

Salmon. Spring salmon run in May and June. The run does not last long and they are hard to catch at the mouth. She remembers using the gill net to catch salmon and seeing her parents use dip nets to catch them. Spring salmon are best because they are better tasting.

The River. The River at the mouth is always changing. There are two sisters who guard the mouth of the River. When one gets tired, one can stretch her legs. That is why the mouth of the River moves from side to side over time. The mouth of the River has closed in over time. When they put riprap in on the north bank, it filled in even more. Water flows in the River are no longer natural and it contributes to the problem.

Dams. The dams have changed the River. The River has cut a deeper bed and is no longer a natural channel. The natural flow of the River has been stopped by the dams. Not enough water flows through anymore, and the water has no strength. It is shallow.

"The River is our life. Our life revolved around the River. For our own subsistence, our own person, later for business, kept our families for year round. We depended on the River for survival. Without the River, you don't have the fish. The River needs to be taken care of".

5. Conclusion

For the Tribes of the Klamath River Basin it is difficult to discuss the traditional and contemporary culture in two distinct life ways. Instead Tribal presence throughout the Klamath River Basin is a continuum running from time immemorial into the future generations yet to come. While this continuum can be marked by periods of change (creator, *woge*, culture heroes, oral tradition of prehistory, oral tradition of proto history, oral and written 20th century history, and 21st century contemporary occurrences.) the basic relationship remains the same: Tribes of the Klamath River Basin rely on the fishery, and tribes and anadromous fish rely on a healthy riverine ecosystem that includes as a necessary requirement adequate flows of high quality water.

The relationship between indigenous people, fish, and rivers with water is fundamentally a cultural relationship. The cultural relationship encompasses all other ways of defining the relationship and thus includes relationships of economics, politics, ecology and environment, and religion. In addition archeological or historical perspective for understanding cultures, while yielding important information, are limited in scope by the requirements of objectivity, evidence and a chronological ordering that may be radically different than that of the cultures to be understood. The River is of such great importance that there is no particular unique word that names the river. Instead, the River is named as „river". Yurok words for „river" are *„la yoh"*, *„ra yoy"*, and are translated „to run" or to „run past" in reference to a liquid. An additional word for river *„?ume?wo"* associated the River with the fish dams that were placed across them. A common euphemism exists among the Yurok people that speaks to human manipulation of water flows. When a particular rock lying at the bottom of water is revealed because of decreased water flows, this revealing signifies the end of the Yurok World.

Yurok interaction and emulation of the environment is a spiritual - ceremonial activity. More than environmental management, for Yurok interaction and emulation are a religious right. This is important for linking Native American environmental practices to additional laws, regulations, policy orders, and policy that acknowledge Native American religious rights (American Indian Religious Freedom Act 1978, Executive Order 13007).

Oral traditions, the spoken word that links people, cultural practices and place are critical to understanding the environment from the perspective of the Yurok and other Klamath River Tribes. The Klamath River as a cultural environment important to indigenous people is more than a collection of individual historic properties or sites. Instead it is the whole of the River considered as a single entity that best frames the meanings and relationships between Indigenous people, fish and water. It is clear from Yurok oral history that the River is such an integral part of the Yurok way of life that without it the traditions of the Yurok people would be perceived in a radically different perspective. Practically every function of the Yurok way of life is associated to the River: The origination of fish, proper methods for taking fish, how the River is to flow, death passage ceremonies, locations for fish dams and ceremonies all reflect the bond between the River and the Yurok people. It is essential that the River be maintained at a level that provides relevance to the young Yurok mind that hears these stories.

The condition of the Klamath River, it's health and quality, is of grave concern to Yurok people. Healthy habitat, adequate and high quality water flows, sustainable and abundant fish populations are of critical importance to Yurok culture. This concern is due to dependence on the River for all aspects of Yurok life, the directives handed to the People by the Creator as Indian Law, and a responsibility for good stewardship of the River and the resources it provides. The role and significance of the River in Yurok life and ceremony, from birth to death, cannot be overstated. The River is the bond that unifies Yurok culture. It is also the bond that unites Yurok with their upriver neighbors in a common life way that has persisted through time.

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DIVISION OF FISH AND GAME OF CALIFORNIA

FISH BULLETIN No. 34

Salmon of the Klamath River California

I. The Salmon and the Fishery of Klamath River
II. A Report on the 1930 Catch of King Salmon in Klamath River

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I

THE SALMON AND THE FISHERY OF KLAMATH RIVER

THE SALMON AND THE FISHERY OF KLAMATH RIVER

INTRODUCTION

The present paper is a digest of the work accomplished in a salmon investigation* conducted under the authority of the Bureau of Commercial Fisheries of the California Division of Fish and Game. Active work was begun in 1919, and is still in progress. At the outset the investigation was so planned as to contribute as directly as possible to the solution of certain questions relating to the 'conservation of the fishery. The work has progressed in a fairly satisfactory way in some directions as will appear, while in others the results are not so good. The information now most needed relates to the seaward migration of young salmon, and to the relative contribution of natural and artificial propagation to the population of the river.

It may seem that the matter of depletion is overstressed in this report, since its progress has been evident for years. A condition of increasing depletion was not sufficiently evident on the Klamath however, to be convincing to those most interested. In fact, opinions to the contrary were commonly held, some asserting that the "run" was not only maintaining itself but that it was gradually building up. There is very little exact information concerning fishing operations on Klamath River previous to 1912, and no really dependable statistics are available relating to the catch before that time. During the period of placer mining on the river, large numbers of salmon were speared or otherwise captured on or near their spawning beds, and if credence is given to the reports of old miners, there then appeared the first and perhaps major cause of early depletion. In 1912 three plants operated on or near the estuary and the river was heavily fished, no limit being placed on the activities of anyone. A resume of commercial fishing near the mouth or the river appears on page 88.

In the collection of statistical data relating to the ocean catch of salmon, the state authorities have not been able to separate the different species. Four occur in the state, but only two species are of commercial importance-the king salmon, or chinook, and the silver salmon or coho; hence all statistics relating to ocean fishing include both of these fishes in unknown proportions, the king salmon certainly predominating in a large measure.

Commercial fishing is now confined to the lower part of the estuary of Klamath River, partly as a matter of convenience and partly because of legal restrictions. Formerly nets were used at certain places as far up stream as Blue Creek, and occasionally beyond. Advantage was taken of slack water below the swift riffles, and much work was done at Ferry Drift and at Hollow Tree Drift. (Fig 6.) An official tide limit, above which fishing was illegal, was first fixed at the mouth of McGarvey Creek. Later it was moved down stream at the point where the highway bridge stands. Salmon are caught by means of drifting gill nets, which are laid out across the river mostly between the lowermost island

* Salmon considered in this report are of the genus *Oncorhynchus,* but principally *tschawytscha* and *kisutch.*

and a safe distance from the jaws. It is the habit of the fishermen to start the layout at a signal from the cannery whistle, usually about eight o'clock in the evening. The nets are laid from the decked stern of a large rowboat, one man at the oars and another at the net. Occasionally a skilful man manages both boat and net. Layouts are accomplished simultaneously from both sides of the river, the nets thus interdigitating across the stream. After the layout the nets drift with the current until recovered. The fisherman passes slowly from end to end of his net removing the entangled fish, evidence of which is apparent from the movements of the corks. Often the fishing is over in a short time, and in rare cases the fish become entangled so rapidly that no time is lost in bringing in both net and fish. Too often however, drift after drift is made with poor success.

Occasionally a large sturgeon runs afoul of the nets, harbor seals have been caught, while small sharks, skates, and almost any fish of small size may become entangled. The capture of some steelheads can not be avoided.

The number of fishermen varies somewhat from year to year, and also during the season, more boats operating after the migration is well on, some fishermen being perfectly willing to allow others to do the prospecting and preliminary exploring when fish may be scarce, and hidden snags not definitely located. Fishing is not usually accompanied with success when there is a bright moon overhead.

The actual fishing and the work in the cannery is to a considerable extent in the hands of Indians who are the descendants of members of the small aboriginal tribes which inhabited the region. Salmon have always furnished a great part of their food, and they have come to depend pretty largely upon the money earned during the fishing season for the few necessities of a simple life. They are skilled in the production of artistic baskets, and formerly, dugout canoes of large size and fine proportions were made by them. Some of these were beautifully carved. The lore of these people is replete with legends relating to the things about them. They were greatly restricted in their geographic outlook, but they seem to have been closely acquainted with every detail of their own land, They were essentially nature worshipers, and the fishes, reptiles, birds and mammals were adopted into intimate spiritual companionship.

The estuary of the river contributes in no small degree to the scenic beauty of the immediate region, and although it is not pertinent here, one finds it difficult to refrain from launching into an attempted description of the beauty of the entire river basin. From mouth to source the course of the stream offers a panorama of unending grandeur, and an incomparable assemblage of mountains and forests and great open spaces.

In connection with this work, invaluable aid was rendered at times by temporary assistants in the laboratory and field. Among these the following deserve particular mention : Messrs. W. L. Scofield, E. C. McGregor, C. D. Duncan, Paul Bonnot, E. C. Scofield, G. H. Clark, and R. P. Hayes. The study would have been impossible without the friendly cooperation of dealers and fishermen, and of officials of the Bureau of Fish Culture and the Bureau of Patrol. Mr. E. V. Cassell, Superintendent of the Fall Creek Hatchery aided in the marking experi-

ments. At the mouth of the Klamath, the writer and his assistants were granted every possible courtesy by Mr. George R. Field who was in charge of the plant of the Klamath Packers Association, and later by Mrs. Field. Finally, the writer wishes to express his obligations to Mr. Norman B. Scofield, Chief of the Bureau of Commercial Fisheries of the California Division of Fish and Game, and a pioneer in salmon investigation, for constant and valuable aid in the work.

GENERAL CHARACTERISTICS OF KLAMATH RIVER SALMON

The salmon of Klamath River, which at present is of chief commercial importance is the king salmon, *Oncorhychus tschawytscha* (Walbaum). It is a species of wide distribution, extending from the region of Monterey Bay northward to Alaska, and across to the Asiatic coast and Japan. Occasional wanderers are taken along the cost of the southern part of California.

In this State it enters the larger streams to spawn, the Sacramento, Eel, Klamath and Smith rivers having migrations of commercial importance. Individuals sometimes enter the smaller streams, and experiments in artificial propagation have demonstrated the possibility of at least temporarily establishing the species in a small creek where the water is cool and the mouth open to the sea.

It is well known that all the species of salmon are anadromous. They enter the coastal streams to spawn, migrate even to the small tributaries, lay their eggs in the gravel and then die, none returning to the sea from whence they came. The young which appear shortly afterward, remain for a time in the stream and then pass out into the ocean where they rapidly grow, and eventually approach maturity.

The actual contribution of the river to the entire salmon catch of the State is not known, nor can it be known, for the reason that the Klamath salmon migrate southward to Monterey Bay and enter the ocean catch from there, as well as from other fishing points to the northward.

A graph, figure 1, representing the entire yearly catch of the State, together with that of Klamath and Sacramento rivers, is presented. From this it will be seen that in the years immediately before and following 1918, the Sacramento contributed largely, and the Klamath rather meagerly, while lately the Klamath compares more favorably through shrinkage of the Sacramento. The fishery of the Klamath is particularly important, however, because of the possibility of maintaining it, while that of the Sacramento probably is doomed to even greater depletion than now appears, on account of commercialization of the river, the damming of its tributaries, irrigation of its valley, pollution, and the introduction of competitive species.

There are current among fishermen and dealers, statements relating to differences which may be seen between king salmon of the Klamath and Sacramento rivers. Most of the alleged differences disappear upon close comparison of examples from the two streams, There are, however, important anatomical differences as was discovered by N. B. Scofield while making a study of salmon in 1900. A detailed examination of these differences was made by E. A. McGregor at a later date.

The Klamath fish have been described by some observers as smaller, more rounded and somewhat heavier in proportion to the length, while

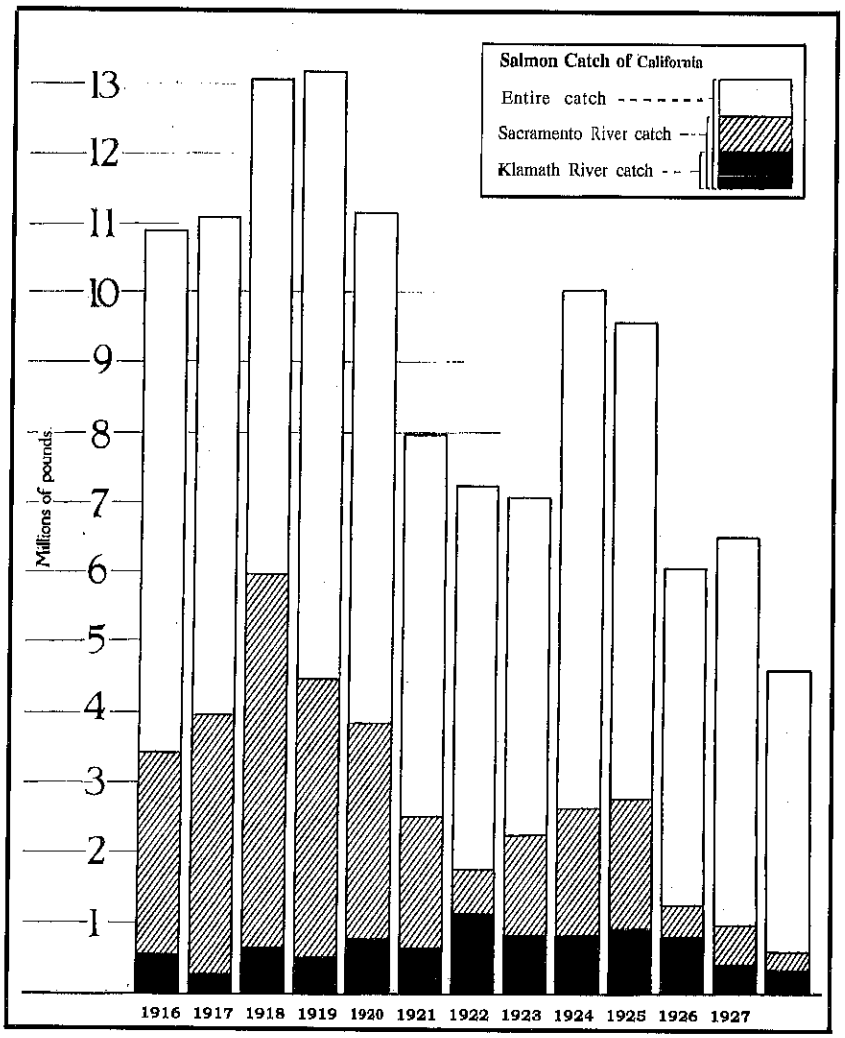

FIG. 1.

the same characteristics, except length, have been ascribed by other persons to Sacramento fish. All agree that Sacramento fish are larger, and this is well illustrated when series of fishes of the same age class are compared. For example, four-year Klamath fish are much smaller than four-year Sacramento River fish as demonstrated in table 1. (Fig. 22.)

In the matter of weight in relation to length, there appears to be very little or no difference. Tables, which after a fashion express the relations between length and weight are presented. In the preparation of these an average weight was computed for twenty examples of a given length and sex class, when as many as that number were available.

As previously stated, N. B. Scofield found that Klamath salmon differ from Sacramento River salmon in having more gill rakers on the

TABLE 1

Illustrating the Relative Lengths of Four-Year-Old Salmon from the Klamath and Sacramento Rivers, and from Monterey Bay

Length in cm.	Number of individuals in each length group		
	Monterey Bay	Sacramento River	Klamath River
58	2		
59	2		
60	1		
61	3		1
62	5		2
63	6		3
64	7		3
65	11		4
66	14		13
67	21	1	13
68	18		24
69	23	1	33
70	34		45
71	55	6	74
72	63	3	80
73	66	5	97
74	69	3	137
75	73	4	161
76	80	7	196
77	81	1	235
78	101	10	291
79	92	10	300
80	106	10	287
81	103	14	300
82	130	18	236
83	110	23	262
84	106	15	202
85	94	20	146
86	112	26	155
87	100	19	114
88	106	28	112
89	93	28	86
90	72	20	64
91	68	35	50
92	68	45	44
93	84	33	30
94	77	41	29
95	57	39	22
96	74	45	15
97	62	32	13
98	60	36	12
99	54	40	12
100	40	33	5
101	32	16	1
102	30	19	1
103	15	20	1
104	15	20	2
105	16	14	
106	6	14	
107	3	6	
108	3	8	
109	3	7	
110	3	6	
111		7	
112	1	5	
113		1	
114		1	
115		1	
116		1	
117		1	
118			
119			
120		1	
Totals	2,730	798	3,913

TABLE 2

Length-Weight Relation-Klamath River Fish

Length of fish in cm.	Average weight 20 males recorded in pounds and tenths	Average weight 20 females recorded in pounds and tenths	Extreme weights males recorded in pounds and ounces	Extreme weights females recorded in pounds and ounces
40	2.0		2-00 to 2-00	
42	2.3		2- 0to 2- 8	
44	2 5		2- 2 to 2-14	
46	2.7		2- 6to 3-00	
48	3.3		3- 0to 3-12	
50	3.7		3- 4to 4-10	
52	3.9		3- 1 to 4- 4	
54	4.4		4 -2 to 5- 0	
56	4.9		4- 0to 8- 4	
58	5.8	6 0	5-4to 6-14	
60	6.5	6.4	5-10 to 8-12	
62	7.0	6.8	6-10 to 10- 4	6- 1 to 7- 2
64	8.0	7.8	7- 8 to 9- 4	7- 4 to 8- 8
66	8 4	8.6	7-12 to 9- 4	8 -0 to 10- 8
68	9 4	9.0	8- 4 to 10- 2	8- 0to 10- 0
70	10.6	10.0	10- 0to 12- 8	9- 0 to 10-12
72	11.0	10.7	10- 0 to 12- 4	9-10 to 12- 0
74	11.6	11.4	10- 4 to 13-12	10- 0to 12- 6
76	12.6	12.5	12- 0 to 14- 2	10-14 to 13-12
78	13.6	13.8	12- 8 to 15- 0	12- 0 to 15- 0
80	14 2	14 7	14- 0to 16- 2	13- 0to 17- 8
82	16.1	15 4	15 0 to 18-10	13- 8 to 16-12
84	16.6	16.8	15 6 to 17-14	15-12to 18- 6
86	18 0	18 0	17- 0 to 19-14	17- 0to 21- 8
88	18 9	19 0	17- 0 to 21- 4	16- 0to 21- 8
90	20 8	19 7	18- 2to 22- 4	18-12 to 23- 0
92	22 5	22 4	20- 2to 26 -8	19-10 to 24- 4
94	24 1	23 3	22- 4to 28- 4	20- 0 to 29- 0
96	24 9	24 2	16-14 to 28- 8	18- 0 to 27-10
98	26 8	26 9	21-14 to 30- 4	24-12 to 32- 0
100	28 8	28 5	23- 8 to 36- 0	28- 0 to 32- 0
102	29 9	31 0	27- 4 to 34-10	26-12 to 34- 0
104	31 6	31 4	27- 4to 35- 2	26- 6 to 36-12
106	33 8	34.8	28- 8 to 37-10	34- 4 to 36- 0
108	34 9		32- 8 to 38- 6	
110	38.9		34- 8 to 43- 8	

first arch, and fewer pyloric caeca. It was later learned that a considerable difference exists in the number of eggs produced by the individual, the Klamath salmon having smaller ovaries.

At the writer's suggestion, the data obtained by field observers of the Fish and Game Commission were reported on by E. A. McGregor in California Fish and Game (Vol. 9, No. 4, pp. 134-150, 1923). McGregor not only confirmed the previously made observations of Scofield, but he also found that Sacramento River fish have fewer vertebrae. The following table 4, taken from McGregor's paper, summarizes these differences.

The distinctive characters here found would be regarded by systemists as subspecific, and they are just such differences as characterize geographic races.

No data are at hand to enable one to make a comparison between these forms and the king salmon of the rivers to the northward, nor can any statement be made at this time regarding characteristics which king salmon from Eel and Mad rivers may possess.

While it is possible to distinguish between king salmon from the Sacramento and Klamath rivers, any attempt at the present time to determine the relative number of either in an ocean catch must be regarded as premature at least, for the very simple reasons that we have

TABLE 3

Length-Weight Relation Sacramento River Fish 1919

Length of fish in cm.	Average weight 20 males recorded in pounds and tenths	average weight 20 females recorded in pounds and tenths	Extreme weights males recorded in pounds and ounces	Extreme weights females recorded in pounds and ounces
68	9.4		8-12 to 9-14	
70	10.0		9- 4 to 10-12	
72	10.8		9-10 to 11- 6	
74	11.0	12.0	10- 2 to 12-12	11- 2 to 13- 0
76	12.0	13.0	11- 8 to 13- 2	10-12 to 14- 2
78	13 2	14.1	11-14 to 15- 0	12-10 to 16- 4
80	14.0	15.1	12- 6 to 15- 6	13-12 to 16-10
82	15.2	16.8	14-10 to 17- 6	15- 8 to 17- 2
84	16.8	17.0	15- 2 to 18-12	15-10 to 18- 8
86	18.6	18.0	16-10 to 20- 2	16- 8 to 20- 8
88	19.7	19.6	16-14 to 27-14	17-12 to 22- 8
90	20.2	20.2	18- 0 to 21- 6	15-10 to 29-10
92	21.9	21.3	20- 6 to 23-10	20- 4 to 23- 6
94	23.0	23.3	22- 6 to 26-14	21-10 to 25-12
96	24 6	24.7	22- 4 to 26-14	21- 8 to 27- 0
98	26.5	26.5	23- 0 to 28-14	23-14 to 31- 8
100	28.2	28.0	25-10 to 31- 6	24- 8 to 33- 4
102	30.1	30.0	28- 8 to 31- 8	22- 2 to 32-14
104	32.0	31.1	27- 8 to 35- 0	23-14 to 35-12
106	34.2	32.1	30- 0 to 38- 2	23- 8 to 35-10
108	36.6	34.0	31- 6 to 41- 2	25- 2 to 41- 4
110	38.3	37.0	33-12 to 44- 4	30- 6 to 44- 4
112	40.1	41.0	34-14 to 45- 0	35-14 to 48-14
114	42.6		37- 8 to 48-12	
116	44.8		40- 4 to 49- 8	
118	46.0		40- 4 to 53- 6	
120	49.a		46- 4 to 50-10	

TABLE 4

	Klamath River		Sacramento River	
	Range	Mean	Range	Mean
Nnmber of Eggs	1,718 to 4,977	3760.0	4,795 to 11,012	7453.0
Number of caeca	93 to 193	132.2	134 to 214	176.4
Numher of gill rakers	24 to 30	24.7	21 to 35	23.5
Number of vertebrae	66 to 68	67.0	62 to 65	63.8

little knowledge of the migration of salmon at sea, and we know almost nothing of any racial traits which may characterize salmon from the rivers entering the ocean to the northward of the Klamath. As information relating to the movements of salmon at sea slowly accumulates it becomes increasingly evident that their migrations are often very extensive, and hence the marine catch in any locality may contain fish which are natives of far distant streams. The notion, once common, that salmon do not in their ocean life move far from the stream in which they were hatched has been abandoned in so far as concerns California fish at least.

As occasion offered, certain anatomical characters of Klamath River salmon useful in the discrimination of species were examined. The results are here presented in tabular form.

TABLE 5

Scales

Scales ub katerakserues	130	131	132	133	134	135	136	137	138	139
Number of speciments	4	6	9	14	9	11	13	8	10	10

Scales

Scales in lateral series	140	141	142	143	144	145	146	147	148
Number of speciments	12	6	7	5	3	4	1	2	1

Scales

Scales Numbercrofspc&mens [illegible] bdore dorsal	55	56	57	58	59	60	61	62	63	64	65	66	67
5:	4	6	6	12	17	14	21	12	13	8	5	5	2

Scales

Scales above lateral line	25	26	27	28	29	30	31	32
Number of specimens	2	7	10	15	38	32	25	6

Fin Rays

Dorsal rays	10	11	12	13	Anal rays	13	14	15	16
Number of specimens	4	82	46	3	Number of specimens	2	35	81	17

Gill Rakers

Number of gill rakers	9–15	10–13	10–15	10–16	10–17	11–14	11–15	11–16	11–17	12–12
Number of specimens	2	1	5	1	2	13	14	12	1	1

Gill Rakers

Number of gill rakers	12–13	12–14	12–15	12–16	12–17	13–14	13–15	13–16	14–15
Number of specimens	1	31	21	11	5	3	6	4	1

Gill Rakers

Number of gill rakers on both sides of arch	23	24	25	26	27	28	29
Number of specimens	1	2	15	43	33	17	9

Branchiostegals

Number of branchiostegals	13	14	15	16	17	18
Number of specimens	3	11	31	55	17	3

TABLE 5-Continued

Individual Characters of 30 Klamath River Salmon

Scales before dorsal	Scales in lateral series	cales above lateral line	Number dorsal rays	Number anal rays	Number branchiostegals	Number of gill rakers
62	136	28	11	14	18	11-15
59	134	29	11	14	16	12-14
55	131	30	12	15	17	11-16
55	137	29	11	14	15	11-15
57	136	29	11	15	16	12-15
58	136	31	11	16	14	11-14
59	132	29	11	14	15	10-13
61	133	28	12	15	14	13-15
56	135	31	11	15	17	13-14
60	144	30	12	15	15	13-16
59	135	29	11	15	15	12-16
66	142	29	12	15	14	12-14
59	136	26	11	14	16	11-14
54	132	26	11	15	17	12-14
65	140	29	11	14	16	12-14
60	135	29	12	15	15	12-15
60	133	31	11	14	16	13-15
61	135	29	12	15	17	12-14
60	139	29	12	15	16	12-16
61	145	29	12	16	16	12-16
61	139	30	11	16	15	12-15
64	142	29	12	15	15	13-16
61	134	29	11	14	16	12-15
60	147	28	12	15	16	12-14
62	139	29	11	15	16	12-14
60	136	29	11	15	15	13-13
61	137	29	11	15	16	12-14
58	139	29	10	15	16	12-14
55	133	29	11	14	16	12-15
66	145	28	11	13	16	12-14

TABLE 6

Silver Salmon in the Klamath River Catch

Date	Number	Weight
September 20, 1919	1,000	6,950
September 22, 1919	618	4,326
September 23, 1919	660	4,620
September 24, 1919	1,059	7,413
September 25, 1919	783	5,481
September 26, 1919	250	1,584
September 27, 1919	287	2,103
September 29, 1919	559	4,063
September 30, 1919	163	1,248
	5,379	37,788
October 1, 1919	47	376
October 2, 1919	151	1,253
October 3, 1919	111	852
October 4, 1919	82	685
October 6, 1919	679	5,100
October 7, 1919	567	4,371
October 8, 1919	800	6,138
October 9, 1919	743	5,795
October 10, 1919	183	1,430
October 13, 1919	328	2,500
October 14, 1919	239	2,031
October 15, 1919	514	4,145
October 16, 1919	361	3,067
October 17, 1919	193	1,649
October 18, 1919	197	1,662
October 20, 1919	290	2,428
October 21, 1919	148	1,237
October 22, 1919	150	1,329
	5,783	46,048
Totals	11,162	83,836

SPECIES OTHER THAN KING SALMON

Besides the king salmon, three other species enter Klamath River to spawn, namely, the silver salmon *(Oncorhynchus kisutch),* the humpback (0. *gorbuscha)* and the dog salmon (0. keta). The humpback and dog salmon are seldom seen and the fishermen are not familiar with them. The silver salmon occur in large numbers, the migration being later than that of the king salmon.

An occasional silver salmon is caught in the nets prior to September 6. The migration starts after that date and it is usually in full progress by the 20th of the month. No statistics of the silver salmon catch were kept prior to 1919 and no effort has been made to catch these fish since that time.

During 1919 only a few silver salmon were taken prior to the closed season which extended from September 6 to 20. On and after that date they appeared in the catch as shown in table 6.

Silver salmon are said to migrate to the headwaters of the Klamath to spawn. Nothing definite was learned about them from inquiry because most people are unable to distinguish them. In 1925, 295 silver salmon appeared at the Klamathon racks, of which 269 were males and 26 were females.

The blue-back salmon or redfish (0. *nerka)* is recorded by Jordan and Evermann (Fishes of North and Middle America, pt. 1, p. *482,* 1896) as occurring in Klamath River. Nothing to substantiate the statement can be found. A fish identified by some fishermen at Requa, July 15, 1919, as a blue-back, proved to be a steelhead (Salmo *irideus),* somewhat more elongate in form than usual, very silvery on the sides and greenish blue above. The flesh was deep red. Scale counts and other characters were as follows. Scales before dorsal, 54; in lateral series, 128 ; above lateral line, 25 ; dorsal rays, 9 ; anal, 12 ; branchiostegals, 13 ; gill rakers, 22. Another proved to be a cutthroat steelhead (S. clarkii), the fine scales attracting attention. It was caught near The Jaws, July 14, 1920. It measured about 16½ inches and was silvery on the sides and pale olive on the upper part of the body. The spots were scarcely distinguishable. There was a trace of red beneath the mandible. There were 196 scales in the lateral series, 46 above the lateral line, and 86 before the dorsal.

Humpback and dog salmon are not common enough anywhere in the State to be of commercial importance; in fact, they are so rarely seen as to be unknown to any but the most observant fisherman. Both species occur as far south as Salinas River. On the other hand silver salmon are fairly common, and because of their habit of entering small streams to spawn, they are much more generally distributed than the king salmon. As king salmon become increasingly difficult to obtain within the State, more attention will be given to the protection and propagation of the silver salmon. Silver salmon seem never to have been so abundant as king salmon, but even now it is not possible to say to what extent they enter into the catch of the State.

Close attention was paid to boatloads of salmon as they appeared at the houses on Noyo Estuary near Fort Bragg, with the following results :

TABLE 7

Date	Number King Salmon	Number Silver Salmon
July 14, 1919	32	72
July 16, 1919	4	49
July 17, 1919	48	2
July 18, 1919	23	17
July 19, 1919	49	23
July 23, 1919	177	25
July 25, 1919	26	25
July 27, 1919	17	23
July 28, 1919	32	11
July 29, 1919	29	10
July 30, 1919	3	1
July 31, 1919	2	1
August 2, 1919	8	1
August 4, 1919	10	2
August 5, 1919	32	13
August 11, 1919	30	13
Totals, 1919	521	288
June 21, 1920	109	43
June 22, 1920	5	1
June 23, 1920	3	5
June 24, 1920	73	11
June 25, 1920	50	4
June 28, 1920	172	19
June 29, 1920	179	24
June 30, 1920	30	12
July 1, 1920	71	116
July 2, 1920	75	60
July 3, 1920	104	62
July 5, 1920	61	31
July 6, 1920	150	67
July 7, 1920	135	62
July 8, 1920	163	98
July 13, 1920	78	12
July 14, 1920	102	28
July 15, 1920	62	25
July 16, 1920	117	22
July 17, 1920	57	56
July 19, 1920	60	28
July 20, 1920	27	17
July 21, 1920	37	17
July 22, 1920	50	27
July 23, 1920	45	10
July 24, 1920	56	15
July 26, 1920	8	10
July 27, 1920	23	39
July 30, 1920	7	6
August 3, 1920	27	9
August 5, 1920	22	35
August 6, 1920	94	128
August 7, 1920	11	17
August 9, 1920	9	5
Totals, 1920	2,272	1,121
June 17, 1922	75	46
June 25, 1922	20	95
July 6, 1922	20	45
July 8, 1922	61	35
August 6, 1922	64	15
August 9, 1922	68	5
August 10, 1922	81	13
August 22, 1922	84	10
Totals, 1922	473	264

Reference has been made to the difficulty which one encounters in trying to assemble exact information relating to either the distribution, abundance, or extent of spawning grounds of any species of salmon, observers in general having difficulty in distinguishing species. Old male king salmon are often referred to as dog salmon, king salmon fresh

from the sea are sometimes called silver salmon, and not infrequently salmon and steelheads are not distinguished.

The steelhead of the State is a sea-run trout which after living one or more years in the stream, enters the ocean, where it grows rapidly. In time it returns to the stream again, mature and ready to spawn. Steelheads usually accompany a salmon migration for the probable reason that conditions are then favorable for spawning, and not to eat salmon eggs as some assert. After spawning, the steelheads usually recover and again enter the sea, not always dying shortly after maturity as do the salmon. From an examination of 100 steelheads taken in the estuary of Klamath River it appears that these fish often spawn for the first time after having spent one year at sea. They usually enter the ocean at or near the end of the second year. Occasionally, one migrates to the sea at the age of one year, and rarely one may be found that has remained three years in the stream. One example had spawned in the second year. None had spawned before having spent a year in the sea. They usually spawn annually after the first time. The following conditions were noted:

TABLE 8

Stream	Ocean	Spawned	Age	Length
1 year	2 years	0 times	3 years	270 mm.
3 years	3 years	2 times	8 years	645 mm.
1 year	4 years	2 times	5 years	625 mm.
2 years	3 years	2 times	5 years	635 mm.
3 years	4 years	3 times	7 years	640 mm.
2 years	2 years	1 time	4 years	480 mm.
3 years	2 years	1 time	5 years	530 mm.
2 years	3 years	1 time	5 years	635 mm.
2 years	2 years	0 times	4 years	370 mm.
3 years	1 year	0 times	4 years	345 mm.

Commercial fishermen working at night in Klamath River distinguish steelheads when removing fish from the nets, by their deeper caudal peduncles and somewhat narrow tail fins, these characters being apparent to the touch. A diagram, figure 2, exhibits tracings of four species of salmon and a steelhead. The difference referred to is apparent. This together with the shorter anal base and the immaculate lining of the mouth should enable anyone to distinguish a steelhead. The lining of the mouth has much black pigment in the salmon.

THE SPRING MIGRATION—(IMMIGRATION)

Although king salmon in small numbers at least, appear to enter the Klamath at all seasons, there are apparently two more or less definite periods of migration, one occurring in the spring and the other in midsummer and early fall. Some doubt appears as to the distinctness of these migrations, the first possibly being little more than a long continued and varying start of the summer influx. However, G. R. Field and W. H. Baily, and the fishermen as well, speak of two distinct runs. Field wrote: "As the run of winter steelheads ceases, about March 30, spring Salmon begin to come. A few enter the Klamath

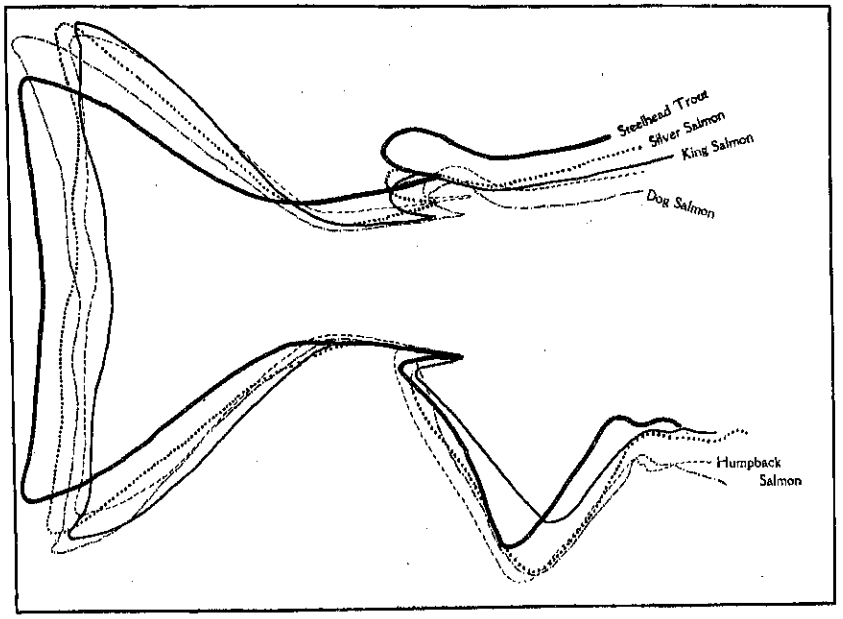

FIG. 2. Tracings of the outlines of the posterior fins and the caudal peduncles of salmon and the steelhead.

in the latter part of February, but the run really starts in March and slackens or almost entirely passes by the last of May. These fish average about 11 pounds in weight and are indistinguishable from those which come later, except that the eggs are always immature. These spring salmon may be caught in the smaller streams fed by melting snow at the headwaters of Salmon River during the month of June."

The spring migration,[1] granting that it was once very pronounced, has now come to be limited as to the number of individuals, and is of relatively little economic importance. The fish of this run begin to materially increase in numbers in the latter part of March or early in April and the migration has reached its maximum, and waned before the middle of June. The river at the time of the spring migration is apt to be in a condition of maximum flood[2] as indicated in figure 3,[3] the

[1] R. D. Hume in a paper without date, and presumably published by himself (Stanford University Library ___) says of the Klamath River: "In 1860 in this river during the running season, salmon were so plentiful, according to the reports of the early settlers, that in fording the stream it was with difficulty that they could induce their horses to make the attempt, on account of the river being alive with the finny tribe. At the present time the main run, which were the spring salmon, is practically extinct, not enough being taken to warrant the prosecution of business in any form. The river has remained in a primitive state, with the exception of the influence which mining has had, no salmon of the spring run having been taken except a few by Indians, as a reservation by the government has been maintained, until within a few years, and no fishing has been allowed on the lower river by white men; and yet the spring run has almost disappeared, and the fall run reduced to very small proportions, the pack never exceeding 6000 cases, and in 1892 the river producing only 1047 cases."

[2] The impounding of flood waters above dams may now control in a measure the violence of spring freshets, and the gradual release of this water may contribute somewhat to the minimum flow of summer.

[3] The graph was constructed from data found in Water Supply Papers, 311-313, U. S. Geological Survey.

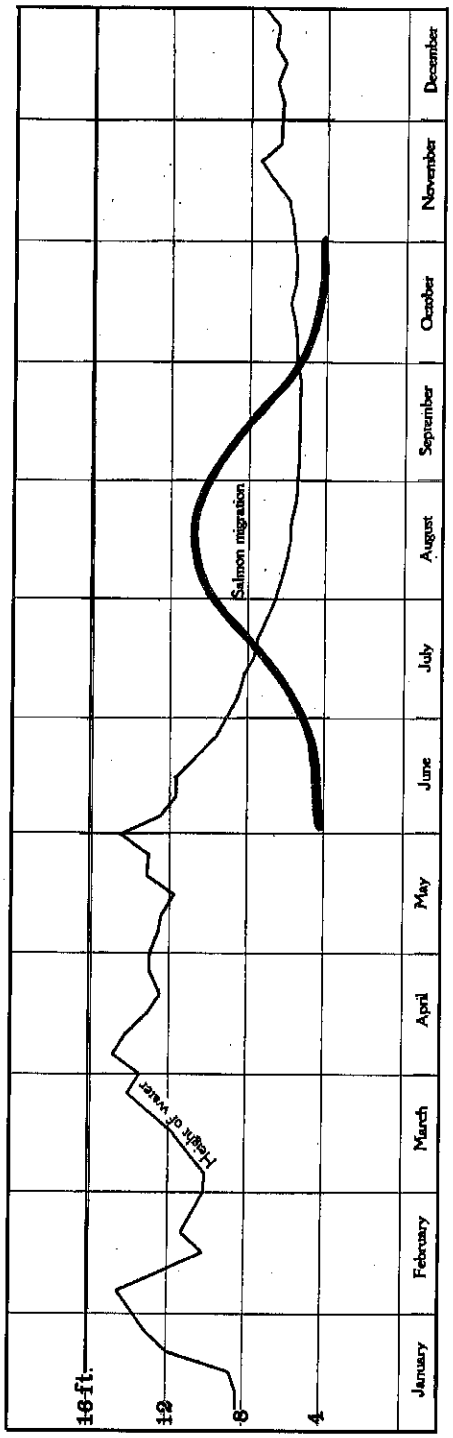

FIG. 3. The relation between height of water and the summer migration of king salmon in the Klamath River.

water bearing quantities of yellow silt and having a very low temperature. A huge yellow fan extends from the mouth outward over the surface of the ocean, occasionally reaching a width of three or more miles. Its shape and extent seemingly influenced by wind and tide, varies from day to day, now shifting far to the north or south and extending a greater or lesser distance out to sea. The line between fresh and salt water is often sharply defined by a narrow band of foam. From some distance to the north and south of the river the shore fauna shows the influence of fresh water.

The number as well as the destination of the fish which enter the river at this time is unknown. It is certain that the number is small

TABLE 9

Spring Run, Klamath River

Date	1918		1919		1920	
	Number fish	Average weight	Number fish	Average weight	Number fish	Average weight
April 16	5	13.0				
April 17	2	11 1				
April 18	6	13 1				
April 19	4	12 8			18	13.1
April 20	2	9.0			5	10.8
April 21					21	12.8
April 22	2	13.0				
April 23	2	10.0			19	13.3
April 24	9	11.2				
April 25	1	19.0				
April 26	4	11.7			23	14.4
April 27					12	16.4
April 28					18	11 2
April 29	6	10.5				
April 30	4	11,7	15	11.0	24	14.0
May 1	7	12 3	23	12.2	9	14 7
May 2	2	19 0				
May 3	2	15.5	4	11 5	6	12.0
May 4					14	13.6
May 5			20	13 3		
May 6	7	11.8				
May 7	7	9.0	54	11.5	2	12.7
May 8	1	8 0	30	12 4		
May 9			31	12 0		
May 10			36	12.1	18	14 7
May 11						
May 12			71	11 7		
May 13			20	12.1		
May 14			24	12.3	6	14.6
May 15	1	10.0	29	11 7		
May 16			57	12.4		
May 17			68	12.8	4	
May 18					18	11 8
May 19			28	13.4	2	11 0
May 20	11	11.4	102	12.8		
May 21	9	10.0	50	14.7		
May 22	1	7.0	21	12.5	9	14.3
May 23	1	13.0	40	13 3		
May 24	13	9 6	46	13 4	15	15 3
May 25						
May 26	2	11 0	8	14 4		
May 27	2	10 0	100	13.6		
May 28	10	9 2	32	12.2		
May 29	8	10 4	94	13.0		
May 30	2	10 4	27	13 0		
May 31	23	9 8				

or insignificant when compared with that of the summer run, yet many fish might easily escape notice in the silt-laden torrent with which the channel is filled. Possibly the migrating fish slowly make their way to the most distant headwaters[4] or they may spread out over a considerable area of the basin and reach maturity at the same time as those of the summer migration.

The fish of the spring run appear to be characterized by the immature condition of the gonads, and by their small stature. The ovaries when examined, April 17-25, 1920, were in all cases very small.

It is reported that spring fish do not exhibit even an approach of breeding colors, nor is the snout ever elongate as is frequently the case among fish of the late summer migration.

There is at hand very little accurate data relating to the fish of this migration. During the years 191.8 to 1920, the Klamath Packers Association operated its plant in the spring, when Field preserved a record of the catch, a summary of which is presented in table 9. Fishing ceased after May in each case, the venture not proving profitable. A comparison of the average weight of these fish with that of others taken in July and August indicates that they are considerably smaller.

TABLE 10

Year	Spring		July		August	
	Number fish	Average weight	Number fish	Average weight	Number fish	Average weight
1918	1,710	9.9	312	12.4	12,140	11.9
1919	1,030	12.8	1,008	13.5	23,591	13.4
1920	242	9.8	948	14.2	46,851	14.8

From April 19 to 25, 1920, all fish to the number of 35 that were brought to the wharf were examined by the writer. The gonads of these were immature, eggs preserved in formalin measuring 3 to 3.2 mm. in diameter.

Fishermen reported that the catches were made at Hollow Tree and Ferry drifts, some distance above the mouth of the river. These fish appeared more silvery than those of the summer migration and

[4] Williamson River and the entire Klamath Lake basin are now closed to the migration of salmon and steelheads, the dam at Copco having become operative as a barrier October 25, 1917, according to H. A. Frazer of the California Oregon Power company. During the summer of 1918, the writer, acting under the authority of the United States Bureau of Fisheries, interviewed many fishermen and old residents of the Klamath Lake region in an effort to learn something of the migration of salmon. Testimony was conflicting and the lack of ability on the part of those offering information, to distinguish between even trout and salmon was so evident, that no satisfactory opinion could be formed as to whether king salmon ever entered Williamson River and the smaller tributaries of the lake. However this may be, large numbers of salmon annually passed the point where the Copco Dam is now located.

the spots were smaller and more linear. Some scale counts resulted as follows :

TABLE 11

Lateral series	Above lateral line
136	27
140	29
141	29
136	30
147	29
145	30
136	33
133	31
139	27
133	26
139	30
135	29
143	29

Of the 35 spring fish, 29 possessed scales of the ocean nuclear type. There were five male and 21 female four-year-old fish measuring from 70 to 83.5 cm. The stream type of nucleus was represented by only six fish. Two of these were four-year-old females 76 and 80 cm. long, while there were one male and three females from 72.5 to 83 cm. long.

THE SUMMER MIGRATION-(IMMIGRATION)

The summer migration of king salmon in Klamath River begins about the first of July, mounts rapidly by the last of the month, reaches its maximum in August, declines gradually in September, and falls away almost entirely before the beginning of winter. There is no definite break between the spring and summer migrations, and it seems also that fish in small numbers continue to appear through November and even later. A spawning migration of steelheads comes with that of the king salmon, and a run of silver salmon starts early in September, and continues through October and November. The spring migration has now lost its economic importance, and seems to have almost entirely disappeared. It was formerly connected at its waning period with the summer run. The fish of the spring run enter the river during its flood height of very cold water, and pass up stream under the same conditions, while the summer migration starts as the winter and spring floods subside, most of its fishes passing upstream during a minimum flow of water, as is shown in figure 3, which was constructed from data found in Water Supply Papers, 311 to 313, United States Geological Survey.

The period of migration of the kingsalmon varies somewhat from year to year, both as to time of starting and duration. In 1919 it was not well begun until late in July, while some years previously, 1913, 1914 and 1915, to be more exact, fish were caught in numbers during the second week in July. (Table 12.) The progress of the migrations of 1914 and 1919 are graphically compared in figure 4.

TABLE 12

Record of the catch of king salmon in the estuary of Klamath River as kept in the office of the Klamath River Packers Association

Number of Fish Taken

Date	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926
June 15		25												
June 16		19												
June 17		24												
June 18		20												
June 19		17												
June 20														
June 21			53											
June 22		39	60											
June 23	95	35	1'3											
June 24	64	21	98											
June 25	94	21	58											
June 26	1'1	32	17	11										
June 27	87	8		155	1									
June 28	33		141	53	1									
June 29		89	175	80										
June 30	112	67	116	43										
July 1	94	67	121	27		13								
July 2	74	23	95		1									
July 3	74	26	1	144	4	5								
July 4	47	6		64	2									
July 5	48		243	173	1			4						
July 6		139	108	106										
July 7	95	125	120	364			1	22						
July 8	174	72	185	32		1		1						
July 9	231	133	201		11		3	6						
July 10	207	104	85	275	14	2	2	2						
July 11	177	23		187	8	3	5							
July 12			375	203	6	3		4						
July 13		394	237	60	5	1		8						
July 14	23 1	" 1	363	37			2	4						
July 15	107	83	203			1	36	3						
July 16	268	60	231		6	2	12	2			258			
July 17	435	45	103	743	6	1	21	19			145			
July 18	468	5		139	7	1	1				1	4	5	
July 19	47		776	73	7		4	181			236			7
July 20		290	362	132		5		156	53		100			8
July 2'	269	154	276	469			39	75	121		55		7	19
July '2	207	216	90	81		4	19	240	[illegible]				86	201
July 23	15	452	101		48	1	3	85	101		178		955	186
July 24	33	1,034	10	188	31	37	34	121			83		288	64
July 25	57	70		311			110		224		37		532	
July 26	165		319	291		32	184	178	11		161			112
July 27								164	94		442		1,507	40
July 28	697	2,052	287	341	25	79	223	262 1	51		56		1,579	37
July 29	822	966	444	178		59	334	227	136	1,514;			1,120	86
July 30	7'4	861	1,495		31	38	195	612	70		125	397	114	77
July 31	411	2,502	242	1,333	91	20	441	582	7	1 3	'7,	233	129	26
August 1	560	323		104		46	442		931	513	3	353	1.676	
August 2	253		3.294	593	28	66	420	1.875	1,165	167	1	980		7
August 3		1,383	929	419	96	88		715	1,192	277			1,892	34
August 4				514	152		491	985	663	1,360		2,071	1,959	1,163
August 5	1,730	918	760	560		"25	167	653	1,939	1,248		833	1,158	719
August 6					140	267	51	1,556	951		138	1,024	1,081	355
August 7	1,218	1,326	'76	600	105	123	483	1,357		2,175	481	855	832	717
August 8	382	355		460	89	181	481		2,376	2,373	218	296	100	
August 9	15		1,057	682	68	4121	401	642	1,008	2,662	1,282	188		1,386
August 10		1,043	554	439	151	270		2,033	990	1,645,	1,109		972	115
August '1	807	1,151	792	1,213	73		1,602	1,780	2,104	1,483	539	222	288	696
August 12	1,155	2,608	1,942	844		252	439	1,264	170	754		1.1201	1,603	620
August 13	1.886	2.456	494		125	115	807	1,449	1,006		984	2,817	2,774	1,557
August 14	1,504	2,363	2,491	1,560	160	190	170	2,918			9,923	2,638	913	304
August 15	1,460	2,427	1,733	784	39	300	366		[illegible]	482	*	1,158	402	
August 16	460		2.343	2'7	62	218	796	*7,420	[illegible]	[illegible]	2,959	2,269		130
August 17.				268	37	373			2,638	3,703	1,666		2,065	145
August 18	2,454	[illegible]	1,279	441	103		758	*2,000	1,803	1,267	1,513	3,887	2,544	51
August 19	832	6,111	1,503	2,001		808	1,214	*2,007	1,670	1,601		809	4,135	75
August 20	830	1,891	654		189	1,628	549	*2,079	963		1,558	2,539	5,905	92
August 21	540	3,137	1,003	310	80	870	1,611	*2,112	2,640	[illegible]	617	1,899	*1,681	131
August 22	504	4,177		353	125	218	3,587				5,216	2,421	1,401	
August 23	704		8,705	678	67	1,211	611	*1,922	482	2,950	2,287	3,280		463
August 24		2,920	*2,832	1,879	162	487		*1,997	3,290	4,406	1,344		3,724	1,566
August 25.	356	1,069	2,518	1,520	105		1,350	*1,984	1,140	1,548	1,736	3,266	2,078	3,030
August 26.	218	1,034	3,087	991		995	1,875	*1,695	1,232	984		1,115	462	1,564
August 27	180	1,285	4,204		305	398	1,256	*1,280	*078		2,438	404	362	4,306
August 28	352	997	2,176	1,803	142	714	1,416	*1,572		1,524	1,270	861	1,923	1,681
August 29	220	1,004		764	126	472	1,097		*	1,334	3,243	503	1,266	
August 30. I I	100		7,529	828	309	539	226	*2,614	*	1,382	4,309	942		578
August 31		1,187	1,852	385	181	665		*1,132	1,895	1,750	1,333		1,005	637

TABLE 12-Continued

Record of the Catch of King Salmon in the Estuary of Klamath River as Kept in the Office of the Klamath River Packers Association

Number of Fish Taken

	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926
September 1	440	418	526	516	182		239	*1,565	905	1,240	*	1,185	1,353	2,037
September 2	177	853	1,797	294		1,072	493		1,108	993	*	2,380	1,410	2,744
September 3	801	509	657		300	423	267	*1,470	481		1,632	1,597	905	566
September 4	411	442	2,550	389	467	767	134	500		3,273	2,645	1,189	398	1,394
September 5	458	553	3,277	1,128	291	386	234		506	1,011	593	657	544	
September 6	192				100	578	238	776	527	1,595	2,944	204		1,146
September 20					722	374	1,402							
September 21					152	238								
September 22					86		330							
September 23						187	378							
September 24					133	49	180							
September 25					79	33	91							
September 26					193	25	66							
September 27					255	31	33							
September 28					464	36								
September 29					166		32							
September 30						133	48							
Totals	28,593	63,706	72,357	30,819	7,213	16,784	29,424	54,126	42,996	61,502	56,999	46,871	54,828	30,772

*A limit was placed on these days.

As might be presumed from what is known of the behavior of other animals, the migration does not consist of a steadily increasing flow with a similar gradual decline, but rather of a continuation of successive waves of varying size which on the whole mount higher and higher until a maximum is reached, and then die away in much the same manner as they came. Some fishermen express the opinion that these waves are caused by the varying conditions of moon and tide, but there seems to be no evidence that large schools are lingering for any great length of time in the sea near by, awaiting proper conditions for entering the river. Fishermen are not able to predict the size of the day's catch with any degree of certainty, nor are they always able to tell whether fish are plentiful in the estuary. The fish often make their presence known by "finning" as the act is called, that is, by cutting the surface with the dorsal fin or a large part of the back, a rather slow and deliberate movement, in strong contrast with the sprightly leap of the steelhead. A large catch may or may not follow a brisk exhibition of finning. It seems that. fish mostly enter the river with the tide, beginning to come in numbers on low water. It is said by some fishermen that they do not come in with the night tides. Anglers appear to meet with more success on an incoming tide, but it is to be noted in this connection that the mouth of the river does not offer a large margin of safety when the tide is passing out, and anglers are not apt to venture there with their boats at that time. Many who have observed the salmon here are positive in their statements that the fish mostly enter the river with the tide, and that migration does not occur in a marked degree with the full moon tides. It is said also that fish enter the river in the daytime and that there is no marked inward movement at night. Direct observation at the mouth of the river is not possible because of the deep, rapid and silty water.

Usually the stomachs of the fish are entirely empty and evidence appears which suggests that the long fast of migration is already under

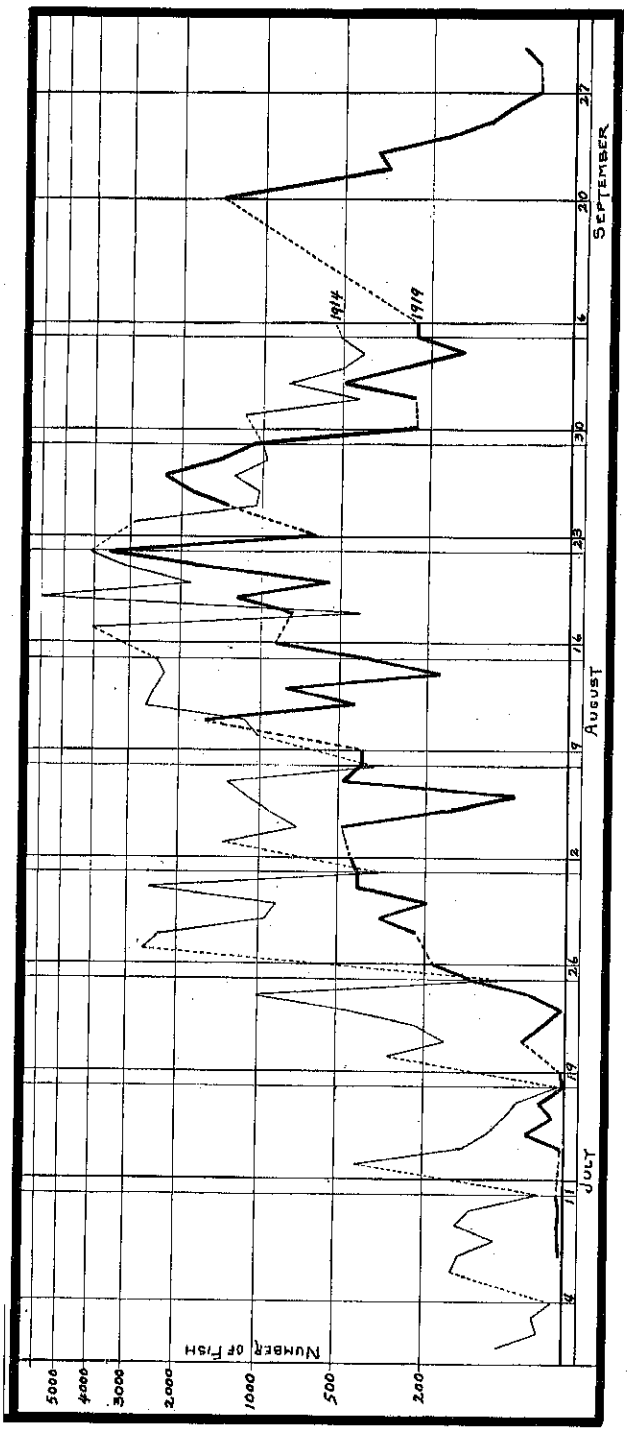

FIG. 4. Illustrating the migrations of 1914 and 1919. The dotted lines represent closed seasons.

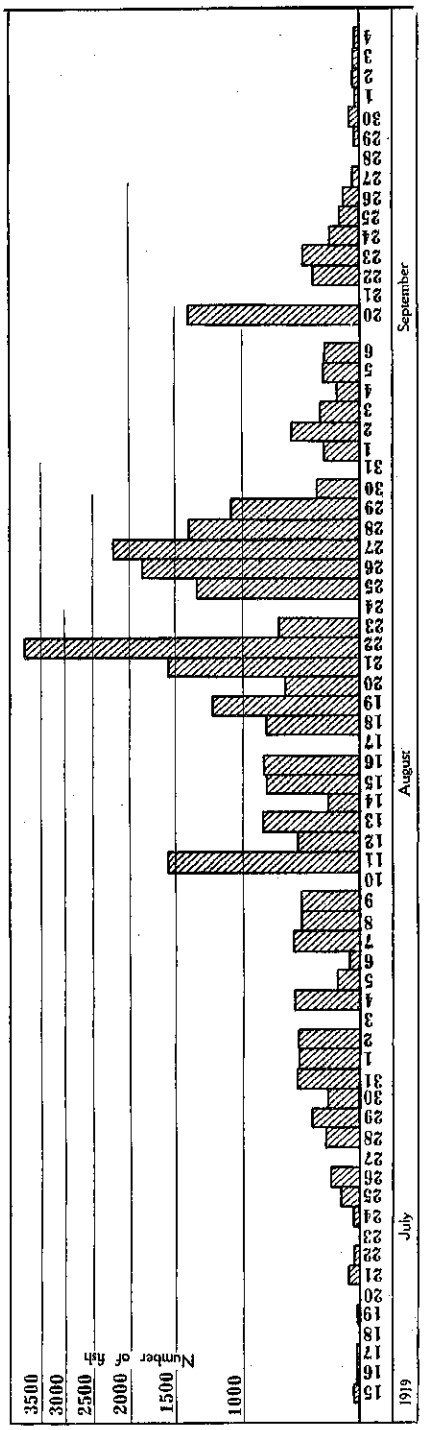

FIG. 5. The migration of 1919 as represented by the daily catch.

way. Occasional individuals have some sea food in the digestive tract and some have been seen with their stomachs full of sardines.

After entering the river, it appears that the fish are accustomed to linger in the estuary for a time at least. This seems to be established by the fact that a closed season whether long or short is generally followed at once by an unusually large catch. This is borne out by an inspection of table 12[5], and also in figure 4, where the dotted lines represent legally closed periods. It will be noted also that when fishing begins late in the season as in 1922 and 1923 the initial catch is large. In many cases two or three successive days of fishing almost clear the river. Exceptions occur, but they are not frequent. From reports it appears that fish sometimes pass quickly up the river after entering the mouth. They also linger at times in the larger pools. Nets are often successful at Ferry Drift or Hollow Tree Drift when very few fish are caught in the estuary. In migration, the fish often rest in the slower parts of the stream which extend between the rapids. They are said to select one side of the river or the other in migration, the choice presumably being made in relation to the current. All this must be taken into account in the consideration of closed periods or restricted areas as aids to conservation.

Sometimes a migratory- wave of unusual size appears, suddenly taking everyone by surprise. In 1920, early in August the fish were coming in numbers and the catch was well sustained during the week ending with the 14th. On the evening of the 15th the layout began at 8.15 at the first sound of the whistle. Almost immediately fish began to strike the nets and the catch progressed so rapidly that the recall was sounded at 8.50. Some of the nets had filled so quickly that several boats were in distress from an overload and other nets had to be hauled without taking time to disengage the fish. 7420 fish were taken into the cannery at this time. From then until the end of the month the catch was limited to the capacity of the plant. At the same time the river was alive with steelheads.

The gonads of the early arrivals are comparatively immature, their size and general appearance not differing from many examples caught at sea, this condition changing with the progress of the season, some of the last fish to come being almost mature. Eggs of fish taken early in the season often measure no more than 3 mm. in diameter, while later, some measuring 7 or even slightly more may be seen. A ripe egg measures about 9 mm.

The late arrivals have in most cases acquired the external marks of mature fish, notably the highly colored skin, deeply embedded and eroded scales, the hooked jaw and enlarged teeth. The appearance of larger and older fish also characterizes the wane of the migration.

Upon entering the stream early in the season the fish are almost uniformly olive greenish above, the color somewhat lighter or darker in different individuals, and bright silver on the sides, the sheen disappearing on the lower surface. The spots of the body are elongate, in many cases almost reduced to zigzag lines each covering 4 or 5 scales and extending obliquely with the rows of scales.

[5] In these tables the catch of the previous evening is recorded as of the following day. For example, the catch of August 14th was begun August 13th at 8.15 p.m. and continued at intervals during the night of that date and the early morning of the 14th.

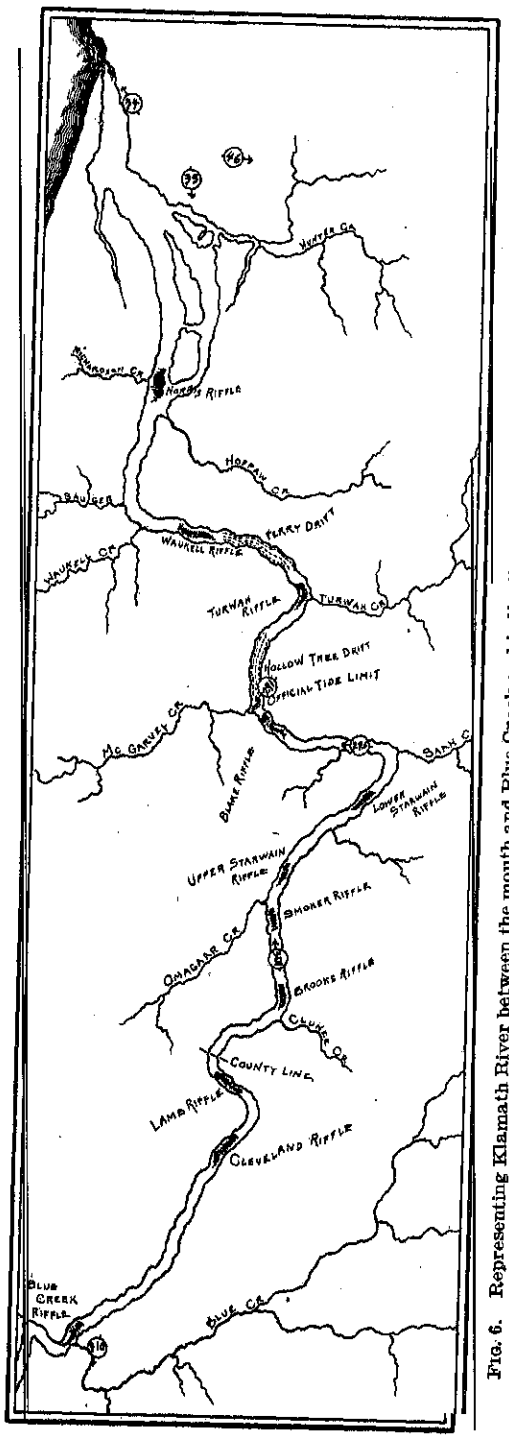

FIG. 6. Representing Klamath River between the mouth and Blue Creek and indicating the location of rapids (riffles) and fishing grounds.

The dorsal fin is profusely spotted. The caudal fin may be completely spotted or immaculate. In a series of specimens exhibiting variously spotted fins the immaculate condition is approached by a disappearance of spots first from the middle of the fin, then downward toward the lower lobe, remaining to the last on the lower edge, then dorsally toward and finally including the upper rays of the upper lobe. The spots of the caudal are round or slightly ovate, usually more elongate near or on the upper and lower edges.

Inside the mouth the tissue is blue black on the lower jaw near the teeth, on the tongue and backward along the gill arches, along inside of upper jaw, on edge of valve and on two elongate areas bordering palatine teeth. This character serves to easily distinguish between salmon and steelheads, the latter having the inside of the mouth white.

About the middle of August fishes begin to appear with traces of the nuptial colors. Some have the back and sides suffused with a brilliant bronze which is often strongly tinted with pink. Others are dark or even blackish and along with the color comes an elongation of the snout and a thickening of the skin. As the season progresses individuals with colors more nearly approaching those of the spawning period appear from time to time, while very late in the season an occasional male is seen the color of which is almost in full bloom.

When about ripe the males become very dark olive or almost black, the silver having entirely disappeared, even the ventral surface being dark, the throat and chin black. The region of the branchiostegals, the jaws and snout and the lower sides of the paired fins are black. Above and behind the anal fin the body is cherry red. Axil and covered areas anterior to branchiostegals and beneath jaws, dead white.

As the bright color stage advances the red progresses anteriorly until the whole head and body are suffused with it. The advanced color phases are not entirely coordinate with maturity, a brilliantly colored example sometimes not being so nearly ripe as one which is much less ornate.

Far up stream even late in the season individuals are occasionally seen with something of the silvery color of the sea. These are identified by the casual observer as silver salmon while the darker colored examples are spoken of as hook-bills.

No observer has had an opportunity to trace a migration up the river, and at present there is nothing to offer in this connection except what may be culled from interviews with residents or anglers and other fishermen along the stream. Information secured in this way is difficult to evaluate because of confusion resulting from an inability to distinguish species or to discriminate between members of the same species. When the observer is called upon to regard males and females, some with their silvery sheen fresh from the sea, and others dark and highly colored as they approach maturity, not to mention old males with hooked jaws, and the steelheads and silver salmon, the difficulty becomes acute. Out of a mass of reports and descriptions it appears safe to accept in the main the following extract.

In the past there were two fairly distinct runs of king salmon, noted even to the headwaters of the river and its larger tributaries. First came the spring or summer salmon, which were later followed by

the fall or snow salmon. The migration of spring salmon has everywhere been diminishing until of late years it has practically disappeared. It is reported that the spring salmon lingered near the spawning beds both in the main river and its tributaries where they at last matured, ripened and spawned with the fishes of a later run. The spring salmon, also known as "silvers" because of their bright color, were said to arrive in the region of Happy Camp in May or June, and in Shasta River in June and early July. These fish are described as being silvery in color, the scales plainly seen on the surface, and the jaws without hook or fighting teeth. These are never seen spawning. The inference is plain that before spawning they assume the characters common to spawning fish, and this at about the time that fish of the summer run appear on the spawning beds. There is said to have been no spring run into Scott River.

The fall or snow salmon sometimes called "hookbills," appeared later in the season arriving near Happy Camp late in August or early in September and continuing to come, entering such streams as Clear, Elk, Indian, China and Grider creeks where they spawned from November on, some even as late as January. Fish of this run enter Scott River and Beaver Creek at about the same time. They formerly came to Shasta River in great numbers, an old resident referring to it as the best spawning tributary of Klamath River. The demands of irrigation have changed all that and now the Shasta is said by many to contribute relatively little to the population of the main river.

The racks at Klamathon, near Hornbrook are usually in place by the latter part of July in anticipation of the early arrivals of the summer migration and they sometimes remain until late in November, most of the fish having then been entrapped. Artificial spawning begins at the racks a little after the middle of October and continues into November. Fish of the summer run, and especially after their entry into the tributaries, which may in some cases be delayed until the rains of early autumn, are often dark in color, some having a conspicuous area of cherry red on the sides. Their skin is then thick and leathery, the scales small (eroded or absorbed) and deeply embedded, and the jaws of the males greatly extended, hooked and armed with large teeth. In a word they are mature, and ready to spawn. The designation "hookbills" or "dogs" as applied to these is easily understood. In spite of the emaciated condition of some of these and their poorly flavored flesh, they were formerly sought with hook and spear and many were destroyed just before the eggs were laid.

The time of arrival of salmon in the tributaries appears to differ markedly, at least in certain cases, and their degree of maturity varies also. For example, during the week beginning October 16, 1927, relatively small numbers of the fish held between the Klamathon racks were ripe. In Shasta River large numbers were actively spawning, while many spent and a few dead fish were seen. At the same time only a few fish were in Scott River, the migration having scarcely begun there. Spawning had not yet started. The volume of Scott River at the time was equal to or greater than that of the Shasta.

During the summer migration the salmon enter the river from a constantly lower temperature to a varying higher one. No careful observations on temperature and its possible relation to migration in

Klamath River has been made, but a cursory examination of conditions prevailing there leads one to suspect that an investigator with temperature control as a thesis will find ample food for thought. In passing up the stream, salmon enter tributaries which are either warmer or colder than the main channel as the case may be. Diurnal variation is great both in the main river and its tributaries. One may at times find a difference of two degrees between the water flowing along the north and south banks where the river is not more than 250 feet across, and where there are neither springs nor tributaries to affect it.

A tributary may at one time of day be colder than the river while at another time it may be warmer. Some tributaries into which salmon migrate have a flow so weak when compared with the main stream that their temperature influence may be detected only a short distance either laterally or below their mouths.

Some scattered observations on temperature may be of interest.

During the summer of 1926, from August 10 to September 15 the ocean temperature near the mouth of the river was 55° Fahrenheit, according to G. H. Clark, assistant to the Bureau of Commercial Fisheries. He reported river temperatures at the same time as follows:

TABLE 13

Date	Time	Depth of water	Bottom temperature (degrees, Fahrenheit)	Top temperature (degrees, Fahrenheit)
August 1, 1926	10.00 a.m.	8′ 6″	71.5	72.0
August 3, 1926	10.30 a.m.	8′ 8″	71.0	72.0
August 4, 1926	10.30 a.m.	9′ 6″	71.0	71.0
August 5, 1926	10.00 a.m.	8′ 2″	70.0	70.5
August 6, 1926	10.00 a.m.	8′ 6″	70.0	70.5
August 11, 1926	10.00 a.m.	8′ 1″	70.0	70:o
August 12, 1926	9.30 a.m.	2′ 8″	68.0	68.0
August 13, 1926	10.00 a.m.	1′ 6″	69.0	70.0
August 16, 1926	8.30 a.m.	3′ 6″	68.0	69.0
August 18, 1926	8.30 a.m.	4′ 0″	68.0	69.0
August 19, 1926	8.30 a.m.	4′ 6″	67.0	69.0
August 21, 1926	8.30 a.m.	4′ 0″	68.0	69.0
August 23, 1926	10.30 a.m.	5′ 2″	61 0	71.0
August 25, 1926	2.30 p.m.	7′ 3″	60.0	65.0
August 30, 1926	10.00 a.m.	5′ 0″	68.0	68.0
September 1, 1926	11.00 a.m.	5′ 0″	68.0	69.0
September 4, 1926	10.00 a.m.	5′ 10″	64.0	67.0
September 7, 1926	9.00 a.m.	5′ 2″	65.0	66.0
September 14, 1926	10.30 a.m.	5′ 0″	67 0	67.0
	10.30 p.m.	5′ 0″	66.0	66.0

At the egg taking station near Hornbrook the water temperatures during the month of July of the same year varied from 60° to 76° Fahrenheit, the daily variation being from 4° to 10°. During August it was just a little lower. In September it fell, going down to 40° at one time. In October and November it was still lower. The following summary may be of interest.

Average temperatures for ten-day periods taken twice each day at 8 a.m. and 5 p.m.:

TABLE 14

Date	Degrees, Fahrenheit (a.m.)	Degrees, Fahrenheit (p.m.)
July 1 to 10	68.1	76.0
July 11 to 20	67.2	72.6
July 21 to 30	61.9	70.7
August 1 to 10	60.0	70.4
August 11 to 20	60.0	68.6
August 21 to 30	60.2	66.6
September 1 to 10	58.6	66.2
September 11 to 20	55.0	62.6
September 21 to 30	49.6	60.0
October 1 to 10	50.6	59.2
October 11 to 20	51.4	56.9
October 21 to 30	47.6	56.8
November 1 to 10	46.6	53.7

From time to time one hears the declaration that the migration is growing later each year. This often accompanies a plea for a late extension of the legal open season. The same report also comes from Eel and Smith rivers. This belief expressed by many fishermen and other observers, is in the writer's opinion a misinterpretation of a phenomenon of depletion. Instead of the curve of migration progressively moving toward the end of the calendar year, the early part of it is being rapidly cut off. The spring run has practically disappeared and the early part of the summer migration has been greatly diminished, while increased effort has sustained the size of the catch which is now largely obtained from what was once the central region of the curve. The partial disappearance of the early fish together with the increased effort necessary to maintain the catch have contributed toward a manifestation of depletion which has been wrongly interpreted as a change in the habits of a species.

The cause of the disappearance or depletion of the early spring migration is another matter and it is doubtful if an entirely satisfactory explanation may now be offered. It is attributed by some to the closure of the river at Copco, this belief resting upon the supposition that the fish of the early part of the migration were bound for Williamson River and the upper Klamath. But depletion of the early run was well under way, if not about complete long before the erection of the dam. Mining operations, overfishing both in the river and at sea, irrigation, and other causes have been suggested.

SEX REPRESENTATION IN THE MIGRATION

During the migration of 1919 the sex of 3136 individuals was recorded. In each case the sex was determined by dissection. Of these, 1461 were found to be males, while 1675 were females. This enumeration takes almost no account of the three-year males, the so-called chubbs or grilse, which, because of their small size, easily escape the nets in numbers and when caught are not usually brought

TABLE 15

Sex Representation in the Annual Catch, Klamath River

Date	1919				1920				1921				1922				1923			
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
July 10					1	1														
July 11	2	3															3	2		
July 12					2	2														
July 13					3	5											2	9		
July 14	1	4			1	2											3	21	8	32
July 15	6	31			1	2														
July 16					1	1											11	44		
July 17	4	16			3	12	12	25									17	58		
July 18																	11	74		
July 19	2	1	15	55	22	47											19	56		
July 20					20	40			24	29							11	49		
July 21	5	31			10	20			47	47							5	44	74	325
July 22	2	16			40	59			18	58										
July 23		2			20	65			32	63	121	229					9	56		
July 24	5	13			25	50	137	281									21	59		
July 25	34	70							47	53							7	22		
July 26	24	26	70	158	23	46			4	4							12	53		
July 27					30	43			43	49							12	68		
July 28	16	24			34	70			20	30							8	2	69	260
July 29	71	78			35	60			40	60			23	57						
July 30	46	39			53	101			34	53	188	231					14	61		
July 31	36	44			47	107	222	427					12	53			4	13		
August 1	29	34							54	56			16	34				3	18	77
August 2	35	24	233	243	81	122			41	68			8	20						
August 3					45	74			50	50			4	36						
August 4	34	30			42	107			55	116			13	62						
August 5	14	11			72	67			49	80			13	71	89	289				
August 6	31	14			66	114			38	62	287	432								
August 7	22	48			60	127	366	611					82	186			20	60		
August 8	37	53							43	66			65	154			9	46		
August 9	1	4	139	160	44	61			39	65			202	428			22	63		
August 10					89	151			36	69			79	212			13	11		
August 11	58	67			97	186			36	64			15	35			10	40	74	286
August 12	34	40			67	119			40	60			17	33	460	1,048				
August 13	20	35			51	139	348	660	44	66	238	380					9	66		
August 14	11	4											20	44			23	77		
August 15	15	20			69	111			33	87			14	43			22	65		
August 16	14	20	152	186	86	133			35	66			15	40			17	53		
August 17					61	134			40	58			100	207			24	56	96	317
August 18	29	30			78	117			34	11			14	46						

August 19	19	36			87	118			43	55			10	50	173	430						
August 20	33	32			130	125	511	758	39	56	224	392					26	50				
August 21	30	43											73	226			13	27				
August 22	41	65							32	73			61	164			23	62				
August 23	38	36	190	242	85	129			22	28			19	30			20	65				
August 24					73	132			79	106			92	177			31	44				
August 25	34	70			87	113			60	44			111	168			16	34	129	282		
August 26	29	46			89	121			53	47			14	25	370	790						
August 27					103	108			49	57	295	355					11	64				
August 28					61	89	498	692					23	61			21	54				
August 29	33	27											48	107			26	49				
August 30	21	18	111	161	60	90							56	134			27	54				
August 31					68	82			49	64			189	281			24	62	109	283		
September 1	39	30			71	79			57	53			185	341								
September 2	51	36							42	57			22	53	523	972						
September 3	32	27			50	95			49	51							24	51				
September 4	66	58			31	49			51	49			24	51			26	53				
September 5	27	25							44	66	292	340	96	179			28	47				
September 6	33	21	248	197	56	84	336	479					101	174	221	484	24	36	102	187		
September 20	70	58																				
September 21																						
September 22	33	21																				
September 23	5																					
September 24	12	17																				
September 25	11	9																				
September 26	14	16																				
September 27	11	13	156	134																		
September 28																						
September 29	5																					
September 30	2	3																				
October 1	4	3																				
October 2	5	5																				
October 3	15	9																				
October 4	3	2	34	22																		
October 5																						
October 6	4	7																				
October 7	18	20																				
October 8	4	17																				
October 9	6	9																				
October 10	13	16																				
October 11	11	5	56	74																		
October 12																						
October 13																						
October 14	21	12																				
October 15	6	11																				
October 16	13	10																				
October 17	5	6																				
October 18	6	4	51	43																		
Totals			1,461	1,675							1,645	2,359			1,836	3,033			678	2,049		

into the cannery. Early in the season there was a relatively large proportion of females in the catch, but as the season advanced the males became more numerous. This is illustrated in table 15 where for comparison the sex enumeration for later years is also recorded. Reduced to percentages, the relative number of females appearing during successive periods of the migration is as follows :

TABLE 16

Percentage of Females in the Catch During Successive Periods of the Summer Migration

	1919	1920	1921	1922	1923
To July 19	70.5	67 5			76 4
July 20 to 26	69.3	67 2	65 4		79.0
July 27 to August 2	51.0	65 7	55 1	76 2	81.0
August 3 to 9	53.5	61 8	60 0	69 4	79.4
August 10 to 16	55.0	65 4	61 4	68 1	76 9
August 17 to 23	56.0	59 7	63 6	68 0	68.6
August 24 to 30	57 9	58 5	54 6	65 0	72.2
September 1 to 6	44 3	58 5	53 8	64 6	64 7
September 20 to 27	46 2				
September 28 to October 4	39 3				
October 5 to 11	56 9				
Total number observed	3,136	6,442	3,975	2,134	2,724

In the case of sex representation the desirability of considering numerically large samples has not escaped attention, and an illustration of what a sample of small size might present may not be out of place here. One day, August 25, 1922, to be more particular, 100 fish picked up without conscious selection resulted in finding 37 males and 63 females. Other hundreds were then examined in small pods just as they came to hand with the following results:

TABLE 17

Males	Females	Males	Females	Males	Females	Males	Females
	17	11	14		13	9	16
8	17	13	12	12	20	9	16
8	17	10		1	13		15
15	10	10	66	36	10	108	17
39%	61%	44%	56%	44%	56%	36%	64%

It appears that we have no means of knowing the relative number of either sex in an entire migration, principally because the small males are allowed to pass the nets in large numbers, and further, there is no opportunity to observe the latter part of the migration when males are apparently more numerous. The results of some observations on Trinity River" in Hoopa Valley, extending over a short period from September 18 to 26, are suggestive. During this time 340 king salmon were caught under such circumstances as would warrant presumption that a fair sample of the migration at this time was secured, Of these, 260 were males which measured less than 64 centimeters in length, all of a size most likely to escape the nets at the mouth of the river. Of

[6] Snyder, J. O. Indian methods of fishing on Trinity River and some notes on the king salmon of that stream. California Fish and Game, vol. 10, no. 4, pp. 163-172, 1924.

TABLE 18

Average Weight of King Salmon in Klamath River as Shown by the Daily Catch for 1917-1925

Date	1917	1918	1919	1920	1921	1922	1923	1924	1925
July 17	14.9		12.4	13.6			14.4		
July 18	16.8		14.0				14.1		
July 19			12.2	14.9			15.6		
July 20	18.8			15.0	13.8		15.0		
July 21			14.1	14.7	14.0		14.3		15.7
July 22			13.6	14.7	15.0				15.0
July 23	18.2		15.7	14.6	14.1		15.0		16.6
July 24	15.1		13.1	14.7			15.5		16.5
July 25	16.1		13.2		14.5		13.6		16.0
July 26	16.0		14.7	14.1	12.2		14.3		
July 27	14.8			14.5	14.4		15.0		16.6
July 28	15.3		13.3	14.6	13.8		14.2		16.3
July 29			13.2	14.1	14.5	15.6			15.8
July 30	14.9		13.8	14.7	13.2	15.0	14.9	14.6	16.3
July 31	14.8		13.8	14.3			14.3	14.0	15.3
August 1		12.7	13.4		13.3	14.9	14.6	13.8	15.6
August 2	15.0	12.9	12.6	14.0	12.6	15.0	10.0	14.6	
August 3	14.9	12.3		14.4	12.8	15.1			15.6
August 4	15.1		13.3	14.4	12.5	14.9		13.6	15.1
August 5		11.9	12.2	13.0	13.1	14.8		13.4	14.8
August 6	14.6	12.5	12.9	14.3	12.2		14.4	13.9	15.3
August 7	14.4	12.3	12.8	14.0		15.0	14.2	13.8	16.0
August 8	15.0	12.2	12.8		14.1	15.1	14.0	12.8	16.1
August 9	13.3	12.4	12.7	14.0	12.7	14.9	14.9	13.4	
August 10	14.9	13.3		14.5	12.6	14.3	14.6		15.1
August 11	14.5		12.7	13.9	13.1	14.9	14.5	14.7	16.0
August 12		13.1	13.0	14.4	13.3	14.6		13.7	15.6
August 13	14.9	12.6	12.5	13.7	13.8		14.2	14.0	15.4
August 14	14.1	12.4	13.0	14.4		15.1	15.0	14.3	14.5
August 15	15.3	12.0	12.5		15.5	14.0		14.2	14.6
August 16	14.4	12.3	13.2	14.4	14.3	14.1	14.1	13.1	15.1
August 17	14.9	11.9			13.3	14.8	14.2		
August 18	15.9		12.6	14.4	13.4	14.6	14.9	14.5	16.0
August 19		12.0	12.6	14.9	13.5	13.2		15.1	15.7
August 20	15.3	12.2	13.0	15.3	12.8		13.9	15.1	15.4
August 21	15.1	11.8	13.5	15.8		13.6	13.6	14.6	16.6
August 22	14.8	12.0	13.8		13.9	13.8	14.1	14.3	15.8
August 23	15.0	12.1	14.1	14.9	15.3	14.6	14.3	16.0	
August 24	13.1	11.1		14.8	14.3	14.8	13.9		16.6
August 25	14.2		13.6	15.1	17.4	15.1	13.3	16.0	15.4
August 26		11.3	13.2	15.5	14.7	15.9		16.0	15.0
August 27	15.1	11.7	13.6	15.2	15.4		13.6	14.4	15.0
August 28	14.1	11.4	14.2	15.1		14.3	13.8	15.5	15.5
August 29	13.9	11.2	14.0			13.5	13.9	14.4	15.8
August 30	16.5	11.3	14.1	16.6		14.0	14.1	13.8	
August 31	15.2	11.3		15.4	15.1		14.7		16.4
September 1	15.0		14.0	16.9	14.6	14.3		14.9	16.6
September 2		11.6	14.2		15.2	14.6		16.5	16.2
September 3	16.2	11.2	15.1	14.9	16.3	15.3	14.0	16.3	16.4
September 4	16.5	12.1	15.3	14.9		15.7	15.0	17.1	16.4
September 5	18.3	12.7	16.9		16.2	15.7	15.4	18.9	15.5
September 6	17.6	12.5	14.8	16.7	15.9	16.4	15.4	16.6	
September 20	21.1	17.3	22.8						
September 21	18.0	17.9							
September 22	20.6		23.3						
September 23		19.1	22.7						
September 24	20.6	20.6	22.9						
September 25	18.3	23.5	21.8						
September 26	14.1	19.1	24.3						
September 27	18.1	21.3	22.9						
September 28	18.5	24.0							
September 29	21.1		21.7						
September 30		23.1	21.0						
October 1		23.9	24.0						
October 2		22.3	17.3						
October 3		25.1	19.0						
October 4		25.1	21.2						
October 5		24.5							
October 6			21.8						
October 7		27.0	18.6						
October 8			23.2						
October 9		24.6	26.6						
October 10		23.4	23.5						
October 11			27.0						
October 12		23.0							
October 13			25.6						
October 14			22.9						
October 15									
October 16			23.2						
October 17		24.3							
October 18			25.2						
October 19		24.2							

TABLE 19

The Increase in the Average Length of Fish as the Klamath River Season Progresses

Date	Number males	Number females	Average length males	Average length females
July 11	2	3	72 8	76.3
July 14	1	4	60 5	77.0
July 15	6	31	75 3	77.1
July 17	3	16	69 8	76.1
July 19	2	1	76 0	72.0
July 21	5	31	68 5	77.5
July 22	2	16	80 5	77.6
July 24	5	13	80 7	78.1
July 25	34	70	75 8	76.5
July 26	24	26	80 4	78.1
July 28	16	24	78 9	77.0
July 29	71	78	77 8	77.4
July 30	42	39	76 8	77.3
July 31	36	44	79 6	76.7
August 1	20	34	79 2	77.0
August 2	35	24	77 7	73.6
August 4	34	30	85 0	77.2
August 5	14	11	79 5	71.8
August 6	31	14	73 5	75.9
August 7	22	48	78 4	78.2
August 8	87	53	76 6	76.4
August 11	58	67	79 8	78.1
August 12	34	40	77 5	75.4
August 13	20	36	77 0	77.7
August 14	11	4	82 9	77.6
August 15	15	20	80 4	77.4
August 16	14	20	75 0	78.3
August 18	27	30	78 0	76.4
August 19	19	36	72 5	75.4
August 20	33	33	81 9	77.3
August 21	30	43	77 3	70.3
August 22	41	65	81 9	79.2
August 23	33	36	80 7	78.9
August 25	46	67	82 1	78.3
August 26	27	46	84 4	78.6
August 29	33	27	80 5	80.2
August 30	19	17	76 9	76.8
September 1	34	30	87 9	83.2
September 2	41	36	84 8	80.5
September 3	32	27	85 2	80.1
September 4	66	57	84 7	80.2
September 5	27	25	85 4	82.9
September 6	33	21	85 3	82.4
September 20	56	57	88.4	89.1
September 22	23	21	89 6	87.0
September24	12	17	94 5	94.1
September 25	11	9	86 2	89.4
September26	14	16	85 0	87.4
September 27	9	13	85 9	87.5
September29	5	0	92 7	0.0
September	2	3	80 5	96.5
October 1	4	3	85 4	89.5
October 2	5	5	93.2	90.6
October 3	15	9	78 8	89.1
October 4	3	2	107 5	94.7
October 6	4	7	90 6	92.7
October 7	18	20	90 2	90.8
October 8	4	17	99 4	91.1
October 9	6	9	95 26	90.5
October 10	13	16	94 2	93.3
October 11	11	5	92 6	97.1
October 14	21	12	96 8	93.0
October 15	6	11	92 8	92.5
October 16	13	10	92 4	98.3
October 17	5	6	92 9	96.1
October 18	6	4	95 6	94.3

the remaining fish there were 47 males and 33 females, just about the proportion of each sex that one would expect to find in the catch near the mouth of Klamath River at the same time. It seems quite likely that the presence of so many small fish here is due largely to the straining process going on in the commercial fishery. It may be noted in

passing that 206 of these small fish were in the second year of growth, examples of which are difficult to find at the mouth of the river.

The racks near Hornbrook are so constructed as to prevent the passage of all salmon. A census of salmon entrapped there since 1925 is presented on page 91. Where the record is complete it will be seen that males are far in excess of females. But of these males the larger number are grilse, the small two and three-year old fish which escape the nets and do not appear in the catch at the mouth of the river. If the grilse are disregarded it will be found that the females exceed in number the males of their own size.

FISH INCREASE IN AVERAGE WEIGHT AND SIZE AS THE SEASON ADVANCES

A considerable increase in the average weight of the fish is observed as the season progresses. The increase is not always gradual from day to day, not even from week to week, but when the fish taken early or late in the season are compared, the latter are always found to average much the larger. This is well illustrated in the catch of 1919 as reported by Field (table 18) as also in the catches of the two previous years. When the fishing season is short as in 1922 for example, the difference is not so marked, while in 1923 and 1925 it scarcely appears. The whole picture might differ somewhat if a record of the small three-year fish, the so-called grilse or chubbs, which escape the nets in numbers, should enter into its composition. Not only do the fish apparently increase in weight, but there is a corresponding gain in their average length as is demonstrated in table 19, which exhibits the average measurements of a number of examples of both sexes as observed from day to day. An inspection of the data here presented should not lead to the inference that the increase in average size is due entirely to seasonal growth, for such is not the case.

An occular inspection of the catch as it lies from day to day, Spread out on the floor of the receiving house, leads one to note the appearance of unusually large fish in increasing numbers as the season progresses. Most of the fish taken early in the season measure less than 90 cm. in length, an example of much larger size being noted as unusual, while late in the season such large fishes are relatively common. The recorded measurements of 3200 fish observed during the season of 1919 are tabulated as follows:

TABLE 20

Date	Number examples	Per cent measuring less than 90 cm.	Per cent measuring 90 cm. or more
July 14-20, 1919	75	98.6	1.4
July 21-27, 1919	208	92.3	7.7
July 28-August 3, 1919	483	91.3	8.7
August 4-10, 1919	302	92.7	7.3
August 11-17, 1919	315	94.3	5.7
August 18-24, 1919	432	90.3	9.7
August 25-31, 1919	355	88.6	11 4
September 1-6, 1919	433	78.9	21 1
September 20-28, 1919	284	51.8	48 2
September 29-October 5, 1919	56	48.2	51 8
October 6-12, 1919	133	37.6	62 4
October 13-19, 1919	83	27.7	73 3

Here as frequently occurs elsewhere, the statistics of the catch fail in a measure to present a true picture of the migration. Fishermen, aware of the fact that unusually large fish appear late in the season, lay their plans accordingly and occasionally provide themselves with nets of very large mesh. The practice does not appear to have been general in the past, and is not now resorted to because of the shortened legal fishing season. A number were in use in the fall of 1919 but there was no means of determining just what effect they may have had on the average size of the fish caught. That the use of a net of large mesh may produce results different from that of a net of small mesh may be demonstrated. For example, on September 21, 1916, Stansbury and Fisher, with a net of 6-3/4 in mesh caught 78 fish weighing 1180 pounds, while at the same time and place, Robinson and Madsen, with a net of 8-3/4 inch mesh took 54 salmon weighing 1070 pounds. The fish of the small meshed net averaged 15.13 pounds; those of the large meshed net 19.81 pounds.

The presence of large fish is by some attributed to artificial propagation, the direct result of the introduction of Sacramento salmon. If true, their appearance would date from the introduction of these fish, and hatchery experts who have had to do with propagation on the Klamath maintain that this is the case. This supposition is not sustained, however, by the reports of old residents at the mouth of the river, including Indian fishermen whose memory reaches a long way back of artificial propagation in the state. According to them these very large fish have always appeared in the fall just as they do now. Moreover they all agree in reporting that these fish mostly enter the lower tributaries to spawn. Many are said to go into Blue Creek, and for this reason the very large fish are locally referred to as "blue-creekers." These "blue-creekers" resemble the fish of Smith River in size, as well as in color, character of snout and other peculiarities associated with maturity. The Smith River fish like the "blue-creekers" enter the river late in the season, are relatively mature, and have but a short distance to migrate to their spawning beds.

Bailey on April 17, 1920, told the writer that these large fish, the so-called blue-creekers, had always been a feature of the latter part of the migration.

A more detailed account of the progressive entry of large fish into the migration is given in table 21, where for a short period of time the percentage of fish which constitute a given length class is recorded. For example, it will be seen from a glance at the table that during the period from July 21 to 31, of the 509 fish measured, only 0.78 per cent, were 90 cm. long, while from September 20 to October 18, of 569 fish, 2.99 per cent were 90 cm. long. From data contained in this table, figure 7 was constructed. This presents the percentage of individuals of any length from 55 to 110 cm. which are found in representative samples of the catch during certain periods of the season. Here a late invasion of large fish is distinctly evident. This invasion would not seem so abrupt if data covering the time from September 6 to 20 were available. An inspection of fish caught, on hooks during this closed season indicated that the large fish gradually became more numerous.

TABLE 21

The Percentage of Klamath River Fish which Constitutes a Given Length Class for a Certain Period of Time

Length in cm.	July 21-31	Aug. 1-14	Aug. 15-16	Aug. 25–Sept. 6	Sept. 7-19 (closed season)	Sept. 20–Oct. 18
	1	2	3	4	5	6
40						
41		.42				
42	.19	.56				.17
43		.14	.19			.34
44		.14		.24		
45		.84		.39		
46		.42		.24		
47		.42		.39		.17
48	.19	.84	.19			.17
49		.14	.19	.84		.17
50		.42	.39	.39		
51	.25	.56	.39	.53		
52			.19	.24		
53	.19	.14		.96		
54	.19	.28		.39		.34
55	.19	.28	.60			.52
56	.58	.14		.24		.71
57	.25	.14	.39	.24		.52
58	.25	.14	.19	.53		.87
59	.19			.39		.71
60	.19	.28	.39	.39		.71
61	.98	.56	.19	.24		.71
62	.58	.28	.60	.12		.34
63	.19	.84	.79	.24		.34
64	.98	1.13	.60			.34
65	1.32	1.55	.79	.66		.87
66	1.57	2.39	1.02	.53		.52
67	2.36	2.93	2.79	1.08		.17
68	2.36	2.64	3.00	1.45		.34
69	3.73	4.23	4.19	1.20		.52
70	3.30	3.63	3.79	2.53		.17
71	4.32	2.93	4.19	1.46		
72	3.73	3.10	4.40	2.29		.52
73	4.52	2.93	4.19	2.89		.17
74	2.74	3.80	4.19	2.53		.17
75	4.91	3.63	3.40	2.53		.17
76	5.50	4.23	4.00	2.88		1.50
77	5.50	4.93	4.59	3.36		.34
78	5.30	5.64	4.59	3.61		.86
79	5.60	4.93	4.79	4.46		1.40
80	5.69	4.93	4.59	5.66		1.40
81	3.54	3.80	4.59	5.55		1.40
82	3.30	2.52	3.60	5.91		2.61
83	3.73	3.10	4.40	5.18		1.98
84	4.13	2.23	3.19	4.82		2.99
85	2.36	2.64	2.79	3.12		2.99
86	2.36	2.64	1.04	2.89		3.32
87	.19	1.53	2.79	3.49		4.00
88	1.37	2.64	2.40	2.89		4.00
89	1.76	1.97	2.00	3.10		4.38
90	.78	1.55	3.00	2.25		2.99
91	1.37	1.55	2.19	1.93		3.13
92	1.96	1.13	.19	1.08		4.92
93	.58	.84	.39	1.08		2.99
94	1.37	.75	.90	1.08		3.50
95	.78	.14	1.02	.96		4.00
96	.19	.56	.19	1.56		3.13
97	.19	.14	.60	1.81		3.13
98	.25	.42	.39	1.08		4.38
99	.25	.28		.39		3.85
100	.25	.42	.39	.53		2.61
101			.19	.24		2.61
102		.28		.66		1.58
103	.19	.28		.24		2.81
104	.19	.14		.39		1.98
105	.19	.28		.12		1.58
106			.19	.24		1.50
107				.12		1.58
108		.14		.12		.52
109				.24		.71
110				.12		1.40
111						.17
112				.12		.34
113						.71
114						.17
115						.17
116				.12		
Number of specimens examined	509	709	507	829		569

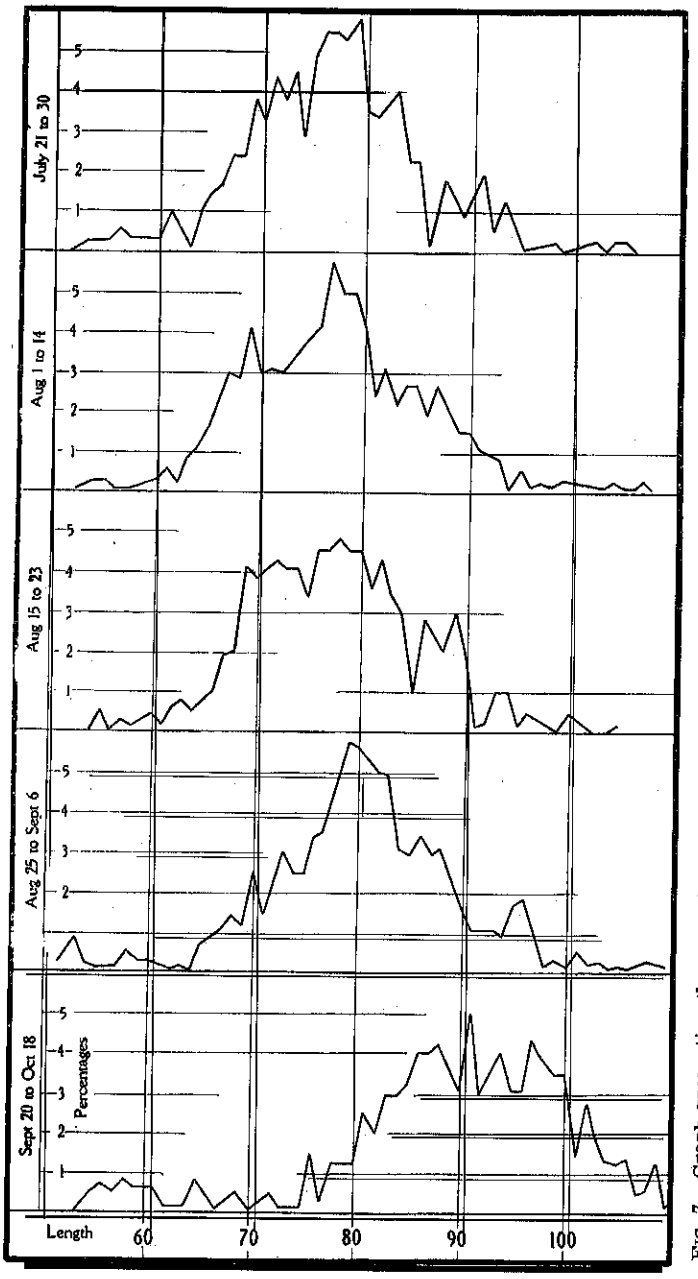

FIG. 7. Graph presenting the percentages of fishes of lengths from 55 to 100 cm., which are found in representative samples of the catch during given periods of the season.

ANGLING FOR SALMON

When the river water becomes sufficiently clear, numerous king salmon are caught by anglers in the lower part of the estuary by means of trolling or casting with a naked spinner. At times, when the river or tidal current is sufficiently strong, it is only necessary to anchor the boat and await a strike.

When hooked with light tackle in the river, the salmon is not given to leaps like the more sprightly steelhead. H'owever, his rushes are strong and often persistent and continued. Occasionally he prefers to fight it out by sulking on the bottom, but soon a new impulse sets him going again, and he is off to resume the struggle. Trolling with heavy line and sinker has been almost entirely superseded by the use of light rods. Casting long distance with a free reel is also a favorite method.

At the height of the season there is scarcely room for the several hundred sportsmen in the restricted estuary. Small canneries have recently sprung up, and now the successful sportsman may have his fish preserved in the usual way, the can even bearing a colored label with his name.

As the fish do not eat after entering the river, the majority of them having initiated their long fast while still at sea, it is commonly supposed by fishermen that the glittering spinner arouses the fighting instinct of the salmon. However this may be, the catch of the angler's hook is much like that of the fisherman's net as regard sex representation and size of the fish. E. A. McGregor paid some attention to this during the season of 1921 and the sum total of his observations may be well represented by the following summary (table 22) of the catch of two days.

TABLE 22

Date	Troll catch				Net catch			
	Number males	Average length males	Number females	Average length females	Number males	Average length males	Number females	Average length females
August 4	20	79.0	49	79.8	34	76.1	70	76.7
August 5	11	78.7	18	76.8	49	78.5	80	77.1

Some king salmon grilse, large and small silver salmon of both sexes, and occasionally a steelhead are caught in the same way. Salmon are occasionally caught with spinners at any place along the river, but they appear to be most easily taken below an obstruction such as an irrigation dam. A resumption of placer mining on the river and resultant silt may at any time put a stop to angling for salmon or steelhead as well.

Reports are current that salmon occasionally bite baited hooks, and one such instance at least, is well authenticated. D. H. Fry, Jr., and R. S. Croker observant anglers, reported to the writer that on September 23, 1927, in a large pool in Salmon River, about 200 yards above the junction of that stream with the Klamath, a salmon was

caught with steelhead roe as bait. The baited hook, intended for a steelhead, was lying on the bottom, when a strike came, which was duly followed by the landing of a small king salmon. The fish weighed 21/2 pounds, and it was a mature male. The stomach was so shrunken as to be entirely functionless.

THE SEAWARD MIGRATION (EMIGRATION)

No one has as yet traced a seaward migration (emigration) of young salmon in Klamath River. One may assume that the habits of the young are similar to those of the same species in other streams as described by Rutter, N. B. Scofield, Gilbert, Chamberlain, Rich and Holmes.

An examination of scales taken from adult fish at the mouth of the river leads to the inference that young fish enter the sea at various stages of growth, from a time shortly after free swimming has been attained to a year or a little more. There appear among these scales several kinds which include not only those bearing what have been termed the stream and ocean type of nuclei, (Figs. 20 and 21) but many others of a composite form, the latter from fish which appear to have prolonged their passage down stream and lingered for a time in the estuary. [7]

Late in the summer and in the early fall, king salmon of the year may be found near the mouth of the river. They are sometimes caught with hook and line and carried away as trout. They are six or seven inches long or even larger. In color they are light yellowish green on the upper surface and silvery on the sides. Faintly traced parr marks are to be seen on the smaller ones, these always standing out in bold relief in preserved specimens. In pursuing these little salmon with net and rod, it became evident that their distribution in the estuary was general. They seemed, however, to prefer the fresh current, although they were sometimes taken in brackish water, Schools of them moved back and forth, before or following the tides. In seining, they were sometimes caught alone, but most often they were associated with such fish as adult salmon, steelheads, flatfish, suckers, sticklebacks, bullheads (Cottus asper), smelt, and others. Both sexes were represented, and an occasional mature male was observed. One is at a loss to account for the presence of a precocious male among down-stream migrants, unless the condition of precocity is soon to disappear in these individuals.

Examples caught early in the season (August 5) are considerably smaller than those taken later (September 15), although an infiltration of small fish seems to be constantly progressing during this time.

A photomicrograph of a scale of one of these estuary salmon, measuring 184 millimeters, is presented as figure 8. Here a well-defined

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7 Rich Willis H. Early history and seaward migration of chinook salmon in the Columbia and Sacramento rivers. U. S. Bureau of Fisheries, Bull., vol. 37 (Doc. 887), p. 70, 1920.

Rich Willis H and Holmes Harlan B Experiments in marking young chinook salmon on the Columbia River, 1916 to 1927. U. S. Bureau of Fisheries, Bull., vol. 44 (Doc. 1047), p. 259, 1929.

Snyder, J. O. The return of marked king salmon grilse. California Fish and Game, vol. 8, no. 2, pp. 102-107, 1922.

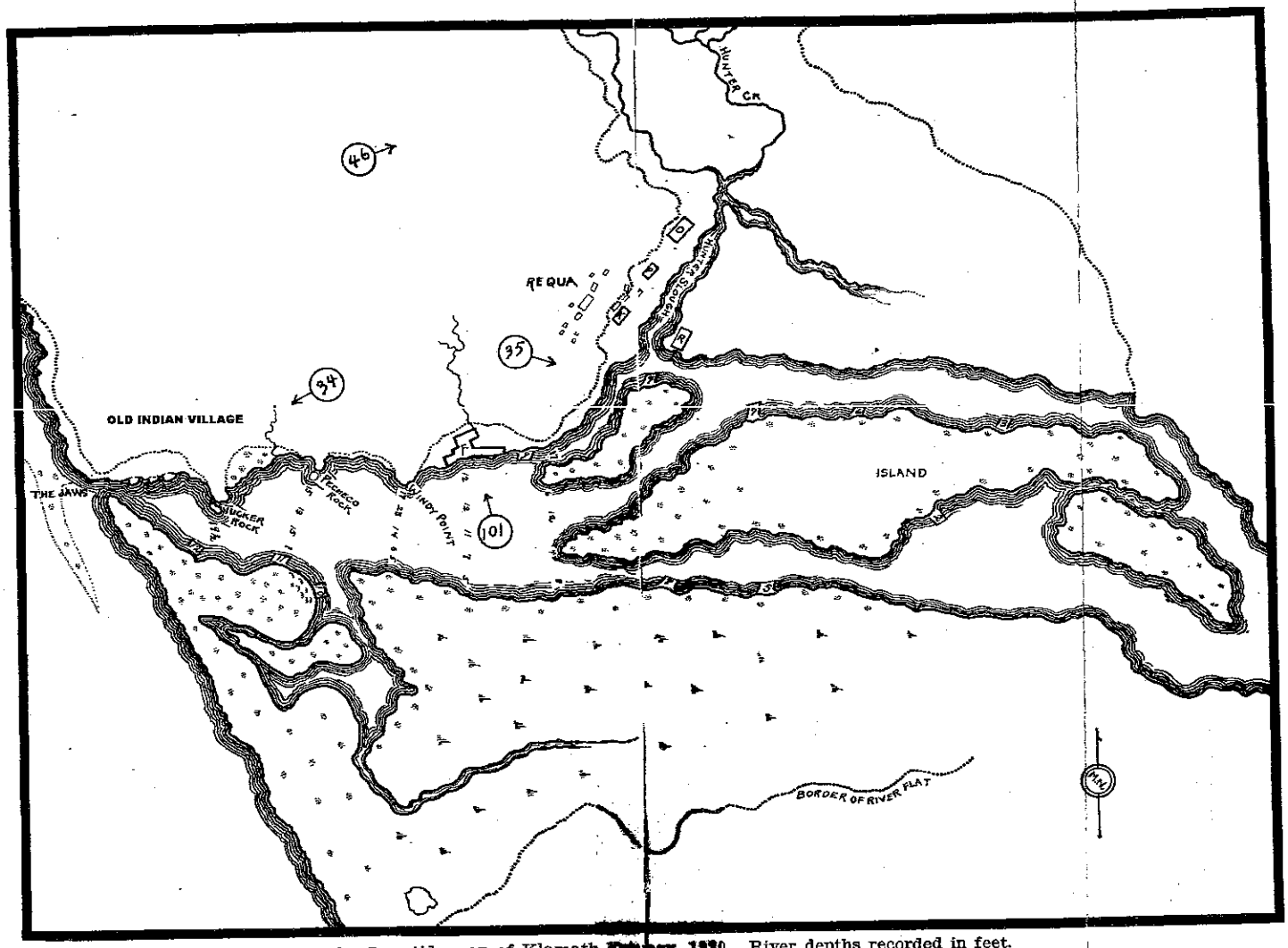

FIG. 9. Low-tide map of Klamath Estuary, 1930. River depths recorded in feet.
F. Plant of Klamath River Packers Association.
D. Del Norte Salmon Canning Company. 1912–1913.
K. Klamath River Canning Company. 1911–1913.
P. W. G. Press. (Never operated.)
R. Requa Cooperative Packing Company. 1917–1918.

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central nuclear region of more or less crowded circuli is to be distinguished from a broad outer area of widely spaced ones. The structure of this scale is typical of every one of the larger estuary fish, the size of the nuclear area remaining fairly constant, while the area lying without or bordering the nuclear part varies in width about as the fish vary in size. There is no evidence that these fish have come in from the sea. On the contrary, it is certain that they are down-stream migrants, lately arrived in the estuary where abundant food has contributed to very rapid growth. It is inferred that the nuclear area of closely apposed circuli represents the growth before reaching the estuary. This inference is supported by observations as follows:

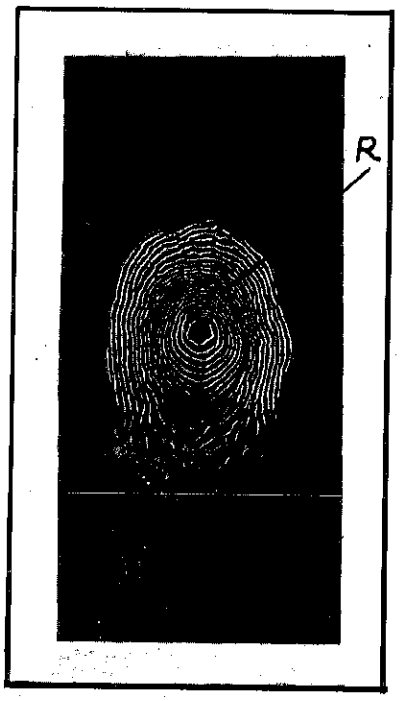

FIG. 8. Photomicrograph of a scale of a small estuary salmon, 184 mm. long.

Early in August, the 6th to be more explicit, many small fish, measuring from 80 to 118 mm., were collected from the estuary. They were then generally distributed, but they could be more easily caught on the bars of the islands and near the mouth of Hunter Creek. Scales from the smallest of these fish are represented by figure 14. It will be observed that this exactly represents a stage comparable with that of R in figure 8. The largest of the fish caught at this time had scales bearing two or three broad rings outside of, or beyond the region represented by the edge of this scale. These rings corresponded exactly with those of figure 8, which are outside of the point *R*. On later dates selections of fish were made, the scales of which bore every intermediate condition of growth between the extremes illustrated by the two figures. The smaller fish were darker in color than the larger, more silvery ones.

Small salmon were collected from points up stream, well above the estuary, and in all cases they bore scales like those represented by figure 14. The fishes themselves were exactly like the smallest ones found in the estuary. No fish like the larger estuary fish was seen there.

In the fall of 1920, September 18 to 26, while observations were being made on a weir which the Indians had placed in Trinity River in Hoopa Valley, young salmon measuring 56 to 75 mm. were secured. Again, on September 27, 1924, they were collected in large numbers. At this time the river was somewhat swollen and roily because of recent rains. Seining was done at two points, at the mouth of Beaver Creek, and about three miles farther up stream near the junction of the main river and the Tishtangatang. The abundance of small salmon was indicated by the presence of some four hundred in a single seine haul.

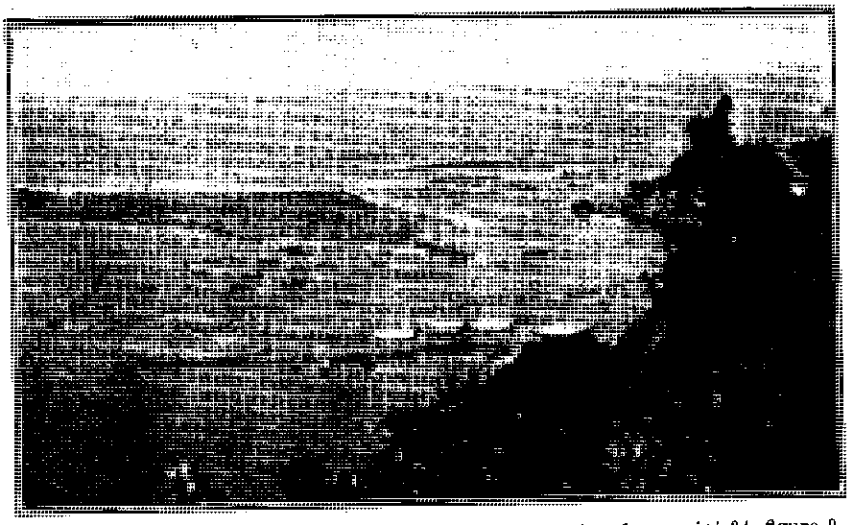

FIG. 10. Line fishing, Klamath Estuary near the Jaws; view from point 34, figure 9.



FIG. 11. Valley of Hunter Creek from point 46, figure 9.



FIG. 12. View up Klamath River from point 35, figure 9.

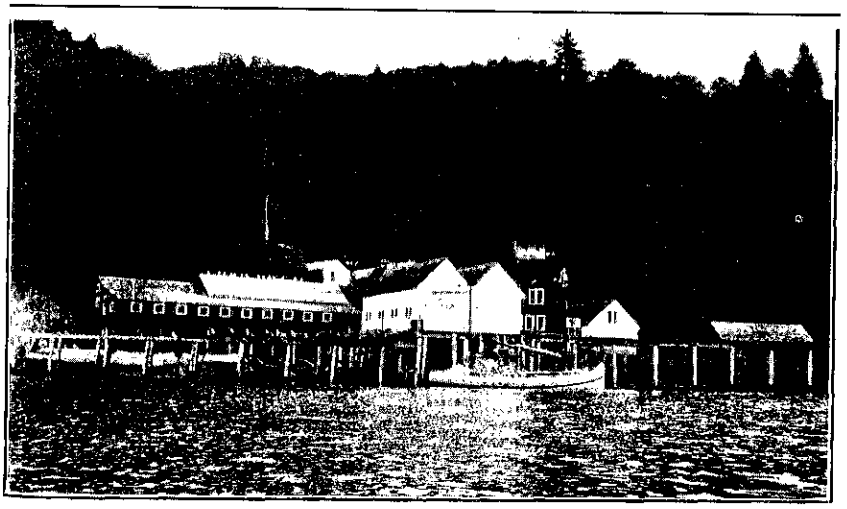

FIG. 13. Plant of the Klamath Packers Association from point 101, figure 9.

As they were plentiful at both places one might safely assume that at least the intervening three miles of river were similarly populated. It was thought that these fish were migrating down stream. They were small in size, measuring 74 to 106 mm. The scales of these were similar to that of figure 14, and the fish looked exactly like those caught in the river above the estuary and like the smallest found in the estuary.

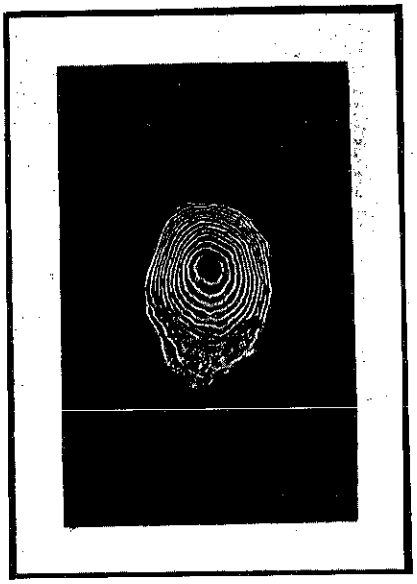

FIG. 14. Photomicrograph of a scale of a small salmon taken in the Klamath Estuary.

Similar salmon from the Sacramento basin, collected from overflow pools near Collinsville, June 22, 1922, had scales exactly like the smaller Klamath specimens, and the fish were like those of the Klamath in size and general appearance.

A pronounced check in growth may be seen at the point R in figure 8. The check is indicated by closely apposed, narrow circuli. Such a check is not present in many examples, the transition from stream to estuary growth being generally abrupt. Such a check has not been seen in any small specimens from either the Trinity or from the Klamath above the estuary.

All this would seem to indicate without doubt that the peculiar structure of scales, such as illustrated in figure 8, may be interpreted as representing an inner nucleus of up-stream growth, and an outer area of varying width of estuary growth. The belief that this type of structure results from environmental conditions as here observed is strengthened by the fact that the scales of fishes of the same species and of the same size as the largest estuary fish, but reared in ponds at Mt. Shasta, bore scales of homogeneous structure throughout.

It would appear from what has been discovered at and near the mouth of the river that a pronounced emigration of young salmon occurs in the late summer and early fall. The extent of this migration is not known and no more information relating to the movements of young salmon in the river is at hand.

A thorough knowledge of the migratory movements of young salmon is essential to any meritorious plan of conservation, and with this in mind observations are now being carried on in the Klamath and one of its tributaries, Shasta River.

When the scales of mature fish are carefully scrutinized, many are found which present exact duplication of the growth record of the large estuary fish. An example of such is illustrated in figure 15, a scale from a fish measuring 50 cm. and caught in the estuary September 1. Here, R represents the stream nucleus and from R to E is thought

to be estuary growth. If the present interpretation of growth as represented by this scale is correct, the individual from which it was taken, hatched from an egg deposited in the fall or early winter, passed down stream in time to arrive in the estuary in the following summer, remained in the estuary until growth represented by ***R-E*** was complete, perhaps late fall, and then migrated to the sea. A check in, growth, probably the first winter check, is plainly indicated at ***E***. From ***E*** to the margin of the scale is no doubt ocean growth. The fish was a mature male in its second year.

A scale from a three-year fish is represented in figure 16. This is from a male, measuring 69 cm. caught in the estuary August 11. Its age is believed to be about three years, and it is very probable that the growth from ***R*** to 1 was made in the estuary.

Among the returned adults in Klamath River are large numbers which bear scales of this type. Intergradations between this record of first year growth and the ocean type, i.e., a very large nucleus of homogeneous structure and even growth, are so complete as to make the two indistinguishable in many cases. The writer is at present unable to state in what proportion either type is represented in the catch, and hence both are termed ocean nuclei and the fishes bearing such scales are separated from those bearing the strictly stream type of nucleus, and which are believed to have remained in the stream somewhat longer than a year.



FIG. 15. Photomicrograph of a scale from a male salmon, 50. cm. long, taken in the Klamath River Estuary, September 1, 1919.

With the tabulated data relating to both ocean and river catches there is a separate enumeration of those fish which have had a protracted life in the stream, extended presumably over a year or somewhat more, and which is indicated in the scales by the presence of the so called stream nucleus. The writer finds nothing of economic importance in this concerning California king salmon. The number of fish which hear scales with stream nuclei which appear in the ocean catch or in the stream immigration is not, in so far as we know, an index to the relative number of young fish which enter the sea either as late or early migrants. Nor has it any known bearing on the question as to whether fry should be released early or late from a hatchery. It appears to be a feature which is entirely beyond artificial control, and in some cases

it is perhaps a matter of chance, as when a tributary becomes closed early in the season by a bar across its mouth, thus entrapping the young fish and delaying emigration.

On several occasions it has been reported that large numbers of young salmon are left to perish in pools of the lower courses of small tributaries as the water dries up. Upon investigation these have proved to be silver salmon. One case may serve to illustrate. On July 8, 1919, the lower course of Turwah Creek was examined. Many isolated pools containing silver salmon were found. Something over 2500 vigorous young fish were rescued from a single pool roughly measuring 10 by 25 feet, and from 3 to 18 inches deep. Seining in the stream above these pools did not reveal any examples of king salmon.



FIG. 16. Photomicrograph of a scale of a male king salmon, 69 cm. in third year, caught in Klamath Estuary, August 11.

OBSTRUCTIONS IN THE RIVER

Klamath River and its principal tributaries are fairly free from obstructions below the large dam at Cnpco. Projects have appeared in the recent past which if carried through would have blocked the stream to most of its migrating fish. Others will come in the future, and eventually the anadromous fish may disappear from the river.

Klamath River presents an almost continuous series Of potential power sites from its source to its mouth. The development of any one of these involves the erection of a high dam which under our present limited knowledge of the habits of salmon and steelhead trout, will constitute an absolute barrier to the upward passage of the migrating adults, or the downward migration of the young. Certain articles have lately appeared in current periodicals which allege that experimental work has conclusively shown that the obstacles presented by high dams to the migration of fish may be easily overcome. These statements are misleading. No method has as yet been devised which will safely provide for the downward migrants, and the only

proposed scheme for overcoming the barrier to up stream migration of adults, which seems at all feasible, is the use of a hoist. The hoist would lift the fish from a channel or fishway at the bottom of the dam. John N. Cobb, who has experimented with the proposed hoist concludes as follows: " If the fish can be induced to enter such a fishway, they may be lifted to almost any desired height. In the majority of cases this method can be employed in getting fish over high dams, provided an experienced biologist, who is familiar with the habits of the fish sought to be lifted is called in before the work on the dam is started. This is absolutely essential as certain precautions must be taken with the bed of the river, etc., before and during the construction period, in order to persuade the fish to foregather in front of the entrance to the fishway or fish hoist. " The writer of the present paper sincerely hopes, however, that the experienced biologist, the dam and the fish may be assembled on some other stream in an effort to persuade the fish to foregather, for if the dam is built and the fish refuse to be persuaded, the jig is up.

In the Klamath River a condition prevails that must be constantly kept in mind in any discussion of the relation of dams and fish, namely, that the principal migrations occur during low water (Fig. 3), and when the water is in greatest demand by the power plant. At this time it will be very difficult to maintain an overflow sufficient for large fishways.

As obstructions appear in a river it becomes increasingly difficult to deal with them, and it seems that no general law or rule will apply to all. If possible, they should be dealt with individually, for each presents a set of problems of its own. A single illustration may serve to explain. On Shasta River is a power plant the chief auxiliary of which is a dam built across the river, at a point about seven miles above its junction with the Klamath. During the migration and spawning period of 1926 the dam was supplied with a functioning fishway and all the requirements of the law were apparently complied with. None the less the presence of the dam was responsible for the daily destruction of large numbers of salmon.

At the time, the dam was about 290 feet long and 7 or 8 feet high. At the left side of the river was a race some 15 or 20 feet wide, which extended 1800 feet or so to the power house. (See figs. 17, 18, and 19.) Its source was protected by a revolving screen. A fishway was placed against the right bank of the river in line with the main channel just as it should be, and an ample flow of water was passing, as was easily demonstrated by tests, fish swimming easily and rapidly up thefishway when given an opportunity. For a long distance below the dam the channel had a deeply scored bed of solid rock with numerous minor channels. One of these channels led from the fishway, while the others came from leaks in the dam and the sides of the race. Fish, in passing up stream, frequently chose the wrong way and instead of reaching the fishway were led aside to struggle up the false channels and at length throw themselves out of the shallow water alongside the race, or batter their heads against the dam. On September 20, 79 large fish, either dead or in impossible situations were seen. A few days later conditions were no better. The remedy in this particular case was both obvious and simple.

Here, also, the law relating to the spearing of fish below a dam was inoperative, for a fish 800 feet below the obstruction was just as much exposed as one 150 feet or less from it.

The Indians sometimes construct a weir on Trinity River[8] where numbers of fish are caught. The weir will not long withstand the high water following the early fall rains, and it appears that the obstruction is rendered inefficient before the migration is well on.

Klamath River has a relatively limited amount of irrigable land in its basin and consequently the problems attending a conflict between agriculture and the conservation of fisheries may not attract attention there for some time.

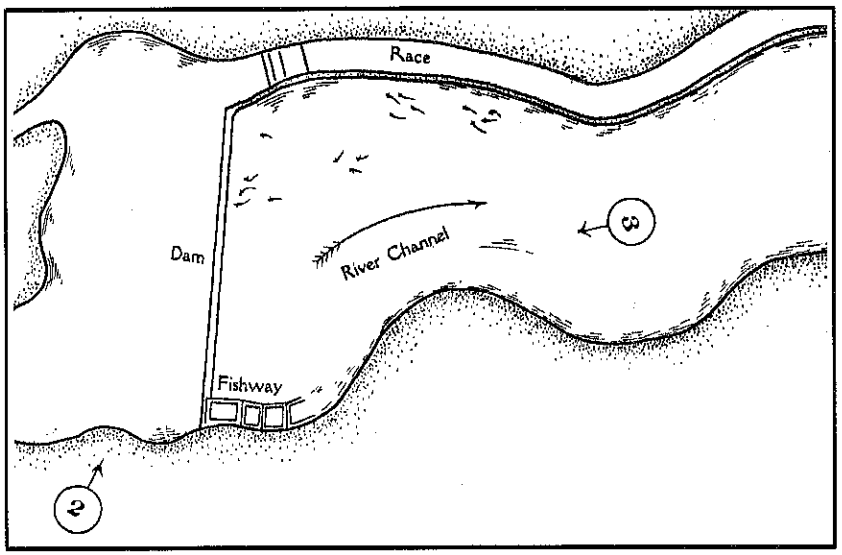

FIG. 17. Map showing dam and the affected part of Shasta River.

THE AGE AT MATURITY OF KLAMATH KING SALMON

An age determination of king salmon has been accomplished here, largely through a microscopic examination of the scales, a method long employed by investigators, and first successfully applied to the various species of Pacific salmon by Dr. Charles H. Gilbert. It is perhaps unnecessary to remark that the method appears to be reliable. In the case of Klamath River fish it has been verified by numerous comparisons with marked individuals of which the age and something of the life history were known. The relations of some details of scale structure to growth are not understood, but these need not enter into the present discussion.

Photomicrographs of two fairly typical scales are here so presented as to illustrate the manner in which the age and one or more details of the life history of the individual fish are portrayed by particulars of structure. (Figs. 20 and 21.) What are commonly known as seasonal

[8]Snyder, 1924, op. cit.

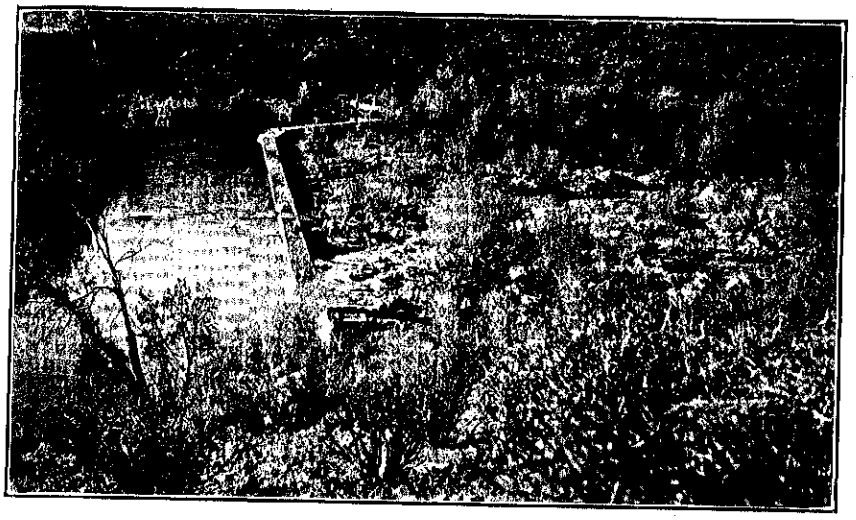

FIG. 18. Shasta River dam with fishway in the foreground and rocky streambed below. View taken from point 2 on map, figure 17.



FIG. 19. Rocky streambed with its numerous false leads fatal to migrating salmon. View from point 3 on the map, figure 17.

checks or annuli, changes in the rate of growth, are depicted at *A* and *D*. That portion of the scale included between *D* and *E* represents the growth of the third year, *i.e.*, from some time in the winter to July 28 in the case of figure 20, and August 27 of figure 21. From *A* to *D* represents the growth of the second year, while from the center of each scale to *A* is a record of the first year. Although somewhat out of place here it may be well to proceed further with an interpretation of the two figures. A marked difference appears in the areas of the two scales from the centers to *A*. One of these (fig. 20) is believed to represent ocean growth while the other (fig. 21) pictures stream growth. From ample observation it appears certain that the fish which bore the former scale entered the sea soon after being able to swim freely, while the one which possessed the latter (fig. 21), to be more particular, remained in the stream for a long time, perhaps a year or so. The parts lying within *A* in both figures, are usually termed nuclear areas, while of the two, the smaller one, representing stream growth, is generally spoken of as a "stream nucleus," and the larger as an "ocean nucleus."

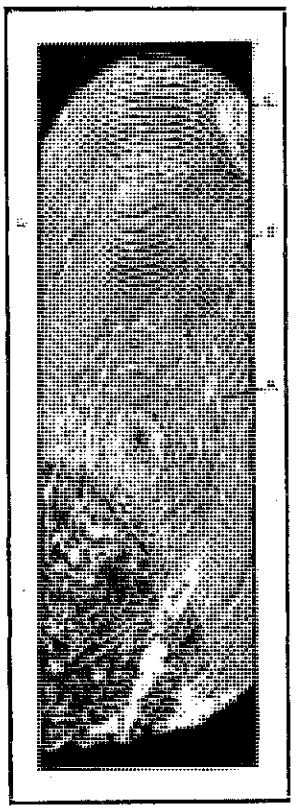

FIG. 20. Photomicrograph of a scale with the ocean type of nucleus.

Klamath River king salmon are found to mature at ages ranging from less than one year to that of six. No seven-year example has been seen. Those which mature before the age of approximately one year are of the male sex only and are usually spoken of as "precocious males." They are numerous at times among fish which are held in hatchery ponds, and they are sometimes found in the rivers, particularly in the estuaries, there mingling with otherwise normal young fish. They appear to mature at about the same time as older individuals, and as a test of the possibility of functioning in the process of spawning, C. V. Cassell, foreman in charge of the Fall Creek Hatchery, was requested to fertilize some eggs with the milt of precocious males. This he did, and the eggs developed in a perfectly normal way. One year later 3000 of the resulting fish were marked by removing the posterior half of the dorsal and the entire left ventral. These were liberated in Klamath River in 1923. Four of them were later recaptured; one in Klamath estuary and one at the Klamathon racks in 1925; one off the coast of Eureka and one at the racks in 1926. All were normal fish. There is some reason to believe that precocious yearlings, together with second-year males, and even the small three-year males, when associating with larger salmon on the spawning beds, may be mistaken for egg-eating trout.

In so far as we know, the two- and three-year males are of no commercial importance in the river catch. There is no way of determining their relative number. If taken at sea, there is no trustworthy method of always separating them from males which might mature at a greater age. In the river estuary they are not entrapped in numbers by the large meshed nets. In the upper courses of the river, as at the

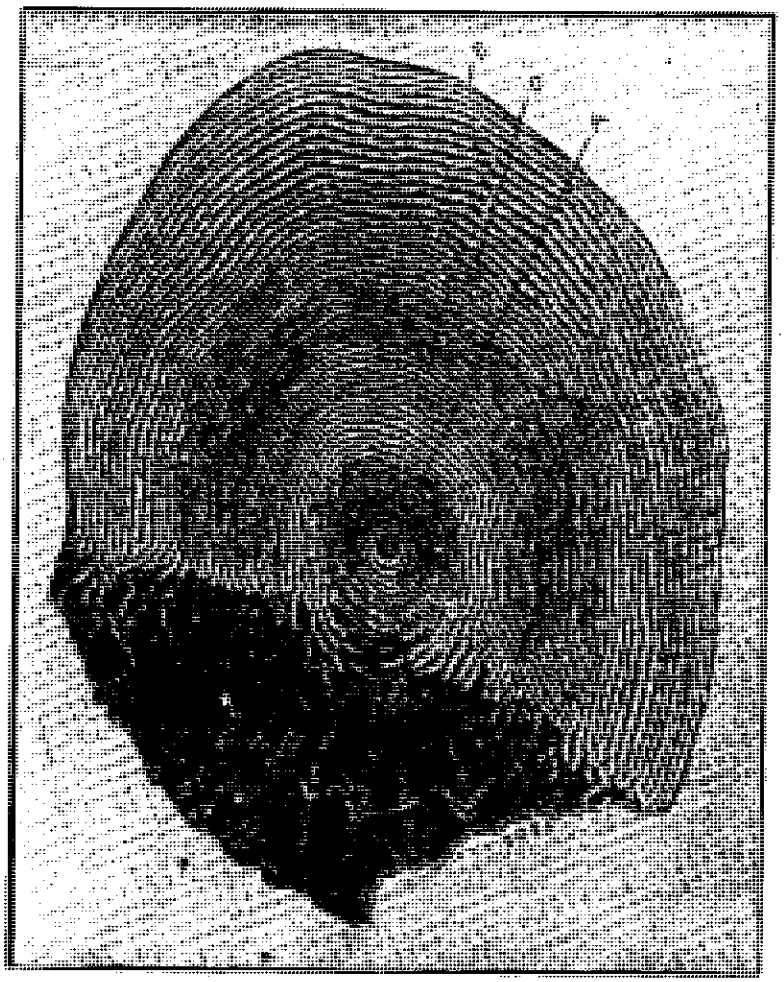

FIG. 21. Photomicrograph of a scale with the stream type of nucleus.

racks, one observes the large number which has escaped the straining process of the estuary fishery. It seems quite probable that these small fish are now reaching the spawning beds in ill-proportioned numbers, and if their propensity to mature at an early age is hereditary and transmissible in a marked degree, their involuntary selection and preservation may be a menace to the fishery of the future. However, so long as the role of precocious yearlings, and of the two- and three-year

males remains unknown speculation regarding them is of little more than passing interest.

Three-year mature males appear to outnumber by far those of two years, but no reliable method of determining anything like an exact proportion of the two classes was found.

Examples of mature fish of the age of two years are not easily obtainable in the Klamath. Those which we have were nearly all caught by means of a small seine. Of 314 specimens from the estuary of the Klamath and from Trinity River, the smallest is 35 cm. in length and the largest 58. The Trinity River individuals average somewhat smaller than the others. Measurements of the series are presented in the following table :

TABLE 23

Length Measurements of Two-year Fish

Length (cm.)	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58
Klamath River, 1919									2	3	1	4	7	5	3	6	8	3	7	3	6	1	3	2		1	1
Klamath River, 1920								1	2	3	2	3	3	4	2	4	2	3	1	3	4		2	2		1	
Trinity River, 1920		1			3	2	2	2	17	17	15	21	28	28	23	18	15	7	3	4							
Totals		1			3	3	4	7	22	21	22	32	35	35	31	29	19	17	10	10	3	5	2	2		1	1

These are smaller than fish of the same class from the Sacramento, where in a series of 33 examples, the smallest is 48 cm. long, the largest 60, and the mean about 55.

All of the above are males and the scales possess the ocean type of nucleus.

When one has at hand samples of the scales of a fish of known length, it is possible, with some degree of accuracy, to compute the length or stature which the particular fish had attained at a given time in its life. This computation presumes that the growth of the scale progresses at about the same rate as that of the fish. It will be of interest to compare the computed second year stature of fish of the same class, i.e., males which entered the sea at an early age but which matured at three, four or five years, with that of these small, two-year individuals.

TABLE 24

Computed Lengths at Two Years, Klamath River, 1919, Males, with the Ocean Type of Nucleus

Length (cm.)	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Length at 2 years of fish matured at 3				1	2	4	6	4	8	8	11	6	9	6	4	2	2					
Length at 2 years of fish matured at 4	1		2	1		4	6	6	13	9	6	12	10	15	11	6	2	7	3	4	1	1
Length at 2 years of fish matured at 5								2	1	4		2	4	13	4	4	1	7	4		2	
Totals	1		2	2	2	8	12	12	22	21	17	20	23	34	19	12	5	14	7	4	3	1

In connection with the above it is to be noted that the measurements of two-year fish were made from individuals which ceased growth in the summer or early fall, while the computed lengths were statures attained at a later date, perhaps midwinter. This may account for the comparatively smaller stature shown by the grilse. The Trinity River fish were smaller than the Klamath River examples, but the former were all

collected by means of a seine of small mesh. The computed length at two years, of fish which matured at three, compares favorably with two-year grilse from the Klamath catch. That of fish which matured at four years is somewhat greater, while that of five-year fish is considerably greater.

Fish of the third year which appear in the catch are included in three categories. The first is of males which have scales of the stream type. These are relatively small, not much larger in fact than two-year males which possess scales of the ocean type. Of this class, 40 exhibited length measurements of from 54 to 67 cm. These fish enter the catch only by accident as they are ordinarily able to pass through the meshes of the nets. The second category consists of males with scales of the ocean type. These fish have evidently spent more time in the ocean than those of the first class and the consequent advantage is reflected in the growth. They are relatively more numerous than those previously mentioned and they are also much larger, ranging in length from 51 to 81 cm., as determined from an inspection of 417 examples. The third group, consists of females which bear scales of the ocean type. These appear in numbers, a condition in the Klamath which is contrary to the observations of Gilbert[9] and Rich[10] in the Columbia. Females of this class appear also in the Sacramento River where they attain large size. Three-year fish contribute something like 11 to 16 per cent to the commercial catch in the Klamath. The three-year fish appear to increase in numbers until about the middle of August after which they grow relatively less numerous until the end of the season.

TABLE 25

Date	Year class			
	Three	Four	Five	Six
	Per cent	Per cent	Per cent	Per cent
July 11-19, 1919	9.9	86.5	3.6	
July 21-26, 1919	9.3	74.3	16.4	
July 28-August 2, 1919	14.3	62.5	22.2	
August 4-9, 1919	25.8	60.2	14.0	
August 11-16, 1919	24.4	64.4	10.8	0.4
August 18-23, 1919	28.3	64.7	7.0	
August 25-30, 1919	23.7	64.8	11.5	
September 1-5, 1919	10.8	73.0	15.9	0.3
September 20-27, 1919	5.5	42.7	44.6	7.2
September 30-October 4, 1919	12.2	38.7	38.7	10.4
Ortober 6-11, 1919	2.8	41.0	43.5	12.7
October 14-18, 1919	4.8	37.5	51.5	6.2

Casual daily observation of the catch as it lies en masse on the floor of the receiving room, reveals an increase of large fish toward the end of the season. The early catches are characterized by comparative uniformity in the size of the fish which are relatively small, while the later catches are distinguished by the incursion of larger and older fish, as is elsewhere shown in detail.

The bulk of the catch consists of four-year fish. In 1919 when the fishing season extended into the late fall, 63 per cent were of the four-

[9] Gilbert, Charles H. Age at maturity of the Pacific coast salmon of the genus Oncorhynchus. U. S. Bureau of Fisheries, vol. 32 (Doc. 767), P. 14, 1913.
[10] Rich, 1920, op. cit., p. 4.

year class. In 1920 and 1923, both shorter seasons, there were 78 and 60 per cent respectively.

Previous to the middle of September, fish of this age class make up 60 to 80 per cent of the catch, while after that date, five- and six-year examples appear in sufficient numbers to reduce the four-year fish to 35 or 45 per cent of the catch.

Four-year fish measure from 61 to 104 cm. in length, the average being somewhere near 80. Individuals smaller than 65 or larger than 95 cm. are very uncommon. Four-year Klamath fish are smaller than those of the Sacramento as is graphically shown in figure 22. Fish which early migrated to sea are on the whole larger than those which spent a year or so in the stream. The males average somewhat larger than the females.

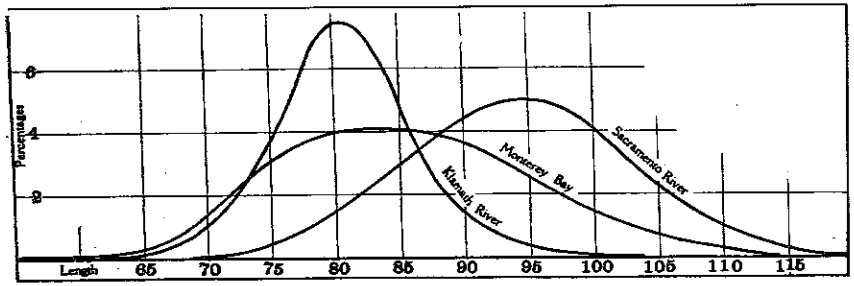

FIG. 22. The number of four-year fish of given lengths in river and ocean catches.

Numerous details relating to the four-year age class are recorded in tables 26, 27, and 28.

TABLE 26

KLAMATH RIVER 1919

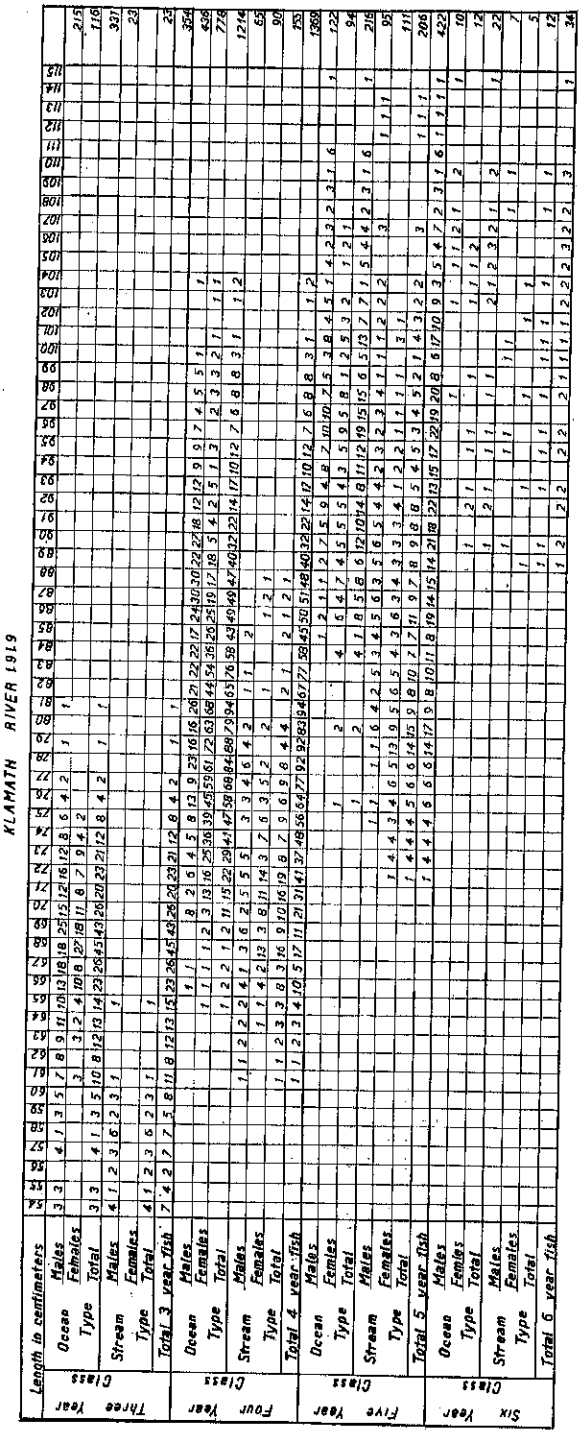

TABLE 27

KLAMATH RIVER 1920

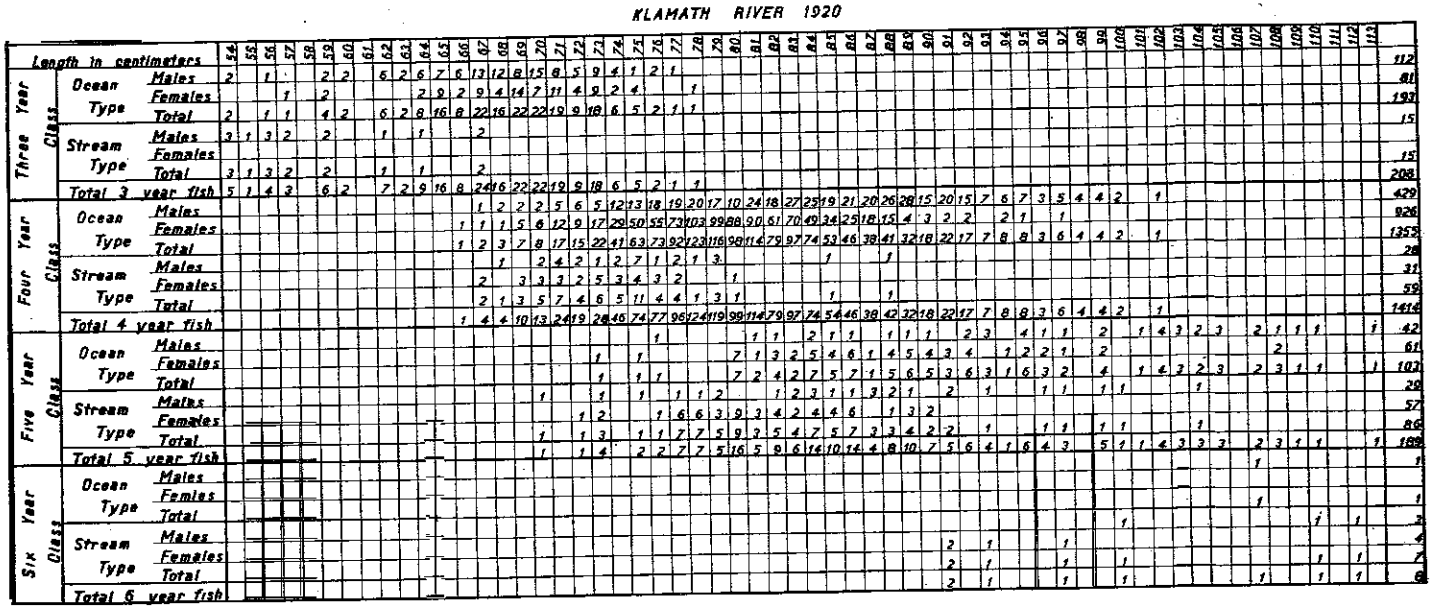

TABLE 28

KLAMATH RIVER 1923

			Length in centimeters	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	
Three Year Class	Ocean Type	Males			1	3		1	2	3	1	6	2	9	11	7	4	10	10	6	4	6	1	2	1																																				90
		Females					1				2	2	7	11	19	24	20	22	12	13	15	2	4	1	1																																				156
		Total		1	3	1	1	2	3	3	8	9	20	30	31	24	32	22	19	19	8	5	3	2																																				246
	Stream Type	Males		1			1																																																		2
		Females																																																							
		Total		1			1																																																		
	Total 3 year fish			1	1	3	1	2	2	3	3	8	9	20	30	31	24	32	22	19	19	8	5	3	2																																		2
Four Year Class	Ocean Type	Males												1	1		1	1	2	3	3	3	4	7	7	9	10	10	21	10	9	17	9	8	6	7	2	10	4	10	2	4																248
		Females										1			3	4	7	6	16	24	19	44	55	64	19	84	82	78	66	59	37	41	16	14	8	7	4	3	2	1		1	1																181
		Total										1			3	4	7	6	16	24	19	44	55	64	19	84	82	78	66	59	37	41	16	14	8	7	4	3	2	1		1	1																826
	Stream Type	Males						1	1			1	3	2	2	1	1	2	4	4	2	2	2	1	1	1			2	1		1																											1007
		Females											1		6	6	10	11	10	12	7	6	1	3	2	1		2			1																												35
		Total						1	1			1	4	2	8	7	11	13	14	16	9	8	3	4	3	2		2	2	1	1	1																												79
	Total 4 year fish						1	1			2	4	3	12	11	19	20	32	43	31	55	62	25	8	9	5	2	2	2	1	1	1																												114
Five Year Class	Ocean Type	Males																							1	1		1	1	2	1	1	1	4	2	6	1			1	3	3		3	1	1	1			1			1		1		1121
		Females																	1		1	1	1		2	3	7	10	18	11	8	7	3	6	6	2	5	1	1	4	2			2	1												39
		Total																	1		1	1	1	1	3	3	8	11	20	12	9	8	7	9	12	3	5	1	2	7	5		3	3	2	1			1			1		1		103
	Stream Type	Males																	1	1					2					2		1		1		1	1	1	1					1		1										142
		Females																	1	2	3		2	2	3	7	2	3	4	2	7	1	4	3			1					1		1											15
		Total																	1	3	4		2	2	3	9	2	3	4	4	4	2	4	4		1	1	1	2					1	1		2										46
	Total 5 year fish																		1	4	4	1	3	3	4	12	5	11	15	24	16	11	12	11	9	13	4	6	3	2	7	5	1	4	3	4	1			1	1			1		1		61
Six Year Class	Ocean Type	Males																														1																								203
		Females																														1																								1
		Total																														1																								1
	Stream Type	Males																								1							1		1		1				1																5
		Females																							1	1	1	2	1		2	1	1	2	1			1			1																15
		Total																							1	2	2	1		2	2	1	2	2		1		1		1	1																20
	Total 6 year fish																								1	1	2	2	1		3	2	1	2	2		1		1		1	1																21

TABLE 29

Summary of Klamath River Age Classes

Year class	3			4			5			6			Totals			Percentages		
Year—	1919	1920	1923	1919	1920	1923	1919	1920	1923	1919	1920	1923	1919	1920	1923	1919	1920	1923
Males	238	127	92	501	457	216	217	71	54	17	4	5	973	659	367	45	36	23
Females	116	81	156	868	957	905	205	118	149	17	4	16	1,206	1,160	1,226	55	64	77
Ocean type	331	193	246	1,214	1,355	1,007	216	103	142	22	1	1	1,783	1,652	1,396	82	91	88
Stream type	23	15	2	155	59	114	206	86	61	12	7	20	396	167	197	18	9	12
Ocean type males	215	112	90	436	429	181	122	42	15	10	1	5	783	584	291	36	32	18
Ocean type females	116	81	156	778	926	826	94	61	103	12	0	1	1,000	1,068	1,086	46	59	68
Stream type males	23	15	2	65	28	35	95	29	15	7	3	5	180	75	57	8	4	4
Stream type females	0	0	0	90	31	79	111	57	46	5	4	15	206	92	140	9	5	9
Totals	354	208	248	1,369	1,414	1,121	422	189	203	34	8	21	2,179	1,819	1,593			
Percentages	16	11	16	63	78	70	20	10	13	1	.4	1						

That the fish of an age class should appear successively larger as the season advances, due to an extended period of ocean growth, might be presumed. Such is the case as is seen in the following table 30 from a series of four-year examples, measured at intervals as they were taken during the season of 1919.

TABLE 30

Date	Average length females in cm.	Number of examples	Averag length males in cm.	Number of examples
July 11–20	77.5	41	75.7	7
July 21–26	77.5	63	81.7	17
July 28–Aug. 2	77.7	122	81.2	48
August 4–9	78.9	73	84.3	27
August 11–26	77.4	72	86.2	54
August 18–23	78.9	114	85.3	57
August 25–30	78.4	80	85.1	51
September 1–6	79.5	123	85.1	99
September 20–25	82.9	26	86.9	25
September 26–October 1	86.8	10	85.6	10
October 2–7	87.9	11	88.9	15
October 8–13	89.7	18	91.9	9
October 14–18	93.2	12	101.1	9

The five- and six-year fish lag behind in the migration, and they are more nearly ripe when they arrive, as is evidenced by the condition of the gonads, by the color of the body and by the development of the snout and teeth. It is presumed that these fish proceed with greater speed to the spawning grounds.

The five-year class contributes 10 or 20 per cent to the catch, the larger percentage appearing when the season is extended to late fall. They measure from 70 to 115 cm. in length. Here again those which migrated to sea early in their stream history average somewhat larger than those which lingered a year or so in the river.

The six-year fish are found only occasionally, 34 examples among 2179 fish in 1919, eight with 1819 fish in 1920, and 21 with 1593 fish in 1923. They are not to be distinguished from the five-year fish in any particular.

From the observations here recorded it will appear that a shortening of the legal fishing season from the late end will allow a relatively greater number of fish which mature at an advanced age, and are consequently larger, to escape the nets. It is believed also that it will contribute in a measure toward a compensation for the straining out of the larger fish by gill net fishing.

The results of an age analysis of catches from Klamath River and also from the Sacramento are here recorded in tabular form. These are based in all cases upon pods of fish which have been received from the fishermen, and from which no selections had been made. Considerable numbers of individuals have been examined, and it is believed that the conditions here found represent the normal for the particular periods. It is to be kept in mind, however, that these are analyses of catches, and not of migrations. They represent individuals which have been selected by the nets. They take no account of fish which are too small to be intercepted, or of those which pass while the nets are inoperative.

TABLE 31

SACRAMENTO RIVER 1919

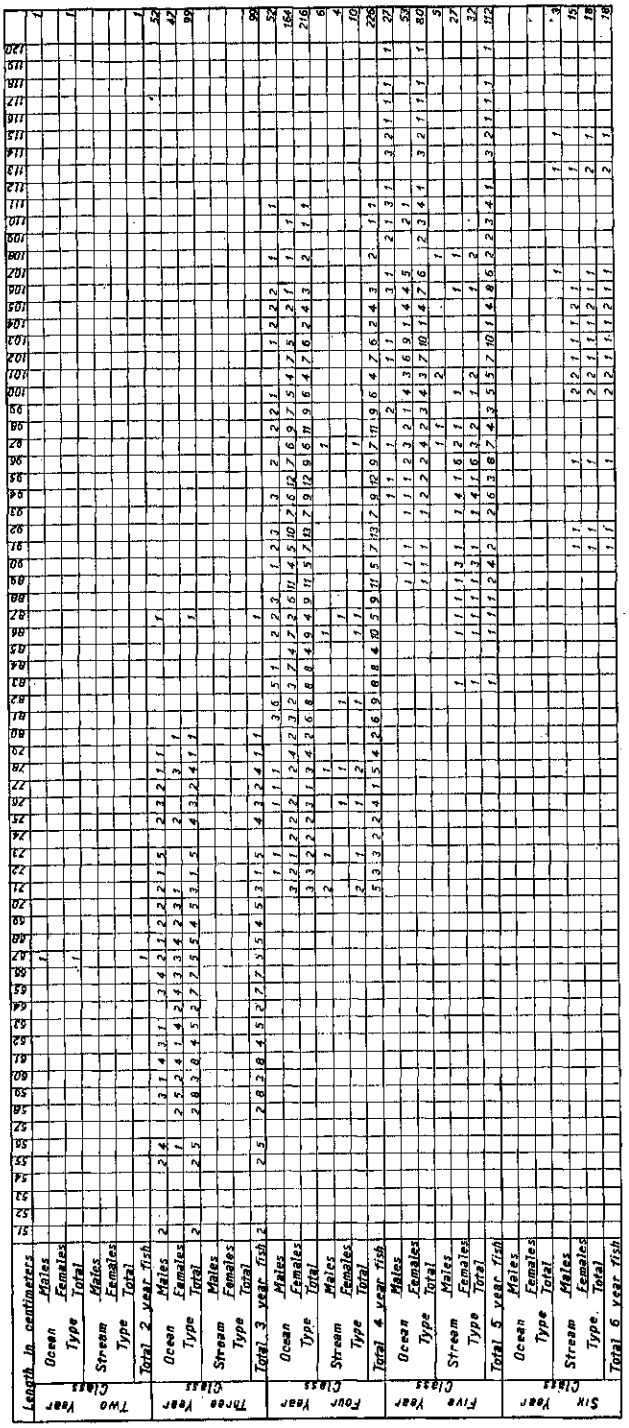

TABLE 32

SACRAMENTO RIVER 1921

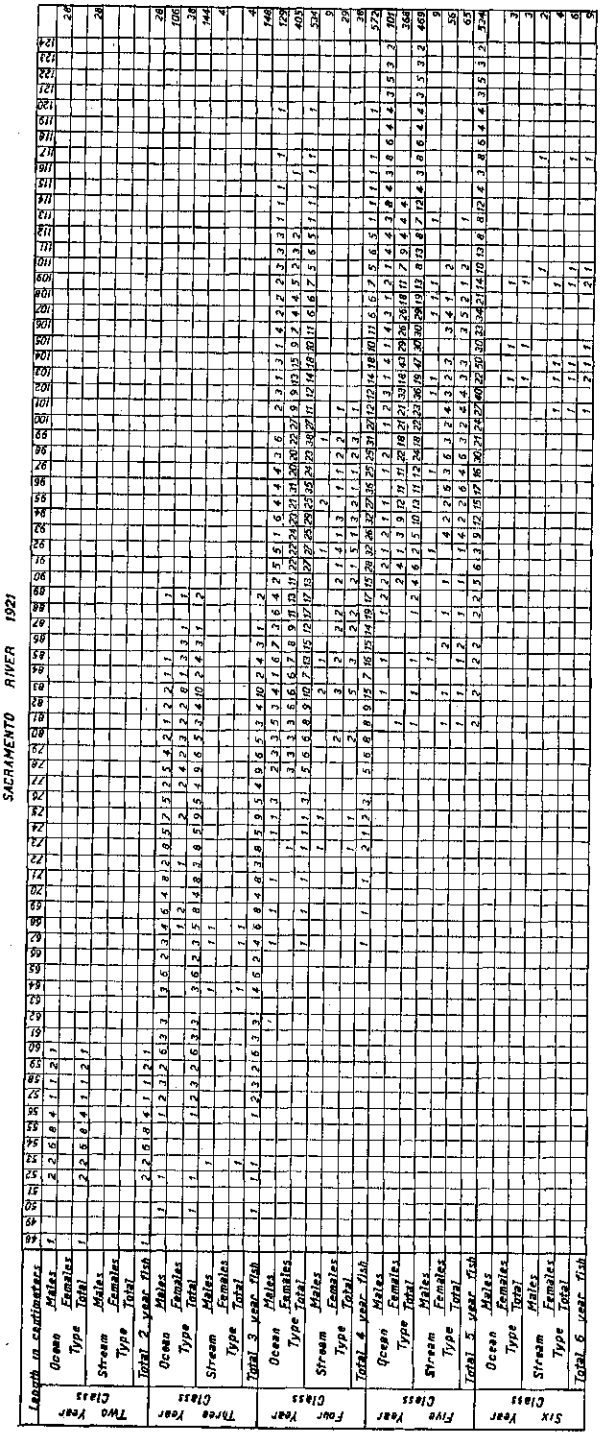

TABLE 33

Summary of Sacramento River Age Classes

Year class	2		3		4		5		6		Totals		Percentages	
Year—	1919	1921	1919	1921	1919	1921	1919	1921	1919	1921	1919	1921	1919	1921
Males	1	28	52	110	68	138	32	110	3	2	146	888	32	30
Females	0	0	47	38	168	434	80	424	15	7	310	903	68	70
Ocean type	1	28	99	144	216	534	80	469	0	3	396	1,178	87	91
Stream type	0	0	0	4	10	38	32	65	18	6	60	113	13	9
Ocean type males	1	28	52	106	52	129	27	101	0	0	132	364	29	28
Ocean type females	0	0	47	38	164	405	53	368	0	3	264	814	58	63
Stream type males	0	0	8	4	6	9	5	9	3	2	14	24	3	2
Stream type females	0	0		0	4	29	27	56	15	4	46	89	10	7
Totals	1	28	99	148	226	572	112	534	18	9	456	1,291	------	------
Percentages	.2	2	22	12	49	44	25	41	4	.7	------	------	------	------

MARKING EXPERIMENTS

Since undertaking the study of Klamath River salmon the writer has come in contact with or initiated several marking experiments, the principal purpose of which was to determine as definitely as possible the ocean range of growing fish, and to test in some detail the parent stream theory.

Previous to this one or more carefully planned and executed experiments were undertaken by State authorities, from which no returns were secured. It was later suspected that failure was due, not to any methods used in the process, but rather to lack of an energetic attempt to secure returns. The method used in all cases was that of fin mutilation. Fishes were held in rearing ponds until of sufficient size, when the adipose together with all, or a part of some rayed fin (fig. 23) was so excised as to prevent regeneration. Returned fish have amply demonstrated the efficiency of the marking method when the

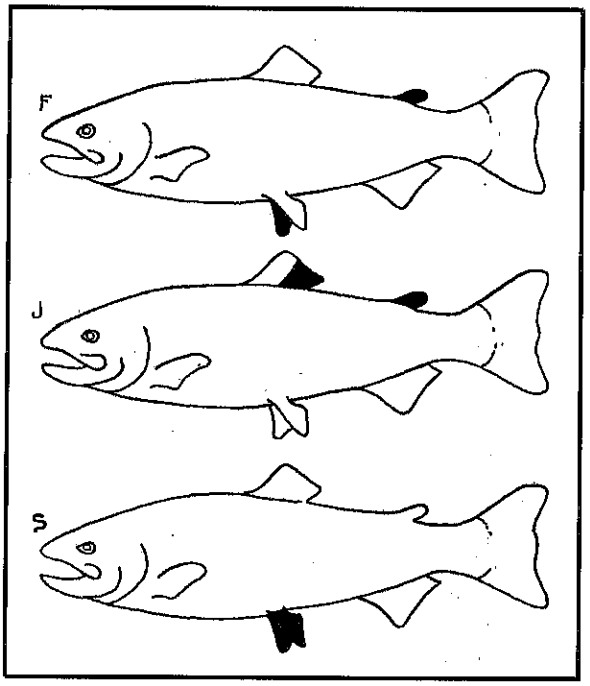

FIG. 23. Diagram showing how various lots of salmon were marked in experiments on the Klamath River.

details are in the hands of careful operators. The employment of good observers, and the cooperation of fishermen, dealers, and others have secured excellent returns from the later experiments.

Experiment in 1916.

On August 29, 1919, a king salmon measuring 43 inches, weighing 35½ pounds, and having the adipose and left ventral fins absent, was taken in the estuary of the Klamath. This was one, and the only one, recovered from 3500 marked yearlings released in the Klamath, February 15, 1916. The eggs were from Battle Creek, a tributary of the Sacramento. This merely served to show that a salmon introduced into the Klamath, although the egg which produced it was from another stream, would return to the Klamath. Also an age estimate made from a scale from the fish was in accord with its known age.

Experiment in 1918.

A later experiment? was somewhat more fortunate. Fry from Sacramento River eggs to the number of 18,000, and marked by removing the adipose and left ventrals, were liberated in Cold Creek, a tributary of the Sacramento on March 19, 1918. Three adults from these young fishes were secured in 1920. One was taken at Monterey, April 6; another was caught at Shelter Cove, August 17; a third entered the Sacramento and was secured near Pittsburg, September 15. From this it became apparent that Sacramento River salmon had a far more extensive ocean range than was suspected. The parent stream theory also found another fact in its support.

Experiment in 1919.

In November, 1919, 25,000 yearling king salmon, marked by the removal of the adipose and right ventral fins, were liberated in Fall Creek, Klamath River. The eggs from which these were hatched came from Mill Creek, a tributary of the Sacramento[12]. Considerable publicity was given to this experiment and a small reward was offered for data relating to captured fish. The following summary (table 34) presents the returns from this attempt.

Here, in accord with previously observed facts, the returning adult fish on their nuptial migration from the sea, entered the river into which they had been introduced, and proceeded toward the particular tributary in the waters of which they were reared. None was taken in the stream where the eggs were procured. It was also demonstrated among other things, that Klamath salmon migrate southward at least to Monterey Bay.

Experiment in 1920.

In September and October, 1920, 20,000 king salmon, hatched from eggs taken at Mill Creek, a tributary of the Sacramento, and reared in ponds at the Mt. Shasta Hatchery, were marked by removing the adipose and posterior half of the dorsal fin.[13] On April 8, 1921,

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11 Snyder, J. O. Three California marked salmon recovered. California Fish and Game, vol. 7, no. 1, pp. 1-6, 1921.

12 Scofield, W. L. King salmon marking experiment at Klamath River, 1919. California Fish and Game, vol. 6, no. 3, p. 101, 1920.
Snyder, J. O. The return of marked king salmon grilse. California Fish and Game, vol. 8, no. 2, p. 102, 1922.
Snyder, J. O. A second report on the return of king salmon marked in 1919, in Klamath River. California Fish and Game, vol. 9, no. 1, p. 1, 1923.
Snyder, J. O. A third report on the return of king salmon marked in 1919 in Klamath River. California Fish and Game, vol. 10, no. 3, p. 110, 1924.

13 Scofield, W. L. Sacramento River salmon marking. California Fish and Game, vol. 7, no. 2, p. 125, 1921.

TABLE No. 34

Summary of Data Relating to the Capture of Fish Marked in 1919

Locality	Number of fish	1921	Number of fish	1922	Number of fish	1923	Number of fish	1924
Monterey Bay			2	June 7–14				
Off Point Reyes			1	July 7				
Off Fort Bragg					1	June 8		
Off Cape Mendocino			1	August 5	1	July 17		
Redding Rock			4	July 21–August 3				
Klamath Estuary			1	August 14	2	August 17–31		
Klamath Racks	23	October 24–November 14	15	October 19–November 15	8	October 24–November 15	1	November 8

the surviving 15,400 were introduced into Sullaway Creek, a tributary of the Sacramento.

The first reported returns from this experimental introduction came from Battle Creek (B on fig. 24) a, hatchery of the U. S. Bureau of Fisheries, where 7 grilse measuring from 53 to 63 cm. in length were taken. These were seen by W. E. Lupardus in charge of the station, on dates from November 4 to 21, 1922.

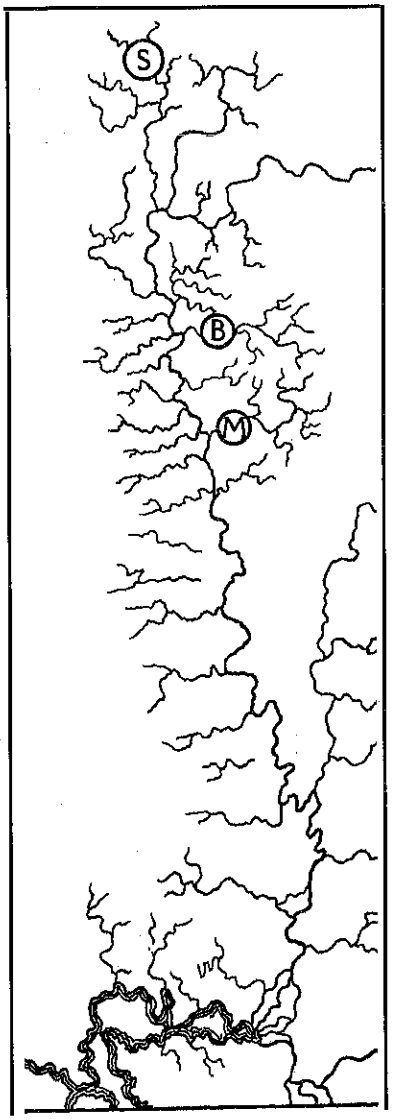

FIG. 24. Map of Sacramento River indicating where marked salmon were liberated when young and caught when mature.

Two were later taken at sea, the first on April 13, 1923, in Monterey Bay, the second July 25, near the Eureka Bar. Here again the wide sea range of Sacramento salmon was demonstrated.

In 1923, from October 27 to December 5, fish bearing the mark of this experiment entered Mill Creek and Battle Creek where they were taken by C. A. Hruby and also by Mr. Lupardus. These fish measured from 66 to 96 cm., and were representative of both sexes.

One other example was reported from Battle Creek, November 20, 1924.

A summary follows in table 35.

Here the yearlings were planted in the headwaters of the river (S on fig. 24), and on their return migration as adults were apparently scattered over the basin. There is no reason to presume that they entered only Mill Creek (M on fig. 24) and Battle Creek, but rather that these were the only places from which they were likely to be reported.

It has been recognized that the Sacramento is not a stream which is well adapted for experimental purposes. The river itself is tempermental, so to speak, responding quickly to periods of rain or drought, breaking over its banks and-flooding its bottoms at times, or shrinking and dwindling when the season is dry. Irrigation projects, dams for power purposes, commerce and pollution, have also contributed to its difficulties. And with all this it is not easy to get returns from experimental work because of the varied nationality of its fishermen. At the time of the return of these fish

the river was unusually low and conditions were not what might be considered as normal. Possibly the behavior of the migrating salmon was not altogether normal,

TABLE 35

Locality of capture—	Date	Sex	Length in cm.
IN 1922, THE THIRD YEAR OF THE EXPERIMENT			
Battle Creek	Nov. 4	Male	
Battle Creek	Nov. 4	Male	
Battle Creek	Nov. 13	Male	63
Battle Creek	Nov. 18	Male	63
Battle Creek	Nov. 18	Male	53
Battle Creek	Nov. 20	Male	53
Battle Creek	Nov. 21	Male	56
IN 1923, THE FOURTH YEAR OF THE EXPERIMENT			
Monterey Bay	April 13	Male	75
Near Eureka Bar	July 25	Female	86
Mill Creek	Oct. 27	Male	66
Mill Creek	Oct. 27	Male	66
Battle Creek	Nov. 7	Female	71
Battle Creek	Nov. 9	Male	74
Mill Creek	Nov. 13	Female	89
Mill Creek	Nov. 14	Female	76
Battle Creek	Nov. 15	Female	86
Battle Creek	Nov. 16	Male	96
Battle Creek	Nov. 17	Male	84
Battle Creek	Nov. 20	Male	86
Battle Creek	Nov. 22	Female	71
Mill Creek	Dec. 4	Male	71
Mill Creek	Dec. 5	Male	71
IN 1924, THE FIFTH YEAR OF THE EXPERIMENT			
Battle Creek	Nov. 20	Female	89

For some years salmon have been reared in the hatchery at Sisson and at opportune times allowed to escape into the upper part of the Sacramento. However, no return migration has been reported to that part of the stream above the mouth of Pit River, and the question has been raised as to what became of these fish. The results of this experiment offer a provisional answer, namely, that such as return are probably scattered over the entire basin, or because of adverse conditions they are forced to enter tributaries before they are able to reach the one into which they were originally introduced. The inference that some of them returned to the tributary from which the eggs were taken because of that, is scarcely to be entertained.

Experiment in 1922 (Sacramento River).

It was desired that evidence be obtained to show whether fish hatched from Klamath eggs, and introduced into the Sacramento would return to that, stream as adults. Accordingly, 15,000 yearlings from Klamath River eggs taken at the Klamathon racks and reared at Mt. Shasta, were marked by removing the adipose and both ventral fins, and introduced into the Sacramento basin from the hatchery in October; 1922. The marking of these fish was performed by E. A. McGregor.

One of these fish measuring 50 cm. was caught at Santa Cruz, May 13, 1924. The next year, 3 others were taken at Eureka, June 7, 15, and 25. Another was secured at Bodega Head, July 25. Nothing further came of this effort,

Experiment in 1922 (Klamath River).

In the fall of 1922 it was planned to initiate an experiment at Fall Creek which should demonstrate whether introduced salmon, on their return from the sea, would tend to enter the particular tributary in which they were planted. A sufficient number of yearlings was not available and the work was postponed. However, in lieu of the intended plantings, 18,500 yearlings from which the adipose and left ventral fins had been removed were released in Fall Creek in November. These fish were reared from eggs taken at the Klamathon station.

In 1924 six individuals carrying the mark of this experiment were secured in the estuary of Klamath River, August 19 to 26. They were all males measuring from 54 to 63 cm. From October 16 to November 1, 13 examples were collected at the Klamathon racks. These were males measuring 47 to 64 cm.

In 1925, 161 examples were observed. Four were caught off the coast near Eureka, May 18, June 25, July 31, and August 1; 1 near Cape Mendocino, May 30 ; 6 off Trinidad, June 21 to July 14; 2 near Patricks Point, June 22; 3 off Big Lagoon, July 10; 92 in Klamath estuary, July 23 to September 3 ; and 53 at the Klamathon racks, September 11 to November 3.

In 1926, 52 fish of this class were caught ; 2 off Trinidad (no date) ; 1 near Eureka, August 25, and 2 more September 5; 33 in Klamath estuary, July 15 to August 28; and 14 at the racks at Klamathon, October 16 to 24.

In 1927,1 was taken off Eureka, July 8 ; 2 in Klamath estuary July 27; and 1 at the same place August 6.

Some of the 1925 fish, four years old, which came into Klamath River were measured with the following results :

TABLE 36

Length in cm.	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94
Male	1	--	--	3	1	5	4	3	2	5	4	--	2	3	--	2	1	1	1	1	1	--	--	--	--
Female	2	2	2	6	11	9	10	4	5	8	6	2	6	2	1	2	--	--	2	1	--	--	--	--	1
Totals	3	2	2	9	12	14	14	7	7	13	9	2	8	5	1	4	1	1	3	2	1	--	--	--	1

When these length measurements are compared with those of a similar class, i. e., four-year fish bearing scales with a stream nucleus, assembled from examples observed in previous years, 1919, 1920 and 1923, to be particular, it appears that the fish of this experiment have attained a considerable greater stature. An inspection of the following table will confirm this:

TABLE 37

Length in cm.	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88
Male	1	1	3	3	2	4	2	3	6	8	5	10	9	10	6	12	17	8	8	8	3	--	1	3	--	2	2	1	--	1
Female	--	--	--	--	1	1	4	4	4	2	17	24	27	18	22	17	12	5	5	2	4	--	3	--	--	--	1	1	2	1
Totals	1	1	3	3	3	5	6	7	10	10	22	34	36	28	28	29	29	13	13	10	7	--	4	3	--	2	3	2	2	2

The five-year fish which appeared in 1926 and entered the river measured from 69 to 98 cm. The sexes were about equally represented.

Experiment in 1923-1924.

An experiment was planned in 1923,[14] the purpose of which was to demonstrate whether returning fish would actually seek out and enter the particular tributary in which they were reared. It was also desired to learn something of the behavior of returning fish which had been reared in the water of one tributary and then introduced into an adjacent tributary. It is perhaps needless to remark that information of this sort is of great practical importance in artificial propagation and distribution.

The upper Klamath furnished an ideal layout for the experiment, as will be seen from an inspection of the accompanying figure 25. The division maintains a hatchery at Fall Creek, and an egg-collecting station on the main river at Klamathon. The racks at this station are so placed in the river as to trap every salmon which passes up during the fall migration, thus enabling an observer, if he so desires, to examine the fish individually. A particular fish after entering the trap may be held for a period between the racks, or it may be passed on and allowed to pursue its way up the river. About 15 miles above this trap is the great Copco dam which presents an impassible barrier to migrating fish. About 2 miles below the dam, Fall Creek enters the Klamath. This is a large, perennial stream of clear, cold water, with a high fall at a point about a mile above its mouth. The hatchery is located at the foot of the fall. The creek below the fall is small and clear enough to permit of inspection throughout its length, and salmon which enter it may be easily seen and taken if occasion warrants. Jenny Creek, a stream similar to Fall Creek, but unfortunately without barriers, enters the main river somewhat over 2 miles below the mouth of Fall Creek. Salmon are known to enter this stream, and there is no apparent reason why they should not do so at any time if so inclined. Several miles below the Klamathon racks, Shasta River enters the Klamath. It is a stream which formerly was famous for its salmon and trout.

The young salmon used for experimental purposes were selected from the large number reared at the Fall Creek hatchery. These were from eggs collected in 1922 and held in the rearing ponds until the following fall, 1923, when 75,000 of them were marked.

From 25,000, the adipose and right ventral fins were removed. (See fig. 23.) These were allowed to enter Fall Creek, October 8, where they might pass down and into the main channel of the Klamath.

Another 25,000 were marked by removing the adipose and posterior half of the dorsal. These were transported to Jenny Creek and introduced at a point about 500 feet above the mouth of the stream on October 4, 9 and 11.

A third lot of 25,000 had both ventrals removed. They were taken to Shasta River and introduced near the highway bridge, eight-tenths of a mile from the junction of that stream with the main river, October 5,10 and 14.

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[14] Snyder, John O., and Scofield, Eugene C. An experiment relating to the homing instinct of king salmon, California Fish and Game, vol. 10, no. 1, p. 9, 1924.

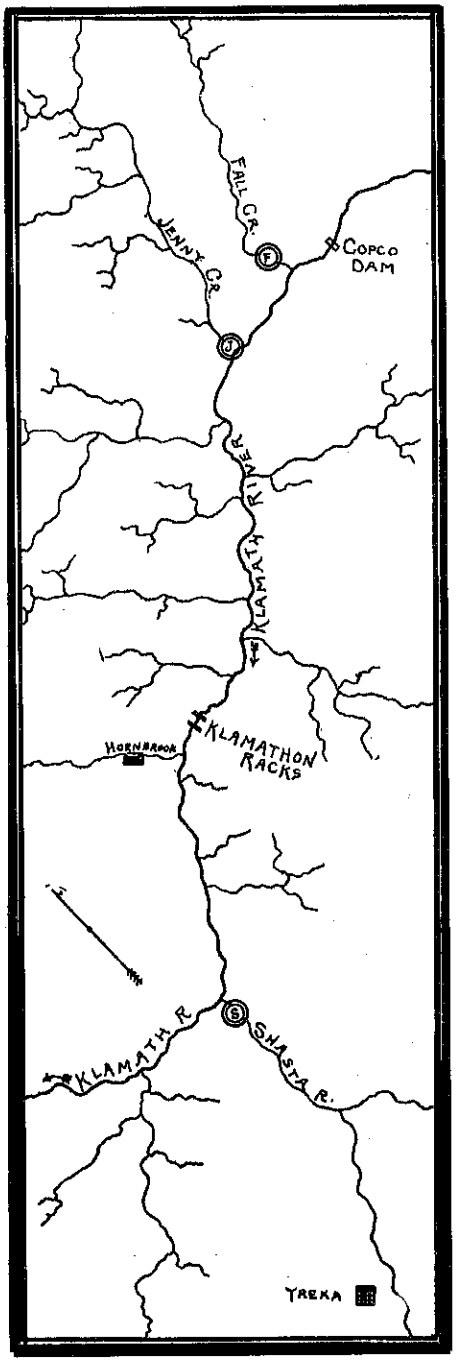

FIG. 25. Map showing location of salmon spawning and marking experiments on the Klamath River.

The first group had been hatched and reared in the waters of Fall Creek, and then allowed to enter the stream at a point which would necessitate a passage of one mile through its channel before entering the main river. The second group was given an exposure of only 500 feet to the waters of Jenny Creek. Some of them only loitered in the stream a few hours before entering the Klamath. Some of these might mingle with others of Fall Creek on their downward migration to the sea. The third lot had an exposure of nearly one mile to the water of Shasta River. It will be seen that if the adults return to the tributaries into which they were placed, all of them will pass the fishery at the mouth of the river; the Jenny Creek and Fall Creek fish will come into the racks at Klamathon; while the Shasta fish may enter this tributary, the one in which they were planted, or they may move up the main channel where they will be intercepted at the racks.

On the following year, 1924, the planting was repeated, each detail of the previous year having been observed.

The greatest care was taken throughout the work, so that no mixing of the fish would occur at the hatchery, and that no marked fish would accidentally escape into the river. Conditions were not favorable in Shasta River as the water was low at the time of both plantings, and fish could not be held at Fall Creek until later in the season when the water might be

expected to rise. It is obvious, however, that the introductions were all successful, for returns were received from them at sea, at the mouth of the Klamath and from points farther upstream as were expected.

A brief summary of the recorded captures of adult fish of this experiment follows:

TABLE 38

Fin marks	Date of capture							
	1925				1926			
	At sea	Klamath estuary	Klamathon racks	Shasta river	At sea	Klamath estuary	Klamathon racks	Shasta river
Right ventral, Fall Creek	8	8	29	0	31	81	140	0
Half dorsal, Jenny Creek	0	3	7	0	17	69	104	0
Both ventrals, Shasta River	0	2	0	1	5	6	2	2

TABLE 38--Continued

Fin marks	Date of capture								Totals
	1927				1928				
	At sea	Klamath estuary	Klamathon racks	Shasta river	At sea	Klamath estuary	Klamathon racks	Shasta river	
Right ventral, Fall Creek	36	185	21	0	9	35	0	0	583
Half dorsal, Jenny Creek	37	151	24	0	2	34	2	0	450
Roth ventrals, Shasta River	8	35	5	1	2	5	2	0	76
Totals									1,109

As might have been predicted, that part of the experiment which pertained to Shasta River was not rewarded by very abundant returns. Fishes bearing its mark were not caught anywhere in large numbers. None the less, they appeared in marine catches and they came into the Klamath on their nuptial migration. The fact of particular interest is that part of them entered the Shasta, while others pursued their course up the main river until they encountered the racks at Klamathon. Apparently all of those fish which were planted in Fall and Jenny creeks and which escaped the nets in the estuary, moved up the main channel and entered the racks as if bound for the tributaries from which they had once migrated toward the sea.

On observing the split in the migration of the Shasta fish, one's curiosity is at once aroused as to how the Fall and Jenny creek fish might have behaved if not intercepted by the racks, and fortunately an answer is at hand.

In 1926, 124 fish bearing the Fall Creek mark and 85 of the Jenny Creek planting were taken out of the Klamathon trap and allowed to pass on up the river. A considerable number of these were tagged with metal bands on the upper lobe of the caudal, that they might be easily recognized in the water. This tagging was soon abandoned because of

the weakened condition of many of the fish, some being unable to stem the strong current after being released. Marked fish were passed over the racks from September 26 to November 7.

Of the fish which were allowed to pass up the river, 59 were eventually recovered as follows :

34 Fall Creek fish caught in----------Fall Creek
3 Fall Creek fish caught in----------Bogus Creek
2 Fall Creek fish caught in----------Klamath River
1 Jenny Creek fish caught in----------Jenny Creek
16 Jenny Creek fish caught in----------Fall Creek
1 Jenny Creek fish caught in----------Bogus Creek
2 Jenny Creek fish caught in----------Klamath River

The fish which came into Bogus Creek (Fig. 26) were intercepted by the traps at an egg collecting station. The single one caught in Jenny Creek was taken in an improvised trap over which others might possibly have escaped, as it was difficult to keep it free from floating leaves.

It would appear from the results of this experiment that when yearlings are introduced into, and given a sufficient exposure to the waters of a particular tributary, they tend on their return migration to seek out and enter that tributary, while under other conditions, they may scatter to a considerable extent.

Observations seem to confirm the belief that in nature a species is under a condition similar to water in a reservoir, namely a proclivity to break down its barriers and spread. The homing instinct is a barrier to dispersal in the case of the salmon, and apparently in many other species as well. For example, striped bass and shad which were introduced into the Sacramento basin, returned there in large numbers after their seaward migration, but a small scatter occurred, the species having attempted to extend their ranges both north and south of the place of introduction. It may be inferred that at least a slight dispersal accompanies the return of either artificially or naturally propagated salmon, the tendency of a few individuals to scatter or break over the natural barrier to dispersal offering the species an opportunity to extend its range.

The four-year-old marked fish which came into the nets of the estuary in 1926 and 1927, and of which measurements and sex detemina-tions are available are very similar to fishes of the same age and type usually taken, as will appear when the following summary is compared with tables 26, 27, and 28.

The summary, table 38, indicates that the toll of marked fish taken by the nets at the mouth of the river grew relatively greater as the fish increased in size. In 1925 when only the small three-year fish returned, the nets stopped 13, while 36 came to the Klamathon trap. In 1926 when both three- and four-year fish appeared, the nets caught 156 while 246 reached Klamathon. Nine of those taken in the nets, and 21 of those taken between the racks at Klamathon were three-year fish In the following year the nets took 371 fish, leaving only 50 to be caught at Klamathon. In 1928, when the largest fish, five- and six-year individuals entered the river, 74 were caught in the estuary, and only 4 were seen at Klamathon. As a matter of fact the number caught in the

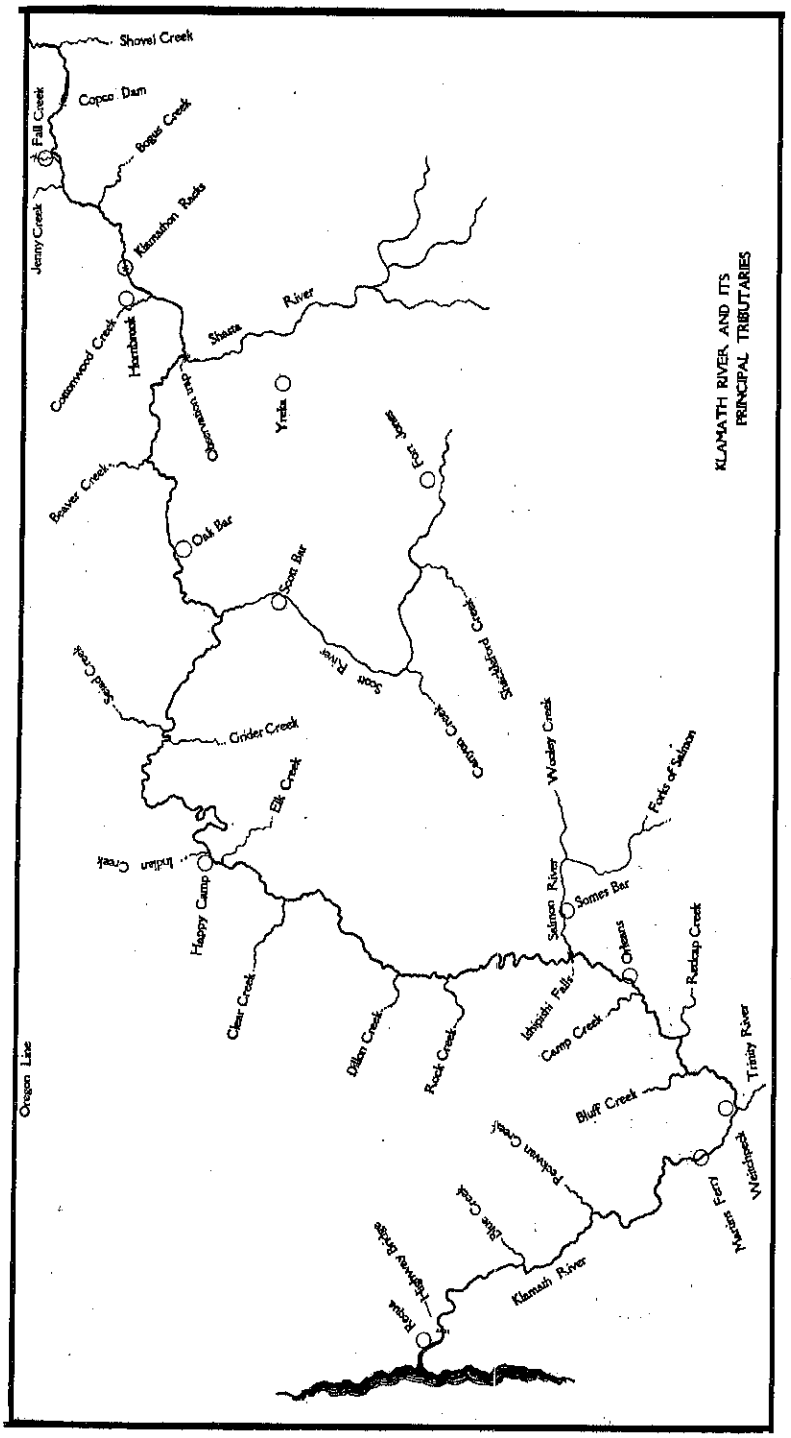
KLAMATH RIVER AND ITS
PRINCIPAL TRIBUTARIES
Shovel Creek
Copco Dam
Fall Creek
Bogus Creek
Jenny Creek
Klamath Rocks
Cottonwood Creek
Hornbrook
Shasta River
Quartz Mountain
Yreka
Beaver Creek
Fort Jones
Oak Bar
Scott Bar
Scott River
Seiad Creek
Seiad Creek
Grider Creek
Elk Creek
Indian Creek
Happy Camp
Clear Creek
Dillon Creek
Rock Creek
Oregon Line
Wooley Creek
Forks of Salmon
Salmon River
Somes Bar
Orleans
Ishipishi Falls
Camp Creek
Redcap Creek
Bluff Creek
Trinity River
Weitchpec
Hoopa
Johnson Bridge
Klamath River
Blue Creek
Pecwan Creek
Myers Ferry

FIG. 26.

nets is considerably larger, for the returns here recorded came almost exclusively from the plant of the Klamath River Packers Association, the various dealers who ship fresh fish from the Klamath being unwilling to delay long enough to report the appearance of marked fish.

TABLE 39

Length in cm.	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83
Four-year fish of 1926—																								
Males	1	-	1	--	--	1	2	--	1	2	2	3	4	4	7	2	9	5	2	2	5	2	2	1
Females	1	--	--	--	--	2	2	1	1	6	5	8	10	15	3	10	5	6	6	2	2	1	--	--
Totals	2	--	1	--	--	3	4	1	2	8	7	11	14	19	10	12	14	11	8	4	7	3	2	1
Four-yew fish of 1927																								
Males	--	1	1	1	--	--	1	2	--	1	--	1	3	--	1	3	6	6	8	2	1	--	--	--
Females	--	--	--	--	--	--	--	1	--	4	4	10	14	10	10	10	17	12	7	7	2	--	--	--
Totals	--	1	1	1	--	--	1	3	--	5	4	11	17	10	11	13	23	18	15	9	3	--	--	--
Total four-year fish	2	1	2	1	--	3	5	4	2	13	11	22	31	29	21	25	37	29	23	13	10	3	2	1

The results of this experiment agree with the observation made on a previous page, that the method of fishing now pursued at the mouth of the river is a deleterious straining process that permits the escape of small fish which later appear in ill-proportioned numbers on the spawning beds. The use of seines under proper regulation might avoid this.

The time of arrival of the market fish in the river was well spread over the migratory season. They appeared in varying numbers much as did the fish of the entire catch as illustrated in table 40.

The writer is convinced that nothing of importance may be determined from a comparison of the number of recorded returns with the number of marked and liberated fish. In these experiments the percentage of captured adult fish is no measure of either the success or failure of artificial propagation. The number of returns depends in a large measure upon the effort put forth in obtaining them. For example, the marine returns in the last experiment were as follows :

1925

5 marked fish near Trinidad, June 23 to July 11.
1 marked fish near Patricks Point, June 22.
2 marked fish near Eureka, July 27, 30.

1926

12 marked fish near Trinidad, June 21 to August 17.
41 marked fish near Eureka, June 21 to September 5.

1927

81 marked fish near Eureka, May 12 to July 8.

1926

13 marked fish near Eureka, July 7 to August 13.

It will be noted that not a single marked fish was reported south of Eureka. It may be stated also that a special observer was located at Eureka, and that he was responsible either directly or indirectly for the recovery of nearly all of the marked fish reported from that region.

TABLE 40

| | Date (1927) | | |

In 1927, 41 fish bearing the mark of this experiment were found in Astoria, Oregon, by Harlan B. Holmes of the United States Bureau of Fisheries. They had all been shipped there after having been purchased from a barge which was anchored in Humboldt Bay near Eureka.

It seems quite probable that the fish marked in 1923-1924 migrated just as far at sea as did those of previous experiments, but the novelty of finding a marked fish had lost its freshness, and in spite of the publicity given to the experiment, and the offer of a small reward for fin scars, the marked fish were pretty generally overlooked.

It was intended that during the season of 1926, salmon should be caught with a seine in the estuary of the river, marked with a metal tag and then liberated. It was thought that the recovery of some of these fish might furnish facts relating to the length of time they linger in the estuary, their progress and speed during the stream migration, the relative number which would come to the Klamathon racks, etc. The work was in charge of E. C. Scofield, and he expected to proceed with it as the migration progressed. One unavoidable delay followed another, however, and productive operations were not begun until August 28. From that date to September 15, 343 fish were caught, tagged and liberated. Recoveries were eventually made as follows:

TABLE 41

Date when tagged	Date of capture	Place of capture
September 13, 1926	October 3, 1926	Johnsons
September 13, 1926	October 17, 1926	Klamathon racks
September 13, 1926	October 20, 1926	Klamathon racks
September 14, 1926	September 25, 1926	Ishipishi Falls
September 14, 1926	October 5, 1926	Johnsons
September 14, 1926	October 13, 1926	Klamathon racks
September 14, 1926	October 17, 1926	Klamathon racks
September 14, 1926	October 19, 1926	Klamathon racks
September 14, 1926	October 20, 1926	Klamathon racks
September 14, 1926	October 26, 1926	Shasta River
September 14, 1926	October 30, 1926	Klamathon racks
September 15, 1926	October 20, 1926	Blue Creek
September 15, 1926	October 3, 1926	Ishipishi Falls
September 15, 1926	October 24, 1926	Shasta River
September 15, 1926	October 26, 1926	Shasta River
September 15, 1926	November 11.1926	Camp Creek

Not enough was accomplished to warrant any generalization, yet the results indicate the possibilities of such an experiment.

OCEAN TAGGING

Attempts to tag salmon at sea were made in 1926 and 1927. The only source of supply was the trolled fish. Because of adverse conditions the project was not successful.

In 1926, 130 fish were tagged at points along the California coast from Monterey Bay to Trinidad. One of these tagged near Trinidad, August 8, was recovered at Mill Creek Hatchery, Sacramento basin, November 14, 1927.

In 1927, 53 fish were tagged in Monterey Bay from April 28 to June 14. This attempt was more successful, 16 of the fish having been retaken. A summary follows:

TABLE 42

Tag number	Tagged		Recovered	
	Date	Locality	Date	Locality
IPSIF 5	May 10	Monterey Bay	Aug. 5, 1927	Monterey Bay
7	May 10	Monterey Bay	Aug. 4, 1927	Monterey Bay
11	May 11	Monterey Bay	July 23, 1927	Monterey Bay
12	May 11	Monterey Bay	Aug. 7, 1927	Off Point Reyes
13	May 11	Monterey Bay	Aug. 6, 1927	Off Point Reyes
17	May 16	Monterey Bay	July 25, 1927	hlonterey Bay
19	May 16	Monterey Bay	April 27, 1928	Monterey Bay
22	May 16	hlonterey Bay	Aug. 15, 1927	Off Point Reyes
27	May 25	Monterey Bay	Sept. 12, 1927	Near Rio Vista
28	May 25	Monterey Bay	July 20, 1927	Monterey Bay
33	May 27	hlonterey Ray	May 22, 1928	Monterey Bay
38	June 12	hfonterey Bay	Sept. 7, 1927	San Francisco Bay
USBF 50	June 14	hlonterey Bay	May 26, 1928	Off Eureka
306	May 18	Monterey Bay	April 27, 1928	Monterey Bay
307	May 18	Monterey Bay	Aug. 6, 1927	Monterey Bay
308	May 19	Monterey Bay	May 25, 1927	Monterey Bay

DEPLETION

It has been said, even of late, that the salmon population of Klamath River is holding its own. That this is not the case, and that rapid depletion of the stock is not only threatened, but is actually under way, will appear.

In an attempt to discover whether the salmon population of Klamath River is being maintained or whether depletion is threatened or is actually in progress, there must be considered not only the conditions in the river itself, but attention must be directed to the fishery of the entire coast to the southward, and also to other rivers of the state where salmon are taken. As the supply from other and more accessible streams becomes reduced, the attack on the Klamath will become more vigorous. As sea fishing in Monterey Bay, where Klamath salmon along with those from other streams are caught, becomes less profitable, the center of effort will move northward and approach the river itself. A decline in the entire catch of the state, or in the region of Monterey Bay, or off the coast to the northward, or even in the Sacramento River, spells decline in the Klamath, even though superficial indications in the river do not now point in that direction.

Dependable salmon statistics for the State date from about 1918, when the catch was somewhat over 13,000,000 pounds. In the following year it was about equally large, but in 1920 a decline began, and this has continued with occasional recoveries until 1928 when about 4,400,000 pounds were taken. Figure 27 illustrates the situation.

With the general decline of the catch of the entire State, there has occurred a somewhat similar falling off in every section, whether the fish were taken at sea or in the rivers.

The condition in Monterey Bay is perhaps more serious than that of any other part of the State. Here a reported catch of over 5,000,000 Pounds in 1916 has dwindled to less than 52,000 pounds in 1926. This

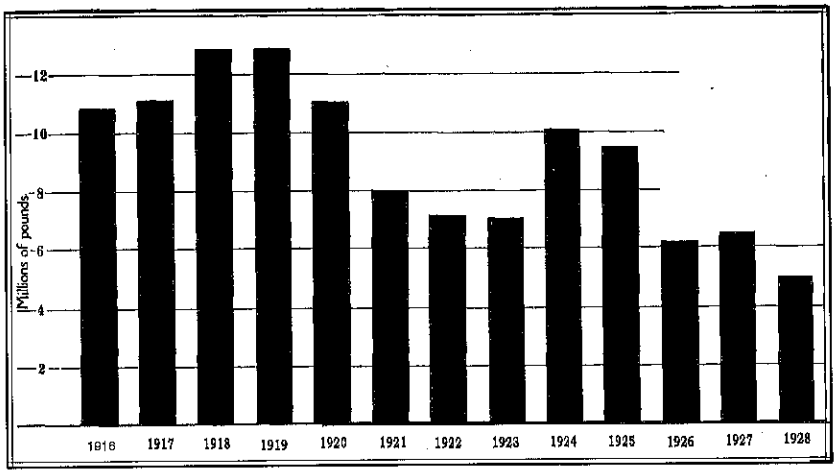

FIG. 27. The salmon catch of California expressed in millions of pounds.

depletion in the catch is not due to a restricted fishing period as will be readily seen by an examination of table 43 and figure 28, where the catch is represented by monthly periods. Here the catch of any month shows a decline through a period of years.

The rapid growth of the fishery near Fort Bragg and along the coast in the vicinity of Eureka has not only suffered a check, but also shows unmistakable evidence of serious decline. The rapid advance and the later recession of the fishery in this region is depicted in figure 29.

Attention is called to table 44, which was compiled from data furnished by the Division of Fish and Game.

During the season of 1928 it became evident that a considerably larger proportion of small fish was being brought to the markets from sea trolling than ever before. The fishermen attempted as usual to account for this in various ways, but a small sampling of the Monterey catch seemed to indicate that a large proportion of young and immature fish was being taken. Of 383 representative examples secured from June 22 to July 15, 56.9 per cent were in the second year of growth; 31.4 per cent were in the third year, 10.9 per cent in the fourth year, and 0.8 per cent in the fifth year. This was an enormous increase in the relative number of two- and three-year fish over what may be regarded as the normal of preceding years.

In 1929 a careful survey of the situation was made at Monterey from April 23 to July 29, inclusive, when samples of the catch were taken. Scales were collected, measurements and sex determinations were made of 2847 fish. Of these 17.5 per cent were in the second year of growth and 62.3 in the third year. Only 17.2 per cent were in the fourth year, 2.9 in the fifth and 0.1 of one per cent in the sixth year. It appears then that 79.8 per cent of the catch was made up of two- and three-year fish. (Fig. 30.) (Full particulars are given in table 45.)

Here is a notable departure from the normal as indicated in tables 64 and 67. It is not only evident that an unusually large number of

TABLE 43

Monthly Salmon Catch of Monterey Bay from 1916 to 1928, Expressed in Pounds

1916		1917		1918		1919		1920		1921		1922		1923		1924		1925		1926		1927		
ta Cruz	Monterey	Janta Cruz	Monterey	Santa Cru	Monterey	anta Cruz	Monterey	Santa Cruz	Monterey	Santa Cruz	Monterey	Santa Cruz	Monterey	Santa Cruz	Monterey	Santa Cruz	Monterey	/Santa Cruz	Monterey	Santa Cruz	Monterey	Santa Cruz	Monterey	
	3,085	531	33,960	0	62,784	0	2,418		2,315	0	161	0	10	0	0	0	0	43	32,874				0	
11:	156,571	6,119	806	0	70,406	0	3,765	29	40,550	73	33,192	0	0	0	0	0	0	248	68,547	8	48	8	0	
1,717	214,726	24,494	498,166	337	187,440	1,687	210 24;	82	104,153	5,620	141,230	0	0	35,169	83,152	[illegible]	842	8,837	238,095	0			4	
8,253	654,361	26,390	512,786	22,938	973,904	74,072	536 83:	54,525	455,531	46,395	150,687	75,243	245,495				222,412	89,248	167,582	0	[illegible]	[illegible]	137,752	
49,653	2,039,919	61,061	1,197,533	79,104	1,029,262	311,247	956 92;	66,048	311,223	208,528	406,643	136,777	101,519	173,753	186,615	90,744	123,088	45,864	157,239	1,968	30,832	23,647	180,318	
22,511	663,232	135,262	908,283	29,911	187,948	57,237	520 50:	47,221	331,779	116,830	123,654	169,660	130,205	47,990	102,468	47,112	51,768	49,121	180,942	7,778	8,031	35,327	145,063	
38,009	728,572	15,947	277,646	75,309	127,675	13,563	83 415	22,967	34,970	6,112	5,790	15,500	5,527	11,456	25,751	104,734	78,692	45,001	8,430	2,016	28':	90,857	29,653	
22,531	377,355	980	170,331	2,309	43,480	1,212	2,676	8,249	11,179	0	45	55	15	37,960	23,970	30,037	28,153	6,233	333	306		6,660	8,052	
14,150	150,571	31	8,936	0	0	150	0	10	0	0	0	13	0	0	0	59	0	78				0	0	
0	0	0	0	0	0	0	0	0	0	0	0	10	0				0	0	8	167	8	0	0	
1,624	82,719	0	88	0	0	0	67	0	0	0	0		0	0		0	0		0	8		0	0	
75	5,780	0	137	15	54	0	0	0	38	0	0	8	0	0	50	0	0	8	0	0	8	0	0	
158,948	5,071,891	270,815	3,608,672	209,923	2,682,953	499,168	2,316 854	199,139	1,291,738	383,558	860,402	397,358	482,771	306,336	421,960	372,231	504,955	244,673	854,042	12,235	39,520	216,185	500,842	

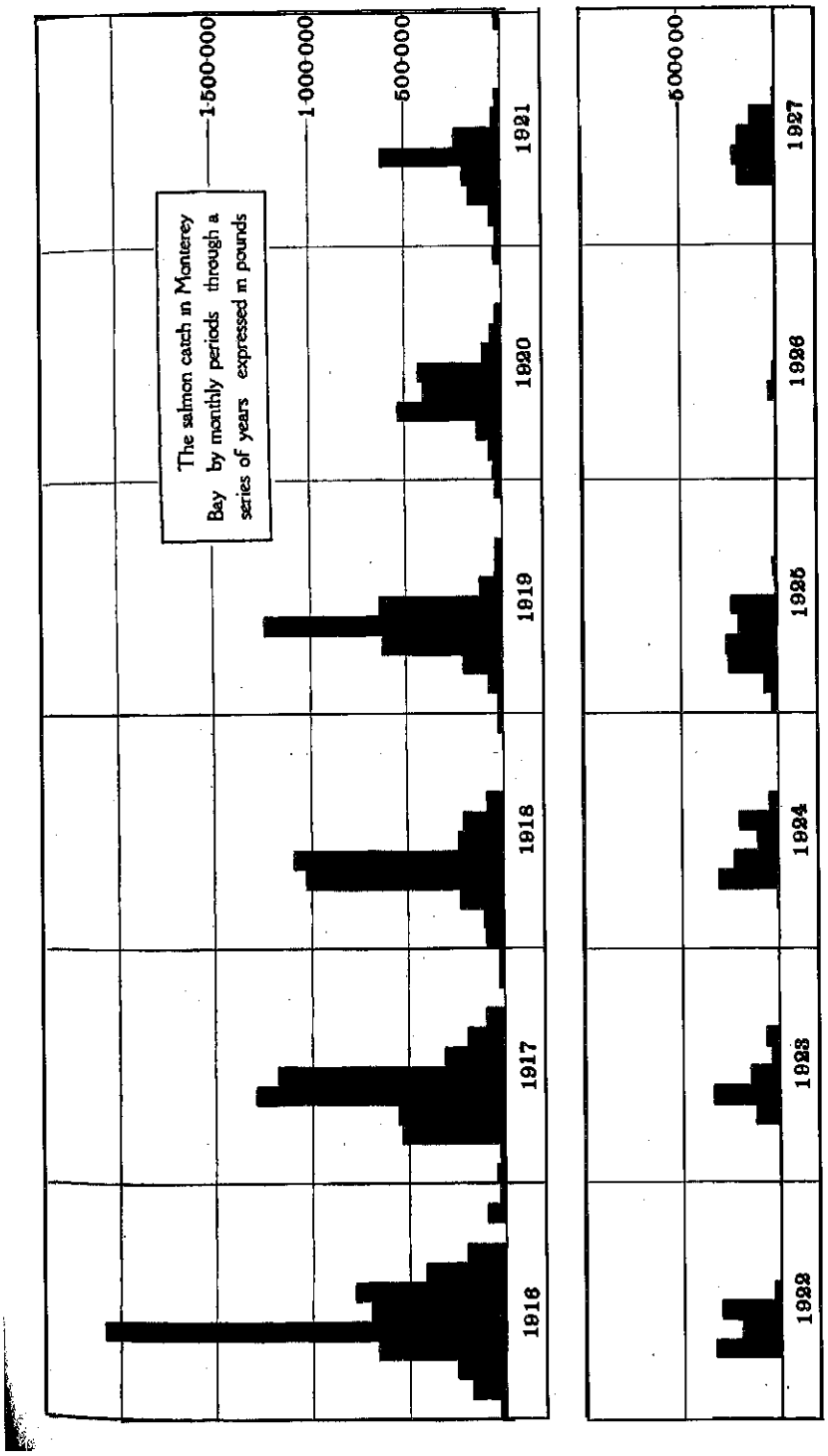
The salmon catch in Monterey Bay by monthly periods through a series of years expressed in pounds
1,500,000
1,000,000
500,000
500,000
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927

FIG. 28.

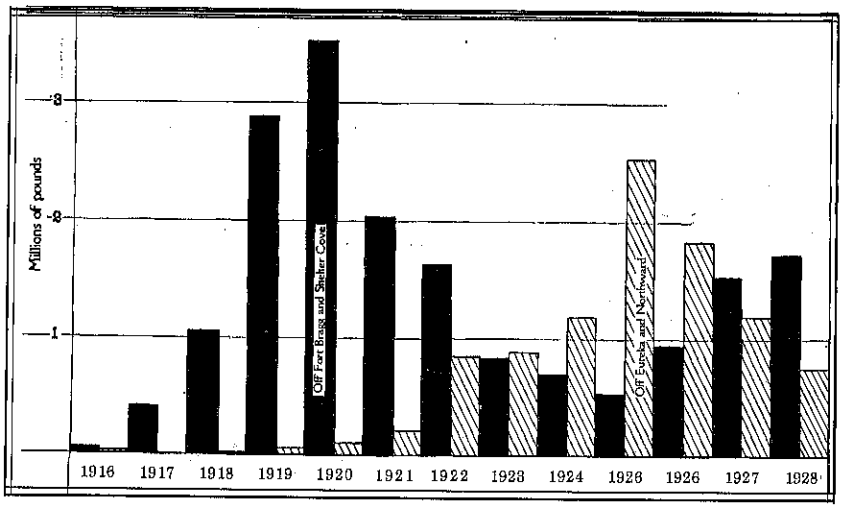

FIG. 29. Salmon catch off Fort Bragg and Shelter Cove, and off Eureka and northward, expressed in millions of pounds.

TABLE 44

Salmon Catch of California from 1916 to 1928 Expressed in Pounds

Year	Monterey	Santa Cruz	Near San Francisco	Year Ft. Bragg and Shelter Cove	Off Eureka and northward
1916	5,071,891	158,948	260,030	7,654	90,699
1917	3,608,672	270,815	1,242,913	401,460	522 742
1918	2,682,953	209,923	1,756,134	1,097,771	12,840
1919	2,316,854	499,168	1,427,137	2,809,803	50,039
1920	1,291,738	199,139	1,451,270	3,015,130	100,251
1921	880,403	383,558	987,452	2,084,080	216,179
1922	482,771	397,358	951,137	1,621,760	875,081
1923	422,000	300,336	1,283,748	812,807	880,844
1924	504,955	372,231	3,616,455	687,240	1,193,102
1925	854,042	244,673	1,270,918	682,194	2,529,691
1926	39,520	12,236	936,330	982,295	1,866,214
1927	500,842	216,185	1,488,746	1,528,898	1,186,908
1928	259,408	75,246	815,815	1,562,715	731,117

young fish were being killed, but it is also reasonable to presume that there is before us ample evidence of extreme depletion. Unless an unsound inference is being made, it would seem that the supply of old fishes is inordinately reduced, and that the Monterey Bay catch of 1929 was greatly reducing the population of young fish which should be left to mature in the near future.

Other offered explanations of the exceptional abundance of small fish in the catch, such as "these fish did not grow large as usual," "the large fish are feeding farther out," or "the abundance of young fish is the precursor of large catches next year," do not seem to be borne out by the facts.

There is no room for the presumption that a large harvest of male fish which would presumably mature as grilse was made, for it is found that sex representation in the catch of 1929 was about normal.

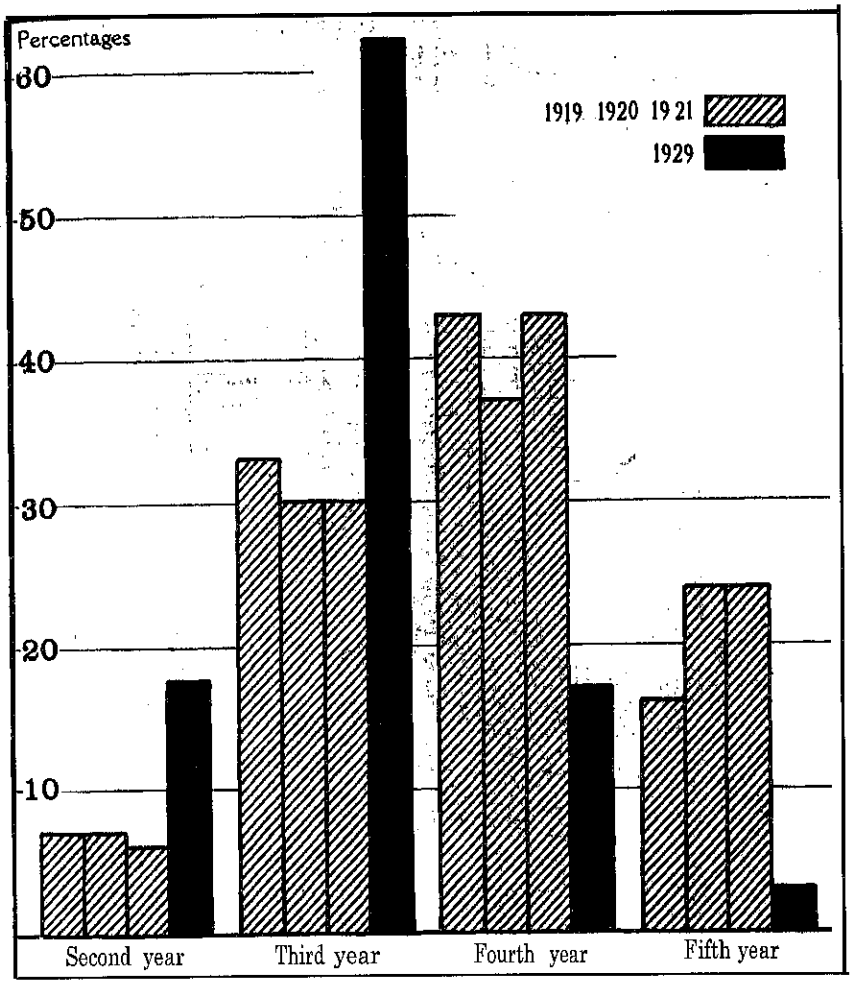

FIG. 30. Graph expressing the percentage of each year class in the Monterey catches for four years. Note the great relative increase of two- and three-year fish (black) in the season ,of 1929.

In the Sacramento River the catch has fallen away in an unmistakable manner as is evidenced by table 48.[15]

Depletion in the Sacramento can only affect the Klamath indirectly, in that an increased demand for fresh fish' will call attention to the nearest supply. But depletion in the ocean affects the Klamath directly, for it has been definitely shown that the feeding grounds of Klamath salmon extend to Monterey Bay.

Previous to the appearance of G. R. Field in the fishing activities of Klamath River no records relating to the catch appear to have been kept. Access to his books which was generously given, revealed a continued expansion of statistics other than those relating to business

15 Clark, G. H. Sacramento-San Joaquiq salmon *(Oncorhynchus tschawytscha)* fishery of California. California Division of Fish and Game, Fish Bull., no. 17, 1929.

TABLE 45

MONTEREY BAY 1929

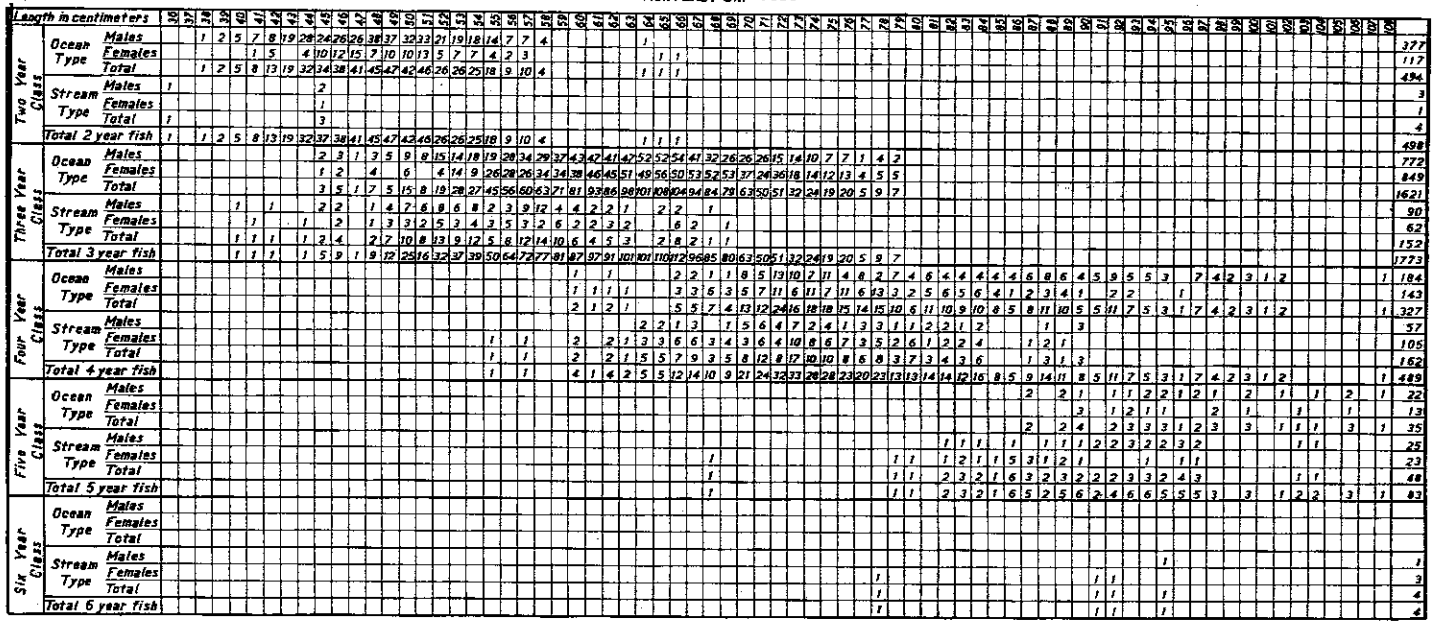

TABLE 46

Summary of Monterey Bay Age Classes, 1929

Year classes	Two	Three	Four	Five	Six	Totals	Percentages
Males	380	862	241	47	1	1,531	53.8
Females	118	911	248	36	3	1,316	46.2
Ocean type	494	1,621	327	35		2,477	87.0
Stream type		152	162	48	4	370	13 0
Ocean type males	376	772	184	22		1,355	47.6
Ocean type females	117	849	143	13		1,122	39 4
Stream type males	3	90	57	25	1	176	6.0
Stream type females		62	105	23	3	194	6.9
Totals	498	1,773	489	83	4	2,847	
Percentages	17 5	62.3	17.2	2.9	.1		

TABLE 47

Catch of	Percentages of	
	Males	Females
1929	53 8	46 2
1919	54.0	46 0
1920	51 0	49 0
1921	51 0	49 0

TABLE 48

Salmon Catch in Sacramento River

Date	Pounds live weight
1916	3,450,786
1917	3,795,486
1918	5,938,029
1919	4,529,222
1920	3,860,312
1921	2,511,127
1922	1,705,066
1923	2,243,945
1924	2,640,110
1925	2,778,846
1926	1,261,776
1927	917,525
1928	553,777

transactions up to 1917 when an interesting record appears, which takes separate account of the king salmon, silver salmon and even the steelheads, when the latter happen to be caught. The year 1912 is there said to have witnessed the greatest run of salmon known to white men. The pack was something over 1,384,000 pounds, and a conservative estimate of the number of fish caught amounted to 141,000. In one day 17,000 were taken. Three plants were then operating and the river was fished to the limit.

A digest of fishing activities compiled partly from Field's notes and partly from records in the State Division of Fish and Game follows :

NOTES RELATING TO THE SALMON CATCH OF KLAMATH

1913. The plant of the Klamath River Packing Company began operations June 4. From June 4 to July 5, 426 cases of halves and 116 cases of one-pound cans were packed. (One case=48 cans) ; July 5 to 15, 550 halves; July 15 to 17, 4 halves. Number salmon caught in June, 1190 ; July, 12,042 ; no detailed data for remainder of season. Total for season, an amount equal to 13,300 cases of one-pound cans.

Three plants operated: Klamath River Packing Company, 13,300 cases of ones; Klamath River Canning Company, 10,611 cases of ones; Del Norte Salmon Canning Company, 5000 cases of ones ; all king salmon. Season's pack, 28,911 cases of ones. Halves were packed, but they are reduced to ones in the above account.

1918. Three plants operated ; Klamath River Packing Company, 5800 cases of ones; Klamath River Canning Company, 3400 cases of ones ; Del Norte Salmon Canning Company, 3000 cases ones. Total, 12,200 cases of ones.

The Klamath River Packing Company took during June, 596 fish; July, 6242 ; August, 19, 276; September, 2479.; total, 28,593 No detailed fall record.

1914. Klamath River Packing Association operated alone. Summer pack, 11,829 cases ones; fall, 5260 cases ones. June, 417 fish; July, 12,758 ; August, 47,558 ; September, inc. 6, 2775 ; total to September 6, inc., 63,508 fish; September 21 to October 1, 127,199 lbs., live weight ; October 1 to 24, 233,985 lbs. ; total, September 21 to October 24, 361,184 lbs., live weight. September-October includes silver salmon. The fall pack was ; Kings, 508 cases of ones ; silvers, 4752 cases of ones. No silver salmon before September 21.

1915. Klamath River Packing Association opened June 21, closed October 25. June, 871 fish; July, 7252 ; August, 55,327 ; September to September 5, 8807; total to date, 72,257, all king salmon; September from 20th, 74,526 lbs. ; October, 146,105 lbs. ; total, September-October, 220,631 lbs., both king and silver salmon. Total for year, about 1.232,229 lbs.

1916. Klamath River Packers Association, June 26 to July, 342 fish ; July, 6841; August, 21,309 ; September 1 to 6, 2327 ; 30,819 king salmon. September 22 to October, 57,761 lbs. ; October, 178,904 lbs. ; total, 236,665 lbs. king and silver salmon. Total for year about 668,131 lbs.

1917. Two companies operated: Klamath River Packers Association as follows : June 27, 2 fish ; July, 427, ; August, 3284 ; September 1 to 6, 1250. Total, 4963. September 20 to October, 2250 fish; October, 10,300 ; November 1 to 26, 1638. Total, 14,188. Total fish for year, 19,151 ; total weight, 241,910 lbs. Forty-four boats in use.

Requa Cooperative Packing Company. No data from this source. The Fish and Game Commission reports all fish from the river as follows: 265,537 lbs. king and silver salmon; 1710 lbs. steelheads.

1918. Two companies operated; Klamath River Packers Association, April, 47 fish; May, 109 ; July, 312 ; August, 12,140 ; September 1 to 6, 3226; September 20 to 30, 1106; October 1 to 23, 466. Total 17,406 king salmon weighing 221,949 lbs.; from September 20 to end of season, 10,893 silver salmon and steelheads weighing 71,014 lbs. were caught.

Requa Cooperative Packing Company—no data.

There were reported from all sources, 672,845 lbs.

1919. Klamath River Packers Association opened April 30. April-May, 1030 fish ; July 7, to August, 1668 ; August, 23,591 ; September 1 to 6, 1605. Total, 27,894 king salmon weighing 375,472 lbs. September 20 to October, 2560 ; October 1 to 30, 670. Total 3230 king and silver salmon weighing 64,023 lbs. Total fish for season, 31,124; weight, 439,495 lbs.

Total reported from river to Fish and Game Commission, 535,198 lbs., including steelheads.

1920. Klamath River Packers Association opened April 19. April-May, 247 fish; July, 2964 ; August, 46,851; September 1 to 6, 4311. Total, 54,373 king salmon; weight, 809,040 lbs.

Total reported to Fish and Game Commission, 872,295 lbs. salmon; 5910 lbs., steelheads.

1921. Two companies operated: Klamath River Packers Association opened July 20. July, 948 fish; August, 38,521 ; September 1 to 6, 3527. Total, 42,996 fish; weight, 604,877 lbs.

The Del Norte Packing Company reported 10,148 lbs.

Total from river reported to Fish and Game Commission, 614,247 lbs.

1922. Two companies: Klamath River Packers Association opened July 29. July, 2227 fish; August, 51,163; September 1 to 6, 8112. Total, 61,502 fish; weight, 903,509 lbs.

Del Norte Packing Company-no data.

Total reported from the river, 1,039,680 lbs. of salmon; 2345 lbs. steelheads.

1923. Klamath River Packers Association opened July 16. July, 2093 fish; August. 47.092 ; September 1 to 6, 7814. Total, 56,999 king salmon; weight, 826,134 lbs.

1924. Klamath River Packers Association opened July 30. July-August, 38,659 fish; September 1 to 6. 7212. Total, 45.871 king salmon; weight, 685,469 lbs.

Several small dealers bought fish, bringing the reported catch up to 814,572 lbs.

1925. Klamath River Packers Association. July 7 to 31, 6317 fish: August, 430,901; September 1 to 6, 4610. Total, 54,828 king salmon, weight, 867,103 lbs.

Some small dealers operated, bringing the reported catch up to 956,393.

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16 Mr. H C. Roberts aided in the preparation of this summary of Field's notes. He also contributed observations relating to the habits of salmon in the estuary.

1926	July	August	September
Ellis	6,692	7,249	
Klamath River Packers Association	13,855	375,997	141,768
Paladini	2,320	25,805	19,924
Patterson Bros.	13,647	138,793	48,230
Fisher		12,632	823
Womack		3,949	
Total pounds	36,544	564,425	210,745

Total for 1926 season: 811,714 pounds.

1927	July	August	September
Horn	11,235	48,257	913
Patterson	3,957	68,044	3,693
Klamath River Packers Association	12,528	208,735	17,981
Ellis		13,290	6,642
Estes		2,798	857
Fisher		2,325	4,163
Paul		1,108	837
Total pounds	27,720	344,557	35,086

Klamath River Packers Association received 239,244 lbs. (16,843 fish in, 1927.
A total of 408,081 lbs. was reported to the State Fish and Game Commission for 1927.

A summary of the above data may be made as follows (table 49) (This table is also graphically represented by figure 31.)

TABLE 49

Year	The catch of the Klamath River Packers Association	Entire catch as reported to Division of Fish and Game
	(lbs.)	(lbs.)
1915	1,232,229	1,232,229
1916	668,131	801,150
1917	241,910	265,537
1918	292,963	672,345
1919	439,495	535,198
1920	809,040	872,295
1921	604,877	614,247
1922	903,509	1,039,580
1923	826,134	824,291
1924	685,469	814,572
1925	867,103	956,082
1926	531,650	811,714
1927	230,244	408,081
1928	164,470	308,826

An inspection of the table and graph might make it appear that depletion is not serious, but it is known that the catch of the Klamath has been maintained chiefly through increased effort. The large catch of 1915 was made with a maximum of 40 boats in service, while in 1926, 126 boats and a correspondingly large number of fishermen were engaged. The only available measure of the effort required to make the catch is the number of boats employed, and all things considered, it appears to be a fair measure. Detailed data relating to boats as furnished by Harry Roberts follows. Figure 32 represents in a graphic way the gradual increase in fishing effort.

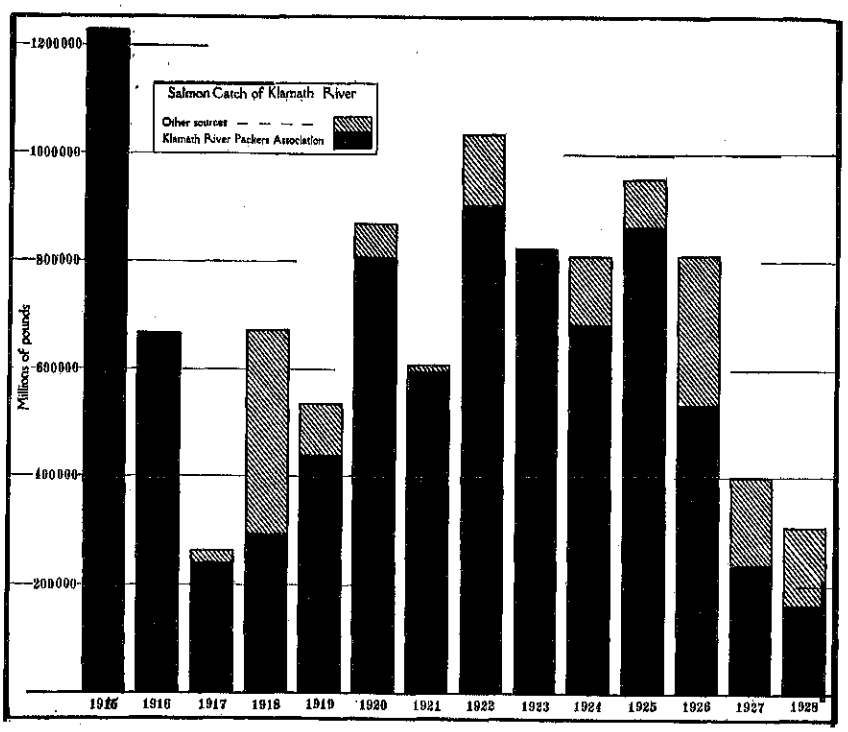

FIG. 31.

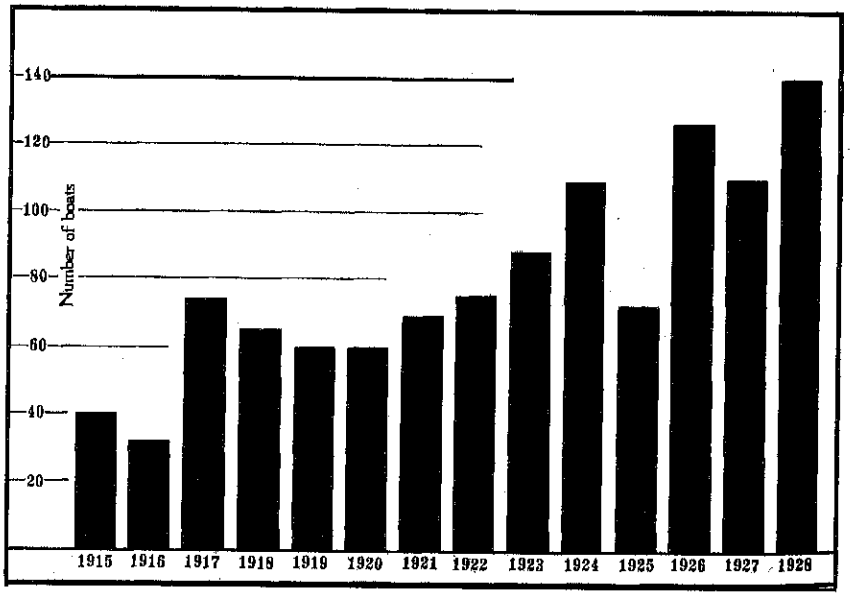

FIG. 32. Graph showing the number of boats annually employed in taking the commercial catch in Klnmath River.

TABLE 50

Number of Boats in Service During the Month of August of Each Year

1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928
40	32	74	65	60	60	69	75	88	109	97	126	110	140

Since a greatly increased effort has not resulted in a corresponding increase of the catch, the only inference to be made is that the supply has diminished.

In 1921 the writer spent some time along the river and its main tributaries in an attempt to learn something of the migration of salmon. In interviews at that time it was constantly affirmed by people living in the region, that the supply of salmon had been greatly depleted in recent years.

The number of spawning fish taken at the racks at Klamathon have greatly decreased since 1925 as is shown by the census recorded in the following table.

TABLE 51

Summary of Klamathon Station Spawning Records

	1925	1926	1927	1928	1929	1930
KING SALMON						
Grilse	1,277	3,401			*1,822	924
Males of spawning age	4,202	1,250	600	540	226	260
Females spawned	4,605	3,872	1,365	1,577	950	618
Males dead on the racks	184	317			506	260
Females dead on the racks	152	302			527	330
Marked salmon	36	246	50	4	0	
Totals	10,420	9,387			4,031	2,392
SILVER SALMON						
Males	269	1,301				
Females	26	307				
Totals	295	1,608				

*On December 26, 1929, E. V. Cassell wrote: "The dead females were all spent. Hundreds of undersize grilse came into Fall Creek during the fall season. These fish slipped through the one and one-half inch spacing of the upper racks at Klamathon. This is unusual."

Fishermen and others interested in the industry report that the migration is appearing later each year. This statement usually accompanies a plea for an extension of the legal season. As expressed elsewhere in this paper, it is believed by the writer that this is a phenomenon of depletion. Instead of the run appearing later in the season, the fish are becoming less numerous, and as a result the curve representing the migration is being reduced, and hence shortened. What is meant may be better illustrated than said by figure 33. Here the catches of the Klamath River Packers Association for the years 1915 and 1926 are represented by curves. A reduction of the curve of 1926 causes it to make its appearance later in the season. The September ends of both curves are lost because of the legal closure of the fishing season on September 6. It is known, however, that this end of the curve falls away very rapidly.

No trustworthy evidence is at hand which may be invoked to show that the supply of salmon is on the increase, or that the stock is being

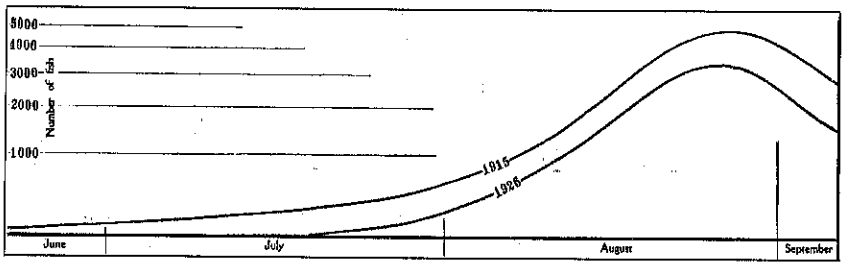

FIG. 33. Curves representing the migrations of 1915 and 1926.

maintained, while on the contrary there is ample reason to believe that the fishery will not long stand the draft that is now being levied against it.

There are indications that some efforts at protection which are now applied are not entirely effective. For example, the short closed period may be mentioned. That this is of little avail may be demonstrated by an inspection of table 12 or figure 4, where it appears that a distinctly large catch usually follows an inactive period. The closed periods accomplish little more than to allow fish to accumulate in the estuary to be taken on the following day.

Whether or not the facts here offered be accepted as an indication of depletion, it goes without question that evidence of a more exact sort should be produced. Such evidence will only come from careful observation. There is at present no certainty that all of the phenomena are known which may manifest themselves as the population of a species of salmon suffers great depletion, and hence the direction of observations which may result in the detection or measure of depletion is difficult and more or less uncertain. There is no question, however, as to the value of a yearly census of the population, when such may be secured. In addition to what we may now get from the catch at the mouth of the river and from the racks at Klamathon, there should be a careful yearly examination of certain representative spawning areas in the Klamath basin which should be made by a competent observer. Also, one or more typical streams should be barred with a rack and traps, in such a way as to furnish the conditions for taking an accurate census of each year's migration.

THE OCEAN CATCH

Until quite recently it was not thought that salmon produced by Klamath River were contributing in any substantial way to the ocean catch. Under the supposition that fish on their nuptial migration from the ocean must return to their native streams, it was presumed that during their ocean life they did not stray far from the mouth of the river of their nativity. The late George R. Field, manager of the plant of the Klamath River Packers Association, was a careful observer and by nature a naturalist. He had implicit confidence in the above presumption and frequently expressed himself as not being disturbed by ocean fishing as long as boats did not operate north of Trinidad. But before boats appeared north of that port, occasional fish came into the Klamath bearing indisputable evidence of contact with marine fishermen, in the shape of hooks, spoons and other pieces of tackle.

Recent observations[17] have amply demonstrated that ocean migrations are extensive, and any study which involves questions of river conservation or depletion, or practices relating to artificial propagation, must take into account many factors of ocean life.

In recent years the catch from the ocean has been gaining in importance when compared with that from the rivers, as expressed in the following table 52, and likewise in figure 34.

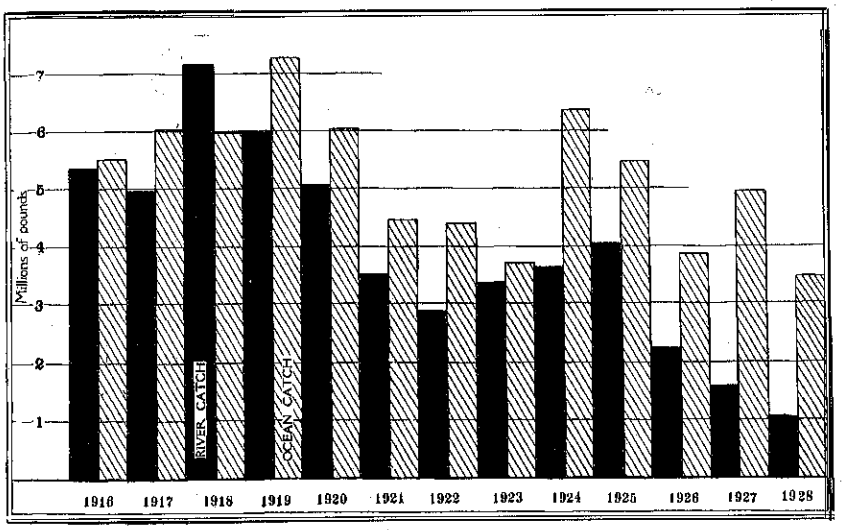

FIG. 34. The river and ocean catches of salmon in California expressed in millions of pounds.

TABLE 52

Year	Total salmon	
	Caught in rivers	Caught in ocean
1916	5,347,378	5,502,081
1917	4,074,584	6,083,091
1918	7,154,542	5,932,281
1919	5,937,296	7,205,372
1920	5,060,705	6,066,190
1921	3,501,663	4,483,100
1922	2,896,807	4,338,317
1923	3,353,336	3,736,924
1924	3,040,696	6,374,573
1925	4,044,217	5,481,536
1926	2,220,402	3,863,677
1927	1,590,329	4,921,600
1928	1,034,260	3,444,306

17 Mottley, Charles McC. Pacific salmon migration: Report on the study of the scales of the spring salmon *Oncorhynchus tschawytscha* tagged in 1926 and 1927 off the west coast of Vancouver Island. Contributions to Canadian Biology and Fisheries, n.s., vol. 4, no. 30, pp. 471–494, 1929.

Rich, Willis H., and Holmes, Harlan B. Experiments in marking young chinook salmon on the Columbia River, 1916 to 1927. U. S. Bureau of Fisheries, Bull. (for 1928), vol. 44, doc. 1047, pp. 215–264, 1929.

Rich, Willis H., and Morton, Frederick G. Salmon-tagging experiments in Alaska, 1927 and 1928. U. S. Bureau of Fisheries, Bull. (for 1929), vol. 45, doc. 1057, pp. 1–23, 1930.

Snyder, John O. A third report on the return of king salmon in 1919 in Klamath River. California Fish and Game, vol. 10, no. 3, pp. 110–114, 1924.

Some difficulty is encountered in segregating the reports of either ocean or river caught fish, but the amounts here given are sufficiently accurate for the purpose of comparison. Discrepancies may be checked against a record of the entire catch in California for the same period.

TABLE 53

Total Catch of Salmon in California Expressed in Pounds

Year	Pounds
1916	10,939,594
1917	11,060,581
1918	13,093,188
1919	13,145,727
1920	11,133,819
1921	7,990,932
1922	7,285,124
1923	7,090,260
1924	10,015,269
1925	9,525,753
1926	6,084,079
1927	6,511,929
1928	4,478,566

The above data are expressed graphically in figure 27. In 1916 the rivers produced an amount about equal to that of the ocean, in 1917 a decided gain appeared in favor of the sea, while in 1918 the river catch was considerably the larger. From 1919 to the present, the ocean catch has remained larger and also increased in relative importance.

Fishermen and others, who have had opportunity to observe king salmon at sea, state that they move in schools. One frequently hears the sea fishermen speak of "finding the school, " "striking the school, " *etc.* Salmon frequently, if not always, enter the river in schools, and the school may remain in compact formation for a time while in the estuary. An observation of the catch will occasionally demonstrate this. For example, in 1922 on the evening of August 23, the Klamath River fishermen, unaware that anything unusual was about to occur laid out their nets in the customary way. The nets which were spread below Windy Point were almost at once clogged with enmeshed fish, and so many were captured in such a brief time, that a lookout, fearing that the cannery would be overtaxed blew the recall whistle. Upon assembly of the boats it was found that 4406 fish had been taken, and that practically all of them were from a small area of the river between Windy Point and Pecheco Rock. Fishermen who laid their nets elsewhere caught very few fish or none at all. Here it was apparent that a large and compact school had been intercepted.

A sample of 69 fish taken at random from the catch gave 61 examples with the ocean type of nucleus, 26 of which were in the third year, 33 in the fourth year and 2 in the fifth. Of the stream type, 3 were four-year fish, while 4 were five and 1 six. Of 200 specimens which were examined for sex, 66 were males and 134 females. It appears then that the school was made up of a rather heterogeneous assemblage, remarkable perhaps for the unusual number of three-year fish. Of these, 14 were females with the ocean type of nucleus.

Sometime ago an observation was made in connection with a marking experiment, which appears to indicate that certain fishes may remain for a considerable time, if not throughout their entire life, in the same

school.[18] The so-called homing instinct of king salmon was understudy and a number of marked fish were turned loose in Klamath River at Fall Creek. When some of these fish returned as grilse in the third year it was apparent that the scales of each one bore a peculiar growth mark in the region representing the period just preceding the winter check. (See C and *D* in fig. 35. This mark, an anatomical peculiarity was unusual and very distinct. From experience gained in the examination of many such scales it was assumed that *D* represented the winter check in the growth of the fish. Abundant material from Monterey Bay demonstrates that this check or slowing down in the normal growth of the fish occurs in the winter or early spring, but not in all individuals at the same time. This winter check is a normal anatomical feature of practically all king salmon scales. The check C which appears within the other occurred at a previous time and may be spoken of as a secondary check. It represents a period in which the rapid growth of the fish was suddenly interrupted for a time, after which growth was resumed only to be again interrupted by the usual period of winter quiescence. This same secondary check appeared in the scales of marked fish of the same experiment, which were taken in the following years.

If one accepts the hypothesis that the growth of the individual is reflected by the growth of the scale, and that the growth is influenced by environment, whatever that may be, the assumption follows that all of these fish must have been in contact with the same environmental conditions for at least a short time during the second year of growth. It suggests that associations formed in the stream continued through the second year at sea, the fish remaining together, possibly in the same large school.

When the marked fish to the number of 25,000 were liberated in Klamath River, approximately 250,000 yearlings with the same life history except that they bore no distinctive fin marks, were set free with them. If any number of these remained together at sea it was to be expected that some of them would bear scales like those of the marked fish. Such was the case, as was found in the returned grilse and also in older fish. (See C and *D* in Fig. 35.) It was thought that unmarked individuals might be found at sea associated with the others and that they might be recognized by scale structure. Accordingly, when marked fish were discovered in a sea catch near Eureka, scales were taken from all fish in the same boat. A search among the scales of 155 individuals so taken from several boats revelead 6 which the writer is satisfied may be regarded as fishes of the 1919 liberation although they bore no fin marks. A scale of one of these is illustrated. (Figs. 36 and 37.)

Here then is evidence, meager though it may be, that salmon may remain closely associated, individuals possibly schooling together while in the ocean, and for a considerable period of their life.

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18 Snyder, J. O. The return of marked king salmon grilse. California Fish and Game, vol. 8, no. 2, pp. 102-107, 1922.

Snyder, J. O. A second report on the return of king salmon marked in 1919, in River. California Fish and Game, vol. 9, no. 1, pp. 1-11, 1923.

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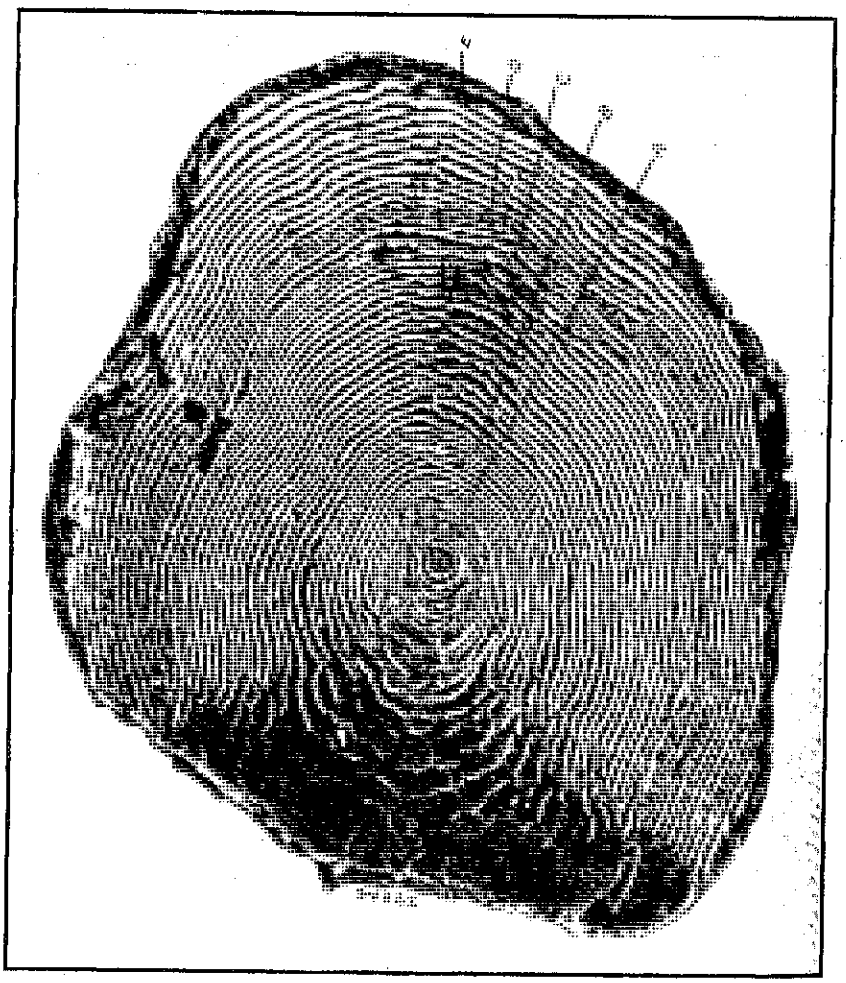

FIG. 35. Photomicrograph of a scale of a marked king salmon grilse which returned to Klamathon racks in 1921.

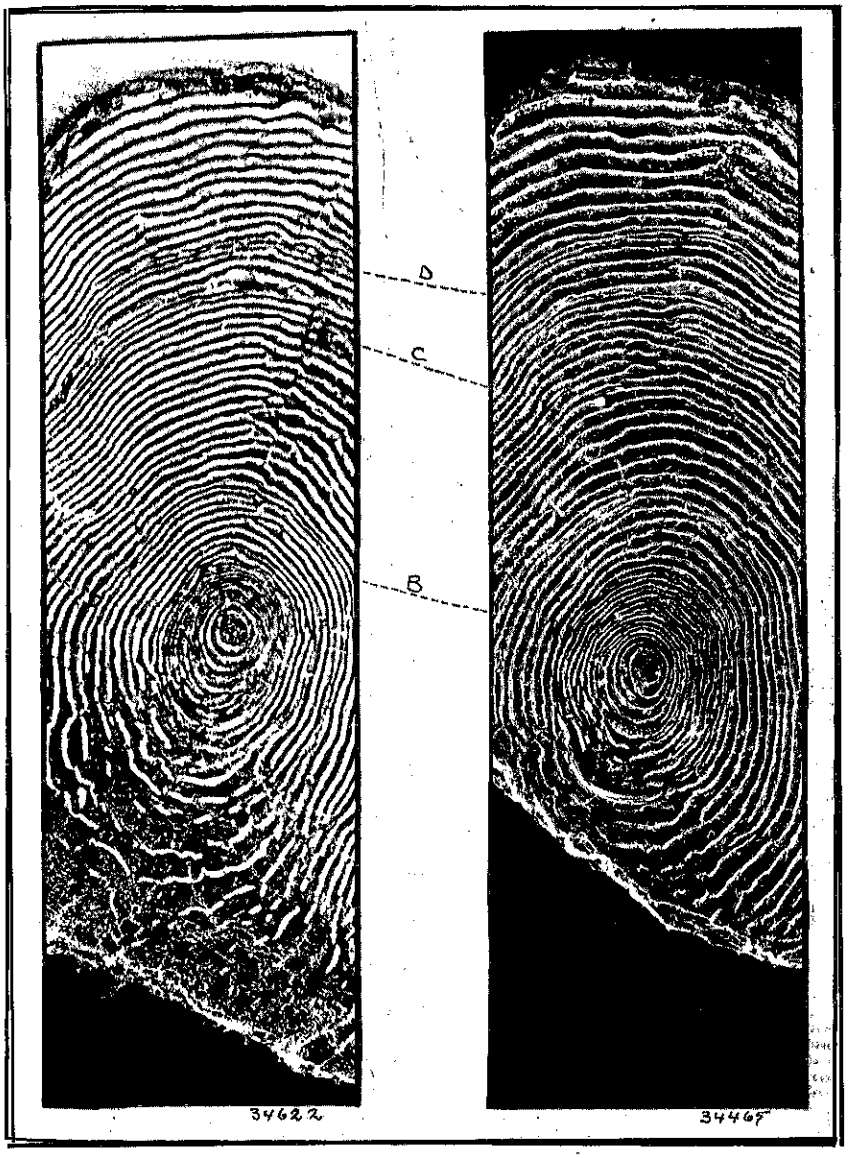

FIG. 36. Scales of marked (34622) and unmarked (34465) king salmon grilse which returned to Klamathon racks in 1921.



FIG. 37. Photomicrograph of a scale of a salmon taken off Cape Mendocino, August 5, 1922, which shows convincing structural resemblance to scales of fish of the 1919 planting.

Ocean trolling[19] for salmon in this state originated in Monterey Bay where a fleet of small sailing craft grew in numbers, only to be replaced by larger, swifter, and more capable power boats. The explorations of the more venturesome operators of these boats extended the fishing area somewhat farther at sea, and also to the northward along the coast until now their activities reach the northern boundary of the state.

Success in the relatively shallow waters in the vicinity of Point Reyes led to fishing beyond Point Arena where a safe harbor was found in the estuary of Noyo River near Fort Bragg. About 1916, salmon from this point began to enter the market in quantity, and in two years a cannery and several mild cure plants were assisting in the care of a rapidly growing catch which reached its maximum in 1920 (fig. 29) and then began to decline. The Noyo industry extended to Shelter Cove where anchored barges took care of a part of the catch. A better picture of the activities in Noyo Estuary than appears from an examination of the statistics of the catch is presented by photographs and a sketch map made by the writer in 1920. The photographs (figs. 38, 39, and 40) were taken from points indicated on the map (fig. 41).

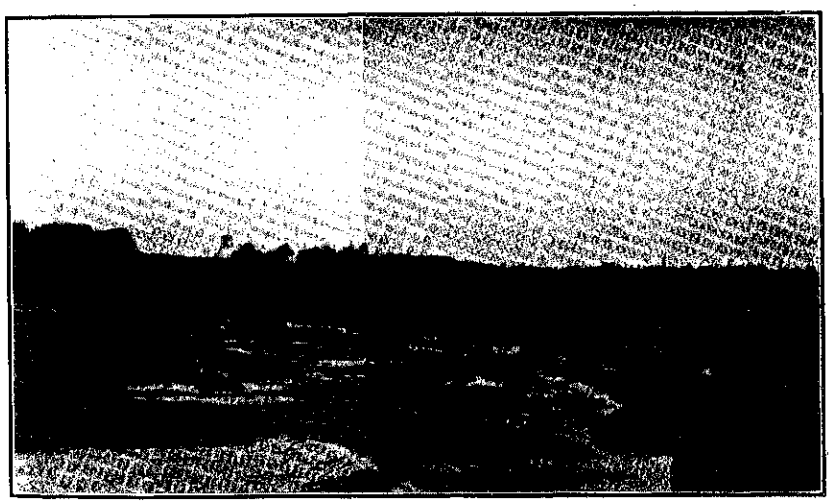

FIG. 38. View of Noyo Bay, from point marked *A* on map, figure 41.

As in Monterey Bay, decline began in the Fort Bragg region, and its progress was followed by a rise in the industry along the coast near Eureka where the greatest harvest was taken in 1925. Here the fishery has already been greatly overtaxed and in spite of increased effort the results rapidly diminish.

An inquiry as to whether ocean caught fish weigh less or more than those of equal length which are taken in the rivers is of interest, as some observers contend that the stream caught fish are heavier and more plump. An entirely satisfactory answer is not forthcoming however as will be seen. A direct comparison is not possible because the salmon

[19] An excellent account of the methods of ocean trolling is given by W. L. Scofield (Gear Used for Salmon Trolling in California in 1920. California Fish and Game, vol. 7, no. 1, pp. 22-38, 1921).

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Fig. 38. View of Noyo Bay, from point marked *A* on map, figure 41.

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FIG. 39. Salmon boats in Noyo River, from point *B*, figure 41.



FIG. 40. Salmon boats Noyo River as seen from point *E*, figure 41.

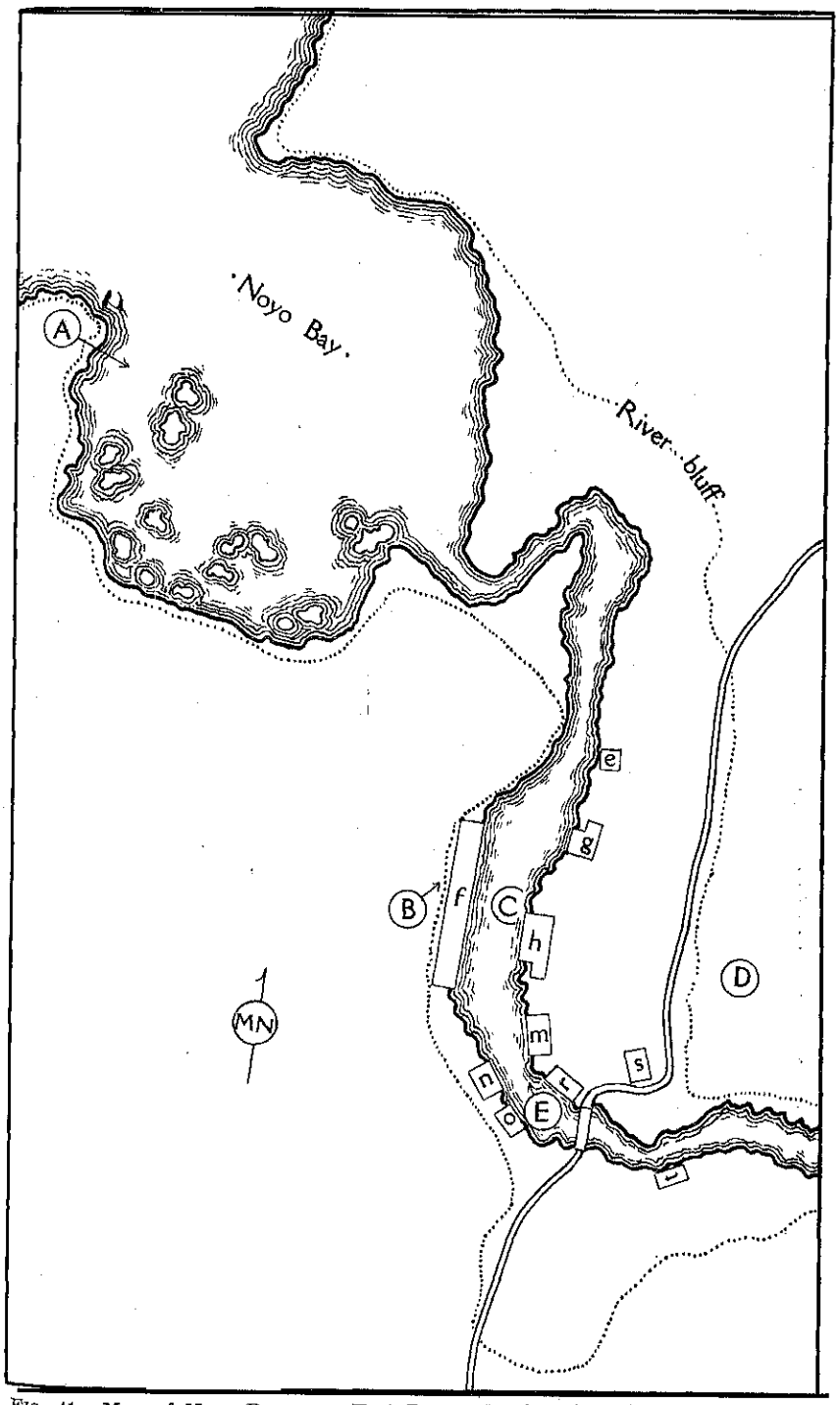

FIG. 41. Map of Noyo Bay near Fort Bragg showing the salmon fishery as of June 21, 1920; *e*, Repair shop; *f*, Noyo Fishermen's Association; *g*, Western California Fish Co.; *h*, Small and Urie; *m*, Columbia and Northern Fishing and Packing Co.; *n*, Independent Fish Co.; *o*, San Francisco Ice and

of an ocean catch are probably from a composite mass, in so far as their stream origin is concerned and no means has as yet been discovered which will enable one to identify without question any 'ocean caught California salmon with the stream of its nativity.20

It has been shown that slight differences are to be found between the fish of Klamath and Sacramento rivers, but nothing of the kind has been determined for the inhabitants of other coastal streams. It is known from experimental evidence that fish taken in Monterey Bay may be from any salmon producing stream in the State. Possibly some Monterey Bay fish may come from rivers which enter the ocean north of the State.

However, numbers of ocean caught fish may be compared with numbers from the streams, and such a comparison is here attempted. Length-weight relations have been computed and it appears that when fish of marine origin are compared with those from the rivers, the later are slightly heavier. Tables 54 and 55, illustrating the length-weight relation of numerous salmon taken in Monterey Bay and off Fort Bragg, are here given. These may be compared with similar tables computed from river fish and presented in tables 2 and 3.

TABLE 54

Length-Weight Relation of Fish Taken in Monterey Bay. 1920

Length of fish in cm.	Average weight 20 males recorded in pounds and tenths	Average weight 20 female recorded in pounds and tenths	Extreme weights of males recorded in pounds and ounces	Extreme weights of females recorded in pounds and
46	2.7	2.5	2- 0 to 3- 0	2- 4 to 2-12
48	2.9	2.9	2- 8 to 3- 8	2-12 to 3- 0
50	3.5	3.2	3- 0 to 3-12	2-12 to 3- 8
52	3.8	3.7	3- 6 to 4- 4	3- 4 to 4- 0
54	4.2	3.9	3- 8 to 4- 8	3- 4 to 4- 4
56	4.9	4.3	4- 8 to 5- 4	3- 8 to 4-12
58	5.4	5.2	5- 0 to 6- 4	4- 8 to 5-12
60	5.9	5.5	5- 4 to 6-8	4-12 to 6- 0
62	6.5	6.1	5- 8 to 7- 0	5- 8 to 7- 0
64	7.1	7.0	6- 8 to 7- 8	5-12 to 8-12
66	7.6	7.6	6-12 to 8- 8	7- 4 to 8- 8
68	8.4	8.3	8- 0 to 9-12	6- 8 to 10- 0
70	8.9	9.4	9- 0 to 10- 8	8- 4 to 10- 8
72	10.0	9.8	9- 4 to 10-12	9- 0 to 12- 0
74	11.2	11.4	Q-12 to 13- 0	10-12 to 14- 8
76	11.8	12.0	9- 0 to 13- 0	11- 8 to 14- 4
78	12.7	12.5	12- 4 to 15- 0	11-12 to 14- 4
80	13.9	13.6	Q-12 to 16- 4	12- 8 to 17-12
82	14.9	14.7	13- 8 to 18- 0	11- 2 to 16- 8
84	15.4	16.0	14- 0 to 18- 4	14- 0 to 19- 4
86	16.5	16.9	14- 8 to 19-12	15- 0 to 19- 4
88	17.5	18.5	16- 4 to 19- 4	16- 0 to 24- 8
90	19.1	19.8	18- 8 to 23- 4	17- 8 to 24-12
92	20.4	20.9	18- 8 to 25- 4	19- 0 to 23- 4
94	22.4	23.0	20- 8 to 26- 8	22- 8 to 29- 4
96	23.8	24.3	21- 0 to 27-12	21-12 to 26- 8
98	24.7	27.5	21- 4 to 26-12	25- 8 to 32- 0
100	28.2	28.1	27- 0 to 31- 8	26- 4 to 31- 8
102	29.9	32.0	25- 4 to 34- 0	29-12 to 33- 4
104	32.8	33.5	29- 8 to 30- 0	30- 0 to 33-12
106	33.4	35.0	27-12 to 36- 4	34- 8 to 35- 8
108	34.4	36.0	25- 4 to 42- 4	36- 0 to 37- 0
110	36.1	37 5	35-12 to 44- 4	37- 0 to 38- 0

20 Notable success has been attained in Washington, British America and Alaska in tagging salmon caught at sea, and many of these have been traced to their native streams. Similar work attempted in California resulted in near failure,

TABLE 55

Length-Weight Relation of Fish Taken at Sea off Fort Bragg, 1819

Length of fish in cm.	Average weight 20 males recorded in pounds and tenths	Average weight 20 females recorded in pounds and tenths	Extreme weights males recorded in pounds and ounces	Extreme weights females recorded in pounds and ounces
58	5.0	4.5	3- 0 to 7- 0	4- 0 to 4-12
60	6.0	5.0	5- 8 to 6-10	5- 0 to 5-10
62	6.4	6.6	6- 0 to 7- 8	6- 0 to 7- 8
64	6.9	6.8	6- 0 to 8- 0	6- 2 to 7- 8
66	8.0	7.9	7-12 to 8- 8	6-12 to 8- 0
68	8.6	8.0	8- 0 to 9- 8	7- 4 to 9- 0
70	9.4	9.5	8- 4 to 10-12	9- 0 to 12- 8
72	10.5	10.2	9- 0 to 13; 0	9- 4 to 11-12
74	11.7	10.7	10- 0 to 13- 2	9- 8 to 13- 0
76	12.2	11.1	10- 8 to 13-12	9- 4 to 13- 2
78	13.1	12.9	11- 4 to 15- 8	9- 5 to 15- 4
80	14.0	13.6	12- 8 to 15- 0	12- 0 to 20- 0
82	15.5	15.4	13- 4 to 16-12	13- 4 to 20-12
84	16.0	16.3	14- 0 to 17- 8	14-12 to 18- 8
86	17.3	17.8	15-12 to 21- 0	16- 0 to 24- 8
88	18.3	18.2	16- 0 to 25- 0	16- 0 to 20- 0
90	19.8	19.4	18- 4 to 24- 0	18-10 to 23- 8
92	22.0	20.8	19- 0 to 28- 8	20- 2 to 26- 8
94	23.2	22.8	20- 8 to 26- 0	19- 2 to 27- 0
96	24.4	24.1	14 8 to 27- 6	20- 0 to 27- 2
98	25.7	26.2	22- 8 to 28- 8	24- 0 to 28- 4
100	28.4	28.2	24- 4 to 36- 0	20- 6 to 31- 8
102	30.7	30.0	29- 8 to 35- 0	26- 4 to 33- 8
104	32.0	33.0	28- 4 to 34-12	28- 8 to 38- 8
106	33.0	35:0	22- 0 to 37- 0	31- 4 to 38- 8
108	35.2	----------	28- 8 to 40: 8	----------
110	37.3	----------	36- 8 to 40- 8	----------
112	39.3	----------	35- 0 to 47- 0	----------

Attention was called to the composite character of the ocean catch. This is well shown when measurements of large numbers of fish of a given age from different streams and from the ocean are brought together. The graph, figure 22, was constructed from a table of measurements, (table 1) consisting of 7441 individuals examined, all of the four-year class; 2730 were from Monterey Bay, 798 from Sacramento River and 3913 from the Klamath. It will be seen that the average length of Klamath fish is near 80 cm., that of Sacramento fish about 95, while the ocean fish represented by the Monterey Bay curve, fall somewhere between.

Conditions permitted of rather extended observations relating to sex occurence in the catch at Monterey during 1919, 1920, and 1921, when a total of 9539 fish was examined, 51.7 per cent of which were males. Of 2371 fish observed in 1919, 1288 or 54.3 per cent were males ; of 3501 in 1920, 1765 or 50.4 per cent were males ; and of 3667 in 1921, 1877 or 51.2 per cent were males. More detailed data are set forth in tables 56-58.

It appears from this that sea fishing does not discriminate in any great measure against either sex. It is evident from an inspection of the tables that a larger proportion of males comes to the market in the later part of March and the early half of April than later in the season. This is graphically shown in figure 42 which is intended to represent the seasonal distribution by weekly periods.

TABLE 56

Sex Representation, Monterey, 1919, Daily and Weekly Periods

Dates	Males		Females		Males		Females	
	Number	Average length in cm.	Number	Average length in cm.	Number	Per cent	Number	Per cent
April 23	36	78.7	34	72.6				
April 24	51	80.0	38	75.4	132	54	112	46
April 25	45	80.0	40	73.7				
April 29	28	76.9	32	77.3				
April 30	45	83.0	33	76.3	100	54	86	46
May 1	27	81.6	21	78.0				
May 4	26	79.3	11	77.3				
May 5	16	72.0	15	66.7				
May 6	17	77.0	15	63.4	153	60	102	40
May 7	41	85.8	25	74.5				
May 8	24	86.4	15	78.0				
May 10	30	78.9	20	70.7				
May 11	10	81.5	10	67.5				
May 12	14	85.5	11	81.5				
May 13	26	76.6	24	77.7	155	52	145	48
May 15	22	78.7	18	77.0				
May 16	71	84.2	74	80.9				
May 17	12	84.8	8	81.0				
May 18	32	78.0	28	83.1				
May 19	27	74.6	23	74.3				
May 21	22	80.0	18	78.5	211	56	172	44
May 22	30	89.0	24	79.9				
May 23	57	86.1	37	77.1				
May 24	48	89.6	42	81.7				
May 26	44	90.9	26	85.2				
May 27	36	80.5	29	79.1	160	62	98	38
May 28	40	92.2	29	83.1				
May 29	31	91.7	14	86.5				
June 4	11	77.3	7	82.3				
June 5	9	89.6	11	87.7	84	62	52	38
June 6	42	90.8	23	84.3				
June 7	22	89.3	11	86.0				
June 8	17	81.6	7	69.5				
June 9	15	74.8	15	70.5	70	60	46	40
June 12	16	86.8	7	78.7				
June 13	22	81.3	17	75.9				
June 16	10	74.3	15	66.1				
June 17	24	67.4	25	76.5				
June 19	12	67.9	23	75.2	64	38	105	62
June 20	10	73.8	10	72.5				
June 21	8	73.0	32	73.5				
June 23	25	63.1	30	68.5				
June 25	40	71.4	40	75.1				
June 26	7	80.7	13	72.0	100	44	125	56
June 27	23	71.4	34	75.3				
June 28	5	78.2	8	84.2				
July 11	10	90.5	10	87.0	10	50	10	50
July 21	10	69.2	9	73.5				
July 22	21	62.1	15	64.0	37	59	26	41
July 23	6	72.5	5	86.2				
July 26	7	78.0	4	90.2	7	64	4	36
Totals					1,289	54	1,083	46

TABLE 57

Sex Representation, Monterey, 1920, Daily and Weekly Periods

Dates	Males		Females		Males		Females	
	Number	Average length in cm.	Number	Average length in cm.	lumber	'er cent	lumber	'er cent
January 29	3	71.3	2	71.0				
January 30	3	68.3	2	68.0	6	60	4	40
February 21	4	77.2	4	71.0	4	50	4	50
February 23	10	74 2	18	73.3				
February 25	19	72.6	21	73.3	57	40	86	60
February 26	22	73.1	38	70.7				
February 27	6	71.8	9	74.2				
March 3	1	75.0	3	74.5	1	25	3	75
March 8	3	74.3	1	83.5				
March 9	0		1	75.0	85	47	94	53
March 11	26	77.1	43	75.3				
March 12	56	80.2	49	70.2				
March 17	10	78.3	20	72.8				
March 18	31	72 9	54	72.8	105	37	175	63
March 19	36	70 9	64	71.1				
March 20	28	70.4	37	69.5				
March 21	10	71.7	29	72.2	23	29	56	71
March 23	13	71.7	27	70.5				
April 5	48	79 3	52	78.3				
April 6	36	81.2	44	75.6				
April 7	22	81.4	61	74.6	157	42	221	58
April 8	30	85 8	40	76 4				
April 10	21	90.7	24	78 7				
April 12	81	91.9	49	86.9				
April 13	71	92.1	39	87.8	235	64	135	36
April 14	35	91.0	25	89.5				
April 16	48	94.3	22	88.1				
April 21	27	89 3	33	x5.7				
April 22	31	83.9	39	81.3	110	47	125	53
April 23	30	76.4	35	78.5				
April 24	22	84.4	18	74.4				
April 26	60	90.2	44	82.8	207	62	127	38
April 27	51	95.6	29	82 4				
April 28	96	95.3	54	88.7				
May 8	57	97.2	38	90.7	57	60	38	40
May 10	50	90.7	40	86 8				
May 11	69	95.2	56	84.6				
May 13	63	94.1	41	78.9	214	58	155	42
May 14	32	98.6	18	89.2				
May 17	27	89.5	38	85.7	59	44	74	56
May 18	32	87.5	36	83.2				
June 2	32	83 6	52	79.0				
June 3	76	66.2	68	72.0	134	45	162	55
June 4	26	81.9	42	83.3				
June 14	62	76.6	43	80.4				
June 15	32	73 9	24	79.5	188	57	143	43
June 16	38	80.3	32	82.0				
June 17	56	70 3	44	80.1				
June 21	42	60 4	38	72.7				
June 22	13	75.2	16	85.6				
June 23	26	83.6	38	79.0	123	48	134	52
June 24	5	66.6	5	74.0				
June 25	20	70.2	19	80.3				
June 26	17	70.8	18	74.4				
Totals					1,765	51	1,736	49

TABLE 58

Sex Representation, Monterey, 1921, Daily and Weekly Periods

Dates	Males		Females		Males		Females	
	Number	Average length in cm.	Number	Average length in cm.	Number	Per cent	Number	Per cent
January 21	1	72.0	0	0	6	50	6	50
February 2	2	76.0	3	65.3				
February 4	3	71.0	2	69.5				
February 7	4	74.0	6	69.5				
February 10	51	68.9	58	67.5	86	45	103	55
February 11	31	66.9	39	65.5				
March 1	6	72.8	1	82.0				
March 2	5	66.8	5	74.4	52	52	48	48
March 3	41	70.8	42	68.5				
March 11	1	96.0	0	0	23	68	11	32
March 12	22	69.3	11	68.8				
March 13	1	75.0	0	0				
March 14	19	74.3	41	74.6				
March 15	21	73.8	40	71.0	111	35	204	65
March 16	21	71.2	33	70.6				
March 17	22	69.9	32	69.9				
March 18	27	70.3	58	70.3				
March 21	27	71.6	43	72.4				
March 22	12	71.5	8	73.3				
March 23	12	82.9	8	79.2	108	47	120	53
March 24	35	77.1	34	73.6				
March 25	12	80.4	16	73.8				
March 26	10	80.6	11	79.7				
March 28	32	73.6	27	73.0				
March 29	20	87.8	23	81.6				
March 30	30	81.1	20	79.7	140	56	112	44
March 31	21	77.7	24	75.5				
April 1	33	95.0	11	86.5				
April 2	4	92.7	7	89.1				
April 5	1	91.0	2	101.0				
April 6	13	96.9	2	88.0				
April 7	3	102.0	1	85.0	27	80	7	20
April 8	1	100.0	0	0				
April 9	9	77.4	2	68.5				
April 10	2	85.5	3	62.7				
April 11	15	93.8	9	89.8				
April 12	17	98.7	3	91.0	39	65	21	35
April 13	0	0	2	95.0				
April 15	5	101.8	4	94.2				
April 16	5	97.2	3	81.3				
April 20	1	75.0	0	0	6	60	4	40
April 21	0	0	1	91.0				
April 25	6	101.2	4	90.5				
April 26	46	95.6	18	89.8				
April 27	30	98.1	20	89.9	237	58	172	42
April 28	70	95.3	60	86.5				
April 29	40	88.7	45	84.8				
April 30	45	89.8	25	82.4				
May 2	19	90.7	35	82.4				
May 3	30	91.6	24	87.6	93	55	75	45
May 4	16	99.4	4	82.2				
May 5	20	100.7	3	95.0				
May 7	8	102.3	9	88.4				
May 9	57	97.2	24	91.0				
May 10	32	97.4	13	94.2				
May 11	30	98.1	14	94.0				
May 12	53	95.8	37	89.6	272	60	179	40
May 13	64	94.5	55	87.6				
May 14	36	86.7	36	86.4				

TABLE No. 58—Continued

Sex Representation, Monterey, 1921, Daily and Weekly Periods

Dates	Males		Females		Males		Females	
	Number	Average length in cm.	Number	Average length in cm.	Number	Per cent	Number	Per cent
May 16	9	96.9	10	82.5				
May 17	3	94.7	1	85.0				
May 18	23	96.6	12	86.4	200	56	159	44
May 19	83	88.1	57	82.7				
May 20	65	90.1	60	82.9				
May 21	17	94.6	19	88.8				
May 23	22	96.8	10	86.4				
May 24	21	94.2	31	85.0				
May 25	40	92.1	32	83.5				
May 26	39	94.5	5	79.6	142	54	123	46
May 27	17	89.7	22	81.7				
May 28	12	94.5	14	93.0				
May 30	2	89.5	6	79.7				
May 31	15	83.1	27	82.6	56	43	73	57
June 1	18	76.7	18	78.8				
June 4	21	85.8	22	80.9				
June 6	26	91.0	20	84.8				
June 7	26	90.6	23	87.0				
June 8	12	88.9	22	81.5	116	45	140	55
June 9	31	81.9	32	77.1				
June 10	21	88.6	43	80.2				
June 13	13	85.4	29	72.9				
June 14	2	79.5	2	76.0				
June 15	2	63.0	0	0	66	41	96	59
June 17	13	79.3	23	76.3				
June 18	36	74.0	42	75.2				
June 21	6	70.8	12	79.3				
June 22	28	82.4	40	77.9				
June 23	28	84.5	44	78.9	93	42	128	58
June 24	17	82.3	12	81.2				
June 25	14	64.8	20	72.2				
June 27	4	79.8	9	71.3	4	30	9	49
Totals					1,877	51	1,790	49

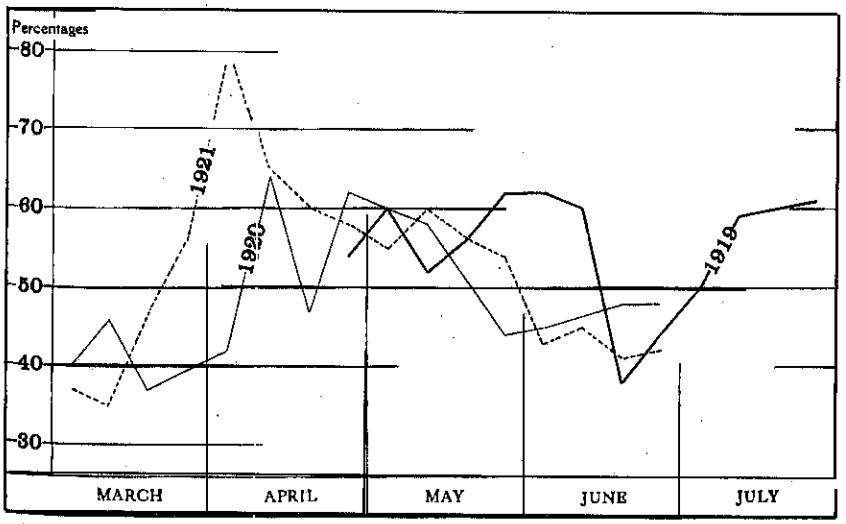

FIG. 42. Occurrence of male fish in the catch at Monterey for three consecutive years over weekly periods, and expressed in percentages.

AGE CHARACTERISTICS OF THE OCEAN CATCH

The ocean catch is made up of fish which range in age from two to six years. Although details are given in tables 61–71, a brief summary in percentages for fish examined at Monterey is offered here.

TABLE 59

Ocean Catch at Monterey

Year	Percentage of fish in each year class					Size of sample	Date of sample
	2	3	4	5	6		
1919	7	33	43	16	1	1,742	April 23 to July 26
1920	7	30	37	24	2	2,171	January 30 to June 26
1921	0.6	30	43	24	2	2,758	February 2 to June 20

As the number of fish examined at Monterey was large, and as every opportunity for obtaining a fair sample was presented, it is reasonably safe to assume that the age representation here is about normal, and any marked deviation from this assumed normal which may occur at a future time will be regarded with interest. Observers have not been able to obtain representative samples during an extended period of time at either Fort Bragg or Eureka, because of selection which often occurred before access to the fish was obtained.

The ocean catch when compared with that of the river is relatively rich in two- and three-year fish as will appear from a comparison of the following table with the previous one.

TABLE 60

Klamath River Catch

Year	Percentage of fish in each year class					Size of sample
	2	3	4	5	6	
1919	0	16	63	20	1	2,179
1920	0	11	78	10	0.4	1,819
1923	0	16	70	13	1	1,593

In the Sacramento River catch the proportion of three-year fish is somewhat greater than in that of the Klamath, the four-year fish are fewer in number, while the five- and six-year individuals are more numerous. In this connection it should be noted that the Sacramento River samples are numerically smaller than those from the Klamath, and that their time of capture extends over a shorter period.

For purposes of comparison, and as a possible check against conditions which might appear in the future, it was found necessary to make age analyses of the catches at Monterey Bay and elsewhere along the coast. At the receiving houses in Monterey the fish arrived in undisturbed boat-loads, just as caught, and it was possible at all times to secure data from a fair sample of the catch, just as at the mouth of the Klamath. At Noyo Estuary near Fort Bragg, at Shelter Cove, and

at Eureka selection was so often made from the boats before the observer came to them, that large samples covering an extended period of time could not be secured.

The samples taken at Monterey may be considered as fairly representative of the ocean catches of 1919, 1920 and 1923, and as a total they probably represent the normal proportions of the various age and other group classes of the period.

There is no knowing how these would have compared with the past, and one looks with interest to the future. Tables which record the results of these analyses are here presented.

TABLE 61

Monterey Bay, 1919

Year class	Number of examples of a given age taken during weekly periods					
	2	3	4	5	6	Totals
April 20–26	5	75	95	24	0	199
April 27–May 3	5	51	69	18	1	144
May 4–10	18	82	77	28	1	206
May 11–17	15	57	87	48	1	208
May 18–24	16	67	120	46	2	251
May 25–31	3	23	80	43	3	152
June 1– 7	1	9	59	30	3	102
June 8–14	7	27	28	11	1	74
June 15–21	13	61	36	6	0	116
June 22–28	15	82	73	25	5	200
July 6–12	3	7	6			16
July 20–26	20	24	13	6	1	64
July 27–August 2	2	1	5	1	1	10
Totals	123	566	748	286	19	1,742

TABLE 62

Proportion of Two and Three Year Fish in the Catch, Monterey Bay, 1919

	Year class			Number individuals examined	Approximate per cent of two and three year fish
	2	3	2+3		
April 20–16	5	75	80	199	40.0
April 27–May 3	5	51	56	144	39.0
May 4–10	18	82	100	206	48.5
May 11–17	15	57	72	208	34.6
May 18–24	16	67	83	251	33.0
May 25–31	3	23	26	152	17.0
June 1– 7	1	9	10	102	9.8
June 8–14	7	27	34	74	46.0
June 15–21	13	61	74	116	64.0
June 22–28	15	82	97	200	48.5
July 6–12	3	7	10	16	62.5
July 20–26	20	24	44	64	68.5
July 27–August 2	2	1	3	10	3.0
Totals	123	566	689	1,742	39.6

TABLE 63

MONTEREY BAY 1919

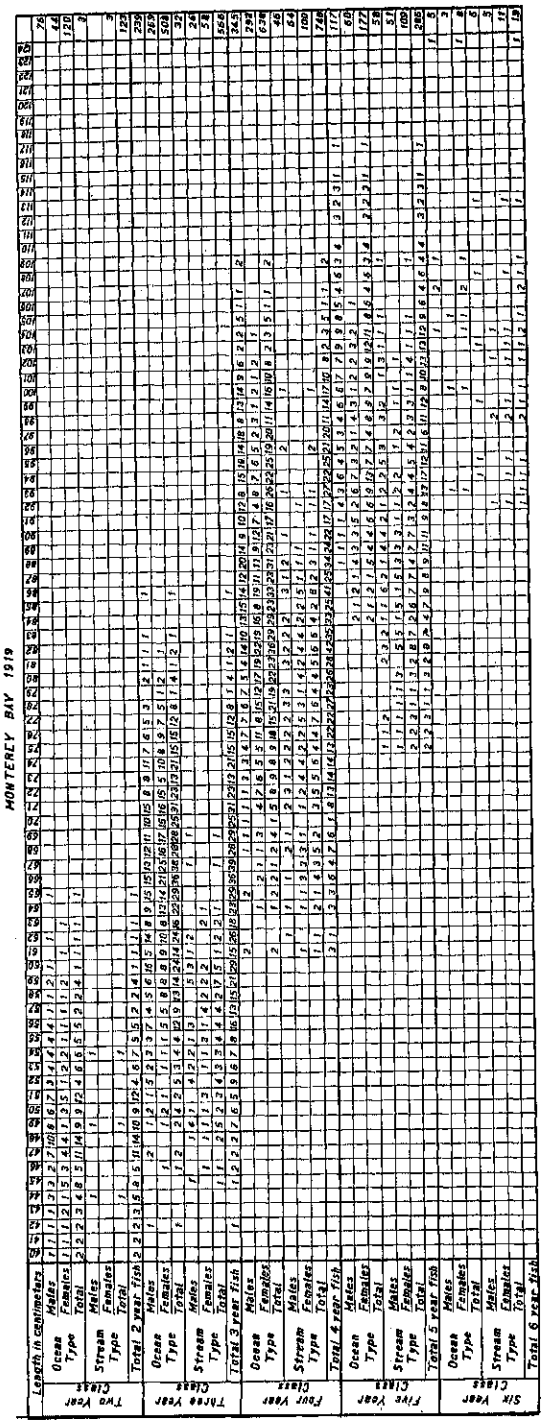

TABLE 64

Proportion of Two and Three Year Fish in the Catch, Monterey Bay, 1919

Year	Year class			Number individuals examined	Approximate per cent of wo and three year fish
	2	3	2+3		
January 25-31		6	6	7	
February 15-21		6	6	9	
February 22-28	1	81	82	120	68.3
March 1-6		3	3	4	
March 7-13	1	67	68	132	51.5
March 14-20	5	98	103	164	62.8
March 21-27		35	35	53	66 0
April 4-10	2	94	96	232	41 4
April 11-17	3	5	8	195	4.0
April 18-24	1	47	48	181	26.5
April 25-May 1	2	14	16	151	10 6
May 2-8		2	2	58	3 5
May 9-15	2	32	34	204	16 6
May 16-22		21	21	102	20 6
May 30-June 5	26	27	53	186	44 6
June 13-19	63	28	91	221	45.7
June 20-26	41	45	86	152	56.5
Totals	147	641	786	2,171	26.3

ARTIFICIAL PROPAGATION IN KLAMATH RIVER

Although some experimental attempts at artificial propagation were early made near the mouth of Klamath River, and a hatchery was later established on Trinity River, active work of this sort dates from 1896, when under the direction of the United States Commission, some fry resulting from eggs taken at Battle Creek, a tributary of the Sacramento were introduced into the upper Klamath. Just why it was deemed necessary to import fish to the Klamath, or why a stream where depletion was already apparent should be further robbed does not appear. However, large numbers of Sacramento eggs were again taken in 1907, 1911, 1913, and later, something like 5,000,000 in all according to hatchery methods of enumeration, and the resulting fry liberated in the Klamath. More detailed information appears in table 72 and a digest of further hatchery operations in table 73. Since 1917 no salmon from other streams have been brought to the Klamath excepting a small number for experimental purposes. Of late years large numbers of Klamath eggs have been sent to the Mt. Shasta hatchery from where the resulting fry have been liberated in the Sacramento.

Upon the closure of the upper reaches of the Klamath by the great dam at Copco, a hatchery was established at Fall Creek (Fig. 26) and a particularly efficient trap, placed in the river near Hornbrook. This trap is sometimes spoken of as the "Klamathon Racks." Its function is to stop all migrating salmon and retain them until they are ripe enough for artificial spawning. Unless some accident occurs which would destroy the racks at a critical time, or our notion of the homing instinct of salmon is at fault, it is apparent that there is here an opportunity to demonstrate that artificial propagation may maintain the species, at least on a par with natural propagation elsewhere in the basin.

A census of all salmon entering the racks was begun in 1925 and has been continued with results as indicated in table 51. It will be seen

TABLE 66

MONTEREY BAY 1920

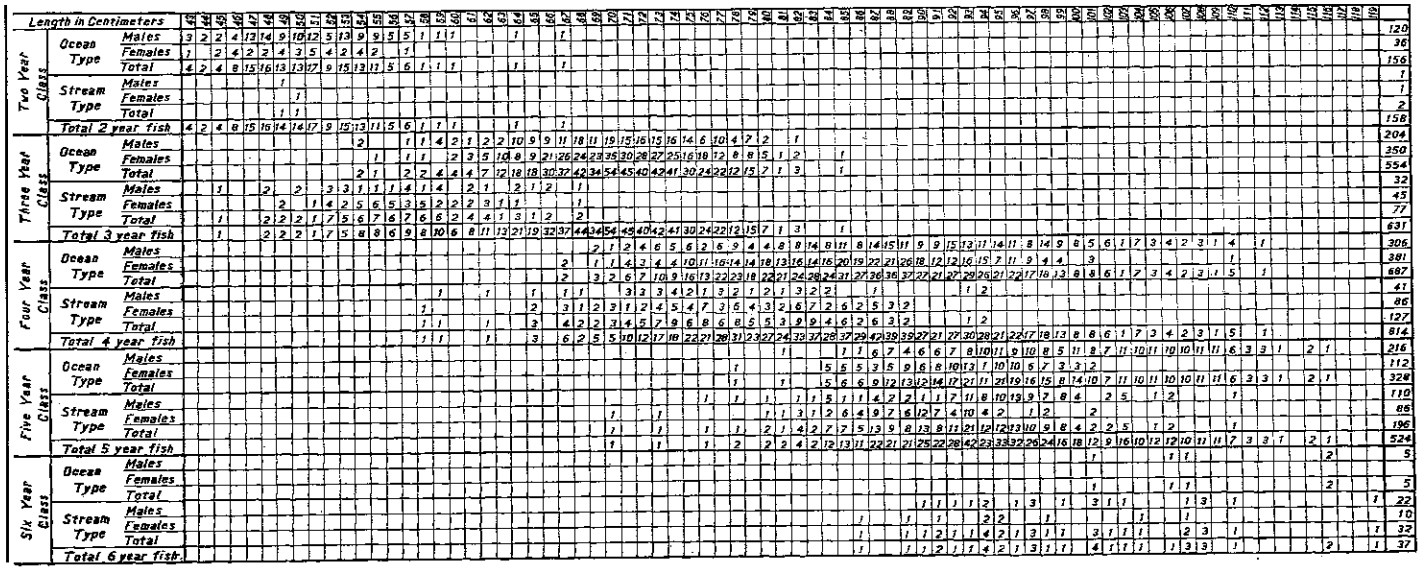

TABLE 66

Monterey, 1921

Year class	Number of examples of a given age taken during weekly periods					
	2	3	4	5	6	Totals
January 20–February 5		9	3			12
February 6–12	2	121	21	1		145
February 27–March 5	2	46	27	1		76
February 6–12		21	8	1		30
February 13–19	3	157	74	3	1	238
February 20–26		106	76	6		188
February 27–April 2		76	72	62	5	215
April 2–9		4	9	14	1	28
April 10–16		5	17	36	1	59
April 17–23			6	6	10	12
April 24–30		15	171	86	15	282
May 1–7		12	64	63		154
May 8–14		11	113	162	10	296
May 15–21		23	81	55	7	166
May 22–28		20	115	51	6	192
May 29–June 4	3	24	40	30	6	103
June 5–11	2	46	124	66	1	
June 12–18	3	54	67	7	2	132
June 19–25	1	68	89	19		179
June 26–July 2		1	5	1		7
Totals	16	819	1,182	670	71	2,758

TABLE 67

The Proportion of Two and Three Year Fish in the Catch, Monterey Bay, 1921

Periods	Year class			Number of individuals examined	Approximate per cent of two and three year fish
	2	3	2+3		
January 20–February 5		9	9	12	75.0
February 6–12	2	121	123	145	84.8
February 27–March 5	2	46	48	76	63.2
March 6–12		21	21	30	70.0
March 13–19	3	157	160	238	67.2
March 20–26		106	106	188	56.3
March 27–April 2			76	215	35.3
April 3–9		74	4	28	14.3
April 10–16		5	5	59	8.5
April 17–23				12	0.0
April 24–30		15	15	282	5.3
May 1–7		12	12	154	7.7
May 8–14		11	11	296	3.7
May 15–21		23	23	166	13.8
May 22–28		20	20	192	10.4
May 29–June 4	3	24	27	103	26.2
June 5–11	2	46	48	244	19.6
June 12–18	3	54	57	132	43.2
June 19–25	1	68	69	179	38.5
June 26–July 2		1	1	7	14.3
Totals	16	819	835	2,758	30.2

TABLE 68

MONTEREY BAY 1921

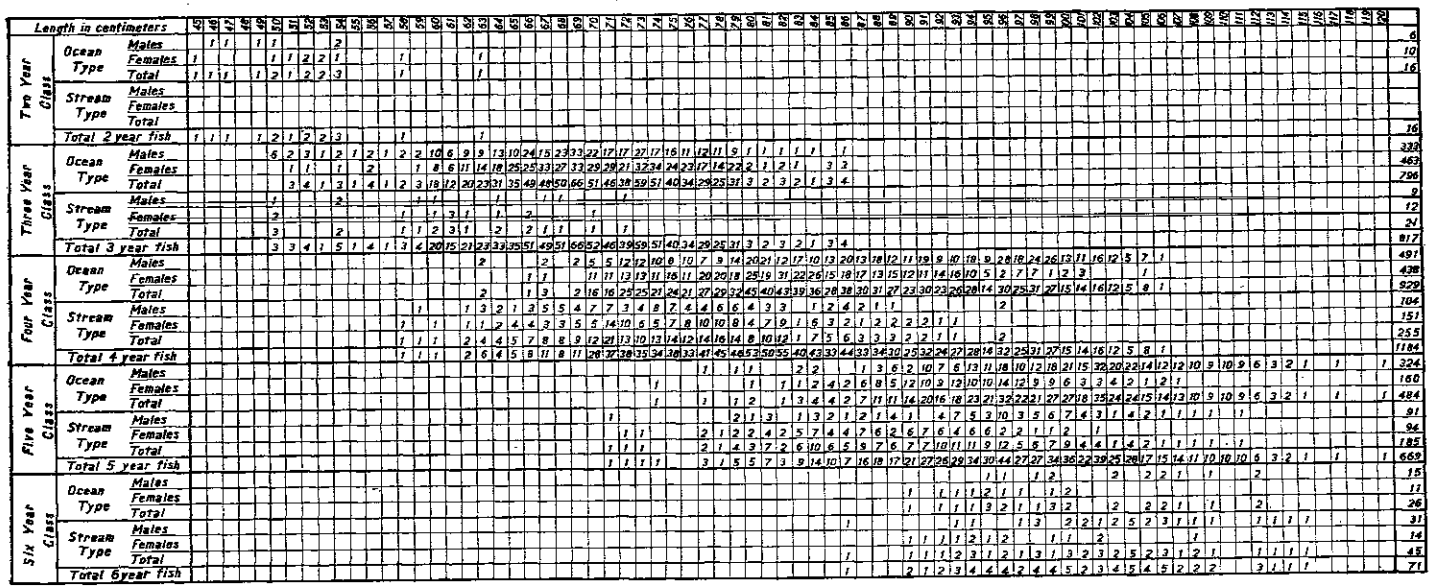

TABLE 69

Summary of Monterey Bay Age Classes

Year	2			3			4			5			6			Totals			Percentages		
Year—	1919	1920	1921	1919	1920	1921	1919	1920	1921	1919	1920	1921	1919	1920	1921	1919	1920	1921	1919	1920	1921
Males	79	121	6	271	236	342	391	347	696	175	326	416	11	27	46	927	1,057	1,405	53.2	48.8	51
Females	44	37	10	295	395	475	357	467	589	111	198	254	8	10	25	815	1,107	1,353	46.8	51.2	49
Ocean type	120	156	16	508	554	796	688	687	929	171	328	484	8	5	26	1,451	1,730	2,251	83.2	79.9	82
Stream type	3	2	0	58	77	21	110	127	255	109	196	186	11	32	45	291	266	507	16.8	20.1	18
Ocean type males	76	120	6	239	204	333	345	306	491	117	216	324	5	5	15	782	851	1,169	44.9	39.3	42
Ocean type females	44	36	10	269	350	463	293	381	438	60	112	160	3	0	11	669	879	1,082	38.4	40.7	39
Stream type males	3	1	0	32	32	9	46	41	104	58	110	92	6	22	31	145	206	236	8.3	9.5	9
Stream type females	0	1	0	26	45	12	64	86	151	51	86	94	5	10	14	146	228	271	8.4	10.5	10
Totals	123	158	16	666	631	811	748	814	1,184	286	524	670	19	37	71	1,472	2,164	2,758			
Percentages	7	7.3	.6	33	29.2	30	43	37.6	43	16	24.2	24	1	1.7	2						

TABLE 70

FORT BRAGG 1920

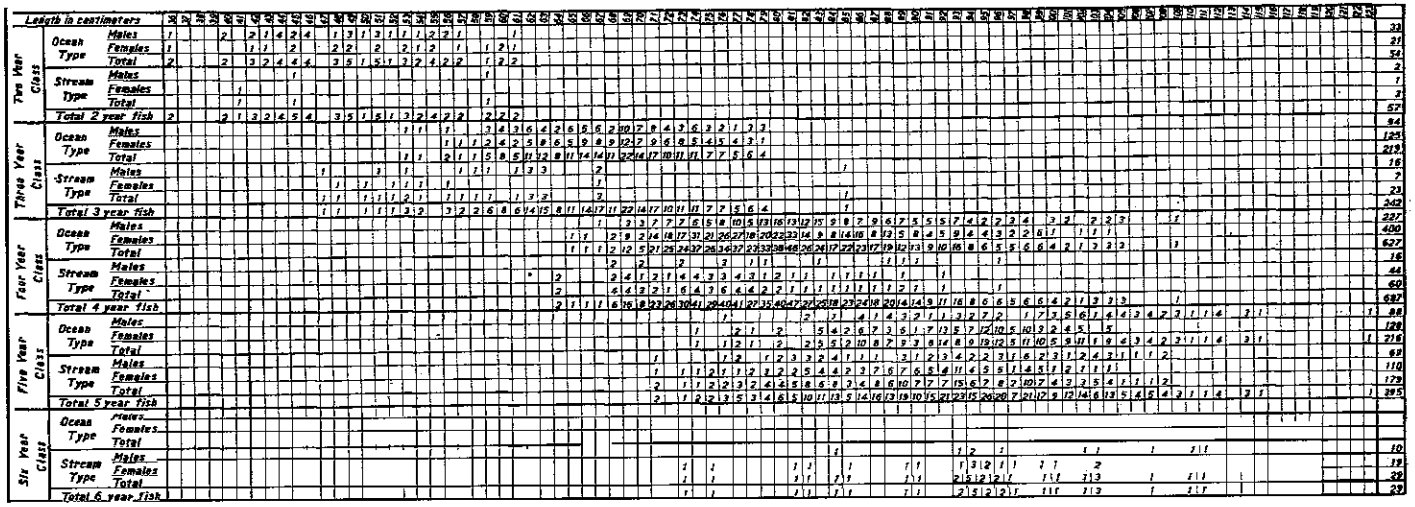

TABLE 71

Summary of Fort Bragg Age Classes, 1920

Year classes	2	3	4	5	6	Totals	Per-centages
Males	35	110	243	157	10	555	39
Females	22	132	444	238	19	855	61
Ocean type	54	219	627	216	0	1,116	79
Stream type	3	23	60	179	29	294	21
Ocean type males	3 3	94	227	88		442	31
Ocean type females	21	125	400	128	8	674	48
Stream type males	2	16	16	69	10	113	8
Stream type females	1	7	44	110	19	181	13
Totals	57	242	687	395	29	1,410	
Percentages	4	17	48.7	28	2		

that a rapid decline in fish of spawning age has occurred. While the number of spawning fishes was less in 1926 when compared with 1925 the number of grilse was considerably greater, possibly indicating a more intensive straining by the nets in the estuary. For some unknown reason the records for 1927 and 1928 are incomplete.

Hatchery operations on Trinity River did not meet with marked success as the following account will show.

The report of the United States Commissioner of Fish and Fisheries for 1889 to 1891 (p. 51) recites, "In view of the urgent and many requests from citizens in the regions of the Rocky Mountains and the Pacific coast to stock their waters ... Lieut. Commander J. J. Brice, U. S. Navy. . . was directed to make a reconnaissance. Upon his recommendations' the reservation at Fort Gaston, Humboldt County, California, was decided upon as offering the necessary requirements." Here then, in one of the most inaccessible parts of the state in so far as transportation was concerned, the Commission established a hatchery. Operations began by shipping salmon eggs from Baird, a station in the Sacramento basin, to Fort Gaston. Owing to difficulties encountered in securing spawning fish at Ft. Gaston, an egg-taking station was later established on Redwood Creek, and finally after several years the Fort Gaston hatchery was abandoned because of its remoteness. A summary of reported[21] hatchery activities in the region of Trinity River follows:

According to W. H. Bailey, a small hatchery was established by R. D. Hume on a stream near the mouth of Klamath River "in the nineties." Eggs were brought from Rogue River somewhere near Grant's Pass. Fish in large numbers were successfully hatched and introduced into the main river near the mouth, and also into Hunter and High Prairie creeks. Many were retained for about a year and then liberated. These were fed with canned salmon eggs, ground-up sturgeon, smelt and other fish. Adults later returned to the creeks into which they had been introduced, but no permanent run was established in either stream. None of the young salmon was ever carried up the Klamath beyond the mouth of Hunter Creek.

There is not available at present any exact information relating to the contribution of natural spawning of king salmon as compared with artificial propagation. Casual observation points to the probability that

21 From the Reports of the U. S. Commissioner of Fisheries.

investigation of the results of natural propagation will receive more attention in the near future by those who seek fundamental facts pertaining to conservation. Incidents like the following are apt to arrest one's attention.

Shasta River, once a noted salmon stream, has of late years been regarded as of little consequence as a contributor to the population of Klamath River. Its decline, as such, has been attributed to local causes such as diversion of water for agriculture, mining, and power purposes, spearing fish on the spawning beds, and what not. When examining

TABLE 72

The following record of artificial propagation of King Salmon in Klamath River was furnished by W. H. Shebley, of Bureau of Fish Culture)

Eggs received at Mt. Shasta during fall and winter of	Source of eggs	Date of planting	Number planted in Klamath River	
1896	Battle Creek	Mar. 8, 1897	200,000	
1896	Battle Creek	Mar. 9, 1897	300,000	
1896	Battle Creek	Mar. 10, 1897	300,000	
1896	Battle Creek	Mar. 11, 1897	300,000	
1896	Battle Creek	Mar. 12, 1897	300,000	
				1,400,000
1907	Battle Creek	Mar. 16, 1908	120,000	
1907	Battle Creek	Mar. 22, 1908	120,000	
1907	Battle Creek	Mar. 23, 1908	120,000	
1907	Battle Creek	Mar. 24, 1908	120,000	
1907	Battle Creek	April 3, 1908	120,000	
				600,000
1911	Battle Creek	April 2, 1912	350,000	
				350,000
1913	Battle Creek	April 5, 1914	330,000	
1913	Battle Creek	April 7, 1914	350,000	
1913	Battle Creek	April 16, 1914	335,000	
1913	Battle Creek	April 18, 1914	335,000	
				1,350,000
1914	Klamathon	May 2, 1915	450,000	
1914	Klamathon	May 4, 1915	200,000	
1914	Battle Creek	Oct. 13, 1915	200,000	
1914	Battle Creek	Nov. 19, 1915	30,000	
				880,000
1915	Klamathon	April 3, 1916	627,000	
1915	Klamathon	April 4, 1916	769,000	
1915	Klamathon	April 5, 1916	691,000	
1915	Klamathon	April 6, 1916	751,000	
1915	Klamathon	April 7, 1916	722,000	
1915	Klamathon	April 8, 1916	667,000	
1915	Klamathon	April 19, 1916	554,000	
1915	Klamathon	April 20, 1916	518,000	
1915	Klamathon	April 21, 1916	700,000	
1915	Klamathon	April 22, 1916	864,000	
1915	Klamathon	Nov. 2, 1916	200,000	
1915	Klamathon	Nov. 4, 1916	200,000	
1915	Klamathon	Nov. 20, 1916	150,000	
1915	Klamathon	Nov. 22, 1916	150,000	
				7,563,000
1916	Klamathon	May 17, 1917	210,000	
1916	Klamathon	May 18, 1917	218,000	
1916	Klamathon	Oct. 19, 1917	150,000	
1916	Klamathon	Oct. 22, 1917	125,000	
1916	Klamathon	Oct. 25, 1917	125,000	
1916	Klamathon	Oct. 27, 1917	100,000	
				928,000
1917	Battle Creek	April 6, 1918	75,000	
1917	Battle Creek	April 8, 1918	75,000	
1917	Battle Creek	April 10, 1918	75,000	
1917	Battle Creek	April 12, 1918	75,000	
1917	Battle Creek	Sept. 12, 1918	150,000	
1917	Battle Creek	Sept. 14, 1918	150,000	
1917	BattleCreek	Sept. 16, 1918	150,000	
1917	Battle Creek	Sept. 17, 1918	150,000	
1917	Battle Creek	Sept. 18, 1918	150,000	
				1,050,000
Total				14,121,000

TABLE 73

Record of Egg Collections on Klamath River and Tributaries

Year	King Salmon	Silver Salmon	Rainbow Trout
1916	15,872,000		1,189,000
1917	1,000,000		4,439,000
1918	277,000		1,709,000
1919	2,102,000	254,000	3,788,000
1920	4,974,000		5600,000
1921	7,110,000		7,677,000
1922	19,178,000		9,780,000
1923	20,824,000		5,842,000
1924	5,762,000		4,941,000
1925	6,735,000	3,295,000	10,667,000
1926	18,042,000		5,838,000
1927*	11,797,000	397,000	1,765,000
1928	4,541,000		5,203,000
Totals	118,214,000	3,946,000	68,438,000

*The year 1927 was one of very high water, and every trout station on the Klamath River and its tributaries was damaged, and most of them were put out of commission for the season.

a part of the stream bed in 1926 in search for marked salmon, the writer assisted by E. C. Scofield, took occasion to make a careful estimate of the number of spawning salmon which might be actually seen between the power dam and the mouth of the stream, a distance of about 6.9 miles. The method employed was to count all individuals actually seen in such parts of the stream as could be approached, and from these counts estimate the number in inaccessible places. No account was taken of fish which might have been concealed in deep pools, nor of those carried away by spearmen. The census thus taken gave an enumeration of 7500 individuals. Any experienced observer appreciates the difficulty of seeing fish in even a small stream, and he will no doubt agree that an estimate made in this way is conservative. Grilse, small three-year males, were almost entirely absent. Spawning fish in numbers had probably passed above the dam, and it seems quite probable that the entire number of fish in the river was far in excess of the above estimate. During the same season 9387 fish by actual count entered the racks at Klamathon on the main river. From what we now know of the return migration of salmon, it is believed that the fish which entered the racks at this time owed their origin to artificial propagation, and it seems equally certain that those of Shasta River were the result of natural propagation.

The relatively small, steady flow of Shasta River during the salmon migration, together with the accessibility of the stream, would suggest it as an ideal place for a study of natural propagation.

SUMMARY

The king salmon which is indigenous to Klamath River differs in size and certain anatomical characters from that of the Sacramento River.

Two species, the king salmon and the silver salmon, are represented in sufficient numbers to be of commercial importance. The humpback and dog salmon are only occasionally seen. The redfish (*Oncorhynchus nerka*) is not found in the river.

Two definite immigrations of king salmon have been observed, a spring and a summer run. The spring run is now so depleted as to be

TABLE 74

Summary of Hatchery Activities on Trinity River

Date	Eggs received	Species	Origin	Eggs distributed	Fish distributed	Destination
1889–90	10,000	King Salmon	Baird			Trinity River
1890–91	45,000	King Salmon	Trinity River			Trinity River
1890–91	30,000	King Salmon	Redwood Creek			Redwood Creek
1891–92	160,000	King Salmon	Redwood Creek		147,000	Supply Creek (Trinity River)
1891–92	160,000	King Salmon	Redwood Creek		142,500	Redwood Creek
1891–92	21,000	Rainbow Trout	Redwood Creek			
1891–92	20,000	Brook Trout	Caledonia, New York			
1891–92	25,000	Von Behr trout	Northville, Mich.			
1892–93		Rainbow Trout	Brood fish		16,000	Local streams (Trinity)
1892–93		Von Behr Trout	Last year, Ft. Gaston		19,960	Local streams (Trinity)
1892–93		Brook Trout	Last year, Ft. Gaston		6,193	Local streams (Trinity)
1892–93	180,000	King Salmon	Redwood Creek, Trinity River		117,000	Local streams (Trinity)
1892–93	375,000	King Salmon	Redwood Creek, Trinity River		540,000	Local streams (Trinity)
1893–94	800,000	King Salmon	Redwood Creek, Trinity River		660,000	Local streams
1893–94	460,000	Rainbow Trout	Redwood Creek, Trinity River	10,000		Wytheville Station, Virginia
				100,000		Northville Station, Michigan
				50,000		Sisson, California
1893–94		Rainbow Trout	"Yearlings"		5,450	Waters of Trinity Mountain
1894–95	221,000	King Salmon	Redwood Creek		220,000	Redwood Creek, Trinity River
1894–95		Silver Salmon	Redwood Creek			
1894–95	241,800	Rainbow Trout and "Steelhead"	Redwood Creek	30,000		Japan
				91,860		Northville Station
				100,000		Duluth Station
				25,000		St. Johnsbury Station
					1,000	Elk River
1894–95	20,800	Von Behr Trout	Brood stock, Ft. Gaston		277,500	Redwood Creek
					1,000	Yager Creek
					3,000	Streams in Marin County
1895–96	73,000	King Salmon	Redwood Creek		65,700	Adjacent streams
1895–96	795,000	Rainbow Trout	Redwood Creek		107,809	Redwood Creek
				686,000		Shipped out of state
1895–96	17,000	Von Behr Trout	Brood stock, Ft. Gaston	10,000		California Fish Commission
1895–96	87,000	Rainbow Trout	Brood stock, Ft. Gaston	30,000		Marin County Country Club
1896–97	406,000	King Salmon	Redwood Creek		405,000	Redwood Creek
1896–97	800,000	Rainbow Trout	Brood stock, Ft. Gaston		202,000	Redwood Creek
				600,000		Shipped out of state
1897–98	1,283,450	King and Silver Salmon	Redwood Creek	710,000		Redwood Creek
			Redwood Creek	710,000		Shipped out of state
1897–98	1,451,000	Rainbow Trout	Redwood Creek		35,950	Trinity River
					Balance of rainbow trout	Redwood Creek

scarcely evident. The summer run is the only one of commercial importance.

The incoming fish show an increase in average size and weight as the season advances. This is due to both additional growth in the sea, and to the incursion of very large fish late in the season.

The time of immigration varies somewhat through a period of years, but it is not growing later as some presume.

From the results of experimental work it is safe to infer that king salmon which have been introduced into a particular tributary of a river usually seek out and enter the same tributary on their return migration, if when planted they were given a sufficient amount of exposure to its waters before they entered the main channel. The homing instinct is a barrier to dispersal. However, a small scatter may follow both natural and artificial propagation, thus constantly affording the species an opportunity to extend its range. It follows that when young salmon are introduced into a basin, they should be planted in widely separated localities if it is desired that the returning fish should distribute themselves to some extent over the basin.

The summer immigration occurs at a time of low water in the river. An emigration of young salmon also occurs, or is at least well begun, before the approach of winter floods.

Emigrating young appear in the estuary in late summer and early fall, where they linger and rapidly grow. There is evidence that at least some of these attain the maximum part of the first year's growth here. Many artificially propagated yearlings appear to tarry for a time in the estuary also.

Increasing knowledge of the habits of Klamath salmon strengthens the belief that the construction of high dams in the river will cause the extinction of the species above the dams.

Klamath salmon are found to mature at ages of from two to six years. No seven-year-old fish has been seen. Three-year females are at times fairly common in the catch. Precocious males occur during the first year of growth, and sperm from these will fertilize eggs. The ensuing young reach maturity and do not appear to differ from other adults.

Depletion of Klamath salmon is not only apparent, but it seems to be progressing at an alarming rate. There is evidence also that artificial propagation alone is not able to cope with the situation.

Gill net fishing at the mouth of the river is a deleterious straining process that permits the escape of small fish which later appear in ill-proportioned numbers on the spawning beds. If the tendency to mature early is inherited, the result may be a weakening of the entire stock in so far as it is of commercial worth.

The week-end closed period during the fishing season does not seem to accomplish its intended end.

During their ocean life, salmon migrate long distances from the mouths of their native streams.

Klamath salmon range at sea as far south as the marine habitat of the species extends. The extreme northern migration is unknown, but

from what has been learned of the movements of Sacramento fish it may be inferred that Klamath salmon migrate northward also.

Ocean trolling results in the capture of immature fish in considerable numbers. Therefore, when an ocean catch is compared with that of a river, it is found to be relatively rich in two- and three-year fish.

In so far as we are able to determine, artificially propagated salmon do not differ in their habits from fish of the same species in a state of nature. Artificially propagated fish become adults which are similar in growth, stature, and other particulars to those produced in nature.

WRITTEN COMMENTS FROM LOCAL AGENCIES

Bogus Elementary School

13735 Ager Beswick Rd

Montague CA, 96064

The Bogus Elementary School Board would like express our concern with the possible Dam removal in the Klamath River Basin.

Dam Removal has many adverse consequences but what concerns the Bogus Elementary School District is the decreased revenue for our small school.

Our income is dependent upon property taxes within the district which includes the Copco 1 Dam. As of now we are already suffering the effects of a decrease in property value due to the inconclusion of this matter. Should the Dams be removed, the property values will significantly decrease further, reducing property taxes and therefore resulting in the reduction of the school's allotment.

Our school produces 8th graders into the high school at levels above the standard of average incoming Freshman. We are able to provide an exceptional education to students that live in our rural area. These students have, and will go on to be contributing members of society. Our alumni include ranchers, business owners and elected officials. We want to continue to provide an education at these high standards.

Along with the decrease in revenue for the school, we are concerned about our residents surrounding the school. Below are several of their concerns that we feel should be addressed before making this important decision. We as a board believe a more cost effective, mutually beneficial decision can be reached through fish ladders or fish tunnels.

· Exposure of the Shasta Nation Sacred Burial ground currently under the lake.

· Property Value Decrease

· Decreased Property Tax which would mean decreased revenue for the local Elementary School District

· Traffic from Dam removal will block and deteriorate the one road in and out of the lake. This could possibly prevent Emergency services from reaching and transporting our residents.

· Removal would eliminate easements to the water's edge. As of this moment, no one can tell us who would take possession of the land between our properties and the water.

· Removal of the Dams would destroy the Meadow ecosystem created by the Dams

· Diminished Esthetic appeal by creating big mudflats between the river and the homes

· Respiratory Health concerns for the residents created by dust and deconstruction

· Silt flowing down river from Dam removal will kill fish and other species that rely on the water from the lake to survive

· Warm water flow from the hot springs without the Dams to cool the water, will increase not decrease Blue Green Algae Bloom.

Thank you for taking the time and we are available to meet any time after 4pm at the Bogus Elementary School should you have any questions.

Bogus Elementary School Board

James Adams – Chairman

Kendra Gill - Clerk

Thaler, Parker@Waterboards

From: Tom Mallams <tmallams@klamathcounty.org>
Sent: Monday, January 02, 2017 6:47 PM
To: Thaler, Parker@Waterboards
Cc: Thomas Mallams
Subject: Fw: FERC Scoping info
Attachments: 1 FERC BOCC ltr.pdf; 2-FERC Report exerts.pdf; 3-CDM highlighted 8 pgs.pdf; 4-Dean Brockbank comments.pdf; 5-ltr of 3-1-16 reaffirming BOCC withdrawal.pdf; 6-Joint Letter SB2379.pdf; 7-letter in opposition klamath, columbia & snake river dam removal.pdf

December 31,2016
to: Mr. Parker Thaler
California Water Board

Dear Mr. Thaler,
For many decades, the Klamath Basin has been struggling with water issues. These issues currently threaten the very existence of the economic and social base of all the Basin's citizens.
There is no doubt that a balanced water settlement is desperately needed. However, the current proposed agreements do not achieve this balance. Any appearance of wide spread support for the current agreements, have NEVER, and will NEVER exist.

Klamath County Board of Commissioners opposition to these agreements to date,has been consistent for the last four years. The citizen's opposition dates back at least another three years. This continued opposition has been upheld by the citizens, specifically in regards to the Klamath Dam Removal Agreement, by the advisory ballot results in the November 2016 election. A resounding 73% of the voters simply said NO to the removal of the four Klamath River dams. And this was achieved with literally no political campaigning.
Siskiyou County citizens said NO to the tune of 80%, in their 2010 ballot. The Siskiyou County Board of Supervisors have opposed Klamath Dam Removal since first being proposed in 2008.
I ask that you read, study and analyze the seven attachments before making any decision on this ill-fated direction. Klamath dam removal clearly does not have the support from the citizens that live and work in the counties where all four of the dams are located.

The actual Federal Government studies show a very cost prohibitive and epic environmental disaster picture of removing dams especially with the 22 million cubic yards of sediment being dumped down river. In contrast, the bought and paid for "science", being presented by those favoring dam removal, ignores the very obvious costs, liabilities and environmental dangers.

Please consider this email correspondence along with the seven attachments, as my formal comments. Please view in electronic form or color printed format for easier to understand viewing.
Thank you for the opportunity to offer comments and documentation,

Tom Mallams
Klamath County Commissioner



Klamath County Commissioners

Tom Mallams, *Commissioner*
Position One

Kelley Minty Morris, *Commissioner*
Position Two

Jim Bellet, *Commissioner*
Position Three

March 23, 2016

Kimberly D. Bose, Secretary
Nathaniel J. Davis, Sr., Deputy Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

RE: Klamath Dam Relicensing Project 2082-027

Dear Chairman Bay, Commissioner LaFleur, Commissioner Clark and Commissioner Honorable,

The Klamath County Board of Commissioners is extremely concerned over the possible Klamath River Dam relicensing verses removal process. This has been a contentious issue for many years. There have been numerous studies completed with again, contentious, debatable results.

Southern Oregon and Northern California have had our economies decimated by overreaching Federal and State regulators. Our once prosperous and growing communities struggle to stay viable. Our annual budget cycles see an ever dwindling revenue, along with soaring costs.
To put things into context, a very short history of Klamath Lake and the Klamath River is in order. The entire system has been appropriately labeled as an "upside down river". Basically, Klamath Lake, besides having an average depth of less than eight feet, also has an enormous amount of natural occurring phosphorus, which originates from the volcanic soils and rock structure. Before any dams were in place, Klamath Lake would often times dry up to nothing more than a large swamp. Klamath River would in turn nearly quit flowing all together. When there were steady flows into Klamath Lake the naturally impaired water would flow down Klamath River and get cleaner the farther down river it would get. The current dams in place have helped with water quality by serving as a "sink" for phosphorus laden sediment as well as providing a deep pool behind each dam which cools the water.

The lowest structure, Iron Gate Dam has a very successful fish hatchery built specifically for "mitigation" purposes when the dams were originally constructed. If Iron Gate Dam is destroyed, the fish hatchery will no longer be viable, as there is no cool water source and the physical location would put it in jeopardy with a major flood event.

These dams were not constructed solely for flood control, but they do offer some storage in a flood event. They also act as a nine hour warning to downstream residents if there is an impending flood event on its way.

Of the four dams on the Klamath River under consideration, J C Boyle Dam is located within Klamath County, Oregon. The loss of tax revenue alone to Klamath County amounts to nearly half a million dollars. Many recreational opportunities will be collateral damage as well. These dams produce enough hydroelectric power to satisfy 70,000 households.

We ask that FERC restudy the FERC Report of November 16, 2007 (see attachment). This extensive analysis came to the conclusion and recommendation that relicensing of the Klamath River Dams is the best alternative. This analysis listed the actual cost of the physical structures amounted to $80 million. Taking into consideration the total **additional** cost associated with the acknowledged major sediment issues ranged from $1.4 billion-$4.4 billion. Remember these numbers are in 2006 dollars.

The current proposal of Klamath Dam Removal allows for the flushing of 22 million cubic yards of sediment down the river. Not all the sediment would head down river, but conservative estimates put that number at 75% or approximately 17 million cubic yards. Many have stated this action would cover historic spawning beds and essentially sterilize the Klamath River for a hundred years. Even some of those that support taking out these dams have openly called this direction the "Great Experiment".

Another Federal Report, the Camp Dresser & McKee Report, CDM Report (see attachment) shows a similar finding. This report was commissioned by the Department of Interior and dated July 2008. It acknowledged that the sediment would be sent down the river. The CDM Report estimated the physical removal of the dams would cost $94.4 million. This report struggled with even trying to quantify the cost associated with the "high level of liability" and "high uncertainty" with the massive amounts of sediment being flushed down the river. The high estimate related to sediment liability was $836.6 million. Add those together and you get $931 million, with a disclaimer that the literal gigantic unknowns were staggering.

When the Department of Interior Secretarial Determination Environmental Impact Statement (EIS) was released in October 2012, the story was different. All the sediment issues identified as having a high liability level in the CDM and FERC reports are now not considered to be a major liability issue. This EIS was based in part on the "Stillwater Science" and an Economic Impact Study that were both commissioned and paid for by pro Klamath Dam Removal stakeholders. Siskiyou County had experts identify numerous faulty data and conclusions.

We believe in private property rights. These dams are owned by PacifiCorp. PacifiCorp's private property rights were threatened in 2008 at a meeting in Virginia, attended by representatives from the Governors Oregon, California and the Department of Interior. They met with Dean Brockbank, Chief Legal Counsel for PacifiCorp (see attachment). Dean Brockbank had a number of interviews following this meeting where he openly portrayed this meeting as a threat from our government that PacifiCorp would not be allowed to relicense these dams and get used to the idea of dam removal.

These dams are in good condition and serve many purposes for all the residents and for the environment including the fisheries. The largest recorded fish runs have occurred after dams were in place.

We thank you for your consideration.

Sincerely,

Tom Mallams
Commissioner

Kelley Minty Morris
Chair

Jim Bellet
Commissioner

Enc: FERC Report, CDM Report and Associated Press article



Industries

Hydropower - Environmental Impact Statements (EISs)

Final Environmental Impact Statement for Relicensing of the Klamath Hydroelectric Project No. 2082-027
Issued: November 16, 2007

Commission staff prepared a Final Environmental Impact Statement (FEIS) for relicensing of PacifiCorp's 169-megawatt Klamath Hydroelectric Project, located primarily on the Klamath River in Klamath County, Oregon and Siskiyou County, California. On average, the project generates 716,820 megawatt-hours of electricity annually. The project occupies 219 acres of lands of the United States, which are administered by the U.S. Bureau of Reclamation and the U.S. Bureau of Land Management.

The existing project consists of eight developments, seven of which are located on the Klamath River. PacifiCorp proposes to decommission the upstream-most East Side and West Side developments and to remove the Keno development, which has no generating facilities, from the project. The remaining project developments on the main stem of the Klamath River are J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate. The proposed project also includes the existing Fall Creek development, located on a Klamath River tributary.

In this FEIS, Commission staff assessed the environmental and economic effects of:

- Continuing to operate the project with no changes or enhancements (no-action alternative);
- Operating the project as proposed by PacifiCorp (PacifiCorp's proposal);
- Operating the project as proposed by PacifiCorp with additional or modified environmental measures (staff alternative);
- Staff alternative with conditions filed by the Department's of the Interior and Commerce;
- Retirement of the Iron Gate and Copco No. 1 developments with additional or modified measures for the remaining developments; and
- Retirement of the Iron Gate, Copco No. 2, Copco No. 1, and J.C. Boyle developments, with additional or modified measures for the remaining developments.

The staff alternative incorporates most of PacifiCorp's proposed environmental measures, some with certain modifications. The staff alternative also includes 25 environmental measures additional to those proposed by PacifiCorp, including:

- Implementation of an integrated fish passage and disease management program;
- Implementation of an adaptive spawning gravel augmentation program in the J.C. Boyle bypassed reach and downstream of Iron Gate dam.

Based on our detailed analysis of the environmental benefits and costs associated with the five action alternatives considered in detail in this FEIS, we conclude that the best alternative for the Klamath Hydroelectric Project would be to issue a new license consistent with the environmental measures specified in the Staff Alternative.

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Hydropower - Environmental Impact Statements (EISs)

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The existing project consists of eight developments, seven of which are located on the Klamath River. PacifiCorp proposes to decommission the upstream-most East Side and West Side developments and to remove the Keno development, which has no generating facilities, from the project. The remaining project developments on the main stem of the Klamath River are J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate. The proposed project also includes the existing Fall Creek development, located on a Klamath River tributary.

In this FEIS, Commission staff assessed the environmental and economic effects of:

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- Operating the project as proposed by PacifiCorp (PacifiCorp's proposal);
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- Staff alternative with conditions filed by the Department's of the Interior and Commerce;
- Retirement of the Iron Gate and Copco No. 1 developments with additional or modified measures for the remaining developments; and
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- Implementation of an integrated fish passage and disease management program;
- Implementation of an adaptive spawning gravel augmentation program in the J.C. Boyle bypassed reach and downstream of Iron Gate dam.

Based on our detailed analysis of the environmental benefits and costs associated with the five action alternatives considered in detail in this FEIS, we conclude that the best alternative for the Klamath Hydroelectric Project would be to issue a new license consistent with the environmental measures specified in the Staff Alternative.

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sediment to be removed would depend on site-specific conditions and the nature of contaminants. It could be feasible to allow sediment not subject to scour following dam removal to remain in place with or without capping. However, to provide a conservative estimate of costs if sediment removal should be needed (preliminary sampling results in GEC, 2006, suggest that this would not be the case), we assume all sediment associated with reservoir lost storage (as shown in table 3-3) would need to be removed. Our base costs also assume that the exposed bottoms of the reservoirs would naturally re-vegetate, except for the areas disturbed by dam removal. We assume that no additional restoration costs for reservoir or downstream riparian habitat that may be influenced by sediment releases during dam removal would be required beyond the immediate dam site. In addition, we assume that all project-related roadways would remain in place with no modifications.

4.7.1 Keno Development

The Taintor gates would be opened to drain the reservoir and then removed. The dam and fishway concrete, earthen abutment, and control building with contents would be removed. The site would be re-graded and re-vegetated along the shore of the river channel in proximity to the dam. We estimate the decommissioning and removal of the Keno facilities would cost about $3,412,000 (2006 dollars). If contaminated sediment requires removal prior to dam removal, it could cost an additional $14 to $43 million. Substantial additional costs would be incurred by others if the water supply intakes at Keno reservoir need to be redesigned to retain their current function. We are not aware of any dam removal estimates prepared for the Keno development by others, and therefore we do not include Keno development in table 4-4.

4.7.2 J.C. Boyle Development

The reservoir would be drained in stages to allow much of the dam and associated structures to be removed in the "dry." This also would enable shoreline habitat to gradually acclimate as the reservoir drains. This approach would be used, to the extent possible, for the removal of other project dams on the mainstem. The Taintor gates could be opened to drain the reservoir to elevation 3,781.5 feet. The reservoir could be further lowered to elevation 3,768 feet through the powerhouse conveyance pipeline, canal, and tunnel. If operable, the dam bypass drains could be used to draw the reservoir down to approximately elevation 3,750 feet. The base of the embankment dam is at about elevation 3,726 feet. The remaining water in the reservoir would need to be removed prior to completion of dam removal. This could be accomplished by creating a diversion channel through the dam using sheetpiles driven to bedrock. The entire embankment dam would be removed. Once this occurs, all concrete structures associated with the power conveyance intake, Taintor gate structure, fishway, and other structural components would be removed. The embankments at each end of the former dam would be re-graded and re-vegetated.

The steel pipeline and supporting steel and concrete would be removed. The concrete structures associated with the canal intake, canal flume, canal spillway, and tunnel entrance structure would be removed. The lands under and adjacent to the canal flume would be backfilled and re-graded to stabilize the slopes and the area would be re-vegetated. The downslope channel associated with the former canal emergency spillway would be backfilled and stabilized to the edge of the Klamath River. The penstocks, supports, and anchors would be removed, and the tunnel portals would be sealed.

The powerhouse crane would be dismantled and removed. The powerhouse substructure and surface slab would remain intact. The powerhouse equipment would be removed. Any wooden materials in the powerhouse would be removed. Any components from the powerhouse containing chemical or other hazardous materials would be removed from the site, including transformers, bushings, batteries, tanks, lead bearings, and asbestos-based insulating products. Windows and doors in the powerhouse and the penstock entrance would be sealed to prevent public access. The turbine/generator openings in the concrete powerhouse slab would be sealed with concrete, as would the draft tube openings. The walls of

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the tailrace flume would remain. The tailrace area would be backfilled and re-graded to match the river embankment upstream and downstream of the powerhouse area and stabilized as necessary.

The 0.24-mile-long, 69-kV, de-energized transmission line from the switchyard to Transmission Line 18 would be removed, and the transmission right-of-way would be restored to natural conditions. The switchyard serves non-project purposes and would be retained.

We assume that the support buildings located near the dam would be sold for other purposes. The warehouse near the powerhouse would be removed.

We estimate the decommissioning and removal of the J.C. Boyle facilities would be $18,911,000 (2006 dollars). If contaminated sediment requires removal prior to dam removal, it could cost an additional $2 to $7 million.

4.7.3 Copco No. 1 Development

We assume that it would be feasible to restore the existing dam drainage tunnel and use it to drain the reservoir. The gate structure would need to be refurbished with a new gate and lift mechanism and the tunnel plugs would need to be removed once the gate structure was operational. This would allow for removal of the dam by drilling and blasting or other methods without the need to notch the dam to lower the reservoir. However, due to uncertainties over the feasibility of using the existing dam drainage tunnel, we have increased our contingency factor for Copco. No. 1 from 25 to 50 percent in case detailed investigations reveal that another method would be needed to drain the reservoir in a controlled release.

The impoundment would be lowered by first sequentially opening each of the spillway gates. The reservoir could be lowered further through the penstocks. Finally, the dam drainage tunnel would be used to drain the remainder of the reservoir volume prior to initiation of dam removal. The dam would be removed to the natural river channel upstream and downstream of the dam. No excess foundation material that was required to provide a solid foundation for the dam would be removed. The penstocks would be removed entirely. The powerhouse intake structure foundation and gatehouse would be sealed and the gatehouse secured. Once the dam is removed, the dam drainage structures would be removed and the tunnel sealed. Reservoir sediment would be allowed to pass downstream naturally.

The powerhouse would remain. The penstock and tailrace openings would be sealed. The powerhouse equipment and any wooden materials in the powerhouse would be removed. Any components from the powerhouse containing chemicals or other hazardous materials would be removed from the site. Windows and doors in the powerhouse would be sealed to prevent public access.

The two 0.7-mile-long, 69-kV lines from the Copco No. 1 powerhouse to the Copco No. 1 switchyard would be removed (the Copco No. 1 switchyard serves as a point of interconnection for the Iron Gate and Copco No. 2 powerhouses). We assume for cost estimation purposes that Copco No. 1 dam would only be removed if the Iron Gate and Copco No. 2 developments were decommissioned, and therefore, the Copco No. 1 switchyard would no longer be needed as a point of interconnection. The switchyard site and transmission line rights-of-way would be restored to natural conditions.

We estimate the decommissioning and removal of the Copco No. 1 facilities would cost $20,368,000 (2006 dollars). If contaminated sediment requires removal prior to dam removal, the costs could increase an additional $955 million to $2.9 billion.

4.7.4 Copco No. 2 Development

The reservoir would be drained through the Taintor gates. Once drained, the gates and gate structure would be removed. The power tunnel entrance would be sealed and the majority of the tunnel intake structure removed. The river banks along the abutments of the dam would be re-graded and re-

FERC

vegetated, and the area where the intake structure had been would be backfilled, re-graded, and re-vegetated. Sediment would be allowed to pass downstream naturally.

The woodstave penstock, supports, and anchors would be removed, and the tunnel entrances sealed. The tunnel exit portal and the tunnel spillway portal would be sealed. The powerhouse would remain, and the penstock and tailrace openings would be sealed. The powerhouse equipment and any wooden materials in the powerhouse would be removed. Any components from the powerhouse containing chemicals or other hazardous materials would be removed from the site. Windows and doors in the powerhouse would be sealed to prevent public access.

The Copco No. 2 powerhouse serves as the point of interconnection for the Iron Gate development via the Copco No. 2 transmission connection to the Copco No. 1 switchyard. We assume for cost estimation purposes that Copco No. 2 development would only be decommissioned if Iron Gate development was decommissioned. Thus, the 1.23-mile-long, 69-kV transmission line from the Copco No. 2 powerhouse to the Copco No. 1 switchyard would be removed. The transmission line right-of-way would be restored to natural conditions. Since the Copco No. 2 switchyard serves non-project purposes, it would be retained.

We estimate the decommissioning and removal of the Copco No. 2 facilities would cost $3,731,000 (2006 dollars). It is unlikely that there would be enough sediment in Copco No. 2 reservoir to substantially influence this cost estimate.

4.7.5 Fall Creek Development

The Spring Creek diversion dam and diversion structures would be removed. The excavated diversion ditch from the diversion dam to its end in the Fall Creek drainage basin would be backfilled and graded. The diversion site would be restored to natural grades, if possible, and re-vegetated along the creek banks.

The Fall Creek diversion dam and diversion structures also would be removed. The earth and rock diversion ditch from the Fall Creek diversion dam to the penstock intake would be backfilled and graded. The diversion site would be restored to natural grades, if possible, and re-vegetated along the creek banks.

The penstock, supports, and anchors would be removed. The powerhouse would remain. The penstock and tailrace openings would be sealed. The powerhouse equipment and any wooden materials in the powerhouse would be removed. Any components from the powerhouse containing chemicals or other hazardous materials would be removed from the site. Windows and doors in the powerhouse would be sealed to prevent public access.

The short 69-kV tap line connection to Transmission Line 18 and the 1.65-mile-long, 69-kV transmission line extending from the Fall Creek powerhouse to the Copco No. 1 switchyard would be removed. The transmission line rights-of-way would be restored to natural conditions. There is no switchyard at Fall Creek.

We estimate the decommissioning and removal of the Fall Creek facilities would cost $1,390,000 (2006 dollars). It is unlikely that there would be enough sediment behind the Spring or Fall Creek diversion dams to substantially influence this cost estimate. We are not aware of any dam removal estimates prepared for the Fall Creek development by others, and therefore we do not include this development in table 4-4.

4.7.6 Iron Gate

We assume that the dam diversion tunnel used during project construction could be used to gradually drain the reservoir and control the release of sediment to the Klamath River downstream of the

FERC

dam. Once the reservoir has been drained, the dam would be removed. The drainage tunnel would be used to maintain flow past the site during dam removal. The concrete penstock intake structure and penstock would be removed as dam removal progresses, as would the water supply lines for the fish facilities. The reservoir spillway would be abandoned in place.

The powerhouse crane would be dismantled and removed. The powerhouse equipment and any wooden materials in the powerhouse would be removed. Any components from the powerhouse containing chemicals or other hazardous materials would be removed from the site. The powerhouse substructure and surface slab would be removed to the lowest slab, which would remain. The powerhouse and tailrace area would be backfilled and re-graded to match the new river embankment upstream and downstream of the powerhouse area. The fish facilities at the base of the dam would be removed entirely. We assume that the Iron Gate Fish Hatchery located south of the dam would remain, although its ability to function as a fish hatchery without its historic water supply would be questionable.

The switchyard and 6.55-mile-long, 69-kV transmission line from the Iron Gate switchyard to the Copco No. 2 powerhouse would be removed. The switchyard site and transmission line rights-of-way would be restored to natural conditions.

We estimate the decommissioning and removal of the Iron Gate facilities would cost $36,853,000 (2006 dollars). If contaminated sediment requires removal prior to dam removal, it could cost an additional $485 million to $1.5 billion.

Table 4-5 contains a summary of our recommendations and costs for dam removal at the Klamath Hydroelectric Project.

Table 4-5. Dam removal recommendations and costs. (Source: Staff)

Dam/Environmental Measure	Capital Costs (2006$)	Annual Costs (2006$)	Annual Energy Costs (2006$)	Total Annualized Cost (2006$)
Keno				
Remove Keno from the licensed project	-$3,935,470 (remove net investment in project facilities from project—this represents the 2003 net investment value of the Keno facilities ($4,810,350) depreciated to 2006)	-$57,980 (remove 2003 O&M cost ($54,000) from project expenses)	$0 (no energy implications)	-$589,210 (reduction in annual expenses)
Remove Keno dam (in some cases, if meeting water quality standards and/or if fish passage is not feasible)	$3,411,650	$0	$0	$460,520
Decommissioning and dam removal plan for Keno development	$75,000	$0	$0	$10,120

TOTAL Cost $79,863,000 (PHYSICAL STRUCTURES ONLY)
WITH SEDIMENT ADD AN ADDITIONAL $1.44 Billion to $4.4 Billion
2006 dollars

CDM

UNITED STATES DEPARTMENT OF THE INTERIOR

This Report, by Camp Dresser & McKee Inc. (CDM Report or Report) was provided to the Department in July of 2008. Though the CDM Report was originally intended for the Department's internal use, we release it now to insure that the parties negotiating a final settlement/dam removal agreement have access to this information, along with other information already available.

During the development of the Agreement in Principle (AIP), substantial attention was devoted to the lack of a settled understanding about the risks and potential liabilities arising from removal of the four PacifiCorp-owned facilities on the Klamath River. These unquantified risks have a direct correlation to the costs and timing of the proposed removal of the facilities. Consequently, last Spring the Office of the Secretary asked CDM to provide an assessment of the status of the known and available scientific, regulatory and economic information known as of that time.

The attached Report is a snapshot of the published science as it existed slightly less than a year ago; it is one piece of the larger scientific, regulatory, and economic framework that will come into full view during the scientific due diligence contemplated by the AIP, leading up to the Secretary's determination in 2012. The Report describes the potential risks and liabilities of dam removal absent an effective strategy to prevent or manage them: it does not compare the risks and liabilities of dam removal and a new license, nor does it evaluate or quantify the potential benefits and values of dam removal. The Report's utility lies in the assistance it offers the parties in specifying the further efforts needed to quantify potential risks and liabilities, develop an effective strategy to prevent or manage them, and compare such risks and liabilities under alternative futures for this project. Because the science is, and will continue to be evolving until 2012, the Report does not reflect the final or interim position of the United States regarding any aspect of the AIP, Final Agreement, or Klamath Basin Restoration Agreement.

We understand the potential for those who oppose dam removal to identify isolated portions of the analysis and postulations of the CDM Report regarding quantification of risk. But because the Secretary will undertake his own analysis, informed by all the parties to the Final Agreement for Dam removal, these postulations are of limited applicability in the final analysis. We encourage the parties to focus on the Report's true value: its identification of factors and data gaps in the science that must be addressed in order for the Secretarial determination of 2012 to be fully informed and sound.

THIS COVER SHEET WAS ADDED AFTER THIS REPORT WAS LEAKED TO THE PUBLIC-1 DAY AFTER PASSAGE OF OREGON SENATE BILL 76

CDM

Evaluation and Determination of Potential Liability Associated with the Decommissioning and Removal of four Hydroelectric Dams on the Klamath River By Any Agent

THIS REPORT WAS LEAKED TO THE PUBLIC 1 DAY AFTER THE PASAGE OF ORE-SENATE BILL 76 WHICH AUTHORIZED PACIFICORP TO CHARGE RATE PAYERS FOR DAM REMOVAL







Prepared By:
Camp Dresser & McKee Inc.
For:
U.S. Department of the Interior
Through:
U.S. Bureau of Reclamation

REPORT

July 18, 2008

Executive Summary

This report presents the results of a liabilities assessment for the removal of four hydroelectric dams (J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Dams) on the Klamath River (See Figure ES-1). This assessment was conducted following the development of the Klamath Basin Restoration Agreement in early 2008 between the U.S. Department of the Interior, PacifiCorp, and the current stakeholder group, which identified the decommissioning and removal of the four dams as a key component of the agreement. Several groups representing resource and regulatory agencies and non-governmental organizations (NGOs) have commissioned studies in an attempt to identify a process and quantify the potential liabilities associated with decommissioning and removal of the four dams. The process for decommissioning studied to date has emphasized the rapid removal of the dams and passage of trapped sediment down the Klamath River.



Figure ES-1. Klamath River System

This report identifies and attempts to quantify specific potential liabilities and the associated costs related to the decommissioning and removal of the four dams based upon the existing information developed to date. The report also identifies additional study needs that would help to reduce the uncertainties associated with facilities removal. Potential liabilities and associated costs were developed using existing reports and studies to present decision makers with a relative scale of the potential costs that could be generated by a dam removal action.

Liability Identification and Costing

Liabilities were identified and placed in four categories: (1) physical, (2) biological, (3) socioeconomic, and (4) legal and regulatory. Within each category the liabilities were further divided by their relative resource area and the dam or reach of river they would affect. The liabilities were numbered sequentially by resource area and assigned a corresponding "uncertainty" ranking to indicate confidence in the available data for quantifying the liabilities' total effect on decommissioning. A defined process was followed by the team to cost the liabilities using existing information, research, and engineering and construction judgment. Liability costs fell into two categories: direct costs and indirect costs. Direct costs arise from an identified decommissioning action where indirect costs are those costs that are a result of a decommissioning action in the form of mitigation, compensation, or the recognition of potential litigation of the liabilities described in Chapter 2 of this report. Many of the indirect costs remain unquantified. Presented in Table ES-1 is a summary of quantified liabilities and costs identified in this study.

Costs in Table ES-1 are presented for the quantifiable liabilities only. The unquantified liabilities that remain are presented in Chapter 3 of this report and have the potential to change the partial totals presented in Table ES-1.

CDM

Table ES-1. Klamath Dam Decommissioning Liability Investigation Liability Cost Estimate (Quantifiable Costs)

Physical Structure Removal Costs[1]			*Cost Estimate*		
J.C. Boyle			$16,914,700		$16,914,700
Copco No. 1			$25,380,100		$25,380,100
Copco No. 2			$6,112,400		$6,112,400
Iron Gate			$46,023,100		$46,023,100
Physical Structure Removal Subtotal			**$94,430,300**		**$94,430,300**
Quantifiable Liability Cost Estimates					
Liability #	***Liability Description***	***Dam Affected***	***Low Estimate***	***Risk Factor***	***High Estimate***
HW-1 to HW-4	Hazardous Waste Mitigation and Cleanup	J.C. Boyle	$100,000	1.5	$150,000
HW-5 to HW-9	Hazardous Waste Mitigation and Cleanup	Copco No. 1	$100,000	1.5	$150,000
HW-10 to HW-13	Hazardous Waste Mitigation and Cleanup	Copco No. 2	$100,000	1.5	$150,000
HW-14 to HW-18	Hazardous Waste Mitigation and Cleanup	Iron Gate	$100,000	1.5	$150,000
HH-4	Operations of Keno Dam	All Dams	$40,326,000	1.5	$60,489,000
HH-5	Highway 66 Bridge foundation	J.C. Boyle	$500,000		$1,500,000
SE-1	Presence of sediment	J.C. Boyle	$5,464,000	2.0	$10,928,000
SE-5	Presence of sediment	Copco No. 1	$93,560,000	2.0	$187,120,000
SE-9	Presence of sediment	Iron Gate	$76,379,000	2.0	$152,758,000
WQ 1, 2, 3	Downstream water quality during decommissioning	All Dams	$899,000	1.5	$899,000
AQ-2	Loss of spawning areas	All Dams	$45,000	1.0	$45,000
AQ-6	Iron Gate Fish Hatchery funding	Klamath Downstream	Presented above as structure removal cost	1.0	Presented above as structure removal cost
TE-1,3	Change in wetland habitat and loss of habitat	All Dams	$48,000	1.5	$72,000
TE-2	Invasive species	All Dams	$5,600	1.5	$8,400
SR-1	Reservoir restoration	J.C. Boyle	$2,510,000	1.5	$3,765,000
SR-4	Reservoir restoration	Copco No.1	$16,582,000	1.5	$24,873,000
SR-5	Reservoir restoration	Copco No.2	$175,000	1.0	$175,000
SR-7	Reservoir restoration	Iron Gate	$15,946,000	1.5	$23,919,000
RE-1,2	PacifiCorp land ownership and Diminution in Property Value	J.C. Boyle, Copco No. 2 & Iron Gate	$3,375,000		$12,000,000

Table ES-1. Klamath Dam Decommissioning Liability Investigation Liability Cost Estimate (Quantifiable Costs)

Quantifiable Liability Cost Estimates					
Liability #	***Liability Description***	***Dam Affected***	***Low Estimate***	***Risk Factor***	***High Estimate***
RE-3	PacifiCorp land ownership	Copco No.1	$2,500,000		$3,750,000
RE-4	Diminution in property value	Copco No.1	$7,500,000	1.5	$11,250,000
RC-1,4,6	Loss of flatwater recreation	J.C. Boyle, Copco No. 1 & Iron Gate	$288,000		$341,000
RC-2,5,7	Increased distance to water feature	J.C. Boyle, Copco No. 1 & Iron Gate	$488,000		$488,000
RC-3,8	Changes in recreational opportunities	J.C. Boyle, Copco No. 1 & Iron Gate	$1,446,000		$3,744,000
PO–1,2	Loss and replacement of renewable power source	All Dams	$65,169,000		$171,911,000
EC-1, 3, 5, 7	Loss of payroll	All Dams	$4,067,000		$4,067,000
EC-2, 4, 6, 8	Loss of regional fisheries	All Dams	$11,896,000[2]		$66,406,000[2]
Quantifiable Liabilities Subtotal			$337,672,600		$674,702,400
Decommissioning Design, Studies and Programmatic Costs at 10% [3]			$33,767,300		$67,470,200
Total of Quantifiable Liabilities			**$465,870,200**		**$836,602,900**

Notes:
1. Physical structure removal cost calculated using the values presented in GEC 2006 with the GEC estimate for hydroseeding removed to prevent double counting with the estimates presented in SR-1, SR-3, SR-4, and SR-6.
2. Not included in total: Since sediment removal should negate fisheries' impacts and the sediment removal costs are included in the total, fishery liabilities are noted here, but will not be included in the total.
3. 10% contingency calculated using the liabilities subtotal, the contingency does not consider the physical structure removal cost estimates to avoid duplication of contingency estimation completed by GEC in its estimate.

Other Important Study Findings

Several important findings relative to the decommissioning of the four dams follow.

1. Approximately 130 physical, biological, and socioeconomic liabilities associated with the decommissioning action were identified. The top 28 high ranked liabilities and/or uncertainties represent a very large percentage of the decommissioning cost. The

remaining liabilities represent a small cost in comparison to the overall decommissioning action. These liabilities are shown in Table ES-2.

2. Decommissioning approaches reviewed as part of this study proposed and evaluated the passage of sediment to the Lower Klamath River through to the Pacific Ocean. The North Coast Regional Water Quality Control Board (NCRWQCB) effectively prohibits the discharge of sediments to the Klamath River system including dam decommissioning projects, and the mouth of the Klamath River at the Pacific Ocean is an Area of Special Biological Significance (ASBS), with further restrictions on sediment discharge. As has been seen on other dam removal programs, including Condit on the White Salmon River in Washington, this approach has many regulatory challenges and has high potential for litigation.

3. The Federal Power Act grants the Federal Energy Regulatory Commission (FERC) significant authority to impose mitigation and restoration measures related to project decommissioning, potentially including measures to address the liabilities described in this report.

4. There is the high potential for litigation with a dam removal program that proposes to pass large volumes of sediment due to the damage to downstream fisheries and the aquatic ecosystem. On other dam removal projects including the Condit dam on the White Salmon River, arguing the state's authority to issue a CWA 401 Water Quality Certification has been used as an effective litigation tool to impede a dam's removal. Potential litigation could come from the Lower Klamath River tribes, fishery groups, riparian residents, boaters, and recreational users. The Siskiyou County Board of Supervisors has openly opposed the Klamath dam removal program sighting many of the above issues.

5. Dam decommissioning would result in the likely PacifiCorp divestiture of Keno Dam to Reclamation or another entity. The new owner/operator would be responsible for fish passage at Keno Dam and screening of three major canals on Keno Reservoir. Keno Dam would likely become the new water quality compliance point for water entering the lower Klamath River. Water quality in Keno Reservoir and Lake Ewauna has historically been very poor. Meeting water quality compliance goals and managing endangered fish species in Keno Reservoir, together with providing agricultural supply and return flow, will present significant challenges to the new operator.

Table ES-2. Liabilities Representing High levels of Liability and/or Uncertainty

Liability	Topic	Dam	Liability Level	Uncertainty
HH-3	Concurrent reservoir drawdown and sediment passage	All Dams	High	High
HH-4	Operations of Keno Dam	All Dams	High	Mod
HH-6	No low water outlet structure	Copco No. 1	High	Low
HH-7	Dam foundation removal	Copco No. 1	High	Mod
HH-9	Iron Gate Fish Hatchery	Iron Gate	High	High
SE-1	Presence of sediment	J.C. Boyle	High	High
SE-2	Composition of sediment	J.C. Boyle	High	High
SE-3	Sediment organic content	J.C. Boyle	Mod	High
SE-4	Reservoir drawdown rates	J.C. Boyle	Low	High
SE-5	Presence of sediment	Copco No. 1	High	High
SE-6	Composition of sediment	Copco No. 1	High	High
SE-7	Sediment organic content	Copco No. 1	Mod	High
SE-8	Reservoir drawdown rates	Copco No. 1	Low	High
SE-9	Presence of sediment	Iron Gate	High	High
SE-10	Composition of sediment	Iron Gate	High	High
SE-11	Sediment organic content	Iron Gate	Mod	High
SE-12	Reservoir drawdown rates	Iron Gate	Low	High
SE-13	Water temperature and sediment	Iron Gate	Mod	High
WQ-4	CWA Compliance at Keno Reservoir	All Dams	High	High
SR-4	Reservoir restoration	Copco No.1	High	Mod
RE-4	Diminution in property value	Copco No.1	High	Mod
PO–1	Loss of electricity currently generated	All Dams	High	Low
PO–2	Procurement of replacement power	All Dams	High	Low
PO–3	Removal of an emissions-free, renewable power source	All Dams	High	Low
RL-1	FERC Authority to impose mitigation	All Dams	High	High
RL-2	CWA Compliance	All Dams	High	High
RL-3	ITAs	All Dams	High	High
RL-4	Potential for litigation	All Dams	High	High

BROCKBANK

Recommend 0
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Utility OKs Klamath dam removals, salmon aid

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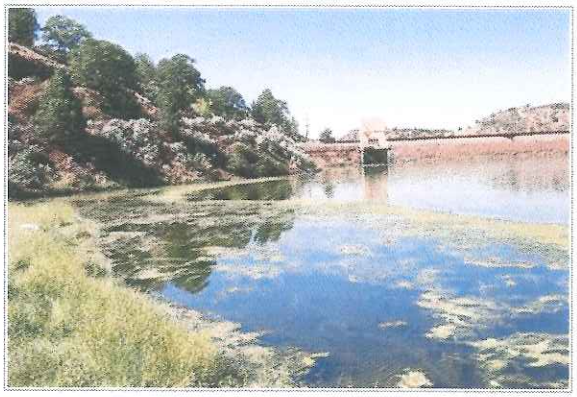
Agreement is milestone in efforts to restore one of the biggest salmon runs

AP Associated Press
updated 9/30/2009 3:33:33 PM ET

MEDFORD, Ore. — The utility that owns four hydroelectric dams on the Klamath River has agreed to terms for their removal, a key milestone in efforts to restore what was once the third-biggest salmon run on the West Coast and end decades of battles over scarce water.

PacifiCorp, the states of California and Oregon, American Indian tribes, federal agencies, irrigators and conservation groups announced the draft agreement Wednesday. It is expected to be signed by the end of the year.

Removal of the dams is not scheduled to start until 2020 and depends on funding for the removal, a federal determination that it will actually help salmon and is in the public interest, and authorization from Congress.



Algae forms Aug. 21, in the reservoir behind Iron Gate Dam on the Klamath River near Hornbrook, three other dams.

"This agreement marks the beginning of a new chapter for the Klamath River and for the communities whose health and way of life depend on it," Interior Secretary Ken Salazar said in a statement. "Hats off to all the stakeholders who have worked so hard to find common ground on one of the most challenging water issues of our time."

Removal costs to be shared

PacifiCorp will not bear the estimated $450 million cost of removing the dams. Oregon has approved $180 million in surcharges on state ratepayers. Another $250 million depends on California approving general obligation bonds.

"We are not in the business of taking out dams, but the Klamath Basin crisis is a unique situation," Dean S. Brockbank, vice president and general counsel of PacifiCorp, said in an interview. "We have been able to arrive at a settlement and a business deal that is in the best interests of our customers because it minimizes costs and guards against the risks of the alternatives."

The turning point came in May 2008, when an aide to former Interior Secretary Dirk Kempthorn summoned Brockbank to a meeting at a U.S. Fish and Wildlife Service training center in Shepherdstown, W.Va. They were locked down for a week with representatives of the Bush administration and the governors of Oregon and California, Brockbank said.

They "made it very clear from a public policy point of view that they did not want these dams relicensed," Brockbank said. "Once that became abundantly clear, we shifted our framework from relicensing to a settlement involving a possible dam removal framework."

Michael Carrier, policy director for Gov. Ted Kulongoski, said the meeting was a "watershed moment" that gave the governor's office a new understanding of what was at stake for PacifiCorp.

The utility serves 1.6 million customers in Oregon, California, Washington, Idaho, Utah and Wyoming, and is owned by MidAmerican Energy Holdings Co., a unit of Warren Buffett's Omaha, Neb.-based Berkshire Hathaway Inc.

The four dams — J.P. Boyle, Copco 1, Copco 2, and Iron Gate — together produce enough electricity for 70,000 customers.

"When the Klamath dams come down, it will be the biggest dam removal project the world has ever seen," Steve Rothert, California director for the conservation group American Rivers, said in a statement. "We will be able to watch on a grand scale as a river comes back to life."

Water wars a problem in Klamath Basin

Charles Bonham, California director for Trout Unlimited, said the next key to successfully restoring salmon to the upper Klamath Basin will be a final agreement among farmers, American Indian tribes, conservation groups and others to ensure salmon restoration will not come at the expense of farming.

"We don't think we will be successful putting salmon back where they haven't been for 100 years unless we have a good, solid relationship with the landowner and farming communities," he said. "We want salmon to be met in Klamath Falls with open arms, not pitchforks."

Water wars have long simmered in the Klamath Basin, where the first of the dams and a federal irrigation project built in the early 20th century turned the natural water distribution upside down, draining marshes and lakes and tapping rivers for electricity to put water on dry farmland that grows potatoes, horseradish, grain, alfalfa and cattle.

A drought in 2001 forced irrigation water to be shut off to sustain threatened and endangered fish. When the irrigation was restored the next year, tens of thousands of salmon died trying to spawn in the Klamath River, which was too low and too warm to sustain them.

Besides blocking salmon, the dams raise water temperatures to levels unhealthy for fish. California water authorities have been taking a hard look at the toxic algae produced by the dam's reservoirs, and river advocates have sued PacifiCorp to fix the algae problem.

Goal is environmental restoration

Pressure has been building since PacifiCorp applied for a new 50-year federal operating license in 2004 and made no provision for fish passage, which stops at Iron Gate near the Oregon-California border.

California and Oregon's governors pressed for dam removal after West Coast commercial salmon fisheries collapsed in 2006 because of declines in Klamath River returns, triggering a disaster declaration.

Final approval of the dam removal agreement is key to authorization of a separate agreement to spend $1 billion over the next decade on environmental restoration in the Klamath Basin.

Some conservation groups were not happy that the deal would allow farming to continue on the Lower Klamath and Tule Lake national wildlife refuges, preventing restoration of wetlands that would contribute to better water quality, and guaranteed irrigation levels for farmers in the upper basin.

"We really can't afford to allow dam removal be linked to making other environmental problems in the basin worse," said Steve Pedery, conservation director of Oregon Wild in Portland.

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www.deadiversion.usdoj.gov/fed_regs/actions/2006/fr05252.htm
DEPARTMENT OF **JUSTICE**. Drug Enforcement Administration. Kevin **Dean Brockbank**, M.D.; Revocation of Registration. On October 14, 2004, the Deputy Administrator of ...

[PDF] Utah State Charter School Board Meeting
schools.utah.gov/charter**schools**/State-Charter-**School**-Board/2012...
Utah State Charter **School** Board **Meeting** Minutes . March 8, 2012 . ... **Dean Brockbank**, John Pingree and Yolanda Francisco-Nez were absent for the vote. Adjourn

NOTE: Mr. Dean Brockbank and Mr. Toby Freeman of PacifiCorp.
www.klamathbucketbrigade.org/SiskiyouCounty_Testimony**ofBrockbank**...
11 Would **Dean Brockbank** and Toby Freeman for 12 PacifiCorp please get behind the hotly wired seats. 13 (Off the record for seating of new panel.)

Eastern meeting led to Klamath dam removal, salmon - Chico ...
www.chicoer.com/news/ci_13458854
Eastern **meeting** led to ... W.**Va**. Michael Bogert, an ... PacifiCorp Vice President and General Counsel **Dean Brockbank** recalled Wednesday after the Portland-based ...

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Utility OKs Klamath dam removals, salmon aid - US news ...
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Klamath County Commissioners

Tom Mallams, *Commissioner*
Position One

Kelley Minty Morris, *Commissioner*
Position Two

Jim Bellet, *Commissioner*
Position Three

March 1, 2016

To All Settlement Parties:

In response to a number of references by Settlement Agreement Parties statements that Klamath County is "still onboard with the Agreements", and that "Klamath County is still a signatory to the Agreements", we offer the following information.

In February 2010, Klamath County signed onto the Klamath Basin Restoration Agreement (KBRA) and the Klamath Hydroelectric Agreement (KHSA). After numerous public meetings and hundreds of public comments, the Klamath County Board of Commissioners, in a posted, public meeting, on March 12, 2013, adopted the attached Order. This Order is still fully in place and speaks for itself.

Kelley Minty Morris
Chair

Jim Bellet
Commissioner

Tom Mallams
Commissioner

305 Main Street, Klamath Falls, Oregon 97601
Phone: (541) 883-5100 | Fax: (541) 883-5163 | Email: bocc@klamathcounty.org

BOARD OF COUNTY COMMISSIONERS

KLAMATH COUNTY, OREGON

In the Matter of Withdrawing from The Klamath Basin Restoration Agreement (KBRA) and the Klamath Hydro Settlement Agreement (KHSA)	))))	**ORDER NO.** 2013-066

WHEREAS, the Klamath County Board of County Commissioners (as it was then constituted) signed the Klamath Basin Restoration Agreement (KBRA) in February 2010; and

WHEREAS, the Klamath County Board of County Commissioners (as it was then constituted) signed the Klamath Hydroelectric Settlement Agreement (KHSA) in February 2010; and

WHEREAS, none of the current members of the Klamath County Board of County Commissioners were sitting on the board at the time the previous board of commissioners entered into the KBRA and KHSA agreements; and

WHEREAS, an amendment to the KBRA was presented to the board of commissioners, which consisted of two previous board members and one existing board member in November 2012; and

WHEREAS, an existing board member, Dennis Linthicum, voted against signing the amendment as he opposes the KBRA with its amendments; and

WHEREAS, the amendment was signed by the two board members on November 20, 2012; and

WHEREAS, the Klamath County Board of County Commissioners has an ongoing responsibility to represent the citizens of Klamath County when determining county policy; and

WHEREAS, the Klamath County Board of County Commissioners held a public meeting to receive comment concerning whether the county should continue to participate in the KBRA and KHSA on February 12, 2013; and

WHEREAS, the Klamath County Board of County Commissioners received approximately 800 verbal, e-mail and written comments concerning whether the county should continue to participate in the KBRA and KHSA; and

WHEREAS, the Klamath County Board of County Commissioners held a public meeting February 26, 2013 to discuss and deliberate whether the county should continue to participate in the KBRA and KHSA.

NOW, THEREFORE, IT IS HEREBY ORDERED that Klamath County shall immediately withdraw from participation in the KBRA and KHSA.

DONE AND DATED this 12 day of March, 2013.

KLAMATH COUNTY BOARD OF COMMISSIONERS

Chair | Commissioner | Commissioner

OR 2013-006

SISKIYOU COUNTY BOARD OF SUPERVISORS
P.O. BOX 750, YREKA, CA 96097
PHONE 530-842-8005

KLAMATH COUNTY BOARD OF COMMISSIONERS
305 Main Street, Klamath Falls, OR 97601
Phone 541-883-5100 | Fax 541-883-5163

November 21, 2014

The Honorable Ron Wyden
221 Dirksen Senate Office Building
Washington, D.C. 20510

The Honorable Dianne Feinstein
331 Hart Senate Office Building
Washington, D.C. 20510

The Honorable Jeff Merkley
313 Hart Senate Office Building
Washington, D.C. 20510

The Honorable Barbara Boxer
112 Hart Senate Office Building
Washington, D.C. 20510

Re: S.2379 – Klamath River Dam Removal

Dear Senators Wyden, Feinstein, Merkley, and Boxer:

The Commissioners of Klamath County, Oregon and the Supervisors of Siskiyou County, California -- the elected officials representing two-thirds of the Klamath River watershed – strongly oppose Senate Bill 2379. The amended Klamath bill that has passed out of the Committee on Energy and Natural Resources on November 13 perpetuates reliance on the fatally-flawed proposal removing the lower dams on the Klamath River. The citizens of both Klamath and Siskiyou County are adamantly opposed to this direction.

The Klamath proposals claim to provide benefits for fisheries, ecosystems and agriculture. They have the support of certain tribes, some environmental interests and some irrigators. But the glue that holds this subset of stakeholders together is blatant self-interest. Other Klamath stakeholders, including agricultural water users, municipal utilities, tribes, and property owners downstream and on the major Klamath tributaries, see nothing but negatives in dam removal. The gains to be made by the winners here are achieved by the losers bearing the cost and risk of redirected impacts.

We believe other Senators will be concerned with the legal maneuvering that S.2379 must resort to in order to circumvent the Clean Water Act, the Federal Power Act, and NEPA. We also believe Congress will have a hard time swallowing the blank check of allowing stakeholders to amend their agreements and be backed up by federal law without returning to Congress for any further approvals. There are also extraordinary limits on normal judicial review that are necessary to insulate S.2379 from its substantive shortcomings and procedural shortcuts.

Unlike most other examples of dam removal, it should be emphasized that the current proposal for the Klamath dams does not come close to restoring the Klamath River watershed to its natural state. The basin landscape will remain highly modified by the Bureau of Reclamation providing agricultural water supplies in the Klamath Basin and diverting a large portion of the Trinity River to California's Central Valley. The runs of salmon that currently exist have adapted to this altered system, with the fall-run Chinook replacing the spring-run as the most numerous. Continual record runs of salmon are becoming common. This is possible because of the late-season flows afforded

by the existence of both the Klamath Irrigation Project and the Klamath Hydroelectric Project. Indeed, just this past August, water was released from storage for the purpose of flushing out fish disease in the Lower Klamath River, while also being released from the very dams proposed for removal to maintain base fish flows in the Klamath main stem while retaining water in Upper Klamath Lake for agriculture.

We continue to support a number of the "interim measures" that are already being implemented on the Klamath River. There is no reason to delay further testing and refinement in the operation of existing facilities and the implementation of less radical and less risky mitigation measures, many of which have already demonstrated their feasibility and effectiveness. There is still much that can be done to advance the interests of all Klamath stakeholders without allowing the almost-religious fervor for dam removal to override scientific reality, environmental risk and damage, and fiscal responsibility.

If the forged relationships are as cohesive as claimed, a more appropriate stakeholder group can certainly modify the proposed agreements, minus dam removal, into legislation that can gain comprehensive local, States and Federal support. Klamath County and Siskiyou County continue to stand ready to work with all of the interests in the Klamath Basin on a properly directed course of action.

Sincerely,

Klamath County
Board of Commissioners

James Bellet, Chairman

Tom Mallams, Vice-Chair

Dennis Linthicum
Commissioner

Siskiyou County
Board of Supervisors

Michael N. Kobseff,
Chairman

Marcia H. Armstrong,
Vice-Chair

Brandon Criss,
Supervisor-District 1

Grace Bennett,
Supervisor-District 4

(absent)
Ed Valenzuela
Supervisor, District 2



Klamath County Commissioners

Tom Mallams, *Commissioner*
Position One

Kelley Minty Morris, *Commissioner*
Position Two

Jim Bellet, *Commissioner*
Position Three

November 30, 2016

RE: Columbia, Snake and Klamath River Dam Removal

Dear Interested Parties,

The Columbia and Snake Rivers are a large part of the economies in Oregon, Washington and Idaho as they are main thoroughfares for cargo transport. Approximately 9 million tons of cargo are transported on the Snake and Columbia Rivers every year. Barges can carry more freight and are the most efficient mode of transportation than semi-trucks. For every four barges carrying a cargo of wheat down the Columbia and Snake Rivers approximately 540 semi-trucks would be needed to transport the same amount of wheat. The economies of Oregon, Washington and Idaho, the communities along these rivers, and the industries that use the transportation system all depend heavily on the trade and commerce that flows up and down these important waterways.

Dams along the Snake and Columbia rivers are key to flood control as many of the cities along the rivers are located in low-lying areas. Today, flood control storage totals 37 million acre-feet, flood-control storage only, while the total of all active storage in all Columbia River Basin reservoirs is 55.8 million acre-feet.

Salmon fisheries are also very important to the economies of the communities along the Columbia and Snake rivers. The dams on the rivers allow for safe fish passage. In 2014, it was reported that a record number of Chinook Salmon were recorded returning up the Columbia and Snake Rivers, 107,000 recorded at the Bonneville dame in one weekend.

The low cost, clean, renewable power that is generated by these dams is also important.
Our constituents are concerned about dam removal on the Klamath River and therefore we felt it important to raise concerns about dam removal on additional waterways in the Pacific Northwest.

Proposed removal of the 4 dams on the Klamath River any of the 4 dams on the Snake River and any of the 10 on the Columbia River could create hardships for the people in the communities in which the rivers are a life-blood. This would include people reaping diverse benefits that the dams provide.

Sincerely,

Tom Mallams
Commissioner

Kelley Minty Morris
Chair

Jim Bellet
Commissioner

305 Main Street, Klamath Falls, Oregon 97601
Phone: (541) 883-5100 | Fax: (541) 883-5163 | Email: bocc@klamathcounty.org

MIKE MALLORY, ASSESSOR - RECORDER
County of Siskiyou

Courthouse • 311 Fourth Street • Room 108 • Yreka, CA 96097-2984
Assessor (530) 842-8036 • Recorder (530) 842-8065 • FAX (530) 842-8059

January 26, 2017

California State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA 95812-2000
Parker.thaler@waterboards.ca.gov

Attn: Mr. Parker Thaler

Re: Scoping Comments Relating to EIR – Proposed Lower Klamath Project License Surrender

Dear Mr. Thaler:

As Siskiyou County Assessor-Recorder I submit the following comments and requests as provided for in the public scoping process. I will be presenting this information at tonight's Yreka Public Scoping Meeting, to be held at the Best Western Miner's Inn – Convention Center.

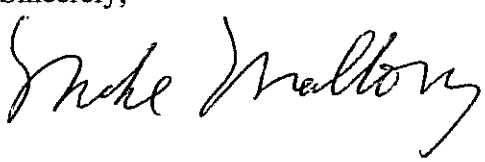
- Valuation studies to date at the Federal level have been woefully inadequate, as the Department of Interior has carefully crafted the Scope of Work to arrive at a predetermined outcome of minimal value impact in the event of dam removal ($2M to $2.5M total value loss). Appraisals to date have been based on the hypothetical assumption that the land underlying the lakes has been restored to its native condition with full access to a free-flowing river; structural and site improvements have been intentionally excluded from the analysis; and an estimate of nearly 1,500 "Potentially Impacted Parcels" has been grossly understated at just under 700 "Impacted Parcels." ***REQUEST:*** *Completely disregard any valuation study relating to Klamath Dam removal as commissioned by the Department of Interior. Provide an objective analysis of the loss in property values and tax revenues to all impacted parcels in the event of dam removal, with consideration of the mud flats and denuded landscape which will remain for years after dam removal.*

- The Klamath River dams, while not constructed specifically for flood control, are utilized to "temper" flows and reduce flooding. Moreover, there is a perception from the general public that the dams do, in fact, provide flood control, and that removal of the dams will increase flooding. Perception is reality when it comes to property values. This issue has been blatantly ignored thus far. ***REQUEST:*** *Analyze the impacts to property values and tax revenues along the Klamath River below Iron Gate Dam due to the real and/or perceived loss of flood control in the event of dam removal. In addition, silt deposition may change the river course and lead to more severe flooding, which must also be considered in the analysis.*

- Valuation of PacifiCorp's assets for property tax purposes is accomplished by the California State Board of Equalization (SBE) and assessed on the Board Roll of State Assessed Property (also known as the Unitary Roll). These values are transmitted to the County annually, and taxes are collected locally by the Siskiyou County Tax Collector. While PacifiCorp's total valuation at $162.6 Million is publically available, the underlying classification by property type is confidential, even to County Assessors. In the event of dam removal, all assets associated with the hydroelectric facilities will be removed along with corresponding assessments. Once represented by PacifiCorp as upwards of 20% of its total assessment, removal of these assets has the potential to reduce the Tax Roll by $32.5 Million in value. The corresponding loss of approximately $370,000 per year in taxes will have a big impact on the County of Siskiyou as well as the Hornbrook Elementary School District (which is the only basic aid school districts in Siskiyou County). ***REQUEST:*** *Analyze the impacts to property values and tax revenues caused by removal of the hydroelectric facilities from the Assessment Roll.*

Thanking you in advance for your attention to my concerns as outlined above. In the event that you should require any additional information and/or clarification, please do not hesitate to contact me.

Sincerely,



Mike Mallory
Siskiyou County Assessor-Recorder

MM:ss

cc: Michael Kobseff, Chair Siskiyou County Board of Supervisors
Elizabeth Nielsen, Siskiyou County Natural Resource Specialist

(4)

Brandon Criss, Siskiyou County Supervisor District 1
Comments regarding 401 certification for the Klamath River Hydropower Dams.

At 10 pm on August 1st, 2014 I received a phone call from Sheriff Lopey advising me that constituents were being evacuated from their homes due to a rapidly spreading fire north of Copco Lake. I drove over to the evacuation center and spent the night their getting feedback of what was happening. Constituents witnessed helicopter bucket load after helicopter bucket load of water being drawn out from behind Copco Dam. The water behind the dam was used to save homes and lives. When you consider this issue, we demand that public health and safety be given priority. Do not take away this fire protection tool that the Dams provide.

We ask that you also consider the health of the migrating salmon. Also in 2014 there was a chance of another fish kill similar to 2002 on the Klamath River. At the North Coast Regional Water Quality Control Board meeting of October 9th, 2014 the Karuk Tribal spokesman Craig Tucker stated, that "increasing flows and the velocity of flows disperses disease on the Klamath. … We averted a fish kill because of Trinity Flows, then the Karuk Tribe observed disease above the Trinity confluence. A lot of credit to PacifiCorp's collaboration with the Bureau of Reclamation 16,000 acre/ft was released with 1700 cubic feet per second"

In total 20,000 acre/feet was released by these dams. Without the dams this 20,000 acre/ft of water would not have been available to save the salmon.

We find it ironic that some claim these dams impair water for fish, yet a release of an extra 20,000 acre/feet of this same water is credited with being pivotal in helping to prevent a fish kill. Please do not take this tool away from us.

The Bureau of Reclamation struck a deal with PacifiCorp to release this 20,000 acre/feet from behind these dams so this water would not have to be taken from farmers in the Klamath Basin. In the BOR August 8, 2014 press release stated that the water released from behind the lower dams would "assist Reclamation by extending the Klamath Project's available water supplies from Upper Klamath Lake to help close the irrigation season." Please for the benefit of those farmers, do not take this tool away from us.

Lastly, do not view agriculture as harming the river, view it as a tool to benefit the river. For example, the State Fish and Game quickly blamed Klamath Basin Agriculture for the 2002 fish kill, yet the National Academy of Sciences made clear in their study that agriculture did not cause the fish kill. It's a proven fact as well that agricultural water run off from the Klamath and Tulelake Basins is cleaner and has less phosphorous loading than natural conditions would give this river. Don't just demand cleaner water, respect and honor that you are already receiving cleaner water due to agriculture.

We request that you allow us to continue to use the dams as a tool, a proven tool to benefit the Klamath River system in whole.

With the dams in place, we are seeing record runs of Klamath River salmon. Tearing out existing hydropower dams that have proven benefits for fish, Klamath and Tulelake Basin agriculture, and firefighting efforts, is no solution, it's instead the start of many problems.

Best Regards,

Brandon A. Criss MPA'
Siskiyou County Supervisor District 1

COUNTY OF SISKIYOU

Board of Supervisors

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District 1	*District 2*	*District 3*	*District 4*	*District 5*

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Best Regards,

Brandon A. Criss

Brandon A. Criss, MPA
Siskiyou County Supervisor District 1

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California State Water Board
Re; Klamath Hydroelectric Facilities License Transfer

Comments regarding proposed Federal Clean Water Act and CA Porter Cologne Act Water Quality Certifications

CEQA/NEPA Comments

The Action of the Board is premature and attempts to sidestep federal processes and use former processes not vetted by Public Review and Appeal Processes or legal scrutiny through the courts.

In your previous Yreka public meeting the water board has stated their intent was to use the environmental analysis of preceding environmental analysis included in the 2012 Klamath Dam Removal EIS. This document has no legal standing and prevents tiering under federal statutes or agreements as outlined in; Council on Environmental Quality document, NEPA and CEQA: Integrating Federal and State Environmental Reviews February 2014.

Legal sufficiency for NEPA analysis is defined in law. CEQA Decisions may not tier to a NEPA Decision when the EIS has not concluded in a Record of Decision; CFR Title 40 section §1506.1 sub-part a; Limitations on actions during NEPA processes.

As recent as November 2016 the Federal Energy Regulatory Commission formally stated they have postponed the analysis of License Transfer until Mid-March 2017. This in part, due to incomplete application appendices from which to properly analyze the action before the commission. What action is the water board undertaking when the action has not been accepted by the body that is responsible for determining whether or not to proceed with License Transfer and subsequent Dam removal?

Using the former EIS Documents for Klamath Dam removal does not meet the thorough and complete look for effects found in NEPA and CEQA Statutes. Those previous documents had as a premise a federally funded mitigation list found in the expired KBRA/KHSA Agreements. Those mitigations were part of the analysis of environmental effect designed to lessen impacts to fisheries, the public and water quality on the Klamath River. The ESA determinations and Environmental Conclusions in those documents are now referred to as "stale" and must be rejected and analysis reinitiated as both NEPA and ESA require when there is a significant change in the proposal.

The former analysis is incomplete. In the ten years of analysis that took place every one of them eliminated the flows of the Trinity River as the analysis was narrowed to 5 miles within the reaches below Iron Gate Dam. Any analysis must include the entire river under federal and state statute prior to any Clean Water Certifications the state may make.

Jurisdictional Comments

Does this State Agency have the jurisdiction to analyze and make a Clean Water Act Certification regarding the Transfer of 4 Dams on the Klamath River under the Clean Water Act?

There is no authority for the State of California to make determinations outside its Sovereign Borders nor do its laws extend beyond them. One of the Dams in the Transfer Application and a large segment of the Klamath River affecting the Lower Klamath are within the Sovereign Borders of Oregon. Several Dams within Oregon have the potential to significantly affect California's water quality with their operations. The flows from Upper Klamath Lake are well outside this states influence and cannot be predicted with any certainty and therefore makes a state level analysis for water quality tenuous at best. The Porter Cologne Act from which the State Water Boards authority originates has no regulatory influence over another state and is the wrong authority at the wrong scale to make an informed water quality determination.

In The Supreme Court Decision, Rampos v. United States & Carabell v. United States clarify the Authority and Jurisdiction of the Clean Water Act for Navigable Waters and is to be under the Army Corps of Engineers and the Federal EPA the court directs them to exert their regulatory authority over them. This jurisdiction is further clarified in the "Civilettii Memorandum at 43 Opinion Attorney General 197(1979).

The NPDES Memorandum between the United States and the state of California defines when a state may take Clean Water Certifications. The states independent certification process is limited to waters not reserved by the EPA for review. Those classifications of discharges reserved to EPA regulation under federal statute include; Discharges to territorial seas, Discharges which may affect the water quality of another state and Discharges from any other source which exceeds a daily average discharge of 1/2 million gallons.

In summary, to properly analyze any action on the Klamath River I urge the Board to start over on all processes using Federal and State Statutes respecting the federal agencies responsible for all interstate actions. To do otherwise and to continue to side step a complete and thorough scientific analysis in full participation of the public will likely lead to severe damage of our river, extirpation of listed Salmon, devastate our local economy and lead our state into years of costly litigation.

January 26, 2017

Ray A. Haupt
Siskiyou County Supervisor, District 5
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1312 Fairlane Rd.
Yreka, CA 96097

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Board of Supervisors

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February 01, 2017

State Water Resources Control Board
Division of Water Rights
Water Quality Certification Program
Attention: Mr. Parker Thaler
P.O. Box 2000
Sacramento, CA 95812-2000

Subject: County of Siskiyou Comments on the *Notice of Preparation and Scoping Meetings for An Environmental Impact Report for the Lower Klamath Project License Surrender*

Dear Mr. Thaler:

The County of Siskiyou would like to provide the following letter, in addition to the public and written statement that we provided at the State Water Resources Control Board (Water Board) public scoping meeting held in Yreka, California on January 26th (attached). We require through this letter that you keep the County, the Board of Supervisors, Siskiyou County Counsel and the Natural Resource Policy Specialist up to date on the progress of this draft Environmental Impact Report, and inform us in an official and timely manner of any future meetings, documents or related activities. We also request that as outlined in Assembly Bill No. 52 (AB 52), the Water Board coordinate with the Shasta Nation who's Traditional Homelands include portions of the Klamath River, which was officially recognized through a Siskiyou County Resolution, to meet the requirements of AB 52 and the California Environmental Quality Act (CEQA). (attached). In addition, the Shasta Nation provided information to the Water Board that there are Native American burial sites, and decorated Shasta Nation Civil War veterans buried under Iron Gate reservoir, which could require special approval from federal agencies, and at the very least extensive archeological review.

We reiterate our concerns about the Water Board's outreach activities regarding public scoping meetings. As we outlined in our statement on January 26th, Siskiyou County was not officially notified of the January 10th meeting until January 4TH, and our County Counsel did not receive notice by mail until January 9th. This is not adequate notice as Siskiyou County strives to keep its public up to date on any activities that would potentially affect the County, and the Board of

Brandon Criss	Ed Valenzuela	Michael N. Kobseff	Lisa Nixon	Ray Haupt
District 1	*District 2*	*District 3*	*District 4*	*District 5*

Supervisors frequently participate and supplies comments on any actions that impact the County. Short notice and limited communication violates, if not the letter, then certainly the spirit, of the law intended to notify and engage the public and solicit active participation. We are requiring that in the future the Water Board make a more concerted effort to keep the public up to date on its future activities and provide enough time for the public to be able to develop and provide ample and thoughtful input.

The Water Board's *Notice of Preparation and Scoping Meetings for An Environmental Impact Report for the Lower Klamath Project License Surrender* (NOP) appears to assume that dam removal is the determined outcome, which would make the environmental document pre-decisional, and would violate the *California Code of Regulations, Guidelines for Implementation of the California Environmental Quality Act*. We demand that the Water Board not make this assumption, and instead meet the needs of all impacted environmental and natural resources, and give due diligence to the people, livelihood, and economy of Siskiyou County. We would also like to point out that in a 2011, vote (Measure G) 80% of Siskiyou County citizen's opposed dam removal, and in a 2016, advisory ballot, 72% of Klamath County citizen's opposed dam removal, which indicates again the statutory requirement for an environmental document that analyzes all viable alternatives.

In the past, environmental documents developed for the now expired Klamath Agreements limited analysis to five miles of the Klamath River, which was inadequate and in no way addresses the total effects and consequences of any proposed action, or meets the requirements outlined under the North Coast Basin Plan (Basin Plan). During the development of this NOP and Environmental Impact Report (EIR), the area of analysis must consider the entire Klamath River system, its tributaries (including the Trinity River), surrounding areas, and local communities, including Siskiyou County; to meet requirements under CEQA and the Water Board's Basin Plan.

However, the Water Board only has jurisdiction over those lands and waters located in California, and nothing outside of California's borders. This becomes an issue when the Water Board is considering issuing a water quality certification that includes a facility and waterbody located in Oregon. As the Water Board only has jurisdiction within California they do not have the ability to address the entirety of the Klamath, which is an issue when evaluating the environmental impacts of potential actions. In addition, the Supreme Court Decision, Rapanos v. United States and Carabell v. United States, clarifies the authority and jurisdiction of the Clean Water Act for Navigable Waters of the United States, which is to fall under the US Army Corps of Engineers and the federal Environmental Protection Agency. These court decisions direct those federal agencies to exercise their regulatory authority over waters of the United States. These decisions are further clarified in the "Civiletti Memorandum" (43 Op. Attorney General 197(1979)". We ask the Water Board how they legally intend to complete a comprehensive and inclusive environmental document, and make a determination, on actions that include infrastructure and waters outside of their jurisdiction?

As we have outlined numerous times in past correspondence, the County would like to address the

multiple potential consequences that would result from removal of the four lower dams on the Klamath River.

- *Water Quality* - Currently, eight Total Daily Maximum Load's (TMDL's) have been adopted for Klamath Basin waters, by the Oregon Department of Environmental Quality and the Water Board; and at least four technical TMDL's have been implemented by the Environmental Protection Agency. These TMDL's outline the attainment of water quality standards for dissolved oxygen/organic enrichment, nutrients, temperature, pH, ammonia, microcystin/chlorophyll-a, and sediment. In coordination with the requirements set forth by these TMDL's, water quality standards must be attained for each TMDL pollutant (Siskiyou, 2011). The impacts analysis of the Water Board's EIR must make clear that under the No Action Alternative, and any of the other Alternatives, water quality standards for the categories listed above, and under a range of conditions, will be attained. The EIR must assess whether dam removal will significantly impact or inhibit attainment of water quality standards, and if not removing the dams will actually cause the same outcome, and what effect proposed actions will have on baseline conditions above and below the dams. We would like to point out that in previous environmental analysis these documents failed to account for the attainment of water quality standards outlined under the TMDL's.
- *Sediment* - Although the Water Board has briefly analyzed sediment issues in previous documentation, there has been no adequate investigation into the 20-30 million cubic yards of sediment that is trapped behind the dams. We are requiring that the Water Board investigate the impacts of releasing these sediments in the event that the dams are removed, and both the short and long-term impacts that would result. Potential consequences that must be addressed, in addition to any others, include;
    - raising the bed height of the Klamath River by several feet through release of sediment (which would affect water quality, water temperature, and fisheries habitat),
    - trapping fine grained sediment within the gravel beds below the dams such that it will take large flood events to rework this sediment to a native state suitable for benthic habitat conducive to healthy salmonid fisheries in these reaches,
    - deposition of polluted sediment into the riverbed and overbank sediment deposits depending on the timing and form of reservoir drawdown,
    - polluting the mouth of the estuary with a large quantity of neutrally buoyant organic waste particles which contain the majority of toxins in the reservoirs (Brownfield Partners, 2008),
    - release of noxious weed seeds and the release of predatory fish (such as Perch) downriver,
    - and polluting the river in such a way that salmonids do not have a spawning area that is relatively free of sediment.

- *Flooding* - The potential for catastrophic floods, either during dam removal activities, or thereafter; with no way to control flows should the dams be removed. These floods would also alter the stream bed and alter the habitat for fish species. Previous environmental documents used the Federal Emergency Management Agency's average daily flow as a flood indicator, rather than peak river flows. This is incorrect and irresponsible as peak flows are higher, and very often significantly higher, than average daily flows, and these peak flows are the ones that will most greatly affect river communities. The impact of peak flood events would be greatly affected by dam removal as these events would occur at a greater capacity and approximately 10 hours sooner than under current conditions (Office of County Cousel, 2011).
- *Property value loss, tax loss, and loss in school funding* – Evaluation and investigation into these issues in previous environmental documents has been preliminary and inadequate, although these consequences would have very real and lasting impacts to Siskiyou County. As a rural County that often struggles financially, funding that is provided to our local schools is vital to the people and children within the County. Specifically, Hornbrook Elementary School District would suffer by removal of the dams, as their primary source of funding is supplied through PacifiCorp assessments on the Unitary Roll ($800,000 per year). Property value appraisals and tax revenue to the County have been based on hypothetical assumptions that the land underlying the lakes would be restored to its native condition with full access to a free-flowing river. In actuality, if the dams are removed, mud flats will dominate the landscape for decades, and will have immediate and severe impacts to property values. We request that a separate section of the EIR be devoted to property value loss, property tax loss, and school funding loss. These will be significant impacts to Siskiyou County, and should be included in the list set forth in Attachment 1 of the NOP. The Water Board should work closely with the Siskiyou County Assessor's Office to ensure that accurate facts are obtained and an appropriate scope of analysis is used for these impacts. They can be reached at 530-842-8036, or assessor@co.siskiyou.ca.us.
- *Inability for controlled flow or pulse flow events* - Over the last several years, water has been released from behind Copco Dam to initiate Klamath River pulse flows to help improve water quality and fisheries habitat during the summer months. If the dams are removed, this water would not be available at the critical time needed, and would have to come from Upper Klamath Lake storage, which would impact agricultural and wildlife refuge deliveries in the Klamath Basin. Analysis into the potential long-term effects of the inability to provide these flows must be completed in any environmental documents concerning the Klamath River.
- *Fire Protection* – During fire events, agencies and firefighters rely on Copco Lake and the Klamath River to provide crucial assistance in firefighting activities. Helicopters and water tenders regularly draw water from the lake and river to assist in fire suppression, which generally occurs during the summer months when flows in the river would be minimal and Copco Lake water storage would no longer exist if the dams are removed.

- *Other impacts to fisheries health and population* - Previous environmental analysis developed by the Department of the Interior relied on findings of the Coho Salmon and Steelhead Expert Panel to evaluate the removal of the four dams, and summarized that dam removal "would result in a modest increase in coho salmon population compared with existing conditions." However, the Expert Panel actually stated that the "difference between the Proposed Action *(dam removal)* and current conditions is expected to be small." This is especially true for the ten years following dam removal, after which "moderate" responses by coho salmon "are possible." But this possibility might happen only "if the KBRA *(now expired)* is fully and effectively implemented...", a result which the Expert Panel had considerable doubt about. In addition, the Expert Panel found that even with full and correct implementation of the KBRA, there is a "high uncertainty" about the actions necessary to truly make a difference for coho salmon and the possibility of moderate responses by coho salmon to dam removal (Office of County Cousel, 2011).
    - It is extremely important to point out that there are an additional eighty-five creeks and rivers from Iron Gate to the mouth of the Klamath River, and over 400 miles of spawning habitat that contribute to the Klamath River system and fisheries health. For example, water that enters the Klamath from the Shasta and Scott rivers is lower in temperature, high in quality, and provides huge benefits to Klamath River water. Lastly, other actions that impact the fisheries system need to be addressed, such as the undisclosed tribal treaty fishing activities that occur near the estuary and reduce the number of fish that migrate upstream; and other similar activities carried out on the Klamath and its tributaries.
    - The Water Board should evaluate other methods to address health concerns for salmonids (Ich and C.shasta), which include suction dredge mining. Activities very similar to suction dredge mining have recently been used in other river systems to stir up compacted river beds to address fish disease concerns and provide a better spawning ground for fish species (Game, 2016). As the Water Board is currently looking into lifting the ban on suction dredge mining in California, this would be an important activity to consider.

We would also like to make reference and incorporate as comments the November 21, 2011, letter and supporting documentation submitted to the Department of the Interior and California Department of Fish and Wildlife from the Office of County Counsel, Siskiyou County. In this documentation you will find unanimously approved resolutions from the City of Yreka, City of Dorris, City of Etna, City of Montague, City of Weed, and Town of Fort Jones; all requesting a thorough and balanced environmental review process concerning the Klamath River dams, and opposing actions that would result in irresponsible adverse impacts to the local area and people.

As requested in the NOP, Siskiyou County would like to provide the following alternatives for consideration. Siskiyou County emphatically supports alternatives to dam removal, especially those

set forth in Section 2.3.1 of the 2007 Federal Energy Regulatory Commission Environmental Impact Statement (EIR), and Section ES.6.4 of the 2012 KHSA EIS/EIR, dealing with fish passage. Siskiyou County is happy to provide additional information at the Water Board's request and to assist in any way to further develop these alternatives. In addition, it is the legal responsibility of the Water Board under the CEQA to "provide public agencies and the public with detailed information about the effect which a proposed project is likely to have on the environment... list ways which the significant effect of the project might be minimized; and... indicate alternatives to such a project." Pub. RES. Code §1061.

- *Trap and Haul* – Trap and Haul has been utilized for other dams in the West, north and south of the Klamath River, where installing a fish ladder is not practical. Trap and Haul would include fish being transferred by specialized tankers to be released back into the Klamath River upstream of the dams.
- *Unassisted Volitional Anadromous Fish Passageway Alternatives to Dam Removal* – This alternative would include fish passageway around Iron Gate and Copco dams, which would prevent destruction of Shasta Nation cultural and archeological artifacts, maintain flow control, maintain hydro-electric power for 70,000 homes, maintain flood protection, protect property owners, and maintain tax and property values, among other benefits.
- *Tunnel Unassisted Anadromous Fish Passageway Including the Gravity Flow: Klamath – Shasta Import Project (John C. Boyle Reservoir to the Shasta Valley)*and *Tunnel Unassisted Anadromous Fish Passageway Including the Pressurized Flow: Klamath-Shasta Import Project (Iron Gate Reservoir to the Shasta Valley)*– These alternatives include the above mentioned Fish Passageway, with a diversion structure at J.C. Boyle reservoir to gravity flow 60,000 acre-feet of Siskiyou County state reserved water right from the Klamath River to the Shasta Valley (Gravity Flow). The pressurized flow alternative would require pumping with the point of diversion at Iron Gate Reservoir. Both of these options would allow cooler Shasta River water to remain instream to be released into the Klamath River.

To reiterate, it is Siskiyou County's expectation that there will be a fair and complete analysis of all environmental consequences throughout this environmental process, for the entire impacted Klamath River system. We appreciate the opportunity to provide these comments and will stay actively involved throughout the process and will continue to provide meaningful input. If you have any questions please contact Elizabeth Nielsen, Siskiyou County Natural Resource Policy Specialist at 530-842-8012, or by email at enielsen@co.siskiyou.ca.us.

Sincerely,

Michael N. Kobseff, Chair
Board of Supervisors

cc: US Department of the Interior
cc: Federal Energy Regulatory Commission
cc: California Governor Jerry Brown
cc: Assembly Member Brian Dahle
cc: Congressman Doug LaMalfa
cc: Ted Gaines
cc: Rural County Representatives of California
cc: California State Association of Counties
cc: National Association of Counties
ATTN: Kevin Cann

Works Cited

Brownfield Partners, E.-P. (2008). *Preliminary Review of the Klamath River Dam and Sediment Investigation.* Denver: Brownfield Partners.

Game, I. D. (2016, November 23). *Idaho Department of Fish and Game*. Retrieved January 28, 2017, from Dredging Effort to begin at Wilson Springs: https://idfg.idaho.gov/press/dredging-effort-begin-wilson-springs

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Board of Supervisors

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Tuesday, January 17, 2017

SISKIYOU COUNTY BOARD OF SUPERVISORS STATEMENT TO THE STATE WATER RESOURCES CONTROL BOARD REGARDING THEIR *NOTICE OF PREPERATION AND SCOPING MEETINGS FOR AN ENVIRONMENTAL IMPACT REPORT FOR THE LOWER KLAMATH PROJECT LICENSE SURRENDER*

The Siskiyou County Board of Supervisors would like to provide the following oral and written statement regarding the Water Boards notice of public scoping meetings in preparation of the Environmental Impact Report (EIR). In addition, the Board of Supervisors will be providing formal written comments by February 1st, 2017, in response to the *proposed* Notice of Preparation.

First, it seems that public notification of the original January 10th meeting was very limited, even within the County in which it is taking place. The Board of Supervisors was informed of the meeting by an individual who read about it on a local environmental group's webpage in late December 2016. We did not receive official notice from the Water Board until January 4, 2017, although it appears the notice was first sent out to certain people and groups on December 22, 2016. This short notice and limited communication violates, if not the letter, then certainly the spirit, of the law intended to notify and engage the public and solicit active participation. Unfortunately, this is not the first time situations like this have occurred. The County of Siskiyou deserves and demands adequate notice, at the earliest possible date, of all future public meetings.

Siskiyou County is concerned with the economic and environmental consequences that would impact the County if the four Lower Klamath River Dams were transferred to and removed by the Klamath River Renewal Corporation. To address a few of these concerns, the County continues to reiterate that the 20-30 million cubic yards of sediment that has collected behind the Dams, and would be released down the Klamath River after dam removal, has not been adequately evaluated to address the adverse local and environmental impacts. Over the last several years, water has been released from behind Copco Dam to initiate Klamath River pulse flows to help improve water quality and fisheries habitat during the summer months. If the Dams are removed, this water would not be available at the critical time needed, and would have to come from Upper Klamath Lake storage, which would impact agricultural and wildlife refuge deliveries in the Klamath Basin. Other issues include the potential for catastrophic floods, either during dam removal activities, or thereafter; and property value loss in the areas around Iron Gate and Copco Dams, which Siskiyou County estimates would be several million dollars. As part of the environmental process, it is the

Brandon Criss	Ed Valenzuela	Michael N. Kobseff	Lisa Nixon	Ray Haupt
District 1	*District 2*	*District 3*	*District 4*	*District 5*

Water Board's responsibility to fully address these issues, impacts to Siskiyou County and impacts to Klamath River water quality.

In the past, when the Klamath Basin Restoration Agreement and Klamath Hydroelectric Settlement Agreement were being developed, environmental documents limited the analysis area to a five mile stretch of the Klamath River, which was inadequate and in no way addresses the total effects and consequences of Dam removal. During any environmental process concerning the Klamath River, the area of analysis needs to consider the entire river system, surrounding areas, and local communities, including Siskiyou County. We also raise the issue that this would be difficult to do as the Water Board does not have any jurisdiction beyond California, which raises the question as to the legal ability of the Board to analyze impacts for a Dam located in Oregon, and waters originating in Oregon. Nevertheless, any deviation from full analysis would be in violation of *Title 14, Chapter 3 of the California Code of Regulations, Guidelines for Implementation of the California Environmental Quality Act.* In relation to this, the Water Board's documents outlining the process for water quality permit certification seem to assume that Dam removal is the determined outcome, which would make the environmental document pre-decisional, and would again violate the Code of Regulations. We are requesting that you not make this assumption, and that you meet the needs of all impacted environmental and natural resources, and give due diligence to the people, livelihood, and economy of Siskiyou County.

To reiterate, it is Siskiyou County's expectation that there will be a fair and complete analysis of all environmental consequences of the proposed Section 401 Certification, for the entire impacted Klamath River system. O*nly* if the Water Board thoroughly and transparently identifies, analyzes and determines whether possible mitigation measures are feasible, and would render identified impacts less than significant – and we submit that this is not possible - can the Water Board approve the requested 401 water quality certification. The California Environmental Quality Act, and interpreting case law, makes clear that proceeding without meeting these requirements would be an improper abuse of the Water Board's discretion in acting on this proposed project.

Thank you for the opportunity to make this statement on behalf of Siskiyou County. As indicated, we will submit more formal and detailed comments, particularly concerning the significant adverse environmental impacts to occur, as the *proposed* EIR progresses.

Michael N. Kobseff, Chairman
Siskiyou County Board of Supervisors

COUNTY OF SISKIYOU

Resolution No. 16-220

RESOLUTION OF THE BOARD OF SUPERVISORS OF THE COUNTY OF SISKIYOU, CALIFORNIA, ADOPTING MAP OF "THE TRADITIONAL HOMELANDS OF THE SHASTA PEOPLE"

WHEREAS, The Shasta People do hereby request consideration on this date of September 13, 2016, by the Siskiyou County Board of Supervisors in adopting the map labeled "The Traditional Homelands of the Shasta People, and;

WHEREAS, Defined under Assembly Bill 52 the designated boundary of the map is the archaeological, cultural, and sacred places significant in tribal cultural traditions, heritages, and identities of the Shasta People, and;

WHEREAS, Production of this map fulfills requirements of California Assembly Bill 52 approved by Governor Brown on September 25, 2014, and;

WHEREAS, The map will be on file with the Native American Heritage Commission in Sacramento, the California Historical Resources Information System in Chico, California, the Klamath National Forest in Yreka, the Shasta-Trinity National Forest in Redding, as well as other pertinent agencies, and;

WHEREAS, The Shasta People also request that this map will be referenced for all future consultation and cultural resource processes, and;

WHEREAS, This map is to be referenced until such time ongoing research illuminates an expansion of Shasta settlement patterns, and;

WHEREAS, Any new and substantiated evidence will be incorporated onto a revised map and will be provided to the Board, and;

WHEREAS, The Shasta People wish to express their deepest appreciation to Brian Daniels, Ph.D., Anthropologist, who has performed valuable research and has assisted the Shasta People for almost two decades. He is well versed in Shasta culture and has provided extensive knowledge throughout the research process.

SISKIYOU COUNTY
RESOLUTION
No. 16-220

NOW THEREFORE, BE IT RESOLVED, that the Siskiyou County Board of Supervisors adopts the map titled "The Traditional Homelands of the Shasta People". The County of Siskiyou will refer to this map as the delineated traditional homelands for the archaeological, cultural, and sacred places significant in tribal cultural traditions, heritages, and identities of the Shasta People.

The foregoing resolution was adopted at a regular meeting of the Board of Supervisors of the County of Siskiyou, State of California, held on the 13th of September, 2016, by unanimous vote:

AYES: Supervisors Kobseff, Haupt, Criss, Valenzuela and Bennett
NOES: NONE
ABSENT: NONE
ABSTAIN: NONE

Grace Bennett, Chair
Siskiyou County Board of Supervisors

ATTEST
COLLEEN SETZER, COUNTY CLERK

By: _____
Deputy



Traditional Homelands of the Shasta People

Township and Range

1:430,000

9/13/2016

Shasta Boundary

4 2 0 4 Miles

Thomas P. Guarino
County Counsel

Dennis M. Tanabe
Deputy County Counsel

Paula L. Baca
Deputy County Counsel

Dana L. Barton
Deputy County Counsel

Office of County Counsel
COUNTY OF SISKIYOU

P.O. Box 659 • 205 Lane Street
Yreka, California 96097

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Rita Haas
Executive Assistant

Diana Midkiff
Paralegal/Deputy Public Guardian

Stacey L. Clough
Legal Office Coordinator

November 21, 2011

Elizabeth Vasquez
Bureau of Reclamation
U.S. Department of the Interior
2800 Cottage Way
Sacramento, CA 95825

Gordon Leppig
California Department of Fish and Game
619 Second Street
Eureka, CA 95501

Dear Ms. Vasquez and Mr. Leppig:

On behalf of the County of Siskiyou, City of Yreka, City of Dorris, City of Etna, City of Montague, City of Weed, and the Town of Fort Jones, we are submitting the attached comments on the Klamath Facilities Removal Draft Environmental Impact Statement/Environmental Impact Report ("EIS/EIR"). The Resolutions of each of the Cities and the Town joining in these Comments prepared by the County of Siskiyou are attached as Appendix 1. The Comments are attached as Appendix 2.

The Proposed Action to remove four dams along the Klamath River will have direct and immediate consequences for the County, the Cities, and the Town (collectively the "Commenters"). Three of the four dams are in the County of Siskiyou. The citizens of the County will bear the burdens of the adverse environmental, economic, and social consequences of the Proposed Action.

A close reading of the EIS/EIR demonstrates that the Proposed Action cannot go forward. The EIS/EIR admits that in far too many cases the effects of the Proposed Action will be significant and adverse, often making existing environmental problems worse. Contrasted with these admissions are the conclusions of Expert Panels appointed by the Department of the Interior which concluded that the benefits claimed for the Proposed Action are not likely or small.

Compounding these problems is the fact that the EIS/EIR incorrectly and inadequately examines the impacts of the Proposed Action, glossing over or ignoring key data, and makes conclusions that have no supporting data. Often, the EIS/EIR simply fails to analyze key issues, some of which have impacts that, according to the Expert Panels, could not only render the claimed benefits of the Proposed Action moot, but could make environmental problems in the Klamath River Basin worse.

The National Environmental Policy Act ("NEPA") and the California Environmental Quality Act ("CEQA") demand better. These statutes require a full and complete analysis of the environmental effects, including the social and economic effects, of a proposed action. They require a thorough analysis of alternatives, mitigation plans, and cumulative effects. None of this is done in the EIS/EIR.

To satisfy NEPA and CEQA, there must be a hard look at the environmental consequences of a proposed action so the decision maker can make an informed decision. Here, the EIS/EIR is so lacking in analysis that a decision maker cannot make an informed decision. Not only has the EIS/EIR not taken the required hard look at the issues, but far too often it has taken no look at all.

For these reasons, and the reasons set forth in the attached Comments, the Commenters urge that the EIS/EIR be withdrawn and be redone so that it meets the legal and substantive standards of adequacy. To rely on the EIS/EIR as presently constituted would be arbitrary and capricious and not in accordance with law.

Sincerely,



Thomas P. Guarino
County Counsel
County of Siskiyou



George J. Mannina, Jr.
of Nossaman LLP

APPENDIX 1

RESOLUTION NO. 2939

RESOLUTION OF THE CITY COUNCIL OF THE CITY OF YREKA JOINING IN EIR/EIS COMMENTS OF THE COUNTY OF SISKIYOU

WHEREAS, the Department of the Interior has recently released the Klamath Facilities Removal Public Draft Environmental Impact Statement/Environmental Impact Report; and,

WHEREAS, this Report will be used to inform the Secretarial Determination in conjunction with the Klamath Hydroelectric Settlement Agreement (KHSA) and the Klamath Basin Restoration Agreement (KHSA); and,

WHEREAS, the City of Yreka is in opposition to a determination that would result in the removal of the Klamath hydroelectric facilities; and,

WHEREAS, due to the lack of resources and other economic limitations, it is to the benefit of the City if it is allowed to participate in the comments of the County of Siskiyou,

NOW, THEREFORE, BE IT RESOLVED that the City of Yreka joins in the comments to be filed by the County of Siskiyou with respect to the Draft EIR/EIS involving the Klamath dams.

BE IT FURTHER RESOLVED that the City of Yreka authorizes a copy of this Resolution to be provided with the comments of the County of Siskiyou and filed concurrently therewith as evidence of the adoption of the County's comments as the comments of the City.

PASSED AND ADOPTED this 3rd day of November, 2011, by the following vote:

AYES: FOSTER, MCNEIL & SIMMEN
NOES: NONE
ABSENT: Bicego & MERCIER
ABSTAIN: NONE

Rory McNeil,
Mayor of the City of Yreka

APPROVED AS TO FORM:

Mary Frances McHugh, City Attorney

Attest:
Elizabeth E. Casson, City Clerk

\\GOLDNUGGET\USERS\MARYFRANCES\MY DOCUMENTS\DOCUMENTS_WATER\FALL CREEK\SECRETARIAL DETERMINATION KHSA-KBRA\CITY OF YREKA RESOLUTION RE JOINDER KLAMATH FACILITIES REMOVAL PUBLIC DRAFT EIS-EIR.DOC

RESOLUTION 11-23

**RESOLUTION OF THE CITY OF DORRIS
JOINING IN EIR/EIS COMMENTS
OF THE COUNTY OF SISKIYOU**

WHEREAS, the Department of the Interior has recently released the Klamath Facilities Removal Public Draft Environmental Impact Statement/Environmental Impact Report; and,

WHEREAS, this Report will be used to inform the Secretarial Determination in conjunction with the Klamath Hydroelectric Settlement Agreement (KHSA) and the Klamath Basin Restoration Agreement (KHSA); and,

WHEREAS, the City of Dorris is in opposition to a determination that would result in the removal of the Klamath hydroelectric facilities; and,

WHEREAS, due to the lack of resources and other economic limitations, it is to the benefit of the City if it is allowed to participate in the comments of the County of Siskiyou,

NOW, THEREFORE, BE IT RESOLVED that the City of Dorris joins in the comments to be filed by the County of Siskiyou with respect to the Draft EIR/EIS involving the Klamath dams.

BE IT FURTHER RESOLVED that the City of Dorris authorizes a copy of this Resolution to be provided with the comments of the County of Siskiyou and filed concurrently therewith as evidence of the adoption of the County's comments as the comments of the City.

PASSED AND ADOPTED this 7th day of November, 2011, by the following vote:

AYES: Clontz, Barkman, Hurst, Baldwin, Smith
NOES: None
ABSENT: None
ABSTAIN: None

DATED: 11/7/2011

CITY OF DORRIS

Liz Clontz, Mayor

ATTEST:
Shelly L. Fehr, City Clerk

RESOLUTION NO: 820-2011

RESOLUTION OF THE CITY COUNCIL OF THE CITY OF ETNA JOINING THE EIR/EIS COMMENTS OF THE COUNTY OF SISKIYOU

WHEREAS, the Department of the Interior has recently released the Klamath Facilities Removal Public Draft environmental Impact Statement/Environmental Impact Report; and

WHEREAS, this Report will be used to inform the Secretarial Determination in conjunction with the Klamath Hydroelectric Settlement Agreement (KHSA) and the Klamath Basin Restoration Agreement (KHSA); and,

WHEREAS, THE City of Etna is in opposition to a determination that would result in the removal of the Klamath hydroelectric facilities; and,

WHEREAS, due to the lack of resources and other economic limitations, it is to the benefit of the City if it is allowed to participate in the comments of the County of Siskiyou,

NOW, THEREFORE, BE IT RESOLVED the City Council of the City of Etna joins in the comments to be filed by the County of Siskiyou with respect to the Draft EIR/EIS involving the Klamath dams.

BE IT FURTHER RESOLVED that the City of Etna authorizes a copy of this Resolution to be provided with the comments of the County of Siskiyou and filed concurrently therewith as evidence of the adoption of the County's comments as the comments of the City.

I HEREBY CERTIFY that the foregoing resolution was passed and adopted by the City Council of the City of Etna at a special meeting thereof held on October 24, 2011 by the following vote:

Ayes: Duguay, Martin, Prather, Seward & Stein
Noes: None
Absent: None
Abstain: None

Mike Duguay, Mayor

ATTEST:

Pamela Russell, City Clerk

RESOLUTION NO: 12-07

RESOLUTION OF THE CITY OF MONTAGUE
JOINING IN EIR/EIS COMMENTS
OF THE COUNTY OF SISKIYOU
IN OPPOSITION TO A DETERMINATION
THAT WOULD RESULT IN DAM REMOVAL

WHEREAS, the Department of the Interior has recently released the Klamath Facilities Removal Public Draft Environmental Impact Statement/Environmental Impact Report; and,

WHEREAS, this Report will be used to inform the Secretarial Determination in conjunction with the Klamath Hydroelectric Settlement Agreement (KHSA) and the Klamath Basin Restoration Agreement (KHSA); and,

WHEREAS, the City of Montague is in opposition to a determination that would result in the removal of the Klamath hydroelectric facilities; and,

WHEREAS, due to the lack of resources and other economic limitations, it is to the benefit of the City if it is allowed to participate in the comments of the County of Siskiyou,

NOW, THEREFORE, BE IT RESOLVED that the City of Montague joins in the comments to be filed by the County of Siskiyou with respect to the Draft EIR/EIS involving the Klamath dams.

BE IT FURTHER RESOLVED that the City of Montague authorizes a copy of this Resolution to be provided with the comments of the County of Siskiyou and filed concurrently therewith as evidence of the adoption of the County's comments as the comments of the City.

PASSED AND ADOPTED this 3rd day of November, 2011, by the following vote:

AYES: Hammond, Robustellini, Benson, Keller, and Singelton
NOES:
ABSENT:
ABSTAIN:

ATTEST:

Janie Sprague
Janie Sprague, City Clerk

CITY OF MONTAGUE:

John Hammond, Mayor

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RESOLUTION NO. 27-2011

A RESOLUTION OF THE CITY OF WEED
JOINING IN EIR/EIS COMMENTS
OF THE COUNTY OF SISKIYOU

WHEREAS, the Department of the Interior has recently released the Klamath Facilities Removal Public Draft Environmental Impact Statement/Environmental Impact Report; and,

WHEREAS, this Report will be used to inform the Secretarial Determination in conjunction with the Klamath Hydroelectric Settlement Agreement (KHSA) and the Klamath Basin Restoration Agreement (KHSA); and,

WHEREAS, the City of Weed is in opposition to a determination that would result in the removal of the Klamath hydroelectric facilities; and,

WHEREAS, due to the lack of resources and other economic limitations, it is to the benefit of the City if it is allowed to participate in the comments of the County of Siskiyou,

NOW, THEREFORE, BE IT RESOLVED that the City of Weed joins in the comments to be filed by the County of Siskiyou with respect to the Draft EIR/EIS involving the Klamath dams.

BE IT FURTHER RESOLVED that the City of Weed authorizes a copy of this Resolution to be provided with the comments of the County of Siskiyou and filed concurrently therewith as evidence of the adoption of the County's comments as the comments of the City.

I HEREBY CERTIFY the foregoing resolution was introduced and adopted at a regular special meeting of the City Council held the 10th day of November, 2011 by the following vote, to wit:

AYES: COUNCIL MEMBERS Broomfield, Hall, Palfini, Pearce, and Sutton.
NOES: None
ABSENT: None
ABSTAIN: None

/s/ Dave Pearce
Mayor, City of Weed

ATTEST:

/s/ Deborah J.Salvestrin
City Clerk, City of Weed

State of California)
) ss
County of Siskiyou)

I hereby certify the foregoing Resolution No. 27-2011 is a true and correct copy of the original adopted by the City Council on November 10, 2011.

Deborah J. Salvestrin
City Clerk, City of Weed

Dated: November 10, 2011

Resolution 999

RESOLUTION OF THE TOWN OF FORT JONES
JOINING IN EIR/EIS COMMENTS
OF THE COUNTY OF SISKIYOU

WHEREAS, the Department of the Interior has recently released the Klamath Facilities Removal Public Draft Environmental Impact Statement/Environmental Impact Report; and,

WHEREAS, this Report will be used to inform the Secretarial Determination in conjunction with the Klamath Hydroelectric Settlement Agreement (KHSA) and the Klamath Basin Restoration Agreement (KHSA); and,

WHEREAS, the Town of Fort Jones is in opposition to a determination that would result in the removal of the Klamath hydroelectric facilities; and,

WHEREAS, due to the lack of resources and other economic limitations, it is to the benefit of the City if it is allowed to participate in the comments of the County of Siskiyou,

NOW, THEREFORE, BE IT RESOLVED that the Town of Fort Jones joins in the comments to be filed by the County of Siskiyou with respect to the Draft EIR/EIS involving the Klamath dams.

BE IT FURTHER RESOLVED that the Town of Fort Jones authorizes a copy of this Resolution to be provided with the comments of the County of Siskiyou and filed concurrently therewith as evidence of the adoption of the County's comments as the comments of the City.

PASSED AND ADOPTED this 7th day of November, 2011, by the following vote:

AYES: McCulley, Berck, Smith, Tasem, Berry
NOES: none
ABSENT: none
ABSTAIN: none

Tom McCulley, Mayor

ATTEST:

Linda Romaine, City Clerk

APPENDIX 2

THE KLAMATH FACILITIES REMOVAL ENVIRONMENTAL IMPACT STATEMENT/ENVIRONMENTAL IMPACT REPORT

COMMENTS OF THE COUNTY OF SISKIYOU, CITY OF YREKA, CITY OF DORRIS, CITY OF ETNA, CITY OF MONTAGUE, CITY OF WEED, AND TOWN OF FORT JONES

November 21, 2011

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On September 21, 2011, the Department of the Interior ("DOI") released for public comment the draft Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report ("EIS/EIR"). These Comments by the County of Siskiyou, City of Yreka, City of Dorris, City of Etna, City of Montague, City of Weed, and Town of Fort Jones review the legal, factual, and analytical issues associated with the EIS/EIR.

I. INTRODUCTION AND SUMMARY

The County of Siskiyou, each City, and the Town are uniquely impacted by the action proposed in the EIS/EIR, the removal of four dams along the Klamath River ("Proposed Action"). Three of the four dams are in the County of Siskiyou. The environmental, economic, and social consequences of the Proposed Action will fall most heavily on the people of Siskiyou County. The citizens of the County, its cities, and its towns, as well as the natural resources in the County, will bear the brunt of the adverse consequences that will flow from a decision to remove the dams.

These Comments document extensive flaws in the EIS/EIR. However, these Comments identify only the most glaring errors, omissions, and legally inadequate aspects of the EIS/EIR. Because the EIS/EIR and its accompanying technical materials reflect inconsistent assumptions and contain inconsistencies between methodologies and actions analyzed, we expect we have not uncovered all of the flaws in the EIS/EIR. In addition, because the EIS/EIR defers substantial portions of the analysis to some later National Environmental Policy Act ("NEPA") and/or California Environmental Quality Act ("CEQA") document, the EIS/EIR does not provide a complete or comprehensive assessment of the impacts of the Proposed Action. The EIS/EIR meets neither the spirit nor the letter of the law.

More importantly, from a practical perspective, the EIS/EIR fails to provide sufficient, or even the most basic, information necessary to enable a decision maker and stakeholders to

adequately compare and contrast project alternatives, and to make informed policy decisions regarding implementation of the Proposed Action. At a minimum, the EIS/EIR should, but does not provide adequate information to enable the Lead Agencies and stakeholders to determine:

- whether, on balance, removal of the four Klamath River facilities is reasonably likely to result in credible and measureable environmental benefits that would not be achieved by implementation of the dozens of existing, legally mandated, and enforceable habitat restoration and water quality management measures specified in: (a) the PacifiCorp Habitat Conservation Plan; (b) the Upper Klamath Lake Drainage Total Maximum Daily Loads ("TMDLs") and the Upper Klamath River and Lost River TMDLs (collectively, the "Oregon TMDLs"); (c) the Klamath River TMDLs, Lower Lost River TMDLs, Scott River TMDLs, Shasta River TMDLs, and Salmon River TMDL (collectively the "California TMDLs); (d) the National Marine Fisheries Service 2010 Biological Opinion; (e) the CDFG Code Section 5927 in-stream flow mandate for tributaries to the mainstem Klamath River; (f) the mitigation and monitoring plan for the 2007 FERC EIS; and (g) those provisions of the Klamath River Basin Restoration Agreement ("KBRA") that are *not* conditioned upon implementation of the Klamath Hydroelectric Settlement Agreement ("KHSA"), which measures (contrary to assumptions of the EIS/EIR alternatives analysis) must be implemented regardless of the implementation of the KHSA; and
- whether, on balance, removal of the four Klamath River facilities is reasonably likely to achieve environmental benefits that outweigh (a) the adverse socioeconomic impacts of the Proposed Action, (b) the numerous short term (0 to 2 years) and long term (2 to 50 years) significant adverse environmental impacts associated with the

Proposed Action, and (c) the substantial risk that many of the short term significant adverse environmental impacts, and some of the "insignificant" adverse environmental impacts, will actually result in long-term, substantial negative impacts on the ecology of the Klamath River watershed.

A revised EIS/EIR must be prepared to address the deficiencies and provide the information needed to determine if the claimed environmental benefits of the Proposed Action outweigh the likely significant adverse social, economic, and environmental impacts of the Proposed Action. Only by circulating a corrected and much expanded document will the EIS/EIR provide adequate information on environmental impacts, alternatives, and mitigation measures with which all stakeholders can evaluate the alternatives and decision makers can act.

II. THE ENVIRONMENTAL EFFECTS ANALYSIS IN THE EIS/EIR

This section will examine the most serious issues for adequacy of the analysis in the EIS/EIR regarding the effects of the Proposed Action.

A. The Legal Framework

1. NEPA

In reviewing the legal adequacy of an environmental impact statement ("EIS"), courts hold federal agencies to rigorous standards. In a landmark administrative law case, the Supreme Court held agencies must take a "hard look" at the environmental issues associated with a proposed action. *Citizens to Preserve Overton Park v. Volpe,* 401 U.S. 402 (1971). *See also Maryland National Capital Park and Planning Commission v. United States Postal Service,* 487 F.2d 1029 (D.C. Cir. 1973). This "hard look" doctrine has been applied to NEPA. *Kleppe v. Sierra Club,* 427 U.S. 390, 411 (1976). *See also All Indian Pueblo Council v. United States,* 975 F.2d 1437 (10th Cir. 1992); *Tongass Conservation Society v. Cheney,* 924 F.2d 1137 (D.C. Cir. 1991). To meet this standard, an EIS may not contain vague, general, or conclusory reasoning.

Silva v. Lynn, 482 F.2d 1282 (1st Cir. 1973). The court in *Sierra Club v. United States Army Corps of Engineers,* 701 F.2d 1011, 1029 (2d Cir. 1983) (citations omitted), summarized the applicable standard as follows:

> [T]he ... [EIS] must set forth sufficient information for the general public to make an informed evaluation ... and for the decisionmaker to "consider fully the environmental factors involved and to make a reasoned decision after balancing the risks of harm to the environment against the benefits to be derived from the proposed action." [The EIS gives] assurance that stubborn problems or serous criticisms have not been "swept under the rug."

At a minimum, the "hard look" doctrine "encompasses a thorough investigation into the environmental impacts of an agency's action and a candid acknowledgment of the risks that those impacts entail." *National Audubon Society v. Department of the Navy,* 422 F.3d 174, 185-186 (4th Cir. 2005) (citations omitted). The Council on Environmental Quality ("CEQ") regulations implementing NEPA reflect these standards. Those regulations require that an EIS be "analytic" and not conclusory. 40 C.F.R. §1502.2(a).

The environmental consequences of a proposed action that are subject to NEPA analysis include the direct and the indirect effects of the action. 40 C.F.R. §1502.16(a) and (b) and §1508.8. The effects to be examined include "ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative." 40 C.F.R. §1508.8. An effects analysis in an EIS must contain an adequate compilation of relevant information that is sufficiently complete to allow informed decision making by the decision maker. *See e.g., National Resources Defense Council v. United States Forest Service,* 421 F.3d 797 (9th Cir. 2005); *Sierra Club v. United States Army Corps of Engineers,* 701 F.2d 1011 (2d Cir. 1983).

2. CEQA

Under CEQA, the purpose of an Environmental Impact Report ("EIR") is to "alert the public and its responsible officials to environmental changes before they have reached ecological points of no return." *Laurel Heights Improvement Ass'n v. Regents of the Univ. of California,* 47 Cal.3d 376, 392 (1988) ("*Laurel Heights 1*"). Thus, an EIR must "provide public agencies and the public with ***detailed*** information about the effect which a proposed project is likely to have on the environment ... list ways which the significant effects of the project might be minimized; and ... indicate alternatives to such a project." Pub. Res. Code §1061 (emphasis added). *See also,* Cal. Code Regs. tit. 14 ("CEQA Guidelines") §15002; *Laurel Heights 1*, 47 Cal.3d at 392. The agency must make a good faith effort at full disclosure. CEQA Guidelines §15151.

An EIR must provide a degree of analysis and detail about the project's environmental impacts such that a decision maker can make intelligent judgments in light of the environmental consequences of the decision. CEQA Guidelines §15151. It is essential that the project is adequately described and that existing setting information is complete. *County of Inyo v. City of Los Angeles,* 71 Cal.App.3d 185, 199 (1977). Both the public and decision makers need to fully understand the implications of the choices that are presented related to the project, the mitigation measures, and the alternatives. *Laurel Heights Improvement Ass'n v. Improvement Ass'n v. Regents of the Univ. of Cal*., 6 Cal.4th 1112, 1123 (1993) ("*Laurel Heights II*").

An EIR must address a proposed project's "significant effects on the environment." Pub. Res. Code §21100(b)(l); *see also* CEQA Guidelines §15126(a) (the EIR "shall identify and focus on the significant environmental effects of the proposed project.") A significant effect on the environment is defined as "a substantial, or potentially substantial, adverse change in the environment." Pub. Res. Code §21068; *see also* Pub. Res. Code §21100(d). The EIR must

identify both direct and indirect significant effects. CEQA Guidelines §15126.2(a). The EIR should encompass both short-term and long-term effects. *Id.* Identification of a project's significant environmental effects is one of the primary purposes of an EIR and is necessary to implement the stated public policy that agencies should not approve projects if there are feasible mitigation measures or project alternatives available to reduce or avoid the environmental impacts. Pub. Res. Code §§21002, 21002.1(a). CEQA requires a finding that a project may have a significant effect on the environment if the "possible effects of a project are individually limited but cumulatively considerable" where "'cumulatively considerable' means that the incremental effects of an individual project are considerable when viewed in connection with the effects of past projects ... current projects, and ... probable future projects." Pub. Res. Code §21083(b)(2); CEQA Guidelines §15130 (b)(1).

B. The Effects Analysis

The remainder of this Part will examine the analysis in the EIS/EIR of the direct and indirect effects of the Proposed Action to determine if the EIS/EIR provides an impacts analysis that meets the applicable legal standards under NEPA and CEQA. As will become clear, the EIS/EIR does not meet these standards.

1. Improper Definition of Existing Conditions, the Proposed Action, the No Action Alternative, and Alternative 4

Before proceeding further, however, it is important to clearly identify the environmentally beneficial measures and activities that are reasonably likely to proceed regardless of whether the Proposed Action is implemented. As acknowledged in the EIS/EIR, such measures and activities, to the extent they are reasonably foreseeable or likely to occur, must be considered a part of the existing environmental conditions. CEQA Guidelines

§§15126.6(e)(2) and (3). Failure to consider such activities and measures results in an inaccurate determination of the relative environmental benefits and risks of the Proposed Action.

a. The Klamath Basin Restoration Agreement

The implementation of the KBRA is incorporated into, and is an integral part of, the Proposed Action. The EIS/EIR clearly states that "the KBRA is a component of the Proposed Action." EIS/EIR at 3.3-138. *See also id.* at 2-19 (the Proposed Action "would include ... the implementation of the KBRA...."); *id.* at 3.3-75 (the Proposed Action "includes the implementation of the KBRA.")

At the same time, however, the EIS/EIR fails to recognize that certain elements of the KBRA are reasonably expected to occur in the foreseeable future if the Proposed Action is not approved. By law, these elements should be considered part of the existing conditions under the No Action Alternative and Alternative 4. The EIS/EIR offers a variety of explanations for considering the KBRA as part of the Proposed Action, while incorrectly ignoring the fact that a significant number of the KBRA measures will be implemented even if dam removal does not occur. As a legal matter, these actions must be included in the analysis of existing conditions.

In an attempt to justify its incorrect application of law, the EIS/EIR states the Proposed Action includes implementation of the KBRA because the environmental restoration activities and water quality management actions under the KBRA will not occur, or alternatively might not continue, or alternatively might not occur as quickly, in the event that the removal of the Klamath facilities and implementation of the KHSA do not proceed. EIS/EIR at ES-3, ES-21, 2-13-18, and 3.2-35. However, the KBRA is a legally binding agreement enforceable by the parties, and is distinct and separate from the KHSA and from Klamath facilities removals. *Id.* at ES-2, ES-4. Further, implementation of many of the environmental restoration and water quality improvement obligations and measures of the KBRA is either already occurring, or their

implementation is not conditioned upon implementation of the KHSA and from Klamath dam removals. *Id.* at ES-3. It is factually incorrect to assume in evaluating the Proposed Action and other Alternatives that no KBRA actions will occur in the absence of dam removal. Instead, the implementation of many of KBRA measures are reasonably expected in the foreseeable future. Those actions should be included in the description of the No Action Alternative, which must reflect actual conditions as well as conditions that would be reasonably expected to occur in the foreseeable future if the Proposed Action were not approved. 40 C.F.R. §§1502.16 and 1508.7; CEQA Guidelines §§15126.6(e)(2), 15126.4(a)(2), and 15130(c). In addition, analysis of all other Alternatives that do not preclude the implementation of the currently pending and unconditional measures of the KBRA, including Alternative 4, must assume that those measures will be implemented regardless of the Proposed Action.

Furthermore, because the EIS/EIR will result in significant adverse impacts with respect to at least some, and arguably with respect to the majority, of water quality and aquatic environmental parameters, the EIS/EIR by law must, but fails to, assess whether the Proposed Action will actually adversely impact or inhibit the environmental and water quality improvements that would otherwise be achieved under the No Action Alternative pursuant to implementation of the ongoing and unconditional obligations of the KBRA. CEQA Guidelines §§15126.6(e)(3)(B) and (C).

Accordingly, the No Action Alternative and Alternative 4 should reflect and presume the implementation of all ongoing and unconditional obligations of the KBRA. All measures that will actually be implemented regardless of the Proposed Action should be clearly and consistently identified throughout the EIS/EIR. The ongoing and unconditional obligations of the KBRA that should be reflected in the No Action and all other Alternatives appear to include

actions such as resource measures to secure additional water storage in the Basin; retirement of Upper Klamath Lake water uses under Section 15 of the KBRA; creation of additional water storage in the Basin under Section 18 of the KBRA, including the Lake Ranch and Barnes Ranch projects; implementation of fisheries restoration and reintroduction plans under Section 11 of the KBRA; measures to protect environmental water and in-stream flows under Section 20 of the KBRA; measures to manage flows and lake levels to improve the ecological, chemical, physical, and biological processes of the Klamath River Basin surface waters, including improving the status of anadromous and resident fish under Section 20.4 of the KBRA; and measures to protect environmental benefits under Sections 20.5 and 25 of the KBRA by, among other things, implementing water quality improvement measures such as TMDLs and other water quality standards.

In general, the false assumption that no KBRA actions (or only certain already ongoing KBRA actions) will proceed absent the Proposed Action leads to an inaccurate impacts analysis for the Proposed Action, improper comparison of the significance of environmental impacts for the Proposed Action versus other Alternatives, and improper identification of the environmentally preferable alternative because the EIS/EIR:

- overstates the environmental benefits of the Proposed Action by falsely linking all KBRA restoration actions to implementation of Klamath facilities removals pursuant to the KHSA; and
- overstates the adverse environmental impacts of the No Action Alternative and Alternative 4 by failing to recognize that certain KBRA restoration activities will proceed and will enhance the Klamath River Basin regardless of the dam removals.

Most importantly, the potential for the significant adverse impacts of the Proposed Action to preclude, limit or interfere with environmental and water quality improvements that would otherwise occur under the ongoing and unconditional provisions of the KBRA is not analyzed. These errors alone render the EIS/EIR legally insufficient.

b. The California TMDLs and the Oregon TMDLs

Currently, at least eight TMDLs have been fully adopted for Klamath Basin waters by the Oregon Department of Environmental Quality ("ODEQ"), California's North Coast Regional Water Quality Control Board ("NCRWQCB"), and California's State Water Resources Control Board ("SWRCB"),[1] and at least four technical TMDLs have been adopted by EPA. Once any TMDL is fully adopted by a State, the Best Management Practices ("BMPs") and Implementation Measures included in the TMDL, even if only conceptually stated, must, by law, be implemented. 33 U.S.C. §1313(d). Further, ODEQ and the NCRWQCB are obligated to assure the implementation of adopted State TMDLs via a variety of legal mechanisms, including issuance of enforceable Section 402 Clean Water Act permits and conditions, issuance of State law waste discharge requirements or conditional waivers of waste discharge requirements, adoption of Basin Plan amendments, adoption of non-point source management plan/Basin Plan requirements, and/or other similar mechanisms. 33 U.S.C. §1313(d). Further, implementation of fully approved State TMDLs, and particularly the BMPs and other Implementation Measures specified in those TMDLs, must, pursuant to the requirements of the Clean Water Act, attain the water quality standards for each TMDL pollutant. Accordingly, the adopted Oregon TMDLs and California TMDLs, including all TMDL BMPs and Implementation Measures (even if only

[1] While the EIS/EIR does not provide a clear explanation of the status of adoption of each TMDL or set of TMDLs, it appears that U.S. Environmental Protection Agency ("EPA") approval is still pending for only one set of State adopted TMDLs, the Oregon Upper Klamath Lake Drainage TMDLs, and Section 3.2.2.4 of the EIS/EIR indicates that EPA approval of those temperature, dissolved oxygen and pH TMDLs is expected.

conceptually described), must by law be implemented to attain water quality standards in the Klamath River Basin for dissolved oxygen/organic enrichment, nutrients, temperature, pH, ammonia, microcystin/chlorophyll-a, and sediment.[2] 33 U.S.C. §1313(d).

Because State TMDL requirements create legally enforceable plans or programs for attaining water quality standards over time, the implementation of the California and Oregon TMDLs and the attainment of water quality standards for dissolved oxygen/organic enrichment, nutrients, temperature, pH, ammonia, microcystin/chlorophyll-a, and sediment (collectively, the "Pollutants of Concern") must be reasonably expected to occur in the foreseeable future even if the Proposed Action is not approved. Consequently, the impacts analysis of the EIS/EIR must make it clear that under the No Action Alternative and any of the other Alternatives, including Alternative 4, water quality standards for those Pollutants of Concern will be attained. 40 C.F.R. §§1502.16 and 1508.7; CEQA Guidelines §§15126.6(e)(2), 15126.4(a)(2), and 15130(c).

In addition, because the EIS/EIR will result in significant adverse water quality impacts with respect to at least some, and arguably with respect to the majority of the Pollutants of Concern, the EIS/EIR by law must, but fails to, assess whether the Proposed Action will actually significantly adversely impact or inhibit attainment of water quality standards under the No

[2] It should be noted that evidence shows the Klamath River water quality standards underlying the recently adopted Klamath River TMDL (NCRWQCB Resolution Nos. R1-2010-0025 and R1-2010-0026 adopted March 24 2010; SWRCB Resolution No. 2010-0043 adopted September 7, 2010) and the Klamath River TMDL targets adopted for temperature, nutrients, dissolved oxygen, and microcystin are flawed. Contrary to the best available scientific data, and due to the errors and omissions in the technical analysis supporting the Klamath River TMDL, NCRWQCB and SWRCB ("Water Boards") relied on water quality standards and TMDL targets for the TMDL constituents that are unrealistically low, because, for example, the Water Boards (a) failed to distinguish natural background sources of the TMDL constituents, as opposed to point source discharges and anthropogenic sources, (b) improperly overestimated and attributed natural background sources of TMDL constituents to point source discharges and anthropogenic sources, such as power generation and fish hatchery operations within the Hydroelectric Reach, and (c) relied on incorrect assumptions and conclusions regarding water quality that is reasonably achievable in surface waters upstream of the Hydroelectric Reach, and particularly in Upper Klamath Lake. Despite these flaws, the State has determined that the implementation of this TMDL and the other California TMDLs will attain water quality standards for the constituents of concern by the end of the TMDL implementation period.

Action Alternative pursuant to the Oregon TMDLs and the California TMDLs. 40 C.F.R. §§1502.16 and 1508.7; CEQA Guidelines §§15126.6(e)(3)(B) and (C). Because the impacts analysis of the EIS/EIR, including the impacts analyses for the Proposed Action, the No Action Alternative, and Alternative 4, fail to account for water quality improvements and the attainment of water quality standards that legally must occur pursuant to adopted TMDLs, the environmental benefits of the Proposed Action are overstated in the EIS/EIR. At the same time, the adverse environmental impacts of the Alternatives allowing the Klamath facilities to continue to operate, including the impacts of the No Action Alternative and Alternative 4, are overstated. Most importantly, the potential for the significant adverse environmental impacts of the Proposed Action to preclude, limit or interfere with environmental and water quality improvements that would otherwise occur under the fully approved State TMDLs is not analyzed, providing an inadequate basis for any decision maker to determine whether the Proposed Action should be pursued.

2. Other Restoration and Water Quality Improvement Measures

The preceding comments regarding the treatment of legally binding TMDL requirements apply with equal force to all of the habitat restoration and water quality improvement measures set forth in the following legally binding and enforceable documents: (a) the PacifiCorp Habitat Conservation Plan; (b) the National Marine Fisheries Service 2010 Biological Opinion; (c) the CDFG Code Section 5927 in-stream flow mandate for tributaries to the mainstem Klamath River; and (d) the mitigation and monitoring plan for the 2007 FERC EIS (collectively, the "Regulatory Restoration Measures"). The implementation of the Regulatory Restoration Measures can be reasonably expected in the foreseeable future, and all those measures and the anticipated resulting improvements in environmental and water quality must be incorporated into the description of the No Action Alternative, which must reflect actual conditions as well as

conditions that are reasonably expected to occur in the foreseeable future if the Proposed Action were not approved. 40 C.F.R. §§1502.16 and 1508.7; CEQA Guidelines §§15126.6(e)(2), 15126.4(a)(2), and 15130(c). In addition, analysis of all other Alternatives that do not preclude the implementation of the Regulatory Restoration Measures, including Alternative 4, must assume that those measures will be implemented regardless of the Proposed Action. Further, because the EIS/EIR will result in significant adverse impacts with respect to at least some, and arguably with respect to the majority, of water quality and aquatic environment parameters, the EIS/EIR by law must, but fails to, assess whether the Proposed Action will actually significantly adversely impact or inhibit environmental and water quality improvements that would otherwise be achieved under the No Action Alternative pursuant to the implementation of all ongoing and unconditional Regulatory Restoration Measures.

Because the impacts analysis of the EIS/EIR, including the impacts analysis for the Proposed Action, the No Action Alternative, and Alternative 4, fail to account for water quality improvements and environmental benefits that legally must occur pursuant the Regulatory Restoration Measures, the environmental benefits of the Proposed Action are overstated in the EIS/EIR. At the same time, the adverse environmental impacts of the Alternatives allowing the Klamath facilities to continue to operate, including the impacts of the No Action Alternative and Alternative 4, are overstated. Most importantly, the potential for the significant adverse environmental impacts of the Proposed Action to preclude, limit or interfere with environmental and water quality improvements that would otherwise occur under the Regulatory Restoration Measures is not analyzed. Again, this failure by itself, makes the EIS/EIR legally insufficient, providing an inadequate basis for a decision maker to determine whether the Proposed Action should be pursued.

3. The Data Quality Act

It is also important to understand that the EIS/EIR fails to comply with the Data Quality Act. P.L. 106-554, §515. This Act requires federal agencies to establish policies and procedures that ensure the quality, objectivity, and integrity of information distributed and used by the agencies. Office of Management and Budget Circular A-130, which implements the Data Quality Act, forbids agencies from distributing substantive information that "does not meet a basic level of quality." OMB's Circular defines this basic level as requiring that information be accurate and the reasoning behind, and support for, analytic conclusions be clear. As discussed below, the EIS/EIR all too often contains inaccurate and incomplete information. All too often, the EIS/EIR makes analytic conclusions for which the facts and reasoning are not only unclear but non-existent. The EIS/EIR does not comply with the Data Quality Act.

C. Aquatic Resources

"The need for the Proposed Action is to advance restoration of the salmonid fisheries in the Klamath Basin...." EIS/EIR at 1-29. This is the sole basis advanced to justify the Proposed Action. In a remarkable failure of NEPA and CEQA compliance, the EIS/EIR does not analyze many of the critical issues relevant to restoring salmonid fisheries. What analysis does exist demonstrates the Proposed Action will not meet the objective of restoring salmonid fisheries. The purported justification and major objective for the Proposed Action simply does not exist.

1. Coho Salmon

The Southern Oregon/Northern California Coast coho salmon evolutionary significant unit has been designated a threatened species under the federal Endangered Species Act ("ESA"). 62 Fed. Reg. 24,588 (May 6, 1997). Critical habitat was identified in 1999. 64 Fed. Reg. 24,049 (May 5, 1999). The EIS/EIR states the Proposed Action, if combined with the

KBRA restoration actions, is "expected to advance the recovery of federally listed coho salmon." EIS/EIR, Summary of Key Conclusions.

To support this claim, the EIS/EIR relies on the findings of the Coho Salmon and Steelhead Expert Panel established by DOI to evaluate the Proposed Action, including the KBRA. According to the EIS/EIR, the Expert Panel concluded the Proposed Action "would result in a modest increase in the coho salmon population compared with existing conditions." EIS/EIR at 3.3-106. That is not what the Expert Panel said.

What the Expert Panel did conclude was that the "difference between the Proposed Action and Current Conditions is expected to be small." Klamath River Expert Panel, Final Report, Scientific Assessment of Two Dam Removal Alternatives on Coho Salmon and Steelhead, April 25, 2011 ("Coho and Steelhead Expert Panel Report") at ii. This is "especially" true for the ten years following dam removal. *Id.* Thereafter, "moderate" responses by coho salmon "are possible." *Id.* But this possibility might happen only "if the KBRA is fully and effectively implemented...", *id.*, a result about which the Expert Panel had considerable doubt, and, as noted above, a result that is not inextricably tied to or conditioned upon implementation of the Proposed Action. In fact, the Expert Panel found that even with the KBRA, there is such a "high uncertainty" about the many and various actions necessary to truly make a difference for coho salmon that there is a "low likelihood" of even moderate responses by coho salmon to the Proposed Action. *Id.*[3] The actual statements of the Expert Panel stand in stark contrast to the

[3] In addition to questions about the feasibility and effectiveness of the KBRA raised by the Expert Panel, the EIS/EIR identifies 13 activities that are responsible for the decline of coho salmon. Among those 13, and unrelated to the Proposed Action, are habitat degradation caused by logging, road building, grazing, mining, urbanization, wetland loss, beaver trapping, water withdrawals, and unscreened irrigation diversions. EIS/EIR at 3.3-20. None of those actions is addressed by the Proposed Action. They are only addressed by the KBRA, and, to the extent that KBRA measures are capable of implementation, many of them are ongoing or unconditional obligations that will be implemented regardless of the removal of the Klamath facilities.

characterization in the EIS/EIR that the Expert Panel agreed the Proposed Action "would result" in a "modest increase" in coho salmon populations. Instead, the Expert Panel's conclusions indicate that the Proposed Action may well inhibit any benefit that might result from implementation of the KBRA.

Further undermining the conclusion in the EIS/EIR that the Proposed Action "would result" in positive benefits are the Expert Panel's finding that so much scientific information for an appropriate analysis is missing that there needs to be "further scientific investigation [including] necessary and feasible data collection, analyses, and modeling...." Coho and Steelhead Expert Panel Report at i. The Panel noted its report is no "substitute for scientific analysis of solid data," *id.*, and that further analysis needs to be done before any conclusions can be made about the effect of the Proposed Action on coho salmon. In other words, DOI lacks the information necessary to reach any real conclusions about the merits of the Proposed Action regarding coho salmon, but what is known indicates the benefits of the Proposed Action will be "small."

Reading beyond the unsubstantiated claims in the EIS/EIR, one finds the admission that the most likely scenario under the Proposed Action for coho salmon downstream of Iron Gate Dam is that coho salmon from the Upper Klamath River Population Unit that spawn in the Klamath River and their progeny will suffer "up to 100% mortality" in the dam removal phase due to the effects of released sediment. EIS/EIR at 3.3-107. There are nine coho salmon population units in the Klamath River watershed. *Id.* Thus, during dam removal, the Proposed Action will destroy the entire population within the mainstem Klamath River of one of nine (11%) population units of the threatened coho salmon. *Id.* at 3.3-110. Overall for the entire coho population, the EIS/EIR states the direct mortality could be as high as 18% of smelts in

various population units. *Id.* at 4-77. The EIS/EIR cannot so lightly dismiss such adverse impacts on an ESA protected species.

Indeed, the EIS/EIR admits that if just one year class of coho salmon is eliminated by the Proposed Action, it "could result in a jeopardy decision" under the ESA. *Id.* at 3.3-53. A jeopardy opinion means the action being considered is likely to jeopardize the continued existence of the ESA-listed species. 16 U.S.C. §1536(a)(2). In plain English, the EIS/EIR admits that the sediment impacts of the Proposed Action could, by themselves, jeopardize the continued existence of coho salmon. This admission belies other statements in the EIS/EIR that there is no question but that the Proposed Action will advance the recovery of coho salmon. This admission is also important because, as discussed next, the EIS/EIR has dramatically understated the amount of sediment that will be released into the environment. In fact, if one considers how all of the dam removal issues will affect coho salmon, the conclusions about the impact of the Proposed Action are even more distressing. There is a real possibility that the Proposed Action will jeopardize the continued existence of coho salmon.

Further, the EIS/EIR must, but fails to, evaluate whether such substantial adverse impacts to coho salmon caused by dam removal could preclude the fisheries restoration and other environmental benefits anticipated to result from the expected implementation of the ongoing and unconditional KBRA measures, the Oregon TMDLs, the California TMDLs, and the Regulatory Restoration Measures (collectively the "Foreseeable Restoration Measures"), all of which have been analyzed and determined to benefit the environment.

a. Sediment Discharges

The EIS/EIR dismisses the effects of sediment discharges from dam removal by claiming the impacts will be "short term," ending "within one year." EIS/EIR at 3.3-110. However, the Expert Panel contradicts the EIS/EIR noting the impacts of high sediment concentrations will

persist not for one year but for "the first two years," and that the overall impacts of sediment releases will not be reversed for "decades." Coho and Steelhead Expert Panel Report at 19 and 28. This conclusive finding of the Expert Panel is certainly not acknowledged in the water quality section (or any other section) of the EIS/EIR.

The expert panel established by DOI to assess the impacts of the Proposed Action on lamprey also disagreed with the EIS/EIR that high sediment concentrations will be short-lived. The Lamprey Expert Panel concluded there will be "chronically high suspended sediment concentrations" for at least "the first year or two." Klamath River Expert Panel, Final Report, Scientific Assessment of Two Dam Removal Alternatives on Lamprey, January 14, 2010 ("Lamprey Expert Panel Report") at 27. The Lamprey Expert Panel went on to say it is "reasonable to expect that this fine-grained sediment will be remobilized over a period ranging from years to decades." *Id.* at 33.

The significance of this decades-long impact is that the EIS/EIR admits salmonids need spawning areas that are "relatively free" of sediment. EIS/EIR at 3.3-5. Thus, a critical question is whether the amount of sediment released from dam removal will so foul spawning areas that they are not relatively free of sediment. On this point, the EIS/EIR contains no comparative analysis of the actual sediment loads in those decades versus the amount of sediment that tips the balance so that the coho's spawning areas are no longer "relatively free" of sediment. Without this analysis, the impact of sediment releases on coho salmon, and all species, cannot be known – and the EIS/EIR cannot be said to have taken a "hard look" at the effects of the Proposed Action. However, the EIS/EIR does note that the sediment loading downstream of the four dams "would be less than 2 feet." EIS/EIR at 3.11-22 [citation omitted]. A two-foot deposition of sediment does not sound as if it leaves spawning beds "relatively free" of sediment.

It is also significant that the Expert Panel's analysis of the effects of released sediment on coho salmon was predicated on the assumption, based on numbers provided by DOI, that 200,000-300,000 tons of sand will be flushed downstream of Iron Gate Dam. Coho and Steelhead Expert Panel Report at 26. However, the Chinook Salmon Expert Panel concluded, again based on DOI data, that sediment releases would be 300,000-400,000 tons, an amount over 30% greater than considered by the Coho Expert Panel when evaluating the impacts of dam removal. Klamath River Expert Panel, Final Report, Scientific Assessment of Two Dam Removal Alternatives on Chinook Salmon, June 13, 2011 ("Chinook Expert Panel Report") at 21. If the Chinook Expert Panel is correct, the adverse impact of sediment release on the threatened coho salmon and on Klamath River beneficial uses are seriously underestimated even by the Coho Expert Panel and most certainly by the EIS/EIR. But, as discussed next, this error pales in comparison to the reality.

The adverse effects of sediment discharges from dam removal on coho salmon and all fish have been grievously underestimated by the EIS/EIR. Using numbers tucked away in other sections of the EIS/EIR, numbers omitted from the aquatic resources impact section, one finds that the basis upon which the ES/EIR and the Expert Panels assessed the impact of sediment release on aquatic resources was so fundamentally flawed that their conclusions about sediment impacts are wrong by orders of magnitude.

Recall that the Coho and Steelhead Expert Panel Report and the Chinook Expert Panel used first year sediment release numbers of 200,000-400,000 tons based on the data DOI gave the Panels. However, the EIS/EIR admits there are 13.15 million cubic yards of sediment behind the dams. EIS/EIR at 3.3-31. Using the numbers tucked away elsewhere in the EIS/EIR reveals that 8,430,000 cubic yards, or 3,540,600 tons, of sediment could be released in the first year after

dam removal.[4] To put this number into context, the EIS/EIR also admits that the average annual sediment load in the Klamath River is 5,834,091 tons. *Id.* at 3.11-10, Table 3.11-1.

In other words, the assessment by the Expert Panels of the impacts of sediment release (200,000-400,000 tons) is based on estimated sediment releases that are only a small fraction of the actual amount of sediment that could be released. Even more shocking is the statement in the EIS/EIR that the amount of sediment that will be released from dam removal is "relatively small compared to the sediment loading from other existing sources...." *Id.* at 3.6-26. *See also id.* at *See also id.* at 3.2-97, 3.11-22, 4-140. If the annual amount of sediment produced from existing sources is 5,834,091 tons and dam removal will produce up to 3,540,000 tons in the first year, the amount of the release is not "relatively small" compared to the normal sediment load.

To put this release in context, consider the likely result if a regulated party were to apply for a permit to release 3.540 million tons of sediment in a year. And remember that there is still more sediment behind the dams to be discharged after the first year of release. If such a permit application were to be submitted, it would almost assuredly be summarily denied based on the

[4] The EIS/EIR states that first year sediment releases could be up to 65% of the sediment behind J.C. Boyle dam, up to 81% of the sediment behind Copco 1 Dam and up to 38% of that behind Iron Gate Dam. EIS/EIR at 3.6-26. According to the EIS/EIR, the amount of sediment behind each dam is as follows: J.C. Boyle Dam-1,000,000 cubic yards; Copco 1 Dam-7,400,000 cubic yards; Copco 2 Dam-0 cubic yards; and Iron Gate Dam-4,700,000 cubic yards. *Id.* at 3.11-18, Table 3.11-3. Applying the above percentages produces the following first year release numbers in cubic yards: J.C. Boyle Dam-650,000 cubic yards (1,000,000 x 65%); Copco 1 Dam-5,994,000 cubic yards (7,400,000 x 81%); and Iron Gate Dam-1,786,000 cubic yards (4,700,000 x 38%) for a total of 8,430,000 cubic yards. Applying the conversion rate derived from the EIS/EIR of 0.42 tons per cubic yard reveals that up to 3,540,000 tons of sediment (8,430,000 x 0.42) could be released into the river in the first year of dam removal. The 0.42 tons per cubic yard conversion rate is derived from Table 3.11-2. EIS/EIR at 3.11-11. That table shows that the percent of clay in the dam reservoirs is 51.7% of the total deposits. Silt is 34.3% for a total silt and clay volume of 86%. The remaining 14% is sand. According to the April 2011 DOI Report titled Hydrology, Hydraulics and Sediment Transport Studies for the Secretarial Determination on Klamath River Dam Removal and Basin Restoration, the unit weight for silt and clay (*i.e.,* cohesive sediments) is 20 pounds per cubic foot and for sand and gravel (*i.e.,* non-cohesive sediments) 100 pounds per cubic foot. Therefore, (86% x 20 pounds per cubic foot) + (14% x 100 pounds per cubic foot) = 31.2 pounds per cubic foot. Converting 31.2 pounds per cubic foot to tons is by the following formula: (31.2 pounds/cubic foot) x (1 ton/2000 pounds) x (27 cubic feet/one cubic yard) = 0.42 tons/cubic yard.

potential for significant adverse affects on sensitive and ESA listed fish and wildlife, water quality, and beneficial uses. Incredibly, the EIS/EIR determines that such impacts are either less than significant or are potentially significant in the short term but do not require mitigation. *Id.* at 3.2-93.

The facts are that the assessment of sediment impacts associated with the Proposed Action in the EIS/EIR and in the Expert Panel Reports are based on clearly erroneous assumptions. The EIS/EIR, which relied on these assumptions and on conclusions of the Expert Panels to assess sediment impacts, is fatally flawed. To claim the EIS/EIR meets even the minimum standards of adequate analysis under NEPA or CEQA is ludicrous. Not only is there no analysis of the real first year impacts of dam removal, but recall that the Expert Panels stated that the impacts of only 200,000-400,000 tons of released sediment would last for decades. Nowhere does the EIS/EIR examine the long-term effects on species, water quality, or beneficial uses of releasing millions of tons of sediment into the Klamath River.

In addition, the EIS/EIR impermissibly dismisses the adverse short term impacts on species, aquatic resources and water quality by inaccurately stating that the sediment released is only a small fraction of typical sediment loads in the Klamath River, estuary and near shore environment. Not only is that factually incorrect, it is also legally improper to conclude that a project's environmental impacts, particularly those impacts associated with the release of pollutants, are insignificant based solely on the fact that the project contributes only a relatively small amount to an already existing pollution condition. Accordingly, even if it were accurate to characterize sediment releases associated with dam removal as relatively small as compared to existing sediment loads, such an analysis is not a permissible basis for concluding that sediment

impacts are less than significant, particularly when several surface water reaches within the Klamath basin that will be impacted by the sediment releases are already impaired for sediment.

In a vain attempt to argue the KBRA has mitigated for the effects of the increased fouling of spawning beds by sediment, the EIS/EIR points to the KBRA's gravel augmentation plan. However, the Coho and Steelhead Expert Panel Report dismissed the gravel augmentation plan in the KBRA as insufficient, as representing only a "small amount" relative to the overall area affected. Coho and Steelhead Expert Panel Report at 29. And recall that the Panel's assessment of the inadequacy of this mitigation measure was based on the assumption that only 200,000-400,000 tons of sediment would be released in the first year after dam removal, a number somewhat less than the actual 3,540,000 tons. Furthermore, the gravel mitigation measure is a measure likely to be implemented in certain bypasses and river reaches under the KBRA and as a part of other Foreseeable Restoration Measures even if the Proposed Action is rejected.

Finally, contrary to the requirements of NEPA and CEQA, the EIS/EIR fails to analyze or provide any conclusions or information regarding the potential adverse impacts of the Proposed Action on the habitat and water quality improvements that would otherwise be achieved by the implementation of the Foreseeable Restoration Measures. As a result of the completely inadequate analysis of adverse impacts of sediment associated with the Proposed Action, the EIS/EIR does not comply with CEQA and NEPA requirements for impacts analysis, has not assessed or prescribed sufficient mitigation measures for the Proposed Action, and does not have a sufficient basis for making an informed decision regarding implementation of the Proposed Action.

b. Water Temperature

Salmon experience "acute thermal effect" when "mean daily water temperatures begin to exceed 20° C." EIS/EIR at 3.3-33 (citations omitted). Will the Proposed Action improve this

important parameter for coho salmon? The Expert Panel concludes "the net effects ... is [sic] not known...." Coho and Steelhead Expert Panel Report at 30. To evaluate the temperature effect "will require more detailed information..." than is presently available. *Id.* at 32. In other words, there is not enough information to know whether dam removal will make any difference.

Moreover, the Expert Panel found that the important issue for salmon is not the average daily mean temperature, which is the exclusive focus of the EIS/EIR analysis. The Expert Panel points out that fish do not experience average mean daily temperatures. Fish experience hour-by-hour temperatures. It is those temperatures, not mean daily averages, that are key. The Expert Panel then states that while dam removal may lower the average daily mean temperature, the "highest temperatures experienced by the fish ... will increase." *Id.* at 31-32. The EIS/EIR recognizes that temperatures will increase in certain reaches of the Klamath River as a result of the Proposed Action (*see e.g.*, EIS/EIR at 3.2-77, 3.2-79, and 3.2-83), but completely fails to assess the increased temperature variability associated with the Proposed Action, and fails to examine the fish population impact of these increased temperatures caused by dam removal, relying instead on generalized averages that ignore and mask the actual temperature effects of the Proposed Action. Due to the completely inadequate analysis of adverse impacts of temperature changes associated with the Proposed Action, the EIS/EIR has not complied with CEQA and NEPA requirements for impacts analysis, has not assessed or prescribed sufficient mitigation measures for the Proposed Action, and does not have a sufficient basis for making an informed decision regarding implementation of the Proposed Action.

c. Nutrients

The principal water quality problems in the Klamath River basin are high nutrient loads that cause low dissolved oxygen and algae blooms. *Id.* Significantly, the EIS/EIR found that "under the Proposed Action total nutrient concentrations in the Klamath River downstream of

Iron Gate Dam would increase." EIS/EIR at 3.2-101. In fact, the EIS/EIR admits that all of the various models "recognize ... that under the Proposed Action total nutrient concentrations in the Klamath River downstream of Iron Gate Dam would increase." *Id.*

These high nutrient concentrations not only affect dissolved oxygen levels, but they cause increased algae growth. In that regard, the EIS/EIR admits there will be "long-term increases" in harmful river algae that will have a "significant impact." *Id.* at 3.4-15. *See also id.* at 5-100 ("the Proposed Action ... would result in increases in nutrient inputs ... that could increase [algae] biomass; ... this impact would be significant and unavoidable."). In other words, the Proposed Action will not solve the principal water quality problem of nutrient loading that inhibits increased salmon populations. Instead, the Proposed Action will make the problem worse, and will adversely impact, to the point of potentially precluding, the success of the Foreseeable Restoration Measures focused on reducing nutrients.

As to the mitigation plan in the KBRA, the Expert Panel concluded that "drastic reductions in loading from the watershed must accompany local amelioration to be effective." Coho and Steelhead Expert Panel Report at 33. Given that, "it would be premature" to conclude that any nutrient loading problems "will be substantially reduced by KBRA." *Id.* at 33-34.

d. New Spawning Habitat

A critical basis for the EIS/EIR's conclusion that the Proposed Action will help coho salmon is the view that the Proposed Action will open up 45 miles in the mainstem Klamath River and its tributaries and 23 miles of currently inundated reservoirs. EIS/EIR, Summary of Key Conclusions. Reacting to this view, the Expert Panel noted that the existence of both positive and negative effects of the Proposed Action downstream of Iron Gate Dam "prevent[s] the Panel from determining the net beneficial effects" of opening up new spawning habitat. Coho and Steelhead Expert Panel Report at 34. In fact, the Expert Panel concluded "it is

impossible to establish the effects of [the Proposed Action] ... with the information available." *Id.* at 38.

Regarding habitat access above Iron Gate Dam, the Expert Panel concluded the Proposed Action "will allow for a small increase in coho ... but information is currently insufficient for providing quantitative estimates." *Id.* at 40. However, the Expert Panel did note that the "potentially lower flows during the fall" caused by dam removal "may reduce the ability of coho to migrate through the mainstem in order to reach spawning areas in tributaries...." *Id.* at 35.

While DOI and the EIS/EIR trumpet the benefit of a free flowing river and the related access to new habitat, the experts appointed by DOI to assess this argument found the available information insufficient to support any conclusions about the effects on coho spawning of increasing access to habitat. But there is one aspect of increased habitat that has very serious implications for coho salmon – and this issue, like so many others, is ignored in the EIS/EIR.

The EIS/EIR forecasts a significant increase in the redband trout population due to dam removal. EIS/EIR at 3.3-127. Redband trout are a major predator of juvenile salmon. Because of that, the Chinook salmon Expert Panel found that predation from increased redband trout population could have the effect of "reducing or cancelling" the benefits to salmon that the EIS/EIR claims will result from increasing salmon access to habitat. Chinook Expert Panel Report at 17. In a major failing, the EIS/EIR ignores the impact of increased redband trout predation on any potential increase in salmon populations, notwithstanding the fact that DOI's expert panel concluded such predation could cancel the alleged benefits of dam removal for salmon. And recall that the sole justification for the Proposed Action is to benefit salmon.

e. Thermal Refugia

For many issues affecting coho salmon spawning success and survival, the Coho and Steelhead Expert Panel found we simply do not have enough information to reach any

conclusion as to whether the Proposed Action will benefit salmon. Regarding the effects of providing thermal refugia on the productivity, capacity, and habitat connectivity for coho, the Expert Panel found the Proposed Action "will likely" increase the availability of thermal refugia but the extent to which that will benefit the productivity of coho salmon "is not known." Coho and Steelhead Expert Panel Report at 43.

f. Ecosystem Function

As to improving natural ecosystem functions, the Expert Panel found there "is insufficient information available" to answer how the Proposed Action compares to the status quo. *Id.* at 51.

g. Disease

Regarding how the Proposed Action differs from the status quo with respect to the incidence and impact of disease, the Expert Panel concluded "[t]he information available is insufficient to determine the net overall effects of the Proposed Action." *Id.* at 51. However, the Expert Panel notes that a "possible consequence" of dam removal will be to spread fish borne disease upstream of the removed dams which now act as a barrier. *Id.* at 53-54. Not only may the geographic range of the disease expand, but, as discussed in Parts II.C.2.b and II.C, the EIS/EIR admits the Proposed Action will make the disease problem worse by increasing the habitat for disease carrying worms.

h. Food Availability

The Expert Panel notes the potential for coho to gain access to additional habitat means increased competition for food in those habitats. However, according to the Expert Panel, "the food aspects of ecosystem function ... have not been rigorously analyzed to date." *Id.* at 51. In other words, the EIS/EIR has failed to consider a critical environmental issue, interspecies interactions. As noted above regarding redband trout predation, these interspecies interactions,

ignored in the EIS/EIR, have the potential to negate the benefits the EIS/EIR asserts will flow from dam removal.

i. Conclusion

The EIS/EIR fails to meet even the minimum standards for acceptable NEPA or CEQA analysis. At the outset, reliance on the Coho and Steelhead Expert Panel Report is misplaced because the EIS/EIR mischaracterizes the Expert Panel's conclusions. While the EIS/EIR claims the Expert Panel validates the conclusion that dam removal "would result" in a modest increase in coho populations, the Expert Panel actually said there is a "low likelihood" of any such increases. Coho and Steelhead Expert Panel Report at ii. In fact, the Panel said the difference between the status quo and the Proposed Action "is expected to be small...." *Id.*

Equally important, the Expert Panel repeatedly affirms that so much information is missing, information essential for proper analysis, that no meaningful conclusions can be made about the alleged benefits of dam removal. In a biting criticism, the Panel notes that its "statements are no substitute for further scientific investigation" and cautions that "its statements not be used in lieu of doing the necessary and feasible data collection, analyses, and modeling...." *Id.* at i. Indeed, the Expert Panel concludes that what is needed is "scientific analysis of solid data." *Id.* at iii. The inescapable conclusion is that the EIS/EIR, based on the same information as was before the Expert Panel, is so devoid of the necessary facts and analysis that reliance on the EIS/EIR as an adequate environmental analysis is arbitrary and capricious.

It is also important to step back and to look at the larger picture. The facts are that the Expert Panel convened by DOI to examine the impact of the Proposed Action on coho salmon rejected the fundamental premise advanced to support the Proposed Action. The EIS/EIR states the need for dam removal is to restore salmonid fisheries. With respect to coho salmon, the

Expert Panel concluded the Proposed Action will not even adequately protect the resource, let alone the fisheries.

Any reliance on the Expert Panel to justify the Proposed Action is misplaced for another significant reason. Although the EIS/EIR identifies five alternatives, the Expert Panel was told to ignore three. One need look no farther than the title of the Expert Panel Report: "Scientific Assessment of Two Dam Removal Alternatives on Coho Salmon and Steelhead." The Report states unequivocally that the Panel was asked to evaluate only "two alternative scenarios," the status quo and dam removal. *Id.* at 1. Other alternatives, such as Alternative 4, were cast aside. Yet, the EIS/EIR relies on the Expert Panel as validating DOI's view that the Preferred Alternative of dam removal is superior to all other alternatives as to coho salmon. That reliance is misplaced because the Expert Panel examined only two of the five alternatives.

2. Chinook Salmon

Chinook salmon is the second salmon species whose restoration is used to justify the Proposed Action. The EIS/EIR concludes that dam removal, combined with actions to be taken under the KBRA, will increase median annual production of adult Chinook salmon by 81.4%. EIS/EIR, Summary of Key Conclusions. To support this claim, the EIS/EIR turns to the Expert Panel appointed by DOI to evaluate the impact of the Proposed Action on Chinook salmon. The EIS/EIR characterizes the Expert Panel as finding that the Proposed Action will be a "major" step forward that will provide a "substantial increase in the abundance of naturally spawned Klamath River Chinook salmon...." EIS/EIR at 3.3-94.

As was the case with the Coho Salmon Expert Panel, the EIS/EIR misstates what the Chinook Expert Panel said. Regarding the alleged "substantial" increase in Chinook salmon, the Expert Panel defined the term "substantial" somewhat differently than what is represented in the EIS/EIR. What the Panel actually said is "[t]he term 'substantial' should be understood here to

mean a number of fish that contributes more than a trivial amount to the population." Chinook Salmon Expert Panel Report at 7, n.3. The Panel then said they expected a possible total increase of just 10% in the average number of natural spawners. *Id.* This is several orders of magnitude below the 81.4% increase claimed in the EIS/EIR. Equally important, the Expert Panel stated that the possibility of gains actually equaling 10%, an amount 72% less than that claimed in the EIS/EIR, is itself questionable. The Expert Panel states it is not suggesting that a 10% number "is a likely increase or a minimum increase that is expected." *Id.* That is because "the nature of the uncertainties precludes attaching a probability" to any prediction. *Id.* at 7.

Not only does the Expert Panel not say what the EIS/EIR claims it says, but the Expert Panel disputes the conclusions in the EIS/EIR about the percentage increase in Chinook salmon populations. That the Expert Panel rejects DOI's position about the benefits of the Proposed Action for Chinook salmon is made abundantly clear by examining what the Expert Panel actually said as to the impact of dam removal on nine factors the Expert Panel said must be addressed if there are to be gains in Chinook salmon numbers. An analysis of the actual effects of dam removal on each of those factors shows just how tenuous, and incorrect, are the claims in the EIS/EIR.

a. Water Quality

The first of the nine factors is water quality. Here, the Expert Panel notes that any benefit of the Proposed Action in reducing nutrient loads and thermal inputs could occur only "if" the KBRA provides otherwise unavailable funding for the implementation of Total Maximum Daily Loads ("TMDL"). Chinook Expert Panel Report at 9. Given today's federal budget climate, that is a major, and perhaps insurmountable, "if." Moreover, the Expert Panel found that "the major Proposed Actions" in the KBRA for addressing water quality "are unlikely to provide substantial improvements in water quality...." *Id.* Why is it "unlikely"? Because "the magnitude of the

proposed solutions may not match the scope and extent of the water quality problem." *Id.* at 10. For example, the principal KBRA proposed actions to reduce nutrient loads, wetland rehabilitation and riparian vegetation to capture nutrients, would require the creation of 18,000 hectares (44,479 acres) of wetlands, 78% of the area of the Upper Klamath Lake or about 40% of the entire area of irrigated agriculture in the Upper Klamath Lake basin. The Expert Panel concludes this as simply not feasible. *Id.* at 11. This conclusion finds significant support in the EIS/EIR which admits that dam removal, when coupled with the planned restoration efforts, will result in a gain of only "approximately 184 acres" of riparian habitat. EIS/EIR at 3.3-56.

Not only is the proposed mitigation likely to be ineffectual but, as noted above in Parts II.C.1.c and II.G.2, the EIS/EIR admits that dam removal will actually increase harmful nutrient loads, making the water quality problem worse, not better.

The Expert Panel found that after controlling nutrient loads, the next major water quality issue is high water temperatures. As to the likelihood of controlling water temperatures through the KBRA's proposed actions, the Expert Panel concluded that it too "seems infeasible." Chinook Expert Panel Report at 11.

In other words, as to water quality, the first critical component for improving Chinook spawning, even "if" the KBRA is 100% funded, the benefits of the Proposed Action are "unlikely" to be large because the actions proposed in the KBRA are not feasible. More importantly, the Proposed Action will make the problem worse. As the EIS/EIR admits: "The Proposed Action ... would result in increases in nutrient loads; ... this impact would be significant and unavoidable." EIS/EIR at 5-100. This finding is somewhat inconsistent with the EIS/EIR statement that the Expert Panel determined the Proposed Action would be a "major" step forward for Chinook salmon abundance.

b. Disease

Disease is the second major factor that must be addressed to increase Chinook numbers. The Expert Panel noted that the "overall success" of the Proposed Action for Chinook salmon hinges "to a large degree" on disease reduction. Chinook Expert Panel Report at 13. As to how the Proposed Action would address this factor, the Panel concluded that "uncertainty about these aspects is very high." *Id.* Uncertainty is high not only because the proponents of dam removal have not done the necessary research to permit true analysis, but also because a reduction in the food supply for disease causing worms "seems like a remote possibility." *Id.* In fact, the population of disease causing worms is likely to increase because the EIS/EIR admits the river algae (periphyton) biomass will increase under the Proposed Action largely due to increases in nutrient loads. *See* Part II.D of these Comments. A significant component of this river algae is the species *Cladophora* which provides important habitat for the worms that are host to fish killing parasites. EIS/EIR at 3.4-5 and 3.4-8. Thus, the net result of the Proposed Action is to increase the habitat for, and the population of, disease carrying worms.

Uncertainty, the absence of necessary research, a remote possibility of progress, and increasing the habitat for disease carrying worms do not sound like statements that comport with the EIS/EIR claim of a "major" step forward under the Proposed Action. In fact, the Expert Panel found that a possible outcome of dam removal is that the disease issue, now made worse, will simply move upstream to other areas where spawning aggregations occur. *Id.* at 13. This concern was echoed by the Coho and Steelhead Expert Panel Report which also reported that dam removal could simply "spread infection upstream of the dams...." Coho and Steelhead Expert Panel Report at 53.

c. Colonization

The Chinook Expert Panel's treatment of the other key factors for improving Chinook spawning numbers is equally critical of the EIS/EIR conclusions. As to the third factor, the actual ability of Chinook salmon to colonize the Upper Klamath Basin, the Expert Panel notes that Chinook salmon migration is influenced by low dissolved oxygen. Chinook Expert Panel Report at 14. Reviewing the Proposed Action, including the KBRA, the Expert Panel concludes it is "uncertain" if the low oxygen problem in the Klamath River can be improved and, "[w]ithout solving the water quality problems, a fully self-sustaining run of fall Chinook salmon to the upper basin is unlikely." *Id.* at 14-15. Recall that the Expert Panel found it "unlikely" the Proposed Action will successfully address the water quality problems and the EIS/EIR admits the Proposed Action will make existing water quality problems worse, and fails to analyze the degree to which it will impede the habitat and water quality improvements that would otherwise result from implementation of the Foreseeable Restoration Measures.

d. Harvest Levels

Regarding the fourth factor, impact of fishery harvests, while the EIS/EIR projects an increase in harvest opportunities, the Expert Panel said "harvest levels may need to be reduced for at least several years" in order to permit the measures in the Proposed Action to take effect. *Id.* at 16. Whether these harvests can ever be increased seems to depend on the success of the Proposed Action in improving water quality ("unlikely," "infeasible"), controlling disease ("a remote possibility"), and re-colonization of the Upper Klamath Basin ("unlikely").

While the EIS/EIR predicts increased harvest levels approximating 50%, the Expert Panel says harvest levels may need to be reduced. Equally important, returning harvest levels to current rates, or expanding them, depends on a series of "unlikely" events and "remote" possibilities.

e. Other Factors

Regarding the fifth factor that must be addressed to increase Chinook numbers, the intermixing of natural and hatchery fish, the Expert Panel notes the proposed closure of Iron Gate Hatchery eight years after dam removal "could" increase the survival rate of naturally spawning Chinook by eliminating interbreeding. *Id.* at 17. However, in a related matter, the impact on commercial and recreational harvest levels of eliminating the hatchery is never analyzed in the EIS/EIR.

The sixth factor that must be addressed to increase Chinook salmon populations is the negative impact on juvenile Chinook caused by redband trout predation. Recall the statement by the Expert Panel that the Proposed Action is projected to increase redband trout populations and that a larger redband trout population means increased predation on juvenile salmon. This is a critical point not only for Chinook salmon but also for coho salmon. In fact, the Chinook Expert Panel concluded increased redband predation could have the effect of "reducing or cancelling the benefits to Chinook salmon due to expansion of habitat." *Id.* at 17. In other words, the claims in the EIS/EIR about the advantages of new salmonid habitat could be moot because of trout predation on salmon. Conspicuously absent from the EIS/EIR is any analysis of the effects of changes in interspecies interactions that will result from the Proposed Action. Instead, the EIS/EIR inappropriately and incorrectly treats each species as an independent silo – ignoring the issue of redband trout predation.

As to the effects of climate change, the seventh factor, the Expert Panel can only point to unknown impacts. *Id.* at 18-19. However, regarding the next factor, the impact of changed river flows, the Expert Panel saw positive and negative impacts, concluding the "net effect ... is unknown." *Id.* at 20. However, as noted in Part II.C.1.b above, the Proposed Action will likely make the problem of high water temperatures worse.

Finally, as to sediment loading, the ninth factor, and a factor discussed in more detail in the coho salmon section above, the Expert Panel noted dam removal will involve the release of "considerable amounts of sand" which may "reduce the quality of some spawning habitat." Further, "it is likely to take more than a decade" for these effects to be reversed and it is possible the fall Chinook run could be "overwhelmed" for some period. *Id.* at 21. The EIS/EIR fails to account for this possibility. And recall that the Expert Panel's analysis was based on estimates of sediment releases that were abysmally low. In fact, the Expert Panel assumed sediment releases that are only any small fraction of the amount that will be released in the first year along. *See* Part II.C.1.a. If the amount of sediment release on which the Expert Panel based its finding that Chinook salmon could be "overwhelmed" for some period of time is only a fraction, 11.3%, of the actual number, then the inescapable conclusion is Chinook salmon will be overwhelmed – and the EIS/EIR fails to consider, let alone analyze, the true impact of sediment release on these salmon.

f. Conclusion

A careful review of the analysis in the Chinook Salmon Expert Panel Report belies the statements in the EIS/EIR that the Proposed Action will be a "major" improvement causing "substantial" gains in Chinook salmon populations. Not only does the Expert Panel say that by "substantial" it means an increase that is "more than a trivial amount," but the Expert Panel estimates the "possible" Chinook salmon population increase to be on the order of 10%, far less than the 81.4% claimed in the EIS/EIR. Equally important, the Expert Panel states that even this number is uncertain because the "uncertainty about the likely outcomes of the Proposed Action is large...." Chinook Expert Panel Report at 21. The uncertainty is large because the Expert Panel's assessment of the effect of the Proposed Action on the nine elements necessary to improve Chinook salmon numbers revealed that the effect of the Proposed Action on these nine

factors is "unknown," "unlikely," and "remote." Further, in some cases such as water quality the Proposed Action makes the problem worse. Equally important, because of the increased predation of redband trout on salmon, it is possible that the alleged advantages of the Proposed Action for salmon will be moot, or even negative. All of this caused the Expert Panel to call the Proposed Action as to Chinook salmon "an experiment." *Id.* at 22. Recalling that the need for the Proposed Action stated in the EIS/EIR is to restore salmonid populations, the Expert Panel established by DOI clearly rejects the premise that the Proposed Action will achieve that objective.

Finally, as was the case with the coho review panel, the Chinook review panel was asked to evaluate only two alternatives, the status quo and dam removal. *Id.* at 4. The other alternatives were never analyzed, a clear violation of the purpose and intent of NEPA and CEQA.

3. Steelhead Trout

The same panel of experts that examined the effects of the Proposed Action on coho salmon examined its effects on steelhead trout. That analysis is contained in the same report covering coho salmon. The conclusions of the Coho and Steelhead Expert Panel regarding coho salmon discussed above apply with equal force regarding steelhead and need not be repeated here. Therefore, this section will focus only on the unique steelhead findings not common to coho salmon.

Recall the Expert Panel concluded that the difference between the Proposed Action and the status quo regarding coho salmon "is expected to be small...." Coho and Steelhead Expert Panel Report at ii. For steelhead, the Expert Panel said it was more optimistic the Proposed Action "could" result in larger numbers. *Id.* However, "could" is far different than "would." The claim in the EIS/EIR that the Expert Panel concluded the Proposed Action "would" result in

increased steelhead numbers is inconsistent with what the Expert Panel actually said. EIS/EIR at 3.3-112.

The EIS/EIR states the steelhead population will increase because "steelhead would be able to access a substantial extent of new habitat...." *Id.* However, the Expert Panel did not characterize any newly available habitat as "substantial." Instead, the experts said dam removal would allow for only "a small extension (likely 10-20 percent) of spawning and rearing" habitat. Coho and Steelhead Expert Panel Report at 18. *See also id.* at 40. As to the actual effect of this new habitat availability on steelhead numbers, the Expert Panel stated the "information is currently insufficient for providing quantitative estimates." *Id.*

Equally important, the Expert Panel said any positive benefits from increased access to habitat depend on whether steelhead "can successfully complete their life cycles." *Id.* at 41. One of the factors inhibiting life cycle completion is predation by other fish. *Id.* at 42. As noted above, predation by an expanding redband trout population is a serious problem ignored in the EIS/EIR. This is a significant failure of analysis in the EIS/EIR because, as the Expert Panels noted, predation arising from interspecies conflicts could cancel the alleged benefits of the Proposed Action. *See* Part II.C.1.d. Further, the Coho and Steelhead Expert Panel found that habitat expansion raises important issues of competition for food and space and these aspects of ecosystem competition "have not been rigorously analyzed to date." Coho and Steelhead Expert Panel Report at 51.

The Expert Panel then found that the short-term effects of sediment release from dam removal would be "especially injurious" to adult steelhead. *Id.* In considering this assessment of the adverse impacts of sediment, recall that this Expert Panel assumed an amount of sediment release that is 30% less than that identified by the Chinook Expert Panel. *Id.* at 18. And recall as

discussed in Part II.C.1.a that both of these estimates of sediment release are off by thousands of percent.

Even with the grossly understated impacts of sediment release on steelhead, the EIS/EIR admits that under the most likely to occur scenario up to 36% mortality is predicted for winter run adult steelhead as a result of dam removal. EIS/EIR at 3.3-113. Moreover, the EIS/EIR predicts that the most likely scenario from dam removal will result in up to 52% mortality for one and two year old juveniles in the mainstem Klamath River. *Id.* Given that the EIS/EIR understates the amount and impact of sediment release, even the worst case scenario where the EIS/EIR predicts 71% mortality for adult steelhead and for one and two year old juveniles, understates the reality. *Id.* at 3.3-118. These numbers do not comport with the alleged beneficial effects of dam removal.

Finally, the Coho and Steelhead Expert Panel confirms that the information relied on in the EIS/EIR is simply too incomplete to be the basis for informed decision making. For example, the Panel concludes that the extent to which thermal refugia will benefit steelhead "is not known." Coho and Steelhead Expert Panel Report at 43. Similarly, improved habitat conditions may occur for steelhead but the "net effects on abundance are unknown." *Id.* at 46.

Once again, the benefits of dam removal claimed to exist in the EIS/EIR are not substantiated by the Expert Panel or even by the EIS/EIR. And once again, the Expert Panel was told to examine the environmental effects of only two of the five alternatives identified in the EIS/EIR.

4. Redband Trout

The EIS/EIR states the Proposed Action will expand the total distribution of redband trout. EIS/EIR, Summary of Key Conclusions. For support, the EIS/EIR turns to yet another expert panel report titled Klamath River Expert Panel, Final Report, Scientific Assessment of

Two Dam Removal Alternatives on Resident Fish, April 10, 2011 ("Resident Fish Expert Panel Report"). The EIS/EIR characterizes this Expert Panel as concluding redband trout abundance "could increase significantly" under the Proposed Action because "the habitat improvements associated with KBRA implementation, including water quality and quantity and riparian corridor improvements and protection, are anticipated to increase trout productivity...." EIS/EIR at 3.3-127.

On this point, recall that the Chinook Expert Panel fully addressed the issues of water quality and riparian corridor improvements. That panel determined the actions proposed in the KBRA to improve water quality are "unlikely to provide substantial improvements in water quality...." Chinook Expert Panel Report at 9. As to riparian corridor improvements, the Chinook Expert Panel found the KBRA plan is not feasible. *Id.* at 11. Also recall, as discussed in Part II.C.1.c of these Comments, the EIS/EIR admits the Proposed Action will make existing water quality problems worse. The bases set forth in the EIS/EIR for concluding the Proposed Action will significantly increase the trout population are without support.

The Resident Fish Expert Panel added its own criticism about assertions of improved habitat for redband trout. This Expert Panel agreed dam removal will increase free-flowing water habitat by 43 miles. Resident Fish Expert Panel Report at 77. However, in considering whether this will make any real difference to redband trout, the Panel found the "quality of this habitat ... has not been carefully evaluated." *Id.* In other words, we simply do not know. Moreover, from what we do know, the quality of these 43 miles is suspect because 22-23 miles are now under reservoirs, four miles have been adversely affected by dewatered flows, and 17 miles have been adversely affected by daily fluctuating flows. *Id.*

In sum, the impact of the Proposed Action on redband trout is not known because the EIS/EIR has not done the required analyses. What we do know says habitat improvements are unlikely and not feasible. The basis upon which the EIS/EIR concludes there will be significant increases in the redband trout population is without foundation. The EIS/EIR provides no reasonable basis to evaluate the effects of the Proposed Action, let alone conclude that the effects will be positive. However, as discussed above, if the EIS/EIR is correct about redband trout population increases, the implications for salmon under the Proposed Action are extraordinarily significant because trout predation of salmon could cancel all of the benefits to salmon alleged to exist because of dam removal.

5. Lost River Sucker and Shortnose Sucker

The Lost River sucker and the shortnose sucker are listed as endangered under the ESA. 53 Fed. Reg. 27,130 (July 18, 1988). They are also listed as endangered under the California Endangered Species Act. These two sucker species are found primarily in lakes upstream of the dam removal sites and the majority of spawning occurs in tributaries above those lakes. Resident Fish Expert Panel Report at 9. Therefore, the EIS/EIR concludes that the difference in habitat value between the status quo and the Proposed Action "would not be substantive." EIS/EIR at 3.3-126. The Resident Species Expert Panel confirms this assessment stating "[d]am removal is not likely to change this species' range and abundance...." Resident Species Expert Panel Report at 66.

6. Green Sturgeon

The southern green sturgeon is classified as threatened under the ESA. 71 Fed. Reg. 52,300 (Oct. 9, 2009). The EIS/EIR concludes southern green sturgeon "are not expected to be affected by the Proposed Action." EIS/EIR at 3.3-123. The northern green sturgeon also "would not be affected by the Proposed Action...." *Id.*

7. Bull Trout

Bull trout are listed as threatened under the ESA. 64 Fed. Reg. 58,910 (April 8, 1999). The best the EIS/EIR can say is that the Proposed Action offers some "promise" for increasing bull trout abundance. EIS/EIR 3.3-129. However, recall that the EIS/EIR claims the Chinook salmon population will experience an 81.4% increase. EIS/EIR, Summary of Key Conclusions. Recall also the EIS/EIR states dam removal will increase steelhead numbers. EIS/EIR at 3.3-112. These are significant statements because the EIS/EIR admits that Chinook salmon and steelhead prey on bull trout fry and juveniles. *Id.* at 4-70. There is no analysis in the EIS/EIR of the effects of this increased predation. If the EIS/EIR is correct as to the population growth of Chinook salmon and steelhead, then the conclusion in the EIS/EIR that dam removal offers some "promise" for the bull trout is not supportable without explanatory analysis – of which there is none.

8. Lamprey

The EIS/EIR states "the Proposed Action could increase Pacific lamprey production by up to 14 percent." *Id.* at 3.3-120, citing the Lamprey Expert Panel Report. What the Expert Panel actually said as to the Upper Klamath was: "Since very little is known about the biology or habitat requirements for the freshwater-resident species in the upper Klamath River Basin, it is difficult to predict whether there would be a significant change in the habitat capacity for these species with dam removal." Lamprey Expert Panel Report at 31.

As to the overall Klamath River system, the Expert Panel states the habitat capacity for Pacific lamprey is predicted to increase 14%. *Id.* at 32. The EIS/EIR then assumes a 14% increase in habitat capacity automatically translates to a 14% increase in numbers, an assumption that is suspect because, as noted above, the quality of that habitat has not been evaluated. Indeed, the Expert Panel found that the extent to which lamprey can use any increased habitat

depends on whether lamprey can actually colonize new habitat areas. *Id.* In yet another conspicuous failure of NEPA and CEQA compliance, the EIS/EIR contains no analysis of whether this will, in fact, happen. The EIS/EIR just assumes it will happen.

In that regard, it is interesting to note that the habitat condition that could make the Proposed Action favorable to lamprey is an increase in fine silt/sand in the river bottom. *Id.* at 15, EIS/EIR at 3.3-120. However, those things that may help lamprey, *i.e.,* increased sedimentation, are not so helpful to salmonids and trout. While the EIS/EIR seeks to downplay the size and duration of the adverse effects of sedimentation on coho salmon, Chinook salmon, and various species of trout, the Lamprey Expert Panel notes it is "reasonable to expect that this fine-grained sediment will be remobilized over a period ranging from years to decades." Lamprey Expert Panel Report at 33. The long-term prospect is for "an increase of approximately 127,000 tons per year of fine sediment" as a result of dam removal. *Id.* This may be helpful to lamprey but it is not helpful to salmon and trout species for which siltation has a detrimental impact on spawning grounds. And this number significantly understates the amount of sediment that will actually be released into the river.

9. Fish Interactions in the River

The EIS/EIR treats each species discussed above as if it is the only occupant of the ecosystem. The EIS/EIR chooses to ignore the fact that these various species share the same habitat, compete for the same space and food, and prey on each other. As a result, the EIS/EIR fails to examine the extent to which these ecosystem interrelationships change its already questionable assertions regarding the alleged benefits stemming from the Proposed Action.

For example, the EIS/EIR is devoid of any analysis regarding the effect of the Proposed Action on resident native fish. The Resident Fish Expert Panel noted there are 16 such species that may benefit from the Proposed Action. Resident Species Expert Panel Report at 64. The

impacts of increasing the numbers of 16 different species and of the resulting predator prey relationships are totally ignored in the EIS/EIR. As the Chinook Expert Panel noted, predation by an increased redband trout population could cancel the benefits to Chinook salmon claimed for the Proposed Action. Chinook Expert Panel Report at 17. Although redband trout is not one of the 16 resident species referenced in this section, the same predation issues exist as to resident species. Not only has the EIS/EIR failed to examine the ecosystem impacts of a possibly increased population of 16 resident species, but, as discussed above, it has also ignored the ecosystem impacts of an enlarged redband trout population.

The absence of any analysis of these interspecies interactions is a conspicuous failure in the EIS/EIR. The Chinook Expert Panel clearly identified this failure stating that the overarching and controlling assumption in the EIS/EIR is that interspecies "interactions are less important" than the single species direct effects of dam removal. Chinook Expert Panel Report at 27. In a telling comment, the Expert Panel states it "does not know if this is true." *Id.* Nevertheless, the EIS/EIR persists with its single species, silo, analytical approach even though "[u]nder the Proposed Action all of the fish species would overlap with all others at some part of their life cycles, and some of them use similar habitat." *Id.* The Panel recommended that "a specific analysis be conducted ... to investigate whether trade-offs or synergies may exist among the various species likely to be affected by the Proposed Action." *Id.* In a total failure of common sense and analysis, the EIS/EIR ignores the fact that species share, and interact in, the same ecosystem. By itself, the failure to consider this environmental effect renders the EIS/EIR inadequate.

A related issue, also not addressed in the EIS/EIR, is the management requirements for ESA protected species and how those requirements affect the claimed benefits of the Proposed

Action. For example, the Chinook Expert Panel noted that a petition has been filed to list the Klamath Spring Chinook salmon under the ESA. The Panel asserted such a listing would be "particularly problematic in the case of Lost River and shortnose suckers ... versus Chinook salmon ... the former would benefit from higher [Upper Klamath Lake] water levels and the latter would benefit from increased flows." Chinook Expert Panel Report at 26. Regardless of whether there is an ESA listing for spring Chinook, the issue of the competing needs of different species continues to exist. Further illustrating this problem, the Chinook Expert Panel found that the "current Biological Opinion [for protected suckers] may reserve more water for suckers than that offered under KBRA." *Id.* The EIS/EIR cannot ignore such issues, particularly when they involve ESA protected species.

Similarly, the EIS/EIR states that implementing the Proposed Action will allow Chinook salmon and steelhead to have access to areas designated as critical habitat for the threatened bull trout. These are areas that Chinook and steelhead have not been able to access since the completion of the Copco 1 Dam in 1981. EIS/EIR at 4-70. The EIS/EIR then admits Chinook salmon and steelhead are likely to prey upon bull trout fry and juveniles in new habitat areas after the dams are removed, and vice versa. *Id.* There is no analysis in the EIS/EIR of the effects of this predation on the threatened bull trout, a significant omission given the EIS/EIR claims an 81.4% increase in the adult Chinook salmon population and an increase in steelhead numbers. EIS/EIR, Summary of Key Conclusions and at 3.3-112. If the EIS/EIR is correct, then the impacts on the threatened bull trout of this interspecies interaction cannot be dismissed with the statement "these species co-evolved in the watershed together and it is anticipated that they would be able to co-exist in the future." EIS/EIR at 4-70. While these species may have evolved together in a different era and in a different ecosystem, the EIS/EIR ignores the fact that the

ecosystem has changed since that era – and the Proposed Action will change it again. The EIS/EIR incorrectly assumes the evolutionary past will somehow once again come into existence. That conclusion has no support in reality. The EIS/EIR inappropriately ignores this interspecies interaction – an interaction of particular note since bull trout is a threatened species.

Another key ecosystem conflict ignored in the EIS/EIR is the relationship between worms that carry fish killing parasites and the claimed increases in fish populations. As discussed above, increases in salmon populations hinge "to a large degree" on the ability to control fish disease. Chinook Expert Panel Report at 13. Yet, the EIS/EIR admits the Proposed Action will increase nutrient loads, which increases river algae populations, which increases the habitat and numbers of worms that host fish killing parasites and disease. EIS/EIR at 3.4-17, 3.2-101, 3.2-102, 3.4-5, 3.4-8. The effects of this ecosystem impact are ignored in the EIS/EIR.

Commenting on all such interspecies conflicts, the Chinook Expert Panel noted that "[r]esolving such potential conflicts may trump or substantially alter agreements developed under the Proposed Action...." Chinook Expert Panel Report at 26. Despite the possibility that these interspecies conflicts may trump the benefits claimed for the Proposed Action, the EIS/EIR is devoid of any analysis of interspecies interactions.

10. Other River Species

The analysis of the impact of dam removal on other river species is equally deficient. For example, as to freshwater mussels the EIS/EIR states high sediment concentrations "for more than 4- to 5- day periods within the mainstem Klamath River … might result in substantial mortality." EIS/EIR at 3.3-131. The EIS/EIR goes on to admit it "seems reasonable to presume that some percentage of Klamath River freshwater mussels buried under 0.5 to 3.0 feet of new sediment could not survive." *Id.* at 3.3-131. In another section of the EIS/EIR one finds the admission that the sediment deposition is not expected to exceed two feet. *Id.* at 3.11-22.

Nowhere does the EIS/EIR discuss the immediate impact of burying freshwater mussels under two feet of sediment. Nowhere does the EIS/EIR discuss the long-term effects of this burial given that the EIS/EIR admits 4-5 days is the critical period before "substantial" mortality sets in and given that the EIS/EIR admits that the period of high sedimentation "would be 3 to 4 months." *Id.* at 4-54. Instead, the EIS/EIR simply concludes the impacts of burying freshwater mussels are "expected to be short-term." *Id.* How the EIS/EIR can make such a claim in light of the evidence is unclear. The reality is that freshwater mussels will be buried for an extended time and mortality will be "substantial." Yet, the EIS/EIR fails to discuss the extent, and the ecosystem implications, of this mortality.

For other filter feeders, the EIS/EIR admits the sediment deposits from dam removal would "be expected to affect filter-feeding [benthic macroinvertebrates] in much the same fashion as described for freshwater mussels." *Id.* at 3.3-133. Based on that, one would expect "substantial" mortality for these macroinvertebrates. Yet, the EIS/EIR is once again devoid of any analysis of the extent, and the ecosystem impact, of this mortality.

11. Estuarine and Ocean Impacts

Repeatedly the EIS/EIR states sediment release from dam removal will not have any real impact on the Klamath River estuary and the aquatic species found there. EIS/EIR at 3.3-110 ("The Proposed Action is not expected to … affect coho salmon estuarine habitat. Sediment … would likely not extend downstream to the estuary."); at 3.3-99 ("The Proposed Action would not …. affect estuarine habitat used by fall-run Chinook."); at 3.3-118 ("The Proposed Action is not expected to … affect steelhead estuarine habitat.... Sediment … would likely not extend downstream to the estuary."); at 3.3-130 ("The Proposed Action is not likely to … affect estuarine habitat …. [S]ediment … resulting from the Proposed Action would likely not extend downstream to the estuary.")

There are two problems with this no impact conclusion. First, if the EIS/EIR is correct, then virtually all of the 3,540,000 tons of sediment released in the first year after dam removal, plus all the remaining sediment that will be released, will stay in the river. *See* Part II.C.1.a. The EIS/EIR fails to explain how leaving millions of tons of sediment in the river, coupled with the statement in the EIS/EIR that salmon need spawning areas that are "relatively free" of sediment, is consistent with the conclusions in the EIS/EIR that dam removal will help salmon or other fish that need sediment free spawning areas. Equally important for NEPA and CEQA compliance, the EIS/EIR fails to examine the overall ecosystem impacts of leaving 3,540,000 tons of sediment in the river.

This leads to the second problem with the many statements in the EIS/EIR that no sediment will reach the estuary and, therefore, the EIS/EIR need not examine estuarine impacts – which it did not. The problem is that these statements are contradicted by other statements in the EIS/EIR. The EIS/EIR states "the released sediment would likely exceed the carrying capacity of the river during some water year types, and it would result in sedimentation … [in] the Klamath River estuary." EIS/EIR at 3.11-20. At another point, the EIS/EIR states that "[essential fish habitat] in the estuary could be affected by elevated turbidity from sediment releases...." *Id.* at 4-72. The EIS/EIR also states there will be suspended sediment in the estuary for up to two years. EIS/EIR at ES28. Thus, the EIS/EIR contradicts its many earlier statements quoted above that sediment from dam release will not reach the estuary with almost as many statements that sediments will reach the estuary. But the contradictions continue.

The EIS/EIR also asserts that any sediment deposition in the river "would be flushed downstream during high-flow events. Any settling or sedimentation … is expected to be minimal and short-lived. Further … there is no sandbar within the mouth of the Klamath River

itself; rather the sandbar is located offshore. As a result, the majority of the suspended sediment load from the river is carried out to sea and does not remain in the estuary itself." *Id.* at 3.11-21. The principal problem with the preceding quote is that it is factually incorrect. There is a rather large sandbar at the mouth of the Klamath River. Figure 1 attached to these Comments shows that several large sandbars exist within the river near its mouth. Moreover, a large spit of sediment is located directly along the coast, substantially blocking the majority of the Klamath River estuary.

Thus, we have multiple statements that "sediment … would likely not extend downstream to the estuary," meaning it stays in the river, followed by statements that there will be sediment deposits in the estuary, followed by statements that because of the absence of a sandbar at the mouth of the Klamath River the "majority" of the sediment will wash into the ocean and not stay in the estuary. So, which is it? The answer is we do not know. No decision maker can make an informed decision based on such inconsistent and poor analysis. There can be no "hard look" because the EIS/EIR cannot tell us what we are looking at.

If there is sediment deposition in the estuary, the inadequacy of the EIS/EIR becomes even more pronounced. The EIS/EIR has not one shred of analysis regarding the impacts of sediment deposit on species that spend all or some of their life cycle in estuarine habitat. For example, the federally listed eulachon (threatened) and the state listed longfin smelt (threatened) generally occur within 8 miles of the coast in the estuary. *Id.* at 3.3-129 and 3.3-130. Anadromous species such as salmon also move through the estuary. Further, the estuary has been designated as essential fish habitat for both pelagic fish and groundfish. *Id.* at 3.3-93 and 94.

If the sediment is going to pass through the estuary to the ocean, then we have a new analytical problem. The EIS/EIR contains absolutely no analysis of the effects on the ocean and its resources of either the volume of the sediment that will be deposited into the ocean or of the contaminants in the sediment. Not only is there no analysis that meets NEPA and CEQA standards, but the EIS/EIR fails to discuss how the Proposed Action complies with Executive Order 13547. That Order directs federal agencies to consider the effects of their actions on the ocean and to ensure no adverse effects consistent with their existing statutory authorities. The EIS/EIR is devoid of the required analysis.

12. The Significance Criteria

The EIS/EIR has categorized the adverse impacts of the Proposed Action as either significant or less than significant. Effects the EIS/EIR deems beneficial are so labeled. EIS/EIR at 3.3-52. However, as used in the EIS/EIR, this system of classification is meaningless for NEPA analysis and for the decision maker.

The EIS/EIR states a "significant" impact is one that has a "substantial" effect. *Id.* at 3.3-52, 53. But what constitutes a "substantial" effect? What level of effect comprises a "substantial" one? Without knowing the metric used in the EIS/EIR, there is no basis to evaluate the significance conclusions in the EIS/EIR. The Chinook Expert Panel, for example, addressed this core definitional issue by defining the term substantial to mean an effect that is more than trivial. Chinook Expert Panel Report at 7, n.3. Since the EIS/EIR cites with approval the Chinook Expert Panel Report, perhaps the EIS/EIR has adopted that Panel's definition of substantial. If so, then the EIS/EIR has misapplied its own significance standard and categorized as less than significant many effects which are significant. The reader and the decision maker are left with no standards by which to evaluate the "significance" conclusions in the EIS/EIR.

13. Conclusion

The EIS/EIR states the need for the Proposed Action is to advance the restoration of salmonid fisheries. DOI created four expert panels to assess the merits of the Proposed Action in achieving that goal, as well as in assisting other fish.

The EIS/EIR mischaracterizes and misstates the findings and conclusions of the Expert Panels. While the EIS/EIR claims the Expert Panels validated the EIS/EIR's assertion of "substantial" and "major" improvements, the Expert Panels called the results of the Proposed Action "small," "remotely possible," "unlikely," "uncertain," and "not feasible." Even these words seem inadequate when one considers the fact that the conclusions of the EIS/EIR regarding sediment impacts are based on estimates of sediment release that are off by orders of magnitude and when the Expert Panels and the EIS/EIR admit the Proposed Action will make existing problems of water quality worse.

A recurring theme in the Expert Panel Reports is that the data and analyses necessary to support the conclusions in the EIS/EIR have not been done. Therefore, the actual effects of the Proposed Action are simply not known despite claims to the contrary in the EIS/EIR. One Expert Panel, after considering this lack of data and analysis, termed the Proposed Action an "experiment."

The Expert Panels also pointed to significant flaws in what analysis has been undertaken. The Panels noted DOI elected to confine its analysis to the impacts of the Proposed Action on individual species, as if each such species exists in the ecosystem all by itself. But these species compete for food and space and often prey on each other. Changing the relative numbers and composition of these species changes the ecosystem. The EIS/EIR does not analyze the effects of interspecies interactions even though one Expert Panel found these interspecies interactions could "cancel" the benefits claimed for salmon under the Proposed Action. The EIS/EIR has not

taken the hard look required by NEPA nor does it meet CEQA's information disclosure provisions. In fact, the EIS/EIR has not taken any look. Moreover, in considering the needs of ESA-protected species, one Expert Panel questioned whether the KBRA projects aimed at benefitting salmon and other species could even be undertaken given the priority needs of ESA-listed species.

Furthermore, the EIS/EIR fails to examine the environmental effects of releasing millions of tons of sediment into the river, its estuary, and the ocean. Not only is the EIS/EIR internally inconsistent but is often factually wrong. These inconsistencies and factual errors make reliance on the analysis in the EIS/EIR arbitrary and capricious. Because of these errors, the analysis in the EIS/EIR fails to meet even the minimum standards of adequacy under NEPA and CEQA.

Finally, in a singular failure of NEPA and CEQA analysis, the Expert Panels were instructed to examine the fishery impacts of only two of the five alternatives identified in the EIS/EIR. Despite the resulting failure to examine all the alternatives, the EIS/EIR relies on the Expert Panel Reports as the basis on which the EIS/EIR can propose its preferred alternative and reject the other four alternatives.

The proper NEPA and CEQA analyses have not been undertaken. The necessary data to reach the conclusions made in the EIS/EIR do not exist. What data exist do not support the claim in the EIS/EIR that the Proposed Action will achieve its objective of restoring salmonid fisheries.

D. Algae

Two algal communities predominate in the Klamath River Basin phytoplankton which is present in lakes and reservoirs and periphyton which is present in the river system. EIS/EIR at 3.4-2. The EIS/EIR admits that if the Proposed Action is implemented, there would be "no change from existing conditions from nuisance" phytoplankton and periphyton in the upper

Klamath Basin upstream of the J.C. Boyle Reservoir. *Id.* at 3.4-13. The result is different within the Hydroelectric Reach, defined in this section of the EIS/EIR as the area from the upstream end of J.C. Boyle Reservoir to Iron Gate Dam, including all sections categorized as mainstem, bypassed, and peaking reaches and including tributaries to the Klamath River such as Jenny, Spencer, Slate, Shovel, and Fall Creeks. *Id.* at 3.4-1.

In the Hydroelectric Reach, the EIS/EIR concludes dam removal will eliminate the reservoirs that are home to phytoplankton and, therefore, these algae blooms would be very limited or cease to exist. *Id.* at 3.4-13. However, for periphyton, the EIS/EIR concludes the Proposed Action will cause "long-term increases in nuisance periphyton growth due to increases in available habitat" and there will "be a significant impact" from dam removal. *Id.* at 3.4-15.

Below the Hydroelectric Reach, the EIS/EIR concludes "[p]eriphyton growth could continue to be relatively high ... following dam removal because of continuing nutrient inputs from the Upper Klamath Basin...." *Id.* at 3.4-17. In that regard, the EIS/EIR admits there are "overall increases in absolute nutrient concentrations anticipated under the Proposed Action...." *Id. See also id.* at 5-100 (the Proposed Action "would result in increases in nutrient inputs ... that could increase periphyton biomass; ... this impact would be significant and unavoidable."). In fact, the EIS/EIR states all of the various models "recognize ... that under the Proposed Action total nutrient concentrations in the Klamath River downstream of Iron Gate Dam would increase." *Id.* at 3.2-101. One model cited in the EIS/EIR concludes that total phosphorous concentrations would increase 2%-12% for the June-October period. However, total nitrogen concentrations would jump 37-42% June-October and 48%-55% for the middle months of July-September. *Id.* at 3.2-102. It is these high nutrient concentrations that feed the growth of harmful algae, making the existing problem worse. As the Chinook Expert Panel noted: "There

is a clear conceptual relationship between nutrient loading to a water body and algal biomass...." Chinook Expert Panel Report at 10.

The increase in nutrients and the corresponding increase in algae is particularly significant given that the stated need for dam removal is to increase salmon populations. One of the key obstacles to achieving that objective is the incidence of fish disease. Indeed, the Chinook salmon Expert Panel found the overall success of any program to increase salmon populations hinges "to a large degree" on disease reduction. *Id.* at 13. However, the EIS/EIR admits that a significant component of periphyton is the species *Cladophora* which provides important habitat for the worms that are host to fish killing parasites. EIS/EIR at 3.4-5 and 3.4-8. In short, the Proposed Action increases the habitat favorable for fish disease, thereby making that problem worse.

In an attempt to rescue the case for the Proposed Action, the EIS/EIR falls back on the alleged benefits of KBRA implementation. A closer look at the EIS/EIR documents the weakness of this reliance. The EIS/EIR states: "If projects were well designed and implemented on a large enough scale ... KBRA projects ... proposed to reduce nutrient loading ... could fully mitigate for" increases in periphyton biomass associated with higher nutrient concentrations resulting from the Proposed Action. *Id.* at 3.4-15. This statement has four significant admissions. First, it is contradicted by the EIS/EIR which admits that the Proposed Action, which includes the KBRA, will increase algae concentrations. Second, the EIS/EIR admits there is not enough information in the KBRA to know if the projects are well designed, let alone if they will work. Third, the EIS/EIR admits the benefits from the KBRA might occur only if the KBRA is fully and completely funded and implemented, an unlikely event in today's budget

climate. Fourth, even if the KBRA projects are well designed and fully implemented, the most that can be said is they "could" mitigate for the adverse effects of dam removal.

In other words, the most likely net result of the Proposed Action is to make the problem of harmful algae blooms a worse problem and to impede the benefits anticipated to result from already adopted Foreseeable Restoration Measures.

E. Terrestrial Resources

In this section, the EIS/EIR pretends to analyze the effects of the Proposed Action on terrestrial species of plants and animals, including birds. The most glaring example of the inadequacy of the EIS/EIR is that the "analysis" of the effects of the Proposed Action on terrestrial invertebrates is confined to just five lines. EIS/EIR at 3.5-40. Nevertheless, those five lines contain three damning statements. First, the EIS/EIR admits several "special-status" invertebrate species may occur in the project area. *Id.* Second, one of those species is of such concern that a petition has been filed to list it under the Endangered Species Act. *Id.* Third, the EIS/EIR excuses its failure to conduct any analysis of the effects of dam removal on invertebrate species by stating that the majority of its information comes from the PacifiCorp Final Technical Report and PacifiCorp simply "did not conduct surveys for terrestrial invertebrates." *Id.* at 3.5-3 and 3.5-40. The legal position appears to be that PacifiCorp's failure to examine the impact of the Proposed Action on terrestrial invertebrates excuses DOI from NEPA and CEQA compliance. The EIS/EIR fails to even come close to the required legal standard of taking a "hard look" at environmental issues.

As to birds, the EIS/EIR states 174 bird species are found in the project area, of which 46 are special-status species. *Id.* at 3.5-18 and 3.5-39. Among those species are bald and golden eagles protected under the Bald and Golden Eagle Protection Act ("BGEPA"), 16 U.S.C. §703. Numerous other birds are protected by the Migratory Bird Treaty Act ("MBTA"), 16 U.S.C.

§668, including the osprey, willow flycatcher, peregrine falcon, and greater sandhill crane. EIS/EIR at 3.5-51-52. Also present is the northern spotted owl, listed as a threatened species under the ESA. *Id.* at 3.5-39. After a simple listing of the species in the project area, all analysis ends.

Instead of examining the impacts of the Proposed Action on these birds, the EIS/EIR simply states that buffer zones will be established around known nests, implicitly acknowledging the existence of adverse impacts that require buffer zones. *Id.* at 3.5-48-52. But there is no discussion of whether the size of these buffer zones is adequate and why. There is no discussion of whether the Proposed Action will affect the availability of new nesting sites that may be needed. There is no discussion about the impact of dam removal on other habitat needs such as feeding sites. Without these analyses, the EIS/EIR provides no basis for DOI to make any informed determination regarding the impact of the Proposed Action on birds. NEPA's and CEQA's standards for analysis and informed decision making are not met.

Also conspicuously absent from the "analysis" in the EIS/EIR is how the Proposed Action complies with existing law and agency policy. In its recently issued draft guidance on how wind power projects are to comply with the BGEPA and MBTA, DOI is suggesting multiple years of surveys on bird use patterns. Land Based Wind Energy Guidelines, U.S. Fish and Wildlife Service, September 13, 2011. The EIS/EIR states that the Proposed Action will only require two years of such studies. EIS/EIR at 3.5-50. The EIS/EIR applies a different and lesser standard to the Proposed Action than DOI is applying to wind power projects. The EIS/EIR fails to explain this inconsistency.

F. Floods and Fire

The EIS/EIR uses incomplete and inadequate criteria to determine if the flood related effects of the Proposed Action are significant. The EIS/EIR states the impact of the Proposed

Action is significant only if it will "substantially increase" the risk that a flood may occur. EIS/EIR at 3.6-20. The criteria are incomplete. Any change in the time available to respond to flood conditions is also a critical element of significance – an element completely ignored in the EIS/EIR.

This failure has particular consequences under CEQA. CEQA Guidelines Appendix G, state that the decision maker should consider whether the project would "Expose people or structures to a significant risk of loss, injury or death involving flooding" and also whether the project would "substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site[.]"

Furthermore, the data used to assess the likelihood of increase flooding understates the potential harm from dam removal. The EIS/EIR states the Lead Agencies "modeled flood events that meet criteria for a 100-year flood using daily average flows…." *Id.* at 3.6-21. The EIS/EIR then incorrectly concludes the Proposed Action will not increase flood risks because the EIS/EIR modeling results are very similar to the current flood risk determined to exist by the Federal Emergency Management Agency ("FEMA"). *Id.*

There are two problems with this statement. First, FEMA flood risk analysis is based on peak river flows. The EIS/EIR uses average daily flow. Peak flows are higher, and very often significantly higher, than average daily flows. It is incorrect to say that the effect of an average flow is comparable to the effect of a peak flow. To a flooded community, peak flows are the critical issue. It is the peak flow that sends the most water cascading into the community. Yet, the EIS/EIR bases its modeling of effects on average flows. The result is an incorrect and

understated flood risk from dam removal. To the people whose lives and property may be swept away in a flood, the callous disregard of the true risks of flooding is nothing short of shocking.

The second problem with the claim in the EIS/EIR that the Proposed Action will not change flood risks is that the EIS/EIR admits the geographic reach of an average daily flow in a post-dam removal flood event is "fairly close" to the geographic reach of a worst-case peak flow without dam removal because the average flow is less than the peak flow. The EIS/EIR is admitting that peak flood events will be worse after dam removal than before dam removal. Indeed, in an understatement noteworthy for its willingness to ignore the problem, the EIS/EIR states "[u]nder the Proposed Action, the 100-year flood plain inundation area downstream from Iron Gate Dam could change.…" *Id.* at 3.6-27. Here, the EIS/EIR finally admits that dam removal will increase flooding and the effect will be "significant." *Id.* at 3.6-22.

In a vain attempt to rescue its case for dam removal, the EIS/EIR states these "significant" flooding effects will be rendered less significant because of the implementation of KBRA proposed mitigation measures. In other words, we need not worry because the KBRA is here. A closer analysis of the KBRA mitigation measures shows this is a false promise.

The principal KBRA mitigation measure is that prior to dam removal, the National Weather Service ("NWS") will be informed of the planned dam removal so that NWS can update its river forecast models to better advise people that a flood is coming. In other words, the mitigation proposed is not to reduce the flood risk but to tell people the flood is coming. The net effect of the Proposed Action is that flooding will be worse but people will be told the flood is coming.

However, the EIS/EIR incorrectly assumes that simply telling NWS the dams are being removed changes the ability of NWS to notify people of a coming flood. The EIS/EIR does not

consider how long it will take NWS to develop new flood forecast procedures based on new hydraulic conditions. Nor does the EIS/EIR consider how much data are required to properly calibrate the updated models to achieve an adequate level of flood forecast accuracy. It may take a decade or more of monitoring post-dam removal river flows to acquire sufficient information for accurate calibration. Furthermore, the EIS/EIR does not consider whether NWS has the funding or the infrastructure to undertake the data monitoring necessary to support adequate river forecasting post dam removal. Finally, simply telling people about a flood risk does nothing to improve the emergency response ability of the community. The EIS/EIR is devoid of any discussion of this important aspect of mitigating the increased risk of flooding caused by the Proposed Action.

Emergency response capability is critical because the timing of the flood peak will be significantly affected by the Proposed Action. Flood peaks under the Proposed Action will occur about 10 hours sooner than under the status quo. Bureau of Reclamation, Hydrology, Hydraulics and Sediment Transport Studies for the Secretary's Determination on Klamath River Dam Removal and Basin Restoration, Technical Report No. SRH-2011-02, 2011, at 6.3-6.7. This cuts the time available for floodplain occupants to escape rising waters by about 20% based on the more rapidly occurring peak, a significant fact ignored in the EIS/EIR.

Ignoring the fact that flooding will increase under the Proposed Action, the EIS/EIR closes with the statement that we can mitigate for increased flooding because, after the dams are removed, we will learn how to notify people of flood risks. EIS/EIR at 3.6-39. The EIS/EIR is telling us that mitigation measures "will be effective" because flood risks will be identified after the fact. In other words, remove the dams then assess the risks. This is backwards and violates the applicable legal standards by avoiding the required "hard look." The EIS/EIR impermissibly

defers the analytical work to the post-action future. *National Audubon Society v. Department of the Navy*, 422 F. 3d 174 (4th Cir. 2005).

Turning from floods to fires, all of the towns in the County of Siskiyou are listed as "at risk" communities for wildfire by the federal government. 63 Fed. Reg. 751 (Jan. 4, 2001); California Fire Alliance, http://www.cafirealliance.org/communities_at_risk/. Fire history maps show that fires in this area are becoming geographically larger as well as greater in intensity.

Siskiyou County has 22 community Fire Safe Councils, a Siskiyou County Fire Safe Council, a Siskiyou County Fire Safe Panel that advises the Board of Supervisors, and a Community Wildlife Protection Plan. Fire is a very significant issue in the County of Siskiyou. With virtually no analysis, other than a significant admission that the loss of the reservoirs behind the dams will increase turnaround time for fire-fighting helicopters, the EIS/EIR concludes the impact of the Proposed Action on government's ability to fight fires will be "less than significant." EIS/EIR at 3.18-18 and 19. Reducing the ability to fight an increasing fire problem does not sound insignificant. The EIS/EIR offers no analysis of the likely effects of this reduced ability to fight wildfires other than the conclusory statement that it will not be a significant problem. Such conclusory statements offer little comfort to the citizens of the County of Siskiyou. Such conclusory statements violate NEPA's and CEQA's standards for adequate analysis.

G. Water Quality

The EIS/EIR identifies seven water quality issues associated with the Proposed Action: (1) sedimentation; (2) nutrient concentrations; (3) algae growth; (4) dissolved oxygen levels; (5) water temperature; (6) pH levels; and (7) the presence of organic and inorganic compounds. EIS/EIR at 3.2-1. Each of these water quality problems has led to determinations that surface waters and designated beneficial uses, including fish and wildlife related uses, of the Klamath

River Basin, including those of the Hydroelectric Reach and the lower Klamath River, are impaired with respect to these constituents of concern. Accordingly, as discussed above, numerous TMDLs have been adopted and will be implemented to address the existing conditions of pollution with respect to each constituent of concern. This section will discuss the inadequacy of the EIS/EIR impacts analysis for each constituent of concern.

1. Sedimentation

As discussed in Parts II.C.1.a, II.C.2.e, and II.C.11 of these Comments, the EIS/EIR proceeds from a series of incorrect and inconsistent assumptions regarding the quantity of sediment that will be released because of dam removal, the time it will take for the effect of the sediment release to dissipate, and whether the released sediment will remain entirely within the river or be deposited in the estuary or the ocean. Until these inconsistencies are resolved, and the baseline data corrected, the EIS/EIR provides no basis on which a decision maker can make an informed decision about the effects of dam removal consistent with the requirements of NEPA and CEQA.

Compounding these problems is the absence of analysis regarding the pollutant content of the sediment and the effects of those pollutant loads on aquatic life and human health. The EIS/EIR concludes, without explanation or supporting data, that there is "little positive indication that substantial aquatic toxicity, or ecological or human health risk, would likely result from exposure to the sediments." EIS/EIR at 3.21-4.

The fact that there are no data to support this conclusion is amply demonstrated by the very next sentence in the EIS/EIR that "further evaluations must be conducted before conclusions about the potential for contaminant-related impacts and risks can be reached. This includes direct laboratory testing of the sediments to assess their toxicity ... and [their] bioavailability ... *i.e.* whether contaminants [can bioaccumulate]...." *Id.* In other words, we do

not know the effects of sediment release, notwithstanding the statement in the EIS/EIR that there is no problem. In fact, the EIS/EIR goes on to say that "some," but not all, of the toxicity and bioaccumulation tests have been done but "[t]he results of this biological testing are pending." *Id.* With only "some" testing done, and the results still "pending," the EIS/EIR somehow concludes there is "little" indication of a problem. Such specious analysis does not, and never can, meet the evidentiary standards of NEPA and CEQA for a hard look at the environmental consequences of the Proposed Action.

Adding insult to analytical injury, the EIS/EIR acknowledges there have been significant nutrient inputs into the Klamath River Basin and, therefore, into the reservoirs behind the dams. *Id.* at 3.2-20, 3.2-101. Thus, mixed with the sediments are likely to be large amounts of nitrogen and phosphorous that will be released when the associated sediment is released. But the EIS/EIR never discusses, let alone analyzes, the environmental impacts of the release of these accumulated nutrients, impacts that could be severe given that up to 3.5 million tons of nutrient enriched/contaminated sediment will be released as a result of the Proposed Action.

2. Nutrient Concentrations

The EIS/EIR admits all of the models "recognize ... that under the Proposed Action total nutrient concentrations in the Klamath River downstream of Iron Gate Dam would increase." *Id.* at 3.3-101. One model concludes phosphorous concentrations would increase 2%-12% in the June-October period. Nitrogen concentrations would rocket up 37%-42% in the same period and 48%-55% July-September. *Id.* at 3.2-102. Thus, the EIS/EIR concludes the Proposed Action "would result in increases in nutrient inputs...." *Id.* at 5-100. *See also id.* at 3.4-17 and 3.2-103 (there are "overall increases in absolute nutrient concentrations anticipated under the Proposed Action...."). In other words, the Proposed Action makes the problem of nutrient concentrations worse. Yet, contrary to CEQA requirements, the water quality section of the EIS/EIR

determines that all impacts from nutrient increases are not likely to be significant. Further, no mitigation measures or measures to try to preserve the efficacy of the Foreseeable Restoration Measures are proposed or analyzed.

3. Algae Growth

The Proposed Action also makes the problem of river algae worse. There is a clear relationship between increased nutrient levels and the growth of harmful algae. Chinook Expert Panel Report at 10. Thus, the EIS/EIR is forced to admit that higher nutrient concentrations are likely to "increase [river algae] biomass; ... this impact would be significant and unavoidable." EIS/EIR at 5-100. *See also id.* at 3.4-15 (the Proposed Action will cause "long term increases in nuisance" algae growth that will have "a significant impact"). Despite these increases, no feasible alternatives or mitigation measures to reduce algae impacts and/or preserve the efficacy of the Foreseeable Restoration Measures are proposed or analyzed, contrary to CEQA.

4. Dissolved Oxygen

The increased levels of sediments, nutrients, and algae discussed above have the concurrent effect of reducing dissolved oxygen levels and increasing the variability in daily dissolved oxygen levels. Indeed, the EIS/EIR recognizes that increased nutrient concentrations and related increases in algae populations consume oxygen (respiratory consumption) and reduce the amount of dissolved oxygen available to other organisms. *Id.* at 3.2-26. Nowhere does the EIS/EIR examine the effects of respiratory consumption by the increased algae populations resulting from the Proposed Action.

Sediment releases could also cause a decrease in dissolved oxygen concentrations in the Klamath River below J.C. Boyle Dam for up to two years and this would have "a significant impact" on the river. *Id.* at 3.2-104, 3.2-109. However, as noted above, the predictions in the EIS/EIR about the amount of sediment to be released and how long it will take to dissipate are

incorrect and are disputed by DOI's own Expert Panels. *See* Parts II.C.1.a and II.C.2.e of these Comments. The actual impact, not analyzed in the EIS/EIR, will be much greater than assumed in the EIS/EIR.

Finally, the magnitude of daily fluctuations in the amount of dissolved oxygen in the river may be greater under the Proposed Action. EIS/EIR at 3.2-104, 3.2-109, 3.2-110. Having admitted that, the EIS/EIR fails to quantify either the amount or duration of these fluctuations. Instead, the EIS/EIR discusses the monthly average amount of dissolved oxygen in the river following dam removal. *Id.* at 3.2108, Table 3.2-13. However, aquatic species feel the effects of oxygen deprivation on a minute-by-minute basis, not on a monthly average. The EIS/EIR employs an incorrect baseline measurement and fails to properly examine the effects on aquatic species of the dissolved oxygen fluctuations.

The EIS/EIR compounds the issues created by improper impacts analysis by failing to evaluate the availability and feasibility of mitigation measures to address dissolved oxygen impacts of the Proposed Action, or the potential for the Proposed Action to significantly adversely affect or inhibit the success of ongoing implementation of Foreseeable Restoration Measures.

5. Water Temperature

Similarly, the EIS/EIR discussion regarding the impact of the Proposed Action on water temperature misses the point. The EIS/EIR reviews the impact of the Proposed Action on the average mean daily temperature. However, aquatic species experience water temperature effects on an hourly basis, not on an average mean daily basis. It is the hourly temperatures that are key. As DOI's Expert Panel for coho salmon and steelhead trout noted, while dam removal may lower the average mean daily temperature, this is not the relevant analytical point because under the Proposed Action the "highest temperatures experienced by fish ... will increase." Coho and

Steelhead Expert Panel Report at 31-32. The EIS/EIR fails to examine the effect on aquatic species of these increased water temperatures, relying instead on generalized averages that ignore and mask the actual temperature effects of the Proposed Action.

In addition, the EIS/EIR fails to evaluate the availability and feasibility of mitigation measures to address temperature impacts of the Proposed Action as required by CEQA. Further, the EIS/EIR fails to examine the potential for the Proposed Action to significantly adversely affect or inhibit the success of ongoing implementation of the Foreseeable Restoration Measures. As a result, the EIS/EIR does not have sufficient information on which to base a decision regarding implementation of the Proposed Action.

6. pH

The EIS/EIR admits that elevated pH levels are linked to the high rates of photosynthesis by river algae (periphyton). EIS/EIR at 3.2-28. However, the EIS/EIR dismisses these effects, and fails to examine them, based on the assertion that increased periphyton growth is only a possibility in the Hydroelectric Reach under the Proposed Action. *Id.* at 3.2-113. The problem with this attempt to avoid analysis is that in the more specific section of the EIS/EIR dealing with algae, the EIS/EIR admits the Proposed Action will cause "long-term increases in nuisance periphyton" and this will have "a significant impact" on the environment. *Id.* at 3.4-15. Below the Hydroelectric Reach, the EIS/EIR admits that increased photosynthetic activity coupled with higher nutrient concentrations "would result in large daily variation in pH and generally high pH levels.... This may result in instantaneously exceeding the North Coast Basin Plan water quality objective maximum pH value of 8.5 ... which may be stressful to fish and other aquatic life and adversely affect beneficial uses." *Id.* at 3.2-115.

Notwithstanding these admissions that the Proposed Action will make the problem of pH levels worse, the EIS/EIR has no analysis of the effects of elevated pH on aquatic species, or the

degree to which the Proposed Action will interfere with or inhibit pH improvements that can be reasonably expected to occur from implementation of the Foreseeable Restoration Measures. Instead, the EIS/EIR says the increased growth in river algae "may" be counteracted by river scouring from flood and storm events that increase river flow. *Id.* There are two major problems with this attempt to avoid meaningful discussion of the adverse effects of elevated pH levels. First, the EIS/EIR admits that notwithstanding any scouring that may occur, algae populations will still increase. Second, there is no analysis of the frequency of any such scouring, let alone the effects of algae growth and elevated pH levels in the years that lie between such events. The facts are that elevated pH levels will occur. The EIS/EIR fails to examine those effects and also fails to examine the impact of the Proposed Action on implementation of the Foreseeable Restoration Measures as required by CEQA.

7. Inorganic and Organic Contaminants

The EIS/EIR states that sediment testing showed "low levels" of metals, pesticides, chlorinated acid herbicides, PCBs, volatile organic compounds, cyanide, and dioxins in the sediments behind the dams. *Id.* at 3.2-121. The EIS/EIR next states that acute bioassay tests designed to determine the toxicity of these contaminated sediments showed no significant harm to aquatic life except for the sediments behind J.C. Boyle Dam. Aquatic species exposed to chemicals at the concentrations found in sediments behind J.C. Boyle Dam showed "considerably lower survival." *Id.* The EIS/EIR claims an analysis of the effects of these admittedly threatening contaminants is not required because the contaminants will mix with, and be diluted by, the sediments and water released from the three dams below J.C. Boyle Dam. *Id.* at 3.2-121-123.

Contrary to the incorrect view embraced by the EIS/EIR, the solution to pollution is not dilution. Moreover, the EIS/EIR ignores the fact that approximately 22 river miles of aquatic

habitat lie between J.C. Boyle Dam and the next downriver dam. *Id.* at 3.3-25. There will be no dilution of organic and inorganic chemicals for the aquatic species in this area. Moreover, the problem is not confined to sediments behind J.C. Boyle Dam. Dioxin, a known carcinogen, exceeded human health screening levels in each of the three reservoirs behind the dams to be removed.

The EIS/EIR also ignores the fact that aquatic life could be threatened even if contaminant levels are diluted. What the EIS/EIR actually says is that dilution will result in "diminishing the potential" problem. *Id.* at 3.2-121. Diminishing the potential for a problem is far different than not having a problem – and the potential harm is never analyzed.

Nowhere is the unwillingness of the EIS/EIR to actually consider the effects of these contaminants on the environment more apparent than with respect to known carcinogens such as dioxin, DDT, and PCBs. The EIS/EIR states dioxin levels in sediment "exceed Oregon human health and bioaccumulation thresholds...." *Id.* at 3.2-31. While this is true, the EIS/EIR fails to explain that the dioxin contamination problem is not limited to the reservoir behind J.C. Boyle Dam. The EIS/EIR also neglects to mention that the dioxin concentrations exceed the Environmental Screening Level for Human Health set by California. The EIS/EIR then fails to consider that DDT is found in J.C. Boyle reservoir sediments above both fresh water and human health standards. Finally, the EIS/EIR fails to consider that dioxin, furan, and PCBs were found in each reservoir sediment at levels above Oregon's hazardous threshold for mammals. *Id.* at 3.2-119. The EIS/EIR cavalierly dismisses all of these problems by stating, for example, that Oregon's "human health thresholds" of harm are "lower" than federal levels and Oregon's standards do not apply in California. Therefore, there is risk to human health or the environment that merits analysis. *Id.* at 3.2-31 and 3.2-119.

Such a dismissal of issues, such a lack of analysis of actual and potential effects of known carcinogens, cannot be said to meet NEPA's or CEQA's standards for a hard look at environmental effects. Compounding these failures is the absence of any analysis of the effects of the plan to spray herbicides over up to 75% of the total reservoir area behind the dams. *Id.* at 3.2-120. The herbicides are to control invasive plant species. *Id.* However, the EIS/EIR does not examine the effects of adding herbicides to the environment, including the riverine environment into which the chemicals will wash. Why is there no analysis? Because DOI will be using approved herbicides and will be doing so in accordance with the labels. *Id.* That position ignores the fact that huge legal battles are now being waged about whether "approved" herbicides used in accordance with their labels are, in fact, causing harm to aquatic species. The EIS/EIR cannot ignore this issue, particularly when ESA protected species inhabit the river.

Finally, it is a telling commentary on the bias in the EIS/EIR that the EIS/EIR concludes the alleged mild contaminant effects of the Proposed Action justify a finding that the Proposed Action will have less than significant impact while the same EIS/EIR concludes that the "minor or limited adverse effects" of the No Action Alternative supports a determination of potentially significant impacts. EIS/EIR at 3.2-74 and 75. The threshold of significance cannot be changed on a whim such that chemicals found in concentrations likely to produce mild effects are significant when evaluating the No Action Alternative, but are less than significant when evaluating the Proposed Action. Lead Agencies have discretion to set significance thresholds, but not the discretion to employ those thresholds in a manner that leads to a biased evaluation of, and conclusions regarding the potential impacts of the Proposed Action as compared to project alternatives.

8. Conclusion

As to water quality, the EIS/EIR admits the Proposed Action makes the problems worse by increasing sediment and nutrient loads and the growth of harmful algae. DOI's Expert Panels conclude that the problem of increased water temperature and temperature variability is made worse by the Proposed Action. The EIS/EIR admits lower dissolved oxygen and elevated pH issues are made worse by the Proposed Action. But the EIS/EIR fails to examine key parameters, fails to properly assess significance of impacts, uses incorrect baseline assumptions, and fails to consider important issues. In short, once again, the EIS/EIR fails to meet even the minimal standards of legal adequacy as to analysis – and where such analysis exists, it shows the Proposed Action makes water quality problems worse, not better, further jeopardizing the already unsure habitat and water quality improvements that should be derived from implementation of the Foreseeable Restoration Measures.

H. Groundwater

To examine the effects of the Proposed Action on groundwater, the EIS/EIR begins by inappropriately limiting the area of analysis. The EIS/EIR states the area of analysis is the Klamath Basin upstream of Copco 1 Dam because this area is covered by a U.S. Geological Survey model designed to determine the effects of various actions on groundwater. EIS/EIR at 3.7-1. The entire area below Copco 1 Dam is excluded from any analysis and never considered in the EIS/EIR because "[n]o model exists for areas below Copco 1 Dam." *Id.* The lack of any such model does not excuse the Lead Agencies from their NEPA and CEQA responsibility to consider the impacts of the Proposed Action. And impacts there will be.

Groundwater in the region is largely fed by percolation from the surface. *Id.* at 3.7-5. Clearly, the reservoirs behind the dams are a source of the percolation. Conspicuously absent from the EIS/EIR is any analysis of how a change from reservoir related groundwater recharge to

river and aerial precipitation recharge will affect groundwater supplies. Instead, the EIS/EIR contains the unsupported conclusory statement that the amount of water will be about the same. *Id.* at 3.7-17. Compounding the lack of analysis regarding supply impacts is the absence of analysis regarding increased usage impacts. For example, the EIS/EIR admits the Proposed Action will result in hundreds of agriculture irrigators "pumping more groundwater." *Id.* at 3.15-72. Notwithstanding no factual analysis of either the supply or the demand side of the groundwater issue, the EIS/EIR concludes the impacts of the Proposed Action on groundwater "would be less than significant." *Id.* at 3.7-17. This type of unsupported conclusory statement is typical of the EIS/EIR and further documents its legal deficiency.

This deficiency is crystallized by the admission that domestic and irrigation wells may need to be deepened so that users can continue to receive water in the needed quantity and flow. *Id.* at 3.7-16. Indeed, the chosen groundwater impact mitigation measure in the EIS/EIR "provides for the deepening (or replacement) of an existing affected domestic or irrigation groundwater well so the groundwater production rate from the well is returned to conditions prior to implementation of the Proposed Action…." *Id.* at 3.7-22. Wells would not need to be deepened if groundwater levels were not dropping because of the Proposed Action. Yet, the EIS/EIR offers no analysis of the impact of the Proposed Action on this natural resource.

Further illustrating the need for, and the absence of, analysis is the discussion of the effects of the KBRA. The EIS/EIR states the KBRA will reduce surface water diversions by a significant amount in order to leave water in the river for fish. *Id.* at 3.7-19. The EIS/EIR goes on to admit this will increase the need for groundwater pumping as a replacement water supply. *Id.* Are the interrelated and cumulative effects of dam removal and the KBRA ever considered in the EIS/EIR? Not surprisingly, the answer is no. The only thing said is that since the surface

actions associated with dam removal are geographically separated from actions associated with changing water diversions, groundwater is not likely to be affected. *Id.*

Finally, as discussed in more detail in the energy issues section of these Comments, (*see* Part II.N of these Comments), the EIS/EIR has no analysis of the cost to domestic and irrigation groundwater users of having to pay for increased pumping costs associated with deeper wells. Nor does the EIS/EIR address the issue of from where users will get temporary water supplies while their wells are being deepened.

I. Air Quality and Climate Change

The EIS/EIR states: "No operational sources are part of the Proposed Action; therefore, this analysis considers only construction-related air quality impacts." EIS/EIR at 3.9-10. While the Lead Agencies are not proposing an "operational" component of the Project, operational sources are a reasonably foreseeable outcome of the Proposed Action. For example, additional operational sources will be necessary to generate the power required to serve customers presently receiving power generated by the dams. This is expressly acknowledged in Section 3.10 of the EIS titled Greenhouse Gases/Global Climate Change. Thus, the statement that no operational sources are part of the Proposed Action is fundamentally flawed and inconsistent with other sections of the EIS/EIR. The EIS/EIR must address the additional pollutants that will be generated from the new sources needed to provide energy once the dams are removed. There is a high likelihood that the sources of this additional power will increase emissions because the hydroelectric power from the dams currently generates only minimal emissions associated with "vehicle exhaust from continued maintenance and operation of the Four Facilities." EIS/EIR at 3.9-10. In fact, the EIS/EIR admits increased air emissions are related to "replacing hydropower at the dams with power that is likely to be produced, at least in part, from fossil fuels through other regional sources." EIS/EIR at 3.10-14.

To compensate for the likely increased air emissions resulting from not using clean hydropower, the EIS/EIR alleges emissions benefits could occur from "alterations in land use, agricultural resources (including the creation of new agricultural areas) and recreation from implementation of the KHSA and KBRA" and the EIS/EIR expects that "a net reduction in carbon emissions could occur from the land use conversion." *Id.* at 3.10-16-3.10-17. The problem with the EIS/EIR's treatment of this issue is that no substantive information is provided that describes the number of acres for which sequestration might be increased or the feasibility and responsibility for implementing such projects to demonstrate that they will in fact provide a net reduction in carbon emissions. Furthermore, while the KBRA includes a Renewable Power Program, that plan has not been developed and the EIS/EIR does not document the extent to which renewable power can realistically replace the existing hydropower from the dams.

Further, the mitigation measures proposed to address increased air emissions do not meet basic standards to qualify as mitigation measures. The measures focus on reducing energy use, presumably to reduce the demand for non-renewable energy resources, which demand will likely increase under the Proposed Action. However, the EIS/EIR is devoid of analysis explaining how these measures would reduce energy consumption over and above current programs in California or Oregon. In addition, "[m]itigation measures must be fully enforceable through permit conditions, agreements, or other legally binding instruments." CEQA Guidelines §15126.4(a)(2). Mitigation Measures CC-1 through CC-3 are lacking critical details such as which party is to implement the measure, how the measures would be implemented, at what point in time these measures would reduce the demand for energy, and any performance standards. Without such information, the alleged mitigation measures are meaningless and do not meet NEPA or CEQA requirements.

An additional mitigation measure should be included for Alternatives 2 and 3. The additional mitigation measure is necessary to provide funding for the extra costs that Siskiyou County and other municipalities and agencies will incur to develop greenhouse gas emission reduction/climate action plans in light of the increase in emissions created by removal of clean hydroelectric power and replacement of such power with non-renewable, greenhouse gas-emitting sources.

To quantify the alleged effectiveness of the various GHG emission reduction measures discussed in the EIS/EIR, that document uses the California Air Pollution Control Officers Association publication. The specific example, EIS/EIR at 3.10-45, is related to efficiency of construction of a non-residential building using additional energy efficiencies compared to the 2008 Title 24 standards. But this example is irrelevant to the actual existing conditions and facts in the project area. The issue in the project area is impacts on existing communities and their existing residential and non-residential units. Providing an example of new development and the efficiencies that could be achieved does absolutely nothing to evaluate the impacts of the proposed project on existing communities.

Moving to the issue of methane gas, the treatment in the EIS/EIR of methane gas release from reservoirs has at least two flaws. First, as the Karuk Tribe 2006 comment letter acknowledges there is "a lack of KPH-specific data, [and] estimating its methane emissions precisely is not possible at this time." The Tribe went on to state that "site-specific studies of KPH reservoirs could be used to refine the estimate." The EIS/EIR does not inform the reader of these substantive qualifications to the results or that the so-called "calculations" are in reality nothing more than comparisons to other reservoirs with no actual site specific information. Rather than conduct the site-specific study called for by the Karuk Tribe, the EIS/EIR simply

inserts the 2006 information, making one small adjustment related to the global warming potential of methane, but not making any other attempt to link the EIS/EIR conclusions to existing conditions at the reservoirs. Second, the EIS/EIR completely ignores potential mitigation measures for the other alternatives. A fair and unbiased comparison of the impacts of the alternatives requires that reasonable and feasible mitigation measures be included for all of the alternatives, not simply for Alternative 2.

In that regard, Tables 3.10-17 and 3.10-18 of the EIS/EIR compare the GHG emissions of the alternatives with and without methane generation from the reservoirs. EIS/EIR at 3.10-45. As previously indicated, the methane generation from the reservoirs is speculative and unsubstantiated. The key point, which the EIS/EIR does not address, is that other alternatives such as Alternative 4 have a dramatically lower GHG emission level than Alternatives 2 or 3. CEQA requires that the Lead Agency "should not approve projects as proposed if there are feasible alternatives or feasible mitigation measures available which would substantially lessen the significant environmental effects" of the project. Pub. Res. Code §21002. Alternative 4 is the environmentally superior alternative relative to GHG emissions, and the Lead Agencies must demonstrate why Alternative 4 is not feasible in order to select Alternative 2.

Finally, it must be noted the EIS/EIR makes several statements and conclusions about free-flowing rivers as compared to systems with dams and the manner in which these two different systems respond to climate change. ***See e.g.***, EIS/EIR at 3.10-9, 3.10-10, 3.10-13. These statements and conclusions are used to support dam removal. But the EIS/EIR ignores the fact that downstream of Iron Gate Dam the river is free flowing for 190 miles. The dams proposed to be removed are a small percentage of the Klamath River. The EIS/EIR does not provide a complete and unbiased comparison of alternatives because no mitigation measures or

design features are included for the No Action/No Project or Fish Passage at Four Dams alternatives. Without an evaluation of the manner in which those alternatives might adapt, respond to, or mitigate the effects of climate change, the analysis is incomplete and skewed to dam removal.

J. Transportation

Dam removal will result in tons of waste material that must be transported to disposal sites. In an understatement of reality, the EIS/EIR concludes "[s]ome of the roads in the area of analysis may not have been designed to sustain heavy roads." EIS/EIR at 3.22-15. The facts are that the roads and bridges were not so designed and cannot support the weights to which they will be subjected. Indeed, the EIS/EIR admits that for the Copco 2 Dam removal "[t]he existing access roads would require substantial upgrades to handle the hauling of the excavated concrete and provide access for a large, crawler-mounted crane." *Id.* at 2-26. For other roads at other dams the EIS/EIR concedes "[c]onstruction equipment could damage existing roads during deconstruction." *Id.* at 4-173. With respect to bridges, the EIS/EIR acknowledges that three bridges that will be important for the transport of dam removal waste "could be incapable of supporting and withstanding the weight of heavy deconstruction and hauling vehicles." *Id.* All of these structural problems are worsened to the extent heavy deconstruction traffic is using these roads and bridges during the wet months of the year.

Instead of conducting the analysis NEPA and CEQA require of these infrastructure issues, the EIS/EIR says "an in depth analysis of bridge and road capacity" will be done later. *Id.* For the EIS/EIR to meet NEPA and CEQA standards for adequacy, that analysis must be in the EIS/EIR. If the existing transportation infrastructure is inadequate to accomplish dam removal, it calls into question the feasibility of the Proposed Action. If it is DOI's position that this is a mitigatable issue, then it is incumbent that the EIS/EIR explain how.

In addition to these fundamental policy issues, the EIS/EIR has numerous factual errors. For example, the EIS/EIR describes Copco Road as a paved, two lane road in good condition, with a speed limit of 55 mph. EIS/EIR at 3.22-4-5. This description might be appropriate on the first three miles from Interstate 5 to the Klamathon Bridge. Beyond that point, 70%-80% of the road is in very poor to failed condition. Moreover, the EIS/EIR assumes construction traffic will be occurring between January and September and spreads construction traffic impacts to Copco Road over this time frame. Because of the documented poor condition of Copco Road, the County has greatly restricted truck traffic to the dry summer months. To the extent the Proposed Action contemplates using Copco Road for heavy machinery access and for waste hauling in months other than the dry summer months, the Proposed Action is inconsistent with applicable County requirements. Equally important, given that Copco Road is already in a state of serious disrepair, the EIS/EIR discusses neither the inevitable need to reconstruct Copco Road after dam removal nor the environmental impacts of that action.

Similarly, the EIS/EIR states Patricia Avenue and Ager Beswick Road would provide haul access from Copco 1 and Copco 2 dams. *Id.* at 3.22-5. However, Patricia Avenue is a residential street and neither road was designed for heavy loads. Furthermore, there is no road connecting Patricia Avenue to either dam. The EIS/EIR also ignores the fact that the "possible" closing of Copco and Topsy Grade Roads during dam deconstruction, *id.* at 3.22-13 n.4, is simply unacceptable given that there are private homes served by these roads.

Lastly, unaddressed are issues related to the maintenance of public roads in the project area. There are, according to information provided by the Siskiyou County Department of Public Works, over 200 culverts beneath the public roads in the project area. These culverts empty into the reservoirs. Many of these culverts have outflow that will have to travel from what is now

lake edge to the new channel. There is no examination of the potential for scour and erosion in these culverts as a result of the Proposed Action.

K. Noise

Like the discussion of transportation impacts, the evaluation in the EIS/EIR of noise impacts is woefully inadequate. It fails to meet the most basic requirements necessary to provide a meaningful review of the Proposed Action. Indeed, the typical review by the County of Siskiyou of the noise effects of much more limited projects provides significantly more detailed information and analysis. The absence of any meaningful analysis in the EIS/EIR of the existing noise environment and of how the Proposed Action will impact existing conditions precludes a decision maker from understanding the noise effects of the Proposed Action.

For example, the County of Siskiyou has a General Plan Noise Element ("GPNE") that identifies acceptable noise levels in open space areas, rural areas, etc. It is not possible to evaluate land use noise impacts for consistency with the County's requirements without providing an analysis of the noise levels that will be associated with the Proposed Action. Nowhere does the EIS/EIR provide these data.

Similarly, the EIS/EIR does not collect data on existing noise levels against which the noise from dam removal could be compared and contrasted. Instead, the EIS/EIR uses generalized assumptions from the U.S. Environmental Protection Agency and definitions from the Federal Highway Administration regarding acceptable noise levels in urban areas. There is no explanation of why it is appropriate to use an urban area, which has high background noise levels, as a baseline for rural Siskiyou County. The Thresholds of Significance: Criteria for Defining Environmental Significance, prepared by California's Office of Planning and Research indicate why that baseline is not valid. Therein, it is stated: "The significance of an activity may

vary with its setting. For instance, a subdivision which would create 10 new lots may not be significant in an urban area, but may be significant in an undeveloped rural area."

The rural character of the County is also important for tourists and local citizens using recreational and camping sites within the County of Siskiyou. Many recreational users enjoy sites in the County specifically because of their remote location and solitude. The effects on these people of increasing noise levels from the Proposed Action is never examined, in part because the increased noise levels are never quantified and compared to existing levels.

In that regard, it should also be noted that the EIS/EIR discusses noise questions based on typical residential construction standards. These generalized standards, applicable to urban areas, are inappropriate when applied to rural Siskiyou County. Many County residents live in mobile homes. Mobile homes have significantly different noise attenuation levels than do urban single family homes. The assumptions in the EIS/EIR regarding the applicable standards by which to judge noise impacts are, once again, incorrect.

Finally, in considering noise impacts, the EIS/EIR fails to take into account the conflict between the dam removal schedule and the County's regulations. For example, the EIS/EIR assumes construction traffic will occur between January and September. However, because of the well-documented poor condition of Copco Road, the County has placed significant restrictions on the use of this road by trucks outside of the dry summer months. The Proposed Action contemplates spreading the noise from the movement of heavy equipment and the hauling of tons of waste over nine months and assumes the total amount of new noise is divided by nine. However, these operations will have to be done in many fewer months because of road conditions and the County's Ordinance. Therefore, the EIS/EIR incorrectly analyzes the monthly impact of truck noise along Copco Road.

The discussion of noise mitigation measures suffers the same defects. For example, Mitigation Measure NV-1 provides that truck loading, unloading, and hauling operations will be scheduled so as to reduce noise impacts "to less than noticeable levels." EIS/EIR at 3.23-22. However, truck volumes will more than double along roads such as Copco Road. Given the enormity of the project and the doubling of traffic from heavy trucks, the proposed mitigation is simply not achievable. Noise and traffic levels cannot be reduced to less than noticeable amounts.

In sum, the evaluation of noise impacts from the Proposed Action is wholly inadequate. It proceeds from incorrect assumptions and fails to discuss, let alone examine, important aspects of the issue.

L. Waste Disposal

The EIS/EIR begins its discussion of waste disposal issues by stating that all concrete and earth waste resulting from dam removal will be disposed of onsite or near the existing dam sites. EIS/EIR at 3.18-21. That leaves 7,200 tons of metal, some of which would be recycled, and 4,500 tons of rebar for disposal offsite. *Id.* The EIS/EIR concludes the disposal of rebar and metals is not an issue with respect to landfill capacity because the combined remaining capacity of the Yreka Solid Waste Landfill and the Klamath Falls Landfill is 4.3 million cubic yards. *Id.* In addition, the Dry Creek Landfill is reported to have 165 million cubic yards of unused capacity. *Id.* The EIS/EIR asserts this is a sufficient capacity. However, the EIS/EIR does not analyze the effect of using this capacity for dam removal waste on the long-term plans of the affected Counties for landfill capacity. The affected Counties are the entities that will bear the long-term burdens and costs of finding new capacity if existing capacity is consumed by dam waste. In that regard, the EIS/EIR acknowledges the "population in Siskiyou and Klamath Counties is expected to increase" and as a consequence "the generation of solid waste would also

be expected to increase...." *Id.* at 4-173. Then, stating the obvious, the EIS/EIR concedes "[s]olid waste facilities have a finite amount of space and can only accept waste if space is available." *Id.* Having identified the problem the Counties will face, the EIS/EIR fails to examine the consequences of dam removal for the Counties' solid waste disposal plans.

The problem becomes even more severe when one considers the fact that the Proposed Action will also generate 1,241,500 cubic yards of earth and 126,000 cubic yards of concrete. EIS/EIR at 3.18-21. At one point, the EIS/EIR states all of this material will be disposed of at or near the dams. *Id.* Later, the EIS/EIR states "[t]he earth, concrete, and rebar waste that would be removed from the facilities under the Proposed Action would be sent to local landfills. The selected landfills in the region have adequate capacity to absorb the debris...." *Id.* at 4-173. So, which is it? How is a decision maker to evaluate the impacts of solid waste disposal when the EIS/EIR presents conflicting strategies and analyzes neither?

Assuming the idea is to bury 1,367,000 cubic yards of earth and concrete onsite, the EIS/EIR opines that "[p]ermanent disposal sites would be needed near the dams on lands currently designated open space and/or conservation." *Id.* at 3.1423. Conspicuously absent from the EIS/EIR is any discussion of the impacts on these protected open space and conservation areas of disposing of 1,241,500 cubic yards of earth and 126,000 cubic yards of concrete. Digging up and burying this enormous volume of waste will have effects on open space and conservation areas. But the EIS/EIR, in yet another failure of analysis, is silent as to these effects.

If, however, the plan is to dispose of 1,367,500 cubic yards of earth and concrete waste at the Yreka Solid Waste Landfill and the Klamath Falls Landfill, the EIS/EIR fails to discuss the impact on the Counties of using 32% of the remaining 4.3 million cubic yards of capacity at

these facilities. The EIS/EIR acknowledges the Counties will grow and will need landfill capacity, but ignores the consequential economic and environmental impacts of using one-third of the remaining capacity of these two landfills for dam removal, including the economic and environmental consequences to the Counties of having to site replacement capacity.

In other words, a decision maker reading the EIS/EIR and attempting to make a reasoned decision about environmental consequences does not know what is planned and does not know the consequences of the possible plans. This is hardly the stuff of informed decision making that satisfies NEPA or CEQA.

M. Socioeconomic, Land Use, and Related Issues

The County of Siskiyou comprises 6,340 square miles of which over 60% is owned and managed by federal and state agencies. EIS/EIR at 3.14-5. The County is home to 44,328 people. *Id.* Unfortunately, according to California's statistical reports, their income is only 73% of the State's average income and their median income is only 60% of the State's average. Currently, the County is experiencing in excess of 17% unemployment. The County and its citizens are suffering extreme economic hardship.

To enable it to serve its citizens, Siskiyou County receives tax revenues that are derived principally from property taxes and from sales and use taxes. *Id.* at 3.15-20. These taxes support essential governmental services such as education, health, public assistance, emergency services, and public recreation.

The vast majority of the County's tax revenue comes from privately-owned property. The EIS/EIR states there are 668 parcels with an assessed land value of $9 million that will be affected by dam removal. *Id.* at 3.15-64. Beyond that statement, the EIS/EIR makes no effort to quantify the loss of revenue the County will experience due to land values adversely affected by dam removal. Nor does the EIS/EIR make any effort to assess the impact of lost revenues on the

County's ability to serve its citizens. The EIS/EIR only states that "the Proposed Action could cause a short- and long-term decline in tax revenue" and that "[l]ost tax revenues to Siskiyou County would be an adverse economic effect." *Id.* at 3.15-65 and 4-162.

After admitting adverse impacts, the EIS/EIR seeks to avoid any analysis of these impacts stating that the magnitude of any loss is unknown. *Id.* at 3.15-65. It is curious that the EIS/EIR characterizes the amount of lost revenue impact as unknown given that a study commissioned by DOI reported on March 22, 2011 that the assessed land value of the 668 parcels the EIS/EIR admits will be adversely affected by dam removal will drop by 26% from $8,570,030 to $6,350,785. Bender Rosenthal, Inc., Dam Removal Real Estate Evaluation Report Prepared for the Department of the Interior, March 22, 2011, at 51. However, this number is understated because this is an assessment of land value only and does not include any structures or other improvements on the land. *Id.* at 23.

It is not clear why DOI elected to ignore its own report in the EIS/EIR. It is also unclear why the EIS/EIR neglects to examine the direct and indirect effects of this revenue loss on the County and its ability to serve its citizenry, particularly when buried in another part of the EIS is the surprising admission that the "[r]eduction in the counties' budgets [from lost tax revenue] and resulting reductions or eliminations in social programs would disproportionately affect low income and minority residents and tribal people." EIS/EIR at 5-104.

The only thing the EIS/EIR has to say in response is that lost County income might be made up by revenue from new land uses and from payments from the State of California for payment-in-lieu of property taxes on PacifiCorp property. *Id.* at 3.15-65. But the EIS/EIR offers no analysis or facts to support this claim. Instead, the EIS/EIR says it will "not describe potential changes in land use" that might occur, *id.* at 3.14-1, and fails to explain how a cash

starved state will find the money for the payments-in-lieu of taxes. In the end, the EIS/EIR admits "the Proposed Action would cause short-term and long-term declines in tax revenues to the counties …", *id.* at 5-104, and that County revenues could be affected "indefinitely," *id.* at 4-160. The impacts of that are never analyzed.

Perhaps in an effort to minimize the significance of the expected revenue losses, the EIS/EIR has a table measuring the average tax revenues received by the County of Siskiyou 2000-2010. *Id.* at 3.15-21, Table 3.15-19. This figure, $16,447,000, might be of historic interest but it obscures the fact that the 2010 tax revenue to the County of Siskiyou was only $11,669,731. This number is 29% lower than the historic average and, in present economic conditions, shows no signs of significant change. Any revenue impact assumptions in the EIS/EIR are based on historic revenue data that are off by 29%.

Absent any facts and any analysis of the magnitude or effects of these tax revenue losses, a decision maker cannot assess the socioeconomic impacts of the Proposed Action on the County of Siskiyou. However, what we do know is that 64% of the land in the County of Siskiyou is in federal or state ownership and, therefore, the County has a very limited ability to make up for lost revenue from taxes on privately owned lands.

Compounding this failure of analysis is that the EIS/EIR effectively ignores other aspects of the long-term economic, employment, and revenue impacts of the Proposed Action. The EIS/EIR admits that under the Proposed Action "the regional economy would lose 49 jobs, $2.05 million in labor income and $5.19 million in output ..." due to dam operations. *Id.* at 3.15-54. Added to this is the loss of four jobs and $0.13 million from the loss of reservoir recreation and 14 jobs and $0.43 million from the loss of whitewater rafting opportunities. *Id.* at 3.15-58 and 3.15-61. None of these socioeconomic impacts are examined.

Not only are none of these job loss impacts examined, but the EIS/EIR offers no recognition of the fact that county government is one of the principal employers in the County of Siskiyou. Already, the County has laid off dozens of valuable employees because of declining revenue. The EIS/EIR fails to consider these present and cumulative impacts when it says the County will experience a further decline in tax revenues because of the Proposed Action – a decline that could last "indefinitely."

Instead, the EIS/EIR pivots to claim significant benefits to commercial and recreational fishermen because of alleged increases in fish abundance. *Id.* at 3.15-56-60. However, as noted in Part II.C of these Comments, such claims are illusory.

In still another failure of analysis, the EIS/EIR says land uses will change but, as noted above, "does not describe potential changes in land use that would occur if the dams were removed." *Id.* at 3.14-1. For example, the EIS/EIR fails to examine the potential impact of converting farmland to non-agricultural use notwithstanding the fact that the impact could be huge. *Id.* at 3.14-27. New and different land uses resulting from dam removal will significantly change the socioeconomic landscape of the County of Siskiyou, and other counties. Yet, the EIS/EIR contains no analysis.

Furthermore, the area of analysis for land use effects of the Proposed Action is too limited, *id.* at 3.14-3, Figure 3.14-1, and should be expanded to include the area where reasonably foreseeable effects of the Proposed Action will occur. The magnitude of all the changes that will result from the Proposed Action, the construction and restoration activities, and the vast reach of the related programs are not addressed by the limited area of analysis. The area of analysis should include the entire Klamath Basin, as the effects of the Proposed Action will extend throughout the Klamath Basin.

Finally, the EIS/EIR does not properly examine the socioeconomic impact of lost recreational opportunities for the local citizenry, tourists, and tourism. For example, Hells Corner Reach is the only Class V rapids in the region and it will be lost because of the Proposed Action. *Id.* at 3.20-46. The closest similar experience can only be had by traveling 80 miles. *Id.* The EIS/EIR also concedes that the lakes that will cease to exist because of dam removal provide important recreational opportunities for the people of the region. *Id.* at 3.20-38. However, the EIS/EIR does not examine the related socioeconomic and recreational effects of this loss. Rather, the EIS/EIR simply says people can go elsewhere. *Id.*

All of these failures of analysis are of particular note under NEPA and CEQA. CEQ's regulations implementing NEPA specifically provide that the effects to be analyzed in the EIS include "growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate...." 40 C.F.R. §1508.8(b). Here, however, the EIS/EIR "does not describe potential changes in land use that would occur if the dams were removed." EIS/EIR at 3.14-1. In a conspicuous failure of NEPA compliance, the EIS/EIR does not even begin to examine the effects of land use changes because the EIS/EIR does not describe changed land uses resulting from dam removal.

The problems for CEQA compliance are equally severe. An EIR must address a proposed project's "significant effects on the environment." Pub. Res. Code §21100(b)(l); ***see also*** CEQA Guidelines §15126.2(a) (the EIR "shall identify and focus on the significant environmental effects of the proposed project"). A significant effect on the environment is defined as "a substantial, or potentially substantial, adverse change in the environment." Pub. Res. Code §21068; ***see also*** Pub. Res. Code §21100(d). The EIR must identify both direct and indirect significant effects. CEQA Guidelines §15126.2(a). Where a project's economic or

social effects will cause physical effects on the environment, those effects must be analyzed in the EIR. CEQA Guidelines §15131(a). Additionally, the "[e]conomic or social effects of a project may be used to determine the significance of physical changes caused by the project." *Id.* at §15131 (b). And in considering the feasibility of changing the project so as to reduce impacts, the agency must consider the project's impacts on economic, social, and housing factors. *Id.* at §15131 (c). The Proposed Action's negative impact on the County's tax base and revenue is a significant economic and social factor as are the anticipated changes in land use. The EIS/EIR has not adequately analyzed any of these factors or given them appropriate weight.

N. Energy Usage and Cost

Closely related to the socioeconomic issues discussed in the preceding section is the issue of energy usage and costs. The Proposed Action "would result" in the loss of 169 MW, or 658,000 MWh" of power. EIS/EIR at 3.18-23. The EIS/EIR attempts to gloss over this power loss by asserting it is minimal when compared to the size of the Northwest Power Pool. *Id.* One is reminded of the unfortunate approach applied elsewhere in the EIS/EIR that the solution to pollution is dilution. If we increase the area in which we measure impacts, and the area is large enough, then there is no longer a harm – except of course to the people at the epicenter of the problem. Here, the people at the epicenter are those who depend on power from the dams. As to those people, the EIS/EIR is forced to admit "the loss of power generated may have some impact to the local area…." *Id.* To put this loss of power into perspective, 658,000 MWh is enough to power approximately 65,000 homes for one year. There are only 23,506 homes in the County of Siskiyou. *Id.* at 3.17-6. In other words, the "some impact to the local area" means that every household in the County of Siskiyou will be affected. In fact, the July 2008 report by Camp, Dresser and McKee Inc. prepared for DOI estimates the cost of replacing this lost power at approximately $172 million.

Beyond admitting there will be "some" local impact, the EIS/EIR says nothing more. There is no analysis of what the socioeconomic effects might be although the EIS/EIR does make two significant admissions. First, PacifiCorp will need to purchase "at least 42.7 MW" of replacement power. EIS/EIR at 3.17-6. Second, irrigators will be pumping more water under the Proposed Action than under the status quo and, therefore, "paying more for electricity under the Proposed Action…." *Id.* at 3.15-72.

The EIS/EIR contains no discussion of the effect of these increased costs on the approximately 550 irrigated farms in Siskiyou County. Nor does the EIS/EIR explain what additional economic costs the consumer will bear because PacifiCorp is having to purchase power after dam removal. DOI's disregard of these economic impacts must be considered in light of the fact that the citizens of the County of Siskiyou are already reeling from 17% unemployment and a flagging economy. Yet, the EIS/EIR is devoid of any analysis of this socioeconomic and human impact of dam removal.

Similarly, the EIS/EIR is devoid of any analysis of the long term environmental impacts of not having clean hydropower. The EIS/EIR dismisses these impacts with the assertion that the four dams provide only a small amount of the total power in the Northwest Power Pool and, besides, PacifiCorp will need to develop more power sources by 2018 in order to meet growing energy demands. *Id.* at 3.18-23-24. While the individual impact of dam removal may, or may not, be small, there is an impact, and it is an impact whose strength is multiplied when it is cumulated with the loss of other power sources and with increasing demands for power. The EIS/EIR contains no analysis of this cumulative effect – and no analysis of the environmental consequences of using other power sources, including the construction of power generating facilities and associated transmission lines.

The reality is that replacing clean hydropower with virtually any other power source increases pollution emissions or otherwise adversely affects the environment. The EIS/EIR seeks to avoid these issues by pointing, for example, to wind power as a clean energy alternative. Even here, the EIS/EIR fails to note the high degree of environmental controversy surrounding wind power – a controversy that has caused DOI to develop new guidelines to reduce the number of birds killed by large wind power turbines. The EIS/EIR also points to coal with its well known environmental issues and to natural gas while noting that natural gas plants require a large amount of fuel. *Id.* at 3.18-23. The fact the EIS/EIR seeks to avoid is that replacing clean hydropower with other energy sources has consequences. But none of these consequences are examined in the EIS/EIR.

O. Water Rights

The discussion in the EIS/EIR regarding the Proposed Action's impacts on surface water supply availability and water rights compliance relies on incomplete data as to the water supplies, rights, and facilities the Proposed Action will affect. The EIS/EIR also impermissibly defers analysis of the Proposed Action's effects to some later time and fails to recognize and analyze important impacts.

1. The EIS/EIR Fails to Analyze the Decreased Reliability of Yreka's Municipal Water Supply That Will Result From Implementation of the Proposed Action

The City of Yreka, which is filing separate and additional comments on the EIS/EIR, is dependent on the Klamath River watershed for its municipal water supply. Specifically, under California State Water Rights Permit No. 15379, the City may draw up to 9.7 million gallons of water per day from Fall Creek, a Klamath River tributary. This diversion has been in place for over forty years. Fall Creek water is transported to the City of Yreka via a 24-inch pipeline that passes under the Eastern (upstream) portion of Iron Gate Reservoir.

This pipeline will have to be relocated before the Proposed Action can proceed. EIS/EIR at 3.18-14. Otherwise, the pipeline will be damaged by construction activities associated with dam removal, or damaged by the increased water velocities that may result once the dam reservoir is drawn down. *Id.* The EIS/EIR contemplates the pipeline will be rebuilt, either along a pipe bridge across the river or attached to the Lakeview Bridge, which is downstream of the Iron Gate Dam and Reservoir.

With no analysis whatsoever, the EIS/EIR concludes that the demolition and reconstruction of this important pipeline, a key part of the City of Yreka's municipal water supply infrastructure, will result in no change from existing conditions. There are six problems with the approach delineated in the EIS/EIR.

First, construction of the type necessitated by demolishing and moving the pipeline is not guaranteed to proceed smoothly. While the EIS/EIR seeks to assure us that the water supply for Yreka will be unaffected by pipeline relocation, it provides next to no discussion of why this is true. The EIR/EIR states the pipeline would be disconnected "for a short period of time" but does not state how short or long that period will be. It fails to specifically discuss the sources from which water for the City will come during the pipeline's disconnection and fails to analyze the environmental and economical effects of using those alternative sources.

Second, the EIS/EIR neglects to discuss whether its proposed new pipeline can survive natural disasters such as flooding, rockslides, and seismic events. A 100-year flood, for example, may carry uprooted trees and other debris that extend far above the water's surface. The new pipeline proposed in the EIS/EIR is an above-ground suspended pipeline bridge or a pipeline attached to the underside of Lakeview Bridge. There is no analysis of the ability of the proposed new structure to withstand natural forces. For example, there is no evidence the

EIS/EIR considered whether the height of the proposed pipeline above a 100-year flood level is sufficient to protect it from the water and floating debris. Equally important, the EIS/EIR omits any discussion of how an above-ground pipeline can be protected from malicious human interference in the form of vandalism or terrorism.

Third, and related to the first point, the EIS/EIR fails to consider the importance of the water supply to the citizens of the City of Yreka. Approximately 7,500 people depend on the existing pipeline for their water. The EIS/EIR is devoid of any discussion of how these people will receive water if there is a disruption in service caused by the problems discussed above. Given the City's Water rights Permit and the needs of its citizens, this is a conspicuous failure of analysis in the EIS/EIR.

Fourth, the proposed above-ground pipeline will be significantly longer than the existing pipeline. The Lakeview Bridge, for example, is located a significant distance from the current crossing location. Therefore, the installation of thousands of feet of additional pipeline becomes a necessity. This significantly changes the hydraulics of the system because there is always friction with the water along the pipeline wall. Increasing pipeline length increases the period of time this friction occurs and slows water speed/pressure, necessitating stronger pumps to maintain the same water pressure that would exist in a shorter pipeline. The EIS/EIR fails to consider whether the existing pump infrastructure can support a longer pipeline.

Fifth, the EIS/EIR fails to consider the economic impacts of building new pumping infrastructure and of maintaining a longer pipeline.

Sixth, the existing pipeline contains a cathodic system to protect it from rusting. The system uses electric energy to safeguard the pipeline from corrosion. The EIS/EIR fails to consider how its proposed above-ground pipeline will be connected to the existing cathodic

system, whether the existing system is sufficient to service a longer pipeline, and who bears the cost of installing and maintaining a larger system.

All these issues could be avoided if the replacement pipeline were constructed in the same way as the original pipeline, but the EIS/EIR refuses to analyze this alternative. *Id.* at 2-29. Instead, the EIS/EIR dismisses the idea of a replacement underground pipeline stating it "would likely require digging in bedrock, which would be complicated and expensive." *Id.* Not only is there no analysis to support this conclusory statement, but it is wrong. It is common in areas where rock geology occurs to bury pipelines. Numerous buried pipelines have been installed in bedrock throughout northern California using rock excavation equipment such as rock trenchers, rock saws, and rock wheels. Trenchless pipe installations using directional drilling or bore and jack methods have also been successfully completed in bedrock. There are many contractors in California who have this type of equipment. Despite these factors, the EIS/EIR rejects this option without any analysis.

The facts are that the existing pipeline was designed and constructed underground to protect it and to assure its long-term service to the City. The Proposed Action should not jeopardize this and any replacement pipeline should be constructed in a manner similar to the original. The demolition and permanent reconfiguration of the pipeline is likely to adversely affect the reliability of water supply to the City of Yreka and the EIS/EIR fails to consider the relevant issues.

This failure is even more glaring given that the California legislature has a clearly articulated policy that the reliability of water supplies, including municipal water supplies, is an important state goal, one that is consistent with the California Constitution. *See* Water Code,

§§10531 and 10610.2. This is especially true in the context of city water supplies. Water Code, §106.5, provides:

> It is hereby declared to be the established policy of this State that the right of a municipality to acquire and hold rights to the use of water should be protected to fullest extent necessary for existing and future uses[.]

Water use in California has to be reasonable and beneficial. Cal. Const. Art. X, §2. Reliability of water supplies is a key component of beneficial use: "Conservation and reliability of water supply fall within the parameters of the constitutional mandate of reasonable beneficial use. (Cal. Const., art. X, §2; Water Code, §§100, 102, 105.)" *Hillside Memorial Park & Mortuary v. Golden State Water Co*., 199 Cal.App.4th 658, 671 (2011). Moreover, "[c]onservation of water and reliability of the water supply are matters of significant public interest and are of transcendent importance." *Central and West Basin Water Replenishment Dist. v. Southern Cal. Water Co.,* 109 Cal.App.4th 891, 903 (2003) (internal quotation omitted).

The deconstruction and relocation of the City of Yreka municipal water supply pipeline will have significant effects on the short- and long-term reliability of the water right represented by the City's permit. However, the EIS/EIR fails to analyze these effects, which is counter to the articulated policy and case law of the State of California, each of which place great priority on water supply reliability in the context of municipal water supplies.

2. The EIS/EIR's Analysis of Impacts to Water Rights is not Based on Sufficiently Specific Data About Those Rights

Although the EIS/EIR makes an effort to identify water rights that will be affected by the Proposed Action, it wholly fails to consider the specific circumstances and physical facilities associated with the vast majority of those water rights and diversions. Accordingly, the evaluation of impacts is not tethered to actual facts.

The EIS/EIR explicitly concedes this shortcoming. In discussing the existing Klamath River water rights that are likely to be affected by the Proposed Action, the EIS/EIR states that although "each of these water rights listings will have associated intake facilities to draw water from the Klamath River … the specific type, location, and layout of each of these intake facilities is unknown at this time." EIS/EIR at 3.8-11. Without any specific knowledge about the location, layout, and construction of the intake facilities and diversion structures associated with the water rights being analyzed, it is hard to understand how the EIS/EIR can possibly analyze the Proposed Action's impacts on those water rights.

The Significance Criteria for the EIS/EIR regarding water rights are: (1) injury to existing water rights or adjudication claims, and (2) decreasing water supplies beyond what is needed for public health and safety (***i.e.***, needs for drinking water and fire suppression) for the current population. ***Id.*** at 3.8-13. Again, it is impossible to apply these criteria to the existing water rights in a vacuum; that is, without knowledge of how those rights are exercised and implemented.

For example, the EIS/EIR analyzes the potential sediment-caused impacts resulting from the Proposed Action and concludes that, although significant adverse impacts would result, Mitigation Measure WRWS-1 would reduce the impacts to a less than significant level. ***Id.*** at 3.8-17. However, as noted in previous sections, the EIS/EIR has seriously understated the amount of sediment at issue and, therefore, the effect of this mitigation measure is in doubt. Mitigation Measure WRWS-1 contemplates that ***after*** the dams are removed, and at the water rights holders' request, there will be an investigation of the impacts caused by the Proposed Action, at which time the Dam Removal Entity will modify the impact points as necessary so as to reduce the Action's effects. ***Id.*** at 3.8-26. This is an example of putting the cart before the

horse, wherein the environmental planning documents have improperly deferred the substantive environmental analysis of the Proposed Action's effects to some future time.

By failing to determine the actual scope and nature of the specific water rights and water intake facilities likely to be affected by the Proposed Action, the EIS/EIR has failed in its obligation to take a "hard look" at the environmental issues and effects that will result from the Proposed Action. Far from being "a thorough investigation into the environmental impacts of an agency's action and a candid acknowledgment of the risks that those impacts entail," the draft EIS/EIR instead impermissibly defers the analytical investigative work to the post-action future. *National Audubon Society v. Department of the Navy*, 422 F.3d 174, 185-186 (4th Cir. 2005) (citations omitted). Although "foreseeing the unforeseeable is not possible, an agency must use its best efforts to find out and disclose all that it reasonably can." CEQA Guidelines §15144. Here, the EIS/EIR does not show that the agency has used its best efforts to find, disclose, and analyze all that it reasonably can about the actual scope and nature of the water rights and facilities that will be impacted by the Proposed Action.

Instead of relying on mitigation measures to provide post-hoc information about the specific environmental impacts of the Proposed Action on water rights, the EIS/EIR needs to establish specific information about the rights and water intake structures that will be affected. This is especially true in light of the EIS/EIR's conclusion that the release of sediment currently stored in the reservoirs will change Klamath River geomorphology and affect water intake pumps downstream from Iron Gate Dam. EIS/EIR at 3.8-17. There again, the EIS/EIR confirms that the "specific layout of the intake facilities is unknown." *Id.* Although these facilities represent important water rights for domestic, irrigation, and/or fire protection use, the EIS/EIR fails to articulate the scope and extent of the Proposed Action's impacts on those rights.

3. The EIS/EIR Fails to Articulate Why Actions Contained in the KBRA Will Not Have an Effect on Water Rights

In conclusory fashion, the EIS/EIR states that impacts from programs contained within the KBRA, which is a component of the Proposed Action, will not affect water rights and water supplies. These conclusions are premised in large part on the vague concept of "geographic separation" between the specific KBRA project components and the hydroelectric facility removal actions.

However, the EIS/EIR fails to articulate where these projects are in relation to the water rights and supplies being analyzed, and why the stated "geographic separation" is sufficient to ensure there are no effects. This lack of analysis is present for the Fisheries Reintroduction and Management Plan, *id.* at 3.8-19, the Wood River Wetland Restoration, *id.* at 3.8-20, the Water Diversion Limitations, *id.*, the Water Use Retirement Program, *id.* at 3.2-21, the Off-Project Water Reliance Program, *id.* at 3.8-22, and the Interim Flow and Lake Level Program, *id.* at 3.8-24. Without a description of the actual "geographic separation" and physical interrelation between these important aspects of the Proposed Action and water rights, the public has no way of critically evaluating the EIS/EIR's conclusion that no effects will result from these components of the Proposed Action.

P. Cultural and Historic Resources

The EIS/EIR states DOI will use the NEPA process to comply with the requirements of section 106 of the National Historic Preservation Act ("NHPA"). EIS/EIR at 3.13-3. However, the EIS/EIR admits it fails to meet the requisite analytical standards. The EIS/EIR states: "The specific details of how the proposed undertaking or the alternatives might be implemented are not fully known at this time and cannot be fully analyzed in the EIS/EIR." *Id.* The EIS/EIR admits: "The identification of a potential effect on some historic properties cannot be fully

determined prior to approval of either the proposed undertakings or an alternative...." *Id.* at 3.13-4. It is hard to see how the EIS/EIR can be considered as complying with NEPA, CEQA, or the NHPA when the EIS/EIR admits it cannot undertake, and has not undertaken, the required NHPA analyses.

Nevertheless, the EIS/EIR persists in claiming it has done an adequate job of analysis. The EIS/EIR states it is integrating the NHPA requirements into the NEPA process "pursuant to the criteria identified in 36 CFR Section 800.8(c)(1)-(4)." *Id.* at 3.13-1. A closer look at the referenced section only serves to demonstrate that the EIS/EIR does not and cannot, comply with the NHPA. 36 C.F.R. §800.8(c)(4) provides:

> If an agency official has found during preparation of an ... EIS that the effects of an undertaking on historic properties are adverse, the agency official shall develop measures in the ... DEIS, or EIS to avoid, minimize, or mitigate such effects.

The regulations go on to say that the agency's responsibilities are "satisfied" when it has entered into a "binding commitment" to implement the identified mitigation measures or the Advisory Council on Historic Preservation has commented on the measures. *Id.* Here, the EIS/EIR cannot yet identify the adverse effects, let alone identify mitigation measures and enter into binding implementation agreements or consultations.

Even more stunning given that the EIS/EIR admits the effects of the Proposed Action and alternatives "are not fully known" and "cannot be fully analyzed" is the next statement that "DOI has developed measures to avoid, minimize or mitigate adverse effects to historic properties and historic resources...." EIS/EIR at 3.13-27. It stretches the outer bounds of credibility to claim that one has successfully mitigated for effects that are not even known. Indeed, there is no indication that the material provided by the County of Siskiyou on behalf of the Shasta Tribe

regarding potential cultural and burial sites currently in the project area was ever meaningfully examined.

This leads to the question of exactly what type of mitigation is contemplated. In describing the mitigation plan, the EIS/EIR begins by stating that "adverse effects to known historic properties ... cannot be avoided. In addition, adverse effects to as yet unidentified or unevaluated historic properties expected to be identified ... may result from [the Proposed Action.]" *Id.* at 3.13-34. The EIS/EIR then gives the mitigation plan: "The adverse effects will need to be minimized or mitigated." *Id.* In other words, the mitigation plan is to decide later. This is not the type of concrete mitigation plan that complies with the NHPA.

The absence of any mitigation plan is amply demonstrated by the mitigation measures referenced in the EIS/EIR. These mitigation measures are comprised of (1) continuing to find out what is the problem, and (2) identifying ways to mitigate. *Id.* at 3.13-39-40. For example, mitigation measures CHR 1-4 all state that the first action is to identify cultural and historic resources that will be affected by the Proposed Action. After that process is complete, mitigation measures CHR 1-4 provide for the "identification and evaluation [of] alternatives to avoid, minimize, or mitigate ... adverse effects...." *Id.* at 3.13-39. The EIS/EIR's unsupported conclusion is that this so-called mitigation "would be effective." *Id.* at 3.14-40.

Try as it might, the EIS/EIR does not meet the NEPA or CEQA standards for a hard look at environmental effects. It is hard to look at effects when you are still trying to find out the effects. Further, the EIS/EIR will not substitute for the analysis and concrete mitigation required under the NHPA.

Q. Environmental Justice

The EIS/EIR admits the Proposed Action will cause a short-term and long-term loss of revenues to the affected counties and that this loss "would disproportionately affect low income

and minority county residents and tribal people." EIS/EIR at 5-104. Neither the extent of the loss nor the impact on low income and minority residents and tribal people is examined, despite the fact the EIS/EIR admits these impacts could last "indefinitely." *Id.* at 4-160.

The EIS/EIR also admits that tribal people depend on freshwater mussels for subsistence and for cultural and economic value and reducing mussel populations would have a "disproportionate adverse effect" on tribal people. *Id.* at 3.16-29. As discussed in Part II.C.10 of these Comments, freshwater mussels are likely to experience "substantial" mortality from the release of sediment following dam removal. The sum total of the analysis of these impacts on tribal people in the EIS/EIR is the statement that these affects cannot be "completely avoided."

The EIS/EIR claims tribal people will benefit from increased salmon and other fish populations. EIS/EIR at 3.16-29. As discussed in Part II.C of these Comments, those claimed benefits are illusory.

The EIS/EIR falls short of anything that approaches adequate analysis of environmental justice issues. Rather, the EIS/EIR makes claims of benefits belied by the facts and then fails to examine the effects of harms that even the EIS/EIR admits will occur.

R. Tributaries

The Proposed Action is the removal of four dams along the Klamath River and implementation of the KBRA. EIS/EIR at 2-19 (the Proposed Action "would include ... the implementation of the KBRA"), 3.3-75 (the Proposed Action "includes the implementation of KBRA"), and 3.3-138. Appendix C-2 of the KBRA contains cost estimates for the various KBRA projects. Among those projects are habitat and aquatic restoration in and around six tributaries of the Klamath River, the Williamson River, Sprague River, Wood River, Shasta River, Scott River, and Salmon River. EIS/EIR at 2-43 citing KBRA, Appendix C-2. For five of those tributaries, there are also upland habitat projects included within the list of KBRA projects.

Id. In addition, there are four projects for tributaries in general. These projects address issues involving water quality, vegetation, physical habitat, and certain fish (listed suckers). KBRA, Appendix C-2 at C.8. Between 2012 and 2021, the expenditures on these tributary projects totals $177,045,000. *Id.* at C.7-C.8.

These are significant and large scale actions. The effects will be felt in the tributaries and in Klamath River. However, the environmental effects analysis in the EIS/EIR has no evaluation or analysis of these projects which are part of the Proposed Action and which impinge, for better or worse, on the Klamath River. The failure to conduct the required analyses is yet another example of the legal and substantive deficiency of the EIS/EIR.

III. THE MITIGATION ANALYSIS

A. The Legal Standard

1. NEPA

CEQ's regulations require that an EIS "[i]nclude appropriate mitigation measures" for the proposed action and its alternatives. 40 C.F.R. §1502.14(f). *See also* 40 C.F.R. §1502.16(h). Mitigation is defined as avoiding the impacts altogether, minimizing the impacts, rectifying the impacts by rehabilitating and restoring the environment, reducing or eliminating the impacts over time, and compensating for impacts by providing substitute resources. 40 C.F.R. §1508.20.

Although NEPA does not impose a substantive requirement that a complete mitigation plan be finalized in an EIS, a mere listing of mitigation measures is not enough. *Sierra Club v. Federal Highway Administration,* 715 F.Supp.2d 721 (S.D. Tex. 2010), *aff'd*, 2011 U.S. App. Lexis 16066 (5th Cir.)(Aug. 2, 2011). The courts have found impact statements that did no more than list mitigation measures to be inadequate because the discussion failed to fully discuss mitigation measures or to include measures that should have been discussed. *Navajo Nation v. United States Forest Service,* 479 F.3d 1024 (9th Cir. 2007), opinion adopted *en banc,* 535 F.3d

1058 (9th Cir. 2008), *cert. denied,* 129 S. Ct. 2763 (2009); *Davis v. Mineta,* 302 F.3d 1104 (10th Cir. 2002); *Neighbors of Cuddy Mountain v. United States Forest Service,* 137 F.3d 1372 (9th Cir. 1998); *Environmental Defense Fund, Inc. v. Froehlke*, 473 F.2d 346 (8th Cir. 1972).

Like other elements of an EIS, mitigation measures must be discussed in sufficient detail to ensure there has been a hard look at the environmental issues and their effects. Courts will not accept conclusory descriptions of mitigation measures and their alleged effectiveness. *Neighbors of Cuddy Mountain v. United States Forest Service,* 137 F.3d 1372 (9th Cir. 1998). *See also* Haugard, Perspectives on NEPA: Let's Bring a Bit of Substance to NEPA – Making Mitigation Mandatory, 30 Environmental Law Report 10638 (2009); Slotterback, Evaluating the Implementation of Environmental Review Mitigation in Local Planning and Development Processes, 28 Environmental Impact Assessment Review 546 (208). In *South Fork Band Council of Western Shoshone of Nevada v. United States Department of Interior,* 588 F.3d 718 (9th Cir. 2009), for example, the court held an EIS inadequate because it did not assess the effectiveness of mitigation measures but said their feasibility would depend on details to be developed later.

The critical importance of mitigation analysis as to both a proposed action and its alternatives is confirmed by CEQ's recent promulgation of a Guidance on the Appropriate Use of Mitigation and Monitoring ("Guidance"). 76 Fed. Reg. 3,843 (Jan. 21, 2011). The Guidance emphasizes CEQ's regulatory requirements that an EIS must analyze the environmental consequences of an action and its alternatives including the "means to mitigate adverse environmental impacts." Guidance §B. The EIS/EIR fails to meet these standards.

2. CEQA

CEQA requires agencies to implement alternative or mitigation measures if they are feasible and found to substantially lessen the significant environmental effects. It is California's

policy that public agencies "should not approve projects as proposed if there are feasible alternatives or feasible mitigation measures available which would substantially lessen the significant environmental effects of such projects[.]" CEQA Guidelines §21002. Accordingly, one of the EIR's fundamental purposes is to identify measures for mitigating the proposed project's significant environmental impacts. *Id.* at §§21002.1(a), 21061. The EIR must describe feasible project impact mitigation measures. CEQA Guidelines §§15121(a), 15126.4(a). These measures should be "pragmatic, concrete means to minimize the impacts and restore ecological equilibrium" *Environmental Council of Sacramento v. City of Sacramento,* 142 Cal.App.4th 1018, 1039 (2006). They should not be remote and speculative. *Federation of Hillside & Canyon Ass'ns v. City of Los Angeles,* 83 Cal.App.4th 1252, 1260 (2000).

The EIR must "describe feasible measures which could minimize significant adverse impacts[.]" CEQA Guidelines §15126.4(a)(1). CEQA requires that "[e]ach public agency shall mitigate or avoid the significant effects on the environment of projects that it carries out or approves whenever it is feasible to do so." Cal. Pub. Res. Code §21002.1(b); *City of Marina v. Board of Trustees*, 39 Cal.4th 341, 360 (2006). CEQA Guidelines §15130(b)(3). *See also,* CEQA Guidelines §§15126.4(a)(1), 15130(b)(3) (the discussion of cumulative impacts must include a summary of the expected environmental effects to be produced by those projects, a reasonable analysis of the cumulative impacts, and full consideration of all feasible mitigation measures that could reduce or avoid any significant cumulative effects of a proposed project).

"Where several measures are available to mitigate an impact, each should be discussed and the basis for selecting a particular measure should be identified." CEQA Guidelines §15126.4 (a)(1)(B). Where the mitigation measures themselves cause one or more significant

effects, the effects of the mitigation measure must be discussed. *Id.* at §15126.4 (a)(1)(D). *See also Stevens v. City of Glendale,* 125 Cal.App.3d 986 (1981).

The "mitigation" concept, is broad, and includes all of the following.

(a) Avoiding the impact altogether by not taking a certain action or parts of an action.

(b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation.

(c) Rectifying the impact by repairing, rehabilitating, or restoring the impacted environment.

(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.

(e) Compensating for the impact by replacing or providing substitute resources or environments.

CEQA Guidelines §15370.

Although the CEQA Guidelines permit agencies to make findings that some mitigation measures are infeasible, (§21081 (a)(3)), those findings must be sufficiently detailed and based "on substantial evidence in the record." CEQA Guidelines §21081.5. *See also Citizens for Quality Growth* v. *City of Mount Shasta,* 198 Cal.App.3d 433, 441 (1988) (agency's findings under §21081 as to mitigation must be sufficiently detailed).

The EIR must also respond to and address specific suggestions for mitigation measures of significant impacts, unless those suggested measures are "facially infeasible." *Los Angeles Unified School Dist. v. City of Los Angeles*, 58 Cal.App.4th 1019, 1029 (1997).

B. The Mitigation Analysis – The Alternatives

The requirement for mitigation analysis applies to both the proposed action and its alternatives. However, the EIS/EIR is almost completely devoid of the required discussion of the mitigation measures for the alternatives. The only discussion of mitigation is with respect to the Proposed Action and to a significantly lesser degree the no action alternative. Absent is the

required mitigation analysis regarding alternatives 3, 4, and 5. On this basis alone, the EIS/EIR fails to meet NEPA's and CEQA's standards for adequacy. There is simply no way to examine and compare the environmental effects of the various alternatives because the EIS/EIR does not include a complete mitigation analysis.

C. The Mitigation Analysis – Bifurcation

The EIS/EIR is also legally defective because it attempts to bifurcate the analysis of dam removal and mitigation, inappropriately leaving the second for a later day. This violates the requirement that the EIS/EIR take a hard look at the environmental effects of a proposed action.

The Proposed Action is the removal of four dams on the Klamath River, including the removal of all associated power generation facilities and "implementation of the KBRA." EIS/EIR at 2-19. To make certain everyone understands that the Proposed Acton includes the KBRA mitigation measures, the EIS/EIR goes on to state "the KBRA is a component of the Proposed Action." *Id.* at 3.3-138. *See also id.* at 3.3-75 (the Proposed Action "includes ... the implementation of the KBRA.") The environmental effects of the Proposed Action depend on the implementation of the KBRA mitigation measures.

Notwithstanding this, the EIS/EIR states it will provide "project-level analysis," *i.e.*, detailed analysis, of dam removal but, as for the KBRA mitigation measures, the evaluation will be "on a programmatic level" only. *Id.* at 3.1-4. The reason for this circumscribed review of the KBRA is that "[w]hile the general goals of the KBRA actions and programs are known, the specific actions that would occur are not yet defined...." *Id.* In other words, the KBRA cannot be evaluated because it is too general.

The preceding admissions render the EIS/EIR legally defective. NEPA and CEQA require that mitigation measures be discussed in sufficient detail to ensure a hard look has been taken at the environmental effects of a proposed action. To know the environmental impacts of

dam removal, the decision maker must know the effects of the planned mitigation. That has not been done, and cannot be done at this time, because the KBRA is only a statement of general goals. How those goals will be achieved is generally not known. The attempt to bifurcate the analysis of dam removal and the analysis of mitigation is a clear violation of NEPA's and CEQA's requirements to include mitigation analysis in the EIS.

In addition to violating the requirements for adequate mitigation analysis, the attempt to bifurcate dam removal from the KBRA mitigation plan also violates CEQ's regulations regarding how to define the federal action. CEQ's regulations define a "major federal action" as including "a group of concerted actions to implement a specific policy or plan" and as "systematic and connected agency decisions." 40 C.F.R. §1508.18(b)(4). Here, the EIS/EIR admits the KBRA is incorporated into the dam removal action – it is one "systematic and connected" action.

In that regard, CEQ's regulations state:

> Agencies shall make sure the proposal which is the subject of an environmental impact statement is properly defined.... Proposals or parts of proposals which are related to each other closely enough to be, in effect, a single course of action shall be evaluated in a single impact statement.

40 C.F.R. §1502.4(a). The EIS/EIR states the Proposed Action incorporates the KBRA. Yet, there cannot be any analysis because the KBRA is to ill-defined to permit proper analysis. In a vain attempt to avoid this legal failure, the EIS/EIR, for purposes of mitigation analysis, suddenly pretends the KBRA is not part of the federal action.

To justify this fiction, the EIS/EIR attempts to define the KBRA as a "connected action" to the dam removal that somehow can be examined later. EIS/EIR at 1-1. First, this is inconsistent with the statements in the EIS/EIR that the KBRA is not just connected to, but is incorporated into, the Proposed Action. Second, even if the EIS/EIR characterization of the

KBRA as a connected action is correct, CEQ's regulations provide that connected actions "should be discussed in the same impact statement." 40 C.F.R. §1508.25(a)(1). For example, in *Hammond v. Norton,* 370 F.Supp.2d 226 (D.D.C. 2005), the court held the Bureau of Land Management erred by not considering two natural gas pipeline projects in a single EIS because the two pipelines did not have independent and separate utility. Here, the EIS/EIR readily admits the KBRA does not have independent utility apart from dam removal. EIS/EIR at 1-26, including Table 1-1 at 1-26-27. A closer look at Table 1-1 further confirms that all the KBRA fisheries programs, for example, are directly linked to dam removal. And recall the EIS/EIR states the need for dam removal is to restore salmon fisheries.

The reality, admitted in the EIS/EIR, is that dam removal and the KBRA are one action, the Proposed Action. The environmental effects of dam removal depend on the specific actions in the KBRA. However, because those actions are unknown, the effects of dam removal are unknown and the EIS/EIR fails to meet the requisite legal standard for mitigation analysis and for a hard look at the environmental effects of the Proposed Action.

Furthermore, as discussed in the next section, DOI cannot attempt to run away from its statements that the KBRA is too general to be analyzed and instead argue that the KBRA's mitigation measures were fully reviewed and that the KBRA will be effective in mitigating the adverse effects of dam removal.

D. The Mitigation Measures of the KBRA

As noted in Part II of these Comments, the alleged benefits of the Proposed Action hinge on the full and effective implementation of the KBRA. However, as the Coho and Steelhead Expert Panel stated in assessing the benefits of the KBRA, "uncertainty is high because the KBRA plan is so unspecific." Coho and Steelhead Expert Panel Report at 47. The Panel found the KBRA is only "a list of possible actions without sufficient detail to estimate quantitatively

their effects on habitat...." *Id.* at 48. As to how the KBRA will impact overall ecosystem functions, the Expert Panel found "the details of the KBRA [are] insufficient to answer this question." *Id.* at 49.

In the same manner, the Resident Fish Expert Panel found that any level of improvement attributed to the KBRA "is uncertain, in part because details of most activities have not been described." Resident Fish Expert Panel Report at 77.

Even the EIS/EIR itself admits that the alleged benefits of the KBRA – benefits DOI relies on to justify the Proposed Action – cannot be determined because the KBRA is too ill defined and, furthermore, the claimed benefits may not exist even if the KBRA is implemented. A few examples suffice to illustrate the point.

- After admitting the Proposed Action will increase nutrient loads and the production of harmful river algae, the EIS/EIR states these effects "could" possibly be mitigated "if" the KBRA mitigation projects are well designed and implemented on a large enough scale. EIS/EIR at 3.4-15. Note there is not enough information about the KBRA projects to determine if the projects are well designed or on a large enough scale to address the problem. Note also that at the end of the day the EIS/EIR admits that even with the KBRA the Proposed Acton will make nutrient loads worse. *See* Part II.C.1.c of these Comments.
- After admitting that a habitat restoration plan is needed due to "the likelihood for invasive or weedy species to colonize newly exposed areas," the EIS/EIR admits the alleged benefits of the KBRA cannot be examined because the plan provided for in the KBRA will be developed later. EIS/EIR at 3.5-44.

Given that the Proposed Action incorporates the KBRA (EIS/EIR at 2-19, the Proposed Action "would include ... implementation of the KBRA ..."), an analysis of the effects of the Proposed Action is also an analysis of the KBRA. Again, a few examples regarding the Proposed Action suffice to illustrate that the mitigation analysis in the EIS/EIR is defective.

- To evaluate the effect of the Proposed Action on water temperatures "will require more detailed information" than is presented. Coho and Steelhead Expert Panel Report at 32.
- Regarding any improvement in ecosystem functions, there "is insufficient information available" to answer how the Proposed Action compares to the status quo. *Id.* at 51.
- Regarding the precise extent to which the Proposed Action differs from the status quo as to the incidence of fish disease, "[t]he information available is insufficient...." *Id.*
- It is uncertain if the Proposed Action together with the KBRA can improve the low oxygen issues in the river. Chinook Expert Panel Report at 14.
- Whether thermal refugia will benefit steelhead "is not known." Coho and Steelhead Expert Panel Report at 43.

Furthermore, it is unlikely the KBRA can be fully implemented or that it will be effective. The Chinook Expert Panel, for example, noted that based on "the Panel's past experiences with large rehabilitation projects in other streams, the stream rehabilitation literature [citations omitted], and increased uncertainty of KBRA funding, the Panel has strong reservations that KBRA will be implemented with sufficient effectiveness...." Chinook Salmon Expert Panel Report at 26-27. The Chinook Expert Panel then said that even if the KBRA is fully funded and implemented its proposed actions and their claimed benefits are "infeasible," "unlikely," "remote," "uncertain," "may not match the scope and extent" of the problems, and

could be subject to species interactions not considered in the EIS/EIR that result in "cancelling" the alleged benefits of the KBRA and the Proposed Action. *Id.* at 10, 11, 13, 14-15, 17.

Repeatedly, the EIS/EIR and the various Expert Panels established by DOI admit the KBRA is so lacking in specifics that its effectiveness cannot be evaluated. Repeatedly, where some details are present, the effectiveness of the KBRA is called into question. Repeatedly, the statement is made that "if" the KBRA is 100% funded and implemented, then it "could" have a mitigating effect. None of this is the type of analysis that passes legal muster. How can a decision maker evaluate the benefits of a plan so lacking in details? The resounding answer from the Expert Panels is he or she cannot. Furthermore, how can a decision maker consider a mitigation plan that experts and even the EIS/EIR admit is not feasible and unlikely to succeed? The answer is he or she cannot. To the extent the EIS/EIR relies on the KBRA as providing mitigation analysis, or mitigation, the EIS/EIR fails to meet NEPA's and CEQA's standards for mitigation analysis.

Furthermore, Appendix C to the KBRA lists 112 projects that are part of the KBRA. KBRA, Appendix C at C.7-C.9. The vast majority of those projects will have environmental effects. Since the KBRA is part of the Proposed Action, one would expect an analysis in the EIS/EIR of those 112 projects. There is virtually none.

E. Conclusion

NEPA and CEQA require a full and complete analysis of the mitigation measures that will be part of the proposed action and each alternative. Otherwise, the decision maker cannot truly compare the actual effects of the proposed action versus its alternatives. The EIS/EIR fails to meet this legal standard because there is no mitigation analysis as to the alternatives. As to the Proposed Action, the mitigation proposals contained in the KBRA are often so ill-defined that they cannot be evaluated. Where more detail is provided, the EIS/EIR and the Expert Panels

often conclude the KBRA is unlikely to succeed, not feasible, and too uncertain as to outcome. The EIS/EIR does not contain a legally adequate mitigation analysis.

IV. ALTERNATIVES ANALYSIS

A. The Analysis of Alternatives

The analysis of alternatives is considered the "heart" of an EIS. 40 C.F.R. §1504.14. The alternatives analysis is the critical element of an EIS. In its famed Forty Questions Guidance, CEQ stated: "The degree of analysis devoted to each alternative in the EIS is to be substantially similar to that devoted to the 'proposed action.'" Memorandum for Federal NEPA Liaisons, Federal, State, and Local Officials and Other Persons Involved in the NEPA Process, 46 Fed. Reg. 18,026 (Mar. 16, 1981), Question 5b. This CEQ Guidance mirrors the NEPA implementing regulations that direct federal agencies to "[r]igorously explore and objectively evaluate all reasonable alternatives...." 40 C.F.R. §1502.14(a).

The EIS/EIR falls short of this standard. As noted in Part II.C of these Comments, DOI convened four expert panels to examine issues surrounding the various fish resources in the Klamath Basin, including Chinook and coho salmon. The reports of these Expert Panels are the foundational documents for the findings and conclusions in the EIS/EIR regarding whether the Proposed Action can, in fact, restore salmon and other fish resources. However, as noted in Part II.C of these Comments, DOI restricted each Expert Panel to an analysis of only two alternatives, no action and the Proposed Action. Not only does this demonstrate a closed mind on the part of DOI, but it violates NEPA and CEQA which require a robust analysis of all alternatives.

DOI cannot rescue its position by arguing the EIS/EIR dutifully examines all alternatives. This attempted defense only serves to document the failed analysis in the EIS/EIR. For example, as to aquatic resources, the EIS/EIR devotes 22 pages of discussion to the No Action alternative and 103 pages to the Proposed Action (Alternative 2), for a total of 125 pages. Alternatives 3, 4,

and 5 get a combined total of 50 pages of discussion. The attention and analysis given to each alternative is hardly comparable.

This pattern repeats itself throughout the EIS/EIR and a few examples suffice. As to the issue of algae production, the Proposed Action receives nine pages of discussion. Alternative 4 receives 14 lines of discussion compressed into one paragraph. For terrestrial resources, the Proposed Action is discussed over 28 pages. Alternative 4 is covered in just over one page. As to water quality, the Proposed Action is reviewed in 56 pages. Alternative 4 gets less than two pages. For air quality and climate change, there are 16 pages of discussion for the Proposed Action and six for Alternative 4. The EIS/EIR even admits it failed to treat the alternatives equally. For example, water temperature model results were "not developed for all the alternatives...." EIS/EIR at 3.3-49.

The EIS/EIR has failed to provide the robust alternatives analysis required by NEPA and CEQA. Instead, DOI instructed its Expert Panels to ignore three of the alternatives and the EIS/EIR then adopts the Expert Panel reports as justifying the selection of the Proposed Action. What discussion does occur regarding the orphaned three alternatives is cursory at best. The EIS/EIR fails to meet CEQA and NEPA standards for a rigorous and objective evaluation of alternatives.

B. The Purpose and Need Statement

CEQ regulations require the agency to identify the purpose and need for the proposed action. 40 C.F.R. §1502.10(d). Here, DOI states the purpose of the Proposed Action "is to achieve a free flowing river condition...." EIS/EIR at 1-29. The need for the action "is to advance restoration of the salmonid fisheries in the Klamath Basin...." *Id.*

DOI's statement of the purpose of the Proposed Action preordains the selection of a dam removal alternative. No other alternative achieves the purpose of a "free flowing river." By

adopting such a limited purpose, DOI has dictated the result of its decision about how to restore salmon resources. DOI's selection of a purpose statement stands in contrast to the statement of purpose approved in *Westlands Water District v. United States Department of the Interior*, 376 F.3d 853, 866 (9th Cir. 2004), where the project's purpose was to restore anadromous fish runs. For the Klamath River, DOI has already selected the method to restore anadromous fish runs – dam removal. Not only does this demonstrate a closed mind in violation of the arbitrary and capricious standards of the Administrative Procedure Act, but it also violates NEPA. As the court said in *Simmons v. United States Army Corps of Engineers*, 120 F.3d 664, 666 (7th Cir. 1997), an agency cannot "contrive a purpose so slender as to define competing 'reasonable alternatives' ... out of existence...."

Because the range of alternatives that must be analyzed under CEQA is tied to the project's objectives, DOI's statement of purpose violates CEQA. CEQA requires that the project purpose help the agency develop and consider appropriate alternatives. DOI's use of the "free flowing river" objective preordains the outcome and thereby undermines CEQA's requirement that decision making occur after, not before, the environmental analysis is done.

V. CUMULATIVE IMPACTS ANALYSIS

A. The Legal Standard – NEPA

A discussion of the cumulative environmental effects of a proposed action is an essential part of the environmental review process. Otherwise, the actual impact of a proposed action cannot be fully understood. *Kern v. United States Bureau of Land Management*, 284 F.3d 1062 (9th Cir. 2002). A "cumulative impact" is defined as:

> the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future action.... Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

40 C.F.R. §1508.7. However, a discussion of the cumulative impact of alternatives to the proposed action is not required. *Soda Mountain Wilderness Council v. Norton,* 424 F.Supp.2d 1241 (E.D. Cal. 2006).

As to past impacts that must be analyzed, CEQ has stated there must be

> a concise description of the identifiable present effects of past actions to the extent that they are relevant and useful in analyzing whether the reasonably foreseeable effects of the agency proposal for action and its alternatives may have a continuing, additive and significant relationship to those effects.

Guidance on the Consideration of Past Actions in Cumulative Impact Analysis, 2005, at 1-2. This interpretation of an agency's responsibilities under NEPA has been upheld by the courts. *League of Wilderness Defenders v. United States Forest Service,* 549 F.3d 1211 (9th Cir. 2008).

As to what future impacts must be considered, courts have held that all "reasonably foreseeable" actions that have potential cumulative effects must be addressed. *Lands Council v. McNair,* 537 F.3d 981 (9th Cir. 2008) *en banc.* However, speculative impacts need not be considered. *Town of Marshfield v. F.A.A.,* 552 F.3d 1 (1st Cir. 2008). Some degree of certainty must exist as to project approval. *Habitat Education Center v. U.S. Forest Service,* 609 F.3d 897 (7th Cir. 2010).

The nature of other actions must also be considered. For example, a non-adjacent similar action having cumulative effects is to be considered. *See, e.g., Grand Canyon Trust v. Federal Aviation Administration,* 290 F.3d 339 (D.C. Cir. 2002) (where airport noise was at issue all sources of noise should be evaluated). Similarly, non-adjacent dissimilar projects should be considered where they have related impacts. *People of State of California v. United States Department of Transportation,* 260 F.Supp.2d 969 (N.D. Cal. 2003) (airport expansion project must address cumulative impacts of nearby projects including hotel construction); *League of*

Wilderness Defenders v. Marquis-Brong, 259 F.Supp.2d 1115 (D. Or. 2003) (timber sale must consider cumulative effects of fire and grazing on nearby land).

In addition to considering the nature of related actions, there are issues of proximity to consider. For example, an agency should consider the impact of a project on an adjacent area. *Earth Island Institute v. United States Forest Service,* 351 F.3d 1291 (9th Cir. 2003) (timber sale required consideration of cumulative impacts on spotted owls in a neighboring national forest). In addition, agencies must consider cumulative impacts even if they are not area specific. *Center for Biological Diversity v. National Highway Traffic Safety Administration,* 538 F.3d 1172 (9th Cir. 2008) (national corporate average fuel economy standards required an evaluation of the cumulative impact of the rule on greenhouse gas emissions in light of reasonably foreseeable similar standards for light trucks and passenger automobiles).

Assuming the scope of the cumulative impact analysis is appropriate, the next issue is what level of analysis is adequate. Here, courts have applied a "rule of reason" test to determine if the analysis is reasonably thorough such that the decision maker can make an informed decision. *Westside Property Owners v. Schlesinger,* 597 F.2d 1214 (9th Cir. 1979). Again, the standard is whether there is sufficient information to demonstrate the agency has taken a "hard look" at the cumulative impacts of the proposed action. *Environmental Protection Information Center v. Blackwell,* 389 F.Supp.2d 1174 (N.D. Cal. 2004). This standard requires "some quantified or detailed information" because general statements about possible effects and some risk "do not constitute a hard look absent a justification regarding why more definitive information could not be provided." *Klamath-Siskiyou Wildlands Center v. Bureau of Land Management,* 387 F.3d 989, 993-94 (9th Cir. 2004). Thus, conclusory statements absent analysis are inadequate. *Muckleshoot Indian Tribe v. U.S. Forest Service,* 177 F.3d 800 (9th Cir. 1999).

Further, a plaintiff need not show that cumulative effects will actually occur but only that such a potential exists. *Te-Moak Tribe of Western Shoshone of Nevada v. U.S. Department of Interior*, 608 F.3d 592 (9th Cir. 2010).

A requirement to consider cumulative impacts is, however, less rigorous in the case of a programmatic EIS when the agency can consider these impacts at the site and project specific stage. *Northern Alaska Environmental Center v. Lujan,* 961 F.2d 886 (9th Cir. 1992).

B. The Legal Standard – CEQA

While NEPA requires an analysis of environmental effects that may not be "significant" on their own but which may be "significant" when combined with similar effects over time, CEQA adopts a "considerable" effect standard. Environmental effects that may not be "considerable" on their own but which may be "considerable" when combined with similar effects over time require analysis. The CEQA Guidelines define a cumulative effect as:

> [T]wo or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts.
>
> (a) The individual effects may be changes resulting from a single project or a number of separate projects.
>
> (b) The cumulative impact from several projects is the change in the environment which results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable probable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time.

CEQA Guidelines §15355. Thus, a lead agency must discuss the cumulative impacts of a project when the cumulative effect is significant and the project's incremental contribution would be "cumulatively considerable." CEQA Guidelines §§15065(a)(3) and 15130(a).

If the combined cumulative impact of the effects of the proposed project and other projects is not considerable, an EIR must explain why that is so. CEQA Guidelines

§15130(a)(2). Further, if mitigation for the proposed project is determined to render the cumulative impacts less than considerable, the EIR must identify the facts supporting that conclusion. CEQA Guidelines §15130(a)(3). With respect to mitigation, however, CEQA requires an EIR to identify all reasonable and feasible mitigation options. CEQA Guidelines §15130. Further, no public agency can approve a project that has significant impacts unless feasible changes have been incorporated into the project to avoid or substantially lessen the significant environmental effects. CEQA Guidelines §15091. Thus, CEQA requires each agency to mitigate or avoid significant environmental effects whenever it is feasible to do so. Pub. Res. Code §21002.1(b).

C. The Cumulative Impact Analysis

As a threshold matter, the cumulative impact analysis in the EIS/EIR is per se deficient. The EIS/EIR relies on the environmental effects analysis in the EIS/EIR to establish the baseline effects caused by dam removal. These effects are then evaluated in the cumulative impact analysis. As discussed in Part II of these Comments, the EIS/EIR understates or fails to analyze the baseline effects. Consequently, the baseline, the foundation from which the cumulative effects analysis proceeds, is incorrect. That alone renders the cumulative impact analysis in the EIS/EIR legally insufficient. No more need be said. Nevertheless, these Comments will examine other weaknesses in the cumulative impacts section of the EIS/EIR.

1. Scope of Analysis

The cumulative impacts analysis must examine the cumulative effects of past, present, and reasonably foreseeable effects of other projects. Table 4-4 of the EIS/EIR lists the "Projects Considered in Cumulative Effects Analysis." EIS/EIR at 4.3-22-26. Sixty-two projects are listed, including multiple surface transportation projects, multiple housing developments and other housing facilities, mining projects, waterfront development, and energy production

facilities. Presumably, these projects would not be on the list if they were not past, present, or reasonably foreseeable projects. However, these projects are not analyzed for cumulative impacts in association with the Proposed Action. Here again, the EIS/EIR fails to meet the standards of legal adequacy.

Also conspicuously absent from this analysis are the KBRA projects proposed for Klamath River tributaries discussed in Part II.R of these Comments. These projects, which are both reasonably foreseeable and part of the Proposed Action, receive not a word of analysis in the cumulative impacts analysis. Since none of these projects were considered in the environmental effects section of the EIS/EIR, one would at least expect some mention of them in the cumulative impacts analysis. But that is not the case. Indeed, Appendix C to the KBRA lists 112 projects, and there is virtually no analysis in the EIS/EIR of the cumulative effects of these reasonably foreseeable actions.

2. Aquatic Resources

The EIS/EIR claims that because of "increased habitat availability and improved habitat quality" the long-term cumulative effects of the Proposed Action will be beneficial. EIS/EIR at 4-78. As discussed in Part II.C of these Comments, the facts do not support this conclusion as to the baseline effects of the Proposed Action – a baseline that must be correct in order to properly assess cumulative impacts. Even the EIS/EIR admits that the starting point for cumulative impact analysis is the baseline environmental effects. EIS/EIR at 4-27. Curiously, the EIS/EIR states this baseline includes the effects of the KBRA, effects which, as noted in Part III of these Comments, have not been analyzed. *Id.*

The same lack of analysis, and the failure to have a proper baseline analysis of the effects of dam removal, also infects the cumulative effects discussion for Chinook salmon (*id.* at 4-73-76), coho salmon (*id.* at 4-76-78), steelhead (*id.* at 4-79-80), Pacific lamprey (*id.* at 4-80), green

sturgeon (*id.* at 4-81), Lost river and shortnose suckers (*id.* at 4-81), redband trout (*id.* at 4-83), bull trout ((*id.* at 4-83), eulachon and longfin smelt (*id.* at 4-83-84), and freshwater mussels and benthic macroinvertebrates (*id.* at 4-85-86).

For almost every fish species, the EIS/EIR has the same language. Because of alleged greater access to habitat, reduced fish disease and algae blooms, and improved water quality and temperature, the species will benefit and, therefore, the cumulative effect is beneficial. A review of the effects of dam removal on aquatic species set forth in Part II.C of these Comments shows that the facts belie any claim of beneficial impact. What the facts show is the impacts of the Proposed Action are unknown, negative, or not analyzed. Rather than repeat the contents of Part II.C, that Part is hereby incorporated into this Part V as if fully set forth herein.

Because the cumulative impacts analysis in the EIS/EIR fails to proceed from a correct baseline of effects and fails to consider the impacts of associated and related actions, the cumulative impacts discussion in the EIS/EIR does not meet the applicable legal standard.

3. Other Resources

As is the case with the cumulative effects analysis of aquatic resources, the analysis regarding the cumulative effects of the Proposed Action on other resources is woefully inadequate and proceeds from an incorrect baseline of effects. A few examples suffice.

- The review regarding algae fails to consider the runoff from other planned projects. EIS/EIR at 4-93.
- For terrestrial resources, the EIS/EIR identifies timber harvesting, agriculture, recreation, residential development, water diversions, and mining as having past, present, and future impacts but fails to state what are those impacts relative to the added impacts from the Proposed Action. *Id.* at 4-95.

- Having identified residential and commercial development as adding impervious surfaces that can channel water into rivers, the EIS/EIR neglects to discuss those impacts relative to the Proposed Action.
- In discussing the existing Klamath River water rights that are likely to be affected by the Proposed Action, the EIS/EIR states that although "each of these water rights listings will have associated intake facilities to draw water from the Klamath River … the specific type, location, and layout of each of these intake facilities is unknown at this time." *Id.* at 3.8-11. Without specific knowledge about the location, layout, and construction of the intake facilities and diversion structures associated with the water rights being analyzed, it is hard to understand how the EIS/EIR can possibly analyze the Proposed Action's impacts on cumulative water rights, or the effectiveness of the proposed mitigation measure WRWS-1. Accordingly, the EIS/EIR conclusion that "With implementation of this mitigation, the Proposed Action's incremental contribution to the cumulative effects on water intake pumps from sedimentation associated with reservoir drawdown will not be cumulative considerable," *id.* at 4-20-21, is premised on conjecture, not on data and analysis. Without knowledge and information about the specific water rights and facilities that will be impacted by the sedimentation and changes in the river's geomorphology, the EIS/EIR cannot properly determine the Proposed Action's cumulative effects, or how those effects are to be mitigated.
- Not only does the EIS/EIR proceed from a wholly incorrect and grossly underestimated baseline regarding the effects of the Proposed Action on sedimentation, but it fails to examine the sedimentation effects of the activities and

projects that are acknowledged to contribute to sedimentation such as timber harvesting, mining, agriculture, livestock grazing, and road related erosion. *Id.* at 4-139.

- The EIS/EIR does not discuss the cumulative impact on the river, estuarine and ocean ecosystems of actions that increase sedimentation, increase water temperature, increase pH levels, increase nutrient concentrations, increase chemical concentrations, lower oxygen levels, and increase algae populations.
- The EIS/EIR does not discuss the cumulative effects of an increased demand for groundwater.
- As to land use issues, the EIS/EIR artificially limits the time frame to 18 months following dam removal as if all land use impacts will be over in 18 months. *Id.* at 4-151.
- The EIS/EIR artificially limits the time frame for analysis regarding solid waste disposal issues associated with dam deconstruction, ignoring the fact that using up to one-third of the existing disposal capacity at two facilities has long-term cumulative effects. *Id.* at 4-108.
- Although the EIS/EIR identifies the Northwest Forest Plan as an applicable authority and regulation, *id.* at 3.14-8, the EIS/EIR has no analysis of the past and continuing effects of this Plan on Siskiyou County. Timber harvests have declined from the 1978-1989 average of 180-250 million board feet to around 20 million board feet. The EIS/EIR fails to examine the associated economic impacts when these losses are added to the job and revenue loss of the Proposed Action.

- The past economic effects of a ban on mining and of reduced agriculture and cattle grazing that continue today are ignored.
- While the individual energy impact of dam removal may, or may not, be small, there is an impact whose strength is multiplied when it is cumulated with the loss of other power sources and with increasing demands for power. The EIS/EIR contains no analysis of this cumulative effect or of the cumulative effect of replacing clean hydropower with other energy sources.

As is the case with the cumulative impacts analysis for aquatic resources, the cumulative effects analysis as to other resources fails to meet the applicable standards.

VI. LOCAL REQUIREMENTS

The EIS/EIR consistently fails to analyze, and account for, the fact that the County of Siskiyou has laws and regulations that apply to the Proposed Action. The analysis starts with statutes such as the Federal Land Policy and Management Act of 1976, 43 U.S.C. §1701, and the Intergovernmental Cooperation Act, 31 U.S.C. §6501, that require coordination with local governmental authorities in land use planning and development. Dam removal falls within this category. Equally important, CEQ's regulations implementing NEPA provide that any EIS "shall discuss any inconsistency of a proposed action with any approved state or local plan and laws…." 40 C.F.R. §1506.2(d). The discussion of local requirements in the EIS/EIR also fails to meet the standards set forth in CEQA Guidelines section 15126 regarding impacts analysis. CEQA Guidelines §15126.

The EIS/EIR attempts to justify its lack of analysis as being due to questions that "remain over the ultimate applicability of local regulations depending on the selection of the Dam Removal Entity (DRE)" or Hydropower Licensee. EIS/EIR at 6-1. Regardless of who is

removing the dams, the County's Ordinances will apply. The EIS/EIR incorrectly defers future "environmental analysis and compliance documentation" to later. Under CEQA and NEPA, the time to analyze impacts of the project is in the Draft EIS/EIR, not later. In fact, the County of Siskiyou has consistently requested that DOI coordinate with the County so as to identify applicable County Ordinances and to discuss compliance. Unfortunately, such requests have been ignored.

The facts are that the EIS/EIR is barren of any substantive discussion of the provisions of the laws and regulations of the County of Siskiyou. A few examples are sufficient to establish the deficiency of the EIS/EIR. Chief among these examples is Title 10, Chapter 13 of the County's Code of Ordinances that makes the "demolition, deconstruction, or removal of major facilities" unlawful absent the issuance of "a permit granted by the County…." A major facility is defined to include dams. Nowhere are the provisions of this Ordinance, let alone compliance with the Ordinance, discussed in the EIS/EIR. The failure to do so is a clear violation of NEPA and CEQA.

The trucks and equipment used in dam deconstruction will bring enormous weights to bear on County roads. The applicable County Ordinances require that loads over 80,000 pounds GVW secure a transportation permit. The EIS/EIR has no discussion of this requirement.

The County of Siskiyou has a General Plan Noise Element ("GPNE") that recognizes the County's size makes it infeasible to have detailed noise contours throughout the County. Therefore, the GPNE provides a detailed process for conducting noise studies to ensure that projects do not individually or cumulatively create adverse noise impacts. The noise analysis in the EIS/EIR does not conform to this process.

The County of Siskiyou has restricted truck traffic along Copco Road to the dry summer months because of the roads substandard surface conditions. Ignoring this County regulation, the Proposed Action improperly contemplates increased heavy truck traffic during the restricted months.

Although the EIS/EIR admits the Proposed Action will increase the risk and severity of flooding, one searches the document in vain for any recognition of the fact that Section 10-10 of the County Code of Siskiyou County requires a flood damage prevention permit for activities affecting the floodplain. Not surprisingly, there is no discussion of whether and how the Proposed Action complies, or will comply, with the County's requirements.

Pursuant to the Klamath Hydroelectric Settlement Agreement ("KHSA") certain parcels of land are transferred to the state and federal government. As such, they would no longer be subject to local zoning and regulation. How these lands will be transferred and managed consistent with the applicable County Ordinances is a topic ignored in the EIS/EIR, again in violation of 40 C.F.R. §1506.2(d) and of CEQA.

As these few examples demonstrate, the EIS/EIR fails to consider the applicable Ordinances of the County of Siskiyou, instead choosing to disregard or ignore those Ordinances.

VII. COASTAL ZONE MANAGEMENT ACT

The Proposed Action will result in impacts between Siskiyou County and the Pacific Ocean, but the EIS/EIR does not address any impacts in Del Norte County nor does it address in a consistent and thorough manner project related impacts on areas downstream of the dams "that would be affected by the removal of the dams and loss of the reservoirs." EIS/EIR at 3.14-2. Specifically, the EIS/EIR does not address project consistency with the Coastal Zone Management Act. Chapter 6 of the EIS/EIR is the section on compliance with applicable laws, policies and plans, and Table 6-1 is titled "Related Federal Laws, Rules, Regulations, Executive

Orders, and Other Authorities." EIS/EIR at 6-1-6-9. Table 6-1 identifies the Coastal Zone Management Act as an applicable law. *Id.* at 6-2. However, the EIS/EIR fails to address coastal zone consistency and includes no analysis of the project relative to the Coastal Zone Management Act. The EIS/EIR also contains only passing references to the California Coastal Management Act, the State's coastal management program. Because of the likely adverse impacts of the Proposed Action on aquatic and other resources resident in the coastal zone, the EIS/EIR must document the consistency of the Proposed Action with the state and federal coastal zone management statutes. It has not done so.

VIII. CONCLUSION

NEPA and CEQA require that there be a "hard look" at the environmental effects of a proposed action. However, this hard look "must be taken objectively and in good faith, not as an exercise in form over substance, and not as a subterfuge designed to rationalize a decision already made[.]" *Western Watersheds Project v. Kraayenbrink,* 620 F.3d 1187, 1205 (9th Cir. 2010). Here, the EIS/EIR fails to take the requisite hard look, ignores key issues, uses incorrect facts, misstates the conclusions of expert review panels established by DOI, and glosses over adverse environmental effects or refuses to acknowledge them. For all intents and purposes, the EIS/EIR appears to be "a subterfuge designed to rationalize a decision already made."

- The EIS/EIR states the need for the Proposed Action is to advance the restoration of salmonid fisheries. DOI established four Expert Panels to study the likelihood of the Proposed Action achieving that goal. After reviewing the data, the Expert Panels called the results of the Proposed Action "small," "remotely possible," "uncertain," "unlikely," and "not feasible." In short, there is a very low likelihood the Proposed Action will achieve its goal.

- A recurring theme in the Expert Panel Reports is that the data and analyses necessary to support the conclusions in the EIS/EIR have not been done. The actual effects of the Proposed Action are simply not known despite claims to the contrary in the EIS/EIR. Because of the absence of data and analyses, one Expert Panel termed the Proposed Action an "experiment." Spending hundreds of millions of dollars on an "experiment" that will, at best, achieve "small" results is highly questionable.
- To justify the Proposed Action, the EIS/EIR makes fundamental errors of analysis. For example, the EIS/EIR examines the effects of the Proposed Action on fish as if each individual species is the only occupant of the ecosystem. However, these species share the same habitat, compete for the same space and food, and prey on each other. Failing to examine interspecies ecosystem relationships is a conspicuous and glaring omission in the EIS/EIR. This is especially true when one Expert Panel determined that interspecies conflicts, including predation on salmon by an expanded redband trout population, could result in "cancelling" the benefits to salmon claimed to result from the Proposed Action. Increased predation resulting from the Proposed Action also poses real threats to the bull trout, a species protected under the Endangered Species Act.
- The benefits claimed for the Proposed Action in the EIS/EIR are illusory or negative. For example, an Expert Panel judged the net benefits of the Proposed Action for salmon to be "small." Among many other things, the Panel noted that salmon need spawning beds that are relatively free of silt and sediment. In concluding that the benefits to salmon would be "small," the Expert Panels based their analysis on an

assumed sediment release of 200,000-400,000 tons after dam removal. The actual number, using data in the EIS/EIR, is 3,540,000 tons.

- An Expert Panel found the EIS/EIR's reliance on average daily mean temperatures to measure the temperature impacts of dam removal on fish was incorrect. Fish do not experience average temperatures. Fish experience hour-by-hour temperatures. If temperatures rise above a certain level, notwithstanding the average, fish are adversely affected. An Expert Panel concluded that dam removal will increase the highest temperatures experienced by fish.
- A key water quality problem in the Klamath River Basin is high nutrient loads that cause low dissolved oxygen and algae blooms. The EIS/EIR admits the Proposed Action will increase nutrient loads and, therefore, make water quality worse.
- Another key water quality problem is algae growth. The EIS/EIR admits the Proposed Action will make this problem worse.
- Water quality is adversely affected by elevated pH levels. The EIS/EIR admits the Proposed Action will make this problem worse.
- Low dissolved oxygen levels are yet another water quality problem. The EIS/EIR concedes this problem is likely to be worse because of the Proposed Action.
- Disease is a major problem affecting fish populations. Because increased river algae biomass provides improved habitat for disease carrying worms, the Proposed Action will make the fish disease problem worse.
- According to the EIS/EIR, freshwater mussels, an important subsistence and cultural species for tribal people, experience "substantial" mortality when buried for more

than four-five days. The EIS/EIR admits freshwater mussels, and all other filter feeders, will be buried under up to two feet of sediment for three-four months.

- The EIS/EIR is also riven with inconsistent statements and inadequate or non-existent analysis. For example, in at least four places the EIS/EIR states it need not examine the effects of dam removal on estuarine habitat, including the essential fish habitat in the Klamath River estuary, because sediment will not reach the estuary. In an equal number of places, the EIS/EIR says sediment will reach the estuary. Both assertions cannot be right. If sediment will reach the estuary, the EIS/EIR has failed to examine the effects of increased sedimentation. If sediment will not reach the estuary, the EIS/EIR has understated the effect of adding 3.5 million tons of sediment to salmon spawning beds and other river habitat. And nowhere does the EIS/EIR discuss the impacts on the ocean environment.
- The EIS/EIR admits that dioxin and other chemicals are present in dangerous levels behind J.C. Boyle Dam. There is no analysis of the likely adverse impacts of these pollutants. Instead, the EIS/EIR says these hazardous pollutants will be diluted when the three dams below J.C. Boyle Dam are removed. The EIS/EIR ignores the habitat between the J.C. Boyle Dam and the next dams. The EIS/EIR also ignores the issue of whether these substances, even if diluted, remain harmful.
- After admitting there are special status invertebrates in the project area, one of which could be listed under the Endangered Species Act, the EIS/EIR completes its "hard look" analysis of the impacts of dam removal on invertebrates in just five lines.
- The EIS/EIR notes the presence of 174 bird species in the project area stating that buffer zones will be needed to protect many of them from activities undertaken as

part of dam removal. There is no discussion of whether the size of the buffer zones are adequate or why.

- The EIS/EIR admits dam removal will increase the risk of flooding and decrease the time people have to respond before the flood hits. There is no analysis of the effects of those increased risks.
- All the towns in the County of Siskiyou are "at risk" communities for wildfires. Dam removal will remove reservoirs that provide water to fight such fires. The EIS/EIR fails to properly examine the effects of this decreased fire fighting ability.
- The EIS/EIR first states that the concrete, earth, and other waste from dam removal will be disposed of on-site. Later, the EIS/EIR states this waste will be taken to local landfills. Both statements cannot be right. If the waste is disposed of on-site, the EIS/EIR says it will be placed in areas that are now protected open space and conservation areas. The EIS/EIR does not examine the impact on these areas of disposing of approximately 1.4 million cubic yards of waste. If the waste is sent to local landfills, the EIS/EIR does not examine the impact on the counties of using up almost one-third of the capacity remaining at two landfills.
- The EIS/EIR acknowledges that roads and bridges in the project area were not designed to sustain the heavy loads associated with dam removal and could be incapable of supporting this weight. After these admissions, the EIS/EIR says an in-depth analysis will be done later.
- The EIS/EIR admits tax revenues to the County of Siskiyou will decline, perhaps indefinitely. There is no analysis of the effects of reduced revenues on the County's ability to serve its citizens.

- The EIS/EIR admits land use changes will occur as a result of dam removal but decides it will "not describe potential changes in land use that would occur if the dams were removed."
- The dams provide energy sufficient to power 65,000 homes for a year. The County of Siskiyou has approximately 23,500 homes. Every household in this and other counties will be affected. The EIS/EIR contains no analysis of the impact of increased energy costs on the citizens of Siskiyou County or of the environmental effects of replacing clean hydropower with other energy sources.
- The EIS/EIR uses incomplete data as to water supplies, rights, and facilities. While the EIS/EIR makes a limited effort to identify exiting water rights, it fails to consider the specific circumstances and physical facilities associated with those water rights and diversions and, therefore, how these water rights will be affected by the Proposed Action.
- The deconstruction and relocation of the City of Yreka municipal water supply pipeline will have significant effects on the short-term and long-term reliability of the water rights granted to the City. These effects are not analyzed.
- The EIS/EIR admits there are significant cultural and historic resources in the project area. The impacts "analysis" in the EIS/EIR is confined to stating DOI will identify affected cultural and historic resources later.
- The EIS/EIR inappropriately attempts to analyze noise impacts on County residents by applying standards used for noisy urban settings to rural Siskiyou County. The EIS/EIR compounds its error by failing to take actual measurements of existing noise levels or of noise levels expected from dam deconstruction.

- The EIS/EIR admits the loss of tax revenue to the affected counties raises significant environmental justice issues because the impacts of lost tax revenue will "disproportionately affect" low income, minority, and tribal people. The EIS/EIR then fails to examine those effects.
- The EIS states the KBRA and its planned actions are part of the Proposed Action. There are 112 such measures, virtually all of which have environmental effects. Virtually none are analyzed in the EIS/EIR. Curiously, among those projects are habitat and aquatic restoration actions on six tributaries of the Klamath River. Valued at over $177 million, these projects will have some effects on the Klamath River. One searches the EIS/EIR in vain for any analysis.
- The EIS/EIR fails to comply with the legal requirement to identify and analyze the mitigation measures that would be associated with alternatives to the Proposed Action. There is simply no way to examine and compare the environmental effects of the Proposed Action with that of various alternatives without an analysis of the mitigation plan associated with the alternatives.
- As to the mitigation for the Proposed Action, the EIS/EIR inappropriately leaves the bulk of that analysis for a later day. Virtually all the mitigation measures for dam removal are in the KBRA. But the EIS/EIR admits those measures cannot be analyzed because "[w]hile the general goals of the KBRA actions and programs are known, the specific actions that would occur are not yet defined...." Where some definition does exist, the Expert Panels formed by DOI generally characterized the KBRA actions as "infeasible" and "not likely" to succeed.

- The heart of an EIS/EIR is a rigorous analysis of alternatives. Consistently, the EIS/EIR fails to meet this analytical requirement. The EIS/EIR examines its favored Proposed Action in dozens of pages while often confining the analysis of alternatives to mere paragraphs. A glaring example of this biased and incomplete analysis is that the four Expert Panels created to examine the effect of the Proposed Action on fish were instructed by DOI to limit their analysis to the Proposed Action and the status quo. They were told to ignore the other three alternatives in the EIS/EIR. Given that the stated need for dam removal is to restore salmon fisheries, and given that the EIS/EIR relies on the Expert Panels to justify its favorable view of dam removal regarding fish resources, this is a singular failure of NEPA and CEQA compliance.
- The EIS/EIR violates the fundamental requirements of NEPA and CEQA to fairly and objectively compare alternatives. The EIS/EIR attributes all of the alleged environmental benefits of implementing the KBRA to the Proposed Action. This ignores the fact that many of the KBRA actions will proceed even if the dams are not removed. Therefore, the benefits of these KBRA actions, if any, must be included in the No Action and other Alternatives, including Alternative 4. The EIS/EIR violates applicable law by not doing so.
- In evaluating alternatives, the EIS/EIR fails to examine whether the adverse environmental effects of dam removal will inhibit or prevent achieving the benefits that are alleged to come from those KBRA actions that will be implemented even if the dams are not removed.
- The bias against any alternative except dam removal is amply demonstrated by the fact that the same pollutant releases considered to have an insignificant effect under

the Proposed Action are considered to have a significant effect under the No Action Alternative.

- The EIS/EIR is devoid of any discussion of how the Proposed Action proposes to comply with the applicable Ordinances of the County of Siskiyou. Many of these Ordinances are never even mentioned. Equally important, in many cases, the Proposed Action violates, or is inconsistent with, the County's Ordinances. Conspicuously absent from the EIS/EIR is any discussion regarding how to address these issues.

The preceding is only a sampling of the myriad problems, failings, and issues associated with the EIS/EIR and with its conclusions. The EIS/EIR meets neither the spirit nor the letter of the law. A revised EIS/EIR must be prepared to address these deficiencies. Only by circulating a corrected and expanded document will the Lead Agencies provide adequate information on environmental impacts, alternatives, and mitigation measures with which stakeholders can evaluate the alternatives and decision makers can act.

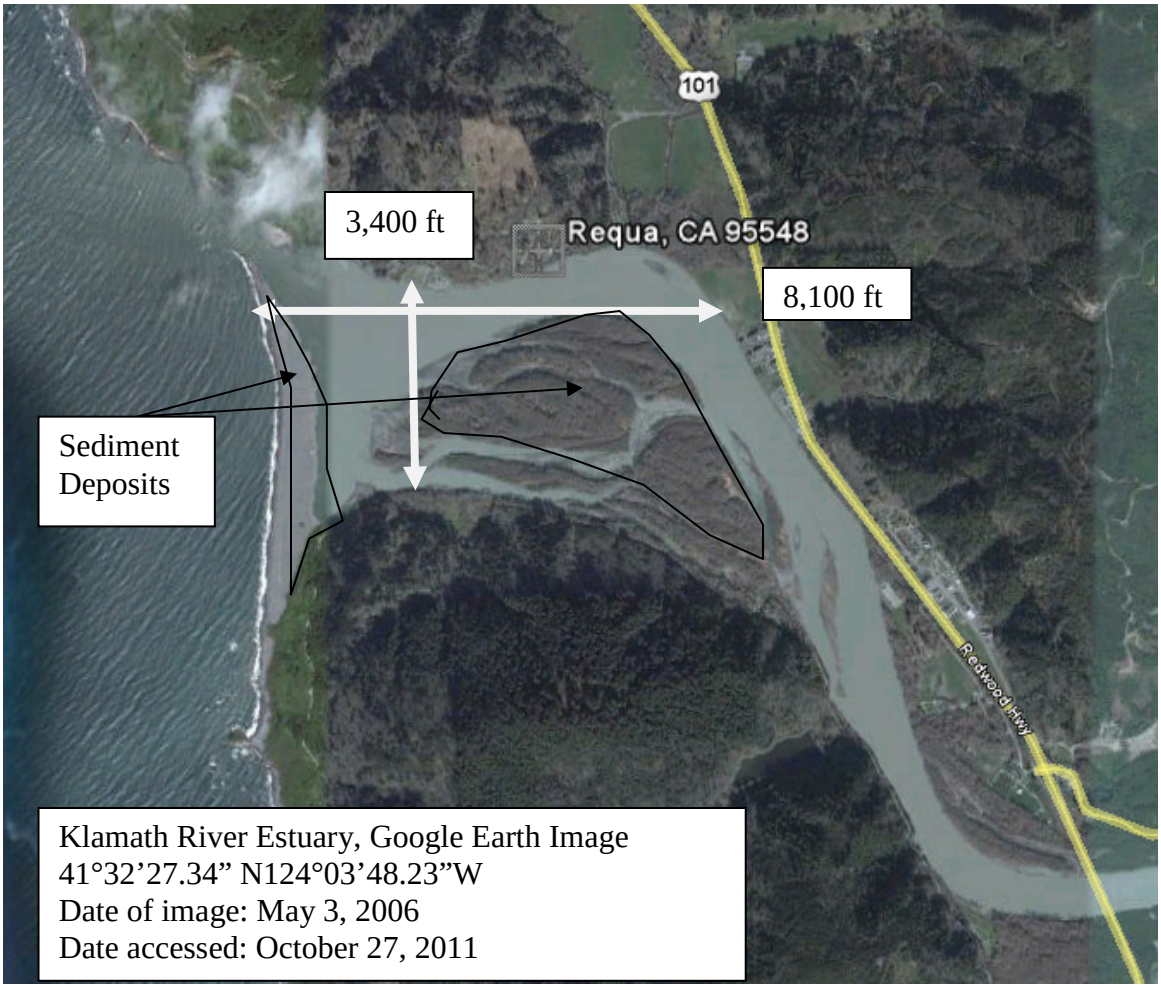

Figure 1. Aerial view of the mouth of the Klamath River.

WRITTEN COMMENTS FROM ORGANIZATIONS

WATER AND POWER LAW GROUP PC
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February 1, 2017

By Electronic Mail

Parker Thaler
Division of Water Rights
State Water Resources Control Board
P.O. Box 2000
Sacramento, CA 95812-2000
Parker.thaler@waterboards.ca.gov

Re: Notice of Preparation and Scoping Meetings for an Environmental Impact Report for the Lower Klamath Project License Surrender (Jan. 10, 2017)

Dear Mr. Thaler:

American Rivers, California Trout, Sustainable Northwest, and Trout Unlimited submit these comments on the Notice of Preparation and Scoping for the Environmental Impact Report in this proceeding.

We are parties to the relicensing proceeding before the Federal Energy Regulatory Commission (FERC). We are signatories to the Klamath Hydroelectric Settlement Agreement (KHSA), as amended. We are represented on the Board of Directors of the Klamath River Renewal Corporation (KRRC), which filed license transfer and surrender applications before FERC on September 23, 2016. We support implementation of the KHSA, including necessary regulatory approvals, to contribute to the sustainability of natural resources and communities in the Klamath River Basin, including attainment of water quality objectives.

We organize our comments per the topical headings in the Notice.

Proposed Project

The Notice (p. 6) describes the project as the removal of four developments to create a free-flowing river and permit volitional fish passage, as proposed in the license surrender application. In addition to those physical elements, the proposed project includes a time element: removal of the developments will begin by January 1, 2020. That date is a deal point in the KHSA, which the KRRC is implementing through the license transfer and surrender applications. *See* KHSA § 7.3. We request that the State Water Board take notice that this date is an integral element of the project description and further, that you organize and manage this proceeding to make a final decision on the water quality certification request before that date.

FERC Process

The Notice (p. 7) describes the relicensing proceeding. We request that you take notice that, on June 16, 2016, FERC stayed the relicensing proceeding pending the conclusion of the license surrender proceeding. *See* "Order Holding Relicensing Proceeding in Abeyance," 155 FERC ¶ 61,271 (2016). As a matter of longstanding practice and policy, FERC will not further consider the new license application during the license surrender proceeding. *See Duke Energy Carolinas, LLC*, 123 FERC ¶ 61,069 (2008).

The Notice (p. 7) describes the filing of the license transfer and surrender applications. We request that you take notice that FERC has issued its own notice that these applications were filed and that KRRC will file proof of financial capacity by March 1, 2017, and a definite plan for removal by December 31, 2017. *See* "Notice of Applications Filed with the Commission" (Nov. 10, 2016), pp. 2, 4.

CEQA Information

The Notice (p. 9) states that the State Water Board will "consider" the 2012 Environmental Impact Statement/Report prepared by the U.S. Department of Interior and California Department of Fish and Wildlife for the KHSA (hereafter, KHSA EIS/R). Pursuant to 14 C.C.R. § 15150 and other applicable authority, we respectfully request that the State Water Board rely on (rather than duplicate) the analysis in this document, except to the extent that you find it is insufficient for your purposes. That analysis was based on exhaustive studies of all potential environmental and other impacts recognizable under the National Environmental Policy Act and the California Environmental Quality Act (CEQA). The document includes extensive public comments and responses as well. We request that the State Water Board expressly designate the KHSA EIS/R, including all studies, as part of the record of this proceeding.

The Notice (p. 9) states that the State Water Board will consider a "range of alternatives" to the proposed project. We support your consideration of such a range. We request that you consider the 18 alternatives already considered in the KHSA EIS/R. *See id*., Table 2-2, Vol. 1 pp. 2-5 – 2-7. We note that the No Project Alternative would be denial of certification of license surrender. While this alternative could return the Klamath Hydroelectric Project to the relicensing proceeding, the State Water Board should not consider any hypothetical outcome in that proceeding, given that PacifiCorp has withdrawn its request for certification of the new license application.

The Notice (p. 9) references Attachment 1 as a "broad summary of potentially significant impacts identified by resource area." While we agree that the attachment identifies adverse impacts, it omits the positive impacts of the proposed project. Positive impacts are relevant for the purpose of your CEQA analysis, both generally and because this project is intended to restore native fisheries and enhance water quality in the Klamath River Basin. Further, the attachment does not recognize that the definite plan for license surrender must include measures to avoid or mitigate damages to natural resources or private properties. *See* KHSA §§ 7.1.2, 7.1.8, 7.2.1.A and Appendix L. We request that the State Water Board take notice of the risk management approach in the detailed plan (attached to the license surrender application as Exhibit E.3), and

that you consider the definite plan (when filed in December 2017) in your analysis of potential impacts.

This is a quasi-adjudicatory proceeding. The record is critical to the integrity of the proceeding. While the State Water Board maintains a webpage for this proceeding (http://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/lower_klamath_ferc14803.shtml), the webpage is not indexed or searchable by date. We respectfully request that Division prepare an index to your record of this proceeding, assure that all past filings before the State Water Board related to this application are downloadable from the webpage or another online source (such as FERC's eLibrary), and establish a procedure that assures that all future filings will be indexed and available in that same manner.

We request that you confirm that the record of this proceeding now includes the relicensing Environmental Impact Statement (2007) and KHSA EIS/R. We also request that you specify whether you are incorporating the records (in whole or part) for the impairment listings under Clean Water Act section 303(d).

Service

We request that the State Water Board add the following representatives to the service list for this proceeding.

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We request that the State Water Board establish a procedure for service (preferably electronic) in this proceeding, to assure that participants will have timely access to future filings.

Thank you for considering these comments.

Respectfully submitted,

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Director, California Office
American Rivers

Curtis Knight
Executive Director
California Trout

Mike Gerel
Program Director
Sustainable Northwest

Brian Johnson
California Director,
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Richard Roos-Collins
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Water and Power Law Group PC

Attorneys for American Rivers, California Trout, and Sustainable Northwest

Dr. Richard Gierak
5814 Hwy. 96
Yreka, Ca. 96097
530 475-3212

Re: Proposed Kalath Hydroelectric Project

Coho & Chinook Salmon listing history

~1992 Federal ESA listed Coho as endangered
~1994 ESA attempted to change regulation of water & substrate rule to be expanded to up 300 feet from the rivers high water mark.
~1995 Coalition of Idaho, Washington, Oregon and California State Granges fought this ruling and were successful in maintaining the Federal ruling of water and substrate only. It is of interest to note that the Karuk tribal records indicated Coho were never native to the Klamath River.
~1997 California & Southern Oregon Granges engaged PLF who won their case and all listings for Coho in California and Southern Oregon were removed as they were not an indigenous species.
2002 Major fish kill in the Klamath blamed on bacterial contamination
Reality: Tribes called for water release for ceremonial water boat dance while salmon were in the estuary. This enticed them to move upstream to spawn and then the water was turned off leaving them high and dry causing a serious salmon kill. Note that prior to any dams on the Klamath at this time of the year the river was nothing but swamps and mud holes. Could not have been traditional Indian ceremony.
2004 National Research Council researched the fish kill and determined Coho were from Cascadia, Oregon proving they are not indigenous to the Klamath and could not be listed.
2005 Based on fish kill Coho were re-listed illegally as they have been proven not to be indigenous species in 2000
2009 CDC investigated the reservoir at Iron Gate and determined it was not the cause of the 2002 fish kill.
~2006 Environmental organizations filed a listing petition for Chinook Salmon in the upper Klamath and I filed a de-listing petition. I received a call from Washington and was told that there was no provision for filing a de-listing petition prior to a species being listed, however, he would evaluate my petition when he reviewed their listing petition. A few weeks later it was announced that their petition to list was denied.

Submitted by;
Dr. Richard Gierak
Bachelors Degrees in Biology, Chemistry, Doctorate in the Healing Arts, Director of Interactive Citizens United, Director of New Frontiers Institute, Inc. Prior Participant of FERC and FPAT (Fish passage advisory team report) and HET (Hatchery evaluation team) Prior Vice President of Greenhorn Action Grange, Prior California State Grange Spokesman for the Water Committee, Prior National Whip of the Property Rights Congress of America, Representative of the Grange States of California, Oregon, Washington and Idaho regarding EFH regulations, Prior member of the SCWUA.

(13)

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Illegal infractions regarding Klamath dam removals

Violation of the Reclamation Act of 1902

The Reclamation Act of 1902 (43 U.S.C. 391 et seq.) authorized the Secretary of the Interior to locate, construct, operate, and maintain works for the storage, diversion, and development of water for the reclamation of arid and semiarid lands in the western States.

Congress facilitated development of the Klamath Project by authorizing the Secretary to raise or lower the level of Lower Klamath and Tule Lakes and to dispose of the land uncovered by such operation for use under the Reclamation Act of 1902. Starting around 1912, construction and operation of the numerous facilities associated with Reclamation's Klamath Project significantly altered the natural hydrographs of the upper and lower Klamath River. Reclamation's Klamath Project consists of an extensive system of canals, pumps, diversion structures, and dams capable of routing water to approximately 200,000 ac (81,000 ha) of irrigated farmlands in the upper Klamath Basin. Water diversions from from UKL for the Klamath Project affects river flows downstream of Link River and Iron Gate dams.

The headwaters of the Klamath River originate in Southern Oregon and flow through the Cascade Mountain Range to the Pacific Ocean south of Crescent City, California. The river extends nearly 250 miles and is just one of three waterways that pass through the Cascades to the Pacific. It is named after a native American name - klamet - meaning swiftness.

Violation of the 1981 National Wild & Scenic Rivers Designation

The Klamath River was designated a Recreational River within the National Wild & Scenic Rivers System in 1981. The Klamath River enters California from Oregon just north of the Goosenest Ranger District. Heading west it is impounded by two dams forming Copco Lake and Iron Gate Reservoir. Nine miles further west it turns south and follows Interstate 5 for a few miles before again turning west and entering the Happy Camp/Oak Knoll Ranger District. The next 85 miles provide many opportunities for recreation and scenic vistas before the river enters the Six Rivers National Forest. Dam removal would release toxic material that would destroy the habitat for all species in addition to physically changing the course of the Klamath River in direct violation of the National Wild & Scenic Rivers designation.

Violation of the Dormant Commerce Clause

No State may impose any regulatory action against navigable rivers in the US of which the Klamath River is considered a navigable river. This would also prohibit removal of any dams located on a navigable river in the US by States.

Violation of the Federal Endangered Species Act

Under the Federal ESA only indigenous species can be listed and under the Final report of Coho Salmon by the Klamath Expert Panel Coho Salmon were planted from Cascadia, Oregon and are not indigenous to the Klamath. The present listing of Coho in the Klamath River is illegal and was determined in the courts in the early 2000's.

Violation of Rogue Valley Oregon Irrigation Rights

Removal of these dams would reduce approximately 40% of water from the Klamath River that now goes to Southern Oregon for agriculture which would result in serious loss of agriculture that now stabilize the economy of Southern Oregon

Serious impact on power costs in Northern CA and Oregon

At this time these hydroelectric dams supply Northern California and most of Oregon homes and businesses with the least expensive power available. The average homeowner is liable for approximately $200 per month and with the proposed natural gas power supply it would increase their costs to approximately $600 per month.

Violation of Shasta Indian burial rights

At the present time Shasta Indian Tribe burial grounds are protected by Iron Gate Reservoir and removal of this dam their burial grounds could be exposed, plundered and desecrated.

Violation of Siskiyou Counties water rights

Removal of these dams would be in serious loss of existing water rights as proposed solutions to avoiding this problem would be in serious possibility of failure and exposed to vandalism.

Possible loss of life and property to all adjoining the Klamath River

Due to occasional flooding Iron Gate Dam was constructed to serve to protect all that lived on the banks of the Klamath River from catastrophic flooding events. Without this dam property values would fall and expose all with the possibility of loss of life and property.

Serious fire danger to all in Siskiyou County

At the present time the dams supply fire helicopters access to water supply to fight forest fires. Removal of these dams would force said fire helicopters to much longer time delays to fill their buckets and thereby expose all to longer wait times and possibility of loss of lives and property.

Violation of the Constitution of the United States

Elections in Siskiyou County California and Klamath County Oregon voted 80% to retain the dams and removal of these dams would be in direct violation of the will of the people and the Constitution.

Prior law decisions

In the late 90's proposal was made to change the definition of Federal ESA regulations regarding endangered salmon to Ecological Society of America regulations which means that instead of regulations applying only to water and substrate would be changed to allow them regulations up to a mile from the banks of a river. Through the States of Idaho, Washington, Oregon and California State Granges we defeated this change.

In the early 2000's the Granges engaged Pacific Legal Foundation and listings of Coho in Northern California and Southern Oregon were cancelled as the Coho were not indigenous to these waters and rivers.

In the mid 2000's an attempt was made by environmental groups to list Chinook Salmon in the upper Klamath and the Siskiyou County Water Users Association filed a de-listing petition which was successful and the Chinook listing was denied.

Submitted by;
Dr. Richard Gierak
Bachelors Degrees in Biology, Chemistry, Doctorate in the Healing Arts, Director of Interactive Citizens United, Director of New Frontiers Institute, Inc. Prior Participant of FERC and FPAT (Fish passage advisory team report) and HET (Hatchery evaluation team) Prior Vice President of Greenhorn Action Grange, Prior California State Grange Spokesman for the Water Committee, Prior National Whip of the Property Rights Congress of America, Representative of the Grange States of California, Oregon, Washington and Idaho regarding EFH regulations, Prior member of the Siskiyou County Water Users Assoc.

(13)

Dr. Richard Gierak
5814 Hwy. 96
Yreka, Ca. 96097

Re: Salmon in the Klamath River

1. Navigable rivers in the United States fall under the Federal Government and not the States. The Klamath River is considered a navigable river.

2. Under the Federal regulations any salmon listed under the Federal guidelines the only remedy is to water and substrate only.

3. Regarding Coho Salmon the first formal planting in the Klamath was in 1895 and was only partially successful. Multiple planting were made without success until the series of plantings from the Cascadia river in Oregon during the 1960's which was successful. Therefore the Coho Salmon is not a native species in the Klamath and therefore does not require any regulatory action under the Federal ESA. FINAL Report_Coho Salmon-Steelhead_Klamath Expert Panels_04 25 11

4. There are two primary reasons why Coho are considered endangered at this time:

A. The hatchery at Iron Gate originally took Coho at the beginning, middle and end of the Coho run. This allowed the bulk of Coho to spawn in natural streams. Due to complaints by property owners the Coho that spawned naturally died after spawning and their carcasses created a smell and sickened pets and livestock that ate them, so, for decades they now capture all the returning Coho diminishing the run considerably.

B. Their present practice is to tag all Coho raised at the hatchery and when they return to the hatchery they are not counted, thereby creating a very small return of Coho.

5. Regarding Chinook Salmon there was an attempt to list them in the upper Klamath River in 2011 and due to historical data regarding the Chinook's spawning grounds this listing was rejected by USFWS after I sent a de-listing petition.

In conclusion it is obvious that there is no legitimate cause to remove the dams as neither species qualifies to be listed as in the case of Coho the species is not native and does not qualify for any consideration and as to the Chinook USFWS rejected listing them above Iron Gate Dam based on considerable research.

Bachelors Degrees in Biology, Chemistry, Doctorate in the Healing Arts, Director of Interactive Citizens United, Director of New Frontiers Institute, Inc. Prior Participant of FERC and FPAT (Fish passage advisory team report) and HET (Hatchery evaluation team) Prior Vice President of Greenhorn Action Grange, Prior California State Grange Spokesman for the Water Committee, Prior National Whip of the Property Rights Congress of America, Representative of the Grange States of California, Oregon, Washington and Idaho regarding EFH regulations, Prior member of the Siskiyou County Water Users Assoc.

(13)

Dr. Richard Gierak
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530 475-3212

Truth about Salmon in Southern Oregon & Northern California

It is of interest to note that all battles over listing of Salmon in Southern Oregon and Northern California has been over the Coho Salmon. As has been stated earlier Coho Salmon are native to the Cascadia River in Central Oregon and under the ESA only a native species can be listed. Any listing in Southern Oregon and Northern California for Coho Salmon is illegal under the ESA.

In the 1990's there was a serious diminution of Coho Salmon in both Southern Oregon and Northern California which was blamed on the dams of the Klamath River. The reality was that the Ring of Fire volcano's were highly active raising the temperature of the Pacific Ocean and since Coho are a cold water species they migrated north into Washington and Alaskan waters. Data going back to the 1700's never demonstrated a rise in temperature of the Pacific as happened in the 1990's.

Of interest is to note that NMFS data appeared to indicate that the Pacific temperature never had a large temperature increase. What was found was that at the end of the first year of temperature rise they reported an increase of 1.6 degrees. However, when they started their survey the next year they started at 0 degrees of change. This continued throughout the 90's and in reality the total rise in temperature of the Pacific Ocean was approximately 10 degrees Fahrenheit This is the reason Coho migrated North into Washington and Alaskan waters.

It becomes apparent that the government would manipulate data to promote the cause of dam removal.

Bachelors Degrees in Biology, Chemistry, Doctorate in the Healing Arts, Director of Interactive Citizens United, Director of New Frontiers Institute, Inc. Prior Participant of FERC and FPAT (Fish passage advisory team report) and HET (Hatchery evaluation team) Prior Vice President of Greenhorn Action Grange, Prior California State Grange Spokesman for the Water Committee, Prior National Whip of the Property Rights Congress of America, Representative of the Grange States of California, Oregon, Washington and Idaho regarding EFH regulations, Prior member of the Siskiyou County Water Users Assoc.

February 1, 2017

Mr. Parker Thaler
State Water Resources Control Board
Division of Water Rights
Water Quality Certification Program
parker.thaler@waterboards.ca.gov
Via e-mail

BerkeleyLaw
UNIVERSITY OF CALIFORNIA

Student-Initiated Legal
Services Projects (SLPS)

RE: Scoping Comments on Application for Water Quality Certification Pursuant to Section 401 of the Federal Clean Water Act for the Relicensing of the Klamath Hydroelectric Project (FERC No. 2082)

Dear Mr. Thaler:

The Karuk-Berkeley Collaborative Legal (KBC) is a student-run organization at Berkeley Law. We have served the Karuk Tribe for more than five years, providing legal research and analysis in support of the Tribe's natural resource goals. In that time, we have gained a tremendous respect for the Tribe's stewardship of the Klamath River and an appreciation for the role of SWRCB in protecting California's water resources. KBC respectfully submits these comments on scoping for the Environmental Impact Report (EIR) for the issuance of a Water Quality Certification for the Relicensing of the Klamath Hydroelectric Project (FERC No. 2082).

We urge the State Water Resources Control Board to prepare an Environmental Impact Review that:

1. **Analyzes long-term beneficial impacts**, not just near-term adverse impacts, of license surrender,
2. **Relies on the 2012 KHSA EIS/EIR** analysis, findings, and record of comments/responses, and
3. **Establishes a schedule for this proceeding**, including a set date for SWRCB's final decision on whether to certify the license surrender application.

CEQA compels SWRCB to analyze the reasonably foreseeable long-term beneficial impacts of license surrender

California's CEQA Guidelines require that EIRs analyze all direct and indirect significant effects of a proposed project that are reasonably foreseeable. CAL. CODE REGS. tit. 14, § 15064. The Guidelines direct State agencies preparing an EIR to consider both "short-term and long-term effects." *Id.* at § 15126.2. Moreover, the Guidelines mandate that the lead agency balance the social and environmental benefits of a proposed project with the unavoidable adverse environmental effects. *Id.* at § 15093(a)–(c). If these and other benefits outweigh the unavoidable adverse environmental effects, "the adverse environmental effects may be considered 'acceptable.'" *Id.* at § 15093(a).

As such, the EIR for the Lower Klamath Project (LKP) must consider not only the near-term adverse impacts of license surrender, but also the long-term beneficial impacts that are sure to come from a free flowing Klamath River. Myriad studies, including FERC's 2007 NEPA document and the 2012 KHSA EIS/EIR, outline the long-term benefits of the LKP. Specifically, the 2012 KHSA EIS/EIR found that:

> Reversing the consequences of barriers to fish passage, degraded fish habitat, and degraded water quality throughout the basin could result in great benefit to tribal communities relying on fish, shellfish, riparian plants, clean water, and other resources for their subsistence, ceremonies, physical health, way of life, and spiritual well-being. While sediment release and other construction related activities during dam removal could cause short-term (1 to 2 years) adverse impacts on fisheries downstream from the Hydroelectric Reach, salmon and other aquatic resources would be expected to return to population levels observed prior to dam removal (in 2010 when the Notice of Preparation was issued) within 5 years, and would provide long-term benefits to Indian Tribes for 50 years and beyond." U.S. DEP'T OF THE INTERIOR & CAL. DEP'T OF FISH & GAME, Klamath Facilities Removal Final EIS/EIR, ES-39 (2012).

SWRCB is right to consider FERC's 2007 EIS and the 2012 KHSA EIS/EIR in its current EIR

As per the CEQA Guidelines, an EIR "may incorporate by reference all or portions of another document which is a matter of public record or is generally available to the public." CAL. CODE REGS. tit. 14, § 15150. The U.S. Department of the Interior and the California Department of Fish and Wildlife have already analyzed the environmental impacts of the LKP in its 2012 KHSA EIS/EIR. Their analysis is extensive and in line with the demands of NEPA and CEQA. SWRCB is right to rely on that analysis, findings, and record of comments/responses to inform its current review. STATE WATER RES. CONTROL BD., Notice of Preparation and Scoping Meetings for an Environmental Impact Report for the Lower Klamath Project License Surrender 9 (2016).

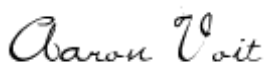
SWRCB should establish a schedule for this proceeding

The Karuk Tribe has been a steward of the Klamath River since time immemorial. Since first becoming aware of the harmful environmental, social, and cultural impacts of the dams on the lower Klamath River, the Tribe has advocated tirelessly for their removal. It has participated in the KBRA/KHSA talks in good faith since as early as 2005. However, in the time that has elapsed without a final resolution on dam removal, there has been further degradation of water quality in the Klamath, additional major fish kills, and more obstruction of the Tribe's traditional lifestyle and sacred rituals. It's time to have a final resolution in this matter. We urge SWRCB to establish a schedule for this proceeding and set a date for its final decision on whether to certify the license surrender application.

Conclusion

As students of the law, we learn that legal processes express our societal values and goals. Through our work with the Karuk Tribe, we have been inspired by the Clean Water Act's mission to ""restore and maintain the chemical, physical, and biological integrity of the Nation's waters." 33 U.S.C. § 1251(a) (2012). We were also moved by the passage of AB 52, which requires lead agencies to engage in "meaningful consultation" with California Native American Tribes regarding proposed projects. 2014 Cal. Legis. Serv. Ch. 532 (West). In these turbulent times, it is more important than ever for California to uphold our values to protect our natural resources and take tribal interests into account. The LKP is an opportunity to put those values into action. Thank you for the opportunity to submit these comments.

Sincerely,



Aaron Voit
Natural Resources Director
Karuk-Berkeley Collaborative Legal
Berkeley Law
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The views and opinions expressed in this comment represent those of the Karuk-Berkeley Legal Collaborative, a student pro bono project, and do not necessarily reflect the views, official policy, or position of the Karuk Tribe, the University of California, the University of California, Berkeley School of Law, or Berkeley Law's Student-Initiated Legal Services Projects (SLPS) Program.

Klamath Bird Observatory

Advancing bird and habitat conservation through science, education, and partnerships

January 30, 2017

Parker Thaler, Senior Specialist
State Water Resources Control Board
P.O. Box 2000
Sacramento, CA 95812-2000

On behalf of the Klamath Bird Observatory, we would like to submit the following comments regarding proposed removal of the four Klamath River dams (Iron Gate, Copco 1 and 2, and J.C. Boyle Dams) known as the Lower Klamath Project. We thank you for holding public scoping meetings, and are very pleased to have the opportunity to submit comments.

We recommend that the best available science be used to inform dam removal and riparian restoration planning. Birds are excellent indicators of habitat quality, respond rapidly to environmental change, and provide a robust measure of ecological function. Further, a wealth of information is readily available on the application of focal bird species to inform management, bird-habitat relationships, and response to restoration in the Klamath Siskiyou Bioregion. We encourage you to integrate Klamath Bird Observatory's robust regional avian science and Partners in Flight conservation objectives into planning and evaluation. Using bird monitoring as a tool, Partners in Flight focal bird species can be studied as indicators of successful restoration and return of ecological function to the riparian and river systems, or to identify habitat components that have not yet been achieved as restoration progresses.

We urge you to consider these comments during the planning process for the potential removal of the four dams known as the Lower Klamath Project. Klamath Bird Observatory would like to express interest in contributing unique expertise to dam removal and restoration planning, monitoring, and evaluation. We have used riparian bird and vegetation monitoring in the past to study the ecological effects of the removal of Gold Ray Dam on the Rogue River, OR, and to evaluate the success of riparian restoration along the Trinity River, CA, in an adaptive management context. We hope to continue collaborating with diverse partners in studying ecological effects of dam removal along the Klamath River. Despite the number of dam removals planned in the U.S., dam removal science is still in its infancy. The Lower Klamath Project provides a unique and timely opportunity to study ecological response to large-scale dam removal, an aspect which is commonly overlooked and not well-understood.

Sincerely,

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KLAMATH RIVERKEEPER®
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February 1, 2017

SWRCB, Division of Water Rights
Water Quality Certification Program
P.O. Box 2000
Sacramento, CA 95812-2000

RE: Environmental Impact Report for the Lower Klamath Project License Surrender

Dear Mr Thaler:

Thank you for the opportunity to comment about the environmental impact report for the proposed Lower Klamath Project license surrender. Please consider the following recommendations from Klamath Riverkeeper.

Rely on 2012 EIS / EIR
The 2012 Environmental Impact Statement / Environmental Impact Report (EIS / EIR) was based upon exhaustive studies, data and public comments. We respectfully request that SWRCB rely upon, rather than duplicate this analysis. Please consider the 2012 EIS / EIR, and all studies it addressed, as part of the record for the current proceeding.

Range of Alternatives
We support your consideration of a "range of alternatives" as stated in the notice and required by CEQA. However, please consider that a "no project" alternative would be hypothetical since PacifiCorp has withdrawn its request to certify a new dam operation license.

Furthermore, as you address the range of alternatives, please disclose the fact that the Lower Klamath Hydroelectric Project has long been operating in violation of the Clean Water Act, and potentially other state and federal laws.

Finally, we request that you analyze the option of removing J.C. Boyle and Keno Dams due to their clear adverse impacts on California water quality and beneficial uses of water.

Natural Baseline Conditions
The "baseline" for EIR comparisons should be natural baseline conditions that existed before the Klamath Hydroelectric Project dams were constructed, and which would presumably exist without the dams in place today.

Fully Analyze Long-Term Beneficial Impacts
The scoping notice identifies negative impacts of dam removal, but does not adequately address the range of positive long-term impacts. We request that you fully analyze long-term beneficial impacts of dam removal for fisheries, water quality, public health and the regional economy.

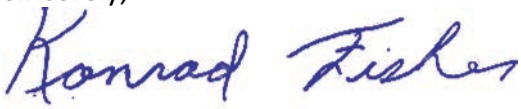
Geographic Scope
For the purpose of analyzing cumulative impacts of various alternatives, the project area must include all impacts on salmon-dependent communities in the Klamath Management Zone. This area extends at least from Shelter Cove, CA to Humbug Mountain, OR and offshore out to 200 miles.

Information Produced Since 2012
Information made available since 2012 further supports the conclusions of the 2012 EIS / EIR. We specifically request that you incorporate new data and studies produced jointly by the Yurok, Karuk and Hoopa Tribes that address the role of dams in the high infection rates of *Ceratonova shasta* parasite among of juvenile salmonids.

Timeline
The proposed project includes both physical facilities removal and a time element. Facilities removal will begin by January 1, 2020 pursuant to the amended KHSA, which the KRRC is implementing pursuant to license transfer and surrender applications. This timeline is an integral part of the overall project. As such, we request that SWRCB complete the EIR and make a final water quality certification decision on a schedule that preserves the timeline described in the amended KHSA.

Thank you for your consideration of these comments. Please don't hesitate to contact me if you have any questions.

Sincerely,



Konrad Fisher
Director

January 31, 2017

SENT VIA EMAIL: parker.thaler@waterboards.ca.gov and wr401program@waterboards.ca.gov

Mr. Parker Thaler
parker.thaler@waterboards.ca.gov
State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA 95812-2000

RE: Notice of Preparation of an Environmental Impact Report for the Proposed Lower Klamath Project License Surrender (FERC Project No. 14803)

Mr. Thaler,

Orca Conservancy and its members stand in support of the License Surrender Application proposed by Klamath River Renewal Corporation (KRRC) for water quality certification pursuant to section 401(a)(1) of the Federal Clean Water Act (CWA) (33 U. S. C. S 1341 et seq.) for the Lower Klamath Project's (Project) Federal Energy Regulatory Commission (FERC Project No. 14803) license surrender process. We are in full support of removal of the dams on the 4 locations proposed: (1) J.C. Boyle; (2) Copco No. 2; (3) Copco No. 1; and (4) Iron Gate.

We are requesting of the State Water Resources Control Board in preparing the Environmental Impact Report (EIR) please bring forward the comments previously submitted on January 27, 2016, in opposition to the relicensing of the Klamath Hydroelectric Project (FERC Project No. 2082). (See Exhibit 1 attached). Contained within those comments are still existing concerns regarding endangered species fisheries in existence within the Klamath watershed and further concerns for the endangered Southern Resident killer whales (SRKW) who are dependent on those fisheries during certain times of the year as a scarce food source due to past failures of managing the river's ecosystem.

Currently, the California (CA) sections of the Klamath River are listed as impaired for Microcystin, Organic Enrichment, Dissolved Oxygen, Temperature, Nutrients, and PH. The current Klamath River dams greatly add to these impairments and are considered a source of pollution and have been assigned Total Maximum Daily Load (TMDL) allocations for much of these impairments. These dams' discharges and reservoirs are currently violating water quality standards for the following objectives: Taste and Odor, Dissolved Oxygen, Temperature, Color, Floating Material, Biostimulatory Substances, and Toxicity.

Although there are some in opposition to the dam removal process, the present owner of these dams, KRRC (formerly PacificCorp), has clearly documented the wish to surrender their license and achieve dam removal along with support of many who have previously negotiated unsuccessfully for years in obtaining a plan for removal by interested parties. This surrender application provides an opportunity never seen before in the history of the Klamath River to restore its ecosystem and the inhabitants' that depend upon a healthy river.

It is the undersigned's understanding that 467 dams have been completely or partially removed in the United States within the 20th Century. At least another 30 dams have been completely removed through 2001.[1] Other estimates put 62 dams removed since 2015 alone. The undersigned would request that in consideration of the water quality permit that the CA State Water Board's consultants look to the successes achieved on the largest dam removal in U.S. History, the Glines Canyon Dam dismantled on the Elwha River in Washington State.[2]

Although it is the directive of California Environmental Quality Act (CEQA) to describe and analyze a range of reasonable alternatives, the focus should be on analysis that is determinative of feasible methods for obtaining dam removal impact mitigation measures. We understand that an EIR must evaluate a "no project" alternative but that should be to a lesser level of detail with the emphasis of the EIR being focused on the surrender of the dam licensing and dam removal.

It is our understanding that some have publicly claimed that water quality behind the 4 dams has improved because of the existence of the dams; however, that's a false narrative. Much like the false narrative that existed in the case of Save Our Sebasticook v. FERC, 431 F.3d 379, 369 (D.C. Cir. 2005). In that instance, landowners who worried about land values pursued litigation to oppose dam licensing surrender. However, the court held that the administrative agency had alternatively proposed and understood the nature of the toxic stagnant waters that existed there, much like what exists on the Klamath River today. As the CA State Water Board is likely aware, this current surrender permitting request by KRRC is founded and justified — based on science — which indicates stagnant waters and a devastated fishery due to the present existence of four dams at issue. "When a licensee applies for a surrender of its license, the Commission believes it may not compel the licensee to continue operating the project." Id at 382.

The undersigned is aware that sediment flows from dam removal are of great concerns for fisheries habitat, but historically as existed on the Elwha River, those concerns will decrease once the river can fully flush itself.

Lastly, we respectfully remind the water board that recent studies "... confirms that ... [S]outhern [R]esidents spend substantial time in coastal areas of Washington, Oregon and California and utilize

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[1] Poff, N. Leroy, and David D. Hart. "How Dams Vary and Why It Matters for the Emerging Science of Dam Removal." BioScience 52.8 (2002): 659-68. Web.

[2] Howard, Brian Clark. "River Revives After Largest Dam Removal in U.S. History." *National Geographic*. National Geographic Society, 2 June 2016. Web. 30 Jan. 2017.

salmon returns to these areas."[3] The SRKWs feed, and are heavily reliant upon Chinook salmon as their main food source which is supported by the Klamath, Sacramento, Eel and other rivers.[4] Additionally, these coastal waters are recognized as an essential foraging area for this critically endangered population which lives along the California coast from Point Lobos (Monterey) up to the Oregon Border during the winter and spring which is currently under consideration as designated critical habitat.[5]

In closing, please grant KRRC the ability to remove sufficient portions of the Iron Gate, Copco No. 2, Copco No. 1, and J.C. Boyle dam developments to create a free flowing Klamath River and provide for volitional fish passage in the Klamath River. The hydroelectric facilities and associated structures should either be removed or decommissioned in place pursuant to the permit applicants' request.

Sincerely,



Shari Tarantino
President, Board of Directors
Orca Conservancy
www.orcaconservancy.org

[3] Michael J. Ford, Nat'l Marine Fisheries Serv., Status Review Update of Southern Resident Killer Whales 26 (2013). In fact, evidence indicates that Southern Residents spend the majority of time in coastal and offshore waters. Cf. M. Bradley Hanson, et al., Assessing the Coastal Occurrence of Endangered Killer Whales Using Autonomous Passive Acoustic Recorders, 134 J. OF THE ACOUSTICAL SOC'Y OF AMERICA 3486, 3486 (2013) [hereinafter Coastal Occurrence] (explaining that "on average the whales occur in inland waters less than half of the days each year")

[4] "Special Report: Southern Resident Killer Whales - 10 Years of Research and Conservation." Northwest Fisheries Science Center. NOAA, 25 June 2014. Web. 30 Jan. 2017. <https://www.nwfsc.noaa.gov/news/features/killer_whale_report/>.

[5] 12-Month Finding on a Petition to Revise the Critical Habitat Designation for the Southern Resident Killer Whale Distinct Population Segment, 80 FR 9682, published 24 Feb. 2015.

EXHIBIT 1

January 27, 2016

SENT VIA EMAIL: parker.thaler@waterboards.ca.gov and wr401program@waterboards.ca.gov

Mr. Parker Thaler
State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA 95812-2000

Re: Environmental Impact Report (EIR) for the Klamath Hydroelectric Project Relicensing (FERC Project No. 2082) / Endangered Southern Resident Killer Whales

Dear Mr. Thaler,

The undersigned stand firmly in direct opposition of the proposed consideration of PacifiCorp's application for certification under Clean Water Act (CWA) § 401 for modifications to and continued operation of the Klamath Hydroelectric Project (KHP), which includes six dams on the Klamath River. In 2006, the U.S. Supreme Court found that hydroelectricity dams "discharge into navigable waters" and held "The issue in this case is whether operating a dam to produce hydroelectricity 'may result in any discharge into the navigable waters' of the United States. If so, a federal license under § 401 of the Clean Water Act requires state certification that water protection laws will not be violated. We hold that a dam does raise a potential for a discharge, and state approval is needed.[6]

Pursuant to the California Environmental Quality Act, Public Resources Code, sections 21000 et seq., (CEQA) the State Water Board not only needs to prepare an environmental impact report (EIR) but in doing so will need to evaluate potential impacts of proposed modifications and continued operation of the KHP to water quality and other resources within California as compared to the environmental baseline, and will also need to evaluate a range of alternatives, including removal of the dams.

Congress passed the CWA to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters," 33 U. S. C. §1251(a); see also PUD No. 1 v. Wash. Dep't of Ecology, 511 U. S., 700, 714. A critical "national goal" to achieve "water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water." 33 U. S. C. §1251(a)(2).[7]

Southern Resident killer whales

On November 18, 2005, after evaluating the five listing factors of the Endangered Species Act, 16 U.S.C. §§ 1531-1544, the National Marine Fisheries Service (NMFS) issued a final ruling listing the Southern Resident Killer Whales (SRKWs), as endangered under the Act. The southern resident population is comprised of three pods (identified as J-, K-, and L- pods) and is arguably the most familiar killer whale population to the general public.

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[6] S. D. Warren Co. v. Me. Bd. of Envtl. Prot., (U.S. 2006) 547 U.S. 370, 126 S. Ct. 1843, 164 L. Ed. 2d 625, 2006 U.S. LEXIS 3955, 74 U.S.L.W. 4244, 17 A.L.R. Fed. 2d 807, 62 ERC (BNA) 1257, 19 Fla. L. Weekly Fed. S 193

[7] See id. at 385

It occurs primarily in the Georgia Basin and Puget Sound from late spring to fall, when it typically comprises the majority of killer whales found in Washington. The population travels more extensively during other times of the year to sites as far north as the Queen Charlotte Islands in British Columbia and as far south as Monterey Bay in California.[8] As NMFS recently acknowledged, "new information ... confirms that ... [S]outhern [R]esidents spend substantial time in coastal areas of Washington, Oregon and California and utilize salmon returns to these areas."[9] These coastal waters are recognized as an essential foraging area for this critically endangered population in the winter and spring, and are currently under consideration to be designated as critical habitat for the SRKW.[10]

Southern Resident killer whales are dietary fish-specialists and depend on abundant populations of Chinook salmon for their survival, social cohesion and reproductive success.[11] Experts anticipate that climate change and ocean acidification will contribute to further significant declines in regional salmon abundance during the coming decades, thus impeding Southern Resident recovery.[12] After over a decade of federal protection, the population has yet to show signs of significant recovery, with 85 members total as of January 2015 – still three members fewer than when they were initially listed. This number includes nine new additions within the last 13 months (an 86th member of the SRKWs, Lolita, currently resides in Miami Seaquarium[13]), though their survival remains in question and is far from guaranteed.[14] While this sudden and unexpected "baby boom" is a move in the right direction, the population growth needs to exceed 200 members to reach historical levels.[15]

Therefore, based on the natural history and behavior of the endangered SRKWs it is imperative that prey species, specifically Chinook salmon, are of sufficient quality and quantity are available to support not only individual growth, reproduction, and development, but to further encourage the overall growth of this population. Prey depletion is recognized as one of the major threats to the survival and recovery of the SRKW community, and rebuilding depleted salmon stocks is listed as a top priority for the population.[16]

SRKWs and the Klamath River

The Klamath Basin is the third-most productive river system for salmon on the west coast of the United States. That said, changes to Klamath River flows and habitat loss due to human development in the last 150 years have driven steep declines in the once-mighty Klamath runs. Dams constructed on the mainstream and in major tributaries have severely limited access to historic spawning grounds, and salmon are now extirpated in many areas of the Klamath River Basin. Spring-run Chinook salmon, once likely the most abundant salmonids in the Klamath and Trinity Rivers, have declined to tiny fractions of historic numbers and are headed for likely extinc-

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[8] Wiles, G. J. 2004. Washington State status report for the killer whale. Washington Department Fish and Wildlife, Olympia. 106 pp.

[9] Michael J. Ford, Nat'l Marine Fisheries Serv., Status Review Update of Southern Resident Killer Whales 26 (2013). In fact, evidence indicates that Southern Residents spend the majority of time in coastal and offshore waters. Cf. M. Bradley Hanson, et al., Assessing the Coastal Occurrence of Endangered Killer Whales Using Autonomous Passive Acoustic Recorders, 134 J. OF THE ACOUSTICAL SOC'Y OF AMERICA 3486, 3486 (2013) [hereinafter Coastal Occurrence] (explaining that "on average the whales occur in inland waters less than half of the days each year")

[10] 12-Month Finding on a Petition to Revise the Critical Habitat Designation for the Southern Resident Killer Whale Distinct Population Segment, 80 FR 9682, published 2/24/2015.

[11] Center for Biological Diversity, Petition to Revise the Critical Habitat Designation for the Southern Resident Killer Whale (*Orcinus orca*) under the Endangered Species Act 5 (Jan. 16, 2014)

[12] See, e.g. Lisa G. Crozier et al., Predicting Differential Effects of Climate Change at the Population Level with Life-Cycle Models of Spring Chinook Salmon, 14 GLOBAL CHANGE BIOLOGY 236, 237, 247 (2008) (predicting that global warming and changing ocean conditions will lower survival and fertility among all populations of Pacific salmon (*Oncorhynchus* spp.)

[13] Amendment to the Endangered Species Act Listing of the Southern Resident Killer Whale Distinct Population Segment, 80 FR 7380, published 2/10/2015.

[14] Olesiuk, P. F., M. A. Bigg and G. M. Ellis. 1990. Life history and population dynamics of resident killer whales (Orcinus orca) in the coastal waters of British Columbia and Washington State. Report of the International Whaling Commission (Special Issue 12):209–243. Estimates neonate mortality between 37-50%.

[15] Palo (1972) put forth a tentative estimate of 225- 300 whales for Puget Sound and the Georgia Basin in 1970 (Palo, G. J. 1972. Notes on the natural history of the killer whale Orcinus orca in Washington State. Murrelet 53:22-24)

[16] National Marine Fisheries Service. 2008. Recovery Plan for Southern Resident Killer Whales (*Orcinus orca*). National Marine Fisheries Service, Northwest Region, Seattle, Washington.

tion. Now, the total number in both rivers rarely exceeds 1,000 fish and drops below 300 in many years.[17] Today, all anadromous runs of salmon and steelhead, once abundant in the upper basin, are extinct above Iron Gate Dam; pink and chum salmon are completely extinct in the river system.[18] This means over 350 miles of historic salmon habitat is unreachable by fish and much of it buried beneath reservoirs. These fish have quite literally been dammed to extinction.

Currently, under the California Endangered Species Act of 1984 (Fish & G. Code § 2050 et seq.), Coho Salmon (Oncorhynchus kisutch) and Chinook salmon (Oncorhynchus tshawytscha) are listed as threatened and endangered respectively. Section 9 of the ESA prohibits any person from taking an endangered species. 16 U.S.C. §1538(a)(1)(B). NMFS has extended the take prohibition to Chinook salmon and steelhead trout as species listed as threatened with extinction. 50 C.F.R. § 223.203(a). Considering the endangered status of these salmon populations and their significance to another endangered species, the SRKW, we are requesting your agency to recognize the ecosystem-wide impacts in its review of this permit request and in the development of an environmental impact report.

DAMS - There are six dams on the main stem of the Klamath River: 1. Iron Gate 2. Copco I 3. Copco II 4. J.C. Boyle 5. Keno 6. Link River. All were built without fish passage. Keno and Link effectively replace natural reefs that were destroyed, and they re-regulate erratic flows for the upstream irrigation project. Copco 1 has permanently blocked access to more than 300 miles of salmon and steelhead habitat in the main stem of the upper Klamath and its tributaries. Copco 2 was constructed just a quarter-mile downstream of the original facility in 1925. The aptly named 173-foot-high Iron Gate Dam was constructed to re-regulate the wildly varying flows from the upstream Copco dams and run a 20-megawatt power plant. With the construction of Iron Gate, an additional seven miles of spawning habitat in the main stem as well as important tributaries such as Jenny Creek were blocked. Today, ALL anadromous runs of salmon and steelhead, once abundant in the upper basin, are extinct above Iron Gate Dam.[19] Again, this means over 350 miles of historic salmon habitat has been unreachable by fish for almost 100 years, and much of the historic spawning grounds are now buried beneath reservoirs.

Multiple studies have confirmed the importance of salmon to the critically endangered SRKWs; most recently an analysis of fish DNA from fecal samples collected over six summers from the SRKWs (published January 6, 2016) confirmed that over 98% of the whales' summer diet consists of salmon; 80% was specifically Chinook; 15% was coho.[20] Early in the summer, Chinook salmon dominated their diet; coho salmon increased in importance in late summer, consisting of over 40% of the SRKWs diet.[21] Non-salmon fish were rarely observed. Previous analyses of remains from predation events have also indicated the preference of Chinook salmon in the SRKWs' summer foraging grounds.[22] Mortality rates are closely correlated to coastwide Chinook abundance, and recent Chinook population crashes in the mid-1990s and late-2000s resulted in significant losses to the SRKW population.[23] Limited sampling in winter distribution surveys confirm that the Southern Residents continue to seek out

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[17] Moyle, P.B., J.A. Israel, and S.E. Purdy. 2008. Salmon, Steelhead, and Trout it California, Status of an Emblematic Fauna: A report commissioned by California Trout. Center for Watershed Sciences, University of California, Davis.

[18] Status of Anadromous fish stocks in the Klamath River. http://www.fws.gov/yreka/HydroStatusAnadromous.html; http://www.pcffa.org/fn-aug01.htm

[19] California Enviornmental Protection Agency State Water Resources Control Board (2008) p.5 http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/klamath_river/100927/staff_report/17_Appendix5_FishandFishery_Resources.pdf.

[20] Ford MJ, Hempelmann J, Hanson MB, Ayres KL, Baird RW, Emmons CK, et al. (2016) Estimation of a Killer Whale (*Orcinus orca*) Population's Diet Using Sequencing Analysis of DNA from Feces. PLoS ONE 11(1): e0144956. doi:10.1371/journal.pone.0144956

[21] Ibid.

[22] Ford, J.K.B., and Ellis, G.E. 2005. Prey selection and food sharing by fish-eating 'resident' killer whales (*Orcinus orca*) in British Columbia. DFO Can. Sci. Advis. Sec. Res. Doc. 2005/041.; Ford, J. K. B. and G.M. Ellis. 2006. Selective foraging by fish-eating killer whales *Orcinus orca* in British Columbia. *Marine Ecology Progress Series* 316: 185-199; Hanson, M.B., R.W. Baird, J.K.B Ford, J. Hempelmann-Halos, D. M. Van Doornik, J.R. Candy, C.K. Emmons, G. S. Schorr, B. Gisborne, K. L. Ayers, S. K. Wasser, K. C. Balcomb III, K. Balcomb, J. G. Sneva, and M. J. Ford. 2010a. Species and stock identification of prey consumed by endangered southern resident killer whales in their summer range." *Endangered Species Research*, 11(1):69-82.

[23] Ford, J.K.B, G.M. Ellis, P. F. Olesiuk, and K.C. Balcomb III. 2010. Linking killer whale survival and prey abundance: food limitation in the oceans' apex predator?*Biology letters* 6(1): 139-142; Ward, E. J., E.E. Holmes, and K.C. Balcomb III. 2009. Quantifying the effects of prey abundance on killer whale reproduction. *Journal of Applied Ecology*, 46(3):632-640.

Chinook salmon in their coastal range, from major west coast rivers, including the Klamath.[24]

Restoration of the Klamath River

TOXINS – If dam removal is the cornerstone of the Klamath River restoration, improved water quality is the foundation. Toxic conditions in the reservoirs threaten the health of fish and people. The reservoirs created by these dams heat the water to lethal temperatures during the hottest parts of the year, and deplete dissolved oxygen which fish need to survive. Warm water releases from Iron Gate Dam into the river have further devastated the fish runs. These fish need adequate flows of cold, clean, well-oxygenated water to survive. Instead, we have given them warm, toxic, oxygen-depleted, agricultural wastewater. These conditions have devastated and continue to devastate the Klamath's once great salmon runs. In many years, water quality and flows from the Upper Klamath has been so bad that salmon runs far downstream have been destroyed, most notably in 2002 when a massive die-off linked to low water levels removed an entire generation of spawning fish.[25] In July 2006, samples from the Iron Gate reservoir had the highest levels of Microcystis aeruginosa (liver toxin) ever recorded in the U.S., 4,000 times higher than the maximum safe limit set by the World Health Organization.[26] Blooms of blue-green algae (cyanobacteria), are sadly becoming commonplace in the Klamath Basin, posing a significant threat to all living things dependent on the river, including people.[27] In the summer of 2015, a health advisory was issued for Klamath River waters extending from the Upper Klamath to the California state line, and salmon scientists feared a die-off similar to the 2002 event, narrowly avoided by federally mandated spill on the river.[28]

In a 2012, a report issued by the Department of the Interior found that the removal of four dams on the Klamath River (J.C. Boyle, Copco 1, Copco 2, and Iron Gate) was expected to result in up to an 81% increase in the Klamath River Chinook population, and open over 420 miles of historic spawning habitat.[29] The report also found that dam removal would increase the diversity of salmon stocks, increase water flow, reduce disease occurrence, and provide access to cold-water refuge areas that would help mitigate the effects of climate change.[30]

The same report addressed the economic benefits of dam removal compared to relicensing the four dams in question, which would require significant remodeling to meet current environmental and safety standards. The cost of upgrades required to meet standards required by the Federal Energy Regulatory Commission[31] is estimated at nearly 48 times the cost of removing the dams. In contrast, dam removal is expected to result in a 43% increase in commercial fishing harvests from the Klamath River over the next 50 years ($134.5 million), with subsequent increases in sport and tribal harvest, as well as increasing recreational opportunities and revenue in the Klamath River and Basin.[32]

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[24] 10 years of research and conservation for Southern Resident killer whales. http://www.nwfsc.noaa.gov/news/features/killer_whale_report/

[25] US Fish and Wildlife Service. Klamath River Fish Die-off. September 2002, Mortality Report, FWS, Arcata, CA. Report Number AFWO-01-03

[26] Moyle, P.B., J.A. Israel, and S.E. Purdy. 2008. Salmon, Steelhead, and Trout it California, Status of an Emblematic Fauna: A report commissioned by California Trout. Center for Watershed Sciences, University of California, Davis.

[27] See EPA information on cyanobacteria in the Klamath: http://www3.epa.gov/region9/water/watershed/klamath.html#algae;

[28] See: ""Klamath River health advisory extended to California state line." http://www.heraldandnews.com/news/local_news/klamath-river-health-advisory-extended-to-california-state-line/article_85994ab1-65e0-529a-9677-36e45a44ad4a.html; "Feds release extra water into Basin to save Klamath salmon from disease" http://www.bendbulletin.com/localstate/3442706-151/feds-release-extra-water-into-basin-to-save

[29] Klamath Dam Removal Overview Report for the Secretary of the Interior http://klamathrestoration.gov/sites/klamathrestoration.gov/files/2013%20Updates/Final%20SDOR%20/0.Final%20Accessible%20SDOR%2011.8.2012.pdf

[30] Ibid.

[31] See PacifiCorp relicensing process: http://www.pacificorp.com/es/hydro/hl/kr.html#

[32] Klamath Dam Removal Overview Report for the Secretary of the Interior http://klamathrestoration.gov/sites/klamathrestoration.gov/files/2013%20Updates/Final%20SDOR%20/0.Final%20Accessible%20SDOR%2011.8.2012.pdf

Recent dam removal projects in Washington, Oregon, and California, including the Marmot Dam on the Sandy River in Oregon; the Condit Dam on the White Salmon River in Washington; and the largest dam removal project in the world to date – two dams on the Elwha River in Washington – have resulted in the restoration of salmon habitat and the remarkable recovery of salmon populations in each river. The ecosystem of the Elwha River has improved quickly and significantly, with salmon returning upstream even sooner than scientists had predicted.[33]

Conclusion

The Southern Resident community of orcas are the most intensively studied population of marine mammals in the world, and what we've learned is that healthy Chinook and Coho salmon runs are critical to their recovery. To save the whales, we need to protect the Klamath. The recovery and restoration of west coast rivers is key to the survival of these whales, and addressing the threat of prey abundance is a priority in recovery plans for this critically endangered population. Their historic use of California waters qualifies this community as an important resource to the state of California, and should be considered when evaluating the potential impact of continued operation of the Klamath River dams.

To preserve water quality levels suitable for Klamath River salmon populations and the greater ecosystem of the Basin, including the continued conservation of the SRKWs, we recommend and support the removal of the following PacifiCorp dams: J.C. Boyle, Copco 1, Copco 2, and Iron Gate. Relicensing and allowing the dams to remain in place has widespread and significant negative impacts on the economy and ecology of the region, with effects extending to the river mouth and beyond. We urge you to deny the permit for relicensing and recommend removal to protect and restore not only the water quality of the Klamath River, but the salmon and killer whales that depend on the Klamath.

Sincerely,

Shari Tarantino
President, Board of Directors
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[33] "Rivers Recover Rapidly Once Dams are Gone, Study Finds." http://www.opb.org/news/article/rivers-recovery-rapidly-once-dams-are-gone-study-finds/

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31 January 2017
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RE: Scoping Comments on CEQA Environmental Impact Report (EIR) for 401 Water Quality Certification for the Klamath Hydroelectric Project (FERC Project P-2082)

Dear Board Members and Staff:

These CEQA "scoping" comments are submitted on behalf of the Pacific Coast Federation of Fishermen's Associations (PCFFA), the Institute for Fisheries Resources (IFR).

We will discuss the "scoping" issues that should be considered in two categories below: (1) basic scoping issues (including baselines, geographic and temporal scope of your EIR analysis) that would generally be required or advisable under CEQA, and; (2) specific issues related to adverse water quality impacts with the dams now in place, and the relation of those impacts to losses of productivity in the Klamath River's once-abundant salmon fisheries and the related impacts of these declines on the economies and lives of coastal and in-river fishing-dependent communities.

These four dams have been highly destructive for the once-huge Klamath native salmon runs, once the third largest salmon runs in the lower 48 states. It is important to assess the current

impacts of the dams in place as the baseline – which would presumably be adverse impacts eliminated once the dams are decommissioned and removed.

A number of important documents are included as Attachments for the Administrative Record, as well as evidence that these adverse impacts are substantial and pervasive. These comments and Attachments are being submitted via email in PDF format for convenience of the Water Board Staff and for posting on the Board's web site devoted to this process.

These fisheries-specific comments are submitted to supplement, and are in addition to, other written comments being submitted separately by other entities, and which we also endorse and incorporate herein by reference, including all written comments to be submitted separately by: the Karuk, Yurok and Hoopa Valley Tribes of California and by the Klamath Riverkeeper.

BASIC SCOPING ISSUES

(1) Geographic Scope of Cumulative Impacts Analysis: The "Project Area" for purposes of cumulative impacts analysis should be the entire area from Upper Klamath Lake's Link River Dam (containing the first structures within the Klamath Hydropower Project (KHP)), downstream to the estuary, *and also including* all impacts from salmon population and fisheries losses and declines that can be causally linked to the KHP and which occur within the coastal areas of the Klamath Management Zone ("KMZ") – an area extending from the shores of California and Oregon offshore out to 200 miles, and which extends north to at least Humbug Mountain, (OR) and south to at least Horse Mountain (near Shelter Cove), California. This, it should be noted, is the same scope of "Project Area" PacifiCorp used in its original Application for Relicensing, so it is nothing new.

Klamath-origin salmon, once they finally leave the Klamath River and enter the Pacific Ocean, are highly migratory. Thus adverse impacts at or below the KHP dams that affect out-migrating juvenile salmon (as for instance increasing their mortalities) also necessarily impacts ocean salmon fisheries and coastal fishing-dependent communities and economies far to the south and far to the north of the Klamath River estuary.

Cumulative impacts analysis (especially socioeconomic impacts) within this broader KMZ area is consistent with the "Project Area" designated by PacifiCorp in its License Application[1] and used as the FERC FEIS geographic scope for its cumulative impacts analysis (FERC FEIS, Sec. 3.2.1 (pp. 3-3—3-4)). In fact, the FERC FEIS itself notes:

[1] See PacifiCorp Final License Application, Socioeconomic Resources Final Technical Report (Feb. 2004), section 2.4.3 "Geographic Scope," particularly the following (page 2-7): "The preliminary study area for the socioeconomic analysis [of KHP impacts] includes Klamath, Jackson, and Curry counties in Oregon and Siskiyou, Humboldt, and Del Norte counties in California. These are the counties that contain the Project boundaries or whose economies, local services, and human resources are potentially affected by the incremental changes to the Project and PM&E measures." For PacifiCorp's own estimates of specific socioeconomic impacts of the Project on coastal salmon fishing dependent ports and communities within the KMZ, see PacifiCorp Final License Application, Socioeconomic Resources Final Technical Report (Feb. 2004), pp. 2-108 through 2-115 inclusive.

> "For anadromous fish, we include the mainstem Klamath River and all habitat that was historically accessible upstream of the mouth of the river… We also consider appropriate management plans for salmon fisheries including those related to the Klamath Management Zone, which extends 200 miles offshore from Humbug Mountain, Oregon, to Horse Mountain (near Shelter Cove), California. We consider these plans because harvest (including commercial, tribal, and recreational) and escapement for Klamath stocks can affect the numbers of adult salmonids returning to the Klamath River Basin to spawn. We acknowledge that management measures for Klamath River fall Chinook salmon currently constrain fishing on other salmon stocks, from central Oregon to central California. As mentioned above, Klamath Hydroelectric Project structures and operation can affect adult spawning and subsequent downstream migration of juvenile salmonids which, in turn, serve as the basis for future harvests." (FERC FEIS pg. 3-4)

Using the same geographic area for the CEQA analysis as was used by FERC in its Final EIS (and indeed was used by PacifiCorp itself in its FERC Relicensing Application) allows a consistent and logical "apples to apples" comparison of impacts generally. Analyzing different areas in different ways would not. This was also the reason the Secretarial Determination NEPA/CEQA analysis choose the same geographic scope as its "Project Area" for analysis. To be consistent, and to have any hope of comparing various scenarios (including dam removal) as against the alternative of relicensing or "no action," logically requires that the same geographic scopes be used for comparison.

(2) Temporal Scope of Analysis: The CEQA EIR should likewise analyze the cumulative and other impacts within the same time scale as the FERC FEIS, which is based on the proposed PacifiCorp license application itself, i.e., 30 to 50 years. (FERC FEIS Sec. 3.2.2 (pg. 3-4)). This was also the time scale used in the Secretarial Determination NEPA/CEQA analysis. There is no rational reason to use any different time scale if there are to be comparisons between the various scenarios and across CEQA analyses.

(3) Proper Comparison Standard Should Be The "Natural Baseline Conditions" That Existed Prior To The KHP Dams: In analyzing whether the KHP dams should come down or not, PacifiCorp must show that it can meet *all applicable water quality standards* with a new FERC license. Mere incremental improvements from an already highly degraded condition – as might be expected from retaining the dams with some mitigation measures -- are <u>not</u> enough, either legally or biologically, for Clean Water Act certification and approval.

The Water Board is being asked to compare various options and alternatives/mitigation measures for bringing into compliance an *already highly degraded river system*. Some of the dams in the Klamath River (such as the CopCo 1 Dam) have been in place since 1917, with others built later but none later than 1962 with the completion of Iron Gate Dam. Adverse impacts on water quality in the Klamath River from Klamath dams have occurred for at least 90 years. The choice of baselines to compare to under CEQA is therefore critically important in obtaining meaningful information on whether water quality standards can be met under *any* future KHP configuration.

Unfortunately, the CEQA process is not well suited to analyzing additional impacts on an *already highly degraded system*. As presently configured and operated, the Klamath River cannot even *currently* meet state water quality standards with the KHP in place. It would therefore be legally inappropriate, as well as quite illogical, to use the current highly degraded system existing on the date of issuance of the NOP as the "baseline" against which to compare the various options for environmental mitigations.

The proper (and far more logical) "baseline" for EIR comparisons for ascertaining the environmental impacts of the dams themselves, as well as changes (positive or negative) that may result from the various dam mitigation and removal options, is instead the comparison of these options to the "natural baseline conditions" that existed before the KHP dams were constructed -- and which would presumably exist without the dams in place today. Use of this more biologically meaningful baseline then gives us a straightforward comparison between the various alternative options and "dams out" or "Project out" environmental conditions meeting all water quality standards, which standards are themselves based on reconstructions of those prior natural conditions.

It should also be noted that PacifiCorp is now requesting approval of the decommissioning and removal of most or all of the KHP, and is no longer requesting relicensing. Thus the "dams out" or "natural conditions" scenario is the only logical baseline against which to compare all potential mitigation measures, and to ascertain the effectiveness of these measures in achieving the target standards.

Water quality standards in the Klamath Basin were in fact originally derived from these pre-Project "natural baseline conditions." Under pre-KHP natural conditions, all existing beneficial uses were preserved, and the full range of water quality parameters the natural aquatic species evolved within were protected. Various specific and numeric water quality standards derived for what this baseline looked like also create specific regulatory standard "baselines" of their own, for each parameter, which by law *must be met by the KHP if the Project as mitigated is to be relicensed.* The Clean Water Act Sec. 401 states clearly that "if the imposition of conditions cannot insure such compliance such agency [in this case FERC] shall not issue such license or permit."[2]

It should be noted that ascertaining the river's "natural baseline conditions" pre-KHP development, and then assessing adverse water quality impacts of the KHP against that pre-development baseline, is also precisely the methodology in use by the North Coast Regional Water Quality Control Board ("Regional Board") in its development of the Klamath Mainstem TMDLs, currently approved and well underway. The same methodology should be used in this instance as well.

This 401 Certification process should at least be consistent with the Regional Board's TMDL analytical methodologies so that this process can take advantage of the extensive prior Regional

[2] Federal Water Pollution Control Act ("Clean Water Act"), Sec. 401(a)(2) [33 U.S.C. §1341(a)(2)].

Board work already done, including its water quality models, and so that the standards used in this certification process will also be consistent with that later TMDL.

(4) J.C. Boyle and Keno Dam Impacts Directly and Indirectly Affect California Beneficial Uses As Well As Water Quality, and Therefore Must Also Be Considered and Their Impacts Analyzed: The Klamath Hydroelectric Project is operated under a single FERC license and as one operationally integrated whole, with each structure upriver influencing the total -- and cumulative -- water quality impacts of the Project as a whole well downstream into California and even out to the estuary. Thus water quality problems generated in the Oregon portion of the KHP inevitably wash downstream into California. The portions of the Project that are upstream in Oregon (J.C. Boyle and Keno Dams) are therefore not exempt from CEQA analysis because they generate "emissions or discharges that would have a significant effect on the environment in this state."[3]

In the prior 401 Certification process, the Notice of Preparation (NOP) dated Sept. 30, 2008, only says this about impacts on the Klamath River coming to California downstream from Oregon KHP structures:

> "Modification to the Oregon facilities will be addressed through the Oregon Department of Environmental Quality's 401 water quality certification. The EIR will address these contingencies as part of the cumulative impacts analysis." (NOP, pg. 10)
>
> "The State Water Board has identified only two potential adverse impacts caused by discharges from the Oregon facilities: (1) impacts of J.C. Boyle peaking operations on California portions of the river, in the event of removal of the California dams that currently re-regulate flows; and (2) sediment release into California if J.C. Boyle Dam is removed."

The Board Staff are correct that at least these two Oregon-KHP impacts exist on the lower river into California, and these impacts still exist. They must therefore also be considered as part of the KHP's cumulative impacts analysis under CEQA in this instance, even though the purposes of the two 401 Certification processes are very different (i.e., removal vs. relicensing).

In fact, prior to the construction of Iron Gate Dam rapid daily ramping rates at J.C. Boyle were extremely destructive to stream-edge fish spawning and rearing habitat in the reaches of the river below J.C. Boyle Dam.[4] This adverse impact well into California would occur once again in any alternative that included keeping J.C. Boyle Dam, even though the fate of the J.C. Boyle dam lies in the hands of Oregon agencies, not California's. This interconnected therefore should be considered in this new process as well.

Remember, both water and water quality problems flow downhill, in this case from Oregon to California *within* the KHP. There are also many other significant impacts from these Oregon

[3] CA Public Resources Code §21080(b)(14).
[4] See Expert Report of Mike Rode, Attachment 1, at 9-10.

KHP structures and operations that also impact California waters and therefore should also be considered under CEQA. Those additional J.C. Boyle and Keno Dam water quality impacts on California waters include *at least* the following:

(1) Both Oregon dams create slack, warm-water reservoirs that expose the Klamath River to sunlight for longer periods of time and with less shade over a much broader surface area, thus raising its overall ambient daily water temperature. This plume of warmed water washes far downstream before it is fully attenuated, if at all, by other colder inflows.

(2) J.C. Boyle and Keno both trap and hold natural sediments that would otherwise contribute to spawning and rearing gravel below them, thus impoverishing instream spawning and rearing habitat in what would otherwise have been prime spawning and rearing areas for resident rainbow and redband trout (and would have similar impacts on salmon and steelhead after fish passage is provided).

(3) Because J.C. Boyle and Keno (as all dams do) trap sediments, they serve to concentrate nutrients that are the food sources for the growth of various algae species that thrive in these warm-water reservoirs, including the highly toxic blue-green algae species *Microcystis aeruginosa*. However, *M. aeruginosa* in turn produces the highly toxic but colorless and odorless liver toxin microcystin, which is highly soluble in water. Several recent algae monitoring studies in the reservoirs (see the comments of the Karuk Tribe of California) indicate that *Microcystis aeruginosa,* which is rare to non-existent in Upper Klamath Lake and Link River, first appears in dangerous concentrations within Keno Reservoir where ideal conditions (warm, still water with high nutrient concentrations) exist there primarily due to the existence of Keno dam.

(4) Microcystin generated by *Microcystis aeruginosa* in Keno Reservoir, then in J.C. Boyle Reservoir, naturally washes downriver and into California waters where it has been shown to concentrate in human food chains. Likewise the algae mats that first develop and grow in Keno Reservoir (toxic and otherwise), also wash downriver where they can "seed" new areas downstream (such as Iron Gate Dam) with these algae species wherever similar conditions exist for their growth.

(5) The very existence of Keno Reservoir further increases already warm Klamath River water temperatures by flooding out and/or inundating a number of small cold-water tributaries and springs that would in the past have served as important cold-water refugia for salmon and steelhead during critical water summer months. Many salmonids depend on these types of cold-water refugia flowing into the Klamath River for their summer survival. Today, several of these cold-water streams and springs are inundated by the reservoirs and their refugial benefits are completely lost.

(6) Problems with high water temperatures at Keno and J.C. Boyle Reservoirs result, as a consequence, in lowered dissolved oxygen (DO) levels.[5] Additional sudden DO concentration dips can be caused by algae bloom die-offs. As these algae mats die off, their natural decay process also leads to elevated ammonia levels and various changes in pH from normal baseline conditions. These pervasive water quality problems all begin at Keno Dam and its warm-water reservoir, are continued downstream into J.C. Boyles Dam and reservoir, where they get more widespread and impactive, and then they all wash downstream into California, where they then exacerbate all the water quality problems of the river below, making it that much harder to meet TMDL and other California water quality standards.

All these adverse water quality impacts at J.C. Boyle and Keno Dams are widely known and just as widely documented. In fact, in his *Ultimate Findings of Fact and Conclusions of Law* in the Federal Adjudicatory Decision[6] of the Hon. Judge Parlen L. McKenna in the Administrative Appeal by PacifiCorp of the federal agency "prescriptions" under the Federal Power Act, on Sept. 27, 2006, Judge McKenna concluded:

> "Ultimate Finding of Fact 6: USFWS/NMFS ISSUE 3: Project operations have and continue to adversely affect the resident trout fishery by, among other things: a) confining the resident trout between the Project dams and associated reservoir thereby impairing their utilization of the full range of life history strategies and spawning productivity; b) unscreened flow through Project turbines result in mortality of juvenile and adult trout migrating down stream; and the inability to effectively migrate adversely affects the genetic health and long term survival of the resident species.
>
> "Ultimate Finding of Fact 7: USFWS/NMFS ISSUE 4: Entrainment at Project facilities have and continue to adversely affect the resident fishery resources.

The Judge was not limiting this findings to only those dams in California, but also included impacts on fisheries at J.C. Boyle and Keno Dams. Judge McKenna also formally found that:

> "Ultimate Finding of Fact 14: BLM ISSUE 16: Current Project operations, particularly sediment blockage at the J.C. Boyle Dam, the flow regime, and peaking operations, negatively affect the redband trout fishery. The proposed River Corridor Management Conditions would improve fishery resources.
>
> "Ultimate Finding of Fact 15: BLM ISSUE 17: The BLM's proposed upramp rate will improve conditions for fish resources and other aquatic organisms by reducing adverse effects caused by the existing nine inch/hour upramp rate."

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[5] The physical ability of water to absorb dissolved oxygen is more or less ***inversely*** proportional to its temperature at normal temperature ranges.

[6] *In the Matter of Klamath Hydroelectric Project (FERC Project No. P-2082),* U.S. Dept. of Commerce Adjudication Docket No. 2006-NMFS-0001, Final Order and Decision Sept. 27, 2006. This Final Order in hereby incorporated into these comments by reference as though full set out herein. It has been included in the FERC 2007 EIS record as well.

Judge McKenna also made numerous other secondary "Findings of Fact and Conclusions of Law" in this Adjudicatory Hearing, all based upon and specifically referencing the evidence submitted on the hearing record, to the effect that both J.C. Boyle and Keno Dams have considerable adverse impacts on both water quality and fish populations (all of which are "beneficial uses" under California's Porter-Cologne Water Quality Act) that would normally have impacts far downriver and well into the State of California.

These various Oregon-origin adverse impacts on California beneficial uses cannot be ignored, simply because they originate in Oregon. None of these impacts are exempt from CEQA analysis as noted above, especially as they are *significant* contributors to cumulative adverse Klamath River environmental impacts in California.

Additionally, if and when the CopCo dams and Iron Gate Dam are ultimately removed, adverse peaking and other water quality impacts from J.C. Boyle will not be moderated by the CopCo and Iron Gate reservoirs, and will once again play an important negative role in the health of the Klamath River much farther downriver than they do today. Before the construction of Iron Gate Dam as a flow regulation dam, these J.C. Boyles daily fluctuating ramping rates killed large numbers of juvenile salmon, stranded many spawning adults and dewatered many salmon egg nests ("redds").[7] There were also documented cases, some resulting in litigation, of in-river fishermen being stranded on rocks and drowned by sudden upsurges of water levels due to high ramping rates at J.C. Boyle prior to the construction of Iron Gate Dam as a flow regulator.

Therefore as a matter of law, the California State Water Board's CEQA analysis must include a review of impacts on California of the entire Klamath Hydro Project, including Oregon dams and reservoir components of the KHP at J.C. Boyle and Keno Dams.[8]

The thorough analysis of the many J.C. Boyle and Keno Dam water quality impacts can easily be coordinated with Oregon's similar and parallel 401 Certification process, which is also proceeding in Oregon albeit on a slower time frame. The Klamath inter-state TMDLs are already coordinated this way through a bi-state Memorandum of Agreement (MOA), and this has proven quite effective.

(5) Inadequacy of Range of Alternatives – Two Additional Dam Removal Options Must Be Considered: Since there are clearly adverse impacts on California water quality and beneficial uses of water from the J.C. Boyle and Keno Dams which must be analyzed under CEQA, the potential futures of J.C. Boyle and Keno Dam should therefore also be included in the CEQA EIR range of dam removal alternatives. Failure to consider a total removal of the KHP unlawfully truncates consideration of the full range of possibilities available, and even likely, in this situation.

[7] See Expert Testimony of Mike Rode, Attachment 1, Sec. 5.2.
[8] CA Public Resources Code §21080(b)(14).

We cannot stress this point enough: both Oregon and California should be analyzing the same range of alternatives. *If California does not analyze removal of dams in Oregon, and Oregon does not analyze removal of dams in California, then who will analyze a complete removal option? If full KHP removal options are not analyzed, this unfairly (and unlawfully) biases the decision toward keeping some parts of the Project intact when indeed that option may not meet legal water quality standards.*

While the removal of J.C. Boyles and Keno Dams (both located in Oregon) are not technically within the power of the State of California to legally *require*, the actual and likely future impacts of these dams are certainly within the power of California to *analyze* – a very different issue. They are part of the same FERC license, and both California and Oregon are supposed to be coordinating their efforts in their parallel 401 certification analyses. *The two states should not be analyzing vastly different alternatives.* If they do so, comparison of the two state analyses in any meaningful way will be impossible.

In summary, not to include analysis of J.C. Boyle and Keno removal options would *wrongfully assume* that Oregon will itself certify these two dams as meeting its standards in its parallel process and that they would remain in place under a new license. This artificially and capriciously biases the final decisions on the fate of these dams toward J.C. Boyle retention – merely by the default of never actually considering the impacts of their removal. The State of Oregon, which does have jurisdiction over those two dams, could also *very well deny* 401 Certification to J.C. Boyle and to Keno, in which case they might remain in place, with all their impacts. Under CEQA, therefore, the State of California should therefore include this as a potential option that must also be analyzed as to its environmental impacts.

Thus a *complete* set of removal options, including (a) the removal of J.C. Boyle alone in Oregon with removals of the California dams, and; (b) removal of both J.C. Boyle and Keno Dam in Oregon with the removals of the California dams (i.e. "Project-out conditions") should be fully analyzed *on both sides of the state border* as part of the bigger suite of likely KHP removal alternatives. Removal of both Oregon dams is at least a potential outcome of Oregon's own parallel water quality certification process, and therefore surely foreseeable. It is also necessary to have these options analyzed *by both states* in order to be sure that both states are considering the full range of potential options.

Again, the Klamath Hydroelectric Project is a single Project, under a single FERC license, for a very good reason – all the parts of the Klamath Hydroelectric Project are intended to work together. Neither state alone has jurisdiction over the whole KHP, but both acting together certainly do. Thus both states should analyze the same full-removal option regardless of state lines.

Nor is there any requirement of actual legal authority to remove a dam necessary in order to *analyze* that removal as a foreseeable or comparative alternative for purposes of environmental impacts analysis within a full range of foreseeable options. Indeed it is FERC – and not the states – that have the power to order dam removals for a FERC-licensed dam.

In summary, to take into account the foreseeable contingency decisions that Oregon might make regarding the KHP dams under its jurisdiction, there should thus be two additional options analyzed in the CEQA Alternatives, which are as follows:

> **Additional Option A:** Removal of Iron Gate, CopCo No. 1, CopCo No. 2 and J.C. Boyle Dams: This would be a four-dam removal option that would leave Keno Dam (and Keno Reservoir) in place with appropriate fish passage prescriptions and water quality mitigation measures, but take out the four hydropower-producing components of the KHP below Keno.
>
> **Additional Option B:** Removal of Iron Gate, CopCo No. 1, CopCo No. 2, J.C. Boyle *and* Keno Dams: In other words, this would be the removal of all KHP structures in the mainstem Klamath River, resulting in a free-flowing river from Link River all the way downstream to the estuary.

(6) Special Problems at Keno Dam: Keno Dam creates its own special water quality problems, including being the first site within the KHP where the toxic blue-green algae species *Microcystis aeruginosa* has been observed in any significant quantity (see Attachment 2 (Kann)). Thus Keno dam's impacts should be assessed in such a way that they can be looked at separately as well as a part of Additional Option B impacts above.

There are a number of rather serious water quality and structural problems at Keno Dam that need to be addressed. Among other problems, Keno: (1) effectively blocks current fish passage, and has no adequate passage for salmonids or Pacific lamprey; (2) traps sediment that would otherwise wash downstream and replenish depleted spawning gravel beds; (3) creates a solar "heat sink" behind it that raises water temperatures; (4) traps and concentrates nutrients washing from upriver; (5) encourages the growth of the toxic blue-green algae *Microcystis aeruginosa,* which in turn produces the highly toxic, bio-accumulative but colorless and odorless liver toxin microcystin, both of which naturally float downriver and into California, where the algae mats from Keno help seed *Microcystis aeruginosa* growth in the lower reservoirs in California, and where the microcystin toxin can be absorbed by fish and mussels and in various other ways adversely affect public health.

We do note that PacifiCorp proposed as part of its original *License Application* to FERC that the Keno Dam be omitted from any future FERC license. It may or may not ultimately be sold by PacifiCorp to the US Bureau of Reclamation. However, this does not release PacifiCorp from responsibility for the Keno dam merely by omission, nor does it remove Keno Dam from FERC's on-going jurisdiction as part of the current FERC license.

Keno Dam is a non-power flow regulatory dam that has *always* been a part of the basic FERC license for this Project. Though Keno Reservoir storage capacity is limited, Keno Dam nevertheless lies in the heart of the Klamath Hydroelectric Project, and controls flows to the dams in the other parts of the Project below it. This allowed PacifiCorp to better time its peaking power generation and to benefit from the peaking abilities primarily of J.C. Boyles. Keno Reservoir levels are kept high enough in the summer time to serve some 91 water diversion

points in Keno Reservoir, but can be varied much more during non-irrigation season, or in emergencies.

FERC's Policy Statement on Decommissioning ("FERC Decommissioning Policy") issued December 14, 1994 (69 FERC ¶ 61,336) states:

> "In those instances where it has been determined that a project will no longer be licensed, *because the licensee either decides not to seek a new license*, rejects the license issued, or is denied a new license, the project must be decommissioned." (FERC Decommissioning Policy, pg. 3 (emphasis added))

and also:

> "The Commission is of the opinion that implicit in the section 6 surrender provision is the view that a licensee ought not to be able simply to walk away from a Commission-licensed project without any Commission consideration of the various public interests that might be implicated by that step. Rather, the Commission should be able to take appropriate steps that will satisfactorily protect the public interests involved." (*Ibid.,* pg. 37)

In other words, PacifiCorp cannot just walk away from the many water quality problems at Keno dam, which it benefited from for 90 years as part of the FERC license, leaving these problems to the States of Oregon and California or to public taxpayers. FERC retains jurisdiction over any dam which leaves a license by default, to make sure the public's interests are protected, including protecting public health, assuring water quality, requiring appropriate fish passage[9] and mitigation for other adverse impacts that arise in this instance. Another good reason for California to analyze the impacts on lower river water quality in California of Keno Dam is that, with FERC retaining jurisdiction over Keno dam, FERC could very well order mitigation and other remediation measures at Keno that would *directly* affect water quality downriver far into California.

Keno Dam would also be the only remaining flow regulation dam in the Klamath River should Iron Gate Dam be ultimately removed. However, Keno dam lies above J.C. Boyle, and therefore cannot mitigate for rapid ramping at J.C. Boyle, only for impacts from unpredictable irrigation withdrawals from the Link River's A-Canal intake for the Klamath Irrigation Project and for irrigation withdrawals from its approximately 91 other much smaller reservoir diversion systems and pumps. These are factors that should be assessed as well.

[9] Otherwise we might have the bizarre result that federal agencies could require, and FERC could order, volitional fish passage through the rest of the Project below Keno Dam up to Keno, but be unable to secure fish passage through Keno Dam because it has lost jurisdiction over it through the act of the Applicant to simply exclude it from a new license. Such a result would make federal and FERC authority to protect public resources, including to require fish passage, virtually meaningless whenever an applicant wants to simply omit a key component of a prior license.

On March 24, 2006, the National Marine Fisheries Service (NMFS) formally recommended full dam removal to FERC as the biologically best option to revive the Klamath's failing salmon runs. In its own Federal Power Act 10(a) recommendations filing, NMFS stated:

> "Recommendation: The Licensee shall develop and implement a plan to remove the lower four Project dams (Iron Gate, Copco 2, Copco 1, and J.C. Boyle dams), restore the riverine corridor, and bring upstream and downstream fish passage facilities at Keno dam into compliance with NMFS guidelines and criteria within ten years of license issuance, expiration or surrender.

Under its justification, NMFS went on to, among many other things, add:

> "While NMFS is prescribing preliminary fishways under its authority in Federal Power Act Section 18, NMFS believes that within this relicensing process the best alternative to contribute to restoration of all fish species of concern in the Klamath watershed is the decommissioning and subsequent removal of the four lower Project dams (Iron Gate, Copco 1 & 2, and J.C. Boyle), combined with improvements in fish passage at Keno Dam. The dam removal alternative is a superior alternative from a fish passage, water quality, and habitat restoration standpoint…. Implementing this dam decommissioning and dam removal alternative would go a long way toward resolving decades of degradation where Klamath River salmon stocks are concerned."

Similar recommendations were also made by the U.S. Fish and Wildlife Service, which has jurisdiction over non-salmon terrestrial fish species in the upper Klamath River.

In summary, J.C. Boyle and Keno Dam removal alternatives must be included in the Board's CEQA analysis because: (1) they are parts of the same FERC license and PacifiCorp's 30 to 50 year license application; (2) they are an integral part of the entire KHP, affecting water quality all the way downstream well into California; (3) impacts at J.C. Boyle and/or Keno may determine whether or not California water quality standards can even be met at the point where the Klamath River enters the California border flowing south; (4) J.C. Boyle's and Keno's warm-water reservoirs both provide ideal breeding conditions for otherwise very rare *Microcystis aeruginosa* toxic blue-green algae, as well as many other algae species, that wash downstream where they adversely affect water quality as well as fisheries, and where they seed new algae blooms into regions and reservoirs far downriver and well into California; (5) FERC retains jurisdiction over Keno regardless of whether it remains in any new PacifiCorp license, and has the power to order mitigation and other remediation measures that would inevitably affect lower river water quality far down river and well into California.

CEQA requires that *all portions* of the same project be analyzed for their environmental impacts. In spite of the artificial divisions of a state line, the Klamath Hydroelectric Project is one single project, under one single FERC license, all parts of the Project are designed to work together and interact in various ways – and all parts affect the waters of the State of California.

California case law also requires that a proposed project *must be analyzed as a whole*, not broken into separate parts to avoid CEQA analysis.[10]

(7) Copco 1 Removal Means Immediate Silting Up of the Much Smaller Copco 2 Dam Just Below: The Copco1 dam is just upriver from the much smaller Copco 2. Since Copco 1 was the first dam built in the system (circa 1916), it naturally has the most sediment trapped behind it in its large reservoir, and by blocking this sediment it has greatly reduced the sediment inflows to the much smaller CopCo 2 dam and reservoir built many years later. Thus removal of the Copco 1 dam would almost immediately result in the complete silting up of the remaining lower CopCo 2 dam, which has almost no remaining reservoir capacity to store this sediment, quickly making it dysfunctional as a dam and forcing the CopCo 2 turbines to be shut off. As a completely silted-up dam it may also then become a serious safety hazard. Failure to acknowledge or address these Copco No. 2 siltation issues was one of the lacks of the 2007 FERC EIS in its analysis of its "Retirement of Copco 1 and Iron Gate Developments" alternative.

Since without CopCo 1 Dam to catch sediment, the CopCo 2 Dam would silt up almost immediately (within weeks, even days) and then have to be retired or removed, its theoretical retention in any proposed alternative would be more or less meaningless. Therefore we strongly recommend that the alternatives for analysis be rethought and that any alternative that included the removal of CopCo 1 but the retention of CopCo 2 dam be discarded as impractical for these reasons, and that the CopCo Dams Nos. 1 & 2 be considered for removal *together* as part of every scenario.

(8) Ramping Rates Contemplated at J.C. Boyle in the Federal Mandatory Conditions Were Developed With the Presumption that Iron Gate Dam Would Remain in Place to Moderate Extreme Flow Changes: Another problem with the FERC 2007 EIS analysis is that it does not take into account that, should Iron Gate Dam and Copco Dams Nos. 1 & 2 all be removed, the intense peaking flow changes at J.C. Boyle would rapidly raise and lower the flows (and thus the height) of the Klamath River far downstream into California on a daily basis. This is precisely what happened time and again before Iron Gate Dam was constructed, leading to massive losses of salmon and other fish species by periodically dewatering large areas of river edge habitat in which they typically lay their eggs, and by adult and juvenile strandings.[11]

(9) Implementing Tribal Water Quality Standards: The Water Board must consider and implement all Tribal Clean Water Act standards, including those from the Hoopa Valley, Yurok, and Karuk Tribes. The Hoopa Valley Tribe's standards have been approved by the US EPA, and so must be incorporated in the Water Board's standards by law. Under the Clean Water Act, the Hoopa Valley Tribe must be considered as equivalent to a "state" in this certification process.

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[10] See *Calif. Farm Bureau Federation v. California Wildlife Conservation Board* (App. 3 Dist. 2006, 49 Cal.Rptr.3d 169, 143 Cal.App.4th 173 ("Improper for an agency to divide a project into separate parts to avoid CEQA analysis"), and *San Joaquin Raptor Rescue Center vs. County of Merced* (App. 5 Dist. 2007), 57 Cal.Rptr.3d 663, 149 Cal.App.4th 654, as modified ("The entirety of a project must be described in an EIR, and not some smaller portion of it.").

[11] See Expert Report of Mike Rode, Attachment 1, Sec. 5.5 (Power Peaking Operations) at pp. 9-10.

The Hoopa Valley Tribes water quality standards are available from the Hoopa Valley Tribe and/or the US EPA.

(10) Consistency With Federal and State Fish Recovery Plans and State Law: Under CEQA, the Water Board must also make sure that any 401 Certification, and any water quality standards required of PacifiCorp, are consistent with various regional Klamath fishery restoration Plans. These Plans include the *Long-Range Plan for the Klamath River Basin Conservation Area Fishery Restoration Program* (January 1991 and various updates) created pursuant to the Klamath Fishery Restoration Act of 1986 (the "Klamath Act").[12] This law is still in effect and mandates various efforts to restore salmon fisheries and their habitat to the Klamath Basin, which the *Long-Range Plan* delineates in greater detail.

Coho salmon in the Klamath are also federally protected as "threatened with extinction" under the federal Endangered Species Act (ESA) (16 U.S.C. § 1531 *et seq*.), as part of what is called the "Southern Oregon/Northern California Coho (SONCC)" population unit. The National Marine Fisheries Service (NMFS) also on September 30. 2014, adopted its *Southern Oregon Northern California Coast Coho Salmon Recovery Plan* for this population.[13] NMFS also prepared and formally released a prior Klamath coho recovery plan that is specific to threatened coho sub-populations in the Klamath mainstem river pursuant to separate requirements of the Magnuson-Stevens Reauthorization Act adopted in 2007, titled *Magnuson-Stevens Reauthorization Act Klamath River Coho Salmon Recovery Plan* (July 10, 2007).[14] The State Water Board's certification process should also be consistent with and take these formal federal Klamath coho recovery plans into account.

Coho salmon are not only federally protected under the federal ESA, but also listed by the State of California under the California Endangered Species Act (CESA) as of 2003. On February 4, 2004, the California Fish & Game Commission formally approved the *Recovery Strategy for California Coho Salmon* to guide future coho restoration efforts in the state, including coho recovery efforts on the Klamath River. There are at least nineteen (19) strategies in this document specifically for the Klamath mainstem, including the following most relevant to this certification process:

> "KR-HU-04. Develop a plan, including a feasibility analysis, for coho salmon passage over and above Iron Gate and Copco dams to restore access to historic habitat.
>
> "KR-HU-10. Support efforts to improve quality of water entering the Klamath River mainstem from the upper Klamath River Basin.

[12] The Klamath Act was signed into law as Public Law 99-552 (Oct. 27, 1986), codified at 16 U.S.C. §460ss-3 et seq. The Long Range Plan is available at: http://www.krisweb.com/biblio/gen_usfws_kierassoc_1991_lrp.pdf .
[13] Available at: www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/recovery_planning_and_implementation/southern_oregon_northern_california_coast/SONCC_recovery_plan.html
[14] Available at: http://swr.nmfs.noaa.gov/salmon/MSRA_RecoveryPlan_FINAL.pdf.

> "KR-HU-11. Perform cost/benefit analysis of full or partial hydroelectric project removal for the purposes of improving water quality, coho salmon passage, and sediment transport.
>
> "KR-HU-13. Ensure that uplands in key cold-water tributaries are managed in a way that preserves their cold-water thermal regime.
>
> "KR-HU-19. Conduct studies in and around the Klamath River Hydroelectric Project to see if the project is contributing to habitat for the ceratomyxosis intermediate host.
>
> "HR-HU-20. Restore appropriate course sediment supply and transport near Iron Gate Dam. Means to achieve this could include full or partial removal of the Klamath River Project, or gravel introduction such as is done below other major dams (e.g., Trinity Dam)."

These specific measures should also be considered as priority mitigation measures necessary under CESA. There are also many more *Recovery Strategy for California Coho Salmon* general fish conservation and recovery measures that would apply to coho salmon in the Klamath below Iron Gate Dam that should also be considered in your analysis.

Finally, it should be noted that the Klamath Hydropower Project remains in continuous violation of fish protections in the California Fish and Game Code § 5937, which reads:

> "**Sec. 5937.** The owner of any dam shall allow sufficient water at all times to pass through a fishway, or in the absence of a fishway, allow sufficient water to pass over, around or through the dam, to keep in good condition any fish that may be planted or exist below the dam. During the minimum flow of water in any river or stream, permission may be granted by the department to the owner of any dam to allow sufficient water to pass through a culvert, waste gate, or over or around the dam, to keep in good condition any fish that may be planted or exist below the dam, when, in the judgment of the department, it is impracticable or detrimental to the owner to pass the water through the fishway."

Given the many negative water quality impacts from the Klamath Dams on downriver salmon fisheries, and the immense fish losses these impacts have caused to these valuable runs, including contributing to the largest adult fish kill ever recorded in the U.S., during the massive 2002 adult spawner fish kill, it could hardly be said that the salmon runs of the Klamath are in "good condition."

(11) Irrelevancy of Nutrient Inflows From Above the Project: There are clearly problems with elevated nutrient inflows, particularly phosphates, coming into the Klamath Hydropower Project area from Upper Klamath Lake -- both from anthropogenic as well as natural sources. How these sources divide up between anthropogenic and natural sources, however, *is not relevant* to this KHP certification process.

While PacifiCorp may not be responsible for, nor can it avoid, most of these nutrient inflows from Upper Klamath Lake which come from areas hydrologically above the Klamath Hydroelectric Project, nevertheless, PacifiCorp's KHP must still operate within the ordinary environmental conditions it finds itself in, *including* any nutrient-enriched water sources.

PacifiCorp is responsible for, *and must mitigate for*, all conditions created by its KHP dams and their operations (and their associated slackened flow, warm-water reservoirs) where, *given already enriched nutrient loads from above the Project*, these nutrients biologically combine with the slack-flow, warm-water conditions artificially created within PacifiCorp's KHP reservoirs to concentrate and "cook" these nutrients under ideal warm-water conditions to contribute to deteriorating water quality and widespread algae blooms. It is these many additional water quality problems, all traceable to configuration and/or operations of the dams, that cause water quality not to meet California state water quality standards at the Oregon/California border, and which greatly and adversely impact lower river salmon as well as in-Project resident fish and other aquatic wildlife. It is these additional KHP impacts which must be analyzed.

And finally, if additional efforts must be made by PacifiCorp to make sure its proposed Project will meet state water quality standards within the KHP (and at Keno if the other dams are removed) because of already degraded conditions in the river, they must nevertheless meet those standards in water discharges from their Project. It is the company asking for the state's permission to use the river, and not the river itself, which must bear the burden of any failures to meet these standards.

(12) Short-Term Impacts vs. Long-Term Benefits of Other Dam Removals: We request that the Board do a thorough analysis of both the short-term impacts, and long-term benefits of dam removal. In the past there have been concerns about the short-term impacts from sediment plumes from dam removal, and much can be learned from recent dam removal projects elsewhere. Since the successful dam removals occurred on the Elwha and White Salmon River, along with dam removals in Florida, Wisconsin, Maine, and Arizona a wealth of scientific information has been collected that shows methods to minimize this risk, and studies and observations have shown that rivers have been extremely efficient at moving fine sediments. Related water quality studies have shown temperature and Dissolved Oxygen (DO) improvement almost immediately, which in turn can have a positive impact on fish disease and attached algal composition. A great deal of work on sediment transport mechanisms within the Klamath Basin itself was also done as part of the 2012 KHSA EIS/EIR as well (see: www.klamathrestoration.gov).

There are several approaches to sediment mitigation during dam removal. They can range from slow drawdown and complete sediment removal to a quick removal allowing sediment to be washed down river. A discussion of these methods can be found at: http://repository.usfca.edu/cgi/viewcontent.cgi?article=1137&context=capstone

Until large scale dam removal was initiated in the Pacific Northwest, physical sediment removal was a preferred method of sediment management. This was true until the Condit Dam

removal in Washington, where a "blow and go" method was used due to monetary concerns. This also proved very effective and not too impactful at the Marmot Dam, as well as much less costly.

The results were impressive — but very different at the two sites. At Marmot, the sediment contained an equal mixture of sand and gravel. Once exposed to river action, it eroded out relatively quickly but sedately, with about half of it gone within 8 months. Researchers were surprised to find that the fish seemed little affected — the first curious salmon poked its nose back towards the former dam site within a day. At Condit Dam, the sediment contained a higher proportion of fine-grained material: 35% mud, 60% sand and just 5% gravel. The result was predictable in retrospect, but nobody anticipated it.

When engineers blew open a hole at the bottom of the Condit Dam, a jet of black liquid shot out as if from a giant fire hose. Instead of the expected flood of water, what came out was more like a mudflow, as waterlogged sediment from the reservoir slumped into the rapidly dropping water, then blasted downriver in a slurry that was as much as 28% sediment by volume. The reservoir lost its water and much of its sediment load in three hours. "It was almost like a volcanic event," says Jon Major, a geomorphologist at the USGS's Cascades Volcano Observatory in Vancouver, Washington. The 5-kilometre-long stretch of river between the dam and its confluence with the Columbia River temporarily became a muddy wasteland. With this kind of approach, says East, "the slug of sediment wipes out everything, but the river can start recovering much sooner." See for instance: http://www.nature.com/news/dam-removals-rivers-on-the-run-1.15636.

In the Elwha Dam removal, a more conservative approach was used. "Unwilling to risk the blow-and-go approach on both dams, engineers opted for a compromise. They quickly removed the lower, 32-metre-high Elwha Dam, which contained only about one-sixth of the total sediment. But the upstream Glines Canyon Dam, which is twice as big, is coming out in a series of steps that have so far lowered it to a 9-metre stub of its former self." East compares the method to deciding whether to uncover a wound quickly or gradually. The approach on the Elwha, she says, is like "pulling the Band-Aid off slowly, over the course of three years." http://www.nature.com/news/dam-removals-rivers-on-the-run-1.15636.

Initial findings on sediment movement during dam removal have shown that gravel has migrated slowly, while silt coming out of the Olympic Mountains tended to move quickly downstream and into the Strait of Juan de Fuca. This fine sediment has thus far been found to be beneficial to river mouths. In the removal of the dams from the Elwha River in Washington new sandy beaches were found to be prime habitat for shellfish, which could greatly benefit the commercial and subsistence fisheries in this area.

Though benefits of sediment recruitment are already occurring at the Elwha, there are short-term kelp and shellfish bed impacts. But as far as short-term sediment releases go, the rivers have proven unexpectedly efficient at rapidly flushing the worst of the mud downstream towards the sea, rather than letting it accumulate in river-choking mudflats. It is important to note that the Klamath reservoirs, and the river itself, have fewer sediment-related issues then the sediment-

impaired rivers where dams were removed in Washington State. Reports and modeling analysis regarding projected sediment transport mechanisms from behind the Klamath dams can be found in the Klamath River dams 2012 KHSA EIS/EIR record at www.klamathrestoration.gov.

Impacts to Fisheries: "Data on these recent dam removals suggest that the fish are now coming back to the unfettered rivers. At Condit, fish were seen returning within weeks of the explosion. Two years later, the total exceeded 5,500, including steelhead and spring Chinook (*Oncorhynchus tshawytscha*), which had been effectively extirpated from the river,: says Jody Lando, a quantitative ecologist with Stillwater Sciences in Portland, Oregon, who reported her results in May, 2016 at an aquatic-sciences meeting in Portland. See: www.nature.com/news/dam-removals-rivers-on-the-run-1.15636.

Furthermore, observations have shown that fish benefits have been almost immediate, with salmon spawning in and above dam tributaries within the first two years that dams were removed. See: www.kitsapsun.com/news/environment/dramatic-changes-following-elwha-dam-removal-ep-416589177-356243611.html/ For salmon and insect dependent species, such as the dipper, recovery was also almost immediately.

"In one study, the researchers documented that American dippers with access to salmon were in better physical condition and more likely to attempt multiple broods of offspring in a season. They also produced larger female offspring and were more likely to stay in breeding territories year-round." The research, published early online, appeared in a recent issue of the journal *Ecography" (https://news.osu.edu/news/2015/12/28/river-ecosystems/)*

FISHERIES-RELATED KHP ADVERSE IMPACTS

(1) The KHP's Biologically Adverse Impacts on Salmon Fisheries: To estimate the enormous ecological and economic benefits that restored Klamath salmon runs would provide with four-dam removal, it is necessary to look closely at the negative impacts of the Klamath Dams under conditions as they are today, with the four dams in place.

Historically the once-great salmon runs of the Klamath were the nation's third largest salmon runs outside of Alaska. But since their construction (without fish ladders) the Klamath Hydroelectric Project (KHP) has contributed substantially to an 88% reduction in salmon runs on the Klamath in many different ways. KHP adverse impacts include but are not limited to:

- Physically blocking salmonid access to habitat above Iron Gate Dam from between 300 (for chinook) and 600 (for steelhead) stream miles of once fully occupied habitat that historically supported runs of between 149,734 to 438,023 adult fish (Huntington, 2004) and today could potentially support at a conservative estimate 111,230 adult fish (Huntington, 2006) (see Attachments 9 and 10).

- KHP reservoirs inundate and dilute the benefits of some of the most important cold-water tributaries in the basin, which historically offered vitally important thermal refugia for salmonids, including Jenny, Spencer, Shovel and Fall Creeks. Occupying these cold water refugia areas during hot summer months was an important strategy for salmonids to survive summer periods of very warm water temperatures. Several former important cold water streams (such as Jenny Creek) now flow *directly into* warm water reservoirs such as Iron Gate where their thermal refugia benefits quickly disappear. Warm-water reservoirs also are high water temperature thermal barriers (even with future fish passage) that will continue to block access to several of these once-important spawning and rearing tributaries. Several formerly important cold-water groundwater springs likewise now disappear into the reservoirs is several places, their cold-water benefits also lost (see Attachment 1, Mike Rode Sec. 5.1 (pg. 9)).

- The Copco 1 and Iron Gate reservoirs particularly slow down and spread out the water that would naturally flow quickly through the river without the dams, and this allows sunlight to heat it up to near-fatal temperatures for downstream cold-water salmon. Warmer waters favor the growth and predation by warm-water fish predators generally, increasing predation against cold-water salmon whose defenses are already weakened by the stress of these warmer waters. Also, adult salmon typically die when exposed to prolonged water temperatures of 20º Centigrade (68º Fahrenheit), but reservoir water temperatures typically exceed such temperatures for several weeks of each year. Elevated water temperatures also not only encourage algae blooms but also encourage warm-water parasites like *Ceratomyxa shasta* and *Parvicapsula minibicornis*, which are fatal to many juvenile salmon, resulting in the mortality equivalent of a major fish kill nearly every year even far below the dams. Currently these diseases result in high rates of juvenile salmonid mortality -- as high as 80% in some studies (see Attachments 1 (Rode), Sec. 5.4.1 (pp. 12-14); Attachment 2 (Kann) on toxic algae studies; Attachments 15 and 16 on the prevalence of fish diseases in juvenile salmonids just below the dams; and the 2007 FERC EIS pp. 3-304 through 3-312).[15]

- Warmed river waters caused by the KHP also stress both adults and juveniles salmon generally, making them much more susceptible to both predators and fish pathogens even far downriver from the dams. Water temperatures consistently above 20° Centigrade – 68° Fahrenheit are fatal to salmon. Juvenile salmon are even more stressed by warm water temperatures than adults. The U.S. Environmental Protection Agency recommends temperature limits for the protection of various life stages of Chinook salmon, including that maximum seven-day floating average water temperatures not exceed 13° C. for spawning times. The KHP has directly changed the hydrology, thermal mass and temperature profiles vs. time of the river below it so that "water temperatures in the

[15] "The Klamath Hydroelectric Project has likely contributed to conditions that foster disease losses in the lower Klamath River by (1) increasing the density of spawning adult fall Chinook salmon downstream of Iron Gate Dam; (2) promoting the development of attached algae beds that provide favorable habitat for the polychaete alternate host for *C. shasta* and *P. minibicornis*; and (3) contributing to water quality conditions that increase the stress level of juvenile and adult migrants and increase their susceptibility to disease." (2007 FERC EIS, pg. 3.309)

mainstem river below Iron Gate Dam are cooler in the spring by up to 5° C. and warmer in late summer and fall by up to 5° C. than they would otherwise be, absent the reservoirs" (see Attachment 1 (Rode), Sec.5.4.1, pg. 13 and Figure 5.4.1-1 (pg. 23); see also 2007 FERC EIS, pp. 2-208 to 2-216).

- Blockage of access by the KHP to the upper river has significantly changed the species composition of the river's salmonid runs generally, as well as their seasonal migration timing. Formerly, spring Chinook were the dominant stocks in the river, today it is fall Chinook. Steelhead runs, also once abundant above the dams, have now been severely limited to below Iron Gate dam and have nearly disappeared. Coho are greatly reduced in number, and some stocks of salmon (such as pink salmon) that were once found in the Klamath are now presumed extinct (see Attachment 1 (Rode), Sec. 4.1.1, pp. 3-5; see also 2007 FERC EIS pp. 2-208 to 2-212).

(2) Changed River Ecosystems: The synergistic combination of decades of poor water quality and altered river flows caused by the dams has dramatically changed the riverine ecosystems in many ways. These changes need to be examined carefully as part of the EIR analysis. Some (but not all) of these impacts are delineated in many places in the 2007 FERC EIS in Section 3.0.

(3) Changed River Morphology: Numerous changes to the historical morphology of the river have been caused by the dams, including reductions of the number of "flood event" flows that typically disturbed the river gravel beds and stream edge riparian vegetation more frequently prior to construction of the dams. These changes have also resulted in impacts to lower river fisheries by reducing natural riparian scouring which allows more growth of permanent stream edge vegetation, which in turn reduces edge habitat necessary for juvenile salmonids during their early rearing periods. These impacts are discussed in detail in the 2007 FERC EIS, particularly at pp. 3-27 through 3-57.

(4) Spawning Gravel Impoverishment Below the Dams: The dams also trap and hold back natural gravel-rich sediments, thereby impoverishing salmon spawning gravel beds for as much as 50 miles downriver of Iron Gate Dam.[16] This greatly limits the ability of both Chinook and coho salmon (as well as steelhead) to spawn in the river as well as pushes them out of some of their best remaining habitat (see 2007 FERC EIS, pp. 3-41 through 3-51 inclusive). This impact has doubtless contributed to salmon declines in the Klamath River over many decades.

(5) Synergistic Causal Links Between Dams and Virulent Lower River Fish Pathogens: Poor water quality and altered river morphology produced by the Klamath Hydropower Project, particularly both in combination, also contribute to higher than normal incidence of various fish diseases such as *Ceratomyxa shasta* and *Parvicapsula minibicornis*. Both these virulent warm-water parasites are simply more active (and thus juvenile exposures more frequent and more likely to be fatal) in the warmer river waters that now occur every summer for longer periods

[16] "[W]e conclude that a sediment deficit could easily exist to the confluence with the Scott River (RM 143)." 2007 FERC EIS, pg. 3-49.

than historically occurred. Juvenile fish are especially vulnerable to these virulent pathogens. When juvenile salmonids contract either of these virulent fish diseases it is frequently fatal, even more so when juvenile fish (as is all too common) contract both.

Among other synergistic casual factors, the dams first impoverish natural spawning gravel recruitment as well as reduce the number of natural high flow events in ways that prevent natural gravel from rolling rapidly downriver as normally would have occurred. Rapidly moving gravel naturally cleans itself (and large portions of the river bed) of algae, and thus reduces the growth and prevalence of the algal species that harbor (and are the major food sources) for the polychaete worm *Manayunkia speciosa* that is the alternative disease vector for *Ceratomyxa shasta.* In other words, less gravel with fewer cleansing flows results in far more algal growth, which harbors more polychaete worms which carry more *C. shasta* spores, which then leads to much greater *C. shasta* exposures of juvenile salmonids than would otherwise naturally have occurred. The *P. minibicornis* pathogen has a similar complex lifecycle.

Additionally, cumulative changes in the annual water thermograph have meant lower river water temperatures in the spring, are typically much warmer. Both growth and timing of out-migration as smolts is affected by changes in ambient water temperatures:

> "The cumulative effect of delayed spawning in the fall with reduced fry growth rates in the spring is that rearing and outmigration are now generally occurring at a later date than would have occurred pre-KHP, thus subjecting these fish to even greater temperature and disease exposure (see Attachment 1 (Rode), pp. 13-14).

Likewise, the larger thermal mass of the reservoirs causes water to warm faster in late spring and to remain at higher temperatures for longer periods of time throughout the summer and fall. These earlier, warmer waters cause *Ceratomyxa shasta* spores to emerge earlier – causing more and longer overlap between juvenile fish remaining later and pathogens emerging earlier today than historically occurred. Thus more juvenile salmon are now in the river when *C. shasta* spores emerge and these spores are more contagious – resulting today in *far* greater juvenile mortalities than normally occurred from this fish pathogen prior to dam construction. Juvenile Chinook are especially susceptible to *C. shasta*, and *once infected nearly all will die* before reaching adulthood. These disease impacts of the KHP are included in the 2007 FERC EIS analysis, particularly at pp. 3-304 through 3-315).

Such a large portion of these juveniles runs are now infected annually that fish pathologists recently observed that:

> "Depending on the juvenile Klamath River salmon population size and smolt to adult return ratio, the effective number of adult salmon lost to *C. shasta* as juveniles could rival the 33,000+ adult salmon lost in the 2002 Klamath River Fish Die-off." (Attachment 15, Summary pg. 1).

The reference to the "2002 die-off" is to the largest adult fish kill ever recorded in the Klamath, said to be the worst in U.S. history, in which it was ultimately determined that more than 78,000

adult fish prematurely died before they could spawn, as they tried to travel upriver. The loss of nearly this entire year-class of adult spawners devastated the west coast salmon fishery, resulting in far fewer eggs being laid and thus fewer juveniles outmigrating in 2003, and this eventually resulted in so few harvestable adults coming back in 2006 that the Secretary of Commerce declared a fishery disaster in 2006 and imposed widespread closures (see Attachments 12 and 13). Economic damages to the west coast salmon fishing industry from the 2006 were estimated at over $100 million, and Congress appropriated $60.4 million in disaster assistance to these affected fishing families and communities.

Adult fish kills make national headlines, but massive *juvenile* fish kills are silent and mostly hidden – yet have economic impacts that may be just as devastating. The disease-caused equivalent of one of these types of major fish kills is apparently happening *nearly every year*, but instead of happening to the spawning adults it happens to the juvenile salmon populations whose wholesale demise is much harder to directly observe (see Attachment 1 (Rode), Sec. 7.0, pp. 15-17; Attachments 15 and 16 for fish pathogen surveys during 2004 and 2007). As seen above, there is a direct causal link between changes created in the river from the Klamath Hydroelectric Project and these nearly annual major fish kills.

Socio-Economic Impacts of Klamath Salmon Declines on Fishing-Dependent Coastal Communities

(1) Original Populations of Salmon on the Klamath: Before European development of the Klamath River, there were an estimated 660,000 to 1.1 million adult salmon returning to the Klamath River, with an average of about 880,000, predominately spring-run Chinook, returning each year to spawn (see *Estimates of Pre-Development Klamath River Salmon Run Size*, Attachment 4). Salmonids were also historically widely distributed throughout the basin, with some species such as steelhead abundant well above Upper Klamath Lake (see Hamilton, *et al.,* Attachment 3).[17]

Today's river water quality conditions are so degraded, and loss of habitat through dam blockage and other factors so devastating, that salmonid runs in the Klamath basin (including both wild and hatchery fish) are now only about 12% of what they once were, averaging only about 105,000 adult returns over the time frame of 1978-2007, but the majority of even these are of hatchery origin (especially in the Trinity River).[18] This means that the wild fish runs still remaining (i.e., fish produced in the wild and not dependent on hatcheries for any portion of their lifecycle) are considerably *less* than 12% of their historic runs size (probably about 6%), though such estimates vary. ESA-listed coho salmon are down to less than 1-2% of their historic abundance in the basin, and were never as abundant as Chinook, which is why they are now federally and state ESA-protected.

[17] The term "salmonids" is a biological category which includes closely related members of the fish genus *Oncorhynchus* such as Chinook (*O. tshawtscha*), and coho (*O. kisutch*) salmon, as well as closely related anadromous steelhead (*O. mykiss gairdneri*) and other species.
[18] See Attachment 1, Expert Report of Mike Rode, Figure 4.1.1-1 (pg. 21).

Prior to dam construction, the predominant salmon population above the current location of Iron Gate Dam were the spring Chinook, which may have historically outnumbered fall-run Chinook in total numbers throughout the basin.[19] Today the dominant population is fall chinook, with spring chinook (which depended upon habitat now mostly blocked by the dams) nearly extirpated in the river except for a few remnant populations spawning in the Salmon River and just below Iron Gate Dam. Since steelhead depended upon upper river habitat (now above the dams) more than other salmonids, steelhead too are greatly reduced in numbers in the Klamath Basin except in portions of the Trinity River, the Klamath's major tributary.

Two other species of salmonids known to exist in the river before the KHP dams blocked it were chum salmon (*O. keta*) and pink salmon (*O. gorbuscha*). However, today chum salmon are extremely rare in the Klamath (and thought to be functionally extinct) and pink salmon, once thought relatively abundant, are extinct.

Thus the very existence of the Klamath Hydropower Project dams has dramatically changed the anadromous species composition as well as run timing for salmonids in the lower river. This has adversely affected the ability of these species and sub-species to remain viable and to respond to changed environmental conditions.

(2) What Is the Value of a Restored Klamath River Salmon Fishery? The present net economic value of a restored pre-development sized Klamath Basin salmon fishery can also be estimated, depending on discount rate assumed. At an assumed discount rate of 3%, the net present economic value of this fishery would have been between $2.634 and $4.347 *billion* dollars, for a net present economic value to the regional economy of just over $3.49 billion dollars (see Attachment 4, Table 4). Other independent studies, using very different methodologies, have come to similarly large value numbers (see USGS Aaron Douglas study, Attachment 5).

Today, even with stringent fisheries management and at least 20 years of targeted habitat restoration efforts, the biological carrying capacity of the Klamath Basin is still so seriously eroded that from 1978-2002, the average fall Chinook run size has been only 85,855 – just 9.7% of historic abundances. Subtracting hatchery-raised spawners from these totals gives only 60,723 natural fall Chinook spawners returning, on average, during this time period – *just 6.9% of the historic run size* (see 2007 FERC EIS, pg. 3-195 (Table 3-48)). And this is for the most *abundant* stock – the fall run Chinook. This does not count other species, particularly coho salmon, that are so depressed they require ESA protection,[20] nor does it count spring-run Chinook, once the dominant run throughout the upper basin, that have today been all but extirpated by the Klamath Hydroelectric Project dams.

Assuming (as a rough estimate) a proportional reduction from pre-development to current run sizes (even counting hatchery fish as partial mitigation) would create a proportional decrease in harvest and thus fishery values, with all other factors kept the same, then the value *reduction* of

[19] See 2007 FERC EIS, pp. 2-208 to 2-212.
[20] Coho in the Klamath Basin are estimated to be at between 1-2% of historic abundance, and are both federally and state listed under the Federal and California Endangered Species Acts.

the present day Klamath fishery would be a 100.0% - 9.7% = 90.3 % reduction in current harvest capacity from historic capacity. *This means that the net loss of net economic value of the Klamath salmon fishery to the regional economy – in large part caused by the Klamath dams – would be calculated as a loss of value of $3.15 billion dollars.* This may be how much the Klamath dams have directly cost the regional fishing-based economy. This does not even begin to count secondary economic costs due to "weak stock management" that requires widespread ocean coastal fishing closures, such as experienced in 2006, that can hit ocean fishing ports far to the north and south of the Klamath over about 700 miles of coastline.

While the impact of the Klamath Project dams is certainly not the only impact on these stocks or their habitat, it is almost certainly the single largest impact, as well as one of the few impacts we have some real control over, through FERC relicensing.

A major impact of the Klamath Dams is that when the losses of Klamath fall Chinook are high, this can trigger "weak stock management" closures of ocean fisheries all up and down the coast. Under the federal Magnuson-Steven Act "Salmon Fishery Management Plan," the Klamath fall Chinook are the key stock around which all other harvest opportunities are regulated in California, Oregon and Washington. Since both weak and strong stocks intermingle in the ocean, all ocean fisheries must be halted – *even on otherwise abundant stocks from other river systems* – whenever intermingling Klamath fall Chinook drop below a certain level, or there would be normal harvest impacts that would bring them below the "minimum spawner floor" of 35,000 adults returning to spawn in the river.[21] This 35,000 minimum spawner floor is the minimum number of returning and spawning adults absolutely necessary to perpetuate the species to the next generation. Fishery managers must diligently restrict total cumulative harvest impacts on the Klamath fall Chinook to always make sure at least the 35,000 "minimum spawner floor" can be met each year.[22]

The situation also appears to be worsening. Poor in-river conditions and disease problems are so pervasive in the Klamath River that fishery managers are now hard pressed to maintain even the "spawner floor" of 35,000 returning adult fall Chinook, *even with zero fishing impacts*. For instance, the ocean commercial fishery in 2006 suffered through a nearly total closure to prevent as much impact as possible on Klamath fall Chinook that might intermingle with otherwise abundant stocks. Economic losses to fishing-dependent economies in 2006 alone were estimated at more than $200 million. Congress ultimately appropriated $60.4 million in direct disaster assistance to these communities.

[21] See 2007 FERC EIS pp. 2-230 to 3-241for a more extensive discussion of the "weak stock management" problem and how it causes extensive coastal ocean fishing closures when Klamath fall Chinook are in very low abundance.
[22] Since 2006 a minor amendment to the Pacific Fishery Management Council's *Salmon Fishery Management Plan* (Amendment 15) has been formally adopted to allow, in some years, a *de minimus* impact exception to the 35,000 minimum spawner floor to avoid massive closures such as occurred in 2006, but this exception is still very narrow and only applies to truly *de minimus* impacts that must be made up later. Otherwise ocean salmon fishery management remains the same as in 2006, i.e., it is largely still controlled by the abundance of Klamath fall Chinook.

With improvements in water quality from dam removal, a large part of the value of the Klamath fishery could be restored, giving fish access once again to hundreds of miles of historic spawning and rearing habitat and improving juvenile survival throughout the system because of better water quality. As noted in the 2007 FERC EIS itself:

> "Huntington (2006) estimates that there are 355.6 miles of existing stream habitat that is currently or was recently capable of supporting anadromous salmonids in tributaries to Upper Klamath Lake and another 70.4 miles that he considers recoverable within the next 30 to 50 years (Table 3-67). Although much of this habitat has been degraded, substantial portions in the Wood and Williamson river systems are considered to be in good condition (Huntington et al., 2006), and habitat conditions are expected to improve over time, due to numerous ongoing restoration efforts in the upper basin (FWS, 2006c)." FERC FEIS pg. 3-284.

Huntington (2004) estimated that the historic returns of adult Chinook salmon to areas upstream of Upper Klamath Lake were between 149,734 and 438,023 fish per year, and were most likely in the lower end of this range. (Attachment 9)

Huntington (2006) (see Attachment 10) later amended his estimate, after additional field research, to say that the upper basin habitat could support an additional run of 111,230 Chinook salmon once fish passage is restored, acknowledging that this was a conservative estimate. Once problems with poor water quality, high water temperatures and conditions that encourage various fish parasites are also cured by dam removal, juvenile survival rates in the lower river would also improve, therefore allowing more fish to survive to adulthood and return as harvestable adults.

If water quality were improved by removal of the dams, and the fish given access to additional habitat above the dams, it is therefore highly likely that an additional 100,000 adult fall Chinook would come back to the river after only a few fish generations. Assuming only a 50% harvest rate on these adult returns, this means an additional 50,000 fish might be available for some form of harvest as a direct result of dam removal. Then turning to Attachment 6, Table 3 (from Meyer Resources, (1984)), with the numbers updated to 2016 dollars[23] for the annual economic benefits to the regional economy per 50,000 additional harvested adult fish, in market benefits *only* (to be conservative) this would mean an additional economic benefit to the regional economy of:

Low Value: $395,374 per 1,000 fish x 50 = $19,768,700 restored economic benefits

This would likely be a low or conservative value of the additional annual economic personal impact benefits that would accrue to the fishing-based and regional economy from dam removal and subsequent water quality improvements (resulting in increased survival rates as well as larger populations) from dam removal.

[23] Using the standard CPI adjustment of 2.30998 to convert 1984 dollars to 2016 dollars. CPI adjustments can be easily calculated on the Internet at: http://data.bls.gov/cgi-bin/cpicalc.pl. See Attachment 4 for methodology.

It should be particularly noted that this conservative estimate of salmon harvest economic benefits which could be readily derived from Klamath dam removal *exceeds* the "annual net benefits" of *all* of the 2007 FERC EIS options except for the "no action" alternative, which is not a legal option. With an incremental annual increase of personal income impacts from restored fisheries conservatively estimated at $19,768,700, this is also more than enough to offset the FERC-estimated annual costs of the Four-Dam Removal Option of -$13,186,870 (see 2007 FERC EIS, pg. 4-2 (Table 4-3)), *by more than $6.58 million/year*.

In other words, using FERC Staff's own 2007 FERC EIS cost estimates, it appears that the most economically beneficial course to follow for society as a whole is to remove all four of the KHP hydropower dams (Iron Gate, CopCo 1 & 2 and J.C. Boyles) in order to restore the lost but very valuable salmon and steelhead fisheries these dams originally destroyed.

It should be noted, however, that these restored Klamath fishery economic benefits could only be fully achieved under a full KHP "Four Dam Removal" option. Anything *less* than a full removal of the KHP dams would mean some dams (and reservoirs) still in place, and this would still mean: (1) higher mortalities due to artificial fish passage as opposed to full volitional free passage in a restored river, since no artificially engineered fish passage system is perfect; (2) remaining large thermal barriers and other problems for salmon migration in the reservoirs behind the dams because reservoirs would still heat up, adding to salmonid stress, encouraging warm-water reservoir predators, and decreasing resistance to diseases; (3) remaining good growing conditions for toxic and other species of algae with all their associated water quality problems.

The above "restored fishery benefits" numbers are also conservative figures in that they excludes *all* non-market benefits. They also exclude other and potentially *much* greater economic benefits to commercial ocean salmon fishermen which would accrue simply by having more fish in the system and thus being able to meet the "spawner floor" of 35,000 minimum escapement requirements far more frequently – thus eliminating potentially severe restrictions such as we saw in 2005, and worse in 2006, on ocean commercial fishermen that are triggered by Klamath salmon populations declines, and thus allowing fishermen far more access to otherwise abundant intermingling oceans stocks from other basins, primarily from the California Central Valley hatcheries.

Fewer fishery restrictions of the sort that required a 90% ocean fishery closure in 2006 and a 60% ocean fishery closure in 2005 over more than 700 miles of Northern California and Oregon coastline has great economic value to the west coast salmon fleet. Had these additional Klamath fish been available during those years, there would have been no question about meeting the "spawner floor," and this would have saved the coastal commercial fishing industry from draconian closures that cost their coastal communities well over $200 million in economic losses and damages -- all caused by mandatory Klamath-driven closures because of very low in-river survival rates, in some large part because of KHP-induced adverse ecological changes in the river.

Some of the potential economic "restored fishery benefits" that may accrue to in-river sportsfishing businesses (particularly within Siskiyou County) from a restored upper basin salmon fishery after dam removals have been delineated in the study, *Preliminary Economic Assessment of Dam Removal: The Klamath River* (January 31, 2006), by Sarah A. Kruze and Astrid Scholz (Kruze, S. A. and A. Scholz (2006)) (see Attachment 8), in which the authors have estimated additional fisheries economic benefits of up to $140 million annually from KHP four-dam decommissioning.

Additional ecological benefits of KHP four-dam removal might also include an addition of 10% or more to existing ESA-listed coho habitat, making them far more viable and resistant to extinction, and finally moving them toward future recovery. This benefit was acknowledged in a Ruling in the EPAct Hearings by Judge McKenna as Finding 7-16:

> "Over time, access to habitat above Iron Gate Dam would benefit the Coho salmon population by: a) extending the range and distribution of the species thereby increasing the Coho salmon's reproductive potential; b) increase genetic diversity in the Coho stocks; c) reduce the species vulnerability to the impacts of degradation; and d) increase the abundance of the Coho population.[24]

Reduced need for restrictive ESA-driven land use regulation also has great value (though exact amounts are hard to quantify) to local landowners in terms of fewer land and water use restrictions, etc., and the hope of coho recovery and eventual delisting.

In general, the 2007 FERC EIS does not properly assess or evaluate the probable economic *benefits* of a restored fishery that would accompany the dam removal options, nor does it adequately assess the *severe economic damages* perpetually being suffered by coastal ocean fishing-dependent communities because of lack of Klamath fish – a lack caused in large part by the KHP dams. One way to measure those loses, and to ascertain the magnitude of these declines, is to look at the recent history of salmon landings to what were once the most productive salmon ports in the lower 48 states – the salmon ports within the Klamath Management Zone (KMZ). We have done so in Attachment 7. Landings averaged over the years (1976-1980) as compared landings in these same port areas averaged over 2001-2004[25] shows huge declines during this time frame, as follows:

[24] Evidence in the record cited by the ALJ in that Ruling was: *Aug. 23, 2006 Transcript at 163:1-2; Aug. 25, 2006 Transcript at 107:5-20; NGO Ex. 27 at 3:11-4:7 (allowing access to additional habitat does not decrease the size of the population existing below Iron Gate Dam); Yurok-Hillemeir Direct Testimony-NMFS/FWS Issue 7 at 5:7-8 (access to project area is one of the quickest ways to increase population abundance), 6:4-22; CDFG-Pisano-Ex. 1 at 5, 11:18-12:23; NMFS/FWS-Issue 7-Simondet-Ex. 1 at 5:21-6:15; NMFS/FWS-Issue 7-Williams-Ex. 1 at 6:15-19, 7:15-9:22 (explaining that additional spatial structure reduces species vulnerability to changing environmental conditions); HVT-Franklin-Ex. 1 at 6:16-7:12 (explaining that diverse habitat leads to populations adapted to diverse life history forms and greater viability for the species); NGO ex. 4 at 11:15-28*. These documents are hereby incorporated into these comments by reference.

[25] To create a representative baseline for landing number by port, fishery managers always average over several years to eliminate sometimes large annual variations.

SALMON FISHERY LOSSES BY PORT AREA OVER TIME
(Average of Years 1976-1980 as compared to Average of 2001-2004 landings)

Port Area		**Decline (%) of Fishery**
Eureka (CA)	=	**97% LOSS**
Crescent City (CA)	=	**87% LOSS**
Brookings (OR)	=	**82% LOSS**

These precipitous losses started within a few short (3-year) salmon generations shortly after the completion of Iron Gate Dam, the last dam in the KHP series of dams, in 1962. See also the 2007 FERC EIS at pg. 3-235 (Table 3-55), and also the PacifiCorp *Final License Application (FLA), Socioeconomic Resource Final Technical Report*, pgs. 2-108 to 2-114 for landing loss figures to the same effect.

These absolute salmon landing losses have been *economically devastating* for these Northern California and Southern Oregon coastal port economies, translating into thousands of lost jobs, fishermen forced to relocate with their families in order to find work or to sell their boats and quit fishing, fragmented fishing-dependent communities and the fleeing of processors, ice plants, fuel depots and other allied infrastructure businesses from these communities over the last 40 years. *If even a small portion of these losses is directly or indirectly attributable to poor water quality problems, or disease problems exacerbated by the dams, then it is far more beneficial to society as a whole to remove the Klamath dams than to keep them, knowing their economic and social costs to these many coastal communities.*

And these losses above are to the commercial salmon fleet only. They do not include separate but also large economic losses to recreational fishing-dependent small businesses throughout the lower river, nor to Tribal communities for the loss of both a source of revenues as well as a basic subsistence fishery that once supported those communities and their ancient, salmon-centered cultures. *The combined cumulative socioeconomic losses to all these fisheries and all these fishing-dependent communities greatly exceeds any potential future economic benefits from hydropower production at the dams.*

In recognition of this fact, the Pacific Fishery Management Council (PFMC), which manages all ocean salmon fisheries in federal waters under the Magnuson-Stevens Fishery Management and Conservation Act (16 U.S. C. §1801 et seq.), formally endorses Klamath Project "Four-Dam Removal" as its recommended option for restoring damaged Klamath fisheries, and so noted in a letter to FERC dated April 24, 2006:

> "The value of ocean fisheries is high when Klamath natural chinook are abundant, but can be much lower when Klamath fish constrain the catch of other healthy stocks. The Council estimates that between 1970 and 2004, the average annual personal income impacts of the recreational and commercial ocean salmon fishery in the area where Klamath fish are found amounted to $92 million. The constraints on the fishery in 2006

> caused by the need to protect Klamath River natural fall chinook are expected to reduce the value of this fishery to less than $33 million. In contrast, the Klamath hydropower project produces 163 megawatts with an annual net economic value of $16.3 million. NMFS notes that the 'generating capacity provided through continued Project operations is nominal … relative to the watershed level of benefits to aquatic resources and regional and national priorities for restoring anadromous salmonids.'…
>
> "The Council believes the proposed relicensing of this project will have substantial adverse impacts on EFH [Essential Fish Habitat] in the Klamath River. The project causes harm to salmon habitat; to the health of fish stocks; to commercial, recreational, and tribal fisheries; and to fishing communities along the Oregon and California coasts and in the Klamath River basin. Consequently, the Council recommends that FERC order the immediate decommissioning and removal of the four lower Klamath River dam structures and full restoration of habitat affected by the dams and reservoirs. "

A copy of this PFMC letter has been filed in the FERC docket and is enclosed as Attachment 17.

(3) Market Impacts of Poor Klamath Salmon Quality: The Klamath River-origin salmon are known in the fishing industry to be of increasingly poor quality due to distinctive "green algae" taste created by the salmon's exposure to excessive algae in the river. There is oral testimony in the record to that effect. While hard to quantify, this does adversely affect coastal and other markets for salmon, and many processors now avoid purchasing salmon caught in the Klamath River.

There are also some recent studies, including one by the State Water Board itself, showing that Klamath River adult salmon are accumulating the potent blue-green algae liver toxin microcystin in their livers and flesh, making their use for human consumption increasingly problematical.[26]

TEMPERATURE AND OTHER WATER QUALITY PROBLEMS WILL BE EXACERBATED BY REGIONAL CLIMATE CHANGE

(1) Water Temperatures in the Klamath River Have Been Steadily Increasing Due To Global Climate Change. Recent studies show that Klamath River average water temperatures have been gradually, over the last several decades, increasing consistent with current projections of overall regional climate change. Bartholow (2005) found a high probability (95% confidence interval) of an 0.5º C./decade upward average summer water temperature trend and that the "season of high temperatures that are potentially stressful to salmonids has lengthened by 1 month over the period studied, and the average length of main-stem river with cool summer

[26] See for instance, *Technical Memorandum: Microcystin Bioaccumulation in Klamath River Fish and Freshwater Mussel Tissue: Preliminary 2007 Results*, by Jacob Kann, Aquatic Ecosystem Sciences (April, 2008), and *Final Report to the U.S. Environmental Protection Agency on Cyanotoxin Accumulation in Fish and Freshwater Mussels of the Klamath River,* CA State Water Resources Control Board publication (Nov. 2008). Both of these documents are hereby incorporated into these comments by reference.

temperatures has declined by about 8.2 km/decade." (see Attachment 14). It is important to note that this adverse water temperature impact is above and *added* to anthropogenic temperature increases caused by the KHP. Since these higher water temperature impacts are apparently related to overall regional average temperature and climate changes of the sort projected to continue (and accelerate) for the foreseeable future over the next 30-50 years, these are foreseeable "global warming" impacts that must also be taken into account as cumulative and foreseeable future impacts under CEQA.

This makes a "Precautionary Approach" to keeping water temperatures in the river as low as possible mandatory. Reducing *all* anthropogenic heat sources – such as the warm water sinks of the reservoirs – is thus even *more* important, given these potential global warming problems which will add additional temperature stress to river ecosystems as well as salmonids in the Klamath Basin, than ever before.

(2) Foreseeable Future Impacts Also Adversely Affecting Water Quality: Foreseeable future impacts also include drought and reduced flows from Upper Klamath Basin, etc., as well as changes in climate.

The Upper Klamath Basin is naturally arid, with an average rainfall in downtown Klamath Falls, OR of only about 12 inches/year. Droughts are not only frequent, but apparently increasing in both number and severity. All water quality parameters must therefore be calculated so as to be achievable *even in the increasingly frequent drought and dry years.* Otherwise, major portions of the basin's aquatic resources – including its economically and culturally irreplaceable salmon runs – could "wink out" because of serious water quality problems occurring during any prolonged drought, and would then be extinct when conditions improved – which could be way too late. Again, a Precautionary Principle approach requires that water quality standards must be satisfied in poor rainfall years as well as wet years.

MITIGATION MEASURES

We do not believe that <u>any</u> conceivable combination of water quality mitigation measures will be effective in the KHP to bring water quality standards in compliance with the law – at least not short of *enormously* expensive reconstructions that would cause the Project to cost far more than it can ever generate in revenues or economic benefits through hydropower production. We therefore support ultimate dam removal supervised by FERC – either through the negotiated KHSA Settlement as proposed, or through a direct FERC decommissioning order.

We believe that the economics and the science are both now clearer than ever that these dams are no longer cost effective, that they will do society as a whole far more environmental and economic harm, even if FERC relicensed, than can be offset or justified by any of their likely economic benefits, and that the best option for these dams is that they be decommissioned and their structures removed from the river, as PacifiCorp is requesting, thus allowing PacifiCorp to invest its saved resources in more efficient renewable energy facilities elsewhere.

If the current dam removal 401 Certification Application is approved, the question then becomes only what interim measures should be imposed between now and the dam removal target date of 2020 to try to mitigate as much as possible the harms these dams would still do prior to their removal.

(1) Potential Interim Mitigation Measures: In the event of dam removal, various mitigation measures to reduce sediment loads expected to be released by dam removal should also be imposed to minimize adverse (though temporary) impacts from these sediment releases, particularly on in-river fish. Simultaneous dam removal and sediment discharges should be preferred over sequential releases, as this minimizes the total number and duration of fish exposure times to high levels of sediment. A single high level sediment surge that may impact a single year-class is much less destructive to lower river salmon runs than smaller (but still fatal) sediment surges poorly timed that impact multiple year-classes.

Trap and haul programs as proposed by PacifiCorp will not work in the Klamath – they would only move smolts from one toxic part of the river to another toxic part. Juveniles will die under such conditions wherever they are placed, plus artificial transportation itself creates intense stresses on juvenile salmon which greatly decreases their chances for survival.

There are some values to retaining Keno Dam – with, of course, installation of appropriate fish passage facilities for salmonids and other species – because of the flow regulation capacity of that dam. Mitigation measures at Keno Dam should involve upgrades to existing poorly functioning fish passage to adapt that structure to both salmonids and to lamprey. Various water quality mitigation measures should also be imposed as appropriate at Keno dam as a pre-requisite to any exclusion from the FERC license or any transfer by PacifiCorp.

(2) Likely Failure of Permanent Mitigation Measures: While it is noted that physical blockage of fish passage by the dams is not an impact on the California environment "caused by a discharge," it is important to also note that even with fish passage installed in hypothetically retained (but retrofitted) dams, there would still be some unavoidable dam-related mortalities at each passage bottleneck. This is particularly true for juveniles migrating downstream, which may also become physically entrained in fish screens or lost in the power turbines that would still be running with the dams in place under either a new FERC license, or until such time under a license surrender that the dams could be decommissioned and removed. These are impacts which must also be analyzed under CEQA, including those types of impacts at dams in Oregon which may adversely affect water quality at California's border.

No artificially engineered fish passage system can ever be as efficient in passing fish as a healthy and free-flowing river corridor. This is important to remember in any analysis of the environmental consequences of dams remaining in place.

In Summary: Dam removal is the only effective option to solve the many water quality problems that occur in these dams. Full "Four Dam Removal" should be analyzed in great detail. Although J.C. Boyles and Keno Dams are physically located in Oregon, nevertheless under

CEQA the State of California can and should analyze both their impacts on lower river water quality in California, as well the impacts (positive and negative) expected from their removal.

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Thank you for the opportunity to comment on this process. Please include these written comments and Attachments in the public record for this proceeding.

Sincerely,

Glen H. Spain

Glen H. Spain, J.D.
NW Regional Director
For PCFFA and IFR

PCFFA/IFR COMMENT LETTER ATTACHMENTS:

(1) Mike Rode *Expert Report* from *McConnell* case Exhibits.
(2) Jacob Kann *Expert Report* from *McConnell* case Exhibits.
(3) Hamilton et al. (April 2005), "Distribution of Anadromous Fishes in the Upper Klamath River Watershed Prior to Hydropower Dams – A Synthesis of the Historical Evidence," *Fisheries* 30(4), pp.10-20.
(4) *Estimates of Pre-Development Klamath River Salmon Run Size* (IFR Report)
(5) Aaron J. Douglas Klamath Fishery Values Report.
(6) *Fishery Values of the Klamath Basin*, Meyer Resources (1984).
(7) Klamath Management Zone Port Landing Losses since 1976-1980.
(8) *Preliminary Economic Assessment of Dam Removal*, Kruze and Scholz (Jan. 2006).
(9) Huntington, C.,W., 2004. *Preliminary Estimates of the Recent and Historic Potential for Anadromous Fish Production Above Iron Gate Dam*.
(10) Huntington, C.W., 2006. *Estimates of Anadromous fish runs above Iron Gate Dam.*
(11) Klamath Index Selections from PFMC Klamath Salmon Management Plan.
(12) Secretary of Commerce 2006 Fishery Failure Declaration.
(13) Governor Schwarzenegger Klamath Fishery Declaration of Emergency (2006).
(14) Barthelow, John M., (2005). "Recent Water Temperature Trends in the Lower Klamath River, California," *North American Journal 0f Fisheries Management* 25:152-162 (2005).
(15) *Health Monitoring of Juvenile Klamath River Chinook Salmon* (USFWS California-Nevada Fish Health Center, Nov. 2005).
(16) *Klamath River Juvenile Salmonid Health Monitoring, April-August 2007*, (USFWS California-Nevada Fish Health Center, Sept. 2008).
(17) Letter to FERC from the Pacific Fishery Management Council (PFMC) dated April 24, 2006.

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ATTACHMENT 1

Mike Rode *Expert Report* from *McConnell* case Exhibits

Adverse Impacts of the PacifiCorp Klamath Hydroelectric Project

On

Anadromous Fishery Resources of the Klamath River

Expert Report

of

Michael Rode

Prepared for:

Lawyers for Clean Water, Inc.
San Francisco, California
July 25, 2008

1.0 Introduction

I was retained to represent the plaintiffs in McConnell vs. PacifiCorp, Inc. (U.S. District Court Northern District of California Case No.: CV 07-02382 WHA) as an expert witness. I was asked to evaluate the effects of the PacifiCorp Klamath Hydroelectric Project (KHP) (FERC: P-2082) Copco 1, Copco 2 and Iron Gate Dams, operations and facilities on the anadromous fish, habitat, and fisheries of the Lower Klamath River in California.

My opinions are based on my professional knowledge and experience, including 15 years of working on Klamath River Basin fishery issues as a professional biologist, and the review of data, reports and studies prepared by PacifiCorp and its consultants, federal and state agencies, Klamath River tribes, university researchers, independent consultants, the National Academy of Sciences and the Federal Energy Regulatory Commission (FERC) and consultation with other expert witnesses for the plaintiffs.

I have been deposed once, I believe in 2004, relative to the September 2002 Klamath River adult fish kill lawsuit, but have never provided direct court testimony.

I am being compensated for my work on this report and subsequent work at the rate of $175.00 per hour and $200.00 per hour for depositions and court appearances, plus travel and other expenses.

2.0 Professional Background

I have thirty years of experience as a fishery biologist and environmental scientist, the last twenty eight years, from 1978 through 2005, working for the California Department of Fish and Game (CDFG), headquartered in Mt. Shasta, California. I have been retired from state service for approximately 2½ years and this testimony is the first paid professional work I have done since then. On May 15, 2008, I was asked to testify as an expert witness before the U. S. House Natural Resources Committee, Subcommittee on Fisheries, Wildlife and Oceans on the role of the Klamath River in the 2008 collapse of west coast salmon fisheries. I was not paid to do this.

I have a Bachelor of Arts degree in Biology from the University of California, Santa Barbara (emphasis in ichthyology and fresh water and marine ecology) and two years graduate work in the Biological Conservation MS (fisheries emphasis) Program at California State University, Sacramento. During the last fifteen years of my employment with the CDFG, my job title was Klamath River Coordinator. In that capacity, I represented the CDFG on numerous committees, working groups and task forces on Klamath River threatened and endangered fish recovery, fish habitat restoration, stream flow studies, harvest management, flow management, dam relicensing and other efforts. I was an early participant in the Klamath Hydroelectric Project relicensing. I was a member of the following: Klamath River Basin Fisheries Task Force, KRBFTF Technical Work Group, Klamath Watershed Coordination Group, Southern Oregon-Northern California Coasts (SONCC) Threatened Coho Salmon Recovery Team, Pacific Fishery

Management Council Habitat Committee, CDFG Threatened Trout Committee, Klamath Technical Team (Hardy Phase II Flow Study) and many Coordinated Resource Management and Planning groups. I was the lead CDFG scientist for the review of the National Marine Fisheries Service Biological Opinions (BOs) on the Effects of the Bureau of Reclamation's Klamath Project on SONCC Coho Salmon and numerous other plans, environmental documents, studies and reports. Based on the above experience, I believe I have expertise in and am qualified to comment on the biology, status, habitat, threats, and recovery needs of Klamath River anadromous salmonids.

3.0 Summary

The Klamath River was one of the great salmon producers of the west coast, exceeded in production only by the Columbia and Sacramento River systems. Close to 1 million salmon and perhaps more than several million steelhead, representing multiple species, numerous runs and complex life history strategies, ascended the river each year, some traveling close to 400 mi from the ocean to reach their natal tributaries. There were literally adult salmon or steelhead in the river every month of the year. This diverse bounty sustained the native peoples of the Klamath River Basin for thousands of years and later non-native inhabitants of the basin. For many years the salmon, steelhead and other fish species supported viable ocean commercial and recreational, native tribal, and inriver sport fisheries.

Although some decline in the fishery had already been noted by the late 1800s, it intensified during the early decades of the 1900s and the decline reached a critical point during the 1970s, resulting in the U.S. Congress enacting Public Law 99-552, the "Klamath Act" in 1986, a 20-year-long Federal-State Cooperative Klamath River Basin Conservation Area Restoration Program for the rebuilding of the Klamath River's fish resources (KRBFTF 1991). However, in spite of the accomplishments of this program, the decline of Klamath River anadromous fisheries has continued, as evidenced by restrictive fishing regulations and complete closure of fisheries in recent years.

The reasons for the dramatic demise of these fisheries are varied and complex but a critically important factor in their decline has been the construction and operation of the lower-most 3 dams of the KHP: Copco 1, Copco 2 and Iron Gate (IGD). Figure 3-1 depicts the location of these dams on the Klamath River. Section 4 of this report describes the known historic status, trends, and present status of the more important anadromous fish species. Particular emphasis is given to the life histories of the various races and runs of Chinook salmon to point out that those fish that require a complex and extended fresh water life history phase are most vulnerable to aquatic environmental perturbations and have, therefore, declined the most. Table 4.1-1 lists the life-stage periodicities for the three most important anadromous salmonids (Chinook salmon, coho salmon and steelhead) for four reaches of the Klamath River. Figure 4.1.1-1 depicts total adult fall Chinook salmon run size for the period 1978-2007. Section 4.2 discusses the importance of the various fisheries and what the economic value of a healthy, pre-development salmon fishery would be in terms of 1996 dollars. Section 5.0 of the report puts the impacts of the KHP in perspective with other factors that have affected

anadromous fishery resources in the Klamath River. Section 5.1 describes the loss of anadromous fish habitat and estimates the loss of Chinook salmon production from the upper basin by the construction of the Copco 1 and 2 Dams and IGD. Section 5.2 documents the adverse effects on anadromous salmonids from 45 yrs of power peaking operations of the Copco facilities. Section 5.3 discusses the failures of IGH to provide full mitigation for lost upstream anadromous fish production and the fact that the hatchery may be contributing to wild anadromous fishery impacts. Figure 5.3-1 depicts total adult fall Chinook salmon returns to IGH for the 1978-2007 period. Sections 5.4-5.4.3 discuss KHP effects on water quality, including temperature, dissolved oxygen (DO) and pH. Figure 5.4.1-1 describes the increase in fall and decrease in spring water temperatures below IGD caused by the KHP and their adverse affect on anadromous salmonids. Figure 5.4.2-1 depicts the decline in DO values that has resulted from KHP operations and IGD. Figures 5.4.3-1 and 2 describe KHP induced increases in pH below IGD. Section 6.0 describes the KHP influence on Lower Klamath River geomorphology and hydrology. Finally, section 7.0 relates how the KHP has altered habitat below IGD that favors proliferation of the secondary polychaete host for two myxozoan parasites that are causing high mortality in juvenile anadromous salmonids (see Figure 7.0-1).

4.0 Historic Fish Populations, Trends and Value

4.1 Anadromous Fish Species

There are thirteen native and two introduced anadromous fish species that occur in the Klamath River watershed (NAS 2004). Of the two introduced species, the brown trout (*Salmo trutta)* is rarely sea-run, though common in some tributaries and the American shad (*Alosa sapidissima*) is uncommon and only occurs in the lower reaches of the river. Of the thirteen native species, nine are tribal trust species (NAS 2004). The more important anadromous fish include Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), steelhead (*O. mykiss*), green sturgeon (*Acipenser medirostris*), Pacific lamprey (*Lampetra tridentata*), coastal cutthroat trout (*O. clarki clarki*) and eulachon (*Thaleichthys pacificus*). Chum salmon (*O. keta*) is today considered rare and pink salmon (O. gorbuscha) is extinct (NAS 2004), thus these two species, which may have had tribal significance historically, no longer play an important role in Klamath River fisheries.

4.1.1 Chinook Salmon

The Klamath River Basin was once the third most productive salmon system in the lower forty-eight states (NMFS 2007). One estimate of historical (pre-development) annual salmon run size ranged from 660,000-1.1 million adults (880,000 annual average) (IFR 1998). The predominant salmon species, in terms of number, size and human utilization, was the Chinook salmon. Two main races of Chinook, each exhibiting varied and different life history strategies, existed in the Klamath: the fall-run and the spring-run. The life histories of Chinook salmon will be examined in more detail below than those of the other anadromous fishes because of their commercial, recreational, and tribal importance, the fact that more is known about them than other anadromous species and

because their life history requirements clearly illustrate the deleterious impacts that aquatic environmental deterioration and modifications have had on the full assemblage of Klamath River anadromous fish species.

In the Klamath, fall-run Chinook are ocean maturing fish that typically spend less than one-year in fresh water, with some exceptions, and are referred to as having an ocean-type life history. Historically, the run started entering the lower river in July and peaked in August before declining in September (Snyder 1931). Due to this run-timing, Snyder (1931) referred to these fish as summer-run. Today the run occurs later. The run peaks at the mouth of the Klamath in early September and continues through late October, with spawning peaking in mid-October and generally finishing by mid-November (NAS 2004). Another run of fall Chinook, referred to as the late fall-run, enters tributaries of the Lower Klamath (e.g. Blue Creek) from November through December with some returning as late as February (Hardy et al. 2006).

The period of egg incubation and time to emergence for fall Chinook is temperature dependent and varies from year to year and for different locations. In the main stem alevins generally emerge from early February through early April. Fry disperse downstream in the tributaries and the mainstem, in response to competitive pressures for food and space, increasing temperatures and sometimes diminishing flows. They take up residence in shallow, slow moving, vegetated near-shore habitats to rear. At about 55 mm in length, they begin downstream movement to the estuary with peak outmigration occurring at the U.S. Fish and Wildlife Service (USFWS) Big Bar Screw Trap (RM 49.7) during June and July (Tom Shaw, USFWS, personal communication). The salmon that exhibit this most common type of life history are referred to as Type I Chinook salmon. The Type I life history strategy has adapted to minimize exposure time to the freshwater environment in the mid-reaches of the Klamath River in order to avoid predation, high water temperatures, and disease. Two other life history forms that may have been more prevalent historically, but are poorly represented today are: Type II Chinook which rear and over-summer in their natal tributaries and then outmigrate through the estuary in the fall as 0+ age fish after main stem temperatures have dropped to tolerable levels and Type III Chinook salmon that over-summer and –winter in tributaries and then outmigrate the following spring as 1+ age fish. The Type II and III strategies result in larger-sized outmigrants that have higher rates of survival and, thus, greater rates of return as adults. However, these life history forms require high quality fry and juvenile rearing habitat with sustained summer flows and ideal temperatures, conditions not as common in the Klamath Basin today.

Sexually immature spring Chinook adults (also called springers) enter the Klamath River from April through July and ascend cold-water tributaries where they hold over the summer before spawning in the fall with peak spawning occurring in October (NAS 2004). Immigration during the high flow season allows springers to access head water tributaries and spawn at higher elevations than can fall Chinook, which are limited in their upstream distribution by low flows and high water temperatures during the summer and fall (Moyle 2002). This type of spatial and temporal separation allows for maximum

niche utilization in an aquatic ecosystem and contributes to genetic isolation between the two races of salmon.

Spring Chinook fry emerge from March through early June and rear in their natal headwater tributaries. Some move downstream in the fall, but most do not outmigrate to the estuary and then the ocean until the following spring (Hardy et al. 2006) and thus, are referred to as exhibiting a stream-type life history.

Table 4.1-1 shows the life-stage periodicities for Chinook salmon, coho salmon and steelhead for different reaches of the Klamath River from Iron Gate Dam to the estuary.

Fall Chinook numbers have declined drastically within the Klamath Basin during the past century. NAS (2004) using Snyder's (1931) estimates of inriver harvest at the mouth of the Klamath River for the 1916-1927 period, estimated that total ocean and inriver harvest averaged 120,000-250,000 fall Chinook/yr. If a 50% harvest rate is assumed for that period, total run sizes (harvest and escapement) averaged 240,000-500,000 adults/yr during the 1916-1927 period. This compares closely with the run sizes reported by Hardy et al. (2006) citing Rankel (1982) who estimated total annual catch and escapement of fall Chinook between 1915-1928 at between 300,000-400,000. In 1972, it was estimated that 148,500 Chinook entered the Klamath system (Coots 1973 cited in Hardy et al. 2006). Between 1978-2007, the estimated total adult fall Chinook run size (hatchery and natural fish) to the entire Klamath Basin has been highly variable and averaged 105,357 fish, ranging from a low of 26,698 in 1992 to a high of 222,768 in 1995 (Figure 4.1.1-1) (CDFG 2008). Natural fall Chinook on average made up 77% of the run; Trinity River Hatchery contributed 8.6% and IGH 14.4% of the run, respectively (CDFG 2008).

Historically, large numbers of both spring and fall Chinook salmon accessed tributaries above Upper Klamath Lake to spawn (Hamilton et al. 2005). The spring-run may have been the more abundant of the two Chinook races above Upper Klamath Lake and may have equaled the fall-run in numbers basin-wide (Hamilton, et al. 2005, NAS 2004). Today, spring-run have been extirpated from the Klamath system, save for one small residual population in the Salmon River and several small remnant natural populations and a hatchery supported run on the Trinity River (Hardy et al. 2006).

4.1.2 Coho Salmon

Coho salmon were historically widely distributed and abundant throughout the Klamath River and it's tributaries as far upstream as Spencer Creek (RM 227.6) (today, tributary to the upper reach of J.C. Boyle Reservoir) (Snyder 1931; FERC 2007; Hamilton et al. 2005). Although accurate estimates of historic numbers are not available, coho have been in serious decline for at least the last fifty years and today the natural population is severely reduced in number and distribution and dominated by hatchery produced coho salmon (CDFG 2002). Klamath River Basin coho are considered part of the Southern Oregon/Northern California Coast (SONCC) ESU and SONCC coho were listed as threatened in 1997 by the National Marine Fisheries Service (NMFS 2007). Commercial

and recreational ocean fishing for coho as well as inriver recreational angling has been banned in California since 1994 (Boydstun et al. 2001, cited in NAS 2004). Hatchery fish appear to far outnumber natural coho. In 2000 and 2001 61% and 73%, respectively of the smolts sampled in the estuary were of hatchery origin (M. Wallace unpublished data 2002 cited in NAS 2004). The fact that coho spend 14 to 18 months of their 3 year life cycle in fresh water (NAS 2004) subjects coho fry and juveniles to a longer period and greater variety of potential environmental hazards than typical Type I fall Chinook experience and plays and is a major reason for their threatened status today.

4.1.3 Steelhead

Steelhead, the anadromous form of rainbow trout, are represented by 3 races in the Klamath Basin: spring/summer-run, fall-run and winter-run (Hardy et al 2006). Steelhead most likely had the widest historical distribution and were the greatest in number of any of the anadromous salmonids in the Klamath Basin (Snyder 1930; Fortune et al. 1966, Hamilton et al. 2005). Hamilton et al. (2005) observed that wherever Chinook salmon are found, steelhead will be found higher in that drainage and concluded that steelhead historically spawned in the headwaters of the Wood, Williamson, Sprague Sycan and other tributaries above Upper Klamath lake. Hardy et al., (2006) postulated that steelhead run sizes prior to 1900 were likely to have exceeded up to several million fish. However, estimates of steelhead runs had declined to 400,000 in 1960 (USFWS 1960, cited in Leidy and Leidy 1984, cited in Hardy et al. 2006), 250,000 in 1967 (Coots 1967, cited in Hardy et al. 2006), 241,000 in 1972 (Coots 1972, cited in Hardy et al. 2006) and 135,000 in1977 (Boydstun 1977, cited in Hardy et al. 2006). This downward trend has continued with estimates during the 1980's indicating that run sizes were approximately 10,000 summer/fall steelhead and 20,000 winter steelhead basin-wide, including returns to Iron Gate and Trinity River Hatcheries (Busby et al. 1994). At Iron Gate Hatchery, steelhead returns averaged only 166 fish per year for the 1991 through 1995 period versus 1935 fish per year for the 1963 through 1990 period (Hiser 1994, cited in Hardy et al. 2006). In 1996, only 11 steelhead returned to Iron Gate Hatchery. Even though such severe declines have led the National Marine Fisheries Service (NMFS) to conclude that, based on available information, Klamath Mountain Province ESU Steelhead populations are not sustainable and are subject to endangerment, they were not listed under the Endangered Species Act (ESA) (NMFS 1998, cited in Hardy et al. 2006). A unique run of steelhead called half-pounders are immature fish that migrate to the sea in spring and then re-enter the Klamath as part of the summer and fall steelhead runs and spend the winter in fresh water. They typically migrate back to salt water the following spring (Moyle 2002).

4.1.4 Green Sturgeon

Green Sturgeon of the Klamath River system constitute the largest spawning population of the species, which ranges from Mexico to the Bering Sea. The NMFS has identified two distinct population segments (DPS) of green sturgeon: (1) a northern coastal population segment including the Eel River and coastal drainages northward and (2) a southern coastal population segment including coastal drainages south of the Eel River,

including the Sacramento River system (FERC 2007). The Klamath River probably accounts for 70-80% of all green sturgeon production with spawning taking place in the lower reaches of the Klamath and Trinity Rivers (NAS 2004). Green sturgeon juveniles rear in the lower reaches of the Klamath until age 1-3 years, then move to the estuary and eventually the ocean, where they spend 3-13 years traveling long distances along the coast (NAS 2004). Some evidence suggests that there has been a general population decline, but recent restrictions in commercial and recreational harvest may be reversing those trends. The fishery supports a constant year-to-year tribal harvest of several hundred fish (Moyle 2002).

4.1.5 Pacific Lamprey

Historically, Pacific lamprey were extremely numerous and widely distributed in the Klamath River system. There is some disagreement as to how far they may have migrated upstream in the Klamath River. Hamilton et al. (2005) note that lamprey show a distribution similar to steelhead and salmon and concluded that they migrated upstream as far as the vicinity of Spencer Creek (RM 227.6), a distance similar to that of coho salmon. The NAS (2004) thought it certain that lamprey entered the upper basin above Klamath Falls at least occasionally based on the genetics of resident lamprey. However, FERC (2007) cites a September 27, 2006 Administrative Law Judge Decision (McKenna Decision) "*that there is insufficient evidence in the record to determine whether Pacific lamprey historically were distributed above the present site of Iron Gate Dam.*" But, the McKenna Decision further concluded that "*the record evidence shows that access to habitat would benefit that species of fish by providing it with additional spawning and rearing grounds.*" Today, their numbers are low and declining (Moyle 2002).

4.1.6 Coastal Cutthroat Trout

Coastal cutthroat trout occur primarily in small streams tributary to the lower 22 mi of the Klamath River. They appear underappreciated and often overlooked because of their similarity to steelhead NAS 2004), and population status is poorly known (Hardy et al 2006). They do not appear to have been present in the Upper Klamath Basin, presumably because of their intolerance to warm water (Moyle 2002).

4.1.7 Eulachon

Eulachon, also known as candlefish, is a smelt that once supported an important tribal fishery (Moyle 2002). Historically, large numbers would migrate into the lower 8 mi of the Klamath River during March and April to spawn (NAS 2004). Since the mid-1970's their numbers have been too low to support a fishery in most years (NAS 2004).

4.2 Fisheries Importance and Value

Chinook salmon have been the mainstay of Klamath River fisheries historically as well as today. Chinook have provided for tribal subsistence and ceremonial needs since time immemorial and, during recent times, tribal commercial fishing during years of

abundance. In addition, Chinook have supported extensive commercial and recreational ocean fisheries from approximately Monterey Bay, California to Cape Falcon, Oregon and inriver recreational fisheries both on the Klamath and Trinity Rivers. Coho salmon contributed to these same fisheries as well until 1997, when commercial and recreational take of Klamath coho was forbidden by regulation because of their depleted status. This fishery remains closed today.

Using the 660,000 – 1.1 million historic salmon population estimate, and a 50% harvest rate, the Klamath should be able to produce a total annual income stream of market-based salmon related economic benefits (excluding non-market values) totaling between $82,900,878 to $137,432,650/yr. in 1996 dollars, thus supporting between 4,145 to 6,870 family wage jobs (IFR 1998). If non-market benefits are included the economic benefits could be as high as $374.86 million /year (IFR 1998). The net asset value (assuming a term of 100-years) of a historic pre-development Klamath salmon fishery (run size of 1.1 million salmon), at a fifty per cent harvest rate, calculated at a three per cent discount rate, has been conservatively estimated to be 4.5 billion dollars in 1996 dollars. If non-market benefits are included, the calculated net asset value of the fishery could then potentially be as high as $11.85 billion dollars (IFR 1998).

Steelhead have supported a very popular recreational fishery throughout the Klamath and Trinity Rivers and their major tributaries, but today this fishery is strictly regulated by specific water closures, season, gear type, and bag limit (wild steelhead may not be possessed) to protect wild salmon and steelhead stocks (CDFG 2007).

5.0 Impacts of The Klamath Hydropower Project

The reasons attributed to the decline of Klamath River anadromous fish runs have been varied and many. KRBFTF (1991), NAS (2004), Hardy et al. (2006) and others have described an extensive list of factors, some permanent and others transitory, that have affected anadromous fish species over the years in the Lower Klamath River. These include, but are not limited to: placer, gravel, and suction mining; timber harvest; salmon over-harvest; global warming; road building and maintenance; agricultural practices; water diversions for mining, power and agriculture; dams; water management and introduction of exotic fish species. Some of these factors, such as placer mining and fish over-harvest, no longer play an important role and fish populations would be expected to recover from these impacts. Others, such as global warming, may form a new baseline of environmental conditions that will have to be considered in species recovery. However, a review of the literature and personal knowledge of factors related to the decline of anadromous fisheries in the Klamath River lead me to conclude that construction and operation of the KHP lower-most 3 dams have been the major contributor to anadromous fish declines. The reasons are: (1) the impacts of the dams to loss of habitat and anadromous fish production in the upper basin were sudden, large, and long-lasting (90 yrs); (2) peaking operations chronically killed massive numbers of fish and aquatic insects and destroyed aquatic habitat for 45 yrs; (3) Iron Gate Hatchery (IGH), rather than mitigating for lost upstream production, has failed to meet mitigation goals and is instead interfering with anadromous fish recovery; (4) The 3 dams have chronically adversely

affected water quality and stream channel morphology and contributed to salmonid disease epidemics.

5.1 Loss of Habitat and Fish Production Above Iron Gate Dam

Upstream passage of anadromous fish on the mainstem Klamath River may have been impacted with the start of construction of Copco 1 Dam in 1911 (RM 198.6)(FERC 2007), but was permanently blocked for the first time in 1917 with the completion of the Copco 1 facility (Hardy et al 2006). Copco 2 Dam (RM 198.3) was completed in 1925 and Iron Gate Dam (IGD) (RM 190.1) in 1962, but IGD, which is the current limit of upstream passage, may have effectively blocked fish migration as early as 1960 (FERC 2007). None of these dams incorporated fish passage facilities.

Prior to construction of the 3 dams, anadromous fish (spring and fall Chinook salmon, coho salmon, steelhead and Pacific lamprey) had access to approximately 600 mi of holding, spawning, incubation and rearing stream habitat above the site of IGD (Hamilton et al. 2005, Huntington 2004). Huntington (2004) estimated that historically this habitat may have been capable of supporting a Chinook salmon run-size of between 149,734 - 438,023 fish, but believed the actual figure was toward the lower end of the estimate. After additional field reconnaissance, Huntington (2006) conservatively estimated that upper basin habitat could support a run of 111, 230 Chinook salmon. Because steelhead generally spawn higher in tributaries and have greater thermal tolerance, it could be expected that the upper basin could support significantly greater number of steelhead than Chinook. Huntington, et al. (2006) have estimated that today the quantity of existing habitat potentially available, but presently inaccessible, in the upper Klamath Basin is 304 mi for ocean-type (Type-1) fall Chinook salmon, 370 mi for stream-type Chinook salmon and 500 mi for fall/winter steelhead.

In addition to the loss of anadromous salmonid spawning and rearing habitat within and above the KHP, the KHP has also blocked anadromous fish access to some of the most significant thermal refugia in the Klamath River. For example, the lower 3 dams block access to inriver springs below J.C. Boyle Dam that provide 225-250 CFS of clear, cold water that, historically, provided thermal refugia for anadromous salmonid adults and juveniles moving up and down stream between the upper and lower basins. Likewise, a number of cold water tributaries, including Spencer, Shovel, Fall and Jenny Creeks, played a major role as cold water thermal refugia but are now inaccessible. In river systems such as the Klamath, where attainment of optimal temperatures for salmonids is difficult, thermal refugia play a critical role (U.S. EPA 2003).

5.2 Power Peaking Operations

Another significant adverse impact created by the dams was that Copco 1 and 2 operated as power peaking operations for approximately 45 yrs. (1918-1962). No minimum flows were required during this period, and during the course of a week flows would vary from 3,200 CFS to 200 CFS while in a 20 minute period water level might drop or rise several feet (Jones and Stokes 1976, Taft and Shapovalov 1935 cited in KRBFTF 1991).

Hazards were created for fishermen and fish due to the extreme and unnatural short-term fluctuations. Complaints were many and eventually lawsuits were filed (KRBFTF 1991).

In several studies, adult and juvenile salmon and numerous insects were observed being stranded along the shore and then the sudden rise in flows would wash-out recently constructed redds (fish nests) (Snyder 1934, Taft and Shapovalov 1935 cited in KRBFTF 1991). The phenomenal biological impact of power peaking was quantified by California Department of Fish and Game (CDFG) biologists who calculated that during the period June 1948-May 1949, the Klamath River below Copco Dam experienced a loss of 1,862,132 salmonid fingerlings, yearlings and adults (primarily steelhead) as a result of the power plant's fluctuating releases (Wales and Coots 1950 cited in KRBFTF 1991). Multiplying this effect by the 45 years it took to solve the problem (a very conservative loss of 84 million salmonids) and the fact that the effect was felt, on a diminishing scale, probably to the estuary especially during summer low flow periods, indicates the magnitude of the tremendous loss to the fishery. Iron Gate Dam, located about 7 mi below the Copco 2 Power House, was constructed to reregulate Klamath River flow, as well as generate power (KRBFTF 1991).

5.3 Iron Gate Hatchery Does Not Fully Mitigate For Project-induced Losses of Fish Productivity

Iron Gate Hatchery (IGH) was constructed in 1962 as a requirement of the 1956 FERC license to mitigate for loss of Chinook and coho salmon and steelhead spawning habitat in the Klamath River and its tributaries between IGD and Copco 2 Dam (FERC 2007). There were no requirements in the FERC license to mitigate for loss of habitat above the Copco facilities. In addition, mitigation was not required for the loss of spring-run Chinook and lamprey production above IGD. The result, for these reasons alone, is that IGH has not fully mitigated for loss of Chinook and coho Salmon, steelhead and lamprey production caused by the KHP. Furthermore, the Klamath Tribes, which have treaty-guaranteed fishing rights, and other Upper Klamath Basin residents have not been able to participate in these fisheries at traditional locations for more than 90 yrs. This last issue has never been satisfactorily addressed.

Broodstock for the IGH fall Chinook program has been attained exclusively from Klamath River stock, however, attempts to establish a spring Chinook run from native stock, as described below, were unsuccessful (KRBFT 1991). Insufficient numbers of native coho salmon returned to IGH after IGD was built to establish a viable coho salmon brood stock, necessitating importation of coho eggs from other hatcheries, including Trinity River Hatchery, Cascade Hatchery in Oregon, and Mt. Shasta Hatchery (perhaps Noyo River strain coho)(CH2MHill 1985 cited in KRBFTF 1991). Steelhead native broodstock were supplemented with eggs imported from Trinity River Hatchery and Cowlitz River steelhead from Washington (KRBFTF 1991).

Current production goals at IGH are 4.92 million subyearling fall Chinook salmon, 1.08 million yearling fall Chinook, 75,000 yearling coho salmon and 200,000 yearling steelhead (Hampton, 2005). For most of the operational history of IGH, subyearling fall

Chinook were released over a several day period by the second week of June, water temperatures permitting. The goal was to rear fish to the largest size possible and then release them to the river before the onset of stressful or lethal temperatures. However, on a number of occasions significant mortalities of released fish occurred when river water temperatures unexpectedly reached lethal levels (KRBFTF 1991). The Chinook subyearling release strategy was changed at the recommendation of the Joint Hatchery Review Committee (CDFG & NMFS 2001) so that fall Chinook smolts were released semi-volitionally in four groups, one group/week, starting in May. This was initiated to increase hatchery Chinook survival and to decrease competition with wild (natural) Chinook. Fall Chinook yearlings are typically released in November, Coho yearlings in March and Steelhead March-May.

Chinook smolt production has ranged from 454,546 fish in 1965 to 12,727,288 in 1985 and has been below production goals 30% of years, above 21% of years, and approximately equal to production goals 49% of years. Coho salmon production has ranged from 0 to 200,000 smolts per year and has met production goals about 70% of the time. Steelhead yearling production has varied widely from a low of 10,702 in 1997 to a high of 642,857 in 1970. Steelhead production has declined steadily since 1970 and the production goal has not been met since 1991 (FERC 2007).

Prior to 1969, spring Chinook salmon were not differentiated from fall-run Chinook. From 1969-1979, springers were counted, with the numbers ranging from 0-181 fish per season with the largest number, 181, returning in 1972. The springer program, such as it was, was discontinued due to small returns of adults and limited hatchery space for continuing the program (CDFG 2008).

Fall Chinook salmon adult (excluding grilse) returns to IGH from 1963-2007 have averaged 11,652 fish per year and ranged from 365 fish in 1965 to 71,154 fish in 2000 (CDFG 2008). The returns have fluctuated greatly, being significantly below average (except 1976) from 1972-1984, above average from 1985-1989, again significantly below average from 1990-1992, and above average from 1993-1998. Record returns occurred in 2000-2001. Since then returns have generally been near average or a little above. (CDFG 2008). Figure 5.3-1 shows adult fall Chinook salmon returns to IGH for the 1978-2007 period during which the average return was 15,176 adults.

Coho salmon returns have averaged 859 adults for the 1963-2007 period, but have fluctuated widely from zero returns in 1964/65 to 3546 in 1996/97. Years of relatively robust returns are often followed by years of only a few hundred fish (CDFG 2008). The 2001/02-2005/06 returns were all above average, perhaps being influenced by the 1997 ban on commercial and sport take of threatened SONCC coho salmon. However, the 2006/07 and 2007/08 runs were only 263 and 625 adults, respectively (CDFG 2008).

Steelhead have exhibited widely fluctuating returns, but during the 1970s and 1980s adult returns to IGH were typically no lower than 1500 fish and as high as 4,000; the largest return of 4,411 fish occurred in 1977/78. During the 1990s, however, steelhead returns experienced a precipitous decline with only 12 fish returning in 1995/96. The runs

recovered somewhat from 2000-2005, but only 161 and 325 steelhead returned in years 2006/07 and 2007/08, respectively (CDFG 2008). One major concern is that a significant portion of IGH-produced steelhead may be residualizing in the mainstem at a greater frequency than wild stocks and not expressing an ocean life history. Chesney (2003) examined the otoliths of 19 IGH origin steelhead returning to the hatchery and determined that 8 steelhead (50%) (3otoliths were inconclusive) had not gone to the ocean.

To summarize, fishing opportunities for anadromous fish species have been non-existent in the Upper Klamath Basin for more than 90 yrs. Iron Gate Hatchery, which was required to mitigate for this loss, has failed to meet its production goals for Chinook and coho salmon 30% of years and has a steelhead program that presently may be totally non-functional. Runs of Chinook, coho and steelhead to IGH in most years have been far below that which would have returned to the Upper Klamath Basin in the pre-dam era. Assuming a harvest of 50% and the average Chinook salmon return to IGH of 11, 652 adults, the total number of adults that could have potentially passed IGD to the upper basin would have averaged 23,304, about 21% of the number of fish estimated conservatively by Huntington (2006) to have reached the upper basin, on average, prior to development.

Survival of IGH Chinook, coho and steelhead production may be severely limited by poor Klamath River water quality, high temperatures and disease (see below). Coho salmon and steelhead broodstock genetics may have been compromised by the introduction of out-of-basin stocks that are poorly adapted to Klamath River environmental conditions. Instead, IGH production may be negatively impacting wild Klamath River fish populations through competition, hybridization and disease transmission (described below).

5.4 Water Quality is Severely Impaired

The entire length of the Klamath River from the Oregon state line to the Pacific Ocean is listed as impaired under the California 303(d) list for nutrients, organic enrichment, DO and temperatures that do not meet either numerical or narrative water quality objectives (SWRCB 2002). Furthermore, Klamath River waters within the KHP do not meet North Coast Regional Water Quality Control Board (NCRWQCB) (2001) objectives for pH, ammonia toxicity, taste and odor, floating material, settleable material, and chemical constituents. The NCRWQCB (2001) has found that the beneficial uses that are impaired by poor water quality include: rare, threatened or endangered species; cold freshwater habitat; migration of aquatic organisms; spawning, reproduction and/or early development; sport and commercial fishing; Native American culture; contact and non-contact recreation; wildlife habitat; navigation; municipal and domestic supply; and agricultural and industrial service supply.

5.4.1 Water Temperature

The Klamath River is considered temperature impaired by the State of California, North Coast Regional Water Quality Control Board (SWRCB 2002). High water temperature can be a major stressor that makes fish more susceptible to other stresses such as disease, or it can cause direct mortality in fish. In conjunction with low dissolved oxygen (DO), high water temperature has been implicated as a major contributing factor in juvenile and adult fish kills in the Klamath River (CDFG 2004, NRC 2004, USFWS 2003, FERC 2007).

The KHP detrimentally alters water temperatures in the Klamath River, thus significantly impacting anadromous fish resources (PacifiCorp 2004). Due to the thermal mass of Copco and Iron Gate Reservoirs, water temperatures in the mainstem river below Iron Gate Dam are cooler in spring by up to 5º C and warmer in late summer and fall by up to 5º C then they would otherwise be, absent the reservoirs (Figure 5.4.1-1) (PacifiCorp 2005, PacifiCorp 2004). These seasonal water temperature shifts would be expected to vary in timing and magnitude from year to year due to variations in river flow and weather.

The U.S. Environmental Protection Agency (EPA) recommends temperature limits for the protection of various life history stages of Chinook salmon. For Chinook spawning, EPA recommends that the maximum seven day floating average (7DADM) not exceed 13º C (U.S. EPA 2003), which is shown as a reference line in Figure 5.4.1-1. Fall Chinook in the Klamath main stem between IGD and Seiad begin spawning about mid-October with the peak occurring in late October-early November (Magnusen et al. 2001). As Figure 5.4.1-1 indicates, most present day spawning occurs at temperatures above 13º C. Eggs laid under such sub-optimal conditions are likely to have higher pre-hatch mortalities, a greater rate of developmental abnormalities and result in lower alevin weight (McCullough 1999). If the mainstem were free-flowing, without the presence of the KHP, water temperatures would decrease to 13º C by the first week of September, three weeks earlier than occurs presently with the KHP in place (Figure 5.4.1-1). As was discussed earlier, Klamath River fall Chinook salmon run-timing today is delayed by about three weeks over that which occurred pre-KHP and subsequently spawning has also been shifted back by three weeks, most likely as a behavioral response to avoid sub-optimally high water temperatures. The delay in run-timing reduces the separation of the main Klamath River fall Chinook run from that of the Trinity River run, potentially leading to denser concentrations of salmon in the Lower Klamath River. Such a condition was an important factor in the unprecedented 2002 Klamath River fish kill (CDFG 2004, USFWS 2003).

The lower limit temperature threshold for salmonid growth is 4º C (U.S. EPA 2003, McCullough 1999). Flows from IGD stay below this threshold from early February through mid-March, while modeled flows with out the KHP in place are mostly above the threshold from early February through March and are significantly warmer throughout the month of April (figure 5.4.1-1). The February-April period is critical for fall Chinook fry rearing in the main stem Klamath River (Hardy et al. 2006). The consequence of the shift to lower temperatures induced by the KHP dams is that fry will grow more slowly than they would have in a free flowing river. Larger smolts generally take less time to

emigrate to the estuary than do smaller ones, thus minimizing exposure to mortality factors such as predation, disease and lethal water temperatures. The larger a smolt is at ocean entry the greater the rate of survival to maturity and spawning (Nicholas and Hankin 1988). The cumulative effect of delayed spawning in the fall with reduced fry growth rates in the spring is that rearing and outmigration are now generally occurring at a later date than would have occurred pre-KHP, thus subjecting these fish to even greater temperature and disease exposure.

5.4.2 Dissolved Oxygen

KHP operations result in reduced DO concentrations in the mainstem Klamath River below IGD, often below the State of California's numerical objectives (minimum of 7.0 mg/L above IGD and 8.0 mg/L below IGD and 50% or more of the monthly means in a calendar year must be above 10 mg/L from the state line to the Pacific Ocean) (FERC 2007). Measurements taken in August, 2004 showed depressed DO concentrations from IGD downstream to the confluence of the Scott River with average daily minimum DO values below 6.0mg/L (Kier Associates 2006).

Figure 5.4.2-1 compares DO concentrations below IGD for existing (Project) and modeled no project scenarios for a low flow water year. DO concentrations are significantly higher without the KHP than with during most of the year but especially during the fall Chinook adult migration and spawning season. Current DO levels below IGD are below State of California standards from early May to early November, often below 5-6 mg/L, thus deleteriously affecting fall Chinook salmon fry rearing, smolt outmigration and adult spawning life history phases. Other anadromous species present in the mainstem Klamath during this period, such as coho and steelhead, are also harmed. In contrast, the with out KHP DO concentrations are above 8.0 mg/L, often significantly so, during the entire year, save for a short period in late June/early July. Modeling results by PacifiCorp show similar results for other water year types, but with more variability (FERC 2007).

5.4.3 pH

Healthy waters typically have a pH of 6.0-8.0 and studies have shown that values exceeding 8.5 are stressful and those at 9.6 or above are lethal to salmonids (Wilkie and Wood 1995). In the Lower Klamath River, the stressful effects of high pH are amplified by the presence of typically high water temperatures and low DO from spring to early fall.

The NCRWQCB (2001) Basin Plan prescribes a standard for the Klamath River of pH not to exceed 8.5. Never-the-less, under present KHP operations this standard is exceeded on a daily basis during summer months along large reaches of the Klamath River with the maximum concentrations occurring from IGD to Seiad Valley (Figures 5.4.3-1 and 5.4.3-2) (Kier Associates 2006). The variability in pH values between years and sites is due to year-to-year differences in weather patterns, flows and other factors.

The persistent exceedance of the 8.5 pH standard is an indication of excessive nutrient loading and subsequently results in chronic fish health problems.

The KHP contributes to high downstream pH levels in two ways: (1) by releasing reservoir-generated high pH water at IGD that directly affects the downstream environment and fish and (2) by altering channel substrate and hydrology below IGD in ways that increase downstream growth of algae, periphyton and rooted macrophytes. Respiration of these organisms increases the CO_2 content of water which causes high pH levels during the day followed by low levels at night (diel swings).

6.0 Fluvial Geomorphology and Hydrology

Reservoirs often cause geomorphic and hydrologic changes that contribute to downstream luxuriant growth of periphyton (benthic algae, attached algae) and aquatic macrophytes (Biggs 2000); Iron Gate and Copco Reservoirs are no exception.

By interrupting sediment transport, Iron Gate and Copco reservoirs deprive downstream reaches of gravel, resulting in an armored streambed composed of larger substrates (e.g. cobble and boulders) that require higher flows for mobilization than smaller substrates such as gravel and sand (PacifiCorp 2004, FERC 2007). Cobble and boulder provide stable substrates that allow periphyton to reach high biomass (Biggs 2000, Anderson and Carpenter 1998). This paucity of gravel has also severely reduced available quality spawning habitat below Iron Gate Dam (FERC 2007).

In addition, flow regulation by reservoirs results in a smoothed hydrograph (reduced magnitude and frequency of peak flows), reducing scour of periphyton and macrophytes and allows biomass to reach higher levels than would occur naturally (Biggs 2000). Upper Klamath Lake is the primary water storage reservoir for the Klamath River, but Iron Gate and Copco Reservoirs do exert some hydrologic effect by allowing capture of small and medium storm flows from tributaries between Keno and Iron Gate Dams (i.e. Spencer Creek, Shovel Creek, Fall Creek, Jenny Creek).

High biomass of periphyton and aquatic macrophytes in rivers can result in degradation of water quality conditions (Tetra Tech 2006, Anderson and Carpenter 1998). Photosynthesis and respiration by periphyton and aquatic macrophytes in the Klamath River below Iron Gate Dam causes large diurnal swings in dissolved oxygen and pH, causing stress to juvenile salmonids. Additionally, one of the species that thrives in the reach below Iron Gate Dam is *Cladophora*, filamentous green algae that is one of the major habitats for the polychaete worm that is the alternate host of *Ceratomyxa shasta*, a major parasite of Klamath River salmonids (Stocking 2006) (See Fish Disease section for more detail).

7.0 Fish Diseases

A critical factor limiting recovery of anadromous fish populations in the Klamath River is the presence of several disease pathogens that annually cause severe mortality in juvenile

Chinook and coho salmon. The two most prevalent and significant pathogens are the myxozoan parasites *Ceratomyxa shasta* and *Parvicapsula minibicomis*, with the disease (Ceratomyxosis) caused by *C. shasta* considered the most important disease affecting juvenile salmon in the Lower Klamath Basin (Nichols et al. 2003). Bartholomew and Courter (2007) (cited in FERC 2007) reported that Coho may have less resistance to *C. shasta* than Chinook salmon and steelhead appear to have strong resistance to the parasite. Stone et al. (2008) confirmed the strong resistance of steelhead to *C. shasta* but found that coho and Chinook appear to have similar susceptibility to the parasite. . A number of studies have shown high *C. shasta* infection rates in mainstem Klamath River outmigrating fall Chinook smolts (Foote et al. 2002; Nichols et al. 2003). In a 2004 study of juvenile Chinook outmigrants, Nichols and Foote (2005) estimated that 45% of the outmigrant population were infected with *C. shasta* and 94% with *P. minibicomis* and that the majority of the dual myxozoan infected fish (98% of *C. shasta* infected fish) would not survive. Furthermore, Nichols and Foote (2005) concluded that:

> *"Depending on the juvenile Klamath River salmon population size and smolt to adult return ratio, the effective number of adult salmon lost to C. Shasta as juveniles could rival the 33,000+ adult salmon lost to the 2002 Klamath River Fish Die-off."*

The pathogenic infections and resultant juvenile anadromous salmonid mortalities are presently an annual occurrence, though the magnitude of the fish losses are sometimes difficult to determine because the small size of the fish causes them to quickly disappear and fish kills often occur in relatively inaccessible areas of the river. A July 21, 2008 USFWS preliminary report estimated that *C. shasta* had been detected in 46% and *P. minibicomis* in 63% of Chinook salmon sampled by June 1, 2008 (Accessed online at: http://www.fws.gov/arcata/fisheries/projectUpdates/FishHealthMonitoring/Klamath%20Juvenile%20Salmonid%20Health%20Update%2007-09-2008.pdf.

Resistance to infection may be reduced by higher water temperatures (Scheif et al. 2001), but Foott et al. (2004) concluded that the degree of parasite exposure may be more important than water temperature. In a 2003 experiment, Stocking et al. (2006) exposed fall Chinook salmon to *C. shasta* in both the upper and lower Klamath River. The experimental Chinook in the upper river did not become infected while those in the lower river suffered a 50% mortality rate. Stocking et al. (2006) concluded that the dramatic difference in mortality between the upper and lower Klamath groups could not be explained by differences in water temperature and are probably differences in infectious dose. Thus far, the presence of *C. shasta* and *P. minibicomis* infections have only been detected in the mainstem Klamath River and have not been found in the tributaries, including the Trinity River (Stocking 2006; Stocking et al. 2006).

The life cycles of both *C. shasta* and *P. minibicomis* utilize a salmonid host and an alternate host polychaete worm, *Manaynukia speciosa* (Figure 7.0-1). The life cycle of *C. shasta* is described in detail by Bartholomew et al.(1997). *C. shasta* myxospores develop in the salmonid and are then released into the water, where they infect the

polychaete worm. They then develop in the polychaete before being released as actinospores which then infect salmonids.

The high incidence of *C. shasta* infections of *M. speciosa* below IGD appear to explain the high spore infectious rates of concurrent studies and the observations of *C. shasta* induced mortality in Klamath River fall Chinook salmon (Stocking and Bartholomew 2007). Recent surveys have found that the preferred habitats of *M. speciosa* are fine benthic organic matter occurring in low velocity areas and beds of *Cladophora spp* (a macro-algae) adhering to harder substrate such as boulders and cobbles and containing diatoms and fine organic material (Stocking and Bartholomew 2007). The highest densities of *M. speciosa* are always found associated with *Cladophora spp*. (Stocking and Bartholomew 2004)

A plausible explanation for the high incidence of *C. shasta* in the Klamath River is that *M. speciosa* populations have increased as a result of an increase in available polychaete habitat (Stocking and Bartholomew 2004). The KHP has altered the hydrodynamics, channel morphology and the nutrient dynamics of the Klamath River below IGD, which has increased habitat for polychaetes, thus increasing their numbers and the infection rates of the *M. speciosa* population. In addition, the KHP has increased water temperatures and pH and reduced DO levels, especially in the reach of river below IGD, thus stressing salmonids and making them more susceptible to myxozoan infections and potential death. All of these dynamics are further aggravated by the fact that IGD and the close proximity of IGH cause large spawning aggregations of fall Chinook to assemble in the river within a limited area that possesses some of the best polychaete habitat in the river. When these large numbers of salmon die in a rather confined space, myxospores are spread in profusion into a large and receptive *M. speciosa* population which then spreads its actinospores to the next generation of fall Chinook the following spring. This becomes a never-ending circular problem unless polychaete habitat is severely disrupted by a major storm event or some other, as yet untested, action.

8.0 Conclusions

The Klamath River anadromous fishery has gone from being one of the west coast's premier fisheries to being on the brink of collapse.

Anadromous fish numbers were severely depleted when the KHP Copco 1 Dam was constructed in 1917, blocking fish access to the Upper Klamath Basin. In spite of this and the fact that power peaking at the Copco facilities killed many millions of fish over a 45 yr period, anadromous salmonid runs persisted, albeit in much smaller numbers, because several cold-water refugia and some spawning and rearing habitat remained below the Copco 2 Power House. With the completion of Iron Gate Dam in 1962, the last remaining significant summer thermal refugia in the upper reaches of the lower river was eliminated. The KHP blocked about 600 mi of habitat above IGD that is estimated to have been able to produce a minimum of 111,230 adult Chinook salmon and many steelhead and coho . The effect of IGD was felt by the mid-1970s as the salmon runs declined to new lows.

Iron Gate Hatchery, constructed to mitigate for lost production above IGD, did not plan to and has not mitigated for spring Chinook or lamprey, has failed to adequately mitigate for steelhead and has not fully mitigated for fall Chinook or coho salmon. Instead it has, at times, grossly over-produced Chinook salmon smolts and yearling steelhead leading to high levels of competition with natural salmonid stocks. At other times (30%) IGH has under-produced Chinook and coho and has failed to sustain a viable steelhead production program.

For 46 yrs IGD has impacted the water quality of the Lower Klamath River in many ways, but most notably by altering the temperature regime, depressing DO and increasing pH, all to the detriment of anadromous salmonids. Geomorphic and hydrological changes induced by IGD have created habitat conditions in the Lower Klamath River favorable for growth of dense beds of algae that support unusually large populations of polychaete worms that act as a secondary host for two myxozoan parasites that infect and kill large numbers of anadromous salmonids. This combination of poor water quality, geomorphic and hydrological changes, and the presence of unnaturally large congregations of spawning Chinook salmon below IGD have worked in concert to create disease mortality in juvenile anadromous salmonids of epidemic proportions.

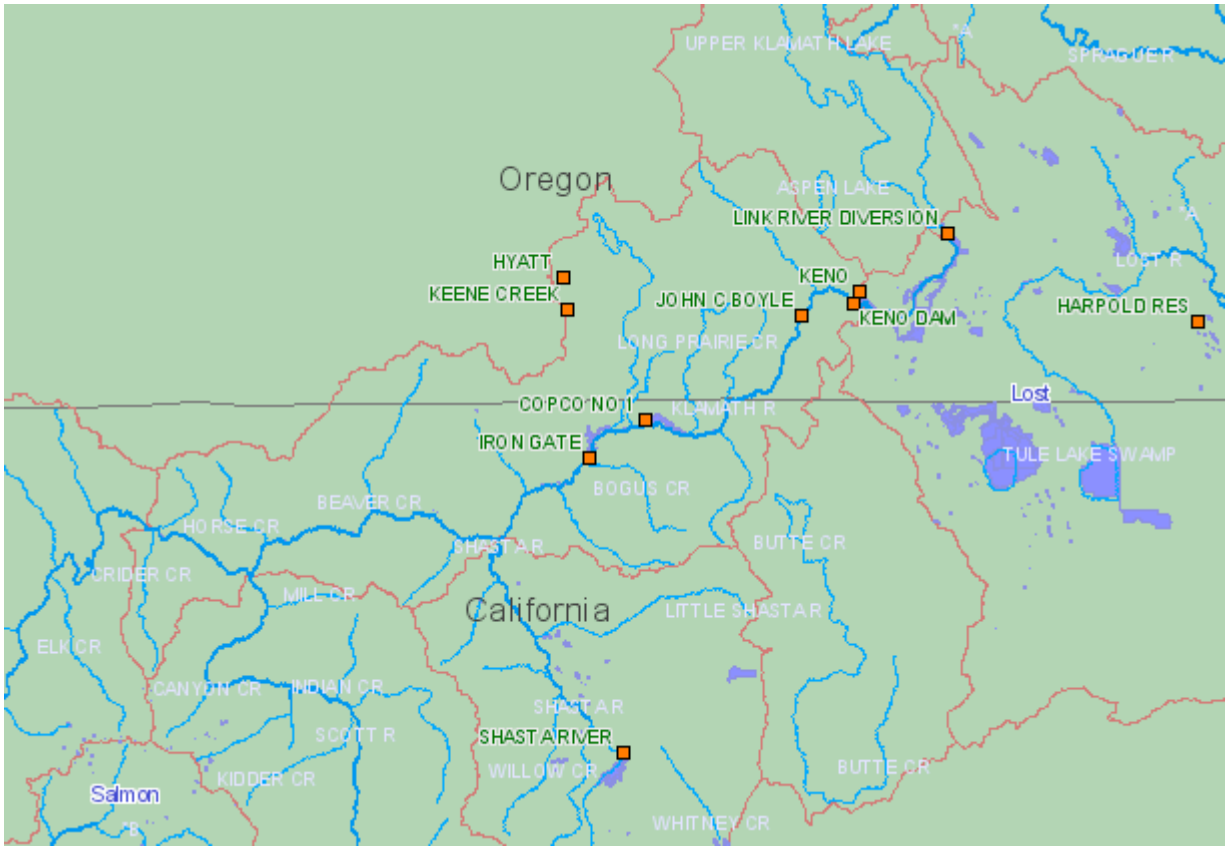
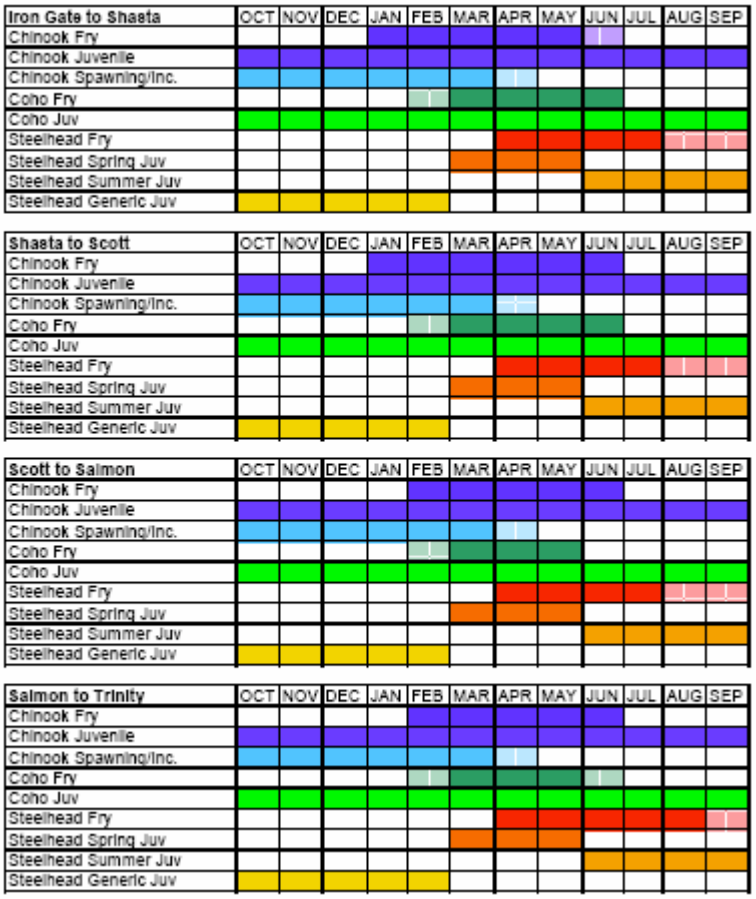


Figure 3-1. Location of the Klamath Hydroelectric Project, including Copco and Iron Gate Dams and Reservoirs (note: Copco 2 Dam is 0.3 mi downstream from Copco 1 Dam). Source: http://klamath.humboldt.edu/php-bin/index.php

Table 4.1-1. Species and life stage periodicities for four reaches of the main stem Klamath River between Iron Gate Dam and the estuary (hatching indicates occasional usage for that month). Source: Hardy et al. 2006 by permission.



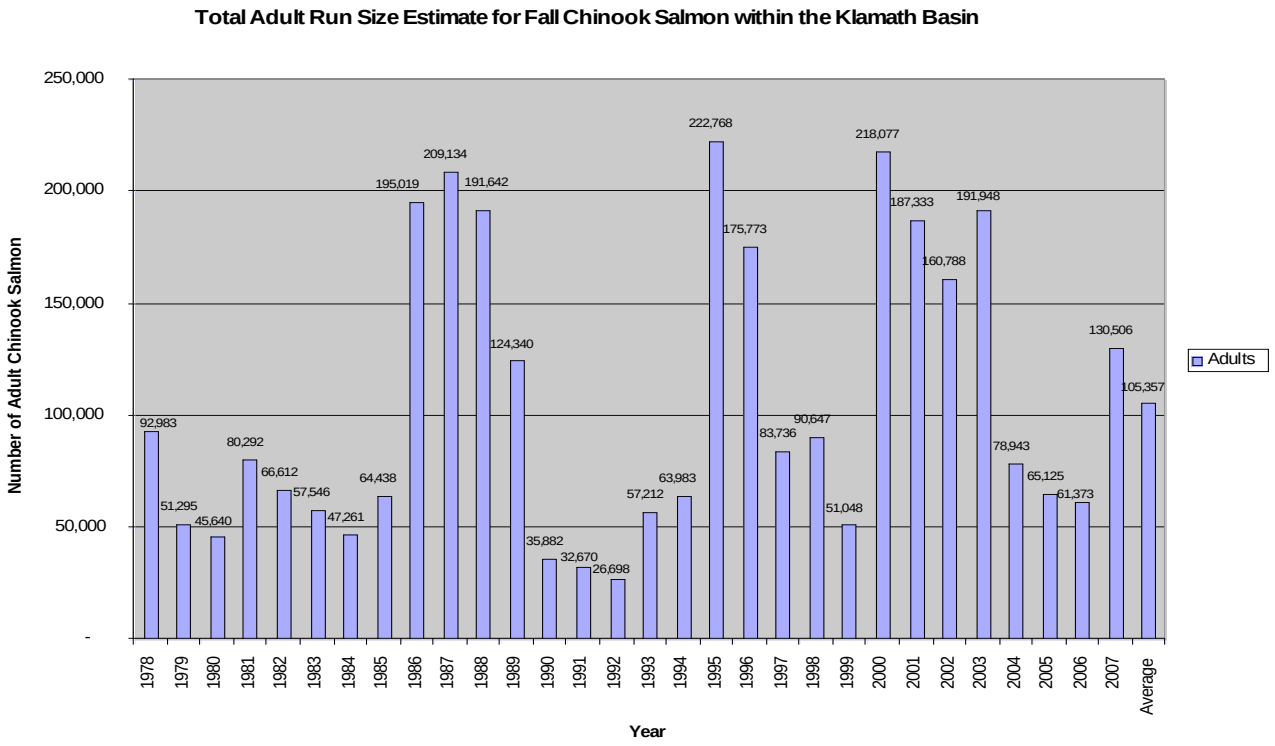


Figure 4.1.1-1. Total adult fall Chinook salmon run size (harvest and escapement) (natural and hatchery fish) for the Klamath Basin, 1978-2007. Source: CDFG unpublished data by permission.

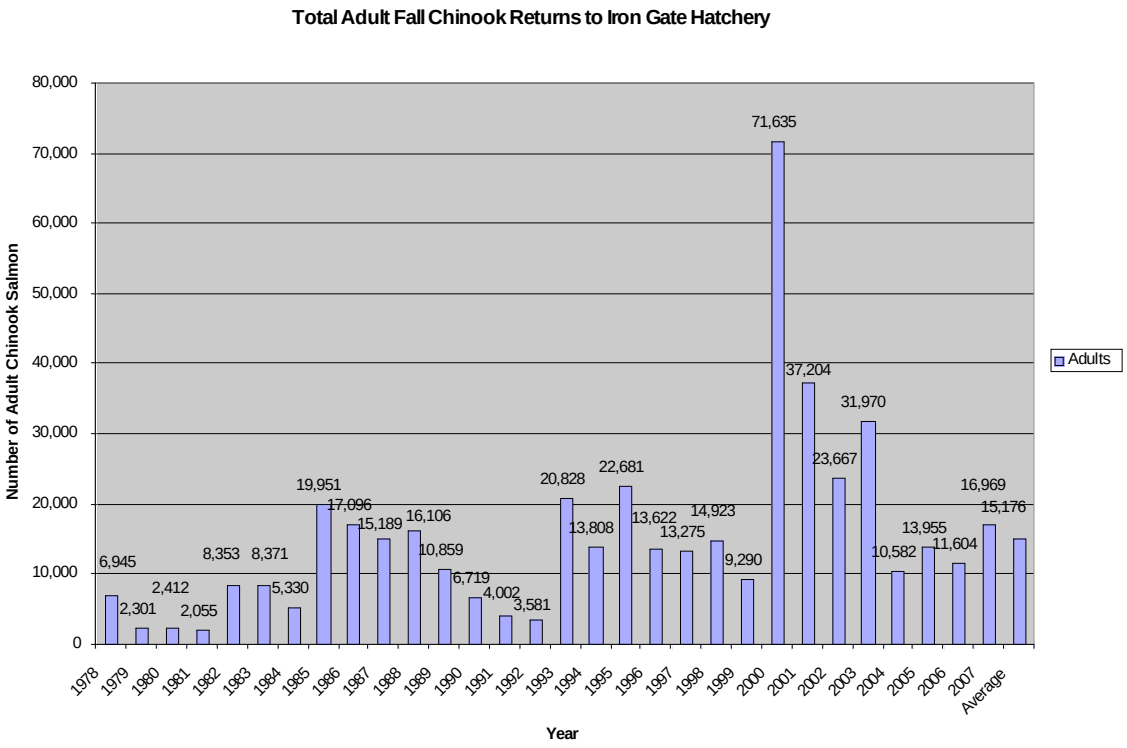


Figure 5.3-1. Total adult fall Chinook salmon returns to Iron Gate Hatchery, 1978-2007. Source: CDFG unpublished data.by permission.

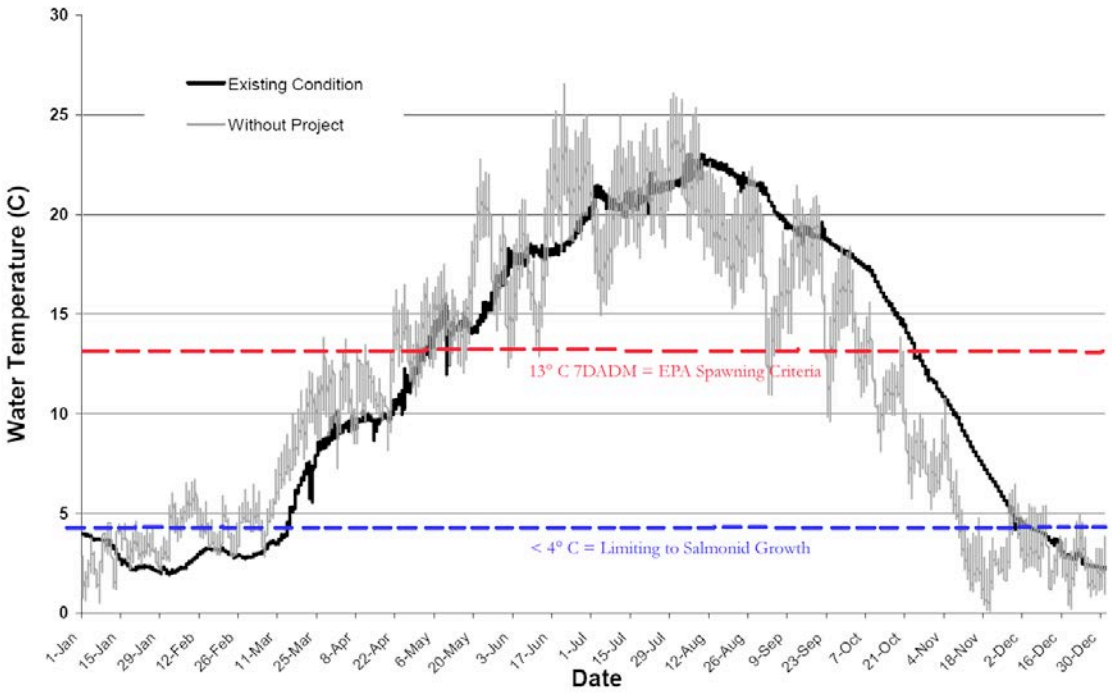


Figure 5.4.1-1. PacifiCorp water quality monitoring output showing water temperatures at Iron Gate Dam for the year 2000, comparing existing conditions (with project) and without project scenarios (PacifiCorp 2005)..References for salmonid spawning and the lower limit for salmonid growth are from U.S. EPA (2003). Accessed online at: http://www.klamathwaterquality.com/ig_temps%20copy.jpg

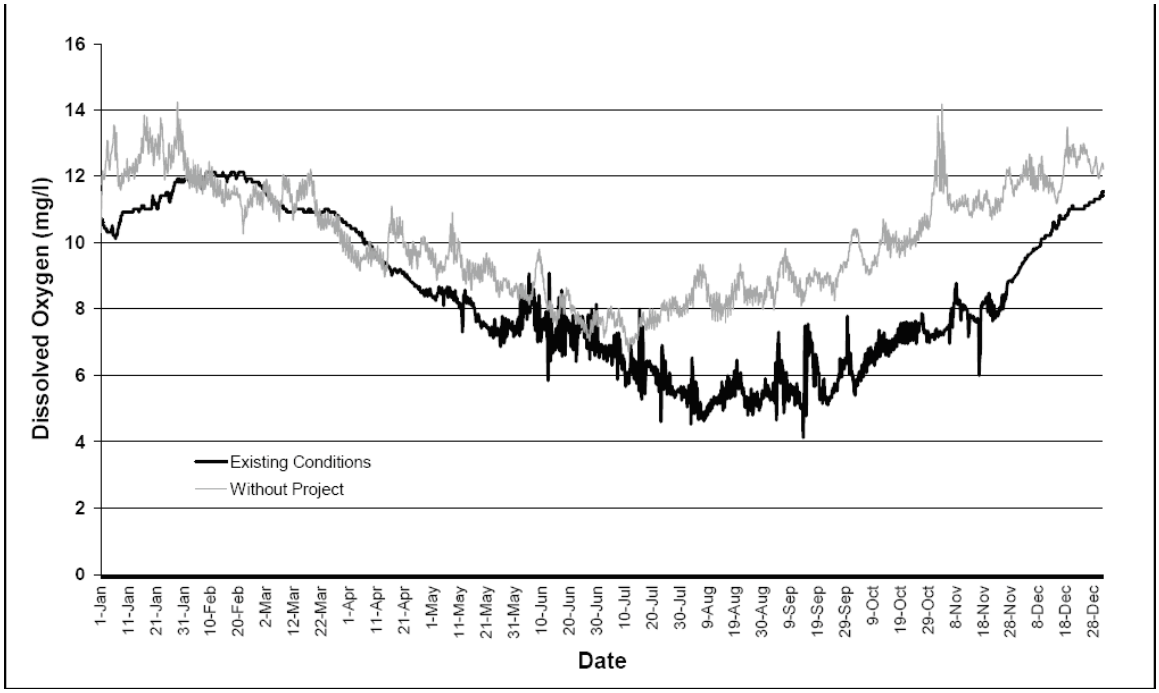


Figure 5.4.2-1. Simulated hourly DO levels below Iron Gate Dam based on 2002 (a dry year) existing conditions (with Project) compared to conditions without Project (Source: PacifiCorp 2005). Accessed online at: http://www.klamathwaterquality.com/ig_temps%20copy.jpg

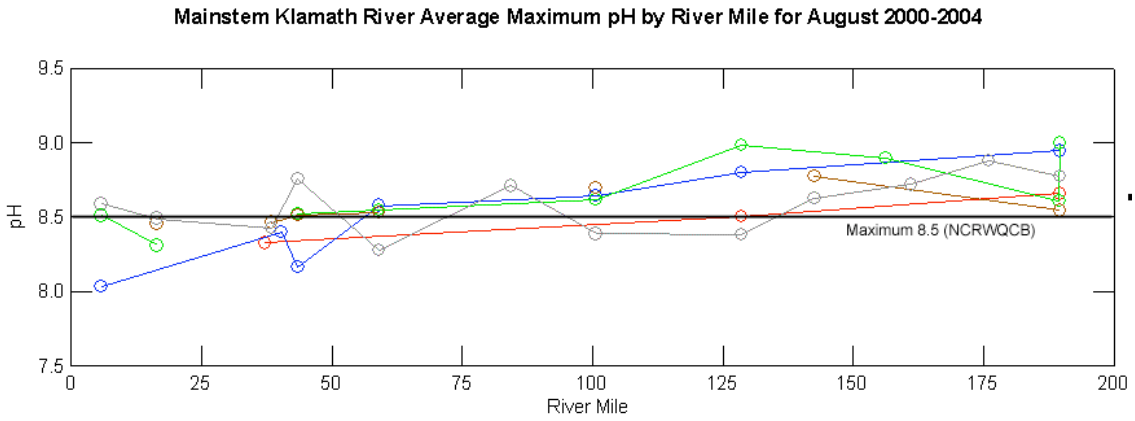


Figure 5.4.3-1. Average maximum pH of the Klamath River by river mile showing patterns for the years 2000-2004. The horizontal line shown on the graph is the NCRWQCB (2001) standard for pH. Data are from the USFWS, Karuk Tribe, Yurok Tribe and USGS. Source: Kier Associates (2006).

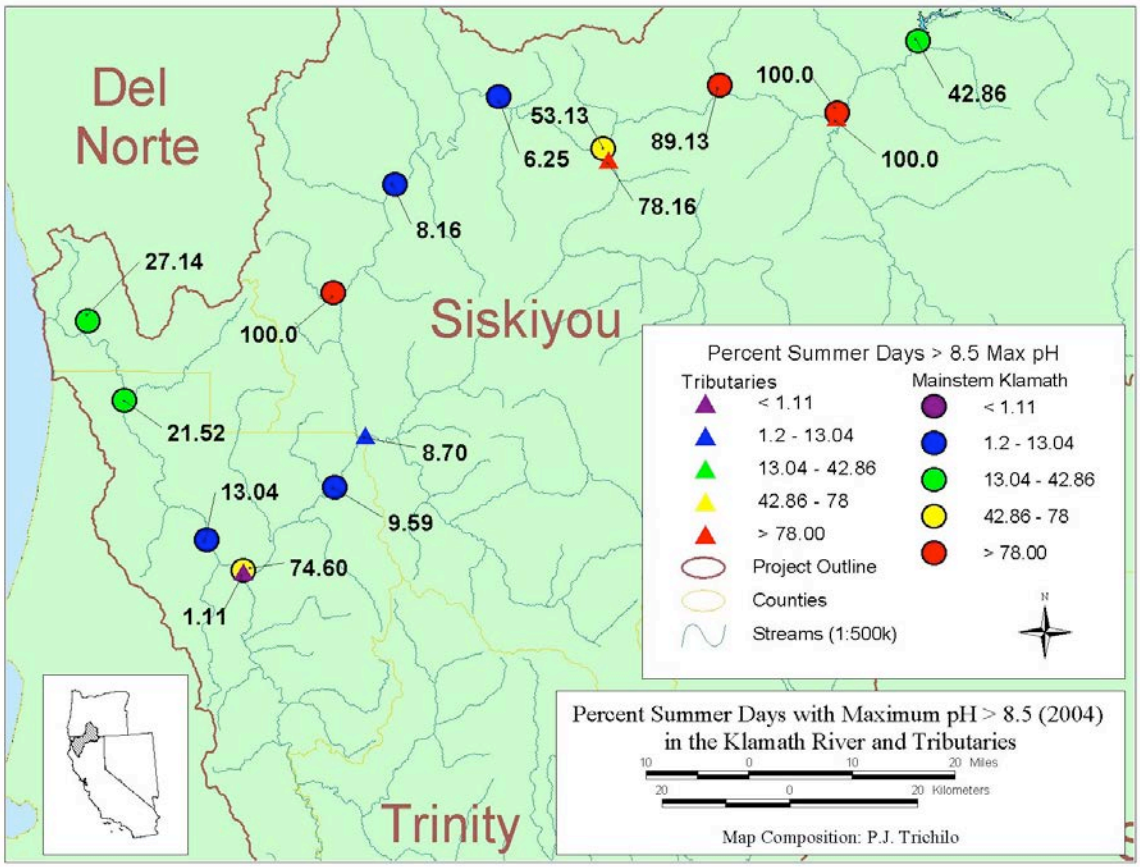


Figure 5.4.3-2. Map showing the percent of summer days in 2004 where maximum pH exceeded 8.5. Data are from Yurok Tribe, Karuk Tribe, and U.S. Fish and Wildlife Service. Figure adapted from Kier Associates (2006).

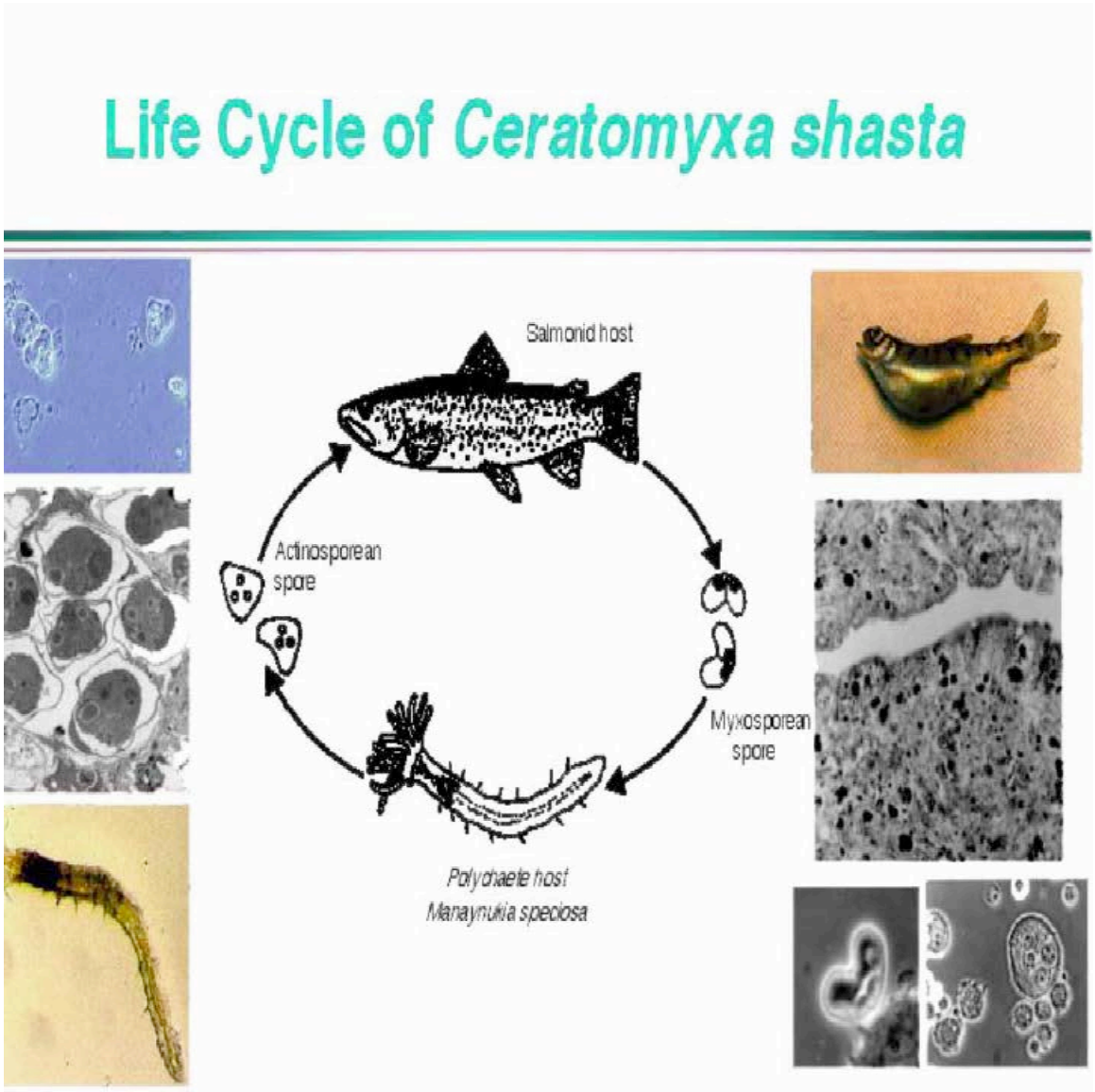


Figure 7.0-1. Life Cycle of *Ceratomyxa shasta* involves two hosts: (1) salmonids and (2) a polychaete worm, *Manayunkia speciosa* as a secondary host. *P. minibicomis* has a similar life cycle. Source: Bartholomew et al. 1997.

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This is to assert that this report was prepared by the individual named below.



Michael Rode



Date

ATTACHMENT 2

Jacob Kann *Expert Report* from *McConnell* case Exhibits

EXPERT REPORT
OF
JACOB KANN, Ph.D.

In the Matter of MCCONNELL et *al*.
v.
PACIFICORP, INC

Prepared for:

Lawyers for Clean Water

Prepared by:

Aquatic Ecosystem Sciences, LLC
295 East Main St., Suite 7
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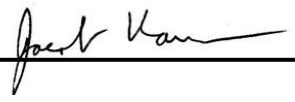

Jacob Kann, Ph.D.
President

July 25, 2008

Introduction

I was retained by Lawyers for Clean Water to evaluate effects of PacifiCorp's Klamath Hydroelectric Project on water quality, toxic algae, and fisheries in the Klamath River system of Northern California. I am the President of Aquatic Ecosystem Sciences, LLC in Ashland, Oregon. I have over twenty years of experience researching the biological, physical, and chemical aspects of aquatic ecosystems. I hold a B.A. degree in Ecology from Rutgers University, an M.S. degree in Fishery Resources from the University of Idaho, and a Ph.D. in Aquatic Ecology from the University of North Carolina, Chapel Hill. I have been involved in specific research activities related to water quality and aquatic ecology of the Klamath River system, as well as on other water bodies in the Northwestern United States. I have presented and provided these results at a variety of professional meetings, and in both research reports and peer reviewed literature. I have over 20 years of specific expertise relating to the ecology of blue-green or cyanobacterial algal blooms, including having performed numerous studies on blooms of toxigenic cyanobacteria (a.k.a harmful algal blooms or HABs) in lakes and reservoirs in California, Oregon, Washington, and Idaho.

My qualifications, along with a list of my publications, are contained in my curriculum vitae, which is attached as Appendix A. In addition, in my role as a research scientist I have been recognized as a regional expert in HAB's, serving as an advisor to the State of Oregon's DHS Environmental Toxicology Program on toxic algal monitoring and public health threshold guidelines, as well as provided expertise on HABs to the U.S. Environmental Protection Agency, the California State Water Resources Control Board, numerous municipalities, and Native American Tribes of the Klamath River system.

Based on my above outlined expertise and my intimate knowledge of water quality and algal dynamics in the Klamath River system, I am highly qualified to comment on matters pertaining to algal bloom (including HABs) and other water quality dynamics related to the presence and operation of the Copco and Iron Gate Dams and Reservoirs located on the Klamath River in California. Below I provide a synopsis of relevant data and studies that demonstrate causal links between conditions created by PacifiCorp Dams (including Copco and Iron Gate Reservoirs) and water quality, as well as the occurrence and growth of the toxigenic blue-green alga *Microcystis aeruginosa* and associated trends in the cyanotoxin microcystin (a potent liver toxin) above, within, and below the reach occupied by PacifiCorp's Copco and Iron Gate Reservoirs.

General Background and Water Quality Impacts

Copco and Iron Gate Reservoirs located on the mainstem of the Klamath River are severely degraded and represent clear cases of highly eutrophic to hypereutrophic (meaning excessive production) reservoir systems that are responsible for poor water quality problems (e.g., high ammonia and pH, and low dissolved oxygen) typical of excessive growth of algae. In addition, these reservoirs foster the growth of extensive toxigenic blooms of the blue-green alga *Microcystis aeruginosa* (MSAE) and associated high concentrations of the liver toxin

(hepatotoxin) microcystin such that cell and toxin concentrations exported downstream to the Klamath River are substantially higher than those upstream from the reservoir complex.

Although substantial nutrients required for algal growth are imported to the reservoir complex from upstream, the damming and subsequent formation of Copco and Iron Gate Reservoirs (without which PacifiCorp could not operate the dams for power generation) alters the free-flowing Klamath River environment from one of flowing, turbulent conditions to that of a relatively calm, thermally stratified, and warm body of water. As demonstrated below, in the presence of adequate nutrients, this change from a riverine to a lake environment provides ideal growing conditions for toxigenic MSAE. In addition, the stratified reservoir condition as evidenced by thermal profiles (e.g., see Kann and Asarian 2007; PacifiCorp 2004; FERC 2007) along with high algal production during the summer season causes releases of water with high pH and low dissolved oxygen (DO) that impair water quality requirements for salmonids downstream of the dam (FERC 2007). Both the existing North Coast Regional Water Quality Control Board (2001) DO (>8 mg / L) and pH objectives for salmonids (not greater than 8.5 and not less than 7.0) for the Klamath River downstream of Iron Gate are exceeded on a regular basis (Hoopa TEPA 2008).

Moreover, primarily due to the thermal mass of Iron Gate and Copco reservoirs, the KHP significantly alters water temperatures in the Klamath River (FERC 2007; PacifiCorp 2004; PacifiCorp 2005) in ways that are detrimental to runs of anadromous fish in the Klamath River. For example, as PacifiCorp notes, water temperatures in the mainstem Klamath below Iron Gate Dam are cooler in spring, and warmer in late summer and fall, than would occur in the absence of the Copco and Iron Gate dams (PacifiCorp 2004, PacifiCorp 2005c, Deas 2004). Such warm temperatures in the fall negatively impacts fall Chinook spawning success and egg survival, and results in a several week delay in run-timing, and cool spring temperatures slows salmonid growth by keeping water temperature below the optimum growth temperatures for juvenile salmonids (see Rode, M. Expert Report July 2008 for additional detail). The resulting smaller-sized Chinook salmon juveniles migrate downstream more slowly than would larger individuals (PFMC 1994) and are less likely to survive to maturity and spawn (Nicholas and Hankin 1988). This increased transit time exposes them to prolonged stress, increasing their likelihood of becoming infected with parasites.

As noted by FERC in its final environmental impact statement regarding the relicensing of the Klamath Hydroelectric Project, removal of Iron Gate and Copco Reservoirs would result in improved temperature, dissolved oxygen, pH, and ammonia (FERC 2007).

Although the effects of the PacifiCorp dams on water temperature, dissolved oxygen, and pH and subsequent effect on salmonid success and survival are one component of dam effects on diminished fisheries and impaired riverine ecology, Copco and Iron Gate reservoirs also provide ideal habitat for growth of toxigenic MSAE and have been shown to export bloom material and toxins to downstream areas of the Klamath River. Following is a description of the aforementioned toxigenic bloom dynamics in the Klamath River system.

Synopsis of Data and Studies Relating to Enhanced Production of Toxic Algal Blooms and Associated Toxin in Copco and Iron Gate Reservoirs and in the Klamath River Downstream from the Reservoirs.

Background

Cyanobacteria, also known as blue-green algae, are a diverse group of single-celled aquatic organisms found in surface waters worldwide. Lakes, reservoirs, ponds, and slow-moving rivers are especially suitable for cyanobacteria, and given the right conditions, e.g., calm water, light, and adequate concentrations and ratios of nitrogen and phosphorus, these organisms can reproduce at a high rate, forming vast blooms in the water (e.g. Reynolds 1984). The resulting high cyanobacterial algal concentrations are not only aesthetically unpleasing, but often produce toxins that have been implicated in human health problems ranging from skin irritation and gastrointestinal upset, to death from liver or respiratory failure (Carmichael 1995, Chorus and Bartram 1999, Chorus 2001, and numerous authors summarized in Hudnell 2007). Copco and Iron Gate Reservoirs have been shown to provide ideal habitat for large blooms of one such cyanobacterial species (*Microcystis aeruginosa*) that produces the potent hepatotoxin microcystin (Kann 2006; Kann and Corum 2006; 2007).

Public Health Thresholds

These hepatotoxins (liver toxins) are powerful cyclical peptides which disrupt the structure of liver cells, causing cell destruction, liver hemorrhage, liver necrosis, and death (Carmichael 1994; and see Carmichael, W.W. Expert Report, July 2008 for additional information). In addition to hepatotoxicity, long-term laboratory animal studies indicate that microcystins can act as liver tumor promoters and teratogens (Kuiper-Goodman et al. 1999). Microcystin poisoning has been implicated in the largest number of cyanobacteria-associated animal deaths worldwide, and enough work has been done, both with rodents and pigs, on microcystin effects at various levels of exposure, that the World Health Organization has issued a provisional guideline of 1 μg/L for microcystin concentration in drinking water as well as developed Tolerable Daily Intake values for use with recreational exposure (WHO 1998). With actual microcystin concentration data frequently unavailable, public health alert level guidelines based on cell counts have been established for MSAE (as well as other cyanobacteria) blooms in drinking and recreational waters (Yoo et al. 1995, Chorus and Bartram 1999, Stone and Bress; SWRCB 2007). Public health advisories have been posted for Copco and Iron Gate Reservoirs and for the Klamath River below Iron Gate (e.g., Jacoby and Kann 2007).

In addition to WHO public health guideline values (as published in documents for the WHO and EPA: e.g., Falconer el al. 1999 and Chorus and Cavalieri 2000), cell density and toxin concentration that are MSAE specific have been recommended by the California State Water Resources Control Board (SWRCB 2007) and by the state of Oregon (Stone and Bress (2007). These levels are 40,000 cells/ml of MSAE and 8 μg/L of microcystin and are also consistent with recent Australian analysis of health risk threshold values (NHMRC 2005). The WHO (Falconer et al. 1999) also lists cyanobacterial scums in swimming areas as having a high probability of

adverse health effects (i.e., the potential to cause acute poisoning) and recommends immediate action to prevent contact with scums. Graham et al. (2008) confirms the appropriateness of surface sampling of scums to determine maximum toxin concentration in recreational areas.

Fish Health Effects

Although mammalian health effects of toxins from the blue-green algae MSAE are better studied (WHO, 1998), fish health effects have also been recently researched (Zambrano and Canelo 1995, Wiegland and Pflugmacher 2005), including effects on salmonids (Tencalla et al. 1994, Bury et al. 1996; Fischer et al. 2000, Best et al. 2003). These effects are discussed here because there is evidence that hepatotoxins created by MSAE are a threat to fish health independently, and may also act synergistically with other water quality problems (i.e. pH, D.O., temperature and ammonia) in causing cumulative stress or in contributing to immunosuppression and subsequent outbreaks of fish disease epidemics.

Microcystin toxins accumulate in the liver where they disrupt many different liver enzymes and ultimately cause the liver to break down (Fischer et al., 2000). Fish species that directly graze algae may be the most susceptible to microcystin poisoning, but other fish may ingest whole MSAE cells or breakdown products from the water column (Wiegland and Pflugmacher 2005). In laboratory experiments, rainbow trout were found to excrete microcystin toxins in bile fluids when exposed to them orally. The toxins caused increased drinking in this species and increased water in the gut, which was a sign of osmoregulatory imbalance and could promote diffusion of toxins into the blood (Best et al., 2003).

Tencalla et al. (1994) noted that large scale fish kills around the world have resulted from microcystin poisoning. They postulated that a 60 g rainbow trout would only have to ingest 0.1-0.4 g of algae (wet weight) or 0.2-0.6% of its body weight to experience massive liver damage.

The most definitive effect of microcystin on fish concerns Atlantic salmon reared in net pens in coastal waters of British Columbia and Washington State, USA. As yet unidentified microcystin-producing organisms produce a progressive degeneration of the liver in salmon smolts placed into open-water net pens (Anderson et al., 1993). The disease, referred to as Net Pen Liver Disease (NPLD), has resulted in significant economic losses for the mariculture industry.

Bury et al. (1996) studied brown trout exposed to sublethal levels of microcystin toxins and found greatly altered blood cortisol levels indicating acute stress and reduced immunosuppression. This is a concern in the mainstem Klamath River because of the recognized fish health problems (Foott et al. 2003; Nichols and Foott 2005), and the potential for additional diminishment of resistance to disease caused by microcystin exposure of juvenile salmonids. As summarized in Fetcho (2006), detection of microcystin toxin in steelhead livers collected from the Weitchpec area indicated that these fish were exposed to microcystin in the lower-Klamath River environment (also see below for recent accumulation studies documenting microcystin in Iron Gate hatchery yearling Chinook).

Longitudinal Patterns of MSAE and Microcystin in the Klamath River

In earlier work I provided a summary of four datasets that included information about the distribution and abundance of MSAE in the Klamath River basin (Kann 2006). These included Upper Klamath Lake data from the Klamath Tribes during 1990-1997, PacifiCorp Klamath River data from below (UKL) to below Iron Gate dam during 2002-2004, Karuk Tribe/State Water Resource Control Board (SRWCB) data for stations above, within, and below the Copco and Iron Gate Reservoirs during 2005, and Yurok Tribe/U.S. Fish and Wildlife Service (USFWS) data from below Iron Gate dam to the Klamath River estuary during 2005.

These data showed that while MSAE was found in Upper Klamath Lake (UKL) and Agency Lake, it was only rarely detected in the outlet of UKL (which is the beginning of the Klamath River and located upstream from Copco and Iron Gate Reservoirs). PacifiCorp's own data showed that MSAE was only detected twice (August 21, 2003 and September 10, 2002) in the Klamath River directly above Copco (river mile 206.42), but was then common in Iron Gate and Copco Reservoirs and below. Karuk Tribe/SWRCB data for 2005 showed that MSAE was never detected at the station above Copco Reservoir, but was common in Iron Gate and Copco Reservoirs and in the Klamath River at the outlet of Iron Gate Dam. Yurok/USFWS data from 2005 showed that MSAE and microcystin toxin were found in the Klamath River from Iron Gate Dam to the Klamath estuary.

The results described above from multiple datasets summarized by Kann (2006) indicate that Iron Gate and Copco Reservoirs were directly responsible for the high levels of MSAE and microcystin toxin detected in the Klamath River below Iron Gate Dam. This conclusion is consistent with literature showing that MSAE and other buoyant cyanobacteria do not dominate in conditions of turbulent mixing (e.g., Huisman et al. 2004) such as that known to occur in the Klamath River above Copco and Iron Gate Reservoirs..

Conversely, because MSAE dominates at low turbulent diffusivity (calm-stable conditions) when their flotation velocity exceeds the rate of turbulent mixing, the stable and stratified conditions created by Copco and Iron Gate Reservoirs provide ideal conditions for MSAE and other buoyant cyanobacteria. For example, Kann and Asarian (2005) show that KHP dams result in hydraulic retention times in the reservoirs ranging from ~10 days in the spring to greater than 50 days during the period of MSAE dominance, and depth profiles of temperature and dissolved oxygen indicate highly stratified water column conditions (e.g., Kann and Asarian 2007). By contrast, the river environment (absent the KHP reservoirs) in this reach would by well mixed (no stratification) and hydraulic retention would be on the order of 1 day.

Analysis of Additional Algal Groups and Depths

Further analysis of the 2005 Karuk/SWRCB data also clearly showed that Iron Gate and Copco Reservoirs hosted large blooms of blue-green algae, including toxigenic (*Microcystis aeruginosa*) and nitrogen-fixing (*Aphanizomenon flos-aquae*, *Anabaena*[1] *sp.*, and *Gloeotrichia*

[1] *Anabaena* can also be toxigenic, producing the potent neurotoxin anatoxin-a; this toxin was detected in Iron Gate Reservoir on 9-3-2005 by the California Department of Health Services (CDHS).

echinulata) species (Kann and Asarian 2007). These blue-green algae were most concentrated in reservoir sites at upper water column depths, and though concentrations generally declined with increasing depth, they were present throughout the water column and were at times the most abundant taxonomic group even at depths of up to 10 meters.

Similar to previous studies, the longitudinal trend in chlorophyll *a*, and both total biovolume and percent biovolume of the Cyanophyta (group including blue-green algae) increased substantially through the reservoirs and below at KRBI (Kann and Asarian 2007), and for the June-September period median and upper quartile biovolume values were 20x to >100x higher in Copco and Iron Gate Reservoirs than they were in the Klamath River above Copco Reservoir, and were 3-7 times higher at KRBI, below Iron Gate Dam (Kann and Asarian 2007). The trend in Cyanophyta percent composition was more pronounced through the reservoir complex than absolute biomass, with upper quartile levels in Copco and Iron Gate increasing from <5% above Copco to >80% in Copco and Iron Gate Reservoirs, and >30% at KRBI. These trends in the upper distribution indicate that periodic high values of both biovolume and percent biovolume of Cyanophyta occurred in the reservoir complex and below relative to stations directly upstream. In contrast to the reservoirs, the Klamath River station upstream from the reservoir (KRAC) was dominated by non-toxigenic diatoms for the majority of the season; while downstream below Copco Reservoir at KRAI and below Iron Gate Dam (KRBI) the Cyanophyta increased in importance on a seasonal basis, at times accounting for >50% of the composition.

Analysis of Recent Data

MSAE and microcystin data collected in 2006 and 2007 continued to show a similar trend of increasing MSAE cell density and microcystin toxin concentration in and below Copco and Iron Gate reservoirs relative to the Klamath River above the reservoirs (Kann and Corum 2007; Kann 2007). All three years (2005-2007) demonstrated widespread and high abundance of toxigenic MSAE blooms in Copco and Iron Gate reservoirs from July-October, with MSAE cell density and toxin concentrations exceeding public health thresholds by 10 to over 1000 times during these months (i.e., a 40 pound child accidentally ingesting 100 milliliters of reservoir water would have exceeded the WHO tolerable daily intake level by 10 to over 1600 times during dense bloom periods).

Although toxin production per unit cell density was highly variable both within a month and between months, the probability of exceeding critical microcystin toxin values generally increased as MSAE cell density increased (Kann and Corum 2006, Kann and Corum 2007; Kann 2007). On several occasions (particularly in 2005 and 2007) when MSAE cell counts remained elevated, corresponding microcystin concentrations tended to be lower than would have been predicted based on July-August cell density-microcystin relationships (Kann 2007). The trend of lower microcystin production was apparent during the mid-September and early-October 2007 sample periods when MSAE levels at KRBI that were more than double the SWRCB/OEHHA (2007) Harmful Algal Bloom Public Health Level were associated with microcystin values that did not exceed 1 µg/L (Kann 2007). Such changes in microcystin over the course of a season can be due to environmental factors (e.g., nutrients *cf.* Gobler et al 2007), genetic shifts in MSAE strain composition, or possible change in the microcystin congener produced that would

then not be detected using standard ELISA technology. Nonetheless, the overall relationships between cell density and toxin concentration showed good correspondence between MSAE cell density and public health guideline values based on microcystins (e.g., SWRCB/OEHHA 2007; NHMRC 2005; Stone and Bress 2007). Such relationships are important to demonstrate because public health advisories in the Klamath River system are often based on cell counts in the absence of laboratory toxin measurements.

In numerous documents PacifiCorp has indicated that the cause of the toxic MSAE blooms is not due to conditions created by the Copco and Iron Gate dams but rather to the presence of such blooms upstream in UKL (e.g., PacifiCorp 2007; Application for Water Quality Certification). For example PacifiCorp states in their Application for Water Quality Certification (PacifiCorp 2007) that:

> "Cyanobacteria capable of producing toxins harmful to humans and other animals are present in UKL, the Klamath River, and a variety of other lakes in California, Oregon, and throughout the country. Their presence is a natural consequence of the environmental conditions that exist in UKL. Currently, they appear to be present at times in Copco and Iron Gate reservoirs in sufficient abundance to cause a potential health risk to humans, domestic animals, or wildlife."

However, as noted in Kann (2006) an analysis of stations near the outlet of UKL shows that there were very few instances when MSAE density exceeded 1 colony/mL, and over the 8-year period there was only 1 incidence in 77 sample collections (1.3%) during July-October when these stations exceeded 1 colony/mL. Moreover, also as noted by Kann (2006) several lines of evidence point to the role of the Copco and Iron Gate Reservoirs in providing ideal habitat conditions for MSAE. First, although MSAE clearly exists in UKL and Agency Lakes and is known to form periodic blooms in both systems[2], when data are filtered by excluding Agency Lake (which is located well north or upstream of the UKL outlet) and by evaluating only what is leaving UKL and entering the Klamath River system, occurrences were rare and density very low over an 8-year period (generally< 1 colony/mL); especially in contrast to MSAE values commonly exceeding 10,000 colonies/mL in Copco and Iron Gate Reservoirs.

Second, similar to the Karuk/SWRCB 2005 data set and the Klamath Tribes UKL data set, the PacifiCorp data set described above (in Kann 2006) showed low incidence and magnitude of MSAE leaving UKL and in the Klamath River above Copco Reservoir, yet high incidence and magnitude was observed in Copco and Irongate Reservoirs.

Third, MSAE was not detected at KRAC (above Copco reservoir) during the Karuk/SWRCB 2005 data collection effort, even when reservoir stations showed substantial concentrations of both toxin and MSAE cell density. In contrast to the Klamath River upstream, 87.5% and 89.7% of the samples were positive for MSAE in Copco and Iron Gate, respectively.
Fourthly, as indicated by cell count and toxin values at KRBI below the Iron Gate Dam and in the Yurok/USFWS data that were higher than those measured in the Klamath River upstream

[2] Although the blue-green algal species *Aphanizomenon flos-aquae* and not MSAE is the predominant bloom-former in UKL.

from the reservoirs, export from the reservoirs of both cells and toxin to downstream environments had clearly occurred.

Continued data collection in 2006 and 2007 confirms the dramatic increase in MSAE cell density and microcystin within and below Copco and Iron Gate relative to concentration leaving UKL. For example, when U.S. Bureau of Reclamation MSAE cell density and microcystin data collected at three stations above the Copco and Iron Gate Reservoirs (below Link River; KBL, below Keno Reservoir; KBK, and below JC Boyle Reservoir; KBB) in 2006 and 2007 are plotted with data contained in Kann and Corum (2006) and Kann (2007) the trend clearly shows that MSAE and microcystin toxin, although present in the outflow from UKL, decreased in the Klamath River between UKL (KBL) and above Copco Reservoir (KRAC), and then increased substantially within (Reservoirs) and below Copco and Iron Gate Reservoirs (KRBI, SV, and OR) relative to KRAC above Copco (Figure 1).

Although the inter-annual pattern varies as does the station pattern for KBB and KBK; values always decrease by the time the river reaches KRAC, and an evaluation over all years comparing above (KRAC) and below (KRBI) the reservoir complex clearly shows an elevated probability of both MSAE cell density and microcystin toxin concentration below the reservoirs relative to above the reservoirs (Figure 2).

This is further illustrated in aerial photographs where a dramatic contrast between inflowing Klamath River water and the vast blooms of MSAE is noted during a September 24th, 2007 fly-over (Figure 3a,b). During this same bloom MSAE cells are shown being actively transported downstream from Iron Gate Dam (Figure 3c).

Although, as noted above, the ratio of microcystin to MSAE cell density had declined during this period and thus associated toxin values were low relative to MSAE cell count (Kann 2007), during other periods of downstream transport toxin values can be elevated (e.g., see Figure 2 above where a microcystin value exceeding the 8 ug/L public health advisory level was observed). As shown below, microcystin transported downstream to the Klamath River can bioaccumulate in downstream organisms.

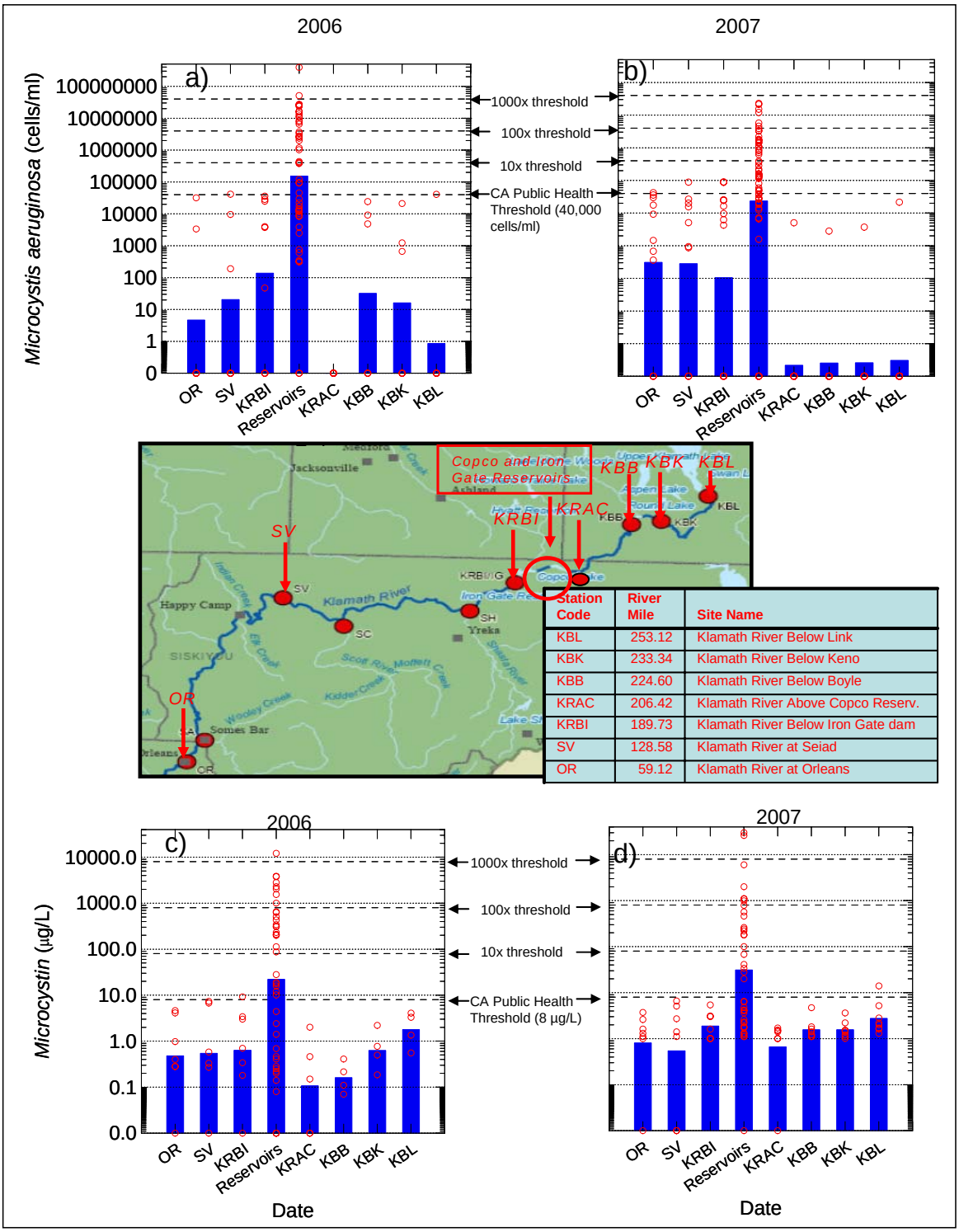

Figure 1. Longitudinal pattern in MSAE cell density (a,b) and microcystin concentration (c,d) in 2006 and 2007; KBL, KBK, and KBB data provided by USBR; data for other stations contained in Kann and Corum (2007) and Kann (2007). X-axis station orientation is upstream- right; downstream- left (following map). The blue bar indicates the station mean and red circles are individual data points (MSAE at KRAC in 2006 includes multiple zeros but appears as one value)

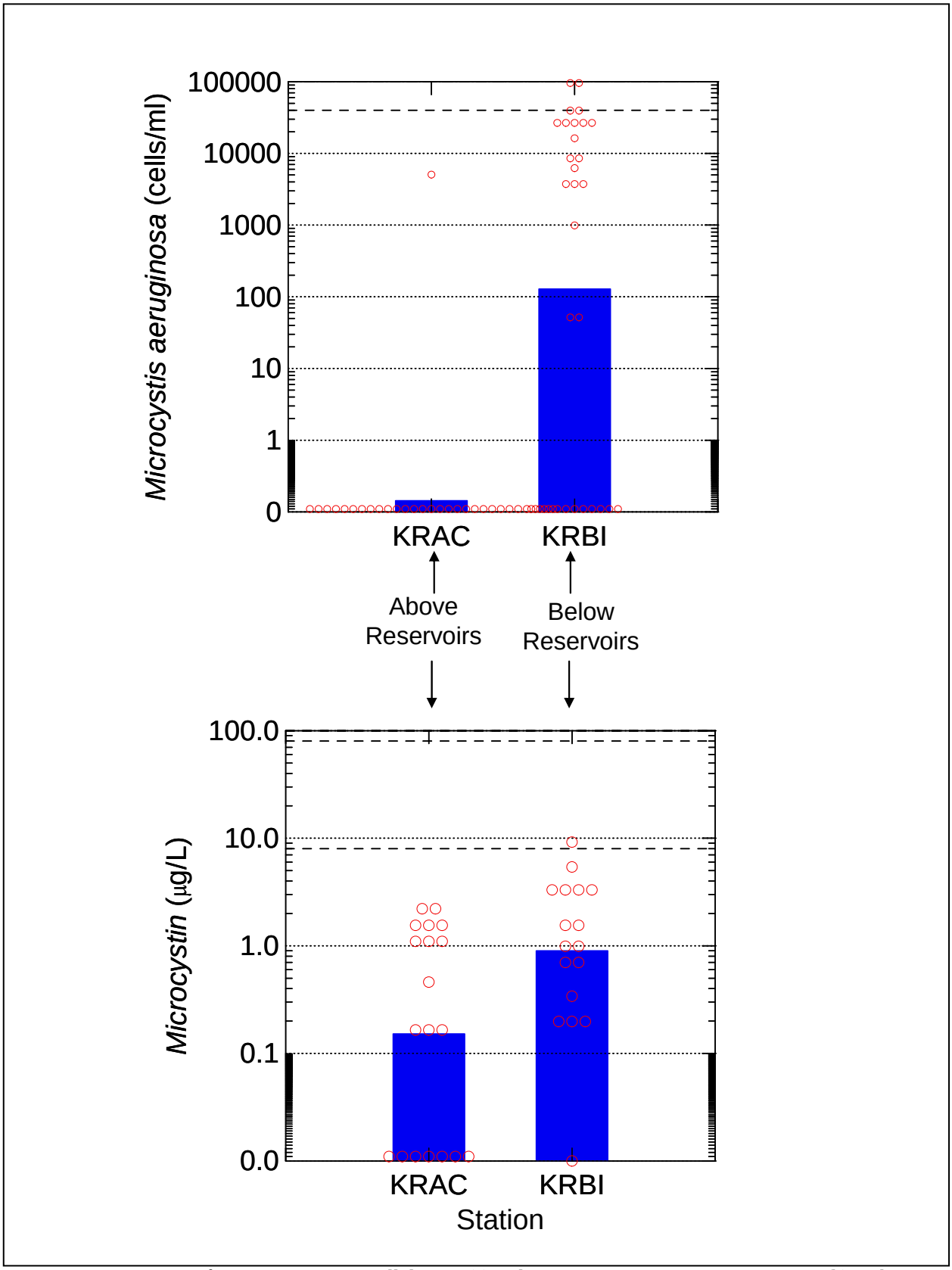

Figure 2. Comparison of 2005-2007 MSAE cell density (a) and 206-2007 microcystin concentration (b) in the Klamath River above Copco (KRAC) and in the Klamath River below Iron Gate Dam (KRBI). The blue bar indicates the station mean and red circles are individual data points grouped by intervals.

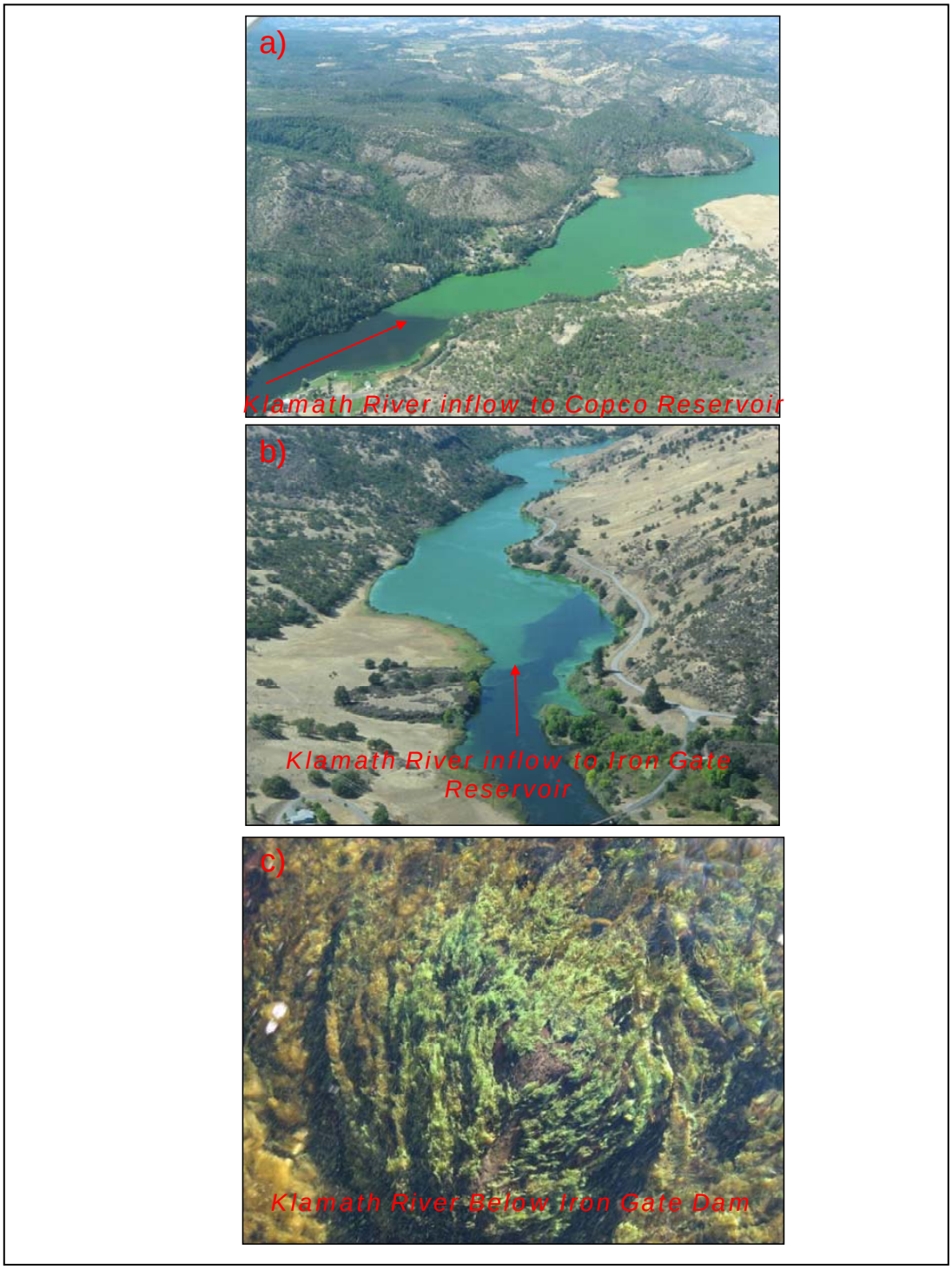

Figure 3. Areal photographs contrasting the Klamath River inflow (red arrows) to massive blooms of MSAE in Copco Reservoir (a), and Iron Gate Reservoir (b), and photo of MSAE colonies transported in the water column and collecting on other periphytic algae at KRBI below Iron Gate Dam (c), September, 24, 2007.

Thus, contrary to PacifiCorp's assertion that the presence of toxigenic MSAE is a natural consequence of the environmental conditions that exist in UKL, these data are consistent with literature showing that MSAE and other buoyant cyanobacteria do not dominate in conditions of turbulent mixing such as that known to occur in the Klamath River above Copco and Iron Gate Reservoirs. Conditions supporting MSAE growth are more likely to occur in lakes and reservoirs as velocity and turbulence are reduced, and numerous studies show MSAE to be favored in lake and reservoir environments that tend to be warmer and less turbulent than riverine ones (Reynolds 1984).

Moreover, as stated earlier, although adequate nutrients are necessary for MSAE blooms to proliferate, such concentrations alone are not sufficient to cause the types of blooms observed in Copco and Iron Gate reservoirs, otherwise the Klamath River above the reservoirs which receives the same nutrient load as the reservoirs, would also show prolific MSAE growths.

Bioaccumulation in Fish Tissue and Freshwater Mussels

As stated above, detection of microcystin toxin in steelhead livers collected from the Weitchpec area indicated that these fish were exposed to microcystin in the Lower Klamath River environment (Fetcho 2006). More recent sampling and analysis performed by the California Department of Fish and Game also shows that tissue concentration results for various microcystin congeners showed some level of bioaccumulation in the majority (85%) of samples tested in July and September of 2007 (see summary in Kann 2008). Evaluation of bioaccumulation in yellow perch fillets and freshwater mussels with respect to public health guidelines indicates that all guideline levels as defined by Ibelings and Chorus (2007) were exceeded to varying degrees in tested Klamath River organisms, including several observations of values exceeding acute thresholds.

Although risk assessment determinations such as those in Ibelings and Chorus (2007) are based largely on the microcystin-LR congener, as reviewed in Sivonen and Jones (1999), most of the known congeners are highly toxic within a comparatively narrow range. Nonetheless even when only the microcystin–LR congener is evaluated using an analysis proved by the California Office of Environmental Health Hazard Assessment (OEHHA 2008) it is clear that for several of the mussels in July that only a single 8oz meal of freshwater mussels for a child would exceed the maximum number of 8oz meals/month advocated by OEHHA (sometimes by many times, and the concentration in one of the mussels would also exceed the single meal/month limit for an adult). Moreover, the approach taken by OEHHA of calculating the number of 8 oz meals allowed per month is similar to the approach followed in Kann (2008) and is equivalent to the Seasonal TDI as defined by Ibelings and Chorus (2007). In other words, the concentration at which a single meal per month is exceeded is equivalent to the Seasonal TDI concentration as computed from Ibelings and Chorus (2007) and utilized by Kann (2008).

It should be noted that using only microcystin-LR underestimates total toxicity and public health risk because other congeners (particularly microcystin-LA) were also prevalent in many of the Klamath River samples (Kann 2008). Microcystin accumulation in livers of Iron Gate Hatchery yearling Chinook also indicates (as noted above) that the hepatotoxins created by MSAE may, through other sub-lethal effects, contribute to overall decline in fish health in the Klamath River

system.

Finally, the bioaccumulation of microcystin in organisms many miles downstream from Iron Gate Dam (e.g., freshwater mussels at Big Bar are ~140 miles below the dam) illustrates the importance of the increased microcystin levels (relative to upstream) leaving the reservoir complex.

Summary

My evaluation of data related to both water quality and to toxic cyanobacterial blooms of *Microcystis aeruginosa* and associated microcystin toxin indicate that Copco and Iron Gate Dams and Reservoirs directly and negatively impact the Klamath River system with respect to human use and fishery needs. Reviewed data clearly indicate that Iron Gate and Copco Dams negatively impact downstream temperature, dissolved oxygen, pH, and ammonia conditions, and as FERC (2007) concluded these downstream conditions would be improved in the absence of the dams.

In addition, based on evaluation of numerous algal and toxin data sets from a variety of Federal, State, and Native American agencies, as well as PacifiCorp, the change from a riverine to the reservoir environments created by Copco and Iron Gate Dams clearly provides ideal growing conditions for toxigenic MSAE (that would not otherwise occur in the river reach currently occupied by the reservoirs) and subsequent transport to the Klamath River downstream. Moreover, observed levels of MSAE and microcystin toxin frequently exceed public health thresholds by 10-1000 times, and bioaccumulation of toxin in freshwater organisms indicates that consumption of such organisms would exceed established public health advisory values. Thus, clear causal links between PacifiCorp's Copco and Iron Gate projects and contribution to poor water quality and input of toxins are demonstrated.

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APPENDIX I

CURRICULUM VITAE

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EDUCATION

B.A., ECOLOGY	1983	**Rutgers University**, Rutgers College Department of Biological Sciences, New Brunswick, New Jersey 08901
M.S., FISHERIES RESOURCES	1987	**University of Idaho**. Department of Fish and Wildlife Resources Moscow, Idaho 83843.
Ph.D., AQUATIC ECOLOGY	1998	**University of North Carolina Curriculum in Ecology** Chapel Hill, North Carolina 27599.

AREAS of SPECIALIZATION

- Ecological research pertaining to limnological, fisheries, wetland, and watershed dynamics.
- Ecology and dynamics of toxic algal blooms.
- Integration of water quality and hydrologic factors with fisheries ecology and management.
- Lake and reservoir restoration and management
- Trophic dynamics
- Ecosystem restoration projects
- Limnological investigations with special emphasis on water quality, nutrient dynamics, and eutrophication
- Statistical analysis and modeling.

CURRENT POSITION

CONSULTING AQUATIC ECOLOGIST 295 E. Main St, Ste 7, Ashland, Oregon, 97520.
AQUATIC ECOSYSTEM SCIENCES LLC. Principal in firm conducting research and providing expertise in aquatic ecology, fisheries, and water quality. Length in position: 11 years (1997 to present)
Environmental Sciences Graduate Program Faculty, Oregon State University, Corvallis, Oregon, 97331.

Recent and Current Clients:
- City of Ashland, OR – Water quality and toxic algae assessment of city water supply reservoir (Reeder Reservoir)
- R2 Resource Consultants/BIA – Upper Klamath Lake Water Quality Analyses
- City of Portland Parks and Recreation – Assessment and Management of Laurelhurst Pond for *Microcystis*

- Karuk Tribe – Nutrient Loading/Toxic Cyanobacteria in Klamath River Reservoirs
- Yurok Tribe – Nutrient and Algal Dynamics in the Klamath River System
- Kier Associates/Karuk tribe – Nutrient Budget for Copco and Irongate Reservoirs
- City of Lakeside Oregon and Tenmile Lakes Basin Partnership – Toxic Algal Blooms in Tenmile Lakes, OR
- Klamath Tribes Natural Resources – Nutrient Loading and Water Quality Research in Streams and Lakes of the Klamath Basin; limnological analysis of Upper Klamath lake data.
- Willamette NF/Eugene Water Board/ PGE – Toxic Cyanobacteria Workshop
- Oregon Human Services – Review Toxic Algal Monitoring and Threshold Guidelines
- Josephine County Parks Dept. – Toxic algal blooms in Lake Selmac
- US Forest Service Umpqua NF – Assessment of Diamond Lake, Oregon Toxic Algal Blooms
- US Environmental Protection Agency – Klamath and Lost River TMDL Planning
- Kier Associates/Klamath Basin Tribal Water Quality Work Group- Klamath River, CA water quality assessment.
- Oregon Dept. of Environmental Quality/JC Headwaters – Diamond Lake TMDL analysis and modeling.
- Betts, Patterson and Mines/City of Lakewood – Limnological Data Assessment, Steilacoom Lake, Washington
- Klamath Basin Rangeland Trust – Water Quality and Fisheries Monitoring in the Wood River Valley Oregon.
- Oregon Department of Fish and Wildlife – Assessment of Diamond Lake Restoration Options
- US Fish and Wildlife Service/Graham Matthews and Associates – Water Quality in Stream Restoration Projects Tributary to Klamath Lake.
- Jim Root Crooked Creek Ranch – Aquatic Habitat Restoration and Monitoring.
- Native American Rights Fund (NARF) – TMDL and Oregon SB1010 Non Point Pollution Research and Modeling in the Klamath Basin.
- US Bureau of Reclamation/JC Headwaters – Upper Klamath Lake Paleolimnological Study and Reservoir Water Quality Modeling Review.
- US Geological Survey Biological Resources Division – Fish Kill Water Quality Study on Upper Klamath Lake.
- The Nature Conservancy – Monitoring and Inventory at the Sycan Marsh Preserve – Klamath Basin.

OTHER COMMITTEE and PROJECT INVOLVEMENT

- Scientific Review Committee for State of Oregon DEQ TMDL on Upper Klamath Lake.
- Technical Advisory Committees for State of Oregon DEQ TMDL and Oregon Dept. of Ag. 1010 Non-point Agricultural Pollution Program
- Technical Advisor for State of Oregon Health Division on toxic algal blooms in Oregon Lakes.
- Wood River Wetland and Channel Restoration Team.
- Williamson River and Wetland Restoration Technical Committee.
- Endangered Lost River and Shortnose Sucker Recovery Team.
- Colleague (peer) reviewer for U.S. Geological Survey Portland Water Resources Division technical reports.
- Klamath River Basin Fisheries Task Force Upper Basin Amendment Technical Team.

ACADEMIC ACTIVITIES

- Environmental Sciences Graduate Program Faculty, Oregon State University.
- Oregon State University Graduate Committee for M.S. Thesis: Nutrient export from irrigated cattle pasture in the Wood River Valley, Oregon.
- Humboldt State University graduate committee of Margaret Forbes, M.S. Thesis: Horizontal Zonation of periphyton in Hanks Marsh, Upper Klamath Lake, Oregon. , 1997.
- Lecturer in the Environmental Sciences Program at the Oregon Institute of Technology and Southern Oregon University.
- Lecturer for a graduate level course in Aquatic Ecology at the University of North Carolina, Chapel Hill.
- Organized and taught laboratory classes in biological and physical/chemical Limnology (aquatic ecology) the University of Idaho.
- Lecturer for a general biology laboratory classes at the University of North Carolina, Chapel Hill.
- Presented aquatic workshops for Dakubetede Environmental Education Program, Headwaters Environmental Center, Orion Society Forgotten Language Tour, and Oregon Trout's Salmon Watch Program.

- Affiliate Faculty Dakubetede Environmental Education Program/Antioch and Prescott College

PROFESSIONAL AFFILIATIONS

- *North American Lake Management Society*.
- *Oregon Lakes Association – Board of Directors 1998-2001*
- *American Fisheries Society.*
- *Pacific Fishery Biologists*
- *Ecological Society of America – Aquatic Ecology Section*

AWARDS

- Awarded the U.S. Fish and Wildlife Service ***Distinguished Service Award*** from the Seattle National Fisheries Research Center in 1988.
- One of three lead biologists awarded the 1996 ***Conservation Achievement Award*** from the Western Division of the American Fisheries Society for research and recovery efforts on the endangered Lost River and shortnose suckers and their habitats.

POSITIONS PREVIOSLY HELD

AQUATIC ECOLOGIST Klamath Tribe Natural Resources, P.O. Box 436, Chiloquin, Oregon, 97624.
Responsible for coordinating and performing research on phytoplankton bloom dynamics and eutrophication trends in lakes and tributaries; including fisheries, watershed, wetland, and tributary linkages/ecology and restoration. Also responsible for wetland, water quality and endangered fish species management. Supervised 1-6 employees. February 1988 to November 1997. (Doctoral research was completed during this tenure).

FISHERY BIOLOGIST U.S. Fish and Wildlife Service, National Fishery Research Center, Seattle, WA 98115.
Performed and coordinated limnological and fisheries research for an inter-agency endangered fish recovery program on Upper Klamath Lake and its watershed. Responsible for monitoring development of massive algal blooms and associated limnological conditions as they relate to fish distribution and habitat. April 1987 to February 1988.

RESEARCH ASSOCIATE Department of Fish and Wildlife Resources, University of Idaho, Moscow, Idaho 83843.
Responsible for procurement of continued funding and research leader for ongoing studies on blue-green algal toxicity. Initiated funding, designed, and conducted research on the use of *in situ* substrate to study periphyton growth as an early indicator of increasing eutrophication rates in Lake Pend Oreille, Idaho. May 1986 to April 1987.

RESEARCH/TEACHING ASSISTANT Department of Fish and Wildlife Resources, University of Idaho, Moscow, Idaho 83843.
Designed and conducted research on blue-green algal toxicity in lakes of northern Idaho. Supervised five employees in limnology laboratory. Assisted in Payette Lake eutrophication-sewer study, Twin Lakes eutrophication study, Bear Lake Marsh nutrient processing study. Taught and organized laboratory classes in biological and physical-chemical limnology. January 1984 to May 1986.

REFERREED ARTICLES

Eilers , J.M., D. Loomis, A. St. Amand, A. Vogel, L. Jackson, **J. Kann**, B. Eilers, H. Truemper, J. Cornett, & R. Sweets. 2007. Biological effects of repeated fish introductions in a formerly fishless lake: Diamond Lake, Oregon, USA. ***Fundamental and Applied Limnology. 169:265-277***

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- Physical Habitat Simulation Modeling - IFG 310. USFWS Instream Flow Group, Ft. Collins, CO. November 1989.

- Field Techniques for Stream Habitat Analysis - IFG 205. USFWS Instream Flow Group, Ft. Collins, CO. August, 1988.
- Designing and Conducting Studies Using Instream Flow Incremental Methodology - IFG 200. USFWS Instream Flow Group, Ft. Collins, CO. March 1988.

*****Certified PADI SCUBA diver.

ATTACHMENT 3

Hamilton et al. (April 2005), “Distribution of Anadromous Fishes in the Upper Klamath River Watershed Prior to Hydropower Dams – A Synthesis of the Historical Evidence,” *Fisheries* 30(4), pp.10-20

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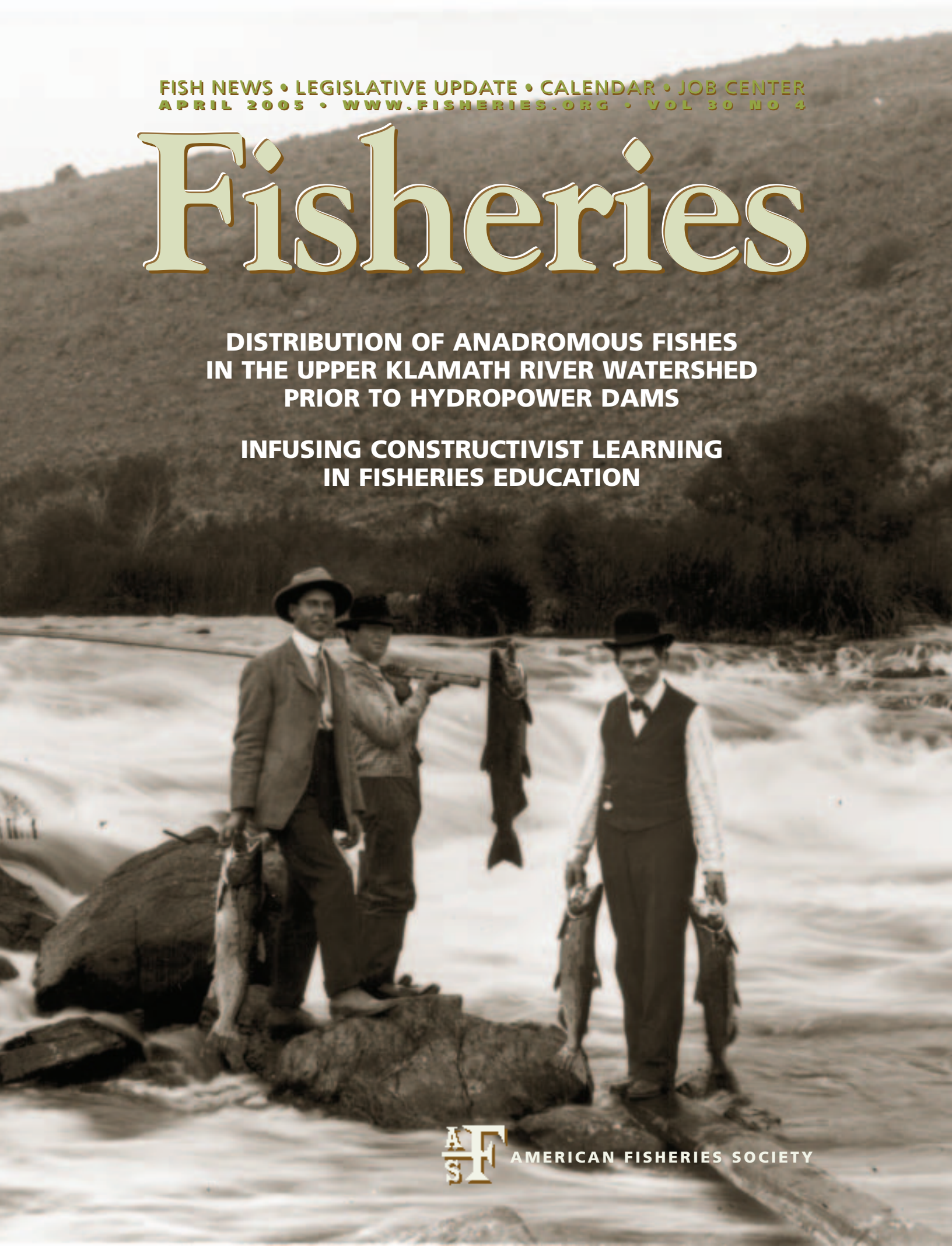
Fisheries

DISTRIBUTION OF ANADROMOUS FISHES IN THE UPPER KLAMATH RIVER WATERSHED PRIOR TO HYDROPOWER DAMS

INFUSING CONSTRUCTIVIST LEARNING IN FISHERIES EDUCATION



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Distribution of Anadromous Fishes in the Upper Klamath River Watershed Prior to Hydropower Dams—A Synthesis of the Historical Evidence

ABSTRACT

Knowledge of the historical distribution of anadromous fish is important to guide management decisions regarding the Klamath River including ongoing restoration and regional recovery of coho salmon (*Oncorhynchus kisutch*). Using various sources, we determined the historical distribution of anadromous fish above Iron Gate Dam. Evidence for the largest, most utilized species, Chinook salmon (*Oncorhynchus tshawytscha*), was available from multiple sources and clearly showed that this species historically migrated upstream into tributaries of Upper Klamath Lake. Available information indicates that the distribution of steelhead (*Oncorhynchus mykiss*) extended to the Klamath Upper Basin as well. Coho salmon and anadromous lamprey (*Lampetra tridentata*) likely were distributed upstream at least to the vicinity of Spencer Creek. A population of anadromous sockeye salmon (*Oncorhynchus nerka*) may have occurred historically above Iron Gate Dam. Green sturgeon (*Acipenser medirostris*), chum salmon (*Oncorhynchus keta*), pink salmon (*Oncorhynchus gorbuscha*), coastal cutthroat trout (*Oncorhynchus clarki clarki*), and eulachon (*Thaleichthys pacificus*) were restricted to the Klamath River well below Iron Gate Dam. This synthesis of available sources regarding the historical extent of these species' upstream distribution provides key information necessary to guide management and habitat restoration efforts.

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Introduction

Gatschet's statement is that salmon ascend the Klamath river twice a year, in June and again in autumn. This is in agreement with my information, that the run comes in the middlefinger month [sic], May–June, and that the large fish run in the fall…They ascend all the rivers leading from Klamath lake (save the Wood river, according to Ball), going as far up the Sprague river as Yainax, but are stopped by the falls below the outlet to Klamath marsh.

—Spier (1930)

Parties coming in from Keno state that the run of salmon in the Klamath River this year is the heaviest it has [sic] ever known. There are millions of the fish below the falls near Keno, and it is said that a man with a gaff could easily land a hundred of the salmon in an hour, in fact they could be caught as fast as a man could pull them in…There is a natural rock dam across the river below Keno, which it [sic] is almost impossible for the fish to get over. In their effort to do so thousands of fine salmon are so bruised and spotted by the rocks that they become worthless. There is no spawning ground until they reach the Upper Lake as the river at this point is very swift and rocky.

—Front page article titled:
"Millions of Salmon—Cannot Reach Lake on Account Rocks (sic) in River at Keno"
Klamath Falls Evening Herald (24 September 1908)

The Klamath River watershed once produced large runs of Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (*Oncorhynchus mykiss*) and also supported significant runs of other anadromous fish, including coho salmon (*Oncorhynchus kisutch*), green sturgeon (*Acipenser medirostris*), eulachon (*Thaleichthys pacificus*), coastal cutthroat trout (*Oncorhynchus clarki clarki*), and Pacific lamprey (*Lampetra tridentata*). One estimate (Radtke, pers. comm. cited in Gresh et al. 2000) put the historical range of salmon abundance for the Klamath-Trinity River system at 650,000–1 million fish. These runs contributed to substantial commercial, recreational, subsistence, and Tribal harvests (Snyder 1931; Lane and Lane Associates 1981; USDI 1985; USFWS 1991; Gresh et al. 2000). In particular, the Upper Klamath River above Iron Gate Dam once supported the spawning and rearing of large populations of anadromous salmon and steelhead (Lane and Lane Associates 1981; FERC 1990).

The first impassable barrier to anadromous fish on the mainstem Klamath River was Copco 1 Dam,

completed in 1918 (followed by Copco 2 Dam in 1925 and Iron Gate Dam in 1962; Figure 1). Prior to dam construction, anadromous fish runs accessed spawning, incubation, and rearing habitat in about 970 km (600 miles) of river and stream channel above the site of Iron Gate Dam. This dam, at river kilometer 307 (river mile 190; Photo 1), is the current limit of upstream passage. The Long Range Plan for the Klamath River Basin Conservation Area Fishery Restoration Program (USFWS 1991) identified the lack of passage beyond Iron Gate Dam as a significant impact to the Klamath River anadromous fishery. At present, significant un-utilized anadromous fish habitat exists upstream of Iron Gate Dam (Fortune et al. 1966; Chapman 1981; NRC 2003; Huntington 2004). The Klamath Hydroelectric Project operating license expires in 2006 and the relicensing process is currently under way.

Need for Information on the Upstream Extent of Anadromous Fish Distribution

Knowledge of the presence and the historical extent of the upstream distribution for anadromous species on the Klamath River is important for restoration planning and future management decision-making. Public Law 99-552, the Klamath River Basin Fishery Resources Restoration Act (Klamath Act), was adopted by Congress on 27 October 1986, for the purpose of authorizing a 20-year federal-state cooperative Klamath River Basin Conservation Area Restoration Program for the rebuilding of the river's fishery resources to optimal levels. Among other charges, the Klamath Act directs the Secretary of Interior to improve and restore Klamath River habitats and promote access to blocked habitats, to rehabilitate problem watersheds, to reduce negative impacts on fish and fish habitats, and to improve upstream and downstream migration by removing obstacles and providing facilities for avoiding obstacles.

In addition to the Klamath Act, the Department of the Interior and the Department of Commerce are authorized to protect and restore anadromous fish and their habitats under several authorities including the Federal Power Act (through the requirement of mandatory fishway prescription under Section 18 of the act). Other authorities include the Endangered Species Act; federal Tribal Trust responsibilities; Pacific Coast Salmon Plan; Magnuson-Stevens Fishery Conservation and Management Act (which incorporates delineation of "essential fish habitat"); Sikes Act, Title II; the Fish and Wildlife Coordination Act; the Wild and Scenic Rivers Act; the National Historic Preservation Act; Federal Lands Protection and Management Act; Northwest Forest Plan; and various policies and initiatives of the U.S. Bureau of Land Management, U.S. Forest Service, the National Park Service, NOAA Fisheries and the U.S. Fish and Wildlife Service (USFWS). The states of Oregon and California also have significant regulatory authorities and responsibilities related to hydropower relicensing and the recovery of listed species.

These authorities provide a basis for restoration of native anadromous fish to their historical habitats. However, there have been persistent questions regarding whether anadromous fish occurred historically above Iron Gate Dam. Thus, prior to implementing anadromous fish restoration and the design of potential fishways that would be species specific, it is important to evaluate the evidence regarding which native anadromous species were present historically above Iron Gate Dam and determine the extent of their upstream distribution.

Methods

We summarize existing information regarding both the recorded historical (tens to thousands of years) presence and, more specifically, the upstream extent of the distribution of native anadromous fish in the Klamath River, based upon photos, historical documents, logical reasoning, and other available information. A distinction was made between presence and the extent of upstream distribution because, for some species, there was clear evidence for presence in general terms, but only vague information on their farthest upstream distribution. When reliable information on the extent of upstream distribution was available, it was important to include this level of certainty for consideration during relicensing and anadromous fish restoration. The presence of species above one dam, but not another, has implications for relicensing.



DAVID WHITE, NOAA FISHERIES

Photo 1. Iron Gate Dam has no fish passage facilities.

In this article, references to the Klamath Upper Basin include the Klamath River watershed upstream from and including the section of the Klamath River known as Link River. (Link River Dam, as shown in Figure 1, is on this short reach of the mainstem Klamath River immediately below Upper Klamath Lake).

Photos

We reviewed historical photo collections of the Klamath County Museum and Klamath Historical Society for documentation of anadromous fish above Iron Gate Dam. We assumed that captions on photos correctly identified the taxa, locations, and dates. The photos used here were taken in the vicinity of Klamath Falls and adjacent Link River.

Documents and Reports

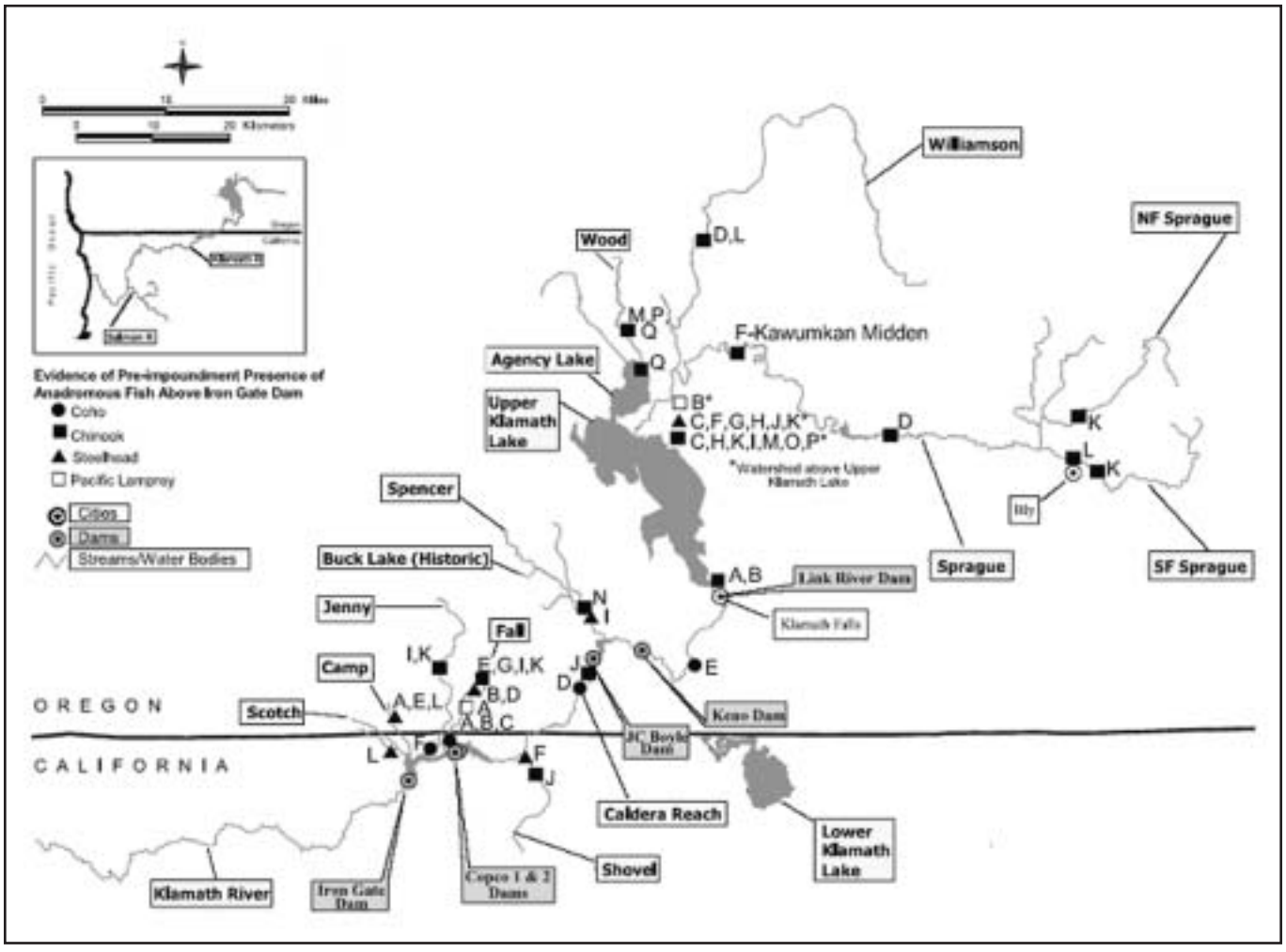
We reviewed published and unpublished fisheries, archeological, and ethnographic reports on the distribution and presence of anadromous fish in the Klamath River watershed. For a given reference we generally cited only the farthest upstream occurrence of a species in the Klamath River and/or its tributaries. When documents identified fish as only salmon, we assumed they were Chinook salmon. While ethnographic (Gatschet 1890; Spier 1930; Kroeber and Barrett 1960) and archaeological (Cressman et al. 1956) sources are cited, other reports from these disciplines may well contain additional documentation not specifically referenced in this paper. Fortune et al. (1966) referenced numerous articles from Klamath Falls newspapers regarding historical accounts of salmon above the current location of Iron Gate Dam. Of these, we have included only one (Klamath Falls Evening Herald 1908).

Personal Communications

We did not reference personal communications that included questionable identifications of species unless the communication included other supporting facts that would corroborate the identification of that species. For example, we discounted the identification of chum salmon (*Oncorhynchus keta*), coho salmon, and steelhead trout in the vicinity of Agency Lake and the Wood River, but included the reference to Chinook salmon because other information communicated on the size of these fish supported that identification.

Personal communications cited in Lane and Lane Associates (1981) regarding the presence of salmon in the Williamson and Sprague rivers were very numerous and we recommend that interested parties refer to this citation. We did not reference these personal communications individually here. When personal communications cited therein provided key information on presence or farthest upstream distribution of a species not cited elsewhere, we referenced Lane and Lane Associates (1981).

Figure 1. Extent of upstream distribution for anadromous fish in the Klamath River and tributaries based upon references in Table 1 (locations for citations are approximate).



Logical Reasoning

For Pacific lamprey and coho salmon we combined existing evidence with logical reasoning for a determination of the extent of upstream distribution of these species in the Klamath River watershed. This reasoning was partly based on the occurrence of the same species east of the Cascade Range in the Columbia River Basin. While we believe this reasoning is valid, we acknowledge that it does not have the same level of certainty as photographs, documents, reports, or personal communications for a specific determination of the limit of upstream distribution.

Results and Discussion

Table 1 summarizes sources of evidence for the historical distribution of Chinook salmon, steelhead, coho salmon, and Pacific lamprey above Iron Gate Dam on the Klamath River. Figure 1 is the corresponding map showing the locations cited for each species.

Evidence for the largest, most utilized species, Chinook salmon, was available from the greatest variety of sources and provided the highest level of certainty. Less information was available for the other three species. Nevertheless, there was substantial information and reasoning to determine that steelhead historically migrated to the Klamath Upper Basin and that the distribution of coho salmon and Pacific lamprey extended above Iron Gate Dam. More detailed information on our evaluation of sources and the presence and farthest upstream distribution is discussed below.

Chinook Salmon

Presence—Information cited here that provides evidence for the presence of Chinook salmon above the current site of Iron Gate Dam includes 2 historical photographs, 14 documents or reports, and 1 personal communication. Numerous other personal communications, testimony, and newspaper articles documenting the presence of Chinook salmon are referenced in Fortune et al. (1966) and Lane and Lane Associates (1981). We found one report that stated there was not enough information to conclude that Chinook salmon accessed tributaries of Upper Klamath Lake.

Chinook salmon spawned in Jenny Creek (Coots 1962; Fortune et al. 1966) and Fall Creek (Wales and Coots 1954; Coots 1957; Coots 1962; Fortune et al. 1966) prior to the construction of Iron Gate Dam. An interview with long-term resident of the area, W. G. Hoover, provided information on large concentrations of fall-run king salmon in Shovel Creek and on spawning that might have occurred near Shovel Creek in the mainstem Klamath River (Coots 1965). Hoover also noted that the river near the "Frame Ranch" was a favorite salmon spearing site and a potential spawning area (Coots 1965). Hoover was undoubtedly referring

Table 1. Documentation for pre-impoundment presence and extent of upstream distribution for anadromous fish in the Klamath River above Iron Gate Dam.

Source	Species			
	Chinook (■)	Steelhead (▲)	Coho (●)	Pacific Lamprey (❑)
Photos of historical presence above Iron Gate Dam	(A) Klamath County Historical Society Photo, Photo 2 (1860) (B) Klamath County Historical Society, Photo 3 (1891)			
Documents/reports/ other evidence	(C) *Gatschet (1890)* (D) *Spier (1930)* (E) *Wales and Coots (1954)* (F) *Cressman (1956)* (G) Coots (1957) (H) *Kroeber and Barrett (1960)* (I) Coots (1962) (J) Coots (1965) (K) Fortune et al. (1966) (L) Lane and Lane Associates (1981) (M)*Nehlsen et al. (1991)* (N) BLM et al. (1995) (O) *Thurow et al. (1997)* (P) *Moyle (2002)*	(A) Wright (1954) (B) Coots (1957) (C) *Kroeber and Barrett (1960)* (D) Coots (1962) (E) King et al. (1977) (F) Fortune et al. (1966) (G) Lane and Lane Associates (1981) (H) *Nehlsen et al. (1991)* (I) BLM et al. (1995) (J) *Thurow et al. (1997)* (K) *Moyle (2002)*	(A) Coots (1957) (B) Coots (1962) (C) CDWR (1964) (D) NMFS (1997) (E) IMST (2003)	(A) Coots (1957) (B) *Kroeber and Barrett (1960)*
Personal communications	(Q) Scarber (2004)	(L) Maria (2003)	(F) Bulfinch (2002)	
Logical reasoning			X	X

Italics = published literature. Reference identification letters correspond to symbols (■, ▲, ●, and ❑) showing approximate locations cited for each species (Figure 1).

to the "Frain Ranch" reach of the Klamath River, which is immediately upstream of the Caldera reach (Figure 1). BLM et al. (1995) referred to accounts of fall-run salmon in Spencer Creek and contained a photo taken prior to 1917 showing a Chinook salmon caught at the confluence of Spencer Creek and the Klamath River.

Two historical photographs document the presence of Chinook salmon at Link River. The Klamath County Historical Society provided these photos, dated 1860 and 1891, showing fishermen with their catch of salmon at Link River (Photos 2 and 3; Photo 2 is dated 1860 but may have been taken later in the nineteenth century; Judith Hassen, Klamath County Museum, pers. comm.). Fortune et al. (1966) reported that C. E. Bond, professor of fisheries at Oregon State University, examined a historical photo of salmonids from the Klamath Upper Basin and positively identified at least one fish as a Chinook salmon. We believe this photo may have been Photo 3 because it was available to the author and is the best known photo from the Klamath Upper Basin with a "salmon fishing" caption. The other three fish shown in this photo are clearly salmonids and likely were Chinook salmon as well.

In a footnote, Snyder (1931) referred to interviews he conducted with fishermen and long-time residents of the Klamath Lake region to learn of the past salmon runs. He reported that "testimony was conflicting and the lack of ability on the part of those offering information to distinguish between even trout and salmon was so evident, that no satisfactory opinion could be formed as to whether king salmon ever entered Williamson River and the smaller tributaries of the lake. However, this may be, large numbers of salmon annually passed the point where Copco Dam is now located." No information is provided in Snyder (1931) regarding the number of interviews or the effort made to interview fishermen and long-time residents.

In contrast, we found numerous historical accounts and fisheries reports referring to the presence of salmon in the tributaries to Upper Klamath Lake, in particular, the Williamson and Sprague rivers. Cressman et al. (1956) reported archeological evidence of salmon bones from the Kawumkan midden on the Sprague River (Figure 1), leading him to conclude that salmon passed the falls at the south end of Upper Klamath Lake. Lane and Lane Associates (1981) provided multiple accounts of the presence of anadromous salmonids and fishing in Sprague and Williamson rivers. This report was done under contract for the Bureau of Indian Affairs in the 1980s. Interviews were included in Lane and Lane Associates (1981) to ensure that a record of anadromous fish presence and the fishery on the Tribal reservation in the Klamath Upper Basin was maintained. In excerpts from 50 interviews, conducted in the 1940s, members of the Klamath Tribe and older non-Indian settlers in the region provided accounts of numerous salmon fishing locations on the Sprague River, the Williamson River, Upper Klamath Lake, and Spencer Creek. These accounts made a distinction between salmon and trout. In many instances the interviews in the document provided details on the weights of fish that indicated they could only be Chinook salmon.

One of the earliest references in Lane and Lane Associates (1981) is to the explorer Fremont's visit to the outlet of Upper Klamath Lake in May of 1846 and his observation of great numbers of salmon coming up the river to the lake. Most likely these would have been spring-run Chinook. Kroeber and Barrett (1960) stated that salmon ran up the Klamath into the Klamath lakes and their tributaries. Gatschet (1890) and Thurow et al. (1997) included the Klamath Upper Basin as within the range of Chinook salmon at the time of European settlement. Nehlsen et al. (1991) and Moyle (2002) referred to historical occurrences of fall, spring, and summer races of Chinook salmon in the Sprague, Williamson, and Wood rivers in the Klamath Upper Basin. Their accounts are similar to those of Fortune et al. (1966) and Lane and Lane Associates (1981) for the Sprague and Williamson rivers. For the Wood River, Nehlsen et al. (1991) and Moyle (2002) both state that Chinook salmon historically used this drainage. While one reference states that salmon did not go up the Wood River (cited in Spier 1930), an account of Chinook salmon harvest (Robert Scarber, former Klamath Agency Reservation resident, pers. comm., 2004) provides specific information that Chinook salmon occurred adjacent to and in the Wood River watershed. The Wood River has and continues to have suitable water quality and physical habitat to support anadromous salmonids. Without the presence of fish passage barriers, salmon undoubtedly inhabited this watershed.

Both spring and fall runs were reported above Upper Klamath Lake by Spier (1930) and Coots (1962). Fortune et al. (1966) provided reports and personal interviews that indicated the Sprague River was the most important salmon spawning stream, on the basis of testimony he received. According to four people interviewed by Fortune et al. (1966), salmon entered the Williamson River in autumn, possibly as early as August. One person interviewed provided the observation that, after salmon passed Link River, it took them five or six days to make their way through Klamath Lake before they reached the Williamson.

It is possible that fall-run Chinook reached Upper Klamath Lake and beyond in only wetter years. The lower Klamath River fall run (below Iron Gate Dam) is generally from August to October/November when flows and depths are often lowest for the year (Myers et al. 1998). Successful fish passage through the high gradient Caldera reach for large-bodied, fall-run Chinook may have been problematic during certain years. This low water passage difficulty was noted a short distance upstream at Keno in the Klamath Falls Evening Herald (1908). Spring-run Chinook salmon, on the other hand, have a bi-modal run distribution

that spreads from April to August. The smaller sized, spring-run Chinook (their average weight was 5 kg or 11 lbs. according to Snyder 1931) encountered higher spring flows and would have been able to pass the Caldera reach. However, salmon runs to the Klamath Upper Basin undoubtedly had a fall-run component as evidenced by the size of salmon harvested (up to 27 kg or 60 pounds) and the timing of spawning noted in Lane and Lane Associates (1981).

Extent of Upstream Distribution—The extent of upstream distribution we found for Chinook salmon is shown in Figure 1. Chinook salmon utilized habitat in the Sprague River in the vicinity of Bly, Oregon, and further upstream. Fortune et al. (1966) reported that Chinook salmon spawned in the mainstem Sprague River; upstream on the South Fork of the Sprague above Bly to the headwaters; and on the North Fork of the Sprague as well (Figure 1). Lane and Lane Associates (1981) provided several independent testimonies that put the farthest upstream distribution of salmon for the Sprague River in the vicinity of Bly, Oregon. It should be noted that testimonies from Tribal members in Lane and Lane Associates (1981) were oriented toward harvest of adult salmon, which was restricted to within the reservation boundary, also located near Bly. Their report contained little information on the extent of anadromous salmonids in the Sprague River upstream of the reservation boundary. For the Williamson River, both Spier (1930) and Lane and Lane Associates (1981) listed the farthest upstream distribution of salmon as being the falls below the outlet to Klamath Marsh (Figure 1).

We note that accounts of Chinook harvest in general are based upon fisheries that took place in locations convenient for harvest, primarily in mainstem channels, and that the true farthest upstream distribution was probably above the sites where these fisheries took place.

Steelhead

Presence—Information cited here that provides evidence for the presence of steelhead above the current site of Iron Gate Dam includes 11 documents or reports and 1 personal communication. Other personal communications regarding steelhead above Iron Gate Dam are referenced in Lane and Lane Associates (1981). One report stated there was not enough information to conclude that steelhead accessed the Klamath Upper Basin.

BLM et al. (1995) includes a photo captioned "Fishing for steelhead on Spencer Creek…around 1900" from the photo collection of the Anderson Family, descendents of Hiram Spencer, an early settler in the Spencer Creek area. Fortune et al. (1966) cited a brochure from Southern Pacific Railroad, published in 1911, that referred specifically to the harvest of steelhead at the mouth of Shovel Creek (Figure 1).



KLAMATH COUNTY HISTORICAL SOCIETY

Photo 2. Link River salmon "fishing" around 1860. Site of present Klamath Falls.



KLAMATH COUNTY HISTORICAL SOCIETYKLAMATH COUNTY HISTORICAL SOCIETY

Photo 3. Gentlemen display their catch while salmon fishing on the rapids of Link River, 1891.

Extent of Upstream Distribution—The extent of upstream distribution we found for steelhead is shown in Figure 1. California Department of Fish and Game (CDFG) files include records of steelhead spawning in Camp Creek up to 1.6 km (one mile) upstream from the California state line, in at least one Camp Creek tributary approximately 0.8 km (0.5 mile) downstream from the California state line, and in nearby Scotch Creek (Dennis Maria, CDFG, pers. comm.). Wright (1954) and King et al. (1977) also reported that steelhead spawned in Camp Creek prior to the construction of Iron Gate Dam.

Coots (1957, 1962) discussed steelhead in Fall Creek. According to Puckett et al. (1966), steelhead were present as far upstream as Link River, but their presence above Upper Klamath Lake could not be documented. However, Kroeber and Barrett (1960), Nehlsen et al. (1991), Lane and Lane Associates (1981), Thurow et al. (1997), and Moyle (2002) all refer to steelhead accessing the Klamath Upper Basin. Fortune et al. (1966) states that due to the difficulty in differentiating steelhead from large rainbow trout (or redband trout, *Oncorhynchus mykiss irideus*), accurate information on the history of steelhead migrations in the Klamath Upper Basin was impossible to obtain. However, Fortune et al. (1966) also stated that there was enough agreement from interviews conducted to derive some general information. Included in this general information were accounts of steelhead in the Wood, Sprague, and Williamson rivers.

Generally, in watersheds where both Chinook salmon and steelhead are present, the range of steelhead is the same if not greater. The reports above, the overlapping distribution for the two species in most watersheds, and the fact that Chinook salmon were present in the Klamath Upper Basin are substantial evidence that steelhead were also present in tributaries to Upper Klamath Lake.

Coho Salmon

Presence—Information cited here that provides evidence for the presence of coho salmon above the current site of Iron Gate Dam includes five documents or reports and one personal communication. Snyder (1931) stated that "[s]ilver salmon are said to migrate to the headwaters of the Klamath to spawn. Nothing definite was learned about them from this inquiry because most people are unable to distinguish them." At the time, he said there was little interest in coho because Chinook salmon were so much larger and more abundant. Fortune et al. (1966) did not discuss coho salmon. However, Coots (1957, 1962) and the California Department of Water Resources (1964) reported that coho salmon spawned in Fall Creek, which now flows into Iron Gate Reservoir. Prior to construction of Iron Gate Dam, the confluence of Jenny Creek with the main stem Klamath River was well known by fishing guides as one of the best places in the upper river to fish for coho (Table 1 and Figure 1; Kent Bulfinch, Klamath River Basin Task Force representative, pers. comm.).

In 1911, 881 female coho were captured at the Klamathon Racks egg-taking facility about 8 km downstream from the current Iron Gate Dam site (CDFG 2002). Coho salmon are generally tributary spawners, and the only sizable tributary between the Klamathon Racks area and Iron Gate Dam is Bogus Creek. It is unlikely that all these spawning fish would have been destined for Bogus Creek and probable that a significant portion of the return was destined for tributaries above the current site of Iron Gate Dam. NOAA Fisheries estimated that within the Klamath River Basin, the construction of Iron Gate Dam blocked access to approximately 48 km (30 miles) of mainstem habitat, about 8% of the historical coho salmon habitat in the entire Klamath River Basin (NMFS 1997).

Extent of Upstream Distribution—The NOAA Fisheries estimate of the loss of approximately 48 km (30 miles) of mainstem coho salmon habitat above Iron Gate Dam would put the species' upper distribution in the vicinity of the J. C. Boyle powerhouse (Table 1 and Figure 1; NMFS 1997). Another report put the historical occurrence of coho salmon in the Klamath River as far upstream as the mouth of Lower Klamath Lake (IMST 2003). However, the report by Moyle (2002) stating that coho salmon once ascended the Klamath River and its tributaries at least as far upstream as Klamath Falls, Oregon, is an error resulting from the author's imprecise use of zoogeographic boundaries (Peter Moyle, University of California Davis, pers. comm.). To the best of his knowledge, there are no records of coho in the Klamath Upper Basin.

Given this information about the distribution of coho salmon in the mainstem Klamath River, the fact that coho are generally tributary spawners, our knowledge of their rearing and spawning habitat, and the characteristics of various Klamath River tributaries, we conclude that coho salmon would have used Spencer Creek, a medium-sized, low-gradient tributary, with suitable spawning habitat. Side channel and beaver pond areas in Spencer Creek would also have provided rearing habitat for this species. Thus, we reason that the farthest upstream distribution of coho salmon likely extended at least to this vicinity.

Anadromous Pacific Lamprey

Presence—We found two documents, but no personal communications, that provided evidence for the presence of Pacific lamprey above the current site of Iron Gate Dam. Coots (1957) reported that *Lampetra tridentata* entered Fall Creek, which now flows into Iron Gate Reservoir. Literature references to Pacific lamprey in the Klamath Upper Basin prior to the construction of downstream dams (Gilbert 1898; Evermann and Meek 1897) may have applied to a resident, non-anadromous taxon of uncertain systematic status (Stewart Reid, USFWS, pers. comm. 2004). Gilbert (1898) reported a "young" specimen that measured 26 cm in length. Lampreys of this size correspond with the larger lamprey taxon still encountered in Upper Klamath Lake, but are considerably smaller than

anadromous adults in the Klamath River (Kan 1975; Lorion et al. 2000). The current lamprey taxon in Upper Klamath Lake was recognized as a distinct subspecies of *L. tridentata* by Kan (1975) in his unpublished dissertation, and as "non-anadromous" *L. tridentata* in Lorion et al. (2000) due to the lack of a formal systematic revision of the Klamath lampreys. Mitochondrial DNA analysis has shown no evidence of contemporary anadromous Pacific lamprey populations in the Klamath Upper Basin or Spencer Creek (Lorion et al. 2000; Margaret Docker, Great Lakes Institute for Environmental Research, pers. comm. 2004).

This taxonomic confusion would have made it difficult to distinguish anadromous Pacific lamprey from resident taxa. However, anadromous Pacific lamprey currently occur throughout the mainstem and principal tributaries of the lower Klamath River and fish fauna are generally considered to be similar throughout the mainstem Klamath River upstream to Spencer Creek. Historically, there were no physical barriers that would have prevented anadromous lampreys from migrating above Iron Gate Dam (Stewart Reid, USFWS, pers. comm.).

Extent of Upstream Distribution—Kroeber and Barrett (1960) reported that Pacific lamprey ascended to the Klamath Lakes, based on the accounts of Native Americans (Table 1, Figure 1). While the difficulty in distinguishing anadromous Pacific lamprey from Klamath Upper Basin resident lamprey taxa brings this account into question, we note that the historical distribution of Pacific lamprey in the Columbia and Snake rivers was coincident wherever salmon occurred (Simpson and Wallace 1978). Wydoski and Whitney (2003) stated that Pacific lampreys occur long distances inland in the Columbia and Yakima river systems. Pacific lamprey still migrate well upstream to at least the Snake River (Christopher Claire, Idaho Department of Fish and Game, pers. comm.) and Idaho's Clearwater River drainage (Cochnauer and Claire 2002). Current limits to the distribution of Pacific lampreys in the Columbia River system are at Chief Joseph Dam on the mainstem Columbia and Hells Canyon Dam on the Snake River (Close et al. 1995). Both of these dams are well over 800 km (500 miles) upstream from the ocean and Pacific lamprey distribution may have extended further upstream prior to the construction of these dams, which have no fish passage facilities. On the Willamette River, Pacific lamprey were historically able to pass upstream at Willamette Falls with winter steelhead and Chinook salmon (USDI 2003).

The extent of Pacific lamprey migrations in other coastal rivers, their general congruence with anadromous salmonid distributions, the historical absence of lamprey passage barriers in the mainstem Klamath River, and the homogeneity of the lower Klamath River fish fauna throughout the mainstem Klamath upstream to Spencer Creek suggest that, historically, anadromous Pacific lamprey would likely have migrated up the Klamath River past where Iron Gate Dam now exists and that their upstream distribution extended to at least Spencer Creek.

Other Anadromous Species

Sockeye Salmon— There is some evidence that a run of sockeye salmon may have occurred in the Klamath River above the current location of Iron Gate Dam. The southernmost distribution of sockeye (*Oncorhynchus nerka*) in North America is recorded as the Klamath River (Jordan and Evermann 1896; Scott and Crossman 1973). Cobb (1930) reported that 20 sockeye were taken in the Klamath River in the autumn of 1915. Sockeye salmon require a lake for rearing. The only potential lake rearing habitat in the Klamath River system accessible to anadromous fish would have been Upper Klamath Lake, Lower Klamath Lake, or Buck Lake (in the upper reaches of Spencer Creek before being drained, Figure 1). Lower Klamath Lake was probably too shallow to provide suitable rearing habitat for sockeye salmon, but some authors (Fry 1973; Behnke 1987) believe that a small run of sockeye may have occurred to Upper Klamath Lake, until eliminated by dams. However, Snyder (1931) reported that no evidence substantiated the statement of Jordan and Evermann (1896) that sockeye salmon occur in the Klamath River, and Moyle (2002) stated that individual anadromous sockeye found in streams south of the Columbia system are probably non-spawning strays or kokanee (the landlocked form of sockeye) that went out to sea. At any rate, if anadromous sockeye were present historically, they have been extirpated.

It is notable that kokanee salmon currently are observed in Upper Klamath Lake (Logan and Markle 1993), especially in springs on the west side of the lake (Bill Tinniswood, ODFW, pers. comm.). These are believed to be fish that have drifted downstream from the Four Mile Lake population, introduced in the 1950s or before (Bill Tinniswood, ODFW, pers. comm.; Roger Smith, ODFW, pers. comm.).

Green Sturgeon—To the best of our knowledge there is no evidence for the distribution of native sturgeon above the current location of Iron Gate Dam. Chuck Tracy (ODFW, pers. comm.) stated that the upstream limit of distribution appears to be Ishi-Pishi Falls (near the confluence of the Klamath River and the Salmon River) on the Klamath River. Moyle (2002) mentioned a green sturgeon spawning site in the Klamath River approximately



208 km (129 miles) below Iron Gate Dam. Sturgeon are known to spawn in the Salmon River, a tributary to the lower Klamath River, which flows into the Klamath River about 201 km (124 miles) below Iron Gate Dam. Kroeber and Barrett (1960) put the upstream-most distribution of sturgeon in the same vicinity. While some green sturgeon may presently migrate beyond the confluence of the Salmon and Klamath rivers, they are the exception rather than the rule (Tom Shaw, USFWS, pers. comm.).

Gilbert (1898) reported that green sturgeon were not observed in Upper Klamath Lake. The current small population of sturgeon in Upper Klamath Lake is derived from white sturgeon (*Acipenser transmontanus*) introduced in 1956 (ODFW 1997).

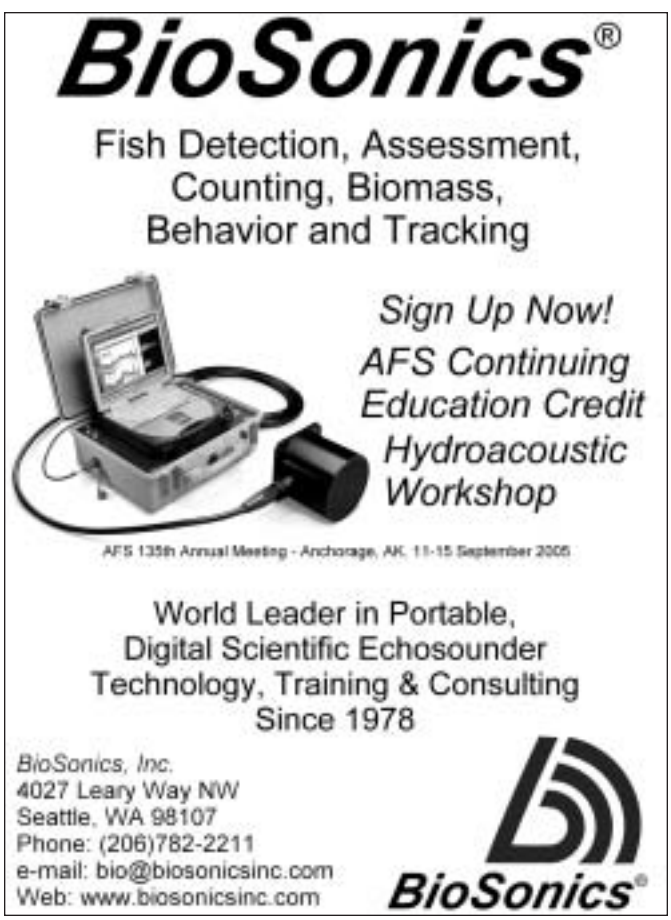
Eulachon—To the best of our knowledge there is no evidence of the distribution of eulachon above the current location of Iron Gate Dam. Eulachon are usually restricted to spawning in lower river reaches (Scott and Crossman 1973). Accounts of Yurok Tribal elders indicate that eulachon utilized the lower Klamath River for spawning at least as far upstream as 40 km (river mile 25; Larson and Belchik 1998). Historically abundant, they may now be extirpated in the Klamath River (Larson and Belchik 1998).

Cutthroat Trout—Typically, coastal cutthroat do not occur more than about 160 km (100 miles) from the coast (Behnke 1992). There are no accounts of cutthroat in the Klamath Upper Basin. Considering the multiple life history strategies cutthroat exhibit, had they been present above Iron Gate Dam historically, there would likely be resident populations in the upper basin or other tributaries above the dam.

Chum Salmon—To the best of our knowledge there is no evidence for the distribution of chum salmon, above the current location of Iron Gate Dam. The distribution of chum salmon is generally limited to lower river reaches (Scott and Crossman 1973). Small runs of this species still maintain themselves in the lower Klamath River (Moyle 2002).

In some historical accounts there are references to dog salmon in the Upper Klamath River Basin. Dog salmon is a common reference used for chum salmon in the Pacific Northwest and Alaska. However, the common name dog salmon was also applied to Chinook salmon in the Klamath River in early accounts (Snyder 1931; Lane and Lane Associates 1981). Hence, there may have been confusion as to the upstream distribution of chum salmon in the Klamath River.

Pink Salmon—To the best of our knowledge there is no evidence for the distribution of pink salmon (*Onchorynchus gorbuscha*) above the current location of Iron Gate Dam. The distribution of pink salmon is generally limited to lower river reaches (Scott and Crossman 1973). Small numbers of pink salmon have been reported in the lower Klamath River (Moyle 2002).



Conclusions

We found numerous sources of information regarding the occurrence of Chinook salmon, steelhead, coho salmon, and Pacific lamprey above the current location of Iron Gate Dam on the Klamath River. We are not aware of any credible reports that these species did not migrate beyond this point. For Chinook salmon and steelhead, we found one report for each species stating there was not enough information to say definitively they migrated into the Klamath Upper Basin. In contrast, we found several lines of evidence that clearly showed that Chinook salmon historically migrated to the Klamath Upper Basin. A determination of the upstream extent of distribution for steelhead, coho salmon, and Pacific lamprey was more difficult. However, available documentation indicates that steelhead accessed habitat in the tributaries of Upper Klamath Lake as well. Pacific lamprey probably accessed habitat upstream at least to Spencer Creek and possibly beyond, as did coho salmon. There is limited evidence that a small run of sockeye salmon may have accessed habitat in Upper Klamath Lake or Buck Lake. Green sturgeon distribution extended upstream to the vicinity of the Salmon River in the mid-Klamath River portion of the watershed. Chum salmon, pink salmon, eulachon, and cutthroat trout were limited to the lower Klamath River, well below the current location of Iron Gate Dam. This documentation resolves a great deal of the uncertainty regarding which species were present above Iron Gate Dam and the extent of their upstream distribution, both key to realizing fisheries restoration opportunities.

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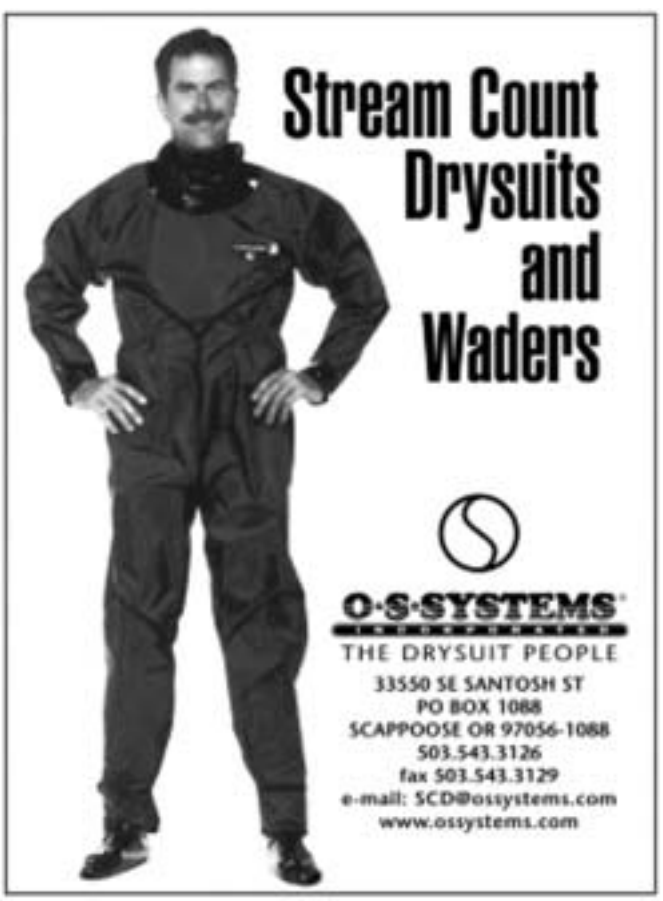

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ATTACHMENT 4

Estimates of Pre-Development Klamath River Salmon Run Size

(IFR Report – Updated to Feb. 2009)

Estimates of Pre-Development Klamath River Salmon Run Size

Historically, salmon were an important food source and cultural symbol for the Indian tribes of California. “It’s been a part of the culture, the religion and the diet for thousands of years,” said Mike Orcutt, director of the fisheries department for the Hoopa Valley Tribe along the Trinity River. “The salmon runs were dependable and dried salmon provided food for the winter.”[1] However, virtually no reliable data exists concerning the magnitude of historic Native American harvest levels on the Klamath and Trinity Rivers.

The California Department of Fish and Game (CDFG) first set the Klamath Basin fall run chinook spawning escapement goal at 115,000 in 1978. This rebuilding goal is based on Klamath Basin escapement estimates for the early 1960s and includes 97,500 natural and 17,500 hatchery spawners.[2] The PFMC later adopted this goal, which however has never been met.[3] By 1983, the goal was modified downward to include a "rebuilding schedule" whose first step, to be in place for four years, was a goal of 68,900 spawners, with the 115,000 goal to be in place by 1995.[4] Soon into the rebuilding plan it became obvious, however, that even though these goals were only a small fraction of the original run size that they still could not be met within the present seriously degraded state of inland habitat. Therefore, in 1986 and long before any of these goals could be met, a whole new methodology was introduced by which the fishery itself was to be managed. Nevertheless these remain the “official” rebuilding goals for salmon in the basin.

Coho runs from the North coast numbered about 150,000 annually in the 1940’s decade, while steelhead runs were estimated to be about 300,000.[5] Since no other information is available on coho and steelhead, a factor of 50 percent harvest rate is used in our calculations as an estimate of what would be potentially available. Thus the estimate is that the Klamath River could have supported harvests of up to 75,000 coho and 150,000 steelhead at that time.

For purposes of analysis some assumptions needed to be made about species/run composition of the chinook salmon harvested, since their economic value varies by species/run. Species of harvested chinook are thus assumed to be in the same proportion as in the Sacramento system (i.e. 5% late fall, 10% winter, 37% spring and 48% fall).

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1. “California’s Chinook Salmon: Upstream Battle to Restore the Resource,” Water Education Foundation, Western Water, November/December 1992.
2. Boydstun, L.B., “Draft Evaluation of Klamath River Fall Chinook Escapement Options,” Memorandum, September 8, 1988, California Fish and Game.
3. *An Assessment of the Current Carrying Capacity of the Klamath River Basin for Adult Fall Chinook Salmon, Hubbell and Boydstun, CDFG, Sept. 1985.*
4. *Ibid., see also Final Framework Amendment for Managing the Ocean Salmon Fisheries..., PFMC, October 1984, p. 3-20.*
5. “An Environmental Tragedy: Report on California Salmon and Steelhead Trout,” State of California, California Department of Fish and Game, March 15, 1971.

There are no generally accepted estimates of pre-development salmon run sizes for California rivers except for the Fisher estimates of Central Valley stocks.[6] For the Columbia River study, the Northwest Power Planning Council made its estimates based on review of habitat and on historical catch records. However, using the number of square miles in a basin as a factor and interpolating production numbers from similar basins where data is more complete, it is possible to arrive at workable estimates of pre-development runs of up to 4 million fish in the Sacramento/San Joaquin system and 1.1 million in the Klamath system (Table 1). These are the figures assumed for purposes of our analysis.

Table 1
Comparison Between Three River Systems: Columbia River, Sacramento/San Joaquin System, and Klamath River, in Terms of Total Square Area, Salmon Habitat Miles, Best Estimate of Historical Harvests, and Present Escapement

	Total Salmon Habitat Land Area in Basin	**Pre-Development Habitat Stream Miles**	**Historic Record Harvests (No. of Fish)**	**Estimated Pre-Development Runs**	**Escapement Goal**
Columbia River System	163,000 sq. miles to 260,000 sq. miles /1	14,666 miles of stream /1	3 to 3.6 /4, record canning pack 630,000 cases, about 40 million pounds	10–16 million fish	varies for stocks in the Columbia
Sacramento/ San Joaquin System	38,340 sq. miles /2	6,000 miles of stream /3	12 million pounds /5, average 5 million pounds from 1873–1910	1.95 million /6 to 4.0 million fish /7	122,000–180,000 /9 (mostly hatchery)
Klamath River System	9,691 sq. miles	no estimates	no estimates	0.66 to 1.1 million fish /8	97,500 natural, 17,500 hatchery /10

Notes: 1. Prior to development, over 163,000 square miles of salmon and steelhead habitat existed in the Columbia River. (Compilation of Information on Salmon and Steelhead Losses in the Columbia River Basin. Appendix D of the 1987 Columbia River Basin Fish and Wildlife Program. Northwest Power Planning Council. Portland, Oregon. Page 87.) The Columbia River drains a watershed that is 260,000 square miles. (Bonneville Power Administration. "The World's Biggest Fish Story: The Columbia River's Salmon." Backgrounder. July 1987. Page 4.)

2. John Snyder. California Department of Water Resources.
Sacramento = 26,548 square miles
San Joaquin = 11,792 square miles
Delta = 4,154 square miles
Personal communication, January 1996.

3. The California Department Fish and Wildlife feels this estimate made in 1928 is too high. ("An Environmental Tragedy." Report on California Salmon and Steelhead Trout. Assembly Concurrent Resolution #64/1970 Session. March 1971. California Department of Fish and Game.)

4. High years:
1892 = 3.3
1895 = 3.3
1898 = 3.3
1911 = 3.1

6. *Fisher, Frank W., "Past and Present Status of Central Valley Chinook Salmon," Conservation Biology, Vol. 8, No. 3, September 1994.*

1918 = 3.6
1919 = 3.1
1923 = 3.2
1924 = 3.1
1926 = 3.0

Radtke, Hans D. and Shannon W. Davis. "Lower Columbia River/Young's Bay Terminal Fisheries Expansion Project." Salmon For All. January 1996.

5. In 1882, the California commercial salmon catch reached its historic peak of 12 million pounds. (E.R.G. Pacific, Inc. "The Economic Issues Associated with the Commercial Salmon Fisheries and Limited Entry in California." A Report to the California Commercial Fishing Review Board. October 1986. Page 1.)

6. Fisher, Frank. "Past and Present Status of Central Valley Chinook Salmon." Conservation Biology. Volume 8, No. 3. September 1994.

7. This estimate is based on the Columbia River Basin land area ratio to Sacramento/San Joaquin land area. This may be a high estimate, especially when compared to Frank Fisher's estimate of 1.95 million fish from the Columbia River.

8. Based on the land area ratios, the Klamath area could have had a pre-development run size of about 0.65 to 1 million fish.

9. Includes natural and hatchery fish. ("Review of 1994 Ocean Salmon Fisheries." Pacific Fishery Management Council. Portland, Oregon. 1994. Page 8.)

10. Although natural production from the Klamath system includes both spring and fall runs, only the dominant fall run is managed by the PFMC. ("Review of 1994 Ocean Salmon Fisheries." Pacific Fishery Management Council. Portland, Oregon. 1994. Page 11.) The escapement goal has been changed to 33%–34% in 1987 with a floor of 35,000. "Natural" as defined by the California Dept. of Fish and Game is not, however, the same as "wild." "Natural" as CDFG uses it may include any hatchery-origin fish so long as it is found outside the hatchery (see discussion in the body of this report).

Surprisingly, there has been little effort to determine the actual population size of the remaining wild salmon runs still left in the Klamath. Thus it is very difficult to determine whether in fact these populations are still declining or by how much. In fact, the current data collection and stock classification system used by the California Department of Fish and Game (CDFG) actually obscures this data. CDFG now classifies ***all*** fish found in hatcheries as "hatchery fish" *regardless of origin*. What is worse, all fish that are found ***outside*** of hatcheries ***during any given sample period*** are classified de facto as "natural fish," *again regardless of genetic origin*. It is obvious that some wild fish may stray into hatcheries, but more important is the fact that the vast majority of hatchery fish *never make it back to their hatchery of origin,* and thus would (if found anywhere just short of the hatchery) be classified by CDFG as "natural fish."

This practice blurs and obscures important genetic differences between hatchery stock (often imported) and the remnant wild stocks, leads to genetic dilution of the hard-won survival traits of the overall wild fish population, and almost completely masks actual wild stock declines. Since these "natural" fish are often confused in the literature with truly indigeneous "wild" stocks, this practice can also easily lead to gross over-estimates of native fish populations. This in turn allows grossly inflated estimates of the success of agency stock reseeding practices and rosy estimates of the total fish present in the system.

However, "natural" fish are not "wild" fish as geneticists define them. Only a comparison between pre-development genetically indigenous *wild* fish and current genetically indigenous *wild* fish populations gives a meaningful estimate or a true "before and after picture" of the extent of indigenous wild salmon stock declines.

It is clear, though, that the majority of the returning Klamath Basin salmon are now hatchery reared fish, rather than wild fish. However, hatchery fish—unlike their wild counterparts—require the continual input of human dollars and energy to generate them, and are thus more costly to society than their wild

counterparts. Hatchery production costs must first be subtracted to get their net economic value. These costs also vary from year to year depending upon widely fluctuating survival rates. In years of good ocean conditions when survival rates are relatively high, hatchery program costs can be amortized over a larger number of returning adults. However, in years of very poor ocean conditions (or when other habitat factors seriously affect smolt survival) the costs of hatchery production must then be amortized over a much smaller number of harvestable fish.

Hatcheries are used most often to compensate for habitat that for all practical purposes can never be restored (as above an impassable dam) as a way to continue to produce at least some fish for sport and commercial harvest. This type of "mitigation hatchery" serves an important economic function. Without mitigation hatcheries there would be nothing coming from many river systems because their native runs have long since been destroyed. However, the belief that hatcheries can adequately and forever substitute for salmon genetically adapted for millions of years for survival in the wild may be a false dream. Precipitous declines of wild salmon runs throughout the region is fundamentally *a biological and social problem* caused by widespread habitat destruction and the way we misuse our own technology.

While hatcheries play (and should continue to play) an important role in maintaining commercially harvestable populations in many areas, hatchery programs should be managed to *supplement and maintain* wild runs, not to *replace* them. Protection and restoration of wild runs puts a limit on land use activities which destroy watersheds, and thus imposes a limit on corporate greed. All too often the mere existence of a hatchery simply becomes a politically expedient excuse to avoid protecting wild fish habitat at all.[7]

Also, hatcheries cost money to run. Even productive hatcheries are now finding it harder to find funding in an era of severely declining state and federal budgets. Hatchery programs can suffer from genetic problems, disease, stress on juvenile fish from overcrowding, behavioral problems with hatchery-reared fish failing to adapt to wild conditions, and many other problems. Overproduction in some years may lead to precipitous declines in both hatchery and wild returns in other years. Also, hatchery programs which are run without careful attention to genetic impacts or competition effects on wild salmon populations can potentially be devastating to the genetic integrity of wild runs.[8]

Artificial hatchery production rarely duplicates the high survival rates and genetic adaptability of wild fish. Neither can hatcheries adequately substitute for the loss of natural spawning and rearing habitat.[9]

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[7]. *This report does not attempt to quantify the job base currently being maintained by the existing hatchery production programs in the Klamath. Unfortunately, the data available to us will not allow us to make that assessment unless a great deal more information about the costs of each of these hatchery programs on a per smolt and per returning adult basis is obtained.*

[8]. *For the most recent criticism of hatchery production programs see the National Research Council report "Upstream: Salmon and Society in the Pacific Northwest," National Academy Press (1996), which concluded among other things that: "Despite some successes, hatchery programs have been partly or entirely responsible for detrimental effects on some wild runs of salmon." For a good summary of all the scientific literature on hatchery and supplementation programs generally and the many problems they face, refer to U.S. Dept. of Energy, Bonneville Power Administration Technical Report 1990 (September, 1990), "Analysis of Salmon and Steelhead Supplementation," (Document DEO/BP-92663-1).*

[9]. *Destroying in-stream salmon habitat destroys both hatchery and wild fish alike. Once released into the wild, hatchery fish use the very same feeding and sheltering habitat as do wild fish. Destroying stream habitat for*

Nor can hatchery production really get fishery management out of the "weak stock management" and ESA downward spirals it has gotten itself into, since these problems are based on wild fish which still continue to decline. Finally—as a matter of political realism—shrinking agency budgets will mean many hatchery programs are likely to be closed simply for lack of funds.

These and many other factors make ultimate reliance by the fishing industry on hatchery programs unstable in the long term. *Ultimately, the only way to "hedge bets" biologically and economically so as to assure a future west coast salmon fishery is to maintain and restore (to as great an extent as possible) the wild salmon runs which are uniquely adapted to long term survival.*

Hatcheries must still be used where necessary to mitigate for permanent loss of habitat and in order to maintain a commercial fishery in the interim, but within an overall policy of genetic conservation *coupled with an aggressive program of habitat protection and restoration.*

How Much is a Restored Klamath Salmon Fishery Worth?

Because most jobs in the fishing industry are seasonal rather than full-time, published employment figures of commercial and recreational fishing may be misleading. Therefore, full-time equivalent employment numbers must be calculated by dividing the estimated total personal income generated by fishing activity by a representative annual personal income average. In the Pacific Northwest in 2009, a $40,000 per year wage or salary is a fair representation of a full-time equivalent job when considering all jobs that are generated by an activity, from crewmen to waitresses to lawyers.

Each fish harvested produces a net economic benefit to society as it travels through the chain of commerce from the boat to the consumer's table. The combined sums of all those benefits is the 'net personal income impact' of that one fish.[10] These values have been quantified for the Klamath Basin in previous studies. For instance, in a recent study entitled "Fishery Values of the Klamath Basin—A Report to CH2M Hill," by Meyer Resources, Inc., May 1984, printed in "Klamath River Basin Fisheries Resource Plan," U.S. Department of the Interior, February 1985, an estimate was made of the potential annual benefits associated with a catch of 1,000 adult Klamath salmonids to be $173,910 in 1984 dollars, which is equivalent to $353,416 including all direct, indirect and induced market-based economic benefits when expressed in 2009 dollars (see Table 3).

However, Meyer's study made no effort to assess historic run sizes. Using the numbers developed in this report by Radtke is appropriate as the best available estimate of the biological potential of the Klamath Basin for salmon production. We therefore combine Meyer's figures with the estimated pre-development run sizes derived in Table 2 to give us a number for the "net economic benefit" which is missing from the salmon-based economy due to recent declines and losses.

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wild fish will also decrease survival rates of hatchery fish—a double whammy which threatens to collapse both wild and artificial runs simultaneously. Allowing the destruction of the wild stocks which have genetically adapted to a particular river system for millions of years also extinguishes the very best gene pool from which to replenish that river's hatcheries.

[10]. *In other words, the sum of all the direct, indirect and induced economic activity generated by that product as it makes its way through the chain of commerce.*

Assuming the pre-development escapement estimates developed above of between 657,500 to 1,090,000 million adult equivalents to be accurate, and assuming only a 50% harvest rate, this would indicate under Meyer's methodologies that the Klamath should be able to produce a total annual income stream of between $116,185,510/year and $192,611,720/year in *market-based* salmon related economic benefits alone (i.e., excluding any of Meyer's non-market values), when expressed in 2009 dollars.

From this we can easily calculate that a total job base (at $40,000/job, which is at or near regional median income) of *between 2,905 to 4,815 family wage jobs could potentially be supported by fishing in the Klamath or generated by salmon fishing on stocks originating from this basin. This is the potential economic productivity of the Klamath as a salmon producer in today's economy. It is also a measure of the potential number of jobs which are at risk if salmon declines in the basin continue.*

This figure also excludes <u>*all*</u> economic benefits allocated by Meyer (Table 3) to the category of "non-market benefits" and so may be greatly understating the true social value of this fishery. Once added back in these non-market economic benefits would bring the total annual personal income impacts to much higher numbers. Hence the above estimates, based entirely on market benefits, should be considered conservative.

Table 2
Annual Potential Harvests Which Could Be Derived from Historic Salmon and Steelhead Run Sizes in the Klamath Basin.[11]

Species	Estimated Pre-Development Run Size - Range /1			Harvest (at 50% of Run Size) - Range			Average Weight per Fish (pounds)	Total Fish Weight (pounds) - Range		
Late Fall Chinook	22,500	-	45,000	11,250	-	22,500	15.0	168,750	-	337,500
Winter Chinook	45,000	-	90,000	22,500	-	45,000	15.0	337,500	-	675,000
Spring Chinook	160,000	-	320,000	80,000	-	160,000	15.0	1,200,000	-	2,400,000
Fall Chinook	205,000	-	410,000	102,500	-	205,000	15.0	1,537,500	-	3,075,000
Coho	75,000	-	75,000	37,500	-	37,500	9.0	337,500	-	337,500
Steelhead	150,000	-	150,000	75,000	-	75,000	8.5	637,500	-	637,500
Total	657,500	-	1,090,000	328,750	-	545,000		4,218,750	-	7,462,500

[11] Notes: Based on square mile comparisons between Columbia River and estimates of historic species comparison of the Sacramento River for chinook. Coho and steelhead estimates are based on northern California harvest rates.

Table 3
Potential Annual Benefits Associated with a Catch of 1,000 Adult Klamath Salmonids (from Meyer) in 1984 Dollars.

Benefiting Group	Business Benefits in Dollars	Non-Market Benefits in Dollars (based on restorative activity)	Subsistence, Cultural, Religious, & Social Benefits
Commercial Fishermen			Supports way of life
			Provides 7,000 to 7,500 lbs of food
• Chinook	22,090		
• Coho	14,040		
Sport Fishermen			Provides 7,000 to 7,500 lbs of food
• Chinook/coho	28,730	128,080	
• Steelhead		172,370	
Indian Peoples			Maintains cultural and religious well-being
• Chinook	22,090		Provides 7,000 to 7,500 lbs of food
• Coho	14,040		
Coastal Communities			Provides 7,000 to 7,500 lbs of food
	10,030		Supports basic community way of life
• Commercial chinook	6,380		
• Commercial coho	56,510		
• Sport fish			

MARKET BENEFITS = $173,910 (expressed in 1984 dollars [12])

Note: One problem with using that figure today was that it was originally in 1984 dollars. In order to convert that into 2009 dollars one must use an escalation factor derived from the increases in the Consumer Price Index (CPI) since that time. This factor turns out to be 2.03.[13] Thus in 2009 dollars 1,000 adult harvested Klamath salmon could generate as much as **$353,416** in total net economic benefits and personal income impacts in accordance with Meyer's figures.

Making this adjustment to 2009 dollars we have the following per 1,000 fish values:

MARKET BENEFITS = $353,416 (expressed in 2009 dollars)

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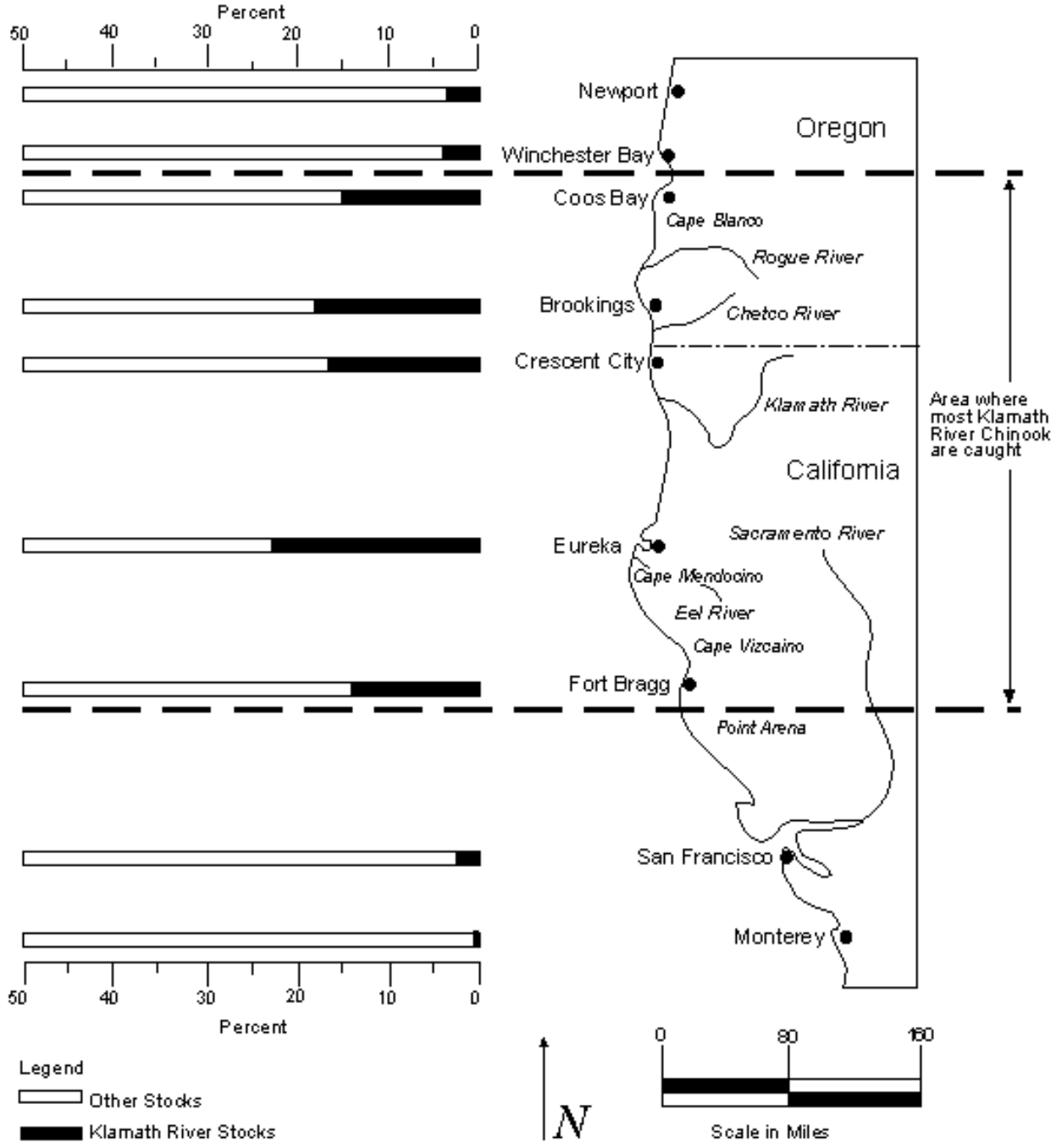
[12] *The Meyer report relied heavily on recreational and aesthetic non-market benefits to estimate total economic values of restoration. However, these values are inherently less certain and more speculative than purely market values. The decision was therefore made in this report to use commercial value as our sole indicator of economic value because it is the most easily quantifiable using well established methodologies.*

[13] *The escalation factor "P" is derived as follows: P = CPI09 ÷ CPI84 = 211.14/103.90 = 2.03. The Consumer Price Index (CPI) set by the Bureau of Labor for 1982-1984 = 100. For more information on the CPI and a CPI calculator see the U.S. Bureau of Labor Statistics site at: http://www.bls.gov/CPI. CPI adjustments can also be easily calculated on the Internet at: http://data.bls.gov/cgi-bin/cpicalc.pl.*

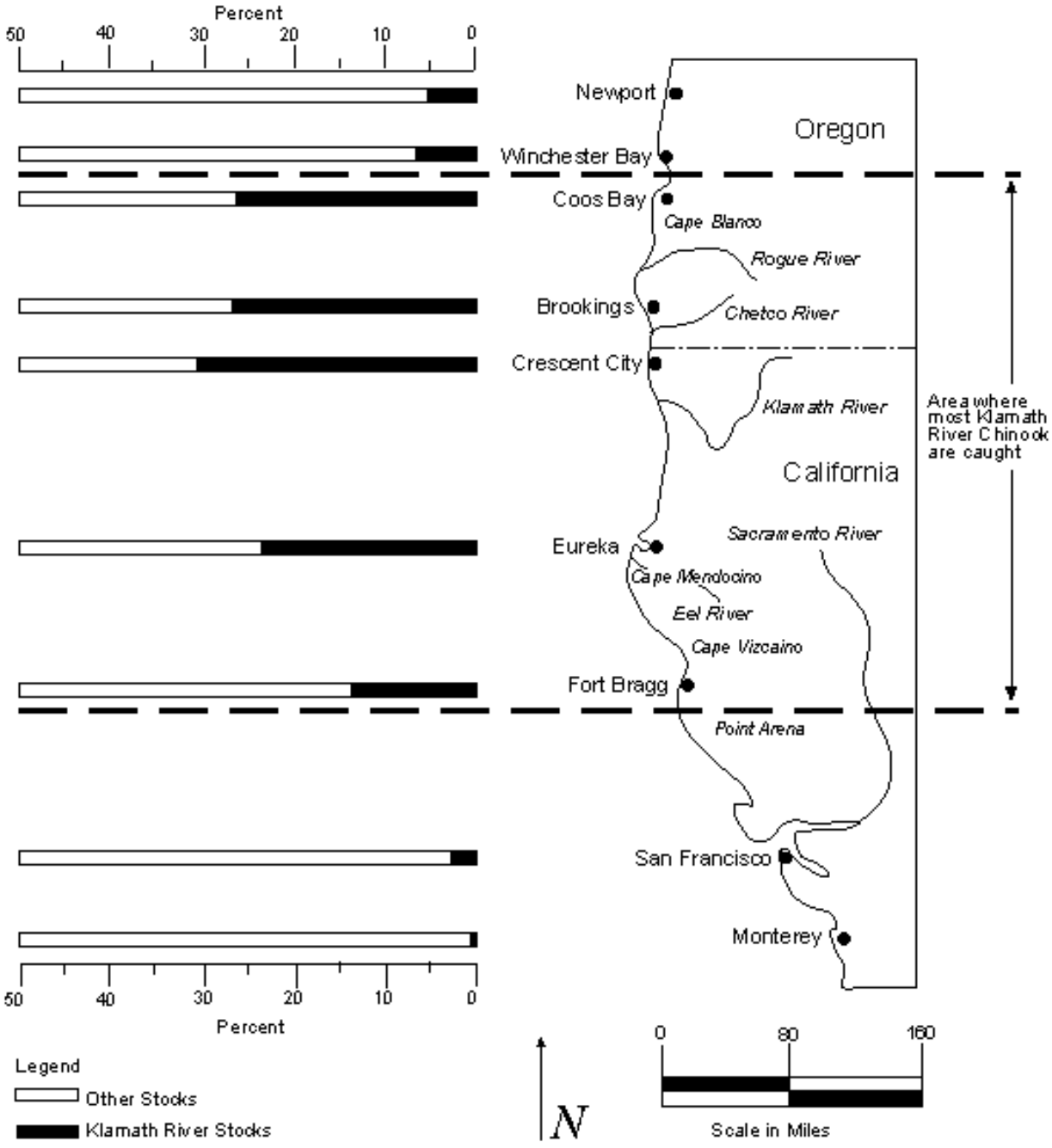
Figure 1

Distribution of Recoveries of Coded Wire Tagged Klamath Fall Chinook in the 1979–1983 Ocean Fisheries



Source: US Dept. of Interior (1985), maps prepared by CH2M Hill

Figure 2
Contribution of Coded Wire Tagged Klamath Fall Chinook by Port in the 1979–1982 Ocean Fisheries



Source: US Dept. of Interior (1985), maps prepared by CH2M Hill

ATTACHMENT 5

Aaron J. Douglas Klamath Fishery Values Report

FINAL PRE-PUBLICATION COPY 12-03

Making Unbiased TCM Benefits Estimates with Klamath River Basin TCM and Contingent Use Data

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ABSTRACT

Several northern California coastal rivers provide important regional social and economic benefits. California's lower Klamath River provides recreationists with an ensemble of activities including swimming, wading, canoeing, whitewater rafting, and angling. In the early 1900's, the Klamath was widely regarded as one of the nation's finest salmonid fishing streams. In this paper we estimate the nonmarket recreational benefits provided by the lower Klamath River with the travel cost method (TCM), and compare the benefits with the costs of restoring the fishery. Klamath River anadromous fish runs have declined in size and viability during most of the post-World War II period, but the decline accelerated sharply during the 1980's and 1990's. Throughout this period, low river water quality has been a major causal factor underlying the decreases in fish stocks. The benefit-cost estimates of the current analysis provide baseline TCM estimates of $2.026531 billion ($7.327008 billion) per annum. Restoration benefits for the Klamath River (of the Klamath-Trinity system) are estimated by combining the baseline TCM estimates with survey based contingent use (CU) data. The combination of these two data types facilitate a comparison of the benefits and costs of improving the water quality of the Klamath River and the freshwater harvests of the Klamath-Trinity system.

1. Introduction

We use the travel cost method (TCM) and survey data to estimate the nonmarket recreation benefits provided by California's lower Klamath River. We also present a new "alternative" TCM consumer surplus model. We argue that conventional TCM techniques overestimate aggregate trip expenditures and regional employment effects. On the other hand, conventional TCM consumer surplus (CS) estimates have a negative bias. This particular set of issues comes to the forefront in the Klamath and Trinity River (Douglas and Taylor, 1999) TCM benefits estimates because aggregate recreation trip expenditures for these rivers are quite large and have a notable economic impact.

The TCM data were gathered from a survey distributed to users of the lower Klamath River and its major tributaries in the winter and spring of 1997-98. A similar Trinity River recreational survey was distributed in this region in 1993-94. Hence, survey respondents were informed that water based recreation trips to the "Lower Klamath River Basin" are trips to "the Klamath River below Iron Gate, all tributaries of the mainstem Klamath River and any streams that flow into Klamath River tributaries--except for the Trinity River".

The headwaters of the Klamath River are in southern Oregon above Klamath Lake (see Figure 1). The Iron Gate and Copco Dams divide the Klamath River into lower and upper reaches; only the lower reach has anadromous fish (Quinn and Quinn, 1983). The Klamath River Development Project (project) has major adverse water quality impacts on both the upper and lower basin (Klamath River Basin Fisheries Task Force, 1991; listed hereafter as "Task Force, 1991").

2. Klamath River Basin Water Management Issues

The Klamath River Development Project

Oregon and California passed legislation ceding lands to the project in 1902; construction began in 1905. The project delivers water designated by U.S. Bureau of Reclamation contracts to 240,000 acres of project land (U.S. Bureau of Reclamation, 2000). The dams, tunnels, canals, and pumping stations of the project are designed so that project waters can be reused several times. The mean per acre net use for project water is 2.0 acre-feet; in 1999 roughly 199,000 acres were irrigated with 400,000 acre-feet of water. The value of the irrigated crops produced on project lands in 1999 was $104 million ($112.3 million in 2002 dollars) (U.S. Bureau of Reclamation, 2000).

The project drains land in the lower Klamath and Tule Lake regions, diverts and stores irrigation water supplies, and prevents flooding on the drained lands (U.S. Bureau of Reclamation, 2000). The Lost River provides substantial quantities of project water although the Klamath is the major source of project irrigation water. Contaminant loading from runoff in the upper basin has adverse aquatic habitat impacts on the lower basin (Task Force, 1991). Klamath River Basin substrate formations contain large amounts of phosphorous and the underground movement of the agricultural return flows does not lower phosphorus levels in the water (Campbell, 2001).

Water Resource Management Issues

The mainstem of the Lower Klamath River is about 190 river miles in length (Quinn and Quinn, 1983). The major tributaries of the Klamath--the Trinity, Shasta, Scott, and Salmon Rivers--are northern California Rivers (see Figure 1). Before the development of the Klamath River Basin project, the mean annual flow (maf) of the Klamath River at Weitchpec was about 1.4 million acre-feet. The maf of the Klamath River at Weitchpec is now about 1.6 million acre-feet (U.S. Bureau of Reclamation, 2000). However, before the completion of the Trinity River project in 1964, the maf of the Trinity River at Weitchpec was 1.2 million acre-feet. It is now about 340,000 acre-feet per annum. Trinity River water diversions have sharply lowered Klamath River flows below Weitchpec and produced major adverse impacts on Klamath-Trinity system fish stocks (Task Force, 1991; Bartholow, 2001).

The Klamath River Basin Act (P. L. 99-552) of 1986 notes that "floods, the construction and operation of dams, diversions and hydroelectric projects, past mining, timber harvest practices, and road-building have all contributed to sedimentation, reduced flows, and degraded water quality which have significantly reduced the anadromous fish habitat in the Klamath River system". The act authorizes funding for a 20-year Federal-State cooperative Klamath River Basin Area Restoration Program to rebuild Klamath River Basin fish stocks.

Figure 1 gives one only a hint of the diversity of the water resources of the lower Klamath River Basin. There are 44.1 river miles in the Salmon, 30.1 miles in the North Fork of the Salmon, 63.6 miles in the Scott, and 43.6 miles in the Shasta River. Dozens of small creeks and streams flow into the Shasta, Scott, Salmon and mainstem of the Klamath River. Hence, there are more than 400 water miles in the lower Klamath River Basin. There are no impoundments on the mainstem of the lower Klamath River.

The recreational activities provided by the lower Klamath River and its tributaries include swimming, wading, canoeing, whitewater rafting, angling, and shoreline activities (Quinn and Quinn, 1983). A fish hatchery at Iron Gate annually releases millions of chinook (king), coho (silver) salmon, and steelhead (trout) fingerlings into the Klamath River (Quinn and Quinn, 1983). The hatchery output has helped sustain regional tribal, marine, and sportfishing harvests. However, declines in Klamath-Trinity system stocks are a major concern (Task Force, 1991).

The river provided habitat for several endemic species including American eel, green sturgeon, white sturgeon, American shad, coast cutthroat trout, steelhead trout, chinook (king) salmon, and coho (silver) salmon (Quinn and Quinn, 1983). Species native to the estuarine area near Requa include surf smelt, starry flounder, and redtail surf perch (Quinn and Quinn, 1983). The freshwater anadromous sport fish harvests below Weitchpec in the 1950's rose to more than 100,000 fish per annum. The Klamath River Basin survey notes

that in the mid-1980's, the average annual harvest on the mainstem was in the 8,000-12,000 fish per annum range although large harvests rose as high as 18,000 fish. The survey assumes that the mean current fresh and marine sport harvests for the lower Klamath Basin are 25,000 fish per annum and that sustained sport harvests of 38,000 (50% increase) and 50,000 (100% increase) are feasible (Task Force, 1991).

3. The Klamath River Survey

The Center for the Resolution of Environmental Disputes (CRED), a northern California based not-for-profit organization, distributed marine and freshwater printed surveys in the winter-spring of 1997-98. CRED supplemented the survey data base with responses to a streamlined phone version of the survey. The phone survey omitted contingent use (CU) queries but included contingent valuation method (CVM) willingness-to-pay (WTP) questions. The phone survey was administered "cold"; respondents did not see printed versions of the survey questions before being contacted by phone calls. The entire survey was also administered over the phone to mail survey non-respondents.

The marine survey preamble designated "a region around the mouth of the Klamath River Basin as being the area in which augmented Klamath-Trinity River fish stocks would have the greatest positive impact on the marine sport fishing harvest". The region stretches from Fort Bragg to Gold Beach just north of the California-Oregon border.

Response Rates

There were only 382 responses to the initial mail-out of 1010 surveys. However, an additional 234 surveys were obtained from a follow-up phone survey administered to non-respondents. Finally, there were 200 responses to the streamlined version of the phone survey in the data base. Thus, 816 completed surveys were returned to CRED, and 809 responses were used in the economic analyses. After address unknowns and mail-outs to non-user households are excluded, there were only 749 potential responses in the initial mail-out. Thus, the response rate (*R.R.*) for the initial mail-out was *R.R.* = (382)/749 = 51.01%; for the phone survey, *R.R.* = (200)/204) = 98.03%; and for the 234 follow-up phone responses *R.R.* = 100%. For the composite data base, *R.R.* = (809)/(953) = 84.8898%.

Participation Rates

CRED randomly called 200 households in Nevada, California, Oregon, and Washington (e.g., 800 households in the western U.S.) and asked if they had been to the Klamath River in the last 3 years. The participation rate is the positive response rate percentage divided by 3. The participation rate(s) are 0.5% for Nevada, 1% for California, 9% for Oregon, and 0% for Washington.

There were 676,000 Nevada households, 11,446,000 California households, and 1,286,000 Oregon households in 1998 (U.S. Bureau of the Census, 2000). Hence, 233,580 households made recreation trips to the lower Klamath River in 1998 including: (1) 3,380 Nevada households, (2) 114,460 California households, and

(3) 115,740 Oregon households (we estimated the number of households with 1998 data and used 1997 dollars to estimate benefits).

4. The TCM data

Foregone Wages

The mean income of the respondents was $64,880.24 (668 cases) in 1997 (1997 dollars). The conventional estimate of mean per trip foregone income is the product of the average trip time and the hourly family wage rate. The mean hourly income is the mean family income divided by the number of hours in 365 days (8,760 hours). The mean hourly family income was $7.4064. For TCM studies the estimation of aggregate foregone wage (FW) is problematic. A graduate textbook notes that: "Another difficulty with the travel cost approach is the unobservable value of time involved for site visits. The greater the travel distance, the less attractive a site becomes, not only because of direct monetary expense but also because of time spent driving, and so on." "Appropriate valuation of user costs necessarily involves determination of leisure time foregone; otherwise, user costs do not adequately reflect true marginal benefits" (p. 292; Just *et al*., 1982).

We use a household wage rate in this paper. Contractual rigidities that prevent an individual from adjusting his hours worked in response to economic factors do not prevent a family from making large shifts in hours worked through entrance into and exit from the labor force by household members.

Transient Visitors

"Transients" provided cost data for trips but did not usually make recreation trips to the lower Klamath River Basin and reported zero trips for the last 12-months. All survey "transient" respondents made at least one recreation trip since 1990. The trips variable we use for the Klamath River data survey analyses is the number of usual trips if it is available, and if it is unavailable, trips for the last 12-months. We imputed a small number of trips for transients, thereby adjusting the original estimate of 7.5520 trips per annum upward to 10.0646 trips (697 cases).

There were 571 non-transient respondents and 128 transients; 56% of the transients made a visit less than 36-months prior to receiving the survey. The maximum number of imputed trips for the transients was 5 (imputed to 8 transients) and the minimum number was zero (imputed to 44 transients). Thus, 6.3% of the 697 cases were "zeros" (e.g., cases with positive costs and zero trips) (Creel and Loomis, 1990).

The probability of imputing a non-zero value to a transient was a monotonically increasing function of the year last visited. The probability of a non-zero value was 0.88888 for those who visited in 1997 and 0.11111 for 1990 visitors. If a transient lived within 50 miles of the site, she was imputed 5 trips. If she lived more than 400 miles from the site, she was imputed 1 trip. Respondents who usually made trips to the site and lived within 50-miles of the site made about 50 trips per annum (sample mean).

The mean (maximum) one-way distance of a trip to the usual site was 268.1628 miles (3,000 miles), and the average (maximum) cost of a trip was $469.131 ($6480). Although no transit time data are available, time on-site data are available for all three sub-samples and we used these data to estimate the value of aggregate foregone wage (FW). We used 6,000 hours on-site--about 8 months and one week--as the cutoff point for outliers for total time on-site. We estimate labor's share of national income to be 78.877% of national income by averaging data from Table 700 of the 1997 *U.S. Statistical Abstract* (U.S. Bureau of the Census, 1998) for 1992-96 and assume that 25% of proprietary income is a return to capital. Hence foregone hourly wages are $5.84195. Because we deduct property income from foregone income, we did not attempt to weed out retiree income. Thus, the use of the conventional methodology indicates that the mean time on-site was 2045.5001 hours, and mean annual FW was $11,949.7015 (547 cases). However, the conventional methodology produces a sharp upward bias in the estimate of aggregate FW.

5. A New Approach to Making TCM Consumer Surplus Estimates

The Definition of Consumer Surplus; the TCM and Consumer Surplus

The consumer surplus (CS) is a generic measure of the benefits provided by a market good or service. The TCM estimates the CS for recreation trips. The CS is the triangular area bounded from above by the demand curve, from below by the horizontal line linking the vertical price axis to the equilibrium price, and by the price axis (see Figure 2). Let p (p_e) be (the equilibrium) price, q be the number of items purchased per unit time, and $f(p)$ be the

demand curve. If $U > p_e$ is the choke price shuts off demand, the CS is the definite integral

$$CS = \int_{p_e}^{U} f(p)dp . \qquad (1)$$

Let y be the trips in the last-12-months, d be roundtrip travel distance in miles, e be trip expenses, $tc = (c*d)$ be "travel cost" in dollars, and let the regression model be

$$y = K + b_1(tc) + b_2(e) \; ; \quad K > 0, \; b_1 < 0, \; b_2 < 0 . \qquad (2)$$

The variable of integration is the "active" price variable, and the other price variable is an "auxiliary variable". To evaluate the definite integral, the product of the estimated coefficients of the auxiliary variables and the respective sample means are added to K to form a grand constant $G = K + \sum(b_i)(\overline{x}_i)$. Because tc is the active price for most TCM studies, Douglas and Taylor (1999) multiply $(CS)_e$ by r, $r = tc_m/e_m$, $0 < r < 1$ to convert $(CS)_e$ into a number comparable to $(CS)_{tc}$. We also use this procedure, and for the Klamath River data C.F. = r = ($166.261/$469.131) = 0.354401939 (the Trinity C.F. = 0.3086566).

If the choke price is infinite we could use the largest sample value of tc as the upper limit of integration because everyone who makes a trip receives at CS of at least a dollar (Douglas and Taylor, 1999). However, because the largest value varies sharply across data sets, Douglas and Taylor (1999)

suggest setting the upper limit of integration so that it is 55%-75% of the maximum sample value.

A Source of Upward Bias

Let $E_s(tc)$ be the mean travel cost for the sample, $E_s(y)$ be the mean number of trips per household for the sample, $E_s[(tc)(y)]$ be the sample mean value of annual household trip expenditures, *TE* be aggregate expenditures for the sample, and N be the number of households making trips. An unbiased estimate of total expenses is

$$TE_u = N\{E_s[(tc)(y)]\} . \tag{3}$$

However, economists estimate TE as $(TE)_b = \{(N)[E_s(tc)E_s(y)]\}$. If COV(tc, y) is the covariance of *tc* and *y*, the conventional estimate of TE is biased;

$$TE_b = TE_u - COV(tc, y) = N E_s[(tc)(y)] - COV(tc,y) . \tag{4}$$

Because COV (tc, y) < 0, the conventional estimate of TE has an upward bias. Moreover, the conventional estimate of the CS underestimates benefits. We estimate p_e, the cost of a trip, as $p_e < E_s(tc)$;

$$p_e = \frac{E_s[(tc)(y)]}{E_s(y)} . \tag{5}$$

The use of this formula increases the estimated value of the TCM CS. If the demand curve is fixed and the supply curve shifts to the right because the social cost of producing the good decreases in a competitive market, the same number of items can be purchased with smaller aggregate expenditure and the social cost of supplying the good decreases (see Figure 3). The CS "triangular area" will increase (see Figure 3). Because the TCM CS is a simulation of a competitive market CS, the decrease in expenditures for trips should generate a correlative increase in the TCM CS. Note that we can and do make unbiased estimates of aggregate foregone wages by estimating the sample mean for the product of time on-site, household wages, and trips.

6. Klamath River Regression Models

The Household Regression Models

We provide regression results for household level and aggregated household data because household level TCM models often produce mediocre fits (Mitchell and Carson, 1989; Hof and King, 1992). We experimented with little success with linear and log-log ordinary least squares (OLS) models as well as Poisson, negative binomial, and Box-Cox maximum likelihood household data models. The Klamath River inverse price model does have high t-values (see Table 1). All of the regressions were run in Limdep™ (Version 7 for DOS; see Greene, 1995). The small finite choke price of the semi-log model precludes using the model to make CS estimates.

We recalculated the Trinity River *CS* with new limits of integration for a

Table 1. Household data OLS TCM regression models for the Klamath and Trinity Rivers. Usual trips is the dependent variable; t-values, p-values (two-sided test), and adjusted R^2 are listed in parentheses.

Klamath Model type	Intercept	Coefficient for TC	Coefficient for E	R^2 and F-statistic
Semi-log (665 cases)	76.500 (t = 13.261) (p = 0.00000)	- 14.710 (t = - 12.116) (p = 0.00000)	--------	0.18128 (0.18005) F = 146.80
Inverse price (649 cases)	0.55749 (t = 0.38917) (p= 0.69716)	19.926 (t = 6.7746) (p = 0.00000)	537.91 (t = 9.873) (p = 0.00000)	0.20019 (0.19772) F = 80.85
Trinity	--------	--------	--------	--------
Inverse price (617 cases)	1.9984 (t = 2.833) (p = 0.00461)	9.6996 (t = 11.566) (p = 0.00000)	60.686 (t = 10.305) (p = 0.00000)	0.38800 (0.38600) F = 194.63

new inverse price model so that the Klamath and Trinity River CS estimates are comparable. Thus, we use the same \$0.31 per mile *tc* for both data sets (Douglas and Taylor, 1999). A dollar is added to the expenses variable and \$0.155 is added to *tc* for both data sets to avoid dividing by zero. The lower limits of integration are determined by equation (5) for both data sets.

The grand constant *G* can be estimated in two ways with an inverse price model. Namely, the coefficient of the passive price variable can be multiplied by the inverse of the mean value of the price or by the mean value of the inverse. If the latter procedure is used to estimate *G*, the model passes through the means of the variables. The former method typically

produces estimates of aggregate trips and the CS that have a downward bias. The original Trinity River CS value is the average of a large unbiased CS estimate and a biased estimate equal to roughly 50% of the unbiased value (Douglas and Taylor, 1999). We use the unbiased estimates.

The Aggregated Data Models

One set of aggregated data was generated by 33 groups sequestered by $100 intervals. Thus, the first point is the mean number of trips, the mean expenses, the mean travel cost, mean one-way distance, and mean income for those respondents whose (mean) trip expense e was between $0 and $100. The last data point for the aggregated models was generated by the mean values for respondents whose mean expenses are greater than $4,000. The intervals used for this type of aggregation are called "bins". For this data set, only 33 bins had both trips and expenses data.

The distance counterparts to the aggregate expenses models have 36 data points. For this data set, there are (potentially as many as) 40 data points formed by estimating mean values for (usual) trips, expenses, travel cost, one-way distance, and income for bins formed by 15 mile increments. The final bin was composed of data from households whose one-way travel distance was greater than 600 miles. However, only 36 bins had both trips and distance data for the relevant interval (see Tables 2 and 3).

Table 2. Two weighted Klamath River OLS TCM regression models. The data points are 33 cases formed by estimating the mean values for trips, expenses, travel cost, and income for groups defined by $100 increments in expenses.

Model type	Intercept	Coefficient for TC	Coefficient for E	R^2 and F-statistic
Log-log model	4.1225 (t = 11.555) (p = 0.00000)	--------	- 0.61522 (t = - 7.540) (p = 0.00000)	0.64714 (0.63576) F = 56.85
Inverse price	0.27134 (t = 0.333) p = 0.74167	--------	362.73 (t = 17.235) (p = 0.00000)	0.90550 (0.90245) F = 297.04

Table 3. Coefficients for two weighted Klamath River OLS TCM regression models. The data are the mean values for trips, expenses, travel cost, and income for 36 groups defined by 15 mile distance increments.

Model type	Intercept	Coefficient for TC	Coefficient for E	R^2 and F-statistic
Log-log	5.1089 (t = 9.896) (p = 0.00000)	- 0.84447 (t = - 7.650) (p = 0.00000)	--------	0.63253 (0.62172) F = 58.53
Inverse price	0.11753 (t = 0.119) (p = 0.90635)	333.73 (t = 22.100) (p = 0.00000)	--------	0.93492 (0.93300) F = 488.41

7. Aggregate Expenditures, Foregone Wages, and Data Alignment

Recall that the product of the sample means for trips and expenses produces a biased estimates of mean household trip expenditures. Unbiased estimates of household and aggregate trip expenditures can be obtained as the sample mean value of the product of expenses and trips. If the mean sample size of the groups visiting the river is greater than the size of the average household, the CS and aggregate expenditures must be adjusted downward.

On the other hand, a correlative inverse upward adjustment must be made to FW. The sample mean size of the Klamath River trip groups is 4.16496 people and the mean size of respondent households is 2.88344. Thus, aggregate expenditures and the CS must be adjusted by multiplying the household values by (2.88344)/(4.16496) = 0.69230917. The FW must be adjusted by (4.16496)/(2.88344) = 1.4444614. The correlative values for the Trinity River are 3.331524 (household size) and 3.986322 (group size), and the adjustment factors are 0.83573881 and 1.1965461 (see Table 4).

We made an inflation rate adjustment of 1.11073 for the Klamath and 1.24498 for the Trinity River and a population growth adjustment of 1.129168 for the Trinity. We used population growth data for California, Nevada, and Oregon to estimate the Klamath River user household population for 2002 (246,041). Our recent inflation data came from the U.S. Department of Labor's online consumer price index (CPI) inflation calculator (http://www.bls.gov.cpi). Recent population data are also online (Family Education Network; http://www.infoplease.com) (both sites accesed in November,

Table 4. Conventional and unbiased estimates of annual household trip expenditures and FW in 1993 (Trinity) and 1997 (Klamath) dollars; conventional and unbiased aggregate expenditures and FW in 2002 dollars and population base for both rivers; and the present value of the 2002 Klamath-Trinity unbiased expenditure estimates (discount rate of 7.5%; cases are in parentheses).

Klamath River	Expenditures	Foregone Wages
Conventional household	$4,721.6382	$11,949.702
Unbiased household	$1,969.8817 (676)	$2,560.8692 (560)
Conventional aggregate	$893,316,485	$4,717,127,450
Unbiased aggregate	$372,696,095	$1,010,899,423
	----------	----------
Trinity River		
Conventional household	$3,312.3886	$5,742.3965
Unbiased household	$1,353.3667 (634)	$2,238.0771 (1172)
Conventional aggregate	$2,769,233,443	$8,714,047,949
Unbiased aggregate	$1,131,445,861	$2,636,090,854
	----------	----------
Unbiased Klam.-Trin. P.V.	$20,055,226,080	----------

2003). Population and price data data are also available in the *U.S. Statistical Abstract* (U.S. Bureau of the Census, 2000) series. We assume that the growth in households is proportional to the growth in overall population.

We use the number of respondents per bin as weights for weighted regressions for the aggregated data sets. Weighting is widely used in situations similar to ours in which the precision of the dependent variable increases with the number of cases. The weighted mean of trips is equal to the mean of the trips variable in the original data set.

We also apply a linear transform to the observations of the independent variables so that they have mean(s) equal to their original counterparts. For the linear and inverse price models the transform did not affect any model statistics--including R^2, *t*-values, and *F*-statistics--but there was a slight effect on the statistics of the log-log models. The back-transform is an "ad hoc" procedure for the log-log models. We use the expenses-to-travel cost C.F. to estimate the lower limit of integration for *tc*. Aggregate CS estimates based on the assumption that each trip is made by a household must be adjusted downward by the ratio (2.88344)/(4.16496) = 0.69230917. The lower limit of integration for the household CS expenses (tc) estimates for the Klamath is $195.72379 ($69.364883) and for the Trinity it is $226.27010 ($69.839750) (see equation (5)).

8. Contingent Use (CU) Data and Benefits Estimates

In the ensuing benefit versus cost analysis we use $2.0265312 billion per annum (1997 dollars; see Tables 5 and 6) as the baseline benefit estimate for the restoration of the Klamath River and its major tributaries (except for the Trinity River). The counterpart value for the Trinity River is $7.1298250 billion per annum in 1997 dollars.

The Klamath River survey queried respondents about the increments in trips generated by certain amenity improvements including: (1) a 45% increase in water quality, (2) a 50% increase in angling harvests, and (3) a 100% increase in angling harvests. These queries provided our contingent use (CU) data Note that the maximum feasible improvement in chlorophyll loading in the

Table 5. Annual per household CS estimates for Klamath and Trinity River TCM models household data models in 1997 dollars, and Klamath River aggregated data TCM model CS estimates in 1997 dollars.

Klamath Models	Raw Benefits	Expenses C.F.	Log C.F.	Final Version
Exp. CS values				
Table 1. Inv. Exp	$9,241.8248	0.354401939	-------	$3,275.3206
Table 2. log-log	$2,681.3058	0.354401939	2.17880109	$2,070.4274
Table 2. Inv. Exp	$2,128.5013	0.354401939	-------	$754.3450
TC CS values				
Table 1. Inv. tc	$7,188.8191	-------	-------	$7,188.8191
Table 3. log-log	$1,148.5356	-------	2.79436340	$3,209.4265
Table 3. Inv. tc	$1,084.9498	-------	-------	$1,084.9498
Trinity Model				
Table 1. Inv. Exp	$15,306.6411	0.308656555	-------	$4,724.4951
Table 1. Inv. tc	$7,594.6240	-------	-------	$7,594.6240

Table 6. Aggregate annual CS, FW, and total benefits estimates for recreation trips to the lower Klamath and Trinity Rivers in 1997 dollars and population levels. System benefits are the sum of values in rows 3 and 6.

Klamath River	Consumer surplus	Foregone wages	Total
Table 1. Inv. Exp.	$529,650,705	$864,030,335	$1,393,681,040
Table 1. Inv. tc	$1,162,500,888	$864,030,335	$2,026,531,223
Trinity River	----------	----------	----------
Table 1. Inv. Exp.	$3,011,274,739	$2,289,202,039	$5,300,476,778
Table 1. Inv. tc	$4,840,622,949	$2,289,202,039	$7,129,824,988
Klamath-Trinity	CS	FW	Total
Grand sums	$6,003,123,837	$3,153,232,374	$9,156,356,211

waters of the lower Klamath River Basin is 45% (Campbell, 2001). Chlorophyll produces algae blooms which create malodorous waters, painful skin rashes on contact, and fish kills.

CU data can be validated by on-site counts estimating the change in visits induced by an amenity improvement (Duffield *et al.*, 1992). CU non-responses were estimated at either 30% (small number of non-respondents) or 25% of the value for respondents. To convert increments in trips to increments in benefits, the percentage increment in trips was multiplied by the baseline value of $2.0265 billion per annum. We have information about the qualitative importance of the various restoration activities, but no quantitative data about the impact of the various activities. Therefore, we simply sum the costs for four major restoration activities and compare them with the sum of the present values (see Table 7) of the CU-TCM benefits estimates for a 45% water quality improvement and a 100% sport fish harvest enhancement.

9. Habitat Restoration Costs

We estimated the present values in 1997 dollars for the costs of: (1) the purchase of project farmland; (2) the purchase of environmentally sensitive forested land; (3) increasing Trinity River instream flows; and (4) the removal of some Klamath River dams. We used 1992 and 1997 data in Table 1103 of the *U.S. Statistical Abstract* for 2000 to estimate the cost of acquiring the 240,000 acres project farmland. In 1997, there were 17.4 million acres of Oregon farmland with a value of $16.316 billion. Hence the mean value of an acre was $16,316 million/17.4 million acres = $937.70 per acre. We multiplied

Table 7. Klamath River CU-TCM values in 1997 dollars. Annual values are 10.0646 for trips and $2.0265 billion for the CS plus FW.

Amenity Improvement	Increment in trips	90% Confidence limits	CU-TCM benefit increment in millions
45% increase in water quality	1.3449929 (13.3636%)	±0.3336213 (±24.8047%)	$270,817,529
50% increase in angling harvest	1.5176829 (15.0794%)	±0.3190164 (±21.01902%)	$305,589,074
100% increase in angling harvest	2.2468121 (22.32391%)	±0.5200510 (±23.1462%)	$452,400,978
45% increase in water quality plus 100% increase in harvest	3.591805 (35.6875%)	--------	$723,218,506

$937.70 by 240,000 to derive the value of project farmland.

We estimated the annual cost of increasing the Trinity River maf from 340,000 to 840,000 acre-feet per annum--$42.897 million in 1993 dollars--by adjusting the published value for inflation to $47.622 million in 1997 dollars and then discounting at 7.5% (Douglas and Taylor 1998).

We imputed the same CS per kilowatt hour (KWH) for the Klamath River PacifiCorp complex as that provided by the Trinity River Bureau of Reclamation complex. The CS is the price differential per KWH between electric power from all sources and Trinity River hydropower times the number of KWH. The 1997

annual output of Copco #1 and #2, J. C. Boyle, and Iron Gate Dams was 916.676 million KWH (Prendergast, 2001). We adjusted the estimated value of $20.625 million for inflation and discounted the annual value by 7.5%.

There are nearly 10,000 acres of forested lands within 200 feet of the river channels of the lower mainstem Klamath and the Scott, Shasta, and Salmon Rivers. Because there are numerous creeks that empty into the mainstem Klamath we estimated the cost of acquiring a 20,000 acre buffer strip around the rivers and streams of the lower basin. There are 622,760 acres located on slopes of more than 20% (rise over run) within 2 miles of the Scott, Shasta, Salmon and the lower mainstem Klamath (Giles, 2001). We used $1200 (buffer strips) and $800 (steep slopes) per acre as acquisition costs (Frey, 2001; see Table 8).

The present value (7.5%; 1997 dollars) of the costs for 3 minor habitat restoration activities are: (1) $50,000,000 for channel management (U.S. Bureau of Reclamation, 1997), (2) $25,000,000 for wetland and farmland re-vegetation and restoration, and (3) $25,000,000 for the removal of project infrastructure and dam alterations (Bartholow, 2001; Campbell, 2001; Flug, 2001; Henriksen, 2001).

The Trinity River CS plus FW estimates for putting more water down the Trinity should be included in our analysis. The Trinity River annual TCM baseline benefits estimate listed in Table 6 is $7.12982499 billion. The annual CU-Trinity increment is 33.9639447% of total benefits, hence the annual Trinity River CU-TCM incremental value is $2.4215698 billion. The annual

Table 8. Present values for benefits and costs of major water quality improvement and aquatic habitat restoration activities in 1997 dollars.

Major activity	Cost	Klamath River TCM-CU benefit P.V.
Acquire Project farmland	$225,048,276	$9.64291342 billion
Acquire forest land	$522,208,000	$9.64291342 billion
Trinity River water	$634,965,398	$9.64291342 billion
PacifiCorp hydropower	$324,067,176	$9.64291342 billion
Total habitat restoration cost	$1.7062889 billion	$9.64291342 billion

Klamath-Trinity system CU-TCM increment is $3.1447883 billion; the present value of the Klamath-Trinity CU-TCM increment is $41.93051095 billion (7.5% discount rate; 1997 dollars).

We include an estimate of the cost of a 24-month fishing moratorium. This ban would be similar to those of the 1992-95 period which--with limited exceptions--closed commercial marine salmonid harvesting from the Oregon-California border to Point Arena. The ban would include freshwater harvests. Annual ceremonial tribal harvests would be limited to 200-300 freshwater fish, and hatcheries would be operated in a mode designed to increase self-reproducing stocks of fish. If the fishery responded quickly to the habitat restoration measures, no ban would be imposed.

Karuk, Yurok, Hoopa Valley, and Klamath tribal members and commercial fishermen would be compensated (see Table 9). The target is $12,500 for every tribal member--hence a family composed of four tribal members would receive $50,000--and $16,665 for every commercial fisherman. We estimated payment costs for 15,000 tribal members including 13,617 members in the four principal tribes and 1,139 members of 5 smaller tribes (Risling, 2002). However, we did not verify the willingness-to-accept a 2-year fishing moratorium in exchange for our payment proposals with any tribal or commercial fishing organizations. There are 19,817 fishing related jobs in California, and we estimated payment costs for 20,000 workers in 1997 dollars (U.S. Bureau of Labor Statistics, 2001a, 2001b; see Table 9).

10. Statistical Reliability

The statistical reliability of TCM CS estimates has rarely been discussed in the literature. Let $\overline{x}$ be the sample mean value of x, S_x be the standard deviation, and $(S.E.)_x$ be the standard error of x. Formulas for $(S.E.)_x$, and $(C.L.)_x$ are

$$(S.E.)_x = \frac{S_x}{\sqrt{N-1}}; \qquad (C.L.)_x = \overline{x} \pm [(S.E.)_x]\, t_{(\alpha/2)}. \tag{6}$$

Bootstrap C.L.'s of CS can be constructed with a computer by generating hundreds of virtual replicates of the original data set by drawing samples with replacement (Efron and Tibshirani, 1993). We computed bootstrap C.L.'s for our original CS estimates for the Klamath and Trinity Rivers. However, Limdep™ (ver. 7 for DOS) provides estimates of the standard deviation of the

Table 9. Costs of major, minor habitat restoration activities, and leasing of regional fishing rights versus the benefits from Trinity River enhanced flow and Klamath River fishery and quality restoration activities (1997 dollars).

Cost or benefit estimate	Present values for Costs	Trinity River Benefits P.V.	Trinity plus Klamath River Benefits P.V.
Minor restoration costs	$100,000,000	-------	------
Major restoration costs	$1.7062889 billion	-------	------
Leasing of Fishing Rights	$520,800,000 million	-------	------
Present value of benefits and all costs	$2.3270889 billion	$32.2875982 billion	$41.9305100 billion

unbiased estimates of the foregone wages and expenditures and we use the output in conjunction with the C.L. estimates for the CU-increments to make bottom-of-range estimates for the unbiased estimates of FW. The lower edge C.L. (90%) for the CU trips increments are 27.205579% (Klamath) and 29.714035% (Trinity). For the Klamath, the bottom-of-range C.L. (90%) estimate of aggregate annual foregone wages (FW) is $190,198,408 and the present value is $2.535978768 in 1997 dollars. The bottom-of-range present value for the CU linked FW increment for the Trinity is the $8.107475616 billion (1997 dollars, 1998 population), and for the Klamath-Trinity system it is $10.64345438 billion in 1997 dollars (see Table 10).

Unfortunately, we had no bootstrap C.L.'s for the CS for our revised CS estimates. However, our perusal of the bootstrap programming results indicate that: (1) the higher the R^2 (multiple correlation coefficient) the tighter the C.L.'s, and (2) the bottom edge of the C.L.'s span a range of about 25%-75% of the mean. If we use a lower C.L. that is 33% of the value of the point estimate of the CS for the Klamath-Trinity system, the C.L. for the CS has a present value of about $7 billion.

We used Limdep™ standard deviation estimates for trip expenditures to estimate a bottom-of-range C.L. (90%) for the CU expenditure increment generated by the restoration of Klamath-Trinity system water quality and fish stocks. The present value of the lower C.L. value is $4,929,243,541 in 2002 dollars for a 2002 population base (see Table 10).

10. Policy Implications and Concluding Remarks

The nonmarket benefits point estimates of restoring the Klamath River anadromous fish runs and improving water quality are much greater than the estimated costs of these amenity enhancements. Moreever, the policy implications of the controversial large CVM existence benefits estimates of river restoration by other economists (Loomis *et al.*, 1990; Welsh *et al.*, 1995; Douglas and Taylor, 1999) are supported by the present study. User CVM benefits are comparable to marginal TCM benefits as measured by survey CU data. Existence benefits are roughly comparable to CS TCM baseline benefits estimates. The Klamath-Trinity system annual baseline CS TCM estimate of $6.0031238 billion (1997 dollars and population) is large even by national

Table 10. Lower 90% C.L.'s for the Klamath-Trinity CU increment in trips expenditures (2002 dollars and population) and benefits (FW) in (1997 dollars, 1998 population) at 7.5% discount rate, and total restoration cost in billions of 1997 dollars (cost in billions of 2002 dollars in parentheses).

1997 (2002) Habitat Restoration Cost	2002 P.V. of CU Expenditure increment	1997 P.V. of CU Benefits Increment
$1.7062889 ($1.8952203)	$4.929243541	$10.64345438
----------	----------	----------
Habitat plus leasing		
$2.3270889 ($2.584759283)	$4.929243541	$10.64345438

survey existence benefits standards.

The Trinity River draws a large number of recreation trips from the large San Francisco-Oakland Bay Area. The Klamath draws a notable visitor contingent from the smaller Portland metropolitan area. Hence, rivers that draw visits from moderate sized urban areas but have attractive amenities can generate large TCM non-market benefits estimates.

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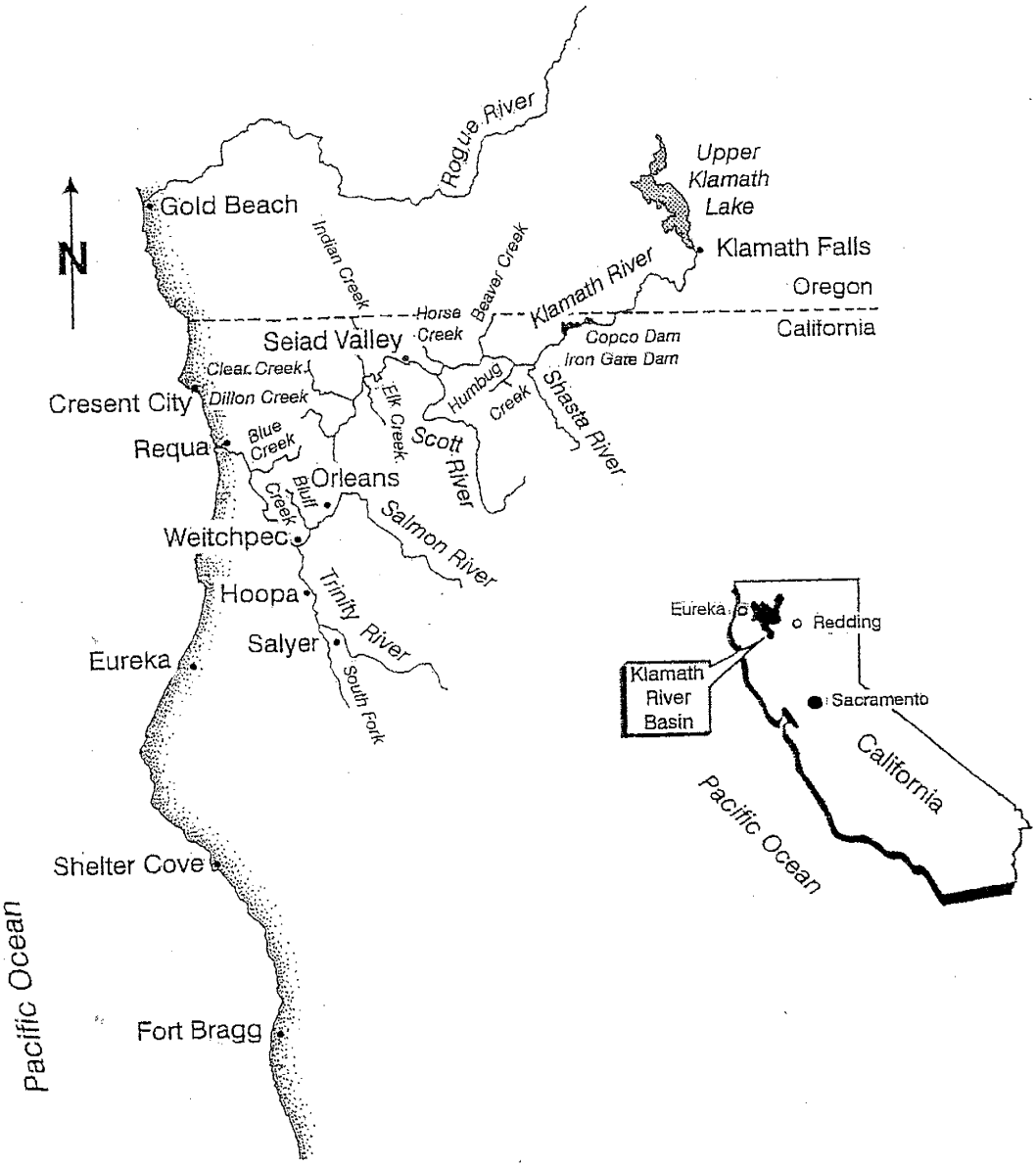

Figure 1. Map of Lower Klamath River Basin, the coastal zone, and major tributaries of the Klamath River.

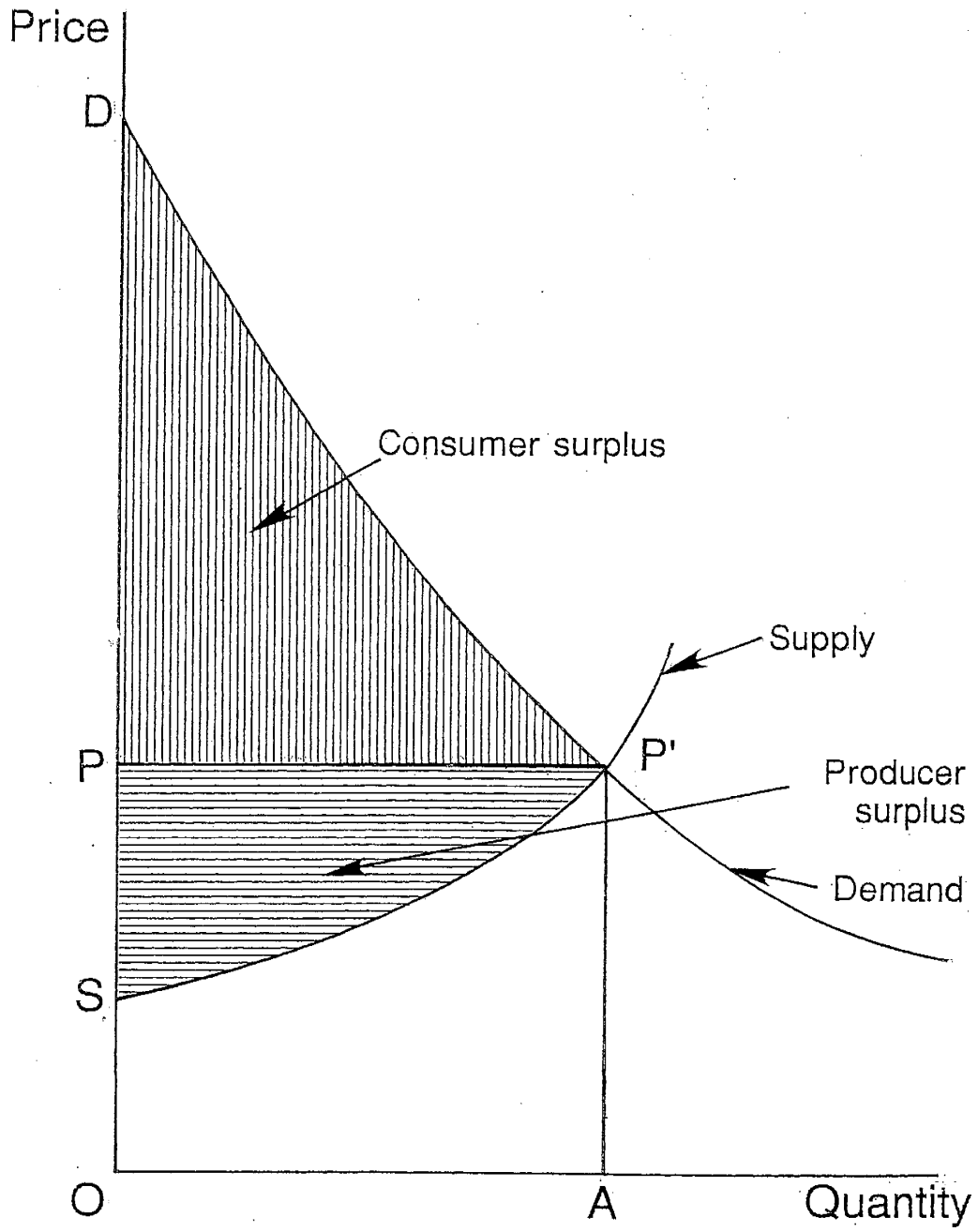

Figure 2. Diagrammatic representation of the consumer surplus and producer surplus components of the social benefits provided by a natural resource using market supply and demand curves.

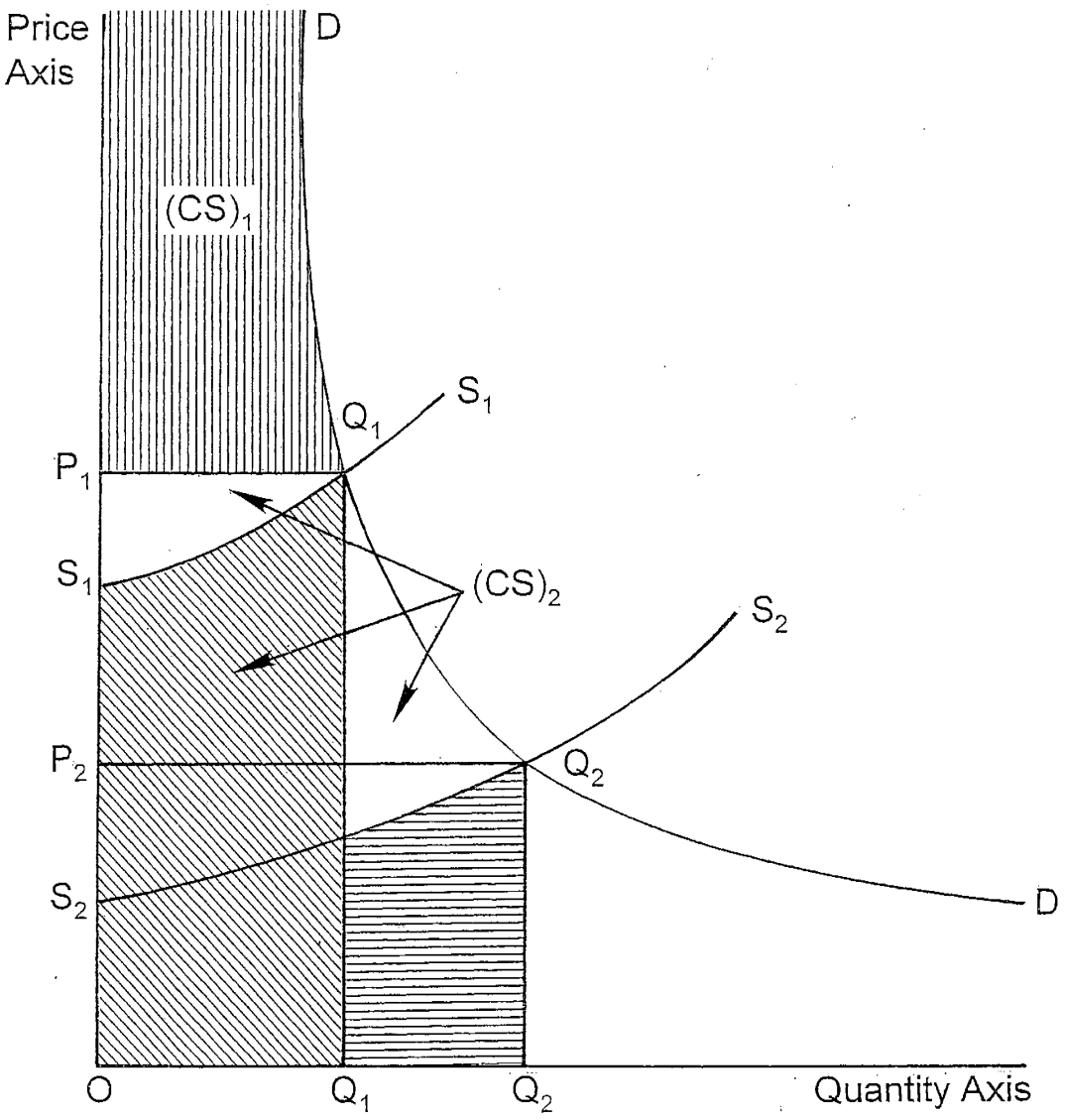

Figure 3. The supply curve shifts from S_1S_1 to S_2 S_2 but the demand curve DD remains fixed; the initial equilibrium price and quantity are $P_1$and Q_1. The area under DD above the horizontal line P_1Q_1 is the consumer surplus $(CS)_1$. The shift in supply increases CS to $(CS)_2$, the sum of CS_1 plus the 3 areas designated by arrows. The initial social cost is the area under S_1S_1 bounded by the line Q_1Q_1; the increase in supply shifts social cost to the area under S_2S_2 bounded by the vertical line Q_2Q_2. Thus, the social cost of output Q_1 decreases and the CS generated by producing Q_1 sharply increases.

ATTACHMENT 6

Fishery Values of the Klamath Basin, Meyer Resources (1984)

Fishery Values of the Klamath Basin

A Report to CH2M Hill

By Meyer Resources, Inc.

May, 1984

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I Summary of Benefits

The fish of the Klamath basin produce multiple benefits. They stand at the center of the Indian's culture and the fisherman's way of life. They provide food for both, for the coastal resident, and for the visitor. They produce significant business revenue in an economy where such opportunities are limited. They provide recreation to sportsmen of all ages. Their mere existence gives pleasure to many. Some of these values are presented in dollar terms in this report. Others are social or cultural and require more descriptive treatment. These benefits are arrayed in Table I in summary form.

Table I

Potential Annual Benefits Associated With a Catch of 1 '000 Adult Klamath Salmonoids

Benefitting Group	Business Benefits $	Non-Market Benefits in Dollars $	Subsistence, Cultural, Religious & Social Benefits
Commercial Fishermen			-Supports way of life.
- Chinook	22,090		-provides 7000 to 7500
- Coho	14,040		lbs. of food.
Sport Fishermen			-provides 7000 to 7500
- Chinook/Coho	28,730	128,080[1]	lbs. of food.
- Steelhead		172,370[1]	
Indian Peoples			-Maintains cultural
- Chinook	22,090		and religious well-being.
- Coho	14,040		-provides 7000 to 7500 lbs. of food.
Coastal Communities			-provides 7000 to 7500
- Commercial chinook	10,030		lbs. of food.
- Commercial coho	6,380		-Supports basic community way of
- Sport fish	56,510		life.

[1] Based on restorative activity.

This table must be read carefully. Each Klamath river salmon has the capability of supporting culture, religion and lifestyle, of providing subsistence, of generating business benefits and of providing recreational enjoyment. Table I provides an indication of the range of potential benefits--but measurement techniques vary, as does comprehensiveness of coverage, and benefits cannot be compared between columns. Further, in this summary analysis based on existing data, results are not accurate enough to definitively compare all business benefits listed in Column (1). We are confident that the relative values for chinook and coho are comparative, for either non-Indians or Indians participating in ocean commercial fishing. Business benefits associated with sport fishing, however, are based, in part, on inference and assumption, and while we feel they provide a reasonable order of magnitude basis to evaluate restorative plans on the Klamath, specific comparison of sport and commercial values would require more work. Finally, community benefit analysis measures additional income generated, and may or may not accurately reflect net value. Consequently, impact on community income should be analyzed separately from net business value by species. With respect to additivity of numbers, community business benefits are in addition to respective species net business values. Subsistence values are additive with cultural, religious, lifestyle and sport fishing values. Non-dollar sport fishing values are in addition to net business benefits of sport fishing, save where the sportsman is also a benefitting businessman. In sum, Table I, displays an

array of potential benefits, that can be associated with restoration of Klamath stocks--benefits which, when considered relative to anticipated restorative costs, may prove benefit/cost effective over a wide range of project applications.

II Past and Present Economic Circumstances of Fisheries of the Klamath Basin

Fishing Klamath river stocks for sustenance, commercial and recreational purposes has been long established. Indian peoples have used fish as a main staple of their existence since earliest times. Fish were important to the Indian diet[1], and were usually available in sufficient numbers to feed the tribes[2]. Primary target species were salmon and steelhead, with sturgeon and eels providing less frequent sustenance, and whales occasionally washing ashore to provide large food supplies[3]. Salmon was generally taken for own use, including that of kin.

> "...salmon was a food staple for the tribes, served as a significant focus for religious ceremonies, and provided opportunities for status, enterprise and, to a lesser extent, wealth". [4]

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[1] W.J. Wallace, "Hupa, Chilula and Whilkut", Handbook of North American Indians, op. cit., pg. 164.

[2] Ibid., pg. 165.

[3] Ibid., pg. 165.

[4] U.S. Department of Interior, Environmental Impact Statement on the Management of River Flows to Mitigate the Loss of the Anadromous Fishing of the Trinity River, California. Vol.I., November, 1980, p. C4-13.

The first cannery on the Klamath was established at Requa in 1888[5]. Others followed, with the peak of salmon canning taking place in 1912-1915. Stocks subsequently declined.

There is no single integrated set of catch statistics that permit a comprehensive assessment of the magnitude of present adult fish returns generated from the Klamath River basin. For fall chinook, statistics on river escapement, sport catch and Indian net catch are available from the Pacific Fishery Management Council (hereafter, PFMC). However, no statistical report on related ocean catch by commercial troll and sport fisheries is available. For other Klamath species, noteably coho and spring chinook, programs have been undertaken by the California Department of Fish and Game that may eventually provide catch data, but no such statistical information is available at this time. In the present survey document, the following reporting procedure will therefore be utilized with respect to catch.

i) Utilizing in-river data from PFMC, a ratio of ocean catch to in-river run size of 2:1[6], and an estimate for ocean sport catch of 7.5 percent of total ocean catch[7], annual estimates of the likely catch of Klamath fall chinook for all fishing sectors will be developed.

ii) Utilizing PFMC data, total catches of chinook and coho from Fort Bragg, Ca. to Coos Bay, Ore., the primary areas where Klamath salmon are delivered, will be reported.

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5 J.N. Cobb, Pacific Salmon Fisheries. U.S. Department of Commerce; Bureau of Commercial Fisheries; Document No. 1092, 1930.

6 L.B. Boydstun, California Department of Fish and Game, personal communication, May 2, 1984.

7 Ibid.

iii) Utilizing data, primarily from Humboldt and Del Norte Counties, the overall economic condition along the north coast of California and the south coast of Oregon will be characterized.

1. Estimated Magnitude of Klamath Fall Chinook Runs

Utilizing data from PFMC[8], and the ocean catch rates outlined in (i) above, estimates of the recent historic magnitude of harvests of Klamath fall chinook are provided in Table II.

Table II

Estimated Harvest of Klamath

Fall Chinook

Year	Spawning Escapement	In-River Catch		Ocean Catch		Total Run
		Sport	Indian	Commercial	Sport	
	'000 fish					
1978	71.5	1.7	18.2	169.1	13.7	274.2
1979	33.4	2.1	13.7	91.0	7.4	147.6
1980	28.0	2.1	12.0	77.9	6.3	126.3
1981	38.3	6.0	33.0	143.0	11.6	231.9
1982[a]	40.5	7.7	14.5	116.0	9.4	188.1
1983[a]	45.7	4.3	7.9	107.1	8.7	173.7
Average	42.9	4.0	16.6	117.4	9.5	190.3

[a] - Preliminary

* Foreign interception of Klamath river salmon is estimated at negligible levels.

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[8] Pacific Fishery Management Council, A Review of the 1983 Ocean Salmon Fisheries and Status of Stocks and Management Goals for the 1984 Salmon Season off the Coasts of California, Oregon and Washington, March, 1984, p. II-8.

Readers are reminded that the ocean catch portion of this table is estimated and does not represent actual data. In fact, in years such as the present, where run sizes may be severely constrained, ratios of ocean catch to river escapement may vary considerably from the assumed longer term average. Further, Klamath natural chinook stocks have been depressed for several years, and escapement goals are not currently being met. Nevertheless, Table I likely provides a general indication of the average magnitude of fall chinook runs over recent time. As noted Klamath runs of coho and spring chinook are much smaller, and no data from which to estimate their magnitude is presently available.

2. Ocean Catches - Fort Bragg to Coos Bay

Salmon from the Klamath system are primarily caught in the ocean between Fort Bragg and Coos Bay. It may therefore be useful to determine recent levels of overall landings of chinook and coho into those two ports, into Eureka, Crescent City and Brookings. In Table III, total catch for these two species, for the 5 ports identified,are presented.

Table III

Coastwide Ocean Catch of Chinook and Coho

- Fort Bragg to Coos Bay -

Year	Commercial Catch		Sport Catch		Total Catch	
	Chinook	Coho	Chinook	Coho	Chinook	Coho
	'000 fish					
1976	419	1392	40	261	459	1652
1977	567	216	61	102	628	318
1978	461	581	20	171	481	752
1979	631	518	25	112	656	630
1980	444	179	18	190	462	369
1981	403	292	24	75	427	367
1982	523	331	46	95	569	426
1983	152	182	29	105	181	290
Average	450	462	33	139	483	600

Due largely to el niño effects, 1983 was a disastrous year for salmon fishermen in northern California and southern Oregon. Prior to el niño, chinook landings to this area seemed to be holding at approximate 1970's levels. Landings of coho were more variable, but seem to have declined markedly since 1976. This is particularly true for landings into northern California ports. Further, the size of adult coho returning to fisheries seems reduced since 1975[9].

Finally, commercial salmon catches off Oregon and Washington have declined in recent years, crab catches are in a natural low cycle, albacore are down, and the west coast groundfish fleet is presently experiencing difficulties in matching capacity with markets[10].

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[9] Meyer Resources, Inc., A Report Concerning Multi-Species Limited Entry in Selected Coastal Fisheries of Washington, Oregon and California. A Report to the National Marine Fisheries Service, March, 1983.

[10] Ibid.

The net result has been increased commercial interest in northern California salmon stocks, both by California fishermen fishing multiple gears, and by out-of-state fishermen, primarily from Oregon. It follows that the Klamath Stock will likely come under increased pressure, and generate enhanced values in the years ahead. While the California limited entry plan for trollers will act to control pressure in the long run, it is our conclusion, in examining all these factors, that salmon stocks in this central coast area, including those of the Klamath system, will come under increasing pressure in the years immediately ahead. El niño has lent urgency to the situation, and it may be that restorative action is now more acutely required than before the precipitous decline in catch experienced in 1983.

3. General Economic Conditions in the Klamath Basin

Fisheries within the Klamath basin primarily impact people living in Humboldt and Del Norte counties, together with upriver residents of Siskiyou, Trinity and Shasta counties. As noted, ocean catches also affect residents of south coastal Oregon. In general, the economy of the area encompassed by the basin is not bouyant. Traditionally, lumber dominated economic activity, with fisheries and limited agriculture providing a continuing source of revenue and food. Mining has provided a periodic revenue source, while tourism provides substantial revenue over summer months.

Lumber production, and associated processing activity has been cut back in recent years--in part due to soft markets, but more importantly for the future, due to progressive reduction in allowable cut of old growth timber, as sustained yield calculations have been refined, and non-harvest forest considerations have gained in importance. Even tourism, a summer economic mainstay in Humboldt and Del Norte counties, may be realizing limits due to congestion on Highway 101. The result for the area, is that unemployment has become characteristically high. While annual rates vary, unemployment in Humboldt County has remained over 10 percent for the past decade[11], while Del Norte County unemployment ranged between 9.8 percent and 22.8 percent, 1978 through 1982[12,13]. Trinity County is in a similar situation, with a 1981 unemployment rate of 17.5 percent, 3rd highest among the 58 California counties[14]. Siskiyou County ranked 6th out of 58 California counties in unemployment during 1981, with a rate of 16.4 percent[15]. The situation in south coastal Oregon appears similar.

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11 Humboldt County Planning Department, Humboldt County Draft General Plan Revision Program, Policy Background Study on Population, March, 1983, p. 2-16.

12 Del Norte County, Overall Economic Development Program,1980, p. 28.

13 Employment Development Department, Labor Market Newsletter-- Del Norte County, 1982-1983, State of California, p. 4.

14 Employment Development Department, Labor Market Newsletter-- Trinity County, 1982-1983, State of California, p. 8.

15 Employment Development Department, Labor Market Newsletter-- Siskiyou County, 1982-1983, State of California, p. 8.

While the residents of Humboldt, Del Norte, Trinity and Siskiyou counties as a whole are experiencing difficult economic conditions, the situation for the people of the Hupa and Yuroks is much worse. Resource opportunities are similar to those established for the counties in general. On the Hoopa reservation, by 1981, all five lumber mills that had operated there were closed, and a current unemployment rate of 81 percent exists on the reservation[16]. Conversation with Yuroks suggests a similar level of unemployment likely exists in the downriver Extension[17]. Data from the Hoopa Valley Study[18] suggests that this rate of unemployment is increased from 50 percent in the fall/ winter of 1979, and 62 percent in the fall/winter of 1980.

> "The Hoopa Valley Indian Reservation is currently experiencing an extreme economic depression. In years past the Reservation population has been significantly dependent upon the logging and timber production industry for non-professional employment opportunities. However, in recent years, overproduction, increased automation, environmental impact priorities, and the rising prime interest rate (with consequent decreases in construction) have crippled the timber industry. The lumber mills on the Reservation that once employed many Indian people have been shut-down. The available employment opportunities in the field of tree harvesting(logging) has been reduced by approximately 85%." [19]

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16 Hoopa Tribal Council, Draft Economic Development Plan, Hoopa, June, 1983.

17 J. Webster, a Yurok, at Klamath, June 22, 1983.

18 Hoopa Tribal Council, op. cit.

19 Ibid.

Under these conditions, opportunities for marginal improvement in the economy of the Klamath basin seem limited. The forest industry will continue to play an important role in north coast economics. However, it is unlikely to grow substantially. Tourism will continue, but again, major increases in Hwy 101 usership cannot be confidently predicted. Consequently, we must turn elsewhere if growth is to redress continuing levels of unsatisfactory income and employment. Undoubtedly, some level of growth in institutional infrastructure (such as that connected with Humboldt State University) can be expected. Further, periodic beneficial opportunities may come from extractive industry. In essence, however, the north coast area will need to carefully conserve every resource, job and dollar it can obtain if it is to ensure a viable economic future. It cannot afford to leave productive resource opportunities undeveloped nor to trade them off against each other--if overall levels of employment and well- being are to improve.

In sum, the economy of the Klamath Basin can be characterized as relatively narrow, beset by levels of income and unemployment that range between relatively inadequate and alarming, and offering few opportunities for economic recovery. In such a setting, it is understandable that interests would seek to gain special concessions from each other--and competition between counties, between Indian and non-Indian, between forestry, fishing, and mining, and so on is clearly evident. However, each of these groups, to some degree, seems disadvantaged. Consequently, resource decisions which simply rearrange existing opportunity between local groups offer little or no benefit

to the region as a whole. Conversely, restoration of Klamath fisheries, offering as it does an opportunity to increase overall regional resource capability, may be of high value, and perhaps can be achieved without significant damage to present important activity. It is from this perspective that the present analysis of the value of restoring the Klamath basin fisheries will be conducted.

III Business Related Benefits from Klamath Fish Stocks

1) Dollar Revenue from Commercial Fishing

In this section, contemporary values per returning adult salmon will be established at ex-vessel, wholesale and community income levels.

a) Ex-Vessel Values

Estimated gross values per adult, for Klamath chinook and coho caught on the California north coast, are presented in Table IV. These data are considered to be most appropriate for Klamath stocks.

Table IV

Commercial Ex-Vessel Values per Dressed

Troll Caught Salmon--California North Coast

Year	Chinook	Coho
	----------$/lb.----------	
1979	2.53	2.19
1980	2.27	1.36
1981	2.45	1.94
1982[a]	2.55	1.36
1983[a]	2.09	1.25
Average	2.38	1.62

Source: Pacific Fishery Management Council, op. cit., p. IV-9.

In real terms, prices for coastal salmon peaked in the late 1970's[20], and have been at lower levels for the past 4 years. Over longer periods of time, ex-vessel real prices have shown steady improvement, however[21]. Considering both short and long term data, it seems reasonable to utilize the five year average price as a basis for contemporary stock evaluation on the Klamath. On that basis, estimated average ex-vessel values for Klamath chinook and coho are presented in Table V. Average fish sizes are overall, and do not distinguish between chinook large, mediums and smalls[22].

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[20] Pacific Fishery Management Counsil, op. cit.

[21] U.S. Bureau of Commercial Fisheries, Fisheries Statistics of the U.S..

[22] Sizes based on L.B. Boydstun, op. cit.

Table V

Commercial Ex-Vessel Values per Dressed

Toll Caught Salmon--Klamath Estimates

Species	Average Size Dressed lbs.	Price $/lb.	Value per Salmon $
Chinook	7.5	2.38	17.85
Coho	7.0	1.62	11.34

Economic analysis requires that impacts, whether beneficial or costly, be expressed in net value terms. In the commercial fishery, net values are calculated by subtracting catching costs from revenues received for catch. Where fishermen and their vessels do not have alternative opportunities for employment, increments of catching effort will incur only limited variable costs such as fuel and ice over a significant range of increased catch[23]. Along the California north coast, where relatively high unemployment is characteristic, where fishermen earn somewhat less than the average household[24], and

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[23] For a conceptual discussion of this issue, see, Water Resources Council, Procedures for Evaluation of National Economic Development (NED) Benefits and Costs in Water Resources Planning (Level C); Final Rule, Federal Register, December 14, 1979, pp. 72892-72976. For a recent non-technical discussion, see, Meyer Resources, Inc. Economic Evaluation of River Projects. Vol. I, a Report for the California Resources Agency, December, 1982, pp. 14-17.

[24] Oregon State University, Socio-Economics of the Idaho, Washington, Oregon and California Coho and Chinook Salmon Industry, Vol. A. A Report to the Pacific Fishery Management Council, Corvallis, September, 1978, p. 23.

where a limited entry plan exists to retard new entry, such limited cost treatment seems warranted. Only limited empirical data is available to determine appropriate incremental costs. In the early 1960's, Fry[25] considering California fisheries, and Crutchfield[26] considering Washington fisheries, concluded that restorative increments of salmon could be taken at costs amounting to 10 percent of ex-vessel value. Later, in 1968, Richards[27] reached a similar conclusion for Columbia river fisheries. In 1980, in British Columbia, where species and fishing methods are similar, Barclay and Morley determined that the existing British Columbia fleet would be able to catch double existing levels of salmon without any change in capital cost, and with variable cost increments that begin at 1 percent of ex-vessel salmon price, and increased to 15 percent for a full doubling of catch[28]. Reviewing these data, we find no reason to depart from earlier conclusions, and will reduce ex-vessel values by 10 percent to obtain present net value estimates for the Klamath. This is done in Table VI.

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25 D.H. Fry, "Potential Profits in the California Salmon Fishery", California Fish and Game, October, 1962, pp. 256-267.

26 J.A. Crutchfield, K.B. Krol and L.A. Phinney, An Economic Evaluation of Washington State Department of Fisheries' Controlled Natural-Rearing Program for Coho Salmon. U.S. Fish and Wildlife Service Contract #14-17-007-246, 1965.

27 J.A. Richard, An Economic Evaluation of Columbia River Anadromous Fish Programs. Ph.D. dissertation, Oregon State University, Corvallis, 1968.

28 J.C. Barclay and R.W. Morley, Estimation of Commercial Fishery Benefits and Costs Data (1976-1978), Department of Fisheries and Oceans, Vancouver, August, 1980, pp. 3-4.

Table VI

Net Value Estimates for Klamath River Salmon Sold by Fishermen

Species	Net Value per Salmon $
Chinook	16.06
Coho	10.21

Again, it should be recalled that these values re based on broader ocean price averages.

b) Processing Values

Additional value is derived from fisheries via processing activities. Little consistent data is available for development of processing estimates however. Generalized data on price markup for salmon are provided in a British Columbia analysis[29], by Penn[30], Oregon State University[31] and Petry[32].

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29 Department of Fisheries and Ocean, Fisheries Statistics of British Columbia, 1978.

30 E. Penn, Cost Analysis of Fish Price Margins, 1972-1977, at Different Production and Distributor Levels. National Marine Fisheries Service, Washington, D.C., Appendix Tables A-31 and A-34.

31 Oregon State University, op. cit., Vol. B., p. 67.

32 G.H. Petry, Pacific Northwest Salmon and Steelhead Fishery Report--The Economic Status of the Oregon and Washington Non-Indian Salmon Gillnet and Troll Fishery, 2 Vols., Washington State University, Pullman, 1979.

The Oregon State University data develops an ex-vessel to processing markup of 65 percent, specific to Humboldt County salmon. It will be used here. Results are reported in Table VII.

Table VII

Recommended Markup to Processing

--Klamath River Salmon--

Species	Ex-Vessel Price $/fish	Markup %	Estimated Processing Price $/fish	Processing Increment $/fish
Chinook	17.85	65	29.45	11.60
Coho	11.34	65	18.71	7.37

These data may prove conservative. Other estimates in the same OSU document suggest processing markups of 136 percent for Tillamook County, Oregon [33], and between 84 percent and 113 percent for Puget Sound[34]. Petry's data suggest markups in the 111 percent to 116 percent range for Oregon and Washington processing respectively[35].

Finally, accrued gross value of processing must be reduced by associated cost to obtain net value. This step is empirically more difficult. At a conceptual level, it is possible over time that processors would divest themselves of all idle capital equipment.

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[33] Oregon State University, op. cit., p. 94.

[34] Ibid. pp. 112, 114.

[35] G.H. Petry, op. cit. Vol. II, p. 46.

Yet, idle equipment has been a common sight over the years at fish processing locations, and is today. The answer to this anomaly may lie not in long term capital immobility, but in the diverse level of catch, measured on a year to year basis. Because of fluctuating catch, the processor must ensure adequate processing capability for the good year--knowing that some of that capacity will lie idle in less than good years. Consequently, and considering the currently depressed level of coastal fisheries, it seems reasonable that processors would be able to handle a significant measure of restored fishery production while encountering only variable costs[36]. National data from Penn[37] suggest that variable costs may range between 46 percent and 50 percent of the processing value increment, exclusive of fish purchases. A similar judgement is reached by Barclay and Morley[38], who estimate variable costs, excluding fish purchases, at 45 percent of processing value increment. For this analysis, we will use the midpoint of the U.S. national data estimate, and reduce value added by processing by 48 percent to obtain the net value increment. Results are presented in Table VIII.

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36 This perception was confirmed in a 1982 conversation with W. Jensen, West Coast Fisheries Developed Foundation.

37 E. Penn, op. cit.

38 J.C. Barclay and R.W. Morley, op. cit.

Table VIII

Net Value Through Processing Levels

Estimates for Klamath Stocks

Species	Net Ex-Vessel Value	Net Processing Value	Total Net Value
	$/fish		
Chinook	16.06	6.03	22.09
Coho	10.21	3.83	14.04

c) Induced Economic Benefits

Revenues received into a community or area are generally recognized to have positive effects beyond those associated with initial cash impacts. These secondary effects are often referred to as "multiplier" effects--and are derived as receivers of income spend a portion of it locally, creating jobs and income for others. The accumulated impacts of such initial expenditures are generally displayed in input/output tables[39], which calculate final effects for any given initial change in revenue. Where both ex-vessel and processing values are developed (as they are here) the analyst must be aware of the fact that input/output data characteristically reports primary and processing sectors separately, and that multipliers for one will likely include economic activity in the other. A netting out procedure will consequently also be required to avoid double counting. Multipliers can measure cumulative affects on output, income or employment,

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[39] For a general discussion, see, W.H. Miernyk, The Elements of Input Output Analysis. New York, Random House, 1965.

and may be expressed in gross or net terms. For this analysis, a net income multiplier is considered most appropriate. There appear to be three candidate income multipliers available with respect to Klamath stocks. These are arrayed in Table IX.

Table IX

Subject	Source	Multiplier
- California forestry and fishery products	- Department of Water Resources, Bulletin 210, March, 1980.	2.15
- California forestry and fishery products	- U.S. Forest Service, IMPLAN, September, 1983.	2.35
- California salmon trollers	- D.M. King & K.L. Schellhammer, The CIF Model, Sea Grant Working Paper #. P-T-S.	- small 2.23 trollers - large 1.81 trollers

These data are closely consistent, with King and Schellhammer's Type II multipliers giving the closest attention to salmon fishing. Consequently, a multiplier of 2 is suggested for the present analysis, with a recommendation that 2.23 be used for exclusively small trollers and 1.81 for exclusively large trollers.

As noted, it is necessary to subtract net processing markups out of multiplier calculations based on fishing activity to avoid double counting. Applying the K-S multiplier to the results of Table VI, and netting out the processing increment of net value identified in Table VIII, estimates of beneficial impact upon communities associated with Klamath salmon stocks is presented in Table X.

Table X

Estimated Beneficial Impact Upon Communities

from Klamath Stocks

Species	Net Ex-Vessel Value	Net Processing Value	Net Community Value
		$/fish	
Chinook	16.06	6.03	10.03
Coho	10.21	3.83	6.38

To the extent that fishermen's variable costs benefit local residents, this value will slightly understate total community impact. Multiplier values are conceptually separate from the net economic benefits calculated at ex-vessel and processing steps and should be so treated in analysis.

2. Dollar Revenue from Sport Fishing

Sport fishing also provides significant commercial revenue for resort and motel operators, restaurants, guides, boat and gear renters, tackle shops, and so on. Estimates of such expenditures have been compiled in a number of studies. EDAW utilize information from the American Automobile Association to estimate daily expenditures by visitors to California of $30 per person day in 1979 dollars[40]. Grobey, et al. developed 1979 expenditure estimates of approximately

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[40] EDAW Inc., Smith River Draft Management Plan. A Report to the California Department of Fish and Game, October, 1979, p. 73.

$14 per person day for visitors to Redwood National Park[41]. Recently, the U.S. Fish and Wildlife Service has published its 1980 National Survey of Hunting and Fishing for California[42]. This study estimates that, in 1980, California sport fishermen spent $32 per day on sport fishing, $13 in travel and $19 on equipment[43].

The American Automobile Association estimate and that of the U.S. Fish and Wildlife Service closely correspond, and as the latter is developed specifically for sport fishing, and utilizes latest available data, it will be employed here. Updating to 1983 via the U.S. Department of Labor's Consumer Price Index, daily expenditures associated with sport fishing for Klamath stock are estimated at $38.31.

Establishing dollar expenditures per day for salmon stocks does not establish values per fish. Traditionally this is obtained by the following formula:

$$(1)\quad V_f = V_d / C_d$$

where: V_f = the value of a fish.

V_d = the value of a fishing day.

C_d = catch per day in number of fish.

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41 J.H. Grobey, T.K. Ruprecht, F.I. Jewett, G.L. Hoopes, & L.M. Kirkham, Redwood National Park Tourism Study: Economic Impacts of Alternative Park Development Plans. Humboldt State University, Arcata, April, 1979.

42 U.S. Fish and Wildlife Service, 1980 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation--California, 1980.

43 Ibid. p. 1.

Estimates of angler days per fish for the north coast area vary. In 1977, Kesner estimated an angler day/fish ratio of 2.3 for inland Klamath sport fisheries, and 1.0 for ocean fisheries[44]. In the same year, Humboldt County reported a ratio of 2.5 for steelhead, 89.5 for coho and 22.3 for chinook[45]. These data were not considered representative, and the low ratio of 2.5 was recommended. In 1978, Smith recommended an angler day to catch ratio of 1.3 for ocean sport, 3.0 for rivers and 2.4 for steelhead for north coast streams[46]. Finally, in 1980, Meyer recommended an angler day to catch ratio of 1.25 for ocean catch, 3 for instream chinook and 2.3 for steelhead from the Trinity[47]. In considering these varying data, an all-fisheries ratio of angler days to catch of 2.5 is considered within a reasonable range, and will be utilized in the present analysis. Using this ratio, gross expenditures associated with capture of one sport salmon are estimated to approximate $95.78.

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44 W.D. Kesner, An Economic Evaluation of the Salmon and Steelhead Fisheries Attributable to Klamath National Forest. USDA Forest Service, Klamath National Forest, May, 1977, p. 7.

45 Humboldt County, Economic Loss to Humboldt County due to Potter Valley Diversion of Eel River Waters. Department of Public Works, Eureka, July, 1977, p. 8.

46 D. Smith, The Economic Value of Anadromous Fisheries for Six Rivers National Forest. USDA Forest Service, February, 1978, pp. 11-12.

47 P.A. Meyer, A Review of Socio-Economic Aspect of the December, 1979 Draft Consultant Report Entitled "Proposed Trinity River Basin Fish an Wildlife Plan". Center for Natural Areas, Sacramento, April, 1980, p. 38.

As noted earlier, not all revenue generated by sport fish related expenditure can be considered as net profit, for costs will be incurred in providing any given levels of service. Frederiksen, Kamine and Associates estimated such costs at 70 percent of revenue during their Trinity River analysis[48]. With a relatively high level of unemployment on the north coast, and the supplemental nature of fish stock associated with the Klamath River restoration plan, this estimate is considered high. It will be used here, as the only one presently available, however. Net business revenue associated with Klamath sport related expenditures is therefore calculated to be $28.73 per fish.

Finally, each dollar spent on sport fishing will have a multiplier effect on the community at large. Available empirical measures vary widely. California Department of Water Resource's Bulletin 210 estimates an income multiplier of 2.55 for "amusement and recreation services", while the U.S. Forest Service (IMPLAN) estimates a multiplier of 3.14 for the same service grouping. Grobey et al[49], on the other hand, in their study of Redwood National Park, cite dissipation of multiplier effects associated with tourism via significant importing of consumer goods to the north coast region, and recommend a multiplier value below unity. In considering this range of potential data, no firm conclusion can be drawn. It is our consequent recommendation

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48 Frederiksen, Kamine and Associates, Proposed Trinity River Basin Fish and Wildlife Management Programs, Appendix A--Socio- Economic Analysis. October, 1980, p. 138.

49 J.H. Grobey, T.K. Ruprecht, F.I. Jewett, G.L. Hoopes, & L.M. Kirkham, op. cit.

that the impact of sport fishing expenditures on north coast communities be treated similarly to commercial fishery expenditures, via use of a multiplier of 2.0, until better empirical data becomes available. On this basis, and utilizing a direct income coefficient of .59 for "amusement and recreation services" from DWR Bulletin 210, each Klamath sport salmon may develop $56.51 of additional community income[50]. Again, it should be remembered that this value should be treated separately from the $28.73 per fish net value associated with direct expenditures by sportsmen.

Calculation of sport based values in this section also depend on an assumed direct relationship between stock size and sport effort. Such a relationship may not hold for large stock changes,but likely provides a reasonable approximation for marginal changes in stock levels.

IV Non-Business Sport Fishery Values--Expressed in Dollar Terms

The value of sport fishing to participants often exceeds what they actually pay. This is due to a number of factors. Prices may not be structured to capture every last cent each participant would be willing to pay to fish, and do not adequately indicate the compensation participants would consider fair if fishing opportunity was preempted; fishermen may live close to the fishing site, so that travel costs are minimal; expenditures don't capture the value of time

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[50] $95.78 x .59.

expended in going fishing, and so on. Economists have developed methods to capture these broader concepts of fishing value, and have made recommendations specific to West Coast sport salmon fishing[51]. Available data was summarized in an 1982 NMFS report[52], and is presented in day value terms in Table XI.

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[51] These concepts of consumer's surplus are also appropriate for commercial and Indian fisheries. However, economists have not pressed forward to develop actual values in these latter areas.

[52] P.A. Meyer, Net Economic Values for Salmon and Steelhead from the Columbia River System. op. cit. pp. 17 & 20.

Table XI

Empirical Estimates of Recreational Day Values

Author	Recreational Product	Year Base Data Collected	Value in 1980 Dollars $
Estimates for Fisheries Enhancement			
Brown/Singh/Castle	Oregon salmon and steelhead fishing	1962	39.02
Gordon	Idaho salmon	1968	19.81
	Idaho steelhead	1968	37.14
Brown/Charbonneau/ Hay	Ocean Fishing	1975	35.20
	River Fishing	1975	81.60
Brown/Sorhus/Gibbs	Pacific Northwest salmon & steelhead	1977	63.94
Cruthfield/Schelle	Washington ocean salmon	1978	24.01
Estimates for Fisheries Protection Or Restoration			
Matthews/Brown	Washington salmon & steelhead	1967	121.00
Crutchfield/Schelle	Washington ocean fishing	1977	107.00

Data Sources

W.G. Brown, A. Singh and E.M. Castle, An Economic Evaluation of the Oregon Salmon and Steelhead Sport Fishery. Oregon Agricultural Experiment Station Technical Bulletin 78, Corvallis, Oregon, 1964; D. Gordon, An Economic Analysis of Idaho Sport Fisheries. Idaho Cooperative Fishery Unit, University of Idaho, 1973; G.M. Brown, J.J. Charboneau and M.J. Hay, Estimating Values of Wildlife: Analysis of the 1975 Hunting and Fishing Survey. Draft Working Paper No. 7, U.S. Fish and Wildlife Service, Washington, D.C., 1978; W.G. Brown, C. Sorhus, and K.C. Gibbs, Estimated Expenditures by Sport Anglers and Net Economic Values of Salmon and Steelhead for Specified Fisheries in the Pacific Northwest. Oregon State U., 1980; J.A. Crutchfield and K. Schelle, An Economic Analysis Of Washington Ocean Recreational Salmon Fishing with Particular Emphasis on the Role Played by the Charter Vessel Industry. U. of Washington, 1978; S.B. Mathews and G.S. Brown, Economic Evaluation of the 1967 Sport Salmon Fisheries of Washington. Washington Department of Fisheries Technical Report No. 2, April, 1970.

The NMFS analysis selected the Brown, Sorhus and Gibbs value for evaluation of enhanced salmon stocks, and the Crutchfield and Schelle value for evaluation of protected or restored stocks. Subsequently, Meyer, Brown and Hsaio have updated these values, and developed related values per recreational salmon[53]. These values are recommended for the present analysis, and are presented in Table XII.

Table XII

Recommended Values per Sport Fish

--1983 Dollars--

Species	Value Per Enhanced Fish	Value per Protected or Restored Fish
	$/fish	
Chinook	93.37	128.08
Coho	93.37	128.08
Steelhead	125.68	172.37

The decision on which value to use will depend upon whether proposals to improve stock levels in the Klamath system are considered to return stocks toward normal levels (use the protected/restored value) or to increase stocks above normal levels (use the enhanced value)[54].

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53 P.A. Meyer, W.G. Brown and C.K. Hsiao, An Updating Analysis of Differential Sport Fish Values for Columbia River Salmon. A Report to the National Marine Fisheries Service, Portland, May, 1983.

54 For a fuller discussion of theoretical issues underlying these value differences, see, for example, W.D. Desvousges, V.K. Smith and M.P McGivney, A Comparison of Alternative Approaches for Estimating Recreation and Related Benefits of Water Quality Improvements. EPA Report 230-05-83-001, March, 1983, pp. 2-2 to 2-9.

V Subsistence, Social and Cultural Values

1. Values to Indian People

As noted, the value of fish to Indian people can be conceptually bounded by theories of consumer's surplus. However, fisheries have considerable religious and cultural meaning for affected tribes that render a complete statement of value in dollar terms impossible. The salmon traditionally provided both basic sustenance and served as a vehicle for status, enterprise, and wealth for Indian people. It also served as a significant focus for religious ceremonies.

> "...Boys learned the dozens of ways in which Hupa fishermen caught the salmon, lamprey eels, sturgeon, steelhead and trout which filled the river and streams in the Valley. Fishing privileges, like hunting rights, belonged to individuals and families. The men taught the boys the strict rules that governed the use of fishing areas. Then the boys learned to set up weirs and fishing platforms; to make and use both hand-held nets and larger nets which could be anchored in the bed of a river or stream; and to catch fish in basket traps and scooping baskets. The Hoopa speared fish with harpoons, shot them with bows and arrows, caught them with hooks and lines, and sometimes even dove into the river to catch them with their bare hands." [55]

> "The major ceremonies of the Yurok reveal the following qualities:
>
> 1. The motive is to renew or maintain the established world. This purpose includes bountiful wild crops, abundance of salmon, and the prevention of famine, earthquakes, and flood. To a greater or less extent, the expression of these objects takes on the character of a new year's rite. This is particularly plain in the First Salmon Ceremony at Wetlkwau and the fish dam building at Kepel." [56]

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[55] B. Nelson, Jr., Our Home Forever--A Hupa Tribal History. U. of Utah, Salt Lake City, 1978, pp. 16-17.

[56] A.L. Kroeber, Handbook of Indians of California. Dover Publications, New York, 1976 (Reprint), p.53.

> "Each year eels and salmon traveled up the Trinity to the valley, and acorns ripened in the surrounding hills. Before the people of the valley gathered these foods, they held special ceremonies. The northern district had the responsibility for the First Eel Ceremony in the spring. After ten days of preparation, a spiritual leader from Takimildin went to a place in the north end of the valley near the entrance to the canyon. He spent the night there fishing for eels, praying for a large catch, and giving thanks for the bounty of the land. Then the people shared a feast of eels. For five days after the feast, the spiritual leader could not travel upstream. If he did, the eels might follow him out of the valley. When the first salmon came up the river in the spring, the southern district held the First Salmon Ceremony. Like the man who conducted the First Eel Ceremony, the spiritual leader from Medildin prepared himself with ten days of prayer. Then he fished for salmon at Sugar Bowl, south of the valley, and once again the people met for a feast.
>
> Throughout the summer, after the First Salmon Ceremony, the people caught salmon in large triangular nets. In September or October, when the summer rains had ended, it was time to build the annual fish dam in the Trinity River for the fall salmon run. For thousands of years the Hupa had built this dam, one year at Medilkin, the next at Takimildin. Like the first food ceremonies, building this dam was a religious activity...Because they never took more than they needed, the annual dam did not deplete the river's supply or threaten the spawning runs."[57]

In these early times, fish on the Klamath were generally plentiful, and were caught only for own use, to feed family, friends and old people in the community, or to trade for other necessities. Above all a unity, a close cohesion with the water, fish, wildlife, roots, berries and other essential elements of their existence--often referred to by Indian peoples as "the land", prevailed.

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[57] B. Nelson, Jr. op. cit., pp. 28-30.

> "The people's religious beliefs affected all that was said and done in the valley. Not only in special ceremonies, but in their daily lives, the Hupa observed beliefs which had passed from generation to generation for centuries. Prayer accompanied many activities. Hunters purified themselves before they took an animal's life. Travelers prayed for a safe journey. Spiritual leaders prayed for the protection of the land, the welfare of the people, and the harmony of the universe. This was the sacred center of Hupa life. The ceremonies, the beliefs, and the land where the people had come into being were the Hupa's greatest treasures, and each new generation learned to honor and care for them." [58]

Over time, conditions for Indians along the river have changed. Guaranteed a homeland where they could live and prosper, the present difficult economic situation of the Indian people of the Hoopa Square and Extension has already been identified. Timber in the Extension is in non-Indian hands and is virtually logged off, while timber production from the Square has provided benefits insufficient to raise Hoopa well-being to acceptable levels.

The fish of the Klamath system thus provide sustaining food for the Hupa, Yurok and Karoks peoples. Further, Indians have particular skills in the catching, preserving and conserving of fish throughout the basin, enjoy fishing as an activity, and consequently possess a comparative advantage in pursuing such activity.

The cultural value of the fishery resource is further evidenced in a recent survey on the Hoopa Square[59]. In this survey, the approximately 380 respondents[60] made proper management of water resources (90 percent of respondents) and proper management of

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[58] Ibid. p. 35.

[59] Hoopa Valley Business Council, Hoopa Valley Survey, Hoopa, November, 1982.

[60] Number of usable responses varied slightly from question to question.

fisheries (89 percent of respondents) their top resource priorities. Other responses, indicative of the preferred Hoopa approach to resource management are presented in Table XIII.

Table XIII

Hoopa Responses on Resource Management Questions

Issue	Response				
	Agree	Somewhat Agree	No Opinion	Somewhat Disagree	Disagree
	% of Respondents				
1. What should be considered most important in forest management?					
1a. Cultural Resources	86.8	1.8	5.8	0.2	5.0
1b. Water	86.1	1.8	5.6	0.0	6.4
1c. Jobs	85.3	1.8	5.5	0.2	7.0
1d. Wildlife	84.9	2.9	6.7	0.5	4.8
1e. Fish	83.6	2.1	5.5	0.7	7.8
1f. Traditional Plant Uses	81.9	2.9	6.8	0.5	7.9
1g. Road Construction	81.3	3.1	6.6	1.0	7.7
1h. Dollar Return	77.1	2.3	6.9	1.0	12.5
2. Economics are more important than environmental concerns in the management of our forest resources.	20.8	9.6	13.5	6.5	49.4
3. Streamside buffers should be preserved along streams.	86.4	3.6	5.7	0.2	3.9

(Cont. next page)

Table XIII (Cont.)

Hoopa Responses on Resource Management Questions

Issue	Response: Agree	Somewhat Agree	No Opinion	Somewhat Disagree	Disagree
	% of Respondents				
4. Timber Harvesting should maximize to produce the most income possible now, at the expense of a continuous income for future generations.	32.4	3.9	7.3	7.5	48.6
5. The Tribe should allow herbicide use on the reservation.	6.5	3.3	7.2	3.1	79.6

Source: See Note (59).

A strong legacy involving use of the "land", and use of its fish, wildlife and other natural attributes is evident in these responses.

Clearly, a salmon, whether caught and used in ceremony, caught and eaten or caught and sold, is highly valued by the Indian peoples of the Klamath basin.

> "The deer and the fish are the only things that will sustain our culture. This is why we dance. We follow through with this as close as we can. Year after year after year" [61]

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[61] Peter Jackson, Sr., a Yurok, at Requa, June 22, 1983.

> "The spirit people prepared this land for the Indian. When we came, some spirit people did not want to leave--and hid in the rocks, streams, mountains, and so on. Why would we destroy the salmon, when we would be destroying the spirit that made it possible to live here? ...We've lost everything but the water and the salmon. That's all we have left to make it on." 62

2. Value and Commercial Fishing as a Lifestyle

Benefits accruing to the commercial fishing sector from restoration of Klamath stocks are not confined solely to dollars. As the Oregon State University study indicates[63], fishermen in the Eureka and Fort Bragg area have deep-seated traditions, and often consider fishing not only as an activity, but as a way of life. The conclusion from that analysis is reported here.

> "Most people do not consider fishing to be a vocation alternative available to them or to their children. But when nonfishers were exposed to the operations and lifestyle of commercial fishing, they are frequently attracted. Almost all vessels are owned by the fisher-operator who has absolute authority aboard his craft--the high value placed on being one's "own boss" by some fishers runs deep in American tradition [Mayer, 1964].
>
> Some fishers claim that all their nonfisher friends (teachers, businessmen, etc.) want to abandon their careers and become fishers after hearing descriptions of the occupation. Indeed, many fishers themselves consider fishing to be exciting and far more enjoyable than a vacation--hardly "work" in the usual sense.

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62 Robley Schwenk, a Yurok, at Requa, June 22, 1983.

63 Oregon State University, op. cit. Volume A, pp. 15-49.

> Actually, when sociologists and industrial psychologists devise "ideal" working conditions or attempt to improve others, they usually do so by unwittingly injecting doses of the most salient conditions of commercial fishing: responsibility, recognition, social exchange, problem-solving and a close connection to the finished product [Price, 1964]. These conditions are simply characteristics of commercial fishing--similar conditions obtained in fisheries around the world. It is, therefore, not surprising that fishing has been described as "not simply an occupation, but a way of life, having more influence on the feelings of individuals and being more pervasive in their lives than most land bound occupations [Poggie, 1974]."[64]

Such values have not been the subject of intensive study on the California coast. They are nevertheless real, and form an important component of full value consideration in the renewal of Klamath river stocks.

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64 Ibid. p. 40. The subreferences contained in the quotation are to:

K. Mayer and S. Goldstein, "Manual Workers as Small Businessmen", Blue Collar World, edited by A. Shostak and W. Grumberg, Prentice- Hall, New Jersey, 1964, p. 537;

C. Price and D. Levin, "Work and Mental Health", Blue Collar World, op. cit. p. 402; and

J. Poggie and C. Gersuny, Fishermen of Galilee, the Human Ecology of a New England Coastal Community, University of Rhode Island Maritime Bulletin #17, Kingston, Rhode Island, 1974, p. 66.

3. Sport Fisheries and Subsistence

Earlier work by Bryan indicates that having fish for eating is a significant sport fishing motive[65] for salt water anglers. Recent work by Kershner[66], and specific to the Klamath river, identifies that sustenance is also a significant motivation for river sport anglers--particularly those over 45 years of age.

In an area such as the California north coast, where the economy is not buoyant, we would expect sport fishing to provide a significant food source for residents. However, Kershner's work suggests that fishing provides food for out-of-county fishermen of Klamath stocks as well--with smoking and canning identified methods for preservation of catch. Using average ocean and in-river sport catch estimates for fall chinook from Table I, it is estimated that present Klamath fall chinook produce over 100,000 annual pounds of edible salmon for sport fishermen. Coho, spring chinook and other species produce additional edible amounts annually.

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65 R.C. Bryan, The Dimensions of a Salt-Water Sport Fishing Trip, or What Do People Look for in a Fishing Trip Besides Fish? Environment Canada, Vancouver, 1974, p. 14.

66 J. Kershner, Characteristics and Attributes of Some Klamath River Anglers. Masters Thesis, Humboldt State University, Arcata, March, 1983.

4. Aesthetic Values Associated with the Existence of Klamath Fisheries

No direct work has been done to estimate an existence value for Klamath fisheries. Work has, however, been done concerning existence of fisheries stocks in California's Central Valley[67], on the upper Sacramento River[68] and on the upper Columbia River[69]. That work is likely generally applicable to the Klamath sytem, and suggests that if significant fisheries of the system were lost, a majority of residents would not consider themselves adequately compensated, regardless of the level of compensation offered.

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67 P.A. Meyer, Recreational/Aesthetic Values Associated with Selected Groupings of Fish and Wildlife in California's Central Valley, a Report to the U.S.Fish and Wildlife Service, Sacramento, November, 1980.

68 Meyer Resources, Inc., Economic Evaluation of River Projects, Volume III, Values for Fish, Wildlife and Riparian Resources, A Report for the California Resources Agency, Davis, December, 1982.

69 Meyer Resources, Inc., Recreational/Aesthetic Values Associated with Salmon and Steelhead of the Columbia River. A Report to the U.S. Bureau of Indian Affairs, Portland, May, 1982.

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ATTACHMENT 7

Klamath Management Zone Port Landing Losses

Since 1976-1980 Annual Average

Pounds Of Salmon Landed By The Commercial Troll Ocean Fishery For Major Klamath Management Zone (KMZ) Port Areas[1]

Year or Average of years	Eureka (CA)	Crescent City (CA)	Brookings (OR)
Salmon Landings (nearest thousands of dressed pounds)[2]			
Av. of 1976-1980	1,794	753	1,057
1995	26	5	55
1996	92	3	142
1997	14	*	73
1998	22	1	52
1999	27	3	80
2000	20	3	114
2001	61	3	152
2002	108	54	218
2003	7	37	142
2004[3]	64	304	267
Av. of 2001-2004	60	100	195

* = Fewer than 500 pounds

SALMON FISHERY LOSSES BY PORT AREA OVER TIME
(Average of Years 1976-1980 as compared to Average of 2001-2004 landings)

Port Area:		Decline (%) of Fishery
Eureka (CA)	=	97% LOSS
Crescent City (CA)	=	87% LOSS
Brookings (OR)	=	82% LOSS

[1] The port areas listed include landings in the following ports: Brookings also includes Port Orford and Gold Beach; Crescent City includes only Crescent City; Eureka also includes Trinidad and Humboldt Bay locations. Brookings is at the far northern end of the Klamath Management Zone, and thus would have received some landings from just north of the KMZ.

[2] Data from the Pacific Fishery Management Council (PFMC), *Review of 2005 Ocean Salmon Fisheries (2/05).* The KMZ coho fishery was closed completely in 1992 after years of increasing restrictions, so years after 1992 reflect only chinook landings. KMZ closures during 2005 and 2006 were almost complete.

[3] Preliminary numbers as of date of publication (2/05), many be slightly adjusted based on final figures

ATTACHMENT 8

Preliminary Economic Assessment of Dam Removal,
Kruze and Scholz (Jan. 2006)

Preliminary Economic Assessment of Dam Removal: The Klamath River

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1. INTRODUCTION

The Klamath River flows over 250 miles from its headwaters in southwestern Oregon through northern California to the coast, where it drains into the Pacific Ocean. The Klamath is one of only three rivers to pass through the Cascades and is the second largest river in California. It is divided into two distinct sections, the Upper and the Lower. A significant amount of water is diverted from the Upper Klamath River for agricultural irrigation within the federal Klamath Irrigation Project, while much of the Lower Klamath runs through the Klamath National Forest. The river and its fish, particularly salmon, are considered sacred by the Native Tribes that live nearby, including the Yurok, Hupa, Karuk and Klamath Tribes.

Historically, the river was considered prime habitat for a variety of species including: Chinook salmon, coho salmon, silver salmon, steelhead trout and Pacific lamprey. Once the third-largest river for salmon spawning on the West Coast, the Klamath River now produces only a fraction of its historic levels. Six dams, constructed between 1908 and 1962, truncate the river and prevent salmon, as well as other anadromous species, from moving upstream. The lowest dam, Iron Gate, sits at river mile 190 and is the current limit of upstream passage for fish moving upstream.

Before construction of the dams began, approximately 600 miles of river and stream channel above Iron Gate were accessible by anadromous fish runs.[1] Significant habitat still exists upstream of the Iron Gate Dam that is not being utilized, and the Long Range Plan for the Klamath River Basin Conservation Area Fishery Restoration Program identified the current lack of upstream passage created by the Iron Gate Dam as a significant impact on the Klamath River anadromous fishery.[2]

The original operating license for the Klamath River Hydropower Project received final approval in 1956 and is set to expire in February 2006. The Federal Energy Regulatory Committee (FERC) is currently overseeing the renewal process for another dam operating license. The Project, which includes the 6 dams on the Klamath River, is currently owned and operated by PacifiCorp, a subsidiary of Scottish Power. The dams collectively generate 151 megawatts of electricity, less than two percent of the power 8,300 megawatts generated by PacifiCorp facilities servicing customers in Oregon, Wyoming, Washington, California, Utah and Idaho.[3]

The FERC renewal application, completed in 2004 by PacifiCorp, did not include any provisions for passage of salmon to rivers and streams above the Iron Gate Dam. For a variety of reasons – including ecological, cultural, and economic factors – stakeholders, including tribes, conservationists, and commercial fishermen, contend that the removal of up to four dams would be a desirable outcome of the re-licensing process.

The purpose of this study is to provide a preliminary assessment of removal of the four Lower Klamath River dams. It will identify and begin to quantify the likely economic impacts, both positive and negative, that dam removal would have on local stakeholders, particularly Siskiyou County, as three of the four dams being considered for removal are located within its borders.

The specific objectives of this study are:

1. identify and quantify both the market and non-market values of dam removal to local stakeholders and to the region;
2. assess the economic impact dam removal would have on Siskiyou County;
3. ascertain the likely impact of dam removal on residential river-front properties; and
4. perform a comparative analysis that examines the costs and benefits associated with both the "status quo" and "without dam" scenarios.

Section 2 of this report examines the value of the Klamath River in its present state and the likely costs and benefits associated with a change in the status quo, as caused by removal of the four lowest dams. The costs of dam removal are discussed in Section 3; in particular, those associated with dam deconstruction, alternative power sources and property values. Section 4 identifies likely benefits of dam removal including: return of a free-flowing river, increases in fish populations and benefits to local Native tribes. When possible, the benefits are discussed in economic terms and quantified. The conclusion summarizes the likely impacts of dam removal on Siskiyou County and also notes topics for continued research.

2. PROPOSING A CHANGE

The North Coast Regional Water Quality Control Board (NCRWQCB) basin plan lists the following existing beneficial uses of the Klamath River[4], in no particular order:

- Municipal and domestic supply
- Agricultural supply
- Industrial service supply
- Industrial service
- Groundwater recharge
- Freshwater replenishment
- Hydropower generation
- Recreation, water contact and non-water contact
- Habitat, cold freshwater and warm freshwater
- Habitat, wildlife
- Preservation of rare and endangered species
- Migration of aquatic organisms
- Spawning, reproduction and/or early development

These multiple uses benefit an equally numerous and varied group of stakeholders including: local communities, Native tribes, farmers, commercial and sport fishermen, outdoor enthusiasts and conservationists, to name a few. Changes in river dynamics, including dam removal, have the potential to impact some, or all, of the benefits currently provided by the Klamath River, and ultimately local and regional stakeholders. For this reason, it is important to identify and, when possible, quantify the likely costs and benefits associated with removing the four lower dams on the Klamath River.

This study specifically examines the likely costs and benefits to Siskiyou County, California. It is important to note that as such there are some benefits to the County that may be costs to others. For example, the benefits the County would receive from spending associated with dam deconstruction also would be a cost to the entity responsible for paying for the removal. In instances where such a discrepancy occurs, we will try to describe the likely group(s) of gainers and/or losers.

2.1 Identifying Costs and Benefits

When considering the impact of dam removal, costs and benefits are normally associated with changes in a good or service. These goods and services (henceforth termed ”goods”) fall into two categories –

market goods and non-market goods. Market goods are defined as those that are bought and sold in a market setting and whose value is typically determined using the price associated with the good. In the case of dam removal, hydropower and commercial fishing are examples of goods and in both cases market transactions provide the data necessary to calculate the estimated costs and benefits.

There are also goods, such as recreational opportunities, subsistence fishing and environmental aesthetics, for which markets do not exist. These goods are known to have value to society, either positive or negative, and changes in their quantity or quality will affect those values. However, market data does not exist to measure the impact of such changes. To address this deficiency, a variety of non-market valuation techniques have been developed by economists and several will be discussed later in this study.

2.2 Estimating the Costs of Dam Removal

Dam removal costs can be broken down into three major categories; dam deconstruction, lost services and external. Dam deconstruction includes all costs directly associated with removal of the physical structure, and may include such things as removal of the physical structure, sediment disposal and storage, and the disposal of waste materials. In the case the four Klamath River Dams, the total value of deconstructing and removing the dams has been estimated by one study to be $35.6 million.[5] This particular estimate was based on the two assumptions; 1) sediments could be naturally eroded downstream, and 2) spoil sites could be located within 10 miles of each dam, and also does not include the costs associated with permitting, restoration or mitigation. These additional considerations have the potential to significantly increase the actual cost of removal.

A more recent study, though yet unpublished, estimates the total cost of removal for the four dams to be $100 million.[6] Both of these cost estimates will be discussed in greater detail in a subsequent section of the study.

The cost of removal, however, is not likely to be born by Siskiyou County, but rather produce benefits for the county through spending and job opportunities related to dam deconstruction. These benefits will be discussed in greater detail in the next section. It is important though to recognize that ultimately someone will be responsible for the cost of dam removal and for that entity the cost would be significant.

Description	Iron Gate	Copco 2	Copco 1	J.C. Boyle
Uses	Hydropower/ Flow	Hydropower	Hydropower	Hydropower
Year Built	1962	1925	1918	1958
River Mile	190	198.3	198.6	224.7
Generating Capacity (MW)	18	27	20	80
Material	Rockfill	Concrete	Concrete	Earthfill
Upstream Fish Passage	No	No	No	Yes
Downstream Fish Passage	No	No	No	Yes

Table 1: Klamath River dams considered for dam removal

Lost services provided by the dam are included in the second category of costs. Again, Siskiyou County would not be directly responsible for establishing an alternative power source, someone must. This cost could indirectly affect both Siskiyou County and its residents if changes in electricity costs were to occur because of the loss of hydroelectric power from the four dams and the switch to an alternative power source. For that reason, the value of lost services is also discussed here.

In the case of the four dams being considered for removal on the Klamath, this value would include the cost of finding an alternative source of energy that provides *at least* the same level and quality of power output. PacifiCorp's Final License Application estimates the annual cost of producing power under the new license to be $23.3 million, or almost $700 million for the entire life of the project.

Assuming a total generating capacity of 147.2 MW for the entire length of the project, Table 2 shows the PacifiCorp study estimates for replacing project power with power generated using alternative sources.

Source[7]	Estimated Annual Cost (in millions)
PacifiCorp Hydropower	$23.3
Natural Gas	$27.7
Cogeneration	$31
Wind	$26.7
Coal	$21.6

Table 2: Annual cost of power replacement using alternate fuel sources

A comparison of the estimated cost of the current project with the estimated costs using alternative sources suggests that using the most expensive alternative source (Cogeneration) would lead to increase in costs of $7 million per year. These estimates include both the initial outlay of capital for alternative resource development as well as the annual operating costs for the projects. As a cautionary note, increases in the cost of alternative power sources (i.e. increased cost of coal or natural gas) would almost certainly increase the actual cost of using an alternative power source.

However, the estimated annual cost of $23.3 million to continue the project does not include the installation of fish ladders and screen turbines on the four dams, which federal agencies could make a requirement of the relicensing agreement. PacifiCorp ran computer simulations to estimate the additional cost of such installations and put the figure at $100 million.[8] An addition of this type to the project would increase the annual cost of the project up another $3 million per year.[9] Inclusion of fish ladders and screen turbines as part of the relicensing agreement is a realistic assumption and is supported by the California Energy Commission (CEC). A recent CEC study concluded that, independent of a decision to relicense or decommission the Klamath dams, habitat improvement and restoration projects will be needed to mitigate currently degraded salmon habitats and address water quality issues.[10]

Another important Klamath River species is the Pacific lamprey, whose historic spawning habitat reached far up the river. Also known as "eel", the Pacific lamprey is an important subsistence food source for local Tribes along the Klamath River and its major tributaries, especially during the winter and early spring months when other fresh food sources such as salmon were not available. Local knowledge data gathered during interviews with tribal members suggests that dam installation is a major cause of declining lamprey populations.[11]

In January 2002, a petition was sent to the United States Fish and Wildlife Services for the listing of four lamprey species, including the Pacific lamprey, as "Endangered" throughout their range under the Endangered Species Act. The same year the Oregon Fish and Wildlife Commission added the Pacific lamprey to Oregon's protected species list.

Given this concern over the Pacific lamprey, it has been suggested that provisions for license re-approval may include not only fish ladders, but also ladders for the Pacific lampreys, which are

considerably more expensive.[12] While cost estimates for these ladders are not currently available, the inclusion of these ladders in the re-licensing agreement would increase the cost of an approved project.

The final category of costs includes any external costs of removing the dam, such as costs resulting from changes in the environment, local economies, and/or jobs. Possible environmental effects of removing these dams may include loss of wildlife habitat on the reservoirs behind the dams, temporary mud flats, and the loss of a "lake view" for residential property owners with waterfront property, which will be discussed in greater detail later. Other concerns frequently related to dam removal are increased risk of flooding and loss of irrigation ability.

One misconception about the four lower dams is that their removal would have a negative impact on water supply for irrigation and/or increase the likelihood of flooding in the region. While the dams generate power, they do not supply flood control or water supply benefits.[13] A recent study concluded that even under a worst-case scenario, the likely effects of downstream sediment deposition and flooding risk would be minimal, so they will not be discussed here.[14]

According to the PacifiCorp Final Technical Report on Socioeconomic Resources, 19 individuals are currently employed in operation and maintenance on the Hydropower Project – 11 are full-time employees and 8 are seasonal.[15] The annual payroll for these employees is approximately $820,000. Estimates of employment levels under the proposed Project could not be found, but with the expected decommissioning of at least two developments (East Side and West Side) it is reasonable to assume that the number of employees is not likely to be greater than the current number. Removal of the dams, or the non-relicensing of the Project would almost certainly eliminate all existing jobs.

For the fiscal year 2002–03, Siskiyou County property taxes totaled in excess of $2.9 billion and revenues from PacifiCorp properties accounted for approximately 3.8%, paying $1.1 million in taxes.[16] Again, these values are for the current Project, not the proposed Project, but should accurately reflect revenue generated from a relicensed Project in that the only dam decommissioning proposed occurs outside of Siskiyou County.[1]

From a market cost-efficiency perspective, if the cost of continued operations becomes greater than the cost of dam removal and replacement of lost services, it may make economic sense for PacifiCorp to not renew their license.

2.3 Property Values

Another issue to consider is the effect dam removal would have on adjacent property values. Because the long-run impacts cannot be determined prior to dam, there is considerable uncertainty associated with this issue, and understanding the likely effects may be of critical importance for owners of bordering properties. While dam reservoirs are really an extension of the river, these property owners may view their property as "lake front" rather than "river front" and as such, worry that dam removal and the subsequent loss of the reservoir created by the impoundment will have a negative effect on property values.[17]

The literature on this issue is limited at best, but preliminary studies in Wisconsin, mainly on small dam removals, found that adjacent property values either remained constant or decreased briefly, but regained their entire value by the end of two years.[18] In fact, one study concluded that property values

[1] While not in the specific scope of this research, Klamath County, Oregon would lose approximately $70,050 (2002–03 dollars) in tax revenues from the removal of the J.C. Boyle Dam.

may actually increase after a dam removal that leads to improvements in water quality, river ecosystem restoration and/or provides new or improved recreational opportunities.[19]

Evidence is mixed, however, and the conclusions and recommendations of existing studies on the subject suggest the impact of dam removal on property values is best done on a case by base basis, and that what happens in one place will not necessarily hold true in another.

The difficulty with assessing the impact of dam removal on property values is two-fold. First, it requires calculation of property values over time, both before and after dam removal. It requires patience, as using only the assessed value of the home may not account for aesthetic changes to the property caused by dam removal and to gather sale prices after dam removal takes time and is dependent on the sale of homes in the area. To date, few opportunities have presented themselves where this type of time series research could be conducted.

Secondly, there are a significant number of variables affecting the value of any residential property including the real estate market, and the numerous characteristics of the property – location, square footage, acreage, number of bedrooms, number of bathrooms – to name a few. Frontage on water is only one of these characteristics. And to make matters more confusing, qualitative data from a Wisconsin study suggests that adjacency to any body of water, whether a lake or a river, is considered valuable.[20]

A joint publication by American Rivers and Trout Unlimited provided a series of questions for stakeholders to ask when considering the effect of dam removal on property values:

1. Who will own the reclaimed land following dam removal?
2. If the reclaimed land changes hands, will the new landowner pay local property taxes?
3. Will landowners gain a scenic view of the stream or river and associated riparian areas (e.g. wetlands and waterfowl)?
4. Will landowners have access to the restored river and reclaimed land for recreation? Will the public?[21]

Answers to questions such as these will not provide a definitive answer, but will help stakeholders and policymakers better understand whether the impacts on property values are more likely to be positive, negative or neutral.

Before delving deeper into possible changes in property values on the Klamath River, there are several related issues that first need to be addressed. The first is ownership of exposed lands. There are two reservoirs on the Lower Klamath with adjacent private residences; Copco Lake and Iron Gate Lake. Dam removal would eliminate these bodies of water, except for the natural riverbed, and submerged lands under the lakes would become exposed. PacifiCorp is the owner of the land under the reservoirs and therefore would be the owner of any land exposed by the draw-down of either the Copco or Iron Gate Lakes.

The final ownership of this land will inevitably impact surrounding property values. There are a variety of options for the previously inundated land, all of which would impact adjacent property values. PacifiCorp could 1) do nothing, 2) convert the land into a park or conservation easement, 3) sell the land, or 4) transfer the land to property owners or to the county. Conversion of the land to a park or conservation easement would provide non-market benefits to society and would likely help mitigate the negative impacts of dam removal on property values. Transfer of the land to the county, presumably to

be used in a public capacity, or to private lake-front property owners as an extension of their current lot, would help mitigate lost property value and/or the associated property taxes.

If lakeside property owners obtain ownership of the previously inundated land either by purchase or through transfer, it would provide increased lot size, and a transition from lake-front to river-front property. In a conversation with the Siskiyou County assessor, Mike Mallory, he cautioned that many of the properties adjacent to the lake have long, narrow parcels with the residences set near the lake, and draw-down of the reservoirs could leave a distance of a quarter to half a mile between many of the homes and the new river channel.[22] Such a distance would likely prevent a river-view for owners able to purchase the uncovered land.

Property owners unable to gain ownership of the previously inundated land would lose both their lake frontage and river view/access. For these individuals, loss of access to water would likely lead to a decline in property values. This would be especially true if the land between their property and the river was purchased and/or developed by other individuals.

The impact of development on existing properties is uncertain, but the price received from the sale and development of the land would be counted on the benefit side of a cost-benefit analysis. This development could also increase property tax revenue from the area. In a conversation with Mike Mallory, he noted that there are a variety of obstacles to development in the area that should be considered though before assuming that the value of development will be sufficient to offset the property values lost by lake-front owners.[23]

Another group of property owners to consider are those that do not have lake-front properties, but own properties with lake-views. Properties with lake-views that do not gain river-views or river access after the dam removal may experience a decrease in property values also.

There is a second property value issue that deserves further analysis – poor water quality of the reservoirs, especially during the summer months when toxic algal blooms have occurred in recent years.[24] Studies examining the impact of water quality on property values found that water quality is a significantly explanatory variable in determining lakefront property values.[25], [26] A question to consider is what impact, if any, does the poor water quality of the Copco and Iron Gate Lakes have on property values, and would the improved water quality resulting from dam removal help offset the potential loss in value due to the removal?

3. Estimating the Benefits of Dam Removal

The primary benefits of dam removal are associated with the ability of the river to return to a free-flowing state. Reconnection of what were previously upstream and downstream sections of a river allows for the restoration of a variety of environmental services such as water quality, aquatic habitat, riparian species, etc. In economic terms, the values of restored environmental functions associated with dam removal fall into two main categories: market values and non-market values, which were discussed previously.

3.1 Klamath Fisheries

The Klamath was historically one of the largest salmon spawning rivers in the United States. According to Glen Spain, Northwest Director of the Pacific Coast Federation of Fishermen's Association, the river once produced an average of 880,000 spawning salmon and steelhead each year.[27] Another estimate

suggests that historic counts of spawning salmon alone for the Klamath-Trinity system were between 650,000 and 1,000,000.[28]

Protecting and restoring natural ecosystem services, including salmon populations, in the Klamath River Basin is vitally important to a variety of local stakeholders as well as conservationists. Commercial and sport fishermen rely on the annual spawning runs to keep salmon fishing sustainable. For Native American tribes the river is the centerpiece of their culture, as well as a source of livelihood and subsistence food.

There are a variety of factors that have likely contributed to declining salmon populations, including dam installation, logging activity near the river and the Klamath Irrigation Project in the Upper Klamath, as well as the low water flows and agricultural run-off associated with it. Evidence suggests though that dam installation is a major contributor to declining salmon populations. Removal of the four lowest dams, among other things, will open additional stretches of river for spawning of anadromous fish. Contrary to speculation, the conclusions of a 2005 study found that salmon, steelhead, Pacific lamprey and other species all historically migrated to these parts of the river and that there is currently unutilized spawning habitat available above the dams.[29]

It is generally agreed that dam removal would lead to an increase in salmon populations. What is not known is to what degree, or how quickly. The Pacific Fisheries Management Council keeps annual counts of the in-river salmon run. Counts for fall Chinook salmon, by far the largest run, are available from 1978 though 2004. Over that time the average in-river run was 107,100 salmon. However, recalculating the estimates using only the last 10 years (1995–2004), the average run increased to 145,200.

The Pacific Fisheries Management Council currently manages the fisheries of the Klamath River System. The paragraph below is taken directly from the PFMC 2005 Pre-season report and describes the current allocation with respect to the Klamath River fall Chinook salmon stocks.

- 50% (8,300 fish) of the available harvest to the Indian tribes of the Klamath-Trinity River Basin with Federally-recognized fishing rights (Yurok and Hoopa Valley tribes);
- 15% (1,200 fish) of the non-Indian harvest to the Klamath River recreational fishery;
- 85% (7,100 fish) of the non-Indian harvest to the ocean fisheries;
- 17.1% (1,200 fish) of the ocean harvest to the KMZ recreational fishery; and
- 50% each (2,200 fish) of the ocean commercial harvest of Klamath River fall Chinook in all areas to the States of California and Oregon.[30]

The earliest posted pre-season report (2001) has the same allocation split for Indian harvest and non-Indian harvest; each received 50% of the available harvest. However, distribution between ocean fishery and recreational fishery was different than that of 2005, with 39.5% of the non-Indian harvest going to the Klamath River recreational fishery and 60.5% going to the ocean fishery. The share of the ocean recreational fishery was the same, receiving 17% of the ocean allocation.

Because of these differences, and because allocation were not available for years before 2001, percent of allocation was determined by taking a 10-year average of percentages harvested by in-river recreation and Indian harvest. For the years 1994–2004, recreational fishermen on average caught 6% of the in-river run for fall Chinook salmon, while Native Tribes caught 19%. These values then allow us to estimate the average ocean fishery allocation (13%). The assumption that actual harvest level equals allowable harvest level will serve the purpose of this analysis by allowing catch rates to serve as a proxy for allocation rates.

While unutilized anadromous fish habitat currently exists above the Iron Gate Dam, the author was not able to locate information on the likely impact access to this section of the river would have on salmon populations. Based on the historic rates of 800,000 to 1,000,000, a reasonably conservative assumption would be that salmon populations would, on average, double. This assumption will be used in the following series of estimates.

Using the assumption that the average in-river runs of fall Chinook salmon double, the increases in harvest by the various fisheries (based on 25-year average and 10-year averages and a 72% spawning escapement rate) are shown in Table 3 below. This exercise is intended to be used only as a demonstration that increases in salmon will lead to increased harvest rates, and as discussed later, increases jobs and economic value.

	Percent of Allocation (10-year average)		100% increase (10-year average)
Total In-river Run	**100%**		**290,440**
Escapement Rate (10-year avg.)	72%		209,117
In-river Fisheries		28%	81,323
Non-landed Fish Mortality	2%		5,809
Native Tribes	19%		55,184
In-river Recreation	6%		17,426
Ocean Fisheries - Total	13%		37,757
▪ Ocean Recreation		17%	6,419
▪ Ocean Commercial		83%	31,338

Table 3: Estimated allowable harvest given a 100% increase in in-river run

While currently known for its fall Chinook salmon run, the Klamath River serves as habitat and spawning grounds for a variety of other fish species; spring Chinook salmon, coho salmon, silver salmon, Pacific lamprey, rainbow trout, and steelhead trout to name a few. The spring Chinook salmon, also known as "Springers" historically were more abundant than the fall Chinook. They are prized and revered by the local Klamath Tribes, but recent population surveys show they annual in-river runs have decreased to returns of only several hundred fish.[31]

Another species, the Klamath River coho salmon has had such severe population declines that it is currently listed as a threatened species under the Endangered Species Act (ESA). Steelhead populations have also experienced a serious decline, with the Klamath Mountain Province steelhead currently listed as a candidate for listing as a threatened species. As mentioned previously, the Pacific lamprey is also being considered for listing under the ESA.

Dam removal would almost assuredly have a positive impact on these and other Klamath River species and would most likely help to restore population counts. While these positive impacts have not been estimated or quantified here, these are values that need to be included on the benefit side of any cost-benefit analysis of dam removal.

3.2 Economic Benefits

The purpose of this section is to examine the economic impact of dam removal on Siskiyou County. Included in this analysis are changes in jobs and income related to expenditures associated with dam removal.

3.2.1 Jobs Related to Dam Removal-Related Expenditures

Three types of jobs need to be considered with calculating the economic impact of increased expenditures related to dam deconstruction: those directly created, those indirectly created, and those "induced" through the multiplier effect. For example, dam deconstruction would directly create jobs related to demolition of the dams and processing/transportation of materials and sediment. Those indirectly created in support industries might include jobs such as heavy equipment maintenance and repair, and project monitoring jobs. The final category of jobs is created not by the initial expenditures related to dam removal, but on expenditures made by those directly and indirectly employed in the deconstruction process. These jobs would most likely be in industries such as entertainment, food services, hotels and real estate. The multiplier effect accounts for each successive round of expenditures related to the initial expenditure. For example, a multiplier of 2 means that for each dollar spent initially, the successive rounds of spending lead to another dollar of spending, for an overall increase of two dollars to the local economy.[32]

This study uses the Regional Input-Output Modeling System (RIMS) II Multipliers for the State of California, as prepared by the CA Technology, Trade and Commerce Agency, Economic Strategy and Research.[33] Three of the dams considered for removal are located in California (Siskiyou County), while the fourth is located in Oregon. County-specific multipliers could not be found, nor Oregon multipliers and for this reason, California multipliers are used, which will provide at least a rough estimate.

Expenditures on dam deconstruction are assigned as "Construction" related spending. For this industry, it is estimated that for every $1 million spent there are approximately 21.5 jobs are created and that for every direct job created in the construction sector, there are an estimated 2.1249 indirect and induced jobs created for the total economy.

The California final demand multiplier for output is 2.3574. This represents the dollar change in output by the total economy for each $1 increase in the construction sector output. Using the estimate of $35.6 million as the value of expenditures related to dam deconstruction, the total economic benefits of the project can be calculated using the RIMS II multipliers. It is estimated that an additional 765 jobs will be created and the increase in economic out will be just under $84 million (See Table 5).

Another study[34] estimates the cost to be $100 million for removal of all four dams (See Table 4 for breakdown by dam). Using this estimate and the RIMS II multipliers, the economic benefits of dam removal can be estimated again. The number of jobs created is estimated to be 2,150, while total benefits to the economy exceed $235 million (See Table 5).

Dam	Estimated Cost (in millions)
Iron Gate	$54
Copco 2	$20
Copco 1	$9
JC Boyle	$17
TOTAL	$100

Table 4: Estimate of dam removal (Greinan, 2005)

If the estimated $17 million dollar cost for deconstruction of the JC Boyle dam is taken out of the calculations, the cost of removal for the three dams located in Siskiyou County is estimated at $83 million. While it is unlikely that the economic benefits of dam removal would be split directly down

state or county lines, Table 5 also provide the estimated increase in jobs and economic output based only on removal of the Siskiyou County dams (Copco 1, Copco 2, and Iron Gate).

		Estimated Economic Benefit		
	Multiplier	Cost: $35.6 million (4 dams)	Cost: $100 million (4 dams)	Cost: $83 million (3 dams)
Total jobs created (per $1m)	21.5	765 jobs created	2,150 jobs created	1785 jobs created
Total increase in economy (per $1)	2.3574	$83,923,440	$235,740,000	$195,664,200

Table 5: Estimated economic benefits of dam removal

3.2.2 Estimates of the Value of Salmon

A 2001 study of the Upper Klamath Basin found the increasing salmon populations could also lead to an increase in jobs, with each additional 1,000 commercially caught salmon generating 1.5 jobs, while each 1,000 salmon caught recreationally support another 4 jobs.[35] Using the estimated harvests calculated previously, we can now estimate the associated increase in jobs.

	Current (10-year avg.)	100% Increase (10-year avg.)
Total in-river run	145,220	290,440
Native Tribes	27,592	55,184
In-river Recreation	8,713	17,426
Ocean Fisheries - Total	18,879	37,757
Ocean Recreation	3,209	6,419
▪ Ocean Commercial	15,669	31,338

Table 6: Estimated allowable harvests based on 100% increase in fall Chinook salmon runs

Using the 10-year average calculations, the resulting increase in commercially harvested salmon would be almost 16,000 and in recreational fisheries would be over 12,000 (combining ocean and in-river sport fishing). The associated increase in jobs would be 48 from recreational fisheries and 24 from commercial fisheries, for an estimated total of 71 additional jobs created by increased salmon harvests.

The same study provided estimates for the value of increased salmon harvest to the economy and calculated that if salmon populations increased in the Klamath River, each additional fish caught by anglers would be worth approximately $200 and $5–70 if caught by commercial fishers. The data in Table 6 show the estimate value to society of a 100% increase in salmon populations.

Fishery	Estimated value (based on 10-year avg.)
Recreation ($200/fish)	$4,417,592
Commercial ($5/fish)	$78,346
Total Value	$4,495,939

Table 7: Estimated value of increased recreational and commercial Chinook salmon harvests

These calculations are intended to serve as an example. Because it is not known exactly what increase in salmon populations will occur, we cannot give precise estimates. Those above are based on the

assumption of a 100% increase in fall Chinook salmon populations, and do not account for increase in other Klamath River fisheries such as steelhead or rainbow trout. Increases in the populations of these species would undoubtedly lead to increased harvests and associated economic benefits as well.

3.2.3 Non-Use Value of Returning the Lower Klamath to a Free-Flowing River

Individuals may value dam removal even if they have never visited nor intend to visit the Klamath River. This type of value is known as a non-use value because an individual(s) can receive benefits even if there is no use of the good or resource. In other words, individuals may have a value for a free-flowing river even if they never fish, raft, swim or even visit the river. Included in the general definition of non-use values are existence values and bequest values. Existence value is frequently mentioned with respect to endangered resources, or when the proposed action may affect a resource in an irreversible way. Similarly, bequest value relates to the notion of preserving the good for use by future generations.

This analysis replicates the methods used for a study of non-use values related to dam removal on the Lower Snake River and uses benefit transfer methodology.[36] The goal of benefit transfer is to use existing values from a specific site(s) and transfer those values to another site with similar resource and policy conditions. Ideally, a non-use valuation study would be conducted in the Lower Klamath region and would gather data and values specific to that dam removal scenario. In this case, both time and financial constraints prevent such an analysis, so benefit-transfer will be used. While not exact, the approach provides a likely range of estimates associated with increased salmon populations resulting from dam removal.

Independent of the use values associated with dam removal on the Lower Klamath is the non-use value associated with restoring the river to a natural free-flowing form. This type of value may also include related benefits, such as ecosystem restoration and improved water quality that are associated with the return of the river to a more natural condition. In this analysis, rough estimates will be calculated though an application of results from existing literature to measure the non-use value of dam removal on the Lower Klamath.

A 1999 study in Colorado found that annual willingness-to-pay (WTP) for non-use values was $77 in 1983, or $147 in 2005, accounting for inflation.[37] In order to calculate the value per mile this value is divided by 555, the number of river miles being valued in the study. This yields a value of 26 cents per mile. Multiplying this by 35 river miles that would be opened by removal of the four lower dams yields a value of $9.10 per household per year.

According to the 2000 U.S. Census, the number of households in California was 11,502,870. Subtracting the number of households in the counties surrounding the Lower Klamath River yields a total of 11,351,108 households. Multiplying this by $9.10 yields an estimated non-use value for restoring the Lower Klamath River of $104,507,239.

Another study estimated the value of preserving the Black Canyon of the Upper Snake River from development.[38] This survey found that non-users had an annual WTP of $58 for preservation. Updating to account for inflation, and dividing by the number of river miles being valued, yields a per mile value of $1.06. This value is higher that that of the previous study because only residents of counties adjacent to the river were sampled. Again, multiplying this by the 35 river miles of the Lower Klamath yields a per household value of $37.10. This value can then be multiplied by the number of non-user residents in Siskiyou County, as the Lower Klamath River flows directly through it, and the surrounding counties of Modoc, Del Norte, Humbolt, Trinity and Shasta. The purpose of including only non-user residents is to avoid double counting.

No statistics were available for the number of users versus non-users in these counties, so estimates were calculated assuming that 50% of residents were users. Multiplying by $37.10 yields a non-user value by adjacent residents of just over $2,815,200. Even assuming 75% of the residents in these six counties were Klamath River users, the non-use value would be $1,407,600.

The aggregate non-use value by the region is finally calculated by adding the two estimates, or $107,322,424, for the return of a free-flowing Lower Klamath River. Even if 100% of residents in the surrounding six counties were users, the estimate non-use value for a free-flowing river would still be $104,507,200.

This is a conservative estimate in the sense that it does not include individuals who use the river for recreation but still independent of their usage still value the existence of a free-flowing river. However, the population of California is very diverse both in terms of socioeconomics and adjacency to the river and because of this, it is possible the estimate may overestimate the total value of a free-flowing river if WTP varies because of differences across different subcategories of the population. Finally, It should also be noted that this value is independent of any effect of dam removal on salmon populations and accounts only for the return of the river to its natural state.

3.2.4 Cultural and Tribal Values

Removal of the four dams on the Lower Klamath will provide a variety of positive benefits to local tribes. In the long run dam removal will provide the return of traditional fishing grounds and increased salmon harvests for ceremonial, subsistence and commercial use. Increased salmon consumption would also likely help improve diet and health of local Tribal members. The conclusions of a recent study of the Karuk diet found that their traditional diet has shifted dramatically.[39] In recent years, the primary cause has been denied access to traditional foods, of which salmon is a primary component. The study stated "the decline of eel and salmonoid populations that once supplied over half the Karuk diet has occurred within the lifetime of most adults today."[40] This altered diet has led to serious health affects, including increased rates of diabetes and heart disease, among Tribal members.

This lack of access to subsistence salmon also affects the ability of tribes to harvest for commercial purposes. At least for the Hoopa Tribe, there is currently no designation between catch for commercial, subsistence, or ceremonial purposes. Indian commercial catch is simply the amount of fish harvested that is not used for subsistence or ceremonial purposes.[41]

Increased salmon harvests would help mitigate the current situation, which forces tribe to choose between using salmon for subsistence or selling it commercially. Diet would also undoubtedly be improved with increased access to traditional foods such as salmon and eel.

The phrase "improvements to subsistence, commercial, and ceremonial salmon harvests" does not adequately describe the varied positive benefits local Tribes would see from dam removal. Further research is necessary to identify and, if possible quantify, those benefits, as the few mentioned here only begin to cover the issue.

3.2.5 Other Recreational Activities (Non-Fishing)

While ocean and river recreational sportfishing are two of the most popular recreational activities, the Klamath River also offers a variety of other recreational activities for outdoor enthusiasts. Whitewater rafting, boating, camping, gold mining, hiking and wildlife watching are all popular activities. Dam removal would inevitably impact reservoir activities such as water-skiing and boating, but it is difficult

to assess what impact, if any, dam removal would have on participation levels and/or visitor days to the area. Preliminary evidence from personal communications suggests that whitewater rafting outfitters feelings are mixed on the subject, with some believing it will improve rafting experience and others wondering if flow levels will be too low during certain parts of the year.

The decrease in users or visitors days associated with reservoir loss may be offset or augmented by new users coming to sport-fish, and this is an area that requires further consideration and analysis. Impacts on recreation, either positive or negative, need to be identified and included in any cost-benefit assessment.

4. CONCLUSION

This analysis is a first-cut effort to identify and, when possible, quantify a number of the likely costs and benefits associated with removing the four lower dams on the Klamath River. This dam removal scenario involves a number of complex variables, and as it typical with dam removal decision-making, likely changes involve a great deal of uncertainty. The findings of this analysis are based on our best efforts to obtain and use current and relevant existing data; continued research on this topic would likely benefit from continued data collection and analysis. The purpose of this analysis is to increase understanding and decrease uncertainly related to the likely economic impacts of dam removal.

Table 7 lists the likely impacts of dam removal and based on the results of this study, the likely direction of the impacts for Siskiyou County in particular. Table 8 lists like impacts for other stakeholders.

Impact	Siskiyou County	In Economic Terms
Dam Deconstruction	▪ Positive – Jobs and Spending	(See local economy)
Power	▪ Neutral – Not responsible for finding alternative source ▪ Negative – If electrical rates increase	Unknown
Property Values	▪ Negative – Loss of lake view, uncertainty over property rights of land under reservoirs	Unknown
Fish Populations	▪ Positive	$4.5 million[2]
Local Economy	▪ Positive – Spending and jobs from deconstruction, increased tourism, visitors ▪ Negative – Loss of jobs and taxes from hydropower project	$172million[3] plus -$2million
Commercial Fishing	▪ Positive	(See fish populations)
Recreational Fishing	▪ Positive	(See fish populations)
Subsistence Fishing	▪ Positive	(See fish populations)
Cultural Values	▪ Positive	Unknown
Recreation (non-fishing)	▪ Unknown	Unknown
Free-flowing River	▪ Positive	$104 million

Table 8: Summary of the costs and benefits of dam removal to Siskiyou County

[2] Assuming a 100% increase in fish populations
[3] Assuming a dam deconstruction cost of $73 million

	Other Stakeholders
Dam Deconstruction	▪ Negative – PacifiCorp or other entity responsible for cost
Power	▪ Negative – PacifiCorp – If alternative power source costs more to operate ▪ Neutral to Positive – PacifiCorp –If alternative power source is cheaper
Property Values	▪ Negative – Property owners – Loss of lake view, uncertainty over property rights of land under reservoirs
Fish Populations	▪ Positive – Fisheries, Visitors, Environmentalists, Fish
Commercial Fishing	▪ Positive – Commercial fishers, processing plants
Recreational Fishing	▪ Positive – Sportfishers
Subsistence Fishing	▪ Positive – Local tribes
Cultural Values	▪ Positive – Local tribes
Recreation (non-fishing)	▪ Unknown
Free-flowing River	▪ Positive – Anyone who value a free-flowing river

Table 9: Summary of the costs and benefits of dam removal to other stakeholders

The issue of dam removal is complex and removal of a dam(s) has the potential to create a variety of impacts, some positive and some negative. Stakeholders and decision-makers alike would undoubtedly benefit from continued and/or additional research of the topics listed below.

- Estimate the current value of subsistence harvests and the increased value that would result from dam removal and the associated increase in salmon harvests
- Identify the likely direction (positive or negative) and magnitude of impact dam removal would have on recreational activities.
- Quantify the associated economic gain (loss) to the local economy based on visitor days and average visitor spending.
- If possible, quantify of the cultural and tribal values associated with dam removal.
- Estimate the impact of dam removal other species, not just fall Chinook salmon.
- Estimate the non-use value for salmon restoration/preservation
- Narrow down the estimated range of costs for dam removal and the estimated increase in salmon populations. Use these values to quantify the impact of such changes on the economy of Siskiyou County.
- Quantify the impact of increased salmon harvest on recreational and commercial fisheries and the associated benefits to Siskiyou County.

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ATTACHMENT 9

Huntington, C.,W., 2004. *Preliminary Estimates of the Recent and Historic Potential for Anadromous Fish Production Above Iron Gate Dam*

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Technical Memorandum

To: Larry Dunsmoor, Biologist, Klamath Tribes

From: C.W. Huntington, Aquatic Biologist

Subject: ***Preliminary estimates of the recent and historic potential for anadromous fish production above Iron Gate Dam***

Date: 05 April 2004

The following memorandum provides ***preliminary estimates*** of the recent and historical potential for anadromous fish production, and specifically chinook salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*O. mykiss*) production, in portions of the Klamath Basin upstream of Iron Gate Dam (IGD; at km 305.9) on the Klamath River. ***These estimates are intended to provide interim answers to several questions that have been posed about this production potential and that will ultimately be answered in a more authoritative way through collaborative modeling efforts now underway in the basin.*** First, how much anadromous fish habitat is present above IGD? Second, what is known about the recent potential of this habitat to produce chinook salmon and steelhead if fish passage and survival problems are resolved at dams and associated slack-water areas along the mainstem Klamath River? Finally, what was the historic production potential of that portion of the drainage basin situated upstream of Upper Klamath Lake (at approximately km 454) and how might restoration of some of this potential influence the capacity of the entire area upstream of IGD to produce anadromous fish?

Anadromous Fish Habitat Above Iron Gate Dam

Working with representatives of multiple governmental agencies, Tribes, non-governmental organizations, and PacifiCorp, I am in the process of compiling available information on habitat within streams in the drainage basin above IGD. Many of these streams are known to have

supported anadromous fish prior to the construction of dams on the Klamath River, although detailed data on which reaches of which streams supported a particular anadromous species are frequently unavailable. For some streams, documentation of historic use by these fish is weak or lacking even though the streams would clearly have provided suitable habitat when in good condition. The lack of historic documentation reflects that fish runs into the area were eliminated or blocked before there was any effort to catalog their freshwater production areas.

At present, I have developed a preliminary list of streams and stream reaches above IGD that appear likely to have had historic potential to produce chinook salmon or steelhead trout. Identification of these streams and reaches has been based on recent stream survey data (from the Forest Service, Oregon Department of Fish and Wildlife [ODFW], and the California Department of Fish and Game [CDFG], on trout abundance and distribution data (from the Forest Service, ODFW, CDFG, and the Klamath Tribe), on water quality and riparian condition data (from the Oregon Department of Environmental Quality and the Klamath Tribe), on model-based estimates of natural flow regimes in the basin's streams (from the Oregon Department of Water Resources), on discussions with local biologists, on reports by Chapman (1981) and Fortune et al. (1966), and on my own professional judgment. The list of historic chinook and steelhead streams will likely be refined during the next few months, but should already provide a reasonable approximation of the areas that at one time provided habitat suitable for use by these two species. Streams above IGD undoubtedly provided important habitat for coho salmon (*O. kisutch*) and Pacific lamprey (*Entosphenus tridentata*) prior to dam construction, but these species have not been a focus of my data compilation effort. Coho salmon would likely have been restricted to streams in the lower-most portions of the drainage basin above IGD, and there are no records or anecdotal accounts of which I am aware that suggest coho were ever present above UKL. Habitat suitable for use by lamprey is widespread in the basin above IGD.

Table 1 gives a brief summary of the just-described list of historic chinook and steelhead streams in the drainage basin above IGD, with the kilometers of suitable habitat that appears to have once been present along the streams contrasted with estimates of recently suitable habitat that were reported by Chapman (1981) and by Fortune et al. (1966). The preliminary estimates of historic habitat total approximately 1183 km of steelhead streams and 635 km of chinook streams, with 1030 km (87%) of the steelhead streams and 502 km (79%) of the chinook streams found above UKL. Streams were classified as historic chinook habitat if they had Rosgen (1996) C, E, F, or B-type channels with low to moderate gradients (<4%), widths of at least 5 meters, (natural) median August flows >0.25 cms (>9 cfs), and adult access unimpeded by barriers (note: 73 km of potential habitat in the upper Sycan River system was excluded due to uncertainty as to whether adult chinook would be able to pass through Sycan Marsh during low flow years). These

threshold conditions describe the smaller Pacific Northwest streams in which I have found adult spring chinook during the spawning season and sounded reasonable to multiple salmon biologists with whom I discussed the issue. Both spring and fall-run chinook were present historically in the drainage network above IGD, and habitat of variable quality is still present for both.

Table 1. Estimates of historic and recently suitable rearing habitat for chinook salmon and steelhead trout in streams within the drainage basin above Iron Gate Dam.

Stream	Preliminary estimates of historic habitat (km) Steelhead	Chinook	Recent steelhead and chinook habitat (km) Fortune et al. (1966)	Steelhead and chinook habitat (km) Chapman (1981)
Areas below Upper Klamath Lake (UKL)				
Klamath River	44.6 (109.9)	44.6 (109.9)	43.4	43.4 (88.5)
Jenny Creek	2.5	2.5	---	---
Fall Creek	1.9	1.9	---	---
Shovel Creek	4.7	4.7	4.0	---
Spencer Creek	15.0	14.2	13.7	---
Others	19.0	---	---	---
Total	**87.7 (153.0)**	**67.9 (133.2)**	**61.1**	**43.4 (88.5)**
Smaller Tributaries to UKL				
Wood River	32.5	32.5	30.2	17.7
Annie Creek	20.0	15.9	---	---
Sun Creek	21.4	8.4	---	---
Fort Creek	6.1	6.1	---	---
Crooked Creek	15.6	15.6	---	---
Agency Creek	3.4	3.4	---	---
Sevenmile Creek	30.4	29.8	27.0	---
Short Creek	2.7	1.0	---	---
Fourmile Creek *	21.6	21.6	---	---
Cherry Creek *	16.1	15.3	---	---
Threemile Creek *	8.2	3.5	---	---
Fourmile (Lake) Creek *	25.9	---	---	---
Denny Creek	9.3	---	---	---
Others	11.6	---	---	---
Total	**224.8**	**147.7**	**57.3**	**17.7**
Williamson River system (excluding Sprague)				
Williamson River	39.9	39.9	33.8	33.8
Spring Creek	3.9	3.9	4.0	3.2
Larkin Creek	6.4	3.2	---	---
Sunnybrook Creek	1.1	---	---	---
Total	**51.3**	**47.0**	**37.8**	**37.0**
Sprague River system				
Sprague River	136.1	136.1	49.9	123.1
N.Fk. Sprague River	57.9	44.4	44.2	19.3
Dead Cow Creek *	6.9	---	---	---
School Creek	6.1	---	---	---
Meryl Creek *	14.0	---	---	---
Fivemile Creek	33.3	21.4	---	---
S.Fk. Sprague River	55.5	36.2	18.2	19.3
Buckboard Creek	6.6	---	---	---
Whitworth Creek *	17.4	---	---	---
Brownsworth Creek *	20.8	---	---	---
Ish Tish Creek	10.9	---	---	---
Paradise Creek	10.3	---	---	---
Fishhole Creek *	57.8	---	---	---
Sycan River	122.1	62.1	---	---
Skull Creek	10.3	---	---	---
Paradise Creek *	34.4	---	---	---
Long Creek *	47.8	---	---	---
Snake Creek *	22.4	---	---	---
Whisky Creek	13.5	6.8	---	---
Trout Creek *	10.3	---	---	---
Copperfield Creek	8.4	---	---	---
Others	59.1	---	---	---
Total	**753.5**	**307.0**	**112.3**	**161.7**
All Streams Above Irongate Dam	**1117.3 (1182.6)**	**569.6 (634.9)**	**268.5**	**259.8 (304.9)**

Note: Values in parentheses include riverine habitat inundated by slack-water by existing dams. Values not in parentheses are for habitat areas that are not currently inundated by slack-water. Asterisks (*) identify streams where one or more tributaries not explicitly identified in the table are included in the estimate of historic habitat.

The Chapman (1981) and Fortune et al. (1966) estimates of anadromous salmonid habitat above IGD will be discussed in greater detail later in this memorandum, but it is clear from Table 1 that they suggest the suitability of far less habitat than is included in my preliminary estimate of the historic condition. Neither Chapman (1981) nor Fortune et al. (1966) estimated the presence of more than about a quarter of the combined length of anadromous salmonid streams that my preliminary estimates suggest was once present above IGD. In the case of Chapman (1981), this may partly reflect the severely flow-depleted character of many of the basin's streams and a lack of information at the time on historic (natural) flows for most tributary streams. Fortune et al. (1996) took a very conservative view of the habitat capability of the basin's streams, most of which had been significantly degraded, during the mid-1960s.

Recent Potential for Chinook Salmon and Steelhead Production Above Iron Gate Dam

There have been three previous estimates of the potential for anadromous fish production within various portions of the drainage basin above IGD. These include the following:

- An estimate of what is labeled "pristine production" of anadromous salmonids above Copco Dam on the Klamath River (km 319.1) by D.W. Chapman (1981) that upon inspection appears to reflect relatively recent production potential in the absence of dams on the mainstem Klamath and of other migratory barriers in the system;

- An estimate Fortune et al. (1966) made of the chinook and steelhead production potential for areas above the upstream end of Copco Reservoir (km 327.8) in the mid-1960s.

- A preliminary estimate of current production potential for chinook salmon between IGD and Spencer Creek (PacifiCorp 2004);

I will review these estimates briefly below, then capture information contained within them as well as from other data sources to provide multiple estimates of recent production potential for chinook salmon and steelhead trout in areas above IGD.

Chapman (1981)

Chapman (1981) worked on an accelerated schedule under contract to the Bureau of Indian Affairs to develop an estimate of anadromous fish production capability lost due to dam construction on the mainstem Klamath River. In assessing the situation, his report notes that the relatively constant flows found in streams of the Upper Klamath Basin should lead to above-average smolt yields, compared to other salmon and steelhead rearing areas. However, Chapman's estimates of the historic level of loss in anadromous production potential do not appear to me to represent pristine conditions within the Upper Klamath Basin, as suggested by the title of his report ("Pristine Production of Anadromous Salmonids – Klamath River"). Rather, the Chapman (1981) estimates probably represent something closer to recent production potential in the absence of dams, associated reservoirs, and artificial migration barriers, provided that fish are able to pass downstream successfully into and through Upper Klamath Lake during their seaward migration. Chapman estimated production potential above Copco Dam (essentially above IGD, given a paucity of suitable habitat between the two) based on 1980 (degraded) habitat conditions in the largest available stream channels. He thus accounted for only a relatively small portion of the combined length of potential anadromous fish streams outlined earlier in Table 1. In fact, within the report itself the author notes that his estimates were conservatively low with reference to "pristine" conditions because they (1) were based on modeling of habitat already degraded by human activities and (2) did not incorporate the historic production potential of many tributary streams that undoubtedly produced salmon and/or steelhead.

In developing his estimates, Chapman (1981) concluded that chinook and steelhead production would be limited by available rearing habitat. He then used an instream flow-based approach at representative (randomly selected) locations to estimate weighted usable rearing area (WUA) within defined habitat strata, applied specific smolt densities per WUA in order to estimate production potential of the rearing habitat within each of these strata, and assumed reasonable rates of marine survival to predict the ability of the drainage basin to produce adult chinook and steelhead. He judged the smolt densities used to estimate the potential to produce steelhead smolts to be very conservative for the basin because they did not account for the stable, alkaline, and extremely productive conditions found in the upper Klamath Basin. The smolt densities Chapman (1981) used for chinook were from studies Bjornn (1978) conducted in the spring-fed and highly productive Lehmi River, but were likely somewhat conservative because they were based on total habitat areas (in the Lemhi River) and not WUAs (as applied in the report).

Ultimately, Chapman (1981) appears to have estimated that in the absence of migratory impediments (including dams), 304.9 km of rearing habitat suitable for anadromous salmonid production in the drainage basin above the site of Copco Dam would have the capacity to support 597,437 chinook smolts, 21,508 returning adult chinook, 106,942 steelhead smolts, and 10,694 returning adult steelhead. Looking more closely at his estimates, Chapman (1981) found that 216.4 km of habitat above UKL appeared to have the capacity to produce 15,052 (70%) of the adult chinook and 8,447 (79%) of the adult steelhead that might have returned above the Copco site in the absence of migratory impediments.

Fortune et al. (1966)

Fortune et al (1966) reported the results of a study of chinook salmon and steelhead production potential upstream of Copco Reservoir that was overseen by a multi-party steering committee that was considering reintroduction of anadromous salmonids to areas above Copco Reservoir. The authors noted that a series of migratory impediments on the mainstem Klamath River, beginning with a log crib structure built at Klamathon (near the current site of IGD) in the late 1880s, severely impeded salmon and steelhead runs into upper portions of the Klamath Basin. These runs were then largely blocked at Klamathon by fish trapping operations initiated by the Bureau of Commercial Fisheries (BOF) in 1910, and completely excluded from the upper basin when Copco Dam was completed in 1917.

In assessing the remaining potential for chinook salmon and steelhead production above Copco Dam (now essentially above IGD, given the paucity of suitable habitat between the two), Fortune et al. (1966) reconnoitered much of the drainage basin upstream for suitable habitat. The authors then developed rough estimates of the numbers of adult fish (i.e., spawners) that could be supported by the quantities of spawning gravel they considered present in channels where the depths and velocities of streamflow were judged sufficient to meet the needs of spawning salmon and steelhead. They thus assumed that spawning habitat in the system would constrain anadromous salmonid production, a conclusion different than that reached by Chapman (1981). They also noted that it was difficult to differentiate areas above UKL used by the large adfluvial redband trout from those historically used by steelhead.

Ultimately, Fortune et al. (1966) concluded that there were 268.3 km of stream still capable of providing suitable salmon and steelhead rearing habitat (excluding reservoirs) in the Klamath Basin above Copco Reservoir. All but 20.5 km of these streams either contained or were downstream of spawning gravel. They estimated that there was about 92,140 m^2 of good

spawning gravel and 107,610 m^2 of total spawning gravel present in areas still suitable for salmon and steelhead use above Copco Dam. This quantity of gravel was estimated by Fortune et al. (1966) to be capable of supporting about 4590 spawning pairs of chinook salmon and 3650 pairs of steelhead.

PacifiCorp (2004)

In a recent Final License Application for its Klamath River projects, PacifiCorp (2004) provided a brief summary of *recent and very preliminary* EDT-based modeling of the current potential for chinook salmon production in the Klamath system from IGD upstream to and including Spencer Creek, but extending no farther into the upper basin. This preliminary modeling accounted for only one of the anadromous species (chinook) for which there is production potential above IGD and included only a small portion of the potential chinook production area above IGD (see Table 1). PacifiCorp (2004) indicates that the modeling suggests that the relatively small area considered would return about 4,500 adult chinook to the spawning grounds with 100% dam and reservoir survival, and no harvest. With 100% dam survival, model-predicted reservoir survivals, and current harvest rates, the preliminary modeling suggests returns to the spawning grounds of approximately 487 adults.

Preliminary Estimates of Recent Potential for Chinook and Steelhead Production Above IGD

After considering the previously discussed estimates of recent potentials for chinook and steelhead production above IGD, and additional available data, I used a multi-method approach to develop what might be termed preliminary "best estimates" of the production potential for each species, assuming 100 percent dam passage and reservoir survival, and no harvest. The resultant estimates are outlined in Table 2 and will be discussed below. For chinook, I used six methods to estimate a potential run of adult fish returning to areas above IGD that ranged from 9,180 to 32,040, with a mean or "best estimate" value of 21,245 fish. For steelhead, I used four of the six methods utilized for chinook to develop estimates of potential adult returns to areas above IGD ranging from 7,460 to 9,550, with a "best estimate" of 8,645 fish. The estimates for both species depend substantially on the ability of juvenile fish to pass downstream successfully into and through UKL during their seaward migration, a critical unknown at present.

Table 2. Multiple preliminary estimates of recent potential for chinook and steelhead returns to the Klamath Basin upstream of Iron Gate Dam assuming 100 % dam passage and reservoir survival, and no harvest[1].

Estimation method	Adult chinook	Adult steelhead
Method 1. Chapman (1981) instream flow method, adjusted for the presence of existing dams and associated slack-water areas along the mainstem Klamath River.	18,220	9,550
Method 2. Fortune et al. (1966) spawning area method.	9,180	7,460
Method 3a. Similar adjacent watershed method, with recent adult counts for Shasta R. expanded to the area above IGD based on the ratio of suitable stream miles in the basin above IGD per Chapman (1981) and in the Shasta R system per West et al. (1990).	26,510	8,640
Method 3b. Similar adjacent watershed method, with recent adult counts for Shasta R. expanded to the area above IGD based on the ratio of suitable stream miles in the basin above IGD per Fortune et al. (1966) and in the Shasta R. system per West et al. (1980).	27,400	8,930
Method 4a. Watershed-wide expansion of PacifiCorp's (2004) EDT-based estimates of production potential for areas between Iron Gate Dam and Spencer Creek, based on relative production potentials estimated by Chapman (1981).	32,040	---
Method 4b. Watershed-wide expansion of PacifiCorp's (2004) EDT-based estimates of production potential for areas between Iron Gate Dam and Spencer Creek, based on relative production potentials estimated by Fortune et al. (1966).	14,130	---
Mean values	**21,245**	**8,645**

[1] All estimates depend substantially on the ability of juvenile salmon and steelhead to pass downstream successfully into and through Upper Klamath Lake, a critical unknown.

Estimation Method 1. Method 1 consisted of taking Chapman's (1981) instream flow-based estimates of chinook and steelhead production potential for areas above IGD and adjusting them downward to account for Fortune et al.'s (1966) estimates of the miles of recently suitable riverine rearing habitat in the mainstem Klamath River. This was necessary because Chapman's estimates of production potentials assumed 88.5 km of riverine rearing habitat and the absence of dams, whereas Fortune et al. (1966) indicated that only 43.4 km of the mainstem provided

suitable riverine rearing habitat. The result was a 15% reduction in Chapman's original estimate of chinook production potential (to 18,220 adults) and an 11% reduction in his estimate of steelhead production potential (to 9,550 adults).

Estimation Method 2. Under this method I simply accepted Fortune et al.'s (1966) estimates of anadromous salmonid production potential above IGD: 9,180 adult chinook salmon and 7,460 adult steelhead trout. As indicated earlier, these estimates were based entirely on a conservative accounting of available spawning area. I believe that these estimates of production potential should be fairly conservative because of difficulty in anticipating those habitat patches that will be used by spawning fish and my perception that spawning habitat is unlikely to limit anadromous fish production in the area above IGD as a whole. Chapman (1981) reviewed information on streams in the area and concluded that rearing habitat, not spawning habitat, was likely to limit anadromous salmonid production.

Estimation Method 3a. Estimates of recent production potential made using Method 3a were based on recent weir counts of adult chinook and steelhead returning to the Shasta River watershed, California, and recent estimates of suitable stream kilometers for each of the two species in that watershed as well as in the drainage basin above IGD. The Shasta River provides a relatively good surrogate for areas above IGD because it has the most geographically proximate Klamath Basin watershed of substantial size still accessible to anadromous fish, it has supported a mix of anadromous species similar to that once present above IGD, and it is a spring-influenced system rich in nutrients that has been strongly affected by riparian degradation and irrigation withdrawals of water.

For chinook salmon, the mean Shasta River adult count for the 20-year period from 1983 through 2002 (3418 fish; A. Manji, CDFG, pers comm.) was adjusted upward to account for approximate ocean harvest rates of 15% and freshwater rates of about 30%, yielding a mean run without harvest of about 5,745 fish. This figure was then scaled up to estimate a potential 26,510 adults returning to areas above IGD. The scaling was based on the ratio between the 259.8 km of suitable stream habitat above IGD in Chapman's (1981) assessment and 56.3 km of streams that West et al. (1990) have identified as being used as chinook rearing habitat within the Shasta River watershed.

For steelhead, the mean of 1,972 adult fish returning to the Shasta River during the four-year period (1979-82) having the highest and most complete annual weir counts (KRIS database) was adjusted upward to account for an assumed harvest rate of 33% (Huntington 1988), yielding a

mean run without harvest of 2,943 adults. This figure was then scaled up to a potential run of 8,640 adult steelhead returning to areas above IGD, based on the ratio between the 259.8 km of suitable stream habitat accounted for in Chapman's (1981) assessment and 88.5 km of streams that West et al. (1990) identified as being used as steelhead rearing habitat within the Shasta River watershed.

Estimation Method 3b. Method 3b was identical to Method 3a except that it used Fortune et al.'s (1966) estimates of suitable stream habitat (268.5 km for chinook salmon and the same quantity for steelhead trout), rather than those included in Chapman (1981), to scale the sizes of fish runs into the Shasta River up to those that might return to areas above IGD. Potential returns of adult fish calculated by this method were 27,400 chinook salmon and 8,930 steelhead.

Estimation Method 4a. This method expanded the recent and very preliminary EDT-based estimate that 4,500 adult chinook would return to that portion of the area above IGD that is below but includes Spencer Creek to the entire drainage basin above IGD. The basis for this extrapolation was the relative production potentials for these areas estimated by Chapman (1981). Method 4a yielded an estimate of 32,040 adult chinook returning to areas above IGD without harvest.

Estimation Method 4b. Method 4b was identical to Method 4a except that it used Fortune et al.'s (1996) estimates of the relative production potentials of differing areas within the drainage basin above IGD as the basis for expanding the EDT-based estimate. Method 4b yielded a potential run of 14,130 adult chinook returning to areas above IGD without harvest.

Historic Potential for Chinook and Steelhead Production above Upper Klamath Lake

The ecological setting, recent data on stream conditions and fish populations, Tribal accounts (e.g., see Lane & Lane Associates 1981), the Fortune et al. (1966) report, and historical information reported by Snyder (1931) all lead me to conclude that areas above UKL once supported chinook salmon, both spring and fall-run fish, and steelhead trout. The spring-run chinook apparently began disappearing early in the development of the Klamath Basin, most likely due to a combination of over-fishing, migratory impediments, and early habitat degradation. This was a pattern repeated in many areas of the Pacific Northwest and reflects that this race of fish was a primary focus of early Euro-American fisheries and highly sensitive to environmental disturbance. Substantial numbers of what were apparently fall-run chinook were still being harvested in Sprague River up until about 1910 (Lane & Lane Associates 1981), the

year in which the BOF began attempting to block fish runs at Klamathon in anticipation of construction of Copco Dam.

I developed low and high-end estimates of historic returns of adult chinook and steelhead to the area above UKL, based on expansion from the highest counts of these two species recorded at the weir on Shasta River (i.e., at Shasta Racks). The intent of these estimates was to develop some preliminary numbers that would bracket historic production values for the area above UKL. My low-end expansions were simply based on the ratios of watershed areas between the Shasta River and each of three suitable production areas above UKL (Williamson River, Sprague River, and Wood River Valley). The high-end expansions were based on the ratios of measured mean annual flows between the Shasta River and the lower-most gauged sites for the same three areas above UKL. Flows were used as an expansion factor because areas with higher unit water yields can be more productive for anadromous salmonids. I used mean annual flows and not mean late season (e.g., August) flows, because late season flows at the downstream ends of the basins of interest may be irregularly affected by irrigation practices at present, particularly in the Shasta River watershed. The historic steelhead returns estimated for areas above UKL were reduced by 50% to account for competitive interactions with redband trout and uncertainties about how the steelhead would have partitioned habitat above UKL with redbands expressing an adfluvial life history. This adjustment of the estimated steelhead returns likely makes my estimates conservative, but I have no information at present upon which to decrement steelhead production to account for the presence of adfluvial redbands.

My preliminary estimates of historic chinook salmon and steelhead trout returns to areas above UKL are summarized in Table 3. The estimates of historic chinook returns ranged from nearly 150,000 adults to more than 400,000 adults, while those for historic steelhead returns ranged from about 6,850 adults to about 20,000 adults. My estimates for the production of both species would have been higher if adjusted for catch that was occurring downstream of the weir on Shasta River during the return years upon which the estimates were based, but I lacked useful information on fish harvest rates. The estimates for both species, and for chinook salmon in particular, might also have been higher if I had accounted for the historic (and unknown) seasonal production potential of UKL itself. Overall, I think that my lower estimate may be closest to the historic potential for chinook production above UKL and that my higher estimate may be closest to the historic potential for steelhead production above the lake. Depending on the outcomes of interactions between anadromous and adfluvial trout, historic steelhead runs into the area above UKL might have been higher than the range contained by my low and high estimates for this species.

Table 3. Preliminary estimates of historic chinook salmon and steelhead trout returns to areas above Upper Klamath Lake, Oregon.

Subbasin/production area	Drainage area (mi^2)	Mean annual flow (cfs)	Maximum adult return: Chinook (1931)	Maximum adult return: Steelhead (1940)	Estimated historic returns of adults: Chinook Low	Chinook High	Steelhead Low	Steelhead High
Shasta R.	793	185	61811	5657	61811		5657	
Upper Klamath (above Klamath L.)								
Williamson R. (below Klamath Marsh)	149	280	---	---	11614	93552	531	4281
Sprague R.	1580	586	---	---	123154	195791	5636	8959
Wood River Valley	192	445	---	---	14966	148681	685	6804
					149734	**438023**	**6852**	**20044**

The estimates of historic production potential provided in Table 3 suggest that much of the historic capacity to produce anadromous salmonids above the current site of IGD was found in areas above UKL. Restoration of even a portion of this potential would have a dramatic influence on the salmon and steelhead production capacity of the entire drainage basin above IGD. The degree to which this capacity might be restored has yet to be examined.

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ATTACHMENT 10

Huntington, C.W., 2006. *Estimates of Anadromous fish runs above Iron Gate Dam.*

ATTACHMENT 11

Klamath Index Selections from PFMC Klamath Salmon Management Plan

PACIFIC COAST SALMON PLAN

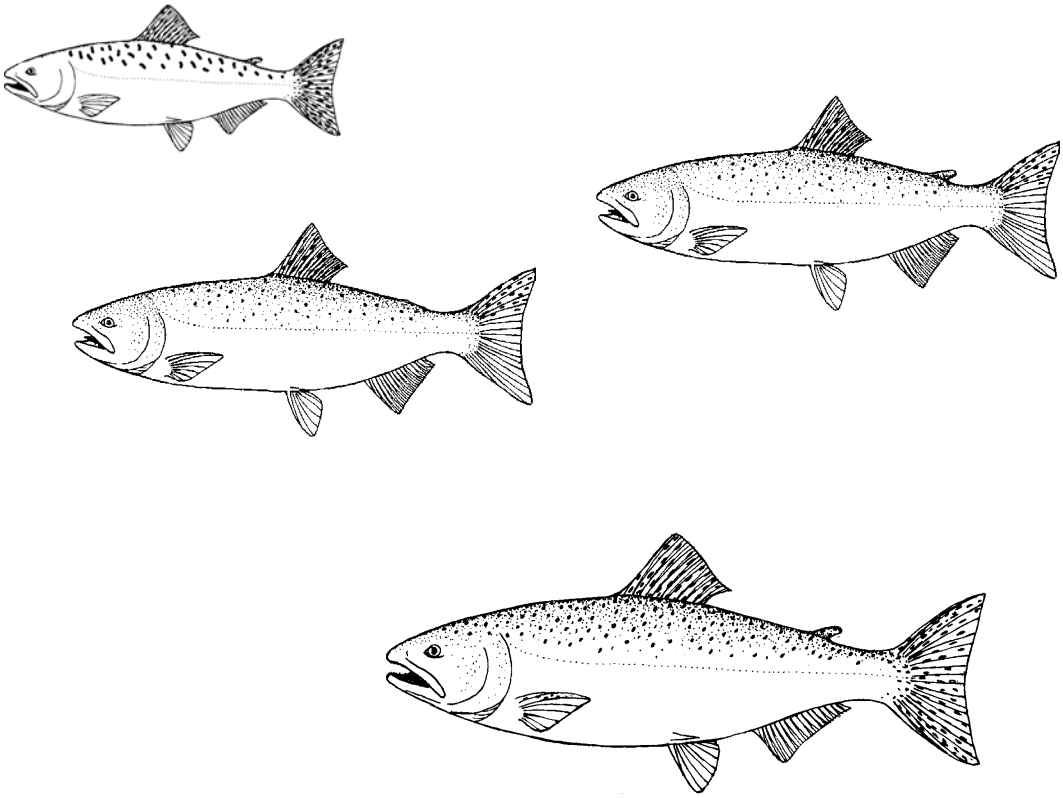
FISHERY MANAGEMENT PLAN FOR

COMMERCIAL AND RECREATIONAL SALMON FISHERIES

OFF THE COASTS OF WASHINGTON, OREGON AND CALIFORNIA

AS REVISED THROUGH AMENDMENT 14

(Adopted March 1999)



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SUPPLEMENTARY FMP DOCUMENTS

(Available from Council office and web site:www.pcouncil.org):

AMENDMENT 14 TO THE PACIFIC COAST SALMON PLAN, APPENDIX A:
IDENTIFICATION AND DESCRIPTION OF ESSENTIAL FISH HABITAT, ADVERSE IMPACTS, AND RECOMMENDED CONSERVATION MEASURES FOR SALMON

AMENDMENT 14 TO THE PACIFIC COAST SALMON PLAN, APPENDIX B:
DESCRIPTION OF THE OCEAN SALMON FISHERY AND ITS SOCIAL AND ECONOMIC CHARACTERISTICS

APPENDIX C TO THE PACIFIC COAST SALMON PLAN:
REVIEW OF OCEAN SALMON FISHERIES (Latest annual edition)

PRESEASON REPORT I:
STOCK ABUNDANCE ANALYSIS FOR OCEAN SALMON FISHERIES (Latest annual edition)

PRESEASON REPORT III:
ANALYSIS OF COUNCIL ADOPTED MANAGEMENT MEASURES FOR OCEAN SALMON FISHERIES (Latest annual edition)

LIST OF ACRONYMS AND ABBREVIATIONS

ASETF	Anadromous Salmonid Environmental Task Force
Council	Pacific Fishery Management Council
EEZ	exclusive economic zone (three to 200 miles offshore)
EIS	Environmental Impact Statement
ESA	Endangered Species Act
EFH	Essential fish habitat
ESU	Evolutionarily significant unit
FAB	Fisheries Advisory Board (established in U.S. v. Washington)
FMP	fishery management plan
FR	Federal Register
FRAM	Fishery Regulation Assessment Model
HC	Habitat Committee
KRSMG	Klamath River Salmon Management Plan
KRTT	Klamath River Technical Team
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MSP	maximum sustainable production
MSY	maximum sustainable yield
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPPA	Northwest Power Planning Act
OCN	Oregon coastal natural coho
ODFW	Oregon Department of Fish and Wildlife
OPI	Oregon Production Index
OY	optimum yield
PFMC	Pacific Fishery Management Council
PSC	Pacific Salmon Commission
RFA	Regulatory Flexibility Act
RIR	Regulatory Impact Review
SAS	Salmon Advisory Subpanel
Secretary	Secretary of Commerce
SEIS	Supplemental Environmental Impact Statement
SFA	Sustainable Fisheries Act
SRFCRT	Sacramento River Fall Chinook Review Team
SSC	Scientific and Statistical Committee
STT	Salmon Technical Team
TAC	total allowable catch
TALFF	total allowable level of foreign fishing
WDF	Washington Department of Fisheries
WDFW	Washington Department of Fish and Wildlife

3 CONSERVATION

"Conservation and management measures shall be based upon the best scientific information available."

Magnuson-Stevens Act, National Standard 2

3.1 SALMON STOCK CONSERVATION OBJECTIVES

"To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination"

Magnuson-Stevens Act, National Standard 3

To achieve optimum yield, prevent overfishing, and assure rebuilding of salmon stocks whose abundance has been depressed to an overfished level, this plan establishes, to the extent practicable, conservation objectives to perpetuate the coastwide aggregate of salmon stocks covered by the plan (Chapter 1). The Council's stock conservation objectives (to be achieved annually) and other pertinent stock management information are contained in Table 3-1 (following Section 3.2). Specific objectives are listed for natural and hatchery stocks that are part of the Council's preseason fishery option development process (Chapter 9), including all stocks listed under the federal ESA. The objectives may be applicable to a single stock or a complex of interrelated stocks (those sharing similarities in life-history traits, geographic distribution, habitat preferences and genetic characteristics). Stocks that are not included in the preseason analyses may lack specific conservation objectives because the stock is not significantly impacted by ocean fisheries or insufficient management information is available from which to assess ocean fishery impacts directly. In the latter case, the conservation objective for a managed stock may serve to provide for the conservation of a closely related stock unless, or until, more specific management information can be developed.

3.1.1 Basis

The Council's conservation objectives for natural stocks may (1) be based on estimates for achieving MSY, an MSY proxy, or MSP, or (2) represent special data gathering or rebuilding strategies to approach MSY and to eventually develop MSY or MSP objectives. The objectives have generally been developed through extensive analysis by the fishery management entities with direct management authority for the stock, or through joint efforts coordinated through the Council, or with other state, tribal or federal entities. Most of the objectives for stocks north of Cape Falcon have been included in U.S. District Court orders. Under those orders for Washington coastal and Puget Sound stocks (U.S. v. Washington, 626 F. Supp. 1405 [1985] and Hoh v. Baldrige No. 81-742 [R] C), the treaty tribes and WDFW may agree to annual spawner targets that differ from the MSP or MSY objectives. Details of the conservation objectives in effect at the time this FMP was approved are available in PFMC (1984), in individual amendment documents (see Table 1 in the Introduction), and as referenced in Table 3-1. Updated conservation objectives ane ESA consultation standards are available in the most recent Preseason Report I, (Appendix A, Table A-1), and Preseason Report III (Appendix A, Table A-3) produced by the STT.

The Council's fixed conservation objectives are generally expressed in terms of an annual fishery escapement believed to be optimum for producing MSY over the long-term. The escapement objective may be (1) a specific number or a range for the desired number of adult spawners (spawner escapement), or (2) a specific number or range for the desired escapement of a stock from the ocean or at another particular location, such as a dam, that may be expected to result in the target number of spawners. The current data gathering and rebuilding objectives may be expressed as fixed or stepped exploitation or harvest rates and may include spawner floors or severely reduced harvest rates at low abundance levels (e.g., Klamath River fall chinook), or as special requirements provided in National Marine Fisheries Service (NMFS) consultation standards for stocks listed under the ESA.

3.1.2 Changes or Additions

Conservation objectives are fixed measures of the FMP intended to provide the necessary guidance during the course of the annual preseason planning process to establish salmon fishing seasons that achieve optimum yield. However, changes or additions to the stock complexes and objectives for most natural stocks may be made without plan amendment if a comprehensive technical review of the best scientific information available provides conclusive evidence that, in the view of the Salmon Technical Team, Scientific and Statistical Committee (SSC), and the Council, justifies a modification. An exception is the 35,000 natural spawner floor for Klamath River fall chinook which may only be changed by FMP amendment. The Council may change objectives for hatchery stocks upon the recommendation of the pertinent federal, state, and tribal management entities. Federal court-ordered changes in objectives will also be accommodated without a plan amendment. Insofar as possible, changes for natural stocks will only be reviewed and approved within the schedule established for salmon estimation methodology reviews (completed at the November meeting prior to the season in which they are effective) and apart from the preseason planning process. The applicable annual objectives of Council-adopted rebuilding programs developed in response to an overfishing concern or the requirements of consultation standards promulgated by NMFS under the ESA may be employed without plan amendment to assure timely implementation. All of these changes will be documented during the Council's preseason planning process.

The Council considers established conservation objectives to be stable and a technical review of biological data must provide substantial evidence that a modification is necessary. The Council's approach to conservation objectives purposely discourages frequent changes for short-term economic or social reasons at the expense of long-term benefits from the resource. However, periodic review and revision of established objectives is anticipated as additional data become available for a stock or stock complex.

3.2 OVERFISHING CRITERIA

> *"Any fishery management plan . . . shall . . . specify objective and measurable criteria for identifying when the fishery . . . is overfished . . . and, . . . contain conservation and management measures to prevent overfishing or end overfishing and rebuild the fishery;"*
>
> *Magnuson-Stevens Act, § 303(a)(10)*

> *"The terms overfishing and overfished mean a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce the maximum sustainable yield on a continuing basis."*
>
> *Magnuson-Stevens Act, § 3(29)*

In applying the Magnuson-Stevens Act definition of overfishing to salmon fisheries and establishing criteria by which to identify it, the Council must consider the uncertainty and theoretical aspects of MSY as well as the complexity and variability unique to naturally producing salmon populations. These unique aspects include the interaction of a short-lived species with frequent, sometimes protracted, and often major variations in both the freshwater and marine environments. These variations may act in unison or in opposition to affect salmon productivity in both positive and negative ways. In addition, variations in natural populations may sometimes be difficult to measure due to masking by artificially produced salmon.

3.2.1 General Application to Salmon Fisheries

In setting criteria from which to judge the conservation status of salmon stocks, the unique life history of salmon must be considered. Chinook, coho, and pink salmon are short-lived species (generally two to six years) that reproduce only once shortly before dying. Spawning escapements of coho and pink salmon are dominated by a single-year class and chinook spawning escapements may be dominated by no more than one or two-year classes. The abundance of year classes can fluctuate dramatically with combinations of natural and human-caused environmental variation. Therefore, it is not unusual for a healthy and relatively abundant salmon stock to produce occasional spawning escapements which, even with little or no fishing impacts, may be significantly below the long-term average associated with the production of MSY. This phenomenon has been observed in recent years for numerous salmon stocks, including Klamath River fall chinook and several Washington coho stocks.

Numerous West Coast salmon stocks have suffered, and continue to suffer, from an onslaught of nonfishing activities that severely reduce natural survival by such actions as the elimination or degradation of freshwater spawning and rearing habitat. The consequence of this man-caused, habitat-based variation is two fold. First, these habitat changes increase large scale variations in stock productivity and associated stock abundances, which in turn complicate the overall determination of MSY and the specific assessment of whether a stock is producing at or below that level. Secondly, as the productivity of the freshwater habitat is diminished, the benefit of further reductions in fishing mortality to improve stock abundance decreases. Clearly, the failure of several stocks managed under this FMP to produce at an historic or consistent MSY level has little to do with current fishing impacts and often cannot be rectified with the cessation of all fishing.

To address the requirements of the Magnuson-Stevens Act to clearly identify when a stock may be approaching an overfished condition or is overfished, the Council has established two separate criteria based on a stock's failure to meet its conservation objective. These criteria are denoted as a "conservation alert" and an "overfishing concern". The criteria for these two categories are based on the unique life history of salmon and the large variations in annual stock abundance due to numerous environmental variables. They also take into account the uncertainty and imprecision surrounding many estimates of MSY, fishery impacts, and spawner escapements. In recognition of the unique salmon life history, the criteria differ somewhat from the general guidance in the National Standard Guidelines (§ 600.310), but equal or exceed them in addressing the overfishing issue as it relates to salmon.

3.2.2 Conservation Alert

> *"A fishery shall be classified as approaching a condition of being overfished if, based on trends in fishing effort, fishery resource size, and other appropriate factors, the Secretary estimates that the fishery will become overfished within two years."*
>
> *Magnuson-Stevens Act, § 304(e)(1)*

To anticipate and react to potential stock declines which might lead to overfishing, the Council has established a conservation alert process with criteria and actions as described below.

3.2.2.1 Criteria

A conservation alert is triggered during the annual preseason process (Chapter 9) if a natural stock or stock complex, listed in Table 3-1, is projected to fall short of its conservation objective (MSY, MSY proxy, MSP, or floor in the case of some harvest rate objectives [e.g., 35,000 natural Klamath River fall chinook spawners]). While a projected one-year shortfall may be of little biological concern, it may also represent the beginning of production problems and is worthy of note to help prevent future stock decline.

3.2.2.2 Council Action

For all natural stocks which meet the conservation alert criteria, the Council will notify pertinent fishery and habitat managers, advising that the stock may be temporarily depressed or approaching an overfishing concern (depending on its recent conservation status), and request that state and tribal fishery managers identify the probable causes, if known. If the stock in question has not met its conservation objective in the previous two years, the Council will request the pertinent state and tribal managers to do a formal assessment of the primary factors leading to the shortfalls and report their conclusions and recommendations to the Council no later than the March meeting prior to the next salmon season.

The Council will take the following actions for stocks which trigger a conservation alert that do not qualify as exceptions under Section 3.2.4 (see Table 3-1):

1. Close salmon fisheries within Council jurisdiction that impact the stock.

2. In the case of Washington coastal and Puget Sound salmon stocks and fisheries managed under U.S. District Court orders, the Council may allow fisheries which meet annual spawner targets developed through relevant U.S. v. Washington, Hoh v. Baldrige, and subsequent U.S. District Court ordered

processes and plans, which may vary from the MSY or MSP conservation objectives. Other than the exceptions noted above, the Council may not recommend ocean salmon fisheries which are expected to trigger a conservation alert.

If postseason estimates confirm that a stock conservation objective is not met, a rebuilding program for the following year is implicit in the conservation objective since it is based on annually meeting MSY or MSP. In addition, the Council reviews stock status annually and, where needed, identifies actions required to improve estimation procedures and correct biases. Such improvements provide greater assurance that objectives will be achieved in future seasons. Consequently, a remedial response is built into the preseason planning process to address excessive fishing mortality levels relative to the conservation objective of a stock.

The Council does not believe that a one year departure from the MSY/MSP spawner objective for salmon affects the capacity of a stock to produce MSY over the long-term (i.e., does not constitute overfishing as defined by the Magnuson-Stevens Act). However, the Council's use of a conservation alert and the rebuilding effect of the conservation objectives provides for sound resource management and responds to the concept in the National Standard Guidelines for action to address overfishing concerns in any one year. The Council's conservation objectives which are used to trigger a conservation alert are generally based on MSY or MSP rather than a minimum stock size threshold. In this respect, the Council's management approach is more conservative than recommended by the National Standard Guidelines.

3.2.3 Overfishing Concern

> *"For a fishery that is overfished, any fishery management plan, amendment, or proposed regulations . . . for such fishery shall–(A) specify a time period for ending overfishing and rebuilding the fishery that shall–(I) be as short as possible, taking into account the status and biology of any overfished stocks of fish, the needs of the fishing communities, recommendations by international organizations in which the United States participates, and the interaction of the overfished stock within the marine ecosystem; and (ii) not exceed 10 years, except in cases where the biology of the stock of fish, other environmental conditions, or management measures under an international agreement in which the United States participates dictate otherwise. . ."*
>
> *Magnuson-Stevens Act, § 304(e)(4)*

The Magnuson-Stevens Act requires overfishing be ended and stocks rebuilt in as short a period as possible and, depending on other factors, no longer than ten years. For healthy salmon stocks which may experience a sudden reduction in production and/or spawner escapement, the limitation on fishing impacts provided by the Council's MSY or MSY proxy conservation objectives provide a stock rebuilding plan that should be effective within a single salmon generation (two years for pinks, three years for coho, and three to five years for chinook). However, additional actions may be necessary to prevent overfishing of stocks suffering from chronic depression due to fishery impacts outside Council authority, or from habitat degradation or long-term environmental fluctuations. Such stocks may meet the criteria invoking the Council's overfishing concern.

3.2.3.1 Criteria

The Council's criteria for an overfishing concern are met if, in three consecutive years, the postseason estimates indicate a natural stock has fallen short of its conservation objective (MSY, MSP, or spawner floor as noted for some harvest rate objectives) in Table 3-1. It is possible that this situation could represent normal variation, as has been seen in the past for several previously referenced salmon stocks which were reviewed under the Council's former overfishing definition. However, the occurrence of three consecutive years of reduced stock size or spawner escapements, depending on the magnitude of the short-fall, could signal the beginning of a critical downward trend (e.g., Oregon coastal coho) which may result in fishing that jeopardizes the capacity of the stock to produce MSY over the long term if appropriate actions are not taken to ensure the automatic rebuilding feature of the conservation objectives is achieved.

3.2.3.2 Assessment

When an overfishing concern is triggered, the Council will direct its STT to work with state and tribal fishery managers to complete an assessment of the stock within one year (generally, between April and the March

Council meeting of the following year). The assessment will appraise the actual level and source of fishing impacts on the stock, consider if excessive fishing has been inadvertently allowed by estimation errors or other factors, identify any other pertinent factors leading to the overfishing concern, and assess the overall significance of the present stock depression with regard to achieving MSY on a continuing basis.

Depending on its findings, the STT will recommend any needed adjustments to annual management measures to assure the conservation objective is met, or recommend adjustments to the conservation objective which may more closely reflect the MSY or ensure rebuilding to that level. Within the constraints presented by the biology of the stock, variations in environmental conditions, and the needs of the fishing communities, the STT recommendations should identify actions that will recover the stock in as short a time as possible, preferably within ten years or less, and provide criteria for identifying stock recovery and the end of the overfishing concern. The STT recommendations should cover harvest management, potential enhancement activities, hatchery practices, and any needed research. The STT may identify the need for special programs or analyses by experts outside the Council advisors to assure the long-term recovery of the salmon population in question. Due to a lack of data for some stocks, environmental variation, economic and social impacts, and habitat losses or problems beyond the control or management authority of the Council, it is likely that recovery of depressed stocks in some cases could take much longer than ten years.

In addition to the STT assessment, the Council will direct its Habitat Committee (HC) to work with federal, state, local, and tribal habitat experts to review the status of the essential fish habitat affecting this stock and, as appropriate, provide recommendations to the Council for restoration and enhancement measures within a suitable time frame.

3.2.3.3 Council Action

Following its review of the STT report, the Council will specify the actions that will comprise its immediate response for ensuring that the stock's conservation objective is met or a rebuilding plan is properly implemented and any inadvertent excessive fishing within Council jurisdiction is ended. The Council's rebuilding plan will establish the criteria that identify recovery of the stock and the end of the overfishing concern. In some cases, it may become necessary to modify the existing conservation objective/rebuilding plan to respond to habitat or other long-term changes. Even if fishing is not the primary factor in the depression of the stock or stock complex, the Council must act to limit the exploitation rate of fisheries within its jurisdiction so as not to limit recovery of the stock or fisheries, or as is necessary to comply with ESA consultation standards. In cases where no action within Council authority can be identified which has a reasonable expectation of providing benefits to the stock unit in question, the Council will identify the actions required by other entities to recover the depressed stock. Upon review of the report from the HC, the Council will take actions to promote any needed restitution of the identified habitat problems.

For those fishery management actions within Council authority and expertise, the Council may change analytical or procedural methodologies to improve the accuracy of estimates for abundance, harvest impacts, and MSY escapement levels, and/or reduce ocean harvest impacts when shown to be effective in stock recovery. For those causes beyond Council control or expertise, the Council may make recommendations to those entities which have the authority and expertise to change preseason prediction methodology, improve habitat, modify enhancement activities, and re-evaluate management and conservation objectives for potential modification through the appropriate Council process.

3.2.3.4 End of Overfishing Concern

The criteria for determining the end of an overfishing concern will be included as a part of any rebuilding plan adopted by the Council. Additionally, an overfishing concern will be ended if the STT stock analysis provides a clear finding that the Council's ability to affect the overall trend in the stock abundance through harvest restrictions is virtually nil under the "exceptions" criteria below for natural stocks.

3.2.4 Exceptions

> *"Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches."*

This plan contains three exceptions to the application of overfishing criteria and subsequent Council actions for stocks or stock complexes with conservation objectives in Table 3-1: (1) hatchery stocks, (2) stocks for which Council management actions have inconsequential impacts, and (3) stocks listed under the ESA.

3.2.4.1 Hatchery Stocks

Salmon stocks important to ocean fisheries and comprised exclusively of hatchery production generally have conservation objectives expressed as an egg-take or the number of spawners returning to the hatchery rack to meet program objectives. This plan recognizes these objectives and strives to meet them. However, these artificially produced stocks generally do not need the protection of overfishing criteria and special Council rebuilding programs to maintain long-term production. Because hatchery stocks can generally sustain significantly higher harvest exploitation rates than natural stocks, ocean fisheries rarely present a threat to their long-term survival. In addition, it is often possible to make temporary program modifications at hatcheries to assure adequate production to sustain the stock during periods of low abundance (e.g., sharing brood stock with other hatcheries, arranging for trapping at auxiliary sites, etc.). If specialized hatchery programs are approved in the future to sustain listed salmon stocks, the rebuilding programs would be developed and followed under the ESA .

3.2.4.2 Natural Stocks With Minimal Harvest Impacts in Council-Managed Fisheries

Several natural stock components identified within this FMP are subject to minimal harvest impacts in Council fisheries because of migration timing and/or distribution. As a result, the Council's ability to affect the overall trend in the abundance of these components through harvest restrictions is virtually nil. Components in this category are identified by a cumulative adult equivalent exploitation rate of less than five percent in ocean fisheries under Council jurisdiction during base periods utilized by the fishery regulation assessment models (1979-1982 for chinook and 1979-1981 for coho). Council action for these components, when a conservation alert or an overfishing concern are triggered, will consist of confirming negligible impacts of proposed Council fisheries, identifying factors which have led to the decline or low abundance (e.g., fishery impacts outside Council jurisdiction, or degradation or loss of essential fish habitat), and monitoring of abundance trends and total harvest impact levels. Council action will focus on advocating measures to improve stock productivity, such as reduced interceptions in non-Council-managed fisheries, and improvements in spawning and rearing habitat, fish passage, flows, and other factors affecting overall stock survival.

3.2.4.3 Stocks Listed Under the Endangered Species Act

The Council regards stocks listed as endangered or threatened under the ESA as a third exception to the application of overfishing criteria of the Magnuson-Stevens Act. The ESA requires federal agencies whose actions may jeopardize listed salmon to consult with NMFS. Because NMFS implements ocean harvest regulations, it is both the action and consulting agency for actions taken under the FMP. To ensure there is no jeopardy, NMFS conducts internal consultations with respect to the effects of ocean harvest on listed salmon. The Council implements NMFS' guidance as necessary to avoid jeopardy, as well as in recovery plans approved by NMFS. As a result of NMFS' consultation, an incidental take statement may be issued which authorizes take of listed stocks under the FMP that would otherwise be prohibited under the ESA.

The Council believes that the requirements of the ESA are sufficient to meet the intent of the Magnuson-Stevens Act overfishing provisions. Those provisions are structured to maintain or rebuild stocks to levels at or above MSY and require the Council to identify and develop rebuilding plans for overfished stocks. For many fish species regulated under the Magnuson-Stevens Act, the elimination of excess fishing pressure is often the sole action necessary to rebuild depressed stocks. This is, however, not the case for many salmon stocks and, in particular, for most listed populations.

Although harvest has certainly contributed to the depletion of West Coast salmon populations, the primary reason for their decline has been the degradation and loss of freshwater spawning, rearing and migration habitats. The quality and quantity of freshwater habitat are key factors in determining the MSY of salmon populations. The Council has no control over the destruction or recovery of freshwater habitat nor is it able

to predict the length of time that may be required to implement the habitat improvements necessary to recover stocks. While the Council could theoretically establish new MSY escapement goals consistent with the limited or degraded habitat available to listed species, adoption of revised goals would potentially result in an ESA-listed stock being classified as producing at MSY and; therefore, not overfished under the Magnuson-Stevens Act. The Council believes that the intent of the ESA and the Magnuson-Stevens Act is the recovery of stocks to MSY levels associated with restored habitat conditions.

The Council considers the consultation standards and recovery plans developed by NMFS for listed populations as interim rebuilding plans. Although NMFS' consultation standards and recovery plans may not by themselves recover listed populations to historical MSY levels within ten years, they are sufficient to stabilize populations until freshwater habitats and their dependent populations can be restored and estimates of MSY developed consistent with recovered habitat conditions. As species are delisted, the Council will establish conservation objectives with subsequent overfishing criteria and manage to maintain the stocks at or above MSY levels.

3.3 SUPPLEMENTARY CONSERVATION INFORMATION

3.3.1 Endangered Species Act Listings

Since 1990, West Coast salmon fisheries have been modified to accommodate special requirements for the protection of salmon species listed under the federal ESA. The ESA listing of a salmon population may have profound consequences for the management of Council mixed-stock ocean fisheries since listed populations are often incidentally harvested with more abundant healthy populations. As additional stocks of salmon have been listed, the Council's preseason process has increasingly focused on protecting listed stocks. In applying the ESA to Pacific salmon, NMFS determined that a population segment of a salmon species must represent an evolutionarily significant unit (ESU) of that species in order to be eligible for listing. ESUs are characterized by their reproductive isolation and contribution to the genetic diversity of the species as a whole. NMFS establishes consultation standards for listed ESUs, which specify levels of incidental take that are not likely to jeopardize the continued existence of the ESU.

The Council must meet or exceed the requirements of the ESA, which is other applicable law. In addition to the stocks and conservation objectives in Table 3-1, the Council will manage all species listed under the ESA consistent with NMFS consultation standards or recovery plans to meet immediate conservation needs and the long-term recovery of the species. These standards are provided annually to the Council by NMFS at the start of the preseason planning process. In so far as is practical, while not compromising its ability to meet the requirements of the ESA, NMFS will endeavor to provide opportunity for Council and peer review of any proposed consultation standards, or the objectives of recovery plans, well prior to their implementation. Such review would ideally commence no later than the last Council meeting in the year immediately preceding the first salmon season in which the standards would be implemented.

Table 3-2 summarizes the relationships of the individual stocks and stock units managed under the FMP to the ESUs identified by NMFS in the course of ESA status reviews. With the exception of some hatchery stocks, the stocks managed under the FMP are generally representative of the range of life history features characteristic of most ESUs. The managed stocks therefore serve as indicators for ESUs and provide the information needed to monitor fishery impacts on ESUs as a whole. In some cases, the information necessary for stock specific management is lacking, leaving some ESUs without adequate representation. For these ESUs, it will be necessary in the immediate future to use conservative management principles and the best available information in assessing impacts in order to provide necessary protection. In the meantime, the responsible management entities should implement programs to ensure that data are collected for at least one stock representative of each ESU. Programs should be developed to provide the information that will permit the necessary stock specific management within five years of completion of this amendment.

TABLE 3-1. Conservation objectives and management information for natural and hatchery salmon stocks and stock complexes of significance to ocean salmon fisheries. Abundance information is generally based on the period 1994-1998. [a/] (Page 2 of 15)

Stock	Conservation Objective[b/] (to be met annually unless noted otherwise)	Subject to Council Actions to Prevent Overfishing	Other Management Information[c/]
	- - - CHINOOK - - -		
NORTHERN CALIFORNIA COAST - All fall and spring stocks of California streams north of the entrance to San Francisco Bay. Management of this stock complex is based primarily on meeting spawning escapements for natural fall chinook. Limited data is available except for the Klamath River. An assessment and monitoring program is under consideration by CDFG for stocks originating from the Smith, Eel, Mattole and Mad Rivers which might provide a more thorough management basis for the future. Significant water diversion problems in several drainages. In the Klamath River Basin, there is significant hatchery production of fall chinook and less so of spring chinook, resulting primarily from mitigation programs for dams constructed in both Upper Klamath and Trinity Rivers.			
Eel, Mattole, Mad, and Smith Rivers (Fall and Spring) Eel, Mattole and Mad River stocks - Threatened (1999)	Undefined. Indices of spawning abundance limited to one tributary of the Mad River and two tributaries of the Eel River. NMFS consultation standard/recovery plan for Eel, Mattole, and Mad River stocks not established at time of printing.	Indirectly. Data insufficient to define MSY criteria. CDFG developing an assessment and monitoring program. Conservation achieved by objective for Klamath River fall chinook which includes an inside allocation to tribal and sport fisheries which lowers ocean fishery impacts.	Depressed. Limited management data. Believed to occur in ocean fisheries off northern California and southern Oregon. Ocean fishery impacts incidental to fisheries for Sacramento and Klamath Rivers fall chinook. No preseason or postseason abundance estimates available.
Klamath River Fall (Klamath and Trinity Rivers)	33-34% of potential adult natural spawners, but no fewer than 35,000 naturally spawning adults in any one year. Brood escapement rate must average 33-34% over the long-term, but an individual brood may vary from this range to achieve the required tribal/nontribal annual allocation. Objective designed to allow a wide range of spawner escapements from which to develop an MSY objective or proxy while protecting the stock during prolonged periods of reduced productivity. Adopted 1988 based on Hubbell and Boydstun (1985); KRTT (1986); PFMC (1988); minor technical modifications in 1989 and 1996 (Table I-1). Natural spawners to maximize recruitment are estimated at 41,000 to 106,000 adults (Hubbell and Boydstun 1985).	Yes. A conservation alert or overfishing concern will be based on a failure to meet the 35,000 floor.	Abundance variable from high to depressed. Major contributor to ocean fisheries from Humbug Mt., OR to Horse Mt., CA (the KMZ) and to Klamath River tribal and recreational fisheries. Significant contributor to ocean fisheries from central Oregon to central California. Coastwide impacts are considered in meeting allocation requirements for Indian tribes with federally recognized fishing rights and the inland fishery. Specific management measures for this stock generally are implemented from Pigeon Pt., California to Florence, Oregon.
Klamath River Spring (Klamath and Trinity Rivers)	Undefined.	Indirectly. MSY criteria undefined. Productive potential protected by the objective for Klamath River fall chinook which includes an inside allocation to tribal and sport fisheries which lowers ocean fishery impacts.	Depressed. Believed to occur in ocean fisheries off northern California and southern Oregon (based on Trinity River Hatchery fish). Impacts incidental to ocean fisheries for Sacramento and Klamath Rivers fall chinook.

ATTACHMENT 12

Secretary of Commerce 2006 Fishery Failure Declaration

THE SECRETARY OF COMMERCE
Washington, D.C. 20230

Declaration Concerning the Klamath River Fall Chinook Salmon Fishery

Klamath River fall Chinook (KRFC) is a key stock used by NOAA's National Marine Fisheries Service (NMFS) to manage the mixed stock ocean fishery off the Pacific Coast, in which salmon from different rivers of origin co-mingle in ocean waters and are harvested together. Fisheries disaster relief is covered by Section 312(a) of the Magnuson-Stevens Fishery Conservation and Management Act, which specifies that the Secretary, at the discretion of the Secretary or at the request of the Governor of an affected State or a fishing community, shall determine whether there is a Commercial Fishery Failure due to a Fishery Resource Disaster as a result of natural causes, man-made causes beyond the control of fisheries managers to mitigate, or undetermined causes. At the request of the Governors of Oregon and California in April 2006, I began an evaluation of the Klamath River fall Chinook. On July 6, 2006, I declared a Fishery Resource Disaster under section 308(b) of the Interjurisdictional Fisheries Act of 1986.

The conservation objective for KRFC established under the Pacific Coast Salmon Fishery Management Plan (Salmon FMP) requires a return of 33-34 percent of potential adult natural spawners, but no fewer than 35,000 naturally spawning adults, each year. In compliance with the Salmon FMP, a "conservation alert" is triggered when a stock is projected to fall below its conservation objective. Under such circumstances, the Pacific Fishery Management Council (Council) is required to recommend the closure of salmon fisheries within Council jurisdiction that impact the stock.

From 2001 through 2005, drought conditions in the upper Klamath Basin resulted in flow conditions in the mainstem Klamath River and tributaries representative of dry water years. As a result of the protracted drought and low flows in the mainstem Klamath River, in-river conditions allowed for the proliferation of endemic diseases, and both juvenile and adult Chinook salmon populations have experienced substantial mortality as a result of these epizootic events. The escapement of KRFC then fell below the 35,000 spawner escapement floor in 2004 and 2005.

A recent decline in ocean conditions, prolonged drought, and subsequent poor in-river conditions in 2002 and 2003, resulted in low numbers of age-3 and age-4 KRFC recruiting to the 2006 fishery. The 2006 preseason forecast of approximately 25,000 naturally spawning KRFC was close to the record low, and less than the minimum escapement of 35,000 required to allow fishing between Cape Falcon, Oregon, and Point Sur, California, (the Klamath impact area) under the Salmon FMP. A complete closure of the 2006 salmon fishery, in the Klamath impact area, was avoided through a collaborative effort by NMFS, Council, state, and tribal representatives to identify a limited fishery that would manage risks and address the conservation concerns for KRFC. NMFS issued a Temporary Rule for Emergency Action to implement very restrictive 2006 annual management measures for the west coast ocean salmon fisheries. These regulations close a majority of the commercial fisheries from Cape Falcon, Oregon, to Point Sur, California, from May 1 to August 31, 2006. As a result of the factors described above, the commercial salmon fishery and the shore-based support sector are enduring severe economic hardship this year in this significant part of the west coast (see Table 1 below). Accordingly, the scope of the Fishery Resource Disaster consideration includes this entire 700 mile stretch of coastline from Cape Falcon to Point Sur.

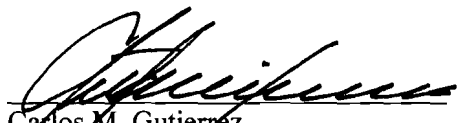
Table 1. Season Revenue (Ex-vessel) Compared to Historical Information from State Data

Management Area	2006	2001-2005 Average	High	Low
Oregon (South of Cape Falcon)	$1,240,000	$7,393,000	$10,090,000 (2004)	$5,116,000 (2001)
California	$1,696,000	$11,519,000	$18,383,000 (2004)	$5,225,000 (2001)
Total	*$2,936,000*	*$18,912,000*	*$28,473,000 (2004)*	*$10,341,000 (2001)*

The season restrictions reduced the fishing opportunity in the Klamath impact area by 71% from recent years. Due to weather and other factors, the actual number of fishing days by vessels has been even lower than expected. Based on information obtained from the States of Oregon and California, catch of salmon in this area will decrease by 88% this season from the recent years' average. Although the price per pound has been higher due to the limited supply, the resulting ex-vessel revenue this season will still drop by roughly 84% compared to the recent years' average.

In light of the foregoing facts, I find the economic losses in the commercial salmon fishery off Oregon and California caused by the low abundance of KRFC between Cape Falcon, Oregon, and Point Sur, California, in 2006 constitute a Commercial Fishery Failure due to a Fishery Resource Disaster. I find further this Fishery Resource Disaster is due primarily to natural causes, including drought, disease, and poor ocean conditions.

Therefore, I hereby declare that a Commercial Fishery Failure due to a Fishery Resource Disaster exists under section 312(a) of the Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended.



Carlos M. Gutierrez
August 10, 2006

ATTACHMENT 13

Governor Schwarzenegger Klamath Fishery
Declaration of Emergency (2006)

A PROCLAMATION

BY THE GOVERNOR OF THE STATE OF CALIFORNIA

WHEREAS California's salmon runs are a vital component of our great State's resources that provide significant environmental, recreational, commercial, and economic benefits to the people; and

WHEREAS Klamath River Basin Chinook Salmon have been significantly impacted by poor ocean conditions, drought, water management, water quality, water flows, disease, and the elimination of access to historical spawning habitat; and

WHEREAS the Klamath Basin Chinook Salmon that commingle with other runs of salmon in ocean waters off of California and Oregon have been declining in abundance to a point where California's and Oregon's recreational, commercial, and tribal fisheries are being significantly constrained to conserve Klamath River Chinook Salmon; and

WHEREAS Klamath River Basin Chinook Salmon are predicted to have extremely low ocean abundance for 2006 in waters from Cape Falcon in Oregon to Point Sur in Monterey County, California, and in the Klamath River Basin; and

WHEREAS restoration of habitat and improved water quality and flows are critical to restoring an environment suitable to the long-term sustainability of the Klamath River Basin Chinook Salmon and other anadromous fish species; and

WHEREAS appropriate management of the Klamath River Basin Chinook Salmon population is critical to California's businesses, and local communities that provide goods and services in support of California's salmon fisheries; and

WHEREAS on April 5, 2006, I requested Secretary of Commerce Carlos Gutierrez to use his authority under the Magnusen-Stevens Fishery Conservation and Management Act to determine that there has been a commercial fishery failure due to a fishery resource disaster; and

WHEREAS on April 28, 2006, the National Marine Fisheries Service adopted an emergency rule to implement the recommendations of the Pacific Fisheries Management Council that resulted in severe restrictions on the commercial ocean salmon and Klamath Basin tribal and recreational fisheries and included restrictions on the recreational ocean salmon fishery; and

WHEREAS these restrictions will have significant impacts to California's commercial ocean salmon and in-river salmon fisheries and will result in severe economic losses throughout the State; and

WHEREAS the Department of Finance has determined that approximately $778,000 is continuously appropriated and available in the Small Business Expansion Fund (Fund 918) for disaster purposes under the Corporations Code section 14030 et seq.; and

WHEREAS the Small Business Expansion Fund's available monies can be leveraged to guarantee up to approximately $9.2 million in loans for disasters, including guaranteeing loans to prevent business insolvencies and loss of employment in an area affected by a state of emergency within the state; and

WHEREAS Governor Ted Kulongoski of Oregon and I signed The Klamath River Watershed Coordination Agreement along with the responsible federal agencies in order to address the impacts to the fisheries in the region and to develop a long-term management approach, common vision, and integrated planning associated with the Klamath Basin; and

WHEREAS the serious circumstances of the Klamath River Chinook Salmon run put at risk the livelihoods of families and businesses dependent upon them.

NOW, THEREFORE, I, ARNOLD SCHWARZENEGGER, Governor of the State of California, find that conditions of disaster or of extreme peril to the safety of persons and property exist within the California counties of Monterey, Santa Cruz, San Mateo, San Francisco, Marin, Sonoma, Mendocino, Humboldt, Del Norte, and Siskiyou due to the poor ocean conditions, drought, water management, water quality, water flows, disease, and the elimination of access to historical spawning habitat and resulting from the significant restrictions that have been imposed on the State's salmon fisheries. Because the magnitude of this disaster will likely exceed the capabilities of the services, personnel, and facilities of these counties, I find these counties to be in a state of emergency, and under the authority of the California Emergency Services Act, I hereby proclaim that a State of Emergency exists in these counties.

Pursuant to this Proclamation, I hereby direct the Director of the California Department of Fish and Game and the Secretary of the Resources Agency to: (1) report to me immediately upon final action of the Department of Commerce and the California Fish and Game Commission on any further actions necessary to ensure the protection of the resource and of the economic livelihood of the fishery participants, tribes, and local communities; and (2) continue discussions for long-term restoration and management of the Klamath Basin with the State of Oregon, federal agencies (including the Secretaries of Commerce, the Interior, and Agriculture), tribal governments, and representatives from conservation, fishing, and agricultural organizations.

I FURTHER DIRECT the Secretary of the Business, Housing and Transportation Agency, with the cooperation of the Department of Finance, to activate the Small Business Disaster Assistance Loan Guarantee Program to guarantee loans to prevent business insolvencies and loss of employment in the counties of Monterey, Santa Cruz, San Mateo, San Francisco, Marin, Sonoma, Mendocino, Humboldt, Del Norte, and Siskiyou as a result of this State of Emergency.

I FURTHER DIRECT that as soon as hereafter possible, this proclamation be filed in the Office of the Secretary of State and that widespread publicity and notice be given of this proclamation.

IN WITNESS WHEREOF I have hereunto set my hand and caused the Great Seal of the State of California to be affixed this 6th Day of June 2006.

_____
ARNOLD SCHWARZENEGGER
Governor of California

ATTEST:

_____
BRUCE McPHERSON
Secretary of State

ATTACHMENT 14

Barthelow, John M., (2005). "Recent Water Temperature Trends in the Lower Klamath River, California," *North American Journal 0f Fisheries Management* 25:152-162 (2005)

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[Article]

Recent Water Temperature Trends in the Lower Klamath River, California

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Abstract.—Elevated water temperatures have been implicated as a factor limiting the recovery of anadromous salmonids in the Klamath River basin. This article reviews evidence of a multidecade trend of increasing temperatures in the lower main-stem Klamath River above the ocean and, based on model simulations, finds a high probability that water temperature has been increasing by approximately 0.5°C/decade (95% confidence interval [CI] = 0.42–0.60°C/decade) since the early 1960s. The season of high temperatures that are potentially stressful to salmonids has lengthened by about 1 month over the period studied, and the average length of main-stem river with cool summer temperatures has declined by about 8.2 km/decade. Water temperature trends seem unrelated to any change in main-stem water availability but are consistent with measured basinwide air temperature increases. Main-stem warming may be related to the cyclic Pacific Decadal Oscillation, but if this trend continues it might jeopardize the recovery of anadromous salmonids in the Klamath River basin.

The Klamath River basin (Figure 1) straddles the border between the states of Oregon and California. The basin drains an area of over 40,000 km^2 through varied landscapes. The upper reaches, above river kilometer (RKM) 375 (as measured from the outlet to the Pacific Ocean), are characterized by rain-shadowed lowlands holding extensive lakes and relic marshlands arising from a border of low mountains. The Klamath River drains these relatively flat valleys, flowing over 400 km through a tall, coastal mountain range that contributes several major tributaries from the flanks of dormant volcanoes and finally emptying through dense forests along the coastal plain into the Pacific Ocean. The middle and lower portions of the river (below RKM 308) are largely constrained within bedrock canyons and interspersed with minor alluvial reaches. Flows vary widely throughout the year; peak flows generally occur in December and January, and the lowest flows extend from June through September. Summer low flows below a series of hydropower facilities on the main-stem Klamath River are often held at Federal Energy and Regulatory Commission (FERC) mandated minima, about 20 m^3/s. Accretions are substantial along the river, however: average annual flows grow from $1,666 \times 10^6$ m^3/year as the river drains the upper basin to 15,768 10^6 m^3/year near the ocean. Historic hill slope and in-channel gold mining, extensive logging, and middle-basin hydropower development, coupled with wetland draining and diversions for agriculture in the upper basin, comprise the major watershed manipulations.

At approximately 42°N, the Klamath River basin is situated far enough north to support a variety of coldwater fishes. However, the isolation of the upper basin from moderating coastal weather and frontal movement, the rapid 550-m drop in the river's elevation below Upper Klamath Lake compared to the surrounding terrain, and main-stem flows that originate from this very large (24,000–36,000 ha) and shallow (3 m) water body, all serve to position the Klamath River on an ecological ''edge'' with respect to water temperatures for coldwater fishes. Measured U.S. Geological Survey (USGS) gauge data reveals that mean monthly temperature in the lower Klamath River, the only portion currently accessible to anadromous salmonids, generally ranges from 3–6°C in January to 20–22.5°C in July or August. Monthly average daily maximum temperature is commonly above 23°C except in areas immediately below hydropower reservoirs or near the ocean. Temperature in the Klamath River is elevated with a greater frequency and remains elevated for a longer time than temperatures in adjacent coastal anadromous streams. Summer maxima in the lower Klamath River basin below the Trinity River confluence (RKM 70; Figure 1) may reach 26.6°C for up to 10 d/year, in contrast to most other nearby coastal rivers, both north and south of the Klamath River, that never exceed this temperature (Blakey 1966).

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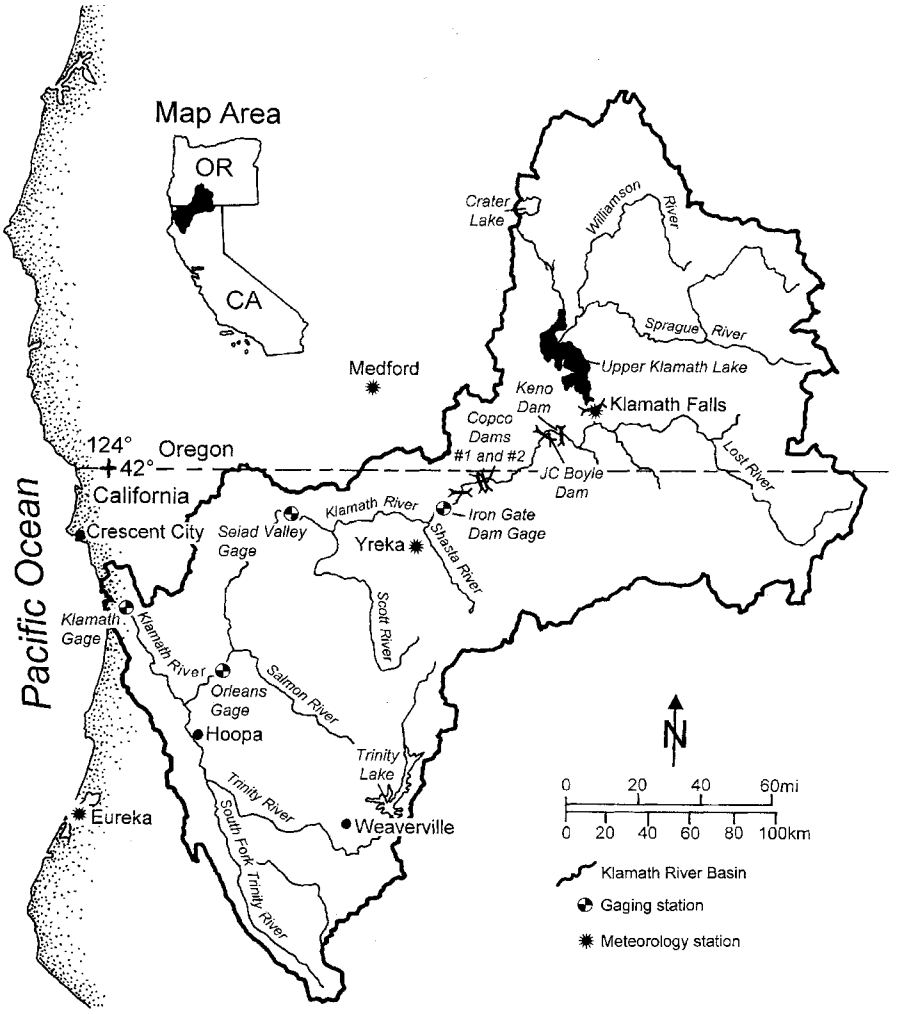

FIGURE 1.—Map of the Klamath River basin, Oregon and California, showing the approximate locations of major dams, water temperature gauges, and meteorological stations. The map was adapted with permission from the Water Education Foundation, Sacramento, California.

Elevated temperature is clearly problematic for salmonids (Brett 1952; USEPA 2003). Nehlsen et al. (1991) listed various salmonid stocks as either extinct or at risk in the Klamath River and two of its California tributaries, the Shasta and Scott rivers, along with many other coastal and inland streams. High temperature is among the many concerns for the successful recovery of salmonids in the Klamath River below Iron Gate Dam, the current upstream terminus of anadromous salmonid migration (CH2M Hill 1985; Klamath River Basin Fisheries Task Force 1991). Elevated temperatures have taken on a greater significance recently because of their potential link to disease outbreaks affecting both adult and juvenile salmonids in the Klamath River (Lynch and Risley 2003).

Researchers at the USGS were asked by the Klamath River Basin Fisheries Task Force to put together a decision support system (DSS) that links Klamath River basin hydrology, water quality, and fish production to create a better understanding of the range of water management opportunities and their potential consequences. Prior to the modeling effort, we reviewed the available data, concentrating on hydrology, water quality, species life history, and channel morphology. The resulting unpublished review confirmed the frequent occurrence of stressful temperatures for salmonids, and

also suggested a basinwide warming of river temperatures of between 0.4°C and 0.6°C per decade. However, the estimated trend contained a large degree of uncertainty due to limitations inherent in the measured water temperature record, specifically the short duration of and large gaps in thermograph records, as well as ordinary intra-annual variability.

As a component of the DSS, a water temperature model was subsequently completed for approximately 400 km of the main-stem Klamath River from Upper Klamath Lake in Oregon to the river's mouth in California, incorporating the best meteorologic and hydrologic data readily available for the 40-year postdam period, water years (WY) 1962–2001 (Hanna and Campbell 2000; Campbell et al. 2001). This temperature model enabled a more complete estimation of mean daily water temperature in the lower Klamath River during periods of incomplete thermograph records, and features several biologically relevant metrics, such as degree-days, duration of high thermal exposures, and length of river with temperatures between specified values.

The objective of this article is to review measured data and model results for evidence, if any, of basinwide warming in the lower Klamath River below Iron Gate Dam during the postimpoundment period, 1962–2001. I assess historical water and air temperature records in the basin along with relevant hydrologic data, and evaluate the simulated water temperature and derived temperature metrics for trends.

Methods

Trend estimation.—All measured data and simulation results (described below) were analyzed with statistical software developed by Battelle Pacific Northwest Laboratory (Gilbert 1987: Appendix B). The software performs a nonparametric analysis that uses the seasonal Kendall test (Hirsch et al. 1982) to estimate trends in the annual data and Sen's (1968) slope estimator for monthly data. These tests are appropriate because the data need not conform to any particular distribution and may contain embedded cycles or exhibit serial correlation (Gilbert 1987). Unlike ordinary least-squares trend estimation, these techniques are therefore unbiased by nonnormal outliers, are relatively insensitive to a moderate amount of missing data, and are less likely to be biased by extreme events at the beginning or end of the time series (Fox et al. 1990; USEPA 1998).

Both methods are related to one another and are conceptually straightforward. The slopes of all possible data pairs (in time series order) are computed and ranked. From this ranked set, the median slope is the best estimate of the trend. Software output includes two-sided confidence intervals (CIs) about the ''true'' slope at the 0.05 level, obtained through nonparametric techniques developed by Sen (1968). Please refer to Gilbert (1987) for software details. Fox et al. (1990) performed a similar analysis to identify linear trends in another West Coast basin's streamflow and precipitation data. However, unlike Fox et al. (1990), I did not smooth any of the time series data.

Historical water temperature records.—The Klamath River basin contained 18 USGS water temperature gauges, each with differing periods of record (Table 1). Seventeen were for riverine stations and one represented Crater Lake, potentially useful because of its long-term data set. Daily maximum and minimum water temperature data for the 13 gauges having at least 10 years of data were extracted from the EarthInfo CD-ROM (EarthInfo, Inc. 1994), and were scanned to remove obvious transcription errors. Mean monthly water temperature was computed as the simple average of all measured minimum and maximum daily values if there were at least 25 d with measurements in that month; otherwise, the value was considered missing.

Simulated river temperature and metrics.—The System Impact Assessment Model (SIAM) DSS (Bartholow et al. 2003) was used to simulate mean daily water temperature on the main-stem Klamath River from Upper Klamath Lake to the ocean based on historical monthly flows and reservoir storage volumes (disaggregated to mean daily values) supplied by SIAM. Monthly flows and storage values were used because they meshed easily with the planning framework employed by the U.S. Bureau of Reclamation and because regulated flows in the Klamath River tend to be relatively constant from day to day except during large rainstorm events that generally occur in winter. The SIAM framework uses the U.S. Army Corps of Engineers Hydrologic Engineering Center's HEC-5Q model (USACE 1986) to estimate water temperatures. The HEC-5Q model is a one-dimensional model that simulates water quality in reservoirs vertically from the surface to the bottom and longitudinally downstream in rivers.

The data requirements for HEC-5Q are daily average temperature values of all inflowing waters and daily average meteorological data, including air and dew point temperatures, wind speed, and

TABLE 1.—Klamath River basin U.S. Geological Survey (USGS) gauges and data used in the preliminary scoping exercise. Estimated trends for stations with over 10 years of data were derived from Gilbert's (1987) technique. Trends in bold italics are statistically different from zero ($P < 0.05$). The four main-stem Klamath River gauges used in subsequent analyses are shown in italics. All stations are in California accept Crater Lake, which is in Oregon.

USGS gauge		Years of record	Years available	Estimated trend (°C/year)
Number	Name			
11530500	*Klamath River near Klamath*	1966–1981	16	0.050
11530300	Blue Creek near Klamath	1966–1978	13	0.000
11530000	Trinity River at Hoopa	1964–1984	21	***0.100***
11529000	South Fork Trinity River near Salyer	1963–1966	4	
11528700	South Fork Trinity River below Hyampom	1966–1979	14	***0.050***
11528500	Hayfork Creek near Hyampom	1961–1974	14	0.029
11528200	South Fork Trinity River near Hyampom	1961–1965	5	
11527000	Trinity River near Burnt Ranch	1962–1983	22	0.000
11525655	Trinity River below Limekiln Gulch	1985–1985	1	
11525600	Grass Valley Creek at Fawn Lodge	1985–1985	1	
11525500	Trinity River at Lewiston	1959–1983	25	0.010
11523000	*Klamath River at Orleans*	1966–1982	17	0.033
11522500	*Klamath River near Seiad Valley*	1964–1979	16	−0.014
11520500	Salmon River at Somes Bar	1966–1979	14	0.040
11517500	Shasta River near Yreka	1965–1979	15	−0.020
11516600	Cottonwood Creek at Hornbrook	1965–1971	7	
11516530	*Klamath River below Iron Gate Dam*	1963–1980	18	0.033
11492200	Crater Lake	1964–1993	30	***0.033***

cloud cover. Solar radiation is not a direct model input, but rather is calculated by a companion program based on the meteorologic data, time of year, and latitude. Boundary temperatures for unmeasured tributaries were derived from regression equations based on air temperature. A complete description of the methods used to set up the HEC-5Q model for the Klamath River can be found in Hanna and Campbell (2000).

The HEC-5Q model was calibrated for 1 year (1996) and validated for 2 years (1997, 1998) with the most reliable data available. Mean absolute errors were 1.0°C for 1996, 1.04°C for 1997, and 0.90°C for 1998. The model also performed well in capturing the essence of the river's seasonal thermal signature, as signified by the highly significant coefficient of determination (r^2) values (e.g., below Iron Gate Dam: $r^2 = 0.96$, $n = 7{,}354$, $P < 0.001$). Overall model bias was −1.1°C at gauge locations from Iron Gate Dam downstream (i.e., the model underestimated temperatures slightly), although temperature predictions for any single day at any single location over the 40-year simulation period contained more uncertainty (average absolute mean daily error, ~1.8°C), especially near the ocean in the tidal zone (Bartholow et al., in press).

For this analysis, the model's goodness of fit to measured data was examined for a temporal trend in the residuals (measured minus simulated water temperature values) that might inflate or deflate trend estimates. Monthly average residuals were calculated from daily values when there were 25 or more measured values per month, and were processed following Gilbert's (1987) methodology. In addition, the SIAM model was run to simulate a period of 10 consecutive years that had identical flow and meteorology regimes to see whether the modeled system might accumulate heat from year to year, falsely generating a trend due to a computation or implementation anomaly.

Daily water temperatures were simulated for the 40-year period, WY 1962–2001 (beginning the year after the last dam was put in place), and exported from SIAM for the four main-stem river locations highlighted in Table 1. In addition to river temperature, SIAM also calculated six biologically relevant metrics for the site immediately below Iron Gate Dam:

(1) the annual number of degree-days exceeding 15°C (e.g., a mean daily water temperature of 17°C counts as 2 degree-days),
(2) the annual number of non-overlapping events when water temperature exceeded 15°C for 7 d in a row,
(3) the annual number of days when water temperature exceeded 20°C,
(4) the annual first day in spring when water temperature reached 15°C,

(5) the annual last day in fall when water temperature reached 15°C, and
(6) the number of river kilometers from Iron Gate Dam to the mouth of the Klamath River with water temperature below 15°C averaged for the summer (1 May to 30 September).

The 15°C and 20°C thresholds in these metrics were chosen as representative of chronic and acute high temperatures for salmonids, based on values reported by the U.S. Environmental Protection Agency (USEPA 2003). Both thresholds are below lethal temperatures for most salmonid life stages, but they are associated with increasingly adverse effects such as sub-optimal growth rates, reduced swimming performance, increased disease risk, and impaired smoltification (USEPA 2003). Unlike Bartholow et al. (in press), who focused only on Chinook salmon *Oncorhynchus tshawytscha*, the first five metrics were calculated for the entire year because one or more life stages for all anadromous salmonids can occur in the Klamath River year-round (Leidy and Leidy 1984). Daily values for all temperatures and metrics were converted to average monthly values by use of utility programs and were subsequently processed with Gilbert's (1987) software.

Historical air temperature and hydrology records.—The HEC-5Q model uses daily average air temperature as one of its dominant inputs. The two closest air temperature stations to the main-stem Klamath River below Iron Gate Dam used by Hanna and Campbell (2000) were Yreka and Eureka, California; Yreka meteorology governs the upstream portions of the river and the maritime station at Eureka governs the river's lowest 50 km, approximately 32 km from the coast (per Lewis et al. 2000). However, because the Yreka station had missing data for air temperature and other required meteorological variables, Hanna and Campbell (2000) used regression techniques to translate some daily values from Medford, Oregon. To eliminate any possibility of contaminating this trend analysis with synthetic values, I used the most consistent source of raw data available (EarthInfo, Inc. 1995). Average monthly maximum and minimum air temperatures for Eureka, Yreka, and Medford and for Klamath Falls, Oregon, were extracted from this database for calendar years (CY) 1962 through 1993, the latest year available in the EarthInfo, Inc. (1995) database. Mean monthly air temperature values were computed from these values as before and were processed by use of Gilbert's (1987) methodology.

TABLE 2.—Estimated trends in simulated water temperature along the main-stem Klamath River and their 95% confidence intervals (CIs) for the 40-year period 1962–2001 (n = 480). Trend estimates at all stations had P-values ≤0.001. Note, however, that the most downstream station (Klamath River near Klamath) showed a significant trend in the analysis of measured less simulated residuals and was not considered trustworthy.

Station	Trend (°C/year)	95% CI
Klamath River below Iron Gate Dam	0.053	0.044–0.063
Klamath River near Seiad Valley	0.051	0.043–0.059
Klamath River at Orleans	0.048	0.039–0.057
Klamath River near Klamath	0.044	0.036–0.051

Another required input for HEC-5Q is hydrology. To detect whether water temperature trends might be due to changes in river flow, I examined the historical monthly average discharge records (WY 1962–2001) for Iron Gate Dam and processed these values by use of the same set of procedures applied to the other data.

Results

Historical Water Temperature Records

The historical gauge data for the 13 stations listed in Table 1 with more than 10 years of data implied an average basinwide warming trend of 0.026°C/year. However, estimated annual trends for individual stations (Table 1) and months (not shown) during the year varied widely. Two stations suggested small negative trends and two indicated no trend at all. Nine stations indicated positive annual trends. Only three stations (Crater Lake, South Fork Trinity River below Hyampom, and Trinity River at Hoopa) had trends that were statistically different from zero at the 0.05 level. If data from only these three stations are averaged, the estimated trend would be 0.06°C/year, but none of these stations is on the main-stem Klamath River and their period of record was inconsistent in both duration and timing. Thus, results from the historical temperature gauges were only *suggestive* of a trend, not statistically conclusive. Without the seemingly obvious trends evident by examining the simulation model's 40-year output (described below), this analysis would not have been continued.

Simulated River Temperature and Metrics

Table 2 indicates that annual water temperature trends derived from HEC-5Q model results have been increasing at each of the four main-stem lo-

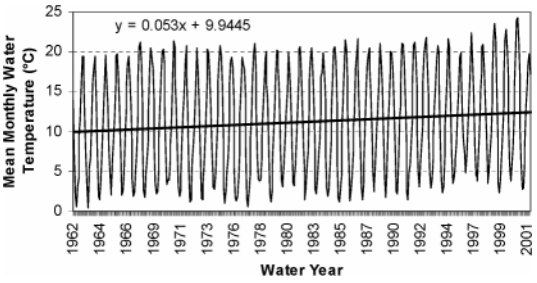

FIGURE 2.—Illustration of the increasing trend in simulated mean monthly water temperature below Iron Gate Dam on the main-stem Klamath River. Mean monthly values were computed from the HEC-5Q model's (USACE 1986) daily simulation results.

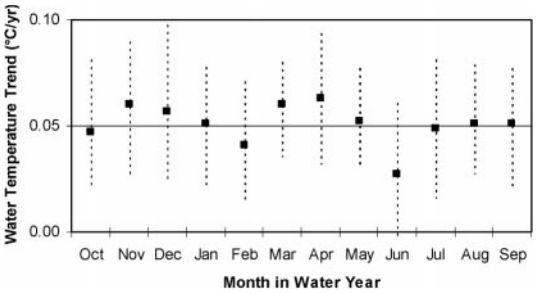

FIGURE 3.—Estimated monthly trends (with 95% confidence intervals) in the simulated mean monthly water temperature for the main-stem Klamath River near Seiad Valley from 1962 to 2001. June was the only month in which the trend was not significant at the 0.05 level. Mean monthly values were computed from the HEC-5Q model's (USACE 1986) daily simulation results.

cations but with slightly less of an increase in the downstream direction. Figure 2 provides an example of the trend observed for the river below Iron Gate Dam. Positive trends were found for each month of the year at all four stations (the Seiad Valley gauge trends are shown in Figure 3), and almost all months were significant at the 0.05 level. June trends were consistently non-significant.

Running the model for the consecutive 10-year period with identical annual flow regimes and meteorology indicated no interannual increase or decrease in thermal storage, confirming that the model's algorithms themselves were not falsely generating any trend. However, a careful examination of residuals (measured minus simulated temperatures) for the full historical period (1962–2001) did reveal some linear and cyclic trends. A small linear trend was identified at each of the four main-stem stations, but the residual trends at the three upstream-most stations were small (average, 0.003°C/year; n = 135–235) and none were significantly different from zero at the 0.05 level when tested with Gilbert's (1987) technique. At the Klamath River near Klamath, California, the linear trend in residuals was large (0.032°C/year; n = 134) and significantly different from zero. These results imply that the model does not introduce any significant trend of its own that would confound an estimate of basinwide warming at all but the most downstream, tidally influenced station. Because the inclusion of that station (Klamath River at Klamath) might influence reliable detection of basinwide trends, it was omitted from the remainder of the analysis.

Table 3 summarizes simulated temperature trends for the six different metrics at three stations along the main-stem Klamath River. Collectively, these metrics indicated that (1) cumulative exposures to stressful temperatures have been increasing in both number and duration; (2) the length of the annual period of potentially stressful temperatures has been increasing (i.e., summer effectively starts earlier in the spring and extends longer into the fall); and (3) the average length of river with suitable temperatures has been decreasing. There was generally a decreasing rate of change

TABLE 3.—Estimated annual trends in metrics derived from simulated water temperature below Iron Gate Dam on the main-stem Klamath River and their 95% confidence intervals (CIs; $P \leq 0.05$) for the 40-year period 1962–2001. See text for definitions of the calculated metrics. All metrics had 40 observations except for the spring and fall dates (n = 39).

Metric	Site	Annual trend	95% CI
Degree-days (>15°C)	Iron Gate Dam	5.55	2.89–8.68
	Seiad Valley	5.94	3.97–8.42
	Orleans	5.99	3.67–8.50
Chronic events (weeks)	Iron Gate Dam	0.09	0.05–0.15
	Seiad Valley	0.08	0.04–0.11
	Orleans	0.07	0.00–0.13
Acute events (d)	Iron Gate Dam	1.09	0.56–1.73
	Seiad Valley	0.91	0.36–1.37
	Orleans	0.81	0.29–1.20
Spring date (d)	Iron Gate Dam	−0.44	−0.75 to −0.18
	Seiad Valley	−0.43	−0.72 to −0.14
	Orleans	−0.33	−0.64 to −0.05
Fall date (d)	Iron Gate Dam	0.46	0.22–0.71
	Seiad Valley	0.31	0.07–0.56
	Orleans	0.25	0.05–0.47
Length of river below Iron Gate Dam <15°C (km)	Downstream of Iron Gate Dam	−0.82	−1.29 to −0.40

TABLE 4.—Estimated trends in measured air temperature in or near the main-stem Klamath River and their 95% confidence intervals (CIs) for calendar years 1962–1993. All stations had *P*-values ≤0.001 except Yreka (*P* = 0.357).

Station (months of data)	Trend (°C/year)	95% CI
Eureka, California (384)	0.056	0.042–0.066
Yreka, California (373)	0.000	−0.029–0.000
Medford, Oregon (366)	0.040	0.019–0.060
Klamath Falls, Oregon (382)	0.035	0.012–0.059

in these metrics in the downstream direction, although there were a few exceptions.

Historical Air Temperature and Hydrology Records

Estimated historical air temperature trends are given in Table 4. The variance in the estimated temperature trend was large across stations, and the Yreka station exhibited no air temperature trend at all. Interestingly, the rate of change appeared strongest at the downstream-most station, Eureka. This station's estimated trend was an increase of 0.056°C/year.

The estimated annual trend in discharge at Iron Gate Dam was quite small (−0.09 m^3/s per year) relative to typical flow rates (>28.32 m^3/s), but it was still significant (95% CI = −0.200 to −0.024 m^3/s per year; $P \leq 0.003$). Although several months showed some discharge trends approaching 1.4 m^3/s per year, most were negligible. Because of the small magnitude of estimated annual change in flow, it appeared unlikely that hydrologic changes could be responsible for trends detected in water temperatures.

Discussion and Conclusion

Best Estimate of Warming Trends

Thirteen USGS water temperature gauges had enough measured data to allow computation of trend statistics, but short records and large blocks of missing data resulted in few statistically significant trend estimates. A few stations with longer historical records did suggest a small, statistically significant warming trend beginning in the 1960s. In particular, Crater Lake (with the longest record) is well off the main-stem Klamath River and indicated a significant trend similar to on-river locations, suggesting that a warming trend, if present, might be basinwide and not related to any specific land use or water use factors. Because the records were short and incomplete, additional analysis was warranted. The best way to continue the analysis was to use a water temperature model to, in essence, fill and extend the record.

Filling the data record via simulation eliminated some of the uncertainty associated with the handling of missing data in the statistical analysis, and extending the record well beyond what was historically available strengthened the statistical power to estimate mean trends and their CIs simply because of increased sample size (Gilbert 1987). However, the use of a simulation model potentially interjects uncertainty because the model itself must introduce no trend of its own. No significant trend in model residuals (measured minus simulated temperatures) through time was detected except at the downstream-most station near Klamath, California. For this reason and because this location was also influenced by unmodeled tides, this station was not used in drawing conclusions about Klamath River basin warming even though its estimated trend was quite similar to those of the other three stations.

Aggregating all other stations from Table 2, it is estimated from the filled record that the average trend in main-stem water temperatures has been 0.5°C/decade (95% CI = 0.42–0.60°C/decade; $P \leq 0.001$) for the 40-year postdam period, 1962–2001. On average, this represents a 2°C increase during the period examined—a change with potentially significant ramifications for the aquatic community. This estimated trend is larger than that found for a British Columbia watershed by Morrison et al. (2002), who estimated a warming trend of about 0.22°C/decade from 1953 to 1998.

Uncertainty Inherent in the Estimated Trend

Many factors must be weighed when attempting to judge the uncertainty inherent in the trend estimate for the main-stem Klamath River. There are a variety of opinions about exactly which statistical methods possess the best ''power'' for attempts to tease trends from real-world data (USEPA 1998). No trend estimation technique, including the software developed by Gilbert (1987), can fully quantify uncertainty. None are immune from problems associated with the analysis period and length (i.e., when the analysis begins and when it ends) (Williams 1991); none can completely factor out serial correlation (Fox et al. 1990); and none can address potential biases in measured or estimated time series data (Gilbert 1987). Further, trends in measured (not simulated) data may be influenced by improvements in measurement precision or technique through time or, in the case of meteorologic data, by anthropomorphic changes at

or near the location of instrumentation (Pielke et al. 2002).

Perhaps most importantly, this analysis relied heavily on a simulation model that, like all models, is an incomplete representation of reality and that exhibited a degree of serial correlation in the residuals that is probably indicative of the decadal-scale temperature oscillations widely reported in the literature on Pacific salmon (e.g., Beamish and Bouillon 1993). Though annual trend estimates at all stations listed in Table 2 were quite similar, they showed a small, unexplained decrease in the downstream direction. The apparent patterns in estimated seasonal or geographic trends could simply be random, but they might warrant further statistical analysis dealing with homogeneity, which was not explored here.

The bottom line is that the estimated trends for Klamath River basin warming in no way imply a permanent change in the system (Helsel and Andrews 1991), and the CIs about the estimate may be too narrowly prescribed. The analysis by Fox et al. (1990) that examined trends in San Francisco Bay outflows by use of similar procedures generated considerable discussion in the literature concerning statistical application, confidence in the results, and implications for the future (Helsel and Andrews 1991; Williams 1991; Fox et al. 1991a, 1991b). Further discussion of the current analysis may certainly be warranted.

Likely Causes of the Warming Trend

If there is a trend, what are its causes? Changes in hydrology have been found by some investigators to be related to regional climatic shifts, though generally at higher latitudes (Danard and Murty 1994; Morrison et al. 2002). However, there was very little indication that water temperature trends on the Klamath River were related to any systematic change in main-stem hydrology below Iron Gate Dam (although changes at a monthly scale may deserve additional attention). Instead, water temperature trends were supported by the estimates of basinwide air temperature warming that averaged 0.33°C/decade (95% CI = 0.11–0.46°C/decade) across all four stations in Table 4. Air temperature is very important in the HEC-5Q model both because it dominates mean daily heat exchange and because air temperature was used to calculate tributary inflow temperatures. Therefore, it is no surprise that any trend detected in air temperatures would have a direct effect on simulation-derived water temperature trends. Differences in the magnitude of estimated water and air temperature trends may be explained by other meteorological parameters known to be important in determining mean daily water temperature (e.g., dew point temperature, solar radiation, and wind speed, none of which were investigated here). It is also possible that temperature trends could be influenced by cumulative watershed changes (e.g., timber harvest), but watershed condition was not a direct input for HEC-5Q simulations. More likely, the difference between air and water temperature trends simply reflects the aggregate uncertainty in each estimate.

It is interesting that the data for Yreka, the station closest to the geographic center of the basin, did not indicate a statistically significant trend in air temperature. Translating some meteorological data from Medford to use as input for the model could have influenced estimated water temperature trends from the model results, but evidence for erroneous water temperature predictions was lacking. Although Medford is outside the Klamath River basin proper (Figure 1), it is physically quite close to a large portion of the watershed contributing ungaged accretions that account for about one-half of the river's flow at the ocean (Bartholow et al., in press). Crater Lake is also in close proximity to Medford, and we know from the analysis of historical data that this station's lengthy record showed a detectable and statistically significant positive trend in water temperatures through time (0.33°C/decade; Table 1). Therefore, the use of Medford meteorological data as a surrogate for Yreka data when necessary may have been appropriate.

Other Confounding Factors

How can a 40-year warming trend be put in perspective? There is evidence that periodic high temperatures occurred in the Klamath River basin in the 1900s prior to 1962. Risley and Laenen (1999) looked at even longer-term air temperature records at Klamath Falls and established that there was no difference in the median annual air temperature for the periods 1922–1950 and 1950–1996. This appeared to be due largely to a series of very hot years occurring in the 1930s that rivaled, but did not exceed, air temperatures recorded in the 1990s. More generally, researchers have noted a recurring climatic pattern in North Pacific Ocean temperatures at decadal time scales that affect continental surface air temperatures. This pattern, aptly named the Pacific Decadal Oscillation (PDO), has been shown to correlate to varying degrees with shifts in salmon production

(Mantua et al. 1997). The correlation is stronger for Alaska's salmon stocks and weaker for stocks in Washington, Oregon, and California. The period examined in this paper, 1962–2001, spans a detected PDO crossover point (1977) from cooler to warmer weather (Mantua et al. 1997) and may be a contributing factor to the trend detected in the Klamath River data, although the coefficient of determination between an annual PDO index and Klamath Falls air temperature was not strong ($r^2 = 0.2$). Nonetheless, if the polarity of the PDO shifts once again, periods of cooler weather may return to the Klamath River basin. If an additional warming trend was superimposed on the recurrent PDO signature, however, one would expect each succeeding air temperature peak and trough to be higher than the last. Klamath River basin waters would not likely continue warming at the same decadal rates reported here even if air temperatures continue to rise. Water temperature does not linearly parallel increases in air temperature but instead is S-shaped due to evaporative cooling and back radiation from the water's surface; above approximately 25°C, stream temperature begins to level with respect to rising air temperature, but not so much that it could not eventually reach 30°C or higher (Mohseni et al. 2002).

Potential Significance of the Warming Trend

Are the trends in water temperature important from a biological perspective? The various metrics derived from simulated water temperature (Table 3) point toward greater exposure (both in frequency and duration) to chronic and acute temperature thresholds that are potentially stressful to salmonids through both time and space. Below Iron Gate Dam, for example, considering both the onset of high temperatures in the spring and their conclusion in the fall, the period of the year when mean daily temperature exceeds 15°C has been increasing by 9 d/decade. This rate of change seems especially large, adding up to over 1 month during the 40-year period studied. In contrast, the decrease in average length of river with temperatures below 15°C (8.2 km/decade) does not appear to be as major an issue, but does demonstrate an incremental elimination of coldwater habitat.

In the Klamath River basin, elevated water temperatures can occur from May through October, a period of concern for many anadromous salmonids since eggs (deposited during fall spawning) and juveniles (out-migrating from late spring through summer) are thermally sensitive life stages. Upstream migrating and spawning adults may also be affected during the late summer. The months of June–September exhibit exceedingly poor water temperatures for any oversummering salmonids at most main-stem Klamath River locations in most years. For example, the mean monthly maximum daily water temperature from the historical data collected at Seiad Valley from 1964 to 1979 was 23.3°C in July, and daily extremes were as high as 29.5°C. In short, water temperature in the lower main-stem Klamath River is currently marginal for anadromous salmonids; their thermal resource is being ''squeezed'' in both space and time. Even the winter period is not immune, as warmer waters would be expected to speed egg and alevin maturation rates and to advance hatching times (Crisp 1981). Southern Pacific coastal salmon streams (below 56°N) are typically viewed as offering a nurturing growth opportunity for young salmon, demonstrated by the fact that they migrate to the ocean as young-of-the-year instead of yearlings as is common above 56°N (Taylor 1990). However, rivers as warm as the main-stem Klamath River might instead be viewed as thermally adverse, essentially requiring out-migration to avoid early- or oversummer death unless rearing fish can locate and take advantage of thermal refugia or coolwater tributaries.

Several researchers have discussed potential impacts of climate change on fishery resources; trends found in Klamath River basin water temperature and associated metrics are reminiscent of those discussions. Meisner (1990) and Sinokrot et al. (1995) pointed to potential losses in thermal habitat associated with warming, and Chatters et al. (1995) projected salmonid population declines accompanying a 2°C rise in temperature. Other biological communities appear to be undergoing shifts in their geographic range (e.g., Edith's checkerspot butterfly *Euphydryas editha*; Parmesan 1996) or changes in life history timing (e.g., flowering times for British plants: Fitter and Fitter 2002) in presumed response to changing climatic conditions. If water temperature trends of the magnitude found for the main-stem Klamath River continue in future decades, some stocks may decline to levels insufficient to ensure stock survival, as was discussed by Chatters et al. (1991) for the Columbia River basin and Eaton and Scheller (1996) for cold- and coolwater guilds in general.

Selection of a single thermal threshold as an indicator of the time when stocks may disappear from a specific geographic area is problematic (Poole et al. 2001; Dunham et al. 2003), but Eaton et al. (1995) listed mean weekly temperatures of

23.4°C for coho salmon *O. kisutch* and 24°C for Chinook salmon as thresholds above which disappearance becomes increasingly likely. Both simulations and measured data suggest that waters in the main-stem Klamath River below Iron Gate Dam, particularly at Seiad Valley and Orleans, are already at or above the 24°C mean weekly threshold, although this is not the case at Iron Gate Dam. This does not mean that cooler Klamath River basin tributaries could not continue to produce salmon, but natural stocks that rely on the main stem as a migration corridor in times of seasonally high temperatures may not survive if they cannot adapt. Lawson et al. (2004) made a similar observation about the survival of coho salmon in Oregon streams north of the Klamath River basin.

No one can say whether warming trends will continue or predict the magnitude and time frame of such trends. It appears certain, however, that if warming does continue, recovery of naturally reared anadromous salmonids in the Klamath River basin may become increasingly problematic. For the moment, discussion about the future of salmon remains heated.

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ATTACHMENT 15

Health Monitoring of Juvenile Klamath River Chinook Salmon (USFWS
California-Nevada
Fish Health Center, Nov. 2005)

FY 2004 Investigational Report:

Health Monitoring of Juvenile Klamath River Chinook Salmon



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Summary
Between 11 May and 27 July 2004, seven hundred and forty-five juvenile fall-run Chinook Salmon (*Oncorhynchus tshawytscha*) were collected for pathogen and physiological assays at 4 general locations in the lower Klamath River. Pathogens of interest included the bacterium *Flavobacterium columnare*, and myxozoan parasites *Parvicapsula minibicornis* and *Ceratomyxa shasta.* Only 2.4% of fish examined were infected with *F. columnare* suggesting it was not a significant problem in these fish in 2004. Expanding from trap efficiency data, we estimated that 45% of the population was infected with *C. shasta* and 94% of the population was infected with *P. minibicornis*. The high incidence of dual myxozoan infection (98% of *Ceratomyxa* infected fish), and associated pathology suggests that the majority of the *C. shasta* infected juvenile Chinook would not survive. The prognosis for *P. minibicornis* infection by itself is not well understood. Depending on the juvenile Klamath River salmon population size and smolt to adult return ratio, the effective number of adult salmon lost to *C. shasta* as juveniles could rival the 33,000+ adult salmon lost in the 2002 Klamath River Fish Die-off.

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Introduction

The California-Nevada Fish Health Center, as a partner in the efforts to restore salmonid populations in the Klamath River basin, conducted pathogen and physiology monitoring of juvenile Klamath River Chinook Salmon (*Oncorhynchus tshawytscha*) since 1991. Pathogens associated with diseased fish in the Klamath River include bacteria (*Flavobacterium columnare* and motile aeromonid bacteria), digenetic trematodes (presumptive *Nanophyetus salmincola*) and myxozoan parasites (*Parvicapsula minibicornis* and *Ceratomyxa shasta*). Ceratomyxosis has been identified as the most significant disease for juvenile salmon in the Klamath Basin (Foott et al. 1999, Foott et al. 2003).

In this study we monitored the weekly incidence of *Ceratomyxa* and *Parvicapsula* infection in juvenile Chinook salmon during their spring emigration at several sites on the Klamath River. We expanded the observed incidence data to the juvenile Fall Chinook population using trap efficiency data. The utility of apparent clinical signs (pale gill, swollen abdomen and swollen kidney) for determining disease status of fish was also examined.

Methods

Sampling – During the spring and early summer of 2004, juvenile Klamath River Chinook Salmon were collected at Persido Bar (RM 81) and Big Bar (RM 51) by rotary screw trap. Fish were also collected at one beach seine site per week alternating between Big Bar and Persido Bar 11-May through 16-June. After 16 June, we were forced to target cooler water refuge sites near creek mouths (RM 50-81, Appendix I). Each week we attempted to examine 30 fish from each trap and 20 fish from the seine collection. Crews operating the traps would collect and hold live fish up to 48 hours prior to sampling depending on number of fish captured each day. Fish captured by seine were sampled immediately following capture.

Necropsy – Fish were euthanized in MS222, measured for fork length and examined for abnormalities. The degree of the abnormality was scored according to Table 1. Tissue samples were collected for bacteriology, ATPase, muscle RNA:DNA and histology assays.

Histology – Gastrointestinal tract (pyloric ceca and intestine) and kidney tissues were rapidly removed from the fish and immediately fixed in Davidson's fixative, transferred to 70 % ethanol after 24-48 hours, processed for 5 µm paraffin sections and stained with hematoxylin and eosin (Humason 1979). All tissues for a given fish were placed on one slide and identified by a unique code number. Each slide was examined at both low (40X) and high magnification (400X). The presence of the myxozoan parasites (*Ceratomyxa* and *Parvicapsula)* and degree of tissue inflammatory response to the parasites (lesions) were rated as 0 (normal or no inflammation), 1 (parasites and inflammatory response in less than 50% of tissue section), 2 (parasite induced inflammatory response in greater than 50% of tissue section), and 3 (entire tissue section demonstrating parasite infection and inflammatory response with little or no normal tissue structure). Individual fish were categorized as uninfected, lightly infected, or

severely infected according to the presence of the parasites and lesion score for the target tissue (gastrointestinal tract for *Ceratomyxa* and kidney for *Parvicapsula)*.

Table 1. Abnormality scoring system used during necropsy.

Abnormality	Score
Pale Gill (Anemia)	0 = normal 1 = pale 2 = grey/white/tan – no pink
Gill Lesion	0 = normal, no lesion 1 = lesion present
Skin/Fin Hemorrhages	0 = normal, no hemorrhaging 1 = hemorrhaging of skin and/or fins
Distended Abdomen	0 = abdomen normal 1 = abdomen distended
Organ Hemorrhaging	0 = normal, no hemorrhaging 1 = hemorrhaging of one or more internal organs
Swollen Kidney (Nephritis)	0 = kidney normal concave shape 1 = kidney flat or slightly convex; some grey color 2 = kidney convex and grey

Bacteriology – If a fish exhibited signs of septicemia (hemorrhaging fins or skin, petechial hemorrhaging on organs) a sample of kidney tissue was inoculated onto Brain Heart Infusion agar slant tubes. Isolates were identified to genera by standard microscopic and biochemical tests (Lasee 1995). Corroboration of bacterial septicemia was performed by examining spleen imprints for large numbers of bacteria. Any fish with visible gill lesions was screened for *Flavobacterium columnare* (the causative agent of Columnaris disease) by examining a gram stained imprint of the lesion for characteristic long filamentous Gram negative rods.

ATPase – Gill Na^+, K^+-Adenosine Triphosphatase activity (ATPase) was assayed by the method of McCormick and Bern (1989). Briefly, gill lamellae were dissected and frozen at -70°C in sucrose-EDTA-Imidazole (SEI) buffer on dry ice. The sample was later homogenized, centrifuged and the pellet sonicated prior to the assay. ATPase activity was determined by the decrease over time in optical density (340 nm) as NADH is converted to NAD+. This activity was reported as µmole ADP/mg protein/hour as 1 mole of NAD is produced for each mole of ADP generated in the reaction. Gill Na-K-ATPase activity is correlated with osmoregulatory ability in saltwater and is located in the chloride cells of the lamellae. This enzyme system transports salts from the blood against the concentration gradient in saltwater.

Muscle RNA:DNA – A section of caudal muscle was assayed for RNA:DNA ratio by the method of Kaplan, Leamon and Crivello (2001). Briefly, approximately 0.5g of

muscle was dissected and frozen on dry ice; the sample was later homogenized and digested in a buffered digest mixture. Quantity of RNA and DNA in the sample was determined by use of fluorescent dyes compared to ribosomal RNA (16S and 23S rRNA from *E. coli*) and lambda DNA standards. RNA:DNA ratios in white muscle are highly correlated with specific growth rate and are useful in detecting growth suppression in fish (Pickering and Pottinger 1995).

Expansion of pathogen incidence – The population estimate was based on Big Bar trap efficiency data provided by the USFWS Arcata Fish and Wildlife Office (Mark Magneson, personal communication). We used estimates of daily fish passage at the trap site to calculate the percent of the total population which passed the Big Bar trap each week (Figure 1). We then multiplied the weekly incidence of infection observed at the Big Bar trap (as a percent) by the percent of the population migrating past the trap each week, and summed these weekly estimates to produce the percentage of juvenile Klamath River Chinook Salmon passing Big Bar which were infected with either *Ceratomyxa* or *Parvicapsula*.

Estimates of the juvenile Chinook salmon population size were difficult to quantify due to poor recapture rates and low trap efficiency. Our population infection expansions were based on these mark-recapture experiments conducted at several times during our study. They were based on the best available information.

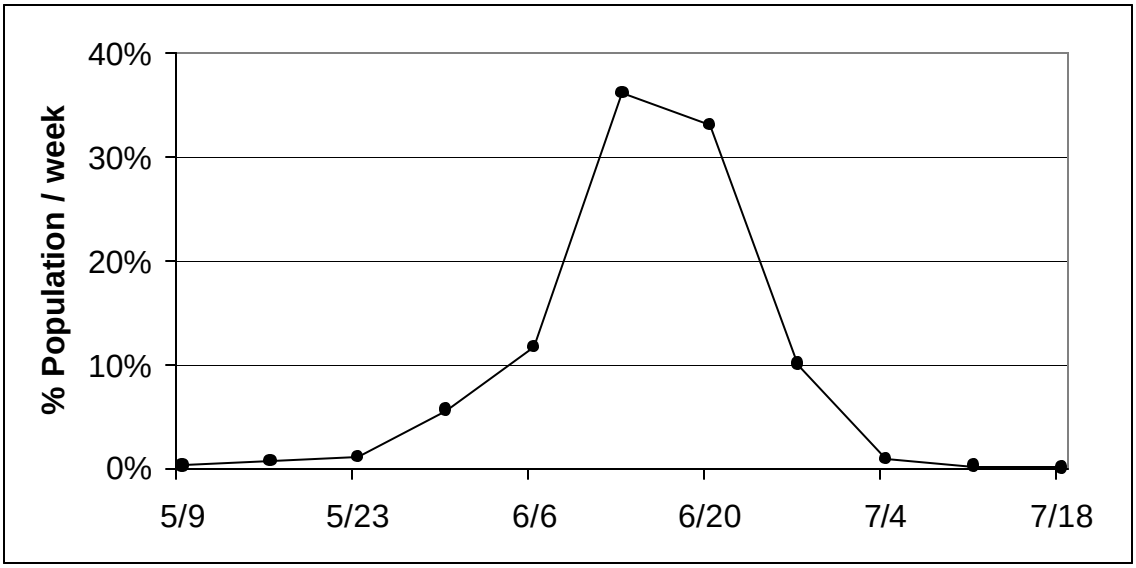

Figure 1. Percent of juvenile Klamath River Chinook Salmon emigration by week estimated at the Big Bar rotary screw trap (Mark Magneson, personal communication).

Statistical Analysis – Wilcoxon paired-sample test was used to determine if any sample sites tended toward higher weekly incidence of infection. Comparisons were made between Big Bar and Persido Bar traps and between Big Bar trap and seine sites to identify if the Big Bar trap was representative of all sample sites. Sample sites with less than 10 samples in a single week were not used in this analysis.

Results

Fish collection – The sample date, sites and number of fish collected are summarized in Table 2. Mean fork length demonstrated no consistent trend between sites, and increased from 52 mm to 89 mm during the first half of the study then remained fairly constant through the end of our study (Figure 2).

Table 2. Number of juvenile Klamath River Fall Chinook Salmon captured by rotary screw trap at Big Bar and Persido Bar, or beach seine (Seine). Seine location is noted for each week.

Week #	Sample Date	Big Bar	Persido Bar	Seine (location)
1	11-May	30	3	20 (Presido Bar)
2	19-May	31	12	20 (Big Bar)
3	25-May	29	29	19 (Presido Bar)
4	1-June	30	30	23 (Big Bar)
5	8-June	28	31	20 (Presido Bar)
6	16-June	27	30	23 (Big Bar)
7	22-June	30	26	18 (Camp Creek)
8	29-June	26	20	20 (Camp Creek)
9	6-July	27	25	0 (Camp Creek)
10	13-July	30	30	20 (Bluff Creek)
11	20-July	31	0	0 (Bluff Creek)
12	27-July	7	0	0
	Sub-totals	326	236	183 = 745 (total)

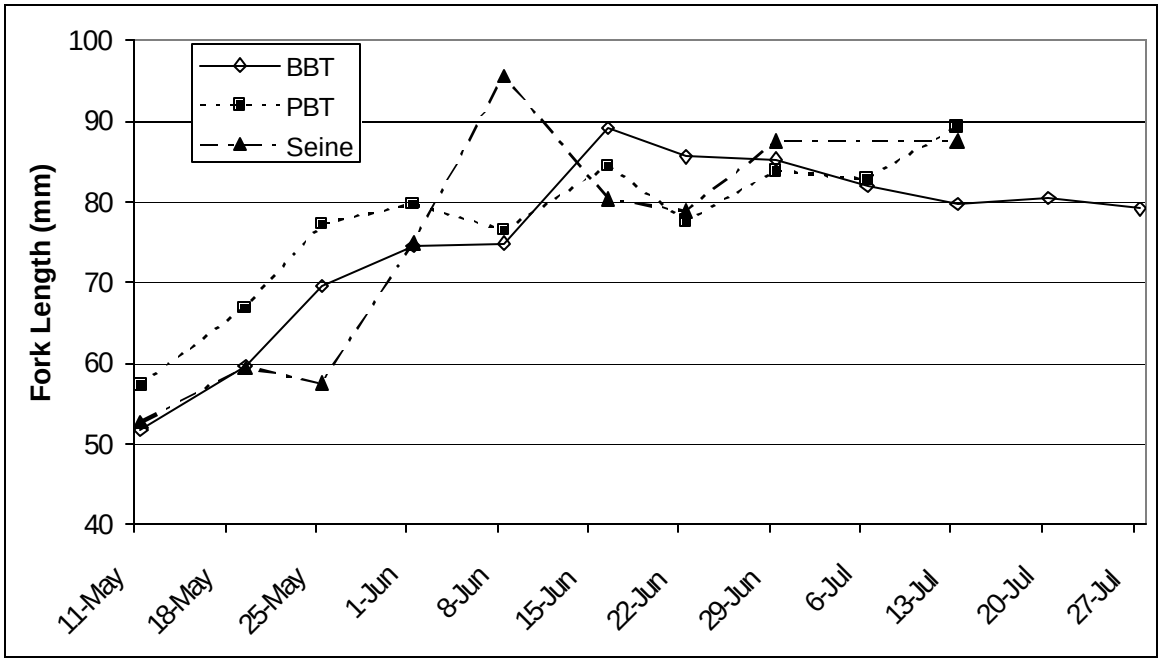

Figure 2. Mean fork length for juvenile Klamath River Chinook Salmon captured in the Big Bar trap (BBT), Presido Bar trap (PBT) and roving seine sites.

Ceratomyxa shasta – Weekly prevalence of infection for all sites combined ranged from 15% to 56%, with the peak observed in fish captured 19-May. Over half of

the sample groups were categorized with a severe infection (Figure 3). Expanding from the trap efficiency data we estimated 45% of the population passing Big Bar was infected with *Ceratomyxa.* There were no significant differences in incidence of infection between Big Bar trap and Persido Bar trap (P=0.074) nor between Big Bar trap and seine sites (P=0.098).

Parvicapsula minibicornis – Weekly prevalence of infection for all sites combined ranged from 36% to 93% with the peak observed in fish captured on 16-June (Figure 4). Expanding from the trap efficiency data we estimated 94% of the population passing Big Bar was infected with *Parvicapsula*. There were no significant differences in infection rates between the Big Bar trap and Persido Bar trap (P=0.203), nor between Big Bar trap and seine sites (P=1.0).

Correlation of field observations to histopathological lesions – Observations made during field collections were not diagnostic to a fish's specific parasite infection. Three clinical signs of disease (pale gill, swollen kidney, and swollen abdomen) noted during necropsy were related to each of the four criteria recorded from histological examination (*C.shasta* positive, *P.minibicornis* positive, intestinal lesion, and kidney lesion). These associations were demonstrated by the statistical significance of each pairing of clinical sign to histological condition in Table 3 ((P<0.01, one-tailed Fisher exact test). Dual parasite infections influenced the lack of diagnostic value for clinical signs.

Bacterial infections – Signs of bacterial septicemia were observed in 4 of 745 fish examined (0.5%). A motile *Aeromonas sp*. (presumptively *Aeromonas hydrophila*) was isolated from the other two of the four affected fish. Gill lesions suggestive of *F. columnare* infection were observed in 18 of 745 fish examined (2.4%). Typical *F. columnare* bacteria were observed in 15 of 18 gill imprints.

Gill ATPase –Gill Na^+, K^+-ATPase activities ranged between 1.7 and 4.3 µmole ADP/mg protein/hour and with peak values observed 19-May (Figure 5). No consistent trend was seen with time or water temperature. There were no significant differences between fish caught by trap or seine on the same sample date (P>0.05, t-test) so all samples from each day were pooled. *P. minibicornis* and *C. shasta* infections had no detectable effect on ATPase activity levels.

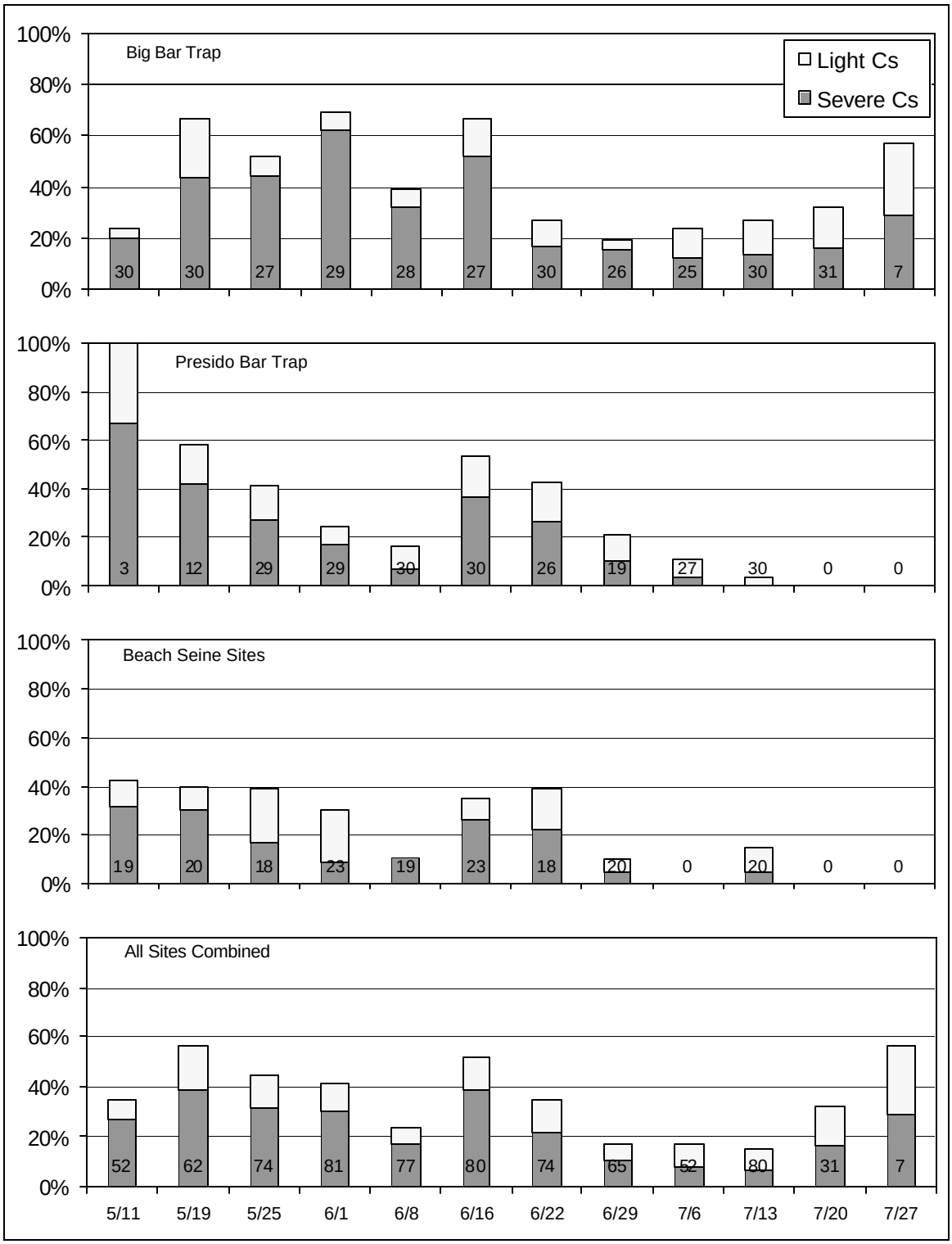

Figure 3. Percent of juvenile Klamath River Chinook Salmon with light and severe infections of *Ceratomyxa shasta* as indicated by examination of intestine by histology. Severe infections were indicated by greater than 50% of the intestinal tract demonstrating an inflammatory response associated with the parasite. Data is presented as percent of fish infected (light + severe) with number of samples in the base of each bar.

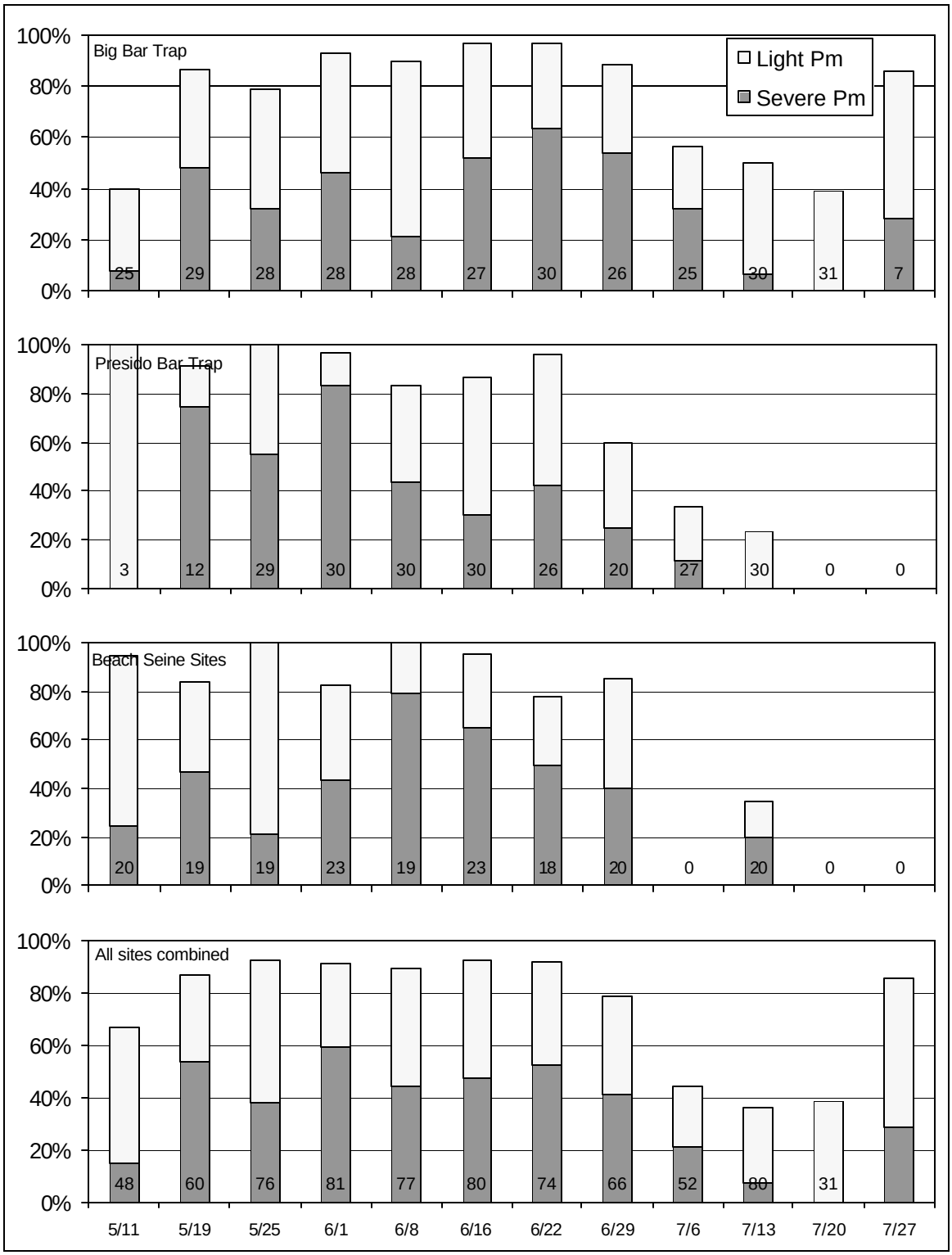

Figure 4. Percent of juvenile Klamath River Chinook Salmon with light and severe infections of *Parvicapsula minibicornis* as indicated by examination of kidney sections. Severe infections were indicated by greater than 50% of the section demonstrating an inflammatory response associated with the parasite. Data is presented as percent of fish infected (light + severe) with number of samples in the base of each bar.

Table 3. Frequency a clinical sign of disease (pale gill, swollen abdomen, swollen kidney) or histopathological condition (*Cs*+, IL, *Pm*+ or KL) co-occurred. Numbers in bold text were significantly greater (P<0.01, one-tailed Fisher exact test) than all samples combined (bottom row). Due to fish condition or problems with lab assay we did not have complete observations of signs and conditions for every fish; therefore, sample number (N) is approximate (±2.8%). All data is reported as percent of the true sample number.

		Percent Co-occurrence with:						
Clinical Sign or Condition	N	PG	SA	SK	*Cs*+	IL	*Pm*+	KL
Pale Gill (PG)	54		**15%**	**35%**	**78%**	**59%**	**96%**	**62%**
Swollen Abdomen (SA)	30	**27%**		**40%**	**70%**	**47%**	**97%**	**77%**
Swollen Kidney (SK)	142	**13%**	8%		28%	13%	**95%**	**72%**
Cs Infected *(Cs+)*	252					**67%**	**98%**	45%
Intestine Lesion (IL)	169				**100%**		**99%**	47%
Pm Infected *(Pm+)*	561				**44%**	**30%**		**48%**
Kidney Lesion (KL)	270				42%	29%	**100%**	
All Samples	744	7%	4%	19%	34%	23%	77%	37%

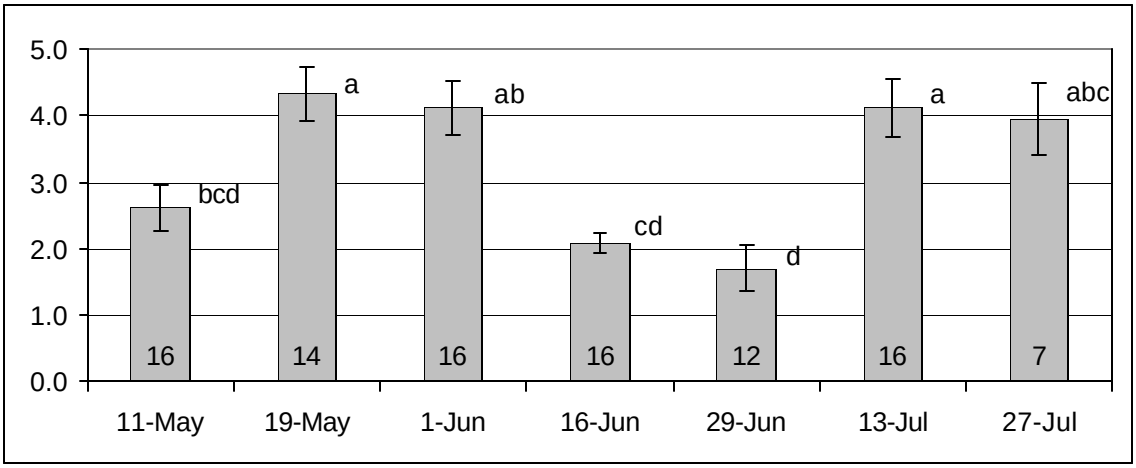

Figure 5. Gill Na+, K+-ATPase values (mmole ADP/mg protein/hour) for juvenile Klamath River Chinook Salmon collected in the Spring and Summer of 2004. Data presented as mean ±SE with sample number in base of each bar. Letters, not in common, indicate statistical differences between groups (p<0.05, ANOVA and Tukey test).

RNA:DNA – Mean muscle RNA:DNA tended to increase through the sampling period (Figure 6). This estimate of specific growth rate was not affected by *P. minibicornis* or *C. shasta* infection. Muscle RNA:DNA values correlated with sample date, fork length, and mean daily water temperature (all P<0.001, n=109). There was no correlation with gill ATPase (P=0.716, n=51).

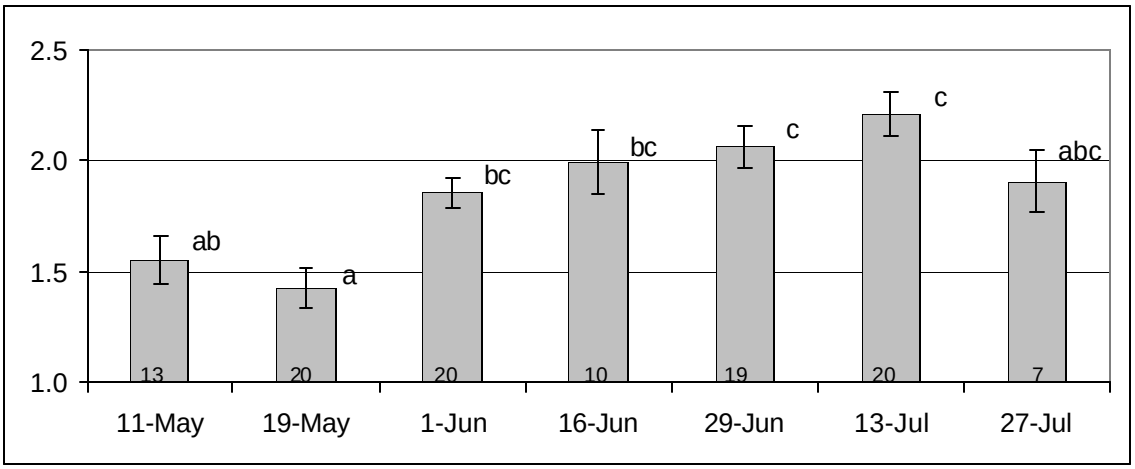

Figure 6. Mean muscle RNA:DNA values from juvenile Klamath River Chinook Salmon. Data is presented as mean ±SE and samples number in the base of each bar. Letters, not in common, indicate statistical differences between groups ($p<0.05$, ANOVA and Tukey test).

Discussion

Representative sampling of out-migrant population - In a given week, similarity in both pathogen prevalence and physiological data, observed between sample groups collected by either seine or rotary screw at different sites, provides confidence that our results accurately estimate the health status of juvenile Chinook salmon in the Klamath River during the spring of 2004. Comparative trends in both *Ceratomyxa* and *Parvicapsula* infection were observed at all sample sites. Similar trends were also noted for gill ATPase activity and RNA – DNA ratios from salmon taken at the different sites during the same sample week. Fish size was similar at all sites and demonstrated the expected pattern of rearing to a sufficient size for salt water entry and then emigrating (Wallace and Collins, 1997).

Potential bias – A collection bias towards healthier fish at the trap sites is a possibility as dead fish were not included in these samples. Fish in a severe disease state are likely to die prior to sampling. It was necessary for the trap crew to hold fish in a live box before we arrived for sampling, and during this holding period we routinely observed 10-20% mortality in the live box. Seine fish were sampled immediately following capture and were not affected by this practice.

Unknown influence of tributary populations on disease observations – The history of each sampled fish is largely unknown to us as only five marked hatchery salmon were collected in 2004. Previous examinations of juvenile salmon from the Shasta, Scott, and Trinity River have not detected *Ceratomyxa shasta* infections (National Wild Fish Health Survey 2005, Foott et al. 2002, Nichols et al. 2003). If we assume that parasite infection is primarily focused in the mainstem Klamath River, then the time of entry and duration of exposure to the mainstem river would be a major determinant in disease. The marked decline in *C.shasta* infection observed between 29-June and 13-July could be influenced by an influx of healthy smolts from a Klamath tributary (Figure 3). We noted a distinct group of fish captured in the 6-July sample (all sites). Histologically these fish

demonstrated no inflammation of the adipose tissue or other characteristics associated with the stress of rearing at warm water temperatures. We hypothesize that many of salmon collected on 6-July had recently reared in a cool water environment.

Drops in the pathogen incidence data in late May and again in late June may represent pulses of fish with a different origin. The sudden dip in gill ATPase activity with no correlation with disease incidence or water quality also supports this theory. These pulses of fish and corresponding changes in infection rates demonstrate the potential bias towards one segment of the population by sampling over a limited time frame. The expanded population infection rates for both parasites were heavily weighed towards the infection rates during the month of June as this is when the majority of smolts passed the Big Bar trap (Figure 1). Since most of the fish observed during this migration peak were of hatchery origin, our estimated population infection rates primarily represent these hatchery fish. Prior to Iron Gate Hatchery smolt releases in mid-May, the infection rates in naturally produced Chinook for *Ceratomyxa* and *Parvicapsula* were 20-60% and 40-100% respectively. Increased marking effort of both the hatchery and tributary populations would allow for analysis of the disease risk as a function of river entry and days of exposure.

Limited diagnostic value of clinical signs - In observations of clinical signs and histopathological conditions we introduced an intentional bias. Only those fish which clearly demonstrated abnormalities were considered "sick". Examples of this include observations of pale gills, swollen kidneys and histological lesions where we scored the abnormalities on a zero-two or zero-three scale with zero being normal. We only considered the scores of 2 or more to be abnormal even through those fish with a rating of one were showing some signs of abnormality. In these cases we considered a score of one to be transitional to a more severe disease state.

The clinical signs of disease we tracked (pale gills, swollen abdomen, and swollen kidney) demonstrated only marginal utility in identifying sick fish. Pale gill is a result of anemia which could be produced by intestinal hemorrhage (ceratomyxosis) or insufficient erythropoiesis due to kidney inflammation (*Parvicapsula* infection). Similarly, swollen abdomen occurs when the fish is unable to maintain its water balance and the peritoneum fills with ascitic fluid. Damage to kidney or the intestine can induce this condition. Dual infections further complicate the diagnostic picture. There may be some benefit in monitoring clinical signs to track population health over time, but the researcher should be aware that many fish without clinical signs were infected and would later progress into a disease state.

Flavobacterium columnare - The one clinical sign with diagnostic value was gill erosion that is often associated with *Flavobacterium columnare* infection. *Flavobacterium columnare* was not a significant health issue in this section of river during 2004 (2.4% incidence of infection). Past fish health examinations at Big Bar has found *F. columnare* to be a more significant problem with up to 20% incidence of infection (Nichols et al. 2003). It was associated with fish kills on the Klamath River most notably during an adult salmon fish die-off which occurred in 2002 (Guillen 2003a).

Low survival is expected in the estimated 45% of the juvenile Klamath River Chinook Salmon infected with *Ceratomyxa.* The progress of *Parvicapsula* infection in juvenile Chinook salmon is not well understood and this is an important question given the high incidence of infection (94%) observed in this study. We conclude that the juvenile Klamath River Chinook population experienced a high mortality prior to their migration to the ocean below our sample reach. There could be some level of mortality above our sample reach which went undetected in our sampling. Depending on the population size and smolt to adult return ratio, the effective number of adult salmon lost to *C. shasta* as juveniles rivaled the 33,000+ adult salmon lost in the September 2002 Klamath River Fish Die-off (Guillen 2003b).

Recommendations for future studies:

- Determine the prognosis of *Parvicapsula* infection.
- Determine the infections rates in other reaches of the Klamath.
- Determine the effects of disease on specific tributary populations.
- Determine the areas of the mainstem Klamath River where most of the fish are dying.

Acknowledgements

Partial funding for this study was provided through the Klamath River Basin Conservation Area Restoration Program under Project ($15,000, project 2004-FP-11). We thank Eric Wiseman for performing the majority of field sampling and lab processing, Ron Stone for help with histology processing, Yurok Tribal Fisheries field crews for fish collection at Big Bar and boat access to seine sites, and the Karuk Tribal Fisheries field crews for fish collection at Persido Bar and surrounding seine sites.

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Notes

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Appendix I

Sample site, date, number and clinical signs of disease observed in juvenile Klamath River Fall Chinook Salmon during the Spring and Summer of 2004.

Site	Date	n	Pale Gill[1]	Gill Les.[2]	Dist. Ab.[3]	Ext. Hem.[4]	Int. Hem.[5]	Sw. Kid.[6]
Big Bar Trap	5/11	30	3%	0%	0%	0%	N/A	N/A
	5/19	31	7%	0%	3%	0%	N/A	N/A
	5/25	29	3%	3%	0%	0%	3%	7%
	6/1	30	30%	0%	3%	0%	0%	21%
	6/8	28	18%	11%	0%	4%	4%	32%
	6/16	27	11%	4%	15%	0%	7%	26%
	6/22	30	17%	3%	7%	7%	7%	57%
	6/29	26	4%	0%	12%	0%	8%	27%
	7/6	27	0%	0%	0%	0%	0%	28%
	7/13	30	0%	7%	0%	0%	0%	0%
	7/20	31	0%	10%	0%	3%	0%	0%
	7/27	7	0%	0%	0%	0%	29%	0%
Presido Bar Trap	5/11	3	66%	0%	0%	0%	N/A	N/A
	5/19	12	17%	0%	0%	0%	N/A	N/A
	5/25	29	7%	3%	0%	0%	0%	14%
	6/1	30	10%	0%	3%	0%	0%	30%
	6/8	31	3%	0%	3%	0%	0%	39%
	6/16	30	0%	3%	3%	0%	3%	40%
	6/22	26	7%	4%	12%	0%	15%	38%
	6/29	20	20%	5%	10%	0%	25%	25%
	7/6	25	0%	0%	0%	4%	0%	0%
	7/13	30	7%	0%	0%	7%	0%	0%
Presido Bar Seine	5/11	20	0%	0%	0%	0%	N/A	N/A
Big Bar Seine	5/19	20	5%	0%	0%	5%	N/A	N/A
Presido Bar Seine	5/25	19	11%	0%	0%	0%	0%	0%
Big Bar Seine	6/1	23	13%	4%	0%	0%	0%	13%
Presido Bar Seine	6/8	20	10%	0%	5%	0%	5%	70%
Big Bar Seine	6/16	23	9%	4%	13%	0%	13%	30%
Camp Creek Seine	6/22	18	6%	0%	17%	6%	6%	50%
Camp Creek Seine	6/29	20	0%	5%	20%	5%	10%	10%
Camp Creek Seine	7/6	0	N/A	N/A	N/A	N/A	N/A	N/A
Bluff Creek Seine	7/13	20	0%	0%	0%	0%	0%	0%

Notes:

1. Pale gill = gills had lost typical red color. Gills were tan or grey color. Gills with were pink or red coloration were considered normal.
2. Gill lesion = focal discoloration on gill possibly due to *Flavobacterium columnare* infection.
3. Distended abdomen = Abdomen notably swollen or inflated.
4. External hemorrhaging = pinpoint hemorrhaging on skin or at base of fins
5. Internal hemorrhaging = pinpoint hemorrhaging on visceral fat, organs or peritoneum
6. Swollen kidney = kidney notably inflated (nephritis)

ATTACHMENT 16

Klamath River Juvenile Salmonid Health Monitoring, April-August 2007, (USFWS California-Nevada Fish Health Center, Sept. 2008)

U.S. Fish & Wildlife Service

California-Nevada Fish Health Center
FY 2007 Investigational Report:

Klamath River Juvenile Salmonid Health Monitoring, April-August 2007

Ken Nichols, Kimberly True, Ryan Fogerty and Lisa Ratcliff



September 2008

US Fish and Wildlife Service
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SUMMARY

The California-Nevada Fish Health Center led a cooperative study to monitor the incidence of two myxozoan parasites (*Ceratomyxa shasta* and *Parvicapsula minibicornis*) in juvenile salmonids within the Klamath River during the spring and summer of 2007. This study utilized two complementary assays: Quantitative real-time Polymerase Chain Reaction (QPCR) for its high sensitivity and efficiency, and histology to assess disease state and provide continuity with previous studies. In juvenile Klamath River Chinook Salmon out-migrants, *C. shasta* incidence of infection peaked at 68% during mid June and *P. minibicornis* reached 100% during late May. In marked (coded wire tagged) hatchery Chinook smolts recaptured within the Klamath River, *C. shasta* was detected in 68% of Iron Gate Hatchery (IGH) origin smolts and 14% of Trinity River Hatchery (TRH) origin smolts; *P. minibicornis* was detected in 83% of IGH smolts and 58% of TRH smolts. Infection incidence in coded wire tagged smolts from IGH peaked the 5th week following release and subsequently declined suggesting the death of infected fish. Coho salmon also were susceptible to infection by both parasites; with 48% *C. shasta* and 65% *P. minibicornis* incidence of infection observed in naturally produced young-of-the-year. Compared to Klamath River salmonid health monitoring conducted in 2004 – 2006, incidence of *C. shasta* was below average, and incidence of *P. minibicornis* was above average.

The correct citation for this report is:
Nichols K, K True, R Fogerty and L Ratcliff. 2008. FY 2007 Investigational Report: Klamath River Juvenile Salmonid Health Monitoring, April-August 2007. U.S. Fish & Wildlife Service California – Nevada Fish Health Center, Anderson, CA. Available online: http://www.fws.gov/canvfhc/reports.asp.

Notice
The mention of trade names or commercial products in this report does not constitute endorsement or recommendation for use by the Federal government.

INTRODUCTION

As a partner in the efforts to restore salmonid populations in the Klamath River basin, the California-Nevada Fish Health Center has conducted pathogen monitoring of juvenile Klamath River salmonids since 1991. Pathogens associated with diseased fish in the Klamath River include bacteria (*Flavobacterium columnare* and motile aeromonads), a digenetic trematode (presumptive *Nanophyetus salmincola*), myxozoan parasites (*Parvicapsula minibicornis* and *Ceratomyxa shasta*) and external parasites (Walker and Foott 1992; Williamson and Foott 1998). Ceratomyxosis (due to *C. shasta*) has been identified as the most significant disease for juvenile salmon in the Klamath Basin (Foott et al. 1999; Foott et al. 2004). Significant kidney damage (glomerulonephritis) has been associated with *P. minibicornis* infection; however, the prognosis of such infections has not been thoroughly studied in juvenile salmonids.

Ceratomyxa shasta and *P. minibicornis* are myxosporean parasites found in a number of Pacific Northwest watersheds (Hoffmaster et al. 1988; Bartholomew et al. 1989; St.-Hilaire et al. 2002; Jones et al. 2004; Bartholomew et al. 2006). The lifecycles of both parasites include the polychaete host, *Manayunkia speciosa*, and salmonids (Bartholomew et al. 1997; Bartholomew et al. 2006). *Ceratomyxa shasta* infection can occur from spring through fall at water temperatures greater than 4°C, although is most active above 11ºC (Ching and Munday 1984; Hendrickson et al. 1989; Bartholomew et al. 1989). Studies conducted in 2004, 2005 and 2006 suggest that *P. minibicornis* has seasonality similar to that of *C. shasta*, while its actinospore concentration and infectivity appears greater than *C. shasta* (Foott et al. 2006; Nichols and Foott 2006; Nichols et al. 2007; Nichols and True 2007; Bartholomew et al. 2007).

In this study we monitored the weekly incidence of *C. shasta* and *P. minibicornis* infections in juvenile Chinook (*Oncorhynchus tshawytscha*) and coho (*Oncorhynchus kisutch*) salmon over 24 weeks of the spring and summer out-migration period. Two complementary assays were utilized: Quantitative real-time Polymerase Chain Reaction (QPCR) for its high sensitivity and efficiency, and histology to assess disease state and provide continuity with previous studies.

METHODS

Fish Collection

Fish collection occurred from 19 April through 22 August, 2007, with a total of 1890 fish examined from the Klamath and Trinity Rivers. Sample reaches and cooperators performing collections are summarized in Table 1. Where possible, fish capture was performed at existing juvenile salmonid out-migration monitoring sites, but supplemental seining or electrofishing was required to achieve our target sample size in some weeks. Fish from multiple sites within each reach and captured over several days were combined into a weekly sample group.

A portion of the Chinook salmon released from the two hatcheries in the basin were marked with an adipose fin clip, and implanted with a coded-wire-tag (CWT). Iron Gate Hatchery (IGH) on the Klamath River released 5.4 million fall Chinook (5.8% CWT) from 18-31 May. Trinity River Hatchery (TRH) located near Lewiston on the Trinity River released 3.0 million spring and fall Chinook (24% CWT) in a week long volitional release from 1-8 June. Heads from any CWT Chinook recovered were assigned unique identification numbers to track lab assay results to individual CWT fish. The US Fish and Wildlife Service, Arcata FWO excised and read the CWT's. The release date for a given CWT group was used to determine weeks since release for individual marked fish. Chinook without adipose fin clips (unmarked) could have been of either hatchery or natural origin.

Table 1. Sample reach location and cooperating agencies performing collections.

Reach	River Miles	Primary collector(s)
Klamath River mainstem		
Iron Gate Dam to Shasta	Klamath 190-177	USFWS and Karuk Tribe
Shasta to Scott	Klamath 177-143	USFWS and Karuk Tribe
Salmon to Trinity	Klamath 66-44	Karuk Tribe
Trinity to Estuary	Klamath 44-4	Yurok Tribe
Klamath Estuary	Klamath 4-0	Yurok Tribe
Trinity River		
Upper – Lewiston Dam to North Fork	Trinity 111-73	Hoopa Tribe
Lower - North Fork to Klamath	Trinity 73-0	USFWS and Yurok Tribe

Target sample numbers for the QPCR assay varied depending on the reach and species sampled. In Klamath reaches above the confluence of the Trinity River the first 30 Chinook encountered per reach and all CWT Chinook were collected each week. In Klamath reaches below the Trinity confluence any adipose clip marked fish encountered were collected. Any juvenile coho salmon encountered in the Klamath River above the Trinity River confluence were collected under endangered species Section 10 permit 1068. In the Trinity River, 60 Chinook were collected in late May and again in late June.

Following capture and preliminary examination by collection crews, fish were euthanized, placed in a plastic bag labeled with date and reach, and arranged between frozen gel pack sheets. At the end of the day, samples were transferred to a freezer until they could be shipped frozen to the CA-NV Fish Health Center laboratory.

Each week personnel from the CA-NV Fish Health Center would accompany the samplers in one or more reaches to collect 10 randomly selected juvenile Chinook for the histology assay. Following preliminary examination by the collection crew, the fish were euthanized, and target tissues were preserved in individually identified 50 ml tubes containing Davidson's fixative. Only unmarked fish were collected for the histology assay.

Laboratory Assays

Necropsy – In the laboratory fish were thawed, measured for fork length, and tissue samples were collected. The intestine (both small and large intestine) and kidney from each fish were removed and combined into an individually numbered 2 ml cluster tube. Due to limited tube volume, total sample weight was limited to 1.0g (tissue weight ranged from 0.01g to 1.0g). Tissue samples were then frozen until DNA extraction was performed.

Histology – Tissues (kidney and intestine) for histological examination were fixed for 24 hours in Davidson's fixative, transferred to 70% ethanol after 24 hours for storage, processed for 5µm paraffin sections and stained with hematoxylin and eosin (Humason 1979). All tissues for each fish were placed on one slide and identified by a unique code number. Each slide was examined at both low (40X) and high magnification (400X). A composite infection and disease rating was developed based on the degree of tissue inflammation associated with the presence of the parasites. A similar histology rating system has been used in Klamath monitoring studies since 2004 (Nichols and Foott 2006; Nichols et al. 2007; Nichols and True 2007). *Ceratomyxa shasta* infections were rated as clinical (parasite present and inflammatory tissue in >33% of the intestine section), subclinical (parasite present, but inflammatory tissue in <33% of intestine

section) or uninfected (no *C. shasta* detected). *Parvicapsula minibicornis* infections were rated as clinical (parasite present and glomerulonephritis in >33% of the kidney section), subclinical (parasite present, and inflammation in <33% of the kidney section) or uninfected (no *P. minibicornis* detected).

DNA extraction – Combined intestine and kidney tissues were digested in 1ml NucPrep Digest Buffer containing 1.25 mg/ml proteinase K (Applied Biosystems, Foster City, CA) at 55ºC for 1 hour with constant shaking. A subsample of digested tissue homogenate was diluted 1:33 in molecular grade water (MGW) and extracted in a 96 well filter plate system (Applied Biosystems Model 6100 Nucleic Acid Prep Station). Due to dilution the weight of tissue entering extraction was limited to 3.0mg given the maximum 1.0g sample weight mentioned above. Extracted DNA was stored at -20ºC until the QPCR assays were performed.

QPCR assay – Samples were assayed in a 7300 Sequence Detection System (SDS) (Applied Biosystems), using probes and primers specific to each parasite. The combined tissues were tested for *C. shasta* 18S rDNA using TaqMan Fam-Tamra probe and primers (Hallett and Bartholomew 2006). The combined tissues were tested for *P.minibicornis* 18S rDNA utilizing TaqMan Minor-Grove-Binding (MGB) probe and primers (True et al. in press). Reaction volumes of 30uL, containing 5uL DNA template, were used for both assays under the following conditions: 50ºC for 2 min; 95ºC for 10 min; 40 cycles of 95ºC for 15 s and 60ºC for 1 min. Standards, extraction control and no template control wells (MGW) were included on each assay plate. Cycle threshold (C_T) values were calculated by the SDS software (v 1.3.1, Applied Biosystems). Preliminary lab trials examining the dynamic range and endpoint of the assays indicated a C_T of 38 and minimum change in normalized fluorescent signal of at least 10,000 units was a reliable indicator of amplification. These thresholds were conservative and underestimate the true incidence of infection for both parasites; however, we believe that any light infections that may have been missed likely had no biologically significant impact on the survival of the animals (True et al. in press; Nichols and True 2007).

Interannual Comparisons

Using the composite histology disease rankings, a comparison of disease incidence and severity between years was possible. Juvenile Klamath River Fall Chinook Salmon historically began out-migration in February, peaked in mid-June, and were captured in large numbers within the Klamath Estuary from June through mid August (Leidy and Leidy 1984; Wallace and Collins 1997). For interannual comparisons of parasite infection, we limited the data to fish captured during the months of May, June and July and from sites in the Klamath River above the confluence with the Trinity River. Limiting the data set in this way offered several advantages:

- These months bracketed the typical peak of Fall Chinook out-migration and included the monitoring periods from previous years
- Infection incidence during the "tails" of the migration (typically lower infection rates in early spring) were not given the same weight as the peak of migration
- The Trinity population was excluded as it is largely *C. shasta* uninfected
- Our target sample size was typically met during this period reducing sample variation due to small sample size

RESULTS

Chinook Salmon

Histology Assay

Ceratomyxa shasta infections were first detected by histology the week of 29 April in 20% (2/10) of fish sampled in the Shasta to Scott reach (Table 2). The peak incidence of infection and clinical ceratomyxosis were both observed the week of 10 June in the Shasta to Scott reach where 50% (5/10) of juvenile Chinook were *C. shasta* infected with 80% (4/5) of the infections rated as clinical. Infection incidence declined in late June and no infections were detected after the week of 22 July. Overall, this parasite was detected in 16.4% (25/152) of Chinook from the Klamath River, with intestinal lesions symptomatic of clinical ceratomyxosis observed in 68% (17/25) of the infected Chinook.

Parvicapsula minibicornis infections were first observed during the week of 15 April in 60% (6/10) of fish sampled in the Shasta to Scott reach (Table 3). Incidence of infection reached 100% (10/10) by the week of 27 May. The peak incidence of clinical glomerulonephritis was 80% (8/10) observed the week of 24 June. Infection incidence remained high through the last week of sampling; however, clinical glomerulonephritis declined in late July. Overall, *P. minibicornis* was detected in 76.3% (116/152) of Chinook sampled in the Klamath, with clinical glomerulonephritis observed in 47.4% (55/116) of the *P. minibicornis* infected Chinook.

QPCR Assay

The earliest detection of *C. shasta* infections was in the week of 29 April. Prevalence remained below 40% until early June. Peak incidence was 68% in Chinook captured above the Trinity confluence during the week of 17 June (Figure 1).

Ceratomyxa shasta was detected in 3% (5/168) of juvenile Trinity Chinook sampled within the Trinity River (Table 4). All were very light infections near the detection threshold of the QPCR assay. Three of the infected fish were captured at the North Fork site in the Upper Trinity reach while the other two infected fish were captured at the Willow Creek site in the Lower Trinity. All 5 *C. shasta* infected Chinook were captured after hatchery release and were of either hatchery or natural origin.

Parvicapsula minibicornis infections were detected from the first Klamath samples taken the week of 15 April. *Parvicapsula minibicornis* incidence reached 100% in the Klamath above the Trinity confluence on 20 May and remained high through the end of the study (Figure 2).

Parvicapsula minibicornis was detected in 41% (54/132) of juvenile Trinity Chinook captured in the Trinity River (Table 4). *Parvicapsula minibicornis* was detected in fish from both the Upper and Lower Trinity reaches before and after hatchery release. Peak prevalence of 88% (14/16) was observed in fish from the Lower Trinity reach in late June.

Marked Hatchery Fish

A total of 103 IGH and 332 TRH CWT marked smolts were collected between 30 May and 18 August. The IGH smolts were captured between Iron Gate Dam and the Klamath Estuary from one to 12 weeks following release. The TRH smolts were captured in the Klamath River between the Trinity River confluence and Klamath Estuary from 3 to 11 weeks following release. All CWT smolts were analyzed by QPCR assay.

Table 2. Incidence of *Ceratomyxa shasta* infection by histology in juvenile Chinook salmon captured in the Klamath River between Iron Gate Dam (IGD) and the Estuary, during spring and summer of 2007. Fish were considered infected (*Cs*+) if *C. shasta* was detected in histological examination of intestinal tract (pyloric ceca, small and large intestine). Fish with inflammation in >33% of the intestinal section were rated as clinically diseased (Clinical).

Sample Reach		15 Apr	29 Apr	13 May	27 May	3 Jun	10 Jun	17 Jun	24 Jun	8 Jul	15 Jul	22 Jul	5 Aug	12 Aug	19 Aug	Total
Shasta to Scott	*Cs*+	0/10	2/10	0/10	1/10		5/10		0/10							8/60
	Clinical	0/10	2/10	0/10	1/10		4/10		0/10							7/60
Salmon to Trinity	*Cs*+					3/10		4/9		1/10	1/2			0/10		9/41
	Clinical					2/10		2/9		0/10	1/2			0/10		5/41
Klamath Estuary	*Cs*+							4/10		2/11		2/10	0/10		0/10	8/51
	Clinical							3/10		1/11		1/10	0/10		0/10	5/51
Total	*Cs*+	0/10	2/10	0/10	1/10	3/10	5/10	8/19	0/10	3/21	1/2	2/10	0/10	0/10	0/10	25/152
	Clinical	0/10	2/10	0/10	1/10	2/10	4/10	5/19	0/10	1/21	1/2	1/10	0/10	0/10	0/10	17/152

Table 3. Incidence of *Parvicapsula minibicornis* infection by histology in juvenile Chinook salmon captured in the Klamath River between Iron Gate Dam (IGD) and the Estuary, during spring and summer of 2007. Fish were considered infected (*Pm*+) if *P. minibicornis* was detected in histological examination of the kidney. Fish with glomerulonephritis in >33% of the kidney section were rated as clinically diseased (Clinical).

Sample Reach		15 Apr	29 Apr	13 May	27 May	3 Jun	10 Jun	17 Jun	24 Jun	8 Jul	15 Jul	22 Jul	5 Aug	12 Aug	19 Aug	Total
Shasta to Scott	*Pm*+	6/10	7/10	6/10	10/10		10/10		9/10							48/60
	Clinical	0/10	3/10	6/10	5/10		7/10		8/10							29/60
Salmon to Trinity	*Pm*+					9/10		5/9		8/10	2/2			5/10		29/41
	Clinical					5/10		2/9		6/10	1/2			0/10		14/41
Klamath Estuary	*Pm*+							8/10		6/11		9/10	8/10		8/10	39/51
	Clinical							7/10		2/11		0/10	2/10		1/10	12/51
Total	*Pm*+	6/10	7/10	6/10	10/10	9/10	10/10	13/19	9/10	14/21	2/2	9/10	8/10	5/10	8/10	116/152
	Clinical	0/10	3/10	6/10	5/10	5/10	7/10	9/19	8/10	8/21	1/2	0/10	2/10	0/10	1/10	55/152

Table 4. Incidence of *C. shasta* and *P. minibicornis* infection in Chinook salmon captured in either the lower (North Fork Trinity to confluence with Klamath) or upper (Lewiston Dam to North Fork Trinity) reaches on the Trinity River. Screening for the parasites was performed by QPCR of a combined kidney and intestine sample for individual fish.

Week	27 May	27 May	3 June	3 June	24 June	8 July	Total
Reach	Lower	Upper	Lower	Upper	Lower	Lower	
Cs incidence	0/31	0/30	1/30	3/30	1/30	0/30	5/181
Pm incidence	0/16	4/17	0/16	NA	14/16	13/18	31/83

Ceratomyxa shasta was detected by QPCR in 68% (70/103) of CWT marked IGH smolts as early as 6 days post hatchery release (Figure 3). Incidence of *C. shasta* infection by QPCR in IGH smolts peaked at 100% (30/30) in the 5th week following release. Overall prevalence of *P. minibicornis* infections was 83% (69/83), reached 100% (2/2) by the third week following release, and remained high through the last IGH smolt recovery 12 weeks after hatchery release.

Ceratomyxa shasta was detected by QPCR in 13.6% (45/332) of the TRH smolts recovered in the Lower Klamath River. Infected fish were detected in the Klamath River within 3 weeks of release (Figure 4). Incidence of *C. shasta* infection by QPCR in TRH smolts peaked at 46% (12/26) 5 weeks after release and decreased beginning the 6th week. *Parvicapsula* infections were detected in 57.7% (191/331) of the TRH smolts recovered in the Lower Klamath River. Incidence of infection peaked in the 5th and 11th weeks after Trinity River Hatchery release at 85% (22/26) and 100% (5/5), respectively.

Interannual Comparisons

Compared to studies performed in 2004, 2005 and 2006 (Nichols and Foott 2006, Nichols et al. 2007, Nichols and True 2007), the incidence of *C. shasta* by histology was below average, and incidence of *P. minibicornis* was above average in juvenile Chinook (Table 5 and 6).

Coho Salmon

QPCR Assay

Ceratomyxa shasta was detected in 48% (25/52) of natural young-of-the-year (YOY) coho, and no infections (0/26) were detected in the yearling juvenile coho. The first detection of *C. shasta* occurred the week of 13 May, and the majority of *C. shasta* infected coho were captured during mid to late May in the Shasta to Scott reach (Table 7).

Parvicapsula minibicornis was detected in 65% (20/31) of natural YOY coho, and 71% (17/24) of yearling juvenile coho. The first detection of *P. minibicornis* by QPCR occurred the week of 29 April, and the majority of *P. minibicornis* infected coho were captured from early May through early June in the Shasta to Scott reach (Table 7).

Table 5. Comparison of *Ceratomyxa shasta* prevalence in juvenile Klamath River Chinook from 1994-2006 assayed by histology. Percentages indicate proportion of the total samples (N) in which the parasite was detected (Infected) or had an intestinal lesion associated with an infection (Clinical). Only fish sampled in May-July and captured above the Trinity confluence were included to aid comparisons between years.

	1994-2002	2004	2005	2006	2007	Average 2004-2007
Infected	20%-50%	34%	35%	21%	21%	28%
Clinical	n/a	23%	21%	18%	15%	19%
N	156	735	134	112	81	n/a

Table 6. Comparison of *Parvicapsula minibicornis* prevalence in juvenile Klamath River Chinook from 1995-2006 assayed by histology. Percentages indicate proportion of the total samples (N) in which the parasite was detected (Infected) or had an intestinal lesion associated with an infection (Clinical). Only fish sampled in May-July and captured above the Trinity confluence were included to aid comparisons between years.

	1995-2002	2004	2005	2006	2007	Average 2004-2007
Infected	47%-88%	77%	92%	58%	81%	77%
Clinical	n/a	37%	65%	29%	53%	46%
N	176	731	134	112	81	n/a

Table 7. Incidence of *C. shasta* and *P. minibicornis* infection in young-of-the-year (YOY) and yearling Coho salmon captured in the Klamath River between the Shasta and Scott Rivers. Screening for the parasites was performed by QPCR of a combined kidney and intestine sample.

	C. shasta		*P. minibicornis*	
Week Beginning	**YOY**	**yearling**	**YOY**	**yearling**
15 April		0/2		0/2
22 April		0/3		0/3
29 April	0/1	0/5		1/3
6 May	0/6	0/14	2/6	14/14
13 May	11/16	0/2	2/2	1 / 2
20 May	6/7		5/5	
27 May	4/5		5/5	
3 June	2/5		4/4	
10 June	1/2		2/2	
17 June	1/6		0/6	
24 June	0/4		0/1	
Total	**25/52 (48%)**	**0/26**	**20/31 (65%)**	**17/24 (71%)**

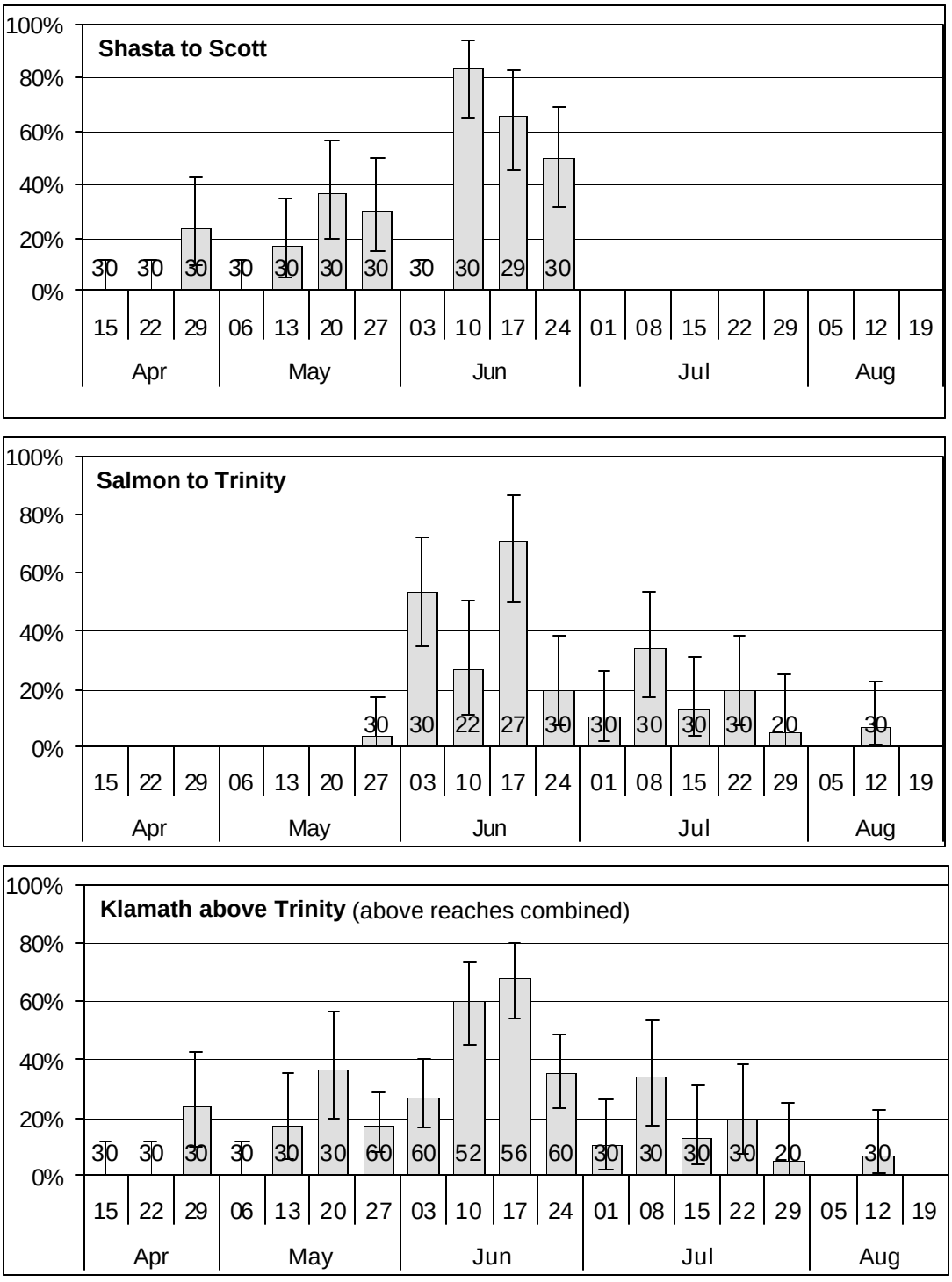

Figure 1. Incidence of *Ceratomyxa shasta* infection assayed by QPCR in juvenile Chinook salmon. Fish were captured in two reaches of the Klamath River above the Trinity River confluence (Shasta R. to Scott R., Salmon R. to Trinity R.) during the spring and summer of 2007. Sample number (n) is listed near the base of each bar. Whiskers indicate 95% confidence interval.

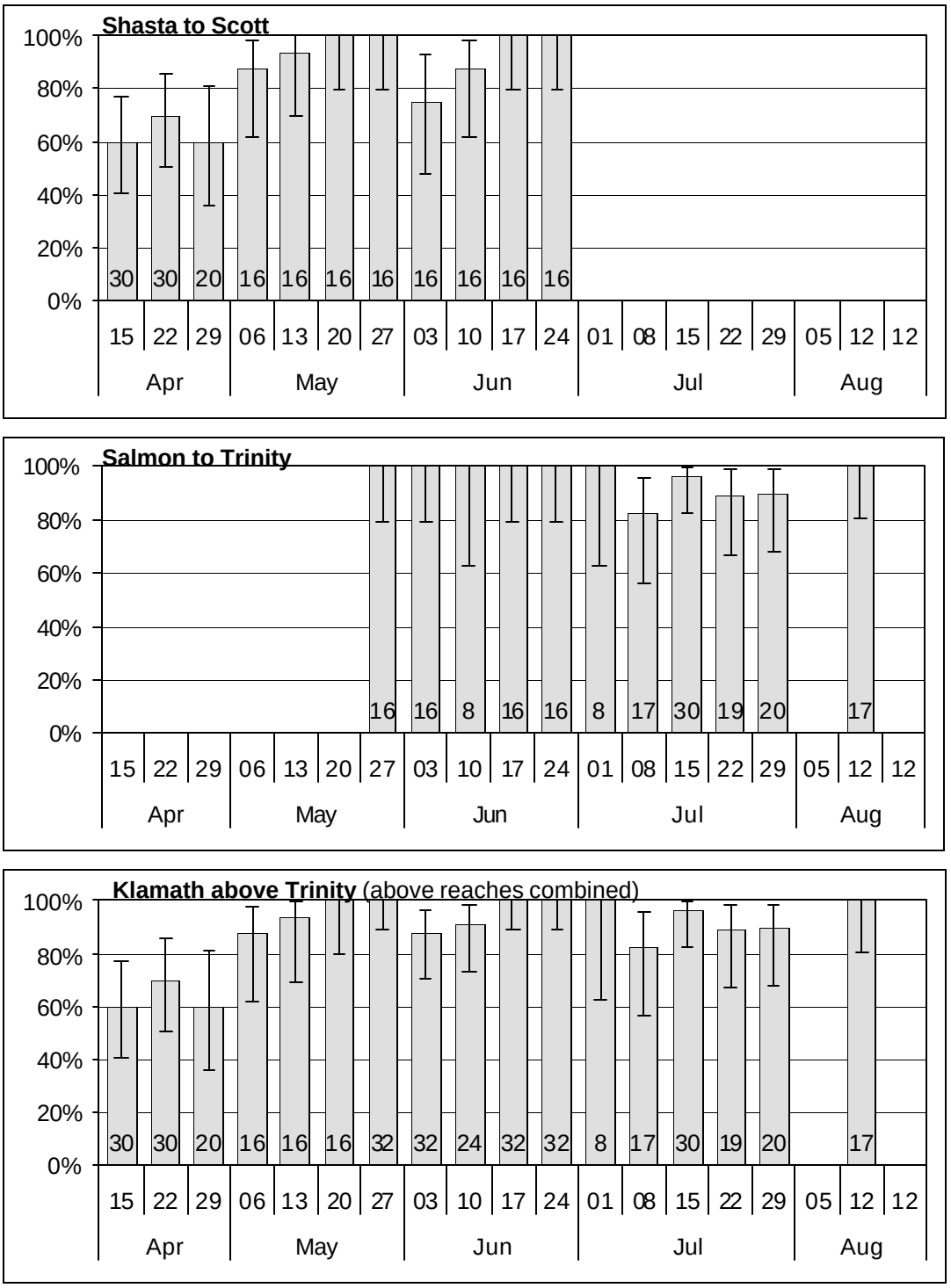

Figure 2. Incidence of *Parvicapsula minibicornis* infection assayed by QPCR in juvenile Chinook salmon. Fish were captured in two reaches of the Klamath River above the Trinity River confluence (Shasta R. to Scott R., Salmon R. to Trinity R.) during the spring and summer of 2007. Sample number (n) is listed near the base of each bar. Whiskers indicate 95% confidence interval.

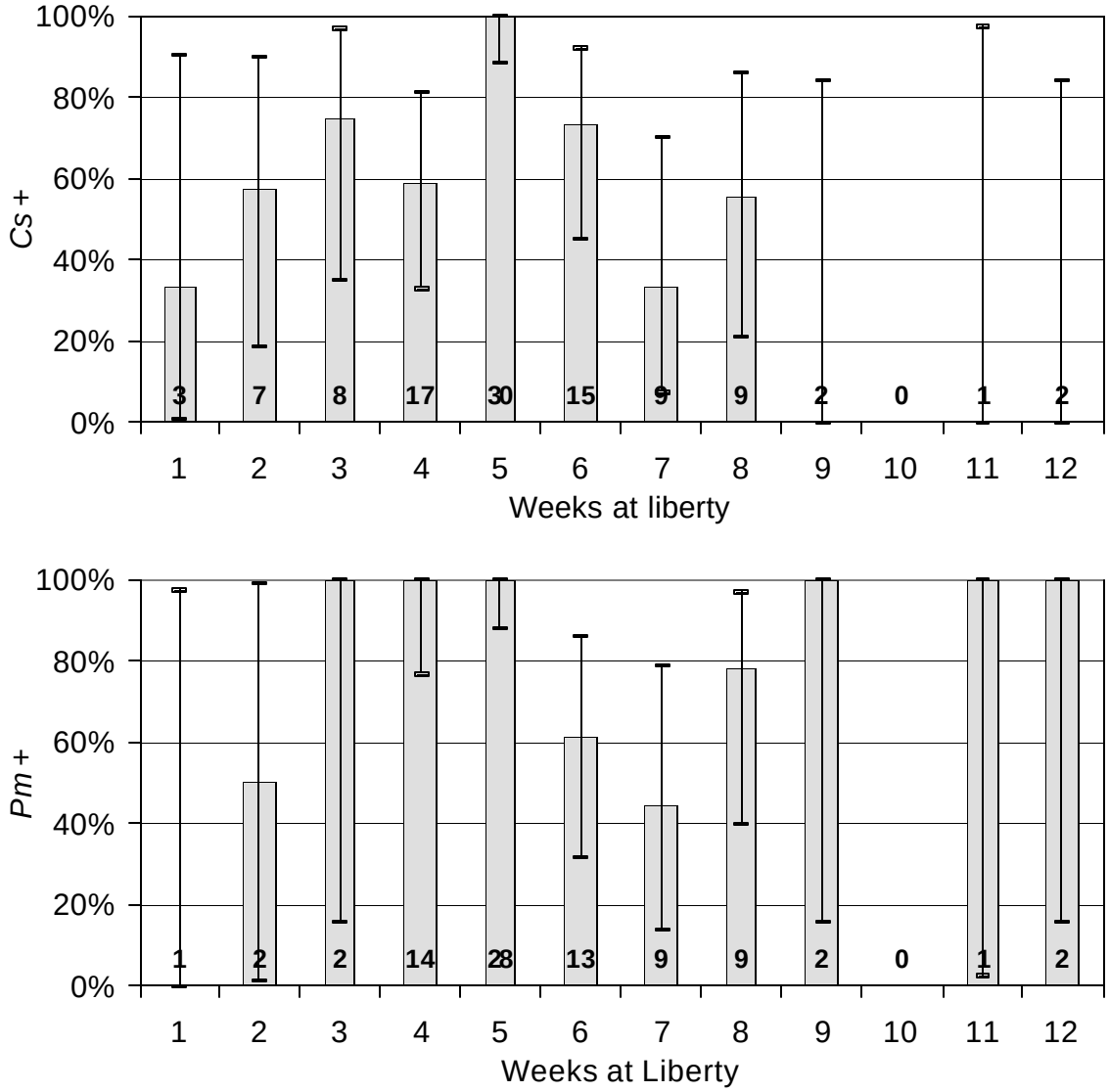

Figure 3. Prevalence of *Ceratomyxa shasta* (*Cs*) and *Parvicapsula minibicornis* (*Pm*) infections in Iron Gate Hatchery origin CWT juvenile Chinook assayed by QPCR. Fish were recaptured in the Klamath River from Iron Gate Dam to the estuary from 1-12 weeks after hatchery release (Weeks at Liberty). Sample number (n) is listed near the base of each bar. Whiskers indicate 95% confidence interval.

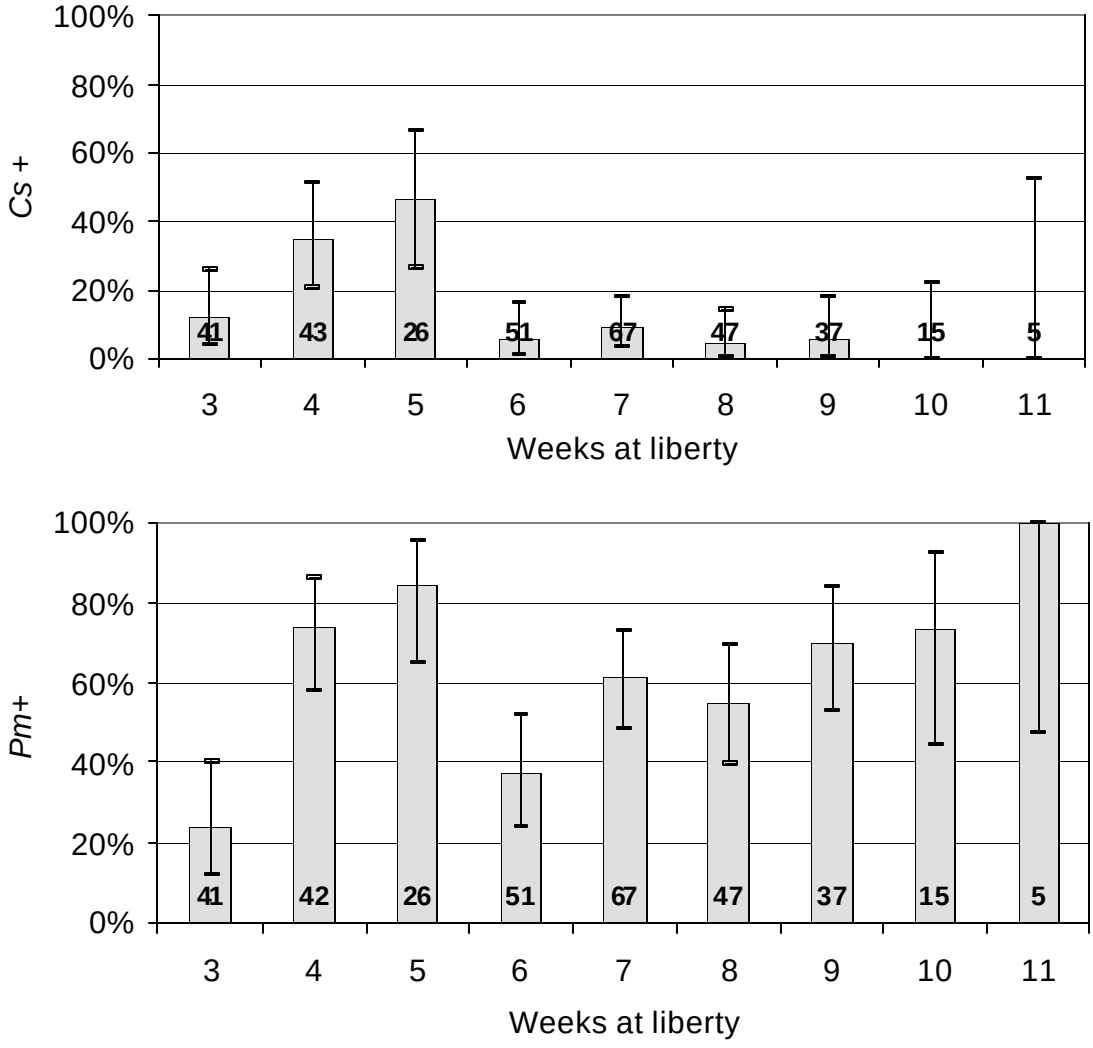

Figure 4. Prevalence of *Ceratomyxa shasta* (*Cs*+) and *Parvicapsula minibicornis* (*Pm*+) infections in Trinity River Hatchery origin CWT juvenile Chinook assayed by QPCR. Fish were recaptured in the Klamath River below the confluence with the Trinity River from 3-11 weeks after hatchery release (Weeks at Liberty). Sample number (n) is listed near the base of each bar. Whiskers indicate 95% confidence interval.

DISCUSSION

Mortality due to infection

The pattern of incidence of both *C. shasta* and *P. minibicornis* indicates moderate mortality in juvenile salmon out-migrating from the Klamath River in 2007. Infection prevalence (particularly *C. shasta*) declined following the peak of infection suggesting a loss of infected fish from the population. It was possible the decline in infection prevalence was due to the influx of uninfected fish from tributaries. However, the loss of infected fish over time was also evident in CWT marked IGH smolts. This similar pattern of infection incidence in known (CWT) and unknown (unmarked) origin fish was most likely due to disease associated mortality in both groups. Past sentinel studies where Chinook salmon were exposed for 72 hours in the Shasta to Scott reach resulted in 82% mortality in less than three weeks at 16ºC, and mean survival time decreased at warmer water temperatures (Udey et al. 1975; Foott et al. 2004).

Prognosis of *Ceratomyxa* and *Parvicapsula* infections

Low survival was expected from fish diagnosed with *C. shasta* infection by histology. No signs of recovery from the *C. shasta* infections were observed in intestines examined by histology during this study (data not shown). This suggests that a significant portion of the infected fish develop debilitating disease before reaching the ocean.

The prognosis of *P. minibicornis* infection in juvenile Chinook salmon is not well understood and is an important question given the high prevalence of infection. We have observed signs of healing and recovery even in severe *P. minibicornis* infections by histology (intact nephrons in clinically infected fish, data not shown). Fish may have recovered if they survived the anemia and osmoregulation problems associated with glomerulonephritis.

The high prevalence of *P. minibicornis* infections results in nearly all *C. shasta* infected fish having dual infections. We speculate that nephron inflammation (due to *P. minibicornis*) and intestinal hemorrhage (due to *C. shasta*) would act synergistically to increase the risk of lethal disease in dual infected fish.

Residence time and infection prevalence

Marked hatchery fish allowed us to relate the residence time in the river to the infection rates for both IGH and TRH origin juvenile Chinook. *Ceratomyxa shasta* was detected in recaptured IGH smolts within the first week following release from the hatchery. Iron Gate Hatchery Chinook were not inspected before release in 2007, so the pre-release infection prevalence was unknown. These early infections may represent infections acquired either in the hatchery or soon after release. The incidence of *C. shasta* infection among IGH smolts peaked within 5 weeks of release. The decline in infection prevalence beginning 6 weeks after hatchery release was likely due to mortality of infected fish. Over half of the IGH smolts sampled were *C. shasta* infected during their 190 mile out-migration. The incidence of *P. minibicornis* infections in IGH smolts jumped to 100% within 3 weeks of hatchery release and remained high through the last IGH smolt recaptures. A similar trend was observed in 2006 and 1995 IGH smolts out-migrants (Nichols and True 2007; Foott et al. 1999). These IGH smolts could be viewed as surrogates for naturally produced tributary smolts (i.e. Bogus Creek, Shasta River,

Scott River) out-migrating through the Klamath. The disease risk to parr rearing in the Klamath prior to out-migration was likely higher.

Among TRH smolts, overall incidence of *C. shasta* was low (13%) and *P. minibicornis* was moderate (58%). Infection trends were similar to that seen in IGH smolts with peak infection 5 weeks after hatchery release and a decline in incidence beginning 6 weeks following release. While this may be due to mortality of infected fish as observed in IGH smolts, this decline in incidence may also be due to large numbers of TRH smolts leaving the Trinity and migrating quickly through the Lower Klamath without having time to become infected.

Conclusions

This study indicates *C. shasta* prevalence was below average and *P. minibicornis* prevalence was above average for May-July of 2007 compared to previous Klamath fish health monitoring studies (Nichols and Foot 2006; Nichols et al. 2007; Nichols and True 2007). Naturally produced Chinook became infected with both parasites while rearing in the mainstem Klamath during March and April, but the incidence remained low during this period in 2007. Both parasites were found in naturally produced young of the year coho salmon rearing within the mainstem Klamath, and the incidence of *C. shasta* in young of the year coho appears greater than for Chinook during May. Infection prevalence in coded wire tagged smolts from both hatcheries peaked the 5th week following release and subsequently declined. This was seen as indicative of a loss of infected IGH smolts. With lower incidence of infection for both parasites and the ability to move quickly through the Lower Klamath, Trinity smolts faired better than their Klamath cohorts.

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AUTHOR ROLES

The contributions of each author have been summarized below.

- Ken Nichols – project coordination, study design, data management, histology analysis, assembly and editing of final report
- Kimberly True – QPCR methods, QPCR QA and QPCR data certification
- Ryan Fogerty – necropsy, field collection coordination, histology processing, DNA extraction, preparation and preliminary analysis of results, tables and figures
- Lisa Ratcliff – necropsy, DNA extraction, QPCR assay

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APPENDIX
Paraphrased Reviewer's Comments

Comment: Both parasites were detected in the first week after hatchery release from IGH. Was pathogen screening conducted at IGH or TRH prior to release.
Authors' Reply: No pathogen screening was conducted in either hatchery population prior to release; however, from previous studies and ongoing work conduced in 2008 it is known that hatchery fish can have light infections of both parasites. The text was changed to reflect this possibility.

Comment: Figures 1 and 2 present weekly pathogen incidence above the Trinity confluence. Is there similar data for fish captured below the Trinity?
Authors' Reply: Only CWT Chinook were collected in the Klamath below the Trinity. Above the Trinity both CWT and random unmarked Chinook were collected. Only the random Chinook were included in estimates of parasite incidence.

Comment: Previous sentinel studies were discussed. It should be noted how long fish were exposed so readers can get a sense of how long it takes for fish to become infected with lethal doses of the pathogens.
Authors' Reply: The study referenced in the discussion used a 72 hour exposure period. This has been added to the text.

Comment: Any explanation for the huge difference in *Cs* vs *Pm* infection prevalence in TRH CWT smolts?
Authors' Reply: The prevalence of *Pm* was higher than *Cs* in all groups. This difference may have been larger in the Trinity origin Chinook, but we do not have data to indicate why at this time. No changes were made to the text.

Comments: Any thoughts on why there was such a steep decline in infection prevalence 5 weeks after hatchery release in TRH fish compared to IGH fish?
Authors' Reply: The text was changed to suggest TRH smolts could escape infections if they moved quickly through the Lower Klamath.

Comment: The QPCR assay is semi-quatitative. Why have you chosen to report the incidence of infection but not the severity of the infections by QPCR?
Authors' Reply: The histology assay has been rated using a similar system for the last 4 years and that data was presented to describe the severity of the infection. The methods used in tissue collection and digestion were modified each year to optimize the QPCR assay. More work is needed to identify the levels of infection by QPCR associated with disease and mortality. As the assay is developed we plan to report the levels and prognosis of the infections.

Comment: Was the same histology methodology used in previous years? It would be useful to reference it.

Authors' Reply: Yes, a similar methodology has been used for histology since 2004. The text of the methods section has been changed to reflect this and reference the earlier studies.

Comment: Results report trends at sites, but no discussion of differences or trends across sites was presented.
Authors' Reply: Since the fish were migrating downstream comparisons between sites would essentially be a discussion of trends over time. For trends over time the best data available was CWT marked Chinook since these fish had a common origin and known release date. No changes were made to the text.

Comment: Text refers to the average incidence of infection and references tables 5 and 6. The tables do not support easy interpretation of this.
Authors' reply: The tables have been changed to include a simple average of 2004-2007.

Comment: Are you inferring that the histology fish are useful to examine proportions of the population that are clinical? Should you recognize that fish captured for histology may have been those that are the easiest to capture?
Authors' reply: It was necessary to keep sample collection simple to avoid unnecessary burdens on field crews; the collection of fish for the histology and QPCR assays was performed randomly. Any bias was likely due to our stated capture methods. The capture methods did not change significantly, and any bias would remain throughout the study.

Comment: Using OSU's water sampling results might strengthen the conclusion that infected fish were dying in June resulting in the declining prevalence of infection and clinical disease.
Author's reply: The focus of this report was to describe the data we collected. The OSU spore count data would be interesting to correlate with our disease data. The OSU's data speaks to a specific time and place where the fish became infected. Mortality would follow by several weeks and we do not know where the fish spent that time which would complicate any correlation of the data sets.

ATTACHMENT 17

Letter to FERC from the Pacific Fishery Management Council (PFMC) dated April 24, 2006

This letter is a Secured File that cannot be electronically attached to this Master Document, but will be submitted for the record separately. It is incorporated herein by reference and may also be obtained directly from the Pacific Fishery Management Council's web site at:

http://www.pcouncil.org/habitat/habdocs/FERC_Klamath_M_Salas.pdf

PACIFIC FISHERY MANAGEMENT COUNCIL

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April 24, 2006

Ms. Magalie R. Salas, Secretary
Federal Energy Regulatory Commission
888 First St., N.E., Room 1A
Washington, DC 20426

RE: Docket Number P-2082 (Pacific Fishery Management Council's Essential Fish Habitat [EFH] Recommendation for the Klamath Hydropower Project)

Dear Ms. Salas:

The Pacific Fishery Management Council (Council) hereby submits its EFH recommendations and formal comments on the relicensing of the PacifiCorp hydroelectric project on the Klamath River. The recommendations are the result of focused deliberation at the Council's March and April meetings, including extensive public testimony and expert advice from scientific and fishery-related advisory bodies. We understand that we may have missed a recent deadline for these comments, but due to the timing of the established public Council process, this is the earliest we are able to provide them. We ask that you give them your full consideration.

For the reasons below, the Council recommends that the Federal Energy Regulatory Commission (FERC) order the decommissioning and removal of Iron Gate, Copco 1, Copco 2, and J.C. Boyle dams on the Klamath River. We ask that you proceed with the development of a decommissioning plan, in consultation with resource agencies, tribes, and other interested parties, that provides full restoration of habitat in and below the project dams and reservoirs. FERC should also consider including mitigation funds to restore future anadromous habitat above the project.

This recommendation is consistent with National Marine Fisheries Service's (NMFS) recommendation pursuant to Section 10(a) of the Federal Power Act (FPA): "The Licensees shall develop and implement a plan to remove the lower four Project dams..., restore the riverine corridor, and bring upstream and downstream fish passage facilities at Keno Dam into compliance with NMFS guidelines and criteria within 10 years of license issuance, expiration, or surrender."[1, 2]

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[1] National Marine Fisheries Service (March 24, 2006). Letter and Attachments from Rodney McInnis to Magalie Salas re: *Comments, Recommended Terms and Conditions and Preliminary Prescriptions for the Klamath Hydroelectric Project, FERC Project 2082*. Page C-4.

[2] We understand that the Keno and Link Dams are not currently being relicensed, and are limiting our recommendations at this time to the four lower dams. However, in the long term, the Council calls upon FERC to improve conditions for anadromous fish in the Klamath River by addressing the operations of Keno and Link Dams.

Background

During the last several years, the Council has written frequently to FERC, the U.S. Bureau of Reclamation, and the U.S. Department of the Interior regarding impacts of Klamath River management on salmon habitat.[3] Although anadromous fish stocks fluctuate naturally, it is now clear that factors associated with hydropower generation, including lack of fish passage and water quality impacts, have had a consistent and increasingly detrimental impact on Klamath River salmon. The Council believes the operations of the full complex of dams in the Klamath River basin can be the limiting factor for anadromous salmonids abundance, and are likely the controlling anthropogenic factor during drought years. Therefore, we believe changes in the effects of these dams offer the greatest opportunity to increase population abundance.

The Council's concerns about dam operations have been heightened in recent years by the low abundance of naturally spawning fall Chinook salmon. As you may know, ocean salmon fisheries on the West Coast target a complex of stocks from various rivers that have consistently produced harvestable surpluses. Under the Council's salmon fishery management plan, fisheries in this ocean complex are managed to achieve the spawning objective of the weakest stock, which has frequently been Klamath River natural fall Chinook. In 2004 and 2005, abundance was so low that the spawning escapement fell below the 35,000 conservation objective in both years. Unfortunately, in 2006 it is expected that the Klamath natural fall Chinook stock abundance will fall even further, to a disastrously low level.

In 2005, fishing off most of Oregon and California was virtually halved to meet the Klamath River fall Chinook natural spawning objective. This year, ocean salmon fishing in this area will be cut back a further 75% to protect these fish. The inriver recreational fishery on adult fall Chinook will be closed in 2006. Inriver tribal fisheries will also be severely affected. The cutbacks and closures adopted by the Council to protect these Klamath River fish will have enormous economic and social impacts on West Coast fishing communities. The effects are so severe that the Governors of the States of Oregon and California have formally called for the Secretary of Commerce to declare a fishery disaster, as provided for under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) §312(a).

Basis for Council Recommendation

There is both a legal basis for the Council's recommendation and a strong rationale to justify it. Legal standing for the Council's recommendation is provided by the MSA. Under §305(b)(3)(B), the Council is obligated to comment on activities that are likely to substantially affect EFH for salmon.[4] In turn, the Federal government is obligated to consider the Council's recommendations and to reply

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[3] December 15, 2005, to U.S. Bureau of Reclamation (BOR) on management of Klamath water flows; April 21, 2005 to U.S. Department of the Interior (DOI) on flow management and essential fish habitat (EFH) in the Klamath basin; April 23, 2004 to FERC on EFH concerns related to PacifiCorp Klamath River Hydroelectric Project FERC-2082; July 7, 2003 to BOR on EFH concerns related to the Klamath project; April 23, 2003 letter to the DOI related to water flows in the 2003 Klamath operations plan; April 22, 2003 to FERC on relicensing rules; December 4, 2002 to the DOI and Secretary of Commerce on the adverse impacts of reduced flows to Klamath salmonids; May 13, 2002 to FERC on EFH conservation responsibilities; April 22, 1999 to BOR on the Klamath project environmental impact statement. Letters available at http://www.pcouncil.org/habitat/habdocs.html.

[4] "[Each Council] shall comment on and make recommendations to the Secretary and any Federal or State agency concerning any such activity that, in the view of the Council, is likely to substantially affect the habitat, including essential fish habitat, of an anadromous fishery resource under its authority." MSA§305(b)(3)(B)

in writing within 30 days.[5] The rationale for the Council's recommendation includes the Council letters and background considerations referred to above and the information provided below.

We understand that the Klamath hydropower project is now operating under an annual license, and that any new long-term license may be in effect for up to 50 years. The Council does not make recommendations for interim annual licenses in this letter, though we believe that until a long-term license is granted, FERC should protect and fully mitigate damages to anadromous salmonids and their habitat with the dams in place. Some recommendations from others, such as those provided by NMFS and U.S. Fish and Wildlife Service pursuant to Section 10(j) of the Federal Power Act for interim modifications to hatchery management and ramping rates, may be appropriate. However, the Council will address recommendations for interim licenses in a separate letter following further public process and discussion.

The Council's recommendation for dam removal is made with the recognization that several factors beyond FERC's jurisdiction can harm Klamath River anadromous stocks.[6] Water withdrawal practices reduce water availability downstream, and timber harvest practices, road building, parasites, and other factors impact stocks. We further recognize that some recommend fish passage at the project dams instead of their removal.

The Long Range Plan for the Klamath River Basin Conservation Area Fishery Restoration Program clearly identifies the lack of passage through and beyond the project area as a significant limitation on the Klamath River anadromous fish resource[7]. Under the current license, the lower three project dams (Iron Gate, Copco 1 and Copco 2) are not equipped with fish passage facilities, and the facilities at J.C. Boyle Dam do not conform to accepted passage criteria. PacifiCorp's proposed license under FERC does not provide passage for anadromous fish.

Lack of fish passage at the Klamath Project facilities blocks access to more than 400 miles of migration, spawning, and rearing habitat for salmon, steelhead and Pacific lamprey, including access to channel areas inundated by the project, access to tributary habitat within the project area, and access to currently-blocked habitat in the upper watershed[8]. The habitat within and above the project area was historically an important producer of spring Chinook, fall Chinook and coho. Reintroducing anadromous fish above the current barrier of Iron Gate Dam is a key component of Klamath River Basin restoration. We understand significant resources are now being directed toward improving potential habitat in the Upper Klamath Basin above Upper Klamath Lake.

Even with fish passage at each of the projects, the following dam-related problems within and below the project area would remain unaddressed:

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[5] "Within 30 days after receiving a recommendation under subparagraph (A), a Federal agency shall provide a detailed response in writing to any Council commenting under paragraph (3) and the Secretary regarding the matter. The response shall include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on such habitat..." MSA§305(b)(4)(B)

[6] National Research Council (2004). *Endangered and Threatened Fishes in the Klamath River Basin – Causes of Decline and Strategies for Recovery*. Washington, D.C.: U.S. Department of Interior and U.S. Department of Commerce.

[7] Klamath River Basin Fisheries Task Force and William M. Kier Associates, 1991. *Long Range Plan for the Klamath River Basin Conservation Area Fishery Restoration Program.*

[8] We recognize that Keno dam, upstream of the project area, now blocks most upper watershed habitat for anadromous salmonids.

- Loss of spawning and rearing area in the Klamath River between Iron Gate and J.C. Boyle dams
- Effects of hydroelectric peaking operations, including reduced flows in bypassed reaches; effects of large flow fluctuations in peaking reaches; reduced abundance of macroinvertebrates; restricted fish movement; decreased water quality; and fish stranding
- Impacts of water impoundment, including changes to water temperature, dissolved oxygen, and nutrient loads; gravel depletion; altered flood flows; and enhanced conditions for toxic algae blooms and parasitic disease vectors
- Alteration of the natural hydrologic regime, including loss of thermal refugia and ecosystem function

In summary, the Council believes removal of the dams is a necessary step in recovering currently unsuitable habitat in the project reach, in providing access to suitable habitat upstream of the project, and in normalizing water conditions below Iron Gate Dam.

Costs and Benefits

The value of ocean fisheries is high when Klamath natural Chinook are abundant, but can be much lower when Klamath fish constrain the catch of other healthy stocks. The Council estimates that between 1970 and 2004, the average annual personal income impacts of the recreational and commercial ocean salmon fishery in the area where Klamath fish are found amounted to $92 million. The constraints on the fishery in 2006 caused by the need to protect Klamath River natural fall Chinook are expected to reduce the value of this fishery to less than $33 million. In contrast, the Klamath hydropower project produces 163 megawatts with an annual net economic value of $16.3 million.[9] NMFS notes that the "generating capacity provided through continued Project operations is nominal...relative to the watershed level of benefits to aquatic resources and regional and national priorities for restoring anadromous salmonids."[10] The California Energy Commission reviewed the effects of full or partial decommissioning and concluded that "because of the small capacity of Klamath hydro units... removal of these units will not have a significant reliability impact on a larger regional scale."[11]

Providing fish passage would be a major endeavor, with cost estimates ranging up to $200 million.[12] The cost of dam removal has been estimated at $35.8 million.[13] Based on these estimates, it is not clear that providing fish passage is a superior economic alternative to dam removal.

It may not be appropriate to directly compare the loss of $59 million in the ocean salmon fishery in one year, due to the low abundance of Klamath River Chinook, with the $16.3 million in power generated annually at the four project dams and the $35.8 million cost of dam removal. However, it may well be that the annual value of the portion of the fishery affected by Klamath River Chinook compares favorably to the annual value of the electrical power. It may also compare favorably with the cost of dam removal, given the number of years that fishery benefits will accrue after the dams

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[9] California Energy Commission (2004). California Energy Commission Staff Comments on PacifCorp's Final License Application to the FERC for the Klamath Hydroelectric Project, FERC No. 82.
[10] National Marine Fisheries Service (March 24, 2006), op. cit.
[11] California Energy Commission, op. cit.
[12] PacifiCorp spokesman Dave Kvamme in "A Good Week for Klamath Salmon." *Sacramento Bee*, March 30, 2006, page A3.
[13] G&G Associates (2003). *Klamath River Dam Removal Investigation.* Seattle, Washington: G & G Associates.

are removed. Further, it must be noted that a comprehensive economic analysis of the benefits of dam removal needs to include the benefits of habitat improvement to all Klamath River fish populations, not merely one stock (naturally spawning fall Chinook) in one fishery (the ocean salmon fishery).

Conclusion

The Council believes the proposed relicensing of this project will have substantial adverse impacts on EFH in the Klamath River. The project causes harm to salmon habitat; to the health of fish stocks; to commercial, recreational, and tribal fisheries; and to fishing communities along the Oregon and California coasts and in the Klamath River basin. Consequently, the Council recommends that FERC order the immediate decommissioning and removal of the four lower Klamath River dam structures and full restoration of habitat affected by the dams and reservoirs.

Sincerely,

Donald O. McIsaac
Executive Director

JDG:rdd

c: Council Members
Habitat Committee
FERC Required Service List Distribution
Salmon Advisory Subpanel
Salmon Technical Team
Scientific and Statistical Committee
Dr. Donald McIsaac
Dr. John Coon
Council Staff Officers
Ms. Eileen Cooney
Ms. Jane Hannuksela
Ms. Mariam McCall
Mr. Judson Feder
Ms. Corinne Pinkerton
Mr. Phil Dietrich

Thaler, Parker@Waterboards

From: corrrinanadmarc <corrinaandmarc@rollingrivernursery.com>
Sent: Wednesday, February 01, 2017 2:46 PM
To: Thaler, Parker@Waterboards
Subject: Comments on the EIS for the Lower Klamath dam removal.

Dear State Water Resources Control Board,

We are writing as residents and business owners who have been living and raising our family on our Klamath river property for the last 20 years.
Due to the terrible water quality we experience in the river every summer we ask that you do everything possible to insure the speedy removal of the four Klamath river dams slated.

Please issue a water quality certification for the dam removal in time for the Federal Energy Regulatory Commission to approve dam removal by 2020.

The 2012 joint California and Federal EIR/EIS reached the correct conclusion. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies of dam removal, all of which be incorporated into the new EIR.

New scientific information produced since 2012 supports the conclusions of the 2012 EIR/EIS.

The water Board should analyze long term beneficial impacts of dam removal, not just the near term adverse impacts addressed in the notice for scoping meetings. Research on the recently removed Elwha dams in Washington state are showing many immediate and ongoing improvements in the river environment. We ask that you move quickly so these positive affects can begin on our beloved Klamath river soon. The salmon can not hold out much longer with the current water conditions.

Also, if you could please add us to the email notification list at the address above that would be great.

Thank you for your help in this matter.

Sincerely,

Marc Robbi Corrina Cohen Rolling River Farm and Nursery
PO Box 332 Orleans, CA 95556
530-627-0012

Thaler, Parker@Waterboards

From: Kristen Sellmer <fisheries@srrc.org>
Sent: Wednesday, February 01, 2017 4:58 PM
To: Thaler, Parker@Waterboards
Cc: Petey Brucker; Karuna Greenberg; Lyra Cressey
Subject: LKP Scoping Comments

Thank you for the opportunity to comment about the environmental impact report for the proposed Lower Klamath Project license surrender. Please consider the following recommendations from the Salmon River Restoration Council.

Rely on 2012 EIS / EIR The 2012 Environmental Impact Statement / Environmental Impact Report (EIS / EIR) was based upon exhaustive studies, data and public comments. We respectfully request that SWRCB rely upon, rather than duplicate this analysis. Please consider the 2012 EIS / EIR, and all studies it addressed, as part of the record for the current proceeding.

Range of Alternatives: We support your consideration of a "range of alternatives" as stated in the notice and required by CEQA. However, please consider that a "no project" alternative would be hypothetical since PacifiCorp has withdrawn its request to certify a new dam operation license. Furthermore, as you address the range of alternatives, please disclose the fact that the Lower Klamath Hydroelectric Project has long been operating in violation of the Clean Water Act, and potentially other state and federal laws. Finally, we request that you analyze the option of removing J.C. Boyle and Keno Dams due to their clear adverse impacts on California water quality and beneficial uses of water.

Natural Baseline Conditions: The "baseline" for EIR comparisons should be natural baseline conditions that existed before the Klamath Hydroelectric Project dams were constructed, and which would presumably exist without the dams in place today.

Fully Analyze Long-Term Beneficial Impacts: The scoping notice identifies negative impacts of dam removal, but does not adequately address the range of positive long-term impacts. We request that you fully analyze long-term beneficial impacts of dam removal for fisheries, water quality, public health and the regional economy.

Geographic Scope: For the purpose of analyzing cumulative impacts of various alternatives, the project area must include all impacts on salmon-dependent communities in the Klamath Management Zone. This area extends at least from Shelter Cove, CA to Humbug Mountain, OR and offshore out to 200 miles. Information Produced Since 2012 Information made available since 2012 further supports the conclusions of the 2012 EIS / EIR. We specifically request that you incorporate new data and studies produced jointly by the Yurok, Karuk and Hoopa Tribes that address the role of dams in the high infection rates of Ceratonova shasta parasite among of juvenile salmonids. Timeline The proposed project includes both physical facilities removal and a time element. Facilities removal will begin by January 1, 2020 pursuant to the amended KHSA, which the KRRC is implementing pursuant to license transfer and surrender applications. This timeline is an integral part of the overall project. As such, we request that SWRCB complete the EIR and make a final water quality certification decision on a schedule that preserves the timeline described in the amended KHSA.

Thank you for your consideration of these comments.
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Kristen Sellmer
Fisheries Program Coordinator
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Salmon River Restoration Council - srrc.org
PO Box 1089
Sawyers Bar, CA 96027
530-462-4665
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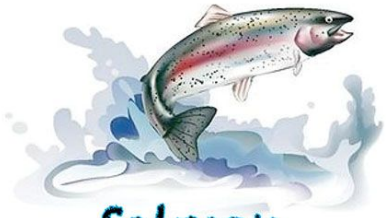
Save the Klamath-Trinity



Salmon

Mr. Parker Thaler
State Water Resources Control Board
Division of Water Rights Water Quality Certification Program
parker.thaler@waterboards.ca.gov
via email

RE: Scoping Comments on Application for Water Quality Certification Pursuant to Section 401 of the Federal Clean Water Act for the Relicensing of the Klamath Hydroelectric Project (FERC No. 2082)

Dear Mr. Parker and Board members,

Please accept the following comment letter related to the current application to provide a 401 certification to take down four of the Klamath River dams from Save the Klamath-Trinity Salmon. We support this application and urge the water board to process and approve the application as quickly as the state CEQA process will allow. This process has been delayed for almost ten years while the serious water quality violations stemming for these dams have rendered the Klamath unsafe and almost unusable for the people and aquatic life of the river. Serious water quality violates have occurred for several months of every year that an abeyance was granted, and will likely continue to occur until these dams are removed.

Years of studies and peer reviewed science surrounding these dams operations have been exhaustive and have proven that the only legal alternative pursuant to state law, is dam removal. All other possible alternatives and mitigations have been explored and found unachievable or to be too expensive to be attainable.

We are also including our January 29th, 2016 comment letter as an attachment, which gives a much more detailed argument for taking down, rather than permitting, the Klamath Dams. The attached letter represents the interests of six groups and thousands of Californians. Our coalition includes environmental interests, the sports fishing industry and fair use of water. We also wish to incorporate by reference the comments of the Pacific Coast Federation of Fishermen's Association, the Karuk Tribe, and the Klamath Riverkeeper.

Our only caveat to supporting this application is that we believe there must be a suitable operations plans, clean-up plan, and a Waste Discharge Report, for the remaining Keno

Reservoir. Keno Reservoir has serious water quality impairments and will limit fish survival and river recovery. A Keno operations and cleanup plan must include a concrete and attainable plan to achieve water quality standards and meet TMDLs. We realize this dam is in Oregon, however it causes serious water quality violations in California, which has state line TMDL allocations, and therefore California has the right and responsibility to address the pollution stemming from this reservoir. Our attached comments go further into the water quality violations at the Keno reservoir.

The remainder of this comment letter will be focused on the impacts from dam removal only and will mainly consist of quotes from dam removal studies or science magazines. Links to referenced studies will be included. They will show that even the fears of short term impacts are overblown and the actual impacts of dam removal and been very short term and less than significant even in dam removal projects with extremely high levels of PCBs and sedimentation.

Please see our attachment comments for all other issues.

Short term impacts verse. Long term benefits of dam removal

Water Quality Impacts From Dam Removal
We request that the board do a thorough analysis of the short term impacts, and long term benefits of dam removal.

"In the past there have been concerns about the short term impacts from sediment plumes as a result of dam removal. Dam removals on the Elwha and White Salmon River, along with dam removals in Florida, Wisconsin, Maine, and Arizona provide a wealth of information on methods to minimize this risk. Studies and observation have shown that rivers have been extremely efficient at moving fine sediments. Related water quality studies have shown temperature and Dissolved Oxygen improvement almost immediately following dam removal, which in turn can have a positive impact on fish disease and attached algae composition.

There are several approaches to sediment mitigation during dam removal. They can range from slow drawdown and complete sediment removal to a quick removal allowing sediment to be washed down river." A discussion of these methods can be found at:"http://repository.usfca.edu/cgi/viewcontent.cgi?article=1137&context=capstone

Until large scale dam removal was initiated in the Pacific Northwest, physical sediment removal was a preferred method of sediment management. This was true until the Condit dam removal in Washington, where a "blow and go" method was used due to monetary concerns. This proved very effective with minimal impacts at the Marmot Dam.

"The results were impressive — but very different at the two sites. At Marmot, the sediment contained an equal mixture of sand and gravel. Once exposed to river action, it eroded out relatively quickly but sedately, with about half of it gone within 8 months. Researchers were surprised to find that the fish seemed little affected — the first curious salmon poked its nose back towards the former dam site within a day. At Condit, the sediment contained a higher proportion of fine-grained material: 35% mud, 60% sand and just 5% gravel. The result was

predictable in retrospect, but nobody anticipated it.

When engineers blew open a hole at the bottom of the dam, a jet of black liquid shot out as if from a giant fire hose. Instead of the expected flood of water, what came out was more like a mudflow, as waterlogged sediment from the reservoir slumped into the rapidly dropping water, then blasted downriver in a slurry that was as much as 28% sediment by volume. The reservoir lost its water and much of its sediment load in three hours. "It was almost like a volcanic event," says Jon Major, a geomorphologist at the USGS's Cascades Volcano Observatory in Vancouver, Washington. The 5-kilometre-long stretch of river between the dam and its confluence with the Columbia River temporarily became a muddy wasteland. With this kind of approach, says East, the slug of sediment wipes out everything, but the river can start recovering much sooner."

http://www.nature.com/news/dam-removals-rivers-on-the-run-1.15636

In the Elwha Dam removal, a more conservative approach was used "Unwilling to risk the blow-and-go approach on both dams, engineers opted for a compromise. They quickly removed the lower, 32-metre-high Elwha Dam, which contained only about one-sixth of the total sediment. But the upstream Glines Canyon Dam, which is twice as big, came out in a series of steps that have so far lowered it to a 9-metre stub of its former self. East compares the method to deciding whether to uncover a wound quickly or gradually. The approach on the Elwha, she says, is like "pulling the Band-Aid off slowly, over the course of three years".
http://www.nature.com/news/dam-removals-rivers-on-the-run-1.15636

Initial findings on sediment movement during dam removal have shown that gravel has migrated slowly, while silt coming out of the Olympic Mountains tended to move quickly downstream and into the Strait of Juan de Fuca. This fine sediment has thus far been found to be beneficial to river mouths. In the removal of the dams from the Elwha River in Washington new sandy beaches were found to be prime habitat for shellfish, which could greatly benefit the commercial and subsistence fisheries in this area. Though benefits of sediment recruitment are already occurring, there are short term impacts to kelp and shellfish beds. As far as short term sediment release, the rivers have proved unexpectedly efficient at flushing the worst of the mud downstream towards the sea, rather than letting it accumulate in river-choking mudflats. It is important to note that the Klamath reservoirs and Klamath River have less sediment-related issues then the sediment-impaired rivers that were removed in Washington. Reports regarding sediment behind the Klamath dams can be found in the Klamath River dams secretarial determination record.

Impacts to Fisheries

We believe that this dam removal project will have limited to no impact on endangered, subsistence, commercial and threatened fisheries if removal is well planned. If well planned, dam removal can mimic a large flood event, which often actually benefit fisheries by scouring out fine sediments and attached algae, providing new habitat.

"Data on the recent dam removals suggest that the fish are now coming back to the unfettered rivers. At Condit, fish were seen returning within weeks of the explosion. Two years later, the total exceeded 5,500, including steelhead and spring Chinook (*Oncorhynchus tshawytscha*),

which had been effectively extirpated from the river," said Jody Lando, a quantitative ecologist with Stillwater Sciences in Portland, Oregon, who reported her results in May at an aquatic-sciences meeting in Portland."
http://www.nature.com/news/dam-removals-rivers-on-the-run-1.15636

"Furthermore, observations have shown that benefits have been almost immediate, with salmon spawning in above-dam tributaries within the first two years that dams were removed for fish entering the river, researchers can barely contain their excitement about last fall's migration of chinook, coho and pink salmon, along with steelhead trout. At least some of every species made it past the spot where the Elwha Dam stood just two years ago."
http://www.kitsapsun.com/news/environment/dramatic-changes-following-elwha-dam-removal-ep-416589177-356243611.html/ For salmon and insect-dependent species, such as the dipper recovery was also almost immediately.

"In one study, the researchers documented that American dippers with access to salmon were in better physical condition and more likely to attempt multiple broods of offspring in a season. They also produced larger female offspring and were more likely to stay in breeding territories year-round. The research, published early online, will appear in an upcoming issue of the journal *Ecography" (https://news.osu.edu/news/2015/12/28/river-ecosystems/)*

"Returning steelhead are not the only signs of success. Just above the old dam site, Coffin winds his way through patches of alder trees that were planted after the dam was removed, then crosses a rocky beach to the river. The rounded stones range from the size of potatoes to loaves of bread, and make for tricky footing. But Coffin is thrilled to see them because none of these ankle-breakers was here when the dam was first taken out. "All of this washed in," he says.

The cobbles provide nesting spots for the trout and a habitat for the insects that the fish eat. "People pay attention to the big animals," Coffin says, "but the bugs are an important part of the system." Reaching into the water, he plucks out a couple of rocks, turns them over and points out six types of insect clinging to the underside, including caddisfly larvae and a stonefly. "The year after the dam was removed, these wouldn't have been here," he says with satisfaction."
http://www.nature.com/news/dam-removals-rivers-on-the-run-1.15636

The lack of water quality impacts and immediate fisheries restoration are not specific to Northwest Rivers. "other parts of the United States have also seen dramatic fish returns. On south-central Wisconsin's Baraboo River, the removal of a string of dams has allowed sturgeon to reach their former spawning grounds. And in New England, the destruction of two dams 7–9 metres high on Maine's Kennebec River and one of its tributaries has allowed Atlantic alewives (*Alosa pseudoharengus*) to repopulate 100 kilometres of previously blocked-off river. In 1999, before the first dam was taken out, no alewives were recorded in the upper part of the watershed, says Serena McClain, head of river restoration for American Rivers. By 2013, the annual run had rebounded to around 3 million."
http://www.nature.com/news/dam-removals-rivers-on-the-run-1.15636

Thank you for the opportunity to comment and provide information as part of this scoping

process. We look forward to working will you to remove four of the Klamath dams.

Sincerely,
Regina Chichizola
Save the Klamath Trinity Salmon Co-director
P.O. Box 142
Orleans, CA 95556

Mr. Parker Thaler
State Water Resources Control Board
Division of Water Rights
Water Quality Certification Program
parker.thaler@waterboards.ca.gov
Via e-mail

January 29, 2016

RE: Scoping Comments on Application for Water Quality Certification Pursuant to Section 401 of the Federal Clean Water Act for the Relicensing of the Klamath Hydroelectric Project (FERC No. 2082)

Dear Mr. Thaler:

The California Water Impact Network (C-WIN), Save the Klamath-Trinity Salmon, the California Sportfishing Protection Alliance (CSPA), AquAlliance, the North Coast Environmental Center, and Safe Alternatives for our Forest Environment (SAFE) respectfully submit these comments on scoping for the Environmental Impact Report (EIR) for the issuance of a Water Quality Certification for the Relicensing of the Klamath Hydroelectric Project (FERC No. 2082).

We incorporate by reference the comments, and attached studies, of the Pacific Coast Federation of Fishermen's Associations (PCFFA), Institute for Fisheries Resources, Klamath Tribal Water Quality Consortium the Klamath Riverkeeper, the Hoopa Valley, Karuk and Yurok Tribes and the Quartz Valley Indian Reservation, and Dr. Josh Strange except where they conflict with the present comments. We recommend that the following documents be entered into the record for the proceeding: all reports related to the Klamath Basin Agreements Secretarial Determination; the Total Maximum Daily Loads for the Klamath and Lost Rivers in Oregon and California and associated studies in Oregon and California; studies on water quality and dam removal within the FERC docket P-2082; monitoring reports and studies related to the "Interim Reservoir

Management" that has been ongoing since the completion of the Klamath Hydropower Settlement Agreement in 2010; all documents from the record of Section 18 fish passage prescriptions and biological opinions issued by National Marine Fisheries Service (NMFS), and all reports on water quality cited and linked in these comments.

These comments are organized as follows. We start with a general statement of position, followed by recommendations for appropriate CEQA alternatives. We next describe issues that must be analyzed in the EIR, in particular issues that are not adequately addressed in PacifiCorp's Application for Certification (*Application for Water Quality Certification Pursuant to Section 401 of the Federal Clean Water Act for the Relicensing of the Klamath Hydroelectric Project (FERC No. 2082)*; hereinafter, Application). Thereafter, we discuss specific issues relating to water quality in the Klamath River watershed. Finally, we summarize our conclusions.

Summary of Position

The EIR should include an alternative that analyzes the removal of Iron Gate, Copco I, Copco II and J.C. Boyle dams and reservoirs. We believe that analysis will prove that these dams cannot be operated without violating state and federal law. The Board should also analyze whether the removal, or changes to the operation of, the Keno Dam and reservoir is also necessary to achieve Basin Plan compliance.

The EIR should analyze issues of pollution that originates in dams located in Oregon. It should analyze TMDL compliance, mandatory fish ladders, cumulative impacts, protective flows, Iron Gate hatchery pollution, economic impacts from dams, and ramping and bypass flows. These issues are not addressed in the Application.

The Board should reject PacifiCorp's proposed Reservoir Management Plan as a mitigation measure, as the proposed plan relies on hypothetical actions, on proven ineffective measures, and on more studies and planning in violation of CEQA requirements.

Ultimately, the EIR should support an action by the Board that either denies certification or that issues a certification that requires removal of at least Iron Gate, Copco I, Copco II and J.C. Boyle dams and reservoirs.

To the degree possible, the State Water Resources Control Board (State Board or Board) should coordinate its process with the Certification process of the Oregon Department of Environmental Quality.

The California sections of the Klamath River are listed as impaired for Microcystin, Organic Enrichment, Dissolved Oxygen, Temperature, Nutrients, and PH. PacifiCorp's Klamath River dams greatly add to these impairments and are considered a source of pollution, and have been assigned TMDL loads allocations for the majority of these impairments. These dams' discharges and reservoirs are violating water quality standards for the following objectives: Taste and Odor, Dissolved Oxygen, Temperature, Color, Floating Material, Biostimulatory Substances, and Toxicity. PaciCorp fails to acknowledge that majority of these violations and TMDL load allocations in its Application.

The beneficial uses of water contact recreations, cold freshwater habitat, commercial and sports fishing, Spawning, Reproduction, and/or Early development (SPWN), Native American Cultural Uses, Estuary Habitat, and non-contact water recreation are all impacted by project dams. However, in its Application PacifiCorp actually claims that the dams benefit the majority of these beneficial uses. This assertion is disproven in all other analyses and scientific findings related to the Klamath Dam relicensing process and Klamath River TMDLs.

The project reservoirs are a major cause of the decline of salmon species, create vectors for fish disease downstream of Iron Gate dam, and block passage to hundreds of miles of cold water habitat above the dams. During most years the dams exceed standards under the Basin Plan, Porter–Cologne Act, the Clean Water Act, and TMDL load allocations. They also create conditions of take of endangered species. Some of the impairments caused by PacifiCorp's impoundments are severe enough to impact all of the beneficial uses of the Klamath River in California and render the river unusable for at least several weeks a year.

The discharges from the dams are a point source of pollution, but the state is generally preempted under the Federal Power Act from enforcing water quality standards under state law. However, the federally mandated authority of the State Board under the Clean Water Act provides the Board with a once in a lifetime opportunity to correct the egregious water quality degradation of the Klamath Dams. In *Karuk Tribe v. California Regional Water Quality Control Board* (2010) 183 Cal. App 4th 330 at 360, the Court described both the limitation and the opportunity:

> A determination of federal preemption does not automatically mean that state input is categorically prohibited and state opinion of no consequence. The Clean Water Act gives states what appears to be a very substantial role by requiring that an applicant for any federal license comply with state water quality procedures. (See fns. 17, ante; S.D. Warren, supra, 547 U.S. 370, 386; PUD No. 1, supra, 511 U.S. 700, 707, 713.) But the crucial points are (1) that it is Congress that determines what is the extent of state input, and (2) that input takes place within the context of FERC licensing procedures as specified in the FPA. It is only when states attempt to act outside of this federal context and this federal statutory scheme under authority of independent state law that such collateral assertions of state power are nullified.

FERC licenses hydropower projects once every 30 to 50 years. Therefore, for procedural as well as substantive reasons, it is vitally important that the State Board get this right.

The number of feasible alternatives that the EIR can analyze is limited.

The Notice of Preparation states on p. 11: "Any feasible alternative must demonstrate the ability to meet California water quality standards."

Under CEQA, the Board is required to analyze a No Project Alternative. In the context of the requirement to meet water quality standards, the EIR should be clear in defining the meaning of No Project. The only feasible No Project alternative is denial of Certification.
The Board should analyze an alternative in which Certification is issued that allows the continued operation of the Fall Creek Development while requiring removal of Iron Gate, Copco I, Copco II and J.C. Boyle dams and reservoirs.

The Board should also analyze an alternative in which Certification is issued that allows the continued operation of the Fall Creek Development while requiring removal of Iron Gate, Copco I, Copco II, J.C. Boyle and also Keno dams and reservoirs.

The Klamath dams and reservoirs block gravel and sediment recruitment, absorb solar radiation and thus create stagnation in the reservoirs, create thermal lag, heat and deoxygenate reservoir water, create toxic algae, and discharge water that greatly amplifies the occurrence of fish disease. These conditions overwhelm the prospective benefit of the reservoirs acting as a "nutrient sink" for phosphorous, an alleged benefit that PacifiCorp argues in its application is determinative. (Application for Certification, Chapter 4) In the Klamath River TMDL, the North Coast Regional Water Quality Control Board (Regional Board) questions the benefits of any nutrient retention when natural conditions would flush out much of this pollution [Staff Report for the Klamath River TMDLs, the Klamath River Site Specific Dissolved Oxygen
Objective, and the Klamath and Lost River Implementation Plans pg. 4-26]. Removal of the dams would allow cold water tributaries to dilute nutrient rich water and would combat attached algae blooms and polychaete growth. Therefore, dam removal would solve many of the issues in the lower river that are attributed to nutrient pollution. Moreover, free flowing water is oxygenated and colder, and therefore does not allow for the growth of toxic algae which threaten nearly every beneficial use of the river downstream of the dams.

"Dam removal is expected to result in significant temperature, dissolved oxygen and cyanobacteria improvements; and nutrients and organic matter reduction." Therefore, "In the Klamath Hydroelectric Project (KHP) reach, dam removal would produce significant and rapid improvements – particularly during the "critical period" - for temperature, algal biomass, microcystin, and DO." (*Assessment of Long Term Water Quality Changes for the Klamath River Basin Resulting from KHSA, KBRA, and TMDL and NPS Reduction Programs*, August 2011 pg. 2http://klamathrestoration.gov/sites/klamathrestoration.gov/files/Final%20Klamath%20WQ%20Changes%20Analysis%20Approach_08_18_2011.pdf)

The FERC FEIS for the Klamath Project relicensing confirms that the Klamath Hydroelectric Project contributes to water quality impairment in the Klamath River and suggests that the only way to fully mitigate the Project's impacts on water quality is through dam removal. (*See* FERC FEIS, p. 3-166). According to the FEIS, dam removal will significantly improve water quality in the Klamath. Dam removal would result in reduced ammonia and pH fluctuations, and reduce the risk of algae and microscystin blooms. *Id*. Temperature, DO, and nutrient impacts would be reduced. *Id.* Disease impacts will also be mitigated.

FERC suggests that water quality objectives will not be met absent dam removal. The FEIS states: (1) "the project [without dam removal] would continue to adversely affect water quality conditions downstream of Iron Gate Dam, which has the potential to adversely affect [ESA-listed] juvenile coho salmon" (FEIS, p. 3-426); (2) "the project, as proposed, would continue to affect temperatures in the Klamath River;" (3) "even with implementation of best management practices that may be developed as part of a project-wide water quality management plan, it is likely that algal blooms would continue to occur in project reservoirs;" and (4) "some degree of project related nutrient enrichment would occur in the Klamath River downstream of Iron Gate Dam."

The Board may not have the power to deny a permit for the J.C. Boyle and Keno dams. However,

the Board has the responsibility to analyze a full dam removal alternative. PacifiCorp's dams impact over sixty miles of the Klamath River in two states. They are operated such that every dam's operation influences the next one downstream. The Klamath Hydroelectric Project is one project with one FERC license. If dam removal of the Oregon dams is not analyzed, the cumulative impacts of the project cannot fully be addressed, and the Oregon Certification will be unable to build on the California process. There are numerous analyses of dam removal on a federal level. Dam removal of J.C. Boyle or of both J.C. Boyle and Keno is reasonably foreseeable. The removal of one or both of these Oregon dams would provide the greatest substantial benefits to water quality in California. There are also many issues that would arise from removal of the three dams in California without removal of J.C. Boyle dam, because J.C. Boyle is a peaking facility that would present a danger to fisheries and humans if left in after the other dams were removed.

An MOU was used to coordinate the TMDL actions between Oregon and California because of the importance of Oregon's pollution to receiving waters in California. (http://www3.epa.gov/region9/water/watershed/pdf/Klamath-Implementation-MOA-090630.pdf) This coordinated method should be replicated in the EIR. In addition, this 401 Certification process should also be consistent with the Regional Board's TMDL analytical methodologies, so that this process can take advantage of the extensive prior Regional Board work already done, including its water quality models, and so that the standards used in this certification process will also be consistent with the TMDL.

PacifiCorp's Application for Certification is incomplete and inaccurate.

PacifiCorp's Application for Certification is incomplete and inaccurate.

The Application inadequately considers the cumulative effects of PacifiCorp's actions.

The Application does not address required fish passage or analyze how water quality impairments will impact fish once fish passage is provided for. Fish passage is not only reasonably foreseeable, it is required under the mandatory FPA Section 18 conditions of a new FERC license.

The Application does not address PacifiCorp's load allocations under the Klamath River TMDL. These impoundments are listed as major sources of water quality impairments and are assigned load allocations in the Klamath River TMDL. The Application also incorrectly states that Oregon needs to address water quality issues in Oregon despite state line TMDL load allocations, and ignores the extreme pollution in the Keno reservoir simply because PacifiCorp no longer wants this dam.

There is a wealth of studies and reports regarding the impacts of PacifiCorp's dams on dissolved oxygen nutrient production, temperature, fish diseases and toxic algae production and Ph. Instead of addressing these issues and their TMDL load allocations, PacifiCorp instead argues their reservoirs are a beneficial nutrient sink, that they aid fisheries, and that unspecified and unproven reservoir management plans can deal with reservoir related pollution

PacifiCorp proposes a Reservoir Management Plan that largely relies on unproven, ineffective actions, and studies, and on assessments of possible actions instead of actual mitigation.

PacifiCorp's Application does not include an analysis of dam removal, despite the fact PacifiCorp has publicly supported dam removal. Many of the NEPA documents related to the FERC relicensing, on which this application will in part rely, include analysis of dam removal.

We contend that the Application as written proposes a project that will not comply with the legal requirements of CEQA, the Clean Water Act, Porter Cologne, the Basin Plan, Klamath TMDL's, and the Endangered Species Act. The application omits, or dismisses without cause, current science literature and studies, related water quality assessments and processes and scientific controversy, as well as Section 18 fish passage prescriptions and biological opinions issued by National Marine Fisheries Service (NMFS).

The geographic extent of the cumulative effects analysis should extend from Link River Dam to the Pacific Ocean 200 miles from the mouth of the Klamath River, and should include affected fisheries in the Trinity River.

The "Project Area" for purposes of cumulative impacts analysis should be the entire area from the headwater of the Klamath River tributaries, downstream to the estuary, and should also include all other areas that suffer impacts from salmon population and fisheries losses and declines that can be causally linked to the Klamath Hydropower Project. These impacts occur within the Trinity River and also in the Pacific Ocean areas of the Klamath Management Zone ("KMZ") – an area extending from the shores of California and Oregon offshore out to 200 miles, north to at least Humbug Mountain, Oregon and south to at least Horse Mountain near Shelter Cove, California.

The DEIR should acknowledge that management measures for Klamath River fall Chinook salmon currently constrain fishing on other salmon stocks, from central Oregon to central California. (FERC FEIS pg. 3-4)

The EIR should not adopt PacifiCorp's Reservoir Management Plan, because it is insufficient as mitigation.

PacifiCorp recommends its Reservoir Management Plan for use as mitigation whenever it acknowledges in its Application that its project has an impact on water quality. However, the Application includes no discussion of the feasibility of this plan's actions, past results of related past actions, or associated costs of the actions in the plan. In many sections of its Application, PacifiCorp proposes to defer that specifics of some of the most important actions needed to meet water quality standards and improve beneficial uses until after a license is issued. Such deferral will not create enforceable conditions or assure protection of beneficial uses.

Under Interim Measure 11 of the KBRA, PacifiCorp has tested many of the mitigations proposed in its Reservoir Management Plan over the last eight years. Studies of these measures and the reports thus generated demonstrate that they have been largely ineffective. Many of the interim reservoir management studies and plans were vague and theoretical; with only incomplete or small scale studies to rely on, PacifiCorp now proposes still more studies as part of its Reservoir Management Plan, instead of actual concrete mitigations that include cost analysis and analysis of probability for success. This violates the intent of CEQA and of Section 401 of the Clean Water Act.

CEQA calls for a detailed analysis of both impacts and mitigation measures. As demonstrated in *Sundstrom v. County of Mendocino* (1988) 202 Cal.App.3d 296 deferred mitigation is not legal

under CEQA. This was recently held up in *Madera Oversight Coalition, Inc. v. County of Madera* (2011) 199 Cal.App.4th 48 where the court found "the plain, unambiguous language" of the mitigation measure violated CEQA, and, "The post certification verification procedure [is contrary to law and] allows for an environmental decision to be made outside an arena where public officials are accountable."

The Board should use the CEQA process to protect beneficial uses by analyzing the potential effectiveness of concrete and effective reservoir management mitigations that would incorporate TMDL and applicable Basin Plan limitations and water quality measures. The Board should evaluate the ability of such measures to protect salmon and other fisheries. If water quality cannot otherwise be legally protected, then the Board must order a dam removal alternative and include it as a condition of the Certification or else deny Certification altogether.

The EIR must analyze cumulative impacts

CEQA requires the identification of significant impacts and the development of alternatives to avoid, reduce, or mitigate the impacts. This includes an analysis of cumulative impacts.

The cumulative impacts analysis must contain:

(1) either (a) a list of past, present, and reasonably anticipated future projects, including those projects outside the agency's control, which produce related or cumulative impacts or (b) a summary of such projections contained in an adopted general plan or related planning document which evaluates regional or area wide conditions, (2) a summary of environmental effects expected to be produced by those projects, and (3) a reasonable analysis of the cumulative effects of the relevant projects and the options for mitigating or avoiding each of the significant cumulative (http://www.ucop.edu/ceqa-handbook/chapter_03/3.3.html)

PacifiCorp's Application does not address the cumulative impacts of the project's reservoirs and operations, let alone impacts with past, present and reasonably anticipated projects. There is a rare mention that TMDL actions will help alleviate algal blooms, but these are not specified or quantified, though they are counted on to improve water quality. PacifiCorp leaves its most polluted reservoir, Keno Reservoir, out of the analysis. The EIR need to address these issues.

The Klamath River could be described as an upside-down type river system, one of the few rivers where water quality improves as water goes down river. In its application, PacifiCorp repeatedly blames upriver water quality conditions for its reservoirs' pollution, without admitting that these reservoirs control much of the management of the watershed or that they impound many springs and creeks that would otherwise allow for this water quality recovery through cold water inputs and dilution. The reservoirs impound many of the point source and non-point pollution that absent the reservoirs would be diluted and assimilated. Without the dams, dilution, water quality recovery, and algae composition changes would begin to occur sixty miles upstream from where they now occur, in contrast with the current situation in which polluted and cold water inputs are impounded and become stagnant.

The EIR must consider all significant impacts of its proposed project, regardless of whether those impacts occur offsite, and regardless of whether those activities would be attributable solely to the permitted activity or to that activity in combination with other circumstances including but not

necessarily limited to other past, present, and reasonably expect[ed] future activities in the relevant area. Under CEQA, an EIR must make at least a preliminary search for potential environmental effects, and if any such effect is perceived, must make at least a preliminary assessment of its significance. If the lead agency determines that there are one or more significant potential cumulative effects, then it must to carefully consider those effects in determining whether, and on what terms, to condition the proposed project. Even though this is not included in the application, it must be considered in the EIR. The administrative record must demonstrate the requisite consideration.

Instead of adhering to this standard in its Application, PacifiCorp fails to address actions that were analyzed as part of the FERC process, and in some cases actions specifically required in the process. These include the requirements for fish ladders and screening; the prior analyses of dam removal; Biological Opinions for fisheries; and the dams' impacts and the Klamath TMDLs for Microcystin, Organic Enrichment, Dissolved Oxygen, Temperature, Nutrients, and pH in Oregon and California. In addition to correcting these deficiencies, the EIR must also analyze related actions such as the historical and current removal and draining of wetlands; the management of wildlife refuges including pesticide use, draining and flooding; on and off Klamath Project Irrigation and tailwater returns; point and nonpoint source agriculture drains; water transfers; feedlot pollution; logging operations on private and public lands; industrial pollution; construction, use, maintenance and failure of roads in the watershed; water diversions throughout the basin; groundwater removal and pumping; chemical use; grazing; and water treatment plants.

Because the project involves "take" and take permits for endangered sucker fish and Coho salmon, this take should be analyzed in conjunction with other "take" throughout the basin. The EIR should analyze how all of these activities impact beneficial uses and Tribal Trust uses and resources.

The EIR should address foreseeable actions and influences such as population growth, climate change, logging, and other land use activities. In analyzing potential future impacts, agencies must do their best: "[d]rafting an EIR ... involves some degree of forecasting. While foreseeing the unforeseeable is not possible, an agency must use its best efforts to find out and disclose all that it reasonably can." [See *Berkeley Keep Jets Over the Bay Committee v. Board of Port Commissioners*] The agency's finding(s) as to whether impacts are reasonably foreseeable must be based on evidence in the record.

The EIR must analyze water pollution in Oregon.

A report from the North Coast Regional Water Quality Control Board states:

> "Achieving compliance with the Klamath River TMDLs in both California and Oregon requires a coordinated approach that involves state and federal agencies as well as responsible parties in both states. The Regional Water Board, Oregon Department of Environmental Quality (ODEQ), and USEPA Regions 9 and 10 have signed a Memorandum of Agreement (MOA) for implementing the Klamath River basin TMDLs." *(Action Plan for the Klamath River Total Maximum Daily Loads April,* 2010, hereinafter TMDL Action Plan. Available at: http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/klamath_river/100927/03_BasinPlanLanugage_Klamath_Lost.pdf)

Under the Clean Water Act, upstream states must ensure that their permitting or certification decision will not result in violations of water quality standards in affected downstream states. *See Arkansas v. Oklahoma*, 503 U.S. 91 (1992). This is true even if the standards imposed by the downstream state or, in this case, EPA-approved Indian tribe are more restrictive than those in the upstream state.

Both of the project dams in Oregon create slack, warm-water reservoirs that expose the Klamath River to sunlight for longer periods of time and with less shade over a broader area then natural river conditions, thus raising water temperature. This warmed water flows downstream before it is cooled by spring inflows. J.C. Boyle and Keno reservoirs both trap and hold natural sediments that would otherwise contribute to spawning and rearing gravel below them, thus impoverishing instream spawning and rearing habitat in what would otherwise have been prime spawning and rearing areas for resident rainbow and redband trout, and, after fish passage is restored, for salmon, suckers, lamprey and steelhead. J.C. Boyle and Keno trap sediments and concentrate nutrients that are the food sources for the growth of various algae species that thrive in warm-water reservoirs, including the highly toxic blue-green algae species. They also are responsible for killing Short Nose Sucker, an endangered species.

> Problems with high water temperatures at Keno and J.C. Boyle reservoirs result, as a consequence, in lowered dissolved oxygen (DO) levels. Additional sudden DO concentration dips can be caused by algae bloom die-offs. As these algae mats die off, their natural decay process also leads to elevated ammonia levels and various changes in pH from normal baseline conditions. These pervasive water quality problems all begin at Keno Dam and its warm-water reservoir, are continued downstream into J.C. Boyles Dam and reservoir, where they get more widespread and extreme, and then move downstream into California, where they then exacerbate all the water quality problems of the river below, making it harder to meet TMDL and other California water quality standards. (*Upper Klamath and Lost River Subbasins Total Maximum Daily Load (TMDL) and Water Quality Management Plan (WQMP) December 2010*. Available at: http://www.deq.state.or.us/wq/tmdls/docs/klamathbasin/uklost/KlamathLostTMDLWQMP.pdf)

CEQA requires that *all portions* of the same project be analyzed for their environmental impacts. In spite of the artificial divisions of a state line, the Klamath Hydroelectric Project is one single project, under one single FERC license, and all parts of the project are designed to interact in various ways. Analyzing California pollution and operations without a discussion of J.C. Boyle and Keno would lead to an incomplete analysis. This could possibly also impact Oregon's application or help to create a situation where only the California dams come down because no single analysis of dams' interactions on the receiving reservoirs' existed. See *Calif. Farm Bureau Federation v. California Wildlife Conservation Board (App. 3 Dist. 2006, 49 Cal.Rptr.3d 169, 143 Cal.App.4th 173 (*"Improper for an agency to divide a project into separate parts to avoid CEQA analysis"*), and San Joaquin Raptor Rescue Center vs. County of Merced (App. 5 Dist. 2007), 57 Cal.Rptr.3d 663, 149 Cal.App.4th 654, as modified* ("The entirety of a project must be described in an EIR, and not some smaller portion of it.").

Section 401 of the Clean Water Act is clear on this issue. It states that to the extent that a state

certifying agency proposes to certify a project under Section 401 that would cause or contribute to violations of a downstream state (or Tribe's) water quality standards, the Clean Water Act provides a mechanism to resolve such disputes. 33 U.S.C. § 1341(a)(2); 33 U.S.C. § 1377(e); 40 C.F.R. §§ 121.11-121.16; 40 C.F.R. § 131.7; *see also Wisconsin v. EPA*, 266 F.3d 741, 748-49 (7th Cir. 2001).

CEQA also stipulates that in a situation where a project includes many facilities working together, they have to be analyzed as one. There is no mention of a state line exemption in any of California Clean Water laws, or Porter Cologne.

A thorough discussion on pollution stemming from dams and reservoirs in the state of Oregon, and impacts to California from polluted receiving water, is included in the TMDL's for the Klamath and Lost Rivers in Oregon and California, cited above.

The EIR must analyze pollution in Keno Reservoir

One of the biggest pollution sources in Oregon that impacts California's receiving water is the Keno Reservoir. PacifiCorp seems to believe that it does not have to address pollution stemming from Keno reservoir because PacifiCorp has decided it does not want to relicense the dam. There is, however, no plan for decommissioning the Keno Reservoir. Keno flows currently control J.C. Boyle operations. The Keno facilities are wholly owned by PacifiCorp.

Keno Reservoir is known to have the worst dissolved oxygen levels in the Klamath River. It is also a heat sink that exacerbates many temperature issues. It has a profound impact on the Klamath River nutrient and algal levels. Keno Reservoir impounds and stagnates return flows from major tailwater drains and also the majority of the river's point source and non-point pollution. (*Upper Klamath and Lost River Subbasins Total Maximum Daily Load (TMDL) and Water Quality Management Plan (WPMP) December 2010*). Keno also greatly changes the nutrient dynamics in the Klamath River. The cumulative impacts to water quality in this part of the river can not be overstated. Keno reservoir is a significant pollution source to the state of California and therefore should be part of this analysis. If Keno dam removal is found to not be prudent, then specific operational changes should be analyzed so it's discharges meet California water quality standards and state line TMDL's.

The EIR must analyze project impacts on fish species that are currently present and that would be present if the project were relicensed with mandatory fish passage prescriptions.

The reaches of the Klamath River between Keno Reservoir and Iron Gate Reservoir have some of the most adverse water quality conditions in the river, but they also have important cold water refugia that are impacted by dam operations. Past analysis and findings show the resident trout have been negatively impacted by water quality conditions, flows and ramping within these river reaches. In addition to taking into account this existing information, the EIR must address how these conditions may affect anadromous fish species, including sucker and lamprey species.

One of the biggest deficiencies in PacifiCorp's Application for Certification, beyond the omission of dam removal, is the Application's failure to acknowledge fish passage prescriptions whose implementation will be required if the project is relicensed, and to evaluate project effects on fish that would pass project facilities as a result of those prescriptions. The National Marine Fisheries

Service (NMFS) issued fish passage prescriptions pursuant to its authority under Section 18 of the Federal Power Act. If the project is relicensed, these prescriptions are not optional. They are mandatory.

Despite these prescriptions PacifiCorp does not address fish passage in its Application for Certification. For instance, PacifiCorp states:

> Notwithstanding the Section 18 fishway prescriptions by the Secretaries of Commerce and Interior, PacifiCorp generally agrees with FERC's FEIS analysis that recommends a trap-and-haul based adaptive management approach to reintroduction before making the substantial investment in volitional fishways at the various Project facilities that would be required by the Section 18 prescriptions. PacifiCorp nevertheless recognizes that the Section 18 prescriptions need to be addressed by FERC licensing of the Project. (Application, p. 5-27)

PacifiCorp challenged the basis of NMFS's Section 18 prescriptions in 2006 in "trial-type hearings" allowed by the Energy Policy Act of 2005. (An explanation of these hearings is available at: http://www.fws.gov/yreka/hydrofaqs.html). Presiding Administrative Law Judge Parlen McKenna made extensive findings-of-fact as a result of these hearings. (The findings are available at http://resighinirancheria.com/Documents/McKenna_Administrative_Law_Judge_Decision%20on%20Klamath%20River%20Dams%20-%20Docket%20Number%202006-NMFS-0001_09_27_2006.pdf).

We reproduce here some of the relevant findings here.

"Flow fluctuations from peaking operations increase energetic demands on salmonids, decreasing energy available for overall health, growth, and reproduction." (ALJ Finding of Fact 16-21)

"Project peaking operations kill, through stranding, large numbers of young fish and aquatic invertebrates that are the primary prey food for trout." (ALJ Finding of Fact 16-9)

"Flow fluctuations from peaking operations increase energetic demands on salmonids, decreasing energy available for overall health, growth, and reproduction." (ALJ Finding of Fact 16-21.)

In summary Judge McKenna found that increased flows, combined with limited peaking and more restrictive ramping requirements would increase available habitat (*Findings 16-1 through 16-6*), reduce impacts from stranding (*Findings 16-7 through 16-15*), reduce flushing of juvenile salmonids downstream (*Findings 16-16 through 16-20*), reduce energetic demands on fish (*Findings 16-21 through 16-23*), and increase macroinvertebrate production and food availability.

The Copco Two bypass reach has many issues with flows. Currently only 10 cfs is released at Copco 2 Dam. The Department of the Interior has stated: "of all river reaches impacted by the Project, the Copco 2 Bypassed Reach is the most strongly affected." (*Department of Interior 10(j) Recommendations,* p. D-24). Alt*ernative Fishway Prescription,* p. 3. This analysis should have a discussion of flows in this reach, and should recommend flows that would be protective of water quality and cold water fisheries beneficial uses.

Bypass operation below J.C. Boyle and Copco Dams deprives the diverted water from a turbulent

journey down the river that would help break down organic matter and phytoplankton. Nitrogen and phosphorus are more easily removed in downstream reaches when they are in inorganic form (ammonia and nitrate for nitrogen; orthophosphorus for phosphorus) than when they are bound up in organic matter. The longer it takes for the organic matter to become mineralized into inorganic nutrients, the further downstream those nutrients will travel before being removed from the water column. Thus, the bypass operations delay the natural improvements in water quality that occur as the Klamath River flows downstream from Keno Dam. Instead of disclosing and addressing these facts, PacifiCorp claims that the project improves water quality, which is actually a result of many cold water springs in this reach. The dilutive and cooling impact from these springs and cold water tributaries in the J.C. Boyle to Copco reaches would have a more significant positive effect with dam removal.

The EIR must analyze how climate change will affect water quality conditions, energy production and project operations and economics.

Recent studies published in the journal *Nature* discussed the fact that climate change is already taking a toll on energy production through lower flows and lesser cooling ability. (See http://www.nature.com/nclimate/journal/v2/n9/full/nclimate1546.html).Other recent studies demonstrate that dams impact climate change through the production of methane. Methane production is an issue in the Klamath reservoirs. Low flow and water warming in the Klamath River also appear to be a direct result of climate change. The EIR should analyze how the need to meet water quality standards will affect energy production in a warming environment. The EIR and the Certification must account for whether or how a relicensed project would meet water quality standards and the standards outlined in Basin Plan in a warmer world. The EIR must also account for the likely reduction in project energy production under climate change.

The EIR must account for, analyze and support the Thermal Refugia Protection Policy of the Klamath River TMDL.

The reaches of the Klamath River that are within the project area take in many springs and creeks that could provide vital refugia for migrating salmon and other anadromous fish species if the dams were not in place. These refugia could also provide needed cold water for migrating fish if fish ladders are put in with the dams remaining in place. The EIR should analyze the impacts of the dams to these potential refugia, how these refugia would benefit fish if dams were removed, and how the Thermal Refugia Protection Policy of the Klamath River TMDL applies to these potential refugia.

"The Thermal Refugia Protection Policy provides enhanced protection of thermal refugia along the mainstem Klamath River and in the lower Scott River. Thermal refugia are typically identified as areas of cool water created by inflowing tributaries, springs, seeps, upwelling hyporheic flow, and/or groundwater in an otherwise warm stream channel offering refuge habitat to cold-water fish and other cold water aquatic species." (*Action Plan for the Klamath River Total Maximum Daily Loads, April, 2010 pg. 4-9* Hereinafter, TMDL Action Plan)

"Regional Water Board staff shall place heightened scrutiny on permits and 401 water quality certifications for activities that have the potential to impact the function of thermal refugia". *(Ibid.pg.4-11***)**

The EIR needs to analyze the water temperature increases caused by discharges from the Iron Gate Hatchery and the resulting impacts to salmon

The TMDL Action Plan states: "The Iron Gate Fish Hatchery is the one point-source heat load in the Klamath River watershed. The interstate water quality objective for temperature prohibits the discharge of thermal waste to the Klamath River, and therefore the waste load allocation for Iron Gate Hatchery is set to zero, as monthly average temperatures." (*TMDL Action Plan, p4-3*)

The same document further describes how the cold water pool in the Iron Gate reservoir is needed to support the Iron Gate hatchery. This support reduces the cold water that is available to manage water temperature in the Klamath River downstream of Iron Gate Dam. The EIR needs to disclose and evaluate thermal loading of water as it passes through the hatchery, as well as the impact of the hatchery on cold water fisheries and fish disease dynamics. The EIR should also address thermal benefits of the hatchery going offline if dams are removed.

The EIR must disclose and analyze the effects of the project on spring-run Chinook salmon and on fish species composition in the Klamath River.

The EIR should analyze how dam operations, including hatchery operations, have impacted spring-run Chinook salmon and salmon composition in the Klamath River, and how effective dam removal and other alternatives would be in reducing or eliminating these impacts.

In its Application, PacifiCorp rarely mentions impacts to fish species composition from the dams and associated water quality conditions, hatchery operations and blockage of fish passage. No species has been more impacted by the dams' operations then spring-run Chinook: the operation of the dams has reduced their habitat and numbers substantially. Changes in species composition of fish in the river, especially the reduced numbers of spring-run Chinook, have greatly impacted beneficial uses. Hatchery production has not fulfilled promises to replace impacted populations. Dam removal is the best option to recover this species.

The EIR should disclose and analyze the economic impacts of project on commercial and recreational salmon fisheries and on recreational steelhead fisheries, and evaluate the economic benefits of fisheries restoration.

The EIR should disclose and analyze the economic impacts of the project in diminishing fisheries in the Klamath River. It should also disclose and analyze project impacts on commercial salmon fishing in the Klamath Management Zone in the ocean and on from lost recreational fishing opportunities in the Klamath and Trinity rivers. These analyses should consider loss of species abundance, changes in run timing, and lost opportunities due to nuisance toxic algae blooms.

The economic analysis in the FERC FEIS mainly focuses on energy production and is therefore not applicable for this analysis. There is a wealth of studies on this issue that were produced during the FERC and KBRA settlement process. These documents need to be used in the analysis and weighed against power production for a true economic analysis of the Public Trust. We incorporate by reference the comments of the Pacific Coast Federation of Fishermen's Association on economic impacts.

The EIR should disclose and analyze Klamath River water quality and project impacts on water quality (overview).

PacifiCorp's reservoirs in the Klamath River become stagnant and warm, creating temperature, dissolved oxygen, toxic algae and fish disease problems that cannot be mitigated if the dams are left in place. The reservoirs also greatly impact the flow regime of the river by reducing flow and by ramping. The reservoirs block vital sediment recruitment and fish passage for salmon.

Rather than directly disclose and analyze these issues and possible mitigations, PacifiCorp's Application denies impacts and repeatedly blames conditions of Upper Klamath Lake for the water quality impairments in the river. PacifiCorp also takes credit for natural cooling and oxygenating processes that the dams actually partially impede, such as cold water spring input in the J.C. Boyle reach of the river. The SWRCB should fully disclose and analyze these impacts, and require mitigation.

Upper Klamath Lake has major water quality issues. However, impounding this water and every tributary for an additional 64 miles downstream makes water quality conditions much worse and slows the natural recovery of water quality. PacifiCorp states the reservoirs act as nutrient sinks. However water quality is actually the most improved in the free flowing sections of river and where cold water tributaries enter the system unimpeded.

Water quality data and the TMDL analysis that are not included in PacifiCorp's Application show that dissolved oxygen concentrations are regularly too low to comply with Basin Plan dissolved oxygen objectives. (See more detailed discussion below). Water temperature conditions regularly exceed temperature thresholds protective of salmonids. Thermal lag slows cooling in the river so that these conditions have a much greater impact on salmon in the fall. Low dissolved oxygen concentrations and elevated water temperatures in the Klamath River, its tributaries, Copco1 and Copco 2, and Iron Gate Reservoirs, and seasonal algae blooms have resulted in degraded water quality conditions that impair designated beneficial uses. An analysis of these impairments and how beneficial users are impacted under all alternatives and mitigations should be included under all proposed alternatives.

The project impairs the following designated beneficial uses: cold freshwater habitat (COLD); rare, threatened, and endangered species (RARE); migration of aquatic organisms (MIGR); spawning, reproduction, and/or early development of fish (SPWN); commercial and sport fishing (COMM); Native American cultural use (CUL); subsistence fishing (FISH); and contact and non-contact water recreation (REC-1 and REC-2).

The designated beneficial uses associated with the cold freshwater salmonid fishery (COMM, COLD, RARE, MIGR, and SPWN) and Native American cultural use and subsistence fishing (CUL and FISH) are interrelated and are the designated beneficial uses most sensitive to the water quality impairments of the Klamath River. Important species in the Klamath River watershed include Coho and Chinook salmon, trout, green sturgeon, eulachon, and Pacific lamprey. (*TMDL Action Plan, pgs. 4-1 and 4-2*)

The EIR should disclose and analyze the impacts of project reservoirs on water temperature.

The TMDL Action Plan states:

> The Klamath River Temperature TMDL for California relies on an implicit margin of safety. The intrastate water quality objective for temperature allows for temperature increases of up to 5°F if beneficial uses of water are not adversely affected. For much of the year the instream temperature of the Klamath River is too hot to accommodate more heat loading without beneficial uses of water being adversely affected. There are periods in the winter and spring months, however, when temperature increases of up to 5°F may occur without beneficial uses of water being adversely affected. The timing of those periods changes from year to year and is difficult to predict. Therefore, this TMDL takes a conservative approach, allocating no temperature increases year-round. This conservative approach constitutes an implicit margin of safety. (*TMDL Action Plan, p. 4-4*)

Temperature is a major issue in the Certification process and in the related Klamath River Temperature TMDL. PacifiCorp inaccurately states in its Application that there are no temperature violations from its reservoirs because the Basin Plan allows for a 5°F increase over background, and it considers background to be the current degraded conditions.

Any temperature increases are a violation of the Klamath River TMDL, and the TMDL and FERC analysis both establish that background conditions are pre-dam conditions. The Application also has no evaluation of the cumulative impacts of extreme drought conditions when coupled with project operations. The EIR must evaluate TMDL compliance under all the alternatives.

Temperature is also a major issue in the reintroduction process for fisheries above the Iron Gate Dam, along with current conditions for salmon: both should be analyzed in the EIR. Temperature impacts or benefits should be analyzed for all alternatives. PacifiCorp's Application denies or ignores project impacts on the Klamath River water temperature. For instance, though the Application discloses the fact that the reservoirs cause significant thermal lag, it proposes no mitigation to address this issue and suggests that the condition does not impact fish. Other temperature impacts are not even mentioned, though five out of seven of heat loads described in the Klamath TMDL are directly related to, or exacerbated by, the presence of these dams. These loads include:

1. Conditions of Klamath River water crossing the Oregon-California border (Stateline) (Keno reservoir, in Oregon especially is a major factor in this source)
2. Thermal discharges from Copco 2 and Iron Gate Reservoirs,
3. The impoundment of water in the Copco 1, Copco 2, and Iron Gate Reservoirs,
4. Temperature effects of Iron Gate Hatchery, and
5. Excess solar radiation.

The TMDL allocations for temperature increases for the Klamath impoundments, and for receiving water at the state line, both which are subject to this application, is zero. However, PacifiCorp's Application continually relies on a standard that allows up to a 5° Fahrenheit (2.8° Celsius) increase above background. Even with that incorrect assumption, project operations still violate temperature standards. The Application states: "During occasional brief periods in the fall from about mid-September to mid-November, the temperature can exceed the objective by about 0.1 to 1.5°C." (p. 5-83) Using the correct standard (TMDL allocation of zero), the exceedance is 2.9°C to 4.3°C.

Thermal lag and stratification impacts from reservoir releases of warm and polluted water are harmful to fish. Temperature increases from the reservoirs impact the river over many more river miles during dry times of year than the Application discloses. The EIR should analyze how thermal lag and stratification impact temperatures and salmon.

During the summer, the majority of the water coming into the Klamath River is from reservoir releases until cold water tributaries begin to enter the river near Happy Camp. Tributaries between the reservoirs and Happy Camp, such as the Shasta and Scott River, have very low flows during dry times of year. Therefore, during critical times of year, temperature impacts from Iron Gate Reservoir have an even larger negative effect on cold water fisheries in the reach between Iron Gate Dam and Clear Creek than the Application suggests. The EIR should carefully analyze the project's thermal impacts in this reach.

The impoundment and warming of the cold water tributaries between Keno Reservoir and Iron Gate dam also has a major impact on water quality. This area of river transitions between snowmelt-dependent and spring-fed tributaries, and would have a much more significant cooling effect on the river absent the dams.

The EIR should disclose and analyze the impacts of project reservoirs on dissolved oxygen, and should evaluate the effects of oxygen impairment both in reservoirs and in the Klamath River.

The TMDL Action Plan states:

> "Achievement of the nutrient and organic matter allocations at Stateline and the tributary nutrient and organic matter allocations will not result in compliance with the DO and temperature load allocations within Copco 1, Copco 2, and Iron Gate Reservoirs during periods of thermal stratification. Therefore, additional dissolved oxygen load allocations are assigned to the reservoirs for the period of May through October to ensure compliance with the SSOs for DO and temperature objectives within the reservoirs, and ensure support of the cold freshwater habitat (COLD) beneficial use." (*TMDL Action Plan, p. 4-5*)

The Application incorrectly relies on upriver TMDL nutrient actions and unspecified mitigations in the Reservoir Management Plan to combat in-reservoir dissolved oxygen (DO) impairments. Keno Reservoir, the Copco reservoirs, Iron Gate Reservoir, and Iron Gate Hatchery are all listed as dissolved oxygen impairment sources in the Klamath River TMDL's. The reservoirs and hatchery are the only source of dissolved oxygen impairment in the mainstem Klamath located in California. Dissolved oxygen levels are near saturation when they enter the Copco reservoir reach. The EIR should compare each alternative to evaluate how well it will meet TMDL loads and other water quality standards and objectives related to DO. DO has a significant impact on migrating salmonids throughout the Klamath system. The Application addresses DO only in Iron Gate Reservoir, not the other dams. Moreover, the Application proposes dissolved oxygen mitigation measures as part of the Reservoir Management Plan that are largely untested and theoretical, and that do not include an analysis of cost.

The Application states:

> From mid-summer through mid-fall, the dissolved oxygen levels in the releases to the river

> from Iron Gate reservoir are typically more variable, ranging both above and below saturation, with minimum values in late September to early October (Figure 5.2-5). The more variable and lower dissolved oxygen conditions in the August-October period reflect: (1) the production and respiration effects from algae blooms at this time; and (2) the increase in subsaturated conditions that occur in deeper waters of Iron Gate reservoir during this period that can at times be entrained into the powerhouse intake. (Application, p. 5-59)

While there is some seasonal impairment in the Klamath River downstream of Iron Gate Dam due to the release of reservoir water with low dissolved oxygen levels, it is likely that the greatest impact of DO impairment in both reservoir and river stems from development of toxic algae in conditions of dissolved oxygen impairment. The EIR should pay particular attention to this phenomenon, as discussed further below.

Dissolved oxygen mitigation measures as proposed as part of the Reservoir Management Plan are largely untested and theoretical, and do not include an analysis of cost. The EIR needs to include actual proven and concrete mitigation measures that will meet TMDL loads and water quality standards for DO throughout the year.

The EIR should disclose and analyze the impacts of project reservoirs and operations on fish pathogens and disease.

The FERC FEIS states:

> The Klamath Hydroelectric Project has likely contributed to conditions that foster disease losses in the lower Klamath River by (1) increasing the density of spawning adult fall Chinook salmon downstream of Iron Gate Dam; (2) promoting the development of attached algae beds that provide favorable habitat for the polychaete alternate host for *C. shasta* and *P. minibicornis*; and (3) contributing to water quality conditions that increase the stress level of juvenile and adult migrants and increase their susceptibility to disease. (FERC FEIS, p. 3.309)

The EIR should analyze how each alternative will affect water quality conditions that increase the stress level of juvenile and adult migrants and increase their susceptibility to disease, and how they impact the attached algae that provide for polychaete worms. We believe this analysis will show that dam removal alternatives would combat juvenile fish disease issues and also greatly reduce adult fish disease issues in the Klamath River.

Elevated water temperatures in the Klamath River not only encourage algae blooms, but also encourage warm-water parasites like *Ceratomyxa shasta* and *Parvicapsula minibicornis*, which are fatal to many juvenile salmon, resulting in the mortality equivalent of a major fish kill nearly every year. Currently these diseases result in high rates of juvenile salmonid mortality. In years of extreme drought such as 2015, up to 90% of juvenile salmon have contracted the *C. shasta* virus.

Ceratomyxa shasta and *Parvicapsula minibicornis* are both virulent warm-water parasites that are simply more active in the warmer river waters that now occur every summer for longer periods than historically occurred. Juvenile fish are especially vulnerable to these virulent pathogens. When juvenile salmonids contract either of these virulent fish diseases, it is frequently fatal, even more so when juvenile fish (as is all too common) contract both.

Rapidly moving gravel naturally cleans the river bed of algae, and thus reduces the growth and prevalence of the algal species that harbor (and are the major food sources) for the polychaete worm *Manayunkia speciosa* that is the disease vector for *Ceratomyxa shasta.* The *P. minibicornis* pathogen has a similar complex lifecycle.

Warm water and low dissolved oxygen are also major factors that cause fish diseases in the adult run of salmon. Adult fish disease issues have been rampant in the Klamath River in the majority of the last ten years due to low flows and warm water. This has led to many emergency actions such as the release of cold water from the Trinity River. Studies prove that water quality conditions are the most important factor in avoiding fish diseases in adult salmon.

We incorporate by reference the technical comments on fish diseases of the Klamath Tribal Water Quality Consortium, Dr. Joshua Strange and the Yurok Tribe.

The EIR should disclose and analyze the impacts of project reservoirs and operations on toxic algae.

Microcystin is a 303(d) listed impairment for the Klamath River. This toxin is dangerous not only for humans but all for all wildlife, stock animals and pets that utilize the Klamath River. The Iron Gate and Copco reservoirs create this algae and release *Microcystis aeruginos,* and its associated toxin *Microcystin* from Iron Gate Dam, which in turn pollutes the entire river, including the estuary, for several weeks a year. This has a huge economic, subsistence and cultural impact on the people that live on, or rely on, the Klamath River. This should be disclosed and addressed as part of the EIR. Despite numerous studies and ten years of data showing toxic algae levels are the highest in the world, PacifiCorp still calls the impairment common, and its Application dismisses its part in causing this nuisance. Even without studies, the people on the reservoirs and rivers can see that the foul-smelling bright green water is a dangerous nuisance.

Documents from numerous sources are emphatic about the prevalence of *microcystis* and other toxic algae in the Klamath system. These documents point out the central role of project reservoirs in promoting the presence of these organisms, and the severity of their impacts.

For example, a North Coast RWQCB staff report for the Klamath River TMDL found:

> The primary impact of the reservoirs as a source area (aside from temperature impacts already described) is their role in creating biostimulatory conditions leading to high levels of chlorophyll-a and blue-green algae (including microcystin), and the oxygen deficits found in the hypolimnion during the summer months." (North Coast RWQCB March 2010 4-26 Staff Report for the Klamath River TMDLs, the Klamath River Site Specific Dissolved Oxygen Objective, and the Klamath and Lost River Implementation Plans, . pgs. 4-26 and 4-27Available at: http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/klamath_river/100927/staff_report/05_Ch4_Pollutant_Source_Analysis.pdf)

The same report notes:

> Chlorophyll-a and blue-green algal related targets are achieved above the reservoirs but not within the reservoirs, thus the slower and warmer waters in the reservoir reaches are the

> cause of these impairments. These conditions are demonstrated previously in Section 2.4 of this document. (*Ibid*, p. 4-26)

The previously cited 2011 Klamath Water Quality Assessment found:

> Of the many factors that may influence these blooms, the removal of the lacustrine (reservoir) environments behind the dams is likely to have the most pronounced influence. Removal of the reservoirs would eliminate optimal habitats for the growth and proliferation of toxigenic nuisance algal species such as *Microcystis aeruginosa*. (*Assessment of Long Term Water Quality Changes for the Klamath River Basin Resulting from KHSA, KBRA, and TMDL and NPS Reduction Programs*, August 2011, p. 13).

Still another independent report found:

> The results of the 2005-2008 sampling program demonstrated widespread and high abundance of toxigenic MSAE blooms in Copco and Iron Gate reservoirs and in the Klamath River downstream, exceeding World Health Organization Moderate Probability of Adverse Health Effect Levels (WHO MPHAEL) for both cell density and toxin by 10 to over 1000 times. Although both cell density and toxin data indicated that MSAE cells and microcystin were either not detectable or detected at very low levels in the Klamath River directly above the reservoirs, levels of both parameters increased directly below the reservoirs in all years. In addition, bioaccumulation studies undertaken in 2007 and 2008 showed accumulation of microcystin toxin in muscle and/or liver tissues of yellow perch, hatchery salmon, and freshwater mussels (Mekebri et al. 2009; Kann 2008; Kanz 2008). Microcystin levels in biota exceeded public health threshold values for safe consumption (Kann 2008; OEHHA 2008)" (*2009 Toxic Cyanobacteria Summary June 2010 Aquatic Ecosystem Sciences LLC*, p. 5. Available at: http://www.klamathwaterquality.com/documents/kann_et_al_2010_Karuk_Public_Health_Cyano_2009_Report_6-30-10.pdf)

The same report noted: "These blooms were associated with high levels of microcystin, a potent hepatotoxin capable of causing chronic liver damage and acting as a tumor promoter." (*Ibid*, p. 5)

This report concludes:

> "Overall MSAE and microcystin levels increased from July through September with a decline occurring in mid August (Figure 3). On 9/28 CRCC had a microcystin concentration of 36,000 µg/L and CRMC had a microcystin concentration of 73,000 µg/L, both exceeding the public health TDI by 10,000x (Figure 3). The 73,000 µg/L microcystin level is the highest observed for these systems to date, and represents maximum world-wide observations." (*Ibid*, p. 12)

PacifiCorp blames upriver water quality impacts for this impairment, and claims that it does not diminish recreation (Application Page 5-6). As mitigations for these water quality violations PacifiCorp proposes the Reservoir Management Plan, which includes no concrete actions and instead proposes more studies and planning. This plan relies on actions that have proven ineffective over the past eight years of interim measures and on potentially dangerous actions such as use of

algaecides, which could actually add to the problem by releasing algal toxins.

The EIR should diligently review available information, and carefully analyze all alternatives and their impacts in producing toxic algae. The EIR must find any proposed mitigations for reservoir management meant to mitigate for toxic algal production to be proven effective. The EIR should also include an economic analysis both of the costs of mitigation and the costs of the unmitigated impairment. If toxic algae impacts can not be mitigated a final permit should require dam removal.

The EIR should disclose and analyze the impacts of project reservoirs and operations on nutrient loading.

The EIR should evaluate the claim that project reservoirs are aiding water quality by retaining nutrients. As stated above, while it is may be true that the Klamath reservoirs do retain some nutrients, analysis will likely show that this nutrient retention does not actually aid the river in the way that natural conditions would through dilution, scour, and impacts on periphyton growth and thus fish disease. The dams actually change nutrient dynamics in way the is harmful to beneficial uses within the Klamath. Furthermore, nutrients can be transferred from sediment on the bottom of reservoirs and releases in water column under high wind conditions, or times of high Ph values, and blue green algae can release high nitrogen releases.

Klamath River TMDL's identifies several ways other ways in which the nutrient capture dynamic impact the Klamath River. These are:

- The effect of retaining the nutrients within the reservoirs with respect to contributions to the nuisance algal conditions in the reservoirs.
- The net retention of nutrients within the reservoirs can be substantial -rich conditions downstream of Iron Gate Dam.
- It is clear that the reservoirs spread out event-driven spikes of nutrient loads. However, this is not necessarily a good thing in regard to algal response in the lower river. Without the impoundments, some of the nutrient load would move in event-driven pulses, and a good portion of such loads would flush through the system without elevating concentrations for long enough or at an appropriate time of year to promote elevated periphyton growth."

(*North Coast RWQCB March 2010 4-26 Staff Report for the Klamath River TMDLs, the Klamath River Site Specific Dissolved Oxygen Objective, and the Klamath and Lost River Implementation Plans*, *ibid*, p. 4-26)

Conclusion

In summary, we request that the EIR include the issues we have discussed in these comments, and that it meet our requests for disclosure and analysis.

Overall, we request the draft EIR for this project include alternatives that evaluate the removal of four or five dams as the preferred alternative, that the Reservoir Management Plan be deemed as insufficient mitigation, and that unless the final Certification includes such includes dam removal, that Certification be denied.

Thank you for the opportunity to comment on scoping for the Environmental Impact Report (EIR) for the issuance of a Water Quality Certification for the Relicensing of the Klamath Hydroelectric Project (FERC No. 2082).

Respectfully submitted,



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January 26, 2017

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Subject: Scoping Meeting Input for Environmental Impact Report for Dam Removal on the Klamath River

Thank you for accepting input to the Environmental Impact Report for dam removal on the Klamath River associated with PacifiCorp's FERC license Surrender. The Shasta Group of the Sierra Club is located in northeastern California and consists of approximately 800 members. Most members have visited the Klamath River for recreation such as rafting, canoeing, sightseeing or fishing. The Sierra Club supports the Klamath River Renewal Corporation (KRRC) proposed project of decommissioning sufficient portions of the Lower Klamath Project to provide for volitional fish passage and a free flowing Klamath River. Only removal of the dams will accomplish the objective of unrestricted fish passage and improvement of water quality. The CEQA process should proceed as quickly as possible and therefore existing documents should be used where appropriate. We look forward to providing comments on the Draft Environmental Impact Report.

Respectfully,

John Livingston

John Livingston
Chair of the Executive Committee, Shasta Group

We are 4 generations at the same location on the Klamath directly below where Iron Gate Dam now exists, before and after, at what is described in all rhetoric as the 'focal point' of dams impacts. I am in the Klamath I love over 50 times a year for nearly 60 years, before and after Iron Gate, as my grandfather before me.

1 The majority of salmon reaching our location are depleted and dying, before and after dams. In combination with multiple impassable upstream reefs, a river often going subsurface in the canyon late summer before dams, and the naturally non-conducive upper basin salmon habitat, salmon were never historically known resident above Spencer Creek near present Copco Dam or to populate the upper Klamath Basin. Historical documentation, experiential testimony, and now a recent proponent study intended to confirm the opposite, referenced and submitted to this Agency many times in the past, have been consistently ignored in pursuit of Agency agenda.

2 Our area has witnessed the dam related dramatic improvements to water quality, late summer quantity, fisheries habitat, riparian stability, drastically reduced flood damage, and environmental improvements. Dams vastly improved the fisheries above and below for optimized and sustainable resident warm and cold water species. Iron Gate Dam artificially creates 'unnaturally' cold downstream water resources for one of the best producing hatcheries in California, far exceeding prior known upstream production. Statistics for nearly a hundred years evidence NO significant alteration in salmon returns occurring at our location as a result of the first dam. The addition of Iron Gate Dam and Hatchery INCREASED averaged returns by well over 100%, and averaged a 200% increase during proponents' media cited so-called 'recent catastrophic declines'. Incoming data now confirms the locally submitted historic documentation, empiric declarations, and studies regarding the environmental benefits of the hydroelectric and storage facilities. However, NONE of that data is allowed to modify failed Biological Opinions until AFTER the dams are scheduled for irreversible removals. Hatchery and cold water resources, along with clean hydroelectric power for 70,000 homes, major holistic ecosystem enhancements, non-reproducible regional recreational opportunities, optimized downstream benefits, property use and valuations, public safety, and both area and downstream public/private infrastructure will be lost as a result of dams removals.

3 Chinook are not endangered, negating any rhetoric for wide spread dams removals devastation. Spending countless billions forcing a naturally non-conducive upper basin square peg into a profiting special-interest round hole, pushing for the return and compounding of detrimental conditions existing prior to the dams, destroying watershed-wide beneficial and irreplaceable resources for a science cited 'chance' of perceptible benefit bears no transparent reason.

4 Coho salmon, which 'endangered' status this KBRA/KHSA special-interest agenda helped create and manipulate, are listed by Fish and Game as a 'coastal fish generally occurring within 20 miles of the ocean; were never known indigenous to the upper Klamath; were unsuccessfully repeatedly planted since the 1890's; never saw a 'marginally sustainable' return until the 1960's 3rd attempt using coho imported from Cascadia AFTER Iron Gate Dam and Hatchery enhanced Klamath conditions; approximately 60% of coho returning to the Hatchery have been found to relocate and spawn in downstream tributaries and mainstem; not surprisingly, so called 'wild' coho are DNA identical to hatchery coho; and from the 1990s to this day ALL coho returning to Iron Gate Hatchery have been systematically killed, upon which exclusion of hatchery numbers from 'wild' salmon allowed the CREATION of 'endangered' status.

5 Sucker Fish, upon which 'endangered' status this KBRA/KHSA special-interest agenda helped create and manipulate, forced upper basin irrigators to agree with predetermined agenda terms of dams removals

and regional water confiscation without compensation before being allowed to even 'sit at the table' of selective secretly held meetings. Those suckers; had previously been subjected to multiple failed earlier attempts at intentional eradication by the same seated KBRA/KHSA Agencies; had been later listed as 'endangered' by those same agencies based upon their hypothesized 'dead zones' and numbers; were later proven in gross error by their own scientist studies but which rather than resulting in 'endangered' status removal instead resulted in the firing of those 7 scientists and court sealing of the records; have been the excuse for decades of oppression and extortion for additional water confiscations raising Upper Klamath Lake to historically unprecedented levels exclusively for sucker fish benefit against the recommendations of local residents, and as a result were found in 2012 to have actually DECLINED in Upper Klamath Lake by up to 86%, but which lake levels and confiscation have not been restored; were a 'modeled' reason calling for removal of John Boyle Dam as being one of those 'dead zones', but which latter study has found one of the most viable populations of suckers in the region which will be lost with dam removals; and are directly incompatible with the species requirements of salmon which the dams removals intend to superimpose upon a historically salmon nonconducive region.

6 A billion dollars spent and 17 years of KHSA/KBRA hypothetically modeled Biological Opinion implementations and confiscated flows destroying thousands of families' futures have resulted in ZERO attributable statistical increase to coho and an imposed 'restored-area' DECLINE in sucker fish.

7 Recent 'KHSA Interim Agreement' ratepayer funded data is now confirming the locally submitted historic documentation, empiric declarations, and studies regarding the environmental benefits of the hydroelectric and storage facilities. However, there appears NO intent to formalize or incorporate that data into the Biological Opinions until years AFTER the dams are scheduled for irreversible removals.

8 The Department of Water Resources Board (DWR) is unelected, appointed by the governor to serve at the governor's pleasure. That unelected Board is there to execute the policy directives of the governor. The governor's self-determined policy directives are subject to legislative review, but NOT to legislative revision. The governor has stated in the California Water Crisis Management Plan that ALL California Agencies are ordered to support and promote the removal of Klamath River Dams. On the 22 of December the DWR Board, without a vetting or determination of validity by FERC on the submitted recently formed and unfunded Klamath River Renewal Corporation (KRRC), took upon itself to initiate an Environmental Impact Report at taxpayer expense on behalf of that private corporation 'in support' of Klamath Dams Removals. The KRRC is a private 'non profit' corporation largely made up of the same KBRA/KHSA profiting special-interest parties, which members under their own created Bylaws are allowed to personally profit by virtue of their positions 'as long as the remaining Board gives its permission'. The October minutes for that KRRC Board showed 'non-member' Water Resources seated on the panel, but as of the 26th of January, no minutes were posted for the December 14th meeting which would reveal funding transfers. Notification of DWR's expedited intent and the 3 scheduled 2 hour long 'Scoping' meetings soliciting 'public input' wasn't received until January 6th. The one meeting scheduled within the most affected region, which 'may or may not' have a DWR Board member in attendance, was to be held 4 days later on the 10th. On the morning of the 10th, the announcement was made that the meeting was canceled 'due to weather' and 'may or may not be rescheduled', but that 'comments could be submitted at the other meetings'. Only upon fervent local protest did DWR announce a rescheduled meeting for the 26th, with ALL PUBLIC COMMENTS to be closed 4 working days later on February 1st, for the largest proposed dams removals in the history of the world. The DWR paid contractor (Stillwater) overseeing the EIR is the same paid 'scientific consultant' previously employed to support dams removals by ALL KBRA/KHSA seated special interest parties. EVERY relevant prior 'determination' the DWR Board has

made at every 'scoping' juncture, without exception, has been in support of confiscatory, regulatory, and administrative authority designed to compel and facilitate Klamath Dams removals. The Boards predicated limiting conditions relegates primary consideration to the prior 2007 FERC and 2012 KHSA EIS. Current science and experimentation refuting prior 2007 FERC EIS assumptions, options, and alternatives have rendered that document completely inapplicable. The KBRA demise was also the demise of KBRA associated promised unknown, uncertain, and unfunded 'restorations and mitigations' held 'intrinsic' to the KHSA. The KHSA EIR conditionally predicated that EVERY KHSA EIR scientific evaluation of removals be based upon the assumed successful implementation of those KBRA 'mitigations' which no longer exist, rendering the 2012 KHSA EIR totally irrelevant. As such, a new EIR MUST be performed that is based upon currently known conditions, fully comprehensive, holistic, transparent, and inclusive of ALL current data, ecosystem interactions, and regional impacts. The DWR Board has initiated this EIR at public expense for a private corporation which FERC has yet to vet, an act likely unprecedented in regulatory permitting history. It is impossible under the projected FERC timeframes for a DWR comprehensive EIR to be produced or for the Board to reasonably evaluate the information. The DWR Board proposes to render a supportive determination regarding dams' removal to influence FERC, inferring a 'comprehensive' evaluation, when DWR internally limits that EIR to considering ONLY conditions occurring in California, effectively disenfranchising an interdependent ecosystem. Given the manipulated and constructed past, it appears unlikely that DWR is capable of or considers producing any 'determination' other than a policy directed recommendation for Klamath Dams removals, regardless of the evidence or the multicounty official supermajority most knowledgeable and impacted citizens voting against Klamath Dams removals. Therefore it MUST fall to a fully comprehensive and inclusive NEPA EIS executed through FERC, encompassing the entire watershed impacts, options, alternatives, and required mitigations, to fulfill the public trust. Only AFTER that NEPA EIS and FERC evaluation would DWR be procedurally called upon or capable of producing a California EIS necessarily conditioned upon and subject to the options and mitigations considered by FERC.

Rex Cozzalio

Siskiyou County Water Users

January 31, 2017

State Water Resources Control Board
Mr. Parker Thaler
PO Box 2000
Sacramento, CA 95812-2000

Re: KRRC Clean Water Scoping Hearing
Klamath Dams, California

Dear Mr. Thaler and Members of CA Water Board,

1. On December 22, 2016 the DWR determined to produce an EIS regarding Klamath Dams removals, the largest proposed dam removal project in the world. Those most regionally affected were not made aware of that determination until January 6th, with DWR announcing the single locally scheduled 2 hour long 'public scoping meeting' and stating no assurance of even a single DWR Board Member in attendance. Even that announced meeting was cancelled on the morning it was to be held and, only after much local protest, was later scheduled for Thursday, January 26nd, with a comment period ending February 1st. Considering the time frame and given the selective conditions of 'review', apparently the DWR is simply going through the perfunctory motions of a mandatory 'process' to expedite a predetermined conclusion facilitating a predefined agenda. Given the time frame, it is not physically feasible for the Board to reasonably review and consider all applicable references.

2. The 'Lower Klamath Project' does not yet officially exist. It is an inappropriate name attached to an as yet FERC unapproved proposal from a non-representative special interest private 'corporation' intending to utilize public funds to destroy unrepresented public/private assets without proven qualifications, mitigations, assurances, justification, or accountability. Even the 'Project' name is ludicrous since the dams are located in the extreme 'environmental unit' upper reaches of the Klamath River, apparently in an attempt to convey a fabricated image of greater applicability and effectiveness for the river than is historically or environmentally supportable.

3. Despite that official recognition of the Klamath River Renewal Corporation (KRRC) by the Federal Energy Regulatory Commission (FERC) has yet to take place, for a 'Project' that does not exist, for a 'private' Corporation with questionable legal authority to even act as an applicant, the DWR has mysteriously self-initiated the use of public funds to produce a preemptory and expedited EIR. Dam removals are NOT a part of the existing PacifiCorp licensed Project (2028). Any intent by DWR to produce an EIS under a 'new' project regarding Klamath dams removals should NOT be initiated UNTIL such time as FERC's full vetting establishing the authority, ability, and privately funded financial capacity of the KRRC to fully carry out all potential imposed requirements, mitigations, and responsibilities involved.

4. Only after FERC approves the submitter's standing, subject to the same requirements as any other applications made by and at the expense of that private entity, should FERC designate a provisional Project number. If FERC is then to consider the largest dams removal 'Project' in the world, it MUST perform a complete NEPA EIS relative to removals. That EIS must encompass all current data,



alternatives, and options to removals, which were unavailable to previous EIS's and which EIS's at the time were predicated upon conditions and mitigations that no longer exist and/or are no longer assured. Therefore, FERC CANNOT utilize the prior EIS assessments predicated on conditions which are inapplicable to the present proposed Project and MUST perform a current NEPA EIS inclusive of ALL current impacts, alternatives, data, cost effectiveness, and consequential losses. Only after that NEPA EIS can DWR reasonably carry forward with any proposed DWR EIS. Since that EIS relates to the complete destruction of public/private resources utilizing public funds affecting the unrepresented lives, environment, and safety of the majority most affected and in opposition to dam removals and environmental degradation, any such EIS MUST be holistically comprehensive and require mitigations and protections for ALL affected environmental, economic, and social 'beneficial use impacts' encompassed. If FERC fulfills its responsibility to produce an inclusive NEPA EIS, then the DWR EIS must also include ALL environmental impacts and required cost assessed KRRC mitigations for those consequential 'beneficial use' damages potentially incurred as would be expected from any other private Project applicant. According to KRRC and 'amended' KHSA public statements, the 'amended' KHSA is a joint bi-state agreement regarding and affecting the entire Klamath watershed. DWR cannot have it both ways, citing inclusive assessment while restricting the 'considered requirements' below the interstate border, effectively dismissing the incoming water quality conditions and limiting potentials both natural and resultant from 'Project' actions occurring in Oregon. DWR cannot reasonably evaluate potential impacts or percentage benefits from dam removals if not incorporating both the naturally occurring and Oregon portion of proposed impacts. Since DWR states it cannot consider comprehensive water quality and beneficial use impacts except for those actions and impacts occurring within California, then the proposed Project review and oversight MUST instead fall to a NEPA EIS for compliance and impacts in entirety to be incorporated under both the FERC EIS defined options and alternatives and any conditionally dependent subsequently performed DWR EIS.

5. It is irrefutable that the DWR Board and its directives have a pre-determined objective of Klamath Dams removals. Even the 'Notice of Preparation (NOP) bears the quote that "The EIR *will be prepared to support* consideration of the Klamath River Renewal Corporation's (KRRC) LKP application for water quality certification" (emphasis added). In spite of the official greatly exceeded supermajority of the most affected voters in opposition to Klamath Dams removals, the DWR Board has relentlessly proceeded with the gubernatorial directives demanding all Agencies comply with Klamath Dams removals (Water Crisis Plan). A board appointed by the governor, which is incumbent to carry out the unilateral policy directives of the governor, and is given the subjective authority to codify regulatory policies executing such directives, including the self-authorized unaccountable ability to sanction overt environmental and regional destruction disallowed under any other circumstances, cannot possibly be held immune from accusation of profound bias. The DWR has openly endorsed and supported the KHSA/KBRA and the functionally unrelated 'amended' KHSA. The DWR's NOP political tactic citing their not 'signing' the agreements, in order to convey an image of independent non-bias is not borne out by Board structure, dictated policy directives, prior policy oriented code revisions, or current selectively defined prejudicial actions.

6. As earlier stated, the 'amended' KHSA special interest 'agreement' currently under consideration, other than for the final 'blow and go' removals of dams, is functionally completely disconnected from the previous KHSA. The Klamath Basin Restoration Agreement (KBRA) was an intrinsic part of the

original KHSA. The KBRA dams removals agenda, by its own self-appointed special interest Board admission, held themselves unaccountable and uncertain in their public 'promise' of transforming a historically non-conducive environment and fully 'mitigating' the environmental damages from dams removals. For the ultimate success of which they could not and would not assure, their 'plan' was to later devise and utilize 'adaptively managed' as yet unknown, currently unavailable, and unfunded means. Nonetheless, the presumed 'success' of that unaccountable KBRA 'promise' was incorporated as an 'intrinsic part' within the KHSA, in which the Secretary of Interior declared 'one could not exist without the other'. As a result, the Department of Interior (DOI) EIS was entirely performed under the prescribed assumption that ALL promised undefined KBRA transformations and 'mitigations' were already completed and successful. With the dissolution of a KBRA no longer in existence, neither are the KBRA 'mitigations' required within the assumptions of the KHSA EIS, thereby rendering the KHSA EIS completely inapplicable. With the 'amended' KHSA having stripped out even those defective and now non-existent KBRA 'promises' to further the bypassing of public representation within Congress, the 'amended' KHSA MUST be submitted to a comprehensive new EIS subject to currently created 'amended' KHSA terms. As the original 2007 FERC EIS is long outdated and presently in error in its limiting options, alternatives, and applicable research; and as a federal 'Project' typically requires a NEPA EIS; and as FERC has officially stated its own policy requiring a full EIS for ALL significant Projects; a comprehensive EIS MUST be performed. Only AFTER a NEPA EIS informs FERC as to the present day options, potential risks of, and alternatives to dams removals, would it be appropriate for DWR to produce its own EIS reviewing 'Project' impacts and mitigations insuring preservation of ALL California impacted beneficial uses.

7. Under the KRRC intent of execution, the decisions and impacts regarding cultural sites, recreational facilities, 'sufficient' removals, consequential damages, public interests, and unrepresented private assets, are being 'determined' by an largely self-appointed agenda defined special-interest Board with a Bylaws-incorporated potential for each of those members to profit as a consequence of those decisions. The 'amended' KHSA and the 'private' KRRC corporation shielding from public disclosure the imposition of an unaccountable agenda to 'bypass' Congress is likely illegal on its face, at minimum attempting to bypass 'public process'. Constitutionally, it is illegal for two or more States to form or break a previous interstate treaty (agreement) without Congressional approval, negating the amended' KHSA and KRRC's stated premise of bypassing Congressional approval.

8. In an attempt to circumvent the demise of the intrinsic KBRA 'mitigations' from the KHSA, the DWR seems to interpret their own opinion of the adequacy of the inherently different 'Klamath Power and Facilities Agreement' (KPFA) simply because it "*expresses* a *commitment* to *continue negotiations* regarding *certain* issues addressed in the KBRA" (italics added). Since when does an 'expressed commitment' to 'continue negotiations' regarding 'certain issues' constitute a DWR determined adequate, definitive, and substantive 'addressing' of regulatory prerequisite procedures, guarantees, and mitigations normally necessary prior to DWR initiating and performing an EIS? Obviously, except in the case of a biased participatory agenda, would DWR ever accept and initiate action at public expense for any such proposal from a 'private entity' applicant. Under such circumstances, any scoping proclaimed DWR Board election to 'determine' that the as yet to be verified KRRC LKP 'adequately protects the beneficial uses throughout the entire watershed' would fail to meet any reasonable legal or scientific level of credibility.

9. DWR Board "consideration to support … water quality certification of the LKP", by limiting themselves to only 'consider' an outdated 2007 FERC and inapplicable 2012 KHSA EIS, intentionally narrows the realm of current scenarios, evidence, research, and options in an effort to achieve a predefined agenda (removals). Options and research now refuting prior limitations and assertions, such as recent microcystis biological life cycle understanding; the only known and now proven hydroelectric water storage facilities' cost effective amelioration of naturally endemic water quality conditions; the current inability to produce previously assumed 'beneficially necessary' mitigations; and the now proven failed earlier environmental assumptions and dam related impacts, now requires a holistic EIS inclusion and comparison of ALL impacts and alternative options to dams removals.

10. Since ALL of DWR NOP cited resultant conditions WILL occur, and more, known detrimental to present beneficial uses as a result of dams removals, DWR cannot merely "examine" those impacts and make an unaccountable, assumptive, and unmitigated 'determination' of acceptability based upon their 'opinion' that removals MAY EVENTUALLY be found 'potentially beneficial' to a limited selectively few 'beneficial uses', without adequately addressing required mitigation and compensation for ALL imposed KRRC associated current and future certain massive and unrepresented losses.

Summary

The DWR has no authority to preemptively self-initiate an EIS at public expense.

The DWR is administratively unable to effect an unbiased opinion due to prevailing policy directives.

The DWR Board is physically unable to produce an effective 'determination' prior to procedural performance of all of the following, in order: 1) FERC verification of the private special interest applicant and Project; 2) the KRRC's demonstrated ability and resources of that Corporation to fully carry out, mitigate, and protect ALL potentially affected beneficial uses; 3) the production of a holistic NEPA EIS considering ALL current data, comprehensive potential impacts, alternatives, and options to dams removals; 4) the evaluation by FERC of the NEPA EIS as to the cost effective public benefit viability of the proposed Project and the KRRC's ability to carry out, mitigate, and compensate ALL affected parties; 5) the resultant FERC, NEPA EIS, and KRRC defined 'Project' terms, execution, and mitigations; 6) and the then DWR produced EIS quantifying ALL relative environmental aspects and regional impacts. Only after performance of the above can the DWR Board reasonably evaluate the 'Project' impacts and any additional potential beneficial use mitigations.

Siskiyou County Water Users

Rex Cozzalio

Technical Assistant to SCWUA

Richard Marshall
Yreka
1/26/17

(2)

Siskiyou County Water Users

January 26, 2017

State Water Resources Control Board
Mr. Parker Thaler
PO Box 2000
Sacramento, CA 95812-2000

RE: California Water Board
KRRC/ Scoping Hearing
Klamath Dams

Dear Mr. Thaler,

My name is Richard Marshall and I am President of the Siskiyou County Water Users Association representing our organization of some 200 members as well as thousands of Siskiyou County citizens who indicated by voting nearly 80% their desire to keep the Klamath Dams in place. I would hasten to add that a recent vote in Klamath County, Oregon produced approximately the same result. In addition I am also a rancher in the Scott Valley.

Mr. Thaler, nearly exactly one year ago on January 26, 2016 we met in the same room on practically the same subject that is a scoping session regarding water quality and the Klamath Dams. There was a large crowd in attendance that evening again on short notice. At that time we registered the same concern regarding the seeming inability of the Water Board to properly notice the public regarding this most important meeting. Certainly it is important to us, if not to you and your associates that we participate in the process. It seems we are constantly finding out about these "public scoping" meetings at the last minute. Even though I am registered on two of the notice lists i.e. yours and the FERC. I never received notice from your organization and surprisingly did get notice until just prior to the proposed meeting of the 20th from the FERC. I don't know the rules that you follow but when I used to conduct public hearings it was required generally speaking to give 90 days' notice of an EIR scoping meeting so that the public could fully participate. I therefore question for the record the authenticity and legality of this meeting because of lack of proper public notice.

At that meeting of Jan. 26, 2016 we were asked to submit our concerns in writing which we did, thinking that our questions and opinions deserved some sort of response from your organization who is willing to take our tax dollars and spend without reserve. However, no such luck as a thank you letter for our thoughts or a response to our considered opinions.

CEQA vs NEPA

Our first issue with the project proposal is that this proposed project requiring an environmental study is not properly done by using CEQA. The Klamath River is a federally designated Wild and Scenic River and also qualifies under the navigable river federal waterway. The project as proposed impacts two states, Oregon and California. This alone demands that an environmental analysis concerning the destruction of the hydroelectric and associated storage facilities; the destruction of environmental protected fish species not the least of which includes the Coho Salmon and the Green Sturgeon; as well as the short and long nosed suckerfish; and much of the aquatic life in the river system; together with the pollution of the riverine system by toxic sediment demands that the EIR/ EIS be done under NEPA rules and prepared by the US Commerce Department and the Department of Interior.

Furthermore, one can't study just part of the Klamath River system in California especially when it comes to sediments and pollution. One must look to the headwater source of the Klamath in Oregon. The production of nitrogen and microcystin which is wrongly attributed to the presence of the hydroelectric facilities occurs naturally and by way of the byproduct of farming operations and particularly the bird life in the Oregon side of the River system. The studies done previously by the Bureau of Reclamation make this point very clear. Among others they concluded that the pollution problems could be substantially reduced or even eliminated by the installation at Keno Dam of a water quality treatment facility. Within this same study the removal of the hydro facilities and storage capability will dramatically impact the ability to modulate the river flow especially in low water times. The BOR estimates that replacing this flow capability may cost upwards of Eighteen Billion dollars.

Therefore we object strenuously to the proposed actions which absent a thorough analysis of the Pacific Decadal Oscillation as well as all seven reaches of the Klamath cannot determine the full impact of the effort to remove the hydroelectric facilities. The study should further include an examination of the impact of the destruction of the facilities will have on the economic well-being of the counties which are impacted. For example there will be an immediate destruction of property values particularly at Copco Lake where owners have already experienced a loss in value.

Finally in this section we raise an objection to the State of California spending tax payer dollars to benefit a private 501 (3) c non- profit corporation the KRRC which although recently filed as a California Corporation came out of New York. It is bad enough that we have been forced to pay an electric surcharge to remove the hydro facilities for many years now against our will and best interest for Siskiyou County. Either KRRC or PacifiCorp should be paying for the studies to be submitted to the State for review, analysis and potential approval. The KRRC has not been recognized by either the FERC or the CPUC to carry out the proposed activity. In fact the FERC

raised an objection to the KRRC both filing simultaneously the license transfer from PacifiCorp to KRRC and filing to terminate the license and remove the hydro power facilities.

Amended KHSA

On April 6, 2016 after the resounding failure of the previous KBRA and KHSA agreements, which had been pursued for many years by the Department of Interior, State of California, State of Oregon and numerous agencies and NGO'S, and rejection by Congress, despite numerous attempts by the environmental arms of California and Oregon reconstructed the previously failed KHSA calling it the amended KHSA. This is the underpinning of your organizations efforts to legitimatize the effort to destroy the hydroelectric facilities. It is our opinion that this document is illegal as the Governor of California had no legislative authority to bind the State in a potentially disastrous project without the benefit of appropriate studies and deliberations by the State Legislature. In short Governor Brown had no authority to enter into an abortive attempt to create a Federal Interstate Compact.

Klamath Bi State Compact

The Klamath Basin is governed by the 1957 Compact between the States of California, Oregon and the Federal Government. This governing doctrine is referred to as "the law of the River". It is a Federal Statute enacted by both legislatures of Oregon and California and codified by the US Congress by Statute enacted on August 30, 1957 (71 Stat. 497). This document arrived after many years of negotiation between the States and their representatives set forth the process for prioritization of beneficial uses of the Klamath River including the hydropower element which was negotiated at the time by COPCO the predecessor to PacifiCorp. The negotiating team included officials from both Oregon and California and the Federal government. The Compact is still in effect and is still the "law of the River". This magnificently versatile agreement arrived at by earnest and artful negotiations included a right to 60,000 acre feet of water to be taken from behind Iron Gate Dam and 200,000 acre feet from behind Keno Dam for the Butte Valley area. Amongst those at the table were members of the Siskiyou County Board of Supervisors under the guidance of Senator Collier. It also resulted in the development of the very successful fish hatchery at Iron Gate which draws cold water to stimulate the development of SIX MILLION FINGERLINGS (6,000,000) per year to keep the Salmon population well stocked. This process if the dams were destroyed would go with them. There will be no way to make up the difference.

Siskiyou County Flood Control and Water Conservation District

A unique piece of legislation flowed from the adoption of the Compact to the benefit of Siskiyou County. Through the legislative process in California Assemblywoman Pauline Davis authored a AB 1592 which was further codified under the California Water Code as Section 89-

1. This unique piece of legislation blessed the County of Siskiyou with special water rights to govern all waters of Siskiyou County including subterranean and surface water excluding the water controlled by the upper basin federal project. This was intended to insure that Siskiyou County would be the master of its own fate to provide for development of hydropower and water usage to benefit industry, agriculture and domestic. Again we would postulate that this unique water right conferred on the County of Siskiyou by the State of California trumps the efforts of the Water Board. These were "quid pro quo" for the County's spearheading the effort to develop the Federal Interstate Klamath Compact.

Conclusion

We reiterate our concerns over the legitimacy of the scoping session by the Water Board first because the notice period was exceedingly short and begs the question of the intent of the board in giving such short notice to the group most impacted by the potential destruction of the hydro facilities i.e. Siskiyou County in which three of the four facilities to be destroyed are located and which has the greatest river frontage to be impacted by the release of sediment and opening up the prospect of flooding and resultant damage. Secondly, we object to the use of state funding to conduct the EIR/EIS for the benefit of a private company, the KRRC, which is not even recognized by either the FERC or by the CPUC. The KRRC has no demonstrated capability to manage such a huge undertaking and they have no significant funding. Thirdly, we believe that the Governor of the State of California had no authority to enter into the Amended KHSA as it had never been reviewed or approved by the Legislature and by signing the agreement he has put the State of California and the citizens of Siskiyou County at great risk and peril. Fourthly, the Water Board planned action violates at least three Federal laws (NEPA, Federal Interstate Compact, Article 1 Sec. 10 US Constitution, and Endangered Species Act) and two State laws (Quo Warranto, and Water Code Sec. 5900-5901). Fifth, the proposed objectives of the project under the KRRC are physically and scientifically unattainable. Sixth, most importantly the existing Interstate Federal Compact has not been dealt with by Congress and therefore remains the law of the river.

Finally, we respectively demand that the Water Board respond in writing to the issues we have raised on or before February 15, 2017.

Sincerely yours

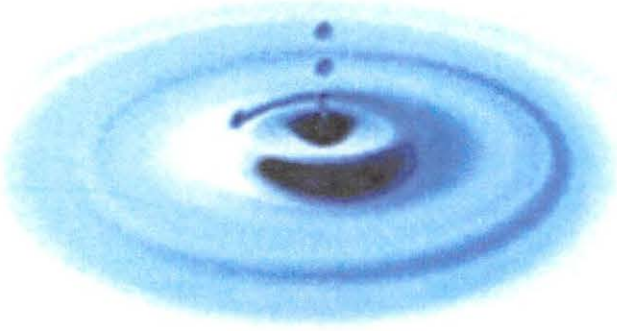
Siskiyou County Water Users

Richard Marshall
Richard Marshall
President

Richard Marshal Yreka 1/20/17

(2)

Siskiyou County Alternatives To Dam Removals



Submitted By S.C.W.U.A

SISKIYOU COUNTY WATER USERS ASSOCIATION

UPDATE 8/4/16

In late 2015 the KBRA came apart at the seams as it was unable to get Congress to agree to fund the destruction of the Klamath Hydro facilities. Although there were some in Congress who were allies of the environmentalists they were held in check by those who felt that it was an outrageous use of funds and subjected the government to potential monumental costs in restoring the Klamath after the dams were gone. They also felt that removing the water storage capability made no sense given the drought and the search for ways to conserve water.

In early 2016 the two governors of Oregon and California both "Browns" together with PacifiCorp and a number of Indian Tribes and representatives of the Federal agencies of the Dept. of Interior and the Dept. of Commerce met with other representatives of the environmental organizations that comprised parties to the KHSA agreement signing an Agreement in Principal to amend the KHSA agreement and circumvent Congress for the sole purpose of destroying the Klamath Hydro Dams. This would accomplish their stated goal of destruction of the dams.

In reviewing the revised KHSA it was clear that the strategy now would entail circumventing Congress by putting the process in the hands of the Federal Energy Regulatory Commission or FERC as it is commonly known. Hand in hand with this effort was to pass off the potential legal liability for damages to the newly created Dam Removal Entity (DRE). This would relieve the States, PacifiCorp and the agencies of any responsibility for the ecological damages that would inevitably result from the massive destruction (the largest dam removal project in the US). If a biological disaster ensued the burden would fall to the ratepayers and taxpayers ultimately. In addition the ratepayer surcharges in amount of $200 MM together with the tax payers $250 MM would be transferred with the dams to the DRE. Interesting to note is that those surcharges were actually supposed to be held in trust by PacifiCorp, meaning that the funds are those of the ratepayers. Also, interesting to recognize that the DRE is a hastily formed California 501 3c but the offices are on the 42nd floor of a building in New York City in the offices of an attorney. Now we find out weeks later that the board of this group which is just being formed is being composed of some KBRA members with others not yet named.

SCWUA is in the process of trying to establish a civil lawsuit to represent the public who have been disenfranchised in this process. The effort will be aimed at bringing an injunction against the FERC to move the matter to the EPA who has so far evaded its responsibilities with regard to the destruction of listed endangered species and the issue of the Clean Water Act which comes under both the State and Federal Water Boards. You can help by becoming a member of SCWUA or making a donation. Thanks for your help.

SCWUA Board of Directors

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SCWUA

Siskiyou County Water Users Association

Making a Difference

Siskiyou County is faced with multifaceted attacks by the Federal Department of Interior and the State of California.

The SCWUA objectives are to provide substantial long term benefits to all of Siskiyou County by:

- **Protection of existing water and property rights.**
- **Retaining our Clean Hydro-Electric Reservoirs on the Klamath River.**
- **Preventing sky rocketing electricity cost and increase to our carbon foot print with replacement power.**
- **Increasing and sustaining property values.**
- **Adding irrigation waters to the Shasta Valley.**
- **Reducing the irrigation demands on Lake Shastina.**
- **Increasing instream flows in the Shasta and Klamath Rivers.**
- **Provide for additional anadromous fish habitat.**
- **Coordinate and Cooperate with Federal, State and County Agencies on projects that are beneficial to Siskiyou Co.**

The (SCWUA) began taking shape in Jan. 2008 when several community leaders in the Yreka area reviewed the Klamath Basin Restoration Agreement (KBRA). The KBRA settlement group represents 2 farming units, 3 tribes, 3 Federal Cabinet Secretaries, 3 Oregon State Depts., 1 CA State Dept., 2 of the 9 Basin counties, 8 environmental groups and 2 fishing associations. **(Siskiyou County is not represented)**

During the past 2 years the KBRA settlement group (in closed **secret** sessions) negotiated agreements contrary to the benefit of most citizens of Siskiyou County.

When the Siskiyou County Board of Supervisors first learned publicly that 3 of the 4 dams slated for removal were in Siskiyou County, they held public hearings which reflected an overwhelming majority of Siskiyou County's citizens' are opposed to the

Settlement Groups' agreement. The County passed a 4 page resolution supporting the County's citizen's feelings, and to obtain a more detailed look at the citizen's concerns. The County Board of Supervisors held 2 more Public Sessions that pointed out the adverse effects of the proposed actions, the lack of supporting scientific evidence, misrepresented use of historical records, and that sustaining the minimum mandatory flow of 1300 cfs for salmon cannot be met without the storage capacities of the dams. Soon afterward, countywide conversations and feelings exploded and several informal roundtable discussions were held amongst knowledgeable residents: scientists, engineers, educators, the Shasta Nation, property owners and pioneers of the river. Their collective understandings of KBRA impacts to the Klamath River's flows, flood potential, water quality issues, fish populations, habitat use, Tribal impacts, property values, clean hydro- power and understanding of the "Law of the River" (1957 Klamath River Compact) demanded a stand. The **SCWUA** took the position that whatever is done to the River **must be done right**, to the Klamath River Basin as a hole; as it will **forever** totally affect the livelihood of the residents of Siskiyou County, the largest county with the most River miles in the 10 million acre Klamath Basin.

In 2009 work began by the 10 volunteer organizers of the SCWUA to review authentic data and begin an organized effort to challenge the Klamath Settlement groups' (KBRA) provisions. (Frank Tallerico, Robert Rice, Leo Bergeron, Anthony Intiso, Betty Hall, Roy Hall sr, Roy Hall jr, Harry Lake, John Menke, Jerry Bacigalupi and Rex Cozzalio)

The volunteers (River Patriots) selected an organizational name of **Siskiyou County Water Users Association (SCWUA)** and Articles of Incorporation were filed as a tax-exempt status corporation as defined in the Internal Revenue Code 501 (c) (7).

Mission

Support and defend county-wide property rights, water rights, and water use priorities as they are identified in the "Law of the River" (1957 Klamath River Bi-State Compact and Appendixes A, B & C).

Objectives

Currently the **SCWUA** is pursuing 6 goals:

1. Protecting Our Water Rights; obtaining legal services when necessary to protect property and water rights held by Siskiyou County residents.

2. Pursue the Shasta Nation (anadromous fish by-pass) alternatives to dam removal within Siskiyou County and preserve the clean sustainable hydroelectric power to 70,000 homes, property values, warm water fisheries, recreation, flood protection, etc. provided by the dams.

3. Pursue the transfer of the annual 60,000 acre feet Klamath River storage adjudicated water right from the State of California Dept of Finance to Siskiyou County Flood Control & Water Conservation District for irrigation and in stream

enhancements in the Shasta Valley, as provided for in Appendix B of the Klamath Basin Compact.

4. Pursue grants and funding opportunities to engineer and develop the Shasta Nation Anadromous Fish By-Pass Alternatives to Dam Removals and the Klamath-Shasta River Canal System for water use within Siskiyou County and the Montague Irrigation District.

5. Pursue opportunities to examine and make repairs to Dwinnell Dam to increase its effective storage capacity to 50,000 acre feet.

6. Explore the possibilities of expanding Siskiyou County's current power supply at Box Canyon Dam to Irongate, Copco I, and Copco II hydro-electric facilities.

Membership in SCWUA

All citizens, property owners, ranchers, farmers, timber lands owners, irrigation districts, businesses, industries, organizations and anyone else using water within the county are membership candidates. Any one that turns on a faucet or flushes a toilet is a water user.

Application Fees & Dues

Annual Membership Dues:

Water user	$25.00
Property Owner	$50.00
Farm, Ranch, Timber Owner:	
Less than 100 acres	$100.00
Greater than 100 acres	$300.00
Commercial Businesses and industries	$500.00
Cities, Water agencies and Irr. Districts	

Siskiyou County Water Users Association, Inc

347 N. Main Street; Yreka, Ca. 96097

This instrument is a correct copy of the original on file in this office.
ATTEST:
COLLEEN SETZER
County Clerk
of the State of California
in and for the County of Siskiyou.
By _____ Deputy

RESOLUTION NO. 11-256

RESOLUTION OF THE BOARD OF SUPERVISORS OF THE COUNTY OF SISKIYOU SUPPORTING THE SISKIYOU COUNTY WATER USERS ASSOCIATION EIR/EIS COMMENTS

WHEREAS, the United States of America, Department of the Interior, has currently issued an EIR/EIS with respect to the removal of the Klamath hydroelectric facilities; and,

WHEREAS, three of the dams that are part of the Klamath hydroelectric facilities project are located in Siskiyou County; and,

WHEREAS, the Siskiyou County Water Users Association has prepared an alternative to removal of the dams; and,

WHEREAS, the Siskiyou County Water Users Association's support of the County effort in looking at alternatives to dam removal has constituted a meaningful voice of the people of the County of Siskiyou; and,

WHEREAS, the Siskiyou County Water Users Association was a major proponent for the placement of Measure G on the ballot which resulted in the citizens of Siskiyou County voting overwhelmingly to oppose dam removal; and,

WHEREAS, the Siskiyou County Water Users Association has prepared an in-depth and comprehensive study of the Shasta Nation Tunnel Unassisted Anadromous Fish Passage alternative to dam removal; and,

WHEREAS, the Siskiyou County Water Users Association's document entitled "Siskiyou County Alternatives to Dam Removals" constitutes an unprecedented effort by a private citizens group for the residents of this County that demonstrates the flaws in the United State's intention to remove the dams on the Klamath River,

NOW, THEREFORE, BE IT RESOLVED that the Board of Supervisors of Siskiyou County supports the Siskiyou County Water Users Association efforts and the filing of the "Siskiyou County Alternatives to Dam Removals" as comments to the EIR/EIS being circulated by the Department of the Interior.

SISKIYOU COUNTY
RESOLUTION
No. 11-256

PASSED AND ADOPTED by the Siskiyou County Board of Supervisors at a regular meeting of said Board, held on the 13th day of December, 2011, by the following vote:

AYES: Supervisors Cook, Bennett, Armstrong, Kobseff and Valenzuela
NOES: NONE
ABSENT: NONE
ABSTAIN: NONE

Jim Cook, Chair
Board of Supervisors

ATTEST:
COLLEEN SETZER,
County Clerk

By _____
Deputy

G:\Share\FERC_Draft EIR_EIS September 2011\Resolution Supporting SCWUA EIR_EIS Comments 12_13_11.wpd

RESOLUTION FOR THE PRESERVATION OF THE KLAMATH RIVER AND THE PRESERVATION OF THE KLAMATH RIVER BASIN WITH RESPECT TO THE HYDRO-ELECTRIC FACILITIES

Whereas: this document exposes the impacts that the Klamath Basin Restoration Agreement **(KBRA)** and the Klamath Hydro Settlement Agreement **(KHSA)** would have on the region **by removing four perfectly sound hydro-electric dams on the Klamath River and taking control of all Klamath Basin water through the creation of a Charter that would give control of the entire Klamath Basin Watershed to a select group of the signatories' of the KBRA & KHSA. And,**

Whereas: the **KLAMATH BASIN COMPACT** between the states of California and Oregon signed by both Governors, Congress, and the President in 1957 was enacted to control waters and water disputes in the Klamath River Basin has been ignored by the KBRA. The KBRA will exclude the public from participation in any decisions that impacts the Klamath Basin for 50 years. And,

Whereas: these agreements falsely propose to create an additional 420 miles of additional anadromous habitat above the dams for the benefits of the questionable ESA listing of the Coho salmon, the short nose and lost river suckers, and to resolve government and state sponsored water wars between Farmers, Ranchers and Indian Tribes, And,

Whereas: KRRA agreements, if implemented, would destroy the Klamath Basin, costing all citizens, communities, farmers, ranchers, ratepayers and taxpayers billions of dollars that will neither improve nor create additional anadromous fish habitat above the dams proposed for removals. The Department of Interior (DOI) National Scientific Review Officer stated in his findings that the KBRA & KHSA would be better termed an experiment rather than a restoration agreement that was doomed for failure. And,

Whereas: this document proposes to create additional water storage and ground water enhancement projects for the benefits of **all** the Klamath River Basin including the questionable ESA listings of the Coho salmon, the short nose sucker, and to resolve government sponsored water wars between Farmers, Ranchers, and Indian Tribes. And,

Whereas: this document presents the following impacts and proposals to address the problems created with the approvals of the KBRA and KHSA.

Resolved: **the Yreka Greenhorn Grange and the Siskiyou County Water Users Association, and the majority of Siskiyou and Klamath Counties Residents OPPOSE DAM REMOVALS (as resolved by MEASURE G where 80% of Siskiyou County voters oppose the removals of the Klamath River Hydro-Electric Facilities proposed for removal under the KBRA and KHSA), and presents the following ISSUES, OBJECTIVES, and PROPOSALS to address the position taken for this resolution.**

ISSUES and OBJECTIVES in THE KLAMATH RIVER BASIN:

1. **To Stop the Federal Department of Interior (DOI) and State Agencies' Scams, Conspiracies, Bribes, Grants and Blackmails** to gain support **to remove four perfectly sound hydro-electric dams** on the Klamath River and **take control of all Klamath Basin water** by over regulating, spinning, and promoting the following events: Over reaching FERC hydro-electric relicensing requirements; Endangered Species Act (EPA) questionable listings; North Coast Regional Water Control Board (TMDL) over reaching Klamath R. water quality regulations; DOI Klamath Project Irrigators electricity rate increases, water cutoffs and irresponsible regulated river flows; Upper Klamath Basin Tribal Water Right Wars against Farmers and Ranchers; Grants and Bribes to tribes, NGO's, Farmers and Ranchers to bring **Stakeholders** together to sign the KBRA. All signatories having to agree to one primary objective (**Dam Removals**). Note: the dams are downstream of Upper Basin Tribal water wars and the DOI Klamath Project and have no effect on either, except they were Federally approved to provide cheap power to the Project Irrigators.

2. **To Save Taxpayers and Ratepayers over one billion dollars in initial cost** associated with the Klamath River **GREEN** Hydro-electric Dams and facilities scheduled for removals ***(down played by the DOI to be less than the $450 million cap in the KBRA & KHSA)***, plus their replacement cost with **NON GREEN POWER.** This cost does not include **the additional long term billions of dollars** in cost associated with future Klamath R. sediment release restorations and secret undisclosed KBRA and KHSA agreements.

3. **To Save Iron Gate Fish Hatchery and the complete destruction of the Klamath River** aquatic and fishery habitat below **Iron Gate Dam and Fish Hatchery** by **PROHIBITING the DOI & CDFG irresponsibly washing 20+/- million cubic yards of contaminated sediments (equivalent to 3 feet deep by 150 feet wide by 190 miles long) retained behind the dams down river during dam removals.** ***(An intentional violation of the State and Federal clean water act to reduce dam removal cost below the $450 million KBRA & KHSA cap).*** Note, dredging the sediments prior to dam removal was considered by the DOI and would be the most environmental preferred alternative, however, it was cost prohibited under the $450 million cap.

4. **To Challenge the DOI claim that dam removals would create an additional 420 miles of anadromous fish habitat above the dams.** Whereas several historical reefs and falls existed on the Klamath River which prohibited anadromous fish to reach the Upper Klamath Basin above dams proposed for removals.

5. **To Achieve the overriding environmental objectives** set forth by the Federal Energy Regulatory Commission (FERC) and the North Coast Regional Water Control Board (NCRWCB) to restudy and negotiate **unreasonable** mitigation recommendations for relicensing the four hydro-electric dams on the Klamath River in Oregon and California

6. **To Restore Historic Water Rights** back to the Upper Basin Off Project Water Users prior to the ESA listings and the KBRA.

7. **To Restore Historic Water Diversions** back to the On Project Water Users prior to the ESA listings and the KBRA.

8. **To Introduce Other Water Development Proposals** to provide the Upper and Lower Klamath Basins with **MORE WATER STORAGE** (with beneficial controlled releases).

PROPOSED PROJECTS:

1. **Implement a trap and haul study** around the dams scheduled for removals to determine that anadromous fish habitat does or does not exists above the dams. If anadromous fish habitat exists, Implement the Shasta Nation Tunnel Unassisted Anadromous Fish Passageway around Iron Gate, COPCO 1 and COPCO 2 Reservoirs at a cost of $50million (1/6th the $300million cost estimated for installing fish ladders & 5% the $1billion cost of dam removals).

2. **Establish additional reliable storage facilities within the Upper Klamath Basin** to augment the Upper Klamath Basin farmer's and rancher's water rights, Klamath Project Water User's demands, instream flows, and to improve water quality in the Upper Klamath River. This will preclude another 2001 Yr. Episode of Federal Agencies' **inappropriate** allocation of water for raising Upper Klamath Lake levels for endangered species, depriving 1400 project irrigators their water and negatively affecting the short nose sucker. In 2013, another episode involving Tribes and Federal & State Agencies allocation of water for endangered species deprived Off Project Irrigators their water resulting in water cutoffs to over 100,000 acres of Upper Basin family farms and ranches.

3. **Establish additional reliable storage facilities within the Scott and Quartz Valleys,** including increasing storage capacities of high-elevation lakes as recommended in the October 1991 Department of Water Resources Study entitled: *SCOTT RIVER FLOW AUGMENTATION STUDY.* These storage facilities will augment late summer and fall instream flows, improve Klamath River water quality and supplement agricultural irrigation water.

4. **Implement the 60,000 ac.ft. (Klamath River, IronGate Reservoir, Shasta Valley) Reserved Water Right (A0169580), and storage facilities** to supplement Montague Irrigation District's irrigation water with Klamath River water at a cost of $500million (1/2th the $1billion cost of dam removals). This project augments current irrigation supplies, allows for additional irrigable lands, and replaces naturally impaired Upper Klamath River water with higher quality water. A portion of the reduced water demands (good water quality) can be released by the Montague Irrigation District from Lake Shastina or from their wells into the Shasta River, improving the

water quality in both the Shasta River and in the Klamath River below Iron Gate Reservoir per FERC recommended requirements for relicensing.

5. **Support and introduce Coho Salmon Restoration Programs on Klamath River tributaries below Iron Gate Fish Hatchery. Note: Coho are cold water fish with their most desirable habit within 30 to 40 miles of the coast.**

6. **Implement a US Forest Service supported Grant Program and a Juniper Removal Program** for wood energy and wood products markets, sustainable forest and wildfire management. These programs will provide local economy, wildfire protection, improved ground water infiltration, instream flow accretion, surface water runoff, and improved grass land production. These programs have the potential to provide several hundred thousand acre feet of surface, ground water, and instream flow to the entire Klamath Basin.

7. **California Establishment of a Joint Powers Authority (JPA)**, Public Utility District (PUD), or the Siskiyou County Flood Control and Water Conservation District's acquisition of Iron Gate, COPCO 1, and COPCO 2 Hydro-Electric Facilities. PaciCorp is a signatory to the KHSA agreement to decommission the Hydro-electric Dams. A **negative one billion dollar** 2020 yr. worth value has been established for the Klamath River Hydro-electric Dams scheduled for removals. The sale of this 65 MW green energy to the PP&L grid would generate an estimated $50 Million per year to a JPA, PUD, or Siskiyou County which could be used for project financing and to **reduce electricity rates to farming and ranching operations and to <u>all ratepayers</u> within the district.**
8. **Oregon Establishment of a Joint Powers Authority (JPA)** or Public Utility District (PUD) acquisition of J.C.Boyle Hydro-Electric Facilities. The sale of this 98 MW green energy to the PP&L grid would generate an estimated $75 Million per year to a JPA or PUD which could be used for project financing and to **reduce electricity rates to farming and ranching operations and to <u>all ratepayers</u> within the District**. Also, a Bi-State Joint Power Authority (JPA) or Public Utility District (PUD) could be formed to acquire all four hydro-electric facilities.

<u>These Proposals Will:</u>

- **Save farmers, ranchers, the public, and tax payers <u>billions</u> of dollars**
- **Save the Klamath River from complete destruction** by eliminating the release of 20 millon cubic yards of sediments.
- **Save the Hydro-electric Dams** which generate **<u>clean, green power</u>** to 70,000 homes, protect the lake habitat and homes values around the reservoirs and provide **<u>flood protection</u>** with a 25% reduction and a 9 hr.delay in peak flows. Given the condition of a complete Klamath River cutoff by the DOI or a severe drought **the dams can also easily protect the Upper and Lower Klamath Basin water demands by providing CDFG's 700 cfs minimum instream river flows for a three month period** with adequate storage retained for lake habitat..

- **Save IronGate Fish Hatchery,** which is dependent on cool low level water releases from Iron Gate Reservoir and releases over **six million salmon and steelhead fingerlings per year** into the Klamath River. **Note:** ***(It is impossible for the Klamath River Habitat above IronGate Dam to duplicate the production of IronGate Hatchery).***
- **Save relocating the City of Yreka's Fall Creek water supply system across Iron Gate Reservoir and prevent future demands on Fall Creek Water Rights under the KBRA.**
- **Save Klamath River water demands** by State and Federal Agencies from the **Upper and Lower Klamath Basins, the Rogue Valley,** and **the Scott and Shasta Rivers** to satisfy requirements proposed in the KBRA for **environmental waters**.
- **Save our forest from future catastrophic fires by proposing needed thinning projects and control present and future invasion of the evasive Juniper population in the entire Klamath River Basin.** This can provide hundreds of thousands acre feet of additional Klamath Basin ground water, surface waters, and instream flows.
- **Preserves the sacred Shasta Nation Villages and Burial Sites** beneath the waters of Iron Gate and COPCO Reservoirs.
- **Provide substantial additional water storage facilities within the Klamath Basin** which will benefit **all water users in the basin** including benefits to instream flows, ground water, fisheries, Tribes, NGO's and fishing interest.
- **Provide reduced electricity rates for On and Off Project irrigators and all rate payers.**
- **Provide Governmental Agencies with public supported alternatives** to maintain the economic and environmental sustainability of the Klamath River Basin.

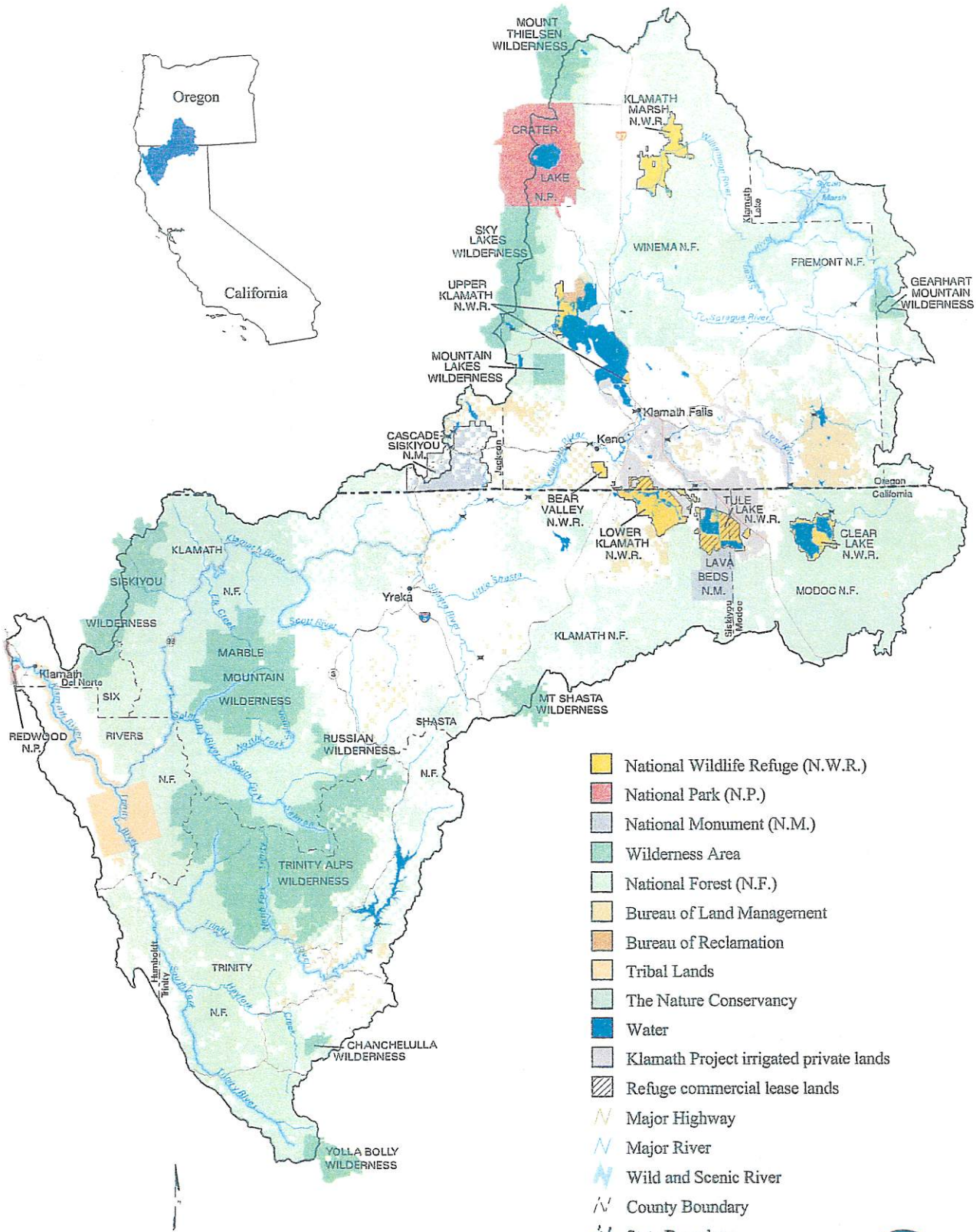
Anthony Intiso
Yreka Greenhorn Grange

Date 2, 2016

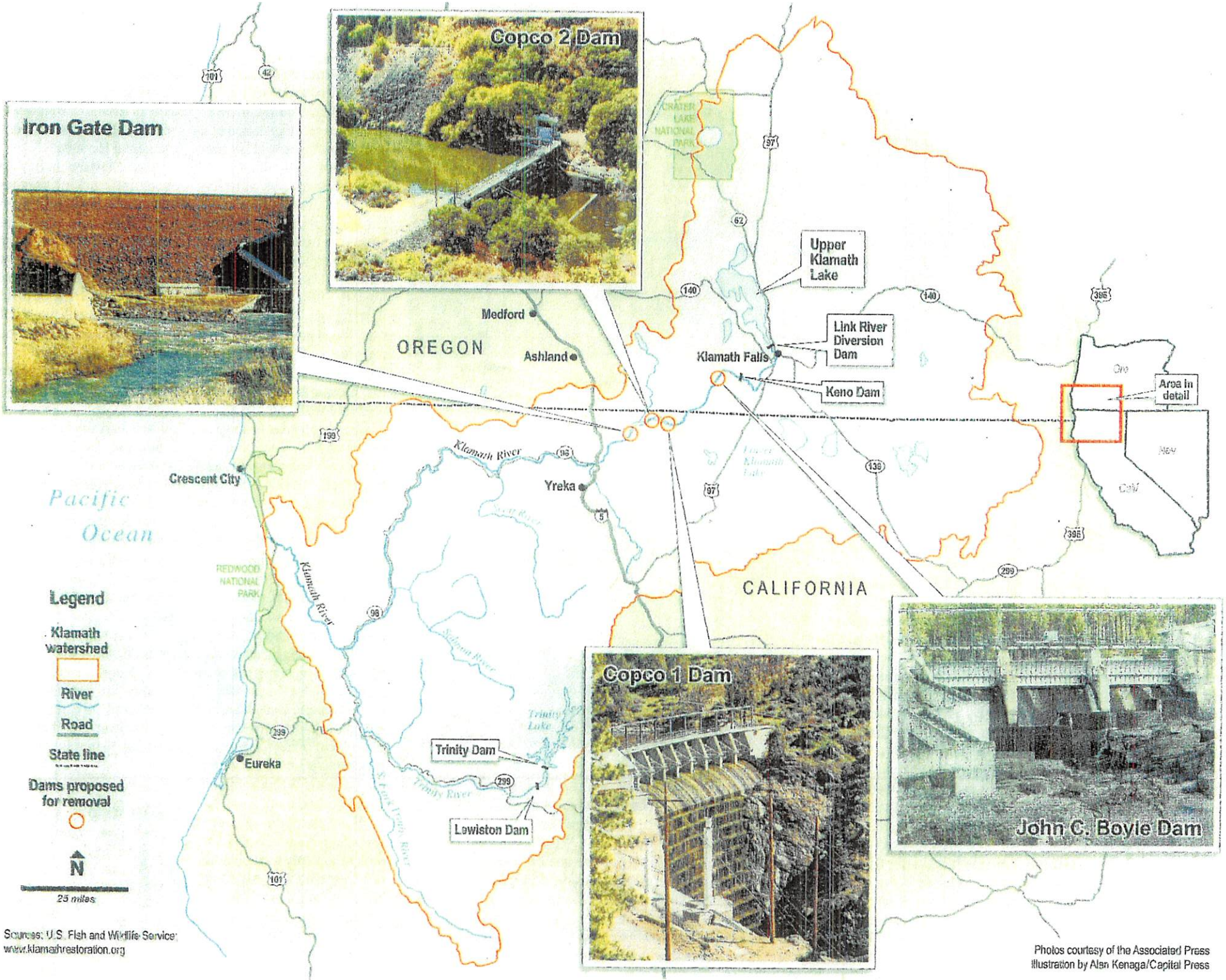
Richard Marshall
Siskiyou County Water Users Assoc.

Date 2-2-16

Klamath River Basin



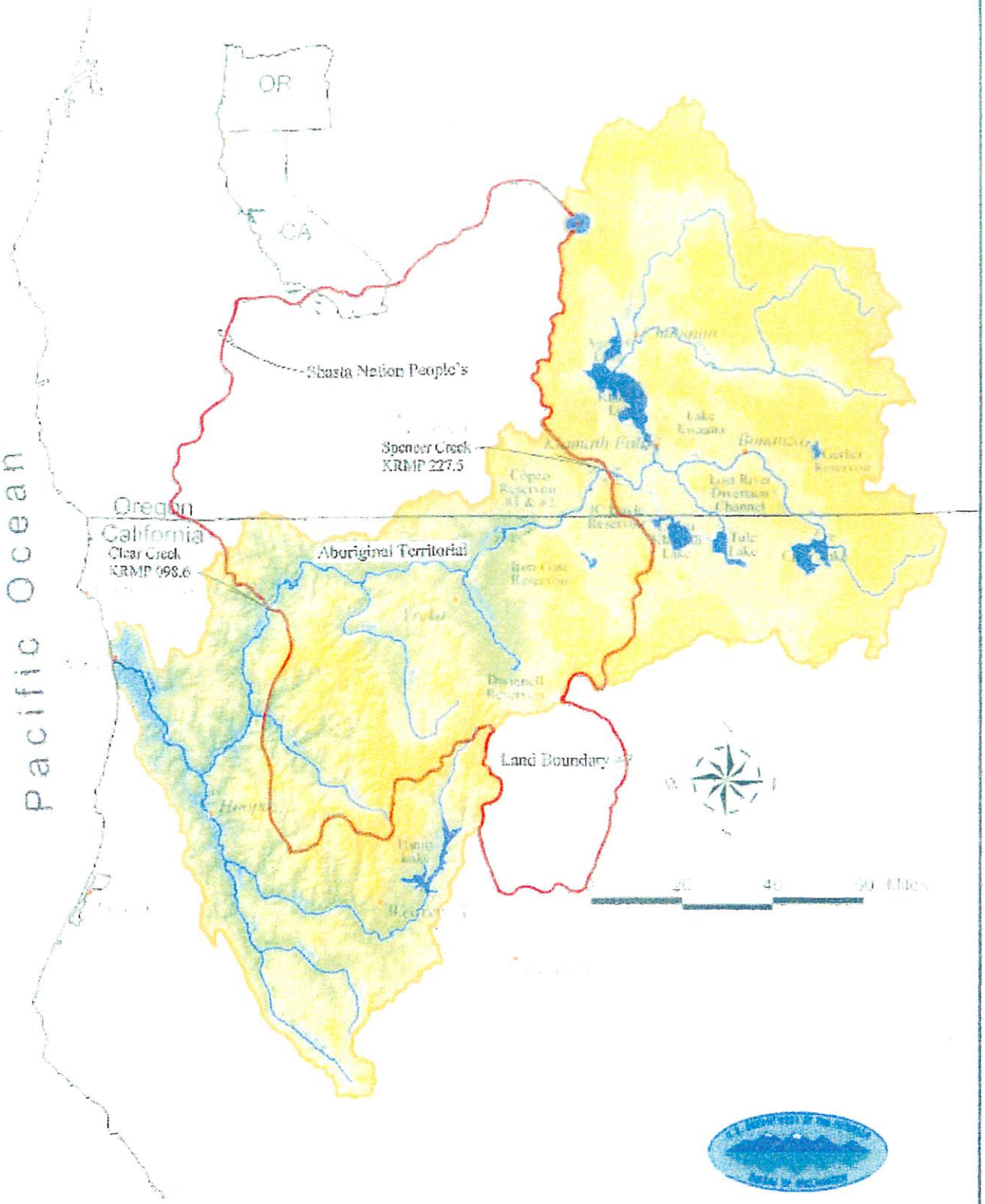
The Wilderness Society
Center for Landscape Analysis

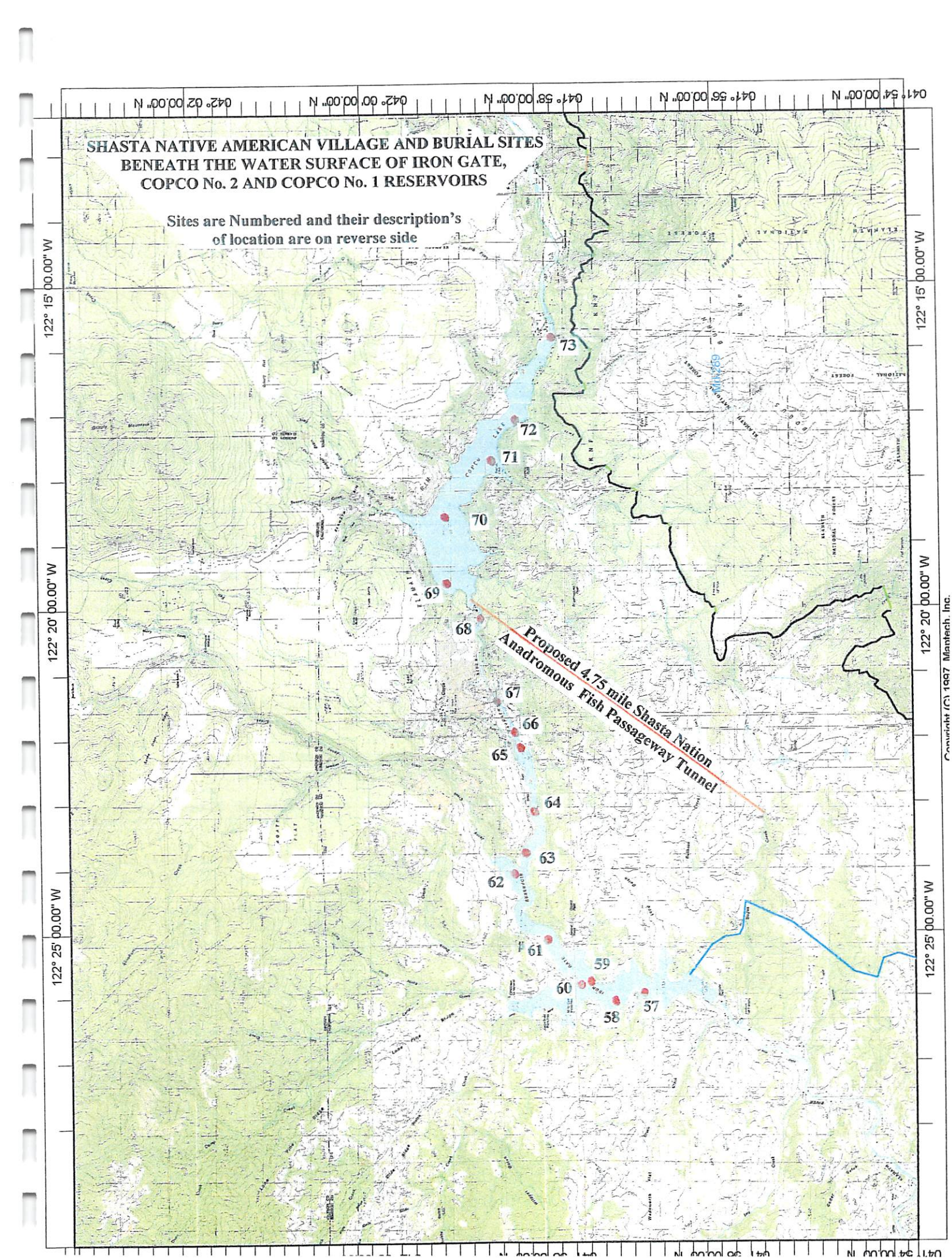


Sources: U.S. Fish and Wildlife Service; www.klamathrestoration.org

Photos courtesy of the Associated Press
Illustration by Alan Kenaga/Capital Press

Klamath River Basin




SHASTA NATIVE AMERICAN VILLAGE AND BURIAL SITES
BENEATH THE WATER SURFACE OF IRON GATE,
COPCO No. 2 AND COPCO No. 1 RESERVOIRS
Sites are Numbered and their description's
of location are on reverse side
Proposed 4.75 mile Shasta Nation
Anadromous Fish Passageway Tunnel
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041° 58' 00.00" N
041° 56' 00.00" N
041° 54' 00.00" N
122° 15' 00.00" W
122° 20' 00.00" W
122° 25' 00.00" W
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57. Kwer'-re-bak'-kik'stok. Village on N. side of Klamath River about half a mile below Okwer'-ker-ram'-mah (Merriam, ms.).

58. O-kwer'-ker-ram'-mah. Village on N. side of Klamath River, half a mile below Camp Creek (Merriam, ms.).

59. Wahp'-pre-wa'-o. On S. side of Klamath River, nearly opposite the mouth of Camp Creek.

60. Id-doo'-kwi. A Shasta village on N. side of Klamath River on E. side of mouth of Camp Creek (Merriam, ms.).

61. Kwah'-tah-kah-pahk'. Village on N. side of Klamath River 1 mile below Koo-kwah-re'-kah (Merriam, ms.).

62. Koo-kwah-re'-kah. Village on N. side of Klamath River at the mouth of Jenny Creek (Merriam, ms.).

63. Enta'warahowa'xa. On N. side of Klamath River and west side of a creek, at its mouth (possibly Jenny Creek; Holt, 1946: map).

64. At-tik'-kah-ha-tat-so. Village on N. side of Klamath River at the old railroad crossing near mouth of Jenny Creek (Merriam, ms.).

65. Ah-soon-nah-ko-witch'-e-rah. Located on a pine flat on S. side of Klamath River a short distance below Copco Dam (Merriam, ms.).

66. Kutsastsus. Dixon (1907: map) and Kroeber (1925:286) refer to it as a Kammatwa settlement on N. side of Klamath River. Holt (1946: map) refers to it as Gu'jas Jas, and places it on the N. side of the Klamath above the village of Enta'warahowa'xa. Merriam (ms.) notes the village as Koo-ches'-ches, and locates it on the N. side of the Klamath at the mouth of Fall Creek.

67. Wah'-ah-ye. Village on Fall Creek (at location of present powerhouse) and on N. side of Klamath River (Merriam, ms.).

68. Ko-soo'-rah. Small Shasta village on N. side of Klamath River, close to Copco Dam and a round hill (Merriam, ms.).

69. Choo-pah'ch-took. Village on N. side of Klamath River below Ik'-kweek and now under water from Copco Dam (Merriam, ms.).

70. Ik'-kweek. Shasta village on N. side of Klamath River below Ho'-a'te-took', and also now under water.

71. Tah-her'-ruk-kwe. Small Shasta village on S. side of Klamath River at mouth of Deer Creek.

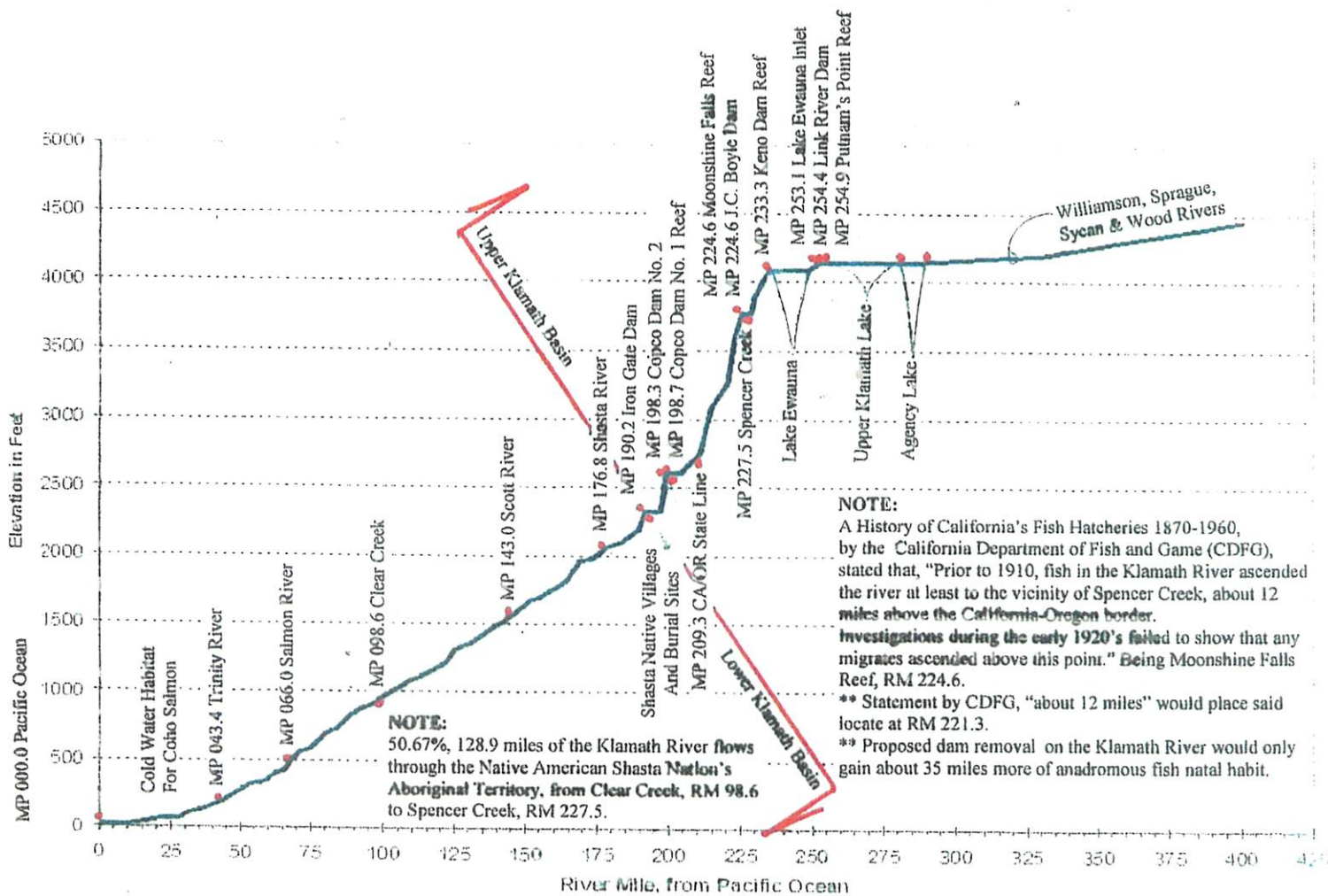
72. Ko-kwan'-nut. Small Shasta village on S. side of Klamath River about half a mile above mouth of Deer Creek (Merriam, ms.).

73. Ho'-a-te-took'. Village on N. side of Klamath River 6 miles below Beswick and 3 miles below wagon bridge (Merriam, ms.).

KLAMATH RIVER PROFILE

Water Surface Profile & Appurtenances Of The Klamath River
Profile excerpted from Technical Report No. SHR-2011-02, USDOI-BOR

Prepared By:
Siskiyou County Water Users Association
Yreka, Siskiyou County, California



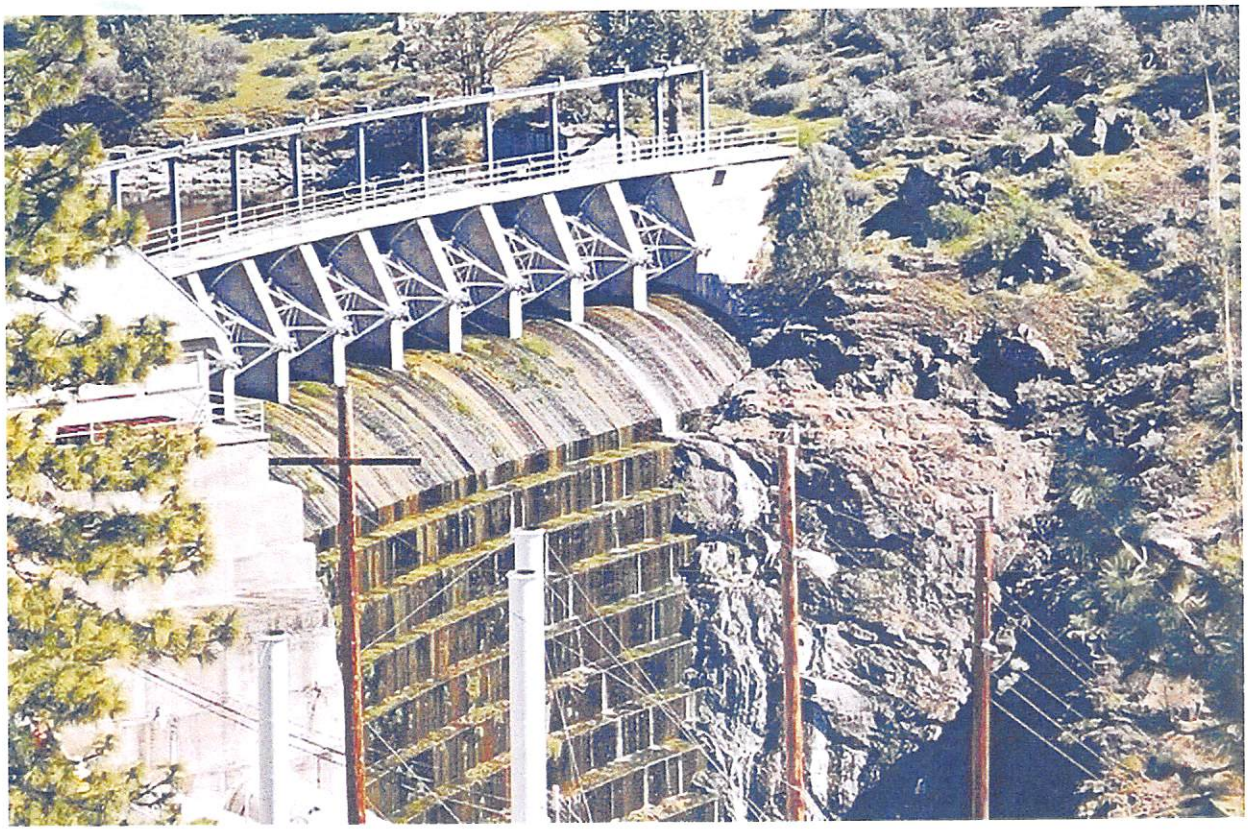
COPOC DAM No. 1 (1918) at an ANCIENT REEF

RM 198.7

The Klamath River Electrical Development Project, written in 1913 by John C. Boyle

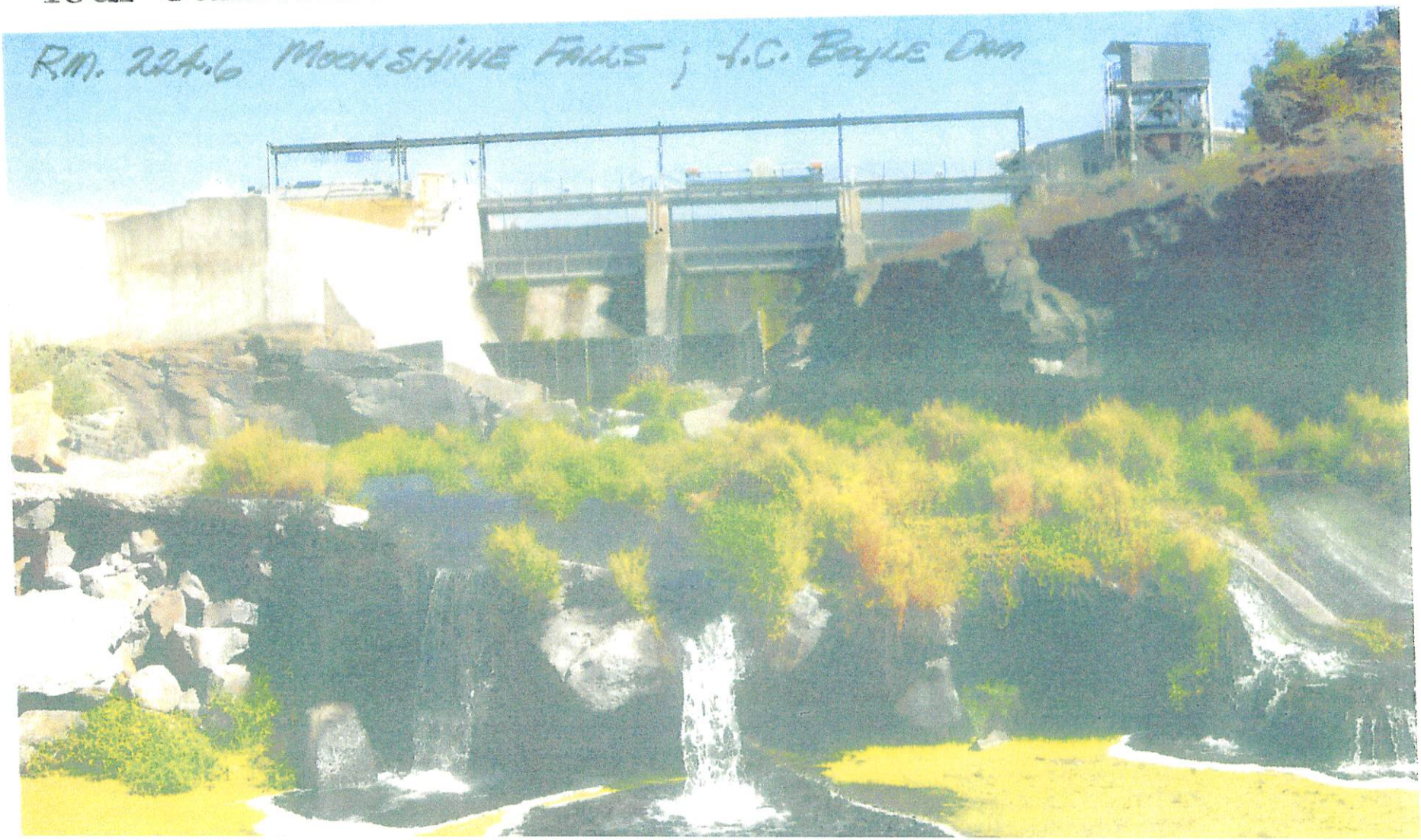
"The engineering structures--the dam, power plant, fore bay, and lake, are combined under the name of the Klamath River Dam No. One. They are located principally as a unit beginning at the head of a canyon formed by the Klamath River eroding five distinct lava flows. Although the surrounding country is principally lava formation, and the walls of the canyon, rising up to 250 feet high is lava rock, the river in its erosion has exposed at the site of the dam an ancient shelf, which was at one time approximately 130 feet high across the canyon, this reef is andesite, apparently continuous for a considerable distance on both sides of the canyon, and it is believed to be the oldest exposed formation in the country.

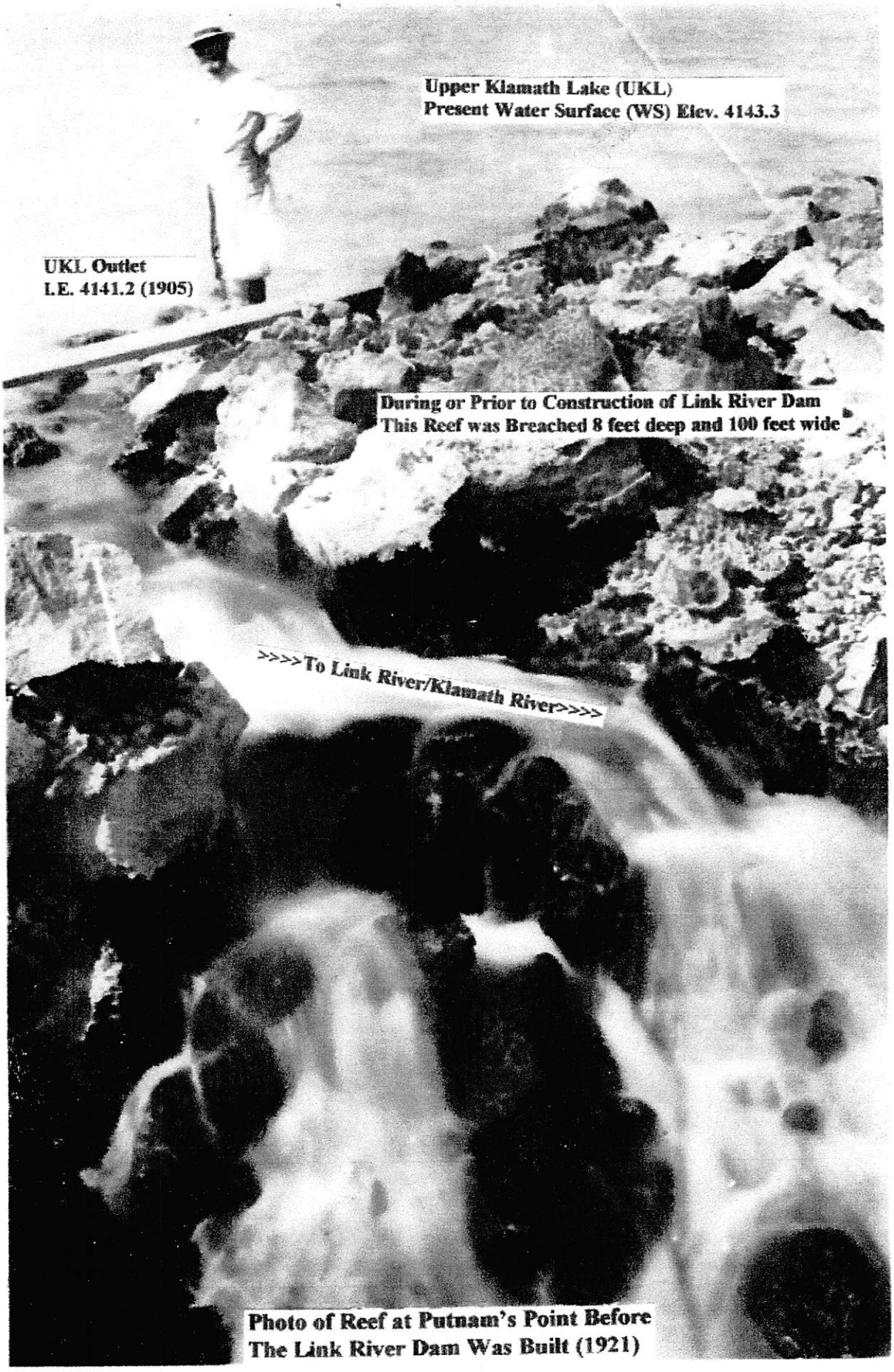
Geological conditions upstream from the site indicate that at one time the river ran over this reef 130 feet above its present bed, and at that period the waters were backed up about 5 miles and formed a lake about one mile in extent at its widest part."



Fish Win

It's Fish 1, People 0 in the fight to remove four California dams. When will the insanity stop? p. 16




Upper Klamath Lake (UKL)
Present Water Surface (WS) Elev. 4143.3
UKL Outlet
I.E. 4141.2 (1905)
During or Prior to Construction of Link River Dam
This Reef was Breached 8 feet deep and 100 feet wide
>>>>To Link River/Klamath River>>>>
Photo of Reef at Putnam's Point Before
The Link River Dam Was Built (1921)

Hydropower Program

Reclamation is the second largest producer of hydropower in the United States with 58 powerplants and an installed capacity of over 14 million Kilowatts.

These 58 powerplants generate more than 44 billion Kilowatt-hours annually. That is enough electricity to meet the annual needs of more than 9 million people and the energy equivalent of replacing more than 80 million barrels of crude oil or about 48.4 billion pounds of coal.

In 2006, Reclamation hydropower plants resulted in avoiding the release of over 31 million tons of carbon dioxide emissions.

When compared to all electric utilities on the basis of nameplate capacity, Reclamation ranks as the tenth largest "utility" in the United States.

Reclamation powerplants range in size from 350 kilowatts at Lewiston Powerplant to 6.8 million kilowatts at Grand Coulee Dam, the nations largest.

Revenues from the sale of Reclamation's power average over $700 million annually. Since 1909, power revenues have contributed over $10 billion in project repayment to the federal treasury.

Since Reclamation began installing hydroelectric powerplants at its dams in the early 1900's, the technology of the generators has evolved and improved. Reclamation has worked to maximize the generating capacity of its generators, increasing the generating capacity at one-third of the generators, increasing the capacity of those generators by an average of 48 percent.

Hydropower is Renewable

It is the primary generator of renewable energy in the United States. Hydropower generating units capture the power of the water as it falls through the penstocks. It does this all and does not generate atmospheric emissions.

The generation of hydropower is also the most efficient way to produce energy with each kilowatt-hour of hydroelectricity being produced at an efficiency of more than twice that of any other energy resource.

Hydropower is also extremely flexible and reliable compared to other energy resources. Hydropower can rapidly change its output to match needs, going from no power generation to maximum power output quickly and as expected. This flexibility makes hydropower a critical energy source to stabilize the electrical grid.

CHRONOLOGY
AND
HISTORY OF DEVELOPMENT ALONG THE KLAMATH RIVER

Pre-1850 Native American tribes lived along and deepened upon the Klamath River and it tributaries

1850 Gold is discovered in the Klamath River Basin

1850 Farms and ranches are established in Scott and Shasta Valleys

1851 Treaties are signed with the various tribes along the Klamath River

1855 November 16, Klamath River Reservation is established. This reservation was abandoned in 1861 after a disastrous flood and terminated in1864

1864 April 8, the president set aside land for four tribes in California, one of them being the Hoopa

1864 Klamath Tribes cede land to the U.S. government and a reservation is created

1868 Two farmers dig first irrigation ditch in the Upper Klamath Basin

1876 June 23, President Grant formally defines the boundaries of the Hoopa Valley Reservation

1878 February 6, The Yreka Journal, Siskiyou County, had 98 mining ditches of 600 miles in length and 20 irrigation ditches supplying 10,000 acres

1888 California court rules lower Klamath Reservation abandoned, opening the lower river to non-Indian commercial fishing and management by the State of California

1888 A large saw mill and a wooden splash dam were built on the Klamath River at Klamathon. The dam was destroyed by fire in 1902

1891 October 16, President Harrison enlarged the Hoopa Valley Reservation.

1895 Introduction of Coho Salmon to the Klamath River, a plant made on Supply Creek, a tributary to the Trinity R. Several out of basin import plantings were made since 1895

1905 Klamath Project is authorized

1907 First deliveries of water through the Klamath Project "A" Canal

1908 President Theodore Roosevelt creates the nation's first wildlife refuge, Klamath Lake Refuge—now called Lower Klamath National Wildlife Refuge

1910 The US Bureau of Sports Fisheries installed the Klamathon Racks as a salmon egg-taking station at the site of the old logging dam, blocking passage for Chinook and Coho salmon

1917 First Klamath Project lands are opened to homesteaders.

1918 COPCO 1 dam hydroelectric facilities become operational

1919 Salmon canning industry on the Klamath and in California were abolished by an act of the California Legislature.

1921 Link River Dam completed allowing control of water releases from Upper Klamath Lake

1922 COPCO 1 second generator becomes operational.

1925 COPCO 2 hydroelectric plant was put into commercial use

1927 Dwinell Dam (Lake Shastina) constructed on the Shasta River

1928 Tule Lake Bird Refuge (Now Tule Lake National Wildlife Refuge) is created

1932 Shasta River and tributaries adjudicated and Water Mastering established

1933/1934 Commercial fishing on Klamath River banned, tribal gillnet fishing prohibited

1954 Congress votes to terminate the Klamath Tribe's reservation

1956 Klamath Project farmers' electricity rate contract set for 0.6 cents per kilowatt-hour for 50 years. The Mid and Upper Basin Klamath farmers did not receive the rate break.

1957 Congress ratifies the Klamath Basin Compact between the states of California and Oregon

1958 J.C. Boyle or "The Bend" dam and power plant were built upstream from COPCO 1 dam in Oregon

1962 Iron Gate Dam is completed

1963 Lewiston dam on the Trinity River is completed diverting a majority of the Trinity River water to the Sacramento River

1964 Large flood on the Klamath River destroys several bridges, roads, and structures. All dams targeted for removal were in place, reducing and delaying peak flows

1964 Kuchel Act precludes homesteading on refuge land; provides for continued leasing of refuge land for farming

1966 Iron Gate hatchery which is dependent on Iron Gate Dam completed and operational

1966 Keno Dam (Lake Ewana) constructed to replace Needle Dam on the Klamath River

1971 Lost River shortnose suckers identified as a species of concern under California law

1972 California Wild and Scenic Rivers Act designates the Klamath River from 100 yards below Iron Gate to the ocean to the list

1973 U.S. Supreme Court rules that stretches of the Trinity and Klamath River flowing through the Hoopa and Yurok reservations is "Indian Country," effectively restoring tribal salmon fishing rights

1976 Oregon Water Resources Department begins the Klamath water rights adjudication process

1977-78 Tribal salmon fishing resumes on Lower Klamath River, but was quickly stopped by the Federal Government on conservation grounds

1980 Scott River Adjudication decree and partial Water Master service enacted

1981 Lower Klamath River federally designated as "wild and scenic" between its mouth and 3,600 feet below Iron Gate Dam

1983 *United States v. Adair* decision upholds Klamath Tribes' right to enough in-stream water to support fishing and hunting, but does not establish how much water is needed to support those activities

1985 California state court confirms limited tribal fishing rights for the Karuk at Ishi Pishi Falls

1986 Klamath River Basin Fishery Resource Restoration Act is passed. Funded at 1 million dollars per year

1986 Klamath Tribes reservation restored

1986 Klamath Tribes close sucker fishery on Upper Klamath Lake and its tributaries

1987 Indian salmon harvest on Klamath River reopened for five years

1988 The Hoopa Yurok Settlement Act; Public Law 100-580 102 Stat. 2924, partitioned certain reservation lands between the Hoopa Valley Tribe and the Yurok Indians

1988 Shortnose and Lost River Sucker listed as endangered under the Endangered Species Act

1988 Oregon State Scenic Waterways Act designated the Klamath Scenic Waterway from J.C. Boyle downstream to the California Oregon border

1990-1992 Severe declines in salmon runs close ocean salmon fishing

1993 Federal government sets Klamath tribal salmon fishing limit at 50 percent of the total available harvest

1994 The Klamath River from J.C. Boyle to the Oregon border is federally designated under the Wild and Scenic Rivers Act

1996-1998 Lost, Klamath, Salmon, Scott, and Shasta Rivers declared impaired under Federal Clean Water Act

1997 Federal EPA listing of the Southern Oregon, Northern California Coastal Coho as a "threatened" species

1997 Minor flood event below Iron Gate Reservoir

1997-2004 DFG killing of all unmarked (wild reared) Coho salmon returning to Iron Gate Fish Hatchery

1998 First of several unsuccessful negotiations undertaken among some Klamath Basin water interest

1999 Final submission of water rights claims (730) and contested (5,664) in Upper Klamath Basin adjudication

2000 PacifiCorp begins (FERC) federal relicensing process for the Klamath Hydroelectric Project dams

2001 In a drought year water deliveries to the Klamath Project were cut off in mid-irrigation season to preserve water for fish in Upper Klamath Lake and the Lower Klamath River, sparking protests and drawing national news media to Klamath Falls. This resulted in foreclosures and distress sales of 1200 family farms and homes.

2002 Klamath Project farmers receive full irrigation allocation while downstream water is cut back. An estimated 33,000 salmon die near the mouth of the Klamath River from undetermined causes, (disease, poisoning, and Trinity River ceremonial ramping), and worsened by the low flow and high temperature conditions

2004 California lists the Coho from San Francisco to the Oregon border as a "threatened" species

2004 Federal Agencies requested that 40 returning (wild reared) unmarked Coho Salmon be implanted with radio transmitters and returned to the river at Iron Gate Hatchery. 23 were accounted for and traveled down river as far as 50 miles and then up tributaries (3 up the Scott River)

2005 Private negotiations between Tribes, Non-Governmental Organizations, State & Federal Agencies, and Klamath Project farmers began KBRA negotiations.

2006 Projected weak runs of Klamath River Chinook Salmon force closure to ocean harvest

2006 PacifiCorp's license for the Klamath Hydroelectric Project expires. The relicensing process continues; the company faces major costs to meet new environmental standards demanded by state and federal regulators

2006, 2008, 2009 Draft Klamath Basin Restoration Agreement (KBRA) released; transfer of public forest to Klamath tribe; alternative sources of energy and some water certainty for the Klamath Project irrigators; idling of off-project farmlands; temporary assignment of salmon fishing rights for the Klamath tribes from the Shasta Indian territory; major fisheries restoration effort; **demands for dam removals.**

2008 PacificCorp agrees to dam removal, in exchange for a waiver of liability, most services costs, and ability to pass most costs to rate payers

2008 In January, Draft Klamath Restoration Agreement (KBRA) is released

2009 Draft Klamath Hydroelectric Agreement (KHSA) Settlement is released

2009 Siskiyou County passes Title 10, Chapter 13 of County Codes – regarding "Demolition, Decommissioning, Removal and Reclamation (applies to dam removals)

2010 Siskiyou County voters **vote NO! to dam removals** Measure G, (an advisory measure,) by an overwhelming 79.04%

2010 February 18 Final Klamath Restoration Agreement (KBRA) and Klamath Settlement Agreement (KHSA) **(demands for dam removals)** signed by several parties, pending funding allocations and review by the Secretary of the Interior

2011 Oct. 22 Defend Rural America Rally and 8 county Constitutional Sheriffs' Town Hall meeting held in Siskiyou County. Excess of 1,000 people in attendance protesting dam removal

2011 Dec. Siskiyou County submits comments on the EIR/EIS on dam removals being circulated by the Department of the Interior (DOI)

2012 March 30 Following a review by the Secretary of the Interior, **and in consideration of all viable alternatives,** a Secretarial Determination will be made whether the removal of the Klamath Hydroelectric Project Dams will help restore anadromous fisheries and is in the public interest

2012 Expected date for Oregon Water Resources Department's final determination on the Upper Klamath Basin water rights adjudication. The determination may be appealed in court

2015 Dec.31 KBRA/KHSA Agreements expire

2016 Dam Removals referred back to the FERC process

2016 DOI, States of California & Oregon in process of reviving the Klamath Hydro Settlement Agreement (KHSA) and forming a Dam Removal Entity (DRE) with little or no assets which will take liability away from Pacific Corp and the Governments

2020 Earliest year in which dam removal could begin under the KHSA

I

MEASURE "G" (November Ballot Measure) (No! to Dam Removals)

- SCWUA LETTER: to the BOS to place Measure G on the ballot
- SCWUA LETTER: to voters and mailers
- SISKIYOU COUNTY BOS RESOLUTION: to place Measure G on the ballot
- RESULTS: (including maps of County and Precinct Districts)

8/3/10 AF from Frank Tallerico

August 2, 2010

To: Members, Siskiyou County Board of Supervisors

From: Frank Tallerico, President
Siskiyou County Water Users Association

Subject: Advisory Measure regarding dam removal on Nov. 2, 2010 ballot

The proposed advisory ballot measure supports every public comment the Siskiyou County Board of Supervisors has made to date. Off the record, we all have heard that the majority of voters in Siskiyou County oppose dam removal. Now is the time to call upon those voters and let's set the record straight.

Whatever letter of the alphabet is assigned to this measure by our County Clerk, this measure is a **proactive approach** to this very serious problem facing our county, and yet has all of ingredients that Board of Supervisors has supported since this dam removal issue reared it's ugly head almost three years ago.

1. In 2008, the Siskiyou County Board of Supervisors passed a resolution opposing dam removal.
2. This ballot measure supports the scoping feedback you have obtained from the many people who attended the three sessions held by the Board and the Department of Interior in the last five months.
3. This ballot measure supports the proposed Shasta Nation/Siskiyou County Water Users Association's Alternative, and which the Board Supervisors has supported, with a logical bypass around Irongate and the two Copco dams.
4. This ballot measure builds upon initiative that there are projects in both the Shasta and the Scott River Basin's that can enhance habitat for migrating salmon and to expand the salmon's use of these two rivers.
5. This ballot measure will generate a county-wide position that can be included in grant applications for funds from bonds that already have been passed and future bonds.
6. The advisory ballot will give the voters of Siskiyou County a **VOICE** in something that will have a direct impact upon their lives and future generations.

MEASURE "W" SAVE OUR DAMS

PURPOSE: To place on the November Election Ballot a measure that will give the citizens of Siskiyou County the opportunity to express their opinion as to whether to retain or to remove the four dams on the Klamath River scheduled for removal by the KBRA and the KHSA.

CONCERN: With respect to the proposed removal of four dams on the Klamath River: Iron Gate, Copco No. 1, Copco No. 2, and the J C Boyle Dam, the Residents and Property Owners within the Klamath River Drainage Basin and all of Siskiyou County Residents have the following concerns related to their rights as Citizens and as Property Owners.

Siskiyou County Government has the Responsibility and Duty under the State Government Code to protect Private Property Rights and to protect the well being of its citizens from floodwaters, water quality, economic and other social and environmental concerns. Siskiyou County Government is our Lead Agency for any proposed changes in land use and for any proposed private property projects within the county such as the removal these dams.

DECLARATION: The removal of these dams will affect **all** of the County's Citizens and Property Owners.

Following list of some concerns that are directed to the Board of Supervisors with the request that they stand by and support the position of the citizens of Siskiyou County as to whether the Dams are to be Retained or Removed.

PARTIAL LIST OF CONCERNS:

- ☐ **Irresponsible expenditures during a national economic crisis**
- ☐ **Unnecessary loss of green hydro-electric power for 70,000 homes**
- ☐ **Cost to replace hydro-power**
- ☐ **Substantial increase in electricity cost**
- ☐ **Replacement of clean hydro- power with fossil fueled power**
- ☐ **Loss of wildlife habitat**
- ☐ **Loss of lake fisheries**
- ☐ **Loss of Iron Gate fish hatchery**
- ☐ **Loss of recreation**
- ☐ **Loss of esthetics**
- ☐ **Loss of property values**
- ☐ **Loss of roads and bridges from flooding**
- ☐ **Loss of emergency services during flooding (public safety)**
- ☐ **Loss of fire protection**
- ☐ **Loss of filtering down river flows**
- ☐ **Loss of sustained minimum river flows**
- ☐ **Irresponsible release of dam sediments down river**
- ☐ **Promised? power cost and water benefits to upper basin landowners**
- ☐ **Lack of any direct physical factual benefits to upper basin land owners**
- ☐ **Lack of factual evidence that dam removals will restore salmon runs**

Should our dams be removed? ☐ **Yes** ☐ **No**

on Measure G Committee
47 N. Main Street
eka, CA 96097

PRST STD
U.S. POSTAGE
PAID
YREKA, CA
PERMIT NO.12

SAVE THE DAMS, SAVE SISKIYOU COUNTY

VOTE ☑ NO ON MEASURE G

DON'T BE FOOLED BY THE LIES!

This is your only chance to be heard

DAM REMOVALS WILL NOT:

- Guarantee Yreka's water supply
- Give us long-term local jobs
- Improve coho habitat or water quality
- Provide enough river flow for fish without taking our water

DAM REMOVALS WILL:

- Increase everybody's electric and water bills
- Cause major flooding damage: roads, bridges, structures
- Decrease everybody's property values
- Eliminate **millions of tax dollars** from the County
- Make our farmers and ranchers **lose** water to a few favored special interests



VOTE ☑ NO ON MEASURE G

RESOLUTION NO. 10-185

RESOLUTION OF THE
SISKIYOU COUNTY BOARD OF SUPERVISORS
CALLING FOR AN ADVISORY ELECTION
WITH RESPECT TO THE
REMOVAL OF DAMS ON THE KLAMATH RIVER
TO BE HELD NOVEMBER 2, 2010

WHEREAS, the Siskiyou County Board of Supervisors wishes to provide the voters of this County with the opportunity to voice their opinion with respect to whether or not they support the removal of the Klamath River dams (Iron Gate, Copco 1, and Copco 2) and associated hydroelectric facilities;

NOW, THEREFORE, BE IT RESOLVED that the Siskiyou County Board of Supervisors hereby call an advisory election to be held on the same date and time as the next statewide regular election, Tuesday, November 2, 2010. At such election the issue to be presented to the voters of the County of Siskiyou shall be:

"SHOULD THE KLAMATH RIVER DAMS (IRON GATE, COPCO 1, AND COPCO 2) AND ASSOCIATED HYDROELECTRIC FACILITIES BE REMOVED?

YES _____ NO_____"

BE IT FURTHER RESOLVED that the Siskiyou County Board of Supervisors hereby authorizes and directs the County Clerk to provide all necessary election services and to canvas the results of the election and conduct such election as required by law as hereinabove requested.

SISKIYOU COUNTY
RESOLUTION
No. 10-185

BE IT FURTHER RESOLVED that the County Clerk is authorized and directed to include notice of the advisory election in any Notice of Election published pursuant to California Elections Code Section 10417 and 10418 as authorized or otherwise required by law respecting statewide elections to be held on the date set forth.

PASSED AND ADOPTED at a regularly scheduled meeting of the Siskiyou County Board of Supervisors, this 6th day of August, 2010, by the following vote:

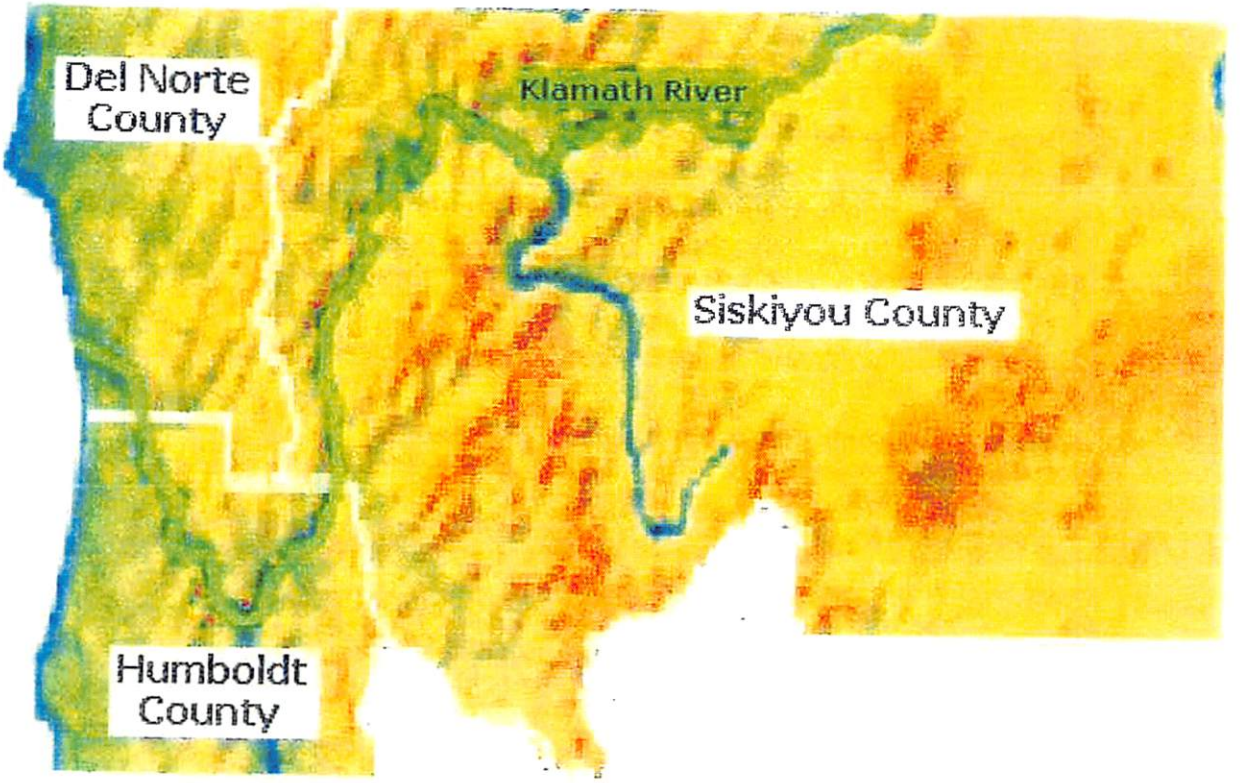
AYES: Supervisors Armstrong, Kobseff, Cook and Bennett
NOES: Supervisor Valenzuela
ABSENT: NONE
ABSTAIN: NONE

Márcia H. Armstrong
Chair, Board of Supervisors

ATTEST:
COLLEEN SETZER, Clerk
Board of Supervisors

By _____
Deputy

Course of Klamath River in California
Voter preference on retention of Dams



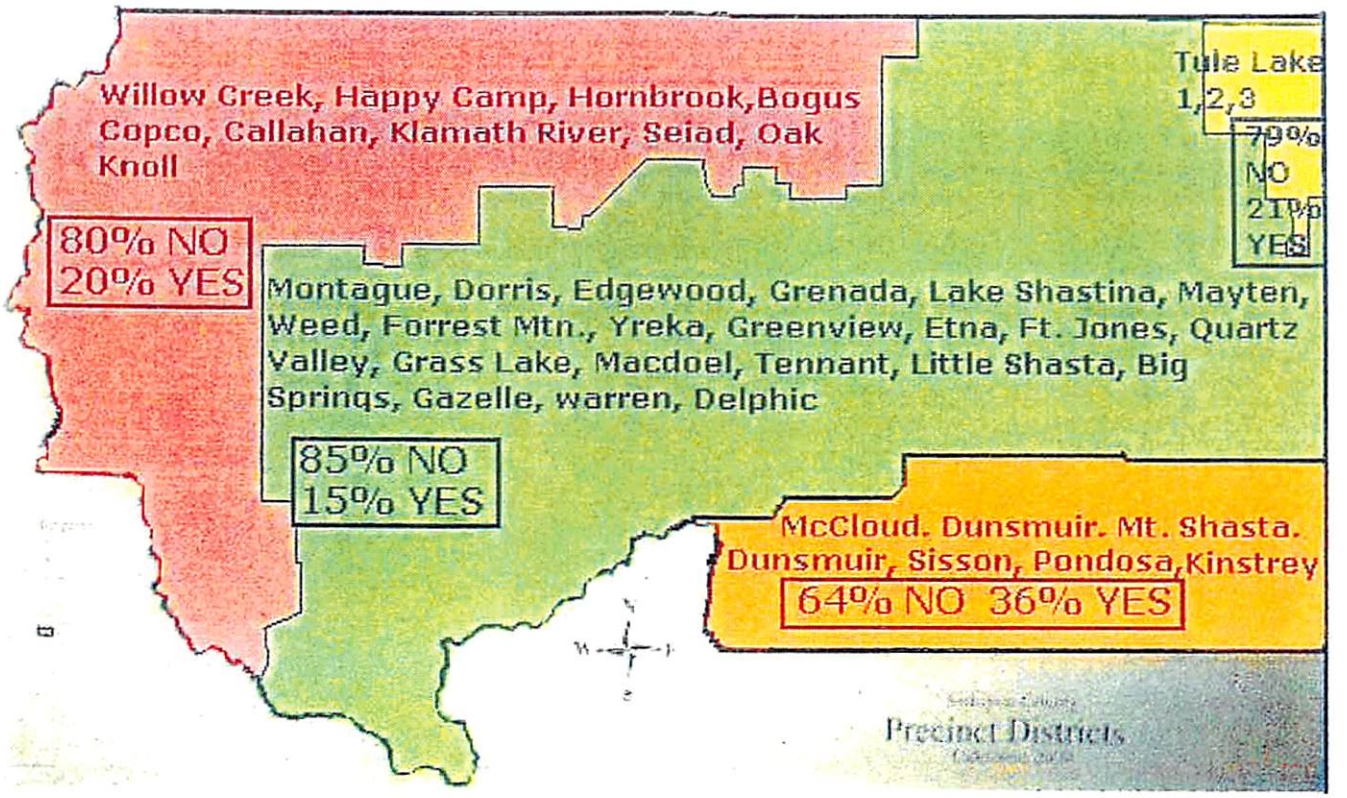
California hosts 195.5 miles of the Klamath River

Siskiyou County hosts 133 miles of the Klamath or 68%
Humboldt County hosts 51.5 miles of the Klamath or 26.4%
Del Norte County hosts 11 miles of the Klamath or 5.6%
There is also mileage in Klamath County, Oregon

79% of Siskiyou County Voters wish to retain the Dams

Sisikiyou County voting record on Dam Removal

Measure G Nov. 2010



There are 25,922 registered voters in Siskiyou County of which 59.73% of the voters cast ballots on this measure.

There were 14,206 votes for measure G
11,229 voted NO on removal of dams or 79.04%
2,977 voted YES on removal of dams or 20.96%

This is a clear mandate by the citizens of Siskiyou County on the issue of dam removal on the Klamath River.

II

RESOLUTION BY SISKIYOU COUNTY BOARD OF SUPERVISORS (BOS):

- RESOLUTION to not be party to or sign the KBRA (Klamath Basin Restoration Agreement)or the KHSA (Klamath Hydro- Electric Settlement Agreement)
  .
- LETTER TO SISKIYOU COUNTY BOS: advising them not to sign the KBRA, recent legislation passed for flood control, including an Inflow Outflow Hydrograph for the flood protection provided by the dams proposed for removals, and responses to and from the DOI

RESOLUTION OF THE
BOARD OF SUPERVISORS
OF THE COUNTY OF SISKIYOU
OPPOSING DAM REMOVAL AND THE CURRENT
"KLAMATH RIVER BASIN RESTORATION AGREEMENT"
AND EXPRESSING ITS WILLINGNESS TO PURSUE
ALL APPROPRIATE AVENUES TO PROTECT
THE INTERESTS OF ITS CITIZENS

WHEREAS, the County of Siskiyou is the area where three of the four dams slated for removal are situated and which will be most affected by dam removal; and,

WHEREAS, the County of Siskiyou wishes to insure that the public health and safety of its residents are fully protected; and,

WHEREAS, Siskiyou County, in order to accomplish the foregoing, has participated in good faith in the Klamath Settlement Group, a group which was ongoing at the time that Siskiyou County was allowed to participate and which had as its mission at the time that Siskiyou County was allowed to participate the exploration of dam removal as opposed to other potential options for fish health, fish restoration, and river health; and,

WHEREAS, the County of Siskiyou, as part of its ongoing efforts to insure that all is done to identify and protect against potential impacts, sought to have neutral, independent, peer-reviewed studies done to seek to articulate the potential impacts which might result and to attempt to identify potential alternate courses of action, which proposal was declined by the Settlement Group; and,

WHEREAS, the County of Siskiyou still seeks to explore options that would maximize fish recovery and river health without dam removal; and,

WHEREAS, the current draft proposal still continues to envision removal of all four PacifiCorp dams on the Klamath River, including three of which are located in Siskiyou County; and,

WHEREAS, the residents of Siskiyou County will suffer economically from lost tax revenues resulting from dam removal, including lost revenues from reduction of property values, which revenues provide a number of governmental services, including law enforcement and other health and safety services. In addition, Siskiyou County will suffer the loss of world class whitewater rafting, the loss of lake recreational and fishing opportunities, the loss of carbon neutral, inexpensive hydropower, the possible unleashing of large amounts of sediment of unknown properties currently lodged at the base of the

SISKIYOU COUNTY
RESOLUTION
No. 08-68

dams, and other possible degradation in the quality of the life of those residing in Siskiyou County; and,

WHEREAS, the County of Siskiyou and its citizens have displayed a strong commitment to river and fish health, as evidenced by the role they have and continue to play in promoting Coho salmon recovery, in concert with the California Department of Fish and Game; and,

WHEREAS, the County of Siskiyou has consistently maintained that the dam owners, PacifiCorp, should be required to undertake all reasonable measures which would promote Coho salmon recovery; and,

WHEREAS, there have been no neutral, independent, peer-reviewed studies conducted that have concretely demonstrated that dam removal would promote significantly greater fish recovery than fish ladders and other measures that PacifiCorp has agreed to install and implement; and,

WHEREAS, dam removal poses a significant threat to water quality in light of the release of many tons of potentially toxic sediment that has accumulated behind the dams; and,

WHEREAS, it does not appear that sufficient studies have been done to support dam removal prior to a commitment to such a course of action; and,

WHEREAS, the proposed restoration agreement would exclude representation from Siskiyou County and the Scott and Shasta Resource Conservation Districts from the group of "Fish Managers" designated to write a new Restoration Plan; and

WHEREAS, the proposed Restoration Agreement would exclude representation from the Scott and Shasta RCDs, farming and ranching communities, Upper Mid-Klamath Watershed Council and Copco landowners from the Klamath Basin Coordinating Council and from setting policies and making decisions regarding the allocation of restoration funding; and

WHEREAS, it appears that the dam owner, PacifiCorp, is hesitant to assume any legal liability for the consequences of dam removal and would desire protection against or limitation of liability for the consequences of dam removal; and,

WHEREAS, it does not appear that any entity, including the state and federal governments, is willing to come forth and assume liability for any consequences of dam removal if PacifiCorp is able to obtain a limitation or waiver of liability for the consequences of dam removal; and,

WHEREAS, the current proposal under review does not mitigate the adverse impacts of dam removal for the citizens of Siskiyou County; and,

WHEREAS, it continues to be indicated that any such mitigation would be part of any settlement agreement with the dam owner, PacifiCorp; and,

WHEREAS, there is presently no such agreement in place with PacifiCorp; and,

WHEREAS, there is no clear policy determination made by the participating states or the federal government regarding dam removal, nor does it appear from the proposed Agreement that all of these entities would be signatories to the Agreement; and,

WHEREAS, there currently is no agreement with the owner of the dams, which would allay the fears of an apprehensive citizenry in Siskiyou County that the reasonable risks and potential consequences of dam removal will be reasonably addressed; and,

WHEREAS, the preliminary review of the adverse consequences of dam removal gives Siskiyou County concerns about this potential course of action without in-depth, sound, scientific studies supporting such a decision to remove; and,

WHEREAS, there is no clear candidate who has emerged to assume the risk of the consequences of dam removal; and,

WHEREAS, while the federal government does possess the legal power to assume the responsibility for acquiring ownership of the dams and therefore the responsibility for removal if it wishes to do so, it has not chosen to do so; and,

WHEREAS, the Klamath River Basin Compact and the Siskiyou County Flood Control and Water Conservation District have powers and duties directly pertinent to ongoing disputes in the Klamath Basin and should be included in any process seeking solutions to those disputes; and

WHEREAS, these unaddressed concerns, including, but not limited to, the failure to satisfactorily address economic losses, loss of economic opportunity, loss of carbon neutral replacement power, the failure to clearly articulate a rehabilitation and restoration commitment, the unwillingness to address and reasonably restore infrastructure stress and serious damage which could occur from dam removal activity (including potential damage to the City of Yreka's water supply lines), lack of full due diligence and thorough economic environmental review and the commitment to not proceed in the face of identified impacts by use of the CEQA override process, the failure to make provision for reimbursement for property owners who can prove that they have been damaged from dam removal or dam removal activity, and because of the potential for yet unknown and unarticulated impacts

which might result from dam removal and dam removal activity, require the Board of Supervisors of the County of Siskiyou, at this time, to conclude and resolve that:

BE IT RESOLVED that the Board of Supervisors of the County of Siskiyou renews and restates its opposition to dam removal.

BE IT FURTHER RESOLVED that the Board of Supervisors of the County of Siskiyou is opposed to the present draft of the Klamath River Basin Restoration Agreement and Siskiyou County, although not willing to sign the agreement, will seek to open discussions in pursuit of actions to improve fisheries, water quality, and Upper Basin water surety, and will continue to work with and pursue all avenues other than dam removal to protect the interests of its citizens.

BE IT FURTHER RESOLVED that any resolution or potential settlement of the pending FERC application should involve license extensions for a period of time reasonably sufficient to allow all the due diligence efforts and public interest determinations required to fully illuminate and inform a possible decision to relicense dams in the longer term, including full exploration and evaluation of the following:

(1) The positive impacts of the Irongate Fisheries Hatchery upon salmonid populations;

(2) The viability of trap and haul methodology as a means of sustaining salmonid survivability above dams;

(3) All fish diseases, including the *C. Shasta* parasite, which currently decrease salmonid survival in the Klamath Basin, and the possible means to alleviate or eradicate these diseases;

(4) Algae ecology related to the dams, and the potential means by which algal concerns in the Klamath Hydro-project area can be alleviated;

(5) The negative impacts on salmonid survival related to conditions in the ocean habitat which can be reasonably influenced, and the potential ways in which these impacts can be alleviated or eradicated;

(6) Impacts of commercial ocean, Tribal, and in-river fishing and natural predators upon anadromous fish; and,

(7) Should dam removal be entertained as an option by any settlement process, a full comprehensive scientific exploration and evaluation of the impacts of sediment release on the physical and biological

environment, and human communities below the dams must be included with such consideration.

BE IT FURTHER RESOLVED that this Resolution be sent to:

(1) The Governor of the State of California.

(2) The Governor of the State of Oregon.

(3) The U.S. Department of the Interior.

(4) The U.S. Department of Agriculture.

(5) The Federal Energy Commission.

(6) The Bureau of Indian Affairs.

(7) The California Department of Water Resources.

(8) The Oregon Department of Water Resources.

(9) The State Water Resources Control Board.

(10) Senator Diane Feinstein.

(11) Senator Barbara Boxer.

(12) Congressman Wally Herger.

(13) Congressman Mike Thompson.

(14) Senator Sam Aanestad.

(15) Assemblyman Doug LaMalfa.

(16) Klamath County, Oregon.

(17) Trinity County, California.

(18) Humboldt County, California.

(19) Del Norte County, California.

(20) All newspapers of general circulation in this County.

(21) All newspapers of general circulation in Klamath County, Oregon.

(22) The Sacramento Bee.

PASSED AND ADOPTED this 15th day of April, 2008, by the following vote:

AYES: Supervisors Overman, Armstrong, Kobseff and Cook
NOES: NONE
ABSENT: Supervisor Erickson
ABSTAIN: NONE

W. R. Overman, Chair,
District 4

LaVada Erickson, Vice Chair,
District 2

Jim Cook, Supervisor, District 1

Marcia Armstrong, Supervisor, District 5

Michael Kobseff, Supervisor, District 3

ATTEST:
COLLEEN SETZER, Clerk
Board of Supervisors
By: _____
Deputy

G:\Share\FERC_KRB Restoration Agreement Resolution 2008\Resolution by Board Opposing Dam Removal and Current KRB Settlement Agreement 04_15_08 FINAL DOC.wpd

4/15/0

Additions to proposed Klamath Basin Restoration Agreement Resolution

Page 4 - 3rd paragraph down insert in second to last line between "and pursue all appropriate avenues" and "to protect the" - the phrase "other than dam removal" full section of sentence would read "and will continue to work with and pursue all appropriate avenues other than dam removal to protect the interests of its citizens."

Under the enumerated BE IT FURTHER RESOLVEDS add:

(6) Impacts of commercial ocean, tribal and in-river fishing and natural predators upon anadromous fish; and

(7) Should dam removal be entertained as an option by any settlement process, a full comprehensive scientific exploration and evaluation of the impacts of sediment release on the physical environment and human communities below the dams must be included with such consideration.

and biological added

APRIL 1, 2010

Jerry L. Bacigalupi, P.E.
P.O. Box 309
Montague, Ca. 96064
530 459 5546
916 768 5015

Siskiyou County Board of Supervisors (B.O.S.)
C/O County Clerk Office
510 North Main Street
Yreka, Ca. 96097

Subject: Written testimony for Proposed Klamath Basin Restoration Agreement (K.B.R.A.) Hearings at the Convention Center on April 1, 2010

As I stated in my letter to the B.O.S. on Nov. 12, 2009, it is time to give serious consideration to the proposed Klamath Basin Restoration Agreement **(DO NOT SIGN).** It is also time that the **B.O.S.** stand to the position that they were sworn to: to protect the property rights and the rights of the public, and to voice the will of the people of Siskiyou, County.

I am a Registered Professional Engineer with extensive experience in water resources engineering, FEMA Base Flood Elevation studies, bridge hydrology and hydraulic studies, bridge and highway design and construction. I am also a Siskiyou County property owner with over 4,800 acres of land in the County.

If this proposal is implemented, it is my opinion and fear that the consequences will be dire and harm many. The proposal is shortsighted with not all the stakeholders at the table. I cannot see one aspect of this proposal that would have a direct benefit to any property owner in our County. The proposed Agreement is a can of worms with no factual benefits to the public, and if allowed to go further, will decrease property values and only produce future problems for the majority of Siskiyou Co. property owners and citizens, with the County **B.O.S.** faced with **major law suits.**

Accordingly, it is imperative that County B.O.S. takes their Legal Position as the Lead Agency at this time.

Please take notice to my following observations and comments:

1. **Applicable Existing Laws and Regulations Need to be Followed.** Federal and State Agencies are proposing to erode (washing) 84% of the estimated 20.4 million cubic yards of the sediment deposits in the lakes down river as the reservoirs are drained. The State Water Quality Control Board and Department of Fish and Game, and the U.S. Corps of Engineers regulate all private construction

projects involving disturbed soil, within a drainage watercourse. How could anyone even consider such an irresponsible recommendation by public agencies? Moreover, the planning and zoning laws of the State of California, starting with Section 65000 of the Government Code, require that all lands be zoned appropriately with regard to their highest and best uses. All dams on the Klamath River subject to dam removal were constructed prior to the enactment of the California Planning and Zoning laws. The Siskiyou County Planning and Zoning Laws and the Land Use Element of the General Plan is required to designate the location and permitted uses of the land within and adjacent to these dam and reservoir areas, and identify **lands down stream which are subject to flooding.** The Conservation Element of the General Plan provides for the conservation, development, and utilization of natural resources including water and it's **hydraulic forces, flood management, water conservation, and the prevention, control and correction of soil erosion.**

The intent and purpose of the State Planning and Zoning Laws is to protect resources and property rights. Property owners adjacent to and downstream from the proposed dam removals expect their **property rights to be protected and upheld by State and Local Governments.**

Further, recent legislation passed in 2007, AB 70 (Ch. 367) and AB 162 (Ch. 369) expands the requirement for Cities and Counties to incorporate **flood control and management** and **provides that a city or county may be required to contribute its fair and reasonable share of the property damage caused by flooding,** & I might add, flooding caused by dam removal.

2. **Where are the Studies and Supporting Data related to Dam Removal?**
   a. Down Stream Flood Studies (FEMA Base Flood Elevation data)
   b. What to do with the bath rings around the dams? They will never be mitigated.
   c. Reducing river temperatures without low-level dam releases?
   d. Sustaining minimum flows with-out sustained dam releases.
   e. Washing dam sediment deposits down river.
   f. Replacing clean hydro-electric power.
   g. Rate increases to PP&L customers.
   h. Etc.

3. **Where are the Studies Supporting Coho Salmon Recovery if the dams are removed?** This appears to be a very controversial subject and one area that is not Supported by fact. **Can or will Coho Salmon migrate above Spencer Falls? Is the big picture being considered? Offshore foreign cannery factories, Protected Sea Lyons, Gill Netting, The killing of thousands of returning Coho Salmon at Iron Gate fish hatchery, etc.**

4. **Dams Provide Clean Energy.** At the present time California and the Nation is faced with three critical issues: a fiscal crisis, a water crisis and an energy crisis. Our state (and nation) should be trying to preserve and improve upon these dams and clean hydroelectric power generation facilities instead of removing them. The dams generate a substantial amount of clean renewable hydroelectric power. The

conditions and constraints being placed on Pacific Corp by Federal and State agencies are so extensive and costly and too "Dams Out" oriented. This is like raising rent so high the tenants are forced to move out.

5. **Dams Provide Critical Flood Protection.** The flood protection currently provided by the dams in place is notable. Without the dams much of the private property adjacent to the Lower Klamath River would be subject to severe flooding and erosion. Highway 96 may have to be relocated in several locations and many bridges replaced to provide the same level of service and protection that we currently enjoy.

   The 1964 flood destroyed many bridges on the Lower Klamath and washed out much of Highway 96. All of the dams that are proposed for removal were in place during the 1964 flooding. All roadways and bridges were re-located above the calculated Base Flood Elevation considering all existing dams in place. For public agencies to even consider removal of these dams without an in-depth study of the flood protection that they provide is very irresponsible.

   Attached is an Inflow / Outflow computer model of the Klamath River at Iron Gate using the 1964 Recorded Flood Data, which shows that there is a 22% reduction in peak flows and a peak delay of nine hours.

   The Board of Supervisors has the duty and is liable for any action, that they take or do not take to control flooding downstream of the Iron Gate Reservoir with the removal of these dams.

6. **Mother Nature Will Hit Hard.** Without the dams the Lower Klamath River peak flows and velocities will increase significantly during flood conditions, well in excess of these conditions experienced with dams in place. The increased velocity of the river will increase the bed load carrying capacity (boulders, rocks, gravel, sand, and silt) and increase the size of the rocks and boulders carried down stream. . With dams in, the tributaries have deposited their bed loads into the river, some of which were carried down stream and some of which (larger rocks and boulders) remain in the river because of reduced historic peak flows caused by the dams being in place and the river's inability to carry the larger bed loads. Most of these recent deposits will be carried down river during future flooding conditions without the dams in place, inevitably changing the river's course at several locations.

7. **The Dams Provide Controlled Necessary Cool Water.** Dams allow a controlled release of water on the Lower Klamath River, which maintains minimum flows and also contributes to filtering and cooling. This benefits fish and wildlife and allows fishing, rafting and other river recreation activities without the danger of sudden rises in river levels.

8. **The Dams Created Iron Gate Fish Hatchery.** The CDF Fish Hatchery at the base of Iron Gate Reservoir receives its water supply from low-level releases from

Iron Gate Reservoir. Without this cold filtered controlled water supply from Iron Gate, the fish hatchery's future operations will be dismal or non-existent.

9. **The K.B.R.A."Dams Out" Public Hearings have Ignored Well Established Science.** At one of the "Dams Out" meetings I pointed out that dams with deep water releases do provide cooling of the river below the dams. The U.S. Fish and Wild Life Service argued against this point stating that the dams are like a bathtub and have little or no effect on river temperatures below the dams. This is contrary to scientific fact.

At a later meeting the same point was raised; this time the U.S. Fish and Wild Life Service argued that the dams cause the river to be too cold at times for spawning fish and fry in the spring and fall.

When asked about the flood protection dams provide, their response was that the dams are like a wide spot in the river and provide little or no flood protection **(wrong! all dams provide some flood protection)**.

At a recent presentation by the State Water Resource Control Board a graph was presented to the public showing that the low-level releases from Iron Gate Reservoir were 10 degrees C or 20 degrees F above their estimated river temperatures with the dams removed **(this is an impossibility)**. I questioned this data and they responded that they did also. I then asked them why is this data being used? Their response was that this is the only data in this area that we have.

In short, the public has been presented with biased data that supports "Dams Out", much of which is contrary to well established and undisputed science in this area.

These are only some of the reasons why it is imperative that the B.O.S. take their sworn duty to Siskiou Co. property owners and citizens as LEAD AGENCY on this proposal at this time.

10. **FACTUAL AND HYPOTHETICAL DATA:**
    a. It is **FACTUAL** that the dams do provide clean electrical power to 70,000 homes; provide flood protection for down stream properties; provide cooler sustaining river flow releases; provide lake recreation; provide a safe pleasing natural looking front yard for several private property owners along the river and around the dams proposed for removal; provide for fish and wildlife habitat; maintains the Iron Gate Fish Hatchery; and much more.

    It is **HYPOTHETICAL** that the removal of 4 dams will provide any benefits what so ever to restore or improve coho salmon runs or provide any direct factual benefits to the Klamath River Basin.

Recommendations:

My recommendations to the Siskiyou County Board of Supervisors, the **PERMIT ISSUING AGENCY** for any proposed private land projects of Siskiyou County, is to:

1, **Demand and Take the Lead Position** on this proposed change in private land use.

2. **Require and Direct an unbiased study** addressing: flood protection, environmental impacts, recreation, costs, benefits, and a study addressing the replacement of clean renewable hydroelectric power, etc.

Removal of these dams without proper studies, environmental documents, and the involvement of the public will set the Federal, State and County Governments up for a **multitude of law suits.**

3. **Do not become signature to the K.B.R.A..**

Thank you for considering my opinions.

Respectfully submitted,

Jerry L. Bacigalupi P.E. (RCE 18063)

Attachment: Inflow/outflow K.R. Hydrograph at Iron Gate

J.L.B. Construction and
Engineering
3097 Sierra Blv.
Sacramento, Ca. 95864
916-484-7807, 916-768-5015

KLAMATH RIVER

INFLOW OUTFLOW COMPUTER MODEL FOR COPCO NO.1 & IRON GATE DAMS

USING 1964 FLOOD OUTFLOW DATA RECORDED 12/22/1964 @ GAGE 11516530 BELOW IRON GATE

OUTFLOW: IRON GATE DAM OF 29,400 cfs

CALCULATED INFLOW: Tc =24hr.; Q100 =35,700cfs

TIME hr.	INFLOW c.f.s.	OUT FL. c.f.s.	"Q"net ave c.f.s.	VOL. net Q(0.25) ac.ft.	AREA ac. (combined)	VOLUMN ac.ft. (V/7.407)*.5 combined	SURFACE EL. 2189.0ft.+ (V/7.407)*.5= 2,328.0+H	HEIGTH "H" (ft.) outflow	OUTFLOW Q=585(H)*1.5 +1000 c.f.s.
PEEK	35,700								
0	1000	1000	0	0	2000	135,000	2328.00	0.00	1000
3	4463	1000	1731	433	2003	135433	2328.22	0.22	1060
6	8925	1060	5633	1408	2014	136841	2328.92	0.92	1517
9	13388	1517	9639	2410	2031	139251	2330.11	2.11	2797
12	17850	2797	12822	3206	2055	142456	2331.68	3.68	5133
15	22313	5133	14948	3737	2081	146194	2333.49	5.49	8523
18	26775	8523	16020	4005	2110	150199	2335.40	7.40	12778
21	31238	12778	16229	4057	2138	154256	2337.31	9.31	17621
24	35700	17621	15848	3962	2165	158218	2339.15	11.15	22788
27	33469	22788	11796	2949	2185	161167	2340.51	12.51	26880
30	31238	26880	5474	1368	2195	162535	2341.13	13.13	28843
33	29006	28843	1279	320	2197	162855	2341.28	13.28	29307
36	26775	29307	-1417	-354	2194	162501	2341.12	13.12	28793
39	24544	28793	-3134	-783	2189	161717	2340.76	12.76	27665
42	22313	27665	-4237	-1059	2182	160658	2340.28	12.28	26160
45	20081	26160	-4963	-1241	2173	159417	2339.71	11.71	24429
48	17850	24429	-5463	-1366	2164	158052	2339.08	11.08	22564
51	15619	22564	-5829	-1457	2154	156594	2338.40	10.40	20623
54	13388	20623	-6120	-1530	2144	155064	2337.69	9.69	18643
57	11156	18643	-6371	-1593	2133	153472	2336.94	8.94	16647
60	8925	16647	-6607	-1652	2121	151820	2336.17	8.17	14654
63	6694	14654	-6845	-1711	2109	150109	2335.36	7.36	12676
66	4463	12676	-7098	-1775	2097	148334	2334.51	6.51	10726
69	2231	10726	-7379	-1845	2083	146490	2333.63	5.63	8818
72	1000	8818	-7202	-1801	2071	144689	2332.76	4.76	7084

INCREASE IN FLOW WITHOUT DAMS : 35,700-29,307= 6,400 c.f.s. OR 22% @ IRON GATE
DELAY OF PEAK FLOW: (33-24) = 9HR
NOTE:above quantities include 1,000 cfs sustained flows through power facilities

DATA:

1964 FLOOD OUTFLOW DATA RECORDED 12/22/1964 @ GAGE 11516530 BELOW IRON GATE DAM OF 29,400 cfs. & DEPARTMENT OF WATER RESOURCES BULLETIN 17-93

DAM	SURFACE AREA	VOLUMN	SPILLWAY ELEV.	FREEBOARD
COPCO NO.1	1,000 ac.	77,000 ac.ft.	2,464 ft.	20 ft.
IRON GATE	1,000 ac.	58,000 ac.ft.	2.328 ft.	15 ft.
COMBINED	2,000 ac.	135,000 ac.ft.		

To: Ms. Elizabeth Vasquez
Bureau of Reclamation
2800 Cottage Way
Sacramento, CA 95825

June 13, 2013

Gordon Leppig
California Department of Fish & Game
619 Second Street
Eureka, CA 95501

From: Jerry L. Bacigalupi
Professional Engineer (P.E.)
P.O. Box 309
Montague, CA. 96064 (530) 459-5546 (916) 768-5015c

Dear Ms. Vasquez and Mr. Leppig:

Following are my comments to the **Klamath Facilities Removal Final EIS/EIR** (dated December 2012, but not mailed to respondents until 04/05/13)

1) As a citizen and Professional Engineer I am disappointed at the professional integrity within the DOI and CDFG. In reviewing several of the EIS/EIR comments submitted to the DOI and the DOI responses, I am disturbed at the DOI's lack of professional knowledge, goal oriented responses, and spin **supporting dam removals**.

2) After reviewing my comments and the DOI responses, I feel that my comments were not addressed. **I would make the same comments again.** The point being that the EIR/EIS has not been properly completed because the **EIS/EIR process is flawed** with responses that lack professional and scientific integrity, and with probable misconduct, all supporting the KBRA / KHSA (Dam Removals). In addition viable alternatives with dams in place were not studied, and the facts that the Upper Basin Water Wars and the Klamath Hydro-Electric Facilities are not physically related. The KBRA & KHSA improperly mandate stakeholders agreeing to Hydro- Electric Dam Facility removals.

3) In particular I would like to address my highlighted comment #5 and DOI response **(Comment 6 Hydrology).** To quote my comment:
"In Chapter 3 - 3.6 Flood Hydrology of the EIR/EIS, data provided does not accurately represent current independent scientific or historical data. The data and conclusions presented was data that supports the Lead Agencies' desired outcomes and not supported by recognized engineering practices.

   a) Table 3.6-5 shows the 100-yr flows at Keno at 11,800cfs and Iron Gate at 31,460cfs. **A statistical analysis using data from Calif. Division of Dam Safety shows 100-yr. flows for Keno at 12,000cfs and Iron Gate at 30,600cfs. This is a close check, however;**
   Table 3.6-9 shows a 6.9% reduction in the flood attenuation of Iron Gate and COPCO Reservoirs combined.

This is in substantial disagreement with an engineered independent evaluation. Using the 1964 flood data for Gage 11516530 (29,400cfs peak flow at Iron Gate) an inflow out flow hydrograph combining both reservoirs shows a 22% reduction in peak flow and a 9 hour delay in peak discharge.

b) Table 3.6-9, the 100 yr. flood plain below Iron Gate Reservoir, and the write up needs to be recalculated and re-evaluated using properly engineered procedures for inflow/outflow analysis **based on historic hydrographs** to **show that the Dams Provide Critical Flood Protection."**

The DOI Response to my comment :

GP_LT_1230_1220-6 Master Response HYDG-1 Flood Protection. The comment author refers to an analysis of the 1964 flood documented in a memo delivered to Siskiyou County (Bacigalupi, 2010). In this analysis, it was concluded that Iron Gate Dam and Copco Dam reduce the 100-yr flood by 22 percent. However, a time step of 3 hours was used in Bacigalupi (2010), which is too large and this caused **errors** in the results. If the same analysis was performed with a time step of 15 minutes or smaller, the flood attenuation effects would be very similar to Reclamation (2D12b) and find that the attenuation of the 100-yr is near 7 percent as stated in the Draft EIS/EIR.

My comment to the DOI response:
The same analysis was performed using the same computerized program, same data, and varying the time steps of the inflow outflow hydrograph as suggested by the DOI. The results are as follows:

Time Step Hr.	Inflow cfs	Outflow cfs	Peak Flow Delay Hr.	Increase In Flow With Out Dams %	Remarks
3	35,700	29,400	9	22	Original
1	36,800	29,400	10	25	1Hr. Steps
.25(15min.)	37,250	29,400	10.25	26.7	15min. Steps

The above results show that the DOI makes rudimentary conclusion and statements that are in **error** and that have definite impacts on the decision of dam removals.
The Dams do provide substantial (26.7%) flood protection. Table 3.6-9, the 100yr. flood plain and write up needs to be revised.
The EIR/EIS process has not been completed. The EIS/EIR is flawed with responses that are in error, and lack professional and scientific integrity, all supporting the KBRA / KHSA (Dam Removals).

Respectfully submitted:

Jerry L. Bacigalupi 06/13/13
Jerry L. Bacigalupi

III

SHASTA NATION ANADROMOUS FISH PASSAGEWAY ALTERNATIVES TO DAM REMOVALS:

WITH A BRIEF HISTORY REVIEW OF THE KLAMATH RIVER, KLAMATH RIVER BASIN, AND THE CURRENT SITUATION

SHASTA NATION UNASSISTED VOLITIONAL ANADROMOUS FISH PASSAGEWAY ALTERNATIVES TO DAM REMOVALS

WITH A BRIEF HISTORICAL REVIEW OF THE KLAMATH RIVER, KLAMATH RIVER BASIN AND THE CURRENT SITUATION

The following data is presented to give a brief introduction to current conditions on the Klamath River, which will lead into the development of the Shasta Nation Unassisted Volitional Anadromous Tunnel Fish Passageway proposal as viable alternatives to the placement of fish ladders on three of the four dams targeted for removals, or the removals of the four dams: **J.C.Boyle, COPCO 1, COPCO 2, and Iron Gate.**

SHASTA NATION TRIBAL HISTORY

The Shasta Nation's First People occupied their aboriginal territorial lands in and around the four Klamath River Dams targeted for removal for centuries before their native way of life was disastrously disrupted by the intrusion of the Euro- American's lust for gold during the 1850's. The Shasta Nation's Aboriginal Territory is now known to be a portion of Southern Oregon and Northern California. The Shasta People were a forceful nation of six groups of Native Indians known as the Shastan Group, with each group speaking a variation associated with the Hokan Family Group language. The Shastan Group Indians were comprised of the Shasta, New River Shasta, Konomihu, Okwanuchu, Achomawi, and the Atsugewi Indians. The post Euro-American Shasta Nation is comprised of the Shasta Valley, Scott Valley, Okwanuchu, New River Shasta, Konomihu and Upper Klamath River Indians who lived downriver from Keno, Oregon.

The Shasta Nation's aboriginal territory, cultural heritage, and burial sites lie under and around the waters behind the dams proposed for removal.

Refer to Table of Contents: "MAPS" showing sites beneath these waters.

KLAMATH RIVER HISTORICAL REVIEW

The river has been the subject of much conversation and study going back to the 1800's. One story relates to General Freemont's expedition down the river. The report states that they tried to camp on its banks but could not because of the amount of dying fish caused by the lack of adequate water which created low flows and warm water temperatures. The conditions created a huge stench. It was so bad that the expedition's horses would not drink the water.
One of the first studies on the river was done in 1897 by Dr. Warren Barton Everman, a Federal Biologist. Some of the noteworthy comments in the report described the water as very warm and cloudy with difficulty seeing the fish occupants. They reported the cause being natural volcanic vents in the Upper Basin Lake (Upper Klamath Lake) emitting natural phosphorous and nitrate into the water. As the Everman team traveled west down River they noted that there were **no anadromous ocean going fish** in the River until they reached a point about where the present Iron Gate Reservoir is now located. They did observe a "species of land-locked salmon," then known as sockeye salmon. In their contacts with the Upper Klamath Lake Tribe, which inhabited the Upper Basin, they were told that the Upper Klamath Lake Indians traveled downriver to Shasta Tribe villages to trade for better quality fish. Evermam and his team were able to observe this trading.

KLAMATH BASIN OVERVIEW

The Klamath Watershed is a large geographical area with a land base of 11.4 million acres: 56% in California, 44% in Oregon, in a total of 9 counties, 5 in California and 4 in Oregon.
The local land use county authorities are:

California	Siskiyou	3,270,000 Acres
	Trinity	1,635,600 Acres
	Modoc	752,600 Acres
	Humboldt	600,000 Acres
	Del Norte	141,000 Acres
		6,399,200 Acres

Oregon	Klamath	3,113,100 Acres
	Jackson	1,600,000 Acres
	Lake	322,700 Acres
	Josephine	3,600 Acres
		5,039,400 Acres

The predominate feature of this watershed is the **Klamath River which originates in the lower one third of the Upper Klamath Basin at Link River Dam (base of Upper Klamath Lake in Klamath Falls, Oregon)** and flows west to the Pacific Ocean, a distance of 254 miles.
The Klamath River is physically located in 3 of the 9 watershed counties in which Siskiyou County has 56% of the River mileage.
The watershed is unique among all the major aquatic systems in the Western United States because of its upside down climatic and topographic conditions. Annual precipitation (snow and rain) amounts to approximately 90 inches in the coastal 1/3 of the river mileage, 15-30 inches in the central 1/3 of the river mileage, and less than 15 inches in the 1/3 that lies in the arid Upper Klamath Basin.
This low rainfall combined with the volcanic soils and shallow topography of the basin creates poor water quality conditions entering the Klamath River at Link Dam (River Mile 254). Water quality does improve moving towards the ocean starting at Iron Gate Dam (River Mile190).

THE KLAMATH PROJECT

In the 1850's, the discovery of gold in the Klamath River and its tributaries brought many people to select areas in the watershed seeking riches and to settle. The Upper Klamath Basin was found to be a hostile location and as a consequence was slow to develop.

The large, warm and shallow marshes of the Upper Klamath Basin were generally considered contaminated and toxic. These waters which were in contact with highly mineralized volcanic soils and geothermal conditions supported algae and disease carrying mosquito infestations. Between evaporation and infiltration in the upper basin marshes, the Klamath River waters between Keno and the Shasta River were frequently known by the locals to retreat subsurface in summer.

In the early 1900's, in cooperation with local landowners, the Bureau of Reclamation (BOR)proposed and engineered **The Klamath Project** for the Upper Basin (Klamath Falls-Tule Lake area) to consolidate a large portion of the marshes minimizing evaporation, infiltration, and mineral contamination. It would also expose rich bottomland for agricultural use, allow habitat and increase food availability for migratory waterfowl, minimize disease potential, and incorporate excess water from the normally landlocked Lost River to supplement Klamath River summer flows for the fisheries and irrigation.

Using an intricate system of canals, storage and diversion dams, and tunnels, electricity would be required to support the necessary pumping for the project. Research was performed and an agreement made for the locally formed Siskiyou Power and Electric Company (later to become COPCO – California Oregon Power Company, Pacific Power, and currently PacifiCorp) to finance a dam and provide power at cost for Project operation in exchange for augmented Klamath flows and Federal licensing. The lower dam (COPCO 1 at river mile 198) location was chosen in part due to consensus that salmon were never known in numbers above Spencer Creek due to impassability of the falls near Keno (river mile 230), generally depleted salmon physical conditions, and poor intermediate upper basin water quality.

Mitigation for the few blocked creeks normally accessible to salmon was accomplished by construction of the Fall Creek Hatchery.

Three dams were built prior to 1930 to satisfy the needs of the Klamath Project. **COPCO 1** in 1918, **Link River Dam** in 1921, and **COPCO 2** in 1925. Over the next forty years additional storage and stream flow maintenance structures were built to augment beneficial use of River and tributary waters for domestic, irrigation, flood protection, sediment control, fish and wildlife enhancement, recreational resources, industrial purposes, and hydro-electric power production. These improvements proved to be successful and concurrent with many of the largest salmon runs on record.

KLAMATH – SHASTA VALLEY RECLAMATION PROJECT

In 1923 the United States Reclamation Service (Horner J. Gault and Foster Towle) in cooperation with the State of California and the Klamath-Shasta Irrigation District investigated the feasibility of diverted water from the Klamath River one mile downstream from Keno, Oregon (at or near the present location of

Keno Dam) to the Shasta Valley via a gravity flow canal and tunnels flowing at 420 to 1100 cfs which would irrigate 25,000 to 65,000 acres. Several similar studies have been made since the 1923 investigation which are reported in this report.

KLAMATH BASIN BI-STATE COMPACT

Prior to 1955, after experiencing some major wet and dry years, representatives from Oregon and California began negotiations related to the water resources of the Klamath River Basin. Their interest was to facilitate and promote the orderly integrated and comprehensive development, use, conservation and control of water for various purposes. Five commissioners were selected representing two counties in Oregon (Klamath and Jackson) and four commissioners were selected representing California, (Modoc, Trinity, Humboldt, and Siskiyou) a 5th Commissioner (Director of Water Resources, State of California) became the 10th member. They developed a Bi-State Federal agreement called the **"Klamath Basin Compact".**
This document contains articles addressing controversial issues, equitable distribution and use between the two states and federal agencies, and for preferential rights for the use of water after 1957 for irrigation purposes in the Upper Klamath Basin in Oregon and California (The Klamath Project). The Compact was ratified by the Legislatures of both States and the U.S. Congress, and **signed into Law by the Governors of each State and the President of the United States on August 30, 1957.** This Act (Law), in conjunction with three appendixes that become a part of the Compact, was consented to by Congress.

Appendix B formed the **Siskiyou County Flood Control and Water Conservation District** (which is Appendix 89 to the California Water Code).
The Siskiyou County Flood and Water Conservation District is a district in politic with twenty-three powers. When Iron Gate Dam was completed in 1962, a provision in the aforementioned Appendix B not only set aside the District's **60,000 acre feet of reserved storage rights to be held for Shasta Valley water use,** it also gave latitude to carry out all works and improvements to make uses of water for any of the purposes authorized by the Bi-State Compact Act. (Articles: e, i, k, m, p, & q),
Including flood control.

MAJOR DAMS IN THE KLAMATH BASIN WATERSHED:

Within the River and its tributaries there are **twelve major water storage structures** from Upper Klamath Lake to the mouth.

Five are on tributaries:

Located in California: Dwinnell on the Shasta River, Trinity and Lewiston on the Trinity River which has a diversion to the Sacramento River.

Located in Oregon: Howard Prairie and Hyatt Prairie on Jenney Creek and Fourmile Lake on Fourmile Creek, all which have diversions to the Rogue Valley.

Seven structures are on the Klamath River main stem:

In addition to providing irrigation water and hydro-electric power, these dams collectively **provide flood control and maintain minimum prescribed water flows** in the River for fish, especially during drought conditions as the River has historically gone dry in the upper reaches during the late summer and early fall.

Located in Oregon:

Link River Dam (Upper Klamath Lake) (Head Waters of the Klamath River) (16'high) (Upper Klamath and Agency Lakes) (River Mile 254), **the largest natural lakes & storage structure,** a 66,000 ac., 400,000+ ac.ft., 30+ mile long shallow lake at the **head waters of the Klamath River,** constructed in 1921 by the Bureau of Reclamation. It has a fish ladder and provides storage for downstream flow maintenance, irrigation waters for the Klamath Project, and hydro-electric diversions for the East and West Side Developments (4 MW@1450 cfs) for PacifiCorp's power grid and the Klamath Project.

Keno Dam (25' high) (Lake Ewana) (River Mile 233), a 20 mile long narrow reservoir which backs up to the city of Klamath Falls, one mile downriver from Link River Dam, with construction completed in 1967. It is owned by PacifiCorp and operated under contract with B.O.R. It has a fish ladder and a storage reservoir. Its primary responsibility is to regulate down river flows on the Klamath River, based on the volume of water released to the River from Link River Dam and the Klamath Project canals.

J.C. Boyle Dam (68' high) (River mile 224), a 420 acre, 3,500 ac.ft., 3.6 mile long reservoir which backs up to 5 miles downriver from Keno Dam near the California/Oregon border, construction was completed in 1958. It is owned and operated by PacifiCorp. It has a fish ladder and conveys water to a penstock and

powerhouse through a two mile concrete canal parallel to the Klamath River. Its only purpose is to generate power (98 MW @1425 cfs).

Located in California:

COPCO #1 (126' high) (River Mile 198), a 1,000 acre, 77,000 ac.ft., 4.8 mile long reservoir which backs up to 21 miles downriver from the J.C. Boyle Dam, owned and operated by PacifiCorp, construction was completed in 1918. The purpose of COPCO #1 was to generate hydro-power (20 MW @1180 cfs, with provisions for additional generation) and sedimentation control for the Klamath Project. It also provides downstream flood protection and many recreational fishing and water sport opportunities for visitors from Oregon and California. There has been considerable land development around the reservoir with permanent and seasonal homes.

COPCO #2 (33' high) (River Mile 198), a small 5 acre, 55 ac.ft., 0.3 mile long reservoir which is directly downriver from COPCO #1 Dam. It is owned and operated by PacifiCorp. and was constructed in 1925. The dam was constructed for a hydro-electric diversion to a nearby penstock and powerhouse (27 MW @1338cfs) for the Klamath Project.

Iron Gate Dam (188' high) (River Mile 190), a 1,000 acre, 58,000 ac.ft., 6.5 mile long reservoir which backs up to one mile downriver from COPCO #2 Dam, owned and operated by PacifiCorp, constructed in 1962. It was designed to provide storage water for in-stream flow maintenance to support minimum flows for fall migration of salmon, down-river flood and surge control at the request of downstream residents, power generation (18 MW @1735 cfs), and cool summer water for Iron Gate Hatchery. It also provides many recreational fishing and water sport opportunities for visitors from Oregon and California.

Iron Gate Hatchery is directly down river and dependent on Iron Gate Dam. Constructed by Pacific Power in 1966 as an alternative mitigation measure to providing fish passage around the Dams to 25 miles of native river and to a few minor creeks which historically provided anadromous fish habitat. The hatchery is currently 80% financially supported by PacifiCorp. and receives its cool 59 degree summer water from two low level releases (20' & 70') from Iron Gate Reservoir, which allows blending to create desired water temperatures and dissolved oxygen. The Hatchery releases over six million fingerlings into the Klamath River a year: five million Chinook (King) Salmon released in the spring and one million released in the fall, 200,000 Steelhead, and 75,000 Coho Salmon.

Reserved Water Rights: Within the reservoir are several reserved water rights for storage and beneficial uses; the **Klamath-Shasta Valley Transfer** will utilize one. The Reservoir reserves a 60,000 acre feet water right that can be diverted to the Shasta Valley for various consumptive uses including irrigation, industrial, domestic, municipal, recreation, and fish and wildlife.

A 1964 study: The California Department of Water Resources (Bulletin No. 87) completed a study consisting of a pumping plant at Iron Gate Reservoir and a delivery system consisting of piping and canals to Northern Shasta Valley. The transfer plan proposed pumping 350 cfs to provide 122,000 ac.ft. of water to serve the Ager and Shasta Valley area. The 1964 estimated annual water cost for this proposal was $16+ per ac.ft.

A 2007 study: "Klamath-Shasta Water Substitution Preliminary Engineering Study", financed by the California Department of Fish and Game (CDFG) in cooperation with the Shasta Valley Resource Conservation District (SVRCD), was performed to consider the 60,000 ac.ft. water right transfer to the Shasta Valley to be used by the Montague Irrigation District's irrigators in exchange for in-stream flow releases from Lake Shastina to the Shasta River. This project proposed diverting Klamath River water from Keno Dam in Oregon to Lake Shastina via canals, tunnels and siphons, and another alternative pumping from Iron Gate Dam to Lake Shastina via piping and canals. There has been no follow up on this study by CDFG, DOI, or the SVRCD to SCWUA knowledge, probably because it does not support the KBRA or KHSA agreements (dam removals).

MID-UPPER KLAMATH RIVER WATER QUALITY

Because of the volcanic origin of the Upper Klamath Basin, the water quality of this basin is high in phosphates and nitrates creating impaired water conditions in the Klamath River. The water quality at the headwaters of the Klamath River (Link River Dam, at the outlet to Upper Klamath Lake) is impaired by having a low dissolved oxygen content and high nutrient loading. This is a naturally occurring phenomenon and is incurable. Early explorers of the River cited the water as being turbid, stinky and not fit to drink. Further, PacifiCorp completed a water quality study in Nov, 2006 for their Federal Energy Regulatory Commission (FERC) relicensing application No. 2082 showing that the nutrients traveling through the dams, proposed for removal, undergo an overall annual net reduction compared to inflow conditions. This study shows that the dams and reservoirs targeted for removal actually **improve** water quality contrary to commonly stated opinions.

COHO SALMON IN THE KLAMATH RIVER

Coho are not considered native to the inland River; CA. Department of Fish and Game (CDFG) records list the earliest record of Coho Salmon being stocked in the Klamath River Basin was of a plant made in 1895 in Supply Cr., a tributary to the Trinity River. Several out of basin import plantings have been made in the Klamath River and tributaries since 1895. Inland Klamath Coho stocks were never considered effective until after conditions improved as a result of Iron Gate Dam and Fish Hatchery. Only then was the planted Cascadia Coho return determined marginally successful.

U.S. Fish & Wildlife and Washington Fish & Game indicates that most Coho Salmon spawn in streams close to the Ocean. Distance from the Coast varies from 15 to 25 miles.

California Fish & Game "Finfish and Shellfish Identification Book" published in December 2006 does NOT list Coho Salmon as being present in California waters.

Karuk Tribal Council Meeting (12,27,2001) It was reported that not one member of the Council believed that Coho salmon were native to the Klamath River.

Current Historical Cyclic Ocean warming has caused the long term migration of the cold water anadromous fish (Coho Salmon) northerly along the California, Oregon, and Washington coast to Canada and Alaska. NOAA data shows that the salmon landings (catches) on the west coast are almost three times greater today than it was in 1970, with 97% of the landings in Alaska (refer to graph in section V). The ocean impacts on Coho Salmon have not been analyzed by Federal and State Agencies.

Trawlers and Ocean Cannery Impacts on Coho Salmon numbers have not been analyzed by Federal and State Agencies.

Predation by Pinnipeds and the Protected Sea Lions Impacts to Coho Salmon numbers have not been analyzed by Federal and State Agencies.

Gill Netting by Indian Tribes on the Klamath and Trinity Rivers has been permitted by agreement with DFG setting limits on the number of salmon takes. The tribes are allowed to monitor their own take. CDFG does not Police or monitor the takings. The gill netting impact on Coho Salmon numbers has not been analyzed by Federal and State Agencies.

1997 to 2003 killing of native Coho Salmon by DFG. During this period CDFG's practice was to kill all returning unmarked (wild reared) Coho Salmon returning to the Iron Gate Hatchery (IGH), which included those used for hatchery spawning purposes (1,791 Coho killings, 22% of all returning Coho Salmon). In 2004, at the request of Federal Agencies, 40 returning (wild reared) unmarked Coho Salmon

were implanted with radio transmitters and returned to the river at (IGH). 23 of the 40 were accounted for and traveled down river as far as 50 miles and up tributaries (3 up the Scott R.)

2002 September killing of 33,000 adult Salmon on the Lower Klamath River. NMFS and FWS attributed the fish killings to an epizootic disease with contributing factors being: 1. above average numbers of Ocean Chinook Salmon entering the Klamath River. 2. River flow in the fish-kill area was atypically low. 3. Water temperatures were very warm.

A Center For Disease Control study initiated in 2009 revealed that the waters released from Iron Gate Reservoirs had no toxic effects.

The Fish & Game report published in 2003 indicated the following: "The CDFG concludes that low flows and other flow related factors (eg, fish passage and fish density) caused of the 2002 fish kill on the Lower Klamath River. Furthermore, of the conditions that can cause or exacerbate a fish kill, flow is the only factor that can be controlled to any degree. Flow is regulated by upstream reservoirs controlled by the USBR on both the Klamath and Trinity Rivers."

The National Marine Science Academy found the Klamath River Iron Gate Dam flow releases not to be the cause of the kill. The most supported cause of the killings is a dumping of methamphetamines in the River upstream within the affected area, the Trinity River Ceremonial Ramping of flows which triggered early salmon runs, and seasonal hot temperatures, contrary to NMFS and FWS determinations.

Similar mysterious virus killings of huge numbers of Fraser River salmon off the west coast of Canada were studied and reported by Dr. Kristi Miller.

In spite of the kill, the healthy salmon return up river was one of the largest.

Iron Gate Hatchery (IGH) reared returning Coho Salmon were not included in the ESA Coho listing by DFG. Wild Reared Coho Salmon Returns to the IGH averaged 22% of all returning Coho during the period 1997 to 2004, 78% were not considered for the listing.

Recent Coho Studies (informed by CDFG personnel) Shasta River Wild Coho Salmon Studies revealed that there are no biological differences between Shasta River Wild Coho Salmon and Iron Gate Hatchery reared Coho Salmon. CDFG was negligent for not including I.G. Hatchery Coho Salmon Returns and the possible impacts of the 1791 native Coho killings before listing Coho as an Endangered Species.

There is little or no record of any of the above Coho information being considered before the listing of Klamath River Coho (a planted species) as an Endangered or Threatened Species.

Klamath Basin Restoration Agreement (KBRA)
and
Klamath Hydro-Electric Settlement Agreement (KHSA)

Nearly ten years ago (2001) a decision by **federal agencies** to allocate most of the useable water from the Upper Klamath Lake to in-stream flows for endangered sucker fish created a dire situation for hundreds of farming operations, resulting in the loss of over 1200 family homes and futures. Locals at the time said the devastating action to increase lake levels would prove counter to sucker fish due to their adapted advantage in low level conditions. Subsequent results revealed years later determined the **experiment** a complete failure. No just compensation was offered or considered for those who suffered.

After the DFG listing of the Coho Salmon as an endangered species and because PacifiCorp was in the process of relicensing their Hydro-electric facilities on the Klamath River, a group of nearly 30 **self described stakeholders** comprised of Federal, State, County, Tribal, Environmentalist, Fishing Organizations, and a minority of Irrigation interests who were **assured guaranteed water deliveries** to participate, organized in **secret** to create the **Klamath Basin Restoration Agreement** (KBRA). The majority of the group formed has no regional vested interest and little but beneficial individual consequence for failed determinations. They ostensibly assumed among themselves oversight and allocation of all regional water resources and of **required acceptance to dam removals** as a condition to sit at the table. Agreements were then made **allocating benefits** and position between and to participating members. Once in place, with the KBRA seated and the Department of Interior in the lead, the **Federal Klamath Working Group** was again formed in **secret** with governmental authority compelling PacifiCorp to negotiate compliance with KBRA provisions and implementation through the Agreement in Principle (later called **Klamath Hydroelectric Settlement Agreement** (KHSA). Key provisions of the KHSA **significantly impact** the assets and resources of many that were unrepresented, including Pacific Corp ratepayers.

The limited hydro-electric relicensing options given PacifiCorp under the **closed** Federal Energy Regulatory Commission Report were heavily influenced by **mitigation requirement recommendations** from many of the later seated KBRA members. PacifiCorp was further limited by the subsequent altered California Regional Water Quality Control Board 401 water quality permit **requirements** imposed after closing of the report, making relicensing too costly and essentially

unfeasible. These changed conditions effectively eliminated the only economically viable options for relicensing. FERC refused to reopen the report to consider newly available studies and alternatives which would have contradicted previous FERC opinions and offered additional far less costly and more effective options.

It is the opinion of the SCWUA that options unjustifiably dismissed under the FERC relicensing requirements, such as preliminary salmon truck and haul studies to ascertain their historically contradicted upper basin survival capabilities, were intentionally dismissed to develop a predetermined objective (removal of dams). Though PacifiCorp has now found it most expedient to secure **economic beneficial agreements** of compliance **at ratepayer and taxpayer expense,** the included implementation of the KBRA and potential removal of the dams greatly impacts the lives, resources, and assets of the unrepresented vested majority in opposition throughout the entire **closed agreement process.** Agencies and entities responsible for the creation of the KBRA and KHSA agreements regarding dam removals have failed to consider local public comments related to potential social and economic impacts on affected local communities; this defies credibility. **Siskiyou County, which will be impacted the most, was not a signing party to either agreement.**

SCWUA believes in the light of the above described proceedings and recent studies providing critical corrective information, that FERC should reopen its Relicensing Report to reconsider previously dismissed and newly advanced options **(Including the Shasta Nation Unassisted Anadromus Fish Passageway Alternatives).** Barring reconsideration of prior dismissed options demonstrating present success, the following alternatives to dam removals are presented outside the previously considered FERC options.

SISKIYOU COUNTY'S PROPOSALS:

It is within this historic and legal framework that we, the **Siskiyou County Water Users Association,** as a task force to the Board of Directors of the **Siskiyou County Flood Control and Water Conservation District,** submit the following studies and report for a proposed anadromous fish by-pass around Iron Gate and the COPCO dams as alternatives to fish ladders or dam removals. In addition, to expose potential spawning and rearing habitat for an additional 25 river miles of the native portion in the Upper 64 miles of Klamath River and adjacent tributaries below Keno Dam.

ALTERNATIVES TO DAM REMOVALS:

I

SHASTA NATION TUNNEL UNASSISTED ANADROMOUS FISH PASSAGEWAY

This study and option is introduced by the Shasta Nation, S.C.W.U.A. and others to offer an alternative to dam removals and to introduce salmon to an additional 25 river miles of native Upper Klamath River. The study was conducted by the Klamath River Advisory Council, a sub-committee of the Siskiyou County Water Users Association. The council consisted of people with backgrounds in Academics, Hydrology, Aquatic Biology, Geology, Surveying, Engineering, and members of the Shasta Nation. This report has several objectives:

1. To provide fish passage around Iron Gate and COPCO Dams. (All dams above the proposed Tunnel Passageway have fish ladders.)
2. To test and increase the use of 25 river miles of native Upper Klamath River habitat.
3. To prevent the destruction of the Shasta Nation's aboriginal cultural, heritage and burial sites under the waters behind the dams
4. Maintain sustained downstream 1,300 cfs. flow from Iron Gate Dam to the Klamath River.
5. Maintain clean Hydro-Electric Power for 70,000 homes.
6. Maintain flood protection for downriver cities, roads, bridges, and private property.
7. Protect property owners and property values adjacent to the river and reservoirs.
8. To redirect funding proposed for dam removals to this project, which will have positive economic and environmental benefits for Northern California and Southern Oregon and the Nation.

The following criterion has been considered:
Cost Benefit Ratio, Environmental Impact, Genetic Imprinting, Thermal Refugia Gradient of Route, Water Quantity, Water Temperature, Water Quality, Length of By-Pass, Tunnel Lighting, and Other Alternatives.

Cost Benefit Ratio: In the past, there have been other proposals offered to get salmon around the dams and up the remaining 64 miles (25 miles natural river) of the total river length of 254 miles. During the construction of the dams, fish ladders were studied and rejected and Iron Gate Fish Hatchery was built to mitigate the loss of the 25 river miles of natural habitat. Recently, under the FERC relicensing requirements, fish passage around 3 dams was required and fish ladders are again being considered with an estimated cost in excess of 300 million dollars. A study of trucking and release of the salmon around the dams was also proposed but rejected by state and federal agencies. Dam removal cost estimates are in excess of one (1) Billion dollars, not including the cost of replacing existing power facilities or mitigating the dams 20+ million cu. yds. of contaminated sediments behind the dams.
The cost of the Tunnel Passageway proposal is estimated to be 50 +/- million, or 1/6 (17%) the cost of fish ladders and 1/20 (5%) the cost of dam removals.

Environmental Impact: One of the most important considerations of these alternatives is the impacts to the existing environment in the Klamath River Watershed. The Tunnel Passageway will have significantly less environmental impact on the total watershed, being that a portion of the proposed Passageway on Bogus Creek is already being used by anadromous salmon and steelhead to migrate and spawn, and the tunnel portion will be below the ground surface. There will be very minimal impacts at the tunnel entrances; versus long term impacts associated with dam removals.
Dam removals will destroy an established 100 year old aquatic and waterfowl habitat in the river and reservoirs, not to mention the irresponsible long term sediment impacts being proposed by Federal and State Agencies **(allowing the 20+ million cubic Yards of contaminated sediments to naturally erode down the river).**

Thermal Refugia: Establishment of resting places ie: thermal refugia for spawning salmon is essential. By the time they get up the Klamath River to the Iron Gate Dam Hatchery they will have traveled nearly 200 miles from the ocean in an environment of water with many changes in the water quality and river conditions. Rest areas (refugia) enlarged areas off to one side of the tunnel) are needed and will be placed at 250' spacing throughout the tunnel.

Gradient Route: This route was selected in order to keep the average gradient at 1% or less. The Hart By-Pass, a previous conceptual proposal, would have had several, gradients that exceed 6% and required several fish ladders.

Water Quality: The water passing through the Tunnel Passageway will be Klamath River water from COPCO #1 Lake at 10 cfs. or greater and will be blended with Bogus Creek water from outlet of the Tunnel Passageway to the Klamath River (3.3 miles). Imprinting (Olfactory) will be accomplished because all waters will have a majority of Klamath River water.

Water Temperature: Water temperatures running through the tunnel should approach 50 to 60 degrees F. at the outlet irrespective of the surface temperatures at COPCO 1 Lake. This should be within the range of water temperatures on Bogus Creek, depending on weather conditions, and be well within range for good salmon habitat conditions

.

Length of Passageway: The entire length of the Passageway from the confluence of Bogus Creek (Iron Gate Fish Hatchery) and the main stem of the Klamath River to Copco 1 Lake is eight miles, 3.3 miles up Bogus Creek and 4.75 through the tunnel, **2 miles shorter** than the travel up the Klamath River to the tunnel inlet structure. Note: as compared to fish ladders, the Tunnel Passageway would also eliminate the predation across Iron Gate and COPCO 2 reservoirs.

Lighting: The Tunnel will be equipped with a programmable- automated lighting system throughout its entire length with a backup system. The entrances will be equipped with a unique designed system intended to attract by brightening and help camouflage the entrances as seen from the water.

Note: This proposal is estimated at about 1/6 (17%) the cost of fish ladders or 1/20 (5%) the cost of dam removals. It will have very little, if any, negative environmental short or long term impacts compared to dam removals. It will have several benefits to Siskiyou County and the Klamath River:

II

SHASTA NATION TUNNEL UNASSISTED ANADROMOUS FISH PASSAGEWAY INCLUDING THE GRAVITY FLOW: KLAMATH - SHASTA IMPORT PROJECT (JOHN C. BOYLE RESERVOIR TO THE SHASTA VALLEY)

SIMILAR TO THOSE STUDIES PERFORMED FOR THE SHASTA VALLEY R.C.D. & CDFG JUNE 2007 (CDFG PROJECT NO. P0310329)

This proposal incorporates the previously discussed Shasta Nation Unassisted Anadromous Tunnel Passageway with the import of the 60,000 ac.ft. Siskiyou County State Reserved Storage Water Right (A016958) from the Klamath River to the Shasta Valley. This alternative would consist of a diversion structure at J.C. Boyle reservoir and a 45 mile gravity flow canal, incorporating several environmentally friendly tunnels and inverted siphons, to a 50,000 ac.ft.+/- storage reservoir or reservoirs on or near Willow Creek. From Willow Creek a 7.6 mile canal would be constructed to the Montague Irrigation District (MID) main canal below the City of Montague diversion.

This proposal would divert water from the Klamath River during high flow periods or by direct diversion during irrigation season at up to 200 cfs, which can provide 400 ac.ft. a day or 12,000 ac.ft. a month. It would take five months, at this rate, to provide 60,000 ac. ft.

The tunnel and siphon entrances will be equipped with special designed gates which would allow water passage, but block the entrance of debris and preclude the entrance by humans and animals. The canal will be widened and the slopes flattened to provide animal friendly crossings at all game trails and at tunnel and siphon entrances.

This proposal will allow the City of Montague to continue receiving its water from Lake Shastina without blending with Klamath River water.

The benefits of this proposal: would provide irrigation water to the Ager area; allow MID to supply the majority of their irrigators with Klamath River water; reduce the demands on Lake Shastina, thereby allowing MID to dedicate a portion of the reduced demands to in-stream flow in the Shasta River, improve water quality and fish habitat in both the Shasta and Klamath Rivers, save the dams, and have minor environmental impacts compared to dam removals.

The cost of this proposal is estimated at $500,000,000 including the Tunnel Passageway, or 67% higher than installing fish ladders and 50% the estimated cost for dam removals.

III

SHASTA NATION TUNNEL UNASSISTED ANADROMOUS FISH PASSAGEWAY INCLUDING THE PRESSURIZED FLOW: KLAMATH - SHASTA IMPORT PROJECT (IRONGATE RESERVOIR TO THE SHASTA VALLEY)

SIMILAR TO THOSE STUDIES PERFORMED FOR THE SHASTA VALLEY R.C.D. & CDFG JUNE 2007 (CDFG PROJECT NO. P0310329)

This proposal is similar to the previous gravity flow import project transfer from J.C. Boyle Reservoir to the Shasta Valley; **however it requires pumping** with the point of diversion out of Iron Gate Reservoir instead of J.C.Boyle. It incorporates the previously discussed Unassisted Anadromous Tunnel Passageway with the transfer of the 60,000 ac.ft. Siskiyou County Reserved Storage Water Right from Iron Gate Reservoir to the Shasta Valley. It would consist of two 12,000 H.P. pumping plants, one at Iron Gate Reservoir (El. 2,343) and one at EL. 2680+/- ; a 6.2 mile 6' diameter pressurized pipeline; and a 5.1 mile gravity flow canal to a 50,000 ac.ft.+/- storage reservoir or reservoirs on or near Willow Creek. From Willow Creek a 7.6 mile canal would be constructed to the Montague Irrigation District (M.I.D.) main canal below the City of Montague diversion. This will allow the City of Montague to continue receiving its water from Lake Shastina without blending with Klamath River water.

The benefits of this proposal: It would provide irrigation water to the Ager area and allow MID to supply the majority of their irrigators with Klamath River water, thus reducing the demands on Lake Shastina, thereby allowing MID to dedicate a portion of the reduced demands to in-stream flow in the Shasta River, improve water quality and fish habitat in both the Shasta and Klamath Rivers, save the dams, and have minor environmental impacts compared to dam removals.

The cost of this proposal is estimated at $300,000,000 including the Tunnel Passageway, or equal cost to installing fish ladders, and 30% the estimated cost for dam removals.

Note: This proposal is estimated at the same cost of installing fish ladders or 30% the cost of dam removals. The estimated cost of this proposal does not consider power cost, which could be considerable ($60.00/ac.ft. at current electrical cost). It will have very little, if any, negative environmental short or long term impacts compared to dam removals. It will provide several benefits to Siskiyou County and the Klamath River; pumping cost may make this alternative prohibitive.

Other Unassisted Anadromous Passageway Alternatives Studied:

1. **Shasta Nation's Alternative to Dam Removals "PROPOSED SHASTA ANADROMOUS FISH PASSAGEWAY (Hart By-Pass)** a previous studied alternative to dam removals utilizing Bogus, Cold, and Deer Creeks, a total travel of 12miles with an elevation rise of over 1,000 feet to the pass between Cold and Deer Creeks and from there over 600 feet decline to Keaton Cove on COPCO 1 Reservoir. This alternative required a 1,500 H.P. pumping station on COPCO 1 Reservoir with a delivery pipe to the divide between the two drainages plus several regulating structures and several fish ladders, and for those reasons, this alternative was determined to be not environmentally or cost beneficial to the Tunnel Alternative. (Refer to original "PROPOSED SHASTA ANADROMOUS FISH BY PASS ROUTE").

2. **The Bogus Creek to J.C. Boles / Shasta Valley Transfer Canal Passageway** This conceptual alternative involved utilizing Bogus Creek up to its intersection with the 60,000 ac. ft. Klamath R.-Shasta Valley Transfer Canal. It would require a water transfer structure at Bogus Cr. to the canal and several flume structures to replace the proposed canal siphons. This alternative was also determined to be not environmentally or cost beneficial to the Tunnel Alternative.

SEE SECTION IV: **FOR PRELIMNARY DRAWINGS, DETAILS, AND ESTIMATES**

REASONS FOR THESE PROPOSALS AND KEEPING THE KLAMATH RIVER DAMS:

- **Irresponsible expenditures during a national economic crisis**
- **Unnecessary loss of green hydro-electric power for 70,000 homes**
- **Cost to replace hydro-with fossil fuel power falls on us, the rate payers**
- **Carbon foot print created to replace hydro-with fossil fuel**
- **Substantial increase in electricity cost**
- **Loss of lake fisheries and wildlife habitat**
- **Loss of Iron Gate fish hatchery**
- **Loss of recreation**
- **Substantial loss of property values**
- **Substantial loss of down river flood protection- FEMA flood insurance - move to high ground**
- **Loss of infrastructure during flooding such as loss of roads and bridges**
- **Loss of sustained 1300 cfs minimum river flows- will be replaced by the Upper Klamath, Scott and Shasta Valley irrigators**
- **Irresponsible release of dam sediments down river by State & Federal Agencies**
- **Promised??? power costs and water benefits to upper basin landowners without any direct factual benefits**
- **Impacts on Shasta Nation Burial Grounds and Yreka water supply are unknown and unstudied**
- **KRBA requirements will replace all water rights in the Klamath Basin Watershed with a Federal Charter in lieu of Constitutional guarantees**
- **The Klamath Lake Tribe and Karuk Tribes will exterminate the Shasta Nation within the KBRA requirements upon dam removals**
- **Lack of factual evidence that removing dams will restore salmon runs**

Respectively submitted by:

Siskiyou County Water Users Association

Board of Directors:

Frank Tallerico
President

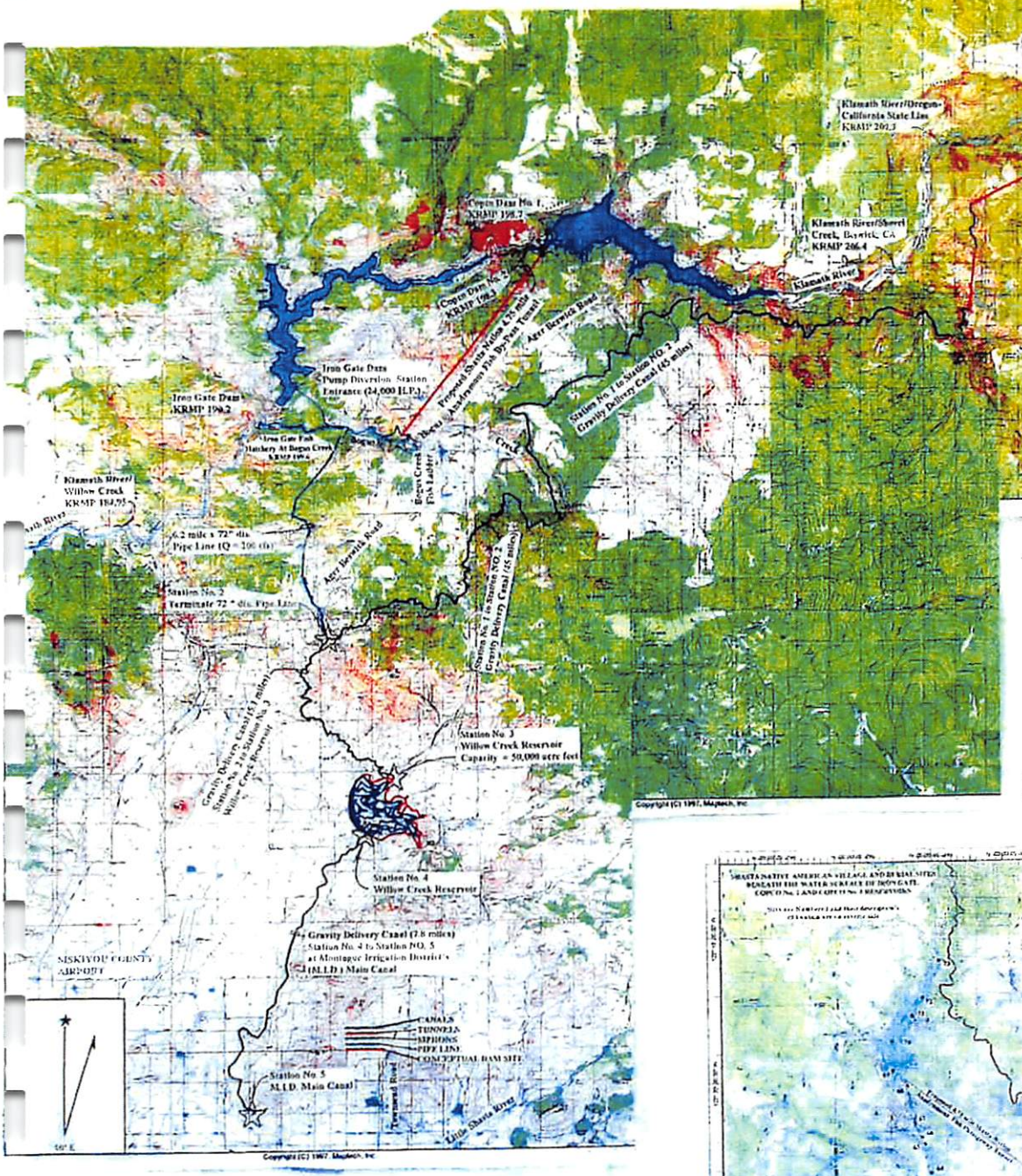
IV

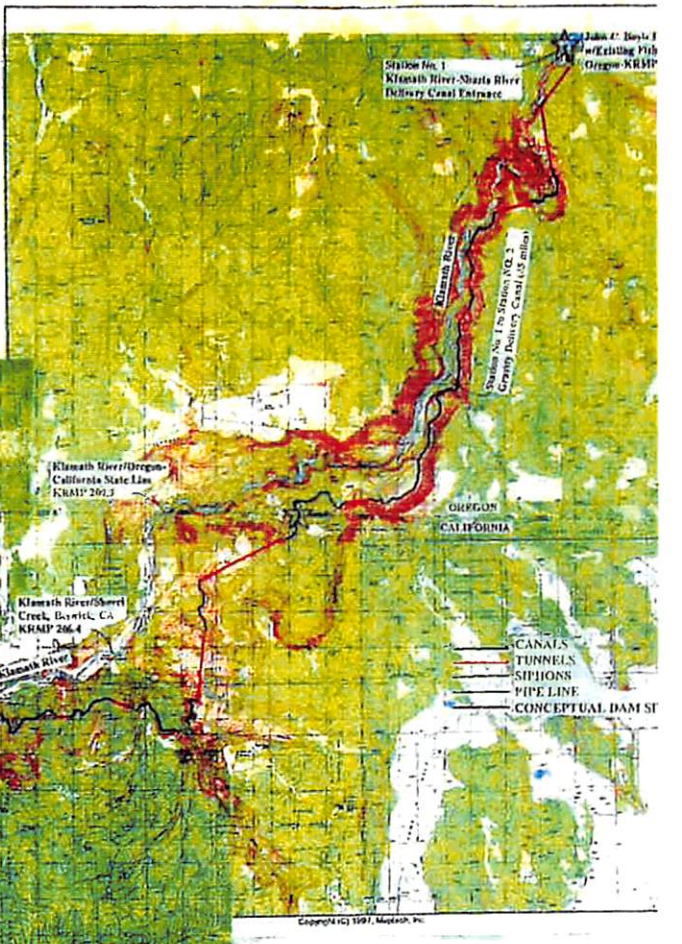
SHASTA NATION ANADROMOUS FISH PASSAGEWAY ALTERNATIVES TO DAM REMOVALS:

PRELIMINARY ENGINEERING DRAWINGS AND COST ESTIMATES

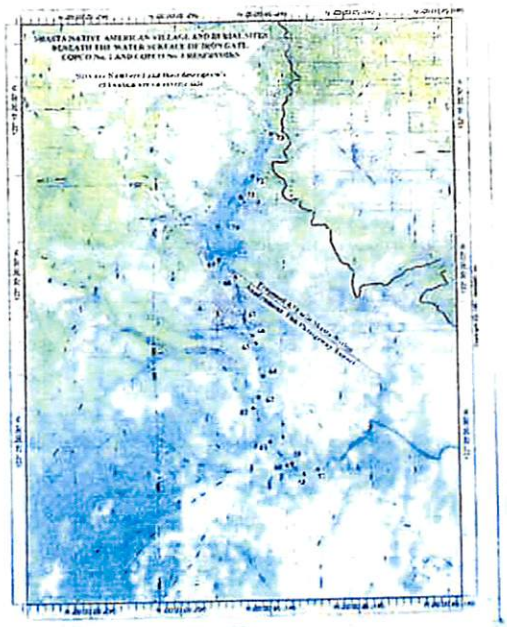
- MEMO T0 SCWUA: in reference to a meeting with the State Water Resources Control Board addressing Alternatives to Dam Removals.
- DOI analyze of Alternative I (TUNNEL BYPASS) THE BEST ALTERNATIVE FOR SISKIYOU COUNTY
- 2007: KLAMATH-SHASTA WATER SUBSTITUTION STUDIES by CDFG and SVRCD

S.C.W.U.A. Alternatives to Dam Removals





Shasta Nation Villages and Burial Sites beneath ~ Copco no.1, Copco no.2 and Iron Gate Reserviors.



ALTERNATIVE I

SHASTA NATION TUNNEL UNASSISTED ANADROMOUS FISH PASSAGEWAY

Via Bogus Creek/and a Proposed Tunnel to COPCO Lake No.1

By Jerry Bacigalupi, P.E. and Harry L. Lake, P.L.S.

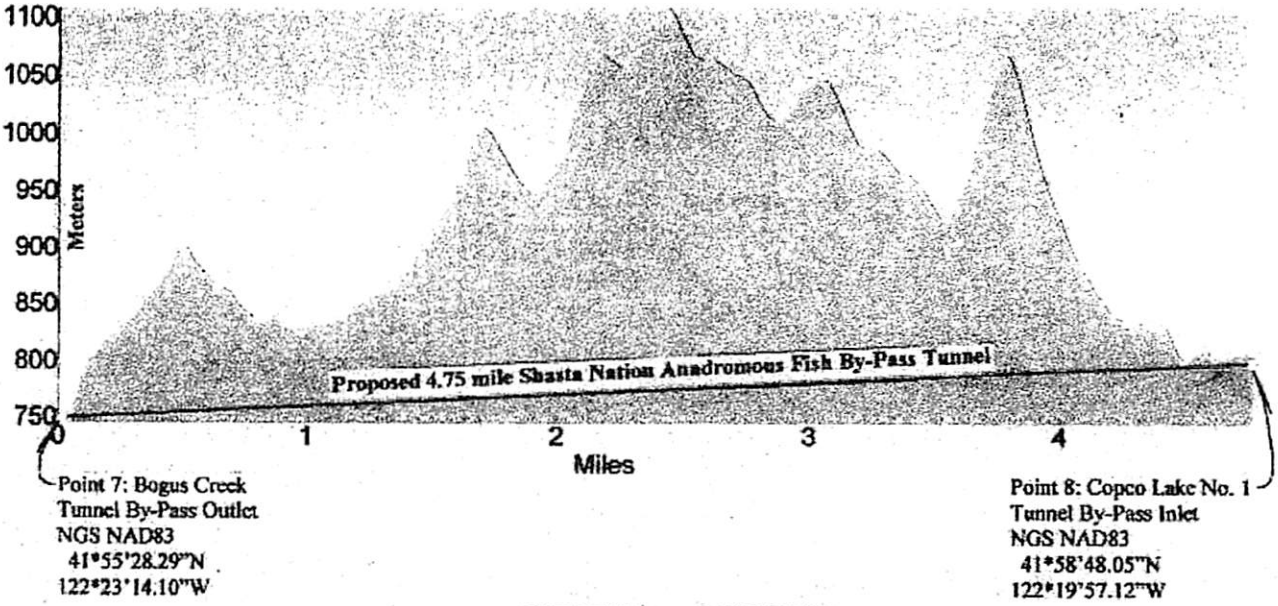
A viable preferred alternative to the previously proposed "Shasta Nation Anadromous Fish By-Pass" utilizing Bogus, Cold and Deer Creeks, is a tunnel passageway commencing 3.3 miles upstream from the Klamath River on Bogus Creek, below the existing falls and fish ladder, and terminating at the narrow portion of the lake just upstream from the dam on COPCO Lake No. 1 Reservoir.

This alternative would require a 4.75 mile lighted tunnel 16 ft. wide by 12 ft. high with a 4 ft. wide by 2 ft. deep concrete lined fish channel off to one side. Fish refugias (rest areas) will be placed at approximately 250 ft. intervals. The entrance structure to the tunnel will be constructed to float and take water from near the surface and allow for lake level fluctuations. The gradient of the tunnel will be less than 1% and the flow will be over 10 cfs.

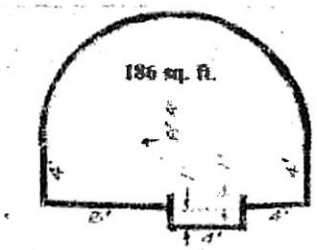
A computer mapping program, California Terrain Navigator by Maptech, Inc., was used as a cursory technical aid to review pertinent geographic features to ascertain horizontal and vertical control, to recommend an unassisted anadromous fish passageway from the Klamath River, around the Iron Gate Dam, COPCO Dam No. 2 and COPCO Dam No. 1 to COPCO Lake.
A final on site survey of said proposed fish passageway is recommended to ascertain pertinent ground feature information on the said proposed route, subject to acceptable design criteria for said project.

Point	Station	Elev. Feet	Lineal Feet	% Gradient	Remarks:
0	0+00	2165			Confluence Klamath River & Bogus Creek
			2833	+1.518	
1	28+33	2208			Bogus Creek (BC)
			3278	+1.403	
2	61+11	2254			BC
			2789	+0.717	
3	89+00	2274			BC
			2743	+2.370	
4	116+43	2339			BC
			2944	+2.345	
5	145+87	2408			BC
			1153	+1.127	
6	157+40	2421			BC
			1703	+1.585	
7	174+43	2448			BC/Tunnel Outlet
			25099	+0.606	
8	425+42	2600			Tunnel Inlet/COPCO Lake No.1/w.s. Elev. 2606'

The estimated cost of this alternative is approximately $50,000,000 or about 17% of the cost of installing fish ladders and about 5% of the estimated cost of dam removals.



TYPICAL TUNNEL PROFILE



TYPICAL TUNNEL DESIGN

INPUT VARIABLES

Depth

n = 0.025

Base Width = 4.0
Slope = 0.0055

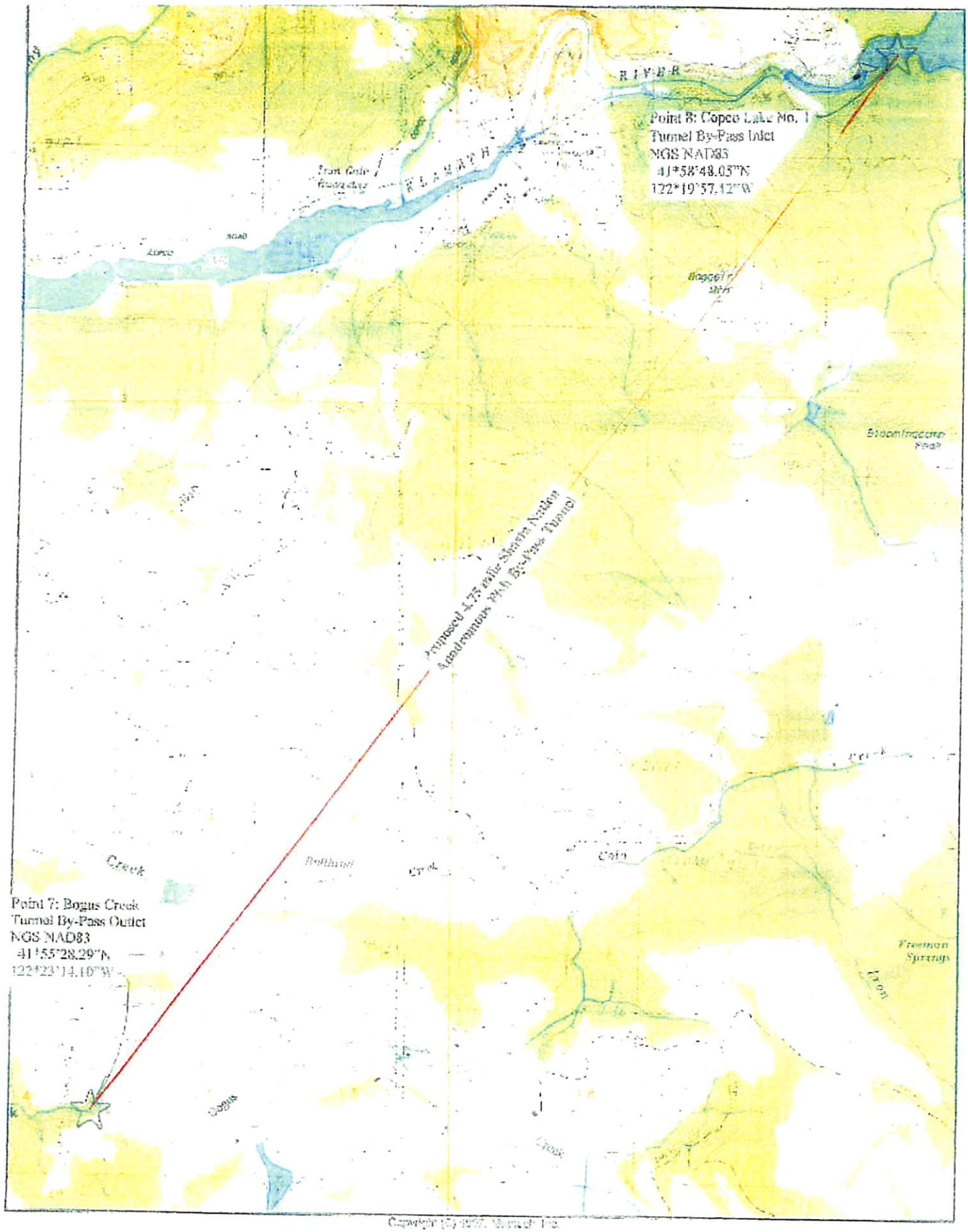
OUTPUT VARIABLES

Depth (ft)	1.00
Discharge (cfs)	13.5
Velocity (ft/s)	3.36
Top Width (ft)	4.0
Froude No.	0.59
Flow Type:	SUBCRITICAL

JLB Construction and Engineering
3097 Sierra Boulevard
Sacramento, CA 95864
916-768-5015, 916-484-7807

ALTERNATIVE I
SHASTA NATION TUNNEL ANADROMOUS FISH PASSAGEWAY
Planning Study
Engineering and Construction Cost Estimate

No.	Item	Quantity	Unit	Unit Price	Amount
	IMPROVEMENTS				
	ENGINEERING DESIGN &CONSTRUCTION ADMINISTRATION	1	LS	$4,000,000.00	$4,000,000
					$4,000,000
	MOBILIZATION	1	LS	$1,000,000.00	$1,000,000
					$1,000,000
	TUNNEL STRUCTURE				
3	Excavation (6.9cy/ft.)	25,000	LF	$ 1,400.00	$35,000,000
4	Refugia (Rest Area)(12'x12'x12')	100	EA	$ 10,000.00	$1,000,000
5	Linning (4" wire reinforced gunnite) (0.4 cy/ft)	25,000	LF	$ 400.00	$10,000,000
					$46,000,000
	INLET STRUCTURE				
1	FLOATING STRUCTURE (with intake control weir).	1	LS	$ 300,000.00	$300,000
2	RAMP STRUCTURE	1	LS.	$ 200,000.00	$200,000
					$500,000
	OUTLET STRUCTURE				
1	Outlet Structure	1	LS	$ 100,000.00	$100,000
2	Outlet Structure Refugia (Rest Area)	1	LS	$ 20,000.00	$20,000
					$120,000
	PLACEMENT OF EXCAVATED MATERIAL OFF SITE	180,000	CY	$ 10.00	$1,800,000
					$1,800,000
	CONSTRUCTION ACCESS				
1	Staging Areas	1	LS	$ 100,000.00	$100,000
2	Access Roads	1	LS	$ 150,000.00	$150,000
3	Erosion Control & Revegetation	1	LS	$ 50,000.00	$50,000
					$300,000
	ELECTRICAL				
1	Tunnel Lighting	1	LS	$ 375,000.00	$375,000
2	Inlet & Outlet Tunnel Lighting	1	LS	$ 50,000.00	$50,000
					$425,000
	R/W COST	1	LS	$ 25,000.00	$25,000
					$25,000
	TOTAL ESTIMATED CONSTRUCTION COST:				$54,170,000


Point 8: Copco Lake No. 1
Tunnel By-Pass Inlet
NGS NAD83
41°58'48.03"N
122°19'57.12"W
Proposed 4.75 mile Siphon Number
Supplemental With By-Pass Tunnel
Point 7: Bogus Creek
Tunnel By-Pass Outlet
NGS NAD83
41°55'28.29"N
122°23'14.10"W

ALTERNATIVE II

SHASTA NATION TUNNEL UNASSISTED ANADROMOUS FISH PASSAGEWAY INCLUDING THE GRAVITY FLOW KLAMATH - SHASTA IMPORT PROJECT (JOHN C. BOYLE RESERVOIR TO THE SHASTA VALLEY)

SIMILAR TO THOSE STUDIES PERFORMED FOR THE SHASTA VALLEY R.C.D. & CDFG JUNE 2007 (CDFG PROJECT NO. P0310329)

60,000 acre feet Siskiyou County Klamath River–Shasta Valley Import Project (John C. Boyle Reservoir to the Shasta Valley) Incorporating the Shasta Nation Tunnel Unassisted Anadromous Fish Passageway.

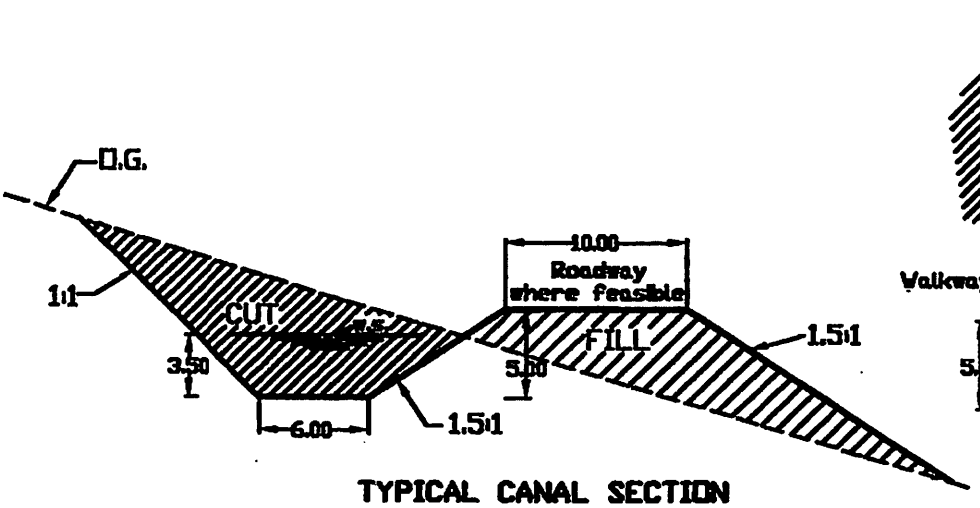
This viable alternative to dam removal proposes to import the 60,000 acre feet Siskiyou County **State Reserved Water Right A016958** from the Klamath River (John C. Boyle Reservoir to the Shasta Valley) via a 45 mile gravity flow canal with a -0.2% grade, flowing at 200 cfs. during the proposed months of December, January, February, March, and April depending on winter rainfall conditions to storage facilities at or near Willow Creek, or by direct application without storage during the irrigation season. A request will be required to move the point of diversion for this water right from Irongate Reservoir to J.C. Boyles Reservoir, and to request for off stream storage facilities.

This alternative proposes 50,000 to 60,000 acre feet storages facilities at or near Willow Creek and a 7.8 mile distribution canal from Willow Creek to the Montague Irrigation District's main canal. The Shasta Nation Tunnel Unassisted Anadromous Fish Passageway will be incorporated in this alternative.

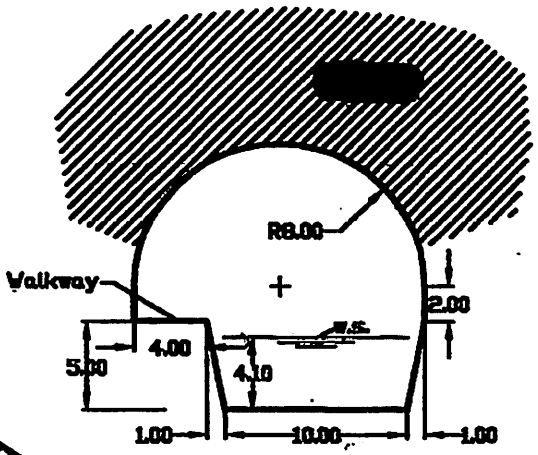
The transfer conduit would consist of a concrete grouted trapezoidal canal with a 6 foot bottom width for its major length and incorporate several 16 foot wide tunnels and 6 foot diameter inverted siphons to satisfy environmental concerns and provide for stream crossings.

The estimated construction costs is approximately $500,000,000 or 67% higher than the estimated cost of installing fish ladders and about 50% of the estimated cost of dam removal.

TYPICAL SECTIONS AND CHANNEL HYDRAULICS



TYPICAL CANAL SECTION

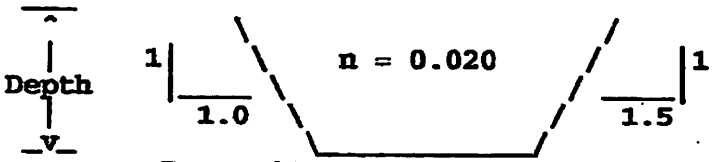


TYPICAL TUNNEL SECTION

CANAL HYDRAULICS:

QUICK - 2
CHANNEL CAPACITY
Trapezoidal Channel

INPUT VARIABLES



Base Width = 6.0
Slope = 0.0020

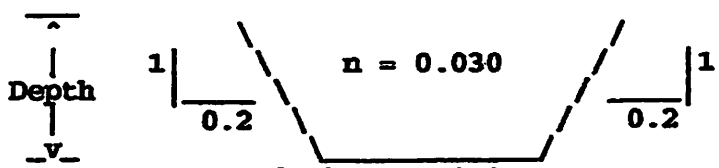
OUTPUT VARIABLES

Depth (ft)	3.50
Discharge (cfs)	198.2
Velocity (ft/s)	5.46
Top Width (ft)	14.8
Froude No.	0.61
Flow Type:	SUBCRITICAL

TUNNEL HYDRAULICS:

QUICK - 2
CHANNEL CAPACITY
Trapezoidal Channel

INPUT VARIABLES



Base Width = 10.0
Slope = 0.0025

OUTPUT VARIABLES

Depth (ft)	4.10
Discharge (cfs)	197.9
Velocity (ft/s)	4.46
Top Width (ft)	11.6
Froude No.	0.40
Flow Type:	SUBCRITICAL

JLB Construction and Engineering
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ALTERNATIVE II
60,000 AC.FT. SHASTA VALLEY WATER RIGHT IMPORT
J.C.BOYLES RESERVOIR to M. I. D. MAIN CANAL
INCLUDING THE SHASTA NATION TUNNEL ANADROMOUS FISH PASSAGEWAY
Planning Study
Engineering and Construction Cost Estimate

IMPROVEMENTS No.	Item	Quantity	Unit	Unit Price	Amount
ENGINEERING DESIGN & CONSTRUCTION ADMINISTRATION		1	LS	$ 35,000,000.00	$35,000,000
					$35,000,000
MOBILIZATION		1	LS	$ 1,500,000.00	$1,500,000
					$1,500,000
TUNNEL STRUCTURES					
1	Inlet Outlet Structures (including grated gates)	22	EA	$ 30,000.00	$660,000
2	Excavation (6.9cy/ft.)	33,800	LF	$ 1,400.00	$47,320,000
3	Linning (4" wire reinforced gunnite) (0.4 cy/ft)	33,800	LF	$ 400.00	$13,520,000
4	Placement of tunnel excavation. materal	233,000	CY	$ 10.00	$2,330,000
					$63,830,000
SYPON STRUCTURES					
1	72 in. Dia. Welded Steel Pipeline	11,400	LF	$ 900.00	$10,260,000
2	Inlet Outlet Structures (incl. grated gates & thrust control)	48	EA	$ 20,000.00	$960,000
					$11,220,000
TRAPAZOIDAL CANAL					
1	6' Depth X 6' Bot. with 1:1 & 1.5:1 side slopes (exc.& emb.)	236,600	LF	$ 600.00	$141,960,000
2	Linning (4" wire reinforced gunnite) (0.4 cy/ft)	236,600	LF	$ 350.00	$82,810,000
3	J.C. Boyles Inlet Structure (including fish screen)	1	LS	$ 400,000.00	$400,000
					$225,170,000
STORAGE FACILITIES (RESERVOIRS 50,000+/- AC.FT COMBINED)					
1	Excavation / Embankment	1	LS	$ 96,000,000.00	$96,000,000
2	Outlet Structures	1	LS	$ 4,000,000.00	$4,000,000
					$100,000,000
CONSTRUCTION ACCESS					
1	Staging Areas	1	LS	$ 200,000.00	$200,000
2	Access Roads	1	LS	$ 500,000.00	$500,000
3	Erosion Control & Revegetation (All Const. Sites)	1	LS	$ 1,000,000.00	$1,000,000
					$1,700,000
R/W Cost					
1	Tunnels	6.4	Mi.	$ 5,000.00	$32,000
2	Sypons	2.15	Mi.	$ 10,000.00	$21,500
3	Canals	44.87	Mi.	$ 10,000.00	$448,700
4	Reservoirs	1,000	Ac.	$ 5,000.00	$5,000,000
					$5,502,200
SHASTA NATION TUNNEL ANADROMOUS FISH PASSAGEWAY					
1	Total cost from previous sheet	1	LS	$ 54,170,000.00	$54,170,000
					$54,170,000
TOTAL ESTIMATED CONSTRUCTION COST:					$498,092,200

ALTERNATIVE III

SHASTA NATION TUNNEL UNASSISTED ANADROMOUS FISH PASSAGEWAY INCLUDING THE PRESSURIZED FLOW KLAMATH - SHASTA IMPORT PROJECT (IRONGATE RESERVOIR TO THE SHASTA VALLEY)

SIMILAR TO THOSE STUDIES PERFORMED FOR THE SHASTA VALLEY R.C.D. & CDFG JUNE 2007 (CDFG PROJECT NO. P0310329)

60,000 acre feet Siskiyou County Klamath River Import Project **State Reserved Water Right A016958** (Irongate Reservoir to the Shasta Valley) Incorporating the Shasta Nation Tunnel Unassisted Anadromous Fish Passageway. This proposal is similar to **Alternative II** but requires pumping from Irongate Reservoir. A request for off stream storage facilities will be required. This viable alternative to dam removal would import the 60,000 acre feet Siskiyou County Reserved Water Right from Iron Gate Reservoir to the Shasta Valley via a 24,000 H.P. pumping system, a 6.2 mile, 72" diameter pipeline and a 5.1 mile gravity flow canal to the proposed 50,000 to 60,000 acre feet storage facilities near or on Willow Creek, and a 7.6 mile canal from Willow Creek to the Montague Irrigation District's main canal. The Shasta Nation Tunnel Unassisted Anadromous Fish Passageway will be incorporated in this alternative.

The estimated construction costs of this proposal is $300,000,000 plus pumping cost, or approximately the estimated cost of installing fish ladders and about 30% of the cost of dam removal.

CONCLUSION:

Either **Alternative II** ,the John C. Boyle or **III** ,the Iron Gate 60,000 acre feet import projects to the Shasta Valley under a Siskiyou County Reserved Water Right, including the Shasta Nation Tunnel Unassisted Anadromous Fish Passageway, has the potential of providing a win-win solution for all including the fish.

By allowing a portion of the Klamath River 60,000 acre feet diversion to storage (or by direct diversion during the irrigation season) to be released from Lake Shastina directly into the Shasta River, the in stream flows conditions and water quality will be improved in both the Shasta River and the Klamath River below Iron Gate Reservoir.

Note: The KBRA does not appear to show direct positive benefits to the Upper Klamath Basin farmers and ranchers except promises or agreements which will likely not be attainable or be broken in the future.

It is recommended that winter water storage facilities be studied and incorporated in the Upper Klamath Basin which can provide additional waters to the Klamath River for increased in stream flows, which will benefit on project and off project water users and benefit fish habitat.

By combining any one of these viable alternatives with new Upper Klamath Basin storage facilities, the money projected towards dam removals could be directed to projects that would have a direct positive benefit to the entire Klamath River Basin, including the fish, verses the hypothetical benefits projected in the KBRA. This Nation does not need to waste the taxpayer's and power ratepayers money on hydro-dam removal projects that 80% of the public does not support.

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3097 Sierra Boulevard
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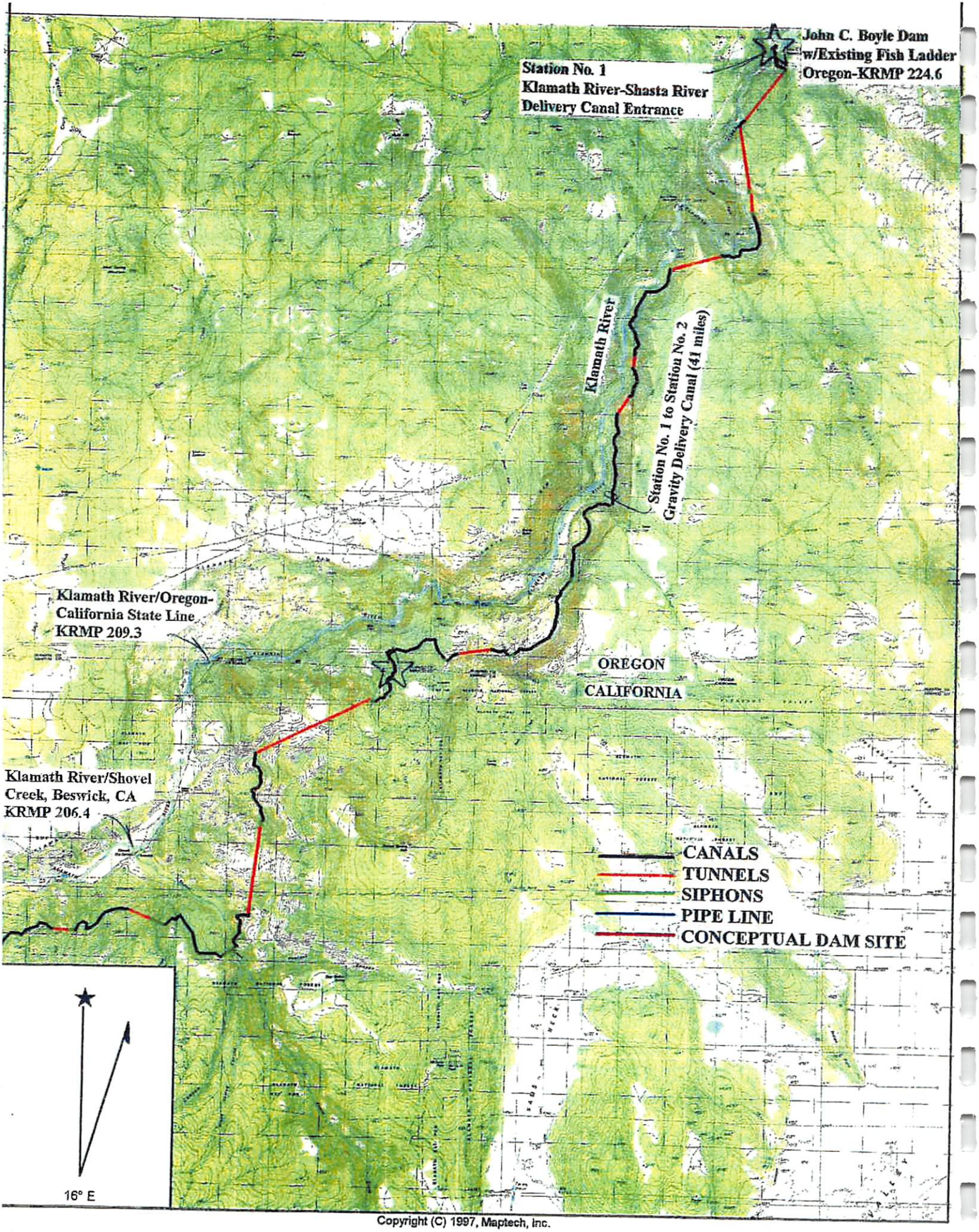
ALTERNATIVE III
60,000 AC. FT. SHASTA VALLEY WATER RIGHT IMPORT
IRON GATE RESERVOIR to M. I. D. MAIN CANAL
INCLUDING THE SHASTA NATION TUNNEL ANADROMOUS FISH PASSAGEWAY
Planning Study
Engineering and Construction Cost Estimate

IMPROVEMENTS No.	Item	Quantity	Unit	Unit Price	Amount
ENGINEERING DESIGN & CONSTRUCTION ADMINISTRATION		1	LS	$ 20,000,000.00	$20,000,000
					$20,000,000
MOBILIZATION		1	LS	$ 1,000,000.00	$1,000,000
					$1,000,000
PUMPING PLANTS (1@ I.G.Res. El.2,343 & 1@ El.2,680'+/-)					
1	Floating Inlet Structure (incl. grated gate and fish screen)	1	LS	$ 850,000.00	$850,000
2	2- 12,000 H.P. Pumping Plants.	2	LS	$ 2,400,000.00	$4,800,000
3	Pumping Plant Facilities	2	LS	$ 750,000.00	$1,500,000
					$7,150,000
PRESSURIZED STEEL PIPELINE					
1	72 in. Dia. Welded Steel Pipeline	32,800	LF	$ 900.00	$29,520,000
2	Thrust Control	250	EA	$ 6,000.00	$1,500,000
					$31,020,000
TRAPAZOIDAL CANAL					
1	6' Depth X 6' Bot. with 1:1 & 1.5:1 side slopes (exc.& emb.)	67,000	LF	$ 600.00	$40,200,000
2	Linning (4" wire reinforced gunnite) (0.4 cy/ft)	67,000	LF	$ 350.00	$23,450,000
3	Inlet Structure (including grate & gate)	1	LS	$ 50,000.00	$50,000
					$63,700,000
STORAGE FACILITIES (RESERVOIRS 50,000+/- AC.FT COMBINED)					
1	Excavation / Embankment	1	LS	$ 96,000,000.00	$96,000,000
2	Outlet Structures	1	LS	$ 4,000,000.00	$4,000,000
					$100,000,000
CONSTRUCTION ACCESS & EROSION CONTROL					
1	Staging Areas	1	LS	$ 50,000.00	$50,000
2	Access Roads	1	LS	$ 100,000.00	$100,000
3	Erosion Control & Revegetation	1	LS	$ 500,000.00	$500,000
					$650,000
R/W Cost					
1	Pipeline	6.2	Mi.	$ 5,000.00	$31,000
2	Canals	12.7	Mi.	$ 10,000.00	$127,000
3	Reservoirs	1,000	Ac.	$ 5,000.00	$5,000,000
					$5,158,000
SHASTA NATION TUNNEL ANADROMOUS FISH PASSAGEWAY					
1	Total cost from Tunnel Passageway Estimate	1	LS	$ 54,170,000.00	$54,170,000
					$54,170,000
TOTAL ESTIMATED CONSTRUCTION COST:					$282,848,000



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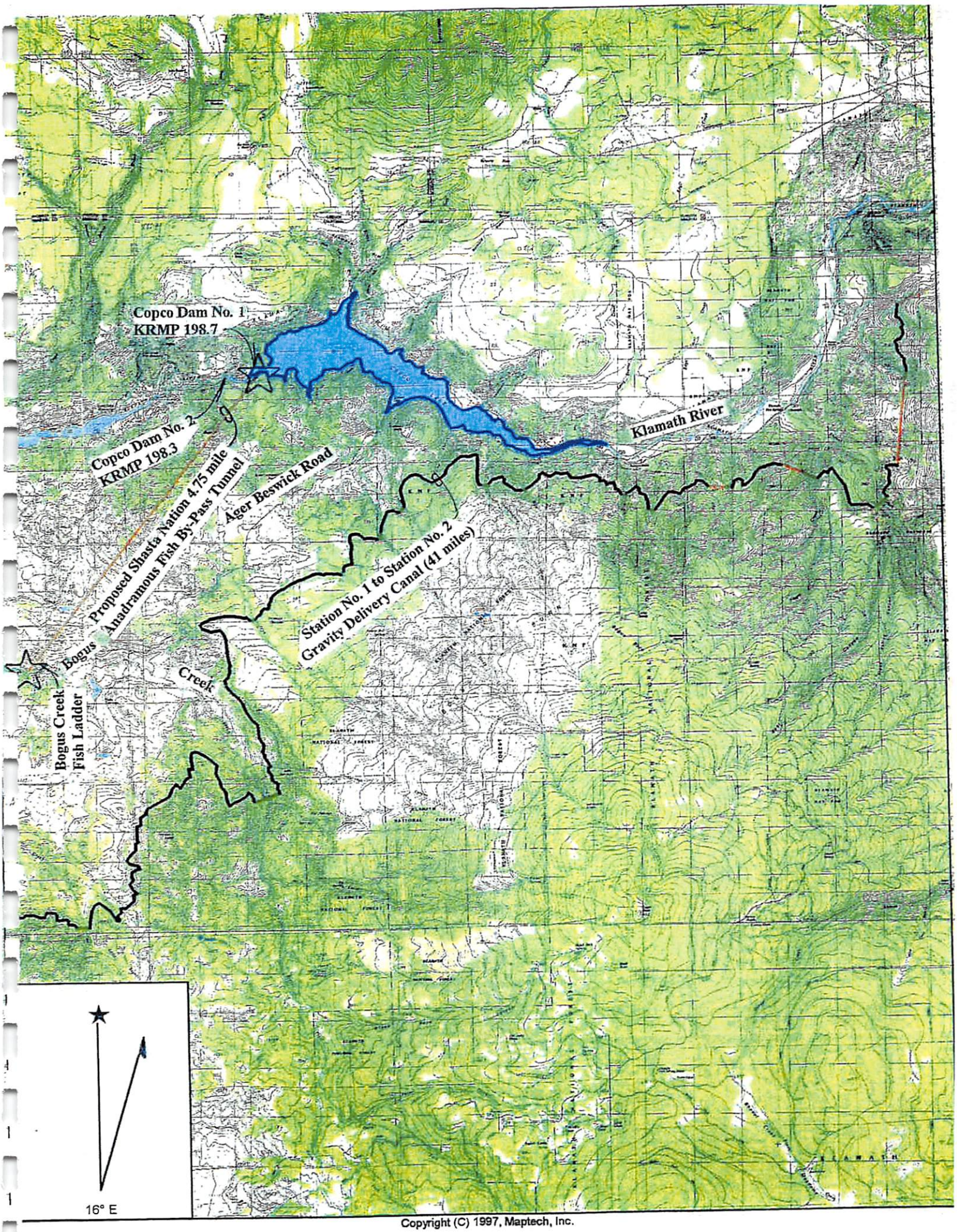

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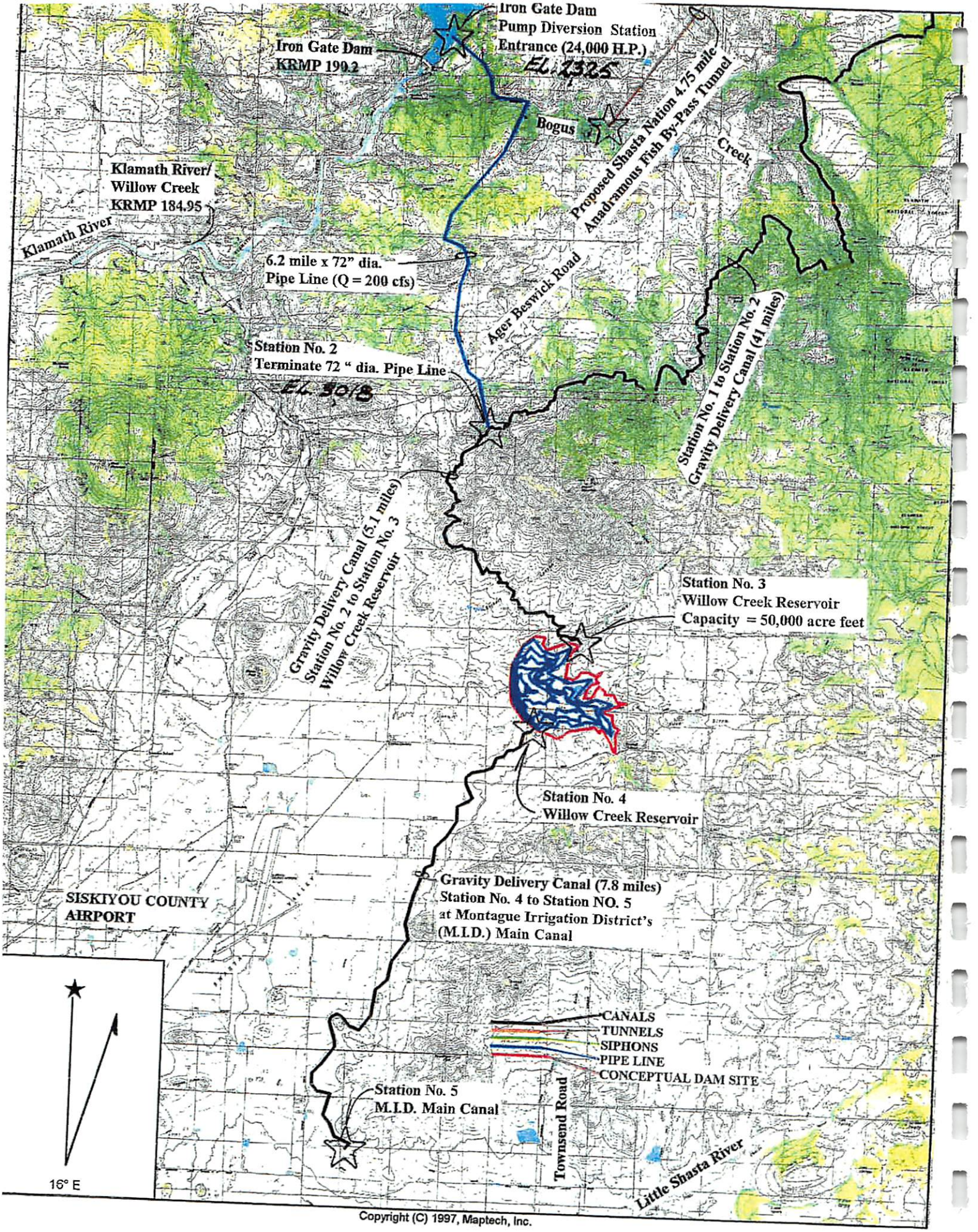

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Memo to: Siskiyou County Water Users Association (S.C.W.U.A.).
347 N. Main St.; Yreka, Ca. 96067

Subject: Meeting with the State Water Resources Control Board (S.W.R.C.B.)
1/20/11 1001 I St, P.O. Box 100 Sacramento, Ca. 95812

Present: Katherine Mrowka, P.E.; Charles Rich, P.E.; Mark Stretars, P.E., all with the (S.W.R.C.B.), and Jerry Bacigalupi, P.E. (J.L.B.), (S.C.W.U.A.)

Subjects:

1. Shasta Nation Fish Bypass Tunnel and the 60,000 Ac. Ft. Shasta Valley Water Right Transfer as a viable alternative to dam removal.
2. Transfer of the state 60,000 Ac. Ft. Klamath River – Shasta Valley storage reserved rights from the State of California to Siskiyou County Flood Control and Water Conservation District.

Subject 1: J.L.B. furnished the S.W.R.C.B. staff with copies of the following, for an open discussion session:

1. SCWUA's preliminary engineering maps and cost estimate for the tunnel bypass and 60,000 ac. ft. transfer to Shasta Valley.
2. Shasta Valley Resource Conservation District, Siskiyou County, California "Klamath-Shasta Water Substitution Preliminary Engineering Study", June 2007 Project No. 205013, California Department of Fish and Game Project No. P0310329.(similar to the S.C.W.U.A. proposal with the point of diversion at Keno Dam, Oregon)
3. March 31, 2004 report on legal issues Klamath-Shasta Water Transfer Study by Law Offices of Donald B. Mooney and Law Office of Marsha A. Burch.
4. Average Klamath River monthly flows for the years 1987 through 2006 (Appendix 30, Page 3 of 18); Measure "G" data; and an Article by Tom Mallams, from the Klamath Falls Herald and News, related to U.S. Rep's. Doc Hasting and Tom McClintok opposition to dam removals.

JLB pointed out that in addition to providing fish passage, this proposal would allow Montague Irrigation District to supply additional irrigation water to the Ager area and a majority of their water users with stored Klamath River winter water. Also, this proposal would allow dedication of a portion of this water to additional in-stream flow releases from Lake Shastina, which would improve water quality in the Shasta and Klamath Rivers. This proposal is supported by a majority in Siskiyou County to be a viable alternative to dam removals.

The S.W.R.C.B. staff had concerns over the spawning salmon and the returning smolt accessing the tunnel and the predatory take across Copco 1 Lake. After discussion, J.L.B. pointed out the following:

1. The Tunnel Bypass access for spawning salmon is located immediately below the Bogus Creek Falls and the CDFG Fish Ladder, and that the 10 CFS flow through

the bypass would be Klamath River water, and would normally be greater than the flow in Bogus Creek.

2. The tunnel would have dusk to dawn lighting with resting pools at 250' intervals.
3. The floating intake structure would be located at a shaded, very narrow portion of Copco #1 Lake, just upstream from the dam, and would provide the first moving surface water discharge on the lake and more than likely the only moving surface water discharge because the hydro-intake structures are located several feet below the surface.

Their initial responses were that the S.W.R.C.B. staff could not take a position on this proposal at this time; however, this alternative might very well be considered as an alternative to dam removals. They were also concerned that the tunnel bypass concept has not been tested to their knowledge.

They suggested that if local proponents wish to pursue this proposal they should see if the U.S. Bureau of Reclamation or the State Department of Water Resources would be willing to further evaluate the project and come up with a more detailed and defendable proposal; however, these agencies will generally not work with a citizens group. Therefore, the S.W.R.C.B. staff recommended that the County Board of Supervisors consider taking the lead to pursue obtaining the involvement of these agencies in defining the project.

The following possible actions were also discussed without the S.W.R.C.B. staff taking a position.

1. Introduce the Tunnel Bypass and 60,000 ac. ft. Klamath River Transfer with provisions to provide additional in-stream Lake Shastina releases into the Shasta and Klamath Rivers, as Siskiyou County's solution to coho salmon restoration, retaining Klamath River Dams for flood control and providing clean hydroelectric power for 70,000 homes.
2 Contact U.S. Rep's Tom McClintok and Doc Hastings to obtain their support along with Rep's Greg Walden and Wally Herger.
3 Contact Assemblyman Jim Nielson and Senator Doug LaMalfa to get their support and introduce a bill to remove the $250,000.000 California contribution for dam removal from the Water Bond. Governor Brown is looking for ways to reduce spending and also to get more support for the passage of the water bond.
4 Request an in-depth study of this alternative to dam removals by the California Dept. of Water Resources or the Bureau of Reclamation through our State and Federal Representatives.

Subject 2: J.L.B. furnished the S.W.R.C.B. staff copies of the following documents:

1. Klamath River Basin Compact
2. Appendix B: Siskiyou County Flood Control and Water Conservation District Act.
3. October 11, 1960, Board of Supervisors Resolution enacting the Siskiyou County Flood Control and Water Conservation District.
4. March 31, 2004 report on legal issues Klamath-Shasta Water Transfer Study by Law Offices of Donald B. Mooney and Law Office of Marsha A. Burch.

5. Average Klamath River Monthly Flows 1987-2006, Appendix 3D.

S.W.R.C.B. staff's response to the data furnished them was that they were familiar with most of the data, but not that the Siskiyou County Flood Control and Water Conservation District had been established. However, they felt that such an entity could be a good choice for the project proponent as a governmental agency that can enter into Joint Power Agreements and qualify for loans or grants as well as petition for assignment of a Status Filing for the transfer of the 60,000 ac. ft. Reserved Water Right.

Initially, because the proposed point of diversion is located in Oregon, they recommended that the State of Oregon be approached to determine if acquisition of a water right from Oregon would not be a problem.

J.L.B. brought up the fact that the 2007 R.C.D./CDFG Study proposed diverting water from Keno Dam, from which Oregon has irrigated land down river between that diversion and J.C. Boyles Dam. The S.C.W.U.A. alternative proposes to divert water from J.C. Boyles Dam, which is at the head of the Klamath River Canyon, and would have little to no impact on water use in the State of Oregon.

J.L.B. requested that the S.W.R.C.B. staff look at and respond to the S.C.W.U.A. alternative of pumping the 60,000 ac.ft. Shasta Valley Water Transfer from Iron Gate Reservoir and not involve the State of Oregon at this time. If no major problems are uncovered with the transfer in California, and because of high pumping cost, they could recommend that the gravity flow alternative from J. C. Boyles be explored through the State of Oregon at a later date.

The S.W.R.C.B. staff informed J.L.B. that the cost to file a petition for assignment of a State Filing for 60,000 ac.ft. water right from the Klamath River in California is $460,673 (including the $850 fee to the DF&G). Additional cost of processing such a petition could include cost for the preparation of a CEQA document, a water availability study, public trust evaluation, and technical/legal support.

J.L.B. was furnished with an informational document pertaining to "State Filing" and a "Petition for Assignment Form.

The Scott Valley Ground Water situation was also briefly discussed with a general consensus that streams and diverters in the valley might benefit if a Ground Water Recharge Program were to be initiated by the Siskiyou County Flood Control and Water Conservation District or some other local entity (ie: Off Stream Secondary Winter Storage Facilities which would recharge the ground water aquifer by infiltration and releasing flows in late spring to early fall, thus providing a higher water table and adding cooler water to the streams).

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THE BEST ALTERNATIVES
for the Community and the Environment

Klamath Settlement BEST alternatives for the community and environment, currently not being considered but reported in the Final Environmental Impact Statement/Environmental Impact Report in the Klamath Facilities Removal FINAL Alternatives Report

3.11 Alternative 11 – Fish Bypass: Alternative Tunnel Route

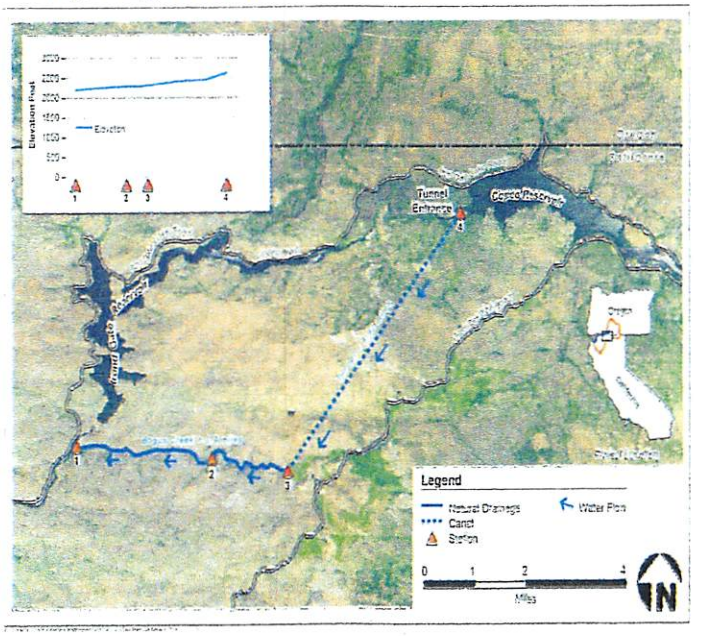
This alternative would use a combination of natural drainages and a constructed tunnel to provide a migratory passage for anadromous species around Copco 1, Copco 2, and Iron Gate Dams while leaving the dams in place. This alternative also includes improvements to fish passage facilities at J.C. Boyle Dam to allow upstream and downstream passage. This alternative would allow continued power generation at the Four Facilities, but the Hydropower Licensee would need to obtain a new FERC license to continue operations.

This alternative bypass would route upmigrating fish into Bogus Creek into an approximately five-mile tunnel that would connect Bogus Creek to Copco 1 Reservoir. The tunnel would connect to Bogus Creek at stream mile 2.9, well downstream of the existing fish ladder on the creek and the confluence with Cold Creek (Bacigalupi and Lake 2010) (Figure 3-8).

The proposed tunnel would be 16 feet wide by 12 feet high and would contain a 4 foot wide by 2 foot deep fish channel on one side. Larger —rest areas‖ for the migrating fish would be placed every 250 feet, and vertical shafts would be installed at regular intervals to provide natural light to the channel (Bacigalupi and Lake 2010). The proposed gradient of the channel would be less than one percent, and flow would be above 10 cfs. The proposed gradient of the channel would be less than one percent, and flow would be above 10 cfs.

A floating entrance structure at Copco 1 Reservoir would provide water and fish access to the tunnel. The structure would float with the level of the lake to provide a year round water supply regardless of the level of the reservoir, as well as serve as the access to the tunnel for anadromous species.

The proposal addresses some of the issues associated with Alternative 10, the Bogus Creek Bypass route: the tunnel would allow migrating salmonids to swim in a consistently upstream direction, as the tunnel would be drilled to connect the reservoir with the downstream tributary. In addition, it would not require a new water supply or negotiations, as would the bypass in the fully appropriated Cold Creek (in Alternative 10), because water for Alternative 11 would be supplied from Copco 1 Reservoir. Finally, the tunnel might provide more capacity for more capacity for the large numbers of migrating salmonids than the smaller drainages of Clear and Deer Creeks.



ES.7.3 Environmentally Preferable/Superior Alternative

NEPA requires the Lead Agency to identify the alternative or alternatives that are environmentally preferable in the Record of Decision (ROD) (40 CFR Part 1505.2(b)). The environmentally preferable alternative generally refers to the alternative that would result in the fewest adverse effects to the biological and physical environment. It is also the alternative that would best protect, preserve, and enhance historic, cultural, and natural resources. Although this alternative must be identified in the ROD, it need not be selected for implementation.

Section 15126.6(e)(2) of the CEQA Guidelines requires agencies to identify the environmentally superior alternative in a draft EIR. If the No Project Alternative is the environmentally superior alternative, an additional environmentally superior alternative must be identified among the other alternatives.

CDFG has identified Alternative 3 (Partial Facilities Removal of Four Dams) as the environmentally superior alternative. All of the alternatives evaluated in the EIS/EIR, including for the No Action/No Project Alternative, have significant unavoidable environmental impacts as identified in Section 5.5. Alternative 2 (Full Facilities Removal of Four Dams, the Proposed Action), Alternative 3, and Alternative 5 (Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate) would have the most short-term significant and unavoidable impacts among the alternatives. These impacts would largely be limited to the time frame of direct dam deconstruction actions and sediment release. After dam deconstruction, impacts would include the loss of reservoir recreation and local economic impacts. Alternatives 2, 3, and 5 would significantly improve water temperature, dissolved oxygen, and algal toxins for aquatic resources and reduce the incidence of fish disease in juvenile salmon by removing the two largest reservoirs—Copco I and Iron Gate. Alternatives 4 and 5 would maintain some power production and recreational benefits thereby reducing local economic impacts.

Although the No Action/No Project Alternative will have no change from existing conditions resulting from construction, this alternative is not the environmentally superior alternative when compared to the Proposed Action, which is intended to improve environmental conditions. Alternative 3 is the environmentally superior alternative when compared with the Proposed Action because it would:

Reduce the air quality impacts from emissions of volatile organic compounds (VOCs), nitrogen oxides (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter < 10 microns (PM_{10}), and particulate matter < 2.5 microns ($PM_{2.5}$) from reduced construction activities;

Reduce the contribution to greenhouse gas emissions from reduced construction activities;

Reduce noise and vibration from reduced construction activities;

Reduce impacts to terrestrial plants and wildlife from fewer truck trips;

Reduce disturbance to archaeological and historic sites from fewer truck trips;

Retain structures for roosting bats; and

Retain historically significant structures at Copco 1.

Alternative 3 would provide similar long-term benefits when compared with Alternative 2, but would reduce short-term impacts because it involves less construction. Alternative 3 would result in superior long-term beneficial environmental effects. In summary, Alternative 3 is considered the environmentally superior alternative among all the alternatives because it provides long-term beneficial environmental effects, while reducing some of the short-term significant effects of the Proposed Action (Alternative 2).

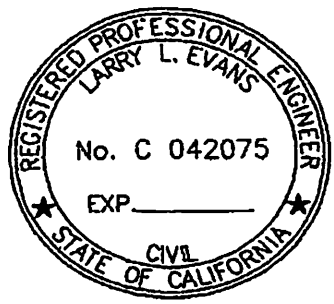
ES.6.3 Alternative 3 - Partial Facilities Removal of Four Dams

The Partial Facilities Removal of Four Dams Alternative would include removal of enough of each dam to allow free-flowing river conditions and volitional fish passage for all Klamath River anadromous species at all times. Under this alternative, portions of each dam facility would remain in place, including ancillary buildings and structures such as powerhouses, foundations, tunnels, and pipes (Figure ES-9). Some of these remaining features would require perpetual maintenance and security measures to prevent unauthorized entry and safety hazards. All tunnel openings would be sealed and all potentially hazardous materials found in powerhouses and machinery would be removed prior to final decommissioning and securing of buildings.

The schedule for Partial Facilities Removal of Four Dams would be the same as for the Proposed Action (the Full Facilities Removal of Four Dams Alternative). The Partial Facilities Removal of Four Dams Alternative also includes the transfer of Keno Dam to DOI and implementation of the KBRA (as in the Proposed Action).

SHASTA VALLEY RESOURCE CONSERVATION DISTRICT SISKIYOU COUNTY, CALIFORNIA

Klamath – Shasta Water Substitution Preliminary Engineering Study



June 2007

Project No. 205013
CDFG Project no. P0310329

FORSGREN ASSOCIATES / INC.

Boise, Idaho

Shasta Valley Resource Conservation District

TABLES

Table 1	Water User Flow Requirements
Table 2	Open Channel Dimensions and Parameters
Table 3	Alternative No. 1 / Option 1 for 205 cfs (Gravity Flow Conduit / Keno to Dwinnell Reservoir, Maximize Use of Tunnels)
Table 4	Alternative No. 1 / Option 1 for 125 cfs (Gravity Flow Conduit / Keno to Dwinnell Reservoir, Maximize Use of Tunnels)
Table 5	Alternative No. 1 / Option 2 for 205 cfs (Gravity Flow Conduit / Keno to Dwinnell Reservoir, Minimize Use of Tunnels)
Table 6	Alternative No. 1 / Option 2 for 125 cfs (Gravity Flow Conduit / Keno to Dwinnell Reservoir, Minimize Use of Tunnels)
Table 7	Alternative No. 2 / Option 1 (Gravity Flow Conduit / Keno to Below Dwinnell Reservoir, Maximize Use of Tunnels)
Table 8	Alternative No. 2 / Option 2 (Gravity Flow Conduit / Keno to Below Dwinnell Reservoir, Maximize Use of Tunnels)
Table 9	Alternative No. 3 (Pressure / Gravity Combination, Iron Gate Reservoir to Below Dwinnell Reservoir)

FIGURES

Figure 1	Location Map
Figure 2	Vicinity Map

APPENDICES

Appendix A	Alignment and Topographic Information
Appendix B	Hydraulic Calculations
Appendix C	Cost Opinion Assumptions

1.0 INTRODUCTION

1.1 General

The Shasta River, located in Syskiyou County, California is a major tributary to the Klamath River. The demand on water resources in the Klamath River Basin has long been a challenging issue. The Shasta River in particular is a primary water supply resourse for agriculture, fisheries, and recreation in Siskiyou County.

In past years a variety of work has been done to investigate development of water resources in the Shasta Valley. These efforts were primarily focused on water resource development to stimulate the local economy and meet local agricultural, municipal, and industrial needs. In recent years the importance of the Shasta River for fisheries habitat has been more clearly recognized and documented. The Shasta River is recognized as one of the most important spawning tributaries in the Klamath Basin.

A concept investigated as early as 1923 to meet water resource demands in the Shasta Valley has been to import water from the Klamath River to the Shasta River Basin. In the past, the driver for considering such a concept has been development of water resources for agricultural, municipal, and industrial use. This study has been prepared to investigate a Klamath-Shasta water import concept within the current context of fisheries habitat restoration for anadromous fish. This study investigates the feasibility of transporting water from the Klamath River to the Shasta River basin to meet irrigation demands. If this were done, water currently being diverted from the Shasta River for irrigation could remain in the river resulting in improved fisheries habitat.

1.2 Project Objectives

The following objectives have been outlined for this particular investigation.

1. Review the feasibility of past-proposed import projects based on current engineering standards and economics.
2. Use information and data from these past studies to develop a minimum of two Klamath-Shasta water substitution alternatives and evaluate these based on current engineering standards. The alternatives will be evaluated from the prospective of salmon habitat restoration instead of water resources for development.
3. Develop preliminary opinions of probable project costs and estimates of annual operation and maintenance costs for each alternative. These costs will be for comparison purposes based on existing survey data, USGS topographic maps, and existing cost data for similar infrastructure.
4. Identify critical legal and environmental issues related to implementing a project of this scale. Issues will include, NEPA and CEQA compliance, easements, and right-of-way issues.
5. Present the findings and recommendations of this effort in a document that can be used to make an informed decision on the current feasibility of the concept and determine whether further investigation is warranted.

1.3 Authorization

Forsgren Associates has been authorized to prepare this report through an agreement with the Shasta Valley Resource Conservation District. Funding for this report has been provided by the California Department of Fish and Game.

1.4 Background

The Shasta River Valley is located in the central region of Siskiyou County in Northern California. A location map is provided in Figure 1. The Shasta Valley is formed by the Cascade Mountain Range to the east and the Klamath Mountain Range to the west. The Shasta River originates near the southern boundary of the valley on the northeastern slopes of Mount Eddy. Runoff from the northern slopes of Mount Shasta also contributes significantly to Shasta River flows. In addition several tributaries feed the river as it flows northwest to intersect the Klamath River west of Iron Gate Dam. A vicinity map of the Shasta River is provided in Figure 2.

A major feature along the Shasta River is Dwinnell Dam and reservoir (See Figure 2). Dwinnell is the largest impoundment along the Shasta River having a total storage capacity of approximately 72,000 acre-ft. However, due to seepage problems and structural stability, actual reservoir capacity is limited to approximately 34,000 acre-ft.

There are also several smaller irrigation diversions along the river diverting water ranging from 1 to 2 cubic feet per second (cfs) to as much as 40 plus cfs.

1.5 Current Water Delivery Requirements

Water delivery requirements for six current users in the Shasta Valley will be considered in this study. Water for these users come from ground water, the Shasta River and the Little Shasta River which is a tributary to the Shasta River. A summary of these users is provided in Table 1.

The Shasta-Klamath import concept being considered in this investigation would provide the water requirements for these users. The water currently being consumed by these users would be left in the Shasta River basin and result in overall higher flows in the Shasta River.

Table 1 Water User Flow Requirements

Irrigation District	Flow[1] (cfs)
Little Shasta Irrigation District	25
Big Springs Users	20
Shasta Water Association	35
Big Spring Irrigation District	20
Grenada Irrigation District (includes Hussman – 8cfs)	25
Montague Irrigation District	80
Total	205

Note:
[1]Flows shown are those anticipated following implementation of water conservation measures

Two water import scenarios have been considered in this study. The first scenario would import water to meet the needs of all the users listed in Table 1 except the Montague Irrigation District. This scenario would require importing 125 cfs from the Klamath River. The second scenario would import enough water to supply the Montague Irrigation district as well and would require a total flow of 205 cfs.

2.0 PREVIOUS INVESTIGATIONS

2.1 General

Two previous water resource studies of the Shasta River Basin that have investigated the concept of a Klamath-Shasta import project are reviewed in this report. These studies include:

1. Klamath-Shasta Valley Reclamation Project (1923) – Bureau of Reclamation
2. Bulletin No. 87 Shasta Valley Investigation (1964) – California Department of Water Resources

These studies present Klamath-Shasta import alternatives and evaluate the feasibility of the concept. When these studies were prepared, the focus of the investigations were on development of water resources for agricultural, municipal, and industrial use. A summary of the Klamath-Shasta import alternatives presented in these investigations are presented below.

2.2 Klamath-Shasta Valley Reclamation Project (1923)

In 1923, Homer J Gault and Forster Towle of the United States Reclamation Service, in cooperation with the State of California and the Klamath-Shasta Irrigation District, investigated the feasibility of reclamation of certain lands in the Shasta Valley by diverting waters from the Klamath River. This investigation considered not only the transmission of water from the Klamath River to the Shasta Valley, but also the distribution of water to individual irrigation districts. The concept consisted of a main conduit, several tunnels, a large siphon, branch canals and laterals supplying individual irrigation districts. Generation of hydroelectric power through the construction of a series of dams was also considered. The study assessed four different plans to provide irrigation for varying acreages and different arrangements of hydroelectric power generation. The four plans are summarized below.

2.2.1 Plan I

Plan I consisted of construction of a low diversion dam in the Klamath River approximately one mile downstream of Keno, Oregon. Under the proposed plan, the diversion dam fed a gravity delivery channel at a flow rate of 1,100 cubic feet per second (cfs). The diverted water would be transferred to the Shasta Valley utilizing lined and unlined canal sections, a concrete bench flume, a lined tunnel, and a steel pipe siphon.

The conduit for this plan included approximately 46 miles of canal and approximately 11 miles of tunnel. The siphon included in the plan was approximately 3,900 feet. At mile 46 the delivery system branched into approximately 68 miles of smaller canals and laterals serving the northern and southern portions of the Shasta valley. The plan included construction of six additional tunnels within the 68 miles of smaller canals and laterals. Under this plan approximately 65,000

acres of land would be irrigated. The construction of six power plants was also included in this plan. A cost of $29,674,465 was estimated for this plan in 1923.

2.2.2 Plan II

Plan II was essentially the same as Plan I except the power plants were not included. The 1923 cost for this plan was estimated at $21,392,640.

2.2.3 Plan III

Under Plan III only the northern portion of the Shasta Valley would be irrigated (approximately 32,000 acres). The diversion dam was located at the same point on the Klamath River. The cross section of the delivery channel was adjusted to reflect the lower water supply demand (approximately 550 cfs). Plan III included the 46 miles of canal and 11 miles of tunnel to reach the northern portion of the Shasta Valley and the smaller canals and laterals associated with the northern portion of the Valley. Plan III included construction of five power plants and had a 1923 estimated cost of $11,014,198.

2.2.4 Plan IV

Under Plan IV the location of the diversion point was changed in order to reduce the length of transmission canal to approximately 38 miles. The diversion point for Plan IV would have been located seven miles above Shovel Creek. This plan would have supplied 420 cfs of irrigation water to approximately 25,000 acres of the northern portion of the Shasta River Valley. The 1923 estimated project cost was $5,019,771.

2.3 Bulletin No. 87 Shasta Valley Investigation (1964)

In 1964 the California Department of Water Resources completed Bulletin No. 87 Shasta Valley Investigation to examine potential development of water resources in the Shasta Valley. The primary objective of the investigation was to examine possibilities for conserving waters of the Shasta River and its tributaries and to investigate the possibility of importing water to the Shasta River Valley from the Klamath River.

This investigation describes a Klamath-Shasta import concept sited in earlier Department of Water Resources Bulletins. The concept included Iron Gate dam and reservoir, an Iron Gate Pumping Plant, an Ager Pumping Plant, Red School Dam and Reservoir, and a Bogus Conduit. The project would have provided approximately 122,000 acre-feet of water to serve the Ager area and Shasta Valley. An estimated capital cost of $19,960,000 with annual operating costs of approximately $1,415,000 was cited from a 1959 Department of Water Resources Bulletin No.83. It was estimated that pumping costs would be approximately $522,000 per year for a total annual cost of $1,937,000. The project did not include costs for a local distribution system.

Since this investigation, Iron Gate Dam has been constructed and is in operation by the California Oregon Power Company (COPCO). The import portion of the project was not constructed at that time because initial reconnaissance studies suggested it would not be feasible.

Specific reasons as to why the import portion of the project was considered unfeasible are not given. Bulletin No. 87 suggests that local interests in the Northern Shasta Valley were unprepared economically. The project would have required approximately 23 miles of canal and a pumping plant capable of lifting nearly 350 cfs approximately 635 feet. Implementation of this

project would have required development of an agreement with COPCO for access to Iron Gate Dam and due compensation.

3.0 DEVELOPMENT AND EVALUATION OF POTENTIAL SHASTA-KLAMATH IMPORT PROJECTS

This section provides a summary of the Klamath – Shasta Import project alternatives investigated in this study. The potential projects investigated utilize information available from previous investigations and expand on the concept of a gravity flow conduit as presented in the 1923 Klamath-Shasta Valley Reclamation Project prepared by the Bureau of Reclamation. The concept of a pressurized transmission line originating from Iron Gate Reservoir as described in Bulletin No. 87 Shasta Valley Investigation prepared in 1964 has also been expanded.

These concepts have been adapted and geared toward meeting the specific need of providing water for the specific users summarized in Table 1. No attempt has been made to investigate the potential for water delivery beyond these specific users.

The following primary conceptual alternatives have been developed during this investigation:

1. Alternative 1: Gravity Flow Conduit, Keno to Dwinnell Reservoir
2. Alternative 2: Gravity Flow Conduit, Keno to below Dwinnell Reservoir
3. Alternative 3 : Pressure / Gravity Combination, Iron Gate Reservoir to Below Dwinnell Reservoir

Alternatives one and two above have been developed with two options. One option maximizes the use of tunnels through the alignment. The other option minimizes the use of tunnels. A detailed description of each alternative and option is presented in Sections 3.1 to 3.4. Alignment details and topographic information for each of the alternatives is provided in Appendix A.

3.1 Basic Design Criteria

Limited field reconnaissance was performed for this investigation. No field surveys were performed. Topography information was obtained from digital topographic maps. The alignments developed were reviewed in the field where access was possible. Data from previous investigations was used as appropriate to develop the alternatives.

For the purposes of this investigation, transmission canals were assumed to be trapezoidal open channel lined shotcrete. Use of a circular section pipeline was considered but did not compete economically with an open channel section.

The alignments investigated required a variation in slope at various locations. Slopes ranged from a minimum of 0.0003 ft/ft to a maximum of 0.0035 ft/ft. The overall average slope of the conduit for the alignments has a value of approximately 0.001ft/ft. This translates to a drop of approximately 5.30 feet per mile of conduit. The dimensions and parameters used in analysis of the open channel conduit are summarized in Table 2. A summary of the open channel flow calculations are provided in Appendix B.

Table 2 Open Channel Dimensions and Parameters

Parameter / Dimension	Flow Rate (Q) = 125 cfs	Flow Rate (Q) = 205 cfs
Manning's n (n)	0.016	0.016
Bottom Width (b)	4.5 ft	6.0 ft
Depth of Water (d)	3.5 ft	4.0 ft
Freeboard (f)	2.0 ft	2.5 ft
Side Slope (z)	1.0	1.0

3.2 Alternative 1 – Gravity Flow Conduit / Keno to Dwinnell Reservoir

Under this alternative, a gravity flow conduit would be constructed originating just below Keno, Oregon and terminating at Dwinnell Reservoir. The alignment for this alternative is similar to the one developed by the Bureau of Reclamation in 1923. An overall view of this alignment is provided in Appendix A on Figure 3. Figures 4, 5 and 6 in Appendix A show details of this alignment as well as the details of each of the alignments considered in this study.

This alternative will require an inlet structure at the Keno Reservoir. The inlet structure could be gravity fed or use low head pumps to lift water into the open channel canal. This alternative allows import water to be delivered to Dwinnell Reservoir. This is accomplished by maintaining elevation along the east side of the Shasta Valley along the foothills of the Cascade Mountains. (See Appendix A)

Two options for this alternative have been developed; one maximizing the use of tunnels and one minimizing the use of tunnels.

3.2.1 Option No.1 – Maximize Use of Tunnels

For this option the transmission conduit includes approximately 52 miles of trapezoidal open channel canal, eighteen lined tunnel sections totaling approximately 20.6 miles, and one siphon approximately 1.2 miles long. The location of the tunnels and siphon are shown in Figures 4, 5 and6. The use of tunnels has the advantage of greater safety in terms of potential obstruction from falling debris and lower ongoing maintenance cost due to in-channel vegetation. In some cases the use of tunnels will prove to be more cost effective due to the reduction in overall conduit length. Tunnels will be required at some sections of the conduit where construction of an open channel along steep or very rocky side slopes will be impractical.

The siphon is included in this Option to traverse a large canyon so a reasonable slope can be maintained and a final elevation above Dwinnell Reservoir be reached. Overall this Option traverses 74 miles from the Keno Reservoir through the eastern region of the Shasta River Valley to Dwinnell Reservoir (See Appendix A).

3.2.2 Option No.2 – Minimize Use of Tunnels

For this Option, the conduit includes approximately 90.3 miles of trapezoidal open channel canal, one 1.3 mile tunnel section, and two large siphons totaling 1.4 miles long. (see Appendix

A). The tunnel included in this Option is necessary to maintain gravity flow throughout the alignment. The two siphons are necessary to traverse two large canyons in order to maintain a reasonable slope to the final elevation at Dwinnell Reservoir. The overall length of this Option is 93 miles from the Keno Reservoir to Dwinnell Reservoir (See Figures Appendix A).

3.2.3 Alternative 1 Constructability Issues

Construction of the canals and tunnels described in this Alternative will present several challenges. These challenges will primarily include severe topography, excess rock excavation, and very limited site access. Other challenges will include hauling and disposal of excavated material, disposal of clearing and grubbing debris, and slope stabilization. Significant challenges will also be encountered during construction of the siphons. These challenges will also include site access, severe topography, and excessive anchoring and thrust control. These challenges have been considered when developing the opinions of probable project cost described in Section 4.0.

3.3 Alternative 2 – Gravity Flow Conduit / Keno to below Dwinnell Reservoir

Under this alternative a gravity flow conduit would be constructed originating at Keno Reservoir and terminating below Dwinnell Reservoir. The alignment for this alternative is similar to the one developed by the Bureau of Reclamation in 1923 for the first approximately 40 miles. The alignment then follows a course lower in the valley. This alignment is closer to potential users and would require less lateral canals to deliver water for service (see Figures Appendix A).

As with Alternative 1, Alternative 2 would require an inlet structure be constructed at Keno Reservoir. This alternative also has two options; one maximizing the use of tunnels and one minimizing use of tunnels.

3.3.1 Option 1 - Maximize Use of Tunnels

This option would consist of approximately 54 miles of trapezoidal open channel canal, fifteen tunnel sections totaling approximately 17 miles, and two large siphons totaling approximately 2.1 miles. The total length of the conduit would be approximately 73 miles from the Keno Reservoir to a region of the Shasta Valley just below Dwinnell Reservoir (see Figures Appendix A).

3.3.2 Option 2 – Minimize use of Tunnels

Under this option approximately 82.1 miles of trapezoidal open channel canal would be constructed. No tunnel would be constructed. Two siphons totaling approximately 1.9 miles would be required. The total length of conduit for this option would be approximately 84 miles (see Figures Appendix A).

3.3.3 Alternative 2 Constructability Issues

Construction of the canals, tunnels, and siphons described in this alternative will have construction challenges similar to those of Alternative 1. These challenges have been considered during the development of opinions of probable project costs as well.

3.4 Alternative 3 – Pressure / Gravity Combination, Iron Gate Reservoir to Below Dwinnell Reservoir

This alternative is similar to the concept discussed in Bulletin No.87 Shasta Valley Investigation prepared by the California Department of Water Resources in 1964. This alternative consists of the following major elements:

1. Iron gate pumping plant;
2. Pressurized transmission line from Iron Gate reservoir to Bogus Mtn.
3. Tie in to Alternative 2 alignment below Bogus Mtn.

Under this alternative a pumping plant would be constructed on the south shores of Iron Gate Reservoir near the Iron Gate Dam. An approximate location is shown in Appendix A on Figure 5. The pumping plant would require approximately 22,800 horsepower and consist of multiple pumps connected in parallel.

Water would be pumped south toward Bogus Mountain via a single 96-inch diameter spiral welded steel pipeline. The pipeline would be approximately seven miles long. A preliminary hydraulic and economic analysis of a series of pipeline sizes and configurations indicate that a single 96-inch conduit will be most economical. Spiral welded steel was the only material considered due to the need for durability at high pressures. The alignment of this pressure transmission pipeline is shown on Figure 5 in Appendix A.

At a location near Bogus Mountain, the pressure pipeline would discharge into the gravity alignment described in Alternative 2 above. An outlet structure would be constructed for control of discharge from the pressure pipeline and outlet into the gravity canal.

3.4.1 Alternative 3 Constructability Issues

Construction of the canals in this alternative will have construction challenges similar to those of Alternative 1. This alternative will also have challenges associated with installation of a large diameter pipeline over very rugged topography. Thrust control as well as anchoring will be critical components of planning and design for the pipeline. These challenges have been considered during the development of opinions of probable project costs as well.

It is important to note that power requirements for Alternative 3 will be significant. The most practical source of power would be from the Iron Gate Power Plant. However, it is likely that additional power generation capacity will need to be constructed to supply power for the pumping plant for Alternative 3. The feasibility of expanding power generation at Iron Gate was not investigated in the study. However, determining power supply expansion capacity and feasibility will be critical to further defining any proposed import project.

4.0 OPINION OF PROBABLE COST

In this section opinions of probable project cost for the alternatives described above have been developed. The opinions presented in this section are based on the preliminary data reviewed in this report as well as current (2006) cost information obtained from various material suppliers and vendors. These cost opinions provide a basis for comparison of the alternatives presented and will need to be updated with current cost information as they are referred to in future investigations and studies.

Cost opinions have been developed based on the basic design criteria presented in Section 3.1. A 25% contingency and a 25% legal, administrative, and engineering cost is included in each cost opinion. In Addition, a 10% environmental permitting cost has been included. Detail regarding development of the opinions of probable cost is provide in Appendix C.

A net present value for each alternative has also been provided. The net present value was determined by estimated annual operation and maintenance cost as well as power costs where applicable. The net present value for O&M and power costs were estimated using an inflation rate of 4.0% over fifty years. The net present value of the O&M and power costs were added to the estimated construction cost to develop an estimate of the total net present value for each alternative.

The opinions of probable project cost are provided in Tables 3 through 9. Assumptions and calculation details are provided in Appendix C.

5.0 ENVIRONMENTAL COMPLIANCE

5.1 National Environmental Policy Act (NEPA)

Implementation of a Klamath-Shasta import project will require compliance with both State and Federal environmental policies. A project of this magnitude will certainly involve federal funding and will required compliance with the National Environmental Policy Act (NEPA). The State of California has a similar policy with the California Environmental Quality Act.

NEPA establishes the Federal government's environmental policy. Its primary goal is to help public officials make decisions based on an understanding of the environmental consequences of their actions. In order to accomplish this, NEPA requires Federal agencies to prepare written assessments that describe:

1. The affected environment and environmental consequences of a proposed project;
2. Reasonable or practicable alternatives to the proposed project; and
3. Any mitigation measures necessary to avoid or minimize adverse environmental effects.

In accordance with NEPA, three levels of environmental review are established. These include the following listed in order of project complexity:

1. Categorical Exclusions,
2. Environmental Assessments, and
3. Environmental Impact Statements.

The magnitude and complexity of a Klamath-Shasta Import project will certainly require preparation of an Environmental Impact Statement.

Table 3 Alternative No. 1 / Option 1 for 205 cfs (Gravity Flow Conduit / Keno to Dwinnell Reservoir, Maximize Use of Tunnels)

Item	Description	Units	Quantity	Unit Price	Total
1.0	Trapazoidal Open Channel Conduit				
	Excavation/Fill	LF	274,300	$ 1,500	$ 411,450,000
	Lining	LF	274,300	$ 400	$ 109,720,000
2.0	Tunnel Sections (12-ft Diameter)				
	Excavation	LF	109,000	$ 1,920	$ 209,280,000
	Lining	LF	109,000	$ 720	$ 78,480,000
3.0	Siphon				
	Inlet Structure	EA	1	$ 1,500,000	$ 1,500,000
	Outlet Structure	EA	1	$ 1,500,000	$ 1,500,000
	Excavation / Backfill	LF	6,200	$ 1,100	$ 6,820,000
	Appurtenances / Thrust Control	LS	1	$ 5,000,000	$ 5,000,000
	Spiral Welded Steel Pipe (96-inch)	LF	6,200	$ 900	$ 5,580,000
4.0	Control Structures				
	Transfer Structures	EA	20	$ 100,000	$ 2,000,000
	Water Measurement	EA	7	$ 65,000	$ 455,000
5.0	Construction Access				
	Staging Areas	EA	10	$ 50,000	$ 500,000
	Access Roads	LF	120,000	$ 150	$ 18,000,000
6.0	Diversion Structure				
	Concrete	CY	150	$ 500	$ 75,000
	Mechanical	LS	1	$ 100,000	$ 100,000
	Earthwork	CY	400	$ 75	$ 30,000
	Site Work	LS	1	$ 150,000	$ 150,000

Construction Subtotal	$	850,640,000
Contingency (25%)	$	212,660,000
Legal, Administrative, Engineering (25%)	$	265,825,000
Environmental Permitting (10%)	$	106,330,000
Total Estimated Project Budget	$	1,435,455,000
Estimated Annual O&M	$	1,276,000
O&M Net Present Value	$	27,411,000
Total Net Present Value	**$**	**1,462,866,000**

Table 4 Alternative No. 1 / Option 1 for 125 cfs (Gravity flow Conduit / Keno to Dwinnell Reservoir, Maximize Use of Tunnels)

Item	Description	Units	Quantity	Unit Price	Total
1.0	Trapazoidal Open Channel Conduit				
	Excavation/Fill	LF	274,300	$ 1,000	$ 274,300,000
	Lining	LF	274,300	$ 320	$ 87,776,000
2.0	Tunnel Sections (12-ft Diameter)				
	Excavation	LF	109,000	$ 1,920	$ 209,280,000
	Lining	LF	109,000	$ 720	$ 78,480,000
3.0	Siphon				
	Inlet Structure	EA	1	$ 1,250,000	$ 1,250,000
	Outlet Structure	EA	1	$ 1,250,000	$ 1,250,000
	Excavation / Backfill	LF	6,200	$ 650	$ 4,030,000
	Appurtenances / Thrust Control	LS	1	$ 3,000,000	$ 3,000,000
	Spiral Welded Steel Pipe (72-inch)	LF	6,200	$ 650	$ 4,030,000
4.0	Control Structures				
	Transfer Structures	EA	20	$ 100,000	$ 2,000,000
	Water Measurement	EA	7	$ 65,000	$ 455,000
5.0	Construction Access				
	Staging Areas	EA	10	$ 50,000	$ 500,000
	Access Roads	LF	120,000	$ 150	$ 18,000,000
6.0	Diversion Structure				
	Concrete	CY	150	$ 500	$ 75,000
	Mechanical	LS	1	$ 100,000	$ 100,000
	Earthwork	CY	400	$ 75	$ 30,000
	Site Work	LS	1	$ 150,000	$ 150,000
				Construction Subtotal	$ 684,706,000
				Contingency (25%)	$ 171,177,000
				Legal, Administrative, Engineering (25%)	$ 213,971,000
				Environmental Permitting (10%)	$ 85,588,000
				Total Estimated Project Budget	$ 1,155,442,000
				Estimated Annual O&M	$ 1,027,000
				O&M Net Present Value	$ 22,062,000
				Total Net Present Value	**$ 1,177,504,000**

Table 5 Alternative No. 1 / Option 2 for 205 cfs (Gravity Flow Conduit / Keno to Below Dwinnell Reservoir, Minimize Use of Tunnels)

Item	Description	Units	Quantity	Unit Price	Total
1.0	Trapazoidal Open Channel Conduit				
	Excavation/Fill	LF	477,000	$ 1,500	$ 715,500,000
	Lining	LF	477,000	$ 400	$ 190,800,000
2.0	Tunnel Sections (12-ft Diameter)				
	Excavation	LF	6,800	$ 1,920	$ 13,056,000
	Lining	LF	6,800	$ 720	$ 4,896,000
3.0	Siphon				
	Inlet Structure	EA	1	$ 1,500,000	$ 1,500,000
	Outlet Structure	EA	1	$ 1,500,000	$ 1,500,000
	Excavation / Backfill	LF	7,500	$ 1,100	$ 8,250,000
	Appurtenances / Thrust Control	LS	1	$ 5,000,000	$ 5,000,000
	Spiral Welded Steel Pipe (96-inch)	LF	7,500	$ 900	$ 6,750,000
4.0	Control Structures				
	Transfer Structures	EA	4	$ 100,000	$ 400,000
	Water Measurement	EA	7	$ 65,000	$ 455,000
5.0	Construction Access				
	Staging Areas	EA	15	$ 50,000	$ 750,000
	Access Roads	LF	156,000	$ 150	$ 23,400,000
6.0	Diversion Structure				
	Concrete	CY	150	$ 500	$ 75,000
	Mechanical	LS	1	$ 100,000	$ 100,000
	Earthwork	CY	400	$ 75	$ 30,000
	Site Work	LS	1	$ 150,000	$ 150,000
				Construction Subtotal	$ 972,612,000
				Contingency (25%)	$ 243,153,000
				Legal, Administrative, Engineering (25%)	$ 303,941,000
				Environmental Permitting (10%)	$ 121,577,000
				Total Estimated Project Budget	$ 1,641,283,000
				Estimated Annual O&M	$ 1,459,000
				O&M Net Present Value	$ 31,342,000
				Total Net Present Value	$ 1,672,625,000

Table 6 Alternative No. 1 / Option 2 for 125 cfs (Gravity Flow Conduit / Keno to Dwinnell Reservoir, Minimize Use of Tunnels)

Item	Description	Units	Quantity	Unit Price	Total
1.0	Trapazoidal Open Channel Conduit				
	Excavation/Fill	LF	477,000	$ 1,000	$ 477,000,000
	Lining	LF	477,000	$ 320	$ 152,640,000
2.0	Tunnel Sections (12-ft Diameter)				
	Excavation	LF	6,800	$ 1,920	$ 13,056,000
	Lining	LF	6,800	$ 720	$ 4,896,000
3.0	Siphon				
	Inlet Structure	EA	1	$ 1,500,000	$ 1,500,000
	Outlet Structure	EA	1	$ 1,500,000	$ 1,500,000
	Excavation / Backfill	LF	7,500	$ 650	$ 4,875,000
	Appurtenances / Thrust Control	LS	1	$ 3,000,000	$ 3,000,000
	Spiral Welded Steel Pipe (96-inch)	LF	7,500	$ 650	$ 4,875,000
4.0	Control Structures				
	Transfer Structures	EA	4	$ 100,000	$ 400,000
	Water Measurement	EA	7	$ 65,000	$ 455,000
5.0	Construction Access				
	Staging Areas	EA	15	$ 50,000	$ 750,000
	Access Roads	LF	156,000	$ 150	$ 23,400,000
6.0	Diversion Structure				
	Concrete	CY	150	$ 500	$ 75,000
	Mechanical	LS	1	$ 100,000	$ 100,000
	Earthwork	CY	400	$ 75	$ 30,000
	Site Work	LS	1	$ 50,000	$ 50,000
				Construction Subtotal	$ 688,602,000
				Contingency (25%)	$ 172,151,000
				Legal, Administrative, Engineering (25%)	$ 215,188,000
				Environmental Permitting (10%)	$ 86,075,000
				Total Estimated Project Budget	$ 1,162,016,000
				Estimated Annual O&M	$ 1,033,000
				O&M Net Present Value	$ 22,191,000
				Total Net Present Value	**$ 1,184,207,000**

Table 7 Alternative No. 2 / Option 1 (Gravity Flow Conduit / Keno to Below Dwinnell Reservoir, Maximize Use of Tunnels)

Item	Description	Units	Quantity	Unit Price	Total
1.0	Trapazoidal Open Channel Conduit				
	Excavation/Fill	LF	284,400	$ 1,000	$ 284,400,000
	Lining	LF	284,400	$ 320	$ 91,008,000
2.0	Tunnel Sections (12-ft Diameter)				
	Excavation	LF	89,700	$ 1,920	$ 172,224,000
	Lining	LF	89,700	$ 720	$ 64,584,000
3.0	Siphon				
	Inlet Structure	EA	2	$ 1,500,000	$ 3,000,000
	Outlet Structure	EA	2	$ 1,500,000	$ 3,000,000
	Excavation / Backfill	LF	11,300	$ 650	$ 7,345,000
	Appurtenances / Thrust Control	LS	1	$ 6,000,000	$ 6,000,000
	Spiral Welded Steel Pipe (72-inch)	LF	11,300	$ 650	$ 7,345,000
4.0	Control Structures				
	Transfer Structures	EA	30	$ 100,000	$ 3,000,000
	Water Measurement	EA	7	$ 65,000	$ 455,000
5.0	Construction Access				
	Staging Areas	EA	20	$ 50,000	$ 1,000,000
	Access Roads	LF	156,000	$ 150	$ 23,400,000
6.0	Diversion Structure				
	Concrete	CY	150	$ 500	$ 75,000
	Mechanical	LS	1	$ 100,000	$ 100,000
	Earthwork	CY	400	$ 75	$ 30,000
	Site Work	LS	1	$ 50,000	$ 50,000
				Construction Subtotal	$ 667,016,000
				Contingency (25%)	$ 166,754,000
				Legal, Administrative, Engineering (25%)	$ 208,442,500
				Environmental Permitting (10%)	$ 83,377,000
				Total Estimated Project Budget	$ 1,125,589,500
				Estimated Annual O&M	$ 1,001,000
				O&M Net Present Value	$ 21,503,000
				Total Net Present Value	$ 1,147,092,500

Table 8 Alternative No. 2 / Option 2 (Gravity Flow Conduit / Keno to Below Dwinnell Reservoir, Minimize Use of Tunnels)

Item	Description	Units	Quantity	Unit Price	Total
1.0	Trapazoidal Open Channel Conduit				
	Excavation/Fill	LF	433,700	$ 1,000	$ 433,700,000
	Lining	LF	433,700	$ 320	$ 138,784,000
2.0	Siphons				
	Inlet Structure	EA	2	$ 1,500,000	$ 3,000,000
	Outlet Structure	EA	2	$ 1,500,000	$ 3,000,000
	Excavation / Backfill	LF	9,900	$ 650	$ 6,435,000
	Appurtenances / Thrust Control	LS	1	$ 6,000,000	$ 6,000,000
	Spiral Welded Steel Pipe (72-inch)	LF	9,900	$ 650	$ 6,435,000
3.0	Control Structures				
	Transfer Structures	EA	2	$ 100,000	$ 200,000
	Water Measurement	EA	7	$ 65,000	$ 455,000
4.0	Construction Access				
	Staging Areas	EA	15	$ 50,000	$ 750,000
	Access Roads	LF	156,000	$ 150	$ 23,400,000
5.0	Diversion Structure				
	Concrete	CY	150	$ 500	$ 75,000
	Mechanical	LS	1	$ 100,000	$ 100,000
	Earthwork	CY	400	$ 75	$ 30,000
	Site Work	LS	1	$ 50,000	$ 50,000
				Construction Subtotal	$ 622,414,000
				Contingency (25%)	$ 155,603,500
				Legal, Administrative, Engineering (25%)	$ 194,504,375
				Environmental Permitting (10%)	$ 77,802,000
				Total Estimated Project Budget	$ 1,050,323,875
				Estimated Annual O&M	$ 934,000
				O&M Net Present Value	$ 20,064,188
				Total Net Present Value	**$ 1,070,388,063**

Table 9 Alternative No. 3 (Pressure / Gravity Combination, Iron Gate Reservoir to Below Dwinnell Reservoir)

Item	Description	Units	Quantity	Unit Price	Total
1.0	Trapazoidal Open Channel Conduit				
	Excavation/Fill	LF	185,000	$ 1,000	$ 185,000,000
	Lining	LF	185,000	$ 320	$ 59,200,000
2.0	Iron Gate Pumping Plant / Force Main				
	Inlet Structure / Pumping Plant	LS	1	$ 7,500,000	$ 7,500,000
	Outlet Structure	EA	1	$ 1,500,000	$ 1,500,000
	Excavation / Backfill	LF	37,000	$ 650	$ 24,050,000
	Appurtenances / Thrust Control	LS	1	$ 15,000,000	$ 15,000,000
	Spiral Welded Steel Pipe (72-inch)	LF	37,000	$ 650	$ 24,050,000
3.0	Control Structures				
	Transfer Structures	EA	2	$ 100,000	$ 200,000
	Water Measurement	EA	7	$ 65,000	$ 455,000
				Construction Subtotal	$ 316,955,000
				Contingency (20%)	$ 63,391,000
				Legal, Administrative, Engineering (25%)	$ 95,087,000
				Environmental Permitting (10%)	$ 38,035,000
				Total Estimated Project Budget	$ 513,468,000
				Estimated Annual O&M	$ 15,848,000
				Estimated Annual Power Cost	$ 5,875,000
				O&M Net Present Value	$ 466,653,000
				Total Net Present Value	$ 980,121,000

5.2 Environmental Impact Statement (EIS)

Preparation of an EIS will require collection of relevant data on environmental resources that may be affected by the proposed project, a review of the project alternatives that have been evaluated, a description of any proposed mitigation measures, and a summary of correspondence and consultation with various concerned agencies.

The general format for an Environmental Impact Statement will include the following:

1. Purpose and Need of Project
2. Alternatives to the Project Action
3. Affected Environment/Environmental Consequences
4. Summary of Mitigation

5. Correspondence
6. Exhibits

A Klamath-Shasta Import project will affect multiple resources and require consultation with multiple agencies. When this is the case, the various agencies involved will agree upon who will be the Lead Agency in directing preparation of the EIS. Actual preparation of the EIS will be done in accordance with guidelines and requirements set forth by the Lead Agency.

Summarized below are the environmental resources that typically are addressed in preparation of an EIS. The level of effort required to address each of the resources affected and develop mitigation plans will be determined during consultation with the appropriate agency.

- Land Use
- General Land Use
- Important Farmland, Prime Range Land and Forest Land
- Formally Classified Lands
- Floodplains
- Wetlands
- Cultural Resources
- Biological Resources
- Water Quality
- Coastal Resources
- Socio-Economic/Environmental Justice
- Miscellaneous Issues
- Air Quality
- Transportation
- Noise

6.0 LEGAL ISSUES

A major legal issue will be addressing water rights associated with diverting water from the Klamath River to the Shasta Valley. In Bulletin No. 87 Shasta Valley Investigation it indicates that prior to construction of the Iron Gate Project by the California Oregon Power Company (COPCO) irrigation in the Shasta Valley and Ager area were considered higher uses than power production. Stipulations to diversion of water from the Klamath river for irrigation purposes in the Shasta Valley have existed up until March 1, 2006. Since this date has passed there would be more flexibility to implementation of an import project. The agreement between California Fish and Game and COPCO requires due compensation be provided to COPCO if water is diverted from the Iron Gate project for use in the Shasta Valley.

Other legal issues will include obtaining easements through private property and obtaining various permits associated with construction of the project. A more detailed review of legal issues and requirements will need to be performed before a Klamath-Shasta Import project is pursued further.

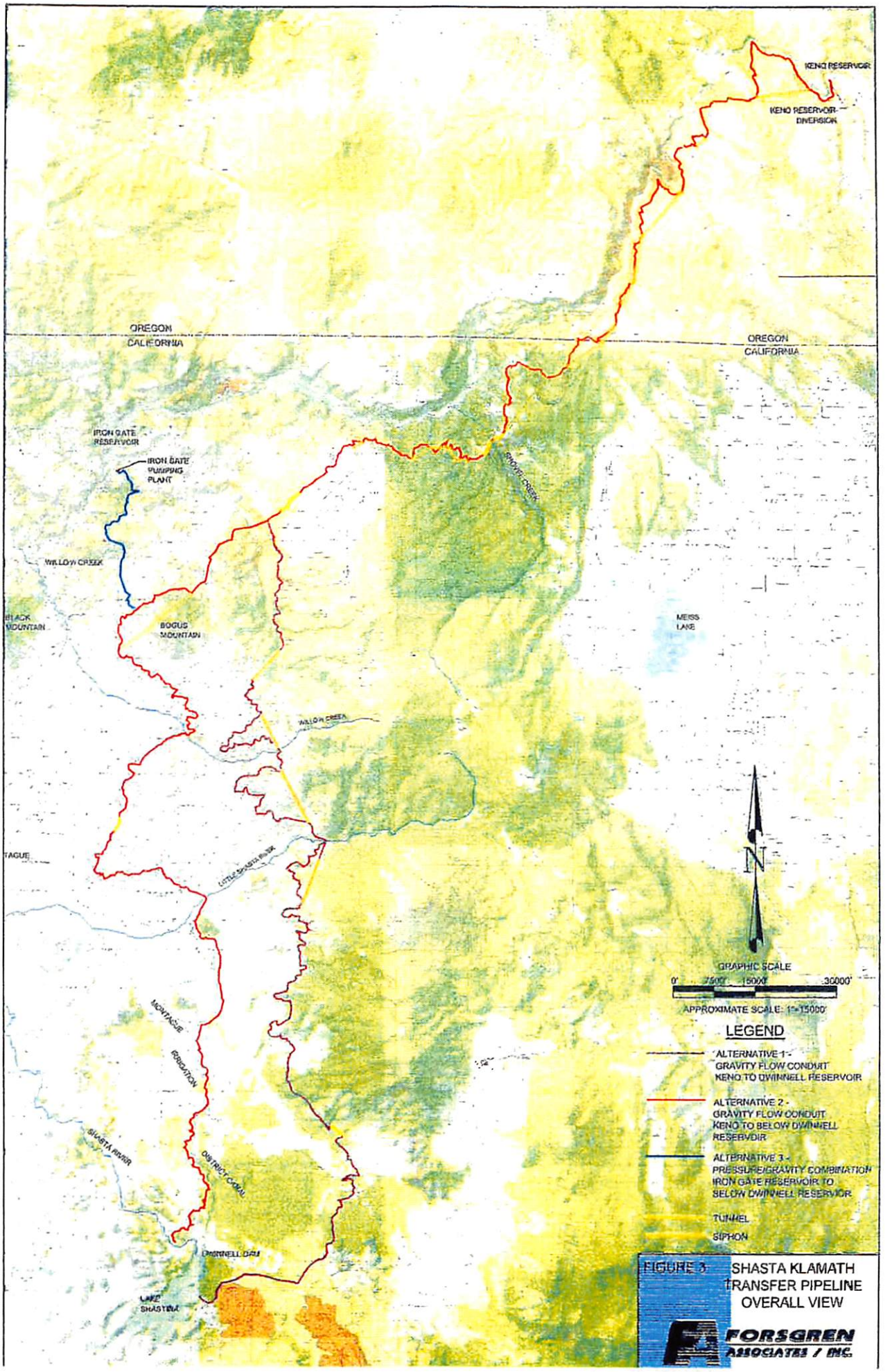


FIGURE 3 SHASTA KLAMATH TRANSFER PIPELINE OVERALL VIEW

FORSGREN ASSOCIATES / INC.

V

SISKIYOU COUNTY SCOPING COMMENTS ON ENVIRONMENTAL IMPACT STATEMENT (EIS)

RELATED TO KBRA, KHSA, and DAM REMOVALS

DAM REMOVAL

ENVIRONMENTAL IMPACT STATEMENT (EIS)

DEVELOPMENT

Federal Register Notice June 14, 2010

?ublic comments on the environmental impact study associated with the Klamath Basin estoration Agreement and the Klamath Hydroelectric Settlement Agreement must be submitted y July 21.

- Go online to www.KlamathRestoration.gov/contact-us/feedback and fill out an online form.
- Send comments by mail to the U.S. Bureau of Reclamation office, Tanya Sommer, 2800 Cottage Way MP-152, Sacramento, CA, 95825; via e-mail to klamathsd@usbr.gov ; or by fax to 916-978-5055.
- Send comments to the California Department of Fish and Game office to Caitlin Bean, 601 Locust Street, Redding, CA, 96001; via e-mail to KSDcomments@dfg.ca.gov or by fax to 530-225-2343.

Official website http://klamathrestoration.gov/

COUNTY TASK FORCE

COMMENTS/PROPOSALS

- May 4, 2010, **Klamath Dams Removal,** Dr. John W. Menke, (retired professor Department of Agronomy and Range Science, University of California, Davis)
- Shasta Nation's Alternative to Dam Removal and **Suggested Anadromous Fish By-Pass proposal; Map of bypass** and proposed diversion rotes for the County's 60,000 acre feet storage water use right;
  - **Proposed Alternate Tunnel Route** Shasta Nation Anadromous Fish Bypass
  - See **Deschutes Passage** - a successful dam bypass project
- Jerry Bacigalupi, (PE-Engineer) - **Flood Control capacity of the dam complex**

- Please do not Restore My Klamath River - Glen Briggs, Civil Engineer, retired, Dept. of Interior, Bureau of Reclamation, 1960 to 1987
- Concerns regarding downstream release of warm water fish from the reservoirs
  - Gierak letter to the editor
- Concerns U.C. Farm Advisor on spread of noxious weeds (paper on yellow starthistle)
- A-Red - an initiative of the Siskiyou County Board of Supervisors to increase salmon production; County to move forward with salmon propagation plans; This option has been dropped due to lack of cooperation and budgetary considerations
- Ocean conditions are driving salmon north to Alaskan waters where they are thriving
- Infrastructure (Roads and Bridges) that would likeley be affected by the impacts of dam removal
- Socio-economic (Cumulative Effects) Cover Letter
  - Demographics - Aging trends
  - Siskiyou County Business Characteristics and Growth 1998-2007
  - Major Employers in Siskiyou County (EDD)
  - Unemployment history 1990 - 2009
  - History of Income in Siskiyou County 1987-2008
  - Poverty in Siskiyou County 1989-2008
  - Number of Farm/nonfarm proprietors in Siskiyou County 1987-2008
  - Agricultural Profit 1987-2008
  - Trends in AG Census Data
  - Timber jobs 1988-2009
  - Timber Harvest Levels in the National Forests of Siskiyou Co.
  - Harvest levels to jobs
  - County Share of CA Timber Harvest and Value -Public and Private Lands
  - Timber Appeals 1998-2008
  - Economic impacts of suction dredge mining

COUNTY TASK FORCE

Citations/Studies of Particular Interest:

- **Final Eligibility and Suitability Report for the Upper Klamath Wild and Scenic River Study** (large file)

- **Klamath Project Operations Biological Assessment 2007** - The Effects of the Proposed Action to Operate the Klamath Project from April 1, 2008 to March 31, 2018 On Federally-Listed Threatened and Endangered Species Mid-Pacific Region; **Appendices**

- **Upper Klamath Lake Basin Nutrient-Loading Study—Assessment of Historic Flows in the Williamson and Sprague Rivers** Risley and Laenen;

- **Recent Water Temperature Trends in the Lower Klamath River, California,** Bartholow

- Committee on Hydrology, Ecology, and Fishes of the Klamath River, National Research Council (National Academy of Sciences) - **Hydrology, Ecology, and Fishes** of the Klamath River Basin - in the last portion of the report, the critiques the utility of the Natural Flow and Instream Flow studies, in conclusion stating: "... the study makes the implicit assumption that the primary limiting factor for the recovery of salmon is physical habitat, directly related to instream flows, but the study does not demonstrate when or even if physical habitat is a limiting factor in any of the life stages of the fishes of concern. The precise nature of any flow-related hydraulic-habitat "bottlenecks" in the population dynamics of the salmon is not demonstrated, so it is possible that temperature, dissolved oxygen, water quality, connectivity, disease, competition, or other factors are more critical to fish persistence than the hydraulic aspects of habitat are. In other words, suitable hydraulic-habitat conditions may be necessary but are not by themselves sufficient for fish persistence."

  "...the two studies do not allow for a detailed and practical analysis of trade-offs among various flow-management regimes with respect to benefits and costs to the anadromous fishes in the river and to the agricultural and other interests in the basin."

- Committee on Hydrology, Ecology, and Fishes of the Klamath River, National Research Council (National Academy of Sciences) **Endangered and Threatened Fishes** in the Klamath River Basin: Causes of Decline and Strategies for Recovery: **Recommendations:** "Actions intended to improve environmental conditions for the threatened coho salmon to date primnarily have involved hydrological manipulation of the main stem at Iron Gate Dam. Continual focus on hydrologic conditions in the main stem is an excessively narrow basis for recovery actions or for a recovery plan..."

- **Scientific Evaluation of Biological Opinions** on Endangered and Threatened Fishes in the Klamath River Basin: Interim Report (2002)
- Predicting the Thermal Effects of Dam Removal on the Klamath River, Bartholow, Flug
- Modeling Klamath River System Operations for Water Quantity and Quality. ASCE Journal of Water Resources Planning and Management
- Klamath River Basin Fisheries Resource Plan (DOI) CH2M Hill
- Water Quality Modeling in the Systems Impact Assessment Model for the Klamath Basin: Keno, OR to Seiad Valley, CA USGS 99-113
- Long Range Plan for the Klamath River Basin Conservation Area 1991 (Klam. River Task Force)
- Life Stage Periodicities of Anadromous Salmonids in the Klamath River Basin 1984, Leidy
- Klamath River Hydrological Conditions Prior to the September 2002 Die-Off of Salmon and Steelhead. USGS Water-Resources Investgative Rpt. 03-4099
- Pacific Salmon at the Crossroads: stocks at risk from CA, OR, ID and WA Fisheries 16(2):4-21 Nehlsen, Lichatowich
- Upper Klamath Basin Nutrient Loading Study - assessment of historic flows in the Williamson and Sprague Rivers: Report 98-4198 Risley, Laenen 1999
- Modeling of Climate Change Effects On Stream Temperatures and Fish Habitats Below Dams and Near Groundwater Inputs, Sinokrot, stefan, McCormick, Eaton Climatic Change 30:181-200
- Northwest Forest Plan - the First Ten Years (1994-2003) Socio-economic monitoring of the Klamath National Forest and Three Local Communities (Cumulative effects)
- Estimated Water Vlaues in the Shasta River Basin
- California Department of Fish and Game Suction Dredge Permitting Program Chapter 4.6
- The Impact of Regulatory Costs on Small Firms (SBA)





The National Environmental Policy Act of 1969; CEQ - Regulations for Implementing NEPA ;

- **Request for Preliminary Injunction** - Central Valley ESA Water Cut-off: **Summary** NMFS and Reclamation, as the consulting and action agencies, must take the hard look under NEPA at the draconian consequences visited upon Plaintiffs, the water supply of California, the agricultural industry, and the residents and communities devastated by the water supply limitations imposed by the RPA Actions. NEPA analysis must include comprehensive analysis of impact to humans and the human environment. **The Consolidated Salmonid Cases**, case 1:09-cv-01053-OWW- DLB, Document 347, U.S. District Ct. for the Eastern District of CA, Judge Wanger: (**Excerpts on NEPA**)
  - **Delta fish rulings could affect endangered species law**



EPA website on **NEPA compliance**; ; **NEPA.net**; A **Citizen's Guide** to NEPA; **Collaboration** and NEPA; Considering **Cumulative Effects** Under the National Environmental Policy Act; **Recent Trends** in Cumulative Impact Case Law Council on Environmental Quality (CEQ) NEPA regulations issued in 1973 and substantially revised in 1978 clearly stated a requirement to consider cumulative impacts for all projects undergoing NEPA analysis (Thatcher 1990), and provided the following definition of cumulative impacts in Section 1508.7:

"The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. "



CEQA website



Tulelake Irrigation District v. All Persons Having or Claiming to Have an Interest in the Validity of Agreements Entered Into by Tulelake Irrigation District Entitled "Klamath River Restoration Aghreement for the Sustainability for Public and Trust Resources and Affected Communities" and "Klamath Hydroelectric Settlement Agreement" Siskiyou County Superrior Court No. SC CV CV 10-0463. (Suit may perfect CEQA/NEPA and other flaws and quash any claims by parties whose interests are injured by the KBRA/KHSA.)



The Klamath Hydroelectric Settlement Agreement and Klamath Basin Restoration **Agreements**;



Hydro Relicensing ; Yreka USFWS site on Hydropower; USBR K-Falls **site**; USGS **site**; EPA

site; Siskiyou County site; FERC Relicensing **EIS documents**; Federal Energy Regulatory Commission. 2007. Final Environmental Impact statement for the Klamath Hydroelectric Project, Docket No. P-2082-027. 11/18/07. U.S. DOE, FERC, Washington D.C. **Download zipped document.** (22 separate files.); **National Marine Fisheries Service.** 2006. Comments, Recommended Terms and Conditions, and Preliminary Prescriptions for the Klamath Hydroelectric Project, FERC Project #2082. NMFS, SW Region, Long Beach, CA. 161 p.

CA Water Code 5900-5901; Klamath River Basin Compact;or here Appendix B - Siskiyou County Water Conservation and Flood Control District Boundaries: "All of that territory of the County of Siskiyou lying within the exterior boundaries thereof, exclusive of the area in Siskiyou County within the Upper Klamath River Basin, as delineated on the Official Map of the Upper Klamath River Basin approved September 6, 1956, and made a part of the Klamath River Basin compact between the States of Oregon and California, ratified by said states on April 17, 1957."

"(r) To control flood and storm waters within the district and the flood and storm waters or streams outside the district, which flow into the district; to conserve such waters by storage in surface reservoirs, to divert and transport such waters for beneficial uses within the district; to release such waters from surface reservoirs to replenish and augment the supply of water in natural underground reservoirs and otherwise to reduce the waste of water and to protect life and property from floods within the district; to commence, maintain, intervene in, defend or compromise, in the name of the district, on behalf of the landowners therein, or otherwise to assume the cost and expenses of any action or proceeding involving or affecting the ownership or use of waters or water rights within or without the district, used or useful for any purpose of the district or of the common benefit of any land situated therein, or involving the wasteful use of water therein; to commence, maintain, intervene in, defend and compromise and to assume the cost and expenses of any and all actions or proceedings now or hereafter begun; to prevent interference with or diminution of, or to declare the rights in natural flow of any stream or surface or subterranean supply of waters used or useful for any purpose of the district or of common benefit of the lands within the district or to its inhabitants; to prevent unlawful exportation of water from said district; to prevent contamination, pollution or otherwise rendering unfit for beneficial use the surface or subsurface water used or useful in said district, and to commence, maintain and defend actions and proceedings to prevent any such interference with the aforesaid waters as may endanger or damage the inhabitants, lands, or use of water in, or flowing into, the district provided, however, that said district shall not have power to intervene or take part in or to pay the costs or expenses of actions or controversies between the owners of lands or water rights which do not affect the interests of the district."

In addition, there is a reserved storage right of 60,000 acre feet per year in Iron Gate Reservoir to serve irrigation and other consumptive uses in the Shasta Valley.

Siskiyou County Code: **TITLE 10; Chapter 10** FLOOD DAMAGE PREVENTION; **TITLE 10: Chapter 12** COUNTY PARTICIPATION IN STATE AND FEDERAL AGENCIES LAND TRANSACTIONS; **TITLE 10: Chapter 13** DEMOLITION, DECONSTRUCTION, REMOVAL AND RECLAMATION

Siskiyou County Code: TITLE 10. PLANNING AND ZONING; CHAPTER 11. RIGHT TO FARM Section 10-11.01-.05 "No agricultural activity, operation or facility or appurtenances thereof, conducted or maintained for commercial purposes, and in a manner consistent with proper and accepted customs and standards and with all chapters of this code, as established and followed by similar agricultural operations, shall be or become a nuisance, public or private, pursuant to this code after the same has been in operation for more than three (3) years, if it was not a nuisance when it began."

Siskiyou County Resolution 93-284 Joint Environmental Planning

Correspondence (See also **County Coordination**)

Correspondence on KHSA/KBRA (dam removal):

- County March 17, 2009 letter to Secretary Chrisman and his March 10 response
- County letter 12/8/09 to Secretary Chrisman on unsatisfied CEQA requirements (similar letter to Governor Schwarzenegger
- County Letter of 12/14/09 to US Bureau of Reclamation regarding coordination requirements/PacificCorp's dams on the Klamath River. (2 MB PDF)
- County Letter of 2/17/09 to Secretary Salazar regarding coordination requirements and the Agreement In Principle for removal of PacificCorp's dams on the Klamath River. (73 KB PDF)
- 2/23/10 Letter from DOI regarding coordination
- County letter of 5/12/10 to John Bezdek (DOI, Mark Stopher (CA DFG) and Dennis Lynch (USGS) NEPA/CEQA and coordination
- County letter 6/8/10 to Secretary Salazar NEPA/CEQA process
- Letter from NOAA fisheries denying coordination
- Letter from US Department of the Interior
- DOI Secretary Salazar's **May 26, 2010 response** to Congressman Herger's letter of March 29, 2010
- 6/14 DFG letter (Stopher) "The Department does not have the resources or the capacity to commit to a separate coordination process with Siskiyou County in regard to the Comprehensive Land and Resource Management Plan, and as a matter of law this is not required."

ARTICLES

Technical Management Team briefing 5/6/10: Column **Part 1; Part 2**

Dr. Gierak - videos on dam removal at Savage Rapids Dam:

http://www.youtube.com/watch?v=rUeeHydjIs8

http://www.youtube.com/watch?v=cYAzsCUS8a4

http://www.youtube.com/watch?v=mK3lkqFt398&feature=related

Articles & Columns:

- The Klamath Basin Agreements: Who's Not at the Table?
- Delta fish rulings could affect endangered species law
- Help us fix the Klamath resource crisis
- Governor to try to push water bond vote to 2012
- Governor wants state water bond off Nov. ballot
- Governor pulls water bond off Nov. ballot; Wolk applauds move
- Public scoping, Web site announced for Klamath agreements
- Western Economists Question USGS Draft Klamath Recreational Study
- Study on Klamath Project recreation impact dead wrong
- County letter to Salazar alleges failure to meet dam settlement commitments
- Siskiyou County Board of Supes talk dam removal at meeting
- Judge lifts water pumping limits
- Fish Ruling in Fresno Sides with Farmers: Wanger found that the federal government "completely abdicated [its] responsibility" to consider other alternatives when it formulated the current biological opinion, decisions that should not only protect endangered salmon, but also "minimize the adverse impact on humans and the human environment."
- Judge sides with farmers in delta pumping lawsuit (Adequacy of NEPA analysis and action re impact to human environment)
- Board approves study of Shasta Nation fish bypass proposal
- Agencies, entities receive update on Klamath science review process
- Multiple studies underway on Klamath River dam removal question
- Jim Cook:Hart Bypass analysis 'insulting'
- County moves toward start of salmon restoration project
- Report identifies key Siskiyou County issues at Klamath science conference
- Science, engineering needs for dam removal decision discussed
- Science Conference looks at diverse perspectives in the Klamath Basin
- Science Conference Column
- Columns KBRA/KHSA: (1) ; (2); (3); (4); (5); (6); (7); (8); (9); (10); (11); (12)
- Deliberative Democracy -
    - **Environmental Dispute Settlement**

      Environmental Dispute Settlement, or Alternative Dispute Resolution, relies on a stakeholder model for organizing deliberation, rather than on open community meetings. A limited number of representatives from affected interests agrees upon rules that are conducive to mutual understanding of each other's interests and perspectives, and seeks common ground for action....The circle of deliberation can be extended considerably by communication of stakeholder representatives with their grassroots constituencies during the negotiations. This form of deliberative democracy has guided state legislatures in policy making and agency officials in rule making. It is often convened and facilitated by administrative officials in agencies such as EPA, the Army Corps of Engineers, and the U.S. Forest Service, leading some scholars to speak of "deliberative cultures" emerging within regulatory agencies. An increasing number of environmental officials, in fact, are aware not only of the practical techniques, but of the theoretical discussions of deliberative democracy. And policy analysts have begun to pay increasing attention to how policy designs can and should encourage citizen deliberation in confronting complex problems and tradeoffs. See the discussion of Environmental Dispute Settlement, and extensive references, in Civic Environmentalism, by

Carmen Sirianni and Lewis Friedland.

APPLICABLE REFERENCE & BACKGROUND

- Compilation of information to Inform USFWS Principals on the Potential Effects of the Proposed Klamath Basin Restoration Agreement (Draft 11) on Fish and Fish Habitat Conditions in the Klamath Basin, with Emphasis on Fall Chinook Salmon
- **Klamath Project Operations Biological Assessment 2007 - The Effects of the Proposed Action to Operate the Klamath Project from April 1, 2008 to March 31, 2018 On Federally-Listed Threatened and Endangered Species Mid-Pacific Region; Appendices**
- Fruit Growers (cumulative effects) **Draft Environmental Impact Statement** for Authorization for Incidental Take and Implementation of Fruit Growers Supply Company's Multi-Species Habitat Conservation Plan
- **Final eligibility and suitability report for the upper Klamath wild and scenic river study.** by United States. Bureau of Land Management. Klamath Falls Resource Area Office. Published in 1990, U.S. Dept. of the Interior, Bureau of Land Management, Klamath Falls Resource Area (Klamath Falls, Or) **Available at Yreka Public Library**
- **A Siskiyou County Perspective (Mid-River overview) Very large file**
- Committee on Hydrology, Ecology, and Fishes of the Klamath River, National Research Council (National Academy of Sciences) - **Hydrology, Ecology, and Fishes** of the Klamath River Basin; **Endangered and Threatened Fishes** in the Klamath River Basin: Causes of Decline and Strategies for Recovery ; **Scientific Evaluation of Biological Opinions** on Endangered and Threatened Fishes in the Klamath River Basin: Interim Report (2002); IFIM and PHABSIM
- **Hardy Phase II flows; NAS Review;** The Water Report - Klamath Basin Science **Dr. T. B. Hardy vs Dave Vogel, Wildlife Biologist; Klamath Watershed in Perspective** A review of historical hydrology of major features of the Klamath River Watershed and evaluation of Hardy Iron Gate Flow requirements. By Dr. K.A. Rykbost, Superintendent, Klamath Experiment Station, Oregon State University, and R. Todd, Klamath County Extension Office, Oregon State University. HERE for Power Point presentation
- **Lake Levels - River Flows**
- **Dam Removal and Klamath River Water Quality: A Synthesis of the Current Conceptual Understanding and an Assessment of Data Gaps (Stillwater)**
- **Long Range Plan For The Klamath River Basin** Conservation Area Fishery Restoration Program
- Ft. Collins USGS K-SIAM- **Quantifying the effect of dam removal on water temperatures** in the lower Klamath River, California, and implications for salmon recovery; **Predicting the thermal**

effects of dam removal on the Klamath River; **Drought allocation modeling** for the Klamath River; Evaluating water management strategies with the Systems Impact Assessment Model: **SIAM Version 4** (Revised October 2005); **SALMOD (1); SALMOD (2); SALMOD: Salmonid Young-of-Year Production Model for the Klamath**, Trinity, and Sacramento Rivers; **Application of the Systems Impact Assessment Model (SIAM) to fishery resource issues in the Klamath River**, California; **Reshaping the annual hydrograph at Iron Gate Dam** to benefit anadromous fish populations in the Klamath River, CA; SIAM - **Animation of Water Temperature Along the Klamath River ; SIAM v.4**

- **Klamath River Modeling Project** (Deas/Orlob)

- **Fish Health Monitoring Reports** (Arcata USFWS); **Ceratomyxa Shasta 2007** Study Summary Jerri Bartholomew ; FY2002 Investigational Report: **Ceratomyxosis resistance in juvenile Chinook Salmon and Steelhead Trout** from the Klamath River.; **Nichols, K. and J.S. Foott. 2005.** Health Monitoring of Juvenile Klamath River Chinook Salmon, FY 2004 Investigational Report. USFWS California-Nevada Fish Health Center, Red Bluff, CA. (77 Kb); **Nichols, K. and K. True. 2007.** Monitoring incidence and severity of Ceratomyxa shasta and Parvicapsula minibicornis infections in juvenile Chinook salmon (Oncorhynchus tshawytscha) and coho salmon (Oncorhynchus kisutch) in the Klamath River, 2006. USFWS California-Nevada Fish Health Center, Anderson, CA 23 p.; **Update on Juvenile Fish Mortalities** Observed in the Klamath River 2008

- **Sediment Management for Dam Removal** Jeffrey B. Bradley, P.E, Ph.D. President, WEST Consultants

- Watershed Condition, **Turbidity, and Implications for Anadromous Salmonids** in North Coastal California Streams

- **Salmon rearing habitats in the main stem Klamath River.** Natural Resource Scientists, Inc. Red Bluff, CA. 37 pp. [1.65Mb] Vogel 2003

- **CA DFG Hatchery EIR / EIS**

- Nutrient Loading: Power Point Presentation: **Nutrient loading in the Klamath Basin: Agriculture and Natural Sources.** Special Report 1023, , by K.A. Rykbost and B.A. Charlton, Oregon State University/Klamath Experiment Station. ; **Nutrient Loading of Surface Waters in the Upper Klamath Basin**: (paper) K.A. Rykbost and B.A. Charlton; **Historical information on Klamath Watershed Hydrology and water quality in the Upper Klamath Basin** Presented to the National Research Council Committee on Hydrology, Ecology and Fishes in the Klamath River Basin by Klamath Water Users Association, posted to KBC 10/13/06; **Farming practices and water quality in the Upper Klamath Basin,** by TID Manager Earl Donosky and UC Davis Agronomist Steven Kaffka, Final Report to the Ca. State Water Resources Control Board (4/16/02) posted to KBC 9/11/06; **Klamath River Nitrogen Loading and Retention Dynamics** 1996-2004 (Yurok Tribe); **Upper Klamath Lake Basin Nutrient-Loading Study—Assessment of Historic Flows in the Williamson and Sprague Rivers** Risley and Laenen; **Upper Klamath Basin Nutrient-Loading Study - Estimate of Wind-Induced Resuspension of Bed Sediment During Periods of Low Lake Elevation** (1996) Laenen, Letourneau and Eaton must be purchased; **Water Quality and Nutrient Loading in the Klamath River Between Keno, Oregon and Seiad Valley, California From 1996-1998** Open File Report 01-301;

- Information about the **Klamath Project**; A Selected Bibliography of Water-Related Research in the **Upper Klamath Basin**, Oregon, through 1994; **Ground-Water Hydrology of the Upper Klamath**

Basin ; Final Natural Flow study - upper Klamath River (Attachments)

- Klamath River Compact Commission: Investigation Into Methods to Control Algae in The Klamath River Basin, June 1962
- CDC Facts about Blue Green Algae; Results of 2007 study
- Distribution of Anadromous Fishes in the Upper Klamath River Watershed Prior to Hydropower Dams—A Synthesis of the Historical Evidence
- Water Allocation Alternatives for the Upper Klamath Basin (This costs out the economic value of water to ag. We need a similar report for comparison of the value of water for fish)
- Estimated Water Vlaues in the Shasta River Basin
- Peace on the River? Social-Ecological Restoration and Large Dam Removal in the Klamath Basin. USA - Gosnell , Kelly
- Northwestern California/Klamath Bioregion Environment Information Sources
- Klamath River Basin 2009 Report to Congress NOAA
- Klamath Basin Science Conference 2010; and Program
- American Rivers links to various studies
- Critique of Science by David Vogel: 8 peer-reviewed reasons for the decline in coho, according to the USFWS studies (VIDEO); Salmon Rearing Habitats in the Main Stem Klamath River.; Major Problems with the Department of Fish and Game (DFG) 'Fish Kill' Report.:. Document by fish-scientist David Vogel, directed to the Fish and Game's statements on the 2002 fish die-off. ; Assessment of Klamath River Water Temperatures Downstream of Iron Gate Dam During September and October 2002, by David Vogel.
- US DOI Modified Terms and Conditions and Prescriptions for Fishways FERC - Klamath River Hydro

SOCIAL and ECONOMIC CUMULATIVE EFFECTS

- Northwest Forest Plan - the First Ten Years (1994-2003) Socio-economic monitoring of the Klamath National Forest and Three Local Communities (Cumulative effects)
- Excerpts Fruit Growers EIS social and economic impacts Draft Environmental Impact Statement for Authorization for Incidental Take and Implementation of Fruit Growers Supply Company's Multi-Species Habitat Conservation Plan
- Assessing the Viability and Adaptability of Forest-Dependent Communities in the United States (USDA Haynes)
- Unemployment History Siskiyou County
- USDA Economic Research: 1990 and 2000 Census Poverty Data; County-Level Unemployment and Median Household Income;

- CAL EDD - Siskiyou County Profile; Enterprise Zone Application
- Siskiyou County Child Care Planning Council Needs Assessment 2010
- Siskiyou County: A Profile of Poverty, Hunger & Food Assistance
- 2007 Ag Census - Siskiyou County; Agriculture pages; Klamath Basin Crops, Products and Livestock
- Economic Impacts of 2001 Klamath Project Water Allocation - OSU
- Kruse, S., Scholz, A. (2006). "Prelminary Economic Assessment of Dam Removal: The Klamath River." Ecotrust. (Mar. 11, 2007)
- U.S. Bureau of Reclamation. (2006). "Economic Modeling of Relicensing and Decommissioning Options for the Klamath Basin Hydroelectric Project." California Energy Commission. (Mar. 20, 2007)
- Forest Management Impacts (Large file - power pt.)
- Forest Economics Research at the Pacific Northwest Research Station, to 2000
- Well-being Assement of Communities in the Klamath Region (Prep. for USFS)
- A business owner in Seiad in northern California discusses the local economic impact of the suction dredging ban
- Suction Dredge Economic Impact; 07/22/2009 Economic Impact of Suction Gold Dredging in California is Over $52 Million Per Year ; Excerpts DEIR
- PacifiCorp proposed rate increses - comment to PUC (Armstrong)

See also Social and Economic Information

VI

DATA, LETTERS AND REPORTS

RELATED TO DAM REMOVALS AND ANADROMOUS FISH

Record copies - Iron Gate Fish Hatchery office

Iron Gate Hatchery

Iron Gate Dam and the spawning facility were completed in 1962. The main hatchery area was completed in 1966. The hatchery and dam were built by Pacific Power & Light Company. The hatchery is operated by the California Department of Fish & Game and was built to handle salmon and steelhead that previously spawned above the dam.

Fish Runs:

Chinook (King) Salmon - Late September to early November
Coho (Silver) Salmon - Late October to early December
Steelhead - November to March

Production Goals:

Chinook Salmon -	5,100,000 smolts (released in May - June)
	900,000 yearlings (released in November)
Coho Salmon -	75,000 yearlings (released in April)
Steelhead -	200,000 yearlings (released April)

A few salmon come back as jacks or grilse (2 year olds), most Chinook come back as 3 or 4 year olds, a very few return as 5 year olds and most Coho return as 3 year olds.

A female Chinook Salmon at Iron Gate Hatchery usually averages about 3,100 eggs.

We give fillets from our adult salmon to various organizations (churches, senior groups, food banks, & etc.) after they are spawned and processed.

Usually we have yearling Steelhead in raceway A, yearling Coho in raceway B, and Chinook fry or yearlings in each raceway C-H.

Fish in the raceways are usually fed 4-8 times per day (depending on size and age). During peak periods we feed in excess of a ton of food per day.

During October adult salmon can be observed spawning in Bogus Creek (walk down the road behind houses to bridge). **THIS ROAD IS OPEN TO PUBLIC ONLY DURING OPEN HOUSE** (check with hatchery to view at other times).

The hatchery water comes from 70 feet down in Iron Gate Reservoir and varies from 39 degrees F (winter) to 58 degrees F (late summer).

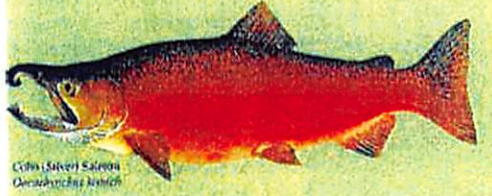
Most of the year, the river water comes through the powerhouse from the 20-foot level in Iron Gate Reservoir. The powerhouse can handle up to about 1,800 cfs. Any amount above that coming into the reservoir will cause the reservoir to fill and then spill.

If you have any questions about the hatchery call (530) 475-3420 (Monday - Friday: 7:00 AM to 3:30 PM).

7/2010

Male steelhead and salmon change colors during spawning season, as depicted below.



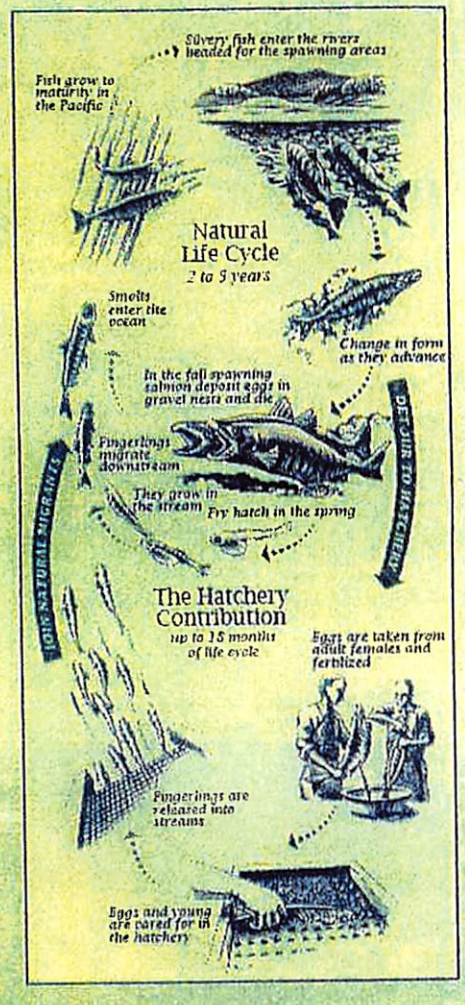


Coho (Silver) Salmon
Oncorhynchus kisutch

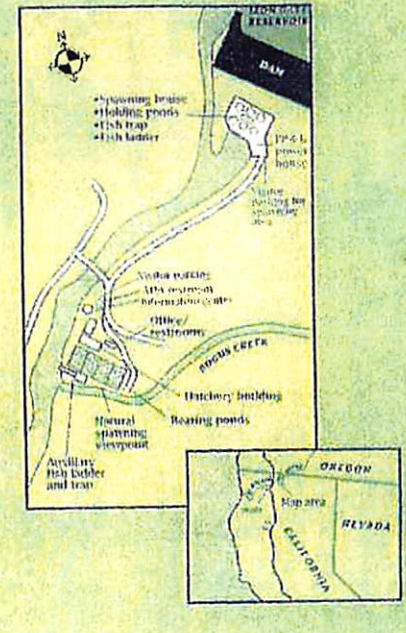


Chinook (King) Salmon
Oncorhynchus tshawytscha

Fish images copyright Windsor Nature Discovery
800-635-4194



Iron Gate Hatchery
8638 Lakeview Road
Hornbrook, California 96044

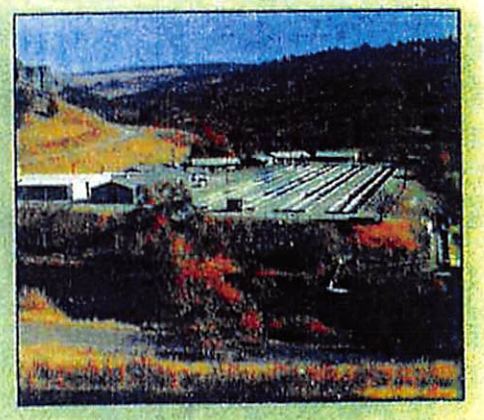


Iron Gate Hatchery is open to the public year-round. Visiting hours are 7 a.m. to dusk, seven days a week. October and early November are best for viewing.

Built by
Pacific Power and Light Company

Operated by
California Department of Fish and Game

Alternate communication methods are available upon request. If reasonable accommodation is needed, contact the Department of Fish and Game at (916) 653-6420 or the California Relay Service serving the deaf or hearing impaired from TDD phones at 1-800-735-2929.

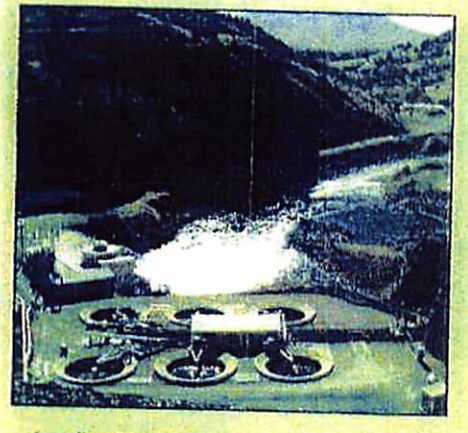


Iron Gate Hatchery









Iron Gate Hatchery is located on the Klamath River near Hornbrook, California. The hatchery, just downstream of Iron Gate Dam, was built in 1966 by Pacific Power as fulfillment of federal license requirements. Pacific Power continues to fund 80 percent of the operations and maintenance of the hatchery.

Iron Gate Hatchery spawns and rears three kinds of fish: chinook (king) salmon, coho (silver) salmon, and steelhead trout. All three species are *anadromous*, meaning the fish spend most of their lifetime in the ocean and swim up fresh water streams to spawn. Salmon die after spawning, but some steelhead return to spawn again.

The hatchery's goal is to raise about 6 million chinook per year. Five million chinook fingerlings are released in the spring and the remaining one million are released in the fall as yearlings. In addition, the hatchery produces 200,000 steelhead and 75,000 coho yearlings.



When they reach the hatchery, fish swim up the fish ladders toward the spawning facility, providing a spectacular sight for visitors.

The returning adult salmon make a 190-mile trip from the ocean to the hatchery. When they reach the hatchery site, fish enter either the 300-foot long fish ladder at the spawning facility below the dam or the smaller ladder and trap at the hatchery. Adults are held in circular holding tanks below the dam until they are ready for spawning.

Some fish enter Bogus Creek, which borders the south end of the hatchery, and spawn naturally in the creek. A viewing site on the north bank of Bogus Creek allows visitors a glimpse of these naturally spawning fish.

The hatchery contains eight standard concrete raceways, 400 feet long, for rearing fish; a hatchery building; an office; and four employee residences. The hatchery building houses 117 stacks of vertical, flow incubators with each stack having the ability to hold about 100,000 – 120,000 eggs. The eggs are collected in the fall and winter, and take approximately 40 to 60 days to incubate. The fry subsist on their own yolk sacs for about four weeks prior to feeding.

Fish are then placed in tanks or raceways and are fed various fish feeds until they are released into the Klamath River.

Iron Gate Hatchery contributes to commercial, sport and tribal fisheries in Northern California and Southern Oregon.

The Hatchery Cycle



1. Eggs are removed from the females and fertilized.



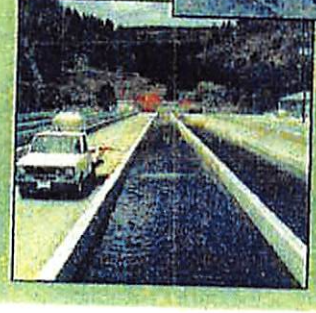
2. Eggs are checked for size and placed into incubation trays.



3. During the 40-60 day incubation period, a continuous supply of fresh water flows through the hatchery building.



4. Small fish, called fry, are moved from the hatchery building to the outdoor raceways.



5. Fry are fed a variety of fish food until they are ready to be released into the Klamath River.



6. Once released, the fish grow to a catchable size to provide recreation and food for California anglers.

Frank Tallerico

From: rgierak2 [rgierak2@hughes.net]
Sent: Tuesday, July 19, 2011 5:22 PM
To: Frank Tallerico
Subject: Fw: Possible lawsuit against CA ESA, NMFS & USF&WS
Sent: Saturday, July 16, 2011 5:52 PM
Subject: Fw: Possible lawsuit against CA ESA, NMFS & USF&WS

PETITION TO DELIST
Coho Salmon (Oncorhynchus kisutch)
Nomination for Delisting of a Taxon of Flora or Fauna (Endangered Species Act 1973)

Presented By
Siskiyou County Water Users Association



347 N. Main St.

Yreka, Ca. 96097

530 842-4400

Prepared By

Dr. Richard A. Gierak

Bachelors Degrees in Biology & Chemistry, Doctorate in the Healing Arts, Director of Interactive Citizens United, Director of New Frontiers Institute, Inc. Prior Participant of FERC and FPAT (Fish passage advisory team) and HET (Hatchery evaluation team) Prior Vice President of Greenhorn Action Grange, Prior California State Grange Spokesman for the Water Committee, Prior National Whip of the Property Rights Congress of America, Representative of the Grange States of California, Oregon, Washington and Idaho regarding EFH regulations, Science consultant to Siskiyou County Water Users Association.

Statement identifying the taxon

Coho Salmon, Silver Salmon, Oncorhynchus kisutch...a salmonid which is a vertebrate fish

Reasons for nominating the taxon for delisting

This petition refers to the listing of Coho Salmon in the Klamath Basin including the Klamath River, Trinity River and associated waterways that empty into the Klamath River.

Known distribution of the taxon.

Occupies the entire Pacific Coastal region is herein challenged. This petition specifically refers to Northern California and the present listing of Coho Salmon as endangered under the California Endangered Species Act on the Klamath River and the proposed Federal ESA listing of Coho Salmon..

Known threats which may affect the taxa.

Nature--Estuarine destruction--predation--over fishing--by catch--Ocean temperature--Climatic

changes

Endangered Species Act of 1973

There is no provision for listing a species that is not indigenous to the ESU. To this date there is no historical evidence indicating that Coho Salmon were ever indigenous to the Klamath Basin.

In 2001, Not one person on the Karuk Tribal Council believed that Coho salmon were native to the Klamath River.

Within the Tribe's jurisdiction between Bluff Creek and Clear Creek on the California portion of the Klamath River, which is approximately between 91 and 140 miles below the lowest slated dam, Iron Gate, for removal this statement is reflected for example, in the **minutes of the Karuk Tribal Council Meeting of December 27, 2001:** Discussion was held by the Tribal Council and whether or not they [Coho] were ever present in the main streams and tributaries… …"Council states it may be **easier to prove the Coho were never present**", and also the comment was made that if they were never here, then **"they should not be encouraged to come back.**". The tribe named the river the Klamath, which translated means "Stinky River" and would not support salmon. http://www.savethedams.com/?page_id=350

Karuk tribal history dates back to 1700 when there were an estimated 2,700 members present and there is no mention of Coho or Silver Salmon prior to plantings in 1895 and 1899.

http://www.fourdir.com/karuk.htm

1913 California Fish and Game Commission Report

(CFGC 1913) , W. H. Shebley, Superintendent of Hatcheries, writes "Strange as it may appear, the presence of the silver [Coho] salmon in the waters of this State remained unnoticed until Dr. Gilbert, Prof. of Zoology at Stanford University, a few seasons ago called attention to them. Heretofore, all the salmon taken in our rivers have been commercially classed as Quinnat [chinook]". Any reported Coho were as a result of plantings in the Klamath River in 1895 and 1899. "Most of the salmon and steelhead eggs were taken at the [Redwood Creek] substation, as there was **no run of either kind of Salmon in the Trinity River".**
http://www.dfg.ca.gov/fish/documents/SAL_SH/SAL_Coho_StatusNorth_2002/SAL_Coho_StatusNorth_2002_D.pdf

Records from History as stated by CA Department of Fish &Game:

Quotes; "The earliest record of Coho salmon being stocked in the Klamath Basin was of a plant made in 1895. Further examination of the original records from the U.S. Commission on Fish and Fisheries (1895) revealed those fish were raised in the Ft. Gaston facility in Hoopa and were stocked in the Trinity River and in Supply Creek, a tributary to the Trinity River. Those fish were reared from eggs taken at a facility in **Redwood Creek**… and also from eggs shipped from another **facility not identified** in the report (but were likely from **out of the basin**)."

http://www.dfg.ca.gov/fish/documents/SAL_SH/SAL_Coho_StatusNorth_2002/SAL_Coho_StatusNorth_2002_D.pdf

Coho Salmon were not native

Dr. Ken Gobalet Professor of Biology Ph.D. California State University, Bakersfield

"The rarity of salmonids in archaeological materials suggests that the ethnographic record overstated the importance of salmonids to the Native Americans of California

No salmon remains of any kind were found south of San Francisco. Chinook salmon were the most abundant salmonid in the Sacramento River drainage. **No salmonids were found in the archaeological record in the San Joaquin River** drainage south of San Joaquin County."

http://www.informaworld.com/smpp/content~db=all~content=a932170617

Dr. Gobalet performed the research on the San Lorenzo River in Santa Cruz and his archeaological evidence (ie

excavation of middens at village sites) that proved that Coho were not native to the Lorenzo river. It has been ignored by the agencies....but it has not been used as evidence in a court case....yet The study only applies south of Pescadero Creek. He was hired to do more work down here and **found no Coho Salmon remains**.
http://www.naturalprocess.net/np_pages/coho.html

Historical Coho sightings in Californaia

"Coho were recorded in 1936 and 1981 from streams in northern San Francisco Bay (Marin County) (Brown and Moyle 1991)".(Peter Moyle is a warm water inland fish person, not an anadromous trained or studied person) This was most likely as a result of multiple plantings in California Rivers by Fish and Game with the earliest plantings in 1895 and 1899 followed by massive plantings in the 1960's and 1980's. "Historically, Coho were reported from streams as far south as the Santa Ynez River (Santa Barbara County) (Bryant 1994)", Once again these are most likely as a result of the massive plantings in the 1960's and 1980's in Northern California. "With respect to the San Francisco Bay, no Coho populations are known to spawn in streams emptying into the bay. Although there are no historical records indicating spawning populations on the bayside of San Mateo County, Coho were recorded in 1936 and 1981 from streams in northern San Francisco Bay (Marin County) (Brown and Moyle 1991)". Plantings of Coho in Northern California rivers in 1895, 1899 and the 1960's and 1980's are indicative of the source of these recorded sightings considering their genetic signature is that of Coho Salmon from Cascadia, Oregon.

http://www.cfses.org/salmonid/html/salmonid/population.htm

FINAL Report_Coho Salmon-Steelhead_Klamath Expert Panels_04 25 11

http://www.dfg.ca.gov/fish/documents/SAL_SH/SAL_Coho_StatusNorth_2002/SAL_Coho_StatusNorth_2002_D.pdf

Genetic Analysis of Hatchery vs. Natural Salmon

The initial statement regarding the controversy between "natural" and "hatchery" fish was made in a report by Busack and Currens in 1995, wherein they stated, "Interbreeding with hatchery fish might reduce fitness and productivity of a natural population", and picked up by noted Ecologist Dr. Richard Primack and many Environmental Radicals and utilized in a listing petition for Cutthroat Trout in the Colorado River. Mr. Michael Rode of the California Department of Fish and Game at a Hatchery Evaluation meeting on September 19, 2002 at Iron Gate Hatchery disclosed that less than a 2% genetic survey has been taken to date and **no genetic differences have been noted between "hatchery" or "natural" Coho Salmon**. A 2011 report by the Expert Panel indicated that their genetic analysis indicated the Salmon in Northern California were from Cascadia, Oregon plantings.

California Fish & Game "Finfish and Shellfish Identification Book" published in December 2006 does NOT list Coho Salmon as being present in California waters.

Expert Science Panel 4-25-2011

"Weitkamp et al. (1995) suggested that natural origin Coho production in the SONCC ESU may not be currently sustainable. Further reduction in survival at sea in response to climate shifts has the potential to offset potential improvements in the freshwater environment, or it could cause further reductions or even extinction of natural origin Coho populations that are presently threatened with extinction."

It is also to be noted that upon genetic analysis of the Coho Salmon in the Klamath Basin appears to be from plantings from Cascadia, Oregon. This statement also verifies the statement that Coho Salmon were never indigenous to the Klamath Basin. "The final expert report on Coho and steelhead appears to indicate that the extinction of the Coho Salmon looks like it cannot be avoided. It does not appear that it is resource users (timber, farming, mining,) in the mid-Klamath is the reason, but is instead Ocean and climatic conditions."

FINAL Report_Coho Salmon-Steelhead_Klamath Expert Panels_04 25 11

Quote from 2009 Water Quality Klamath TMDL scoping comment responses -
"The Regional Water Board can not establish life cycle-based water quality objectives for the mainstem Klamath River because the DO concentrations associated with salmonid life cycle requirements **can not be met even under natural**

conditions- conditions in which there are no anthropogenic influences. As such, the Regional Water Board staff has proposed water quality objectives that protect natural DO conditions from further degradation."

1800's Explorers comments

Explorers noted when first visiting the Upper Klamath Basin that water quality was so undesirable that even their riding horses and pack animals would not drink let alone support salmon populations.

Summation:

Based on evidence presented in this petition Coho Salmon were never indigenous to the Klamath River and the listing of Coho Salmon by California ESA and Federal ESA should be considered unlawful, arbitrary and capricious. Concluding that Coho Salmon were not indigenous there is no provision in the Endangered Species Act to list a non-native species.

Respectfully Submitted;

Leo Bergeron

SCWUA President

PETITION TO DELIST
Coho Salmon (Oncorhynchus kisutch)
Nomination for Delisting of a Taxon of Flora or Fauna
(Endangered Species Act 1973)

Presented By
Siskiyou County Water Users Association





PRESS RELEASE

June 23, 2011

Siskiyou County Water Users Association has submitted a second Coho delisting petition to delist Coho Salmon in the Klamath Basin based on the following parameters.

1. There is no historical evidence that Coho Salmon were ever indigenous to the Klamath Basin.

http://www.dfg.ca.gov/fish/documents/SAL_SH/SAL_Coho_StatusNorth_2002/SAL_Coho_StatusNorth_2002_D.pdf

http://www.informaworld.com/smpp/content~db=all~content=a932170617

http://www.naturalprocess.net/np_pages/coho.html

http://www.cfses.org/salmonid/html/salmonid/population.htm

FINAL Report_Coho Salmon-Steelhead_Klamath Expert Panels_04 25 11

2. The Karuk tribal Council meeting of Dec. 27, 2001 indicated that Coho Salmon were never in the Klamath River and they should not try to bring them back.

http://www.savethedams.com/?page_id=350

3. In a 1913 California Fish & Game Commission report indicated there were no run of either kind of Salmon in the Trinity River even after Coho were planted in 1895 and 1899.

4. There is no provision in the Federal Endangered Species Act for listing a non- indigenous species.

http://www.nmfs.noaa.gov/pr/laws/esa/text.htm

5. California ESA and NMFS are in violation of the Endangered Species Act by listing Coho Salmon which is unlawful, arbitrary and capricious.

6. U.S. Fish & Wildlife service are in violation of their mandates which are restricted to freshwater species only. By being involved in the KBRA and KHSA regarding a saltwater species, ie: Salmon, their actions are unlawful, arbitrary and capricious.

http://www.fws.gov/endangered/

7. Based on these historical records and the violation of the Federal Endangered Species Act Coho Salmon must be removed from the endangered list in California.

Respectfully submitted;

Leo Bergeron

SCWUA president

Frank Tallerico

From: rgierak2 [rgierak2@hughes.net]
Sent: Tuesday, July 19, 2011 5:30 PM
To: Frank Tallerico
Subject: Fw: ESA, Historical & Ocean

Subject: ESA, Historical & Ocean
Frank: These are the latest condensed version of the above topics with graphs.

Re: Coho Salmon in the Klamath Basin and Commercial Fisheries in the Pacific Northwest

1. There is no historical evidence that Coho Salmon were ever indigenous to the Klamath Basin.

http://www.dfg.ca.gov/fish/documents/SAL_SH/SAL_Coho_StatusNorth_2002/SAL_Coho_Stat

http://www.informaworld.com/smpp/content~db=all~content=a932170617

http://www.naturalprocess.net/np_pages/coho.html

http://www.cfses.org/salmonid/html/salmonid/population.htm

FINAL Report_Coho Salmon-Steelhead_Klamath Expert Panels_04 25 11

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6. U.S. Fish & Wildlife service are in violation of their mandates which are restricted to freshwater species only. By being involved in the KBRA and KHSA regarding a saltwater species, ie: Salmon, their actions are unlawful, arbitrary and capricious.

http://www.fws.gov/endangered/

7. Based on data from NOAA, NMFS, NASA, WEBECS, UK Pacific Ocean Temperatures have driven cold water Salmon North into Alaskan waters.

http://www.google.com/search?
q=history+of+pacific+ocean+temperature&hl=en&prmd=ivns&sa=X&ei=sCYiTp6ZLIe2sAOx9Q9&ved=0CDwQpQI&tbm=&tbs=tl:1,tlul:1950,tluh:2010

http://earthobservatory.nasa.gov/Features/OceanCooling/page4.php

8. NMFS and NOAA data indicate that Commercial Salmon fisheries in the Pacific Northwest are 273% better today than it was in 1950 due to dams and hatcheries.

http://www.st.nmfs.noaa.gov/st1/commercial/landings/annual_landings.html

9. Dams and hatcheries are not the cause of Salmon decline in California and Oregon waters. In 1950 the total catch of Salmon in the Pacific Northwest was 149,000 metric tons with 80 % caught in Alaskan waters and in 2007 the total catch was 403,000 metric tons with 97% caught in Alaskan waters.

http://www.st.nmfs.noaa.gov/st1/commercial/landings/annual_landings.html

Based on these historical records and the violation of the Federal Endangered Species Act Coho Salmon must be removed from the endangered list in California.

Respectfully submitted;

Dr. Richard A. Gierak

Planetary Changes Noted



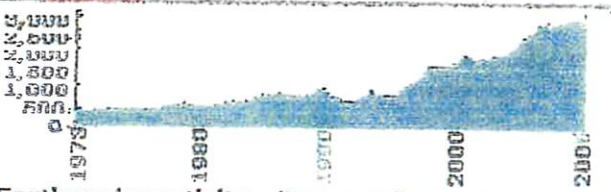
Pacific Ocean Temperature

http://www.google.com/#q=history+of+pacific+ocean+temperature&hl=en&sa=X&tbo=p&tbs=tl:1,tll:1950,tlh:1999&ei=XQL7S-zVJcL68AaJkPXXCg&oi=timeline_histogram_main&ct=timeline-histogram&cd=10&ved=0CGwQyQEoCg&fp=244bc79c41741c3



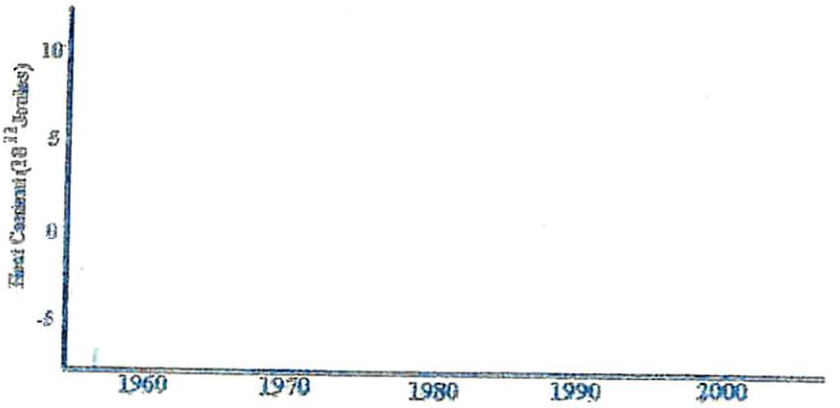
Volcanic activity in the Pacific Ring of Fire

http://www.google.com/search?q=volconic+history+of+eruptions+in+the+ring+of+fire&hl=en&sa=X&ei=K4PYTKWHHI7WtQPH4I8NCw&ved=0CGQQpQI&tbs=tl:1,tll:1700,tlh:2010



All Planetary Earthquake activity (Increased sensors add to increase)

http://www.earth.webecs.co.uk/



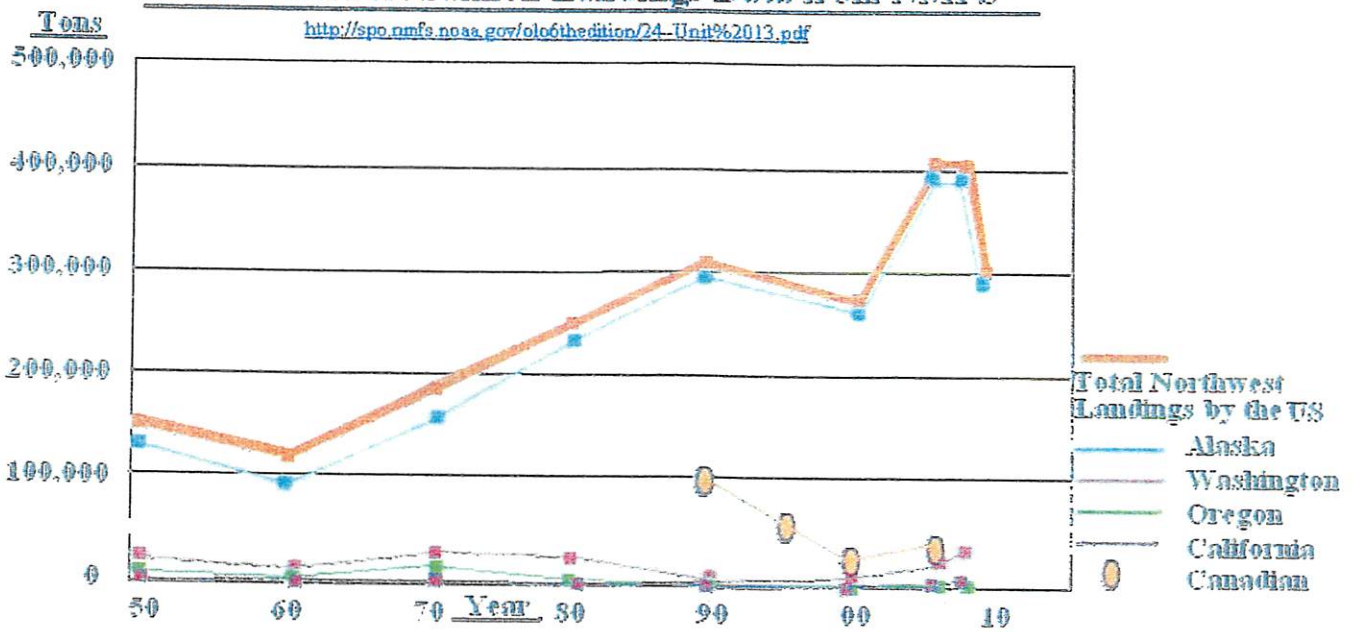
Heat Content of the Pacific Ocean

http://earthobservatory.nasa.gov/Features/OceanCooling/page4.php

Prepared by Dr. Richard Gierak 11-19-2010

U.S. Northwest Salmon Landings Data from NMFS

http://spo.nmfs.noaa.gov/olo6thedition/24-Unit%2013.pdf



NOTE: It is of interest to note that the largest landing of Salmon occurred in the year 2005 with over 400,000 tons. Compare that with the 1950 value of only 149,071 tons. That is an increase of a 273% increase in total Salmon catch. The decrease in 2008 to 300,000 tons is still a 201% increase over the 1950 value. We must assume from looking at the data that our Salmon fisheries are in great shape even though the landings in Oregon and California have dropped significantly. The overall Salmon landings are still healthy and would corroborate that Pacific Ocean warming has driven the Salmon North. It is apparent from NMFS data that landings in Oregon, California and Washington are but of small importance.

Of most importance is to note that increase in Pacific Ocean temperature has driven Salmon North as evidenced by the landing data.

Frank Tallerico

From: rgierak2 [rgierak2@hughes.net]
Sent: Tuesday, July 19, 2011 5:51 PM
To: Frank Tallerico
Subject: chinook halt listing

Frank;
This is the Halt Chinook Listing and associated press release. If you would like anything else feel free to ask.
Have fun.
Doc

Petition To Halt Listing Upper Klamath Chinook Salmon (Oncorhynchus Tshawytscha) As a Threatened Or Endangered Species



Prepared By
Siskiyou County Water Users Association



530 842-4400

May 18, 2011

Statement identifying the taxon

Chinook salmon, *O. tshawytscha* is an anadromous salmonid, the National Marine Fisheries Service has jurisdiction over this petition. Petitioner files this petition pursuant to § 553(e) of the Administrative Procedure Act ("APA"), 5 U.S.C. §§ 551-559 and § 1533(b)(3) of the Endangered Species Act, and 50 C.F.R. part 424.14, which grant interested party the right to petition for removal of a rule. This petition sets in motion a specific administrative process as defined by § 1533(b)(3) and 50 C.F.R. § 424.14(b), placing mandatory response requirements on the National Marine Fisheries Service.

Petitioner also requests the removal of future critical habitat for Upper Klamath-Trinity Rivers The spring run component of the Upper Klamath-Trinity Rivers ESU has seen dramatic declines from historic levels and is in danger of becoming extinct in the foreseeable future should hatcheries and dams be removed. Most known spring run populations have been extirpated and the few runs that do still exist have undergone severe declines as a result of historic rise in the temperature of the Pacific Ocean driving these cold water fish North into Alaskan waters. In the past 25 years, wild fish have consistently returned at much lower numbers and only when hatchery fish are included do numbers approach historical estimates in some years. However, Salmon and steelhead hatcheries have historically had the twin goals of (1) helping to recover and conserve Natural spawning populations, and (2) supporting sustainable commercial, recreational, subsistence, and ceremonial fisheries. Most hatcheries in the Pacific Northwest and Alaska have been operating for many decades and have generally been very successful in producing fish for harvest and compensating for declines in wild salmon populations. Hatcheries are critical to maintaining future recreational and commercial fishing in the Pacific Ocean and in meeting Treaty harvest obligations. Like it or not, hatchery populations now comprise a major component of Pacific salmon/steelhead species gene pools. This year (2001) for example, 60-80% of salmon that will be harvested originated in state, federal, and Tribal hatcheries. Given the additional 20-40 million in human population growth predicted for the Pacific Northwest in coming decades, it is almost certain that the downward trend in purely wild salmon populations will continue. For example, the east coast of the US, Europe, China, Japan, and Korea formerly supported large populations of purely wild salmon. They no longer do so and it is unlikely they will ever do so again (Lackey, 2001). At the present time, hatchery runs are thriving and must not be destroyed.

Historical habitat for Fall Chinook Salmon

Native tribes and environmental NGO's have claimed that prior to the dams on the Klamath river there were millions of Salmon that spawned in the river. However, the reality based on Division of Fish & Game 1930 report, fish bulletin #34, the total number of Salmon on the Klamath totaled between 30,000 and 45,000 prior to the dams being installed. After the dams the numbers went up to between 45,000 and 90,000 fish. They seem to forget that in a dry summer the Klamath River turned into swamps and marshes and could not support any kind of Salmon run.

Historically Chinook Salmon on the Klamath River sported a Spring Run and in wet years a Fall Run. Before the dams were built, during a dry summer, there would be no water for a Fall Run of Salmon and with the building of the dams there is now a significant Fall Run due to the storage of water behind the dams. It is clear that since 1950 the actual tonnage of Salmon off the California Coast has been rather

level through 2000.

Genetic analysis of wild vs. hatchery salmon

Not only did today's hatchery salmon originate from the eggs and sperm of naturally reproducing salmon populations, hatchery produced fish have been thriving and returning to Pacific Northwest Rivers in unprecedented numbers. Unfortunately, these same hatchery fish are now being labeled genetically inferior, hunted down and clubbed, and their eggs sold as fish bait. There is a very real danger that present anti-hatchery policies will, if pursued, reduce salmon/steelhead populations to the point that there will be no significant recreational or commercial fishing for decades to come. In addition, the deliberate destruction of these hatchery populations by natural resource management agencies may actually be destroying genetic material needed for the continued health of salmon populations in general. Once genetic material is lost from a species gene pool, it can never be recovered. The populations of some remaining "wild" fish are now so small that their genetic diversity has been reduced to the point that they may be unable to grow sufficiently without an infusion of genetic material from hatchery fish.

In 2002 there was a serious fish kill of 33,000 salmon on the lower Klamath River. Environmentalists sounded the alarm that the toxic algae above the hydroelectric dams was responsible for the kill. Indian tribes raised the cry that warm water and lower flows were the primary cause of the kill. Fish & Game did not sample the waters until a week after the kill was complete. As a result of the environmental alarm of toxic algae in the reservoirs above the hydro dams the lakes were posted as toxic and the public was warned. Because of this action it was deemed that the dams had to be removed to protect people and the Salmon runs and thus the cry to remove dams and hatcheries were born. A Center For Disease Control study was initiated in 2009 and the waters in the reservoirs found no health related detrimental evidence.

Of primary importance was the Fish & Game report published in 2003 which indicated the following: ***"The DFG concludes that low flows and other flow related factors (eg; fish passage and fish density) caused of the 2002 fish kill on the lower Klamath River. Furthermore, of the conditions that can cause or exacerbate a fish kill, flow is the only factor that can be controlled to any degree. Flow is regulated by upstream reservoirs operated by the USBR on both the Klamath and Trinity Rivers." "Fish and Game also determined that the floods of 1997 and 1998 caused deposition of material in the lower Klamath that reduced the depth for returning Salmon. In addition to this factor the Trinity River had 70% of its waters diverted to Southern California thereby reducing not only the depth of the river but the increase in the temperature of the Klamath River."***

The Hoopa tribe water/boat celebration called for a pulse flow into the river system which decoyed the Salmon into the river system and the flows were then decreased leading to low flow conditions trapping Salmon in a narrow part of the river with shallow water and increased temperatures.

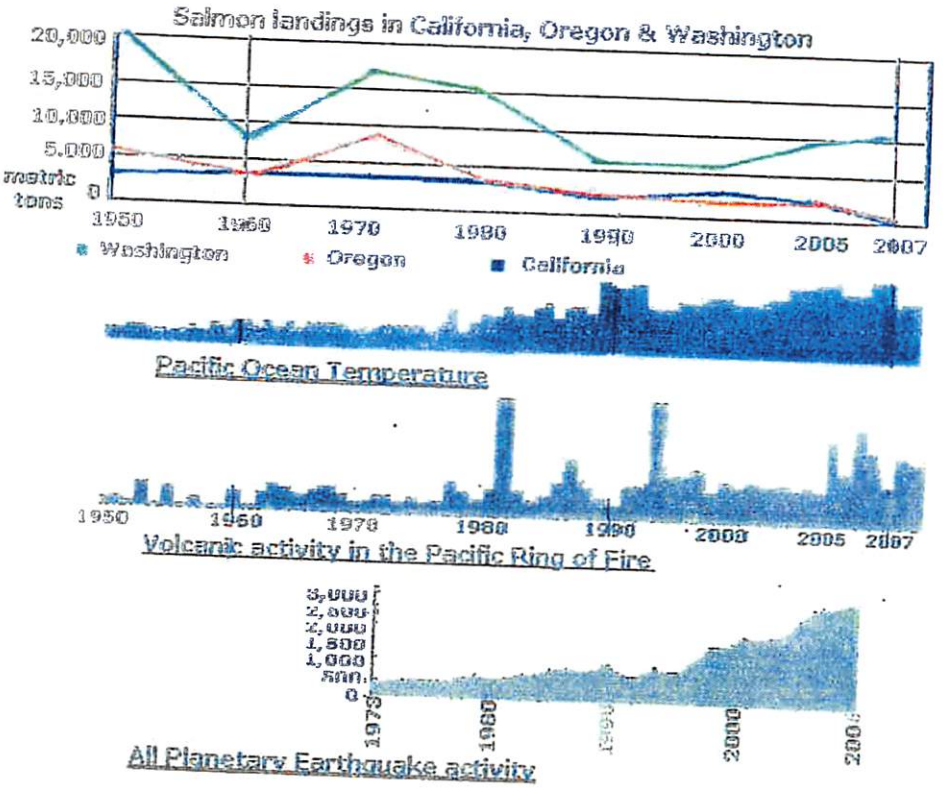
The initial statement regarding the controversy between "natural" and "hatchery" fish was made in a report by Busack and Currens in 1995, wherein they stated, "Interbreeding with hatchery fish might reduce fitness and productivity of a natural population", and picked up by noted Ecologist Dr. Richard Primack and many Environmental Radicals and utilized in a listing petition for Cutthroat Trout in the Colorado River. According to Mr. Michael Rode of the California Department of Fish and Game at a Hatchery Evaluation meeting on September 19 at Iron Gate Hatchery disclosed that less than a 2% genetic survey has been taken to date and no genetic differences have been noted between "hatchery" or "natural" Salmon. It should be noted that the NMFS listing of Coho Salmon in Northern California and Southern Oregon in 1997, (Federal Register: May 6, 1997 (Volume 62, Number 87, 50 CFR Part 227 [Docket No. 950407093-6298-03; I.D. 012595A]) Page 24588-24609) utilized the same data as in the coastal Oregon Coho listing. This listing also distinguishes "natural coho" from "hatchery coho" and they did not count "hatchery coho" even though there is no biological distinction between the two. Therefore, any listing affecting Northern California and Southern Oregon is also unlawful and should be set aside as arbitrary and capricious.

Recently an Appeal Court has set aside the 2001 ruling of the ninth District where the listing affecting Northern California and Southern Oregon Salmon is that "naturally spawned" and "hatchery spawned" argument for listing Oregon coastal Coho salmon The NMFS listing decision, contained at 63 Federal Register 42,587, is declared unlawful and set aside as arbitrary and capricious. United States District Judge, Michael R. Hogan stated the NMFS listing decision was arbitrary and capricious and thus unlawful under the Administrative Procedures Act 5 U.S.C. 706.

Understanding Salmon reduction in California Waters

In an attempt to understand the movement of commercial Salmon into Alaskan waters research found that there has been a historic rise in temperature of the Pacific Ocean which directly correlates with the historic increased activity in the Ring of Fire volcanoes. Since 1980 97% of all commercial Salmon in the Pacific Northwest have been caught in Alaskan waters. Although California, Oregon and Washington commercial fisheries are suffering there is scientific evidence that the Pacific Ocean temperature increase is the primary cause. In 1950 the total catch of all Salmon species in the Pacific Northwest totaled 149,000 metric tons with 80% caught in Alaskan waters. In 2007 the total catch in the Pacific Northwest was 403,000 metric tons with 97% caught in Alaskan waters. This scientific data clearly demonstrates that the commercial Salmon industry is in better shape than it has ever been. However, due to severe reduced landings of Chinook Salmon in California, Oregon and Washington have nothing to do with conditions on the Klamath River and its tributaries, but, is a direct result of the historic rise in Pacific Ocean temperatures.

Causative Factors in Salmon Decline



Prepared by Dr. Richard Glerak 11-19-2010

Pacific Ocean Temperature

http://www.google.com/search?q=history+of+pacific+ocean+temperature&hl=en&prmd=ivns&sa=X&ei=D_N3TbhSg4KxA7b61ccE&ved=0CHAQpQI&tbm=&tbs=tl:1,tlul:1970,tluh:2010

Pacific Northwest Salmon landings. http://www.st.nmfs.noaa.gov/st1/commercial/landings/annual_landings.html

Summary

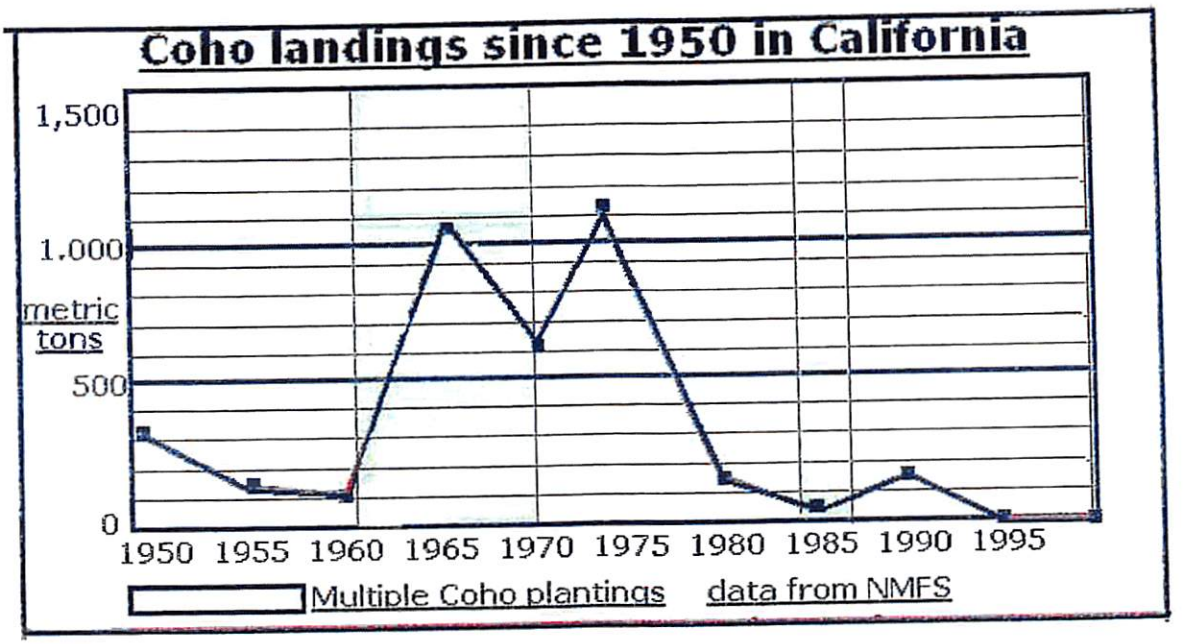
At this time NMFS and NOAA Fisheries has identified 17 evolutionarily significant units (ESUs) of Chinook salmon in Washington, Oregon, Idaho and California. Each ESU is treated as a separate species under the Endangered Species Act. Click the link below to get information about a specific ESU, its status, and other relevant information. Southern Oregon and Northern California Coastal in addition to the Upper Klamath and Trinity River ESU's are listed as NOT WARRENTED.

NMFS/NOAA data

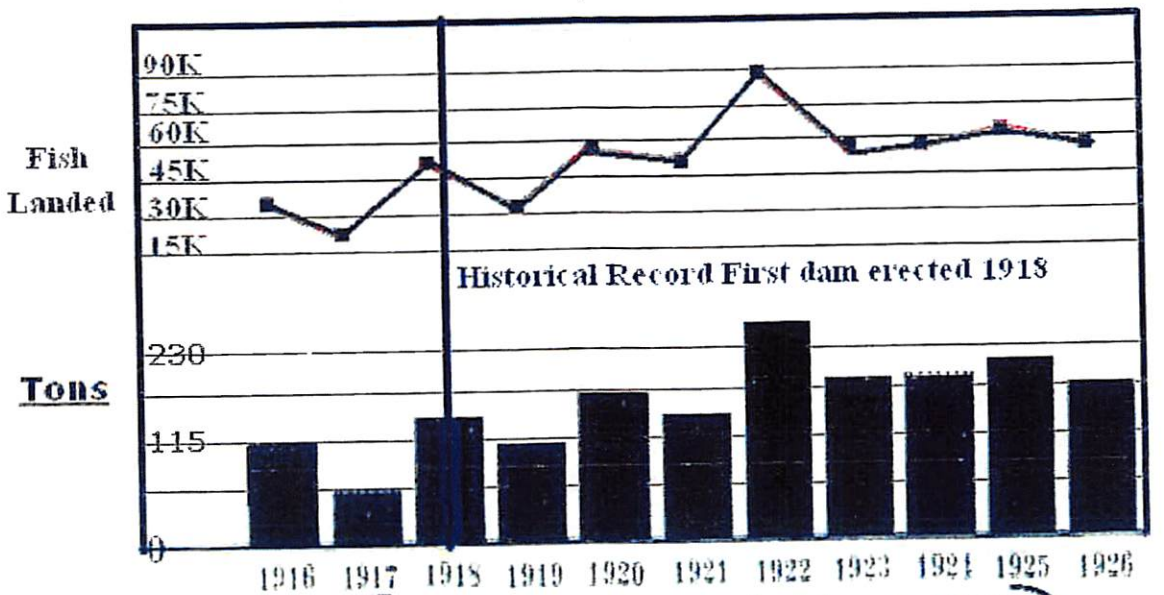
http://www.nwr.noaa.gov/ESA-Salmon-Listings/Salmon-Populations/Chinook/

Not only did today's hatchery salmon originate from the eggs and sperm of naturally reproducing salmon populations, hatchery produced fish have been thriving and returning to Pacific Northwest Rivers in unprecedented numbers. Unfortunately, these same hatchery fish are now being labeled genetically inferior, hunted down and clubbed, and their eggs sold as fish bait. There is a very real danger that present anti-hatchery policies will, if pursued, reduce salmon/steelhead populations to the point that there will be no significant recreational or commercial fishing for decades to come. In addition, the deliberate destruction of these hatchery populations by natural resource management agencies may actually be destroying genetic material needed for the continued health of salmon populations in general. Once genetic material is lost from a species gene pool, it can never be recovered. The populations of some remaining "wild" fish are now so small that their genetic diversity has been reduced to the point that they may be unable to grow sufficiently without an infusion of genetic material from hatchery fish. Listing Chinook in these ESU's is unwarranted and will not restore Chinook Salmon.

The year (2001) for example, 60-80% of salmon that will be harvested originated in state, federal, and Tribal hatcheries. Given the additional 20-40



Klamath History of Salmon Landings

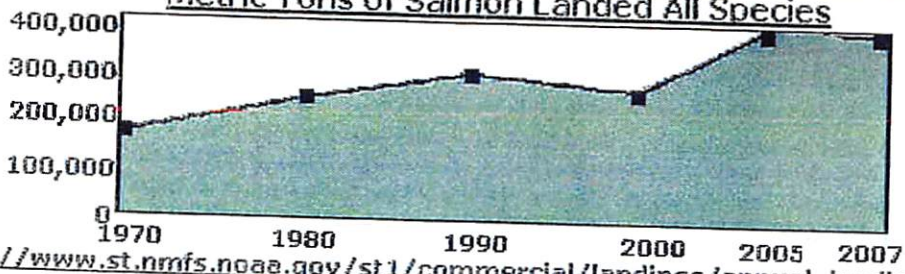


Fish caught numbers are based on an average of 14= per fish as per the 1930 Snyder report

http://content.cdlib.org/xtf/view?docId=kt538nb0tr&brand=calisphere&doc.view=entire_text

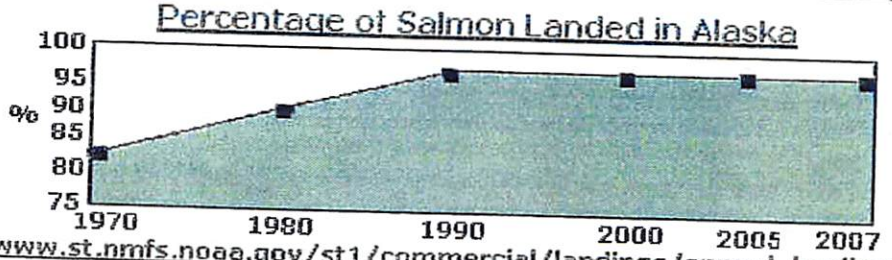
Division of Fish & Game 1930 Report
Fish Bulletin #34
The Salmon and the fishery of the Klamath River

Metric Tons of Salmon Landed All Species



http://www.st.nmfs.noaa.gov/st1/commercial/landings/annual_landings.html

Percentage of Salmon Landed in Alaska



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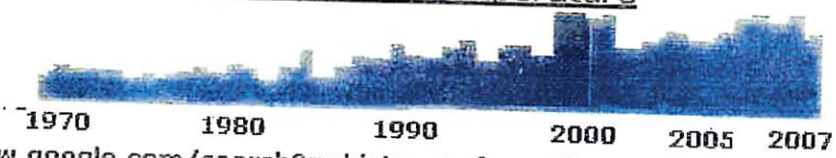
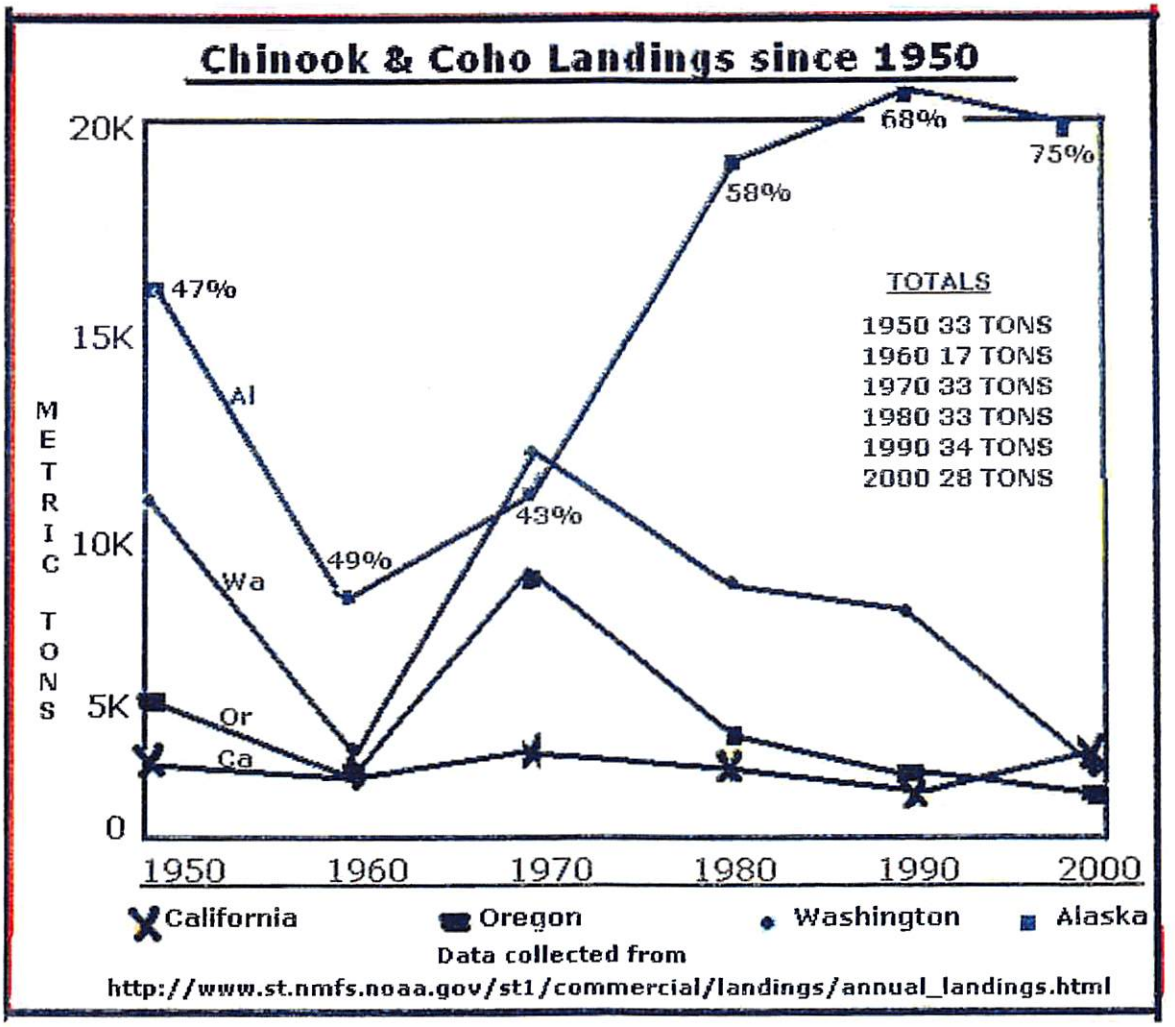
Pacific Ocean Temperature



http://www.google.com/search?q=history+of+pacific+ocean+temperature&hl=en&prmd=ivns&sa=X&ei=v5shTfjaLpKmsOPA6pTxAQ&ved=0CHoQpQI&tbs=tl:1,tlul:1970,tluh:2010


Chinook & Coho Landings since 1950
20K
15K
10K
5K
0
METRIC TONS
1950
1960
1970
1980
1990
2000
47%
49%
43%
58%
68%
75%
Al
Wa
Or
Ca
TOTALS
1950 33 TONS
1960 17 TONS
1970 33 TONS
1980 33 TONS
1990 34 TONS
2000 28 TONS
California
Oregon
Washington
Alaska
Data collected from
http://www.st.nmfs.noaa.gov/st1/commercial/landings/annual_landings.html

million in human population growth predicted for the Pacific Northwest in coming decades, it is almost certain that the downward trend in purely wild salmon populations will continue. For example, the east coast of the US, Europe, China, Japan, and Korea formerly supported large populations of purely wild salmon. They no longer do so and it is unlikely they will ever do so again (Lackey, 2001).

http://www.propertyrightsresearch.org/role_o.htm

Respectfully submitted;

SCWUA President;

Leo Bergeron

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Siskiyou County Water Users Association
Yreka, California

Re: Removal of hydroelectric dams on the Klamath River in Northern California to restore Salmon fisheries.

Are commercial fisheries in the pacific northwest in serious trouble?? Will removal of hydroelectric dams restore salmon fisheries?? These are the questions being asked about the dams on the Klamath River River. An opinion by National Marine Fisheries Service states clearly that removing dams on the Snake River will not help in restoring salmon. As to the dams on the Klamath River, radical environmental NGO's, tribal governments, commercial fisherman and governmental agencies believe that this action by the Klamath Basin Restoration Agreement and the **Klamath Hydroelectric Settlement Agreement "may" restore salmon runs.**

This presentation will investigate the reality of Salmon Fisheries in the Pacific Northwest. The primary premise for removing four dams on the Klamath River is to restore Salmon Fisheries. In 2002 there was a serious fish kill in the lower Klamath River that was attributed to toxic algae from the reservoirs above the dams. **A Center For Disease Control study was initiated and the waters in the reservoirs were deemed non-toxic.**

Recreational exposure to microcystins during algal blooms in two California lakes
Lorraine C. Backer a,*, Sandra V. McNeel b, Terry Barber c, Barbara Kirkpatrick d, Christopher Williams e, Mitch Irvin f, Yue Zhou f, Trisha B. Johnson g, Kate Nuremberg d, Mark Aubel e, Rebecca LePrell a, Andrew Chapman e, Amanda Foss e, Susan Corum h, Vincent R. Hill g, Stephanie M. Kieszak a, Yung-Sung Cheng Received 8 April 2009 Received in revised form 26 June 2009 Accepted 6 July 2009

It is of interest to note that Fish & Game did not sample the waters during the fish kill, but, waited over a week before sampling. Del Norte, Humboldt and Siskiyou County Sheriffs Departments in addition to the California Conservation Corps believed that the kill was caused by a metamphetamine dump into a stream which emptied into the Klamath.

FERC analysis of proposed re-licensing of Dams on the Klamath River

In their final report in 2006 FERC believed that the best option in considering the dams on the Klamath River was to leave them in place with mitigating factors.

What caused salmon deaths? Siskiyou Daily News (excerpted) ^ | February 16, 2003 | Barry Clausen

Salmon killed by illegal drug activities?

Journalist's findings challenge official explanation of cause of death

Posted: February 22, 2003 By Sarah Foster © 2010 WorldNetDaily.com

As a result the Coho Salmon were listed as endangered by the California Fish & Game and have instituted a plethora of regulations on the Klamath River in direct violation of the Magnusson Stevens Act and the Sustainable Fisheries Act. They are proposing fish ladders, TMDL regulations, algae control and a variety of other meaningless regulations. **It is a well known fact and the latest NorthCoast Water Board information states that the waters in the Klamath River have the largest amount of algae as it leaves Klamath Falls and that as the waters move downstream they become cleaner as a result of the reservoirs allowing sediments to settle out.** The latest report of the 2002 Salmon kill by U.S. Fish and Wildlife indicate that the kill was caused by unusually warm water, exceptionally large run of Salmon, Shallow waters due to 1997 flood depositing silt and debris, and 70% of Trinity River water being diverted South. **They have admitted that the reservoirs and dams did not cause the catastrophic salmon kill thereby negating the entire premise for removing the dams.** Under the Dormant Commerce Clause no State can impose regulatory actions on Waterways that are considered navigable or harbor commercial fisheries. Due to a loophole that was initiated in a lawsuit filed in 1970 is the premise for these actions.

Historic Salmon landings1916:

Native tribes and environmental NGO's have claimed that prior to the dams on the Klamath river there were millions of Salmon that spawned in the river. However, the actual numbers of Salmon during the years of 1916 to 1918 numbered an average of 34,000 fish per run. They seem to forget that in a dry summer the Klamath River turns into swamps and marshes and cannot support any kind of Fall Salmon run.

Between 1916 and 1918 prior to the dams being built it was noted that the Salmon catch on the Klamath River averaged 120 tons per run. After the first dam was built the next five years produced an average of 188 tons per run. This clearly demonstrates that the dam increased the tonnage by over 50%. The following link is a Fish and Game 1930 report.

http://content.cdlib.org/xtf/view?docId=kt538nb0tr&brand=calisphere&doc.view=entire_text

Not only will these actions not restore salmon fisheries in the Pacific Northwest but **Fish & Game cannot document that Coho Salmon were ever native to the Klamath River**. Plantings were made in the Klamath in 1895, 1899, the 1960's and the 1980's according to historical records. After plantings there was a rise in returning Coho for the following three years, however, without further plantings Coho levels again dropped to historical low levels. As a scientist I would classify these failed plantings as a failed experiment and that you cannot list a species that was never native to the River.

A REPORT UPON SALMON INVESTIGATIONS ON THE PACIFIC COAST IN 1896. By BARTON WARREN EVERMANN AND SETH EUGENE MEEK.

Predation by Pinnipeds

Both El Nino and the recent drought has been indicated as having an effect on the prey and predator species distribution. **Threatened California sea lions were porking out on threatened salmon.** Efforts to capture and relocate harbor seals exhibiting the same tendency have been unsuccessful in solving the problem. The (LRP) Ch4, pages 37-39, states that estimates of **mortality of anadromous salmonids from natural predators run as high as 98 percent (Fresh in Steward and Bjornn 1990)** Yuroks traditionally harvested marine mammals (McEvoy 1987), but today many of these species are protected by the Marine Mammals Protection Act." In the typical logic of fisheries scientists, the report proceeds to ignore its own stated facts in favor of the politically correct.

Chinook and Coho landings in California waters

It is clear that since 1950 the total landings of Coho and Chinook in California has dropped significantly. However, if we look at the total tonnage of these two species caught in the Pacific Northwest the total tonnage has not dropped significantly, but, the Coho and Chinook have moved North into Alaska. **In 1950 47% of these two species were caught in Alaskan waters and in 2000 the Alaska catch has gone up to 75%.** We will consider what has caused the movement of these two species North into Alaskan waters. http://www.st.nmfs.noaa.gov/st1/commercial/landings/annual_landings.html

Chinook landings in California waters

The most important Salmon in California is the Chinook which traditionally sported a Spring Run and in wet years a Fall Run. **Before the dams, during a dry summer, there would be no water for a Fall Run of Salmon** and with the building of the dams there is now a significant Fall Run due to the storage of water behind the dams. If we look at the data it is clear that since 1950 the actual tonnage of Salmon off the California Coast has been rather level through 2000, unlike the Coho which have basically disappeared. In 1950 the tonnage of Chinook caught off of California was 3,200 tons. In 2005 the total tonnage was 2,300 tons and the numbers continue to fall. However, in 2000 Alaska landed 34% of all Chinook in the Pacific Northwest and in 2009 Alaska landed 53% of all Chinook in the Pacific Northwest.

The **true cause of Salmon decline** in California, Oregon and Washington are **as a result of a historic rise in temperature of the Pacific Ocean driving these cold water fish North into Alaska. In 1950 the total catch of Salmon in the Pacific Northwest was 149,000 metric tons with 80% caught in Alaskan waters. In 2007 the total catch was 402,000 metric tons with 97% caught in Alaskan waters. This represents a 270% increase in commercial Salmon caught in the Pacific Northwest.**

Pacific Ocean Temperature
http://www.google.com/search?q=history+of+pacific+ocean+temperature&hl=en&prmd=ivns&sa=X&ei=D_N3TbhSg4KxA7b61ccE&ved=0CHAQpQI&tbm=&tbs=tl:1,tlul:1970,tluh:2010

Pacific Northwest Salmon landings.
http://www.st.nmfs.noaa.gov/st1/commercial/landings/annual_landings.html

This alone verifies that the intervention of man with dams and hatcheries has been a successful endeavor with a 270% increase in Salmon in the Pacific Northwest since 1950.

"Dr. Victor Kaczynski, a fish biologist and consultant on fishing issues in the pacific Northwest, says that per classical ecological theory, a 70 percent decline in zooplankton biomass results in a 70percent reduction in predators dependent on zooplankton. Since 1979, zooplankton levels have declined by an estimated 70 percent due to ocean warming. With a reduction in zooplankton levels by more than 70 percent over the past two decades, West Coast salmon have declined by at least 70 percent."

The Pacific Ocean has had an increase in temperature since 1970 that is historic in nature driving Salmon North into cooler waters.

It is also of interest to note that our planet is undergoing a historical rise in earthquake activity and Ring of Fire volcanic activity since 1973.

Volcanic Activity;
http://www.google.com/search?q=volcanic+history+of+eruptions+in+the+ring+of+fire&hl=en&prmd=ivns&sa=X&ei=Z_x3TfLGBo62sAP9_ozSBA&ved=0CGwQpQI&tbm=&tbs=tl:1,tlul:1970,tluh:2010

Earthquake Activity;
http://www.earth.webecs.co.uk/

Caspian Tern impact on salmonids

In recent months Fish & Wildlife, Fish & Game and environmental NGOs have theorized that **increases in the Caspian Tern in the Columbia Basin in the state of Oregon has been a causative factor in decreased salmonid production**, as they prey on salmonid smolts. **Rather than considering thinning of the tern population they are proposing relocating some of them throughout Washington, Oregon, Idaho, California and Nevada.** The rationale behind this proposal is insanity, as the relocation and building of new habitats for the tern would seriously affect present ecosystems in addition to allowing them to continue populating new areas for these predatory birds. As has already been presented, the causative factor in decreased commercial salmonid production in Washington, Oregon and California is the increased warming of the Pacific Ocean driving cold water Salmon North into Alaska. Refer to the following link:
http://www.fws.gov/pacific/migratorybirds/cate.htm

Impact on property owners residing on the Klamath River

Since the proposal of the KBRA and KHSA property values are plummeting on the property owners along the Klamath River. Specifically, the residents at Copco Lake are in such dire straits that realtors will not even list their properties. Not only are values being devastated, but, **Iron Gate Dam was built in the 50's for the primary function of reducing devastating floods downriver**. Iron Gate Dam allows for a 90 minute warning blanket to residents downriver in the event of an impending flood thereby saving property and lives.

Dam Removal on Salmon Fisheries

It becomes apparent from the preceding data that **dam removal will not restore Salmon Fisheries, but, will devastate it.** The Expert Panel in their conclusions indicated that dam removal will decrease Salmon production in the first years and **"MAY" increase Salmon production in 50 years**. Not only will we be looking at **Salmon spawning grounds upended and buried in silt and mud from the removal of dams, and it would release a "biomass" of yellow perch to feed on Salmon eggs and smolts. There is no scientific basis for assuming that dam removal will restore Salmon Fisheries** in the Klamath Basin as stated in the U.S. Fish & Wildlife report that the reservoirs and dams did not cause the 2002 Salmon Kill. .

Latest Pacific Northwest Fisheries data

Big Salmon Run spawns Profits: The Wall Street Journal Tuesday, February 8, 2011
http://online.wsj.com/article/SB10001424052748704124504576118462016940744.html
Dan Springer of Fox News reported that National Marine Fisheries Service indicated that removal of Snake River Dams would not restore Salmon Fisheries.

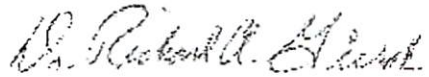
Conclusions

Should this dam removal proposal continue to move forward it would devastate property owners and subject those downriver of the dams to suffer inundating floods when you consider that Iron Gate Dam was specifically built to ameliorate the floods downriver by giving residents a 90 minute evacuation buffer in the event of a serious flood. This in addition to the fact that power rates will skyrocket and that Pacific Corps is pursuing "clean coal plants" to replace the most environmentally clean, green energy production. With the advent of electric cars we need more power, not less.

In the FERC analysis of the various options referring to dam removal their conclusion was that the dams should remain in place with mitigating factors.
http://www.ferc.gov/industries/hydropower/enviro/eis/2007/11-16-07.asp

For further information and references to these statements please go to the following you tube links.

Klamath Basin Salmon
http://www.youtube.com/watch?v=QOR8kBc0V6k
Historical Fisheries
http://www.youtube.com/watch?v=2-NkcLS68nw
global warming 7min.
http://www.youtube.com/watch?v=WffQhAOjVB8
Salmon bird 5min
http://www.youtube.com/watch?v=6a8Y-YEaMvo
Respectfully submitted;
Dr. Richard A. Gierak



An Engineers Quick Review and Analysis of the "Proposal to Remove the Klamath River Power Plants"

By

Werner F. Hoyt, PE (Mechanical/Marine Engineer)

31 March 2010

The National Science Foundation Review issued in March 2010 of the science behind decisions regarding water use cut off decisions. Driving these decisions were suppositions based on various ideas that certain activities were responsible for the collapse and subsequent listing of Delta Smelt and Longfin Smelt as threatened or endangered species. The foundation cited although the individual study science was good, they directed that the agencies go back and "Quantify the various elements of the situation. Spending 95% of your effort which attacks 5% or less of the global problem is bad science and bad management of scarce resources.

Subsequent to this Pacific Legal Foundation won their case *Stewart & Jasper Orchards, et al. v. United States Fish and Wildlife Service, et al.*). 18 May PLF statement **"Judge Wanger recognized that federal regulators had not taken account of how water cutoffs could damage the human environment, and they did not use the best available science," said PLF attorney Brandon Middleton.**

"This is a powerful, excellent ruling," said Middleton. "The judge is telling the feds that they can't ignore the harsh human and environmental impacts of cutting off water to farms, workers, businesses, and communities. The judge is also saying the feds can't get away with using slippery science to justify environmental restrictions that rob communities of their lifeblood – water."

We have a similar situation with the efforts from outside – The removal of the Klamath River Dams is an initiative largely on the part of individuals and agencies who do not have a personal stake in the issue. The impact of the changes imposed by these outsiders will fall on the residents of Siskiyou, Del Norte, Jackson, and Klamath Counties in the form of increased energy costs and reduced power reliability and security.

A quick review of the Parameters impacting the Klamath River Power Plant Removal Proposal

1 – What are the Major Factors Impacting Salmon and Steel Head Runs
- a) Marine Mammals/Predation
- b) International fishing
- c) Habitat
- d) Environmental Quality

e) What has changed that impact the Salmon and Steelhead Runs

2 – What are the Impacts of the alternatives
- a) Costs
- b) Reliability
- c) Environmental –clean vs CO2 emissions
- d) Security – Local power vs import from out of area
- e) Security – Trade Deficit/Dependence on foreign oil

The above all require quantification to determine where effort is to be applied.
The 5% solution yields 95% of the desired goal.

1a – Pinniped impact on fish populations

California Sea Lion Census 2007 – 238,000 Estimate by NOAA National Marine Fisheries
Current Population estimate extrapolated at 6%/yr. 1978 Census was 11,000 when the Marine Mammals Protection Act was established.

Year	Population
2007	238,000
2008	252,280
2009	267,417
2010	283,462

California Seal Population Census 2004 by NOAA National Marine Fisheries estimated West Coast Population at 31,000. Population growth per census appears to be starting to level. Assume declining growth rates at 1% per year from 2004 for extrapolation. Growth rate provided by Census was 9%/year

Year	Harbor Seal Population
1978	6,000
2004	31,000
2005	33,480
2006	35,824
2007	37,973
2008	39,872
2009	41,467
2010	42,711

Sea Lion/harbor seal Daily Food requirement ~ 16 kg (35 lb)/day equates to 3 ½ 10 lb fish per day = 35 lb x 365 = 12,775 lbs Estimated West coast population of pinapeds as of 2010 is approx 325,700 harbor seals and sea lions - equating to a food requirement of 4 billion lbs (2 million tons) of fish or 400 million 10lb sized fish.

Seal Pop	Pinniped Pop	Food Rqmt (lbs)	Food Rqmt(tons	Number of 10# fish
6,000	17,000	211,225,000	105,613	21,122,500
42,700	325,700	4,046,822,500	2,023,411	404,682,250

Pinnipeds are smart – they go where they can find food. In particular they congregate at the mouth of the rivers when the salmon and steelhead runs take place and compete with the Indian Tribes for what fish return. The have moved into the Columbia River as far as the Grand Coolee Dam, have been found as far inland as Stockton, California. Recently with the collapse of the fish stocks in the San Francisco Bay Estuary the resident population in SF Bay relocated for better hunting grounds.

1 b. Impact of Foreign Fish Trawlers and Fish Factories. Salmonoids range of migration is TransPacific in nature. Currently there is no management of take regarding populations originating from West Coast Spawning Areas. Drift net practices by Pacific Rim Countries result is a near complete take of Salmon Schools and steelhead when encountered by these fishing vessels. A quick look at total Pacific ocean take with National Marine Fisheries oversight indicates declining fish takes and collapses in fish stocks over the last 30 years. A rough estimate of current fish take all species by Commercial Fishing Trawlers is approximately 10% of that during the early 1970's. Current Data is not immediately available by web search. Best estimate base on trends is that the current take on the part of Commercial Fishing is similar to the impact on fish by marine mammals. The take in Alaskan waters in 1988 was 700,000 metric tons in a study regarding incidental take of marine mammals by the National Marine Fisheries Service. Best estimate without direct input from NMFS is that this number will be on the order of 2 million tons of fish.

Environmental Quality Trends Regarding West Coast Watersheds

Establishment of the Clean Water Act has resulted in -

1) substantially increased clarity of rivers and streams
    a. personal observation from having been diving in sections of the Klamath river below I-5 from 1970 to present, there is significantly less fine sedimentation and suspended clay fines. Summer visible distance has increased by several orders of magnitude. " inches to feet"
2) elimination of pesticides such as DDT
3) substantial reductions of pesticides entering the watershed
4) substantial reductions of phosphates entering the watershed
5) timber buffers on all streams/rivers prohibiting cutting w/in 50 to 100 ft – this has been in place since the early 1970's for private

companies/individuals. Believe this ha been s extended to publicly owned lands regarding timber harvest.

6) Substantially reduced timber harvest activity – on the order of 10% of the 1970 numbers on an annual basis for Northern California. We have seen the closure of
   a. Two mills in Mt. Shasta
   b. Two mills in Yreka
   c. Decrease in milling operations at Weed
   d. Two mills at Hilt
   e. Two mills in Dorris
   f. One mill in McCloud

Remaining Milling activity in Siskiyou Count of significant size
   a) 1 mill in Yreka
   b) 1 mill in Weed
   c) 1 mill in Dorris

Salmon Runs in the 1960's and Early 1970's – local fisher's were lining both sides of the Klamath River. Our family limited out routinely during both Chinook and Steelhead runs during the 60's.

Environmental Quality Trends – Need to Quantify
Annual Timber Harvest in the Klamath Basin from 1960 to present.
Annual Cattle production – as far back as we can go
Annual grain production – indicator of farming intensity/soils loss
Annual estimate salmon catch as far back as records go
- Various runs for both salmon and steelhead.

Klamath River water quality indicators
- As far back as records go
- TMDL records – into and out of the power plant system.
- Temperature of water released from iron gate vs the pre-dam river temperature profiles prior to construction of the power plants.

Build the case that the power plant system is beneficial to downstream water quality/beneficial to the health of the salmon/steelhead returning up

What has been a constant through this period – The Power Generation Facilities on the Klamath River (Iron Gate, Copco, etc)

What has changed.

1) Explosive growth of Sea Lion and Harbor Seal Populations - 20X based on National Marine Fisheries Data
2) Massive increased use of fishing trawlers and fish factories on the high seas by pacific rim countries from 1970 to present – 10X or greater.
3) Decreased environmental pressure on spawning stocks from human generated activity all across the North State. Reductions and quality

indexes need to be generated to quantify. But these numbers are on the order of 90% or more from the mid 60's.

Economic Impact of the Change

Current Power Rates for Siskiyou, Jackson, Klamath Counties 0.07/KWH vs 0.11/KWH from Pacific Power due to the Klamath River Hydroelectric Facilities.

Current Residential Billed Rate - May 2010 at Lake Shastina

KWH	Cost	unit price
1152	135	0.117188

Customers will face both the cost of the facility removal as well as increased power rates.

Alternative Clean Power – Suitability and Cost

Wind power – I believe that all attempts to permit wind generation in Siskiyou County have been blocked to date on the basis of "Visual pollution". Wind power although it has promise to contribute to the clean power in the county is only part of the solution to provide local energy security. Wind is not constant. There are a substantial number of days insufficient to generate power. The wind probability mapping for power suitability of wind generation indicates such installations are "marginal at best" Installed cost is $5.2 million per 2.5Mw turbine. Cost to replace the Klamath river Power system is 160/2.5x5.2= $322 Million dollars for 64 each 2.5Mw turbines.

Solar power – present cost $10,000/kW or higher. Replacement of power generated by the Klamath River Power by solar alone is

160 Mw peak gen capacity = 160,000 Kw = > $1.6 billion

Total annual Klamath river power generation =

Peak Power Output = 160 MW

Average Annual output = 80 MW to Siskiyou/Jackson/Klamath counties

Power output = 80MW*24*365/1000= 700 million KWH

Power Cap	Hrs	Days	Conv	KWH	Cost/k wh	Cost	Revenue/k wh	Revenue
80,000,000	24	365	1,000	700,800,000	0.07	49,056,000	0.018	12,614,400

Customer cost @ $0.07/KWH

Electric Generation from fossil fuel creates the following CO2 emissions.

955 g/kWh CO2 Coal
893 g/kWh CO2 Oil
599 g/kWh CO2 Natural gas

		lbs CO2/yr	ton CO2/yr	gallons/oil	Barrels/Oil	Import cost @ 50/Barrel	Import co 150/bar
2.101	lb/kWh Coal	1,472,380,800	736,190				
1.9646	lb/kWh Oil	1,376,791,680	688,396	62,581,440	1,862,543	$93,127,143	$279,381
1.3178	lb/kWh Nat Gas	923,514,240	461,757				
			49	100%			
			93	190%			
			279	569%			

Presently the cost of power produced by the Klamath river – assuming an average production of 80Mw

Is 49 million – local resource at $0.07/kWH

Removal and replacement by either oil or natural gas will result in pricing at

93 Million/year + generation and distribution cost – assuming $50/barrel of crude oil this is a 190% + increase over our current power

The bulk of this revenue will be exported overseas

279 million/year + generation and distribution cost – when prices return to $150/barrel as we previously experienced. This is 569% increase in cost the customers served.

Again this money is exported overseas as this is a new demand on fossil fuel sources where the United States is increasingly dependent on international markets for energy.

At $100/barrel over

$180 million/yr

$1.8 billion dollars over the next 10 years not indexing for inflation the cost

$18 billion dollars over the next 100 years not indexing for inflation

2010 Population Estimates

Siskiyou County 49,000 , Jackson County 201,000, Klamath County 68,000 Total Population Served ~ 338,000 -- estimated number of households assuming average household size of 3 = 113,000 households.

This equates to an additional **household burden of ~**

$1,000/household/year for $100 barrel oil

$2,000/household/year for $150 barrel oil

assuming that the change impacts the entire of each county if less that the entire then the burden proportionally increases.

1.8 billion – 0.49 billion = 1.31 billion => Cost/#households = 1.31 billion/113,000 = an increased cost of 12,000/household. ~ 1,000/household/year not indexed for inflation or likely energy cost increases for fossil fuels.

Existing Hyrdoelectric Power Plants Provide

1 – Clean Power

2 – Renewable resource

3 – Provides a power source locally

4 – Power is not subject to variability of weather or availability of the sun. Available based on demand by households and business.

5 – Does not contribute to global warming (no CO2 Emissions)

6 – Did not contribute to the decline of the Salmon/Steel head populations as evidenced by:

a. the explosive growth of the Pinnaped populations – establish a normalized trend line. Establish food demand trend line for population preying on salmonids at sea. Need NMFS to cough up their data on

- Sea Lion Population monitoring in the area from Humbolt to Coos Bay.
- Movements and behavior of the larger groups.
- Conflicts between fishermen and sea lions at the mouth of the Klamath River.

- Behavior and estimated take from the Sea Lions.

b. international fish trawler fish takes. – Establish trend lines
c. US fisher fish take – establish trend lines
c. improved water quality trends over the period of the decline
c. no evidence of decline as a result of the power plant construction

7 – Provides local jobs in the maintenance and generation of power.

Need to cite # of jobs – direct and indirect – indefinitely

Vs

No jobs in county provided by the facility removals. County resident construction companies will be unable to bond the size of the project $100+million. Outside companies will bring in their own workers.

Loss of the jobs currently provided.

8 – Provides an economical source of energy for local residents

Cost of power on the basis plants are maintained in current configurations. Including structural seismic upgrades if needed (No ladders)

Vs cost of power incorporating fish ladders

Vs cost of power with no power plants – note the cost of removal ultimately will be paid by the rate payers/tax payer – primarily the county residents.

9 – Power security independent of fluctuations in the fossil fuel markets

Power security that is local not subject to
- Major seismic events outside Siskiyou County
- Winter weather interruption of power grid outside of Siskiyou County
- Local power source allows for repair locally.

10 – Not subject to international events.

11 – Keeps local money here at home, in the county, in the country – does not add to the balance of trade deficit

12 – Does not increase our dependence on foreign energy sources.

13 – Flood protection

Define current flood boundaries as a result of the presence of the power plants.

Define the spring thaw snow melt flood event conditions – size and duration of flood event.

Define areas subject to that flood event – historical research of flood events, flood crests that took place on the Klamath as a result of spring snow melt/rain events in the upper Klamath Basin

Define the damage estimate of an uncontrolled flood event.

Define who would be affected from Iron Gate to the Coast based on the largest known flood event prior to the Construction the Power System Complex.

All presently protected residences, businesses in the new flood plain band would be required to obtain flood insurance. Note I believe current FEMA policy is to pay off and not rebuild in the flood plain if a business or residence is destroyed.

Conclusion based on sound analysis of the overall factors affecting fish populations.

1) **Predation** – Marine Mammals and Commercial Fisheries are the 95-99% portion of the equation affecting the Salmon and Pacific Fish Stock Populations. The **correlation** between Predation and fish stock collapse is **extremely strong.** Very strong impact versus rapid species decline.

2) **Habitat** – Environmental Quality has Steadily Improved for fish reproduction over the past 40 years. **Improving trend** while there has been a collapse in fish stocks indicating that habitat has not been a contributing factor to the species collapse. All indicator trends run **counter to the fish stock collapse.**

3) **Power Facilities** are not the source of the fish stock collapse – they have been a **constant factor** in the Habitat since construction. **No correlation.**

Ownership – Eminent Domain on the basis that FERC/Pacific Power have completely mismanaged the Resource???

How much of the income from the facilities is exported. How much infrastructure outside of our county are we paying for?

Recommendation –

(1) **Build fish ladders:** The cost of construction of fish ladders at each of these facilities is far less expensive proposition to the 3 counties than the future cost of energy and is the overall least damaging environmental solution to our energy needs.

1) Cost 90-300 million versus 1.8 Billion in increased costs to the county
2) It maintains our source of clean, reliable, low cost energy
3) Restores salmon access to the upper Klamath basin.
4) Prevents the creation of
    700,000 tons/year of CO2,
    7 million tons/next 10 years
    70 million tons/nest 100 years
5) Conserves fossil fuels oil or equivalent in coal/natural gas
    62 million gallons/year
    620 million gallons/next 10 years
    6.2 billion gallons/next 100 years
6) Maintains the recreation resource provided by the associate lakes behind the power facilities.

(2) **Seek assistance of the Pacific Legal Foundation** for assistance in this issue to force quantification of the sources causing the collapse. We will never restore Salomon Populations if the 95% portion of the problem is not addressed first.

Note: Detailed quantification is required to fully document the conclusions of this preliminary study of the Removal of the Kamath River Power Plants.

(3) **Full quantification** should be required of the agencies producing their studies as was recommended by the National Science Foundation in the case of the Delta Smelt calling for the removal of the Power Plants. The ESA requires that economic factors be considered in actions to be taken as well as an estimate of the effectivess of those proposed actions under the ESA. Does the proposed action really have a productive effect?

Known factors negatively contributing to species decline due to adverse fish management policy.

(1) Failure by NOAA/FWS to control take beyond the 200 mile limit by commercial fishers

(2) Adverse water releases from the trinity reservoir triggering fish movement when movement is not a normal event due to weather. Need to request records of water releases from the Trinity Reservoir

(3) Fish kill by agencies of reproductive adult fish at the Iron Gate facility that would otherwise migrate back downriver to another stream to reproduce.

County Government is the responsible agency for the CEQA review. As part of that review any or all of the NEPA accomplished by FERC can be called into question.

- Security analysis
- Energy analysis
- Cost of alternatives
- Economic impact on the 3 county area of Siskiyou, Jackson and Klamath
- Environmental quality trend analysis
- Population trend analysis
- Predator trend analysis
- Fish Take trend analysis by
  - Commercial Fishers
  - Tribes
  - Recreational anglers

Has FERC completed and issued their NEPA analysis regarding their imposition of requirements on Pacific Power.

KLAMATH RIVER DAMS REMOVAL: THE ISSUE IN BRIEF

(Prepared by Dr. John W. Menke, July 27, 2010)

Removal of four Klamath River dams as proposed in the KHSA and KBRA will result in unintended consequences that collectively add up to negative cost-benefit outcomes individually and collectively using scientific, engineering, economic, and Native American cultural criteria.

First and foremost, the dams provide flood protection for residences, businesses, agency offices, bridges, and other structures adjacent to reservoirs and within the floodplain of the Klamath River downstream from Iron Gate Dam (IGD) to the ocean. The railroad levee parallel to Highway 97, from approximately 4 miles north of Dorris, CA to Klamath Falls, OR restricts floodplain flows away from the river upstream of the geologically-formed Keno-divide and causes higher peak-flood-flows in the Klamath River today compared to pre-dam conditions (NRC 2008). If the dams are removed the levee must be removed or modified to provide the natural 'escape-valve' for the river above Keno. The Klamath River dams provide a minimum 9-hour peak-flood-delay below Iron Gate Dam which results in a significant reduction in risk to property loss. Additionally, the reservoirs provide local water supplies to helicopters used in fighting wildland fires that are threatening property.

Second, responsible federal and state fisheries management agencies and the Bureau of Reclamation have inappropriately devoted almost exclusive attention to natural and instream flow studies and agricultural flow-reduction strategies in the Klamath River watershed without studying, modeling and showing that Klamath River flow is the limiting factor or bottleneck to producing more salmon (NRC 2008). The studies and models that have been developed are too gross (monthly verses daily time step) and 'black-box' (not mechanistic) in design to accurately account for critical factors affecting fish abundance and health. In the case of the short-nosed sucker fish in Upper Klamath Lake, the agencies used a flawed Biological Opinion based on one naïve model to cut off irrigation water to farmers when that fish was not limited by lake levels according to vast amounts of empirical data. Until the true limiting factors are identified and justified with sound scientific studies and model demonstrations with sensitivity analysis to show causal mechanisms, it is premature to remove dams and hope that that action might help (see more on this below).

Third, only the freshwater life-stage portions of salmon and steelhead life-cycles have been discussed as affecting salmon abundance when we all know ocean temperatures and recent record harvest of Chinook salmon in Alaskan waters show ocean currents and food availability are affecting local fish abundance as well. The NOAA Fisheries component (ocean effects) of agency responsibility is never discussed in local meetings concerning salmon and steelhead in the Klamath River watershed. Likewise marine mammal depredation rates are never discussed. Now that large proportions of marine mammals have moved north to follow the salmon and steelhead, it is time for responsible agency officials to present their data and models concerning growth rates and harvest in the ocean where the vast majority of fish growth and harvest takes place.

Fourth, even though a vast majority of the freshwater fishery management agency workforce is devoted to surveys and monitoring studies including fish returns, spawning dates

and locations, live fish surveys, carcass surveys, juvenile escapement screw-trap-monitoring in the mainstem Klamath River and tributaries, disease incidences, coded-wire-tag marking and return information, harvest information: tribal netting, and sport-fishers catches, marine mammal predation studies, etc., no dynamic simulation models have been developed to allow prioritizing of possible limiting factors to salmonid productivity. Again it is time for this vast information database to be put to good use, and at least a freshwater component of the salmonid life-cycles be developed and demonstrated to the public. The NRC (2008) study stated that this process should precede any adaptive management program, after limiting factors or bottlenecks to improved salmonid production are identified—this has not been done.

In 1984, a Yreka sporting goods store owner put faith and hope in a $40,000,000, 20-year-long state funding commitment to California Department of Fish and Game to make improvements to the Klamath River fishery. Nothing of significance was shown or discussed with the public justifying the money spent during a review field trip to the river in 2004. During the partially concurrent 10-year Klamath Act and the NRCS EQIP Program efforts including the clearing of culverts and log-jams that restrict fish access to small tributary creeks, construction of fish screens to reduce incidental take, construction of pipe-lines to reduce ditch losses in agricultural diversions, and installing cost-shared pivot-irrigation systems to replace less efficient flood and wheel-line irrigation systems, no improvement in salmon and steelhead numbers can be demonstrated. With less flood irrigation, reduced ditch losses, and with 'efficient irrigation' systems, groundwater replenishment has most certainly been reduced and cold-water refugia have likely been reduced in effectiveness. Winter-time tributary stream temperatures have likely declined during egg incubation so that emergence has been delayed due to less groundwater accretion to tributaries. These are clear examples where hypotheses are not tested prior to implementation of un-educated guesses on what's broke about the system.

(Another 3-4 paragraphs will be added concerning water quality, sediment, and fish disease—the greatest risk of dam removal; and cultural issues of burial site disturbance and ?)

But agencies are in need of projects since most diversions have been screened, those wanting cost-share pivots have been satisfied, and seasonal monitoring needs are not year-round jobs. Why not develop a mega-restoration project even before the impact assessment is done?

Literature Cited

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Quartz Valley Red Angus
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May 11, 2011

We live (since 1993) in rural Siskiyou County where cattle, hay, logs and gold sales are the economy. We have way too much government employment in our county. Since forestry has largely been shut down on public lands the number of employees on National Forests far exceeds the work load. It is basically a government welfare system going on in our area as far as the Federal agencies are concerned. To show Federal support (short-term local construction jobs) two new large buildings have and are being constructed for the US Forest Service at tremendous unnecessary expense to the federal taxpayer.

Currently we are fighting using civil disobedience to counter State Fish and Game and North Coast Regional Water Quality Control Board (NCRWQCB) efforts to take our irrigation water away. Fish and Game tried to implement an illegal ITP (incidental take permit) program and has violated landowners with extortion actions by armed game wardens committing color of authority violations in the process. They are now in the process of replacing the Fish and Game Director since they know he is liable for jail time having authorized an illegal method of forcing landowners to make decisions contrary to their will.

US Department of Interior, through the President, is illegally using the Antiquities Act to designate a new monument and expand an existing one from southern Oregon into north Siskiyou County, and is ignoring the Congress of the United States which is the only body legally able to designate wilderness. The Department of Interior is going to make a unilateral decision about hydroelectric dams removal which the citizens of Siskiyou County overwhelmingly voted (80%) to keep the dams in place producing green power. The NCRWQCB is in collusion with the US Department of Interior using their waiver program to stop grazing on part of the proposed monument area, and they have violated the Data Quality Act (EPA oversight) in giving the public the impression that Upper Klamath Lake water can be cleansed by bioremediation through extensive, expensive wetlands construction. Even the expert scientific panel on Chinook salmon related to dams removal doesn't buy their claims, but the government is 'MOVING FORWARD' on their efforts regardless.

Fish and Game has been practicing Federal take on coho salmon since 1995, to reduce the population initially get the fish listed in 2005, and now to take further property rights away from landowners via water controls. The NCRWQCB has used their EPA connections to force the dams owner, PacifiCorp, to agree to dams removal, and now the National Marine Fisheries Service has forced PacifCorp to secure an ITP and HCP, so that power rates will be raised again to further hurt agricultural irrigators' pocket books. In fact, all citizens (70,000 residences in northern California, southern Oregon, and as far away as Wyoming using power generated by the Klamath River dams) are being ripped

off with power rate increases to supposedly pay for dams removal, even though the decision has not been made or funded by California and Oregon nor the Federal governments.

Fish and Game has prepared suction gold dredge guidelines that essentially eliminates economical gold dredging on the Klamath River. In actuality gold dredging helps the river by dislodging an overly cemented armor bottom on the riverbed disallowing spawning salmon to dig their nests to deposit their eggs. Lack of sufficiently frequent flood events with more common drought cycles in the last several decades have caused abnormally cemented gravel materials to develop, disallowing good salmon reproduction. Fish and Game, like all their sister agencies, are part of a larger agenda to force people out of Siskiyou County because it is a rare place in an otherwise overpopulated state. These folks see the county as a park, given its relatively pristine/undisturbed state when comparing it to even the 'visited-to-death' Yosemite National Park. Agenda 21 has mapped the whole county as a corridor of organism movement for otherwise non-gene sharing segregated meta-populations of plants and animals that have 'human rights'.

Given the collusion that has been taking place among Federal and state regulatory agencies and coastal communities including Indian tribes to the west of Siskiyou County, it would be to Siskiyou County's detriment to be pooled with counties to the west from a representation standpoint. Siskiyou County shares custom, culture and economies with Modoc County and other counties to our south including Shasta, Lassen, Tehama, and Plumas counties. The proposal to make the dividing line Interstate 5 and pooling western Siskiyou County with Trinity, Humboldt and Del Norte counties would not be welcomed by Siskiyou County residents.

Sincerely, John and Jennifer Menke, Ranchers

KLAMATH RIVER ISSUES-PERSONAL INVOLVEMENT and OBSERVATION

I am fully aware of the Lower Klamath and Tule Lake Basin reclamation projects where shallow lakes and marshes were drained and manipulated into manageable farmland and made available to lottery winning American war veterans. I am also aware of the water issues of 2001 and the Endangered Species Act which have caused social unrest and division in our region. However, as a state wildlife officer I had no direct professional or personal involvement in any way, shape or form, other than monitoring media reports. My personal and professional views have not been publicly shared.

During and after my professional career I have been an active board member of the Collier Interpretive and Information Center (CIIC), located north of Yreka at the juncture of Interstate 5 and the Klamath River. CIIC provides the public with interpretation and information specific to the geographical region and the Klamath River watershed.

It is clear to me that the Klamath River drainage is a unique **"upside down watershed"**. Whereas many natural drainages of the Pacific Northwest originate high in the coastal mountains where precipitation levels are high and somewhat maintained through snow pack, this system originates in a high desert, plateau-like environment with sparse annual precipitation. As a result, the upper end of this system is typically a spring fed or artesian water supply with slight elevation changes and marginal water velocity variations as it flows from the high desert towards the ocean. In this case, where water velocity is low or relatively consistent, any sedimentation that occurs creates alluvial deposits locally over time. There are several regional examples of this process, called "succession", but a prime example is the shallow body of water called Upper Klamath Lake and Agency Lake. This is a relatively long and shallow mostly natural-impoundment in Klamath County, Oregon. Historically speaking, and I mean thousands and thousands of years ago, anadromous fish species undoubtedly traversed the watershed from the Pacific Ocean to the Williamson, Wood and Sprague River drainages. As a result of time, naturally occurring water flow scouring and water-caused sedimentation have produced the river-lake conditions that exist today. And, because of that historic anadromous access there are indigenous trout above present day Upper Klamath Lake; just as they exist in several closed watersheds in the region. Over time, warm water and cold water fish species have adapted to the current given environments, the carp or sucker fish are examples thereof.

As the watershed naturally drains towards the ocean it meets a sharp gradient change in the Keno, Oregon area and begins to flow through deeply carved canyons and the coast range where annual precipitation is comparatively high. Because of the elevation change the rapidly flowing water is cutting and filling the river's channel until it bluntly meets sea level which is a relatively consistent "plug" to the drainage system. This natural degradation and periodic flushing action of the river, during high flows especially, are uniquely tolerated by anadromous and catanadromous fish species and their life and cyclic movements are triggered as a result of the fluctuation.

Water quality above the John C. Boyles Dam near the California-Oregon state line is historically poor for anadromous fish species and has declined further since the farmland reclamation project in the early 1900s and settlement downstream from the Klamath Lake outlet at Link River.

Anadromous fish utilize the river system as a freeway-like route with a strong desire reach its headwaters and/or to enter the river's femoral feeder streams to spawn. Bogus Creek, near the current Iron Gate Fish Hatchery, is a good example of this where spawning salmon choke the spawn able gravels and then die. Each and every stream feeding the Klamath River system in those lower reaches will receive adult steelhead and salmon if that is where they originated

and other conditions are acceptable. I have seen very large steelhead trout spawning in femoral streams at the uppermost extremes of the drainage (or natural barrier) where their backs are out of the water and they can't turn around without considerable effort.

Shovel Creek, above the Iron Gate and two Copco Lake power generating dams, is a prime example of one of the last streams where anadromous fish were able to successfully spawn prior to the river being impounded for electrical production. The adult fish utilizing Shovel Creek spawning habitat went as far as the natural barrier at the confluence of Panther Creek, but indigenous, naturally reproducing trout exist above it simply because previous generations were able to maneuver beyond the barrier before it naturally became impossible to do so.

When Iron Gate Dam on the Klamath River was proposed every governmental agency involved had to know that there would be an anadromous fish passage issue above that point. Through studies and first hand knowledge they had to realize too that there was historically marginal spawning habitat and conditions for those migrating fish species above that point. Because of that knowledge the Iron Gate Hatchery was not only proposed, it was mandated by scientific based agreement with government agencies to maintain anadromous fish in the Klamath River into perpetuity.

That hatchery, placed at the base of the Iron Gate Dam, did not happen haphazardly. There were strong reasons for it and planning mandates that came with its construction design and long term maintenance. Cold water would be drawn from well below the surface level of water behind the dam so as to assure cold water temperatures for the hatchery's fish spawning byproduct and rearing. Though built by federal agency dollars the hatchery is professionally and capably managed by the California Department of Fish and Game personnel on a year round basis. The number of adult fish processed and eggs fertilized is mandated by oversight authorities based on several factors and those numbers serve to mitigate the permanent loss of spawn able habitat above the dam. In my opinion, there are more genetically strong fish being produced by this fish hatchery than what the watershed can produce in ocean-entering and river-returning individuals naturally on its own.

The vast ocean environment is a critical factor in the returning number of Klamath River Salmon and Steelhead and is yet an unknown influence on the population dynamics of Klamath River fish. When 100% enter the ocean at the mouth of the Klamath River on their outward migration into the ocean and more than 80% fail to return as adult spawners four years later, the loss is considerable and thus far unexplained. Commercial take of Klamath River fish is considerable in ocean waters as far north as Alaska and west towards International and Russian controlled waters.

OPINION and CONCLUSION

After serious deliberation, I am of the opinion that Alternative 1 (No Action/No Project) is the best alternative at this time in American history. We are in critical economic strife nationally and worldwide currently and I believe this is an unnecessary expenditure of tax payer dollars. The adverse impacts of dam removal to Siskiyou County are potentially disastrous and unacceptable and I feel the opinion and concerns of Siskiyou County were poorly addressed from the start.

I feel PacifiCorp, a privately held corporation, is being unduly regulated by the federal and California state re-licensing authorities and have been forced to destroy the electrical power facilities on the Klamath River simply because the regulations and political demands have become cost prohibitive to effectively and efficiently run their business. It's insane to regulate this clean energy source out of existence, absolutely insane here in America.

I also feel this public input process has been pre-conceived and determined to force any opinion options towards dam

removal. As such, I think all of the alternatives except Alternative 1 are unacceptable and have unfairly forced respondents into a box. Any input honestly offered is simply a forced reaction to the alternatives on the table. I think the whole process is a farce. The dams are not the problem with the Klamath River fish!! The ocean holds the answers and further knowledge should be obtained before money is wasted on dam and clean energy destruction.

And, regardless of what Native Americans upstream of the Klamath Lake impoundment believe, I do not think salmon or steelhead trout would navigate the shallow lake from its outlet into the Link River and find their way to the Wood, the Williamson or any other tributary on the north end of the lake even if they were trucked there and released. This whole project is ignorant from the start and to offer rebuttal to insanity is worthless and senseless from the start.

The rainbow trout that inhabit Klamath and Agency Lakes, and spawn in those river and stream systems, have adapted to this unique system and adequately provide any and all cultural opportunities for their Native People. The carp, or sucker fish, have been their staple fish source for many, many moons, not the ocean run salmon and steelhead that they are professing historical ownership to.

The Klamath Tribe has been fully compensated over the years by the US Government and the American public. There is absolutely no acceptable reason for US tax dollars be used to purchase the 92,000 acre "tree farm" that is currently being considered as part of the Klamath Basin Restoration Agreement. They are doing well with the corrupt casino businesses throughout the nation now and money is literally flowing into their pockets. If the property is for sale, they should have the opportunity to purchase it just like others throughout the world do.
The downriver tribes have little or no ground to stand on. They have all the Klamath River fish they want or could ever need. They have gill nets across the river that take upwardly migrating salmon and steelhead. Not for subsistence or cultural uses, but for commercially motivated reasons that are unlawful and unethical in today's world. They will soon introduce the California Condor into the Klamath River watershed and it too will become a cultural icon to them that will again adversely affect current civilization and spawn conflict with other Americans.

In conclusion, I am critical of the process used in this KBRA/KHSA. I believe we are catering to a second generation of privileged farmers that for fifty-years enjoyed bargained power rates offered only to the American war veterans who literally won a once in a lifetime lottery to own and work potential farmland in the Tulelake, California area of the Klamath Basin. When that time frame was over, they were to assume the power rates that everyone else in the region was paying. They are now complaining that their power costs have gone up two thousand percent (2,000%) literally over-night. Welcome to the real world, now they're finally paying exactly what everyone else has been paying for the last fifty years.

Bottom line, keep the Dams in place. Re-license the PacifiCorp dam operation on the Klamath River and keep the rogue individuals working in Government out of the way. Sensible oversight for the overall public good is one thing. This is incredibly insane in America.

Sincerely yours,

Rennie D. Cleland
Dorris, Siskiyou County, California

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17 Nov 2008, 9:10pm
Homo sapiens Salmon and other fish
by admin

Sophie's Choice on the Klamath

The following letter is from Ric Costales. Ric has lived and worked on the land and in the woods in the Klamath Basin for 35 years. He is currently the Natural Resource Policy Specialist for Siskiyou County. This letter represents his personal opinions and is not an expression on behalf of the County of Siskiyou.

Dear Green River friends:

I understand from a friend of mine in Rock Springs that there was a recent forum having to do with water issues and the matter of the Klamath Basin was brought up as a solution in progress. Apparently an image was conveyed of happy stakeholders awaiting a New Day. Well, yeah, the Tribes are probably happy for numerous reasons. And, yeah, the big irrigators are probably content thinking they have secured the amount of water that is positively the absolute minimum they can economically live with. And, yeah, environmentalists are thinking they have taken a small step, but a first great step for mankind in "freeing" all the rivers. But that is it. It is not any sort of a rosy picture for the majority of people in the Klamath Basin, especially the small irrigators who are so far left out in the cold. Nor does it come without impact on the future of renewable hydropower and irrigated agriculture in America.

The position of Siskiyou County has been and still is that a decision to take the dams out is premature. Given the magnitude of the irrevocable step being proposed, no compelling argument based on fish or water quality science or economic feasibility has been presented. Neither has sufficient effort been made to investigate the mitigation for negative impacts. This is a shameful rush to judgment for political reasons, plain and simple. Any other analysis of the situation is self-serving, ignorant or both.

We in Siskiyou County are well aware of the flow characteristics of the Klamath River. People are going to be shocked when they see how little water comes down the river in dry years. The dams are the only thing mitigating the flow in those years. They are the last thing between the irrigated agriculture in the Upper Basin and losing the water completely. When (not if!) the salmon fail to rebound if the dams are decommissioned, there will be immense pressure to end irrigated agriculture in the entire Klamath Basin. The farmers who have sold out thinking that supporting decommissioning will somehow guarantee their way of life will have only bought themselves time to live out their lives on their farms. It will be the next generation who will have to live with the final round of "takings."

To be fair, the big irrigators were faced with "Sophie's Choice," having to choose which "child" was "killed." The dams weren't in their backyard, so it was easiest to cut them loose. I think they know what they did, and the futility of the bargain they made. Honestly, I don't know that I would have done differently had I been in their shoes. But the point is, this is not a rosy scenario by any stretch.

I heard that "intrinsic value" was mentioned as something taxpayers were willing to subsidize to some significant extent. How much are the American people willing to pay for that? Was this pitch made before or after the economic meltdown that is in the process of making the world reassess the limits of governments' abilities to make everyone's dreams come true? I can flat guarantee you that people are pretty soon going to pick commodity production and renewable energy over amorphous things like "intrinsic value" of "wild" rivers. This is particularly true when the difference in "intrinsic value" is the difference between one of the most picturesque, productive and ecologically diverse agricultural landscapes in America and what the landscape will turn into in the absence of irrigation. The only way this "intrinsic value" will ever be actually paid for is if the government pays, and the Federal Reserve printing presses are already working overtime. It is tragic that one has to visit the Klamath Basin to dispel the images of ecological abuse portrayed in the media and thus understand what is at stake in all this nonsense.

I also heard that logging was again referenced as a scapegoat for the problems of the Klamath River. The timber industry in the Klamath Basin in California has almost been extirpated since the spotted owl issue came to town. Siskiyou County is the 5th largest of California's 58 counties, and we have never been less than the 3rd largest timber producing County annually and often have been Number 1. There is now not a single board sawn in our County. We have two veneer mills but no one is sawing any boards. There are a handful of logging contractors left struggling to survive. The sediment alluded to in all the finger pointing on the dams is a relic of long bygone days. Timber harvest regulations in coho salmon watersheds in California are so strict that the season is so short that it is almost impossible to retain skilled employees. At least in a few locations the ground does freeze and some winter operations can take place. That is if the snowfall is not too severe and the haul roads freeze or are rocked.

What sediment issues that do exist and are tied to logging are legacy issues. The culprits are almost exclusively roads on USFS land, because the Forest Service can't log to pay for the infrastructure investment required by redesigning roads, resizing culverts, rocking roads, etc. This past summer, over 200,000 acres have burned in Siskiyou County, probably greater than 30% catastrophically. The

USFS has been told by local environmental groups that, "You won't salvage a stick!" because they will appeal and litigate until all value is lost. Being continuously victimized by such ideological demagoguery and senseless waste, it should be obvious that the Klamath National Forest's ability to generate any funding for infrastructure through timber projects is non-existent.

And this is logging's problem? Just like nature but exponentially faster, industries change and adapt. The forestry and wood products industries of today have experienced a similar evolution in technology over the past 30 years as has happened in the computer industry. But still, we hear the hue and cry of days gone by....

As to the $100+ million on permitting and $100+ million in fish ladder mitigation that was mentioned as an argument as to why decommissioning was the right choice. The analysis and process required by the California Environmental Quality Act (CEQA) for dam removal including the 20,000,000 cubic yards of sediment (perhaps toxic) behind the dams is going to approach the money spent on permitting, so there may be no appreciable savings on "bureaucratic paper." The best solution to mitigation for fish passage has not even been looked at adequately. There is an alternative that connects two creeks (Bogus Creek and Cold Creek) by a short canal that would bypass the three dams that don't have fish ladders and cost far less than the exorbitant figure seized on to make fish passage appear prohibitive.

And, finally, there has been absolutely no credible investigation on what decommissioning is going to cost. There have been some people in the know who are throwing around a figure of $1 billion total. However, virtually nothing official has been done to yield something that would give us the ability to assess feasibility or generate some sort of Cost/Benefit analysis. In other words, the figures being bandied around are not comparing apples to oranges, they are comparing apples to.....nothing!!!!

There is absolutely no denying that mitigation of dam impact is challenging. It may, in fact, be prohibitive and decommissioning the least bad alternative. At this point, however, the Powers-That-Be have decreed that America shall experiment with dam decommissioning in an effort to set America's rivers "free." And the Klamath River has been selected as the guinea pig. Viewed in the light of experimentation, our area probably is the best place to try this idea out. No large urban populations, with money, lawyers and political horsepower to combat the iniquity. No one here but us poor people, and damn few of us to boot (read: the local uproar is manageable). And the watershed is probably in excess of 60% federal ownership. For good or ill, Siskiyou County will almost inevitably be the poster child of America's return to "wild" rivers.

So, this whole thing is fraught with political hardball, uncertainty and hardship. Portraying it as anything less is irresponsible. But then again, personal responsibility has been vanishing from the American character at an alarming rate since my generation (Baby Boomers) came of age... .

26 Feb 2010, 2:54pm
by Leo "T" Bergeron

A great piece, could not have done it any better myself!!!!!! My hat is off to Mr. Costales.

The shame of it all is that the supporters of this movement to remove these dams are stupid. They accept fantasy and hype for facts and feel good about it. Get real, check it out!!!!!!!

*name

Outline for Todd Neeley meeting 5/18/11 by the Siskiyou County Water Users Association

- Overview of KBRA –

- 1820s to 1850s. Explorers such as Ogden, Abbott, Kroeber, and Freemont documented references to the upper Klamath Basin as a difficult region for both them and Indian tribes to survive having extensive marshlands of contaminated non potable warm odorous waters conducive to disease. Statements to them by tribes was that anadromous salmon were not known above the current Keno (Spencer Creek/Copco dam) area.

- 1850s to 1880s. Gradual 'settlement' of upper basin region contended with difficulties of extremes of climate and environmental conditions and investigated options to optimize and stabilize those conditions. Chronicles were written by authors such as Gibbs regarding lower Klamath conditions, its naturally extremely poor river water quality, diseased condition of salmon, and the lower Klamath Indian built fish dams blocking the river to trap migrating salmon.

- 1890s to 1920s. Studies such as those by Evermann, Lietretz, and Boyle documented conditions and supported the movement by locals in conjunction with Bureau of Reclamation to consolidate marsh waters to reduce contamination which reduced high volcanic phosphorous absorption, expose inundated areas as productive agricultural lands using a fraction of the previous water lost to percolation and evaporation, assure waterfowl refuge area with reliable forage from surrounding agricultural production, and use that saved previously closed basin water plus man-made accessible water storage from the Upper Klamath Lake to augment flows in the Klamath River frequently going subsurface in the canyon below in late summer before the Project. Electricity to support the Project pumping was to be supplied at cost by agreement with Siskiyou Power Company (later Copco) in exchange for the advantage of increased summer water flows making generation feasible. A hatchery at Fall Creek was built at the time to supplement the few affected salmon habitat areas immediately above Copco Lake. The Project was considered extremely successful on all counts. Copco Lake comprised a fraction of the surface area with much deeper and colder water provision than the shallow (0 – 6 feet deep) much larger warm bodied Upper Klamath Lake immediately above, and sequestered much of the nutrients natural to it. Many of the greatest salmon runs occurred long after dams were in place.

- 1930s to 1960s. Concern over sudden salmon decline in the late 30s was determined due to gill netting by Yurok on the lower Klamath which was curtailed resulting in salmon numbers rebounding. The Klamath Tribe sold their reservation, petitioned to have it given back, only to sell it again. During this time and with little opposition, Government agencies were known to have tried several times to eradicate sucker fish in upper basin but failed.
Though locals experienced dams greatly reduced riparian flood damage in the erosion prone upper river, repetitive flood damage still occurred due to yet insufficient storage capacity to fully moderate incoming flows. Locals supported addition of Iron Gate Dam immediately below Copco to give added capacity to

moderate the spring floodwaters, summer John Boyle pulses, and help with late summer Klamath flows. Locals below the dam saw tremendous success and improvement in riparian stability, water quality and flows. In sequestering naturally high nutrients, the far more consistent late summer flows below the dams also saw far less periphyton (moss, algae, and aquatic plants harboring indigenous polychaete worm hosting Ceratomyxa Shasta salmon parasite). Iron Gate Hatchery was then built to mitigate both the handful of salmon blocked Fish and Game designated 'marginal' habitat creeks and those at Copco formerly mitigated by Fall Creek Hatchery. Much 'colder than natural' lower lake water as a result of the dam allowed one of the most productive hatcheries in the state. The region realized improved separated fisheries both above and below the dam. The benefits on all counts were hailed for decades as a tremendous unquestioned success, all managed under the openly negotiated equally based legislated into law Klamath Basin Compact.

- 1970s to 1990s. Environmentalists take aim with an agenda focused on the Klamath region where mining, timber, and agriculture formed the ongoing economic base of a relatively stable community living closely with their environment. With mining the smallest fraction due to increasing impediments on state and federal lands comprising over 60% of regional property, mining was shut down through lawsuits and fear driven by media highlighting any 'abuses' as the norm. Agenda implementing environmentalists later funded operatives, such as Felice Pace founding the Klamath Forest Alliance, to shut down logging through repetitive lawsuits using the locally known and subsequently proven fabrication of spotted owl 'declines' in a region based upon sustainable harvest for nearly one hundred years. Effectively destroying that industry devastated those unheeded regional people who stated that forest harvest management shutdown would see their precious environment and timber resources lost to repetitive cycles of burning brush. (30 years of unmanaged fuel growth later in a county still economically reeling have seen surviving residents lose precious forests, homes, and sustainable environment to uncontrollable massive fires. Those fires have likely caused far greater massive killing of species, erosion, sedimentation, contaminated water and air pollution than any 'human caused' impacts. In spite of a study confirming that increased wildfires are primarily due to forest shutdowns, environmentalists now simply claim the destruction is 'good for the environment' and the fault of nonexistent regional 'climate change' and 'prior forest management' curtailed over 30 years earlier. Those and additional personally benefiting 'environmental' groups now with even greater funding have simply moved their broken prior promises of benefit 'to the mouth of the Klamath' as their 'next step' lucrative cause).

In the late 1970s, after a armed and media supported standoff with Yurok Tribes when Fish and Game attempted to enforce laws against their renewed illegal gill netting and commercial salmon take on the Klamath, secret negotiations were conducted and 'legal decisions' resulting in Department of Fish and Game backing off enforcement and 'aligning' with and funding 'environmental' Tribal interests. (The renewal of extensive and unregulated salmon gill netting banned since the 1930s, perhaps coincidentally, coincides with the recent 'decline' in Klamath salmon in an ecosystem remaining virtually unchanged except for decreased human impacts over the prior hundred years). In 1991 many of those Agencies, groups, and Tribes created the Dept of Interior's 'Long Range Klamath Plan' setting the assumptions and format for dams' removals and resource reallocation using the then pending FERC

Klamath Dam's relicensing. (In the first dams' relicensing event 50 years prior, approval was easily made as many of the regional residents familiar with the pre and post Project Klamath conditions were still alive). Dams were constructed to enhance the environment and water quality as well as create farmland from reclaimed naturally contaminated marshes, which proved very successful. Prior to the Project, naturally occurring mercury was panned from the marsh banks and often toxic geothermal springs were used to heat Klamath Falls. However, the pending Dams' relicensing by FERC was seen as opportunity by environmentalists/media/government agencies to force a precedent resource and asset reallocation agenda upon the region's area and people using Pacific Power's (PP&L) coerced 'cooperation'.

Funded by Interior and Environmentallsts, Klamath Tribes filed constant litigation against ag for 'water rights' sold along with their reservation, seeking to once again restore the reservation and have authority over water usage. Karuk and Yurok Tribes filed lawsuits suddenly claiming 'impacts' to Klamath water 160 miles downstream from dams accounting for less than 15% of the water below.

National Marine Fisheries launched a campaign to both obtain ostensible takeover of 600 feet (300 feet on either side) of every stream and river in the Klamath Basin, along with 'authority' over every square foot of ground that drains into any stream or river, based upon constructed 'threatened' salmon status. Under their 'review', 1996 studies showing protected compounded predation of up to 80% salmon stocks, exponential international ocean harvesting of 2 million tons, and cyclical ocean conditions, were determined of little impact. However, the less than 2% assessed Trinity 'human impact' and the unquantified but greatly reduced Klamath 'human impacts' compared to those existing during claimed historical 'salmon runs' were considered 'unacceptable'. Their overstepping position and illegal basis eventually resulted in withdraw of the 600 foot taking, but effective oversight of all ground was assumed. NMFS (aka NOAH) was a federal lead on the 'Long Range Klamath Plan' and a seated member of the subsequent KBRA.

At the same time, the Scott Valley in Siskiyou County was targeted by ESA driven CA Fish and Game and CA Water Quality TMDL (Total Maximum Daily Loads) 'research and recommendation' programs. Seeing the pending massive expansion of regulatory intent, locals responded with showing their voluntary initiatives already taken and continuing through locally created Resource Conservation Districts. Claiming benign 'cooperation' and offering funding through RCDs to 'aid' in 'projects' and staffing, RCDs soon became an enforcement arm of the two agencies dependent upon funds for operation and later agency determined 'necessary' projects.

- 2001 - Pushed by environmentalists and the Klamath Tribe asserting water control, the agencies required 'shutdown' of upper Klamath Basin ag water to 'save' sucker fish by raising lake levels, claiming suckers were 'endangered' and facing imminent extinction. Locals said if they wanted to benefit suckers, raising water was the worst thing to do and they rather should lower water levels to allow suckers their natural competitive advantage. Unheeded, over 1200 of those homes, lives, and futures were lost. Only 8 years later did Fish and Wildlife acknowledge that they knew little about suckers and were now spending taxpayer millions to build a hatchery to 'study' sucker needs. It also was discovered

that the 'endangered numbers' were intentionally or incompetently flawed and there were actually many times more suckers than cited for 'endangered' status.

At same time, Bruce Babbitt working in conjunction with a group formed under the World Wildlife Fund created the Soda Mountain Monument originally slated to include portions of southern central Oregon and extending into California to the Klamath River east of Interstate-5, but after much opposition the monument was retracted back to the Oregon border before executed by executive order of Clinton. The following year BLM attempted to 'expand' their California 'Horseshoe Ranch' to encompass the same exact previously intended California Soda Mountain Monument territory, stating their sudden 'need to preserve the biodiverse region'. Only after additional extensive opposition exposing falsified documents and failed 'Horseshoe Ranch' mandates, BLM withdrew the proposal. In 2010 secret documents were leaked of Interior Salazar's plan to create many new monuments by executive order including the 'Siskiyou Cascade Monument', effectively greatly expanding the current monument encompassing an area west of I-5 to the coast range and from well within Southern Oregon south to the Klamath River. The secret papers also included the 'extension' of the Soda Mountain Monument to once again include the area south of the Oregon border to the Klamath River. That fully developed 'unacknowledged' document is currently engendering opposition but remains pending, during which time Salazar released his 2011 'changes' to Interior's mandates defining himself the power to 'administer' lands in a new direction 'for the people' and creating a new 'designation' of regions 'requiring protection' as 'Wildlands', which as of this writing is pending.

- 2002 – Occasionally happening throughout Klamath history, a combination occurred of a salmon run concurrent with high day and night temperatures in the lower Klamath. A salmon kill happened nearly 160 miles downstream from the dams. Initially reported as 13,000 fish in a specific stretch of river, over the years those 'most massive fish kill' numbers have escalated to over 80,000 reported in media and rhetoric, with most unsupported 'generous' formal accounts actually estimating it at around 33,000. A known methamphetamine dump had also occurred immediately above and just prior to the kill but the kill was well over by the time water was tested. In spite of the incessant media repeated 2002 farmer caused low flow 'salmon kill' rhetoric, reports seldom include the fact that the run still realized one of the best overall returns, and the National Research Council found it not a result of upper Klamath water releases. In fact, the flows at the Klamath dams had long been kept unnaturally high at the time of the kill.

Using money from international environmental groups and 'grants' from Dept of Interior's BIA and Federal and State Environmental agencies, select profiting tribes and NGOs (non-governmental organizations) supplied 'directed' studies and 'mitigation wish lists' often unrelated to dams' operation, to FERC pushing to make PP&L operation conditions economically unfeasible while simultaneously filing repeated litigations against PP&L for 'water quality impairment'. FERC accepted those 'mitigation recommendations' rejecting all other alternatives and thereby proposed 6 extortive 'relicensing' options with only 2 being remotely economically feasible short of dams' removals including the one

'recommended' at PPL breakeven at best and one at substantial PPL loss compelling 'economic' decision.

Coincident with Agencies' 'scoping' and permit revisions, the Karuk Council launched a grant funded public media campaign with NGOs alleging 'toxicity' from dams without a single reported health related case occurring in a hundred years of existence, but nonetheless filing litigations, media campaigns, and 'posting' the lakes and Klamath in conjunction with Water Quality and CDC and against local county findings. A subsequent CDC 'study', while spending the vast majority of its report on the potential 'dangers' of microcystin, could report no found evidence of health impairment.

To bypass the well functioning 50+ year legislated and equally based Klamath Basin Compact, the majority of those same described players including Federal and State agencies/tribes/environmental groups orchestrated the 'KBRA' (Klamath Basin Restoration Agreement) secret meetings requiring agreement to dams removals and the taking and reallocation of assets to sit at the table. To bring agriculture beleaguered by ESA and environmentalist litigation to the table, a promise was made of 'consensus agreements' and 'assurance of water' to seated agriculture in exchange for publically supporting requirement of dams' removals and a new hierarchy (federal, state, environmentalist taking of resources for 'fish first', tribes second, seated agriculture 3rd, and the Klamath Wildlife Refuge fourth, later to change placing Refuge 3rd and ag 4th) A number of upper basin ag districts attended but upon exposed KBRA corruption, broken promises of 'consensus', Board manipulation, and the obvious intent for attrition of majority agriculture, most could not accept conditions they knew would be destructive to the environment and region. Given preferential position, the KWUA (Klamath Water Users Association) and TID (Tule Lake Irrigation District in California) agreed to publically 'represent' agriculture. Actually representing less than 10% of agriculture, that effectively made the vast majority of ag unrepresented and intentionally subject to indeterminate shutdowns. The self created KBRA terms enjoy a self appointed Board, will have legislated charted 50 years of funding (a minimum of 2 billion dollars initially, one before dam removals and one after), and protected unaccountable authority with the only recourse of affected individuals being 'presentation' of their 'grievance' to the Council. Not requiring their own decisions to be successful, scientifically supported, or historically proven, they grant themselves (26 benefitting special interest groups at signing) the right to unhindered 'adaptive management' without consequence.

Several of the lead seated federal agencies (BOR, Fish and Wildlife, etc) instrumental in creating the KBRA are under direction of the Secretary of Interior (then Kempthorne). Upon that preconditioned exclusionary KBRA creation in secret, the Secretary of Interior also created and administered the AIP (Agreement In Principle) (later called KHSA – Klamath Hydroelectric Settlement Agreement). Held in the same exclusionary Interior mandated secrecy as the KBRA, seating was allowed only to those accepting all terms and dams removal objective coercing PPL 'cooperation'. Governors Kulongoski and Schwarzenegger seeking environmental political standing included the complying threat and benefits of the resident States.

Further 'prompting' PPL, CA Water Quality suddenly 'decided' to revise long standing CEQA 401 permitting 'standards' ignoring 'public input' to make 'lake' water unacceptable and effectively eliminating the only 'break-even' option allowed under the closed FERC Report. In addition to threat of 401 permit refusal demanding dam removals and the promise of continued 'litigation liability' if 'negotiations' failed, both of which are legislated away if PP&L 'cooperates', Interior also offered PP&L extensive financial concessions placed upon the unrepresented backs of ratepayers and the regionally affected majority. Presenting PP&L with absolutely no viable alternatives, a great many far less costly of which have been presented throughout the entire 'process' and rejected out of hand, Interior and other KBRA seated members now pontificate to the public how they support Pacific Power's right to make a 'business decision' in its best economic interest

Upon 'signing' of the KHSA and adopting the absolutely least estimated cost of dams' removals of close to half a billion (see CDM Report), a 'proposal' was sponsored by Oregon Governor Kulongoski for SB 76 legislated ratepayer bypass of PUC funding paying not only the 'capped' portion for dams' removals but also the 'unreported' majority of KHSA PP&L 'concessions' and 'mitigations'. SB 76 senate committee, ignoring much public input against, still passed 'in support of a politically expeditious agreement', but only after undisclosed behind closed door concessions to the Oregon Manufacturers as the only powerful and well funded entity in opposition apparently warranting political concern.

With KBRA projections of a taxpayer funded minimum 2 billion dollars to be funneled through the seated members, the Secretary of Interior presented the already signed KHSA 'agreement' for 'public process' 'administered' by his own agency (USGS) and aiming for eventual 'congressional approval'. 'Studies' to be 'reviewed' by USGS for 'recommendation' still leaves the ultimate 'determination' to be made by the Secretary alone. His terms mandate only 'fisheries', and 'in his opinion', whether removals would 'harm' salmon and suckers, and whether 'in his opinion' it would be in the best 'public interest', 'considering but not limited to regional impacts'. While the Secretary and KHSA acknowledged KHSA/KBRA being intrinsically tied together and the intention for KBRA to be also implemented upon 'approval' of KHSA' under limited KHSA 'review' criteria, the KBRA 'agreement' is not directly being 'assessed' for legality, self appointed authority, Constitutional compliance, equity, or consequence for damages to community and environment beyond any 'actual harm' to salmon and sucker fish. Interestingly, the KHSA validates the KBRA requiring dams' removals and the associated asset reallocations and hierarchy overriding the Klamath Basin Compact, regardless of final Secretarial 'determination' concerning dams' removals. In the unlikely event the Secretary instrumental in creating the prerequisite of dams' removals would find against dams' removals, the exorbitant ratepayer/taxpayer costs would still be incurred by requiring implementation of KBRA seated member 'wish lists' demanded under the closed FERC relicensing requirements.

In the meantime CA Water Quality staff working with 'memorandums of understanding' are creating mutually compatible TMDLs reinforcing KBRA reallocating positions. Catherine Kuhlman, head of North Coast Regional Water Quality and also simultaneous employee of US EPA stated her intention in public to see the Klamath dams removed long before research had been assigned or 'scoping' performed. The original 'research and recommendation' begun by North Coast Regional Water Quality in Scott Valley

TMDLs was transformed by them into 40 years of unaccountable judicial enforcement under the 'progressive' Shasta Valley TMDL, with those authorities made retroactive to the Scott. The Klamath TMDL now being finalized expands Shasta TMDL unaccountable subjective authority and self determined requirements and fees to include even greater restrictions and KBRA 'MOU' agreements, making all retroactive to the Shasta and Scott.

Also, CA Department of Fish and Game (DFG), as a seated KBRA creating 'member' independently launched their drastically onerous newly 'interpreted' 1602 and created ITP (Incidental Take Permit) requirements, along with a DFG proposed legislated passage of 'agencies' ability to charge 'permitees' for generating a 'fully funded budget'. After a group exposed DFG's illegal threats, intimidation, and abuses used in attempting implementation of 1602 'permits', DFG publically replaced the regional head, Mark Stopher identified as responsible. In spite of that proven abuse, Mark Stopher was and continues to be the lead 'creator' and seated negotiator for the State of California on both the KBRA/KHSA 'agreements'. His then 'assistant', Neil Manjii, stepped into his '1602' public position, with a recent judicial decree that the permits aren't restrictive enough and to virtually ignore private property rights. Throughout this time, DFG has practiced killing of <u>all</u> hatchery harvested marked and unmarked returning coho and Chinook salmon known able to spawn instream, have routinely 'marked' salmon by clipping off the upper jawbone greatly reducing survivability, and have required 'diversion removals' increasing temperature, destroying refugia, and reducing salmon populations. Agencies working with NGOs are coercing 'purchases' of primary water rights throughout the region, and the demanding those unused water rights normally available to downstream users be untouchable as 'environmental' water. Claiming purchases such as the Big Springs Ranch in Montague would 'relieve' ranchers from increasing fisheries' burdens, shortly after the Big Springs purchase a call was made to extend 'habitat' designation well above Dwinell Dam.

NMFS, a seated founding KBRA lead, is the primary responsible agency requiring unnaturally high flows down the Klamath for over 10 years resulting in severe manmade water shortages and human hardship and loss with <u>no</u> corresponding statistical salmon improvement. In 2011, NMFS newly demanded even <u>greater</u> suddenly increased life and property threatening flows with virtually no public warning to flush 'disease carrying periphyton' exclusively for the area immediately below the dams. Insanely, there was almost no periphyton prior to the flush in that reach which another study recently found to have the highest salmon survivability in the Klamath from the dams to the coast range a hundred miles downstream. That continued unsustainable release will likely create future precedent oppression in the upper basin beyond one of the greatest snowpack years on record. All agencies and members of the KBRA hailed the action as an example of the 'cooperation' attained under the terms of the KBRA (which by law should have no legal authority at the time).

Throughout this entire so called 'process', the Shasta Tribe in opposition to removal of dams within aboriginal ground have been completely shut out. Against the loss of improvements to environment, loss of clean power, and the exposing of now underwater burial sites, their ignored pleas under the KBRA terms instead divide 'fishing rights' between seated Klamath and Karuk Tribes to aboriginal grounds they historically never held. In effect, the Shasta culture is being erased by KBRA special interest decree.

The majority of above regulatory actions and 'requirements' are based upon the 'determination' that the indistinguishable DNA identical hatchery spawned salmon are 'different' from so called 'wild stocks', thus artificially creating a 'threatened' species. It is well proven that a large percentage of hatchery spawned salmon as well as salmon from other watersheds repopulate the Klamath mainstem and tributaries and are indistinguishable from, and counted as, 'wild' stocks. In fact, coho salmon were never known native to the upper mid stem Klamath and failed attempts at planting coho had occurred since the 1800's. Only after 3 additional attempts under the improved Klamath conditions from Iron Gate was the 3rd attempt considered marginally successful using Cascadia stocks and from which returns the 'threatened' coho status is based. With Klamath DNA identical hatchery salmon mitigating natural cycles and human harvest since the late 1800s, a large portion of 'justification' from benefitting interests demanding 'dams removals' is to eliminate hatcheries and hatchery spawned salmon from the 'gene pool'. Hypocritically, it is anticipated by the same promoting groups that dams' removals will likely extirpate all indigenous salmon from the Klamath which can only be replaced years later by hatchery reared stocks. With removal of Iron Gate dam providing the 'unnaturally' cold water allowing successful hatchery operation, the KHSA imposes upon unrepresented PP&L ratepayers, among a multitude of other costs, the burden of 'providing alternate cold water' not known to exist in the area or constructing an entire hatchery elsewhere.

With contradictory 'cold water' salmon upper basin 'warm water' sucker fisheries being the only two considered, all other world class local fisheries upon dams' removals stand a high chance of extirpation, such as the bass and brown trout, through competition, predation, habitat alteration, and introduction of disease.

Recent studies (ie 2008 Columbia Sockeye Salmon Study) confirm that 'riparian conditions' have had virtually no effect upon returning salmon populations, but are rather an effect of ocean conditions. While likely cyclic increased ocean temperatures have driven much salmon habitat northward, Pacific fisheries' harvests are over 250% greater than in the 1950s. With virtually all Klamath Basin 'human impacts' tremendously reduced over the past hundred years, the only recent 'significant' changes have been international offshore fishing, shifting ocean conditions, exponentially increased protected species' salmon predation, and resumed Tribal gill netting. With those being the only significant quantitative increases during claims of salmon decline, then maintaining an optimized hatchery augmented population is the only reasonable way to assure sustainable returns.

Funded rhetoric is assuring residents of governmental competence and financial benefit from future 'environmental money' 'offsetting' regional financial devastation and uncompensated asset reallocation. However, that 'competence' is frequently regionally revealed as in the recent spending of over 4 million taxpayer dollars to build 3 'islands' in the upper Klamath Basin. In an area being ravaged to create historically non-existent habitat for salmon, the islands were built to transplant tens of thousands of Caspian terns from the Columbia River. The 'reason' for transplant is due to the severe pressure on the Columbia fisheries from the terns consuming millions of salmon smolts. The local 'economic benefit' of those contracted Agency administered funds was the temporary hiring of 4 resident laborers and 'attendance at a charity BBQ'. Dams' removal and 'mitigation' contracts will produce the same results, particularly since funding is 'only' to be provided correcting damages affecting salmon or sucker fish.

Even before being completed or determined legal, the unrepresented Pacific Power ratepayers are already being burdened with KHSA 'agreed' tremendous cost increases just beginning to be imposed for 'mitigations' often totally unrelated to PP&L operation. Due to just the possibility of dams' removals and the locally known consequential regression to environment and property rights, property values along the Klamath have already plummeted far beyond the current real estate downturn with properties by the lakes being virtually unsalable at any price, causing many to suffer the loss of their homes. Obvious opposition, in the face of well funded rhetoric claiming otherwise, prompted a vote in Siskiyou County to determine the opinion of people whose region maintains 3 of the 4 dams proposed for removal. With virtually no money to fund opposition and tens of thousands of outside dollars promoting 'jobs for removals' in an economically distressed county, nearly 80% voted against dams' removals. Concurrently in Klamath County unaffected by the dams a vote was held to determine simply whether the county should remain at the then yet unfinished KBRA table. Reportedly hundreds of thousands of dollars were directed at the public also promising many jobs and a 'final agreement benefitting all'. Even with that campaign and vague directive, the vote was barely a majority to continue sitting at the table. Interestingly, the money funding the promotion in both counties was from California Trout, deriving a portion of its funds from Ca Department of Fish and Game, and a 'formed for the purpose' group called PROSPER, who though not publically disclosed were found to be formed of several seated KBRA benefitting members, with funding appearing to involve agency and NGO grant monies targeted for 'education'.

In spite of current science refuting KBRA oppressive failed theory basis and many ignored far less expensive and more effective presented alternatives, as of now the KBRA/KHSA creators are already implementing the previously failed 'agreement' 'policies'. By mutual agreement carried on in contradiction to the legally established Klamath Compact authority while waiting for the Secretary to 'objectively determine' approval of the plan and the objectives he was instrumental in creating, those policies even now being implemented are proving the progression towards inevitable elimination of the vested majority. Escalating power costs, decreasing property values, uncertain water for the 90% unrepresented ag, insurmountable permits/EIR/fees to pay for increasing agencies and programs and time delays incurred, vacillating 'adaptive management' requirements, and the inability to make timely, responsive, experienced, and knowledgeable decisions regarding vested interests upon which quality of life and environment depend, can only lead to eventual attrition for all but the unaccountable seated few, the wealthy, and corporate agriculture able to pass on uncertainties and increased costs to the public.

Conclusion: Klamath history was historically worse pre project, salmon were never known in numbers above Spencer Creek (in the vicinity of Copco), the Klamath Project and Dams were in place for nearly a hundred years and considered extremely successful and beneficial for all uses including fisheries until 'dams effects' claims of arguable recent salmon 'decline'. Regional 'human impacts' during this 'decline' are a mere fraction of what they were during the often repeated 'huge salmon runs' with many of the greatest runs actually occurring long after dams were in place, Half a billion dollars in 'restoration' based on asset reallocation 'theories' over the last 20 years have produced 0 statistical benefits and increased declines. Increased Klamath River flows for over 10 years for salmon have resulted in 0 statistical benefits and increased declines. Sucker fish 'estimates' justifying 'endangered' status were fabricated and later discovered faulty with no change in authoritative designation (Vogel). Higher Upper Klamath Lake levels occurring for 10 years at tremendous loss to the regional community has resulted in 0 statistical sucker fish benefit. The KBRA is advancing those failed theories and historically unattainable goals into unaccountable chartered 50 year 2 billion dollar funded authority, 'governed' by a minority of self appointed special interests. Their rules leave little recourse to the unrepresented affected majority in opposition. The grossly minimized stated costs (see CDM Report) of dams' removals to assure public and congressional acceptance places that understated burden on the unrepresented taxpayer/ratepayers/region landowners and guarantees underfunded environmental Klamath disaster and unattainable KBRA/Agencies' goals. Unattained goals will greatly escalate already devastating regulatory oppression. KBRA protected special interest minority mandates accelerated by the likely 'determination' for dams' removals carries no assurances and has less than zero history of success posing tremendous potential for environmental unrecoverable disaster.

Under current KBRA/KHSA terms it is those seated on the KBRA, corporate agriculture picking up prime lands for cents on the dollar, and NGOs 'administering' acquired remaining lands, who will profit mightily.

TMDLs, 1602s, ITPs, 401s and many more interrelated requirements implement costly already regionally failed boilerplate mandates eliminating the input and judgment of the experienced vested knowledgeable in the region suffering the greatest consequence of decisions. Subjective and arbitrary 'adaptive management' requirements by all of the Agencies involved assessing self supporting fees and EIRs to force an unattainable 'agenda' will destroy the very environment and peoples which support them. Those conditions have already cost the lives, homes and futures of many, and unless stopped now, will invariably cause the attrition of most of us here today.

PETITION

CLASS ACTION LAWSUIT

We the undersigned hereby declare our support to carry out a Class Action lawsuit for recovery of funds which have been taken from us against our will by actions of PacifiCorp and the California Public Utilities Commission for the removal of the Klamath Dams providing clean hydropower to Siskiyou and other northern California counties. A referendum known as Measure G was approved by nearly 80% of Siskiyou voters to keep the Klamath Dams in place. Yet, a cabal of State and Federal Agencies, various Tribal groups together with a number of so called environmental groups have conspired to destroy the Klamath Dams no matter the environmental damage to the eco system, to ranchers, farmers, businesses and the general populace. Removal of the dams amounts to a substantial threat to the health, safety and welfare of our area.

These same parties as part of a newly revised KHSA agreement are now trying to remove all potential liability to themselves and their cohorts by creating a third party shadow group to be called the Dam Removal Entity, a faceless group in New York City being given title to the dams with a requirement to destroy them. In addition the DRE is being given the money held in trust collected from the consumers of PacifiCorp together with a promise of TWO HUNDRED FIFTY MILLION DOLLARS ($250,000,000) of taxpayer money. No regard is being given to the ultimate destruction that will result to the Klamath River or those who depend on it. The U.S. Department of Interior has attested in the EIR EIS to significant damage to the eco system that will result from removal of the hydropower facilities. No one can assure the return of the Klamath or its fish to its natural beauty. It is our belief that damage in Siskiyou County alone may exceed ONE BILLION DOLLARS ($1,000,000,000). We are therefore advocating that a bond in the amount of FIVE BILLION DOLLARS ($5,000,000,000) be created by the State of California and PacifiCorp to be held by a neutral third party naming the County of Siskiyou and its citizens and PacifiCorp consumers as beneficiaries of said bond. In addition should damage occur the perpetrators of the amended KHSA shall be held accountable jointly and severally for damage to the eco system, businesses and land value impacts.

(signatures follow)

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Jenny O'Gorman	Jenny O'Gorman	108 Jenny Ln Yreka, CA 96097	(530) 842-7604
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Sally McCoy	Sally McCoy	217 Wetzel Way Yreka CA	YrekaMccoys@sbcglobal.net
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Greg Hood			(530) 643-2129
TRISTAN ALLEN			530 598-6267
Daven Dark			530-340-1960
Don Knowles			559 285-0104
Greg Kuck			530-454-3248
Carlos Aguiniga	Carlos Aguiniga		530 598 8198
Greg Horne			530 357-1290
John M Knight			530 459-5752
Scott Pynes			530 -598 7662
Gary Haceton			530-598-4455
Ernie Rizzo			530-643-1623
Dustin Brown			530-598-5058
Tim Wilmer	TIM WILMER		530 459 0417
Herman Meeuwenberg			530 598 9990
Olive Darlene Johnson			530-459-5416
William Mowen			530-468-5720
Stacy Sanders	Stacy Sanders		530-598-8095
Michael Sanders			530-598-0595
Matthew I. Evans			530-643-3984
Brandis Geib			530-643-3554

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Bob Jochim			530 598-4628
Chris Taylor			530-926-1776
Claudya Akkerman			530 598 2220
Robert O Bell			530 459-5788
Michael Cavere II			530-340-3607
WAYNE Borch			530-598-0945
CASEY BIGLER			530-598-6320
Marlin Harrison		5128 BL, MT, RD Montague, CA	951-541-1767
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Dana J Enselle		1706 Airport Rd	530 598 7834
Tom Roberts		Montague, CA	
JARED KLOMPARE		MONTAGUE	
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Rebecca Davis	Rebecca Davis	17114 Janice Rd Montague	(831) 246-2753
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Paul Muelrath	Paul Muelrath	9410 Azalea Dr. Etna, Ca. 96027	(530) 905-0710
Christopher Muelrath	Christopher Muelrath	9410 Azalea DR Etna Ca 96027	(530) 467-3356
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Diane Olson	Diane Olson	B471 Forest Lane Etna	530-598-2781
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Peggy Arton	Peggy Arton	890 Sawyers Bar RD Etna, CA	530-467-3762
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John Anderson	John Anderson	PO Box 5 Greenview CA	530 468 4033
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Lisa Hayden	Lisa Hayden	4901 NHW 43	530 467 3034
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Margaret Johnson	Margaret Johnson	460 Scott Valley Rd	Etna Ca 530-598-4508
Charles Kelly	Charles Kelly	Box 28	Greenview, CA 96037
Heather Whitchurch	Heather Whitchurch	4121 French Creek Etna	530-598-0796
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Bill Parry	Bill Parry	424 Main Dr Etna	530-598-5983
Dennis Thomas	Dennis Thomas	613 Yreka Ty Yreka CA	530-310-4489
Roy Besosin	Roy Besosin	424 Kidder Ck	—
Wm Wise	Wm Wise	1535 Shasta View dr	5419731657
Kaydee Watkins	Kaydee Watkins	Etna Ca	—
Nick Kraus	Nick Kraus	Po. Box 1086 Fortuna	(530) 598-1857
Jeremy Ravenscroft	Jeremy Ravenscroft	9100 Belgian Ln. Ft. Jones	(530) 510-1770
James Kurtz	James Kurtz	5447 Scott Rv	530 340-2670
Jarrett Airhart	Jarrett Airhart	3622 North Kidder	530(410) 7042
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ALAN LABRIERE	Alan Labriere	10409 QUARTZ MT. LO RD	4682925
Mary STREETER	Mary Streeter	10409 Quartz Hill	468-0945
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Gordon Thomas	Gordon Thomas	1837 Sawyers Bar Rd	530-467-5727
RICK Gephart	Rick Gephart	9521 ORO Fino Rd	530 598 0948
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Dylan Berryhill	Dylan Berryhill	6917 Myrtle St	598-9612
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Karen Gilmore	Karen Gilmore	715 South Fork Rd Callahan CA 96014	530-467-5681
Rhonna Sanders	Rhonna Sanders	535 Main Street Etna CA	530-65-2829
Antonia Ryder	Antonia Ryder	9015 Quartz Rm Rd	530-468-5326
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Dennis Jervey	Dennis Jervey	6904 Shackleford LN	468-4758
Trevor Dunay	Trevor Dunay	14447 McAdams Cr Rd Ft Jones CA	468-2789
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Anne Bradley	Anne Bradley	15432 Otter Valley FJ	468 2066
John Bauer	John N Bauer	1907 Sawyers Bar Rd ETNA	530 467 4237
RANDALL HABERMAN		5728 SCOTT RIVER RD	FORT JONES 530 598 6141
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Leon Eisley		CV	— " —
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Linda Zoller	Linda Zoller	9026 Ager Beswick Montague CA 96064	530-459-5054
Charles Zoller	Charles Zoller	9026 Ager Beswick Montague CA 96064	530-459-5054
Debbie Kulpa	Debbie Kulpa	5339 Klamath River Rd	530-475-3537
Charles D Kulpa	C D Kulpa	5339 Klamath River Rd. Yreka	530-475-3537
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Dean Harris	Dean Harris	504 Woodridge Ct	530-859-0758
Mike Adams	Mike Adams	1209 Cleary Maple Horse Cir	530 496 3346
Gerald Benton	Gerald Benton	659 Burke St Yreka	530-842-4426
Dave Somerlot	Dave Somerlot	5334 Agerro	530-459-5358
Della Somerlot	Della Somerlot	Montague 5334 Ager Rd	530-459-5358
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Dell Grissen	DELWIN GRISSEN	2526 Owens Way Hornbrook CA	530-475-0625
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DAVID MARSH	David Marsh	15629 Klamath River Hwy	475-3700
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Debra A Ohlund	Debra Ohlund	81351 Ja Ct Yreka	530-842-2350
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Mary Henry		3115 Fairlane Rd Spc #33 Yreka	(530) 598-3805
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Francis Gill		20820 Ager Beach Montague Ca 96064	(530) 459-5629

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Harlowe Kittle		13747 Rattlesnake Cr Rd Fort Jones CA	
Robert Downs	ROBERT DOWNS	13731 Rattlesnake	
CHARLES R. KITTLE		13747 RATTLESNAKE	FORT JONES, CA
Lynn Wright		13731 Rattlesnake	" " "
Scot Lee		P.O. Box Greenview CA	
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RICHARD OBER	Richard Ober	Grenada, CA	
John McGee	John McGee	YREKA	
George Gleason	George Gleason	Yreka Ca	
Jack Cowley	Jack Cowley	Montague Ca.	
CLIFF MUNSON		GTNA, CA	
Michael Eiler	Michael Eiler	YREKA. CA	
WILLIAM BAKER	W.L. Baker	YREKA, CA	
CAROL BAKER	Carol Baker	YREKA, CA.	
Jerry Reed & Pearl		Yreka Ca	
Mary Pearl	Mary Pearl	Yreka Ca	
Howard Wells	Howard Wells	Yreka CA.	
Audrey Wells	Audrey Wells	YREKA, CA.	
CHARLOTTE RICE	Charlotte Rice	YREKA, CA	
Barbara Hardy	Barbara E Hardy	Yreka, CA	
Brenda Evans	Brenda E Evans	Montague, CA	
Sunday Bogart	A Bogart	Dunsmuir CA	
Douglas Langford	Douglas Langford	Montague Ca.	
MICHAEL P. NEWS	Michael P News	Yreka, Calif.	
KAREN L. Shipman	Karen L Shipman	Yreka, CA	
ALBERT H. Newton	Albert H Newton	Yreka Ca	
Alan Dyar	Alan L Dyar	Happy Camp CA - 493-5262	

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Linda Thornburg		800 South St Yreka	530-842-2815
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Patricia Ferguson	Patricia Ferguson	Gazelle Ca	
Donna Phillips	Donna Phillips	Grenada Ca.	
patricia keyes	patricia Keys	Gazelle, Ca.	
John Elsner	John Elsner	21001 Gazelle/Callahan Rd. 96034	
Jennifer Burleigh	Jennifer Burleigh	21001 gazelle Callahan Rd Gazelle 96034	
Roger Bridwell	Roger Bridwell	5515 Mark Gavich Rd Gazelle Ca.	
Patricia Cates	PATRICIA CATES	Gazelle Ca 96034	
Carl Cates	Carl Cates	Gazelle Ca	
Harry Shelvock		GRENADA CA	
Ken Mouw	Ken Mouw	Montague	
Nancy Mouw	Nancy Mouw	Montague	
Linda Campbell	Linda Campbell	Yreka	
Elaine Taylor	Elaine Taylor	Yreka	
Berta Rowe	Berta Rowe	GAZELLE	
Beverly M Hooper	Beverly M Hooper	Gazelle	
Mary Cameron	Mary Cameron	Mt Shasta Vista	
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Dorothy Gourley	Dorothy Gourley	5231 Klamath River Rd	475-3147
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Linda Oliver	Linda Oliver	20820 Agger Bosworth	530-459-5623
Kenneth E Oliver	Kenneth E Oliver	20820 Agger Bosworth Rd	530 459-5623
LINDA JO YAWN	Linda Jo Yawn	544 N. Main St, Yreka CA	842-1100
John W. Menke	John W. Menke	10935 Quartz Valley Rd Ft Jones	468-5341
[illegible]			
Bethany Elliott	B Elliott		530 340-0680
Ted Knox	Ted Knox	9202 Old English Rd F.J.	468-2486



Sweet River SCIENCES

February 1st 2017

Public Scoping of Klamath Dam Removal 401 Certification
Comments to the California Water Board from Dr. Joshua Strange of Sweet River Sciences

I am writing in support of the Water Board issuing a 401 certification for removal of the Klamath Hydroelectric Project as proposed. This action will provide numerous benefits to the waters of the state, anadromous fisheries, the river ecosystem, and river dependent communities. It will also benefit agricultural communities by reducing the rates of fish diseases. I recommend expanding the mitigations for the East and West Side projects to include additional actions and experiments to improve water quality in Lake Euwana/Keno Reservoir. I also encourage, as a starting point for analyses, the use of the 2012 EIS/EIR and Secretarial Determination Report.

I also want to emphasize the importance of dam removal for alleviating the myxosporidian diseases (*C. shasta*) that are killing excessive numbers of juvenile salmon, reducing the risk of Ich outbreaks in adult salmon, and removing reservoir habitat for toxic blue green algae. These three problems are serious with population level impacts and cannot be mitigated or solved with the dams and reservoirs in place, even under a scenario of successful volition fish passage.

I also direct the Board and its team to further consider and investigate the following points:

1) I have been actively involved with *Ceratonova shasta* (formerly *Ceratomyxa shasta*) research and management in the Klamath River basin since 2005. I have participated in, and been a long-standing member of, previous iterations of the Klamath River Disease Technical Advisory Team (DTAT) (e.g., Bartholomew et al. 2007) and have attended and presented at numerous Klamath River basin fish health workshops. I have assisted with, conducted, and led monitoring and research studies on infected juvenile and adult salmonids infected with *C. shasta* as well as the alternate host, the polychaete worm *Manayunkia speciosa*. My research experience has included logging extensive underwater dive hours sampling polychaete worms in the Klamath River between Iron Gate Dam and the Scott River as well as extensive microscopy of polychaete worms and both types of parasitic spores. I have authored and co-authored multiple reports regarding such studies. It is my professional opinion, based on multiple and compelling lines of evidence, that the single biggest action that can be taken to alleviate *C. shasta* disease impacts is the removal of the four hydroelectric dams and associated reservoirs. In similar fashion, disease impacts will continue to get cumulatively worse in the future without dam and reservoir removal regardless of implementation of other potential management actions. I have served as an expert witness in Federal Court in litigation related to fish diseases in the Klamath basin.
2) Dam and reservoir removal will benefit the agricultural communities in the benefit. Currently *C. shasta* disease impacts are the single biggest threat to ESA listed coho salmon in the upper

Klamath region. This includes coho from the Scott and Shasta rivers, which suffers disease impacts once those fish migrate through the mainstem Klamath River. Without dam removal, these communities will face greater pressure to curtail diversions to mitigate disease impacts. Recently, the BOR is facing a court order to implement augmented flow releases in the winter and spring/early summer to reduce disease impacts from *C. shasta*, which will decrease the amount of water storage available in Upper Klamath Lake for diversion to agriculture. Such flows will be needed until dam removal occur at which time it as anticipated that augmented flows can decrease in frequency and magnitude. Simple state, farmers and ranchers are paying a steep price for the presence of the Klamath Hydroelectric project in form of increased regulations for ESA coho protections, while at the same time receiving no benefits in the form of irrigation storage, flood control, or future discounted electrical rates. These disease impacts are undermining restoration efforts in the Scott and Shasta rivers and the Klamath basin in general. These impacts will continue if the dams and reservoirs are in place even under a scenario of successful volition fish passage. Notably, disease impacts are not expected to shift upriver to Keno Dam under decommission for a variety of reasons, including that no production hatchery will be constructed at Keno.

3) Recently, the FWS Arcata Field Office completed four memos summarizing current knowledge regarding *C. shasta* disease dynamics, which served as the scientific basis for a Disease Management Guidance Memo developed by Klamath basin tribes. The purpose of this guidance memo was to recommend flow based actions that could improve disease conditions until dam removal occurred. These underlying foundation of these recommendations is that dam removal is the key action to alleviate disease impacts but that increased flows are needed in the interim.
4) In my 2012 publication on adult Chinook salmon research (Strange 2012 TAFS), I documented unprecedented slowed migration displayed by adult Chinook salmon in the lower Klamath River regardless of flows. This behavior greatly increases the risk of deadly Ich outbreaks such as occurred in September of 2002. I hypothesized that this behavior is most likely due to thermal shifts created by the Klamath hydroelectric project. Since that time, this hypotheses has been strengthened but ultimately can only be tested by dam removal. I predict that removal of the Klamath hydroelectric project will greatly reduce the risk of Ich outbreaks and the associated need for augmented flow releases, and conversely failure to remove the dams will lead to ever increasing risks of Ich outbreaks in combination with global warming.
5) Global warming impacts to water quality in the Klamath River will be extreme and impossible to mitigate without dam removal. I encourage the use of the most pessimistic global warming scenarios in effect analyses, which I would contend will represent the scenarios most likely to occur in the future.
6) Mitigation for East and West Side projects should include implementation of treatment wetlands in addition to feasibility analyses and pilot tests of engineered approaches to improving water quality and reducing temperature, inducing groundwater exchanges and reverse infiltration galleries.

This letter is brief by necessity but please feel free to contact me for any additional details or information sources.

Sincerely,

Dr. Joshua Strange

The Nature Conservancy
Protecting nature. Preserving life.™
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Mr. Parker Thaler,
California State Water Resources Control Board
Division of Water Rights
Water Quality Certification Program
P.O. Box 2000
Sacramento, CA 95812-2000

Dear Mr. Thaler,

On behalf of the California and Oregon Chapters of The Nature Conservancy, we are writing to express our support for removal of four hydroelectric dams on the Klamath River. Dam removal is a critical part of a comprehensive solution to alleviate the complex water-related issues and disputes that have impacted the Klamath Basin for decades.

The Nature Conservancy is a science-based, solution-oriented global conservation organization. We are guided by our mission of conserving the lands and waters upon which all life depends. We enjoy the support of over one million members, and are engaged in projects on the ground in all 50 states and in 70 countries around the world. The Nature Conservancy has long been involved in efforts to reengineer and remove old dams. We will be happy to lend this expertise as you consider removal of the four hydroelectric dams on the Klamath River.

The Klamath Basin is a priority region for the Conservancy in both Oregon and California. Working collaboratively with farmers, ranchers, tribal governments and local organizations, we have invested extensively in the protection and restoration of native species and habitats while continuing to support the Klamath Basin's working landscapes. These efforts include:

- Using best available science to restore wetland, stream, lake and riparian habitat in Upper Klamath watersheds essential to native fishes and migratory birds;
- Promoting and implementing wildlife-friendly agriculture and ranching methods in collaboration with landowners;
- Working with ranchers and agencies in California to develop a ground-breaking Safe Harbor Agreement that offers regulatory protection to landowners who are undertaking voluntarily salmon restoration projects;
- Identifying opportunities to work with landowners to increase flows into Upper Klamath Lake.

We are committed to collaborating with you and others to develop science-based, multi-stakeholder solutions to restore key river functions on the Klamath River and to address the long-standing resource-management challenges of the Klamath Basin.

Thank you for your consideration.

Jay Ziegler
Director, External Affairs & Policy, California

Catherine Macdonald
Director, External Affairs & Policy, Oregon

31 January, 2017

Mr. Parker Thaler
State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA 95812-2000
Via email to: parker.thaler@waterboards.ca.gov

Dear Mr. Thaler,

This letter conveys the comments of the California Council of Trout Unlimited, and of our Feather River, North Bay, Redwood Empire, Sac-Sierra, El Dorado, Steinbeck Country, John Muir, and South Coast chapters on the State Water Board's water quality certification permit for decommissioning four dams on the Klamath River.

The California Council of Trout Unlimited (TU) and our California chapters strongly support the prompt issuance of the water quality certification permit for this purpose.

The Klamath River, historically, produced the third largest runs of salmon and steelhead on the West Coast. But this amazing fishery has suffered for decades from a variety of problems, including loss of habitat and degradation of water quality related to four dams below Klamath Lake. For Trout Unlimited, the long effort to restore the Klamath and its legendary runs of salmon and steelhead is our highest priority conservation campaign in California.

The revised Klamath Hydroelectric Settlement Agreement and its primary goal of restoring the Klamath River, and pending petitions from PacifiCorp and the Klamath River Renewal Corporation to decommission four dams on the Klamath below Klamath Lake, provide a rare opportunity to restore this river, which is so important for tribes, upper basin irrigators and communities, and salmon and steelhead—the most prized freshwater sport fishes in California.

We understand the Water Board must prepare an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission the four dams. A joint federal and state environmental impact analysis concluded in 2012 that dam removal on the Klamath is in the best interest of the public. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies, which can be relied upon for your EIR. Since 2012, there has been no scientific analysis questioning the conclusions of the 2012 EIR/EIS.

We strongly support restoration of the Klamath River and removal of the four dams. We urge the Water Board to consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

Trout Unlimited's 10,000 members in California, and the many angling-based businesses that provide goods and services for our angling needs, depend on healthy fisheries, especially for iconic species such as salmon and steelhead. Removing four old, unproductive dams on the Klamath River is the key to restoring this fabled fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, we urge you to promptly issue the water quality certification permit for dam removal on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

s/ Cindy Noble
Chair, California Council of Trout Unlimited
President, Feather River Chapter of Trout Unlimited
Portola, CA

Peter Mangarella
President, John Muir Chapter of Trout Unlimited
Oakland, CA

Eric Young
President, North Bay Chapter of Trout Unlimited
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Bill Burden
President, El Dorado Chapter of Trout Unlimited
Placerville, CA

Christy Fischer
President, Steinbeck Country Chapter of Trout Unlimited
Carmel Valley, CA

Bob Blankenship
President, South Coast Chapter of Trout Unlimited
Long Beach, CA

From: Nell Scott <nscott@tu.org>
Sent: Tuesday, January 31, 2017 10:37 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

Other key points I urge you to consider:

1. The 2012 joint California and federal EIR/EIS and related documents concluded that dam removal on the Klamath is in the best interest of the public. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies, which can be relied upon for your EIR.

2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Nell Scott, Trout Unlimited
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WDC is a registered 501(c)3 non-profit organization.

State Water Resources Control Board
Division of Water Rights
Water Quality Certification Program
Attention: Mr. Parker Thaler (parker.thaler@waterboards.ca.gov)
P.O. Box 2000
Sacramento, CA 95812

February 1, 2017

Dear Mr. Thaler,

Whale and Dolphin Conservation (WDC) is the leading global charity dedicated to the conservation and protection of whales, dolphins, and their habitats worldwide. We are writing to request that the California State Water Resources Control Board (Water Board) fully consider dam removal in their Environmental Impact Report (EIR) and subsequently issue a water quality certification in time for the Federal Energy Regulatory Commission (FERC) to approve dam removal by 2020 to prevent the extinction of critically endangered Southern Resident orca population. This unique community is the only Resident orca population to utilize the California Current ecosystem and is one of the most endangered marine mammal populations living in US waters[1].

Added to the Endangered Species List in 2005 with 88 members, the Southern Resident orcas now have just 78 individuals in the population[2]. This unique orca community is threatened by prey depletion, toxic contamination, and vessel impacts including noise and harassment. Due to their small population size, they are also at risk from disease outbreak or oil spill, both of which have the potential to affect the entire population. The threats facing this fragile population operate in a synergistic manner, and thus recovery efforts must encompass the sum effects of these threats. The Southern Residents are currently living on the brink of extinction, and they are in dire need of meaningful, science-based recovery efforts for the whales, Chinook salmon, and their habitats to prevent this orca community from being lost forever.

As part of the fish-obligate ecotype of orcas, the Southern Residents prefer salmon and are particularly reliant on Chinook salmon, which can comprise up to 80% of their diet[3]. Prey depletion is recognized as the top threat to this small population, and ensuring a reliable and abundant food supply is a priority in recovery efforts for the Southern Resident orcas. Chinook abundance has impacted their survival and recovery[4], and the ecosystem recovery of rivers on the west coast – including the Klamath – is necessary to restore salmon populations and help ensure the long-term survival of the Southern Resident orcas (Figure 1).

[1] Krahn, M.M. et al. 2004. 2004 status review of southern resident killer whales (Orcinus orca) under the Endangered Species Act. NOAA Technical Memorandum NMFS-NWFSC-62, U.S. Department of Commerce, Seattle, Washington; Reynolds, J.E. H. Marsh & T.J. Ragen. 2009. Marine Mammal Conservation. Endangered Species Research. 7. Pp23-28.

[2] ESA listing rule for Southern Residents 70 FR 69903 (11/18/2005); population census data from Center for Whale Research.

[3] Ford M.J et al. 2016. Estimation of a Killer Whale (Orcinus orca) Population's Diet Using Sequencing Analysis of DNA from Feces. PLoS ONE 11(1): e0144956 doi:10.1371/journal.pone.0144956; Hanson, M.B. et al. 2010. Species and stock identification of prey consumed by endangered southern resident killer whales in their summer range." Endangered Species Research, 11(1):69-82.

[4] Ford, J.K.B et al. 2005. Linking prey and population dynamics: Did food limitation cause recent declines of 'resident' killer whales (Orcinus orca) in British Columbia. Fisheries and Oceans; Ford J.K.B et al. 2010. Linking killer whale survival and prey abundance: food limitation in the oceans' apex predator? Biology Letters 6: 139–142; Ward E.J et al. 2009. Quantifying the effects of prey abundance on killer whale reproduction. Journal of Applied Ecology, 46: 632–640.

WHALE AND DOLPHIN CONSERVATION
WDC

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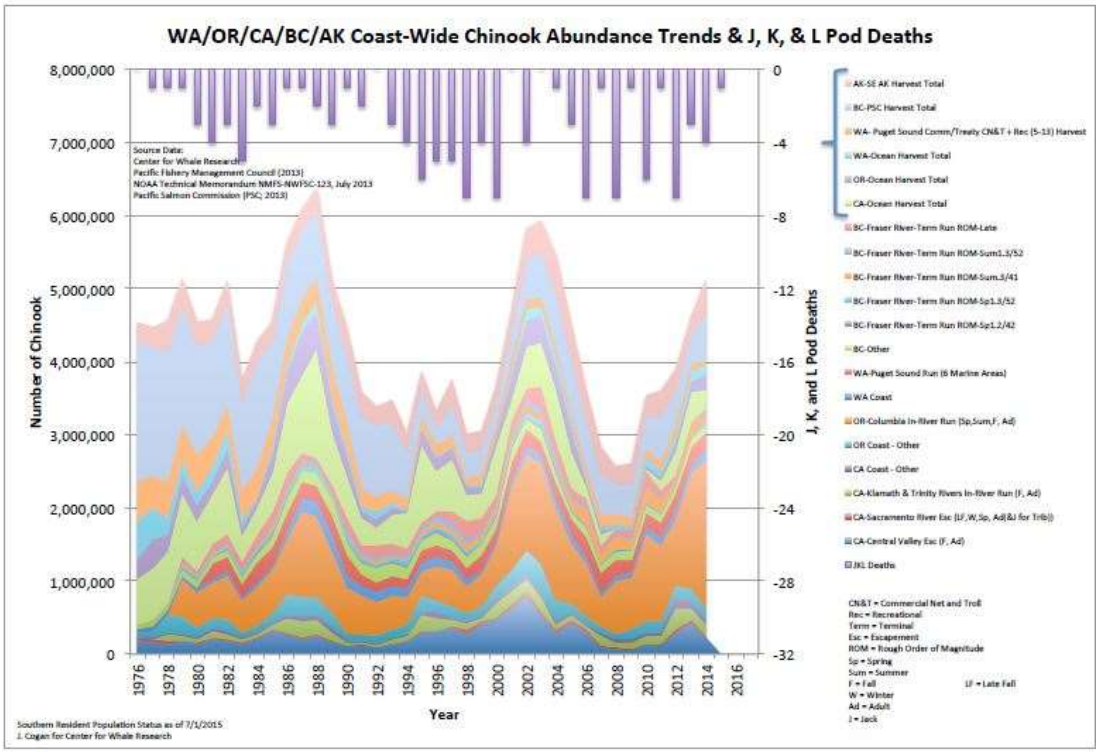

Figure 1: Mortality in the Southern Resident population is correlated with coastwide Chinook abundance (graph courtesy Center for Whale Research)

Over a decade of research efforts for the Southern Resident orcas by the National Oceanic and Atmospheric Administration (NOAA) have confirmed that they utilize the coastal habitats of Washington, Oregon, and California, particularly in late fall through spring months[5] (Figure 2). The same research has also shown that the Southern Residents continue to target Chinook salmon when foraging on the outer coast, and consume Chinook from the major west coast salmon rivers, including the Klamath[6].



Figure 2. Tracks of satellite-tagged Southern Resident orcas in 2013 showed their presence off the coast of Northern California for an extended period of time (Data and image from NOAA).

[5] NOAA Fisheries. 2014. Southern Resident Killer Whales: 10 Years of Research & Conservation.

[6] Ibid; Ford JKB. 2012. Resident killer whale feeding habits: assessment methods, winter diet, and chum stock ID. Evaluating the Effects of Salmon Fisheries on Southern Resident Killer Whales: Workshop 2, March 13–15, 2012. NOAA Fisheries and Fisheries and Oceans Canada:Vancouver, BC.

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River restoration efforts, including dam removal, are vital to rebuilding wild salmon populations in the western United States and addressing the threat of prey depletion for the Southern Residents. Four dams on the Klamath River – Iron Gate, J.C. Boyle, Copco No. 1 and Copco No. 2 – have contributed to the decline of as much of 98% of the Klamath's Chinook salmon population (Table 1)[7]. These dams block access to historic spawning habitat, alter the natural flow of the river, and create poor water quality that affects both wildlife and human populations in the Klamath Basin. Removing these four dams and restoring the Klamath River are efforts essential to ensuring the lasting recovery of wild salmon in Oregon and California.

*Table 1: Declines in Klamath River salmon *Spring-run Chinook salmon likely substantially outnumbered fall-run Chinook (abundance in the millions) but have been extirpated from a large part of their historical range. (Data from Dept. of Interior Klamath Dam Removal report)*

Species	Observed Historical Levels	% Reduction
Steelhead	400,000	98%
Coho	15,400-20,000	52-95%
Fall-run Chinook	500,000	92-96%
Spring-run Chinook	100,000	98%
Shasta River (subset)	20,000-80,000	88-95%

The Water Board must consider the long-term and ecosystem-wide impacts of dam removal, including the positive effect of increased wild salmon abundance on the Southern Resident orca population. While the near-term adverse impacts of dam removal addressed in the Water Board's public notice are important to consider and should be mitigated as much as possible, the ultimate effect of a free-flowing Klamath River on the California and Oregon ecosystems must be considered in the Water Board EIR.

We urge the Water Board to also consider the detailed analyses already completed in the 2012 State and Federal EIR/EIS[8]. This report, and the 2013 report from the Department of the Interior[9], concluded that dam removal would have a net benefit on the Klamath and larger Pacific ecosystems, and could restore Chinook populations by as much as 81%[10].

Removing the four Klamath River dams in question – Iron Gate, J.C. Boyle, Copco No. 1 and Copco No. 2 – must be an alternative included in the Water Board's EIR, along with the long-term, ecosystem-wide impacts of dam removal. The net positive effects of a free-flowing river will be observed outside of the river itself, in the beneficial recovery of anadromous salmon populations. Salmon support more than 130 other species, including the critically endangered Southern Resident orcas. Recovering the Klamath River benefits more than just the people and other wildlife that live on, in, or near the river. It benefits entire ecosystems in Oregon and California, the California Current, and a healthy river for future generations of people and orcas alike.

The Southern Resident orcas are already living on the edge of extinction, and any delay of the current proposed timeline for dam removal would be extremely detrimental to the continued survival of these whales, as well as the salmon upon which they depend. The 2012 joint California and Federal EIR/EIS concluded that removing the four Klamath River dams would have a net positive impact for water quality and fish in the Klamath Basin[11]. This conclusion, and the extensive research and information the EIR analyzes, should be considered in the Water Board EIR.

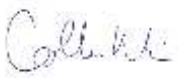
[7] Dept of Interior Klamath Dam Removal report (Klamath Dam Removal Overview Report for the Secretary of the Interior http://klamathrestoration.gov/sites/klamathrestoration.gov/files/2013%20Updates/Final%20SDOR%20/0.Final%20Accessible%20SDOR%2011.8.2012.pdf)
[8] See Final EIS on https://klamathrestoration.gov/
[9] See footnote 7.
[10] Ibid.
[11] See footnote 8.

WHALE AND DOLPHIN CONSERVATION
WDC

WDC, 7 Nelson Street, Plymouth, MA, 02360
T +(508) 746-2522 F+(508)746-2537 E contact@whales.org W whales.org
WDC is a registered 501(c)3 non-profit organization.

Thank you for the opportunity to provide comments on the Water Board EIR, and please contact WDC with any questions or for more information about how Southern Resident orcas depend on Klamath River salmon.

Regards,



Colleen Weiler
colleen.weiler@whales.org
810-813-1643
Rekos Fellow for Orca Conservation
Whale and Dolphin Conservation

WHALE AND DOLPHIN CONSERVATION

A world where every whale and dolphin is safe and free

WRITTEN COMMENTS FROM INDIVIDUALS

From: Bo Adams <bo@adamsappr.com>
Sent: Thursday, January 26, 2017 12:26 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

Other key points I urge you to consider:

1. The 2012 joint California and federal EIR/EIS and related documents concluded that dam removal on the Klamath is in the best interest of the public. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies, which can be relied upon for your EIR.

2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Bo Adams
5021 Beran St
Torrance, CA 90503
bo@adamsappr.com

Thaler, Parker@Waterboards

From: Jim & Yvette Adams <jyadams@outdrs.net>
Sent: Tuesday, January 31, 2017 9:59 PM
To: Thaler, Parker@Waterboards
Subject: Copco and Irongate Dam

State Water Resources Control Board
Division of Water Rights-Water Quality Certification Program
P.O. Box 2000 Sacramento, CA 95812-2000

Attn: Parker Thaler

Re: Opposition to the Dam removal

We work(ed) for a government agency, so we do know how this is most likely going to go. We do feel this is a waist of time as we feel persons in political power have an agenda of their own and really don't care what the citizens of Siskiyou County want. However, we will say our peace.

We are AGAINST the dams coming out.

First, they keep our power bills down, and produce clean energy. Better than buying it from another state, or entity that will charge us more.

Secondly, it provides small towns below the dams flood protection.

Third, we have water storage for drought years. Of which we have been experiencing for the last 6-7 years, and with out the water storage from JC Boyle, Copco, and Irongate the fish would have suffered greatly. The state has discussed adding 4 new reservoirs from Colusa to Red Bluff, and another near Colfax on Bear River. Why in the world during a drought or otherwise would you remove already existing dams?? The dams have also provided fire protection as they did in 2014.

Since, DWR takes water from the Trinity system to send down to the Delta. JC Boyle, Copco, and Irongate supplement the water to the lower part of the Klamath to enable you to send water from the Trinity to the Delta. So, does that mean that you will no longer send water from the Trinity to the farmers in the Delta if the water in the Klamath is not enough?

If it was truly about getting the fish up and over the dams this could be done using the natural topography of the area, and create an additional water way around the dams. Americans have created some of the most wonderful things (Mount Rushmore, put a man on the moon, enormous bridges, well you know where I'm going with this. I believe it could be done. If the word "Compromise" was only in a politicians or government workers vocabulary.

I would also like to say the only reason PPL pulled their permit was because of all the additional requirements state and federal agencies were going to require of PPL to keep the dams they were just cutting costs.

My husband and I paid $250,000 for our home and I don't even have a view of the lake, and now my home is worth about $160,000. All because of the threat of the dams coming out. The amount of a million stated at the meeting at Miners Inn in Yreka is way understated.

The Shasta Indians should also be included as they are the ones with family buried under the lake. You are not including all parties in this process. The lack of notification to all parties including land owners around the lake. My husband and I have NEVER been notified by mail of any meetings. Some person around the lake received notification, but not us or many of our friends around the lake.

Other comments:

Oregon needs to improve the water quality above John C Boyle
Federal government should be involved since it involves two states (Oregon and California)
Studies should and need to be more inclusive than just a 5 mile study area
Studies of traffic congestion around Copco and Irongate areas

Recommendations to try first:
Dredge Copco and Irongate Lakes
Do a 5 year truck and haul fish above dams and study fish (tagging fish) movement
Construct man made water way around the lakes using the natural topography to allow fish passage.

We request that the California State Water Resources Control Board:

(1) Do NOT issue a water quality certification for the KRRC for the Klamath River!!

(2) Do NOT incorporate the information from the 2012 joint California and Federal EIR/EIS into the EIR currently being developed. The previous EIR/EIS was NOT based on exhaustive studies and did NOT reach the correct conclusion.

- *Only five miles of the entire river system, designed to generate data that would best support dam removal, was submitted.

- *It was clearly NOT an exhaustive study as the river waters above the dams was NOT studied, nor was the water quality entering California from Oregon.

- *A **new and complete** analysis of the **entire** river must be performed, including the water management of the Trinity River that is diverted into the State Water Project and the central canal as these flow impacts on the fish are unknown. The complete environmental consequences have not been adequately evaluated.

(3) Evaluate ALL scientific data and studies produced BEFORE and since 2012. This will further contradict the conclusions of the 2012 EIS/ EIR as being inconclusive and prejudicial in nature.

- This fact is supported by Dr. Paul Houser, the hydro meteorologist, hired to oversee the scientific integrity, when he revealed that the study was designed to align with those favoring dam removal.

- The tribes still gill net across the mouth of the Klamath and this has had an effect on salmon populations.

(4) Fully analyze the environmental and economic impacts of dam removal with respect to the certainty of removal ramifications, not just what "might", "could", language used in the 2012 EIR/ EIS studies used in support of dam removal.

- The loss of property values is reflected in the declining property taxes, and therefore a loss to Siskiyou County Revenue. The 2012 study only looked at bare land values. They did not go through the process of the Record of Decision. Improvements were not considered.

- The KRRC does not have the funding or a plan for river or reservoir aesthetic restoration. It would take many, many years, if not a lifetime, to return the Klamath River behind the reservoirs to their native beauty.

- Unless the entire river is studied, all the impacts to fish and birds can't be know as to the impact.

- There are Perch and Bass behind the dams and if they are released into the lower river, that consequence must be considered since they are predatory to Salmon eggs. This is an ESA impact that has not been studied.

- The Shasta Native American Tribe, which precedes other Klamath tribes are not a signatory to the KHSA and have not been represented. Dam removal will expose sensitive Shasta burial grounds and possibly tribal artifacts.

- As the tribes, downstream from the dams are demanding that their tribal and cultural customs be respected, so shall the Shasta Nation be respected. If you engage with **some** tribal entities without taking into consideration **all** entities and be certain that the interests of all tribes are taken into equal consideration you will be acting prejudicially.

There is no possible way that you can base your current study on such flawed analyses such as the 2012 EIR/EIS study!! Unless a **new, transparent,** and **complete** study of the entire river system is performed, the SWRCB cannot make a **credible** determination concerning water quality!!

Sincerely,

Jim and Yvette Adams
16500 Patricia Avenue
Montague CA. 96064

This letter is to inform to who it may concern below as follows:
RE: Klamath River Dams - Stop Dam removal
#1 at Copco Lake Copco Reservoir #2 and Dam& powerhouse
Iron Gate Dam and powerhouse, Iron Gate Fish Hatchery and the Fall creek Fish Hatchery and powerhouse close to Copco #2 powerhouse

In response to actions by:
Pacific Power – PacifiCorp (Owner: Warren Buffet)
Klamath River Renewal corp.
California Governor Jerry Brown
Oregon Governor Kate Brown
Energy Regulatory Commission
Lower Klamath Hydroelectric Project
The States of California and Oregon
U.S. Department of the interior and others. FERC

Oct. 28th 2016 in response to: Signing of an agreement On April 6th, 2016 by PacifiCorp (current licensee) Calif. and Oregon States. Dept of the Interior and US Dept. of Commerce's National Marine Fisheries Service. The Yurok Tribe and the Karuk Tribe Signed an agreement to basically remove Clean Energy Hydroelectric Dams from the upper Klamath River system that have been productive making clean energy and used as a system to control river flow to help the Salmon and other fish that spawn west of the Dams. Approx. 240 miles to the Mouth of the Klamath at the Pacific Ocean.

We were not informed of any important meeting were there was an agreement to be signed by parties listed above including the Governors of California and Oregon that was held April 6th , 2016. Meeting did not inform those affected by proposed Dam removal who live around Copco Lake and others that live close by.
We find it very wrong That a meeting was held without public knowledge of the agenda of the meeting held on the coast 2540 miles away to make it impossible for those opposed of the Dam removals to travel the long distance and to even consider finding a room for the night to make the long journey back home the next day. If we were informed of the importance of the meeting some would have traveled to be at the meeting to make our voices heard. Most people can't afford to take that many days off just to go to a meeting. It should have held a meeting close to the area of those most affected like maybe in the city of Yreka still a good 45 minute drive from Copco Lake as an example.

The actions of those attending keeping the notification of the meeting in secret from those back at the lake and others against dam removal is condemned and foul play and backroom deals cast more mistrust at our system of government.

All the people of the area affected the most by Dam removal got the issue put on the voter's ballot so everyone could vote. They did and it was 78% in favor to keep the dams and not remove them. Why is this being ignored?

I have spent much time at the lake and have seen Birds stopping in and around the lake like Egrets, white pelicans, Canada Geese, Heron both blue and white. There are large flocks of Mallard Ducks raising their babies around the lake. There are loons and Swans & other birds I could just go on and on about. Please do not remove the Dam.

We have been fighting to keep the dams in and protect the migratory Birds and their nesting grounds from removal of the lake at Copco Dam. Do you realize that times especially during a drought ,Water levels can be controlled by the Dam so some extra water can be let out to help the Salmon and other fish be able to go upstream and spawn. Without the Dam there would be no extra water to release for the fish . Also cold water from the deep lake keeps the Klamath River cooler that far inland .

Without the lake there is NO fire protection and we do have wildfires and just a large one just two years ago at the lake. What is going to happen if water levels drop so much that all the wells go dry for all the residents who live there? Families purchased land around the lake and built their homes there. They put their life saving into their homes & land. We built docks and we helped create habitat for the wild animals that live at the lake. Even the Bats love the area and keep the bugs down to a minimum. Families have live and farmed , ranched since the 1880's.

Do you realize that just the threat of the dam coming out has caused the residents homes to lose over 70% or more of their value. Banks won't lend money and these owners have built their homes as their only source of income for their old age. We have build and lived at the lake for over 35 years and we want the Dam to stay in. Clean hydroelectric power costs the least over all other sources of electricity. Approx. 2 cents per kilowatt hour compared to 10 or 12 cents per Kilowatt hour using new forms of energy. Why would anyone want to remove a clean source of green energy. The Dam should stay and so the lake too.. Keeps the dam powerhouse working. It was built very well

Do you realize how important we have the dam and lake stay as they are.!
We have a Fish hatchery that produces over one million fish each year by Iron Gate Below Copco Dam. These hatchery fish are released and travel all the way to the ocean feed all the migratory birds along the way and a few animals too. The entire eco system for the Klamath River works together and the hatchery fish renews the Klamath each year.
Do you realize only very cold water will allow the salmon fish to live. They die if the water is warm. The cold water taken from the depth of the lake and reservoir at Copco #2 Keeps the correct temp for the hatchery. I have researched this fact.

If the Dam comes out then all the sludge and sediment behind the dam goes downstream and kills the entire ecological river system for the next 65 years as a recent report came out and it states the river may never come back. No spawning – silt suffocates the eggs and all the other bugs to feed on too are gone. Can you imagine the sludge and fine sediment making it's way all the way to the ocean? What would happen if all the abalone died and no krill could grow so the whales suffer or go away. What about the mussels or crabs or other fish that will be affected. If the hatcherys are taken out or the cold lake

water is not there for the hatchery to work well and the wild salmon can't spawn because of the dirty river beds then the report was right. It will take 65 years for the river to recover if it can. That is a big chance to take especially since they reported the Klamath river eco system may never recover.

Please keep the dams and the **green clean hydroelectric energy powerhouses** working providing electricity for all the residents that benefit from their low cost. We voted 78% to keep the dams so please respect our wishes.

It would be a really bad legacy for the two governors if the Klamath river died. It is a delicate eco system and not just the water.

Sincerely

Alan Andersen _____

Becky Davis _____

From: Alan <alan@andersenjewelry.com>
Sent: Friday, January 20, 2017 12:29 PM
To: Wr401program; parker.thaler@waterboards.ca.gov.; Robert Davis
Subject: Jan.20th scooping meeting in Sacramento comments
Attachments: About the Copco Lake Dam Removal Oct. 2016.docx

Follow Up Flag: Follow up
Flag Status: Flagged

I went to the webanar @ https://video.calepa.ca.gov/ and watched it until you closed down the meeting unexpectedly at 10:42 after just a few comments were heard. I spent the time to be able to comment myself but could not since you did not provide me with a phone number so I could of call live and made my comments and you could of put me on speaker phone for the few people that showed up and the board to hear. You did not provide me with that oppertunity. All I have is this e-mail letter that I send with an attachment of the letter I have sent so it will be placed on the public record for today at that meeting.

I was surprised that you also at the very end changed the date for public comment about saving the dams in the upper and lower Klamath river Basin from Feb. 5th 2017 to Feb.1st . You didn't have enough people there to be able to vote that in. You canceled the Yreka meeting where most of the areas voters voted 78% to keep the dams in and not to remove Hydro Electric- clean energy Dam at Copco lake or Iron gate Dam. That meeting was the most important meeting since you would of had standing room only turn out against Dam removal. What is your hidden agenda to have a meeting in Sacramento where most are not even affected by what goes on in the Klamath river basin?? You need to hold a meeting In Yreka, CA and allow enough time on a agreed to time that way people who are affected by your proposed actions and attemp to go forward with Dam removal will have a chance to further comment . Not in a middle of a work day. You need to contact everyone who will be affected to come to the meeting and not just running a tiny ad in a newspaper. A well informed letter and contact for a front page news article - emails and other announcements to give fair chance for the residents to partisapate and come to the meeting. Again I am requesting you record this e-mail letter I am sending you as if I was at your meeting but not allowed to comment or talk since you did not have that available or post a phone number for all to see who watched the webenar; except what I have done by writing you this letter and read and post on record the attached 3 page letter from Alan R. Andersen and Rebecca Davis - property owners at Copco lake.

P.S. The only way I even heard about the canceled meeting up in Yreka or the webanar that started today Jan.20th , 2017 (right in the middle of the new President oath of office.) was from a relative who also lives at the Copco Lake.

Please read letter attached for comments to the meeting on the record for today's webenar.

-------- Forwarded Message --------
Subject: About the Copco Lake Dam Removal Oct. 2016
Date:
From:>
To:

ATTEN: Federal Energy Regulatory Commission

Subject: Jan.20th scooping meeting in Sacramento comments
From: Alan <alan@andersenjewelry.com>
Date: 1/20/2017 12:28 PM
To: wr401program@waterboards.ca.gov, parker.thaler@waterboards.ca.gov., Robert Davis <viking3135@hotmail.com>

I went to the webanar @ HTTP://video.calepa.ca.gov/ and watched it until you closed down the meeting unexpectedly at 10:42 after just a few comments were heard. I spent the time to be able to comment myself but could not since you did not provide me with a phone number so I could of call live and made my comments and you could of put me on speaker phone for the few people that showed up and the board to hear. You did not provide me with that oppertunity. All I have is this e-mail letter that I send with an attachment of the letter I have sent so it will be placed on the public record for today at that meeting.

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P.S. The only way I even heard about the canceled meeting up in Yreka or the webanar that started today Jan.20th , 2017 (right in the middle of the new President oath of office.) was from a relative who also lives at the Copco Lake.

-------- Forwarded Message --------
Subject: About the Copco Lake Dam Removal Oct. 2016
Date:

3 page letter Enclosed

20170124-0060 FERC PDF (Unofficial) 01/24/2017

Talking Waters

Siskiyou County Water Users Association

"SAVE THE DAMS SAVE THE SALMON"

347 North Main Street, Yreka CA 96097

Issue 7 ***Bob Rice Man of the Year 2016*** **Winter 2016**

Officers: President: Richard Marshall richard@marshall-ranch.com 468-4204 ; **Treasurer/Secretary** Kathy Bergeron bergeron@inreach.com 459-S266 **Board Members:** Rex Cozzalio, Jerry Bacigalupi, Louise Gliatto, Sam Jackson, Richard Marshall, Kathy Bergeron, Charlie Blackburn **Oregon**: Joe Watkins, Dennis Linthicum

Consultants: Bob Rice, George Webb **Emeritus:** Leo Bergeron and Mark Baird

The Board of Directors and its officers serve as volunteers with no remuneration.

MAJOR ISSUES

I. **FERC**—Recently the States of Oregon and California entered into an Agreement in Principle to destroy the Klamath Facilities. The above referred to agreement in principle was also signed by two federal agencies, Sally Jewell, Secretary of the Interior and Kathy Sullivan, Secretary of Commerce for NOAA. This despite the fact that the Congress over the past many years made it clear that they weren't in favor of removing the dams. The agreement spells out that despite the adverse impacts of dam removal they want to proceed by pursuing the transfer of the Hydro-facilities to a Dam Removal Entity located in New York City. This requires the approval of the Federal Energy Resource Commission (FERC).

The spotlight has shifted to the FERC process whose commissioners are appointed by the President. PacifiCorp filed a Petition with the commission to simultaneously transfer the dams and license to the Klamath River Renewal Corp (KRRC) and also filed with the CPUC (Public Utilities Commission) to transfer the trust assets (surcharge) funds of approx. $200 Million plus another $250 Million from the California Prop 1 (water bond funds) to the KRRC a newly formed non profit 501 c3 California Corporation instituted for the express purpose of taking over and destroying the four hydro electric facilities, thereby removing carbon free, clean energy production facilities, flood control, and water storage, and fish hatchery facility, to presumably raise the production of Salmon for the Pacific Coast Fisherman.

The PacifiCorp organization has no regard for the ratepayers or the County of Siskiyou or Klamath County or others who have all indicated in local voting that they are adamantly opposed to the removal of these dams. Warren Buffet owner of the PacifiCorp facilities has substantial financial interests in Mid West energy which will benefit by the removal of the Klamath Dams. The potential damage that could occur would **result in the**

agencies and NGO groups, tribes etc of liability for what could be an ecological disaster of enormous consequences.

The County Board of Supervisors on behalf of the County have also filed objections with the FERC on the dam removal process. This has been filed by the law firm of Nossaman et al a nationwide legal firm with offices in Washington DC.

A recent conversation with officials at FERC indicate that PacifiCorp may have been caught off guard by opponents by their filing incomplete documents. They have asked for additional time suggesting to the FERC that they will refile next year and asking that comments be held in abeyance until after March 2017. They still have before the CPUC a request to approve the process and agree to release the Trust Funds to KRRC.

II. **CPUC** — As mentioned earlier the CPUC has been Petitioned by PacifiCorp to accept the amended KHSA agreement which authorizes the formation of the KRRC and allows the transfer of the facilities and the Trust Funds to KRRC. They have been joined by the DOI and the Secretary of Commerce and California Dept. of Natural Resources in pushing the CPUC to accept the Petition. Meanwhile both the Siskiyou Water Users and the County of Siskiyou County Counsel have independently submitted challenges to the CPUC requesting a full hearing and analysis of the proposed transfer. PacifiCorp has suggested that the CPUC approve their request out of hand suggesting that in fact this was "only a ministerial action" and didn't deserve a full hearing process. At this time the Administrative Law Judge, an employee of the CPUC, is coosidering the matter based on the

WWW.WATERBOARDS.CA.GOV HTTPS://VIDEO.CALEPA.CA.GOV/
MR. PARKER TH

Talking Waters, Siskiyou County Water Users Assoc.

PARKER.THALER@ 347 North Main St. Yreka CA 96097
WATERBOARDS.CA.GOV

river not to mention the amount of debris left in the river as a result. The Elwha was many hundreds of times smaller in size and the concomitant release of sediments and debris into the water.

The destruction of the Klamath Dams will be the largest dam removal project in the history of the United States yet the project has not yet received the proper EIR study of the seven reaches of the River. Because of this evident effort to not look at the full amount of damage that will result, we at SCWUA remind everyone that this is not about the fish or the water; ***this is about politics and money***.

IV. **COPCO** — Siskiyou County Citizens living in and around the COPCO Lake area have been affected by the proposed removal of Klamath Dams for some time but recently this came to a head with the letter sent to many of them by KRRC regarding the taking of a portion of their property rights namely their view and resultant substantial loss of property value. Many of these citizens have a substantial part of their retirement funds tied up in the properties. SCWUA conducted a meeting in COPCO with the support of the community association to review the letter from KRRC and share information regarding the inappropriate if not unlawful letter from KRRC. KRRC has no status at this point as the FERC has not reviewed and or agreed to put KRRC in the position of taking over from PacifiCorp who remains to this date the party in the chain of title of the dams and who is liable for any and all damages resulting from the removal of the hydro facilities.

It was recommended that the association on behalf of the group retain the services of a qualified attorney to file an inverse condemnation and damage suit against KRRC and PacifiCorp for their part in damaging the property values of the COPCO citizens without compensation being offered.

Many of those present also signed the class action Petition regarding the collusion of PacifiCorp and CPUC to deprive them of their property without compensation and charge them a surcharge for dam removal which is against their will.

From: Alan <alan@andersenjewelry.com>
Sent: Tuesday, January 17, 2017 5:26 PM
To: Thaler, Parker@Waterboards
Subject: Re: Yreka meeting

HELLO - We appreciate getting the information. Please , could you put in our vote at the next meeting that we as property owners at Copco Lake want the Dam to stay in. It provides water - low cost electric power. Flood control for the entire lower river system and provide water in the summer when it is too low for the fish. We have sent letters in Oct. of last year detailing the positives for keeping the Dam. Our Property Values have gone down a lot since threat of Dam Removal these past years. Our post office Box Number : Alan Andersen & Rebecca Davis , P.O.Box 1117 , Felton , CA 95018

On 1/17/2017 7:57 AM, Thaler, Parker@Waterboards wrote:

> Hi Alan,
>
> Thank you for your comments. I'd be happy to add you to our hard copy mailing list. Can you please provide me with your address?
>
> Thank you,
>
> Parker

From: Alan [mailto:alan@andersenjewelry.com]
Sent: Wednesday, January 11, 2017 6:48 PM
To: parker.thaler@waterboards.ca.gov.; vicking3135@hotmail.com
Subject: Fwd: Yreka meeting

I forgot to mentioned in the e-mail below that again we have not been informed of any meetings by mail. Please put us on your mailing lists and any meeting regarding anything abo9utr Copco Lake Dam removal scooping meetings.
It seems clear that the people most affected by and against Dam removal are not being informed of these important meetings. I am sure you are in violation of the BROWN ACT. when you have meetings that don't include those people who live on Copco lake or close by. Any citizens of Yreka or any close towns like Montique need to be informed way in advance of any of your meetings you are to have with plenty of time so we can attend.
Sincerely, Alan Andersen & Becky Davis

-------- Forwarded Message --------

Subject: Yreka meeting
Date: Tue, 10 Jan 2017 20:03:36 -0800
From: Alan <alan@andersenjewelry.com>
To: parker.thaler@waterboards.ca.gov., Robert Davis <viking3135@hotmail.com>

We didn't even know there was going to be a meeting.
Please keep us informed about any meeting regarding the Copco Lake Dam. Thank you - Alan R. Andersen and Becky Davis -(Property owners at Copco Lake)

If you are receiving this notice in a forwarded message and would like to receive future emails regarding the Lower Klamath Project, please subscribe to the "Lower Klamath Project License Surrender" email subscription list, under "Water Rights" at:,,http://www.waterboards.ca.gov/resources/email_subscriptions/swrcb_subscribe.shtml

mail subscription list, under "Water Rights" at:,,http://www.waterboards.ca.gov/resources/email_subscriptions/swrcb_subscribe.shtml

From: Jason Anderson <jbaypobox@gmail.com>
Sent: Thursday, January 26, 2017 8:43 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

Other key points I urge you to consider:

1. The 2012 joint California and federal EIR/EIS and related documents concluded that dam removal on the Klamath is in the best interest of the public. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies, which can be relied upon for your EIR.

2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Jason Anderson
439 Palo Verde Ave
Monterey, CA 93940
jbaypobox@gmail.com

From: kurt arens <kurtarens530@gmail.com>
Sent: Thursday, January 26, 2017 5:01 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

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Sincerely,

kurt arens
921 Craig Pl
Davis, CA 95616
kurtarens530@gmail.com

From: Kevin Ashbran <kashbran@westernu.edu>
Sent: Friday, January 27, 2017 5:50 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Kevin Ashbran
24091 Ramada Ln
Mission Viejo, CA 92691
kashbran@westernu.edu

ER/PT

State Water Resources Control Board Scoping Meeting
Notice of Preparation (NOP)
For the Environmental Impact Report (EIR) for the Lower Klamath Project (LKP) License Surrender by Pacific Corp to the Klamath River Renewal Corporation (KRRC) with the intent of decommissioning in place or removing four Hydroelectric Dams on the Klamath River

Best Western Miners Inn Convention Center
122 E. Miner St, Yreka, Calif.

STATE WATER RESOURCES CONTROL BOARD
2017 JAN 31 PM 1:46
DIV OF WATER RIGHTS
SACRAMENTO

January 27, 2017

State Water Resources Control Board
Division of Water Rights
P.O. Box 2000; Sacramento, Calif. 95812

Attention: Mr. Parker Thaler

As a Professional Engineer, if Responsible for moving the Proposed Action forward, I would propose the following actions <u>PRIOR TO THE PREPARATION OF AN EIR:</u>

1. Because of the controversy over the Department Of Interior's (DOI) statements' that the proposed action would provide 420 miles of additional Anadromous Fish Habitat above the dams proposed for removal, **insist** that a 5 year **Truck and Haul Study** be initiated utilizing at least 50 tagged migrating female Coho Salmon with corresponding males per year captured at the Iron Gate Hatchery (R.M.190) and transported to the head waters of the Klamath R. (R.M.254). Note: the beginning of the Klamath R. coincides with the end of Link River which drains from Upper Lake and the inlet waters of Lake Ewanna in the city of Klamath Falls.

   This controversy exists because historically several reefs and dikes were present above Iron Gate Reservoir that precluded anadromous fish travel to Upper Lake. Currently because of the steep River gradient between Copo 1 Reservoir and J.C. Boyle's Dam, coupled with the environmental negatives of Upper Lake and Agency Lake (30+ miles length, shallow, high predation, high in nitrates and sulfates) it appears that it would be almost impossible for Anadromous fish to traverse to the five river tributaries above Upper Lake, spawn, and the Juveniles return to the point of release. Former employees of the Dept. of F&WL made the comment that it is impossible for the river habitat above Iron Gate Dam to produce the 6 million fingerlings produced by the Hatchery and It is impossible for this portion of the Rived to ever be Anadromous Fish Habitat. **DO THE STUDY**
2. As a matter of State Law, submit the Dam Removal Proposals to the **Division of Dam Safety** for their Statuary Requirements and Approvals.

   Recognizing that the Dams are currently in good condition and provide a 25% reduction in peak flows, based on the 1964 flood hydrograph gage located near the Iron Gate Hatchery. I would recommend that a major flood study is necessary to address

potential damage and protect private properties and the Public Roads and Bridges along Hwy 96.

3. As a matter of State Law, require the preparation of a **Storm Water Pollution Prevention Plan (SWPPP)** submitted to the State Water Resources Control Board. Currently the Board requires a SWPPP be prepared and approved for **all projects** disturbing more than 1 acre of soil.

   The proposed Dam Removal Project exposes upwards of 3,000 acres of exposed soils with the potential of eroding 20 million cubic yards of contaminated sediments down the Klamath R. These sediments equate to a mass 150 feet wide by 190 miles down the Klamath R. below Iron Gate Dam to the estuary. In my opinion it would be an impossibility to meet SWRCB and Environmental Requirements without removing contaminated sediments prior to Dam breaching or removals.

4. As a matter of State Law, give Notice and apply for a Stream Bed Alternation Agreement under the **CDFW 1600 Program**.

5. As a matter of County Regulations, submit the Dam Removal Proposals to the **Siskiyou Co. Flood Control and Water Conservation District (SCFCWCD)** and **Klamath Co. Ore.** for their Requirements and Recommendations.

   Siskiyou County and Klamath County has the statutory responsibility to provide public safety to all citizens and protect the environment for present and future generations. Before any Dams are breached or removed, the Proposed Project must be submitted to Siskiyou County and Klamath County for approvals under existing statutes and regulations as required by the **SCFCWCD** and in the **Klamath Basin Compact.**

As a Professional Engineer, Responsible for <u>THE PREPARATION OF AN EIR</u>, I would propose the following after the above recommended studies were completed and State and County Agencies have been consulted and made their recommendations and requirements. The Calif. Environmental Quality Act (CEQA) requires the following:

1. **Sec. 21000 Legislative Intent:** (d) *The capacity of the environment is limited, and it is the intent of the Legislature that the government of the state take immediate steps to identify any critical thresholds for the health and safety of the people of the state and take all coordinated actions necessary to prevent such thresholds being reached.*
2. **Sec. 21001 Additional Legislative Intent:** (c) *Prevent the elimination of fish or wildlife species due to man's activities, insure that fish or wildlife populations do not drop below self-prepetuating levels etc.*
3. **Sec. 21002 Approval of projects: feasible alternatives or mitigation measures:** *The Legislature finds and declares that it is the policy of the state that public agencies should not approve projects as proposed if there are feasible alternatives or feasible mitigations measures available which would substantially lessen the significant environmental effects of the project etc.*
4. **Sec. 21003.1 Environmental effects of projects; comments from public and public agencies to lead agencies; availability of information:** (b) *Information relevant to the significant effects of a*

project, alternatives, and mitigation measures which substantially reduce the effects shall be made available as soon as possible by lead agencies, etc.

The release of a potential 20 million cubic yards of contaminated sediments down river, the removal of flood protection structures, and the absence of viable studies and alternatives such as those proposed by Siskiyou County and the Siskiyou County Water Users Association violates the Legislative Intent of CEQA.

Siskiyou County and the SCWUA supports and recommends to the NCRWCQB the following projects which will mitigate water instream flow, water quality, retain Iron Gate Hatchery and promote fish passage:

1. Implement the Shasta Nation Tunnel Unassisted Anadromous Fish Passageway around Iron Gate, Copco 1 and Copco 2 Reservoirs at a cost of $50 million (1/6th the $300 million cost estimated for installing fish ladders). This will provide anadromous fish passage around Iron Gate, Copco 1, and Copco 2 reservoirs to the pre dam 20 miles of native river habitat above Copco 1 Reservoir. Moonshine Falls, directly below J.C. Boyles Reservoir, is cited by CFW to be the upper most habitats for anadromous fish. **Note: 1.**The downstream Dams have absolutely nothing to do with the Upper Basin water wars or the DOI Klamath Project regulated flows to farmers and ranchers. **2.** The California dams have been recently inspected by the Division of Dam Safety and are in good condition. These dams provide considerable down river flood and surge protection and provide an average yearly water quality improvement. **3.** Given the condition of a complete Klamath River cutoff by the DOI or a severe drought. The dams can also **easily provide CDFG's (CFW) 700 cfs minimum instream river flows for a three month period** with adequate storage retained for Lake Habitat.
2. Implement the 60,000 ac.ft. Klamath River/Shasta Valley Reserved Water Right (A0169580), transfer canal and storage facilities to supplement Montague Irrigation District's irrigation water with Klamath R. water (poor water quality containing high nutrients). This project augments current irrigation supplies, allows for additional land to become irrigable, and replaces naturally impaired upper Klamath R. water with higher quality water. A portion of the reduced water demands (good water quality) can be released by the District from Lake Shastina or from their wells into the Shasta River, improving the water quality in both the Shasta River and in the Klamath River below Iron Gate Reservoir per FERC recommended requirements for relicensing. The Shasta Valley RCD & CDFG contracted a similar augmentation study in 2007 that has since been shelved. *(Because it depends on retaining the dams scheduled for removals)* Ref: (CDFG Project No. P0310329)

3. Establish additional reliable storage facilities within the Scott and Quartz Valleys, including increasing storage capacities of high-elevation lakes as recommended in the October 1991 Department of Water Resources Study entitled: *SCOTT RIVER FLOW AUGMENTATION STUDY.* These storage facilities will augment late summer and fall instream flows and supplement agricultural irrigation water.

These Proposals Will:

- **Save the Hydro-electric Dams** which generate clean, green power to 70,000 homes and protect the lake habitat and homes in and around the reservoirs by removing dam removals from the KBRA and eliminating the KHSA.
- **Save IronGate Fish Hatchery,** which is dependent on cool low level water releases from Iron Gate Reservoir, that releases over **six million salmon and steelhead fingerlings per year** in to the Klamath River. **Note: (** It is *impossible for the Klamath River Habitat above IronGate Dam to duplicate the production of IronGate Hatchery).*
- **Save the Klamath River from complete destruction** by eliminating the **irresponsible** releasing of 20 million cubic yards of sediments retained the dams.
- **Save future Klamath River water demands** by State and Federal Agencies to satisfy requirements proposed in the KBRA for **environmental waters**.
- **Preserves the sacred Shasta Nation Villages and Burial Sites** beneath the waters of Iron Gate and CopCo Reservoirs.
- **Provide additional instream flows** which will enhance fisheries and benefit the Tribes, NGO's and fishing interest.
- **Provide reduced electricity rates for On and Off Project irrigators and all ratepayers** with the creation of a Bi-State Alliance JPA or PUD to take over the Hydro- Facilities.
- **Provide Governmental Agencies common sense and engineered alternatives** to maintain the economic and environmental sustainability of the Klamath River Basin.
- **Note: The Dams have the capacity to supply CDFW's minimum flows of 700cfs for a three month period given a drought or complete shutoff of the Klamath River.**

This proposed over reach by State and Federal Agencies to remove structural sound Hydro Dams on the Klamath River will impact the environment, local economy, and lives of the local citizens and for those reasons the above alternatives must be studied to comply with CEQA requirements and existing laws and regulations, including Coordination between County, Federal, and State Governments.

Respectfully submitted:

Attachments: Comments on the Klamath Facilities Removal, Public Draft, EIR.

Comments on the Klamath Facilities Removal, Final EIS/EIR

Jerry L. Bacigalupi PE 1/27/17
PO Box 309 Montague, Calif. 96064

Nov, 18, 2011

Jerry L. Bacigalupi, P.E.
P.O. Box 309
Montague, CA. 96064
530 459 5546 916 768 5015

Ms. Elizabeth Vasquez
Bureau of Reclamation
2800 Cottage Way
Sacramento, CA 95825

Gordon Leppig
California Department of Fish & Game
619 Second Street
Eureka, CA 95501

Dear Ms. Vasquez and Mr. Leppig:

The following are comments to the **Klamath Facilities Removal, Public Draft, EIS/EIR**

1) **The DOI and DFG are improperly committed to dam removals such that they will not and cannot consider feasible alternatives and mitigation measures because they have already committed to the KBRA and KHSA settlement agreements which will become invalid if dams are not removed.**

The California Supreme Court in *Save Tara v. City of West Hollywood* (2008) 45 Cal.4th 116 (*"Save Tara"*) cautioned lead agencies that CEQA compliance should occur before committing to a particular project so that environmental review does not devolve into a *post hoc* rationalization of a decision already made. "A fundamental purpose of an EIR is to provide decision makers with information they can use in deciding *whether* to approve a proposed project, not to inform them of the environmental effects of projects that they have already approved." (*Laurel Heights Improvement Assoc. v. Regents of the University of California* (1988) 47 Cal.3d 376, 394 [emphasis in original]). Accordingly, "before conducting CEQA review, agencies must not 'take any action' that significantly furthers a project 'in any manner that forecloses alternatives or mitigation measures that would ordinarily be of CEQA review of that public project.'" (*Save Tara, supra*, 45 Cal.4th at 138).

a) Page ES-17 states "This EIR/EIS is being prepared in compliance with NEPA and CEQA." This Statement is intentionally misleading since these actions were reached in secret meetings, with a pre-determined out-come as expressed by the Secretary of the Interior in his speech to the Commonwealth Club in San Francisco, California on September 9, 2011 (prior to the comment period for this document).

2) **The Environmental Impact Report/Environmental Impact Statement (EIR/EIS) <u>fails</u> to follow the law as required by the National Environmental Policy Act of 1969 :**

(Pub. L. 91-190, 42 U.S.C. 4321-4347 January 1, 1070, as amended, and Pub. L. 94-52, July 3, 1975, Pub. L. 94-83, August 9, 1975, and Pub. L. 97-258, sec. 4(b), Sept. 13, 1982).

Title 42 of the United States Code 4331, Section 101 (b) states: Section 101 (42 USC 4331) states:

" In order to carry out the policy set forth in this Act, it is the continuing responsibility of the Federal Government to use all practicable means, consistent with other essential considerations of national policy, to improve and **<u>coordinate</u>** federal plans, functions, programs, and resources to the end that the nation may:

1. Fulfill the responsibilities of each generation as trustee of the environment to succeeding generations;
2. Assure for all Americans safe, healthful, productive, and for an aesthetically and culturally pleasing surroundings;
3. Attain the widest range of beneficial uses of the environment without degradation, risk to health and safety, or other undesirable and unintended consequences;
4. Preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment that supports diversity, and variety of individual choices;
5. Achieve a balance between population and resource which will permit high standards of living and a wide sharing of life's amenities;
6. Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources."

3) **The "Lead Agencies", as defined in the EIR/EIS, have been and continue to violate applicable existing federal, state, and local laws and regulations.**

a) The planning and zoning laws of the State of California, starting with Section 65000 of the Government Code, require that all lands be zoned appropriately with regard to their highest and best uses. The Siskiyou County Planning and Zoning Laws and the Land Use Element of the General Plan is required to designate the location and permitted uses of the land within and adjacent to these dam and reservoir areas, and identify **lands downstream which are subject to flooding.** The Conservation Element of the General Plan provides for the conservation, development, and utilization of natural resources including water and its **hydraulic forces, flood management, water conservation,** and **the prevention, control and correction of soil erosion.**

b) Recent legislation passed in 2007, AB 70 (Ch. 367) and AB 162 (Ch. 369) expands the requirement for Cities and Counties to incorporate **flood control and**

management and provides that a city or county may be required to contribute its fair and reasonable share of the property damage caused by flooding, including State and Federal Government caused flooding by dam removal. As such, it is a critical legal and budgetary matter of the local city and county governing bodies to not only be included in this process, but to also weigh in on the final decisions in this matter. The Siskiyou County Board of Supervisors did not sign the KBRA & KHSA for such matters and the Lead Agencies have failed to consider this and other important matters addressed herein and by other stakeholders.

c) The State Planning and Zoning Laws gave authority to the local governing body (The Siskiyou County Board of Supervisors) for controlling land uses and to protect resources and property rights.

d) The Secretary of the Interior does not have proper legal jurisdiction over private land use in Siskiyou County to make a determination to remove 3 privately owned dams with out coordination and approvals by Siskiyou County.

4) **The Lead Agencies and this EIR/EIS have failed to identify and properly weigh and consider the benefits of alternatives that do not support the KBRA & KHSA No. 11 (Siskiyou County's environmentally preferable and superior alternative).**

Per EIR/EIS section ES.7.3 Environmentally Preferable/Superior Alternative:
"NEPA requires the Lead Agency to identify the alternative or alternatives that are environmentally preferable in the Record of Decision (ROD) (40 CFR Part 1505.2(b)). *to quote*
"**The environmentally preferable alternative generally refers to the alternative that would result in the fewest adverse effects to the biological and physical environment. It is also the alternative that would best protect, preserve, and enhance historic, cultural, and natural resources.** Although this alternative must be identified in the ROD, it need not be selected for implementation."
Section 15126.6(e)(2) of the CEQA Guidelines requires agencies to identify the environmentally superior alternative in a draft EIR. If the No Project Alternative is the environmentally superior alternative, an additional environmentally superior alternative must be identified among the other alternatives.

a) **<u>Alternative 3</u> (Partial Facilities Removal of Four Dams) has been identified as the environmentally superior alternative:** *to quote*
"Alternative 3 would provide similar long-term benefits when compared with Alternative 2*(complete removals),* but would reduce short-term impacts because it involves less construction. Alternative 3 would result in superior long-term beneficial environmental effects. **In summary, Alternative 3 is considered the environmentally superior alternative among all the alternatives because it provides long-term beneficial environmental effects, while reducing some of the short-term significant effects of the Proposed Action (Alternative 2)."**

b) **The following environmentally preferable and superior alternative was not properly considered; Alternative 11 (Fish Bypass: Alternative Tunnel Route) on page 4-11 (4.2.11)** clearly states that it does not meet consideration because it is not consistent with the requirements of the KBRA and KHSA as it would not remove any of the four dams. Under NEPA and CEQA **THIS ALTERNATIVE MUST BE RECONSIDERED and must not be dependent on the predetermined, undisclosed KBRA/KHSA agreements.**

c) **Alternative 11 (Fish Bypass: Alternative Tunnel Route) is identified by Siskiyou County as the "environmentally preferable alternative that would result in a cost of 1/6 the cost of installing fish ladders, 5% the cost of dam removals, and the fewest adverse effects to the biological and physical environment." THIS ALTERNATIVE IS SUPPORTED BY 80% OF THE COUNTY AND MUST BE RE-CONSIDERED under CEQA and NEPA requirements not dependent on secrete KBRA/KHSA agreements.**

5) **In Chapter 3 - 3.6 Flood Hydrology of the EIR/EIS, data provided does not accurately represent current independent scientific or historical data. The data chosen for the study was that the data that supports the Lead Agencies desired outcomes.**

a) Table 3.6-5 shows the 100-yr flows at Keno at 11,800cfs and Iron Gate at 31,460cfs. **However, a statistical analysis using data from 1961 provides flows at Keno at 12,000cfs and Iron Gate at 30,600cfs** (close).

b) Table 3.6-9 shows a 6.9% reduction in the flood attenuation of Iron Gate and Copco Reservoirs combined. **This is in substantial disagreement with an engineered independent evaluation.** By using the 1964 flood data for Gage 11516530 and a t/c in of 24 hr, t/c out of 48 hr. an inflow out flow hydrograph shows a 22% reduction in peek flow and a 9 hour delay in peek discharge.

c) Table 3.6-5, the 100 yr. flood plain below Iron Gate Reservoir, and the write up needs to be revised to **show that the Dams Provide Critical Flood Protection.**

6) **The EIR/EIS fails to weigh basic risks associated with Flood Hydrology.** The flood protection currently provided by the dams in place is notable. Without the dams much of the private property adjacent to the Lower Klamath River would be subject to severe flooding and erosion. Highway 96 may have to be relocated in several locations and many bridges may need to be replaced to provide the same level of service and protection that we currently enjoy.

a) The 1964 flood destroyed many bridges on the Lower Klamath and washed out much of Highway 96. All of the dams that are proposed for removal were in place during the 1964 flooding. All roadways and bridges were re-located above the calculated **B**ase **F**lood **E**levation considering all existing dams in place. DOI

determined the existing floodplain by computing the 100 year flood and then mapping the extent of that floodplain on the existing topography. The existing floodplain may be different than that proposed by FEMA because it is based upon more current information.

b) DOI determined the 100-yr floodplain after dam removal. Based upon the most current inventory of structures downstream of Iron Gate Dam to Humbug Creek over 24 residences are within the existing 100 year flood plain. Less than 6 residences and other structures such as garages are outside of this flood plain, but may be put into the 100 year floodplain after removal of the dams. However, the final determination of the future 100-yr floodplain after dam removal will be made by FEMA. The purpose of the analysis was to estimate the costs to mitigate the increase in flood risk. The existing bridges are within the 100-year floodplain; however, these structures would need to be evaluated to determine if they would still maintain enough clearance to not be inundated by flooding. Not all of the structures that could be exposed to increased flooding risks are permanent..

7) The EIR/EIS Mitigation Measures downplay real risks presented and put the public and environment at severe risk. **The EIR/EIS change to the 100-year floodplain inundation area downstream from Iron Gate Dam would increase the risks of flooding structures; therefore, the impact on flood hydrology would be significant. Mitigation Measures H-1 and H-2 assign and thereby reduce the impact to flood hydrology to <u>less than significant</u>.** This conclusion is, at best, irresponsible. By definition, an increase in risk to one habitable structure or bridge is to be considered significant according to the significance criteria.

8) **Statements made in the EIR/EIS about current dam conditions and impacts of removing the dams are unsupported and dishonest.** These dams are in very good condition according to the Ca. Div. of Dam Safety. The primary benefits and reasons for building dams is for water conservation and management, clean energy production and flood control. For example;

a) The EIR/EIS states; *"removing the Four Facilities could reduce the risks associated with a dam failure.* The Four Facilities, collectively, store over 169,000 acre-feet of water when they are full. The dams are inspected regularly, and the probability for failure has been found to be low. However, if a dam failed, it could inundate a portion of the downstream watershed (Siskiyou County website 2011). **Removing the Four Facilities would eliminate the potential for dam failure and subsequent flood damages.** Therefore, eliminating the dam failure risk associated with the Four Facilities would have a beneficial effect on flood hydrology."

b) The EIR/EIS states; **"Therefore, it is anticipated that implementation of the Emergency Response Plan would generate no change in flood risk when compared to existing conditions, although it would likely help to reduce damage to property or loss of life due to a flood event which would be a beneficial effect to flood risks. Implementing the Emergency Response Plan will likely require**

the analysis of changes to flood risks in future environmental compliance investigations as appropriate."

9) The EIR/EIS Mitigation Measures downplay real risks presented, offer inadequate mitigation measures and put the public and environment at severe risk ***For example;***

   a) ***Per EIR/EIS section 3.6.4.4 Mitigation Measures, Mitigation Measure H-1:*** "Prior to dam removal, the **DRE will inform the National Weather Service, River Forecast Center, of a planned major hydraulic change (removal of four dams)** to the Klamath River that could potentially affect the timing and magnitude of flooding below Iron Gate. **The River Forecast Center is the federal agency that provides official public warning of floods.** As needed, the River Forecast Center would update their hydrologic model of the Klamath River to incorporate these hydraulic changes so that changes to the timing and magnitude of flood peaks would be included in their forecasts. As currently occurs, flood forecasts and flood warnings would be publicly posted by the River Forecast Center for use by federal, state, county, tribal, and local agencies, as well as the public, so timely decisions regarding evacuation or emergency response could be made. Prior to dam removal, the DRE will inform FEMA of a planned major hydraulic change to the Klamath River that could affect the 100-year flood plain. The DRE will ensure recent hydrologic/hydraulic modeling, and updates to the land elevation mapping, will be provided to FEMA so they can update their 100-year flood plain maps downstream of Iron Gate Dam (as needed), so flood risks (real-time and long-term) can be evaluated and responded to by agencies, the private sector, and the public.

10) The EIR/EIS Mitigation Measures display the agencies force of will over residents, fail to offer adequate mitigation plans to the potentially affected inhabitants and put the public and environment at severe risk ***For example;***

   a) ***Mitigation Measure H-2:*** The **DRE will work with willing landowners to move or relocate permanent, legally established, permitted, habitable structures in place before dam removal.** The DRE will move or elevate structures where feasible that could be affected by changes to the 100-year flood inundation area as a result of the removal of the Four Facilities.
   b) **Effectiveness of Mitigation in Reducing Consequence** These mitigation measures will be effective as they will identify the extent of the increased flood risks and take measures which will reduce the risks for loss, injury or death from flooding.
   c) **Agency Responsible for Mitigation Implementation.** The DRE would be responsible for implementing mitigation measures H-1 and H-2.

   These are not "Mitigation Measures"... a telephone call or radio broadcast to tell you that you are about to be flooded. As stated above, the EIR/EIS fails to present and weigh sound scientific data and make conclusions that are in the best interest of the environment, community and lives of humans and species downstream of the dams.

11) **The sediment removal proposal is a scientific impossibility. The Lead Agencies failed to demonstrate adequate scientific knowledge to perform and make scientifically sound decisions.**

Per the EIR/EIS; 3.2 Sediment Removal: Dam removal would release some of the accumulated sediments downstream. The Proposed Action includes the use of erosion from river flows to flush the sediment behind the dams downstream during facility removal. Reservoir drawdown would focus on the wet season in order to flush the sediment downstream with the natural seasonal high flows. Modeling studies indicate that drawdown would erode and flush 41 to 65 percent of the stored sediment downstream (DOI 2011). The initial drawdown would begin slowly, to minimize riverbank erosion, with the rate increasing as water levels drop to maximize the amount of sediment flushed down stream. Most of the sediment remaining on the riverbank slopes would stabilize and would not erode downstream in subsequent years.

a) **As an engineer of dams and bridges, formerly with Cal Trans, I can attest that the standing water behind the dam will not transport sediments to the breached area of the dam during drawdown. The only sediment transport will be within the remaining river after the reservoirs are drained.**

12) **The EIR/EIS fails to consider logical scientifically supported impacts and mitigation measures related to the removal the sedimentation during and after dam removal.** This failure leads to an unnecessary risks presented to the public and the environment.

Per the EIR/EIS section3.2.1 Option: Sediment Removal, "If analysis indicates that the release of sediment could result in significant effects, the EIS/EIR may include consideration of dredging sediments out of the reservoirs before removing the dams if this measure is determined to be feasible. Dredging would focus on the area within the new river area; sediment remaining above the new stream level would only require removal if the slopes would not be stable."

a) Surveys to date have shown water content in the sediments behind the reservoir to average 80 percent by volume (Eilers and Gubala 2003). Once dredging began, the spoils would be pumped to a detention area near the reservoir for the sediments to dry. Dredging and the mechanical removal of sediment from the reservoirs would require equipment in addition to that needed for dam removal. This additional equipment would include barges, dredges, and pumps.

b) Storing the spoils after removal from the reservoirs would require an area of sufficient size to allow the sediment to be spread and dried

c) **This option, being the only viable option to mitigate sediment impacts upon dam removals is not on the table because of predetermined conclusions that funding would not be approved or available to support actual projected cost. This is the reason that Alternative 3 (Partial removal of 4 dams) was selected as the:**

i) **Initial sediment study:** 20.4 million cubic yards with 84% washing down river

ii) **Recent sediment analysis:** 13.1 million cubic yards with 41 to 65% washing down river

iii) **Analyses:** Sediment depth below Iron Gate to the ocean assuming a river bottom width of 150'and a length of 190 miles
Initial sediment study: 3.1 feet depth
Recent sediment analysis: 1.0 to 1.5 feet depth

d) The recent study appears to be in line with recent attempts to reduce cost in support to dam removals with limited funding. The State Water Quality Control Board and Department of Fish and Game, and the U.S. Corps of Engineers regulate all private construction projects involving disturbed soil, within a drainage watercourse. **How could public agencies (for and by the peope), even consider such an irresponsible action?**

13) The Lead Agencies failed to present a truthful and logical cost/benefit analysis for the Secretary or any reviewer to make a logical determination. **The cost proposals for all the alternatives are either intentionally omitted or were not conducted. How could you make a decision on a project without accurate detailed cost estimates?**

CONCLUSION:

This document is riddled with bias conclusions and inappropriate mitigation measures which are not supported by fact, respected science or properly engineered studies. **This document was prepared supporting a predetermined goal (Removing 4 dams on the Klamath River) and needs major revisions to comply with NEPA and CEQA regulations.**

Thank you for considering my opinions.

Respectfully submitted,

Jerry L. Bacigalupi

Jerry L. Bacigalupi P.E. (RCE 18063)

To: Ms. Elizabeth Vasquez
Bureau of Reclamation
2800 Cottage Way
Sacramento, CA 95825

June 13, 2013

Gordon Leppig
California Department of Fish & Game
619 Second Street
Eureka, CA 95501

From: Jerry L. Bacigalupi
Professional Engineer (P.E.)
P.O. Box 309
Montague, CA. 96064 (530) 459-5546 (916) 768-5015c

Dear Ms. Vasquez and Mr. Leppig:

Following are my comments to the **Klamath Facilities Removal Final EIS/EIR** (dated December 2012, but not mailed to respondents until 04/05/13)

1) As a citizen and Professional Engineer I am disappointed at the professional integrity within the DOI and CDFG. In reviewing several of the EIS/EIR comments submitted to the DOI and the DOI responses, I am disturbed at the DOI's lack of professional knowledge, goal oriented responses, and spin **supporting dam removals.**

2) After reviewing my comments and the DOI responses, I feel that my comments were not addressed. **I would make the same comments again.** The point being that the EIR/EIS has not been properly completed because the **EIS/EIR process is flawed** with responses that lack professional and scientific integrity, and with probable misconduct, all supporting the KBRA / KHSA (Dam Removals). In addition viable alternatives with dams in place were not studied, and the facts that the Upper Basin Water Wars and the Klamath Hydro-Electric Facilities are not physically related. The KBRA & KHSA improperly mandate stakeholders agreeing to Hydro- Electric Dam Facility removals.

3) In particular I would like to address my highlighted comment #5 and DOI response **(Comment 6 Hydrology).** To quote my comment:
"In Chapter 3 - 3.6 Flood Hydrology of the EIR/EIS, data provided does not accurately represent current independent scientific or historical data. The data and conclusions presented was data that supports the Lead Agencies' desired outcomes and not supported by recognized engineering practices.

   a) Table 3.6-5 shows the 100-yr flows at Keno at 11,800cfs and Iron Gate at 31,460cfs. **A statistical analysis using data from Calif. Division of Dam Safety shows 100-yr. flows for Keno at 12,000cfs and Iron Gate at 30,600cfs. This is a close check, however;**
   Table 3.6-9 shows a 6.9% reduction in the flood attenuation of Iron Gate and COPCO Reservoirs combined.

This is in substantial disagreement with an engineered independent evaluation. Using the 1964 flood data for Gage 11516530 (29,400cfs peak flow at Iron Gate) an inflow out flow hydrograph combining both reservoirs shows a 22% reduction in peak flow and a 9 hour delay in peak discharge.

b) Table 3.6-9, the 100 yr. flood plain below Iron Gate Reservoir, and the write up needs to be recalculated and re-evaluated using properly engineered procedures for inflow/outflow analysis **based on historic hydrographs** to **show that the Dams Provide Critical Flood Protection."**

The DOI Response to my comment :

GP_LT_1230_1220-6 Master Response HYDG-1 Flood Protection.
The comment author refers to an analysis of the 1964 flood documented in a memo delivered to Siskiyou County (Bacigalupi, 2010). In this analysis, it was concluded that Iron Gate Dam and Copco Dam reduce the 100-yr flood by 22 percent. However, a time step of 3 hours was used in Bacigalupi (2010), which is too large and this caused errors in the results. If the same analysis was performed with a time step of 15 minutes or smaller, the flood attenuation effects would be very similar to Reclamation (2D12b) and find that the attenuation of the 100-yr is near 7 percent as stated in the Draft EIS/EIR.

My comment to the DOI response:
The same analysis was performed using the same computerized program, same data, and varying the time steps of the inflow outflow hydrograph as suggested by the DOI. The results are as follows:

Time Step Hr.	Inflow cfs	Outflow cfs	Peak Flow Delay Hr.	Increase In Flow With Out Dams %	Remarks
3	35,700	29,400	9	22	Original
1	36,800	29,400	10	25	1Hr. Steps
.25(15min.)	37,250	29,400	10.25	26.7	15min. Steps

The above results show that the DOI makes rudimentary conclusion and statements that are in **error** and that have definite impacts on the decision of dam removals.
The Dams do provide substantial (26.7%) flood protection. Table 3.6-9, the 100yr. flood plain and write up needs to be revised.
The EIR/EIS process has not been completed. The EIS/EIR is flawed with responses that are in error, and lack professional and scientific integrity, all supporting the KBRA / KHSA (Dam Removals).

Respectfully submitted:

Jerry L. Bacigalupi 06/13/13
Jerry L. Bacigalupi

From: Patrick Backer <user@votervoice.net>
Sent: Wednesday, January 25, 2017 9:20 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

Other key points I urge you to consider:

1. The 2012 joint California and federal EIR/EIS and related documents concluded that dam removal on the Klamath is in the best interest of the public. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies, which can be relied upon for your EIR.

2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Patrick
2415 Main St SE
Albany, OR 97322
pat_rick014@yahoo.com

From: Mr. & Mrs. Jesse Bahm <user@votervoice.net>
Sent: Monday, January 30, 2017 6:38 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

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Sincerely,

Sincerely, Jesse Bahm
752 W Los Altos Ave
Clovis, CA 93612
jessebahm@yahoo.com

From: Edward Barich <ebarich@sonic.net>
Sent: Friday, January 27, 2017 8:47 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

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Sincerely,

Edward Barich
5499 Newanga Ave
Santa Rosa, CA 95405
ebarich@sonic.net

From: K.L. Barton <kennethlbarton@msn.com>
Sent: Thursday, January 26, 2017 5:41 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

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As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

K.L. Barton
13654 Almetz St
Sylmar, CA 91342
kennethlbarton@msn.com

Thaler, Parker@Waterboards

From: loyalbme2@yahoo.com
Sent: Tuesday, January 31, 2017 9:15 AM
To: Thaler, Parker@Waterboards
Subject: Public comments

I request that the California State Water Resources Control Board:

(1) Do NOT issue a water quality certification for the KRRC for the Klamath River!!

(2) Do NOT incorporate the information from the 2012 joint California and Federal EIR/EIS into the EIR currently being developed. The previous EIR/EIS was NOT based on exhaustive studies and did NOT reach the correct conclusion.

- Only five miles of the entire river system, designed to generate data that would best support dam removal, was submitted.
- It was clearly NOT an exhaustive study as the river waters above the dams was NOT studied, nor was the water quality entering California from Oregon.
- A **new and complete** analysis of the **entire** river must be performed, including the water management of the Trinity River that is diverted into the State Water Project and the central canal as these flow impacts on the fish are unknown. The complete environmental consequences have not been adequately evaluated.

(3) Evaluate ALL scientific data and studies produced BEFORE and since 2012. This will further contradict the conclusions of the 2012 EIS/EIR as being inconclusive and prejudicial in nature.

- This fact is supported by Dr. Paul Houser, the hydro meteorologist, hired to oversee the scientific integrity, when he revealed that the study was designed to align with those favoring dam removal.
- The tribes still gill net across the mouth of the Klamath and this has had an effect on salmon populations.

(4) Fully analyze the environmental and economic impacts of dam removal with respect to the certainty of removal ramifications, not just what “might”, “could”, language used in the 2012 EIR/ EIS studies used in support of dam removal.

- The loss of property values is reflected in the declining property taxes, and therefore a loss to Siskiyou County Revenue. The 2012 study only looked at bare land values. They did not go through the process of the Record of Decision. Improvements were not considered.
- The KRRC does not have the funding or a plan for river or reservoir aesthetic restoration. It would take many, many years, if not a lifetime, to return the Klamath River behind the reservoirs to their native beauty.
- Unless the entire river is studied, all the impacts to fish and birds can’t be know as to the impact.
- There are Perch behind the dams and if they are released into the lower river, that consequence must be considered since they are predatory to Salmon eggs. This is an ESA impact that has not been studied.
- The Shasta Native American Tribe, which precedes other Klamath tribes are not a signatory to the KHSA and have not been represented. Dam removal will expose sensitive Shasta burial grounds and possibly tribal artifacts.
- As the tribes, downstream from the dams are demanding that their tribal and cultural customs be respected, so shall the Shasta Nation be respected. If you engage with **some** tribal entities without taking into consideration **all** entities and be certain that the interests of all tribes are taken into equal consideration you will be acting prejudicially.

There is no possible way that you can base your current study on such flawed analyses such as the 2012 EIR/EIS study!! Unless a **new, transparent,** and **complete** study of the entire river system is performed, the SWRCB cannot make a **credible** determination concerning water quality!!

Cathy Beardsmore

Thaler, Parker@Waterboards

From: loyalbme3@yahoo.com
Sent: Tuesday, January 31, 2017 9:14 AM
To: Thaler, Parker@Waterboards
Subject: Scoping comments

I request that the California State Water Resources Control Board:

(1) Do NOT issue a water quality certification for the KRRC for the Klamath River!!

(2) Do NOT incorporate the information from the 2012 joint California and Federal EIR/EIS into the EIR currently being developed. The previous EIR/EIS was NOT based on exhaustive studies and did NOT reach the correct conclusion.

- Only five miles of the entire river system, designed to generate data that would best support dam removal, was submitted.
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- A **new and complete** analysis of the **entire** river must be performed, including the water management of the Trinity River that is diverted into the State Water Project and the central canal as these flow impacts on the fish are unknown. The complete environmental consequences have not been adequately evaluated.

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There is no possible way that you can base your current study on such flawed analyses such as the 2012 EIR/EIS study!! Unless a **new, transparent,** and **complete** study of the entire river system is performed, the SWRCB cannot make a **credible** determination concerning water quality!!

Ed Beardsmore

Thaler, Parker@Waterboards

From: jeff beardsmore <jeffbeardsmore@gmail.com>
Sent: Monday, January 30, 2017 11:05 AM
To: Thaler, Parker@Waterboards
Subject: Scoping Comments-Klamath River

I request that the California State Water Resources Control Board:

(1) Do NOT issue a water quality certification for the KRRC for the Klamath River!!

(2) Do NOT incorporate the information from the 2012 joint California and Federal EIR/EIS into the EIR currently being developed. The previous EIR/EIS was NOT based onexhaustive studies and did NOT reach the correct conclusion.

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- A **new and complete** analysis of the **entire** river must be performed, including the water management of the Trinity River that is diverted into the State Water Project and the central canal as these flow impacts on the fish are unknown. The complete environmental consequences have not been adequately evaluated.

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into consideration **all**entities and be certain that the interests of all tribes are taken into equal consideration you will be acting prejudicially.

There is no possible way that you can base your current study on such flawed analyses such as the 2012 EIR/EIS study!! Unless a **new, transparent,** and **complete** study of the entire river system is performed, the SWRCB cannot make a **credible** determination concerning water quality!!

Thank you,

Jeff Beardsmore

ER/PT

Comments to the State Water Resource Control Board regarding Notice of Preparation and Scoping Meetings for an Environmental Impact Report for the Lower Klamath River Project License Surrender for Klamath River Dam Removal.

January 23, 2017

Dear State Water Resources Control Board c/o Mr. Parker Thaler,

We were NOT notified of the scoping meetings in a transparent way. We own property on Copco Lake, so we are obviously stakeholders! We had been included by the Department of the Interior and the Bureau of Reclamation, when they were doing scoping meetings for their studies. We were notified by the Klamath River Renewal Corporation, KRRC, of their application to FERC. Unless we went to extraordinary measures to stay informed, no one received notice of the public scoping meetings. While on the surface, it appears you sent out the required notifications, you did not adhere to the spirit of the law as it was intended to notify and engage the public, and we find it ironic that the parties that support dam removal were notified much earlier than even the Siskiyou Board of Supervisors. This is not the first time that lack of transparency in this process has occurred.

The Siskiyou Board of Supervisors represent and speak for the 80% of voters in the county that voted to register their comments when they voted to keep the dams. Since Siskiyou County is home to 2/3 of the river system, you should give the Siskiyou Board of Supervisor's comments **extraordinary** consideration in your determination. You need to also consider **economic** and **environmental** consequences of dam removal. I am hopeful you will consider ALL our comments.

To begin, the Klamath River Renewal Corporation has filed an **incomplete** initial application. This is alarming, as they have had years to formulate a plan to consider such an application, since the KRRC is essentially the original signatories to the KHSA and KBRA. Given the simple fact that the US Congress was not willing to follow through and underwrite the liability of dam removal, how can a non-profit, that cannot even fill out a **complete** application, take over the Klamath Dams? This should be a major red flag that they will not be able to assume such an undertaking with any kind of organization or complexity of such a massive project! This is one reason, of many, that we believe that you should not grant certification.

Water Quality

- The 2012 California and Federal EIR/EIS reached incorrect conclusions. They did not do exhaustive engineering and environmental studies and therefore should NOT even be considered or used in the new EIR.
- The Bureau of Reclamation and Department of Interior studies were pushed by the signatories of the KHSA and KBRA chose the area of the river to study that would cost the least to remove the dams and have the highest environmental effect for dam removal to fit dam removal agenda. This opinion is fortified by Dr. Paul Houser, the hydro meteorologist, hired to oversee the scientific integrity of the BOR's study.
- Only FIVE miles of the ENTIRE Klamath River, as quoted in the Biological Assessment in the original studies, were performed. The five miles studied were below the Iron Gate Dam and nothing was studied above the dam all the way into Oregon.
- The most polluted water in the Klamath River is between Keno and Copco 1 Dam, and yet this area was not studied. Reports show the water leaving Copco Dam is cleaner than it was when it entered the river.
- If the entire river system had been studied correctly, the effects of dam removal with sediment release might/could (both terms used in the DOI report) kill all aquatic live in the river for at least 2 years. The report then states that aquatic life will magically reappear by year 5, and the fish would be thriving with renewed water quality. How is that possible?
- A **new and complete** analysis of the **entire** river must be performed, including the water management of the Trinity River that is diverted into the State Water Project and the central canal as these flow impacts on the fish are unknown. The complete environmental consequences have not been adequately evaluated.

- Unless a new, transparent, and complete study of the entire river system is performed, the SWRCB cannot make a credible determination concerning water quality.
- What agency is going to monitor the water quality coming into California from Klamath Lake? California is bearing the burden of compromised water due to geologic factors contributing to the volcanic, phosphorous nature of the river system and by pesticides and fertilizers.
- The warm, shallow waters in the Klamath in Oregon contribute to poor water quality.
- The most polluted water in the Klamath River is between Keno and Copco Dam and yet after the water leaves the dams, it is cleaner than what flowed into the river from Oregon.

Economic Impacts

- The economic impacts of the dam removal agreements are already being witnessed in Siskiyou County.
- Home values on Copco Lake have already plummeted due to dam removal agreements. Dam removal would precipitate a further loss.
- Homeowners are not able to sell their homes without disclosing possible dam removal and, as such, are forced to reduce their prices even more, IF they can even sell their homes.
- The loss of property values is reflected in the declining property taxes, and therefore a loss to Siskiyou County Revenue.
- When the BOR did their study they only looked at bare land values. They did not go through the process of the Record of Decision. Improvements were not considered. The KRRC does not have the funding or a plan for river or reservoir aesthetic restoration. It would take many, many years, if not a lifetime, to return the Klamath River behind the reservoirs to their native beauty.
- There are no plans for restoration after dam removal further lowering our property values.
- Even if there were to be a restoration period, the study looked at that as a period of only five years!! I'd like to see the science proving this study's assumption.
- There is a lack of transparency with the economic studies.
- It's my understanding that Siskiyou County has demanded an economic analysis so that they may inspect the details of this study, but their demands have not been met.
- Property value loss translates into lost tax dollars for school funding.
- If the dams are removed, the possibility exists that we could lose our water well, making our home uninhabitable, and therefore worthless. I'm certain the KRRC will not take on the expense of drilling a deeper well so that we can remain in our home.
- Will the KRRC compensate us for lost property value? Or will the KRRC reimburse Siskiyou County for millions of dollars of lost tax revenue as property values become worthless? I doubt that the KRRC will assume any liability and therefore in preparing your report you must take into consideration the economic effects of dam removal.
- The projected $450 million that dam removal is projected to cost, although other studies have shown this figure closer to $1 billion, are funds that can be spent on crumbling infrastructure, education, and other projects rather than a project that has not been adequately studied.

Fish and Animal habitat

- In 2001 The Karuk Council did not believe that Coho Salmon were indigenous to the Klamath River, but saw the value in misrepresenting the facts. The Coho are not native to the river, but the Karuk tribe now claims this to be true.
- Historically the salmon never came up above where Copco Lake is now due to warm waters from area hot springs per Native Shasta elders that lived in the area as well as early settlers, but these facts were never entered into the record when the BOR and DOI did their studies, as this area of the river was NOT studied.
- Under the ESA, a species cannot be decimated by a project, so how is dam removal a viable project to be considered by the Water Board if complete analysis is not performed?
- We have read that there is 20-30 million cubic yards of sediment behind the dams. There is great concern that this impact has not been adequately addressed. I assure you that if the fisheries are to be decimated for even a short period, the tribes will litigate for their losses of their fisheries.
- Unless the entire river is studied, all the impacts to fish and birds can't be know as to the impact.
- There are Perch behind the dams and if they are released into the lower river, that consequence must be considered since they are predatory to Salmon eggs. I believe this is another ESA impact that has not been considered.

- The last few years, water behind the Copco 1 Dam, as well as the others, has been released to improve water quality downstream to save the fish from parasites. Craig Tucker, of the Karuk tribe, admitted that without these water releases there would have been a major fish die off. No one at Copco Lake complained about their docks being temporarily unusable due to low lake levels, the inability to launch boats from the boat ramps because of low lake levels, and because boat could not be used there was a temporary loss of recreation at the lake.
- Governor Brown has said we need more water storage, not less. He cannot have it both ways. If this water storage was not there, at this crucial time, the fish would have died, and this winter with heavy rainfall, snow, and runoff there would have been floods.
- Aside from the original studies of only an extremely limited section of the Klamath River being evaluated, not all the creeks and rivers from below Iron Gate Dam to the mouth of the Klamath River, that make up the entire river system, and the actions of all parties that impact the fisheries, were and need to be taken into consideration. Gill netting still takes place across the mouth of the Klamath and this has not been studied as to the effect on Salmon population as well as ocean waters warming.
- Released sediments could alter the habitats of essential fish habitats and adequate studies have not been performed.
- It is ironic that even with these dams in place there have been record salmon runs and yet the tribes are still litigating. They sell their surplus fish to anyone who will buy them.
- Dam removal resulting in lake removal will impact migratory birds and the birds and animals that live in and around the lakes. Bald eagles, white pelicans, blue herons, and others have made this area their home and are thriving. Canadian geese and other migratory birds use the lake as a resting and breeding place and so the impacts to these species all need to be studied and have not been done so.

Public Health, Safety, and Flood Control

- The risk of floods downstream is great. Part of the reason for the dam construction initially was flood control. The sediments behind the dams could exacerbate the flood risk.
- Dam removal could also change the existing flood plains and you cannot ignore the need to realign the pipeline for the City of Yreka's water supply.
- The water behind the dams have aided in wildfire protection. Without the readily available water in the recent wildfires, many homes would have been lost.
- Despite warnings about coming in contact with the water due to toxins, not a single person around Copco Lake that has recreated in the lake have ever had any skin or health related issues due to water contact despite years of contact with the lake waters.
- Dam removal could result in problems with mosquito habitat and related diseases such as the Zika virus.
- There will be a considerable amount of debris because of dam removal possibly posing risks downstream of the destruction of the dams.

Historical and Archeological Effects

- The Shasta Native American Tribe, which precedes other Klamath tribes are not a signatory to the KHSA and have not been represented. Dam removal will expose sensitive Shasta burial grounds and possibly tribal artifacts.
- As the tribes, downstream from the dams are demanding that their tribal and cultural customs be respected, so shall the Shasta Nation be respected. If you engage with tribal entities without taking into consideration all entities and be certain that the interests of all tribes are taken into equal consideration you will be acting prejudicially.

Aesthetics

- Dam removal would have a long-term effect of the aesthetics of the river and the reservoirs behind the dams, as well as sediment transport would change the appearance and erosion issues for the Klamath River.
- Our home currently looks out onto a beautiful lake. When lake levels have been lowered for dam maintenance or when water releases have occurred to improve water quality for the fish, the mud, trash debris, and sediment exposed is not aesthetically appealing.

Recreation

- If dam removal takes place there will be a great recreational loss to the public. Currently the lakes provide such activities as boating, fishing, water skiing, wake boarding, kayaking, standup paddling, canoeing, and swimming. There is also camping along the lakes that would be eliminated with dam removal.
- White water rafting activies would be altered with dam removal.

Greenhouse gas emissions

- Removal of effective hydroelectric power providing power to over 75,000 homes will most likely result in increased greenhouse gas emissions from replacement sources at a time when California will not meet the 33% legal mandate of electric power sales from renewable sources by 2020 even with the dams in place.

Alternative Solutions for Analysis

- Once there has been a thorough and complete analysis, a determination has found that salmon were native to the area above Copco 1 Dam and that the fish would survive and thrive in this area of the river, then there can be alternative solutions for analysis.
- Siskiyou County has offered solutions to address Klamath River Water Quality, such as fish ladders, and Trap and Haul where fish ladders might not be a practical application.
- Another solution might be using Bogus Creek as a bypass around the dams for fish passage.
- "Fish cannons" are also used in certain cases for transporting fish.
- Siskiyou County and landowners have taken many measures to improve water quality, improve fish habitats and water conservation.

In conclusion, you must take into consideration all the above reasons to complete the process for permit application **without the assumption of a predetermined** outcome. To do anything less, than a complete and independent analysis, would violate the Code of Regulations. We ask that you **deny** the certification request for Section 401(a)(1) of the Federal Clean Water Act for the KRRC to move forward with dam removal.

Respectfully submitted,

John Beardsmore Loy Beardsmore

John and Loy Beardsmore

17635 Patricia Ave.
Montague, CA 96064
Mailing address:
1751 Overlook Lane
Santa Barbara, CA 93103
Phone: (805) 705-6886 (Loy)
(805) 319-9007 (John)
Email: loyalbme@yahoo.com
Email: lonewolfjb@yahoo.com

Thaler, Parker@Waterboards

From: John Beardsmore <lonewolfjb@yahoo.com>
Sent: Tuesday, January 31, 2017 11:52 AM
To: Thaler, Parker@Waterboards
Subject: Comments

I request that the California State Water Resources Control Board:

(1) Do NOT issue a water quality certification for the KRRC for the Klamath River!!

(2) Do NOT incorporate the information from the 2012 joint California and Federal EIR/EIS into the EIR currently being developed. The previous EIR/EIS was NOT based on exhaustive studies and did NOT reach the correct conclusion.

· Only five miles of the entire river system, designed to generate data that would best support dam removal, was submitted.
· It was clearly NOT an exhaustive study as the river waters above the dams was NOT studied, nor was the water quality entering California from Oregon.
· A **new and complete** analysis of the **entire** river must be performed, including the water management of the Trinity River that is diverted into the State Water Project and the central canal as these flow impacts on the fish are unknown. The complete environmental consequences have not been adequately evaluated.

(3) Evaluate ALL scientific data and studies produced BEFORE and since 2012. This will further contradict the conclusions of the 2012 EIS/EIR as being inconclusive and prejudicial in nature.

· This fact is supported by Dr. Paul Houser, the hydro meteorologist, hired to oversee the scientific integrity, when he revealed that the study was designed to align with those favoring dam removal.
· The tribes still gill net across the mouth of the Klamath and this has had an effect on salmon populations.

(4) Fully analyze the environmental and economic impacts of dam removal with respect to the certainty of removal ramifications, not just what “might”, “could”, language used in the 2012 EIR/ EIS studies used in support of dam removal.

· The loss of property values is reflected in the declining property taxes, and therefore a loss to Siskiyou County Revenue. The 2012 study only looked at bare land values. They did not go through the process of the Record of Decision. Improvements were not considered.
· The KRRC does not have the funding or a plan for river or reservoir aesthetic restoration. It would take many, many years, if not a lifetime, to return the Klamath River behind the reservoirs to their native beauty.
· Unless the entire river is studied, all the impacts to fish and birds can’t be know as to the impact.
· There are Perch behind the dams and if they are released into the lower river, that consequence must be considered since they are predatory to Salmon eggs. This is an ESA impact that has not been studied.
· The Shasta Native American Tribe, which precedes other Klamath tribes are not a signatory to the KHSA and have not been represented. Dam removal will expose sensitive Shasta burial grounds and possibly tribal artifacts.
· As the tribes, downstream from the dams are demanding that their tribal and cultural customs be respected, so shall the Shasta Nation be respected. If you engage with **some** tribal entities without taking into consideration **all** entities and be certain that the interests of all tribes are taken into equal consideration you will be acting prejudicially.

There is no possible way that you can base your current study on such flawed analyses such as the 2012 EIR/EIS study!! Unless a **new, transparent,** and **complete** study of the entire river system is performed, the SWRCB cannot make a **credible** determination concerning water quality!!

John Beardsmore
Copco Lake Homeowner

Sent from my iPhone

Thaler, Parker@Waterboards

From: Shaun Beardsmore <shaun.beardsmore@gmail.com>
Sent: Monday, January 30, 2017 11:02 AM
To: Thaler, Parker@Waterboards
Subject: Scoping Comments-Klamath River

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--

From: Chris Beath <chris.beath@gmail.com>
Sent: Wednesday, January 25, 2017 6:11 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

Other key points I urge you to consider:

1. The 2012 joint California and federal EIR/EIS and related documents concluded that dam removal on the Klamath is in the best interest of the public. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies, which can be relied upon for your EIR.

2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Chris Beath
1090 W 27th Ave
Eugene, OR 97405
chris.beath@gmail.com

From: Hal Beaver <user@votervoice.net>
Sent: Thursday, January 26, 2017 5:47 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Hal Beaver
157 W Blithedale Ave
Mill Valley, CA 94941
halbeaver@sbcglobal.net

From: Trevor Beer <user@votervoice.net>
Sent: Wednesday, January 25, 2017 4:57 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Trevor Beer
10836 Ivoryton Way
Mather, CA 95655
tbeer666@yahoo.com

From: Jerry Bender <user@votervoice.net>
Sent: Friday, January 27, 2017 10:58 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Jerry Bender
620 Lombard Ave
Santa Rosa, CA 95409
jerrybender@sbcglobal.net

January 31, 2017

To: State Water Resources Control Board

Subject: Dam removal on Klamath River

On January 26, 2017 I attended the State Water Board public comment meeting on the EIR for the removal of the four dams on the Klamath River. I have attended similar meetings since the federal license for these dams held by Pacific Corporation expired. Although I have little understanding of the questionable scientific verification that the removal of these dams is necessary, I do understand the social, economic and human implication of this action, having worked in this area as a real estate broker for almost 20 years.

Communities have grown around the various lakes formed by the damming of the Klamath River. These communities have enjoyed an extraordinary life style: clean air and water, no noise pollution, and a bounty of recreational opportunities--fishing, hunting, hiking, and water sports. Many of the citizens living in the Copco Lake and Iron Gate Lake areas, as citizens in urban areas, have invested much of their financial resources in the homes they own. The removal of the dams would certainly cause financial hardship for many as the value of their homes diminish.

Not only may the homes lose value, they may become unlivable. The domestic water supply for most of the homes in the area is a well. Should the lakes disappear due to dam removal, the water table that now sustains these wells may also disappear. Without a clean water supply, these communities will sustain tremendous hardship.

Please take into consideration the destruction the removal of the dams would cause in the lives of so many people. Perhaps the money now being collected from PP&L costumers in our area in anticipation of dam removal can instead be used for dam improvements.

Sincerely,

Ursula Bendix

Ursula Bendix
Bendix Real Estate, CalBRE#01238730
655 Lane Street
Yreka, CA 96097

ER/PT

STATE WATER RESOURCES CONTROL BOARD
2017 JAN 31 PM 1:
DIV OF WATER RIGHT
SACRAMENTO

Some History of the Klamath River Prepared for the California Water Board Meeting Held January 26th, 2017 in Yreka, California.

Amended Comments

These are things that I have researched

People I have talked to

1. Tribal Elders moved away from the River in the Summer the river was to stinky
2. George Gibb's journal from his early travels along the river he was one of the first white explorers Horses wouldn't drink the water
3. Family members tell stories from their ancestors who have lived on the River they talk about the Floods stinky water river very low in summer beginning in the 1850's
4. Klamath River Compact Commission in 1962, one of the first things that they did after the Klamath Compact was signed by the Governors of Oregon, California and President Eisenhower a binding document for the water usage on the Klamath River, was to have a study prepared about the water of the Upper Klamath Lake.
   Alga in upper Klamath Lake and bad water quality
5. CDM report

This is the only report that can be trusted because after this was released, Mr. Salazar from the Dept of Interior said in his public speeches that the dams would come out, after that, reports, studies and models were all written to reflexes this pre-determined decision.

6. Expert Panels in their report they stated that dam removal would only open 8 miles of new habitat and they were very concerned about the induction of a listed species and the loss of the red band trout that have been able to develop in the area above the Dams.
7. Work that Farmers, Ranchers, Loggers, County have done

Erosion work to stop sediment, Beaver dams, removal of weir dams, new pumping stations, lined ditches, Fenced off rivers so cattle don't get into rivers, Replace culvert replaced with bridges, Water storage to provide cold water, Major changes in irrigation practices. Very little logging is done now with many changes logging regulation Suction dredge Mining has stopped. Water banks, and many many hours of volunteer work provide by the people that live and work here.

8. Two of the biggest ranches along the Shasta River were purchased and are operated by the Nature Conservancy, water right sold to Cal Fish and Wildlife to put more water in the Shasta River.
9. Water releases from Iron Gate Dam to flush the system when the spawning season starts and maintain year round flow.
10. We have learned how to grow fish and we do it well. We send million upon millions of little fish out to the ocean every year, only to have them die from the C Shasta and other diseases in the mainstream river. California Fish and Wildlife has Not addressed this problem. In 2013-14 we had over half of the entire counts for the State of California, of Coho salmon return to the Scott and Shasta Rivers, these were drought years and as

much as we tried to save fingerling, it has shown up this year with very few returning adults. Mother Nature happens and we have no control over her actions.
11. If you allow the 20 to 30 million tons of sediment and fish behind the dams to be sweep down the river, it will be destroy it for a very long time and all of the effort and money that has already been spent to improve this system will have been wasted.
12. The other thing that must be watched very carefully is the City of Yreka Water supply at Fall Creek: this must not be put in any jeopardy. It is the City's only water source.
13. I am appalled and the California tax payers should all be upset that in the last 2 years, this water board has spent $400,000 in Oregon to improve their water quality. The water quality in Oregon is not the responsibility of the California Taxpayer, that bill should be paid for the Oregon taxpayer. It is their nasty water.
I am tired of hearing that you and other agencies think that they can make the WARM Klamath River system Cold, at the expense of our citizens,

14. Siskiyou County has 84 creek and rivers below Iron Gate dam to help dilute the Oregon's mucky water but we won't have enough if the dams are taken out, the settling process will be lost if the dams are removed, you see the water coming from Oregon is cleaner when it comes out Iron gate than when it goes in, because the phosphorus, nitrates and organic matter settles as it goes through the series of dams. There are also 471 miles of spawning habitat below the dams surely this is enough to produce a thriving salmon population if the disease in the main stream river was controlled. There are no counting stations on any of these streams except on the Scott, Shasta Rivers and Bogus Creek and they are 150 to 190 miles from the ocean, where do the fish go on their way up the river?

13. FIXES
Leave the Dams In the sediment behind them will sterilize the entire River for years and fill the harbors of Crescent City and Eureka
Put a water filtration system at the state line between Oregon and California
Stop the Fish Disease in River
Investigate what is happening with Ocean conditions
Currently there are only 3 counting stations on the entire river install a
Counting station at the Mouth of the Klamath report TRUE Tribal catch
Expansion of water storage in wilderness areas to provide more cold clean water

14. STILL UNANSWERED QUESTIONS
a. If the dams come out and there isn't enough water in the Klamath will this water board shut off the agriculture water in the Butte, Shasta and Scott Valleys to have enough water for the fish?
b. Does the Klamath Renewal corporation have the resources to restore the Dam beds to stop the spread of the invasive start thistle and other weeds, stop the sediment transport from the bare reservoir banks, what about the Shasta Tribal Burial and ceremonial sites

under the lakes, who will repair the roads leading to the Dams, what are they going to do with the Concrete, where will they put it or will they leave it in the river, how does all this help the water quality and the fish that we have worked so hard to improve habitat in our many tributaries and who will accept the liability for the disaster and destruction of the river when this grand experiment doesn't work out as planned. Millions and millions of dollars have been spent; do we have to spend more to take down these perfectly good Hydro electric power dams?

c. If the 401 certification couldn't be approved for re-licensing, how now with no improvements in water quality in the main stream river can it be approved for dam removal?

The citizens of Siskiyou County have the right to know the answers to these and many more question, after 10 to 12 years of living with this threat.
Let our people get back to work so they can support their families and enjoy life in our Beautiful Siskiyou County;
I am requesting a reply to these comments and questions.

Grace Bennett
Former Supervisor for Siskiyou County
P.O. Box 884
Yreka California 96097
Phone 530-842-4037
email gben@anowcrest.net



ER/PT

STATE WATER RESOURCES CONTROL BOARD
2017 JAN 31 PM 1:2
OFFICE OF WATER RIGHTS SACRAMENTO

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Erosion work to stop sediment, Beaver dams, removal of weir dams, new pumping stations, lined ditches, Fenced off rivers so cattle don't get into rivers, Replace culvert replaced with bridges, Water storage to provide cold water, Major changes in irrigation practices. Very little logging is done now with many changes logging regulation Suction dredge Mining has stopped. Water banks, and many many hours of volunteer work provide by the people that live and work here.

8. Two of the biggest ranches along the Shasta River were purchased and are operated by the Nature Conservancy, water right sold to Cal Fish and Wildlife to put more water in the Shasta River.
9. Water releases from Iron Gate Dam to flush the system when the spawning season starts and maintain year round flow.
10. We have learned how to grow fish and we do it well. We send million upon millions of little fish out to the ocean every year, only to have them die from the C Shasta and other diseases in the mainstream river. California Fish and Wildlife has Not addressed this problem. In 2013-14 we had over half of the entire counts for the State of California, of Coho salmon return to the Scott and Shasta Rivers, these were drought years and as

much as we tried to save fingerling, it has shown up this year with very few returning adults. Mother Nature happens and we have no control over her actions.
11. If you allow the 20 to 30 million tons of sediment and fish behind the dams to be sweep down the river, it will be destroy it for a very long time and all of the effort and money that has already been spent to improve this system will have been wasted.
12. The other thing that must be watched very carefully is the City of Yreka Water supply at Fall Creek: this must not be put in any jeopardy. It is the City's only water source.
13. I am appalled and the California tax payers should all be upset that in the last 2 years, this water board has spent $400,000 in Oregon to improve their water quality. The water quality in Oregon is not the responsibility of the California Taxpayer, that bill should be paid for the Oregon taxpayer. It is their nasty water.
I am tired of hearing that you and other agencies think that they can make the WARM Klamath River system Cold, at the expense of our citizens,

14. Siskiyou County has 84 creek and rivers below Iron Gate dam to help dilute the Oregon's mucky water but we won't have enough if the dams are taken out, the settling process will be lost if the dams are removed, you see the water coming from Oregon is cleaner when it comes out Iron gate than when it goes in, because the phosphorus, nitrates and organic matter settles as it goes through the series of dams. There are also 471 miles of spawning habitat below the dams surely this is enough to produce a thriving salmon population if the disease in the main stream river was controlled. There are no counting stations on any of these streams except on the Scott, Shasta Rivers and Bogus Creek and they are 150 to 190 miles from the ocean, where do the fish go on their way up the river?

13. FIXES
Leave the Dams In the sediment behind them will sterilize the entire River for years and fill the harbors of Crescent City and Eureka
Put a water filtration system at the state line between Oregon and California
Stop the Fish Disease in River
Investigate what is happening with Ocean conditions
Currently there are only 3 counting stations on the entire river install a
Counting station at the Mouth of the Klamath report TRUE Tribal catch
Expansion of water storage in wilderness areas to provide more cold clean water

14. STILL UNANSWERED QUESTIONS
a. If the dams come out and there isn't enough water in the Klamath will this water board shut off the agriculture water in the Butte, Shasta and Scott Valleys to have enough water for the fish?
b. Does the Klamath Renewal corporation have the resources to restore the Dam beds to stop the spread of the invasive start thistle and other weeds, stop the sediment transport from the bare reservoir banks, what about the Shasta Tribal Burial and ceremonial sites

under the lakes, who will repair the roads leading to the Dams, what are they going to do with the Concrete, where will they put it or will they leave it in the river, how does all this help the water quality and the fish that we have worked so hard to improve habitat in our many tributaries and who will accept the liability for the disaster and destruction of the river when this grand experiment doesn't work out as planned. Millions and millions of dollars have been spent; do we have to spend more to take down these perfectly good Hydro electric power dams?

c. If the 401 certification couldn't be approved for re-licensing, how now with no improvements in water quality in the main stream river can it be approved for dam removal?

The citizens of Siskiyou County have the right to know the answers to these and many more question, after 10 to 12 years of living with this threat.
Let our people get back to work so they can support their families and enjoy life in our Beautiful Siskiyou County;
I am requesting a reply to these comments and questions.

Grace Bennett
Former Supervisor for Siskiyou County
P.O. Box 884
Yreka California 96097
Phone 530-842-4037
email gben@anowcrest.net



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EXCERPTS FROM KLAMATH RIVER EXPERT PANEL FINAL REPORT: SCIENTIFIC ASSESSMENT OF TWO DAM REMOVAL ALTERNATIVES ON CHINOOK SALMON OF JUNE 13, 2011

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Welcome: gbennett@snowcrest.net

Subject: Current Klamath Flows
From: "Cozzalio" <coz@1access.net>
Date: Sun, August 21, 2016 10:49 pm
To: "Cozzalio" <coz@1access.net>
Priority: Normal
Mailer: Microsoft Outlook 14.0
Options: View Full Header | View Printable Version | Download this as a file | View Message details | View as plain text | Spam | Not Spam| Add to Addressbook

Good evening all,

Well, now that we have the hottest days of the year and lowest tributary levels, dam removal proponents have jacked the flows in the Klamath up, using water from the dams that 'don't store water', to trigger a large run of salmon waiting at the ocean up during the normally and naturally worst conditions possible. What does that suggest? The only thing they would have liked better are hot night temperatures which we often also get near this time of year, allowing the day/night averaging downriver Klamath water temperatures to rise exacerbating conditions conducive to disease during the period of minimal upriver available spawning habitat. Likely better to hold the water back to keep salmon at the coast as historically occurred until the natural conditions alter. However, whichever 'opinion' is more accurate, if sincere about intended outcome, both inescapably reveal the agenda of dams' removals to be totally hypocritical.

As sent to some of you previously, the current data being produced now proves the tremendous improvement dams have made to the historic regional fisheries' habitat, which local experience and salmon return statistics to the upper river, before and after, have long since repeatedly shown. Only problem is, like the prior studies, experience, and historical documentation available before, that new data seems to have NO current intent of 'analysis' and NO revisions allowed to the 'Biological Opinions' until AFTER dams are scheduled to be removed, and the damages to environment, citizenry, property, economics, and reason are irreversible. Under their current iteration of intimidation, blackmail, and compelled dams' removals, the one constant is the complete lack of accountability or liability for the losses to regional environment, life, and vested property. The newly created 'Dam Removal Entity' so far is comprised entirely of the same self-benefitting removal proponents responsible for fabricating the removal agenda and 'premise' to begin with. Under their 'selection' of taxpayer paid insurance for removals, it will be up to individual damaged parties to lose everything suing first the 'company' for compensation, and then the 'pennyless non-profit' DRE when the insurance company's narrowly defined liability 'protections' being offered only to government agencies and 'agreement' organizers doesn't extend to the communities and public.

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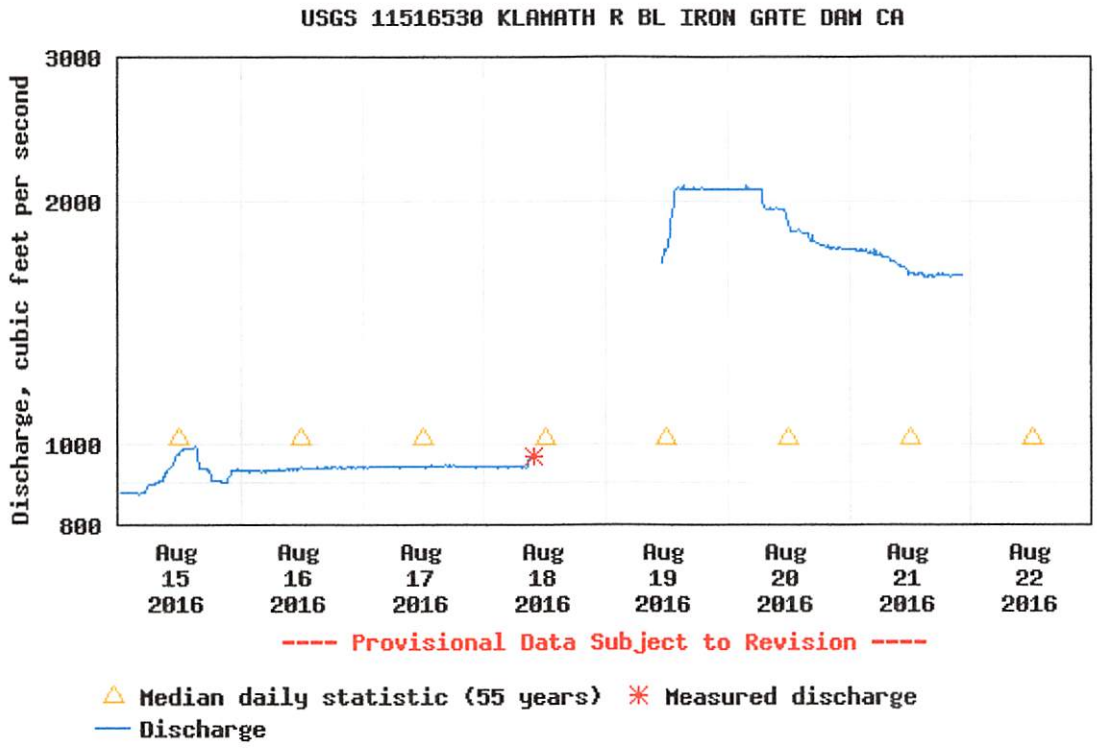

All the Best,

Rex Cozzalio

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Erosion spooks Northwestern Lake cabin owners

Landscape continues to transform two months after breaching of Condit Dam



Photo by Steven Lane

Cabins along what used to be Northwestern Lake are threatened by erosion as the White Salmon River cuts a new path to the Columbia River after Condit Dam was breached.

By Eric Florip
Columbian Staff Reporter

Wednesday, January 11, 2012

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Wells dry up as reservoir is drained

Cabin owners tepid on well settlement offer

Red flag raised at White Salmon River

Date Set to Breach Condit Dam

Dam removal changes White Salmon River landscape

Photo Gallery

Northwestern Lake



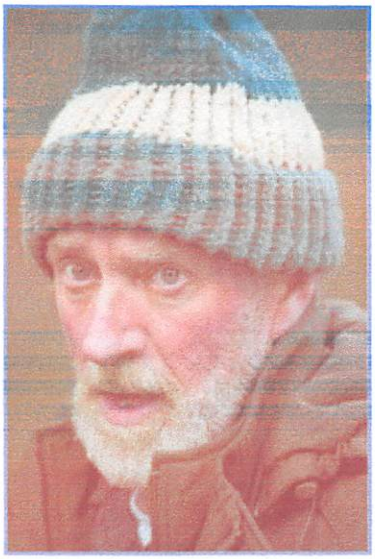

Photo by Steven Lane

David Johnson, cabin owner

WHITE SALMON — David Johnson uses a simple rule of thumb to find solid ground in the ever-shifting landscape around the White Salmon River, snaking through a deep muddy canyon that used to be Northwestern Lake.

Look for a tree trunk.

"If you don't see a tree trunk," Johnson said, "you're not there yet."

In other words: Many of the soft, bare slopes that now plunge toward the river's new path — and a handful of tributary creeks feeding into the former reservoir — won't be there for long.

"There's a lot of dirt up here still to be moved out of here," Johnson said. "It's still changing."

The White Salmon began charting its new course Oct. 26, when a blast of dynamite breached Condit Dam and drained Northwestern Lake in barely an hour. Nearly a century's worth of mud and sediment buildup behind the dam started working its way down toward the White Salmon's confluence with the Columbia River.

Much of that process will depend on how much rain and snowmelt the coming months bring. But as it starts to play out, a few cabin owners along the former reservoir fear they might lose more than a lakefront view. Erosion continues to rapidly reshape the landscape, in some places washing away banks uncomfortably close to structures and docks. Those impacts are evident even past Northwestern Park, about a mile and a half upstream of Condit Dam.

PacifiCorp, which owns Condit Dam and the surrounding land that dozens of cabins sit on, has constantly monitored conditions since the day of the breaching. Contractors JR Merit and Kleinfelder occupy a sort of home-base office in a building just a stone's throw from the dam itself.

PacifiCorp spokesman Tom Gauntt said the company has mostly let nature take its course in shaping the river above Condit Dam so far. Crews step in when needed to keep things flowing smoothly, he said — pulling debris away from the hole at the bottom of the dam to keep it from plugging up, for example. PacifiCorp also cut down several trees near Big Buck Creek recently after cabin owners feared erosion may cause them to topple over.

Heavy rainfall will cause unstable ground to shift and move more quickly, though this winter so far hasn't been particularly wet. Still, that doesn't mean the area is inactive, Gauntt said.

"The river's always flowing," Gauntt said. "So there's cutting going on regardless of whether it's high volume or not."

Shifting landscape

Among the most striking views of the evolving landscapes around the White Salmon River are just upstream of the dam, where cabins sit high above what's now the riverbed. Where Mill Creek empties into the river from the west, huge banks of sediment gradually slope downward, cracks visible as the ground continues to shift. A handful of docks droop with it, sunken from their original orientation.

Before the dam breaching, PacifiCorp asked cabin owners to submit plans to secure docks left vulnerable, Gauntt said. The company isn't aware of any

structures imminently threatened, he added, but there are a few being watched closely.

Johnson considers himself fortunate. At his family's cabin, dropping water appears to have given way to solid, stable ground. He walked out past his dock on a recent afternoon, dogs Blaze and Harley bounding alongside. Johnson, who lives in Washougal, pointed out clay and tree stumps nearby. That's what suggests mostly firm land, or trees that were cleared before the reservoir filled almost 100 years ago, he said.

Johnson bought the cabin in 2007, well aware of PacifiCorp's plan to decommission the dam rather than install costly upgrades for fish passage. But he admits he had "no idea" what the land would do in front of his cabin when Northwestern Lake drained.

Farther north, eroding banks near Big Buck Creek have retreated much closer to cabins along the west bank of the White Salmon. At least one cabin has been temporarily vacated, said Johnson, a board member of the Cabin Owners Northwestern Lake Association. A "FOR SALE" sign hangs in front of another. Orange fencing lines the bank in front of several others.

The erosion includes areas where U.S. Fish and Wildlife Service biologists last year dropped hundreds of salmon in anticipation of the dam breach. Fish and wildlife officials are hopeful that spawning upstream of the dam will eventually restore historic fish runs.

"A new river"

By spring, the deconstruction of Condit Dam will resume in earnest. That's when crews will dismantle the 125-foot concrete barrier, aiming to finish by September. Then comes landscaping work, planting and revegetation planned for subsequent months.

Rafters Doug Hepburn, Terry Neal and Jim Waddell made a trip up to the White Salmon River last Thursday. The trio had rafted the river years ago, and stood near their old take-out spot at Northwestern Park, surveying the transformed area. None had seen the river since the Condit Dam breaching.

Hepburn, of Vancouver, said the group came mostly for "nostalgia." Neal, of Washougal, said he was "blown away" by how different the lowered river looks now.

As the three spoke highly of the White Salmon's active rafting runs, they spoke in the past tense. This river was great. This was a favorite spot.

Truth be told, most of the river miles above the park haven't changed since Northwestern Lake disappeared. Hepburn said he hoped the river — now closed — will keep its popular status. He hoped the park might be refurbished to fit the dropped waterway.

Johnson called some of the recent changes "depressing" for cabin owners. But he's not giving up his optimism, either.

"I think a lot of us have accepted that it's going to be a new river. That's fine," Johnson said.

Standing on a dock outside his cabin later, Johnson surveyed a mostly muddy view on a gray day. It's a view he hopes he'll see change again.

"I'm hopeful that someday this will be a pristine, pretty area like it was before," Johnson said. "Just different."

Eric Florip: 360-735-4541; http://twitter.com/col_enviro; eric.florip@columbian.com.

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8 comments **Add a comment**



Earl Poulsen · Top Commenter · Clark College

I believe PP&L did more harm than good.

Reply · 6 · Like · Follow Post · Wednesday at 7:37am



Rob Smith · Top Commenter

Raft Ramp? That river is ruined for our lifetime. Maybe in about 20 years it will be worth floating a raft down. You can't even get a boat over the mud flow at the mouth...its a terrible sight..

Reply · 3 · Like · Follow Post · Wednesday at 9:08am



Terry Busch · Top Commenter

Take a good look America this is the result of Flat Earth anti-progress Greenies. These non-elected NGO are self appointed organizatons. They advise and make policy decisions for We The People.
This was done to "save the salmon" When the dam was breeched it killed every living thing downstream, they knew that, but making sense is not a priority! Removing the dam was!
They are un-educated in the field that they are advising. They want to remove ALL dams and force us to live under their totalitarian rule. No Oil, No Coal, NO energy and no cars!

Reply · 2 · Like · Follow Post · Wednesday at 10:24am



Chris Young · Top Commenter · Boston University

Terry, your comment does not make sense in this case. The Condit Dam was not producing enough electricity to make a retrofit worthwhile. Breaching the dam removes an artificial restriction to the river to allow salmon, steelhead and other wildlife (aquatic and otherwise) full access to the river. The lake behind the dam was very shallow and did not provide much, if any flood control value either.
Leaving the dam in would just require its removal later when the structural concrete and steel deteriorated to an unsafe condition. At least with this planned, considered removal the hazards of a catastrophic breach has been avoided.
Did it "Kill everything below the dam"? Possibly, but I doubt it. Nature has a way of protecting itself from mudslides, silt and debris.
Did it create a new silt delta downstream? Yes, just like the White River lahar did for Hood River several years ago.
Will it "recover" to allow full access and recreation? Absolutely.
Will we need to replace the lost generation capacity? Yes. Nuclear anyone?

Reply · 2 · Like · Wednesday at 10:50am



Eric Zimmerman · Subscribe · Top Commenter · Vancouver, Washington

Chris Young - Actually, we have too much power in the Columbia river basin...our transmission lines to California cannot even handle all of the excess.

Reply · 1 · Like · Wednesday at 11:16am



Wayne Dixen · Top Commenter · Owner at The institute of getting hit in the head with a SLEDGE HAMMER!

Chris Young "The Condit Dam was not producing enough electricity to make a retrofit worthwhile,VThe lake behind the dam was very shallow and did not provide much, if any flood control value either" Then why did they build it????

Reply · 2 · Like · Wednesday at 11:44am

View 5 more



Robert Winslow · Top Commenter

build a dam, we need power, we need water storage.no tear own the damn we need fish passage, no you should not have torn the dam down our docks are land based now.our wells are dry now, seems no matter what one does, no one likes what has been done.

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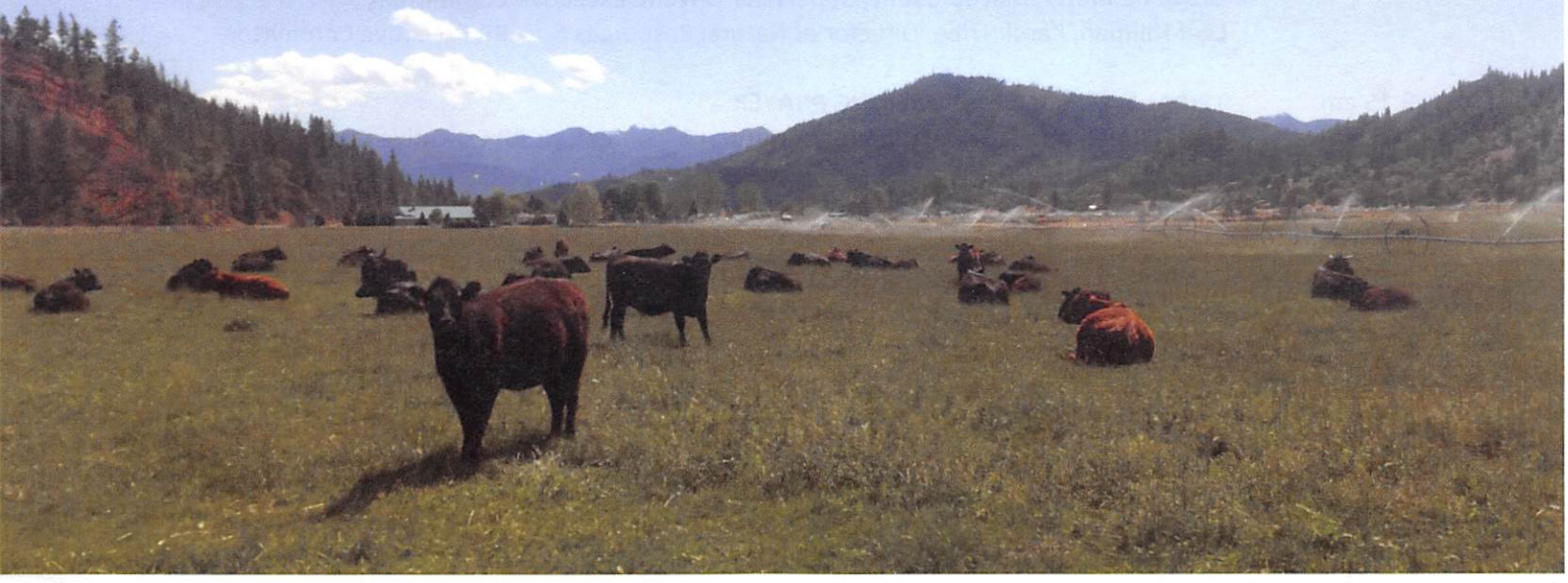
NORTH COAST RESOURCE PARTNERSHIP

CELEBRATING TEN YEARS OF COLLABORATION & POSITIVE IMPACT
&
DEVELOPING A STRATEGY FOR THE NEXT DECADE

EVENT PROGRAM

April 21 & 22, 2016

Historic Yreka Elks Lodge, 332 W Miner St, Yreka



NORTH COAST RESOURCE PARTNERSHIP

CELEBRATING TEN YEARS OF COLLABORATION & POSITIVE IMPACT & DEVELOPING A STRATEGY FOR THE NEXT DECADE

EVENT PROGRAM

LOCATION: Historic Yreka Elks Lodge, 332 W Miner St, Yreka

Thursday, April 21, 2016

2:45 - 5 pm **NORTH COAST RESOURCE PARTNERSHIP (NCRP) PROJECTS TOUR**
(BUS PICKUP at the Yreka Elks Lodge parking lot)

- **Shasta Valley Resource Conservation District:** Shasta Water Association Fish Passage & Tailwater Re-Use Projects
- **Montague Water Conservation District:** Instream Flow Enhancement through Water Conservation
- **Shasta Valley Watershed**
- **Fruit Growers Saw Mill**

5 - 7 pm **EVENING RECEPTION**
Yreka High School Vocal Ensemble

Friday, April 22, 2016

9:00 am **CELEBRATION WELCOME**
Judy Morris, Trinity County Supervisor & NCRP Policy Review Panel (PRP) Chair
Efren Carrillo, Sonoma County Supervisor & NCRP PRP Vice Chair
Grace Bennett, Siskiyou County Supervisor & NCRP Executive Committee
Leaf Hillman, Karuk Tribe, Director of Natural Resources & NCRP Executive Committee

9:15 am **TRIBAL WELCOME AND OPENING PRAYER**
Leaf Hillman, Karuk Tribe, Director of Natural Resources, NCRP Executive Committee

9:30 am **LOCAL, STATE, FEDERAL OFFICIALS & TRIBAL COUNCIL MEMBERS**

9:50 am **OVERVIEW OF NCRP ACCOMPLISHMENTS & IMPACT TO DATE**
NCRP Technical Peer Review Committee Co-Chairs:
Wayne Haydon, Certified Engineering Geologist, Sonoma County
Sandra Perez, Five Counties Salmonid Conservation Program, Trinity County

10:10 am **NCRP IMPLEMENTATION PROJECTS: RETURN ON INVESTMENTS IN NORTH COAST COMMUNITIES**

Toz Soto, Karuk Tribe Senior Fisheries Biologist and **Earle Crosby**, Karuk Tribe Watershed Restoration Program: Klamath River Habitat Protection, Road Decommissioning & Implementation Project

Adriane Garayalde, District Administrator, Shasta Valley Resource Conservation District: Araujo and Shasta Water Association Dams Restoration

Wes Scribner, General Manager, Weaverville Community Services District: Lewiston Valley Drinking Water Intertie and Water Metering Project

11:00 am **AGENCY FUNDING OBJECTIVES & RESOURCES**

Carlos Suarez, State Conservationist, USDA Natural Resources Conservation Service

Curtis Anderson, Northern Region Office Chief, Department of Water Resources

Rebecca Fitzgerald, Senior Environmental Scientist, North Coast Regional Water Quality Control Board

11:45 pm LUNCH

12:30 pm **INTERACTIVE SESSION: NEW ENVIRONMENTAL & ECONOMIC OPPORTUNITIES FOR THE NORTH COAST**
Sonoma Supervisor **James Gore**

1:30 pm BREAK

1:45 pm **BREAK OUT SESSION: NEW ENVIRONMENTAL & ECONOMIC OPPORTUNITIES FOR THE NORTH COAST**

2:45 pm **BREAK OUT SESSION: REPORT SUMMARY**

3:00 pm BREAK

3:15 pm **STRATEGIC SESSION SYNTHESIS & NEXT STEPS**
NCRP Chair Supervisor **Judy Morris**

3:25 pm **PUBLIC COMMENT**

3:30 pm **ADJOURN**

*A big **THANK YOU** to NCRP Chair and **Trinity County Supervisor Judy Morris** for overall leadership and coordination of the event and to NCRP Executive Committee Member and **Siskiyou County Supervisor Grace Bennett** for hosting & coordinating the evening reception and project tour. Additional thanks to the project **tour guides**, the **event presenters**, and **Yreka High School Vocal Ensemble**.*

HELP US PLAN FOR THE NEXT TEN YEARS OF SUCCESS!

INTERACTIVE SESSION: NEW ENVIRONMENTAL & ECONOMIC OPPORTUNITIES FOR THE NORTH COAST

We appreciate you taking the time to share with us your ideas and perspectives – your input and strategic thinking will help to guide the NCRP in supporting the health and economic vitality of our region. We are hoping to have an efficient, effective and FUN interactive session to share ideas across a broad range of viewpoints. We suggest the following approach to make the best use of our time together.

- *During the introductory sessions outlining the goals and objectives of the NCRP and its accomplishments to date, please develop a list of strategies that you think will be important for the NCRP to consider in moving forward.*
- *Please hone your strategic ideas down to something that can be articulated in 30 seconds during the facilitated session – we will use these to get all the "spaghetti on the wall" and then narrow the list down to 5-10 strategies to dive deeper into in small group discussions.*
- *When asked to break out into small groups, please select a group that is addressing one of the strategic areas that you are most interested in and work with the group to expand upon that strategy. Each group will select a facilitator, reporter and recorder to capture people's ideas.*
- *We will come back together and each group's reporter will summarize key discussion points and strategies. Chair Morris will share the NCRP approach for incorporating the input into the adaptive NCRP planning process and close with some thoughts on next steps.*



NORTH COAST RESOURCE PARTNERSHIP

WHO WE ARE

The North Coast Resource Partnership (NCRP) is an innovative, stakeholder-driven collaboration among local government, Tribes, watershed groups, water and wastewater service providers, Resource Conservation Districts, non-governmental organizations, business leaders, agricultural organizations, and interested stakeholders. For ten years, the NCRP has worked collaboratively on water and energy management challenges to: reduce conflicts; integrate federal, state, regional and local priorities; and utilize a multi-benefit approach to funding for the highest priority project needs throughout the region. The overarching themes of the North Coast Resource Partnership include salmonid recovery, enhancing beneficial uses of water, intra-regional cooperation, energy independence and climate change mitigation & adaptation, and enhancing public health and economic vitality in disadvantaged communities.

The NCRP approach to planning acknowledges and incorporates the unique issues, information and planning approaches of local areas (watersheds, Tribal lands and counties) within a framework that integrates local, regional and statewide priorities. This flexible and adaptive approach allows the NCRP to accomplish effective planning at a large scale while retaining and enhancing high-resolution data and planning at the local scale. The NCRP acts as a nexus between statewide and local planning efforts.

The NCRP consists of a collaborative partnership between the NCRP Policy Review Panel (PRP), the Technical Peer Review Committee (TPRC), project staff, consultants, and the stakeholders within the North Coast Region. With the exception of Modoc County, with one representative, the PRP consists of two representatives appointed by each County's Board of Supervisors and three Tribal Representatives appointed by North Coast Tribes as outlined in the 'Tribal Representation Process' described in the NCIRWMP Memorandum of Mutual Understandings. The TPRC is comprised of technical experts also appointed by each County's Board of Supervisors and Tribal representatives. The TPRC reviews and evaluates the development of the North Coast Integrated Regional Water Management Plan and proposed projects based on technical criteria and the PRP is the governing and decision-making body providing policy level direction and oversight for the NCRP planning process.

The NCRP is by design a voluntary, non-regulatory, stakeholder-driven planning framework meant to emphasize shared priorities and local autonomy, authority, knowledge, and approaches to achieving Tribal, state, regional, and local priorities related to North Coast water infrastructure, watersheds, public health, and economic vitality. The NCRP focuses on areas of common interest and concern to North Coast stakeholders and on attracting funding to the North Coast Region, and recognizes unique local solutions in different parts of the Region.

NCRP GOALS AND OBJECTIVES

Goal 1: Intraregional Cooperation & Adaptive Management

- Objective 1 - Respect local autonomy and local knowledge in Plan and project development and implementation
- Objective 2 - Provide an ongoing framework for inclusive, efficient intraregional cooperation and effective, accountable NCIRWMP project implementation
- Objective 3 - Integrate Traditional Ecological Knowledge in collaboration with Tribes to incorporate these practices into North Coast Projects and Plans

Goal 2: Economic Vitality

- Objective 4 - Ensure that economically disadvantaged communities are supported and that project implementation enhances the economic vitality of disadvantaged communities by improving built and natural infrastructure systems and promoting adequate housing
- Objective 5 - Conserve and improve the economic benefits of North Coast Region working landscapes and natural areas

Goal 3: Ecosystem Conservation and Enhancement

- Objective 6 - Conserve, enhance, and restore watersheds and aquatic ecosystems, including functions, habitats, and elements that support biological diversity
- Objective 7 - Enhance salmonid populations by conserving, enhancing, and restoring required habitats and watershed processes

Goal 4: Beneficial Uses of Water

- Objective 8 - Ensure water supply reliability and quality for municipal, domestic, agricultural, Tribal, cultural, and recreational uses while minimizing impacts to sensitive resources
- Objective 9 - Improve drinking water quality and water related infrastructure to protect public health, with a focus on economically disadvantaged communities
- Objective 10 - Protect groundwater resources from over-drafting and contamination

Goal 5: Climate Adaptation & Energy Independence

- Objective 11 - Address climate change effects, impacts, vulnerabilities, and strategies for local and regional sectors to improve air and water quality and promote public health
- Objective 12 - Promote local energy independence, water/ energy use efficiency, GHG emission reduction, and jobs creation

Goal 6: Public Safety

- Objective 13 - Improve flood protection and reduce flood risk in support of public safety

NCRP FUNDING AWARDS

The NCRP has worked over the past ten years to find common ground to more effectively meet shared objectives and in turn, leverage more than $65 M in state funding for vital environmental and municipal water system enhancement projects.

Proposition 50, NCIRWM Planning Grant	2005	$500,000
Proposition 50, Implementation Grant, Round 1	2006	$25,000,000
Proposition 50, Implementation Grant, Round 2	2007	$2,079,000
Proposition 50 Implementation Supplemental Funding	2010	$2,176,860
CEC Energy Efficiency and Conservation Block Grant	2010	$959,117
Proposition 50, DWR directed funding for Water & Wastewater Service Provider Outreach & Support Program	2011	$500,000
Proposition 84, NCIRWMP Planning Grant	2011	$1,000,000
Proposition 84, NCIRWMP Implementation Grant, Round 1	2011	$8,222,000
Proposition 84, NCIRWMP Implementation Grant, Round 2	2013	$5,386,000
Strategic Growth Council, Sustainable Communities Grant	2014	$1,000,000
NCRP 2014 IRWM Drought Project Grant	2014	$8,700,000
NCRP 2015 IRWM Project Grant	2015	$11,047,939
		$66,570,916

IMPACT OF NORTH COAST RESOURCE PARTNERSHIP INVESTMENTS

With funding from key state partners such as the California Department of Water Resources, the State Water Resources Control Board, the Strategic Growth Council, the California Energy Commission - as well as local in-kind and matching funds from the Sonoma County Water Agency, the partner North Coast counties and Tribes - the North Coast Resource Partnership has achieved significant on-the-ground benefits for communities, watersheds and the local economy. Over 17 miles of streams and 1350 acres of watersheds have been enhanced or restored; with over 6,405,991 cubic yards of sediment removed or stabilized and over 180 miles of road decommissioned or upgraded. Water supply reliability and conservation projects save nearly 1.5 million gallons of water per day and 57 energy efficiency projects save over 1,700,000 electric kWh/year. Forty-five water and wastewater projects are completed or underway in economically disadvantaged communities. In all, 145 projects have been or are being implemented using local labor and creating over 613 jobs during economically challenging times.

POLICY REVIEW PANEL MEMBERS

Chair: Supervisor Judy Morris, Trinity County
Vice-Chair: Supervisor Efren Carrillo, Sonoma County
Edwin Smith, Tribal Council, Bear River Band of the Rohnerville Rancheria, Central District
Supervisor Gerry Hemmingsen, Del Norte County
Supervisor Chris Howard, Del Norte County
Alternate: Supervisor David Finigan, Del Norte County
Supervisor Ryan Sundberg, Humboldt County
Supervisor Mark Lovelace, Humboldt County
Alternate: Supervisor Virginia Bass, Humboldt County
Supervisor Carre Brown, Mendocino County
Supervisor John McCowen, Mendocino County
Alternate: Supervisor Dan Gjerde, Mendocino County
Supervisor Geri Byrne, Modoc County
Leaf Hillman, Director of Natural Resources, Karuk Tribe, Northern District
Alternate: Vernon Ward, Social Services Coordinator, Pit River Tribe, Northern District
Supervisor Grace Bennett, Siskiyou County
Supervisor Ray Haupt, Siskiyou County
Supervisor James Gore, Sonoma County
Alternate: Dale Roberts, TPRC member, Sonoma County
Alternate: Grant Davis, General Manager, Sonoma County Water Agency, Sonoma County
Brandi Brown, Redwood Valley Little River Band of Pomo, Southern District
Alternate: Martina Morgan, Tribal Council Vice-Chair, Kashia Band of Pomo, Southern District
Supervisor Karl Fisher, Trinity County

TECHNICAL PEER REVIEW COMMITTEE MEMBERS

Co-Chair: Wayne Haydon, Certified Engineering Geologist, Sonoma County
Co-Chair: Sandra Perez, Program Manager, Five Counties Salmonid Conservation Program, Trinity Co
Javier Silva, Environmental Director, Sherwood Valley Rancheria, Central District
Jim Barnts, Director of Public Works, Del Norte County
Zack Larson, Smith River Watershed Coordinator, Del Norte County
Paul Helliker, General Manager, Humboldt Bay Municipal Water District, Humboldt County
Hank Seemann, Deputy Director, Environmental Services, Public Works Department, Humboldt County
Patricia Hickey, Executive Director, Mendocino County Resource Conservation District, Mendocino Co
Sean White, Director of Water and Sewer, City of Ukiah, Mendocino County
Sean Curtis, Modoc County Natural Resources, Modoc County
Toz Soto, Senior Fisheries Biologist, Karuk Tribe, Northern District
Alternate: Marissa Fierro, Environmental Coordinator, Pit River Tribe, Northern District
Marilyn Seward, City of Etna, Siskiyou County
Richard Tinsman, Deputy Director, Planning Division, Siskiyou County
Dale Roberts, Engineer, Sonoma County Water Agency, Sonoma County
Nathan Rich, Kashia Band of Pomo, Southern District
Alternate: Emily Luscombe, Environmental Director, Coyote Valley Band of Pomo, Southern District
Wes Scribner, General Manager, Weaverville Community Services District, Trinity County
Alternate: Mark Lancaster, Director, Five Counties Salmonid Conservation Program, Trinity County

EXECUTIVE COMMITTEE

Chair: Supervisor Judy Morris, Trinity County
Vice-Chair: Supervisor Efren Carrillo, Sonoma County
Supervisor Grace Bennett, Siskiyou County
Leaf Hillman, Karuk Tribe, Northern District

FUNDING & CELEBRATION AD HOC COMMITTEE

Supervisor Judy Morris, Trinity County
Supervisor Efren Carrillo, Sonoma County
Supervisor Grace Bennett, Siskiyou County
Supervisor James Gore, Sonoma County
Javier Silva, Environmental Director, Sherwood Valley Rancheria, Central District
Marissa Fierro, Environmental Coordinator, Pit River Tribe, Northern District
Wayne Haydon, Certified Engineering Geologist, Sonoma County

STRATEGIC GROWTH COUNCIL AD HOC COMMITTEE

Supervisor Mark Lovelace, Humboldt County
Toz Soto, Senior Fisheries Biologist, Karuk Tribe, Northern District

PROPOSITION 1 AD HOC COMMITTEE

Supervisor Judy Morris, Trinity County
Supervisor Grace Bennett, Siskiyou County
Supervisor Mark Lovelace, Humboldt County
Emily Luscombe, Environmental Director, Coyote Valley Band of Pomo, Southern District

North Coast IRWMP Proposition 84, Round 2 Implementation Projects

ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
101	Big Rock Community Services District	Big Rock CSD Stabilize Water Storage Tank	Water District (WS & WW)	Del Norte	$649,200	$875,221	40.4	40.0

Big Rock CSD's (BRCSD) is proposing a project to stabilize the system's 100,000 gallon water storage tank and foundation before the fill prism under the tank fails causing a massive landslide that would take out the District's water system as well as homes, portions of Highway 199, and eventually reach the Smith River. The project will prevent water supply shortages in this disadvantaged community. BRCSD serves Hiouchi, Jedediah Smith Redwoods State Park, and the Smith River National Park. It is located in Del Norte County alongside the pristine Smith River 10 miles inland from Crescent City. The District's 100,000 gallon tank was built in 1971, was sited on a steep hillside with grades of between 50% to 70%. Significant erosion of the tank pad has become evident and has likely been undercutting the foundation for many years. Civil engineers predict the tank will slide down Hiouchi Mountain during the combined factors of a wet winter and at least a 5.5 magnitude earthquake,. The project includes access-road improvements, replacement of the tank, a new tank foundation anchored in bedrock, a retaining wall, and drainage improvements. All improvement will be built to modern seismic standards which is not the case with the existing tank. The tank must be replaced as it is at the end of its useful life and research has shown there are no companies to reconstruct it on a new tank pad. If the tank and pad were to fail, the result would be the tank, hundreds of feet of flexible pipeline heavily laden with water, mud and trees, residential structures, and other debris falling down Hiouchi Mountain. The effects of a landslide triggered by the tank failure would include probable human injury, loss of human life, destruction of many residences, reduced firefighting capability, closure of an important evacuation route, potential degradation of the Smith River, catastrophic economic impacts, and damage to utility lines feeding 2 of 5 townships in the county.

102	County of Del Norte	Waste Water Lift Station Replacement	Government	Del Norte	$221,875	$665,625	38.3	38.9

The existing CSA lift stations were constructed in the mid-ninteen seventies. Mechanical and electrical equipment which is forty years old has reached its anticipated service life. Because of that the stations are suseptable to clogging and communication failures, which result in sewer overflows. These stations are at the lowest points in the sewer system so that the spills end up discharging into drainage areas which discharge into creeks.

The existing lift stations are made up of a wet well and a dry well. These two wells are large manhole like strucures which can be up to ten feet in diameter and thirty feet deep. Into the wet well the raw sewage is tranmitted by the collection system. Housed in the dry well is the motors, pumps, electrical equipment and the control equipment. Both of these wells are at approximately the same depth. Because of the type of pumps used in these stations, fiberous materials accumulate in the pumps and they become very ineffiecent. As more and more material clogs the pumps they do not pump fast enough to keep up with the amount of sewage coming into the station. Generally the lift station alarms the CSA employees who respond to the station and clean out the clog. Because the control/communication system is also antiquated there are times that the CSA personel are not made aware of the problem before sewage is spilled into a drainage area.

The proposed lift stations would be using submersable pumps with new electrical and communication equipment. A submersable pump is lowered directly into the wetwell and pumps from that wet well. The pumps proposed have chopper blades that keep them free from clogging. The new communication software would keep the CSA personel informed of the status of the lift stations at all times. The chance of spills would be greatly reduced. The new pumps and motors are much more energy efficient and require a lot less maintenance.

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North Coast IRWMP Proposition 84, Round 2 Implementation Projects

ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
103	Smith River Community Services District	Smith River Community Services District Infrastructure Improvement Project	Water District (WS & WW)	Del Norte	$292,790	$346,000	38.2	37.6

The Smith River Community Service District is requesting finacial assistance to improve their distribution system infrastructure. CSD's current Improvement Design Report and Board highlight system weaknesses into fire flow reliability, treatment time, lack of emergency backup systems and security of critical infrasture. This project divideds improvments into 4 priorities or phases. They include:

• Priority 1 - Installation of a Backup Generator. CSD willl install a standby generator set be installed for used during extended power outages. For the current source pumps and booster pump system a portable 120 KW generator will be required. An engineers estimate is complete. Once funding is secured, procurement and installation will move forward. Amount Requested: $55,000
• Priority 2 - Install 1710' of 6' Security Fence. Currently our yard and tanks are not secured. Perimeter fence will be installed around 4 tanks and enclose our yard including source pumps. Amount Requested: $47,000
• Priority 3 - Improve emergency flow reliability and treatment contact time by completeing Phase 1 of the Fred Haight Pipeline Project. This includes installion of a new 24" and 12' mainline beginning at our source pumps and running under Fred Haight for 2,400' before connecting with exsiting main. Project Total: $291,200 Requested: $146, 000
• Priority 4 - Improve emergency flow reliability by completeing Phase 2 of the Fred Haight Pipeline Project: Enlarge 1,100' of exisiting Line #1, the second section of our mainline under Fred Haight, before it connects to sections running north and south along HWY 101. SRCSD plans on replacing this 8"line with a 12" line. Once funding is secured for construction a county encroachment permits will be obtained easily.

ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
204	California State Parks	Benbow Dam Removal	Government	Humboldt	$202,044	$2,011,099	29.5	27.7

Benbow Dam is a seasonal dam that was operated by California State Parks for recreational purposes from the early 1960's until 2008. Due to the deteriorated condition of the main structure, difficulty in permitting due to its potential effect on salmonids and possibly earthquake and flow hazards, and the State budget condition, the seasonal dam has not been operated since 2008. This project proposes removal of the dam's concrete hollow core and supporting structures, and riparian planting along the southern bank of the former lake to help protect old growth redwoods from erosion and to enhance cover for salmonids. The dam is a partial fish barrier and also contributes to heating of the river due to the seasonal impoundment (increased evaporation and stream temperature increases). Wind driven erosion from the lake surface also impacts the southern bank of the lake/river, where a number of old growth redwoods have toppled. Removal of the dam is a priority for both the California Department of Fish and Game's and NOAA Fisheries coho recovery plans.

Engineering plans have been prepared outlining the dam removal impacts to nearby highway bridge infrastructure (no impact), project methods and staging, implementation costs, permitting needs and development of some baseline biological (yellow legged frogs, spotted owls) and physical (stream profile) monitoring for the project. Initial results of a cultural study indicate the dam is not historically significant but this study requires completion and approved by the State Historic Preservation Officer in early 2013. The tentative budget outlined below assumes an EIR is needed to address historical significance; if deemed to not be significant a less rigorous level of environmental review will be required and the costs should be less.

North Coast IRWMP Proposition 84, Round 2 Implementation Projects

ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
205	California Trout	Elk River Recovery Assessment and Pilot Implementation Projects	NGO	Humboldt	$500,937	$276,800	31.6	29.5

Two primary initiatives are underway to promote recovery of Elk River from sediment impairment: (1) the Regional Water Board is developing the Elk River Sediment TMDL, and (2) CalTrout and project partners have initiated the Elk River Recovery Assessment, with $501,000 funding from SWRCB Cleanup and Abatement and Coastal Conservancy. The Recovery Assessment will (1) conduct a system-wide analysis of sediment; (2) assess a suite of sediment removal and restoration activities; and (3) develop an implementation framework that promotes recovery of ecosystem functions and beneficial uses in Elk River. We are seeking implementation funds from IRWMP Prop 84 Phase 2 to implement several pilot projects. Three project types will be assessed: sediment trapping, sediment removal (along with channel rehabilitation), and vegetation understory removal. Each project will provide valuable information for the Recovery Assessment, demonstrate feasible recovery options, contribute to lowering sediment loads and flood risks, and inform development of an over-arching Recovery Plan for Elk River.

3	Humboldt Bay Municipal Water District	Ranney Collectors 1 & 1A Lateral Replacement	Water District (WS & WW)	Humboldt	$750,000	$750,000	40.0	40.4

The proposed project is of regional importance to assure water supply reliability for 2/3rds of Humboldt County's population, including the disadvantaged communities within the region. HBMWD supplies wholesale treated groundwater to 87,000 people through 7 municipal agencies, and serves water to numerous other industrial and public entities in the region. The project protects and enhances drinking water quality, and is the most cost effective, environmentally sensitive way of ensuring a reliable, high quality drinking water supply for the region. It has an added benefit of protecting against agencies pursuing alternate water supplies at higher financial and environmental costs. The District is a committed member of the IRWMP and is committed to this project, along with all of the cities and special districts in the region, and will provide a 50% match of project costs through District reserves and increased water rates.

The proposed project installs new laterals in Collectors 1&1A ensuring capacity is maintained in order to provide water to the area. The Collectors are large concrete caissons that extend from the surface up to 100ft below grade. The HBMWD system included 4 collectors. Laterals, 1 ft steel well screens, are projected horizontally from the caissons into the surrounding aquifer and supply the groundwater to the Collector. The Collectors are almost 50 years old and some of the laterals have collapsed and all of them have buildup of calcium deposits reducing capacity. This project will replace laterals in the existing caissons. HBMWD provides flow to the collectors by releasing water from Ruth Lake, and in addition to assuring water supply reliability, this project will maintain beneficial flows for salmonids in over 60 miles of the Mad River. The new laterals will also improve groundwater recharge, reducing water turbidity and the energy needed to run the system.

North Coast IRWMP Proposition 84, Round 2 Implementation Projects

ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
207	Humboldt County Resource Conservation District	Humboldt Bay Nutrient Management Program	Water District (WS & WW)	Humboldt	$119,150	$182,500	37.7	35.5

The purpose of the Humboldt Bay Nutrient Management Program is to provide improved protections to water quality associated with dairy operations in Humboldt County. The program will help protect water quality in the Eel River delta and Mad River delta regions of Humboldt County, which contain the largest number of dairy operations in the county. Activities are focused on enhancing water quality of creeks and sloughs that feed into the estuaries of these delta regions. Improvements will be accomplished by developing Comprehensive Nutrient Management Plans (CNMPs) and providing cost-share funding for key elements of dairy waste management and handling systems for dairies located in the delta regions of Humboldt Bay.

The California Water Quality Control Board – North Coast Region adopted a three-tiered permit program for North Coast dairies in January 2012. Each permit carries monitoring and reporting requirements. CNMPs assist producers in meeting these new requirements as well as providing water quality protections. CNMPs are also required for participants seeking cost share assistance from USDA – Natural Resources Conservation Service (NRCS) Environmental Quality Incentives Program for improvements to specific dairy manure handling equipment or practices, containment facilities or storage methods.

Expected water quality benefits from the program include reductions in the amount of dairy wastes leaving facilities and fields by improving nutrient management planning and practices, and through the diversion of storm-water runoff from manured areas. The program will use a phased approach for implementation, including the utilization of Humboldt County RCD staff and contracted consultants to prepare CNMPs. The Humboldt County RCD and the NRCS will provide the technical assistance necessary for cost-share project planning, prioritization and development.

ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
208	Mattole Restoration Council	Mattole Watershed Integrated Climate Adaptation Initiative	NGO	Humboldt	$935,000	$750,000	37.1	34.2

This project is a comprehensive and integrated effort to begin developing resilience to two observed climate change impacts—longer dry seasons and more intense winter rains—as well as future sea level rise. These impacts will exacerbate existing legacy impacts that resulted in the Mattole watershed being listed as impaired for both sediment and temperature. Accordingly, this project seeks to proactively restore the watershed using both traditional and innovative techniques.

In the headwaters land conservation will protect streamflows from future impacts, ensure sustainable forestry, enable wetland enhancement and groundwater recharge projects to be developed on the property, provide high-quality habitat to a wide variety of species, and provide increased water supply reliability to downstream residents. Groundwater recharge component will increase streamflows by slowing winter runoff and increasing groundwater infiltration and retention.

In the estuary this project focuses on the installation of 10 engineered log jams consisting of ten whole trees each complemented by extensive riparian planting and bioengineering. The overall impact of this work will be to increase the complexity of habitat in the estuary, increase vegetation on floodplain terraces, and increase the topographical and bathymetrical complexity of the estuary. The outcomes of this work will be increased winter refugia and summertime survival for salmonids in the short term, and resilience in the mid to long term. In addition, this project will increase understanding of watershed trends by enabling monitoring of streamflow, groundwater, sediment, and turbidity as well as analyses of water temperature, LWD loading in the headwaters, and georeferncing of wood installed in the estuary. This project will also ensure that the Mattole Technical Advisory continues to meet and provide feedback for implementation and development of this and future projects in the watershed.

North Coast IRWMP Proposition 84, Round 2 Implementation Projects

ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
209	McKinleyville Community Services District	Mad River Estuary Enhancement	Water District (WS & WW)	Humboldt	$0	$490,000	34.6	32.5

MCSD owns land adjacent to the Mad River estuary, including a linear patch of riparian forest and a large historical floodplain used for pasture. Within the riparian forest are two large percolation ponds (3 acres), used to discharge treated wastewater. As part of MCSD's 20-Year Facilities Plan, the ponds will be removed from the wastewater disposal system and the floodplain pasture will be converted into a managed native black cottonwood forest to receive MCSD's treated wastewater. MCSD is seeking funding for a two-phase project, to connect the existing percolation ponds to the Mad River estuary for fish habitat; specifically for high flow refugia, adult holding, and juvenile rearing habitat for salmonids.

PHASE I:

In 2011, MCSD planted an acre with 300 black cottonwoods to observe the trees' vitality and test the groundwater for nitrate removal. Phase I includes minor grading and installing a new irrigation system to distribute treated wastewater into the project area and planting approximately 9,000 black cottonwoods. Cyclical harvesting every 10 to 20 years is proposed to maintain water and nitrate demand, and will be on rotated across the floodplain. Engineering drawings and specifications for the irrigation system will be prepared prior to implementation. Permits will be needed to start work; however, the project will be implemented well out of the streamside management area of the Mad River and any floodplain wetlands.

PHASE II:

While the forest is being established, plans for the conversion of the percolation ponds can be prepared/permitted. The project will require surveying, demolition of existing infrastructure, grading, materials to construct a self-sustaining backwater channel, and erosion control. Engineering designs and specifications will be prepared and agency approval will be obtained. Once the wastewater discharge from the percolation ponds has been re-plumbed to the riparian forest, implementation of the off-channel ponds can begin.

ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
210	McKinleyville Community Services District	McKinleyville CSD Radio-Read Water Meter Upgrade	Water District (WS & WW)	Humboldt	$6,700	$1,300,000	27.0	27.8

The McKinleyville CSD (MCSD) serving approximately 6,100 housing units with municipal water and records water usage with manually-read Badger Record All ® standard water meters. The area served by MCSD is rural; and reading meters manually requires condsiderable travel, labor, and fuel consumption, which collectively create significant operational costs for MCSD. The proposed project will upgrade all existing water meters with radio-read Badger Orion ® Water Endpoints equipped with telemetry. Orion ® Water Endpoints allow remote meter-reading, provide real-time analysis of customer water usage, identify excess water usage and consumption, and report possible leak-detection and back-flow situations. The new meters can also monitor water usage during drought or emergency rationing conditions. The proposed upgrade will also allow individual customers to place a remote water-meter indicator inside their house to monitor water usage in real time. Allowing residents to monitor their water usage in real-time will help educate the public and promote water conservation.

The proposed project includes the purchase of Orion ® Water Endpoints, installation by MCSD staff, and an educational program to promote water conservation. No permits, plans, engineering, or other documents will be required for this project.

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ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
211	McKinleyville Community Services District	McKinleyville CSD Water Reliability Development	Water District (WS & WW)	Humboldt	$432,500	$1,222,200	31.9	32.4

Approximately 6,100 housing units are served by the McKinleyville CSD (MCSD), which is supplied water by a single, 18-inch ductile iron pipe (DIP) pipeline that runs beneath the Mad River from an existing pipe at Boyd Rd located on the south bank of the river, to the Ramey lift station. The pipeline was constructed in 1972 before current seismic codes were put in place, and would be virtually impossible to repair if damaged during an emergency event. The need for additional water reliability has been documented as the most pressing issue for the MCSD relating to emergency planning (Humboldt Operation Area Hazard Mitigation Plan, adopted by FEMA, 2008).

To address this issue, the proposed project will provide an alternative emergency water supply pipeline for MCSD and the City of Arcata, by connecting their existing water supply pipeline networks to the Ramey pump station using the new Mad River Bridge across Highway 101. The proposed project includes improvements in both Arcata and McKinleyville. MCSD has pre-installed a 12-inch water pipeline in the Highway 101 Mad River Bridge, which seperates the two communities. The project extends from the MCSD Ramey Pump Station along North Bank Road to the Mad River Bridge and continues from the south end of the bridge down Wymore Rd to tie into Arcata's water supply system at Guintoli Rd. Additionally the project includes the Aldergrove intertie, which connects the Humboldt Bay Municipal Water District (HBMWD) transmission main to Aldergrove Rd. All new pipe will be composed of 12-inch polyvinyl chloride (PVC). Project elements include surveying, permitting, engineering, and construction (implementation).

All planning, engineering, surveying, and permitting components of this project will be completed by January 2013. The construction of the bridge intertie was completed when Caltrans constructed the new Mad River Bridge in 2012.

212	Redwood Community Action Agency	Martin Slough Enhancement Project	NGO	Humboldt	$1,014,000	$600,000	36.4	31.8

Martin Slough is a 3,300 acre watershed, tributary to Humboldt Bay via Swain Slough and Elk River and is the first Elk River tributary upstream of Humboldt Bay. The project area encompasses the lower 120 acres of floodplain and approximately 7,000 feet of stream channel which is habitat for coho salmon, coastal cutthroat trout, steelhead trout, tidewater goby, other diadromous fish, dungeness crab, and other wildlife. The project area is diked former tide land, now used for cattle grazing (lower 40 acres) and a municipal golf course (upper 80 acres). A dike separates Martin Slough from Swain Slough and 3 forty-eight inch diameter tide gates at the mouth of Martin Slough exclude tide water from the channel upstream of the tide gates. The tide gates close during incoming tide and slow the velocity of the stream flow discharging into Swain Slough, causing sediment to settle out and deposit in the channel upstream of the tide gates. This has reduced channel capacity and increased the incidence of flooding through the project area. Due to the presence of endanegered species, and the cost of the surveys and studies required to obtain the ncessary permits, dredging is cost-prohibitive for the landowners. Regulatory agencies are also not in favor of derdging as a management tool. RCAA, through GHD engineering, has developed 30% designs and is working on 65% project designs to reduce flooding and enhance fish and wildlife habitat. RCAA and Eureka are preparing a CEQA document and permit applications. The project will install new tide gates, repair the dike, increase channel capacity, and add ponds to provide fish and wildlife habitat and floodwater storage to reduce flooding on the pasture and golf course. Other project actions include replacing undersized culverts with bridges, installing cattle exclusion fencing, and planting brackish marsh and riparian plants. Funding has been secured to develop 100% designs, secure permits, and begin implementation.

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ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
213	Resort Improvement District #1	Teleraph Creek Barrier Removal and Channel Restoration	Water District (WS & WW)	Humboldt	$147,433	$602,750	32.0	34.7

Telegraph Creek is a coastal stream in Shelter Cove, CA, tributary to the Pacific Ocean. The watershed is within the BLM's Kings Range National Conservation Area and drains directly into a California Marine Waters Area of Special Biological Significance. NMFS has identified Telegraph Creek as critical steelhead habitat.

RID owns and maintains a water supply dam that was constructed approximately 1.1 miles upstream from the creek mouth. RID's dam has been identified by NMFS as a partial barrier to fish migration. RID has completed several projects in an attempt to improve fish passage over the dam, none of which have provided adequate passage. The county owns a second fish barrier (a triple-culvert crossing under a county road) approximately 75 ft upstream of the dam.

In 2010, RID received funding from CDFG to design a fish passage corridor through the dam and the triple-culvert stream crossing at Telegraph Creek Road, in coordination with Humboldt County Public Works. Final construction plans and specifications for the dam demolition and channel restoration were completed, reviewed, and accepted by NMFS, CDFG, RID, and Humboldt County Public Works in 2011. Humboldt County Public Works secured funding through the Five Counties Salmonid Conservation Program to complete the road crossing designs. Project permit applications are planned to be sent to all governing agencies in January 2013 and the project will be ready for bid when all permits are received; during the construction season of 2013 at the earliest; however, the project is planned for construction in 2014.

Implementation of the proposed project will provide habitat for migrating salmonids within the project reach with incorporated geomorphic features for high-flow refugia (inset and off-channel floodplains); migration access to 1.6 miles of steelhead habitat; and holding and rearing area, including three pools with tailouts into riffles.

214	City of Trinidad	Trinidad-Westhaven Coastal Water Quality Restoration Program	Government	Humboldt	$125,000	$375,000	38.0	35.2

Trinidad contains approximately 200 developed parcels, all on OWTS, 75% of which are 25 years or older (no recorded permits). The extended Planning Area has 1000 additional parcels with a similar percentage of old systems, with poorer soil conditions. Given the Disadvantaged Community status of the Planning Area, property owners do not have the means to fix the problems, and there have been documented failures in the area. The City recognizes that OWTS are a long-term waste treatment method that can only remain viable if systems are properly functioning. Research for a recent watershed planning effort found that the Trinidad-Westhaven area has very high bacterial pollution in the local creeks and public beaches – some readings exceed the public safety contact standard by almost 60 times. Analyses of the bacteria counts, OB and the proximity of waterways to parcels with older or unpermitted OWTS provide the priority basis for inspection and upgrading of OWTS. Twenty-three OWTS have been repaired thus far with previous grant funding, and many more have been identified as high priority systems for inspection and repair. This program will result in the prioritized implementation of a solution that reduces the chance of OWTS failure and resulting contribution of pollutants to the near shore environment, public beaches and the Trinidad Kelp Bed ASBS.

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ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
215	Westhaven Community Services District	Westhaven CSD Water Tank	Water District (WS & WW)	Humboldt	$0	$360,000	40.4	40.0

The Westhaven CSD water system relies on a single 100,000 gallon concrete storage tank with a metal roof supported by fir (wood) trusses that are in an advanced state of rot due to the damp environment inside the roof. A CDPH annual inspection conducted in 2005 listed the condition of the tank roof as a "system or operational defect and/or potential health hazard – costly to correct – to be included in any long-range water improvement project."

The proposed project consists of; 1. the construction of a new glass-lined steel 85,000 gallon storage tank adjacent to the existing concrete tank to allow the system to take the existing tank out of service and; 2. replacement of the roof on the existing tank.

Components of the proposed project are:

1. Construction of a new concrete ringwall foundation;
2. Construction of a new 85,000 gallon glass-lined steel storage tank;
3. Installation of station piping connecting the new tank to the treated water effluent piping and connection to the existing outlet piping of the existing storage tank;
4. Installation of a cathodic protection system, tank floats, and related controls.
5. Construction of a new free-span aluminum roof on the existing tank.

ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
316	California Land Stewardship Institute	Fish Friendly Farming and Fish Friendly Ranching Environmental Certification in the Russian, Navarro, and Gualala River Watersheds	NGO	Mendocino/ Sonoma	$520,000	$190,000	36.4	36.8

The Fish Friendly Farming (FFF) and Fish Friendly Ranching (FFR) Environmental Certification Programs, implemented by CLSI, work to increase the environmental values and functions on agricultural and grazing lands while sustaining economic viability. The FFF/FFR program implements water quality improvements, including comprehensive sediment source control, road and gully repair, water conservation and water use efficiency, enhancement of riparian corridors through removal of invasive species and revegetation, and widening of riparian corridors. The FFF program has implemented improvements on over 120,000 acres in five counties in conjunction with private property owners. This proposal would provide program implementation funds for an additional 20,000 acres in the Russian, Gualala and Navarro River watersheds for both grazing land and irrigated agriculture with a focus on lands in disadvantaged communities. Working together, CLSI and the farmer produce and implement a detailed and comprehensive Farm Conservation Plan using the FFF/FFR template. This approach reviews all potential sources of fine sediment generation and delivery including grazing and farm lands, roads, creek channels, and ditch erosion. The plan also inventories the potential for chemical runoff, all water supply facilities and their effects on fish habitats, the condition of the stream network and aquatic habitats, and many other features. Best Management Practices (BMPs), and major projects are implemented. The site is then certified by the National Marine Fisheries Service, the Region 1 Water Quality Control Board, and the County Agricultural Commissioner. In order to maintain the certification, the grower/rancher must be recertified every 5 years. CLSI works with the grower/rancher to implement improvements and complete monitoring.

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ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
317	California Land Stewardship Institute	Russian River Watershed Agricultural Water Conservation and Water Supply Reliability Program	NGO	Mendocino/ Sonoma	$2,221,000	$890,000	35.6	36.2

The Russian River Frost Program (RRFP) includes hundreds of agricultural landowners, agricultural organizations, water districts, and the Ca. Land Stewardship Institute (CLSI). The RRFP has built over 30 water infrastructure projects in Sonoma and Mendocino Counties to eliminate direct diversions of water for frost control and reduce impacts to listed salmonids. These projects have totaled over $10 million mostly in private funding and include offstream storage ponds, deep wells, and wind machines. The RRFP has also installed stream flow gaging networks in tributaries, additional gages on the Russian River, and formed the Russian River Independent Science Review Panel (ISRP) to provide scientific leadership and oversight to address water issues.

This proposal will fund a portion of several RRFP projects: implementation of a municipal recycled water system for agricultural frost control and irrigation to replace direct diversions, two projects on Mark West Creek to replace direct diversions, and the ISRP. CLSI in partnership with the City of Ukiah would construct Phase 1 of its Master Plan Recycled Water Project along with a storage pond at the treatment plant, a distribution line from the plant to the farms, a new pump station at the plant, and two storage ponds on private farm land. The recycled water system in Ukiah would replace a minimum of 186.6 ac ft of direct diversions per year from the Russian River and reduce treated wastewater discharge to the Russian River. This project would benefit federally listed species in the Russian River by reducing instantaneous drawdown of streamflow and fish stranding during frost events, and the community by providing a sustainable water source that is independent of the river and groundwater supplies and by reducing the rates to residents in the disadvantaged community of Ukiah. The Sonoma County projects will benefit listed salmonids by eliminating direct diversions from a coho and steelhead stream.

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ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
318	Gualala River Watershed Council	Gualala River Watershed Management and Enhancement	NGO	Mendocino/ Sonoma	$658,248	$431,725	36.8	35.9

Coast Ridge Community Forest: The local community forest has developed a community forest plan for small acreage timber owners. The organization currently has 27 lanowner members covering 4,000 acres in the South Fork basin of the Gualala River watershed. Most members have either direct diversions or shallow wells for water consumption and supply. Tributaries in the South Fork basin have extreme low flows (<1cfs) or non-existent flows during summer months and shallow wells run dry during late August, September and October. The Community Forest will assist the GRWC with outreach to landowners in the South Fork Basin and participating members will develop rain water harvest demonstration projects for workshops and educational opportunities for the surrounding Gualala Ranch and Seaview rural developments. Through this proposal the 30 rain water catchment projects will be installed saving up to 150,000 gallons of water per year.

Stewarts Point Rancheria: The Rancheria Water Company uses a direct diversion from the Wheatfield Fork of the Gualala that services. In collaboration with the Kashia Band of Pomo Indians we plan to install 10 rain water catchment projects, saving 50,000 gallons of water per year, on the Rancheria.
Gualala Redwoods, Inc: Is a local timber company that owns 30,000 acres in the Gualala. The company is a collaborative partner of the GRWC and provides matching funds for the GRWC Wood In the Stream Program and flow gauge monitoring on the South Fork Gualala.

United States Geological Survey: USGS provides matching funds for flow gauge monitoring on the main-stem South Fork Gualala River and assists the GRWC with flow monitoring through the GRWC Cooperative Monitoring Program.

Sea Ranch Water Company: Provides matching funds for flow gauge monitoring.

The Conservation Fund: Provides matching funds and is a collaborative partner in the GRWC Wood In the Stream Program.

ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
319	Jug Handle Creek Farm and Nature Center	Jug Handle Creek Farm and Nature Center Ecological Enhancement Project	NGO	Mendocino	$180,000	$555,000	28.5	27.9

Jug Handle, with the prior and pending support of State Coastal Conservancy, is poised to implement an ecological site enhancement project which will combine new buildings with Low impact Development techniques such as pervious concrete parking areas, rain gardens, berms and bioswales, roof water catchment, advanced wastewater treatment through an AdvanTex septic system, and wetland protection, enhancement and access.The main thrust of this project is to practice, demonstrate, and teach aspects of sustainable LID and advanced wastewater treatment methods in a public setting. We will capture 25,000 gallons of rain water, restore wetland areas on site, create immediate energy and water savings and protect ground water supplies while teaching the public why and how these sustainable practices are so important. Our project will affect approximately 3,500 local and regional California residents including 1,000 children, at least 400 local Latino families each year. Our Coastal Development Permit is now under review by Mendocino County. In 2013, we will receive an implementation grant from the Conservancy of $ 500,000 for building construction. This project will increase Jug Handle's capacity as an educational venue, demonstrate a reduced energy resource footprint, resource self-sufficiency; reduce contamination by sediment and nutrients, prevent storm water runoff, retain soils on site, provide water for irrigation, fire safety, toilet flushing and protect and restore environmentally sensitive habitat areas.Jug Handle's mission as an environmental education center will be greatly expanded through implementation of these practices in conjunction with the new buildings.We will be able to provide water conservation educational opportunities to thousands of overnight and day use visitors each year.

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ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
320	Mendocino County Resource Conservation District	Mendocino County Working Landscapes Riparian Demonstration Project	RCD	Mendocino	$81,600	$369,600	36.3	35.8

Riparian ecosystems contain more than 70% of all the wildlife native to our region, however it is some of the most threatened and impaired landscape on the North Coast. Riparian habitats are the critical interface between terrestrial and aquatic systems crucial to the reduction of erosion and filtration of sediments and pollutants. Mendocino County's working landscapes are a mosaic of agriculture, forestry, fishing, and aggregate production. Approximately 50% of the riparian vegetation in the Russian and Navarro Rivers has been lost since 1942. Consequently, stream corridor restoration is identifed as a primary strategy in regional and area plans including the Russian River Integrated Coastal Watershed Management Plan and the Navarro Watershed Restoration Plan. The Mendocino County Resource Conservation District (MCRCD) and Natural Resources Conservation Service (NRCS) have partnered to promote voluntary riparian enhancement on working lands for over 28 years. MCRCD is proposing a suite of riparian demonstration projects on five diverse working landscapes in the Upper Russian and Navarro Rivers watersheds to inform the working landscape community of effective solutions using best management practices by networking with constituents of the Farm Bureau, UC Coop Extension, and the County Agriculture Dept. MCRCD's Watershed Coordinators developed 5 projects as a platform for best management practices to be demonstrated through workshops and tours: Mill Ck Talmage Riparian Restoration-next to an aggregate plant; Upper Russian River Arundo Removal and Riparian Enhancement- agriculture; Red Barn Ck Riparian Restoration-livestock operation; Navarro-Highway 128 Gully Restoration-livestock operation; and, Denmark Ck Riparian Restoration, Phase 2-livestock operation. Nearly a mile of riparian habitat will be restored through these projects. Anticipated benefits of the Project include: Riparian corridor enhancement; water quality improvement; and outreach and education.

ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
421	Siskiyou County	Siskiyou County Septage Pond Closure	Water District (WS & WW)	Siskiyou	$129,925	$389,775	43.9	42.5

Siskiyou County is under a long-standing North Coast Regional Water Quality Control Board (RWQCB) directive to close an unpermitted septage receiving facility located in the Shasta and Klamath River watersheds, both of which are 303(d)-listed streams. Currently, an estimated 750,000 gallons per year of raw sewage is discharged into an unlined pond that has exceeded its design life. Groundwater beneath the site is known to be shallow (6-10' deep) and flows approximately 900' westward toward nearby Oregon Slough, a tributary to the Shasta River. In addition, the site is unsecured and vulnerable to discharge of illegal waste.

The Board of Supervisor has committed to closing the site by November 1, 2013. While the County has previously closed three other unpermitted septage ponds, the County lacks adequate finances to close the remaining site. In October 2009, the Klamath Riverkeeper notified the County and RWQCB of its intent to file a preemptory writ of mandate regarding use of the unpermitted facility.

The County is seeking funding to implement a RWQCB-approved closure plan to avoid potential impacts to groundwater (including drinking water), nearby surface waters, and aquatic habitat and to avoid issuance of a cease and desist order, costly fines, and possible litigation.

The County hired a consultant to prepare a Septage Waste Feasibility Study that, in part, discusses closure of the site. The Feasibility Study was used to develop the RWQCB-approved closure plan. The proposed project would excavate and dry septage and impacted soil on an impermeable surface located on adjacent County-owned airport property and then land apply the dried material on adjacent County-owned agricultural land. If the dried waste does not meet the criteria for land application, it would be hauled to a lined landfill for disposal. The County intends to dispose of as much waste as possible with available funding and phase the remaining disposal as additional funds become available.

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ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
522	Gualala River Watershed Council	Gualala River Sediment Reduction Program	NGO	Mendocino/ Sonoma	$225,288	$259,299	36.1	37.9

The Gualala River Restoration Program is a cooperative program developed by stakeholders and members of the community to implement basin-wide sediment reduction strategies to maintain and enhance water quality in accordance with the Gualala River TSD. This proposal incorporates a priority NPS reduction project to continue sediment source reduction at the CalWater planning watershed scale. High priority projects for road related sediment source completion are based on a high road density, percent of erosion total from road sources, planning watershed disturbance index and refugia potential for coho and/or steelhead.

Through this priority project, GRWC will partner with the landowners to treat sediment sources on high and medium priority road networks that will prevent sediment from entering the watercourses in the Gualala River Watershed. Basin-wide TMDL attainment road based sediment reduction will increase from 17.6% to 18.2% by the implementation of this project.

This project is in the Lower Rockpile basin, a highly erosive area with excessively high in-stream sediment deposits. The Lower Rockpile Creek project will treat sediment sources on 10.4 miles of road and will prevent 25,827 cubic yards of sediment from entering 12.9 miles of blue line stream. Project cost: NCIRWMP cost of $255298.73 with a 47% ($225,288.40) match provided from participating landowners and the GRWC.

A suite of construction monitoring components will determine project construction effects within the project site. This will guide future management measures in the GRWC Sediment Solutions Program

ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
523	Gold Ridge Resource Conservation District	Gold Ridge Coastal Watersheds Enhancement Project	RCD	Sonoma	$530,000	$400,000	38.2	38.0

The Gold Ridge Coastal Watersheds Enhancement Project integrates a variety of strategies to restore instream habitat and enhance stream flows for salmonids and other aquatic organisms, while allowing the district's rural communities and agricultural producers to adapt their water management strategies to the uncertainties of a changing climate. The project will build on the RCD's Bodega Bay HU Water Resources Management Project, expanding its focus area to include the Dutch Bill and Green Valley watersheds, two of only five Russian River tributaries identified by the Russian River Coho Salmon Keystone Initiative as critical for near-term salmonid recovery. This proposal includes the implementation of large-scale water conservation and storage systems in key coastal stream reaches, including the last major water diversion along Dutch Bill Creek. Improved winter storage combined with comprehensive water conservation efforts will be implemented to eliminate summer diversions from this critical Russian River tributary. Water storage systems supplied by rainwater catchment will also be constructed on a dairy operation along Salmon Creek. Dairies are currently both significant water users forced to draw from sources influencing riparian flows, and integral contributors to the agriculture-based economy of their surrounding communities. These projects further advance the RCD's expanding water conservation program, working to provide immediate benefits to riparian systems while advancing technologies to prepare its communities for less predictable rainfall patterns in the long run. In addition to streamflow augmentation, these key reaches will benefit from instream habitat improvements and upland sediment source management. These components all contribute to the project's integrated approach to water management, balancing watershed health with community water resource needs.

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ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
524	Laguna de Santa Rosa Foundation	Restoring Sebastopol Railroad Forest	NGO	Sonoma	$68,750	$275,000	29.1	28.2

This project brings environmental health benefits to disadvantaged communities in and surrounding the City of Sebastopol by restoring aspects of the Sebastopol Railroad Forest, Sonoma County, California. The forest, a 10-acre site east of Sebastopol and west of Highway 101, is located on Calder Creek, a tributary to the Laguna de Santa Rosa, Mark West Creek, and the Russian River. The site lies directly south and is a part of the environmentally and educationally important Laguna de Santa Rosa Wetlands Preserve. The forest is protected by an existing City open space easement. By removing invasive species, restoring native plantings, reducing sediment inputs to surface water, and restoring aspects of natural hydrologic function on the property, the project will enhance aesthetic aspects for visitors, catalyze outreach to the community, build on past work in the watershed, build accessibility within an underserved population, and restore important riparian habitat.

The project will be implemented by a partnership among the Laguna de Santa Rosa Foundation, the Sonoma Ecology Center, and the City of Sebastopol. The Laguna Foundation and the Sonoma Ecology Center will work collaboratively to design a planting plan and install plants, address invasive species issues, monitor project success, and ensure habitat establishment through the course of the project. Expected outcomes are reestablishment and enhancement of riparian habitat, reduced streambed and bank erosion that contribute to sedimentation of the Laguna and Russian River, and improved public access and educational opportunities (using match funds and existing outlets for K-12 education within disadvantaged communities and the Laguna's Learning Laguna program, all of which use the adjacent, popular trails system linked to the Joe Rodota Trail).

525	Occidental County Sanitation District/ SCWA	Occidental Recycled Water and Restoration Project	Water District (WS & WW)	Sonoma	$4,412,055	$1,075,002	33.9	33.9

The Occidental Recycled Water Storage and Restoration Project will 1) construct a new 12.5MG lined storage pond for treated effluent from the Wastewater Treatment Facility (WWTF) to end discharges to Dutch Bill Creek (identified in 2004 by CDFG as a 'core' area for coho recovery in the NMFS Coho Recovery Plan); 2) eliminate an on-stream storage reservoir (Graham's Pond); and 3) mitigate water quality discharge violations for a small community sanitation district that has been seeking a viable solution for over 10 years. It will expand the use of recycled water for agricultural irrigation to move the District's sanitation system to a zero discharge system.

The WWTF operates under an NPDES Permit and has been subject to Cease and Desist Orders (CDOs) and Time Schedule Orders (TSO) since 1997. To comply, the District must complete a collection system upgrade project, stop discharges in violation of the WDRs, and comply with the WDRs and the Water Quality Control Plan for the North Coast Region by addressing storage capacity, treatment and operation of the WWTF.

The Project will meet the CDO and WDRs by adding new storage and expanding the irrigation system (Phase 1). The Project will also address surface water runoff, water quality, and habitat needs via restoration and agricultural management of the adjacent lands that are subject to degraded environmental conditions (Phase 2).

The larger irrigation area will allow summer discharge of all water generated during a high rainfall year. Graham's Pond will revert to use as a recreational on-stream fish pond. The surrounding area, which has been subject to extensive grazing, will be restored under a Ranch Management Plan prepared by Gold Ridge RCD. That Plan will address water quality, habitat restoration, soil erosion, and domestic animal water access by employing revegetation, fencing, and water development; work will be done as Phase 2 of the Project.

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ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
526	Russian River Watershed Association	Russian River Watershed Urban Creek Care Program	Government	Sonoma	$27,724	$73,951	27.1	26.9

This Project implements watershed-wide creek cleanup and streambank stabilization projects; urban creek crossing identification; and stewardship actions to improve water quality and natural habitat in the waterways of the Russian River watershed. The target results include removal of toxics and litter from the waterways, improvements to creek banks to reduce siltation, reduction of populations of invasive species, increase in shade-forming tree canopy, and slowing the velocity of runoff. The Project achieves the target results with three actions: 1) expanded community stream cleanups for one year from the date of funding under the leadership of the Russian River Cleanup Committee in the lower watershed, and the Friends of Gibson Creek in the upper watershed; 2) creation of an Urban Creek Care Guide to assist residents and landowners in their stewardship of urban creek systems, targeting specific Russian River watershed water quality and environmental challenges including turbidity, temperature and pathogens (the Guide could be adapted to other North Coast urban areas); 3) installation of signs to identify waterways in the urban areas to increase residents' stewardship identification.

527	City of Santa Rosa	Santa Rosa Plain Groundwater Monitoring Well Installation and Data Analysis	Government	Sonoma	$63,000	$250,000	25.6	27.2

The objective of this proposal is to secure funding to install up to 3 groundwater monitoring wells (MWs) in areas within the City of Santa Rosa where groundwater data gaps have been identified. The City is located within the Santa Rosa Plain sub-basin of the Santa Rosa Valley Groundwater Basin. The City has on-going groundwater programs and is participating in the development of regional groundwater studies that would benefit tremendously from the installation of additional MWs. These programs and studies include:

- Development of the Santa Rosa Plain Sub-basin Groundwater Management Plan
- Development of the Santa Rosa Plain Sub-basin Salt and Nutrient Plan
- California Statewide Groundwater Elevation Monitoring (CASGEM) Program
- Development of the City's Groundwater Master Plan

Each of these programs and studies would benefit from the installation of additional MWs in areas where data gaps have been identified. The City has a serious need for additional groundwater MWs to provide water level and water quality data for these programs and studies. The lack of site specific data is hampering the City's establishment of baseline hydrologic conditions and will make it more difficult to identify any potential impacts from the various water resource management plans under consideration for implementation in the Santa Rosa Plain groundwater basin. The goal of this project is to increase the number of site and depth specific MWs to provide additional information related to the groundwater basin and its response and reaction to both naturally occurring and man-created events. To achieve this goal, the project proposes to install up to 3 MW sets at 3 strategically located sites in areas of the City where data gaps have been identified. The MWs will provide needed water elevation and water quality data for the proposed Santa Rosa Plain Sub-basin Groundwater Management Plan, the draft Santa Rosa Plain Sub-basin Salt and Nutrient Plan, and the CASGEM program.

North Coast IRWMP Proposition 84, Round 2 Implementation Projects

ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
528	City of Santa Rosa	Santa Rosa's Russian River Friendly Landscapes and Low Impact Development Project	Government	Sonoma	$57,860	$466,700	26.9	27.2

The economic and ecological costs of obtaining additional water storage and delivery systems are far greater than increasing efficient use of existing resources. In Santa Rosa, and throughout the State, a significant portion of potable water is consumed by landscaping needs. This project will serve as an example of how the urban landscape can be redefined to be more sustainable.

The City of Santa Rosa seeks $466,700 in grant funding to support a project to alter existing landscapes and foster the implementation of low impact design (LID) strategies. This program proposes a multi-faceted approach to address landscape water efficiency and storm water treatment in the urban environment. A demonstration garden that exhibits low water use plants and irrigation efficiency combined with many storm water features consistent with the newly adopted LID Technical Design manual is the cornerstone of the this proposal and will be installed at the City of Santa Rosa's City Hall Campus. This facility is a complex of buildings within the downtown urban core and is the destination that the development community and the general public utilize each day to apply for building permits, attend council meetings and coordinate new projects. In addition, the City of Santa Rosa's Water Use Efficiency (WUE) Program will work with existing property owners to implement landscape conversions similar to those in the demonstration landscape.

The program proposes to promote water use efficiency and LID by creating educational materials for new development and retrofitting existing urban areas. The City of Santa Rosa's recently approved LID design manual, the Russian River Friendly Guidelines and a newly developed return on investment calculator for landscape water efficiency will be promoted to conduct over 1,000 landscape audits combined with $50,000 worth of rebates for increased water efficiency, cash for grass, graywater systems and rainwater harvesting in existing developments.

North Coast IRWMP Proposition 84, Round 2 Implementation Projects

ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
529	City of Sebastopol Public Works	Arsenic Removal Pilot Project for Well 6	Government	Sonoma	$57,000	$125,000	28.4	29.0

The City of Sebastopol is proposing an Arsenic Removal Pilot project to protect and enhance drinking water supplies, protect public health, and assure water supply reliability. The City owns and operates its own water system, producing water via 5 wells (No. 6-8) which feed two pressure zones. Well 6, which is the City's most productive well is currently impacted with Arsenic (As) and been exceeding Maximum Contaminant Levels (MCL) set by the State.. The City installed a blending station in 2012 at Well 6 to blend with Zone 1 water, but due to rising As, the blending station is steadily becoming less effective.

Of the city two pressure zones, Zone 1 is served by Wells No. 4, 5 and 7 and Zone 2 is supplied by Wells 6 and 8. Currently only 3 of the City's 5 wells are active for production. Two of the wells, Well 5 and 7, had to be taken off line due groundwater contamination from chlorinated hydrocarbons and naturally occurring Arsenic. Keeping two wells active in each zone is critical to the water system.

The City conducted a Water Quality System Feasibiltiy Study, which recommended improvements to Well 7 which the City will initiate. However improved treatment is still needed at Well 6 to assure supply reliability and prevent shortages.

The Feasibility Study recommended a pilot project be conducted at Well 6 to assess two options for As removal, which include an Iron Co-Precipitation system or a Granular Ferric Hydroxide system to reduce As to below MCL limits. The pilot project will be conducted to validate the process, develop design criteria, and provide accurate life cycle costs. If successul the pilot project will form the foundation of a full scale project (Phase 2) at Well 6 with the possibility of being utilized at other City wells requiring As removal in the future. Naturally occuring As in the GW is a problem affecting not only Sebastopol but neighboring agencies. This study could possibly benefit others located in the same GW basin.

ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
530	City of Sebastopol Public Works	Arsenic Treatment Implementation for Well 6	Government	Sonoma	$0	$2,321,000	26.3	26.7

The City of Sebastopol is proposing an Arsenic Removal Pilot project to protect and enhance drinking water supplies, protect public health, and assure water supply reliability. The City owns and operates its own water system, producing water via 5 wells (No. 6-8) which feed two pressure zones. Well 6, which is the City's most productive well is currently impacted with Arsenic (As) and been exceeding Maximum Contaminant Levels (MCL) set by the State.. The City installed a blending station in 2012 at Well 6 to blend with Zone 1 water, but due to rising As, the blending station is steadily becoming less effective.

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North Coast IRWMP Proposition 84, Round 2 Implementation Projects

ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
531	Sonoma County Water Agency	Regional Water Use Efficiency Program	Water District (WS & WW)	Sonoma	$459,214	$476,172	30.7	32.4
The proposed Regional Water Use Efficiency Program will leverage and expand the implementation of water conservation education and consumer incentive programs and build on regional water conservation initiatives. The Program includes a suite of program elements that promote high-efficiency technologies and best water conservation practices to improve indoor and outdoor water use efficiency throughout the North Coast Region. The six specific program elements include: 1) Water-Efficient Landscape Rebate/ Landscape Design Consultation Program, 2) Qualified Water Efficient Landscaper Training, 3)Weather Based Irrigation Controller (Single Family and Commercial/Multi-Family, 4) High Efficiency Toilet and Urinal Rebate Program, 5) High Efficiency Washer Rebate, 6) Residential Water Audit. The project is needed to increase uptake of water use efficiency measures in the North Coast region, particulary in the Russian/Bodega Bay Watershed. The expected outcomes include annual savings of 115,645,464 gallons (355 acre feet).								
532	Sotoyome Resource Conservation District	Austin Creek Watershed Restoration Program	RCD	Sonoma	$207,000	$591,930	39.9	35.9
The Austin Creek Watershed Restoration Program will integrate several innovative strategies in order to improve water quality and quantity issues for both humans and endangered aquatic species in Austin Creek Watershed in Sonoma County. These strategies include the installation of a water storage tank at a local elementary school to decrease its dependency on Austin Creek during the low-flow period and a water systems analysis with site specific recommendations for the largest providers of potable water in the watershed, which provide water to over 800 residences in Austin Creek. The Program will also analyze and create site specific draft plans to improve 15 small systems for individual households that will lead to a decrease in the dependency on Austin Creek during the low-flow months. This analysis, planning, and implementation will occur in and around the Economically Disadvantaged Community of Cazadero, CA. In addition to recovering flow in critical salmonid streams, our program will address insufficient instream habitat by installing 43 large wood structures at 19 sites in two large tributaries to Austin Creek in order to improve habitat conditions. We will also develop plans for more wood structures to be installed in the Austin Creek mainstem to improve habitat for breeding salmon. Near the confluence of Austin Creek and the Russian River, the installation of a cutting-edge large wood, rock, and willow structure will act to confine the flows in Austin Creek, scouring a deep channel that will maintain the connection between Austin Creek and the Russian River during low-flow months. All of these actions lead to the recovery of flow in this important drainage for humans and salmonids alike as well as build upon the first phase of the NCIRWMP program which will act to decrease sediment inputs from roads in East Austin Creek and work with landowners in the lower Russian River to decrease septic systems contamination from along the river and Austin Creek.								

North Coast IRWMP Proposition 84, Round 2 Implementation Projects

ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
533	Sotoyome Resource Conservation District	LandSmart Laguna: Achieving TMDL Compliance and Ag Water Quality Improvements in the Laguna de Santa Rosa Watershed	RCD	Sonoma	$288,745	$497,785	34.0	32.7

The proposed project will help English and Spanish speaking agricultural landowners (and land managers) in the Laguna de Santa Rosa watershed comply with upcoming TMDL and agricultural waiver requirements by completing LandSmart water quality plans and implementing recommended BMPs. Projects implemented will benefit water quality by reducing sediment inputs to waterways by 300 cubic yards, adding 1500 native plants to riparian areas, and managing manure to reduce nutrient and pathogen inputs to impaired waterways. Benefits beyond water quality will include water conservation and supply reliability (as a result of a rainwater catchment project and as a result of LandSmart plan elements that address water sources and conservation). The outreach element of this project will focus on the Spanish speaking community in and around Roseland (a disadvantaged community) by translating Sotoyome RCD's guide "Management Tips to Enhance Land and Water Quality on Small Acreage Properties" into Spanish, and presenting bi-lingual workshops that leverage BMP demonstration projects. The assessment element of this project will use tools developed through the RCD's Laguna de Santa Rosa water quality credit trading program to analyze the water qulaity benefits of the implemented BMPs. The results of this analysis will provide examples of the quantitative benefits of various BMPs, and will provide a demonstration of quantification tools beyond the water quality credit trading setting.

534	Town of Windsor	Windsor Groundwater Banking Pilot Demonstration Project	Government	Sonoma	$323,626	$680,000	27.8	27.8

The proposed Project will inform the development of a basin-wide groundwater banking project in the Santa Rosa Plain (SRP) groundwater basin. The SRP Groundwater Banking Program will further conjunctive management of surface water supplies from the Russian River with local groundwater resources. In general, the groundwater banking program will extract Russian River water during high-flow periods and convey this water using existing infrastructure to various locations around the basin for injection. Banked water will be extracted during low flow periods (i.e. summer) to meet demands. This program is a primary strategy identified for sustaining groundwater resources in Sonoma County, and builds upon an ongoing groundwater banking study. Successful demonstration of groundwater banking and development of the basin-wide program will help to improve regional water supply reliability and adaptation to climate changes by promoting conjunctive management of surface and groundwater, and will help protect the Russian River fisheries and aquatic and riparian environments by removing stresses from the Russian River and Dry Creek during low flow periods.

The proposed Project would demonstrate the feasibility of groundwater injection and recovery in the Windsor area, and would act as a demonstration project for similar pilot studies basin-wide, in addition to providing needed information for design and permitting of the basin-wide Groundwater Banking Program. The Project would utilize Russian River drinking water, extracted at the Town's Russian River Well Field and conveyed through the existing distribution system to an existing well at the Town's Bluebird Court well site. Under the proposed study, the water would be temporarily placed within the groundwater basin, and then extracted and tested for changes to water quality and aquifer hydrodynamics. A second well, located adjacent to the proposed test well, will be utilized as a monitoring well during the pilot program.

North Coast IRWMP Proposition 84, Round 2 Implementation Projects

ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
635	Salyer Mutual Water Company	Larger capacity storage tanks, dedicated main line, meters/master meter	Water District (WS & WW)	Trinity	$0	$210,000	38.8	39.3

The SMWC was recently formed to take over the operation of the previously privately owned water company. Defered maintanence & regulatory violations causes the community to endure major leaks, low water pressure, water outages, lack of proper chlorination & unsafe water. Since 1998, the CDPH has imposed a standing boil order advisory because the unfiltered source water does not meet SDWA requirements.

The SMWC has two storage tanks holding 20,000 gallons total. Residents level to the tanks experience low pressure & power outages require severe water conservation to avoid water shortages. This level of storage is insufficient for the 56 homes served & insuficient for fire protection. Salyer is considered at high risk for wildland fires.

The water main line from the pump house to the storage tanks consists of 40+ year old galvanized pipe and plastic sewer line. The "non dedicated" water main serves eight homes prior to storage, providing residents with water insufficiently chlorinated. Other existing water mains are also decades old, poorly installed and frequently break or leak causing water outages. Valves and meters are insufficient, failing or non-existent.

The potential for wildland fire is high in Salyer. The water system has 20 (?) two inch warf head flushing hydrants, and the flow from these hydrants is insufficient for fire protection. The SMWC lacks any fire hydrants. Fire hydrants every 500 feet per AWWA standards is desired.

The project would include:

a. Storage tank(s)
b. Dedicated water line to storage tank(s) and new water mains thoughout
c. Install a master meter at pump house and meters at consumers home

ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
636	Trinity County Resource Conservation District	West Weaver Creek - Channel and Floodplain Rehabilitation	RCD	Trinity	$78,500	$745,000	37.6	37.5

The Trinity County Resource Conservation District (TCRCD) proposes to implement creek restoration on a degraded reach of West Weaver Creek, near Weaverville, Trinity County, California. West Weaver Creek, a headwater tributary to the Trinity River, has good water quality making it ideal for supporting improved habitat for Coho and Steelhead, important salmonid species of concern. Recently, the TCRCD worked with geomorphologists and engineers at ESA PWA to assess conditions and develop conceptual restoration designs for a degraded reach of West Weaver Creek located 1,000 feet upstream of the confluence with Grub Gulch that is in need of immediate rehabilitation action. This reach lies in the portion of the watershed severely impacted by historic hydraulic mining and recent fires, has poor salmonid habitat, and supplies fine sediment to the downstream Trinity River. The instream habitat problems are largely the result of degraded geomorphic form and function of the creek, and the proposed rehabilitation actions (pool and riffle construction; spawning gravel augmentation; riparian planting) would provide benefits including increased in-channel and floodplain sediment sorting and retention, decreased fine sediment yield, improved passage to upstream habitat, increased spawning and rearing habitat, increased colonization surfaces for macroinvertebrates, and increased high flow refugia. Located in the Weaverville Community Forest, the project allows local stewardship of important natural resources and strengthens development of community-based conservation. The Forest Service Redwood Sciences Lab will continue their fish population monitoring and modeling of the creek, and their post-project monitoring will document the fish population response and benefits of the project in relation to the wider region. Fish habitat and water quality improvements will also translate to the downstream Trinity River, expanding the geographic range of benefits of this restoration project.

North Coast IRWMP Proposition 84, Round 2 Implementation Projects

ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
637	Weaverville Community Services District	East Weaver Treatment Plant Improvement Project	Water District (WS & WW)	Trinity	$160,000	$1,411,000	35.7	35.1

The East Weaver Treatment Plant (EWTP) provides drinking water for the disadvantaged communities of Weaverville and Douglas City. The EWTP is a direct filtration plant that is prone to high levels of disinfection byproducts (DBP) that have exceeded the maximum contaminant levels set by the EPA. The EWTP practices prechlorination that is introduced at the system intake located approximately 2800'from the existing pressure filters down stream. Many of the DBP are produced from the chlorine contact time with raw water laden with high levels of organics prior to filtration. This project proposes the construction of a roughing filter down stream of the intake where the chlorine injection will also be relocated. By removing the majority of the organics with the roughing filter and then chlorinating, the DBP will be decreased. The roughing filter is also designed with equipment to optimize the dosage of coagulant to efficiently reduce the turbidity of the raw water. This project also proposed the installation of tank mixers in three of the Districts reservoirs in order to reduce stratification and short circuiting in tanks which causes pockets of low residual water and increases chlorine demand.

ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
638	Weaverville Sanitary District	Weaverville Sanitary District Water Reclamation Project	Water District (WS & WW)	Trinity	$50,000	$2,074,470	34.9	34.5

This project will recycle waste water for industrial and irrigation uses while reducing water diversion from Weaver Creek, a coho salmon stream. A water reuse project will minimize the use of surface and groundwater of Weaver Creek. This project is being done in phases, with Phase 1 feasibility and design of the water reuse system completed and 50% of the permitting process has been completed. Phase 2 would be the implementation of the design. Based on designs completed in Phase 1, the project would require secondary treatment followed by coagulation, filtration, and disinfection of waste water before storage and pumping to end users. Most of these processes are already installed at the Weaverville treatment plant. Based on these requirements, the project would consist of adding the following elements to the Weaverville treatment plant: filter pumping, coagulation, filtration, effluent pumping and pipeline to reuse area and auxiliary systems, such as chemical feed and storage tanks, monitoring instruments, automatic valves and a flow equalization basin. The flow equalization basin is used to equalize the large daily flow variations and it would allow use of the existing chlorination facility. This flow equalization will maximize the reuse of water, while minimizing the filter size, effluent pumping station and reuse pipeline. Because Weaver creek holds a year over year population of coho and is the primary water source for Weaverville, the protection of water resources through the maximization of efficiency is paramount for water quality, water quantity, community sustainability and fisheries health. Currently, land irrigators including both public and private entities must use potable water to irrigate their land. This project will benefit these irrigators, has the potential to benefit additional industrial water users, and will increase stream flows in Weaver Creek.

North Coast IRWMP Proposition 84, Round 2 Implementation Projects

ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
739	Karuk Tribe	Lower Mid-Klamath Habitat Protection-Road Decommissioning Implementation Project	Tribe	Karuk Tribe	$75,000	$300,000	37.9	39.0

This road decommissioning project will remove unstable fill at stream crossings, swales, springs, seeps and reestablish the natural hillslope drainage pattern along the intervening road reaches. Our treatment specifications detail the work schedule by itemizing: excavation and disposal sites and post-project erosion and sediment control measures. The treatment specifications require the removal of road fill from stream crossings, swales, and other unstable areas that threaten downstream water quality and salmonid habitat. Stream crossings are excavated to original width, depth, and slope to expose natural channel and buried topsoil. Unstable fill material with high failure potentials is excavated to reduce erosion hazard and expose buried topsoil. Excavated material is moved to stable road locations, placed along cutbanks, and then shaped to specific slope and compaction requirements.

Treatment specifications are designed with tentative grades and dimensions, which provide the basis for estimates of volumes to be excavated. As the work progresses, the site supervisor determines the final grades and dimensions. The final grades and dimensions provide the basis for determining actual volumes excavated. While excavating, the equipment operators adjust the excavation's grade, alignment, and bank dimensions to preserve latent boundary conditions, such as: original topsoil, natural channel armor, bedrock outcrops, or stumps in the growth position (It is extremely important not to remove or disturb these natural boundary features.) Post project erosion and sediment control measures (post project management measures) are to be implemented as specific slope, compaction requirements, and channel gradients have been obtained. The appropriate treatment will include but not be limited to vegetated rock armoring, in-stream grade control structures, hydroseeding, handseeding, and lop and scatter of native mulch material over exposed soils.

ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
740	Yurok Tribe - Yurok Tribal Fisheries Program (YTFP)	Restoration of Lower Klamath River Habitats	Tribe	Yurok Tribe	$503,375	$842,709	38.8	38.2

A priority water resource need of the Yurok Tribe is the ability to harvest anadromous fish from the Klamath River. Anthropogenic activities over the past century have resulted in substantial declines to Klamath River fish runs and drastically altered or degraded their habitats. Although impairments exist, the Yurok consider Lower Klamath habitats to be "salmon strongholds" since these areas support both natal (Lower Klamath populations) and non-natal (Mid & Upper Klamath, Trinity populations) salmonid populations. This project will result in restoration of spawning and rearing habitats for native salmonids (chinook, coho, steelhead, coastal cutthroat) in three priority Lower Klamath tributaries: Blue Creek (2.0 miles), Terwer Creek (2.0 miles), and Hunter Creek (2.0 miles). Project activities consist of developing feasible restoration designs for lower Blue Creek (#1 priority Lower Klamath tributary), and building constructed wood jams (CWJs), implementing complimentary bioengineering techniques (willow baffles), and planting riparian habitats with native conifers in reaches of Hunter and Terwer creeks. The Yurok Tribal Fisheries Program (YTFP) will work closely with our restoration consultant Rocco Fiori (Fiori GeoSciences - FGS) to conduct the work in a manner that will immediately address known limiting factors and facilitate self-maintaining processes to ensure long-term benefits to native salmonids and the Yurok who rely on them for cultural, subsistence, and economic purposes. These actions will be implemented over a three year period and provide quality employment to Yurok Tribal members and economic stimulus to disadvantaged communities. This project is part of the larger-scale, prioritized restoration plan developed by YTFP and FGS for the Lower Klamath River Sub-basin.

North Coast IRWMP Proposition 84, Round 2 Implementation Projects

ID	Organization Name	Project Name	Project Proponent Type	General Location	Match	Amt Requested	Average Project Score	Updated Average Score
841	Rural Community Assistance Corporation	DAC/ Tribal DAC Implementation Circuit Rider	NGO	North Coast region	$0	$250,000	34.3	31.2

Rural Community Assistance Corporation (RCAC) will address water quality and quantity issues in NCIRWMP DACs and Tribal DAC (DACs) communities by assisting the Water & Wastewater service provider outreach & support program (WSWW) and Tribal Coordinator efforts with project identification and design and by providing project management to implement up to six projects. In addition, RCAC will develop and implement non-construction solutions to address utility needs.

Project Management --RCAC will assist DACs with meeting environmental compliance, completing mitigation and obtaining all required permits and will provide project management services including conducting public procurement processes, construction management, labor compliance monitoring, project closeout and utility start up for up to six projects. RCAC will train staff to operate new or improved utility and assist management on utility operational requirements.

RCAC has developed a working relationship with many of the DACs over the past 30 years and is currently providing training for WSWW. RCAC is aware that most DACs do not charge enough for water. RCAC's efforts will include issues around the economics of water. Rate studies and rate setting are critical components of project sustainability and will be done as needed. RCAC has extensive expertise in rural infrastructure project finance, rate setting, Prop. 218 compliance and identifying the financial resources DACs can assess for utility infrastructure projects.

RCAC will assist in accessing additional financial sources, including assistance in application and administration of construction grants, in addition to assistance with grants for training and certification. RCAC is a certified Community Development Financial Institution (CDFI).



http://www.siskiyoudaily.com/news/x512657686/Expert-panel-assesses-Klamath-dam-removal-impacts-on-salmon-steelhead

Expert panel assesses Klamath dam removal impacts on salmon, steelhead

by David Smith, Siskiyou Daily News January 14, 2011

Klamath River — Jan. 8 saw the release of an expert panel's draft report on the assessment of the potential effects of two Klamath dam alternatives on Coho and steelhead populations, a document which reports the potential impacts on those fish species from the implementation of the Klamath Hydroelectric Settlement Agreement and the Klamath Basin Restoration Agreement (KBRA).

The report was prepared by Drs. Thomas Dunne, Greg Ruggerone, Daniel Goodman, Kenneth Rose, Wim Kimmerer and Joseph Ebersole and assesses two alternatives, keeping the dams in and taking the dams out and implementing the KBRA.

According to the executive summary, the panel was asked a number of questions regarding the expert opinion on what each scenario could mean for steelhead and Coho salmon.

"The Panel faced a difficult challenge," the document reads. "The Panel was presented with an enormous amount of material, spread out in many documents, and not synthesized in an overview document compiling the program's conclusions along with the evidence for them."

Another obstacle, according to the document, was the five day time constraint placed upon the team to review the data and write the report.

Answering 13 questions, the panel suggested that the removal of the dams would have "injurious" effects on migrating Coho and steelhead in the short term as sediment from behind the dams is released, with an expected improvement of spawning habitat in the long term, more for steelhead than Coho.

Other areas were also analyzed, with the panel stating that it believes that dam removal would cause increased temperatures before August and decreased temperatures after "with ambiguous results for affected life stages that span that divide."

According to the report, the panel struggled with the lack of data regarding some of the questions it was asked to answer, as well as the uncertainty regarding the KBRA's implementation. Because of that uncertainty, the panel states that it expects that nutrient loading and dissolved oxygen would not show an appreciable change above Keno Dam.

With respect to fish disease, ecosystem function and the recreational fishery, the panel states that more information is needed, either in the form of more studies or in better defining KBRA actions in the future.

Both with the dams in and with the dams out, the panel expressed a concern that Coho salmon will still face survival issues. The benefits of taking out the dams, the panel says, "will result from small increases in habitat area usable by Coho with dam removal, small changes in conditions in the mainstem, positive but unquantified changes in tributary habitats where most Coho spawn and rear, and the potential risk for disease and low ocean survival to offset gains in production in the new habitat."

Ultimately, the panel states, "large improvements are needed to put this population on the road to recovery."

The panel explains that it is more optimistic about steelhead numbers improving in the decades after dam removal, if that project and the KBRA are implemented effectively.

With the uncertainty regarding the topics that the panel assessed, it states in its executive summary, "the panel hesitantly answered the questions because of the potential for misinterpretation of the Panel's responses.

"'Expert opinion,' even of an independent panel, should not be used as a substitute for scientific analysis."

Offering recommendations on how to reduce uncertainty, the panel suggests that an overall conceptual model be constructed, a "centralized science advisory group with strong leadership" be formed and actions in the KBRA be specified, among other actions.

The panel's responses are expected to receive internal comments by Jan. 18.

– David Smith can be reached at dsmith@siskiyoudaily.com

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Hydroelectric power water use

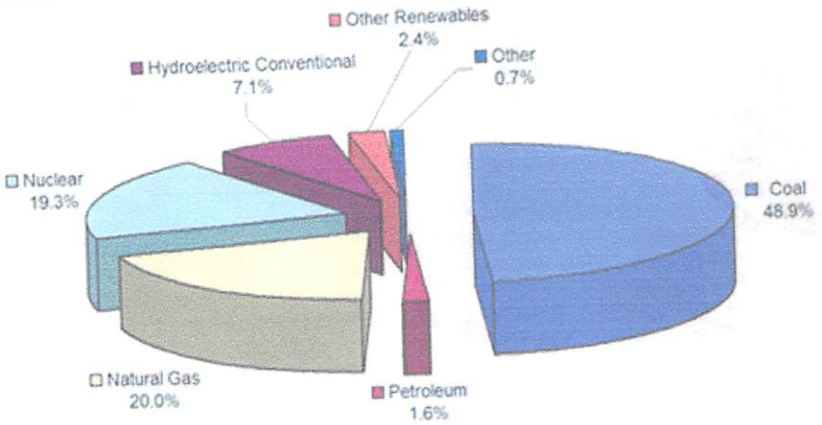
What percent of the nation's power do you think came from hydroelectric-power plants in 2006?

Get answer

Hydroelectric power must be one of the oldest methods of producing power. No doubt, Jack the Caveman stuck some sturdy leaves on a pole and put it in a moving stream. The water would spin the pole that crushed grain to make their delicious, low-fat prehistoric bran muffins. People have used moving water to help them in their work throughout history, and modern people make great use of moving water to produce electricity.

Hydroelectric power for the Nation

Although most energy in the United States is produced by fossil-fuel and nuclear power plants, hydroelectricity is still important to the Nation, as about 7 percent of total power is produced by hydroelectric plants. Nowadays, huge power generators are placed inside dams. Water flowing through the dams spin turbine blades (made out of metal instead of leaves) which are connected to generators. Power is produced and is sent to homes and businesses.



Sources of electricity in the USA 2006. Data from http://www.eia.doe.gov/cneaf/electricity/epa/epat1p1.html

World distribution of hydropower

Hydropower is the most important and widely-used renewable source of energy.
Hydropower represents 19% of total electricity production.
China is the largest producer of hydroelectricity, followed by Canada, Brazil, and the United States (Source: Energy Information Administration).
Approximately two-thirds of the economically feasible potential remains to be developed.
Untapped hydro resources are still abundant in Latin America, Central Africa, India and China.

Producing electricity using hydroelectric power has some advantages over other power-producing methods. Let's do a quick comparison:

Advantages to hydroelectric power:

Fuel is not burned so there is minimal pollution
Water to run the power plant is provided free by nature
Hydropower plays a major role in reducing greenhouse gas emissions
Relatively low operations and maintenance costs
The technology is reliable and proven over time
It's *renewable* - rainfall renews the water in the reservoir, so the fuel is almost

Read an expanded list of advantages of hydroelectric power from the Top World Conference on Sustainable Development conference, Johannesburg, South Africa (2002)

Disadvantages to power plants that use coal, oil, and gas fuel:

They use up valuable and limited natural resources
They can produce a lot of pollution
Companies have to dig up the Earth or drill wells to get the coal, oil, and gas
For nuclear power plants there are waste-disposal problems

Hydroelectric power is not perfect, though, and does have some disadvantages:

High investment costs
Hydrology dependent (precipitation)
In some cases, inundation of land and wildlife habitat
In some cases, loss or modification of fish habitat
Fish entrainment or passage restriction
In some cases, changes in reservoir and stream water quality
In some cases, displacement of local populations

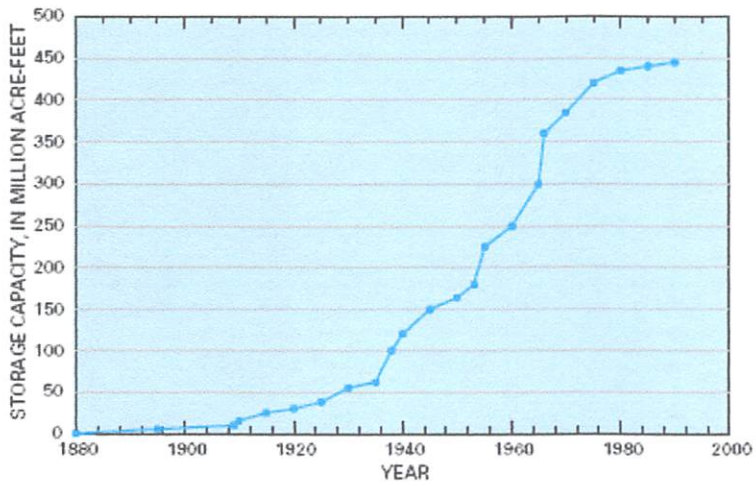
Hydropower and the Environment

Hydropower is nonpolluting, but does have environmental impacts

Hydropower does not pollute the water or the air. However, hydropower facilities can have large environmental impacts by changing the environment and affecting land use, homes, and natural habitats in the dam area.

Most hydroelectric power plants have a dam and a reservoir. These structures may obstruct fish migration and affect their populations. Operating a hydroelectric power plant may also change the water temperature and the river's flow. These changes may harm native plants and animals in the river and on land. Reservoirs may cover people's homes, important natural areas, agricultural land, and archeological sites. So building dams can require relocating people. Methane, a strong greenhouse gas, may also form in some reservoirs and be emitted to the atmosphere. (EPA Energy Kids)

Reservoir construction is "drying up" in the United States

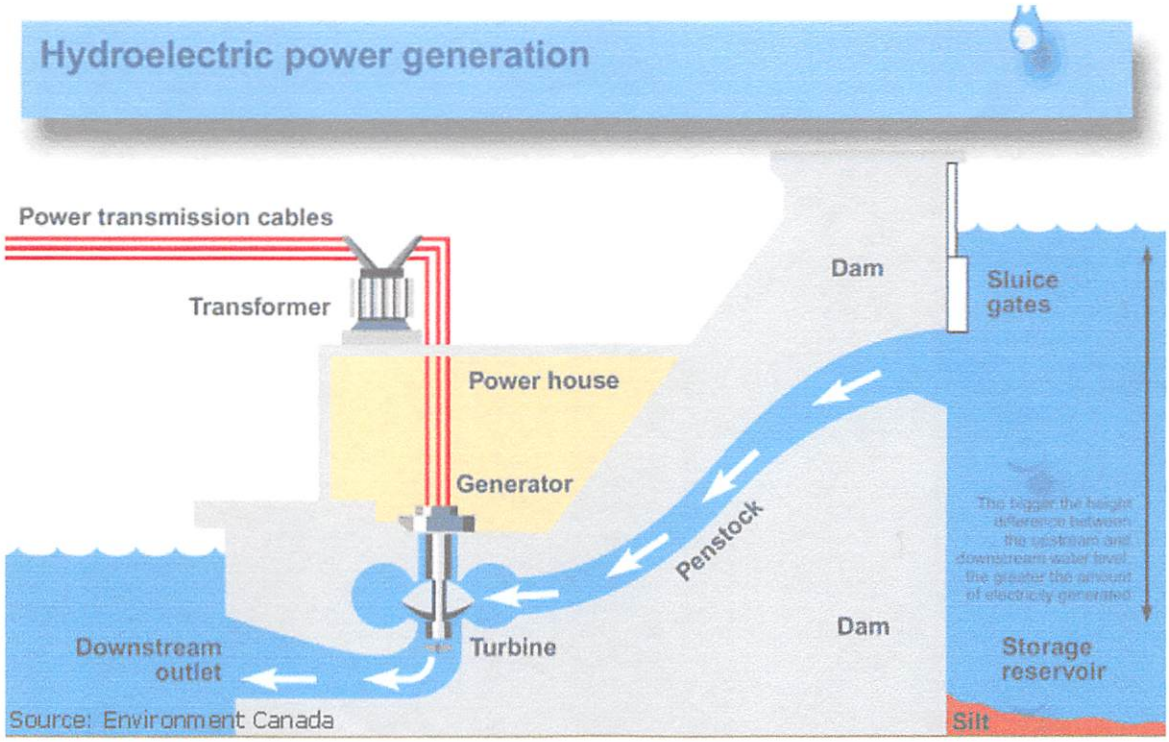


Gosh, hydroelectric power sounds great -- so why don't we use it to produce all of our power? Mainly because you need lots of water and a lot of land where you can build a dam and reservoir, which all takes a LOT of money, time, and construction. In fact, most of the good spots to locate hydro plants have already been taken. In the early part of the century hydroelectric plants supplied a bit less than one-half of the nation's power, but the number is down to about 10 percent today. The trend for the future will probably be to build small-scale hydro plants that can generate electricity for a single community.

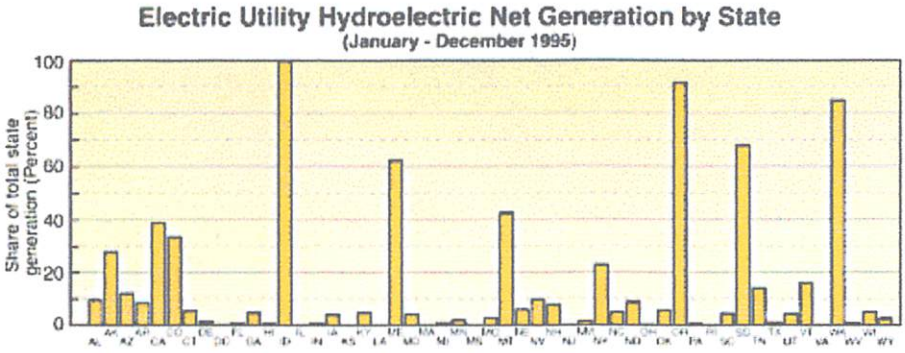
As this chart shows, the construction of surface reservoirs has slowed considerably in recent years. In the middle of the 20th Century, when urbanization was occuring at a rapid rate, many reservoirs were constructed to serve peoples' rising demand for water and power. Since about 1980, the rate of reservoir construction has slowed considerably.

Typical hydroelectric powerplant

Hydroelectric energy is produced by the force of falling water. The capacity to produce this energy is dependent on both the available flow and the height from which it falls. Building up behind a high dam, water accumulates potential energy. This is transformed into mechanical energy when the water rushes down the sluice and strikes the rotary blades of turbine. The turbine's rotation spins electromagnets which generate current in stationary coils of wire. Finally, the current is put through a transformer where the voltage is increased for long distance transmission over power lines. (Source: Environment Canada)

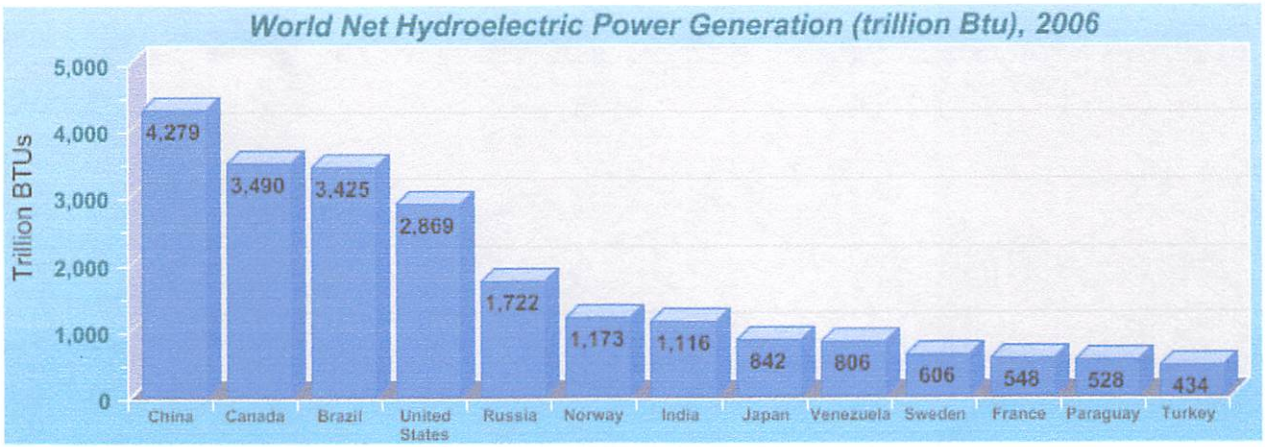


Hydroelectric-power production in the United States and the world



As this chart shows, in the United States, most states make some use of hydroelectric power, although, as you can expect, states with low topographical relief, such as Florida and Kansas, produce very little hydroelectric power. But some states, such as Idaho, Washington, and Oregon use hydroelectricity as their main power source. in 1995, all of Idaho's power came from hydroelectric plants.

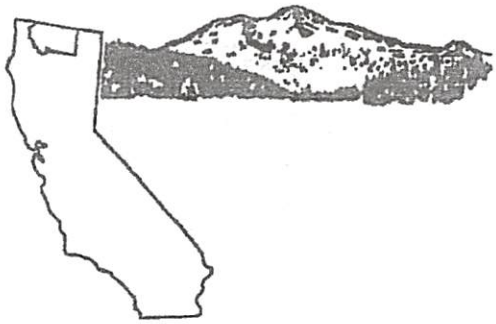
The second chart shows hydroelectric power generation in 2006 for the leading hydroelectric-generating countries in the world. China has developed large hydroelectric facilities in the last decade and now lead the world in hydroelectricity usage. But, from north to south and from east to west, countries all over the world make use of hydroelectricity—the main ingredients are a large river and a drop in elevation (along with money, of course).



Source: Energy Information Administration (EIA):
http://www.eia.doe.gov/emeu/international/electricitygeneration.html

To view PDF files, the latest version of Adobe Reader (free of charge) or similar software is needed.

U.S. Department of the Interior | U.S. Geological Survey
URL: http://ga.water.usgs.gov/edu/wuhy.html
Page Contact Information: Howard Perlman
Page Last Modified: Monday, 03-Dec-2012 11:29:49 EST



Siskiyou County

DEPARTMENT OF PUBLIC WORKS

P.O. BOX 1127
YREKA, CALIFORNIA 96097
PHONE: (530) 842-8250
FAX (530) 842-8288

Scott Sumner
Director

Todd Lamanna
Road Superintendent

Scott Waite
Engineering/Survey

STATE WATER RESOURCES CONTROL BOARD
2017 JAN 31 PM 1:37
DIV OF WATER RIGHTS
SACRAMENTO

June 30, 2010

Dennis D. Lynch, Program Manager
Klamath Basin Secretarial Determination
U.S. Geological Survey, NW Area Office
2130 SW Fifth Avenue
Portland, Oregon 97201

Subject: Scoping comments in consideration of proposed removal of dams on the Klamath River

Dear Mr. Lynch,

As Road Commissioner for Siskiyou County, I am responsible for our County maintained road system including those roads and bridges adjacent to, and in some cases, directly over the Klamath River. This responsibility is consistent with applicable sections of the California Streets and Highways Code. With this in mind, any proposed project activity utilizing or impacting the Siskiyou County road system must be described and evaluated as part of the preliminary planning, feasibility, and engineering studies.

To adequately and effectively address the impacts of the project will require a complete project description outlining all phases of the work. Engineering studies and feasibility studies need to be completed to assess the potential impacts to the County roads and bridges. The comments below are provided to you as a brief summary of the concerns the Road Department has related to the proposed project.

- Many of our roads within the sphere of the proposed project are in poor condition, and in some cases, have safety concerns that must be identified and mitigated. To that end, any and all haul routes should be identified and evaluated in the context of the proposed impacts.
- The soil native to the Irongate Lake and Copco Lake areas is well known as a very weak expansive clay that contributes to a myriad of problems with our roads including structural section damage, drainage issues, cut slope failures, fill slope failures, slides, and rutting. Please consider that no hauling of heavy loads should be allowed during the wet season, which generally runs from October through June.
- A traffic study should be performed to assess all impacts to the County roads resulting from heavy hauling and at a minimum should include an evaluation of the existing road structural section with respect to project impacts. Potential concerns related to road geometry and width as it relates to public safety should also be addressed in this study. It needs be acknowledged that Copco Road in particular passes through subdivided areas where homes exist very close to the roadway.
- Bridges should be identified and evaluated for structural adequacy on the haul routes, as well as any long term impacts from hauling of heavy loads.
- All bridges, both up and downstream of the project, should be evaluated for potential adverse hydraulic effects due to potential scour (degrading) or aggrading of the river channel following dam removal.
- All material proposed for disposal resulting from the work needs to be identified both in character and quantity. Disposal sites should be identified, in advance, that can accept the material and any costs and impacts to the County should be mitigated.

- The long term erosion of the barren slopes and sediment left behind where the lakes now exist needs to be considered.
- It would seem contradictory to implement a Klamath TMDL with strict criteria and requirements dealing with sediment along our roads, and then to remove the dams exposing a 50 year accumulated sediment load with all types of potential biological and geological issues that could potentially trigger impacts that would dwarf that of any other anthropogenic impacts to the river system.
- In consideration of our comments, I have attached a list below that identifies many of the roads and bridges that may be impacted by the project. This list does not include the State owned and maintained bridges or State Highway 96, nor does it include any privately owned infrastructure.

County Road Name	Road Number
Ager Beswick Road	8L003
Ager Road	7K01
Copco Road	9K02
Klamath River Road	8J001
Klamathon Road	8K003
Walker Road	8G004
Walker Bridge Connection Road	8G002
Bar Road	8F003
Ladd Road	8D004
Grider Road	8D001
Gordons Ferry Road	7C014
China Grade Road	7C002
Elk Creek Road	7C001
Curly Jack Road	7C006

County Bridge Name	Bridge Number	State Bridge #	Waterway	Road Conveyed
Copco Bridge	10M1	2C-039	Klamath River	Copco Road
Jenny Creek	10L2	2C-061	Jenny Creek	Copco Road
Brush Creek	09L3	2C-224	Brush Creek	Copco Road
Fish Hatchery(PacifiCorp-owner)	09L4	2C-255	Klamath River	Lake View Road (Private)
Fish Hook Bridge	09K5	2C-144	Dry Creek	Copco Road
Klamathon	09K4	2C-029	Klamath River	Ager Road
Ash Creek	08J3	2C-041	Klamath River	Klamath River Road
Walker	08G3	2C-080	Klamath River	Walker Bridge Conn. Road
Horse Creek	08F1	2C-008	Klamath River	Horse Creek Road
Rusty Bridge	08F4	2C-271	Klamath River	Bar Road
Klamath River at Happy Camp	07C1	2C-271	Klamath River	Elk Creek Road

Thank you for considering our comments. Should you have any questions, please do not hesitate to contact me.

Sincerely,

Scott Sumner
Director of Public Works

STATE WATER RESOURCES
CONTROL BOARD

2017 JAN 31 PM 1:37

DIV OF WATER RIGHTS
SACRAMENTO

CALIFORNIA
Water Boards

EDMUND G. BROWN JR.
GOVERNOR

MATTHEW RODRIQUEZ
SECRETARY FOR
ENVIRONMENTAL PROTECTION

State Water Resources Control Board

NOTICE OF PETITIONS FOR CHANGE OF PLACE OF USE AND PURPOSE OF USE TO DEDICATE WATER FOR THE PRESERVATION AND ENHANCEMENT OF FISH AND WILDLIFE RESOURCES FOR SHASTA RIVER DECREE NO. 7035 DIVERSION NUMBERS 167, 168, 169, 170, 171, 172, 241, 243, 244, 245, 246, 247, 248 (ADJUDICATED WATER RIGHTS J000014, J000015, J000016, J000017, J000018, J000019, J000020, J000021)

COUNTY: Siskiyou

STREAM SYSTEM: Hole in the Ground Creek
Little Springs Creek
Big Springs Creek
Shasta River

The Nature Conservancy has filed petitions for change for Shasta River Decree 7035 diversion numbers 167, 168, 169, 170, 171, 172, 241, 243, 244, 245, 246, 247, 248. Any correspondence directed to the Petitioner should be mailed to:

The Nature Conservancy
c/o Amy Hoss
701 Mt. Shasta Blvd.
Mt. Shasta, CA 96067

The State Water Resources Control Board (State Water Board) will determine whether to approve the petitions and whether such changes should be conditioned to protect other legal users of water, the public interest, or the environment. If the State Water Board approves the petitions, either the State Water Board or The Nature Conservancy may initiate the procedures in the Siskiyou County Superior Court to amend the Shasta River Decree to reflect the approved changes. If approved, the State Water Board may file a Notice of Exemption for the petitions pursuant to the California Environmental Quality Act for minor alterations to land, water or vegetation, environmental and natural resources protection projects, and small habitat restoration projects. (Cal. Code Regs., §§ 15304, 15307, 15308, 15333.)

In general, The Nature Conservancy proposes to forego diversion under some or all of the above-listed water rights during certain water years, as determined in coordination with the Department of Fish and Game and the Watermaster. The portion of such water that would otherwise have been consumptively used would be protected downstream from the point of diversion to the United States Geological Survey gage on the Shasta River. The instream dedication should not result in any change to water availability to downstream users from a situation where the water was applied to pasture. Petitioners anticipate that in most years, the water would continue to be applied to irrigate pasturelands. A summary of the changes for each individual water right follows.

320

State of California
State Water Resources Control Board
DIVISION OF WATER RIGHTS
P.O. Box 2000, Sacramento, CA 95812-2000
Info: (916) 341-5300, FAX: (916) 341-5400, Web: http://www.waterboards.ca.gov/waterrights

STATE WATER RESOURCES CONTROL BOARD
2012 JUL 18 AM 10:08
DIV OF WATER RIGHTS SACRAMENTO

PETITION FOR INSTREAM FLOW DEDICATION
(WATER CODE 1707)

This type of petition is only for projects to preserve or enhance wetlands habitat, fish and wildlife resources, or recreation in or on the water (See Water Code section 1707).

Application _____ Permit _____ License _____ Statement* X SEE ATTACHMENT 1

*For pre-1914 appropriative rights and/or riparian rights - provide an attachment describing the basis of right (points of diversion, place of use, quantities and season of diversion, date of origination, map of point of diversion and place of use (Cal. Code Regs., tit. 23, § 715, et seq.)). Also, if the right has been verified by a court, provide a copy of the court ruling.

I (we) hereby petition for instream flow dedication as shown on the accompanying map and described as follows:

Upstream Location of Flow Dedication Reach of Stream: (Give coordinate distances in California Coordinates, NAD 83, or other ties as allowed by Cal. Code Regs., tit. 23, § 715. Also provide the 40-acre subdivision in which the upstream location of flow dedication reach is located.)

NAD 83 ZONE 10N 545617.24e 4606334.191n NE 1/4 NW 1/4, SEC. 5, T. 43 N., R. 5 W., M.D.B.& M.

Downstream Location of Flow Dedication Reach of Stream:

AT THE USGS GAGE #11517500 (SHASTA RIVER NEAR YREKA, CA): NAD83 10N 534025.088e 4630969.301n

List the quantities dedicated to instream flow in cubic feet per second:

Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
			1.2	1.2	1.2	1.2	1.2	1.2			

Will the dedicated flow be diverted from the stream for consumptive use at a downstream location? If so, provide the location and the quantities of flow that will be diverted from the stream. The information for the point of diversion should be provided in California Coordinates, NAD 83, or other ties as allowed by Cal. Code Reg., tit. 23, § 715:
NO

Are there any persons taking water from the stream in the instream flow dedication reach? YES (yes/no)

If so, list the name and addresses of the persons taking water from the stream in this stream reach.

SEE ATTACHMENT 2, TABLE 2

A copy of the petition must be provided to the California Department of Fish and Game (DFG). Indicate the date that the petition was provided to DFG and provide a copy of the transmittal letter to DFG: JUNE 25, 2012 - SEE ATTACHMENT 3

THIS CHANGE DOES NOT INVOLVE AN INCREASE IN THE AMOUNT OF THE APPROPRIATION OR SEASON OF USE.
I (we) declare under penalty of perjury that the above is true and correct to the best of my (our) knowledge and belief.

Dated July 16, 2012 at SISKIYOU COUNTY, California

Signature(s)

530-926-3199
Telephone No.

NOTE: All petitions must be accompanied by the fee (see fee schedule at www.waterboards.ca.gov/waterrights), made payable to the State Water Resources Control Board (State Water Board) and an $850 fee made payable to the Department of Fish and Game must accompany the petition. Separate petitions are required for each water right. Separate State Water Board fees are required if both a change and time extension petition are being filed.

Attachment 2 to Accompany the Petition for Change
Instream Flow Dedication (Water Code 1707)
For Water Rights within the Shasta River Adjudication and Decree 7035, 1932
RE: Diversion No. 247, Shasta River (1.2 cfs)
The Nature Conservancy

Project Description
1.2 cubic feet per second (cfs) may be diverted from Diversion Point #247, pursuant to the Shasta River Adjudication and Decree (Decree) in Siskiyou County, California.[1] By this Petition for Instream Flow Dedication (Petition)[2], TNC seeks to dedicate up to 1.2 cfs to instream uses for the purpose of preserving and enhancing fish and wildlife resources.

As set forth in the Decree, this water right is for direct diversion from the natural flow of the Shasta River during the period between March 1st and November 1st of each year for beneficial use on 60.0 acres. Diversion #247 has a priority date of March 18, 1914 (Priority 25). Diversions within the Shasta River system are administered as part of the Scott and Shasta Watermaster District (SSWD).[3] These water rights are located on the Shasta River near River Mile 31 in the region referred to as the "Big Springs Complex"—an area with cold water refugia for coho salmon, Chinook salmon, and steelhead trout.

Pursuant to this Change Petition, water withdrawals from Diversion #247 in certain circumstances will be reduced or curtailed during some or all of the irrigation season for the purpose of preserving and enhancing fish and wildlife resources in the Shasta River. Decisions about whether and when diversions will be reduced or curtailed will be made by TNC and the Department of Fish and Game in coordination with the Watermaster, based on natural flow conditions, water temperatures, biological needs of fish and wildlife and other relevant considerations.

TNC requests that the water that is subject to this dedication be in addition to water that is, or may in the future be required, to be used for instream purposes to satisfy any applicable federal, state, or local regulatory requirements governing water quantity, water quality, in-stream flows, fish and wildlife, wetlands, recreation, and other instream beneficial uses. TNC further requests that the California State Water Resources Control Board and all other state and local agencies, as well as the courts, not credit the water subject to this petition towards compliance with any regulatory requirements, including any existing or future minimum instream flow requirements, but rather this water be in addition to (or applied on top of) any future required bypass or minimum instream flow requirements (per §1707 (c) (1)).

Present Purpose of Use:
Irrigation.

Proposed Purpose of Use:
Irrigation and preserving and enhancing fish and wildlife resources.

---

[1] Judgment No. 7035 entered into the Superior Court of the State of California in and for the County of Siskiyou on December 30, 1932 (Shasta River Decree).

[2] As the holder of a pre-1914 appropriative right, TNC is not required to obtain State Water Resources Control Board approval to change the place of use, purpose of use or point of diversion of its water right. Water Code §1706; see also *Barnes v. Hussa* (2006) 136 Cal.App.4th 1358. Nonetheless, TNC submits this Petition pursuant to Water Code §1707 in the interest of ensuring that its proposal to include as a purpose of use *preserving and enhancing fish and wildlife resources* is adequately documented and enforceable.

[3] On December 22, 2011, the Siskiyou County Superior Court granted the petition of the Scott and Shasta Watermaster District (SSWD) to replace the Department of Water Resources as watermaster. The SSWD began to provide watermaster services on or about February 1, 2012.

Present Place of Use:
Since TNC purchased the property in 2005, irrigation has continued as it had prior to TNC's acquisition. However, since 1932 when the decree was adopted, the water rights at Diversions 247 and 248 have been combined and diverted at the location of Point of Diversion #247.

There have also been minor changes over time due to improved irrigation infrastructure and more efficient use of other nearby POD's. The acreage listed in Table 1 and shown on Map 1 describes the acres outlined in the decree and also shows the revisions to the place of use. This amendment does not change the total use on any given day for either irrigation or instream benefits and will not exceed the decreed amount of the water right from Diversion #247.

Table 1. Revised Place of Use for Diversion #247.

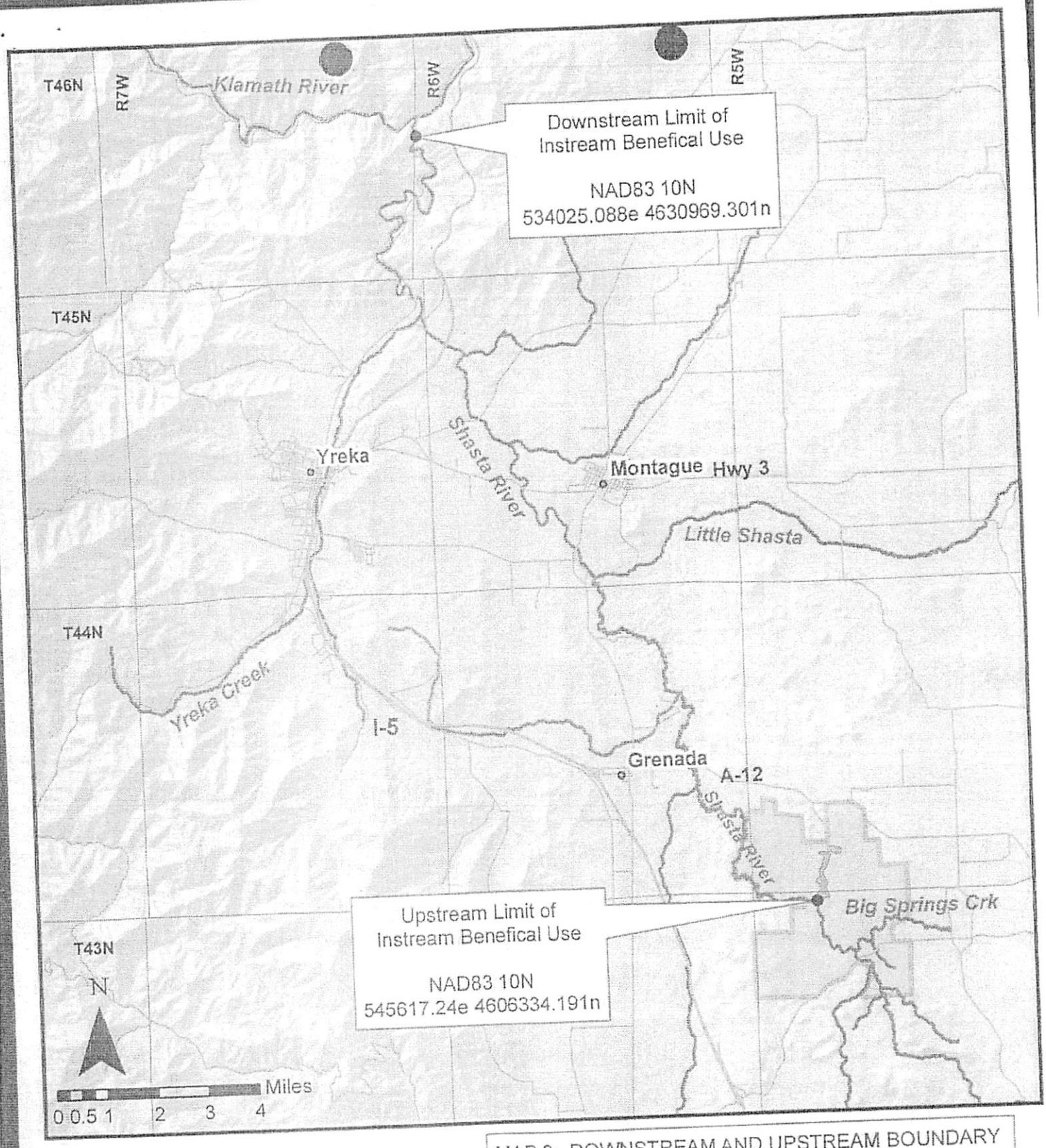
Irrigation Use is Within:	Section	Township	Range	B & M	Decreed Acres	Present Acres Irrigated
NW ¼ NE ¼	32	T44N	R5W	M.D.	7.5	21.3
SW ¼ NE ¼	32	T44N	R5W	M.D.	0.8	1.2
NE ¼ NW ¼	32	T44N	R5W	M.D.	6.3	6.1
SE ¼ NW ¼	32	T44N	R5W	M.D.	20.3	16.5
NE ¼ SW ¼	32	T44N	R5W	M.D.	10.1	15.6
SE ¼ SW ¼	32	T44N	R5W	M.D.	15.0	21.9
SW ¼ SW ¼	32	T44N	R5W	M.D.	0	0.9
NW ¼ SW ¼	32	T44N	R5W	M.D.	0	0.2
NW ¼ NW ¼	5	T44N	R5W	M.D.	0	1.2
				TOTAL	60.0 acres	84.9 acres

Proposed Place of Use:
Irrigation as described in Table 1 and shown on Map 1. The instream place of use for preserving and enhancing fish and wildlife resources would be an instream dedication reach from the POD (upper limit of project) to the mouth of the Shasta River (lower limit of project), as shown on Map 2 and described as follows:

Upper Location of Flow Dedication Reach (location at Point of Diversion #247):
NAD83 10N 545617.24e 4606334.191n
Downstream location of flow dedication reach (near the mouth of the Shasta River):
At the USGS gage # 11517500 (Shasta River near Yreka, Ca): NAD83 10N 534025.088e 4630969.301n

Shasta River Irrigation
Diversions #247 and #248 are combined and diverted at the location of the POD #247 located near River Mile 32 on the Shasta River along the boundary between Nelson and Shasta Big Springs Ranches. Water is pumped directly from the Shasta River roughly 80 yards up into an irrigation ditch. Water then flows 1.7 miles through an earthen ditch to irrigate pastures to the north of the river and is typically run on a continuous basis. By adding the instream use for preserving and enhancing fish and wildlife resources as a beneficial use, the total use on any given day for either irrigation or instream benefits will not exceed the decreed amount of TNC's water rights on the Shasta River.

Other Water Diverters in the Project Area
Below is a list of the water diverters in the project area. Those diverters above the bold line have a lower priority than the Priority associated with Diversions Number 247 (Priorities 25). These lower priority rights are those rights that will need to be bypassed in the event that there is not enough water in the system to accommodate the instream dedication and all other water rights downstream.



MAP 2: DOWNSTREAM AND UPSTREAM BOUNDARY OF INSTREAM BENEFICAL USE

Map to Accompany Petition for Change to
Shasta River Decree 7035,
Diversion #247
Siskiyou County, CA

Scott Shasta River Project

In 2008, the Scott River and Shasta rivers were identified as high priority water sheds. However, salmonid populations continue to decline. As the state agency responsible for conserving, protecting, and managing California's fish, wildlife, and native plant resources, the California Department of Fish and Game (CDFG) is implementing a collaborative process to collect information, identify issues and concerns, and define future study needs. This collaboration process could include steps to evaluate instream and out-of-stream water use in the Scott and Shasta valleys.

We need your help – Coordination with our partners to lay the groundwork for the identification of flow strategies that will improve watershed conditions is a priority. We have established multiple opportunities for feedback and discussion. The next opportunity for input is the LIAM (*Legal Institutional Analysis Model*) workshop, a process for identifying different points of view, resulting in a common framework for future action. The workshops and debriefs will result in appropriate communication and negotiation strategies for a given issue.

The workshop will use computers to record people's observations and an electronic record will be kept. Participants will be answering questions about groups, organizations, or areas of interest who are likely to be involved in study planning. Every identified group will be examined. Once we have this information, we will compile the results and report to everyone who wishes to attend a second meeting. At the second meeting, people will be able to review the results and enter comments about accuracy and other information. The results will be posted on the project website, where comments and suggestions can also be given. In this way we can get a good idea of the needs and interests of everyone.

Because you indicated that you want to participate but cannot attend the first workshop we ask that you complete this short questionnaire. Please return the questionnaire to us before the first workshop by using the enclosed postage paid envelope. Or, you can drop it off at the Holiday Inn Express Yreka by December 4.

Nobody's personal information will be collected in this process. The questionnaire does not have identifying numbers, and we are asking for no identifying information.

We ask that you please answer questions for only one group perspective. You may contact us if you wish to answer questions for a second group. We would be happy to send another questionnaire.

Please do not return this cover page with your questionnaire.

Thank you for your help,

Sincerely,

The Scott/Shasta Project Team

Scott Watershed

LIAM Workshop Meeting for the Scott River watershed is scheduled for December 4, 2012, 9 AM to 4 PM, at the Fort Jones Community Center.

A LIAM Workshop Debrief and Presentation for the Scott River watershed is December 6, 2012, 4 PM to 7 PM, at the Holiday Inn Express Yreka.

Shasta Watershed

LIAM Workshop Meeting for the Shasta River watershed is scheduled for December 11, 2012, 9 AM to 4 PM, at the Holiday Inn Express Yreka.

A LIAM Workshop Debrief and Presentation for Shasta River is scheduled for December 13 , 2012, 4 PM to 7 PM, at the Holiday Inn Express Yreka

Note: Attendees would be expected to attend both the workshop and debrief meetings for either watershed workshops.

Scott River Questionnaire

Please tell us about the group for which you are most identified:

___Farmers ___Ranchers ___Small Businesses ___Irrigators

___Tribe (Name:_____)

___Non-governmental Organization (Name:_____)

___ Public Agency (Name:_____)

Other: _____

Please answer the following questions to describe the group you indicated above:

(Please fill in the oval that best corresponds to your answer)

(1) This group prefers the support of an objective, scientific community in developing a study plan rather than relying on political backing.

Strongly Agree ◯ ◯ ◯ ◯ ◯ *Strongly Disagree*

(2) This group will attempt to shift the focus in developing this study plan away from economic development concerns.

Strongly Agree ◯ ◯ ◯ ◯ ◯ *Strongly Disagree*

(3) Does this group believe the study plan should include the needs of each of the organizations involved when study plans are developed through negotiation?

Almost Always ◯ ◯ ◯ ◯ ◯ *Almost Never*

(4) This group typically promotes non-commercial uses of land, wildlife, or water resources when designing studies of this kind.

Almost Always ◯ ◯ ◯ ◯ ◯ *Almost Never*

(5) In designing this study this group will solicit political support.

Strongly Agree ◯ ◯ ◯ ◯ ◯ *Strongly Disagree*

(6) Typically, this group sees conventional water, wildlife, or land use goals as right.

Almost Always ◯ ◯ ◯ ◯ ◯ *Almost Never*

(7) This group would prefer to participate in formal hearings, when developing study plans, rather than in less structured negotiations.

Strongly Agree ◯ ◯ ◯ ◯ ◯ *Strongly Disagree*

Scott River Questionnaire

(8) This group typically has PHYSICAL control of the land or water resources in the study plan area.

Almost Always ○ ○ ○ ○ ○ *Almost Never*

(9) This group will argue in terms of economic progress in the development of this study plan.

Strongly Agree ○ ○ ○ ○ ○ *Strongly Disagree*

(10) This group prefers an economic approach, such as benefit/cost analysis, in decision-making about designing studies like this.

Almost Always ○ ○ ○ ○ ○ *Almost Never*

(11) Does this group typically try first to negotiate disputes with other parties in actions similar to designing studies like this?

Almost Always ○ ○ ○ ○ ○ *Almost Never*

(12) This group will argue in terms of ecological values in designing this study.

Strongly Agree ○ ○ ○ ○ ○ *Strongly Disagree*

(13) Does this group frequently offer critical comments or intervene in study planning activities such as this?

Almost Always ○ ○ ○ ○ ○ *Almost Never*

Please tell us any other information you think may be important to understand the position or needs of the group (*feel free to use additional paper if needed*).

_____

_____

_____

Please give us other comments or suggestions that can help with the study planning process (*feel free to use additional paper if needed*).

_____

_____

_____

Roger Kossell

Now, Carrie Marrow

COUNTY OF SISKIYOU

Board of Supervisors

P.O. Box 750 • 201 Fourth Street
Yreka, California 96097
www.co.siskiyou.ca.us

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STATE WATER RESOURCES CONTROL BOARD
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SACRAMENTO

February 7, 2012

VIA FAX 202-208-4561

Honorable Ken Salazar
Secretary of the Interior
U.S. Department of the Interior
1849 C Street NW
Washington, D.C. 20240

Re: Notice of Intent to File Suit Regarding the Secretarial Determination on the Future of the Klamath Project

Dear Secretary Salazar:

Based on your 2009 statement that the proposal to remove the Klamath River dams "will not fail" and the subsequent course of action that has been followed by the Department of the Interior to construct such an outcome, the County of Siskiyou is convinced legal action is necessary to challenge a decision that is contrary to science and the stated goals for Klamath River and which will be inimical to the interests of the people of Siskiyou County. If you do indeed press forward at this time and issue the Secretarial Determination, Siskiyou County intends to challenge the decision in federal court.

The County of Siskiyou has repeatedly voiced serious objections to both the processes and substance underlying your forthcoming determination. Given the steps that have yet to be taken to coordinate federal agency decision-making and actions with local governments on a government-to-government basis, as well as delays in completing mandatory elements of the Klamath Hydroelectric Settlement Agreement (KHSA), we do not see how you can possibly make a legally defensible determination by the March deadline.

Jim Cook	Ed Valenzuela	Michael Kobseff	Grace Bennett	Marcia H. Armstrong
District 1	*District 2*	*District 3*	*District 4*	*District 5*

In previous correspondence we have been very clear about our objections to this process moving forward without the Department of the Interior (DOI), its agencies, and other federal entities fulfilling their statutory obligations to coordinate with local governments by considering and analyzing issues of local concern and attempting to reconcile, or at least minimize, inconsistent federal actions. Less than one year ago, President Obama issued Executive Order 13575, creating the White House Rural Council and pledging to coordinate and increase the effectiveness of federal engagement with local governments to address the needs of rural America. Complete disregard for coordination obligations by the Bureau of Land Management (BLM) and other federal agencies with respect to the Klamath agreements is not only contrary to the President's recent directives, but is also in violation of the Federal Land Policy and Management Act, the National Environmental Policy Act, and the Administrative Procedure Act, among other federal laws.

For example, the Klamath Hydroelectric Settlement Agreement, the Klamath Basin Restoration Agreement, and the attendant EIS/EIR identify a multitude of actions and responsibilities involving (or likely to involve) the Bureau of Land Management:

- The current FERC boundary encompasses large tracts of public land managed by BLM, including campgrounds and other public resources.
- In the larger area analyzed in the EIS/EIR, BLM manages public lands for recreation, open space, and forest and mineral resources.
- BLM currently manages lands near Copco 1 Reservoir and Copco 2 Dam.
- Below Iron Gate Dam, the Klamath River passes through lands managed by BLM.
- Most of the land along the J.C. Boyle peaking reach of the Klamath River is managed by BLM.
- Lands around the Keno Development will be transferred to DOI.
- BLM manages whitewater boating in various reaches of the river and boater access at various locations.
- BLM had issued conditions under Federal Power Act section 4(e) related to whitewater recreation and other protection, enhancement, and mitigation measures which would have been required under a new FERC license. DOI's support for the Klamath settlement agreement effectively withdraws the 4(e) conditions and advances a radically different management scheme for the river.

- Scenic resources in the area are regulated in part by BLM Resource Management Plans.
- BLM has identified the section of the Klamath River between the Oregon-California state line and Copco Reservoir as being suitable and eligible for wild and scenic river status, creating an obligation on the part of BLM to protect that section of river against any adverse consequences of dam removal, such as reductions in water quality.

Many of these actions and responsibilities relate to – and potentially conflict with – policies and objectives specified in BLM's Resource Management Plans for the Redding, Klamath Falls, and Medford areas. As examples:

- The BLM objective for water quality is to ensure that all waters on public land meet or exceed federal and state water quality standards. The Klamath River is already identified as water-quality-impaired for a number of pollutants under Clean Water Act section 303(d), and the settlement agreement actions include additional negative impacts to water quality. In particular, the Klamath River is already listed by both the California State Water Resources Control Board and U.S. EPA as being impaired by sediment. Dam removal will not only release massive amounts of sediment that has already been retained behind the dams, but it will also eliminate the reservoirs' current function of allowing some of the Oregon sediment to settle out of the water column.
- The BLM plan for Horseshoe Ranch and Jenny Creek calls for allowing long-term natural restoration of riparian zones. A rapid reservoir drawdown will create a zone of habitat disconnection between the Klamath River and upper reaches of Jenny Creek.
- The BLM plan for the Upper Klamath River corridor calls for the protection of cultural resources. Drawdown of the reservoirs will cause further disruption to Native American burial sites and other cultural resources.
- Jenny Creek had been designated as eligible for Wild and Scenic status based on its scenic qualities. The BLM plan for the Jenny Creek area above Iron Gate Reservoir calls for maintaining existing scenic quality.
- Based on the Upper Klamath River being designated as eligible for Wild and Scenic status, the BLM plan calls for all public land within ¼ mile of normal high water along the southern bank to be managed to protect scenic values. Removal of the reservoirs will eliminate existing scenic values on abutting public

lands and leave stretches of the river canyon with no views other than post-reservoir destruction and debris.

Regardless of whether BLM is ultimately determined to be taking actions that are inconsistent with existing Resource Management Plans or to be effectively amending its Resource Management Plans by way of participating in the Klamath settlement agreements, either one is a violation of the Federal Land Policy and Management Act. Also, by participating in such substantial changes in management of the Klamath River resources, BLM triggers an obligation under 43 U.S.C. 1712 to undertake the processes to coordinate the new management scheme with local government plans and policies.

Siskiyou County continues to be willing to work with the Department of the Interior, other federal agencies, and other Klamath River stakeholders to see that coordination requirements are addressed and that local issues are given proper consideration and attention before final decisions are made to approve the EIS/EIR and proceed with dam removal. We believe your only alternative will be to engage in similar processes following judicial review of your decisions. At this point in the Klamath process, it would be an unfortunate and tragic misstep for the settlement parties to force the courts to become involved as the only avenue of redress for the local government coordination issues, as well as for substantive violations of the Endangered Species Act, Clean Water Act, and Federal Power Act, among other things. A turn toward litigation will only add substantial delay, unnecessary expense, and tremendous uncertainty to a final Klamath River solution.

Beyond the coordination issue, there are also other fundamental obstacles that make issuance of the Secretarial Determination premature. The KHSA requires the following actions, among other things, to be completed prior to any determination:

1. **Enactment of federal legislation to implement the settlement.** The target date to enact implementing legislation for the KHSA was in May 2010. Legislation was not even introduced in Congress until November 2011, and to date no action has been taken in either the Senate or the House of Representatives to advance any bill. This prerequisite to the Secretarial Determination obviously has not been satisfied.

2. **State of California authorization of funding.** Section 4.1.2.A. requires the State of California to authorize $250,000,000 to implement the settlement. At the time the settlement agreement was signed, such funding was included in a bond measure that was set to go before California voters in November 2010. However, in August 2010, the California Legislature postponed consideration of the bond measure until

November 2012 based on concerns that it would not secure voter approval in the midst of a state budget crisis and national recession. The ability to pass such a bond measure in the current economic climate continues to be a concern to the bond's supporters, and it is an open question whether the bond will remain on the November 2012 ballot.

Aside from the bond measure, California has taken no other action to authorize the funding required by the KHSA and, with the State of California facing chronic, multi-billion-dollar annual deficits, has little financial capability to do so.

The issue of the California bond funding is also tied to the federal legislation, since alternatives to the bond funding may not be considered as part of the determination in the absence of enacted federal legislation to implement the settlement.

3. **Agreement on terms to transfer the Keno facility.** Section 3.3.4.B. requires the Secretary and PacifiCorp to agree upon acceptable terms for transfer of the Keno facility prior to the Secretarial Determination. We have seen no indication that such terms have been agreed upon and the terms of such an agreement are not included in the draft EIS/EIR, which characterizes the transfer as being addressed as a "connected action" but also only "programmatically." The EIS/EIR simply claims to assume, for purposes of analysis, that the transfer has been completed, despite the fact that the terms and details of such a transfer have not been agreed upon. However, transfer of the Keno facility is inextricably tied to dam removal and implementation of the KHSA. Not only has this prerequisite to the Secretarial Determination not been satisfied, but there also appears to be an improper deferral (or outright circumvention) of adequate NEPA analysis.

Additionally, section 3.2.5 of the KHSA contemplates the possibility of the Secretarial Determination being made at a time before environmental review is complete, although there is a clarification that the settlement does not require that the determination be made before such time. The State of California, wisely, has made clear that it will not concur in an Affirmative Determination until it has completed its review under the California Environmental Quality Act. We hope you will recognize the ultimate futility of attempting to take such a significant action without full compliance with the National Environmental Policy Act and other applicable laws. The Secretarial Determination should only be made after the final environmental impact statement is complete and the public has had sufficient time to review its analysis, conclusions, and responses to comments.

We urge you to set aside any impulses to make a premature decision on the Secretarial Determination. We also request that you provide 30 days advance formal notice to the other settlement parties, as required by the KHSA, if you realize it is best to defer your determination beyond the March deadline.

Very truly yours,

Grace Bennett, Chair
Siskiyou County Board of Supervisors

cc: Senator Dianne Feinstein
Senator Barbara Boxer
Congressman Wally Herger
Congressman Mike Thompson
Congressman Greg Walden
Congressman Tom McClintock
Senator Doug LaMalfa
Assemblyman Jim Nielsen
Senator Ron Wyden
Senator Jeff Merkley
Governor Jerry Brown
Governor John Kitzhaber
Secretary John Laird
Director Charlton Bonham, California Dept. of Fish and Game
John Bezdek, Solicitor to Secretary Salazar
Greg Norton, President, RCRC
Mike McGowan, President, CSAC
Siskiyou County Board of Supervisors
Klamath County Commissioners
Humboldt County Board of Supervisors
Del Norte County Board of Supervisors
Trinity County Board of Supervisors
Modoc County Board of Supervisors
Dean Brockbank, PacifiCorp

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Project Charter
Shasta River Coho Supplementation Partnership

A. General Description

Introduction - This Charter is adopted by the Shasta River Coho Supplementation Partnership to establish the expectations and commitment of the Core Partners (Siskiyou County, Siskiyou County Farm Bureau, California Trout, The Nature Conservancy) to the supplementation of coho salmon in the Shasta River watershed (Project). This Charter may be modified with the agreement of the Core Partners to adapt to new information and circumstances. While not specifically a party to this Charter, the Resources Agencies (California Department of Fish and Game, National Marine Fisheries Service) have indicated that they are supportive of the Project and this Charter.

Background – As elsewhere in the Klamath Basin, coho salmon (Oncorhynchus kisutch) populations in the Shasta Watershed have declined to critically low levels. They are currently listed as a "threatened" species under state and federal law. A variety of threats to their continued existence have been identified and significant efforts to eliminate or minimize those impacts have been undertaken; many of which are on-going.

The Core Partners have been working together to develop the Project since the spring of 2011. This Charter was drafted because the Core Partners recognize the need to more specifically define their purpose, goals and objectives as well as their relationships with each other in order to help ensure the success of the Project. They also recognize the importance of defining their relationships with the Resources Agencies and indicating their commitment to involve other stakeholders in the planning and implementation of the Project. The Partners feel strongly that establishing acceptable assurances for area land owners in regard to Endangers Species Act provisions is essential to the success of the Project.

The Core Partners have agreed with the Resources Agencies that the initial form of the supplementation, targeted for the winter of 2013, will be the relocation of up to fifty returning pairs of coho salmon that are collected at Iron Gate hatchery. It is understood that the fish will be a combination of natural and hatchery-origin coho that are in excess of the Hatchery's needs. The form of supplementation in subsequent years has not been determined and will be established as part of the Project.

Project Purpose - The Purpose of this Project is to initiate a supplementation program to help restore a self-sustaining population of coho salmon in the Shasta River in conjunction with other efforts to improve habitat conditions in the watershed.

Project Goals - To develop a coho supplementation program that:

1. Supports the recovery of a self-sustaining natural run of coho in the Shasta River.
2. Complies with all applicable local, state and federal legal requirements.

3. Provides landowners with acceptable assurances and protections against take of ESA listed species in the Shasta Watershed.
4. Includes outreach to and consideration of input from stakeholders.
5. Is sensitive to budget constraints and capitalizes on existing and future opportunities with a prudent and fiscally responsible approach.
6. Includes a well-planned and funded monitoring program that can adequately assess the degree of program success.
7. Includes an adaptive management component.
8. Includes clearly defined criteria for terminating supplementation activities.
9. Recognizes that ongoing improvements to habitat essential to improving the production and survival of coho salmon in the watershed.

B. Project Objectives

1. Establish a Project management structure that provides for shared responsibility among the Core Partners and efficient decision-making while providing reasonable opportunities for two-way communication with other stakeholders.
2. Utilize a Project Coordinator to staff and organize the effort and keep it moving forward on schedule.
3. Acquire all required permits and approvals for the Project.
4. Work with local governments, landowners and regulatory agencies to identify what assurances are needed by landowners to support the Project and support the actions required in order for the Resources Agencies to provide such assurances.
5. Collectively agree upon a supplementation strategy(s) that meets the Program Purpose, Goals and Objectives.
6. Develop a monitoring plan that will adequately assess the results of the selected supplementation strategy or strategies.
7. Develop a timeline to guide Project efforts.
8. Develop performance Project measures to help evaluate Project success.

C. Assumptions - This Charter is based upon the following shared assumptions of the Core Partners:

1. That the Core Partners are each committed to the Purpose, Goals and Objectives contained in this Charter.
2. That the Core Partners are committed to combining their efforts to implement the Project consistent with the Purpose, Goals and Objectives contained in this Charter.
3. That the Core Partners recognize that ongoing habitat improvements are essential to improving the production and survival of coho salmon in the watershed.
4. That the Core Partners believe that other stakeholders, including landowners in the watershed, will expect to be informed and consulted with as an essential part of the Project.
5. That the Resources Agencies are each committed to the Purpose, Goals and Objectives contained in this Charter. It is further assumed they will actively participate in and support the Project as defined in this Charter and they will commit to providing necessary staff time to the effort.

Additionally, it is assumed the Resources Agencies will manage the monitoring program in coordination with Humboldt State University (subject to FRGP grant approval).

6. That the Core Partners in conjunction with the Resources Agencies will coordinate to reasonably generate the resources (staff and funding) required to implement the Project.
7. That the Core Partners in conjunction with the Resources Agencies will coordinate to outreach to other stakeholders as part of the Project.
8. That the core partners understand and agree that without an adequate monitoring plan in place, supplementation will not occur.
9. That the core partners understand and agree that coho salmon broodstock availability from Iron Gate Hatchery used for Shasta River supplementation is secondary to the mitigation requirements of the Hatchery.

D. Project Scope

The Project includes the planning, permitting, implementation, monitoring and evaluation of the initial supplementation with the relocation of up to 50 adult spawners collected at Iron Gate Hatchery, which is targeted for the fall/winter of 2013. The Project also includes supplementation and monitoring in subsequent years. The method and source for supplementation in subsequent years will be determined by the Core Partners and the Resources Agencies in conjunction with input from other stakeholders as part of the Project.

E. Roles and Responsibilities

Core Partners - The Core Partners will actively participate in and support the project as defined in this Charter. They will commit substantial time on the part of a key staff member(s) to the effort. They will communicate openly, honestly and respectfully with each other, respect the perspectives of the other Partners and work together to resolve any issues that may arise. An individual Partner may contract for the services of the Project Coordinator and/or Project Facilitator with funds obtained by the Partnership in coordination with the other Core Partners.

Project Coordinator – The Project Coordinator will organize and assist the interactions of the Core Partners and the Resources Agencies and the development of Project plans and schedules as directed by the Core Partners. The Coordinator will be empowered to expect timely performance by the Core Partners and to act to promote their timely completion of assignments and meeting of other Partnership responsibilities.

Project Facilitator – The Project Facilitator may help to plan and directly manage meetings of the Core Partners and the Resources Agencies as well as outreach meetings with stakeholders as required when directed by the Core Partners.

F. Project Management

The Core Partners will reach consensus on all substantive decisions related to the Project. It is recognized that the agreement and support of the Resources Agencies will be a key consideration in all decisions made by the Partnership.

G. Milestones

Initial Supplementation – Supplementation Year 1

1. Project Charter adopted by the Core Partners with agreement of the Resources Agencies.
2. Project Coordinator retained.
3. Plan and timeline for the initial supplementation established.
4. Permitting requirements for the Project determined.
5. Funding acquired for the initial monitoring program.
6. Permits for the initial supplementation obtained.
7. Initial supplementation implemented.
8. Initial monitoring implemented.
9. Evaluation of initial monitoring input and lessons learned for adaptive management completed

ATTEST:
COLLEEN SETZER
County Clerk & Ex-Officio
Clerk of the Board
By: _____
Deputy

Subsequent Supplementation – Year 2 and beyond

Milestones will be established as part of the Project for supplementation following the initial year on the basis of the best information available at that time and adaptive management of the initial supplementation.

H. Core Partner Signatures

The signatures of the persons below document each of the Core Partner's support for this Charter. This Charter is not intended as a binding agreement, but rather a vision statement that will form the basis upon which the Core Partners will collaborate towards a shared objective. None of the Core Partners will rely on this Charter as a binding contract. Furthermore, notwithstanding the use of the word "partnership" in this Charter, no provision of this Charter shall be interpreted to impose a partnership relationship in either law or equity on any of the Core Partners.

Entity	Name/Position	Signature	Date
Siskiyou County	Grace Bennett, Board Chair		9/4/, 2012
Siskiyou County Farm Bureau	Jim Morris, Board Member		9-13, 2012
California Trout	Curtis Knight, Conservation Director		9/13, 2012
The Nature Conservancy	Gregg Werner, Sr. Project Director		9/19, 2012

Shasta	Coho	Chinook
2011	62	11,384
2012	115	29, 544
2013	134	8,023
2014	46	18,359
2015	37	6,544

Scott	Coho	Chinook
2011	344	4,537
2012	201	8,144
2013	2,731	3,372
2014	485	9,476
2015	217	386

Bogus Creek	Coho	Chinook
2011	142	4,524
2012	182	11,193
2013	405	2,932
2014	94	11,177
2015	14	2,131

There are only these three counting station on the Klamath River and none at the mouth of the river where the Tribes harvest their fish. So these numbers are not true to the amount of fish that return to the river. The Steelhead are not counted. These numbers don't include hatchery counts.

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Part 1 - Siskiyou County

Marcia

How Water and Land Use Regulations and Litigation Are Destroying Us

By Marcia H. Armstrong © 2012
armsrtrng@sisqtel.net
(reprint granted with attribution)

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Background on Siskiyou County and its Economy

GENERAL:

Sixty-three % (63%) of the land base in Siskiyou County is in Federal (or state) ownership. There are portions of the Klamath National Forest; Shasta-Trinity National Forest; Six Rivers National Forest; Modoc National Forest; and Rogue Siskiyou National Forest in Siskiyou County. The Klamath National Forest's 1.7 million acres alone comprises 42% of Siskiyou County's land base. The county also includes the Tule Lake and Lower Klamath National Wildlife Refuges, as well as the Lava Beds National Monument. There are various BLM lands administered by the Redding, Medford, Ashland and Susanville BLM offices. There are more than 152 miles of wild and scenic rivers in the County. There are lands held in tribal trust for the Karuk and Quartz Valley Indian tribes.

The entire land base of Siskiyou County is 4,038,843 acres or 6,287 square miles. Of this, 1,153,246 acres (29%) is in farmland, however only 138,000 acres (3% of tot. county acres) are irrigated. 2,525,216 acres is considered rangeland/woodland/ forest (inc. National Forest.) Our relatively sparse population of 44,301 classifies the county as "frontier." There are nine small incorporated cities that date back to the California Gold Rush. Eight tenths of one percent of private land is urban.

In the year 2000, the average unemployment rate for the year was 7.5%. By 2008, it had risen to 10.2%, rising again to 15.8% in 2009. In March of 2012, the unemployment rate was 18.7%, ranking Siskiyou 50th out of 56 counties in the state. There are many forest-dependent communities in our county where local unemployment is estimated from 30-40%. The average wage per job in 2008 was $32,707. That was only 63% of the state average. The median household income was $36,823 — or 60% of the state median. Non-household median income is currently $27,718 — a ranking of 47th in the state. The AP Economic Stress Index ranks Siskiyou County as the 14th most economically stressed county in the United States.

Siskiyou County has a substantial low income population. In 2010, 18.6% of all residents in Siskiyou County, 26.6% of children under the age of 18 and 7.3% of those 65 years or older lived below the poverty line. In 2010, the economic impact of jobs at Human Services and entitlement benefits to County residents was $71,581,874. This includes: $11.6 million in annual "assistance costs" (CalWorks/welfare, Foster Care;) $8.8 million in annual food stamps; $4.7 million in In-Home-Support-Services for the elderly and disabled; and $36.7 million in Medical Assistance/Medi-Cal.

Social statistics indicate that Siskiyou County has the second highest child abuse/neglect rate in the state - (3 times the state average.) Compared to Los Angeles County, Siskiyou County has higher rates of all forms of violent crime except homicide. [aggravated assaults, forcible rape, and robbery.] Often these crimes have similar underlying causes, namely, social strain combined with the selective disinhibition fueled by alcohol and drug use (read Robert Nash Parker; Robin Room; and Jeffery A Roth). The premature death rate for the general population is almost twice that of the national average.

According to Indicators of Alcohol and Other Drug Risk and Consequences for California Counties *Siskiyou County* 2007, the number of local fatalities in alcohol-involved motor vehicle accidents was three times that of the statewide average; the death rate due to alcohol and drug use was 32.5 deaths per 100,000 persons (compared to a state average of 20.9/1000.) Methamphetamine accounted for 44% of admissions for alcohol and drug treatment. Admissions for alcohol use accounted for 31 percent of admissions in 2004. The death rate for cirrhosis if the liver was three times the Healthy People 2010 goal. Drug-induced deaths were 19 times higher than the Healthy People 2010 goal per 1,000. About 85% of child abuse cases involve methamphetamine.

The economy of Siskiyou County is based on small business. In 2008, there were 6,857 non-farm proprietors in Siskiyou County. According to 2007 data, 61% of non-farming establishments in Siskiyou County had less than 4 employees; 82% had less than 10 employees and 93% had less than 20.

Agriculture is a major economic sector of the county. Our 2010 Siskiyou County Annual Crop and Livestock Report indicates that the agricultural valuation in the county was $195,711,956 (gross and excluding timber.) According to the USDA Ag Census, in 1992 Siskiyou County had 647,446 acres in farms. By 2007, this had been reduced to 597,534 acres. The 1996-2008 Land Use Summary, Farmland Mapping and Monitoring Program indicates that during the span of the report, Siskiyou County lost 15,164 acres of prime farmland; 3,036 acres of farmland of statewide importance; 40,456 acres of farmland of local importance. With an addition of 16,126 acres of grazing land and 2,390 acres of unique farmland, this mean a total loss of 40,140 acres of farmland. In 2000, there were 895 farm proprietors in Siskiyou County. This declined to only 730 in 2008. The county lost 81 livestock ranches from 1992 to 2007, with an accompanying loss of 20,882 fewer cattle and calves in inventory. According to the CA D.O.T. Siskiyou County Economic Forecast, since 1995, Siskiyou County's agriculture industries have experienced substantial job loss of about 586 jobs, declining almost 45%.

During the past 20 years, there has also been a restructuring of size and sales in agricultural operations. Since 1992 to 2007, there has been an increase in the number of small farms: farms under 10 acres doubled to 80. Farms under 50 acres increased 59% to 229. Farms 50-179 acres increased 27% to 228. Farms from 180-449 acres remained about the same at 79. However, there was a 19% reduction in farms 1000 acres or more to 100 farms in 2007. One aspect of this is land conversion from private to Federal lands. Since 1999, 8,625.71 acres valued at $3,922,179 have been converted to Federal land. Another 11,236 acres of ranch land in the Shasta Valley is currently proposed for conversion to a new wildlife refuge. In addition, the proposed Klamath Basin Restoration Agreement seeks to convert 44,479 acres of farmland in the Upper Klamath Basin to wetlands, (some of which may be in Siskiyou County.) It also proposes to secure 21,800 acres of farmland by acquisition or conservation easements in the Scott and Shasta Valleys of Siskiyou County.

At the same time, farms having less than $2,500 in sales increased 105% to 359. Farms selling $2,500-9,999 stayed about the same at 151. Farms selling $10-$24,999 decreased 10% to 95. Farms selling $25,000-$49,999 decreased about 18% to 60. Farms selling $50,000 to $99,999 decreased 45% to 44 and farms with sales in excess of $100,000 increased by 28% to 137.

Siskiyou County accounts for 15% of the timber harvested in California. At one time, it was the second largest timber production area in the state. However, our forest industries have been devastated by Federal and State regulations. For instance, the forestry section of Siskiyou County's 1972 Conservation Element of the General Plan indicated that there were 17 sawmills in the county (employing 2,055 people or 24% of the employment base) and 8 wood processing facilities (employing 294 people or 3% of the employment base). There were 46 logging contractors and support establishments employing 501 people or 5% of the employment base. By 2007, all 17 sawmills were gone. The census indicates that there were a total of 6 wood products manufacturing establishments (including veneer mills) employing 380 people (one mill has subsequently closed in Butte Valley). There were 38 Logging, Forestry and Support Establishments employing 157 employees.

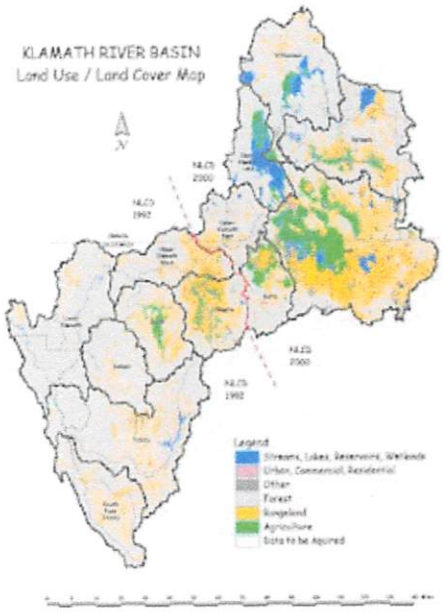
There is no doubt that the restrictions on timber harvest from public lands under the Northwest Forest Plan have played a significant role in this decline. In 1978, 239 MMBF of timber was harvested from the Klamath National Forest (KNF), 274 MMBF from the Shasta Trinity National Forest (STNF) and 73 MMBF from the Six Rivers National Forest (SRNF.) In 2008, 20 MMBF was harvested from the KNF, 22 MMBF from the STNF and 8 MMBF from the SRNF. [See http://users.sisqtel.net/armstrng/regulatory%20impacts.htm for links to tables and reports]

AGRICULTURAL AREAS:

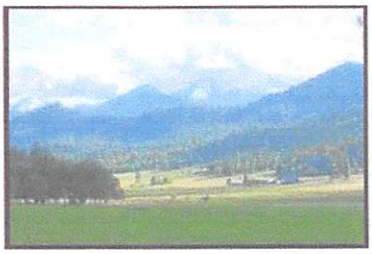
The Klamath basin drains approximately 16,000 square miles with 35% of the watershed in Oregon and 65% in California. The uppermost reaches of the watershed originate in Oregon, and the main-stem river flows through the basin for about 250 miles and enters the Pacific Ocean about 20 miles south of Crescent City, CA. In Oregon, the basin occupies portions of Jackson, Lake, and Klamath counties; in California, it flows through the counties of Siskiyou, Modoc, Trinity, Humboldt, and Del Norte (NRCS 2006).

Siskiyou County's agricultural centers include the Scott Valley, the Shasta Valley, the Butte Valley and the Tulelake areas. (left to right) In 2010, the total market value of non-timber agricultural crops and livestock inventories in Siskiyou County was $195,711,956. (Siskiyou County Annual Crop and Livestock Report.)





SCOTT VALLEY:



Scott Valley is a 814 sq. mile basin (or 520,968 acres.) Base elevation at Fort Jones is 2,747 feet. The mean temperature ranges from 33°F in winter to 70°F in summer. Extreme temperatures range from high of 110°F and low of -23°F. The growth season is 143 days. Sixty one percent of the land base is privately owned (or 316,471 acres.) Of these, 32,443 acres are irrigated. The number of irrigated acres in Scott valley has not changed substantially since 1950. (It was 34,100 acres in 1988.) Methods of irrigation, (flood, wheel lines, pivot wheels,) have changed over the years. In 1968, when water was more commonly diverted for flood irrigation, 86% of irrigation was through diversion of surface water, 2% groundwater and 12% mixed. In 2000, 48% was surface water, 45% groundwater and 7% mixed. [Siskiyou RCD and Scott River Watershed Council restoration projects; Siskiyou RCD; Scott River Watershed Council; Scott River Water Trust]

Crops are mainly pasture, alfalfa and grain. Cattle and other livestock are raised. There is a large nursery operation for reforestation.

The average precipitation is 21.78, with annual snowfall of 30.4 inches. However, the western portion of the valley and the south side mountains average substantially greater rainfall than the eastside. Summer and fall flows in the Scott vary from year to year, but are largely controlled by the precipitation and snowpack of the prior 12 months. (Drake, Tate and Carlson) From 1951-1998, there has been a decrease

in the water content of the snowpack in the area, particularly in the western mountains. There has been a correlating decline in fall river flows over time. The Scott River has no dams or reservoirs. [Historically, there was storage of cool water in 28 high mountain lakes located on the Klamath National Forest. As many of these are now located in Wilderness, they have fallen into disrepair as functional storage structures. With 292 acres of surface, one foot of additional water storage in these lakes could provide 5 cfs of instream flow for a 30 day period in the summer.] Storage for summer flows in the Scott is primarily in the form of natural snowpack. Snow can hold the water into late spring when it melts to feed the streams.

According to a presentation by Dr. Thomas Harter of U.C. Davis, the average annual discharge in the Scott Valley watershed is 615,000 acre feet of water. This is more than the groundwater basin can hold (400,000 acre ft. capacity– U.S. Geological Survey.) Of this, the Department of Water Resources has estimated that agriculture uses only 70-90,000 acre ft. annually. In general, any groundwater loss is recharged within a year. The Scott River is 63.6 miles long. Natural river flows from the Scott River contribute 4% of the Klamath River's flows.

In the early twentieth century, large Yuba type gold mining dredges ran in the Scott River system leaving large piles of tailings in the six miles below Callahan. In 1930s, the Army Corps of Engineers channelized and rip rapped sections of the Scott.

Because of the discovery of gold on the Scott River, Scott Valley was settled by non-Indian miners and farmers in the 1850s. (Many of the small family ranches and farms are 150 years old and operated by 5th or 6th generation descendants.) Appropriative and riparian water rights **[i]** here are vested **[ii]** and among the oldest in post-Mexican California. Almost all of them pre-date the 1911 declaration by the California Legislature (Calif. Stats. April 8, 1911, pg. 821) **[iii]** that "all water or use of water within the state of California is the property of the people of the state of California" and the 1914 California Water Commissions Act (Calif. Water Code 2774) **[iv]** when all new appropriations of surface water required either a certificate of registration (for small scale domestic use,) or a permit (leading to a license.)**[v]** [California Water Rights Fact Sheet]

The Scott River adjudication : decree no. 30662 : Scott River stream system, Siskiyou County / Superior Court for Siskiyou County was entered on January 30, 1980. The water rights set forth in the decree include use to all surface waters that contribute to the flow of the Scott River stream system, including rights to tailwater, waste and return flow, supporting underflow and interconnected ground water, (a maximum of 500 feet adjacent to the river as delineated on the State Water Resources Control Board map,) and excluding Shackleford and French Creeks and their tributaries - previously adjudicated in 1950 and 1958 respectively. Ground water outside the delineated area is not adjudicated. A diverter may take his adjudicated amount either by surface or groundwater in the interconnected zone.

The adjudication identifies 40 tributaries or stream groups that are independent in respect to non-surplus rights on other streams or stream groups. Rights to divert the natural flow of the main stem Scott River are separated into 5 separate sections. Non-surplus rights within each section may be exercised independently from those in another section but relative to the priority established for the section in which they lie. Post-1914 appropriative rights are held to be inferior to all other rights except surplus rights. (This included 34 permits, 41 licenses and 7 stockpond certificates.)

Irrigation season is established "from about April 1 to about October 15 of each year." Diversion structures must be constructed to allow an water in excess of the specific diversion allotment to pass to the stream channel to allow passage of fish during irrigation season, but prior to about June 1. Those with gravel diversion dams must breach the dam at the end of the irrigation season to allow adult fish to ascend to spawning grounds. There is no general limitation for consideration of fisheries during the

period between June 1 and October 15. However, the U.S. Forest Service has a quantified riparian right to instream flows for minimum level fishery subsistence and use by wildlife within the Klamath National Forest. The USFS also has an additional quantified right to instream flows for incremental fish flows, recreational, scenic and aesthetic purposes. These rights are of a first priority basis, correlative to other first priority rights included in the section beginning at the USGS gaging station at Fort Jones and in specified amounts on specified tributaries. Although all rights to "surplus waters" in all section are junior to the USFS rights, the USFS instream rights have no relation to non-surplus rights in other sections and non-specified independently adjudicated tributaries.

The CA Dept. of Fish and Game attempted to make a claim for instream flows for fish. They were denied by the court because they owned no "reserved" riparian land for that purpose and because an appropriative right requires actual "possession" or taking control of water - not just instream.

The decree states that the Superior Court of Siskiyou County retains continuing jurisdiction of parties to these proceedings, and of the subject matter hereof, including motion by the State Water Resources Control Board to review its decree and to change or modify the same as the interests of justice may require.

Comments made by the California Department of Fish and Game in connection with the filing of the 1974 Adjudication "Notice of Intent" included the following:

"Problem sections of the stream noted for going dry or intermittent flows during the summer months: (1) Scott River at river mile 50 for 1-3 miles below the diversion ditch; (2) East Fork Scott River below diversion dams; (3) Etna, Kidder and Patterson Creeks over several miles of lower reaches; (4) Sniktaw and Shackleford Creeks near mouths; (5) Patterson Creek (near Meamber Bridge) and Indian Creek; (6) Moffet Creek."

State of CA SWRCB Order WR 98-08 In the Matter of the Declaration of Fully Appropriated Stream Systems in California includes the Scott River.

SHASTA VALLEY



Shasta Valley is a 795 sq. mile basin (or 508,734 acres.) Base elevation at Montague is 2,640 feet. 72% of the land is privately owned (364,729 acres.) There are from 50-55,000 irrigated acres. Precipitation averages l2.12 inches annually with 75 to 80 percent of it occurring between October and March. Annual snowfall averages 8.9 inches. The length of the average growing season is about 175 days. The average seasonal runoff is 160,000 acre feet of water. The mean temperature ranges from 34°F in winter to 73°F in summer. Extreme temperatures range from a high of 110°F to low of -15°F. The natural flows of the Shasta River contribute 2% to Klamath River flows. [Shasta Valley RCD and CRMP restoration projects; Shasta Valley RCD; Shasta River Water Trust; Shasta River CRMP]

Crops are mainly pasture, alfalfa and grain. Cattle and other livestock are raised.

Mount Shasta, a compound stratovolcano rising to an elevation of 4,317 meters, dominates the south end of Shasta Valley. The debris-avalanche deposits underlie the western two-thirds of Shasta Valley. Hundreds of mounds, hills, and ridges formed by the avalanche deposits are separated by flat areas that slope generally northward at about 5 meters per kilometer. The hills and ridges are formed by the block facies of the deposits, which includes masses of andesite lava tens to hundreds of meters across as well as stratigraphic successions of unconsolidated deposits of pyroclastic flows, lahars, air-fall tephra, and alluvium, which were carried intact within the debris avalanche. Mount Shasta hosts five glaciers, including the Whitney Glacier, the largest in California.

The Shasta River is 43.6 miles long. It originates within the higher elevations of the Eddy Mountains lying southwest of the town of Weed in Siskiyou County. It flows in a northerly direction, passing through the Shasta Valley. Numerous springs and a number of small tributary streams enter the Shasta River as it passes through the Shasta Valley. Major tributaries include Parks Creek, Big Springs Creek, Little Shasta River, and Yreka Creek. Dwinnell Dam and reservoir (Lake Shastina) provide water for downstream irrigation and the city of Montague. After leaving the valley, the Shasta River enters a steep-sided canyon where it flows for a distance of seven river miles before emptying into the Klamath at 176.6 river miles upstream from the Pacific Ocean.

"Dwinnell Dam was constructed in 1928 to capture winter and early spring run-off. Originally, the dam measured 1,265 feet in length, was 98 feet high and had an effective storage capacity of approximately 34,000 acre feet. In 1955, the height of the dam was raised which increased the total storage capacity to **50,000** acre-feet. When full, the reservoir has an average depth of 22 feet with a-maximum depth of 65 feet and a surface area of 1,824 acres (2.85 mi2). Wales (1951) estimated that construction of Dwinnell dam eliminated access to about 22 percent of **the** total spawning habitat formerly available to salmon and steelhead and approximately 17 percent of the drainage area." ("A Biological Needs Assessment for Anadromous Fish in the Shasta River Siskiyou County, California")

As a primary gold mining area, the water rights in the Shasta Valley are also very old. (Many of the small family ranches and farms are 150 years old and operated by 5th or 6th generation descendants.) On February 15, 1928, an adjudication of appropriative water rights on the Shasta River and tributaries was decreed, entitled "Order Determining and Establishing the Several Rights by Appropriation to the Use of the Waters of Shasta River and its Tributaries," (Book 1 of Orders of Determination, page 117.) A water master service was established. Prior historic agreements between individual landowners were incorporated into the adjudication. Riparian rights were not included in the adjudication.

> According to the decree, beneficial uses were established as: Domestic; Municipal; Mining; Power; Stockwatering; Irrigation of described lands; and Winter impoundment in reservoirs to be utilized for these same beneficial uses.

During irrigation season, (March 1 - November 1,) the Shasta system was divided into 10 sub-systems, each considered unrelated to the others:

> Shasta River above its confluence with Big Springs Creek; Boles Creek and tributaries; Beaughan Creek and tributaries; Carrick Creek and tributaries; Parks Creek and tributaries; Shasta River below confluence with Big Springs Creek, and Big Springs Creek and its tributaries Little Shasta and tributaries; Willow Creek and tributaries; Yreka Creek and tributaries, and Miscellaneous independent springs, gulches and sloughs (including Ellison, Fiock and Garden springs; Inconstance Creek; White, Kiernan, McCloud and Orr sloughs; Schulmeyer, Guys and Hanly Gulch.

The decree states: "Each of these units can be administered more or less independently of the others during the low flow or critical period of each season, therefore the rights in each unit have been grouped together as shown in said tables." Each of the 10 systems has been adjudicated as a separate unit as to relative priorities of water rights users on that system during irrigation season. The earliest right dates to 1850, although there are a great number dating back to the 1850s, 1860s and 1870s.

A separate section ranks the priority of appropriators to the use of the Shasta River and its tributaries during non-irrigation season. Specified uses include:

> Domestic, Municipal, Stockwatering, Mining, Power (such as used for flour/ lumber mills and by the California Oregon Power Co.,) Alternate supplies of water and winter reservoirs.(1)
>
> Some water use rights were licensed subsequent to the adjudication. The Shasta Valley Wildlife Area (SVWA,) managed by the California Department of Fish and Game, has nine state licensed water rights, (#5066 A/B dating back to the mid 1940s-1950s,) obtained with the land purchase of the former Whiskey Lakes Ranch. Water rights originate from the Little Shasta River. The original stated beneficial uses of their license are: Irrigation; Stock watering; and Recreation.

The Klamath River Basin Fisheries Task Force 1991 Long Range Plan For The Klamath River Basin Conservation Area Fishery Restoration Program lists the adjudication decree for the Shasta River as 1932. The adjudication, including Willow Creek (1972) and Cold Creek (1978) lists 212 decreed users and a total of 618.82 total decreed water rights.

According **Shasta Valley groundwater** (Bulletin 118,) "Estimates of groundwater extraction for agricultural and municipal/industrial uses are 50,000, and 2,210 acre-feet respectively. Deep percolation of applied water is estimated to be 18,600 acre-feet. Because of the volcanic nature of Shasta Valley, groundwater is not universally available in all areas.

State of CA SWRCB Order WR 98-08 In the Matter of the Declaration of Fully Appropriated Stream Systems in California includes the Shasta River.

BUTTE VALLEY



The Butte Valley Basin is 498.6 square miles. Butte Valley is considered high desert plateau with a base elevation of 4250 ft. The mean temperature in winter is 28°F and in summer- 63°F. Temperature extremes run from 100°F to -22°F. The average growth season is 81 days. Annual precipitation is 10.89 inches with annual average snowfall of 27.6 inches. The average seasonal runoff is 100,000 acre feet of water. Normally, Butte Valley is hydrologically disconnected from the Klamath River by surface flows unless flood conditions exist. Then excess water is pumped at Sam's Neck into the Klamath River to relieve flood conditions.

Butte Valley has dropped down between faults in this volcanic area and is completely surrounded by volcanoes to form a closed drainage basin. The down-faulted valley has subsequently been filled to its present elevation by alluvial debris washed into the valley from the surrounding volcanic mountains, by lava flows and by lake deposits. The 3750 acre Meiss Lake, in the west central part of Butte Valley, is the remnant of a large lake that once occupied the entire valley when temperatures were cooler and melt water from receding glaciers filled the numerous basins in northern California. The combined depth of the deposits in Butte Valley is greater than 900 feet. The valley floor is exceptionally flat because of wave action when it was covered by water.(The Soils of Butte Valley, CA.)

Butte Valley National Grassland is 18,425 acres and the Butte Valley Wildlife Area (BVWA) is 13,200 acres.

Crops are mainly pasture, alfalfa, grain and strawberry and raspberry stock. There are 22,716 acres of irrigated cropland, with 3,690 of these acres in berry stock. (Sisk. Co. Ag Commissioner) Cattle and other livestock are also raised.

Lava Beds-Butte Valley RCD

TULELAKE



The base elevation at Tulelake is 4,036 feet. The mean temperature ranges from 30°F in winter to 65°F in summer. Temperature extremes run from 100°F to -27°F. The average growth season is 113 days. Annual precipitation averages 10.21 inches with an annual average snowfall of 23.5 inches. The average seasonal runoff of the Tulelake basin is 73,000 acre feet of water. Principal crops are barley, irrigated pasture, alfalfa hay and other hay, oats, potatoes, onions, horseradish, mint and wheat. Some livestock are raised. Water rights in the Upper Klamath Basin are currently in the process of being adjudicated.

The Tulelake area is portion of part of the area known as the "Klamath Basin" or "Upper Klamath Basin" (as opposed to the entire "Klamath River Basin.") Much of this area is served by the Klamath Project - a federal water development project that provides irrigation to approximately 210,000 acres of cropland. The Secretary of the Interior authorized development of the project on May 15, 1905, under provisions of the Reclamation Act of 1902 (32 Stat. 388.) The drainage canals in the Klamath Project allowed land that would otherwise be wetlands or lake to be farmed. Some of the new farmland was awarded to returning war veterans through a lottery system. Water rights were included in their deeds. Prior to the Project, the Lower Klamath Lake was 80,000 acres before it was drained and would naturally evaporate about 240,000 acre feet each summer. This is now roughly equivalent to the annual water delivery of the Project's A canal. [Nutrient Loading in the Klamath Basin: Nutrient Loading of Surface Waters in the Upper Klamath Basin: Agricultural and Natural Resources; Mapping out a new mindset/Studies indicate phosphorous occurs naturally]

In California and Oregon. 62 percent of the lands served by the Project are in south-central Oregon and 38 percent in north-central California. The Project includes portions of Klamath county in Oregon and Siskiyou and Modoc counties in California. The portion in Siskiyou County lies in the extreme

Northeastern portion of the county. There are over 717 miles of canals, laterals, diversion channels and drainage canals in the Klamath Project. The dams, tunnels, canals and pumping stations of the project are designed so that project waters can be reused several times for maximum efficiency. The mean per acre net use for project water is 2 acre feet. The canals transport irrigation water from Klamath Lake and the Klamath River, Gerber Reservoir, Clear Lake Reservoir, the Lost River, and Tule Lake. There are only about 26,557 irrigated acres of cropland in Tulelake and the lease lands of the federal Wildlife Areas in Siskiyou County. [Ground-Water Hydrology of the Upper Klamath Basin, Oregon and California; Groundwater Simulation and Management Models for the Upper Klamath Basin, Oregon and California]

The region above Keno Dam in the Upper Klamath Basin contributes about 12% of the Klamath River's flows. "Before the development of the Klamath River Basin project, the mean annual flow (maf) of the Klamath River at Weitchpec was about 1.4 million acre-feet. The maf of the Klamath River at Weitchpec is now about 1.6 million acre- feet (USBR 2000). However, before the completion of the Trinity River project in 1964, the maf of the Trinity River at Witchpec was 1.2 million acre-feet. It is now about 340,000 acre-feet per annum. Trinity water diversions have sharply lowered Klamath River flows below Weitchpec and produced major adverse impacts on Klamath-Trinity system fish stocks (Task Force, 1991; Bartholow, 2001)." (Making Unbiased TCM Benefits Estimates with Klamath Basin TCM and Contingent Use Data.") Since 1964, Trinity/Shasta Project 75-90% of the inflow to Trinity Lake has been diverted to California's Central Valley Project. A 2000 Record of Decision (ROD) guides restoration of the Trinity River.

There are about 220,000 acres of Federal, State and private refuges in the region. For every 2 acres of irrigated farmland in the Upper Klamath Basin there exists 1 acre of refuge. This represents a 66% farm to 33% refuge ratio. It is estimated that historical wetlands in the Upper Klamath Basin totaled 359,000 acres while existing wetlands total 141,920 acres. Historical wetlands consumed over 1 million-acre feet of water annually. Forty percent of the historical wetland acreage of the Upper Klamath Basin has been maintained and/or restored. The Central Valley of California would need to restore 2.5 million acres of wetlands to compare with the Upper Klamath Basin. (Klamath Project) The National Wildlife Refuges include: Lower Klamath National Wildlife Refuge; Upper Klamath National Wildlife Refuge; Tule Lake National Wildlife Refuge; Clear Lake National Wildlife Refuge

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Farming is allowed on the Refuges under the Kuchel Act through a lease land program. The program directly benefits waterfowl by providing cereal grain residues for their consumption. Row crops are rotated through the land on a program designed to increase fertility of the soil. Revenue from the program is used for a number of environmental purposes. Ninety percent of the registered pesticides used in California are disallowed on the lease lands in accordance with the Integrated Pest Management Plan for Leased Lands at Lower Klamath and Tulelake National Wildlife Refuges Oregon/California.

The Klamath River Basin Compact became effective in 1957, when it was approved by Congress, signed by the President, and ratified by the States of California (chapter 113, California Statutes 1957) and Oregon. It applies to the Klamath River Basin - the drainage area of the Klamath River and all its tributaries within the States of California and Oregon and all closed basins included in the Upper Klamath River Basin. (It delineates the "Upper Klamath River Basin" as the drainage area of the Klamath River and all its tributaries upstream from the boundary between the States of California and Oregon. Its' state purpose is to "facilitate and promote the orderly, integrated and comprehensive development, use, conservation and control thereof for various purposes, including, among others: The use of water for domestic purposes; the development of lands by irrigation and other means; the protection and enhancement of fish, wildlife and recreational resources; the use of water for industrial purposes and hydroelectric power production; and the use and control of water for navigation and flood prevention."

The Compact recognizes vested rights to the use of waters originating in the Upper Klamath River Basin established prior to the compact under the laws of the state in which the use or diversion was made. It also establishes state priorities for uses in new appropriations of water in the Upper Klamath Basin: (a) Domestic use, (b) Irrigation use, (c) Recreational use, including use for fish and wildlife, (d) Industrial use, (e) Generation of hydroelectric power, (f) Such other uses as are recognized under the laws of the state involved. After the superiority of (a) and (b) uses, once a right is vested it is prioritized by date of right. It does not govern groundwater until it has been used and becomes surface water. Both states are given the objective to support hydropower in order to distribute water and to keep electrical rates as low as reasonably possible.

The State of Oregon has a right to irrigate a maximum of 200,000 acres and the State of California a maximum of 100,000 acres with water originating in the Upper Klamath Basin under a superior right to divert that water elsewhere in the Klamath River basin or outside of the Klamath River Basin.

The Compact establishes a three person Commission - one representative from each state and one representative of the United States shall serve as chairman of the commission without vote. Actions by the Commission require two votes, although there are provisions for arbitration.

Appendix B of the Klamath Compact, known as the "Siskiyou County Flood Control and Water Conservation District Act," is acknowledged in CA Water Code 5900-5901. It establishes the District's boundaries as all of Siskiyou County with the exception of the area above Butte Valley in the Upper Klamath River Basin. Section (q) authorizes the District "To do any and every lawful act necessary to be done that sufficient water may be available for any present or future beneficial use or uses of lands or inhabitants within the district, including but not limited to, the acquisition, storage, and distribution for irrigation, domestic, fire protection, municipal, commercial, industrial, recreational and all other beneficial uses."

Section (r) authorizes the District: "To control flood and storm waters within the district and the flood and storm waters or streams outside the district, which flow into the district; to conserve such waters by storage in surface reservoirs, to divert and transport such waters for beneficial uses within the district; to release such waters from surface reservoirs to replenish and augment the supply of water in natural underground reservoirs and otherwise to reduce the waste of water and to protect life and property from floods within the district; to commence, maintain, intervene in, defend or compromise, in the name of the district, on behalf of the landowners therein, or otherwise to assume the cost and expenses of any action or proceeding involving or affecting the ownership or use of waters or water rights within or without the district, used or useful for any purpose of the district or of the common benefit of any land situated therein, or involving the wasteful use of water therein; to commence, maintain, intervene in, defend and compromise and to assume the cost and expenses of any and all actions or proceedings now

or hereafter begun; to prevent interference with or diminution of, or to declare the rights in natural flow of any stream or surface or subterranean supply of waters used or useful for any purpose of the district or of common benefit of the lands within the district or to its inhabitants; to prevent unlawful exportation of water from said district; to prevent contamination, pollution or otherwise rendering unfit for beneficial use the surface or subsurface water used or useful in said district, and to commence, maintain and defend actions and proceedings to prevent any such interference with the aforesaid waters as may endanger or damage the inhabitants, lands, or use of water in, or flowing into, the district provided, however, that said district shall not have power to intervene or take part in or to pay the costs or expenses of actions or controversies between the owners of lands or water rights which do not affect the interests of the district."

[KWAPA; 2009 Water Supply Enhancement Study (formerly the Water Bank); Klamath Water Users Assoc. (Klamath and Tulelake Irrigation District) ; Lava Beds-Butte Valley RCD; Bureau of Reclamation Klamath Project]

TRIBAL WATER RIGHTS

- *KLAMATH TRIBE* - (Upper Klamath Basin) The 1864 Treaty where the Klamath Tribe ceded their territory to the United States provided that the Tribe would have "secured" to them "the exclusive right of taking fish in the streams and lakes, included in said reservation, and of gathering edible roots, seeds, and berries within its limits." In 1954 when Congress terminated the Klamath Reservation, it enacted an express provision continuing the Indians' right to fish on the former reservation land.

  In **U.S. v. Adair,** (AdairII) 723 F.2d 1394 (9th Cir. 1983,) the court noted that the federal water right reserved by the Treaty is a non-consumptive use that entitles the Tribes to "prevent other appropriators from depleting the streams waters below a protected level in any area where the non-consumptive right applies." The court interpreted Adair I as confirming "to the Tribe the amount of water necessary to support its hunting and fishing rights as currently exercised to maintain the livelihood of the Tribe members, not as these rights once were exercised by the Tribe in 1864." The court explained that the Tribes are entitled to enough of the resource to maintain a "moderate living." Id. at 1415 (citing Washington v. Fishing Vessel Ass'n, 443 U.S. 658, 99 S.Ct. 3055, 61 L.Ed.2d 823 (1979), which cites Arizona v. California, 373 U.S. 546, 83 S.Ct. 1468, 10 L.Ed.2d 542 (1963)). However, the court left open, as did the district court, how much water would satisfy the Tribes' right. [As Modified on Denial of Rehearing January 24, 1984. Oregon Fish & Wildlife Dept. v. Klamath Tribe 473 U.S. 753 (1985.) U.S. v. State of Oregon Water Resources Dept. No 92-36983, No. 92-36985, No. 92-36987, No. 92-37001 US Ct. of Appeals, Ninth Circuit, 44 F.3d 758; 1994 U.S. App; No. 95-151 - 1995 The Klamath Tribe v. State of Oregon Dept. of Water Resources - petition for a writ of certiorari to the US Court of Appeals for the Ninth Circuit; No. 95-151 Klamath Tribe v. State of Oregon petition for writ of certiorari;]

  Adair III (2002) The court held that the Tribes "have reserved gathering rights, along with supporting water," with a priority date of time immemorial; 9th Circuit Court vacates Adair decision (July 23, 2003) Article Court stated Oregon District Court Judge Owen Panner erred by citing 25-year old opinions of the U.S. District Court for Oregon and the Ninth Circuit Court of Appeals because the tribe had conveyed away those rights years ago. The Court also stated; "nor should he have given a judgment in favor of the Tribes which expanded upon those rights." The earlier decisions Judge Panner had relied upon giving the

tribes certain rights to the water hinged on the Tribes' dependence upon the water for daily sustenance, which opponents argued is no longer the case. The Tribal/BIA Claims as Filed The water rights have a time immemorial priority date for nonconsumptive uses and a priority date of October, 14 1864, for consumptive uses. The water rights of the Klamath Tribe have a high priority in the Oregon Upper Klamath Basin Adjudication. [*Department of Interior v. Klamath Water Users Association:* An End to Secret Advocacy by Tribes During Water Allocation Proceedings?]

- *YUROK & HOOPA* - Indian land rights were extinguished **[vi]** under Mexican rule of California before U.S. ownership. Congress refused to ratify treaties negotiated by Indian agents. In the Act of March 3, 1853, 10 Stat. 238, Congress authorized the creation of "military reservations." In 1855, the Klamath River reserve was created by Executive Order **[vii]**on a strip of land on the lower Klamath River. This Klamath River reservation was to "commenc[e] at the Pacific Ocean and extend 1 mile in width on each side of the Klamath River . . . with the provision . . . that . . . a sufficient quantity be cut off from the upper end thereof to bring it within the limit of 25,000 acres." The 1864 Act authorized the location of the Hoopa Valley Reservation and abandoned the Klamath River Reservation. A June 23, 1876 Executive order by President Grant declared the boundaries and "reserved" the land. [See 1888 "Forty-Eight Pounds of Rising Star Tea, Etc."and 1966 Elser v. Gill Net Number One]

  The Hoopa Valley Reservation was expanded in 1891 by Executive Order of President Benjamin Harrison, adding "a tract of country one mile in width on each side of the Klamath River, and extending from the present limits of the said Hoopa Valley reservation to the Pacific Ocean."[The validity of this executive order was challenged and upheld in Donnelly v. United States, 228 U.S. 243 (1913)]. 1988 Hoopa Yurok Settlement Act; Public Law 100-580 102 Stat. 2924 See Partitioning Certain Reservation Lands Between the Hoopa Valley Tribe and the Yurok Indians.[Reservations created by Executive Order **[viii]** Water rights attached to reserved lands are governed by the "Winter's Doctrine."**[ix]**

  In 2002, the Hoopa Tribe established its own water quality control plan that claims "jurisdiction over waters that flow into and through the Reservation, regardless of the geographic origins of water sources." [Arizona Public Service Co. v. EPA, .No. 98-1196; State of Wisconsin v. Environmental Protection Agency and Sokaogon Chippewa Community; Montana v. US EPA 450 U.S. at 565-66)

- *KARUK TRIBE* - The Karuk tribe was determined not to have to rights to the Hoopa reservation. Karuk v. United States (complaint filed 1990) -Claimed rights in Square and Extension (Similar complaint filed by Ammon group and Yurok Tribe - all Yurok members also in Ammon (plaintiff groups overlap); Karuk Tribe v. United States (Court of Federal Claims 1993) - 28 Fed. Cl. 694; Karuk Tribe v. United States (Court of Federal Claims 1998) 41 Fed. Cl. 468 Plaintiff tribes and individuals had no vested property rights; [Karuk Tribe of California v. Carol McConnell Ammon, et. al.andYurok Indian Tribe, v U.S. and Hoopa Valley Tribe; (2); Karuk Tribe v. United States (Court of Appeals for Federal Circuit 2000) 209 F.3d 1366; Cert. petitions denied 523 U.S. 941 (2002) Karuk v. U.S. Fifth Amendment taking of property interests. ; U.S. Fed Circuit Court of Appeals 99-5002,-5003,-5006.] The Karuk Tribe does not have a reservation.

- *QUARTZ VALLEY INDIAN RESERVATION* (QVIR): The QVIR was established for the Shasta and Upper Klamath Indians in 1938. The QVIR/Rancheria was terminated in 1967.Notice of Termination of Federal Supervision Over Property and Individual Members Thereof. The case of Tillie Hardwick vs. United States (restored reservation status in 1983);

REGULATORY/LITIGATION ENVIRONMENT IN SISKIYOU COUNTY

At one time, Siskiyou County farmers owned some of the most stable and secure water rights in the State of California. This allowed for the development of century and a half old family farms and ranches, as well as the development of reclaimed lands for returning veterans. Through what seems like a systematic progression of policies and regulations, those rights and their value in supporting long-standing family farms and ranches in the county have been steadily undermined. Under the leadership of federal and state agencies, control over water is shifting to basin-wide stakeholder groups with plans to reallocate water away from agricultural use to uses that economically benefit other interests.

ENDANGERED SPECIES:

Several local species have been listed under the State and federal endangered species acts: bald eagle; great gray owl; Lost River and shortnose sucker fish; northern spotted owl and associated old growth species, including those under "survey and manage"; northern CA coastal coho salmon; vernal pool fairy shrimp; Shasta crayfish; delta smelt; California red-legged frog; western yellow-billed cuckoo; western pond turtle; Siskiyou salamander; Scott Bar salamander; California wolverine; Swainson's hawk; peregrine falcon; greater sandhill crane; Sacramento splittail fish; bank swallow; marbled murrelet; northern goshawk and Oregon spotted frog (candidates.) We have also experienced endangered species reviews of the green sturgeon; Pacific lamprey; Pacific fisher; steelhead trout; McCloud redband trout; and spring, fall, and winter run chinook salmon (currently under additional review in the Klamath River System and proposed for re-introduction in the Sacramento River system in Siskiyou County.) Consultations and biological opinions are a regular factor in the delay of processing water quality and other permits.

The fish species that most impact Klamath water are the shortnose sucker (*Chasmistes brevirostris*) and the Lost River sucker (*Deltistes luxatus,)* listed by US Fish & Wildlife Service (FWS) as "endangered" in 1988 and the Southern Oregon/Northern California Coastal coho salmon (*Oncorhynchus kisutch,*) listed by NOAA fisheries as a "threatened" species in 1997. In August, 2002 the California Fish and Game Commission issued a finding that coho salmon warranted State listing as a threatened species from the Oregon border south to Punta Gorda. The sucker fish require specific minimum lake levels and the coho salmon require specific river flows below the dams.

1982 KLAMATH RIVER BASIN FISHERIES RESOURCE PLAN: In 1982, the Bureau of Indian Affairs responded to concerns about declining salmon runs by commissioning the Klamath River Basin Fisheries Resource Plan.

***1986 KLAMATH RIVER BASIN FISHERY RESOURCE RESTORATION ACT*:** (Public Law 99-552, 16 U.S.C. 460ss-3 et seq.) pledged the appropriation of $21 million by the Department of Interior from October 1, 1986, through September 30, 2006. A matching $21 million is to be provided by nonfederal sources. Under the act, a fourteen-member Klamath River Basin Fisheries Task Force was created . Members were appointed by and represent the Governors of California and Oregon; the U.S. Secretaries of Interior, Commerce and Agriculture; the California counties of Del Norte, Humboldt, Siskiyou and Trinity; Klamath County, Oregon; the Hoopa Valley, Karuk, Yurok and Klamath native tribal fishers; anglers and commercial salmon fishermen. The imbalanced Task Force did not include water users or effected land uses- ranching, farming, timber, mining, urban, although restoration plans largely focused on these activities. Much of the Task Forces early meetings included the question whether the scope of their area included the Upper Klamath Basin and what representation the Upper Basin interests should have on the Task Force. 1991 Long Range Plan For The Klamath River Basin

Conservation Area Fishery Restoration Program; 1999 Mid-Term Evaluation Report Proposals at the sunset of the Act included merging the Task Force with the Hatfield Group. (However, this still left water and resource users in the mid-Klamath without direct representation.) The 2004 Addendum 1 to the Long Range Plan was aggressive in seeking restrictions on economic land uses and securing instream flows for salmon. The Task Force has now ceased to be.

The Act also established the Klamath Fishery Management Council for recommendations on the allocation of the fishery. (The Klamath River Basin Fishery Resource Restoration Act was not Reauthorized by Congress.) GAO Report; Armstrong Column on how the money was spent.

1990 CALIFORNIA WILDLIFE PROTECTION ACT: This act harmed local ranchers by designating mountain lions a protected species. This has resulted in livestock and wild game predation. Local deer herds have been decimated by predation, depressing a once robust tourism opportunity for hunters. Siskiyou County is one of the first counties in California that will have to contend with federally protected wolves – another dangerous predator - particularly in cattle country..

1995 KPOP: Klamath Project Operating Plan; Ch2MHill Tech Mem.

1996 UPPER KLAMATH BASIN WORKING GROUP: Upper Klamath Basin Working Group, was established by Public Law 104-333 to develop consensus solutions to complex agricultural and endangered species issues associated with water allocations. (Key partners: Bureau of Land Management, Bureau of Reclamation, California Waterfowl Association, Crater Lake Realty, Klamath Basin Audubon Society, Klamath Basin Ecosystem Restoration Office, Klamath Compact Commission, Klamath County Cattlemen's Association, Klamath County Commissioner, Klamath County Economic Development Association, Local Businesses, Natural Resource Conservation Service, Oregon Department of Fish and Game, Oregon Institute of Technology, Oregon Water Resources Department, PacifiCorp, Soil and Water Conservation District, The City of Klamath Falls, The Klamath Tribes, Tulelake Growers Association, Tulelake Irrigation District, U.S. Fish and Wildlife Service, U.S. Institute for Environmental Conflict Resolution, U.S. Timberlands, U.S.D.A. Forest Service, and others. (Crisis to Consensus)

1996- 17 RIVERS LAWSUIT: The "17 rivers" lawsuit, Pacific Coast Fishermens Assocs. v. Marcus, No. 95-4474, against the U.S. EPA and the SWRCB (CA State Water Resources Control Board) brought water quality regulation to the county's major northern water-bodies (Klamath, Scott, Shasta, Salmon Rivers.) The lawsuit directed the establishment of Total Maximum Daily Loads for sediment, temperature, dissolved oxygen and nutrients. Section 303(d) of the federal Clean Water Act (33 USC §1313) requires that "Each state shall identify those waters within its boundaries for which the effluent limitations . . . are not stringent enough to implement any water quality standard applicable to such waters." The Clean Water Act requires states to establish a priority ranking for waters on the Section 303 (d) list of impaired waters and to establish total maximum daily loads for such waters. TMDL Schedule

[Under the California Porter- Cologne Water Quality Act and Section 303(d) of the federal Clean Water Act, the North Coast Regional Water Quality Control Board (NCRWQCB) has established a list of "beneficial uses" of water for each river system, including the Scott and the Shasta. (These would be uses such as irrigation, recreation, and cold water fisheries.) For each beneficial use, water quality standards are established. (For instance, salmon are a cold water fish that need habitat that does not exceed a certain range of temperature.) When a river does not meet the water quality standards for each of its beneficial uses, it is declared water quality "impaired." A Total Maximum Daily Load or TMDL is the maximum amount of pollutant that a river can receive and still meet the water quality standards for its beneficial uses. When a TMDL is established, the NCRWQCB also establishes an Action Plan for restrictions on land and water uses in order to meet water quality objectives. NCRWQCB staff explained

why requirements for fish at the expense of agriculture follow the law: What quality objectives for agriculture are principally salinity levels. However, "water quality" habitat factors for fish included shade, clean gravel, cold water, cover and channel structures that depend upon an entire well functioning hydrologic system to exist. So, requiring land uses such as agriculture to be subservient to those habitat needs does not pose a conflict under water quality considerations.]

1999-2006 HARDY FLOWS: Dr. Thomas Hardy completed his models of the relationship of flows in the Klamath River to habitat available for anadromous salmonids. The National Academy of Sciences (NAS) team reviewed the study as did others. ; Rykbost **Klamath Watershed in Perspective**

http://www.klamathbasincrisis.org/science/04watershedken032304.ppt#284,1,

1999 NOAA FISHERIES/NMFS ISSUES CRITICAL HABITAT DESIGNATION FOR SONCC COHO

1999 CA DFG INTRODUCES NEW CEQA COMPLIANCE REQUIREMENTS ON 1602s: As a result of a lawsuit, the CA DFG introduces new CEQA compliance requirements on streambed alteration agreements. [Fish and Game Code 1602: "(a) An entity may not substantially divert or obstruct the natural flow of, or substantially change or use any material from the bed, channel, or bank of, any river, stream, or lake, or deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake, unless all of the following occur: (1) The department receives written notification regarding the activity in the manner prescribed by the department. The notification shall include, but is not limited to, all of the following: (A) A detailed description of the project's location and a map. (B) The name, if any, of the river, stream, or lake affected. (C) A detailed project description, including, but not limited to, construction plans and drawings, if applicable. (D) A copy of any document prepared pursuant to Division 13 (commencing with Section 21000) of the Public Resources **Code**. (E) A copy of any other applicable local, state, or federal permit or agreement already issued. (F) Any other information required by the department. (2) The department determines the notification is complete in accordance with Chapter 4.5 (commencing with Section 65920) of Division 1 of Title 7 of the Government **Code**, irrespective of whether the activity constitutes a development project for the purposes of that chapter. (3) The entity pays the applicable fees, pursuant to Section 1609. (4) One of the following occurs: (A) (i) The department informs the entity, in writing, that the activity will not substantially adversely affect an existing fish or wildlife resource, and that the entity may commence the activity without an agreement, if the entity conducts the activity as described in the notification, including any measures in the notification that are intended to protect fish and wildlife resources."

2000 US DOI & BIA v KWUA: Dept. of Interior v. Klamath Water Users Protect. Assoc.; The Supreme court grants certiorari regarding an issue nondisclosure in a Freedom of Information Act (FOIA) request regarding the Bureau of Reclamation's meeting with tribal interests and their influence on KPOP.1999 US Court of Appeals - Ninth Circuit - 189 F.3d 1034

2000 PACIFICORP COMMENCES PROCESS OF PREPARING FOR DAM FERC RELICENSING: (Federal Energy Regulatory Commission relicensing of Klamath River Dams - Iron Gate, Copco 1 and 2, and the J.C. Boyle Dams.)

2000 KLAMATH BASIN WATER SUPPLY ENHANCEMENT ACT: Public Law 106-498 106th Congress The Klamath Basin Water Supply Enhancement Act is authorized and directed, in consultation with affected State, local and tribal interests, stakeholder groups and the interested public, to engage in feasibility studies of the following proposals related to the Upper Klamath Basin and the Klamath

Project, a Federal reclamation project in Oregon and California: (1) Increasing the storage capacity, and/or the yield of the Klamath Project facilities while improving water quality, consistent with the protection of fish and wildlife. (2) The potential for development of additional Klamath Basin groundwater supplies to improve water quantity and quality, including the effect of such groundwater development on nonproject lands, groundwater and surface water supplies, and fish and wildlife. (3) The potential for further innovations in the use of existing water resources, or market-based approaches, in order to meet growing water needs consistent with State water law.

***2000 KWUA v. PATTERSON*:** Klamath Water Users Association v. Patterson (15 F. Supp. 2d 990, 996 (D. Or. 1998), 204 F.3d 1206 (9 Cir. 2000) that BOR is legally obligated to operate the Project "to meet the requirements of the ESA, requirements that override the water rights of the Irrigators." The court relied on the principal that "contractual arrangements can be altered by subsequent Congressional legislation" even when the legislation was passed after the contracts were made.

2001 PCFFA LAWSUIT UNDER ESA: In Pacific Coast Federation of Fishermen's Assoc. v. Bureau of Reclamation, 138 F. Supp. 2d 1228 (N.D. Cal. April 3, 2001), the federal court faulted the Bureau of Reclamation for failing to consult with National Marine Fisheries Service (NMFS) on the effects of irrigation releases on downstream coho salmon under its 2000 operating plan, and enjoined (prohibited) Reclamation from making further irrigation releases until it formally consulted on its next (2001) annual plan.

2001 SHUT OFF OF WATER TO KLAMATH PROJECT FARMERS: Requirements under the Biological Opinions [see federal nexus **[x]** for minimum lake levels for sucker fish and Klamath River flows for downriver salmon, caused the federal Bureau of Reclamation to shut down the headgates for water delivery to Federal Klamath Water Project farms in the Upper Klamath Basin in 2001, a drought year. (Each year, Reclamation establishes a management plan for the Project based on its April 1 designation of water year type.) Farmers sought an injunction to prevent BoR's implementation of the 2001 operating plan, but were denied. The federal court encouraged parties to pursue a negotiated solution.**[xi]** The water shut-off caused mass economic hardship with farmers losing their farms and migrant farm workers becoming stranded without work. Protests were held at the headgates with farmers twice manually opening them in defiance. A civil disobedience event called the "Bucket Brigade" drew 20,000 people to pass water buckets down the main street into the dry A Canal. In August, well into the growing season, the Secretary of Interior authorized the release of an additional 75,000 AF from Upper Klamath Lake for agricultural purposes. Klamath Basin Farmers Take Water Issue into Their Own Hands Protesting farmers used their bare hands to open the headgates on a Klamath Lake canal in Klamath Falls, OR; Judge Denies Klamath Farmers' Desperate Plea for Water; Soil blowing away from lack of irrigation; photos of the impact; Federal Circuit Decision a Big Win for Klamath Basin Water Users; *Klamath Irrigation District v. United States*, No. 01-591 L ; Restoring Harmony in the Klamath Basin

***2001 CA NORTH COAST WATERSHED ASSESSMENT PROGRAM*:** Multi-agency watershed assessment and planning. Power Point

2002 BIOLOGICAL ASSESSMENT AND OPINION: The BOR produces its Final Biological Assessment: The Effects of Proposed Actions Related to Klamath Project Operation (April 1, 2002 – March 31, 2012) on Federally-Listed Threatened and Endangered Species. NMFS produces Biological Opinion: Klamath Project Operations. The Bureau of Reclamation is required to: restore wetlands in the

Shasta Valley; Study development of Shasta and Scott groundwater resources to replace surface water use in those valleys; Use non-government organizations (NGOs) to acquire water rights totaling 25,000 acre-feet in the Scott and Shasta Valleys. (The intention was to find water flows outside of the Klamath Project that would contribute 43% of the flow required from Iron Gate Dam for the Klamath River under the coho Biological Opinion.) In addition, the BoR was directed to develop a comprehensive basin-wide plan for ecosystem restoration and scientific research through 2012. The plan was to be developed by "networking stakeholder groups" in the basin. It would then provide direction for activities on the federal, State and local level, as well as for interest groups. It was envisioned that the program would be built around of the Oregon Resource Conservation Act of 1996 (ORCA P.L. 104-208, Title 2, Section 201) to promote ecological restoration, as well as economic development and stability. [The Bureau of Reclamation has no geographic jurisdiction outside the Klamath Project.]

***2002 FISH DIE OFF*:** Fish die off of more than 32,897 salmon in lower Klamath River. Tribes, fishermen and environmentalists blamed the Bush Administration for releasing water to Klamath Project farmers. Sept. 2002 Klamath River Fish-kill: Final Analysis of Contributing Factors and Impacts; Dr. David Vogel's analysis; William Lewis chair of the National Research Council (NRC) Committee on Endangered and Threatened Fishes in the Klamath River Basin ("Klamath Committee") between 2002 and 2004 testimony to House Natural Resources Committee. In 2005, a federal judge dismissed a lawsuit brought by the Yurok Indian tribe that sought to hold the U.S. Bureau of Reclamation responsible for a salmon die-off in the lower Klamath River. A 2003 USFWS report attributed the die off to: (1) The large size of the fall run of Chinook salmon returning to the Klamath River from the Pacific Ocean; (2) High densities of fish in the lower river, which allowed the pathogen outbreaks to spread quickly. Large numbers of fish congregated in the lower river one to two weeks earlier than normal, but a lack of rainfall or freshwater pulses left the fish with no cues to begin their upstream migration; (3) Relatively low flow in the lower Klamath River. Average monthly flow in 2002 was the fifth lowest in the period from 1978 to 2002; (4) Hot weather, which left water temperatures higher than optimum for salmon.

2002 NAS REVIEW: The National Academy of Sciences (NAS) formed a Committee on Endangered and Threatened Fishes in the Klamath River Basin in order to review the scientific information used in preparing the Biological Assessment and Biological Opinion. National Research Council's (2002) Interim Report "Scientific Evaluation of Biological Opinions and Endangered and Threatened Fishes in the Klamath River Basin" is also used in the 2002 BA, and BOR states that there is no substantial evidence to suggest that increased stream flow would improve the salmon runs. The review found that there was "no sound scientific basis for cutting off water to farmers in 2001 in order to help the habitat of endangered fish" (National Research Council 2002, 4.)

2002 THE NORTH COAST INTEGRATED REGIONAL WATER MANAGEMENT PLAN (NCIRWMP): was adopted by resolution by the seven north coast counties, (Modoc, Siskiyou, Humboldt, Del Norte, Trinity, Sonoma and Mendocino,) comprising the North Coast Regional Water Management Group in July 2007. The plan was a prerequisite for application for project grant money under CA Proposition 50 and Proposition 84. CA IRWM Program.

2002 NINTH CIRCUIT NON-POINT POLLUTION and TMDLS: In May 2002, the Ninth Circuit ruled in Pronsolino v. Nastri that the Total Maximum Daily Load (TMDL) provision of the Clean Water Act (CWA) authorized the Environmental Protection Agency (EPA) to list and develop a TMDL for the Garcia River in Northern California, polluted solely by nonpoint source pollution. (The Garcia was part of the 17 rivers lawsuit of 1997); A Breathtaking Assertion of Power"? Not Quite. *Pronsolino v. Nastri* and the Still Limited Role of Federal Regulation of Nonpoint Source Pollution

2003 CA RECOVERY STRATEGY FOR CA COHO SALMON: Separate Shasta Scott Pilot Recovery Strategy process begins and will include provision for a programmatic Incidental Take Permit when

coho is listed.

2003 WATER SHUTDOWN AVERTED: The Bureau of Reclamation announced that irrigation water would be shut off until minimum lake levels for sucker fish were achieved. The White House interceded to halt the shutoff. Basin farmers voluntarily reduced irrigation deliveries and pumped more groundwater. Tri County Courier:: "On the day Klamath Project irrigators were told the Project would be shut down to meet required levels in Upper Klamath Lake, more than 2,000 acre-feet of water was released over Iron Gate Dam. The rate of the release exceeded that called for in the Bureau of Reclamation's 2003 Operations Plan, which set a release of 1,300 acre-feet per day. The same plan also includes the minimum lake levels that Klamath Project Manager Dave Sabo told irrigators on June 25 he could not violate under "explicit directives" that came from within the Department of Interior." "Sabo said the release schedule was modified in May after he was approached by the National Marine Fisheries Service, now called NOAA Fisheries, and representatives of the Yurok Tribe. 'We had reached an agreement with NMFS and the Tribe to provide higher flows downstream,' Sabo said. 'NMFS can change the schedule any way they want. The water went down because I had additional water from inflows into the lake.' When the Bureau saw that the July 1 lake level as set in the Operations Plan was going to be "busted," Sabo said he contacted NMFS to seek flexibility in the Iron Gate release rate. He was not successful. 'I was told 'no way,'' Sabo said. 'We will release 950 cubic feet per second through July, and 1,000 cubic feet per second through August." (Under that year's current water year designation, the Operations Plan calls for an average of 730 cfs to be released over Iron Gate in July, and 979 cfs in August. Should the water year be changed back to "dry" from its current designation as "below average," the disparity widens. The Operations Plan calls for releases of 515 cfs in July and 560 cfs in August under a "dry" water year schedule. "Because of the agreement, more than 31,800 acre-feet of water above what was called for in the Operations Plan was sent downstream during the month of June.")

2003 PCFFA SUES BoR UNDER ESA: In Pacific Coast Federation of Fishermen's Associations v. Bureau of Reclamation, 2003 U.S. Dist. LEXIS 13745 (N.D. Cal.2003,) the US District Court rules NMFS Biological Opinion to be "arbitrary and capricious" The district court ruled that the NMFS alternative was arbitrary and capricious and did not fully explain how its implementation would avoid the likelihood of jeopardy to coho salmon. The district court's ruling was upheld on appeal by the Ninth Circuit Court of Appeals, which later remanded the case to the district court with instruction for the "issuance of appropriate injunctive relief." The district court issued an injunction on March 27, 2006

2004 MORE WATER DOWN THE TRINITY: A lawsuit by Hoopa and other interests secured additional flows for the Trinity River - a major tributary to the lower Klamath River. Historically, as much as 90 percent of the river had been diverted for crops in the San Joaquin Valley, more than 200 miles south, as well as for power generation. The 9th Circuit Court of Appeals reduced the amount diverted to 52%. Depending on precipitation, the Trinity River will ultimately get between 368,600 and 815,200 acre-feet of water each year.

2004 MID-KLAMATH TMDL: TMDLs for sediment.

2004 CA LISTING OF COHO: Coho was proposed for state listing in 2000. While a recovery plan was being prepared, the CA Fish and Game Commission held off on listing until 2004. Local participation in the planning effort resulted in a proposal for a watershed-wide programmatic approach to "Incidental Take" permitting (ITP.) Siskiyou County declined to take on the responsibility of permitting. The Resource Conservation Districts (RCD) were approached to organize the application; provide subsequent guidance and assistance to landowners; and to pursue mitigation projects on a watershed basis. Negotiations of the terms and conditions of that programmatic permit approach between the CA DFG and RCDs took several years.

2004 DROUGHT MANAGEMENT PLAN (NRCS): Work Plan for Adaptive Management Klamath River Basin Oregon & California; Draft Klamath (KBRA) drought plan; Siskiyou Co. Board of Supervisors and the Siskiyou Co. Flood Control District's Response to the Draft Drought Plan

2004 USFWS FLOW STUDIES: USFWS (Tom Shaw) conducts flow and habitat studies on the Klamath mainstem and part way up the Scott and Shasta tributaries. He determined that edges of the Klamath should be flooded for rearing habitat.

2004 SHASTA GROUNDWATER STUDIES: The Shasta Coordinated Resources Management Planning group begins studies on Shasta groundwater.

2004 KLAMATH TRIBES SUE PACIFICORP: The Klamath Tribes requested damages related to the alleged destruction and interference with federal treaty fishing rights due to PacifiCorp's construction and operation of hydroelectric dams on the Klamath River. The case was dismissed due to a lack of timeliness.

2004 KLAMATH RIVER WATERSHED COORDINATION AGREEMENT: The Klamath River Watershed Coordination Agreement established the State and Federal Klamath Basin Coordination Group consisting of the designees of OR and CA, the U.S. Departments of the Interior, Agriculture, and Commerce, and the Environmental Protection Agency. The group is to "place a priority on their Klamath Basin activities and on their coordination and communications with one another and with tribal governments, local governments, private groups and individuals, to resolve water quantity, water quality and fish and wildlife resource problems in the basin" and "work diligently to recover the threatened and endangered fish species in the Klamath basin, enhance anadromous fish runs, improve and protect fish and wildlife habitat and water quality, and provide water for irrigation and other beneficial uses." All agree to "develop a long-term management approach, a common vision, and integrated planning..."

2004 CONSERVATION IMPLEMENTATION PROGRAM (CIP): In the 2002 ten year Biological Assessment for the Klamath Project Appendix A, 2.B, the Bureau of Reclamation proposed to develop a comprehensive plan to provide direction for research efforts, implementation of restoration projects, and monitoring of results. The geographic scope of this Program was the entire Klamath River Basin. The plan would be developed with the Tribal and state governments and a network of stakeholder groups and would provide a mechanism for implementation of activities to improve habitat conditions for the listed species. The purpose of the basin-wide plan was: 1) To largely restore the Klamath River ecosystem to achieve recovery of the Lost River and Shortnose suckers, and to substantially contribute to the recovery of the SONC ESU of Coho salmon; 2) To contribute to, but not to fully discharge, the tribal trust responsibilities of the federal government; and 3) To allow continued sustainable operation of existing water management facilities and future water resource improvements for human use in the Klamath Basin. The plan was entitled the Klamath River Basin Conservation Implementation Program.

The CIP governance structure as proposed was 3-tiered. The Policy Administration Group would oversee the policy issues of CIP as they relate to government policy, funding, and authorization. [Comprised of Tribal Chair, Regional Director, Regional Administrator, Executive Director, Area Manager, State Supervisor, Governor's representative] A Coordination Council would conduct the CIP's regular business including planning, coordinating with other entities, and preparing an annual work plan/budget. Support for these two Committees would be provided by four standing committees: Public Involvement, Science, Water Quality, and Tribal Trust Committees. {The Public Involvement Committee (PIC) would actively coordinate with outside groups, and be responsible for the production of information and education materials about the CIP and its mission and accomplishments.) The Science Committee will be supported by 5 subcommittees: An Independent Science Review Panel, and the Salmon, Sucker, Native Aquatic Species, and Other Resources subcommittees. Subcommittees could

be created and dissolved as needed. A Program Administrator and staff could be created. The CIP Administrator will track and manage the budget, keep records, plan and manage meetings, and conduct other support services for the Policy Administration Group and Coordination Council. Each select CIP Participant would appoint one individual to represent them on each of the committees as appropriate. A backup would be designated to hold official proxy for the member when the member cannot be present for a meeting. [The CIP did not proceed forward, although elements are included in the KBRA.]

2004-2005 CHADWICK CONSENSUS PROCESS: In 2004 1nd 2005, Bob Chadwick held several consensus workshops throughout the Klamath River Basin to identify focus areas of concern to different interest groups and areas of the basin. The process brought together "stakeholders" from the entire region to share perspectives with the objective of forming a basin-wide or "One Basin" approach. However, two Klamath Compact Commissioners imposed a dam removal agenda on the "grassroots" process. The workshops were funded by the Bureau of Reclamation and other agencies. At the final workshop, it was proposed to create a "One Basin Congress." The formal process faded out when funding ceased. One Basin Klamath Congress Proposed

2005 KLAMATH SETTLEMENT GROUP BEGINS TO MEET: The Klamath Settlement group begins as a spin off from the "settlement group" PacifiCorp assembled as part of its FERC licensing process. The new 2005 Settlement group makes agreement to require endorsement of "dam removal" as a condition of participation and expands its focus to restoration. Klamath River Settlement Takes Shape; The Board of Supervisors is unaware of this change Non-tribal Klamath mid-basin left out of Settlement Group

2005 FEDERAL COHO LISTING (temporarily) DISMISSED: In the case *Grange v. National Marine Fisheries Service,* Judge Michael Hogan agreed that the federal government violated the ESA when it failed to consider hatchery fish in its assessment of coho in southern Oregon and northern California rivers. However, Judge Hogan did not set aside the illegal listing, but left it in place while the agency completed the review of 26 west coast salmon listings, which it agreed to undertake as a result of its loss in *the similar Alsea* decision. (In June, 2004, NOAA proposed a new hatchery policy, but simultaneously announced that it would result in the relisting—not delisting—of west coast salmon and steelhead populations. SONCC coho were eventually relisted.) [2009 Appeals Court Upholds NOAA's Hatchery vs. Wild ESA Salmon Listing Policies]

2005 RANCH GROUPS (unsuccessfuly) SUE TO NEGATE CA STATE COHO LISTING: (Fact sheet; Summary of Coho conservation measures already in place.

2005 CAI/EPA ENVIRONMENTAL JUSTICE ACTION PLAN: Pilot Project for Klamath River Tribal governments. **Goal:** Effectively involve the Klamath River Tribes in the development of actions to restore fishery habitat and consequently fishery production in this important Pacific-Northwest watershed. Also, utilize cumulative impact analysis and the proposed Cal/EPA precautionary approach in implementation of this project

2005 NINTH CIRCUIT COURT of APPEALS RULING: Coast Federation of Fishermen's Associations, the Oregon Natural Resources Council, Waterwatch of Oregon rejects the Bush administration's water diversion plan for the Klamath River because "it fails to protect threatened Klamath River coho salmon."The Ninth U.S. Circuit Court of Appeals in San Francisco ruled that the Bureau of Reclamation's irrigation plan from 2002 to 2010 provides the coho with only 57 percent of the water it needs and fails to explain how the species will survive.A three-judge panel of the 9th Circuit Court of Appeals said the president's water plan failed to provide adequate water flows in the river until the final two years of the 10-year plan.

2005 YUROK FEDERAL RESERVE RIGHT CLAIM DISMISSED: On March 7, 2005, the U.S. District Court for the Northern District of California dismissed a claim for declaratory and injunctive relief by the Yurok Tribe based on federal reserved water rights. The Tribe alleged that the U.S. Bureau of Reclamation (Bureau) violated the Tribe's federal reserved fishing rights and breached its trust obligation to the Tribe by failing to provide adequate levels of water flow in the Klamath River in August and September 2002. The Tribe contended that the Bureau's failure substantially contributed to the death of at least 34,000 fish in the lower Klamath River on the Yurok Reservation from September 19, 2002 to October 1, 2002. The tribe wanted the Bureau to dedicate its stored water to them first, and only if there was water left over could any be used by the Klamath Project's farmers.

2005 PCFFA v BoR ON FLOWS FOR COHO: In Pacific Coast Federation of Fishermen's Association, et al. v. United States Bureau of Reclamation et al., 426 F.3d 1082 (9th Cir. 2005), the 9th Circuit held that the 2002-2012 Biological Opinion (BO) issued by the National Marine Fisheries Service for certain coho salmon runs, was arbitrary and capricious. Specifically, the Ninth Circuit held that Phase I and Phase II of the BO, which cover eight years of the ten-year plan, could not be supported because they failed to avoid jeopardy to the Southern Oregon/ Northern California Coast (SONCC) coho salmon - specifically the plan did not go far enough to ensure sufficient flows to protect the salmon. The court then remanded the action to the district court to issue injunctive relief. *Denied appeal by* Klamath Water Users

2005 KARUKS CLAIM DAMS IMPAIR HEALTH: In the FERC relicensing porcess for the Klamath dams, the Karuk assert that their health has become impaired because of a change in diet brought on by a lack of salmon. The four PacifiCorp dams up for relicensing have contributed to the salmon decline.

2005 KARUK and YUROK TRIBES CLAIM ALGAL TOXINS POSE HEALTH RISK: A news release from the Karuk and Yurok tribes claim that "Klamath Reservoirs Plagued by Toxic Algae - Algal Toxins Pose Significant Health Risk to Community." (Microcystis aeruginosa)

2005 LETTER OF INTENT: The CA DFG requires those wishing to participate in the coho programmatic Incidental Take Permit (ITP) and watershed-wide 1602 in the Scott and Shasta to submit a letter of intent.

2005 NATURALIZED PRE-PROJECT FLOW STUDY: Final Natural Flow study of the Upper Klamath River

2006 PCFFA v. BOR: PCFFA and others filed another lawsuit for injunctive relief. U.S. District Judge Saundra Armstrong ordered Reclamation to limit Klamath Project irrigation deliveries if they would cause water flows in the Klamath River at and below Iron Gate Dam to fall below 100 percent of the long-term flows specified in NMFS' 2002 biological opinion

2006 SCOTT VALLEY (local) STATIC WELL STUDY COMMENCES: Scott Valley Groundwater study

2006 STUDY ON SURFACE TO GROUNDWATER RELATIONSHIPS SHASTA VALLEY: Bureau of Reclamation and CA Dept. of Water Resources study on surface to groundwater relationships in the Shasta River. Dr. Harter

2006 SCOTT RIVER TMDL ESTABLISHED. Total Maximum Daily Load limitations established for temperature and sediment. Requires a groundwater study to:1) Evaluate changes in river flows and the water table elevations from groundwater pumping; 2) Study Plan (Dr. Thomas Harter) to determine the magnitude of groundwater recharge from leaking ditches and percolation of irrigated water; 3)

Determine the impacts of water table fluctuations on riparian vegetation; and 4) Identify opportunities, such as conjunctive use, to increase subsurface water storage. It also required a County road sediment source inventory and work plan; encouraged a grading ordinance; required review of suction dredge mining impacts; encouraged the RCD to help landowners plant riparian trees for shade; placed special focus on grazing and forestry limitations. At the hearing by the State Water Resources Control Board for adoption of the TMDLs, State Board members discussed how to recommend specific increased "flow options" in the Scott River. Since the Scott River has no dams and the major flows are from snowmelt, discussing "flow options" means dipping into the state law protected water right adjudications. SOSS (Save Our Shasta and Scott valleys and towns) attorney, Daniel O'Hanlon, cited four legalities during an additional comment period: (1) The agenda did not include flow options; (2) "In the Scott Valley, many of the water rights are pre-1914 rights and therefore not subject to the State Board's permitting jurisdiction," claims O'Hanlon citing lawsuit cases and the state water code 1200. For these water rights to be changed, the state would need to petition Siskiyou County Superior Court for any amendment or adjustment of such rights;(3) The Board did not publicly noticed that any other action will be taken at its meeting other than adoption or non-adoption of the Scott River TMDL Action Plan; and (4) recent legal decisions, the State Board was told to allow for flexibility in implementation of Action Plans and avoid constraints on flexibility.

2006 NCRWQCB REGION-WIDE SWSPP: The North Coast Regional Water Quality Control Board announced that it was developing a region-wide Stream and Wetlands System Protection Policy (SWSPP.) The regional SWSPP will be in addition to the TMDL process for each water body. The policy's first purpose is to protect the overall hydrologic structure, (stream channels; riparian areas; floodplains, wetlands and the connection between them.) The second purpose is to protect the functions that these physical characteristics perform: filtration, flood water storage, groundwater recharge, distributing river energy and nutrients, fish and wildlife habitat etc. The third purpose is to consider the impacts to these characteristics by all human uses together on a cumulative and watershed basis. Narrative water quality objectives will now be set for hydrology, active channel, floodplains, riparian vegetation and in-stream habitat. SWSPP will aim to maintain soil infiltration of water, prevent excessive erosion or depositing of sediment by encouraging space for river meanders, moderate flows, protect floodplain buffers, establish and maintain riparian vegetation and protect instream habitat. Implementation of the SWSPP will be done on the basis of locally developed watershed plans that propose changes and "best management practices" to avoid, minimize and mitigate negative impacts.

2006 UPPER KLAMATH PROJECT FARMERS ELECTRICAL RATE INCREASE: Under a 1917 contract that was extended for another 50 years in 1956, farmers within the project paid six-tenths of a cent to run pumps. Irrigation districts and the federal government had five-tenths cent Kwh rates for on-peak pumping, three-tenths cent Kwh for off-peak demands. The 700 ranches beyond the project's irrigated cropland have since 1956 had a three-quarter cent Kwh pumping charge. Klamath irrigators will now be phased in to the same Tariff rate of 6.98 cents per kilowatt-hour on both sides of the California-Oregon border as other (non-Project such as the Scott and Shasta) irrigators pay. CA will have a four year phase in and OR a seven year phase in of the new rate.

2006 INTERIOR & YUROK AGREEMENT: "The Department of the Interior and the Yurok Tribe of Northern California today announced a major agreement to cooperate in the management of land and fishery resources in the Klamath Basin. This unprecedented agreement will assure the coordination of resource management programs, and expand the cooperation between the Tribe and Interior agencies in river monitoring, data collection, strategic planning, land acquisition and recovery and related natural resource management efforts."

2006 CHINOOK FISHERY CLOSURE: The Chinook Fishery was closed during the summer to

commercial fishermen for 700 miles along the Pacific Coast due to decline in chinook fish runs.

2006 PACIFICORP LOSES CHALLENGE TO FISH LADDER REQUIREMENTS: (Dam relicensing DEIS)

2006 KWUA TRADE FOR DAM REMOVAL SUPPORT: Addington, spokesman for the Klamath Water Users Association stated they could support dam removal in the mid-Klamath if irrigators were promised three things in return: (1) Upper Basin farmers need a dependable supply of water each year; (2), they need affordable electrical power to run irrigation pumps; and (3) they need to be protected from harmful sanctions if another endangered species - salmon - was reintroduced to the Upper Klamath Basin.

2007 SHASTA RIVER TMDL ESTABLISHED: TMDLs established for nutrients, low dissolved oxygen and temperature. Lake Shastina included for mercury. Action plans include an increase in riparian shade, minimizing tail water return flows from irrigation users, increasing stream flows from Big Springs Creek by 50 percent, (45 cubic ft./sec. of water used by agriculture reallocated to instream fish production,) individual landowners to report activities, re-engineering or limiting the way irrigation districts take water from the river, and obtaining an engineering study of potential reductions in nitrogen levels at Dwinnell Dam. Notice to landowners to comply. The plan threatened that if Shasta Valley Water Users could not meet the criteria that the board is setting to improve water quality within a five-year time limit, that there is a possibility of re-adjudication of water rights. When it was suggested that the potential for re-adjudication be eliminated from the language in the plan document, North Coast Region executive director Catherine Coleman said, "I don't think we are going to go quite that far."

2007 CA DFG and CALTROUT INSTREAM FLOWS ON SHASTA RIVER: CA DFG/CalTrout pilot strategy and protocols to establish flow/habitat relationship in order to impose flows through 1602s..They want to "develop the relationship between flow and habitat availability for the different life stages of coho." They will start on a small scale with CDFG, Bureau of Land management and Nature Conservancy lands on the Shasta. Within five years, ultimate plans to do the studies on both the Shasta and the Scott on a watershed wide basis.

2007 COUNTY ROAD MAINTENANCE (5Cs): County Road maintenance performed under the "Water Quality and Stream Habitat Protection Manual for County Road Maintenance in Northwestern California" acquires protection from take of coho or steelhead under Limit Number 10 of the ESA section 4(d) rule.

2007 DAM RELICENSING EIS - Final Environmental Impact Statement for Relicensing of the Klamath Hydroelectric Project No. 2082-027 ; PacifiCorp Considers $300M Fish Ladders; NMFS Modified Prescription for Fishways and Alternatives Analysis for the Klamath Hydroelectric Project; Federal licensing authorities Friday recommended keeping PacifiCorp's four hydroelectric dams on the Klamath River, siding with the utility and ignoring calls from fisheries agencies to build fish ladders.

2007 SISKIYOU CO. TAKES POSITION AGAINST DAM REMOVAL:

2007 KLAMATHRIVERKEEPER v. IG HATCHERY: The Klamath Riverkeeper filed suit against the CA DFG and PacifiCorp alleging that discharges from the Iron Gate fish hatchery violated the Clean Water Act.

2007 SUIT FILED ON TOXIC ALGAE: Klamath Riverkeeper, Yurok and Karuk tribes file lawsuit against PacifiCorp claiming damages from toxic algae Microcystis aeruginosa as a hazardous waste

caused by the four Klamath River dams. The court gives the North Coast Regional Water Quality Control Board 90 days to reconsider the groups' petition to include microsystis algae as a water quality impairment and regulate its source. Bobby Kennedy joins Klamath Tribes, fishermen and Riverkeeper in PacifiCorp toxin suit

***2007 KLAMATH IRRIGATION DISTRICT v. UNITED STATES*:** The U.S. Court of Federal Claims rejects breach of contract claims filed by irrigators for water lost due to court-ordered flows for fish listed under the Endangered Species Act (ESA).

***2007 CA FISH & GAME DENIES COHO DELISTING PETITION*:** The CA Fish and Game commission denies a second petition to delist CA coho based on the allegation that coho is not a native species. Capital Press: "Buchal stated that coho salmon in the region have come from hatchery-raised fish. Because of drought and flood patterns, and other factors, native coho have not thrived. " "To maintain populations of coho salmon, you have got to run hatcheries," he said. "That is not consistent with self-sustaining, natural populations that can survive. All we are asking is that you accept the petition for full status review, no changes in existing coho protections and to think ---- does it make sense to lock the State of California into a fatally doomed restoration program." "Dr. Kenneth Gobalet, a biology professor at California State University-Bakersfield, buttressed Coupe's remarks and said archeological studies he has done show that coho salmon bones existed in the region. Speaking in a rising tone and visibly shaking in anger that his work on coho populations was being challenged in a fishery publication, Gobalet lashed out at the petitioners. "

2007 - 7,200 ACRES OF AG LAND CONVERTED TO WETLAND: 97,160 acres of agricultural land have already been converted into wetlands from ag as primary water usage (above Klamath Lake.) Another 7,200 acres is added by blowing levees near Klamath Lake. Explosions Destroy Levee Near Klamath Lake; The average consumptive use for the crop mix in the project is just about 2.0 Acre Feet/acre. Wetlands probably use about 3.0 to 3.5 AF/acre or maybe a little more for permanently flooded wetlands with cattails and tules. So it's a little less than twice but certainly well above the use for crops." (Ref,: Desert Resource Institute, evaporation information.)

***2008 LOST RIVER TMDLS*: TMDLs** established for nutrients and PH. Capital Press: "The report calls for a 50 percent reduction in nutrient loads and contains more than 65 "recommendations" for irrigators to perform, including schedules and timetables. Some of the recommendations include minimizing use of fertilizers, not discharging irrigation tailwaters into watercourses, lining ditches, building recovery ponds, providing more wildlife habitat, establishing basin-wide monitoring program and stations, establishing a memorandum of understanding with the agency and more. "

***2008 PROGRAMMATIC ITP & 1602*:** The EIR is completed for the Scott and Shasta watershed wide 1602 and coho ITP permits for agriculture.

***2008 FERC RELICENSING*:** Mitigations for protection of upstream and downstream fisheries are imposed on PacifiCorp as conditions of relicensing of the Klamath River dams.

2008 KLAMATH WATER USERS v. FERC: Klamath Water Users Assoc. sues FERC over discontinuance of electrical rate break in the relicensing of the Klamath dams. The federal appeals court dismisses the case.

2008 COASTAL OCEAN FISHING CLOSED: Coastal ocean fishing closed due to crash of Sacramento Chinook salmon runs. Klamath system instream fishing allowed.

***2008 EPA REQUIRES ALGAE TMDL LISTING*:** The EPA reconsiders its previous decision to allow the state to omit TMDL listing for mycrosystin algae, requiring the state to list portions of the Klamath.

***2009 FORMAL STUDY ON HEALTH EFFECTS OF TOXIC ALGAE*:** Center for Disease Control's report on health effects of microsystin algae is embargoed. County requests Congressional assistance in getting it released. It shows negligible effects on humans.

2009 ESA VIOLATES ITSELF: There is insufficient water in February (before irrigation starts) to meet minimum lake levels for sucker fish and downstream flows for coho salmon.

2009: PACIFICORP BLOCKED IN GETTING WATER QUALITY PERMIT: PacifiCorp is blocked in attempts to get a 401 Clean Water certification on dams and withdraws application; 401 Scoping

2009 SIERRA CLUB, PCFFA,RIVERKEEPER et al. v. NORTH COAST REGIONAL WATER QUALITY CONTROL BOARD: Environmentalists petition court to require NCRWQCB to adopt a program of implementation for total maximum daily loads ("TMDLs") within the North Coast Region of California, which comprises all basins draining into the Pacific Ocean from the California-Oregon state line to the boundary of the Estero de San Antonio and Stemple Creek in Marin and Sonoma Counties

2010-2018 BoR BIOLOGICAL OPINION

2010 ADVISORY MEASURE ON DAMS: An advisory measure was placed on the Siskiyou County ballot - Should the Klamath River Dams (Iron Gate, Copco 1, and Copco 2) and associated hydroelectric facilities be removed? 79% of voters said no.

2010 CA DFG/RCD's SOLICIT PARTICIPATION IN PROGRAMMATIC COHO ITP (Incidental "take" permit) [xi] and WATERSHED WIDE 1602: The new programmatic ITP for the Scott River and Shasta River are rolled out. Under the RCD process, once enrolled, a fisheries biologist will visit the diversion with the irrigator, discuss his individual circumstances and select from a master list of possible terms and conditions for the permit. These cover 14 possible activities that have been determined to cause prohibited take. Agricultural water users who have not signed up for the program are visited by armed Fish and Game Wardens to solicit their participation.



There is considerable local resistance by small landowners against participation in the program and a backlash against CA DFG tactics. Public meetings are attended by cadres of armed Fish and Game Wardens.

Fish and Game Code 1602, (written originally in 1960,) places conditions on anyone who "substantially divert[s] or obstruct[s] the natural flow of, or substantially change[s] or use[s] any material from the bed, channel, or bank of, any river, stream, or lake, or deposit or dispose[s] of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake…" This used to be called a "streambed alteration permit" and was required for moving material for gravel push up dams. A new interpretation requires the permit for just the "diversion" of water or the mere operation of a headgate - a concrete structure that controls water flow down a ditch. The DFG applies its new interpretation of the 1602 as applying to all surface water irrigation effectively reaching every farm and ranch. It then makes the watershed-wide 1602 conditional upon having an ITP.

[The California Endangered Species Act prohibits anyone from "taking" a state listed species. (Take is defined in Section 86 of the Fish and Game Code as "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill.") Fines and jail sentences, may be imposed upon individuals who "take" a state-listed species without appropriate permits and without California Department of Fish and Game approval. Violations of the California Endangered Species Act can include a criminal penalty of up to $5,000 and/or one year imprisonment for each violation, and a civil penalty of up to $10,000 for each listed species taken.

The State of California also allows the DFG to authorize "incidental take" of threatened species as part of an otherwise authorized activity (such as irrigating) through the issuance of a conditional permit to an applicant (such as an irrigator) as long as it does not jeopardize the species. People who are at risk of "taking" a coho at any life stage have to make the decision whether or not they want protection under an incidental take permit.

Fish and Game code 2081. The department may authorize acts that are otherwise prohibited pursuant to Section 2080, as follows: (a) Through permits or memorandums of understanding, the department may authorize individuals, public agencies, universities, zoological gardens, and scientific or educational institutions, to import, export, take, or possess any endangered species, threatened species, or candidate species for scientific, educational, or management purposes. (b) The department may authorize, by permit, the take of endangered species, threatened species, and candidate species if all of the following conditions are met: (1) The take is incidental to an otherwise lawful activity. (2) The impacts of the authorized take shall be minimized and fully mitigated. The measures required to meet this obligation shall be roughly proportional in extent to the impact of the authorized taking on the species. Where various measures are available to meet this obligation, the measures required shall maintain the applicant's objectives to the greatest extent possible. All required measures shall be capable of successful implementation. For purposes of this section only, impacts of taking include all impacts on the species that result from any act that would cause the proposed taking. (3) The permit is consistent with any regulations adopted pursuant to Sections 2112 and 2114. (4) The applicant shall ensure adequate funding to implement the measures required by paragraph (2), and for monitoring compliance with, and effectiveness of, those measures. (c) No permit may be issued pursuant to subdivision (b) if issuance of the permit would jeopardize the continued existence of the species. The department shall make this determination based on the best scientific and other information that is reasonably available, and shall include consideration of the species' capability to survive and reproduce, and any adverse impacts of the taking on those abilities in light of (1) known population trends; (2) known threats to the species; and (3) reasonably foreseeable impacts on the species from other related projects and activities. (d) The department shall adopt regulations to aid in the implementation of subdivision (b) and the requirements of Division 13 (commencing with Section 21000) of the Public Resources Code, with respect to authorization of take. The department may seek certification pursuant to Section 21080.5 of the Public Resources Code to implement subdivision (b).

***2010 FISH AND GAME CODE 5937*:** In 1915, the California Legislature created Fish and Game Code section 5937, [xii] which requires the owner of any dam shall allow sufficient water at all times to pass through a fishway, or in the absence of a fishway, allow sufficient water to pass over, around or through the dam, to keep in good condition any fish that may be planted or exist below the dam. Under Fish and Game Code 5937, CA DFG installs devices to maximize bypass flows around fish screens to create instream flows for fish. In Scott Valley, DFG shuts water flow off one irrigation ditch without notifying owner causing horses and cattle to knock down fences in order to find water. According to CA DFG representatives (Harris,) the Department's position is that Fish and Game Code 5937 creates a "vested right" in minimum flows pre-dating any local water rights. [The Rebirth of California Fish & Game Code Section 5937: Water for Fish - "Changing public perceptions of California's natural resources, including fish, led to the birth of the modern public trust doctrine. The Legislature's continuing efforts,

coupled with the public trust doctrine, began to revive 5937 in the 1970s. Key holdings in early public trust cases reinforced the State's responsibilities in safeguarding trust resources and broadened private standing to protest violations of the public trust. Courts recognized 5937 as the legislative expression of the State's public trust obligation to protect below-dam fish.{Cal. Trout v. State Water Res. Control Bd. (*CalTrout I*), 255 Cal. Rptr. 184, 209 (Ct. App. 1989).}"]

2010 BUTTE VALLEY TMDLS: TMDLs established for nutrients and temperature.

2010 KLAMATH RIVER (FROM OREGON TO PACIFIC) TMDLS: Total Maximum Daily Load limitations established on the Klamath River from Oregon to the Pacific for nutrients, organic enrichment, low dissolved oxygen and temperature.

2010 COPCO LAKE, IRON GATE RESERVIOR & MID-LOWER KLAMATH RIVER TMDLS: TMDLs established for Cyanobacteria Hepatotoxic Microcystins (algae)

2010 CLIMATE LEADERSHIP INITIATIVE: Klamath Basin - National Center for Conservation Science & Policy The Climate Leadership Initiative March 2010 Concludes: The presence of a Basinwide governance structure (such as an advisory council) could facilitate cost effective climate change preparation planning. Cross-Basin governance is critical, especially for water, forest, and other resources that cut across multiple political boundaries.

2010 KLAMATH BASIN RESTORATION AGREEMENT: In February 2010, many of the few select participants who had met behind closed doors in the Klamath settlement process signed the Klamath Basin Restoration Agreement (KBRA); and the Klamath Hydroelectric Settlement Agreement (KHSA) to remove four dams on the Klamath River (three are hydroelectric.) This included PacifiCorp, and the States of California and Oregon. (The U.S. Department of Interior (DOI) and other federal agencies await legislative approval from Congress to sign. Siskiyou County and the Siskiyou County Flood Control District did not sign.) A determination has not yet been made whether removal of the four dams: 1) will advance restoration of the salmonid fisheries of the Klamath Basin; and 2) is in the public interest, which includes (but is not limited to) consideration of potential impacts on affected local communities and tribes .(The Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report - Comments of the County of Siskiyou, City of Yreka, City of Dorris, City of Etna, City of Montague, City of Weed, and Town of Fort Jones (dated November 21, 2011); Dams Not Main Cause of Salmon Collapse, Study Says; Surprising study shows more salmon survive West's dammed rivers; The effect of ocean Conditions on salmon survival and returns

KBRA Governance: *Council of Fish Managers* - The agreement would establish a council of "fish managers" drawn from state, federal and tribal agencies. Over the next 50 years, throughout the "Klamath River Basin" or "Klamath Basin," (which is defined to include lands tributary to the Klamath River in California and Oregon – excluding the Trinity River,) this council would create and implement plans for fisheries restoration, reintroduction and monitoring. Implementation will be done according to the principles of "Adaptive Management." The Council would be funded with $493.2 million for the first 10 years and government agencies would agree to reallocate current available restoration funds to this pot of money. Fish species covered would include chinook, coho, steelhead, rainbow trout, lamprey, bull trout, suckers, sturgeon and eulachon.

Klamath Basin Coordinating Council (KBCC): Its purpose is to promote "sustainable restoration and renewal of the Klamath River Basin." It will serve as a FACA (Federal Advisory Committee Act) body that will make recommendations to federal agencies for funding and other actions. The Fish Managers Council will send it annual reports of what it has done with the restoration money. The KBCC will set

priorities, share information, seek funding and provide dispute resolution related to the implementation of the Settlement Agreement. The KBCC will operate on a "basin wide perspective for holistic solutions and approaches;" and "no Klamath Basin interest shall bear an unreasonable portion of the burdens imposed."

The interim KBCC will include state, federal, tribal and local governments that are parties to the Agreement. Then a corporate governance Charter will be drawn which will include selected representation from the federal agencies, the two states, Klamath Siskiyou and Humboldt Counties, the Klamath Yurok, Hoopa and Karuk tribes, the "On-Klamath Project" Water users; the Upper Basin "Off-Project Water Users, commercial fishing, and environmental groups. The KBCC will link and coordinate the Settlement Agreement with Biological Opinions, Recovery Plans, watershed working groups and RCDs in the entire Klamath River Basin in a new regional governance structure.

An expert panel of fish scientists hired in connection with the preparation of the DEIS/DEIR (environmental impact statements) reports out that the presumption has been made that the KBRA will accomplish: 13 miles of floodplain rehabilitation; 198 river miles of large woody debris placement; 153 river miles of cattle exclusion; 21,800 acres of acquisitions or conservation easements; improvement of 73 fish passage sites; planting of 346 riparian acres; securing of minimum instream flows for fish (including purchase of water rights); 1,330 miles of road decommissioning and treatment of 240 sediment sources in the Scott, Shasta and other tributaries. It also presumes the conversion of 40% of Upper Basin irrigated farms (44,479 acres) to wetlands. The EIS/EIR fails to analyze the impacts or costs of these actions.

***2010 GROUNDWATER LAWSUIT*:** Environmental Law Foundation, Pacific Coast Federation of Fishermen's Associations, Institute for Fisheries Resources vs. State Water Resources Control Board, County of Siskiyou complaint and request for injunction on basis of "failing to manage groundwater resources interconnected with the Scott River in a manner consistent with the Public Trust Doctrine of California Scott River Public Trust appeal attracts more parties to the suit; Board of Supervisor's Statement on the ELF groundwater lawsuit; Siskiyou statement shows intent to appeal Public Trust suit decision; Statement of the Board of Supervisors 2/1/11

***2010 KLAMATH RIVER TMDLs* (Water Quality Total Maximum Daily Loads):** On March 24th, 2010, the North Coast Regional Board approved the TMDLs for the Klamath River in California for Temperature, Dissolved Oxygen, Nutrients, and Microcystin Impairments. On September 7th, 2010, the State Water Resources Control Board (State Board) approved these TMDLS. The California Office of Administrative Law approved the amendment on December 7, 2010. On December 28, 2010, EPA approved California's Klamath River TMDLs, in compliance with a consent decree requiring EPA approval by December 31, 2010. EPA also approved California's revisions to its site-specific objective for dissolved oxygen for the Klamath River, which was part of the State's TMDL package and Basin Plan Amendments. (See Klamath Basin Tribal Water Quality Work Group);

Implementation Plan: Upper Basin: Explore engineered treatment options such as treatment wetlands, algae harvesting, and wastewater treatment systems to reduce nutrient loads to the Klamath River; Complete a water quality study based on best available science to characterize the seasonal and annual nutrient and organic matter loading through USBR's Klamath Project and refuges; Develop a water quality management plan to meet and/or offset the Lower Lost River and Klamath River TMDL allocations; Process the 401 water quality certification for the FERC relicensing of the Klamath Hydroelectric Project to meet Basin Plan requirements, including Klamath River TMDL allocations and targets; Implement measures to improve the water quality of discharges from the Iron Gate Hatchery to meet TMDL allocations and targets ;

The Regional Water Board shall consider adopting a resolution and accompanying waiver for maintenance of county roads certifying the Five Counties Salmonid Conservation Program (5C Program) if it complies with the TMDL and attains standards in accordance with California Impaired Waters Guidance; CALTRANS Incorporate certain measures into the NPDES Statewide Storm Water Permit and Waste Discharge Requirements for the State of California, Department of Transportation (Caltrans permit) to address sediment sources from road and highway facilities under Caltrans control;

Agriculture: Develop a conditional waiver of WDRs for discharges associated with agricultural activities, including grazing and irrigated agriculture, in the entire Klamath River basin. The conditional waiver shall require compliance with the Klamath River TMDL load allocations where they apply and will serve as the means of compliance with the Lower Lost River TMDL load allocations associated with agricultural sources. Agriculture to: 1. Document past projects and current practices that address sources of pollution from their operations. 2. Organize into watershed groups to report to the Regional Water Board as a group as part of the future waiver program. 3. Participate in the development of the conditional waiver through a Technical Advisory Group that will convene to develop the draft waiver by December 2011. 4. Attend water quality training on implementing management practices and/or water quality management plan development.

> The Technical Advisory group for the mid-Klamath indicates that it appears the Region 5 model being applied will subject all irigators to reporting, monitoring, and payment requirements (fee to farm.) Region 5 is an area of intense agricultural practices, high fertilizer use and dairy cows - conditions not present in the mid-Klamath. "The initial high quality of Region 1's surface and ground water would suggest that a very targeted program was called for, not an intrusive program that regulates virtually every farmer and rancher." "Any ag program in Region 1 should be very narrowly tailored to only include those operations where actual data shows and impact to water quality and beneficial uses and where voluntary efforts have proven ineffective."(Walker)

Private Timber lands: The Regional Water Board shall adopt individual watershed-wide and ownership Waste Discharge Requirements, in lieu of the general WDR or conditional waiver of WDRs, to achieve the TMDL load allocations and water quality standards as appropriate. Implement riparian management measures that meet the riparian shade allocations and water quality standards. Where the Forest Practice Rules, including the Anadromous Salmonid Protection Rules, are not sufficient to meet the TMDL allocations or water quality standards, implement additional measures as directed by Regional Water Board staff during the timber harvest review process. USFS: Develop a conditional waiver of WDRs for nonpoint source activities on USFS lands that includes conditions that implement the Klamath TMDL.

2011 KLAMATH IRRIGATION v. U.S.: Property takings lawsuit against the U.S. for compensation for irrigation water taken in 2001 to proceed. The Klamath Compact states: 'the United States shall not, without payment of just compensation, impair any rights to the use of water for [domestic or irrigation purposes] within the Upper Klamath River Basin.'

2011 WATERMASTER SERVICE: [xiii] Prior to 2004, State watermaster service was funded half through fees from water diverters and half by the state's General Fund. In 2004, Senate 1107 and the Budget Act eliminated the state's contribution. In addition, the CA Dept. of Water Resources determined that true costs of the program had not been recovered for more than a decade. As a result, it announced an astronomical rate increase. This was subsequently rolled back and a Klamath Bureau of Reclamation grant took care of the lost state match under normal fees. Locally, this meant that last year there was no increase felt in the diverter's share of watermaster fees. Through State legislation and the courts, a local watermaster district was authorized. In 2011, there was a rate hike of a 7-8 fold increase to local water users. The fee is collected through property tax rolls for the fiscal year July 1- June 30 and

are payable in August. The prior total bill for watermaster service to Shasta River water users was $62,200. This was slated to go up to around $500,000, (8.1 times greater.) The bill for Scott Valley services was $22,600. This was slated to go up to $173,000, or (7.7 Times greater.) The local watermaster district was formed. The initial rates have remained high until expenses stabilize.

2011 RANCHER VISITED BY ARMED AGENTS: The Jenner Ranch was visited by a fully armed and "flak jacketed" DFG warden and federal law enforcement agent and were told they were investigating whether or not to criminally or civilly charge them for killing salmon.



Conversation with Kirk MacKenzie (DRA)

Dec 2, 2011 on Become Vocal Local

2011 DRAFT DROUGHT MANAGEMENT PLAN: (Pursuant to the KBRA) This plan was created by a group dubbed the "lead entity," comprised of Klamath Tribes, Karuk Tribe, Yurok Tribe, Upper Klamath Water Users Association, the Klamath Water and Power Agency (KWAPA,) the Klamath Basin National Wildlife Refuges, Oregon Water Resources Department, California Department of Fish and Game, and Trout Unlimited. The plan starts out by designating the Oregon Water Resources Department (OWRD) as responsible for declaring a drought. The National Fish and Wildlife Foundation (NFWF) is designated to hold the project funding purse. (NFWF is a non-profit, originally created by Congress.) Under the KBRA, the agencies agreed to redirect some of their funding in their budgets to the NFWF fund for Klamath restoration. This will be used to fund the Drought Plan. NFWF will also be made a part of the "lead entity."

The Drought Plan would reduce diversions or use of surface water so that instream flows can be maintained. The fund would be used to compensate users for their loss. KWAPA would distribute money on the Klamath Project and a federal agency designated by NFWF would distribute the money off-Project.

In addition, a TAT or Technical Advisory Team will be given a federal charter. The TAT will consist of representatives from the U.S. Fish and Wildlife Service; Bureau of Reclamation; Bureau of Indian Affairs; NOAA/National Marine Fisheries Service; USDA; three State of Oregon agencies; California Dept. of Fish and Game; the Klamath, Yurok and Karuk Tribes; Humboldt County; KWAPA, a representative of off-Project irrigators; a representative of conservation groups; and a representative of commercial fishing interests. The TAT will create an Annual Water Management Plan and provide recommendations to the Secretary of the Interior concerning "Managed Environmental Water," storage and releases down the Klamath River at Link River Dam. The TAT will also make recommendations to the State of Oregon on drought conditions.

Within seven days of a declaration of Drought or Extreme Drought, KWAPA and a NFWF designated federal agency will determine the amount and sources of water likely to be available. The TAT will develop alternative water management scenarios to protect species of concern. Actions such as voluntary conservation, use of "new" stored water, use of groundwater substitution, water transfers and leasing or forbearance agreements could be used. A sliding scale of diversion limitations, water use retirement provisions and land idling could be used so that water can be managed whereby "no Klamath Basin interests bear an unreasonable portion of burdens imposed."

In the case of "extreme drought, under Alternative 1, the "Fish Managers," (Klamath Tribes, Yurok

Tribe, Karuk Tribe, California Department of Fish and Game, Oregon Department of Fish and Wildlife, U.S. Fish and Wildlife Service, and the National Marine Fisheries Service,) will have the power to reduce the water available for diversion in the Klamath Basin from March – October. Under Alternative 2, the amount of diversion reductions will be deferred until more information is known about the status of fisheries restoration, water quality improvement, and other actions in the Agreement.

2011 WaterSMART: Pursuant to the 2009 federal Secure Water Act, the Bureau of Reclamation has included the Klamath River system in its WaterSMART (Sustain and Manage America's Resources for Tomorrow) program. (Section 4(a) of Secretarial Order 3297 creating WaterSMART) "Bureau of Reclamation, Oregon's Water Resources Department, and California's Department of Water Resources are partnering to conduct the Klamath River Basin Study to identify strategies to meet current and future water demands in the Basin." (See also Basin Study Framework; DOI WaterSMART Strategic Implementation Plan; Cooperative Watershed Management Program authorized by the Omnibus Public Land Management Act of 2009, P.L. 111-11 , which brings together local watershed stakeholders to design and implement projects that enhance water conservation, improve water quality, increase ecological resiliency, and reduce the potential for water conflict. This program will include DOI bureaus as well as state and local governments and other interested entities.)

"Employing broad stakeholder involvement, the Klamath Basin Study will accomplish the following objectives: • Evaluate supply and demand imbalances in the basin which may be exacerbated by climate change; • Identify possible impacts to the Basin's agricultural water requirements, hydroelectric facilities, recreational facilities, fish and wildlife habitats, flood control facilities, and water storage and distribution facilities; and • Develop both structural and non-structural adaptive strategies to balance supplies with demands.Stakeholder involvement in the Study includes a broad spectrum of Klamath tribal governments, water user groups, agriculture associations and environmental interests."[Additional inormation about the Secure Water Act.)

The study's conclusions will fulfill a small section of the Klamath Basin Restoration Agreement, which says signatories — including Oregon, California, U.S. Department of the Interior and U.S. Bureau of Reclamation — will work to identify and mitigate the effects of climate change.

2011 INSTREAM FLOWS FOR FISH: The CA Department of Fish and Game (DFG) announced that it would issue a Request for Proposal (RFP) to establish minimum instream flows for fish needs in the Scott and Shasta Rivers. The Instream Flow Incremental Methodology (IFIM) process will have five steps. http://www.fort.usgs.gov/Products/Software/IFIM/ The first step is problem identification and diagnosis. It also includes identification of "stakeholders" with an interest in flows for fish. This initial step includes the establishment of "baseline" data, identification of data gaps and timelines. The second step is the study plan and objective, including identification of the fish species of interest and the life stages at issue. The third step in implementation of the study. The fourth step is analysis and the fifth step is resolution or recommendation.

The first two steps will be done using the "Structured Decision Making Process" (SDM.) http://structureddecisionmaking.org/ This collaborative process includes three parts: a facilitator; an "Expert Science Team" or EST (composed of tribal, State and federal "resource specialists,") and a Stake Holder Committee or SHC comprised of landowners, environmental groups and other interested parties. The facilitator will reach out to identify the SHC members. The role of the SHC will be to establish technical qualifications for experts and nominate and review candidates to be their representatives on the EST.

The facilitator will use a consensus process to manage relationships between the SHC and EST, including the task of problem identification. The EST will review the data and research and come up

with specific recommendations on technical approaches, implementation strategies and timing for the study planning. Specific work products will be adopted through a facilitated consensus between the EST and SHC.

2011 PROPOSED FEDERAL COHO RECOVERY PLAN: The proposed plan is poorly crafted. It identifies agriculture as a "very high" threat to threatened coho salmon on the Scott and Shasta rivers. The plan calls for cutbacks on Scott and Shasta farmers' stream water use as well as establishing statewide groundwater permitting programs. There's also litany of habitat restoration efforts including planting more trees along streams, adding gravel to the streambeds to improve salmon spawning areas, limiting road run off and removing barriers for passing fish. Among other things, the plan identifies "ephemeral" streams or arroyos with historically documented intermittent flows as having "intrinsic potential" for fish. This results in a substantial overstatement in the expectation of potential fish production goals. (Siskiyou County comments on proposed NOAA recovery plan for coho salmon.)

2011 LAWSUIT TO KNOCK DOWN THE PROGRAMMATIC ITP: A successful lawsuit filed by Klamath Riverkeeper, Quartz Valley Indian Reservation and other fishing and environmental interests stopped the programmatic ITP permit process on the basis that it was too lenient. Many water users also opposed the permit and refused to participate in the program because it was too restrictive and took property in water without compensation. Individual ITPs and 1602s may be acquired. The California Environmental Quality Act (CEQA) will apply to both the ITP and the 1602 permitting process. Depending on the extent and impact of the project, this could mean a simple Categorical Exemption with a checklist for projects with no significant effects (unlikely); a mitigated negative impact declaration with various required studies and a public comment period; or a full blown Environmental Impact Report (EIR) prepared by a contracted consultant. Costs of such reports can range from $10,000 for a small project to well over $100,000 for an irrigation district. There are also fees for the application and filing.

2012 HOOPA TRIBE PETITIONS FERC: The Hoopa Tribe has petitioned FERC to re-assert jurisdiction over the Klamath Hydroelectric Dams and their relicensing or removal. In the petition the Tribe asks FERC to issue a Declaratory Order: *"(a) finding that the license applicant, PacifiCorp, has failed to diligently pursue re-licensing of the Klamath Project; (b) ordering PacifiCorp's re-license application dismissed; and (c) directing PacifiCorp to file a plan for decommissioning of Project facilities."*

ENDNOTES

[i] California has a dual system of water rights that blends civil law with common law. The gold fields of California continued the law established under Mexican rule of "first in time, first in right." Appropriative rights were acquired by "possession" through "posting and recording notice of intention to divert a specific quantity of water, actual diversion and application of water to beneficial use with reasonable diligence, continued exercise of the right, priority of time of initiating the appropriation, and doctrine of prior appropriation of water for beneficial use." (Wells A. Hutchins in Water Rights Laws in the Nineteen Western States, pg. 161) The 1851 California Practice Act affirmed mining customs and usages.

However, in 1850, California had also adopted the common law of England so far as not repugnant to or inconsistent with the Constitution of the United States or laws of the State; (Ca. Stats. pg. 219.) This included the English doctrine of riparian rights. Riparian lands are those contiguous to a stream.

Riparian rights include natural use/domestic purposes (household, garden, barnyard) and artificial use/commercial purposes (watering of commercial herds, irrigation of commercial riparian farmland, power, recovery of gravel.) Riparian users share water "correlatively" or equally.

Most western states use just the Doctrine of Appropriative Rights. Most eastern states use just English common law as regards water rights. The "dual system" in California has blended the two systems. Because of its early and rapid settlement, most "appropriative rights" were acquired while land was still in the public domain. Under the "Doctrine of Presumption," it was presumed by the CA Supreme Court, that absent specific legislation, everyone who wished to "appropriate" water or to dig gold on the public domain within California could do so. Ownership of a water right "as a substantive and valuable property" was held to be "distinct sometimes, from the land through which it flows." [Conger v. Weaver, 6 Cal. 548, 555; (1856); McDonald v. Bear River and Auburn Water and Min. Co.. 13 Calif. 220, 232; (1859).] Until transfer of title from the public lands to private ownership could be made through patent, the "right of possession" and priority of use, determined the right of ownership in water use, mineral extraction, range use, rights-of-way, entry and homesteading of land as between individuals. This right was considered perfect against any claimant but the U.S.[Palmer v. Railroad Commission, 167 Calif. 163, 168, 138, 170-173, 138 Pac 997 (1914.) With no formal act of control by Congress over the public domain, the courts accepted inaction by Congress as a "period of silent acquiescence" or tacit consent [Forbes v. Gracey, 94 U.S. 762, 763, 766-767 (1877.)

Later, the court ruled that the United States had formally accepted the appropriative invasion of its riparian title through the Mining Acts of 1866 and 1870, and the Desert Land Act of 1877. Riparian rights did not attach to land owned by individual owners until the land was formally patented. The owner then took title to the land subject to these previously acquired appropriative rights. (Duckworth v. Watsonville Water & Light Co., (150 Calif. 520, 525, 528-529, 531 89 Pac. 338 (1907); San Joaquin & Kings River Canal & Irr. Co. v. Worswick, (1922); Duckworth v. Watsonville Water & Light Co., 170 Calif. 425, 432, 150 Pac. 58 (1915); 1921 Holmes v. Nay, 186 Calif. 231, 234-235, 199 Pac. 325.)

[ii] One of the basic doctrines of English law received by the United States was "that the king is bound by his own and his ancestors' grants; and cannot, therefore, by his mere prerogative, take away vested rights, immunities or privileges." (Chitty's Prerogatives of the Crown, page 132.) Barring specific reservation and subject to pre-established servitudes, a government land patent to an individual vests legal title and right to the located property to the extent it was held by the State or United States. It is considered in the nature of a compact and is an executed contract. It is a covenant that cannot be resumed, annulled or later modified by the grantor through legislation or otherwise. [A right vested, cannot be divested. Cited, 2 Dall. 297, 304; 9 Cranch 52; Green v. Biddle, 8 Wheat. 1; Fletcher v. Peck, 6 Cranch 136.] By such grant, the property interest of the grantor is extinguished. The title passed is subject or subordinate only to the legitimate exercise of the police and eminent domain powers delegated by the body politic to government. (The early cases of Fletcher v. Peck, New Jersey v. Wilson, and Dartmouth College v. Woodward also established that the States could not "impair the obligation of contracts" by attempting to repeal or modify acts which had already created vested rights.)

[iii] In 1921, San Bernardino v. Riverside (186 Calif. 7, 29-30, 198 Pac. 784,) the court specifically stated that the 1911 amendment did not apply to private water use rights already vested:

> "Taken literally, this would include all the water in the state privately owned and that pertaining to the lands of the United States, as well as that owned by the state. It should not require discussion or authority to demonstrate that the state cannot in this manner take private property for public use...The constitution expressly forbids it..."

In 1914 Palmer v. Railroad Commission, 167 Calif. 138, 163, 168, 170-173, 138 Pac. 997, the Court

again ruled that this Amendment was not and could not be retroactive and could not operate to divest private property rights already vested at the time it was enacted. The only effect it could have would be as a dedication to the general public use of any riparian rights which the State at the time it was enacted might still have retained by virtue of its ownership of lands bordering upon a stream.

[iv] In 1939 Meridian v. San Francisco (13 Calif.-2d-424, 445, 449, 90 Pac.-2d-537,) the court clarified the assertion of State control over allocation of surplus or public waters of the State under the 1914 Water Commissions Act stating:

> "There are waters in the rivers and the streams of the state to which the riparian right first attaches. The rights of other lawful users on the stream also rightfully attach. In addition there are in many of the rivers and the streams of the state great volumes of water which pass on unused to the sea or to an inland drainage basin. In a real sense the excess water is a great natural resource available for the benefit of this and future generations, as the occasion for its use may arise. These excess waters constitute the public waters of the state to be used, regulated and controlled by the state or under its direction."

[v] The Court ruled in Acton v. United States, 401 F.2d 896 (9th Cir. 1968), cert. denied, 395 U.S. 945 (1969) that no property rights accrued to a licensee upon revocation which are compensable in condemnation.

[vi] Under the California Land Settlement Act of 1851, "each and every person claiming lands in California by virtue of any right or title derived from the Spanish or Mexican government" was required to submit a claim to a three-person commission or tribunal. This commission investigated claims to land, and made a determination of their validity as respected the United States. Act of March 3, 1851, ch. XLI ' 8, 9 Stat.631.(See California Powder Works Co. v. Davis , 151 U.S. 389 (1894) This provision was interpreted to include Indian tribes. In 1900, the Supreme Court affirmed a California court's confirmation of title of non-Indian claimants against Mission Indians claiming a right of permanent occupancy to the same lands. In Barker v. Harvey, 181 U.S. 481 (1900), the Supreme Court indicated that the Indian right of occupancy should be considered as a "right or title derived from the...Mexican government" even though that right may have antedated the establishment of the Mexican government. The Indians' right of occupancy was deemed abandoned for failure to present it to the land claims commission. Twenty-four years later, the Supreme Court declined to overrule Barker because of the unsettling effect it would have upon property titles in California. United States v. Title Ins.& Trust Co., 265 U.S. 472, 486 (1924). See also Summa Corp. v. California Ex Rel. Lands Comm'n, 466 U.S. 198 (1984) As a consequence of Article VIII, some Mexican land grants to "pueblos" or Indian cities were recognized by the lands commission.

[See Kappler on Indian Land Tenure particularly " LIMITATIONS ON INDIAN RIGHT TO OCCUPANCY AND POSSESSION OF LANDS IN CERTAIN PARTS OF UNITED STATES." excerpts: Hayt v. United States, et al. (38 Court of Claims, 455-460-465) "...the King of Spain made no concessions respecting Indian titles in Mexico, but claimed the whole country for his own; that this claim by virtue of conquest was maintained until Mexico acquired its independence and that Government in turn never acknowledged the existence of aboriginal title. The significance of the proposition is that if the Indian title to occupancy was never recognized by Spain and Mexico the title acquired by the United States was obtained free of encumbrance by virtue of previous Indian occupancy." "...as for Mexico, neither the researches of counsel nor the investigation of the court disclose recognition of aboriginal title by that Government."] See also Tee-Hit-Ton Indians v. U.S., 348 U.S. 272 (1955.)

The United States has accepted the fact that it long ago acquired the lands of the California Indians,

extinguishing their Indian title. The Jurisdictional Act of May 18, 1928, 45 Stat. 602, authorized the attorney general of the state of California to bring suit in the Court of Claims on behalf of the "Indians of California" for claims they might have against the United States "by reason of land's taken from them in the state of California by the United States without compensation . . .," any decree to be based upon the compensation proposed in certain ratified treaties of 1851-1852. Section 3 of that act provides: "Any payment which may have been made by the United States or moneys heretofor or hereafter expended . . . for the benefit of the Indians of California, made under specific appropriations for the support . . . of Indians of California, including purchases of land, . . . may be pleaded by way of set-off."

"The Court of Claims decided October 5, 1942, that the California Indians were entitled to recover as compensation the sum of $10,648,625, for 8,518,900 acres taken, less $764,033.50 for lands "set aside by the United States for the plaintiff Indians as reservations and otherwise, by Executive Orders, Acts of Congress . . ." 98 C. Cls. 583, Cert. Den. 319 U.S. 764, 102 C. Cls. 837. The court held that whatever lands those Indians may have held "became a part of the public domain . . ." because the Indians did not qualify before the Commission set up by the Act of March 3, 1851 (9 Stat. 631) to settle private land claims in California. (p. 592) (According to an article by Professor Edward D. Castillo, $17,053,941.98 was offered in 1944 minus deductions for costs. There was a distribution to 36,000 eligible Indians in California in the amount of $150. This was in reimbursement for the unratified treaty lands promised to Indians.)

> "It will be noted that this action in favor of the California Indian's is not a payment for money due the Indians, since the basis of the litigation and judgment is that these Indians lost their rights by reason of laches. Nor did this involve all lands of the California Indians. The payment is in the nature of a gift, equitable because the United States Senate failed to ratify an agreement with the Indians concerning those particular lands. The claims of the California Indians, based upon aboriginal title, is now in process of litigation. This suit also is based upon acquisition of the Indians' lands by the United States."

According to the Castillo article, the suit precipitated the creation of the federal Indian Claims Commission in 1946 for the purpose of seeking compensation for lost tribal lands. [Claimants had 12 years to file, after which suit was to be barred by the federal statute of limitations. Once claim was settled, according to a 1985 decision of the U.S. Supreme Court regarding the Shoshones, [Northwestern Bands v. U.S. 324 U.S. 335 (1945),] further claims to regain possession are barred.] By August of 1951, twenty-three separate petitions had been filed by attorneys on behalf of tribes in California. These were consolidated and a settlement of $29,100,000 was offered. In 1964 the offer was accepted and in 1968, about $600 was distributed to nearly 65,000 Indians in California. This was in reimbursement for non-treaty land claims that were not already settled [It should be noted that interest was not allowed on compensation claims if they were just an "aboriginal title" and not a "recognized title" secured by treaty.]

See Solicitor's memo 8/1/1960 suit in the Court of Claims on behalf of the "Indians of California" for claims they might have against the United States "by reason of land's taken from them in the state of California by the United States without compensation . . .,"

[vii] Memorandum Regarding the Power of the President to Set Aside by Proclamation or Executive Order Public Lands for Indian Reservations and Other Public Purposes, and the Right of the President to Revoke Such Order

[viii] In Hynes v. Grimes Packing Co., 337 U.S. 86 (1949) the Court stated: "An Indian reservation created by Executive Order of the President conveys no right of use or occupancy to the beneficiaries beyond the pleasure of Congress or the President. Such rights may be terminated by the unilateral action

of the United States without legal liability for compensation in any form even though Congress has permitted suit on the claim. Sioux Tribe v. United States, 316 U.S. 317 ; see United States v. Santa Fe Pacific R. Co., 314 U.S. 339 , at page 347, 252. When a reservation is established by a treaty ratified by the Senate or a statute, the quality of the rights thereby secured to the occupants of the reservation depends upon the language or purpose of the congressional action. Since Congress, under the Constitution, 3 of Art. IV, has the power to dispose of [337 U.S. 86 , 104] the lands of the United States, it may convey to or recognize such rights in the Indians, even a title equal to fee simple, as in its judgment is just. Shoshone Indians v. United States, 324 U.S. 335 , 339, 340, 692, 693. When Congress intends to delegate power to turn over lands to the Indians permanently, one would expect to and doubtless would find definite indications of such a purpose."

[ix] Winters v. United States (207 U.S. 564 (1908) Reserved Water Rights. Winters Doctrine. The Court upheld the power of the federal government to exempt waters from appropriation under state water law, and held that the government had in fact reserved the waters of the Milk River in order to fulfill the purposes of the agreement between the Indians and the United States. The case dealt only with current needs and did not address the future needs of the Indians. *Skeem v. United States*, 273 F. 93 (9th Cir. 1921)(applying *Winters* Doctrine to allotted lands:)

> "Reserved" water rights are unlike riparian rights or prior appropriation rights, although they contain elements of both. For example, like riparian rights, reserved rights are appurtenant to land; that is, land ownership is the basis of the right. Also like riparian rights, reserved rights are not lost by nonuse. But reserved water can be used on nonriparian lands. And like prior appropriation rights, reserved rights have priority dates which reflect the security of the right. . . . However, the priority date for reserved rights is the date of the reservation or earlier, not the date of diversion, as in the case of most appropriation rights.'

The chief characteristic of reserved rights is that they are federal rights, grounded on the (mostly implied) intent of the federal government to reserve water for its purposes. This characteristic serves to distinguish reserved rights from both prior appropriation and riparian rights. [In Re: The general Adjudication of all rights to use water in the Big Horn System and all other Sources, State of Wyoming Case Number: 00-296 Decided: 06/14/2002]

[x] "Federal nexus" - Federal Endangered Species Act Section 7 - federal agency funds, authorizes or carries out the program or project. Federal agency determines effects. Federal agency consults with USFWS. Trigger "may effect" determination. USFWS writes concurrence letter or biological opinion. Non-federal entity involved in program or project follows conservation measures provided by federal agency.

[xi] Under the California Endangered Species Act (CESA,) anyone is prohibited from "taking" a listed species in the process of an otherwise legal activity without getting an ITP. ("Take" means pursue, catch, capture, or kill, or attempt to pursue, catch, capture or kill.) The permit application process involves the submission of an application with supportive information. The DFG will determine what actions need to be taken to "avoid and minimize" take. A permit cannot be issued if the activity will jeopardize the species. Under Fish and Game Code 2081, permit holders are also required to "fully mitigate" their take. This means that the fish population is to be left no worse for the activity. For a small landowner, this may require mitigating conditions such as paying into a fund to restore coho or a requirement to reduce their diversions below their adjudicated water use right.

[xii] Fish and Game Code 5937: "The owner of any dam shall allow sufficient water at all times to pass through a fishway, or in the absence of a fishway, allow sufficient water to pass over, around or through the dam, to keep in good condition any fish that may be planted or exist below the dam. During the

minimum flow of water in any river or stream, permission may be granted by the department to the owner of any dam to allow sufficient water to pass through a culvert, waste gate, or over or around the dam, to keep in good condition any fish that may be planted or exist below the dam, when, in the judgment of the department, it is impracticable or detrimental to the owner to pass the water through the fishway. "

[xiii] Watermaster service is required under the Shasta River (water) Adjudication. Under the Scott River Adjudication, Shackleford, French Creek, Oro Fino, Sniktaw and Wildcat Creeks are watermastered, but not the mainstem Scott. Water adjudications result in a "decree" of the Superior Court finalizing the priority, quantity, point of diversion, season, purpose and place of water use for every water use right claimant in the system. The watermaster service assures that the adjudicated amounts are fairly distributed among water right owners according to the court decree. The watermaster is an officer of the court.

Part 2 - The Global Agenda –

IWRM - a Blueprint for Control

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The most widely accepted definition of IWRM is that given by the Global Water Partnership: ***"IWRM is defined as a process that promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems".*** (Report on Progress on IWRM and Water Efficiency Plans (2008).

It is the consensus of the International community that water resources shall be managed according to the tenets of Integrated Water Resources Management (IWRM):

> " Article 26 of the Plan of Implementation adopted at the World Summit on Sustainable Development (WSSD) in Johannesburg in 2002 called for countries to develop Integrated Water Resources Management and Water Efficiency Plans by 2005." (The United Nations World Water Assessment Programme (UNEP) Integrated Water Resources Management in Action WWDR3)
>
> "The Intergovernmental Panel on Climate Change (IPCC) emphasizes the goal of achieving 'sustainable' water resources management through IWRM. Land and water governance are seen as important components…" (The United Nations World Water Assessment Programme (UNEP) Integrated Water Resources Management in Action WWDR3)
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> …"it is generally accepted that to manage water resources there is no alternative to IWRM." (IWRM for Sustainable use of Water - Background document to the FAO/Netherlands Conference on Water for Food and Ecosystems 2004)
>
> "This is the rationale for the Integrated Water Resources Management (IWRM) approach that has now been accepted internationally as the way forward for efficient, equitable and sustainable development and management of the world's limited water resources and for coping with conflicting demands."(Report on Progress on IWRM and Water Efficiency Plans (2008).
>
> "Integrated approaches:.... Rio+20 should adopt a target (rather than resolution) calling for "each country to develop, by 2015, its specific targets and timeframes for preparing and implementing a programme of action and financing strategy to implement integrated water resources management plans". (Policy brief Global Water Partnership Rio+20: Water Security for Growth and Sustainability)

The platform from which Integrated Water Resources Management (IWRM) was internationally launched is called the The Dublin Statement on Water and Sustainable Development which included the "Four Dublin Principles." These principles were formulated at the International Conference on Water and the Environment held in Dublin Ireland in 1992. [This was in preparation for the United Nations Conference on Environment and Development (UNCED) or "Earth Summit" scheduled later that year in Rio de Janeiro, Brazil.]

The keynote paper at the Dublin Conference entitled Water and Sustainable Development, stated: "The real value of the concept of sustainable development is that it emphasizes that the potential - or carrying capacity- of resources should be examined first, rather than just planning [for socio-economic development] and minimizing the adverse environmental impacts later." (IWRM for Sustainable use of Water - 50 Years of international experience with the concept of integrated water management Background document to the FAO/Netherlands Conference on Water for Food and Ecosystems.)

The Four Dublin Principles are:

(1) "*Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment.* Since water sustains life, effective management of water resources demands a holistic approach, linking social and economic development with protection of natural ecosystems. Effective management links land and water uses across the whole of a catchment area or groundwater aquifer.

(2) "*Water development and management should be based on a participatory approach, involving users, planners and policymakers at all levels.* The participatory approach involves raising awareness of the importance of water among policy-makers and the general public. It means that decisions are taken at the lowest appropriate level, with full public consultation and involvement of users in the planning and implementation of water projects.

(3) "*Women play a central part in the provision, management and safeguarding of water.* This pivotal role of women as providers and users of water and guardians of the living environment has seldom been reflected in institutional arrangements for the development and management of water resources. Acceptance and implementation of this principle requires positive policies to address women's specific needs and to equip and empower women to participate at all levels in water resources programmes, including decision-making and implementation, in ways defined by them.

(4) "*Water has an economic value in all its competing uses and should be recognised as an economic good.* Within this principle, it is vital to recognize first the basic right of all human beings to have access to clean water and sanitation at an affordable price. Past failure to recognize the economic value of water has led to wasteful and environmentally damaging uses of the resource. Managing water as an economic good is an important way of achieving efficient and equitable use, and of encouraging conservation and protection of water resources."

Two additional sections of the Dublin Statement promoted "integrated management:"

(1*)" Protecting aquatic ecosystems* -Integrated management of river basins provides the opportunity to safeguard aquatic ecosystems, and make their benefits available to society on

a sustainable basis.

(2)"*Resolving water conflicts* -In the coming decades, management of international watersheds will greatly increase in importance. A high priority should therefore be given to the preparation and implementation of integrated management plans, endorsed by all affected governments and backed by international agreements." (The Dublin Statement on Water and Sustainable Development)

In 1992, Agenda 21was adopted by more than 178 Governments, (including the United States – signed by President G.H.W. Bush,) at the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil. As Agenda 21 was considered a "soft law" [i] agreement, the Senate was not required to ratify it. The most salient statements in Chapter 18, the chapter on Integrated Water Resources Management, are found at Section 18.6 and Section 18.35

> "Integrated water resources management is based on the perception of water as an integral part of the ecosystem, a natural resource and a social and economic good, whose quantity and quality determine the nature of its utilization. To this end, water resources have to be protected, taking into account the functioning of aquatic ecosystems and the perenniality of the resource, in order to satisfy and reconcile needs for water in human activities. In developing and using water resources, priority has to be given to the satisfaction of basic needs and the safeguarding of ecosystems. Beyond these requirements, however, water users should be charged appropriately."
>
> "Long-term development of global freshwater requires holistic management of resources and a recognition of the interconnectedness of the elements related to freshwater and freshwater quality...Many of these problems have arisen from a development model that is environmentally destructive and from a lack of public awareness and education about surface and groundwater resource protection. ... There is a widespread lack of perception of the linkages between the development, management, use and treatment of water resources and aquatic ecosystems. A preventive approach, where appropriate, is crucial to the avoiding of costly subsequent measures to rehabilitate, treat and develop new water supplies."

UN Agenda 21, Chapter 18 ; Protection of the Quality & Supply of Freshwater Resources: Application of Integrated Approaches to the Development, Management & Use of Water Resources" details the concept, stating that integrated water resources management:

(1) Should apply to "freshwater bodies, including both surface water and groundwater"; (Section 18.3.)

(2) "Should be carried out at the level of the catchment basin or sub-basin";(Section 18.9.)

(3) "Should incorporate environmental, economic and social considerations based on the principle of sustainability"; (Section 18.16)

(4) Should give consideration "to water quantity and quality aspects"; (Section 18.3.)

(5) Should "understand and quantify the threat of the impact of climate change on

freshwater resources" and the "potential impacts of climate change on areas prone to droughts and floods"; (Section 18.84)

(6) Should maintain "ecosystem integrity, according to a management principle of preserving aquatic ecosystems, including living resources, and of effectively protecting them from any form of degradation on a drainage basin basis"; (Section 18.38)

(7) "Should Conserve and protect wetlands; (Section 18.40)

(8) Should ensure that "rural communities will have access to safe water in sufficient quantities and adequate sanitation to meet their health needs and maintain the essential qualities of their local environments"; (Section 18.73)

(9) Should be incorporated into the planning framework at the national level where response strategies to climate change are developed, reviewed and implemented; monitoring of freshwater resources, legislation, regulation and economic measures established; (Sections 18.12 and 18.90.)

(10) Should harmonize Regional Action programs with national strategies; (Section 18.12.)

(11) Should delegate government services to local authorities, private enterprises and communities; (Section 18.12.)

(12) Should utilize public participation, including women, youth, indigenous people and local communities in decision-making, particularly the enhancement of the role of women in water management policy-making and decision-making; (Section 18.9.)

(13) Should include "measures for the protection and conservation of potential sources of freshwater supply, including the inventorying of water resources, with land-use planning, forest resource utilization, protection of mountain slopes and riverbanks and other relevant development and conservation activities"; (Section 18.12)

(14) Should monitor and assess the use of water and land resources, including the identification of potential sources of freshwater supply and the "extent, dependability and quality of water resources and of the human activities that affect those resources"; (Section 18.23.)

(15) Should "identify the surface and groundwater resources that could be developed for use on a sustainable basis and other major developable water-dependent resources and, simultaneously, initiate programmes for the protection, conservation and rational use of these resources on a sustainable basis"; Section 18.39)

(16) Should take into account the "need for integration with land-use management"; (Section 18.21.)

(17) Should "put in place strategies for the environmentally sound management of freshwaters and related coastal ecosystems, including consideration of fisheries, aquaculture, animal grazing, agricultural activities and biodiversity"; (Section 18.39)

(18) Should implement "allocation decisions through demand management, pricing mechanisms and regulatory measures"; (Section 18.12.)

(19) Should "promote community ownership and rights to water-supply and sanitation facilities"; (Section 18.76)

(20) Should recognize water as a social, economic and life-sustaining "good" [commodity;] (Section 18.17)

(21) Planning should consider the various available options for charging fees to water users (domestic, urban, industrial and agricultural water-user groups) to include "opportunity costs and environmental externalities," in recognition of water as a social and economic good; (Section 18.15.)

(22) Should reflect the "true cost" of water as an economic good – reflecting benefits investment, environmental protection, operating costs, the most valuable alternative use of water and the "ability of the communities to pay" in establishing charging mechanisms; (Section 18.16.)

(23) Should a) apply the "polluter pays" [ii] principle, where appropriate, to all kinds of sources, including on-site and off-site sanitation; and b) require "mandatory environmental impact assessment of all major water resource development projects potentially impairing water quality and aquatic ecosystems, combined with the delineation of appropriate remedial measures"; (Section 18.40)

(24) Should "introduce suitable cost-recovery mechanisms, taking into account efficiency and equity through demand management mechanisms"; (Section 18.76)

(25) Should promote "water conservation through improved water-use efficiency and wastage minimization schemes for all users, including the development of water-saving devices;" (Section 18.12.)

(26) Should establish, "biological, health, physical and chemical quality criteria for all water bodies (surface and groundwater), with a view to an ongoing improvement of water quality"; (Section 18.39)

(27) Should prevent "aquifer pollution through the regulation of toxic substances that permeate the ground and the establishment of protection zones in groundwater recharge and abstraction areas"; (Section 18.40)

(28) Should "prevent adverse effects of agricultural activities on water-quality for other social and economic activities and on wetlands, inter alia, through optimal use of on-farm input and the minimization of the use of external input in agricultural activities"; (Section 18.76)

(29) Should, based upon the 1977 Mar del Plata Action Plan, assess and forecast the quantity and quality of water resources, in order to estimate the total quantity of water resources available and their future supply potential, to determine their current quality status, to predict possible conflicts between supply and demand and to provide a scientific database for rational water resources utilization [iii];(Section 18.24)]

(30) Should "improve networks to meet accepted guidelines for the provision of data on water quantity and quality for surface and groundwater, as well as relevant land-use data; (Section 18.27) and

(31) Should include consideration of sustainable urban development. (Section18.5)

Agenda 21 recommended that all states "…adopt an integrated approach to environmentally sustainable management of water resources, including the protection of aquatic ecosystems and freshwater living resources; (Section 18.39) It gave a target of the year 2000 for all states "to have designed and initiated costed and targeted national action programmes, and to have put in place appropriate institutional structures and legal instruments"; (Section 18.6)

In 1997, at the 11th Plenary Meeting, the U.N. General Assembly Adopted the Programme for the Further Implementation of Agenda 21 stating that there is an urgent need: (a) "To assign high priority, in accordance with specific national needs and conditions, to the formulation and implementation of policies and programmes for integrated watershed management, including issues related to pollution and waste, the interrelationship between water and land, including mountains, forests, upstream and downstream users, estuarine environments, biodiversity and the preservation of aquatic ecosystems, wetlands, climate and land degradation and desertification, recognizing that subnational, national and regional approaches to fresh-water protection and consumption following a watershed basin or river basin approach offer a useful model for the protection of fresh-water supplies";(e) …"Consideration should be given to the gradual implementation of pricing policies that are geared towards cost recovery and the equitable and efficient allocation of water, including the promotion of water conservation, in developed countries."

In 1998, freshwater was discussed at the intergovernmental level at the sixth session of the United Nations Commission on Sustainable Development , affirming a commitment to Chapter 18 of Agenda 21. and IWRM. In 2000, the World Water Forum at the Hague issued the World Water Vision: Making Water Everybody's Business:

Executive Summary:

> (Describing the future) "Secure and equitable access to and control of resources—and fair distribution of the costs and associated benefits and opportunities derived from conservation and development— will be the foundation of food and water security. Efforts to overcome sector-oriented approaches and to integrate catchment management strategies will continue to be supported by wider social and institutional changes...They will fully incorporate the value of ecosystem services in their cost benefit analysis and management."
>
> "*Reallocating water from lower- to higher-value uses.* Shifting from agriculture to municipal and industrial uses—or from low-value to high-value crops—can increase the economic productivity or value of water."

Chap. 2 The Use of Water Today:

> "Freshwater and terrestrial ecosystems are integral parts of the water cycle. Their protection requires careful management of the entire ecosystem. For freshwater

ecosystems, this implies integrated planning and management of all land and water use activities in the basin, from headwater forests to coastal deltas."

Chap. 3 Water Futures:

" Above all, ecosystems will be protected by integrated land and water resource management basin by basin— along with full cost pricing for water services and management reforms for water delivery and wastewater disposal."

Chap. 4 Our Vision of Water and Life in 2025:

"Institutional structures, including river basin commissions and catchment committees, actively support the equitable distribution of goods and services derived from freshwater ecosystems. Both husbands and wives are members with voting rights in water user associations in farming communities. Clear property and access rights and entitlements ensure that individuals, companies, and organisations holding those rights meet their associated responsibilities. Enforcement by government regulatory agencies at the local, regional, and national levels is still important for resolving a number of conflicts, such as those between upstream and downstream users.

"Empowered communities and individuals, both women and men, regularly participate in all levels of decisionmaking on water resource management. In the United States in 2000, all states, territories, and tribes had completed unified watershed assessments. Local involvement and coordination with stakeholders was an important element in all assessments. Now more equitable conditions give local communities rights, access to, and control over land, water, and other resources. Laws, markets, and regulations increasingly recognise local people's rights and needs, making possible the sustainable use of natural resources and reconciling livelihood needs with ecosystem functions and requirements."

In 2000, the influential IUCN (International Union for Conservation of Nature) released a Vision for Water and Nature as an integral part of the World Water Vision.

"...In this world, more equitable distribution will bind people, societies and nations, reducing the schism between 'haves' and 'have-nots'. It envisages people-centred development that values both quality and quantity, that concentrates on equitable sharing, that recognises the need to maintain the diversity and productivity of ecosystems, and that values long-term sustainability above short-term revenue."

"Respecting the intrinsic values of ecosystems, and the benefits they provide, implies leaving water in ecosystems to maintain their functioning. This water, together with the water that is needed to meet basic human needs, is a reserve that has priority above all other water uses. Only water resources in excess of these basic needs should be thought of as "available" for allocation to other uses. 'Water resources,' in the broadest sense, include water in all compartments of the water cycle, together with all the living resources this water supports, such as fish, amphibians and water flora."

"To leave water in ecosystems will, in many cases, require a reduction in the total

amount of water abstracted from rivers and groundwater systems. Inevitably this will require a corresponding reduction in the water demands of agriculture, industry and direct human consumption. To reduce total human water demand requires both behaviour changes, such as reduced consumption, and technical improvements in water distribution, such as improved irrigation efficiency and water supply leakage reduction."

"... Decommissioning of dams is increasingly seen as an option to bring back the proper functioning of river ecosystems. In many countries, like France, the United States and Canada, the relicensing of a dam facility provides the opportunity to improve the dam structure to allow environmentally-appropriate flows, or to decommission the dam if environmental impacts are judged too severe (Delaunay 1999)."

"Achieving sustainable use of freshwater ecosystem resources will require equity in both decisionmaking and sharing of resources. To achieve equity within and between households, communities and nations will require NGOs, governments and private companies to maintain and sometimes create efficient, representative and sustainable institutions for catchment management. These institutions will have to provide alternatives for disenfranchised individuals and communities whose security is based on access to freshwater ecosystems and whose control over these resources has eroded."

"...To establish this process there are at least two prerequisites: firstly, an effective legal system that protects citizens against injustice should be in place and, secondly, an appropriate institutional set-up that provides equal opportunities for all parties to be informed and participate in the planning and negotiation process. In many cases, local groups will only be able to join the planning or negotiations when they are able to raise sufficient public attention and action or build a legal case that allows them to participate."

"Policies and laws at international, national, subnational and regional levels should be further developed and harmonised by governments, and possibly United Nations agencies, to enable nature conservation and more equitable water and land resource use. The entire legal framework should facilitate accountability for environmental care for both the corporate and public sectors, as well as individuals..."

In 2000, the "Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy" (EU Water Framework Directive) established integrated river basin management for Europe. By 2010, most of the first WFD River Basin Management Plans (RBMP) were submitted to the EC in Brussels, and were in an early stage of implementation. The Framework established a single system of water management (river basin management) for all EU countries present and future. Its ultimate objective is to achieve "good ecological and chemical status" for all Community waters by 2015. Other goals are to:

- Expand the scope of water protection to all waters, surface waters and groundwater;
- Establish a "combined approach" of emission limit values and quality standards;
- Get the prices right;
- Get the citizen involved more closely; and
- Streamline legislation

Common Implementation Strategy (CIS): By 2003, Member States (MS) were directed to identify all the river basins lying within their national territory and to assign them to individual river basin districts. River basins covering the territory of more than one MS would be assigned to an international river basin district. MS were then to designate a competent authority for the application of the rules provided for in the Framework-Directive within each river basin district.

By 2004, each MS had to produce: an analysis of the characteristics of each river basin district; a review of the impact of human activity on water; an economic analysis of water use; a register of areas requiring special protection; a survey of all bodies of water used for abstracting water for human consumption and producing more than 10 m^3 per day or serving more than 50 persons.

By 2006, each MS was to have operational monitoring programs in place.

In 2009, management plans were to be produced for each river basin district, taking account of the results of the analyses and studies carried out. The plans cover the period 2009-2015. They shall be revised in 2015 and then every six years thereafter.

From 2010, Member States must ensure that water pricing policies provide adequate incentives for users to use water resources efficiently and that the various economic sectors contribute to the recovery of the costs of water services, including those relating to the environment and resources. In order to achieve the environmental aims and to include the major economic principles, water pricing policies must reflect the following costs:

- Financial costs: direct costs embracing the costs of supply and administration, operation and maintenance, and also capital costs.
- Environmental costs: cost of the waste caused by water use on the ecosystem, for example: salination or degradation of productive soils.
- Resource costs: cost of resource depletion leading to the disappearance of certain options for other users.

The HarmoniCOP project (Harmonising Collaborative Planning 2002 -2005) was to increase the understanding of participatory river basin management planning (RBMP) in Europe. The project's objective was to "generate practical information about participation processes in river basin management and to support the implementation of the public participation provisions of the European Water Framework Directive." Handbook on PP (Public Participation.) [This model was highlighted in the CA Water Plan Update.]

The Methods and Tools for Integrated Sustainability Assessment (MATISSE project) ended in 2008. The objective of MATISSE was "to achieve a step-wise advance in the science and application of Integrated Sustainability Assessment (ISA) of EU policies. In order to reach this objective the core activity of the MATISSE project is to improve the tool kit available for conducting Integrated Sustainability Assessments." Working papers; Integrated Sustainability Assessment: What? Why? How?; Tools for Integrated Sustainabiility Assessment: a Two-Track Approach; Developing new methods and tools for the Integrated Sustainability Assessment of water. The MATISSE project and the Ebro River Basin.; Participatory Modelling for the Integrated Sustainability Assessment of Water: the World Cellular Model and the MATISSE Project; Sustainability learning in the management of social-ecological systems; Incentives and frameworks for increasing the capital value,

service value and use rates of durable goods; Modelling cultural and behavioural change in water management: An integrated, agent-based, gaming approach.; A Novel Hybrid Architecture for Agriculture and Land Use in an Integrated Modeling Framework

In 2002, the World Summit on Sustainable Development (WSSD) was held in Johannesburg South Africa. U.N. General Assembly resolution 55/199 directed that the Summit should focus on areas where further efforts were needed to implement Agenda 21. The General Assembly, in resolution 56/226, also encouraged new initiatives that would contribute to the full implementation of Agenda 21. Special emphasis was to be given in the areas of water, energy, health, agriculture and biodiversity. The United States was a participant. The following are excerpts of particular interest from the."Johannesburg Plan of Implementation"

IV.Protecting and managing the natural resource base of economic and social development

Article 24. Human activities are having an increasing impact on the integrity of ecosystems that provide essential resources and services for human well-being and economic activities. Managing the natural resources base in a sustainable and integrated manner is essential for sustainable development. In this regard, to reverse the current trend in natural resource degradation as soon as possible, it is necessary to implement strategies which should include targets adopted at the national and, where appropriate, regional levels to protect ecosystems and to achieve integrated management of land, water and living resources, while strengthening regional, national and local capacities..."

(c) "Promote priority action by Governments, with the support of all stakeholders, in water management and capacity-building at the national level and, where appropriate, at the regional level, and promote and provide new and additional financial resources and innovative technologies to implement chapter 18 of Agenda 21;"

Article 26. "Develop integrated water resources management and water efficiency plans by 2005, with support to developing countries, through actions at all levels to:

(a) "Develop and implement national/regional strategies, plans and programmes with regard to integrated river basin, watershed and groundwater management and introduce measures to improve the efficiency of water infrastructure to reduce losses and increase recycling of water;

(b) "Employ the full range of policy instruments, including regulation, monitoring, voluntary measures, market and information-based tools, land-use management and cost recovery of water services, without cost recovery objectives becoming a barrier to access to safe water by poor people, and adopt an integrated water basin approach;

(c) "Improve the efficient use of water resources and promote their allocation among competing uses in a way that gives priority to the satisfaction of basic human needs and balances the requirement of preserving or restoring ecosystems and their functions, in particular in fragile environments, with human domestic, industrial and agriculture needs, including safeguarding drinking water quality;"

A feature of the 2002 World Summit on Sustainable Development was the WEHAB (Water, Energy, Health, Agriculture and Biodiversity) working group. One of their products was "A Framework for Action on Biodiversity and Ecosystem Management" The document introduces the concept of "ecosystem services":

> *"Ecosystem Services*. Forests, wetlands, coastal ecosystems and so on provide essential services that contribute in numerous ways to the productive activities of rural and urban poor people, including through the generation of water, cycling of nutrients, replenishment of soil fertility and prevention of erosion. These services are public goods, [iv] providing indirect values that are not traded in the market-place but are vital to the livelihoods of all people."

The Framework talks about the relationship of IWRM to "ecosystem" management - a concept advanced by the Convention on Biological Diversity (a treaty signed by President Clinton but never ratified by the Senate.):

> "The main framework for action under the CBD is the ecosystem approach, which is intended to help reach a balance of the three objectives of the Convention through the application of a strategy for the integrated management of land, water and living resources that promotes their conservation and sustainable use in an equitable way. It recognizes that humans, with their cultural diversity, are an integral component of many ecosystems. Principles and operational guidance for the ecosystem approach have been approved by the Conference of the Parties."

On 12 November, 2002, the United Nations Committee on Economic, Social and Cultural Rights (CESCR) adopted General Comment Number 15 (GC15), 'The Right to Water'. Under this policy framework, national governments would have six explicit obligations:

1. Realize that people have a right to lead a life with human dignity.
2. Recognize the entitlement of everyone to sufficient, safe, acceptable, physically accessible, and affordable water for personal and domestic uses.
3. Guarantee that the right to water is enjoyed without discrimination.
4. Recognize citizens' right to seek, receive and impart information concerning water issues.
5. Agree to the government's obligation to respect, protect and fulfill its citizens' rights to water.
6. Refrain from interference and sanction, and prevent violations by organizations of which the state is a member or which it administers.

The third World Water Forum was held at Kyoto, Japan in 2003, where IWRM concepts were detailed further. Analysis of the 3rd World Water Forum It was stated:

> "That water resources are a common property resource does not imply that water services should be free of charge"

> "The need to recognize explicitly access to drinking water and sanitation as a basic human right was crucial to most of the participants ... Rights to land and use of water are key determinants for people's potential to break out of the poverty trap. When rights are redistributed or new rights are assigned, this must be done on an equitable basis, recognizing the rights of women and men."

"Users not only have the right to have access to water services, but should also participate in decisionmaking on the management of resources. User participation has become an accepted principle but this should include the sharing of power: democratic participation of citizens in elaborating and implementing water policies and projects and in managing water resources."

"Water services, as a public good, must remain in the public sector and all governments must commit to public sector delivery of water services."

"IWRM is a process of political nature where different and often opposing water related interests are considered, balanced and decided upon. ... The importance, but also the difficulty of implementation of decentralization and stakeholder participation in water management are recognized and obtaining consent of all affected people as a selection of the stakeholders to be included in the decision making processes can be very difficult and controversial."

"Government agencies need to be enabled as 'guardians of groundwater' – working flexibly with local stakeholders as partners in resource administration, protection and monitoring, whilst also acting on broader water resource planning and management strategies."

"'Ecosystems are not only water users, but also and equally importantly water service providers. Environmental flows, with consideration to quantity, quality and timing, are an essential component of the catchment management approach... The estimates of environmental water requirements in river basin range from 20 to 50% of the total renewable water resources. On average, at least 30% of the world's water resources have to be kept in the environment to maintain a fair condition of freshwater ecosystems worldwide...As the sum of environment and human needs are greater than the resources available, the need for a multi-stakeholder approach to make necessary choices on water allocation priorities is pressing."

UNESCO (United Nations Educational, Scientific and Cultural Organization) Water and Sciences Program has published a lengthy IWRM "tool box" summarizing the basic elements of IWRM as it has matured: Highlights include:

Basis of IWRM: "Integrated water resources management is based on the perception of water as an integral part of the ecosystem, a natural resource and a social and economic good, whose quantity and quality determine the nature of its utilization. (Integrating three E`s) The IWRM approach "seeks to identify and achieve trade-offs between different management objectives, including environmental sustainability, economic efficiency and social equity." (A1.03 Climate change adaptation policies)

The Three Es: The IWRM framework, as developed by the GWP, [Global Water Partnership] consists of three Es - economic efficiency, social equity and ecosystem sustainability. The three Es are somehow in competition: a drop of water that is used for economy is not available for the ecosystem and for social needs; a drop of water kept for the benefit of an ecosystem is not available for the social needs and for the economy. How can a balance be achieved between these competing needs? The IWRM challenges to integrate these three Es: (1) Economic efficiency in water use: water must be used with maximum possible efficiency; (2) Equity: The basic right for all people to have access to water of

adequate quantity and quality for the sustenance of human well-being; and (3) Environmental and ecological sustainability: The present use of the resource should be managed in a way that does not compromise use by future generations of the same resource.

National Planning: IWRM is driven by a National Water Resources Policy which "sets goals and objectives for the management of water resources at the national scale and includes policies for regions, catchments, shared or transboundary water resources, and inter-basin transfers, all within an IWRM framework. It addresses both the quantity and quality aspects of both surface and groundwater resources and also deals with delivery of water services." It integrates planning for land and water resources. National planning will enable comprehensive redevelopment of water resources policies. By considering water as a social and economic good, policies will be designed to allocate resources to where they offer the greatest value to society, starting with the fulfillment of basic needs.

Government's role will be "as regulator, as organiser of the participatory process and as a last resort adjudicator in cases of conflict." (A101 Preparation of a national water resources policy)

"National IWRM plans include actions necessary to develop an effective framework of policies, legislation, financing structures, capable institutions with clearly defined roles and a set of management instruments. The purpose of such framework is to effectively regulate the use, conservation and protection of the water resources, balancing requirements for broad economic development and the need to sustain ecosystems..."The emphasis here is on the process of establishing priorities and actions for integrated management of water resources. Priorities include ecosystem protection and conservation." (C2 Plans for IWRM - Combining development options, resource use and human interaction)

National high-level "Apex Bodies": "Apex bodies consist of a range of entities such as high level steering groups within national governments, inter-agency task forces (for specific purposes e.g. water pollution control), and international consortia for the management of water resources. The aim of such bodies is to provide structures for co-ordination between different organisations involved in water resource management." Functions include: "Improved co-ordination of government functions through integrated plans of action"; "Structural change within government agencies to facilitate better co-ordination"; and "Creation of new departments or commissions and authorities for natural resources management, aligned to river basins and/or ecological zones."(B1.03 National apex bodies)

Management of activities in entire basin: The intent is: "The integrated management of water resources, ideally across the entire basin."... "All human activities have environmental repercussions that impact freshwater ecosystems. This requires regulation with respect to all aspects of human impacts on water-related resources in order to take into account flow regime, water quality, land use and freshwater fauna and flora. Legislation regulating these aspects includes permits, quotas, and restrictions on harvesting methods, endangered species protection, habitat protection and regulation against invasive species." (A2.01 Elements of Water Law)

Integration of water and land use law: "Integration of legal frameworks refers to the need for cross-sectoral inter-connectivity so as to minimize the potential conflicts between the various legal, policy and institutional frameworks that apply to the management of water resources. IWRM expresses the idea that water resources should be managed and allocated

in a holistic way, coordinating and integrating all aspects of water and land management, so as to bring sustainable and equitable benefit to those dependent on the resource. This is why the legal regime for managing water has to follow an integrative approach as well; which on a practical level means the legal, policy and institutional frameworks directly or indirectly affecting water resources management (e.g. forestry, energy, industrial development, municipal water supply, agriculture and environment) should be complimentary and regard must be given to the competing needs/requirements of these different sectors in any water plan, policy, legislation or permit to use water." (A2.03 Integrating Legal Frameworks for IWRM)

River Basin Organizations: "River basin organisations (RBOs) are specialised organisations set up by political authorities."... "Their functions vary from water allocation, resource management and planning, to education of basin communities, to developing natural resources management strategies and programs of remediation of degraded lands and waterways. They may also play a role in consensus building, facilitation and conflict management." Their function is "basin-wide planning to balance all user needs for water resources." (B1.04 River basin organisations)

Role of local government: "Local governments have a variety of economic instruments available to them to influence the behaviour of their citizenry. These include rate structures and charges, fees for permits and other governmental services, special taxes and surcharges, incentives (such as bonuses and rebates) as well as fines and penalties. These economic instruments are complemented by a variety of regulatory instruments, such as by-laws, that local governments can use to influence the implementation of IWRM practices within their boundaries." "Stakeholder based initiatives, such as Local Agenda 21 planning, can play a significant role in breaking down political barriers to IWRM activities in urban areas." (B1.10 Local authorities)

Role of Civil Society (Public)[v] "Appropriately organised, the public (civil society) can become a central partner in IWRM....For people to perform management tasks and influence overall management, they need to be organised, e.g. in water users' associations (WUAs). Other groupings include consultative groups, community groups and lobby groups....WUAs may form an "association of associations...All relevant categories of water users should be represented in the association. ..Public participation needs to be carefully managed to avoid capture by minority or particularly articulate groups; where this happens decision making becomes overly influenced by groups with limited legitimacy." (B2.01 Participatory capacity and empowerment in civil society)

Shared Vision Planning: "Changing water practices to achieve IWRM requires changes of deeply held attitudes in individuals, institutions, professionals and social organisations within civil society" ..."The key to encouraging an IWRM oriented civil society lies in the creation of shared visions, through joint diagnosis, joint creation of options, joint implementation, and joint monitoring. This itself requires broad stakeholder participation in water planning and operating decisions, and is another strong tool for encouraging such new civil orientation." (C4 Social change instruments - Encouraging a water-oriented society)

Water Resources Assessment: "A water resources assessment involves taking a holistic view of the water resources in a given country or region related to its use by society. The assessment looks at both the quantity and quality of surface- and groundwater. It identifies the pertinent parameters of the hydrological cycle, and evaluates the water requirement of different development alternatives. The assessment pinpoints the major water resources

issues and potential conflicts, their severity and social implications, as well as risks and hazards such as flood and drought. The understanding of the terrestrial and aquatic ecosystems is an essential element of resource assessment. " (C1 Water Resources Assessment - Understanding resources and needs)

Managing Water as an Economic Good: "There is also a need for mechanisms which ensure that economic sector decision makers take water costs and sustainability into account when making production and consumption choices. The development of an institutional framework capable of integrating human systems – economic, social and political – represents a considerable challenge." (Water is finite and vulnerable resource) "…it is vital to recognize first the basic right of all human beings to have access to clean water and sanitation at an affordable price." (Social and economic value of water;) [See also Resolution adopted by the UN General Assembly 64/292. The human right to water and sanitation: 1. Recognizes the right to safe and clean drinking water and sanitation as a human right that is essential for the full enjoyment of life and all human rights; 108th plenary meeting 28 July 2010]

Economic Instruments : "In general, economic instruments involve the use of prices and other market-based measures to provide incentives to consumers and all water users to use water carefully, efficiently and safely. Economic instruments may offer some advantages over other tools, such as providing incentives to change behaviour, raising revenue to help finance necessary adjustments, establishing user priorities and achieving overall IWRM management objectives at least overall cost to society." "Water pricing is an increasingly common tool applied to recover costs, to give the right incentives to users, and to protect the environment." "Pollution charges work in an analogous way, providing a disincentive for the anti-social release of polluted wastewater."

"The use of water for agriculture often illustrates a widespread problem that arises when water users have rights which are enshrined in law or custom, and cannot easily be revoked or amended. In such cases, the redistribution of water can sometimes be achieved by setting up markets in which rights can be traded, and holders are compensated through the market for surrendering their claims, either temporarily or permanently. Markets can also come to the aid of pollution prevention and control: the "right to pollute" within limits set by environmental regulators can be traded amongst firms, leading to abatement being achieved in the least cost manner."

"The use of water is, however, affected not only by its own price, but also by the prices of goods and services that consume water or affect its use in other ways. These prices are often distorted, and produce wrong signals to water users. A balanced programme of reforms has to address corrections to prices in agriculture, industry and other areas that affect the use of water. Taxes and subsidies can also be used to reinforce "green" behaviour." (C7 Economic Instruments - Using value and prices for efficiency and equity)"

Cap-net (Capacity Building for Sustainable Water Resources Management - U.N. Development Program) has an online IWRM tutorial that adds the following points:

> *"IWRM requires reform* -Because of the existing institutional and legislative frameworks, implementing IWRM is likely to require reform at all stages in the water planning and management cycle."
>
> *"Step-by-step process* -Implementation of IWRM is best done in a step-by-step

process, with some changes taking place immediately and others requiring several years of planning and capacity building."

"An overall plan - An overall plan is required to envisage how the transformation can be achieved and this is likely to begin with a new water policy to reflect the principles of sustainable management of water resources. To put the policy into practice is likely to require the reform of water law and water institutions. This can be a long process and needs to involve extensive consultations with affected agencies and the public."

The UN and other international organizations have played a significant role in the development of the IWRM concept through international conferences. UN agencies assumed a leadership role in the application of IWR in international transboundary agreements between nations sharing a water body. The European Union embraced IWRM as a policy backbone in its framework directive on water. During the past several years, concepts have been added and others refined.

In 2005, The Food and Agriculture Organization (FAO) published a "synthesis report" of an E-Forum organized as part of the FAO Netherlands Conference on Water for Food and Ecosystems - A "New Economy" for Water for Food and Ecosystems . The report expands on the notion of *PES - Payment for ecosystem services*:

"The challenge is to move towards a '*new economy*' for water for food and ecosystems that provides a sound mechanism to manage the values that water resources represent to societies. The basis for such a 'new economy' would be that water resources are managed in a way that reflects their values. Water policy and management decisions should reflect the economic, social and ecological value of fresh water with a given quality and in a given quantity, available in a certain place and at a certain time...Finally, a new economy, if it is to find general applicability, has to cut across different levels of water resources management: the local, national, regional and global levels."

"When water is scarce, choices have to be made on the use and allocation of these resources. These choices should take account of benefits to each user, the costs of service provision, and foregone benefits to users who do not have access to water. Although in theory market-pricing and tradable water rights can lead to an efficient allocation in a 'new economy' of water for food and ecosystems, the role of these instruments in water management is limited in practice. Water resources and water-related services are generally common pool resources with important public good aspects and this means that market, governance and institutional failures are likely to occur."

"Some of the market failures and practical constraints may be addressed through appropriate arrangements, but generally, "free market" solutions are rarely found in practice. Therefore, public interventions are required to ensure that water allocations, through market mechanisms or through public channels, satisfy the various demands of society as a whole..."

"Payment schemes for environmental services (PES) offer an example of a mechanism that can be applied at the catchment level to translate water values into

> economic incentives and financial flows. It means that upstream farmers in a catchment are financially compensated by downstream users to maintain or modify a particular land use that affects the availability and/or quality of downstream water resources"

PES schemes come with some specific requirements:

1. A clear link between downstream benefits and upstream management practices.
2. Downstream benefits that are relatively easy to translate into monetary terms and that can be ascribed to certain users (who then can pay.)
3. Downstream beneficiaries that have the ability to pay upstream farmers and landowners.
4. A legal framework and accompanying enforcement mechanisms that regulate the way in which PES schemes work and their contribution to desired outcomes.

> "...results indicate that the role of market mechanisms in water resources management appears to be smaller than what was envisaged a decade years ago in the Dublin declaration and than what is stated in the more recent EU Water Framework Directive: "Member states shall ensure that by 2010 water pricing policies provide adequate incentives for users to use water resources efficiently...." The E-Forum discussion clarifies that it is hard in practice to solve water problems that are essentially political in nature (income distribution, environmental sustainability, gender equity) through markets and pricing."

> "In the end, the political character of water resources management means that neither analytic valuation studies nor markets can be the primary drivers of water management decisions. Due to the political character of many water-related problems, politicians and stakeholders are the ones to be responsible and take responsibility for water management decisions. They may chose to use pricing instruments or to establish markets to establish a more efficient water allocation among users, but these will then require a well-formulated legal framework that safeguards certain basic societal values, as well as the institutional arrangements to enforce this legal framework. Instead of markets, policy makers and stakeholders can also choose to use other allocation mechanisms such as a right-based approach or participatory negotiations through local stakeholder platforms. Water markets and water pricing instruments do have a role in the new economy, but for now it seems to be limited to those situations where certain (institutional) requirements are met."

In 2007, UN-Water and GWP organized the International Conference on Managing Water Resources Towards 2015. The conference resulted in development of the statement UN - Water and Global Water Partnership (GWP) Roadmapping for Advancing IWRM Processes which established various global targets.

> "At the Thirteenth Session of the Commission on Sustainable Development (CSD) in 2005, all countries were called upon to accelerate the preparation of nationally-owned IWRM and water-efficiency plans...In addition, in 2006 all countries were requested by the UN Secretary General to "report on progress on IWRM and Water Efficiency Plans" at the CSD16 in 2008, in keeping with a recommendation of the UN Secretary General's Advisory Board on Water and Sanitation."

(Targets for 2009):

"Enabling conditions in place - Here, the focus would be on ensuring that enabling conditions are in place, and that change processes have been initiated in accordance, with a politically supported and approved legal framework and with allocation of appropriate financing sources for management functions. To illustrate the way in which countries might monitor progress in these areas, here are some possible examples of process indicators that could be used:

"Changes in enabling environment: Revision and amendment of policies and laws; Water is mainstreamed into national development policies, strategies, plans; Allocation of appropriate and sustainable funding in national budgets.

"Changes in institutional framework: Establishment of cross-sectoral coordination frameworks; Change of ministerial and departmental mandates; Formal involvement of stakeholder groups; Decentralization and delegation of decision making at the river basin, provincial/local and community levels; Capacity development of government staff and stakeholder groups.

"Changes in management instruments: Improvements in information management; Water resources issue assessment; IWRM strategy and plan development; Demand management of user behaviour and water use efficiency ; Social change instruments for public awareness, mobilization and conflict mediation; Regulatory instruments and associated enforcement frameworks; Economic instruments for behavioural change."

(Targets for 2012)

"IWRM change process taking effect - Here, the focus would be on ensuring that actual implementation of change processes takes place and that changes begin to take effect in the way "water managers" at all levels deal with water. here are some possible examples of performance indicators that could be used:

"Enabling environment: New legislation and standards, institutional capacity building is taking effect; Water resources agencies are starting to administrate according to new IWRM principles

"Institutional framework: Sector ministries are actively promoting and implementing the IWRM approach; Water use organisations and the private sector is increasingly coordinating water use in cooperation with government authorities; Awareness and management capacity is growing measurably in government and user groups.

"Management instruments: Monitoring and research programs are documenting the impacts and causes of major water issues; Transparent, coherent and consensus-based planning and strategy making is taking effect in all sectors; Social, economic and regulatory instruments are changing inappropriate water allocations and uses; Water conflicts across the sectors are mediated through participation of appropriate stakeholder groups."

(Targets for 2015)

> *"Mitigating key water constraints* - Here, the focus would be on reviewing the extent to which required water infrastructure has been developed and water resources management issues addressed, in accordance with the strategic goals and targets in water resources development and management plans "

In 2009, the United Nations World Water Development Report Number 3 "Water in a Changing World" dialogue paper Integrated Water Resources Management in Action incorporated the idea of "minimum flows" into IWRM:

> "Under its 2007 water policy and strategy, the UNEP2 freshwater programme promotes and assists ecosystem management to be an integral part of national and regional IWRM reform processes. Allocation of minimum flows for ecosystems (environmental flow) is strongly promoted by the IUCN3 and can be considered as a component of the IWRM framework."

In 2009, the influential IUCN released its paper "Rule, Reforming Water Governance" detailing a step by step approach on policy and institutional transition to the IWRM approach. The IUCN Water and Nature Initiative "Toolkit" includes elements on: Flow: the essentials of environmental flows; Change: adaptation of water resources management to climate change; Value: counting ecosystems as water infrastructure; Pay : establishing payments for watershed services; Share: managing waters across boundaries; and Negotiate: reaching agreements over water.

> "*Rule, Reforming Water Governance*" states that: "A unified code of water law must establish water rights and fair allocations, protect water quality for human and ecosystem uses as defined by water policy, and set up an institutional water management structure." The key to national water management is to establish river basin institutions to coordinate upstream-downstream water allocations and uses. "Success requires restructuring of National, legal and institutional frameworks to ensure they are appropriate for a new paradigm in water resources management."
>
> "Environmental Justice. This is defined as 'An existing condition where environmental risks and hazards and investments and benefits are equally distributed with a lack of discrimination, whether direct or indirect, at any jurisdictional level; and when access to environmental investments, benefits, and natural resources are equally distributed; and when access to information, participation in decision making, and access to justice in environment-related matters are enjoyed by all." "The preamble of national water laws usually contains statements of principles relating to social equity, conservation, protection of water sources and ecosystems, and sustainable development that reflect the idea that good water management practices are underpinned by a sound balance of developmental, environmental and conservation policies and practices."

3.2.4 Water law reforms

> "... a movement to review existing water laws and enact comprehensive new legislation has gained momentum since the early 1990s in reaction to global concern over scarcity of water and growing concerns over climate change. International insistence on the application of the IWRM concept and goals is an important driver of this change. Demand for broadening the scope of water law has grown to

encompass goals relating to distributional equity, environmental protection, efficiency of allocation, and security of legal tenure in the face of a volatile and shrinking resource base."

3.3.1 Who owns water and who has water rights?

"Because of water's fundamental role in sustaining life, new or reformed water policy and law should keep water rights within the public domain...These concepts range from ownership of water by the state to the state holding water 'in trust' for the public. In certain cases, the state has been recognized as having possession of 'superior use' rights. Regardless of the concept chosen, the concept of public waters makes the government the custodian of water resources and gives it both the authority to allocate water and the responsibility to protect it."

"In line with public ownership, the private rights of individuals have been relegated to being usufructuary in character. Usufruct rights are rights to the use of water resources without ownership. Replacement of the concept of private water rights with water rights conferred by government permit has produced an interface with property law, which is particularly poignant at two junctures: (a) when a reform is legislated for the first time, and (b) after the reform, if a permit-based right must be sacrificed in whole or in part to accommodate another use for water or for conservation..."

3.3.2 Allocating water to users

"A fundamental role of water law is to allocate available water resources to competing uses, whether in-stream or off-stream" ..."A transparent permit system enables the orderly allocation of a scarce resource, and provides checks and balances between the profit, or other, motivation of the permit seeker and the interest of the general public that the resource base is not depleted or contaminated beyond acceptable levels."

3.5.1 Environmental flows

"The IUCN toolkit FLOW defines an 'environmental flow' as the water regime provided within a river, wetland, or coastal zone to maintain ecosystems and their benefits when flows are regulated and when there are competing water uses. Environmental flows are usually different from natural flows, but they vary seasonally in volume according to the needs of ecosystems. They are determined through assessment of the impacts of changes in the volume and timing of flow on both the condition of ecosystems and river and water users..."Environmental flows are a scientific advance over the concept of 'minimum flows', which also appear in water law. The minimum flow is the least quantity of water required to maintain water quality and support the aquatic environment."

3.5.2 National water reserves and protected areas

"Many water laws contain provisions obligating the State to set aside national water reserves. A useful definition of 'national reserve' is 'the quality and quantity of water that is required to satisfy present and future basic human needs, as well as to

protect aquatic ecosystems and to secure sustainable development and use of that water resource'. Therefore water should not be extracted or used in a manner that will deplete the national reserve. Reserves are usually incorporated into water resource master plans or river/lake basin water resource plans and used in setting conditions for granting water licences."

"...establishment of protected areas to safeguard 'any water resource, riverine habitat, watershed, wetland, environment or ecosystem at risk of depletion, contamination, extinction or disturbance from any source, including aquatic and terrestrial weeds'. These provisions include the duty to publicize the purposes of declaring such an area, its geographic boundaries, and the activities that are prohibited within it. Declaration of a protected area can trigger restrictions on water abstraction, application of pesticides or fertilizers, road construction, or crop cultivation that modifies land contours, tree felling, mining, and effluent discharge."

"Areas of scenic beauty or recreational values can be subject to special protection. The U. S. Wild and Scenic Rivers Act of 1968 declares that certain selected rivers that have remarkable scenic, recreational, geological, fish and wildlife, historic, cultural or similar values, should be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations."

3.5.3 Ground water protection

"Specific provisions for protection of aquifers are common in water laws"... "Laws contain especially stringent controls to safeguard against overexploitation or depletion of ground waters. This concern reflects the need for water policy and law to preserve the natural interconnection between ground water and stream water because of the severity of damage to the environment that can result from overexploitation and pollution of aquifers."

"In the context of increasing competition for ever scarcer water resources, government-administered permit systems hold the best promise across the spectrum of legal systems for the orderly arbitration of conflicting interests, and for legitimizing the environment as a 'user' of the resource."

4.3.3 Basin level

"Almost all recent international conferences dealing with water have advocated for the river basin as the most appropriate unit to implement water management. The United Nations Water Conference (Mar del Plata, 1977) recommended that states should consider the establishment and strengthening of river basin authorities. The International Conference on Freshwater (Bonn, 2001) noted that river basins are the most appropriate frame of reference for water resource management, and the World Summit on Sustainable Development (Johannesburg, 2002) recommended countries adopt an integrated water basin approach."

"As shown in the IUCN toolkit VALUE, economic values can be determined for ecosystem services in watersheds. As a result, schemes can be put in place to enable beneficiaries to pay for the upkeep or restoration of ecosystem services. The IUCN

toolkit PAY provides a guide to the design and application of payment schemes for watershed services."

Water in the Green Economy in Practice: Towards Rio+20, .Zaragoza, Spain, 2011 details the emerging new "green economy" trading in "ecosystem services.[vi] The Earth Summit (called "Rio+20") will take place on June 20-22, 2012. The objectives of the Summit are: "to secure renewed political commitment to sustainable development; to assess progress towards internationally agreed goals on sustainable development and to address new and emerging challenges. The Summit will also focus on two specific themes: a green economy in the context of poverty eradication and sustainable development, and an institutional framework for sustainable development," (which includes the role of international environmental arbitration – e.g. an International Environmental Court.)

Where we are headed:

Chapter 1 Water : On the Road to Rio 20+

> "Rio+20 will focus on two themes: (1) how to build a green economy which delivers sustainable development and lifts people out of poverty; and (2) how to improve the institutional framework and international coordination for sustainable development. The emerging concept of the green economy has shaped much of the discussions in the preparation for Rio+20."
>
> "The green economy is, simply put, the practical and operational framework that will serve to implement the three pillars of sustainable development (environmental, economic and social). The United Nations Environment Programme (UNEP) define a green economy as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities...articulating the details of a green economy and identifying possible pathways to get there will be a major task for the Rio+20 Summit."
>
> "Water is the common thread that connects the three critical issues of food, energy and climate change. Sustaining economic growth is only possible if we recognise the limited capacity of ecosystems to supply the water needed for agriculture, industry, energy generation and the production of the many goods and services demanded by society. The green economy implies managing water in a way that catalyses social and economic development, whilst also safeguarding freshwater ecosystems and the services they provide."
>
> " To reverse the degradation of freshwater ecosystems, improved governance is needed which defines property rights, incorporates the full cost of water into decision making, and allocates water to the environment."

Chapter 2- Challenges and Opportunities for Water in the Transition to a Green Economy

> "Integrated approaches to water resources management are being implemented and are having impact on the ground. A recent global survey on water resources management shows that most governments have made progress with water sector reform to adopt principles of integrated management of water resources and are working through the process from policy to laws, strategies and plans...."

"Ecosystem Services - Environmental flow assessment is becoming an influential decision-support tool. Environmental flows describe the quantity and timing of water needed to sustain freshwater ecosystems and the services they provide. The implementation of policies to restore and protect environmental flows ensures the maintenance of ecosystems services which people and economies rely upon."

"Integrated management - Integration of land and water management instead of treating them as separate problems or allowing land management to drive water management."

Chapter 4 Conference Summary. Water in the Green Economy in practice

"...By influencing individuals' decisions, economic instruments can be used to incentivise individuals' behaviour in order to meet the goals of the green economy. Economic instruments are not ends in themselves but means to an end. For example, water prices, subsidies and water trading are neither 'right' nor 'wrong' but should be adopted on the basis of their ability to contribute to specific water policy objectives, including targets related to economic efficiency, social equity and environmental preservation."

"Water trading develops as part of the evolving progress in water governance... More advanced markets might even open the possibility, as in Australia, of introducing the environment as a formal water user through the buy-back of water use rights to return water to the environment."

"...The proper recognition and valuing of the services provided by ecosystems is a central requirement for a greener economy. Watersheds provide services that are critical for sustaining human life, economies and human welfare. The capacity of watersheds to support human welfare depends on their state of conservation."

"Markets recognise the importance of some of the services of natural ecosystems, mainly those that can be converted into commodities that can be traded in formal markets (such as crops, timber or electricity). Markets can reflect the value of benefits obtained from using water or the financial cost of capital and maintenance of water and sanitation services (e.g. the use of channels, irrigation devices, distribution networks or hydropower turbines). However, the opportunity costs of the detrimental impacts of these interventions (negative externalities) have been largely neglected and because of that there has been a failure to allocate water to its most beneficial uses. The limited recognition of the value of water and ecosystem services in decision-making has led to the overabstraction of water and systemic environmental degradation...."

"*Focus on Payment for Ecosystem Services* - Payment for Ecosystem Services (PES) provides a means to internalise the hidden benefits and costs of water use and water conservation, and a tool for financing watershed protection and conservation....Broadly defined, PES is a payment arrangement whereby beneficiaries of ecosystem services –typically those in cities downstream– pay those who engage in activities to secure the sustainable provision of those ecosystem services. Buyers and sellers will only engage in a PES scheme if it is of mutual benefit for both parties. The emergence of PES is therefore evidence of the benefits

that can be derived from coordinating individuals' actions to conserve watersheds and restore natural capital. PES is both a social arrangement to invest in natural capital and a means to agree on the distribution of the benefits from enhanced ecosystem services."

"The successful implementation of PES schemes around the world demonstrate that changes in land use practices can contribute to the restoration and conservation of watersheds. These changes can be achieved by paying farmers in an equitable manner, providing a means to improve their livelihoods whilst ensuring the sustainability of all water use in the catchment...in some countries PES may not be an option because farmers are already obliged to adopt good management practice and environmental protection by law."

"...Charges paid by water users must be set at a level that is acceptable to the water users but which still generates sufficient income to finance planned investments in environmental protection upstream; Payments to upstream land/water managers must be set at a level that is equitable and sufficient to act as an incentive to conserve natural resources (regardless of the stipulations of any contract or sanctions for non-compliance) rather than continue exploiting them unsustainably;"

"Water Planning - A major objective of water planning is to determine the desired balance between water use and water protection within an integrated water resources management framework. Successful cases of planning have shown that building governance and institutional capabilities to design and effectively implement long-term integrated water management plans can support green growth."

"Water planning enables the coordination and alignment of the many public policies (such as land use, urban and rural development, manufacturing and energy policies) and public policy objectives (such as economic efficiency, equity, basic needs coverage or cost recovery) which influence and are influenced by water management. Water planning makes water policy a horizontal axis connecting and coordinating many individual areas of public action."

"Deciding on the objectives for a river basin is a political and not a technical exercise. Identifying tradeoffs between different objectives and decision criteria in water management (such as efficiency, fairness, financial and environmental sustainability) is key to the planning process and provides the basis for political decisions to be made over what actions to take...Participation can address and manage the many social conflicts associated with the distribution of water amongst individuals, economic uses, time and regions. Planning is a means to promote a common vision of the river basin as a collective asset. Achieving this is dependent on effective participation that fosters the perception of water as a shared asset to be conserved by mutual cooperation rather than a common pool resource to be depleted by open access and competition."

"...Green growth requires considering water management at the heart of economic public policy;...River basin planning is the foundation for designing water policy that reconciles economic growth, the enhancement of freshwater ecosystems and the creation of jobs linked to the green economy. For this reason it is a priority that all river basins throughout the world develop a River Best management Plan"

Chapter 5 The Way Forward

"UN-Water and its member agencies have a number of monitoring mechanisms that can be instrumental in monitoring performance against commitments and targets agreed upon at the Rio+20 Summit. The UN World Water Assessment Programme (WWAP) and Global Analysis and Assessment of Sanitation and Drinking Water (GLAAS), FAO's global information system of water and agriculture AQUASTAT, and the UN-System of Environmental-Economic Accounting for Water (SEEA-Water) are prime examples of tools which could be utilised to assess the implementation of green economy policies, ensuring that governments live up to their commitments."

"Key Messages from UN-Water to Rio+20 - The integrated approach to water resources management, as defined in Agenda 21, remains relevant and must be central in strategies towards a green economy. In a recent global survey carried out by UN-Water as a contribution to the Rio+20 Summit, 80% of countries reported that they have embarked on reforms to improve the enabling environment for water resources management based on application of integrated approaches."

"Green economies can only be achieved if they are supported by green societies. Achieving sustainable development calls for enabling policies that take into account not only economic but also water-related scientific, social, educational and environmental considerations. This will foster "green societies" that promote a culture of sustainability together with a shift in behaviour and lifestyles, which would lead to sustainable consumption and production patterns."

"Economic instruments for water management in a green economy -Economic instruments (EIs) are all incentives to modify individuals' behaviour in a predictable way such as, for example, reducing water consumption, reducing pollution loads or adopting a modern irrigation technique. There is a need to increase the use of economic instruments, enforce them and share experiences in order to improve efficiencies in water supply and sanitation services and in water use. Utilising economic instruments in water management has a number of advantages. They can (i) avoid costly investments and make the case for low-cost, non-technical measures (e.g. ecosystem services to secure water or protect against floods); (ii) generate revenues to fund water management and water-related infrastructure; (iii) align incentives and strengthen policy coherence across the board (water, energy, food, land use); and (iv) provide information on the costs of status quo, the benefits of reform, and the distribution of these costs and benefits."

"Approaches - Environmental or green taxes; Water and sanitation charges; Marginal pricing to incorporate the scarcity value of water; Fees; Subsidies; Markets and trading (of water use and pollution rights); Market based instruments such as payment of ecosystem services; Consumer driven accreditation and certification schemes; Arrangements to send scarcity signals (including trading of water and emission rights, and offset schemes); Insurance schemes; Buy-back of water use rights for the environment."

The Global Water Partnership (GWP) was founded in 1996 by the World Bank, the United Nations Development Programme (UNDP), the Swedish International Development Cooperation Agency (SIDA) to foster integrated water resource management (IWRM.)

GWP is supported financially by the United States and other countries. It has prepared various recommendations for consideration at Earth Summit (Rio+20) to be held in June, 2012.

- "Water is a vital ingredient for the transition to a green economy, for poverty reduction and for sustainable development in all countries. It is crucial that the Conference outcomes include a sustainable development goal for water security as part of an agreed green growth agenda.."
- "Green growth is thus a means for countries to achieve green economies that provide well-being for present and future generations. This means that we all have to manage our economies differently, in a way that shows we know the future matters: inter-generational economic equity rather than short-termism."
- "Managing our natural resources for future generations, while harnessing them for necessary use now, is a balancing act that is increasingly recognised as fundamental for sustainability. Climate change has made even the highly industrialised countries (those responsible for the problem) realise that their economies are not sustainable and they now have to rethink the way they work."
- "...Water resources development and management requires joined-up thinking and institutional cohesion to decide on the re-allocation of water resources among users and to encourage more efficient use by all economic sectors."
- "There is a need for an integrated approach to water resources management – one that views water management as a means to advance a society's equity goals and not as an end in itself."
- IWRM's social equity goal is 'to ensure equitable access to water, and to the benefits from water use, between women and men, rich people and poor, across different social and economic groups both within and across countries, which involves issues of entitlement, access and control.'

Emerging Concept for Rio+20 - Integrated Environmental Governance

ENDNOTES

[i] "Soft law" are quasi-legal instruments which do not have any legally binding force, or whose binding force is somewhat "weaker" than the binding force of traditional law," Wikipedia]

[ii] Polluter Pays - Regulations to force polluters to bear the real costs of their pollution Encyclopedia Britanica

[iii] "*The goals of rational use include ensuring the conditions for human survival and obtaining material benefits. Also among the goals of rational use of natural resources are maximum utilization of every natural territorial complex and the prevention or maximum reduction of possible harmful consequences of production processes or other types of human activity. In addition, the rational use of natural resources is directed at maintaining and enhancing the productivity and attractiveness of nature, as well as at maintaining and regulating the economic exploitation of natural resources. Irrational use is manifested in the lowering of the quality of natural resources, in the squandering and exhaustion of resources, in the undermining of the restorative or generative powers of nature, and in the pollution of the environment and the decline of its healthful and aesthetic qualities*". - The Great Soviet Encyclopedia, 1979

[iv] *Public goods - Also called collective goods. These are a very special class of goods which cannot practically be withheld from one individual consumer without withholding them from all (the "nonexcludability criterion") and for which the marginal cost of an additional person consuming them, once they have been produced, is zero (the "nonrivalrous consumption" criterion). The classic example of a nearly pure public good is national defense: you cannot defend the vulnerable border regions of a country from the ravages of foreign invaders without also simultaneously defending everyone else who lives within the borders. The inability of potential providers to exclude people who refuse to pay from nevertheless consuming and benefitting from an expensive public good usually means that very many of the consumers of the good will act as free riders and choose not to help pay for its provision. Consequently private production of the good or service may prove unprofitable, and the good or service thus may not be provided at all by the free market — even though everyone might concede they would be better off with some positive level of production of the good in question.* A Glossary of Political Economic Terms

[v] Civil society: sphere of autonomous institutions, protected by the rule of law, in which men and women may conduct their business freely and independently of the state.

[vi] Living resources are of immense value and benefit to people. The materials and processes that ecosystems produce that are of value to people are known as "ecosystem services" and can be organized into four general categories (Millennium Ecosystem Assessment 2005):

- *Provisioning Services,* including food, water, medicines, wood, etc.
- *Regulating Services,* such as climate regulation, flood suppression, disease/pest control, or water filtration, etc.
- *Cultural Services*, such as aesthetic, spiritual, educational, and recreational services.

Supporting Services, such as nutrient cycling, soil formation, pollination and plant productivity, etc.

Welcome: gbennett@snowcrest.net

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Subject: Fw: Klamath juvenile fish health update
From: "Adriane Garayalde, SVRCD" <garayalde@snowcrest.net>
Date: Mon, February 1, 2010 1:22 pm
To: "Grace Bennett" <gbennett@snowcrest.net>
Priority: Normal
Options: View Full Header | View Printable Version | Download this as a file | View as HTML | Spam | Not Spam | Add to Addressbook

Hi Grace,
Here is some information on the fish health efforts and a link to the F which should have current information posted.

STATE WATER RESOURCES CONTROL BOARD
2017 JAN 31 PM 1:37
DIV OF WATER RIGHTS SACRAMENTO

Adriane Garayalde

Shasta Valley RCD
530-905-1055
Sent: Tuesday, September 01, 2009 8:48 AM
Subject: Klamath juvenile fish health update

The California-Nevada Fish Health Center is leading a collaborative eff agencies and Tribes to monitor the incidence of Ceratomyxa shasta ar minibicornis infection in juvenile Chinook and coho salmon in the Klan Fish are being collected within major hydraulic reaches located downs Shasta River by biologists from the Karuk Tribe, Yurok Tribe, Hoopa V and Arcata Office of the US Fish and Wildlife Service. The Fish Health providing laboratory support and analyses for the project. Sampling b of April 20, 2009, and will continue through early August. A summary rates by sample week and location is attached below and will be poste website early next week at:

http://www.fws.gov/arcata/fisheries/default.htm

Many thanks to Kim True and the Service's CA/NEV Fish Health Cente preliminary data available to us. It's also important to acknowledge th collaborative spirit that has gone into this monitoring program, which jointly funded by the Klamath Falls Area Office, Trinity River Restorati the Arcata Fish and Wildlife Office, and CA/NEV Fish Heath Center of t with valuable field support provided by the Hoopa Valley, Karuk, and the Salmon River Restoration Program, and CDFG. Thanks again to al this possible.

nick

(See attached file: Klamath Juvenile Salmonid Health Update 08-31-2

Nicholas J. Hetrick
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Attachments:

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Klamath Juvenile Salmonid Health Update 08-31-2009.pdf	**42 k**	[application/pdf]

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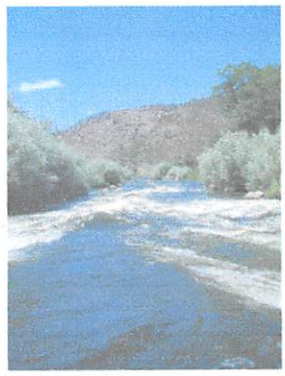
MYXOZOAN PARASITES IN KLAMATH RIVER SALMON



OVERVIEW

CURRENT RESEARCH: Monitoring || Infectious Zone || Bogus Creek Carcass Removal ||

BARTHOLOMEW LAB

FIELD TRIPS: Polychaete Float 2009

MEETINGS: Klamath River Fish Health Conference 2009

NEWS ITEMS and WEBSITE LINKS

JOURNAL ARTICLES

Disease Reduction in Klamath River Salmon
OVERVIEW

Problem: The effects of declining Pacific NW salmon populations on coastal economies and tribal communities have been felt for several decades, but the reduction of the commercial catch by 90% in 2006 was a direct result of the weak returns of Chinook salmon to the Klamath River (KR). Severe infection by the myxozoan parasite *Ceratomyxa shasta* has, in large part, been responsible for the declining numbers of juvenile KR fall Chinook and coho salmon and subsequent impacts on later adult returns. Compared with infection of juvenile Chinook salmon from other Pacific NW rivers, the numbers in the KR are striking. For example, incidence of *Ceratomyxa shasta* infection in juvenile Chinook salmon, collected in the Klamath River above the confluence with the Trinity River between May and the end of July, examined histologically has varied between 21 - 37% (2004 - 2008 data); this infection rate is much higher (31 - 62%) in samples analyzed by QPCR for the same time period. (Juvenile salmonids outmigrate during this period but also at other times of the year when infection prevalence is lower). Whereas, in the Fraser River, Canada, *C. shasta* infection prevalence was estimated to be 3.3% and in the Columbia River estuary, *C. shasta* was detected in 9.6% and 12% of juvenile Chinook salmon in 1983 and 2001, respectively. The high prevalence and severity of *C. shasta* infections in

KR fish indicates this parasite is a key factor limiting salmon recovery in that system.

Search

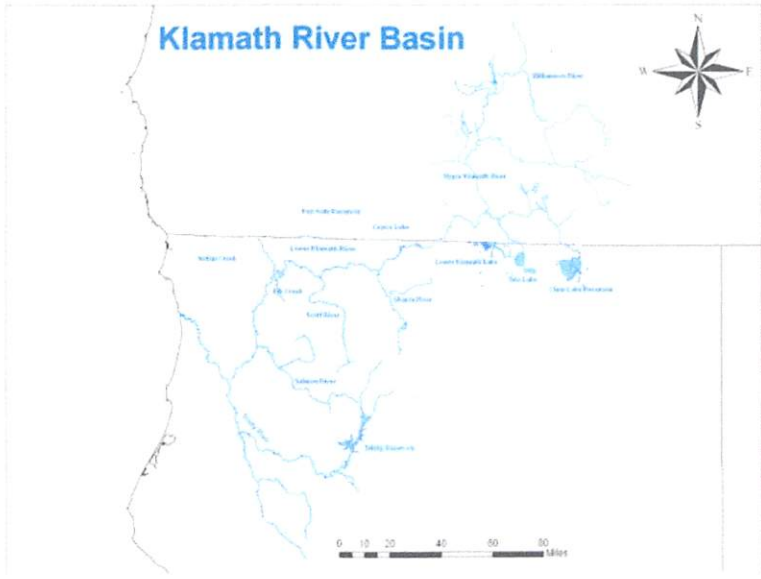


Fig. 1 Map of the Klamath River which straddles the border of Oregon and California in the Pacific North West of USA. It flows westward over 400 km into the Pacific Ocean.

High resolution

Ceratomyxa shasta has a complex life cycle, involving an invertebrate (polychaete worm) host as well as salmon (see Fig. 2). Salmon in the KR have evolved with *C. shasta* and are relatively resistant to infection compared to salmon from rivers where the parasite is absent, thus the current severity of ceratomyxosis in these fish suggests a shift in the host:parasite balance. Research conducted by OSU and the US Fish and Wildlife Service (USFWS) have identified a stretch of the river in which high parasite densities and large numbers of infected invertebrate hosts result in severe disease and high mortality, thus providing a target for management actions.

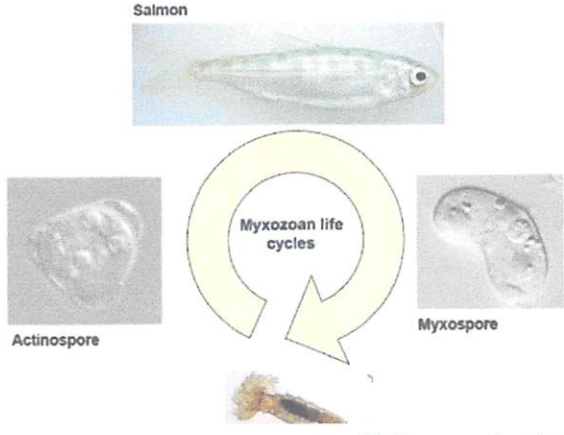


Fig 2. Life cycle of the myxozoan parasite *Ceratomyxa shasta:* the actinospore released from the tiny invertebrate host, *Manayunkia speciosa*, infects salmonids via the gills and in the intestione develops into the myxospore stage. Clinical disease signs in the fish include swollen abdomen from ascites accumulation, inappetance, hemorhaging intestinal lining.

Infection is seasonal and progression is temperature dependent. Each spore stage is 10μm or less in size.

Solution: In 2007, a multidisciplinary panel of fish disease experts and fishery managers met to develop a research plan focused on management actions to reduce disease (ceratomyxosis) in natural juvenile salmon of the KR. This proposed research effort is in addition and complementary to on-going monitoring in the basin. The reach from Iron Gate Dam to the Scott River was identified as the primary management area, based on juvenile salmon infection status and data from fish exposures, invertebrate host surveys and water sampling studies.

Potential management actions would have the goal of:

1. Reducing polychaete host populations in the selected KR reach,

2. Reducing the effects of the infectious actinospore on juvenile salmon,

3. Reducing the input of myxospores from specific salmonid fishes

4. Decreasing fish exposure/Increasing fish resistance

A preliminary ranking of management actions was made based on the likelihood that the action would result in a **reduction in ceratomyxosis in natural salmon populations of the Klamath River.** Other considerations included the effect on non-target organisms and the ability to monitor effects. The panel recommended several actions as being the most likely to cause a biological effect and as high priority for further research. We propose to test the feasibility of the highest priority management actions through controlled laboratory and field experiments. These studies would be conducted over 2-3 years, leading to large-scale tests or implementation.

Impacts: Salmon losses in the Klamath basin have had devastating effects on tribal communities along the river and the coastal communities of Oregon and California. The recent closure of the salmon troll industry in 2006 was a management decision in response to the low contribution of the Klamath basin - only 5% of the fishery - with disease being a primary factor. The cost to Oregon coastal communities was estimated to be $28 million dollars in 2006 and Governors of both Oregon and California declared fishery disasters that resulted in allocation of $60 million dollars in federal assistance. Salmon trollers estimate that reducing disease effects by as little as 10% would increase the number of Klamath River adult salmon to the point that fishing on

that population could resume and allow that industry to survive.

Research collaborators:

Kirsten Arkush, University of California, Davis

Jerri Bartholomew, Oregon State University

Susan Corum, Karuk Tribe

J. Scott Foott, USFWS CA-NV Fish Health Center

Gary Hendrickson, Humboldt State University

Joshua Strange, Yurok Tribe

Peggy Wilzbach, Humboldt State University Cooperative Fisheries Unit

Funding for KR research and monitoring at OSU has been provided through the Bureau of Reclamation, Oregon Sea Grant, the US Fish and Wildlife Service, the Karuk, Yurok and Hoopa Tribes, PacifiCorp, a federal appropriation and Oregon Commercial Restoration and Enhancement (through ODFW)

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INFECTIOUS ZONE STUDY

AIM: Provide finer resolution of the infectious zone in the lower Klamath River

BACKGROUND: Ceratomyxosis is a leading disease of Klamath River salmonids, causing mortality in outmigrating juvenile Chinook and coho salmon. Sentinel fish studies conducted at multiple time points over several years have consistently identified the area immediately above Beaver Creek (Rkm 259) as highly infectious, but with mortality in Chinook salmon occurring as far downriver as Seiad Valley (Rkm 208). This pattern is supported by river water sampling, which targets waterborne *Ceratomyxa shasta* spores. However, data from surveys of the parasite's polychaete host, suggest this highly infectious zone may extend upriver to around the confluence of the Shasta River (Rkm 280; itself not a source of the infectious stage of the parasite). Characterization of the infectious zone is coarse, with consistent data available only from four index sites in the lower river, below Iron Gate Dam. This study aims to more accurately define this zone using developed water sampling and molecular methods.

APPROACH: In 2009, replicate water samples were collected on three days spanning a six week period at 16 sites along 79 Rkm of the lower Klamath River; a further 6 sites and 76 Rkm were included on the final day. River water samples were taken at 3 time points at each site, at 9 or 10 am, 12 or 1pm and 3 or 4pm on May 13, June 3 and June 24. The water was filtered using a vacuum pump, the DNA that was captured was extracted using a kit and any parasite DNA present was quantified with a QPCR assay. These data produce a longitudinal map of parasite density in this section of the river for each time period which can be used to identify areas that could be targeted for control of polychaete populations.

Collaborators: Karuk Tribe, Yurok Tribe

WATER FLOW



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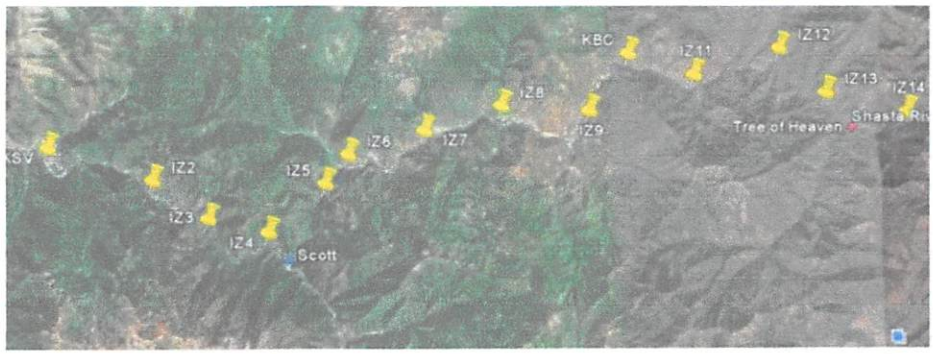

Map of a section of the lower Klamath River (below Iron Gate Dam) showing the 16 primary sampling sites. The region encompasses the confluences of the Shasta and Scott Rivers and two monitoring index sites, Beaver Creek (KBC) and Seiad Valley (KSV).

For the full report on the study, click here

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Investigators and Partners

Below is a list of the fish disease investigative group which includes **Oregon State University Members** and **Affiliate Members** from the greater northwest region of the United States.

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JOHN L. FRYER SALMON DISEASE LAB

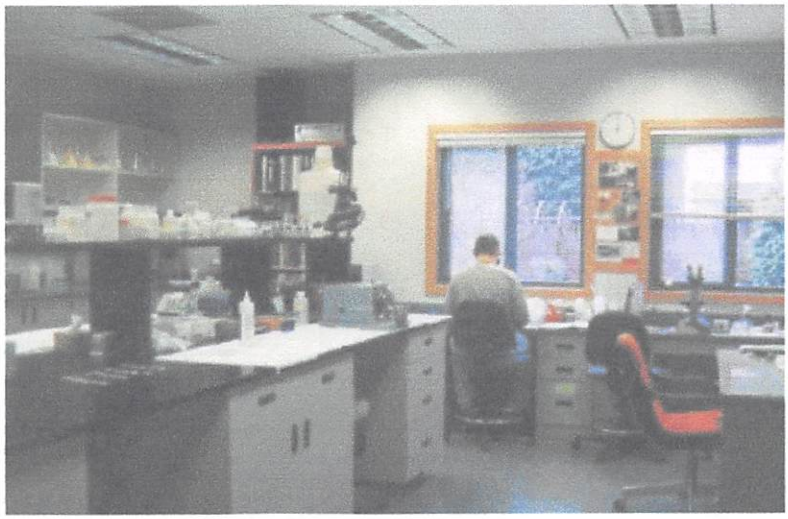


The faculty of Oregon State University have been at the forefront of fish disease research for over 30 years, beginning with the pioneering efforts of Dr. John L. Fryer, OSU Distinguished Professor of Microbiology. Faculty at OSU have trained many of the nation's professional fish pathologists and fish health researchers, have identified the causes of several important diseases afflicting fishes in the Pacific Northwest, and developed vaccines and diagnostic tests that are routinely used for cultured and wild stocks of fish. In addition, they have provided a wealth of knowledge on the pathogenic mechanisms and epidemiology of most of the serious diseases of salmonids and other fish. Since inception of the fish disease program, the fish species under investigation have broadened to include wild marine fishes, ornamental species, and fish used as research models. Nevertheless, diseases of salmonid fishes remain a primary research focus.



The John L. Fryer Salmon Disease Laboratory (SDL) is a 9000 sq. ft. regional fish disease research facility dedicated to the study of organisms infectious for salmonids and other species of freshwater fish. The SDL has wet laboratory capacity for maintaining fish, as well as providing space for an analytical laboratory, a histology facility, a microscopy room, office space and a conference room/library.

The laboratory is supplied with specific-pathogen free fresh water from two wells, each with a capacity of more than 300 gpm. The water, which has an ambient temperature of 12.8°C, is processed through UV sterilization and a degassing tower to eliminate pathogens, gas supersaturation and allow oxygen to saturate into the water. Effluent from the laboratory is treated with chlorine to prevent the escape of any pathogens from the facility. All systems are redundant and can be operated with a diesel-electric generator in the event of commercial power failures.



The wet laboratoı is divided into two sections, one for stock fish and experime not involving infectiou agents and the other for holding fish to be used in disease experiments. The stock area has forty-nine tanks of various sizes from three to twelve feet in diameter. The experimental area has 128 one hundred-liter tanks and 120 twenty-five liter tanks which will accommodate various sizes of fish. Added at the end of 2004 are 18 thirty gallon aquaria for zebrafish research. **User fees for the various size tanks**. (pdf)

Heated water provides high-quality fresh water for warm water species and for research on the effects of temperature on disease processes. Temperature units can be programmed to deliver heated water from 13-28°C, making this laboratory ideally positioned for conducting studies on the effects of climate change on aquatic organisms. Temperature controls can also be programmed to replicate diurnal temperature fluctuations, allowing researchers to closely emulate natural conditions. The laboratory also has some capacity for chilling water below ambient temperature.



An added important piece of the facility is the isolation/quarantine laboratory that provides an area to work with non-endemic aquatic pathogens. The facility has

24 twenty-five liter tanks and over 300 square feet of space for specialized studies, plus a separate necropsy room. Effluent from all tanks runs through filters and UV sterilization units before undergoing the normal chlorination treatment.

The laboratory was constructed through a grant from the Bonneville Power Administration with matching funds from OSU.

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Long-Term Fish Disease Monitoring Program In The Lower Klamath River

FY09

Objective 4. **PROVIDE FINER RESOLUTION OF THE INFECTIOUS ZONE IN THE LOWER KLAMATH RIVER**

Collaborators: Yurok Tribe, Karuk Tribe

Report prepared by: S. Hallett, G. Buckles, R. Ray, J. Bartholomew (Oregon State University)

BACKGROUND

Ceratomyxosis is a leading disease of Klamath River salmonids, causing mortality in outmigrating juvenile Chinook and coho salmon. Sentinel fish studies conducted at multiple time points over several years have consistently identified the area immediately above Beaver Creek (Rkm 259) as highly infectious, but with mortality in Chinook salmon occurring as far downriver as Seiad Valley (Rkm 208) (Stocking et al. 2006). This pattern is supported by river water sampling, which targets waterborne *Ceratomyxa shasta* spores (Hallett & Bartholomew 2006). However, data from surveys of the parasite's polychaete host, suggest this highly infectious zone may extend upriver to around the confluence of the Shasta River (Rkm 280; itself not a source of the infectious stage of the parasite)(Stocking & Bartholomew 2006). Characterization of the infectious zone is coarse, with consistent data available only from four index sites in the lower river, below Iron Gate Dam. This study aims to more accurately define this zone using developed water sampling and molecular methods (Hallett & Bartholomew 2006). Replicate water samples were collected on three days spanning a six week period at 16 sites along 79 Rkm of the lower Klamath River; a further 6 sites and 76 Rkm were included on the final day. This data produces a longitudinal map of parasite density in this section of the river for each time period which can be used to identify areas that could be targeted for control of polychaete populations.

METHODS

During spring/early summer 2009, water samples were collected in a longitudinal river transect, at 16 approximately equidistant sites, from Seiad Valley to east of the I5 bridge (**Fig. 1**). Sampling occurred on three days, three weeks apart: May 13 (A), June 3 (B) and June 24 (C). Each day, 3 x 1L water samples were collected from each site (exception: only 1 sample was collected at each time point at Rkm 231 and 234 on June 24), three times at three hour intervals. Every other site was sampled simultaneously: either at 9am, 12 noon and 3pm or at 10am, 1pm and 4pm. Samples (total of 144 per day) were chilled during transportation to the Salmon Disease Laboratory, OSU, where they were filtered within 24 hours. On June 24, an additional six downstream sites were included in the study. These were sampled (3 x 1L) once in the morning and once in the afternoon.

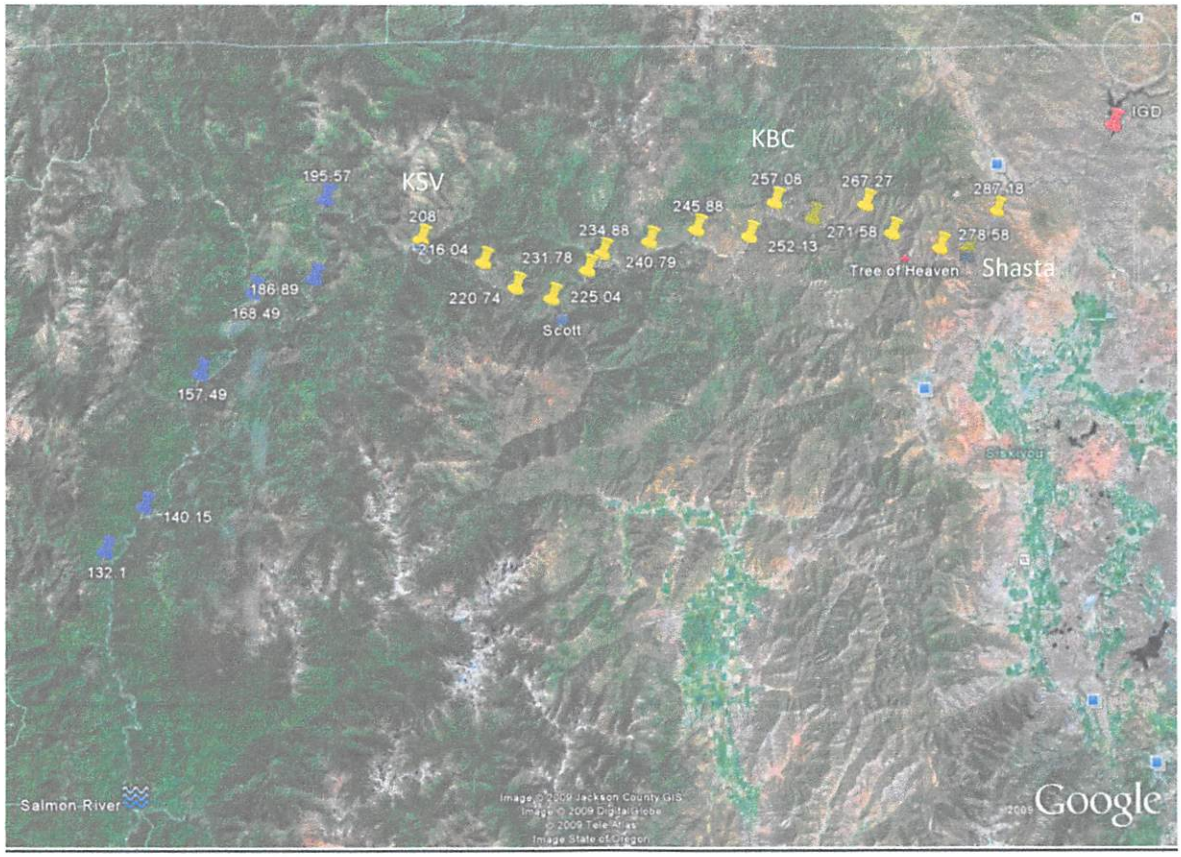

Figure 1. Overview of water sampling sites on the lower Klamath River. The 16 sites from Rkm 208-287 (yellow pins) were sampled on all three dates, May 13, June 3 and June 24, whereas the 6 from Rkm 132-195 (blue pins) were included only on the third sampling day. The Klamath River flows westward into the Pacific Ocean.

In the laboratory, each water sample was filtered through a nitrocellulose membrane using a vacuum pump, the filter paper folded into a microfuge tube and frozen. The filter paper was dissolved in a series of acetone/ethanol washes, removed, and the remaining DNA extracted using a kit (QIAGEN DNeasy Blood and Tissue). Any *Ceratomyxa shasta* DNA present was quantified by a TaqMan PCR assay on a 7300 platform (Applied Biosystems)(Hallett and Bartholomew 2006).

Reference samples with known numbers of *Ceratomyxa shasta* spores were processed in the same manner as the field samples. Positive (tissue) and negative (water) controls were included on each plate. All samples were run in duplicate (i.e. two wells each). Data generated by the SDS software (Applied Biosystems) was exported into Excel where averages and standard deviations were calculated. Any sample whose two wells differed by greater than 1 standard deviation was rerun.

RESULTS and DISCUSSION

Parasite abundance on May 13, June 3 and June 24 is displayed in **Figs 2-4**. All water samples contained *Ceratomyxa shasta* DNA. Levels varied from >1 - >100 spores/L and overall site averages were all >10

spores/L (**Fig. 5, 6**). Daily abundance was consistent at some sites (<1Ct) whereas it fluctuated over 10-fold (>4Ct) at other sites.

Parasite abundance was unusually high in May and decreased at the beginning of June, notably at KBC. Discharge rates from hydrographs don't explain the data, but there was a 9C increase in temperature between sample days. At the end of June the overall pattern had changed and spore abundances were higher at some sites but lower at others.

There was no consistent pattern in abundance between days. Levels increase for about 20 Rkm downstream of the Shasta River confluence to peak east of KBC, thus providing some basis for defining an upstream limit of the infectious zone. On the first two collection days, levels were clearly lower downstream of the confluence of the Scott River, suggesting this as a downstream limit; however, on the third day levels increased markedly both above and below these locations. These levels are more variable between dates than expected, and likely reflect changes in water flow and temperature which affect the polychaete host, release of the parasite from the polycahaete and subsequent survival of the waterborne stage infective to fish. For example, flows from the Scott River (data from Seiad Valley gauge) decreased approximately 1000 cfs over the course of the study and thus contributed less to parasite dilution during the latter sample period.

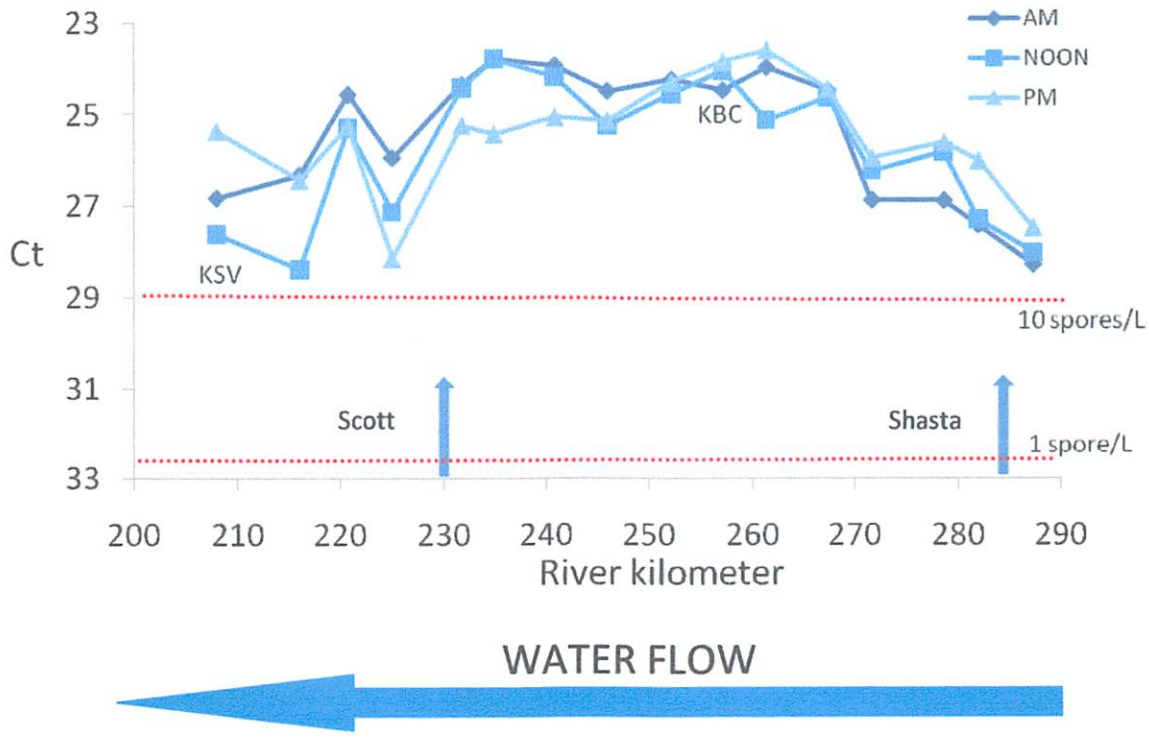

Figure 2. Abundance of *Ceratomyxa shasta* in water samples collected from at 16 lower Klamath River sites. Each data point is the average of 3 x 1L water samples. Samples were taken at 3 time points at

each site, at 9 or 10 am, 12 or 1pm and 3 or 4pm on May 13, 2009 (IZA). The lower the Ct value the more parasite DNA is present. Approx. 3.3 Ct equates to a 10-fold difference in spore numbers.

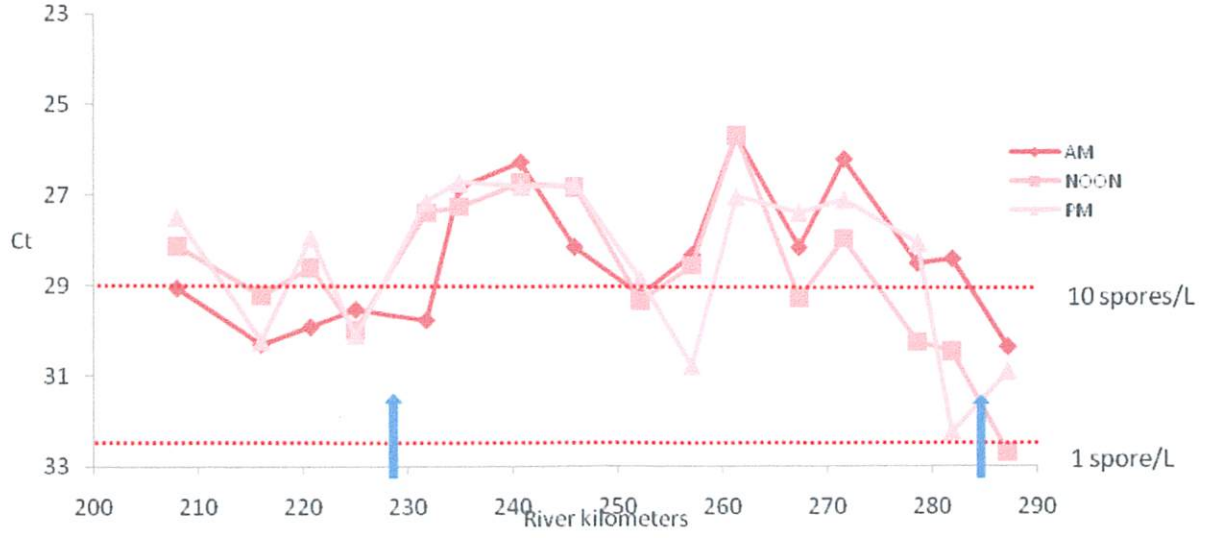

Figure 3. Abundance of *Ceratomyxa shasta* in water samples collected from 16 lower Klamath River sites. Each data point is the average of 3 x 1L water samples. Samples were taken at 3 time points at each site, at 9 or 10 am, 12 or 1pm and 3 or 4pm on June 3, 2009 (IZB). The lower the Ct value the more parasite DNA is present. Approx. 3.3 Ct equates to a 10-fold difference in spore numbers.

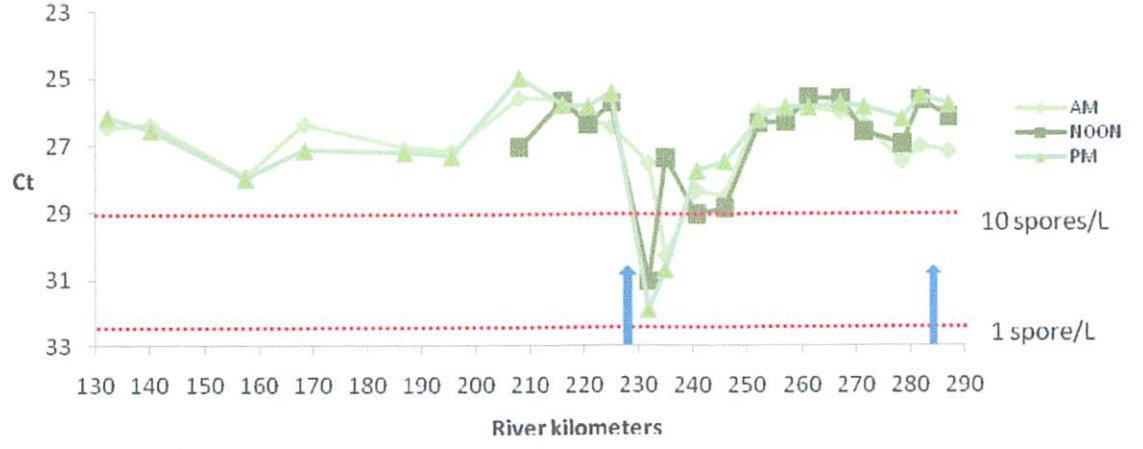

Figure 4. Abundance of *Ceratomyxa shasta* in water samples collected from 16 lower Klamath River sites. Each data point is the average of 3 x 1L water samples. Samples were taken at 3 time points at

each site, at 9 or 10 am, 12 or 1pm and 3 or 4pm on June 24, 2009 (IZC). The lower the Ct value the more parasite DNA is present. Approx. 3.3 Ct equates to a 10-fold difference in spore numbers.

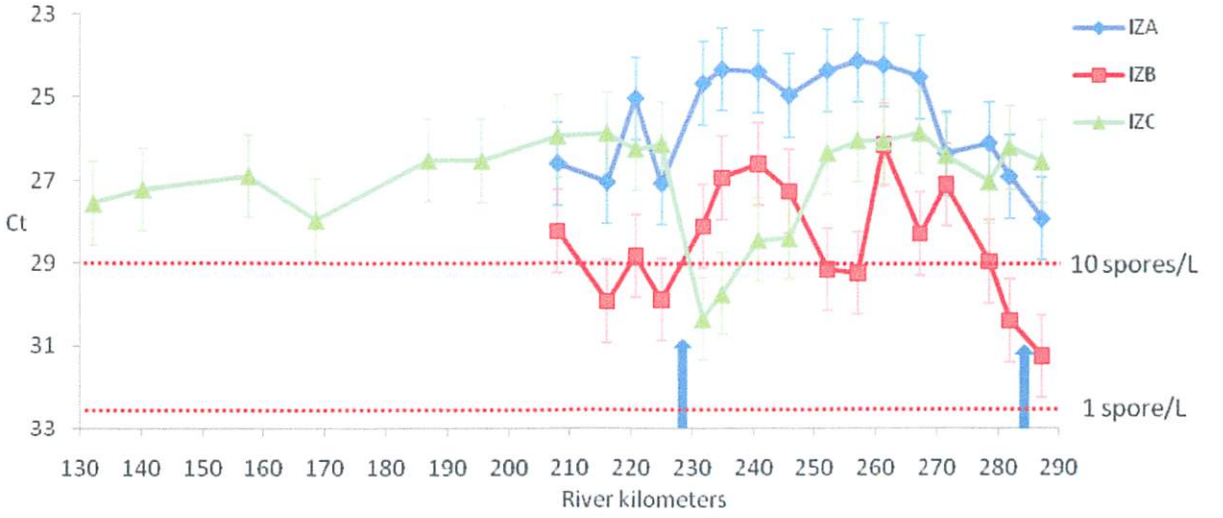

Figure 5. Comparison of abundance of *Ceratomyxa shasta* in water samples collected from 22 lower Klamath River sites on three dates, three weeks apart: May 24 (IZA), June 3 (IZB) and June 24, 2009 (IZC). Each data point is the average of 6-9 x 1L water samples. Samples were taken at 2 time points at the lower 6 sites and at 3 time points at the upper 16 sites. The lower the Ct value the more parasite DNA is present. Approx. 3.3 Ct equates to a 10-fold difference in spore numbers.

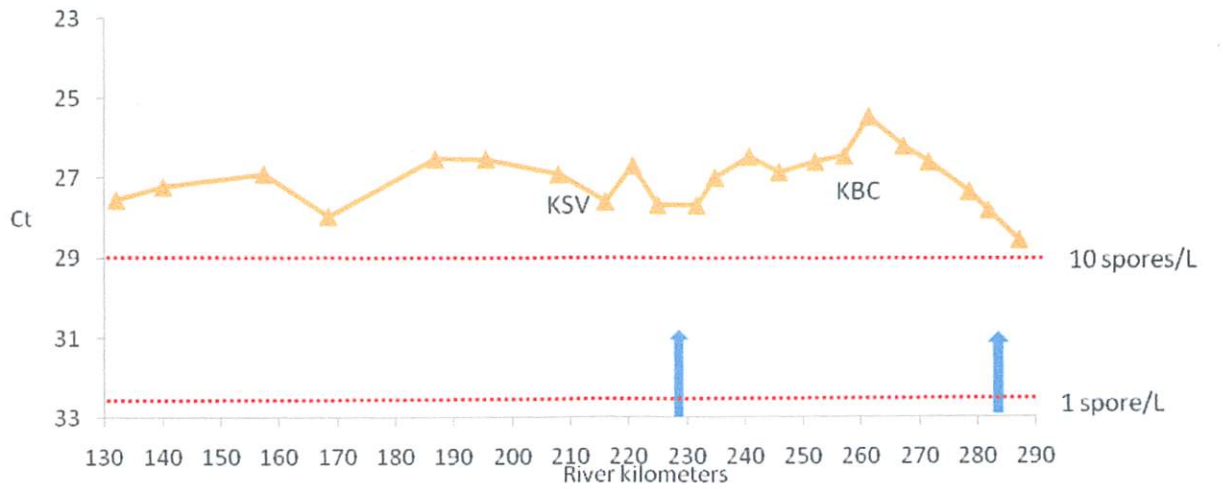

Figure 6. Overall abundance of *Ceratomyxa shasta* in water samples collected from 22 lower Klamath River sites on three dates, three weeks apart: May 24 (IZA), June 3 (IZB) and June 24, 2009 (IZC). Each data point is the average of 6-27 x 1L water samples. The lower the Ct value the more parasite DNA is present. Approx. 3.3 Ct equates to a 10-fold difference in spore numbers. KSV=Seiad Valley index site, KBC = Beaver Creek index site.

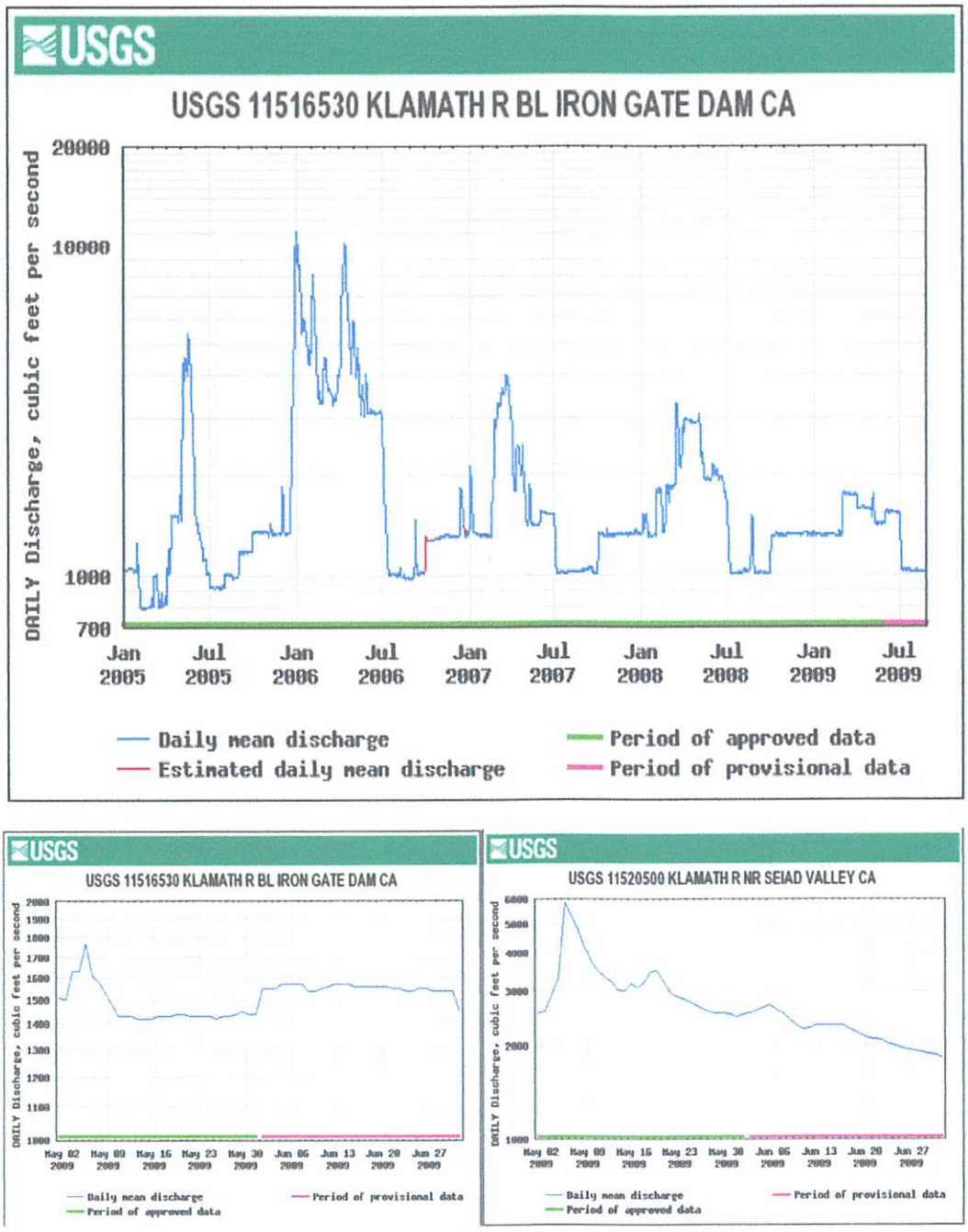

Figure 7. Hydrographs of daily mean discharges from Iron Gate Dam from 2005 – 2009 (upper), Iron Gate Dam May-June 2009 (lower left) and Seiad Valley May-June 2009 (lower right).

This study characterizes spore abundance in the water column, it does not identify the source of the spores ie where the infected polychaetes are located. Decreases in spore abundance e.g. as progress

downstream towards Scott River may be caused by fewer spores being released in this region, or spores being contributed upstream are degrading as they disperse downstream due to high water temperature.

Also, note that water flows have decreased over the past four years (Fig. 7). This may have allowed accumulation of materials suitable for polychaete habitat and conducive to polychaete and parasite propagation.

Acknowledgements

Jill Pridgeon (OSU) helped filter water samples. Steve Christy (OSU) assisted with extraction of water samples. Matt Stinson and Michelle Jordan helped prepare the site map. Hydrograph obtained from http://waterdata.usgs.gov/nwis/.

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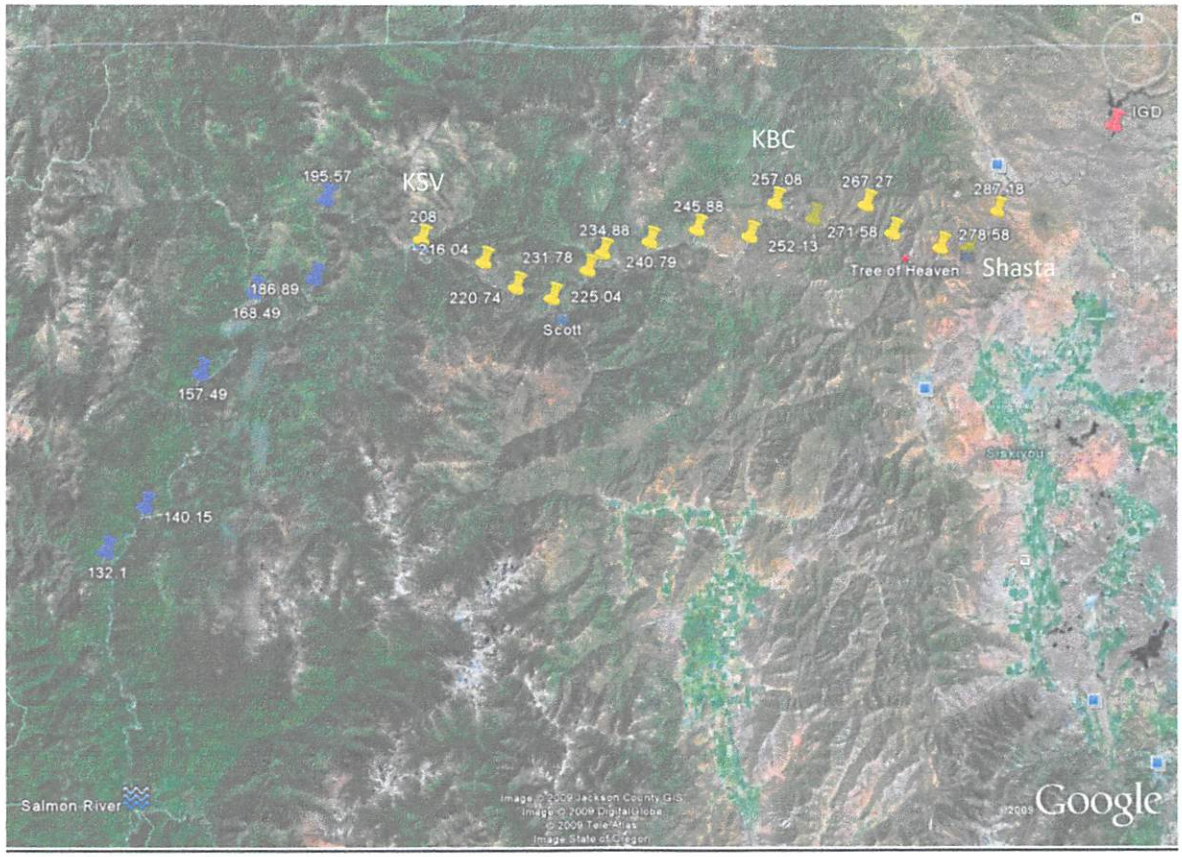

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Reference samples with known numbers of *Ceratomyxa shasta* spores were processed in the same manner as the field samples. Positive (tissue) and negative (water) controls were included on each plate. All samples were run in duplicate (i.e. two wells each). Data generated by the SDS software (Applied Biosystems) was exported into Excel where averages and standard deviations were calculated. Any sample whose two wells differed by greater than 1 standard deviation was rerun.

RESULTS and DISCUSSION

Parasite abundance on May 13, June 3 and June 24 is displayed in **Figs 2-4**. All water samples contained *Ceratomyxa shasta* DNA. Levels varied from >1 - >100 spores/L and overall site averages were all >10

each site, at 9 or 10 am, 12 or 1pm and 3 or 4pm on May 13, 2009 (IZA). The lower the Ct value the more parasite DNA is present. Approx. 3.3 Ct equates to a 10-fold difference in spore numbers.

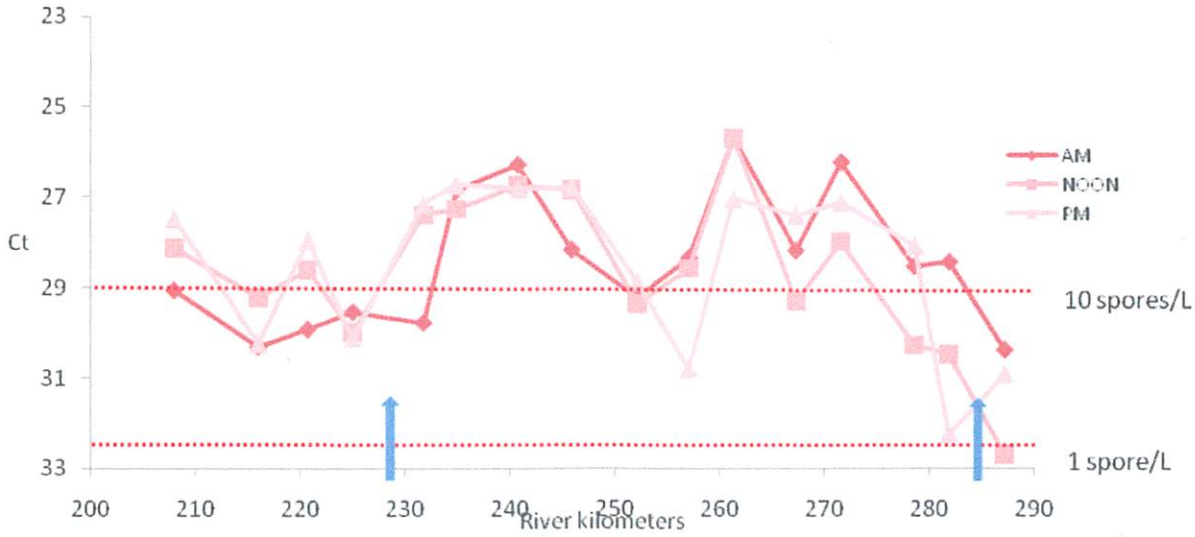


Figure 3. Abundance of *Ceratomyxa shasta* in water samples collected from 16 lower Klamath River sites. Each data point is the average of 3 x 1L water samples. Samples were taken at 3 time points at each site, at 9 or 10 am, 12 or 1pm and 3 or 4pm on June 3, 2009 (IZB). The lower the Ct value the more parasite DNA is present. Approx. 3.3 Ct equates to a 10-fold difference in spore numbers.

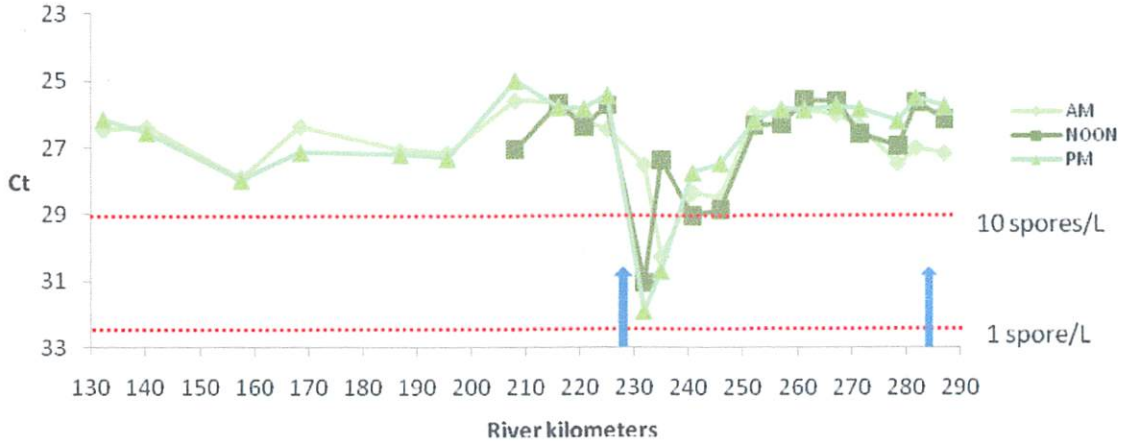


Figure 4. Abundance of *Ceratomyxa shasta* in water samples collected from 16 lower Klamath River sites. Each data point is the average of 3 x 1L water samples. Samples were taken at 3 time points at

each site, at 9 or 10 am, 12 or 1pm and 3 or 4pm on June 24, 2009 (IZC). The lower the Ct value the more parasite DNA is present. Approx. 3.3 Ct equates to a 10-fold difference in spore numbers.

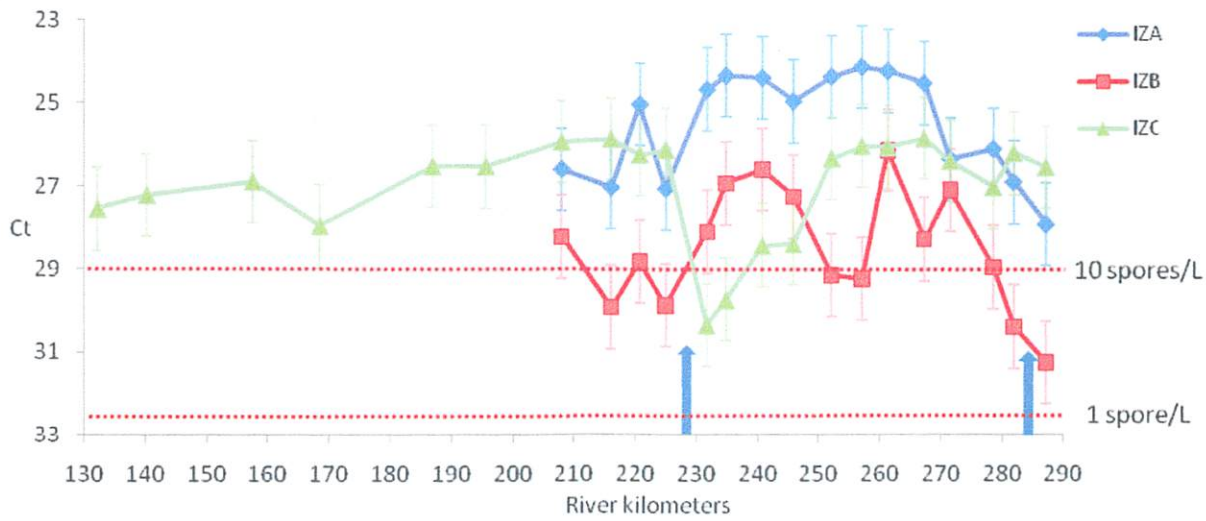


Figure 5. Comparison of abundance of *Ceratomyxa shasta* in water samples collected from 22 lower Klamath River sites on three dates, three weeks apart: May 24 (IZA), June 3 (IZB) and June 24, 2009 (IZC). Each data point is the average of 6-9 x 1L water samples. Samples were taken at 2 time points at the lower 6 sites and at 3 time points at the upper 16 sites. The lower the Ct value the more parasite DNA is present. Approx. 3.3 Ct equates to a 10-fold difference in spore numbers.

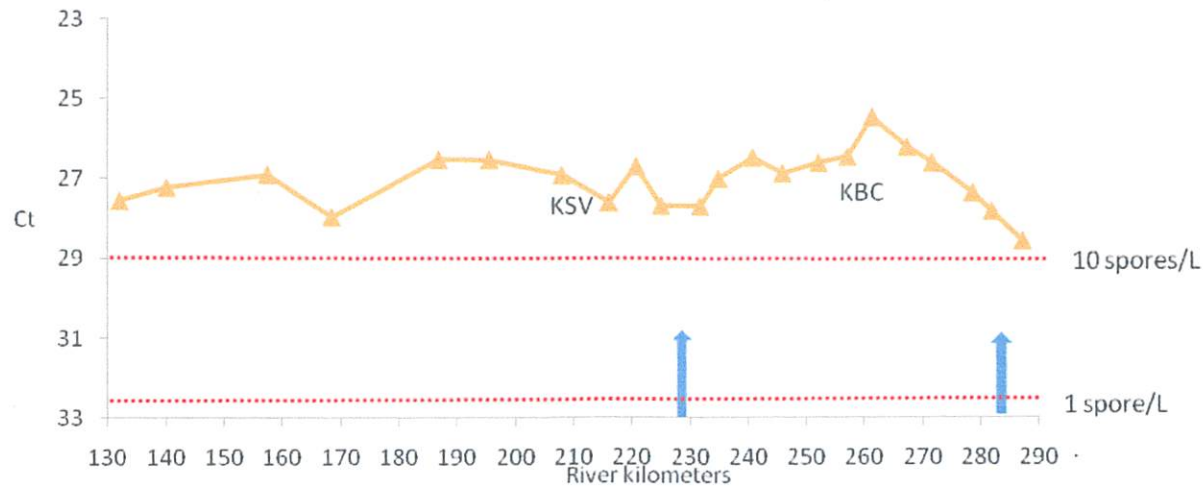


Figure 6. Overall abundance of *Ceratomyxa shasta* in water samples collected from 22 lower Klamath River sites on three dates, three weeks apart: May 24 (IZA), June 3 (IZB) and June 24, 2009 (IZC). Each data point is the average of 6-27 x 1L water samples. The lower the Ct value the more parasite DNA is present. Approx. 3.3 Ct equates to a 10-fold difference in spore numbers. KSV=Seiad Valley index site, KBC = Beaver Creek index site.

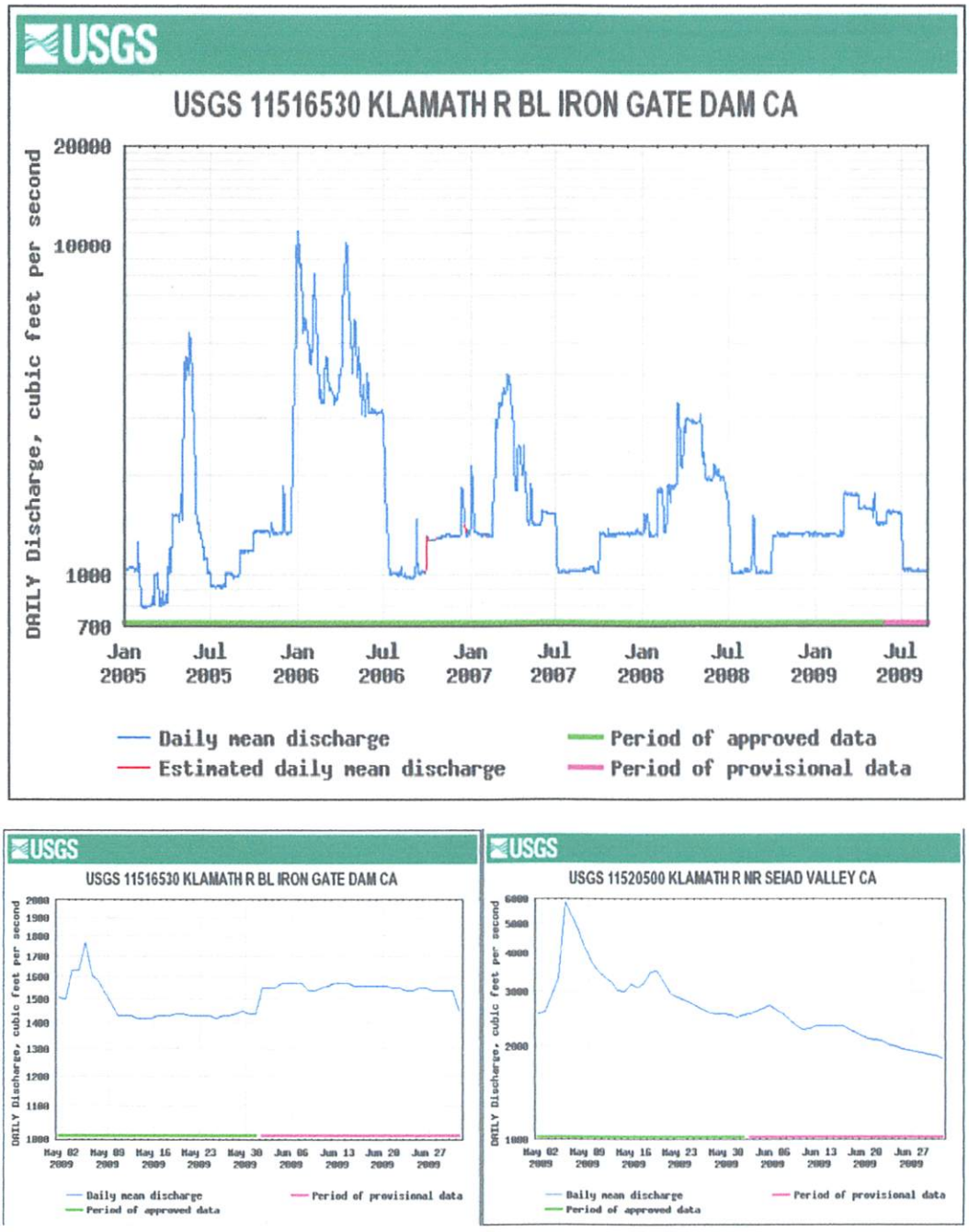


Figure 7. Hydrographs of daily mean discharges from Iron Gate Dam from 2005 – 2009 (upper), Iron Gate Dam May-June 2009 (lower left) and Seiad Valley May-June 2009 (lower right).

This study characterizes spore abundance in the water column, it does not identify the source of the spores ie where the infected polychaetes are located. Decreases in spore abundance e.g. as progress

downstream towards Scott River may be caused by fewer spores being released in this region, or spores being contributed upstream are degrading as they disperse downstream due to high water temperature.

Also, note that water flows have decreased over the past four years (Fig. 7). This may have allowed accumulation of materials suitable for polychaete habitat and conducive to polychaete and parasite propagation.

Acknowledgements

Jill Pridgeon (OSU) helped filter water samples. Steve Christy (OSU) assisted with extraction of water samples. Matt Stinson and Michelle Jordan helped prepare the site map. Hydrograph obtained from http://waterdata.usgs.gov/nwis/.

MEMORANDUM

DATE: **8/31/2009**

TO: **Nick Hetrick, Arcata FWO**

FROM: **Kimberly True**
CA-NV Fish Health Center
(530) 356-4271
Kimberly_True@fws.gov

SUBJECT: **2009 Klamath River Salmonid Health Monitoring**

As a component of Klamath River fish health assessment, the California-Nevada Fish Health Center is examining juvenile Klamath River Chinook Salmon to monitor the incidence of *Ceratomyxa shasta* and *Parvicapsula minibicornis* infection. Fish are collected by biologists with the Karuk Tribe, Yurok Tribe, Hoopa Tribe and US Fish and Wildlife Service. The CA/Nev Fish Health Center is providing laboratory support for the project. Sampling began the week of April 20 and continued through August 10.

Pathogen testing by QPCR has been performed for fish collected through 10 August; with the exception of one estuary sample set of 30 fish collected the week of July 27, which is pending laboratory analysis. Data are summarized in Figures 1-5. *Ceratomyxa shasta* has been detected in 45% (489/1090) and *Parvicapsula* minibicornis has been detected in 80% (873/1090) of Klamath Chinook juveniles tested this field season.

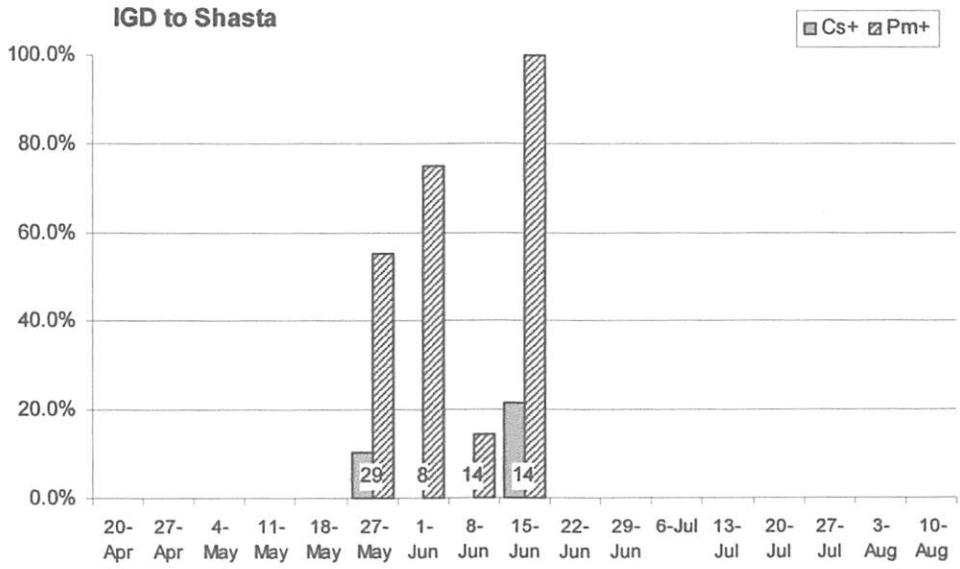


Figure 1. Weekly incidence of *Ceratomyxa shasta* and *Parvicapsula minibicornis* infection in juvenile Klamath River Chinook salmon captured in K5 reach on the Klamath River (Iron Gate Dam to Shasta River). Sample numbers collected each week are displayed at the bottom of each column; Cs was not detected on 1 June and 8 June. All data are preliminary and subject to revision.

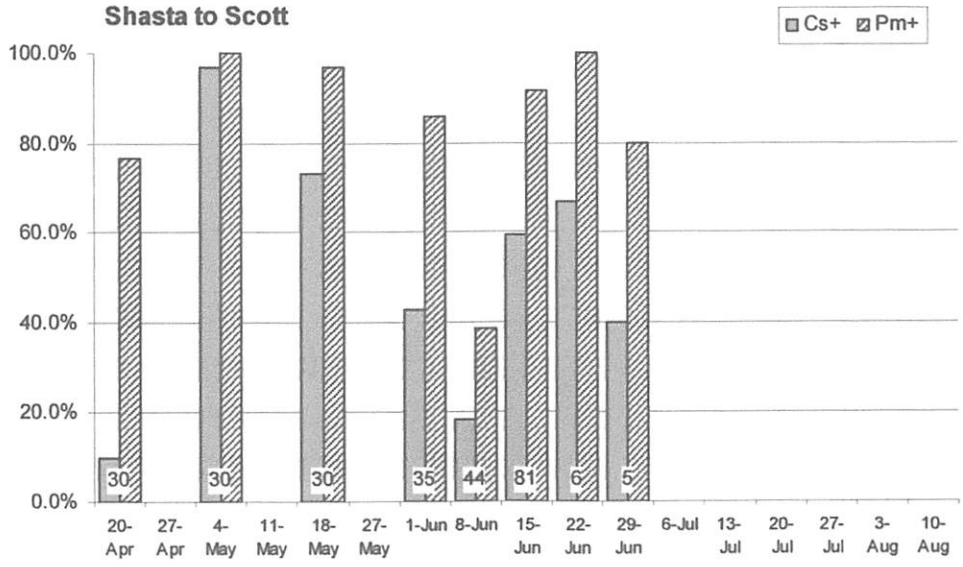


Figure 2. Weekly incidence of *Ceratomyxa shasta* and *Parvicapsula minibicornis* infection in juvenile Klamath River Chinook salmon captured in K4 reach on the Klamath River (Shasta to Scott River). Sample numbers collected each week are displayed at the bottom of each column. All data are preliminary and subject to revision.

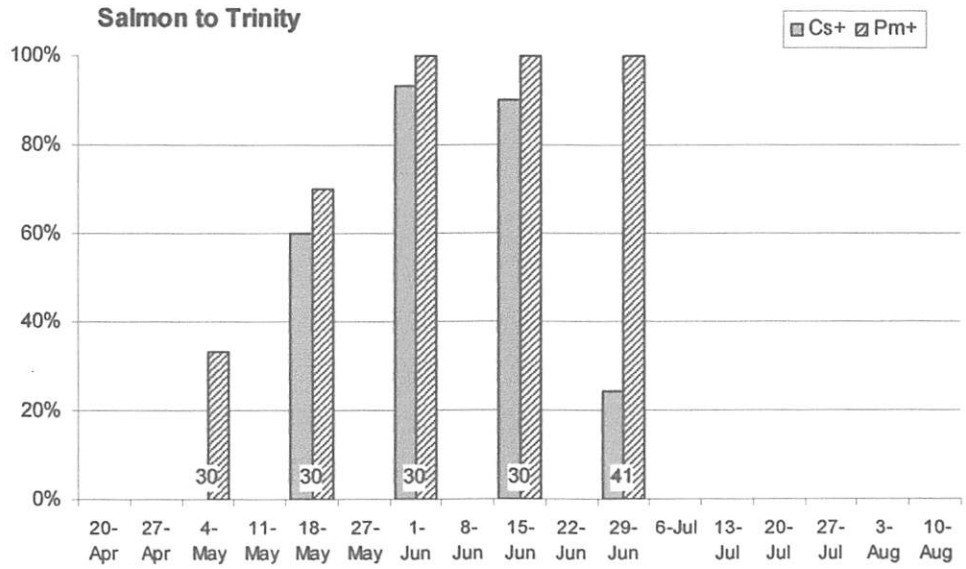


Figure 3. Weekly incidence of *Ceratomyxa shasta* and *Parvicapsula minibicornis* infection in juvenile Klamath River Chinook salmon captured in K2 reach on the Klamath River (Salmon River to Trinity River confluence). Sample numbers collected each week are displayed at the bottom of each column; Cs was not detected on 4 May. All data are preliminary and subject to revision.

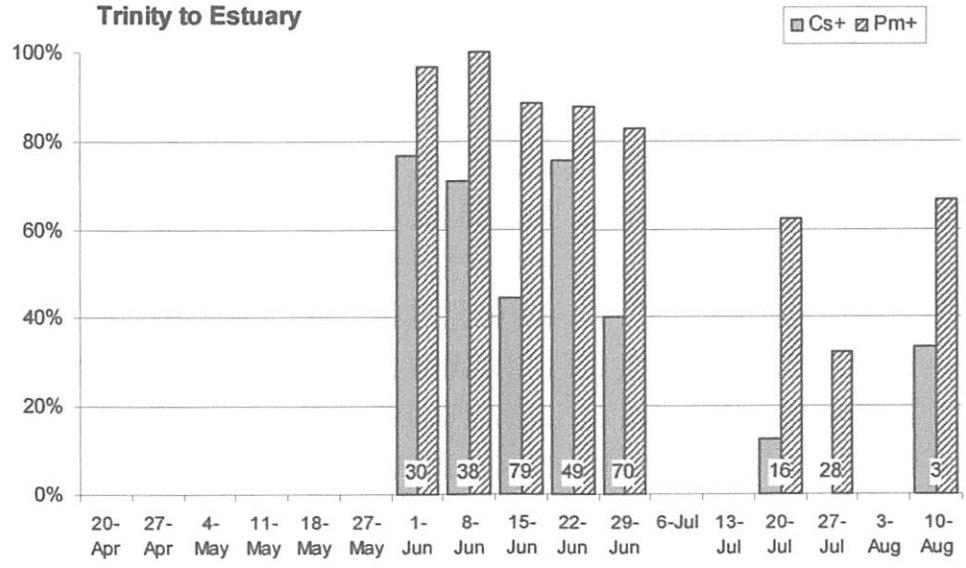


Figure 4. Weekly incidence of *Ceratomyxa shasta* and *Parvicapsula minibicornis* infection in juvenile Klamath River Chinook salmon captured in K1 reach on the Klamath River (Trinity River confluence to Estuary). Sample numbers collected each week are displayed at the bottom of each column; Cs was not detected on 27 June. All data are preliminary and subject to revision.

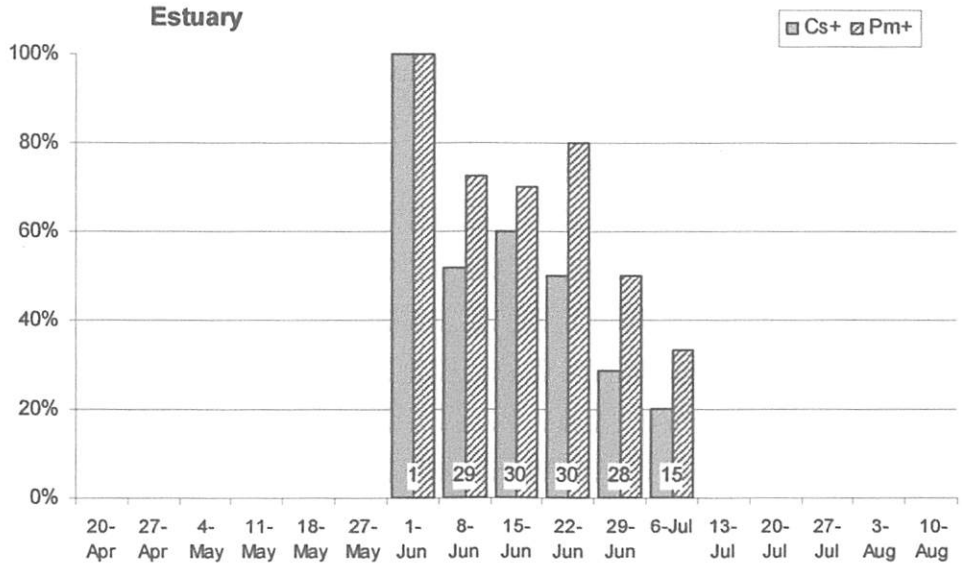


Figure 5. Weekly incidence of *Ceratomyxa shasta* and *Parvicapsula minibicornis* infection in juvenile Klamath River Chinook salmon captured in K0 reach (Estuary). Sample numbers collected each week are displayed at the bottom of each column. All data are preliminary and subject to revision.

spores/L (**Fig. 5, 6**). Daily abundance was consistent at some sites (<1Ct) whereas it fluctuated over 10-fold (>4Ct) at other sites.

Parasite abundance was unusually high in May and decreased at the beginning of June, notably at KBC. Discharge rates from hydrographs don't explain the data, but there was a 9C increase in temperature between sample days. At the end of June the overall pattern had changed and spore abundances were higher at some sites but lower at others.

There was no consistent pattern in abundance between days. Levels increase for about 20 Rkm downstream of the Shasta River confluence to peak east of KBC, thus providing some basis for defining an upstream limit of the infectious zone. On the first two collection days, levels were clearly lower downstream of the confluence of the Scott River, suggesting this as a downstream limit; however, on the third day levels increased markedly both above and below these locations. These levels are more variable between dates than expected, and likely reflect changes in water flow and temperature which affect the polychaete host, release of the parasite from the polycahaete and subsequent survival of the waterborne stage infective to fish. For example, flows from the Scott River (data from Seiad Valley gauge) decreased approximately 1000 cfs over the course of the study and thus contributed less to parasite dilution during the latter sample period.

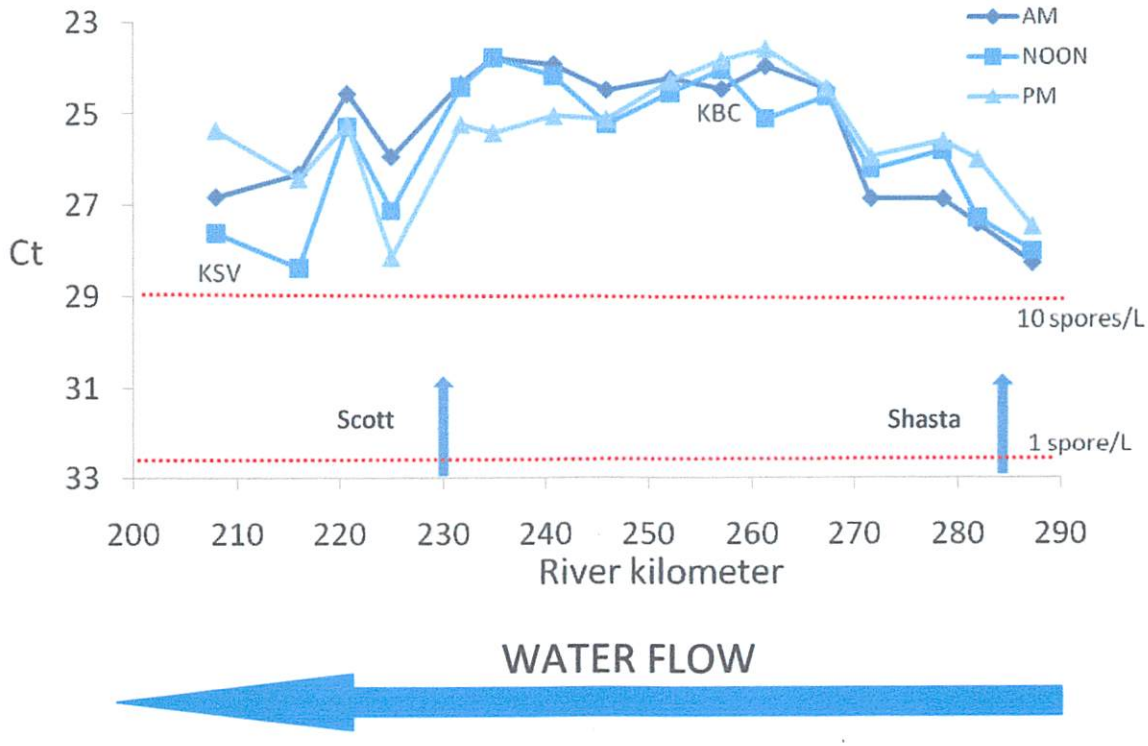
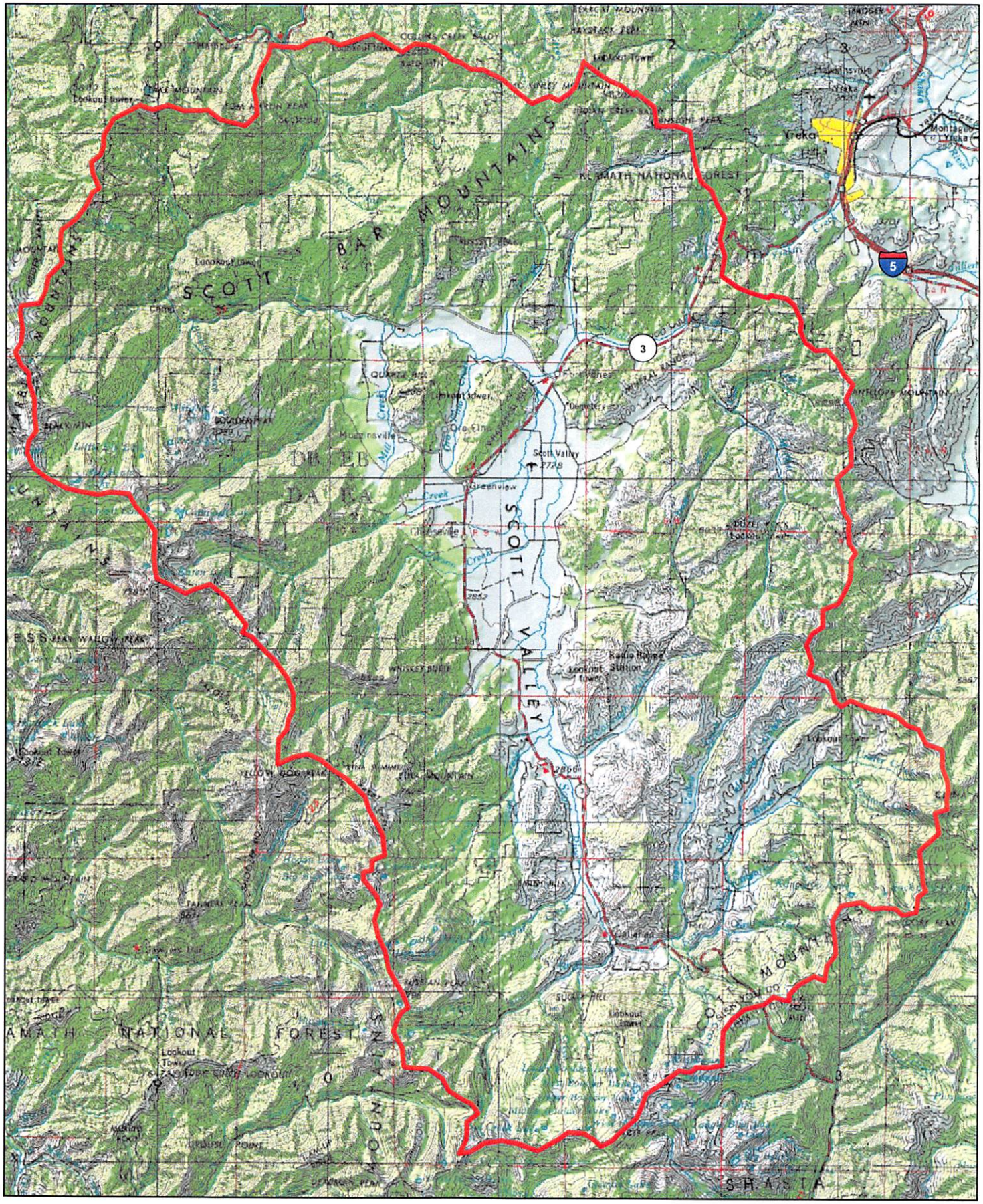


Figure 2. Abundance of *Ceratomyxa shasta* in water samples collected from at 16 lower Klamath River sites. Each data point is the average of 3 x 1L water samples. Samples were taken at 3 time points at

Scott River Cooperative Restoration Area



Cooperative Restoration Boundary

1:395.000

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Dedicated to the Scott River Watershed

Current Activities, Fall 2008

Moffett Creek Watershed

Working with a Moffett Creek landowner group, NCRC is planning and implementing exclusion fencing on Fruit Growers Supply Company and two adjacent, downstream landowners' property. Efforts include future riparian planting within exclusion fencing and main stem riparian restoration on two miles near Duzel Creek.



Scott River Tailings Restoration

Recently completed the widening of the floodplain, bank stabilization, sediment reduction (approximately 2,500 cu. yds./year), and reconstruction of the river channel along an approximately 3,000 foot reach of the Scott River. Funding for the reconstruction of the riparian area has been applied for. Planning efforts are being accomplished for an additional six miles of tailings restoration.

French Creek Watershed

Completed pre-restoration assessment of the French Creek Watershed.

Rattlesnake Creek Watershed

The riparian restoration and exclusion fencing of a one mile reach of Rattlesnake Creek Watershed.



East Fork of the Scott River

Recently completed a 130 mile sediment risk road inventory on public lands in the East Fork of the Scott River Subshed.

Scott Valley Watershed Council, Upland Committee

The Upland Committee Group has recently been formed to provide a medium for stakeholders involved in the Scott Valley uplands to address issues and concerns in a collaborative approach. The committee consists of four major commercial timber companies, the US Forest Service, BLM, the Scott River Watershed Coalition of Fire Safe Councils and NCRC. The committee's first steps will be to collect existing assessment data, identify accomplished project sites and indentify future needs within the watershed.

Scott River Watershed Coalition of Fire Safe Councils

The coalition was formed in 2007 to marshal the resources of six stakeholder driven fire safe councils operating in the Scott River watershed. These fire safe councils are placing a heavy emphasis on hazardous fuels reduction to reduce the risk of catastrophic fire and increase watershed health. In the past 5 years, through various programs, more than 2,000 acres of hazardous fuels reduction activities have been accomplished. More than 500 additional acres are currently planned and funded for implementation.

Northern California Resource Center
P.O. Box 342
Fort Jones, CA 96032
530-468-2888
www.californiaresourcecenter.org

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[attachment 5]

COUNTY OF SISKIYOU

Board of Supervisors

P.O. Box 750 • 201 Fourth Street
Yreka, California 96097
www.co.siskiyou.ca.us

(530) 842-8005
FAX (530) 842-8013
Toll Free: 1-888-854-2000, ext. 8005

February 7, 2012

VIA FAX 202-208-4561

Honorable Ken Salazar
Secretary of the Interior
U.S. Department of the Interior
1849 C Street NW
Washington, D.C. 20240

Re: Notice of Intent to File Suit Regarding the Secretarial Determination on the Future of the Klamath Project

Dear Secretary Salazar:

Based on your 2009 statement that the proposal to remove the Klamath River dams "will not fail" and the subsequent course of action that has been followed by the Department of the Interior to construct such an outcome, the County of Siskiyou is convinced legal action is necessary to challenge a decision that is contrary to science and the stated goals for Klamath River and which will be inimical to the interests of the people of Siskiyou County. If you do indeed press forward at this time and issue the Secretarial Determination, Siskiyou County intends to challenge the decision in federal court.

The County of Siskiyou has repeatedly voiced serious objections to both the processes and substance underlying your forthcoming determination. Given the steps that have yet to be taken to coordinate federal agency decision-making and actions with local governments on a government-to-government basis, as well as delays in completing mandatory elements of the Klamath Hydroelectric Settlement Agreement (KHSA), we do not see how you can possibly make a legally defensible determination by the March deadline.

Jim Cook	Ed Valenzuela	Michael Kobseff	Grace Bennett	Marcia H. Armstrong
District 1	*District 2*	*District 3*	*District 4*	*District 5*

[attachment 5]

In previous correspondence we have been very clear about our objections to this process moving forward without the Department of the Interior (DOI), its agencies, and other federal entities fulfilling their statutory obligations to coordinate with local governments by considering and analyzing issues of local concern and attempting to reconcile, or at least minimize, inconsistent federal actions. Less than one year ago, President Obama issued Executive Order 13575, creating the White House Rural Council and pledging to coordinate and increase the effectiveness of federal engagement with local governments to address the needs of rural America. Complete disregard for coordination obligations by the Bureau of Land Management (BLM) and other federal agencies with respect to the Klamath agreements is not only contrary to the President's recent directives, but is also in violation of the Federal Land Policy and Management Act, the National Environmental Policy Act, and the Administrative Procedure Act, among other federal laws.

For example, the Klamath Hydroelectric Settlement Agreement, the Klamath Basin Restoration Agreement, and the attendant EIS/EIR identify a multitude of actions and responsibilities involving (or likely to involve) the Bureau of Land Management:

- The current FERC boundary encompasses large tracts of public land managed by BLM, including campgrounds and other public resources.
- In the larger area analyzed in the EIS/EIR, BLM manages public lands for recreation, open space, and forest and mineral resources.
- BLM currently manages lands near Copco 1 Reservoir and Copco 2 Dam.
- Below Iron Gate Dam, the Klamath River passes through lands managed by BLM.
- Most of the land along the J.C. Boyle peaking reach of the Klamath River is managed by BLM.
- Lands around the Keno Development will be transferred to DOI.
- BLM manages whitewater boating in various reaches of the river and boater access at various locations.
- BLM had issued conditions under Federal Power Act section 4(e) related to whitewater recreation and other protection, enhancement, and mitigation measures which would have been required under a new FERC license. DOI's support for the Klamath settlement agreement effectively withdraws the 4(e) conditions and advances a radically different management scheme for the river.

[attachment 5]

- Scenic resources in the area are regulated in part by BLM Resource Management Plans.
- BLM has identified the section of the Klamath River between the Oregon-California state line and Copco Reservoir as being suitable and eligible for wild and scenic river status, creating an obligation on the part of BLM to protect that section of river against any adverse consequences of dam removal, such as reductions in water quality.

Many of these actions and responsibilities relate to – and potentially conflict with – policies and objectives specified in BLM's Resource Management Plans for the Redding, Klamath Falls, and Medford areas. As examples:

- The BLM objective for water quality is to ensure that all waters on public land meet or exceed federal and state water quality standards. The Klamath River is already identified as water-quality-impaired for a number of pollutants under Clean Water Act section 303(d), and the settlement agreement actions include additional negative impacts to water quality. In particular, the Klamath River is already listed by both the California State Water Resources Control Board and U.S. EPA as being impaired by sediment. Dam removal will not only release massive amounts of sediment that has already been retained behind the dams, but it will also eliminate the reservoirs' current function of allowing some of the Oregon sediment to settle out of the water column.
- The BLM plan for Horseshoe Ranch and Jenny Creek calls for allowing long-term natural restoration of riparian zones. A rapid reservoir drawdown will create a zone of habitat disconnection between the Klamath River and upper reaches of Jenny Creek.
- The BLM plan for the Upper Klamath River corridor calls for the protection of cultural resources. Drawdown of the reservoirs will cause further disruption to Native American burial sites and other cultural resources.
- Jenny Creek had been designated as eligible for Wild and Scenic status based on its scenic qualities. The BLM plan for the Jenny Creek area above Iron Gate Reservoir calls for maintaining existing scenic quality.
- Based on the Upper Klamath River being designated as eligible for Wild and Scenic status, the BLM plan calls for all public land within ¼ mile of normal high water along the southern bank to be managed to protect scenic values. Removal of the reservoirs will eliminate existing scenic values on abutting public

[attachment 5]

lands and leave stretches of the river canyon with no views other than post-reservoir destruction and debris.

Regardless of whether BLM is ultimately determined to be taking actions that are inconsistent with existing Resource Management Plans or to be effectively amending its Resource Management Plans by way of participating in the Klamath settlement agreements, either one is a violation of the Federal Land Policy and Management Act. Also, by participating in such substantial changes in management of the Klamath River resources, BLM triggers an obligation under 43 U.S.C. 1712 to undertake the processes to coordinate the new management scheme with local government plans and policies.

Siskiyou County continues to be willing to work with the Department of the Interior, other federal agencies, and other Klamath River stakeholders to see that coordination requirements are addressed and that local issues are given proper consideration and attention before final decisions are made to approve the EIS/EIR and proceed with dam removal. We believe your only alternative will be to engage in similar processes following judicial review of your decisions. At this point in the Klamath process, it would be an unfortunate and tragic misstep for the settlement parties to force the courts to become involved as the only avenue of redress for the local government coordination issues, as well as for substantive violations of the Endangered Species Act, Clean Water Act, and Federal Power Act, among other things. A turn toward litigation will only add substantial delay, unnecessary expense, and tremendous uncertainty to a final Klamath River solution.

Beyond the coordination issue, there are also other fundamental obstacles that make issuance of the Secretarial Determination premature. The KHSA requires the following actions, among other things, to be completed prior to any determination:

1. **Enactment of federal legislation to implement the settlement.** The target date to enact implementing legislation for the KHSA was in May 2010. Legislation was not even introduced in Congress until November 2011, and to date no action has been taken in either the Senate or the House of Representatives to advance any bill. This prerequisite to the Secretarial Determination obviously has not been satisfied.

2. **State of California authorization of funding.** Section 4.1.2.A. requires the State of California to authorize $250,000,000 to implement the settlement. At the time the settlement agreement was signed, such funding was included in a bond measure that was set to go before California voters in November 2010. However, in August 2010, the California Legislature postponed consideration of the bond measure until

[attachment 5]

November 2012 based on concerns that it would not secure voter approval in the midst of a state budget crisis and national recession. The ability to pass such a bond measure in the current economic climate continues to be a concern to the bond's supporters, and it is an open question whether the bond will remain on the November 2012 ballot.

Aside from the bond measure, California has taken no other action to authorize the funding required by the KHSA and, with the State of California facing chronic, multi-billion-dollar annual deficits, has little financial capability to do so.

The issue of the California bond funding is also tied to the federal legislation, since alternatives to the bond funding may not be considered as part of the determination in the absence of enacted federal legislation to implement the settlement.

3. **Agreement on terms to transfer the Keno facility.** Section 3.3.4.B. requires the Secretary and PacifiCorp to agree upon acceptable terms for transfer of the Keno facility prior to the Secretarial Determination. We have seen no indication that such terms have been agreed upon and the terms of such an agreement are not included in the draft EIS/EIR, which characterizes the transfer as being addressed as a "connected action" but also only "programmatically." The EIS/EIR simply claims to assume, for purposes of analysis, that the transfer has been completed, despite the fact that the terms and details of such a transfer have not been agreed upon. However, transfer of the Keno facility is inextricably tied to dam removal and implementation of the KHSA. Not only has this prerequisite to the Secretarial Determination not been satisfied, but there also appears to be an improper deferral (or outright circumvention) of adequate NEPA analysis.

Additionally, section 3.2.5 of the KHSA contemplates the possibility of the Secretarial Determination being made at a time before environmental review is complete, although there is a clarification that the settlement does not require that the determination be made before such time. The State of California, wisely, has made clear that it will not concur in an Affirmative Determination until it has completed its review under the California Environmental Quality Act. We hope you will recognize the ultimate futility of attempting to take such a significant action without full compliance with the National Environmental Policy Act and other applicable laws. The Secretarial Determination should only be made after the final environmental impact statement is complete and the public has had sufficient time to review its analysis, conclusions, and responses to comments.

[attachment 5]

We urge you to set aside any impulses to make a premature decision on the Secretarial Determination. We also request that you provide 30 days advance formal notice to the other settlement parties, as required by the KHSA, if you realize it is best to defer your determination beyond the March deadline.

Very truly yours,

Grace Bennett, Chair
Siskiyou County Board of Supervisors

cc: Senator Dianne Feinstein
Senator Barbara Boxer
Congressman Wally Herger
Congressman Mike Thompson
Congressman Greg Walden
Congressman Tom McClintock
Senator Doug LaMalfa
Assemblyman Jim Nielsen
Senator Ron Wyden
Senator Jeff Merkley
Governor Jerry Brown
Governor John Kitzhaber
Secretary John Laird
Director Charlton Bonham, California Dept. of Fish and Game
John Bezdek, Solicitor to Secretary Salazar
Greg Norton, President, RCRC
Mike McGowan, President, CSAC
Siskiyou County Board of Supervisors
Klamath County Commissioners
Humboldt County Board of Supervisors
Del Norte County Board of Supervisors
Trinity County Board of Supervisors
Modoc County Board of Supervisors
Dean Brockbank, PacifiCorp

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Posted in Construction, Fish

Tower completion delayed

Wednesday, April 15th, 2009 by Richard Myhre



The completion of the underwater tower near the Round Butte dam has been delayed by at least four months. When crews were assembling the three components of the tower on April 11, segments of the central conduit separated. The lower portion of the conduit fell to the bottom of Lake Billy Chinook.

Read the rest of this entry.

Comments may be made by following the link to the full post

Posted in Construction

Tower construction in final stages

Friday, March 27th, 2009 by Richard Myhre

Anticipation is growing as PGE and the Confederated Tribes of Warm Springs enter the final phases of constructing the underwater tower that will restore fish passage on the Deschutes River.

Read the rest of this entry.

Comments may be made by following the link to the full post

Posted in Construction, Media Gallery

How will Deschutes River temperatures change?

Wednesday, January 28th, 2009 by Chad Croft



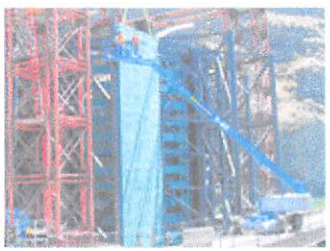
A fishing guide asked whether the river water downstream of the underwater tower (officially known as the Selective Water Withdrawal tower) would become warmer or cooler when the fish passage system is operational. Here's my answer:

Comments may be made by following the link to the full post

Posted in Construction, Fish

Construction update photos: 7/31/08

Saturday, August 2nd, 2008 by Chad Croft



Construction update photos from 7-31-08 showing the installation of fish exclusion plates and the bottom control gate frames from the inside.
View photos and descriptions

Comments may be made by following the link to the full post

Posted in Construction, Media Gallery, Portland General Electric

Construction update photos: 7/25/08

Monday, July 28th, 2008 by Chad Croft



Photographs of underwater tower construction from July 25, 2008. These include an aerial view of the lowering of the bottom section and shots of the installation of the frames for the bottom control gates that control the water flow at the bottom of the tower.
View photos and descriptions

Comments may be made by following the link to the full post

Posted in Construction, Media Gallery, Portland General Electric

Underwater tower: Now you see it, soon you won't

Monday, June 9th, 2008 by Chad Croft

The bottom section of the underwater tower is nearing completion and is getting closer to being lowered to its final resting place 270 feet below the surface. Because of the size of the bottom section and the challenges of building on the water, the contractor will lower the structure approximately 20 feet in June to allow them to finish erecting its top. Read the rest of this entry.

Comments may be made by following the link to the full post

Posted in Construction

Underwater tower construction update

Tuesday, April 22nd, 2008 by Chad Croft

We are making good progress on the construction of the underwater tower. Similar to most construction projects, we have encountered some surprises but the contractor has worked through these challenges and is still on schedule.
We are building the major components on floating barges in Lake Billy Chinook, and will set them into place once they are completed.
continue reading…

Comments may be made by following the link to the full post

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- June 2010

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27	28	29	30			

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  - April 2008
  - March 2008

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« How will Deschutes River temperatures change?
Tower completion delayed »

Tower construction in final stages

March 27th, 2009

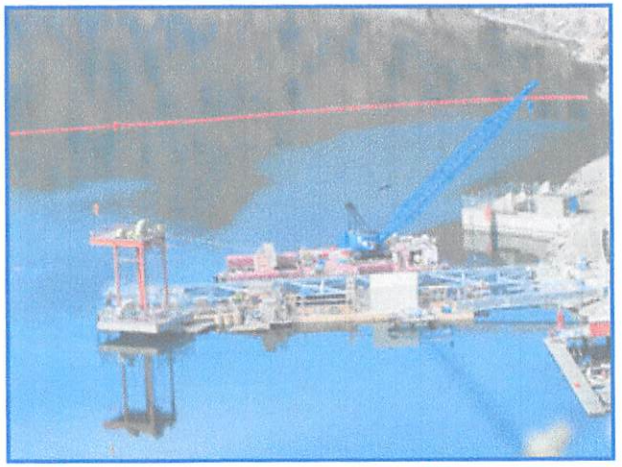
PGE and the Confederated Tribes of Warm Springs are entering the final phases of constructing the underwater tower that will restore fish passage on the Deschutes River. Over the next two months, crews will make the final connections and test the equipment on the 273-foot-tall structure in Lake Billy Chinook.

The tower was built in three main sections on barges anchored near the Round Butte dam, then towed to its final destination on the other side of the lake.

- The bottom section was completed in October of 2008. Crews towed it across the lake, sunk it and attached it to the bottom of the lake in front of the existing powerhouse intake.
- The top structure has been towed into place and the 40 foot diameter pipe will be lowered to its final location (on top of the bottom section) in late April. The top structure will be attached to a steel bridge that anchors it to the shore. This segment of the tower will capture the migrating fish.
- After the fish are captured in the top structure, they are transferred by a pipe to the Fish Transfer Facility. PGE personnel will then sort and mark the fish and eventually transport them below the dam to the Deschutes River where they can continue their journey to the ocean.

Once the construction is complete, engineers and crews will spend the next month thoroughly testing and balancing the system. This unique tower is designed to selectively draw cold water from the bottom of Lake Billy Chinook and warm water from the surface during different parts of the year to meet downstream water temperature and quality requirements. Withdrawing water from the surface of the lake will also create surface guidance current to attract migrating young salmon and steelhead into the floating top structure. Engineers will be fine-tuning the equipment to achieve optimal flow balance. For more information on the tower design, see Underwater Tower.

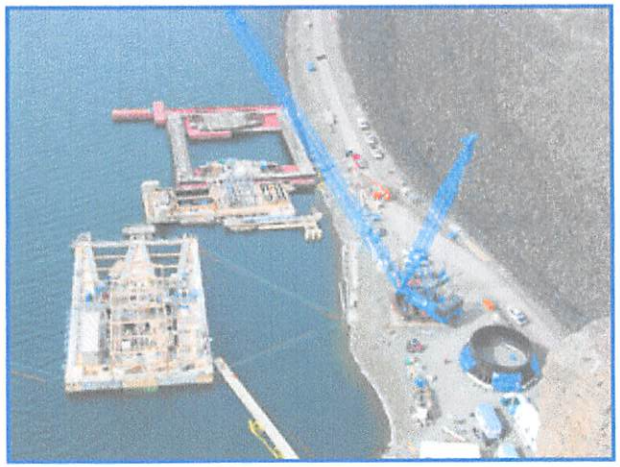
Most of the structure is underwater, but you can see the top structure of the tower near the original power intake tower. By late April, if you go to the viewpoint above Lake Billy Chinook, you should be able to see the surface current created by the tower guiding the young seaward migrating fish into the V-shaped openings of the Selective Water Withdrawal structure.



The bridge to the underwater tower has been attached to the shore. The other end will be connected to the top structure of the underwater tower.



The Fish Transfer Facility is being pushed and towed to its final location next to the access bridge on the left.



This photo shows the top structure with its large V screens nearing completion along side Round Butte Dam When completed in mid April, it will be towed over and attached to the end of the access bridge. On the top of the dam is one section of the 40-ft diameter vertical flow conduit that will be attached the top structure to the bottom structure.

When operating, water will enter the open end of each large V. Water for generation will move through the sides of each V and down the vertical flow conduit while the fish will be captured at the apex of each V. After capture the fish will be moved in water through a large fish pump over to the Fish Transfer Facility attached to the side of the access bridge. After marking, the young salmon will be loaded onto a truck at the base of the bridge, then transported and released into the lower Deschutes River.

This entry was posted on Friday, March 27th, 2009 at 9:30 am and is filed under Construction, Media Gallery. You can follow any responses to this entry through the RSS 2.0 feed. You can leave a response, or trackback from your own site.

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« Study finds extra feeding not necessary for fry
Tower construction in final stages »

How will Deschutes River temperatures change?

January 28th, 2009



A fishing guide asked whether the river water downstream of the underwater tower (officially known as the Selective Water Withdrawal tower) would become warmer or cooler when the fish passage system is operational. Here's my answer:

Once the underwater tower is built and operational, it will likely take a year or so for the temperatures in Lake Billy Chinook to stabilize. Computer modeling has shown that the temperatures in the Deschutes River below the Pelton-Round Butte Project will increase or decrease, depending on the time of year.

The modeling shows:
- December and January temperatures will see relatively little or no change.
- February through July temperatures will increase between 0 to 2 degrees Celsius (0 to nearly 4 degrees Fahrenheit).
- August will see relatively no change.
- September through November temperatures will be lower by 0 to 1.5 degrees Celsius (0 to almost 2 degrees Fahrenheit).

These changes will bring the lower river temperatures to at or below pre-dam conditions. Bringing river temperatures back to pre-dam conditions is required under our federal operating license.

It's important to note that these temperatures are projected for the Madras gage, just downstream of the Pelton Reregulating dam, which measures river temperature, flow and elevation. I'm not sure how the temperature changes translate downstream, or if the modeling extended downstream beyond the Madras gage. In my opinion, it seems logical that the minor temperature changes will be even less dramatic the farther downstream from the project.

This entry was posted on Wednesday, January 28th, 2009 at 10:59 am and is filed under Construction, Fish. You can follow any responses to this entry through the RSS 2.0 feed. You can leave a response, or trackback from your own site.

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« Lower Whychus Creek Crossing project repairs off-road vehicle damage
Underwater tower completed Dec. 3; first fish passing through »

Tower expected to begin operating by year's end

July 20th, 2009

The underwater tower near Round Butte dam is now expected to be completed and operating by the end of 2009, ready for the 2010 fish migration period.

The massive tower, originally scheduled for completion in May 2009, was delayed when a portion of the 40-foot diameter steel conduit connecting the top and bottom structures broke off April 11 during assembly in Lake Billy Chinook.

All segments have been retrieved from the lake floor. Design modifications have been made, and construction crews have begun work on repairs and replacements. An analysis of the incident by PGE staff and independent structural experts is continuing to determine the exact cause.

Technically known as a "Selective Water Withdrawl Tower," the structure will rise 140 feet from the lake floor, draw in water and attract fish to a collection facility. Juvenile salmon and steelhead will be separated out and trucked downstream to continue their migration.

Mitigation plans have been implemented for downstream passage of the salmon and steelhead fry planted in the upper Deschutes, Metolius and Crooked rivers and several tributaries. Smolts have been collected using traps and trucked for release into the Deschutes River below Pelton Round Butte. Tracking tags indicate transported fish have already successfully passed Bonneville Dam on their journey to the Pacific.

This entry was posted on Monday, July 20th, 2009 at 12:49 pm and is filed under Construction, Fish. You can follow any responses to this entry through the RSS 2.0 feed. You can leave a response, or trackback from your own site.

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CONSTRUCTION

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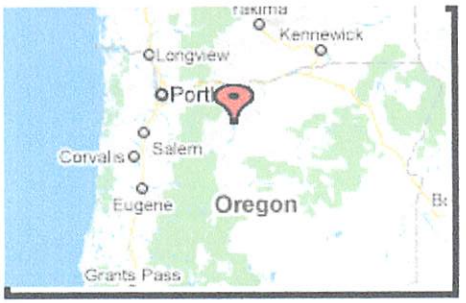
Who We Are | What We Do | How We Do It | Working Here

Round Butte Dam Selective Water Withdrawal

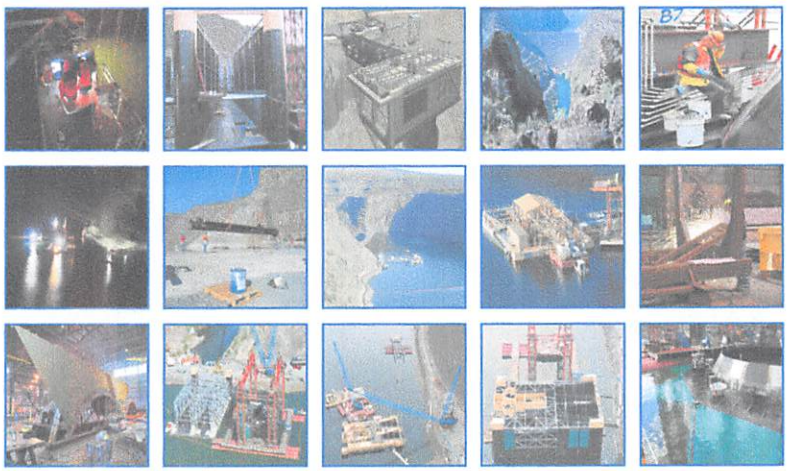
Project Type:
Special Projects

Location: Madras, Oregon
Owner: Portland General Electric Company
Engineer: CH2MHill
Contract Value: Confidential at owner's request
Contract Type: Design-Assist (negotiated)

Project Location



Project Photos



*Click on thumbnail to enlarge

Project Highlights

- 2010 Edison Award, electric utility industry's highest honor for innovation, leadership, and "exceptional contributions to the industry"
- 200 CY of rock excavation at 270 feet deep
- 11-each 24-inch-diameter piles drilled and grouted to 320 feet
- Steel Structure Fabrication and Erection: 700-ton SWB structure - 68 feet long by 57 feet wide by 67 feet tall; steel structure submerged to 270 feet deep; 270-ton VFC structure - 40-foot-diameter steel conduit
- 1,316-ton SWT structure - 150 feet long by 90 feet wide by 50 feet tall floating concrete and steel structure
- 287-foot-long access bridge
- Included 300+ items fabricated in structural steel
- For further details about this project's history, go to www.deschutespassage.com.

Project Details

To ensure that Summer Steelhead and Spring Chinook Salmon survive in the Upper Deschutes, Metolius and Crooked rivers, Portland General Electric and the Confederated Tribes of the Warm Springs Reservation (joint owners) determined that a selective water withdrawal and fish bypass

structure was necessary at the Round Butte Dam located roughly 90 miles southeast of Portland, Oregon, on and adjacent to the Warm Springs Reservation. Barnard Construction was part of a team drawn together to address the challenging nature of this three-year project. Barnard served as General Contractor, providing overall management, cost and schedule controls, deep-water rock excavation, and the drilling and grouting of 11 piles 50 feet into the lake bottom, 320 feet below the water's surface. Barnard also provided all on-shore construction.

Although the Round Butte Dam was originally constructed with fish passage facilities in the early 1960s, the downstream system failed to work properly. Part of the problem arose from unusual currents in Lake Billy Chinook. This new structure has been designed to draw water in a more natural fashion, attracting fish which are screened and released downstream en route to the Pacific Ocean. The project involved fabricating and assembling three large steel structures: a Selective Water Bottom Structure (SWB), a 40-foot-diameter vertical steel conduit (VFC), and a Selective Water Top Structure (SWT). The SWB was submerged to 270 feet deep and attached to the existing powerhouse intake. The floating fish screen structure (SWT) was positioned directly above the SWB. The VFC connects the

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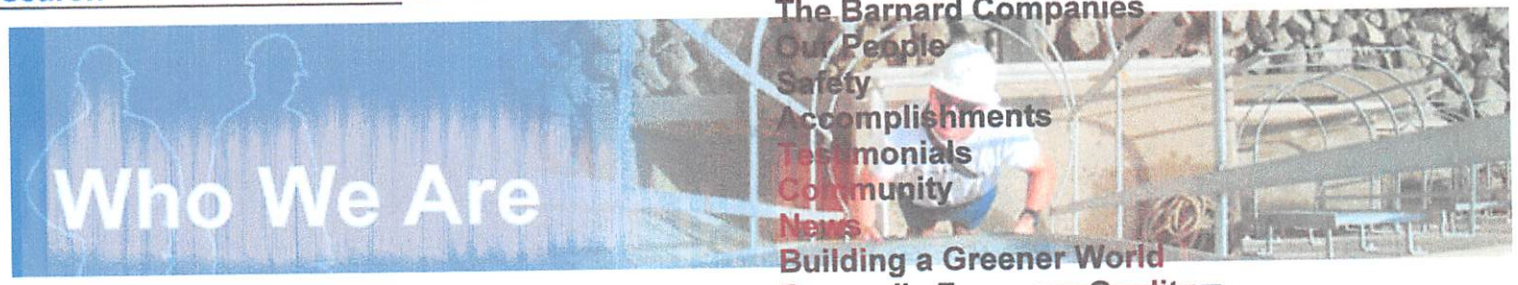


Company Overview

Timothy Barnard founded Barnard Construction Company, Inc. in 1975. Since then, the company has grown from a one-man operation into a multimillion dollar heavy civil contractor. Mr. Barnard continues to serve as Chief Executive Officer. We are headquartered in Bozeman, Montana, but build nationwide. Other Barnard companies, such as Barnard Pipeline, Inc., Barcon, Inc., Barnard of Nevada, Inc., Barnard of Canada, Inc., and Barnard Environmental, Inc. have been formed to complement Barnard Construction in special projects.

Among these companies, we have extensive experience in all aspects of heavy civil construction, including dams, reservoirs, tunnels, pipelines, utilities, oil and gas pipelines, environmental efforts, and special projects. The variety of projects we've constructed are as varied as the terrain and regions of the country in which they've been built – from a cooling system on campus at Cornell University in New York to a utilities tunnel under a busy thoroughfare in Orange County, California, or from a 1.3 million CY RCC backup dam in South Carolina to assembly of an intake structure 270 feet below water surface in Central Oregon. At Barnard, we enjoy challenges.

Who We Are

The Barnard Companies
Our People
Safety
Accomplishments
Testimonials
Community
News
Building a Greener World
Barnard's Focus on Quality

Related Content

- Meet our key personnel
- Join the team!

Our Projects

Our Advantages

Our Reputation

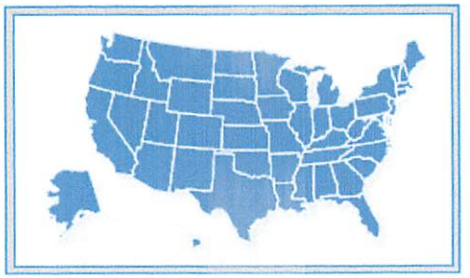
- We have achieved a bonding capacity of nearly $1 billion.
- We remain completely debt-free.
- Our safety record is exceptional; we've received numerous safety awards and have an EMR well below the industry average.
- We have a history of completing projects ahead of schedule.
- Our management structure focuses on Partnering with Owners and Engineers.
- The Barnard Companies seek unique and difficult projects that challenge our skills and creativity.

Our Experience

- Dams & Reservoirs
- Tunnels
- Pipelines & Utilities
- Oil & Gas Pipelines
- Environmental
- Special Projects

Our People

Barnard's people are the reason for the success of the company. We're proud to have more than 70 engineers on our staff. Our reputation attracts the highest quality personnel, hard-working people who are committed to producing projects that set a standard for excellence. Integrity, innovation and sophistication in constructing a quality project have earned the company great respect throughout the construction industry.



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Klamath Settlement

Map Series on Flood Risk along the Klamath River

With known flood risk along the Klamath River, concern has been expressed that removals of Iron Gate, Copco I & II, and J.C. Boyle Dams would lead to increased flood risk downstream. The Reclamation Denver Technical Service Center modeled flood events meeting criteria for a 100 year event from Iron Gate Dam (mile 190) downstream to the community of Happy Camp (mile 105). This simulated 100 year flood event corresponds to FEMA flood zone designations of A, AE, and AO. The methodology followed is similar to modeling done for the FEMA flood risk assessment, but does not represent the same hydrographic base data for flood events. For model development, enhanced elevation data was collected that was not available for the analysis developed by FEMA. Areas identified as inundated in these simulated flood events do not correspond directly with FEMA Flood Insurance Rate Maps (FIRM). The Reclamation analysis is based on LiDAR data with elevation values sufficient to support 2 foot (0.60 meter) contours along the reach of the Klamath River from Happy Camp to above Iron Gate Dam. The collection was in March, 2010 and included orthophoto raster imagery.

A simulated flood event indicates that the inundation area could change with removal of the dams. These four dams are not operated for flood control. However, there is a small attenuation of peak flood flows provided by Copco II and Iron Gate Dams. Preliminary estimates by Reclamation were that the discharge of the 100-yr peak flood immediately downstream of Iron Gate Dam would increase up to 7% after dam removal. The increased discharge would increase 100-yr flood elevations by approximately 1 to 2 feet on average in the reach from Iron Gate Dam (mile 190) to Willow Creek (mile 185). The impact of dam removal decreases with distance downstream of Iron Gate dam and Reclamation estimates that there is no significant effect of dam removal on flood elevations downstream of Humbug Creek (mile 172). This modeling represents a preliminary assessment that would be replaced by a detailed evaluation with a mitigation plan should a determination be made by the Secretary of Interior to remove the dams.

This map series (Page 3 to 97) represents a subset of maps along this portion of the Klamath River. They identify areas where structures may be at risk with or without dam removal. Actual risk cannot be determined without a site visit by a qualified representative of the County. Some structures which appear in this map series already have determinations that they are outside of the FEMA flood zones. These are documented with either a letter of map revision (LOMR) or elevation certificate on file with the County or FEMA. The FEMA FIRM panels can be expected to be revised based on this enhanced elevation data. Base data for this map series is available on the Klamath Restoration home page (http://klamathrestoration.gov/) under the map section.

David T. Hansen, GISP
GIS Specialist / Soil Scientist
Phone: (916) 978-5268
Email: dhansen@usbr.gov
U.S. Bureau of Reclamation

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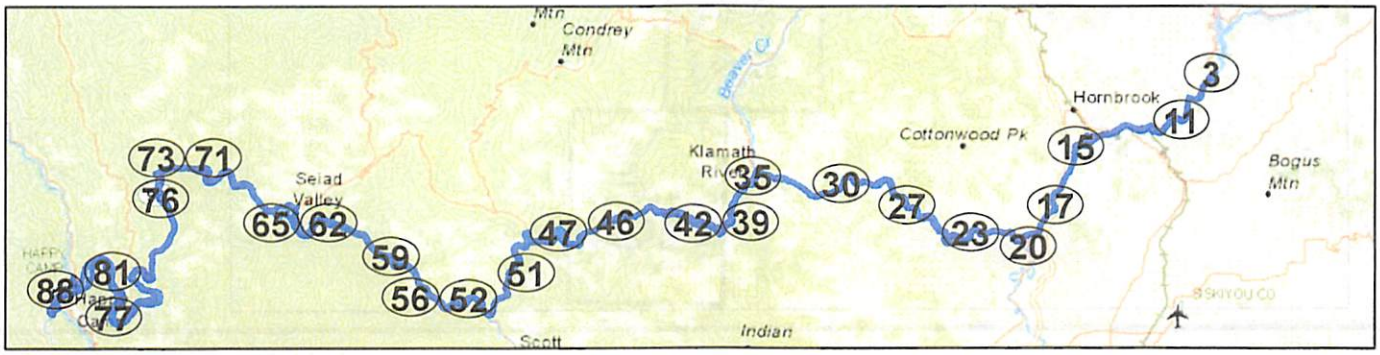
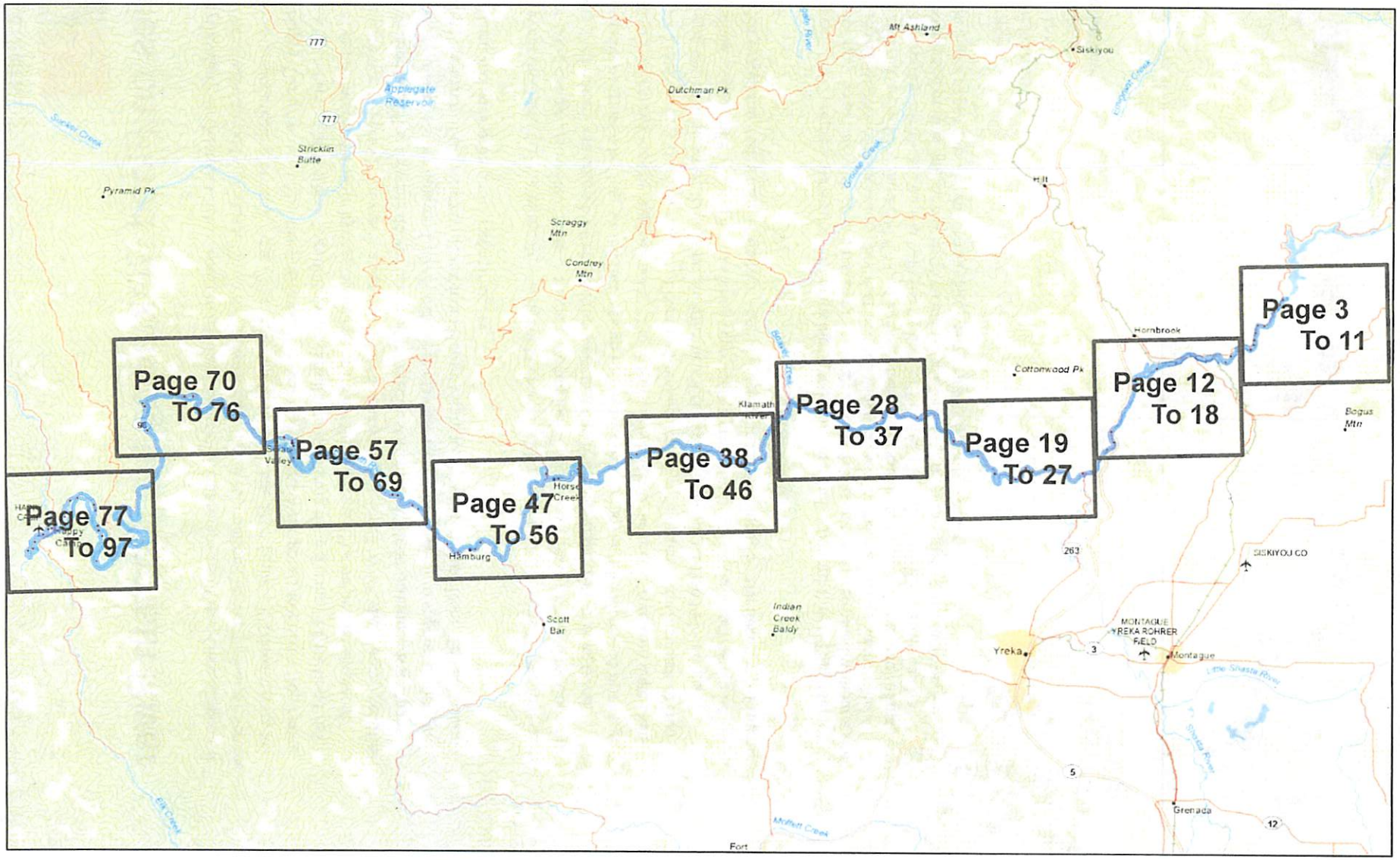


Klamath Settlement

Index Map for Flood Risk Assessment



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NRCS Natural Resources Conservation Service

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Klamath River Basin — Overview

Understanding the "Klamath Basin"

The greater Klamath Basin is often divided into the Upper and Lower Klamath Basins.



click to view a larger image

Upper Klamath Sub-basins

- Sprague River, Oregon
- Williamson River, Oregon
- Upper Klamath Lake, Oregon
- Lost River, Oregon, California
- Upper Klamath East, Oregon, California
- Butte Creek, California, Oregon

Lower Klamath Sub-basins

- Upper Klamath West, California, Oregon
- Shasta, California
- Scott, California
- Salmon, California
- Lower Klamath, California, Oregon
- Trinity, California
- South Fork Trinity, California

Upper Klamath Basin

The Upper Klamath Basin includes the headwaters in south-central Oregon and north-central California, and contains the US Bureau of Reclamation's (BOR) Klamath Project Area. The Lower Klamath Basin, includes the mouth of the Klamath River in the northwest coast region of California. The Klamath Basin is further divided into sub-basins, as shown in the map above and the tables below.

Initially the NRCS accelerated planning and implementation assistance addressed only the Upper Klamath Basin. This focus allowed us to define our scope of work to achieve our objectives in a limited (and accelerated, when

compared to traditional planning efforts) amount of time. It also reflected that the initial request came from the RCDs in the Upper Klamath Basin, who were affected by reduced water deliveries in the summer of 2001. For this study we have defined the Upper Klamath Basin as all the watersheds that occur above the Iron Gate Dam, and are therefore part of the BOR's Klamath Project area.

The Upper Klamath Basin consists of the six hydrologic sub-basins that occur above the Iron Gate dam, and are included in the BOR's Klamath Project. It includes the Williamson, Sprague, Upper Klamath Lake, Lost, Butte and Upper Klamath (East) sub-basins. The Upper Klamath Basin covers 5.6 million acres. It is located in 3 counties in Oregon: Jackson, Lake and Klamath, with Klamath having the largest share; and two counties in California: Siskiyou and Modoc.

Lower Klamath Basin

The Lower Klamath Basin consists of the six hydrologic sub-basins that occur below Iron Gate, plus the West section of the Upper Klamath sub-basin. It includes the Shasta, Scott, Lower Klamath, Salmon, Trinity, South Fork Trinity, and the Upper Klamath (West) sub-basins. The Lower Klamath Basin flows through the California counties of: Trinity, Humboldt, and Del Norte.

Klamath River Sub-basins Size and Hydrologic Unit

Note: For this project, the Upper Klamath Sub-basin (18010206) has been divided into two sections, East and West of the Iron Gate dam.

Upper Klamath Basin

USGS ID	Name	Acres
18010201	Williamson	934,490
18010202	Sprague	1,029,824

18010203	Upper Klamath Lake	464,903
18010204	Lost	1,926,303
18010205	Butte	386,034
18010206E*	Upper Klamath, East Section*	416,786
	Upper Klamath Basin Total	5,158,340

** The East Section of the Upper Klamath Sub-Basin includes 5 watersheds: 18010206-01, 18010206-02, 18010206-03, 18010206-04, 18010206-05*

Lower Klamath Basin

USGS ID	Name	Acres
18010206W**	Upper Klamath, West Section**	489,887
18010207	Shasta	508,481
18010208	Scott	520,612
18010209	Lower Klamath	984,709
18010210	Salmon	480,178
18010211	Trinity	1,303,253
18010212	South Fork Trinity	594,895
	Lower Klamath Basin Total	4,882,015

*** The West Section of the Upper Klamath Sub-Basin includes 6 watersheds: 18010206-06, 18010206-07,*

18010206-08, 18010206-09, 18010206-010, 18010206-11

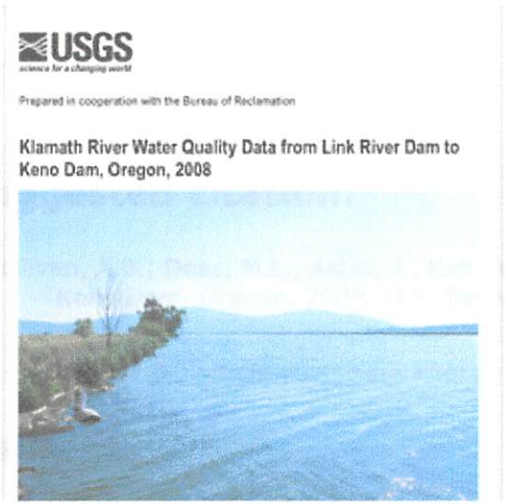
USGS ID	Name	Acres
1801	Klamath Basin Grand Total	10,040,354

Open-File Report 2009-1105

Prepared in cooperation with the Bureau of Reclamation

Klamath River Water Quality Data from Link River Dam to Keno Dam, Oregon, 2008

By Annett B. Sullivan, Michael L. Deas, Jessica Asbill, Julie D. Kirshtein, Kenna Butler, and Jennifer Vaughn



ABSTRACT

This report documents sampling and analytical methods and presents field data from a second year of an ongoing study on the Klamath River from Link River Dam to Keno Dam in south central Oregon; this dataset will form the basis of a hydrodynamic and water quality model. Water quality was sampled weekly at six mainstem and two tributary sites from early April through early November, 2008. Constituents reported herein include field-measured water-column parameters (water temperature, pH, dissolved oxygen concentration, specific conductance); total

- **Report** PDF (572 KB)
- **Appendixes A-D** (ZIP, 1.3 MB)

For additional information contact:
Director, Oregon Water Science Center
U.S. Geological Survey
2130 SW 5th Avenue
Portland, Oregon 97201
http://or.water.usgs.gov

nitrogen and phosphorus; particulate carbon and nitrogen; total iron; filtered orthophosphate, nitrite, nitrite plus nitrate, ammonia, organic carbon, and iron; specific UV absorbance at 254 nanometers; chlorophyll *a*; phytoplankton and zooplankton enumeration and species identification; and bacterial abundance and morphological subgroups. Sampling program results indicated:

- Most nutrient and carbon concentrations were lowest in spring, increased starting in mid-June, remained elevated in the summer, and decreased in fall. Dissolved nitrite plus nitrate had a different seasonal cycle and was below detection or at low concentration in summer.
- Although total nitrogen and total phosphorus concentrations did not show large differences from upstream to downstream, filtered ammonia and orthophosphate concentrations increased in the downstream direction and particulate carbon and particulate nitrogen generally decreased in the downstream direction.
- Large bacterial cells made up most of the bacteria biovolume, though cocci were the most numerous bacteria type. Cocci, with diameters of 0.1 to 0.2 micrometers, were smaller than the filter pore sizes used to separate dissolved from particulate matter.
- Phytoplankton biovolumes were dominated by diatoms in spring and by the blue-green alga *Aphanizomenon flos-aquae* after mid-June. Another blue-green, Anabaena flos-aquae, was noted in samples from late May to late June. Phytoplankton biovolumes generally were highest at the upstream Link River and Railroad Bridge sites and decreased in the downstream direction.
- Zooplankton densities were largest in late April. Populations were dominated by rotifers and copepods in early spring, and by rotifers and cladocerans in summer, with cladocerans most common at the most upstream site.

Part or all of this report is presented in Portable Document Format (PDF); the latest version of Adobe Reader or similar software is required to view it. Download the latest version of Adobe Reader, free of charge.

Suggested citation:

Sullivan, A.B., Deas, M.L., Asbill, J., Kirshtein, J.D., Butler, K., and Vaughn, J., 2009, Klamath River water quality data from Link River Dam to Keno Dam, Oregon, 2008: U.S. Geological Survey Open File Report 2009-1105, 25 p.

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1949—2009 60th Anniversary

Siskiyou Resource Conservation District

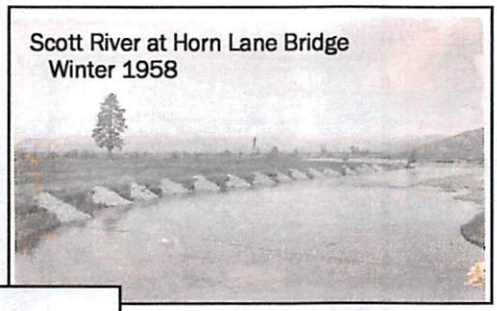
2008 ANNUAL REPORT & 2009 NEWSLETTER

Published June 1, 2009

Our Mission...

- To identify conservation and restoration needs...
- To offer to landowners and resource users assistance...
- To meet those needs and assistance through technical, financial, and educational leadership.

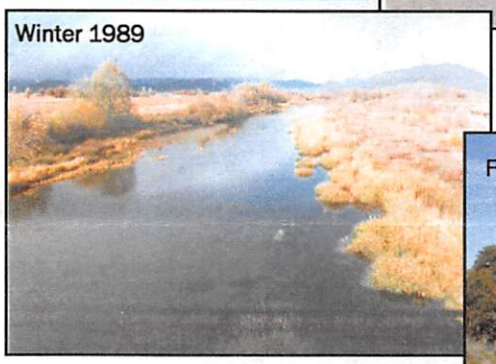
THEN



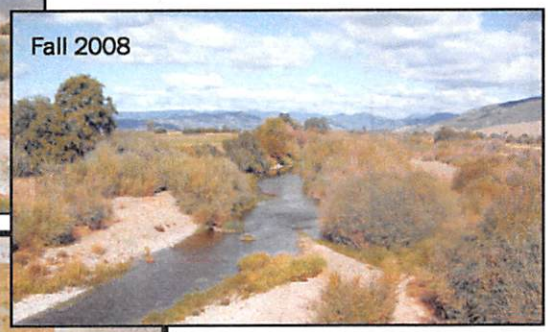


First 1949 Board of Directors

Seated: Bill Mathews-Sec., Frank Bryan-Pres., Harry Tozier-Dir., and Joe Serpa-Dir.
Standing: Ralph Simpson-Assistant Dir., and Clarence Dudley-Dir.







NOW



2009 Board of Directors

Seated: Bill Krum-Pres., Ernie Wilkinson-Associate Dir., Greg Farnam-Dir., Dave Black-Dir. Standing: John Spencer-Dir., Rick Barnes-Dir.

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2008 Board Meetings:

Regular: 12

Special: 6

Total: 18

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FEW STAFFING CHANGES in 2008:

In February Danielle agreed to take on Incidental Take Permit (ITP) Coordinator position for the District, and Carolyn was appointed as Interim SRWC Coordinator by the Council Executive Committee, and serves as both RCD Manager and Council Coordinator.



Carolyn Pimentel
District Manager
Interim Scott River Watershed Council Coordinator



Brenda Hurlimann
District Bookkeeper



Gary Black
Project Coordinator: Implementation, Permitting & Planning



Danielle Yokel
Project Coordinator: Technical, Monitoring, Planning & Grant Writing
Incidental Take Permit (ITP) Coordinator



Erich Yokel
Project Coordinator: Fisheries, Biologist & Assessment



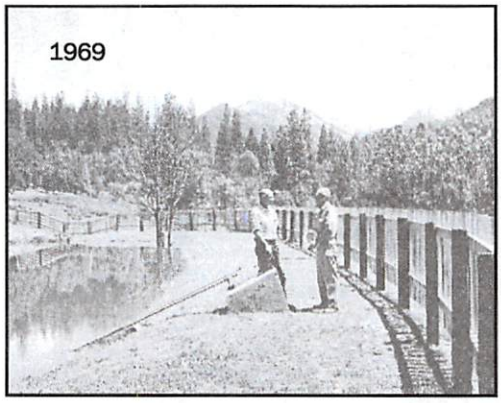
Preston Harris
Project Coordinator: Assistant/Apprentice



Brannon Walsh
Technical Assistant: Water Quality & Fisheries Monitoring Program



Bill & Sandy Watrous
Specialist & Assistant: Fish Screen Maintenance



Olyan Gould, Cecelville ranch owner with Frank Jackson, Soil Conservation Service technician



Dr. Harter, UC Davis & landowners... Discussing surface & groundwater.

Key to Funding Source Acronyms:

- **BLM**—USDI Bureau of Land Management
- **BOR** - USDI Bureau of Reclamation
- **CCSRP**—California Coastal Salmon Recovery Program
- **CDF**—California Department of Forestry & Fire Protection
- **CDFG**—California Department of Fish and Game
- **CFSC**-California Fire Safe Council
- **CTC**—Cantara Trustee Council
- **FRGP**—Fisheries Restoration Grant Program
- **FWS**—USDI Fish and Wildlife Service
- **KRRG**—Klamath River Restoration Grants
- **KTOC**—Karuk Tribe of California
- **NFWF**—National Fish & Wildlife Foundation
- **NOAA**-USDC National Oceanic Atmospheric Administration
- **NRCS**—USDA Natural Resource Conservation Service
- **PSMFC**—Pacific States Marine Fisheries Commission
- **RLFF**—Resource Legacy Fund Foundation
- **RWB**—North Coast Regional Water Quality Control Board
- **SWRCB**—State Water Resource Control Board
- **SRWWQIP**—Scott River Watershed Water Quality Improvement Proj.
- **TMDL**—Total Maximum Daily Load
- **USDA**-United States Department of Agriculture
- **USDI**-United States Department of the Interior
- **USDC**-United States Department of Commerce
- **WCB**—Wildlife Conservation Board

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2008 ANNUAL REPORT of PROGRAMS & SUPPORTING PROJECTS: Total 2008 Expenditures $1,181,884*

*Includes 8% Administrative Overhead of $95,500

To carry out the Programs of the District during the calendar year of 2008, **56** project grant agreements were managed throughout the year, of which **27** came to completion. The Fiscal Year Budget ending June 30, 2009 was approved in July of 2008 for Total Revenues of **$1,495,186.75** , and Total Expenditures of **$1,434,351.75.**

The District utilizes local personnel, labor, contractors, equipment and resources as much as possible, and only out-sources when qualified resources are not locally available. The Siskiyou RCD is dedicated to strengthening the local economy by acquiring grants and circulating those dollars into the local economy with all activities funded solely through grants.

The 2008 dollars invested into each program activity are listed below and on the following pages for District Programs:

Fisheries
Incidental Take Permit (ITP)
Land
Outreach & Education
Planning
Riparian
Water Quality
Water Supply & Fish Passage

Fisheries: $319,183

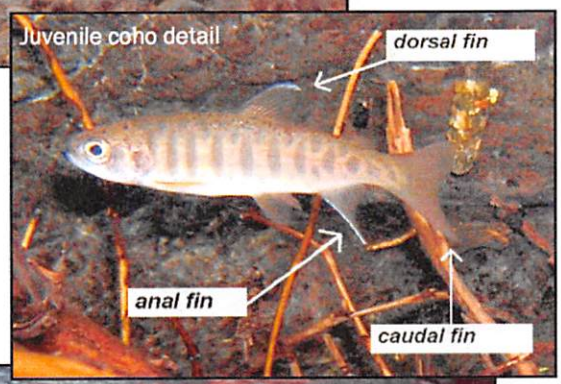
COMPLETED:

- # 8-4 Mid Klamath Chinook Survey—USDA-KNF
- # 11 Scott River Juvenile Coho Summer Habitat Utilization Surveys—CDFG
- # 35-2 Scott River Fish Screen Maintenance Program—CDFG
- # 61-5 Jenner-Hurlimann Fish Screen—PSMFC

IN PROGRESS:

- # 3 Farmers Ditch Off-Channel Rearing Project—CDFG/PSMFC
- # 3-2 Scott River Off-Channel Groundwater Monitoring Program—CDFG/FRGP
- # 27 Aquatic Habitat Needs Study Plan for Scott Mainstem & Tributaries—USFWS
- # 34-4 Adult Coho Spawning Ground Survey—USFWS
- # 35-3 Scott River Fish Screen Construction & Maintenance—CDFG/KRRG
- # 41-4 Fish Passage Through Diversion Improvement—CDFG/KRRG
- # 41-5 Rail Creek Fish Passage—CDFG/KRRG
- # 41-6 Scott River Head Gate & Measuring Weir Installation—CDFG/KRRG
- # 41-11 China Cove Fish Passage Project—PSMFC
- # 41-12 Young's Dam Fish Passage Modifications—PSMFC
- # 44-2 Scott River Summer Habitat Improvement—CDFG/KRRG
- # 44-3 Scott River Rearing Habitat Improvement—CDFG/KRRG
- # 44-4 Scott River Spawning Gravel Demonstration—CDFG/KRRG


Juvenile coho rearing in tributary to Scott River




Adult

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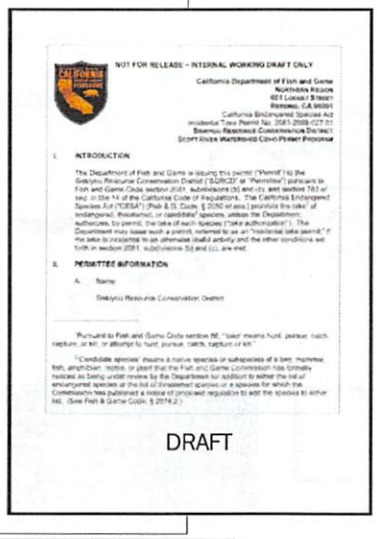
ITP: $58,509

COMPLETED:

- # 15 NEPA Support for Programmatic ITP—NOAA
- # 100-2 Scott River Organizational Support—PSMFC
- # 101 Watershed Wide Permitting Program —NRCS
- # 101-2 Watershed-Wide Permit Program Implementation, Administration & Monitoring—NRCS

IN PROGRESS:

- # 100-3 Scott River Recovery Program Task 1 Capacity Building Needs—NOAA
- # 102 Implementation of Programmatic Permit Programs—USFWS
- # 103 ITP Capacity Building for Scott & Shasta RCDs—CDFG
- # 104 Scott River & Shasta River Valley Planning—Prop. 50 via Humboldt & # 116 Implementation of Key Coho Recovery Task in Scott River Watershed—CDFG/FRGP



NOT FOR RELEASE – INTERNAL WORKING DRAFT ONLY

California Department of Fish and Game
NORTHERN REGION
601 Locust Street
Redding, CA 96001

California Endangered Species Act
Incidental Take Permit No. 2081-2008-027-01
Siskiyou Resource Conservation District
Scott River Watershed Coho Permit Program

I. INTRODUCTION

The Department of Fish and Game is issuing this permit ("Permit") to the Siskiyou Resource Conservation District ("SCRCD" or "Permittee") pursuant to Fish and Game Code section 2081, subdivisions (b) and (c), and section 783 et seq. in title 14 of the California Code of Regulations. The California Endangered Species Act ("CESA") (Fish & G. Code, § 2050 et seq.) prohibits the take of endangered, threatened, or candidate species, unless the Department authorizes, by permit, the take of such species ("take authorization"). The Department may issue such a permit, referred to as an "incidental take permit," if the take is incidental to an otherwise lawful activity and the other conditions set forth in section 2081, subdivisions (b) and (c), are met.

II. PERMITTEE INFORMATION

A. Name:

Siskiyou Resource Conservation District

Pursuant to Fish and Game Code section 86, "take" means hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture or kill."

"Candidate species" means a native species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant that the Fish and Game Commission has formally noticed as being under review by the Department for addition to either the list of endangered species or the list of threatened species or a species for which the Commission has published a notice of proposed regulation to add the species to either list. (See Fish & Game Code, § 2074.2.)

DRAFT

Outreach & Education:



$12,295

Scott River Watershed Council Logo by Skip Hanna

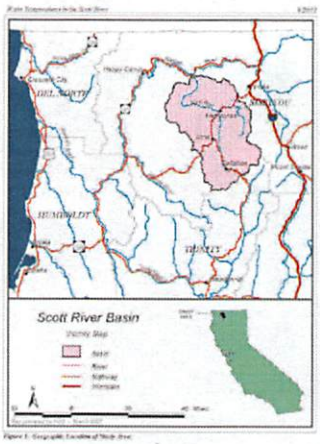
IN PROGRESS:

- # 89-19 Scott River Watershed Council Coordinator—USFWS
  - * Scott Watershed Information Forum
  - * Executive Committee
  - * Strategic Action Plan Review & Update
  - * Water Committee
  - * Fish Committee
  - * Dry Year Plan
  - * Klamath Joint Councils
  - * Moffett Landowner Group
  - * www.ScottRiver.org

Land: $74,400

COMPLETED:

- # 20-2 Scott Valley Fire Safe Council—USDA Forest Service
- # 20-3 Defensible Space Assistance for Low Income Residents—BLM/CFSC



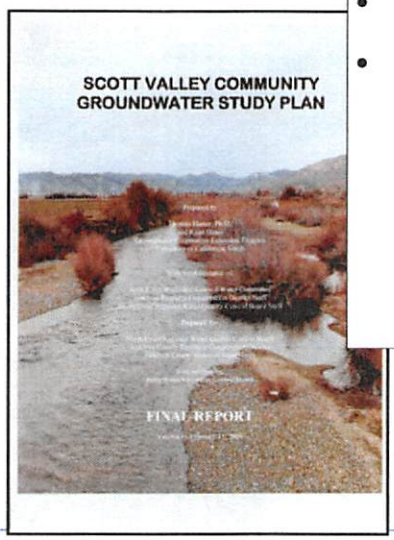
Water Quality: $126,879

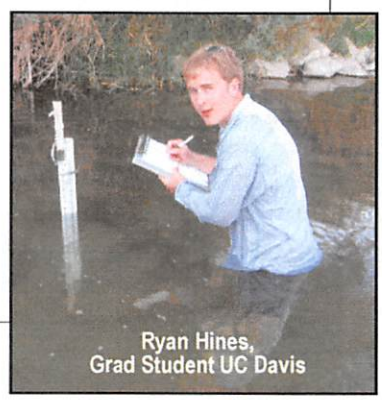
COMPLETED:

- # 13 Scott River Thermal Refugia—KTOC
- # 14 Evaluation of Gaining & Losing Reaches of Scott River—RWB
- # 99-5 Scott River Watershed Monitoring Program—Water Quality—CDFG

IN PROGRESS:

- # 76-2 SRWWQIP Task 2-Scott River Watershed Planning & Assessment—CTC
- # 99-6 Water Quality Monitoring and Habitat Assessment on Scott River & Major Tribs—USFWS-Arcata





Ryan Hines, Grad Student UC Davis

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Riparian: $17,381


Example of riparian & livestock exclusion fencing.

IN PROGRESS:

- # 7 Scott River Riparian Restoration Analysis—USFWS
- # 46-2 French Creek Drainage Protection & Enhancement—USFWS-PFW
- # 46-3 French Creek Planting & Fencing—CDFG


Bio-engineered planting techniques enhance riparian success.


Riparian planting stabilizes the stream bank and traps sediment.

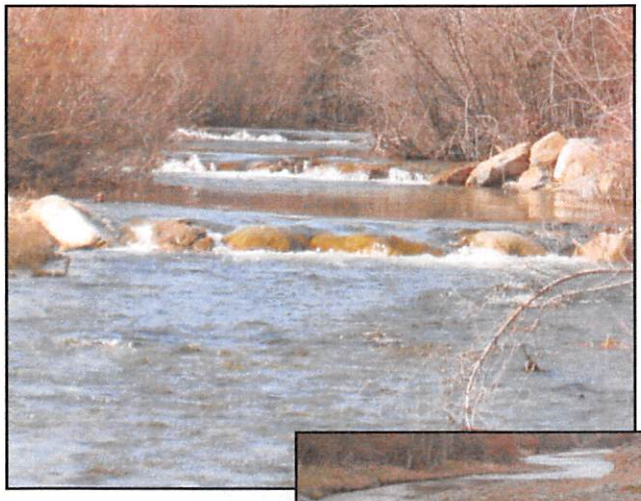
Water Supply & Fish Passage: $398,662

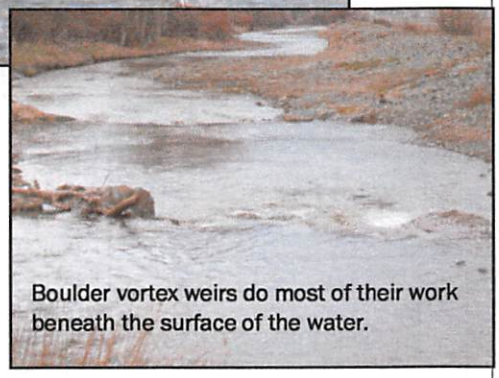
COMPLETED:

- # 2 Scott Valley Community Groundwater Monitoring Program—Siskiyou Co.
- # 5 Cliff Lake Rehibilitation Project—USDA-KNF
- # 32-3 & 4 Accelerate Implementation of USDA Farm Bill Program Irrigation Water Management—NRCS
- # 43 Scott River & Major Tributaries Instream Flow Analysis—USFWS
- # 70-3 Scott River Water Balance: Streamflow & Precipitation Gauging—CDFG

IN PROGRESS:

- # EFE Scott River Emergency Flow Enhancement Project—DWF
- # 2-2 Scott Valley Community Groundatwer Monitoring Program—Siskiyou Co.
- # 6 Storm Damage Repair of Vortex Boulder Weirs—CDFG/KRRG
- # 6-2 Shackleford Creek Repair of Vortex Boulder Weirs—USFWS-PW
- # 6-Ph2 Storm Damage Repair of Vortex Boulder Weirs in Scott River Watershed Additional Funds—PSMFC
- # 39-3 Scott Valley Water Trust—DWR
- # 41-7 Shackleford Creek Diversion Structure Improevement—CDFG/KRRP
- # 41-8 Fish Passage for Agricultural Diversion in Scott River System—USFWS
- # 70-4 Scott River Trubutary Flow Gauging & Percipitation Monitoring—CDFG/FRGP
- # 76–3 Sugar Creek Flow Enhancement Through Diversion Piping – CDFG/CCSRP
- # 83-2 East Fork Water Quality Improvement Project—CDFG
- # 85-7 Farmer's Ditch Alternative Stock Watering System - CTC SRWWQIPTask 3
- # 85-8 Farmer's Ditch Diversion Improvement—CDFG
- # 85-9 Farmer's Ditch Fish Passage—CDFG/KRRG




Boulder vortex weirs do most of their work beneath the surface of the water.

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THEN: THE 20 YEAR REPORT 1969

SISKIYOU SOIL CONSERVATION DISTRICT

This is a re-publication with some photos of the 20 year report from of the Siskiyou Soil Conservation District.

District name was changed in 1971 to Siskiyou Resource Conservation District to reflect broadened scope of RCDs.

Twenty years ago (1949), the land owners in Scott Valley, Siskiyou County, California, formed the Siskiyou Soil Conservation District. It encompassed 396,160 acres of the Scott River watershed as it applies to Scott Valley. It was to provide an organization of farmers and ranchers who, working together, could help themselves and others solve their soil and water conservation problems on a community wide basis.

In 1957 the landowners of the Salmon River watershed elected to have their lands included in the district. This increased the acreage of the district 780,000 acres, making the total of 1,176,160 acres.

They had good reason for the formation of their district. Periodically Scott River flooded and did heavy damage to large acreages of the best farm lands in the valley, When flood waters receded, the land that had not been badly eroded was left covered with silt, sand, gravel and debris. Buildings, livestock, fences, irrigation systems, and equipment were destroyed. There seemed to be plenty of irrigation water, but water distribution and irrigation systems were inadequate. Erosion control work was needed. Higher producing forage plants had to be found. Large acreages needed to be drained.

Immediately five resident landowners were elected as directors with the responsibility of handling the business of the district and working with the various federal, state and county agencies which would have resources available to help in establishing a sound soil and water conservation program for the district.

Those first directors were: Frank Bryan, president, Bill (Pinky) Mathews, secretary, Harry Tozier, Joe Serpa and Clarence Dudley.

Through the years, there has been a natural turnover of directors. Others who served were Ralph Simpson, Hearst Dillman, Maynard (Bud) Tozier, Earl Simpson, George Rose and Gordon Dunlap. Serving at present are Keith Whipple, president, Bill Mathews, Bill Coe, George Edwards and Vernon Smith. These men have and are serving without pay. They give their time and energy because they believe not only in the conservation of our soil and water, but of our total resource.

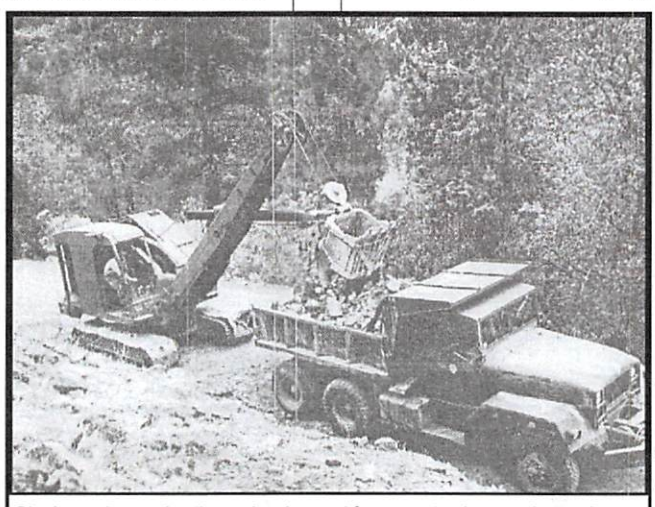
The first directors immediately made analysis of the problems confronting the district in soil and water conservation. They then drew up a long range plan covering the steps which they felt necessary to follow in overcoming the problems and bringing the district lands up to their potential production.

With this analysis of the problems and the plan of action for overcoming them, they were able to enter into an agreement with the U.S. Department of Agriculture which allowed the Soil Conservation Service to furnish resident technicians who would help with the technical end of the work.

The first major job completed was a survey or inventory of the soils in the district. This gave all of the physical characteristics of the land. It gave the depth, texture, relief, degree of wetness, exposure and any limiting factors which would affect crop production or contribute to erosion. From the survey, it was possible to tell the capability or potential of each field or acreage to produce crops, and what treatment would be needed to bring it to top production and maintain it.

Over eighty species of forage plants were tested to find which ones were best adapted to the various soil and climatic conditions. Out of those tests came the forage plants now being used in improved pastures and hayland.

The first requirement for the establishment or improvement of any enterprise, whether it be the building of a house, the running of a business, conducting a war, or operating a ranch, is a basic plan which covers the steps necessary to the accomplishment of that enterprise. The new Siskiyou SCD immediately set about helping individual land owners who became district cooperators, develop step by step basic plans which would help them with their soil and water conservation problems and bring their lands to maximum potential crop production. At present there are about 200 district cooperators. One hundred forty-seven of these cooperators now have basic plans covering approximately 91,000 acres. The goal of the district, is to eventually have a basic plan completed for every operating unit within its boundaries.



District equipment loading rock to be used for streambank protection work.

After the devastating flood of 1955 and the high water of 1958, the banks of Scott River were badly eroded. The channel, which originally was 120 feet wide, had been washed until there were many places over 1000 feet across. Large acreages of some of the best land in Scott Valley had been lost. The Siskiyou SCD directors set about getting the landowners to stabilize the raw river banks and strengthen them to withstand future floods. The soil Conservation Service granted the district several 6x6 GI dump trucks and a dipper stick shovel from excess equipment. With this equipment, the district teamed up with private contrac-

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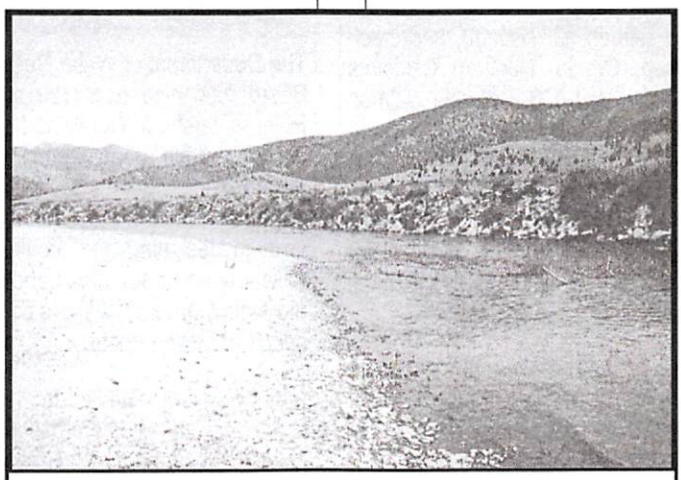
tors and rushed the job of placing large rock rip rap along the more critical reaches of the river banks. In a few years, about twenty miles of the banks were in good shape. The work had slowed down enough for private contractors to stay ahead of it. The trucks were disposed of and the private operators carried on the work.

The 1964 flood gave the rock a real test. About two and one half miles of it were lost. Land in unprotected areas was washed away. The land owners immediately set about replacing the lost rock and extending it to other critical areas. At present about thirty miles of the river banks have been strengthened. The job is still not complete. About twenty miles are still needed. The time to do it is now. It would be much easier and less costly than postponement until another disaster comes.



Representative example of stream bank protection work along Scott River. Besides protecting the land from further erosion, a good fishing hole is formed.

In 1964, at the request of the several service clubs and towns in Scott Valley, the district directors hired private enterprise to make a comprehensive study of the Scott River watershed as it pertains to Scott Valley. The study would give the people data on the total resource and how it is being used. The study was completed in 1967. It projected into the future, the probable population growth, irrigation and domestic water needs, increasing demand for recreation enterprise, and most of all, the need for flood control works.

The information was distributed to all interested people and many meetings were held to discuss it. As a result, the people of the Kidder Creek portion of the watershed applied for assistance in establishing a flood control, irrigation and recreation enterprise on Kidder Creek. This was soon followed by a similar application from the City of Etna, covering Etna Creek. The next application came form the people on the land serviced by Farmers Ditch and the Scott Valley Irrigation District. A short time later the City of Fort Jones applied for help on the Moffett, Duzel and McAdam Creek watersheds.

With this many applications on hand and the show of interest by the people of the area, the district directors asked the Soil Conservation Service to make a detailed study of the whole watershed and determine the feasibility of the proposed projects. The study was started on October of 1968. Early in 1970 it should be completed.* With this, the people of the area will know exactly what they have and what it will take to establish needed flood control, irrigation and recreation works to their satisfaction.

The Soil Conservation District, its directors, the technicians assigned to work with them, and the land owners themselves have found that they can't hold their thinking and work to the narrow confines of soil and water alone. They have found that they must think and work in terms of the community as a whole and its total resource. Soil and water are the base or foundation upon which all things are built. They, therefore, are the natural starting point. But, as work is done with these elements, opportunities arise to broaden and diversify efforts for the benefit of the community. Non-profit service clubs sometimes need assistance. Beautification of the community is a constant challenge. Now, more than ever, we are confronted with the pollution problem. Population changes make changes in overall thinking and goals. People are becoming more and more recreation conscious, and interested in the revenues which can be realized by combining recreation enterprises with farming and ranching operations. Along these broader lines, the Siskiyou SCD has tried to help wherever possible.

To illustrate, the following items are a few projects where help has been given: The design and layout of the Little League park in Etna. Assistance in surveying and layout of several fish ponds to fit recreation enterprises. Design and layout of the new Pleasure Park rodeo grounds in Etna after destruction in the flood of 1964. Landscaping of the Etna Elementary School grounds. Landscaping of the Etna Catholic Church grounds. Survey and layout of quarter mile racetrack for Etna High School and a plan for future use of the total fifty acres owned by the school.

The record shows that individual landowners have taken advantage of the technical help the district offered them. They have applied soil and water conservation practices to their lands as listed below: Irrigation Reservoirs=27, Channel Clearing & Snagging=98,100', Diversion Dams=81, Multipurpose Dams=1, Dikes & Levees=3,270', Farm Ponds=39, Field Ditches=400,900', Drain Ditches=105,261', Fishpond Stocking=7, Grade Stabilization Structures=81, Grassed Waterways=1,312', Irrigation Pipelines=76,784', Sprinkler Systems=88, Other Irrigation Systems=85, Land Leveling=10,729 ac., Land Smoothing=2,100 ac., Streambank Protection=158,700', Channel Improvement=8,800', Water Control Structures=86, Tile Drains=18,258', Irrigation Wells=69, and Grass-Legume Seeding=16,740 ac.

This represents a large cash investment by the landowners. It shows that there is universal interest in soil and water conservation in the Siskiyou SCD. It proves that the people of the district can and will carry on with their individual and community wide conservation projects until the total land and water resource is stabilized and able to give full return for the time and effort spent.

The District directors meet in the Soil Conservation Service Office on Diggle Street in Etna at 8:00 P.M. on the second Tuesday of each month. These meetings are open to the public. People who wish to discuss soil and water conservation problems are especially invited.

*See inset on page 11 for additional information on this study.

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NOW: NEW CHALLENGES FOR THE DISTRICT

Through the years the focus of the District has always been on the protection and improvement of resources, but forces have changed from post-war driven production to regulation driven environmental protection.

The Scott River is a major tributary to the Klamath River and provides spawning, incubation and rearing habitat for Chinook salmon (*Oncorhynchus tshawytscha*) , coho salmon (*O. kisutch*), and steelhead trout (*O. mykiss*). The Southern Oregon Northern California Coast (SONCC) Environmental Sensitive Unit (ESU) of coho salmon was listed as a threatened species under the federal Endangered Species Act (ESA) in 1997 (NMFS 1997) and by the California ESA in 2004. The Scott River is included within the range of SONCC coho. The California North Coast Regional Water Quality Control Board has designated the Scott River as impaired under section 303d of the Clean Water Act. A Total Maximum Daily Load (TMDL) has been developed for temperature and sediment in the Scott River.

In order to address the CESA listing of coho salmon the California Dept. of Fish and Game (CDFG) developed a Recovery Strategy for California Coho Salmon (SSRT, 2003). This Strategy identifies a pilot program for the Shasta and Scott River Watersheds with specific restoration and educational tasks. In order to address the recommendations of the Recovery Strategy, the Siskiyou RCD, CDFG and other stakeholders have been developing the Scott and Shasta River Watershed Wide Permit Program (Permit Program). The Permit Program identifies specific measures that landowners in the Scott River Watershed need to undertake to protect coho salmon and their habitat. To insure that restoration projects are designed and implemented in the most effective manner, the RCD has been developing Priority Plans for the different elements of watershed restoration required by the Permit Program. Development of these plans utilizes a compilation and analysis of existing water quality and fisheries data from the Scott River to identify locations with the highest probability of providing benefit to the fishery through restoration.

The Siskiyou RCD has been completing watershed wide restoration efforts in the Scott River Watershed since the early 1980's. Many of these instream and riparian restoration projects have been focused on restoring coho salmon habitat in the Scott River and tributaries. Restoration projects have included riparian fencing and planting, stream bank stabilization, instream habitat structures, fish passage barrier removal, fish screen installation, and fish friendly livestock and vehicle crossings.

In order to better direct restoration project site selection and design, the RCD and Scott River Watershed Council (SRWC) have been conducting watershed wide monitoring efforts since the early 1990's. The RCD has monitored stream water temperature, stream discharge, stream bed sediment composition, habitat types, riparian condition and population and distribution of anadromous salmonids. In 2004, the SRWC developed a watershed wide monitoring program to direct both trend monitoring and project monitoring efforts. The SRWC and RCD utilize the data collected through this monitoring program to identify key areas and develop appropriate restoration project proposals.

A major goal of the Siskiyou RCD and the SRWC is to install CDFG/NOAA approved fish screens as well as DWR approved head gates and measuring weirs on all active diversions within the Scott River Drainage.

The Department of Water Resources and State Water Resource Control Board recognize over 150 surface water diversions within the Scott River watershed. The RCD has identified approximately 100 active diversions within areas used by coho salmon. Recent efforts to screen all the diversions within coho use culminated with the last screen installed in March of 2009. Now the focus is on proper diversion management through designing and providing diversion facilities that maintain fish passage, and adjustable head gates and measuring weirs to ensure the amount of water diverted is consistent with the appropriate court decree specifying water rights.

Irrigation water obtained from diversions is important to the agricultural community, which is the backbone of the economy in Scott Valley. Adjustable head gates and measuring weirs are necessary to properly manage diversions, and fish screens are needed to protect fish. The cost of designing and fabricating a self-cleaning fish screen, installing a head gate and measuring weir is above what most landowners can afford. The RCD has set up a standardized agreement where we seek funding for the design and installation of a fish screen, measuring weir and head gate if the water user agrees to maintain the units. Under this agreement, the RCD has received funds for numerous installations of head gates and measuring weirs throughout the watershed.

Efforts are on-going to improve the riparian area in the watershed. In 2008 Jon Fripp, USDA-NRCS Stream Mechanics Civil Engineer, and Chris Hoag, USDA-NRCS Wetland Plant Ecologist assessed a proposed site to bio-engineer 300' of stream bank for protection and enhancement of fish habitat. RCD riparian designs were modified by adding bio-engineered structures along the bank. Siskiyou RCD staff and Lorrie Bundy, USDA-NRCS Yreka Engineer completed hydraulic calculation for the final project design to demonstrate multiple bio-engineered structures: vertical bundles, facines, brush mattresses, clump & cluster plantings, vegetated stone sills, "dragon's teeth", stream barbs with rock, vegetation and/or root wads, live poles and brush spurs. A locally contracted excavator and dump truck were utilized in the construction, as well as, voluntary hand labor in the field-day portion of the "Bio-Engineering Workshop" in September of 2008.

In addition to riparian planting, construction of livestock exclusion fencing along the riparian zone has been a restoration focus for the Siskiyou RCD and SRWC. Protection of the riparian zone from adverse effects of livestock is accomplished through approved fencing specifications which can reverse a degraded condition and improve instream conditions. Riparian restoration can stabilize stream banks, trap and hold sediment, reduce excessive active channel widths, increase moisture holding content of the soil and improve in-stream functions. The entire life cycle of riparian trees improves in-stream habitat and provides benefit to anadromous fish.

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1992 – 2008 SUMMARY OF DISTRICT PROGRAMS:



FISHERIES & WILDLIFE HABITAT IMPROVEMENTS:

- Collected water temperature data since 1995, and continuing as an ongoing program.
- Collected macro invertebrate data since 1998, and continuing as an ongoing program.
- Completed the newly established habitat assessment and studies program.
- Completed 8 years of annual adult coho spawning surveys, and continues as an ongoing program.
- Improved fish passage by installing weirs to replace gravel dams at 24 diversions.
- Installed 66 fish screens with headgate structures throughout the Scott River watershed with an ongoing maintenance program.

WATER QUANTITY CONSERVATION:



- Installed 20 alternative stock watering systems by converting from inefficient open ditch livestock watering methods to efficient pressurized on-demand groundwater fed systems. Water saved is returned to or not diverted from the stream during low flow seasons, and more systems are scheduled for installation.
- Installed 38 sets of moisture sensors for 20 landowners to improve irrigation efficiency.
- Designed/installed efficient water delivery systems by piping 7 miles of inefficient open earthen ditches to increase flows in Sugar Creek up to 5.9 cfs.
- Continually working with irrigation districts and diversion ditch owners for water management efficiency.
- Water Balance development is continuing with more projects seeking better understanding of watershed hydrological balances within the watershed guided by the Scott Valley Community Groundwater Study Plan, and U.C. Davis' development of a Water Balance Model and Groundwater Model for Scott Valley by Sept. of 2009.
- Scott Valley Groundwater Static Well Level Monitoring started in the spring of 2006 with 35 volunteered wells and now 42 are being monitored, with more planned.
- The Water Trust Program: Assessment Phase completed 2004, Implementation Phase initiated in 2007, and ongoing.

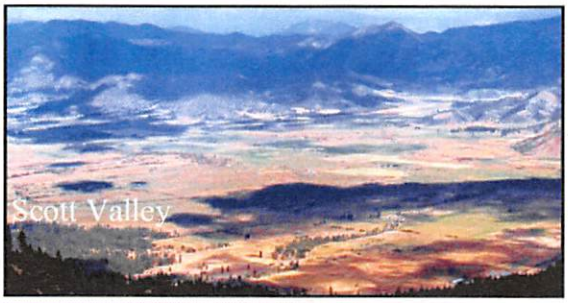
WATER QUALITY & SOIL EROSION REDUCTION:



- Completed sediment studies for 1990, 2000, and 2006.
- Completed 17,490 feet of stream channel enhancement projects: Fish friendly bank stabilization with 317+ instream structures on private properties.
- Improved upland road related practices: Inventoried over 400 miles of roads, implemented erosion reduction improvements of out-sloping, culvert removal, and rocking on 127 miles of roads, and decommissioning 19.2 miles of both public and private roads.
- 100% of privately owned portions of the Scott River mainstem from Callahan to Meamber Bridge (30+ miles) are fenced where cattle are present. The remaining unfenced portions are permanent croplands that exclude cattle. 40% of the tributaries were cattle are present are fenced.

WATERSHED-WIDE PLANNING:

- Initial Phase of the Scott River Watershed Council Strategic Action Plan & Limiting Factors Analysis–completed 2004, updated October 2005, and Strategic Actions updated December 2008.



- Siskiyou RCD Scott River Watershed Coho Permit Program (ITP) DEIR completed & certification expected sometime in 2009. Watershed-Wide Permit being prepared by the Department of Fish and Game.
- Scott Valley Community Groundwater Study Plan—Approved by the Siskiyou County Board of Supervisors February 12, 2008.

Boulder Vortex Weirs & Instream Structures

Replacing the existing push up gravel dam diversion structures at diversion takeout sites with boulder vortex weirs and instream structures maintains the channel capacity, reduces scouring energy, and eliminates the repeated need for heavy equipment in the stream channel.

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Featured Project: Farmers Ditch Diversion Improvement

Comprised of projects:

Farmers Ditch Diversion Improvement Project DFG (RCD Ref. #85-8) and
Farmers Ditch Fish Passage (RCD Ref. #85-9) Funded by Department of Fish and Game
Farmers Ditch Off-Channel Rearing Project (RCD Ref. # 3) Funded by Pacific States Marine Fisheries Commission with Matching Contributions from USDA Natural Resource Conservation Service

Gary Black, Project Coordinator

The Scott River is a major tributary to the Klamath River which supports runs of Chinook salmon, coho salmon and steelhead trout. The Farmers Ditch is the second largest diversion in the watershed diverting up to 36 cfs from the Scott River. The Farmers Ditch is located in the Southern portion (River Mile 52) of the Scott River watershed within a reach of five miles of historical gold mine tailings on the Scott River. This reach is a vital corridor for adults migrating to prime spawning areas and for juveniles moving through or rearing within the reach as there remains pockets of satisfactory water temperatures during the summer months.

Prior to this project the Farmers Ditch diverted water by constructing a large gravel dam across the Scott River in stages. As flows reduced throughout the irrigation season the Farmers Ditch users would extend the gravel dam until the dam reached across the active channel diverting most of the flow to obtain their adjudicated water right. At that point, the gravel dam was a barrier to fish passage and the process resulted in a rapid dewatering of the channel downstream of the diversion. This often resulted in an extensive coordinated fish rescue and relocation effort; although, many fish were still lost.

The primary intent of the project was to provide for fish passage when flows were present and eliminate rapid dewatering of the channel downstream of the diversion. The secondary intent of the project was to rear and protect juvenile fish on site over the summering months instead of being trapped and relocated. The project was a large cooperative effort that included participation from the Farmers Ditch Company, CDFG, NRCS, and the Siskiyou RCD. Several grant agreements were coordinated in this cooperative program entitled the Farmers Ditch Diversion Improvement Program.

The Siskiyou Resource Conservation District (RCD) and the Scott River Watershed Council (SRWC) work closely together to determine and improve watershed health conditions related to water quality and anadromous fisheries. Together, the two community groups address watershed conditions and limiting factors including in-stream enhancement, water quality improvement measures, riparian planting, upland issues, monitoring and assessments, road improvement/decommission projects, fish screen design and construction and numerous educational endeavors. The focus over the past five years has been on improving conditions for coho salmon within the agricultural areas of Scott Valley.

The development of gravel dams (bed load) to divert water into gravity flow diversions is a common occurrence in the Scott River. Prior to this project, Farmers Ditch moved approximately 80 - 200 cubic yards of bed load material annually to build a diversion dam structure in the active channel. The barrier caused by the gravel dam segregates the stream and prevents fish passage during the summer and early fall.

The Farmer's Ditch Diversion Improvement Project is a continuing effort in improving fish passage by altering existing diversions operating under the adjudications within Scott Valley. Surface water diversions which use diversion structures preventing fish passage within quality rearing areas are being selected for conversion on a priority basis. Challenges for this project were difficultly in the design and implementation due to the size and instability of the active channel in this section of the Scott River, and ceasing of surface flows below the diversion from early July to early November increasing issues for stranded fish. This project provided an excellent opportunity to demonstrate resolution through redeveloping the diversion and addressing its management.

The project considered all facets of future fish/water compliance and implementation through a comprehensive design carried out in a series of task accomplishments:

- Converted the method of diversion from a gravel dam to a series of boulder weir(s)



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- Installed a head gate and water measuring structure to regulate and measure diverted flow. Re-profiled the diversion to reduce head between point of diversion and channel elevation.





- Aided with the refurbishment of the fish screen to meet CDFG/NOAA fish screening criteria.

- Constructed an anadromous fisheries rearing pond connected to the diversion between the head gate and the fish screen.





In Conclusion:

Much of the project was installed in the late summer and fall of 2007 and adjustments continued in the summer of 2008. Thus far the function of the system has worked well. Management of the diversion is much easier and the annual impact to the stream has been reduced or nearly eliminated. Rather than 80 to 200 cubic yards of bed load moved each year, only about 5 to 7 cubic yards were moved in 2008 to divert flows. The screw-type head gate, culvert, and measuring weir all worked well. The operations will continue to be monitored in 2009 and any further adjustments will be made as needed through future funding.

Fish passage over the diversion structure has been achieved during all flow conditions thus far. The channel did dry up at the diversion site again in the summer of 2008, but occurred slowly and the fish rearing in the dewatering area seemed to be able to either move up stream to the mouth of Sugar Creek where there is cold year-round flow or they moved into the ditch and reared in the constructed pond. An estimated 1,800 fish reared throughout the summer in the pond.

Immediate Success: The CDFG did not need to trap the reach of stream below the diversion last year as the flows subsided slowly allowing the juvenile fish to exit the area. The concept of coordinating diversion structures, head gate placement, fish screen placement and measuring weirs was a cooperative process that evolved throughout this successful demonstration project.

Long-term Success: The management responsibilities of the diversion, fish screen and pond needs to be determined. Siskiyou RCD is working with the Farmers Ditch Company and the CDFG in developing an understanding of needs/responsibility between each party and ultimately coming up with a management plan that is consistent and works for all.

Scott Valley Plan

The study referred to in the *20 Year Report 1969* was specifically requested by the Directors of the Siskiyou Soil Conservation District in 1968. It represented nearly 1,000 hours of research, study, compilation, and mapping. The resulting "*Inventory and Evaluation of the Natural Resources Scott River Watershed*" was completed and printed May 1972 by the USDA – Soil Conservation Service.

This document was used extensively by the Siskiyou County Planning Department in preparing the Scott Valley Plan, which was finally adopted by the County Board of Supervisors on Nov. 12, 1980. It was a grass roots effort by Valley citizens to try to manage development, protect the natural resources, and still allow for reasonable population growth.

The County Board of Supervisors appointed a committee of eleven local citizens, supported by their alternates, to guide the development of the Area Plan, to work with the County Planning staff, and to report regularly to the Board of Supervisors. This group was locally known as "The Scott Valley Eleven." In 1979, a Valley wide poll was taken and the proposed plan passed by a 2 to 1 margin and was subsequently accepted by the Board of Supervisors and amended as part of Siskiyou County's general plan.

This unusual and unique citizen directed plan all started by the vision of the Board of Director's of the Siskiyou Soil Conservation District in 1968. Now, 29 years later, it is an honored and respected guide by which Scott Valley's population prospers and grows.

Contributed by David Black, original member of The Scott Valley Eleven, and Siskiyou RCD Director since 1982

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Siskiyou Resource Conservation District
P. O. Box 268 / 450 Main Street
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SISKIYOU COUNTY
ADMINISTRATOR'S OFFICE
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Monthly Board Meetings:

First Thursday evening of each month at the District Office. The public is always welcome!!

Contact us to be placed on our agenda mailing list (postal or email).

Phone: 530-467-3975
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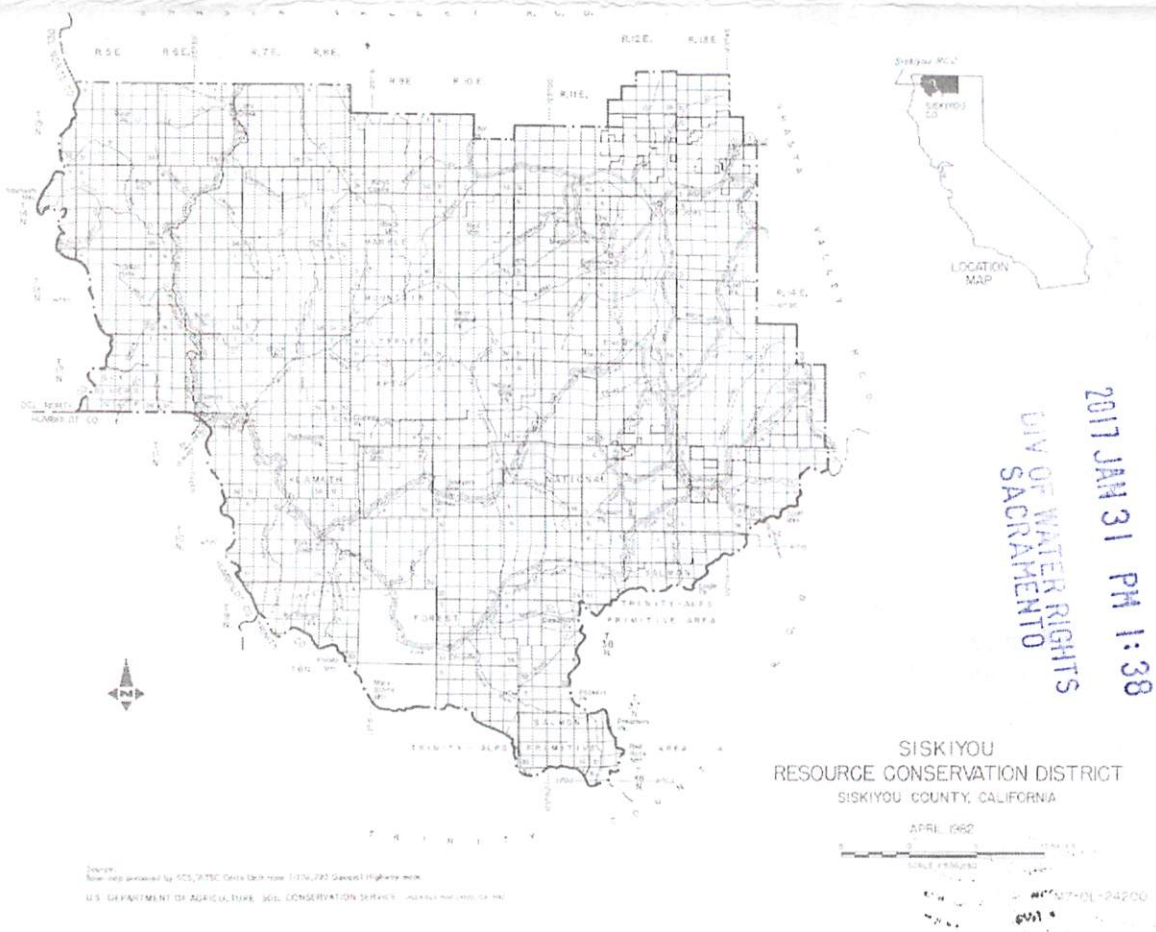

STATE WATER RESOURCE CONTROL BOARD
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DIV OF WATER RIGHTS
SACRAMENTO

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Voluntary Groundwater Management & Enhancement Plan for Scott Valley
Advisory Committee approved 10-22-12

Prepared by the Scott Valley Groundwater Advisory Committee

Approved by the Siskiyou County Board of Supervisors

_____, 2013

2017 JAN 31 PM 1:38
SACRAMENTO

Overview

Plan Purpose: To provide a voluntary, locally driven direction for the management and enhancement of the Scott Valley groundwater basin that is mutually beneficial for the community and the environment. This strategy will be an ongoing effort and be reviewed periodically.

Goal #1: Keep the control of groundwater supply within Siskiyou County, protect property rights and Scott Valley's agricultural economy, and develop solutions to resolving environmental-related issues for the Scott Valley aquifer .

Goal #2: Seek ability to implement plan, which will take time and money, skills and commitment.

Basin Management Objectives:

1. Develop improved understanding of how groundwater and surface water behave.

2. Continue to maintain the long-term viability of the aquifer (which has never been in an overdraft condition).

3. Reduce the conflict between groundwater use and other uses of water; scientifically validate the effect of groundwater use on salmon and steelhead use of the Scott River and its tributaries.

4. Improve public understanding of how agriculture uses wells and applies irrigation to local crops.

5. Identify non-agricultural water demands.

6. Identify groundwater use efficiency and enhancement projects and implement through grants, agencies and the community.

"Overdraft" definition: Groundwater overdraft is defined as the condition of a groundwater basin or subbasin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years, during which the water supply conditions approximate average conditions. Overdraft can be characterized by groundwater levels that decline over a period of years and never fully recover, even in wet years. (DWR Bulletin 118)

1. Background

1.1 Groundwater Rights

All water rights are usufructuary; that is, the right pertains to the use of the water, and not to ownership of the "corpus" or body of the water itself. In California, most surface water

rights are riparian or appropriative. Riparian rights are considered "part and parcel" of land ownership and are real property. To qualify, a parcel of land generally must be contiguous to the stream. Riparian rights are "correlative" - that is, shared equally by all riparian owners on a stream. The individual riparian water use right is not "fixed" in quantity, but is shared equally as available and can be put to beneficial use. In addition, the use of water by a riparian user must be consistent with the rights of all other owners of land riparian to the same supply.

Appropriative water rights are acquired through possession and control of water by diversion, application of the water and continued beneficial use. Those who were "first in time, are first in right." (Fisheries were denied an appropriative right in the Scott River Adjudication because, under historic water law, they could not take discrete control of the water.)

Groundwater is treated similarly to riparian rights. All overlying owners of a groundwater basin share the right to use groundwater according to the "correlative rights doctrine."

1.2 Scott River Decree (see also Appendix A)

The Scott River Stream System is an adjudicated groundwater basin. In 1980, the Superior Court of Siskiyou County decided, upon recommendation of the State Water Resources Control Board (SWRCB), the water rights of surface water users as well as groundwater users in the interconnected groundwater zone under the Scott River Adjudication Decree. The California Water Code first had to be changed by the Legislature (section 2500.5) to declare that groundwater supplies which are interconnected with the Scott River are part of the "stream system" as a "foundation for a fair and effective judgment" of rights to the water of the Scott River. No other stream system in California has such a legal determination for similar hydrologic interconnections.

The Decree has several sections pertaining to interconnected groundwater, which was defined as "all groundwater so closely and freely connected with the surface flow in the Scott River that any extraction of such ground water causes a reduction in the surface flow in the Scott River prior to the end of a current irrigation season." A map delineates this zone of varying width in the reach between Clarks Creek and Meamber Bridge. [CDWR 2004; SWRCB 1980]

1.3 Past Studies

In 1953, a special groundwater investigation of Scott Valley was begun by the U.S. Geological Survey (Mack 1958). Field work confirmed descriptions of the geology and groundwater features, with the results providing the most comprehensive study of the aquifer to date. A decade later, the California Dept. of Water Resources (CDWR) explored the potential of groundwater development in Scott Valley to provide irrigation to existing and new lands (CDWR 1964). Their report concluded that managing the groundwater

supply would cost less than developing surface storage projects. As background for the Scott River Decree, the State Water Board investigated the water supply and use of water in the early 1970s (SWRCB 1974) as well as the hydrology and geology of the sub-basin (SWRCB 1975). In a 1991 report, CDWR analyzed opportunities to augment streamflows in the Scott River during periods of inadequate fishery flows, at the request of the Klamath Basin Fisheries Task Force. Their study provided an updated groundwater contour map of Scott Valley and recommended further study of the surface flow-groundwater relationship, as well as an expansion of groundwater monitoring. The defining physical features of the Scott River Valley Groundwater Basin, classified as Basin Number 1-5, are summarized in the CDWR Bulletin 118 – *California's Groundwater*.

1.4 Regulatory Setting

Scott Valley's groundwater is the object of several regulatory approaches by state and federal agencies. In 2006, the North Coast Regional Water Quality Control Board (RWB) incorporated the "Action Plan for the Scott River Watershed Sediment and Water Temperature Total Maxim Daily Loads" (TMDL) into the *Water Quality Control Plan for the North Coast Region.* The TMDL's temperature model found that groundwater inflows may be a "primary driver" of stream temperatures in Scott Valley. To help address the issue of water temperature excessive to the needs of cold water fisheries, one of the plan's tasks was to have Siskiyou County prepare a groundwater study plan for the Scott Valley groundwater basin (see below.) More restrictive TMDL compliance actions do not appear to be forthcoming by the RWB as long as adequate progress is being made on the Action Plan. The RWB has no authority to regulate groundwater use, but it can set water quality targets which could influence how groundwater is managed.

California's Fish & Game Code and Endangered Species Act (CESA) rules and regulations are becoming focused on providing sufficient streamflow for salmon and steelhead, with an emphasis on the threatened coho salmon. Federally, the ESA as administered by NOAA's National Marine Fisheries Service (NMFS) is also seen as a potential tool to possibly regulate "take" of the threatened coho species through water use. Groundwater is implied as affecting streamflows in the Scott River sub-basin (NOAA 2012).

A lawsuit over management of Scott River's groundwater was initiated in 2010 by environmental and fisheries groups. The lawsuit seeks to extend the Public Trust Doctrine to groundwater and require Siskiyou County to undertake a Public Trust analysis for new well permits, as well as to make the State Water Resources Control Board assert authority over groundwater use. The State does not currently regulate groundwater use (with certain exceptions). As of September 2012, a procedural issue in the case was pending before the court of appeal, and the merits of the case had yet to be addressed.

Siskiyou County has the right to govern the management and extraction of groundwater resources within its jurisdiction in order to protect the health, welfare and safety of the residents of the County. This police power of counties and cities was

confirmed in a 1994 court decision (Harter & Rollins 2008). Several groundwater ordinances to implement the County's authority have been adopted by the Board of Supervisors, as described below.

1.5 Voluntary Setting & the Scott Valley Groundwater Advisory Committee

The Scott Valley community desires to promote the voluntary management of groundwater in Scott Valley as a more positive approach. Keeping local control is an enduring interest and critical principle. The County Board of Supervisor established a county-wide ordinance in 2010 providing for the creation of Groundwater Advisory Committees for each of its groundwater basins (as defined in CDWR 2004). Their community experience and knowledge is considered very important in helping the County implement its legal groundwater management authority. Scott Valley was the first basin to have a Groundwater Advisory Committee created (via Board Resolution 10-291), with members appointed in early January 2011. Its eleven members represent groundwater users geographically distributed throughout the valley. As agriculture is the greatest user of groundwater, agricultural operators whose commercial production of agricultural commodities rely upon groundwater compose 7 of the members. Other members include the City of Fort Jones, which is solely dependent upon groundwater for its water supply, representatives of agricultural organizations, and a domestic groundwater user.

The Committee has many tasks and functions as outlined in the Resolution, with several directly related to this Plan:

- Identify proposed voluntary groundwater management strategies to address groundwater management challenges and/or concerns.
- Recommend possible goals and objectives for voluntary management of groundwater in the Scott Valley.
- Recommend appropriate voluntary management strategies to achieve these goals and objectives.
- Based upon the Scott Valley Community Groundwater Study Plan approved by the Board on February 12, 2008, and upon consideration and analysis of the items listed above, make recommendations to the Board on the possible development and content of a County voluntary groundwater management and protection plan.

The Committee finds that developing as well as exercising this Scott Valley Groundwater and Management Enhancement Plan is of immediate importance.

2. Current Management Approaches

Present efforts to better understand and manage the groundwater resources of Scott Valley provide the foundation for any additional strategies.

2.1 Scott Valley Well Monitoring

2.1.1 Community Groundwater Measuring Program

In 2005, the Scott Valley Community Groundwater Measuring Program was begun through a Memorandum of Understanding (MOU) among 5 partners: Siskiyou Resource Conservation District (RCD), Natural Resource Conservation Service (NRCS), Scott River Watershed Council, University of California Cooperative Extension (UCCE), and Siskiyou County. Its objective is "to understand changes in the recharge/discharge balance in the Scott Valley aquifer, particularly how this balance changes by location in the valley, by season of year, and as a result of inter-annual variations in precipitation and climate." Measurement protocols were designed and approved, participants solicited, and wells selected to cover a valley-wide grid (SRWC 2006). Monthly data collection began in April 2006 for 24 wells, later expanding to 42 wells, and now at 36. Funding has come from various local, state and federal government sources but is now privately and locally funded. The program is no longer a partner with any State or Federal agency. Data is submitted to the UC Davis Groundwater Cooperative Extension Program (see below.)

2.1.2 DWR Groundwater Level Monitoring

California DWR has overseen a well monitoring network collecting groundwater levels twice a year (spring and fall) for many decades. Scott Valley has had between 5 and 8 different wells in the program, with the oldest data going back to 1953. A few wells were dropped over the years and others were recently added, with 6 currently in the grid. All data are available on DWR's website under Groundwater.
http://www.water.ca.gov/groundwater/

2.1.3 CASGEM Program

As the result of state legislation passed in 2009, the California State Groundwater Elevation Monitoring (CASGEM) Program was established. Its purpose is to collaborate between local monitoring parties and DWR to voluntarily collect groundwater elevations statewide and make this information available to the public. Siskiyou County has applied to be the local "monitoring entity", which will preserve the eligibility of local agencies to access grants and loans for water supply and wastewater projects. In addition to DWR's existing monitoring wells in Scott Valley, another 3 wells were volunteered to be added to the CASGEM network. All data are available on the DWR-CASGEM website.

2.1.4 Quartz Valley Indian Reservation Well Monitoring

QVIR received funding to install 13 groundwater monitoring wells on its Reservation lands near Shackleford Creek, all of which were installed by late 2011. This network is measuring (via dataloggers) groundwater temperatures and levels in and near streams for the purpose of helping develop a groundwater management plan and a drought management

plan for QVIR. Data for the first full year of operation will soon be available. (USBR 2010; Rebecca Sluss, QVIR, personal communication).

2.2 Scott Valley Community Groundwater Study Plan

As part of the Scott Valley Temperature TMDL Action Plan (see above), the Regional Water Board requested Siskiyou County to produce a Groundwater Study Plan in partnership with the community. Several issues were of concern:

- The connections between groundwater and surface water (Scott River)
- The impacts of groundwater use on surface flows and temperature;
- The impacts of groundwater levels on the health of riparian (streamside) vegetation.

Technical assistance was sought from Dr. Thomas Harter, a groundwater specialist with the U.C. Davis Groundwater Cooperative Extension Program. With the help of several community and agency members, the Scott Valley Community Groundwater Study Plan(GWSP) was developed in 2007-08. Its goal is:

> *"To provide a scientific approach that can be used by Siskiyou County, the Scott Valley community, the State of California, and other interested parties to objectively assess the Scott Valley's groundwater resources and their effect on surface water resources."*

Included in the Study Plan are: hypotheses, current Scott Valley conditions, description of groundwater dynamics, research methods, and a "road map" for plan implementation in three phases over a 20 year period (dependent on available funding). The GWSP was adopted by the County Board of Supervisors in February 2008.

2.2.1 UC Davis Groundwater Model

Implementation of the Plan's Phase I tasks began immediately after County adoption with the development of a groundwater model of Scott Valley. Through the work of graduate students under Dr. Harter's guidance, the model's framework has gradually evolved. Community feedback and detailed comments by the GWAC continue to provide improvements. An initial version has progressed to the present Version 2. Model validation is still needed before hypothesis testing can happen with results. Funding for the model has primarily been provided by the SWRCB.

2.2.2 Current Field Studies

Since Scott Valley data are needed for critical model inputs, a field monitoring program by UCD and UCCE is working with local landowners during the 2012 irrigation season on alfalfa fields. The purpose is to compare theoretical and grower application rates of water use. Measurements are being collected of applied irrigation amounts, soil moisture dynamics, crop water uptake, crop yield, and rainfall contribution. When field work is

completed, data analysis will provide valuable inputs to help the groundwater model's use as a predictive tool.

2.3 Siskiyou County Ordinances

2.3.1 Standards for Wells (1990): Requires permit for well drilling, sets health and safety standards for construction, repair, and destruction of all wells.

2.3.2 Groundwater Management (1998): Primarily focused on regulating through a permit system the export of groundwater from the county.

2.3.3 Groundwater Advisory Committees (2010): To provide for the establishment of such local committees for each of the County's groundwater basins.

2.4 DWR Land & Water Use Surveys

About once a decade since the 1950s, DWR has performed a survey of land and water use in Scott Valley. The most recent completed survey was in 2000 but the 2010 results should be available soon. Estimates are based on aerial photo analysis of acreages for land use types, irrigated lands, crop types, and irrigation methods. Water use is estimated by assuming a standard amount of applied water per acre for each of the various crops. The surveys also indicate the amount of surface water and groundwater use for the surveyed years.

3. Future Management & Enhancement Approaches

Managing water resources involves the balance between supply and demand. In addition to current management actions described above, the following future voluntary actions are recommended.

3.1 Supply-side Management & Enhancement

3.1.1 Approach:

3.1.1.1 Identify and explore options to help increase groundwater and surface water supply.

3.1.1.2 Identify realistic scenarios in response to anticipated changes due to climate change (e.g., less snow; more rain; different precipitation patterns; hotter temperatures).

3.1.1.3 Determine which ones are economically, hydrologically and environmentally feasible and which are not.

3.1.1.4 Develop which potential solutions need to be run on the UCD model and evaluated as hypotheses, and/or pursued through assessment or implementation (adaptive management).

3.1.2 Increase Groundwater Recharge

3.1.2.1 Assess recharge effects from irrigation ditches and spring irrigation practices.

3.1.2.2 Evaluate the potential for an aquifer recharge project on the tailings reach on upper Scott River below Callahan.

3.1.2.3 Investigate the recharge effect of slowing down runoff, through natural (e.g., beaver dams) or intentional means (e.g., artificial beaver dams).

3.1.2.4 Search other alternatives for increasing the timing and amount of groundwater recharge.

3.1.3 Improve Upland Storage and Management

3.1.3.1 Research if significant water yield benefits can be obtained in the Scott River watershed through forest management (e.g., managing forest canopy to manipulate snowmelt; patterns of timber harvest)

3.1.3.2 Review progress of the Watershed Council's Upland Management Committee's work and pursue promising options.

3.1.3.3 Assess yield and feasibility of adding more water storage at existing high mountain lakes.

3.1.3.4 Assess yield and feasibility of new storage facilities on the Scott's tributaries.

3.2 Demand-side Management

3.2.1 Continue to improve water efficiency practices that are supportive of environmental benefits.

3.2.1.1 Work with landowners to address inefficient irrigation systems.

3.2.1.2 Encourage UC Cooperative Extension / Farm Advisor to demonstrate improved irrigation methods through growers' seminars, workshops, and field tours. Encourage high participation by all local growers. Document cost savings of water efficient practices.

3.2.1.3 Evaluate new and existing irrigation management strategies and techniques to improve water-use efficiency.. Promote and encourage adoption of soil-moisture monitoring as a simple method to improve alfalfa and pasture irrigation management (see Orloff, Hanson & Putnam handout.)

3.2.1.4 Assess changes in applied water use over time with more efficient practices.

3.2.1.5 Assess impacts on flow and seasonal timing from changes in applied water use.

3.2.2 Explore opportunities for other groundwater saving practices.

3.2.2.1 Explore new genetic varieties of crops bred for water efficiency.

3.2.2.2 Consider the efficiency and environmental benefits of the alternative irrigation practice of using sump ponds.

3.2.2.3 Understand different seasonal irrigation needs , for fall irrigation of alfalfa (Orloff 2009).

3.2.2.4 Seek economic incentives for those wanting to apply deficit irrigation of alfalfa and pasture grass which will adequately compensate for the reduced yield in production [in drought years].

3.2.3 Promote education about groundwater management.

3.2.3.1 Solicit technical assistance to help irrigators become more aware of the latest, available best practices about water efficiency and conservation.

3.2.3.2 Pursue sufficient financial assistance to help implement improved practices.

3.2.3.3 Develop publicity about this Plan and its implementation. Provide updated information to the media and public websites about current and planned groundwater management and enhancement efforts in Scott Valley.

4. Administrative Resources

4.1Siskiyou County

4.1.1 Scott Valley Groundwater Advisory Committee: Advises the Board of Supervisors as per Resolution.

4.1.2 Environmental Health Division: Oversees implementation of Well Standards Ordinance.

4.1.3 Natural Resource Policy Specialist: Assists the Board and GWAC as needed and as available on water issues.

4.1.4 Agricultural Commissioner: Promotes and protects the local agricultural industry through pesticide use enforcement, environmental monitoring, noxious weed management, and other programs.

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Appendices:

A – Scott River Decree: excerpts related to groundwater

APPENDIX A – SCOTT RIVER ADJUDICATION

Decree No. 30662 Superior Court for Siskiyou County (1980)

Groundwater Excerpts

Definitions

4. Interconnected Ground Water (p.3)

Interconnected ground water means all ground water so closely and freely connected with the surface flow of the Scott River that any extraction of such ground water causes a reduction in the surface flow in the Scott River prior to the end of a current irrigation season. The surface projection of such interconnected ground water as defined herein is that area adjacent to the Scott River as delineated on the SWRCB map in the reach from the confluence of Clarks Creek and Scott River to Meamber Bridge.

General Entitlement

20. Ground Water Interconnected with the Scott River (Schedule C) (p.6.)

Claimants listed in Schedule C are allotted that amount of water, by subirrigation or by pumping from ground water interconnected with the Scott River, reasonably required to irrigate the acreage shown opposite their names. Rights for lands in Schedule C are not related to rights in Schedule D and may be exercised independently from rights in Schedules B, D and E and those set forth in Paragraphs 45 and 46.

Location of existing and proposed wells or sumps (diversion points) are described in Schedule 2. Additional wells or sumps may be constructed to augment irrigation or to replace subirrigation but must be located at least 500 feet from the Scott River or at the most distant point from the river on the land that overlies the interconnected ground water, whichever is less.

44. Changing from Surface Diversion to Interconnected Ground Water Diversion (p.11)

In lieu of exercising rights to divert surface water from the Scott River, Big Slough, Etna Creek, or Kidder Creek in Schedules D2, D3, D4, B18, B23, and B26, claimants may irrigate that portion of the place of use designated in said schedules that overlies the Scott River ground water basin by pumping from interconnected ground water under the same priority as rights in Schedule C, provided that the new wells or sumps must be located at least 500 feet from the Scott River, or at the most distant point from the river on the land that overlies the area of interconnected ground water, whichever is less.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northern California Office
1655 Heindon Road
Arcata, California 95521
Tel (707)825-5163; Fax (707)825-4840

FEB 2 1 2013

Ric Costales
Natural Resource Policy Specialist
County of Siskiyou
P.O. Box 750, 201 Fourth Street
Yreka, CA 96097

Dear Mr. Costales:

NOAA Fisheries National Marine Fisheries Service (NMFS) welcomes the opportunity to comment on the Draft ***Voluntary Groundwater Management & Enhancement Plan for Scott Valley Advisory Committee*** (Plan) and would like to congratulate the members of the Scott Valley Groundwater Advisory Committee (Committee) in reaching this important milestone. As the federal agency overseeing the recovery of Southern Oregon/Northern California Coast (SONCC) coho salmon under the Endangered Species Act, NMFS supports comprehensive efforts that work towards resolving conflicts over water use and coho recovery in the Scott Valley.

A key objective of the draft Plan is to develop a better understanding of the relationship between groundwater and surface water. In particular, the collection and inclusion of site-specific parameters (evapotranspiration values, water application rates, etc.) developed under the guidance of Thomas Harter PhD., and Steve Orloff PhD., from the University of California Davis Cooperative Extension, will improve the performance of the groundwater model and will hopefully simplify calibration of the model in the near future. We are optimistic that the use of the model will lead to development of management solutions that will provide for sustainable agriculture as well as improve instream conditions for salmon.As described in the draft Plan, future approaches will involve balancing both water supply-side management and enhancement with water demand-side management for both agricultural and environmental benefits. We appreciate the Committee's willingness to consider NMFS' recent suggested groundwater model simulation scenarios and we were pleased to find that many of our scenarios were similar to those recommended by other participants and landowners within Scott Valley. We look forward to continuing to work with the Committee by providing technical support during the validation phase of Dr. Harter's model.

The inclusion of beaver and the potential influence they have on surface water and groundwater through their activities as one of the potential scenarios to improve water supply in the valley is

welcome. Given the value of habitats created by beaver for coho salmon rearing, we are optimistic that this scenario (in addition to other actions) may play a valuable role towards improving instream conditions for salmonids at strategic locations throughout Scott Valley. Dr. Michael Pollock works at our Northwest Fisheries Science Center and is an expert on ecological stream processes and is particularly knowledgeable about the influence of beaver habitat on coho smolt production and ecosystem function. We are encouraged and appreciate the Committee's willingness to consider inviting Dr. Pollock to provide technical information and assist the Committee in their desire to seek improved water management alternatives. We look forward to hearing some of his initial thoughts on the use of beaver management to improve both groundwater supply and fish and wildlife habitat along the Scott River.

As resources allow, NMFS is committed to providing support and assistance to the Committee's efforts to develop a voluntary management and enhancement plan.

Sincerely,

Irma Lagomarsiono
Northern California Office Supervisor

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February 20, 2013

Ric Costales
Siskiyou County
P.O. Box 750
Yreka, CA 96097

RE: Comments on Scott Valley Groundwater Management Plan

Ayukii Mr. Costales:

The Karuk Tribe appreciates the opportunity to comment on the Scott Valley Groundwater Advisory Committee's draft Voluntary Groundwater Management and Enhancement Plan for Scott Valley. The Karuk Tribe has a keen interest in the management of the Scott River Basin as it provides critically important habitat for native species such as Chinook salmon, ESA listed coho salmon, steelhead, and Pacific lamprey. All these species are culturally important to the Karuk Tribe. In addition, salmon, steelhead, and lamprey are still important food sources for Tribal members as they have been since the beginning of time.

We have long advocated for stronger measures to protect Klamath River fisheries in general and Scott River fisheries in particular. Our research and investigations lead us to conclude that in order to restore Klamath fisheries, much emphasis must be placed on flows and habitat in the Scott River sub-basin.

The Tribe has voiced concern in various public forums over the steady decline of summer flows on the Scott River. This downward trend in summer flow correlates with an increase in groundwater pumping particularly since the Scott adjudication in 1980. The importance of groundwater accretions to the Scott River as they pertain to stream temperature is noted in the Scott TMDL Action Plan. Thus, we are very pleased that the County and a local Groundwater Advisory Committee are working to address groundwater issues.

However, we have a number of concerns with the draft Groundwater Management and Enhancement Plan detailed in the attached comments. In particular, we note that the plan fails to address fish flow needs.

We request that you consider our comments on the draft Voluntary Groundwater Management and Enhancement Plan for Scott Valley and we trust you will give these comments due consideration.

Yôotva,

Michael Thom

Michael Thom
Vice-Chairman
Karuk Tribe

Karuk Tribe Comments on draft Voluntary Groundwater Management and Enhancement Plan for Scott Valley

Comment #1: The Scott Groundwater Advisory Committee has no representatives from fish dependent communities

The draft Voluntary Groundwater Management and Enhancement Plan for Scott Valley (GMEP) was developed by irrigators, a representative from Fort Jones, and a domestic water user. Despite the fact that one of the GMEP's "basic management objectives" is to "Reduce the conflict between groundwater use and other uses of water; scientifically validate the effect of groundwater use on salmon and steelhead use of the Scott River and its tributaries," there is no representative on the Advisory Committee representing communities in Siskiyou County or elsewhere downstream that actually have a vested interest in fisheries. Thus, we are concerned that the current Advisory Committee lacks the qualifications necessary to address the above stated management objective.

We recommend adding a position on the Advisory Committee from one or more of these communities.

Comment #2: The GMEP ignores the report *Groundwater Conditions in Scott Valley, California* (2012) by S. S. Papadopulos and Associates (SSPA) commissioned by the Karuk Tribe.

Section 1.3 of the GMEP is titled "Past Studies," yet the authors ignore the most recent report on the topic. The SSPA report affirms one of the GMEP's key points, that is that the Scott Valley aquifer is not currently in a state of overdraft. However, the SSPA report makes several other key conclusions such as:

- Groundwater elevations in winter are minimally affected by long-term pumping. Groundwater elevations in late summer/early fall have been subject to declines on the order of a few feet, depending on location.

- The Scott River and tributaries can be and have been impacted by increased levels of groundwater pumping. These impacts, termed "stream depletion", involve a combination of a reduction in gains to the stream from groundwater and increased seepage losses from the stream to groundwater, depending on location and time of year.

- Stream depletion can occur from pumping at any location within the Scott Valley; however, the magnitude and timing of impacts to the river or tributaries depends on the amount, duration, location and depth of pumping.

- Higher stream depletion impacts occur during the summer than during the winter/early spring period, reflecting the seasonal occurrence of irrigation pumping.

The full Executive Summary of this report with a longer list of key conclusion is included along with these comments. The entire report complete with all raw data sets used in our analysis is available along with an addendum describing how pumping beyond the existing zone of

adjudication impacts stream flow. All can be downloaded at: http://www.karuk.us/karuk2/departments/natural-resources/dnr.

We recommend a review of these materials by the Advisory Committee for inclusion in the GMEP.

Comment #3: The GMEP fails to discuss public trust doctrine

In section 1.4 (Regulatory Setting), the GMEP mentions the fact that fishermen and conservation groups are suing the State Water Resources and Control Board for failing to regulate groundwater pumping pursuant to the public trust doctrine. However, the GMEP fails to provide any discussion on how the public trust doctrine may or may not apply.

We recommend including such a discussion in this section.

Comment #4: The GMEP fails to discuss the US Forest Service water right granted for the explicit purpose of protecting fisheries and public trust resources

The GMEP briefly describes the 1980 Scott River Decree, but fails to note that the Decree explicitly grants the US Forest Service a water right for fish. The GMEP also notably ignores the fact that since the 1980 Adjudication, the number of days that this water right for fish is not met has steadily increased as the groundwater pumping capacity of the Valley has increased. Although the GMEP notes that fish were not granted an appropriative water right, no other discussion of what water rights fish do have was included. These are important issues to be considered in the development of a management plan.

We recommend including a broader discussion on the legal framework designed to protect flows for fish in the Scott River.

Comment#5: The GMEP fails to make any commitments to fisheries or fish-dependent communities downstream.

The GMEP's primary goal is for locals to maintain local control of the water and "develop solutions to resolving environmental-related issues for the Scott Valley aquifer." By local, the GMEP appears to mean Scott Valley. We urge a less ambiguous commitment to environmental-related issues and recognition of the fact that stakeholders outside of Scott Valley exist. The Scott's fisheries resources belong to all Californians, not just residents of Scott Valley.

It is not enough to manage the aquifer in a manner that simply avoids overdraft. It must be managed in a way that provides adequate flows for our shared fisheries resources. To understand what flows are adequate, three documents inform the discussion:

- CDFG (California Department of Fish and Game). 1974. Report to the State Water Resources Control Board summarizing the position of the Department of Fish and Game on the water rights adjudication of the Scott River drainage, Siskiyou County, California.

California Department of Fish and Game, Region 1, 601 Locust Street, Redding, CA 96001. .

- Siskiyou County Superior Court. 1980. Scott River Adjudication, decree #30662.
- CDFG (California Department of Fish and Game). Unpublished. Development of Interim Flow Recommendations for Protection of Fishery Resources in the Scott River Watershed, Siskiyou County. California Department of Fish and Game, Region 1, 601 Locust Street, Redding, CA 96001.

The Fish and Game reports recommend similar flow targets based on two different methodologies for developing such targets. The Decree legally defines targets for the protection of fish and public trust resources.

We recommend using these documents as a guide for developing in-stream flow targets that could be achieved in part by improved groundwater management.

Although studies as to what flows are adequate are on-going, simply meeting the existing US Forest Service water right would be a good starting goal until additional studies

Comment #6: Modification of groundwater withdrawal rates and locations are not considered.

Section 3 of the GMEP describes groundwater management and enhancement approaches. This section fails to contemplate the simplest methods by which groundwater can be managed – reduction in pumping or changes in pumping locations. These options for management should be included in this section.

Comment # 7: It is Premature to Approve Groundwater Plan before the County and State Water Resources Board Publishes findings of the Groundwater Study currently in Progress

Since 2007, the County, members of Scott Valley irrigation community, and the State Water Resources Board have been working with researchers at UC Davis to develop a groundwater model and study. Our presumption has been that this analysis would serve as the foundation for a groundwater conservation plan. It is our understanding that some results and findings from this analysis will be published in the near future.

Without this technical analysis or utilization of the technical analysis provided by the Karuk Tribe, the GWEP lacks any tangible quantitative goals for conservation or flow augmentation.

We recommend that parties table the approval of the current GWEP and instead invest their efforts in completing the UD Davis analysis as soon as possible. Then, the results and underlying data should be shared with the public allowing interested stakeholder to provide a technical review. Then using this report as well as other existing reports and datum, develop a groundwater conservation plan based on scientific analysis and quantitative benchmarks for

conservation and stream augmentation. To do otherwise is to place the proverbial cart before the horse.

Voluntary Groundwater Management & Enhancement Plan for Scott Valley
Advisory Committee approved 10-22-12

Comments Rec'd from Quartz Valley Indian Reservation on 2-21-2013

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Prepared by the Scott Valley Groundwater Advisory Committee
Approved by the Siskiyou County Board of Supervisors
_____, 2012

Overview

Plan Purpose: To provide ~~a voluntary, locally driven~~ direction for the management and enhancement of the Scott Valley groundwater basin that is voluntary, locally driven and mutually beneficial for the community and the environment. ~~This strategy will be an ongoing effort and be reviewed periodically.~~

Comment [ED1]: To help readability

Comment [ED2]: Probably not needed to say this here as part of the plan purpose...

Goal #1: Keep the control of groundwater supply within Siskiyou County, protect property rights and Scott Valley's agricultural economy, ~~and~~

Goal #2: Ddevelop solutions to resolving environmental-related issues for the Scott Valley aquifer

Comment [ED3]: Separate this second part out as a separate goal. As written, it is

Goal #~~2~~3: Seek ability to implement plan, which will take time and money, skills and commitment.

Basin Management Objectives:

1. Develop improved understanding of how groundwater and surface water behave.
2. Continue to maintain the long-term viability of the aquifer ~~(which has never been in an overdraft condition)~~.
3. Reduce the conflict and misunderstandings about ~~between~~ groundwater use and its potential effects on other uses of water;
4. Sscientifically validate the effect of groundwater use on surface water that may be used by salmon and steelhead ~~use of~~in the Scott River and its tributaries.
4. Improve public understanding of how agriculture uses wells and applies irrigation to local crops.
5. Identify non-agricultural water demands.
6. ~~Identify~~ Quantify groundwater use efficiency.
7. Identify and develop enhancement projects ~~and implement through~~that may be appropriate for grants, agencies and the community.

Comment [ED4]: Again, this is a true statement, but you probably do not want to put it just here. It is sort of out of place and more importantly, it begins to appear that you are being overly defensive. This can weaken your position as a credible science effort.

"Overdraft" definition: Groundwater overdraft is defined as the condition of a groundwater basin or subbasin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years, during which the water supply conditions approximate average conditions. Overdraft can be characterized by groundwater levels that decline over a period of years and never fully recover, even in wet years. (DWR Bulletin 118)

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1. Background

1.1 Groundwater Rights

All water rights are usufructuary; that is, the right pertains to the use of the water, and ~~not to~~ does not convey ownership of the "corpus" or body of the water itself. In California, most surface water rights are either "riparian" or "appropriative." Riparian rights are considered "part and parcel" of land ownership and are real property. To qualify, a parcel of land generally must be contiguous to the stream. Riparian rights are "correlative" - that is, shared equally by all riparian owners on a stream. The individual riparian water use right is not "fixed" in quantity, but is shared equally as available and can be put to beneficial use. In addition, the use of water by a riparian user must be consistent with the rights of all other owners of land riparian to the same supply.

Comment [ED5]: Probably needs a cite. I looked on Wikipedia and it said real property is real estate and immovable property. Another site said real property can be easements or air space for building... I think you may want to say that riparian rights are recognized in California.. because they are not generally recognized in the western US

Appropriative water rights are acquired through possession and control of water by diversion, application of the water and continued beneficial use. Those who were "first in time, are first in right." (Fisheries were denied an appropriative right in the Scott River Adjudication because, under historic water law, they could not take discrete control of the water.)

Groundwater is treated similarly to riparian rights. All overlying owners of a groundwater basin share the right to use groundwater according to the "correlative rights doctrine."

Comment [ED6]: This is unique to California.

1.2 Scott River Decree (see also Appendix A)

The Scott River Stream System is an adjudicated groundwater basin. In 1980, the Superior Court of Siskiyou County decided, upon recommendation of the State Water Resources Control Board (SWRCB), the water rights of surface water users as well as groundwater users in the interconnected groundwater zone under the Scott River Adjudication Decree. The California Water Code first had to be changed by the Legislature (section 2500.5) to declare that groundwater supplies which are interconnected with the Scott River are part of the "stream system" as a "foundation for a fair and effective judgment" of rights to the water of the Scott River. No other stream system in California has such a legal determination for similar hydrologic interconnections.

The Decree has several sections pertaining to interconnected groundwater, which was defined as "all groundwater so closely and freely connected with the surface flow in the Scott River that any extraction of such ground water causes a reduction in the surface flow in the Scott River prior to the end of a current irrigation season." A map delineates this zone of varying width in the reach between Clarks Creek and Meamber Bridge. [CDWR 2004; SWRCB 1980]

Comment [ED7]: A indent style of paragraph was used here which is different from the space style used above... stick to one or the other.

1.3 Past Studies

In 1953, a special groundwater investigation of Scott Valley was begun by the U.S. Geological Survey (Mack 1958). Field work confirmed descriptions of the geology and groundwater features, with the results providing the most comprehensive study of the aquifer to date. A decade later, the California Dept. of Water Resources (CDWR) explored the potential of groundwater development in Scott Valley to provide irrigation to existing and new lands (CDWR 1964). Their report concluded that managing the groundwater supply would cost less than developing surface storage projects. As background for the Scott River Decree, the State Water Board investigated the water supply and use of water in the early 1970s (SWRCB 1974) as well as the hydrology and geology of the sub-basin (SWRCB 1975). In a 1991 report, CDWR analyzed opportunities to augment streamflows in the Scott River during periods of inadequate fishery flows, at the request of the Klamath Basin Fisheries Task Force. Their study provided an updated groundwater contour map of Scott Valley and recommended further study of the surface flow-groundwater relationship, as well as an expansion of groundwater monitoring. The defining physical features of the Scott River Valley Groundwater Basin, classified as Basin Number 1-5, are summarized in the CDWR Bulletin 118 – *California's Groundwater.*

1.4 Regulatory Setting

Scott Valley's groundwater is the object of several regulatory approaches by state and federal agencies. In 2006, the North Coast Regional Water Quality Control Board (RWB) incorporated the "Action Plan for the Scott River Watershed Sediment and Water Temperature Total Maxim Daily Loads" (TMDL) into the *Water Quality Control Plan for the North Coast Region.* The TMDL's temperature model found that groundwater inflows may be a "primary driver" of stream temperatures in Scott Valley. To help address the issue of water temperature excessive to the needs of cold water fisheries, one of the plan's tasks was to have Siskiyou County prepare a groundwater study plan for the Scott Valley groundwater basin (see below.) More restrictive TMDL compliance actions do not appear to be forthcoming by the RWB as long as adequate progress is being made on the Action Plan. The RWB has no authority to regulate groundwater use, but it can set water quality targets which could influence how groundwater is managed.

California's Fish & Game Code and Endangered Species Act (CESA) rules and regulations are becoming focused on providing sufficient streamflow for salmon and steelhead, with an emphasis on the threatened coho salmon. Federally, the ESA as administered by NOAA's National Marine Fisheries Service (NMFS) is also seen as a potential tool to possibly regulate "take" of the threatened coho species through water use.

Groundwater is implied as affecting streamflows in the Scott River sub-basin (NOAA 2012).

A lawsuit over management of Scott River's groundwater was initiated in 2010 by environmental and fisheries groups. The lawsuit seeks to extend the concept of the Public Trust Doctrine (e.g., that certain resources are preserved for public use and should be administered by the government) to groundwater and require Siskiyou County to undertake a Public Trust analysis for new well permits, as well as to make the State Water Resources Control Board assert authority over groundwater use. The State does not currently regulate groundwater use (with certain exceptions). As of September 2012, a procedural issue in the case was pending before the ~~court~~ Court of ~~appeal~~Appeal, and the merits of the case had yet to be addressed.

Siskiyou County has the right to govern the management and extraction of groundwater resources within its jurisdiction in order to protect the health, welfare and safety of the residents of the County. This police power of counties and cities was confirmed in a 1994 court decision (Harter & Rollins 2008). Several groundwater ordinances to implement the County's authority have been adopted by the Board of Supervisors, as described below.

1.5 Voluntary Setting & the Scott Valley Groundwater Advisory Committee

The Scott Valley community desires to promote the voluntary management of groundwater in Scott Valley as a more positive approach. Keeping local control is an enduring interest and critical principle. The County Board of Supervisor established a county-wide ordinance in 2010 providing for the creation of Groundwater Advisory Committees for each of its groundwater basins (as defined in CDWR 2004). ~~Their~~ The local community experience and knowledge is considered very important ~~in helping~~by the ~~County~~ County to implement its legal groundwater management authority. Scott Valley was the first basin to have a Groundwater Advisory Committee created (via Board Resolution 10-291), with members appointed in early January 2011. Its eleven members represent groundwater users geographically distributed throughout the valley. As agriculture is the greatest user of groundwater, agricultural operators whose commercial production of agricultural commodities rely upon groundwater compose 7 of the members. Other members include the City of Fort Jones, which is solely dependent upon groundwater for its water supply, representatives of agricultural organizations, and a domestic groundwater user.

The Committee has many tasks and functions as outlined in the Resolution, with several directly related to this Plan:

- Identify or proposed voluntary groundwater management strategies to address groundwater management challenges and/or concerns.
- Develop and r~~R~~ecommend ~~possible~~ goals and objectives for ~~voluntary~~ management of groundwater in the Scott Valley.

Comment [ED8]: Can you provide a cite for this or qualify it that most of the community or it appears that a majority?.... For example QVIR is not necessarily on record as opposing a regulatory management of groundwater, however, it may be that a voluntary management would be desirable.

Comment [ED9]: Would the committee consider QVIR representative to serve the committee? I think it has been requested and/or suggested previously. Or a rep from CDFW or USFS? I don't think this would upset the committee structure and would give them more credibility as being representative. I think they need some sort of fish rep. Maybe say you are considering this...?

Comment [ED10]: One of the recommendations could be that management is voluntary. As written, it suggests that all management must be voluntary and it becomes more of a mandate. This may be true, but it suggests that the committee is somehow biased or influenced by politics and this hurts their scientific credibility.

- Recommend appropriate voluntary? management strategies to achieve these goals and objectives.
- Based upon the Scott Valley Community Groundwater Study Plan approved by the Board on February 12, 2008, and upon consideration and analysis of the items listed above, make recommendations to the Board on the possible development and content of a County voluntary groundwater management and protection plan. The Committee finds that developing as well as exercising this Scott Valley Groundwater and Management Enhancement Plan is of immediate importance.

Comment [ED11]: I realize the importance of stating that management is only going to be voluntary, but maybe one way to do this is to say that "voluntary strategies will always be sought ove regulatory strategies. This desire is based on the expressed desires of the majority of the Scott Valley community." This becomes a true statement of more fact and reality and less of dictate.

2. Current Management Approaches

Present efforts to better understand and manage the groundwater resources of Scott Valley provide the foundation for any additional strategies.

Comment [ED12]: This is unclear to me...

2.1 Scott Valley Well Monitoring

2.1.1 Community Groundwater ~~Measuring~~ Level Monitoring Program

In 2005, the Scott Valley Community Groundwater Measuring Program was begun through a Memorandum of Understanding (MOU) among 5 partners: Siskiyou Resource Conservation District (RCD), Natural Resource Conservation Service (NRCS), Scott River Watershed Council, University of California Cooperative Extension (UCCE), and Siskiyou County. Its objective is "to understand changes in the recharge/discharge balance in the Scott Valley aquifer, particularly how this balance changes by location in the valley, by season of year, and as a result of inter-annual variations in precipitation and climate." Measurement protocols were designed and approved, participants solicited, and wells selected to cover a valley-wide grid (SRWC 2006). Monthly data collection began in April 2006 for 24 wells, later expanding to 42 wells, and now at 36. Funding has come from various local, state and federal government sources but is now privately and locally funded. The program is no longer a partner with any State or Federal agency. Data is submitted to the UC Davis Groundwater Cooperative Extension Program (see below.)

Comment [ED13]: The exact measurement or data is not stated.. I think it is water levels, yes? You might add the methods used to collect the data.. well tape?

2.1.2 DWR Groundwater Level Monitoring

California DWR has overseen a well monitoring network collecting groundwater levels twice a year (spring and fall) for many decades. Scott Valley has had between 5 and 8 different wells in the program, with the oldest data going back to 1953. A few wells were dropped over the years and others were recently added, with 6 currently in the grid. All data are available on DWR's website under Groundwater.
http://www.water.ca.gov/groundwater/

2.1.3 CASGEM Program

As the result of state legislation passed in 2009, the California State Groundwater Elevation

Monitoring (CASGEM) Program was established. Its purpose is to collaborate between local monitoring parties and DWR to voluntarily collect groundwater elevations statewide and make this information available to the public. Siskiyou County has applied to be the local "monitoring entity", which will preserve the eligibility of local agencies to access grants and loans for water supply and wastewater projects. In addition to DWR's existing monitoring wells in Scott Valley, another 3 wells were volunteered to be added to the CASGEM network. All data are available on the DWR-CASGEM website.

2.1.4 Quartz Valley Indian Reservation Well Monitoring

QVIR ~~received funding to~~ installed 13 groundwater monitoring wells on its ~~Reservation~~ reservation lands near Shackleford Creek, ~~all of which were installed by late 2011~~in 2012. This network is measuring (via dataloggers) groundwater levels and groundwater temperatures ~~and levels in and near streams~~in 40-foot deep monitoring wells. ~~for t~~The purpose of the project is ~~of helping develop a~~to understand groundwater ~~management~~ behavior~~plan~~ and how Shackleford Creek surface water and nearby groundwater are inter-related. QVIR is interested in whether surface flows in Shackleford can be maintained year round and how groundwater levels may change as drinking water supplies for member's homes. ~~and a drought management~~ QVIR is interested in sharing their data with others interested in groundwater research.

~~plan for QVIR. Data for the first full year of operation will soon be available. (USBR 2010; Rebecca Sluss, QVIR, personal communication).~~

2.2 Scott Valley Community Groundwater Study Plan

As part of the Scott Valley Temperature TMDL Action Plan (see above), the Regional Water Board requested Siskiyou County to produce a Groundwater Study Plan in partnership with the community. Several issues were of concern:

- The connections between groundwater and surface water (Scott River)
- The impacts of groundwater use on surface flows and temperature;
- The impacts of groundwater levels on the health of riparian (streamside) vegetation.

Technical assistance was sought from Dr. Thomas Harter, a groundwater specialist with the U.C. Davis Groundwater Cooperative Extension Program. With the help of several community and agency members, the Scott Valley Community Groundwater Study Plan(GWSP) was developed in 2007-08. Its goal is:

> *"To provide a scientific approach that can be used by Siskiyou County, the Scott Valley community, the State of California, and other interested parties to objectively assess the Scott Valley's groundwater resources and their effect on surface water resources."*

Included in the Study Plan are: hypotheses, current Scott Valley conditions, description of groundwater dynamics, research methods, and a "road map" for plan implementation in three phases over a 20 year period (dependent on available funding). The GWSP was adopted by the County Board of Supervisors in February 2008.

2.2.1 UC Davis Groundwater Model

Implementation of the Plan's Phase I tasks began immediately after County adoption with the development of a groundwater model of Scott Valley. Through the work of graduate students under Dr. Harter's guidance, the model's framework has gradually evolved. Community feedback and detailed comments by the GWAC continue to provide improvements. An initial version has progressed to the present Version 2. Model validation is still needed before hypothesis testing can happen with results. Funding for the model has primarily been provided by the SWRCB.

2.2.2 Current Field Studies

Since Scott Valley data are needed for critical model inputs, a field monitoring program by UCD and UCCE is working with local landowners during the 2012 irrigation season on alfalfa fields. The purpose is to compare theoretical and grower application rates of water use. Measurements are being collected of applied irrigation amounts, soil moisture dynamics, crop water uptake, crop yield, and rainfall contribution. When field work is completed, data analysis will provide valuable inputs to help the groundwater model's use as a predictive tool.

2.3 Siskiyou County Ordinances

2.3.1 Standards for Wells (1990): Requires permit for well drilling, sets health and safety standards for construction, repair, and destruction of all wells.

2.3.2 Groundwater Management (1998): Primarily focused on regulating through a permit system the export of groundwater from the county.

2.3.3 Groundwater Advisory Committees (2010): To provide for the establishment of such local committees for each of the County's groundwater basins.

2.4 DWR Land & Water Use Surveys

About once a decade since the 1950s, DWR has performed a survey of land and water use in Scott Valley. The most recent completed survey was in 2000 but the 2010 results should be available soon. Estimates are based on aerial photo analysis of acreages for land use types, irrigated lands, crop types, and irrigation methods. Water use is estimated by assuming a

standard amount of applied water per acre for each of the various crops. The surveys also indicate the amount of surface water and groundwater use for the surveyed years.

3. Future Management & Enhancement Approaches

Managing water resources involves the balance between supply and demand. In addition to current management actions described above, the following future voluntary actions are recommended.

3.1 Supplyside

Management & Enhancement

3.1.1 Approach:

3.1.1.1 Identify and explore options to help increase groundwater and surface water supply.

3.1.1.2 Identify realistic scenarios in response to anticipated changes due to climate change (e.g., less snow; more rain; different precipitation patterns; hotter temperatures).

3.1.1.3 Determine which ones are economically, hydrologically and environmentally feasible and which are not.

3.1.1.4 Develop which potential solutions need to be run on the UCD model and evaluated as hypotheses, and/or pursued through assessment or implementation (adaptive management).

3.1.2 Increase Groundwater Recharge

3.1.2.1 Assess recharge effects from irrigation ditches and spring irrigation practices.

3.1.2.2 Evaluate the potential for an aquifer recharge project on the tailings reach on upper Scott River below Callahan.

3.1.2.3 Investigate the recharge effect of slowing down runoff, through natural (e.g., beaver dams) or intentional means (e.g., artificial beaver dams).

3.1.2.4 Search other alternatives for increasing the timing and amount of groundwater recharge.

3.1.3 Improve Upland Storage and Management

3.1.3.1 Research if significant water yield benefits can be obtained in the Scott River watershed through forest management (e.g., managing forest canopy to manipulate snowmelt; patterns of timber harvest)

3.1.3.2 Review progress of the Watershed Council's Upland Management Committee's work and pursue promising options.

3.1.3.3 Assess yield and feasibility of adding more water storage at existing high mountain lakes.

3.1.3.4 Assess yield and feasibility of new storage facilities on the Scott's tributaries.

3.2 Demand-side Management

3.2.1 Continue to improve water efficiency practices that are supportive of environmental benefits.

3.2.1.1 Work with landowners to address inefficient irrigation systems.

3.2.1.2 Encourage UC Cooperative Extension / Farm Advisor to demonstrate improved irrigation methods through growers' seminars, workshops, and field tours.
Encourage high participation by all local growers. Document cost savings of

water efficient practices.
3.2.1.3 Evaluate new and existing irrigation management strategies and techniques to improve water-use efficiency.. Promote and encourage adoption of soilmoisture monitoring as a simple method to improve alfalfa and pasture irrigation management (see Orloff, Hanson & Putnam handout.)
3.2.1.4 Assess changes in applied water use over time with more efficient practices.
3.2.1.5 Assess impacts on flow and seasonal timing from changes in applied water use.
3.2.2 Explore opportunities for other groundwater saving practices.
3.2.2.1 Explore new genetic varieties of crops bred for water efficiency.
3.2.2.2 Consider the efficiency and environmental benefits of the alternative irrigation practice of using sump ponds.
3.2.2.3 Understand different seasonal irrigation needs , for fall irrigation of alfalfa (Orloff 2009).
3.2.2.4 Seek economic incentives for those wanting to apply deficit irrigation of alfalfa and pasture grass which will adequately compensate for the reduced yield in production [in drought years].
3.2.3 Promote education about groundwater management.
3.2.3.1 Solicit technical assistance to help irrigators become more aware of the latest, available best practices about water efficiency and conservation.

Voluntary Groundwater Management & Enhancement Plan for Scott Valley
Advisory Committee approved 10-22-12

3.2.3.2 Pursue sufficient financial assistance to help implement improved practices.
3.2.3.3 Develop publicity about this Plan and its implementation. Provide updated information to the media and public websites about current and planned groundwater management and enhancement efforts in Scott Valley.

4. Administrative Resources

4.1Siskiyou County

4.1.1 Scott Valley Groundwater Advisory Committee: Advises the Board of Supervisors as per Resolution.

4.1.2 Environmental Health Division: Oversees implementation of Well Standards Ordinance.

4.1.3 Natural Resource Policy Specialist: Assists the Board and GWAC as needed and as available on water issues.

4.1.4 Agricultural Commissioner: Promotes and protects the local agricultural industry through pesticide use enforcement, environmental monitoring, noxious weed management, and other programs.

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Appendices:

A – Scott River Decree: excerpts related to groundwater

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APPENDIX A – SCOTT RIVER ADJUDICATION

Decree No. 30662 Superior Court for Siskiyou County (1980)

Groundwater Excerpts

Definitions

4. Interconnected Ground Water (p.3)

Interconnected ground water means all ground water so closely and freely connected with the surface flow of the Scott River that any extraction of such ground water causes a reduction in the surface flow in the Scott River prior to the end of a current irrigation season. The surface projection of such interconnected ground water as defined herein is that area adjacent to the Scott River as delineated on the SWRCB map in the reach from the confluence of Clarks Creek and Scott River to Meamber Bridge.

General Entitlement

20. Ground Water Interconnected with the Scott River (Schedule C) (p.6.)

Claimants listed in Schedule C are allotted that amount of water, by subirrigation or by pumping from ground water interconnected with the Scott River, reasonably required to irrigate the acreage shown opposite their names. Rights for lands in Schedule C are not related to rights in Schedule D and may be exercised independently from rights in Schedules B, D and E and those set forth in Paragraphs 45 and 46.

Location of existing and proposed wells or sumps (diversion points) are described in Schedule 2. Additional wells or sumps may be constructed to augment irrigation or to replace subirrigation but must be located at least 500 feet from the Scott River or at the most distant point from the river on the land that overlies the interconnected ground water, whichever is less.

44. Changing from Surface Diversion to Interconnected Ground Water Diversion (p.11)

In lieu of exercising rights to divert surface water from the Scott River, Big Slough, Etna Creek, or Kidder Creek in Schedules D2, D3, D4, B18, B23, and B26, claimants may irrigate that portion of the place of use designated in said schedules that overlies the Scott River ground water basin by pumping from interconnected ground water under the same priority as rights in Schedule C, provided that the new wells or sumps must be located at least 500 feet from the Scott River, or at the most distant point from the river on the land that overlies the area of interconnected ground water, whichever is

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February 22, 2013

Ric Costales, Natural Resource Policy Specialist
Siskiyou County
P.O. Box 750
Yreka, CA 96097

RE: Voluntary Groundwater Management and Enhancement Plan for Scott Valley

Dear Mr. Costales:

Thank you for the opportunity to comment on the Voluntary Groundwater Management and Enhancement Plan for Scott Valley. Our diverse members have an interest in water use practices in the Scott Valley because they rely on healthy fisheries for their food supply, jobs, and cultural survival. These comments are also submitted and joined by the Pacific Coast Federation of Fishermen's Associations (PCFFA) and the Institute for Fisheries Resources, which represent the economic interests of coastal commercial fishing industry-based family fishing businesses who also depend on healthy river systems for their livelihoods.

The Plan Ignores Existing Science

This groundwater plan relies on the false assumption that we need additional science to prove that groundwater pumping reduces flows in the Scott River. According to the February 2008 report, *Scott Valley Community Groundwater Study Plan*[1]:

1) "Groundwater pumping during the summer and, hence, groundwater levels during the mid to late summer months also significantly control groundwater contributions to the Scott River."
2) "Stream flows in the valley exhibit a direct correlation to changes in groundwater table elevation."

This report not only confirms the correlation between groundwater pumping and surface water flows, it asserts that existing groundwater level monitoring is sufficient to predict and quantify this correlation. According to the report:

1) "Current groundwater level monitoring is sufficient to predict, whether groundwater is discharging into the Scott River."
2) "Rating curves can be developed to predict the amount of average groundwater discharge from the Scott Valley aquifer into the Scott River based on the current groundwater level monitoring network."

---

[1] Harter, Thomas and R. Hines. 2008. *Scott Valley Community Groundwater Study Plan*. Prepared for the Siskiyou County Board of Supervisors, North Coast Regional Water Quality Control Board, and the Siskiyou County Resource Conservation District. 93 pp. Available online: http://groundwater.ucdavis.edu/files/136426.pdf

The conclusions of this study are corroborated by subsequent studies, notably the March 2012 study *Groundwater Conditions in Scott Valley, California.*[2] This study is not mentioned or cited in the groundwater plan, but should be.

Even when the Scott River decree was created in 1980, officials acknowledged that groundwater pumping impacts surface flows by establishing an "interconnected groundwater zone." Subsequent scientific research has indicated that the boundaries of this "interconnected groundwater zone" were drawn too narrowly. If Siskiyou County does not acknowledge this fact by taking steps to reduce groundwater consumption, the state of California may restrict groundwater withdrawals pursuant to California Water Code Section 2100.

The "Groundwater Advisory Committee" is Missing Stakeholders

As Klamath Riverkeeper and others have explained to Siskiyou County previously, water use practices in the Scott Valley impact stakeholders who rely on non-consumptive water uses such recreation, fishing, and traditional ceremonies. Despite this fact, the Groundwater Advisory Committee is comprised exclusively of consumptive water users who reside within the Scott Valley.

As Written, Demand-side Management Will Not Reduce Demand

The discussion of demand-side management focuses primarily on water use efficiency projects, which, contrary to the claims by many project proponents, do not necessarily increase instream flows. In fact, water use efficiency projects can actually reduce instream flows because previously "wasted" water is no longer "lost," and thus available to recharge groundwater or augment surface flows.

According to the aforementioned report by Dr. Harter and Mr. Hines:

1) "Water loss or incidental recharge from ditches, irrigation canals, and over-irrigation of fields during winter, spring, and/or early summer significantly influences the amount of later groundwater discharge into the Scott River System, during summer and fall ("delayed base-flow contribution")."
2) "Time-varying (transient) groundwater table elevations, and thereby stream flows, are partially caused by leaky ditches, deep percolations, artificial recharge, and by pumping, ET, and discharge to streams."
3) "Higher irrigation efficiency (application of less water) through recently introduced pivot sprinkler systems has a significant but unknown impact on groundwater levels and, hence, on summer and fall Scott River base-flow and temperature. While there is decreased demand for groundwater pumping in the summer, there is also a simultaneous decrease in groundwater recharge."

Given the unintended consequences of water efficiency projects, large sums of taxpayer money have been spent conserving water in ways that don't necessarily increase stream flows, and may in fact decrease stream flows.

---

[2] Papadopulos, S. 2012. *Groundwater Conditions in Scott Valley, California*. Technical report prepared by S.S. Papadopulos & Associates, Inc. for the Karuk Tribe, Orleans, CA. 96 pp + appendices. Available for download from the Karuk Tribe at: http://www.karuk.us/karuk2/departments/natural-resources

Does Not Challenge Unregulated Issuance of New Well-Drilling Permits

The Voluntary Groundwater Plan does not address de-watering due to excessive groundwater pumping, and allows Siskiyou County to continue issuance of new well drilling permits. At present, County regulations do not consider cumulative effects on the aquifer and local stream-flows, or potential interference of proposed new wells with existing wells and local aquifer levels. New wells should not be approved when the only water quantity regulation is coming from voluntary demand-side "efficiency" measures that may decrease, rather than increase, streamflows in the Scott River.

Recommendations

1) Acknowledge existing scientific evidence about the correlation between groundwater pumping and surface water in the Scott River watershed.
2) Establish a balanced Groundwater Advisory Committee that includes equal representation from consumptive and non-consumptive water user groups and equal representation between Scott Valley residents and stakeholders who reside downstream of the Scott Valley. At a minimum, the Committee should be comprised of representatives from tribes within and downstream from the Scott Valley, the commercial fishing industry, the sport fishing industry, the outdoor tourism industry, and nonprofit organizations whose public membership has a vested interest in water quality and quantity on the Scott River.
3) Stop spending public money on water efficiency projects that decrease stream flows.
4) Implement water efficiency projects only when it can be demonstrated that conserved water will augment stream flows.
5) Stop issuing new well new well permits.
6) Siskiyou County should rewrite its current well permit ordinance to include consideration of cumulative effects of new wells on the aquifer and local stream-flows, and potential interference of proposed new wells with existing wells and local aquifer levels.
7) Stop allowing groundwater export from Siskiyou County.

I urge you to consider the fact that it is in the interest of the Siskiyou County agricultural community to reduce groundwater consumption through locally controlled measures rather than wait for regulation from state or federal agencies. The longer we issue new well drilling permits and invest in efficiency projects that don't improve stream flows, the more likely it is that Siskiyou County will lose control of its groundwater.

Please don't hesitate to contact me if you have any questions.

Sincerely,

Konrad Fisher

Konrad Fisher, Executive Director
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Historical High Flow Events

December 12th 2014 peak discharge (cfs): 4,790 Stage (feet): 11.47

Historical Stage/Flow Data			
Water Year	**Peak Discharge (cfs)**	**Stage (feet)**	**Date**
Most Recent 5 Years			
2013	5,890	12.46	Dec 2, 2012
2012	5,100	11.81	Mar 31, 2012
2011	3,620	10.47	Mar 16, 2011
2010	4,730	11.48	Jun 04, 2010
2009	3,120	9.95	May 05, 2009
Historical High Stage/Flow Events (Period of Record - Oct 1941 to Present)			
1965	54,600	25.34	Dec 22, 1964
1956	38,500	21.40	Dec 22, 1955
1974	36,700	23.67	Jan 16, 1974
1997	34,300	23.47	Jan 01, 1997
1982	25,500	20.52	Dec 20, 1981

The Scott River Watershed Council has a new Board Chairman

Betsy Stapleton is the new Chairman of the Board for the Scott River Watershed Council.



Betsy, with her husband Michael, moved to Scott Valley full-time in 2010 after having bought their property on French Creek in 2000. The incredible beauty of the area was the initial attraction, as well as the opportunity to live a rural life, but once Betsy and Michael were here they realized that they were unimaginably fortunate to have landed in Scott Valley. They found a community that was a real community with deep roots, families with strong heritages and the values of hard work, honesty and appreciation of the natural world, all based on a functioning resourced based economy.

Prior to moving to Scott Valley, Betsy lived in Humboldt County for 38 years, She worked as Nurse Practitioner and raised three children.

After being invited to join the Scott River Watershed Council, Betsy began to learn about the threats to the lifestyle of the Valley: legacy environmental impacts, climate change, and the ever increasing regulatory burden. She hopes that her term of service as the Council Board Chair will be the opportunity to serve the community she loves.



Photo 2: Southern end of RM 52 project site, December 2014 (Siskiyou RCD).



Photo 3: Shot during last week's flood

Scott River Bioengineered Streambank Project

By Preston Haris

This project took place on private property in the southern end of Scott Valley. The active channel width at this site is approximately 800 feet and composed of a gravel and sand streambed with areas of clay exposure. During high flows, the velocities near the bank are very swift and were actively eroding the sand lenses at the toe of the bank, which undermined the above clay layer and led to an estimated 469 tons of sediment contributions per year in a reach that is important to spawning and rearing Chinook salmon, coho salmon and steelhead trout. The continued erosion on the outside of this meander did not only impact adjacent agriculture fields, but it had the potential to flank the downstream riparian corridor and move the river into neighboring properties.

The objectives of this design are to reduce stream bank erosion by pushing the thalweg off the bank with the installation of anchored log barbs and engineered log jams. The project also addresses a secondary and highly erosive cusp, near the downstream end of the bank, with similar treatments. In addition, a complete revegetation of the 0.6-acre site was completed post construction to enhance the existing riparian corridor and establish trees to supply shade to the river. Thirty cottonwood pole cuttings were planted along the top of the left bank, an up to forty vertical willow bundles were buried between each of the instream log barbs. Photo points will be revisited annually when vegetation is fully leafed out (July) and counts will be made to evaluate survival.

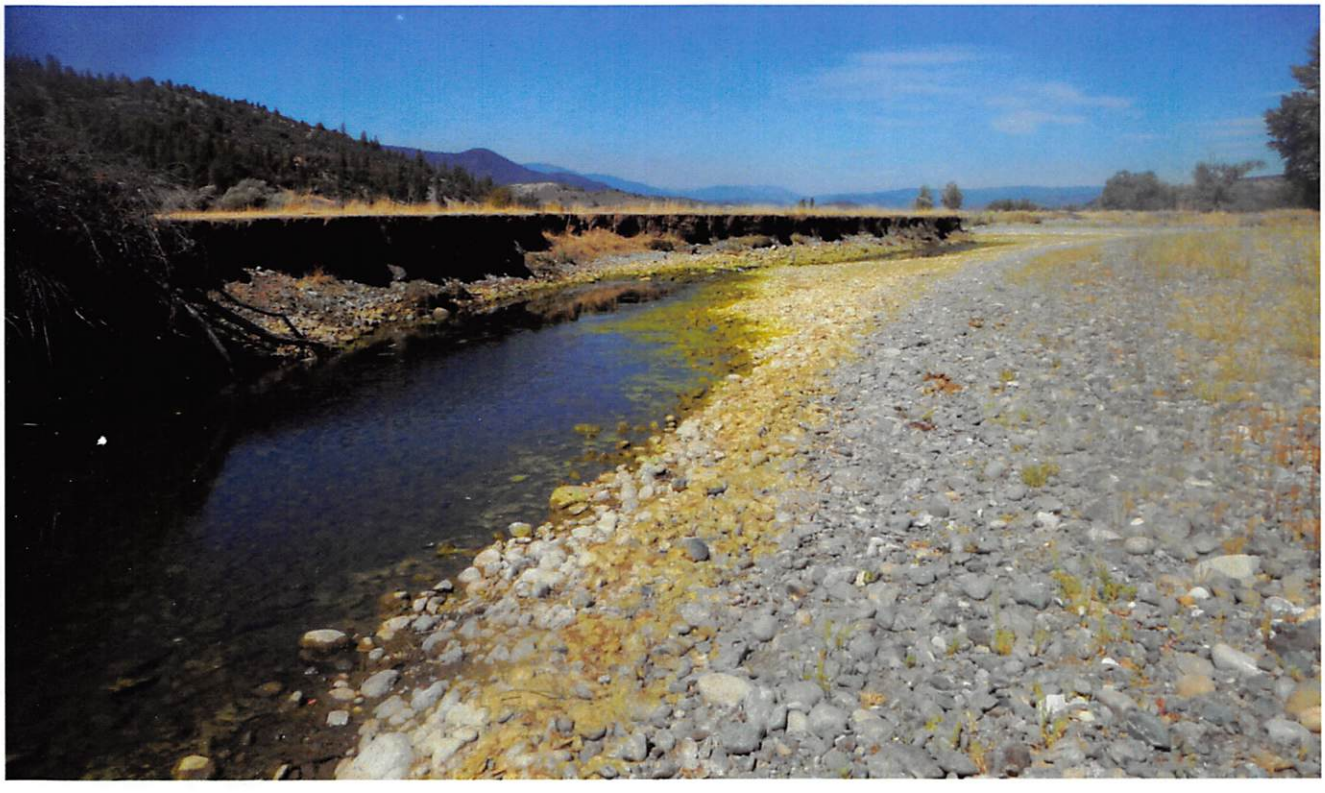
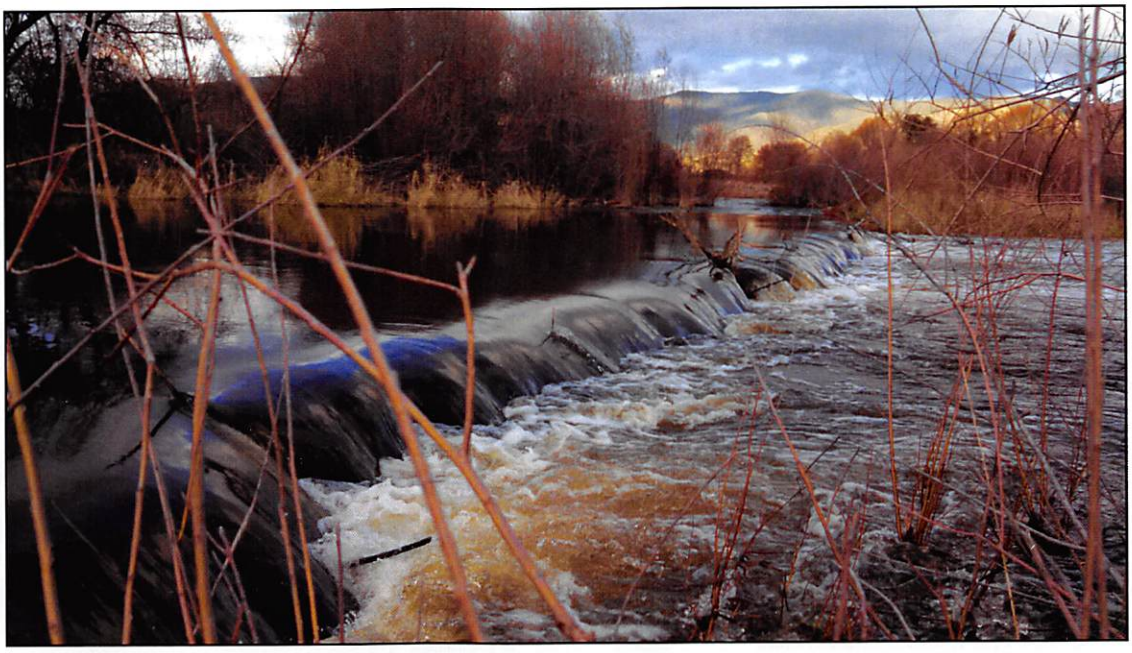


Photo 1: Bank to be treated, looking downstream, September 2014 (Siskiyou RCD)

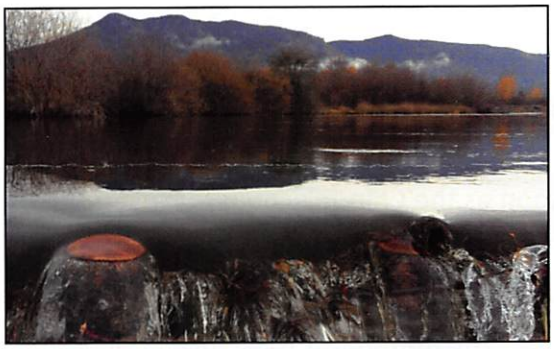
PAWS Project Update

By Anne Hilton



PAWS near French Creek confluence

The construction phase of this project has been completed and heavy monitoring has begun. The last structure in this phase of the project was installed and the willows were woven during the second week of October. The willow weave is designed to trap leafs and debris during fall leaf off to form a seal that then traps sediment and creates complex, slow water habitat. This has happened accordingly and the structures have sealed off nicely. "It has been really exciting to see the large, extensive new slow water habitat that is being created by these structures" says Peter Thamer, the project coordinator and resident PAWS guru. "I am anticipating a large beneficial impact on the Scott's coho salmon population." Thamer, is closely monitoring the structures throughout the winter for fish passage and how they respond and are impacted by high flow events. Observations to date suggest that both chinook and coho adults are well distributed throughout the watershed, both upstream and downstream of the structures. Thamer is working with scientist Michael Pollock of NOAA Fisheries, local rancher Betsy Stapleton, and CDFW scientists in Yreka, to create a fish monitoring protocol that will assess the benefits of PAWS on our watershed's coho salmon population. Thirty two monitoring wells were installed in order to evaluate the impact the PAWS have on groundwater. Water temperature and dissolved oxygen will also be monitored.



Pool created by PAWS



Salmon above a PAWS structure

Update on the 2014 Chinook Salmon Spawning Surveys preformed by the Siskiyou RCD Throughout the Scott Valley portion of the Scott River



Male & female chinook salmon (male above female below)

This year, the valley portion of the Scott River experienced a very concentrated spawning season. The Scott River connected with the canyon following the October 23rd/24th rains. The USGS stream flow gage at river mile 21 climbed from <20 cfs on October 24th to over 200 cfs on October 26th (Magranet, *2014 Chinook run, Summary of Observations*). As soon as the Chinook could make it up the river, they came in large numbers and spawned within a three-week period. There was heavy spawning observed between Blacks Bridge and Fay Lane the last week of October and first couple of weeks in November. The number of Reds observed has not been confirmed but it was on the order of several hundred. The RCD crews took inventory of sex and fork length of all carcasses encountered. These numbers have not been confirmed but are well above 1,000. Chinook were documented 2.5 miles up Shackleford Creek, 2.8 miles up French Creek, and 6.3 miles up the East Fork of the Scott River. There were no live Chinook observed after December 1st (Magranet, *2014 Chinook run, Summary of Observations*).



2014 Siskiyou RCD salmon survey crew



Coho salmon from 2013 RCD salmon surveys

2014 Salmon Surveys

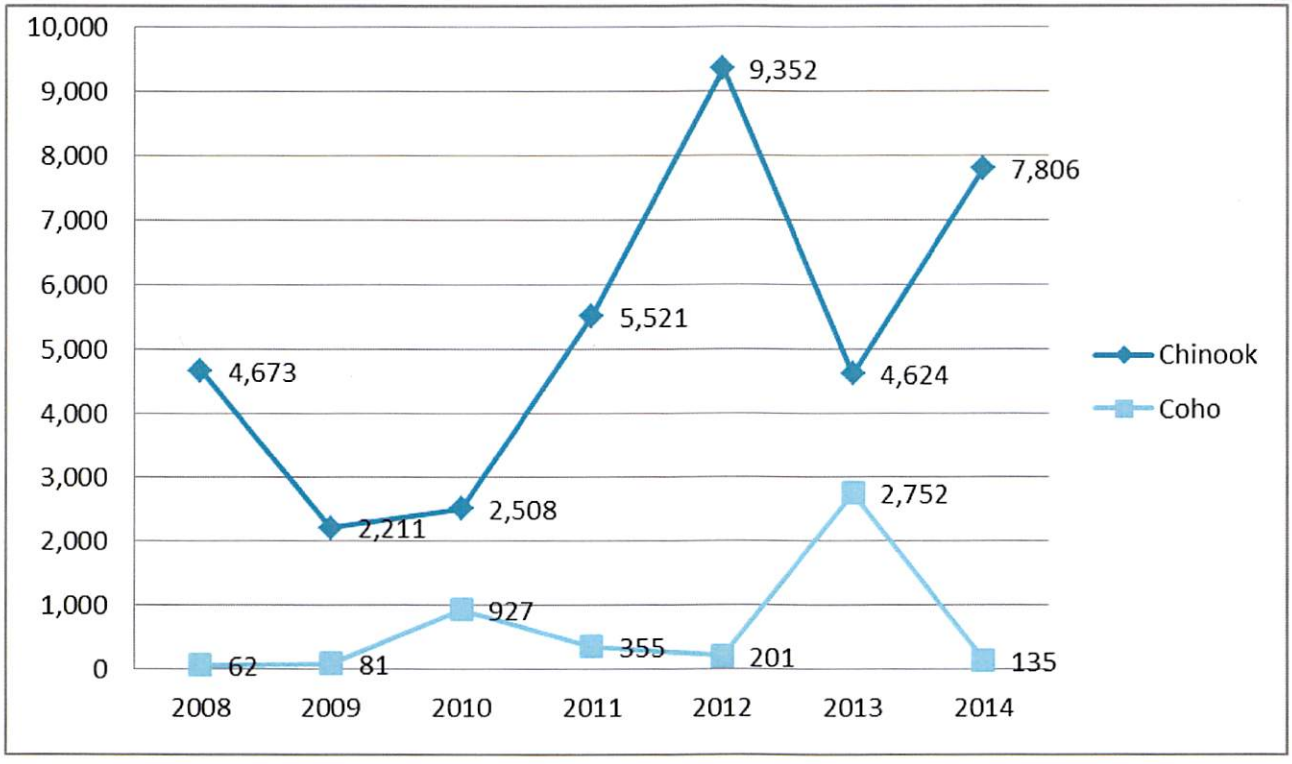
Salmon in the Scott River

The table below illustrates the total amount of chinook and coho salmon that have entered the Scott River since 2008. The totals are calculated based on the number of salmon that pass through the CDFW Scott River Fish Counting station plus the Jolly-Seber mark recapture carcass-based estimates that are conducted in the areas downstream of the counting station. The counting station is located on the Scott River between Jones Beach and Indian Scottie Camp Ground. It is very encouraging that over the past three seasons a positive growth rate for Scott River coho salmon has been observed (Knechtle and Chesney, *2013 Scott River Salmon Studies Final Report)*.

Table & Chart: ***Annual adult chinook and coho salmon population totals for the Scott River***

	2008	2009	2010	2011	2012	2013	2014
Chinook	4,673	2,211	2,508	5,521	9,352	4,624	7,806
Coho	62	81	927	355	201	2,752	135*

*The coho total for 2014 is incomplete, they are still moving up the river.





Scott River Watershed Council

Winter 2014

CREATING COMMUNITY-BASED SOLUTIONS

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UPCOMING EVENTS

- RCD meeting – January 1st, 7pm
- SRWC meeting — January 13th, 11am
- Ground Water Advisory Committee Meeting — January 26th, 7pm

Members of the House Committee on the Environment and Water:

As a multiple degreed geologist, I would like to comment on SB 76.

As Representative Garrard has testified, the day AFTER SB 76 passed out of Senator Dingfelder's Senate Committee on Feb 3rd, 2009, a report regarding the issues of SB 76, was suddenly made available to the public. This report, called the "Evaluation and Determination of Potential Liability Associated with the Decommissioning and Removal of four Hydroelectric Dams on the Klamath River" by Camp Dresser and McKee, Inc. which was kept from the public until after the hearing, was commissioned by the Bureau of Reclamation. This report determines a high liability for many costs associated with dam removal. We do know the Oregon Department of Justice was in possession of this report well before the Senate committee hearing was undertaken. I have to question why it was not allowed to be released to the general public until this bill passed out of committee. The following contents of the CDM report may have something to do with this report being held back from the legislative body that voted on this bill.

On page 3-1, it states " The purpose of this chapter is to quantify the potential costs that could be incurred by the decommissioning agent for the decommissioning action (note: many liabilities remain uncosted; hence the costing does not represent a total potential cost for dam decommissioning)."

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The costs associated with sediment management liability are as follows: on P. 3-7 CDM Report

JC Boyle Dam $10, 928,000
Copco One $187, 120,000
Iron Gate $152, 758,000

These sediment management costs do NOT include costs if the sediment is found to contain asbestos and other hazardous materials trapped in the sediment. Asbestos was used extensively in the creation of these dams and the CDM report states on P 2-88 "The removal of the Klamath River Dams has the potential to generate the risk for litigation or regulatory intervention. Potential for litigation is a high liability with high uncertainty given the many different stakeholders representing a spectrum of interests that have yet to be engaged in the decommissioning process."

Futher evidence of the sediment removal cost issue is contained in the last available Federal Energy Regulatory Commission environmental impact statement on the removal of the Klamath dams *.

This report states that complete studies have not been undertaken to understand the total amount of sediment accumulated behind the four Klamath mainstem dams to be removed, nor the riverine and fluvial effects generated by the release of this sediment. Until those studies are completed and we understand the nature of the sediment and its

totality, it is very unwise to pass legislation regarding ratepayer monetary assumptions resulting from dam removal.

The FERC report states that removal of the sediment, should that be the course chosen, could range up to $4.5 BILLION. That assumption is that there are no heavy metals or toxics in the sediment that would require a Superfund type cleanup of the sediment. If that is the case, an order of magnitude greater cost will be incurred. The few sediment cores taken to date are only a few centimeters deep, while the actual accumulated sediment ranges from about 1 and a half to four million metric tons of fine sediment. So no real knowledge of the toxicity or heavy metal analyses are available for all four dams. 540,000 ratepayers, most of whom are in Oregon, divided by the FERC high estimate of sediment removal would be a cost of about $8000 per ratepayer.

Citizens who live on the river year round are very concerned about the flooding of the mainstem Klamath during the months of December through April. Many who have lived there prior to the building of Irongate state that extensive flooding and erosion of the river regularly occurred. The FERC report also states that no definitive studies have yet been undertaken to determine probablility of flooding, whether they be 50, 100, 500 or thousand year flood events. When major runoff events happen in the Klamath Basin, above the mainstem of the river, the dams now provide a "ponding" effect which decreases the water velocity and decreases overall turbidity throughout the system. If the dams are removed, the massive erosional effect of these runoff events will destroy most of the gravel beds which provide the salmon breeding grounds of the river. Sediment will be redistributed irregularly throughout the lower areas of the fluvial system and many of the salmonids known breeding locations will be eradicated.

The FERC report states that $35 million additional per year will be required from 540,000 Pacificorp ratepayers as the cost of replacement electricity. That will increase the average ratepayer's monthly electric bill by 10% for the next ten years, at today's rates. If "green" electricity is required as a replacement that will increase the monthly electricity charges by an order of three or four times their present rates. The replacement cost is presently determined based on coal fired replacement. Pacificorp presently uses power generated from its Wyoming coal fired plants. To exchange clean hydropower for coal fired electricity is draconian at best.

Page 3-19 of the CDM Report states " The FEIS (FERC 2007) reports a potential increase in greenhouse gas emissions by 71,680 metric tons, to 111,100 metric tons of carbon per year if the current project electric output were replaced with carbon emitting, fossil-fueled generation facilities. These carbon emissions cannot currently be translated into dollar cost figures."

How can Oregon's legislature and Governor, who's stated mandates are to pass laws and regulations limiting the carbon emissions of Oregon's citizens, support the removal of clean and inexpensive hydropower generated electricity for its citizens?

I urge SB 76 not be released from committee until a better understanding of the actual cost ** to ratepayers and the geology and geomorphology of the system without the dams is accurately understood.

Respectfully submitted by:

Gail Hildreth Whitsett

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*FERC Report –FINAL ENVIRONMENTAL IMPACT STATEMENT FOR HYDROPOWER LICENSE –FERC/EIS -0201F Vol 1 and Klamath Hydroelectric Project FERC Project No. 2082-027 Appendices Vol. 2

Pages 853-891 add estimated costs of option implementations. Intentionally spreading any reference to possible sediment removal costs apart from other costs, references on estimated sediment volumes totaling approximately 9100 acre feet is on Table 3-3 (page 3-21) and the estimates of sediment removal costs range up to $487,000 per acre foot (page 4-6) , with individual possible sediment removal estimates for: John C. Boyle on page 4-8 ($7 million); Copco 1 on page 4-8 ($2.9 billion) and Iron Gate p. 4-10 ($1.5 Billion)

**A facet of SB 76 that is not addressed is that no one is responsible in the event dam removal results in cost overruns. The Agreement in Principle (page 9) states:

"The final Agreement shall resolve how to provide for further funding of costs in excess of the State Cost Cap, if during the process of Facilities removal it becomes reasonably apparent that actual Facilities removal costs are likely to exceed $450,000,000 or in fact do exceed that amount. The United States, California, Oregon, Pacificorp and Pacificorp's customers do not accept liability for any costs in excess of $450,000,000 for Facilities removal, absent specific subsequent agreement."

It seems imprudent to apply $200 million toward a project when there is not currently a plan in place for funding the project in its entirely. It is foreseeable that in the future there will be cost overruns and the state will be required to authorize additional funding or be left with a partially removed dam or set or dams. Undoubtedly, the state will feel compelled to provide additional funding under these circumstances, or perhaps legislation will be required to put the additional charges on the shoulders of the ratepayers. The state should wait until there is a plan in place for funding the entire cost of dam removal before investing money in this project. Otherwise, the initial contribution puts the state in a position where it will be required to either force taxpayers or ratepayers to cover a portion or all of the unforeseen costs associated with these dams removal.

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MYXOZOAN PARASITES IN KLAMATH RIVER SALMON

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FIELD TRIPS: Polychaete Float 2009

MEETINGS: Klamath River Fish Health Conference 2009

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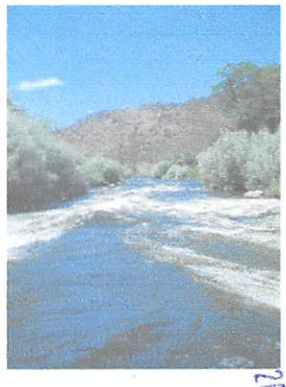
JOURNAL ARTICLES



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Disease Reduction in Klamath River Salmon
OVERVIEW

Problem: The effects of declining Pacific NW salmon populations on coastal economies and tribal communities have been felt for several decades, but the reduction of the commercial catch by 90% in 2006 was a direct result of the weak returns of Chinook salmon to the Klamath River (KR). Severe infection by the myxozoan parasite *Ceratomyxa shasta* has, in large part, been responsible for the declining numbers of juvenile KR fall Chinook and coho salmon and subsequent impacts on later adult returns. Compared with infection of juvenile Chinook salmon from other Pacific NW rivers, the numbers in the KR are striking. For example, incidence of *Ceratomyxa shasta* infection in juvenile Chinook salmon, collected in the Klamath River above the confluence with the Trinity River between May and the end of July, examined histologically has varied between 21 - 37% (2004 - 2008 data); this infection rate is much higher (31 - 62%) in samples analyzed by QPCR for the same time period. (Juvenile salmonids outmigrate during this period but also at other times of the year when infection prevalence is lower). Whereas, in the Fraser River, Canada, *C. shasta* infection prevalence was estimated to be 3.3% and in the Columbia River estuary, *C. shasta* was detected in 9.6% and 12% of juvenile Chinook salmon in 1983 and 2001, respectively. The high prevalence and severity of *C. shasta* infections in

KR fish indicates this parasite is a key factor limiting salmon recovery in that system.

Search

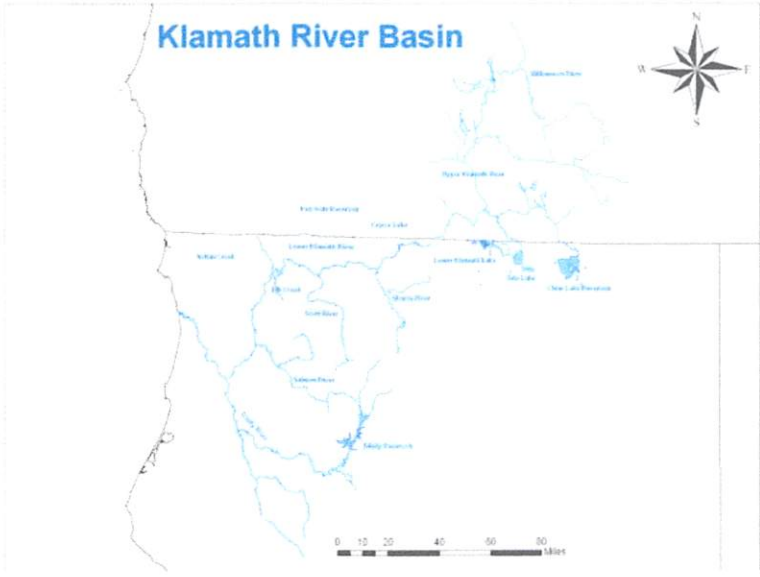

Fig. 1 Map of the Klamath River which straddles the border of Oregon and California in the Pacific North West of USA. It flows westward over 400 km into the Pacific Ocean.

High resolution

Ceratomyxa shasta has a complex life cycle, involving an invertebrate (polychaete worm) host as well as salmon (see Fig. 2). Salmon in the KR have evolved with *C. shasta* and are relatively resistant to infection compared to salmon from rivers where the parasite is absent, thus the current severity of ceratomyxosis in these fish suggests a shift in the host:parasite balance. Research conducted by OSU and the US Fish and Wildlife Service (USFWS) have identified a stretch of the river in which high parasite densities and large numbers of infected invertebrate hosts result in severe disease and high mortality, thus providing a target for management actions.

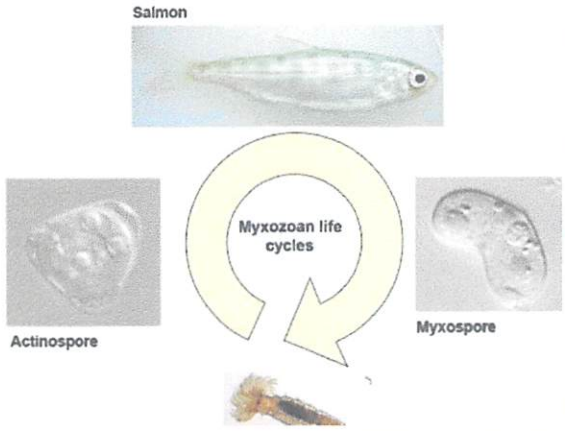

Fig 2. Life cycle of the myxozoan parasite *Ceratomyxa shasta:* the actinospore released from the tiny invertebrate host, *Manayunkia speciosa*, infects salmonids via the gills and in the intestione develops into the myxospore stage. Clinical disease signs in the fish include swollen abdomen from ascites accumulation, inappetance, hemorhaging intestinal lining.

Infection is seasonal and progression is temperature dependent. Each spore stage is 10µm or less in size.

Solution: In 2007, a multidisciplinary panel of fish disease experts and fishery managers met to develop a research plan focused on management actions to reduce disease (ceratomyxosis) in natural juvenile salmon of the KR. This proposed research effort is in addition and complementary to on-going monitoring in the basin. The reach from Iron Gate Dam to the Scott River was identified as the primary management area, based on juvenile salmon infection status and data from fish exposures, invertebrate host surveys and water sampling studies.

Potential management actions would have the goal of:

1. Reducing polychaete host populations in the selected KR reach,

2. Reducing the effects of the infectious actinospore on juvenile salmon,

3. Reducing the input of myxospores from specific salmonid fishes

4. Decreasing fish exposure/Increasing fish resistance

A preliminary ranking of management actions was made based on the likelihood that the action would result in a **reduction in ceratomyxosis in natural salmon populations of the Klamath River.** Other considerations included the effect on non-target organisms and the ability to monitor effects. The panel recommended several actions as being the most likely to cause a biological effect and as high priority for further research. We propose to test the feasibility of the highest priority management actions through controlled laboratory and field experiments. These studies would be conducted over 2-3 years, leading to large-scale tests or implementation.

Impacts: Salmon losses in the Klamath basin have had devastating effects on tribal communities along the river and the coastal communities of Oregon and California. The recent closure of the salmon troll industry in 2006 was a management decision in response to the low contribution of the Klamath basin - only 5% of the fishery - with disease being a primary factor. The cost to Oregon coastal communities was estimated to be $28 million dollars in 2006 and Governors of both Oregon and California declared fishery disasters that resulted in allocation of $60 million dollars in federal assistance. Salmon trollers estimate that reducing disease effects by as little as 10% would increase the number of Klamath River adult salmon to the point that fishing on

that population could resume and allow that industry to survive.

Research collaborators:

Kirsten Arkush, University of California, Davis

Jerri Bartholomew, Oregon State University

Susan Corum, Karuk Tribe

J. Scott Foott, USFWS CA-NV Fish Health Center

Gary Hendrickson, Humboldt State University

Joshua Strange, Yurok Tribe

Peggy Wilzbach, Humboldt State University Cooperative Fisheries Unit

Funding for KR research and monitoring at OSU has been provided through the Bureau of Reclamation, Oregon Sea Grant, the US Fish and Wildlife Service, the Karuk, Yurok and Hoopa Tribes, PacifiCorp, a federal appropriation and Oregon Commercial Restoration and Enhancement (through ODFW)

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INFECTIOUS ZONE STUDY

AIM: Provide finer resolution of the infectious zone in the lower Klamath River

BACKGROUND: Ceratomyxosis is a leading disease of Klamath River salmonids, causing mortality in outmigrating juvenile Chinook and coho salmon. Sentinel fish studies conducted at multiple time points over several years have consistently identified the area immediately above Beaver Creek (Rkm 259) as highly infectious, but with mortality in Chinook salmon occurring as far downriver as Seiad Valley (Rkm 208). This pattern is supported by river water sampling, which targets waterborne *Ceratomyxa shasta* spores. However, data from surveys of the parasite's polychaete host, suggest this highly infectious zone may extend upriver to around the confluence of the Shasta River (Rkm 280; itself not a source of the infectious stage of the parasite). Characterization of the infectious zone is coarse, with consistent data available only from four index sites in the lower river, below Iron Gate Dam. This study aims to more accurately define this zone using developed water sampling and molecular methods.

APPROACH: In 2009, replicate water samples were collected on three days spanning a six week period at 16 sites along 79 Rkm of the lower Klamath River; a further 6 sites and 76 Rkm were included on the final day. River water samples were taken at 3 time points at each site, at 9 or 10 am, 12 or 1pm and 3 or 4pm on May 13, June 3 and June 24. The water was filtered using a vacuum pump, the DNA that was captured was extracted using a kit and any parasite DNA present was quantified with a QPCR assay. These data produce a longitudinal map of parasite density in this section of the river for each time period which can be used to identify areas that could be targeted for control of polychaete populations.

Collaborators: Karuk Tribe, Yurok Tribe

WATER FLOW



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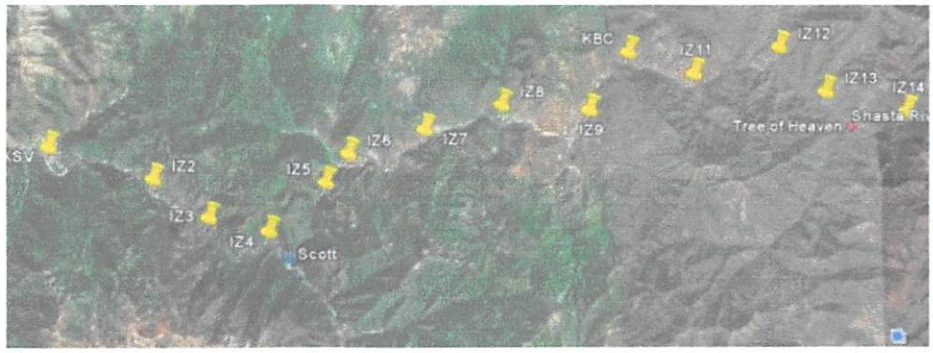

Map of a section of the lower Klamath River (below Iron Gate Dam) showing the 16 primary sampling sites. The region encompasses the confluences of the Shasta and Scott Rivers and two monitoring index sites, Beaver Creek (KBC) and Seiad Valley (KSV).

For the full report on the study, click here

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Investigators and Partners

Below is a list of the fish disease investigative group which includes **Oregon State University Members** and **Affiliate Members** from the greater northwest region of the United States.

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Long-Term Fish Disease Monitoring Program In The Lower Klamath River

FY09

Objective 4. **PROVIDE FINER RESOLUTION OF THE INFECTIOUS ZONE IN THE LOWER KLAMATH RIVER**

Collaborators: Yurok Tribe, Karuk Tribe

Report prepared by: S. Hallett, G. Buckles, R. Ray, J. Bartholomew (Oregon State University)

BACKGROUND

Ceratomyxosis is a leading disease of Klamath River salmonids, causing mortality in outmigrating juvenile Chinook and coho salmon. Sentinel fish studies conducted at multiple time points over several years have consistently identified the area immediately above Beaver Creek (Rkm 259) as highly infectious, but with mortality in Chinook salmon occurring as far downriver as Seiad Valley (Rkm 208) (Stocking et al. 2006). This pattern is supported by river water sampling, which targets waterborne *Ceratomyxa shasta* spores (Hallett & Bartholomew 2006). However, data from surveys of the parasite's polychaete host, suggest this highly infectious zone may extend upriver to around the confluence of the Shasta River (Rkm 280; itself not a source of the infectious stage of the parasite)(Stocking & Bartholomew 2006). Characterization of the infectious zone is coarse, with consistent data available only from four index sites in the lower river, below Iron Gate Dam. This study aims to more accurately define this zone using developed water sampling and molecular methods (Hallett & Bartholomew 2006). Replicate water samples were collected on three days spanning a six week period at 16 sites along 79 Rkm of the lower Klamath River; a further 6 sites and 76 Rkm were included on the final day. This data produces a longitudinal map of parasite density in this section of the river for each time period which can be used to identify areas that could be targeted for control of polychaete populations.

METHODS

During spring/early summer 2009, water samples were collected in a longitudinal river transect, at 16 approximately equidistant sites, from Seiad Valley to east of the I5 bridge (**Fig. 1**). Sampling occurred on three days, three weeks apart: May 13 (A), June 3 (B) and June 24 (C). Each day, 3 x 1L water samples were collected from each site (exception: only 1 sample was collected at each time point at Rkm 231 and 234 on June 24), three times at three hour intervals. Every other site was sampled simultaneously: either at 9am, 12 noon and 3pm or at 10am, 1pm and 4pm. Samples (total of 144 per day) were chilled during transportation to the Salmon Disease Laboratory, OSU, where they were filtered within 24 hours. On June 24, an additional six downstream sites were included in the study. These were sampled (3 x 1L) once in the morning and once in the afternoon.

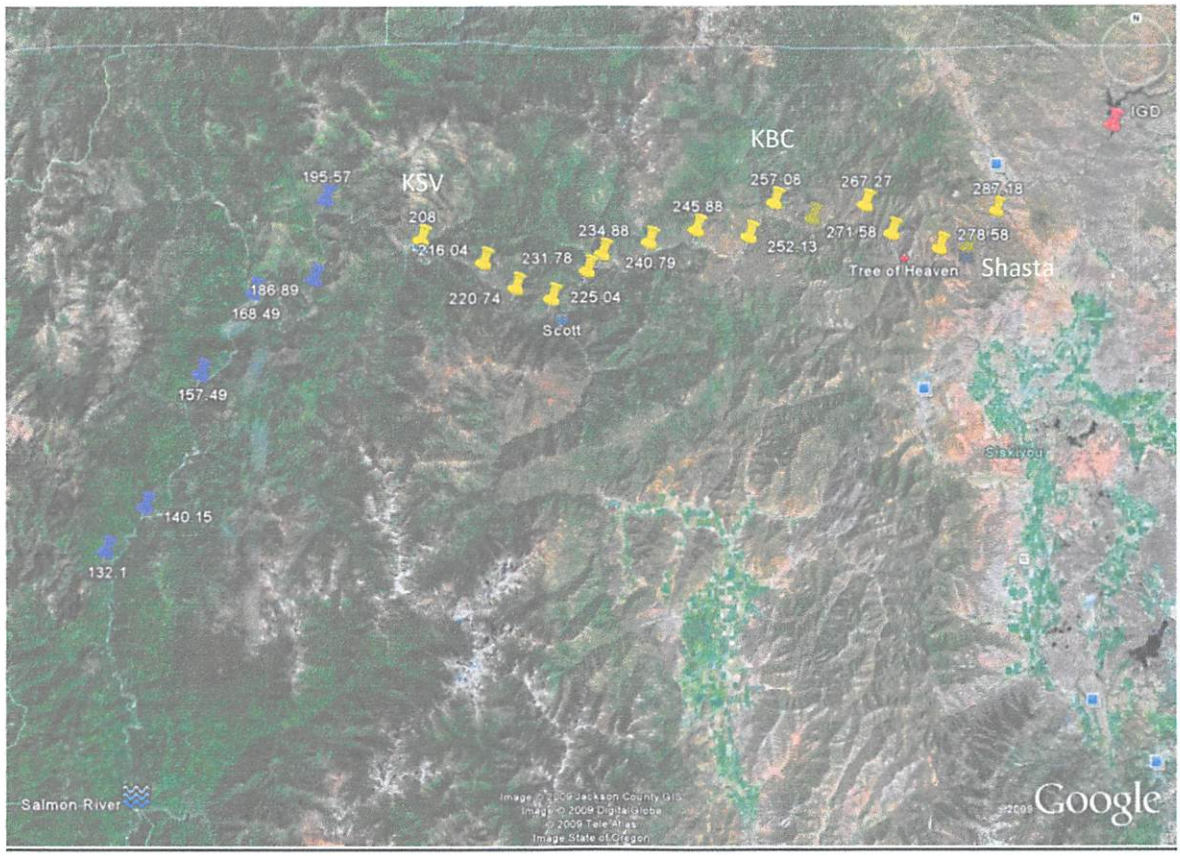


Figure 1. Overview of water sampling sites on the lower Klamath River. The 16 sites from Rkm 208-287 (yellow pins) were sampled on all three dates, May 13, June 3 and June 24, whereas the 6 from Rkm 132-195 (blue pins) were included only on the third sampling day. The Klamath River flows westward into the Pacific Ocean.

In the laboratory, each water sample was filtered through a nitrocellulose membrane using a vacuum pump, the filter paper folded into a microfuge tube and frozen. The filter paper was dissolved in a series of acetone/ethanol washes, removed, and the remaining DNA extracted using a kit (QIAGEN DNeasy Blood and Tissue). Any *Ceratomyxa shasta* DNA present was quantified by a TaqMan PCR assay on a 7300 platform (Applied Biosystems)(Hallett and Bartholomew 2006).

Reference samples with known numbers of *Ceratomyxa shasta* spores were processed in the same manner as the field samples. Positive (tissue) and negative (water) controls were included on each plate. All samples were run in duplicate (i.e. two wells each). Data generated by the SDS software (Applied Biosystems) was exported into Excel where averages and standard deviations were calculated. Any sample whose two wells differed by greater than 1 standard deviation was rerun.

RESULTS and DISCUSSION

Parasite abundance on May 13, June 3 and June 24 is displayed in **Figs 2-4**. All water samples contained *Ceratomyxa shasta* DNA. Levels varied from >1 - >100 spores/L and overall site averages were all >10

spores/L (**Fig. 5, 6**). Daily abundance was consistent at some sites (<1Ct) whereas it fluctuated over 10-fold (>4Ct) at other sites.

Parasite abundance was unusually high in May and decreased at the beginning of June, notably at KBC. Discharge rates from hydrographs don't explain the data, but there was a 9C increase in temperature between sample days. At the end of June the overall pattern had changed and spore abundances were higher at some sites but lower at others.

There was no consistent pattern in abundance between days. Levels increase for about 20 Rkm downstream of the Shasta River confluence to peak east of KBC, thus providing some basis for defining an upstream limit of the infectious zone. On the first two collection days, levels were clearly lower downstream of the confluence of the Scott River, suggesting this as a downstream limit; however, on the third day levels increased markedly both above and below these locations. These levels are more variable between dates than expected, and likely reflect changes in water flow and temperature which affect the polychaete host, release of the parasite from the polycahaete and subsequent survival of the waterborne stage infective to fish. For example, flows from the Scott River (data from Seiad Valley gauge) decreased approximately 1000 cfs over the course of the study and thus contributed less to parasite dilution during the latter sample period.

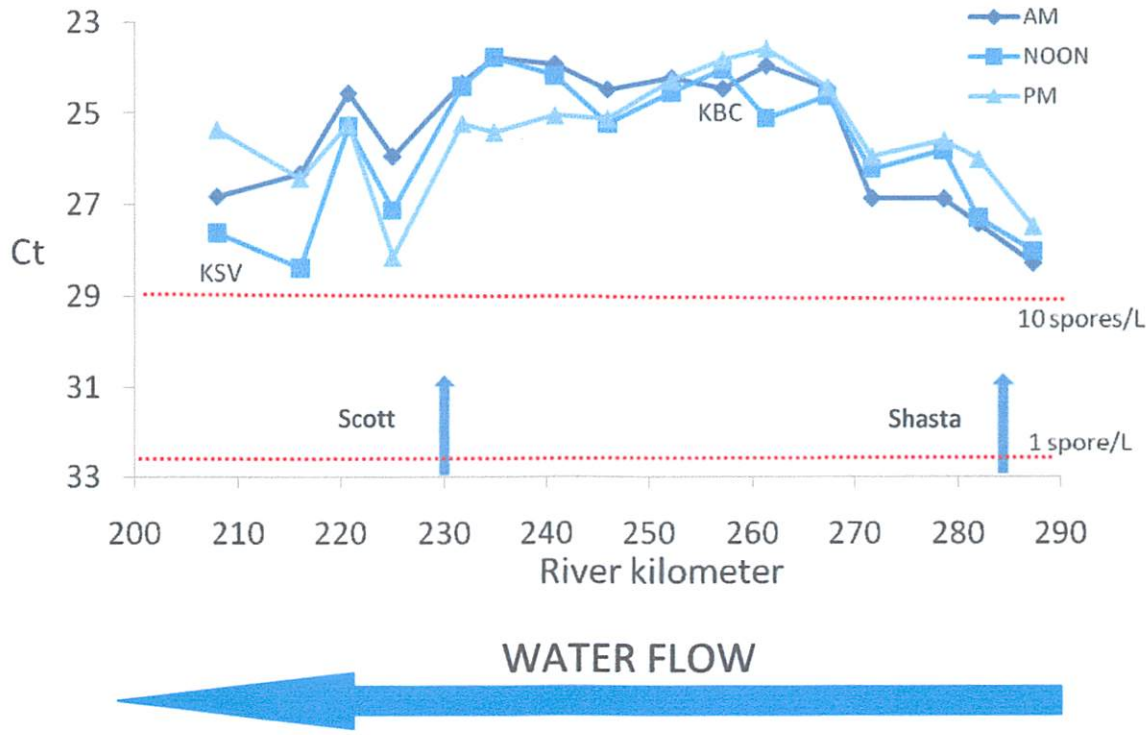


Figure 2. Abundance of *Ceratomyxa shasta* in water samples collected from at 16 lower Klamath River sites. Each data point is the average of 3 x 1L water samples. Samples were taken at 3 time points at

each site, at 9 or 10 am, 12 or 1pm and 3 or 4pm on May 13, 2009 (IZA). The lower the Ct value the more parasite DNA is present. Approx. 3.3 Ct equates to a 10-fold difference in spore numbers.



Figure 3. Abundance of *Ceratomyxa shasta* in water samples collected from 16 lower Klamath River sites. Each data point is the average of 3 x 1L water samples. Samples were taken at 3 time points at each site, at 9 or 10 am, 12 or 1pm and 3 or 4pm on June 3, 2009 (IZB). The lower the Ct value the more parasite DNA is present. Approx. 3.3 Ct equates to a 10-fold difference in spore numbers.

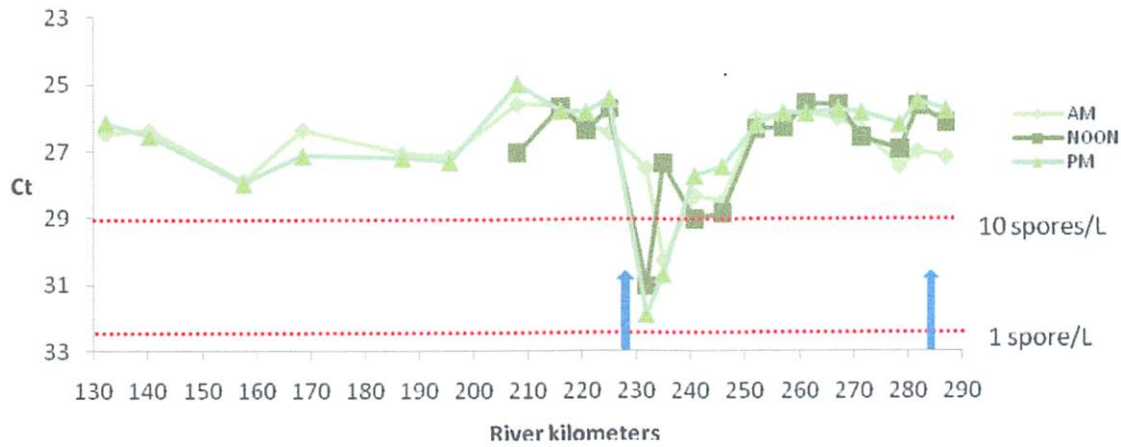


Figure 4. Abundance of *Ceratomyxa shasta* in water samples collected from 16 lower Klamath River sites. Each data point is the average of 3 x 1L water samples. Samples were taken at 3 time points at

each site, at 9 or 10 am, 12 or 1pm and 3 or 4pm on June 24, 2009 (IZC). The lower the Ct value the more parasite DNA is present. Approx. 3.3 Ct equates to a 10-fold difference in spore numbers.

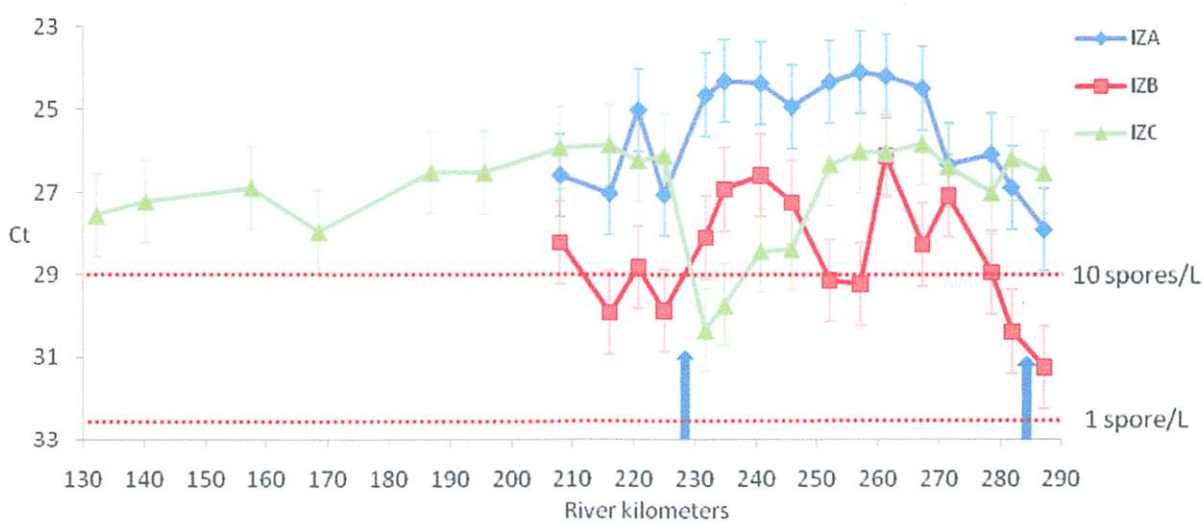


Figure 5. Comparison of abundance of *Ceratomyxa shasta* in water samples collected from 22 lower Klamath River sites on three dates, three weeks apart: May 24 (IZA), June 3 (IZB) and June 24, 2009 (IZC). Each data point is the average of 6-9 x 1L water samples. Samples were taken at 2 time points at the lower 6 sites and at 3 time points at the upper 16 sites. The lower the Ct value the more parasite DNA is present. Approx. 3.3 Ct equates to a 10-fold difference in spore numbers.

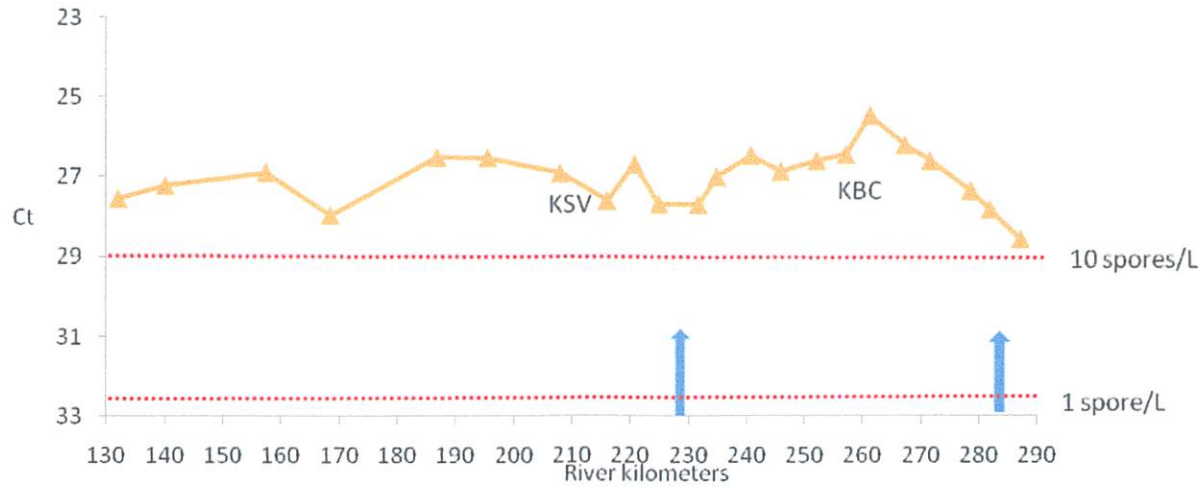


Figure 6. Overall abundance of *Ceratomyxa shasta* in water samples collected from 22 lower Klamath River sites on three dates, three weeks apart: May 24 (IZA), June 3 (IZB) and June 24, 2009 (IZC). Each data point is the average of 6-27 x 1L water samples. The lower the Ct value the more parasite DNA is present. Approx. 3.3 Ct equates to a 10-fold difference in spore numbers. KSV=Seiad Valley index site, KBC = Beaver Creek index site.

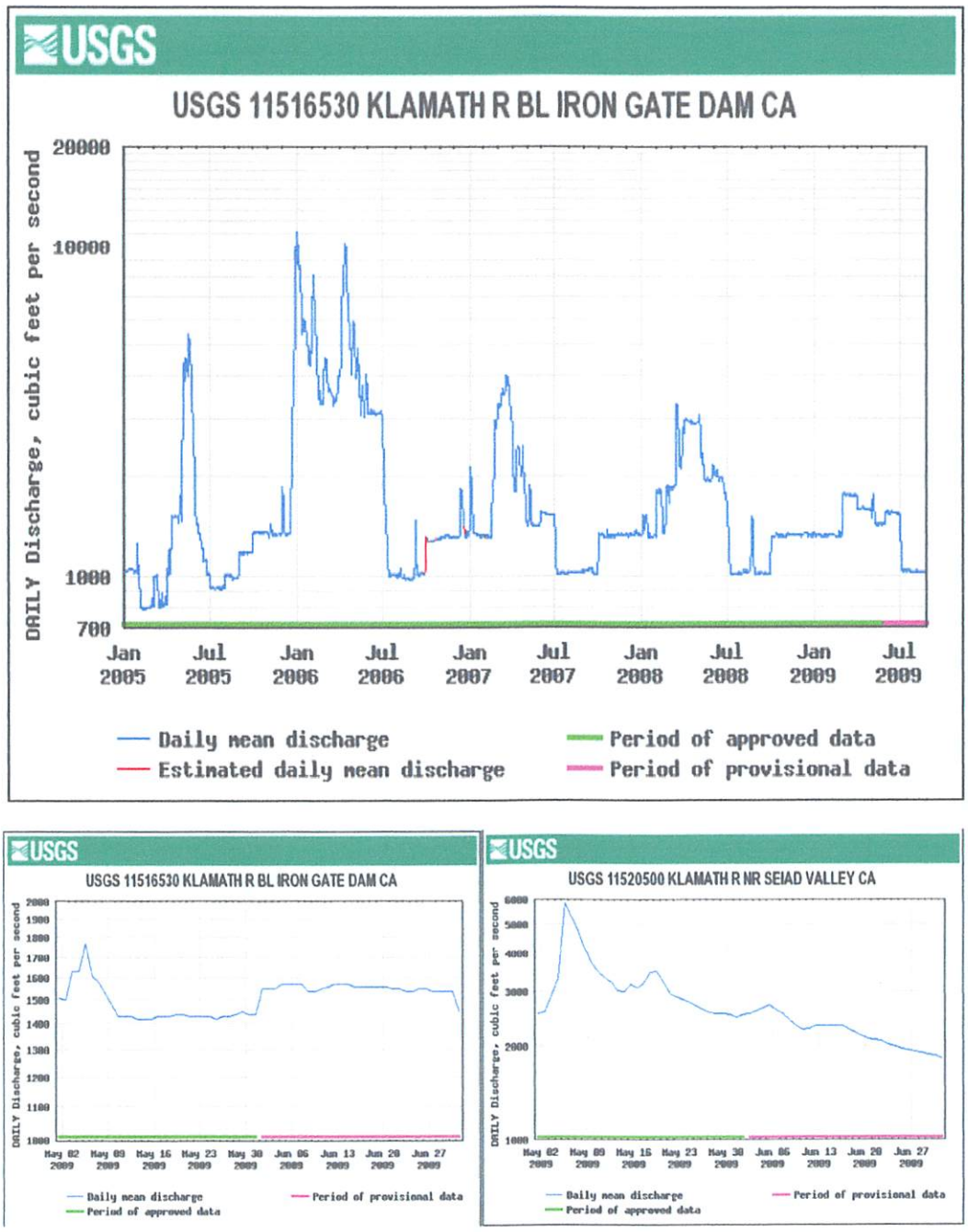


Figure 7. Hydrographs of daily mean discharges from Iron Gate Dam from 2005 – 2009 (upper), Iron Gate Dam May-June 2009 (lower left) and Seiad Valley May-June 2009 (lower right).

This study characterizes spore abundance in the water column, it does not identify the source of the spores ie where the infected polychaetes are located. Decreases in spore abundance e.g. as progress

downstream towards Scott River may be caused by fewer spores being released in this region, or spores being contributed upstream are degrading as they disperse downstream due to high water temperature.

Also, note that water flows have decreased over the past four years (Fig. 7). This may have allowed accumulation of materials suitable for polychaete habitat and conducive to polychaete and parasite propagation.

Acknowledgements

Jill Pridgeon (OSU) helped filter water samples. Steve Christy (OSU) assisted with extraction of water samples. Matt Stinson and Michelle Jordan helped prepare the site map. Hydrograph obtained from http://waterdata.usgs.gov/nwis/.

CLEAR LAKE WATER STORAGE AND MANAGEMENT PROPOSAL

PROPOSED MODIFICATION OF CURRENT ALLOCATION METHODS

Mission: To ensure reliable irrigation water supplies to Basin farmers and ranchers

Current Water Allocation

Klamath Project currently not receiving full irrigation deliveries

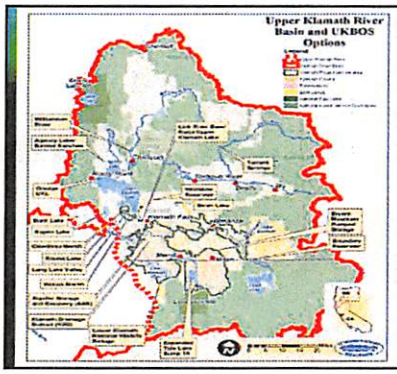
- Reclamation Project requires 400,000 acre feet of water for full project operations
- 2014 received 260,000 acre feet of water
- Idled 18,000 acres of land (54,000 ac/ft)
- Pumped additional water from aquifer (allocated 86K ac/ft)

BASIN SOLUTIONS

- Conveying excess, including flood water (October thru May flows) from Upper Klamath Lake and Lost River to Clear Lake utilizing the current Klamath Project Canal System
  - Potentially up to 150,000 acre feet
- Stored water would be managed for benefit of the project water supply supplementing available water allocation from Upper Klamath Lake
- Water from the Lost River system can be used anywhere throughout the project
- Refuges??
- Water quality in the Lost River will be affected in a positive way by increased flows

BOUNDARY DAM

- Potential location is south of the Oregon/California border
- Potential to store an additional 75,000 acre feet
- Potential cold water inputs into the Lost River will benefit water quality
- Potential to generate electricity to power pumping station at base of Clear Lake.
- Potentially supply enough water delivery to irrigators in the Gerber/Clear Lake system



PROPOSED OFF-STREAM WATER STORAGE

Photo shows 21 proposed Upper Klamath Basin Offstream Storage locations.

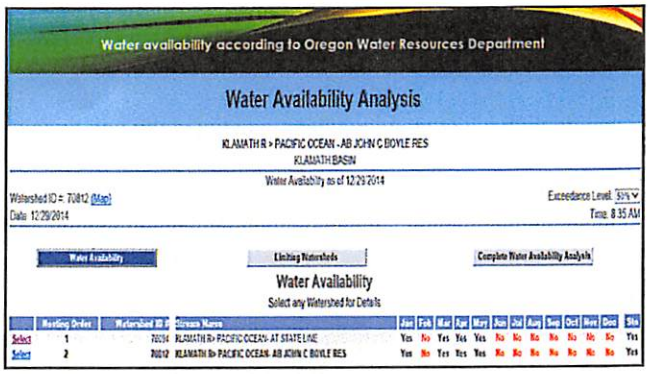
(US Department of the Interior and BOR)

Approx 87,000 ac/ft inflow on average
Approx. 170,000 ac/ft available for storage

Reservoir Information					
Station ID	CLK	Dam Name	Clear Lake	Lake Name	Clear Lake
Stream Name	Lost Creek	Capacity	451,000 af	Year Built	N/A
Year Fill	1953	Start Year Avg.	1956	End Year Avg.	2005

Monthly Averages	
October	201053 af
November	202564 af
December	212402 af
January	228997 af
February	246801 af
March	276123 af
April	288314 af

Table 1. Reservoir storage capacity information at Clear Lake. From California Data Exchange Center



Water availability according to Oregon Water Resources Department

Water Availability Analysis

KLAMATH R > PACIFIC OCEAN - AB JOHN C BOYLE RES
KLAMATH BASIN

Water Availability as of 12/29/2014

Watershed ID = 70812 (Map)
Date: 12/29/2014

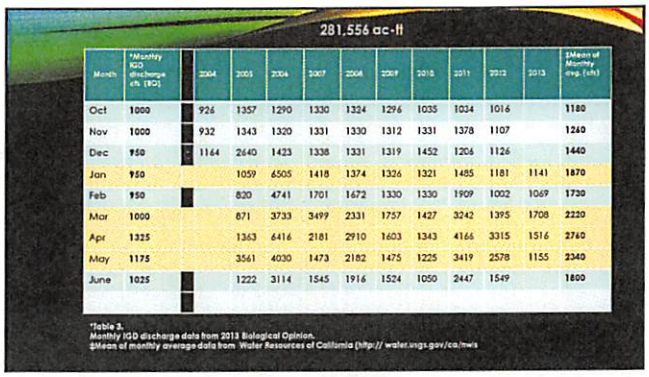
Exceedance Level: 95%
Time: 8:35 AM

Water Availability | Limiting Watersheds | Complete Water Availability Analysis

Water Availability

Select any Watershed for Details

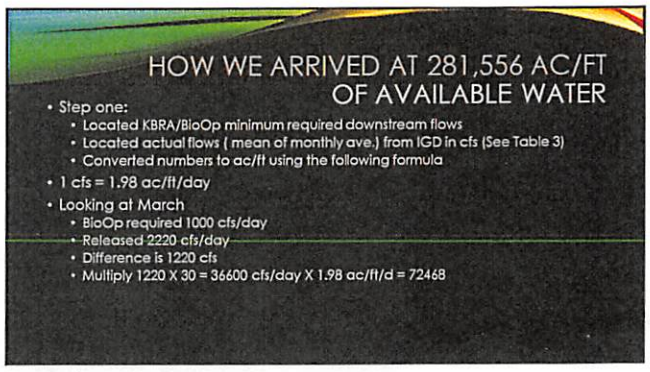
	Routing Order	Watershed ID #	Stream Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Select	1	70234	KLAMATH R> PACIFIC OCEAN- AT STATE LINE	Yes	No	Yes	Yes	Yes	No	No	No	No	No	No	No	Yes
Select	2	70812	KLAMATH R> PACIFIC OCEAN- AB JOHN C BOYLE RES	Yes	No	Yes	Yes	Yes	No	No	No	No	No	No	No	Yes



281,556 ac-ft

Month	*Monthly IGD discharge cfs (BO)		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	‡Mean of Monthly avg. (cfs)
Oct	1000		926	1357	1290	1330	1324	1296	1035	1034	1016		1180
Nov	1000		932	1343	1320	1331	1330	1312	1331	1378	1107		1260
Dec	950		1164	2640	1423	1338	1331	1319	1452	1206	1126		1440
Jan	950			1059	6505	1418	1374	1326	1321	1485	1181	1141	1870
Feb	950			820	4741	1701	1672	1330	1330	1909	1002	1069	1730
Mar	1000			871	3733	3499	2331	1757	1427	3242	1395	1708	2220
Apr	1325			1363	6416	2181	2910	1603	1343	4166	3315	1516	2760
May	1175			3561	4030	1473	2182	1475	1225	3419	2578	1155	2340
June	1025			1222	3114	1545	1916	1524	1050	2447	1549		1800

*Table 3.
Monthly IGD discharge data from 2013 Biological Opinion.
‡Mean of monthly average data from Water Resources of California (http:// water.usgs.gov/ca/nws



HOW WE ARRIVED AT 281,556 AC/FT OF AVAILABLE WATER

- Step one:
  - Located KBRA/BioOp minimum required downstream flows
  - Located actual flows (mean of monthly ave.) from IGD in cfs (See Table 3)
  - Converted numbers to ac/ft using the following formula
- 1 cfs = 1.98 ac/ft/day
- Looking at March
  - BioOp required 1000 cfs/day
  - Released 2220 cfs/day
  - Difference is 1220 cfs
  - Multiply 1220 X 30 = 36600 cfs/day X 1.98 ac/ft/d = 72468

WHO STANDS TO BENEFIT FROM WATER STORAGE

- Project Irrigators
  - Langell Valley, Shasta View, Enterprise, Horsefly, Poe Valley, Klamath, Tulelake.....
- Klamath, Modoc, Siskiyou Counties
  - Local businesses including:
    - Real estate, restaurants, beauty solons, etc.
- Clear Lake water used primarily for irrigation purposes
- Subsequently other benefits could include
  - Refuges, fish.....

ECONOMICS OF SUSTAINABLE FARMING

- Idled land in the Project currently costs the county approx. 2 mil annually
- Loss of production in Langell Valley est. at 4-5 mil
- Loss of income from grazing in the Sprague River Valley potentially 5 mil annually

- Benefits to the Klamath Basin on an annual basis from lost production on AG lands is est. 12 million

ECONOMIC BENEFITS TO WATER STORAGE IN KLAMATH COUNTY

- Agriculture is a 300+ million dollar industry
  - Provides jobs for thousands of resident
    - Your job is probably dependent on Agriculture
  - Provides funding through property taxes for schools, emergency services, seniors etc.
  - Provides food for millions of American through production of cattle, potatoes, strawberries, dairy, and other products

CURRENT

- Currently, through KWAPA, the federal government is providing 8 million dollars per year to a group of irrigators in the Klamath Project to idle land and pump water from already taxed aquifers.
- The Langell Valley area, has been left without irrigation water 4 out of the last 6 years.
- KSWCD is looking into options and funding for a feasibility study to store water for irrigation in Clear Lake and Boundary Dam that would realize full water allocations for all irrigators in the project.
- Water storage to the extent KSWCD is proposing would eliminate the project irrigators calling the water on Upper Klamath Basin Irrigators and put the burden directly, solely on the Klamath Tribe.

SB 839

((WATER SUPPLY DEVELOPMENT FUND (WSDF))

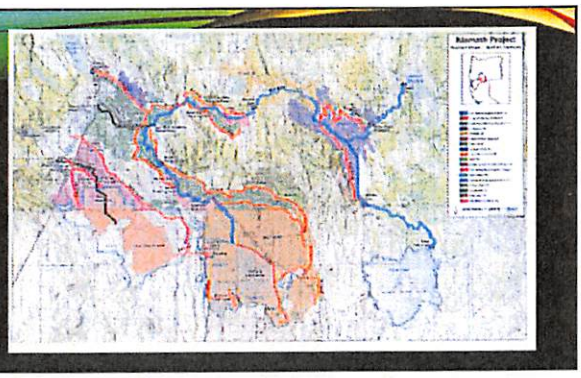
- helps the OWRD fund multi-purpose water development projects.
- will award grants and loans to water development projects
- $10 million appropriation from lottery-backed bonds (appropriated under SB 5533-A).
- Includes:
  - new or expanded above or below ground storage facilities;
  - infrastructure expansion, improvement, or replacement;
  - efficiency improvements;
  - streamflow protection and restoration;
  - conservation and reuse.
- encourages the development of water projects that will return multiple benefits to both consumptive water users and to instream interests
- first funding will be available sometime in early 2015

ELIGIBLE PROJECTS INCLUDE THOSE THAT WILL:

- Repair or replace infrastructure to increase the efficiency of water use
- Provide new or expanded water storage
- Improve or alter operations of existing water storage facilities in connection with newly developed water
- Create new, expanded, improved or altered water distribution, conveyance or delivery systems in connection with newly developed water
- Allocate federally stored water
- Promote water reuse
- Promote water conservation
- Provide streamflow protection or restoration
- Provide for water management or measurement in connection with newly developed water
- Determine seasonally varying flows in connection with newly developed water

OTHER POTENTIAL FUNDING SOURCES

- Bureau of Reclamation WaterSMART grant program
  - congressionally authorized sponsors of Title XVI Water Reclamation and Reuse projects
  - funding can be used to establish or expand a watershed groups.
  - opportunity to cost-share on projects that conserve and use water more efficiently, projects that support water sustainability
  - Funds can be used for feasibility studies or implementation of projects



[document 6]

COUNTY OF SISKIYOU

Board of Supervisors

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Yreka, California 96097
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FAX (530) 842-8013
Toll Free: 1-888-854-2000, ext. 8005

January 31, 2012

STATE WATER RESOURCES CONTROL BOARD
2012 JAN 31 PM 1:38
OFFICE OF WATER RIGHTS
SACRAMENTO

VIA FAX 202-208-4561

The Honorable Ken Salazar
Secretary of the Interior
U. S. Department of the Interior
1849 C Street, N.W.
Washington, DC 20240

Re: Comments to Overview Report on Klamath Dam Removal Studies

Dear Secretary Salazar:

This letter is to serve as my comments with respect to the Draft Overview Report on the Klamath Dam Removal Studies that the Department of the Interior has issued.

In preparing these comments, I am reminded of your comment in front of Supervisor Jim Cook and others at the Department of the Interior a couple of years ago that the effort to remove the dams "must not fail." While you have tried to avoid the consequences of that comment and engaged in political spin to the effect that it meant something else, it is evident from this Report and the EIR/EIS that has been prepared that you apparently are going to honor your predetermined conclusion no matter what the science and people of this country say.

Mr. Secretary, what you are about to do will be a failure of epic proportions.

You will fail in your duty to be a good steward of the lands entrusted to your supervision. As demonstrated by this Report, you will fail to even acknowledge the flaws in this proposal pointed out by your own experts. You will fail to provide a "robust" scientific analysis as you have promised. You will fail to engage in a "robust" NEPA process, and, most tellingly, you will fail to restore the fisheries that purportedly underlie the whole ill-conceived scheme

Jim Cook, District 1 | Ed Valenzuela, District 2 | Michael Kobseff, District 3 | Grace Bennett, District 4 | Marcia H. Armstrong, District 5

to remove the Klamath dams.

My comments above are supported by the very science in which you have invested millions of taxpayer dollars and by the very scientists that have been engaged by your Department. We hope that this newly created "six member independent panel" that is to review the Draft Overview Report is not comprised of lackeys or political scientists that will merely produce your predetermined desired result.

I do not lightly make the charges above, and as set forth hereinbelow in detail, I back up my comments with facts.

Executive Summary

With respect to the Executive Summary produced, if it is indicative of the advice that is being given to you, then it is clear that you are being presented with a one-sided view in support of a predetermined decision in favor of dam removal. In fact, only if you take what in some people's opinion could easily be characterized as a work of fiction to be true, then you will be able to self-validate your commitment to not fail to take the dams out.

In the portion dealing with impacts to fish, the Report continues to ignore the actual contents of the four fisheries Expert Panels Report. The Report does not vary from the flawed conclusions in the Draft Environmental Impact Statement (DEIS). There is no recognition of the errors in the sediment release calculations, the related impacts on fish stocks, the diminished water quality occurring because of dam removal and no discussion of the interspecies conflict issues which increase redband trout populations such that they could actually diminish salmon populations after dam removal. Absent from the entire analysis is any response to the fisheries issues and other issues that this County raised in its comments to the Draft EIR/EIS.

In the section of the Report discussing water quality benefits[1], the Report confines its discussion to reservoir algae, concluding that eliminating the reservoir will eliminate algae toxins. There is absolutely no recognition of the fact that the DEIS admits that there are two types of algae and that the second type of algae, river algae, will increase under a dam removal scenario with attendant adverse impacts to water quality and fish restoration.

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[1]Pages 11, 27 and 31.

The sediment discussion[2] is limited to short-term in-river impacts occurring immediately after dam removal. There is no discussion of residual impacts from sediment remaining in the river. There is no discussion of estuarine and ocean impacts. There is no discussion of the pollutant loads in the sediments. However,[3] the Report acknowledges that sediment released could have unknown and adverse effects if the release does not go according to plan. The County has presented evidence with mathematical certainty that there are significant errors in the volume of sediment to be released and significant adverse effects even if the sediment release occurs as planned. There is absolutely no discussion of these issues.

With respect to water quality, there is no discussion in the Report[4] of water quality problems associated with dam removal. The fishery Expert Panels and other facts in the Draft EIR/EIS demonstrate that the issues with water quality will in fact have a harmful effect. There is no discussion with respect to the fact that the draft TMDL proposed by the State of California is currently the subject of litigation between PacifiCorp and the State of California and no examination of the substantial flaws in how that TMDL was arrived at. It is PacifiCorp which has pointed out the flaws in the TMDL; yet, nowhere is this issue examined in any detail, nor is there any scientific review. There is merely an assumption that all will be well. It is likely that this assumption is made because if PacifiCorp gets the "deal" and millions promised, of course, they would withdraw their challenge to the flawed TMDL. In dealing with water quality, there is no mention of the fact that the water coming in from Oregon is the source of the problem. No amount of dam removal or other efforts in the river downstream from the dams can effectively deal with the poor water quality coming in from Oregon. The analysis silence on this issue is unfathomable.

The water supply for the City of Yreka is also an issue that needs further review. While the Report acknowledges[5] that dam removal will compromise the water supply to the City of Yreka, and although the DEIS suggest that the Interior Department has effectively decided how to replace the Yreka pipeline, there is no meaningful analysis of the objections to this idea filed by the City, nor is there any response to the detailed criticism of an elevated pipeline that was filed by the City of Yreka. The Report merely indicates that this

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[2]Page 13.

[3]Page 17.

[4]Except for a charge on page 11 that claims all will be well.

[5]Page 14.

decision will be "made in consultation" with the City. If anyone had bothered to review the comments from the City, they would see, in fact, that there is no agreement as to how that is going to be handled and no conclusion that there will be sufficient funding for safely securing the water supply for 7,500 people.

Siskiyou County has repeatedly raised the issue of flooding. The Report itself acknowledges that there is a risk of flooding, but then attempts to diminish that issue by stating it is "small."[6] If it is your house being flooded, perhaps you may not think it is so "small." In fact, the loss of the dams will diminish the time that the people downstream will have to get out of the way of any flood and place the lives of the citizens of the County in jeopardy. The County filed many comments on this issue and none are addressed in the Report. It is encouraging to see that the Report finally acknowledges that dam removal will affect cultural and historical sites that are now submerged. However, there is no plan to deal with the issue of these sacred and other sites. The Shasta Tribe has provided detailed information to the County which was forwarded to and given to the representatives conducting the EIR/EIS; yet, nowhere is there an acknowledgment of the risk to these sites. Particularly disturbing is that the Benefit Cost and Regional Economic Development Technical Report, at page 1-46, states that for the cultural resources site mitigation costs, such costs were extracted from the facilities removal cost estimate and treated somewhere else in the Benefit Cost Analysis. If they are extracted from the removal estimates, who is going to fund them? This seems a rather shabby way to treat the cultural resources of the Shasta Tribe. We know they have not been "recognized" by the federal government, but certainly their existence and the sanctity of their cultural sites cannot be so callously overlooked.

The Draft Overview Report in discussing economic benefits is also disturbing in its purposeful ignoring the harm that will be caused to Siskiyou County, failure to identify any mitigation and use of a suspect nonuse valuation analysis to justify dam removal. The nonuse valuation and survey need to be put in perspective. I am informed that at one time there was a nonuse valuation conducted for 168 whooping cranes. That valuation resulted in a cost of about $3.72 Billion to save each of the endangered whooping cranes or somewhere in the neighborhood of $625 Billion to conserve and protect 168 whooping cranes. In short, these nonuse surveys often result in unrealistic and invalid numbers. If the nonuse values are what is underlying the determination to remove the dams, there are serious concerns with the methodology utilized by the Department of the Interior in conducting this survey. Setting aside the "nonuse values" in the net-benefit calculation

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[6]Page 18.

in Table ES-9, the sum of the benefits and foregone benefits is a negative $1,138,300,000, resulting in a negative benefit-cost ratio of approximately 2.5. We have some other observations on the nonuse valuation below, however, providing the County and others only a couple of weeks to review a survey that has taken a couple of years for the Department to prepare is essentially depriving the County and others of any meaningful opportunity (not to forget the lack of economic resources) to meaningfully review this summary. The County has produced many comments and information throughout the process which are simply ignored. The County Assessor has on many occasions provided information with regard to the valuation of the County tax base. Those who conducted the study chose an improper base year for the study failed to include the structures in their analysis, and it appears may have preselected the properties and other sites to be utilized. No one has ever meaningfully addressed the estimates in the original Camp, Dresser & McKee (CDM) Report which identified millions of dollars of impact to the tax base of Siskiyou County.

This Draft Executive Summary is as flawed as the original EIR/EIS and engages in a selective disregard of the facts and science which demonstrate that, at a minimum, there is insufficient information to move forward in this matter and expend over a Billion Dollars of taxpayer money on this flawed endeavor.[7]

Economic Impacts

Over the past several years, the County has repeatedly pointed out to those conducting the EIR/EIS and now points out to the Peer Review Panel the flawed nature of the studies undertaken to examine the impacts to Siskiyou County. Notwithstanding the fact that because the science demonstrates that there will be a failure in the fisheries restoration expectations and therefore the projected benefits for San Francisco Management Area, the Fort Bragg Management Area, Humboldt and Del Norte Counties in California, Central Oregon Management Area, and Curry County, Oregon and Klamath County, Oregon will simply never occur, there is no mitigation or identification of how the impacts to Siskiyou County are going to be addressed. For example, the Executive Summary at Table ES-3, in its discussion of regional economic development impacts, identifies that there will be 49 jobs lost in Siskiyou County, $2 Million of labor income lost, $5 Million of output lost, as well as job loss in recreation and other uses. They are simply not identified in the Draft

[7]Benefit Cost and Regional Economic Development Technical Report identified KBRA costs in 2007 and 2012 dollars as $798.5 Million and $860.4 Million, respectively. This is in addition to the $200 Million-$400 Million costs of dam removal.

Overview Report. The Overview Report falsely identifies $20 Million that would come to Siskiyou County. It is hard to understand how this falsehood can continue to be perpetrated in good faith by the Department of the Interior. The County is not a signatory to the KBRA and, even if it were, the $20 Million identified in the KBRA was illusory to begin with. It was to come from unidentified funds in an unidentified manner at some unidentified time in the future. Significantly, it was money being used to simply try to buy Siskiyou County officials' signature on the document, while at the same time depriving them of any ability to determine how that money was going to be spent. Under the proposals given to the County in the KBRA, those funds would have been overseen by officials from nongovernmental organizations, other state organizations, people from other states, Tribes, and others. No duly elected governing body in the County of Siskiyou could abdicate its authority in such a base manner.[8]

Significantly, the economic analyses have ignored the County's comments and suggestions that they look at the timber management practices as a way to increase the available water for the Klamath region. The County of Siskiyou was devastated by the *Northwest Forest Plan*. This economic devastation was demonstrated and the failure of this Plan is demonstrated by the *Northwest Forest Plan--The First 10 Years (1994-2003)--Socioeconomic Monitoring of the KNF and Three Local Communities*, published in 2008. This study demonstrates harmful impacts of this federal policy. Rather than ignoring the basic fact that timber management practices have reduced the availability of water and that the whole Klamath restoration program will fail without additional cool, clean water, the economic analysis should look at revitalization of the timber industry in Siskiyou County as a way to increase available water. Because timber management practices have resulted in an increase in undesirable growth of some trees and other plants in the forest and their corresponding consumption of water, the effect of the Klamath dam project will be to focus pressure for clean, cold water on the Scott and Shasta Rivers which support major agricultural activity in the County of Siskiyou. Nowhere in either the economic analysis or in the water studies is the fact that without additional water, the whole plan to restore anadromous fish will fail and destroy agriculture in Siskiyou County as a result.

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[8]Siskiyou County does acknowledge that there is a $20 Million proposal for economic development in the California Water Bond. However, this money is not linked to the removal of the Klamath dams. In fact, these funds are speculative at best given that anyone in their right mind would seriously question the probability of success of a $10-$11 Billion bond being passed by the California electorate in November 2012.

The County has repeatedly asked that the impact of the *Northwest Forest Plan* and the cumulative impact of that Plan and the proposed removal of the Klamath dams be examined. This request has been ignored. Its examination is a required component of the EIR/EIS. The following bullet points demonstrate why the National Economic Development Benefit Cost Analysis is flawed. These are just examples.

- Table 1.3-1. In addressing Tribal commercial fisheries, the table states: "Insufficient data available to quantify these benefits. However, dam removal is anticipated to positively affect Tribal commercial fisheries dependent resources." How, if there is insufficient data, can such a result be "anticipated"?

- Table 1.3-1. There is "insufficient data available to quantify these benefits" with respect to in-river steelhead and redband trout sport fishing.

- Table 1.3-1. There is "insufficient data available to quantify these benefits" with respect to refuge wildlife viewing. How can this unsubstantiated, unsupported "anticipation" serve to meaningfully inform anything?

Let's look at some of the cost benefit comparisons with respect to real estate values and hydropower.

- Table 1.3-1. This states that with respect to real estate values, "insufficient data available to quantify changes in real estate values. The extent to which these changes are positive or negative depends on the magnitude of property value changes, over time, for lands proximate to the reservoirs and to the restored river."

- Table 1.3-1. With respect to hydropower ancillary services, i.e., services that support transmission of electricity from its generation site, this table states: "Explicit consideration of ancillary services is outside the scope of the analysis."

- Table 1.3-1. With respect to regional powerplant emissions, the table states: "The hydropower analysis fully described in this document does not consider the effect, if any, of changing hydropower production levels on system-wide powerplant emissions or regional air quality."

Again, if there is insufficient data or excluded information, how can a true cost benefit analysis that is to any extent meaningful be created? Given President Obama's concern about the environment and specifically renewable energy, how can an economic cost benefit analysis ignore the increased burden on the environment of replacing hydropower

with some other energy alternative (although unspecified in the EIR/EIS) and what this will be? What if it is coal? What if it is oil? Certainly there would be not only an economic impact but an environmental impact to such things. In a footnote to Table 1.3-1, on page 1-66 of the National Economic Development Benefit Cost Analysis Technical Report, there is a comment of interest with respect to the recreational and fishing industry. It states: "Although the extinction risk for coho salmon would improve under the action alternatives, those alternatives do not indicate a prospect for delisting of coho. This indicates there would be very little possibility of any use value (e.g., recreational fishing) associated with this species in the foreseeable future under the action alternatives." While we do not concede that there will be an improvement under the dam removal scenario, certainly it is of concern that there is no real possibility of an increase in recreational fishing. Recreational fishing increases is something that has been advanced throughout this process as a reason to remove the dams.

- In the Siskiyou County area, the Economic Analysis conducted at page 2-8 discusses recreational fishing.[9] This discussion for the Siskiyou County area speculates that there will be an increase of "three more jobs" in the recreational salmon fishery. However, there is insufficient data to estimate any potential impact with the recreational steelhead fishery and no examination of any potential regional economic impacts in an increase in the redband trout fishery. With respect to the redband trout, one must ask if there is to be a sevenfold increase in redband trout and the Expert Fish Panels identify salmon as the prey of redband trout, it is of concern that there is no discussion of these apparent contradictory facts. We also know from Section 2.9 of this same table that an additional four jobs will be lost in reservoir recreation in Siskiyou County with dam removal. Section 2.10 of this same analysis indicates that whitewater recreation expenditures would decline by 14 and labor and income output would decline by over a Million Dollars (0.43 for labor and 0.89 for income).

Klamath River Basin Restoration Nonuse Value Survey

We believe the Expert Review Panel should not only review what we believe is flawed methodology of this Nonuse Value Survey, but also the comments of individuals returning the surveys. Siskiyou County has been told that often in such surveys, it is what is good for the country, not what is good for a small region or area. The comments of the people

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[9]This is Chapter 2, page 2-8, Regional Economic Development Impact Analysis Benefit Cost and Regional Economic Development Technical Report.

throughout the United States, as well as of the area, are enlightening on this issue. Here are a few of their comments from the Appendix:

- "I thank you for giving me information on the Klamath River, I never heard of it . . . (C-71)
- "I feel this survey should only have been given to the people it concerns." (Page C-74)
- "This should be a local concern with local responsibility." (Page C-66)
- "Whenever your company conduct the survey next time sent the survey to people live in that area otherwise it is a waste of money." (Page C-66)
- "Those living in the affected area should be given special consideration for the pros and cons the changes will have on their lives thanks." (Page C-67)
- "I live in Fernley, NV; not sure this survey is relative to my location (i.e. gov't waste)" (Page C-68)
- "I read the information thoroughly, but do not think people can knowledgably answer questions here without studying more and asking other questions , for e.g. I've never heard of these sucker fish--do people eat them . . ." (Page C-69)
- "I think I live too far from Klamath to survey." (Page C-76)

These are comments from people in the rest of the United States about who should be taking part in the survey. Also tellingly, many folks were of the mind that they were excited about getting a $2 bill in the survey, while others expressed disappointment on the waste of tax dollars and the fact that many of them would be throw away.

- "Thanks for the $2 bill . . ." (Page C-67)
- "Extremely annoyed that an actual $2 bill was sent with this survey as most people just threw the survey unopened. Typical waste of government money." (Page C-64)

After various comments about the $2 bill, the wastefulness of the study, and other such issues, the survey also was sent to folks in other places in the United States who

apparently have a deep affection for fish in that they stated:

- "I would like to save the fish. I love fish." (Page C-60)

Of course, it is this type of well informed, learned analysis this type of survey elicits.

There are many other comments and with respect to the integrity of the survey, a significant portion of them thought the survey was heavily slanted toward fish restoration and dam removal.

- "This survey is very one sided favoring the environmentalist views. It does not consider how it will effect the people living in the Klamath Basin region." (Page C-3)

- "I think this survey was heavily slanted toward fish restoration and dam removal." (Page C-6)

While there are many other such instances in the comments, tellingly, the overwhelming nature of the comments show that both in the region and throughout the United States, the opinions of most folks is that it is a bad idea. It is difficult to see how this nonuse valuation, when the comments are reviewed, indicates anything other than the people of the United States and the region feel that this is not a good idea, not a good use of taxpayer dollars, in many cases is a waste of taxpayer dollars, and overwhelmingly, except for the individual who "likes fish", appear not to support this endeavor.

Many good questions were asked by the people receiving the slanted survey, in spite of the effort to skew it in favor of dam removal. They asked for more information, they asked why fish passage was not studied, they questioned the utility of removing hydroelectric power facilities and why the corresponding harm to the environment is not addressed. While the colored in circles of the survey may have led to a statistical result that, of course, was predetermined to be in favor of dam removal (stated to be so by some of the commenters), it is clear that when the comments are reviewed, no matter where they live, people really don't think it is a good idea.

While I understand that my letter is somewhat lengthy and that your Peer Review Panel may treat it with equal disregard as those drafting the Overview Report did with our EIS/EIR comments, I am providing some specific observations, along with the request that the Peer Review Panel actually read the County's EIS/EIR comments in peer reviewing this Overview Report. Addressing our comments in the Report can lead to no other conclusion that the Secretarial Determination in favor of dam removal will be a failure.

I believe that NEPA and CEQA require that there be a hard look at the environmental and economic effects of your proposed action. The underlying EIS/EIR is not fairly examined in the Overview Report. The Report proposed to be presented to you fails to take the requisite hard look that NEPA and CEQA require, ignores key issues, uses incorrect facts, misstates the conclusions of expert Review Panels established by the Department of the Interior, and glosses over adverse environmental and economic effects or outright refuses to acknowledge them. This Overview Report is nothing more than a subterfuge designed to rationalize a decision that has already been made. We provide the following specific observations that we provided in the EIR/EIS that we believe the Peer Review Panel should address specifically:

- The EIS/EIR states the need for the Proposed Action is to advance the restoration of salmonid fisheries. DOI established four Expert Panels to study the likelihood of the Proposed Action achieving that goal. After reviewing the data, the Expert Panels called the results of the Proposed Action "small," "remotely possible," "uncertain," "unlikely," and "not feasible." In short, there is a very low likelihood the Proposed Action will achieve its goal.

- A recurring theme in the Expert Panel Reports is that the data and analyses necessary to support the conclusions in the EIS/EIR have not been done. The actual effects of the Proposed Action are simply not known despite claims to the contrary in the EIS/EIR. Because of the absence of data and analyses, one Expert Panel termed the Proposed Action an "experiment." Spending hundreds of millions of dollars on an "experiment" that will, at best, achieve "small" results is highly questionable.

- To justify the Proposed Action, the EIS/EIR makes fundamental errors of analysis. For example, the EIS/EIR examines the effects of the Proposed Action on fish as if each individual species is the only occupant of the ecosystem. However, these species share the same habitat, compete for the same space and food, and prey on each other. Failing to examine interspecies ecosystem relationships is a conspicuous and glaring omission in the EIS/EIR. This is especially true when one Expert Panel determined that interspecies conflicts, including predation on salmon by an expanded redband trout population, could result in "cancelling" the benefits to salmon claimed to result from the Proposed Action. Increased predation resulting from the Proposed Action also poses real threats to the bull trout, a species protected under the Endangered Species Act.

- The benefits claimed for the Proposed Action in the EIS/EIR are illusory or negative. For example, an Expert Panel judged the net benefits of the Proposed Action for salmon to be "small." Among many other things, the Panel noted that salmon need spawning beds that are relatively free of silt and sediment. In concluding that the benefits to salmon would be "small," the Expert Panels based their analysis on an assumed sediment release of 200,000-400,000 tons after dam removal. The actual number, using data in the EIS/EIR, is 3,540,000 tons.

- An Expert Panel found the EIS/EIR's reliance on average daily mean temperatures to measure the temperature impacts of dam removal on fish was incorrect. Fish do not experience average temperatures. Fish experience hour-by-hour temperatures. If temperatures rise above a certain level, notwithstanding the average, fish are adversely affected. An Expert Panel concluded that dam removal will increase the highest temperatures experienced by fish.

- A key water quality problem in the Klamath River Basin is high nutrient loads that cause low dissolved oxygen and algae blooms. The EIS/EIR admits the Proposed Action will increase nutrient loads and, therefore, make water quality worse.

- Another key water quality problem is algae growth. The EIS/EIR admits the Proposed Action will make this problem worse.

- Water quality is adversely affected by elevated pH levels. The EIS/EIR admits the Proposed Action will make this problem worse.

- Low dissolved oxygen levels are yet another water quality problem. The EIS/EIR concedes this problem is likely to be worse because of the Proposed Action.

- Disease is a major problem affecting fish populations. Because increased river algae biomass provides improved habitat for disease carrying worms, the Proposed Action will make the fish disease problem worse.

- According to the EIS/EIR, freshwater mussels, an important subsistence and cultural species for tribal people, experience "substantial" mortality when buried for more than four-five days. The EIS/EIR admits freshwater mussels,

and all other filter feeders, will be buried under up to two feet of sediment for three-four months.

- The EIS/EIR is also riven with inconsistent statements and inadequate or non-existent analysis. For example, in at least four places the EIS/EIR states it need not examine the effects of dam removal on estuarine habitat, including the essential fish habitat in the Klamath River estuary, because sediment will not reach the estuary. In an equal number of places, the EIS/EIR says sediment will reach the estuary. Both assertions cannot be right. If sediment will reach the estuary, the EIS/EIR has failed to examine the effects of increased sedimentation. If sediment will not reach the estuary, the EIS/EIR has understated the effect of adding 3.5 million tons of sediment to salmon spawning beds and other river habitat. And nowhere does the EIS/EIR discuss the impacts on the ocean environment.

- The EIS/EIR admits that dioxin and other chemicals are present in dangerous levels behind J.C. Boyle Dam. There is no analysis of the likely adverse impacts of these pollutants. Instead, the EIS/EIR says these hazardous pollutants will be diluted when the three dams below J.C. Boyle Dam are removed. The EIS/EIR ignores the habitat between the J.C. Boyle Dam and the next dams. The EIS/EIR also ignores the issue of whether these substances, even if diluted, remain harmful.

- After admitting there are special status invertebrates in the project area, one of which could be listed under the Endangered Species Act, the EIS/EIR completes its "hard look" analysis of the impacts of dam removal on invertebrates in just five lines.

- The EIS/EIR notes the presence of 174 bird species in the project area stating that buffer zones will be needed to protect many of them from activities undertaken as part of dam removal. There is no discussion of whether the size of the buffer zones are adequate or why.

- The EIS/EIR admits dam removal will increase the risk of flooding and decrease the time people have to respond before the flood hits. There is no analysis of the effects of those increased risks.

- All the towns in the County of Siskiyou are "at risk" communities for wildfires. Dam removal will remove reservoirs that provide water to fight such fires. The EIS/EIR fails to properly examine the effects of this decreased fire fighting ability.

- The EIS/EIR first states that the concrete, earth, and other waste from dam removal will be disposed of on-site. Later, the EIS/EIR states this waste will be taken to local landfills. Both statements cannot be right. If the waste is disposed of on-site, the EIS/EIR says it will be placed in areas that are now protected open space and conservation areas. The EIS/EIR does not examine the impact on these areas of disposing of approximately 1.4 million cubic yards of waste. If the waste is sent to local landfills, the EIS/EIR does not examine the impact on the counties of using up almost one-third of the capacity remaining at two landfills.

- The EIS/EIR acknowledges that roads and bridges in the project area were not designed to sustain the heavy loads associated with dam removal and could be incapable of supporting this weight. After these admissions, the EIS/EIR says an in-depth analysis will be done later.

- The EIS/EIR admits tax revenues to the County of Siskiyou will decline, perhaps indefinitely. There is no analysis of the effects of reduced revenues on the County's ability to serve its citizens.

- The EIS/EIR admits land use changes will occur as a result of dam removal but decides it will "not describe potential changes in land use that would occur if the dams were removed."

- The dams provide energy sufficient to power 65,000 homes for a year. The County of Siskiyou has approximately 23,500 homes. Every household in this and other counties will be affected. The EIS/EIR contains no analysis of the impact of increased energy costs on the citizens of Siskiyou County or of the environmental effects of replacing clean hydropower with other energy sources.

- The EIS/EIR uses incomplete data as to water supplies, rights, and facilities. While the EIS/EIR makes a limited effort to identify exiting water rights, it fails to consider the specific circumstances and physical facilities associated with those water rights and diversions and, therefore, how these water rights will

be affected by the Proposed Action.

- The deconstruction and relocation of the City of Yreka municipal water supply pipeline will have significant effects on the short-term and long-term reliability of the water rights granted to the City. These effects are not analyzed.

- The EIS/EIR admits there are significant cultural and historic resources in the project area. The impacts "analysis" in the EIS/EIR is confined to stating DOI will identify affected cultural and historic resources later.

- The EIS/EIR inappropriately attempts to analyze noise impacts on County residents by applying standards used for noisy urban settings to rural Siskiyou County. The EIS/EIR compounds its error by failing to take actual measurements of existing noise levels or of noise levels expected from dam deconstruction.

- The EIS/EIR admits the loss of tax revenue to the affected counties raises significant environmental justice issues because the impacts of lost tax revenue will "disproportionately affect" low income, minority, and tribal people. The EIS/EIR then fails to examine those effects.

- The EIS states the KBRA and its planned actions are part of the Proposed Action. There are 112 such measures, virtually all of which have environmental effects. Virtually none are analyzed in the EIS/EIR. Curiously, among those projects are habitat and aquatic restoration actions on six tributaries of the Klamath River. Valued at over $177 million, these projects will have some effects on the Klamath River. One searches the EIS/EIR in vain for any analysis.

- The EIS/EIR fails to comply with the legal requirement to identify and analyze the mitigation measures that would be associated with alternatives to the Proposed Action. There is simply no way to examine and compare the environmental effects of the Proposed Action with that of various alternatives without an analysis of the mitigation plan associated with the alternatives.

- As to the mitigation for the Proposed Action, the EIS/EIR inappropriately leaves the bulk of that analysis for a later day. Virtually all the mitigation measures for dam removal are in the KBRA. But the EIS/EIR admits those measures cannot be analyzed because "[w]hile the general goals of the

KBRA actions and programs are known, the specific actions that would occur are not yet defined...." Where some definition does exist, the Expert Panels formed by DOI generally characterized the KBRA actions as "infeasible" and "not likely" to succeed.

- The heart of an EIS/EIR is a rigorous analysis of alternatives. Consistently, the EIS/EIR fails to meet this analytical requirement. The EIS/EIR examines its favored Proposed Action in dozens of pages while often confining the analysis of alternatives to mere paragraphs. A glaring example of this biased and incomplete analysis is that the four Expert Panels created to examine the effect of the Proposed Action on fish were instructed by DOI to limit their analysis to the Proposed Action and the status quo. They were told to ignore the other three alternatives in the EIS/EIR. Given that the stated need for dam removal is to restore salmon fisheries, and given that the EIS/EIR relies on the Expert Panels to justify its favorable view of dam removal regarding fish resources, this is a singular failure of NEPA and CEQA compliance.

- The EIS/EIR violates the fundamental requirements of NEPA and CEQA to fairly and objectively compare alternatives. The EIS/EIR attributes all of the alleged environmental benefits of implementing the KBRA to the Proposed Action. This ignores the fact that many of the KBRA actions will proceed even if the dams are not removed. Therefore, the benefits of these KBRA actions, if any, must be included in the No Action and other Alternatives, including Alternative 4. The EIS/EIR violates applicable law by not doing so.
- In evaluating alternatives, the EIS/EIR fails to examine whether the adverse environmental effects of dam removal will inhibit or prevent achieving the benefits that are alleged to come from those KBRA actions that will be implemented even if the dams are not removed.

- The bias against any alternative except dam removal is amply demonstrated by the fact that the same pollutant releases considered to have an insignificant effect under the Proposed Action are considered to have a significant effect under the No Action Alternative.

- The EIS/EIR is devoid of any discussion of how the Proposed Action proposes to comply with the applicable Ordinances of the County of Siskiyou. Many of these Ordinances are never even mentioned. Equally important, in many cases, the Proposed Action violates, or is inconsistent with, the County's Ordinances. Conspicuously absent from the EIS/EIR is any

discussion regarding how to address these issues.

The preceding is only a sampling of the myriad problems, failings, and issues associated with the EIS/EIR and with its conclusions.

In closing, I would ask you not to fail to uphold the oath of office that you took and your obligation to uphold the laws of the United States and not fail to put an end to this boondoggle.

Very truly yours,

Grace Bennett, Chair
Siskiyou County Board of Supervisors

cc: E-mail to ksdor@atkinsglobal.com
Hard copy to: Atkins North America Inc.
c/o Tamara Mayer
7406 Fullerton Street, Suite 350
Jacksonville, FL 32256

cc: Senator Dianne Feinstein
Senator Barbara Boxer
Congressman Wally Herger
Congressman Mike Thompson
Congressman Greg Walden
Congressman Tom McClintock
Senator Doug LaMalfa
Assemblyman Jim Nielsen
Senator Ron Wyden
Senator Jeff Merkley
Governor Jerry Brown
Governor John Kitzhaber
Secretary John Laird
Director Charlton Bonham, California Dept. of Fish and Game

John Bezdek, Solicitor to Secretary Salazar
Greg Norton, President, RCRC
Mike McGowan, President, CSAC
Siskiyou County Board of Supervisors
Klamath County Commissioners
Humboldt County Board of Supervisors
Del Norte County Board of Supervisors
Trinity County Board of Supervisors
Modoc County Board of Supervisors
Dean Brockbank, PacifiCorp

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SHORT BIOGRAPHY

Dr. Houser is an expert in local to global land surface-atmospheric remote sensing, in-situ observation and numerical simulation, development and application of hydrologic data assimilation methods, and global water and energy cycling. He received his B.S. and Ph.D. degrees in Hydrology and Water Resources from the University of Arizona in 1992 and 1996 respectively. His dissertation research, titled "Remote Sensing Soil Moisture using Four-Dimensional Data Assimilation" introduced data assimilation into hydrological models, and demonstrated the benefit of including information from soil moisture observations in land-surface energy and water balance simulations. Dr. Houser's previous experience includes exploration of surface water quality issues at the U.S. Geological Survey, development of landfill cover technology at Los Alamos National Laboratory, study of fracture flow in volcanic tuff near Globe Arizona, hydrometerological instrumentation design and measurment of surface water and energy fluxes throughout Arizona, and teaching general hydrology, hydrologic field camp, and graduate hydrometerology seminar classes. Dr. Houser joined the NASA-GSFC Hydrological Sciences Branch and the Data Assimilation Office in 1997, and served as manager of NASA's Land Surface Hydrology Program from 1999-2000, and served as branch head of the Hydrological Science Branch from 2000-2005. In 2005, he joined the George Mason University Climate Dynamics Program as the Professor of Global Hydrology, and formed the Center for Research for Environment and Water with the mission to quantify and predict water cycle and environmental consequences of earth system variability and change through focused research investments in observation, modeling, and application. During 2008-2010, Dr. Houser worked with EarthWater Global to help countries solve their fresh water shortages, where he was responsible for providing satellite-based"local short term statistical information on rainfall, snowpack and glaciers, especially in heavily fractured mountainous regions. Dr. Houser has led numerous scientific contributions, including the development of Land Data Assimilation Systems (LDAS), the Hydrospheric States Mission (Hydros), the Land Information System (LIS), the NASA Energy and Water cycle Study (NEWS), and the Water Cycle Solutions Network (WaterNet). Dr. Houser's current research focuses on integrating water cycle research across traditional disciplines in an end-to-end program that transitions theoretical research to academic/public education and real-world application, through partnerships with universities, governments, and international agencies.

CAREER OBJECTIVE AND OVERALL SUMMARY

Dr. Houser's career goal is to continually improve his leadership in global water cycle research of direct relevance to society, including local to global land surface-atmospheric process observation and numerical simulation, and development and application of ecohydrologic data assimilation methods. He is also broadly interested in exploring the physical, spatial, and temporal interconnections between all the earth system components as they relate to the global water and energy cycles. His more specific interests include, water and energy flux studies at various scales including vadose zone, surface, and atmospheric interactions, regional land surface-atmospheric hydrologic modeling, remote sensing, surface flux observation, and near surface soil moisture investigation. He is especially interested in applying cutting-edge research to develop practical solutions to water problems faced by society.

LEADERSHIP

Dr. Houser has proven leadership skills and ability to build world-class research capabilities, as demonstrated in his leadership positions at NASA and CREW. This is evidenced by his terms as NASA Headquarters Program Manager in Hydrology, Head of the NASA Hydrological Sciences Branch, Project Scientist for the Hydros soil moisture satellite mission and the NASA Energy and Water cycle Study (NEWS), and as Director of the Center for Research on Environment and Water (CREW). Moreover, during his time at NASA he established a team of more than 30 support scientists through his national competitive funding awards. Currently CREW (a Center that is wholly supported by his national competitive funding awards), has already grown to more than 10 support scientists in only 3 years. Dr. Houser has been awarded a considerable number of large research grants with very ambitious goals. These grants have been successfully completed as evidenced by his significant publication track record in highly regarded peer-reviewed journals. Moreover, his research has often bridged interdisciplinary boundaries. He has also received several prestigious awards, including a U.S. Presidential Award. Evidence of his substantial track record relative to his relatively short career. Dr. Houser was recognized as one of the most exceptional and visionary scientists amongst NASA's already gifted and forward thinking leaders. It is no surprise then that it is Dr. Houser who has been

chosen to lead many innovative and ambitious projects. As a gifted leader he consistently takes action to motivate, inspire and coordinate the talents of others, directing their efforts in areas of groundbreaking research to attain excellence in all of their endeavors.

Since his decision in 2005 to join George Mason University as a faculty member, Dr. Houser has guided his students and empowered them with the necessary skills to achieve their goals and become successful. He encourages and trusts others around him to think independently but also engage as a team when necessary while applying cutting-edge research to develop practical solutions to water problems faced by society today.

Dr. Houser is often described as a visionary leader, and has demonstrated his capacity to leave an enduring legacy at NASA, which includes several hydrology missions, modeling projects, and research themes. An esteemed colleague once described Dr. Houser as one of the most exceptional scientists amongst NASA's already gifted and forward thinking leaders. Dr. Houser actively engages colleagues and partners on collaborative projects and quite frequently is the member who is chosen to lead collaborative, interdiciplinary endeavors. Projects under the direction of Dr. Houser invariably impact the international, as well as lnational scientific community. As a gifted leader he consistently takes action to motivate, inspire and coordinate the talents of others, directing their efforts in areas of groundbreaking research to attain excellence in all endeavors. Dr. Houser keeps current and connected to others by attending, presenting and coordinating seminars and workshops, teaching, presenting lectures at graduate and undergraduate levels, developing academic curricula, dissertation advising and continuing his research activities. Dr. Houser has a proven reputation in the educational as well as scientific community and has an extensive list of collaborations. Dr. Houser encourages and trusts others around him to think independently but also engage as a team when necessary while applying cutting-edge research to develop practical solutions to water problems faced by society today. Dr. Houser is a team builder with the motto of 'water cycle research making a difference'.

TEACHING

Dr. Houser has actively guided his students and empowered them with the necessary skills to achieve their goals and become successful. As a teacher and mentor, he consistently takes actions to coordinate the talents of outstanding young scientists from diverse backgrounds and cultures, directing their efforts in the most effective way. He has mentored students from Australia, Belgium, South America, Europe and throughout the United States and no matter if they are high school interns or postdocs, advising individually, or in groups, Dr. Houser believes the greatest gift you can give others is to enable them to succeed, never be selfish about your ideas, and one good idea can benefit many. Dr. Houser carries out this philosophy by encouraging others to think, question, and go beyond to explore the fringes of science. He enjoys sharing his knowledge with others, is not afraid of confronting the unknown, and pushes to search for answers to questions that still have not been addressed.

Dr. Houser has taught courses in principles of hydrology, land-climate interactions, environmental remote sensing, hydrologic data assimilation, global water cycling, micrometeorological observation, and snow hydrology. In addition, Dr. Houser is interested in developing coursework at both the undergraduate and graduate levels in local to global land surface-atmospheric process observation (both in-situ and remotely-sensed), numerical hydrological simulation, the physical, spatial, and temporal interconnections between all the earth system components as they relate to the global water and energy cycles, water and energy processes at various scales including vadose zone, surface, and atmospheric interactions, regional land surface-atmospheric hydrologic modeling , and near surface soil moisture investigation. Finally, Dr. Houser is especially interested in developing coursework on the application of cutting-edge science that bridges the gap between cutting-edge research and practical application to make a real contribution to society.

PERSONAL

Born in Lafayette Indiana (April 8, 1970). Married to Jennifer Houser (March 1993); three children: Alexandra (Nov 1996), Amy (April 1999), and Ashley (April 1999).

EDUCATION

University of Arizona, B.S., Hydrology and Water Resources, 1992
University of Arizona, Ph.D., Hydrology and Water Resources, 1996

PROFESSIONAL EXPERIENCE

2005 – Present	*Associate Professor*, George Mason University, Fairfax, Virginia Geography and Geoinformation Science Department; Atmosphere, Ocean and Earth Science Department
2008 – 2010	*Consultant for* EarthWater Global (Robert "Bob" A. Bisson) Alexandria, Virginia
2008 – 2009	Adjunct *Research Scientist*, Center for Research on Environment and Water, Calverton, Maryland
2005 – 2008	*Director*, Center for Research on Environment and Water, Calverton, Maryland
2007 – 2010	*Affiliate Faculty*, Department of Atmospheric, Oceanic and Earth Sciences, George Mason University, Fairfax, Virginia
2000 – 2005	*Head* (GS-15), Hydrological Sciences Branch, Goddard Space Flight Center, Greenbelt, Maryland

DATE: February 24, 2012

TO: Office of the Executive Secretariat and Regulatory Affairs
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FROM: Dr. Paul R. Houser
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SUBJECT: Allegation of scientific and scholarly misconduct and reprisal for a disclosure concerning the biased summarization of key scientific conclusions for the Klamath River dam removal Secretarial determination process.

SUMMARY: With this letter, I submit two allegations of scientific and scholarly misconduct and reprisal intended to compromise scientific integrity for a disclosure concerning the Department of the Interior's biased (falsification) summarization of key scientific conclusions for the Klamath River dam removal Secretarial determination process. These allegations violate different parts of the 305 DM 3 Scientific Integrity Policy, but are being submitted together, as their possible motivation and topics are related. In my role as Science Advisor and Scientific Integrity Officer for the Bureau of Reclamation, I provide my comments at various points during this presentation.

1. *Intentional Falsification:* Motivated by Secretary Salazar's publically stated 2009 intention to issue a Secretarial determination in favor of removing four dams on the Klamath River (due on March 31, 2012), the Department of the Interior has followed a course of action to construct support for such an outcome. An example of this intentional biased (falsification) reporting of scientific results is contained in the September 21, 2011 "*Summary of Key Conclusions: Draft EIS/EIR and Related Scientific/Technical Reports*" [attachment 1]. Other examples provided by third parties are provided in the attached documents.

    a. Person(s) alleged to have committed misconduct:
        i. Unreported author(s) of report "*Summary of Key Conclusions: Draft EIS/EIR and Related Scientific/Technical Reports*"
        ii. Department of the Interior officials

2) *Intentionally circumventing policy that ensures the integrity of science and scholarship, and actions that compromise scientific and scholarly integrity:* On September 15, 2011, I expressed concern via written disclosure relating to the scientific integrity of a draft press release on the draft environmental analysis for removing four Klamath River dams [attachments 2, 3], and via verbal disclosure about the integrity of the larger Klamath River dam removal Secretarial determination

process. My disclosure was clearly made to people who had authority to fix the press release (*Department Press Secretary, Department Solicitor's Office*), and people who had influence on the Secretarial decision process (*Department Solicitor's Office, Reclamation Deputy Commissioner*). My disclosure was never directly addressed, and supervisors have used my probationary status to enact reprisal for the disclosure culminating in the termination of my employment (effective February 24, 2011).

Even though some changes were in the final press release (showing I had made the disclosure to people with the authority to change the press release), the subsequent reprisal indicates that these same people questioned my commitment to Secretarial intentions to support the Klamath River dam removal. This Secretarial decision (due March 31, 2012) is reported to have a cost to the public (taxpayers and ratepayers) in excess of $1B, so a poor decision would result in gross waste of funds.

Following my disclosure, I faced systematic reprisal that enacted a 1-year probationary period to issue threats of termination, gave a low performance rating, denied travel, denied training and executive development, denied mentoring, and terminated my position. This period of reprisal demonstrates a pattern of hindering and not being supportive or honest about the scientific integrity process; the subsequent reprisal shows intentional actions that directly compromise 305 DM 3, and therefore constitutes a violation of rules and regulations. Finally, the expectation for employees to compromise scientific integrity in support of Departmental mission and goals, and to engage in systematic reprisal when an employee question's the Department's scientific integrity is clearly an abuse of authority.

a. Person(s) alleged to have committed misconduct:
    i. Mr. Adam Fletcher, *Department of the Interior, Press Secretary*
    ii. Ms. Kira Finkler, *Deputy Commissioner for External and Intergovernmental Affairs, Bureau of Reclamation*

By submitting these allegations, I request that the Department of the Interior Scientific Integrity Officer conduct a review of the allegations and submitted materials to determine whether an inquiry is warranted. To assist in this process, these allegations are more fully explained and justified below.

BACKGROUND:

Klamath River Secretarial Determination (from http://klamathrestoration.gov):

The Klamath River Basin covers over 12,000 square miles in southern Oregon and northern California and contains many natural and economic resources related to fisheries, farming, ranching, timber, mining and recreation. Each of these resources and opportunities has economically sustained communities throughout the basin for many decades. The Klamath Basin is also home to six federally recognized Indian tribes who have depended on many of these same natural resources for thousands of years to support their way of life and spiritual wellbeing. Natural resources in the basin, including clean water, abundant and reliable supplies of fish, and terrestrial plants and animals are central to their cultural identity.

The construction of PacifiCorp's hydroelectric dams on the Klamath River combined with the development of irrigated agriculture, both beginning in the early 1900s, contributed to declines in fisheries and water quality as well as to detrimental impacts to tribal resources and culture throughout the Klamath Basin. Crises in agricultural water availability and fish populations, combined with challenges and uncertainties involved in obtaining a new long-term Federal Energy Regulatory Commission (FERC) license for

PacifiCorp's Klamath Hydroelectric Project 2082 (inclusive of the J.C. Boyle, Copco 1, Copco 2, and Iron Gate dams) led willing basin stakeholders to come to agreement on the Klamath Hydroelectric Settlement Agreement (KHSA) and the Klamath Basin Restoration Agreement (KBRA).

The KHSA is a multi-party agreement that, if fully implemented, would result in the removal of the Four Facilities within the Klamath Hydroelectric Project. Signatories of the KHSA, with the exception of the Federal government and PacifiCorp, also signed the KBRA. The Federal government is not able to sign the KBRA until Congress passes Federal legislation authorizing the agreement. The KBRA includes interrelated plans and programs intended to benefit fisheries throughout the basin, water and power users in the upper basin, counties, Indian tribes and basin communities. KBRA fisheries programs include extensive habitat restoration, improvements to water flow and quality, and a fish reintroduction program in the upper basin. Full implementation of the KBRA requires an affirmative Secretarial determination on the removal of the four dams, and will likely cost taxpayers and ratepayers in excess of $1B to implement.

Department of the Interior Scientific Integrity Policy.

The Department's Manual (305 DM 3) defines scientific and scholarly misconduct as:

(1) Fabrication, falsification, or plagiarism in proposing, performing, or reviewing scientific and scholarly activities, or in the products or reporting of the results of these activities. (Federal Policy on Research Misconduct, 65 FR 76260-76264, December 6, 2000.) Misconduct also includes: (a) intentionally circumventing policy that ensures the integrity of science and scholarship, and (b) actions that compromise scientific and scholarly integrity. Scientific and scholarly misconduct does not include honest error or differences of opinion.

(2) Fabrication, falsification, or plagiarism in the application of scientific and scholarly information to decision making, policy formulation, or preparation of materials for public information activities.

(3) A finding of scientific and scholarly misconduct requires that:

a. There be a significant departure from accepted practices of the relevant scientific and scholarly community.

b. The misconduct be committed intentionally, knowingly, or recklessly

c. The allegation be proven by a preponderance of evidence.

305 DM 3 indicates that scientific misconduct must be an intentional and significant departure from accepted practices of scientific community that is proven by evidence, such as intentional fabrication, falsification or plagiarism, or actions that intentionally circumvent or compromise the policy.

ALLEGATION I: *Intentional Falsification:* Motivated by Secretary Salazar's publically stated intention to issue a Secretarial determination in favor of removing four dams on the Klamath River (due on March 31, 2012), the Department of the Interior has likely followed a course of action to construct such an outcome. In 2009, Secretary Salazar stated that the proposal to remove the Klamath River dams "*will not fail*", and on September 19, 2011, Ms. Kira Finkler, *Deputy Commissioner for External and Intergovernmental Affairs,* told me directly that "*the Secretary wants to remove those dams*". This intention has motivated Department of the Interior officials to "spin" or incompletely report the scientific results towards a more optimistic scientific story that supports dam removal.

An example of this intentional falsification is contained in the September 21, 2011 "*Summary of Key Conclusions: Draft EIS/EIR and Related Scientific/Technical Reports*" [attachment 1]. This summary intentionally distorts and generally presents a biased view of the Klamath River dam removal benefits. It intends to present only the positive, without the uncertainties or negatives. This is ascertained by

comparing the *summary* with the underlying Klamath River Expert Panel Reports compiled by Atkins (see http://klamathrestoration.gov).

- Climate changes are projected to play an important role in fish recovery (as stated by several of the Atkins expert panel reports), but climate is never mentioned in the *summary*. This is especially important for the projected impact of temperature increases on salmon recovery.
- The *summary* section on Chinook Salmon recovery projects an 81.4 percent recovery, but says nothing about the nine contingencies summarized in the June 13, 2011, *Klamath River Expert Panel Final Report: Scientific Assessment of Two Dam Removal Alternatives on Chinook Salmon* report that could completely negate this projected recovery: Upper Klamath Lake (UKL) and Keno Reservoir (KR) water quality issues, reduction in disease, enabling free migration to the upper basin, hatchery salmon do not overwhelm spawning grounds, predation is sufficiently low, climate change, small reductions in fall flows, and no long-term dam removal impacts. Neglecting to report on these contingencies provides the public and the Secretary with a falsified and incomplete scientific summary.
- The *summary* states that "Coho salmon reclaim 68 miles of habitat", but says nothing about the April 25, 2011 statement in the *Klamath River Expert Panel Final Report: Scientific Assessment of Two Dam Removal Alternatives on Coho Salmon and Steelhead* that "the difference between the Proposed Action and Current Conditions is expected to be small, especially in the short term (0-10 years after dam removal)." By omitting this additional information, and only reporting the positive, the summary distorts and falsifies the science.
- The *summary* states that dam removal will likely reduce salmon disease, but does not properly state its uncertainty. Whereas the June 12, 2011 *Klamath River Expert Panel Final Report: Scientific Assessment of Two Dam Removal Alternatives on Chinook Salmon report states* "Although several aspects of the Proposed Action could lead to a reduction in disease-related mortality, uncertainty about these aspects is very high".
- The *summary* also spins an optimistic outlook for Steelhead trout, providing access to 420 miles of historical habitat. However, the April 25, 2011 *Klamath River Expert Panel Final Report: Scientific Assessment of Two Dam Removal Alternatives on Coho Salmon and Steelhead* states that this success would be dependent on effective implementation of the proposed and related actions [e.g.Total Maximum Daily Load (TMDL)]; whereas ineffective implementation would result in no detectable response.

Several Bureau of Reclamation employees agreed with this assessment of the *summary* and associated draft press release [attachment 2]:

1) Mr. Keith Schultz, *Fisheries Chief, Reclamation Klamath Office*: Supporting message attached [attachment 4].
2) Mr. Pedro "Pete" Lucero, *Public Affairs Chief , Reclamation Mid-Pacific Region:* Verbally agreed during September 15, 2011 phone call with bias in the science summary.
3) Mr. Daniel DuBray, *Chief of Public Affairs, Reclamation:* Stated that bias issues were above his pay-grade (September 15, 2011).
4) Mr. David Gore, *Mid-Pacific Region Asst. Regional Director for Technical Services:* Verbally expressed concerns about the integrity of Klamath Secretarial Determination science, agreed that process was biased, and was concerned that the Solicitors Office (Mr. Bezdek) was so heavily involved in writing the reports (October 12, 2011).

Other examples of science integrity issues provided by third parties are provided in attached documents. These examples should also be considered when evaluating the scientific integrity of the Klamath River dam removal Secretarial decision process.

1) February 7, 2012 Siskiyou County notice of intent to file suit [attachment 5].
2) January 31, 2012 Siskiyou County comments on report [attachment 6].
3) July 12, 2011 Siskiyou County KBRA and KHSA letter [attachment 7].
4) November 11, 2011 Letter from Tom Connick [attachment 28].
5) July 21, 2011 Science, Secrecy and Salmon Restoration [attachment 29].
6) December 27, 2011 *Klamath dams: County's comments in* by John Bowman, Siskiyou Daily News, December 27, 2011 [attachment 30].

ALLEGATION II: *Intentionally circumventing policy that ensures the integrity of science and scholarship, and actions that compromise scientific and scholarly integrity.*

305 DM 3 establishes a scientific code of conduct (section 3.7). Specifically, for all Departmental employees, volunteers, contractors, cooperators, partners, permittees, leasees and grantees, the *code* requires *communication of the results of scientific and scholarly activities clearly, honestly, objectively, thoroughly, accurately, and in a timely manner* (3.7.A.2), *not intentionally hindering the scientific and scholarly activities of others* (3.7.A.6), and *clearly differentiating among facts, personal opinions, assumptions, hypotheses, and professional judgment in reporting the results of scientific and scholarly activities and characterizing associated uncertainties in using those results for decision making, and in representing those results to other scientists, decision makers, and the public* (3.7.A.7). Additionally for scientists and scholars, the *code* requires *providing constructive, objective, and professionally valid peer review of the work of others, free of any personal or professional jealousy, competition, non-scientific disagreement, or conflict of interest* (3.7.B.6). And finally, for decision makers, the *code* requires *supporting the scientific and scholarly activities of others and not to engage in dishonesty, fraud, misrepresentation, coercive manipulation, censorship, or other misconduct that alters the content, veracity, or meaning or that may affect the planning, conduct, reporting, or application of scientific and scholarly activities* (3.7.C.1), and to *adhere to appropriate standards for reporting, documenting and applying results of scientific and scholarly activities used in decision making* (3.7.C.3).

On September 15, 2011, I expressed concern via written disclosure relating to the scientific integrity of a draft press release on the draft environmental analysis for removing four Klamath River dams, and via verbal disclosure about the integrity of the larger Klamath River dam removal Secretarial determination process. My disclosure was never directly addressed, and supervisors have enacted and used 1-year probationary status to enact reprisal culminating in the termination of my employment (effective February 24, 2011). The details leading to the termination show a pattern of hindering and not being supportive or honest about the scientific integrity process; the details themselves are not the scientific integrity issue but are rather a case of subsequent reprisal that show intentional actions that compromise the scientific and scholarly integrity *codes* called out above. Below I outline the actual disclosure, and subsequent reprisal.

Disclosure:

On September 14, 2011 I was asked to review a draft Department of the Interior press release titled: *Studies Show Removing Klamath Dams Could Add Thousands of Jobs and Boost Dwindling Salmon Runs Draft Environmental Analysis also Released, Public Comment Period Opens* [attachment 2]. The draft press release was casually given to me by Ms. Nell Zeitzmann, *Reclamation Public Affairs Officer*, because she had concerns about its science reporting. Reviewing press releases and developing releases is not in my position description [attachment 8], nor is it in my performance elements [attachment 9], and I am not in the public affairs office. However, I had visited Reclamation's Klamath Office and toured the dams considered for removal in late June 2011, and I was relatively familiar with the available scientific documents, so I felt that I could provide a constructive review.

My initial disclosure [attachment 10] was provided to Ms. Nell Zeitzmann on the morning of September 15, 2011. Ms. Zeitzmann brought my initial disclosure to the attention of Mr. Daniel DuBray, *Reclamation Chief of Public Affairs,* who referred us to Mr. Adam Fletcher, Press Secretary, *Department of the Interior.* Ms. Zietzmann and I met with Mr. Fletcher in person to relay my initial disclosure. Mr. Fletcher asked for a hardcopy of my disclosure, and specifically asked for it to not be emailed to him. Mr. Fletcher also referred us to Mr. John Bezdek, *Assistant Solicitor, Department of the Interior*, who was reportedly also responsible for drafting the press release. Ms. Zietzmann and I then sought out Mr. Bezdek, who was out of the office, so we were referred to and able to convey the initial disclosure to Mr. Carter Brown, *Attorney/Advisor, Department of the Interior.* Being the Department Press Secretary, and a member of the press release author team, Mr. Fletcher and Mr. Brown clearly had authority to act on the disclosure.

Following these meetings on the morning of September 15, 2011, I developed the full written disclosure, and confirmed the information by studying the expert panel reviews available from http://klamathrestoration.gov. I also contacted a number of experts in Reclamation's Klamath Area Office via Email for confirmation of the bias issue. I received verbal confirmation of the bias issue from Mr. Pedro "Pete" Lucero, *Public Affairs Chief, Reclamation Mid-Pacific Region*, during a September 15, 2011 phone conversation. Based on this information gathering, on the afternoon of September 15, 2011, I provided hardcopies of my final written disclosure to Mr. Fletcher and Mr. Carter, and emailed the same disclosure information to my supervisor, Ms. Kira Finkler, *Reclamation Deputy Commissioner for External and Intergovernmental Affairs* (who was out of town) [attachment 10].

Subsequently, I received email confirmation of the positive bias issue from Mr. Keith Schultz, *Fisheries Chief, Reclamation Klamath Office* [attachment 4]. I also later (October 12, 2011) verbally confirmed the bias concern with Mr. David Gore, *Mid-Pacific Region Asst. Regional Director for Technical Services*, who verbally expressed concerns about the integrity of Klamath Secretarial Determination science, agreed that process was biased, and was concerned that the Solicitors Office (Mr. Bezdek) was so heavily involved in writing the reports. On September 19, 2011, I received feedback from Ms. Christine Karas, *Deputy Area Manager, Klamath Basin Area Office, Bureau of Reclamation,* who provided more information on the Secretarial determination process, pointed out that the science of the Klamath River dam removal is not my job, and warned against creating discoverable records [attachment 11].

Finally, as part of my disclosure I also verbally expressed concerns to Ms. Zietzmann (on September 15, 2011), Ms. Finkler (On September 19, 2011) and Mr. Gore (on October 12, 2011) about the integrity of the larger Klamath River dam removal Secretarial determination process. I was concerned that if the department was summarizing the science in a biased manner, that that same bias may infuse the March 2012 Klamath River dam removal Secretarial determination. Further, I stated that I was not for or against the Secretarial determination outcome, but rather was concerned that the science be reported accurately

with critical uncertainties and caveats, so that the Secretarial determination can be made without scientific bias. This Klamath dam removal Secretarial determination is reported to have a cost to the public (taxpayers and ratepayers) in excess of $1B, so a misinformed or premeditated decision could be a gross waste of funds.

Direct Response to Disclosure:

I received no direct response or follow-up on my disclosure from Mr. Fletcher or Mr. Carter. However, the tone and bias of the final press release scientific reporting was improved, and the title was changed [attachments 1, 2, and 3]. My specific disclosure comments, which primarily addressed issues with the *Attachment: Summary of the major findings and a schedule for public hearings*, were not addressed in the final release.

When my supervisor, Ms. Finkler, returned to the office on September 19, 2011, I discussed the issue with her, and she expressed concern that I chose to document the disclosure via Email. She cited concerns about creating discoverable records that could be subject to FOIA for this contentious issue, and pointed out to me that that "*the Secretary wants to remove those dams*". In subsequent discussions with Ms. Finkler on this issue, she told me that she thought the press release and related materials were unbiased, but she also conceded that she had not reviewed the underlying documents, including the expert panel reports.

Reprisal for Disclosure:

Following my disclosure related to the Klamath Dam Press release [attachment 10], I faced systematic reprisal on several fronts. These include, enacting and using a 1-year probationary period to issue threats of termination, issuing a low performance rating, denying travel, denying training and executive development, denying mentoring, and termination of my position.

Performance Appraisal: On October 27, 2011, my supervisor, Ms. Finkler, presented me with a minimally successful performance rating. She invited Mr. David Murillo, Reclamation *Deputy Commissioner for Operations* to the meeting as a witness. Areas identified as being below fully successful were as follows [attachment 12]:

1) *Needs to pay closer attention to detail when submitting a written product. For example, he submitted a memo to the Commissioner that still was labeled "draft" and had no date on it. He also needs to work on his writing - he needs to take the time to review the substance of his written products more carefully, organize information in a logical way and make the final product easy to read.*
2) *Needs to make sure he responds in a timely way to requests from me and follows directions.*
3) *Needs to work on contributing to a positive workplace that supports the organization's missions and goals.*
4) *Needs to better engage in strategic planning, for example, he needs to proactively suggest ways he can add value to various priorities rather than waiting for Instructions.*
5) *Needs to work on using sound judgment to make effective decisions, for example, he should not assume, and take action on such assumption, that his input has been ignored prior to knowing the final decision.*

The review involved extensive discussion of my September 15, 2011 disclosure, and was clearly the subject of performance items 2, 3 and 5. On point 2) Ms. Finkler felt that I did not follow Mr. Fletcher's directions (to not send him my disclosure in Email), when I chose to Email the disclosure to Ms. Finkler. I had intentionally decided to Email the disclosure to Ms. Finkler to make sure that the situation was properly documented and transparent. On point 3), Ms. Finkler felt that my disclosure actions were not in support of the organization's mission and goals (i.e. Secretary Salazar's desire to remove the four Klamath River dams). Also, she felt that my disclosure did not contribute to a positive workplace and showed that I was

not a team player. Finally, she included point 5), because she thought making the disclosure was a poor decision and that by communicating it so broadly I was making an assumption that it was being ignored, when in fact I was simply trying to make sure it was in the hands of someone who could act on it.

Finally, during the review she gave me the first indication that I was on a 1-year probation period, by presenting me with a SF-50, revised to reflect the probationary period [attachment 14].

Probation: Neither my offer letter or my original SF-50 mentioned a 1-year probationary period [attachments 13 and 14]. Due to my previous civil service at the USGS (3 years) and NASA (8 years), I have lifetime reinstatement eligibility based on acquired career tenure by completing 3 years of substantially continuous credible service [attachment 16]. None-the-less, a revision to put a probationary period in place was initiated on September 29, 2011 [attachment 15], which is closely coincident with my September 15, 2011 disclosure. Therefore, I submit that here is adequate evidence that my disclosure prompted my supervisor, Ms. Finkler, to start proceedings toward my eventual termination by enacting and taking advantage of the 1-year probation period. Essentially, Ms. Finkler thought that my disclosure indicated an unwillingness to support Departmental missions and goals, so she enacted and used the 1-year probationary period as reprisal for my disclosure, with the intent to terminate my employment.

Letter of concern: On November 10, 2011, I received a "letter of concern during probationary period" [attachment 17] from Ms. Finkler, concerning an incident on November 3, 2011. The incident involved an Email message [attachment 18] that I forwarded to Mr. David Hayes, *Deputy Secretary of the Department of the Interior*. I forwarded this message as instructed by Ms. Devon Ryan, *Association of Fish and Wildlife Agencies* [attachment 19]. Ms. Finkler believed that an October 28, 2011 request she had made to discuss departmental coordination on the same topic overrode Ms. Ryan's instructions [attachment 20]. I did not see a conflict between these two actions, and subsequently never heard that Mr. Hayes was upset that he received the information from me. On November 3, 2011, Ms. Finkler told me verbally that it was inappropriate for me to contact David Hayes directly, and that she does not even take that liberty. This is an unwritten rule for which I did not receive training or mentoring.

The letter references "previous examples (discussed during your performance review)", which directly refers to the September 15, 2011 disclosure. In fact, when Ms. Finkler presented the letter, she said she had been planning to write a letter of concern regarding the September 15, 2011 disclosure, but she decided to focus on this second incident instead. The letter goes on to make a direct threat of termination and provides an offer of assistance (these topics are discussed below).

The letter of concern grossly exaggerates a minor incident that can easily be attributed to my short tenure and lack of knowledge or training on the "unwritten rules". The letter is clearly aimed at paving the way to the termination of my position, and can be directly linked back to the September 15, 2011 disclosure.

Travel: My position as Reclamation's Science Advisor requires frequent interaction with scientists, stakeholders, partners and managers. So, travel is critical to the success of this position. The original advertisement for the position stated that the position required a 25% travel commitment.

The date of my disclosure (September 15, 2011) marked a distinct change in my travel. Between my start date (April 11, 2011) and the disclosure (September 15, 2011), I traveled 42 out of 158 days (26%). Between the disclosure (September 15, 2011) and the termination date (February 24, 2012), I traveled 7 out of 163 days (4%). Prior to the disclosure, I did not have any travel requests denied, but afterwards, all but the most essential travel were denied [attachment 21], which limited my ability to do my job.

It is quite clear that at the time of the disclosure, my supervisor decided to restrict access to travel, in an apparent attempt to reduce my effectiveness, which would further her goal of using the probationary period to terminate my position.

Training: On November 29, 2011 I finalized a standard Executive Professional Development plan [attachment 22], which was focused on the learning and improvement goals outlined in my performance review [attachment 12]. This plan was carefully developed in close coordination with Ms. Norma Martinez, *Reclamation's Learning Officer.* Ms. Finkler signed the plan without even reading or discussing its details. I presented a plan for implementing this training to Ms. Finkler on January 11 [attachment 23], which she said she would review later, but then disapproved at a subsequent meeting, citing budget concerns. By denying training in the very areas that were cited for needing improvement in my performance plan, Ms. Finkler further undermined my success. This action further illustrates that Ms. Finkler did not intend to give me an opportunity for improvement, having decided at the time of disclosure to proceed towards termination.

Mentoring: Based on the establishment of a probationary period for my position on September 29, 2011 [attachment 15], and Ms. Finkler's offer of "*assistance which will better enable you to meet the requirements of the position*" in the November 10, 2011 letter of concern [attachment 17], on November 10, 2011, I requested that Ms. Finkler provide me written guidance on how she would evaluate success in my probationary period. Ms. Finkler indicated that she had given me all the guidance I needed in the letter of concern. In summary, the letter of concern essentially says that *one more incident of using poor judgment or failing to listen and follow directions will result in termination during the probationary period.*

Between the November 10, 2011 and January 24, 2012, I met with Ms. Finkler seven times at regularly scheduled weekly check-in meetings (11/15/11, 11/23/11, 11/29/11, 12/6/11, 1/11/12, 1/18/12, and 1/24/12). At each meeting I asked Ms. Finkler how I was performing, and each time she said "you are doing OK". I also asked at each meeting how I can improve, and she always replied that she could not think of anything.

Further, to better engage in strategic planning, and proactively suggest ways that I could add value to various priorities (as pointed out in my performance review), I presented Ms. Finkler with seven proposals ranging from ways to engage in California Water [attachment 24] to FY14 budget proposals [attachment 25]. Ms. Finkler took the proposals, but never offered discussion, feedback or decisions to proceed. At a meeting in early November 2011, she told me that the "*ball was in her court*" with respect to the California Water proposal [attachment 24], and later in November 2011 she told me that she did not trust me to act on the California water ideas.

It is clear that since the time of the disclosure (September 15, 2011), Ms. Finkler's intention has been to use my probation status to terminate my position. She has not offered genuine mentoring or guidance, and has not made decisions regarding my proactive strategic planning suggestions.

Termination: On February 8, 2012, Ms. Finkler informed me that my expertise and skills were not a good match for the science advisor position [attachment 26], and gave me until February 10, 2012 to resign or be terminated. There was no specific incident sited for the action, and the termination did not result from *using poor judgment or failing to listen and follow directions*, as was her guidance in the letter of concern [attachment 17]. On February 10, 2012, I decided to let the position be terminated because I firmly believe the evidence points to it being the direct result and the ultimate reprisal for the September 15, 2011 disclosure. The timing of the termination, being just one month before the Klamath Secretarial Determination, suggests that my supervisors did not want me included in the decision process; for fear that I would make another disclosure that does not support the Department's goal to remove the dams.

After receiving the termination notice on February 8, 2012, I contacted Ms. Laurie Larson-Jackson, *Associate Inspector General for Whistleblower Protection.* I was subsequently interviewed by Mr. Steven Futrowsky, *OIG Senior Investigator*, and Mr. Gregory Gransback, *OIG Investigator.* Ms. Larson-Jackson thought that I had a reasonable complaint, and encouraged me to contact Ms. Kira Finkler to negotiate a solution. On February 10, 2011, I met with Ms. Finkler and Mr. Murrillo to offer such a discussion. Mr. Murillo indicated that they would discuss my offer to find a solution with the Department and get back to me the following week. I contacted Ms. Finkler via Email on 2/14/2012, and 2/21/2012 asking for a phone discussion. Ms. Finkler responded on 2/14/2012 asking for clarification of what I meant by "negotiate a solution", to which I responded with some options to find a positive outcome [attachment 27]. Having not heard from Ms. Finkler since 2/14/2012, it is clear that she is not interested in mitigation.

Summary of Allegation II:

305 DM 3 specifically calls all Department employees to *communicate the results of scientific and scholarly activities clearly, honestly, objectively, thoroughly, accurately, and in a timely manner*, to *not intentionally hinder the scientific and scholarly activities of others, and* to *clearly differentiating among facts, personal opinions, assumptions, hypotheses, and professional judgment in reporting the results of scientific and scholarly activities and characterizing associated uncertainties in using those results for decision making, and in representing those results to other scientists, decision makers, and the public.*

On September 15, 2011, I expressed concern via written disclosure relating to the scientific integrity of a draft press release on the draft environmental analysis for removing four Klamath River dams, and via verbal disclosure about the integrity of the larger Klamath River dam removal Secretarial determination process. My disclosure was clearly made to people who had authority to fix the press release (Department Press Secretary, and Department Solicitor's Office), and people who had influence on the Secretarial decision process (Department Solicitor's Office and Reclamation Deputy Commissioner). Even though some changes were in the final press release (showing I had made the disclosure to people with the authority to change the press release), the subsequent reprisal indicates that these same people questioned my commitment to Secretarial intentions to support the Klamath River dam removal. This Secretarial decision (due March 31, 2012) is reported to have a cost to the public (taxpayers and ratepayers) in excess of $1B, so a poor decision would result in gross waste of funds.

Following my disclosure, I faced systematic reprisal that used my 1-year probationary period to issue threats of termination, giving a low performance rating, denying travel, denying training and executive development, denying mentoring, and terminating my position. This period of reprisal demonstrates a pattern of hindering and not being supportive or honest about the scientific integrity process; the subsequent reprisal shows intentional actions that directly compromise 305 DM 3, and therefore constitutes the violation of rules and regulations. Finally, the expectation for employees to compromise scientific integrity in support of Departmental mission and goals, and to engage in systematic reprisal when an employee question's the Department's scientific integrity is clearly an abuse of authority.

CONFLICT OF INTEREST STATEMENT:

305 DM 3 requires all accusers to declare any conflicts of interest that may be inherent in their submissions. Conflict of interest exists when a person has ties to activities that could inappropriately influence his or her judgment, whether or not judgment is in fact affected. Financial relationships with industry, for example, through employment, consultancies, stock ownership, honoraria, expert testimony, either directly or through immediate family, are usually considered to be the most important conflicts of

interest. However, conflicts can occur for other reasons, such as personal relationships, academic competition, and intellectual passion.

I attest that I have no fiduciary ties or conflicts associated with the Klamath River Secretarial decision process. I do not have any financial relationships with Klamath River associated industry, employment, consultancies, stock ownership, honoraria, expert testimony, either directly or through immediate family. I am not an author of any reports or the recipient of any research support associated with the Klamath River. However, I do have personal impact (loss of job) associated with accusation II, but have nothing to directly gain or lose from the potential result of this accusation. I also plan to submit an appeal for whistleblower protection with the Merit System Protection Board (MSPB), and with the Office of Special Council (OSC). My motivation for submitting this allegation is to uphold the principles of scientific integrity and its code of conduct, as is my responsibility as a practicing research scientist.

Cordially,



Dr. Paul R. Houser
Science Advisor & Scientific Integrity Officer, Bureau of Reclamation, Washington D.C.
Associate Professor, George Mason University, Fairfax, VA

HUGE SAVINGS ON

UPDATED: Ousted scientist claims Salazar 'spun' Klamath dam removal reports

By Ryan Sabalow
Posted February 28, 2012 at 2:23 p.m., updated February 28, 2012 at 3:48 p.m.

A federal scientific integrity adviser studying dam removal on the Klamath River has filed a whistleblower complaint saying he was fired from his job after he began questioning top officials "spinning" the benefits of removing the dam while downplaying the negatives of the project.

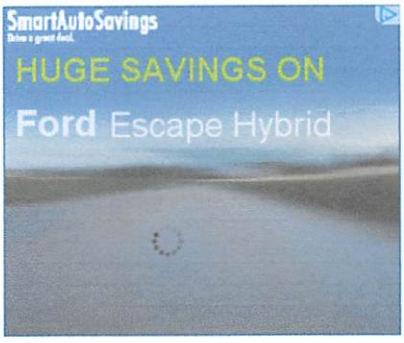
"The bottom line is they need to be honest about the science and the decision making," Paul R. Houser, an associate hydrology professor at George Mason University, told the Record Searchlight today in his first remarks to the media about his whistleblower complaint.

Houser's complaint, filed last week with Department of the Interior's Office of Executive Secretariat and Regulatory Affairs, is already having a ripple effect in the contentious debate over removing the four dams, three of which are in Siskiyou County.

County Supervisor Jim Cook, who traveled to Washington, D.C. this week to lobby federal officials against dam removal, said today the complaint is currently being investigated by staff members of north state U.S. Reps. Wally Herger, R-Chico and Tom McClintock, R-Fair Oaks. A number of House committees have expressed interest as well, Cook said.

Supervisors and other dam-removal opponents have complained about the scientific integrity of the process. The supervisors already have threatened to sue, saying Interior Secretary Ken Salazar isn't being genuine when he says officials are thoroughly reviewing the proposal before making a decision. The supervisors complain dam removal is a foregone conclusion, with federal regulators "cherrypicking" science to support their views.

"It is what our fear has always been," Cook said today in a phone interview from Washington.



Top Community Movers

Today:

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Updated 2/28/2012 at 5:13 p.m. 66 comments

Redding boy, 6, dies in blaze
Published 2/27/2012 at 11:52 p.m. 45 comments

UPDATED: Family of 16-year-old boy injured Friday asking for donations

Department of the Interior spokeswoman Kate Kelly said in a statement officials are reviewing Houser's complaint. The statement didn't address any of the allegations.

"Interior has established a strong scientific, public input, and peer review process that is guiding the studies that will lead to a decision about potential removal of the four Klamath River dams," Kelly said.

Houser said today he was hired last spring to be the Bureau of Reclamation's scientific integrity advisor. His duties included the Klamath dams studies.

He said in September he began growing concerned about federal officials issuing reports and press releases that "intentionally distort" the negatives of the project, something he calls "intentional falsification."

He says there have been a number of scientific studies that showed dam removal comes with some risks or wouldn't be nearly as beneficial to threatened coho salmon habitat as Salazar's staff made it seem.

He said he was told by one of his supervisors that Salazar "wants to remove those dams" and he'd violated "unwritten rules" when he began sending emails to his superiors questioning what appeared to him to be a deliberate spin.

"That was my goal as scientific integrity officer, the kind of obligations I was hired to do," Houser, 41, said today in an interview.

In a lengthy whistleblower report posted on his website, Houser said he was especially concerned the scientific information was being manipulated because removing the dams would cost more than $1 billion, "so a misinformed or premeditated decision could be a gross waste of funds."

He said he was reprimanded, placed on probation and eventually fired this month.

Last week, he filed a whistleblower complaint challenging violations of the government's scientific code of conduct. He said he's not that interested in getting his job back considering what happened to him.

He's since returned to teaching full time at George Mason, he said.

"My motivation is to get the scientific integrity and get the science honored in the process," he said. "... I really hope this doesn't happen to somebody else."

Congressman Herger described Houser's allegations as "troubling concerns."

"An independent entity at Interior should thoroughly and objectively vet these concerns, and the results should be shared openly with the public," Herger said in a statement. "Interior's promotion of sound science in this process is of paramount importance."

Efforts to reach California's two other north state congressmen, McClintock and Mike Thompson, D-St. Helena weren't immediately successful this afternoon.

Houser's allegations come as Salazar announced Monday that he was putting off making a decision on dynamiting the Klamath River dams because Congress has not yet given him the go-ahead.

Updated 2/28/2012 at 12:59 p.m. 74 comments

Decision to withhold private chapel's permit spurs protest
Published 2/28/2012 at 12:00 a.m. 77 comments

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Shasta Dam Boulevard wreck


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Weather

Currently 36-Hour Your Photos



Currently 49°
Light Rain and Windy
Wind: S 36mph

Today 41° 40°

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Calendar

FEB	FEB	MAR	BROWSE
28	29	1	
TUESDAY	WEDNESDAY	THURSDAY	MORE

NVAL members show "An Artistic Venture " 11 a.m.
Carter House Art Gallery

Redding Rambling A's Model A Ford Club of America meeting noon
Holiday Quality Foods - Placer

South Shasta Seniors dancing 7:30 p.m.
Frontier Senior Center

Cimmeron Concert 7:30 p.m.
Frontier Senior Center

Bostonian Tea Party meetings 6 p.m.
See Description

More Events »



Two years ago, a group of federal officials, farmers, fishermen, conservation groups, American Indian tribes, the governors of Oregon and California and the dams' owners signed two agreements that agreed to study taking down the dams.

Under the agreements, Salazar was given until March 31 to make a decision. Salazar said Monday he had no choice but to stall because the agreements call for congressional backing before he makes a decision. A Democrat-backed bill authored this fall that authorizes the removal plus $800 million in environmental restorations hasn't yet made it to a committee hearing in the Republican-controlled House.

S. Craig Tucker, Klamath campaign coordinator for the Karuk Tribe, said Houser's complaint deals with how the science was presented to the public, but Houser doesn't address the merits of some 6,000 pages of scientific evidence federal officials and judges will need to review before making a final decision on whether to tear down the dams.

Tucker said it would be impossible to condense all that scientific data in a simple press briefing in a way that pleases everyone, including dam-removal advocates like him.

"There are a lot of people who weren't happy about what got included either," Tucker said.

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Redding woman dies in collision; Three injured in head-on crash

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Comments » 24 Hide

February 28, 2012 2:34 p.m.
Mark insightful
Suggest removal

Reply to this post

Jimmy_Valmer writes: 4

As a hydrology professor myself, I have to agree with him. You need to respect science. Especially the part about evolution.

Help us to improve the quality of comments. Earn rewards for contributing 'insightful' comments.

February 28, 2012 2:38 p.m.
Mark insightful
Suggest removal

Reply to this post

Jack_Bauer writes: 8

The Obama Administration pursuing an agenda over science? Color me "SHOCKED!"... Not.

This is but the latest example of Obama's comprehensive war against whistleblowers, the biggest such in US history.

February 28, 2012 2:46 p.m.
Mark insightful
Suggest removal

Reply to this post

Raoul_Duke2 writes: 2

Question everything. Let the jellyfish be jellyfish. Bravo Paul R. Houser.

February 28, 2012 2:52 p.m.
Mark insightful
Suggest removal

Reply to this post

Strengthen writes: 5

I have to think there are two sides to this. I understand there are interest groups both supportive and against removing the dams, however it sounds like Houser was just voicing concerns for which he was hired to present. I guess he didn't conform like a good little monkey and go along with the Democratic party line. Well, this is why we have the Whistleblower Law, so now we shall shed some light on the truth and go from there, hopefully.

February 28, 2012 3:09 p.m.
Mark insightful
Suggest removal

Reply to this post

braveheart writes: 2

Due to the lack of specificity in the allegations by Mr. Houser as reported here, I will reserve judgement.

February 28, 2012 3:11 p.m.
Mark insightful
Suggest removal

Reply to this post

CptCaveman writes: 2

After reading Dr.Housers complaint I have to say that the number of contradictions and the scrambling of dates left me somewhat concerned. It also appears that the crux of his complaint is that the Department of Interior decided to use the EIR for most of the press release information instead of the report from the "expert panel". Sounds like sour grapes to me.

http://www.klamathbasincrisis.org/set...

February 28, 2012 3:13 p.m.
Mark insightful
Suggest removal

Reply to this post

CptCaveman writes: 4

in response to Jack_Bauer:

> The Obama Administration pursuing an agenda over science? Color me "SHOCKED!"... Not.
>
> This is but the latest example of Obama's comprehensive war against whistleblowers, the biggest such in US history.

Have you read the entire complaint? Have your read all the EIR's? Have you read all the reports from the expert panels? If not I suggest doing so prior to commenting.

you can start here:

http://www.klamathbasincrisis.org/set...

February 28, 2012 3:19 p.m.
Mark insightful
Suggest removal

Reply to this post

Smapdi writes: 1

But he's a whistleblower. A WHISTLEBLOWER!!
The left loves whistleblowers, right?
He's a HERO! Let's make a movie about him, championing his courage!
Hello? Hello?

February 28, 2012 3:46 p.m.
Mark insightful
Suggest removal

Reply to this post

loveslittledogs writes: 2

Professor Houser may be exactly right—that he was terminated for being a whistleblower. However, because of privacy protections afforded him and all other employees, we will never know what is in his personnel file.

It would be good to know. Perhaps he's done something wrong and being a whistleblower is a way of "spinning" it in a positive light.

I have no knowledge on this either way, just saying it's difficult to make an informed judgement without ALL of the facts.

I'm confident, though, that in spite of a lack of facts, we'll have plenty of folks here who "know" exactly what happened.

February 28, 2012 3:51 p.m.
Mark insightful
Suggest removal

Reply to this post

Good_Ol_Boy writes: 1

The real question: Who has the most at stake/most invested in these dams being removed!

February 28, 2012 3:56 p.m.
Mark insightful
Suggest removal

Reply to this post

Reddingite001 writes: 2

Do we really need to spend nearly two billion taxpayer dollars to eliminate clean hydropower energy generation when we're trillions in debt and the benefits to the fish are not even certain?

February 28, 2012 4:08 p.m.
Mark insightful
Suggest removal

Reply to this post

Vegigardener writes: 2

in response to Smapdi:

> But he's a whistleblower. A WHISTLEBLOWER!!
> The left loves whistleblowers, right?
> He's a HERO! Let's make a movie about him, championing his courage!
> Hello? Hello?

The LEFT only loves a whistleblower if it suits them and there agenda. Where is the ACLU?? Oh that's right! Fighting for this man's right does not help the left.

February 28, 2012 4:23 p.m.
Mark insightful
Suggest removal

Reply to this post

AnonymousArmadilloAgain writes:

WTG Hauser.

Once politicians get hold of scientific data, whether they be Democrats or Republicans, they contort it to confirm and back their agenda. Inevitably, the part of the research that disagreed with the agenda "disappears", and the part that supports it is treated as gospel.

The world is not black and white, people.

Thats what causes disasters.

February 28, 2012 4:49 p.m.
Mark insightful
Suggest removal

Reply to this post

braveheart writes: 1

in response to CptCaveman:

> After reading Dr.Housers complaint I have to say that the number of contradictions and the scrambling of dates left me somewhat concerned. It also appears that the crux of his complaint is that the Department of Interior decided to use the EIR for most of the press release information instead of the report from the "expert panel". Sounds like sour grapes to me.
>
> http://www.klamathbasincrisis.org/set...

Thank you for sharing that link. Mr. Houser's case does indeed look extremely weak.

February 28, 2012 4:56 p.m.
Mark insightful
Suggest removal

Reply to this post

jazavac writes:

in response to braveheart:

> Due to the lack of specificity in the allegations by Mr. Houser as reported here, I will reserve judgement.

Indeed.

I will need further proof that the sky is falling before running about hap-hazardly.

February 28, 2012 4:56 p.m.
Mark insightful
Suggest removal

Reply to this post

Green-Bubba writes: 1

I'm no scientist but it seems very basic. The fish were fine for thousands if not millions of years. Then, people decide that growing potatoes and whatever else was a good idea, so they dammed the rivers and turned a semi-arid region into a green zone. The power companies decided to make some money on all the water power and the final result is the fish are dead or dieing and are close to vanishing from the earth totally. Now we need a study? I call BS. Tear down the dams! Tell the farmers to go farm somewhere else and tell the power companies to switch to wind or solar. Have some respect for eco-system that makes life possible for all the creatures in the area including the humans.
Extinction is forever. What part of that don't we understand.

February 28, 2012 5:06 p.m.
Mark insightful
Suggest removal

Reply to this post

CptCaveman writes: 2

in response to Green-Bubba:

> I'm no scientist but it seems very basic. The fish were fine for thousands if not millions of years. Then, people decide that growing potatoes and whatever else was a good idea, so they dammed the rivers and turned a semi-arid region into a green zone. The power companies decided to make some money on all the water power and the final result is the fish are dead or dieing and are close to vanishing from the earth totally. Now we need a study? I call BS. Tear down the dams! Tell the farmers to go farm somewhere else and tell the power companies to switch to wind or solar. Have some respect for eco-system that makes life possible for all the creatures in the area including the humans.
> Extinction is forever. What part of that don't we understand.

While it is true that part of the problem with Klamath River water quality is related to irrigation in the upper drainage, the removal of the dams on the lower river will have not effect on that water usage. The four dams in question; Iron Gate, Copco 1, Copco 2 and JC Boyle are not used for irrigation.
That said, one of the key benefits with dam removal are the springs under what is now the JC Boyle reach which historically provided mid-summer refuge for smolt and returning adults. My research indicates that these springs historically provided 250 CFS of 48F water to the system year-round, but now have been slowed due to siltation and the effects of the dams.

February 28, 2012 5:22 p.m.
Mark insightful
Suggest removal

Reply to this post

quercus writes:

How many times have we heard such comments as, "we made our decision based on the science"?...spoken as if science is just one, irrifutable thing. It's commonly heard in discussions with regard to climate change, endangered species, forest management, and many other topics. The truth is science is not just one thing that all can agree on. Scientists have agendas too and many examples can be found of them manipulating, or even contriving false evidence to support their agendas. So the next time you hear someone make reference the "the science", think about that critically...they may just be trying to end the conversation and nullify your valid point of view.

February 28, 2012 5:35 p.m.
Mark insightful
Suggest removal

Reply to this post

RidgeRunner writes: 1

I am Shocked, I tell you, Shocked !!

February 28, 2012 6:02 p.m.
Mark insightful
Suggest removal

Reply to this post

easymoney writes: 1

in response to RidgeRunner:

> I am Shocked, I tell you, Shocked !!

I join u in ur shockness. To think our Dear Leaders appointees would try and hide or change facts is beyond belief. It may take a little time for the truth to come out. (did all the reports on Kennedy's assassination every get released ?) And I am sure it is just a matter of Holder looking at his notes before we know

about Fast and Furious. The full report on the missing bail out funds will surly be found shortly . I'm sure.....gotta go feed the dog.

February 28, 2012 6:06 p.m.
Mark insightful
Suggest removal

Reply to this post

JustThis writes:

Good story. Glad there are wistleblower protections for this man. It is important for both sides to protect the process. This guy may well have a case.

I like that we have this process in our laws. I hope the facts come out in this case.

February 28, 2012 6:26 p.m.
Mark insightful
Suggest removal

Reply to this post

David0000 writes:

Almost as good as the right "cherry picking" the science behind global weather change?

February 28, 2012 6:33 p.m.
Mark insightful
Suggest removal

Reply to this post

David0000 writes:

in response to Jack_Bauer:

> The Obama Administration pursuing an agenda over science? Color me "SHOCKED!"... Not.
>
> This is but the latest example of Obama's comprehensive war against whistleblowers, the biggest such in US history.

The war against ignorance is a hard fought war.

Santorum just said he doesn't want us to be college educated,..... because his religion goes with bare foot ignorance.

Another Obama war against religion, right?

February 28, 2012 6:41 p.m.
Mark insightful
Suggest removal

Reply to this post

David0000 writes: 1

in response to quercus:

> How many times have we heard such comments as, "we made our decision based on the science"?...spoken as if science is just one, irrifutable thing. It's commonly heard in discussions with regard to climate change, endangered species, forest management, and many other topics. The truth is science is not just one thing that all can agree on. Scientists have agendas too and many examples can be found of them manipulating, or even contriving false evidence to support their agendas. So the next time you hear someone make reference the "the science", think about that critically...they may just be trying to end the conversation and nullify your valid point of view.

Science has no agenda, just ignorance on one side and reality on the other.

And then politicians steal it for their own games.

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DATE: February 24, 2012

TO: Office of the Executive Secretariat and Regulatory Affairs
Department of the Interior
1849 C Street, N.W.
Mail Stop 7328
Washington, DC 20240

FROM: Dr. Paul R. Houser
Science Advisor, Bureau of Reclamation, Washington D.C.
Scientific Integrity Officer, Bureau of Reclamation, Washington D.C.
1849 C Street NW
Washington DC 20240-0001
and
Professor, George Mason University
240 Research Hall, MSN: 6C3
4400 University Dr. Fairfax, VA 22030
(301)-613-3782
prhouser@gmail.com

SUBJECT: Allegation of scientific and scholarly misconduct and reprisal for a disclosure concerning the biased summarization of key scientific conclusions for the Klamath River dam removal Secretarial determination process.

SUMMARY: With this letter, I submit two allegations of scientific and scholarly misconduct and reprisal intended to compromise scientific integrity for a disclosure concerning the Department of the Interior's biased (falsification) summarization of key scientific conclusions for the Klamath River dam removal Secretarial determination process. These allegations violate different parts of the 305 DM 3 Scientific Integrity Policy, but are being submitted together, as their possible motivation and topics are related. In my role as Science Advisor and Scientific Integrity Officer for the Bureau of Reclamation, I provide my comments at various points during this presentation.

1. *Intentional Falsification:* Motivated by Secretary Salazar's publically stated 2009 intention to issue a Secretarial determination in favor of removing four dams on the Klamath River (due on March 31, 2012), the Department of the Interior has followed a course of action to construct support for such an outcome. An example of this intentional biased (falsification) reporting of scientific results is contained in the September 21, 2011 "*Summary of Key Conclusions: Draft EIS/EIR and Related Scientific/Technical Reports*" [attachment 1]. Other examples provided by third parties are provided in the attached documents.

    a. Person(s) alleged to have committed misconduct:
        i. Unreported author(s) of report "*Summary of Key Conclusions: Draft EIS/EIR and Related Scientific/Technical Reports*"
        ii. Department of the Interior officials

2) *Intentionally circumventing policy that ensures the integrity of science and scholarship, and actions that compromise scientific and scholarly integrity:* On September 15, 2011, I expressed concern via written disclosure relating to the scientific integrity of a draft press release on the draft environmental analysis for removing four Klamath River dams [attachments 2, 3], and via verbal disclosure about the integrity of the larger Klamath River dam removal Secretarial determination

process. My disclosure was clearly made to people who had authority to fix the press release (*Department Press Secretary, Department Solicitor's Office*), and people who had influence on the Secretarial decision process (*Department Solicitor's Office, Reclamation Deputy Commissioner*). My disclosure was never directly addressed, and supervisors have used my probationary status to enact reprisal for the disclosure culminating in the termination of my employment (effective February 24, 2011).

Even though some changes were in the final press release (showing I had made the disclosure to people with the authority to change the press release), the subsequent reprisal indicates that these same people questioned my commitment to Secretarial intentions to support the Klamath River dam removal. This Secretarial decision (due March 31, 2012) is reported to have a cost to the public (taxpayers and ratepayers) in excess of $1B, so a poor decision would result in gross waste of funds.

Following my disclosure, I faced systematic reprisal that enacted a 1-year probationary period to issue threats of termination, gave a low performance rating, denied travel, denied training and executive development, denied mentoring, and terminated my position. This period of reprisal demonstrates a pattern of hindering and not being supportive or honest about the scientific integrity process; the subsequent reprisal shows intentional actions that directly compromise 305 DM 3, and therefore constitutes a violation of rules and regulations. Finally, the expectation for employees to compromise scientific integrity in support of Departmental mission and goals, and to engage in systematic reprisal when an employee question's the Department's scientific integrity is clearly an abuse of authority.

a. Person(s) alleged to have committed misconduct:
    i. Mr. Adam Fletcher, *Department of the Interior, Press Secretary*
    ii. Ms. Kira Finkler, *Deputy Commissioner for External and Intergovernmental Affairs, Bureau of Reclamation*

By submitting these allegations, I request that the Department of the Interior Scientific Integrity Officer conduct a review of the allegations and submitted materials to determine whether an inquiry is warranted. To assist in this process, these allegations are more fully explained and justified below.

BACKGROUND:

Klamath River Secretarial Determination (from http://klamathrestoration.gov):

The Klamath River Basin covers over 12,000 square miles in southern Oregon and northern California and contains many natural and economic resources related to fisheries, farming, ranching, timber, mining and recreation. Each of these resources and opportunities has economically sustained communities throughout the basin for many decades. The Klamath Basin is also home to six federally recognized Indian tribes who have depended on many of these same natural resources for thousands of years to support their way of life and spiritual wellbeing. Natural resources in the basin, including clean water, abundant and reliable supplies of fish, and terrestrial plants and animals are central to their cultural identity.

The construction of PacifiCorp's hydroelectric dams on the Klamath River combined with the development of irrigated agriculture, both beginning in the early 1900s, contributed to declines in fisheries and water quality as well as to detrimental impacts to tribal resources and culture throughout the Klamath Basin. Crises in agricultural water availability and fish populations, combined with challenges and uncertainties involved in obtaining a new long-term Federal Energy Regulatory Commission (FERC) license for

PacifiCorp's Klamath Hydroelectric Project 2082 (inclusive of the J.C. Boyle, Copco 1, Copco 2, and Iron Gate dams) led willing basin stakeholders to come to agreement on the Klamath Hydroelectric Settlement Agreement (KHSA) and the Klamath Basin Restoration Agreement (KBRA).

The KHSA is a multi-party agreement that, if fully implemented, would result in the removal of the Four Facilities within the Klamath Hydroelectric Project. Signatories of the KHSA, with the exception of the Federal government and PacifiCorp, also signed the KBRA. The Federal government is not able to sign the KBRA until Congress passes Federal legislation authorizing the agreement. The KBRA includes interrelated plans and programs intended to benefit fisheries throughout the basin, water and power users in the upper basin, counties, Indian tribes and basin communities. KBRA fisheries programs include extensive habitat restoration, improvements to water flow and quality, and a fish reintroduction program in the upper basin. Full implementation of the KBRA requires an affirmative Secretarial determination on the removal of the four dams, and will likely cost taxpayers and ratepayers in excess of $1B to implement.

Department of the Interior Scientific Integrity Policy.

The Department's Manual (305 DM 3) defines scientific and scholarly misconduct as:

(1) Fabrication, falsification, or plagiarism in proposing, performing, or reviewing scientific and scholarly activities, or in the products or reporting of the results of these activities. (Federal Policy on Research Misconduct, 65 FR 76260-76264, December 6, 2000.) Misconduct also includes: (a) intentionally circumventing policy that ensures the integrity of science and scholarship, and (b) actions that compromise scientific and scholarly integrity. Scientific and scholarly misconduct does not include honest error or differences of opinion.

(2) Fabrication, falsification, or plagiarism in the application of scientific and scholarly information to decision making, policy formulation, or preparation of materials for public information activities.

(3) A finding of scientific and scholarly misconduct requires that:

a. There be a significant departure from accepted practices of the relevant scientific and scholarly community.

b. The misconduct be committed intentionally, knowingly, or recklessly

c. The allegation be proven by a preponderance of evidence.

305 DM 3 indicates that scientific misconduct must be an intentional and significant departure from accepted practices of scientific community that is proven by evidence, such as intentional fabrication, falsification or plagiarism, or actions that intentionally circumvent or compromise the policy.

ALLEGATION I: *Intentional Falsification:* Motivated by Secretary Salazar's publically stated intention to issue a Secretarial determination in favor of removing four dams on the Klamath River (due on March 31, 2012), the Department of the Interior has likely followed a course of action to construct such an outcome. In 2009, Secretary Salazar stated that the proposal to remove the Klamath River dams "*will not fail*", and on September 19, 2011, Ms. Kira Finkler, *Deputy Commissioner for External and Intergovernmental Affairs,* told me directly that "*the Secretary wants to remove those dams*". This intention has motivated Department of the Interior officials to "spin" or incompletely report the scientific results towards a more optimistic scientific story that supports dam removal.

An example of this intentional falsification is contained in the September 21, 2011 "*Summary of Key Conclusions: Draft EIS/EIR and Related Scientific/Technical Reports*" [attachment 1]. This summary intentionally distorts and generally presents a biased view of the Klamath River dam removal benefits. It intends to present only the positive, without the uncertainties or negatives. This is ascertained by

comparing the *summary* with the underlying Klamath River Expert Panel Reports compiled by Atkins (see http://klamathrestoration.gov).

- Climate changes are projected to play an important role in fish recovery (as stated by several of the Atkins expert panel reports), but climate is never mentioned in the *summary*. This is especially important for the projected impact of temperature increases on salmon recovery.
- The *summary* section on Chinook Salmon recovery projects an 81.4 percent recovery, but says nothing about the nine contingencies summarized in the June 13, 2011, *Klamath River Expert Panel Final Report: Scientific Assessment of Two Dam Removal Alternatives on Chinook Salmon* report that could completely negate this projected recovery: Upper Klamath Lake (UKL) and Keno Reservoir (KR) water quality issues, reduction in disease, enabling free migration to the upper basin, hatchery salmon do not overwhelm spawning grounds, predation is sufficiently low, climate change, small reductions in fall flows, and no long-term dam removal impacts. Neglecting to report on these contingencies provides the public and the Secretary with a falsified and incomplete scientific summary.
- The *summary* states that "Coho salmon reclaim 68 miles of habitat", but says nothing about the April 25, 2011 statement in the *Klamath River Expert Panel Final Report: Scientific Assessment of Two Dam Removal Alternatives on Coho Salmon and Steelhead* that "the difference between the Proposed Action and Current Conditions is expected to be small, especially in the short term (0-10 years after dam removal)." By omitting this additional information, and only reporting the positive, the summary distorts and falsifies the science.
- The *summary* states that dam removal will likely reduce salmon disease, but does not properly state its uncertainty. Whereas the June 12, 2011 *Klamath River Expert Panel Final Report: Scientific Assessment of Two Dam Removal Alternatives on Chinook Salmon report states* "Although several aspects of the Proposed Action could lead to a reduction in disease-related mortality, uncertainty about these aspects is very high".
- The *summary* also spins an optimistic outlook for Steelhead trout, providing access to 420 miles of historical habitat. However, the April 25, 2011 *Klamath River Expert Panel Final Report: Scientific Assessment of Two Dam Removal Alternatives on Coho Salmon and Steelhead* states that this success would be dependent on effective implementation of the proposed and related actions [e.g.Total Maximum Daily Load (TMDL)]; whereas ineffective implementation would result in no detectable response.

Several Bureau of Reclamation employees agreed with this assessment of the *summary* and associated draft press release [attachment 2]:

1) Mr. Keith Schultz, *Fisheries Chief, Reclamation Klamath Office*: Supporting message attached [attachment 4].
2) Mr. Pedro "Pete" Lucero, *Public Affairs Chief , Reclamation Mid-Pacific Region:* Verbally agreed during September 15, 2011 phone call with bias in the science summary.
3) Mr. Daniel DuBray, *Chief of Public Affairs, Reclamation:* Stated that bias issues were above his pay-grade (September 15, 2011).
4) Mr. David Gore, *Mid-Pacific Region Asst. Regional Director for Technical Services:* Verbally expressed concerns about the integrity of Klamath Secretarial Determination science, agreed that process was biased, and was concerned that the Solicitors Office (Mr. Bezdek) was so heavily involved in writing the reports (October 12, 2011).

Other examples of science integrity issues provided by third parties are provided in attached documents. These examples should also be considered when evaluating the scientific integrity of the Klamath River dam removal Secretarial decision process.

1) February 7, 2012 Siskiyou County notice of intent to file suit [attachment 5].
2) January 31, 2012 Siskiyou County comments on report [attachment 6].
3) July 12, 2011 Siskiyou County KBRA and KHSA letter [attachment 7].
4) November 11, 2011 Letter from Tom Connick [attachment 28].
5) July 21, 2011 Science, Secrecy and Salmon Restoration [attachment 29].
6) December 27, 2011 *Klamath dams: County's comments in* by John Bowman, Siskiyou Daily News, December 27, 2011 [attachment 30].

ALLEGATION II: *Intentionally circumventing policy that ensures the integrity of science and scholarship, and actions that compromise scientific and scholarly integrity.*

305 DM 3 establishes a scientific code of conduct (section 3.7). Specifically, for all Departmental employees, volunteers, contractors, cooperators, partners, permittees, leasees and grantees, the *code* requires *communication of the results of scientific and scholarly activities clearly, honestly, objectively, thoroughly, accurately, and in a timely manner* (3.7.A.2), *not intentionally hindering the scientific and scholarly activities of others* (3.7.A.6), and *clearly differentiating among facts, personal opinions, assumptions, hypotheses, and professional judgment in reporting the results of scientific and scholarly activities and characterizing associated uncertainties in using those results for decision making, and in representing those results to other scientists, decision makers, and the public* (3.7.A.7). Additionally for scientists and scholars, the *code* requires *providing constructive, objective, and professionally valid peer review of the work of others, free of any personal or professional jealousy, competition, non-scientific disagreement, or conflict of interest* (3.7.B.6). And finally, for decision makers, the *code* requires *supporting the scientific and scholarly activities of others and not to engage in dishonesty, fraud, misrepresentation, coercive manipulation, censorship, or other misconduct that alters the content, veracity, or meaning or that may affect the planning, conduct, reporting, or application of scientific and scholarly activities* (3.7.C.1), and to *adhere to appropriate standards for reporting, documenting and applying results of scientific and scholarly activities used in decision making* (3.7.C.3).

On September 15, 2011, I expressed concern via written disclosure relating to the scientific integrity of a draft press release on the draft environmental analysis for removing four Klamath River dams, and via verbal disclosure about the integrity of the larger Klamath River dam removal Secretarial determination process. My disclosure was never directly addressed, and supervisors have enacted and used 1-year probationary status to enact reprisal culminating in the termination of my employment (effective February 24, 2011). The details leading to the termination show a pattern of hindering and not being supportive or honest about the scientific integrity process; the details themselves are not the scientific integrity issue but are rather a case of subsequent reprisal that show intentional actions that compromise the scientific and scholarly integrity *codes* called out above. Below I outline the actual disclosure, and subsequent reprisal.

Disclosure:

On September 14, 2011 I was asked to review a draft Department of the Interior press release titled: *Studies Show Removing Klamath Dams Could Add Thousands of Jobs and Boost Dwindling Salmon Runs Draft Environmental Analysis also Released, Public Comment Period Opens* [attachment 2]. The draft press release was casually given to me by Ms. Nell Zeitzmann, *Reclamation Public Affairs Officer*, because she had concerns about its science reporting. Reviewing press releases and developing releases is not in my position description [attachment 8], nor is it in my performance elements [attachment 9], and I am not in the public affairs office. However, I had visited Reclamation's Klamath Office and toured the dams considered for removal in late June 2011, and I was relatively familiar with the available scientific documents, so I felt that I could provide a constructive review.

My initial disclosure [attachment 10] was provided to Ms. Nell Zeitzmann on the morning of September 15, 2011. Ms. Zeitzmann brought my initial disclosure to the attention of Mr. Daniel DuBray, *Reclamation Chief of Public Affairs,* who referred us to Mr. Adam Fletcher, Press Secretary, *Department of the Interior.* Ms. Zietzmann and I met with Mr. Fletcher in person to relay my initial disclosure. Mr. Fletcher asked for a hardcopy of my disclosure, and specifically asked for it to not be emailed to him. Mr. Fletcher also referred us to Mr. John Bezdek, *Assistant Solicitor, Department of the Interior*, who was reportedly also responsible for drafting the press release. Ms. Zietzmann and I then sought out Mr. Bezdek, who was out of the office, so we were referred to and able to convey the initial disclosure to Mr. Carter Brown, *Attorney/Advisor, Department of the Interior.* Being the Department Press Secretary, and a member of the press release author team, Mr. Fletcher and Mr. Brown clearly had authority to act on the disclosure.

Following these meetings on the morning of September 15, 2011, I developed the full written disclosure, and confirmed the information by studying the expert panel reviews available from http://klamathrestoration.gov. I also contacted a number of experts in Reclamation's Klamath Area Office via Email for confirmation of the bias issue. I received verbal confirmation of the bias issue from Mr. Pedro "Pete" Lucero, *Public Affairs Chief, Reclamation Mid-Pacific Region*, during a September 15, 2011 phone conversation. Based on this information gathering, on the afternoon of September 15, 2011, I provided hardcopies of my final written disclosure to Mr. Fletcher and Mr. Carter, and emailed the same disclosure information to my supervisor, Ms. Kira Finkler, *Reclamation Deputy Commissioner for External and Intergovernmental Affairs* (who was out of town) [attachment 10].

Subsequently, I received email confirmation of the positive bias issue from Mr. Keith Schultz, *Fisheries Chief, Reclamation Klamath Office* [attachment 4]. I also later (October 12, 2011) verbally confirmed the bias concern with Mr. David Gore, *Mid-Pacific Region Asst. Regional Director for Technical Services*, who verbally expressed concerns about the integrity of Klamath Secretarial Determination science, agreed that process was biased, and was concerned that the Solicitors Office (Mr. Bezdek) was so heavily involved in writing the reports. On September 19, 2011, I received feedback from Ms. Christine Karas, *Deputy Area Manager, Klamath Basin Area Office, Bureau of Reclamation,* who provided more information on the Secretarial determination process, pointed out that the science of the Klamath River dam removal is not my job, and warned against creating discoverable records [attachment 11].

Finally, as part of my disclosure I also verbally expressed concerns to Ms. Zietzmann (on September 15, 2011), Ms. Finkler (On September 19, 2011) and Mr. Gore (on October 12, 2011) about the integrity of the larger Klamath River dam removal Secretarial determination process. I was concerned that if the department was summarizing the science in a biased manner, that that same bias may infuse the March 2012 Klamath River dam removal Secretarial determination. Further, I stated that I was not for or against the Secretarial determination outcome, but rather was concerned that the science be reported accurately

with critical uncertainties and caveats, so that the Secretarial determination can be made without scientific bias. This Klamath dam removal Secretarial determination is reported to have a cost to the public (taxpayers and ratepayers) in excess of $1B, so a misinformed or premeditated decision could be a gross waste of funds.

Direct Response to Disclosure:

I received no direct response or follow-up on my disclosure from Mr. Fletcher or Mr. Carter. However, the tone and bias of the final press release scientific reporting was improved, and the title was changed [attachments 1, 2, and 3]. My specific disclosure comments, which primarily addressed issues with the *Attachment: Summary of the major findings and a schedule for public hearings*, were not addressed in the final release.

When my supervisor, Ms. Finkler, returned to the office on September 19, 2011, I discussed the issue with her, and she expressed concern that I chose to document the disclosure via Email. She cited concerns about creating discoverable records that could be subject to FOIA for this contentious issue, and pointed out to me that that "*the Secretary wants to remove those dams*". In subsequent discussions with Ms. Finkler on this issue, she told me that she thought the press release and related materials were unbiased, but she also conceded that she had not reviewed the underlying documents, including the expert panel reports.

Reprisal for Disclosure:

Following my disclosure related to the Klamath Dam Press release [attachment 10], I faced systematic reprisal on several fronts. These include, enacting and using a 1-year probationary period to issue threats of termination, issuing a low performance rating, denying travel, denying training and executive development, denying mentoring, and termination of my position.

Performance Appraisal: On October 27, 2011, my supervisor, Ms. Finkler, presented me with a minimally successful performance rating. She invited Mr. David Murillo, Reclamation *Deputy Commissioner for Operations* to the meeting as a witness. Areas identified as being below fully successful were as follows [attachment 12]:

1) *Needs to pay closer attention to detail when submitting a written product. For example, he submitted a memo to the Commissioner that still was labeled "draft" and had no date on it. He also needs to work on his writing - he needs to take the time to review the substance of his written products more carefully, organize information in a logical way and make the final product easy to read.*
2) *Needs to make sure he responds in a timely way to requests from me and follows directions.*
3) *Needs to work on contributing to a positive workplace that supports the organization's missions and goals.*
4) *Needs to better engage in strategic planning, for example, he needs to proactively suggest ways he can add value to various priorities rather than waiting for Instructions.*
5) *Needs to work on using sound judgment to make effective decisions, for example, he should not assume, and take action on such assumption, that his input has been ignored prior to knowing the final decision.*

The review involved extensive discussion of my September 15, 2011 disclosure, and was clearly the subject of performance items 2, 3 and 5. On point 2) Ms. Finkler felt that I did not follow Mr. Fletcher's directions (to not send him my disclosure in Email), when I chose to Email the disclosure to Ms. Finkler. I had intentionally decided to Email the disclosure to Ms. Finkler to make sure that the situation was properly documented and transparent. On point 3), Ms. Finkler felt that my disclosure actions were not in support of the organization's mission and goals (i.e. Secretary Salazar's desire to remove the four Klamath River dams). Also, she felt that my disclosure did not contribute to a positive workplace and showed that I was

not a team player. Finally, she included point 5), because she thought making the disclosure was a poor decision and that by communicating it so broadly I was making an assumption that it was being ignored, when in fact I was simply trying to make sure it was in the hands of someone who could act on it.

Finally, during the review she gave me the first indication that I was on a 1-year probation period, by presenting me with a SF-50, revised to reflect the probationary period [attachment 14].

Probation: Neither my offer letter or my original SF-50 mentioned a 1-year probationary period [attachments 13 and 14]. Due to my previous civil service at the USGS (3 years) and NASA (8 years), I have lifetime reinstatement eligibility based on acquired career tenure by completing 3 years of substantially continuous credible service [attachment 16]. None-the-less, a revision to put a probationary period in place was initiated on September 29, 2011 [attachment 15], which is closely coincident with my September 15, 2011 disclosure. Therefore, I submit that here is adequate evidence that my disclosure prompted my supervisor, Ms. Finkler, to start proceedings toward my eventual termination by enacting and taking advantage of the 1-year probation period. Essentially, Ms. Finkler thought that my disclosure indicated an unwillingness to support Departmental missions and goals, so she enacted and used the 1-year probationary period as reprisal for my disclosure, with the intent to terminate my employment.

Letter of concern: On November 10, 2011, I received a "letter of concern during probationary period" [attachment 17] from Ms. Finkler, concerning an incident on November 3, 2011. The incident involved an Email message [attachment 18] that I forwarded to Mr. David Hayes, *Deputy Secretary of the Department of the Interior.* I forwarded this message as instructed by Ms. Devon Ryan, *Association of Fish and Wildlife Agencies* [attachment 19]. Ms. Finkler believed that an October 28, 2011 request she had made to discuss departmental coordination on the same topic overrode Ms. Ryan's instructions [attachment 20]. I did not see a conflict between these two actions, and subsequently never heard that Mr. Hayes was upset that he received the information from me. On November 3, 2011, Ms. Finkler told me verbally that it was inappropriate for me to contact David Hayes directly, and that she does not even take that liberty. This is an unwritten rule for which I did not receive training or mentoring.

The letter references "previous examples (discussed during your performance review)", which directly refers to the September 15, 2011 disclosure. In fact, when Ms. Finkler presented the letter, she said she had been planning to write a letter of concern regarding the September 15, 2011 disclosure, but she decided to focus on this second incident instead. The letter goes on to make a direct threat of termination and provides an offer of assistance (these topics are discussed below).

The letter of concern grossly exaggerates a minor incident that can easily be attributed to my short tenure and lack of knowledge or training on the "unwritten rules". The letter is clearly aimed at paving the way to the termination of my position, and can be directly linked back to the September 15, 2011 disclosure.

Travel: My position as Reclamation's Science Advisor requires frequent interaction with scientists, stakeholders, partners and managers. So, travel is critical to the success of this position. The original advertisement for the position stated that the position required a 25% travel commitment.

The date of my disclosure (September 15, 2011) marked a distinct change in my travel. Between my start date (April 11, 2011) and the disclosure (September 15, 2011), I traveled 42 out of 158 days (26%). Between the disclosure (September 15, 2011) and the termination date (February 24, 2012), I traveled 7 out of 163 days (4%). Prior to the disclosure, I did not have any travel requests denied, but afterwards, all but the most essential travel were denied [attachment 21], which limited my ability to do my job.

It is quite clear that at the time of the disclosure, my supervisor decided to restrict access to travel, in an apparent attempt to reduce my effectiveness, which would further her goal of using the probationary period to terminate my position.

Training: On November 29, 2011 I finalized a standard Executive Professional Development plan [attachment 22], which was focused on the learning and improvement goals outlined in my performance review [attachment 12]. This plan was carefully developed in close coordination with Ms. Norma Martinez, *Reclamation's Learning Officer*. Ms. Finkler signed the plan without even reading or discussing its details. I presented a plan for implementing this training to Ms. Finkler on January 11 [attachment 23], which she said she would review later, but then disapproved at a subsequent meeting, citing budget concerns. By denying training in the very areas that were cited for needing improvement in my performance plan, Ms. Finkler further undermined my success. This action further illustrates that Ms. Finkler did not intend to give me an opportunity for improvement, having decided at the time of disclosure to proceed towards termination.

Mentoring: Based on the establishment of a probationary period for my position on September 29, 2011 [attachment 15], and Ms. Finkler's offer of "*assistance which will better enable you to meet the requirements of the position*" in the November 10, 2011 letter of concern [attachment 17], on November 10, 2011, I requested that Ms. Finkler provide me written guidance on how she would evaluate success in my probationary period. Ms. Finkler indicated that she had given me all the guidance I needed in the letter of concern. In summary, the letter of concern essentially says that *one more incident of using poor judgment or failing to listen and follow directions will result in termination during the probationary period.*

Between the November 10, 2011 and January 24, 2012, I met with Ms. Finkler seven times at regularly scheduled weekly check-in meetings (11/15/11, 11/23/11, 11/29/11, 12/6/11, 1/11/12, 1/18/12, and 1/24/12). At each meeting I asked Ms. Finkler how I was performing, and each time she said "you are doing OK". I also asked at each meeting how I can improve, and she always replied that she could not think of anything.

Further, to better engage in strategic planning, and proactively suggest ways that I could add value to various priorities (as pointed out in my performance review), I presented Ms. Finkler with seven proposals ranging from ways to engage in California Water [attachment 24] to FY14 budget proposals [attachment 25]. Ms. Finkler took the proposals, but never offered discussion, feedback or decisions to proceed. At a meeting in early November 2011, she told me that the "*ball was in her court*" with respect to the California Water proposal [attachment 24], and later in November 2011 she told me that she did not trust me to act on the California water ideas.

It is clear that since the time of the disclosure (September 15, 2011), Ms. Finkler's intention has been to use my probation status to terminate my position. She has not offered genuine mentoring or guidance, and has not made decisions regarding my proactive strategic planning suggestions.

Termination: On February 8, 2012, Ms. Finkler informed me that my expertise and skills were not a good match for the science advisor position [attachment 26], and gave me until February 10, 2012 to resign or be terminated. There was no specific incident sited for the action, and the termination did not result from *using poor judgment or failing to listen and follow directions*, as was her guidance in the letter of concern [attachment 17]. On February 10, 2012, I decided to let the position be terminated because I firmly believe the evidence points to it being the direct result and the ultimate reprisal for the September 15, 2011 disclosure. The timing of the termination, being just one month before the Klamath Secretarial Determination, suggests that my supervisors did not want me included in the decision process; for fear that I would make another disclosure that does not support the Department's goal to remove the dams.

After receiving the termination notice on February 8, 2012, I contacted Ms. Laurie Larson-Jackson, *Associate Inspector General for Whistleblower Protection.* I was subsequently interviewed by Mr. Steven Futrowsky, *OIG Senior Investigator*, and Mr. Gregory Gransback, *OIG Investigator.* Ms. Larson-Jackson thought that I had a reasonable complaint, and encouraged me to contact Ms. Kira Finkler to negotiate a solution. On February 10, 2011, I met with Ms. Finkler and Mr. Murrillo to offer such a discussion. Mr. Murillo indicated that they would discuss my offer to find a solution with the Department and get back to me the following week. I contacted Ms. Finkler via Email on 2/14/2012, and 2/21/2012 asking for a phone discussion. Ms. Finkler responded on 2/14/2012 asking for clarification of what I meant by "negotiate a solution", to which I responded with some options to find a positive outcome [attachment 27]. Having not heard from Ms. Finkler since 2/14/2012, it is clear that she is not interested in mitigation.

Summary of Allegation II:

305 DM 3 specifically calls all Department employees to *communicate the results of scientific and scholarly activities clearly, honestly, objectively, thoroughly, accurately, and in a timely manner*, to *not intentionally hinder the scientific and scholarly activities of others, and* to *clearly differentiating among facts, personal opinions, assumptions, hypotheses, and professional judgment in reporting the results of scientific and scholarly activities and characterizing associated uncertainties in using those results for decision making, and in representing those results to other scientists, decision makers, and the public.*

On September 15, 2011, I expressed concern via written disclosure relating to the scientific integrity of a draft press release on the draft environmental analysis for removing four Klamath River dams, and via verbal disclosure about the integrity of the larger Klamath River dam removal Secretarial determination process. My disclosure was clearly made to people who had authority to fix the press release (Department Press Secretary, and Department Solicitor's Office), and people who had influence on the Secretarial decision process (Department Solicitor's Office and Reclamation Deputy Commissioner). Even though some changes were in the final press release (showing I had made the disclosure to people with the authority to change the press release), the subsequent reprisal indicates that these same people questioned my commitment to Secretarial intentions to support the Klamath River dam removal. This Secretarial decision (due March 31, 2012) is reported to have a cost to the public (taxpayers and ratepayers) in excess of $1B, so a poor decision would result in gross waste of funds.

Following my disclosure, I faced systematic reprisal that used my 1-year probationary period to issue threats of termination, giving a low performance rating, denying travel, denying training and executive development, denying mentoring, and terminating my position. This period of reprisal demonstrates a pattern of hindering and not being supportive or honest about the scientific integrity process; the subsequent reprisal shows intentional actions that directly compromise 305 DM 3, and therefore constitutes the violation of rules and regulations. Finally, the expectation for employees to compromise scientific integrity in support of Departmental mission and goals, and to engage in systematic reprisal when an employee question's the Department's scientific integrity is clearly an abuse of authority.

CONFLICT OF INTEREST STATEMENT:

305 DM 3 requires all accusers to declare any conflicts of interest that may be inherent in their submissions. Conflict of interest exists when a person has ties to activities that could inappropriately influence his or her judgment, whether or not judgment is in fact affected. Financial relationships with industry, for example, through employment, consultancies, stock ownership, honoraria, expert testimony, either directly or through immediate family, are usually considered to be the most important conflicts of

interest. However, conflicts can occur for other reasons, such as personal relationships, academic competition, and intellectual passion.

I attest that I have no fiduciary ties or conflicts associated with the Klamath River Secretarial decision process. I do not have any financial relationships with Klamath River associated industry, employment, consultancies, stock ownership, honoraria, expert testimony, either directly or through immediate family. I am not an author of any reports or the recipient of any research support associated with the Klamath River. However, I do have personal impact (loss of job) associated with accusation II, but have nothing to directly gain or lose from the potential result of this accusation. I also plan to submit an appeal for whistleblower protection with the Merit System Protection Board (MSPB), and with the Office of Special Council (OSC). My motivation for submitting this allegation is to uphold the principles of scientific integrity and its code of conduct, as is my responsibility as a practicing research scientist.

Cordially,



Dr. Paul R. Houser
Science Advisor & Scientific Integrity Officer, Bureau of Reclamation, Washington D.C.
Associate Professor, George Mason University, Fairfax, VA

Houser, Paul R

From: Houser, Paul R
Sent: Thursday, September 15, 2011 3:15 PM
To: Finkler, Kira L
Subject: FW: Press Release Review
Attachments: klamath press release 9 14 11 MPandWOEdits ver2.docx

Hi Kira –

I just wanted to update you on a press release review I did for Nell. She asked me to look at the attached press release, and it raised some red flags with me. I am concerned that this press release generally presents a biased view of the Klamath dam removal benefits. It tends to present only the positive, without the uncertainties or negatives. For example:

- Climate changes are projected to play an important role in fish recovery, but climate is never mentioned in the draft press release.
- The section on Chinook Salmon recovery projects an 83 percent recovery, but says nothing about the nine contingencies summarized in the June 13, 2011 report that could completely negate this projected recovery: Upper Klamath Lake (UKL) and Keno Reservoir (KR) water quality issues, reduction in disease, enabling free migration to the upper basin, hatchery salmon do not overwhelm spawning grounds, predation is sufficiently low, climate change, small reductions in fall flows, and no long-term dam removal impacts.
- Press release states that "Coho salmon reclaim 68 miles of habitat", but says nothing about the April 25, 2011 statement "the difference between the Proposed Action and Current Conditions is expected to be small, especially in the short term (0-10 years after dam removal). Larger (moderate) responses are possible under the Proposed Action if the KBRA is fully and effectively implemented and mortality caused by the pathogen C. shasta is reduced.".

I brought my concerns to Nell and Pete Lucero. Pete agreed with my concern and suggested contacting the solicitors office, so Nell and I talked to Carter (nothing came of that). In the end, Dan decided this was not a fight Reclamation should engage, and signed off on the press release with a few minor suggestions.

Best Regards, Paul

Dr. Paul R. Houser, Science Advisor | Bureau of Reclamation
P:202-513-0594 | F:410-970-6643 | phouser@usbr.gov

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**"Proceedings, Federal Interagency Workshop,
"Sediment Technology for the 21'st Century,"
St. Petersburg, FL, February 17-19, 1998"**

Bureau of Reclamation's Needs in Sediment Technology for the 21st Century.

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By
Yang, Chih Ted and Young, Christ A.

Abstract

The Bureau of Reclamation(Reclamation) conducts sediment related studies of river and reservoir to meet planning, design, operation, maintenance, and environmental needs of Reclamation's projects. Reclamation's needs in sediment technology can be classified into two major categories: (1) Improved sediment measurement and survey technologies applicable to field conditions; (2) Improved computational methods and capabilities to predict and simulate sediment transport and river morphologic changes. This paper provides a brief summary of Reclamation's sediment technology needs for the 21st Century.

1. **Sediment measurement and survey technology**

    - **Bed load measurement of coarse material**--Different types of bed load samplers, such as the Helley-Smith and Elwha samplers, have been developed by FISP and other organizations. More field testing is needed to improve their accuracy and applicabilities to field conditions. Determination of the compatibility of measured results using different types of samplers is also important.

    - **More accurate direct/indirect measurement of roughness coefficients of natural rivers under different flow and sediment conditions**--Roughness coefficients have been widely used for water surface profile and energy loss computations. Roughness varies with flow and sediment conditions. There is a lack of reliable and consistent methods for the determination of roughness coefficients under different flow and sediment conditions.

    - **Evaluate real time kinematic(RTK) GPS equipment for reservoir sedimentation survey**--Commercially available RTK hydrographic survey equipment can allow collection of accurate water surface and bed profile elevations at a fast rate with relatively accurate horizontal and vertical positions. FISP should evaluate and compare the relative accuracies and field applicability of such equipment.

2. **Computational capabilities**

    - **Develop and/or evaluate computer models which can be applied to solving general river engineering problems with limited field sediment and hydraulic data.**

    - **Develop and/or evaluate truly three-dimensional computer models for solving localized scour and deposition problems.**

- **Develop and/or evaluate process based computational methods for estimating surface erosion rate.**--The application of the empirical Universal Soil Loss Equation (USLE) is limited to the Eastern U. S. agriculture communities.

⇧Workshop Contributions

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conjunction with surveys and population monitoring throughout the range of each species in California for the purpose of enhancing their survival.

Permit No. TE–045994

Applicant: U.S. Geological Survey, Biological Resources Division, Western Ecological Research Center, San Diego Field Station, San Diego, California.

The applicant requests an amendment to an existing permit (July 7, 2009, 74 FR 32179) to take, (transport and release) the mountain yellow-legged frog (*Rana muscosa*) in conjunction with a captive breeding and translocation program in Riverside, San Bernardino, and Los Angeles Counties, California, for the purpose of enhancing its survival.

Permit No. TE–14237A

Applicant: Wildlife Science Center, Livermore, California.

The applicant requests a permit to take (survey, capture, handle, and release) the California tiger salamander (*Ambystoma californiense*) in conjunction with surveys and population monitoring throughout the range of the species in California for the purpose of enhancing its survival.

We invite public review and comment on each of these recovery permit applications. Comments and materials we receive will be available for public inspection, by appointment, during normal business hours at the address listed in the **ADDRESSES** section of this notice.

Michael Long,

Acting Regional Director, Region 8, Sacramento, California.

[FR Doc. 2010–14165 Filed 6–11–10; 8:45 am]

BILLING CODE 4310–55–P

DEPARTMENT OF THE INTERIOR

Bureau of Reclamation

Klamath Hydroelectric Settlement Agreement, Including Secretarial Determination on Whether to Remove Four Dams on the Klamath River in California and Oregon

AGENCY: Department of the Interior.

ACTION: Notice of intent to prepare an Environmental Impact Statement/ Environmental Impact Report (EIS/EIR) and notice of public scoping meetings.

SUMMARY: Pursuant to the National Environmental Policy Act of 1969 (NEPA), as amended, and the California Environmental Quality Act (CEQA), the Department of the Interior (Department), through the Bureau of Reclamation (Reclamation), and the California Department of Fish and Game (CDFG) intend to prepare an EIS/EIR. The Department and CDFG will conduct public scoping meetings to solicit comments concerning the issues, alternatives, and analyses to be considered in the evaluation of whether to remove four dams on the Klamath River pursuant to the terms of the Klamath Hydroelectric Settlement Agreement (KHSA). Section 3.3.1 of the KHSA states: "Based upon the record, environmental compliance and other actions described in Section 3.2, and in cooperation with the Secretary of Commerce and other Federal agencies as appropriate, the Secretary shall determine whether, in his judgment, the conditions of Section 3.3.4 have been satisfied, and whether, in his judgment, Facilities Removal (i) will advance restoration of the salmonid fisheries of the Klamath Basin, and (ii) is in the public interest, which includes but is not limited to consideration of potential impacts on affected local communities and Tribes."

In light of this potential determination by the Secretary of the Interior (Secretary) pursuant to the KHSA, the public and agencies are invited to comment on the scope of the EIS/EIR and potential alternatives including, but not limited to: (1) How other potential actions within the KHSA should be analyzed in this EIS/EIR, and (2) the nature and extent to which the potential environmental impacts of implementing the Klamath Basin Restoration Agreement (KBRA) should be analyzed in this EIS/EIR.

DATES: Written comments on the scope of the EIS/EIR and potential alternatives to be analyzed are requested within 30 days of the publication of this notice. Oral comments will also be accepted during the public scoping meetings. Please see the **SUPPLEMENTARY INFORMATION** section for public scoping meeting dates and locations.

ADDRESSES: Please send written comments to Ms. Tanya Sommer, Bureau of Reclamation, 2800 Cottage Way, Sacramento, CA 95825, or by e-mail to *KlamathSD@usbr.gov*. Written comments may also be submitted during the public scoping meetings. Please see the **SUPPLEMENTARY INFORMATION** section for meeting locations and dates.

FOR FURTHER INFORMATION CONTACT: Ms. Tanya Sommer, Bureau of Reclamation, 916–978–6153, *TSommer@usbr.gov*, for technical information. For public involvement information, please contact Mr. Matt Baun, U.S. Fish and Wildlife Service, 530–841–3119, *Matt_Baun@fws.gov*.

SUPPLEMENTARY INFORMATION:

Background

Conflicts over water and other natural resources in the Klamath Basin between conservationists, tribes, farmers, fishermen, and State and Federal agencies have existed for decades. In particular, several developments affecting the Klamath Basin have occurred in the last several years. These developments include:

—In 2001, water deliveries to irrigation contractors to Reclamation's Klamath Project were substantially reduced.
—In 2002, returning adult salmon suffered a major die-off.
—In 2006, the commercial salmon fishing season was closed along 700 miles of the West Coast to protect weak Klamath River stocks.
—In 2010, due to drought conditions, the project is forecasting a curtailment of deliveries that could result in the potential short-term idling of farmland and increased groundwater pumping.
—In 2010, the c'waam (Lost River suckers) fishery for the Klamath Tribes has been closed for the 24th year, limiting the Tribes to only a ceremonial harvest.

Since 2003, the United States has spent over $500 million in the Klamath Basin for irrigation, fisheries, National Wildlife Refuges, and other resource enhancements and management actions. Consequently, the United States, the States of California and Oregon, the Klamath, Karuk, and Yurok Tribes, Klamath Project Water Users, and other Klamath River Basin stakeholders negotiated the KBRA and the KHSA (including the Secretarial Determination) to resolve long-standing disputes between them regarding a broad range of natural resource issues. The agreements are intended to result in effective and durable solutions which: (1) Restore and sustain natural fish production and provide for full participation in ocean and river harvest of fish species throughout the Klamath Basin; (2) establish reliable water and power supplies which sustain agricultural uses, communities, and National Wildlife Refuges; and (3) contribute to the public welfare and the sustainability of all Klamath Basin communities. It is the conclusion of the United States that in order to reach these goals, both agreements must be authorized and implemented.

Ongoing programs that may be expanded include habitat restoration and fish population monitoring

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activities being conducted by Federal, Tribal, and State governments and agencies, fish disease research activities, continued implementation of Reclamation's Pilot Water Bank Program, and programs to improve fish passage and screen irrigation diversions.

New programs that may be established by the KBRA include a Fisheries Restoration Plan, Fisheries Reintroduction Plan, Fisheries Monitoring Plan, Water Diversion Limitation and Pumping Plan, Water Rights Purchase Plan, Drought Plan, Environmental Water Plan, Counties' Impacts-Mitigation and Benefits Program, Tribal Programs, establishment of wildlife refuge water allocation, and additional water conservation and storage actions.

The KHSA lays out the process for additional studies, environmental review, and a decision by the Secretary regarding whether removal of four dams owned by PacifiCorp: (1) Will advance the restoration of the salmonid fisheries of the Klamath Basin, and (2) is in the public interest, which includes, but is not limited to, consideration of potential impacts on affected local communities and tribes.

Purpose and Need and Proposed Action

The purpose of the proposed Federal action is to advance restoration of the salmonid fisheries in the Klamath Basin that is in the public interest, and is consistent with the KHSA and the KBRA. Pursuant to the KHSA, the Secretary needs to make a determination whether to proceed with the removal of the four PacifiCorp Dams on the Klamath River. The proposed action is to make a determination, pursuant to the KHSA, as to whether removal of the four lower dams on the Klamath River to achieve a free-flowing condition and allow full volitional passage of fish is in the public interest, will advance restoration of the salmonid fishery and is consistent with statutory obligations and tribal rights. The potential impacts of any connected actions, including any such actions under the KBRA, will be analyzed.

Environmental Issues and Resources To Be Examined

The EIS/EIR will be used to inform the Secretary when making his decision regarding implementation of the KHSA and any potential follow-on programs that may be implemented as part of the KBRA. If, pursuant to the KHSA, the Secretary's decision is affirmative, the EIS/EIR will be used by the Governors of the States of California and Oregon to inform each whether to concur in that determination. The EIS/EIR will include analysis and disclosures of the effects on the quality of the human and physical environment that may occur as a result of implementation of the KHSA and any potential follow-on programs including those programs in the KBRA. Issues to be addressed may include, but are not limited to, impacts on biological resources, historic and archaeological resources, geomorphology, hydrology, water quality, air quality, safety, hazardous materials and waste, visual resources, socioeconomics, including real estate, and environmental justice.

Public Scoping Sessions

The Department and CDFG will hold six public information and scoping meetings according to the dates and locations listed below. Oral and written comments will be accepted at the public meetings.

Dates, Times, and Locations:

- Wednesday, July 7, 2010, 10 a.m. to 1 p.m., Copco Community Center, 27803 Copco Road, Montague, CA 96064.
- Wednesday, July 7, 2010, 6 p.m. to 9 pm, Yreka Community Center, 810 N. Oregon Street, Yreka, CA 96097.
- Thursday, July 8, 2010, 6 p.m. to 9 p.m., Klamath County Fairgrounds, 3531 S. 6th Street, Klamath Falls, OR 97603.
- Friday, July 9, 2010, 6 p.m. to 9 p.m., Chiloquin Community Center, 140 First Street, Chiloquin, OR 97624.
- Tuesday, July 13, 2010, 6 p.m. to 9 p.m., Chetco Activities Center, 550 Chetco Way, Brookings, OR 97415.
- Wednesday, July 14, 2010, 6 p.m. to 9 p.m., Arcata Community Center, 321 Community Park Way, Arcata, CA 95521.
- Thursday July 15, 2010, 6 p.m. to 9 p.m., Karuk Tribe Community Room, 39051 Highway 96, Orleans, CA 95556.

Public Disclosure

Before including your name, address, phone number, e-mail address, or other personal identifying information in your comment, please be aware that your entire comment—including your personal identifying information—may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

Dated: June 7, 2010.

Dennis Lynch,

Program Manager, Klamath Basin Secretarial Determination.

[FR Doc. 2010–14174 Filed 6–11–10; 8:45 am]

BILLING CODE 4310–MN–P

DEPARTMENT OF THE INTERIOR

Bureau of Land Management

[LLES956000–L14200000–BJ0000]

Eastern States: Filing of Plat of Survey

AGENCY: Bureau of Land Management, Interior

ACTION: Notice of filing of plat of survey; Minnesota.

SUMMARY: The Bureau of Land Management (BLM) will file the plat of survey of the lands described below in the BLM—Eastern States office in Springfield, Virginia, 30 calendar days from the date of publication in the **Federal Register**.

FOR FURTHER INFORMATION CONTACT: Bureau of Land Management—Eastern States, 7450 Boston Boulevard, Springfield, Virginia 22153. Attn: Cadastral Survey.

SUPPLEMENTARY INFORMATION: This survey was requested by the Bureau of Indian Affairs.

The lands surveyed are:

Fourth Principal Meridian, Minnesota

T. 49 N., R 18 W.

The plat of survey represents the corrective dependent resurvey of a portion of the North boundary, a portion of the West boundary, a portion of the subdivisional lines, and the subdivision of Section 6, in Township 49 North, Range 18 West, of the Fourth Principal Meridian, in the State of Minnesota, and was accepted April 22, 2010.

We will place a copy of the plat we described in the open files. It will be available to the public as a matter of information.

If BLM receives a protest against the survey, as shown on the plat, prior to the date of the official filing, we will stay the filing pending our consideration of the protest.

We will not officially file the plat until the day after we have accepted or dismissed all protests and they have become final, including decisions on appeals.

Dated: *June 7, 2010.*

Dominica Van Koten,

Chief Cadastral Surveyor.

[FR Doc. 2010–14168 Filed 6–11–10; 8:45 am]

BILLING CODE 4310–GJ–P

STATE WATER RESOURCES
CONTROL BOARD

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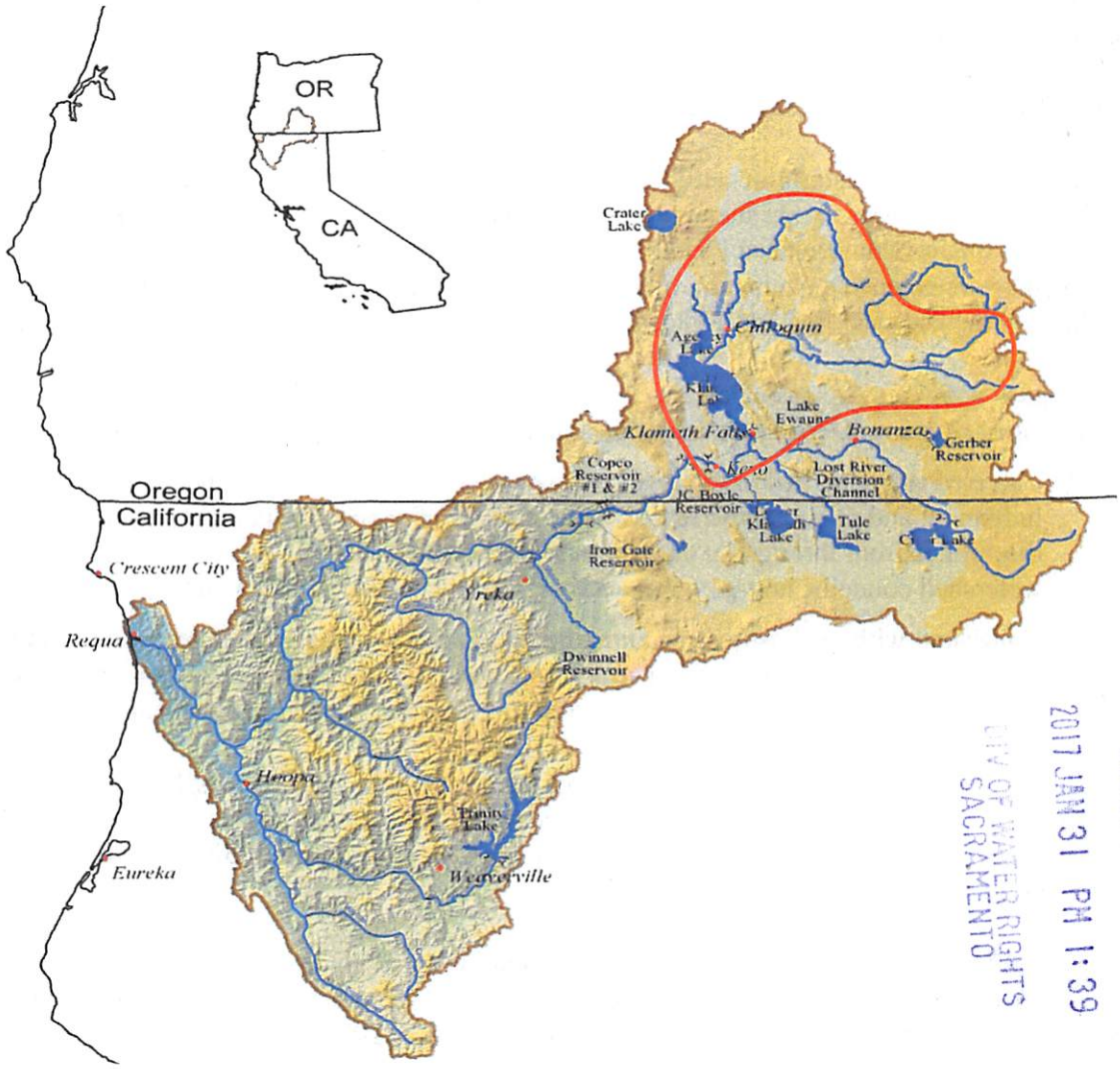
DIV OF WATER RIGHTS
SACRAMENTO

Ryes Sed Study

Projected Restoration Actions and Associated Costs Under the Klamath Basin Restoration Agreement for the Upper Klamath River Basin Above Keno, Oregon

July 30, 2010



STATE WATER RESOURCES CONTROL BOARD
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CITY OF WATER RIGHTS
SACRAMENTO

Jointly authored by:

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and
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U. S. Fish and Wildlife Service

Larry Dunsmoor

Klamath Tribes

Shannon Peterson

Klamath Basin Rangeland Trust

Danette Watson

Ranch and Range Consulting

Projected Restoration Actions and Associated Costs Under the Klamath Basin Restoration Agreement for the Upper Klamath River Basin Above Keno, Oregon

- We outlined projected restoration activities for the Upper Klamath River Basin (above Keno), focusing on the geographic scope identified in the Klamath Basin Restoration Agreement (KBRA). Elements of the KBRA budget (Appendix C-2) covered here include row numbers 3, 4, 5, 8, 11, and 12. These activities are intended to improve conditions affecting fish production, survival, and recovery in and above Keno Reservoir and Upper Klamath Lake, with an emphasis on valley-floor rivers and streams. Consequently, areas targeted for these activities are predominately privately-owned, but some publicly managed lands are included. In addition to providing direct benefits to the Upper Klamath Basin, the significant improvements to water quality and nutrient/organic loads expected to result from these actions will benefit the Klamath River for many miles downstream of Keno.

- We did not prioritize restoration activities. Instead, we identified suites of activities by sub-basin that will be fed into the process producing the Phase I Fisheries Restoration Plan under KBRA Section 10.1, which will finalize and prioritize Phase I habitat restoration actions. The Phase I plan will also be informed by an extensive evaluation of past restoration projects that is presently under way, a product of funding by the National Fish and Wildlife Foundation and the Oregon Watershed Enhancement Board.

- Restoration activities and associated costs listed in this document represent the consolidated knowledge and opinions of many Klamath Basin professionals. Users of this information should consider that:
    - Targeted activities and associated costs integrate current scientific understanding, professional judgment, and project experience from a number of experts in fisheries, restoration, and other disciplines from throughout the Klamath Basin representing a variety of sources (e.g., Tribes, watershed councils, non-governmental organizations, and government agencies).
    - Consistent with the basin-wide commitment to adaptive management expressed in the KBRA, the nature, scope, and priority of restoration actions will likely change as scientific understanding and experience with restoration measures reveal more effective or efficient approaches.

- Monitoring needs are substantial and very important to the long-term, successful implementation of this Upper Basin restoration initiative. Monitoring costs are not included in this document, which is meant to detail on-the-ground project work. Monitoring costs covered by the KBRA are detailed in Appendix C-2 rows 37-59.

- Costs were calculated including a 30% "Implementation Cost" to provide necessary support (staff, environmental compliance, permitting, fiscal management, contract management, etc.), without which the necessary work cannot be accomplished. Costs are listed 2007 dollars to be consistent with Appendix C-2 of the KBRA, which also uses 2007 dollars.

- Increased capacity for key organizations at the local level will be very important to successfully implement restoration activities of the magnitude needed to meet the social, economic, and ecosystem goals of the Klamath Basin Restoration Agreement, the Klamath Hydroelectric Settlement Agreement, the Oregon Plan for Salmon and Watersheds, and Oregon's Water Quality Management Plan for TMDL attainment.

KBRA Restoration Needs for Basin Above Keno								
Reach	Restoration target	Activities	Miles of Stream	Miles, acres, or number of activity	Estimated Cost	Implementation Costs @ 30%	Total with implementation costs	Details
Williamson River								
Main Stem	Riparian Cooridor Management	Fence construction and offstream watering	25	50	$1,320,000	$396,000	$1,716,000	Miles. Cost to build fence is $4 per foot; used $5 per foot to account for offstream watering facility cost.
		Maintain existing fences, manage weeds & exotic plants	56	112	$562,909	$168,873	$731,782	Miles. Costs based on a 4 person crew @ $40 per hour working full time for 9 months per year, plus $60,000 for supplies including vehicles, fencing materials, etc., which totals $3,096,000 over 10 years. Costs are allocated across Wood, Williamson, and Sprague river sub-basins, weighted by stream miles.
		Riparian corridor management agreements	38	1,386	$2,079,360	$623,808	$2,703,168	Riparian acres. 38 miles of river at 0.057 miles (300 ft) wide = 1,386 acres * $1,500/acre. Acreage, and $/acre estimated value (based on existing Federal agreement mechanisms), may be modified by OPWAS (KBRA Sec 16) and/or GCP (KBRA Sec 22).
	Stream Channel Restoration	Levee removal, setback, or breaching	1	2	$300,000	$90,000	$390,000	Miles. Levees on lower Williamson River; costs of $150,000 per mile based on recent projects completed by KFFWO.
		Physical habitat improvements	12	12	$420,000	$126,000	$546,000	Miles. $35,000 per mile to increase rearing capacity using large wood and to increase spawning habitat with gravel placement. Emphasis on maximizing productivity and capacity for early life stages of anadromous fish to facilitate reintroduction.
	Lower Williamson Delta Adaptive Management	Native vegetation management		5,500	$450,000	$135,000	$585,000	Acres. Establishing desirable native plant species (e.g., culturally and ecologically significant species like wocus), and eradicating non-native species. One FTE for 6 months per year estimated at $60,000 salary = $30,000 per year for 10 years plus supplies of $15,000 per year.
		Improve quality of and connectivity among endangered sucker nursery habitats		5,500	$291,360	$87,408	$378,768	Acres. Includes future earthwork and other activities to improve existing habitats and hydrologic connectivity allowing larval fish better access to all nursery areas within the Delta. Cost of moving 58,272 cubic yards of material at $5 per cubic yard; based on previous work in Delta.
Tributaries	Riparian Cooridor Management	Fence construction and offstream watering	2.2	4.4	$116,160	$34,848	$151,008	Miles. Spring Ck, Larkin Ck. Cost to build fence is $4 per foot; used $5 per foot to account for offstream watering facility cost.
		Maintain existing fences, manage weeds & exotic plants	5	10	$50,260	$15,078	$65,338	Miles. Costs based on a 4 person crew @ $40 per hour working full time for 9 months per year, plus $60,000 for supplies including vehicles, fencing materials, etc., which totals $3,096,000 over 10 years. Costs are allocated across Wood, Williamson, and Sprague river sub-basins, weighted by stream miles.
		Riparian corridor management agreements	2.5	91.2	$136,800	$41,040	$177,840	Riparian acres. 2.5 miles of river at 0.057 mi (300 feet wide) = 91.2 acres * $1,500/acre. Acreage, and $/acre estimated value (based on existing Federal agreement mechanisms), may be modified by OPWAS (KBRA Sec 16) and/or GCP (KBRA Sec 22).
	Stream Channel Restoration	Channel narrowing	2.1	2.1	$252,000	$75,600	$327,600	Miles. Larkin Ck and Sunnybrook Ck. Cost estimates based on KFFWO experience @ $120,000 per mile. Planning and review required, final delineation may change.
		Physical habitat improvements	5	5	$175,000	$52,500	$227,500	Miles. $35,000 per mile to increase rearing capacity using large wood and to increase spawning habitat with gravel placement. Emphasis on maximizing productivity and capacity for early life stages of anadromous fish to facilitate reintroduction.
Totals							**$8,000,000**	

			KBRA Restoration Needs for Basin Above Keno					
Reach	Restoration target	Activities	Miles of Stream	Miles, acres, or number of activity	Estimated Cost	Implementation Costs @ 30%	Total with implementation costs	Details
Sprague River mainstem								
Main Stem	Riparian Coordor Management	Fence construction and offstream watering	65.0	130	$3,432,000	$1,029,600	$4,461,600	Miles. North Fork (10 miles), South Fork (15 miles), and Sycan below Coyote Bucket (12 miles), main stem (28 miles). Cost to build fence is $4 per foot, used $5 per foot to account for offstream watering facility cost.
		Maintain existing fences, manage weeds & exotic plants	110	220	$1,105,714	$331,714	$1,437,429	Miles. Costs based on a 4 person crew @ $40 per hour working full time for 9 months per year, plus $60,000 for supplies including vehicles, fencing materials, etc., which totals $3,096,000 over 10 years. Costs are allocated across Wood, Williamson, and Sprague river sub-basins, weighted by stream miles.
		Grazing management		1 FTE	$500,000	$150,000	$650,000	Salary. Cost covers one grazing management specialist to assist landowners with developing ranch management plans that meet landowner needs and maintain/enhance the riparian corridor conditions. Could be a consultant or a staff member, 5 years full time, part-time thereafter, will cover Sprague River tributaries as well.
		Improving dryland range to reduce need for riparian pastures		19,000	$3,075,000	$922,500	$3,997,500	Acres. 19,000 acre estimate = 8,000 acres dryland range ripped and re-seeded @ $75 per acre, plus juniper removal and re-seeding on 11,000 acres of uplands @ $225 per acre. Intent is to increase dry rangeland alternatives to riparian grazing, may increase water infiltration rate, and may reduce ET water loss via juniper. Planning and review required, final delineation may change.
		Riparian corridor management agreements	85	6,202	$9,302,400	$2,790,720	$12,093,120	Riparian acres. Assumes riparian corridor 0.114 miles (600 feet) wide by 85 miles long = 6,202 acres * $1,500/acre. Acreage, and $/acre estimated value (based on existing Federal agreement mechanisms), may be modified by OPWAS (KBRA Sec 16) and/or GCP (KBRA Sec 22). Includes Sprague tributaries.
	Stream Channel Restoration	Levee removal, setback, or breaching	20	30	$4,500,000	$1,350,000	$5,850,000	Miles. Cost is $150,000 per mile based on previous completed KFFWO projects. Focus is on reconnecting floodplains and re-establishing associated hydrologic processes.
		Whole channel reconstruction	10	15	$8,298,240	$2,489,472	$10,787,712	Miles. Fifteen miles on South Fork Sprague, extrapolated costs from Crane Creek project. Extensive planning is required, including manging flood risk to Bly, final delineation may change.
		Physical habitat improvements	22	22	$2,640,000	$792,000	$3,432,000	Miles. Includes measures to enhance fish use of thermal refugia (e.g. overhangs, narrowing, structural complexity), enhance rearing capacity (e.g. large wood, off channel habitats, structural complexity), enhance spawning habitats (e.g. gravel placement), site-specific narrowing or channel re-alignment. Cost esimated at $120,000 per mile. Extensive planning and review required, final delineation may change.
		Spring improvement, enhancement, and reconnection		20	$1,521,380	$456,414	$1,977,794	Number of springs. Includes revegetating and reconstructing outlet channels, substrate treatments, and morphological changes to spring ponds. Guidance from FLIR and TIR coverages.
	Fish Passage	Barrier and impediment removal		2	$300,000	$90,000	$390,000	Number of impediments. Fish passage impediments will be eliminated by modifying two diversions on the South Fork Sprague.
Totals							**$45,077,150**	

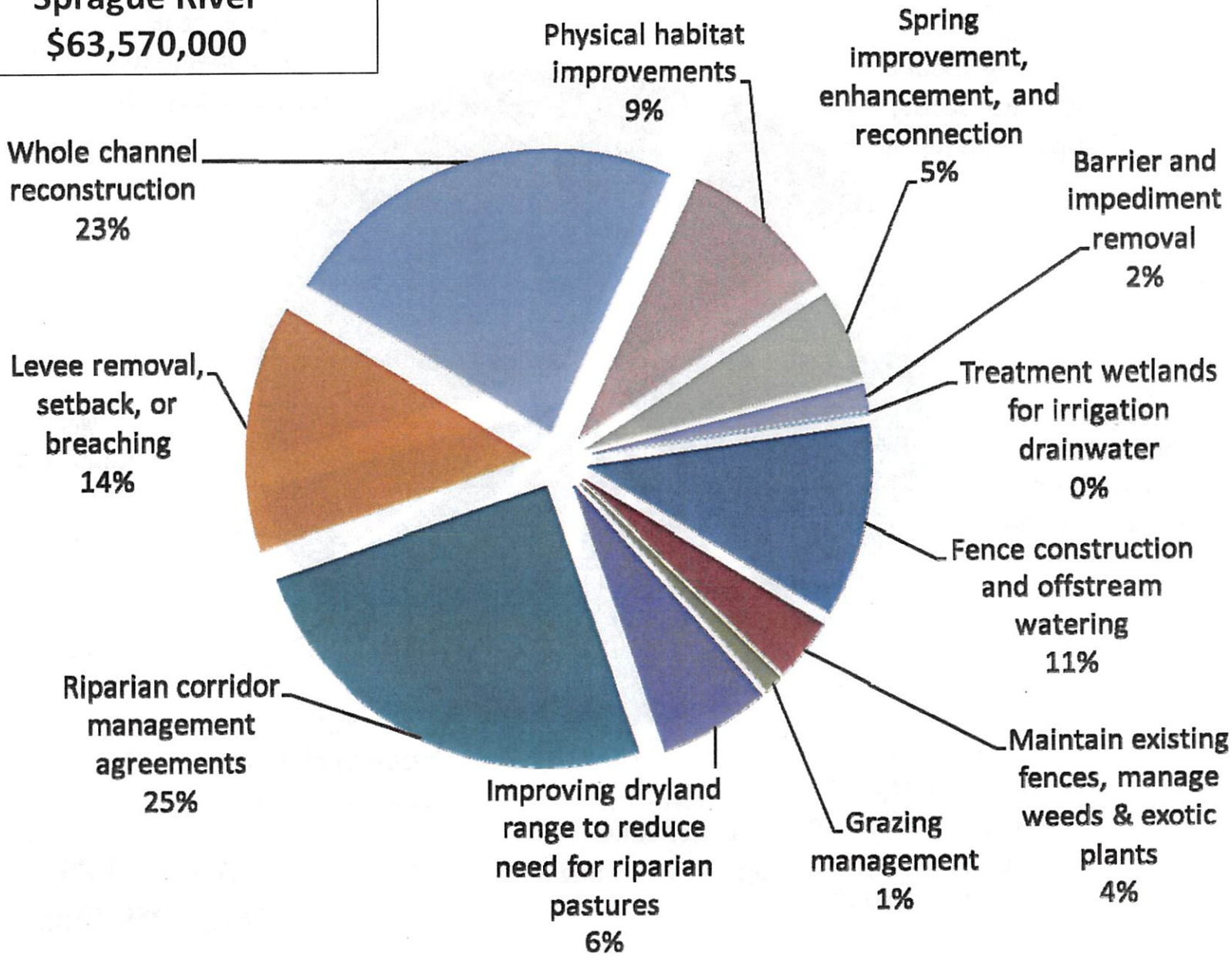
			KBRA Restoration Needs for Basin Above Keno					
Reach	Restoration target	Activities	Miles of Stream	Miles, acres, or number of activity	Estimated Cost	Implementation Costs @ 30%	Total with implementation costs	Details
Sprague River tributaries								
Tributaries	Riparian Corridor Management	Fence construction and offstream watering	38	76	$2,006,400	$601,920	$2,608,320	Miles. Fivemile (2 miles), Fishhole (7 miles), Meryl (5 miles), Trout (3 miles), Snake (2 miles), Deming (3 miles), Whiskey (6 miles), Brown Ck/Spring Ck (4 miles), Sycan from Torrent to Coyote Bucket (6 miles on Teddy Powers Meadow and Sycan Ford). Cost to build fence is $4 per foot, used $5 per foot to account for offstream watering facility cost.
		Maintain existing fences, manage weeds & exotic plants	66	132	$663,429	$199,029	$862,457	Miles. Costs based on a 4 person crew @ $40 per hour working full time for 9 months per year, plus $60,000 for supplies including vehicles, fencing materials, etc., which totals $3,096,000 over 10 years. Costs are allocated across Wood, Williamson, and Sprague river sub-basins, weighted by stream miles.
		Riparian corridor management agreements	52	1,897	$2,845,440	$853,632	$3,699,072	Riparian acres. Assumes riparian corridor 0.057 miles (300 feet) wide by 52 miles long = 1,897 acres * $1,500/acre. Acreage, and $/acre estimated value (based on existing Federal agreement mechanisms), may be modified by OPWAS (KBRA Sec 16) and/or GCP (KBRA Sec 22). Includes Sprague tributaries.
	Stream Channel Restoration	Levee removal, setback, or breaching	8	16	$2,400,000	$720,000	$3,120,000	Miles. Levees on Five Mile (2 miles), Fishhole (4 miles), Merrill (1 mile), Trout (2 miles), Whiskey (4 miles), Sycan (1 mile), Deming (1 mile), Brown (1 mile). Cost is $150,000 per mile based on previous completed KFFWO projects. Focus is on reconnecting floodplains and re-establishing associated hydrologic processes.
		Whole channel reconstruction	10	10	$3,000,000	$900,000	$3,900,000	Miles. Brownsworth (0.5 miles), Paradise (0.5 miles), Ish Tish (1 mile), Deming (4 miles), Mercer (1 mile), Fivemile (1 mile), Whiskey (1 mile), Trout (1 mile). Extensive planning and review required, final delineation may change.
		Physical habitat improvements	15	15	$1,800,000	$540,000	$2,340,000	Miles. Includes measures to enhance fish use of thermal refugia (e.g. overhangs, narrowing, structural complexity), enhance rearing capacity (e.g. large wood, off channel habitats, structural complexity), enhance spawning habitats (e.g. gravel placement), site-specific narrowing or channel re-alignment. Cost esimated at $120,000 per mile. Extensive planning and review required, final delineation may change.
		Spring improvement, enhancement, and reconnection		20	$1,000,000	$300,000	$1,300,000	Number of springs. Includes revegetating and recontructing outlet channels, substrate treatments, and morphological changes to spring ponds.
	Fish Passage	Barrier and impediment removal		6	$450,000	$135,000	$585,000	Number of impediments. Fishhole and Whiskey cks.
	Water quality improvement	Treatment wetlands for irrigation drainwater		3	$60,000	$18,000	$78,000	Number of wetlands. Cost per treatment wetland $20,000, covers Sprague main stem and tributaries. Planning and review required, final delineation may change.
Totals							**$18,492,850**	

KBRA Restoration Needs for Basin Above Keno								
Reach	Restoration target	Activities	Miles of Stream	Miles, acres, or number of activity	Estimated Cost	Implementation Costs @ 30%	Total with implementation costs	Details
Wood River mainstem								
Main Stem Wood	Riparian Corridor Management	Fence construction and offstream watering	12.5	25	$860,000	$198,000	$858,000	Miles. Cost to build fence is $4 per foot, used $5 per foot to account for offstream watering facility cost.
		Maintain existing fences, manage weeds & exotic plants	21	42	$211,091	$63,327	$274,418	Miles. Costs based on a 4 person crew @ $40 per hour working full time for 9 months per year, plus $60,000 for supplies including vehicles, fencing materials, etc., which totals $3,096,000 over 10 years. Costs are allocated across Wood, Williamson, and Sprague river sub-basins, weighted by stream miles.
		Grazing management		1 FTE	$500,000	$150,000	$650,000	Salary. Cost covers one grazing management specialist to assist landowners with developing ranch management plans that meet landowner needs and maintain/enhance the riparian corridor conditions. Could be a consultant or a staff member, 5 years full time, part-time thereafter, will cover Wood River tributaries as well.
		Riparian corridor management agreements		720	$1,080,000	$324,000	$1,404,000	Riparian acres. Acreage needed to complete work started by KBRT. Acreage, and $1,500/acre estimated value (based on existing Federal agreement mechanisms), may be modified by OPWAS (KBRA Sec 16) and/or GCP (KBRA Sec 22).
	Stream Channel Restoration	Levee removal, setback, or breaching	3	3	$450,000	$135,000	$585,000	Miles. Does not include the 2 miles above mouth (may be added later, pending analysis). Inlcudes 3 miles immediately south of Weed Road. Costs are based on Wayne Ranch and similar projects completed by KFFWO.
		Physical habitat improvements	15.4	15.4	$539,000	$161,700	$700,700	Miles. $35,000 per mile to increase rearing capacity using large wood and to increase spawning habitat with gravel placement. Emphasis on maximizing productivity and capacity for early life stages of anadromous fish to facilitate reintroduction.
Wood River Tributaries	Riparian Corridor Management	Fence construction and offstream watering	13	26	$686,400	$205,920	$892,320	Miles. Sun Ck (2 miles), Annie Ck (6 miles), and Crooked Ck (5 miles). Cost to build fence is $4 per foot, used $5 per foot to account for offstream watering facility cost.
		Maintain existing fences, manage weeds & exotic plants	19	38	$190,987	$57,296	$248,283	Miles. Costs based on a 4 person crew @ $40 per hour working full time for 9 months per year, plus $60,000 for supplies including vehicles, fencing materials, etc., which totals $3,096,000 over 10 years. Costs are allocated across Wood, Williamson, and Sprague river sub-basins, weighted by stream miles.
	Stream Channel Restoration	Physical habitat improvements		7	$75,000	$22,500	$97,500	Miles. $52,000 for upper 5 miles of Crooked Creek, $21,000 for two miles of Fort Creek.
		Whole channel reconstruction		3	$1,658,202	$497,461	$2,155,663	Miles. Sun Ck (2 miles), Annie Ck (1 mile). Costs based on Crane Ck and similar projects completed recently by KFFWO.
Totals							**$7,865,880**	

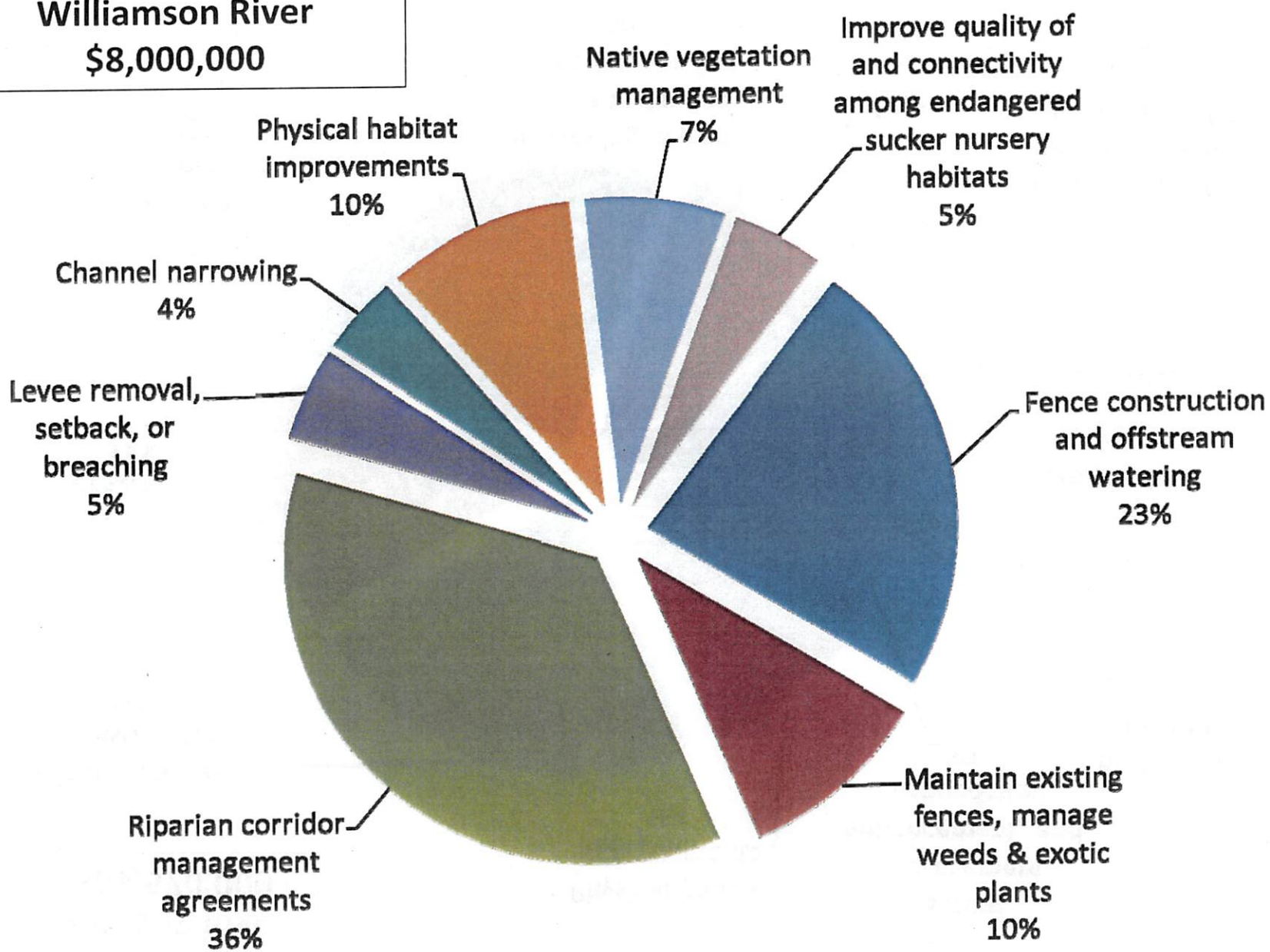
KBRA Restoration Needs for Basin Above Keno								
Reach	Restoration target	Activities	Miles of Stream	Miles, acres, or number of activity	Estimated Cost	Implementation Costs @ 30%	Total with implementation costs	Details
Wood River tributaries								
Sevenmile Creek/Canal System	Riparian Corridor Management	Fence construction and offstream watering	3	6	$158,400	$47,520	$205,920	Miles. Short Ck and Crane Ck (not including Forest Service; fence is needed only between McQuiston Road and start of Federal property at Barnes Ranch). Cost to build fence is $4 per foot, used $5 per foot to account for offstream watering facility cost.
		Maintain existing fences, manage weeds & exotic plants	23	46	$231,195	$69,358	$300,553	Miles. Costs based on a 4 person crew @ $40 per hour working full time for 9 months per year, plus $60,000 for supplies including vehicles, fencing materials, etc., which totals $3,096,000 over 10 years. Costs are allocated across Wood, Williamson, and Sprague river sub-basins, weighted by stream miles.
		Riparian corridor management agreements		175	$262,500	$78,750	$341,250	Riparian acres. Includes Fourmile system. Acreage needed to complete work started by KBRT. Acreage, and $1,500/acre estimated value (based on existing Federal agreement mechanisms), may be modified by OPWAS (KBRA Sec 16) and/or GCP (KBRA Sec 22).
	Stream Channel Restoration	Whole channel reconstruction	3.0	4.5	$2,489,715	$746,915	$3,236,630	Miles. Lower channelized 3 miles on Sevenmile Ck above federally ownership will be restored to 4.5 miles of channel. Costs are based on other recent, similar projects competed by KFFWO. Extensive planning and review are needed, actions will undergo NEPA process, final delineation may change.
Fourmile Creek/Canal System	Riparian Corridor Management	Fence construction and offstream watering	1	1	$26,400	$7,920	$34,320	Miles. Fourmile Creek above Fourmile Canal. Cost to build fence is $4 per foot; used $5 per foot to account for offstream watering facility cost.
		Maintain existing fences, manage weeds & exotic plants	8	16	$80,416	$24,125	$104,540	Miles. Costs based on a 4 person crew @ $40 per hour working full time for 9 months per year, plus $60,000 for supplies including vehicles, fencing materials, etc., which totals $3,096,000 over 10 years. Costs are allocated across Wood, Williamson, and Sprague river sub-basins, weighted by stream miles.
	Stream Channel Restoration	Whole channel reconstruction	1.5	2.3	$1,239,156	$371,747	$1,610,903	Miles. Changing lower channelized portion of Fourmile Ck. Costs are based on other recent, similar projects competed by KFFWO.
Totals							**$5,834,120**	

KBRA Restoration Needs for Basin Above Keno								
Reach	Restoration target	Activities	Miles of Stream	Miles, acres, or number of activity	Estimated Cost	Implementation Costs @ 30%	Total with implementation costs	Details
Upper Klamath Lake								
Upper Klamath/ Agency Lake	Lake-fringe Wetlands Restoration	Floodplain wetland restoration and storage		10	$9,615,385	$2,884,616	$12,500,001	Miles. Ten miles of levee material to be removed and utilized for additional habitat features such as raised channels or island habitats. Effort will be coordinated with Sevenmile Creek channel reconstruction in the Wood River. Costs based on similar activities at the Williamson River Delta. Extensive planning and review are needed, actions will undergo NEPA process, final delineation may change.
	Physical habitat improvement	Enhance endangered sucker spawning habitat in springs		10	$153,846	$46,154	$200,000	Number of spawning sites. Improvements mostly involve adding gravel to springs used by endangered suckers.
Totals							**$12,700,000**	
In or Above Keno Reservoir								
In or above Keno Reservoir	Organic and nutrient load reduction and management	Study of management and reduction of organic and nutrient loads		1	$3,846,154	$1,153,846	$5,000,000	Estimated 10% of the total cost in KBRA as available for study and 90% for implementation of a treatment strategy in or above Keno Reservoir, which includes Upper Klamath Lake.
		Implement recommended organic and nutrient reduction actions			$34,615,385	$10,384,616	$45,000,000	Likely to be combination of treatment wetlands, engineered water treatment facilities, physical removal of particulate organics, treatments to precipitate nutrients (alum, clay, etc.). Cost certain to be large, precise estimates will follow appropriate studies. Intent is to improve conditions in the Klamath River, as well as in the lake and reservoir.
	Wetlands	Restore wetlands on Keno Reservoir		TBD from study	$3,846,154	$1,153,846	$5,000,000	Location, size, and nature of wetlands to be determined based on above mentioned water quality improvement studies.
Totals							**$55,000,000**	
Fish Entrainment Reduction at Diversions								
Williamson, Sprague, and Wood rivers	Fish Passage and Entrainment	Screening pumps and diversions		100	$2,307,692	$692,308	$3,000,000	Number of diversions. Based on ODFW inventories on Wood, USFWS and OWRD records on Sprague. Inventories are incomplete for some areas, number and cost requires some refinement.
Upper Klamath Lake		Screening pumps and diversions		20	$384,616	$115,385	$500,000	Number of diversions. Approximate number, number and cost requires some refinement.
Keno Reservoir		Screening pumps and Klamath Irrigation Project diversions			$19,230,769	$5,769,231	$25,000,000	Screening of pumps in Keno Reservoir, and major diversions for Klamath Irrigation Project. Studies of best screening apporaches under way, costs here are placeholders pending study results.
Totals							**$28,500,000**	

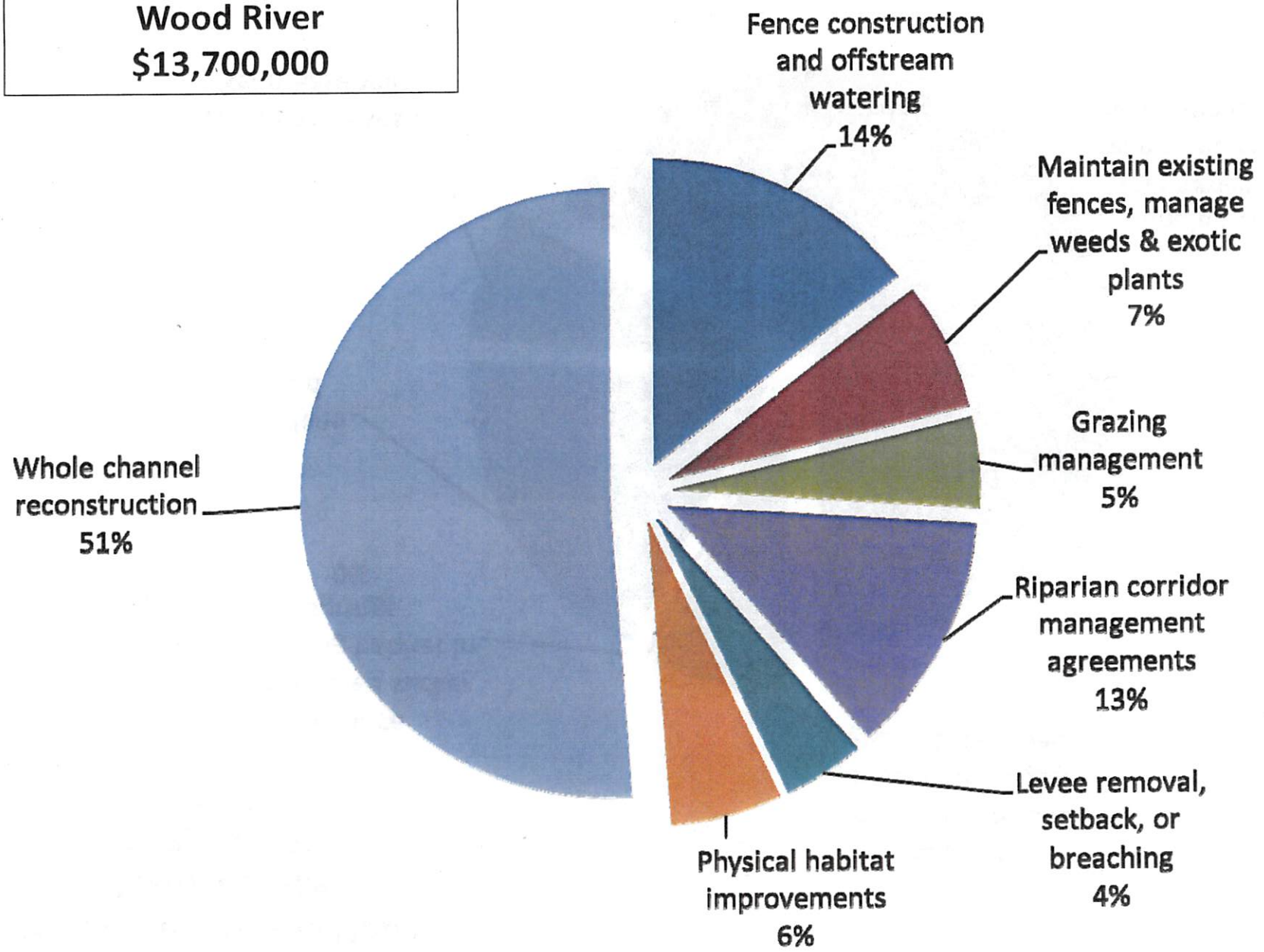
Sprague River
$63,570,000



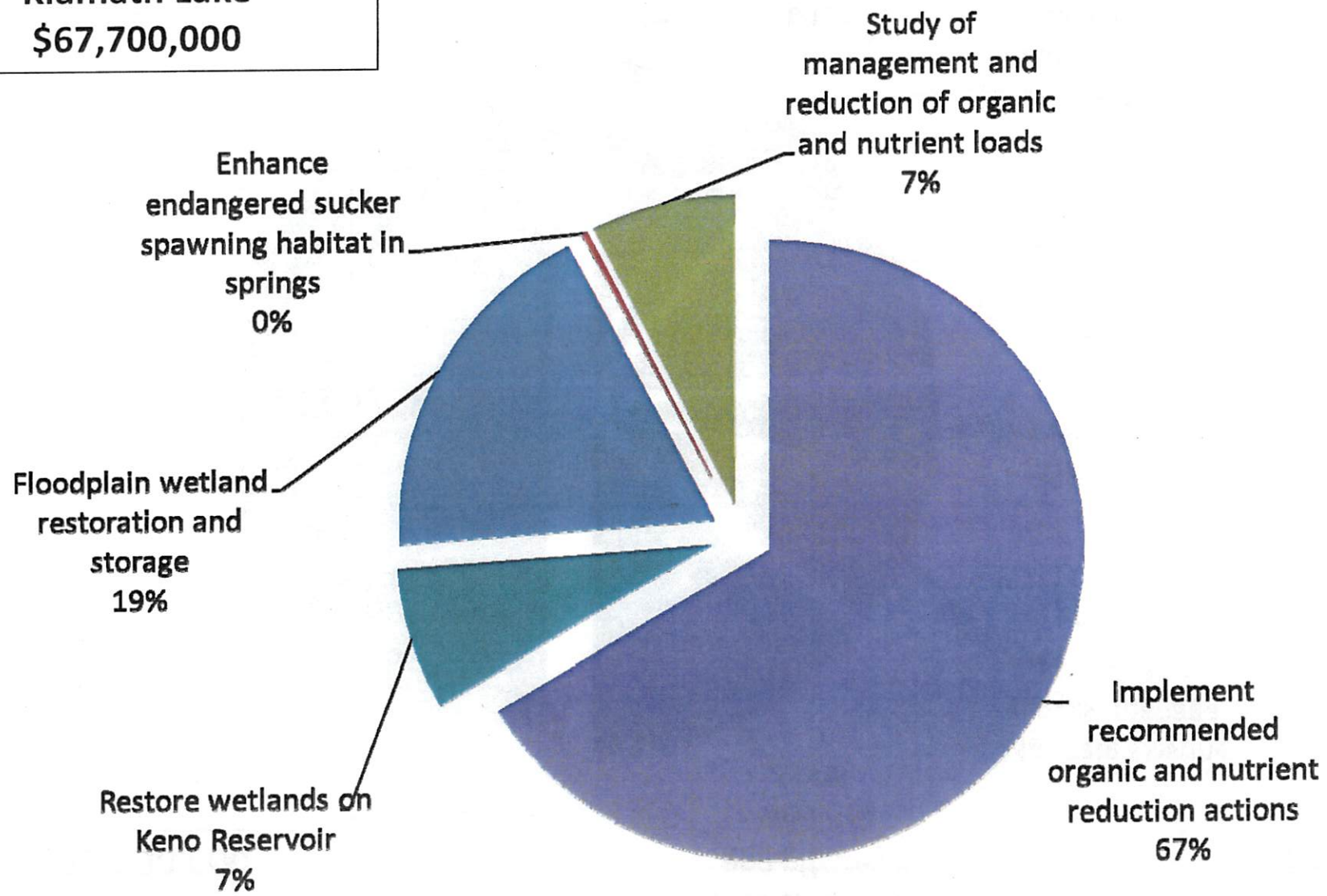
Williamson River
$8,000,000



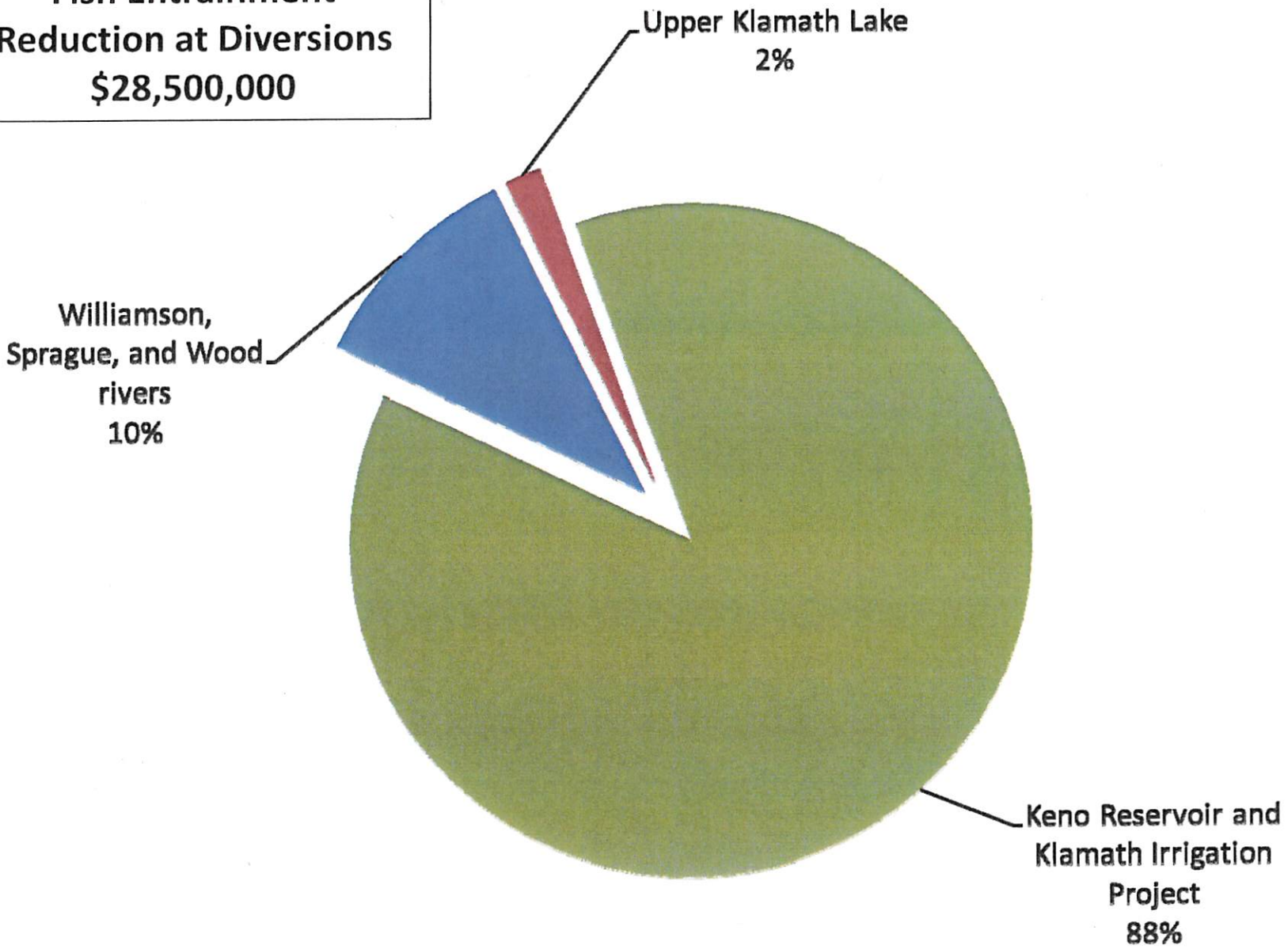
Wood River
$13,700,000



Keno Reservoir and Upper Klamath Lake
$67,700,000



Fish Entrainment Reduction at Diversions $28,500,000



SCWUA
Siskiyou County Water Users Association
347 N. Main St. Yreka, CA 96097
530-842-5443 scwua@yahoo.com
siskiyoucountywaterusers.weebly.com

STATE WATER RESOURCES CONTROL BOARD
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There are 25,922 registered voters in Siskiyou County:

There were 15, 483 people who voted which makes our participation in the voting process 59.73%. There are 63 precinct in Siskiyou County.

There were 14,206 votes casted for measure G. 11,229 voted No (79.04%) and 2,977 voted yes (20.96%).

Should the Klamath River Dams (IronGate, Copco 1 and Copco 2) and associated hydroelectric facilities be removed:

Here is the breakdown according to the precinct map:

Pink: 20% yes 80% No
Willow Creek, Happy Camp, Hornbrook, Bogus, Copco, Callahan consolidated, Klamath River consolidated, Seiad Consolidated, and Oak Knoll Consolidated

Green: 15% yes 85% No
Montague 2, Dorris1, Montague 1, Edgewood, Grenada, Lake Shastina M, Lake Shatina E, Mayten, Weed 1, Weed 2, Forrest Mtn., Yreka 1, Yreka 2, Yreka 3, Yreka 4, Yreka 5, Yreka 6, Greenview, Etna 2, Ft. Jones 2, Quartz Valley, Etna 1, Fort Jones 1, Dorris 2, Grass Lake, Macdoel, Tennant, Little Shasta A, Big Springs, Gazelle consolidated, Warren, Montague 3, Delphic Consolidated, Greenhorn 4 and Greenhorn 5.

Yellow: 21% yes 79% No
Tulelake 2, Tulelake 3, Tulelake 1,

Organge: 36% yes 64% No
MCCloud 1, MCCloud 2, Dunsmuir 3, Mt. Shasta 3, Mt. Shasta 5, Kinstrey, Dunsmuir 1, Dunsmuir 2, Mt. Shasta 1, Mt. Shasta 2, Mt. Shasta 4, Sisson, Pondosa Consolidated, and MCCloud 3.

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Columbia Basin Bulletin Issue Summary No. 1:

Salmon and Hydro: An Account of Litigation over Federal Columbia River Power System Biological Opinions for Salmon and Steelhead, 1991-2009

This issue summary offers a historical account of the continual litigation over Columbia Basin salmon and steelhead biological opinions since the first Endangered Species Act listings and summarizes the major issues that have dominated Columbia Basin Salmon recovery since 1991.

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STUDY LINKS HABITAT CHANGES, MANAGEMENT WITH 'PARASITE LOADS' IMPACTING SALMON MORTALITY

Posted on Friday, August 26, 2011 (PST)

A recent study suggests that parasites in fish, including threatened species of Oregon coho salmon, may have more profound impacts on fish health than has been assumed, and could be one of the key mechanisms by which habitat and land use changes cause salmon mortality.

It's not just the presence or absence of parasites that is important, the research found, but their numbers that can build up over years or decades and ultimately cause major impacts.

The study (available at http://hdl.handle.net/1957/22084) will be published soon in the journals Aquaculture, Journal of Parasitology, and International Journal of Parasitology. It was done by researchers from Oregon State University and other agencies, and concluded that heavy loads of parasites can affect salmon growth, weight, size, immune function, saltwater adaptation, swimming stamina, activity level, ability to migrate and other issues. Parasites drain energy from the fish as they grow and develop.

"We've known for a long time that salmon and other fish are affected by parasites, so that isn't new," said Mike Kent, an OSU professor of microbiology. "Because parasites have been present for decades, they have often been dismissed as a cause of increasing salmon mortality.

"But we're now getting a better appreciation that it's the overall parasite load that is so important," he said. "The higher levels of mortality only show up with significant increases in the parasite burden."

And that increase in parasite numbers, Kent said, is a slow, gradual response to warmer waters and heavier nutrient loads that can be a result of logging, agriculture, inadequate streamside protection and other land use or management changes over many years.

"Salmon can actually tolerate a fairly wide range of

MOST VIEWED CBB STORIES

NOAA Fisheries Status Review: 13 Columbia Basin Salmon, Steelhead Stocks To Retain ESA Listing

Some Question New Water Release Regime Intended To Return Salmon, Steelhead To Upper Deschutes

Willamette Plan Released; Calls For Reintroducing Salmon, Steelhead Above Santiam, McKenzie Dams

Columbia River Estuary's Salmon-Eating Tern Colony Produces No Chicks This Year

Tribes To Test Run Fish Processor Facility As Way To Market 'Indian-Caught' Columbia River Salmon

117,500 Triploid Trout Escape Columbia River Net-Pen Operation; Might Pose Threat To ESA Steelhead

Redden Orders New Salmon BiOp By 2014; Says Post-2013 Mitigation, Benefits Unidentified

Group Gains OK From Oregon Sec. Of State To Launch Non-Tribal Gill-Net Ban Initiative

Year's First Snake River Sockeye Makes It Back To Sawtooths; Over 1,000 Counted At Lower Granite

More 'Fouled' Boats Being Identified As Quest Continues To Keep Quaggas At Bay

temperatures, it's not just the fact a stream is warmer that's killing them, in and of itself," he said. "We now believe that some of these forces are leading to heavier parasite loads. This could be important in understanding declining salmon populations."

Some of the digenean parasites that can infect salmon and other fish have complex life cycles, which include passage through the intestinal tracts of birds that eat fish, producing eggs and then infecting snails. Snails thrive in warmer water with higher nutrient loads from common fertilizers.

It's been historically difficult to study these issues in salmon, Kent said, because they migrate and cannot be easily analyzed, as fish can when they are trapped in a lake or pond.

In the new study, researchers did both laboratory and field analysis of fish in Oregon's West Fork Smith River. The impact of parasites on fish health were much more severe in a part of the river where water moved more slowly and nearby logging and agricultural practices increased water temperature and nutrient loads. Fish in this area had parasite infestations about 80 times higher than those higher up in the tributary.

The various impacts on fish health, the researchers said, could affect their ability to survive. Fish size influences juvenile overwinter survival, for instance, and swimming ability that's essential to avoiding predators.

"Understanding why certain salmon populations are heavily infected with these parasites, which likely are driven by landscape characteristics, could help in management or recovery planning," the scientists wrote in their conclusion, "given that our data indicates that severity of these infections are associated with survival."

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'They Are Nice Big Fish'; 2009 Outplants Return To Upper Deschutes As Adult Chinook, Sockeye

Naturally Produced Smolts Showing Higher Presence In Snake River Sockeye Restoration Efforts

Re-Introducing Chinook To Okanogan Basin; Another Proposal For An ESA 'Experimental' Designation

Ocean Vs. Freshwater Impacts On Salmon: Council Wants Report To Show Value Of Ongoing Research

American Fisheries Society Western Division Again Calls For Breaching Snake River Dams

Study: Removing Large Fish (Apex Consumers) Triggers 'Trophic Cascade' In Ecosystems

Genetically Modified Salmon: Study Looks At Danger Of 'Trojan Gene Effect' If GM Fish Escape

Sockeye Run Picks Up, Could Be Fourth Largest Since 1980; Over 2,000 Snake River Fish Forecasted

Deadly Virus Forces Euthanization Of Over 300,000 Juvenile Steelhead At Dworshak Hatchery

Feds, Kalispel Tribe Propose 10-Year, $39 Million Agreement For Pend Oreille River Mitigation

For First Time, Alternatives To Gill Nets Being Tested In Summer Chinook Commercial Harvest

Bald Eagles' Predation Decimates Columbia's Salmon-Eating Tern Colony; Cormorants Also Hit Hard

Council's Science Review

Panel Questions Hatchery Supplementation Effectiveness In Lower Snake

Deep Snowpacks Continue Slow Melt; Basin Water Supply Expected To Be Third Largest On Record

Marine Scientists' Report Says World's Ocean At Risk Of Entering Mass Species Extinction Phase

Final Regulatory Approvals Sets $32 Million Decommissioning Of Condit Dam For This Fall

Oregon Approves New Water Quality Rules Based On Highest 'Fish Consumption Rate' In Nation

Condit Dam Removal Likely To Bring More Bull Trout, Lamprey To White Salmon River Basin

Summer Chinook Run Expected To Be Best Since 1980, Fishing Starts June 16; Summer Steelhead Moving

Study: Unprecedented Snowpack Losses In West Last 50 Years May Signal Fundamental Shift

States Suspend Sea Lion Removals While Awaiting Decision From Federal Court

Umatilla Project Rebuilds Miles Of Creek Channel To Restore Salmon, Steelhead, Bull Trout, Lamprey

Levels Of Gas Bubble Trauma On Migrating Salmon, Steelhead Not Alarming At This Point

Mid-Columbia Net Pen Trout Rearing Operation Taking Losses From Gas Bubble Disease

Record High Water Supply, Flow Overrides BiOp Spill For Listed Kootenai White Sturgeon

Big Flows Bring Limits On Non-Hydro Energy; Spill Stirs Gas Levels Potentially Harmful To Fish

Reservoirs Being Managed To Prepare For Biggest Chunk Of Runoff Volume That Has Yet To Come

Upper Columbia: Peak Runoff Yet To Come On Rivers Already Exceeding Flood Stage

Humane Society Files Legal Challenge To NOAA's Authorization Of Sea Lion Removal

American Shad: Commercial Fishery Test Approved Using Experimental Gear, Purse Seines, Drift Nets

NOAA Re-Authorizes Lethal Sea Lion Removal, Says Has Responded To Appeals Court Concerns

Study Indicates Substantial Salmon Mortality May Occur Later In Migration, Rather Than Near-Shore

American Shad: Non-Native To Columbia Basin, Runs Exceed One Million Fish, Peaking At 6.5 Million

BiOp Oral Arguments: Redden Asks About Accountability If Future Survival Evaluations Fall Short

Judge Redden Informs Salmon BiOp Litigants Issues He Wants Discussed At Monday's Oral Arguments

Study Of Portland Watershed Council Shows Disproportionate Representation By Wealthier, Liberal

Researchers Discuss Declining Columbia Basin Lamprey Numbers, Options For Reversing Trend

Interior Climate Change Water Resources Report: Columbia Basin Warmer, More Rain, Less Snow

Tree Ring Records Show El Nino Intensity In Pacific Past 1100 Years; Could Improve Climate Modeling

Snowpack Has Upper Basin Dam Managers Looking For Ways To Avoid Flooding During Peak Runoff

Spring Chinook Return 'Appears To Be Significantly Later Than Normal'; Water Record-Breaking Cold

Inland Waterbird Colonies Show Unexpectedly High Predation Rate On Specific, Listed Salmonid Stocks

Groups File Notice To Sue Over Sandy River Hatchery, Contends Harms Wild Salmon, Steelhead

First Time In Recorded History Wolverine Tracks Confirmed In Oregon's Wallowa Mountains

Selective Gear Testing For Commercial Salmon Fishery Encouraging; Might Go Full-Fleet In 2013

Black Bear Somehow Finds Itself On Dalles Dam Spillgate; Had To Be Killed

Highest Basin Water Supply In 12 Years; April 1-11 Precipitation 203 Percent Above Average

Budget Bill Removes Montana, Idaho Wolves From Federal Endangered Species Act List

Big Flows Slow Chinook Fishing, States Approve Another Week; Run Late Or Smaller Than Expected?

Lack Of Dredging Behind Lower Granite Forces Balancing Act For Fish, Navigation, Flood Control

Study Details How Biodiversity, Accelerated Species Loss Impacts Water Quality

Spring Chinook Fishing Success Hitting Allocation Targets Based On Run Forecast

Interior Reports Details Potential For Expanding Hydro Energy At Existing Northwest Dams

Fraser River: First Large Scale Study Showing How Wild Salmon Adapt To Specific Migration Conditions

Major Effort Underway To Monitor, Research And Recover Declining, ESA-Listed Smelt

Research Indicates Wild Fish Conservation Best Served By Minimizing Wild/Hatchery Interactions

Thousands Of Kokanee Flushed Through Dworshak Dam Into Clearwater; Keep All The Fish You Can Catch

Research Directly Links Salmon Abundance With Diversity, Productivity Of Riparian Plant Life

New Snake River Sockeye Hatchery Would Boost Recovery Efforts With Much Larger Smolt Releases

Montana Inspectors Find Quagga Mussel On Sailboat Near Flathead Lake, Came From Infested Lake Mead

Judge Rules On Grande Ronde/Imnaha Tribal Fishing Issue But Not On Treaty Fishing Rights

Clearwater Coho Restoration Reaches Milestone With Release Of Juveniles Coming From Returning Fish

ODFW Expects Promising Summer Steelhead Season With Forecasted

391,000 Fish

ESA-Listed Steller Sea Lions Munching Away On Non-Listed White Sturgeon; Management Options Few

Predator-Prey Relationships, Other Lake Billy Chinook Issues Focus Of Bull Trout Study

States Seek Delisting Of Steller Sea Lions; NOAA To Decide By Aug. 30 Whether Warranted

Summer Steelhead Run Expected To Be About Average; Data For 2010 Return Shows Wild At 37 Percent

Study Suggests Habitat Restoration Efforts Need Increase To Produce Measurable Fish Abundance

Early Run Forecasts Predict Record Return Of Naturally Produced Snake River Fall Chinook

Columbia River Fall Chinook Return Predicted To Be Fifth Largest Since 1948; 760,000 Fish

For Repair Work Corps Removes Large Numbers Of White Sturgeon Wintering In Bonneville Fish Ladders

Alaska, NW Lawmakers Seek Ban On Genetically Engineered Salmon (Or At Least Labeling)

Spring Chinook Fishing Dates Aimed At Relieving Boat Congestion; Forecasted Run Close To Average

Council Rejects State Agencies' Funding Request For More Sea Lion Traps At Bonneville Dam

Mekong River Resource Development Looks For Fish Protection Lessons From Columbia, Fraser Rivers

Expanding Fleet Of Undersea Gliders Revolutionize Study Of Ocean Off Pacific Northwest

First Spring Chinook Arrive; Run Expected To Have Large Component Of Big Five-Year-Olds

Restoring Upper Willamette River Basin Salmon Runs Challenged By Soaring 'Pre-spawn Mortality'

Study Measuring Swimming Performance Differences Of Wild Vs. Hatchery Fish

Study: Healthy PNW Steelhead Populations May Require Healthy Wild Rainbow Trout Numbers

Snake River Fall Chinook 2010 Redd Count Includes Records For Tributaries, Creeks

BiOp: Oregon, Nez Perce, Coalition Again Contend Fish Survival Benefits 'Remain Speculative'

Mitchell Act Economic Impact: 17 Hatcheries, 70 Million Juveniles, Almost Half The Basin Harvest

Mitchell Act Fund Expansion Aimed At Segregating Wild Salmon From Hatchery-Produced

Mysis Shrimp Invasion Changed Entire Flathead Food Web, Study Says

Salmon River Snorkeling Sampling Shows Dramatic Impact Of Cooler Water Temperatures

Salmon Survival: It's All About The Early Days In The Ocean And 2010 Tough To Call

Analysis: Size Of Pacific Ocean's 'Great Garbage Patch' Grossly Exaggerated, Undermines Credibility

NOAA Fisheries Proposes

Lower Columbia River, Tributaries As Critical Habitat For Listed Smelt

Agencies Release Progress Report On Salmon, Steelhead Protection Under FCRPS BiOP

BiOp Litigation: Briefs Filed Contending Agencies' Salmon Plan Legally, Scientifically Valid

January-July Early Water Supply Forecast: Will It Be First Above Average Runoff Since 2006?

'Ocean Indicators' Efforts Leading To More Certainty In Predicting Annual Salmon Returns

Record Bycatch Of Salmon In Gulf Of Alaska Sparks Concern: Impacts On PNW Fish Unknown

Tagging Study Aims To Measure Extent Of Pinniped Salmon Predation From River Mouth To Bonneville Dam

2011 Salmon Forecast: Summer Chinook May Be Record Breaker, Upriver Spring Chinook Near Average

Test Fishing With Alternatives To Gill Nets – Purse And Beach Seines – Show Positive Results

Hatcheries And Salmon Recovery: Agencies, Tribes Comment On NOAA's Draft Hatchery EIS

New $51 Million Dalles Dam Spillway Wall Boosts Juvenile Salmon Survival Above BiOp Targets

Lower Columbia Cormorant Colony's 2010 Salmonid Consumption Shoots Up To 19 Million Smolts

Montana Biologist, National Geo Photographer Bring Upper Columbia Bull Trout To

Screen, Online

Appeals Court Rejects Lethal Removal Of Salmon-Eating Sea Lions; Remands Issue Back To NMFS

Population Crash, ESA Listing, Leads To Smelt Fishing Ban In Columbia River Basin

Tribes Detail Success, Promise Of Supplementation To Boost Natural Spawning Salmon Populations

This Year's La Nina Likely To Bring Cold, Moist Jet Streams Into Northwest This Winter

Hundreds Of Steelhead Found Trapped In Dworkshak Turbine Tube; About 1,000 Fish Killed

Draft Recommendations On Sea Lion Removal Urge Firearm Use, Shooting From Boats

BiOp Challengers: 2010 Supplemental Salmon BiOp 'Adds Nothing Of Legal Significance'

Snake River Fall Chinook Return To Lower Granite Shattering Record; Fishing Not So Great

Report Analyzes Efforts To Move Nesting Terns From Columbia River To Interior Oregon

NOAA Ship Taking Samples From 'Great Pacific Garbage Patch' To Study Impacts On Marine Ecosystem

NOAA: Research Indicates Hatchery Fish Have Poor Reproductive Success When Spawn In The Wild

Huge Hatchery Releases From Japan, Alaska Fill North Pacific With Pink, Chum, Sockeye; Too Much?

Lake Pend Oreille Operations Set In

Continued Effort To Revive Kokanee, Aid Bull Trout

Idaho Governor Says State Will No Longer Be 'Designated Agent' For Wolf Management

Study Details How Whales, And Whale Feces, Play Key Role In Ocean Productivity

Kootenai Tribe Gets Go Ahead To Expand White Sturgeon Hatchery Program, Launch Burbot Production

Scientists: Reams Of Technical Info Not Enough To Spur Social Acceptance Of Climate Change

$27 Million Awarded To Remove Elwha Dams; Salmon Numbers Expected To Go From 3,000 to 300,000

Hatchery Mishap Kills Young Snake River Sockeye Part Of Captive Broodstock Program

Four New Studies Detail Economic Contribution Of Fisheries

Pikeminnow Catch Ahead Of Last Year's Pace; One Angler Hooks 12 Tagged Fish For Six Grand

From A Few Fish To A Thousand; Sawtooth Basin Sockeye Salmon Return Highest Since 1955

Oregon, BPA Close To Proposed $103.5 Million Agreement On Willamette Valley Mitigation

'La Nina' Now Reigns PNW Weather; Colder Ocean Should Be Boost To Basin Salmon Survival

Legal Sparring Begins On 2010 Supplemental Salmon BiOp; Oregon Wants Document 'Vacated'

Council Recommends Using $16 Million In BPA Funds For Willamette

Habitat Acquisitions

Lightning Apparently Electrocutes Half The Fish In Idaho Hatchery Adult Chinook Pond

For First Time, Captive Broodstock Program Allows Snake River Sockeye To Swim Through Trap To Spawn

Fall Chinook Hit 1,000 A Day At Bonneville Dam; Treaty, Non-Treaty Commercial Fisheries Approved

Trapping Of Returning Snake River Sockeye Salmon Off To Fast Start, Heading For A Record

NOAA Fisheries Releases For Comment Draft EIS For Guiding Columbia Basin Hatcheries

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Monday, December 15, 2014

Klamath Basin: A lesson in war tactics, bias, distortion

by Theodora Dowling, WLJ Correspondent

Water's for fighting, and if you're going to fight and win, you need strategy. A few strategies famously used over the millennia have been "divide and conquer" and the old "Trojan horse" trick.

Some farmers and ranchers in Northern California and southern Oregon think that both strategies are being used against them in the Klamath River watershed. In 2002, a federal judge granted the Klamath Tribes senior water rights in the Klamath Basin. Now, at any time, the tribes could "call" their water rights and completely deny water from farmers and ranchers in the basin. A tenuous agreement was reached in 2010 that, for now, provides basin producers with enough water to keep some of them in business.

But for the agreement to stick, the tribes, environmental groups, and commercial fishermen negotiating with farmers and ranchers have demands. In the name of protecting the federally listed Coho salmon and suckerfish, they are demanding that: four significant dams be removed downstream from the basin; hundreds of miles of riparian areas be fenced throughout the entire watershed; farmers and ranchers in the Klamath Basin give up 30,000 acre-feet of water rights (being used to irrigate 18,000 acres); and farmers and ranchers drop their legal challenge of the tribes' water rights.

Also necessary to finalize the agreement is federal legislation. Farmers and ranchers in the basin know they need some kind of resolution in order to avoid what happened in 2001—a complete water shut-off. But other producers and communities downstream from the dams are hollering "whoa!" So far, their opposition has been enough to stop the legislation pending in the Senate that would finalize the agreement.

ESA at work once again

Historically, the area's farming and ranching community has stood strong together. But according to Klamath County Commissioner Tom Mallams, who testified before the U.S. Senate in 2013, "Our community has been divided by the age old method of 'divide and conquer.'" It would seem that in the Klamath Basin, as in so many examples across the country, the Endangered Species Act (ESA) is being wielded to control resources—and farming and ranching communities at opposite ends of the Klamath watershed are being placed in a position of opposition to one another.

How? Klamath Tribes Chairman Don Gentry may have summarized it best when he stated, "We have successfully used regulatory tools like the Endangered Species Act... and have had some important victories in court." He continued, "We have also learned that winning one battle does not end a long-lasting war..."

When "at war," negotiations are sometimes necessary—and there can be casualties. But U.S. Representative Doug LaMalfa (R-CA) has warned that Klamath Basin farmers' and ranchers' negotiations may not end up as fruitful as they hope.

"There's no guarantee, if this 'agreement' ever gets codified by law, that someone else won't come along and sue to deny the rest of farmers' and ranchers' needed water," LaMalfa told WLJ.

"The Klamath Basin has an existing water shortage problem. Removing the dams downstream does nothing to change that. Neither will any other provisions of the 'agreement.' So when, lo and behold, there's still a water problem for endangered fish, guess who's going to be targeted to give up their water? The same farmers and ranchers who are now trying to negotiate a deal they think they can live with."

Siskiyou County Supervisor Michael Kobseff told WLJ that litigation may not be the only way for such losses to occur. The legislative language offered this session by Senator Ron Wyden (D-OR) would empower the stakeholders of the agreement to amend it at any time in the future without congressional approval. "Thus setting up an unelected regional form of government in the Klamath Basin," he said.

In other words, these elected officials say, the tentative agreement may be little more than a Trojan horse—a way to get federal legislation through to tear out the dams, with potential loss of all benefit to the producers negotiating the deal.

Meanwhile, loss of the dams will be devastating, according to local sources.

In 2013, Siskiyou County Supervisor Kobseff testified before a U.S. Senate committee regarding the implications of the dam removals.

Siskiyou is home to approximately 150 miles of the Klamath River and three of the four dams that are proposed for removal. "Except for a minority of agricultural interests receiving promises of water," he stated, "the majority of agriculture and ranchers will suffer significant losses."

Also in Daily News:

Understanding dietary needs, conflicts of range livestock, wildlife

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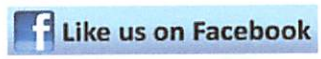





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December 2014

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California Female Expo
Turlock Livestock Auction Yard
Western Video Market

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11•	12•	13•
14	15	16•	17	18•	19	20•
21	22	23	24	25	26	27
28	29	30	31			



Kobseff said loss of the dams meant more than loss of water storage. Eighty percent of Siskiyou County residents had earlier voted to oppose the removal of the dams. They provide hydropower to some 70,000 residents. No replacement source of power has been identified. The dams also serve to control catastrophic floods, have "transformed former marginal habitat into world-class fisheries," provide water for fish in times of drought, improve water quality generally by providing a settlement basin for naturally occurring toxins, and cool the warm water coming in from the upper high desert basin in Oregon. The Iron Gate dam makes possible a fish hatchery that produces over six million salmon smolts annually, Kobseff added.

Dam removal, Kobseff noted, would prove catastrophic—not just because of the loss of the above functions, but because the removals would release nearly 20 million cubic yards of sediment loaded with toxic minerals.

"This release may result in massive destruction of the ecosystem... Although on considerably smaller scales, one need only look to the damage done by the removal of other dams (Elwha, Condit, Gold Ray, Savage Rapids) to see the destructive consequences of dam removal," Kobseff testified.

The expected damage to the environment and economy, Kobseff explained, was rationalized on the basis that salmon will have access to approximately 35 miles of what he called "historically inconsistent and marginal habitat."

He described the federal analysis of the dam removal proposal as "replete with examples of bias, distortion, and circumvention of legal, scientific, and scholarly standards..." He said the federal government incorrectly cited "marked declines" of fish populations in recent years. The government's projection of economic effects was also grossly miscalculated, he said. The report cited "non-use values" amounting to $98 billion.

"Without these phantom benefits," Kobseff asserted, "the proposal for full facilities removal has negative economic results."

Dam removal trend?

Will dam removals on the Klamath incite a trend toward dam removal westwide? Farmers and ranchers negotiating the agreement in the Klamath Basin have been careful to point out there are special circumstances surrounding the possible dam removals in this case. But others are concerned that this dam removal, if implemented, could set a precedent. This could mean a lot to residents in the vicinity of the Grand Coulee dam and four dams on the lower Snake River in Washington, which are reportedly in the crosshairs. Of the Snake River dam removals, a representative of Save our Wild Salmon Coalition last year stated, "Of course [dam removal] is best for the salmon."

There are many more dams being targeted across the country—just look up "dam removal" on Wikipedia. Is the Klamath Basin a special exception, or will it become the rule? Will the ESA continue to be used as "a tool," as the Klamath Tribes spokesman put it, and will the "long-lasting war" continue? These are the questions that the agricultural community, local governments, and U.S. Congress must consider as they move forward with Klamath Basin negotiations. — **Theodora Dowling, *WLJ* Correspondent**

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2014 Bull Survey
Livestock Tours
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Denver, CO
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Western Livestock Journal

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Is A Solution Achievable?

For the past 2 decades, agencies, institutions, Tribes, stakeholders and individuals have and will continue their search for ways to resolve the water allocation battles. Here on the Klamath River, the demand for water exceeds supply on an average of about 7 out of 10 years. The late summer months are particularly challenging as crops need water at the same time salmon are returning to spawn.

Fix, sustain, cooperate, allocate and showcase issues are terms most often used to describe how to distribute and send enough water down the 255 mile system to accommodate long standing use and water management priorities. Currently action agencies have and are pursuing sustainability projects for in River and watershed values, but they cannot accommodate climatic changes or ocean habitat mortalithy.

Agency actions currently being implemented are :

1. Sport and commercial salmon hook and line fishing closer along the coastal waters of the Pacific
2. Acquiring retired farms to reduce crop water allocations
3. Removing land dikes to free up more area for water storage in Upper Klamath Lake
4. Adjudication River & tributary water diversions to regulate water taking
5. Make grants available to convert to more water efficient irrigation systems
6. Install fish screens at major water diversion points
7. Continue to repair high elevation stream flow maintenance dams on lakes in wilderness areas to lengthen the flow of snow melt water into major tributaries

8. County supervised employment of water masters in Scott and Shasta Valley to make sure irrigation districts divert the adjudicated amount and enforce drought year controls

These individual agency efforts can have an input on resolving minor disputes but an update of the comprehensive solutions referred to in the 1955 Bi-state compact is long overdue.

The 2004 Norton Agreement is still on the table. It carries provisions to bring agencies together and make that final push to find a middle ground solution that will sustain the unique values of this beautiful watershed and river for future generations

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Interior Denies Spinning Klamath Science

Author: Public Employees for Environmental Responsibility (PEER)
Published on Mar 25, 2013 - 1:51:39 PM

Washington, DC March 25, 2013 - The U.S. Interior Department has rejected a complaint from one of its own Scientific Integrity Officers that it presented distorted summaries of studies on the effects of a still-pending decision to remove dams in the Klamath River. Interior's review confirmed the substance of the complaint but concluded that blatant inaccuracies and critical omissions did not constitute scientific misconduct, according to a response posted today by Public Employees for Environmental Responsibility (PEER).

Dr. Paul Houser, a hydrometeorologist, took leave from his university position to become a Science Advisor to the U.S. Bureau of Reclamation and to serve as its Scientific Integrity Officer. In September 2011, he was asked to look over a draft press release and a summary of analyses on expected effects of removing four dams from the Klamath. The release described only positive aspects, omitting a number of major contingencies, uncertainties and possible negative effects. He elevated these concerns to the Secretary's office. Although Reclamation's technical staff seconded his objections and the release was ultimately changed, two weeks later he was put on probationary status and the Department took numerous related retaliatory actions. In February 2012, his position was terminated. Dr. Houser then filed a complaint that the actions against him violated the core tenets of the Interior Scientific Integrity Policy that he was formerly administering.

To help review the complaint Interior hired a consultant firm; the firm convened a three-member panel and produced a report in August that was only released last week. The panel concluded that the complaint was factually correct but did not amount to misconduct for some very curious reasons. For example â€"

Â· Instances of "false precision" (where a summary has a finding that does not exist in the studies it purports to summarize) are dismissed because they are "not inconsistent" with the underlying studies;

Â· Repeated inaccuracies â€" all slanted in one direction â€" in these short documents are excused by a panel finding that it is "normal practice" for press releases to exhibit hyperbole or falsities; and

Â· Explicit efforts to prevent these concerns from being put into writing were discounted because the panel found them "not sufficiently unusual" to be "automatically alarmed" by them.

"By blessing abuse as â€˜standard practice' this review stood Interior's scientific integrity policy on its head," said Dr. Paul Houser, who also filed a whistleblower retaliation complaint which has since been resolved. "I feel like I fell through the looking glass into a world propelled by circular reasoning."

Although the panel interviewed no witnesses, did not question Dr. Houser nor did any kind of actual investigation, it made findings about motives and intent of several of the actors inside Interior. Rather than conduct its own inquiry, Interior's Scientific Integrity Officer, Dr. Suzette Kimball, accepted the panel's conclusions as "definitive" and formally declared the complaint to be "Not Warranted." Her ruling came in a January 29, 2013 letter which did not include a copy of the report on which it was based.

"It is becoming obvious that Interior's scientific integrity process suffers from a glaring lack of integrity," stated PEER Executive Director Jeff Ruch, noting that no scientific misconduct complaints filed under Interior's integrity rules have been found to have merit. "These rules were created at the behest of President Obama to root out rampant political manipulation of science yet in more than two years Interior has managed not to find a single instance of it."

Read Dr. Houser's rebuttal

Revisit the original complaint

See the consultant report

View Interior's adoption of the report

Look at Interior's dismissal of every scientific misconduct complaint

See resolution of Dr. Houser's whistleblower retaliation complaint

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Presented to the Siskiyou County
Board of Supervisors AKA Board of Directors
Siskiyou County Flood Control and Water Conservation District
April 1, 2010

Thank you once again for the opportunity to appear before you.

I have prepared a more detailed response to the issues raised today regarding The Klamath River, The Klamath Basin and the salmon occupying the River and tributary habitat. They have already been presented to you for review.

My remarks come from a collection of 52 papers and documents about the river and basin used to develop video documentaries currently being show by the Collier Joint Power Authority at our Interpretative Center at the junction of Interstate 5 and The Klamath River. Over 1 million people a year visit this Calif State Safety Roadside Rest Center and can view the video documentaries.

The points I briefly focus on today are the decision factors not adequately presenter or addressed by the authors who have prepared 2 agreements that will have a major impact on the water flows, water uses and the fish & wildlife habitat in the Klamath Basin.

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1. SISKIYOU COUNTY

As a reminder that there are 9 Counties partially or fully within the 10 million acre Klamath Basin, Siskiyou County has the largest land base (4 million of the 10 million acres) and controls with Federal partners, 60% of the River mileage shoreline. You and the residents of Siskiyou County have a major responsibility to make sure that all provisions of the National Environmental Policy Act are fully carried out. If, as has been reported , Agencies, stakeholders and the Power Co. have oriented agreements without stated and evaluated options then both State and Federal policies have not been complied with.

2. Annual Precipitation

From a water resource perspective, annual precipitation (snow & rain) is the most significant consideration in evaluating potential changes to storage, the availability of water for use & providing minimum flow requirements for the fish habitat. Annual precipitation varies greatly from the amt that falls and the geographic position in the watershed that receives it. 100 inches on the coast, 30 inches midway up River and 10-15 inches at the headwaters near Upper Klamath Reservoir.

It is pretty obvious why our forefathers energized a series of Public Works projects (primarily in the mid to upper Klamath Basin) to harmonize the flows of water in 3 of the 4 major valleys in Siskiyou County. The provisions for water supply to accommodate the 5 major uses depicted in the Bi-State Compact is a challenge for water mgt. agencies.

A recent 8 year weather pattern study for the Klamath Basin identified 6 conditional responses to the amt. of annual precipitation received each year. They categorized them as drought, semi-drought, normal, above normal and flood. In this study 6 of those study years were either drought or semi-drought . In Shasta Valley the adjudicated right holders for the Shasta River had to reduce their irrigated land by at least 10,000 acres, in the study years, which represents a sizeable loss in crop & cattle production.

Managing the current flows to meet mandated releases from an almost unpredictable annual weather pattern is very challenging. Can you

envision what it would be like if you authorize the removal of some of their storage and release tools?

Flow studies of the River were conducted in the mid-90's and early 2000's over a 6 year , 72 month period. The study shows that 6 of the 72 months during the examination period did not meet the 1,200 minimum second ft release requirement for salmon spawning. These months were over 3 yrs from late July to early Sept.

3. Stream Flow Maintenance Structures

There are more than 50 stream flow maintenance structures within the Klamath River and its tributaries. Lake Siskiyou, Dwinell, Irongate & Copcos are just 5 of them. At least 2/3 of the structures in the basin are in need of repair to perform their intended water flow responsibilities of flood control, storage and long term release. Lewiston, Dwinell, Irongate & Keno are the key structures for flow regulation to and within the Klamath River.

4. Crop, Land and Water Values

There are approximately 200,000 acres of crop, pasture and grazible land in Siskiyou County. 138,000 acres are irrigated in the 4 valleys. Nature Conservancy did a study in 2008 and determined that an acre foot of water used for the growing an alfalfa crop had a value of $535.00. They also determined that an acre ft. of water used to grow pasture for livestock had a value of about $385/acre. Utilizing the 60,000 ac ft of water currently stored behind Irongate Dam for use in Shasta Valley would raise the irrigated acreage to 20,000 acres. Split it 50/50 crop & pasture means that Irongate Reservoir is annually storing approx 1 million $$ worth of water and has done so since 1957 when appendix B of the Bi-State Compact was amended into it. We have often wondered what the water value for fish might be? That should be derived in the NEPA Economic Analysis process now being developed by the Dept. of Interior.

5. River Flows

The National Science Foundation Committees' recommendations in Chapter 7 "Conclusions & Recommendations" of their 2007/2008 report have not received the attention they deserve in the development of the KBRA & Hydro agreements. The NEF Committee stated that after reviewing flow studies (Hardy 2006 & USBR 2005) and the use of them by the Bureau of Reclamation to target flows for the River presented concerns that would detrimentally affect Coho and Chinook salmon. The committee found that studies and reports were evaluated piecemeal and without link to major science and engineering investigations. They concluded that important characteristics of research for management of a complex River Basin were missing from Klamath River studies and that a "Big Picture" perspective is needed using conceptual models encompassing the entire Basin and its many components. Siskiyou County should, as part of their Compact responsibilities, direct the agreement agencies to model flows using various precipitation predictions and public works studies.

6. The Bi-State Compact for the Klamath Basin.

Because of the precipitation patterns obtained from historic weather records, many studies were undertaken to search ways to prevent floods and more conservatively utilize the precipitation available on the Klamath and its major tributaries. The principle theme of the studies was to find ways thru the use of water to enhance the economic well being of the counties and the citizens residing within it.

Commissioners were appointed by the 2 State Governors. 5 from Oregon, representing Klamath & Jackson Counties and 5 from Calif. representing the State Water Resources Agency and 4 counties, Modc, Trinity, Humboldt & Siskiyou. An 11th person was appointed by the US Govn't. These 11 Commissioners developed and agreed on Articles to be put forth in a Bi-State Compact. In 1955 State Legislatures endorsed as did the US Congress. Appendix B of that Compact was written and endorsed in 1957 forming the Siskiyou County Flood Control and Water Conservation District. It is a Federally mandated Water District with a Board of Directors. The purpose is to promote orderly, integrated and comprehensive development, use, conservation and control for the use of water .

7. Appendix B of The Compact

Early to mid 1900's studies are referenced searching out ways to prevent floods and conservatively use water in the Klamath Basin. Passage of the 1902 Reclamation Act provided funds to finance Public Works projects. The Klamath Project and major River storage structures were envisioned and constructed in the Klamath Basin over the next 50 years. Between 1955 & 1957 the Klamath Basin Compact was written and ratified with approved amendments. Appendix B was a 1957 addition to the Compact and put in place a Federally Mandated Siskiyou County Flood Control & Water Conservation District. It along with its territorial boundaries are displayed as Appendix 89 of the Calif Water Code. It provides to the District Board of Directors perpetual succession and 26 corporate articles giving them control and disposition over any and all storm, flood and other waters within the Federally Mandated District.

In 2008 Siskiyou County passed a resolution stating fully its position against the Klamath River Restoration Agreement and in so doing so cited the Klamath Basin Compact and more specifically, the Flood Control and Water Conservation District Act. Article (r) of the Act (the longest of all the Articles) specifically & with great detail gives the Board of Directors control of flood & storm waters within the District and outside the District if the waters flow into the District.

If each of you will take the time to review and discuss this article it provides a reflection of the many things you give away by signing either of the two agreements before you.

8. Klamath Basin Fisheries Basin Task force 1987-1997

The 1992 mgt. plan prepared for the Klamath /River by the Klamath Basin Fishery task Force found that only 35% of the available habitat below Irongate Dam was being utilized for spawning by fall run Salmon. No studies have been publicly reported as to the survival possibilities of adult or fingerlings in the main stream of the Klamath between Irongate Reservoir and Keno Dam. Even though Fish & Wildlife reports historical photos show salmon were in Upper Klamath, prior to 1918 causes the question as to whether it was spring run or fall run.

Power Co. spokespersons on several occasions have commented that water coming into the River system above Keno Dam is not cold or clear & toxicity levels not beneficial for Salmon survival. This same Power Co. spokesperson said the River watershed is not in good shape and we do not think it makes good sense to build Fish ladders and screens at a high cost to pass fish into a troubled ecosystem.

There is certainly a big window for a research need that clearly defines the scientific investigation of the water quality habitat by State of Oregon that begins on the Williamson/Wood/Sprague sub watershed and extends all the way to the clear water tributaries that begin below the Scott River. This kind of research will disclose why 35% of the main stem is used and whether or not the River from Keno to Irongate is suitable for Salmon spawning and fingerling survival. This should be a requirement to be addressed in the Dept. of Interiors NEPA process.

9. Salmon Mortality

Mortality of fry, fingerlings, smolt, juveniles & adults and where it occurs in the fresh & salt water habitat is critical to the decision making process in suggesting options to change current River & tributary harmonics.

A report released covering the mid 1990's stated that Irongate Hatchery released approx 13 million fingerlings. The normal annual release is 5 million. One of the results from that above normal release was to see how much more of the unused habitat (65%) in the mainstream and tributaries would be used. That investigation never materialized because escapement into the estuary from the ocean amounted to a mere 1 ½ % and the return to Irongate Hatchery was between 15-20 thousand adults, which is not too much different from the 5 million release and a return of 10-15 thousand adults. Other factors for the low escapement maybe reasons causing life losses. Unconfirmed but openly discussed are these 7 causes of mortality:

1. **Bird & wildlife prey of fingerlings in fresh water environment**
2. **Diseases obtained in River environment**
3. **Toxicity & temperature conditions in River & ocean**
4. **Predators in the ocean**
5. **Sustenance & commercial harvest in Lower River**
6. **Sportsmen & commercial harvest in ocean & River**
7. **Asian net harvest in ocean**

Salmon spend 3 ½ years of their life in the ocean & ½ year in the River & tributaries and are therefore at greatest risk in the ocean.

Until something gets done to resolve the mortality problems, it leaves the question open as to why Fish Biologists & Agencies are pursuing additional habitat when they haven't solved the problem of increasing the population. The place to begin is the Ocean environment.

DRAFT

Scott River Cooperative Restoration Area

The Scott River Cooperative Restoration Area is a very unique and diverse ecosystem area (see map) that has been identified by the various stakeholders. This area is consists of both private and public lands, contains numerous listed species, and has a wide range of management activities. Also located within the area are several endangered species, a wild and scenic river, State, County, private, federally managed roadways and key anadromous stream systems. Influences on the area include the Scott/Klamath TMDL, Incidental Take Permitting, and Coho and Steelhead recovery plans and programs.

Objective:
For stakeholders within Cooperative Restoration Area, through an MOU, to voluntarily collaborate together to manage, protect, sustain, improve or restore ecosystem health throughout the restoration area.

Identified Stakeholders (land owners and managers):

- Klamath National Forest
- BLM
- Fruit Growers Supply Co.
- Timbervest
- Mason, Bruce & Girard
- Timber Products
- Siskiyou County
- Scott River Watershed Coalition of Fire Safe Councils
- Quartz Valley Indian Reservation
- Northern California Resource Center

Identified Collaborative Organizations:

- College of the Siskiyous (Natural Resource Training Program)
- Pacific Forest Trust
- Natural Resource Conservation Service
- U.S. Fish and Wildlife Service
- Siskiyou Training & Employment Program (Internship Training Program Support)
- Scott River Watershed Council
- Scott River Watershed Upland Committee
- Siskiyou RCD

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The group of stakeholders, within the Restoration Area, through collaboration, will identify and plan project and management activities that will benefit the Restoration Area ecosystems.

Potential Types of Projects and/or Management Activities Could Include:

- Road System Management
- Forest Heath Activities (includes hazardous fuels reduction and commercial extraction)
- Wildlife enhancement
- Fishery enhancement
- Riparian/water quality restoration
- Community fire safety improvement
- Monitoring

Key Considerations for the MOU:

- **Participation in the MOU would not limit in any way the activities of any single stakeholder on their private or public managed lands.**
- Document the relationship between the stakeholders to provide a framework for cooperation concerning management activities necessary to maintain and restore functioning ecosystems within the Restoration Area.
- Provide a framework for providing or acquiring funds through grants or any other sources to perform planning and implementation of projects within the Restoration Area.
- Establish a solid, collective base to influence the ecosystem health activities within the Restoration Area.
- Be supportive of both the collective or individual stakeholder activities.
- Provide an opportunity for creation of jobs.
- Provide an opportunity for natural resource education and training.
- Provide an opportunity for public information, outreach, and education.

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Scott River Watershed Council

Upslope Monitoring Plan

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Proposed by:

Stuart Farber Timber Products Company
Larry Alexander Northern California Resource Center

Northern California Resource Center
PO Box 342
Fort Jones CA 96032
www.californiaresourcecenter.org

1.0 Introduction

The Scott River was listed as impaired for sediment in 1992 and temperature in 1998 under Section 303(d) of the Clean Water Act by the North Coast Regional Water Quality Control Board (NCRWQCB). In 2006, the NCRWQCB completed a Total Maximum Daily Load (TMDL) target for both sediment and temperature. The TMDL not only describes targets for future desired sediment amounts in the Scott River watershed, but describes monitoring the may be applicable to determine if the goals of the TMDL are being met. The TMDL also describes that implementation, effectiveness, compliance and trend monitoring may all be appropriate to determine if the goals of the TMDL are being met (TMDL Action Plan Chapter 6). Specifically, the TMDL describes that monitoring upslope conditions and upslope effectiveness monitoring is desirable to determine "...if control practices are effective at keeping the pollutant from being discharged to a water body"(TMDL Action Plan Chapter 6).

Existing Efforts

Numerous organizations have been and are working to enhance or restore water quality and fisheries in the Scott River watershed. These organizations include, but not limited to, the Scott River Watershed Council, French Creek Watershed Advisory Group, Five Counties Salmon Conservation process, Siskiyou Resource Conservation District, several private forestland owners and companies, United States Forest Service, Scott River Watershed Coalition of Fire Safe Councils, Northern California Resource Center and several state and federal regulatory agencies. To remain in compliance with the TMDL many of these organizations complete enhancement or restoration efforts and subsequent monitoring through several existing permit processes. Private forestland owners and companies, whose land is primarily located in upslope locations in the watershed, seek Waste Discharge Requirements (WDR) permits from the NCRWQCB which may require some type of monitoring. Upslope monitoring requirements are specifically addressed in proposed Memorandum of Understandings with the County of Siskiyou, United States Forest Service and the Bureau of Land Management. However, currently, no coordination of these various enhancements and restoration efforts or monitoring efforts is on-going, but is warranted to better understand the effectiveness of these actions and water quality trends in the entire Scott River watershed.

Proposed Plan

This document proposes a Scott River Watershed Council's Upslope Monitoring Plan which would better coordinate existing upslope water quality enhancement and restoration activities and monitoring. As recognized by the NCRWQCB in the TMDL, "...due to the complexity and expense of compliance and trend monitoring, Regional Water Board staff shall attempt to work cooperatively with other agencies and organizations to develop the plan and conducting monitoring. In particular, Regional Water Board staff shall attempt to coordinate efforts with the Scott River Watershed Council. The SRWC, as described in the Strategic Action Plan, is engaged in a pro-active monitoring effort designed to establish baseline information in the Scott River watershed by describing current conditions both quantitatively and qualitatively so that restoration needs can be identified and projects prioritized..."(TMDL Action Plan Chapter 6). This Upslope Monitoring Plan does not replace or change any existing monitoring efforts by the Scott River Watershed Council, rather the Upslope Monitoring Plan will may eventually be part of the overall Scott River Watershed Council Monitoring Plan and Strategic Action Plan and attempt to achieve a pro-active, local monitoring effort described by the TMDL.

2.0 Upslope Monitoring Plan Steps

The proposed Upslope Monitoring Plan will succeed in coordinating existing upslope water quality enhancement and restoration activities and monitoring by following several key principles. One, a local approach designed and supported by local resource professionals who have vast cumulative experience in the Scott River watershed. Two, following a systematic watershed level design, in contrast to a project level design will increase the likelihood of attainment of TMDL objectives. Three, adaptive management recognizes both previous successful and unsuccessful efforts so that unsuccessful efforts are not repeated in the future. Four, all organizations participating in the plan recognize that the plan is a voluntary tool to guide enhancement and restoration efforts and monitoring. With support of local resource professionals and following these key principles, it is envisioned that both effective and efficient attainment of TMDL upslope objectives can be achieved.

Step 1 Existing Upslope Erosion Inventories (Baseline monitoring)

Step 1 in the Upslope Monitoring Plan will be to document all existing upslope erosion inventories that have occurred within the Scott River watershed. This assimilation of all existing inventories should provide a better baseline monitoring inventory than currently exists. This baseline monitoring inventory will be more qualitative in nature, due to the relatively large size of the watershed, number of existing erosion inventories, and need to assimilate this information sooner rather than later. Each baseline monitoring inventory should consist, at a minimum:

1. GIS shapefile of either area or roads inventoried as part of the baseline inventory,
2. Landowner and staff that completed the baseline inventory,
3. Inventory method used, and
4. Number of miles, crossings and area surveyed.

From this assimilation of baseline inventory data, it can be determined where opportunities exist for additional baseline inventories, if any.

Step 2 Completed Upslope Erosion Restoration (Implementation monitoring)

Step 2 in the Upslope Monitoring Plan will be to document the status of enhancement or restoration of upslope erosion sites found during baseline inventories.

Step 3 On Going Upslope Erosion Restoration (Implementation monitoring)

Step 3 in the Upslope Monitoring Plan will be to document the current enhancement or restoration projects that are targeted at upslope erosion sites found during baseline inventories.

Step 4 Develop Priority for New Upslope Erosion Restoration (Implementation monitoring)

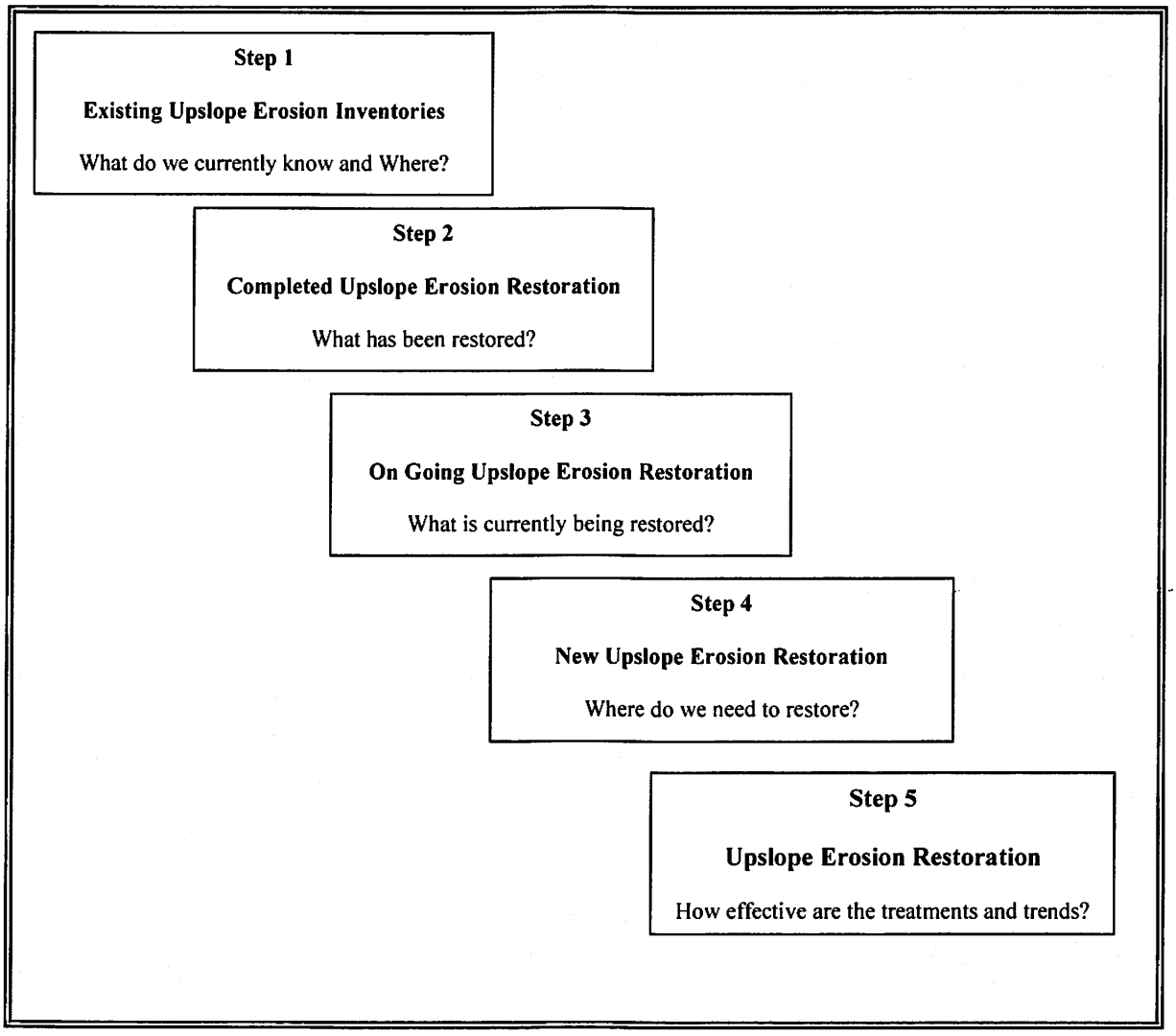
Based on the results and reports from Steps 1, 2 and 3, the Upslope Monitoring Plan will develop a list of new upslope erosion restoration opportunities. This prioritized list will be sub-watershed based and will

rely on the results of Steps 1, 2 and 3 and sub-watershed level water quality and fisheries values. These new opportunities will be voluntary opportunities for restoration, and are not intended to prevent other efforts to enhance or restore water quality or fisheries. These new opportunities will provide landowners, local companies and state and federal agencies with a systematic and better watershed level basis for planning of enhancement or restoration.

Step 5 Upslope Erosion Restoration (Effectiveness and Trend monitoring)

If staffing or funding is available, and necessary, it would be prudent to complete assimilate existing or conduct new effectiveness and trend monitoring of upslope erosion control projects. This Step 5 would be completed on an as needed basis and as staffing or funding becomes available.

Figure 1 Upslope Monitoring Plan Steps



3.0 Monitoring Information Management Policy

Similar to the overall Scott River Watershed Council Monitoring Plan, to ensure continued local support of proposed monitoring activities, proper and professional management of information from private landowners is necessary. This proposed Upslope Monitoring Plan is follow policies adopted by the Scott River Watershed Council in 2001.

(1) Monitoring data will be collected with full written consent of the participating landowner.

(2) Monitoring reports created from the monitoring data, will be available to the public and agency review.

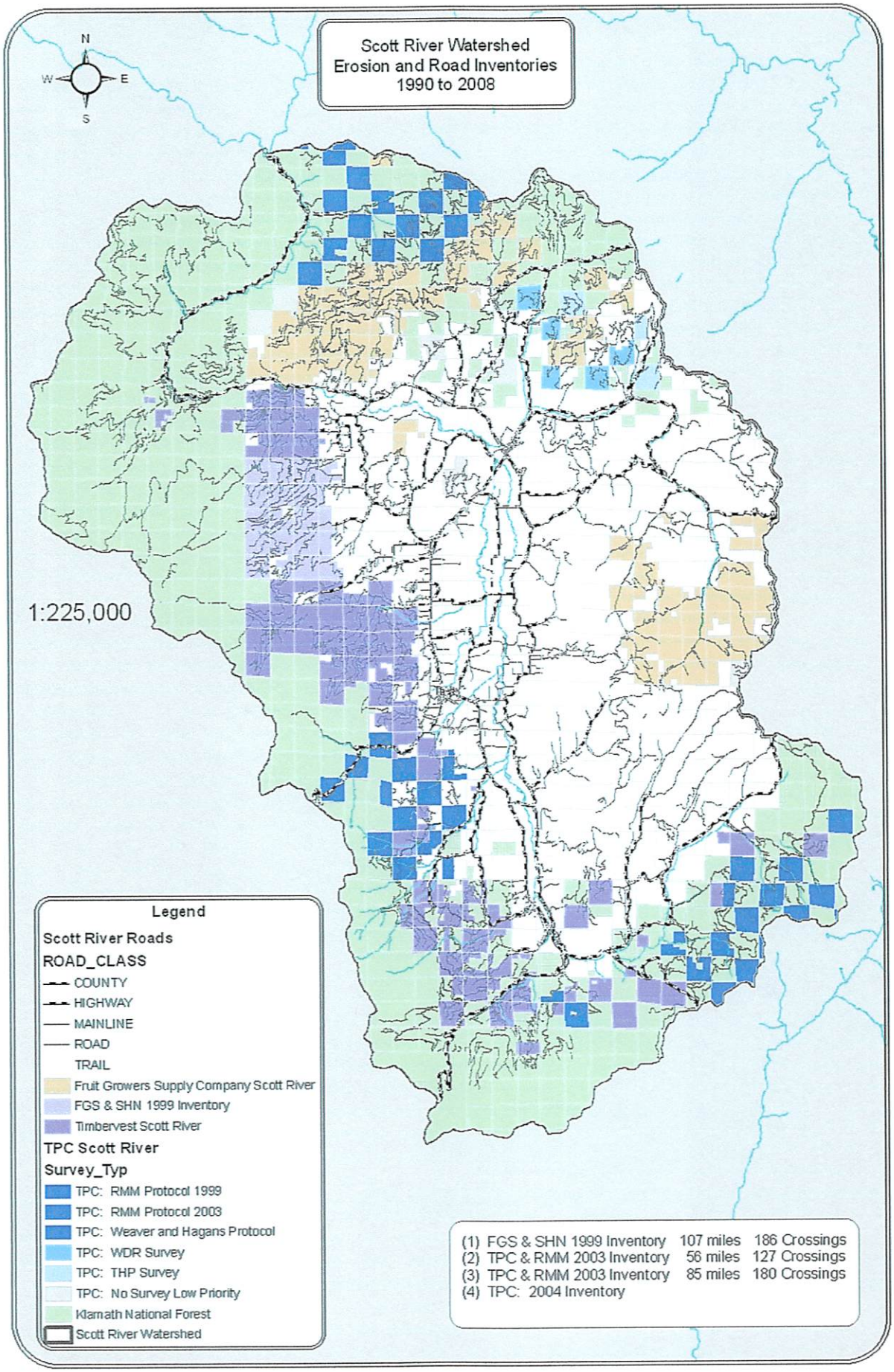
(3) Before release of any monitoring reports; 1. Landowner names and addresses will not be released upon request, 2. Monitoring data will be screened for quality control. 3. Prior to release of reports, landowners will receive a copy 30 days prior to its public release. 4. Monitoring reports will include interpretations of monitoring data which will includes limitations of data, natural background levels and variability, 5. The Upslope Monitoring Plan will work cooperatively with any participating landowner to determine the source of any identified concerns or project related monitoring.

4.0 Reporting of Results

A report will be produced based on the results of each step in the proposed Upslope Monitoring Plan. The report will be produced by the participating landowners and members of the Scott River Watershed Council monitoring committee. The reports will be first available in draft form to the participating landowners and then release to the general public and state and federal agencies.

5.0 References

6.0 Appendix


Scott River Watershed
Erosion and Road Inventories
1990 to 2008
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W
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S
1:225,000
Legend
Scott River Roads
ROAD_CLASS
COUNTY
HIGHWAY
MAINLINE
ROAD
TRAIL
Fruit Growers Supply Company Scott River
FGS & SHN 1999 Inventory
Timbervest Scott River
TPC Scott River
Survey_Typ
TPC: RMM Protocol 1999
TPC: RMM Protocol 2003
TPC: Weaver and Hagans Protocol
TPC: WDR Survey
TPC: THP Survey
TPC: No Survey Low Priority
Klamath National Forest
Scott River Watershed
(1) FGS & SHN 1999 Inventory 107 miles 186 Crossings
(2) TPC & RMM 2003 Inventory 56 miles 127 Crossings
(3) TPC & RMM 2003 Inventory 85 miles 180 Crossings
(4) TPC: 2004 Inventory

My Opinion: Coho in the Klamath River

Printed in Pioneer Press and the Klamath Basin Crisis.

This report has been made by history research writer and former and half-century resident of the Klamath River, James A. Waddell in 2009.

Below are notes to the Klamath Basin people in 2007, with info from research.

1. Salmon did not exist in the Klamath Falls area of the Upper Klamath Basin in known history *(The only reports of such existence comes from commentary by* wilderness-types *of people such as* Oregon Wild, Klamath RiverKeeper, etc...*)*;
2. No spawning gravels above State line rapids; (***research*** does not list salmon ***as using Spencer Creek as "...a spawning stream"; Spencer Creek is a spawning area and recruitment source of*** Redband trout*.)*
3. No spawning gravel in slow, warm waters of lakes, refuges or wet lands in Upper Klamath Basin.

Reference: Book ***"Tribes of California"*** by Stephen Powers. ... 1871 and 1872... regarding the Modoc Indians. See Page 256 see paragraph 4... *"But the salmon, king of the finny tribes, they had not, for that royal fish ascends the Klamath only to the first rapids below Lower Klamath Lake."*

Reference: Book ***"Handbook of the Indians of California"*** by A. L. Kroeber ... in 1925... See Chapter 22, The Modoc. See page 325, paragraph 5 *"The salmon are said not to run into the Klamath Lakes or above..."*

This quote is from OR Senator Doug Whitsett's 6/23/2008 speech:

"This plan to introduce salmon into the Upper Basin has a critical flaw that will be potentially devastating to not only agricultural and timber interests, but to all inhabitants of the Upper Basin. Most of the proposed salmon habitat includes water that is much too warm and eutrophic for these species to survive and reproduce. The very high natural background levels of phosphorous, the nearly flat river valleys, and the extremely shallow nature of Upper Klamath Lake have resulted in warm eutrophic waters for millennia, and will continue to do so for millennia to come. Nothing that man can do will alter that reality."

Records from History as stated by CA Department of Fish &Game: Quotes;

"The earliest record of Coho salmon being stocked in the Klamath Basin was of a plant made in 1895. Further examination of the original records from the U.S. Commission on Fish and Fisheries (1895) revealed those fish were raised in the Ft. Gaston facility in Hoopa and were stocked in the Trinity River and in Supply Creek, a tributary to the Trinity River. Those fish were reared from eggs taken at a facility in **Redwood Creek**... and also from eggs shipped from another **facility not identified** in the report (but were likely from **out of the basin**)."

"**Apparently**, no Coho salmon eggs were collected at the Klamathon Racks during the 1911-1912 and 1917-1918 seasons... However, Coho salmon eggs were taken during the five consecutive seasons beginning with the 1912-1913 season."

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This report has been made by history research writer and former and half-century resident of the Klamath River, James A. Waddell in 2009.

Below are notes to the Klamath Basin people in 2007, with info from research.

1. Salmon did not exist in the Klamath Falls area of the Upper Klamath Basin in known history *(The only reports of such existence comes from commentary by* wilderness-types *of people such as* Oregon Wild, Klamath RiverKeeper, etc...*)*;
2. No spawning gravels above State line rapids; (***research*** **does not list salmon** ***as using Spencer Creek as "...a spawning stream"; Spencer Creek is a spawning area and recruitment source of*** Redband trout*.)*
3. No spawning gravel in slow, warm waters of lakes, refuges or wet lands in Upper Klamath Basin.

Reference: Book ***"Tribes of California"*** by Stephen Powers. ... 1871 and 1872... regarding the Modoc Indians. See Page 256 see paragraph 4... *"But the salmon, king of the finny tribes, they had not, for that royal fish ascends the Klamath only to the first rapids below Lower Klamath Lake."*

Reference: Book ***"Handbook of the Indians of California"*** by A. L. Kroeber ... in 1925... See Chapter 22, The Modoc. See page 325, paragraph 5 *"The salmon are said not to run into the Klamath Lakes or above..."*

This quote is from OR Senator Doug Whitsett's 6/23/2008 speech:

"This plan to introduce salmon into the Upper Basin has a critical flaw that will be potentially devastating to not only agricultural and timber interests, but to all inhabitants of the Upper Basin. Most of the proposed salmon habitat includes water that is much too warm and eutrophic for these species to survive and reproduce. The very high natural background levels of phosphorous, the nearly flat river valleys, and the extremely shallow nature of Upper Klamath Lake have resulted in warm eutrophic waters for millennia, and will continue to do so for millennia to come. Nothing that man can do will alter that reality."

Records from History as stated by CA Department of Fish &Game: Quotes;

"The earliest record of Coho salmon being stocked in the Klamath Basin was of a plant made in 1895. Further examination of the original records from the U.S. Commission on Fish and Fisheries (1895) revealed those fish were raised in the Ft. Gaston facility in Hoopa and were stocked in the Trinity River and in Supply Creek, a tributary to the Trinity River. Those fish were reared from eggs taken at a facility in **Redwood Creek**... and also from eggs shipped from another **facility not identified** in the report (but were likely from **out of the basin**)."

"**Apparently**, no Coho salmon eggs were collected at the Klamathon Racks during the 1911-1912 and 1917-1918 seasons... However, Coho salmon eggs were taken during the five consecutive seasons beginning with the 1912-1913 season."

"**Historically**, the practice of **importing non-native fish was common**, especially in systems where native fish had been extirpated or were in low abundance..."

"After the completion of Trinity River Hatchery in 1963, adult Coho salmon returns at this facility rarely exceeded 1,000 fish prior to 1971. In an effort to increase returns to **Iron Gate Hatchery**, Coho salmon from the **Cascade River** in Oregon were stocked in 1966, 1967 and 1969... The first significant transfer of Coho salmon to **Trinity River Hatchery** occurred in 1964 when **Eel River Coho** salmon stocks were brought in."

"This was followed by plantings of Coho salmon originating from the **Cascade River**, Oregon in 1966, 1967 and 1969. **Noyo River** stock was also planted in 1969 and **Alsea River** stock was planted in the Trinity in 1970... It **appears** the intent of these out-of-basin transfers was to augment already existing, albeit dwindling, natural Coho salmon populations."

"Current California Fish and Game Commission policy now **essentially** prohibits all out-of-basin fish transfers."

"Coho salmon returns to the Shasta River have been documented in almost every year since 1934. ... Similar information is **lacking** for the **Scott River**..."

Spotted Owls, a subspecies of the populous **Barred Owl** species, were listed as Endangered by false proclamation of government agents; now known from Mexico to CA, OR, WA to Canada. **Marble Murrelets** were listed as Endangered by false proclamation of government agents; have a Pacific population of 4.5 to 5 million birds. **Polar bears** were listed as Endangered by false proclamation of government agents; now more Polar bears than ever. **Shortnose and Lost River sucker fish** are not at risk; but false proclamations of government agents had them listed under the ESA.

CA DF&G; "**Information** on the historical occurrence of **Coho salmon** in the upper Klamath River is **sparse**."

Facts presented here are that **non-Native Coho** were planted in multiple streams of the Klamath River System for over a century."

Such information of **Coho history was not** included in the Listing of **Klamath Coho as an Endangered Species** so the listing is without scientific support!

Another fraud by governmental agents? That is my opinion!

By James A. Waddell, 1101 Stone Canyon Dr. #1334, Roseville, CA 95661.

▻ Information of Klamath River Indian Tribes, their lands and their languages. Many of "Indians" of the Klamath River are of mixed blood with area tribes and with non-Indians and are mingled throughout the western land ... and shop for their groceries at the local markets... just like everybody else!

In the distant past, all the Indian tribes of the Klamath River could and did speak two or three neighboring tribal languages, frequently in the same conversations.

No known Indian Treaties gave any of these tribes "Salmon" fishing rights.

It is my conclusion that the vast majority of Tribal Members are not actively supportive of Tribal Management groups in these Klamath Dam Removal efforts!

Karuk People are of the Karuk **Hokan language.** Karuk People had a territory from Seiad Valley to Preston Peak and from above the mouth of the Trinity River to the Siskiyou Mountains. An indirect comment made at the mouth of the Trinity River, by newcomer George Gibbs 1851, of Clear Creek being the lower limit of Shasta People, was made without research and with limited knowledge of the multiple languages of the Klamath River Indians. Karuk land; Est. 60 miles downriver from Iron Gate dam.

Yuruk People were one of two tribes of an eastern language of **Algonquian;** including the Wiyot of Humboldt. Yuruk People were from the mouth of the Trinity River and downriver on each side to the Pacific Ocean and south to Trinidad.

Yuruk Reservation; An average of 120 miles downriver of Iron Gate dam.

Hupa People were one of a group of northern California tribes that spoke **Athabascan language.** Hupa People were in the valley along the lower Trinity River. **Hupa was the name of the people** and Hoopa (Hoop-ah) was the name of the valley; Hoopa Reservation is 144 square miles. Hoopa Valley Reservation; On Trinity River 100 miles below Iron Gate dam.

Shasta People are of group of tribal clans that spoke a **Shasta Hokan** language.

The Shastas were in: Scott Valley; Shasta Valley; Klamath River areas from Horse Creek to Fall Creek; Bear Creek of Rogue River; and in Salmon River and over the Trinity Mountains south; two Shasta language tribes were in the Pit River area.

Klamath People and the **Modoc People** were of a **Lutuamian language.**

The Indian Treaties for the Klamath Tribes did not "Give" the Klamath Tribe "Salmon" fishing rights: ...only to allow them to "...continue to gather fish."

The Klamath People were in the land at Klamath Falls and Upper Klamath Lake including the Wood River, the Williamson River, the Sprague River and Sycan River and the Modoc People were in the land of Tule Lake, Lower Klamath Lake, Butte Valley, Lost River and Clear Lake. Klamath land; Estimate 18 river miles above the 14 miles of white water rapids near and above Stateline.

The Klamath Indians made trading agreements with the Shastas that allowed them to come downriver on the Klamath to near Bogus Creek, Willow Creek and to the Shasta River near Montague to gather salmon; other history told of those gathered salmon being battered and with sores.

This is where the Klamaths of the past had to go to find salmon.

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A DIFFERENT POINT OF VIEW
(response to letter written by Glen Spain to Glen Biggs dated June 30, 2009)

The above referenced letter seems to be in response to my (Glen Briggs) paper titled "PLEASE/ Do not Restore My Klamath River" and not to something written by someone named Glen Biggs, My paper referred to facts and conditions along the Klamath River downstream from the confluence of the Scott River during Fall months when water within the Klamath main stem was low and warm. There was really nothing in Mr. Spain's letter that addressed expected conditions within the river down stream from the dams should they be removed. In spite of that, I will give a different point of view concerning the FACTS included in the above letter. I wish to thank Mr. Spain for giving me this opportunity.

I have found that FACTS come in many forms. Some are incomplete such as my name in the salutation in Mr. Spain's letter, some are brightly colored and placed in fancy wrapping in order to make them say more than they really do, and then, somewhere down the line, there is the true or factual fact that holds its form regardless of the amount of scrutiny or varied interpretation applied.

Paragraphs (1) and (2): There is actually no known historical physical evidence substantiating the fact that Salmon were caught upstream from Upper Klamath Lake. Certain members of the Shasta Tribe state that tribes from the Upper Klamath Lake area came downstream to catch and dry Salmon within the fishing area ancestral to the Shasta tribes. Both Hamilton and Huntington use models developed from empirical data that is then applied to tributaries upstream from the Upper Lake. At one place in Hamilton's presentation, he reasoned that fish could travel upstream past the Cascades in the Klamath River because they do it in the Columbia River. The difference in the two rivers is so extreme that this assumption is ludicrous. Their analysis completely ignores the one pre-dam reference included that says the predominance of the salmon run referred to could not get past the natural barrier and into the Upper Basin. Also missing from those documents is any reference to <u>any</u> studies done during development of the Klamath Project, development of the hydropower system, or documentation of any kind from either the California or Oregon Departments of Fish and Game as to actual extent of early fish runs in that area. My instinct tells me that there had to be considerable discussion before the decision was made to settle for a hatchery instead of fish passage facilities. It seems the main emphasis of the two studies mentioned above was to determine how many anadromous fish the upper basin could accommodate without realistically evaluating just how many are likely to get that far.

Coho Salmon are stated to be a Fall run species and are known to have inhabited the lower Klamath up to the Salmon River and migrating into that river as well as Blue Creek and the Trinity River. Coho Salmon were not known to resident fishermen fishing the mid to upper Klamath. They were called Silvers in the lower tributaries referred to above. Sometime in the late 1940's Coho were introduced into the mid-Klamath after construction of the dams had improved fall water temperature conditions. This information was relayed to members of my family by a local Warden. On going Water

Quality Studies by the California North Coast Water Quality Control Board puts stringent requirements on water temperatures in their TMDL programs where Coho Salmon are considered part of the resident fish population. I would think that a thorough search of the California State Dept. of Fish and Game records would reveal some interesting facts concerning Coho. The above documents make no mention of expected river water temperatures with the Power Dams gone and with large, shallow Upper Klamath Lake discharging warm water, when it does discharge water, and with no source of cooling water to introduce downstream. Predicted Fall flows and water temperatures are conspicuous by their absence from these documents. Recent late summer and fall studies sponsored by the U. S. Bureau of Reclamation has shown that with releases of 500 CFS, river water temperatures are not cooled by incoming tributaries until you get to Seiad Valley and then between there and Orleans, water temperature cools by about 4 degrees. I have yet to see the facts that will make me believe that river water temperatures after dam removal will be any different than they were 150 years ago. Are you going to shut off all volcanic inflow in order to accomplish the TMDL's?

True, salmon dying after spawning will contribute to stream pollution. However, in the case of the Klamath River, conditions described by Mr. Gibbs along with occurrences past on by earlier members of my family indicates more than just that. Mr. Gibbs was trained as a lawyer in one of our country's premier universities, and, like it or not, one of the benefits of being exposed to the educational process required of prospective lawyers is that it forces one to learn to think. You can scoff at the conclusions described in his Journal; however, an open minded review giving due credit to conditions he was encountering along with the small amount of knowledge available for the area being studied should lead you to the conclusion that Mr. Gibbs was very capable both physically and mentally.

Before completion of the first Power Dam across the Klamath, my family, living in the Mid-Klamath area, experienced episodes where the stench from dead fish was so great that the children were told to take sharp sticks to throw the fish back into the water. A past brother-in-law of mine who happened to be a fisheries biologist some years back with California Dept. of Fish and Game confirmed from Fish and Game records that at least some of these episodes were the result of diseased fish. This along with the notation by Gibbs that the salmon looked diseased only a short distance inland has to tell a story.

ARMY RATIONS for the Lewis and Clark expedition! You have got to be kidding!

Paragraph (3): I must admit that I will choose to stay at the disadvantage in these discussions because I do not wish to scan the FERC files which in my opinion have been padded with colored and incomplete facts in addition to much reliable information. I will stay with the knowledge I have acquired over the years and, though it may be as incomplete as the above referenced studies, I am comfortable with it. First, water coming to the reservoir already contains nutrients and, also, that portion of it that has passed through Upper Klamath Lake already would contain the toxins if such toxins are carried downstream instead of dissipating. The top few feet of the reservoirs are normally heated by the sun's rays; however, colder water settles to the lower depths, something about the

density of cold water, and the sun's rays have little effect on this cold water. Toxins that do not dissipate would generally be found within that top few feet of warm water or within the organic sediment. Upper Klamath Lake, being a shallow lake would not have the benefit of colder water at depth plus it has whatever warming local hot springs might generate so I have a problem with your contention that water from the reservoirs kill off the salmonids and yet you say hundreds of thousands will pass through Upper Klamath Lake successfully. Water for use in the hatchery is drawn from the reservoir just a few feet below the surface and yet the hatchery has been able to operate successfully. Suction dredge mining has been a popular activity in the Klamath River for a number of years. These miners stay under water in the Klamath day after day with no apparent ill effects. It is true that salmon living within the waters of the Klamath are subject to different diseases and some of these diseases kill off large numbers of the young and others large numbers of the adults. Be this as it may, I know of no study that relate these diseases to the Dams.

Paragraph (4): Cost studies and conclusions referred to in this paragraph are incomplete in their overall cost analysis; therefore, I will hold off comments pending completion of presently planned studies. The CEC letter strikes me as being more oriented around assumptions and suppositions than true and complete all around analysis.

Paragraph (5): Comprehensive studies presently being planned should determine toxicity of sediments and a pretty fair guess of total quantity. Existing sediments will probably contain a fair amount of organic material from the algae so if it is not toxic, just where does the toxicity exist and for what period of time? Whatever sediments sent downstream by whatever means will end up coating the banks along the river for decades. Sand, silt and other fine sediments thrown up along the river by various high waters back to and including the 1964/5 flood still coat the banks in many places. If sediment from the reservoirs contain toxins or other toxic material, it will be a threat to wildlife along the river for generations.

Paragraph (6): To reason that the dams should come out just because they only represent a very small percentage of the companies overall generating capacity is not good reasoning. This power is renewable with the energy removed from the falling water having no side affect on the physical world around this source of power except possibly erosion of the streambed for a short distance downstream. With the Klamath, loss of renewable gravel source through the dammed area would not be great, especially with Upper Klamath Lake in close proximity upstream and with many mountain tributary streams downstream acting as replacement sources. Whereas, continual expansion of wind farms should be expected to have a changing affect on weather patterns in those areas. Winds are created by differences in atmospheric pressure which could be subject to change with interruption of the air movement. I have seen nothing speaking to this possible problem and, if it has not been investigated, it should be. If I remember my lessons correctly, there is no action without a reaction.

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FEDERAL COURT DISMISSES TRIBE'S SUIT TO USURP WATER RIGHTS OF KLAMATH BASIN FARMERS

OAKLAND, CA; January 14, 2005: In the second major court victory for Klamath farmers this week, a federal court yesterday ruled in favor of the Klamath Water Uses Association when it dismissed the case brought by the Yurok Tribe to usurp the water rights of Klamath farmers. Pacific Legal Foundation successfully represented the Klamath Water Users Association as interveners in the tribe's case against the federal government. (The case is *PCFFA v. United States Bureau of Reclamation.*)

"This is a great victory for Klamath farmers, and for all of the people who worked hard to put a balanced plan in place for the Klamath Basin," said Pacific Legal Foundation attorney Andrew Lloyd. "The farmers and the federal government understood that everyone needs to work together to manage scarce resources."

"Unfortunately, the Yurok Tribe used the Klamath crisis as a political opportunity to wrest operational control of the Klamath Project from the Bureau of Reclamation. The tribe wanted the Bureau to dedicate its stored water to them first, and only if there was water left over could any be used by the Klamath Project's farmers. The judge made it clear that the tribe does not have that authority," Lloyd said.

In 2001, Klamath Basin farmers lost their crops and farms when environmentalists forced a shutdown of water deliveries to the farmers to protect coho salmon and sucker fish in the Upper Klamath Lake. The federal government's decision to end water deliveries to hundreds of farming families who have lived and farmed in the basin for a century left many farmers bankrupt and severely damaged the community economically. Despite the devastation they suffered, the farmers have continued to work with the federal government to make more water available for in-stream flows through a water bank program.

The Yurok Tribe, which lives nearly 200 miles downriver from the Klamath Project, claimed the operation of the Klamath Project and low water flow caused an unprecedented fish die off in 2002. They contended the bureau should have released more water, and that the low flows violated their fishing rights under federal law. They sued to force the federal government to give more water to them and less to the farmers, but failed to establish any legal basis for the court to do so.

The court agreed with PLF's position that the 2002 fish die off occurred only once in recorded history, and found that the tribe could not establish that a similar fish die off was likely to occur in the future. Despite the fish die off, the California Department of Fish and Game reported that during the 2002 fishing season, the Yurok Tribe and the Hoopa Valley Tribe were able to catch more than 24,000 fish, which was well above the historical average harvest of 22,500.

Earlier this week, Pacific Legal Foundation won another long-fought victory on behalf of Klamath farmers when a federal judge ruled that the Endangered Species Act listing of the Coho salmon in the Klamath Basin rivers of southern Oregon and northern California was unlawful. ***(Grange v. Evans and National Marine Fisheries Service.)***

About Pacific Legal Foundation

Founded in 1973, Pacific Legal Foundation is a national leader in the effort to reform the Endangered Species Act and raise awareness of the Act's impact on people. More information on the Foundation can be found at *www.pacificlegal.org.*

National Research Council from Merrill businessman Bob Gasser, presented 1/29/07 Klamath Falls.

Good Afternoon. I'd like to thank all of you for volunteering your time to sit on this committee. I wish time was not an issue because in order for you to fully understand this irrigation project, a day's tour is imperative.

For example, take Lower Klamath Lake. The committee could stand on the old lake bed and see that Klamath River is 18' higher in elevation than Lower Klamath Lake. It is interesting that uniformed people have stated that water from Lower Klamath Lake flowed into the Klamath River. Well unless water runs uphill, before 1905 (pre-project) this could not have happened. I do know that since 1905 water does run downhill!!

I would like to take you on a tour to stand on Sheepy Ridge and look at Lower Klamath Lake and Tulelake to see how big these shallow lakes were pre-project. What would be important about that?

#1. There was no outlet for these lakes so all that water came here to die by evaporation. Now these two lakes are 2/3 smaller because those lands are being farmed. Since growing crops uses less water than open, standing water, there is 200-400 thousand extra acre feet of water in Klamath River just because of this project.

#2. You would see two large wildlife refuges that the Klamath Project supports.

#3. You would see farmland being flooded with the cooperation of the National Fish & Wildlife service. Farmers are working hand in hand with the Fish & Wildlife service to make better habitats for birds.

On this tour, I would take you to see the diversion canal to see how floodwaters are diverted to Klamath River. This canal allows more water to be stored for later use in Upper Klamath Lake.

When we were finished with our tour, you would understand why the Klamath Project has a 92% efficiency rating.

In my opinion, the most valuable point of your visit would be if the local scientific community would listen to your findings and try to implement them-- unlike the last National Academy of Science recommendations that were mostly ignored.

The Klamath Project is not afraid of good peer reviewed science. Our communities have been devastated by models, graphs and fuzzy feelings. However, we want to do our part in solving the watershed problems.

Thank you once again for trying to make this country a better place to live.

Bob Gasser
Merrill, OR 97633

Herald and News 11/10/09 Dam removal bond bill gets signature

California Gov. Arnold Schwarzenegger signed an **$11.1 billion** water bond bill that would provide $250 million to remove dams on the Klamath River **if approved** by voters.

Most of the bond would be spent to improve the state's water supply by building new dams and underground storage, according to the Associated Press.

The bond goes to voters in November 2010. Along with language to fund the Klamath River dam removal, Republican state Sen. Sam Aanestad managed to include another $20 million for economic development in Siskiyou County, where three of the four dams are.

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KLAMATH RIVER COMPACT COMMISSION

INVESTIGATION INTO METHODS TO CONTROL ALGAE IN THE KLAMATH RIVER BASIN

JUNE 1962

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KLAMATH RIVER COMPACT COMMISSION

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Honorable Arthur A, Ohnimus
Chief Clerk of the Assembly
State Capitol
Sacramento, California

Honorable Robert Duncan
Speaker of the House
State Capitol
Salem, Oregon

Gentlemen:

Pursuant to Senate Joint Resolution No. 6, 1961 Session, California State Legislature, there is hereby transmitted to you a report entitled "Investigation Into Methods to Control Algae in the Klamath River Basin."

Excessive algal growth in the Klamath River Basin is a natural phenomenon that has been present for many years. The life cycle of algae is short. They have a tendency to grow rapidly during the daylight hours and die during the hours of darkness. During the period of growth algae give off oxygen to the water and as they die and start to decompose they consume oxygen from the water thereby depleting the oxygen content of the water. As a mass of dead algae decomposes, it produces obnoxious odors to the extent of creating a nuisance. Extensive studies in progress throughout the world seek methods of controlling this algal growth.

Although the algae problem in the Klamath River Basin has been present for many years, recreational use of the streams in the Klamath River Basin makes the problem increasingly more evident. With the increased use of the streams in the Klamath River Basin and more particularly the main Klamath River, more people are becoming aware of the nuisance problem.

Pursuant to Senate Joint Resolution No. 6, 1961 Session, California State Legislature, and requests from the Water Pollution Control Agencies in both the States of California and Oregon, the Klamath River Compact Commission has made a study of the problem to determine what action could be taken to expedite the development of some method of control. The report attached hereto is the result of this investigation and is submitted for your Information and consideration.

Sincerely yours,

A. E. Kuiper
Executive Director

Attachment

INVESTIGATION INTO METHODS TO CONTROL ALGAE IN THE KLAMATH RIVER BASIN

Pursuant to Senate Joint Resolution #6, relative to pollution of the Klamath River, California State Legislature, 1961 Session, which is quoted in part as follows:

> "Resolved by the Senate and the Assembly of the State of California, jointly, THAT the legislature of the State of California respectfully request the United States and the State of Oregon to Join with the State of California in conducting a cooperative study of the problem existing on the Klamath River;..."

and letters from the State Water Pollution Control Board of California and the Oregon State Sanitary Authority of Oregon dated June 22, 1961, and June 28, 1961, respectively, the Klamath River Compact Commission has undertaken a cooperative study of the pollution problem in the Klamath River Basin.

The pollution problem in the Klamath River Basin, resulting from extensive growth of blue-green algae, first came to the attention of the Klamath River Compact Commission during negotiation of the compact. At that time the two state commissions supported a study of the problem from July 1, 1955, through June 30, 1956. Subsequently, from July 1, 1956, through June 30, 1958, the study was supported jointly by the Klamath County Court, the City of Klamath Falls and the Klamath County Chamber of Commerce. The study period was extended through a fourth year to June 30, 1959, at a somewhat reduced rate of support. The study was confined in a large part to Klamath Lake, although there is also an algae problem at times in Copco Lake and Klamath River, and to a lesser degree its influent waters. A brief study was also made of the reservoirs and natural lakes in the surrounding territory and the extent of the pollution in the Klamath River was determined.

The principal points that were investigated vere biology of the algae bloom, distribution of the bloom in the Klamath Basin, chemistry of influent waters, effect of the algal population of the effluent waters, distribution of bloom organisms in the area, detrimental effect arising from the presence of the bloom population including the aesthetic problem and the oxygen relations and control of the bloom.

During the investigation it was learned that the physical features of the lake are ideal for production of algae. The great area of the lake provides an extensive trap for the conversion of radiant energy into plant material. The shallovness of the lake provides the possibility of nearly constant circulation of raw materials and organisms between top and bottom. This constant circulation and the uniform temperature from top to bottom of the lake combine to make nutrient released from the bottom by decomposition almost immediately available to the algal plants.

It has been concluded that the limited funds that were available for this four-year study did not permit sufficient investigation to arrive at definite conclusions that could be submitted with respect to control of the algal growth in the Klamath River Basin.

Senate Joint Resolution #6 by the California State Legislature was considered and discussed by the Klamath River Compact Commission at their regular meeting on June 29, 1961. Representatives from public agencies and local interests were invited to attend and participate in the discussion of the algae problem. It was at this meeting that the California State Water Pollution Control Board and the Oregon State Sanitary Authority requested the Klamath River Compact Commission to coordinate any studies that might be developed with respect to SJR 6.

The commission arranged for the convening of a meeting of interested agencies and technical people in the field of water quality to discuss the algae problem in the Klamath River Basin and to develop one or more approaches to carry out the Intent of Senate Joint Resolution #6. Subsequent meetings with interested agencies and technical people in the field of water quality participating were held to discuss the algae problem in the Klamath River Basin and available published data with respect to blue-green algae were reviewed to obtain a better understanding of the problem. This was followed by a public meeting on October 10, 1961, for a thorough discussion of what action could be taken. Technical experts were also invited to this meeting to assist the commission in obtaining information and background.

The meeting was held in Klamath Falls on October 10, 1961, and ~~various ways of proceeding to investigate~~ the Klamath River algae problem were discussed. It was finally concluded that with such a complex problem, ~~the next step should be to arrange~~ for the convening of a panel of experts to ~~discuss the problem and submit~~ recommendations to the commission on what action could be taken. The meeting was arranged and a panel of experts was assembled in Corvallis, Oregon, on February 19 and 20, 1962, consisting of:

Dr. W. T. Edmondson, Dept. of Zoology, Univ. of Washington, Seattle
Dr. C. G. Golueke, Dept. of Sanitary Engineering, Univ. of Calif., Berkeley
Dr. H. K. Phinney, Dept. of Botany, Oregon State Univ., Corvallis
Dr. C. E. Warren, Dept. of Fish and Game Management, Oregon State Univ., Corvallis
Mr. J. H. Wales, Dept. of Fish and Game Management, Oregon State Univ., Corvallis
Mr. J. N. Wilson, U. S. Public Health Service, Portland

A report on the discussion by the panel was submitted by Professor Harry K. Phinney, dated March 12, 1962. A copy of this report is attached hereto as Attachment A for your Information.

The purpose of the meeting was to develop one or more approaches to carry out the intent of Senate Joint Resolution #6 approved by the 1961 session of the California State Legislature. The paragraphs that follow are submitted in consideration of this objective, and summarize the discussion by the panel of experts at Corvallis on February 19, 1962. The following points are called to your attention:

1. Chemical treatment to control algae in the Klamath River Basin would not be economically feasible and would be extremely dangerous. The risk of extensive damage to other resources within the basin would be very great.

2. Operations being carried on throughout the world by other agencies in an attempt to control blue-green algae are so extensive that any contribution that might be made by an investigation that could be financially supported by the commission would be relatively minute.

3. To take advantage of possible future discoveries in the field of chemical control agents, two types of information would be required: (1) an economic study to establish the benefits to be derived from control and (2) a chemical and biological characterization of the lake to determine whether future chemical discoveries permitting control of blue-green algae would be applicable to the problem In the Klamath Basin.

4. Control of algae by introduction of biological agents including daphnia is not feasible.

5. Harvesting of algae would require processing the total flow of the river if control was to be effective to any appreciable extent. Research has shown that an algae concentration equivalent to 200 or 300 parts per million of solid is required before harvesting is economically feasible. Klamath River waters have a much lower concentration than this. Also the blue-green algae in Klamath River has a potential toxic element that would be adverse to marketing the harvested product.

6. The vast area that is infested by algae in the Upper Klamath River Basin and the physiography of the area make it infeasible to control algae by elimination of the nutrient from the Klamath River Basin water.

7. The control of algal production by artificially reducing the light penetration in the Klamath Lake region was considered. It was concluded that in addition to the danger of the adverse effects such as increase in water temperature, the cost of an operation of this type would exceed those of control with chemicals.

After a thorough discussion of the above seven items, during which other methods of control were touched on briefly and dismissed as being impractical, the discussion turned to what could be done at the present time with respect to algae in the Klamath River Basin that would be constructive. The panel considered that there were two types of information that were needed. One was an economic study to determine the value that would be obtained by controlling algae growth and the other was a study of the algae condition to learn enough about it so that when control measures are discovered by other

research programs that are being carried on, it could be readily determined whether the control could be applied in the Klamath River Basin.

The Kiamath River Compact Commission concluded that in general they concurred in the findings of the panel of experts. However, they felt that to make an economic study of the benefits that could be derived tram controlling algae In the Klamath River Basin at this tine would be premature. This type of study would be more practical when more Information is available on the physical effects and extent of control of the algae.

A general llmnologlcal study to characterize the Klamath River drainage basin both chemically and biologically would be beneficial. It was noted that the Executive Board of the Water Resources Research Institute at Oregon State University has such a program under consideration at the present time. It was also indicated by the panel that to operate effectively such a study should be supported by a national Institute of Health or a National Science Foundation grant.

It was concluded by the commission that the appropriate action to be taken at this time would be to support the proposal of the Executive Board of the Water Resources Research Institute at Oregon State University to establish a cooperative study to examine the fundamental limnology of the entire Klamath drainage system. It was further concluded that if and when a method of control of algae is developed, the Klamath River Compact Commission again consider the possibility of an economic study to determine the benefits to be derived from such control of algae in the Klamath River Basin.

Attachment

OREGON STATE UNIVERSITY Corvallis, Oregon

School of Science March 12, 1962

Klamath River Compact Comaisslon
A. E. Kuiper, Executive Director
P. 0. Box 388
Sacramento 2, California

Gentlemen:

Pursuant to the request of the Compact Commission, a panel of experienced aquatic biologists was convened at Corvallis on February 19th. The purpose of this meeting was to discuss possible future action that might be taken by the Commission with respect to the problem of over-abundant production of blue-green algae in the waters of the Klamath River drainage basin.

Present at the meeting on February 19th were:

Dr. W. T. Edmondson, Dept. of Zoology, Univ. of Washington, Seattle
Dr. C. G. Golueke, Dept. of Sanitary Engineering, Univ. of Calif., Berkeley
Dr. H. K. Phinney, Dept. of Botany, Oregon State Univ., Corvallis
Mr. J. H. Wales, Dept. of Fish and Game Management, Oregon State Univ., Corvallis
Dr. C. E. Warren, Dept. of Fish and Game Management, Oregon State Univ., Corvallis
Mr. J. N. Wilson, U. S. Public Health Service, Portland

Representing the Commission were:

Mr. 0. L. Abbott
Mr. A. E. Kuiper
Mr. Lewis Stanley
Mr. C. L. Wheeler

The major portion of the discussion was completed on the 19th; however, further consideration of the extent and form of these recommendations occurred at a meeting of the panel of consultants on the 20th. Below in brief form, omitting the detailed discussion, is the consensus of the panel.

I. Chemical control of the production of algae.

A. Chemical treatment of Upper Klamath Lake and of the marshes draining into the Lake with any of the known chemical materials would appear to be not only uneconomic, but in the present stage of knowledge of the chemistry and biology of the basin, extremely dangerous. The probability of extensive damage to the resource arising from injury to desirable organisms living in, on, or about the Lake, or to organisms receiving water through the irrigation system, is very great.

B. It was concluded that the contribution that night be made by the Commission by supporting intensive investigations designed to discover a suitable chemical control agent is extremely problematical and would moreover be dwarfed by the extensive parallel operations already sponsored by a number of other agencies.

C. It was further concluded that it will be necessazy to have two types of information in order to take Immediate advantage of possible future discoveries in the rapidly developing field of chemical control agents. An economic study is needed to establish the economic necessity for, and the benefits that would be derived from, any type of control problem. In addition a chemical and biological characterization of the Lake is needed to allow intelligent selection of agents that might be available.

II. Control of algal production by the introduction of biological agents.

A. The algal problem has existed in Upper Klamath Lake for a considerable number of years without any evidence that any biological agent can make a significant reduction in the numbers of nuisance organisms.

B. The suggestion that Daphnia, introduced in large numbers, might effect a reduction in the population of Aphanizomenon is definitely contra-indicated by three observations.

1. Daphnia has long been present in the Lake and there is no evidence that they presently exert a control on the numbers of nuisance organisms.

2. Research elsewhere has shown that Daphnia is unable to ingest the filaments of Aphanizomenon effectively.

3. If there were an aquatic organism living in this kind of water anywhere in the world, successfully utilizing these blue-green algae for food, it is to be expected that they would be known and put into use by now.

III. Removal of the algae by harvesting.

A. It must be pointed out that harvesting the algae from the lake water would make but a very minor reduction In the quantity of algae in the Lake and in the River, and only if the total outflow were processed would the problem be alleviated to any extent in the River.

B. Research has proven that the cost of equipment and power dictate that to harvest algae for an animal feed supplement the algae must be present at a concentration equivalent to 200-300 parts per million of solids to allow their separation by centrifugation. As this concentration exceeds the maximum

occurring in Klamath Lake by several times, and since the organisms in the Lake possess a demonstrable toxic element, the product would be of necessity cost more to harvest and would not have the market value to make harvesting economic at the present time.

IV. Control of algal productivity by elimination of nutrient.

The opinion of the panel was that the diffuse nature of the nutrient sources militates against the successful application of this approach. In the cases where this method has been successfully applied the sources of enrichment have been man made, easily defined and easily intercepted. In fact, they were detected because the normal ecology of the lakes in question was being disturbed. In Klamath Lake this approach, even if otherwise feasible, promises to interfere with the natural high productivity of the basin and could result in severe economic repercussions.

V. Control of algal production by artificially reducing light penetration.

A discussion of the possibility of reducing light penetration by 1) introduction of dye materials, 2) introduction of inert suspended solids, and 3) stirring the bottom sediments, led to the conclusion that in addition to the danger of such side effects as increase in water temperature to be expected from such operations, there is a very great probability that the costs would even exceed those of control with chemicals. The consensus was against recommending a study of this type of control.

The discussions of the panel made it clear that if the Compact Commission feels compelled to embark on a program to investigate the Lake and/or the feasibility of methods of algal control it should be understood that in the present state of knowledge the studies would have to be supported for a period of a good many years at a level of approximately $50,000 a year without any real promise that control would be forthcoming.

Following the discussion of these proposals the attention of the panel turned to consideration of recommendations for positive action that could be placed before the Compact Commission.

I. An economic study of the water resources of the Klamath drainage.

Repeatedly during the discussions of the panel the desirability of an economic study was emphasized. There is a necessity of placing in proper perspective the present and projected valuations that can be assigned to the resource in its various applications.

The knowledge to be obtained from such a study would be of great value (1) in the deliberations of the Compact Commission and other government agencies concerned with the desirability of, or economic necessity for, support of studies of methods of control; (2) in determining the economic feasibility of any control program that might become available in the future; (3) in establishing the changes in the value of the resource that would result from the institution of new plans for developing the resource.

It is the opinion of the panel that the Compact Commission could obtain this information from a study of a year or two in duration. The probable cost of the study was estimated to be $50,000.

II. A general limnological study to characterize the Lake and associated drainage system.

As conceived by the panel, this study would consist of an examination of the fundamental limnology of the entire drainage system. It would not channel effort into looking for methods of control. In order to operate effectively this project should be free of all political pressure and therefore should be supported under an N. I. H. or H. S. F. grant. It was recognized that the magnitude of the problem would require expenditure of approximately $50,000 a year for an indefinite period to allow satisfactory investigation of all facets of the problem.

One item is included here which, although not a matter discussed by the panel, was a direct outcome of the panel's discussions. The Executive Board of the Water Resources Research Institute at Oregon State University met a day or two later and recommended the Institute support a move to establish a cooperative project that would have as its objective the above-mentioned limnological study. A meeting of a group of potential cooperators was held on the 28th of February at which a tentative plan of action was outlined. There is every reason to believe that this group will actively prosecute the plans outlined with the result that the study outline under II above will be supported.

Respectfully submitted,

/s/ Harry K. Phinney

Harry K. Phinney
Associate Professor of Botany

Tributary name	River mile	miles of coho habitat
Aikens Creek	48.9	**0.9**
Aubrey	86.3	**0**
Barkhouse (part of McKinney/Horse)	157.4	**0**
Beaver Creek	161.1	**23.2**
Bluff Creek	50.2	**4.5**
Bogus (part of Bogus-Willow)	189.6	**9.6**
Boise Creek	54.6	**3.8**
Cade	109.4	**0.3**
Camp Creek	56.9	**10.3**
China Creek	117.5	**0.5**
Clear Creek	98.7	**2.7**
Coon	89.1	**0**
Cottonwood Creek	182.1	**0.01**
Crawford (Hum)	56.8	**0.1**
Crawford (Sis)	93	**0**
Dillon Creek	84	**3.1**
Doggett (part of McKinney/Horse)	154.8	**0**
Dutch (part of Humbug/Lumgrey)	166.6	**0**
Elk Creek	105.5	**13.2**
Elliott	87.1	**0**
Empire (part of Humbug/Lumgrey	165.8	**4.6**
Fort Goff Creek	126.5	**0.9**
Grider	130.4	**11.8**
Halverson	73.6	**0**
Hopkins Creek	46.6	**0.1**
Horse Creek (part of McKinney/Horse)	147.3	**8.7**
Humbug Creek (part of Humbug/Lumgrey	171.5	**7.4**
Independence	94	**0.9**
Indian Creek	107	**21.6**
Irving Creek	75.1	**1.5**
King Creek	90.6	**0.3**
Kohl Creek		**0**
Little Grider	105.9	**0.3**
Little Horse	114.3	**0.4**
Lumgrey (part of Humbug/Lumgrey)	165.7	**2**
McKinney (part of McKinney/Horse)	154.7	**0**
Natuket	68	**0**
Oak Flat Creek	100.3	**0.3**
O'Neil	137.2	**0.1**
Pearch Creek	59.9	**0**
Portuguese Creek	127.5	**0.4**
Red Cap Creek	52.5	**9.7**
Reynolds	70	**0**
Rock Creek	79.1	**0.7**

Tributary name	River mile	miles of coho habitat
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Aubrey	86.3	**0**
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Elliott	87.1	**0**
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Kohl Creek		**0**
Little Grider	105.9	**0.3**
Little Horse	114.3	**0.4**
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Coon	89.1	**0**
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O'Neil	137.2	**0.1**
Pearch Creek	59.9	**0**
Portuguese Creek	127.5	**0.4**
Red Cap Creek	52.5	**9.7**
Reynolds	70	**0**
Rock Creek	79.1	**0.7**

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Rogers Creek	72.3	**0**
Sandy Bar	76.9	**0.3**
Seiad (part of Seiad/Walker)	130	**6.5**
Slate Creek	50.4	**4.7**
Stanshaw	76.2	**0.1**
Swillup	88.5	**0.1**
Teneyck	68.1	**0**
Thompson Creek	122.8	**7**
Ti	80.1	**0**
Titus	95.4	**0.5**
Tom Martin	143	**0.1**
Ukonom Creek	89.9	**0**
Ullathorne	56.2	**0.1**
Walker (part of Seiad/Walker)	134.4	**1.6**
West Grider	130	**?**
Willow (part of Bogus-Willow)	185	**12.2**

Rogers Creek	72.3	**0**
Sandy Bar	76.9	**0.3**
Seiad (part of Seiad/Walker)	130	**6.5**
Slate Creek	50.4	**4.7**
Stanshaw	76.2	**0.1**
Swillup	88.5	**0.1**
Teneyck	68.1	**0**
Thompson Creek	122.8	**7**
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Titus	95.4	**0.5**
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CHAPTER 10. ECONOMIC ANALYSIS

10.1 Introduction

The Regional Water Boards are legally required to consider economics in Total Maximum Daily Load (TMDL) development and water quality control planning (basin planning), as described in a memorandum from Sheila K. Vassey, Senior Staff Counsel in the Office of Chief Counsel of the State Water Resources Control Board (Vassey 1999). Under state law, there are three triggers for Regional Water Board consideration of economics or costs in basin planning. They are:

- The Regional Water Boards must estimate costs and identify potential financing sources in the basin plan before implementing any agricultural water quality control program.
- The Board must consider economics in establishing water quality objectives that ensure the reasonable protection of beneficial uses.
- The Boards must comply with the California Environmental Quality Control Act (CEQA) when they amend their basin plans. CEQA requires that the Boards analyze the reasonably foreseeable methods of compliance with proposed performance standards and treatment requirements. This analysis must include economic factors.

Chapter 9 is the analysis of potential environmental impacts associated with implementation of the TMDL and compliance with the recalculated Site Specific Objectives (SSOs) for dissolved oxygen (D0) as required under CEQA. In Chapter 9, staff identifies the reasonably foreseeable compliance measures necessary of land owners/dischargers to achieve compliance with the TMDLs and the proposed revised DO objectives. These compliance measures, or best management practices, are not requirements of individual landowners/dischargers. They are simply those management practices most likely to be necessary to achieve compliance. Land owners/dischargers have the responsibility of identifying the means of achieving compliance best suited to the site specific characteristics of their particular land and operation.

What follows is an estimate of the costs associated with those management practices which are reasonably foreseeable as necessary to achieve compliance with the TMDL and proposed revised DO objectives. The costs are given as a range, dependent on the specific characteristics of the land or operation to which a given management practices is applied. A list of potential funding sources is also given.

The Regional Water Board is not obligated to consider the balance of costs and benefits associated with implementation of a TMDL or basin plan amendment. It is only obligated to consider economic factors and may adopt a TMDL or basin plan amendment even if the costs are significant.

10.2 Scope of the Economic Analysis

10.2.1 Existing Requirements

Landowners and dischargers are bound by various existing regulatory requirements that involve water quality and natural resource protection. The economic impact of existing obligations should not be attributed to the costs of compliance with the proposed Klamath River TMDL Action Plan and revised DO objectives. But, limiting the scope of the economic analysis is difficult given the similarity of measures necessary to achieve a wide range of water quality and wildlife protection goals. To remain as focused as possible, this economic analysis only contemplates the costs of measures identified as reasonably foreseeable (see Chapter 9) in the implementation of the Klamath River TMDL Action Plan and revised DO objectives. But, if taken as a whole, they are likely an overestimate of the actual costs of compliance. This is because of the multiple and overlapping regulatory programs under which the same measures are reasonably foreseeable.

For example, some temperature, nutrient, or dissolved oxygen control costs are related to actions necessary to avoid a violation of the sediment prohibitions in the Basin Plan and to avoid a taking under the Endangered Species Act or to fully mitigate impacts of authorized takes. Other costs may be incurred as a result of compliance with the Clean Water Act, other related statutes and regulations, or local land use ordinances. Conversely, compliance with the proposed Klamath River TMDL Action Plan will help dischargers comply with the other regulatory requirements.

Applicable existing requirements include:

- Existing Basin Plan requirements (such as the federal and state antidegradation policies, the controllable factors requirement, the general Waste Discharge Requirements and general waiver for timber harvest activities, and the existing water quality objectives for temperature, dissolved oxygen).
- State nonpoint source program requirements.
- Porter-Cologne Act requirements (such as the requirement of Section 13260 for every person who discharges a waste that impacts water quality to file a report of waste discharge with the Regional Water Board, and the cleanup and abatement requirements of Section 13304).
- The California Department of Forestry and Fire Protection requirements for timber harvest activities.
- The federal and state endangered and threatened species requirements.
- Obligations imposed by other local, state and federal natural resource agencies.

As discussed in Chapter 9, the decommissioning of one or more of PacifiCorp's dams is being contemplated in other forums and not in the context of the TMDL Action Plan and revised mainstem Klamath River DO objectives. Whether the dams are ultimately removed is a decision before several federal and state agencies in consideration of other factors in addition to water quality, including water allocations, species protection and

power needs. Both dam alteration/modifications and dam removal are recognized as possible strategies by which final compliance with the TMDL load allocations may be accomplished. The Regional Water Board can only determine whether a selected outcome will meet its TMDL. The implementation plan provides for Regional Water Board review of more site specific environmental assessments of dam removal. Dam removal is something that may or may not occur, and is separate and independent of the TMDL. Nonetheless, at PacifiCorp's request and consistent with the Chapter 9 CEQA analysis, economic considerations from the Final Environmental Impact Statement for Relicensing of the Klamath Hydroelectric Project No. 2082-027 have been incorporated into this analysis. Because there is not yet a plan for dam decommissioning, the proposed costs are very broad, and actual costs remain uncertain.

10.2.2 Geographic Scope

The implementation actions proposed by the Klamath River TMDL Action Plan for compliance with the TMDLs and revised DO objectives (see Chapter 6) are not uniformly required across the Klamath River watershed or even across properties with similar land uses. Instead, many of the implementation actions will be required of landowners/dischargers on an as-needed, site-specific basis or are simply activities that are encouraged by the Regional Water Board. While this flexibility adds greatly to the effectiveness of the Klamath River TMDL Action Plan, it is one factor preventing this economic analysis from totaling costs on a watershed scale. Another factor preventing the development of watershed scale costs is the lack of a watershed scale inventory of pollution-causing activities/features (e.g., miles of roads requiring decommissioning).

Additionally, more intensive land use activities will face greater costs than less intensive land use activities. Activities on steep, erosive slopes in proximity to waterbodies will require greater care and higher costs than activities on lands that do not deliver to a water body or on lands that are not highly erosive.

10.2.3 Methodology

The costs identified in this chapter primarily come from four sources of information: the Natural Resources Conservation Service (NRCS) ProTracts cost dataset; California Department of Fish and Game (CDFG) Salmonid Stream Habitat Restoration Manual (2006) (Manual) for road-related costs, estimates provided by PacifiCorps for reservoir-related measures and the *Final Environmental Impact Statement for Relicensing of the Klamath Hydroelectric Project No. 2082-027* released by the Federal Energy Regulatory Commission on November 16, 2007. ProTracts is a national dataset maintained by NRCS to assist local NRCS Districts in setting cost shares for implementing conservation practices. Cost estimates are provided at the county level and the data used for this analysis are specific to Siskiyou County, as described in their California Approved Fiscal Year 2008 Payment Schedule.

The costs included in the CDFG Manual are described as upslope erosion inventory and sediment control guidance. The numbers are based on estimates from Pacific Watershed Associates, a consulting firm specializing in erosion control work. Actual costs can vary

considerably depending on operator skill and experience, equipment types, local site conditions, and regional location.

The cost estimates for interim measures to work toward compliance with the TMDL and DO objectives while it is determined whether PacifiCorp will decommission one or more of its dams are set forth in the AIP. Despite the fact that the parties to the AIP have not yet decided whether or not to decommission one or more of PacifCorp's dams and no plans for how that process will look have yet been created, the Regional Water Board has nonetheless attempted to consider economics of dam decommissioning, as those costs have been reported in the Final Environmental Impact Statement for Relicensing of the Klamath Hydroelectric Project No. 2082-027, prepared by FERC, which is incorporated herein by reference.

10.3 Estimated Costs of Compliance

10.3.1 PacifiCorp

PacifiCorp has entered into an agreement in principle (AIP) with the State of Oregon, the State of California, and the federal government to resolve "certain litigation and other controversies in the Klamath Basin, including a path forward for possible Facilities removal" (AIP 2008).[1] The AIP constitutes PacifiCorp's interim funding commitments while the negotiations continue on the topic of dam removal. Table 10.1 presents the costs associated with the measures related to interim compliance with the TMDL while decisions are being made to determine which regulatory path to pursue. Costs for the breadth of interim measures discussed in Chapter 6 (Implementation Plan) and Chapter 9 (CEQA Environmental Analysis) are included as a lump sum in item #11. Costs for dam removal are taken from the Final Environmental Impact Statement for Relicensing of the Klamath Hydroelectric Project No. 2082-027 (page 4-6 of the EIS). Costs to remove Copco 1 and 2 and Iron Gate dams range from $51 million to 75.3 million with additional decommissioning costs (e.g. re-vegetation) of between $9.2 million to to 55.3 million depending on individual site constraints.

Table 10.1: Costs to PacifiCorp of interim compliance measures

#	Interim Measure Task Title	Funding Commitment
9	California Klamath Restoration Fund/Coho Enhancement Fund	$500,000 annually until dams removed
10	Iron Gate Turbine Venting	$73,310 annually
11	Nutrient Reduction Measures	$5 million plus $500,000 annually
12	Water Quality Monitoring	$500,000 annually
13	Fish Tissue Consumption Risk Analysis	$250,000 one time cost
21	Iron Gate Gravel Placement	$7,131 annually
23	Water Quality Technical Conference	$100,000 one time cost
	One time costs	$5,350,000
	Annual costs	$1,580,441

[1] State of California is defined as the State of California Resources Agency and its constituent departments and excludes all other state agencies, departments, boards and commissions. The Regional Water Board is not a constituent department under the Resources Agency.

10.3.2 Irrigated Agriculture

Irrigated agriculture occurs primarily in the upper Klamath Basin, including the Lost, Shasta and Scott River valleys. USBR reports that approximately 225,000 acres of rangeland in the upper Klamath Basin (south-central Oregon and north-central California) have been transformed into productive farmland due to the availability of irrigation water provided by USBR. Principal irrigated crops are barley, irrigated pasture, alfalfa hay and other hay, oats, potatoes, and wheat (http://www.usbr.gov/dataweb/html/klamath.html). Table 10.2 presents the estimated costs to irrigated agriculture in California of reasonably foreseeable compliance measures for the Klamath River TMDL, and are taken from the Natural Resources Conservation Service (NRCS) Siskiyou County District Office Fiscal Year 2008 payment schedule. For most of the management practices, a range of costs is given, depending on numerous site-specific factors to be determined by landowners/dischargers.

Table 10.2: Estimated costs to irrigated agriculture of reasonably foreseeable compliance measures

Reasonably Foreseeable Compliance Measure	NRCS Practice Name	NRCS Practice Cost	NRCS Practice Code
Nutrient Management			
Comprehensive Nutrient Management Plan	Nutrient management	$2000-6000/plan	#100
Monitor soil, irrigation water and residual plant matter	To	be determined	
Time fertilizer application with plant needs	Timing No	cost	NA
Water Management (see below)	See below	See below	See below
Cover crops	Irrigated or non-irrigated	$61-112/acre	#340
Buffer areas	Non-native or native seedbed preparation; tree/shrub establishment	$75-371/acre #	386, #612
Pest Management			
Precision Pest Control Application	Precision pest control	$30/acre	#718
Pest Management	IPM, reduced risk, or transition to organic certifi ation	$30-125/acre #	595
Erosion and Sediment Control			
Maintain crop residue or vegetative cover	Cover crop	$60-112/acre	#340
Improve soil properties	Deep tillage Mulch till Cover crop	$55-105/acre $30/acre $60-112/acre	#324 #345 #340
Reduce slope length, steepness, or unsheltered distance	Precision land forming	$175/acre	#462
Practices to reduce detachment	Chiseling and subsoiling Conservation cover Conservation crop rotation Residue management Cover crop Critical area planting Seasonal residue management Diversion Windbreak/shelterbelt establishment	$55-106/acre $97-750/acre $50/acre $60-113/acre $249-1,229/acre $30/acre $10/ft $0.08-1.47/ft	#324 #327 #328 #329 #340 #342 #344 #362 #380

Table 10.2 (cont.): Estimated costs to irrigated agriculture of reasonably foreseeable compliance measures

Reasonably Foreseeable Compliance Measure	NRCS Practice Name	NRCS Practice Cost	NRCS Practice Code
Erosion and Sediment Control (cont.)			
Practices to reduce detachment (cont.)	Windbreak/shelterbelt renovation	$0.13-0.57/ft	#650
	Mulching	$78-299/acre	#484
	Irrigation water management	$5-50/acre	#449
	Cross wind ridges/stripcropping/trap strips	Not available	#589
	Surface roughening	Not available	#609
	Tree planting	$75-283/acre	#612
	Waste utilization	$30-50/acre	#633
	Wildlife upland habitat management	$10-50/acre	#645
Practices to reduce transport within the field	Contour farming	Not available	#330
	Field windbreak	Not available	#392
	Grassed waterway	$250-470/acre	#412
	Contour stripcropping	Not available	#585
	Herbaceous wind barriers	$400/acre	#442A
	Field stripcropping	Not available	#586
	Terrace	$5/acre	#600
	Contour buffer strips	Not available	#332
Practices to trap sediment below the field or critical area	Sediment basins	$4701/no.	#350
	Field border	$82-370/acre	#386
	Filter strip	$117-393/acre	#393
	Water and sediment control basin	$245-4,902/no.	#638
Protect and manage existing wetland and/or riparian areas for their natural filtering functions	Riparian herbaceous cover/forest buffer, wetland restoration	$75-1,200/acre #	390, #391, #657
CEQA Mitigation Measures			
Mulch exposed areas	Mulching	$78-299/acre	#484
Protect drainage channels from sediment contributions with vegetated buffers, wattles, or similar erosion control devices	Filter strip	$117-393/acre	#393
Wetland wildlife habitat management	Low, medium or high intensity	$10-50/acre	#644
Installation of grade stabilization structures	Grade stabilization structure	$250-10,000/no.	#410
Streambank and shoreline protection	Low-high complexity	$24-122/ft	#580
Stream channel stabilization	Stream channel stabilization	$25/ft	#584
Use exclusion	Forage exclusion, wetlands	$15/acre	#472
Riparian forest buffer/herbaceous cover	Riparian forest buffer/herbaceous cover	$75-1170/acre #	390, #91
Control of streambank erosion via vegetative or structural practices	Streambank and shoreline protection	$23-122/ft #	580

Table 10.2 (cont.): Estimated costs to irrigated agriculture of reasonably foreseeable compliance measures

Reasonably Foreseeable Compliance Measure	NRCS Practice Name	NRCS Practice Cost	NRCS Practice Code
Irrigation Management			
Irrigation scheduling	Irrigation water management	$5-50/acre	#449
Efficient application of irrigation water	Microirrigation, sprinklers	$250-1250/acre	#441, 442
Efficient transport of irrigation water	Installation of piping to replace open ditches	$2-5/ft #	516
Use of runoff or tailwater	Irrigation system/tailwater recovery	$77-102/acre #	447
Management of drainage water	Runoff management system	$5000/no.	#570
CEQA Mitigation Measures			
Vegetated filter strips	Filter strip	$117-393/acre	#393
Surface field ditch	Field ditch	$3/cy	#607
Water table control, controlled drainage	Subsurface drain	$1-2/ft	#606

Source: California Approved Fiscal Year 2008 Payment Schedule for Siskiyou County District of the Natural Resources Conservation Service.

10.3.3 Grazing

Grazing activities occur throughout the Klamath River basin both on private and public lands. As with the estimated costs to the irrigated agricultural community to comply with the Klamath River TMDL and revised DO objectives, the estimates to the grazing community are derived from NRCS Fiscal Year 2008 Payment Schedule for Siskiyou County. Costs for each of the reasonably foreseeable compliance measures identified in Chapter 9 are provided in Table 10.3

Table 10.3: Costs to grazing of reasonably foreseeable compliance measures

Reasonable Foreseeable Compliance Measure	NRCS Practice Name	NRCS Practice Cost	NRCS Practice Code
Grazing Management Practices			
Grazing Management Plan		To be determined	
Pasture and hay planting	Seedbed preparation, see and seeding, non-native	$125/acre #	512
Rangeland planting	Drill or broadcast, native or non-native	$26-644/acre #	550
Forage harvest management	Forage harvest management	Not available	#511
Vegetation control with grazing	Prescribed grazing	$10/acre	#528A
Use exclusion	Forage exclusion	$15/acre	#472
Nutrient management	AFO Manure Management	$25/acre	#590

Table 10.3 (cont.): Costs to grazing of reasonably foreseeable compliance measures

Riparian Grazing Practices			
Use exclusion	Fence	$0.39-5.25/ft	#382
Animal trails and walkways	Animal trails and walkways	$3/ft	#575
Stream crossing	Ford, culvert, bridge	$1000-50,000	#578
Alternate Water Supply Practices			
Irrigation management	Irrigation water management	$5-50/acre	#449
Installation of pipeline for off-channel water	Pipeline, rough terrain, steel or plastic	$2-5/ft #	516
Constructing off-stream pond	Pond up to 50 AcFt	$4,534-23,625/no.	#378
Installing trough or tank for off-channel water	Watering facility	$245-1,230/no.	#614
Constructing well	Water well	$990-9,905/no.	#642
Improving springs	Spring development	$981-1,981/no.	#574
Land and Streambank Stabilization Practices			
Nutrient management	AFO Manure Management-North Coast	$25/acre #5	90
Channel vegetation	Channel bank herb., tree, shrub vegetation	$321-536/acre #	322
Pasture and hay planting	Seedbed preparation, see and seeding, non-native	$125/acre #	512
Rangeland planting	Drill or broadcast, native or non-native	$26-644/acre #	550
Critical area planting	Tackifier, erosion blanket, strawmulch	$248-1,229/acre	#342
Brush management	Biological, mechanical	$47-462/acre	#314
Grazing land mechanical treatment		To be determined	#548
Grade stabilization structure	Grade stabilization structure	$250-10,000/no.	#410
Prescribed burning	Prescribed burning	$70/acre	#338
Stream corridor improvement Str	eam crossing	$1000-50,000/no.	#578
Land reclamation	Landslide treatment No	t available	#453
Sediment basin	Sediment basin	$4701/no.	#350
Wetland wildlife habitat management	Low-high intensity	10-50/acre	#644
Stream channel stabilization	Stream channel stabilization	$25/ft	#584
Wetland restoration	Northern CA, coast, planting only, shaping/grading	$157-1,200/acre	#657
Streambank and shoreline protection	Low-high complexity	$24-122/ft	#580
Riparian forest buffer/herbaceous cover	Riparian forest buffer/herbaceous cover	$203-971/acre #	391A #390
CEQA mitigations			
Mulch	Moisture and erosion control	$299/acre	#484B
Protecting drainage channels from sediment contributions	Channel bank vegetation	$321/acre	#322B

Source: Source: California Approved Fiscal Year 2008 Payment Schedule for Siskiyou County District of the Natural Resources Conservation Service.

10.3.4 Suction Dredging

Staff recommends to the Regional Water Board the limitation of suction dredging in the Klamath River Basin to certain times and locations in order to protect thermal refugia that mitigate water temperatures that are stressful to salmonids. Staff concludes that there are no specific costs to the suction dredging community associated with the TMDL or revised DO objectives. This is because the prohibition proposed for adoption does not prohibit suction dredging throughout the watershed; only in those tributaries in which thermal refugia exists.

10.3.5 Iron Gate Hatchery

The issues associated with the Iron Gate Hatchery are complex due to the location and issues surrounding the hatchery operation. Site-constraints and technical factors make it necessary for an engineering study to be completed before an economic analysis can be completed for the hatchery aspect of the TMDL and revised DO objectives. Some of the potential improvements that might be required in order for the hatchery to meet the TMDL requirements and revised DO objectives under a revised NPDES permit, could include improvements to settling ponds, treatment technologies (such as installation of a package treatment plant), modifications of operations, additional monitoring and laboratory analyses, and a potential off-sets program including up-stream treatment.

PacifiCorp has agreed to provide certain funding to the hatchery including "100% of the hatchery operations and maintenance necessary to fulfill annual mitigation objectives developed by the California Department of Fish and Game in consultation with the National Marine Fisheries Service (AIP 2008)." There may be some overlap in the requirements of these agencies and those of the Regional Water Board under the Klamath TMDL Action Plan. Further, some of these costs to the hatchery associated with water quality protection would be required as part of the upcoming NPDES permit update, regardless of the TMDL or revised DO objectives.

At present both the reasonably foreseeable compliance measures and their costs are too speculative to include here. Staff concludes that addressing these complex issues and creating an effective implementation plan is likely to be costly. The Regional Water Board has already begun working with the CDFG to address these difficult issues.

10.3.6 Roads

The road networks in the Klamath Basin contribute to elevated temperatures in tributary watersheds through the discharge of excess sediment. The implementation plan requires parties responsible for managing roads in the Klamath Basin to implement measures that meet the TMDL allocations, TMDL targets, and revised DO objectives. In some cases, an inventory of roads will determine that decommissioning or upgrading of roads is required. Table 10.4 outlines the estimated costs for this type of work. The targets, rationale for the targets, and the specific implementation measures that will be required under the TMDL for private, county, state (Caltrans) and federal (USFS, BLM) maintained roads are discussed in Chapter 6.

Regardless of the method of regulation or the responsible party, the requirements for controlling sources of sediment from roads are similar and implementation will potentially focus on the following process:

1. Inventory: Identify sources of excess sediment discharge or threatened discharge and quantify the discharge or threatened discharge from the source(s).
2. Prioritize: Prioritize efforts to control discharge of excess sediment based on, but not limited to, severity of threat to water quality and beneficial uses, the feasibility of source control, and source site accessibility.
3. Implement: Develop and implement feasible sediment control practices to prevent, minimize, and control the discharge. Road decommissioning may be required as part of a responsible parties' load allocation if maintaining the road is cost prohibitive, road is not needed or is a source of uncontrollable excess sediment discharge.
4. Monitor and Adapt: Use monitoring results to direct adaptive management in order to refine excess sediment control practices and implementation schedules until discharges are reduced to a level that meets the TMDL load allocations and water quality standards.

Table 10.4: Estimated costs for reasonably foreseeable compliance measures for roads

Reasonably Foreseeable Compliance Measure	Best Management Practice	BMP estimated cost	Source of data
Costs for Road and Crossing Construction and Maintenance Activities			
Surface stabilization	Asphalt paving	$238,000/mile	Siskiyou County Public Works
	Chip sealing	$57,000/mile	Siskiyou County Public Works
	Rocking	$4,250-10,000/1000 ft	Weaver, et. al. (2006)
	Dust abatement	$90hr	Harris Blade Rental, Livermore - operated water truck
Fill slope/cutbank compliance measures	Removal/stabilization of unstable fill.	$2-5/cubic yard	Weaver, et. al. (2006)
	Soil stabilization (mulch/vegetate) of fill and cut slopes.	$19-22/1000 ft.	Weaver, et. al. (2006)
Control sediment discharge from insloped or crowned roads	Disconnect road drainage from watercourses (drain to hillslopes).	$170/1000 ft	Weaver, et. al. (2006)
	Install rolling dip	$85-170/ each	Weaver, et. al. (2006)
	Install ditch relief culvert	$645-825/ each	Weaver, et. al. (2006)
	Install stream crossing	$3,270/each	Weaver, et. al. (2006)
CEQA mitigation measures	Conservation cover	$189-509/acre	NRCS#327
Mu	lching	$299/acre	NRCS #484

Table 10.4 (cont.): Estimated costs for reasonably foreseeable compliance measures for roads

Reasonably Foreseeable Compliance Measure	Best Management Practice	BMP estimated cost	Source of data
Costs for Stream Crossing Activities			
Stabilize/treat crossing approach	Rock road surface	$4,250-10,000/1000 ft	Weaver, et. al. (2006)
	Water for dust abatement	To be determined	
	Install additional road drainage: waterbars, rolling dips, cross drains	$85-3,270/each Weave	r, et. al. (2006)
	Mulching $	299/acre	NRCS #484
	Streambank and shoreline protection	$24-122/ft N	RCS #580
Stabilize/treat crossings and associated fills	Remove undersized/failing culverts	$3-10/cubic yard	Weaver, et. al. (2006)
	Remove unstable fill	$2-5/cubic yard	Weaver, et. al. (2006)
	Rock armor, rip rap fill slopes	To be determined	
	Provide "fail safe" road drainage on crossings with diversion potential	To be determined	
	Drain road away from unprotected fills	$10,000-75,000/mile	Weaver, et. al. (2006)
	Bioengineered structures (e.g. willow waddles)	To be determined	
	Mulch, vegetate or rock exposed soil with access to watercourses	To be determined	
Construct storm-proof crossings and associated fills		To be determined	
CEQA mitigation measures	Conservation cover	$189-509/acre	NRCS#327
	Mulching $	299/acre	NRCS #484
	Streambank and shoreline protection	$24-122/ft N	RCS #580
Costs of Road Planning Activities			
Develop a Road System Plan	Erosion Control Plan, non-timber land use	$3528-7,740/100 acres	R. Fitzgerald Memo dated August 6, 2005
	Erosion Control Plan, timber land use	$2,370-7,740/100 acre	
	Road System Plan	To be determined	
Road decommissioning	Recontour road to provide for a stable, hydrologically "invisible" site (e.g. remove perched fill, outslope old road prism, remove crossings)	$2,000-$50,000/mile depending on steepness and location of road	Weaver, et. al. (2004)
	Minimize road system (density) to correspond with maintenance resources	$2,000-$50,000/mile to recontour unnecessary roads	Weaver, et. al. (2004)
	Decommission roads adjacent to watercourse and relocate to midslope or ridgetop if possible	To be determined	
CEQA mitigation measures	Conservation cover	$189-509/acre	NRCS#327

10.3.7 Timber

Timber harvest activities can substantially impact water temperature. The Klamath implementation plan focuses on controlling sediment and protecting riparian functions from timber harvest activities to meet the watershed-wide TMDL allocations for temperature described earlier in this section. Timber harvest on nonfederal lands is currently regulated by the Regional Board through a combination of general WDRs and conditional waivers of WDRs. The costs associated with WDRs are not outlined here as they are a current requirement. Roads that are part of a timber harvest plan or Non-Industrial Timber Management Plan (NTMP) area require an erosion control plan to be implemented by the WDRs and waivers for timber harvest on nonfederal lands. Table10.5 includes the reasonably foreseeable compliance measures identified in Chapter 9. However, staff judges that there are no additional costs to timber operators associated with TMDL compliance.

Table 10.5: Estimated costs to timber operators of reasonably foreseeable compliance measures

Reasonably Foreseeable Compliance Measures	Best Management Practice	Estimated cost of BMP	Source of data
Compliance measures on private land	Increased riparian canopy retention in Class I and II watercourses	None St	aff judgment
	Retain in-channel trees following timber operations	None St	aff judgment
	No timber harvest activities (including tree felling) within the channel zone of a Class III watercourse except for use and maintenance of road and crossings.	None St	aff judgment
	Implement Threatened and Impaired Rules (Forest Practice Rules, 2009, section 916.9, 936.9) watershed-wide in the Klamath River watershed.	No additional cost	Staff judgment

10.3.8 Summary

Sunding and Zwane (2004) produced the Recovery Strategy for California Coho Salmon: Report to the California Fish and Game Commission (Strategy) in which they assessed the costs of implementing the Strategy in each hydrologic unit, including the Klamath River. The main activities associated with implementation of the Strategy are similar to those associated with compliance with the Klamath River TMDL and revised DO objectives, the estimated costs of which are reproduced in Table 10.6. As described above, where costs are incurred as a result of the implementation/enforcement of another

program, they can not be attributed to the Klamath River TMDL and revised DO objectives. However, because these costs were estimated for the whole watershed, they are included here for illustration purposes.

Table 10.6: Estimated costs of coho recovery actions for the Klamath River basin

Action	Potential Sites (#)	Actual Sites (#)	Estimated Cost ($)	Unit Cost ($/unit)
Barrier removal (dam)	31	16	7,137,216	460,456
Barrier removal (non-structural sites)	752 37	6	3,635,213	9,668
Barrier removal (stream crossings)	291	146	18,220,276	125,225
Barrier removal (unknown/other barriers)	17 9		94,292	37,367
Barrier removal (water diversions)	78	39	1,344,905	34,485
Riparian revegetation	NA	103 stream miles	18,721,487	80,993
Streambank restoration	NA	20 stream miles	25,893,312	316,722
Fencing NA		1,748 stream miles	12,830	
Klamath Basin Total			75,059,531	

Monies spent under the Strategy are monies saved under the Klamath River TMDL and revised DO objectives for the following categories of expenditures:

- Non-structural barrier removal to temperature refugia,
- Stream crossing repairs,
- Riparian revegetation,
- Streambank restoration, and
- Fencing.

10.4 Sources of Funding

Potential sources of funding include monies from private and public sources. Public financing includes, but is not limited to: grant funds, as described below; single-purpose appropriations from federal, state, and/or local legislative bodies; and, bond indebtedness and loans from government institutions.

10.4.1 Funding Source Provided through the Agreement In Principle (AIP)

The United States, State of California, State of Oregon, and PacifiCorp signed an Agreement In Principle (AIP) on November 13, 2008 in which certain interim provisions are made with respect to the hydroelectric facilities on the Klamath River prior to final agreement on the decommissioning of the dams.[2] In the AIP, PacifiCorp agreed to provide $500,000 annually to the California Klamath Restoration Fund/Coho Enhancement Fund (Restoration and Enhancement Fund) to be administered jointly by

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[2] State of California is defined as the State of California Resources Agency and its constituent departments and excludes all other state agencies, departments, boards and commissions. The Regional Water Board is not a constituent department under the Resources Agency.

the California Department of Fish and Game (in conjunction with the State Water Resources Control Board) and NOAA Fisheries. The Restoration and Enhancement Fund is intended to fund habitat and fish restoration actions within the Klamath Basin that will benefit coho salmon.

10.4.2 Summary of Pertinent State Funding Programs

There are several potential sources of public financing through grant and funding programs administered, at least in part, by the Regional Water Board and the State Water Board. These programs vary over time depending upon federal and state budgets and ballot propositions approved by voters. State funding pertinent to the proposed Action Plan for the Klamath River are summarized and described below. Additional information can be found on the State Water Resources Control Board webpage (http://www.waterboards.ca.gov/water_issues/programs/grants_loans/).

10.4.2.1 Agricultural Drainage Loan Program

The Agricultural Drainage Loan Program was created by the Water Conservation and Water Quality Bond Act of 1986 to address treatment, storage, conveyance, or disposal of agricultural drainage water that threatens waters of the State. There is a funding cap of $20 million for implementation projects and $100,000 for feasibility studies. Loan repayments are for a period of up to 20 years.

10.4.2.2 Agricultural Drainage Management Loan Program

The Agricultural Drainage Management Loan Program, created by Proposition 204 and distributed through the Agricultural Drainage Management Subaccount, provides loan and grant funding for Drainage Water Management Units. Drainage Water Management Units are land and facilities for the treatment, storage, conveyance, reduction or disposal of agricultural drainage water that, if discharged untreated, would pollute or threaten to pollute the waters of the State. This program is available to any city, county, district, joint power authority, or other political subdivision of the State involved with water management.

10.4.2.3 Agricultural Water Quality Grants Program

The Agricultural Water Quality Grant Program provides funding for projects that reduce or eliminate non-point source pollution discharge to surface waters from agricultural lands. Funding from Propositions 40 and 50 were administered through two solicitations, most recently the 2005-2006 Consolidated Grants Process. Additional funds will be made available in the future through Proposition 84.

10.4.2.4 Federal Clean Water Act Section 319 Nonpoint Source Implementation Program

This program is an annual federally funded nonpoint source pollution control program that is focused on controlling activities that impair beneficial uses and on limiting pollutant effects caused by those activities. States must establish priority rankings for waters on lists of impaired waters and develop action plans, known as Total Maximum Daily Loads (TMDLs), to improve water quality. Project proposals that address TMDL implementation and those that address problems in impaired waters are favored in the selection process. There is also a focus on implementing management activities that lead

to reduction and/or prevention of pollutants that threaten or impair surface and ground waters.

10.4.2.5 Clean Water State Revolving Fund

The Federal Water Pollution Control Act (Clean Water Act or CWA), as amended in 1987, provides for establishment of a Clean Water State Revolving Fund (CWSRF) program. The program is funded by federal grants, State funds, and Revenue Bonds. The purpose of the CWSRF program is to implement the CWA and various State laws by providing financial assistance for the construction of facilities or implementation of measures necessary to address water quality problems and to prevent pollution of the waters of the State.

The CWSRF Loan Program provides low-interest loan funding for construction of publicly-owned wastewater treatment facilities, local sewers, sewer interceptors, water recycling facilities, as well as, expanded use projects such as implementation of nonpoint source (NPS) projects or programs, development and implementation of estuary Comprehensive Conservation and Management Plans, and storm water treatment.

10.4.3 Summary of Pertinent Federal Funding Programs

Several federal agencies, including but not limited to the U.S. Environmental Protection Agency, NOAA Fisheries, U.S. Fish and Wildlife Service, and USDA Natural Resources Conservation Service, also provide grants and other funding opportunities. The U.S. Environmental Protection Agency provides access through its webpage to a catalog of federal funding opportunities: <http://cfpub.epa.gov/fedfund/>. Table 10.7 lists the federal funding programs pertinent to the water quality protection work required in the Klamath River watershed.

Table 10.7: Summary of pertinent federal funding programs

Funding Program	Program Description	FY2009 Funds
Aquatic Ecosystem Restoration (CAP Section 206)	Work under this authority may carry out aquatic ecosystem restoration projects that will improve the quality of the environment, are in the public interest, and are cost-effective. There is no requirement that an existing Corps project be involved	$28.7 million
Bring Back the Natives Grant Program	The Bring Back the Natives initiative (BBN) funds on-the-ground efforts to restore native aquatic species to their historic range. Projects should involve partnerships between communities, agencies, private landowners, and organizations that seek to rehabilitate streamside and watershed habitats. Projects should focus on habitat needs of species such as fish, invertebrates, and amphibians that originally inhabited the waterways across the country. Funding for the BBN program is administered through NFWF from federal agencies cooperating to support this program. Cooperating agencies and organizations include the US Fish and Wildlife Service (USFWS), Bureau of Land Management (BLM), USDA Forest Service (USFS), and Trout Unlimited (TU).	TBD

Table 10.7 (cont.): Summary of pertinent federal funding programs

Funding Program	Program Description	FY2009 Funds
Coastal Program	The U.S. Fish and Wildlife Service (USFWS) Coastal Program works to conserve healthy coastal habitats on public or private land for the benefit of fish, wildlife, and people in 22 specific coastal areas. The program forms cooperative partnerships designed to (1) protect costal habitats by providing technical assistance for conservation easements and acquisitions; (2) restore coastal wetlands, uplands, and riparian areas; and (3) remove barriers to fish passage in coastal watersheds and estuaries. Program biologists provide restoration expertise and financial assistance to federal and state agencies, local and tribal governments, businesses, private landowners, and conservation organizations such as local land trusts and watershed councils.	$14.74 million
Community-based Habitat Restoration Partnership Grants	The NOAA Community-based Restoration Program (NOAA CRP) provides funds for small-scale, locally driven habitat restoration projects that foster natural resource stewardship within communities. The program seeks to bring together diverse partners to implement habitat restoration projects to benefit living marine resources. Projects might include restoring salt marshes, mangroves, and other coastal habitats; improving fish passage and habitat quality for anadromous species; removing dams; restoring and creating oyster reefs, removing exotic vegetation and replanting with native species; and similar projects to restore habitat or improve habitat quality for populations of marine and anadromous fish.	$6.3 million
Conservation Reserve Program	The Conservation Reserve Program (CRP) is a voluntary program for agricultural landowners. Through CRP, you can receive annual rental payments and cost-share assistance to establish long-term, resource conserving covers on eligible farmland.	$1.9 billion
Conservation Security Program	The Conservation Security Program (CSP) is a voluntary conservation program that supports ongoing stewardship of private lands by providing payment for maintaining and enhancing natural resources. CSP identifies and rewards those farmers and ranchers who are meeting the highest standards of conservation and environmental management on their operations.	$283 million
Emergency Watershed Protection	The USDA Natural Resources Conservation Service's Emergency Watershed Protection (EWP) program helps protect lives and property threatened by natural disasters such as floods, hurricanes, tornadoes, droughts, and wildfires. EWP provides funding for such work as clearing debris from clogged waterways, restoring vegetation, and stabilizing river banks. The measures that are taken must be environmentally and economically sound and generally benefit more than one property owner. EWP also provides funds to purchase floodplain easements as an emergency measure. Floodplain easements restore, protect, maintain, and enhance the functions of the floodplain; conserve natural values including fish and wildlife habitat, water quality, flood water retention, ground water recharge, and open space; reduce long-term federal disaster assistance; and safeguard lives and property from floods, drought, and the products of erosion. EWP can provide up to 90 percent cost share in limited resource areas as determined by the US Census.	TBD (Total funding depends on the amount of emergency funds requested during the fiscal year)

Table 10.7 (cont.): Summary of pertinent federal funding programs

Funding Program	Program Description	FY2009 Funds
Environmental Quality Incentives Program	The USDA Natural Resources Conservation Service's Environmental Quality Incentives Program (EQIP) was established to provide a voluntary conservation program for farmers and ranchers to address significant natural resource needs and objectives. EQIP offers contracts with a minimum term that ends one year after the implementation of the last scheduled practices and a maximum term of ten years. These contracts provide financial assistance to program participants to implement conservation practices. Persons or legal entities, who are owners of land under agricultural production or who are engaged in livestock or agricultural production on eligible land may participate in EQIP. EQIP activities are carried out according to an environmental quality incentives program plan of operations developed in conjunction with the producer that identifies the appropriate conservation practice or practices to address the resource concerns. The practices are subject to NRCS technical standards adapted for local conditions. NRCS approves the plan of operations and obligates contract funds for the conservation practices listed in the plan of operations.	$1.067 billion
Farm and Ranch Lands Protection Program (FRPP)	The USDA Natural Resources Conservation Service's Farmland Protection Program (FPP) is a voluntary program that helps farmers and ranchers keep their land in agriculture and prevents conversion of agricultural land to non-agricultural uses. The program provides matching funds to organizations with existing farmland protection programs that enable them to purchase conservation easements. These entities purchase easements from landowners in exchange for a lump sum payment, not to exceed the appraised fair market value of the land's development rights. The easements are for perpetuity unless prohibited by state law. Eligible land is land on a farm or ranch that has prime, unique, statewide, or locally important soil or contains historical or archaeological resources; supports the policy of a State or local farm and ranch land protection policy; is subject to a pending offer by an eligible entity; and includes cropland, rangeland, grassland, pasture land, forest land and other incidental land that is part of an agricultural operation.	$105 million (for technical and financial assistance)
Five-Star Restoration Program	The EPA supports the Five-Star Restoration Program by providing funds to the National Fish and Wildlife Foundation and its partners, the National Association of Counties, NOAA's Community-based Restoration Program and the Wildlife Habitat Council. These groups then make subgrants to support community-based wetland and riparian restoration projects. Competitive projects will have a strong on-the-ground habitat restoration component that provides long-term ecological, educational, and/or socioeconomic benefits to the people and their community. Preference will be given to projects that are part of a larger watershed or community stewardship effort and include a description of long-term management activities. Projects must involve contributions from multiple and diverse partners, including citizen volunteer organizations, corporations, private landowners, local conservation organizations, youth groups, charitable foundations, and other federal, state, and tribal agencies and local governments. Each project would ideally involve at least five partners who are expected to contribute funding, land, technical assistance, workforce support, or other in-kind services that are equivalent to the federal contribution.	$300,000

Table 10.7 (cont.): Summary of pertinent federal funding programs

Funding Program	Program Description	FY2009 Funds
Healthy Forests Reserve Program	The Healthy Forests Reserve Program (HFRP) is a voluntary program established for the purpose of restoring and enhancing forest ecosystems to: 1) promote the recovery of threatened and endangered species, 2) improve biodiversity; and, 3) enhance carbon sequestration. Program implementation has been delegated by the Secretary of Agriculture to the Natural Resources Conservation Service.	TBD
Forest Legacy Program	Through its Forest Legacy Program (FLP), the USDA Forest Service supports state efforts to protect environmentally sensitive forest lands from the conversion to non-forest uses through the use of conservation easements and fee-simple purchase. Designed to encourage the protection of privately owned forest lands, FLP is an entirely voluntary program. The program enables landowners to retain ownership of their land and continue to earn income from it while keeping drinking water safe and clean, conserving valuable open space as well as protecting critical wildlife habitats and outdoor recreation opportunities. The program promotes professional forest management and requires forest management plans. The program emphasizes strategic conservation - working in partnership with States, local communities and non-governmental organizations to make a difference on the land and for communities by conserving areas of unbroken forest, watershed or river corridor forests or by complimenting existing land conservation efforts. FLP conservation easements restrict development, protect a range of public values and many require public access for recreation.	$57 million
NOAA Open Rivers Initiative	The NOAA Open Rivers Initiative (ORI) provides funding and technical expertise for community-driven, small dam and river barrier removals, primarily in coastal states. Projects are expected to provide an economic boost for communities, enhance public safety, and improve populations of NOAA trust resources such as striped bass, Atlantic and shortnose sturgeon, Atlantic and Pacific salmon, American eel, American shad, blueback herring, and alewife. Proposals selected will be implemented through a cooperative agreement	$7 million
National Integrated Water Quality Program (NIWQP)	The National Integrated Water Quality Program (NIWQP) provides funding for research, education, and extension projects aimed at improving water quality in agricultural and rural watersheds. The NIWQP has identified eight "themes" that are being promoted in research, education and extension. The eight themes are (1) Animal manure and waste management (2) Drinking water and human health (3) Environmental restoration (4) Nutrient and pesticide management (5) Pollution assessment and prevention (6) Watershed management (7) Water conservation and agricultural water management (8) Water policy and economics. Awards are made in four program areas - National Facilitation Projects, Regional Coordination Projects, Extension Education Projects, and Integrated Research, Education and Extension Projects. Please note that funding is only available to universities.	$12 million

Table 10.7 (cont.): Summary of pertinent federal funding programs

Funding Program	Program Description	FY2009 Funds
National Wildlife Refuge Friends Group Grant Program	The National Fish and Wildlife Foundation provides grants for projects that help organizations to be effective co-stewards of our Nation's important natural resources within the National Wildlife Refuge System. This program provides competitive seed grants to help increase the number and effectiveness of organizations interested in assisting the refuge system nationwide. The program will fund: (1) Start-up Grants to assist starting refuge support groups with formative and/or initial operational support (membership drives, training, postage, etc.); (2) Capacity Building Grants to strengthen existing refuge support groups' capacity to be more effective (outreach efforts, strategic planning, membership development); and (3) Project Specific Grants to support a specific project (conservation education programs for local schools, outreach programs for private landowners, habitat restoration projects, etc.)	TBD
Native Plant Conservation Initiative	The National Fish and Wildlife Foundation's Native Plant Conservation Initiative (NPCI) supports on-the-ground conservation projects that protect, enhance, and/or restore native plant communities on public and private land. Projects typically fall into one of three categories and may contain elements of each: protection and restoration, information and education, and inventory and assessment. Applicants are encouraged, when appropriate, to include a pollinator component in their project. This program is funded by the Bureau of Land Management, Forest Service, Fish and Wildlife Service, and National Park Service.	TBD
North American Wetlands Conservation Act Grants Program	The U.S. Fish and Wildlife Service's Division of Bird Habitat Conservation administers this matching grants program to carry out wetlands and associated uplands conservation projects in the United States, Canada, and Mexico. Grant requests must be matched by a partnership with nonfederal funds at a minimum 1:1 ratio. Conservation activities supported by the Act in the United States and Canada include habitat protection, restoration, and enhancement. Mexican partnerships may also develop training, educational, and management programs and conduct sustainable-use studies. Project proposals must meet certain biological criteria established under the Act. Visit the program web site for more information. (Click on the hyperlinked program name to see the listing for "Primary Internet".)	$83 million
Partners for Fish and Wildlife Program	The Partners for Fish and Wildlife Program provides technical and financial assistance to private landowners to restore fish and wildlife habitats on their lands. Since 1987, the program has partnered with more than 37,700 landowners to restore 765,400 acres of wetlands; over 1.9 million acres of grasslands and other upland habitats; and 6,560 miles of in-stream and streamside habitat. In addition, the program has reopened stream habitat for fish and other aquatic species by removing barriers to passage.	TBD

Table 10.7 (cont.): Summary of pertinent federal funding programs

Funding Program	Program Description	FY2009 Funds
Pesticide Environmental Stewardship Grants	EPA's Pesticide Environmental Stewardship Program (PESP) offers grants to support the reduction of risks from pesticides in agricultural and non-agricultural settings, and to implement pollution prevention measures. All organizations with a commitment to pesticide risk reduction are eligible to join PESP as members, either as Partners or as Supporters. For more information about membership requirements and available grants, click on the program name and refer to the link listed under "Primary Internet."	$500,000
Project Modifications for Improvement of the Environment (CAP Section 1135)	Work under this authority provides for modifications in the structures and operations of water resources projects constructed by the Corps of Engineers to improve the quality of the environment. Additionally, the Corps may undertake restoration projects at locations where an existing Corps project has contributed to the degradation. The primary goal of these projects is ecosystem restoration with an emphasis on projects benefiting fish and wildlife. The project must be consistent with the authorized purposes of the project being modified, environmentally acceptable, and complete within itself	$28.7 million
Pulling Together Initiative	The National Fish and Wildlife Foundation's Pulling Together Initiative (PTI) provides a means for federal agencies to partner with state and local agencies, private landowners, and other interested parties to develop long-term weed management projects within the scope of an integrated pest management strategy. The goals of PTI are: (1) to prevent, manage, or eradicate invasive and noxious plants through a coordinated program of public/private partnerships; and (2) to increase public awareness of the adverse impacts of invasive and noxious plants. PTI provides support on a competitive basis for the formation of local weed management area (WMA) partnerships, allowing them to demonstrate successful collaborative efforts and develop permanent funding sources for the maintenance of WMAs from the involved parties. Successful projects will serve to increase public awareness and interest in future partnership projects.	TBD
Watershed Protection and Flood Prevention Program	Also known as the 'Watershed Program' or the 'PL 566 Program,' this program provides technical and financial assistance to address water resource and related economic problems on a watershed basis. Projects related to watershed protection, flood mitigation, water supply, water quality, erosion and sediment control, wetland creation and restoration, fish and wildlife habitat enhancement, agricultural water conservation, and public recreation are eligible for assistance. Technical and financial assistance is also available for planning new watershed surveys.	$40 million

Table 10.7 (cont.): Summary of pertinent federal funding programs

Funding Program	Program Description	FY2009 Funds
Sustainable Agriculture Research and Education	The Sustainable Agriculture Research and Education (SARE) program of the U.S. Department of Agriculture works to advance farming systems that are more profitable, environmentally sound and good for communities through an innovative grants program. More specifically, SARE funds scientific investigation and education to reduce the use of chemical pesticides, fertilizers, and toxic materials in agricultural production; to improve management of on-farm resources to enhance productivity, profitability, and competitiveness; to promote crop, livestock, and enterprise diversification and to facilitate the research of agricultural production systems in areas that possess various soil, climatic, and physical characteristics; to study farms that have are managed using farm practices that optimize on-farm resources and conservation practices; and to promote partnerships among farmers, nonprofit organizations, agribusiness, and public and private research and extension institutions. Click on program name and check the link in the Primary Internet box for more information about grant opportunities and program results.	$14.4 million
Watershed Rehabilitation Program	This program provides Federal cost-share funding for the rehabilitation of aging dams that were installed primarily through the Watershed Protection and Flood Prevention Program over the past 55 years. The purpose for rehabilitation is to extend the service life of dams and bring them into compliance with applicable safety and performance standards or to decommission the dams so they no longer pose a threat to life and property.	$40 million through the FY2009 Appropriations, $50 million through the American Recovery and Reinvestment Act
Watershed Rehabilitation Program	This program provides Federal cost-share funding for the rehabilitation of aging dams that were installed primarily through the Watershed Protection and Flood Prevention Program over the past 55 years. The purpose for rehabilitation is to extend the service life of dams and bring them into compliance with applicable safety and performance standards or to decommission the dams so they no longer pose a threat to life and property.	$40 million through the FY2009 Appropriations, $50 million through the American Recovery and Reinvestment Act
Wetlands Reserve Program	Through this voluntary program, the USDA Natural Resources Conservation Service (NRCS) provides landowners with financial incentives to restore and protect wetlands in exchange for retiring marginal agricultural land. To participate in the program landowners may sell a conservation easement or enter into a cost-share restoration agreement (landowners voluntarily limit future use of the land, but retain private ownership). Landowners and the NRCS jointly develop a plan for the restoration and maintenance of the wetland.	$500 million

Table 10.7 (cont.): Summary of pertinent federal funding programs

Funding Program	Program Description	FY2009 Funds
Wildlife Habitat Incentives Program	The Wildlife Habitat Incentives Program (WHIP) is a voluntary program for people who want to develop and improve wildlife habitat on private lands. It provides both technical assistance and cost sharing to help establish and improve fish and wildlife habitat. Participants work with USDA's Natural Resources Conservation Service to prepare a wildlife habitat development plan in consultation with a local conservation district. The plan describes the landowner's goals for improving wildlife habitat, includes a list of practices and a schedule for installing them, and details the steps necessary to maintain the habitat for the life of the agreement.	$74 million

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CHAPTER 10. REFERENCES

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Municipal, Industrial and Rural Residential Water Balance Calculations

Year: 2000
DAU: 3
County: Siskiyou

User Group	**2000 SUMMARY**			
Population	4810			
Groundwater Production	416.39 mg	1,274 af		
Surface Water Production	0.00 mg	0 af		
Single Family Residential Use	330.97 mg	1,013 af	79.5%	SFR WU Factor
Multi-Family Residental Use	0.00 mg	0 af	0.0%	MFR WU Factor
Commercial Use	85.42 mg	261 af	20.5%	Com. WU Factor
Industrial Use	0.00 mg	0 af	0.0%	Ind. WU Factor
Landscape Use	0.00 mg	0 af	0.0%	Lan. WU Factor
Energy Production	0.00 mg	0 af	0.0%	En. WU Factor
Urban Per-Capita Water Use	237 gpcd	0.265 afpca		
Indoor Per-Capita Water Use Estimate	194 gpcd	0.218 afpca		
Single Family Residential Use - Interior	256.72 mg	788 af		
Multi-Family Residental Use - Interior	0.00 mg	0 af		
Sewerage	50.48 mg	155 af		
Evaporation Pond	1.31 mg	4 af		
Deep Percolation Pond	49.18 mg	151 af		
Total Sewerage & Septic	342.30 mg	1,050 af		
Septic System - Deep Percolation	291.81 mg	896 af		
Outdoor Depletion	62.98 mg	190 af		
Outdoor Deep Percolation - Groundwater	11.11 mg	34 af		
Outdoor Deep Percolation - Surface Water	0.00 mg	0 af		
Total Deep Percolation - Groundwater	352.10 mg	1,080 af		
Total Deep Percolation - Surface Water	0.00 mg	0 af		

User Group	**2000 PUBLIC WATER SUPPLY SUMMARY**			
Population	670			
Groundwater Production	58.00 mg	177 af	Unacc. (%)	0.00%
Surface Water Production	0.00 mg	0 af	Unacc. (AF)	0 af
Single Family Residential Use	46.10 mg	141 af	79.5%	SFR WU Factor
Multi-Family Residental Use	0.00 mg	0 af	0.0%	MFR WU Factor
Commercial Use	11.90 mg	36 af	20.5%	Com. WU Factor
Industrial Use	0.00 mg	0 af	0.0%	Ind. WU Factor
Landscape Use	0.00 mg	0 af	0.0%	Lan. WU Factor
Energy Production	0.00 mg	0 af	0.0%	En. WU Factor
Urban Per-Capita Water Use	237 gpcd	0.265 afpca		
Indoor Per-Capita Water Use Estimate	206 gpcd	0.231 afpca		
Single Family Residential Use - Interior	37.86 mg	116 af		
Multi-Family Residental Use - Interior	0.00 mg	0 af		
Sewerage	50.48 mg	155 af		
Evaporation Pond	1.31 mg	4 af		
Deep Percolation Pond	49.18 mg	151 af		
Total Sewerage & Septic	50.48 mg	155 af		
Septic System - Deep Percolation	0.00 mg	0 af		
Outdoor Depletion	6.39 mg	19 af		
Outdoor Deep Percolation - Groundwater	1.13 mg	3 af		
Outdoor Deep Percolation - Surface Water	0.00 mg	0 af		
Total Deep Percolation - Groundwater	50.30 mg	154 af		
Total Deep Percolation - Surface Water	0.00 mg	0 af		

User Group	**2000 SELF-PRODUCED WATER SUPPLY SUMMARY**			
Population	4140			
Groundwater Production	358.39 mg	1,097 af		
Surface Water Production	0.00 mg	0 af		
Single Family Residential Use	284.87 mg	872 af	79.5%	SFR WU Factor
Multi-Family Residental Use	0.00 mg	0 af	0.0%	MFR WU Factor
Commercial Use	73.52 mg	225 af	20.5%	Com. WU Factor
Industrial Use	0.00 mg	0 af	0.0%	Ind. WU Factor
Landscape Use	0.00 mg	0 af	0.0%	Lan. WU Factor
Energy Production	0.00 mg	0 af	0.0%	En. WU Factor
Urban Per-Capita Water Use	237 gpcd	0.265 afpca		
Indoor Per-Capita Water Use Estimate	193 gpcd	0.216 afpca		
Single Family Residential Use - Interior	218.86 mg	672 af		
Multi-Family Residental Use - Interior	0.00 mg	0 af		
Sewerage	0.00 mg	0 af		
Evaporation Pond	0.00 mg	0 af		
Deep Percolation Pond	0.00 mg	0 af		
Total Sewerage & Septic	291.81 mg	896 af		
Septic System - Deep Percolation	291.81 mg	896 af		
Outdoor Depletion	56.59 mg	171 af		
Outdoor Deep Percolation - Groundwater	9.99 mg	30 af		
Outdoor Deep Percolation - Surface Water	0.00 mg	0 af		
Total Deep Percolation - Groundwater	301.80 mg	926 af		
Total Deep Percolation - Surface Water	0.00 mg	0 af		

Municipal, Industrial and Rural Residential Water Balance Calculations

Year: 2005
DAU: 3
County: Siskiyou

User Group	**2005 SUMMARY**			
Population	4868			
Groundwater Production	470.86 mg	1,445 af		
Surface Water Production	0.00 mg	0 af		
Single Family Residential Use	375.47 mg	1,152 af	79.7%	SFR WU Factor
Multi-Family Residental Use	0.00 mg	0 af	0.0%	MFR WU Factor
Commercial Use	95.40 mg	292 af	20.3%	Com. WU Factor
Industrial Use	0.00 mg	0 af	0.0%	Ind. WU Factor
Landscape Use	0.00 mg	0 af	0.0%	Lan. WU Factor
Energy Production	0.00 mg	0 af	0.0%	En. WU Factor
Urban Per-Capita Water Use	264 gpcd	0.297 afpca		
Indoor Per-Capita Water Use Estimate	144 gpcd	0.161 afpca		
Single Family Residential Use - Interior	170.65 mg	524 af		
Multi-Family Residental Use - Interior	0.00 mg	0 af		
Sewerage	35.42 mg	109 af		
Evaporation Pond	1.31 mg	4 af		
Deep Percolation Pond	34.11 mg	105 af		
Total Sewerage & Septic	255.98 mg	786 af		
Septic System - Deep Percolation	220.56 mg	677 af		
Outdoor Depletion	182.65 mg	560 af		
Outdoor Deep Percolation - Groundwater	32.23 mg	99 af		
Outdoor Deep Percolation - Surface Water	0.00 mg	0 af		
Total Deep Percolation - Groundwater	286.90 mg	880 af		
Total Deep Percolation - Surface Water	0.00 mg	0 af		

User Group	**2005 PUBLIC WATER SUPPLY SUMMARY**			
Population	672			
Groundwater Production	65.00 mg	199 af	Unacc. (%)	0.00%
Surface Water Production	0.00 mg	0 af	Unacc. (AF)	0 af
Single Family Residential Use	51.83 mg	159 af	79.7%	SFR WU Factor
Multi-Family Residental Use	0.00 mg	0 af	0.0%	MFR WU Factor
Commercial Use	13.17 mg	40 af	20.3%	Com. WU Factor
Industrial Use	0.00 mg	0 af	0.0%	Ind. WU Factor
Landscape Use	0.00 mg	0 af	0.0%	Lan. WU Factor
Energy Production	0.00 mg	0 af	0.0%	En. WU Factor
Urban Per-Capita Water Use	264 gpcd	0.297 afpca		
Indoor Per-Capita Water Use Estimate	144 gpcd	0.162 afpca		
Single Family Residential Use - Interior	23.61 mg	72 af		
Multi-Family Residental Use - Interior	0.00 mg	0 af		
Sewerage	35.42 mg	109 af		
Evaporation Pond	1.31 mg	4 af		
Deep Percolation Pond	34.11 mg	105 af		
Total Sewerage & Septic	35.42 mg	109 af		
Septic System - Deep Percolation	0.00 mg	0 af		
Outdoor Depletion	25.14 mg	77 af		
Outdoor Deep Percolation - Groundwater	4.44 mg	14 af		
Outdoor Deep Percolation - Surface Water	0.00 mg	0 af		
Total Deep Percolation - Groundwater	38.55 mg	118 af		
Total Deep Percolation - Surface Water	0.00 mg	0 af		

User Group	**2005 SELF-PRODUCED WATER SUPPLY SUMMARY**			
Population	4196			
Groundwater Production	405.86 mg	1,245 af		
Surface Water Production	0.00 mg	0 af		
Single Family Residential Use	323.64 mg	993 af	79.7%	SFR WU Factor
Multi-Family Residental Use	0.00 mg	0 af	0.0%	MFR WU Factor
Commercial Use	82.23 mg	252 af	20.3%	Com. WU Factor
Industrial Use	0.00 mg	0 af	0.0%	Ind. WU Factor
Landscape Use	0.00 mg	0 af	0.0%	Lan. WU Factor
Energy Production	0.00 mg	0 af	0.0%	En. WU Factor
Urban Per-Capita Water Use	264 gpcd	0.297 afpca		
Indoor Per-Capita Water Use Estimate	144 gpcd	0.161 afpca		
Single Family Residential Use - Interior	147.04 mg	451 af		
Multi-Family Residental Use - Interior	0.00 mg	0 af		
Sewerage	0.00 mg	0 af		
Evaporation Pond	0.00 mg	0 af		
Deep Percolation Pond	0.00 mg	0 af		
Total Sewerage & Septic	220.56 mg	677 af		
Septic System - Deep Percolation	220.56 mg	677 af		
Outdoor Depletion	157.51 mg	483 af		
Outdoor Deep Percolation - Groundwater	27.80 mg	85 af		
Outdoor Deep Percolation - Surface Water	0.00 mg	0 af		
Total Deep Percolation - Groundwater	248.35 mg	762 af		
Total Deep Percolation - Surface Water	0.00 mg	0 af		

Municipal, Industrial and Rural Residential Water Balance Calculations

Year: 2000
DAU: 4
County: Siskiyou

User Group	**2000 SUMMARY**			
Population	21546			
Groundwater Production	825.27 mg	2,527 af		
Surface Water Production	1,315.19 mg	4,026 af		
Single Family Residential Use	1,378.74 mg	4,219 af	64.4%	SFR WU Factor
Multi-Family Residental Use	177.22 mg	543 af	8.3%	MFR WU Factor
Commercial Use	181.10 mg	555 af	8.5%	Com. WU Factor
Industrial Use	132.76 mg	408 af	6.2%	Ind. WU Factor
Landscape Use	270.65 mg	830 af	12.6%	Lan. WU Factor
Energy Production	0.00 mg	0 af	0.0%	En. WU Factor
Urban Per-Capita Water Use	271 gpcd	0.304 afpca		
Indoor Per-Capita Water Use Estimate	99 gpcd	0.111 afpca		
Single Family Residential Use - Interior	547.95 mg	1,682 af		
Multi-Family Residental Use - Interior	25.42 mg	250 af		
Sewerage	563.95 mg	1,731 af		
Evaporation Pond	61.29 mg	188 af		
Deep Percolation Pond	25.81 mg	79 af		
Total Sewerage & Septic	780.65 mg	2,396 af		
Septic System - Deep Percolation	216.70 mg	665 af		
Outdoor Depletion	1,142.32 mg	3,492 af		
Outdoor Deep Percolation - Groundwater	92.58 mg	283 af		
Outdoor Deep Percolation - Surface Water	124.91 mg	382 af		
Total Deep Percolation - Groundwater	335.08 mg	1,027 af		
Total Deep Percolation - Surface Water	124.91 mg	382 af		

User Group	**2000 PUBLIC WATER SUPPLY SUMMARY**			
Population	14078			
Groundwater Production	163.01 mg	499 af	Unacc. (%)	31.44%
Surface Water Production	1,148.10 mg	3,513 af	Unacc. (AF	1,261 af
Single Family Residential Use	868.87 mg	2,659 af	66.3%	SFR WU Factor
Multi-Family Residental Use	176.01 mg	539 af	13.4%	MFR WU Factor
Commercial Use	167.49 mg	513 af	12.8%	Com. WU Factor
Industrial Use	3.72 mg	12 af	0.3%	Ind. WU Factor
Landscape Use	95.02 mg	291 af	7.2%	Lan. WU Factor
Energy Production	0.00 mg	0 af	0.0%	En. WU Factor
Urban Per-Capita Water Use	254 gpcd	0.285 afpca		
Indoor Per-Capita Water Use Estimate	114 gpcd	0.128 afpca		
Single Family Residential Use - Interior	386.29 mg	1,186 af		
Multi-Family Residental Use - Interior	25.41 mg	250 af		
Sewerage	538.15 mg	1,652 af		
Evaporation Pond	61.29 mg	188 af		
Deep Percolation Pond	0.00 mg	0 af		
Total Sewerage & Septic	588.88 mg	1,807 af		
Septic System - Deep Percolation	50.74 mg	156 af		
Outdoor Depletion	613.89 mg	1,874 af		
Outdoor Deep Percolation - Groundwater	16.84 mg	51 af		
Outdoor Deep Percolation - Surface Water	91.49 mg	279 af		
Total Deep Percolation - Groundwater	67.58 mg	207 af		
Total Deep Percolation - Surface Water	91.49 mg	279 af		

User Group	**2000 SELF-PRODUCED WATER SUPPLY SUMMARY**			
Population	7468			
Groundwater Production	662.26 mg	2,028 af		
Surface Water Production	167.09 mg	513 af		
Single Family Residential Use	509.87 mg	1,560 af	61.5%	SFR WU Factor
Multi-Family Residental Use	1.21 mg	4 af	0.1%	MFR WU Factor
Commercial Use	13.61 mg	42 af	1.6%	Com. WU Factor
Industrial Use	129.04 mg	396 af	15.6%	Ind. WU Factor
Landscape Use	175.63 mg	539 af	21.2%	Lan. WU Factor
Energy Production	0.00 mg	0 af	0.0%	En. WU Factor
Urban Per-Capita Water Use	303 gpcd	0.340 afpca		
Indoor Per-Capita Water Use Estimate	70 gpcd	0.079 afpca		
Single Family Residential Use - Interior	161.66 mg	496 af		
Multi-Family Residental Use - Interior	0.01 mg	0 af		
Sewerage	25.81 mg	79 af		
Evaporation Pond	0.00 mg	0 af		
Deep Percolation Pond	25.81 mg	79 af		
Total Sewerage & Septic	191.77 mg	589 af		
Septic System - Deep Percolation	165.96 mg	509 af		
Outdoor Depletion	528.43 mg	1,618 af		
Outdoor Deep Percolation - Groundwater	75.74 mg	232 af		
Outdoor Deep Percolation - Surface Water	33.42 mg	103 af		
Total Deep Percolation - Groundwater	267.50 mg	820 af		
Total Deep Percolation - Surface Water	33.42 mg	103 af		

Municipal, Industrial and Rural Residential Water Balance Calculations

Year: 2005
DAU: 4
County: Siskiyou

User Group	2005 SUMMARY			
Population	22654			
Groundwater Production	1,323.33 mg	4,061 af		
Surface Water Production	1,235.09 mg	3,790 af		
Single Family Residential Use	1,455.77 mg	4,467 af	56.9%	SFR WU Factor
Multi-Family Residental Use	143.32 mg	440 af	5.6%	MFR WU Factor
Commercial Use	308.03 mg	944 af	12.0%	Com. WU Factor
Industrial Use	170.55 mg	523 af	6.7%	Ind. WU Factor
Landscape Use	480.77 mg	1,476 af	18.8%	Lan. WU Factor
Energy Production	0.00 mg	0 af	0.0%	En. WU Factor
Urban Per-Capita Water Use	309 gpcd	0.347 afpca		
Indoor Per-Capita Water Use Estimate	110 gpcd	0.123 afpca		
Single Family Residential Use - Interior	541.33 mg	1,661 af		
Multi-Family Residental Use - Interior	26.28 mg	357 af		
Sewerage	667.75 mg	2,049 af		
Evaporation Pond	61.29 mg	188 af		
Deep Percolation Pond	25.81 mg	79 af		
Total Sewerage & Septic	906.92 mg	2,783 af		
Septic System - Deep Percolation	239.17 mg	734 af		
Outdoor Depletion	1,377.28 mg	4,226 af		
Outdoor Deep Percolation - Groundwater	181.13 mg	556 af		
Outdoor Deep Percolation - Surface Water	93.09 mg	286 af		
Total Deep Percolation - Groundwater	446.11 mg	1,369 af		
Total Deep Percolation - Surface Water	93.09 mg	286 af		

User Group	2005 PUBLIC WATER SUPPLY SUMMARY			
Population	14651			
Groundwater Production	218.65 mg	671 af	Unacc. (%)	89.45%
Surface Water Production	1,152.68 mg	3,537 af	Unacc. (AF)	3,764 af
Single Family Residential Use	877.03 mg	2,691 af	64.0%	SFR WU Factor
Multi-Family Residental Use	143.32 mg	440 af	10.5%	MFR WU Factor
Commercial Use	274.02 mg	840 af	20.0%	Com. WU Factor
Industrial Use	41.51 mg	127 af	3.0%	Ind. WU Factor
Landscape Use	35.46 mg	109 af	2.6%	Lan. WU Factor
Energy Production	0.00 mg	0 af	0.0%	En. WU Factor
Urban Per-Capita Water Use	256 gpcd	0.287 afpca		
Indoor Per-Capita Water Use Estimate	132 gpcd	0.147 afpca		
Single Family Residential Use - Interior	368.29 mg	1,130 af		
Multi-Family Residental Use - Interior	26.28 mg	357 af		
Sewerage	641.94 mg	1,970 af		
Evaporation Pond	61.29 mg	188 af		
Deep Percolation Pond	0.00 mg	0 af		
Total Sewerage & Septic	703.47 mg	2,159 af		
Septic System - Deep Percolation	61.53 mg	189 af		
Outdoor Depletion	567.68 mg	1,742 af		
Outdoor Deep Percolation - Groundwater	23.57 mg	72 af		
Outdoor Deep Percolation - Surface Water	76.61 mg	235 af		
Total Deep Percolation - Groundwater	85.10 mg	261 af		
Total Deep Percolation - Surface Water	76.61 mg	235 af		

User Group	2005 SELF-PRODUCED WATER SUPPLY SUMMARY			
Population	8003			
Groundwater Production	1,104.68 mg	3,390 af		
Surface Water Production	82.41 mg	253 af		
Single Family Residential Use	578.74 mg	1,776 af	48.8%	SFR WU Factor
Multi-Family Residental Use	0.00 mg	0 af	0.0%	MFR WU Factor
Commercial Use	34.01 mg	104 af	2.9%	Com. WU Factor
Industrial Use	129.04 mg	396 af	10.9%	Ind. WU Factor
Landscape Use	445.31 mg	1,367 af	37.5%	Lan. WU Factor
Energy Production	0.00 mg	0 af	0.0%	En. WU Factor
Urban Per-Capita Water Use	406 gpcd	0.455 afpca		
Indoor Per-Capita Water Use Estimate	70 gpcd	0.078 afpca		
Single Family Residential Use - Interior	173.04 mg	531 af		
Multi-Family Residental Use - Interior	0.00 mg	0 af		
Sewerage	25.81 mg	79 af		
Evaporation Pond	0.00 mg	0 af		
Deep Percolation Pond	25.81 mg	79 af		
Total Sewerage & Septic	203.45 mg	624 af		
Septic System - Deep Percolation	177.64 mg	545 af		
Outdoor Depletion	809.60 mg	2,484 af		
Outdoor Deep Percolation - Groundwater	157.57 mg	484 af		
Outdoor Deep Percolation - Surface Water	16.48 mg	51 af		
Total Deep Percolation - Groundwater	361.01 mg	1,108 af		
Total Deep Percolation - Surface Water	16.48 mg	51 af		

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Comparing The work Harry Lake Did - Salmon Migration 1978 - 2008 (Table) with The Pacific Corp Table page 11

The in River Run 1985 Thru 2025 with The in river HARVES FOR That Same period presents These results

	(1) In River Run	(2) Harvest Reservation	(3) Harv. Sports Angler	(4) Return To Trangate	(5) Planted Fingerlings	(6) need (7) Annual Precip Class	In River mortality	(8) Pink Trib Spawn (35) Escapt
1985	133827	13572	14777	23,000	2			47000
1986	239559	26631	30425	17,000	2			85846
1987	229182	54346	25605	[illegible]	2			79863
1988	215696	53168	27614	16,000	2			78493
1989	133440	46290	11042	[illegible]	2			46724
1990	40774	11328	5655	6000	2			14095
1991	134425	[illegible]	4067	3000	2			12048
1992	40341	6453	5.22	7000	2			14137
1993	64810	10229	5097	21000	2			22684
1994	73534	12667	4388	13000	5mm	97469	21000	27424
1995	245542	67786	10501	23500	5mm	120738	[illegible]	86000
1996	185305	57123	15078	12000	12 mm	141057	36248	64856
1997	91[illegible]	12531	5085	11000	12 mm	52721	39008	32105
1998	95286	10097	5813	12500	12 mm	65327	29954	33350
1999	70246	15[illegible]	5545	11000	12 mm	55078	15218	24604
2000	228323	30486	7252	72000	5mm	189651	29672	79913
2001	198673	38[illegible]	17834	39000	5mm	161181	37515	69536
*2002	170044	29[illegible]	11365	25000	5mm	120654	48163	59505
2003	195791	30534	10494	31000	5mm	140555	55236	68527
2004	88589	26272	6744	11000	5mm	75033	13587	31006
2005	69523	6623	3015	12500	5mm	45771	21762	23633
2006	88369	11189	5581					30405

* lost 34,000

Klamath is not

9. Salmon Mortality

Mortality of fry, fingerlings, smolt, juveniles & adults and where it occurs in the fresh & salt water habitat is critical to the decision making process in suggesting options to change current River & tributary harmonics.

A report released covering the mid 1990's stated that Irongate Hatchery released approx 13 million fingerlings. The normal annual release is 5 million. One of the results from that above normal release was to see how much more of the unused habitat (65%) in the mainstream and tributaries would be used. That investigation never materialized because escapement into the estuary from the ocean amounted to a mere 1 ½ % and the return to Irongate Hatchery was between 15-20 thousand adults, which is not too much different from the 5 million release and a return of 10-15 thousand adults. Other factors for the low escapement maybe reasons causing life losses. Unconfirmed but openly discussed are these 7 causes of mortality:

1. **Bird & wildlife prey of fingerlings in fresh water environment**
2. **Diseases obtained in River environment**
3. **Toxicity & temperature conditions in River & ocean**
4. **Predators in the ocean**
5. **Sustenance & commercial harvest in Lower River**
6. **Sportsmen & commercial harvest in ocean & River**
7. **Asian net harvest in ocean**

Salmon spend 3 ½ years of their life in the ocean & ½ year in the River & tributaries and are therefore at greatest risk in the ocean.

Until something gets done to resolve the mortality problems, it leaves the question open as to why Fish Biologists & Agencies are pursuing additional habitat when they haven't solved the problem of increasing the population. The place to begin is the Ocean environment.

See Marine Survival

Fall Chinook returns

2015

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My Opinion: Coho in the Klamath River

Printed in Pioneer Press and the Klamath Basin Crisis.

This report has been made by history research writer and former and half-century resident of the Klamath River, James A. Waddell in 2009.

Below are notes to the Klamath Basin people in 2007, with info from research.

1. Salmon did not exist in the Klamath Falls area of the Upper Klamath Basin in known history *(The only reports of such existence comes from commentary by* wilderness-types *of people such as* Oregon Wild, Klamath RiverKeeper, etc...*)*;
2. No spawning gravels above State line rapids; (***research*** **does not list salmon** ***as using Spencer Creek as "...a spawning stream"; Spencer Creek is a spawning area and recruitment source of*** **Redband trout***.)*
3. No spawning gravel in slow, warm waters of lakes, refuges or wet lands in Upper Klamath Basin.

Reference: Book ***"Tribes of California"*** by Stephen Powers. ... 1871 and 1872... regarding the Modoc Indians. See Page 256 see paragraph 4... *"But the salmon, king of the finny tribes, they had not, for that royal fish ascends the Klamath only to the first rapids below Lower Klamath Lake."*

Reference: Book ***"Handbook of the Indians of California"*** by A. L. Kroeber ... in 1925... See Chapter 22, The Modoc. See page 325, paragraph 5 *"The salmon are said not to run into the Klamath Lakes or above..."*

This quote is from OR Senator Doug Whitsett's 6/23/2008 speech:

"This plan to introduce salmon into the Upper Basin has a critical flaw that will be potentially devastating to not only agricultural and timber interests, but to all inhabitants of the Upper Basin. Most of the proposed salmon habitat includes water that is much too warm and eutrophic for these species to survive and reproduce. The very high natural background levels of phosphorous, the nearly flat river valleys, and the extremely shallow nature of Upper Klamath Lake have resulted in warm eutrophic waters for millennia, and will continue to do so for millennia to come. Nothing that man can do will alter that reality."

Records from History as stated by CA Department of Fish &Game: Quotes;

"The earliest record of Coho salmon being stocked in the Klamath Basin was of a plant made in 1895. Further examination of the original records from the U.S. Commission on Fish and Fisheries (1895) revealed those fish were raised in the Ft. Gaston facility in Hoopa and were stocked in the Trinity River and in Supply Creek, a tributary to the Trinity River. Those fish were reared from eggs taken at a facility in **Redwood Creek**... and also from eggs shipped from another **facility not identified** in the report (but were likely from **out of the basin**)."

"**Apparently,** no Coho salmon eggs were collected at the Klamathon Racks during the 1911-1912 and 1917-1918 seasons... However, Coho salmon eggs were taken during the five consecutive seasons beginning with the 1912-1913 season."

"**Historically**, the practice of **importing non-native fish was common,** especially in systems where native fish had been extirpated or were in low abundance..."

"After the completion of Trinity River Hatchery in 1963, adult Coho salmon returns at this facility rarely exceeded 1,000 fish prior to 1971. In an effort to increase returns to **Iron Gate Hatchery**, Coho salmon from the **Cascade River** in Oregon were stocked in 1966, 1967 and 1969... The first significant transfer of Coho salmon to **Trinity River Hatchery** occurred in 1964 when **Eel River Coho** salmon stocks were brought in."

"This was followed by plantings of Coho salmon originating from the **Cascade River**, Oregon in 1966, 1967 and 1969. **Noyo River** stock was also planted in 1969 and **Alsea River** stock was planted in the Trinity in 1970... It **appears** the intent of these out-of-basin transfers was to augment already existing, albeit dwindling, natural Coho salmon populations."

"Current California Fish and Game Commission policy now **essentially** prohibits all out-of-basin fish transfers."

"Coho salmon returns to the Shasta River have been documented in almost every year since 1934. ... Similar information is **lacking** for the **Scott River**..."

Spotted Owls, a subspecies of the populous **Barred Owl** species, were listed as Endangered by false proclamation of government agents; now known from Mexico to CA, OR, WA to Canada. **Marble Murrelets** were listed as Endangered by false proclamation of government agents; have a Pacific population of 4.5 to 5 million birds. **Polar bears** were listed as Endangered by false proclamation of government agents; now more Polar bears than ever. **Shortnose and Lost River sucker fish** are not at risk; but false proclamations of government agents had them listed under the ESA.

CA DF&G; "**Information** on the historical occurrence of **Coho salmon** in the upper Klamath River is **sparse**."

Facts presented here are that **non-Native Coho** were planted in multiple streams of the Klamath River System for over a century."

Such information of **Coho history was not** included in the Listing of **Klamath Coho as an Endangered Species** so the listing is without scientific support!

Another fraud by governmental agents? That is my opinion!

By James A. Waddell, 1101 Stone Canyon Dr. #1334, Roseville, CA 95661.

⊳ **Information of Klamath River Indian Tribes, their lands and their languages. Many of "Indians" of the Klamath River are of mixed blood with area tribes and with non-Indians and are mingled throughout the western land ... and shop for their groceries at the local markets... just like everybody else!**

In the distant past, all the Indian tribes of the Klamath River could and did speak two or three neighboring tribal languages, frequently in the same conversations.

No known Indian Treaties gave any of these tribes "Salmon" fishing rights.

It is my conclusion that the vast majority of Tribal Members are not actively supportive of Tribal Management groups in these Klamath Dam Removal efforts!

Karuk People are of the Karuk **Hokan language.** Karuk People had a territory from Seiad Valley to Preston Peak and from above the mouth of the Trinity River to the Siskiyou Mountains. An indirect comment made at the mouth of the Trinity River, by newcomer George Gibbs 1851, of Clear Creek being the lower limit of Shasta People, was made without research and with limited knowledge of the multiple languages of the Klamath River Indians. Karuk land; Est. 60 miles downriver from Iron Gate dam.

Yuruk People were one of two tribes of an eastern language of **Algonquian;** including the Wiyot of Humboldt. Yuruk People were from the mouth of the Trinity River and downriver on each side to the Pacific Ocean and south to Trinidad.

Yuruk Reservation; An average of 120 miles downriver of Iron Gate dam.

Hupa People were one of a group of northern California tribes that spoke **Athabascan language.** Hupa People were in the valley along the lower Trinity River. **Hupa was the name of the people** and Hoopa (Hoop-ah) was the name of the valley; Hoopa Reservation is 144 square miles. Hoopa Valley Reservation; On Trinity River 100 miles below Iron Gate dam.

Shasta People are of group of tribal clans that spoke a **Shasta Hokan** language.

The Shastas were in: Scott Valley; Shasta Valley; Klamath River areas from Horse Creek to Fall Creek; Bear Creek of Rogue River; and in Salmon River and over the Trinity Mountains south; two Shasta language tribes were in the Pit River area.

Klamath People and the **Modoc People** were of a **Lutuamian language.**

The Indian Treaties for the Klamath Tribes did not "Give" the Klamath Tribe "Salmon" fishing rights: ...only to allow them to "...continue to gather fish."

The Klamath People were in the land at Klamath Falls and Upper Klamath Lake including the Wood River, the Williamson River, the Sprague River and Sycan River and the Modoc People were in the land of Tule Lake, Lower Klamath Lake, Butte Valley, Lost River and Clear Lake. Klamath land; Estimate 18 river miles above the 14 miles of white water rapids near and above Stateline.

The Klamath Indians made trading agreements with the Shastas that allowed them to come downriver on the Klamath to near Bogus Creek, Willow Creek and to the Shasta River near Montague to gather salmon; other history told of those gathered salmon being battered and with sores.

This is where the Klamaths of the past had to go to find salmon.

California Department of Fish and Game records Quotes" the earliest record of Coho salmon being stocked in the Klamath River was of a plant made in 1895. Further examination of the original records from the U.S. Fish and Fisheries (1895) revealed those fish were raised at the Ft. Gaston facility in Hoopa and were stocked in the Trinity River and Supply Creek, a tributary of the Trinity. Those fish were reared from eggs taken at a facility on Redwood creek...and also from eggs shipped from another facility not identified in the report (but likely out of the basin).)

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California Dept. of Fish and Game "Information on the historical occurrence of the Coho Salmon in the upper Klamath River is sparse."

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Such information of the Coho history was not included in the listing of the Klamath Coho as an Endangered Species so the listing is without scientific support.

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ASSOCIATED SPORTSMEN OF CALIFORNIA
DANGER
WHEN
WATER RISES
RIVER SUBJECT TO SUDDEN RISES
This warning given without assuming liability
ASSOCIATED SPORTSMEN OF CALIFORNIA
CO-OPERATING WITH
SHASTA VALLEY & GUN CLUB

The Potential Impact of Warm Water Fish Released into the Klamath River

The writings of early trappers and explorers indicate that the waters of the Klamath River have always been of poor quality. This is not surprising when you consider the source. Klamath Lake is a large shallow lake with high mineral content and is partially fed by warm springs within the lake. This combination produces a heavy algae bloom which exits the lake via Link River and, eventually, the Klamath. This results in conditions more compatible to warm water species of fish than to salmonids.

The dams created for hydro-electric power generation did two things:

A. They blocked salmon runs to the upper portion of the river and,
B. They made fine habitat for warm water species.

Because of this a number of plants of warm water fish were made at various times during the last century. Today these fish offer recreational fishing for large numbers of people and subsistence fishing for others.

There are four species of primary concern within the hydro impoundments. They are:

A. Largemouth bass
B. Yellow perch
C. Crappie
D. Catfish (channel)

All of these fish share a common trait. They are predators As such they have the potential to adversely impact salmonids in several ways, more about this later.

At present there are small numbers of one or more of these species below Iron Gate Dam. Their numbers are too few to cause harm to salmon or steelhead, but if the fish now in the lakes were flushed into the river below Iron Gate Reservoir the result could be disastrous.

Many of these fish would be taken by predators but others could well establish breeding populations and become residents within the river system. They would impact salmonids by:

A. Competition with salmonids for available food sources. This would effect the salmon smolts moving to the ocean, and
B. Preying on smolts.

The extent of this predation could cause a decline and, possibly, the eventual loss of salmon and steelhead runs.

Of the species mentioned, yellow perch are the most likely to become resident because they spawn in cooler water than the others. Crappie could also pose a problem if they are able to find a niche in the system. Bass and catfish would be less likely to become a problem although channel catfish are river dwellers and potentially could find a niche of their own.

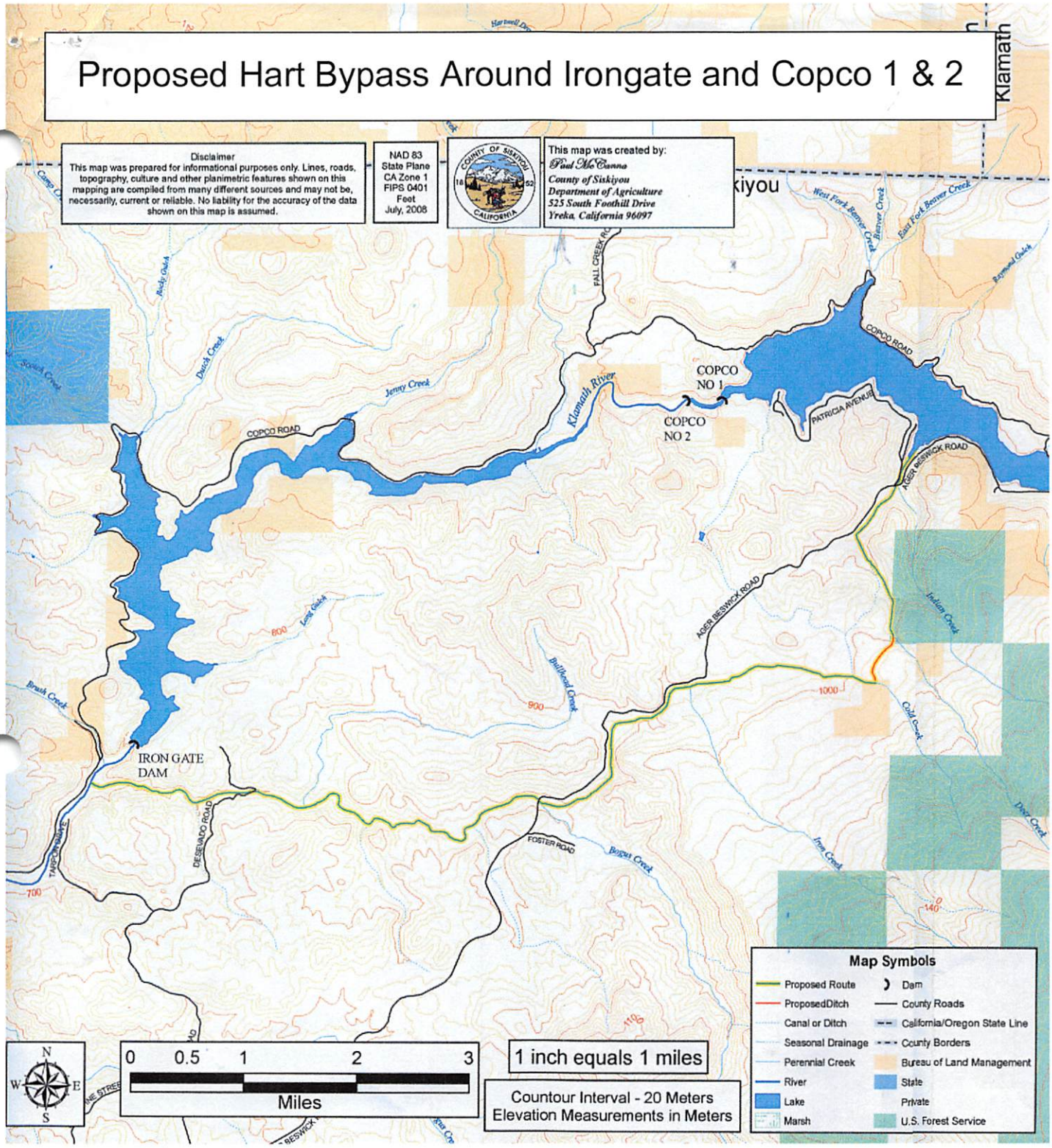
A scenario that causes me concern is a combination of events:

A. Heavy predation on salmonid smolts and.
B. Several consecutive years of drought.

This could be the death knell for salmonid runs.

Over the course of a thirty-eight year career with the California Department of Fish and Game, I have never heard of the kind of irresponsible solution being proposed to deal with the warm water fish problem. Indeed, this seems totally at odds with good fish management procedures. The Department has taken heroic measures to eradicate Northern Pike from lakes in the Sierras yet they seem unconcerned about the potential devastation of the Klamath salmon runs. The only consistency I can see here is the total lack of good scientific procedure in the formulation of this plan.

written by Frank Lightsmeir
retired Hatchery worker at
Iron Gate Hatchery



KNOWN LOCALLY AS THE HART BYPASS, THIS ROUTE OFFERS AN ALTERNATIVE FOR FISH BYPASS AROUND IRONGATE AND BOTH COPCO DAMS

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's Quick Review and Analysis of the ve the Klamath River Power Plants"

By

Werner F. Hoyt, PE (Mechanical/Marine Engineer)

31 March 2010

The National Science Foundation Review issued in March 2010 of the science behind decisions regarding water use cut off decisions. Driving these decisions were suppositions based on various ideas that certain activities were responsible for the collapse and subsequent listing of Delta Smelt and Longfin Smelt as threatened or endangered species. The foundation cited although the individual study science was good, they directed that the agencies go back and "Quantify the various elements of the situation. Spending 95% of your effort which attacks 5% or less of the global problem is bad science and bad management of scarce resources.

We have a similar situation with the efforts from outside – The removal of the Klamath River Dams is an initiative largely on the part of individuals who do not have a stake in the issue. The impact of the changes imposed by these outsiders will fall on the residents of Siskiyou, Del Norte, Jackson, and Klamath Counties in the form of increased energy costs and reduced power reliability and security.

A quick review of the Parameters impacting the Klamath River Power Plant Removal Proposal

1 – What are the Major Factors Impacting Salmon and Steel Head Runs
- a) Marine Mammals/Predation
- b) International fishing
- c) Habitat
- d) Environmental Quality
- e) What has changed that impact the Salmon and Steelhead Runs

2 – What are the Impacts of the alternatives
- a) Costs
- b) Reliability
- c) Environmental –clean vs CO2 emissions
- d) Security – Local power vs import from out of area
- e) Security – Trade Deficit/Dependence on foreign oil

The above all require quantification to determine where effort is to be applied.
The 5% solution yields 95% of the desired goal.

An Engineers Quick Review and Analysis of the "Proposal to Remove the Klamath River Power Plants"

By

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1a – Pinniped impact on fish populations

California Sea Lion Census 2007 – 238,000 Estimate by NOAA National Marine Fisheries
Current Population estimate extrapolated at 6%/yr. 1978 Census was 11,000 when the Marine Mammals Protection Act was established.

Year	Population
2007	238,000
2008	252,280
2009	267,417
2010	283,462

California Seal Population Census 2004 by NOAA National Marine Fisheries estimated West Coast Population at 31,000. Population growth per census appears to be starting to level. Assume declining growth rates at 1% per year from 2004 for extrapolation. Growth rate provided by Census was 9%/year

Year	Harbor Seal Population
1978	6,000
2004	31,000
2005	33,480
2006	35,824
2007	37,973
2008	39,872
2009	41,467
2010	42,711

Sea Lion/harbor seal Daily Food requirement ~ 16 kg (35 lb)/day equates to 3 ½ 10 lb fish per day = 35 lb x 365 = 12,775 lbs Estimated West coast population of pinapeds as of 2010 is approx 325,700 harbor seals and sea lions - equating to a food requirement of 4 billion lbs (2 million tons) of fish or 400 million 10lb sized fish.

Seal Pop	Pinniped Pop	Food Rqmt (lbs)	Food Rqmt(tons)	Number of 10# fish
6,000	17,000	211,225,000	105,613	21,122,500
42,700	325,700	4,046,822,500	2,023,411	404,682,250

Pinnipeds are smart – they go where they can find food. In particular the congregate at the mouth of the rivers when the salmon and steelhead runs take place and compete with the Indian Tribes for what fish return. The have moved into the Columbia River as far as the Grand Coolee Dam, have been found as far inland as Stockton, California,

1 b. Impact of Foreign Fish Trawlers and Fish Factories. Salmonoids range of migration is TransPacific in nature. Currently there is no management of take regarding populations originating from West Coast Spawning Areas. Drift net practices by Pacific Rim Countries result is a near complete take of Salmon Schools and steelhead when encountered by these fishing vessels. A quick look at total Pacific ocean take with National Marine Fisheries oversight indicates declining fish takes and collapses in fish stocks over the last 30 years. A rough estimate of current fish take all species by Commercial Fishing Trawlers is approximately 10% of that during the early 1970's. Current Data is not immediately available by web search. Best estimate base on trends is that the current take on the part of Commercial Fishing is similar to the impact on fish by marine mammals. The take in Alaskan waters in 1988 was 700,000 metric tons in a study regarding incidental take of marine mammals by the National Marine Fisheries Service. Best estimate without direct input from NMFS is that this number will be on the order of 2 million tons of fish.

Environmental Quality Trends Regarding West Coast Watersheds

Establishment of the Clean Water Act has resulted in -

1) substantially increased clarity of rivers and streams
    a. personal observation from having been diving in sections of the Kamath river below I-5 from 1970 to present, there is significantly less fine sedimentation and suspended clay fines. Summer visible distance has increased by several orders of magnitude. " inches to feet"
2) elimination of pesticides such as DDT
3) substantial reductions of pesticides entering the watershed
4) substantial reductions of phosphates entering the watershed
5) timber buffers on all streams/rivers prohibiting cutting w/in 50 to 100 ft – this has been in place since the early 1970's for private companies/individuals. Believe this ha been s extended to publicly owned lands regarding timber harvest.
6) Substantially reduced timber harvest activity – on the order of 10% of the 1970 numbers on an annual basis for Northern California. We have seen the closure of
    a. Two mills in Mt. Shasta
    b. Two mills in Yreka
    c. Decrease in milling operations at Weed
    d. Two mills at Hilt
    e. Two mills in Dorris
    f. One mill in McCloud

Remaining Milling activity in Siskiyou Count of significant size

a) 1 mill in Yreka
b) 1 mill in Weed
c) 1 mill in Dorris

Salmon Runs in the 1960's and Early 1970's – local fisher's were lining both sides of the Klamath River. Our family limited out routinely during both Chinook and Steelhead runs during the 60's.

What has been a constant through this period – The Power Generation Facilities on the Klamath River (Iron Gate, Copco, etc)

What has changed.

1) Explosive growth of Sea Lion and Harbor Seal Populations - 20X based on National Marine Fisheries Data
2) Massive increased use of fishing trawlers and fish factories on the high seas by pacific rim countries from 1970 to present – 10X or greater.
3) Decreased environmental pressure on spawning stocks from human generated activity all across the North State. Reductions and quality indexes need to be generated to quantify. But these numbers are on the order of 90% or more from the mid 60's.

Economic Impact of the Change

Current Power Rates for Siskiyou, Jackson, Klamath Counties 0.07/KWH vs 0.11/KWH from Pacific Power due to the Klamath River Hydroelectric Facilities.

Customers will face both the cost of the facility removal as well as increased power rates.

Alternative Clean Power – Suitability and Cost

Wind power – I believe that all attempts to permit wind generation in Siskiyou County have been blocked to date on the basis of "Visual pollution". Wind power although it has promise to contribute to the clean power in the county is only part of the solution to provide local energy security. Wind is not constant. There are a substantial number of days insufficient to generate power. The wind probability mapping for power suitability of wind generation indicates such installations are "marginal at best" Installed cost is $5.2 million per 2.5Mw turbine. Cost to replace the Klamath river Power system is 160/2.5x5.2= $322 Million dollars for 64 each 2.5Mw turbines.

Solar power – present cost $10,000/kW or higher. Replacement of power generated by the Klamath River Power by solar alone is

160 Mw peak gen capacity = 160,000 Kw = > $1.6 billion

Total annual Klamath river power generation =

Peak Power Output = 160 MW

Average Annual output = 80 MW to Siskiyou/Jackson/Klamath counties

Power output = 80MW*24*365/1000= 700 million KWH

80,000,000	24	365	1000	700,800,000	49,056,000	Current PP rate of 0.07/KWH
					77,088,000	At averge california rate of 0.11/KWH
						Proposed increase when existing contracts expire
					122,640,000	Rate at $0.175/KWH

Customer cost @ $0.07/KWH

Electric Generation from fossil fuel creates the following CO2 emissions.

955 g/kWh CO2 Coal
893 g/kWh CO2 Oil
599 g/kWh CO2 Natural gas

		lbs CO2/yr	ton CO2/yr	gallons/oil	Barrels/Oil	Import cost @ 50/Barrel	Import cost 150/barrel
2.101	lb/kWh Coal	1,472,380,800	736,190				
1.9646	lb/kWh Oil	1,376,791,680	688,396	62,581,440	1,862,543	$93,127,143	$279,381,4
1.3178	lb/kWh Nat Gas	923,514,240	461,757				
			49	100%			
			93	190%			
			279	569%			

Presently the cost of power produced by the Klamath river – assuming an average production of 80Mw

Is 49 million – local resource at $0.07/kWH

Removal and replacement by either oil or natural gas will result in pricing at

93 Million/year + generation and distribution cost – assuming $50/barrel of crude oil this is a 190% + increase over our current power

The bulk of this revenue will be exported overseas

279 million/year + generation and distribution cost – when prices return to $150/barrel as we previously experienced. This is 569% increase in cost the customers served.

Again this money is exported overseas as this is a new demand on fossil fuel sources where the United States is increasingly dependent on international markets for energy.

At $100/barrel over

$180 million/yr

$1.8 billion dollars over the next 10 years not indexing for inflation the cost

$18 billion dollars over the next 100 years not indexing for inflation

2010 Population Estimates

Siskiyou County 49,000 , ackson County 201,000, Klamath County 68,000 Total Population Served ~ 338,000 – estimated number of households assuming average household size of 3 = 113,000 households.

This equates to a **household burden of ~**

$1,000/household/year for $100 barrel oil

$2,000/household/year for $150 barrel oil

assuming that the change impacts the entire of each county if less that the entire then the burden proportionally increases.

1.8 billion – 0.49 billion = 1.31 billion => Cost/#households = 1.31 billion/113,000 = an increased cost of 12,000/household. ~ 1,000/household/year not indexed for inflation or likely energy cost increases for fossil fuels.

Existing Power Plants Provide

1 – Clean Power

2 – Renewable resource

3 – Provides a power source locally

4 – Power is not subject to variability of weather or availability of the sun. Available based on demand by households and business.

5 – Does not contribute to global warming (no CO2 Emissions)

6 – Did not contribute to the decline of the Salmon/Steel head populations as evidenced by the explosive growth of the Pinaped populations and interational fish trawler fish takes.

7 – Provides local jobs in the maintenance and generation of power.

8 – Provides an economical source of energy for local residents

9 – Power security independent of fluctuations in the fossil fuel markets

10 – Not subject to international events.

11 – Keeps local money here at home, in the county, in the country – does not add to the balance of trade deficit

12 – Does not increase our dependence on foreign energy sources.

Conclusion based on sound analysis of the overall factors affecting fish populations

1) **Predation** – Marine Mammals and Commercial Fisheries are the 95-99% portion of the equation affecting the Salmon and Pacific Fish Stock Populations. The **correlation** between Predation and fish stock collapse is **extremely strong.** Very strong impact versus rapid species decline.

2) **Habitat** – Environmental Quality has Steadily Improved for fish reproduction over the past 40 years. **Improving trend** while there has been a collapse in fish stocks indicating that habitat has not been a contributing factor to the species collapse. All indicator trends run **counter to the fish stock collapse.**

3) **Power Facilities** are not the source of the fish stock collapse – they have been a **constant factor** in the Habitat since construction. **No correlation.**

Recommendation –

(1) **Build fish ladders:** The cost of construction of fish ladders at each of these facilities is far less expensive proposition to the 3 counties than the future cost of energy and is the overall least damaging environmental solution to our energy needs.

1) Cost 90-300 million versus 1.8 Billion in increased costs to the county
2) It maintains our source of clean, reliable, low cost energy
3) Restores salmon access to the upper Klamath basin.
4) Prevents the creation of
    700,000 tons/year of CO2,
    7 million tons/next 10 years
    70 million tons/nest 100 years
5) Conserves fossil fuels oil or equivalent in coal/natural gas
    62 million gallons/year
    620 million gallons/next 10 years
    6.2 billion gallons/next 100 years
6) Maintains the recreation resource provided by the associate lakes behind the power facilities.

(2) **Seek assistance of the Pacific Legal Foundation** for assistance in this issue to force quantification of the sources causing the collapse. We will never restore Salomon Populations if the 95% portion of the problem is not addressed first.

Note: Detailed quantification is required to fully document the conclusions of this preliminary study of the Removal of the Kamath River Power Plants.

(3) **Full quantification** should be required of the agencies producing their studies as was recommended by the National Science Foundation in the case of the Delta Smelt calling for the removal of the Power Plants. The ESA requires that economic factors be considered in actions to be taken as well as an estimate of the effectivess of those proposed actions under the ESA. Does the proposed action really have a productive effect?

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From hillslope to stream: methods to investigate subsurface connectivity

Overview

THERESA BLUME, H.J. (ILJA) VAN MEERVELD

Published Online: Feb 25 2015
DOI: 10.1002/wat2.1071

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Abstract Images References

Hydrologic connectivity is the linkage of separate regions of a catchment via water flow. Knowledge of hillslope–stream connectivity (both at the surface and in the subsurface) is essential for understanding and predicting runoff responses and streamwater quality. Connectivity can be very dynamic: hillslopes may connect to the stream only during certain events or seasons. While surface connectivity is often discussed, particularly in the context of sediment transport, subsurface connectivity is more difficult to describe and assess. This difficulty has led to a wide variety in methodologies that are used in various contexts. Field approaches have focused on intensive monitoring of processes on the hillslope or the fingerprint of connectivity in the stream. Combining experimental studies with modeling allows for testing of hypotheses with respect to thresholds and controls on connectivity, and extrapolation from the hillslope scale to the catchment scale. However, as most modeling approaches are based on datasets from a few intensively studied hillslopes, this carries the inherent risk of oversimplification because it assumes that the observed hillslope responses are representative for the catchment or even the region. Focussed efforts on catchment scale assessment of hillslope–stream connectivity, as well as site intercomparisons and the search for similarity measures may allow us to capture the wider picture of the mechanisms and factors that control hillslope–stream connectivity, and its effects on flow and transport at the catchment scale. This overview focuses on how hillslope–stream connectivity has been studied and describes the advantages, disadvantages, and challenges of the different methods. *WIREs Water* 2015, 2:177–198. doi: 10.1002/wat2.1071

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Status and trends of dam removal research in the United States

Advanced Review

J. RYAN BELLMORE, JEFFREY J. DUDA, LAURA S. CRAIG, SAMANTHA L. GREENE, CHRISTIAN E. TORGERSEN, MATHIAS J. COLLINS, KATHERINE VITTUM

Published Online: Sep 05 2016
DOI: 10.1002/wat2.1164

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Abstract Images References

Aging infrastructure coupled with growing interest in river restoration has driven a dramatic increase in the practice of dam removal. With this increase, there has been a proliferation of studies that assess the physical and ecological responses of rivers to these removals. As more dams are considered for removal, scientific information from these dam-removal studies will increasingly be called upon to inform decisions about whether, and how best, to bring down dams. This raises a critical question: what is the current state of dam-removal science in the United States? To explore the status, trends, and characteristics of dam-removal research in the U.S., we searched the scientific literature and extracted basic information from studies on dam removal. Our literature review illustrates that although over 1200 dams have been removed in the U.S., fewer than 10% have been scientifically evaluated, and most of these studies were short in duration (<4 years) and had limited (1–2 years) or no pre-removal monitoring. The majority of studies focused on hydrologic and geomorphic responses to removal rather than biological and water-quality responses, and few studies were published on linkages between physical and ecological components. Our review illustrates the need for long-term, multidisciplinary case studies, with robust study designs, in order to anticipate the effects of dam removal and inform future decision making.

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From: "Randy Turner" <randyt@sfei.org>
Date: Fri, September 9, 2016 9:31 am
To: undisclosed-recipients:;
Priority: Normal
Options: View Full Header | View Printable Version | Download this as a file | View Message details | View as plain text | Spam | Not Spam | Add to Addressbook

KBMP members,

Chauncey Anderson with the USGS forwarded information on new research and resources which synthesize dam removal science research. Below is the email sent from James Bellmore with USFS, a lead scientist on some of these studies, along with some additional resources James has included (see below):

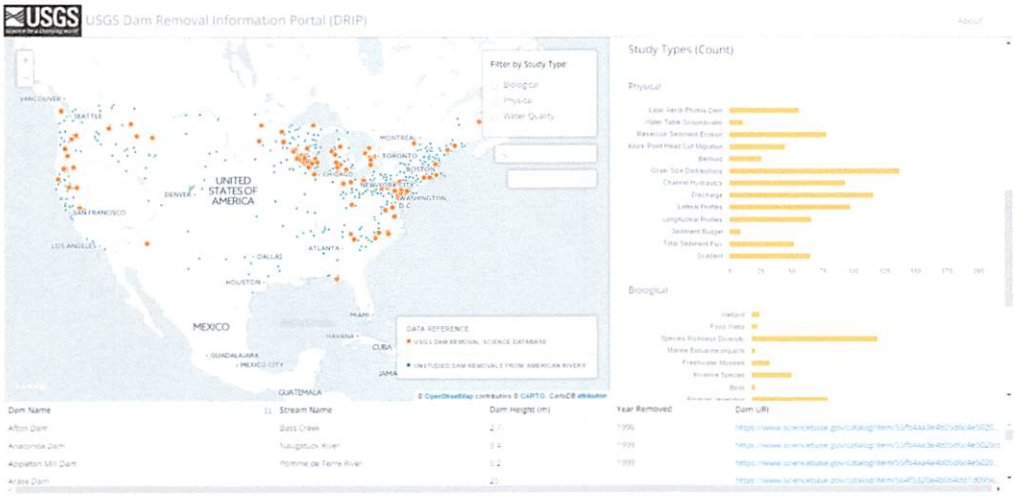
Dear Friends, Colleagues and Collaborators:

Myself and several colleagues just published a paper in WIRES Water, which provides an up-to-date review of the status and trends of dam removal research in the United States (see attached; http://wires.wiley.com/WileyCDA/WiresArticle/wisId-WAT21164.html). This paper was a product of a working group on Dam Removal funded by the USGS John Wesley Powell Center for Analysis and Synthesis (see: https://powellcenter.usgs.gov/view-project/526ae54ae4b0be4db9fbf979).

This paper clearly illustrates potential gaps in the scientific assessment of dam removal projects that could limit our ability to inform decision-making. For instance, we found that less than 10% of dam removal projects have associated studies which report ecosystem responses, and, most of those studies are short in duration (1-2 years post dam removal), and many have no pre-removal monitoring. Further, there is bias towards evaluations of short-term physical responses to dam removal (such as sediment evacuation), over longer-term ecological responses.

It is our hope that this analysis will provide feedback that can help close these gaps. As we suggest in the paper, one way of "closing the gap" is to provide up-to-date information to researchers and practitioners. To do this, we worked with our colleagues at American Rivers and USGS Core Science Systems to construct the "Dam Removal Information Portal" (DRIP), which provides a way to visualize and analyze dam removal data. See: https://www.sciencebase.gov/drip/. DRIP is a one-stop shop for locating information on dam removals in the US (and abroad).

We encourage you to distribute this information to any colleagues and collaborators that may be interested. Specifically, we are hoping to spread the word to resource managers and dam removal practitioners.



Additional Resources:

1. USGS Dam Removal Science Database
2. Within the newly launched DRIP portal (image above), you cannot yet click on the study type charts to filter for research projects which include these specific studies. I have attached an excel file *DamRemovalDesignAndStudyResults.xls* that does allow you to perform this filter based on your subject interest. This will link you to the study summary where you can find additional information.
3. Research paper- Tullos, D. D., Collins, M. J., Bellmore, J. R., Bountry, J. A., Connolly, P. J., Shafroth, P. B., and Wilcox, A. C. 2016. Synthesis of Common Management Concerns Associated with Dam Removal. Journal of the American Water Resources Association (JAWRA) 1-28. DOI: 10.1111/1752-1688.12450

With the potential for dam decommisioning getting closer, I hope these resources allow your organizations to learn from the research performed by other dam removal efforts so we can better prioritize our own monitoring efforts in the Klamath Basin.

Best,

Randy

Randy Turner
Environmental Scientist
Coordinator- Klamath Basin Monitoring Program
San Francisco Estuary Institute
707-499-5521 cell
707-630-3533 office

Attachments:

Bellmore_et_al-2016-Wiley_Interdisciplinary_Reviews__Water.pdf	**1.3 M**	[application/pdf]	Download
DamRemovalDesignAndStudyResults.xls	**255 k**	[application/vnd.ms-excel]	Download
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Scott Valley pioneers instream flow and groundwater management for reconciled water use

Posted on August 21, 2016 by UC Davis Center for Watershed Sciences

by Gus Tolley



Scott River at Horn Lane, November 2013. Photo credit: Sari Sommarstrom.

The Scott River is one of California's four major undammed streams and important spawning habitat for coho (a species listed as "threatened") and Chinook salmon. This peaceful and pastoral agricultural valley is at the center of several water-related conflicts and lawsuits. However, it is also pioneering a range of instream flow and groundwater management activities that could set the example for balanced water use in California.

At first glance, water management in the Scott Valley appears to be a story of farms vs fish, one that is common in California: A dry year results in dry stream reaches near groundwater-irrigated fields in August that persist beyond the irrigation season into September, even October. With the Chinook fall spawning migration arriving in mid-October and coho following soon after, a dry streambed raises valid concerns about how irrigation pumping and the removal of riparian vegetation may have led to warmer and drier streamflow patterns in Scott Valley.

Historic land use practices contribute to dry conditions in the Scott Valley

- **Logging:** The end of intensive logging in the late 20th century and a long-term policy of suppressing fires has increased forest vegetation density and thus consumptive water use in the watershed above Scott Valley.
- **Flood control:** The Army Corps of Engineers straightened, deepened, and reinforced some of the wild riverbed around the middle of the 20th century for flood-control purposes; much of the riparian vegetation (providing shade and habitat) disappeared in the early 20th century due to vegetation removal by floods and flood-control projects.
- **Gold mining:** A Yuba dredge in the 1930s-1950s turned the southern (upstream) portion of the valley and streambed upside down, leaving behind about five miles of barren cobble heaps and sending finer sediments downstream.

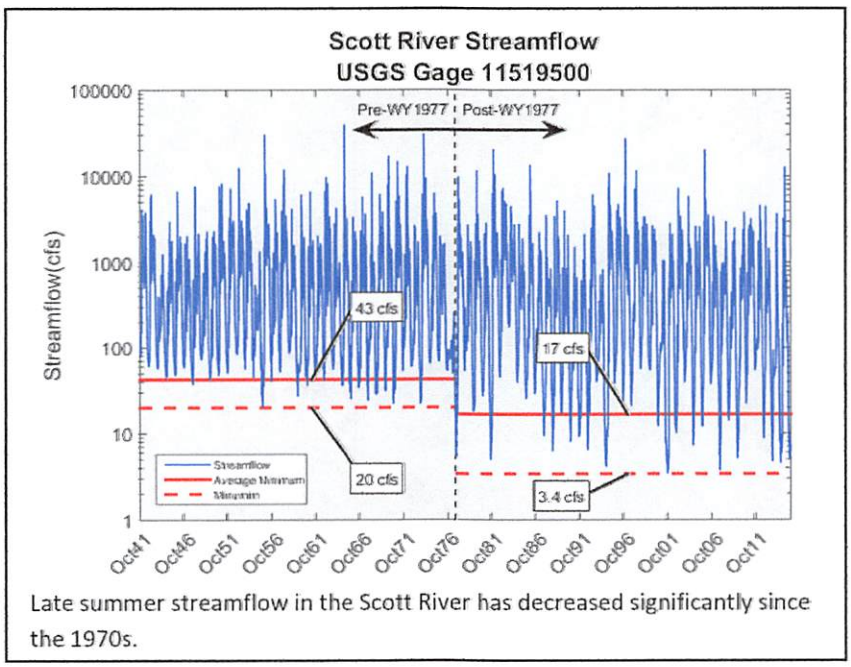
The story behind the valley's seasonally dry streams is complex. Irrigated pasture, alfalfa, and cattle production have

been part of the socioeconomic fabric since it was settled by white people during the mid 1800s. Current dry conditions are partly due to legacy impacts from historical land management policies, flood control, and gold mining, along with natural climatic and geologic variations.

> Irrigation technology that improved irrigation efficiency may have inadvertently contributed to drier stream conditions.

On average, the annual discharge of the Scott River is more than five times the total evapotranspiration demand from the 34,000 irrigated acres in the valley; seemingly enough water for fish and farming. But – like elsewhere in California – surface water supplies usually dry up around July when the last of the snowmelt in the upper watershed disappears. Streamflow from mid-summer until the beginning of the rainy season largely depends on baseflow from the valley aquifer. Fed by recharge from tributaries, rainfall, and excess irrigation, the aquifer acts as a large, sponge-like reservoir that provides a steady contribution to streamflow in the summer and early fall.

In the 1970s, average late-summer streamflow in the Scott River decreased markedly by about 50%, resulting in increased stream temperatures and – during dry years – more pronounced dry stream reaches along the lower valley floor. How did the Scott River get to the condition it is in today?



Late summer streamflow in the Scott River has decreased significantly since the 1970s.

Figure 1: Late summer streamflow in the Scott River has decreased significantly since the 1970s.

A driving factor for the change in average summer flows may be a switch from reliance on surface-water prior to the 1970s to a greater use of groundwater for irrigation. Following the 1977 drought, many farmers moved from using surface water for flood irrigation to pumping groundwater. Groundwater is more reliable and the preferred source for more efficient irrigation methods such as wheel lines and center-pivots that are encouraged by agencies like the National Resource Conservation Service (NRCS). Access to groundwater allows for irrigation after surface water supplies are no longer available, but pumping groundwater reduces discharge from the aquifer to the stream.

Changing sources of irrigation water has had several major impacts in the valley, including:

1. decreased groundwater recharge in the spring and summer due to increased irrigation efficiency,
2. increased groundwater pumping, and
3. net increase in consumptive crop water use (evapotranspiration) due to the ability to irrigate alfalfa into August or September for a third or fourth cutting instead of two cuttings through July.

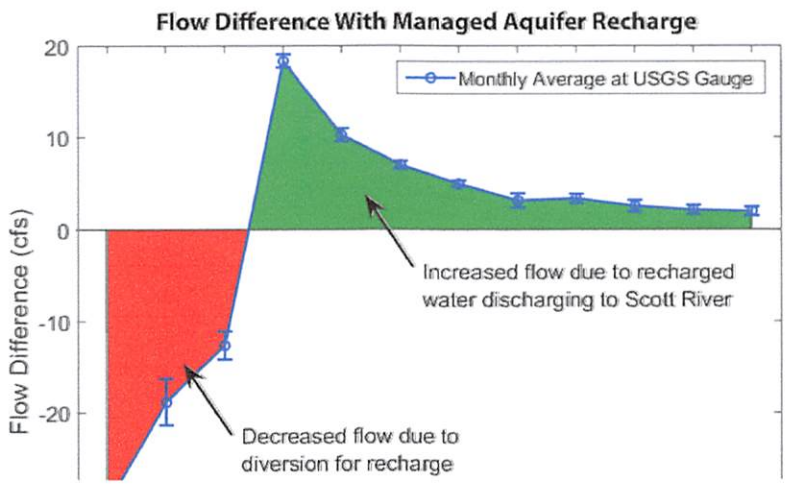
Notably, with water supplies greatly exceeding water demand, there is no evidence of long-term groundwater overdraft in the Scott Valley. However, pumping near the Scott River seasonally lowers groundwater levels sufficiently to impact streamflow during the late summer, especially during the critical time between the end of the irrigation season and the beginning of the rainy season when Chinook and coho start their fall spawning runs.

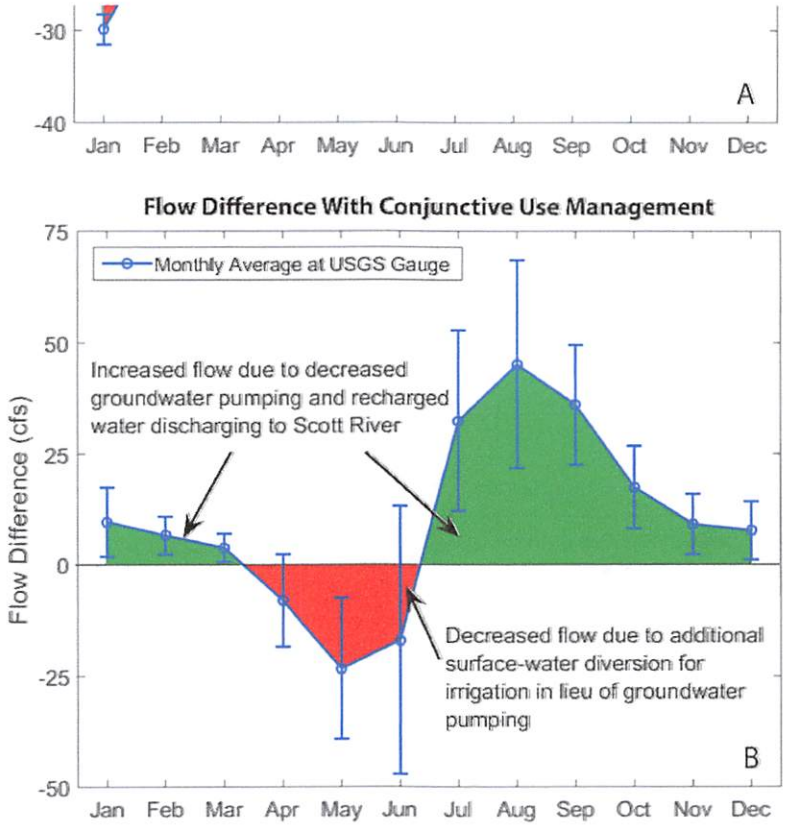
Valley residents have been proactive in finding solutions to the problem of decreased late-summer streamflow. The Scott River Water Trust, the first active water trust in California, leases water from farmers with the goal of improving streamflow for salmon and steelhead at critical points during their lifecycle. The Scott Valley Groundwater Advisory Committee was established, which assists with data collection and monitoring, provides information about local farming practices, and suggests potential methods for increasing late-summer streamflow in the Scott River. Additionally, a Community Water Level Measuring Program has been monitoring about 34 wells monthly since 2006. UC Davis professor Thomas Harter and his research group have used this information to develop an integrated groundwater-surface water model of the Scott Valley that can test different management options for increasing late-summer streamflow.

Firsts in the Scott Valley:

- *The Scott River Water Trust* – a program that allows farmers to lease water rights with the goal of improving streamflow for salmon and steelhead during critical points in their life cycle.
- *Temporary Groundwater Storage Permit* – agricultural fields are flooded for groundwater recharge during the wet months.

One proposed solution for groundwater recharge is flooding dormant agricultural fields during the winter when streamflow is high and water is available. In January 2016, the Scott Valley received the first temporary groundwater storage permit issued in California to test this option. The goals of the groundwater recharge project, headed by UC Davis professor Helen Dahlke, are to quantify how much water can be recharged on agricultural fields, determine potential negative effects on the crop, and identify best management practices in the hopes this method can be applied to other areas in California as well.





Another management option is the conjunctive use of surface-water and groundwater involving a dual-irrigation system where more surface-water is used while it is available during the spring months to reduce groundwater pumping. Although this would require an investment in infrastructure and coordination among stakeholders, preliminary modeling results show promising streamflow increases when this management scenario is implemented.

Work will continue to improve fish habitat quality and quantity in the Scott Valley while also maintaining agriculture. There is no magic bullet, and the path forward will rely on a portfolio of management solutions, supported by active stakeholder engagement, monitoring, assessment, and modeling. Some actions may be achieved relatively easily, while others will require coordination and cooperation among stakeholders with some significant investments to successfully implement.

Gus Tolley is a doctoral candidate in the Hydrologic Sciences Graduate Group at UC Davis and 2015 UC President's Global Food Initiative fellow. His work focuses on numerical modeling of interactions between groundwater and surface water in agricultural areas.

Further Reading

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Fleckenstein, J.H., Niswonger, R.G., and Fogg, G.E., 2006, River-Aquifer Interactions, Geologic Heterogeneity, and Low-Flow Management: Ground Water, v. 44, p. 837–852, doi: 10.1111/j.1745-6584.2006.00190.x.

Foglia, L., McNally, A., and Harter, T., 2013, Coupling a spatiotemporally distributed soil water budget with stream-depletion functions to inform stakeholder-driven management of groundwater-dependent ecosystems: Water Resources Research, **v. 49, no. 11, p. 7292–7310, doi: 10.1002/wrcr.20555.**

Hall, M., Harter, T., and Frank, R., Groundwater problems and prospects, part 7: Groundwater-dependent ecosystems and the groundwater-surface water connection, **Maven's Notebook.**

Hoben, M. L., 1999, Scott River Coordinated Resource Management Council, **in *Systematic Assessment of Collaborative Resource Management Partnerships* [Master's Thesis], University of Michigan, 357 p.**

Kendy, E., and Bredehoeft, J.D., 2006, Transient effects of groundwater pumping and surface-water-irrigation returns on streamflow: Water Resources Research, **v. 42, no. 8, p. n/a–n/a, doi: 10.1029/2005WR004792.**

Website for Professor Dahlke's Research Group

Website for Professor Harter's Research Group

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4 Responses to *Scott Valley pioneers instream flow and groundwater management for reconciled water use*

gymnosperm *says:*
August 22, 2016 at 7:55 am

It is not clear if the monthly averages in the last two graphs are anomaly or absolute flow. It seems absolute flow should be integrated. Higher winter and spring flows that are otherwise lost to the system diverted to groundwater recharge are a net gain for the system.

Groundwater is not only a sponge. It also flows.

★ Like

Reply



Gus Tolley *says:*
August 22, 2016 at 2:54 pm

The last two graphs are simulated monthly streamflow gains at the USGS gage near the outlet of the Scott Valley. Our model currently runs from October 1, 1990 through September 30th, 2011, so the graphs show the simulated average monthly streamflow gain over this 21 year period (the error bars indicate one standard deviation). I apologize for not making that more clear in the article.

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Reply

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Subject: RE: [Fwd: Scott Valley pioneers instream flow and groundwater management for reconciled water use | California WaterBlog]
From: "Ray Haupt" <rhaupt@co.siskiyou.ca.us>
Date: Wed, August 24, 2016 7:50 am
To: "Grace Bennett" <gbennett@snowcrest.net>
Cc: "eneilsen@co.siskiyou.ca.us" <eneilsen@co.siskiyou.ca.us> (more)
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Grace; I have thoroughly reviewed this article and find it to be a balanced understanding of the situation and plausible cures that could encourage agriculture to thrive in the presence of a fish friendly management of water in the Scott basin. The coupling of flood irrigation with high mountain lake storage use in the late season is exactly what makes the quartz valley so Coho friendly. Dr. Menke and I have been preaching these benefits for nearly a dozen years now as one fix for ailing streams and groundwater recharge in the Sacramento and San Joaquin River basins that are also a replicate of our Scott water use saga. DWR has been our constant enemy in this dialogue ramming the political position of releasing more water into the sea from our Governor down our scientific throats.

A few important points I saw in this release was the recognition by Harter and Gus tying the forest density problem to the flow issues and taking on the position of DWR that eliminates spring flood irrigation for ground water recharge. In my view DWR and CA F&G do more damage to our stream hydrology than good as they continue to refuse to accept solid science in their policy making. This will be a problem as we develop our Basin Plans.

What is missing is a discussion linking the high mountain lakes to Ag flood irrigation as being part of the solution to this situation.

What I have known for 20 years now; There was a dramatic shift in irrigation techniques beginning in the late 60's directly linked to the loss of effective ground water recharge, snow melt and dysfunction of high mountain storage, effects of dredging on the river function with the depression of the water table exceeding 6 feet in places and the policy mandates of regulatory agencies who have pushed the river over the edge because they have no idea how the river functions nor the true impacts of agriculture that has been specifically altered by these agencies in the wrong direction for river function and health.

If we follow the known and now published hard hydrology science with the science of stream geomorphology this issue can easily be fixed. Our next step is to get DWR to

back off on their current ridiculous regulatory control and permitting required for flood irrigation. Cost prohibitive permits artificially imposed to protect the stream hamper any proactive responsible actions on the part of the Ag industry.

Ray A. Haupt

District 5 Supervisor

Siskiyou County

530-925-0444

From: Grace Bennett [gbennett@snowcrest.net]
Sent: Monday, August 22, 2016 3:59 PM
To: Ray Haupt
Cc: eneilsen@co.siskiyou.ca.us
Subject: [Fwd: Scott Valley pioneers instream flow and groundwater management for reconciled water use | California WaterBlog]

---------- Original Message ----------
Subject: Scott Valley pioneers instream flow and groundwater management for reconciled water use | California WaterBlog
From: "Adriane Garayalde" <garayalde@snowcrest.net>
Date: Mon, August 22, 2016 11:46 am
To: "'Sari Sommarstrom'" <sari@sisqtel.net>
"'Ric Costales'" <tmbst@sisqtel.net>
"Grace Bennett" <gbennett@snowcrest.net>
"'SiskiyouRCD'" <sisqrcd@sisqtel.net>
"'Preston Harris'" <preston@scottwatertrust.org>
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https://californiawaterblog.com/2016/08/21/scott-valley-pioneers-instream-flow-and-groundwater-management-for-reconciled-water-use/

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The TMDLs set unrealistic and unattainable goals for the Klamath River.
The structure of the Klamath River Basin is like no other because of the natural nutrient loading that occurs in the Upper Klamath Lake which feed algae growth, creates high temperatures, toxicities and organic matter for the rest of the river. The frequent floods change the channels, wash willows from the shore lines and cause erosions in the canyons along the river; this is a natural occurrence and can not be changed by Man.

I have attended many of the scoping meetings for the TMDL process at first Water was the focus of the meetings, then it was fish and now it is Dam removal. The dams act a filter for the toxins the come from the Upper Klamath Lake, the Lost River Canal and the Klamath Straights drainages. The water that leaves Iron Gate Dam has 31% less Nitrogen and 8% less Phosphorus, less sediment and organic material, thus reducing the levels of nutrients the TMDL require for the rest of the river.

The temperature objective is not reasonable. The temperature target for the TMDL of zero increase of temperature is not attainable. The Regional Water Board basin plan's objective allows for up to 5 F increase. The new target of zero increase alone guarantees the dams will have to come out, since no reservoir anywhere cannot at least cause a slight increase in water temperature. You can't expect the waters in Siskiyou County to clean and cool the impaired water that comes from Oregon. The time line for the KBRA and the KHSA Settlements have had undue influence on the TMDL process and trumped the actual need for a longer TMDL process.

If the Water Board would like the Natural Conditions in the river, those conditions would be much worse if the water from Oregon is allowed to flow unfiltered into California after Dam Removal. How will adaptive management –"learning by doing "–be incorporated in a transparent and collaborative way with TMDL implementation? If the TMDL requirements are not meet by the Oregon TMDLS by 2020 will the dams still come out?

One of the models that were used in developing the Revised Draft TMDL, SPARROW is used on the East Coast and has nothing to compare with the Upper Klamath Lake and the Klamath Basin; Using this model is not compatible with our area and offers no reliable data to be used in the Klamath Basin. In developing the TMDL reasonable estimates must be considered not the levels that are believed necessary to support proposed water quality targets. The State should ensure that all water quality data used for its regulatory process are collected from unbiased sources.

The Legislative findings of the State's Porter –Cologne Water Quality Control Act, the governing law for the Regional Water Board: "The legislature further finds and declares that activities and factors which may affect the highest water quality which is reasonable, considering all demands being made and to be made on those waters and total values involved, beneficial and detrimental, economic and social, tangible and intangible" This is the law and must be followed.

The Shasta River is unique to the Klamath River system because of its temperatures, nutrients and slow flows it is one of the best rearing areas for Coho, Steelhead and Chinook salmon.
The Scott and Shasta Rivers have their own TMDL plans to improve water quality and they are working. The Implementation Plan's requirements for the Klamath River basin agricultural community apply for a Conditional waiver of Waste Discharge Requirement for all agricultural uses, this will create monitoring costs for temperature, nutrients and dissolved oxygen this action is a sneaky way to add more regulations to existing Scott and Shasta TMDL without any evidence that the existing TMDL are not adequate.

The farmers, rancher, miners and loggers of Siskiyou County have been working to improve their practices for many years and have accomplished many of the things outlined in your regulations. They love this land and wish to continue using it to produce products that improve the lives of the rest of us and to make our lives better. I have always thought the there should be some sort of reward or recognition for the work that has already been finished. In conversations with a member of the EPA, I was informed of just such a program called the Early Compliance Program. This should be brought to the attention of those people that have accomplished the improvements to water quality and quality.

There has to be an end to the regulations, if we are to balance the use of the land and the water. The land can't just go back to wilderness; we must be able to work and supports our families.

Grace Bennett
Siskiyou County Supervisor District 4

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Shasta	Coho	Chinook
2011	62	11,384
2012	115	29, 544
2013	134	8,023
2014	46	18,359
2015	37	6,544

Scott	Coho	Chinook
2011	344	4,537
2012	201	8,144
2013	2,731	3,372
2014	485	9,476
2015	217	386

Bogus Creek	Coho	Chinook
2011	142	4,524
2012	182	11,193
2013	405	2,932
2014	94	11,177
2015	14	2,131

There are only these three counting station on the Klamath River and none at the mouth of the river where the Tribes harvest their fish. So these numbers are not true to the amount of fish that return to the river. The Steelhead are not counted. These numbers don't include hatchery counts.

STATE WATER RESOURCES
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USDA
United States Department of Agriculture

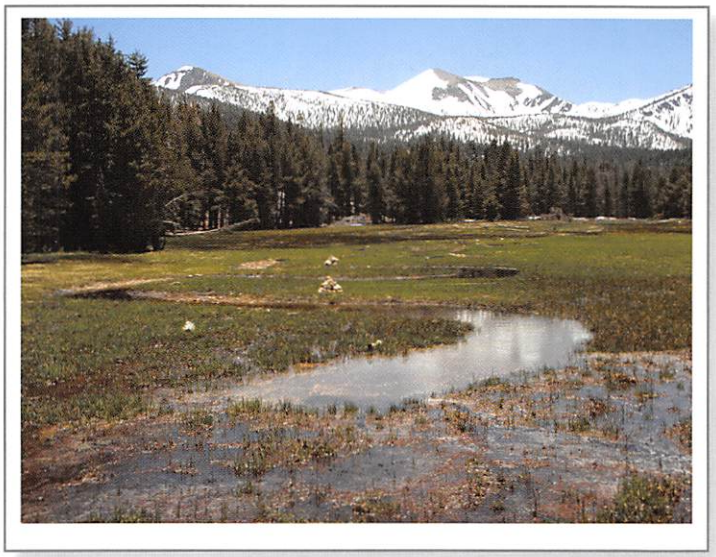
Ecological Restoration:
Engaging Partners in an All Lands Approach
U.S. Forest Service, Pacific Southwest Region

Region 5 Ecological Restoration Leadership Intent

The mission of the Forest Service is to sustain the health, diversity and productivity of the Nation's forests and grasslands to meet the needs of present and future generations. It is our intent to establish a regional vision and corresponding goals for Ecological Restoration consistent with this mission and the laws, regulations and policies that guide National Forest management.

Our goal for the Pacific Southwest Region[1] is to retain and restore ecological resilience of the National Forest lands to achieve sustainable ecosystems that provide a broad range of services to humans and other organisms. Ecologically healthy and resilient landscapes, rich in biodiversity, will have greater capacity to adapt and thrive in the face of natural disturbances and large scale threats to sustainability, especially under changing and uncertain future environmental conditions such as those driven by climate change and increasing human use. Our goal is based on a commitment to land and resource management that is infused by the principles of Ecological Restoration and driven by policies and practices that are dedicated to make land and water ecosystems more sustainable, more resilient, and healthier under current and future conditions.

Ecosystem services are the goods and services that flow from wildlands and forests that are valued and used by people, and that directly or indirectly support human well-being. Wildlands and forests are valued for basic goods, such as wood, fiber, and water, but these ecosystems also deliver important services that are perceived to be free or limitless such as air and water purification, flood and climate regulation, biodiversity, scenic landscapes, wildlife habitat, and carbon sequestration and storage. The National Forests are important providers of ecosystem services to humans and to other inhabitants of our wildlands as well. Our commitment to restoration-based management includes a commitment to a renewed focus on the sustainable delivery of ecosystem services.



Meadow restoration in Sierra Nevada high country retains water and extends the benefits it provides. Lake Tahoe Basin Management Unit.

In the 21st century, three major drivers of change define restoration needs on the National Forests of the Pacific Southwest Region: climate change and shifting hydrologic patterns; increasingly dense and unhealthy forests; and rapidly growing human populations. These synergistic sources of change are resulting in increasingly over-allocated and undervalued ecosystem services (especially water); a dramatic increase in disturbance events such as uncharacteristic large-scale wildfires, floods, and insect and disease outbreaks; new and growing threats from terrestrial and aquatic invasive species; and a growing need to revitalize rural economies in California, Hawaii and the Pacific Islands.

1 The Pacific Southwest Region (also known as Region 5) includes California, Hawaii and the Pacific Islands. It also includes small portions of the state of Nevada, managed by the Inyo National Forest, and the state of Oregon, managed by the Klamath National Forest.

While sound restoration work is being conducted throughout the Region to increase forest and watershed resilience, important indicators suggest that disturbance impacts already outpace the benefits of this work, and that we will fall further behind over time. Wildland fires in California are becoming larger and more frequent. Of greatest concern is a notable increase in the area of forestland burning at high severity over the last quarter-century. Fire exclusion over many decades, in conjunction with other forest management choices, has resulted in dense, middle-aged forests over large areas of California. These forests are highly susceptible to severe wildfire, which fragments forests, emits carbon, increases erosion rates and sedimentation, negatively affects water quality and delivery, and damages old-growth forest habitats that sustain important components of the Region's biodiversity. Dense middle-aged forests are also more susceptible to drought stress, large-scale insect outbreaks and disease epidemics.



Healthy riparian areas provide many benefits.
Plumas National Forest.

The ability of the Region's forestlands to sequester and store carbon has become a matter of national and international significance. Human additions of greenhouse gases to the atmosphere are altering the climate, and federal land management agencies like the Forest Service are expected to play a major role in U.S. adaptation and mitigation responses to global warming. Mitigation responses revolve around the maintenance and enhancement of carbon sequestration processes on forestlands. In the Mediterranean climate that characterizes much of California, annual summer droughts and frequent fire are the norm, retention of carbon in most of the forest landscape requires stand structures and compositions that are resilient to fire. Nearly a century of fire exclusion in California, coupled with other management decisions on both private and public land, has resulted in forests that are at an increasing risk of loss due to large scale disturbances. There is an additional crisis taking place in our Southern California Forests as an unprecedented number of human-caused fires have increased fire frequency to the extent that fire-adapted chaparral can no longer survive and is being replaced with non-native annual grasses at an alarming rate. To counter these trends, forest managers will need to significantly increase the pace and scale of the Region's restoration work. Only an environmental restoration program of unprecedented scale can alter the direction of current trends.

From this point forward, Ecological Restoration will be the central driver of wildland and forest stewardship in the Pacific Southwest Region, across all program areas and activities. Future Land and Resource Management Plans, other strategic plans and project plans will identify Ecological Restoration as a core objective. Our Ecological Restoration work will include coordination and support for all wildlands and forests in the Region to promote an "all lands" approach to restoration. It will lead to a new way of doing business with our partners and neighbors, to coordinate work and priorities across forests and wildlands regardless of ownership. Collaboration across ownerships and jurisdictions to achieve Ecological Restoration will require active use of Forest Service State and Private Forestry authorities; an expanded effort to engage tribes, partners, and neighbors and to work in closer coordination with other agencies.

Resource program managers will have the responsibility for promoting Ecological Restoration activities including, but not limited to, management of vegetation, water, wildland fire, wildlife and recreation. Activities may include monitoring resource conditions; managing, restoring or enhancing terrestrial and aquatic ecosystems; or regulating human uses. Activities to be promoted include, among others,

forest thinning and prescribed fire to decrease fuel loading and increase forest heterogeneity; meadow and riparian restoration to improve watershed function; environmentally and ecologically sensitive fire management practices; invasive species eradication; and wildlife and fish habitat improvement. Emphasis will be placed on expanding and developing partnerships to increase organizational capacity and the use of large-scale stewardship contracts operating at the landscape level to achieve restoration goals. We will expand and improve our consultation with tribal governments to utilize their traditional knowledge of stewardship and caring for the land. Emphasis will be placed on collaboration with stakeholders, communities, local government, volunteers, and citizens to facilitate dialogue and to decrease conflict in planning and implementing Ecological Restoration efforts.

With Ecological Restoration as the driving force behind the Region's work, and with a pace and scale sufficient to reverse current trends, it is our intent to accomplish the following in the next 15-20 years:

- Work together to achieve a collaborative and financially supported effort among forest land management agencies, private land owners, and the public to implement a large scale restoration program to accelerate the scale and pace of forest restoration activities on both public and private lands.
- Increase forest resilience through treatments (including prescribed fire and thinning) and wildfire, resulting in resource benefits to approximately 9 million acres on national forest system lands.
- Restore at least 50% of accessible, degraded forest meadows to improve their habitat function and ability to hold water longer into the summer and deliver clean water when most needed.
- Decrease the occurrence of uncharacteristically severe wildfires and their associated impacts through environmentally and ecologically sensitive vegetation treatments, fire management, and public education.
- Work with key partners in Southern California to expand fire prevention efforts in order to retard the loss of native ecosystems like chaparral and coastal sage scrub.



Reforestation with community stakeholders following a wildfire.

- Ensure vegetation and fire management efforts are grounded in concern for biodiversity and ecological process both before and after disturbances like fire.
- Reforest after wildfire where appropriate and implement suitable stand maintenance activities that meet project goals and site conditions.
- Ensure the retention and sustainability of forests, forest resources, and forest carbon over the long term, even as climates change.
- Expand watershed improvement programs at the forest level (inventory, prioritization, and scheduling of restoration).
- Target fuel reductions activities in key watersheds for protection of aquatic species and municipal watersheds.
- Work with partners to increase restoration actions that will improve habitat connectivity.
- Decrease the impacts of invasive species through preventative practices, rapid response control, management, rehabilitation and restoration, emphasizing cooperative work with federal, state, and community partners.
- Restore landscapes affected by unmanaged recreation.
- Identify the minimum road system needed for safe and efficient travel for administration, utilization and

protection of National Forest System lands; establish priorities and a time schedule to decommission or close unneeded roads.

- Increase conservation education, interpretation and volunteer programs to promote understanding and support for restoration actions and increase understanding of the value of healthy watersheds and the ecosystem services that they deliver.

With a focus on Ecological Restoration, the following ecosystem services and community economic benefits will be enhanced:

- Delivery of clean water and an improved flow regime that benefits people, fish, and wildlife
- Fish, wildlife, and plant habitat, for both common and rare species
- Maintenance of biodiversity
- Forest resilience in the face of climate change and changing disturbance processes
- Carbon sequestration
- Air quality
- Rural economic health
- Outdoor recreation and scenic beauty
- Landscapes for health and renewal
- Wood products
- Wood biomass for energy
- Forage for wildlife and livestock
- Green economic activity

As we work toward the goals outlined above, we will learn and adjust as we go. Over time there will be new science, new ideas, and new collaborations that will improve our understanding. With this new understanding, we will make course corrections in policy and practice and move even more efficiently toward our overall goal of resilient forests and wildlands.



The Student Conservation Association (SCA) is one of the many partners that help restore California's National Forests. On the Angeles National Forest, SCA students restore a trail as part of a partnership called the "Angeles Wildfire Recovery Project."



A wood chipper processes woody biomass from a restoration thinning project, Mt Hope Stewardship Project, Plumas National Forest.

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April 2013

Salmon River Restoration Council

1992 to 2012 Accomplishments Report: 20 Years of Restoration!



Cover photo by Ford Lowcock of SRRC crew out on a Fall Chinook Carcass and Redd Count



North Fork Salmon River, by Scott Harding.

SRRC's Mission Statement

Our mission is to assess, protect, restore and maintain the Salmon River ecosystems with the active participation of the local community; focusing on restoration of the anadromous fisheries resources and the development of a sustainable economy. We provide assistance and education to the general public and cooperating agencies, by facilitating communication and cooperation between the local communities, managing agencies, Native American Tribes and other stakeholders.

The Salmon River Restoration Council is celebrating 20 years of work protecting and restoring the Salmon River watershed. During that time the SRRC and the Salmon River community have accomplished many things, coming together around numerous issues that concern us all. 2012 was a milestone year for us - twenty years of working to restore the river's imperiled fisheries; twenty years of bringing together diverse interests to find common ground and workable solutions; nearly twenty years of managing noxious weeds to keep toxic herbicides out of our watershed and protect our native ecosystems; many years of critical fuels reduction to protect the watershed and the community from catastrophic wildfire; and well over twenty years of taking the conversation about our natural environment to the people who matter.

Our effort began in 1992, when a group of Salmon River community members received support from the Klamath River Fisheries Task Force to host a series of cooperative workshops for the communities in the Salmon River subbasin. These workshops about the dwindling populations of spring Chinook salmon and summer steelhead in the Salmon River were intended to increase local awareness. The community response was overwhelmingly positive and illegal harvest of these species was noticeably reduced.

In response to the local community's desire to protect and restore the Salmon River's anadromous fisheries, the Salmon River Community Restoration Program (CRP) was created in 1993. Through the vehicle of the CRP local involvement and volunteer efforts increased, leading to the formation of the Salmon River Restoration Council, which grew into a 501(c)(3) non-profit corporation in 1995.

Since 1996 the Salmon River Watershed Center has been maintained in the off-grid community of Sawyers Bar. This facility is open to the public, and serves as a community center for restoration meetings and outreach events, a library and resource-related information center, and as an office for SRRC staff.

Our programs have grown and expanded over the years in our effort to keep all aspects of our watershed healthy, from the fish to the forests to the community. We sincerely hope that this anniversary is just the beginning, the first installment of a lifetime of assessing, protecting, and maintaining the beautiful Salmon River watershed.

Early Salmon Ed silk screened poster








Top 10 Accomplishments

Poach Eggs Not Fish Campaign – Substantially decreased the illegal harvest of Salmon River Spring Chinook through educational workshops, helping to inspire an engaged community of local fish conservationists.



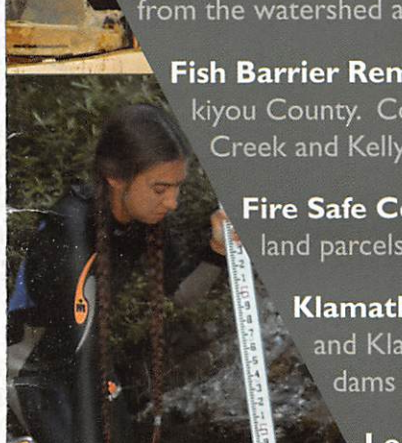
Nature in the Classroom – Provided watershed education to Salmon River schools for 18 years, bringing up the next generation of natural resource professionals.

Clean Water and Wild Fish – Monitored and assessed baseline river conditions and fisheries populations since 1992



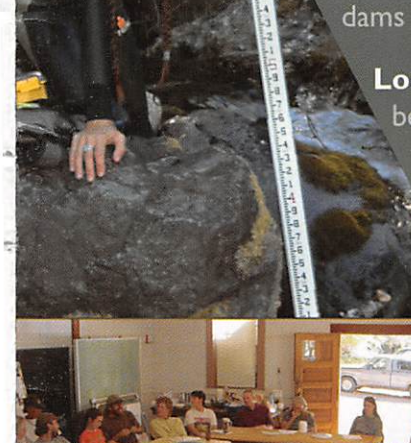
Pesticide Free Watershed – Reduced or eliminated spotted knapweed populations on over 270 sites without the use of herbicides, achieving a reduction of over 99% between 1996 and 2012, aiding in the recovery of healthy and diverse native plant communities.

Fish Friendly Roads – Completed sediment source assessments for all federal and most private roads in the watershed, totaling nearly 900 miles of road, leading to extensive road restoration efforts by the USFS and the SRRC.



Leave No Junker Behind – Over 330 junk vehicles, 625 tons of scrap metal, and 37 tons of tires were removed from the watershed and recycled in 2006. This project involved more than 2000 hours of volunteer work

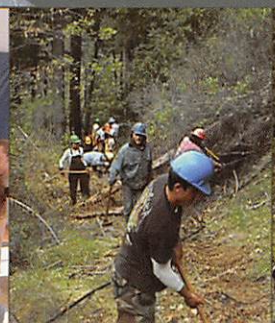
Fish Barrier Removal – Removed 2 dams on White's Gulch - the number 1 priority fish barrier in Siskiyou County. Cooperated in the removal of several other major fish passage barriers including Merrill Creek and Kelly Gulch.



Fire Safe Community – Completed over 925 acres of fuels reduction work on 168 private land parcels, reducing fire risk and raising wildfire awareness.

Klamath Dam Removal – Participated in the Klamath Basin Restoration Agreement and Klamath Hydroelectric Settlement Agreement for the removal of Klamath River dams and the restoration of Klamath River fisheries.

Local Restoration Economy and Community Engagement – We've become the largest employer in the Salmon River watershed, creating restoration jobs for Salmon River residents since 1992, sustaining a critical economic base in our remote area. We've actively involved the community in protecting and restoring the Salmon River watershed in all of our projects and programs for 20 years and counting.







Fisheries Program

Photos of Salmon River Spring Chinook - above by Janjaap Dekker, behind the graph on the next page by Michael Bravo.

In the twenty years since SRRC's inception, much of our work has been focused on the recovery of the Salmon River's spring-run Chinook salmon. Spring-run Chinook populations in the Klamath Basin faced severe decline in the 20th century. Today, the Salmon River hosts one of the Klamath's last runs of wild spring Chinook, and it is one of the greatest accomplishments of our community to have preserved this unique fishery.

In the first Salmon Education Workshops hosted on the Salmon River, CDFG biologist Bill Chesney, demonstrated the clear trajectory of extinction for Salmon River fish if harvest was to continue unchecked. There simply weren't enough fish for everyone. Through subsequent workshops and even educational theatre, the message was powerful enough to pull a community together to ensure there would be fish for generations to come. Not only was poaching curtailed, the local community became interested in the management of all Salmon River fish. Local fish population surveys became a way for people to engage and voluntarily share in the responsibilities of management.

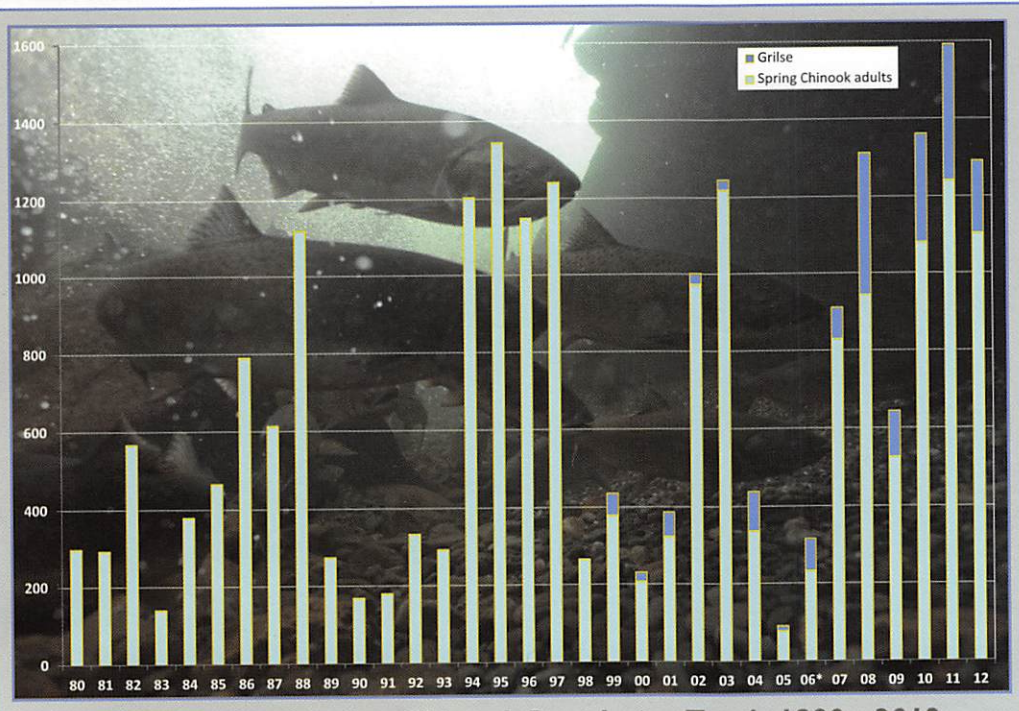
The Salmon River is an unusually intact river ecosystem, and hosts runs of all the remaining anadromous fishes in the Klamath watershed, including several at risk of extinction. Unlike most rivers, there has never been a hatchery on the Salmon River, which makes it a repository of wild fish genetics that could be used to help restore fish runs elsewhere in the Klamath Basin. Despite its excellent habitat, the fishery of the Salmon is a remnant of what it once was.

Over the years we have hosted many activities engaging the community in fisheries monitoring and restoration, including: annual surveys for adult and juvenile fish, restoration projects to enhance upland and aquatic habitat, educational workshops, and cooperative research opportunities. These activities have included everyone from local youth, to the most experienced fisherman and scientists, as well as many in between.

There have been days spent walking the river in February, during the glory of steelhead season, days spent surveying for the first spring salmon in May, annual population census dives for spring-run Chinook and steelhead in the summer, and weeks spent counting redds and carcasses of spawning salmon in the fall. We have tracked down the rare green sturgeon, the endangered coho, and the unusual Pacific lamprey in the Salmon River. We've monitored outmigrating fish at the rotary trap in coordination with the Karuk Tribe. We are proud to have produced a Fish Identification and Survey Training video with the Klamath-Salmon Media Collaborative and to have co-hosted SRF's Spring Chinook Symposium twice.

The SRRC has been improving fish passage into tributaries and doing habitat enhancement projects for a number of years. We've assessed and treated 40 tributaries through this project. These small-scale restoration efforts involve a few trained fisheries technicians making well-informed adjustments to our creeks and streams. Moving a few rocks here and there can improve fish passage into smaller creeks and streams, side-channels and ponds, which is where juvenile fish find their primary rearing habitat. These are places where juvenile fish can feed and conserve energy while growing, increasing their chances of survival when they migrate to the ocean. Placing additional wood and willows in these slow-water habitats can provide needed cover and protection from predators.

There are also several large-scale fisheries restoration projects that have occurred in the last twenty years - most notably the remediation of fish passage at Merrill Creek, Kelly's Gulch and Whites Gulch (see page 13). Future large scale projects on the drawing board include fish passage improvement at Hotelling Gulch, and engineered side channels and ponds to provide quality rearing habitat for coho salmon. Currently, we are working to maintain our ongoing fisheries projects, surveying for adult and juvenile fish populations, maintaining long-term data sets, and continuing to engage the community in this work to preserve Salmon River fisheries.



Salmon River Spring Chinook Population Totals 1980 - 2012

**2006 is an estimate due to a wildfire interfering with completing of the dive that year.*
Grilse, 1 year old salmon also called half pounders, have only been separated out since 1999.

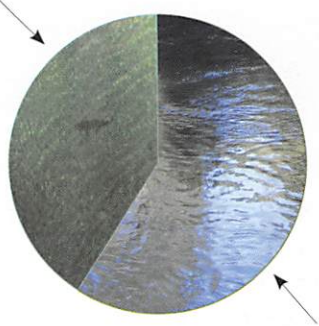




Early Salmon Education linoleum print.

Funding for Fisheries Assessment & Protection Programs

In-kind Donation of Labor, Mileage & Equipment Use $271,794



Grant Funding $383,226

Salmon River Fisheries Program by Species

SRRC and Partners' Fisheries Projects



Spring Chinook run timing assessments; Salmon River Cooperative Spring Chinook & Summer Steelhead Dive since 1992; spawning & carcass surveys; disease & mortality assessments; refugia, summer & winter rearing assessments; otolith & scale research; downstream out-migration fish trap



Klamath Basin Cooperative **Fall Chinook** Carcass & Redd Surveys; otolith & scale sampling & research; disease monitoring; juvenile refugia & summer & winter rearing assessments; downstream out-migration fish trap



Coho juvenile presence/absence surveys; Salmon River coho spawning surveys; off-channel juvenile coho rearing habitat enhancement; downstream out-migration fish trap



Salmon River Cooperative Spring Chinook & Summer **Steelhead** Dive; winter steelhead spawning & redd surveys; Klamath Salmon Anglers & Guides Association monitoring program; downstream out-migration fish trap



Green Sturgeon dives on the lower 8 miles of the Salmon River; green sturgeon larval sampling & radio telemetry; downstream out-migration fish trap



Pacific Lamprey redd surveys & presence/absence surveys; downstream out-migration fish trap

Fish Facts

The Salmon River hosts one of the last wild spring Chinook runs left in the Klamath River basin. Our run varies from 90 to 1600 fish annually. Spring Chinook were once the predominant run in the Klamath Basin.

Since 1992 cooperators have counted the redds and carcasses to obtain population estimates, rather than using a weir, which blocked migration. Fall Chinook are now the predominant run in the Klamath Basin.

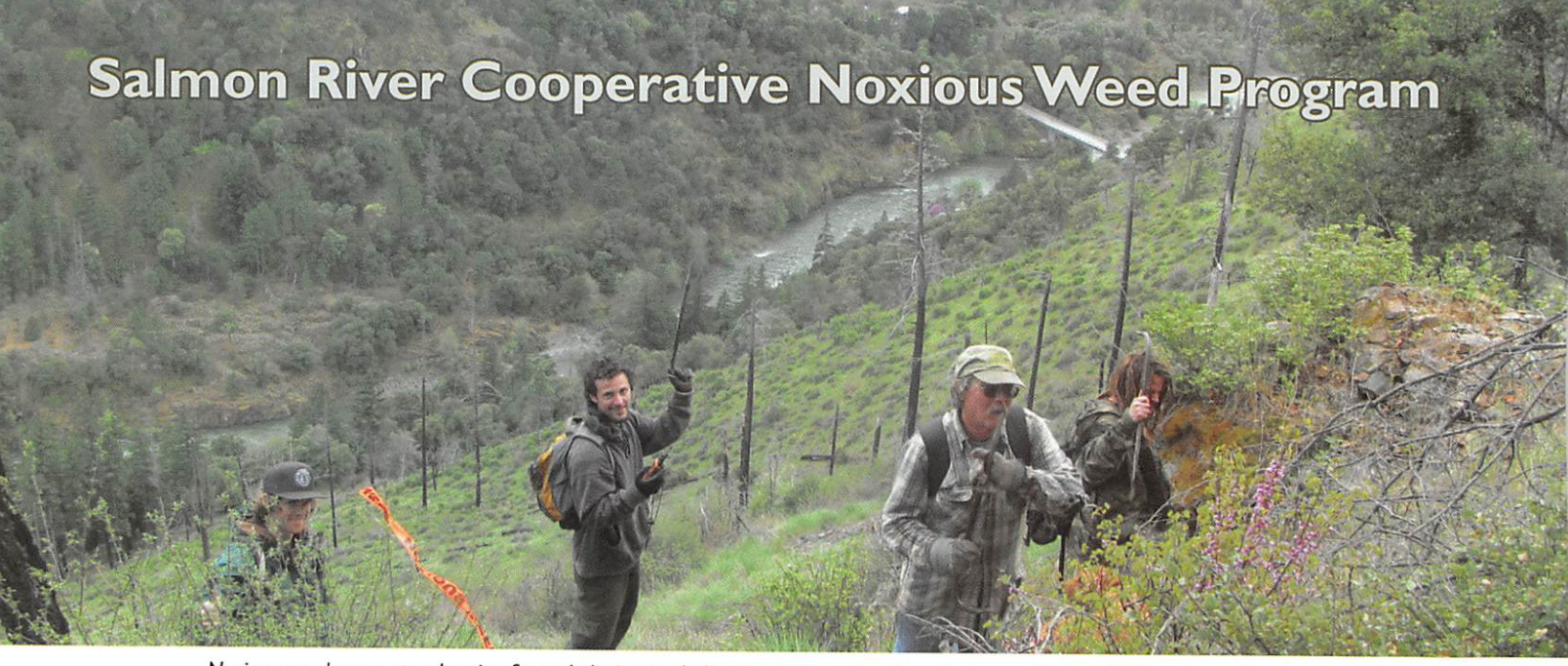
Until 2005, when the Karuk Tribe & SRRC found several hundred juveniles, some thought coho were extinct in the North Fork Salmon River. Coho salmon were listed in 2002 as an endangered species.

Winter steelhead runs are getting stronger after years of low returns; summer steelhead returns remain low. The Salmon River is a prime catch and release, steelhead fishing river.

The Salmon River is one of only a few known spawning areas for green sturgeon. The northern population (including those in the Salmon River) are listed as a Species of Concern by NMFS.

A Pacific Lamprey may hitch a ride all the way from the ocean to the Salmon River on a salmon. Eel and salmon populations once supplied over half the Karuk diet.

Salmon River Cooperative Noxious Weed Program



Noxious weed crews start hunting for and eliminating Italian thistle on a site above the town of Forks of Salmon in early spring.

The Salmon River Cooperative Noxious Weeds Program (CNWP) is a community-based effort that is recognized as one of the most unique and effective watershed scale weed control programs in the West. The success of the program relies on a strong community volunteer component and a commitment to chemical-free control.

The Salmon River Restoration Council and its partners (USFS, Siskiyou County, Karuk Tribe, concerned citizens, landowners, and others) started the CNWP in 1994. Volunteer workdays initially focused on managing Scotch broom and Marlahan mustard, then expanded in focus with our increasing understanding of the detrimental effects invasive plants could have on our wild landscape.

The program really came into its own after spotted knapweed, a class A invasive species, was discovered on the Salmon River in 1997, bringing with it herbicide use and prompting a surge of community support for manual eradication methods. The CNWP has been manually removing knapweed ever since, with amazing results. ***We've achieved a 99% reduction of spotted knapweed plants throughout the watershed.*** The SRRC and its partners are now effectively managing 20 key species on over 550 sites, spread across the 751 square mile watershed, without the use of herbicides. Prompted largely by our intensive management of knapweed, SRRC and its cooperators developed the Salmon River CNWP Comprehensive Management Strategy in 2003. The goal of the Strategy is to aid in the recovery of healthy native plant communities in the Salmon River.

Over the last 18 years of managing noxious weeds we have learned many valuable lessons. At the top of this list is the need for education, prevention, and community involvement. The considerable success of CNWP over the years is in large part due to the consistent and enthusiastic involvement of the Salmon River community. We've come to believe that ongoing success controlling invasive plants requires the active participation of a well-informed public. The SRRC's effort to eliminate knapweed on the Salmon River is a potent example of the real success that can be achieved by putting community solutions at the forefront of the invasive species eradication movement.

CNWP Treatment Summary 1994-2012

Noxious Weed Species	No. of Sites	No. of Plants Removed	% of plants Left
Spotted Knapweed	268	>400,000	<1
Diffuse Knapweed	5	>200	<1
Meadow Knapweed	3	>50	0
Oblong Spurge	9	>40,000	Too early
Leafy Spurge	5	>500	<1
Italian Thistle	4	>250,000	<5
White Top	9	>1,000	<5
Marlahan Mustard	168	>100,000	<15*
Canada Thistle	1	>50	<1
Puncture Vine	3	>27,500	<1
Tree of Heaven	8	>1,000	<25
Scotch Broom	13	>1,000	<5
French Broom	20	>5,000	<5
Water Hemlock	1	27	0
Butterfly Bush	2	>100	<25
Teasel	3	>500	<10
Yellow Star Thistle	28	>10,000	<5*
Malta Star Thistle	3	>2,500	<10*
Jubata Grass	3	5	<25

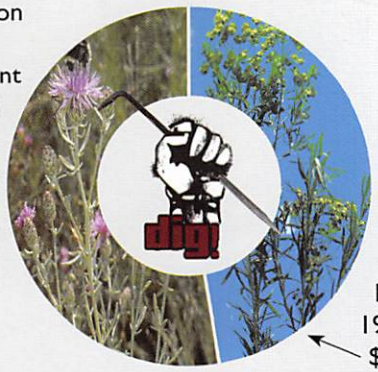
** % remaining of sites treated. Other populations may exist of this species, but targeted sites are prioritized for treatment*

Goals of the Noxious Weed Program:

- Maintain a healthy native plant community that is biologically functional and maintains biodiversity;
- Involve the local community and other cooperators in the control of prioritized noxious weed populations;
- Effectively manage prioritized noxious weed species without using chemical herbicides;
- Develop and apply adaptive techniques and effective tools to achieve control.

Funding for the Salmon River Cooperative Noxious Weed Program

In-kind Donation of labor, mileage & equipment use 1992-2012 $224,437.



Grant Funding 1992-2012 $202,079.

As noxious weed issues gain increasing publicity, regionally and internationally, for their costs to wildlife, agriculture, and land management, the Salmon River community is poised to prevent and/or eliminate new infestations in our area, and offers a model of success that can help other communities succeed as well.

SRRC put noxious weeds on the front page in this 2001 edition of the Siskiyou Daily News



Weeds threaten indigenous plants and native wildlife

BY LORI SELLSTROM
Daily News Staff Writer

SAWYERS BAR — They come armed with tire irons and sunscreen. Their mission: to seek out and destroy foreign invaders at Kelly's Bar.

The invader is an unassuming, greyish-green plant with delicate purple flowers known as "knapweed."

To the unknowing eye, it seems harmless enough and quite pleasant to look at. However, to noxious weed experts in the Forest Service and the Salmon River Restoration Council (SRRC), these weeds are a threat to the indigenous plants and animals of the region.

Knapweed was first discovered along the banks of the Salmon River at Kelly's Bar around 1997. At first there were just a few spots, however, it didn't take long for these spots to multiply and the plant began taking over the area it was growing in.

As the river, the wind, animals and human activity carried the seeds down stream and into other areas of the forest, satellite sites started cropping up, and soon, the entire River area was known as the second largest knapweed site in California.

Knapweed's indigenous environment is in Europe and Asia. It becomes highly problematic when it takes root in American soil because there are no natural enemies, such as insects or disease, to control its numbers. If left unchecked, it will literally take over an area — pushing out the indigenous vegetation.

Thus far, only a few sites in California have been detected, and Forest Service officials are hoping to eradicate the weed before it becomes an enormous problem like the starthistle epidemic in Siskiyou County.

Coming from a Forest Service district in Idaho, Salmon River District Ranger Chance Gowan has witnessed the detrimental effects of knapweed first hand.

"I've seen thousands and thousands of acres in Montana and Idaho literally covered with knapweed," Gowan said. "When it gets to that level, knapweed is virtually impossible to eradicate and can only be controlled through herbicides."

This is probably why it is listed as a class "A" noxious weed in the State of California. According to Anne Yost, Klamath National Forest (KNF) noxious weed coordinator, the normal procedure to eradicate the weed is through herbicides.

See WEEDS on page



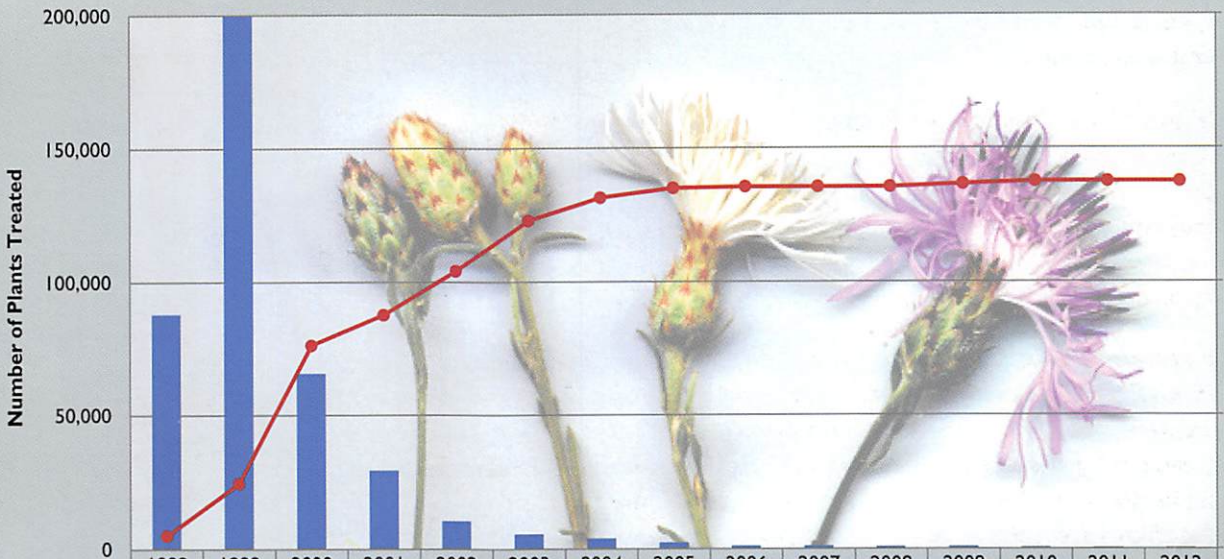
SISKIYOU DAILY NEWS PHOTO/LORI SELLSTROM

Chris "Bird" McCullough, a volunteer with the Salmon River Restoration Council, uses a crowbar to loosen the soil around the roots of a juvenile knapweed.



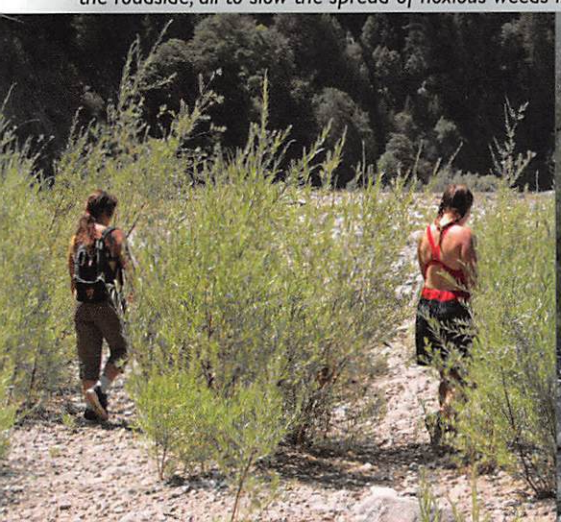
SRRC has specialized the crowbar into an effective weed digging tool.

SR CNWP: Knapweed Plants Treated and Sites Managed Over Time



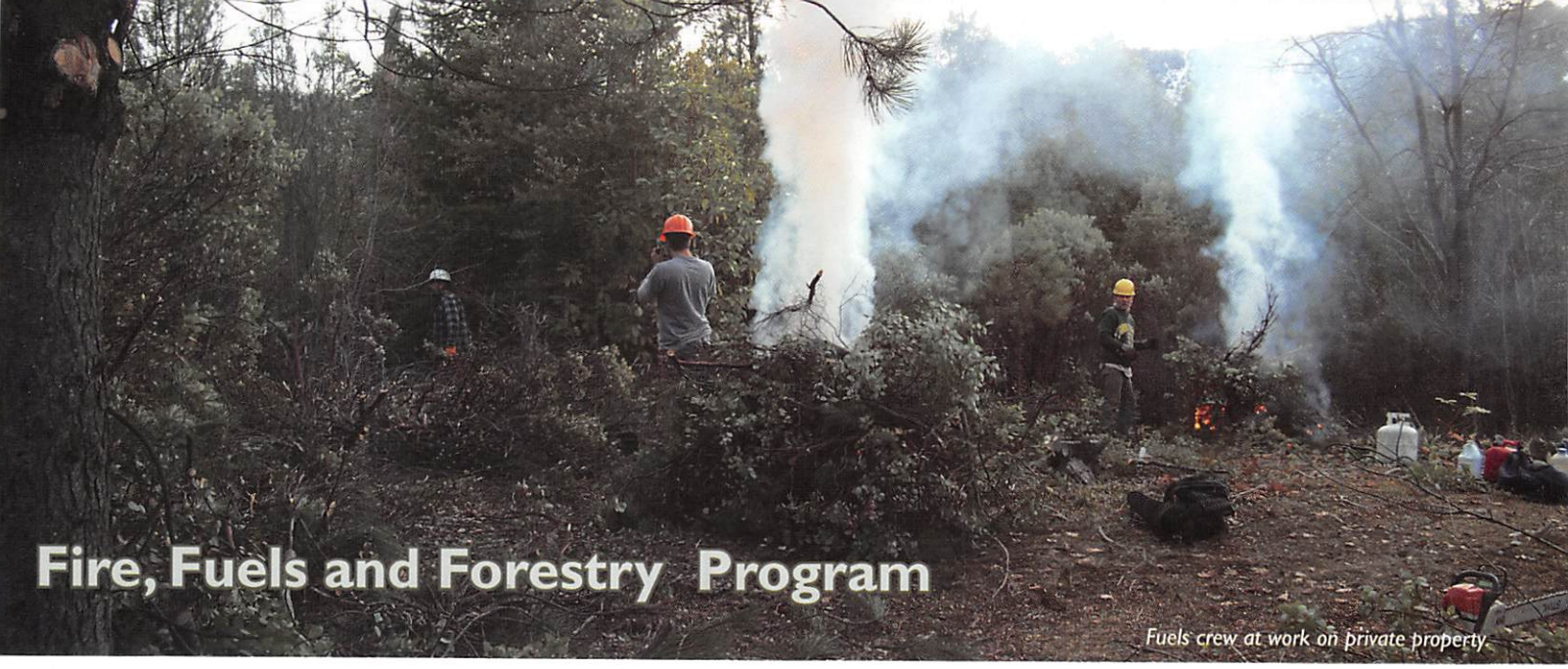
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
knapweed plants treated	87,841	199,806	65,643	29,492	10,511	5,667	3,927	2,395	1,073	1,123	852	831	614	406	396
SRRC sites	10	49	152	175	208	246	263	270	271	271	271	273	275	275	275

Photos from the archives of SRRC - noxious weed volunteers and crew searching the river bar, mulching dense areas of juvenile weed growth and removing weeds from the roadside, all to slow the spread of noxious weeds in our watershed.









Fire, Fuels and Forestry Program

Fuels crew at work on private property.

Wildfire has played a critical role in shaping and maintaining the Klamath region for hundreds of thousands of years. Many of the unique ecosystems of the Salmon River are dependent on periodic wildfire to remain healthy and in balance. Sadly, today, catastrophic wildfire is likely the greatest single threat to fisheries, ecosystem health, and biodiversity in the Salmon River watershed.

The SRRC understands that over 100 years of fire suppression has actually increased the size and intensity of wildfires in many areas of the Klamath Mountains. Preventing nearly all natural fires had the unintended result of greatly increasing fuel loads throughout the watershed. Now many fires are unable to be suppressed, and can grow to many times their historic potential size as they consume the additional fuel load. The Salmon River watershed began experiencing a series of large, catastrophic wildfires in the second half of the 20th century. Today our watershed is one of the highest risk fire areas on the entire Klamath National Forest and has had the greatest concentration of wildfires in Siskiyou County (*see chart*).

In 1994 the SRRC began seeking funding for fuel reduction on private and public property to help reduce the likelihood of catastrophic fires and the risks that they pose to the watershed and community. We received our first grant in 1995, beginning years of work reducing fire prone fuel loads on private property. In order to get more involvement and collaboration from agencies and the community on fire related issues we started the Salmon River Fire Safe Council (SR FSC) in 2000. One significant action of the SR FSC was to create a Community Liaison Program which facilitates communication between USFS Incident Command Teams, local Forest Service, the SR FSC, and local community members during large wildfire events.

The Salmon River FSC's mission is, "...to help plan, implement and monitor the reinstatement of natural fire regimes in the Salmon River ecosystem in a manner that protects life, property, improves forest health, and enhances the resources valued by its stakeholders."

Since 1995 we've treated over 925 acres of land on the Salmon River; working on 56% of the private properties at least once. Through the SR FSC we completed a Salmon River Community Wildfire Protection Plan (CWPP) for the entire watershed and several Neighborhood CWPP's, addressing more detailed fire related issues for towns, neighborhoods, and surrounding Wildland Urban Interface zones (WUI).

We believe our program has stimulated the community, as well as agency personnel, to have a better understanding of fire's role in the watershed and what we can all do to reduce the risk of fire damage to our properties and the public lands surrounding them. Since we've started our fuels program there has been a visible transformation on private lands on the Salmon River. Awareness of fire risk and fuel loading has seeped into the consciousness of the community. Even those who haven't participated directly in our Fire, Fuels and Forestry program have begun to reduce fuels on their property as a part of basic maintenance.

Over time we've come to understand that fire isn't only about safety, but also forest health. People are beginning to see fire as a natural and necessary part of our ecosystem. If we adequately protect our homes and most valued resources we can let fire burn in the landscape without as high a risk of catastrophic wildfire, and fire can once again become an important solution to watershed health.

Over the years our Fire, Fuels and Forestry program has grown to include:

- Prioritized fuel reduction projects;
- Annual Fire Awareness Week;
- Coordinating the Salmon River Fire Safe Council;
- Volunteer fuel reduction workdays;
- Coordinating Multi-Party Monitoring of forestry projects;
- Distributing Fire Safe information;
- Fuel loading workshops and fire safety training;
- Collaborative fire planning for the Salmon River watershed;
- Detailed fire planning for the community and outlying neighborhoods.

Major Wildfires on the Salmon River 1970-2012		
Year	Fire Name	Acres Burned
1973	Offield	8,200
1977	Hog	50,000
1987	1987 Complex	90,900
1994	Specimen	7,500
2002	Forks	1,387
2006	Uncles Complex	48,085
2008	Ukonom Complex	80,000
2009	Backbone & Red Spot	6,324



Salmon Mountain Forestry Fuels crew circa 1997

Below, Fuels reduction work on private land - Before, After, 1 year after

Bottom, 2008 fire by Scott Harding and afterwards in Crapo Creek drainage by Lyra Cressey



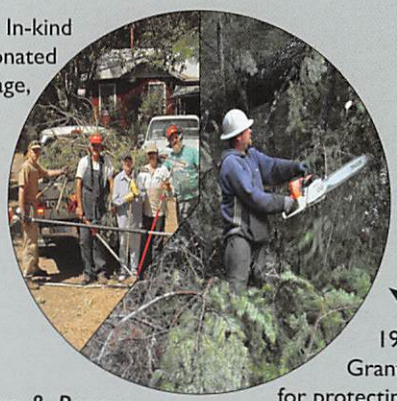




SRRC & Salmon River Fire Safe Council Significant Accomplishments have included:

- *Treated over 925 acres of land on the Salmon River*
- *Worked on 56% of the private properties in the watershed*
- *Completed the Salmon River Community Wildfire Protection Plan*
- *Developed Neighborhood Wildfire Protection Plans for Forks of Salmon, Sawyers Bar, Cecilville, Butler, Black Bear, and Knownothing Creek*
- *Identified, mapped and signed all Salmon River Engine Fill Sites*
- *Identified and mapped all Helispots for emergency response*
- *Identified Emergency Access Routes for treatment*
- *Developed Wildland Urban Interface Areas for the Salmon River*
- *Developed a Fuels Reduction Prescription Policy*
- *Developed and implemented the Forks of Salmon Hydrant System with SR Volunteer Fire & Rescue*
- *Developed Fire Prevention Posters with the help of the Forks School students*
- *Distributed information on fuels reduction technique, fire safe landscaping, and appropriate building materials*
- *Provided uniform address signs for residential emergency response along roads*

1992-2012 In-kind value of donated labor, mileage, equipment $734,836.



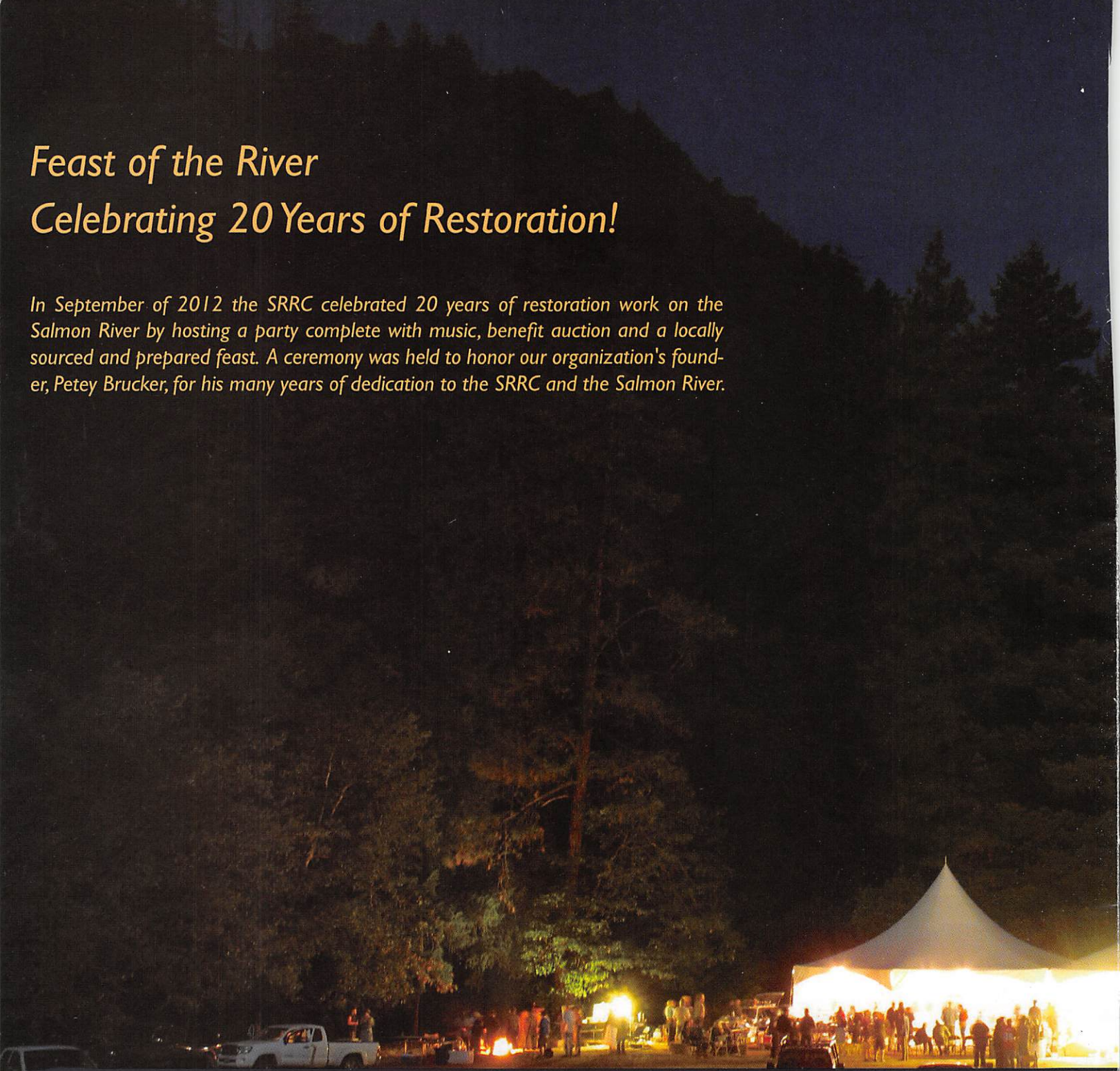
1992-2012 Grant funding for protecting at-risk private and public lands by reducing fuels $1,136,025.





Feast of the River
Celebrating 20 Years of Restoration!

In September of 2012 the SRRC celebrated 20 years of restoration work on the Salmon River by hosting a party complete with music, benefit auction and a locally sourced and prepared feast. A ceremony was held to honor our organization's founder, Petey Brucker, for his many years of dedication to the SRRC and the Salmon River.



We would like to thank the many people and businesses who donated their time, products and sp

Business Sponsors:
McBroom & Co. Packers & Guides, Scurfield Solar, Lukes Joint & the Other Place,.

Donations of Goods & Services:
Ashland's Own Shop 'n Kart, Berryvale Grocery, Brio Breadworks, Costco Eureka, Dania Colegrove, Eco Teas, Eureka Natural Foods, Josh Saxon, Lloyd Ingle, Medford Food Co-op, Moonstone Crossing Winery, Myanna Nielsen, Northcoast Coop, Pierce Family Farms, Raley's of Yreka, Ron Reed, Shannon Monroe, Six Rivers Brewing, Wildberries, and Winette Winery

Donations of Auction Items: *Aida Kastel Baskets, Amanita Molier Silk Painting, Amara Hollowbones, Arcata School of Massage, Arcata Scoop Ice Cream, Beau Pre Golf Course, Benbow Hotel & Resort, Ben Saxon, Betty Ann Hanauer, Brian Pierce Knives, Briceland Vineyards, By Nieves Body Care Products, Cabot Vineyards, Cara Saunders Bear Wallow Herbs, Cathy Leavens Beautimous, Cold Creek Inn, Elsa Marley, Etna Brewing Company, Eureka Spa and Aveda Salon, Frank Lake & Luna Latimer, Geba Greenberg, Holly Yashi Jewelry, Jack & Karen West Egg Tooth Originals, Janjaap Dekker Photography, Jeremy Dahl Tree*

SRRC is very grateful for all the love and energy that the many volunteers added to this event. It cou

Photo top right by









onsorship to make this unforgettable event a success:

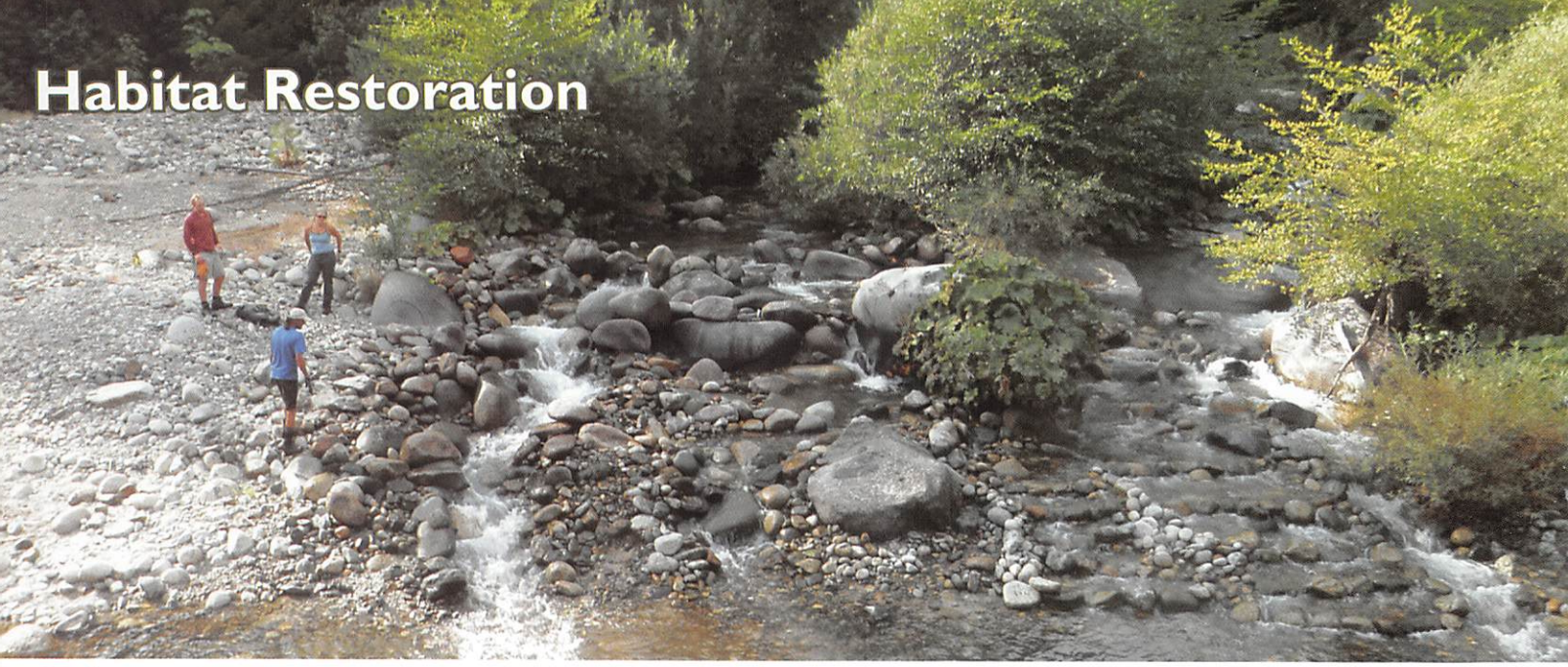
Care & Climbing, Jessy Boone Ford, Judy Beaver Therapeutic Massage, Karuna Greenberg, Klamath River Lodge, Leif & Erik Silvertsen Pottery, Lenny Zeigler Massage, Lyra Cressey, Mad River Brewery, Michael Kauffmann, Mount Shasta Resort, Nature's Kitchen & Market, Pam Lauer, Pepper Forrest Spices, Ralph Starritt Studio, Rex Richardson Salmon River Jade, Robert Goodman Wines, Robert Will, Rolling River Nursery, Salmon River Outpost, Sandy Bar Ranch, Sarah Hugdahl, Sara Krueger, Scott Harding Photography, Four Winds Growers, Sidney Replogle Animals Are Wise, Soul to Sole Spa & Foot Bar, Otter Bar Lodge, Sue Terence, Susanne Cardiff, Tommy & Karen Cesaro, Viola's Garden, Klamath River Outfitters, Will Harling, and Thalia Truesdale Wood 'n I

ldn't have happened without you. You know who you are!

Malcolm Terrance, second on the right by Ben Beaver, all others on this page by Scott Harding



Habitat Restoration



On the ground restoration is a key part of our mission. We accomplish this in diverse ways in our programs, by removing invasive species to restore riparian and upland habitats, reducing excessive fuels accumulated from years of fire suppression to restore the historic fire regime, or moving a few rocks to allow juvenile fish access to refugia (*photo above*), to name a few. There are numerous other ways that we work toward restoring this watershed to health and balance; some of these are detailed below.



River cleanup - Community members have been picking up trash for as long as any of us can remember. Continuing the tradition, SRRC and the Forks of Salmon Community Club organize yearly River and Road Cleanup Days to walk, float, bike, and/or drive to pick up trash along the Salmon River. River clean-up days have often been coordinated with regional Coastal Cleanup Days, sponsored by the CA Coastal Commission. These fun volunteer workdays garner strong support; it's always gratifying to see such immediate results. Since 1997, over 570 volunteer hours, 70 pickup loads of trash and 22 tons of debris (including a 20 ton bridge by Les Harling and crew) have been removed during River and Road Cleanup days.



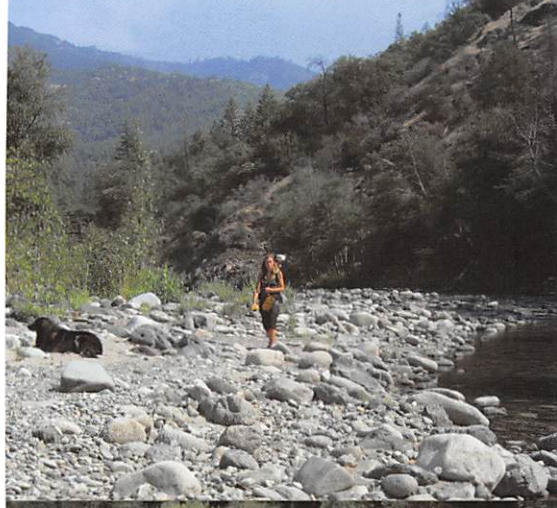
Leave No Junker Behind - In 2004 we took "river cleanup" to the next level when SRRC received a grant through the Siskiyou Co. Resource Advisory Committee to inventory abandoned and/or unwanted vehicles, large appliances and scrap metal on public and private property. We found plenty; vehicles and appliances that make it to the river don't tend to leave as easily once they die. In 2006, with the tireless help of community volunteers, we coordinated the collection of 332 junker vehicles, an astounding 630 tons of scrap metal, and tons of tires and batteries at three crusher sites. North State Recycling crushed and hauled off 32 semi loads of scrap metal. It was epic. The Salmon River sighed in relief with that weight removed, and many meadows and flats were opened up for other life to grow.



Roads - Many of the once thriving streams in the west have been choked out due to huge additions of sediment. Much of this sediment comes from roads. The SRRC, in cooperation with our partners and specialists, developed a multifaceted approach to help manage our roads. We mapped and did a sediment source assessment of all of the federal and many of the private roads in the Salmon River - a total of 884 miles of road. An overall ranking of roads needing to be storm proofed, or decommissioned to reduce sediment reaching the river was made. This assessment led to millions of dollars of road improvements and decommissioning by the US Forest Service on public lands. Additionally, SRRC improved roads on private lands that posed a threat to fisheries.

On a more grass roots level, the Driver's That Care Program is a hands-on maintenance program performed by citizens, where community members have provided low level maintenance on the roads they travel on a regular basis. This includes moving rocks, cleaning culverts, or pulling noxious weeds. SRRC holds periodic volunteer and training workdays, helping landowners learn how to maintain their roads.

Riparian Restoration - The Salmon River seems pristine, with free flowing, clean waters and no upstream polluters; however, past disturbances have caused damage to the river system that will not be fixed for hundreds of years without active restoration. With all of the successes of our fisheries program, the spring Chinook population seems to have stabilized but we haven't seen the swell in numbers that we had hoped. One of the biggest limiting factors to fisheries recovery on the Salmon River is the lack of quality rearing habitat for juveniles. This includes riparian cover, off-channel and side channel habitat, and access to floodplains during high water events. Much of the riparian forest and its soils were washed away by hydraulic gold mining from the late 1800's to early 1900's leaving a legacy of extensive boulder fields. In response to the Salmon River TMDL's recommendation to increase riparian shading (*see pg. 14*), and our growing understanding of the impaired floodplains of the Salmon River, SRRC developed a project to assess the river's riparian zone. Areas deficient in vegetation (including tailing piles) were assessed using numerous criteria to determine whether there was potential for planting vegetation and/or other ways of restoring the sites. Three priority reaches were selected for restoration as a result of this process: the North Fork from Redbank to Sawyers, South Fork from Indian Crossing to Negro Creek, and South Fork from East Fork Campground to South Fork Trailhead. Two pilot sites were selected from the North Fork reach - Red Bank and Kelly Gulch(*being planted, photo right*). With the help of Pacific Watershed Associates we have drafted conceptual designs for these sites with the goals of increasing quality side-channel rearing habitat, riparian shading, and channel complexity.

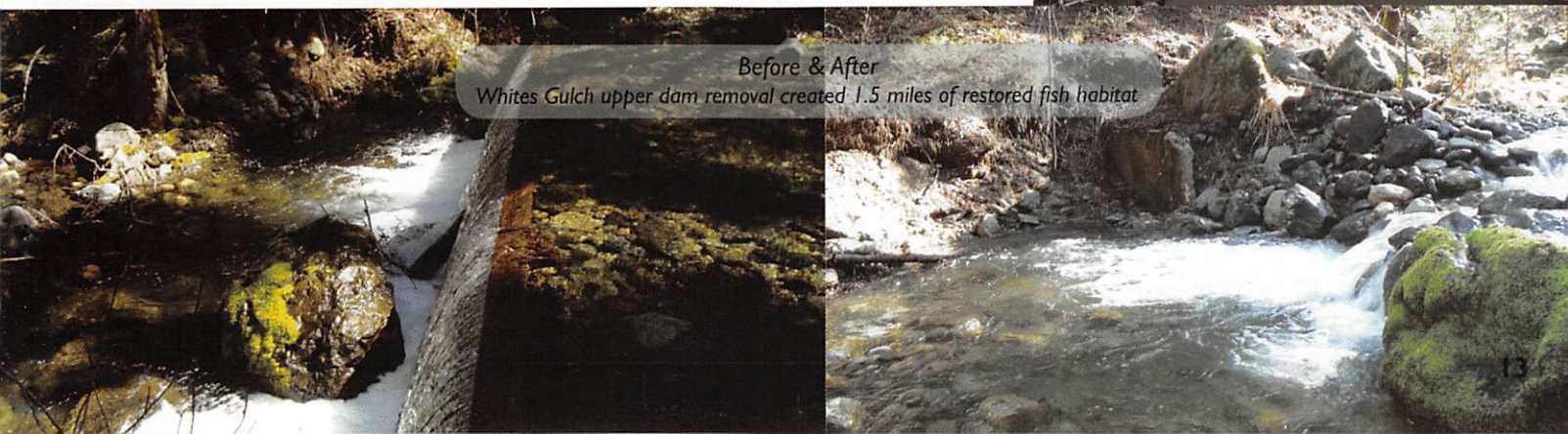




Barriers - Man-made fish barriers such as culverts and dams commonly block access to important spawning and rearing habitat. These cold tributaries serve as critical refugia and rearing areas for juvenile fish year-round. Fish barrier assessments have been completed on the Salmon River for both county and federal roads. The Siskiyou Co. Public Works Dept. (with CDFG funds) replaced barrier culverts with bridges at Merrill Creek in 2002, and Kelly Gulch (*new bridge area being planted photo right*) in 2006. SRRC cooperated on both projects. These cooperative efforts made over 1.5 miles of habitat available for anadromous fish. The SRRC, the Karuk Tribe, and the Mid Klamath Watershed Council completed pre and post fish surveys on both creeks, and planted riparian vegetation to stabilize the new creek banks. Fish have been documented spawning above the bridge in Merrill Creek and are hopefully using Kelly Gulch as well. In 2008, after years of work (supported by CDFG and NOAA) SRRC removed two dams on Whites Gulch, which were blocking 1.5 miles of anadromous fish habitat. A new water diversion was made for the private landowners, the upper dam was blown up, and the lower dam was breached. An additional barrier culvert was replaced with a bridge by Siskiyou County the following year. SRRC and our collaborators are getting close to agreeing upon a solution for the Hotelling Creek barrier. If we can work together to fix Hotelling we will have addressed all of the major barriers on county roads on the Salmon River.

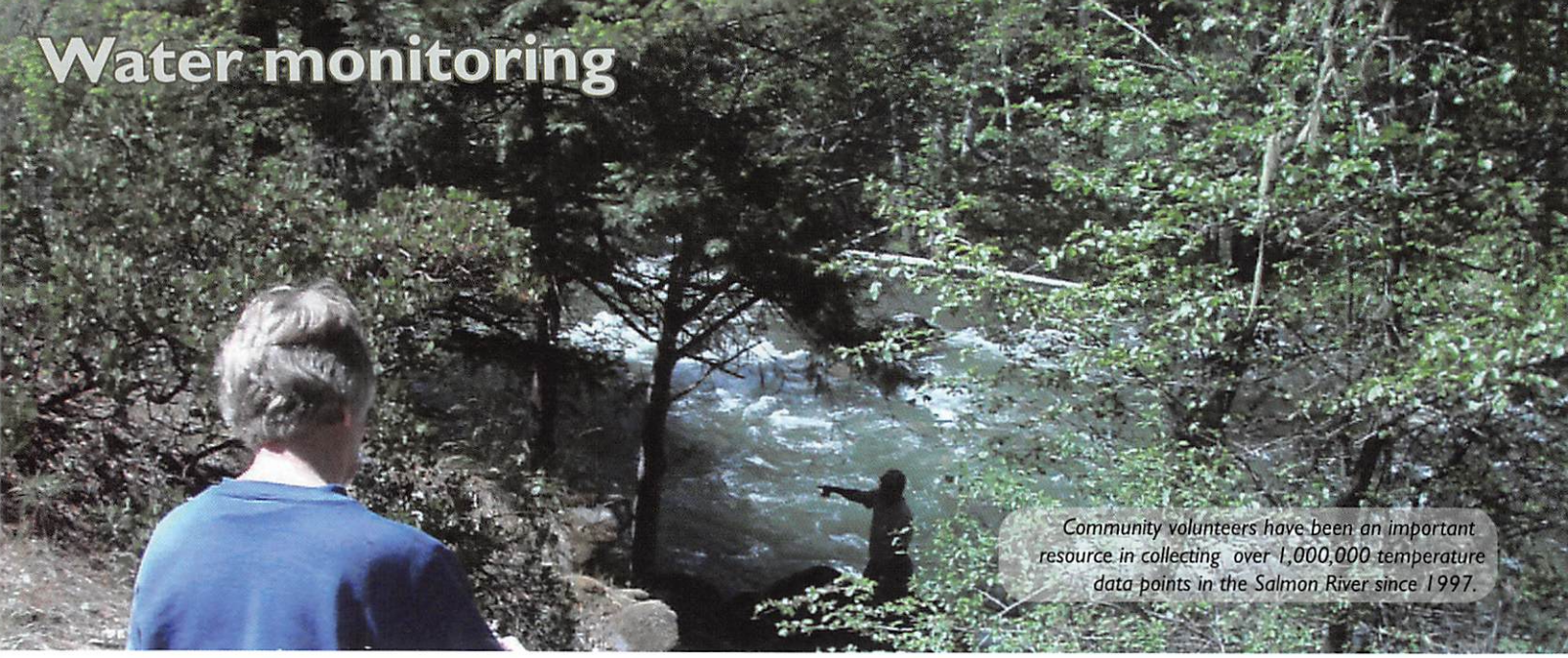


Through many diverse efforts SRRC continues to work towards it's mission of protecting, maintaining and restoring the Salmon River watershed.



Before & After
Whites Gulch upper dam removal created 1.5 miles of restored fish habitat

Water monitoring



Community volunteers have been an important resource in collecting over 1,000,000 temperature data points in the Salmon River since 1997.

The Salmon River Monitoring Program is a cooperative effort involving SRRC, the US Forest Service, the Karuk Tribe, the North Coast Regional Water Quality Control Board, and community volunteers. The monitoring program focuses on stream temperatures and stream flow especially during the summer months when low flows and warm temperatures pose a threat to the health of the fishery. Stream temperature is one of the most important environmental factors affecting aquatic ecosystems, and this data helps us better understand the health of the river.

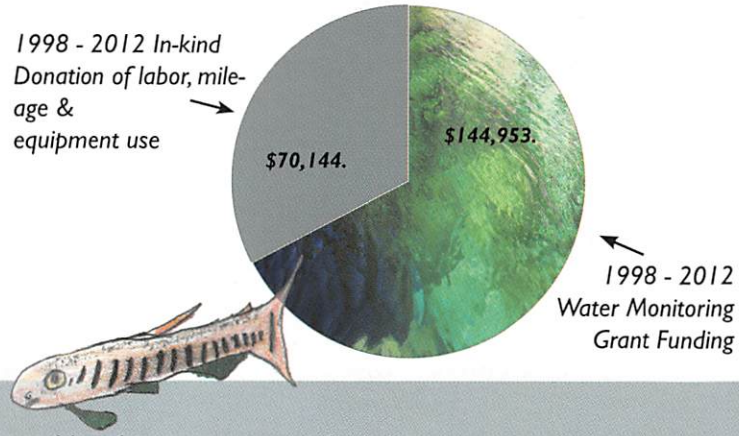
In 1987, some citizens began monitoring temperature in the Salmon River, using hand held min/max thermometers. This community driven concern about potential water temperature issues gave rise to the Salmon River Cooperative Monitoring Program, which the SRRC began coordinating in 1997. The program began as a part of the watershed education curriculum, and involved a close association between SRRC and the 3 river elementary schools. Students adopted responsibility for several temperature monitoring sites and the SRRC provided technical oversight and data compilation for the program. Over the years, the program has expanded in number of cooperators, number of sites, and in its focus.

As a result of excessive summertime stream temperatures, the Salmon River is considered to be temperature impaired and subject to regulation under the Clean Water Act. **In 2005**, the North Coast Regional Water Quality Control Board adopted the Salmon River TMDL (total maximum daily load) and Implementation Plan. The SRRC contributed much of the temperature data on which the TMDL was based, and coordinates with the Regional Water Board and the USFS to help bring about its implementation through habitat restoration.

In 2009, the SRRC, with funding from the Bureau of Reclamation, had a Thermal Infrared Flyover conducted for the Salmon River. This produced a detailed image of surface water temperatures for the entire river corridor. Thermal Infrared data, illustrates the location and thermal influence of point sources, tributaries, and surface springs. The data can be used to establish baseline conditions and help to direct future on-the-ground monitoring and restoration efforts.

SRRC and cooperators have maintained between 35-50 temperature monitoring devices (hobo temps) throughout the Salmon River watershed during the summer months since 1997. This program has always had a strong component of community participation in the form of residents adopting monitoring sites near their homes. We also conduct flow monitoring at several sites during the low water season. Our flow monitoring focuses on tributaries since they contribute crucial cold water to the Salmon River during the hotter months.

SRRC's water quality monitoring program plays an important role in the scientific assessment of overall river health. This data is also used to guide restoration activities.



Goals of the monitoring program:

- Establishing baseline water quality data
- Supporting the implementation of the Salmon River TMDL
- Correlating river temperatures with fish behavior
- Characterizing fisheries refugia conditions
- Identifying opportunities for habitat improvement
- Assessing restoration effectiveness
- Encouraging community participation in the monitoring process

Watershed Education





The Salmon River Restoration Council believes that informed, caring people are some of the most effective stewards of our watershed. Our community is essential to the restoration of our ecosystem. Toward this end we've coordinated a Watershed Education Program in local elementary schools since 1994.

Watershed Ed operates in both local schools, teaching natural resource sciences, ecosystem management, and watershed stewardship. Students at Forks of Salmon Elementary School and Junction Elementary School are given the opportunity to learn scientific methods and gain valuable watershed knowledge through field work and experiential teaching.

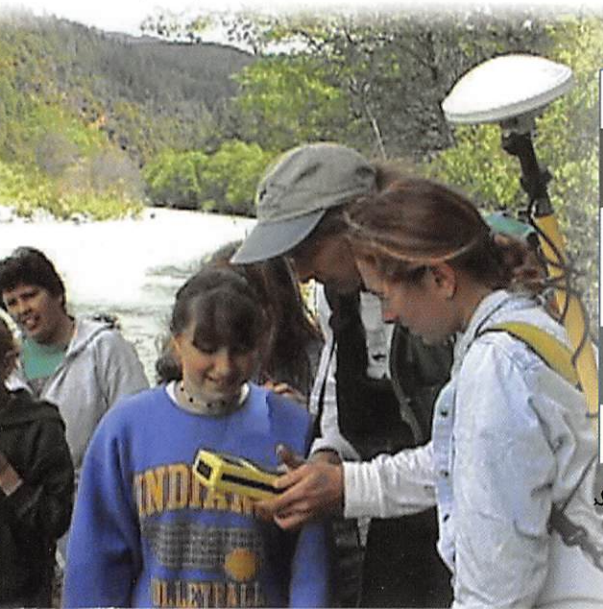
The core program gives kids hands-on experience with fish surveys, water monitoring, salmonid aquarium incubation, and native and invasive plant management. We also incorporate science education about fire, geology, roads, wildlife, and climate. The project is enriched by volunteers from the community, local tribes, and resource agencies. We continually seek to build upon the already strong alliances with the education programs of the Karuk Tribe of California, Mid Klamath Watershed Council and the River School's staff.

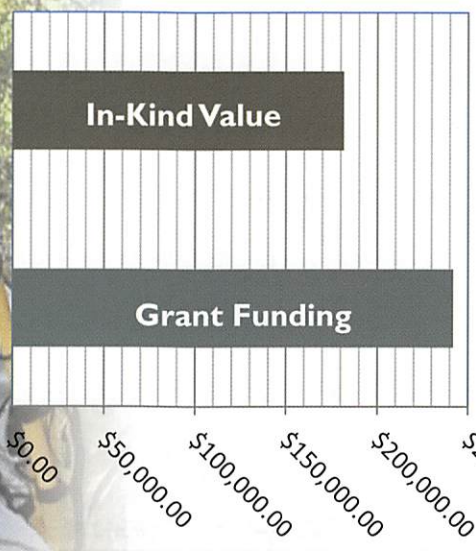
The Watershed Ed program facilitates many activities. Students serve as fisheries technicians during the annual fall spawning surveys, and have received awards from CA Dept. of Fish & Wildlife for their excellent contributions. Our students practice native plant propagation as well as invasive weed removal, and many graduates continue to participate in keeping the Salmon River watershed noxious weed-free. The river schools have often participated in natural history raft floats, where wildlife and fish species are seen up close and personal. In winter, climate, snow melt, mountains geography, and avalanche physics are hot topics. During the annual Watershed Fair, interesting guests are invited to present and all the students' projects are on display and shared with the community.

In addition to our program in the schools, we also hold watershed outreach and education activities for the community and visitors. We distribute outreach material at events and on bulletin boards throughout the area and conduct a variety of workshops in the community.

Watershed Education Funding 1998-2012 Grants and In-Kind Donation of labor, mileage and equipment use

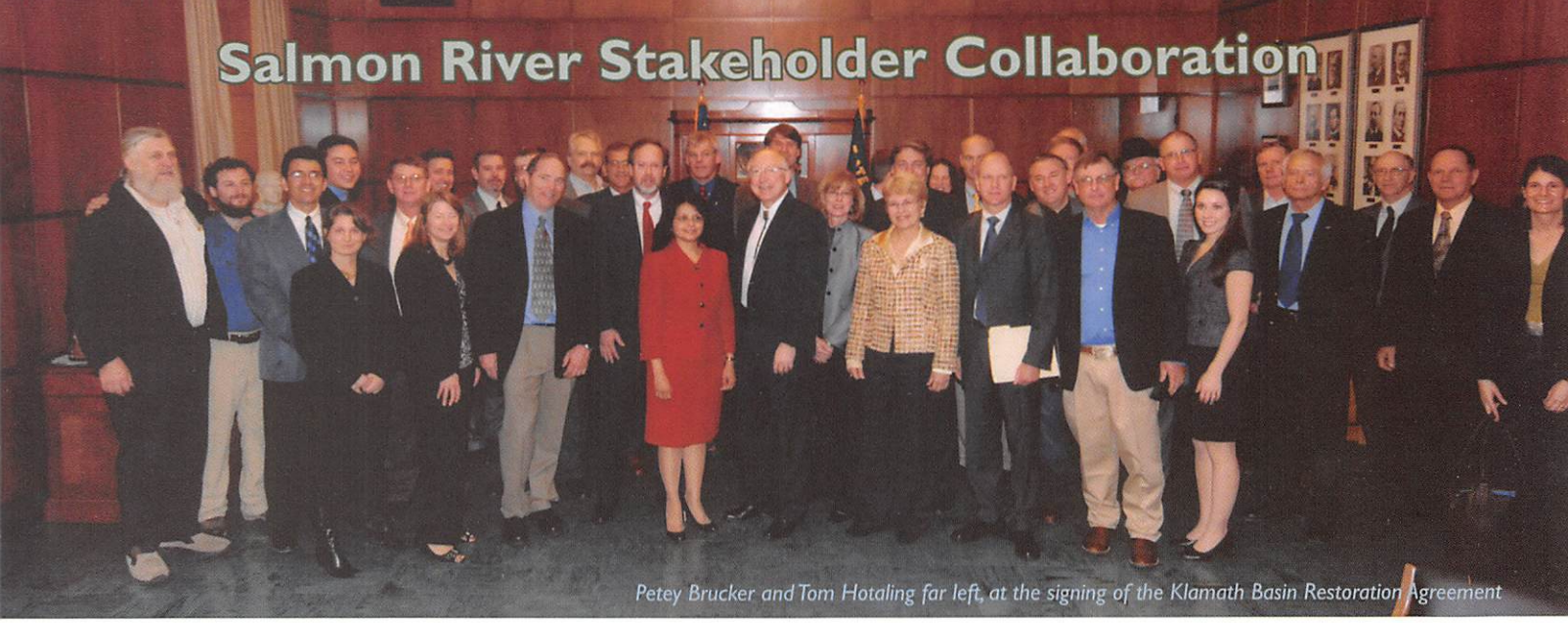
SRRC's Watershed Education in action: Below left, 1998 GPS tracking being demonstrated at the school's adopted water monitoring site and Below right and above, students participating in the 2012 and 1994 Fall Carcass count by taking data from chinook carcasses.







Salmon River Stakeholder Collaboration



Petey Brucker and Tom Hotaling far left, at the signing of the Klamath Basin Restoration Agreement

Since 1992, when the Salmon River Restoration Council was created with support from the Klamath Fisheries Task Force and its Technical Work Group, we have been striving to build strong collaborative relationships with Salmon River stakeholders. All of our programs are collaborative efforts that involve working with partners and community members to come up with improved methods and outcomes. **The results of these efforts have increased salmon numbers, decreased noxious weed populations, increased our community knowledge of local habitat and species, decreased the amount of garbage and waste in our watershed, decreased the amount of fuels in our forest, and increased the number of local kids who now have jobs in natural resources.** Finding common ground can be difficult at times, but the rewards can be seen when those efforts are successful.

There are many examples of how the SRRC has developed and participated in collaborative efforts to foster common solutions for our watershed. Here are a few of note:

- In 2002 SRRC and the Klamath National Forest co-authored the **Salmon River Subbasin Restoration Strategy: Steps to Recovery and Conservation of Aquatic Resources.** This collaborative document has guided restoration efforts for the past 10 years. SRRC also produces an annual **Community Restoration Plan.** We enlist the cooperation and support of the US Forest Service and other federal agencies, the State of California, the Karuk Tribe, all Klamath Basin tribes, resource user groups, the environmental community, recreation users and others to accomplish our goals.

- The SRRC formed the **Salmon Learning and Understanding Group** (SLUG) in 1998 to coordinate activities taking place on the Salmon River with our closest partners, the local USFS District Rangers, the Karuk Tribe and Klamath Forest Alliance. In the years since, the group has expanded to include other participants, but remains a forum for coordination, collaboration and keeping informed on each other's projects and plans.

- We participate in (and serve as fiscal agent for) the **Klamath Basin Monitoring Program,** a multi-agency organization which strives to implement, coordinate and collaborate on water quality monitoring and research throughout the Klamath Basin. Members of the group include federal and state agencies, tribes, counties, NGO's, private consultants and others.

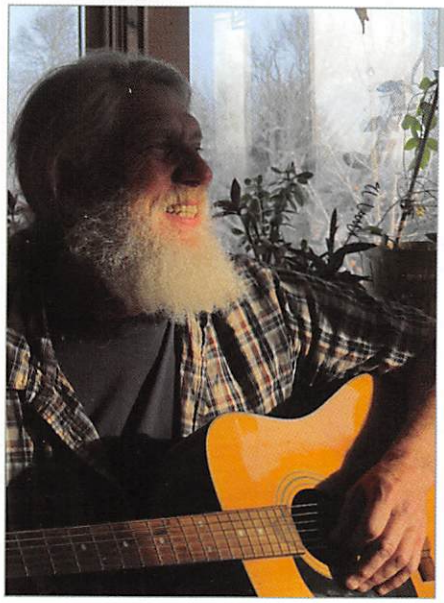
- From 2001-2008, the SRRC coordinated the **Salmon River Spring Chinook Voluntary Recovery Work Group** in an effort to bring together fisheries biologists and managers to work towards developing a recovery plan for spring Chinook salmon. The work group coordinated Salmon River spring Chinook research and developed a draft limiting factors analysis for the population. The group was a cooperative effort involving the US Forest Service, California Department of Fish and Game, North Coast Regional Water Quality Control Board, the Karuk and Yurok Tribes, US Fish and Wildlife Service, NOAA Fisheries, and many others.

- The SRRC has taken on the role of coordinating **Multi-Party Monitoring** of USFS forestry related projects on the Salmon River. Multi-Party Monitoring is a requirement for projects funded through the Healthy Forest Restoration Act. This effort brings together people of varied backgrounds and interests to work towards finding common ground and better understanding of projects and their impacts. The group provides a forum for stakeholders to communicate with one another about forest wide planning and implementation of fuels, timber, and fire projects.

- SRRC, through the tireless efforts of Petey Brucker as representative, has participated in the **Klamath River Settlement** process since 2007, and is the only Klamath River based non-governmental organization Party to the Klamath Basin Restoration Agreement and the Klamath Hydroelectric Settlement Act. The purpose of the Agreement is to remove four dams on the Klamath River to open the upper Klamath Basin to fish passage and increase coordination and funding for Klamath basin restoration efforts.

Additional Collaborative Efforts the SRRC has coordinated and/or participated in:

- Salmon River Fire Safe Council (see *pg. 8*)
- Klamath Salmon Anglers & Guides Association
- Klamath Fisheries Task Force



An Interview with Petey Brucker, SRRC's Founder, by Josh Saxon

Josh: What did you think about the Salmon River when you first moved here in 1972?
Petey: When I first came here I couldn't figure out what was going on. Where I came from the measure of wealth was how much stuff you had. Here it was almost like your measure of wealth was how well you took care of people and places. Coming into an environment where people were happy if everyone was willing to participate and give of themselves was a good change for me.

Josh: How did SRRC come about? What was the beginning like, and how did that shape what we are trying to accomplish today?
Petey: The Restoration Council has always been about bringing people together. When the Klamath Fisheries Task Force first funded us in the early 90's, it wasn't about restoring the watershed, it was about doing everything together. There was a feeling that we needed to come together to talk about what restoration was going to look like – not just the habitat, but the people too. I remember our first Salmon Education workshop – it wasn't about preaching, it was more about sharing, so we sang some songs and did a skit and people really rallied around the idea of protecting spring Chinook. Jack West, the Forest Service fish biologist who started the Spring Chinook Dives, was coerced into being a part of the skit because I told him, "Jack, there's a lot of people who don't want to do a lot of things for salmon, so get out there." Since we are a public watershed everyone in the community is a part of the process. It's good for us to see each other as family.

Josh: What were some successes over the last 20 years that have had a lasting positive impact on the Salmon River?
Petey: Probably our work with spring Chinook has been our biggest success. If people had just kept harvesting there would have been battles and a lot of animosity. If the SRRC wasn't actively involved in pushing to find common ground, I think our community would be a lot different now. Anyone who was close to the water had an understanding of what we were trying to do. It was okay to share information, and we could all make sense of it together, and get an understanding of what we could do better for fish. Another big success that we had was our cooperative approach to controlling noxious weeds without the use of herbicides as a tool for treatment. The use of herbicides is not acceptable to many people in the community. Through the SRRC we have eliminated some species of weeds and significantly reduced others. Our community should be recognized and commended for doing such a good job in putting their hands-on approach to work.

Josh: What's the most challenging collaboration effort you've been involved with?
Petey: The Klamath Dam Removal and Klamath Basin Restoration Agreement process. It's hard to know where it's going to go from here. A lot of issues needed to be worked out, and it was difficult to negotiate each one. All the different Tribes not being on the same page in the KBRA was hard. We were used to having all the Tribes involved whenever we mentioned spring Chinook restoration.

Josh: What kept you up at night over the last 20 years?
Petey: Usually it was a party! Hanging out and playing music was great

Josh: Any words of advice for SRRC's leadership team as we try to navigate the next 20 years of restoration?
Petey: It's important for everyone to participate so the things we have in common come to the surface. Allowing a local voice for how things should be, from the inside out, this is how we do things---not from the outside coming in, having other people figure things out for us.

Above photo taken by Geba Greenberg.
Right, Petey from 2004, holding up an Italian thistle, one of the priority noxious weeds SRRC is manually treating with great success.



The Financial Overview

Since 1992, SRRC has received approximately $4,500,000.00 in grant funding from 190 grant agreements. We've also recorded over $3 million dollars in volunteer and in-kind services during that time. We are proud to report we have employed 185 people over the years. We employ an average staff size of 10 people working out of the Watershed Center and many seasonal field crew.

SRRC has sponsored more than 1,650 restoration related workshops & workdays. Community members, staff, technical specialists, and others have contributed over 95,500 volunteer hours to watershed restoration activities.

Between 1992 and 2012, SRRC has been generously funded by the following:

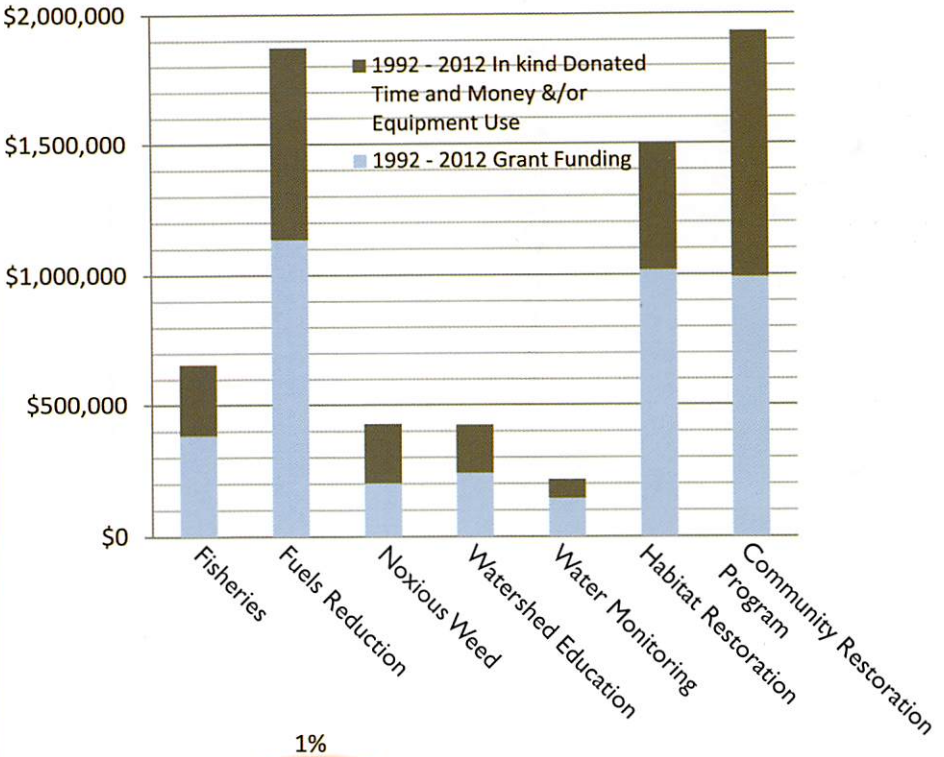
Private Donors
Ayers Family Fund
Frank Colver
SRRC Members

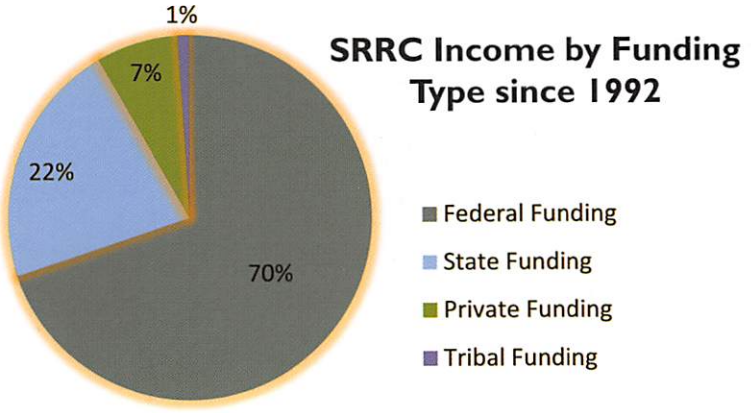
Government Agencies
US Fish & Wildlife Service
US Forest Service
US Bureau of Reclamation
NOAA Restoration Center
Klamath Fisheries Task Force
CA Fire Safe Council Grants Clearinghouse
California Department of Fish & Game
California Department of Conservation
California State Water Quality Control Board
California Department of Food and Agriculture
Siskiyou County RAC
Siskiyou County Department of Agriculture
Karuk Tribe

Private Foundation Funders
Bella Vista Foundation
McConnell Foundation
Shasta Regional Community Foundation
Norcross Wildlife Foundation
Firedoll Foundation
The Strong Foundation for Environmental Values
Dancing Tides Foundation
Cereus Fund of the Trees Foundation
Clif Bar Family Foundation
National Fish and Wildlife Foundation
Sidney Stern Memorial Trust
Humboldt Area Foundation
Mountaineers Foundation
Fish America Foundation
Sacramento Regional Foundation

Corporate Donors
Trimble
Hewlett Packard
Bank of America
Outback Power
ESRI

Total Grant Funding and In-kind Contributions By Program





Thank you to our current funders: *CA Department of Conservation, CA Department of Food & Agriculture, CA State Water Quality Control Board, CA Fire Safe Council/Grants Clearinghouse, US Fish & Wildlife Service, US Bureau of Reclamation, US Forest Service, Karuk Tribe, Firedoll Foundation, Clif Bar Family Foundation, Norcross Wildlife Foundation, Sidney Stern Memorial Trust, National Fish and Wildlife Foundation, and SRRC Members!*

YES! I want to support the work SRRC does and become a member!

Membership Categories:

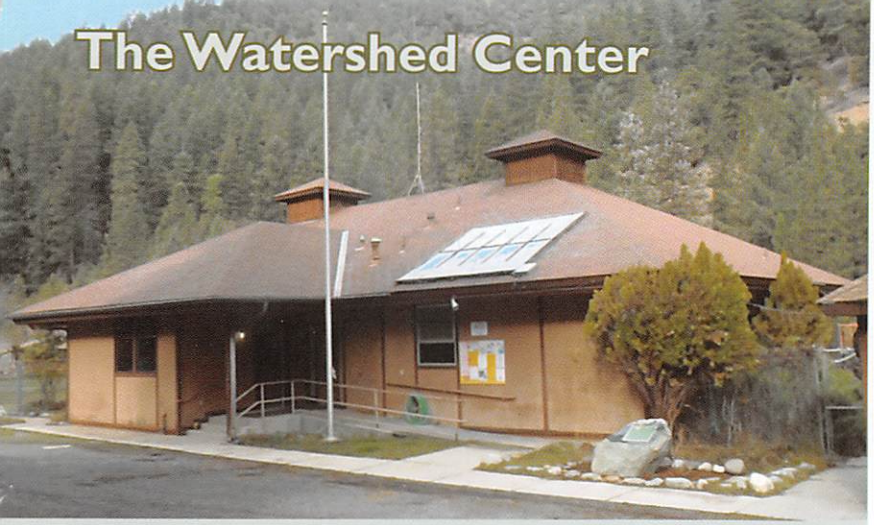
- Winter Steelhead - $25
- Fall Chinook - $50
- Coho - $100
- Green Sturgeon - $250
- Spring Chinook - $500+

All members receive SRRC's newsletter.
Coho: Please send me a ○ Gift card packet, ○ No Gift
Green Sturgeon and up: Please send me a ○ SRRC T-shirt, ○ Gift card packet, ○ No Gift

Three Ways to Join
1. Online at www.srrc.org/getinvolved
2. Mail us a check or money order with your contact info to:
   Salmon River Restoration Council
   P. O. Box 1089
   Sawyers Bar, CA 96027
3. Come visit the Watershed Center



The Watershed Center



The SRRC has its office and Watershed Center in Sawyers Bar. In 2012, a dedication to Jim Villeponteaux was inlaid into a boulder out front.

The SRRC has operated the Salmon River Watershed Center in Sawyers Bar since 1996. The facility is open to the public and serves as a community center and an office for SRRC staff. The large, multi-purpose room is perfect for the many educational outreach events the SRRC puts on as well as meeting space for local stakeholders. Services include: wireless internet and computer access, photocopies, maps, phone and fax, a library, and information about the watershed and river.

A brass plaque in honor of Jim Villeponteaux was mounted onto a local boulder and installed in front of the Watershed Center this past fall. It acknowledges Jim's significant work coordinating stakeholders to plan and implement restoration projects. Jim, a founding member of SRRC, was largely responsible for setting up the Salmon River Fire Safe Council and did a lot of ground breaking work for other Siskiyou County FSCs.

Our river communities are a wealth of history. SRRC has spent many years collecting and archiving historic photos, documents stories, movies, interviews and maps. Much of this history was compiled in a Salmon River History CD in 2001. We hope to do a 2nd History CD in the future. We have digitalized and archived many family photo collections, print media and other historic records. If you have anything to add to this community collection, please bring it in to the Watershed Center.



Current SRRC staff gathered for a photo this winter



Watershed Center open house in 1997

SRRC Board Members

Petey Brucker, President
Toz Soto, Vice President
Kathy McBroom, Secretary/Treasurer
Ben Beaver
Creek Hanauer
Will Harling
Scott Harding
Ron Reed

SRRC Staff and Project Leaders

Josh Saxon, Executive Director
Karuna Greenberg, Restoration Director, Fire Fuels & Forestry Coordinator
Lyra Cressey, Associate Director, Monitoring Coordinator
Petey Brucker, Noxious Weed Coordinator
Kathy McBroom, Office Manager
Brenda Hurlimann, Bookkeeper
Tom Hotaling, Fisheries Coordinator
Robert Will, Fuels & GPS Technician
Sarah Hugdahl, Program Assistant
Shannon Monroe, Program Staff
Mitzi Rants, Watershed Ed Coordinator

SRRC 2012 + 2013 Crew Leaders and Crews

Steve Adams
Steven Addison
Bonnie Bennett
Sheri Campbell
Tanya Chapple
Garry Collins
Eric Cousineau
Kyle Cousineau
Robert Cousineau Jr.
Robert W. Cousineau
Jesse Cullen
Timothy Darling
Kevin Dunbar
Samuel Elledge
Jon Feutz
Dawn George
Steve Gunther
Jessica Hanscom
Sara Hayden
George Heck
Daniel Hendrickson
Chris Inskeep
Eric Johnson
Kelly Jones
Mike Kerrick
Scott Kingery
Rebecca Lawrence
Tamara Lightle
Wyatt McBroom
Kenny McDonald
Kasey O'Brien
James Peterson
Brian Pierce
Nicolas Ramirez
Katie Reinhart
Beulah Simas
Joe Stoltz
Jake Sutter
Irie Swift
Emily Tornroos
Bill Varga
Ron Ward
Bob Webster

Salmon River Restoration Council
P. O. Box 1089
Sawyers Bar, CA 96027

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The Salmon River watershed is located in the Klamath Mountains of far Northwestern California. It flows out of wilderness mountains -- Trinity Alps, Russians, Marble Mountains, and Salmon Mountains – and their rugged topography is deeply incised by the river and its tributaries. Ranging in elevation from 8,560 feet at Caribou mountain down to 456 feet at the mouth, 45% of the 751 square mile watershed is designated wilderness area. Nearly 99% of the watershed is federally owned, leaving just over 1% to be inhabited by a local population of around 250 people spread throughout three towns and outlying neighborhoods.

It is a land of biodiversity superlatives and is one of the key areas of biodiversity in the Pacific Northwest. It boasts one of the greatest concentrations of coniferous tree diversity in the world. There are 30 species of conifers in the watershed, including 7 endemics, a convergence of trees found in both Alaska and Mexico, a wide variety of Ceanothus species, and astoundingly diverse butterfly and forest-type mollusk populations.



By water volume, the Salmon River is the second largest tributary of the much larger Klamath River system. The river is designated Wild & Scenic, is completely lacking in dams or diversions, and has water of exceptionally high quality. There are no dams between the Salmon River and the ocean, providing unimpeded access to anadromous fish.

The Salmon River hosts all native anadromous fish runs present in the Klamath watershed: spring Chinook, fall Chinook, coho, steelhead, green sturgeon, and Pacific lamprey. It has the largest remaining wild spring Chinook run in the Klamath River.

photo of the Main stem Salmon River by Scott Harding

Shasta Valley Resource Conservation District

Our Vision

Community
The communities within the District's boundaries will focus on wise use of local available resources. We will foster trust to resolve conflicts to build and maintain a strong economy in Siskiyou County. The rural character and environmental health of the region will be preserved for future generations through effective stewardship and sustainable agricultural activities by facing problems and committing to work for solutions. Restoration efforts will improve rural and urban areas for residents and visitors while enabling irrigated agriculture to remain profitable.

Natural Resources
The region will prosper with a balanced and efficient use of economic and environmental resources that leads to a delisting of endangered species. Growth will be encouraged in safe areas to avoid fragmenting agriculture and forest lands and to maximize preservation of natural resources.

Education
People within our communities will be informed about natural resources and external communities will become aware of the needs to sustain our rural lifestyle.

Board of Directors

Kerry Mauro, *Chairman*

Bill Hirt, *Vice Chairman*

Mike Matherly, *Director*

Chris Robertson, *Director*

Ryan Walker, *Director*

District Administrator

Adriane Garayalde

Mission Statement

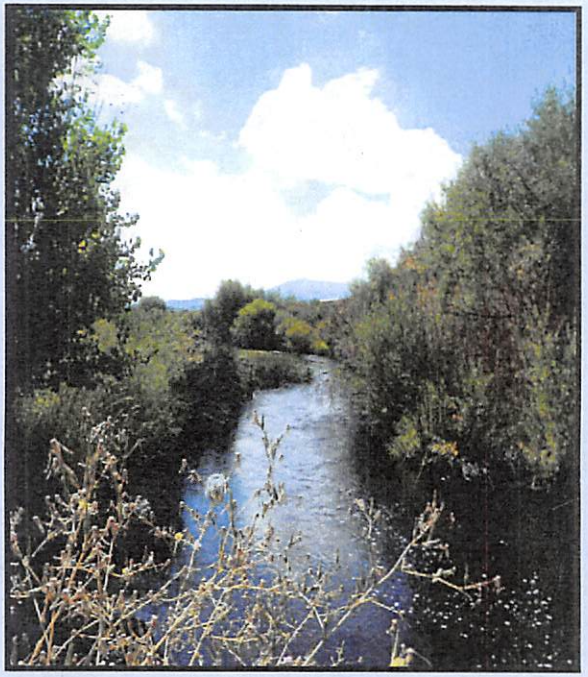
The Shasta Valley Resource Conservation District's mission is to enhance the conservation and economic stability of natural resources by coordinating and supporting landowner activities, both public and private, and by providing information, education, and project implementation to residents within all watersheds in the district boundaries.

RCD
SHASTA VALLEY
RESOURCE CONSERVATION DISTRICT

Shasta Valley Resource
Conservation District
215 Executive Court, Suite A
Yreka, CA 96097
(530) 842-6121, Ext 106
www.svrcd.org

Find us on Facebook

Shasta Valley Resource Conservation District



Getting to know your Local Conservation District

Shasta Valley Resource Conservation District
215 Executive Court, Suite A
Yreka, CA 96097
(530) 842-6121, Ext 106
www.svrcd.org

These are some examples of projects that the Shasta Valley RCD does:

Pipelines for Irrigation Efficiency

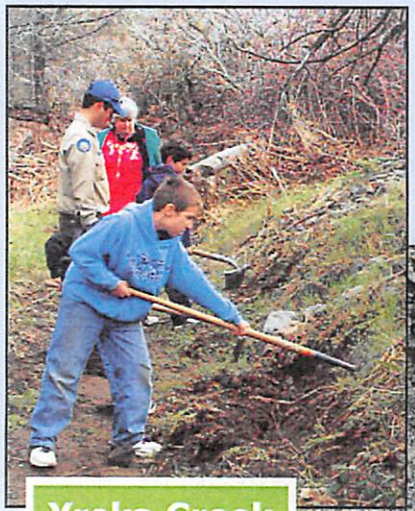




Fish Screens



Fish Ladders

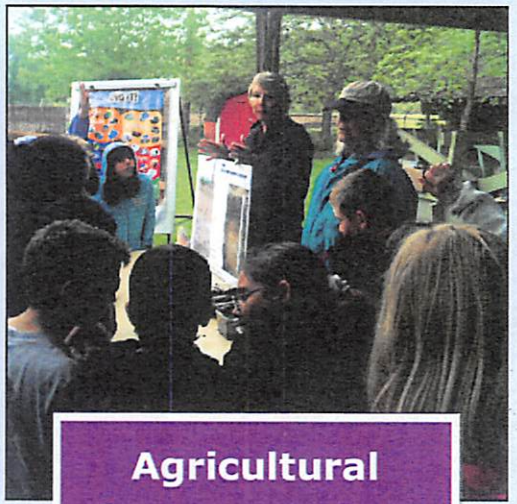




Yreka Creek Clean-up

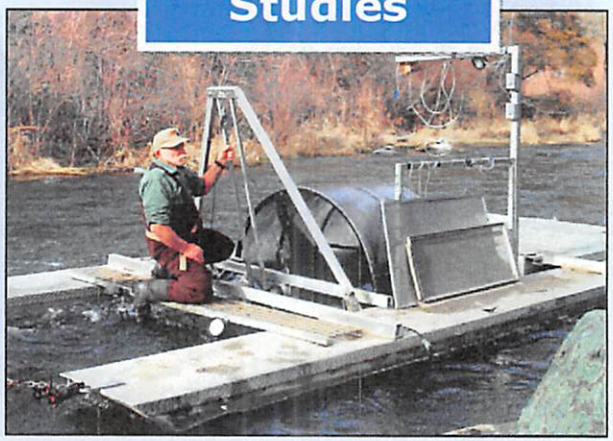
Forestry Workshop





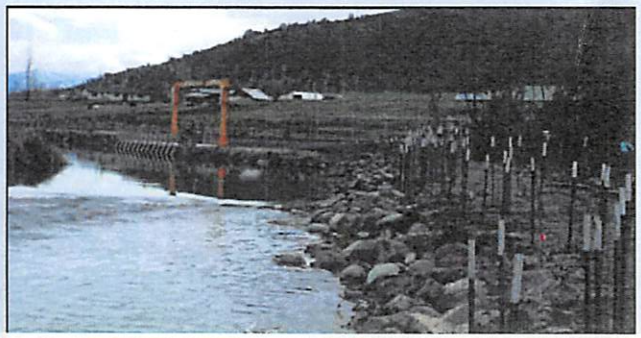
Agricultural Awareness Day

Fisheries Studies





Irrigation Infrastructure Upgrades



Diversion Dam Upgrade

Funding for this publication is provided by the National Forest Foundation, Community Capacity and Land Stewardship Program

Fiscal Sponsor and Program Contact

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Fort Jones, CA 96032

Phone: 530-468-2888
Fax: 530-468-4426
E-mail: lalexander@sisqtel.net

SCOTT RIVER COOPERATIVE RESTORATION AREA PROGRAM



Developing a Plan for the Upslope Regions of the Scott River Watershed that complements existing efforts and accomplishments.

Published June 2015

Why this Program is needed...

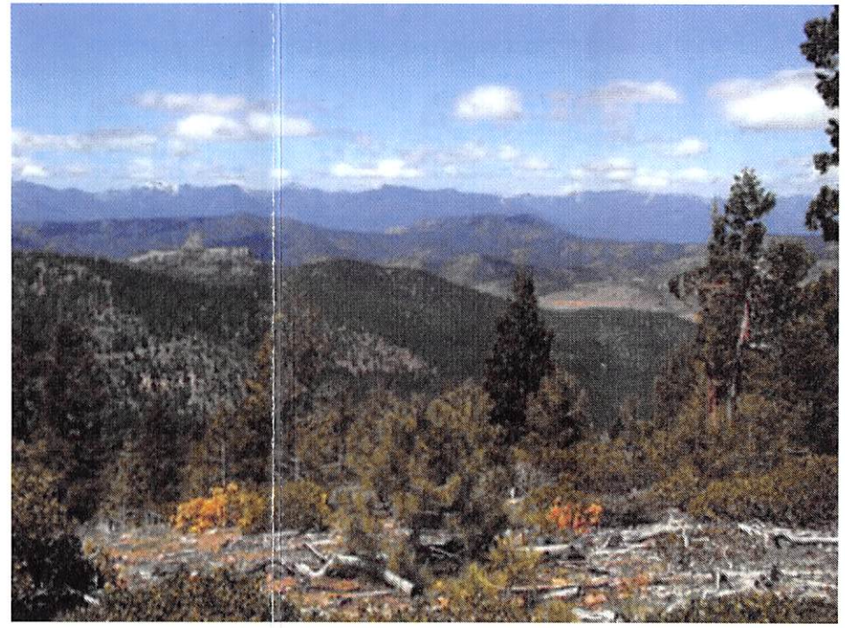
Managing watersheds for wildlife, recreation, plus economical sustainability is difficult in itself, add the need for job growth, then you must attempt to mesh technical knowledge and skills with societal demands and interests.

Public outreach and education regarding the natural resources within our forests will result in a better understanding of protection and restoration options available for those resources. With added public knowledge it is easier to make more informed decisions about enhancing the value of the land, their resources and our use of them.

Planning products are used to guide decision makers and land managers in project development and prioritization that best meets the common goal to revitalize the forests within the Program area.

The Program area is located in the Scott River Watershed,
Siskiyou County, California.





View from the Upper East Fork Scott River

What this Program is intended to accomplish...

The purpose of the Scott River Collaborative Restoration Area Program is to "manage, protect, sustain, improve or restore ecosystem health within the National Forest System and surrounding communities through voluntary cooperation of stakeholders and the community at large". This Program focuses on the effects the forested areas have on the entire watershed including the sustainability of the health, diversity and productivity of the forests and grasslands as they meet the needs of present and future generations. This Program relies on a successful cooperative process within the Klamath National Forest and adjacent properties. It requires a well-structured planning group to be successful in meeting various objectives that have been identified by community stakeholder organizations and Klamath National Forest personnel.

Program Objectives

- Build the capacity of a local stakeholder planning group.
- Inform and educate the public of local watershed health issues.
- Gain public support and "buy-in" for work on public lands so it is a "cooperative" effort.
- Develop a strategic action plan for the forested (upland) areas of the Scott River Watershed that includes the following:

  Identify and design restoration projects for future implementation.

  Create baseline monitoring values and perform annual monitoring tasks for the purpose of adaptive management where needed.

  Continue and identify new research needs and opportunities.

The Planning Group

The primary purpose of the *Planning Group* is to provide leadership in data analysis, upslope restoration planning, monitoring and project design. Until 2014, and with no funding, a small planning group has been meeting since 2003 to identify restoration projects that will best improve forest health, promote fire safe landscapes, provide natural resource restoration job training experiences, and promote cooperative agreements on public lands in the Scott River watershed. The current group is composed of stakeholders from the Scott River watershed including resident land owners and representatives from the Scott River Watershed Council, Bureau of Land Management, Klamath National Forest, Quartz Valley Indian Reservation, commercial timber companies, six Fire Safe Councils, and Northern California Resource Center, the Program's fiscal sponsor.

A *participating agreement* with Klamath National Forest and a *Stewardship Agreement* with Bureau of Land Management are in effect. Six restoration areas have been identified--with three noted as top priorities.

Until recently the Scott River Watershed has a developed restoration plan that focuses on the non-forested areas. This Program brings additional community participants into the continued efforts for revitalization of the upland, or forested, areas of the watershed. The group's desire is for all stakeholders to work together and provide for a healthy ecosystem, sustainable recreation and economic development.



Sugar Creek, a tributary to the Scott River

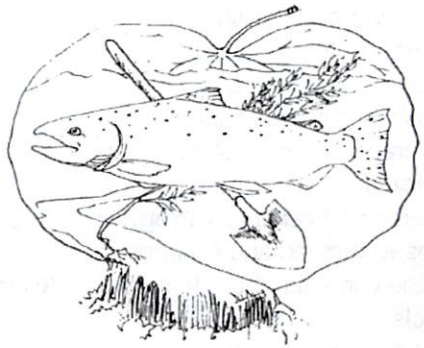
Salmon River Restoration Council (SRRC)
PO Box 1089
25631 Sawyers Bar RD
Sawyers Bar, CA 96027

Phone: 530-462-4665
Fax: 530-462-4664
e-mail: info@srrc.org
website: www.srrc.org

Stop in if you are passing by our Watershed Center located in the "old" Sawyers Bar school building for:

- computers the public can use,
- wireless Internet access,
- a media library,
- up to date information center,
- history archive,
- meeting space,
- copy and fax services and more

The Watershed Center is open most weekdays and provides office space, as well as room for seminars and workshops.



The SRRC would like to thank our current funders for their essential support: CA Dept. of Fish & Game, Siskiyou County RAC-USFS, US Fish & Wildlife Service, US Bureau of Reclamation, US Forest Service, Bella Vista Foundation, Grants Clearinghouse, Norcross Foundation, The Strong Foundation, Firedoll Trees Foundation, Karuk Tribe

Become a member of the SRRC

We are expanding our restoration community and would like to officially invite you to join our annual membership program. By becoming a member of the SRRC, you will help our organization continue to effectively achieve our goals of enhancing the Salmon River ecosystem and the local economy.

Winter Steelhead - $25
Fall Chinook - $50
Coho - $100
Green Sturgeon - $250
Spring Chinook - $500 or more

All new members will receive a beautiful printed map of the Salmon River, as well as SRRC's newsletters and annual report. Members at Fall Chinook and above have their choice of a T-shirt, Salmon River History CD, or a gift card pack.

Name _____

Address _____

City _____ State ___ Zip _____

Email _____

Phone _____

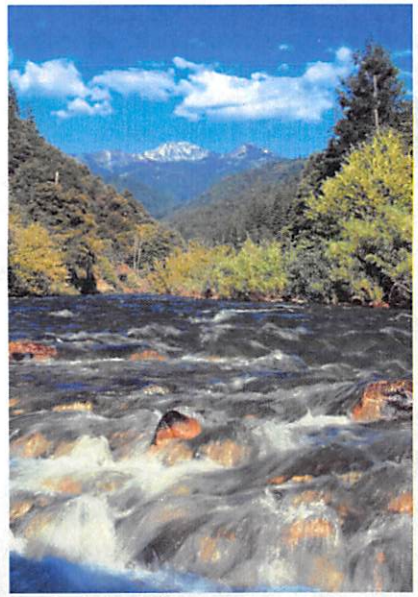
I am donating $_____ Date_____

☐ T-shirt size___ ☐ History CD ☐ Gift cards

Make a donation using a check or money order, or make an online donation at **www.srrc.org**. Donations are tax deductible.

Salmon River Restoration Council

20 years dedicated to restoring and protecting the Salmon River ecosystem



North Fork, Salmon River
Photo courtesy of Scott Harding.

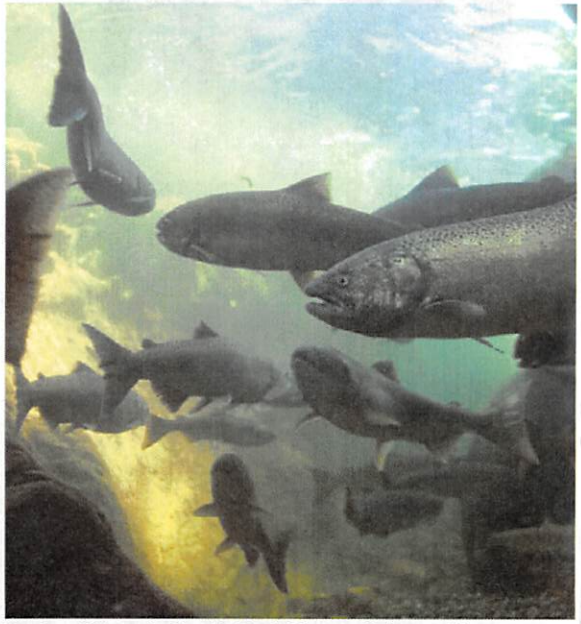
"The aquatic and terrestrial ecosystems are the single most important factor in determining the ecological and economic well-being of our rural riverine communities."

— Salmon River Restoration Council
2009 Community Restoration Plan

Salmon River Restoration Council's mission is to restore, maintain, and protect the Salmon River ecosystems through stakeholder collaboration, highlighting active community participation and the development of a sustainable economy based on ecological compatibility.

Long Term Goals

- **Enlist** community members in a cooperative approach to protect and restore the Salmon River aquatic and terrestrial ecosystems.
- **Create** economic stability in the community by diversifying job opportunities based on restoration and conservation.
- **Promote** cooperative planning, education and management efforts with the managing agencies, academia, the Native American Tribes, the community and other stakeholders.
- **Help** fill the resource management gaps left by traditional large governmental agencies which have a difficult time conceptualizing and implementing small or non-traditional projects.



Spring Chinook, South Fork Gorge, Salmon River, Photo courtesy of Mike Bravo.



The Salmon River Restoration Council (SRRC) is a non-profit organization that has been serving California's Salmon River watershed and its community since 1992. We work cooperatively to assess, protect, maintain, and restore the ecosystems of the spectacular Salmon River.



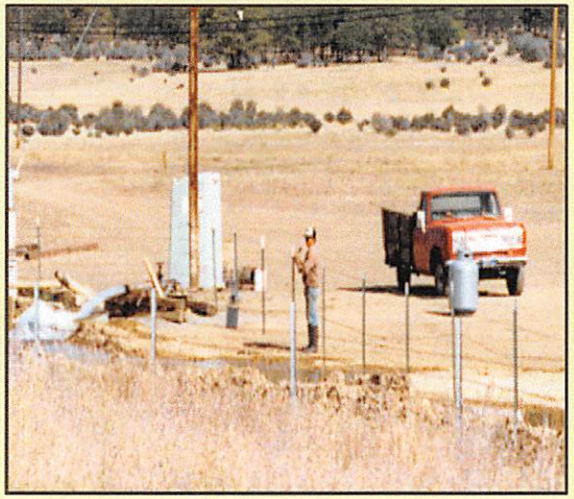
With the active participation of the local community, our projects focus on anadromous fisheries resources and the development of a sustainable economy. Strong community partnerships are essential to our work.



We believe that educating and empowering the river community to become effective stewards of the ecosystem is a centerpiece in the recovery of our watershed and in particular the declining fisheries resource.

We work to foster the health and well being of our region and its inhabitants through a variety of projects and programs. The programs include our:

- **Fisheries Program** - engages in cooperative fisheries monitoring, research, and habitat restoration for multiple species throughout the Salmon River watershed; improves fish passage to spawning and rearing habitat.
- **Cooperative Noxious Weed Program** - a community-based approach to eradicating noxious weeds in our watershed using manual control methods rather than toxic herbicides.
- **Fire Planning and Fuels Reduction Program** - promotes a collaborative approach to fire planning and fuels reduction projects in the Salmon River landscape.
- **Water Quality Monitoring Program** - monitors water quality and quantity on the Salmon River and its tributaries in order to better promote and understand the health of the river and its fisheries.
- **Riparian Restoration Program** - improves riparian habitat in order to benefit fish; increases shade to reduce water temperatures, and restore native riparian vegetation.
- **Watershed Education Program** - integrates watershed and fisheries awareness into the curricula of the two Salmon River schools.
- **Road Stewardship Program** - works to reduce or eliminate the problems caused by public and private roads in the Salmon River watershed, emphasizing neighborhood stewardship activities.
- **River Clean-Up Program** - helps maintain a clean and litter-free watershed.



How Groundwater is used in the Shasta Valley?

Most wells in the Shasta Valley are used for domestic use, with about 82 percent of all groundwater wells being domestic. Irrigation wells account for approximately 9 percent of groundwater wells.

Although the percentage of wells that are used for irrigation is small, the amount of groundwater pulled from these wells is more than any of the domestic wells in the area. A survey done by the California Department of Water Resources shows 8,400 acres are irrigated only with groundwater. Additional acreage is partially irrigated with groundwater.

What is being done to understand groundwater in the Shasta Valley?

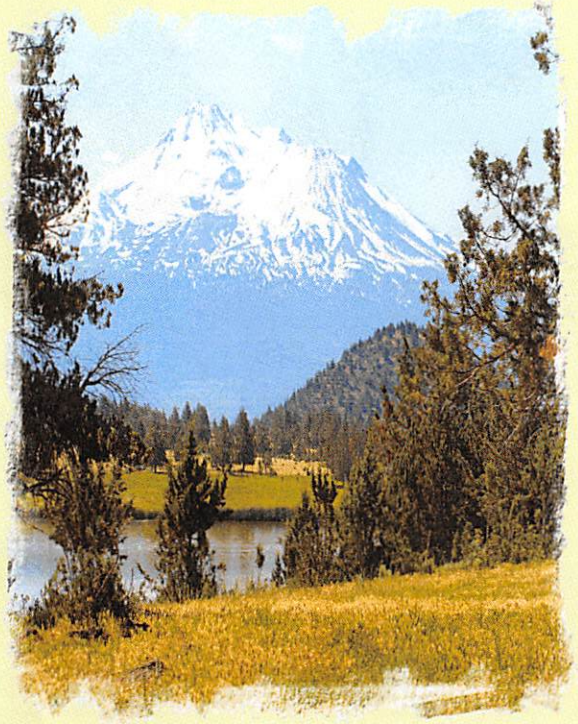
Over the last several years, California has made grant funds available for local entities to begin to develop an understanding of local groundwater availability, by evaluating existing and future groundwater demand. The Shasta Valley RCD has taken advantage of that opportunity to develop an unprecedented level of understanding of groundwater in the unique and highly complex underground conditions of the Shasta Valley.

Interested in learning more about groundwater in your area?
Contact us:

RCD
SHASTA VALLEY
RESOURCE CONSERVATION DISTRICT

215 Executive Court, Suite A
Yreka, CA 96097
(530)842-6121, Ext 106

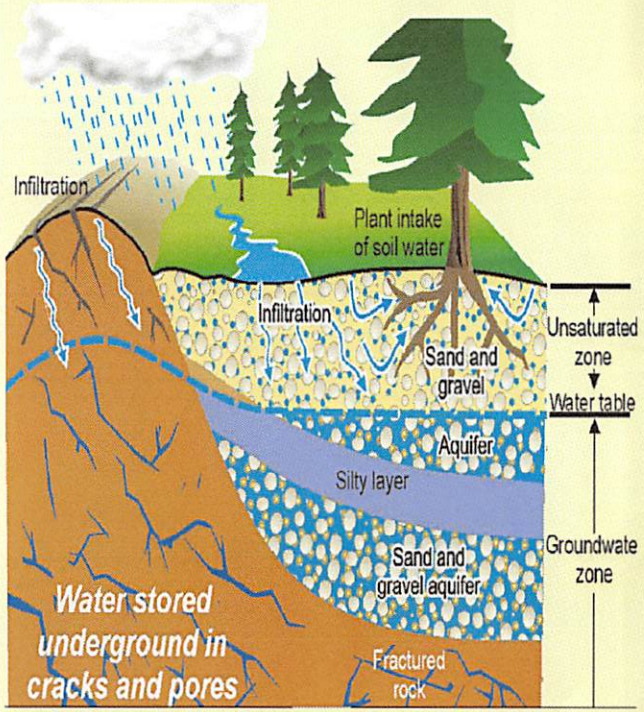
Groundwater in the Shasta Valley



A Guide to Understanding Groundwater in the Shasta Valley

What is Groundwater?

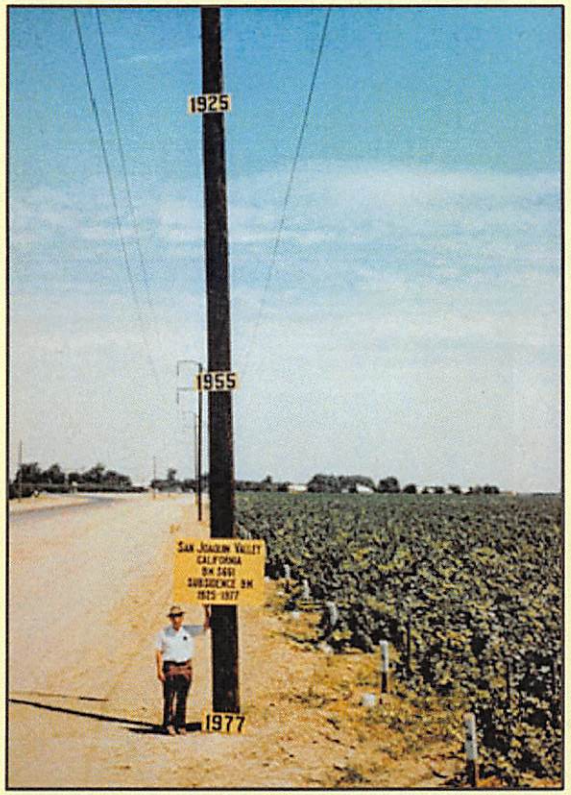
Groundwater is water that soaks into the soil from rain or other precipitation and moves to fill cracks and other openings in beds of rocks and sand. This is known as the Hydrologic Cycle. The water is then stored in underground streams and aquifers; this is where well water is withdrawn for domestic and agricultural use.



The picture above is of part of the Hydrologic Cycle and shows how groundwater is created and recharged by sinking through the earth's surface.

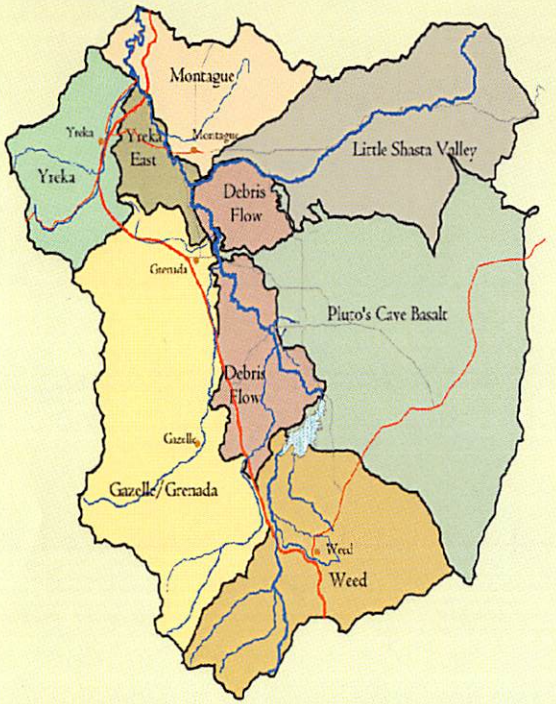
The Dangers of Overdrafting

Overdrafting groundwater is the process of extracting groundwater beyond what can be naturally replaced (groundwater re-charge). Major problems arise from this depletion of water. For example, the more water that is used, the lower the water level drops and the deeper a well has to be drilled. This can lead to subsidence (sinking) of the earth's surface.



The picture above is of the San Joaquin Valley in California and how subsidence has changed the earth's surface in that area over the last 52 years. Result – since 1925 the surface has dropped 50 feet!

The Shasta Valley



The map above is of the Shasta Valley Watershed showing the 9 different groundwater sub-basins. Of the nine sub-basins, fresh useable groundwater is available in quantity only from the Pluto's Cave Basalt and the Gazelle/Grenada sub-basins.

IN THE COMMUNITY

RIDIN' POINT

Scott River TMDL Conditional Waiver

Scott River TMDL Conditional Waiver: Under the California Porter Cologne Water Quality Act and the federal Clean Water Act, the beneficial uses for rivers are protected from pollution. First, the beneficial uses are determined. (These can include agriculture, fisheries, recreation, hydropower, etc.) Then the water quality needed for those beneficial uses is established and described numerically or narratively.

When the actual water quality present does not meet the requirements of the beneficial use, then the Regional Water Quality Control Board or the federal Environmental Protection Agency (EPA) determines whether the source of the pollution is a "point source" (such as coming from the end of a pipe) or a "non-point source" (general and cumulative such as sheet runoff.) They also may determine if it is manmade, an historic legacy or coming from a natural source. Eventually, the agency establishes Total Maximum Daily Loads (TMDLs) – or discharge limits on human sources of pollution in an effort to achieve the target water quality for all beneficial uses.

One of the beneficial uses of the Scott River is cold water fisheries. Salmon egg hatching requires clean gravels of a certain size and the eggs are smothered by too much fine sediment. The agencies have listed the Scott River as polluted by sediment. Species like coho salmon oversummer – rearing in the system. Temperatures above a certain point are lethal to these fish. The Scott is listed as polluted by temperature.

The report on sediment sources in the Scott River identified: irrigated crop production, mining tailings, pasture grazing (riparian and upland), forestry, mining, non-point and natural sources. Sources of temperature were identified as: agricultural return flows, drainage and filling of wetlands, flow modification, habitat modification, irrigated crop production, pasture grazing (riparian and upland), removal of riparian vegetation, forestry, streambank modification/destabilization, water diversions and non-point source.

The Scott River TMDL Action Plan listed many actions that the agencies felt needed to be taken to meet the needs of fish. This included fixing sediment sources on roads, avoiding and minimizing sediment sources in farming practices, planting trees to provide shade, preventing livestock from breaking down riparian soils and eating vegetation, as well as determining how groundwater use is affecting water temperature.

www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/scott_river/060307/bpl/Basin_Plan_Language.pdf

The California Porter Cologne Water Quality Act requires either an absolute prohibition on pollution discharge or a permit. "Conditional Waivers of Waste Discharge Requirements" or permits can be allowed for a period of five years, at which time they are renewed or replaced. The "waiver" covers actions listed as sources of pollution as long as the landowner complies with the conditions. (The exceptions are timber, construction, storm water discharge, dredge and fill and rip rap, which need permits.)



Marcia Armstrong

Many farmers and ranchers voluntarily participated in habitat enhancement and restoration projects. Siskiyou Resource Conservation District (RCD) programs were initiated to reduce sediment, cool stream temperature and plant riparian vegetation.

The county and timber land owners inventoried and were addressing sediment sources. The community moved forward on studying groundwater hydrology under a grant for U.C. expert Dr. Thomas Harter. In recognition of this, the North Coast Regional Water Quality Control Board (NCRWQCB) adopted a "conditional waiver" for discharges related to certain land management activities or uses and did not charge a fee. (In other areas, there is a fee levied on agricultural acreage for the waiver.) The current waiver lapses on Oct. 31.

NCRWQCB has found it difficult to determine whether and which landowners are complying with the land management conditions of the waiver. At a recent public meeting, water quality staff indicated that certain groups have questioned the legitimacy of the process and whether they were adequately discharging their responsibility to protect water quality.

The new approach will be for staff to contact land owners. They will concentrate on those who pose the greatest risk – those with activities in proximity to streams, the longer the stream segment the greater the risk. They will request that Regional Water Board staff have reasonable access to the property. They will work collaboratively with the landowner on stewardship. They may request a small issue be immediately addressed or they may request ranch/farm water quality plans and monitoring, (such as photo documentation.) Depending on site specific conditions, the plans requested could be simple or complex. (Refusal when contacted will remove the landowner from coverage under the waiver.)

A guidance list has been provided of the types of management measures necessary to minimize, control and prevent discharge of sediment and elevated solar radiation loads. This includes management of riparian areas, grazing in riparian corridors, stockpiling of waste and manures, road maintenance and tailwater interception.

www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/scott_river/

The NCRWQCB will likely meet on Thursday, Oct. 4 in Yreka to consider adoption of the new waiver.

KLAMATH VIEWS

Back to school time

It is back to school time. Today the teachers of the four river schools are invited to the Happy Camp Elementary School by Casey Chambers for a love and logic workshop. What the fire. He came and enjoyed the firefighter's breakfast. What those bears won't do for a good breakfast of bacon and eggs. They didn't re-

Karuk Tribal Reunion and it is always a great gathering at the River Park in Happy Camp. Well, except for the first years, when it was held

RECORD BREAKER

Apple sets record for company value at $623B

PETER SVENSSON
AP Technology Writer

the last twelve months. The company's "price-to-earnings ratio" is 15.6,

Merry Christmas from the Daily News staff!

WE WILL BE CLOSED MONDAY, DEC. 26



Scott Valley Decorating Contest winners B1

SISKIYOU DAILY NEWS

FRIDAY, DECEMBER 23, 2011 | Siskiyou County's news source since 1859 | Vol. 151, No. 161 70¢ plus tax

5 THINGS TO DO THIS WEEKEND

1 FRIDAY
Hope Christian Fellowship (community Lutheran) Christmas candlelight service: starts at 4 p.m. at St. Mark's Square, Fourth and Lane streets, Yreka.

2 SATURDAY
Yreka community Christmas Eve dinner: from 3-5 p.m. at the Greenhorn Grange Hall, 300 Ranch Lane, Yreka.

3 SATURDAY
Yreka Church of the Nazarene Christmas Eve service: starts at 5 p.m. at 415 Evergreen Lane. There will be special music, readings, drama and carols by candlelight. www.ynaz.com

4 SATURDAY
Mt. Zion Lutheran Church Christmas Eve candlelight worship service: starts at 6 p.m. at the corner of Sherman and Knapp streets, Yreka. 842-3915

5 SUNDAY
Free movie night at Decision Life Church: movie starts at 6 p.m. at 1301 S. Main St., Yreka. The movie will be "Christmas with a Capital C" (putting Christ back in Christmas).

COHO SALMON RETURN



This coho salmon carcass was found during a survey in French Creek on Dec. 11. The round lesions are bite marks from lampreys that latch onto the fish during its upstream migration, a natural and common occurrence. PHOTO/SISKIYOU RCD

On the rise

Scott River coho return 'substantially higher' than expected

By John Bowman
Daily News Staff Writer

"The Scott Valley community should be proud of the unexpectedly higher coho return because measures taken by its residents have helped the stream habitat in the Scott River and tributaries to become much better than it was 10-15 years ago."
– Siskiyou RCD Contractor Gary Black

SCOTT VALLEY – Preliminary data from the California Department of Fish and Game's (DFG) Scott River fish counting weir indicate that this year's return of adult coho salmon to the Scott River is substantially higher than expected.

As of Dec. 13, 344 coho had passed through the weir on their way upstream to their spawning grounds in Scott Valley. The weir is located 18 miles from the Scott River's confluence with the Klamath River and some portion of the run may spawn in areas downstream of that location.

A joint press release issued by the Siskiyou Resource Conservation District (RCD) and the Scott River Water Trust (SRWT) said,

Coho, A7

PARK CLOSURES

Saving Castle Crags

Keeping park open is expensive and time is short

STATE WATER RESOURCES CONTROL BOARD
2011 JAN 31 PM 1:39
DIVISION OF WATER RIGHTS
ACTION TAKEN

By Richard DuPertuis
GateHouse News Service

DUNSMUIR – The state of California plans to permanently close the gates at Castle Crags State Park July 1 if no one comes forward with an operating proposal.

"The county is definitely not interested," Cascade Sector Superintendent for California State Parks Heidi Horvitz said in her Shasta County office Tuesday of last week, a few miles west of Redding.

Horvitz said that an applicant would have to show the ability to finance three years of operations before the state would consider a proposal.

"It would have to be lucrative," she said.

Her numbers described a need for $180,000 per year, minus revenues that Castle

Crags, A2

YOUR QUESTION ANSWERED By John Bowman | Staff Writ

California. It bills itself as the state's largest law enforcement organization.

The group successfully lobbied for the exemption that was added to state law in 2001, which allowed individual officers to buy semi-automatic assault weapons.

Cottingham said the intent was to let officers buy weapons their departments could not afford as a way of keeping up with criminals' increasing firepower. The intention was that officers have the weapons available for law enforcement emergencies around the clock, whether they were on- or off- duty, he said.

Cottingham said retired officers still could use their assault weapons to battle criminals or terrorists in an emergency.

"They're obviously not for official use once you're retired," he said. "You have it for target practice, you have it for safety. I would agree the arguments are probably not as strong to have the retired officer have this weapon."

Some agencies now provide all the weapons their officers need on the job while still letting officers buy assault weapons for their own use as permitted by state law, the AP reported Wednesday.

The legal exemption for peace officers came under scrutiny after federal authorities served search warrants in November on officers with several Sacramento-area law enforcement agencies. That ongoing investigation focuses on officers selling weapons that are not available to the general public, but it is not known whether assault weapons are involved. No charges have been filed.

whether formula from that batch

fection can be treated with antibi-

tested positive since 2002.

COHO

Continued from A1

"This season's surprisingly higher return of coho salmon to the Scott River is generating lots of local excitement."

The release said that this year's return "represents a significant increase over the 62 fish counted when this brood year last returned three years ago in 2008."

Gary Black, contractor and former senior project manager with the RCD, said in the release that he believes the higher fish returns are due in part to restoration efforts by Scott Valley landowners.

"The Scott Valley community should be proud of the unexpectedly higher coho return because measures taken by its residents have helped the stream habitat in the Scott River and tributaries to become much better than it was 10-15 years ago," Black said.

This year's run has peaked and is now dwindling, but the Siskiyou RCD and DFG will continue to conduct several more field surveys to document the remainder of the run to its conclusion.

The surveys performed upstream of the weir – in the valley – are primarily intended to gather data on spawning distribution since those fish have already been counted by the video-monitored weir.

Surveys conducted in the canyon reaches of the river – downstream of the weir – will provide limited fish counts of coho that have not passed through the weir, in addition to providing spawning distribution data.

Klamath River coho salmon were listed as a threatened species in 1997 under the federal Endangered Species Act (ESA) and in 2005 under the California ESA.

Since then, survival and restoration of the species has been a key issue at the heart of several local environmental projects.

Some environmental activism groups have focused on disconnected surface flows in the Scott River, claiming the condition is a major obstacle to coho survival, while local property and water rights activists have insisted that the dwindling numbers are a natural occurrence.

Several Scott River tributaries are still disconnected from the river, rendering them inaccessible to coho spawners. However, Shackleford, Shackleford-Mill, French and Miner's creeks, as well as the south fork of the Scott River, have been connected this season.

"The rain that occurred Nov. 18 was enough to provide access through the mainstem as far upstream as the confluence of the East Fork/South Fork," Danielle Yokel of the Siskiyou RCD said. "It appears that the extended dry fall and relatively small amount of rain in November presented difficulties in accessing Patterson, Etna and Kidder creeks, which have large alluvial fans that flow sub-surface during the summer months."

These tributaries are among those still disconnected.

"Despite the dry weather, coho distribution seems to be throughout most of the watershed, with coho being able to utilize the prime spawning/rearing habitat available in Shackleford-Mill and French-Miners Creeks," Yokel added.

According to Yokel, coho spawning likely also occurred in the mainstem Scott River, where several carcasses were recovered.

Yokel also believes that juveniles will have the opportunity to re-distribute into suitable summer habitat during the spring run-off period.

DFG Biologist Morgan Knechtle told the Daily News he thinks it's safe to say that improved Klamath River conditions in the spring of 2010, when this year's juveniles were out-migrating, did contribute to a higher survival rate for this brood year.

Knechtle added that more favorable ocean conditions were probably a contributing factor, as well.

Though DFG staff members have not finished reviewing videos from the Shasta River counting weir, Knechtle said that so far, it does not appear that the increase in coho will be as substantial on that river this year.

– John Bowman can be reached at jbowman@siskiyoudaily.com

Klamath conditions have improved

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OB'S AUTOMOTIVE

sometimes

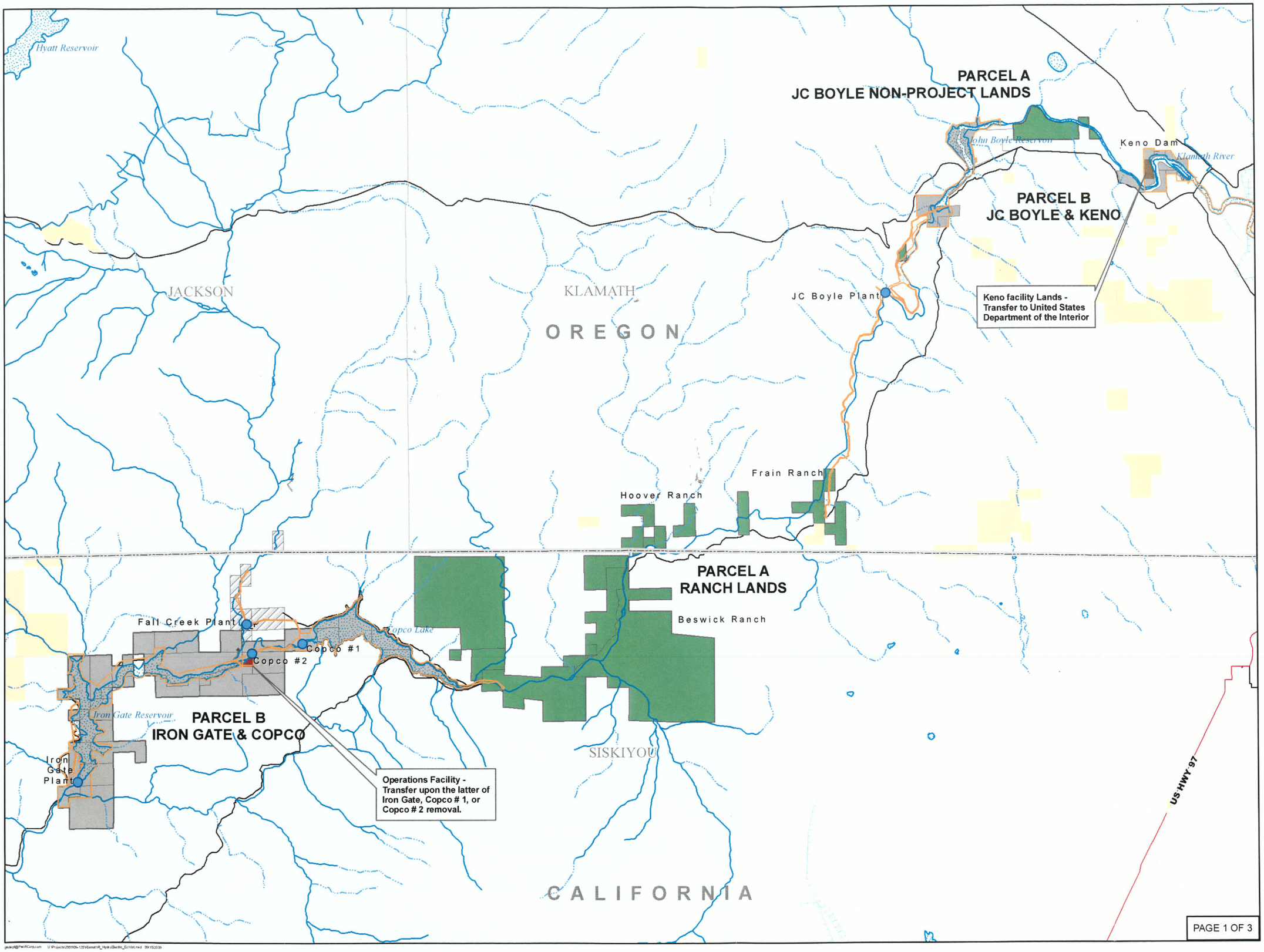
opportunity knocks at your door

• advertise your business, product or service in over 480 GateHouse newspapers.

• reach over 4 million readers every week.

PacifiCorp
Klamath River
Hydroelectric Project
Lands Disposition

Project Overview



Klamath River Hydroelectric Project

Project Parcels
- Parcel A Lands
- Parcel B Lands
- Excluded - Fall Creek Plant
- Operations Facility
- Keno facility Lands

State Lands

Administrative Boundaries
- State
- County
- FERC Boundary

Generation Facilities

Generation Type
- Hydro

Major Roads
- PRIMARY, INTERSTATE HWY
- PRIMARY, U.S. & STATE HWY
- SECONDARY, CONNECTING, STATE &COUNTY HWY

Aquatic Features
- INTERMITTENT CANAL, DITCH, AQUADUCT
- INTERMITTENT WATER FEATURE, STREAM, RIVER, WASH
- PERENNIAL CANAL, DITCH, AQUADUCT
- PERENNIAL WATER FEATURE, STREAM, RIVER, WASH
- Regional Lakes

N

0 1 2 Miles

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PacifiCorp GIS collects data from a variety of government and private sources. PacifiCorp makes no warranty as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. For complete validation, the source organization should be contacted or source documents consulted to verify the findings of this product.

From: Lisa Beranek <lisa.a.beranek@gmail.com>
Sent: Monday, January 30, 2017 11:57 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

Other key points I urge you to consider:

1. The 2012 joint California and federal EIR/EIS and related documents concluded that dam removal on the Klamath is in the best interest of the public. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies, which can be relied upon for your EIR.

2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Lisa Beranek
PO Box 2564
White Salmon, WA 98672
lisa.a.beranek@gmail.com

Thaler, Parker@Waterboards

From: Pilotrock@copper.net
Sent: Saturday, January 28, 2017 1:50 PM
To: Wr401program
Subject: Dam Removal on the Klamath

Parker Thaler,
State Water Resources Control Board
Division of Water Rights-Water Quality Certification Program

Dear Parker Thaler:

Writing your office regarding the proposed removal of the four dams on the Klamath River. Clearly, the science is behind dam removal and I have read some of the evidence that supports it. As a resident of Hornbrook, California, I have witnessed firsthand the toxic algae in both Copco and Irongate "lakes" that is harming the life of the River. Silt just below the dams has been the breeding site for parasites that kill salmon. Warm water also fosters rapid parasite growth. This has been monitored and documented by legitimate sources. As to claims issued by some speakers at the recent Scoping Meeting held in Yreka that "dirty water comes from Oregon": I say, if this is true, create a two State entity that is in charge of water quality on the Klamath. If California and Nevada can create a legal body to enforce clean water in Lake Tahoe, surely Oregon and California can do the same. I strongly urge you to proceed ahead with Dam Removal on the Klamath. Thank You for your consideration.

Sincerely,
John K. Bermel
Hornbrook, California

From: mark bevans <markbevans@comcast.net>
Sent: Thursday, January 26, 2017 8:35 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

MBevans
PO BOX 366
GEORGETOWN, CA 95634
markbevans@comcast.net

From: Brian Bic <Thebigbic@gmail.com>
Sent: Friday, January 27, 2017 12:37 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Brian B.
7932 SW 10th Ave
Portland, OR 97219
Thebigbic@gmail.com

From: Michael Bland <calciobland@gmail.com>
Sent: Thursday, January 26, 2017 5:02 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Michael Bland
1243 14th Ave Apt A
San Francisco, CA 94122
calciobland@gmail.com

ERC/PT
P9 1

Comments to the State Water Resource Control Board regarding Notice of Preparation and Scoping Meetings for an Environmental Impact Report for the Lower Klamath River Project License Surrender for Klamath River Dam Removal.

2017 JAN 30 AM 10:40

January 24, 2017

Dear State Water Resources Control Board c/o Mr. Parker Thaler,

We were NOT notified of the scoping meetings in a transparent way. We own property near Copco Lake area so we are obviously stakeholders! We had been included by the Department of the Interior and the Bureau of Reclamation, when they were doing scoping meetings for their studies. We were notified by the Klamath River Renewal Corporation, KRRC, of their application to FERC. Unless we went to extraordinary measures to stay informed, no one received notice of the public scoping meetings. While on the surface, it appears you sent out the required notifications, you did not adhere to the spirit of the law as it was intended to notify and engage the public, and we find it ironic that the parties that support dam removal were notified much earlier than even the Siskiyou Board of Supervisors. This is not the first time that lack of transparency in this process has occurred.

The Siskiyou Board of Supervisors represent and speak for the 80% of voters in the county that voted to register their comments when they voted to keep the dams. Since Siskiyou County is home to 2/3 of the river system, you should give the Siskiyou Board of Supervisor's comments **extraordinary** consideration in your determination. You need to also consider **economic** and **environmental** consequences of dam removal. I am hopeful you will consider ALL our comments.

To begin, the Klamath River Renewal Corporation has filed an **incomplete** initial application. This is alarming, as they have had years to formulate a plan to consider such an application, since the KRRC is essentially the original signatories to the KHSA and KBRA. Given the simple fact that the US Congress was not willing to follow through and underwrite the liability of dam removal, how can a non-profit, that cannot even fill out a **complete** application, take over the Klamath Dams? This should be a major red flag that they will not be able to assume such an undertaking with any kind of organization or complexity of such a massive project! This is one reason, of many, that we believe that you should not grant certification.

Water Quality

- The 2012 California and Federal EIR/EIS reached incorrect conclusions. They did not do exhaustive engineering and environmental studies and therefore should NOT even be considered or used in the new EIR.
- The Bureau of Reclamation and Department of Interior studies were pushed by the signatories of the KHSA and KBRA chose the area of the river to study that would cost the least to remove the dams and have the highest environmental effect for dam removal to fit dam removal agenda. This opinion is fortified by Dr. Paul Houser, the hydro meteorologist, hired to oversee the scientific integrity of the BOR's study.
- Only FIVE miles of the ENTIRE Klamath River, as quoted in the Biological Assessment in the original studies, were performed. The five miles studied were below the Iron Gate Dam and nothing was studied above the dam all the way into Oregon.
- The most polluted water in the Klamath River is between Keno and Copco 1 Dam, and yet this area was not studied. Reports show the water leaving Copco Dam is cleaner than it was when it entered the river.
- If the entire river system had been studied correctly, the effects of dam removal with sediment release might/could (both terms used in the DOI report) kill all aquatic live in the river for at least 2 years. The report then states that aquatic life will magically reappear by year 5, and the fish would be thriving with renewed water quality. How is that possible?
- A **new and complete** analysis of the **entire** river must be performed, including the water management of the Trinity River that is diverted into the State Water Project and the central canal as these flow impacts on the fish are unknown. The complete environmental consequences have not been adequately evaluated.
- Unless a new, transparent, and complete study of the entire river system is performed, the SWRCB cannot make a credible determination concerning water quality.

- What agency is going to monitor the water quality coming into California from Klamath Lake? California is bearing the burden of compromised water due to geologic factors contributing to the volcanic, phosphorous nature of the river system and by pesticides and fertilizers.
- The warm, shallow waters in the Klamath in Oregon contribute to poor water quality.
- The most polluted water in the Klamath River is between Keno and Copco Dam and yet after the water leaves the dams, it is cleaner than what flowed into the river from Oregon.

Economic Impacts

- The economic impacts of the dam removal agreements are already being witnessed in Siskiyou County.
- Home values on Copco Lake have already plummeted due to dam removal agreements. Dam removal would precipitate a further loss.
- Homeowners are not able to sell their homes without disclosing possible dam removal and, as such, are forced to reduce their prices even more, IF they can even sell their homes.
- The loss of property values is reflected in the declining property taxes, and therefore a loss to Siskiyou County Revenue.
- When the BOR did their study they only looked at bare land values. They did not go through the process of the Record of Decision. Improvements were not considered. The KRRC does not have the funding or a plan for river or reservoir aesthetic restoration. It would take many, many years, if not a lifetime, to return the Klamath River behind the reservoirs to their native beauty.
- There are no plans for restoration after dam removal further lowering our property values.
- Even if there were to be a restoration period, the study looked at that as a period of only five years!! I'd like to see the science proving this study's assumption.
- There is a lack of transparency with the economic studies.
- It's my understanding that Siskiyou County has demanded an economic analysis so that they may inspect the details of this study, but their demands have not been met.
- Property value loss translates into lost tax dollars for school funding.
- If the dams are removed, the possibility exists that we could lose our water well, making our home uninhabitable, and therefore worthless. I'm certain the KRRC will not take on the expense of drilling a deeper well so that we can remain in our home.
- Will the KRRC compensate us for lost property value? Or will the KRRC reimburse Siskiyou County for millions of dollars of lost tax revenue as property values become worthless? I doubt that the KRRC will assume any liability and therefore in preparing your report you must take into consideration the economic effects of dam removal.
- The projected $450 million that dam removal is projected to cost, although other studies have shown this figure closer to $1 billion, are funds that can be spent on crumbling infrastructure, education, and other projects rather than a project that has not been adequately studied.

Fish and Animal habitat

- In 2001 The Karuk Council did not believe that Coho Salmon were indigenous to the Klamath River, but saw the value in misrepresenting the facts. The Coho are not native to the river, but the Karuk tribe now claims this to be true.
- Historically the salmon never came up above where Copco Lake is now due to warm waters from area hot springs per Native Shasta elders that lived in the area as well as early settlers, but these facts were never entered into the record when the BOR and DOI did their studies, as this area of the river was NOT studied.
- Under the ESA, a species cannot be decimated by a project, so how is dam removal a viable project to be considered by the Water Board if complete analysis is not performed?
- We have read that there is 20-30 million cubic yards of sediment behind the dams. There is great concern that this impact has not been adequately addressed. I assure you that if the fisheries are to be decimated for even a short period, the tribes will litigate for their losses of their fisheries.
- Unless the entire river is studied, all the impacts to fish and birds can't be know as to the impact.
- There are Perch behind the dams and if they are released into the lower river, that consequence must be considered since they are predatory to Salmon eggs. I believe this is another ESA impact that has not been considered.
- The last few years, water behind the Copco 1 Dam, as well as the others, has been released to improve water quality downstream to save the fish from parasites. Craig Tucker, of the Karuk tribe, admitted that without these water releases there would have been a major fish die off. No one at Copco Lake complained about their docks being temporarily unusable due to low lake

levels, the inability to launch boats from the boat ramps because of low lake levels, and because boat could not be used there was a temporary loss of recreation at the lake.

- Governor Brown has said we need more water storage, not less. He cannot have it both ways. If this water storage was not there, at this crucial time, the fish would have died, and this winter with heavy rainfall, snow, and runoff there would have been floods.
- Aside from the original studies of only an extremely limited section of the Klamath River being evaluated, not all the creeks and rivers from below Iron Gate Dam to the mouth of the Klamath River, that make up the entire river system, and the actions of all parties that impact the fisheries, were and need to be taken into consideration. Gill netting still takes place across the mouth of the Klamath and this has not been studied as to the effect on Salmon population as well as ocean waters warming.
- Released sediments could alter the habitats of essential fish habitats and adequate studies have not been performed.
- It is ironic that even with these dams in place there have been record salmon runs and yet the tribes are still litigating. They sell their surplus fish to anyone who will buy them.
- Dam removal resulting in lake removal will impact migratory birds and the birds and animals that live in and around the lakes. Bald eagles, white pelicans, blue herons, and others have made this area their home and are thriving. Canadian geese and other migratory birds use the lake as a resting and breeding place and so the impacts to these species all need to be studied and have not been done so.

Public Health, Safety, and Flood Control

- The risk of floods downstream is great. Part of the reason for the dam construction initially was flood control. The sediments behind the dams could exacerbate the flood risk.
- Dam removal could also change the existing flood plains and you cannot ignore the need to realign the pipeline for the City of Yreka's water supply.
- The water behind the dams have aided in wildfire protection. Without the readily available water in the recent wildfires, many homes would have been lost.
- Despite warnings about coming in contact with the water due to toxins, not a single person around Copco Lake that has recreated in the lake have ever had any skin or health related issues due to water contact despite years of contact with the lake waters.
- Dam removal could result in problems with mosquito habitat and related diseases such as the Zika virus.
- There will be a considerable amount of debris because of dam removal possibly posing risks downstream of the destruction of the dams.

Historical and Archeological Effects

- The Shasta Native American Tribe, which precedes other Klamath tribes are not a signatory to the KHSA and have not been represented. Dam removal will expose sensitive Shasta burial grounds and possibly tribal artifacts.
- As the tribes, downstream from the dams are demanding that their tribal and cultural customs be respected, so shall the Shasta Nation be respected. If you engage with tribal entities without taking into consideration all entities and be certain that the interests of all tribes are taken into equal consideration you will be acting prejudicially.

Aesthetics

- Dam removal would have a long-term effect of the aesthetics of the river and the reservoirs behind the dams, as well as sediment transport would change the appearance and erosion issues for the Klamath River.
- Our home currently looks out onto a beautiful lake. When lake levels have been lowered for dam maintenance or when water releases have occurred to improve water quality for the fish, the mud, trash debris, and sediment exposed is not aesthetically appealing.

Recreation

- If dam removal takes place there will be a great recreational loss to the public. Currently the lakes provide such activities as boating, fishing, water skiing, wake boarding, kayaking, standup paddling, canoeing, and swimming. There is also camping along the lakes that would be eliminated with dam removal.
- White water rafting activies would be altered with dam removal.

Greenhouse gas emissions

- Removal of effective hydroelectric power providing power to over 75,000 homes will most likely result in increased greenhouse gas emissions from replacement sources at a time when California will not meet the 33% legal mandate of electric power sales from renewable sources by 2020 even with the dams in place.

Alternative Solutions for Analysis

- Once there has been a thorough and complete analysis, a determination has found that salmon were native to the area above Copco 1 Dam and that the fish would survive and thrive in this area of the river, then there can be alternative solutions for analysis.
- Siskiyou County has offered solutions to address Klamath River Water Quality, such as fish ladders, and Trap and Haul where fish ladders might not be a practical application.
- Another solution might be using Bogus Creek as a bypass around the dams for fish passage.
- "Fish cannons" are also used in certain cases for transporting fish.
- Siskiyou County and landowners have taken many measures to improve water quality, improve fish habitats and water conservation.

In conclusion, you must take into consideration all the above reasons to complete the process for permit application **without the assumption of a predetermined** outcome. To do anything less, than a complete and independent analysis, would violate the Code of Regulations. We ask that you **deny** the certification request for Section 401(a)(1) of the Federal Clean Water Act for the KRRC to move forward with dam removal.

Respectfully submitted,

Paul Boos

Margaret Boos

Paul and Margaret Boos
16038 Ager Beswick
Montague, CA 96064
Pboos1@hotmail.com

From: William Boosman <piscobill@gmail.com>
Sent: Tuesday, January 31, 2017 12:27 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

Other key points I urge you to consider:

1. The 2012 joint California and federal EIR/EIS and related documents concluded that dam removal on the Klamath is in the best interest of the public. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies, which can be relied upon for your EIR.

2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

William Boosman
135 Forest Ave
Pacific Grove, CA 93950
piscobill@gmail.com

From: James Bowen, Jr <jim.viv@charter.net>
Sent: Thursday, January 26, 2017 6:28 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

James Bowen
30112 Hall Rd
Escalon, CA 95320
jim.viv@charter.net

From: Steve Boyle <mr212@comcast.net>
Sent: Saturday, January 28, 2017 11:16 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Steve Boyle
2106 E South Bear Creek Dr
Merced, CA 95340
mr212@comcast.net

From: craig bradshaw <user@votervoice.net>
Sent: Friday, January 27, 2017 1:51 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

craig bradshaw
11 Crosby Ct
Martinez, CA 94553
boxersdaddy@yahoo.com

From: John Bretl <jbmissionfloors@comcast.net>
Sent: Sunday, January 29, 2017 7:22 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

John Bretl
223 San Juan Ave
Santa Cruz, CA 95062
jbmissionfloors@comcast.net

Thaler, Parker@Waterboards

From: Glen Briggs <gleno@sisqtel.net>
Sent: Monday, January 23, 2017 3:23 PM
To: Thaler, Parker@Waterboards
Subject: Meeting concerning "Notice of Preparation and Scoping-----Lower Klamath Project---=Yreka, Ca. meeting

Dear Mr. Thaler;

My name is Glen Briggs. I am a resident of Siskiyou County and live along the Mid-Klamath a short distance upstream from Happy Camp. My family has been residing at or very near my present location since the mid 1860's and, as a result I am very concerned about the outcome of the attempt to remove the Klamath Dams. I plan to attend the meeting scheduled for Yreka this coming Thursday, the 26th.

In reviewing the information I received in the mail concerning this Project, I am unclear as to just what the environmental baseline referred to on page 2 of the notice is. I would appreciate a brief explanation if that should be possible.

Thank you:

Glen Briggs
53005 State Highway 96,
Seiad Valley Ca.
(530) 496-3343

ER/PT

STATE WATER RESOURCES CONTROL BOARD
2017 JAN 30 AM 10: 33
DIVISION OF WATER RIGHTS
SACRAMENTO

January 27,2017

State Water Resources Control Board
Division of Water Rights
Water Quality Certification Program

Attention: Mr. Parker Thaler

P.O. Box 2000
Sacramento, Ca. 95812-2000

Dear Mr Thaler:

This letter is in response to the request for comments contained in your "NOTICE OF PREPARATION AND SCOPING AND MEETINGS FOR AN ENVIRONMENTAL IMPACT REPORT FOR THE LOWER KLAMATH PROJECT LICENSE SURRENDER"

First, as to the long-term changes to the water temperature regime, I feel there is an abundance of available evidence to show that removal of the dams and return to an uncontrolled river through the reach included in the study would be an environmental disaster for the downstream river for at least the next 100 miles, below which, incoming fresh water from clean, cold tributaries moderate the condition.

During late summer through fall to early winter, particularly during dry periods, water reaching the location of this project from above is, and will continue to be, extremely warm and contaminated as a natural condition created by the large shallow lake from which it derives and from whatever inflow happens to make it's way to the Klamath from the bird sanctuaries. This condition is commented on by George Gibbs on page 39 of "GEORGE GIBBS' JOUNAL OF REDICK McKEE'S EXPEDITION THROUGH NORTHWESTERN CALIFORNIA IN 1851" published by the ARCHEOLOGICAL RESEARCH FACILITY , Department of Anthropology, University of California, Berkley, 1972 and available on-line. On September of that year while describing the Trinity River, Mr. Gibbs writes "It is in size about half that of the Klamath, likewise rapid, are of transcendent purity; contrasting with those of the latter stream which never lose the taint of their origin." This must be taken in light of the fact that waters leaving the upper basin has already been diluted by inflow from major tributaries such as Beaver Creek, Indian Creek, Elk Creek, Clear Creek Salmon River and numerous lesser clean water creeks along the way.

A treatise on the condition of Klamath Lake in late summer or fall can be found in journals covering the explorations of John C. Fremont. Also, an article in an early Klamath Falls newspaper mentions the fact that during a very dry year, inflow into Upper Klamath Lake was so small that a strong wind from the south prevented any water from passing over the existing natural dam.

From a personal point of view, I have been involved with the Klamath River since 1931, the year of my birth, my mother, Violet Fehely Anderson was involved with this river from 1909 to 2009 and my grandmother, Catherine Wood Fehely from 1875 to 1970. My great grandfather, John C. Wood came to this area as a young man in 1860 and remained here the rest of his life. During this time, conclusions made and passed along have had a strong influence on my opinions. Stories about the diseased salmon contaminating the banks of the Klamath past their home 10 miles upstream from Happy Camp during the 1900's early teens substantiate accounts of warm, polluted water prior to dam construction. My brother-in-law, Richard Haley (deceased), a former employee of California Fish and Game confirmed through Fish and Game records that this die-off was indeed caused by a gill disease. Another, story evolving from this same period of time concerned how the family gathered on the river bar in late fall to catch and cook the large, red crawdads that came up the river by the hundreds. These runs have completely disappeared following construction of the dams. My guess is that the water stayed too cold for their existence.

Now to the fish. First, the Coho or Silvers as they were called, never naturally occurred in the mid to upper Klamath. Several attempts to introduce them, starting as early as the 1890's proved unsuccessful until after the 1940's when a small run has been maintained in the cooler water furnished by the reservoir. Even so, refuge areas must be provided to insure their survival. My earlier family consisting of several avid fishermen, as relayed by my mother, never knew of the Coho Salmon while fishing the mid-Klamath from the 1870's to the 1940's.

When the dams were constructed, there was good reason that the California Fish and Game did not insist on fish ladders. It is my belief that legend had it that few salmon, if any, ever made it to the upper basin and, that later comprehensive studies proved this, thus removing the need for ladders. This is very easily understood if one looks at the physical restraints. Elevation of Copco reservoir is listed as 2605 feet while the reservoir surface for J. C. Boyle reservoir is listed as 3795 feet. A difference of 1191 feet in 26 river miles. A very steep gradient for fish that have just completed swimming upstream in a swift river for 200 miles. Besides that a river channel that steep would be devoid of any bedding gravels and most likely would consist of rapids and deep holes in the bedrock.

It is my understanding that river releases from the power dams in question have been modifies in response to directives from the National Marine Fisheries Agency to benefit fish runs which, as a result, restricts efficient generation of available power capability. And, also, I am aware of required releases in addition to the regular requirements for specific fish problems such as fish diseases and efforts to sweep certain river sections free from some troublesome biota. All of this sharply impacts the ability of the Power Company to economically operate the dams and power facilities. When these dams are gone and extra water is requested by the fisheries people, where will that water come from? It seems logical that federal

fingers will be pointed upstream to the upper basin and demanding water presently needed to accommodate the irrigation demand.

In view of the above, you really have no moral nor ethical way to go except to determine major and unacceptable environmental impact to the mid-Klamath river region with removal of the power dams included in your study.

Thank You

Glen Briggs
Civil Engineer, Retired
U.S. Bureau of Reclamation
1960 to 1987

2005 State Hwy 96
Seiad Valley, Ca.
96086
(530) 496-3343

Copy To:
Richard Marshall
President
Siskiyou County Water Users Association
P. O. Box 187
Fort Jones, Ca.
96032

From: Gerald Brooks <dland123@pacbell.net>
Sent: Thursday, January 26, 2017 7:00 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Gerald Brooks
835 Covington Rd
Belmont, CA 94002
dland123@pacbell.net

From: Mark Brown <mebrown54@earthlink.net>
Sent: Friday, January 27, 2017 6:25 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Mark Brown
27986 Rural Ln
Laguna Niguel, CA 92677
mebrown54@earthlink.net

From: Brandon Bugge <user@votervoice.net>
Sent: Monday, January 30, 2017 11:01 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

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Sincerely,

Brandon Bugge
2216 Bell Flower Ln
Santa Rosa, CA 95404
buggeman@rocketmail.com

From: Matt Burns <mattburns@oregonoils.com>
Sent: Friday, January 27, 2017 3:53 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

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As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Matt burns
14726 SW 78th Ave
Portland, OR 97224
mattburns@oregonoils.com

From: Adrian Cardenas <user@votervoice.net>
Sent: Thursday, January 26, 2017 5:44 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

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Sincerely,

Adrian Cardenas
531 Baker St
San Francisco, CA 94117
cardenas_adrian@yahoo.com

ER/PT

STATE WATER RESOURCES
CONTROL BOARD
2017 FEB -2 PM 12: 33
DIV OF WATER RIGHTS
SACRAMENTO

Mr. Parker Thaler
State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA 95812-2000

Dear Mr. Thaler,

Thank you for the opportunity to comment to SOMEONE who is actually listening.

I am an individual stakeholder who has not had a chance to comment heretofore.

I was not advised when all the "agreements" and decisions about this abomination were being made. The meetings were done mostly behind closed doors where dam removal was held out as the foregone conclusion that could not be debated about.

Aren't public utilities (ie; Pacific Power) supposed to produce power for their ratepayers/users? Instead, for the last 15 years, I have been charged extra money to fund the removal these dams. No one asked me, they just took my money. And now my hard-earned money is to be given to others to do what I and many of my neighbors don't want; the removal to these dams - its called being disenfranchised.

In closing, I can give many reasons why this FERC-sponsored process should NOT go forward.

1. This process is a VIOLATION of the public trust that empowers utilities to seek to keep affordable renewable power production as a priority.

2. As stated in your letter, 163 MW of electrical power production will be FOOLISHLY DESTROYED without replacement. This is insanity by itself!

3. Loss of flood control capability will result in PUBLIC LOSSES of all kinds; loss of jobs, property values, cheap hydroelectric power, public safety of predictable water flows.

4. KRRC has no legal standing in this matter and is an insider -created entity with HOSTILE(anti-publically-minded) INTENTIONS.

5. Pacific Power customers have been STOLEN FROM for years to fund this

irresponsible destruction of public property and infrastructure.

6. Dam destruction WILL TRAUMATIZE affected wildlife populations not adapted to this kind of radical change.

7. Fish and game CAN manage around these dams to improve and make fish passage possible.
8. Upstream fish transport via truck and fish ladder construction or enhancement has not even been seriously discussed throughout this process.

9. The public has not been properly informed.

10. Positive proactive leadership has not been shown. The right thing has NOT been done.

Again, thank you for the opportunity to be heard.

Sincerely,

WM Case 

5510 Blue Mountain Drive
Klamath Falls, OR 97601

casepb@charter.net

Thaler, Parker@Waterboards

From: Tim Cate <timcate71@gmail.com>
Sent: Monday, January 30, 2017 9:22 AM
To: Wr401program
Subject: Klamath River Dam Removal

Dear State Water Resources Control Board,

I am in favor of removal of the four hydroelectric dams on the Klamath River. These old dams do more harm than good. The Yurok Indian rights to salmon in the river should supersede all other considerations. They were here first and the salmon is integral to their culture.

Dams on the tributaries to the Klamath should be enough flood protection for residents below these dams. Perhaps the uppermost dam could be breached rather than removed if flooding is a legitimate concern.

PacificCorp has agreed to the removal, so do what is right and proceed.

Sincerely, Tim Cate 471 Parkside Dr. Ashland, OR. 97520

From: Anthony Chacon, Sr <achaconsr8@gmail.com>
Sent: Thursday, January 26, 2017 2:12 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

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Sincerely,

Anthony Sr Chacon
3730 Brotherton St
Corona, CA 92879
achaconsr8@gmail.com

From: Paul Chua <user@votervoice.net>
Sent: Thursday, January 26, 2017 7:49 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Paul chua
4070 Morrell St Unit 4
San Diego, CA 92109
paulcasurfer@yahoo.com

Thaler, Parker@Waterboards

From: Rennie <cleland@cot.net>
Sent: Wednesday, February 01, 2017 4:51 PM
To: Wr401program; Thaler, Parker@Waterboards
Subject: Klamath River Dam Removal: OPPOSITION

My name is Rennie Cleland and I am a retired California Department of Fish and Game Warden in Siskiyou County. I attended the LKR License Surrender meeting in Yreka on January 26, 2017. I listened intently to the 48 speakers that you allowed to speak. In my opinion, supported by four generations of family living in Siskiyou County and 30.5 years of state service and 27.5 in wildlife protection, there is absolutely no logic in removing these hydroelectric dams; especially in the name of water quality.

Mitigation measures were considered when those dams went in and the state managed fish hatchery at Iron Gate puts more fish back into the river than would occur naturally from tributaries above. The Indians above Upper Klamath Lake are crazy to think these anadromous fish will return to the the Wood, Williamson, Sprague and other smaller tributaries.

Leave these dams in place and utilize the clean power they generate.

Rennie Cleland
PO Box 805
Dorris, California
cleland@cot.net
530-260-1147

Virus-free. www.avg.com

From: Brian Cochran <briancochran@mac.com>
Sent: Wednesday, January 25, 2017 6:28 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

BC
1533 NW Spruce Ave
Redmond, OR 97756
briancochran@mac.com

From: robert cockcroft, jr. <rhcbob@g-mail.com>
Sent: Saturday, January 28, 2017 7:18 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

RH Cockcroft
40590 Sierra Way
Fall River Mills, CA 96028
rhcbob@g-mail.com

Thaler, Parker@Waterboards

From: Jim Cody <cody100@gmail.com>
Sent: Friday, January 27, 2017 9:33 PM
To: Thaler, Parker@Waterboards
Subject: please do not destroy the dam

how many years have plant life and animal life and human life spent adapting to the present lake and river condition? removing the klamath dam destroys all those years of toil, wiping away the homes and environment of all of those living things.

to make such a destructive move should require an overwhelming need that does not seem to exist. please help us in siskiyou county to preserve what we have worked hard to create. respect us and our animals and our plants. thank you.

jim cody (35 year owner resident)
15504 valley view dr
weed, ca 96094
530-938-3225

From: Alex Corum <racorum@hotmail.com>
Sent: Sunday, January 29, 2017 10:37 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Alex Corum
PO Box 749
Happy Camp, CA 96039
racorum@hotmail.com

Thaler, Parker@Waterboards

From: Earle Cummings <earlecummings@gmail.com>
Sent: Tuesday, January 31, 2017 5:35 AM
To: Wr401program
Subject: Klamath Dam Removal

A recent press report from Yreka indicated there was significant local support for keeping the dams in place. As a member of a waterfowl hunting club with property adjoining the Lower Klamath National Wildlife Refuge in California, I support Dam removal. Our hunting property is in the bed of what was once the Lower Klamath Lake, and was farmed for barley after the Bureau of Reclamation drained that navigable body of water. We have restored the barley fields to seasonal wetlands, and believe that by doing so, we are sequestering nutrients and carbon. Those consequences help reduce the nutrients that leave the croplands in irrigation tailwater and cause toxic algae growth that poisons fish and wildlife downstream.
The reservoirs on the Lower Klamath are part of a complex ecosystem that was barely considered and poorly understood when the permits for the reservoir and irrigation system were approved. Our hunting club has tried to be thoughtful in restoring the health to a small portion of that system. We hope your decision will not prevent our access to the irrigation tailwater that we use in a way that is sustainable for beneficial use by aquatic life downstream as well as avian species like bald eagles that rely on terrestrial and aquatic life supported by the river and marshes that were so altered when the complex was originally permitted.
I am a retired wildlife biologist and environmental specialist with past employment at then-DFG, SWRCB, and DWR.

Earle Cummings
Certified Wildlife Biologist by TWS
PO Box 1080
Geyserville CA 95441

Thaler, Parker@Waterboards

From: marycunningham@charter.net
Sent: Wednesday, January 25, 2017 5:19 AM
To: Thaler, Parker@Waterboards
Subject: Klamath Dam Comments

January 23, 2017

Dear State Water Resources Control Board c/o Mr. Parker Thaler,

We were NOT notified of the scoping meetings in a transparent way. We own property on Copco Lake, so we are obviously stakeholders! We had been included by the Department of the Interior and the Bureau of Reclamation, when they were doing scoping meetings for their studies. We were notified by the Klamath River Renewal Corporation, KRRC, of their application to FERC. Unless we went to extraordinary measures to stay informed, no one received notice of the public scoping meetings. While on the surface, it appears you sent out the required notifications, you did not adhere to the spirit of the law as it was intended to notify and engage the public, and we find it ironic that the parties that support dam removal were notified much earlier than even the Siskiyou Board of Supervisors. This is not the first time that lack of transparency in this process has occurred.

The Siskiyou Board of Supervisors represent and speak for the 80% of voters in the county that voted to register their comments when they voted to keep the dams. Since Siskiyou County is home to 2/3 of the river system, you should give the Siskiyou Board of Supervisor's comments **extraordinary** consideration in your determination. You need to also consider **economic** and **environmental** consequences of dam removal. I am hopeful you will consider ALL our comments.

To begin, the Klamath River Renewal Corporation has filed an **incomplete** initial application. This is alarming, as they have had years to formulate a plan to consider such an application, since the KRRC is essentially the original signatories to the KHSA and KBRA. Given the simple fact that the US Congress was not willing to follow through and underwrite the liability of dam removal, how can a non-profit, that cannot even fill out a **complete** application, take over the Klamath Dams? This should be a major red flag that they will not be able to assume such an undertaking with any kind of organization or complexity of such a massive project! This is one reason, of many, that we believe that you should not grant certification.

Water Quality

- The 2012 California and Federal EIR/EIS reached incorrect conclusions. They did not do exhaustive engineering and environmental studies and therefore should NOT even be considered or used in the new EIR.

- The Bureau of Reclamation and Department of Interior studies were pushed by the signatories of the KHSA and KBRA chose the area of the river to study that would cost the least to remove the dams and have the highest environmental effect for dam removal to fit dam removal agenda. This opinion is fortified by Dr. Paul Houser, the hydro meteorologist, hired to oversee the scientific integrity of the BOR's study.

- Only FIVE miles of the ENTIRE Klamath River, as quoted in the Biological Assessment in the original studies, were performed. The five miles studied were below the Iron Gate Dam and nothing was studied above the dam all the way into Oregon.

- The most polluted water in the Klamath River is between Keno and Copco 1 Dam, and yet this area was not studied. Reports show the water leaving Copco Dam is cleaner than it was when it entered the river.

- If the entire river system had been studied correctly, the effects of dam removal with sediment release might/could (both terms used in the DOI report) kill all aquatic live in the river for at least 2 years. The report then states that aquatic life will magically reappear by year 5, and the fish would be thriving with renewed water quality. How is that possible?

- A **new and complete** analysis of the **entire** river must be performed, including the water management of the Trinity River that is diverted into the State Water Project and the central canal as these flow impacts on the fish are unknown. The complete environmental consequences have not been adequately evaluated.

- Unless a new, transparent, and complete study of the entire river system is performed, the SWRCB cannot make a credible determination concerning water quality.

- What agency is going to monitor the water quality coming into California from Klamath Lake? California is bearing the burden of compromised water due to geologic factors contributing to the volcanic, phosphorous nature of the river system and by pesticides and fertilizers.

- The warm, shallow waters in the Klamath in Oregon contribute to poor water quality.

- The most polluted water in the Klamath River is between Keno and Copco Dam and yet after the water leaves the dams, it is cleaner than what flowed into the river from Oregon.

Economic Impacts

- The economic impacts of the dam removal agreements are already being witnessed in Siskiyou County.

- Home values on Copco Lake have already plummeted due to dam removal agreements. Dam removal would precipitate a further loss.

- Homeowners are not able to sell their homes without disclosing possible dam removal and, as such, are forced to reduce their prices even more, IF they can even sell their homes.

- The loss of property values is reflected in the declining property taxes, and therefore a loss to Siskiyou County Revenue.

- When the BOR did their study they only looked at bare land values. They did not go through the process of the Record of Decision. Improvements were not considered. The KRRC does not have the funding or a plan for river or reservoir aesthetic restoration. It would take many, many years, if not a lifetime, to return the Klamath River behind the reservoirs to their native beauty.

- There are no plans for restoration after dam removal further lowering our property values.

- Even if there were to be a restoration period, the study looked at that as a period of only five years!! I'd like to see the science proving this study's assumption.

- There is a lack of transparency with the economic studies.

- It's my understanding that Siskiyou County has demanded an economic analysis so that they may inspect the details of this study, but their demands have not been met.

- Property value loss translates into lost tax dollars for school funding.

- If the dams are removed, the possibility exists that we could lose our water well, making our home uninhabitable, and therefore worthless. I'm certain the KRRC will not take on the expense of drilling a deeper well so that we can remain in our home.

- Will the KRRC compensate us for lost property value? Or will the KRRC reimburse Siskiyou County for millions of dollars of lost tax revenue as property values become worthless? I doubt that the KRRC will assume any liability and therefore in preparing your report you must take into consideration the economic effects of dam removal.

- The projected $450 million that dam removal is projected to cost, although other studies have shown this figure closer to $1 billion, are funds that can be spent on crumbling infrastructure, education, and other projects rather than a project that has not been adequately studied.

Fish and Animal habitat

- In 2001 The Karuk Council did not believe that Coho Salmon were indigenous to the Klamath River, but saw the value in misrepresenting the facts. The Coho are not native to the river, but the Karuk tribe now claims this to be true.

- Historically the salmon never came up above where Copco Lake is now due to warm waters from area hot springs per Native Shasta elders that lived in the area as well as early settlers, but these facts were never entered into the record when the BOR and DOI did their studies, as this area of the river was NOT studied.

- Under the ESA, a species cannot be decimated by a project, so how is dam removal a viable project to be considered by the Water Board if complete analysis is not performed?

- We have read that there is 20-30 million cubic yards of sediment behind the dams. There is great concern that this impact has not been adequately addressed. I assure you that if the fisheries are to be decimated for even a short period, the tribes will litigate for their losses of their fisheries.

- Unless the entire river is studied, all the impacts to fish and birds can't be know as to the impact.

- There are Perch behind the dams and if they are released into the lower river, that consequence must be considered since they are predatory to Salmon eggs. I believe this is another ESA impact that has not been considered.

- The last few years, water behind the Copco 1 Dam, as well as the others, has been released to improve water quality downstream to save the fish from parasites. Craig Tucker, of the Karuk tribe, admitted that without these water releases there would have been a major fish die off. No one at Copco Lake complained about their docks being temporarily unusable due to low lake levels, the inability to launch boats from the boat ramps because of low lake levels, and because boat could not be used there was a temporary loss of recreation at the lake.

- Governor Brown has said we need more water storage, not less. He cannot have it both ways. If this water storage was not there, at this crucial time, the fish would have died, and this winter with heavy rainfall, snow, and runoff there would have been floods.

- Aside from the original studies of only an extremely limited section of the Klamath River being evaluated, not all the creeks and rivers from below Iron Gate Dam to the mouth of the Klamath River, that make up the entire river system, and the actions of all parties that impact the fisheries, were and need to be taken into consideration. Gill netting still takes place across the mouth of the Klamath and this has not been studied as to the effect on Salmon population as well as ocean waters warming.

- Released sediments could alter the habitats of essential fish habitats and adequate studies have not been performed.

- It is ironic that even with these dams in place there have been record salmon runs and yet the tribes are still litigating. They sell their surplus fish to anyone who will buy them.

- Dam removal resulting in lake removal will impact migratory birds and the birds and animals that live in and around the lakes. Bald eagles, white pelicans, blue herons, and others have made this area their home and are thriving. Canadian

geese and other migratory birds use the lake as a resting and breeding place and so the impacts to these species all need to be studied and have not been done so.

Public Health, Safety, and Flood Control

- The risk of floods downstream is great. Part of the reason for the dam construction initially was flood control. The sediments behind the dams could exacerbate the flood risk.

- Dam removal could also change the existing flood plains and you cannot ignore the need to realign the pipeline for the City of Yreka's water supply.

- The water behind the dams have aided in wildfire protection. Without the readily available water in the recent wildfires, many homes would have been lost.

- Despite warnings about coming in contact with the water due to toxins, not a single person around Copco Lake that has recreated in the lake have ever had any skin or health related issues due to water contact despite years of contact with the lake waters.

- Dam removal could result in problems with mosquito habitat and related diseases such as the Zika virus.

- There will be a considerable amount of debris because of dam removal possibly posing risks downstream of the destruction of the dams.

Historical and Archeological Effects

- The Shasta Native American Tribe, which precedes other Klamath tribes are not a signatory to the KHSA and have not been represented. Dam removal will expose sensitive Shasta burial grounds and possibly tribal artifacts.

- As the tribes, downstream from the dams are demanding that their tribal and cultural customs be respected, so shall the Shasta Nation be respected. If you engage with tribal entities without taking into consideration all entities and be certain that the interests of all tribes are taken into equal consideration you will be acting prejudicially.

Aesthetics

- Dam removal would have a long-term effect of the aesthetics of the river and the reservoirs behind the dams, as well as sediment transport would change the appearance and erosion issues for the Klamath River.

- Our home currently looks out onto a beautiful lake. When lake levels have been lowered for dam maintenance or when water releases have occurred to improve water quality for the fish, the mud, trash debris, and sediment exposed is not aesthetically appealing.

Recreation

- If dam removal takes place there will be a great recreational loss to the public. Currently the lakes provide such activities as boating, fishing, water skiing, wake boarding, kayaking, standup paddling, canoeing, and swimming. There is also camping along the lakes that would be eliminated with dam removal.

- White water rafting activies would be altered with dam removal.

Greenhouse gas emissions

- Removal of effective hydroelectric power providing power to over 75,000 homes will most likely result in increased greenhouse gas emissions from replacement sources at a time when California will not meet the 33% legal mandate of electric power sales from renewable sources by 2020 even with the dams in place.

Alternative Solutions for Analysis

- Once there has been a thorough and complete analysis, a determination has found that salmon were native to the area above Copco 1 Dam and that the fish would survive and thrive in this area of the river, then there can be alternative solutions for analysis.

- Siskiyou County has offered solutions to address Klamath River Water Quality, such as fish ladders, and Trap and Haul where fish ladders might not be a practical application.

- Another solution might be using Bogus Creek as a bypass around the dams for fish passage.

- “Fish cannons” are also used in certain cases for transporting fish.

- Siskiyou County and landowners have taken many measures to improve water quality, improve fish habitats and water conservation.

In conclusion, you must take into consideration all the above reasons to complete the process for permit application **without the assumption of a predetermined** outcome. To do anything less, than a complete and independent analysis, would violate the Code of Regulations. We ask that you **deny** the certification request for Section 401(a)(1) of the Federal Clean Water Act for the KRRC to move forward with dam removal.

Respectfully submitted,

Bart Kent and Mary Cunningham

17107 Patricia Ave.

Montague, CA 96064

Mailing address:

125 Annandale Ct.

Crescent City, CA 95531

Phone: (530) 459-1544

(707) 464-6166

Email: kentappraisal@charter.net

From: Lisa Cutter <lcutter@earthlink.net>
Sent: Saturday, January 28, 2017 9:03 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

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As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Lisa Cutter
14140 Sunrock Rd
Nevada City, CA 95959
lcutter@earthlink.net

Penn Museum
UNIVERSITY of PENNSYLVANIA MUSEUM
of ARCHAEOLOGY and ANTHROPOLOGY

January 31, 2017

Mr. Parker Thaler
State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA 95812-2000

Subject: Klamath Hydroelectric Project (FERC Project 14803)

Dear Mr. Thaler:

Thank you for the opportunity to provide comments for the record regarding the impact to Tribal Cultural Resources on FERC Project 14803. I am writing as an anthropologist and archaeologist at the University of Pennsylvania Museum who has spent the past eighteen years studying Shasta Indian culture in the Upper Klamath Canyon area and working closely with present-day Shasta descendant communities.

Based upon my research and knowledge about this area, the 2012 EIS and EIR do not properly consider the impact to Shasta Indian cultural sites and traditional cultural landscapes in the Upper Klamath Canyon. A new EIR is required that involves full consultation with the relevant present-day Shasta Indian representatives as is required under CEQA Section 15064.5 and California AB 52. The reason for this inadequacy is straightforward: the Shasta Indian representatives most closely associated with the Upper Klamath Canyon cannot participate in Federal consultation process as a Tribe because they lack Federal recognition. However, the consultation process afforded by CEQA permits Shasta Indian representatives to be included fully.

When considering an EIR for FERC Project 14803, the historic circumstances of the Shasta Indians in northern California must be taken into account. The discovery of gold in Siskiyou County had devastating consequences for Native people. Death and disease took a toll on the Native population. Miners and settlers displaced Shasta people from their traditional villages in Scott Valley, Shasta Valley, and along the Klamath River to less desirable lands in the valleys or to remote, inaccessible locations away from the new Euro-American towns. By the early 1860s, surviving Shasta people established "rancherias," typically consisting of a few extended families, in Etna, Quartz Valley, Moffett Creek, Hamburg, Yreka, and in the Upper Klamath Canyon.

Each of these rancherias followed a unique historical trajectory. The Federal government purchased 441 acres of land for the Etna rancheria in 1907, pursuant to the Act of June 21, 1906; the rancheria was terminated under the California Indian Rancheria Act of 1958. A reservation was established at Quartz Valley in 1940 under the Indian Reorganization Act of 1934. It, too, was terminated under the California Indian Rancheria Act but was restored to Federal status following the decision in *Tillie Hardwick v. U.S.* Currently, the majority of residents are Karuk. The Federal government sued on behalf of the Moffett Creek rancheria in 1919, arguing that the rancheria retained tribal ownership over its lands; a final decision by the U.S. Supreme Court in *Cramer v. U.S.* (1923) affirmed the existence of individual

aboriginal title to the rancheria lands but not a tribal ownership right. At Hamburg and Yreka, Shasta people received Indian allotments from National Forest lands. The Yreka rancheria was depopulated during the Influenza Epidemic of 1918-1919, when many of the residents perished. The few Yreka survivors resettled elsewhere.

The Shasta rancherias in the Scott and Shasta Valleys maintained connections to Shasta people living in the Upper Klamath Canyon through shared social, cultural, and trade linkages. Particularly strong social bonds anchored the Etna, Moffett Creek, Yreka, and the Upper Klamath Canyon rancherias, whose families intermarried. Similarly strong ties existed between the pre-Indian Reorganization Act rancherias at Quartz Valley and Hamburg in northern Scott Valley.

The Upper Klamath Canyon rancheria was located in a place called *k'íka·c'é·ki*. The term likely referred to the principal village recorded as the archaeological site CA-SIS-17 and the smaller settlements, campsites, graveyards, and sacred landscape surrounding it. Shasta people settled here after their forced relocation from the Bogus Creek area around what is now Iron Gate Reservoir. Working together and under the leadership of Bogus Tom and Indian Jake, Shasta people purchased land and obtained Indian allotments to create a contiguous land mass for their rancheria. By 1920, it was likely the largest Shasta rancheria in terms of population and in land acreage under Native control. Moreover, the inhabitants at *k'íka·c'é·ki* showed some political and cultural differentiation from other Shasta groups along the Klamath River. Bogus Tom insisted to Smithsonian anthropologist C. Hart Merriam that he held political authority over the lands at *k'íka·c'é·ki* downriver to Hornbrook, after which other Shasta leaders exerted their control. He thus asserted the political autonomy of the group living in the Upper Klamath Canyon. Additionally, Sonoma State University linguist Shirley Silver recognized that Shasta speakers at *k'íka·c'é·ki* spoke a slightly different dialect than the downriver communities. On the basis of this distinction, Victor Golla's *California Indian Languages* (Univ. of California, 2011, p. 91-2) termed this group to be the "Jenny Creek Shasta."

The area around *k'íka·c'é·ki* was situated in a valley—a valley that proved ideal for the construction of the Copco Number 1 Dam and its reservoir. Shasta people living below the reservoir waterline were forced to sell their lands and relocate. John C. Boyle, the vice president, general manager, and long-time chief engineer of the California Oregon Power Company, provided an eyewitness account of the dispossession of Shasta people at *k'íka·c'é·ki* in his memoir *Fifty Years on the Klamath* (1976). As he recounted it:

> The area surrounding the project was a happy hunting ground for the Indians, plenty of fish in the river and bountiful wildlife in the lava canyons, especially in wintertime. … Most of the … Indians in the neighborhood were mixed bloods, such as the Keatons, Griffiths, Raymonds, Frains, and others.
>
> Kitty Ward, a full-blood Indian, lived in a tall log cabin which she and her white husband Tim built for a home. It was beautifully located on the lower end of the proposed reservoir beside flowing springs ample to irrigate some of the lands.
>
> The cabin was below the flow line so when time to fill the reservoir came, Kitty was told it was necessary for her to move. She certainly knew how to put the white man in his place. Between sobs and tears, she refused again and again to leave her home saying, "I no move, let water come, I die here." Tim had been dead for several years, but Andy Marlow, as a ranch foreman and keeper of her wampum [and Kitty's son-in-law] cooperated in getting Kitty to visit in Hornbrook, a visit from which she never returned.

Kitty Ward died in the aftermath of her forced relocation. The Shasta community at *k'íka·c'é·ki* never recovered fully, either. Those above the waterline stayed on their lands. Most of those below the waterline

relocated elsewhere. Absent the shared land base and mutual reinforcement of Shasta cultural traditions and regular interactions in the language, it became more difficult to maintain a sense of Shasta identity at *k'íka·c'é·ki.* This disruption in Shasta community life had outsized historical consequences. Arguably, the construction of the Copco Number 1 Dam is a significant contributing factor as to why the Shasta lack Federal recognition in the present day.

Certainly, the California State Water Resources Board must balance many considerations in FERC Project 14803. The decline of the historic salmonid fishery, which united and sustained the religious life and annual ritual cycle of the Yurok, Hupa, Karuk—as well as the Shasta—is a matter of substantial concern. It is also clear that many Siskiyou County residents remain apprehensive about what this project will mean for their livelihood and the sustainability of their rural communities and economy. My purpose in these comments is not to propose a particular outcome or mitigation strategy for FERC Project 14803. Rather, my intention is to highlight the inadequacy of the 2012 EIS/EIR for decision-making. In my view, it would be a grave injustice to compound the historical loss of the Shasta lands at Iron Gate Dam, *k'íka·c'é·ki*, and the Upper Klamath Canyon by adopting the 2012 EIS/EIR without modification. A full consultation with the relevant present-day Shasta descendant communities is now required.

Sincerely,



Brian I. Daniels, Ph.D.
Director of Research and Programs
Penn Cultural Heritage Center
University of Pennsylvania Museum

From: Brett David <brett@tightlinepress.com>
Sent: Wednesday, January 25, 2017 6:46 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Brett Davis
62660 Larkview Rd
Bend, OR 97701
brett@tightlinepress.com

From: Brittany Davis <badavis9@gmail.com>
Sent: Sunday, January 29, 2017 12:04 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Brittany davis
52 Saroni Ct
Oakland, CA 94611
badavis9@gmail.com

From: Lori Day <ranchgirl2006@gmail.com>
Sent: Wednesday, January 25, 2017 5:10 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Lori Day
1850 SW Tamarack St
McMinnville, OR 97128
ranchgirl2006@gmail.com

From: Timothy Devine <user@votervoice.net>
Sent: Thursday, January 26, 2017 9:45 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Timothy Devine
24702 Broadmore Ave
Hayward, CA 94544
goosedevine@yahoo.com

From: Peter Douglas <user@votervoice.net>
Sent: Saturday, January 28, 2017 2:57 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Peter Douglas
81 W Santa Inez Ave
San Mateo, CA 94402
pdouglas81@yahoo.com

From: Michael Drais <okiedokie33@gmail.com>
Sent: Friday, January 27, 2017 7:58 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Michael Drais
28632 HISTORIC COLUMBIA RIVER HWY
TROUTDALE, OR 97060
okiedokie33@gmail.com

Thaler, Parker@Waterboards

From: Ann Duchi <annmduc@hotmail.com>
Sent: Tuesday, January 31, 2017 3:30 PM
To: Wr401program

Comment regarding dam removal on Lower Klamath
Thank you for hosting the scoping meeting for Siskiyou County residents. Danielle Jester wrote a very informative and comprehensive article regarding same in the Siskiyou Daily News. It is unfortunate that you had to contend with outrage and threatened lawsuits. I am wondering how many individuals, like me, stayed away from the meeting because of this anticipated uncivil behavior? There does not appear to be an easy solution, we need to take care of that Salmon run, to keep the population from diminishing, homeowners need flood control. How much water do farmers use from these reservoirs? There is a fish ladder in place on the Sacramento River at Keswick Dam. Is it successful? Please continue a thorough study to search for sustainable, scientifically sound and effective solutions to this issue.

Ann Duchi
122 Montair Drive
Montague, CA 96064r
Sent from my Surface Pro

From: Anderson Dunn, IV <user@votervoice.net>
Sent: Wednesday, January 25, 2017 8:19 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Anderson Dunn IV
PO Box 91
Louviers, CO 80131
adunniv@yahoo.com

From: Elizabeth Earthman <rainskirts@gmail.com>
Sent: Friday, January 27, 2017 9:37 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Elizabeth Earthman
27830 State Highway 128
Winters, CA 95694
rainskirts@gmail.com

From: Gordon Ehrman, CPA <ehrman1@msn.com>
Sent: Thursday, January 26, 2017 6:10 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Gordon Ehrman CPA
16 Drakes View Cir
Greenbrae, CA 94904
ehrman1@msn.com

From: Paul Elkins <elkins0260@gmail.com>
Sent: Friday, January 27, 2017 6:44 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Paul Elkins
9125 Posada Way
Sacramento, CA 95826
elkins0260@gmail.com

From: David Enelow <denelow@gmail.com>
Sent: Friday, January 27, 2017 5:57 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon. I have finished for over sixty years in California and the state of its rivers is of special concern to me.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

Other key points I urge you to consider:

1. The 2012 joint California and federal EIR/EIS and related documents concluded that dam removal on the Klamath is in the best interest of the public. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies, which can be relied upon for your EIR.

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Sincerely,

David Enelow
1606 Rose St
Berkeley, CA 94703
denelow@gmail.com

From: Celio Enriquez <user@votervoice.net>
Sent: Thursday, January 26, 2017 6:38 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Celio Enriquez
32636 Pine Canyon Rd
Lake Hughes, CA 93532
carneasadaman@yahoo.com

From: Joshua Feltenberger <user@votervoice.net>
Sent: Thursday, January 26, 2017 6:24 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Joshua feltenberger
3930 Holly Rue
Erie, PA 16506
joshuafeltenberger@yahoo.com

From: Miles Fidler <milesfidler@gmail.com>
Sent: Thursday, January 26, 2017 7:23 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Miles Fidler
20088 Beth Ave Unit 2
Bend, OR 97702
milesfidler@gmail.com

From: Bruce Finney <finney@isu.edu>
Sent: Thursday, January 26, 2017 4:56 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Bruce Finney
948 Prospect Hts
Santa Cruz, CA 95065
finney@isu.edu

Thaler, Parker@Waterboards

From: Richard Flynn <user@votervoice.net>
Sent: Tuesday, January 31, 2017 10:16 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

Read this comment!!!!!!!!!! With thousands of comments like mine being submitted it's easy to thumb over them, but please read mine. I was a whitewater and fishing guide on the Klamath river for a couple seasons around 2012-2013. The Klamath river has some of the weirdest geology on the west coast and this creates some unique biology. The nature of this warm river puts it in a far more delicate balance for harbor ing steelhead and salmon populations. Everything that grows out of this river is larger than normal. The insects, the tule grass, and the current fish species. It stands to reason that this nutrient rich system will produce some of the largest king salmon and steelhead on the west coast due to the nature of the feed sources. Right now the lakes made by the dams in question reach temperatures in excess of 70 degrees F which is way too warm properly support these cold water species. The river has few tributaries but has many springs in the mainstream of the river itself. Again it is an extremely unique system. It needs to be restored it is not a question. We can obtain power from other sources that do not destroy an entire ecosystem. Agricultural practices in the upper basin will not be hindered by these dam removal actions contrary to the belief of the farmers in the upper Klamath basin. There are no and to remove the keno dam(which has no turbines to justify it staying) or the link river dam which makes A canal possible and sends water to the farms east of Klamath falls. In summary if there was ever a river system that is truly unique and deserves preservation, it is the Klamath river. It is capable of producing over a million anadramous fish which will lead to $ for sport fishing and ultimately commercial harvest. I know $$ is the bottom line for those in power who make decisions like this. Sad but true so if this is what you need to think about to make this decision so be it .
-Richard Flynn. Outdoor enthusiast

Sincerely,

Richard Flynn
1223 W 8th St
Medford, OR 97501
woodz77@rocketmail.com

Thaler, Parker@Waterboards

From: Linda-Marie Franks <lynnsbuns@aol.com>
Sent: Wednesday, February 01, 2017 5:12 PM
To: Thaler, Parker@Waterboards
Subject: Fwd: my objection to dam removal

-----Original Message-----
From: Linda-Marie Franks <lynnsbuns@aol.com>
To: patrickthaler <patrickthaler@waterboards.ca.gov>
Sent: Wed, Feb 1, 2017 5:08 pm
Subject: Fwd: my objection to dam removal

-----Original Message-----
From: Linda-Marie Franks <lynnsbuns@aol.com>
To: thaler <thaler@waterboards.ca.gov>
Sent: Thu, Jan 26, 2017 2:33 pm
Subject: my objection to dam removal

I can not attend the meeting tonight due to the ice hazard in my driveway, after dark it is unsafe to attempt to drive up my driveway and slide into the culvert.

No one can tell the whole truth, only their truth. My truth is as follows -

I can not leave Copco Lake to end my daily misery and fear. I can not sell the house of my dreams. Appraisers and lenders are not moving forward due to the continual threat of dam removal. There will be no water to fight wildland fires without the dam. Having lived through the last fire, where water from the dam made the difference between life and death, my fear magnifies.
The dam provides life to those who utilize it well. It provides life, food, and peace to body and soul. It provides sanctuary to migratory birds, substance to cougars, eagles, hawks, bear, and those in search of food and water. It becomes nesting grounds and birth sanctuaries for Northern white pelican, bald eagle, golden eagle, ducks, raccoons, deer, bear frogs, toads, sucker fish and so many more.
My frustrations are the people making decisions which do not communicate with all those who be impacted by their decisions. I am a scientist by trade and to negate what I know, by education and experience is disgraceful. To negate how I feel is disrespectful. The dams are not a one or two dimensional issue. It is not about just the fish. Please truly consider all the evidence and information. To give the people a voice and disregard what they present and vote upon is an ethical misgiving. To arrive at a meeting with prejudged outcomes is never correct. and a disservice to all those who present.
I don't know what else to say to make you listen to all sides of the issues, I can only ask you to consider the lives you hold are precious and worthy of your consideration.

Thank you
Linda Franks, Property holder and steward of the earth

From: Dan Frazier <frazier.d@comcast.net>
Sent: Friday, January 27, 2017 9:17 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

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Sincerely,

Dan Frazier
245 Evergreen Ave
Mill Valley, CA 94941
frazier.d@comcast.net

Thaler, Parker@Waterboards

From: christy@whoishere.com
Sent: Monday, January 30, 2017 5:11 PM
To: Wr401program
Subject: Lower Klamath Project

Dear Mr Thaler,

I have lived on both ends of the Klamath River: the towns of Klamath Falls and Klamath. Such a claim doesn't qualify me for any special influence on the final outcome for the LKP, I am simply an inhabitant of the region who feels an obligation to voice my approval of the LKP's mission to remove the four lower dams. It will always be the case that certain stakeholders will lose certain privileges, such as irrigation water or property with views of a reservoir. But these instances must be weighed against the deprivations of other stakeholders. Citizens of the region, and beyond, ask for our decision makers to consider the value of intact natural environments. The suffering of the few losing lakefront access from their front yard will eventually come to nothing. The suffering of us all from the incremental industrialization of the land will come to even greater suffering for centuries to come. The LKP was not an endeavor made in haste. Time will work against a good outcome if a decision is not carried out within the lifetimes of all involved, even if that be no removal of the dams. In my opinion, removing the dams within at least a decade is the best outcome of the available options.

Respectfully Yours,

Christy Frenzen
1257 Orchid St
Ashland, OR 97520

From: Vince Fugina <v.fugina@gmail.com>
Sent: Thursday, January 26, 2017 5:16 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Vince Fugina
2649 Harkness St
Sacramento, CA 95818
v.fugina@gmail.com

From: Robert Fuller <rgfuller12@gmail.com>
Sent: Thursday, January 26, 2017 5:52 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Robert Fuller
3350 Greenview Dr
El Dorado Hills, CA 95762
rgfuller12@gmail.com

From: Thomas Galindo <user@votervoice.net>
Sent: Thursday, January 26, 2017 8:44 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Thomas Galindo
1039 Clarendon Cres
Oakland, CA 94610
galindo.thomas@yahoo.com

From: Joe Garoutte <joe@garoutte.me>
Sent: Thursday, January 26, 2017 10:34 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Joe Garoutte
476 W Jewett Blvd
White Salmon, WA 98672
joe@garoutte.me

From: Lawrence Gatt <lfgatt@att.net>
Sent: Saturday, January 28, 2017 6:52 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Lawrence Gatt
506 Avila Rd
San Mateo, CA 94402
lfgatt@att.net

From: Vanessa Gayton <user@votervoice.net>
Sent: Wednesday, January 25, 2017 10:01 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Vanessa Gayton
1811 Denkinger Rd
Concord, CA 94521
v.gayton@yahoo.com

From: Miranda Geller <gellerm@oregonstate.edu>
Sent: Thursday, January 26, 2017 8:36 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Miranda Geller
1973 NW Grant Ave
Corvallis, OR 97330
gellerm@oregonstate.edu

Thaler, Parker@Waterboards

From: rgierak2@hughes.net
Sent: Friday, January 13, 2017 3:45 PM
To: Thaler, Parker@Waterboards
Subject: Re: Klamth Hydroelectric Project

Dr. Richard Gierak
5814 Highway 96
Yreka, Ca. 96097
530 475-3212

Illegal infractions regarding Klamath dam removals

Violation of the Reclamation Act of 1902

The Reclamation Act of 1902 (43 U.S.C. 391 et seq.) authorized the Secretary of the Interior to locate, construct, operate, and maintain works for the storage, diversion, and development of water for the reclamation of arid and semiarid lands in the western States.
Congress facilitated development of the Klamath Project by authorizing the Secretary to raise or lower the level of Lower Klamath and Tule Lakes and to dispose of the land uncovered by such operation for use under the Reclamation Act of 1902. Starting around 1912, construction and operation of the numerous facilities associated with Reclamation's Klamath Project significantly altered the natural hydrographs of the upper and lower Klamath River. Reclamation's Klamath Project consists of an extensive system of canals, pumps, diversion structures, and dams capable of routing water to approximately 200,000 ac (81,000 ha) of irrigated farmlands in the upper Klamath Basin. Water diversions from from UKL for the Klamath Project affects river flows downstream of Link River and Iron Gate dams.

The headwaters of the Klamath River originate in Southern Oregon and flow through the Cascade Mountain Range to the Pacific Ocean south of Crescent City, California. The river extends nearly 250 miles and is just one of three waterways that pass through the Cascades to the Pacific. It is named after a native American name - klamet - meaning swiftness.

Violation of the 1981 National Wild & Scenic Rivers Designation

The Klamath River was designated a Recreational River within the National Wild & Scenic Rivers System in 1981. The Klamath River enters California from Oregon just north of the Goosenest Ranger District. Heading west it is impounded by two dams forming Copco Lake and Iron Gate Reservoir. Nine miles further west it turns south and follows Interstate 5 for a few miles before again turning west and entering the Happy Camp/Oak Knoll Ranger District. The next 85 miles provide many opportunities for recreation and scenic vistas before the river enters the Six Rivers National Forest.
Dam removal would release toxic material that would destroy the habitat for all species in addition to physically changing the course of the Klamath River in direct violation of the National Wild & Scenic Rivers designation.

Violation of the Dormant Commerce Clause

No State may impose any regulatory action against navigable rivers in the US of which the Klamath River is considered a navigable river. This would also prohibit removal of any dams located on a navigable river in the US by States.

Violation of the Federal Endangered Species Act

Under the Federal ESA only indigenous species can be listed and under the Final report of Coho Salmon by the Klamath Expert Panel Coho Salmon were planted from Cascadia, Oregon and are not indigenous to the Klamath. The present listing of Coho in the Klamath River is illegal and was determined in the courts in the early 2000's.

Violation of Rogue Valley Oregon Irrigation Rights

Removal of these dams would reduce approximately 40% of water from the Klamath River that now goes to Southern Oregon for agriculture which would result in serious loss of agriculture that now stabilize the economy of Southern Oregon

Serious impact on power costs in Northern CA and Oregon

At this time these hydroelectric dams supply Northern California and most of Oregon homes and businesses with the least expensive power available. The average homeowner is liable for approximately $200 per month and with the proposed natural gas power supply it would increase their costs to approximately $600 per month.

Violation of Shasta Indian burial rights

At the present time Shasta Indian Tribe burial grounds are protected by Iron Gate Reservoir and removal of this dam their burial grounds could be exposed, plundered and desecrated.

Violation of Siskiyou Counties water rights

Removal of these dams would be in serious loss of existing water rights as proposed solutions to avoiding this problem would be in serious possibility of failure and exposed to vandalism.

Possible loss of life and property to all adjoining the Klamath River

Due to occasional flooding Iron Gate Dam was constructed to serve to protect all that lived on the banks of the Klamath River from catastrophic flooding events. Without this dam property values would fall and expose all with the possibility of loss of life and property.

Serious fire danger to all in Siskiyou County

At the present time the dams supply fire helicopters access to water supply to fight forest fires. Removal of these dams would force said fire helicopters to much longer time delays to fill their buckets and thereby expose all to longer wait times and possibility of loss of lives and property.

Violation of the Constitution of the United States

Elections in Siskiyou County California and Klamath County Oregon voted 80% to retain the dams and removal of these dams would be in direct violation of the will of the people and the Constitution.

Prior law decisions

In the late 90's proposal was made to change the definition of Federal ESA regulations regarding endangered salmon to Ecological Society of America regulations which means that instead of regulations applying only to water and substrate would be changed to allow them regulations up to a mile from the banks of a river. Through the States of Idaho, Washington, Oregon and California State Granges we defeated this change.

In the early 2000's the Granges engaged Pacific Legal Foundation and listings of Coho in Northern California and Southern Oregon were cancelled as the Coho were not indigenous to these waters and rivers.

In the mid 2000's an attempt was made by environmental groups to list Chinook Salmon in the upper Klamath and the Siskiyou County Water Users Association filed a de-listing petition which was successful and the Chinook listing was denied.

Submitted by;

Dr. Richard Gierak
Bachelors Degrees in Biology, Chemistry, Doctorate in the Healing Arts, Director of Interactive Citizens United, Director of New Frontiers Institute, Inc. Prior Participant of FERC and FPAT (Fish passage advisory team report) and HET (Hatchery evaluation team) Prior Vice President of Greenhorn Action Grange, Prior California State Grange Spokesman for the Water Committee, Prior National Whip of the Property Rights Congress of America, Representative of the Grange States of California, Oregon, Washington and Idaho regarding EFH regulations, Prior member of the Siskiyou County Water Users Assoc.

From: Brandon Gomez <Hawgseeker721@gmail.com>
Sent: Wednesday, January 25, 2017 6:00 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Brandon gomez
1615 Worden Ave
Klamath Falls, OR 97601
Hawgseeker721@gmail.com

From: Michael Gonnella <mcgonnella1@gmail.com>
Sent: Monday, January 30, 2017 1:13 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

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Sincerely,

Michael Gonnella
12550 Glide Way
Redding, CA 96003
mcgonnella1@gmail.com

Thaler, Parker@Waterboards

From: Juliet Grable <julietgrable@gmail.com>
Sent: Wednesday, February 01, 2017 4:46 PM
To: Thaler, Parker@Waterboards
Subject: comments on Scoping Period for Lower Klamath Project dam removal

Dear Mr. Thaler,

I am a resident of southern Oregon, and I am writing to comment on the EIR for the proposed Lower Klamath Project License Surrender. I support the decommissioning and removal of the Klamath River dams in order to restore a free-flowing river that supports healthy salmon runs and downstream user rights. I urge the Water Board to issue a water quality certification for dam removal so that the Federal Energy Regulatory Commission can approve dam removal by 2020. I would also urge the Water Board to consider the long-term beneficial impacts of the dam removal, not just the immediate adverse impacts, such as the release of sediment. The 2012 EIR concluded that dam removal is in the public interest, with net positive impacts for our water quality, fisheries, regional economies, power customers, and cultural resources. The new updated EIR should incorporate all of the sound science-based conclusions found in the 2012 report.

Thank you for considering my comments. My contact information is below

Sincerely,

Juliet Grable

Juliet Grable

541.778.8174

--
Juliet Grable
julietgrable@gmail.com
www.amazon.com/author/julietgrable

From: Jason Grant <user@votervoice.net>
Sent: Wednesday, January 25, 2017 6:19 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Jason Grant
670 NW Green Forest Cir
Redmond, OR 97756
ifishgrant@yahoo.com

Thaler, Parker@Waterboards

From: Clancy and Nora Grant <ret65@verizon.net>
Sent: Tuesday, January 31, 2017 8:23 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River Dam Removal

My Name is Nora Grant
My Address: P O Box 1505 (physical: 15455 Shasta Lane, Hornbrook CA 96044),
City/State/Zip: Yreka, CA 96097
E-mail: ret65@verizon.net
Telephone: 760-310-5699

Re: Klamath River Dam Removal

As a resident and property owner here in Siskiyou County I implore you to please stop the removal of these dams. I feel that the real reason behind the removal is more of dollar in the pockets of Tribal and environmentalist than it is a betterment for the river and fish. The dams play a very vital part to this county. They provide clean energy, flood control, enough water in the river for the salmon to return and spawn, water for wild fire protection, a bird and turtle refuge, and many more benefits. What happens to all of us property owners when all of this is destroyed by dam removal?? No one wants to answer our questions or concerns. Will this effect our water tables? Will all of us that have properties near the existing lakes lose our wells? Who will compensate us for our devaluation of property if our wells are gone? Where will the CDF and local volunteer fire departments obtain water for fighting fires? What about the current established eco-system that exists here? What about the local farmers and ranchers that depend on the lakes and rivers for crops and livestock? The wildlife, ranchers, and residents, do we not have a voice in this matter? Do the environmentalists or Tribes Care? No! They do not! As long as their pockets are lined with money they are happy. Warren Buffet and Pacific Power have nothing to lose as they will come out on top either way this goes.

Residents here at Irongate Lake Estates, and Copco Lake have fought this for 10+ years to preserve our current way of life and properties. So much of the articles in the press and in the arguments the environmentalists are using are filled with unsubstantiated falsehoods.

Our families have even been part of the studies done on the supposed danger of the algae of which show no side effects to any of them. People and dogs swim and play in the lake all summer long, cattle and wildlife drink out of the lake daily and NO ONE dies. In anything there is always going to be one person out of a million that has a reaction to something, whether it is an allergy related incident or just stupidity, but the majority should not have to suffer or be punished just because of one out of a million. There are pictures supposedly taken at Irongate Lake with tons of algae and dead fish. Our family has been at Irongate Lake Estates since 1999 and never once have we seen any of this. There were thousands of dollars given out to do water studies, but when we have asked for reports of results conveniently the water testing lab has gone out of business. Let alone the actual testing being done at all. Why do we not hear about the contamination of the river below all the dams by an illegal Meth Lab which produced one of the largest fish kills ever on the Klamath? Or how the tribes net thousands of salmon at the mouth of the river before the salmon even have a chance to start their journey upstream, while shooting seal lions at the same time so they don't lose any of the salmon to them, and then half of those taken end up rotting and wasted. Have been there and seen it! No one will hear of this or many other factors as they serve no purpose to the tribe's and environmentalist spew of lies.

The contamination of dam removal will last for years as they try to clean up all of silt and re-new the river, towns down river will flood, in the summer and fall there will be only a trickle in the now flourishing river, fish will be not be able to come upstream as there will be no stream to come up, new sources of electric power will have to be established with costs being passed on to the local residents, the current eco-system and wildlife will suffer and some like the turtles at their refuge will die. We have such a large array of wildlife, and birds including the endangered osprey that call this home. How can their survival and rights not be considered also. As for the salmon they have not been beyond Irongate Lake for over a century and the existing salmon will never go beyond the fish hatchery even with the dam removed, if and when the contaminated trickle of water will even be enough to allow them to get this far.

I implore you, please help us put a stop to this terrible tragedy once and for all.

Sincerely,
Nora Grant
Irongate Lake Estates Resident

From: Ben Halay <bhalay4@gmail.com>
Sent: Sunday, February 05, 2017 9:26 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

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Sincerely,

BCH
14800 NW Cornell Rd
Portland, OR 97229
bhalay4@gmail.com

From: Charles Hammerstad <user@votervoice.net>
Sent: Thursday, January 26, 2017 6:36 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Charles Hammerstad
780 Portswood Dr
San Jose, CA 95120
chamerstad@aol.com

From: Kris Hamrick <kris_hamrick@hotmail.com>
Sent: Thursday, January 26, 2017 9:41 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

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Sincerely,

Kris Hamrick
16 Hillway Ave
San Francisco, CA 94117
kris_hamrick@hotmail.com

From: Tim Harden <timhardenfly@gmail.com>
Sent: Thursday, January 26, 2017 4:50 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Tim Harden
744 Whipple Ave
Redwood City, CA 94063
timhardenfly@gmail.com

Thaler, Parker@Waterboards

From: bharri1@charter.net
Sent: Saturday, January 21, 2017 1:47 PM
To: Thaler, Parker@Waterboards
Cc: 'ben.harris@klamathtribes.com'
Subject: dam removal written comment due Feb 5

Parker:
Thank you for the opportunity to comment on potential removal of four dams on the Klamath River. I moved to Klamath Falls, Oregon, almost fourteen years ago to work for the Klamath Tribes of Oregon. I am a Chemist, for the Natural Resource Department, and I am representing myself and not the Klamath Tribes. On a daily basis, I run water quality analysis on Upper Klamath Lake, Agency Lake, and their tributaries. At some point every summer, dissolved oxygen levels plummet, pH values flex from low to high, and water temperatures increase. Recently, we have also been testing toxic algae which is also alarmingly high. These issues make it very difficult for native Redband Trout and suckers to thrive. In addition, native Chinook salmon and Steelhead salmon have been blocked from this area since construction of the first dam. Please consider my opinion the the four dams on the Klamath River need to be removed for the health of the whole river system. Monies have been secured, plans are in place, and reasonable public support is there. Please bring salmon home to the Klamath Basin.
Ben Harris
2725 Montelius St.
Klamath Falls, Oregon 97601

From: Adam Hart <ahartgolf@gmail.com>
Sent: Wednesday, January 25, 2017 6:20 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Adam Hart
5416 Almond Falls Way
Rancho Cordova, CA 95742
ahartgolf@gmail.com

ER/PT

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Sincerely,

Jon Hazlett

STATE WATER RESOURCES CONTROL BOARD
2017 FEB -2 PM 12:31
BY CLERK TO THE BOARD
SACRAMENTO

From: Doug Heald <dougheald@comcast.net>
Sent: Monday, January 30, 2017 10:57 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

Other key points I urge you to consider:

1. The 2012 joint California and federal EIR/EIS and related documents concluded that dam removal on the Klamath is in the best interest of the public. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies, which can be relied upon for your EIR.

2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Doug Heald
2176 Frascati Dr
El Dorado Hills, CA 95762
dougheald@comcast.net

Wilma E Heiney
2200 Sloan St
Klamath Falls, OR 97601-6429

State Water Resources Control Board
Division of Water Rights
Water Quality Certification program

Jan. 14, 2017
Comments on Removal of Klamath Dams; 2-1-17

attn: Parker Thaler
P.O. Box 2000
Sacramento, CA 95812-2000

Irrigation water shut-off 2001, because of the biological opinion that the sucker fish, in Klamath Lake needed higher water levels. Well, that was just "junk science" or "agenda science". The population of the sucker fish, dwindled to only a few, all over 20 yrs. old. — Now apparently these same scientists are pushing for little, or no water at all, in the Klamath Lake.

I'm just a farmer's widow with a high school education, having lived here in this basin my whole life; I did love school and life here until this EPA battle that we have been fighting for the last 30 years. It is interesting that your meeting, Jan 20th, is in the CalEPA building. I wish you were all at home watching President-elect Trump's inauguration instead!

1. Don't you think any last minute decision, from your board, just might be unacceptable or dropped?

2. Marzulla is a great water lawyer and

Attn: Parker Thaler (cont.)

2. cont. I believe you would be knowledgeable of this history.!

3. The 5th amendment, of the U.S. Constitution, states the taking or making laws that cause the taking of our property is covered by "emmient domaine." No wonder Warren Buffet, owner of the dams doesn't want the responsibility of dam removal. Furthermore, the new owners may not consider any responsibility to "emmient domaine."; Just use your approval to steal our property.

4. We need the dams to secure the production of electricity. Taking our land and cutting off our electricity supply is a sure way to turn us into a communist country.

5. FERC board is likly to be changed by Pres. Trump, so don't hurry to make a decision

Thank - you for reading the letter;
Sincerely
Wilma Heiney

P.S. Feel free to make copies of the enclosed, and to pass them out freely. — WEH.

Wilma E Heiney
2200 Sloan St
Klamath Falls, OR 97601-6429

KEEP THE DAMS

DREDGE THE LAKE

ONE SOVEREIGN NATION FOR ALL

Thaler, Parker@Waterboards

From: Heather Hendrixson <hhendrixson@yahoo.com>
Sent: Wednesday, February 01, 2017 4:26 PM
To: Thaler, Parker@Waterboards
Subject: I support dam removal

Dear Parker,

I am writing today in support of removing four dams on the Klamath River to restore migratory fish, improve wildlife habitat, and resuscitate local economies and communities on both sides of the border. I am asking that the Water Board: 1) Issue the Water Quality Certification in time for dam removal in 2020; 2) Include all the hard work that went into the 2012 joint California/Federal evaluation; 3) Incorporate new scientific information produced since 2012; and 4) Analyze the long term benefits of dam removal on water quality, fish populations, public health and our economy.

I support any actions that restore water quality conditions in the mainstem Klamath river and provide fish passage at the dam sites. I believe the Water Board can set a precedence for dam removal by issuing the water quality certification.

Thank you.
Heather Hendrixson

Thaler, Parker@Waterboards

From: Danielle Hereford <danielle.fish.johnson@gmail.com>
Sent: Friday, January 13, 2017 8:09 AM
To: Thaler, Parker@Waterboards
Subject: Please remove the dams

Dear Mr. Parker Thaler,

I am writing to express my support for the removal of all four dams on the Klamath River. I am very concerned about poor water quality conditions above each dam, the age of these dams, and their inability to comply with necessary needs for fish passage. These dams are out dated and it is time for the Klamath River to become a functioning ecosystem again. The dams are no longer an economical investment for our community. Please remove the dams.

Danielle Hereford
Klamath Falls

--
Danielle Hereford

From: Mr. & Mrs. Steve Heron <user@votervoice.net>
Sent: Tuesday, January 31, 2017 7:35 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

Other key points I urge you to consider:

1. The 2012 joint California and federal EIR/EIS and related documents concluded that dam removal on the Klamath is in the best interest of the public. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies, which can be relied upon for your EIR.

2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Steve Heron
56 Upper Cir
Carmel Valley, CA 93924
steveheron@sbcglobal.net

From: John Hewitt <user@votervoice.net>
Sent: Thursday, January 26, 2017 6:05 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

John Hewitt
16 Marquard Rd
Carmel Valley, CA 93924
jhewitt198@aol.com

From: Diane Higgins <4joy@suddenlink.net>
Sent: Monday, January 30, 2017 12:58 PM
To: Wr401program
Subject: Re: request for Klamath Dams meeting in Arcata

Hello Robot,
Apparently you have taken over the job of humans. Maybe you will do it better.

If a human actually reads this - Why would you enter this comment into the document? It has nothing to do with the issue of dam removal - it was a suggestion (solicited by you) for how to set up the room for the hearing.

Regards,
A Person
==========

On 1/30/2017 11:06 AM, Wr401program wrote:
> Hi Diane,
>
> Thank you for submitting comments. Your comments will be considered in development of our California Environmental Quality Act document.
>
> Parker Thaler
>
> -----Original Message-----
> From: Diane Higgins [mailto:4joy@suddenlink.net]
> Sent: Wednesday, January 11, 2017 12:36 PM
> To: Wr401program
> Subject: request for Klamath Dams meeting in Arcata
>
>
> I attended your scoping meeting about Klamath Dam removal that was held at the Community Center in Arcata last year, The room was set up so that in order to face your panel, speakers had their backs to the audience. The PA system was terrible, making it very difficult for the audience to hear what speakers were saying.
>
> During the proceedings, I suggested to the woman from your agency that the podium and panel table should be arranged so that speakers could face the audience and the panel. I don't think my suggestion was accepted, as her response was "people can face any direction they want". This was delivered in a very nasty tone.
>
> Please accept this as a helpful tip, and ask your co-worker to be more courteous to people who attend your meetings.
>

From: John Hogan <jwhogan@charter.net>
Sent: Friday, January 27, 2017 9:21 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

John Hogan
16985 Malaga Dr
Morgan Hill, CA 95037
jwhogan@charter.net

From: Junko Hoshi <hoshijunko@hotmail.com>
Sent: Tuesday, January 31, 2017 5:43 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Junko Hoshi
2543 Overhill Ln
Davis, CA 95616
hoshijunko@hotmail.com

From: Jeff Howard <jhighcntry1@gmail.com>
Sent: Thursday, January 26, 2017 5:10 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Jeff Howard
5700 Teck St
Fair Oaks, CA 95628
jhighcntry1@gmail.com

Lake Shatina, CA

Werner F. Hoyt, PE

2017-01-10

To : North Coast Regional Quality Control Board

State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA 95812-2000
parker.thaler@waterboards.ca.gov
(916) 341-5321

Re: Comment Submittal for Scoping conference for Federal Energy Regulatory Commission (FERC) Project No. 14803
Project Name: Lower Klamath Project

Dear Mssrs:

The scoping conference and subsequent CEQA EIR/EIS should incorporate principles of scientific rigor, quantification, & cost evaluation. Any CEQA approval on the part of the Waterboard requires that **all** factors must be evaluated and looked at in totality.

In reviewing the following as the basis of accepting the proposed license surrender it only begins to outline the issues surrounding the delicensing and power plant removal.

Klamath River Water Quality Issues

Blue-green algal blooms occur yearly in the Klamath River and in Iron Gate and Copco Reservoirs. One species, *Microcystis aeruginosa* (microcystis), produces microcystin, a liver toxin, and has led to annual issuance of state health advisories during the late summer and early fall (health advisory poster). The anadromous fish populations in the Klamath River watershed have declined significantly in recent years, which may be related to various factors including fish passage blockage, parasitic fish diseases in the watershed, and poor water quality. The Klamath River and Project dam developments are listed inÂ the California's 2012 Clean Water Act Section 303(d) List of Impaired Water Bodies (2012 Integrated Report) as follows:

- The Klamath River from the Oregon border to the Pacific Ocean is listed for nutrients, organic enrichment/low dissolved oxygen, and temperature.
- Iron Gate and Copco No. 1 reservoirs are listed for mercury and microcystin, a liver toxin produced by blue-green algae.
- The Klamath River from Copco No. 1 reservoir to the Trinity River is listed for microcystin.
- The Klamath River from the Trinity River to the Pacific Ocean is listed for sediment.
- The Klamath River from Iron Gate Dam to the Scott River is listed for aluminum.

The proposed license surrender, decommissioning, and removal of the Klamath River Power plants will generate conditions which cause water quality of the river to decline. The source of waters above the Scott and Trinity Rivers is from the Shasta Valley and Klamath Basin. These are volcanic alkaline basins with relatively arid conditions. The early exploration in the Mid 1800s notes water conditions at the junction of the Klamath and Shasta Rivers as fit for neither man nor beast. Accounts of my grandfather, Sidney F. Terwilliger (1894-1977) regarding water quality before the installation of the Kamath Power System were that the river reeked and above the Shasta River the salmon were so parasite ridden that they were in edible and no one fished for salmon in this area of the river.

This is a testament that the blue green algal blooms will continue exist in absence of the reservoirs in the river system due to the low flows in the August to October period before the winter storms begin bringing appreciable precipitation to the Klamath and Shasta River Basins. In years of low flow the river temperatures will not be moderated by the reservoirs as they now are. Power plant removal will not improve this condition and from historical accounts of water quality will exacerbate the algal and parasite problems on the Klamath River upstream of the Scott and Trinity Rivers where we begin to receive cooler waters from the Trinity and Scott Valley Watersheds.

Issues of declines in andronomous fish need to be analyzed through trend analysis of all contributing factors. These are:

A. Environmental

1. Pesticide and Fertilizer usage – peaked during the 50's and 60's and been declining ever since improving water quality trend here.
2. Timber Harvest – Substantially reduced in the basins. Today is <10% of it's peak in the 1950s-1960's. Implemtation of stream belt protections has additionally improved water quality. Trend here has been steadily improving.
3. Power plant system – resulted in improved water quality below the power plants. From a step improvement the installation to the present this environmental factor has been a constant regarding fish behavior.
4. Bureau of Reclamation unseasonable releases of water from the Trinity Reservoir to support the Hoopa Boat festival, an artificially created cultural event, generates cold water pulses at the end of August and early September that trigger fish migration by simulating onset of early rains and precipitation in the basins. This results in stranding of returning fish and loss of their spawning efforts. The natural order is for the basin to be cooled by fall weather, fall rains increasing river flows and cooling the river system before the fish migrations are triggered by increased flow with cooler temperatures.
5. Andronomous fish are transpacific in nature. Returns are affected by fisheries as far away as the Sea Of Okask and the Sea of Japan. Trend lines need to be developed for this factor.
6. International fisheries/domestic fisheries within the US 200 mi economic zone take impacts returns. Trend lines need to be developed for this factor.

7. Global climate trends regarding sea water temperature. Increased ocean temperature off of the west coast causing migratory returns to make landfall further north than would otherwise take place. Trend lines need to be developed for this factor.
8. Marine Mammals Protection Act. – sea lion populations have exploded from a population of 5,000 to over a half a million today. There is now evidence of starvation an pup loss due to inadequate fish stocks to support. Sea lions congregate at the river mouths and wait for the returning populations to come to them. Trend lines need to be developed for this factor.
9. Native American Fisheries – take is now commercial for sales rather that subsistence utilization. Trend lines need to be developed for this factor.

B. Other considerations

1. Removal will impact the behavior of migratory water fowl which now use the reservoirs as a stop over and feeding ground.

2. Loss of green power generation

3. Loss of flood control on the Klamath River

4. Loss of jobs.

5. Decreased energy security

6. An effective increase in CO2 emissions to replace the power currently generated.

7. Minimal increase in effective salmon spawning habitat in the river from COPCO to Boyle reservoir due to the impassible reef under Boyle. Salmon did not range into the upper Klamath.

8. Increase risks to property due to lack of flood control on the Klamath River, to the communities of Happy Camp, and other communities on the lower Klamath

9. Release of sequestered Hg, PCB's, and sediments from breach of the reservoirs. Estimates place the quantity of sediments that will be released will initially generate a 1-3 ft. layer of new sediment from the lower dam the coast. This will effectively kill the river for 3-5 years or more. Environmental balance restoration is likely to be substantially longer. The releases will completely eliminate any spawning on the Kamath below Boyle due to the sediments for a period likely to exceed 10 years or more for the basin to wash the sediments out of the upper Klamath.

To date Environmental Impact Studies and reports have failed to look at the overall picture regarding the Klamath River Power Plants in pursuit of a predetermined objective – removal. CEQA and NEMA both require that these studies look at all factors, quantify and assign values. The California FWS, National Marine Fisheries Service, and Fish and Wildlife Service have all been chastised for failing to apply rigorous science in their Biological Opinions. The Federal Courts have also weighed in on their failure to quantitatively evaluate factors as well as costs.

With the lack of scientific rigor, quantification, cost evaluation the studies presented to date fail to provide adequate justification for the power plant removals. Any scoping for an EIS/EIR needs to properly cover all aspects and not cherry pick for a predetermined outcome. There are significant issues involved that affect the residents of the Klamath River, Siskiyou County, and Klamath County. Any approval on the part of the Waterboard requires that all factors must be evaluated and looked at in totality. Only this way can we come to a reasoned decision.

Sincerely,

Werner F Hoyt

Werner F. Hoyt, PE

Lake Shastina

Weed Ca

Thaler, Parker@Waterboards

From:	Voter's Petition\vps <voterspetition@voterspetitions.com>
Sent:	Thursday, January 19, 2017 12:58 PM
To:	Thaler, Parker@Waterboards
Cc:	voterspetition@voterspetition.com
Subject:	Don't Ruin the Klamath River Hydroelectric Dams!
Attachments:	Klamath River map.jpg

2029 Sargent Avenue
Klamath Falls, OR 97601-1747
Tel.: 541-205-6079
Epost: branchfork@voterspetitions.com

01/19/2017

State Water Resources Control Board
Division of Water Rights
Water Quality Certification Program
Attention: Mr. Parker Thaler
Email: parker.thaler@waterboards.ca.gov

Don't Ruin the Klamath River Hydroelectric Dams!

Dear State Water Resources Control Board Personnel:

Herewith now I disapprove of and I vote against approving Klamath River Renewal Corporation (KRRC) removal of any Klamath River hydroelectric dam. Similarly, I herewith vote against granting approval for any Klamath River hydroelectric dam to be removed, if the dam to be removed is not to soon be replaced with a nearly equivalently, or greater than equivalently, functional dam at or near the original location of the dam to be removed. Also, I herewith vote against the California State Water Resources Control Board granting an approval for any Klamath River Renewal Corporation (KRRC) removal of any Klamath River hydroelectric dam.

I herewith vote that the United States of America (U.S.A.) Department of the Interior should purchase and manage the Klamath River hydroelectric dams, and where necessary, the dams should be improved with upper Klamath River fish-adequate fish ladders and fish screens, so that the dams continue to provide much multiuse--including hydroelectric power production--of the Klamath River, and so that the dams are responsibly managed as public property per the United States of America's national citizenship.

Here are some of the facts from which I approve, support, and vote for both retaining the Klamath River hydroelectric dams, and providing adequate fish passageways in the Klamath River hydroelectric dams:

1) an established, plentiful, and operational supply of U.S.A. full time hydrodam-powered renewable electricity generation, provides greater U.S.A. electricity production security, than does only a plentiful supply of intermittent generation (such as wind or solar) renewable electricity generation;

2) every U.S.A. river is first and foremost exclusively for humanity's survival; salmon's river-dependent survival is never more than secondary to humanity's river-dependent survival, where humanity is not extremely underpopulated, or extremely infertile, or extremely food scarce;

3) ruining humanity's vital life support is much easier than preventing humanity's vital life support from being ruined, and--especially in North American war times--the Klamath River hydroelectric dams may provide much vital life support for North Americans;

4) the Klamath River hydroelectric dams provide much vital life support—-including home heating, cooking fuel, inanimately mechanized traveling fuel, lighting, powered irrigation with resulting food biomass production—-for a technologically advanced large human population economic culture, whereas substituting the Klamath River salmon for the Klamath River hydroelectric dams, provides one of humanity's more primitive and exclusively small human population size supporting hunter/gatherer/farmer economic cultures—-i.e., a greatly wildcrafted food and fertilizer based economy--, that is less sheltering, less environmentally compensating, less food productive, much less large human population supporting, more environmentally variable, and therefore less secure for humanity's survival;

5) when and/or if any Klamath River dam should be repaired, upgraded, or rebuilt to provide its best Klamath River multiuse service, it should be so fixed;

6) J.C. Boyle and Iron Gate dams are both mostly earthfill, and so they are both easily and inexpensively repairable, and they should last a very long time without needing major fill repair;

7) iron reinforcement within the dams is deeply sealed within concrete, and in at least Copco 1, often of large "rail" size, and should not rust excessively for centuries;

8) adequately functional fish passageways and fish screens—-such as a flow-through loose rock cobble and pebble aggregate turbine canal screen--are very readily and affordably installable in Copco 2 dam, and affordably and satisfactorily easily installable in Copco 1 and Iron Gate Dams,

9) J.C. Boyle Dam has an adequate fish--e.g., salmon--ladder and fish screen already;

10) equipping the dams with fish passageways--including screens--likely costs less or nearly the same as both the $200 million currently required collected for Klamath River dam destruction from PacifiCorp Pacific Power ratepayers, plus the $250 million proposed collected from California taxes for Klamath River dam destruction, especially since only three of the dams are without any fish ladder and any fish screen;

11) dam reservoir water quality varies with the seasons and withheld water volume, and has always been adequate for fish habitat and fish passage of some of the reservoir resident fish;

12) Boyle Dam and Iron Gate Dam reservoirs' waters equilibrate rapidly to natural environment ambient conditions within a few miles or less downriver from those dams;

13) trophy size salmon catching downriver of and near to Iron Gate Dam is an annual event;

14) many of California's and Oregon's salmon rivers have been stocked with salmon from other rivers, and many of those salmon have successfully returned back to the river that they were stocked in;

15) in the event that the United States of America inadvertantly, mistakenly, or wrongly explodes a military weapon tresspassingly against a foreign and/or an allied power, the Klamath River hydroelectric dams provide a remote and major population-safe retaliatory target, for the trespass-offended foreign and/or an allied power to damage in caution to the United States of America;

16) humanity's best civilization is for preserving humanity healthily, so that humanity may best survive for the longest time that humanity may continue existing alive, and the Klamath hydoelectric dams provide some of humanity's least wasteful, least expensive, most healthy best life support possible, thus—-and allowing for possible large scale natural and/or artificial alteration to the dams--the dams are at or near where they should be forever more;

17) the dams reduce habitat for the salmon diseases *Ceratomyxa shasta* and *Parvicapsula minibicornis* that both inhabit the same polychaete host,

Manayunkia speciosa, because *Manayunkia speciosa* prefers shallow running water over an exposed pebble and small stone riverbed, rather than a dam reservoir silted bottom; thus removing the Klamath hydoelectric dams' reservoirs, perhaps may increase Klamath River presence of the Klamath River salmon-killing salmonid parasites,*Ceratomyxa shasta* and *Parvicapsula minibicornis*, per restoring free-flowing river environment that favorably supports the parasites' common polychaete worm host, *Manayunkia speciosa* (*Manayunkia speciosa* has been found (e.g Journal of Parasitology 93(1):78-88. 2007) inhabiting Klamath River pools, Klamath River eddies, and river-inflow areas of either Klamath Lake or Klamath River reservoirs, in much greater densities (please see Figure 1 below) than in most sampled nonriver-inflow areas of Klamath Lake or Klamath River reservoirs. *Manayunkia speciosa* is very likely currently present from the Sprague River tributary of the Williamson River, through parts of Upper Klamath Lake and alternating parts of the Klamath River, to within a few miles of the Klamath River's mouth. Whether or not Klamath River reservoir water releases may effectively temporarily reduce *Manayunkia speciosa Klamath R*iver habitat enough, so as to reduce disease infection of Klamath River salmon, currently appears to be a productive area for multi-year Klamath River Dam research.);

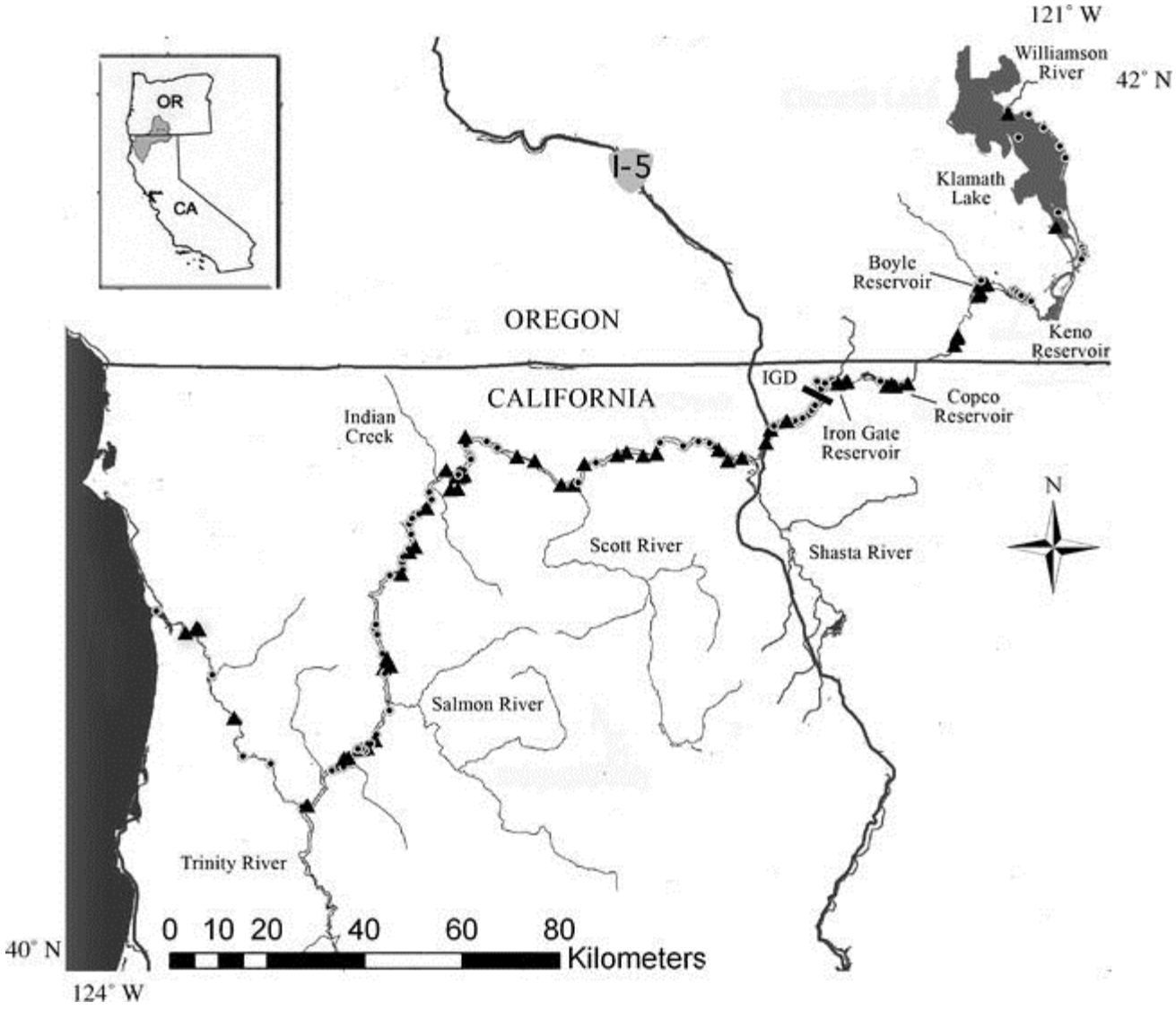

Figure 1. Map showing 2003–2005 sample sites in the Klamath River California–Oregon. Circles are sample sites where ***Manayunkia speciosa*** was not identified and filled triangles are sites where the polychaete was identified. For this study, Iron Gate Dam (IGD) divides the Upper Klamath River from the Lower Klamath River. The Lower Klamath River was further divided and sampled from IGD to Interstate-5 (I-5), to Scott River, to Indian Creek, to Salmon River, then from Trinity River to the estuary. (Map from Journal of Parasitology 93(1):78-88. 2007)

18) the same blue green algae—-including toxic *Microcystis aeruginosa*--that are in the Klamath River hydroelectric dam reservoirs, are also substantially present in Upper Klamath Lake and Agency Lake, and occur more readily in the warmer climate of Klamath River's lower elevations than in the cooler climate of Klamath River's higher elevations. During the immediately previous 30 years, large blue-green algae blooms have apparently first commenced to routinely occur in several higher elevation volcanic soil Cascade mountain range lakes, including Odell Lake, Lemolo Lake, and Diamond Lake, however some of those blooms may greatly be due to septic tank and/or outhouse sewage effluent migration;

19) much—-if not most—-of the bluegreen algae growth in Klamath River, is due to the extremely naturally nutrient rich (hypereutrophic) Upper Klamath Lake and Agency Lake tributary waters to Klamath River. Per the Williamson River, Upper Klamath Lake receives secondarily treated municipal sewage effluent from the small City of Chiloquin, and per Lake Ewauna, Klamath River receives both bioremediated sewage lagoon effluent from the Klamath Falls South Suburban Sanitary lagoons, and Klamath Falls Municipal Waste Water Treatment Plant secondarily treated waste water effluent. Those processed sewage effluents may likely be significantly more nutrient-—including phosphorous and nitrogen--rich, than is the municipal fresh well water supply of either Chiloquin or Klamath Falls;

20) the dam reservoirs provide in-river water storage for fish habitat, and have been used to augment lower Klamath River flows all the way to the ocean;

21) since the 1940's, Crater Lake's average snowfall has declined 26% (information derived from U.S. Department of the Interior Crater Lake Winter/Spring 2008-2009 *Crater Lake Reflections* newspaper), and the dams are necessary to provide substitute water storage for both the Klamath River biota, and for agricultural irrigation withdrawals from Upper Klamath Lake and Klamath River;

22) Fall Creek fish hatchery, and upon its replacement by Iron Gate fish hatchery, Iron Gate fish hatchery, has provided many--if not most--of the chinook salmon that have returned to the Iron Gate Dam area since Copco 2 was built in 1925;

23) Iron Gate fish hatchery has always been quite affordably funded annually from Klamath River hydroelectric dam-generated electricity sales, and Iron Gate fish hatchery should continue to always be used for salmon--including endangered Klamath River tributary Coho salmon--production,

after installation of Upper Klamath River anadromous fish migration-adequate fish passageways in all of the Klamath River hydroelectric dams is completed;

24) the Klamath River hydroelectric dams are fraudulently opposed as competition against expansion of fossil fuel--e.g. natural gas--powered electricity generation, and greedily opposed as not providing local government tax revenue that is equivalent to natural gas combustion substitution for Klamath River hydroelectric production, and selfishly opposed for not providing leasing fees to private land owners like a Malin, Oregon Ruby natural gas pipeline extension could;

25) a successful private enterprise Fort Klamath Oregon salmon hatchery exists currently, and could be readily employed to assist Klamath River basin salmon production;

26) why should California's taxpayers have to pay—-per California's 2014 Water Bond Proposition 1--$250 million dollars, to help destroy one excellent hydroelectric dam and three very good hydroelectric dams that are owned by multibillonaire Warren Buffet (W.Buffet owns near $71 billion)?;

27) J.C. Boyle Dam provides important Klamath County tax revenue;

28) fire suppression, recreation, wildlife habitat, clean renewable electricity production, possible transfer of Klamath River water to the Shasta, Scott, or Sacramento rivers, and Trinity Reservoir water conservation* in low Klamath River water flow years, are all provided from and per the Klamath River hydroelectric dams;

29) the Klamath River chinook salmon runs have been good with the dams, and those runs should improve after adequate fish passageways are installed in all of the Klamath River hydroelectric dams, so that chinook salmon may migrate to cool upper Klamath River and/or cool Upper Klamath Lake tributary waters;

30) because the Klamath River hydroelectric dams are located in a mostly remote and undeveloped “fail-safe” area, if any of the dams should ever suddenly collapse, any flooding that may result of the collapse shouldn't cause great loss of life or property;

31) the claim that insufficient quantities of chinook salmon will swim past all four of the Klamath River hydroelectric dams, once all of those dams are equipped with upper Klamath River fish-adequate fish passageways, depends greatly on how chinook salmon fry and fingerlings adapt and develop in the agriculturally altered and non-native fish-stocked Sprague River tributary and mainstem system, Williamson River, and Seven Mile Creek, and how chinook salmon fingerlings adapt and develop in the greatly algaenated and greatly non-native fish species populated waters of Agency Lake, Upper Klamath Lake, and the Klamath River hydroelectric dams' reservoirs, and how many chinook salmon may survive 1) increasing ocean

acidity that is due to increasing atmospheric carbon dioxide, 2) climate change-produced ocean warming, 3) ocean fishing, 4) river fishing, and 5) the rather small Klamath River estuary, and is not justified as a necessary consequence of fish passage-adequate fish passageway equippage of the Klamath River hydroelectric dams;

32) our U.S.A. judicial court system has determined that for the Klamath River hydroelectric dams to be worthy for relicensing, the Klamath River hydroelectric dams must have fish passageways installed in those dams, and therefore I find that J.C. Boyle Dam is worthy of and overdue for relicensing now;

33) I estimate that because of J.C. Boyle Dam Reservoir's length of near 3.5 miles, and Copco 1 Dam Reservoir's length of near 6 miles, and Iron Gate Dam Reservoir's length of near 5.25 miles, and because of each of those reservoirs' headwater area width, much of the headwater and middle area of those reservoirs provide an effective sediment trap, so that upon lowering the water level in those reservoirs, much of any slow water flow-deposited sediment in those areas may be bulldozed out of those reservoir areas, and thus the reservoirs' headwater sediment traps be restored;

34) per upgrading Copco 1 and Iron Gate dams with fish passageways, those dams need to be repurposed for fish passage, water conservation, and river water level augmentation uses, in addition to those dams remaining hydroelectric dams. Copco 1 and Iron Gate dams need multi-level inlet/outlet fish ladders at or near the dams' faces, so as to allow fish passage during drawdown of the dams' reservoirs, that is for the purpose of Klamath River water level maintenance during low Klamath River water level periods;

35) Copco 2 (33 feet high) and J.C. Boyle (68 feet high) dams have small reservoirs, and can completely shut down water flow to their hydroturbines to maintain water flow over the dams. Both of those dams need only a single level fish ladder outlet each, to adequately assure fish ladder passage past the dams. Installation of an original never before existent fish counting station at the proposed Copco 2 Dam fish ladder, and at the current J.C. Boyle Dam and Keno Dam fish ladders, would greatly improve Klamath River Fish monitoring;

36) once a Klamath River hydroelectric dam is furnished with a concrete fish ladder, that is adequate for passage of all native upper Klamath River fish, concrete roofs that are over only each even numbered “every other” (i.e. alternate) fish ladder step of that dam (counting the steps from ladder bottom to ladder top sequentially as 1,2,3, etc.), might possibly improve salmonid utilization of that dam's fish ladder, per providing fish habitat seclusion, shade, and water topside surface security for migrating fish;

37) I estimate that the Klamath River hydroelectric dams have paid for themselves several times over, and I don't find that upgrading with fish passageways three or four of the Klamath River hydroelectric dams, must be

excessively expensive, especially since those upgrades are likely much tax deductible. For example, per my current PacifiCorp electricity bill, I pay near 5.15¢/kwh, so based on the Klamath River hydroelectric dams usually being operated at an 81.5MW one-half generation capacity annually, I calculate that the dams provide near $36,818,905.00 in annual revenue for PacifiCorp, and thus the dams can pay for their upgrade within 18 years, or about the same amount of time that was required to first build the dams.

Because the proposed removal of the Klamath River hydroelectric dams would be the largest United States of America hydroelectric dam removal in U.S.A. history, I find that dam removal proposal is very likely significantly supported per ecoterrorists.

Per reiteration, I disapprove of and vote against Klamath River Renewal Corporation (KRRC) removing any Klamath River hydroelectric dam, and I herewith vote against granting an approval to the Klamath River Renewal Corporation (KRRC) to have any Klamath River hydroelectric dam removed of, and I herewith vote against the California State Water Resources Control Board granting an approval for any Klamath River Renewal Corporation (KRRC) removal of any Klamath River hydroelectric dam.

Thank you for your help with this “Don't Ruin the Klamath River Hydroelectric Dams!” petition of my voluntary nonsalaried voting!

Built onto a plaque at J.C. Boyle Dam is the following message: "Through God's merciful providence and man's ingenuity this plant was placed in operation October 1, 1958, and dedicated to the lasting benefit of the people we are privileged to serve."

Respectfully yours,

Danny Hull, B.S. Biology (Medical Technology major); A.A.S. Environmental Health Technology (Water Quality Control major).

*e.g.: **Reclamation to Release Additional Water from Trinity Reservoir to Supplement Flows in the Lower Klamath River; Environmental Documents Released** Media Contact: 916-978-5100 For Release: August 24, 2016 SHASTA LAKE, Calif. – The Bureau of Reclamation will release additional water from Trinity Reservoir for the lower Klamath River to help protect returning adult fall run Chinook salmon from a disease outbreak and mortality. Supplemental flows from Lewiston Dam will commence on August 25 and extend into late September. On August 2, Reclamation released a Draft Environmental Assessment (EA) for the plan to use water from Trinity Reservoir for the supplemental flows. . . . The Final EA and Finding of No Significant Impact are available at http://www.usbr.gov/mp/nepa/nepa_projdetails.cfm?Project_ID=26477 . . . . Reclamation is the largest wholesale water supplier and the second largest

producer of hydroelectric power in the United States, with operations and facilities in the 17 Western States.

Its facilities also provide substantial flood control, recreation, and fish and wildlife benefits. Visit our website at www.usbr.gov and follow us on Twitter @USBR.

From: Timothy Hunt <sea2peak@gmail.com>
Sent: Friday, January 27, 2017 3:06 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

Other key points I urge you to consider:

1. The 2012 joint California and federal EIR/EIS and related documents concluded that dam removal on the Klamath is in the best interest of the public. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies, which can be relied upon for your EIR.

2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Timothy Hunt
5233 Quaker Hill Ln
San Diego, CA 92130
sea2peak@gmail.com

From: Kyle Huntley <kyle.huntley33@gmail.com>
Sent: Saturday, January 28, 2017 4:06 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

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Sincerely,

K. Huntley
11824 Payson Ln
Oregon City, OR 97045
kyle.huntley33@gmail.com

Thaler, Parker@Waterboards

From: Nancy Ihara <nancyihara@gmail.com>
Sent: Thursday, January 26, 2017 4:56 PM
To: Wr401program
Subject: Lower Klamath Project License Surrender

Dear Mr. Thaler,

There are people better informed than myself regarding water quality issues related to the Klamath River and water quality issues related to the removal of Iron Gate, Copco 1 & 2, and the J.C. Boyle dams. However several key points made by others have made an impression on me.

1) The Klamath River presently is notably unhealthy. Swimming in the river is often not advised. Algae blooms threaten pets exposed to the river with illness and death. Salmon acquire parasites and diseases at abnormal levels. The Klamath dams are the major factor in these conditions.

2) Prior to the dams, under the management of indigenous tribes, the Klamath was healthy and supported abundant quantities of salmon and other fish and wildlife for hundreds if not thousands of years. When these successful managers call for dam removal, we should listen to them.

3) While dam removal will have immediate negative impacts on water quality, these impacts, according to experts who have studied dam removal elsewhere, are temporary and fairly quickly resolved.

I urge the State Water Board to approve the Lower Klamath Project License Surrender.

Nancy R. Ihara

Mary Ingram
1400 Pine Grove Dr.
Mt. Shasta, Ca. 96067

January 30, 2017

Parker Thaler
State Water Resources Control Board
Division of Water Rights – Water Quality Certification Program
PO Box 2000
Sacramento, Ca 95812-2000

Re: Comments in response to the Notice of Preparation.

To Whom It May Concern:

I, Stanley Swenson, want to go on record as being opposed to the dam removal which is part of the Lower Klamath Project License Surrender. My personal opinion is, the removal of the dams will create more environmental problems as a result of breaching the dams and flushing and estimated 8.6 million cubic yards of silt down the Klamath River all the way to the Pacific Ocean. If the dams are removed, through all of the wisdom of the proponents, and the goals of opening historical (not likely) spawning grounds of the chinook and coho salmon, does not happen due to low flows, impassable barriers, or unacceptable conditions, will the proponents pay for the construction of new replacement dams?

It is my understanding that California State Water Resource Control Board is the lead agency that is preparing the CEQA review on applications for water quality certifications for hydropower projects under section 401 of the federal Clean Water Act. Why are the citizens of California paying CSWRCB, through public funds, to prepare the CEQA review? As a developer or proponent, the Klamath River Renewal Corporation (KRRC) should bear the costs of preparing the CEQA review.

I have some concerns that need to be studied, addressed and mitigation requirements agreed to before the dams are breached. My concerns are listed as follows:

1. The breaching of the 3 dams on the lower Klamath Project and the 1 dam in Oregon, will release up to 8.6 million cubic yards of silt. In the past, the central valley region of the California Water Quality Control Board, fined the City of Redding for clean water act violation to the tune of $450,000. The fine was for storm runoff, during a 1 inch midsummer lightning storm, that muddied a season creak during the

construction of a baseball field in one of the city parks. On the bridge replacement project on Interstate 5 at Lake Head, California, the Federal EPA fined the project contractor and Caltrans, a state agency, $80,000 each for violating the Clean Water Act, when storm water muddied Shasta Lake during a winter storm.

a. When the dams are breached on the Klamath River will the sediment create a muddied water situation that will be in violation of the Federal Clean Water Act?
b. Who will pay the fine for any violations?
c. Will the fine be passed on to the consumer?
d. What will the effect of the silt and sedimentation have on the salmon spawning beds.
e. How do you mitigate the effect of the loss of spawning beds?
f. Will the release of sediment result in the death of any coho salmon, which is listed as rare and endangered?

2. The breaching of the 4 dams on the Lower Klamath Project will release a variety of game fish which are captive behind the existing dams. The game fish released include bluegill, perch, small and large mouth bass, crappie, catfish, and more.
   a. What will the effect of the above named fish have on the salmonids between Iron Gate Dam and the Pacific Ocean?
   b. If the above named released fish establish populations on the lower Klamath River, will it result in the populations feeding on spawned eggs?
   c. If the above named released fish establish populations on the lower Klamath River, will it result in the populations feeding on juvenile salmonids?
   d. If the mitigation measure requires the killing of the above named game fish, is that allowed per the California Fish and Wildlife Codes?
3. The breaching of the 3 dams on the lower Klamath Project and the 1 dam in Oregon, will release up to 8.6 million cubic yards of silt.
   a. What toxic materials are in the 8.6 million cubic yards of sediment?
   b. How will the release of toxic materials be mitigated?
   c. Is the release of sediments and toxic materials allowed under the federal Clean Water Act?
4. The breaching of the Klamath River Dams will remove an important flood control system.
   a. What measures will be taken to prevent flooding on the Klamath River once the dams are removed?
   b. What financial provisions will be in place to assist people along the Klamath River when their private properties are damaged by flooding?

5. The existing dams on the Klamath River release water to aid in the migration of spawning salmon and help to prevent disease and parasites from injuring the salmon.
    a. What system will be in place to assist migrating salmon after the Klamath River Dams are breached?
    b. If the reports of the 1850s military expedition are true, will there be sufficient water, and not stagnate pools, to allow for the salmon migration?
6. A detailed study, by Eric Logan and David Hankin, in 2005 & 2006 an estimated 8 million juveniles are released by the Iron Gate Hatchery. The estimated fish returning to spawn is approximately 8 thousand fish.
    a. With the number of fish released and the low number of fish returning to spawn at the Iron Gate Hatchery would indicate that there is a mortality rate that is not caused by the conditions in the Klamath River. Is the mortality rate due to over fishing in the Pacific Ocean?
    b. An alternative to dam removal, to increase salmon populations in the Klamath River System, would be to put a moratorium on tribal fishing for a period of time and see if it helps the number of returning salmon.
    c. When the tsunami destroyed the Japanese Fishing Fleet, in 2011, the fall run of spawning fish was high in the fall of 2011. The fish biologist studying the Klamath River that fall, hypothesized, the problem with returning salmon was not in the Klamath River System. The problem was in the over fishing in the Pacific Ocean. This needs to be studied.
7. The dams on the Klamath River Hydro Project produce enough electricity for 70,000 customers. The power produced it clean, environmentally, compared to alternatives.
    a. What are the environmental damages that will result from power production if the dams are removed?
    b. How will the power companies mitigate the environmental damages without increasing power rates to the consumer?
8. Federal and State law required both the state and federal government to coordinate with local groups; such as county supervisors, school boards, fire districts and irrigation districts. Measure G, which was a local advisory ballot measure, clearly showed that approximately 80% of the Siskiyou County Voters wanted the dams left in place. The board members were part of the 80% local voters that supported leaving the dams in place.
    a. Why has the coordination process broken down?
    b. The board members have reached out to the government proponents of the dam removal project, why have the proponents now responded to these groups?

c. Why has the voice of the local people, in light the of constitutional phrase "for the people and by the people", not been heard?

In closing, I look forward to reading the final draft of the EIR to see if the voice of Siskiyou County Residents are heard and understood in relation to the Dam Removal Project.

Thank You For Your Time,

Mary Ingram

Mary Ingram

From: Yadao Inong <user@votervoice.net>
Sent: Thursday, January 26, 2017 7:39 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Yadao N Inong
PO Box 497
Hoopa, CA 95546
yurok_otter@yahoo.com

From: Trevor Iodence <trevoriodence707@gmail.com>
Sent: Wednesday, January 25, 2017 10:28 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Trevor Iodence
475 Benvenuto Ln
Sebastopol, CA 95472
trevoriodence707@gmail.com

From: Eric Iwafuchi <user@votervoice.net>
Sent: Thursday, January 26, 2017 7:34 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Eric Iwafuchi
1516 Bel Aire Cir
South Lake Tahoe, CA 96150
eiwafuchi@yahoo.com

1/30/17 EIR/PT

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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1. The 2012 joint California and federal EIR/EIS and related documents concluded that dam removal on the Klamath is in the best interest of the public. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies, which can be relied upon for your EIR.

2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible.

Thank you!

Aura Johnson

STATE WATER RESOURCES CONTROL BOARD
2017 FEB -2 PM 12: 33
OFFICE OF ADMINISTRATIVE LAW
SACRAMENTO

From: Dan Johnson, dtjohnsonis <dtjohnsonis@gmail.com>
Sent: Friday, January 27, 2017 3:25 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

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Sincerely,

Dan Johnson
606 Fallen Leaf Cir
San Ramon, CA 94583
dtjohnsonis@gmail.com

From: Matt Johnson <matthewrjohns75@hotmail.com>
Sent: Thursday, January 26, 2017 8:54 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Matthew R. Johnson
8620 Sherwood Blvd
Los Molinos, CA 96055
matthewrjohns75@hotmail.com

FER/P1

Dear Mr. Thuber,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

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Thank you,
Will Johnson
Owner
The Ashland Fly Shop
Ashland, Oregon

STATE WATER RESOURCES CONTROL BOARD
2017 FEB -2 PM 12:32
OFFICE OF ENFORCEMENT
SACRAMENTO

Thaler, Parker@Waterboards

From: michelenbobbyj <michelenbobbyj@aol.com>
Sent: Monday, January 30, 2017 3:13 AM
To: Thaler, Parker@Waterboards
Subject: ORE. DAMS. DIFFICULT TIMES.

Gov blm, fake & lying environmentalist's gov employees; Brown, Gore, Bobbit, etc. told the American loggers & 100's of other legal businesses to get out of "their" forests by lying. 20 years later, very few logging business. Company's hire illegals with fake & stolen id's. They are living & working in terrible & dangerous conditions. Dont understand why non citizens would have to pay taxes. Not their country. Angry that money is taken out of their lower wage checks. Not able to read or speak English. Driving without license/insurance & voting D at every different polling place throughout several towns. Have been known to verbally attack & physically assult R voters. Logging job's created thousands of other jobs in smaller poorer communitys. Including the boot & shoe sales & repair store. Those privately owned industries & small businesses are gone. Delapitating empty buildings. Community's are broke & so are the heavily burdened tax paying & honest working families. Livelyhoods & homes are crumbling. Logging types of jobs paid for the sheriffs, emergency services, schools, etc. Skies were blue. Air was clean. Less sicknesses & breathing disorders.
Forests are unnecessarily left to burn up. Exploding wildfires until it snows. Sounds & looks like bombs going off. Terified & suffering. Wildlife in flames. Burning up. True: Not encluded in fraud surveys are the spotted owls not living in the old growth. They live in subdivisions & parks in the green shrubbery & trees. Like any other mice eating owls. JAN - MAY your wasted tax money is being used up by gov BLM employees. Yeah, sure ..hiking miles in 5' of snow in steep & rugged mountains counting ("planted & placed") delicate spotted owls. Months of no work. Deeper in debt. JULY - DEC forest service "manages forest fires." Those counted costly owls catch on fire & valuable timber burns up.
Roads are gated off. Historical CCC trails not maintained. Not safe to use & enjoy - widow makers. Don't get lost or hurt. Not fair to your rescuers to risk their time & lives. Gov mismanagement year round. No salvage logging. No replanting. Privately owned land is valuable.
Green & healthy responsibly managed logged & reforested.
Tax paying families aren't able to enjoy their land.
But others are. Traveling through? Pack a gun. Visitor's parked cars are vandalized/stolen. Expensive forest service trucks, equipment, tools, clothes etc... fuel too, stolen. Gov doesn't want fires put out. Another hoax. Stop the expensive smokey the bear campaigns. Ask the farming & ranching community members what the catastrophic results have been due to obama, clinton .. & the other wealthy lifetime democrates of Cal, Ore, & Wash? Gov controls the air, water & land. Devastating land grabs, higher taxes & fees. Many regulations. Counties are loosing their farms, orchards, dairies & ranches. Except for our governor & congressman. GMO gov. seeds, friuts, veg meats only. Cattle grazing prevented wildfires. Ask questions when gov agency's shut down, threaten, jail, shoot & kill. Don't believe the gov & media BS spoon feeding. Liberal democrats kill. Encluding their eagle dismembering windmills. Morning shows. Stream KMED Bill Meyers & KCNR Sunday "State Of Jefferson 51", "Sovereign Minds" & "We, The People". Current new's updates from community members, authors & guest speakers.

LIVING THE NIGHTMARE. SINCERELY BOBBY & MICHELE JONES

Sent from my U.S. Cellular® Smartphone

From: Chris Juanes <user@votervoice.net>
Sent: Sunday, January 29, 2017 12:16 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

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Sincerely,

Chris Juanes
476 Yosemite Ave
Mountain View, CA 94041
Chrisjuanes@sbcglobal.net

From: Tim Kallas <thkallas@comcast.net>
Sent: Thursday, January 26, 2017 7:28 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

ThKallas
12 Meadow Ridge Dr
Corte Madera, CA 94925
thkallas@comcast.net

From: Patrick Kallerman <pkallerman@gmail.com>
Sent: Thursday, January 26, 2017 4:54 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Patrick Kallerman
630 Thomas L Berkley Way
Oakland, CA 94612
pkallerman@gmail.com

From: Austin Kamp <user@votervoice.net>
Sent: Thursday, January 26, 2017 4:13 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Austin Kamp
330 Pear St
Oakland, OR 97462
akamp120@yahoo.com

From: Matt Kane <user@votervoice.net>
Sent: Thursday, January 26, 2017 10:00 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Matt Kane
240 San Marcos Ave
San Francisco, CA 94116
matthew_kane@yahoo.com

From: Randy Kane <meanwhilecharters@gmail.com>
Sent: Sunday, January 29, 2017 9:18 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am a charter boat operator in Garibaldi, OR. Part of my business is fishing for salmon off the central coast of Oregon. Many fish that are caught off Oregon have the Klamath basin as their natal streams.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

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Sincerely,

Randy Kane
33991 SE Davona Dr
Scappoose, OR 97056
meanwhilecharters@gmail.com

From: Alan Keller <alanrkeller@me.com>
Sent: Sunday, January 29, 2017 9:34 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Alan Keller
52 Saroni Ct
Oakland, CA 94611
alanrkeller@me.com

From: Kevin Kennedy <kkflyfishinfreak@gmail.com>
Sent: Sunday, January 29, 2017 7:42 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River. We also understand that it is our right as Californians to review and comment on this eir.?

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

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Sincerely,

Kevin Kennedy
2140 Forestlake Dr
Rancho Cordova, CA 95670
kkflyfishinfreak@gmail.com

From: Lawrence Kenney <lmkenney@earthlink.net>
Sent: Friday, January 27, 2017 9:22 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Lawrence Kenney
260 Bungalow Ave
San Rafael, CA 94901
lmkenney@earthlink.net

Thaler, Parker@Waterboards

From: Alexander P. Khartchenko <alkhart@yahoo.com>
Sent: Monday, January 30, 2017 12:04 PM
To: Thaler, Parker@Waterboards
Subject: Copco Lake and dam removal on the Klamath water shed

Those are my Comments to the Project

Copco Lake and dam removal on the Klamath water shed

Attention: State Water Resources Control Board

My name is Al Khart (Alexander Khartchenko)
I am the resident of Copco Lake, Montague, CA where I bought a property 5 years ago.

After attending the State Water Board Meeting on Feb 26th at Yreka Miner's Inn Convention Center and listening to the presentation related to the Project of Removal of Klamath River Dams I wish to raise my concerns about the situation around Klamath River.

Definitely the presentation was not well thought out and prepared.
It had stated that the only possible and feasible project is 'to remove dams'.
With no alternatives to it. (Really?)

This is not a constructive way to do any project in the current world which is so important for people living near dams, for local economy and environment.

There were no scientific evidence to support the statement 'to remove the dams":
no modeling or mathematical simulation was done related to consequences of dams removal.
Absence of any alternatives in the presentation shows that the authors of the presentation and the project do not see the whole picture of humanitarian, economical and ecological damages which could be done to the Siskiyou county environment by this project.

Below is a short list of positive things which existing dams
- those dams as you know are 100 years old -
provide:

1. The strongest protection against Fire (the example of 2014 fire, when Copco Lake provided all water for helicopters fighting the fire; in fact my house and many houses are alive thanks to the Lake
2. Flood prevention: Dams are the regulator of dangerous water levels, and save people from flooding
3. Droughts are easier to survive only because of Lakes as well
4. The cheapest Electric Energy provided for local communities;
5. The Lakes (Copco Lake and Iron Gate Lake) provide the habitat for a lot of species including those which are in a Red Book, for example Bald Eagles (7 nests of Bald Eagles are around the Copco Lake only)
6. Recreation opportunities: thousands of people enjoy every year opportunities to fish, hike, water skiing, canoing, hunting, etc.
7. The housing near Lakes shores provides excellent living conditions for several hundred of families with kids who just enjoy living so close to the beautiful Mother Nature, who grow there with love to environment and become real patriots of their great country.

The removal of Dams will destroy all mentioned positive conditions and do not create anything to substitute.
I wish to mention that the international approach to old dams is a quite different: In Germany very old dams never being destroyed – they accept the hundred years changes in ecology as an excellent life condition)

Also I learned that archaeological research showed that many hundred years ago the analog of Copco Lake existed in the borders of existing Copco. By the way American Engineers built the dam exactly in the place where natural dam existed in ancient years. A very genius way of delivering the progress and listening to the historical natural situation.

And finally I would like to suggest (it is not my invention, a lot of local people know this alternative way to save dams) the Bogus Creek Project – to restore this creek to the sizes which may offer salmon if it wishes to come to the local Klamath river neighborhood and reproduce themselves.

Alexander Khartchenko
16812 Jacqueline Ave
Montague, CA 96064

P. S.
Me overall conclusion:
Dams removal project is not scientifically grounded;
remove of dams may cause humanitarian, environmental and ecological disaster and should be considered as a crime against Nature.

I am sure that all residents of Copco Lake and Siskiyou county shall go the legal authorities to protect our lives and life of our lakes.

Our lakes must live – this is an alternative to the death penalty which stated in Dams removal project.

Please respond to my concerns.

Thank you

Cordially

Alexander

From: Mary Ann King <maryannking22@gmail.com>
Sent: Friday, January 27, 2017 9:42 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

Other key points I urge you to consider:

1. The 2012 joint California and federal EIR/EIS and related documents concluded that dam removal on the Klamath is in the best interest of the public. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies, which can be relied upon for your EIR.

2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Mary Ann King
1733 Walnut St
El Cerrito, CA 94530
maryannking22@gmail.com

ER/P1

TO: FAX (916) 341 5400

ATTN.: MR. PARKER THALER

FROM: LYNDA KING-CLEGG
P.O. BOX 302
BLY, OREGON 97622

STATE WATER RESOURCES CONTROL BOARD
DIVISION OF WATER RIGHTS
WATER QUALITY CERTIFICATION PROGRAM
P.O. BOX 2000
SACRAMENTO, CALIFORNIA 95812-2000

STATE WATER RESOURCES CONTROL BOARD
2017 FEB -1 PM 1:45
DIVISION OF WATER RIGHTS
SACRAMENTO

Dear Mr. Parker Thaler,

Please accept this FAX for inclusion for public comment concerning the Klamath River Dams.

I am strongly against removal of the dams. In 2013, lead scientist, for the Bureau of Reclamation, Dr. Paul Hauser exposed many reasons to keep our clean hydro-power in place.

Thank you for taking our comments.

Sincerely,
Lynda King-Clegg
Lynda King-Clegg

Thaler, Parker@Waterboards

From: knnknig@aol.com
Sent: Monday, January 30, 2017 10:27 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River Dams

Mr Parker,

My name is Kenneth Knight. I am a Klamath Tribal member and have lived in Klamath county all my life. I reside on property that I inherited from my family. This land is located on the Williamson River below the town of Chiloquin. This property was tribal land allotted to my grandfather during the termination years and has never been out of tribal ownership. On this land, the "Klamath's of Old" built a rock fishing weir next to a natural reef. Using this weir enabled them to harvest Trout, Salmon, Steel-Head, and Suckers during their annual runs.
My family and friends also used this weir, but only to collect suckers because the Salmon and Steel-head were blocked by dams unjustly constructed during the early nineteen hundreds.
I fully support removing the dams In order to allow the Salmon and Steel-Head access to their original spawning grounds, Please help us restore the Klamath Basin.
Thank You,
Kenneth Knight and Family

From: Ryan Knoblock <Boldtfit@gmail.com>
Sent: Saturday, January 28, 2017 1:18 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

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Sincerely,

Ryan Knoblock
1780 Oak Ct
McKinleyville, CA 95519
Boldtfit@gmail.com

From: Joe Kopczynski <czynski@sonic.net>
Sent: Thursday, January 26, 2017 9:46 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Joe Kopczynski
625 Tzabaco Creek Rd
Geyserville, CA 95441
czynski@sonic.net

From: Daniel Kowalski <dank8@me.com>
Sent: Thursday, January 26, 2017 4:56 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Daniel Kowalski
3780 Torrey Hill Ln
San Diego, CA 92130
dank8@me.com

From: Roger Krause <rogerkrause415@gmail.com>
Sent: Thursday, January 26, 2017 9:19 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Roger Krause
149 Rivoli St
San Francisco, CA 94117
rogerkrause415@gmail.com

State Water Resources Control Board
Division of Water Rights
Water Quality Certification Program
Attention: Mr. Parker Thaler
Phone: (916) 341-5321
Fax: (916) 341-5400
Email: parker.thaler@waterboards.ca.gov

From Jacqui Krizo
7890 County Rd 120
Tulelake, CA 96134
530 664 3862
krizohr@cot.net

February 1, 2017

Several years ago Dean Brockbank, vice president and general counsel of PacifiCorp was quoted as saying the government "made it very clear from a public policy point of view that they did not want these dams relicensed. Once that became abundantly clear, we shifted our framework from relicensing to a settlement involving a possible dam removal framework." Since top level officials within the Department of Interior decided to remove the dams from the beginning, other options have not been thoroughly explored.

Since then, more than 80% of Siskiyou County residents voted against destroying the dams for environmental, social and economic reasons. Klamath County Board of Commissioners has opposed dam removal for four years. In the November 2016 election, 73% of Klamath County voters voted against the removal of the four Klamath River dams.

22 million cubic yards of sediment would flow to the ocean with dam removal. I am not allowed to put over 5 yards of rock or dirt into the river because of the harm it could do to the fish and their habitat. This massive amount of sediment can easily sterilize the entire river for 100 years or more.

In 2011, Interior's report said that the entire dam removal and restorations could boost salmon population in parts of the upper basin by 10%, only if all the other water quality problems were solved first. Solving all the water quality problems would require reversing "mother nature's" natural occurring phosphorus that is prevalent in the entire upper basin.

Alternatives to dam removal were not fully explored, such as improved fish ladders or trucking fish as is conducted on the Columbia River.

There were bumper crops of salmon through the 60's.

Since Marine Mammals Protection Act of 1972, sea lion population grew from 5,000 to over 300,000 on the northern California/Oregon coast. Sea Lions consume an average of 18 lbs of fish per day to thrive; 18 lbs per day x 365 days x 300,000 sea lions = 1.971 billion lbs (986,000 tons) of fish/year - assuming an average of 10lbs per fish – this is 197 million fish.

Uncontrolled commercial fishing by Asian fishing fleets is also a huge factor in our salmon population.

Klamath dams provide electricity for 70,000 homes. Please don't destroy this clean energy and then raise our power rates with more expensive and less reliable energy. Dam removal is expected to cost

somewhere between 450 million and 4 billion dollars. This does not include the cost of replacement power.

Klamath dams provide water storage, ecosystems for wildlife in and near the reservoirs, flood control, recreation, clean green energy, forests, water in reservoirs for firefighting, agriculture and air quality. We've had some record runs of salmon since the dams were built. Without firefighting capabilities, wildfires severely affect our air quality and oxygen in the river. Forests, wildlife and housing get burned up. Dam removal will destroy the economy of Siskiyou County.

Thank you for considering my comments. Please relicense the Klamath River Dams.

Jacqui Krizo

From: Donald Krueger <dkruegerfisher@gmail.com>
Sent: Thursday, January 26, 2017 6:34 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Donald Krueger
134 Heaton Way
Folsom, CA 95630
dkruegerfisher@gmail.com

Thaler, Parker@Waterboards

From: Matt Kurth <mattskurth@gmail.com>
Sent: Tuesday, January 31, 2017 6:42 PM
To: Thaler, Parker@Waterboards
Subject: Kalamath River Dam Removal Comments

I firmly believe that the dams on the Kalamath River need to be removed as soon as possible for many reasons:

a. to protect and grow native fish populations
b. to improve the tourism and fisheries economies
c. the dams are unnecessary and costly to maintain for electric generation
d. to improve recreation in the river corridor
e. to abide by agreements made with Native Tribes

Thank you for receiving my comments.

Matt Kurth
McKinleyville, CA

From: Steven Kwok <stevek@qka.com>
Sent: Thursday, January 26, 2017 8:48 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

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Sincerely,

Steven Kwok
8325 Singing Hills Trl
Santa Rosa, CA 95404
stevek@qka.com

From: Michael Laing <user@votervoice.net>
Sent: Thursday, January 26, 2017 7:48 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Michael Laing
4931 Marlborough Way
Carmichael, CA 95608
mwlaing@aol.com

From: Chris Lang <cjameslang@gmail.com>
Sent: Friday, January 27, 2017 5:34 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Christopher Lang
368 N Pierce St
El Cajon, CA 92020
cjameslang@gmail.com

From: Gavin Lantry <gml999@cox.net>
Sent: Thursday, January 26, 2017 7:47 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Gavin Lantry
755 E Grand Ave
Escondido, CA 92025
gml999@cox.net

From: Maurice Ledoyen <user@votervoice.net>
Sent: Wednesday, January 25, 2017 11:10 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Maurice Ledoyen
10296 Snoe Way
Durham, CA 95938
mdledoyen@sbcglobal.net

From: Mr. & Mrs. Michael Legrande <mklegrande@gmail.com>
Sent: Friday, January 27, 2017 2:07 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Michael Legrande
2001 Quail Oaks Rd
Valley Springs, CA 95252
mklegrande@gmail.com

From: Jack Lemein <jaahlem@comcast.net>
Sent: Thursday, January 26, 2017 5:35 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

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I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

Other key points I urge you to consider:

1. The 2012 joint California and federal EIR/EIS and related documents concluded that dam removal on the Klamath is in the best interest of the public. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies, which can be relied upon for your EIR.

2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Jack Lemein
2201 Bayhill Ct
Half Moon Bay, CA 94019
jaahlem@comcast.net

From: Brian LeNeve <bjleneve@att.net>
Sent: Friday, January 27, 2017 6:04 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Brian LeNeve
PO Box 1012
Carmel by the Sea, CA 93921
bjleneve@att.net

Thaler, Parker@Waterboards

From: Maxine Levinson <maxinelevinson@gmail.com>
Sent: Monday, January 30, 2017 11:04 AM
To: Thaler, Parker@Waterboards
Subject: Scoping comment for Klamath River

I request that the California State Water Resources Control Board:

(1) Do NOT issue a water quality certification for the KRRC for the Klamath River!!

(2) Do NOT incorporate the information from the 2012 joint California and Federal EIR/EIS into the EIR currently being developed. The previous EIR/EIS was NOT based on exhaustive studies and did NOT reach the correct conclusion.

- Only five miles of the entire river system, designed to generate data that would best support dam removal, was submitted.

- It was clearly NOT an exhaustive study as the river waters above the dams was NOT studied, nor was the water quality entering California from Oregon.

- A **new and complete** analysis of the **entire** river must be performed, including the water management of the Trinity River that is diverted into the State Water Project and the central canal as these flow impacts on the fish are unknown. The complete environmental consequences have not been adequately evaluated.

(3) Evaluate ALL scientific data and studies produced BEFORE and since 2012. This will further contradict the conclusions of the 2012 EIS/EIR as being inconclusive and prejudicial in nature.

- This fact is supported by Dr. Paul Houser, the hydro meteorologist, hired to oversee the scientific integrity, when he revealed that the study was designed to align with those favoring dam removal.

- The tribes still gill net across the mouth of the Klamath and this has had an effect on salmon populations.

(4) Fully analyze the environmental and economic impacts of dam removal with respect to the certainty of removal ramifications, not just what “might”, “could”, language used in the 2012 EIR/ EIS studies used in support of dam removal.

- The loss of property values is reflected in the declining property taxes, and therefore a loss to Siskiyou County Revenue. The 2012 study only looked at bare land values. They did not go through the process of the Record of Decision. Improvements were not considered.

- The KRRC does not have the funding or a plan for river or reservoir aesthetic restoration. It would take many, many years, if not a lifetime, to return the Klamath River behind the reservoirs to their native beauty.

- Unless the entire river is studied, all the impacts to fish and birds can't be know as to the impact.

- There are Perch behind the dams and if they are released into the lower river, that consequence must be considered since they are predatory to Salmon eggs. This is an ESA impact that has not been studied.

- The Shasta Native American Tribe, which precedes other Klamath tribes are not a signatory to the KHSA and have not been represented. Dam removal will expose sensitive Shasta burial grounds and possibly tribal artifacts.

- As the tribes, downstream from the dams are demanding that their tribal and cultural customs be respected, so shall the Shasta Nation be respected. If you engage with **some** tribal entities without taking into consideration **all** entities and be certain that the interests of all tribes are taken into equal consideration you will be acting prejudicially.

There is no possible way that you can base your current study on such flawed analyses such as the 2012 EIR/EIS study!! Unless a **new, transparent,** and **complete** study of the entire river system is performed, the SWRCB cannot make a **credible** determination concerning water quality!!

Sincerely,

Maxine Levinson

From: Walt Levitus <user@votervoice.net>
Sent: Thursday, January 26, 2017 9:24 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Walt Levitus
9316 Honeysuckle Ave
Fountain Valley, CA 92708
jscpw1@yahoo.com

From: David Lipscomb <davidlipscomb@comcast.net>
Sent: Saturday, January 28, 2017 11:18 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

David Lipscomb
3341 Springhill Rd
Lafayette, CA 94549
davidlipscomb@comcast.net

Causes and Effects of Nutrient Conditions in the Upper Klamath River

Klamath Hydroelectric Project
(FERC Project No. 2082)

PacifiCorp
Portland, Oregon

November 2006

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1.0 EXECUTIVE SUMMARY

The purpose of this document is to summarize information on the causes and effects of nutrient conditions in the upper Klamath River in the vicinity of the Klamath Hydroelectric Project (Project). The information in this document focuses in particular on the likely effect of the Project on nutrient loads in the river – loads known to be very large as a result of releases from hypereutrophic (highly enriched) Upper Klamath Lake, the principal source of flows to the upper Klamath River.

The Klamath River system is complex and unique, particularly because water quality generally improves as water flows from its source at Upper Klamath Lake towards the estuary. In most river systems, water quality is highest at the source and degrades as water flows downstream. Upper Klamath Lake is a substantial source of both phosphorus and nitrogen to the Klamath River, particularly during the months June through October.

Owing to its hypereutrophic state, Upper Klamath Lake has been the subject of scientific investigation dating back to the 1950s. Concerns about the quality of water in the Upper Klamath Lake date back to the earliest recorded contacts with the lake. Although the lake has probably been naturally enriched with nutrients (eutrophic) since before settlement of the basin by non-Native Americans, it has apparently changed substantially over the past several decades concurrent with dramatic changes in the basin as a result of agricultural modifications, and diking and draining of large areas of marsh surrounding the lake.

High algal productivity in Upper Klamath Lake has been accompanied by violations of Oregon's water quality standards for dissolved oxygen, pH, and free ammonia. In May of 2002, ODEQ established a total maximum daily load (TMDL) for the Upper Klamath Lake drainage to define "the maximum amount of pollution [from all sources] that a water body can receive without violating water quality standards". To address the high productivity issue, the TMDL called for a 40 percent reduction of total phosphorous loading to Upper Klamath Lake.

In 2004, the National Research Council's Committee on Endangered and Threatened Fishes in the Klamath River Basin issued a report concluding that even if the TMDL's targeted 40 percent reduction in external phosphorus loading could be achieved, it would "probably be ineffectual without suppression of internal phosphorus loadings, given that internal phosphorus loading is very large for Upper Klamath Lake" and that "available evidence indicated that … internal loading appeared sufficient to maintain algal populations".

In March 2004, PacifiCorp submitted a Final License Application (FLA) to the Federal Energy Regulatory Commission for relicensing of the Klamath Hydroelectric Project. In March 2006, PacifiCorp submitted applications for Section 401 water quality certification to ODEQ for the Oregon portion of the Project and the State Water Resources Control Board (SWRCB) for the California portion of the Project. Based on these previously-reported analyses, PacifiCorp concluded that the Project does not contribute to excess concentration of nutrients in the Klamath River. The abundance of chlorophyll *a*, and the growth of phytoplankton are a natural consequence of the occurrence of excess nutrients from upstream sources, notably Upper Klamath Lake. Nevertheless, PacifiCorp proposed Reservoir Management Plans to help address primary production in Project reservoirs resulting from nutrient loading from upstream sources. The Reservoir Management Plans will have the effect of reducing algae growth and thus

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reducing chlorophyll concentrations within the reservoirs, as well as benefiting water quality in general.

In July 2005, Kann and Asarian (2005) issued a report of their analysis of 2002 nutrient loading to Copco and Iron Gate reservoirs. They concluded that the "reservoirs can act as a nutrient source during critical periods" and that their analysis does not support PacifiCorp's conclusion that the reservoirs benefit water quality by processing organic matter and nutrients from upstream sources. Subsequently, in July 2006, Asarian and Kann (2006) issued a report of their analysis of nitrogen loading and retention in Copco and Iron Gate reservoirs and for the river reaches below Iron Gate dam. On the basis of this analysis, Asarian and Kann (2006) concluded that "the river consistently provides moderate positive retention, while the combined retention of Iron Gate and Copco reservoirs alternates between positive and negative values", and further concluded that "the reservoir effect on retention was minimal (4.6% of incoming load) or even negative (-3.3% of incoming load) for the periods evaluated."

As discussed in this document, the Kann and Asarian (2005) and Asarian and Kann (2006) analyses have substantial flaws. Notwithstanding these flaws, Kann and Asarian's (2005) analysis itself clearly shows that Copco and Iron Gate reservoirs act as net sinks for P and N over the longer term – the same basic conclusion reached by PacifiCorp as noted above. Despite the wording of their stated conclusion to the contrary, this net retention of nutrients indicates that the reservoirs help to store and process the very large amounts of organic matter and nutrients from upstream sources. In addition, contrary to Asarian and Kann's (2006) stated conclusions, the analyses described below in this document indicate that Iron Gate and Copco reservoirs consistently provide net positive retention, while the river reaches do not.

The very large loads of algae biomass that are discharged to the upper Klamath River from Upper Klamath Lake, particularly during summer, diminish in consistent fashion with distance from Keno reservoir through the Project area reservoirs and river reaches downstream to near the mouth of the Shasta River. The decomposition of these very large algae loads during downriver transit is not only a large potential source of nitrogen (via mineralization) but also of biochemical oxygen demand (BOD) imposed on the water's dissolved oxygen (DO) content.

Research has shown that mineralization of inorganic nitrogen and short-term oxygen demand from blue-green and other algae decay approximately follows a first-order decay rate. As such, decay is quite rapid during the initial stages of the decomposition process (e.g., about ¾ of the oxygen demand present would on average be expended within about 10 days). The analyses described below in this document indicate that, under existing conditions, the processing of the loads to the upper Klamath River of upstream organic matter is largely completed by the time water travels past Iron Gate dam.

By contrast, under hypothetical without-Project conditions, about 50 percent or more of the load of upstream organic matter would still be present as water travels past Iron Gate dam. This indicates that, in the absence of Project reservoirs, a substantial amount of organic matter would remain available throughout the lower Klamath River downstream of Iron Gate dam, acting as a source of inorganic nitrogen, phosphorus, and BOD from ongoing decay. This substantial remaining organic matter would exacerbate water quality impairment in the river downstream of

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Iron Gate dam to the estuary by increasing BOD, reducing DO, and further promoting growth of benthic algae (periphyton).

As described in this document, the total annual net retention of nutrients by Copco and Iron Gate reservoirs is substantial, particularly when both reservoirs are considered in combination. The observed concentrations of total inorganic nitrogen (TIN) and total nitrogen (TN) in particular are consistently lower in water released from Iron Gate reservoir than in the water entering Copco reservoir. These observations support the conclusion that Iron Gate and Copco reservoirs act as a net sink for both total nitrogen and total phosphorous over the long term (i.e., on a seasonal or annual basis).

Overall, the monthly nitrogen retention values summarized in this document indicate that the reservoirs acted to retain a significant percentage of inflowing TN (21 percent) and TIN (42 percent) over the entire evaluation period of March-November 2002. This generally corresponds to previous conclusions from PacifiCorp's FLA analysis. Given the large inflowing nitrogen load of nearly 600 metric tons to Copco reservoir over the entire evaluation period of March-November 2002, the substantial net retention provided by Copco and Iron Gate reservoir is an important process for reducing downstream loads to the Klamath River below Iron Gate dam.

It is important to note that the effect of Copco and Iron Gate reservoirs on upstream-downstream nutrient flux does not occur instantly, but rather over several days or weeks due to both the duration of the upstream conditions and the extended residence time of the reservoirs. Evidence of this lag effect is examined in this document. Because of this lag, it is expected that at times the nutrient concentration in release waters from Iron Gate reservoir on a given day may be greater than in the inflowing waters to Copco reservoir on the same day, even though the reservoirs act to retain and reduce the loads from these nutrient "events" as they move through the reservoirs. This lag effect was not recognized and accounted for in the analyses of Kann and Asarian (2005) and Asarian and Kann (2006).

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5.0 CONCLUSIONS

The key conclusions from information presented in this document include:

- There is no specific process or discharge associated with the Klamath Hydroelectric Project that contributes nutrients to the Klamath River. The nutrient concentrations observed in the Project area are the result of input from upstream sources, particularly Upper Klamath Lake, and as modified by physical and biological processes in the river and reservoirs during transit.
- Upper Klamath Lake is hypereutrophic – that is, it is highly-enriched with nutrients. Upper Klamath Lake has been recognized as the cause of poor water quality in the Klamath River, all the way to the mouth, since at least the 1950s. Upper Klamath Lake has had abundant blue-green algae blooms since at least the 1930s. Blue-green algae blooms have extended the entire length of the river even before the construction of Iron Gate dam.
- Nutrient concentrations and loads in the Upper Klamath Basin (upstream of the Project) have been and remain very large. These large nutrient concentrations and loads are unusual for a river headwaters and cause significant water quality impairments in the system.
- Nutrients traveling through the Project area undergo an overall annual net reduction compared to inflowing conditions. This annual net reduction is much greater than would occur in the absence of the Project reservoirs.
- In contrast to the conclusions of Asarian and Kann (2006), the actual data suggests that the reservoirs are retaining and reducing total nitrogen during most months.
- In contrast to the conclusions of Asarian and Kann (2006), the actual data suggest that the Klamath River reaches in the Project area have a small and inconsistent effect on the retention of total nitrogen.
- Periphyton in the Project area and in the Klamath River downstream of Iron Gate dam would be substantially increased in the absence of the Project reservoirs. This increase in periphyton could increase the habitat for the polychaete host of *C. shasta*.

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Comment in response to the EIR for the Lower Klamath Project License Surrender

Don Mackintosh

5322 Hoy Road

Weed, CA 96094

I am a rancher in Siskiyou County and I am also retired from PG&E . I spent 28 years in Power Grid Operations and my job was controlling power generation, transmission, and distribution. It is a fact that Hydro electric generation is the cleanest cheapest of all generation. The fuel for Hydro generation is water. The water goes in as water and comes out as water. All other generation fuel changes state after it is used as a fuel. That is also true with wind and solar because wind and solar are not a dependable source of power and have to have rolling generation on line for back up. I will not go into the many benefits of hydro, but when a power grid collapses and is dead, it takes power to start generation again. Hydro generation is used for this purpose because it can be started instantly.

Once the dams are breached the release of toxic material downstream begins and a perfectly good $40 million plus business has been destroyed. The Hydro generation from the dams produces 169 mega watts of power to Siskiyou county and the southern portion of Oregon with 70 mw left over that goes south and is sold to PG&E. The Klamath Hydro Dams that are in place are in good condition.

I have read that the complete removal of this project is estimated at $2 billion.

The 169 mw of generation that will be destroyed has to be replaced to maintain the electrical grid and that alone could cost $1 billion.

Taking out the dams will put at risk the water supply to the City of Yreka, the irrigation water to farmers and the Indian graves. It will also cause flooding, toxic water for years to come, erosion, loss of homes and land along the river all the way to the coast, the loss of fish and wild life, loss of water for firefighting, the loss of storage water, the loss of river flow regulation, the loss of water cooling and filtration. There will also be the risk of destruction to the many bridges on the Klamath river from the Oregon border to the California coast during the winter high water runoff. There is history of high water damage to the US I-5 bridge and that was with the dams in place. There will be loss of private land being washed away and the jobs involved in control and maintaining the dams will also be lost.

Because of the environmental damage and liability risk, the law suits could go on for decades. At the end of this project there will be almost nothing left, no generation,

no revenue, no capital investment, no irrigation and NO FISH! But there will be one big fat multibillion dollar price tag that will take decades to pay off.

I believe the dam removal will cause long term toxicity and could not possibly be in compliance with specified provisions of the Clean Water Act, including water quality standards and any appropriate requirements of state law.

Furthermore, the Klamath Hydro Dams should not be transferred to the Klamath River Renewal Corp (KRRC). I believe that the KRRC does not have the right to take charge of the trust assets (surcharge) funds of $200 million or take possession of the dams and license for the purpose of destroying the four hydro electric facilities. I believe KRRC does not have the knowledge for generation operation, and is financially unable to deal with the liability and law suits that will be coming for years. So in the end it will be the people that will pay for the whole thing……

Thaler, Parker@Waterboards

From: Mary Ann Madej <maryann.madej@gmail.com>
Sent: Tuesday, January 31, 2017 12:21 PM
To: Thaler, Parker@Waterboards
Subject: Lower Klamath Project

I am writing in support of the Klamath River dam removal projects, and so I encourage the Water Quality Board to approve the necessary Clean Water Act permits to facilitate this removal. Many, many studies have already been conducted on the Klamath River, and FERC's 2007 Environmental Impact Statement already has summarized the concerns and the study results.

I have worked on watershed assessments and river restoration projects in the Pacific Northwest since 1975. In 2010 I was involved in a water quality and river temperature study on the Klamath River downstream of Iron Gate Dam. I experienced first-hand the elevated water temperatures in the mainstem Klamath as we measured elevated summer temperatures along the mainstem Klamath. Cool water tributaries provided only spatially limited thermal refugia. Algae blooms were also common. Our observations confirmed what many other studies had shown, that water quality in the Klamath River is impaired.

We have learned a great deal from large dam removal projects, such as the Elwha in Washington State. I look forward to the day when we can remove the four lower Klamath dams as well.

Mary Ann Madej, Ph.D.

Consultant

From: peter mangarella <pmangarella44@gmail.com>
Sent: Thursday, January 26, 2017 7:37 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

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Sincerely,

peter mangarella
663 Cleveland St
Oakland, CA 94606
pmangarella44@gmail.com

From: Tressa Mannion <user@votervoice.net>
Sent: Thursday, January 26, 2017 2:44 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Tressa Mannion
756 Normal Ave
Ashland, OR 97520
tressa_mitchell@yahoo.com

From: Mr. & Mrs. Terry Mar <tmar13@comcast.net>
Sent: Friday, January 27, 2017 7:10 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Terry Mar
18007 Almond Rd
Castro Valley, CA 94546
tmar13@comcast.net

From: Ken Martinez <user@votervoice.net>
Sent: Thursday, January 26, 2017 7:10 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

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2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

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As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Ken Martinez
PO Box 492162
Redding, CA 96049
kpmtz@yahoo.com

From: Vince Martino <user@votervoice.net>
Sent: Thursday, January 26, 2017 9:21 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

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Sincerely,

Vince Martino
64623 Cammann Rd
Coos Bay, OR 97420
vince.martino@verizon.net

From: Erik Mason <Dandalures@gmail.com>
Sent: Friday, January 27, 2017 9:22 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

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Thank you for your time.

Sincerely,

Erik Benjamin Mason
53 Bundren St
Oak View, CA 93022
Dandalures@gmail.com

From: William Matchett <wematchett@gmail.com>
Sent: Friday, January 27, 2017 10:18 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I travel to the redwoods every summer and spend time on and around the Klamath, particularly out of Requa. It is a special river/resource and I applaud any effort to restore its vitality.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

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Sincerely,

William Matchett
1635 Superior Ave Ste 2
Costa Mesa, CA 92627
wematchett@gmail.com

From: Kevin Mather <losrios2@gmail.com>
Sent: Thursday, January 26, 2017 11:40 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon. The Klamath river is a fabulous resource for all Californians and is a river I've fished, explored and come to love.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

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Sincerely,

Kevin Mather
3947 Milmar Way
Sacramento, CA 95821
losrios2@gmail.com

From: Raymond Mattz <lindamattz24@gmail.com>
Sent: Saturday, January 28, 2017 4:18 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

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Sincerely,

Raymond Mattz
PO Box 404
Klamath, CA 95548
lindamattz24@gmail.com

From: Nathan Mayl, M.D. <nathanmayl@hotmail.com>
Sent: Thursday, January 26, 2017 7:11 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

Dear Mr. Thaler:

I am an angler who travels regularly to fish internationally and locally to fish. I much prefer to fish locally. I most enjoy fishing for steelhead and value the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

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Thank you for your consideration and help for all anglers.

Sincerely,

Nathan Mayl M.D.
4 Pepper Tree Ln
Palos Verdes Peninsula, CA 90274
nathanmayl@hotmail.com

From: Stephen McCaffrey <smccaffrey@pacific.edu>
Sent: Thursday, January 26, 2017 6:07 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Stephen McCaffrey
30900 The Horseshoe
Winters, CA 95694
smccaffrey@pacific.edu

From: Mattheau McCreary <mattheau.mccreary@gmail.com>
Sent: Friday, January 27, 2017 1:27 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Mattheau McCreary
13230 SW Edgewood St
Beaverton, OR 97005
mattheau.mccreary@gmail.com

From: Thomas McGee, Sr <tomasmcgee@comcast.net>
Sent: Thursday, January 26, 2017 10:33 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Thomas McGee Sr
285 Piedmont Ave
Pacifica, CA 94044
tomasmcgee@comcast.net

Thaler, Parker@Waterboards

From: John Menke <jmenke@sisqtel.net>
Sent: Friday, January 27, 2017 10:24 AM
To: Thaler, Parker@Waterboards
Subject: Fwd: Key paper--the up-shot of this work is taking away irrigation water and agriculture in the Upper Klamath Basin reduces water quality in the Klamath River

Parker:

Re: As promised to the January 27, 2017 Yreka Water Board Meeting-leader lady.

See key 2002 paper below (PDF file); research funded by the California State Water Resources Control Board showing improved water quality in agricultural drain water from farms in the Upper Klamath Basin. I have highlighted in red the key statements in Danosky and Kaffka's summary—see below an email I shared with other interested people as a lead up to the meeting.

Agriculture uses soil and water-borne nutrients like phosphorus which are natually in excess supply in the Upper Klamath Basin (UKB) soils, rivers, streams and spring water—all due to abundance of the mineral apatite in parent rock and therefore soil parent materials of the UKB—truly a unique UKB watershed for that reason, and the reason for poor water quality in the Klamath River.

Apatite is a group of phosphate minerals, usually referring to hydroxylapatite, fluorapatite and chlorapatite, with high concentrations of OH^-, F^- and Cl^- ions, respectively, in the crystal. The formula of the admixture of the four most common endmembers is written as $Ca_{10}(PO_4)_6(OH,F,Cl)_2$, and the crystal unit cell formulae of the individual minerals are written as $Ca_{10}(PO_4)_6(OH)_2$, $Ca_{10}(PO_4)_6(F)_2$ and $Ca_{10}(PO_4)_6(Cl)_2$.

Definition of apatite from my Apple iMac computer:

apatite |ˈapəˌtīt| nouna widely occurring pale green to purple mineral, consisting of calcium phosphate with some fluorine, chlorine, and other elements. It is used in the manufacture of fertilizers.ORIGIN early 19th cent.: coined in German from Greek ***apatē* 'deceit'** (from the mineral's diverse forms and colors).

It is this phosphours nutrient UKB watershed condition coupled with bluegreen algae and its associated symbiotic cyanobacteria that naturally leads to hyper-eutrophic diurnal too-high-oxygen supplies during the day and too low oxygen supplies in water for fish at night, due to respiration demands for oxygen by the algae when the sun is not shining whem the algae cannot photosynthesize but still need to 'breathe'.

Concerns about toxicity of bluegreen algae/cyanobacteria by UKB Indians and others shows lack of understanding about concentrations necessary to show symptoms of health effects. Unmanaged livestock watering ponds in Oklahoma, for example, when defecated in by cattle can develop highly viscous bluegreen algae/cyanobacteria concentrations that can kill cattle.

During drought and drying river conditions prior to the dams keeping the river channel wetted and flowing continuously, Indians may have experienced such. Unfortunately one North Coast Regional Water Quality Control Board staffer (CK) too emphasized such risks leading to PacifiCorp implementing periodic chemical treatments of some algal blooms in parts of some reservoirs.

Interestingly, one of my wife Jennifer's and my first bull sales (1996) was to senior ranchers Walt and Barbara Robinson in Seiad Valley along the Klamath River; this gentleman told us of his frequent experiences as a child and young person of 'being able to walk across the Klamath River and not getting his feet wet'. He and his family likely experienced the 1930s regional drought during the concomitant Great Plains Dust Bowl Era of that time when it was likewise a drought period as evidenced by Yreka rainfall records which I have investigated. Walt Robinson began working for the Forest Service in Happy Camp in 1933.

The slowing of the passage rate of water down the Klamath River due to the dams gives bluegreen algae added time in reservoirs to bio-remediate the high phosphorus levels in the waters of the Upper Klamath River Watershed. The often less-than-one-day life cycle of bluegreen algae cells dying and taking phosphorus with them in 'sediment' deposition to the bottoms of the reservoirs is the reason for improvement of water quality below the Klamath River dams compared to Lake Ewauna. Evidence is the millions of cubic yards of algal muck on the bottoms of the reservoirs. Flushing such high organic materials down the Klamath River would be a tragic mistake. Dispersing massive quantities of organic material downstream coupled with likely bacterial decomposition of those organic materials could lead to hyper-hyper-eutrophic conditions for all fish and aquatic organisms in the river—never before challenging the biota of an otherwise outstanding fishery—the best I have ever experienced in my lifetime from Johnson's Bar to Blue Creek many Labor Day weekends 1978-88 catch-and-release fly fishing for up to 60 steelhead up to 6-pounds each before becoming a too busy-all-the-time rancher in 1993.

So removal of active farming/ranching practices and the dams is the anthesis of what is required to deal with this naturally too high phosphorus condition. Livestock export phosphorus in growing bone materials especially, as does the export of all crop foods for human and animal consumption elsewhere outside the Upper Klamath Basin. Remarkably Dr. Hans Jenny at UC Berkelely, who wrote the book Factors of Soil Formation (see PDF below) reasoned that phosphorus will be the limiting nutrient for feeding a growing World population. The algal muck from dead bluegreen algae cells on the bottoms of the dam reservoirs will someday be of extraordinary value for fertilizer to produce food.

[PDF] msu.ac.zw
[BOOK] **Factors** of **soil formation**: a system of quantitative pedology
H **Jenny** - 1994 - books.google.com
One of the most influential works by a world authority on soils and their formation. This advanced treatise on theoretical soil science, long considered a masterpiece of scientific methodology offers pedologists, geologists and geophysicists both a detailed discussion of the nature of the earth's terrestrial environment, and a method of subdividing and studying it.
Cited by 4718Related articlesAll 19 versionsCiteSaveMore

Sincerely,

John W. Menke, A.A., B.S., M.S., Ph.D., retired 25-year UC professor, now seedstock red angus breeder in Siskiyou County since 1993 with my wife Jennifer since 1969.
Quartz Valley Red Angus
10935 Quartz Valley Road
Fort Jones, CA 96032
530-468-5341
jmenke@sisqtel.net

[PDF] psu.edu
[PDF] **Farming Practices** and **Water Quality** in the Upper Klamath Basin
E Danosky, **S Kaffka** - … the California State **Water** Resources Control Board, **2002** - Citeseer
Summary The Upper Klamath Basin (UKB) is a high desert region straddling the California-
Oregon border east of the Cascade Range. Irrigation and other agricultural practices in the
US Bureau of Reclamation's Klamath Project may result in impaired surface water quality,
reducing its use for wildlife and fish in important national wildlife refuges that receive drainage water from farms, and in the Klamath River. By 2004, a system of total maximum ...
Related articlesAll 4 versionsCiteSaveMore

Begin forwarded message:

From: John Menke <jmenke@sisqtel.net>
Subject: Fwd: Key paper--the up-shot of this work is taking away irrigation water and agriculture in the Upper Klamath Basin reduces water quality in the Klamath River
Date: January 25, 2017 at 5:31:28 PM PST
To: ray haupt <rhaupt@sisqtel.net>, Erin Ryan <erin@erinmryan.com>, Brenda Haynes <haynes034@att.net>, Richard Marshall <richard@marshall-ranch.com>, Rex Cozzalio <coz@1access.net>, Thomas Mallams <tmbrokenboxranch@gmail.com>, Jacqui Krizo <krizohr@cot.net>

Steve Kaffka is in my old department at UC Davis and is a good friend and I am in close touch with and have been for decades.

FARMING PRACTICES AND WATER QUALITY IN THE UPPER KLAMATH BASIN

Final Report to the California State Water Resources Control Board

205j program

Earl Danosky
Manager,
Tulelake Irrigation District P.O. Box 787
Tulelake, CA

Stephen Kaffka
Extension Agronomist
Department of Agronomy and Range Science University of California, Davis 530-752-8108
FAX: 530-752-4361
srkaffka@ucdavis.edu

April 16, 2002

John

Begin forwarded message:

From: John Menke <jmenke@sisqtel.net>
Subject: Key paper
Date: January 25, 2017 at 5:14:36 PM PST
To: jmenke@sisqtel.net

[PDF] psu.edu
[PDF] **Farming Practices** and **Water Quality** in the Upper Klamath Basin
E Danosky, **S Kaffka** - … the California State **Water** Resources Control Board, **2002** - Citeseer
Summary The Upper Klamath Basin (UKB) is a high desert region straddling the California-Oregon border east of the Cascade Range. Irrigation and other agricultural practices in the US Bureau of Reclamation's Klamath Project may result in impaired surface water quality, reducing its use for wildlife and fish in important national wildlife refuges that receive drainage water from farms, and in the Klamath River. By 2004, a system of total maximum ...
Related articlesAll 4 versionsCiteSaveMore

Summary

The Upper Klamath Basin (UKB) is a high desert region straddling the California-Oregon border east of the Cascade Range. Irrigation and other agricultural practices in the U. S. Bureau of Reclamation’s Klamath Project may result in impaired surface water quality, reducing its use for wildlife and fish in important national wildlife refuges that receive drainage water from farms, and in the Klamath River. By 2004, a system of total maximum daily loads (TMDL) for nutrients must be established for the Klamath River. To investigate the relationships among agricultural practices and surface water quality in the Upper Klamath Basin, a two year reconnaissance survey of surface water and agricultural tile drain locations, focusing on nitrogen and phosphorus concentrations and mass transfers was conducted. Data was collected at 18 surface locations and 10 tile drain locations. Triplicate samples were taken every ten days during the growing season (April through October) and one or two times a month during the remainder of the months, depending on opportunity. No samples were taken from tile drains during the winter months because there was no irrigation and drainage during that period. Water samples were analyzed for phosphorus (total P, soluble reactive P, total filterable P, and particulate P) and nitrogen (total N, soluble N, Soluble organic N, total filterable N, particulate N, and ammonia N), temperature, pH and electrical conductivity, a measure of salinity or total dissolved solids. Analyses of data,

including data quality, estimates of the transfer of nutrients in surface waters in the region, and hypotheses about the relationship between agriculture and water quality are reported.

1. The salt and nutrient content of surface waters increases nearly threefold as water moves through the watershed from the Lost River and J canal diversion to the Klamath Straits Drain. Mean EC_w levels in input waters at the J canal diversion were approximately 250 μS cm^{-1}, while water sampled at the D pump increased to 600 μS cm^{-1} on average over the sample period. By the time water reenters the Klamath River, salt concentrations have increased to approximately 700 μS cm^{-1}.

2. The EC_w values observed in subsurface tile drains were higher on average than in input waters and surface waters elsewhere in the region, especially in the Lease Lands area of the Tulelake Irrigation District (TID). EC_w values averaged approximately 2,500 μS cm^{-1} . Recycling irrigation water through soils in the TID increases the salinity of the water, especially by the time it reaches and is reused in the Lease Lands area of the Tulelake National Wildlife Refuge (TLNWR). Soils in this part of the Klamath Project area are naturally high in salt.

3. Water temperatures in agricultural subsurface tile drains were significantly lower than surface water temperatures during the growing season when tile drains were active. pH values in tile drains were lower than surface water values. The temperature and pH of tile drains does not influence surface water values.

4. For total phosphorus (TP) input waters at the J canal irrigation diversion for the TID averaged approximately 0.27 mg L^{-1} for the two years reported. Water leaving the Tulelake Sumps at the D pump increases to 0.33 mg L^{-1}. Water leaving the Lower Klamath National Wildlife Refuge (LKNWR) sampled at the start of the Klamath Straits Drain, averaged 0.33 mg L^{-1}, similar to those at the D pump. TP increased further to 0.40 mg L^{-1} a the end of the Klamath Straits Drain. The overall increase in P concentration in surface waters was much less than for salt, suggesting that processes other than simple enrichment are occurring, particularly those associated with the exchange of sedimentary P and aquatic plant species. TN increases from 2.3 mg L^{-1} to 4.0 mg L^{-1} over the same pathway. Atomic ratios (TN:TP) of surface water samples remain constant at approximately 10:1 throughout the system, suggesting that the amount of sediment and other small particulate matter in surface waters affects the values observed. The amount of sediment is influenced in part by the agitation of surface water as it passes through pumps and over weirs.

5. The average seasonal TP value in tile drains beneath farm fields is approximately 0.34 mg L^{-1} . While average total P values in subsurface tile drains were not different from those found at the D pump and the LKNWR outlet, the range in values was great (0.1 to 0.8 mg L^{-1}). Similarly, high NO_3 -N values were observed at times in tile drains. Very high values in tile drains lead to the inference that some fertilizer N and P is lost in drainage water, combined with nutrients derived from decaying soil organic matter. The amount estimated as lost is much less than the amount of surplus fertilizer P applied and the amount of P surmised to be mineralized from decaying soil organic matter. P from fertilizer and decaying organic matter appears to be accumulating in soils and lake sediments in the region.

6. Ammonia N concentrations are at or below the limit of detection in subsurface agricultural tile lines and one to two orders of magnitude below the values observed in surface soils. Un-ionized ammonia increases with temperature. Values above 0.25 mg L^{-1} were observed in late summer at several locations.

7. Some leaching of soluble salts and nutrients is unavoidable when crops are irrigated. P fertilizer is applied at rates higher than crop removal, while fertilizer n is applied at rates less than crop removal. Reduced fertilizer use can help bring P inputs and outputs into balance and may reduce further any avoidable losses of P. This objective should be the subject of an agronomic research program in the region.

8. Surface waters entering the TID, the TLNWR, and the LKNWR are already enriched with N and P. It seems unlikely that reducing N and P losses from farming in the TID, if possible, would influence surface water quality sufficiently to make them significantly less eutrophic. For P, the hypothesized threshold concentration limiting algae growth in fresh waters is 5 to 25 times smaller than the values observed in waters entering the TID for irrigation use. The addition of nutrients from agriculture probably does not influence significantly surface water quality in the region. Wetland sediments, large amounts of organic matter in soils, and water introduced for irrigation contain essentially unlimited amounts of nutrients for aquatic plant growth. It is not clear how this circumstance could be changed under any reasonable time frame, if ever.

9. Using a TMDL approach may not result in reduced amounts of nutrients returned to the Klamath River because wetlands and farming practices in the southern portion of the Klamath Project result in the net removal of nutrients from the waters diverted for irrigation on a yearly basis, compared to allowing the same amount of water simply to flow down the river unused. Because of large errors of estimation for the amounts of water transferred, combined with smaller errors associated with estimating nutrient concentrations in water samples, and with year to year climate variation, TMDLs may not be an effective or efficient means of reducing nutrients in return flows to the Klamath River. Rational confidence limits for TMDLs may have to be too broad to be effective. Recycling of some drainage water for irrigation would reduce the amount of nutrients returned to the river more effectively than implementing a TMDL program.

Thaler, Parker@Waterboards

From: Tom Menne <haydude@sisqtel.net>
Sent: Saturday, January 28, 2017 1:18 PM
To: Wr401program
Subject: Comment, Lower Klamath

To whom may concern,

If water quality is the main concern of the State Water Board just how do you think taking out 4 working dams in the Klamath River will improve the water quality?
I'm 55 years old now and I don't think that I will live long enough to see the water quality get any better than it is now, if you blow the dams.

The risk definitely does not outweigh any potential gain in water quality.

Removing the dams will wipe out an entire ecosystem that is built in and around each lake and killing millions fish in the process. 80% of Siskiyou County residences are adamantly against dam removal and for good reason, we will have to live with the consequences of your actions.

What do you think the water quality will look like in late summer without reservoirs to help maintain minimum flows for fish passage?

As a farmer is Siskiyou County we are in the cross-hairs to help save fish, as a tribe you can kill them and sell the fish for profit.

Please don't give in to the tribes, do the right thing for the working people of Siskiyou County as we are the true stakeholders.

Tom Menne

From: Wayne Merhoff, DVM <drwayne.merhoff@gmail.com>
Sent: Thursday, January 26, 2017 9:30 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

Other key points I urge you to consider:

1. The 2012 joint California and federal EIR/EIS and related documents concluded that dam removal on the Klamath is in the best interest of the public. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies, which can be relied upon for your EIR.

2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Wayne Merhoff DVM
13070 Montecito Rd
Red Bluff, CA 96080
drwayne.merhoff@gmail.com

From: Jay Monahan <mojowkn@mac.com>
Sent: Friday, January 27, 2017 12:14 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Jay Monahan
17391 High St
Los Gatos, CA 95030
mojowkn@mac.com

From: Mike Monroe <mikefmonroe@mac.com>
Sent: Friday, January 27, 2017 4:23 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

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Sincerely,

Mike Monroe
330 Castenada Ave
San Francisco, CA 94116
mikefmonroe@mac.com

From: Dave Moore <user@votervoice.net>
Sent: Thursday, January 26, 2017 10:05 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Dave Moore
18718 Vista del Canon Unit E
Newhall, CA 91321
pavmentenz@aol.com

Thaler, Parker@Waterboards

From: Warren <n7ipg@charter.net>
Sent: Friday, January 27, 2017 10:09 PM
To: Thaler, Parker@Waterboards
Subject: Dam Removal on the Klamath River

Sir,

Removing the dams on the Klamath River would be a huge mistake. Anyone that thinks it's a good idea, needs to research "The Challenge at Glen Canyon" on You Tube. This 3 part series is about the repair of the Glen Canyon Dam after a thousand year flood on the Colorado River. I spent a year working on the repair.

The Keno Dam above the J.C. Boyle Dam came about after a 50 year flood in the 60's on the Klamath River.

Better to have dams in place than want to put them in after a major flood event. Its not a matter of if it happens, but a matter of when. The thousand year flood is going to happen, its only a matter of when.

Warren Morehead
Keno Oregon

From: Tom Morehouse <tmorehouse@gmail.com>
Sent: Wednesday, February 01, 2017 4:48 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Tom Morehouse
2 Dalewood Ter
Orinda, CA 94563
tmorehouse@gmail.com

From: Maxwell Morgan <user@votervoice.net>
Sent: Tuesday, January 31, 2017 12:31 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Maxwell Morgan
2140 Yew St SE
Salem, OR 97302
levimorgan09@aol.com

From: Michael Morgan, G <mmorganmg1@gmail.com>
Sent: Monday, January 30, 2017 11:20 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Michael Morgan
23530 Lampara Dr
Valencia, CA 91355
mmorganmg1@gmail.com

Thaler, Parker@Waterboards

From: Mosier <mosiers@att.net>
Sent: Tuesday, January 31, 2017 10:40 AM
To: Wr401program
Subject: Klamath River Dam Removal

Dear State of California Water Board Decision-makers,

Thank you for dutifully engaging in your important task of public comment consideration. In regards to effects and benefits of Klamath River dams on Klamath River ecosystems and social well-being, I believe I am an exceptionally informed citizen in Siskiyou County, and I support dam removal.

I served as a Klamath National Forest landscape architect from 1977-2012, providing recreation and scenery analysis and recommendations for all major projects. From 1981 onward I also provided Wild and Scenic Rivers Act input, when the Klamath, Salmon, Scott Rivers and Wooley Creek were designated as National Wild and Scenic Rivers. The Wild and Scenic Rivers Act (WSRA) regulations focus on the protecting the river values of free-flowing river channel conditions, water quality, fisheries, wildlife, recreation and scenic quality. From 2003-2012 I served the Forest Service continuously on multi-agency Klamath Hydropower and dam removal analysis teams to integrate and achieve Wild and Scenic Rivers Act requirements, including the Secretary of the Interior's analysis completed in 2013. I served as a primary author of recreation and scenery analyses, and as a contributing author for interagency WSRA Section 7 compliance determination documents.

Based on this experience, here are key facts I find most pertinent to Klamath River dam removal:

1) The Clean Water Act, Endangered Species Act (ESA), and Wild and Scenic Rivers Act are the primary federal laws that guide the Klamath River dam removal decision.

2) The Klamath's 4 major dams function primarily as a "run of the river" system, with a maximum storage of only about 3 days of river flow. This means the reservoirs only slightly reduce peak flooding events, because as they fill, nearly 100% of river floodwater is directly released down river. The system's flow moderating effects have resulted in reduced diversity and dynamics of the river channel, riverbed and riparian habitats, at least down to about the Shasta River. However, during the river's relatively brief time within the reservoirs, three major water quality impairments occur, and are passed downstream to the river (water temperature increases, oxygen levels decrease, algae concentrations increase). These impairments violate the Clean Water Act, further threatening endangered fish species downstream within the Klamath Wild and Scenic River's fishery, so that the ESA and WSRA are both violated as well.

3) Based on the collective analyses performed by hundreds of national-level best-science experts, dam removal would greatly benefit long term Klamath River water quality, re-activate the river's original bed/channel geomorphology, expand and enhance endangered fish habitats and populations, improve scenic quality through greater water clarity and stream channel/riparian diversity, and better support recreational fishing, boating and swimming. Short term adverse effects lasting 1-3 years would result from sediment flushing from the reservoir's 1-5' thick sediment beds along the future free-flowing river bed/bank locations would impact all the above values adversely. However, most salmon runs would not be seriously affected, and all runs are predicted to flourish in the future river's superior water quality.

4) Social impacts to current lakeside residents and businesses are real, and should be fully mitigated through fair compensation. Shasta tribal site exposure vulnerabilities should also be promptly evaluated and fully

mitigated. All other currently inundated sites would simply be transformed to pre-dam conditions, similar to the hundreds of other sites within ancestral Shasta territory. All native American people within the river's watershed would seem to benefit from a healthy, free-flowing river and fishery, for their cultural and spiritual sustenance.

5) Hydropower lost from the project is regrettable, but this power currently results in adverse impacts on water quality, fish, and the river's original free-flowing conditions. Funding should be made available to replace the power with clean, sustainable energy sources such as solar and wind.

For these reasons I believe that removal of the dams is the only viable solution to meet the laws of our land, and to conserve what is most important for current and future generations: an environment as clean, healthy and durable as possible. I have visited the Elwha River system in Washington State, where the river and reservoir area has responded so quickly and positively to dam removal, and where oceangoing salmon returned immediately to repopulate its headwaters. I would not hesitate in choosing dam removal on the Klamath River, and hope all people, life and waters will receive the many inevitable benefits as soon as possible.

Thank you for considering my observations and aspirations for the Klamath River's ecosystem and human community.

Sincerely,

Jerry Mosier
1009 Northridge Drive
Yreka, Ca 96097

From: Mark Moskowitz <mountainglory@icloud.com>
Sent: Thursday, January 26, 2017 5:20 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

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Sincerely,

Mark Moskowitz
367 Bryan Dr
Alamo, CA 94507
mountainglory@icloud.com

From: John G. Motlow <geoff.motlow@gmail.com>
Sent: Friday, January 27, 2017 1:50 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

John G. Motlow
52 W Clay St
San Francisco, CA 94121
geoff.motlow@gmail.com

From: Nate Moylan <chicken-_-nugget@hotmail.com>
Sent: Wednesday, January 25, 2017 6:38 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Nate moylan
748 Gardner St
South Lake Tahoe, CA 96150
chicken-_-nugget@hotmail.com

From: Dennis Murphy <dennisrmurphy@me.com>
Sent: Friday, January 27, 2017 8:27 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

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Other key points I urge you to consider:

1. The 2012 joint California and federal EIR/EIS and related documents concluded that dam removal on the Klamath is in the best interest of the public. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies, which can be relied upon for your EIR.

2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Dennis Murphy
68 Cavalcade Cir
Sacramento, CA 95831
dennisrmurphy@me.com

Thaler, Parker@Waterboards

From: John Murphy <jmurphyedh@comcast.net>
Sent: Thursday, January 26, 2017 11:08 AM
To: Thaler, Parker@Waterboards
Subject: Water quality certification permit for dam removal on the Klamath River

Mr. Parker Thaler
parker.thaler@waterboards.ca.gov
State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA 95812-2000

Dear Mr. Thaler,

The Klamath River, historically, produced the third largest runs of salmon and steelhead on the West Coast. But this amazing fishery has suffered for decades from a variety of problems, including loss of habitat and degradation of water quality related to four dams below Klamath Lake. For Trout Unlimited's chapters in this state, and for our California Council, the long effort to restore the Klamath and its legendary runs of salmon and steelhead is our highest priority conservation campaign.

The revised Klamath Hydroelectric Settlement Agreement and its primary goal of restoring the Klamath River, and pending petitions from PacifiCorp and the Klamath River Renewal Corporation to decommission four dams on the Klamath below Klamath Lake, provide a rare opportunity to restore this river, which is so important for tribes, upper basin irrigators and communities, and salmon and steelhead—the most prized freshwater sport fishes in California.

We understand the Water Board must prepare an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission the four dams. A joint federal and state environmental impact analysis concluded in 2012 that dam removal on the Klamath is in the best interest of the public. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies, which can be relied upon for your EIR. Since 2012, there has been no scientific analysis questioning the conclusions of the 2012 EIR/EIS.

We strongly support restoration of the Klamath River and removal of the four dams. We urge the Water Board to consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

Trout Unlimited's 10,000 members in California, and the many angling-based businesses that rely on our support, depend on healthy fisheries, especially for iconic species such as salmon and steelhead. Removing four old, unproductive dams on the Klamath River is the key to restoring this fabled fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, we urge you to promptly issue the water quality certification permit for dam removal on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

Sincerely,
John Murphy
2821 Tamoshanter Dr.
El Dorado Hills, CA

From: James Naughton <jimnaughton1946@gmail.com>
Sent: Thursday, January 26, 2017 6:34 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

Other key points I urge you to consider:

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2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

James Naughton
35 Edwards Ave
Sausalito, CA 94965
jimnaughton1946@gmail.com

Thaler, Parker@Waterboards

From: Mike Nelson <nelsonoregon@gmail.com>
Sent: Wednesday, February 01, 2017 8:37 AM
To: Thaler, Parker@Waterboards
Subject: I support removal of the dams on the Klamath River

Dear sir,
I am writing to voice my support for removing the dams currently impeding salmon and steelhead runs, and adversely affecting water quality on the Klamath River in California and Oregon. I am a longtime resident and have been a registered fishing guide in the state of Oregon for several years. I also work in the service industry in Ashland. Clean waterways without dams that affect temperatures in the summer and impede fish migration is good for river health, which in turn is good for our local economy.

I support removing all dams from the Klamath River to help water quality, increased opportunities for sport fishing and offshore commercial fishing, and to help mitigate increased water temps in the summer.

Thank you,
Michael Nelson
541-613-2135

From: Robert Nelson <fishingbobnelson@comcast.net>
Sent: Thursday, January 26, 2017 5:25 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

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2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Robert Nelson
4233 Hedge Ave
Sacramento, CA 95826
fishingbobnelson@comcast.net

From: Steve Netti <snetti@cox.net>
Sent: Thursday, January 26, 2017 5:56 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

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As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Steve Netti
1266 Via Escalante
Chula Vista, CA 91910
snetti@cox.net

Thaler, Parker@Waterboards

From: Linda Newton <lindalnewton47@gmail.com>
Sent: Monday, January 30, 2017 7:45 PM
To: Thaler, Parker@Waterboards
Subject: Klamath Dam Removal

I am concerned about the removing of the Klamath Dams. We have a home there that is very lovely but will b worth nothing if taken out because of a fish. I know this because my grandchildren are of a tribe that are fighting to remove them and it is about money too. The lake is beautiful and full of life and kept out home from being burned in 2014 as a lot of other homes were saved. I know that thousands of years ago dinasores roamed the earth but my life has not been affected because I didn't get to eat a dinasor steak,and it won't be any different for people in the future. We are Christian people and we r very aware that we are to take care of God's creation he did after all put us in charge,but he never intended to have animals and land more important than his greatest creation MANKIND,made in his image. Please think of the lives that will be affected by this shameful action.

Cordially,
Jerry & Linda Newton

From: Thomas Nickelson <kisutch@gmail.com>
Sent: Friday, January 27, 2017 9:43 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

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2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Thomas Nickelson
75 Alydar Pl
Paso Robles, CA 93446
kisutch@gmail.com

From: Gail Nicola <gailnicola@hotmail.com>
Sent: Wednesday, January 25, 2017 6:06 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am the mother of angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

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As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Gail Nicola
495 Selkirk Dr
Corona, CA 92881
gailnicola@hotmail.com

From: Nathan Niebergall <nathanniebergall@mac.com>
Sent: Thursday, January 26, 2017 5:04 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

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As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Nathan Niebergall
1574 35th Ave
San Francisco, CA 94122
nathanniebergall@mac.com

From: Craig Nielsen <Craig@shastatrout.com>
Sent: Friday, January 27, 2017 10:40 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler and guide who enjoys fishing for steelhead and values the availability of local salmon and steelhead.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

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2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Craig Nielsen
512 Sarah Bell St
Mount Shasta, CA 96067
Craig@shastatrout.com

Thaler, Parker@Waterboards

From: Susan Nolan <snolan@humboldt1.com>
Sent: Tuesday, January 17, 2017 4:47 PM
To: Thaler, Parker@Waterboards
Subject: WR401program@waterboards.ca.gov

Dear Mr. Thaler,
Thanks you for coming out to Arcata to hear testimony on removal of the Lower Klamath dams. The community is strongly in favor of this project.

As you weigh social and economic impacts in the new EIR, please consider the value of healthy salmon runs, which dam removal will help foster by reducing toxic algae blooms, reducing water temperature, and scouring out disease pathogens.

Salmon were a foundation of traditional diet and economy to Indian communities along the river, and remain central to this day. A sense of excitement and well-being is palapable along the river when the salmon are running.

In the larger community, in the 1950s and 60s, recreational fishing for salmon was not only a sporting highlight of the year for locals, but an income generator for vacation rentals, restaurants, retailers, and guides. Even in remote small towns, it provided a welcome bump after the summer tourist season ended. Recreational ocean fishing used to offer the same opportunities for pleasure and profit to coastal residents.

Commercial fishing has also suffered hugely from the collapse of salmon stocks. The Klamath was once the third-largest producer of salmon on the West Coast, supporting many small boat operators and processors. Restoration of commerically harvestable runs of this valuable fish will be a boon to families in towns all along the coast.

It's been a long struggle, and we're all hoping that dam removal is finally coming together now. The benefit to the river and the people who live along it will be huge.
Thank you,
Susan Nolan.

Sorry to send a duplicate, my first was not addressed correctly, just wanted to be sure.

UNIVERSITY OF OREGON

To: State Water Resources Control Board
Division of Water Rights, Water Quality Certification Program
Attn: Mr. Parker Thaler
PO Box 2000
Sacramento, CA 95812-2000

February 9, 2017

Re: Public Comments Supporting 401 Certification for Klamath Dam Removal

Dear State Water Resources Control Board:

I am writing with the **strongest possible support of your agency granting a Clean Water Act Section 401 permit for decommissioning and removal** of Iron Gate, Copco I, Copco II and J.C. Boyle dams on the Klamath River. I am a Sociologist with a specialization in social impacts from environmental change and specifically tribal impacts from denied access to salmon. I have worked as a consultant for the Karuk Tribe who are downstream of these dams. In 2004 I was the lead author on a report documenting the relationship between the declining salmon populations in the Klamath river and the increase in diet related disease (diabetes, heart disease and strokes) in the Kaurk tribal population (Norgaard 2004). My report and others illustrate the profound environmental injustice posed by these dams.

Your agency has the unique power to right this situation. I therefore urge you to consider all the evidence already in the record supporting dam removal, including testimony and comments from the Karuk, Yurok and Klamath Tribes, Klamath Riverkeeper, the California and Oregon Public Utility Commissions, the US Fish and Wildlife Service, the National Marine Fisheries Service, US Geological Survey, California Department of Fish and Wildlife, the Pacific Coast Federation of Fishermens' Associations, PacifiCorp, and many, many others.

This one action you can take will do more than any other single action to restore the Klamath River ecosystem and West Coast fisheries, economies and recreational opportunities on a landscape level. Please grant Klamath dam removal a CWA Section 401 permit so that the Federal Energy Regulatory Commission can carefully,yet expeditiously move ahead with this action by 2020.

Sincerely,

Kari Marie Norgaard

Dr. Kari Marie Norgaard
Associate Professor
Department of Sociology and Environmental Studies
University of Oregon
Eugene, OR 97403
norgaard@uoregon.edu
(541) 346-8615

Thaler, Parker@Waterboards

From: CaLamblady@aol.com
Sent: Tuesday, January 24, 2017 2:27 PM
To: Thaler, Parker@Waterboards
Subject: Siskyou Dam Removal

Dear Parker Thaler,

I own a cabin at Copco Lake but am not a year round resident. We come up anywhere from April through November to relax, deer hunt, watch wldfe and do some fishing in the lake and river. My cabin has been in our family since I was 20 years old. That means we have had it for 46 years. My parents passed it down to my sister and I, and some day I hope to pass it along to my kids. I have enjoyed it as a young person, my kids have enjoyed it and now my grand kids do too. I have been following the dam removal process for the last 4-5 years. I have read through the reports the best I can but it all seems pretty complicated.
All I know is our property values have dropped about 60% and for anyone who is trying to sell their home up there, it is impossible.
We actually are a few of the fortunate ones in that our cabin is located above the bridge and sits on the Klamath River, not the lake. We are hopeful that if the dam is removed, the river may still meander by our cabin and stay close by. But for many other people, dam removal means removal of the lake too and they will then be far removed from any body of water! I feel very sorry for them....
I was up at our cabin when the fire that started in Oregon spread all the way down to Copco Lake. Luckily, no cabins were lost due to a huge effort of Cal Fire and other agencies to keep it at bay. The thing that saved us was Copco Lake. I watched as the helicopters came time after time to get water from the lake and carry it off to be dumped on the approaching flames. Thank goodness we had a water supply there!
California has just gone through terrible times the last 8-9 years with a drought that just kept getting worse and worse. Hopefully, the rains of this winter will make a substantial dent and ease the restrictions that have been placed upon us.
We live near Sacramento and we see all the water from these current rains cause flooding and run off through the streams, rivers and canals. All I can think of is "What a waste of water!!" We definitely need to be building more dams to capture the water for future use...not destroying dams and losing our ability to store it!
I feel this is all about restoring salmon habitat since that is about the only thing I have read that the dam removal would help. But in that process you are destroying a wide swath of area that serves many people and purposes...such as, water for recreation, boating, fishing, irrigation, fire suppression, water source and water storage while also depressing property values, etc.

The other thing that people don't mention is it will take probably 15-20 years to restore the habitat of the lake property before it will be beautiful again. In the meantime, it will look like a big wasteland with a little stream running through it.
Please, please reconsider this move. There are many more reasons to **keep the dam**, then remove it!!

Sincerely,

Cheryl and John Noutary
Copco Lake Cabin owners

645 Wiegand Way
Dixon, CA 95620

From: Tom Obermeier <user@votervoice.net>
Sent: Friday, January 27, 2017 10:59 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

Other key points I urge you to consider:

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3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Tom Obermeier
3960 Peterson Dr
Calistoga, CA 94515
sprketom@aol.com

From: Hugh O'Donnell <hughodonnell44@gmail.com>
Sent: Sunday, January 29, 2017 7:19 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

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Sincerely,

Hugh O'Donnell
208 SE 59th Ln
Hillsboro, OR 97123
hughodonnell44@gmail.com

From: Rodney Oien <rodneyo@suddenlink.net>
Sent: Monday, January 30, 2017 10:05 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

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2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

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As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Rodney Oien
PO Box 659
Blue Lake, CA 95525
rodneyo@suddenlink.net

From: Niall O'Kane <niall.m.okane@gmail.com>
Sent: Thursday, January 26, 2017 4:51 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

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Sincerely,

Niall O'Kane
1842 21st Ave
San Francisco, CA 94122
niall.m.okane@gmail.com

1/21/2017

To State Water Resources Control Board,

My name is Linda Oliver and I am a resident of Copco Lake on the Upper Klamath River. I also currently hold the position of Chairman of the Copco Lake Fire Protection District Board. I am opposed to Dam Removal and feel is would cause great hardships not only to the residents but to the environment around the lake as well.

Significant Negative Effects would include but are not limited to:

· Exposure of the Shasta Nation Sacred Burial ground currently under the lake.

· Property Value Decrease

· Decreased Property Tax which would mean decreased revenue for the local Elementary School District

· Traffic from Dam removal will block and deteriorate the one road in and out of the lake. This could possibly prevent Emergency services from reaching and transporting our residents.

· Removal would eliminate easements to the water's edge. As of this moment, no one can tell us who would take possession of the land between our properties and the water.

· Removal of the Dams would destroy the Meadow ecosystem created by the Dams

· Diminished Esthetic appeal by creating big mudflats between the river and the homes

· Respiratory Health concerns for the residents created by dust and deconstruction

· Silt flowing down river from Dam removal will kill fish and other species that rely on the water from the lake to survive

· Warm water flow from the hot springs without the Dams to cool the water, will increase not decrease Blue Green Algae Bloom.

There has never been accurate science to prove that Dam removal would benefit the health of the Klamath River Basin. In fact, many experts determined that Dam removal would be detrimental to the health of the river and animal live that depends on the lakes for survival. These experts have all been dismissed in favor of a political agenda.

Finally, there have been multiple attempts to propose alternatives to Dam removal. These alternatives are not only more cost effective than Dam removal, but would be a win / win for the residents at the lake and for the environment around the dams. It will even allow Pacific Corp to continue to provide clean energy to the power grid. These proposals have also been dismissed.

In closing, I hope that you are open to seeing the real cost of Dam removal and not just financially. Should the dams be removed, the damage would be great and irreparable. Please consider instead, an alternative such as Fish tunnels or Fish ladders.

Thank you for your time.

Linda Oliver

From: Devin Olsen <devino@nezperce.org>
Sent: Friday, January 27, 2017 10:00 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Devin Olsen
211 Court St
Enterprise, OR 97828
devino@nezperce.org

Thaler, Parker@Waterboards

From: AGeorgeOlson@aol.com
Sent: Monday, January 30, 2017 10:34 AM
To: Thaler, Parker@Waterboards
Subject: Fwd: Save the Dams on the Klamath

Dear Board:
Prior to the dams being built on the Klamath River, my grandfather, George Washington Miller, lost his entire herd and lively hood when the Klamath River flooded. If the dams are removed, we can expect the same things to happen again.

Farms and ranches along the river rely on the flood control and the steady water supply for irrigation that will not be possible with a water source that will be wildly fluctuating throughout the year. I have witnessed the devastation caused by the 1955 and 1964 floods even with the dams being present.

The burial sites of my Shasta Nation ancestors will also be at risk and must be preserved and protected.

There is evidence that in other areas where long standing dams have been removed that concentrated pollution held in the bottoms of the lakes have been released and killed all fish from the previous dam site to the ocean. This has been tremendously defeating to the idea of conservation or increasing the number of fish in the river as a whole.

Fish ladders can be constructed to increase the use of the upstream area be fish for spawning.

There is also no other electric power producing program that is more efficient and less polluting to the environment than hydroelectric power.

Keep the Dams on the Klamath

Sincerely yours,
Albert George Olson

Thaler, Parker@Waterboards

From: Buck And Judy Olson <olsonju1@gmail.com>
Sent: Sunday, January 29, 2017 3:02 PM
To: Thaler, Parker@Waterboards
Subject: dam removal

Several facts dictate the removal of the J C Boyle, Copco 1, Copco 2, And Irongate Dams on the Klamath River.
1. The dams are old and must be updated to allow the passage of migrating fish or decommissioned and removed. Pacific Corp does not want to update therefore the dams must be removed.
2. Water users were instructed by congress to come to an agreement about water allocation which, over a period of many years, produced the KBBA. One of the essential requirements of the KBBA was the removal of the 4 dams
3. The Klamath Tribe has the most senior water rights ("since time immemorial") in the Basin and can completely shut down the water to irrigators during drought to protect the fish. The KBBA protects the farmers during these dry times against the complete shut down of irrigation water.
4. From experience with other dam removals (ie. on the Rogue) scientists have shown that the ecosystems above and below the dam site improve almost immediately after dam removal.

In short, these dams should be removed.
I support dam removal and and the KBBA.

Sincerely,
Judith Oyama Olson
40975 Copeland St
Chiloquin, Oregon
97624
541 783 2

From: Jason Olson <jjolson21@hotmail.com>
Sent: Thursday, January 26, 2017 8:20 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

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Sincerely,

Jason Olson
9744 Eagle Glen Way
Elk Grove, CA 95757
jjolson21@hotmail.com

From: Vernon Olson <vaolson237@gmail.com>
Sent: Friday, January 27, 2017 7:49 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Vernon Olson
98 Hillcrest Dr
Orinda, CA 94563
vaolson237@gmail.com

From: james orosz <jaojmh@msn.com>
Sent: Thursday, January 26, 2017 6:26 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

james orosz
3824 Clear Rdg
Santa Rosa, CA 95404
jaojmh@msn.com

PT

STATE WATER RESOURCES
CONTROL BOARD

2017 JAN 17 PM 2:09

WATER RIGHTS
SACRAMENTO

24990 Owen Lane
Klamath Falls, OR
97603

530-397-7051
Fax: 541-884-8690

facsimile transmittal

To:	Parker Thaler	Fax:	916-341-5400
From:	Jay Owen	Date:	January 17, 2017
Re:	Comments on dam removal	Pages:	one
Cc:			

☐ Urgent ☐ For review ☒ Please comment ☐ Please reply ☐ Please recycle

January 17, 2017

State Water Resources Control Board
Division of Water Rights, Water Quality Certification program
Attention: Parker Thaler
P.O. Box 2000
Sacramento, CA 95812-2000

Dear Mr. Thaler:

For myself and my family, please consider this as our opinion that it is a bad idea to remove the Klamath River Dams.

These dams are critical for flood control. The impact studies regarding flood control are wrong. Removing the dams will lead to future flooding disasters.

Copco 1 and Copco 2 dams were originally built without power generating facilities. These dams were built for no other purpose, than flood control.

In the aftermath of the flood of 1889-1890, high water marks were measured on canyon walls near Happy Camp, California, at 92 feet. There have been numerous floods since that time.

I just got through reading an Associated Press article highlighting how climate change is causing more and more monster storms.

Common sense dictates that the dams are critical for flood control and must remain in place. The decision to remove the dams was a political decision made in Washington by political bureaucrats. This decision was then affirmed by appointing local stakeholders.

BUT GET this – you could not be appointed a stakeholder unless you agreed up front, to taking out all 4 dams. Ingenious way to eliminate any opposition. Nobody is allowed to oppose dam removal.

Liberal media does not report "the fix is in".

Safety dictates – KEEP THE DAMS.

Sincerely,

Jay Owen
24990 Owen Lane
Klamath Falls, OR
97601
Telephone 530-397-7051

From: Patrick Owen, PE <patrick.owen@cox.net>
Sent: Friday, January 27, 2017 6:00 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Patrick Owen
910 Vallata Ln
Spring Valley, CA 91977
patrick.owen@cox.net

From: Dennis Pagones <dgp1080@gmail.com>
Sent: Thursday, January 26, 2017 7:31 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Dennis Pagones
119 Oyster Pond Rd
Alameda, CA 94502
dgp1080@gmail.com

From: Allen Parker <tparker@cpsco.net>
Sent: Friday, January 27, 2017 6:14 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

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Sincerely,

Allen Parker
2387 45th Ave
San Francisco, CA 94116
tparker@cpsco.net

From: mark pastorius <user@votervoice.net>
Sent: Sunday, February 05, 2017 7:10 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

mark pastorius
18140 Stallion Mdw
Granada Hills, CA 91344
Stocktonite@yahoo.com

From: George Paul <geo9204@gmail.com>
Sent: Friday, January 27, 2017 9:10 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

George Paul
40967 Long Hollow Dr
Coarsegold, CA 93614
geo9204@gmail.com

Thaler, Parker@Waterboards

From: sue <s.perlick@sbcglobal.net>
Sent: Sunday, January 29, 2017 12:25 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River Damn removal.

January 28, 2017

Dear State Water Resources Control Board c/o Mr. Parker Thaler,

We were NOT notified of the scoping meetings in a transparent way. We own property on Copco Lake, so we are obviously stakeholders! We had been included by the Department of the Interior and the Bureau of Reclamation, when they were doing scoping meetings for their studies. We were notified by the Klamath River Renewal Corporation, KRRC, of their application to FERC. Unless we went to extraordinary measures to stay informed, no one received notice of the public scoping meetings. While on the surface, it appears you sent out the required notifications, you did not adhere to the spirit of the law as it was intended to notify and engage the public, and we find it ironic that the parties that support dam removal were notified much earlier than even the Siskiyou Board of Supervisors. This is not the first time that lack of transparency in this process has occurred.

The Siskiyou Board of Supervisors represent and speak for the 80% of voters in the county that voted to register their comments when they voted to keep the dams. Since Siskiyou County is home to 2/3 of the river system, you should give the Siskiyou Board of Supervisor's comments extraordinary consideration in your determination. You need to also consider economic and environmental consequences of dam removal. I am hopeful you will consider ALL our comments.

To begin, the Klamath River Renewal Corporation has filed an incomplete initial application. This is alarming, as they have had years to formulate a plan to consider such an application, since the KRRC is essentially the original signatories to the KHSA and KBRA. Given the simple fact that the US Congress was not willing to follow through and underwrite the liability of dam removal, how can a non-profit, that cannot even fill out a complete application, take over the Klamath Dams? This should be a major red flag that they will not be able to assume such an undertaking with any kind of organization or complexity of such a massive project! This is one reason, of many, that we believe that you should not grant certification.

Water Quality

· The 2012 California and Federal EIR/EIS reached incorrect conclusions. They did not do exhaustive engineering and environmental studies and therefore should NOT even be considered or used in the new EIR.

· The Bureau of Reclamation and Department of Interior studies were pushed by the signatories of the KHSA and KBRA chose the area of the river to study that would cost the least to remove the dams and have

the highest environmental effect for dam removal to fit dam removal agenda. This opinion is fortified by Dr. Paul Houser, the hydro meteorologist, hired to oversee the scientific integrity of the BOR's study.

· Only FIVE miles of the ENTIRE Klamath River, as quoted in the Biological Assessment in the original studies, were performed. The five miles studied were below the Iron Gate Dam and nothing was studied above the dam all the way into Oregon.

· The most polluted water in the Klamath River is between Keno and Copco 1 Dam, and yet this area was not studied. Reports show the water leaving Copco Dam is cleaner than it was when it entered the river.

· If the entire river system had been studied correctly, the effects of dam removal with sediment release might/could (both terms used in the DOI report) kill all aquatic live in the river for at least 2 years. The report then states that aquatic life will magically reappear by year 5, and the fish would be thriving with renewed water quality. How is that possible?

· A new and complete analysis of the entire river must be performed, including the water management of the Trinity River that is diverted into the State Water Project and the central canal as these flow impacts on the fish are unknown. The complete environmental consequences have not been adequately evaluated.

· Unless a new, transparent, and complete study of the entire river system is performed, the SWRCB cannot make a credible determination concerning water quality.

· What agency is going to monitor the water quality coming into California from Klamath Lake? California is bearing the burden of toxic water polluted by farmers and ranchers in Oregon. The most polluted water in the Klamath River is between Keno and Copco Dam and yet after the water leaves the dams, it is cleaner than what flowed into the river from Oregon.

Economic Impacts

· The economic impacts of the dam removal agreements are already being witnessed in Siskiyou County.

· Home values on Copco Lake have already plummeted due to dam removal agreements. Dam removal would precipitate a further loss.

· Homeowners are not able to sell their homes without disclosing possible dam removal and, as such, are forced to reduce their prices even more, IF they can even sell their homes.

· The loss of property values is reflected in the declining property taxes, and therefore a loss to Siskiyou County Revenue.

· When the BOR did their study they only looked at bare land values. They did not go through the process of the Record of Decision. Improvements were not considered. The KRRC does not have the funding or a plan for river or reservoir aesthetic restoration. It would take many, many years, if not a lifetime, to return the Klamath River behind the reservoirs to their native beauty.

· There are no plans for restoration after dam removal further lowering our property values.

· Even if there were to be a restoration period, the study looked at that as a period of only five years!! I'd like to see the science proving this study's assumption.

· There is a lack of transparency with the economic studies.

· It's my understanding that Siskiyou County has demanded an economic analysis so that they may inspect the details of this study, but their demands have not been met.

· Property value loss translates into lost tax dollars for school funding.

· If the dams are removed, the possibility exists that we could lose our water well, making our home uninhabitable, and therefore worthless. I'm certain the KRRC will not take on the expense of drilling a deeper well so that we can remain in our home.

· Will the KRRC compensate us for lost property value? Or will the KRRC reimburse Siskiyou County for millions of dollars of lost tax revenue as property values become worthless? I doubt that the KRRC will assume any liability and therefore in preparing your report you must take into consideration the economic effects of dam removal.

· The projected $450 million that dam removal is projected to cost, although other studies have shown this figure closer to $1 billion, are funds that can be spent on crumbling infrastructure, education, and other projects rather than a project that has not been adequately studied.

Fish and Animal habitat

· In 2001 The Karuk Council did not believe that Coho Salmon were indigenous to the Klamath River, but saw the value in misrepresenting the facts. The Coho are not native to the river, but the Karuk tribe now claims this to be true.

· Historically the salmon never came up above where Copco Lake is now due to warm waters from area hot springs per Native Shasta elders that lived in the area as well as early settlers, but these facts were never entered into the record when the BOR and DOI did their studies, as this area of the river was NOT studied.

· Under the ESA, a species cannot be decimated by a project, so how is dam removal a viable project to be considered by the Water Board if complete analysis is not performed?

· We have read that there is 20-30 million cubic yards of sediment behind the dams. There is great concern that this impact has not been adequately addressed. I assure you that if the fisheries are to be decimated for even a short period, the tribes will litigate for their losses of their fisheries.

· Unless the entire river is studied, all the impacts to fish and birds can't be know as to the impact.

· There are Perch behind the dams and if they are released into the lower river, that consequence must be considered since they are predatory to Salmon eggs. I believe this is another ESA impact that has not been considered.

· The last few years, water behind the Copco 1 Dam, as well as the others, has been released to improve water quality downstream to save the fish from parasites. Craig Tucker, of the Karuk tribe, admitted that without these water releases there would have been a major fish die off. No one at Copco Lake complained about their docks being temporarily unusable due to low lake levels, the inability to launch boats from the boat ramps because of low lake levels, and because boat could not be used there was a temporary loss of recreation at the lake.

· Governor Brown has said we need more water storage, not less. He cannot have it both ways. If this water storage was not there, at this crucial time, the fish would have died, and this winter with heavy rainfall, snow, and runoff there would have been floods.

· Aside from the original studies of only an extremely limited section of the Klamath River being evaluated, not all the creeks and rivers from below Iron Gate Dam to the mouth of the Klamath River, that make up the entire river system, and the actions of all parties that impact the fisheries, were and need to be taken into consideration. Gill netting still takes place across the mouth of the Klamath and this has not been studied as to the effect on Salmon population as well as ocean waters warming.

· Released sediments could alter the habitats of essential fish habitats and adequate studies have not been performed.

· Dam removal resulting in lake removal will impact migratory birds and the birds and animals that live in and around the lakes. Bald eagles, white pelicans, blue herons, and others have made this area their home and are thriving. Canadian geese and other migratory birds use the lake as a resting and breeding place and so the impacts to these species all need to be studied and have not been done so.

Public Health, Safety, and Flood Control

· The risk of floods downstream is great. Part of the reason for the dam construction initially was flood control. The sediments behind the dams could exacerbate the flood risk.

· Dam removal could also change the existing flood plains and you cannot ignore the need to realign the pipeline for the City of Yreka's water supply.

· The water behind the dams have aided in wildfire protection. Without the readily available water in the recent wildfires, many homes would have been lost.

· Despite warnings about coming in contact with the water due to toxins, not a single person around Copco Lake that has recreated in the lake have ever had any skin or health related issues due to water contact despite years of contact with the lake waters.

· Dam removal could result in problems with mosquito habitat and related diseases such as the Zika virus.

· There will be a considerable amount of debris because of dam removal possibly posing risks downstream of the destruction of the dams.

Historical and Archeological Effects

· The Shasta Native American Tribe, which precedes other Klamath tribes are not a signatory to the KHSA and have not been represented. Dam removal will expose sensitive Shasta burial grounds and possibly tribal artifacts.

· As the tribes, downstream from the dams are demanding that their tribal and cultural customs be respected, so shall the Shasta Nation be respected. If you engage with tribal entities without taking into consideration all entities and be certain that the interests of all tribes are taken into equal consideration you will be acting prejudicially.

Aesthetics

· Dam removal would have a long-term effect of the aesthetics of the river and the reservoirs behind the dams, as well as sediment transport would change the appearance and erosion issues for the Klamath River.

· Our home currently looks out onto a beautiful lake. When lake levels have been lowered for dam maintenance or when water releases have occurred to improve water quality for the fish, the mud, trash debris, and sediment exposed is not aesthetically appealing.

Recreation

· If dam removal takes place there will be a great recreational loss to the public. Currently the lakes provide such activities as boating, fishing, water skiing, wake boarding, kayaking, stand up paddling, canoeing, and swimming. There is also camping along the lakes that would be eliminated with dam removal.

· White water rafting activies would be altered with dam removal.

Greenhouse gas emissions

· Removal of effective hydroelectric power providing power to over 75,000 homes will most likely result in increased greenhouse gas emissions from replacement sources at a time when California will not meet the 33% legal mandate of electric power sales from renewable sources by 2020 even with the dams in place.

Alternative Solutions for Analysis

· Once there has been a thorough and complete analysis, a determination has found that salmon were native to the area above Copco 1 Dam and that the fish would survive and thrive in this area of the river, then there can be alternative solutions for analysis.

· Siskiyou County has offered solutions to address Klamath River Water Quality, such as fish ladders, and Trap and Haul where fish ladders might not be a practical application.

· Another solution might be using Bogus Creek as a bypass around the dams for fish passage.

· "Fish cannons" are also used in certain cases for transporting fish.

· Siskiyou County and landowners have taken many measures to improve water quality, improve fish habitats and water conservation.

In conclusion, you must take into consideration all the above reasons to complete the process for permit application without the assumption of a predetermined outcome. To do anything less, than a complete and independent analysis, would violate the Code of Regulations. We ask that you deny the certification request for Section 401(a) (1) of the Federal Clean Water Act for the KRRC to move forward with dam removal.

Respectfully submitted,

Suzanne Perlick

27700 Copco Road

Montague, CA 96064

Mailing address:

5575 Bocuer Dr

Orient, OH 43146

Phone: (614) 406-3475

Email: s.perlick@sbcglobal.net

From: Jeff Pierce <user@votervoice.net>
Sent: Thursday, January 26, 2017 7:58 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

Other key points I urge you to consider:

1. The 2012 joint California and federal EIR/EIS and related documents concluded that dam removal on the Klamath is in the best interest of the public. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies, which can be relied upon for your EIR.

2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Jeff Pierce
19513 Hinsdale Ave
Torrance, CA 90503
piercesjkd@verizon.net

From: Morgan Pierce <morganspierce@gmail.com>
Sent: Thursday, January 26, 2017 4:52 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Morgan Pierce
270 Currey Ln
Sausalito, CA 94965
morganspierce@gmail.com

From: Randal Pope <randalpope@gmail.com>
Sent: Monday, January 30, 2017 2:27 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Randal Pope
1218 Pacific Ter
Klamath Falls, OR 97601
randalpope@gmail.com

ER/P1

STATE WATER RESOURCES
CONTROL BOARD

2017 JAN 31 PM 1:35

DIV OF WATER RIGHTS
SACRAMENTO

California Water Resources Board

Division of Water Rights

Water Quality Certification Program

Attention: Mr. Parker Thaler

P. O. Box 2000

Sacramento, Ca 95812-2000

Dear Mr. Thaler,

I am opposed to the removal of the Klamath Dams for a number of reasons but in addressing water quality I wanted to point out that, since the environmental movement got underway in the 90's the quality of the Klamath River water has markedly improved. For the Miners and Residents along the River it was a Fish & Game Violation for a plume of muddy water to appear in the River. Now I understand that it is the decision on Dam Removal to release the many years accumulation of sediment into the River to wash down stream. This is not a good decision.

The string of Dams to be removed are very close to the California/Oregon border, and east of the I5 Freeway. The last downstream Dam is "Iron Gate" This Dam is 190 Miles from the Pacific Ocean. This is not a rational decision. Deposits of the sediment will be felt over the entire 190 miles of River plus the buildup of material across the mouth of the River where it meets the Pacific Ocean has been a problem, blocking fish entry to the river, and the sediment release from the Dams will only make it worse.

River Water flow is another area of concern. During years of low flows the Klamath Dams have provided releases that keep the river at a constant flow and adding cooling water from the lakes. The Klamath River is a East to West flowing stream and receives little if no shade during hot seasons. Of course the Tributaries also add cooling water but I believe that a large part of this equation can be contributed to the Dams. Allowing the river to be free means, at times, extremely low water. Predators will strip the pools of fish. Some pools will dry up stranding small fish. One danger that the IRONGATE dam alleviated was loss of life along the river due to drowning. When the river water level rose due to unexpected storm events or dam releases, fishermen were trapped out in the stream. This danger will once again return and plans should be made accordingly.

Thank You

Ed Prather

Ed Prather

Resident

PO Box 719

Seiad Valley CA 96086 530 496-3663

CC: Richard Marshall, President

Siskiyou Water Users Ass'n, PO Box 187, Fort Jones, Ca 96032

Thaler, Parker@Waterboards

From: Maymi C. Preston-Donahue <mp455@humboldt.edu>
Sent: Tuesday, January 31, 2017 9:34 PM
To: Thaler, Parker@Waterboards
Subject: Klamath Damn Removal Comment

Ayukii,
I would like to submit my comment in support of dam removal along the Klamath River because I am a life long resident there as well as a mother. My family works here. River health is important to our economy, or physical health, adn to the fish we eat and live off of. My family is also Karuk and Yurok. We have ties to this river and it's health spanning beyond this current government. Dam removal is key to keeping this river alive and well for prosterity. Thank you for your time.

Yootva koovura
Thanks for it all

Maymi Preston-Donahue
MSW Intern Cohort 2017
mp455@humboldt.edu
(530)627-3008

From: Errol Previde <eprevide@gmail.com>
Sent: Thursday, January 26, 2017 3:42 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

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As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Errol Previde
2366 Hewitt Rd
McKinleyville, CA 95519
eprevide@gmail.com

From: Sam Rametta <samthecardman@ca.rr.com>
Sent: Thursday, January 26, 2017 9:39 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Sam Rametta
2485 Irvine Ave
Costa Mesa, CA 92627
samthecardman@ca.rr.com

From: Michael Ream <mikeflyfish35@gmail.com>
Sent: Friday, January 27, 2017 1:17 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Michael Ream
2632 Rochon Way
Sacramento, CA 95818
mikeflyfish35@gmail.com

Thaler, Parker@Waterboards

From: Joanna Reichhold <salmonmoon17@gmail.com>
Sent: Wednesday, February 01, 2017 2:31 PM
To: Thaler, Parker@Waterboards
Subject: Public comment Supporting 401 Certification for Klamath Dam Removal

Dear State Water Resources Control Board:
I recreate on and around, live near, and love the Klamath River. I love it's salmon and it's native peoples.

I urge you to grant a Clean Water Act Section 401 permit for decommissioning and removal of Iron Gate, Copco I, Copco II and J.C. Boyle dams on the Klamath River.

As you are already well aware, construction and operation of these dams represent a grave environmental injustice which your agency has the unique power to right. Salmon and salmon-dependent communities cannot withstand another 30 or 50 years of river impoundment. As Martin Luther King said, justice too long delayed is justice denied. Don't participate in a denial of justice. Instead, be champions of wild, free-flowing rivers and small, rural communities that subsist off them (like the one I live in!)

Please, consider all the evidence already in the record supporting dam removal, including testimony and comments from the Karuk, Yurok and Klamath Tribes, Klamath Riverkeeper, the California and Oregon Public Utility Commissions, the US Fish and Wildlife Service, the National Marine Fisheries Service, US Geological Survey, California Department of Fish and Wildlife, the Pacific Coast Federation of Fishermens' Associations, PacifiCorp, and many, many others.

This one action you can take will do more than any other single action to restore the Klamath River ecosystem and West Coast fisheries, economies and recreational opportunities on a landscape level. Please grant Klamath dam removal a CWA Section 401 permit so that the Federal Energy Regulatory Commission can carefully, yet expeditiously move ahead with this action by 2020.

Thank you for all you do to protect and restore our water resources.

Sincerely,

Joanna Louise Reichhold

Po Box 312

Blue Lake, CA 95525

Thaler, Parker@Waterboards

From: Chrissie Reynolds <littleeaglewomanseeing@gmail.com>
Sent: Tuesday, January 31, 2017 8:53 AM
To: Thaler, Parker@Waterboards
Subject: deny the water certification for removing the dams

There are so many people that would be adversely affected by removing the dams. You will be violating peoples Constitutional rights by moving forward. As a Mom No means No. It is a complete sentence. But for some reason the State and Federal governments think they can bypass Congress and the Will of the American People as well as spend MILLIONS of tax payer money trying to get around NO. No means NO! No dam removal, no exposing Shasta burial grounds and sacred sites, no sediment going down the river, no more property value losses, no damage to our road (Ager Beswick and Copco Rd, specifically) no more eco terrorism for our children, no more lies and secret meetings and denying actual stakeholders their rights, no more corruption by State agencies who are supposed to be looking out for the People who pay their salaries, no more lies. No holding Californians responsible for water that comes in that way from Oregon, no more protecting fish that are not indigenous to the water way, no more bullying by the State. No using the old unfounded not scientifically accurate EIR previously produced by the DOI, no more extortion, no more postings of our resevoirs. PROVE to me with actual data who was harmed and when by the algae in Copco or Irongate. I have talked to our local doctors, veterinarians, and county health officials and there has not been one documented case, so unless you can provide me with specific cases of harm done, then YOU are the ones causing harm by posting that the lakes are a health risk. The postings create a perception. CAN YOU PROVE that any person, livestock or animal was injured or harmed? Because IF what you have posted was true, there would be dead bodies everywhere and there aren't any, haven't been any and will never be any. Your paychecks and your pensions are paid for by The People and The People say NO. Please do your due diligence and refuse to give certification where it is not warranted. Chrissie Reynolds, Copco Lake Resident

Thaler, Parker@Waterboards

From: Phil Reynolds <kahunaphilly@gmail.com>
Sent: Sunday, January 29, 2017 9:41 PM
To: Thaler, Parker@Waterboards
Subject: Copco Lake and dam removal on the Klamath water shed

Attention:
State Water Resources Control Board

I have been a resident of Copco Lake for 36 years. My family move to this beautiful location when I was only 8 years old. In the many summers of my childhood, swimming, fishing, and eating the fish that were caught the same day we swam and played in the lake was a weekly occurence. I've hunted and consumed the waterfowl, quail, and deer that use and drink from the lake. I am now 44 years old with an 8 year old daughter of my own. She, like me, loves to swim, fish, and hunt in and around water of Copco lake . In the short 36 years of life spent on Copco lake I have never been ill nor have any friends, family, or others from the water or the fish or the animals havested and consumed in or around the waters of this small valley. "Health warnings from the state ;Toxic blue green algea bloom do not swim in or consume fish from this lake."..... what a joke. For the past 10 to 15 years the agenda has been to get these dams off of the Klamath river system. The state and the federal government continue to use what ever tactics necessary to achieve this goal. Health threats,the precious coho salmon, dwindling numbersof Chinook, these are all forms of eco-terrorism. If fish or water quality were truly the problem we could work to solve it. Stop fishing in the ocean for salmon in international waters....the fish can't come back from the ocean when they are aboard vessels from other countries. Work on water quality and temperature for overall betterment of the environment. Research has been done to prove the desired result. We all know it is false science. We live here. We know our surroundings . Ask us for information. The knowledge of our elders. It is called history. We all take it in school. Lets learn from it. 80 percent of siskiyou count said NO to dam removal. Do those incharge not care about the people actually affected by this decision. The simple answer is no. The removal of these dams is not about the fish, it is not about the Indian tribes, it is not about the water quality, it is about money and the power of control. Please consider everything in all that you read from the people who know, the people who are affected, the people who experience this way of life every day.
Thank you for yor time.
Copco Lake resident
Phil Reynolds
27912 mallard rd
Montague, Ca. 96064

From: Mr. & Mrs. Matt Richardson <richardson034@gmail.com>
Sent: Friday, January 27, 2017 10:00 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am born and raised in California and I recognize that dams have caused incredible harm to river systems.

Taking down the Klamath dams is an amazing and realistic opportunity!!

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

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Other key points I urge you to consider:

1. The 2012 joint California and federal EIR/EIS and related documents concluded that dam removal on the Klamath is in the best interest of the public. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies, which can be relied upon for your EIR.

2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Matt Richardson, DPT
1855 Green St
San Francisco, CA 94123
richardson034@gmail.com

Thaler, Parker@Waterboards

From: Tom Rickard <trickard@hughes.net>
Sent: Friday, January 27, 2017 3:46 PM
To: Thaler, Parker@Waterboards
Subject: FW: Scoping meeting for Environmental Impact Report - Yreka Ca. 01-26-17

Hi Parker,
I had the wrong e-mail.

From: Tom Rickard [mailto:trickard@hughes.net]
Sent: Friday, January 27, 2017 11:26 AM
To: parkerthaler@waterboards.ca.gov
Cc: Lee Rickard
Subject: Scoping meeting for Environmental Impact Report - Yreka Ca. 01-26-17

Good morning Parker,
We are writing to you to have our comments included in your data that was collected last night at the Yreka Ca. scoping meeting.
First let me say that we were impressed by the presenters and their information and that overall people were polite and let each speaker have their say.
We have read the data that you put out regarding the project and it would appear that pages 1 thru 4 of the attachment list pretty clearly why the dams should not come out. There was however, one very important thing left off of this list. The loss of property value. The only thing that we have seen regarding this was a study that was done by some group which was totally misleading. They showed the loss of property value for the land only and not for the buildings which is the biggest part of the value. They also looked at this as though the river had been totally restored so the aesthetic value was not really impacted. This as you know will never fly. I will give you one example using our property. We have two parcels that border the lake. One is 11 acres and one is 10.9 acres one has a cabin on it with a garage and sold in 1991 for $120,000.00 this has since been updated and should be selling under normal circumstances for around $200,000.00. We would be lucky to get $100,000.00 for it now. The other parcel was empty property and we built a 5,200 square foot custom home on it when we retired. We have approximately $900,000.00 invested in this and this would probably not sell for more than $500,000.00 if that.
These are just two examples of something that we have the figures on. Other residents have similar stories as well.
We hope that this information will be helpful and if there is anything else that we can provide, please let us know.
Regards,
Tom and Lee Rickard
Copco Lake Residents.
(530) 459-1002

From: Kevin Riddle <kevinriddle6113@gmail.com>
Sent: Sunday, January 29, 2017 12:53 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

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Sincerely,

Kevin riddle
146 N 14th St Apt Apt6
Philomath, OR 97370
kevinriddle6113@gmail.com

From: Bob Rosenberg <endobob@earthlink.net>
Sent: Thursday, January 26, 2017 6:08 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Bob Rosenberg
32 Toussin Ave
Greenbrae, CA 94904
endobob@earthlink.net

From: ed rossi <user@votervoice.net>
Sent: Friday, January 27, 2017 9:47 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

ed rossi
595 Francisco Blvd E
San Rafael, CA 94901
e.rossi5@yahoo.com

From: Jim Rowland, jr <slope@comcast.net>
Sent: Friday, January 27, 2017 9:51 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Jim Rowland jr
26840 Hawk Rd
Willits, CA 95490
slope@comcast.net

Thaler, Parker@Waterboards

From: Tim Ryan <tryan10@alumni.nd.edu>
Sent: Friday, January 20, 2017 11:48 AM
To: Wr401program
Subject: Lower Klamath Project

Dear Mr. Thaler,

I am writing to supply a comment on the Lower Klamath dam removal project. I have spent the past few years doing wildlife field research, much of it in anadromous fisheries with agencies including California Sea Grant, NOAA National Marine Fisheries Service, and the California Department of Fish and Wildlife. I would like to emphasize that I am writing as a concerned citizen and not on behalf of any of these agencies.

I have seen firsthand that there are very few quick fixes in any conservation work, but removing barriers to anadromy is about as close as it gets. The Elwha Dam removal is a striking example of how quickly salmonids return to previously unavailable spawning habitat. More recently, and more close to home, the removal of an old and unnecessary barrier on Mill Creek - a tributary to the Russian River - resulted in the return just this year of coho salmon to spawning habitat upstream of the barrier. A healthy fisheries is a key component to restoring ecological balance to any anadromous watershed and the economic, aesthetic, and environmental benefits to such a restoration effort are incalculable. I hope that the process to begin this removal is expedited as quickly as possible, especially since, as was mentioned during the scoping meeting, the longer we wait, the larger the sediment load behind these dams will get.

Sincerely,

Tim Ryan

From: Charles Salomon <mcsalomon12@gmail.com>
Sent: Thursday, January 26, 2017 4:55 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Charles Salomon
23395 Sun Terrace Ct
Auburn, CA 95602
mcsalomon12@gmail.com

From: Jim Sangster <jim.sangster@comcast.net>
Sent: Sunday, January 29, 2017 10:12 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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As a native California angler, I am very excited about the potential to bring back many of our fisheries. I have fished the Trinity many times and look forward to future trips on the Klamath without impediment to the anadromous fish.

Sincerely,

Jim Sangster
117 Forest Hill Dr
Los Gatos, CA 95032
jim.sangster@comcast.net

From: Michael Sapunor <user@votervoice.net>
Sent: Monday, January 30, 2017 9:07 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Michael Sapunor
3231 Maplethorpe Ln
Soquel, CA 95073
msapunor@yahoo.com

Thaler, Parker@Waterboards

From: Suzie Savoie <klamathsiskiyou@gmail.com>
Sent: Sunday, January 29, 2017 8:03 AM
To: Wr401program
Subject: Public comment: Klamath Dam Removal

Dear SWRCB,
As a landowner in Siskiyou County, California that pays property taxes to Siskiyou County, I am wholeheartedly in favor of dam removal along the Klamath River. It is the common sense thing to do given the needs of endangered fish, local downstream tribes such as the Karuk and Yurok, and the needs of Pacificorp who wants the dams removed. This decision is for all public good, not just the needs of a few local residents who may be opposed. Do not be fooled: not all landowners in Siskiyou County are against dam removal.

I urge the SWRCB to use science as your guide in this decision making process. That is the only unbiased and fair way to measure the needs of the ecological function of the Klamath River. Water quality, native species, downstream communities, the economic importance of fisheries, and the economic gains of dam removal should be weighed heavily in this matter.

As a person who loves the Klamath River dearly and wants to see the river and its fisheries returned to some level of ecological function that benefits local communities, I urge you to keep pressing hard for removal of the Klamath River dams. It is the only way forward for the future. Keeping these obsolete and archaic dams will only hurt the river and local communities in the long run.

Sincerely,
Suzie Savoie
klamathsiskiyou@gmail.com

--
Suzie Savoie
Klamath-Siskiyou Native Seeds
www.klamathsiskiyouseeds.com

Thaler, Parker@Waterboards

From: jcschaef@igc.org
Sent: Thursday, January 12, 2017 8:39 PM
To: Wr401program
Subject: Lower Klamath Project

Thanks for coming to Arcata. I believe that no decision that the Water Resources Board makes could assure as much clean water as rapid approval of this project would.
John Schaefer
Arcata CA

This is what I think too! EB

ERS TRIBUNE Volume 23 Issue 3 1.24.17

To fellow residents of the Klamath-Trinity River Basin,

I live at Klamath Glen, five river miles from the Pacific. I've been all over the Basin and a Klamath River activist for 31 years. I continue to care passionately about our Rivers' future and I'm involved in lots. So it might surprise you that I didn't attend the recent dam hearings or comment to the Water Board about the dams. The reason, to quote our president, is because "the system is rigged". Let me explain:

The dams are owned by PacifiCorp which is owned by Warren Buffet. Because the dams would loose double digit millions each year if relicensed, PacifiCorp's Klamath River Dams are a huge corporate liability. When big liabilities are coming down on a member of the one-percent in the good ol' USA the liability is usually socialized. In this case, California taxpayers are footing $25 million of the bill while PacifiCorp's customers (I'm one!) pick up the rest. The one-percenter bears none of the cost; he gets rid of a failing asset cost free.

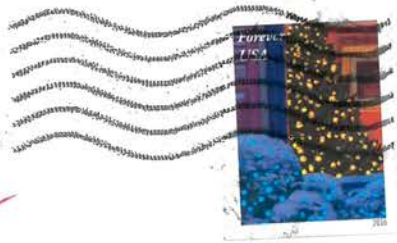
There are, of course, peripheral winners and losers whose concerns are not trivial. In the end, however, I believe the claims of benefit to salmon and loss of land value will both prove overblown; gains and losses will be modest; Siskiyou County taxes will take a significant hit. Fisheries and water quality benefits will be limited mostly because a fifths dam, Keno up in Oregon, will remain in place and continue to send toxic water downstream.

The Water Board will provide a permit for removal of four dams; meanwhile the same Water Board refuses to order the clean-up of Keno Reservoir. The system serves the one-percent, not the public interest in clean water. One might say that "the system is rigged!" ■

Sincerely,
Felice Pace
Klamath Glen

Eric Schmidt
5411 Saering Ave
Woodland Hills, CA
91367

SANTA CLARITA CA 913
31 JAN 2017 PM 5 L



PT

Mr. Parker Thaler
State Water Resources
Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA
95812-2000

2017 FEB -7 AM 10:16
DIV. OF WATER RIGHTS
SACRAMENTO

From: Andrew Schneider <aschneid22@gmail.com>
Sent: Thursday, January 26, 2017 10:00 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Andrew C Schneider
195 Tivoli Way
Sacramento, CA 95819
aschneid22@gmail.com

Kay Schulz
Paul Schulz
481 Cedar Ave
Trinidad, CA 95570

January 31, 2017

Parker Thaler
State Water Resources Control Board
Division of Water Rights-Water Quality Certification Program
P.O. Box 2000
Sacramento, CA 95812-2000

Dear Mr Thaler,

After careful review of the Klamath Facilities Removal EIR/EIS and the FERC EIS completed in 2012, we have come to the conclusion that these two documents adequately address water quality issues in the Klamath River System. Very little would be gained by the State of California embarking on a new study.

While the above documents do not address the fish disease issues that have been identified in the last two years that should not preclude the adequacy of those documents. Fish disease issues are due to the poor water quality, high summer water temperatures and the existence of the dams.

Moving forward expeditiously to ensure dam removal by 2020 is in the best interest of the Klamath River and all parties that would be affected.

Sincerely,

Kay Schulz and Paul Schulz

From: Evan Sedlock <erscls2@gmail.com>
Sent: Friday, January 27, 2017 6:34 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Evan Sedlock
109 Ash Way
San Rafael, CA 94903
erscls2@gmail.com

Thaler, Parker@Waterboards

From: Mary Seeger <mahajsee@gmail.com>
Sent: Thursday, February 02, 2017 12:38 PM
To: Thaler, Parker@Waterboards
Subject: Klamath Decommissioning and dam removal

State Water Resources Control Board
Division of Water Rights, Water Quality Certification Program
Attn: Mr. Parker Thaler
PO Box 2000
Sacramento, CA 95812-2000

Re: Public Comments Supporting 401 Certification for Klamath Dam Removal

Dear Mr. Thaler,

As a land owner in the greater Klamath River drainage, I respectively request that you grant a Clean Water Act Section 401 permit for decommissioning and removal of Iron Gate, Copco I, Copco II and J.C. Boyle dams on the Klamath River.

When you take into account all the evidence in the record about dam removal, including testimony and comments from the Karuk, Yurok and Klamath Tribes, Klamath Riverkeeper, the California and Oregon Public Utility Commissions, the US Fish and Wildlife Service, the National Marine Fisheries Service, US Geological Survey, California Department of Fish and Wildlife, the Pacific Coast Federation of Fishermens' Associations, PacifiCorp, and many, many others, I think you will find your decision well supported.

This one action will do more than any other single action to restore the Klamath River ecosystem and West Coast fisheries, local economies and recreational opportunities.

Please grant Klamath dam removal a CWA Section 401 permit so that the Federal Energy Regulatory Commission can carefully, yet expeditiously move ahead with this action by 2020.

Thank you for all you do to protect and restore our California water resources.

Sincerely,

Mary Helen Seeger

mahajsee@gmail.com

From: Vincent Sereno <user@votervoice.net>
Sent: Thursday, January 26, 2017 7:59 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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1. The 2012 joint California and federal EIR/EIS and related documents concluded that dam removal on the Klamath is in the best interest of the public. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies, which can be relied upon for your EIR.

2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Vincent Sereno
PO Box 2892
Arnold, CA 95223
smtbear@aol.com

From: Bryan Shadden <bryanshadden@gmail.com>
Sent: Friday, January 27, 2017 11:09 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

(my own words): This is a total no brainer for for California. The work has been done, partnerships have been made on all sides. It's time to make this happen.

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

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Sincerely,

Bryan Shadden
5948 12th Ave
Sacramento, CA 95820
bryanshadden@gmail.com

From: Bill Sharp <user@votervoice.net>
Sent: Wednesday, January 25, 2017 7:46 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Bill Sharp
17341 Gibson Cir
Huntington Beach, CA 92647
hbsurfschool@yahoo.com

From: Daniel Shaw <danielpatrick_88@hotmail.com>
Sent: Wednesday, January 25, 2017 6:03 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Daniel P. Shaw
84485 Parkway Rd Unit B
Pleasant Hill, OR 97455
danielpatrick_88@hotmail.com

Thaler, Parker@Waterboards

From: Barbara Short <barbarajshort@yahoo.com>
Sent: Wednesday, February 01, 2017 3:15 PM
To: Thaler, Parker@Waterboards
Subject: Klamath Dam Removal

February 1, 2017

To: State Water Resources Control Board
Division of Water Rights, Water Quality Certification Program
Attn: Mr. Parker Thaler
PO Box 2000
Sacramento, CA 95812-2000

Via electronic mail to parker.thaler@waterboards.ca.gov

Re: Public Comments Supporting 401 Certification for Klamath Dam Removal

Dear State Water Resources Control Board:

Please approve the Clean Water Act Section 401 permit for decommissioning and removal of Iron Gate, Copco I, Copco II and J.C. Boyle dams on the Klamath River.

Decades of sound science demonstrates that the construction and operation of these dams has had dire environmental and societal impacts on our river system and communities. Salmon, crawfish, eel and fishing-dependent communities have been in declining health due to the effects of these dams. We need immediate action from your agency to start the process of mitigating effects and hopefully reversing the long term damage to species and communities.

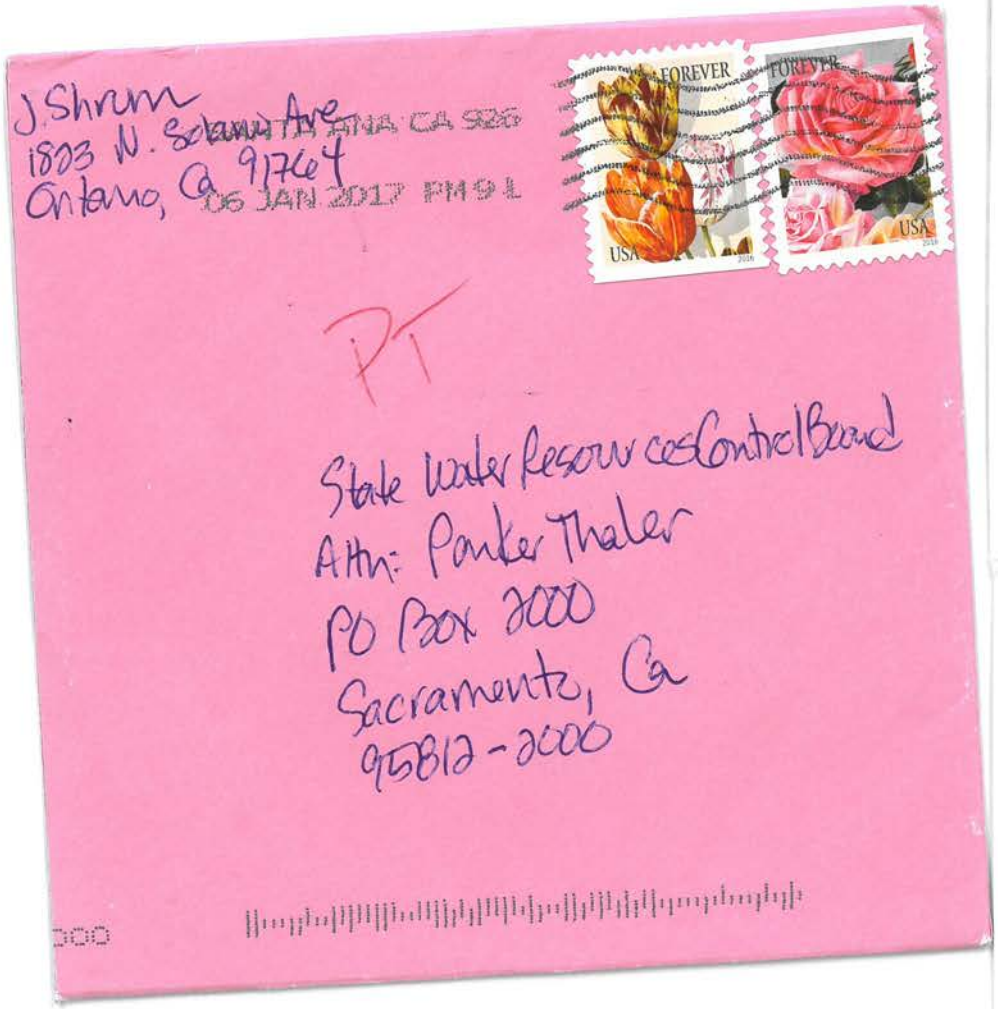
Evidence in the record suggests that dam removal is the only step that will make a positive difference for the river system. Testimony supporting dam decommissioning from the Karuk, Yurok and Klamath Tribes, Klamath Riverkeeper, the California and Oregon Public Utility Commissions, the US Fish and Wildlife Service, the National Marine Fisheries Service, US Geological Survey, California Department of Fish and Wildlife, the Pacific Coast Federation of Fishermens' Associations, and PacifiCorp, to name a few organizations, is based on research and fact. There is major support from these diverse stakeholders for your decision to remove the dams. There is no other action examined proven to have a significant positive effect other than the removal of these four dams.

Please grant Klamath dam removal a CWA Section 401 permit so that the Federal Energy Regulatory Commission can carefully, yet expeditiously move ahead with this action by 2020. Time is of the essence.

Thank you for all you do to protect and restore our water resources. Your work is greatly appreciated.

Sincerely,

Barbara J Short, D.Ed.



Only 78 Resident Orcas
left.
They need the Salmon.
We need the nature.

Mr. Thaler

Take Down the Dams!

Please restore the Klamath
basin. The damage can
be reversed but we have to
continue on track & take them
DOWN!

-Jennifer Shrum

From: Judith Simmons <jsjudysimmons09@gmail.com>
Sent: Wednesday, January 11, 2017 9:39 AM
To: Thaler, Parker@Waterboards
Subject: Re: Hello how about answers!

thanks a lot. now I know, and feel so much wiser.

On 1/11/17, Thaler, Parker@Waterboards <parker.thaler@waterboards.ca.gov> wrote:
> Hi Judith,
>
> "Scoping" is referencing the public comment period that is currently
> occurring as part of the State Water Resources Control Board's process
> as it relates to the Lower Klamath Hydroelectric Project's water
> quality certification application.
>
> We released an Notice of Preparation (NOP)(attached) on December 22,
> 2016, and also announced public scoping meetings (included on page 4 of the NOP).
>
>
> Our public comment period ends February 1, 2017. There will be
> additional comments periods as part of the California Environmental
> Quality Act and Water Quality Certification processes.
>
> Thank you,
>
> Parker
>
> -----Original Message-----
> From: Judith Simmons [mailto:jsjudysimmons09@gmail.com]
> Sent: Tuesday, January 10, 2017 4:41 PM
> To: Thaler, Parker@Waterboards
> Subject: Hello how about answers!
>
> Hey Mr. Parker how about a short sentence describing what "scoping"
> actually is?
>
> Maybe easier for you is to explain why I would get this email?
>
> Still waiting....2nd time for this request.
>

Daniel F. Simon, P.E.
Civil & Environmental Engineering Siskiyou County, California Republic

Parker Thaler February 1st, 2017
State Water Resources Control Board (SWRCB)
Division of Water Rights – Water Quality Certification Program
PO Box 2000
Sacramento, California 95812 via email: wr401program@waterboards.ca.gov

Re: Proper Analysis for Heavy Metals (Arsenic, Mercury, etc…);
Klamath Facilities Removal Environmental Impact Statement/ Environmental Impact Report

I wish to communicate my concerns of the release of heavy metal impacts upon aquatic life in the Klamath River when the dams are removed. This is provided on-record so that when a law suit occurs, I have complied with an "administrative notice", and this concern has "standing." In addition, performing Environmental Phase I & Phase II studies, I am required to investigate leads I have discovered on a site. This is also providing you a "lead" from history and technology.

I would hope my concerns can be addressed properly, by providing to the SWRCB, a more precise method of determining the location of heavy metal pockets. From this I would hope that the SWRCB performs sampling of said pockets for ensuring that aquatic life is protected. There is a specific fish-kill that I will address in the next paragraph.

Fall-Creek Fish Hatchery. According to Christopher Lilly (former Mayer of Etna), there were multiple fish die-offs in the hatchery. After multiple die-offs, they determined that they occurred after heavy rains. The rains brought forth Arsenic into the hatchery, and that was the cause of the die-offs. The Arsenic (naturally occurring) was in the top soils, and was eroded by rains.

Precise Location of Sampling: Although there has been some sampling reported in the EIR, I would advocate for more precise locations of sampling for heavy metals. Figure 1 provides a conceptual understanding of where heavy metals will "congregate." These are based on laws of particle settling. According to Stoke's Law of particle settling, particles of different densities have different settling velocities. Of course, any seasoned civil engineer can tell you that.

Let's consider how particles separate. Consider various particles of the same size but have different densities. These are released from a pipe into a stream together. The stream will carry particles downstream with the flow. The more dense particles will

Box 51, Hornbrook, California 96044 530-598-9671 danielfsimon@yahoo.com

settle faster, and land on the stream bed sooner than lighter particles like clay or soil. For example, gold particles will settle faster than sand particles, and the gold will be found closer to the release point. Sand particles will be found further down-stream. Any seasoned gold miner will tell you they will look for pockets to dig for gold in a stream bed. As a hobby, I have also done this, and always find flakes.*

From this, pockets of concentrated Arsenic, Mercury, and other heavy metals have been formed along the Klamath River bed. Figure 2 displays in a "big-picture" the potential for pockets of heavy metals from this concept.

Table 1 provides settling velocities of various density particles. Heavy metals settle much faster than clay (soil) particles, and thus Figure 1 & 2 a conceptual drawings are a real possibility. (Additional detailed studies and modeling is required.)

In addition, the lighter materials, like clay and other soils can be easily "uplifted" and removed from these "pools." This is explained by fluid mechanics, but I have not the time today to explain. This means that over the years, clay will go in and out of the "pools", and larger Clay particles might stay, but the smaller particles will be lifted out. Meanwhile the heavy metals will settle in the pools.

Recommendations:

1. **Prior to lowering the water of the dams:**
   - Sample soil areas in the Klamath River Drainage Shed for heavy metals;
   - Use Ground Penetration Radar to identify "pools" in tributaries of suspicion;
   - Sample "pools" in tributaries for
     - Arsenic
     - Mercury
     - Other heavy metals
   - Use Ground Penetrating Radar to identify "Pools" in the Klamath River bed.
   - Prepare a RFP for automated hourly sampling of the Klamath River for heavy metals.

2. **While draining the dams in preparation for demolition:**
   - Sample with an automated sample system for any spikes of heavy metals in the Klamath River, as these pools are exposed and potentially washed out.
   - Sample "pools" found in tributaries now exposed as the water level decreases
   - Sample "Pools" within the Klamath River bed when access is possible.

* I have performed exhaustive settling velocity calculations to determine the different settling velocities of gold, black sand and quartz to capitalize on the separation of said particles for gold extraction. From this, I have successfully invented a gold extraction device that will extract gold down to 20 um. Possible as small as 1um, yet, smaller than 40 um, it is not economically viable to extract in most ores. I have had extensive experience in computational fluid mechanics to provide other additional understandings of "uplift" of particles. In general clay particles will uplift and move along the stream bed, while Arsenic, Mercury, and other heavy metals will remain and concentrate in specific locations (pockets/ pools in the stream bed.)

3. **From what is discovered by the above, increase sampling protocols to ensure heavy metal concentrations are not washed out of pools and into the Klamath River.**

4. **Should continual sampling discover hazardous levels of sediment, toxic to aquatic fish, then there may be a necessity to remove and remediate sediment with concentrated heavy metals.**

Conclusion: Now you have a more precise method of locating pockets of heavy metals that will impact/ kill aquatic life prior to the removal of the Klamath Dams.

Closing: On the basis of heavy metal settling into pockets, and how these can threaten aquatic life, when disturbed, I object to the removal of the Klamath Dams unless precise locations can be sampled for pockets of concentrated heavy metals, and either the pockets can be remediated, or proven that they are not toxic to aquatic life, when released.

I am available to assist in focusing sampling efforts with this technique. I would welcome a phone call.

You are now on notice,

[Electronic signature for e-mail]

Daniel F. Simon, P.E.
BS/MS Civil Engineering (Focusing on Environmental Engineering), Calif. RCE#58237

PS: Note that in a dry year, once the dams are removed, and water flow is low, fish will congregate in these heavy metal concentrated pools, and may experience toxic impacts.

Attachments

Table 1
Figure 1
Figure 2

cc: Siskiyou County Board of Supervisors, Siskiyou Daily News, California Legislatures, etc…

Table 1. Estimated SETTLING Velocities of Arsenic Species, Soil (Clay), & Mercury. (Stokes Law)

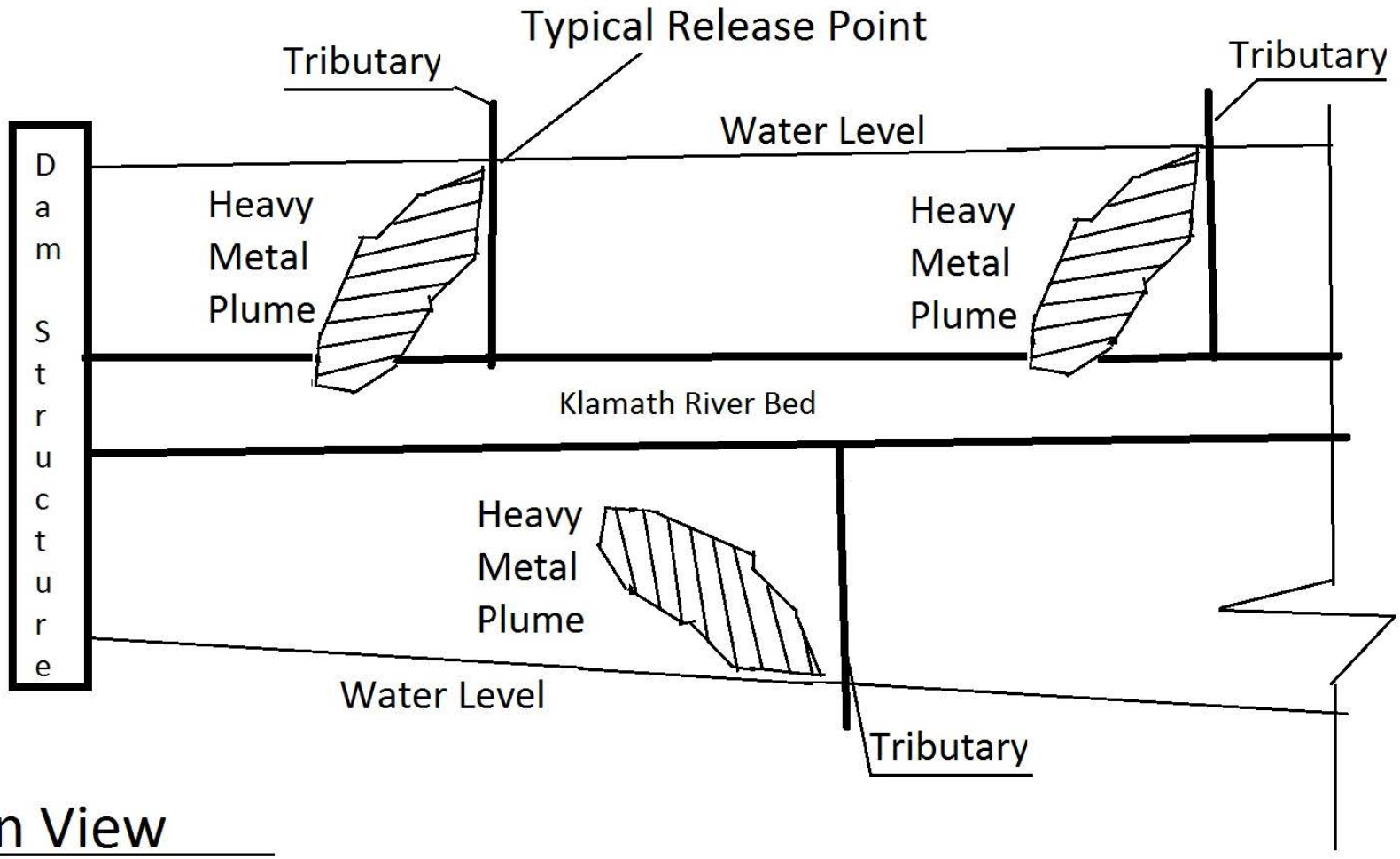
Particle	Specific Gravity	Settling Velocity (um/sec) based on particle diameter **1 um**	**2 um**	**5 um**
As (Aresenite)	3.74	**1.22**	**4.8**	**30.5**
Soil (Clay)	2.8	**0.8**	**3.2**	**20**
Mercury	13.59	**5.6**	**22.4**	**140**
Gold	19.1	**8**	**32.2**	**201**
Grey Arsenic	5.73	**2.1**	**8.4**	**52.6**

Cory Shape Factor (For flat-like particles in Clay), a Reduction of soil settling velocity by 30%

Soil (Clay)	2.8	**0.56**	**2.24**	**14**	um/ sec.	<=====

Note: A detailed model of settling velocities needs to be performed based on the percentage of particles of various sizes, and other factors.

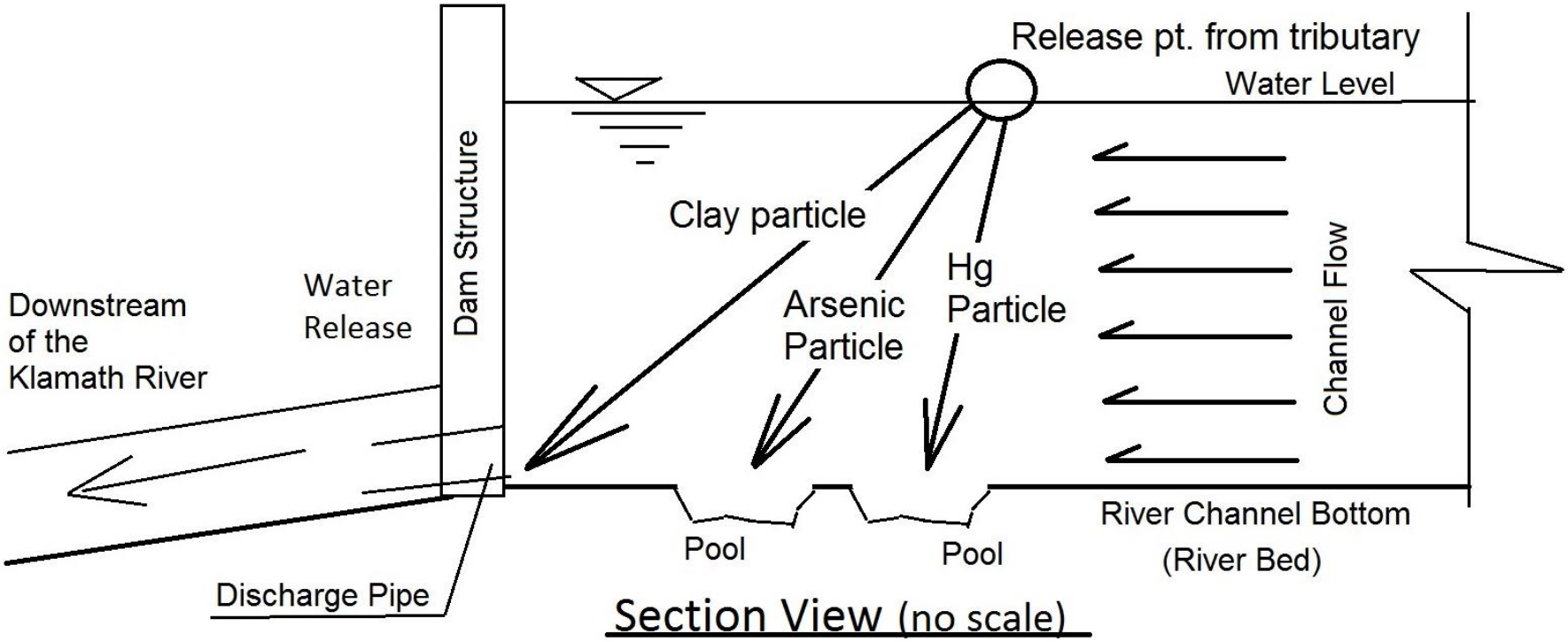
Figure 1. Locations of Potential Concentrations of Heavy Metals



Plan View

(no scale)

Figure 2. Settling Paths & Locations of Particles of Differnt Densities



Note: This is a conceptual representation of the settling paths of particles of different densities based upon settling velocities of Table 1. From this, settling paths of particle is displayed by arrows. Because of different densities, the paths differ and different settling locations are displayed. To accurately model particle settling paths, and settling locations requires exhaustive modeling analysis. However, this concept is sound in displaying particle separation, and the potential of concentrated particles of heavy metals in pools below the typical river bed. In dry years, this is where fish will congregate, as the water level lowers after the dams are removed. In addition, these pools if flushed-out will cause a spike of concentrations of constituents of concern. Possibly creating a toxic spike downstream in the Klamath River.

Thaler, Parker@Waterboards

From: Rich Slusser <slusserrich@gmail.com>
Sent: Wednesday, January 11, 2017 9:29 PM
To: Thaler, Parker@Waterboards
Subject: Klamath Dam Removals

Since accompanying my Uncle and Father to the base of the newly completed Iron Gate dam in the early '60's, where we watched as hundreds of migrating salmon hopelessly jumped against the grates at the bottom of the dam, I have been saddened at what these short-sighted dams have done to a once magnificent river. The time has finally come when we can start to mitigate that damage. MAKE IT HAPPEN - REMOVE THESE DAMS!!!

- Richard Slusser
  1724 Bristol St.
  Ashland, OR 97520


This email has been checked for viruses by Avast antivirus software.
www.avast.com

From: Chad Smith <chmith27@netscape.net>
Sent: Wednesday, January 25, 2017 6:43 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the enormous contributions made to an ecosystem by wild salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

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Sincerely,

Chad Smith
11905 Andretti Ave
Bakersfield, CA 93312
chmith27@netscape.net

From: Mark Speer <msspeermd80@gmail.com>
Sent: Friday, January 27, 2017 8:19 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Mark Speer
5302 Tufton St
Westminster, CA 92683
msspeermd80@gmail.com

From: Mike Spurlock <spurlinov@comcast.net>
Sent: Thursday, January 26, 2017 5:35 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Mike Spurlock
20 San Domingo Way
Novato, CA 94945
spurlinov@comcast.net

From: Darek Staab <dstaab@tu.org>
Sent: Monday, January 30, 2017 11:57 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am a resident of Central Oregon and spend time visiting and recreating along the Klamath River. For too long we have stretched those resources too thin, and it is time to actively restore and conserve the critical water quality needed for species downstream.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

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Sincerely,

Darek Staab
237 NW Hunter Pl
Bend, OR 97703
dstaab@tu.org

From: Richard Stein <dickstein38@gmail.com>
Sent: Friday, January 27, 2017 1:42 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Richard Stein
3200 Soscol Ave Apt 225
Napa, CA 94558
dickstein38@gmail.com

Dear Mr. Thaler,

In the year of 2009, we voted to keep our three dams by 80%; the people in Oregon also voted to keep their one dam. There is great manipulation and conniving going on here with those who want to take out the dams, holding secret meetings with some of our Representatives and the two governors named "Brown." These NGO-Stakeholder-Environmentalists will do anything to have our dams destroyed. The KBRA expired and now they have made a KRRC. They are involving every agency in hopes they will get their way. There is also another problem, the Klamath river is flowing over the burial grounds of the Shasta tribe. It was covered by water, and now they want to expose it, all against the Antiquities Act. There has been no courtesy or respect shown to the Shasta Tribe, or the common people, so you should not be cooperating with these "killers of dams!" You should not cooperating with these NGO-Stakeholder-Environmentalists!

The TMDL's will not be what you want them to be, because the Klamath river runs through a volcanic area, and there are hot springs running from tributaries near the Keno Dam. A company named, "Quick Silver Mining," mined mercury in that area in the 19th century. Mercury is also called quicksilver. Besides, it is the truth that the water, after if goes through the dams, is much cleaner.

If the dams are destroyed there will be much less water in the river so the TMDL's will be worse.

In 1851, George Gibbs went with another man who was having the Indians along the Klamath river to sign treaties. He told about one area, possibly, sometime in October, maybe near the Hamburg community, where there were thousands of dead salmon, possibly because the water was low and or some of them had spawned. They had to move their camp way up a tributary to get away from the bad odor. There are at least 60 tributaries for the Klamath river below Iron Gate dam. To add to the problem and they did not go through the dams.

The Karuk tribe in the 1970's took the Shasta "R Treaty" and became a recognized tribe; they are also claiming Shasta Territory, as well as claiming there is not enough fish for them when there has been more than enough fish. It is just a sob story when they tell you there is not enough fish. I used to work in Nursing for the Karuk tribe in Yreka, April 2004 to April 2006. One July they had a picnic for their employees, I saw them barbecuing three, 24 inch salmon for themselves. The BIA gave the Karuk Tribe permission to fish only at Ishi Pishi Falls. Ishi Pishi Falls is more like rapids in the river near Somes Bar. But, if the dams are destroyed, there will not always be enough water for the salmon swim upstream to spawn or available water for the Karuk to do their "canoe dance." And the Coho Salmon is NOT indigenous to this area! The conditions in the Pacific ocean has lots to do with the amount of returning salmon and now we have the radiation from Fukushima to contend with, it has reached our shores. You guys ought to do something about that pollution!

Please, do not involve yourselves in something that is as conniving, mean and unjust, as is this plot to destroy our dams! We would like you to respect our Rights as well as to be Honest!

Thank you, Sincerely, Nita Still - Yreka, California

All “authorities” need to quit holding secret meetings about our dams. In 2009 we had a ballot about keeping the dams. We voted 80% to keep the dams. The water is cleaner after it goes through the dams! Several years ago a professional from one of the Departments of Interior pronounced our dams in very good condition, yet because of these Stakeholder, NGO and Environmental groups, he was fired. In Syria and Japan they have dams that are over two thousand years old and still functioning. The Environmental Impact Report, EPA, ESA, and Clean Water Act are all corrupt and need to be annihilated, along with many other of your environmental Laws, such as Sustainable Development. Quit manipulating our dams and listening to those Stakeholder, NGO, Environmental groups who want to destroy all dams as their goal, besides putting wolves where they have not been for one hundred years and then calling them endangered. They have already wrecked our economy and Freedoms, you are doing the same thing, they closed down 19 logging mills and stopped Gold dredging, among other things. We are really upset with all of this crap you and other so called authorities keep putting upon us! You must stop all of this hateful manipulation and leave our dams alone! Unless you want to save them for us!
Nita

From: Ivaylo Stoilov <dilianaivo@icloud.com>
Sent: Thursday, January 26, 2017 8:03 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

Other key points I urge you to consider:

1. The 2012 joint California and federal EIR/EIS and related documents concluded that dam removal on the Klamath is in the best interest of the public. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies, which can be relied upon for your EIR.

2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Ivaylo Stoilov, MD
536 Shorebird Cir Unit 5102
Redwood City, CA 94065
dilianaivo@icloud.com

From: Brian Stompe <user@votervoice.net>
Sent: Friday, January 27, 2017 1:19 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Brian Stompe
110 San Mateo Way
Novato, CA 94945
bkstompe@verizon.net

From: Bj Stone <bjstone14@icloud.com>
Sent: Wednesday, January 25, 2017 7:30 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

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Sincerely,

Bj Stone
106 N Noble St
Whitehall, MT 59759
bjstone14@icloud.com

Thaler, Parker@Waterboards

From: Jeff Stone <stonepitts2@gmail.com>
Sent: Saturday, January 28, 2017 12:50 PM
To: Wr401program
Subject: Klamath River dam removal comments

I am a Siskiyou County resident, and I support the KRRC's proposal to decommission significant portions of the LKP dam developments.

Klamath River dam removal will open more than 400 miles of historic fish habitat, reduce toxic algae levels in the river, improve the regional tourism and fishing industries, and increase access to healthy food sources for local communities. Dam removal is also less costly than infrastructure upgrades required by the Clean Water Act and Endangered Species Act.

My support is conditional upon providing sufficient funding for restitution for lakeside property owners and the protection of the City of Yreka's water pipeline. Local contractors should be given preference for decommissioning work where appropriate. It is also necessary to come to an understanding of how PacificCorp's real property will be disposed of to provide for the greatest public benefit.

Thank you for this opportunity to comment.

Jeff Stone

Thaler, Parker@Waterboards

From: Arnie Strand <ArtArnie@hotmail.com>
Sent: Wednesday, January 11, 2017 1:20 PM
To: Wr401program
Subject: Removing Iron Gate Reservoir

wr401program@waterboards.ca.gov
To Whom It May Concern

Recently the Iron Gate hatchery had to install a very expensive filtration system because the fry (baby fish) were dying off. Heavy metals were hindering the fry's development resulting in poor yields.

Question#1 When the dam is removed how are you going to handle these heavy metals, is this toxic mud going to be transported to a special dump or do you plan to let it just wash down river?

Question#2 Has an Environmental Impact Study been done on the results of toxic heavy metals being released from Iron Gate Reservoir into the undammed section of the Klamath?

I am against damming our rivers however I fear what you will do to river downstream! Decades of heavy metal has built up at Iron Gate Reservoir fed by a huge basin in Oregon. These metals will do the same as gold and work its way down into the deepest places in the river. We wrecked the Klamath by building the dams, removing the dams may destroy it! Maybe the Board should conceder leaving the Iron Gate Reservoir as trap for the heavy metals our neighbors to the north are sending to California?

Sincerely

Arnold Strand
Po box 471
Hornbrook Ca 96044
artarnie@hotmail.com

From: Chris Stromsness <chris@stromsness.net>
Sent: Thursday, January 26, 2017 6:49 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

Other key points I urge you to consider:

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3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Chris Stromsness
4220 Patricia Way
Dunsmuir, CA 96025
chris@stromsness.net

From: Kenneth Stucki, Sr <user@votervoice.net>
Sent: Thursday, January 26, 2017 5:16 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Kenneth Stucki Sr
471-325 Circle Dr
Susanville, CA 96130
kenstuk58@aol.com

From: John Sullivan <user@votervoice.net>
Sent: Friday, January 27, 2017 8:02 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

John Sullivan
1132 Palomino Rd
Santa Barbara, CA 93105
steelhead1@yahoo.com

From: Steve Swadley <metoc@comcast.net>
Sent: Wednesday, January 25, 2017 6:13 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an atmospheric scientist and angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

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Sincerely,

Steve Swadley
12319 Maravilla Dr
Salinas, CA 93908
metoc@comcast.net

Stanley Swenson
1400 Pine Grove Dr.
Mt. Shasta, Ca. 96067

January 30, 2017

Parker Thaler
State Water Resources Control Board
Division of Water Rights – Water Quality Certification Program
PO Box 2000
Sacramento, Ca 95812-2000

Re: Comments in response to the Notice of Preparation.

To Whom It May Concern:

I, Stanley Swenson, want to go on record as being opposed to the dam removal which is part of the Lower Klamath Project License Surrender. My personal opinion is, the removal of the dams will create more environmental problems as a result of breaching the dams and flushing and estimated 8.6 million cubic yards of silt down the Klamath River all the way to the Pacific Ocean. If the dams are removed, through all of the wisdom of the proponents, and the goals of opening historical (not likely) spawning grounds of the chinook and coho salmon, does not happen due to low flows, impassable barriers, or unacceptable conditions, will the proponents pay for the construction of new replacement dams?

It is my understanding that California State Water Resource Control Board is the lead agency that is preparing the CEQA review on applications for water quality certifications for hydropower projects under section 401 of the federal Clean Water Act. Why are the citizens of California paying CSWRCB, through public funds, to prepare the CEQA review? As a developer or proponent, the Klamath River Renewal Corporation (KRRC) should bear the costs of preparing the CEQA review.

I have some concerns that need to be studied, addressed and mitigation requirements agreed to before the dams are breached. My concerns are listed as follows:

1. The breaching of the 3 dams on the lower Klamath Project and the 1 dam in Oregon, will release up to 8.6 million cubic yards of silt. In the past, the central valley region of the California Water Quality Control Board, fined the City of Redding for clean water act violation to the tune of $450,000. The fine was for storm runoff, during a 1 inch midsummer lightning storm, that muddied a season creak during the

construction of a baseball field in one of the city parks. On the bridge replacement project on Interstate 5 at Lake Head, California, the Federal EPA fined the project contractor and Caltrans, a state agency, $80,000 each for violating the Clean Water Act, when storm water muddied Shasta Lake during a winter storm.

a. When the dams are breached on the Klamath River will the sediment create a muddied water situation that will be in violation of the Federal Clean Water Act?
b. Who will pay the fine for any violations?
c. Will the fine be passed on to the consumer?
d. What will the effect of the silt and sedimentation have on the salmon spawning beds.
e. How do you mitigate the effect of the loss of spawning beds?
f. Will the release of sediment result in the death of any coho salmon, which is listed as rare and endangered?

2. The breaching of the 4 dams on the Lower Klamath Project will release a variety of game fish which are captive behind the existing dams. The game fish released include bluegill, perch, small and large mouth bass, crappie, catfish, and more.
   a. What will the effect of the above named fish have on the salmonids between Iron Gate Dam and the Pacific Ocean?
   b. If the above named released fish establish populations on the lower Klamath River, will it result in the populations feeding on spawned eggs?
   c. If the above named released fish establish populations on the lower Klamath River, will it result in the populations feeding on juvenile salmonids?
   d. If the mitigation measure requires the killing of the above named game fish, is that allowed per the California Fish and Wildlife Codes?
3. The breaching of the 3 dams on the lower Klamath Project and the 1 dam in Oregon, will release up to 8.6 million cubic yards of silt.
   a. What toxic materials are in the 8.6 million cubic yards of sediment?
   b. How will the release of toxic materials be mitigated?
   c. Is the release of sediments and toxic materials allowed under the federal Clean Water Act?
4. The breaching of the Klamath River Dams will remove an important flood control system.
   a. What measures will be taken to prevent flooding on the Klamath River once the dams are removed?
   b. What financial provisions will be in place to assist people along the Klamath River when their private properties are damaged by flooding?

5. The existing dams on the Klamath River release water to aid in the migration of spawning salmon and help to prevent disease and parasites from injuring the salmon.
    a. What system will be in place to assist migrating salmon after the Klamath River Dams are breached?
    b. If the reports of the 1850s military expedition are true, will there be sufficient water, and not stagnate pools, to allow for the salmon migration?
6. A detailed study, by Eric Logan and David Hankin, in 2005 & 2006 an estimated 8 million juveniles are released by the Iron Gate Hatchery. The estimated fish returning to spawn is approximately 8 thousand fish.
    a. With the number of fish released and the low number of fish returning to spawn at the Iron Gate Hatchery would indicate that there is a mortality rate that is not caused by the conditions in the Klamath River. Is the mortality rate due to over fishing in the Pacific Ocean?
    b. An alternative to dam removal, to increase salmon populations in the Klamath River System, would be to put a moratorium on tribal fishing for a period of time and see if it helps the number of returning salmon.
    c. When the tsunami destroyed the Japanese Fishing Fleet, in 2011, the fall run of spawning fish was high in the fall of 2011. The fish biologist studying the Klamath River that fall, hypothesized, the problem with returning salmon was not in the Klamath River System. The problem was in the over fishing in the Pacific Ocean. This needs to be studied.
7. The dams on the Klamath River Hydro Project produce enough electricity for 70,000 customers. The power produced it clean, environmentally, compared to alternatives.
    a. What are the environmental damages that will result from power production if the dams are removed?
    b. How will the power companies mitigate the environmental damages without increasing power rates to the consumer?
8. Federal and State law required both the state and federal government to coordinate with local groups; such as county supervisors, school boards, fire districts and irrigation districts. Measure G, which was a local advisory ballot measure, clearly showed that approximately 80% of the Siskiyou County Voters wanted the dams left in place. The board members were part of the 80% local voters that supported leaving the dams in place.
    a. Why has the coordination process broken down?
    b. The board members have reached out to the government proponents of the dam removal project, why have the proponents now responded to these groups?

c. Why has the voice of the local people, in light the of constitutional phrase "for the people and by the people", not been heard?

In closing, I look forward to reading the final draft of the EIR to see if the voice of Siskiyou County Residents are heard and understood in relation to the Dam Removal Project.

Thank You For Your Time,



Stanley Swenson

February 1, 2017

To: State Water Resources Control Board
Division of Water Rights, Water Quality Certification Program
Attn: Mr. Parker Thaler
PO Box 2000
Sacramento, CA 95812-2000

Re: Public Comments Supporting 401 Certification for Klamath Dam Removal

Via electronic mail to parker.thaler@waterboards.ca.gov

Dear State Water Resources Control Board:

I urge you to grant a Clean Water Act Section 401 permit for decommissioning and removal of Iron Gate, Copco I, Copco II and J.C. Boyle dams on the Klamath River.

As you are already well aware, construction and operation of these dams represent a grave environmental injustice which your agency has the unique power to right. Salmon and salmon-dependent communities cannot withstand another 30 or 50 years of river impoundment. As Martin Luther King said, justice too long delayed is justice denied. Don't participate in a denial of justice. Instead, be champions of wild, free-flowing rivers and small, rural communities that subsist off them (like the one I live in!)

Please, consider all the evidence already in the record supporting dam removal, including testimony and comments from the Karuk, Yurok and Klamath Tribes, Klamath Riverkeeper, the California and Oregon Public Utility Commissions, the US Fish and Wildlife Service, the National Marine Fisheries Service, US Geological Survey, California Department of Fish and Wildlife, the Pacific Coast Federation of Fishermens' Associations, PacifiCorp, and many, many others.

This one action you can take will do more than any other single action to restore the Klamath River ecosystem and West Coast fisheries, economies and recreational opportunities on a landscape level. Please grant Klamath dam removal a CWA Section 401 permit so that the Federal Energy Regulatory Commission can carefully, yet expeditiously move ahead with this action by 2020.

Thank you for all you do to protect and restore our water resources.

Sincerely,

Erica Terence
6304 Butler Mountain Road
Somes Bar, CA 95568
terenski@gmail.com, (530)509-5041 home phone, (530)925-9710 mobile

Thaler, Parker@Waterboards

From: Sue Terence <salmonriversilk@gmail.com>
Sent: Tuesday, January 31, 2017 4:25 PM
To: Thaler, Parker@Waterboards
Subject: Klamath Dams Removal comment

Dear Mr. Thaler,

For the past thirty-eight years I have lived on a tributary of the Klamath River and watched the decline of the salmonids. Temperatures that are lethal to juveniles have become commonplace in the summer, and sediment build-up is endemic. The dams have contributed mightily to these problems, and unless removed very soon will cause (if they have not already caused) irreparable harm. (i.e., extinction.)

The fish ladders that were supposed to have been built when the dams were given their fifty year permit were never constructed, leaving the fish no access to over two hundred of miles of spawning habitat.

The 50 year permit expired 15 years ago, so there is no legal basis for the operation of the dams at this point.

The toxic build-up of blue-green algae in the reservoirs behind the dams is dangerous and unacceptable.

As a Siskiyou County citizen I am adamantly opposed to retaining these dams and in favor of their removal in 2020. Therefore I support issuance of a Clean Water Act Section 401 permit for dam removal (NOT for relicensing.)

I would encourage you to thoroughly consider the volumes of evidence and testimony supporting Klamath dams' removal. As responsible members of the water board charged with protecting water quality, I cannot fathom that you could take any position other than moving forward with the permit for the four dams' removal.

Thank you.

Susan Terence
January 31, 2017

From: Brian Theriot <user@votervoice.net>
Sent: Sunday, January 29, 2017 4:43 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

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2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Brian Theriot
5965 Dunsmuir Ave
Dunsmuir, CA 96025
theriot2323@yahoo.com

From: Jody Thompson <jody@ttdg.com>
Sent: Friday, January 27, 2017 8:05 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Jody Thompson
PO Box 610
San Geronimo, CA 94963
jody@ttdg.com

Thaler, Parker@Waterboards

From: loyalbme4@yahoo.com
Sent: Monday, January 30, 2017 11:18 AM
To: Thaler, Parker@Waterboards
Subject: Public comment for Klamath River water certification

I request that the California State Water Resources Control Board:

(1) Do NOT issue a water quality certification for the KRRC for the Klamath River!!

(2) Do NOT incorporate the information from the 2012 joint California and Federal EIR/EIS into the EIR currently being developed. The previous EIR/EIS was NOT based on exhaustive studies and did NOT reach the correct conclusion.

- Only five miles of the entire river system, designed to generate data that would best support dam removal, was submitted.
- It was clearly NOT an exhaustive study as the river waters above the dams was NOT studied, nor was the water quality entering California from Oregon.
- A **new and complete** analysis of the **entire** river must be performed, including the water management of the Trinity River that is diverted into the State Water Project and the central canal as these flow impacts on the fish are unknown. The complete environmental consequences have not been adequately evaluated.

(3) Evaluate ALL scientific data and studies produced BEFORE and since 2012. This will further contradict the conclusions of the 2012 EIS/EIR as being inconclusive and prejudicial in nature.

- This fact is supported by Dr. Paul Houser, the hydro meteorologist, hired to oversee the scientific integrity, when he revealed that the study was designed to align with those favoring dam removal.
- The tribes still gill net across the mouth of the Klamath and this has had an effect on salmon populations.

(4) Fully analyze the environmental and economic impacts of dam removal with respect to the certainty of removal ramifications, not just what “might”, “could”, language used in the 2012 EIR/ EIS studies used in support of dam removal.

- The loss of property values is reflected in the declining property taxes, and therefore a loss to Siskiyou County Revenue. The 2012 study only looked at bare land values. They did not go through the process of the Record of Decision. Improvements were not considered.
- The KRRC does not have the funding or a plan for river or reservoir aesthetic restoration. It would take many, many years, if not a lifetime, to return the Klamath River behind the reservoirs to their native beauty.
- Unless the entire river is studied, all the impacts to fish and birds can’t be know as to the impact.
- There are Perch behind the dams and if they are released into the lower river, that consequence must be considered since they are predatory to Salmon eggs. This is an ESA impact that has not been studied.
- The Shasta Native American Tribe, which precedes other Klamath tribes are not a signatory to the KHSA and have not been represented. Dam removal will expose sensitive Shasta burial grounds and possibly tribal artifacts.
- As the tribes, downstream from the dams are demanding that their tribal and cultural customs be respected, so shall the Shasta Nation be respected. If you engage with **some** tribal entities without taking into consideration **all** entities and be certain that the interests of all tribes are taken into equal consideration you will be acting prejudicially.

There is no possible way that you can base your current study on such flawed analyses such as the 2012 EIR/EIS study!! Unless a **new, transparent,** and **complete** study of the entire river system is performed, the SWRCB cannot make a **credible** determination concerning water quality!!

Regards,

Licia Todhunter

From: Tom toretta <tfarms@netxn.com>
Sent: Thursday, January 26, 2017 10:29 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

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Sincerely,

Tom toretta
13200 San Juan Ave
Bakersfield, CA 93314
tfarms@netxn.com

From: Robert Torre <r.torre@comcast.net>
Sent: Friday, January 27, 2017 9:56 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Robert Torre
771 Jean Marie Dr
Santa Rosa, CA 95403
r.torre@comcast.net

From: Joshua Tracy <jgt21@humboldt.edu>
Sent: Friday, January 27, 2017 9:23 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Joshua Tracy
730 I St Apt 7
Eureka, CA 95501
jgt21@humboldt.edu

From: daniel trent <daniel.e.trent@gmail.com>
Sent: Thursday, January 26, 2017 5:52 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

daniel trent
1420 Hidden Mesa View Dr
El Cajon, CA 92019
daniel.e.trent@gmail.com

From: Steve Tubbs <user@votervoice.net>
Sent: Thursday, January 26, 2017 9:53 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Steve Tubbs
511 I St
Petaluma, CA 94952
stubbs6882@aol.com

From: Mark Utter <mdutter@qti.qualcomm.com>
Sent: Thursday, January 26, 2017 5:49 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Mark Utter
16220 Deer Trail Ct
San Diego, CA 92127
mdutter@qti.qualcomm.com

From: ray Valencia <proparabellum@gmail.com>
Sent: Friday, January 27, 2017 7:37 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Ray Valencia
1944 Harriman Ave
Klamath Falls, OR 97601
proparabellum@gmail.com

From: Ron Van Fleet <Flyrodder7@gmail.com>
Sent: Tuesday, January 31, 2017 12:45 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Ron van Fleet
31311 L St
Ocean Park, WA 98640
Flyrodder7@gmail.com

From: Jim Vasquez <vasquez.jim@gmail.com>
Sent: Monday, January 30, 2017 8:56 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

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Sincerely,

Jim Vasquez
1559 De Leon Way
Livermore, CA 94550
vasquez.jim@gmail.com

From: Todd Vick <toddvick@hotmail.com>
Sent: Wednesday, January 25, 2017 4:01 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Todd Vick
701 Sierra St
Manteca, CA 95336
toddvick@hotmail.com

From: Gary Vonderohe <gvonderohe@hotmail.com>
Sent: Friday, January 27, 2017 8:47 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and salmon. I may live in Oregon but our ocean sport and commercial salmon fisheries depend on salmon produced in the Klamath Basin and other basins in California. Without salmon from Klamath Basin our southern Oregon commercial fleet would be shut out from fishing each year.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

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Sincerely,

Gary Vonderohe
1450 Virginia Ave
North Bend, OR 97459
gvonderohe@hotmail.com

From: Yee Vue <user@votervoice.net>
Sent: Friday, January 27, 2017 3:41 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Yee Vue
4375 E 14th St
Long Beach, CA 90804
yeevue25@yahoo.com

EIR/PT

Comments to the State Water Resource Control Board regarding Notice of Preparation and Scoping Meetings for an Environmental Impact Report for the Lower Klamath River Project License Surrender for Klamath River Dam Removal.

2017 JAN 30 AM 10:35

January 24, 2017

Dear State Water Resources Control Board c/o Mr. Parker Thaler,

We were NOT notified of the scoping meetings in a transparent way. We own property on Copco Lake, so we are obviously stakeholders! We had been included by the Department of the Interior and the Bureau of Reclamation, when they were doing scoping meetings for their studies. We were notified by the Klamath River Renewal Corporation, KRRC, of their application to FERC. Unless we went to extraordinary measures to stay informed, no one received notice of the public scoping meetings. While on the surface, it appears you sent out the required notifications, you did not adhere to the spirit of the law as it was intended to notify and engage the public, and we find it ironic that the parties that support dam removal were notified much earlier than even the Siskiyou Board of Supervisors. This is not the first time that lack of transparency in this process has occurred.

The Siskiyou Board of Supervisors represent and speak for the 80% of voters in the county that voted to register their comments when they voted to keep the dams. Since Siskiyou County is home to 2/3 of the river system, you should give the Siskiyou Board of Supervisor's comments **extraordinary** consideration in your determination. You need to also consider **economic** and **environmental** consequences of dam removal. I am hopeful you will consider ALL our comments.

To begin, the Klamath River Renewal Corporation has filed an **incomplete** initial application. This is alarming, as they have had years to formulate a plan to consider such an application, since the KRRC is essentially the original signatories to the KHSA and KBRA. Given the simple fact that the US Congress was not willing to follow through and underwrite the liability of dam removal, how can a non-profit, that cannot even fill out a **complete** application, take over the Klamath Dams? This should be a major red flag that they will not be able to assume such an undertaking with any kind of organization or complexity of such a massive project! This is one reason, of many, that we believe that you should not grant certification.

Water Quality

- The 2012 California and Federal EIR/EIS reached incorrect conclusions. They did not do exhaustive engineering and environmental studies and therefore should NOT even be considered or used in the new EIR.
- The Bureau of Reclamation and Department of Interior studies were pushed by the signatories of the KHSA and KBRA chose the area of the river to study that would cost the least to remove the dams and have the highest environmental effect for dam removal to fit dam removal agenda. This opinion is fortified by Dr. Paul Houser, the hydro meteorologist, hired to oversee the scientific integrity of the BOR's study.
- Only FIVE miles of the ENTIRE Klamath River, as quoted in the Biological Assessment in the original studies, were performed. The five miles studied were below the Iron Gate Dam and nothing was studied above the dam all the way into Oregon.
- The most polluted water in the Klamath River is between Keno and Copco 1 Dam, and yet this area was not studied. Reports show the water leaving Copco Dam is cleaner than it was when it entered the river.
- If the entire river system had been studied correctly, the effects of dam removal with sediment release might/could (both terms used in the DOI report) kill all aquatic live in the river for at least 2 years. The report then states that aquatic life will magically reappear by year 5, and the fish would be thriving with renewed water quality. How is that possible?
- A **new and complete** analysis of the **entire** river must be performed, including the water management of the Trinity River that is diverted into the State Water Project and the central canal as these flow impacts on the fish are unknown. The complete environmental consequences have not been adequately evaluated.

- Unless a new, transparent, and complete study of the entire river system is performed, the SWRCB cannot make a credible determination concerning water quality.
- What agency is going to monitor the water quality coming into California from Klamath Lake? California is bearing the burden of compromised water due to geologic factors contributing to the volcanic, phosphorous nature of the river system and by pesticides and fertilizers.
- The warm, shallow waters in the Klamath in Oregon contribute to poor water quality.
- The most polluted water in the Klamath River is between Keno and Copco Dam and yet after the water leaves the dams, it is cleaner than what flowed into the river from Oregon.

Economic Impacts

- The economic impacts of the dam removal agreements are already being witnessed in Siskiyou County.
- Home values on Copco Lake have already plummeted due to dam removal agreements. Dam removal would precipitate a further loss.
- Homeowners are not able to sell their homes without disclosing possible dam removal and, as such, are forced to reduce their prices even more, IF they can even sell their homes.
- The loss of property values is reflected in the declining property taxes, and therefore a loss to Siskiyou County Revenue.
- When the BOR did their study they only looked at bare land values. They did not go through the process of the Record of Decision. Improvements were not considered. The KRRC does not have the funding or a plan for river or reservoir aesthetic restoration. It would take many, many years, if not a lifetime, to return the Klamath River behind the reservoirs to their native beauty.
- There are no plans for restoration after dam removal further lowering our property values.
- Even if there were to be a restoration period, the study looked at that as a period of only five years!! I'd like to see the science proving this study's assumption.
- There is a lack of transparency with the economic studies.
- It's my understanding that Siskiyou County has demanded an economic analysis so that they may inspect the details of this study, but their demands have not been met.
- Property value loss translates into lost tax dollars for school funding.
- If the dams are removed, the possibility exists that we could lose our water well, making our home uninhabitable, and therefore worthless. I'm certain the KRRC will not take on the expense of drilling a deeper well so that we can remain in our home.
- Will the KRRC compensate us for lost property value? Or will the KRRC reimburse Siskiyou County for millions of dollars of lost tax revenue as property values become worthless? I doubt that the KRRC will assume any liability and therefore in preparing your report you must take into consideration the economic effects of dam removal.
- The projected $450 million that dam removal is projected to cost, although other studies have shown this figure closer to $1 billion, are funds that can be spent on crumbling infrastructure, education, and other projects rather than a project that has not been adequately studied.

Fish and Animal habitat

- In 2001 The Karuk Council did not believe that Coho Salmon were indigenous to the Klamath River, but saw the value in misrepresenting the facts. The Coho are not native to the river, but the Karuk tribe now claims this to be true.
- Historically the salmon never came up above where Copco Lake is now due to warm waters from area hot springs per Native Shasta elders that lived in the area as well as early settlers, but these facts were never entered into the record when the BOR and DOI did their studies, as this area of the river was NOT studied.
- Under the ESA, a species cannot be decimated by a project, so how is dam removal a viable project to be considered by the Water Board if complete analysis is not performed?
- We have read that there is 20-30 million cubic yards of sediment behind the dams. There is great concern that this impact has not been adequately addressed. I assure you that if the fisheries are to be decimated for even a short period, the tribes will litigate for their losses of their fisheries.
- Unless the entire river is studied, all the impacts to fish and birds can't be know as to the impact.
- There are Perch behind the dams and if they are released into the lower river, that consequence must be considered since they are predatory to Salmon eggs. I believe this is another ESA impact that has not been considered.

- The last few years, water behind the Copco 1 Dam, as well as the others, has been released to improve water quality downstream to save the fish from parasites. Craig Tucker, of the Karuk tribe, admitted that without these water releases there would have been a major fish die off. No one at Copco Lake complained about their docks being temporarily unusable due to low lake levels, the inability to launch boats from the boat ramps because of low lake levels, and because boat could not be used there was a temporary loss of recreation at the lake.
- Governor Brown has said we need more water storage, not less. He cannot have it both ways. If this water storage was not there, at this crucial time, the fish would have died, and this winter with heavy rainfall, snow, and runoff there would have been floods.
- Aside from the original studies of only an extremely limited section of the Klamath River being evaluated, not all the creeks and rivers from below Iron Gate Dam to the mouth of the Klamath River, that make up the entire river system, and the actions of all parties that impact the fisheries, were and need to be taken into consideration. Gill netting still takes place across the mouth of the Klamath and this has not been studied as to the effect on Salmon population as well as ocean waters warming.
- Released sediments could alter the habitats of essential fish habitats and adequate studies have not been performed.
- It is ironic that even with these dams in place there have been record salmon runs and yet the tribes are still litigating. They sell their surplus fish to anyone who will buy them.
- Dam removal resulting in lake removal will impact migratory birds and the birds and animals that live in and around the lakes. Bald eagles, white pelicans, blue herons, and others have made this area their home and are thriving. Canadian geese and other migratory birds use the lake as a resting and breeding place and so the impacts to these species all need to be studied and have not been done so.

Public Health, Safety, and Flood Control

- The risk of floods downstream is great. Part of the reason for the dam construction initially was flood control. The sediments behind the dams could exacerbate the flood risk.
- Dam removal could also change the existing flood plains and you cannot ignore the need to realign the pipeline for the City of Yreka's water supply.
- The water behind the dams have aided in wildfire protection. Without the readily available water in the recent wildfires, many homes would have been lost.
- Despite warnings about coming in contact with the water due to toxins, not a single person around Copco Lake that has recreated in the lake have ever had any skin or health related issues due to water contact despite years of contact with the lake waters.
- Dam removal could result in problems with mosquito habitat and related diseases such as the Zika virus.
- There will be a considerable amount of debris because of dam removal possibly posing risks downstream of the destruction of the dams.

Historical and Archeological Effects

- The Shasta Native American Tribe, which precedes other Klamath tribes are not a signatory to the KHSA and have not been represented. Dam removal will expose sensitive Shasta burial grounds and possibly tribal artifacts.
- As the tribes, downstream from the dams are demanding that their tribal and cultural customs be respected, so shall the Shasta Nation be respected. If you engage with tribal entities without taking into consideration all entities and be certain that the interests of all tribes are taken into equal consideration you will be acting prejudicially.

Aesthetics

- Dam removal would have a long-term effect of the aesthetics of the river and the reservoirs behind the dams, as well as sediment transport would change the appearance and erosion issues for the Klamath River.
- Our home currently looks out onto a beautiful lake. When lake levels have been lowered for dam maintenance or when water releases have occurred to improve water quality for the fish, the mud, trash debris, and sediment exposed is not aesthetically appealing.

Recreation

- If dam removal takes place there will be a great recreational loss to the public. Currently the lakes provide such activities as boating, fishing, water skiing, wake boarding, kayaking, standup paddling, canoeing, and swimming. There is also camping along the lakes that would be eliminated with dam removal.
- White water rafting activies would be altered with dam removal.

Greenhouse gas emissions

- Removal of effective hydroelectric power providing power to over 75,000 homes will most likely result in increased greenhouse gas emissions from replacement sources at a time when California will not meet the 33% legal mandate of electric power sales from renewable sources by 2020 even with the dams in place.

Alternative Solutions for Analysis

- Once there has been a thorough and complete analysis, a determination has found that salmon were native to the area above Copco 1 Dam and that the fish would survive and thrive in this area of the river, then there can be alternative solutions for analysis.
- Siskiyou County has offered solutions to address Klamath River Water Quality, such as fish ladders, and Trap and Haul where fish ladders might not be a practical application.
- Another solution might be using Bogus Creek as a bypass around the dams for fish passage.
- "Fish cannons" are also used in certain cases for transporting fish.
- Siskiyou County and landowners have taken many measures to improve water quality, improve fish habitats and water conservation.

In conclusion, you must take into consideration all the above reasons to complete the process for permit application **without the assumption of a predetermined** outcome. To do anything less, than a complete and independent analysis, would violate the Code of Regulations. We ask that you **deny** the certification request for Section 401(a)(1) of the Federal Clean Water Act for the KRRC to move forward with dam removal.

Respectfully submitted,

Ken Wallace

Ken Wallace

23411 Copco Lake Rd.
Montague, CA 96064

Mailing address:
1604 Baylor Circle
Woodland, CA 95695

Dan & Susan Wallace
PO Box 425 Hornbrook, CA 96044

Mr. Parker Thaler
State Water Resources Control Board
Division of Water Rights
Water Quality Certification Program
PO Box 2000
Sacramento, CA 98512-2000

January 27, 2017
Via e-mail & USPS

Re: WR401 Program – Dam Removal – Siskiyou County

Dear Mr. Thaler & Staff Members,

I spoke briefly at the Scoping Meeting held in Yreka yesterday evening. To say the least, the government's habit of having preconceived outcomes and then skewing the "science" to back it is not well received. One gentleman asked that you "think independently" and we can hope for that but, being government employees, we seriously doubt that will happen. In the meantime, there are many basic observations about the Klamath River and the fish that cannot be ignored.

1) The Irongate fish hatchery supplies thousands of salmon to the river each year. There are records of releases and fish returns. Since I have been here, gill netting by the Indians at the mouth of the Klamath have seriously affected the numbers of returning salmon several times. To claim there were not enough fish to give each tribe member one is suspect. Check the records.

2) I have a friend, a resident here, who operates as a fishing guide each year since about 1996. If the salmon cannot get over the sand bars at the mouth of the Klamath, there is very poor fishing until the dam releases enough water to clear the sand bar. Again, check the records. No dam. No water. Sand bar remains.

3) I have seen the salmon that make it up this far – to the Irongate dam area above the Klamathon bridge. They are near death; covered with sores and black areas; and something I wouldn't eat! Is this the supposed salmon that will have the vitality needed to go beyond Irongate? It was suggested that these fish be caught and trucked around the dam to see if they can actually make any additional distance. Do the test.

4) The Karuk tribe is notorious for being a dupe in the dam removal fiasco. If they are "indigenous" as claimed, how is it we have a Mount Shasta, a Shasta River, Little Shasta, Shasta Lake, Shasta County, etc,. etc., with no mention of a Karuk anything? The Shasta People are indigenous and should be of top consideration here – not the Karuks.

5) Historical documents that have no bias are plentiful for your use. The word "Klamath" means "stinky" and there was a reason for that title. When the animals won't drink from it, and the people move away from it, one can reasonably assume the river wasn't really running all that much. Salmon don't like slow moving, stinky warm water. Read the documents.

6) The County Assessor spoke to the devaluation of our properties as being minimized and that is true. Once a potential buyer discovers the possibility of dam removals, they "disappear" or back out of the sale. That's happening now! A prime example is the Blue Heron RV park and the Fishhook restaurant - both for sale since its owner passed away. Buyers abandoned the purchases based upon the potential dam removals. The properties are becoming worthless.

7) The fact that the water from Oregon comes to California contaminated should put the skids on forcing Siskiyou County to "clean up their mess." Grace Bennett noted that there was a proposal to filter the water coming in from Oregon which would greatly assist this County's efforts to clean the Klamath. Put the blame where it belongs! It's not the dams.

8) The Coho was never a "native" fish to the Klamath. Another concoction by the government and the Karuks. Read the historical documents.

9) The forced removal of dams that provide clean renewable energy makes absolutely NO sense to any thinking person - unless - the goal is to force us out of our rural areas. Remember, what goes around generally comes around. You in Sacramento are fed by rural farms and ranches. You don't provide anything towards feeding people and think that the demise of our ranchers and farmers is "saving the planet". Well, you too may become expendable at some point.

10) You were informed of the mercury issue at Fall Creek. We believe this is only the tip of the iceberg as far as what toxic metals are being held in the sediment behind these dams. (Oregon dam removals have loosed horrible amounts of toxic metals.) I am sure you have been told that you would be held harmless for any liability that may arise regarding this issue. Don't be so sure. You have positions of fiduciary responsibility and would have to prove that your actions were reasonable given all the information available.

I doubt you were very comfortable sitting at that table in front of a mostly hostile audience but you need to know how angry we are about all this.

Please - Do your job. Do <u>real</u> research and <u>real</u> science. Think for yourselves.

Sincerely,

Susan Wallace

Susan Wallace

From: Thomas Wargo <user@votervoice.net>
Sent: Thursday, January 26, 2017 6:14 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

Please help advance this effort by promptly issuing the water quality certification permit for removal of four dams on the Klamath River, as provided for in the revised Klamath Hydroelectric Settlement Agreement, so that FERC can act as soon as possible to authorize this action.

Other key points I urge you to consider:

1. The 2012 joint California and federal EIR/EIS and related documents concluded that dam removal on the Klamath is in the best interest of the public. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies, which can be relied upon for your EIR.

2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Thomas Wargo
22400 Skyline Blvd
La Honda, CA 94020
tomwargo@yahoo.com

From: Wayne Watanabe <waynemwatanabe@gmail.com>
Sent: Thursday, January 26, 2017 5:33 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Wayne Watanabe
650 Jensen Pl
Placentia, CA 92870
waynemwatanabe@gmail.com

From: L David Waterbury <davidwinca@hotmail.com>
Sent: Thursday, January 26, 2017 4:52 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

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Sincerely,

L David Waterbury
685 Cordilleras Ave
San Carlos, CA 94070
davidwinca@hotmail.com

From: Dan Watson <dan.watson123@att.net>
Sent: Thursday, January 26, 2017 7:38 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Daniel Watson
6235 Robertson Ave
Newark, CA 94560
dan.watson123@att.net

Thaler, Parker@Waterboards

From: iliamna_bernie@reagan.com
Sent: Wednesday, February 01, 2017 2:12 PM
To: Thaler, Parker@Waterboards
Cc: iliamna weisgerber
Subject: Klamath River Dam Removal

Jan 31, 2017
Reference: Klamath River Dam Removal

Dear Sirs,
I support the position of No Dam Removal of the four dams on the Klamath River. Some of my reasons are as follows.
Klamath County Commissioners have been elected twice because they strongly opposed dam removal. This represents the viewpoints/wishes of the citizens of Klamath County.
Shasta County citizens and County Government has also strongly opposed the dam removal as 3 of the dams are in California.
Dam removal will adversely affect private land values on the current lakes behind the dams.
Dam removal will adversely affect possible food control measures. Both States have Green Energy goals (quotas) in place for future energy use.
Removing existing hydroelectric power that is in place is counter- productive to these goals.
Cost estimates to replace this Green Energy, in the original Agreements, have to be a pure guess as no type/place or times are documented.
The original cost estimate in the Agreements was about 1 Billion dollars. Local Representative Walden told them the could not get that package cost through Congress. The Agreement writers went back to the drawing board and came back with a figure of about ½ Billion dollars.
This shows there is no credibility to any costs in the documents and is completely unacceptable.

Cost estimates for dam removal have to be a guess as best and is highly suspect and is most likely totally unrealistic and will be low to help sell the removal option.
Scientific studies, done above Klamath Lake, show salmon have NEVER lived above the lake. All references to restoring salmon runs to the Klamath River above the Lake are all bogus.
It is curious this entire boondoggle stated with the Governors of Oregon and California telling the owners of the dams they wanted the dams removed! How did they insert their influence into a Federal Relicensing proposal?
Fish ladders are a perfectly acceptable alternative but have been summarily rejected by the owner and has never been questioned.

Bernie Weisgerber

From: Ryan Willis <user@votervoice.net>
Sent: Monday, January 30, 2017 8:05 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

rw
6631 SE 85th Ave
Portland, OR 97266
ryanpwillis@yahoo.com

From: michael wilson <user@votervoice.net>
Sent: Saturday, January 28, 2017 11:47 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

michael wilson
812 Pordon Ln
Healdsburg, CA 95448
maw6866@yahoo.com

From: Tim Wilson <twilson@mbay.net>
Sent: Sunday, January 29, 2017 7:42 AM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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1. The 2012 joint California and federal EIR/EIS and related documents concluded that dam removal on the Klamath is in the best interest of the public. The 2012 EIR/EIS was based on an exhaustive set of engineering and environmental studies, which can be relied upon for your EIR.

2. No scientific analysis since 2012 calls into question the conclusions of the 2012 EIR/EIS.

3. The Water Board should consider the long-term beneficial impacts of dam removal as documented in the record, not simply the near-term adverse impacts of decommissioning.

As our wild salmon and steelhead runs continue to decline, we must take advantage of every opportunity to rebuild them. Removing four old, unproductive dams on the Klamath River is the key to restoring the fabled salmon and steelhead fishery. Consistent with the conclusions of the 2012 EIR, and the negotiated settlements on the Klamath, please conclude the EIR for water quality certification on this issue as quickly as possible

Sincerely,

Tim Wilson
PO Box 2291
Marina, CA 93933
twilson@mbay.net

From: Eric Wiseman <1wisefish@gmail.com>
Sent: Wednesday, January 25, 2017 7:37 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

I strongly support restoration of the Klamath River and removal of the four dams. The Klamath River is the third most productive watershed for salmon and steelhead on the West Coast and this action represents what might be the single most important action for fisheries restoration in the country.

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Sincerely,

Eric Wiseman
PO Box 2180
Weaverville, CA 96093
1wisefish@gmail.com

From: Jami Witherspoon <jamiwitherspoon@gmail.com>
Sent: Thursday, January 26, 2017 4:51 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Jami Witherspoon
1055 Redbud Dr
Redding, CA 96001
jamiwitherspoon@gmail.com

From: Edward Wolf, jr <yellowlion@hotmail.com>
Sent: Wednesday, January 25, 2017 5:25 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Edward Wolf
601 N Grape St
Medford, OR 97501
yellowlion@hotmail.com

From: Chris Yarnes <chris.yarnes@gmail.com>
Sent: Wednesday, January 25, 2017 6:21 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Chris Yarnes
213 Creekside Way
Winters, CA 95694
chris.yarnes@gmail.com

From: Randall Yates <user@votervoice.net>
Sent: Thursday, January 26, 2017 6:00 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

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Sincerely,

Randall Yates
5300 E El Parque St
Long Beach, CA 90815
oyates@verizon.net

From: Mark Zemke <user@votervoice.net>
Sent: Friday, January 27, 2017 6:13 PM
To: Thaler, Parker@Waterboards
Subject: IMPORTANT! Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

We have ONE chance, ONE opportunity to restore the Klamath River system the RIGHT way the FIRST time ... don't waste our time nor our money --- DO IT RIGHT -- DO IT TO BENEFIT FISH AND WILDLIFE and let human use be a SECOND priority to be considered ONLY after fish and wildlife, specifically WILD STEELHEAD AND WILD SALMON, are PRIORITIZED OVER HUMAN USE OF ANY SORT ...

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

I understand the California State Water Resources Control Board is preparing an Environmental Impact Report prior to issuing a water quality certification permit for the Federal Energy Regulatory Commission's approval of a decision to decommission four dams on the Klamath River.

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Sincerely,

Mark Zemke, Retired veteran
258 Palo Alto Ave Apt 3
Mountain View, CA 94041
markzemke@yahoo.com

From: Robert Zimmerman <zimn2t@gmail.com>
Sent: Thursday, January 26, 2017 7:58 PM
To: Thaler, Parker@Waterboards
Subject: Klamath River – EIR for Water Quality Certification

Dear Division of Water Rights Thaler,

I am an angler who enjoys fishing for steelhead and values the availability of local salmon.

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Sincerely,

Robert Zimmerman
1335 N 3rd Ave
Sturgeon Bay, WI 54235
zimn2t@gmail.com

WRITTEN COMMENTS FROM KLAMATH RIVERKEEPERS

KLAMATH RIVERKEEPER®
An affiliate of the Waterkeeper Alliance
www.KlamathRiver.org

PO Box 751
Somes Bar, CA 95568
(530) 627-3311
info@klamathriver.org

State Water Resources Control Board
Division of Water Rights, Water Quality Certification Program
Attention: Mr. Parker Thaler
P.O. Box 2000
Sacramento, CA 95812-2000
Delivered by email to: parker.thaler@waterboards.ca.gov

February 1, 2017

RE: Notice of Preparation of an Environmental Impact Report for the Proposed Lower Klamath Project License Surrender

Dear Mr Thaler:

Attached is a letter signed from 953 Klamath Riverkeeper supporters as well as additional comments from individuals regarding the Water Board's Notice of Preparation of an Environmental Impact Report for the Proposed Lower Klamath Project License Surrender. Please include these individual comments into the comment record.

> We the undersigned request that the California State Water Resources Control Board:
>
> (1) Issue a water quality certification for Klamath River dam removal in time for the Federal Energy Regulatory Commission to approve dam removal by 2020.
>
> (2) Incorporate all information from the 2012 joint California and Federal EIR/EIS into the EIR currently being developed. The previous EIR/EIS was based on exhaustive studies and reached the correct conclusion.
>
> (3) Evaluate scientific data and studies produced since 2012. This will further support the conclusions of the 2012 EIS/EIR.
>
> (4) Fully analyze long-term beneficial impacts of dam removal.

Sincerely,

Konrad Fisher

Konrad Fisher, Director

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PO Box 751
Somes Bar, CA 95568
(530) 627-3311
info@klamathriver.org

First	Last	State	Comments
Tyler	Emerson	AK	
lynn	wilbur	AK	
lynn	wilbur	AK	
lynn	wilbur	AK	
Carol	Brooks	AL	
charlotte	byrams	AL	
Alison	Anabal-Walker RN	AR	
Kellie	Barcelon	AZ	
Heather	Campbell	AZ	
Susie	Hoskie	AZ	
Dona	LaSchiava	AZ	
Jamie	Lockwood	AZ	
John	Lovelace	AZ	We know the damage some dams have done to the environment. We also know some dams are needed to conserve water, provide electricity and flood control. IT appears we are talking about dams on the Klamath that are not needed. Remove and recover the environment.
Doug	Rohn	AZ	
Tammy	Yazzie	AZ	
Mary	Abbott	CA	
Delia	Aceves	CA	
Wanda	Adams	CA	
Alicia	Adrian	CA	
Gisele	Albertine	CA	
susan	alexander	CA	
Carrie	Anderson	CA	
Gordon	Anderson	CA	
Paul	Andrade	CA	
susan	andrews	CA	
Cathy	Anello	CA	
John	Angus	CA	
Peter	Aronson	CA	Flowing water is healthy water.
Michael	Asher	CA	
Robert	Attebery	CA	
Stephanie	Aufdermaur	CA	This dam needs to come down NOW. This has taken way too long. Please.

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Charlotte	August	CA	Please support the dam removal as soon as possible to allow for the recovery of the Klamath River in order to avert catastrophic damage to the ecosystem and to re-establish Salmon habitat.
Kristine	Avila	CA	
k	b	CA	
Chuck	Bailey	CA	
Deanna	Bailey	CA	
Nancy	Bailey	CA	
Ginny	Barker	CA	
Sheila	Barnes	CA	
Melanie	Barnett	CA	
Ted	Barone	CA	The Klamath River dams are not useful to agriculture and are severely damaging the North Coast salmon fisheries and ecosystems. Please move quickly to remove them.
Stephanie	Barron	CA	
Deborah	Baskette	CA	
Nicolas	Bauer	CA	It makes sense financially, politicaly, and environmentally.
Madeline	Bauman	CA	Save the Salmon. Everything is connected.
Sonia	Baur	CA	
Erin	Bayer	CA	
Andrew	Bear	CA	
Stacy	Becker	CA	
Candice	Bell	CA	
Leslie	Bellas	CA	
elisha	Belmont	CA	
Manuel	Belmonte	CA	
Destiny	Beltran	CA	
Greg	Bennett	CA	
Victoria	Bennington	CA	
John	Bermel	CA	Initiate a Two State (California&Oregon) Agency that will enforce Water Quality in the Klamath River- from its origins to the sea.
Michael	Beyer	CA	
Lydia	Biggs	CA	
Petra	Bingham	CA	

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Ray	Binner	CA	WE NEED THOSE FISHING JOBS. I DONT KNOW WTF YOU WERE THINKING KILLING MILLIONS OF SAMON AND THATS OK...
Dustin	Bispo	CA	
Marianne	Bithell	CA	Please issue this certification so the Yurok tribe and other tribes can continue building their infrastructure work for their futures.
Elissa	Blair	CA	
Rebecca	Blanco	CA	
Amanda	Bloom	CA	
Harry	Blumenthal	CA	
Sharon	Bodman	CA	
Juliette	Bohn	CA	
allen	bohnert	CA	
Elizabeth	Bonner	CA	Water is life
Heidi	Bourne	CA	
Joseph & Susan	Bower	CA	
Donna	Boyd	CA	We are downstream property owners on the Klamath River. Dam removal will improve our long term water quality! Each year late in the summer, we are routinely advised that the water isn't safe for us. We are supposed to keep our dogs and kids out of the river during the hottest months of the year. This is directly due to the water temp in the reservoirs. Please help us eliminate this annual problem by supporting dam removal
Randall	Boyd	CA	
Sharon	Bradbury	CA	
Sarah	Brandt	CA	
Leslee	Bray	CA	
John	Brennan	CA	
jorge	briceno	CA	ecology is a huge issue in california right now. The people would love to see a comeback of spiecies and rivers that would only expand the ability to recreate and the love to recreate. This will also bring more money to forests as tourism rises to some areas that have never been visted before
C	Briggs	CA	Please allow dam removal. It's the right thing to do and it's time has come!
Carman	Broderick	CA	
Tiffany	Brogdon	CA	

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Allison	Bronson	CA	
Deborah	Brooks	CA	
Pamela	Brown	CA	
William	Browning	CA	
Jermaine	Brubaker	CA	
Allegra	Brucker	CA	
Donna	Brucker	CA	All of the above is so important for a healthy river system
Ellen	Bryant	CA	
Erin	Buchan	CA	
Keoki	Burbank	CA	
Camille	Bush	CA	
Lisa	Butterfield	CA	
Kimberly	Cabot	CA	The dam removal benefits fish and humans alike, creates jobs and attracts eco-tourism to a healthy ecosystem.
Christina	Cafferata	CA	Please remove the damn! Thank you
Pamela	Cahill	CA	Its time to get this done. The difference in fish populations in the 73yr Ive been here is dramatic. The flood control that was promised did not happen. The '64 flood is proof. We need our salmon back.Now!
Tim	Carlson	CA	We need to open up this fishery before it is too late and ends up like the eel river!
Brooke	Carothers	CA	Please!!!!
Sydney	Carothers	CA	
Shelly	Carpenter	CA	
Bianca	Carroll	CA	Let our River Flow Free and save her fish
Dillon	Castleton	CA	
Patt	Causey	CA	
Kim	Chamberlain	CA	
Teri	Chanturai	CA	
Veronica	Chapman	CA	
Anita	Chapple	CA	Elwah river restoration.....bring it to the Klamath.
Tanya	Chapple	CA	
Ronnie	Chausse	CA	
Nat	Childs	CA	
Michael	Christian	CA	
Amethyst	Cilley	CA	

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Elizabeth	Claman	CA	Un-damming the Klamath will benefit all humans and wildlife within the Klamath Basin. It is essential to the health of this unique ecosystem!
Jennifer	Clatty	CA	
mike	cleary	CA	
Aldonna	Cloud	CA	
Julie	Coar	CA	
Paulaanne	Coburn	CA	
Thomas	Cockle	CA	
Deborah	Cogswell	CA	
Corrina	Cohen	CA	
Joanne	Cohn	CA	
Lesa	Coleman	CA	
Kathleen	Commins	CA	Preserve the life cycle of the salmon. Preserve the rights of indigenous.
Suzanne	Cook	CA	
Fernando	Cook-Morales	CA	Because dam's are Environmental Hazards and it damages and obstruct's the Earth's natural water cycle !!
Morgan	Corviday	CA	I fully support dam removal on the Klamath River for the ecological health of the watershed and in particular the survival of salmon and native livelihoods along the river.
Todd	Cory	CA	please, this was decided on years ago. lets not try to reinvent the wheel. the documentation on why these dams need to be removed is clearly evident already. pp&l has been collecting the necessary funds from their ca (like me) and or ratepayers for years.
Todd	Cory	CA	
Lindsay	Corzine	CA	
Sunny	Cosce	CA	We need the dams removed for the health of the fishery and the river, as well as our way of life. Left undone too long, I fear that the Trump administration will come up with a way to overcome and dismantle all the hard work completed by both sides of the issue all in the name of profit over knowledge. Please support damn removal on the Klamath River by 2020!
Ella	Craig	CA	
Johanna	Creson	CA	
Jason	Crews	CA	
Earl	Crosby	CA	

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Mack	Cross	CA	
Robert	Cushman	CA	
Rose	Dana	CA	Dam removal is essential for riverine and human health.
patricia	daniels	CA	
kimble	darlington	CA	
julia	dashe	CA	Rivers are the life blood of our species. Please do all you can to support excellent water quality in the Klamath River- and remove this dam to improve the long-term survival of this crucial natural resource. Thank you for your work, JD
Ellen	Davidson	CA	Let's not risk our water for short term profit for a few!
Annette	DAVIS	CA	For the future of Our People
Shira	Dawson	CA	
Cesar	De la rosa	CA	
Sylvia	De Rooy	CA	
Larry	Dennis	CA	
Erin	Derden-Little	CA	
Patricia	Deuter	CA	
Timothy	Devine	CA	the science has been clear on this for at least 20 years. Time to take action. There are temporary jobs to be had and salmon and steelhead to be saved! Let's move on this now. thank you!
Wilma	Dibelka	CA	
Margaret	Dickinson	CA	Restoration of the river's health has taken far too long already. Remove the dams NOW! so the river can be restored to health, and salmon and other fish species can begin a return to normal, historic levels.
Amy	Diekmeyer	CA	
WINCHELL	DILLENBECK	CA	
Crystal	Dobbs	CA	
Daniel	Doble	CA	
Yvonne	Doble	CA	
Dennis	Dougherty	CA	
Patricia & Joseph	Dougherty	CA	
Carla	Douglas	CA	
Emily	Driskill	CA	
Iva	Dubyak	CA	

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Norman	Dyche	CA	The facts, and answerers are there. why is the magical year of 2020 on the board. START in 2018 and lets get it moving. Way long enough for politicians to act.
Tayla	Ealom	CA	Please let life flow as it is meant to - both in the form of the river and within yourself. The decision not to kills more than just you.
Amy	Eberwein	CA	
Douglas	edwards	CA	The evidence is in and other communities have started benefitting from taking action on damn removal. Please act on this for the welfare of the present and future generations.
Kathy	Eldredge	CA	
Love	Electric	CA	
Jim	Elferdink	CA	
Linda	Elkins	CA	
Livier	Enciso	CA	
Linda	Evans	CA	
Julie	Evens	CA	
Michael	Evenson	CA	
Douglas	Eversole	CA	
Rayna	Eyster	CA	
Elizabeth	Eytchison	CA	
Yassy	Faal	CA	
Julia	Farnum	CA	
Dan	Farquhar	CA	
Alexander	Farrell	CA	
Kai	Ferrara	CA	Salinization of soils being watered with Klamath water. Native rights to fisheries and water quality.
Sarah	Fields	CA	
Ann	Fiester	CA	
Beverly	Filip	CA	
Alice	Finen	CA	
Francine	Fischl	CA	
Kimberly	Fiscus	CA	
Dylan	Fitzwater	CA	
Janet	Flanagan	CA	
Robert	Flasher	CA	
Teanna	Flippo	CA	
Richard	Flittie	CA	
Sara	Fogan	CA	

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jennifer	fogg	CA	
Ida	Foo	CA	
Jimmy & Susie	Foot	CA	
Joanne	Fornes	CA	
Cynthia	Forsyth	CA	
Suzanne	Forsyth	CA	
Gary	Freedman	CA	
Steve	Frie	CA	The dams are all silted up and produce no power, they mostly just kill a world-class fishery and the hopes and dreams of the native people living there.
Kara	Friedhaber	CA	
Adam	Frohwein	CA	
Michael	Frost	CA	Water is life. A Klamath River with toxic algae blooms cannot supply fresh drinking water, clean ground water, or clean irrigation water. Cool freshwater flows keep the ecosystem alive. We humans are part of the ecosystem. If the salmon die, we die. If the salmon flourish, we flourish! Free flowing rivers deliver sediment to the ocean. Salmon deliver high nitrogen fertilizer to the forest. Salmon represent a renewable resource... a SUPERFOOD with immense economic value. The economic value that can be derived from a thriving salmon/steelhead river is immense and should not be discounted. The obselete dams represent stranded assets, no longer providing economic benefit. They have outlived their useful life. In 2017, these ancient pieces of 20th century grandeur now represent the degradation of a part of Northern California's heritage, wild Steelhead and Chinook salmon. Please
Corinne	Frugoni	CA	
Thomas	Frye	CA	Undam the Klam. You only need to look at the Rogue River in Oregon to see all the positive impacts that a free-flowing river can bring to all of us. Lead us into a better world in the 21th Century! Thank you.
Brian	Fugler	CA	
Michelle	Fuller	CA	
Marie	Garabedian	CA	
Betina	Garsen	CA	

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cynthia	gerard	CA	You promised us all there would be removal. Our water has poisoned us killed our fish, we cant take our dogs to the river and all our fish are dead,please remove the dams, please i beg of you
Sue	Ghilotti	CA	
Richard	Gienger	CA	Go ahead on -- the removal process.
Mariane	Gilbert	CA	It is clear that dam removal is long overdue. The native people have managed this river basin for eons and kept the river ecology in balance.
Jax	Gill	CA	
Nancy	Gingrich	CA	
P.	Givins	CA	
Kathryn	Glaessner	CA	I am a land owner along the Klamath the rivers health is hanging by a thread dam removal is essential to prevent the collapse of this ecosystem and it needs to happen soon this fight has been going for over 20 years and the power produced is minimal please take the dams out!!
Larry	Glass	CA	Take down all the dams
Lin	Glen	CA	
Regina	Glock	CA	
Janice	Gloe	CA	
laura	goodwin	CA	
Bailey	Gordon	CA	
iris	greenberg-smith	CA	
Elizabeth	Greene	CA	
Christine	Griffin	CA	
Suzanna	Griffin	CA	
Laurel	Grinnell	CA	
Suzanne	Guerra	CA	
Amy	Gustin	CA	
Christi	Hadley	CA	
Deborah	Hadley	CA	Restore the river to its natural state. Leave nature alone.
Barbara	Haley	CA	Please issue a certification
Sue	Hall-Goossen	CA	
Randy	Hamann	CA	
Patricia	Hamilton	CA	
Mike	Hanna	CA	
Kathryn	Hannay	CA	

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Carla	Hara	CA	
Wendy	Harden	CA	
Joy	Hardin	CA	
Teresa	Hardy	CA	
Celia	Haro	CA	
Forest	Harpham	CA	
Jennifer	Harris	CA	
Ronald	Hart	CA	
Ronald	Hart	CA	
Catlin	Harvey	CA	The time is now, lets get this done!
Tim	Haskett	CA	Salmon and people who depend upon the river flowing as it should need this done.
Ellyn	Henderson	CA	
Laura	Hennings	CA	
Margaret and Charles	Herbelin	CA	
cheryl	higgins	CA	
Connie	Hill	CA	
Sue	Hilton	CA	
Tom	Hinz	CA	
Jessica	Hobba	CA	
Susan	Hobbs	CA	
Matthew	Hoffman	CA	
Patricia	Holcomb	CA	
Nicole	Holland	CA	
Charles	Horn	CA	
Cheri	Howard	CA	
Sarah	Hugdahl	CA	
Laura	Hughes	CA	
ann	hunt	CA	
steve	huntley	CA	
Susan	Hutchinson	CA	
David	Hyde	CA	
Nancy	Ihara	CA	
Leroy	Ikerd	CA	
Rita	Jacinto	CA	
Robert	Jackson	CA	Salmon runs provide healthy protein to our nation
verla	Jackson-Robbins	CA	
Robert	Jamgochian	CA	

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Alissa	Johnson	CA	
Michael	Johnson	CA	
Montanna	Jones	CA	This project includes many hours of volunteer work from community members. You owe them timely resolution for this project. Our fish need the protection.
Eugene	Kaczmarek	CA	
Patricia	Kanzler	CA	
kelly	karaba	CA	
Lyla	Karolczuk	CA	
Jonathan	Kastin	CA	
Tracy	Katelman	CA	This project is being watched by communities throughout the world in terms of restoring rivers. Make California proud!
Lincoln	Kaye	CA	Long overdue. Now, more than ever, state level action on environmental issues is crucial.
Marria	Kee	CA	
Laura	Keenados	CA	
Robert	Kehrig	CA	
Heidi	Keller	CA	
Mark	Kennedy	CA	It is time to improve the health of the Klamath River and all those that rely on it by removing the dams.
Lawrence	Kenney	CA	
Mandi	Kindred	CA	
Nancy E	King	CA	
Linda	Kjesbu	CA	I have been a Humboldt resident for just a little over 24 years, and have watched the evolution of this issue through Mike Thompson leaving 10,000 dead salmon on the Capitol steps to draw attention to the issue of bringing the Klamath back to its (necessary for survival of salmon) healthy state. I therefore, support the Klamath dam removal.
Carolyn	Knoll	CA	
Carolyn	Knoll	CA	
Caroline	Koch	CA	
Karl	Koessel	CA	
Jessica	Komaromy	CA	
Daniel	Krall	CA	
Rachel	Krasner	CA	
Linda	Kutil	CA	

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Cynthia	Kuttner	CA	Water is Life. Set it free.
Nancy	Kuykendall	CA	
Rebecca	Lacasse	CA	
Zoe	Lacoco	CA	
Donna	LaGraffe	CA	
Denice	LaGrassa	CA	When humans interfere with the natural ebb and flo of the environment, we've destined all mankind to destruction.
Jennifer	Lance	CA	
Marilyn	Lang	CA	
J	Lasahn	CA	
Brian	Lavelle	CA	
Stephen	Laviletta	CA	
Bruce	Lazar	CA	
Michael	Le	CA	The Klamath is an amazing river that needs to be protected and restored. When I lived in Orange County I couldn't understand why those Northern California Hippies wanted to keep their water so bad. Didn't they realized we needed green lawns? I'm not joking, this was my real perspective. The Klamath means so much to citizens, tribal members, Humboldt State Students, and visitors from all over. Please help to remove the dams and restore this mighty river. Best, Mike
Seabrook	Leaf	CA	
Jon	Lee	CA	
Trisha	Lee	CA	How many letters to we have to write? How many petitions do we have to sign, and what more has to happen?
Roslyn	Lehman	CA	
Adina	Leone	CA	
Susan	Leskiw	CA	
Amber	Lewis	CA	
Jason	Lewis	CA	This decision is one that not only is a long time in its making but..it's been made. Please allow the decisions made by those most invested in this issue to be fulfilled.
Zak	Lieby	CA	
Ann	Lindsay	CA	
Elliott	Linn	CA	Please do the right thing for a change and protect our future and not just agribusiness, if you can. Thanks
Judith	Little	CA	

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John	Livingston	CA	The fish and the County will be much better off with the dams removed.
George	Lloyd	CA	
Hailee	Lollar	CA	
Christine	Long	CA	
Pastor	Lopez	CA	Please help, with this worthy cause. California was once ,truly a paradise.
austen	lorenz	CA	
Carol	Lowe	CA	Don't fool with Mother Nature! You'd think we would learn by our past mistakes. When something has been proven to be a mistake, and there is a way to correct it, then correct it!
Jim	Lozano	CA	Let the Klamath flow.
Sara	Lucarelli	CA	Nothing is more important than clean and protected natural resources
John	Ludington	CA	
Kitty	Lynch	CA	
Michelle	MacKenzie	CA	
Ashton	Maggetti	CA	
Maya	Makino	CA	
sacha	marini	CA	
Jennifer	Markman	CA	
Tony	Marks-Block	CA	
Chris	Martell	CA	Free the River and Salmon into natural sustainable health for a long term viable investment in holistic natural operating systems that are better for all of us. Thank you!
Melissa	Martin	CA	
Tracy	Martin	CA	
Bec	Massell	CA	
Pamela	Mattz	CA	
KAREN	MAYER	CA	Natural water flows must be restored for so many ecological health reasons!
Larry	Mayfield	CA	
Susan	McCarthy	CA	This would be a great time for governmental efficiency and clarity.
Kate	Mcclain	CA	
sandra	mccolley	CA	
Robert	McCombs	CA	
Bob	McConachie	CA	
Maureen	McCready	CA	

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Don	McEnhill	CA	It's the only way to fulfill your mandate and meet water quality standards for fish and people - time is now!
C	McFarland	CA	
Richard	McFarland	CA	The dams are private property. Let the owners remove them!
Mashaw	McGuinnis	CA	
Juanita	Mckinnon	CA	This river is the lifeline to our people and community, without it and the sustanance it provides, we would cease to exist as a people.
Angela	McLaughlin	CA	Save the salmon and coast line...please undam the Klamath!!
Alicia	McQuillen	CA	
Alicia	McQuillen	CA	
Melissa	Medina	CA	
Loi	Medvin	CA	
Joyce	Meier	CA	
Janine	Melzer	CA	
Pam	Mendelsohn	CA	
Lindsay	Merryman	CA	It would be a rare and historic example of western salmon restoration to see improvements in this endangered population after dam removal and the opening of uptstream spawning grounds.
Colette	Metz	CA	
Sa	Meyers	CA	
David	Mierkey	CA	
Kathleen	Miller	CA	Overdue.
Ken	Miller	CA	
Shannon	Mondor	CA	
Carol	Mone	CA	
Marie	Monrad	CA	
Christopher	Monreal	CA	
Martin	Monroe	CA	What are you waiting for? Bring Em down!
Greta	Montagne	CA	Save the Salmon before it's too late!
Melissa	Moore	CA	
Patricia	Morey	CA	
Linda	Morgan	CA	
Nicole	Morgan	CA	
Dr. Mariel	Morison	CA	It is time.
Emily	Morris	CA	
Linda	Mortenson	CA	

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Greg	Movsesyan	CA	
Megan	Mucioki	CA	Dam removal will help river dependent traditional foods consumed by local tribes to replenish without toxic waters and high summer temperatures killing them.
Robert	Mulready	CA	
Barbara	Mumby	CA	
Jean	Munsee	CA	
Mike	Napolitano	CA	
Daniel	Nelson	CA	
Daniel	Nelson	CA	Please remove the dams free the river
Daniel	Nelson	CA	
Daniel	Nelson	CA	The dams do nothing but block the river from thousands of fish, during summer months the reservoirs hold toxic bacteria, please remove the dams! !!!
Rachel	Neumann	CA	please no more delays. Issue the reports. We need the dam removed now-for all our health and long term survival. The time is now.
Donald	Nielsen	CA	
Val	Nordeman	CA	
Carolyn	Norr	CA	I am a parent and am asking this to protect my kids future environment!
Sherri	Norris	CA	
Sherri	Norris	CA	
Sherri	Norris	CA	
Rosa	Novak	CA	I have family who live and run two local organic California farms and nurseries on either side of the Klamath river. In support of their quality of life and the health of the surrounding ecosystem on the Klamath I hope the water board will allow the dam to be removed.
Ed	Nute	CA	There will be many beneficial impacts once these dams have been removed including flyfishing and rafting.as well as a greatly improved downstream fishery.
Chris	O'Keefe	CA	
Julie	O'Rielly	CA	
Jean	Okamura	CA	
Laureen	Oliveira	CA	
Adel	Olvera	CA	
Elaina	ORourke	CA	

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Jody	Otolski	CA	
Noemi	Pacheco	CA	
Marilyn	Page	CA	
Will	Palmer	CA	It's time to move into the 21st century. Accommodate renewables.
Walter	Paniak	CA	
Keith	Parker	CA	As a Fish Biologist and Yurok tribal member, I have a vested interest in the Klamath River dam removal project for the repatriation of hundreds of miles of anadromous fish spawning grounds, habitat restoration, a free flowing river free of toxic blue-green algae blooms which currently require health quarantines each summer, reduced methane gas releases from Klamath reservoirs which is 35 times higher heat-trapping gas than CO2 affecting climate change, sufficient flows to lower the water temperature to prevent a repeat of the nation's largest adult salmon fish kill in 2002, and the stoppage of destructive logging practices which destroys both aquatic and terrestrial wildlife habitat. Facilitating these tasks will significantly increase fish and wildlife populations as anadromous fish contribute essential biomass of marine-derived nutrients and organic matter to the food web of oligotrophic streams from carcass decomposition. The nutrients are an important food source for bear, blue heron, mink, fishers, river otters, hawks, eagles, osprey, cutthroat trout, rainbow trout, salmon smolts, mergansers, kingfishers, seagulls, terns, along with increased riparian plant growth which increases herbivorous food supply, macroinvertebrate and terrestrial insect habitat. Marine derived phosphorus has also been isolated in Redwood and other trees of the Pacific Northwest. In essence, upriver forests are made of fish.
Mara	Parker	CA	
Megan	Parker	CA	
Pamela	Parsons	CA	
Jason	Patton	CA	thanks for your support!
MaryAnne	Paul	CA	

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Jean	Paulson	CA	In the time of global warming, with the images of the great fish kill still too fresh in our minds, we need to be ever more mindful of the human action on the natural world. we need these dams to be removed!
Ted	Pease	CA	These dams have strangled the Klamath for decades, destroying salmon stocks, scarring the landscape and infringing on native people's tradition culture and rights. Mr. Water Resources Control Board, tear down these walls!
Ralph	Penfield	CA	
Bella	Peralta	CA	The Klamath river is a vital water source for a wide variety of life, with plenty to share, if allowed to be in its naturally intended state without mans intervention to dam it, all will be well!
Benjamin	Perone	CA	
Claire	Perricelli	CA	
Tom	Peters	CA	As a FORMER commercial salmon fisherman, I say it is time to get these antiquated dams out of the river and let it return to good health.
Davin	Peterson	CA	
Vanessa	Peterson	CA	Let nature thrive!
Adam	Pickett	CA	
Susan	Piercy	CA	
william	piercy	CA	
Paul	Pitino	CA	
nicole	planchon	CA	
Laura	Porter	CA	
Quinlan	Porter	CA	
JAcob	Pounds	CA	The Klamath dams contribute to a preventable, but egregious water quality issues and toxic cyanobacteria blooms. The dams need to be removed as soon as possible to correct these issues.
Charles	Powell	CA	
Lauren	Preston	CA	
Mark	Pringle	CA	
Peggy	Pryor	CA	
Karuna	Purcell	CA	
April	Quigley	CA	
Dana	Quillman	CA	

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Holly	Quinn	CA	I am convinced these dams must be removed for the health of the river, its populations (specifically salmon, but all animal and plant life dependent on it which it should be able to sustain - not foreign), and the human communities, i.e., First Nations, dependent on it for their ongoing cultural and spiritual lives. Thank you,
leslie	quinn	CA	
Rudy	Ramp	CA	
Rudy	Ramp	CA	
Joshua	Ramsey	CA	
Rosa	Rashall	CA	
Debie	Rasmussen	CA	
Charles	Ray	CA	
Terry	Raymer	CA	I care for Yurok, Hoopa and other American Indian people at United Indian Health Services. Having local stocks of their traditional food is key to the return of their good health. thank you.
Catherine	Recinos	CA	
Kelsey	Reedy	CA	
lise	rehbock	CA	
Jane	Reid	CA	
Angela	Rex	CA	
Rebeka	Reyes	CA	
rachel	Rhinehart	CA	
Laurie	Ricahrdson	CA	
Paul	Richards	CA	
Miles	Richardson	CA	
Trisha	Ridenour	CA	
fred	rinne	CA	
Sharon	Ritsch	CA	
Alex	Robbi	CA	The Klamath rivers water quality is terrible. We see many dead and sick fish every summer and can not let our children swim on our own beach. The dams must come down! Thank you!
Pauli and Michael	Robinson	CA	
Rod	Rochambeau	CA	
maureen	roche	CA	Begone Damn
Reina	Rogers	CA	
David S.	Rose	CA	

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Doug	Rose	CA	time to help our future generations.
Patti	Rose	CA	
Mary Lynn	Rounds	CA	Water is our most precious resource, and we cannot allow dams to interfere with river ecosystems.
Erin	Rowe	CA	
Annalisa	Rush	CA	
Karen	Rusiniak	CA	
Robert	Rust	CA	
Lynn	Ryan	CA	I have been writing and attending hearings for 15 plus years working toward Klamath dam removal. This work continues. For the water and fish,
Tim	Ryan	CA	
Amber	Ryno	CA	
Rick	S	CA	
Steph	S	CA	
Richard	Salzman	CA	
Marco	Sanchez	CA	
Marco	Sanchez	CA	
Polly	Savoie	CA	
John	Schaefer	CA	
Kay	Schaser	CA	
Kay	Schaser	CA	
NOah	Schillo	CA	
Nancy	Schimmel	CA	For flood control, we need the small dams the beavers build, not the big ones made by humans.
Claudia	Schimmer	CA	It is the right thing to do!
Buffie	Schmidt	CA	
Steve	Schramm	CA	
Judy	Schriebman	CA	These dams are no longer functioning effectively--EXCEPT as keeping fish from upper reaches. We need free flowing Klamath for salmon, fisheries, and health of the lower reach. It is time to remove these dams. Thank you.
Greg And Laurie	Schwaller	CA	
Meredith	Seawell	CA	
Azra	Sehic	CA	
Raquel	Selcer	CA	
Patrice	Sena	CA	
Linda	Serrato	CA	

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Margaret	Shaffer	CA	
Linda	Shapeero	CA	
Leslie	Shapiro	CA	Please protect our waterway and remove the dams on the Klamath River. Thank you
Katherine	Sharp	CA	
Chip	Sharpe	CA	
Corinne	Shea	CA	
elaine	shelley	CA	
Therese	Shere	CA	
Deva	Sherman	CA	Tear the damn things down!
Beth	Shipley	CA	
Emily	Siegel	CA	
Dana	Silvernale	CA	
Suzanne	Simpson	CA	
Terry	Slack	CA	
Harold	Sloane	CA	
Charles	Smith	CA	
Josine	Smits	CA	Please restore the free-flowing river and help to bring back the salmon.
Barbara	Snell	CA	
Donald	Snow	CA	
Monique	Sonoquie	CA	
Richard	Spicer	CA	
Katie	Stalker	CA	Save the salmon!
Melissa	Stansberry	CA	
ken	stanton	CA	
Linda	Stanton	CA	
Melinda	Stearns	CA	
Barrie	Stebbings	CA	
Earl	Steen	CA	
Kurt	Stegen	CA	
Nancy	Stevens	CA	
Atta	Stevenson	CA	Beneficial uses must include EIS/EUR Tribal traditional fishing rights. Scientific water quality and quantity is mandatory for habitat survival. I support dam removal.
Erin	Stevenson	CA	If we don't act now to remove the dams, it will never happen and the salmon ppulation will suffer irreverable damage and that is one legacy that is worth protecting-and we have to act now. There is no 'later'. This is later and this IS the TIME TO ACT. REMOVE THE

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DAMS.

John	Stewart	CA	
Jeff	Stone	CA	
Sara	Sunstein	CA	
Anne	Szostek	CA	
judith	Talaugon	CA	
Bari	Talley	CA	Super important to get this done without delay.
Kristopher	Tamburello	CA	
Jennifer	Taylor	CA	The science is there, the agreement is signed, please honor this process.
Monica	Taylor	CA	
Susan	Terence	CA	
Ken	Terrill	CA	
Tiffany	Theden	CA	
Franklin	Thom	CA	For the sake of the natural resources; that the habitat return too it's original river flow. Plant life needs clean water. Our tribal ceremonies rely on the rivers clean flow...
Sandra	Thomas	CA	
Ann	Thompson	CA	
Ronald	Thompson	CA	The salmon used to run in the hundreds of thousands. The birds at Klamath Lake blotted out the sky for long periods of time. The Indians were managing thing. Then the White Man thought he could do better.
Johannes	Thrul	CA	
Stephanie	Tidwell	CA	
Kathleen	Tillinghast	CA	
Julie	Timmons	CA	
Holly	Tomatis	CA	
Holly	Tomatis	CA	
Monica	Tonty	CA	
Maxine	Torres	CA	
Mike and Nancy	Tout	CA	
Lisa	Townsend-Schmitt	CA	Save our Salmon!
Gene R.	Trapp & Jo Ellen Ryan	CA	

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connie	turgon	CA	
Zachary	Turner	CA	Thank you for recognizing these dams have had their day. They've done their damage far too long. They need to go.
Brendan	Twieg	CA	
Samuel	TwoBears	CA	
Joe	Tyburczy	CA	This is a historic opportunity to restore salmon access to a healthy major river system while removing dams that longer provide any significant benefits.
Jacqueline	Van Der Hout	CA	
Michael	Van Devender	CA	
Cyn	Van Fleet	CA	
Robert	Van Fleet	CA	
Melissa	Van Scoyoc	CA	
Lee	Vandeveer	CA	
Julie	VanTilburg	CA	
Irene	Vasquez	CA	
Mary	Vedovi	CA	Water, as we have learned these past few drought years, is our greatest resource. Please do all you can to protect our precious water resources. Healthy ecosystem means healthy humans.Please remove the dam.
Jean	Vengua	CA	Please join the growing movement to decommission American dams, and save our water resources.
Megan	Vierra	CA	
Kristin	Vogel	CA	The Klamath can perform its myriad services to a greater number of living things only if the dam is removed.
Jennifer	W	CA	
Severin	Walston	CA	
Pam	Ward	CA	
Jeff	Wasielewski	CA	
Rebecca	Waters	CA	
Virginia	Waters	CA	
Harriet	Watson	CA	
Jonathan	Weber	CA	It is time now to do these actions to open up the Klamath River to natural flow rates for all fish and wildlife.
Sandy	Webster	CA	
Debbi	Weiler	CA	
Michael	Welch	CA	
Daniel	White	CA	Take out those dams!

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Edward	White	CA	
Laura	White	CA	
MANI	WHITE	CA	
Carlotta	Whitecrane	CA	My family lives near the river and we eat the salmon and eels from the Klamath. Dams have heated water temperatures and created toxic algae blooms that threaten our lives and subsistence diets. The health of the river and all life around it is more important than recreation, lake front views, and fear of sediment. We cannot eat those things.
Carol	Wiebe	CA	Water is life! We have to stop poisoning it with chemicals and ag.runoff
Chris	Willis	CA	
karen	wilson	CA	Incorporate the scientific basis already set and move forward to soon un-dam the Klamath!
Jan	Windz	CA	
Lynn	Wolf	CA	
Kathleen	Wolfberg	CA	
Paul	Wolfberg	CA	
Marcia	Wolhandler	CA	
Cheryl	Wood	CA	
Leslie	Wood	CA	
Linda	Woodward	CA	
Lupine	Wread	CA	
Alfreda	Wright	CA	
R	Y	CA	The Water Board has an obligation to follow through with documented, pier-reviewed science in not obstructing Klamath Damn removal. Please do your damn job and fulfill your mandate.
Heidi	Young	CA	
Rebecca	Younger	CA	
Rebecca	Younger	CA	
Ron	Zemel	CA	
Gretchen	Ziegler	CA	Please support our fragile and crumbling ecosystem before it is too late.
Joel	Ziegler	CA	These dams need to be removed and Riparian vegetation re-established along the river course for the benefit of aquatic life.
George	Zimninsky	CA	
Leslie	Zondervan-Droz	CA	

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Jessica	Black	CO	
JoAnne	Carlson	CO	Water needs to be cared for and protected everywhere...it affects us all & remains a part of the ecosystem forever!
Susan	Kraft	CO	
Margaret	Ludlow	CO	
Donald	Wharton	CO	
Joan	Bennett	DE	
Lynda	Constable	FL	
C	Day	FL	
Oleg	Finodeyev	FL	
MAGALI	FREDERIC	FL	
david	gonzalez	FL	
Gail	Knight	FL	
Paul	McPhee	FL	
Casey	Muhs	FL	Protect the nation's water, please!!!
Mickelle	Riley	FL	
Cee	Roth	FL	
Allie	Tennant	FL	
Doug	Mishler	GA	
Janean	Murdock	GA	
Scott	Jarvis	HI	
James	Long	HI	
Wandalea	Walker	HI	
Jennifer	Kellogg	IA	
Joella	Steffenson	IA	
Solo	Greene	ID	
cheryl	henley	IL	
Jill	Koch	IL	
Caitlin	Divine	IN	
Ande	Kobek	IN	The time is now to do what is right.
brad	higgs	KS	
Paul	Cameron	MA	
Claire	McCoy	MA	
Karen	McClaskey	MD	
J.	Sherfey	MD	
Sarah	Filer	MI	
Margaret	Green	MI	
Luan	Marks	MI	
Luan	Marks	MI	

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Suzanne	Neefus	MI	
Mandy	Powell	MN	
Donald	Kalleck	MO	
Mark	Rutherford	MO	
Jim	Davis	MT	
Kristin	Freeman	MT	
Kristin	Freeman	MT	
lois	redelk	MT	
Cassandra	Schafer	ND	
Barbara	Bailey	NE	
mary	raine	NH	
DONALD C	BECK	NJ	CA. ST WATER CONTROL BOARD- STICK TO YOUR GUNS, DON
Logan	LaVail	NJ	
Brian	Reynolds	NJ	
Carolyn	Serebreny	NJ	
Ed	Somers jr	NJ	You must get rid of this dam.our eco system is a delicate thing and it's being destroyed all over the country assive salmon kills are a massive blow to our delicate ecosystem please remember every species has its place and purpose in our world,you destroy one you cause a domino affect witch eventually leads back to us.!!!!!
Galaxy	Dancer	NM	
Phillip	Hayes	NM	
Martha	Johnson	NM	
Arlo	Starr	NM	
Luke	Frey	NV	
Jackie	Mix	NV	The full impact of this dam is so enormous the impact is still being felt at each tribal village clear to the ocean.
Nicole	Stephens	NV	
Melvin	Walter	NV	
Susan	Breloff	NY	
Benjamin	Dakota	NY	
Joe	Ellrott	NY	
Michelle	Hayward	NY	
Louisa	J	NY	
Laura	King	NY	Save the salmon!
Elizabeth	Kocher	NY	
Ruth	Lanton	NY	

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Dawne	Santopietro	NY	
Richard	Stout	NY	
Tami	Swartz	NY	
Elizabeth	Watts	NY	
Miklos	Bosarge	OH	
jeffery	eaton	OH	
mitzi	frank	OH	
Kathy	Jacobson	OH	
Lydia	Garvey	OK	
Kemberlee	Starritt	OK	
Kevin	Vue	OK	
Kevin	Vue	OK	
Paul	Alexander	OR	
Tamara	Alexander	OR	
Carol	Ampel	OR	
donna	anderson	OR	
Michele	Antico	OR	
Tana	Atchley	OR	
Ranie	Baker	OR	
Doug	Barrett	OR	Please keep our water clean! Thank You, Doug
Darcy	Belshaw	OR	
Carol	Bennett	OR	
Rae	Benson Jr	OR	
carolyn	blackmon	OR	it is past time to remove the dams
Pat	Bognar	OR	
Ashley	Bowers	OR	
Tod	Boyer	OR	
John	Brinkley	OR	
Jerome	Brown	OR	
Elizabeth	Buitron	OR	
Patricia	Burke	OR	
Kristiana	Burrow	OR	
Paula	Campbell	OR	
Alex	Cano	OR	
Henry	Carlile	OR	
Elissa	Carlson	OR	
Marsha	Carrino	OR	
Sheri	Chenoweth	OR	

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Paul	Cienfuegos	OR	It's absolutely urgent that you not allow the salmon run on this river to become any more endangered than it already is. Take that damn dam down before it's too late! Thank you.
ben	cochran	OR	It no longer serves a purpose that is greater than the lose of habitat
Mary	Cody	OR	
Anessa	Connor	OR	Bless our SACRED WATERS! SUSTAINABLY!
jonnel	covault	OR	As a former homeowner on Copco "Lake" I can attest to the foul water behind the dam. All the manure run off into the lake combined with stagnation was/is truly disgusting. Free the Klamath and it's beautiful salmon.
l	d	OR	
Jennifer	Dadigan	OR	
Rachael	Daniel	OR	
kim	day	OR	We need to recognize that the reason the mother nature had spent so much time designing water systems globally. It had sustainability, naturally it was 'managed 'naturally. Now what we really need to manage our population. Admit we made mistakes over managing the Klamath River and other water systems and let them recover and restore the biodiversity and water tables so we all can survive.
mark	day	OR	
Lacey	Decker	OR	
Tom	Derry	OR	
Lee	DeVeau	OR	
Michael	Dotson	OR	
Deborah	Einbender	OR	
Charles	Erdman	OR	
Joanne	Feinberg	OR	
Jennifer	Forbes	OR	
Michelle	Foster	OR	
Irene	Francis	OR	We are familiar with the Elwah River Restoration and Dam removal. Also the Nisqually Wildlife Refuge and the removal of the Brown Farm Dike in Washington State. These projects both show the wonder of dam removal. We hope you continue on the path to long term water quality in the Klamath

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River. Sincerely John & Irene Francis

Alessandro	Freddi	OR	
Andrew	Fuller	OR	
Ray	Galbavy	OR	Do it as soon as possible. The last word has been said!
Jennifer	Garcia	OR	
Lauren	Gill	OR	
Anne	Golden	OR	It's time to follow through with the commitment to and by the owners of the dams on the Klamath river to begin the process of removing the dams straight away.
Juliet	Grable	OR	
Keri	Green	OR	
Lacie	Greenig	OR	
Amber	H.	OR	
Kevin	Hamilton	OR	
Joshua	Hanna	OR	Please don't allow corporations to destroy our planet and enviornment, our greatest resource is the health and integrity of our water and our planet.
Jenifer	Hayes	OR	
Allene	Hebert	OR	
Karen	Hefner	OR	
Mark	Hereford	OR	
Rachel	Hess	OR	
Jessica	Hewlett	OR	
Phillip	Hext	OR	
Todd	Hildebrandt	OR	
marla	Hillman	OR	please.....
Patricia	Hine	OR	
Ray	Hockaday	OR	
Terri	Horn	OR	
Peter	Howland	OR	
Matthew	Hunter	OR	
Marianne	Itkin	OR	
Rebecca	Jacobsen	OR	
Kelly	Jacobson	OR	

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Leigh Anne	Jasheway	OR	
Lois	Jean	OR	
ophoff	joel	OR	
Kaetlin	Kennedy	OR	
Bernadette	Kero	OR	
Nicole	Kittersong	OR	
Kim	Klein	OR	
Gregg	Kleiner	OR	
Brenda	Kluhsman	OR	
Kenneth	Knight	OR	As a Klamath Tribal member and property owner on the Williamson river the loss of salmon and steel-head was/is devastating. On my property is a ancient fish weir that was used to trap the now missing fish. Please unblock the Klamath River and allow nature to again flourish. Thank You, Kenny Knight
Cynthia	Laughery	OR	
Nicole	Lawless	OR	
Laura	Lawver	OR	
Casey	Lay	OR	
Anita	Lemke	OR	
Judith	Lienhard	OR	
Rachel	Lileet-Foley	OR	
Jim	Lockhart	OR	
Wisteria	Loeffler	OR	
Dwight	Long	OR	
Genevieve	Long	OR	This will improve long-term water quality in this valuable river for California. We respect California as a global leader in sustainable environmental change. Thank you!
Paula	Long	OR	
Nicole	Lorsong	OR	
Leslie	Lowe	OR	There really isn't another choice at this late date.
Nancy	Lyles	OR	
Nancy	Lyles	OR	
Nancy	Lyles	OR	
Ericka	Macy-Gustafson	OR	
Laura	Madeline	OR	free the water and heal this earth!!

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Liza	Maltsberger	OR	Now more than ever, each individual and each local or specialized agency needs to take care to be sure their neck of the natural woods is well-stewarded. Please incorporate the exhaustive research done in the 2012 EIR/EIS, and please incorporate all the research done since then that points toward dam removal on the Klamath being the right thing to do for long term water quality. Thank you.
lydia	mancilla	OR	
Bill	Marlett	OR	
Brooke	Marmolejo	OR	
Art	Martin	OR	
Michael	Mayne	OR	We should be moving toward tourism jobs. Dam removal will attract hikers,guides,and outdoorsmen.
anne	mcavoy	OR	
Nancy	McClain	OR	A healthy river system will help with tourism. Just look north to the rogue river and see how it is thriving. The dam removal will assist in bringing $$$$ back into a depressed community.
Melanie	McCloskey	OR	
Lou	Mcdonald	OR	
Kelly	Mcneil	OR	I've seen first hand how a river blossoms after being undammed. It's a beautiful thing for wild life
charles otter	mcsweeney	OR	
Jackson	Meadows	OR	
paul	merz	OR	It's the right thing to do for the environment and the human population.
Dax	Messett	OR	Free this river!
Gregory	Monahan	OR	
Matt	Moreland	OR	Please remove these outdated non-sustainable torture devices
Julaine	Morley	OR	
Robert	Mumby	OR	
Kenneth	Nakazawa	OR	
John	Nettleton	OR	
Mark	Newberger	OR	
dena	nickell	OR	

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Kari	Nordgaard	OR	Dam removal is the single biggest restoration and human rights opportunity of our time. This is such a win win for our state and our nation. Thank you for your work.
Ciry	Null	OR	
Hugh	Null	OR	Native salmon are worth saving.
Helen	Nutt	OR	
Bridget	O'Connor	OR	
Dove	Oldham	OR	
Heidi	Oregon	OR	
Christina	Pasillas	OR	
Cynthia	Peachey	OR	
Eric	Peterson	OR	
Elaine	Phillips	OR	
Angela	Pittaluga	OR	
Barbara	Poulsen	OR	
Kyle	Pritchard	OR	
Kate	Proctor	OR	
Amber	Rau	OR	
James	Reid	OR	
Chris	Rempel	OR	
Kristina	Ribeiro	OR	
justin	riede	OR	
Derrick	Roffman	OR	
Jeanette	Rutherford	OR	A multi-interest group concluded dam removal to be the best solution - let's just get on with it!!
Lucy	Ryan	OR	
Lucy	Ryan	OR	
aurora	Sancoy	OR	
Shantara	Sandberg	OR	
Jason	Sanger	OR	
Carrie	Sanneman	OR	
Kim	Savage	OR	
George	Sexton	OR	
Cecile	Shohet	OR	
Denise	Sims	OR	
Imants	Slegelis	OR	
Sara	Smith	OR	
Stacy	Smith	OR	
Dennis	Specht	OR	Thank YOU for assisting in this Dam removal

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			process!
Connie	Stringer	OR	
Jasmine	Stuverud	OR	
Diane	Taudvin	OR	Our fish, our ecosystems need to be restored to health. The protects the water as well as wildlife and humans.
Norma Jean	Taylor	OR	
Charles	Thomas	OR	
james	thompson	OR	
Arthur	Ticknor	OR	
Sarah	Tiller-Holman	OR	
Julie	VandenBerg	OR	
Hilary	Vander Veer	OR	
Myra	Villella	OR	Please support Dam Removal on the Klamath River. Fish need water, people need water. Thank you.
Dale	Visinaiz	OR	
sara	vitagliano	OR	
Janet	Voorhies	OR	
Susan	Waggoner	OR	Please do the right thing for nature.
Scott	Wagner	OR	
Susan	waterman	OR	
kayte	wehinger	OR	For all fish and wildlife and people, it is vital for rivers to flow freely to maximize there full potential.
Courtney	Weiler	OR	
Dave	Willis	OR	
John Wilson	Wilson	OR	
Roberta	Wong	OR	
John	Wood	OR	The dams should come out.
ashley	wright	OR	Let the Salmon run <3
becca	wynne	OR	
Daphne	Wysham	OR	
Sage	Zanth	OR	
Lucas	zeeberg	OR	
Peg	Pennington	PA	
Fred	Stevens	PA	
Cheryl	Woodford	PA	
Diana	Fox	RI	The Klamath is such an important river. The dam is no longer necessary. Undaminf will restore the river to health and surrounding ecosystem.

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Scott	Crutcher	SC	
Brennon	Murdock	SD	Give nature back
Richard	Gillaspie	TN	
Pam	Tate	TN	
Debra	Atlas	TX	
Barry	Madison	TX	
Terri	Walsh	TX	
Chris	Ackerson	UT	
Pattie	Hyde	VA	
Tanya	Roland	VA	
Shelinda	Quinland	VI	
Thea	Appleton	WA	
April	Atwood	WA	
William	Baumgartner	WA	I have been regular visitor to the Klamath region for 30 years now. It is among the most important ecosystems on earth. Maintaining it's natural functionality is important to all humans.
Megan	Bloom	WA	
Wendy	Bloom	WA	
Paul	Brown	WA	
M J	Caputo	WA	
Sandra	Dojcinovic	WA	
Eve Marie	Eells	WA	
Maggie	Everett	WA	
Susan	Fox	WA	
Elizabeth	Hickman	WA	
Shane	Ho	WA	
Jessica	Jiang	WA	
Mark	Kacmarcik	WA	Please remove these obsolete dams, restore wild salmon runs, respect indigenous peoples' rights, work with landowners, and welcome the improved recreation and tourism economy. Moving forward, mark
Joel	Kawahara	WA	
Kate	Lancour	WA	
John	Leary	WA	
Kim	McCary	WA	
James	Mulcare	WA	
Gabriel	Newton	WA	
Ron	Park	WA	

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Cris	Pemberton	WA	
Joan	Peter	WA	
Leaanne	Peterson	WA	
Rose	Schwabe	WA	
RoxAnne	Simon	WA	
Madeleine	Sosin-Rocha	WA	
Pat	Spray	WA	Bring back the salmon by making the Klamath River free again. The future is at stake. The river can heal itself without the dam there.
Donna	Starnes	WA	
Ilysea	Sunderman	WA	
Maury	Vezzolini	WA	
Micah	Wait	WA	
Rachelle	Walters	WA	
Marco	Garza	WI	
Monalisa	Langner	WI	
Hilda J	Richey	WI	
Sally	Wise	WI	
Sidney	Bailey	WY	

Appendix B

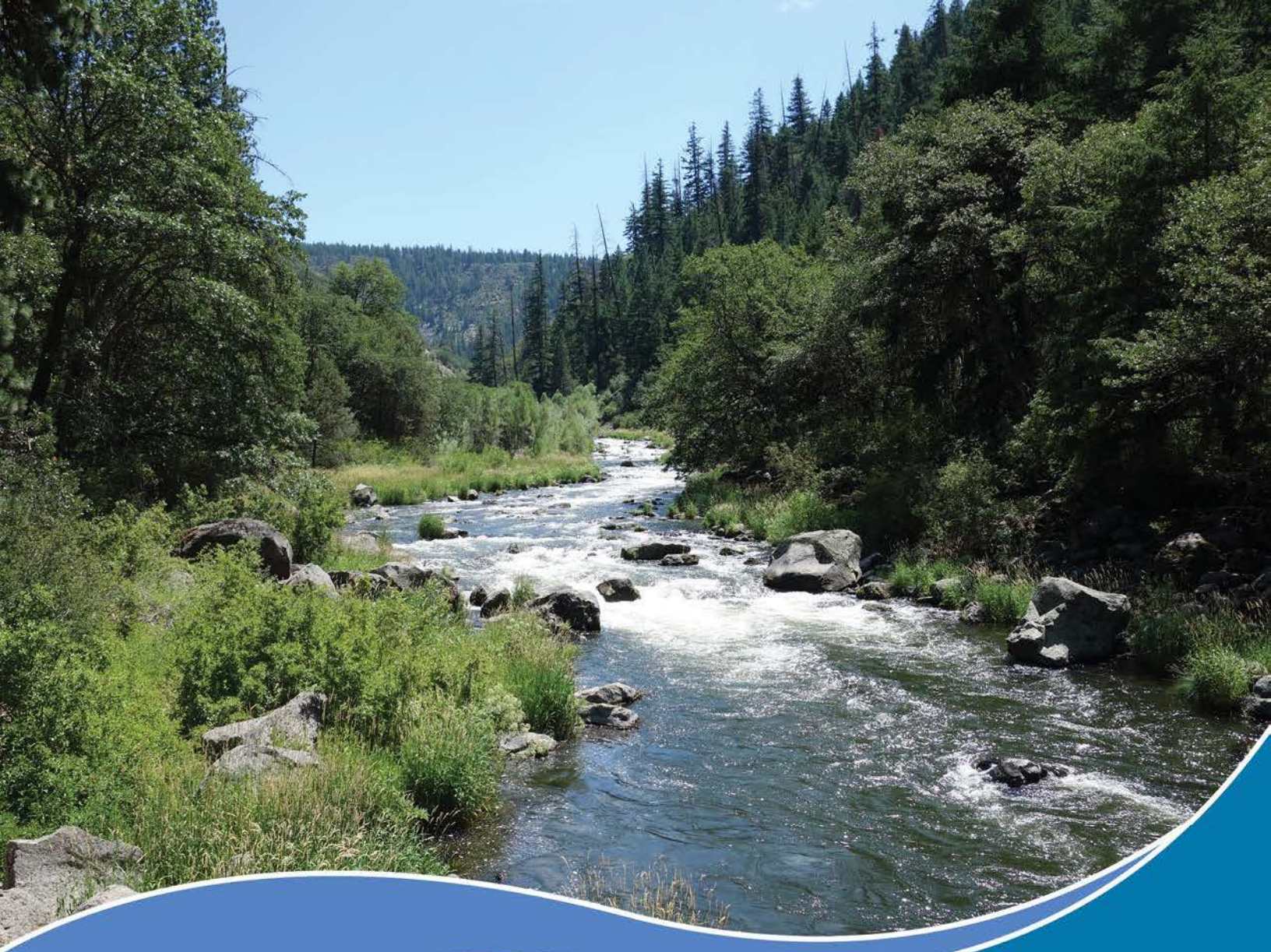
Definite Plan for the Lower Klamath Project

The Definite Plan (Appendix B) for the Lower Klamath Project is available on the State Water Board's website at the following link (originally released on June 29, 2018):

https://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/docs/lower_klamath_ferc14803/lkp_def_pln.pdf

The Definite Plan Updated Aquatic Resource Measure 7 Freshwater Mussels for the Lower Klamath Project is available on the State Water Board's website at the following link (originally released on October 16, 2018):

https://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/docs/lower_klamath_ferc14803/krrc_updatear.pdf



Definite Plan for the Lower Klamath Project

June 2018

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CORPORATION

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Klamath River Renewal Corporation

Prepared by:

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Acronyms and Abbreviations

ACHP	Advisory Council on Historic Preservation
ACM	Asbestos Containing Material
ADA	Americans with Disabilities Act
AR	Aquatic Resources
ATWG	Aquatic Technical Work Group
BCE	before the Common Era
BLM	Bureau of Land Management
CA	California
Caltrans	California Department of Transportation
CDFW	California Department of Fish and Wildlife
CDM	Camp Dresser and McKee
CE	California Endangered
CEII	Critical Energy/Electric Infrastructure Information
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
cfs	cubic feet per second

CFM	Cubic Feet per Minute
CFR	Code of Federal Regulations
CHP	California Highway Patrol
CHR	Cultural and Historic Resources
CMP	Corrugated Metal Pipe
CNDDB	California Natural Diversity Database
COD	Chemical Oxygen Demand
CORP	Central Oregon and Pacific Railroad
CRHR	California Register of Historical Resources
CSSC	California Species of Special Concern
CT	California Threatened
CWT	coded wire tag
CY	cubic yards
D	Diameter
DDT	Dichlorodiphenyltrichloroethane
DEM	Digital Elevation Model
DRE	Dam Removal Entity
DSOD	California Division of Safety of Dams
DSSMP	Dam Safety Surveillance and Monitoring Plan
DWR	California Department of Water Resources
EAP	Emergency Action Plans
EIR	Environmental Impact Report
EIS/R	Environmental Impact Statement/Report
EM	Engineering Manual
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily significant unit
FC	Federal Candidate Species
FE	Federal Endangered
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FP	Fully protected
FSC	Federal Species of Concern
FT	Federal Threatened
ft^2	feet squared
GHG	Green House Gas
GIS	Geographic Information System

GPS	Global Positioning System
GW	Groundwater
H	Horizontal
HABS	Historic American Building Survey
HAER	Historic American Engineering Record
HALS	Historic American Landscape Survey
HEC-RAS	Hydrologic Engineering Center River Analysis System
HGMP	Hatchery and Genetics Management Plan
hp	horsepower
I	Interstate
IEV	Invasive Exotic Vegetation
IGH	Iron Gate Hatchery
IM	Interim Measure
IPaC	Information for Planning and Conservation
JPBO	Joint Preliminary Biological Opinion
KBMP	Klamath Basin Monitoring Program
KBRA	Klamath Basin Restoration Agreement
KHHD	Klamath Hydroelectric Historic District
KHP	Klamath Hydroelectric Project (FERC Project no. 2082)
KHSA	Klamath Hydroelectric Settlement Agreement (2010, as amended 2016)
KIP	Klamath Irrigation Project
KRRC	Klamath River Renewal Corporation
kV	kilovolt
kVA	kilovolt amperes
KWAPA	Klamath Water and Power Authority
lb	pound
LBP	Lead Based Paint
LiDAR	Light Detection and Ranging
LKP	Lower Klamath Project
MBTA	Migratory Bird Treaty Act
MOA	Memorandum of Agreement
MPH	Most Probable High
MPL	Most Probable Low
MVA	Megavolt-amperes
MW	Megawatt
N/A	Not Applicable
NAGPRA	Native American Graves Protection and Repatriation Act

NAHC	Native American Heritage Commission
NAVD	North American Vertical Datum
NISIMS	National Invasive Species Information Management System
NGVD	National Geodetic Vertical Datum
NMFS	National Marine Fisheries Service
No.	Number
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NSO	Northern Spotted Owl
NW	Northwest
OC	Candidate listing by ODA
ODA	Oregon Department of Agriculture
ODC	Other Direct Cost
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
OE	Listed as endangered by ODA or ODFW
ONHP	Oregon Natural Heritage Program
OR	Oregon
ORBIC	Oregon Biodiversity Information Center
ORS	Oregon Revised Statute
OSS	Oregon Sensitive Species
OT	Listed as threatened by ODFW
OWRD	Oregon Water Resources Department
PAH	Polynuclear aromatic hydrocarbons
PCB	Polychlorinated biphenyls
PFMA	Potential Failure Modes Analysis
PIT	Passive Integrated Transponder
PRO	Partial Removal Option
QA	Quality Assurance
QAP	Quality Assurance Plan
QC	Quality Control
QCIP	Quality Control Inspection Program
RL	Reporting limit
RM	River Mile
RSET	Regional Sediment Evaluation Team
RSL	Regional screening levels

RT	Round Trip
RV	Recreational Vehicle
RWQCB	Regional Water Quality Control Board
RWS	Reservoir Water Surface
SAP	Sampling Analysis Plan
SE	Southeast
SEF	Sediment Evaluation Framework
SDOR	Secretarial Determination Overview Report
SIR	Supplemental Information Report
SL	Screening level
SLV	Screening level values
SONCC	Southern Oregon Northern California Coast
sUAS	Small Unmanned Aircraft System
SVOC	Semi-volatile organic compound
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	California State Water Resources Control Board
SPT	Standard Penetration Test
TCPs	Traditional Cultural Properties
TER	Terrestrial Resources
TMP	Transportation Management Plan
TSS	Total Suspended Sediments
UKBCA	Upper Klamath Basin Comprehensive Agreement
U.S.	United States
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
V	Vertical
VOC	Volatile organic compound
WQ	Water Quality
WSE	Water Surface Elevation
WUMA	Water User Mitigation Authority
WY	Water Year

Definitions

The following definitions are provided for use throughout this report:

- Decommissioning means PacifiCorp's physical removal from a facility of any equipment and personal property that PacifiCorp determines has salvage value, and physical disconnection of the facility from PacifiCorp's transmission grid. KHSA section 1.4.
- Detailed Plan means U.S. Bureau of Reclamation *Detailed Plan for Dam Removal – Klamath River Dams – Klamath Hydroelectric Project – FERC License No. 2082 – Oregon-California* (July 2012). See also KHSA section 7.2.2.
- 2012 EIS/R means U.S. Department of the Interior and California Department of Fish and Wildlife, *Klamath Facilities Removal: Final Environmental Impact Statement/Environmental Impact Report* (December 2012), State Clearinghouse # 2010062060.
- Facilities Removal means physical removal of all or part of each of the Facilities to achieve at a minimum a free-flowing condition and volitional fish passage, site remediation and restoration, including previously inundated lands, measures to avoid or minimize adverse downstream impacts, and all associated permitting for such actions. KHSA section 1.4. For this purpose, Facilities are: Iron Gate Dam, Copco No. 1 Dam, Copco No. 2 Dam, J.C. Boyle Dam, and appurtenant works currently licensed to PacifiCorp. KHSA section 1.4.
- Klamath Hydroelectric Project means FERC Project No. 2082. As originally licensed, the project consisted of eight developments: East Side, West Side, Keno, Fall Creek, J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate, and appurtenant works. Federal Power Commission, "In the Matters of the California Oregon Power Company," 13 FPC 1 (January 28, 1954), as amended by "Order Adopting Decision of Presiding Examiner," 23 FPC 59 (January 13, 1960). In 2018 FERC amended the license for this project to remove J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Developments and appurtenant works. FERC, "Order Amending License and Deferring Consideration of the Transfer Application," 162 FERC 61,236 (March 15, 2018).
- Klamath River Renewal Project means Facilities Removal consistent with the terms of the KHSA.
- Lower Klamath Project means the J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Developments and appurtenant works. FERC has stayed the effectiveness of the license for the Lower Klamath Project, pending its final action on the transfer application. The Definite Plan uses the term Lower Klamath Project for ease of reference. See, "Order Granting Stay and Dismissing Request for Rehearing," 163 FERC 61,208 (June 21, 2018). The Definite Plan uses the term "Lower Klamath Project" for ease of reference.

Executive Summary

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EXECUTIVE SUMMARY

The Definite Plan for the Lower Klamath Project prepared by the Klamath River Renewal Corporation (KRRC) implements the Klamath Hydroelectric Settlement Agreement (2010, as amended 2016) (KHSA). The KHSA resolved disputes among numerous parties regarding the relicensing of the Klamath Hydroelectric Project (FERC No. 2082) (KHP). The parties include: U.S. Departments of Interior and Commerce; States of California and Oregon; Humboldt County, California; Yurok and Karuk Tribes; Upper Klamath Water Users Association; conservation and fishing groups; and PacifiCorp, as the licensee for the KHP.

In the KHSA, the parties agreed to a process whereby PacifiCorp and a dam removal entity, now KRRC, would apply to the Federal Energy Regulatory Commission (FERC) to split the KHP into two projects, the KHP and the Lower Klamath Project, and proceed with the actions necessary to achieve dam removal, a free-flowing condition on the Klamath River, and volitional fish passage. The KHP was constructed between 1911 and 1962 and includes eight developments: East Side, West Side, Keno (non-generating), J.C. Boyle, Copco No. 1, Copco No. 2, Fall Creek, and Iron Gate. PacifiCorp operated the KHP under a 50-year license issued by FERC, until the license expired in 2006. PacifiCorp continues to operate the developments under an annual license.

In September 2016, PacifiCorp and KRRC submitted an application to FERC to amend the existing license for the KHP, establish an original license for the Lower Klamath Project consisting of four developments (J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate), and transfer the original license for the Lower Klamath Project to the KRRC. At that time, the KRRC also applied to surrender the license for the Lower Klamath Project, including removal of the four developments. Now that the applications have been filed, KRRC is moving forward with the Definite Plan in accordance with Section 7.2 of the KHSA.

Proposed Action

The KRRC proposes to remove four hydroelectric developments: J.C. Boyle, Copco No. 1, Copco No. 2, Iron Gate, along with appurtenant facilities (the Project). The purpose of the Project is to achieve a free-flowing condition and volitional fish passage in the Klamath River, in the reaches currently occupied by these developments (river miles 193.1 to 234.1). Under the KHSA, the Project consists of measures to remove the four developments; remediate and restore the reservoir sites; avoid or minimize adverse impacts downstream; assure completion of the Project with committed funds; and avoid damages and liabilities for PacifiCorp, the States, and third parties. The Project also proposes a schedule for decommissioning of the developments, which may commence on January 1, 2021 without payment to PacifiCorp for foregone power generation, and subsequent removal.

As outlined in Section 7.2 of the KHSA, KRRC's Definite Plan provides a comprehensive statement of the methods and other specifications to implement the Project. The Definite Plan states the scientific and engineering analyses that support those specifications. The Definite Plan will be a basis for FERC's hearing of the license transfer application for the Lower Klamath Project, subsequent hearing of the surrender

application, reviews by other regulatory agencies with jurisdiction over certain portions of the Project, and public comment. KRRC expects to revise the Definite Plan over the next year, as a result of (1) regulatory hearings; (2) the engagement of a Board of Consultants, required by FERC to provide an independent review, starting in August 2018; and (3) the KRRC's engagement of a general contractor, as well as insurers and similar entities for risk management, by early 2019. The KRRC will propose to incorporate the Definite Plan, in its final form, into all regulatory authorizations, including license surrender, to implement the Project.

Definite Plan Components

The Definite Plan is comprised of nine Sections, seventeen appendices, and numerous figures and tables:

- Section 1 describes the KRRC's objective for the Definite Plan and provides a Project description and background, corrections to elevation and river miles from previous documents, and document organization.
- Section 2 describes the existing features and developments of the four dams and their powerhouses.
- Section 3 provides an explanation of KRRC's proposed program to comply with FERC dam safety requirements and engineering guidelines.
- Section 4 describes the drawdown facilities, process, flows and sediment releases, anticipated downstream effects, monitoring, and adaptive management measures.
- Section 5 describes the removal limits, construction access, staging and disposal areas, removal process, demolition methods and equipment, imported materials, and waste disposal for the four dams and powerhouses.
- Section 6 describes the restoration plan for the former reservoir areas and other areas disturbed by the Project.
- Section 7 describes other features of the Project including proposed aquatic and terrestrial resources measures, long-term road improvements, City of Yreka water supply infrastructure improvements, recreation facilities demolition/restoration, and other resource management plans.
- Section 8 provides the latest understanding of project costs and construction schedules.
- Section 9 provides citations for references used in the Definite Plan document.
- The appendices, figures and tables are listed in the table of contents of the Definite Plan.

Chapter 1: Objectives and Background

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1. OBJECTIVES AND BACKGROUND

1.1 Objectives

This Definite Plan for the Lower Klamath Project (Definite Plan) provides information that the Federal Energy Regulatory Commission (FERC) requires to act on the transfer and surrender applications for the Lower Klamath Project. The Definite Plan serves as a basis for all other regulatory approvals required to implement the Klamath Hydroelectric Settlement Agreement (2010, as amended 2016) (KHSA). The Definite Plan is consistent with the requirements of Section 7.2 of the KHSA.

The Klamath basin's hydrologic system consists of a complex of inter-connected rivers, lakes, marshes, dams, diversions, wildlife refuges, and wilderness areas. Alterations to the natural hydrologic system began in the late 1800s, accelerating in the early 1900s, including water diversions by private water users, water diversions by and to the United States Bureau of Reclamation's (USBR) Klamath Irrigation Project and by hydroelectric developments operated by PacifiCorp.

PacifiCorp's Klamath Hydroelectric Project (KHP) (FERC No. 2082) was constructed between 1911 and 1962. The KHP included eight developments: East Side, West Side, Keno (non-generating), J.C. Boyle, Copco No. 1, Copco No. 2, Fall Creek, and Iron Gate. PacifiCorp operated the KHP under a 50-year license issued by FERC, until the license expired in 2006. PacifiCorp continues to operate the developments under an annual license. In March 2018, FERC amended the KHP license to remove four developments (J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate), which now comprise the Lower Klamath Project. In June 2018, FERC stayed the effective date of the Lower Klamath Project license pending its final decision on the joint license transfer request. As noted in the definitions above, the term "Lower Klamath Project" is used in this document for ease of reference.

The KRRC proposes to decommission and remove the Lower Klamath Project consistent with the terms of the KHSA (the Project). This Definite Plan provides the blue print to achieve this purpose. The Definite Plan delineates the (i) methods to be undertaken to effect dam removal and a timetable for dam removal; (ii) plans for management, removal, and disposal of sediment, debris, and other materials; (iii) plans for site remediation and restoration; (iv) plans for measures to avoid or minimize adverse downstream impacts; (v) a plan for compliance with all applicable laws; (vi) a detailed statement of the estimated costs of dam removal; and (vii) measures to reduce risks of cost overruns, delays, or other impediments to dam removal. The purpose of the Project is to provide for a free-flowing river with volitional fish passage from Keno Dam to the Pacific Ocean.

Figure 1.2-1 provides an overview of the Klamath River watershed and the locations of the four dams. Figure 1.2-2 (Appendix C) provides an overview of the Project area and the major access routes to the area.

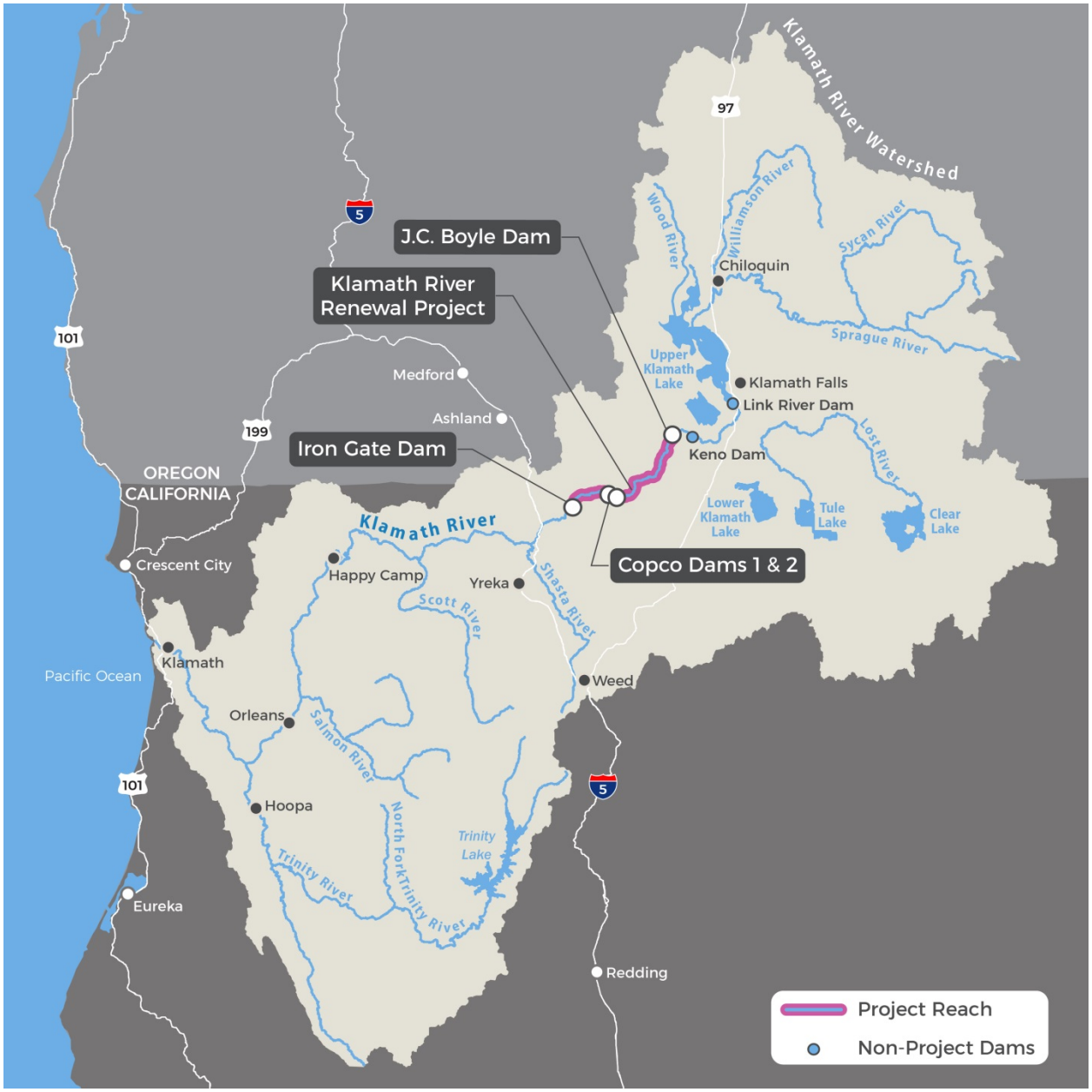

Figure 1.1-1 Klamath River Watershed and Development Locations

Figure 1.1-2 Project Vicinity and Access (Appendix C)

1.2 Project Description

The KRRC proposes a Project which is the physical removal of the four dam developments of the Lower Klamath Project (Iron Gate, Copco No. 1 and No. 2, and J.C. Boyle), consistent with the terms of the KHSA, to achieve at a minimum a free-flowing condition and volitional fish passage. The Project also includes site remediation and restoration, including previously inundated lands, and measures to avoid or minimize adverse downstream impacts, and all associated permitting for such actions. The Project is located on the Klamath River approximately 200 miles from the Pacific Ocean in the states of Oregon and California (see Figure 1.1-1).

The Definite Plan describes "Full Removal" as the proposed Project. Full Removal involves the complete removal of dams, power generation facilities, water intake structures, canals, pipelines, and ancillary buildings, of the Lower Klamath Project. The Definite Plan also describes a "Partial Removal" alternative for purposes of environmental review. Under the Partial Removal alternative, portions of each dam could remain in place, along with ancillary buildings and structures such as powerhouses, foundations, tunnels, and pipes, while still achieving the project purpose to achieve a free-flowing condition and volitional fish passage.

Prior to removal of the hydropower developments, KRRC (through its contractor) will draw down the water surface elevation in each reservoir as low as possible to facilitate accumulated sediment evacuation and to create a dry work area for development removal activities. Section 4 describes the drawdown timing and duration, as well as any infrastructure modifications necessary to facilitate drawdown. In general, drawdown will begin on or about January 1, 2021, and will extend through March 15, 2021.

After drawdown is accomplished, remaining reservoir sediments will be stabilized to the extent feasible, as described in Section 6, and dam and hydropower development removal will begin. Section 5 details the development removal and summarizes pertinent activities, material volumes, truck trips and other construction means and methods information.

Full reservoir area restoration will also be accomplished as described in Section 6, and will begin after drawdown, and extend throughout the year, and possibly extend into the subsequent year. Vegetation establishment could extend several years.

Other key project components include measures to reduce project-related effects to aquatic and terrestrial resources, road and bridge improvements, relocation of the City of Yreka's pipeline across Iron Gate Reservoir and associated diversion facility improvements, demolition of various recreation facilities adjacent to the reservoirs, recreation improvements, downstream flood control improvements, groundwater system improvements, water supply improvements, fish hatchery modification and improvements, and measures to protect identified historic, cultural, and tribal resources. Section 7 summarizes these other project components.

Since the development of the Detailed Plan by USBR as part of the 2012 EIS/R process, the KRRC assessed whether the new information resulted in any changes to the project description as new information became

available. The numbered list below, and further detailed in the referenced sections of this document, summarizes changes or refinements to the project description relative to the Detailed Plan resulting from new information or analyses.

1. Copco No. 1 Dam Modifications: The Detailed Plan (USBR 2012b) included sequential dam notching activities as part of the reservoir drawdown. Due to constructability and schedule risks associated with this activity, it is no longer the preferred plan for demolition of the Copco No. 1 development. The modification activities at Copco No. 1 now include a larger new gate installed on the downstream end of the existing diversion tunnel, to be used as the primary mechanism for reservoir drawdown. Sections 5.2 and 4 provide additional detail on the refined approach and the issues associated with the discarded notching option.
2. Maximum Reservoir Drawdown Rate: Based on the stability analyses and assessments in Appendices D and E, the maximum recommended drawdown rate is 5 feet per day. Section 4 describes associated drawdown plans for each development.
3. Material Quantities: Material quantities have been refined and updated to reflect the latest understanding of the work. Sections 5.2, 5.3, 5.4 and 5.5 summarize material quantities in text and table format for each development.
4. Partial Removal Alternatives: While KRRC proposes full removal at each development location, an alternative for leaving some existing infrastructure is included as an alternative for purposes of environmental review. A list of these alternatives is included in table format at the beginning of Sections 5.2, 5.3, 5.4 and 5.5.
5. Aquatic and Terrestrial Resource Measures: Aquatic and terrestrial resource measures have been refined from the previous AR and TER mitigation measures included in the 2012 EIS/R (USBR and CDFW 2012), and these measures are now included in the project description. The refinement process included collaboration with state and federal fisheries, other biological resource agencies, and tribes, to develop measures that have the highest potential to reduce project-related effects, using the latest science and case studies available. Sections 7.2 and 7.3, with further detail provided in Appendices I and J, summarize the measures.
6. Road and Bridge Improvements: Field and technical assessments concerning road and bridge improvements required for construction access, or to address project-related effects, have updated the understanding of what is required for the Project. Section 5 summarizes refined construction access improvements, while Section 7.4 summarizes road improvements required to address project-related effects.
7. City of Yreka Waterline Relocation: The Detailed Plan (USBR 2012b) included an overhead pipe bridge as the pipeline relocation solution for the Project. Due to ongoing technical assessments and discussions with the City of Yreka, there are three possible options for waterline relocation included in this document. Section 7.5 describes each option that KRRC will analyze for possible implementation.
8. Recreation Facilities Removal and Development Plan: The Project includes demolishing existing recreation facilities and restoring the areas to native habitat, and the Project will provide new

recreation facilities. Section 7.6 provides additional information on the recreation facilities and proposed recreation plan.

9. Downstream Flood Control Improvements: For those habitable structures and river crossings downstream along the Klamath River that the Project will impact, flood control improvements will be constructed to maintain the current level of flood control. See additional information provided in Section 7.7.
10. Fish Hatchery Improvements: The Project will implement the agency-developed hatchery plan to meet agency expectations and requirements associated with fish production. See additional information provided in Section 7.8.
11. Cultural Resources Plan: The Project will comply with all local, state, and federal laws, including those for cultural and tribal resources. Section 7.9 and Appendix L outline the plan for compliance.

To the extent that there is conflicting information in this document relative to the 2012 Detailed Plan, the information in this document supersedes the information in the Detailed Plan.

1.2.1 Project Area and Other Definitions

The Definite Plan and appendices use several terms to describe the location of the Project in its environs. The following summarizes these terms and their uses in the Definite Plan.

- Project area: refers to the area defined by the boundaries of the Lower Klamath Project. Such boundaries encompass lands and waters between the upper reach of J.C. Boyle Reservoir (RM 234.1) and the toe of Iron Gate Dam (RM 193.1). This definition of Project area is used for purposes of the Definite Plan. It may be revised for purposes of environmental review under the National Environmental Policy Act, the California Environmental Quality Act, or other applicable laws, in future procedures.
- Limits of work: refers to the physical extent of on-the-ground construction activities (i.e., demolition and removal) and restoration activities proposed as part of the Project, to occur within the Project area.
- Construction area: refers to areas where construction activities will occur in the Project area.
- Action area: this term has a specific meaning under Section 7(a)(2) of the Endangered Species Act and will be defined in the biological assessment.
- Area of Potential Effects: this term has a specific meaning under the Section 106 of National Historic Preservation Act and will be defined in the appropriate Section 106 document.

1.3 Compliance with Applicable Laws

The following text summarizes the KRRC's plan for compliance with applicable laws and regulations. This portion of the Definite Plan is responsive to the requirements of Section 7.2.2 E of the KHSA.

1.3.1 Federal

Federal Power Act

Pursuant to Sections 7.1.5 and 7.1.7 of the KHSA, on September 23, 2016 PacifiCorp and KRRC filed a "Joint Application for Approval of License Amendment and License Transfer" (Transfer Application) seeking a separate license for the J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate developments (the Lower Klamath Project) and to transfer the license for the Lower Klamath Project from PacifiCorp to KRRC. Concurrently with this filing, the KRRC filed an Application for Surrender of License for Major Project and Removal of Project Works (Surrender Application) seeking FERC's approval of an application to surrender the license for the Lower Klamath Project and to achieve, by implementation of the Definite Plan, a free-flowing condition and volitional fish passage through the portions of the Klamath River that are currently occupied by the Lower Klamath Project.

FERC noticed the Transfer Application and the Surrender Application on November 10, 2016. FERC initiated informal consultation with: (a) the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) under Section 7 of the Endangered Species Act and the joint agency implementing regulations at 50 C.F.R. Part 402; (b) NMFS under Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations at 50 C.F.R. § 600.920; and (c) the California and Oregon State Historic Preservation Officers, as required by Section 106 of the National Historic Preservation Act, and the implementing regulations of the Advisory Council on Historic Preservation at 36 C.F.R. Part 800. FERC also designated PacifiCorp and the KRRC as the Commission's non-federal representatives for carrying out informal consultation, pursuant to Section 7 of the Endangered Species Act, Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act, and Section 106 of the National Historic Preservation Act and the Advisory Council's regulations at 36 C.F.R. § 800.2(c)(4). KRRC is undertaking such consultations as the non-federal representative.

On March 15, 2018, FERC amended the KHP license. It created the Lower Klamath Project, consisting of J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Developments. On June 21, 2018, FERC stayed the effectiveness of the license for the Lower Klamath Project, pending its final action on the transfer application. The Definite Plan uses the term Lower Klamath Project for ease of reference.

Transfer Application

In making its decision on the Transfer Application, FERC will evaluate and determine whether KRRC is qualified to be a licensee and whether the transfer of the License from PacifiCorp to KRRC is in the public interest (18 C.F.R. § 9.3). FERC may impose conditions relating to the KRRC's legal, technical, and financial capacity to fulfill its responsibilities as a licensee. KRRC will accept the license subject to Section 7.1.4 of

the KHSA, which provides that "[b]efore the FERC license transfer to the DRE [Dam Removal Entity] will become effective, the DRE must demonstrate to PacifiCorp's and the States' reasonable satisfaction that the DRE has met the obligations in KHSA Appendix L and the following conditions:

A. The DRE has provided Notices required under Section 7.2.1.B of the KHSA;

B. The DRE has met the requirements of Section 7.1.3 and Appendix L of the KHSA;

C. PacifiCorp and the States agree that the DRE has made sufficient and Timely progress in obtaining necessary permits and approvals to effectuate Facilities Removal;

D. The DRE, the States, and PacifiCorp are assured that sufficient funding is available to carry out Facilities Removal;

E. The DRE, the States, and PacifiCorp are each assured that their respective risks associated with Facilities Removal have been sufficiently mitigated consistent with Appendix L of the KHSA;

F. The DRE, the States, and PacifiCorp agree that no order of a court or FERC is in effect that would prevent Facilities Removal;

G. The DRE and PacifiCorp have executed documents conveying the property and rights necessary to carry out Facilities Removal; and

H. The DRE accepts license transfer under the conditions specified by FERC in its order approving transfer."

If the conditions of transfer are acceptable to KRRC and satisfy the above requirements to the reasonable satisfaction of PacifiCorp and the States, KRRC will accept the license and comply with all terms and conditions of the license and the transfer order in connection with its implementation of the Definite Plan.

Surrender Application

In taking action on the Surrender Application, FERC will evaluate and determine whether surrender and decommissioning are in the public interest. It has the authority to impose conditions necessary to protect the public interest in connection with project decommissioning and, as in this case, dam removal. However, there is generally no public interest in keeping a decommissioned project under the Commission's jurisdiction for an extended time. Surrender is not effective upon the issuance of a surrender order, but when the licensee fulfills all the conditions of the surrender order. KRRC expects that implementation of the Definite Plan (as proposed) is in the public interest and does not anticipate that FERC will impose any conditions that conflict with, or are inconsistent with the Definite Plan. Additionally, Section 7.1.8 of the KHSA states: "The DRE will perform Facilities Removal in accordance with the Definite Plan, as approved and as may be modified by the FERC surrender order and other applicable Regulatory Approvals."

On October 5, 2017, FERC issued a directive to PacifiCorp and KRRC to convene an Independent Board of Consultants (BOC) to review and assess various aspects of the proposed dam removal process. FERC approved the BOC on May 22, 2018. The BOC is a six-member fully independent body that includes three members with experience in civil engineering (with specialized experience in dam construction and removal of both concrete and embankment dams, hydrology, hydraulics, and stream diversion) and geotechnical engineering. In addition, the BOC includes members with experience in aquatic and terrestrial biology, and a heavy civil construction cost estimator with experience in dam removal and restoration activities. KRRC anticipates that the BOC will commence its review of the Definite Plan in August of 2018. Initially, the BOC is called upon to review and provide recommendations regarding the adequacy of available funding and reasonableness of updated cost estimates for the most probable cost and maximum cost for implementation of the Definite Plan. The BOC is also called upon to review and provide recommendations regarding the adequacy of amounts and types of insurance coverage and bonding arrangements for dam removal, and to review and provide recommendations regarding other technical aspects of the Definite Plan to better define and understand the plans, schedules, specifications, staging, and sequencing for taking on the responsibilities for dam removal and decommissioning of the Lower Klamath Project. KRRC will incorporate the BOC recommendations into a revised Definite Plan and will provide FERC with a greater level of detail of the various project elements proposed in the Definite Plan. These recommendations will build upon and improve the Definite Plan and assist KRRC in maintaining compliance with the Federal Power Act, and in particular, FERC dam safety requirements and engineering guidelines.

FERC's decision on the Surrender Application requires compliance with additional regulatory requirements. Section 7.1.4 of the KHSA requires that before the FERC license transfer to KRRC will become effective, the KRRC must demonstrate to PacifiCorp's and the States' reasonable satisfaction that the KRRC has made sufficient and timely progress in obtaining necessary permits and approvals to effectuate Facilities Removal. As a means to provide such assurances to PacifiCorp and the States with respect to the following requirements, KRRC will pursue a proactive approach with each agency to develop draft terms and conditions of approval that are consistent with the Definite Plan.

National Environmental Policy Act (NEPA):

FERC will act as lead agency for purposes of securing compliance with NEPA. In order to provide FERC sufficient information to undertake environmental review, KRRC provided FERC as part of its Surrender Application "Exhibit E" (Environmental Report) comprised of: the Klamath Facilities Removal Environmental Impact Statement/Report (2012), published by the U.S. Department of Interior and California Department of Fish and Wildlife; the Klamath Dam Removal Overview Report for the Secretary of the Interior: An Assessment of Science and Technical Information (2013); the Detailed Plan for Dam Removal – Klamath River Dams, Klamath Hydroelectric Project, FERC License No. 2082, Oregon – California (2012); and a contact list for property owners pursuant to 18 C.F.R. § 4.32(a)(3). This "Exhibit E" information is supplemented by this Definite Plan (updating, replacing and superseding the 2012 Detailed Plan) and KRRC's responses to FERC's July 14, 2017 Request for Additional Information. KRRC intends to further supplement Exhibit E with the Draft Environmental Impact Report (EIR) being prepared by the California State Water Resources Control Board (SWRCB) in compliance with the California Environmental Quality Act (CEQA). The plan and schedule approved by FERC for the BOC states that if the Commission approves the

transfer, FERC will issue a public notice of the surrender application inviting comments, interventions, and protests. Based on any comments received, FERC will then determine if there is a need to further supplement the environmental record.

Section 401 of the Clean Water Act (CWA):

Activities that may result in any discharge into navigable waters require certification from the State in which the discharge will originate that any such discharge will comply with the applicable provisions of the Clean Water Act (CWA) (i.e., effluent limitations, other limitations necessary to assure compliance with provisions of the CWA, and appropriate state law requirements). No federal license or permit shall be granted until the water quality certification required by Section 401 of the CWA has been obtained from the state agency authorized to administer the CWA. Appropriate conditions of a water quality certification as determined by such state agency are binding upon FERC, and FERC must include them in the surrender order. See generally, PUD No. 1 of Jefferson City. v. Washington Dep't of Ecology, 511 U.S. 700 (1994).

KRRC has requested a water quality certification from the SWRCB and from the Oregon Department of Environmental Quality (ODEQ). Both agencies have released draft certifications for public comment. Before it can issue a water quality certification, the SWRCB, as lead agency in California, must also comply with the requirements of CEQA.

On May 23, 2018, ODEQ issued a proposed water quality certification identifying the requirements of state and federal law that are applicable to the certification. The proposed certification states that the Project, as proposed, will comply with the applicable provisions of Sections 301, 302, 303, 306 and 307 of the Clean Water Act, Oregon Administrative Rules, Chapter 340, Division 41 and other appropriate requirements of state law, provided KRRC conducts activities as proposed and implements the Section 401 conditions proposed in the certification.

On June 7, 2018, SWRCB issued a draft water quality certification identifying the requirements of state and federal law that are applicable to the certification. The draft certification states that the Project, as proposed, will comply with Sections 301, 302, 303, 306, and 307 of the CWA, and with applicable requirements of California State law, provided KRRC conducts activities as proposed and implements the Section 401 conditions proposed in the certification.

Exhibit E to KRRC's Surrender Application and the Definite Plan, as augmented by additional information that was requested and provided to the SWRCB, provide a basis for CEQA compliance. SWRCB is developing a draft EIR that will be released for public review and comment in 2018. Prior to drafting final conditions for certification and taking a final action on the certification application, SWRCB will consider public comments, issue and certify a final EIR, and make relevant CEQA findings. KRRC will submit comments on the Draft EIR, as appropriate. As noted above, KRRC will also file the Final EIR with FERC as a supplement to Exhibit E to KRRC's Surrender Application.

Endangered Species Act and Magnuson-Stevens Fishery Conservation and Management Act:

KRRC is serving as FERC's designated non-federal representative for carrying out informal consultation with the USFWS and NMFS under Section 7 of the Endangered Species Act and with NMFS under Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act. The KRRC is working informally with NMFS and USFWS to confirm species lists, the definition of the proposed action, identification of the Action Area, effects analysis methods, environmental baseline conditions, and to identify the best available science. These compliance efforts are ongoing. The complete list of terrestrial federal and state-listed, proposed, candidate, and petitioned for listing species that are known to occur or that may be present in the Action area is found in Appendix J. Identification of critical habitat and essential fish habitat that may be present in the Project Area will be described in a Biological Assessment that KRRC will submit to USFWS and NMFS in 2018.

KRRC anticipates that any measures that may be determined by the U.S. Fish and Wildlife Service and NMFS to comply with the Endangered Species Act and the Magnuson-Stevens Fishery Conservation and Management Act will be consistent with the Definite Plan and that FERC will include them in the surrender order. Sections 6, 7.2, 7.3, 7.8, and Appendices H, I, and J of the Definite Plan are responsive to these regulatory requirements.

National Historic Preservation Act

KRRC is serving as FERC's designated non-federal representative for carrying out consultation with the California and Oregon State Historic Preservation Officers (SHPOs), Tribal Historic Preservation Officers (THPOs), and other interested parties as required by Section 106 of the National Historic Preservation Act (NHPA). These efforts are ongoing. The information provided in Appendix L discusses efforts to comply the NHPA and its regulatory requirements.

Native American Graves Protection and Repatriation Act

The Native American Graves Protection and Repatriation Act (NAGPRA), 32 U.S.C.§ 3001, et seq. establishes the ownership of cultural items excavated or discovered on federal or tribal land lies with the lineal descendants and culturally affiliated Indian tribes and Native Hawaiian organizations and, among other things, establishes procedures for the inadvertent discovery or planned excavation of Native American cultural items on federal or tribal lands. Information on compliance with NAGPRA is included in Appendix L.

Section 404 of CWA

Implementation of the Definite Plan will result in fill and/or dredging of jurisdictional waters of the United States, including wetlands, within and adjacent to the Klamath River during construction activities. These activities will require a Section 404 individual permit from the United States Army Corps of Engineers (USACE).

KRRC representatives attended a pre-application meeting with the USACE on May 25, 2017, and KRRC is providing periodic informal updates to the USACE's assigned project manager. At this juncture, USACE has

not identified any issues that give rise to any concern that the USACE cannot issue an individual permit on terms and conditions that are consistent with the Definite Plan. KRRC believes that the preferred and best means to achieve this result is to continue pre-application meetings and discussion with the USACE, and to review a draft application with the USACE when KRRC is ready to do so. The application may be available for submittal in mid-to-late 2018, although KRRC has not established a firm date for a submittal. Issuance of a Section 404 individual permit by the USACE is contingent upon the issuance of the 401 water quality certifications, completing the Section 106 consultation, as well as the completion of Section 7 consultation with USFWS and NMFS. KRRC will pursue a proactive approach with USACE and seek to develop draft terms and conditions of approval that are consistent with the Definite Plan and can be shared with the States and PacifiCorp.

Section 402 of CWA

Implementation of the Definite Plan will require coverage under National Pollutant Discharge Elimination System (NPDES) Construction Stormwater General Permits for construction-related stormwater discharges to surface waters in California and Oregon. NPDES permit applications for general construction stormwater discharges are required to be submitted at least 30 days prior to commencement of land disturbance. The selected dam removal construction contractor will likely prepare the applications by February of the year prior to reservoir drawdown, with submission to each state agency planned for the end of March in the year that pre-drawdown construction activities are planned to occur. KRRC does not anticipate any significant issues or concerns in connection with securing and complying with these permits.

Section 10 of the Rivers and Harbors Act

Section 10 of the Rivers and Harbors Act prohibits the obstruction or alteration of navigable waters without a permit from the USACE. KRRC will monitor whether any project components require a Section 10 permit, and will obtain such permit from the USACE as needed.

Wild and Scenic Rivers Act

The National Park Service designates two segments of the Klamath River as Wild and Scenic Rivers (WSRs), one in Oregon and one in California. The Oregon segment commences 0.25 miles downstream of the J.C. Boyle Powerhouse and flows 11 miles to the Oregon/California state line. The California section commences 3,600 feet downstream of Iron Gate Dam and ends 189 miles later at its confluence with the Pacific Ocean.

A Section 7(a) determination of the WSRA for a proposed project is required if there could be a potential to unreasonably diminish the scenic, recreational, fish, or wildlife values present within a designated river from its date of designation. The National Park Service will develop a determination following the evaluation procedure under the direct and adverse effects standard for existing projects licensed by FERC, or other federally assisted projects inside the designated river (Section 7(a)). Permits, such as the 404 permit, may not be issued until any adverse effects are eliminated. KRRC has initiated discussions with the National Park Service and will provide requested documentation in 2018.

1.3.2 State and Local Permits

The Federal Power Act, 16 U.S.C. 791 et seq. vests FERC with broad authority to regulate hydropower facilities and establishes that state and local regulation of matters to be decided by FERC with respect to such hydropower facilities is preempted by operation of the Supremacy Clause of the U.S. Constitution. *California v. FERC*, 495 U.S. 490 (1990); *First Iowa Hydro-Electric Cooperative v. Federal Power Commission*, 328 U.S. 152 (1946). This preemptive authority extends to license surrender and project decommissioning decisions. For example, in the case of *PacifiCorp*, 115 FERC ¶ 61,194 (2006), FERC ruled:

> *It is well-established that the FPA preempts all state and local law concerning hydroelectric licensing apart from those adjudicating proprietary water rights. Furthermore, since the determination of whether a license should be surrendered is an action taken pursuant to the FPA, and the Commission retains jurisdiction over the Project until the license surrender is accepted and becomes effective, federal preemption applies to a license surrender.*

However, in this case, FERC stated the licensee has a responsibility to work with state and local jurisdictions and address state and local requirements in an appropriate manner:

> *We prefer for our licensees to be good citizens of the communities in which projects are located, and thus to comply with state and local requirements, where possible. However, to the extent that state or local regulations make compliance with our orders impossible or unduly difficult, we will conclude that such regulations are preempted.*

Consistent with FERC's preference, KRRC will address state and local interests by reaching out to state and local agencies and pursuing mutually acceptable means and methods to address their interests in the FERC process.

The first step in this process has been to meet and consult with state and local jurisdictions to develop a better understanding of their interests and concerns. Outside of general public meetings, KRRC has held numerous working group workshops to discuss aquatic resources, terrestrial resources, cultural resources, and the restoration plan. Applicable regulatory agencies and other stakeholders attended these workshops.

Based on this outreach and the information obtained from state and local jurisdictions and other stakeholders, KRRC has made changes or modifications to the Definite Plan to address these agencies' and stakeholders' interests and concerns. Changes that fall under this category include revisions to the aquatic resource measures, terrestrial resource measures, the restoration plan, and the fish hatchery plan. Specifically, this includes Sections 6, 7.2, 7.3, 7.8, and Appendices H, I, and J. This outreach and iterative process is ongoing and is "business as usual" for purposes of the development and implementation of the Definite Plan.

KRRC also understands that in a given instance, the specific actions to be taken, or avoided, to address state and local regulatory requirements may need to be documented outside of the Definite Plan and presented to FERC as recommended conditions of approval. In such circumstances, KRRC proposes that

KRRC and the relevant state or local agency enter into an agreement to submit joint recommendations to FERC regarding terms and conditions that should be adopted by FERC as conditions of approval.

The parameters for such agreements are limited only by the requirements of applicable law, consistency with the KHSA, and the requirements that the KHSA established for the Definite Plan. The factual nexus of any recommended condition to implementation of the Definite Plan, as well as the reasonableness of any recommendations that would be contained in the agreement, are further considerations just as they would be in any regulatory context. These "good neighbor" agreements with state and/or local agencies would specify reasonable measures that the parties agree are appropriate to recommend that would address the state and local regulatory requirements that are otherwise preempted by the Federal Power Act. These agreements will commit both parties to propose and advocate for these recommended measures to FERC in the surrender proceeding.

California

As noted above, KRRC has requested a water quality certification from the SWRCB pursuant to Section 401 of the Clean Water Act. Before the SWRCB can issue a water quality certification, the SWRCB must comply with the requirements of CEQA. As part of CEQA, SWRCB must also consult with California Native American tribes pursuant to Assembly Bill 52 (AB 52). SWRCB's CEQA review and AB 52 consultation remain ongoing.

California state law requirements preempted by FERC's authority under the FPA include California Fish and Game Code Sections 1602 and 2081. Implementation of the Definite Plan may require local permits and approvals for construction traffic, road maintenance, grading, minor road widening, tree trimming and similar activities at various locations. KRRC will first seek to address these state and local interests in the context of its ongoing outreach efforts through incorporation of measures included in the Definite Plan. Should there be outstanding issues that otherwise would be addressed through state and local permitting outside of the FERC context, KRRC will pursue "good neighbor" agreements with the jurisdictions that view this mechanism as an appropriate and effective means to address their interests. In the event that these state and local requirements are not addressed in the FERC Surrender Order and such requirements are deemed to not be preempted by the Federal Power Act, KRRC's contractor will be instructed to apply for any additional local permits that may be required at the appropriate time.

Oregon

As noted above, KRRC has requested a water quality certification from the ODEQ under Section 401 of the Clean Water Act. In connection with this pending request, KRRC filed Findings In Support Of Land Use Compatibility For Removal Of John C. Boyle Dam "[a]n exhibit that … includes land use compatibility findings for the activity prepared by the local planning jurisdiction (OAR 340-048-0020(2)(i)(A))" with ODEQ on May 10, 2018 to demonstrate that the Project is compatible with the applicable comprehensive plan and land use regulations of Klamath County. ODEQ found the material submitted by KRRC in lieu of a Land Use Compatibility Statement (LUCS) from Klamath County adequately identifies and addresses specific provisions of local land use and the implementing regulations applicable to the proposed activity and

demonstrates project conformity with local land use regulations. KRRC will continue to consult with Klamath County as a means to fully and satisfactorily address Klamath County's interests through the FERC process.

Oregon state law requirements preempted by FERC's authority under the FPA include Oregon Fill/Removal permit from Oregon Department of State Lands and the Oregon Fish Passage Approval. Implementation of the Definite Plan may require local permits and approvals for construction traffic, road maintenance, grading, minor road widening, tree trimming and similar activities at various locations. KRRC will first seek to address these state and local interests in the context of its ongoing outreach efforts through incorporation of measures included in the Definite Plan. Should there be outstanding issues that otherwise would be addressed through state and local permitting outside of the FERC context, KRRC will pursue "good neighbor" agreements with the jurisdictions that view this mechanism an appropriate and effective means to address their interests. In the event that FERC does not address these requirements in the surrender order and such requirements are deemed to not be preempted by the Federal Power Act, KRRC's contractor will be instructed to apply for any additional permits that may be required.

1.3.3 Further Consultation

This Definite Plan includes many measures that, as of the date of publication, are subject to further consultation. As non-federal representative under certain laws, and under the good neighbor policy described in Section 1.3.2, KRRC will undertake further consultation in an effort to reach agreements on measures that will protect resources affected by the Project. Such consultation will include the following entities:

- Federal and state agencies which have permitting or regulatory jurisdiction over the Project, including USFWS, NMFS, USACE, and the SWRCB. Consultations with these agencies will be complete prior to FERC's decision on the surrender application.
- KRRC will also consult with a number of state agencies, including ODFW and CDFW, that may not have jurisdiction over the Project; however, KRRC understands that these state agencies are important stakeholders in the process.
- Federally recognized tribes in the Klamath Basin, specifically, Cher'Ae Heights of the Trinidad Rancheria, Hoopa Valley Tribe, Karuk Tribe, Klamath Tribes, Modoc Tribe of Oklahoma, Quartz Valley Indian Reservation, and Yurok Tribe; and other tribes, including Shasta Nation and Shasta Indian Nation pursuant to Section 106 of the NHPA and California AB 52. These consultations will be complete prior to issuance of the FERC surrender and SWRCB decisions, respectfully.
- Siskiyou, Del Norte, and Humboldt Counties, California; and Klamath County, Oregon.
- City of Yreka, California.
- Other consulting parties designated or required under applicable procedures.

1.4 Elevations and Measurement Corrections

Previous documents and reports prepared for the project developments used older datum sources and outdated measurement techniques. When applicable, KRRC has updated numbers cited in this report. Some project record drawings note elevations in "project datum", which is the National Geodetic Vertical Datum of 1929 (NGVD29). Elevations were converted from project datum to North American Vertical Datum of 1988 (NAVD88) according to Table 1.4-1. In addition, some older documents provide elevations in "local datum" (a datum relevant to only specific locations in the Lower Klamath Project), and elevations were converted from local datum to NAVD88 according to Table 1.4-1.

River miles (the distance a river feature or location is demarked from the Pacific Ocean in river miles (RMs)) were previously incorrectly calculated; the river mile locations noted in this report have also been updated using a river route that aligns with the channel thalweg shown in the 2018 bathymetry surveys of Iron Gate Reservoir and Copco Lake. The river route in J.C, Boyle Reservoir will be updated in summer 2018 based on the latest bathymetric survey of that reservoir. Table 1.4-2 provides a sampling of river mile conversions from those noted in the Detailed Plan (U.S. Bureau of Reclamation (USBR) 2012). KRRC has also used GIS to update areas and acreages previously reported.

Table 1.4-1 Elevation Conversion Factors

Location	From project datum (NGVD29) to NAVD88	From local datum[1] to NAVD88
J.C. Boyle	+ 3.71 feet	
Copco No. 1	+ 3.48 feet	+ 2414.48 feet
Copco No. 2	+ 3.48 feet	+2214.48 feet
Iron Gate	+ 3.33 feet	

Note:

1. Local datums were used during design and construction of Copco No. 1 and No. 2

Table 1.4-2 River Mile Comparison

Location	River Mile in Detailed Plan	River Mile in Definite Plan
Upstream end of J.C. Boyle Reservoir	228	234.1
J.C. Boyle Dam	224.7	230.6
J.C. Boyle Powerhouse	220	226.0
Upstream end of Copco Lake	204	209.0
Copco No. 1 Dam	198	202.2
Copco No. 2 Dam	199	201.8
Copco No. 2 Powerhouse	196	200.3
Upstream end of Iron Gate Reservoir	197	200.3

Location	River Mile in Detailed Plan	River Mile in Definite Plan
Iron Gate Dam	190	193.1

1.5 Document Organization

The document is organized into the following sections:

- **Section 1 –Objectives & Background**: describes the objectives of the Definite Plan, background on the Project, corrections to elevations and river miles from previous documents, and document organization.
- **Section 2 – Existing Feature Descriptions**: describes the existing features and developments of the four dams and their powerhouses.
- **Section 3 – FERC Compliance & Dam Safety**: provides an explanation of KRRC's proposed program to comply with FERC dam safety requirements and engineering guidelines
- **Section 4 – Reservoir Drawdown & Diversion Plan**: describes the drawdown facilities, process, flows and sediment releases, anticipated downstream effects, monitoring, and adaptive management measures.
- **Section 5 – Dam Removal Approach**: describes the removal limits, construction access, staging and disposal areas, removal process, demolition methods and equipment, imported materials, and waste disposal for the four dams and powerhouses.
- **Section 6 – Reservoir and Other Restoration**: describes the restoration plan for the former reservoir areas and other areas disturbed by the Project.
- **Section 7 – Other Project Components**: describes other features of the Project including proposed aquatic and terrestrial resources measures, long-term road improvements, Yreka water supply improvements, recreation facilities demolition/restoration, and other resource management plans.
- **Section 8 – Project Costs and Schedule**: provides the latest understanding of project costs and construction schedules
- **Section 9 – References**: provides citations for references used in the document.
- **Figures**: the document includes figures throughout text as well as in two appendices. Figures throughout the document are numbered according to their respective subsection and then sequentially. Figures that can be found in an appendix are noted after the figure number with a letter in parentheses. For example, Figure 2.1-2 is associated with the text of Section 2.1 and can be found in the text; whereas, Figure 2.1-3 (B) can be found in Appendix B.
  - Appendix B includes figures designated as Critical Energy Infrastructure Information (CEII) that is not generally available to the public. Information in Appendix B will only be provided to specific agencies and individuals according to FERC rules and regulations.
  - Appendix C includes figures that do not contain CEII.

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Chapter 2: Existing Feature Descriptions

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2. EXISTING FEATURE DESCRIPTIONS

This section describes the four dam developments (Iron Gate, Copco No. 1 and No. 2, and J.C. Boyle) KRRC will remove as part of the Project. The purpose of this description is to support our analyses, described in later sections, and to support the surrender application. The April 2015 Supporting Technical Information Documents prepared by PacifiCorp for FERC provide additional detail on the four developments.

2.1 J.C. Boyle Dam and Powerhouse

The J.C. Boyle Development (originally known as the Big Bend Development) consists of a reservoir, combination embankment and concrete gravity dam, gated spillway, diversion culvert, water conveyance system, and powerhouse located on the Klamath River between RM 234.1 and RM 226.0, in Klamath County, Oregon. Refer to Figure 2.1-1 (C) for plan views of these features.

Figure 2.1-1 J.C. Boyle Dam Existing Features (Appendix C)

California-Oregon Power Company completed J.C. Boyle Dam in 1958 at RM 203.6, and is downstream of Keno Dam and upstream of Copco No. 1 Dam. The primary purpose of the development is to generate hydroelectric power. Structures at the site include an office building (known as the Red Barn), maintenance shop, fire protection building, communications building, two occupied PacifiCorp-owned residences near the dam, and a large warehouse near the powerhouse.

2.1.1 Reservoir

J.C. Boyle Dam impounds a narrow reservoir (J.C. Boyle Reservoir) of 350 acres based on 2010 aerial imagery (Woolpert 2010), and according to a 2003 bathymetric survey (Eilers and Gubala 2003), provides approximately 2,267 acre-feet of total storage capacity at reservoir water surface (RWS) elevation 3797.2.[1] The maximum and minimum operating levels are between RWS elevations 3796.7 and 3791.7, a vertical operating range of 5 feet, although the reservoir is normally maintained at RWS elevation 3796.7, or 0.5 foot below the top of the spillway gates.

2.1.2 Dam, Spillway, and Diversion Culverts

The dam is composed of an earthen embankment section, fish ladder, spillway and diversion culverts, intake to the powerhouse, and concrete gravity section (from right abutment to left abutment, looking downstream). Figure 2.1-2 shows the dam.

[1] All elevations in this Definite Plan are in NAVD88 vertical datum. Previously reported elevations were in project datum. See Table 1.3-1 for conversion factors.



Credit: River Design Group

Figure 2.1-2 J.C. Boyle Dam

The earthfill embankment portion is 68 feet tall (on the dam axis at its maximum height above the original streambed elevation 3735.7) with a 15-foot-wide crest and a crest length of 413.5 feet at elevation 3803.7 (Figure 2.1-3 (B)). The zoned embankment has a central impervious clay core flanked by upstream and downstream shells composed of compacted sand and gravel, with a downstream filter blanket. The upstream face above elevation 3783.7 has a 2½H:1V slope with a 3-foot-thick riprap layer, and a 3H:1V slope below elevation 3783.7. The downstream face has a 2½H:1V slope, with a 2-foot-thick riprap layer below approximately elevation 3771.7. The dam includes a 3-foot-high concrete cutoff wall along the bedrock foundation about 7 feet upstream of the dam axis.

Figure 2.1-3 Cross Section of J.C. Boyle Dam (Appendix B)

The concrete portion of the dam is 279 feet long and from right to left (looking downstream) is composed of a 117-foot-long spillway section, a 48-foot-long intake structure, and a 114-foot-long concrete gravity section with a maximum height of 23 feet (Figure 2.1-4 (B)).

Figure 2.1-4 Elevation of J.C. Boyle Spillway and Diversion Culverts (Appendix B)

The spillway section is a concrete gravity overflow structure with three 36-foot-wide by 12-foot-high radial gates and upstream stoplog slots (Figure 2.1-5 (B)). The spillway crest is at elevation 3785.2, with the top of gates at elevation 3797.2 (0.5 feet above the normal operating level). The spillway includes a traveling gate hoist for operation of the spillway gates. The spillway bays discharge onto a 13-foot-long concrete apron

stepped at three elevations generally following the profile of the bedrock surface. Below the apron is a vertical drop of 15 feet to the discharge channel, which was excavated in rock. The discharge channel is generally unlined. The estimated spillway discharge capacity at RWS elevation 3796.7 with all three gates open is 15,400 cubic feet per second (cfs).

Figure 2.1-5 Cross Section of J.C. Boyle Dam Spillway (Appendix B)

A concrete box culvert with two 9.5- by 10-foot bays is located beneath the center and right spillway gates at invert elevation 3755.2 (30 feet below the spillway crest, as shown in Figure B2.1-4 (B)). This feature was used for diversion during construction of the dam, and has been sealed with concrete stoplogs at the upstream end. Approach and outlet channels for the diversion culvert were excavated in bedrock.

2.1.3 Intake, Fish Screens, and Fish Ladder

The intake structure is located to the left of the spillway and consists of a 40-foot-high reinforced concrete tower (Figure 2.1-6). It has four approximately 11-foot by 37-foot openings to the reservoir, each of which has a steel trash rack followed by a stoplog slot and a vertical traveling fish screen (with 0.25-inch-square openings) with high pressure spray cleaners. Spray water along with any screened fish are collected and diverted downstream of the dam through a 340-foot-long, 24-inch-diameter fish screen bypass pipe, which provides approximately 20 cfs to the Klamath River below the dam. A fabricated metal building was added to the intake structure in 1989. Downstream of the traveling fish screens is the entrance to a 14-foot-diameter steel pipeline. The upstream end of the 14-foot pipeline includes a wheel-mounted slide gate and hoist, with upstream stoplog slots, for operation and maintenance purposes.

A concrete pool and weir fish ladder located along the abutment wall between the embankment and concrete sections provides upstream fish passage at the dam. The fish ladder is approximately 569 feet long with 63 pools. A 24-inch slide gate regulates reservoir releases to the fish ladder, and the fishway operates over a head range of approximately 61 to 66 feet.



Figure 2.1-6 J.C. Boyle Intake Structure

2.1.4 Water Conveyance to Powerhouse

A water conveyance system connects the dam to the powerhouse and has a total length of 2.56 miles. The conveyance system from upstream to downstream consists of a steel pipeline, a headgate, a flume, a forebay, a tunnel, and 2 penstocks connecting to the powerhouse.

From the intake structure at the dam, the water flows through a 638–foot-long, 14-foot-diameter steel pipeline, supported on steel frames where it spans the Klamath River. The downstream end of the pipeline is equipped with a 14- by 14-foot automated fixed-wheel gate within a concrete headgate structure completed in 2002, which discharges into an open concrete-lined flume (the power canal).

The power canal is nearly 2.2 miles long and located along a bench cut in the slope of the river canyon (Figure 2.1-7). Depending on the terrain, the power canal either has walls on the down-slope side only or on both the down-slope and up-slope sides. The power canal is a concrete flume approximately 17 feet wide and 12 feet high, with shotcrete applied to the canyon walls where exposed. It has overflow structures at the upstream end (consisting of a siphon pipe) and at the downstream forebay (consisting of a gated overflow weir).



Figure 2.1-7 J.C. Boyle Power Canal (left) and Klamath River Bypass Reach (right)

The forebay is a somewhat enlarged area at the end of the power canal that connects to the tunnel, the next downstream component in the water conveyance system. The forebay has an overflow or spillway equipped with two float-operated automatic spill gates, which release water from the power canal during a hydraulic surge following any load rejection at the powerhouse. The released water discharges through a short,

concrete-lined chute and returns to the bypass reach of the Klamath River (between the dam and powerhouse) via a large eroded channel (or scour hole) in the hillside (Figure 2.1-8). A forebay sluiceway pipe has been abandoned in place.



Figure 2.1-8 Forebay Overflow Chute and Upper Portion of Scour Hole

A 60-foot-wide and 17.9-foot-high trash rack with 2-inch bar spacing draws water for power generation from the forebay (Figure 2.1-9) into a 15.5-foot-diameter, concrete-lined, horseshoe-shaped tunnel, which is 1,644 feet long. The last 57-foot length of the tunnel before the downstream portal is steel-lined with the liner bifurcating into two 10.5-foot-diameter steel penstocks. A concrete anchor block encases the bifurcation and includes a 78-foot-high, 30-foot-diameter steel surge tank.



Figure 2.1-9 J.C. Boyle Forebay and Tunnel Trash Rack (rear)

Descending to the powerhouse, the penstocks reduce in two steps to 9 feet in diameter. Ring girders seated on concrete footings support each 956-foot-long penstock (Figure 2.1-10). The downstream end of each penstock includes a 108-inch-diameter butterfly valve.



Figure 2.1-10 J.C. Boyle Penstocks

2.1.5 Powerhouse

A conventional outdoor-type reinforced concrete peaking powerhouse (Figure 2.1-11) is located on the right bank of the river and approximately 4.6 river miles downstream of the dam, at RM 226.0, and is the largest power generating development in the Lower Klamath Project. The two turbines are vertical-shaft, Francis-type units with a total rated discharge capacity of 2,850 cfs. The turbines are rated at 75,700 horsepower (hp) for Unit 1 (replaced in 1994) and 63,900 hp for Unit 2, with a net head of 440 feet. The system provides no bypass capacity. Four draft tube bulkhead gates and slots, with two hoists, are provided downstream of the units. A single 150-ton gantry crane is currently located at the J.C. Boyle powerhouse, but can also be used at the Iron Gate powerhouse.



Figure 2.1-11 J.C. Boyle Powerhouse

The generators are rated at 53 megavolt-amperes (MVA) for Unit 1, with a 0.95 power factor (50 megawatts (MW)), and 50 MVA for Unit 2, with a 0.95 power factor (48 MW). The power from the powerhouse is transmitted a very short distance to the adjoining J.C. Boyle substation. Two three-phase transformers step up the generator voltage for transmission interconnection. Line No. 58 (to Lone Pine) and Line No. 59 (to Klamath Falls) extend from the J.C. Boyle substation to a line tie. There is also a third line that pre-dates the substation. The 0.24-mile 69-kV transmission line (PacifiCorp Line No. 98) connects the J.C. Boyle powerhouse to a tap point on PacifiCorp's Line No. 18, but based on field observation and aerial photos this line appears to have been removed.

2.1.6 Site Access

Oregon Route 66 (OR66, Green Springs Highway) and Topsy Grade Road provide site access via a network of unpaved project access roads. A small timber bridge crosses the Klamath River downstream of the dam.

2.1.7 Recreation Facilities

Recreation facilities include Topsy Campground and boat launch (managed by the Bureau of Land Management, BLM), Pioneer Park east and west units and boat launches (managed by PacifiCorp), Spring

Island whitewater boating launch (managed by BLM), and numerous smaller dispersed shoreline recreation sites, including two picnic areas, thirteen campsites, and eleven shoreline access points. Section 7.6 provides additional detail on the facilities.

2.2 Copco No. 1 Dam and Powerhouse

The Copco No. 1 Development consists of a reservoir, concrete dam, gated spillway, diversion tunnel, intake structure, and powerhouse located on the Klamath River between approximately RM 209.0 and RM 202.2, in Siskiyou County, California. Refer to Figure 2.2-1 (C) for plan views of these features.

Figure 2.2-1 Copco No. 1 and Copco No. 2 Dams Existing Features (Appendix C)

Siskiyou Power and Light Company then California-Oregon Power Company constructed Copco No. 1 Dam between 1911 and 1922 at RM 202.2, and which is downstream of J.C. Boyle Dam and upstream of Copco No. 2 Dam. The primary purpose of the development is to generate hydroelectric power. Structures at the site include an occupied residence with small garage, a vacant house, and a maintenance building.

2.2.1 Reservoir

Copco No. 1 Dam impounds a reservoir (Copco Lake) of approximately 972 acres based on 2010 aerial imagery (Woolpert 2010), and according to a 2003 bathymetric survey (Eilers and Gubala 2003), provides approximately 33,724 acre-feet of total storage capacity at RWS elevation 2611.0.[2] The maximum and minimum reservoir operating levels are between RWS elevations 2611.0 and 2604.5, a vertical operating range of 6.5 feet, although the reservoir is normally maintained at RWS elevation 2609.5, or 1.5 feet below the top of the spillway gates.

2.2.2 Dam, Spillway, and Diversion Tunnel

The dam is composed of a concrete gravity arch which also functions as a spillway, diversion culverts, and intakes to the powerhouse. Figure 2.2-2 shows the dam.

[2] All elevations in this Definite Plan are in NAVD88 vertical datum. Previously reported elevations were in project datum. See Table 1.3-1 for conversion factors.



Figure 2.2-2 Copco No. 1 Dam (right) and Powerhouse (left)

The dam is a concrete gravity arch structure approximately 133 feet tall from the pre-dam river bed elevation to the top of the spillway deck, with a 492-foot radius at the upstream face. The crest length between the rock abutments is approximately 410 feet at elevation 2616.5. The upstream face of the dam is vertical at the top, then battered at 1 horizontal to 15 vertical. The downstream face is stepped, with risers generally about 6 feet in height.

A 224-foot-long, ogee-type overflow spillway is located on the crest of the dam, and is divided into 13 bays controlled by 14- by 14-foot radial (Tainter) gates, with a spillway crest at elevation 2597.0 (Figure 2.2-3 (B)). Three traveling gate hoists are provided for operating the spillway gates, and stoplog slots are provided upstream of each opening.

Figure 2.2-3 Cross Section of Copco No. 1 Spillway (Appendix B)

As originally designed, the spillway crest was approximately 115 feet above the original river bed. After construction began, the river gravel was found to be over 100 feet deep at the dam site, and was excavated and then backfilled with concrete, making the total structural height of the dam 230 feet, measured from the lowest depth of excavation to the spillway crest, or 250 feet to the top of the spillway deck (Figure2.2-4

(B)). The estimated spillway discharge capacity at RWS elevation 2611.0 with all 13 gates fully open is 35,000 cfs.

Figure 2.2-4 Cross Section of Copco No. 1 Dam (Appendix B)

A 16- by 18-foot diversion tunnel was excavated through the left abutment for streamflow diversion during construction, but was later sealed by the construction of a concrete plug approximately 200 feet upstream from the downstream tunnel portal (Figure 2.2-5). A gated concrete intake structure, which regulated flows during construction, is located at the upstream end of the tunnel and has three 72-inch-diameter flap (or clack) valves, three 72-inch-diameter butterfly regulating valves, and three 12-inch-diameter filling lines with valves. All valves were manually-operated using gate stems and wire ropes from hoists located on a concrete deck upstream of the left abutment of the dam. The current condition of the valves and upstream tunnel is unknown as they are submerged by reservoir sediment. The existing hoists, stems, and wire ropes were abandoned in place and are not currently operational.



Figure 2.2-5 Copco No. 1 Diversion Tunnel Downstream Portal

2.2.3 Water Conveyance to Powerhouse

The intakes for the three penstocks, two 10–foot-diameter and one 14–foot-diameter (Figure 2.2-6), are located at the right abutment at approximately invert elevation 2,578.5.[3] Each penstock includes two cast-iron slide gates with electric motor hoists located in two concrete gatehouses. The two 10-foot-diameter (reducing to 8-foot-diameter) steel penstocks closest to the river feed Unit No. 1 in the powerhouse, and the 14-foot-diameter (splitting and reducing to two 8-foot-diameter) steel penstock feeds Unit No. 2. Trash racks with bar spacing of 3 inches proceed each intake.

A third generating unit at the powerhouse was planned, but never built. Some conveyance facilities (two slide gates and a short penstock section) were built to the right of the existing penstocks for this possible future expansion.



Figure 2.2-6 Copco No. 1 10-ft (left and middle) and 14-ft (right) Penstocks

[3] PacifiCorp's Supporting Technical Information Document and the Detailed Plan show the intakes having an invert of 2,578.5 feet (NAVD88). 1921 as-built drawings for the 14-foot penstock show an invert of 2,575.5 feet (NAVD88).

2.2.4 Powerhouse

The Copco No. 1 Powerhouse (Figure 2.2-7) is a reinforced-concrete substructure with a concrete and steel superstructure located at the base of Copco No. 1 Dam, on the right bank of the river. It operates as peaking powerhouse. The two turbines are horizontal-shaft, double-runner Francis-type units with a total rated discharge capacity of 3,650 cfs. The turbines have a rated output of 21,759 hp and 18,600 hp for unit 1 and 2, respectively, with a net head of 125 feet. The system provides no bypass capacity.

The generators are each rated at 12,500 kilovolt-amperes (kVA) with a 0.8 power factor (10 MW). Unit 1 has three indoor, single-phase 5,000-kVA, 2,300/72,000-volt (V) transformers, and Unit 2 has three indoor, single-phase 4,165-kVA, 2,300/72,000-V transformers, to step up the generator voltage for transmission interconnection.

The Copco No. 1 Powerhouse has four associated 69-kV transmission lines. PacifiCorp Line Nos. 26-1 and 26-2 are each approximately 0.07 mile long and connect the Copco No. 1 Powerhouse to the Copco No. 1 switchyard, located on the right abutment upslope of the powerhouse. PacifiCorp Line No. 15 is approximately 1.23 miles long and connects the Copco No. 1 switchyard to the Copco No. 2 Powerhouse, and Line No. 3 is approximately 1.66 miles long and connects the Copco No. 1 switchyard to the Fall Creek powerhouse.



Figure 2.2-7 Copco No. 1 Powerhouse

2.2.5 Site Access

Copco Road from Interstate 5 provides site access, and access continues via a steep and narrow access road to the dam right abutment and powerhouse. Copco Road provides access to the north side of the reservoir. Ager-Beswick Road provides access to the south side of the reservoir, and is an extension of the Topsy Grade Road in Oregon.

2.2.6 Recreation Facilities

Recreation facilities include Mallard Cove and Copco Cove each with boat launches (both managed by PacifiCorp), and smaller dispersed shoreline recreation sites. Additional detail on the facilities is provided in Section 7.6.

2.3 Copco No. 2 Dam and Powerhouse

The Copco No. 2 Development consists of a small reservoir, concrete diversion dam, embankment section, gated spillway, water conveyance system, and powerhouse located on the Klamath River between approximately RM 202.2 and RM 200.3, in Siskiyou County, California. Refer to Figure 2.2-1 (C) for plan views of these features.

California-Oregon Power Company completed the dam in 1925 approximately 0.4 mile downstream of Copco No. 1 Dam at RM 201.8, while the powerhouse is located at RM 200.3, just upstream of Iron Gate Reservoir. The purpose of the development is to generate hydroelectric power.

Structures near the powerhouse include a control center building, maintenance building, and oil and gas storage building. The nearby PacifiCorp-owned Copco Village includes a former cookhouse/bunkhouse, modern bunkhouse, garage/storage building, bungalow with garage, three occupied modular houses, four older ranch-style houses, and a school house/community center, all of which are within the FERC project boundary.

2.3.1 Reservoir

The reservoir created by Copco No. 2 Dam is approximately 0.3 miles long (unnamed), and has a total storage capacity of approximately 70 acre-feet at the normal operating RWS elevation 2486.5.[4]

2.3.2 Dam and Spillway

The dam is composed of a concrete gravity section which also functions as a spillway, an earthen embankment section, a small penetration for bypass flows, and a water conveyance intake for the powerhouse. Figure 2.3-1 shows the dam.

[4] All elevations in this Definite Plan are in NAVD88 vertical datum. Previously reported elevations were in project datum. See Table 1.3-1 for conversion factors.



Figure 2.3-1 Copco No. 2 Dam from Downstream Side

The dam is a concrete gravity structure with a gated side intake to a water conveyance tunnel at the left abutment, a central 145-foot-long spillway section with five 26- by 11-foot radial (Tainter) gates, and a 100-foot-long earthen embankment with gunite cutoff wall on the right abutment (Figures 2.3-2 (B), 2.3-3 (B), and 2.3-4 (B)). The dam is 32 feet high, with an overall crest length of 305 feet and a crest width of 9 feet at elevation 2496.5.

Figure 2.3-2 Layout of Copco No. 2 Dam Features (Appendix B)

Figure 2.3-3 Cross Section of Copco No. 2 Dam (Appendix B)

Figure 2.3-4 Elevation of Copco No. 2 Dam (Appendix B)

A manually-operated slide gate controls a small sluiceway adjacent to the intake, but is not currently believed to be operational. A small corrugated metal half-pipe provides approximately 5 cfs of flow to the bypass reach below the dam. The concrete gravity spillway crest is at elevation 2476.5, with a downstream apron at elevation 2459.5, between two concrete retaining walls. The estimated spillway discharge capacity at RWS elevation 2486.5 is 13,500 cfs with the five spillway gates fully open.

The remnant of a cofferdam is located upstream of the dam below the normal waterline. An old rock-filled timber crib is located high above the left abutment of the dam (Figure 2.3-5).



Figure 2.3-5 Copco No. 2 Dam from Upstream Side Showing Intake (at water level) and Crib Wall (high) on Left Abutment

2.3.3 Water Conveyance to Powerhouse

Water conveyance to the powerhouse is via the intake at the dam to a first tunnel, then through a wood-stave penstock, a second tunnel, and into a pair of steel penstocks to the powerhouse.

The intake structure incorporates a large trash rack and a 20- by 20-foot roller-mounted (caterpillar) gate at invert elevation 2459.5. The trash rack is 36.5 by 48 feet with 4-inch bar spacing.

The water conveyance system for the powerhouse includes 2,500 feet of concrete-lined tunnel (including an adit and an air vent shaft), 1,330 feet of wood-stave pipeline (Figure 2.3-6), an additional 1,110 feet of concrete-lined tunnel, an underground surge tank (including an air vent and overflow spillway), and two steel penstocks. The diameter of the tunnel and wood stave pipeline sections is 16 feet. The two penstocks, one 405 feet long and one 410 feet long, range from 16 feet in diameter at the upstream ends to 8 feet in diameter at the turbine spiral casings. A 138-inch butterfly valve is provided near the downstream end of each penstock.



Figure 2.3-6 Copco No. 2 Wood-Stave Penstock

2.3.4 Powerhouse

The Copco No. 2 Powerhouse (Figure 2.3-7) is a reinforced-concrete structure located 1.6 miles downstream of Copco No. 2 Dam on the left bank of the river. It operates as peaking powerhouse. The two turbines are vertical-shaft, Francis-type units with a total rated discharge capacity of 2,786 cfs. Each turbine has a rated output of 26,285 hp and 20,000 for Units 1 and 2, respectively, with a net head of 145 feet and 140 feet for Units 1 and 2, respectively. No bypass capacity is provided.

The synchronous generators are each rated at 15,000 kVA with a 0.9 power factor (13.5 MW). There are three outdoor, single-phase 10/20-MVA, 6,600/72,000-V transformers for each generator to step up the voltage. There are also three outdoor, single-phase 10/20-MVA, 73,800/230,000-V step-up transformers for interconnection to the transmission system.

A 69-kV transmission line (also Line No. 15) is approximately 0.20 miles long and connects the Copco No. 2 Powerhouse to the Copco No. 2 switchyard. A distribution line approximately 0.21 miles long connects to Copco No. 2 Dam. Line No. 62 runs along the north side of Iron Gate reservoir for approximately 6.32 miles, from the Iron Gate powerhouse to the Copco No. 2 switchyard. Drawings provided by PacifiCorp also note Lines 1, 2, 4, 14, 18, 19, and 67 connecting to the Copco No. 2 switchyard.



Figure 2.3-7 Copco No. 2 Powerhouse

2.3.5 Site Access

Copco Road from Interstate 5 provides site access. Access to the dam is via a steep and narrow access road; the same access road as for Copco No. 1. Access to the powerhouse is via the Daggett Road crossing of the Klamath River on a single-lane bridge.

2.3.6 Recreation Facilities

Two water access points exist directly upstream of the Copco No. 2 dam, but they are not publically accessible.

2.4 Iron Gate Dam and Powerhouse

The Iron Gate Development consists of a reservoir, embankment dam, side-channel spillway, diversion tunnel, intake structures, and powerhouse located on the Klamath River between RM 200.3 and RM 193.1, about 17 miles northeast of Yreka, California, in Siskiyou County. Refer to Figure 2.4-1 (C) for plan views of these features.

Figure 2.4-1 Iron Gate Dam Existing Features (Appendix C)

California-Oregon Power Company completed the development in 1962 at RM 193.1. It is the farthest downstream hydroelectric development of the Project. The primary purpose of the Iron Gate development is to generate hydroelectric power. Structures at the site include a communications building, a restroom building, a maintenance shop, two occupied residences, and a fish spawning building.

2.4.1 Reservoir

Iron Gate Dam impounds a reservoir of 942 acres (Iron Gate Reservoir) and according to a 2003 bathymetric survey (Eilers and Gubala 2003), provides approximately 50,941 acre-feet of total storage capacity at RWS elevation 2331.3.[5] The maximum and minimum operating levels are between RWS elevations 2331.3 and 2327.3, a vertical operating range of 4 feet.

2.4.2 Dam, Spillway, and Diversion Tunnel

The dam is composed of a side channel spillway, earthen embankment section, diversion tunnel, intake to Iron Gate hatchery water supply, and intake to the powerhouse (from right abutment to left abutment, looking downstream) (Figure 2.4-2). A fish ladder and trapping and holding facilities are located at the downstream base of the dam.

The dam is a zoned earthfill embankment with a current height of 189 feet from the rock foundation (elevation 2157.5) to the dam crest at elevation 2346.3. The dam crest is 20 feet wide and approximately 740 feet long (Figure 2.4-3 (B)). The embankment includes a central impervious clay core, with filter zones and a downstream drain, and is flanked by compacted pervious shells. The upstream face has a 2H:1V slope above elevation 2331.3, a 2½H:1V slope between elevations 2331.3 and 2303.3, and a 3H:1V slope below elevation 2303.3, with a 29-foot-wide bench at elevation 2278.3. The upstream face includes a 10-foot-thick riprap layer for slope protection (Figure 2.4-4 (B)).

The downstream face has a 1.75H:1V slope above and a 2H:1V slope below elevation 2326.3, with a 10-foot-wide bench at elevation 2278.3. The downstream face includes a 5-foot-thick riprap layer for slope protection. The dam is founded on a sound basalt rock foundation, with a grout curtain beneath the impervious core.

[5] All elevations in this Definite Plan are in NAVD88 vertical datum. Previously reported elevations were in project datum. See Table 1.3-1 for conversion factors.



Figure 2.4-2 Iron Gate Dam, Spillway (left), and Powerhouse (right)

Figure 2.4-3 Elevation of Iron Gate Dam (Appendix B)

Figure 2.4-4 Cross Section of Iron Gate Dam (Appendix B)

PacifiCorp completed modifications in 2003 to raise the dam crest five feet from elevation 2341.3 to elevation 2346.3 by over-steepening the upstream and downstream slopes and decreasing the crest width from 30 feet to 20 feet. A sheet pile wall was also driven upstream of the dam centerline to extend five feet above the dam crest to provide freeboard in addition to the 5-foot crest raise. The top of the sheet pile wall is at elevation 2351.3. Additional riprap materials were placed on the upstream face of the dam to protect those areas inundated by the higher reservoir elevations during large flood events.

The spillway is excavated in rock on the right abutment, and consists of an ungated side-channel spillway crest with a concrete-lined chute. The spillway crest is at elevation 2331.5, or 15 feet below the raised dam crest. The spillway crest is 727 feet long and consists of a concrete ogee crest and slab placed over the excavated rock ridge. Concrete partly lines the upper part of the channel. The downstream end of the spillway crest includes a 10- by 8-foot hinged trash/sluice gate for sluicing sediments and debris.

A flip-bucket terminal structure is located at the downstream end of the spillway chute. The spillway has an estimated discharge capacity of 22,350 cfs at RWS elevation 2336.3. The modifications completed in 2003 included shotcrete protection at the top of the spillway crest and chute.

The diversion tunnel used during construction of the dam was driven through bedrock in the right abutment and terminates in a reinforced concrete outlet structure near the downstream toe of the dam (Figure 2.4-5). The diversion tunnel intake is a reinforced concrete structure equipped with four 10- by 33-foot trash racks and is located approximately 520 feet upstream from the dam axis near the upstream toe. A two-piece

concrete slide gate located in a gate shaft approximately 119 feet upstream of the dam axis controls flow in the tunnel. A reinforced concrete tower accessible by footbridge from the dam crest houses the slide gate hoist and controls. Operation of the upper sluice gate is limited to an opening of 23.5 inches at RWS elevation 2331.3, with a corresponding discharge capacity of 1,750 cfs; under emergency conditions, a full gate opening of 57 inches would produce a release of 2,700 cfs.[6] The lower diversion gate is currently welded in place. Recent modifications added a 9-foot-diameter hinged blind flange and concrete ring approximately 20 feet downstream of the concrete slide gate (designed for full reservoir head) to permit underwater inspection of the gate.



Figure 2.4-5 Iron Gate Diversion Tunnel Outlet (center-right, in shadow)

2.4.3 Water Conveyance to Powerhouse

Water conveyance to the powerhouse consists of an intake structure and penstock.

The intake structure for the powerhouse is a 45-foot-high, free-standing, reinforced-concrete tower, located in the reservoir immediately upstream of the left abutment and accessible by footbridge from the abutment. It houses a 12- by 17-foot wheel-mounted slide gate, which controls the flow into a 12-foot-diameter, welded-steel penstock. The penstock is concrete-encased where it penetrates the dam approximately 35 feet below the normal maximum reservoir level. Concrete supports down the dam abutment support the penstock. There is a 17.5- by 45-foot trash rack at the penstock intake with 4-inch bar spacing.

6 From PacifiCorp – Iron Gate Dam – Diversion Tunnel Gate Rating Curve dated February 26, 2008.

2.4.4 Powerhouse

The Iron Gate Powerhouse is an outdoor-type development located at the downstream toe of the dam on the left bank (Figure 2.4-6), and consists of a single vertical-shaft, Francis-type turbine with a rated discharge capacity of 1,735 cfs. The turbine has a rated output of 25,000 hp with a net head of 154 feet. In the event of a turbine shutdown, a synchronized Howell-Bunger bypass valve located immediately upstream of the turbine diverts water around the turbine to maintain flows downstream of the dam. The synchronous generator is rated at 18,975 kVA with a 0.95 power factor (18 MW).

There is a single outdoor, three-phase 19-MVA, 6,600/69,000-V step-up transformer at the powerhouse for interconnection to the transmission system. A 69-kV transmission line is approximately 0.21 miles long and connects the Iron Gate switchyard to Tower P 2/007. A second 69-kV transmission line is approximately 0.33 miles long and connects the Iron Gate switchyard to the Iron Gate Hatchery tie-in. Two distribution lines totaling 0.21 miles provide local distribution around the dam and powerhouse area.



Figure 2.4-6 Iron Gate Powerhouse

2.4.5 Fish Trapping and Holding Facilities

There are fish trapping and holding facilities (Figure 2.4-7) located on "random fill"[7] at the downstream toe of the dam. The top of the random fill area is at elevation 2192.3. The fish facilities at the dam include six

[7] This is the type of material shown on the construction drawings used to fill in the area.

fish holding tanks, a spawning building, a fish ladder, and an aerator for the hatchery water supply. High- (elevation 2313.3) and low- (elevation 2253.3) level intakes for the fish facility cold water supply are incorporated in the dam on the left abutment.



Figure 2.4-7 Iron Gate Fish Holding Tanks and Spawning Building

2.4.6 Iron Gate Fish Hatchery

The Iron Gate fish hatchery was constructed in 1966 and is located on the left bank downstream of Iron Gate Dam, adjacent to the Bogus Creek tributary. The hatchery complex includes an office, warehouse, hatchery/incubator building, four fish rearing ponds, a fish ladder with trap, visitor information center, and four employee residences. Up to 50 cfs of water is diverted from the Iron Gate reservoir to supply the 32 raceways and fish ladder. The hatchery provides the capacity to capture, hold, and spawn adult returning Chinook salmon, steelhead trout, and Coho salmon and to hatch and rear fish until their release. The California Department of Fish and Wildlife (CDFW) operates the hatchery, with a large portion of the operations and maintenance costs currently funded by PacifiCorp. See Section 8.11 for a more detailed description of the existing facility and operation.

2.4.7 Site Access

Site access is provided from Interstate 5 via Copco Road and then by Lakeview Road to the dam crest and reservoir area, or by a project access road to the powerhouse. The single-lane Lakeview Road Bridge crosses the Klamath River downstream of the dam.

2.4.8 Recreation Facilities

Recreation facilities include Fall Creek day-use area and boat launch, Jenny Creek campground, Wanaka Springs day-use area and campground, Camp Creek campground and boat launch, Juniper Point campground, Mirror Cove campground, Overlook Point day-use area, and Long Gulch campground and boat launch (each managed by PacifiCorp), and smaller dispersed shoreline recreation sites. Among the referenced facilities there exist a visitors' center at Iron Gate hatchery, two interpretive displays, five boat launches, one fishing platform, two picnics areas, six campgrounds (with sixty-six campsites), five dispersed camping areas (with 20 campsites), and four other water access points. Section 7.6 provides additional detail on each of the facilities.

Chapter 3: FERC Compliance and Dam Safety

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3. FERC COMPLIANCE AND DAM SAFETY

This section explains KRRC's proposed program to comply with FERC dam safety requirements and Engineering Guidelines.

KRRC is developing a dam safety program to allow removal of the Project to be undertaken in a manner that minimizes risk to people, structures, infrastructure, and the natural resources of the Klamath River Basin. Such removal will fully comply with FERC's dam safety requirements, and will be consistent with FERC Engineering Guidelines (FERC 2017). Additionally, KRRC will seek the review and recommendations of the Oregon Water Resources Department and the California Department of Water Resources, Division of Dam Safety to the full extent of any state agency jurisdiction over the decommissioning and removal of the hydroelectric facilities that comprise the Lower Klamath Project.

3.1 Board of Consultants

On October 5, 2017, FERC issued a directive to PacifiCorp and KRRC to convene an Independent Board of Consultants (BOC) to review and assess various aspects of the proposed dam removal process. The BOC was approved on May 22, 2018 The BOC is a six-member fully independent body that includes three members with experience in civil engineering (with specialized experience in dam construction and removal of both concrete and embankment dams, hydrology, hydraulics, and stream diversion) and geotechnical engineering. In addition, the BOC includes members with experience in aquatic and terrestrial biology, and a heavy civil construction cost estimator with experience in dam removal and restoration activities.

KRRC anticipates that the BOC will commence its review of the Definite Plan in August 2018. Initially, FERC has requested that the BOC review and provide recommendations regarding the adequacy of available funding and reasonableness of updated cost estimates for the most probable cost and maximum cost for implementation of the Definite Plan. FERC has also requested that the BOC review and provide recommendations regarding the adequacy of amounts and types of insurance coverage and bonding arrangements for dam removal, and to review and provide recommendations regarding other technical aspects of the Definite Plan to better define and understand the plans, schedules, specifications, staging, and sequencing for taking on the responsibilities for dam removal and decommissioning of the Lower Klamath Project.

The BOC recommendations will be incorporated into a revised Definite Plan and will provide FERC with a greater level of detail of the various project elements proposed in the Definite Plan. These recommendations will build upon and improve the Definite Plan and assist KRRC in maintaining compliance with the Federal Power Act, and in particular, FERC dam safety requirements and engineering guidelines.

In advance of their review, the BOC will be provided project documents including the Potential Failure Mode Analyses, Part 12D Independent Consultant Inspection Reports and the Supporting Technical Information Documents, to understand project-specific aspects that could be significant to the dam removal process. KRRC will also provide the BOC copies of monthly construction reports, and any additional information or analysis requested by the BOC within the scope of their review. The BOC will play a significant role in reviewing the dam safety program described below and in evaluating project risks.

3.2 Part 12 Requirements

KRRC proposes a general schedule and approach for compliance with these requirements below.

3.2.1 Potential Failure Modes Analysis Background

The KRRC will complete a Potential Failure Modes Analysis (PFMA), which is a dam and project safety evaluation tool developed by FERC to be used in the Part 12, Subpart D program of dam and safety evaluations for FERC regulated projects. Since initiation of the PFMA program, a PFMA has been performed for all FERC regulated dams that are required to undergo Independent Consultant Safety Inspections as defined in 18 CFR Part 12, Subpart D. Iron Gate, Copco No. 1, and J.C. Boyle fall under these regulations, and Part 12D Reports and PFMAs have been performed accordingly. As Copco No. 2 does not meet the requirements for a Part 12D Independent Consultant's inspection, PacifiCorp has not performed a PFMA for this dam.

The following sections outline the process and steps the KRRC will go through to complete the PFMA for the Project.

3.2.2 Supplemental PFMA

FERC's Engineering Guidelines indicate that Supplemental PFMAs shall be conducted for dams that will be undergoing major modifications, remedial work or are scheduled to have substantial changes, including removal. One purpose of this Supplemental PFMA is to evaluate the recommended dam removal plan prior to demolition. Thus, KRRC will perform supplemental PFMAs for Iron Gate, Copco No. 1, and J.C. Boyle, and for the previously unevaluated Copco No. 2.

The KRRC has reviewed dam safety submittals for the Powerdale (FERC Project No. 2659) and Condit (FERC Project No. 2342) decommissioning projects, which involved recent FERC regulated dams in the region that share similarities based on size, type, and location. For both examples, a separate Core Team was assembled, and a supplemental PFMA workshop was held. KRRC will assemble a PFMA Core Team for the Project.

For the PFMA to be comprehensive, consistent, and complete, the following outline describes the dam safety approach the KRRC will employ when carrying out the Supplemental PFMA.

Step 1: Collection of Background Data

The KRRC will collect all data, removal plans, studies and information on the investigation, design, construction, analysis, performance and operation of the Project in preparation for review by the PFMA Core Team. A listing will be made of the data available for review and considered in the PFMA. The list will be included in any PFMA documentation. Data requests made of PacifiCorp in April of 2017 will provide the fundamental background information for the Core Team. Additionally, KRRC will make the Definite Plan available to the PFMA Core Team members for review prior to the PFMA session. If any dam safety incident reports exist, KRRC will also make them available to the PFMA Core Team for review.

Based on the estimated time to gather all the data, 60 days for FERC Regional Office review, and the time to perform the PFMA workshops, the process should begin 1 year prior to the planned construction contract award date, and/or negotiation of the guaranteed maximum price. The goal of the proposed PFMA schedule is to complete the session in accordance with FERC Guidelines, provide FERC with adequate time to complete their review and provide any comments to the KRRC without impacting the project schedule.

Studies conducted in preparation for development removal are relevant to the activities of the PFMA Core Team. In particular, the PFMA report will incorporate:

- Updated slope stability analysis and any recent surveys of new or previously unidentified landslides along the reservoir rims.
- An evaluation of the rock in the area of the planned dam removal and breaching.
- A structural evaluation of any facilities needed to support heavy equipment (e.g., cranes) to verify support for anticipated loads.

Step 2: Selection of the PFMA Core Team

The PFMA Core Team members will have knowledge and experience related to dam safety evaluations and will consist of the applicants' Technical Representatives, FERC Inspector, Facilitator, Independent Consultant (if available), and a geologist or geotechnical engineer. FERC's participation and involvement will be guided by FERC's ex parte rule, as applicable. Considering that the Project is in both Oregon and California, KRRC will invite the state dam safety organizations located in those states to participate. In addition to the PFMA Core Team members, key project staff will be available during the PFMA session so they may answer questions from the PFMA Core Team, to clarify operating rules, and provide key site-specific information.

The BOC, discussed in Section 3.1, will have a role in PFMA proceedings. This group is distinct from the Core Team in that they are to provide independent, expert opinions on matters related to their subject area. The Supplemental PFMA process is an opportune time to educate the BOC about the Project and discuss risks; KRRC will provide more detail on their role when the KRRC finalizes their plan for the BOC.

Step 3: Site Visit

Typically, the PFMA Core Team is assembled at the time of the review, and depending on the PFMA Core Team's familiarity with the Project, a site visit may be requested. For a site visit, the Team Leader will

prepare an advanced review package for the participants to get familiarized with the Project. At the site, the Facilitator will review the basic concepts of the PFMA process for the PFMA Core Team, the objectives, and answer any questions the participants may have. The PFMA Core Team will complete the site visit just before it conducts a comprehensive review of the background material.

Step 4: Comprehensive Review

The PFMA Core Team begins the PFMA session with review of the gathered data on the developments. The review will take place at a convenient location that allows the PFMA Core Team to review all the necessary data and have collaboration on items that may need clarification. KRRC has not yet identified this location.

Step 5: PFMA Session

The Facilitator begins the session by outlining the goals and ground rules, ensures the PFMA Core Team follows the process and performs the PFMA following the FERC Engineering Guidelines. The session will then move on to a brief review of the existing PFMAs compiled from previous PFMA sessions with an emphasis on dam removal. The group will then focus on potential new failure modes that could occur as part of dam removal.

Step 6: Evaluation of Surveillance and Monitoring

The Core Team members will assess the dam safety surveillance and monitoring plan (DSSMP) for the dams considering potential failure modes and develop a DSSMP for any “highlighted” potential failure modes and any selected “not highlighted” potential failure modes.

Step 7: Documentation

The KRRC will document the Major Findings and Understandings and prepare the draft PFMA Report which documents the PFMA session, surveillance and monitoring, and/or risk reduction opportunities identified by the PFMA. The PFMA report will be prepared following the outline contained in FERC’s Engineering Guidelines. KRRC will send a draft report to the PFMA Core Team members for review and comment. After receiving the PFMA Core Team’s comments, KRRC will finalize the report and provide it to the BOC. KRRC will address and incorporate BOC recommendations and provide them to FERC.

3.3 FERC Required Plans and Submittals

Table 3.1-1 indicates the plans and submittals to be provided by the KRRC to the BOC and then to FERC.

Table 3.3-1 FERC Required Plans and Submittals

Plan Name
Coffer Dams
• Coffer Dam Design
• Coffer Dam Certification
Temporary Construction Emergency Action Plan
Quality Control Inspection Program (QCIP)
Dam Stability Analysis (Iron Gate and J.C. Boyle)
Blasting Plan
Reservoir Rim Stability Analyses
Flood Routing Analysis and Inundation Study
Rock quality evaluation in the areas of planned breaching

The KRRC will develop and submit specific plans and schedules for compliance at FERC's direction, and consistent with any further recommendations as may be provided by the BOC.

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Chapter 4: Reservoir Drawdown and Diversion Plan

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4. RESERVOIR DRAWDOWN AND DIVERSION PLAN

4.1 Introduction

KRRC proposes the following reservoir drawdown and streamflow diversion plan to facilitate the Project while minimizing flood risks and downstream impacts due to the release of impounded reservoir sediments. This plan results in drawdown of the reservoirs impounded by J.C. Boyle, Copco No. 1, and Iron Gate dams by March 15, 2021, to minimize downstream impacts resulting from the natural release and transport of impounded sediments. Section 2: Existing Hydrology Conditions in USBR's *Hydrology, Hydraulics, and Sediment Transport Studies for the Secretary's Determination on Klamath River Dam Removal and Basin Restoration Klamath River, Oregon and California* (USBR 2012c) provides historical daily and monthly streamflow data downstream of each of the dams.

Drawdown of the reservoirs will generally take place between January 1 and March 15, 2021. However, the proposed plan includes early drawdown of Copco No. 1 and delayed cessation of power generation at Copco No. 2. KRRC proposes early drawdown of Copco No. 1 for the reservoir drawdown to be completed by about March 15 (prior to spring salmonid migration). To offset lost revenue from shutting Copco No. 1 down prior to January 1, the KRRC proposes that generation of power at Copco No. 2 Dam (with sediment-laden flow) will continue for up to four months after January 1, 2021 (or until May 1, 2021). This assumes the Copco No. 2 generating equipment will be capable of operating under such conditions. The KRRC proposes that power generation at Copco No. 1 Dam will end after the reservoir reaches the minimum operating level at reservoir water surface (RWS) elevation 2604.5, which would be nearly 2 months before January 1, 2021. Reservoir drawdown below the minimum operating level will commence at each dam when power generation has ceased at that dam. The proposed plan assumes power generation at each of the dams will end as shown in Table 4.1-1.

The following sections describe the reservoir drawdown facilities (and infrastructure modifications required to facilitate drawdown), flood frequency flows, the anticipated drawdown rates (i.e., rate of elevation change and discharge rates) and timing of drawdown, and the portion of discharge associated with specific structures (spillways, diversion tunnels, etc.). Appendix F provides additional information and results beyond those presented here.

Table 4.1-1 End Date for Power Generation

Location	End Date
J.C. Boyle	January 1, 2021
Copco No. 1	November 1, 2020
Copco No. 2	May 1, 2021
Iron Gate	January 1, 2021

The bulleted list below provides a roadmap for specific information related to drawdown:

- Description of structures used for drawdown operation and associated flows is provided in Section 4.2
- Physical modifications to the dams to facilitate drawdown are summarized in Section 4.2
- Additional information concerning the retrofit of the diversion tunnels is provided in Section 4.2
- Total anticipated discharge (cfs) associated with drawdown for each reservoir is discussed in Section 4.4
- Proposed duration and timing of drawdown operations is discussed in Sections 4.4 and 4.5
- Schedule and sequence for drawdown of all Lower Klamath Project dams is provided in Sections 4.4 and 4.5
- Proposed reservoir elevation change per day is provided in Section 4.5
- Strategies for managing drawdown under low, medium and high flow conditions are provided in Section 4.5
- Slope stability monitoring during and after reservoir drawdown is discussed in Section 4.6
- Studies conducted to verify reservoir drawdown rates are protective of slope stability and potential flooding are discussed in Section 4.7
- Description of measures associated with possible tunnel failure is provided in Section 4.7.1
- Measures to implement if slope stability issues are identified are discussed in Sections 4.7.2 and 4.7.3

4.2 Diversion Facilities

Table 4.2-1 shows facilities that KRRC will use for drawing down the reservoirs and diverting Klamath River flows around J.C. Boyle, Copco No. 1, and Iron Gate dams. The major drawdown facilities at J.C. Boyle are the spillway, power intake, and diversion culverts beneath the dam. At Copco No. 1, drawdown facilities are the spillway and a modified diversion tunnel. [8] At Iron Gate, the drawdown will occur via the spillway and a modified diversion tunnel. The penstocks at Copco No. 1 and Iron Gate provide only a minor amount of

[8] KRRC analyzed two options for diversion at Copco No. 1 Dam, as described later in this section. Option 1 used the spillway, diversion tunnel, and dam notches, and Option 2 used the spillway and a modified diversion tunnel. Option 2 is the proposed action, and Option 1 is only discussed for comparison purposes.

potential additional diversion, and KRRC assumes they will be closed when power generation ceases, so they are not included in the drawdown modeling.

Table 4.2-1 Facilities to be Used for Reservoir Lowering and Diversion

	(a)	(b)	(c)
Location	**Diversion Facility**	**Invert Elevation**	**Notes**
J.C. Boyle Dam			Normal operating elevation 3796.7
	Spillway	3785.2	
	Power Intake	3771.7	
	Power Canal, Tunnel, and Turbines	–	Pass power intake flows through turbines without generating power
	Diversion Culvert – Bay 1	3755.2	
	Diversion Culvert – Bay 2	3755.2	
Copco No. 1 Dam			Normal operating elevation 2609.5
Option 1	Spillway	2597.0	For comparison purposes only
	Modified Diversion Tunnel	2485.5[1]	
	Notches in Dam	Varies	
Option 2	Spillway	2597.0	Proposed action
	New Gate in Diversion Tunnel	2485.5[1]	
Iron Gate Dam			Normal operating elevation 2331.3
	Spillway	2331.3	
	New Gate in Diversion Tunnel	2176.3[2]	

1. Estimated from Drawing 1475.
2. Drawing 8860 shows the invert at 2173 feet NGVD (2176.3 feet NAVD); Drawing 8862 shows invert at 2175 feet NGVD (2178.3 feet NAVD).

The removal of Copco No. 1 and Iron Gate dams requires the successful completion of modifications to restore and increase the discharge capacity of the existing diversion tunnels for low-level releases. Both require underwater work that KRRC will need to perform the year prior to reservoir drawdown. The design and fabrication of large gates that are the major component of both modifications will also require a significant lead time (up to 10 months for design and fabrication) ahead of installation. KRRC does not expect impacts to power generation for the modification work.

The following sections describe the diversion facilities and any modifications required prior to reservoir drawdown.

4.2.1 J.C. Boyle Reservoir

Water releases for reservoir drawdown at J.C. Boyle will be made through the gated spillway (crest elevation 3785.2), the power canal (intake invert elevation 3771.7), and through the two 9.5- by 10-foot diversion culverts (invert elevation 3755.2) located below the gated spillway (see Figure 4.2-1(B). Modifications of these facilities are not required prior to drawdown. Figure 4.2-2 shows discharge rating curves for the J.C. Boyle facilities, as well as the stage-storage curve for J.C. Boyle Reservoir.

Figure 4.2-1 J.C. Boyle Diversion Facilities (Appendix B)

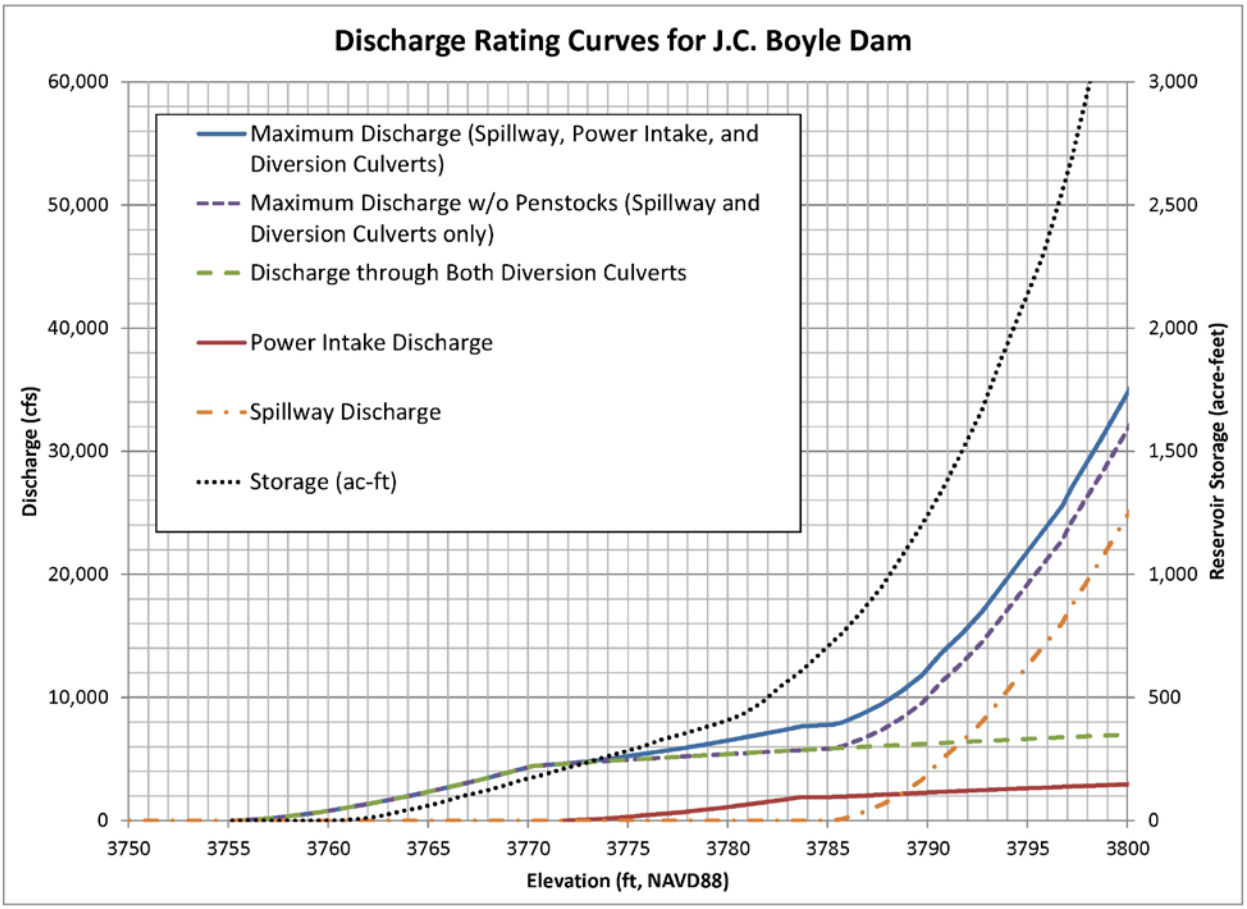


Figure 4.2-2 Discharge Rating Curve and Stage-Storage Curve for J.C. Boyle

4.2.2 Copco Lake

KRRC analyzed two options for reservoir drawdown at Copco No. 1. Option 2 is the action proposed by KRRC, but Option 1 was also included in the drawdown analysis because it was the method originally proposed in the Detailed Plan.

Option 1 (for comparison only) includes making releases through a combination of the diversion tunnel modified to restore operation through three existing 6–foot-diameter pipes in the diversion tunnel intake structure, in addition to a series of notches sequentially excavated in the dam. Option 2 would make releases solely through the diversion tunnel modified to restore full use of the tunnel by installing a new large gate at the downstream end of the tunnel and removing the intake structure at the upstream end. Figure 4.2-3 shows discharge rating curves for the diversion facilities for the two Copco No. 1 options, as well as the stage-storage curve for Copco Lake.

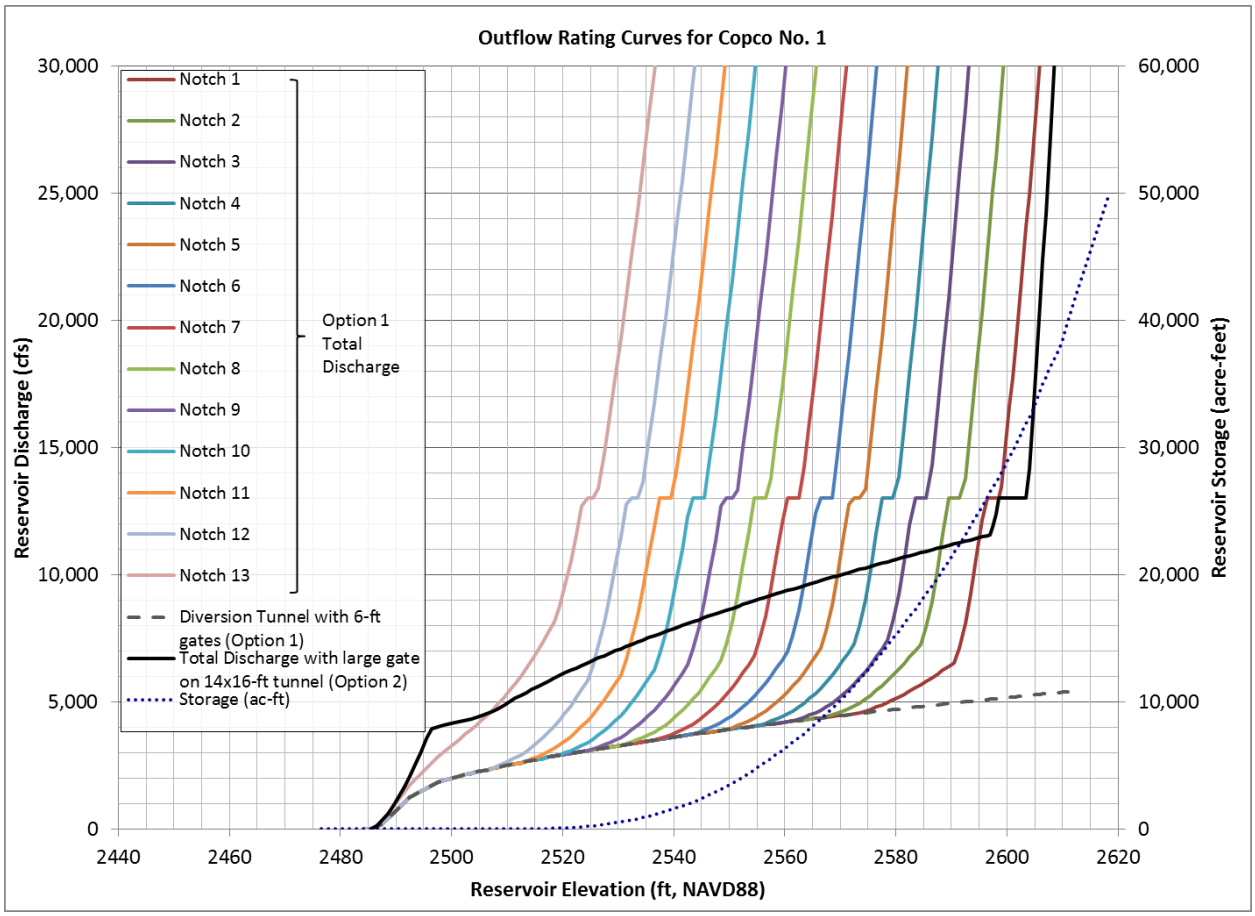


Figure 4.2-3 Discharge Rating Curve and Stage-Storage Curve for Copco No. 1

The following sections provide a more detailed description of the diversion tunnel modifications analyzed for Option 1 and Option 2. KRRC will perform the Option 2 modification prior to reservoir drawdown, in 2020.

Option 1 (for comparison only) – Diversion Tunnel Modification to Restore Release Capacity

1. Design, fabricate, and deliver three new 6- by 6-foot slide gates.
2. Mobilize barge-mounted crane onto Copco Lake (assume normal RWS elevation 2609.5). Remove deposited sediment from diversion tunnel intake using clamshell or suction dredge, as required.

3. Remove three existing 72-inch flap gates on the upstream face of diversion intake structure (invert elevation 2485.5) under balanced head and no flow conditions, using hard hat divers (124-foot depth) (Figure 4.2-4 (B)). Upstream tunnel should be full of water (due to valve leakage since tunnel was plugged), but should be confirmed.
4. Install three new 6- by 6-foot slide gates with hydraulic operators and remote controls at upstream face of diversion structure using hard hat divers (see Figure 4.2-4(B)).
5. With new upstream slide gates and diversion intake closed, drill drain and air vent holes through concrete tunnel plug from downstream side to unwater tunnel (see Figure 4.2-5(B)). Remove concrete tunnel plug in dry conditions. Inspect the unlined diversion tunnel for possible reinforcement (lining with shotcrete or concrete) or repairs.
6. Remove (or open) three existing 72-inch butterfly valve disks from downstream side of inlet in dry conditions, after drilling drain and air vent holes through each disk. Determine need for air vent piping and provide as necessary for operation of upstream slide gates.
7. All work in the tunnel would be in compliance with local, state and federal codes and regulations (e.g., Title 29 of the Code of Federal Regulations (29 CFR 1926.800)) and would include safety provision of adequate ground control, flood control, air monitoring, ventilation, illumination, communication, personal protective equipment, access and egress procedures, mechanical equipment, and emergency procedures.

Figure 4.2-4 Copco No. 1 Diversion Modification, Intake Structure (Appendix B)

Figure 4.2-5 Copco No. 1 Diversion Modification, Tunnel (Appendix B)

Option 2 (proposed action) – Diversion Tunnel Modification to Increase Release Capacity

1. Design, fabricate, and deliver new 14- by 16-foot roller gate.
2. Construct new gate shaft with new gate structure and 14-foot by 16-foot roller gate at downstream end of diversion tunnel (see Figure 4.2-6 (B)).
3. Mobilize barge-mounted crane onto Copco Lake (assume normal RWS elevation 2609.5). Remove sediment from diversion tunnel (see Figure 4.2-4(B)) intake using clamshell or suction dredge, as required.
4. Remove three existing 72-inch flap (or “clack”) gates on upstream face of diversion intake structure (invert elevation 2485.5) under balanced head and no flow conditions, using hard hat divers (124-foot depth). Upstream tunnel should be full of water (due to valve leakage since tunnel was plugged), but should be confirmed. Install three new 6-foot blind flanges (see Figure 4-2.4(B)) using hard hat divers.
5. With new blind flanges in place, drill drain and air vent holes through concrete tunnel plug from downstream side to unwater tunnel (see Figure 4.2-5(B)). Remove concrete tunnel plug in dry conditions. Inspect the unlined diversion tunnel for possible reinforcement (lining with shotcrete or concrete) or repairs. Line tunnel with shotcrete or concrete, if determined to be necessary.

6. Remove three existing 72-inch butterfly valve disks from downstream side of inlet in dry conditions, after drilling drain and air vent holes through each disk.
7. Close new large gate and fill tunnel upstream of gate with water.[9] Under balanced head and no flow conditions, remove the 6-foot blind flanges at the inlet using hard hat divers.
8. Using hard hat divers, demolish intake structure and install grating to minimize potential for large debris entering the diversion tunnel.
9. Perform all work inside the tunnel in the same manner described for Copco No. 1 (Option 1).

Figure 4.2-6 Copco No. 1 Diversion Modification, New Gate Structure (Appendix B)

4.2.3 Iron Gate Reservoir

Reservoir drawdown at Iron Gate Dam will involve releases made solely through the diversion tunnel. KRRC will modify the diversion to restore full use of the tunnel by installing a new large gate in place of the current concrete bulkhead and gate. Figure 4.2-7shows discharge rating curves for the diversion facilities for Iron Gate Dam, as well as the stage-storage curve for Iron Gate Reservoir.

A detailed description of the Iron Gate diversion tunnel modifications includes the following:

1. Design, fabricate, and deliver new 14- by 16-foot roller gate.
2. With the existing gate closed, remove downstream stop-log structure and miscellaneous metalwork from downstream tunnel in the dry. Maintain air vent pipe in tunnel crown if needed for final operation. Securely bolt existing blind flange to the reinforced concrete ring downstream of the concrete sluice gates (see Figure 4.2-8(B)) to retain full reservoir head. A preliminary assessment indicates the existing features are capable of accommodating this loading condition and KRRC's contractor will verify this prior to construction.
3. Raise upper sluice gate slowly to fill portion of downstream tunnel between the gates and blind flange. Provide air vent and drain valve through downstream concrete ring as necessary. Close air vent when filling has been completed.
4. Mobilize a barge-mounted crane onto the reservoir in June 2020. Raise the upper sluice gate to top of control tower using the existing hoist and remove using barge-mounted crane. Send hard-hat divers to the bottom of wet-well shaft to install lifting device for lower diversion gate, and to cut welded connection along downstream seal of lower diversion gate.
5. Raise the lower diversion gate to the top of the control tower using existing hoist and remove using barge-mounted crane. Install new 16.5- by 18-foot roller gate into existing slots in gate shaft (with a 160-foot design head) using hard hat divers and barge-mounted crane. Install new gate operator with remote controls. Close new roller gate.

[9] Tunnel filling could be accomplished several ways such as by inserting a small valve into the blind flange or by drilling a small opening into the tunnel adjacent to the intake structure.

6. With new roller gate closed, drain downstream tunnel using air vent and drain valve provided at the blind flange. Remove blind flange and reinforced concrete ring.

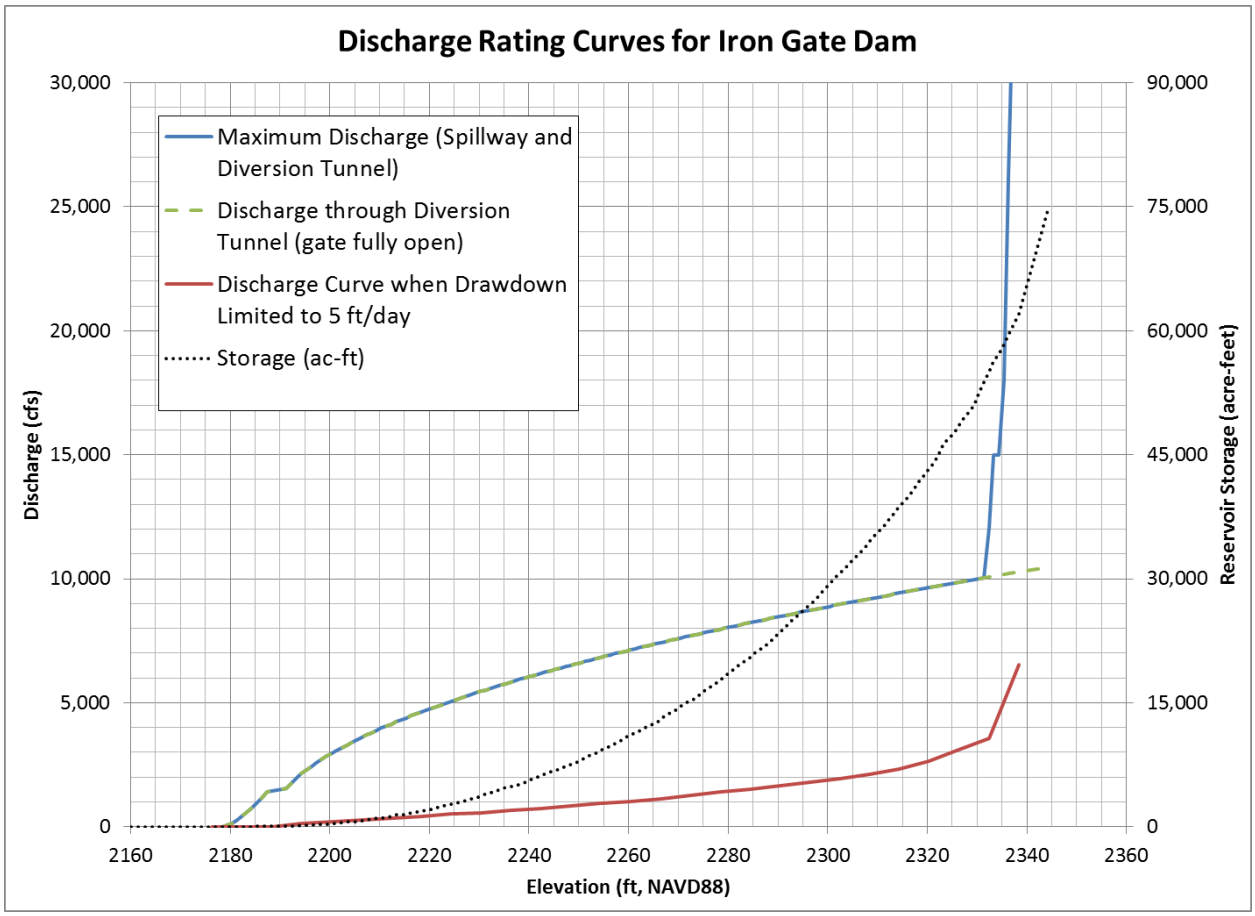


Figure 4.2-7 Discharge Rating Curve and Stage-Storage Curve for Iron Gate

7. Inspect the downstream portion of the diversion tunnel for possible reinforcement (lining with shotcrete or concrete) or repairs (see Figure 4.2-8 (B)).
8. Perform all work inside the tunnel in the same manner described for Copco No. 1 (Option 1) in Section 4.2.2.

Figure 4.2-8 Iron Gate Diversion Modification (Appendix B)

4.2.4 Drawdown Controls

KRRC's contractor will manage the drawdown of Copco No. 1 and Iron Gate reservoirs through automated gate control systems with operator oversight. Inputs to determine the amount of gate opening at each reservoir will include continuous measurement of reservoir levels by remote sensor. The gate control system will incrementally open (or close) the gate to increase (or decrease) flow through the diversion tunnel to

maintain the reservoir drawdown at an approximate constant rate as the inflows vary due to watershed response to storms or due to changes in drawdown rates of upstream reservoirs.

Once the Copco No. 1 and Iron Gate reservoirs have reached full drawdown, the gates will remain in the full open position to limit reservoir refilling during subsequent storm events. Storm inflows large enough to cause refilling of the reservoir will pass through the spillway.

For this analysis, KRRC assumed that the gates on the diversion tunnels would temporarily be closed during a large storm event once outflow over the spillway reached a pre-determined discharge level. The gates fully open again once discharge over the spillway dropped back below the pre-determined level. At Copco No. 1, this was assumed to be 13,000 cfs (between the 10-year and 20-year events) to help prevent downstream flooding of the Copco No. 2 powerhouse. At Iron Gate Dam, the discharge level was set to 15,000 cfs, which is just above the 10-year peak flow.

The spillway and then the capacity of the power intake will control the initial drawdown on J.C. Boyle Reservoir. Once the reservoir stabilizes with the spillway and intake fully open, the diversion culvert concrete stop logs in the culverts will be blasted, and flow will only be controlled by the capacity of the culverts, which is about 6,000 cfs at the spillway elevation (between the 2 and 5-year events). For storm flows that refill the reservoir before deconstruction, higher discharge rates will be experienced over the spillway.

4.3 Flood Frequency Analysis

Flood frequency analyses were performed at four locations on the Klamath River using the USACE HEC-SSP software (V2.1), following the Bulletin 17B method for Log-Pearson Type III distributions (USGS 1982).[10] Table 4.3-1 provides details on the gauges. J.C. Boyle and Copco records correlate well with the Keno data. Therefore, KRRC extended the records at J.C. Boyle and Copco based on linear correlations with USGS gauge data at Keno to allow for a coincident period of analysis. Appendix F provides the correlations used to extend the data. KRRC could not obtain a good correlation with Keno data for Iron Gate gauge, likely due to significant tributary inflows. Therefore, KRRC used the historical period of record (1960 to 2017) for Iron Gate.

[10] Log-Pearson Type III distributions are intended to fit the distribution of annual peak flows from natural watersheds (i.e., non-regulated watersheds). The Klamath Basin is highly regulated for irrigation water supplies and fishery flows, but the regulated flows primarily describe low flows (non-storm event flows) as there are no flood control reservoirs in the basin. We found that after ignoring the low flows in the data, the annual peak flow data fit well with the Log-Pearson Type III distribution.

Table 4.3-1 U.S. Geological Survey Streamflow Gaging Stations Analyzed

USGS Gaging Station No.	Station Name	Drainage Area (mi²)	Latitude	Longitude	Gauge Elevation (feet, NGVD29)	Period of Record (Water Years)
11509500	Klamath River at Keno, OR	3,920	42°08'00"	121°57'40"	3,961	1905-1913 1930-2016
11510700	Klamath River below John C. Boyle Power Plant near Keno, OR	4,080	42°05'05"	122°04'20"	3,275	1959-2016
11512500	Klamath River below Fall Creek near Copco, CA	4,370	41°58'20"	122°22'05"	2,310	1924-1961
11516530	Klamath River below Iron Gate Dam, CA	4,630	41°55'41"	122°26'35"	2,162	1961-2016
11520500	Klamath River near Seiad Valley, CA	6,940	41°51'14"	123°13'52"	1,320	1913 – 2016
11523000	Klamath River at Orleans	8,475	41°18'13"	123°32'00"	355.98	1927 – 2016
11530500	Klamath River near Klamath, CA	12,100	41°30'40"	123°58'42"	5.60	1961 – 2016

Releases from Upper Klamath Lake and Link River Dam control flows in the Klamath River. The operations at Link River Dam could influence the flood frequency curves calculated using the USGS gauge data. KRRC compared plots of the flood-frequency curves before and after censoring peak flow data to determine if there was a low flow threshold below which flows did not fit the distribution. For all locations except J.C. Boyle, the data visually appeared to fit within the 95 percent confidence limit of the distribution. Therefore, KRRC only censored the J.C. Boyle data. KRRC censored flows below 3,400 cfs as low flow outliers. The Bulletin 17B procedures adjusted the probabilities to account for the censored data. Table 4.3-2 shows the results. Appendix F provides plots of the data and distributions.

Table 4.3-2 Annual Flood Frequency Results

Location	2-Year	5-Year	10-Year	20-Year	50-Year	100-Year	200-Year	500-Year
Keno	4,329	6,957	8,830	10,699	13,210	15,156	17,152	19,872
Blw J.C. Boyle [1,2]	4,736	7,719	9,438	10,862	12,405	13,370	14,194	15,104
Blw Fall Creek nr Copco[2]	5,974	9,114	11,340	13,567	16,580	18,937	21,377	24,742
Below Iron Gate	5,942	10,895	14,912	19,295	25,744	31,169	37,106	45,796
Seiad Valley	16,418	34,673	52,002	73,229	108,545	141,806	181,736	246,577

Orleans	61,712	114,819	157,209	202,710	268,332	322,432	380,576	463,907
Klamath	140,056	239,890	313,456	388,200	490,163	570,125	652,719	766,069

Notes:

1. Flows below 3,400 cfs were censored as low flow outliers due to the influence of Link River Dam.
2. The gauge record was extended to cover 1932 to 2017 based on the flows measured at the Keno gauge.

4.4 Summer Flow Frequency Analysis

This section describes the analysis of summer flows into J.C. Boyle and Iron Gate reservoirs. KRRC conducted a frequency analysis of summer flows to determine the flow rates associated with low frequency events such as the 1% probable event for the months May through September. KRRC then used these results to calculate the peak water surface elevations in the reservoir associated with these events. The analysis used USGS measured stream flow data for the two gauges shown in Table 4.4-1.

Table 4.4-1 USGS Gauge Data Used in the Summer Flows Frequency Analysis

USGS Gauge Number	Gauge Name	Annual Maximum and Daily Average Flow Period of Record	15 minute data, Period of Record[1]
11510700	Klamath River BLW John C Boyle Powerplant, Nr Keno OR	1/1/1959 -7/11/ 2017	5/1/1967 – 9/30/2017
11516530	Klamath River Below Iron Gate Dam, CA	10/1/1960 – 7/11/2017	5/1/1989 – 9/30/2017
[1] Date range only includes summer data (May through September)			

Annual maximum peak flow, average daily flow, and instantaneous (generally 15- to 30-minute intervals) flow data are available at both gauges. Since the maximum annual peak flow data generally occur in the winter, and peak summer flow data are required for this analysis, KRRC used the instantaneous flow data to estimate the annual peak flow for each month from May through September.

4.4.1 Iron Gate Reservoir

The Iron Gate gauge is located just downstream from Iron Gate Dam. It drains an area of 4,630 square miles. Bogus Creek is a small tributary located between Iron Gate Dam and the Iron Gate gauge. It drains an area of 52 square miles, which is approximately 1% of the Iron Gate gauge drainage area, so KRRC assumed it did not significantly affect the peak flow statistics for the Iron Gate gauge. Iron Gate reservoir is a run-of-the river reservoir used for power generation, and it is generally not used to store runoff. Therefore, it was assumed that the flow measured downstream of the dam is representative of the inflow to the reservoir, especially for infrequent events such as a 1% annual peak event (i.e., 100-year event).

Fifty-seven years (1961-2017) of average daily and instantaneous annual maximum flow rates are available at the Iron Gate gauge. In addition, 29 years (1989 – 2017) of 15-minute data are available. The Detailed Plan used the average daily flows to estimate the peak summer flows. Since instantaneous flows are larger

than the average daily flows, the Detailed Plan used a correction factor based on comparing the annual maximum instantaneous flow to the average daily flow on the same day. Figure 4.4-1 compares the instantaneous flows to the daily average flow rates for the same day for the years 1961 to 2017. The comparison indicates that the annual maximum instantaneous flows are about 14% higher than the daily average flow for the same day using the relationship in Equation 4.4-1. For comparison, the Detailed Plan estimated instantaneous peaks from daily average values at the Iron Gate gauge using the relationship in Equation 4.4-2.

Equation 4.4-1

$$Q_{peak} = 1.1399\ Q_{average} - 161.08$$

Equation 4.4-2

$$Q_{peak} = 1.1408\ Q_{average} - 140.18$$

The difference between the relationships is the addition of 8 more years of data. As described below, KRRC used the 15-minute data for the flood frequency analysis. However, since the daily flow data has a longer period of record than was used in the Detailed Plan, results using the daily flow record are also presented in Figure 4.4-2 for comparison. KRRC calculated results using the regression equation shown in Figure 4.4-1 (Equation 4.4-1) for two periods: the same period as the 15-minute data (1989 – 2017) and the entire period of record (1961 – 2017). The results show that there is not much of a difference in the 100-year peak flows, regardless of the method or period of record used.

KRRC conducted a flood frequency analysis for each of the months from May through September using the peak flows based on the 15-minute data for each year within the period of record (1989 – 2017). Table 4.4-2 provides the flood frequency flows for the monthly peak flows for May through September. Table 4.4-3 provides the water surface elevations corresponding to the flows shown in Table 4.4-2. The diversion tunnel rating curve used in the drawdown study is the basis of these elevations. Note that the water surface elevations in the Detailed Plan were based on a slightly different rating curve.

The Detailed Plan used seasonal peak flow values for two seasons: June through October (representing June), and July through November (representing July). These periods were selected in the Detailed Plan because deconstruction of the Iron Gate and J.C. Boyle Dams will occur primarily from July 1 through November 30; and, the Detailed Plan did not permit any excavation of the embankment section of Iron Gate Dam until June 1 and required completion by September 30 to minimize hydrologic risk. For the Definite Plan, KRRC developed monthly flood frequency flows to better define the risk. However, Tables 4.4-2 and 4.4-3 also provide the seasonal flood frequency flows used in the Detailed Plan for comparison.

There were two very large storm events in the June data, one in 1993 (on June 5th) and one in 1998 (on June 1st). The 1993 peak flow in June was greater than any of the peak flows that occurred in May. In addition, there were a large number of low outliers in the May data (primarily in the first half of the month). Because of these large events in June and multiple low outliers in May, the extreme events in June (> 100-year) were greater than the similar extreme events in May.

The data indicate that there is a transition in the hydrology in June from winter to summer flows. Figure 4.4-2 shows the predicted 100-year event at Iron Gate for the period May through September (the predicted 100-year peak flows based on average daily values rather than 15-minute data are also provided for comparison since that method was used in the Detailed Plan). In May and the first half of June, the 100-year event is between approximately 8,000 and 10,000 cfs. It drops sharply in the second half of June through September when the 100-year event is between approximately 2,000 and 4,000 cfs.

Figure 4.4-3 plots the water surface elevations corresponding to the return periods shown in Table 4.4-3 for Iron Gate. Figure 4.4-3 clearly shows the reduced likelihood of higher reservoir levels starting in the middle of June.

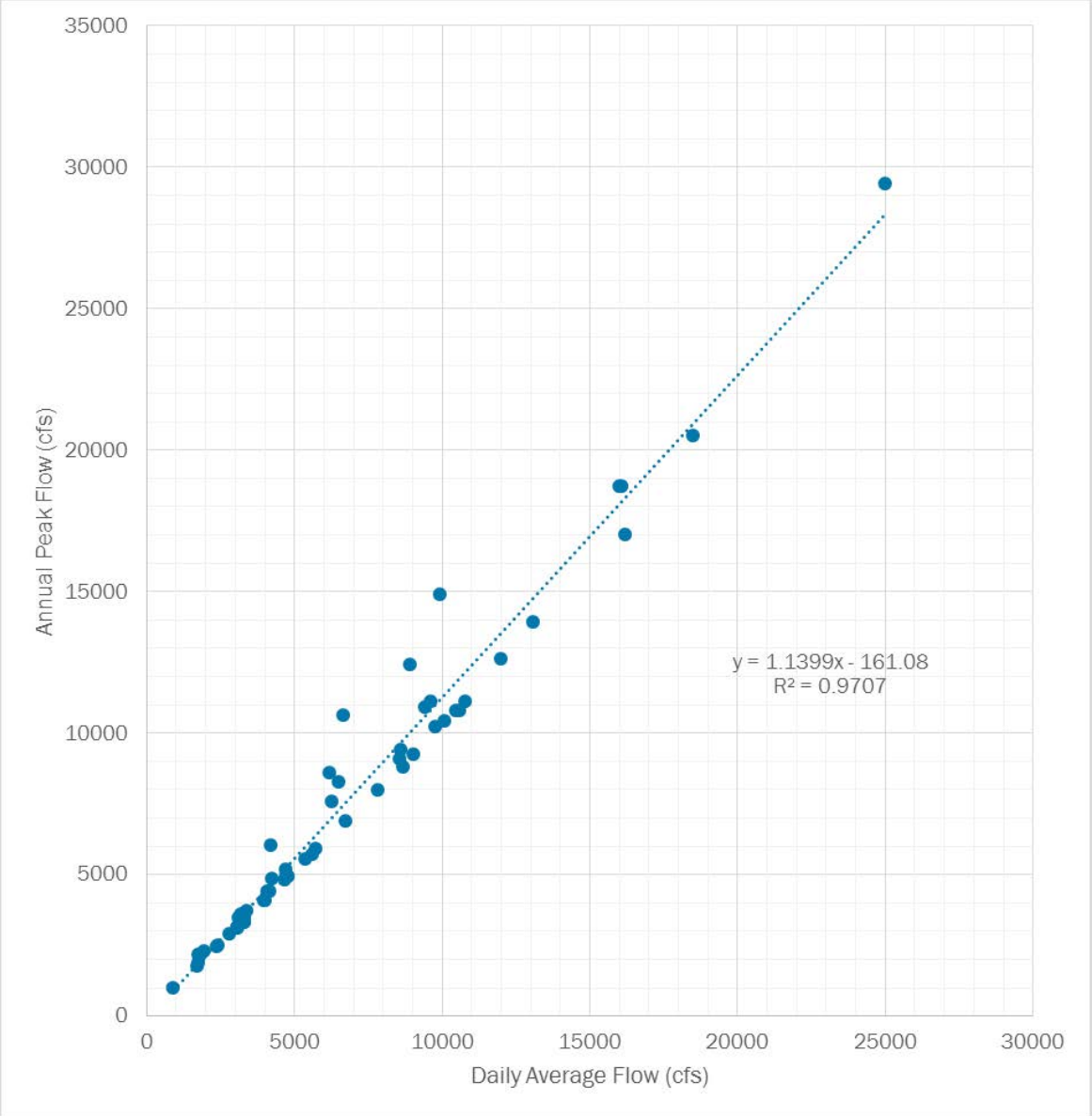


Figure 4.4-1 Relationship between Annual Maximum Flows and Daily Average Flow at the USGS Iron Gate Gauge

Table 4.4-2 Monthly Flood Frequency Flow at Iron Gate Reservoir

Exceed-ance Percent	Return Period	Maximum Peak Flow (cfs)							USBR Study[d] (cfs)			
	Years	May	June	June (1-15)	June (16-30)	July	Aug	Sept	Aug	Sept	Jun - Oct	Jul - Nov
0.2	500	11,339	17,948	15,406	5,830	3,498	2,448	2,363	NA	NA	NA	NA
0.5	200	10,212	12,549	11,348	4,837	3,081	2,237	2,201	NA	NA	NA	NA
1	100	9,321	9,526	8,932	4,172	2,778	2,080	2,077	2585	3386	9647	8387
2	50	8,394	7,192	6,965	3,573	2,485	1,924	1,951	2503	3221	7724[b]	7095[c]
5	20[a]	7,100	4,903	4,918	2,868	2,107	1,718	1,779	2416	3052	6110	5914
10	10	6,054	3,622	3,700	2,388	1,825	1,558	1,641	2291	2816	4364	4497
20	5	4,923	2,629	2,703	1,943	1,538	1,390	1,492	NA	NA	NA	NA
50	2	3,174	1,625	1,618	1,369	1,121	1,132	1,251	NA	NA	NA	NA

[a] Detailed plan is for the 25-year event.
[b] Detailed plan specifies to maintain a minimum flood release capacity of approximately 7,700 cfs in June (see Table 4.4-3 for elevation).
[c] Detailed plan specifies to maintain a minimum flood release capacity of approximately 7,000 cfs in July (see Table 4.4-3 for elevation).
[d] USBR Hydrology Studies for the Secretary's Determination on Klamath River Dam Removal and Basin Restoration (March 2011)

Table 4.4-3 Maximum Water Surface Elevation in Iron Gate Reservoir

Exceed-ance Percent	Return Period	Maximum Water Surface Elevation (ft, NAVD88)[a]							Detailed Plan[b] (ft, NAVD88)			
	Years	May	June	June (1-15)	June (16-30)	July	Aug	Sept	Aug	Sept	Jun - Oct	Jul - Nov
0.2	500	**2332.0**	**2335.3**	**2334.5**	2236.3	2205.3	2196.4	2195.8	NA	NA	NA	NA
0.5	200	2331.4	**2332.5**	**2332.0**	2221.2	2201.4	2195.0	2194.8	NA	NA	NA	NA
1	100	2311.7	2317.2	2301.6	2212.7	2198.9	2194.0	2194.0	2193	2196	2294	2267
2	50	2288.3	2261.6	2257.0	2206.1	2196.7	2193.1	2193.3	2193	2195	2254	2243
5	20	2259.7	2222.1	2222.3	2199.6	2194.2	2192.1	2192.4	2192	2195	2227	2224
10	10	2240.1	2206.6	2207.4	2196.0	2192.6	2191.3	2191.7	2192	2194	2205	2207
20	5	2222.4	2197.7	2198.3	2193.2	2190.8	2187.4	2189.7	NA	NA	NA	NA
50	2	2202.2	2191.6	2191.6	2187.2	2186.1	2186.2	2186.7	NA	NA	NA	NA

[a] Bold values overtop the spillway at elevation 2331.5 feet NAVD88.
[b] Elevations are from Appendix B in Detailed Plan – Iron Gate Diversion Capacities during Dam Removal. Values have been rounded up to nearest foot and converted from NGVD29 to NAVD88 by adding 3.3 feet.
[c] Detailed plan specifies to maintain a minimum flood release capacity of approximately 7,700 cfs in June which corresponds to an elevation of 2254 feet NAVD88.
[d] Detailed plan specifies to maintain a minimum flood release capacity of approximately 7,000 cfs in July which corresponds to an elevation of between 2242 and 2243 feet NAVD88.

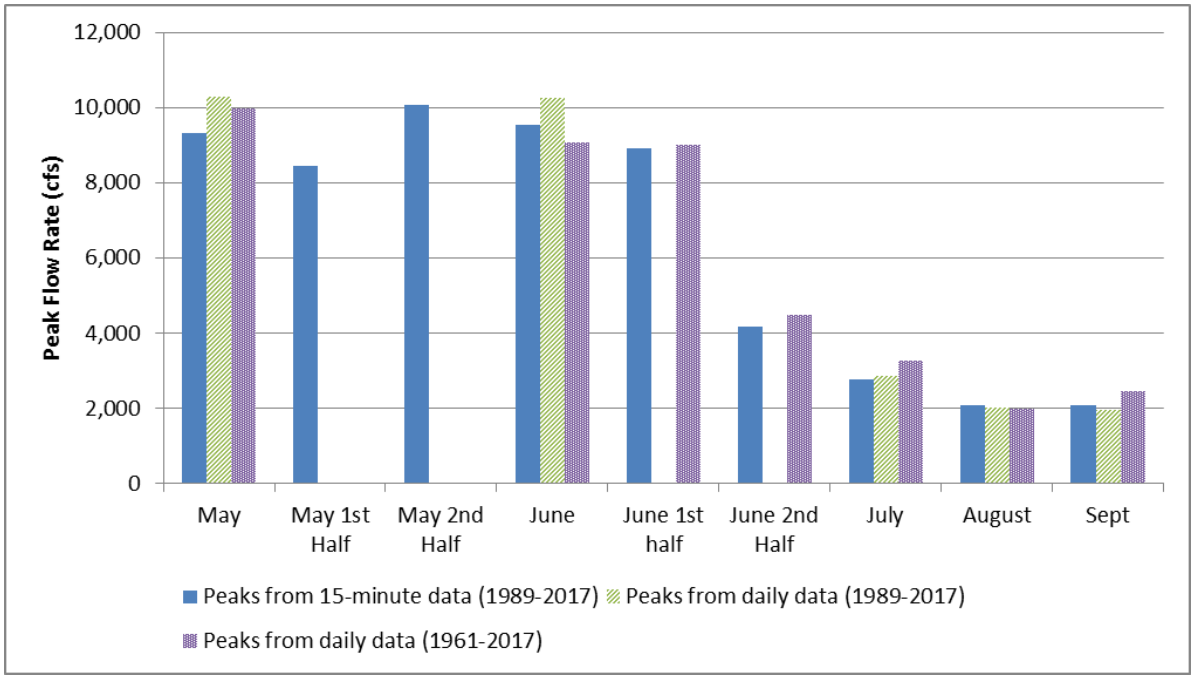


Figure 4.4-2 Predicted 100-year Flood Flow at Iron Gate for the Period May through September

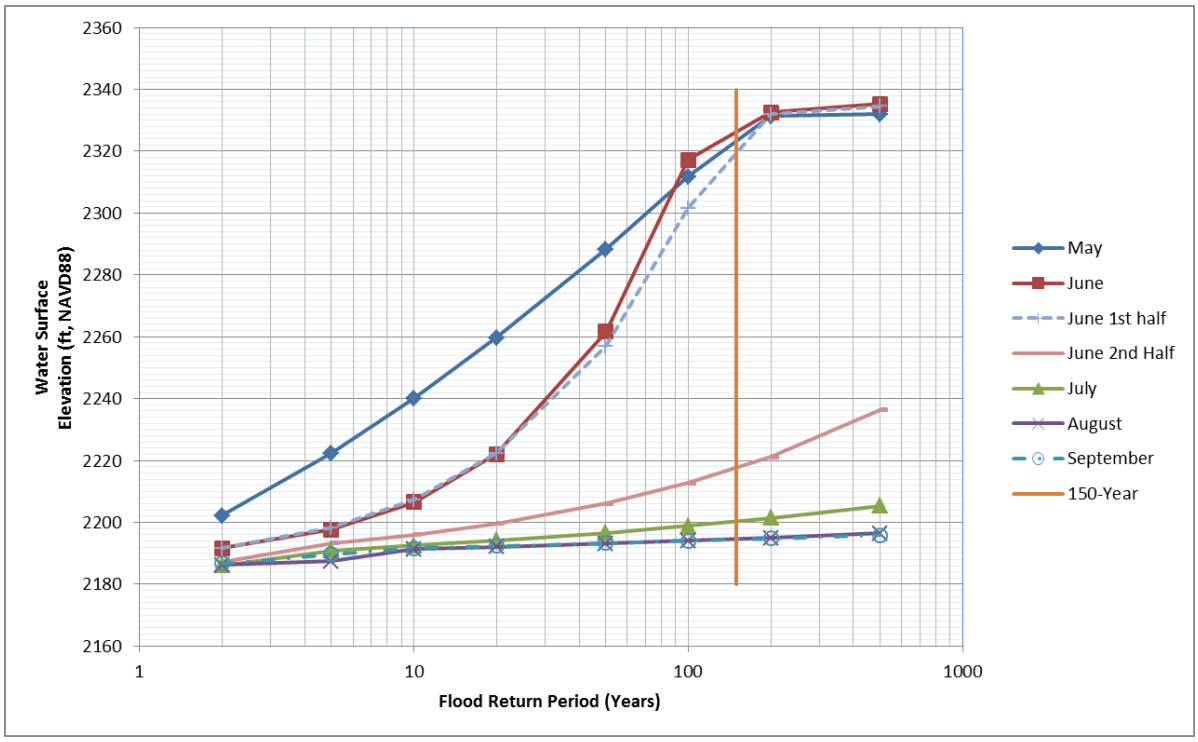


Figure 4.4-3 Frequency of Reservoir Levels at Iron Gate Dam for Summer Flows

4.4.2 J.C. Boyle Reservoir

The J.C. Boyle gauge is located 0.7 miles downstream from the J.C. Boyle powerhouse and 5 miles below the J.C. Boyle Dam. It drains an area of 4,080 square miles. There are no significant inputs to the river between the dam and the gauge. J.C. Boyle reservoir is a small run-of-the river reservoir used for power generation, and it does not store runoff. Therefore, it was assumed that the flow measured downstream of the dam is representative of the inflow to the reservoir, especially for infrequent events such as a 1% annual peak event (i.e., 100-year event).

Fifty nine years (1959-2017) of average daily and instantaneous annual maximum flow rates are available at the J.C. Boyle gauge. In addition, 30 years (1988 – 2017) of 15- to 30-minute data are available (data from 1967 are also available but were not used in the analysis). The Detailed Plan used the average daily flows to estimate the peak summer flows. Since instantaneous flows are larger than the average daily flows, the Detailed Plan used a correction factor based on comparing the annual maximum instantaneous flow to the average daily flow on the same day. Figure 4.4-4 compares the instantaneous flows to the daily average flow rates for the same day for the years 1959 to 2017 (the data only went to 2009 in the Detailed Plan). The comparison indicates that the annual maximum instantaneous flows are about 11% higher than the daily average flow for the same day using the relationship in Equation 4.4-3. For comparison, in the Detailed Plan estimated instantaneous peaks from daily average values at the J.C. Boyle gauge using the relationship in Equation 4.4-4.

Equation 4.4-3

$$Q_{peak} = 1.1142\ Q_{average} + 269.31$$

Equation 4.4-4

$$Q_{peak} = 1.0706\ Q_{average} + 863.66$$

For average daily flows less than about 3,200 cfs, the instantaneous peak flow is almost constant at about 2,800 cfs. This is likely due to flow controls from Upper Klamath Lake and Keno Dam. These values were not included in the regression relationship (i.e., data were censored). The Detailed Plan censored flows below 4,000 cfs when calculating the annual frequency distribution, but it did not state whether any censoring occurred as part of the seasonal frequency analysis. The regression plot [Figure 18 in the *Hydrology Studies for the Secretary's Determination on the Klamath River Dam Removal and Basin Restoration* (USBR 2011b; Hydrology Report)] has significantly fewer data points than are found in the table of values in Appendix A of the same report. There are also no average daily flows less than 2,000 cfs or greater than 10,000 cfs shown on the plot in the Hydrology Report, though there are values of those magnitudes in the table of values in the appendix to the Hydrology Report. It appears that some data were censored but it is unclear which data and why.

KRRC conducted a flood frequency analysis for each of the months from May through September using the peak flows based on the 15- to 30-minute data for each year within the period of record (1988 – 2017). Table 4.4-4 provides the flood frequency flows for the monthly peak flows for May through September. Table

4.4-5 provides the water surface elevations corresponding to the flows shown in in Table 4.4-4. The diversion tunnel rating curves used in the drawdown study are the basis for these elevations. Note that the water surface elevations in the Detailed Plan were based on a slightly different rating curve.

KRRC also conducted a flood frequency analysis using the maximum daily average flow for each of the months from May through September for comparison since that was the method used in the Detailed Plan. KRRC used the regression equation shown in Figure 4.4-4 with the monthly maximum daily average flows for two periods: the same period as the 15- to 30-minute data (1988 – 2017) and the entire period of record (1959 – 2017). Consistent with the results at Iron Gate, the results at J.C. Boyle also show that there is not much of a difference in the 100-year peak flows, regardless of the method or period of record used.

Similar to the results for Iron Gate, the data indicate that there is a transition in the hydrology in June from winter to summer flows. Figure 4.4-5 shows the predicted 100-year event at J.C. Boyle for the period May through September (the predicted 100-year peak flows based on average daily values rather than instantaneous data are also provided for comparison since that was used in the Detailed Plan). In May and the first half of June, the 100-year event is between approximately 7,000 and 11,000 cfs. It drops sharply in the second half of June through September when the 100-year event is between approximately 2,000 and 4,000 cfs.

Figure 4.4-6 plots the water surface elevations corresponding to the return periods shown in Table 4.4-5 for J.C. Boyle. Figure 4.4-6 clearly shows the reduced likelihood of higher reservoir levels starting in the middle of June.

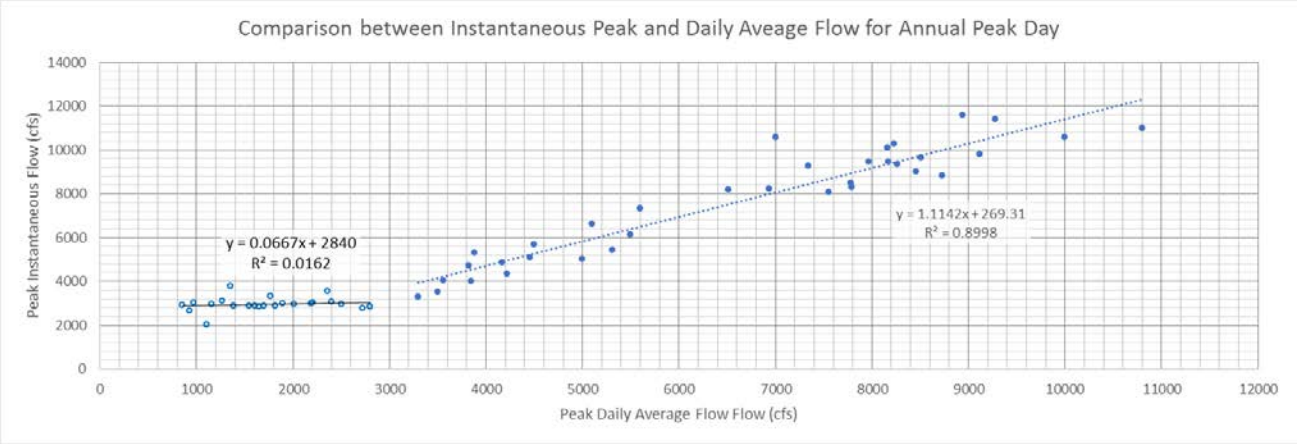


Figure 4.4-4 Relationship between Annual Maximum Flows and Daily Average Flow at the USGS J.C. Boyle Powerhouse Gauge

Table 4.4-4 Monthly Flood Frequency Flow at J.C. Boyle Reservoir

Exceed-ance Percent	Return Period	Maximum Peak Flow (cfs)							USBR Study[c] (cfs)			
	Years	May	June	June (1-15)	June (16-30)	July	Aug	Sept	Aug	Sept	Jun - Oct	Jul – Nov[b]
0.2	500	14,676	13,032	13,503	5,571	5,013	4,965	5,144	NA	NA	NA	NA
0.5	200	12,173	9,980	10,203	4,884	4,464	4,311	4,534	NA	NA	NA	NA
1	100	10,465	8,127	8,228	4,402	4,072	3,865	4,106	3,970	3,840	8,680	6,300
2	50	8,901	6,591	6,612	3,947	3,698	3,455	3,703	3,720	3,730	7,470	5,770
5	20[a]	7,025	4,955	4,914	3,382	3,225	2,962	3,203	3,460	3,590	6,370	5,250
10	10	5,728	3,956	3,893	2,974	2,877	2,620	2,843	3,080	3,340	5,070	4,560
20	5	4,508	3,117	3,049	2,574	2,529	2,297	2,491	NA	NA	NA	NA
50	2	2,919	2,180	2,125	2,016	2,032	1,874	2,002	NA	NA	NA	NA

[a] Detailed plan is for the 25-year event.
[b] Detailed plan specifies that removal of the embankment dam cannot begin until July 1.
[c] USBR Hydrology Studies for the Secretary's Determination on Klamath River Dam Removal and Basin Restoration (March 2011)

Table 4.4-5 Maximum Water Surface Elevation in J.C. Boyle Reservoir

Exceed-ance Percent	Return Period	Maximum Water Surface Elevation (ft, NAVD88)[a]							Detailed Plan[b] (ft, NAVD88)			
	Years	May	June	June (1-15)	June (16-30)	July	Aug	Sept	Aug	Sept	Jun - Oct	Jul - Nov
0.2	500	**3792.8**	**3791.9**	**3792.1**	3781.8	3775.8	3775.3	3777.2	NA	NA	NA	NA
0.5	200	**3791.3**	**3790.0**	**3790.1**	3774.5	3770.5	3769.9	3771.1	NA	NA	NA	NA
1	100	**3790.2**	**3788.5**	**3788.6**	3770.1	3769.4	3768.9	3769.5	3771	3770	**>3802**	**3786**
2	50	**3789.2**	**3786.6**	**3786.7**	3769.1	3768.5	3767.9	3768.5	3770	3770	**3797**	3782
5	20	**3787.2**	3775.2	3774.8	3767.7	3767.3	3766.7	3767.3	3769	3769	**3787**	3779
10	10	3783.6	3769.1	3769.0	3766.7	3766.5	3765.8	3766.4	3767	3768	3777	3774
20	5	3770.9	3767.1	3766.9	3765.7	3765.5	3764.9	3765.4	NA	NA	NA	NA
50	2	3766.6	3764.6	3764.4	3764.1	3764.1	3763.7	3764.0	NA	NA	NA	NA

[a] Bold values overtop the spillway at elevation 3785.2 feet NAVD88.
[b] Elevations are from Appendix B in Detailed Plan – Iron Gate Diversion Capacities during Dam Removal. Values have been rounded up to nearest foot and converted from NGVD29 to NAVD88 by adding 3.7 feet.
[c] Detailed plan specifies to maintain dam crest elevation no lower than 3767 to ensure minimum 100-year flood protection (with freeboard) in September for flows up to about 3,500 ft3/s through left abutment.

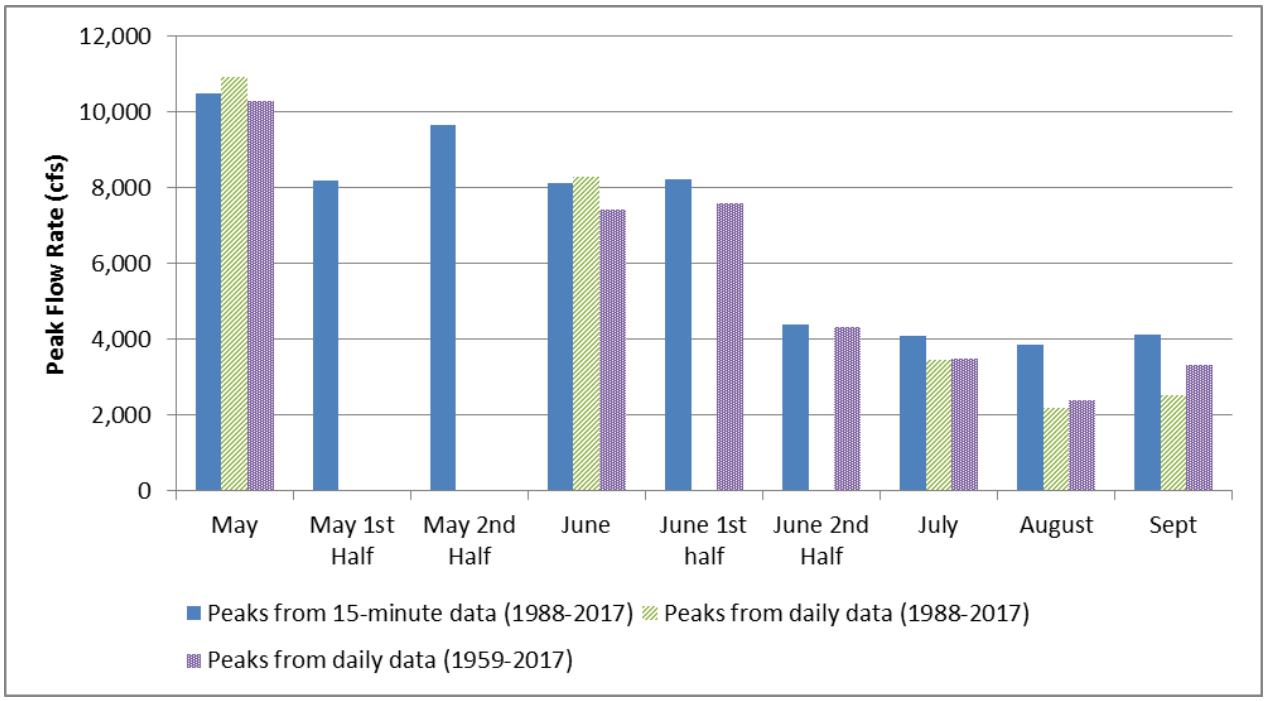


Figure 4.4-5 Predicted 100-year Flood Flow at J.C. Boyle for the Period May through September

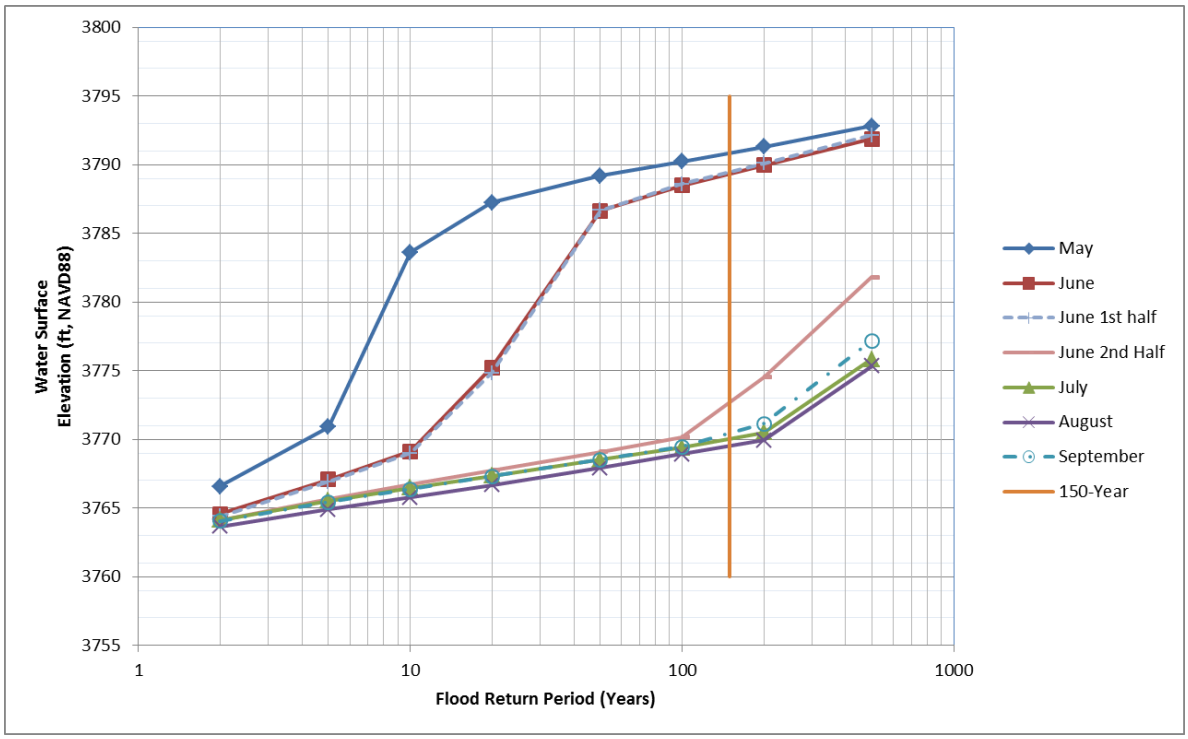


Figure 4.4-6 Frequency of Reservoir Levels at J.C. Boyle Dam for Summer Flows

4.5 Drawdown Timing

KRRC proposes the simultaneous removal of the four dams with the dewatering periods scheduled to minimize sediment release into downstream areas during critical times for important aquatic species and life stages (e.g., anadromous fish spawning, rearing, and in- and out-migration). The deconstruction period, including site preparation, dewatering, and facilities removal, will occur over about 20 months. The drawdown period could vary depending on water year type, with longer drawdowns occurring during wet years and shorter drawdowns during dry years.

To reduce the uncertainty regarding the length of time over which flows with high suspended sediment concentrations will occur and potentially negatively affect aquatic resources, the Definite Plan includes an updated approach to the drawdown at Copco Lake. This updated approach (Option 2 summarized in Section 4.2) dewaters the reservoir via an upgraded diversion tunnel, and no longer relies on dam notching to complete the drawdown. In contrast, the dam notching proposed in the 2012 EIS/R and Detailed Plan could have caused delays during wet water years. Specifically, the Contractor would need to wait in wet years for the water level to drop below the crest to enable equipment access to the notch area to complete the next notch. These delays can be seen in the modeling results discussed further in Section 4.6.

Therefore, relying on the diversion tunnel at Copco No. 1, rather than notching, significantly increases the likelihood that drawdown, or at least an initial drawdown, will occur by the end of February. Thus, the release of the majority of suspended sediment during that period will reduce the likelihood of high suspended sediment concentrations after March 15.

Due to the improvement of the probability of drawdown being completed within the January 1 to March 15 time period, the potential effects on downstream environmental resources by deconstruction implementation during a wet year is considered to be similar to potential effects in a normal water year. The updated drawdown approach at Copco No. 1 significantly reduces the probability of an increase in the cost of deconstruction of Copco No. 1 due to the occurrence of a wet year because drawdown is much less likely affected by high flows.

In the proposed construction schedule, the embankment removals at Iron Gate Dam and J.C. Boyle Dam and the concrete dam removal at Copco No. 1 Dam within the river channel will all start between May and July and be completed by October, months when high flows have receded in most years. The embankment removal schedules assume that the minimum embankment height maintained through removal will accommodate a 0.01 chance (100-year) storm plus 3 feet of freeboard in any given month. If a wet year were to delay the start of embankment or concrete removal to July, KRRC's Contractor will increase productivity to complete the removal on time.

Based on the discussions and analyses summarized above, the current drawdown schedule minimizes the release of sediment during the previously identified critical times for important species and life stages.

4.6 Reservoir Drawdown Releases

The following sections describe how KRRC will use the diversion facilities to draw down the reservoirs and release sediment, the timing of the discharges, the range of discharge rates anticipated, the portion of discharge associated with specific structures, and the change in reservoir elevation per day.

Copco No. 2 Dam does not impound a significant volume of sediment, and KRRC will remove it during the same year as the three larger dams. Drawdown of Copco No. 2 Reservoir will not be necessary until after Copco No. 1 Dam has been breached to final grade. No drawdown rate limitations will apply to the removal of Copco No. 2 Dam.

Analyses of the embankment and reservoir rims demonstrate the Project will maintain adequate factors of safety to prevent embankment slope instability provided the drawdown rate is controlled (see Appendices D and E). Based on analyses in Appendix E, the reservoir rim stability is independent of drawdown rate. Reservoir drawdown rates at Iron Gate, Copco No. 1, and J.C. Boyle (until diversion culverts are opened) will be limited to 5 feet per day; however, the actual drawdown rates may be less (or negative) during storm periods because of increased inflows to the reservoirs. For the modeling, KRRC assumed the starting elevations of Iron Gate and Copco No. 1 were at the spillway crest on January 1.[11] KRRC assumed the starting elevation at J.C. Boyle was the normal operating elevation on January 1.

To provide information on the range of flows that are likely to be released from the reservoirs during drawdown, a detailed analysis of the reservoir drawdown for water years 1961 through 2009 was completed. The purpose of this analysis was to provide information on the following points.

1. Anticipated discharges from each reservoir to the Klamath River in cfs associated with reservoir drawdown operations.
2. Description of structures used for reservoir drawdown operations including the flow (cfs) anticipated for each structure during drawdown operations.
3. Timing of reservoir drawdown operations.
4. For each reservoir, confirmation on proposed reservoir elevation change per day.

Section 4.6.1 describes the detailed analysis. Table 4.6-1 provides the range of approximate additional outflow due to minimum and maximum reservoir drawdown rates. The maximum drawdown rate is set at 5 feet per day until drained, and the minimum drawdown rate assumes it takes 59 days to drain the reservoir (January 1 to February 28). These flows will be in addition to the flows in the river from Keno Reservoir releases and tributary contributions. For comparison, Table 4.6-1 also provides the average release flows as a percentage of 2-year and 10-year peak flows in the Klamath River.

For J.C. Boyle, KRRC expects the increase in flow to the river due to drawdown to be from less than 1% up to 3%. For Copco No. 1, KRRC expects the increase to be between 3% and 13%, and for Iron Gate, KRRC

[11] Copco Lake drawdown from normal operating elevation is assumed to begin on November 1 (prior to the January 1 drawdown process). The period from November 1 to January 1 is assumed sufficient to draw down from normal operating elevation to the spillway crest elevation (approximately 12.5 feet) with a maximum historic drawdown of 2 feet per day. The Copco Lake modeling starts on January 1 with the reservoir elevation at the spillway crest.

expects the increase to be between 3% and 14%. Note the minimum drawdown rate will likely occur during periods with large storm events, so the increase in flow will be closer to the <1% to 3% range during a storm event at the three reservoirs (see Column 8 in Table 4.6-1).

During dry periods the reservoirs can be drawn down quicker, resulting in a larger percent increase in flow to the river, but since the river flows are relatively small, the impacts are not necessarily greater (see column 10 in Table 4.6-1). For comparison, the 2-year flood downstream of J.C. Boyle is 4,700 cfs and at Iron Gate is 5,900 cfs. The 5-year flood event downstream of J.C. Boyle is 7,700 cfs and at Iron Gate is 10,900 cfs. Compared to these flood events, the incremental increase in flow due to reservoir drawdown is minimal.

Table 4.6-1 Range of Release Flows from Reservoirs due to Drawdown

Reservoir	Initial WSE (ft, NAVD)	Invert Elevation of Diversion Structure (ft, NAVD)	Total Depth (feet)[1]	Total Volume (acre-feet)[2]	Min Avg Release Flow (cfs)[3]	Min Avg as % of 2-Year Flow in Klamath River[4]	Min Avg as % of 10-Year Flow in Klamath River[5]	Max Avg Release Flow (cfs)[6]	Max Avg as % of 2-Year Flow in Klamath River[4]	Max Avg as % of 10-Year Flow in Klamath River[5]
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
J.C. Boyle	3796.7	3755.2	41.5	2,267	19.4	0.4%	0.2%	138	3%	1%
Copco	2597	2485.5	111.5	33,724	288	5%	3%	762	13%	7%
Iron Gate	2331.3	2176.3	155	50,941	435	7%	3%	828	14%	6%

Notes:

1. Depth calculated as difference between normal operating level (J.C. Boyle) or spillway elevation (Copco and Iron Gate) and invert elevation of diversion structure.
2. These are total volumes based on a 2003 bathymetric survey (Eilers and Gubala 2003). See Sections 2.1.1, 2.2.1, and 2.4.1 for total volumes associated with each reservoir.
3. Minimum assumes 59 days to drain reservoir.
4. Based on flood frequency results in Table 4.3-2 for 2-year flow (4,736 cfs for J.C. Boyle; 5,974 cfs for Copco; and 5,942 cfs for Iron Gate).
5. Based on flood frequency results in Table 4.3-2 for 10-year flow (9,438 cfs for J.C. Boyle; 11,340 cfs for Copco; and 14,912 cfs for Iron Gate).
6. Maximum assumes continuous drawdown of 5 feet per day for total reservoir depth.

4.6.1 Detailed Modeling

KRRC conducted detailed analysis of the drawdown using the USACE Hydrologic Engineering Center River Analysis System (HEC-RAS) model (version 5.0.3). KRRC used the model to calculate flows and water levels due to the drawdown of J.C. Boyle Reservoir, Copco Lake, and Iron Gate Reservoir. For modeling stability purposes, KRRC divided the Klamath River into two modeling reaches. Reach 1 covers the J.C. Boyle Reservoir and extends from approximately 1 mile upstream of J.C. Boyle Reservoir to approximately 0.4 mile downstream of J.C. Boyle Dam. Reach 2 extends from approximately 1.5 miles upstream of Copco Lake to approximately 0.6 mile downstream of Iron Gate Dam.

The HEC-RAS model requires inputs for topography/bathymetry, inflow rates, and rating curves for dam outlets. The following sections discuss input sources and data.

Topography/Bathymetry

KRRC generally obtained the cross-section bathymetry in the HEC-RAS model from the SRH1-D model provided by the USBR. The data were representative of Scenario 8 in USBR (2012). The bathymetry data extended from above J.C. Boyle to Happy Camp, CA, however KRRC only used the data for the two reaches listed above.

Inflow Rate

KRRC used inflow data based on the Klamath Basin Restoration Agreement (KBRA) flows as river flows (Keno flows).[12] KRRC obtained these flows from the SRH1-D model input files (USBR 2012c). The data were compared to the measured flows at the USGS gauge at Keno (gauge no. 11509500, Klamath River at Keno, OR). Figure 4.6-1 compares the USGS measured data at Keno to the SRH1-D data used in the model. As seen in the figure, the Keno flows closely follow the measured flows at the USGS Keno gauge but some of the variability has been "smoothed" out during non-storm periods when the Keno flows are relatively constant by month. During large storms the Keno flows data occasionally have a sharp peak that exceeds the USGS measured flows. These sharp peaks generally last a few days. During the winter (January – April), including the months when drawdown will occur, the flow frequency curve for the flows used in the model and the measured USGS flows are very similar. The data prior to 1969 appears to be time shifted or mislabeled by approximately 1 year.

KRRC simulated water years 1961 through 2009 in the model. Results are presented for 6 years representative of the various conditions that could occur during construction (results for the other years are provided in Appendix F). All simulations started on January 1 with J.C. Boyle at normal operating elevation and Copco Lake and Iron Gate reservoirs full to the spillway crest elevation. It is possible that during construction, water levels could be lower or higher depending upon the hydrologic conditions that occurred in the preceding December. The 6 years selected for discussion are summarized below:

- 1965: Largest storm of record occurred between December 1964 and April 1965 (Corresponds to water year 1966 in the SRH1-D and HEC-RAS output)
- 1970: Years drier than 1970 (based on ranking the maximum 15-day volume of flow between January and May at Keno) drained by March 1
- 1973: The median year based on ranking the maximum 15-day volume of flow between January and May at Keno
- 1979: Representative dry year
- 1986: Representative wet year
- 2006: Representative wet year

[12] The 2013 Joint Biological Opinion for USBR's Klamath Irrigation Project (NMFS and USFWS 2013) modified the flows from the 2010 KBRA. The 2013 Joint Biological Opinion slightly increases the annual average water supply by about 9,000 acre feet when compared with the KBRA Flows, and it maintains higher minimum summer flows in dry years. The changes to flows in January and February (during drawdown) are negligible. The small changes to flows in the 2013 Joint Biological Opinion will not affect the drawdown of the reservoirs, nor the level of flows released during drawdown. NMFS and USFWS are working on a new Joint Biological Opinion to be released in 2019, which may again alter flows released by USBR's Klamath Irrigation Project.

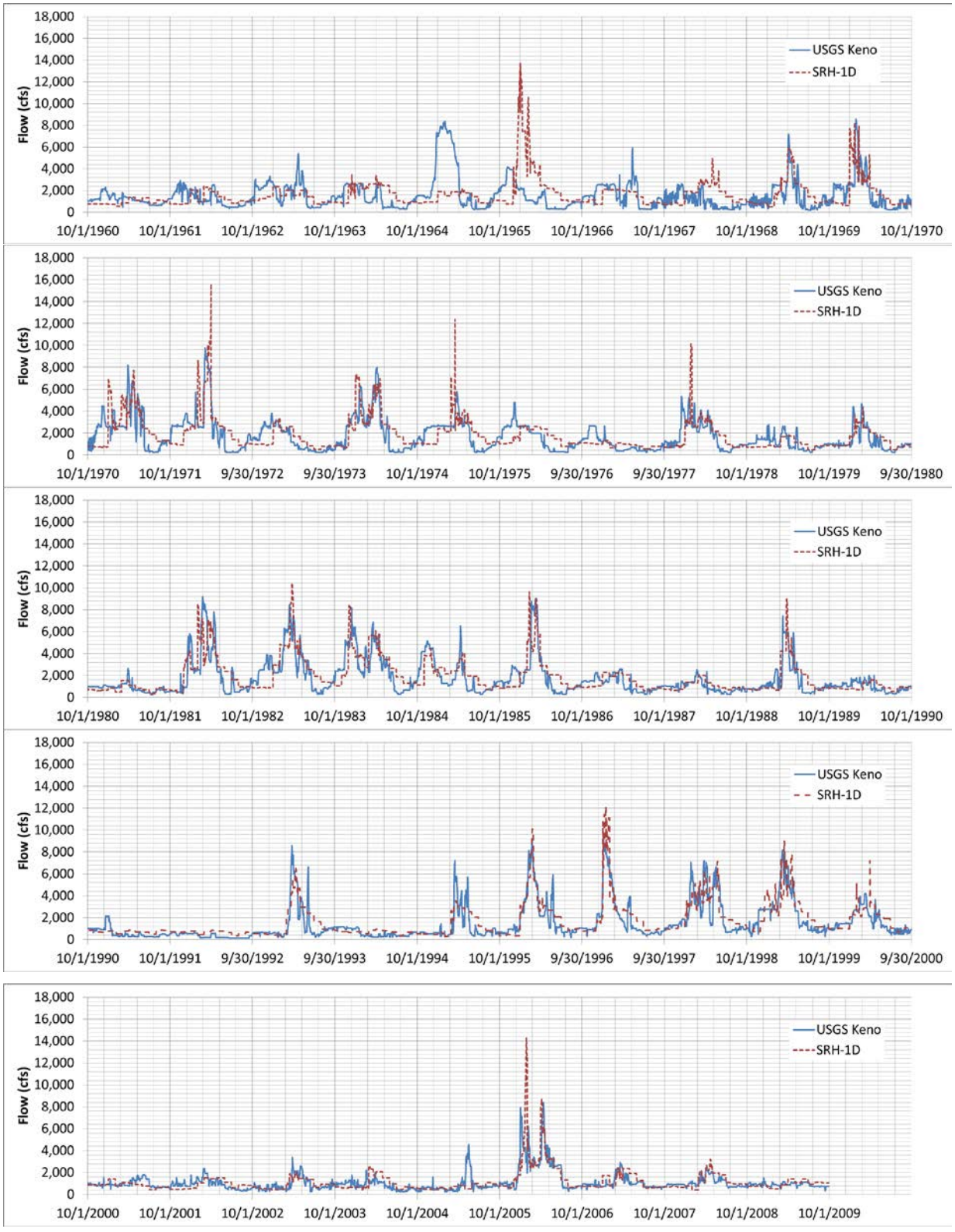


Figure 4.6-1 Comparison of Gauged Flows at Keno to Modeled Flows in SRH-1D

4.6.2 J.C. Boyle Reservoir

Drawdown Procedure

The following numbered list summarizes the drawdown procedure at J.C. Boyle:

1. Reservoir drawdown will begin on January 1, 2021 by making controlled releases through the gated spillway (crest elevation 3785.2) and the power intake (invert elevation 3771.7). Additional discharges to the river during drawdown using the spillway and power canal will be on the order of the values shown in Table 4.6-1 but these will be short-term. Once the reservoir drawdown elevation (dependent on base inflow) stabilizes with both the spillway and power intakes fully open, KRRC's contractor will hold the reservoir elevation for about a week. However, because of the minimal storage available above the power intake invert, the water level in the reservoir will fluctuate in concert with the changing inflow. The maximum flow through the power intake is about 2,800 cfs. About 25% of the analyzed years for drawdown have an average flow in January greater than 2,800 cfs and almost 40% have a maximum flow greater than 2,800 cfs. Flows above about 2,800 cfs will go over the spillway.
2. With the reservoir at the lowest possible level (depending upon inflow) using spillway and power intake, drawdown will continue by removing the concrete stoplogs from one 9.5- by 10-foot bay of the 2-bay diversion culvert (invert elevation 3755.2) by blasting, if necessary.[13] There is relatively little storage below the spillway crest elevation compared to storm volumes, so the elevation will change rapidly with changes in inflow rate. Additional drawdown releases will rapidly increase to a maximum of about 3,000 cfs for a short duration dropping back to near the inflow value over a period of a few hours. For reference, the 2-year and 5-year flow events downstream of J.C. Boyle Dam are 4,736 cfs and 7,719 cfs, respectively. The reservoir elevation will be allowed to stabilize and be held for one to two weeks to allow dissipation of pore pressures in the embankment and the reservoir rim.
3. With the reservoir at the lowest possible level (depending upon inflow), drawdown will continue by removing the concrete stoplogs from the remaining two 9.5- by 10-foot diversion culverts (invert elevation 3755.2) by blasting, if necessary.[14] Additional drawdown releases will rapidly increase to a maximum of 1,000 to 2,000 cfs for a short duration, dropping back to the inflow value over a period of about an hour or less. This will provide the maximum reservoir drawdown possible prior to removal of the dam embankment section, except for the natural drawdown resulting from the subsequent reduction of streamflow. The reservoir drawdown should be completed by January 31, 2021 to minimize potential impacts at the downstream dam removal sites. KRRC assumes the potential formation of reservoir ice in January at this site will not impact reservoir drawdown significantly during this period. Reservoir releases at the dam will be maintained below any ice cover.
4. The timing of the removal of the stoplogs from either diversion culvert will take into consideration inflow conditions with a possibility of shifting stoplog removal to avoid contributing additional flow during very high flow conditions. The power intake gate will be closed once the reservoir is drawn

[13] For modeling purposes, KRRC assumes the 1st culvert opens on January 14.
[14] For modeling purposes, KRRC assumes the 2nd culvert opens on February 1.

down below the intake invert or following removal of the stoplogs from the second bay of the diversion culvert, whichever is earlier, and the power canal will be drained through the powerhouse turbines, not through the forebay spillway.

Results

Figures 4.6-2 through 4.6-7 show results from the HEC-RAS analysis for the six representative years discussed above. Because of the small size of the J.C. Boyle Reservoir, the reservoir will refill partially or completely during a storm until dam removal is complete. The capacity of the two diversion culverts for water levels below the spillway elevation is about 5,700 cfs. The results show about 15% of the years have a maximum January or February flow that exceeds 5,000 cfs and will result in reservoir refilling and associated flows over the spillway.

During the representative drier years (1973 and 1979, see Figures 4.6-6 and 4.6-7), the reservoir easily draws down in January, and it did not refill after that point.

During the representative wetter years of 1966[15], 2006 and 1986 (see Figures 4.6-2, 4.6-3 and 4.6-4), the reservoir completely draws down early (January to mid-February), but quickly refills later in the year when storms occur. The majority of the accumulated sediment will mobilize during the initial drawdown, and subsequent reservoir filling and drawdown is expected to cause only moderate increases in high suspended sediment (relative to background) (USBR 2012c).

For all water years, any increase in peak flows with drawdown compared to peak flows without drawdown is small due to the relatively limited amount of attenuation associated with the existing reservoir.

KRRC does not anticipate that sediment concentrations resulting from the proposed drawdown procedure and associated hydraulics will differ from those previously estimated (USBR 2012c).

[15] Largest storm of record occurred between December 1964 and April 1965 in WY1965, but due to the data shift noted in Section 4.6.1, this corresponds to WY1966 in the modeling.

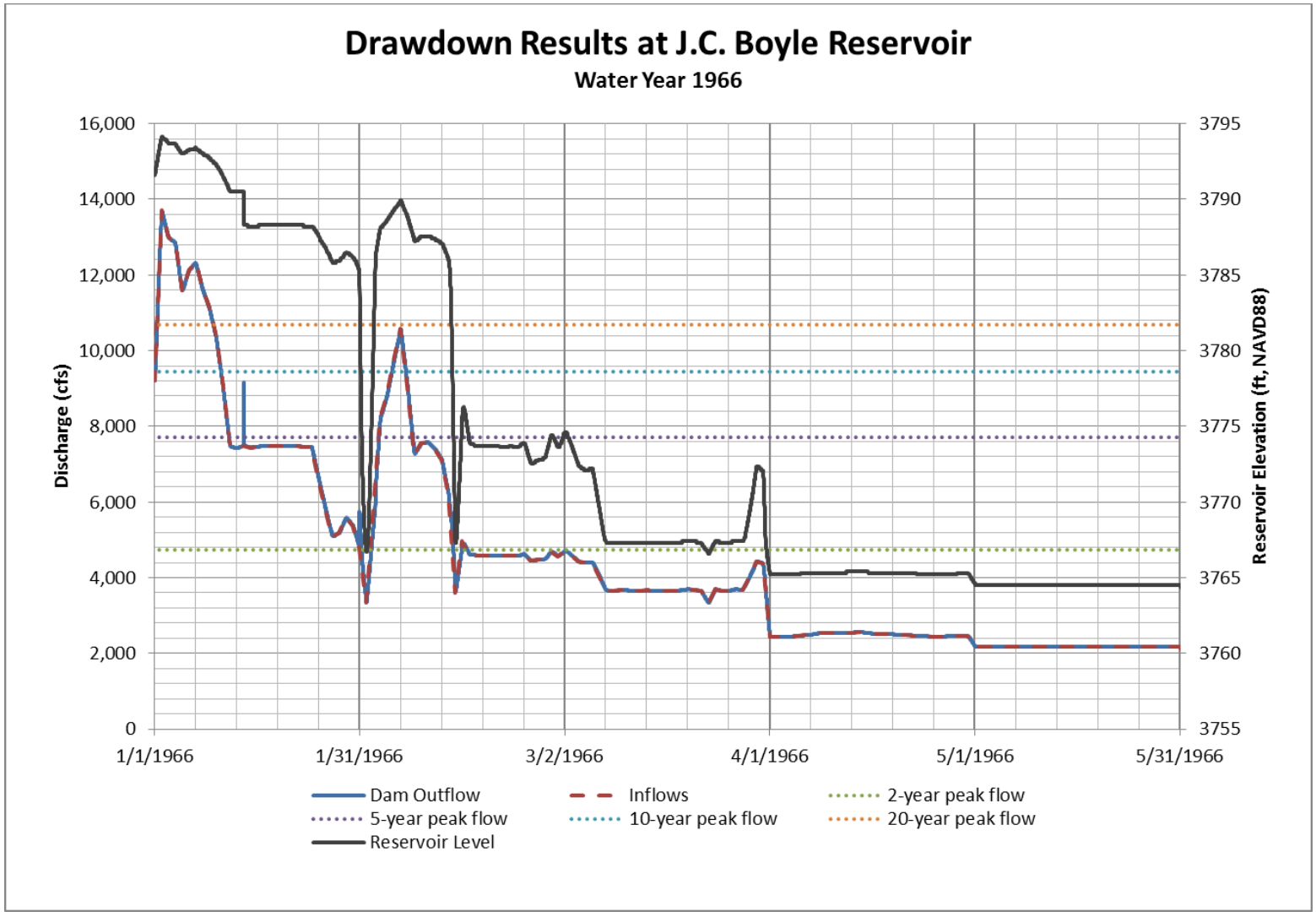


Figure 4.6-2 J.C. Boyle Reservoir Drawdown, Water Year 1966 (Wettest Year)

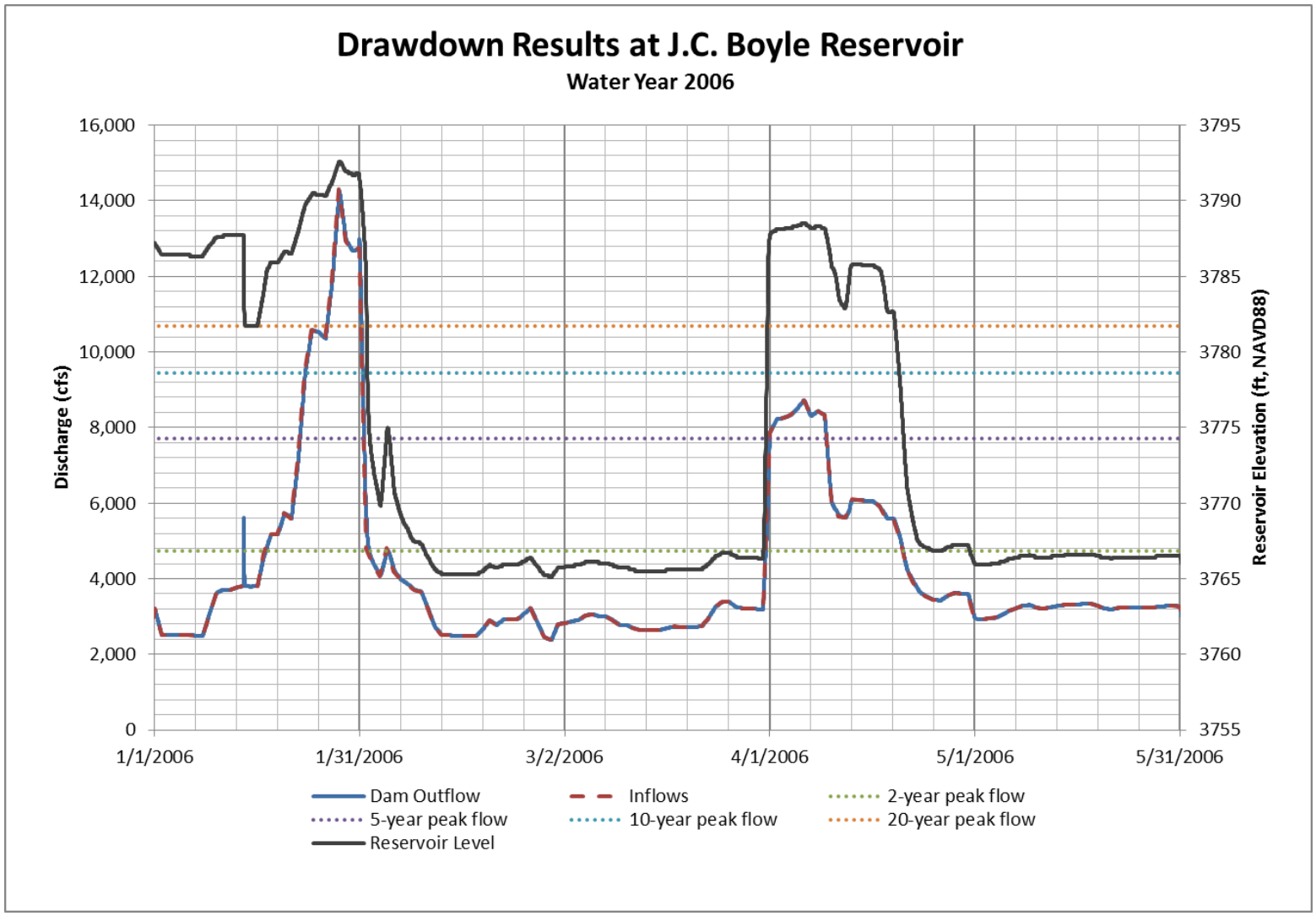


Figure 4.6-3 J.C. Boyle Reservoir Drawdown, Water Year 2006 (Wet Year)

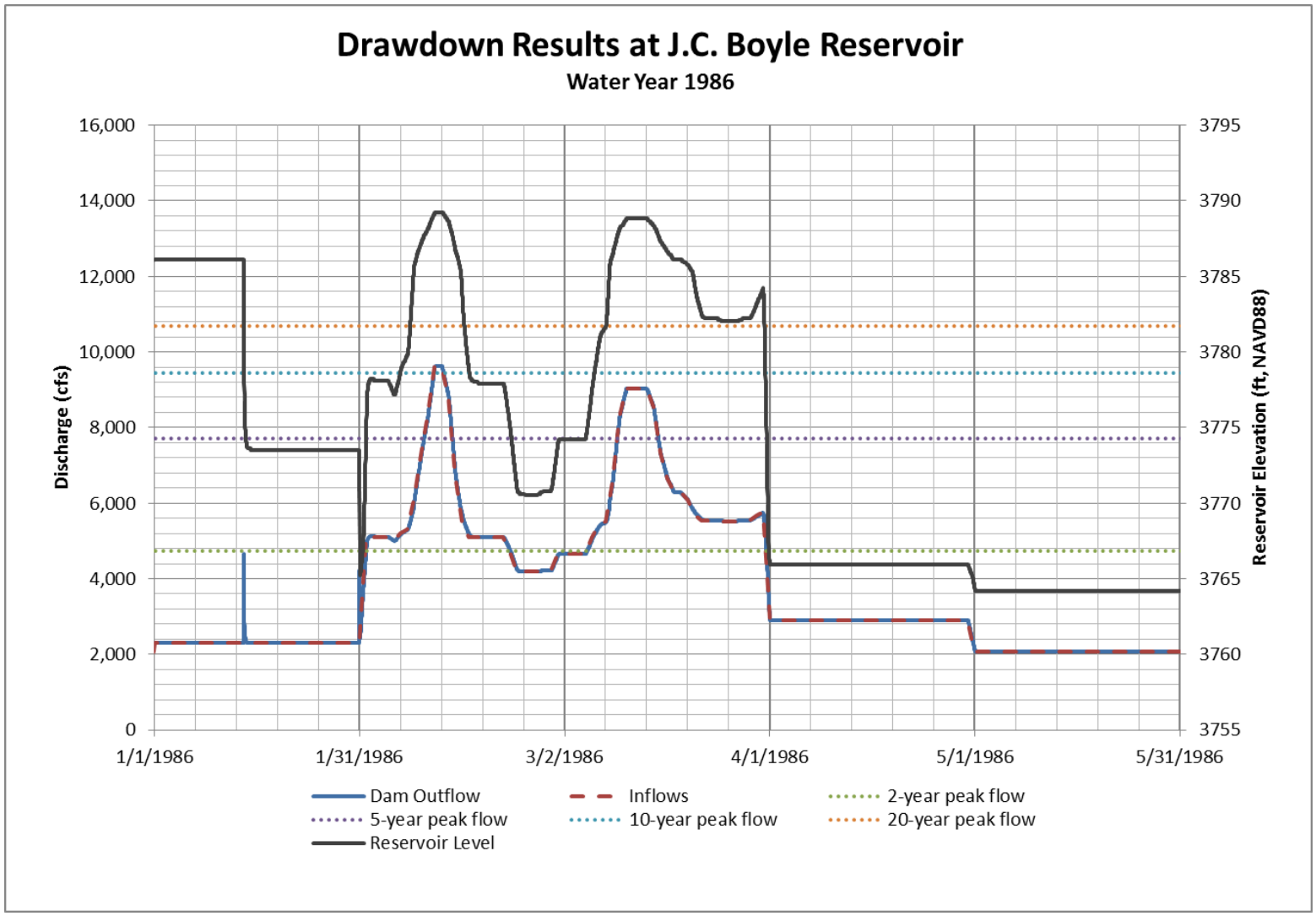


Figure 4.6-4 J.C. Boyle Reservoir Drawdown, Water Year 1986 (Wet Year)

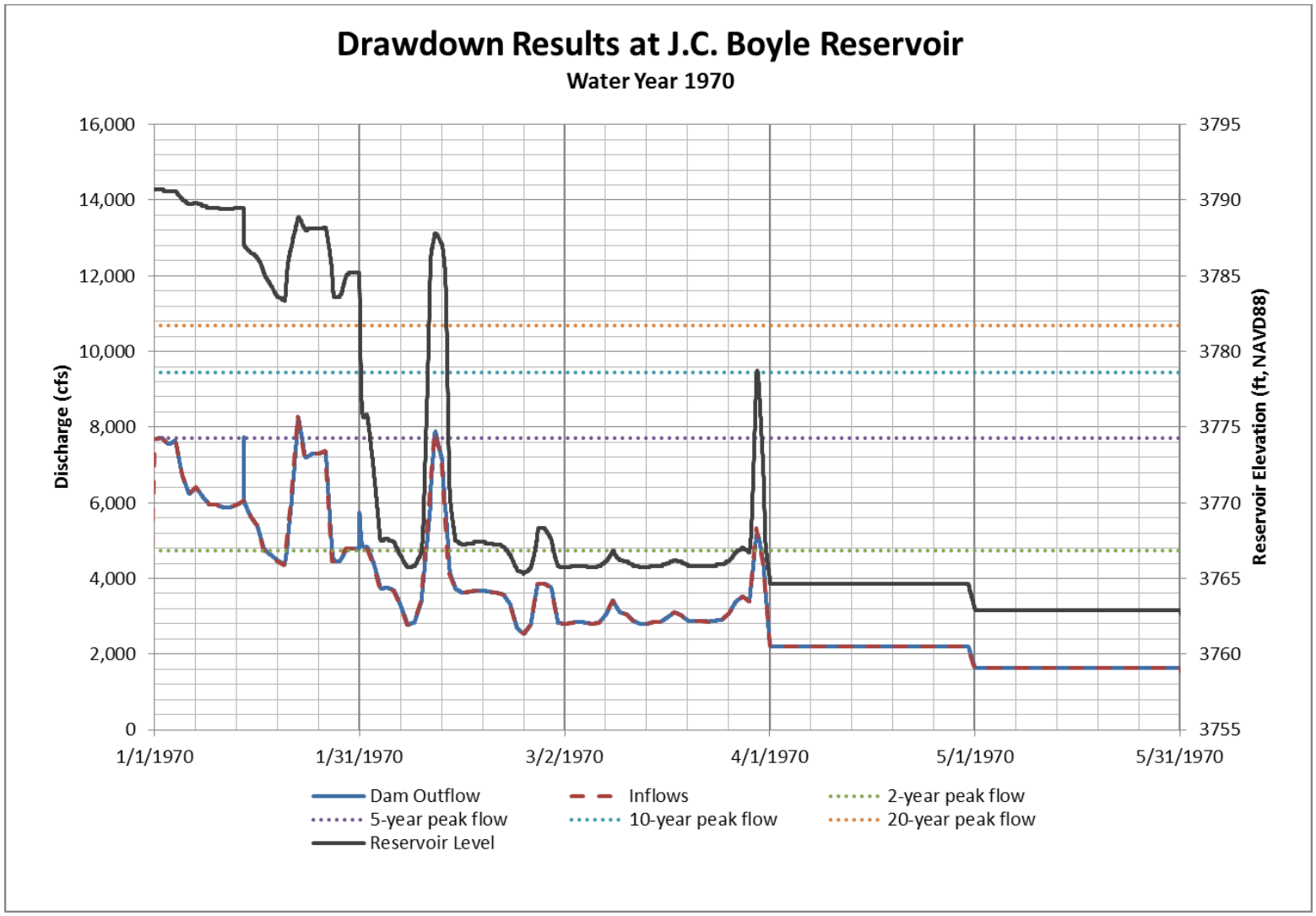


Figure 4.6-5 J.C. Boyle Reservoir Drawdown, Water Year 1970 (Above Normal Year)

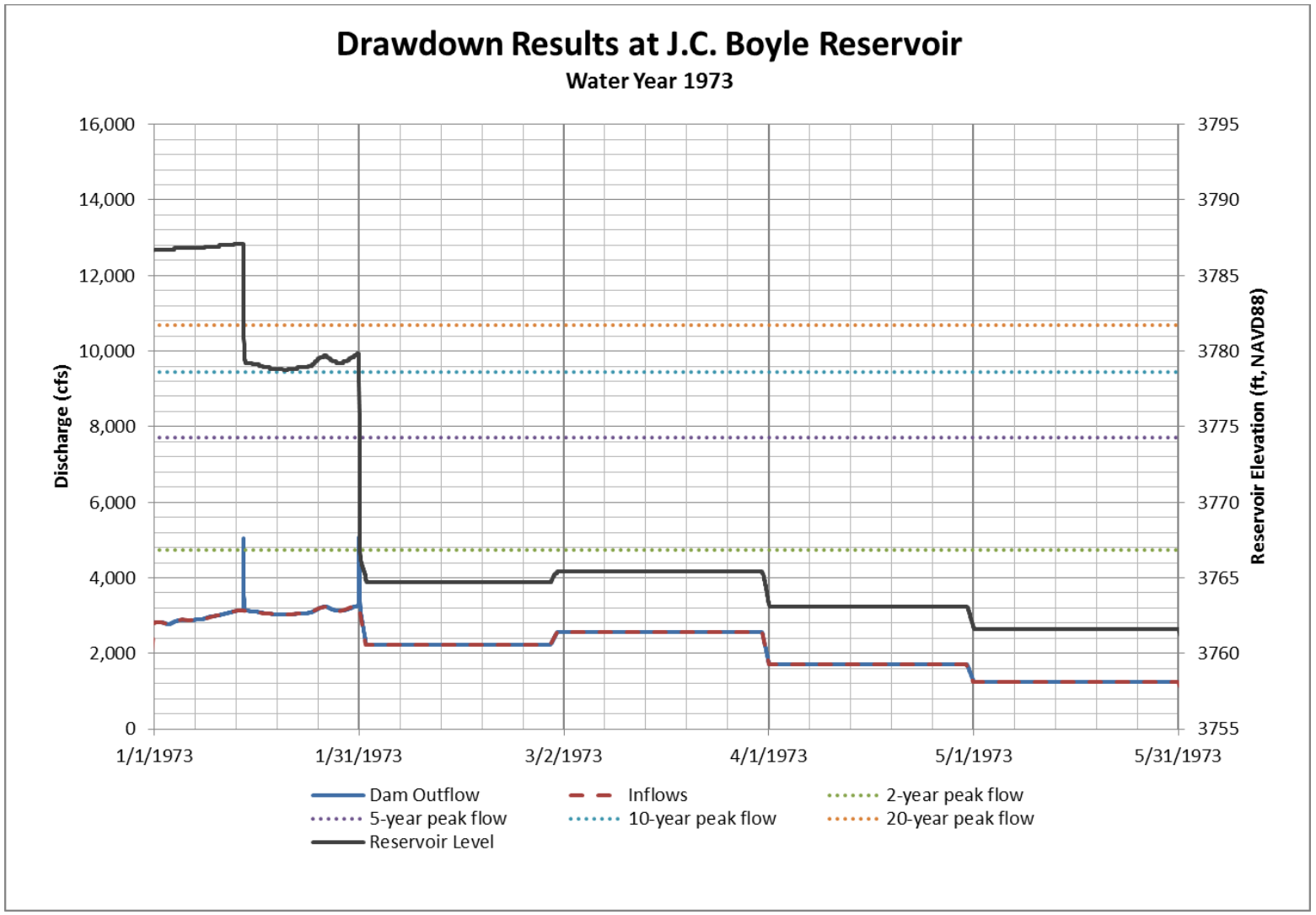


Figure 4.6-6 J.C. Boyle Reservoir Drawdown, Water Year 1973 (Normal Year)

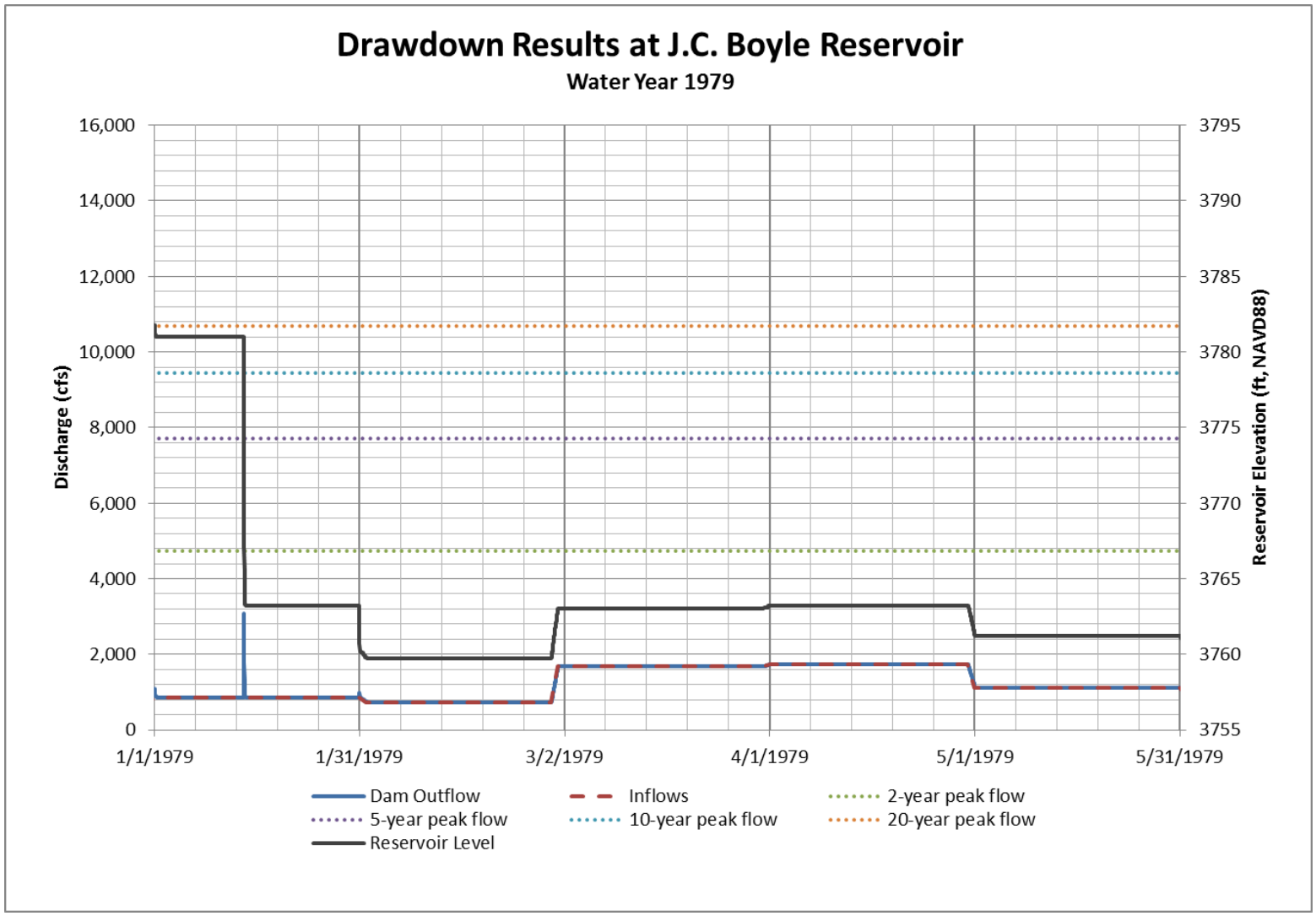


Figure 4.6-7 J.C. Boyle Reservoir Drawdown, Water Year 1979 (Dry Year)

4.6.3 Copco Lake

Drawdown Procedure

Drawdown of Copco Lake is discussed separately for the two tunnel modification options KRRC analyzed and described in Section 4.2.2.

Option 1 (for comparison only) – Diversion Tunnel Modified to Restore Capacity and Dam Notching:

The numbered list below summarizes the drawdown procedure at Copco Lake for Option 1:

1. Begin reservoir drawdown from normal operating elevation 2609.5 feet on November 1 in the year prior to the main drawdown by making controlled releases through the gated spillway (crest elevation 2597.0) and from the modified diversion tunnel. Continue releases to the powerhouse for power generation for as long as possible (minimum operating elevation 2604.5), although plant shutdown on November 1 has been assumed. Limit initial reservoir drawdown to the maximum historical drawdown rate of about 2 feet per day. KRRC expects no significant sediment release for this upper range of reservoir levels and rate of drawdown.
2. Once drawdown has begun, remove spillway features using a barge mounted crane (see Section 5.3).
3. Starting January 1, 2021, make controlled releases from the modified diversion tunnel. Limit reservoir drawdown to a maximum of 5 feet per day to maintain reservoir rim slope stability and to control drawdown releases from both reservoirs upstream of Iron Gate. Due to the limited capacity of the diversion tunnel modified to reuse the three 6-foot openings in the intake structure, the reservoir drawdown rate and reservoir elevation will be highly dependent on reservoir inflows, with full reservoir drawdown by March not possible for about 50 percent of historical flows between 1961 and 2008 (USBR 2012c).
4. To fully draw down the reservoir, notch the concrete dam with a series of 13 notches: an initial 24.5-foot notch, followed by 11 18–foot-deep notches (measured from lowered dam crest to notch elevation; sequentially lowering the notches in 6-foot increments), then a final notch of 22 feet down to the channel bed elevation. Proceed with lowering the dam crest in 6-foot lifts as the notching progresses. Bottom width of all notches is 8 feet. Locate the notches at the left abutment of the dam. Control instantaneous reservoir releases and drawdown rates during notching by excavating the notches in stages or by controlling the diversion tunnel discharge. The elevation of the first notch would be 2,572.5 feet. The elevation of the final notch would be at elevation 2484.5 (regardless of water year) with the lowered dam crest at elevation 2518.5. Target drawing down the reservoir to RWS elevation 2486.5 (reservoir level maintained by Copco No. 2 Dam) by March 15, 2021, to minimize downstream impacts due to sediment release. Retain Copco No. 2 Reservoir to permit continued power generation at the Copco No. 2 powerhouse.
5. Maximum additional discharge downstream of the dam due to drawdown activities is about 4,000 cfs immediately following opening of a notch (assuming an 18-foot-deep notch with a bottom width of 20 feet) with the additional flow due to drawdown decreasing as the reservoir level drops in

the notch. For reference, the 10-year, 20-year, 50-year, and 100-year flow events downstream of Copco No. 1 are about 11,300 cfs, 13,500 cfs, 16,560 cfs, and 18,950 cfs, respectively.

6. Successful reservoir drawdown using Option 1 is highly dependent on successful dam demolition and notching during January and February. There are several risks associated with Option 1 that should be considered:
   a) Safety of construction workers operating on very narrow, steep access roads during winter months with wet and icy conditions.
   b) Weather impacts to production that are likely to be worse in the wettest years when reservoir drawdown will rely on notching more than in dry years.
   c) During wet years, complete drawdown may not occur until notching is complete. If notching is delayed, drawdown will be delayed by an equal amount. [16]

Option 2 (proposed action) – Diversion Tunnel Modified to Increase Capacity

The numbered list below summarizes the drawdown procedure at Copco Lake for Option 2:

1. Begin reservoir drawdown from normal operating elevation 2609.5 feet on November 1 in the year prior to the main drawdown by making controlled releases through the gated spillway (crest elevation 2597.0) and from the modified diversion tunnel. Continue releases to the powerhouse for power generation for as long as possible (minimum operating elevation 2604.5), although plant shutdown on November 1 has been assumed. Limit initial reservoir drawdown to the maximum historical drawdown rate of about 2 feet per day. No significant sediment release is expected for this upper range of reservoir levels and rate of drawdown.
2. Once drawdown has begun, remove spillway features using a barge mounted crane (see Section 5.3).
3. Starting January 15, 2021, make controlled releases from the new gate structure. With Option 2, drawdown releases are delayed two weeks after drawdown releases begin at Iron Gate Dam (January 1) to create additional reservoir capacity at Iron Gate, [17] which will better handle drawdown releases from Copco Lake and help attenuate outflows from Iron Gate Reservoir due to storms. Limit reservoir drawdown to 5 feet per day to maintain reservoir rim slope stability and control drawdown releases from both reservoirs upstream of Iron Gate Reservoir.
4. Maximum additional discharge downstream of the dam due to drawdown activities is about 6,000 cfs when the gate is opened on January 15. During other times the increase is generally 1,000 to 2,000 cfs. The total discharge capacity of the new gate structure with the reservoir at the spillway crest elevation 2597.0 feet is nearly 12,000 cfs. As water levels increase above the spillway crest, the gate will be closed down to limit the total discharge to 13,000 cfs to avoid high water levels that will impact power production at Copco No. 2 powerhouse.
5. For reference, the 10-year, 20-year, 50-year, and 100-year flow events downstream of Copco No. 1 are 11,300 cfs, 13,500 cfs, 16,560 cfs, and 18,950 cfs, respectively.

[16] For modeling, it was assumed a notch would be delayed if the water level was less than 1 foot below the lowered crest.
[17] Without this delay, Iron Gate Reservoir would often remain full until Copco Lake is drawn down and outflows are decreasing because the increased Copco diversion tunnel capacity is similar to the Iron Gate diversion tunnel capacity.

Results

Figures 4.6-8 through 4.6-13 show the drawdown results for Copco No. 1 for both drawdown options.

In general, Option 1 with notching performs worse than Option 2 in terms of minimizing peak flows and drawdown duration, particularly in wet years. Therefore, KRRC proposes to proceed with Option 2 for Copco No. 1 drawdown, and the remainder of the results discussion will focus on Option 2.

During the representative dry years (1973 and 1979, see Figures 4.6-12 and 4.6-13), the reservoir easily draws down by the end of February, and does not refill after that point.

For Option 2 during the wetter years of 1966, 2006, 1986, and 1970 (see Figures 4.6-8 and 4.6-11), the reservoir completely draws down by the end of Febrary, but in some cases partially refills later in the year when storms occur. The majority of the accumulated sediment will mobilize during the initial drawdown, and subsequent reservoir filling and drawdown is expected to cause only moderate increases in high suspended sediment (relative to background) (USBR 2012c).

For Option 2 during the wetter years of 1966, 2006, 1986, and 1970 (see Figures 4.6-8 and 4.6-11), flows are higher than what will be expected via the spillway alone (i.e., without drawdown), but the increases are limited to those periods when flows are below the 10-year flood elevation. As discussed above (see Figure 4.6-1), the peak inflows used in the model are occasionally greater than the measured USGS peak flow for that year. In those cases, the peak outflow from the reservoir during drawdown may exceed the peak flow recorded by USGS for that year. This is due to the use of larger inflows rather than due to an increase in flow in the river due to drawdown.

KRRC does not anticipate that sediment concentrations resulting from the proposed drawdown procedure and associated hydraulics will differ from those previously estimated (USBR 2012c).

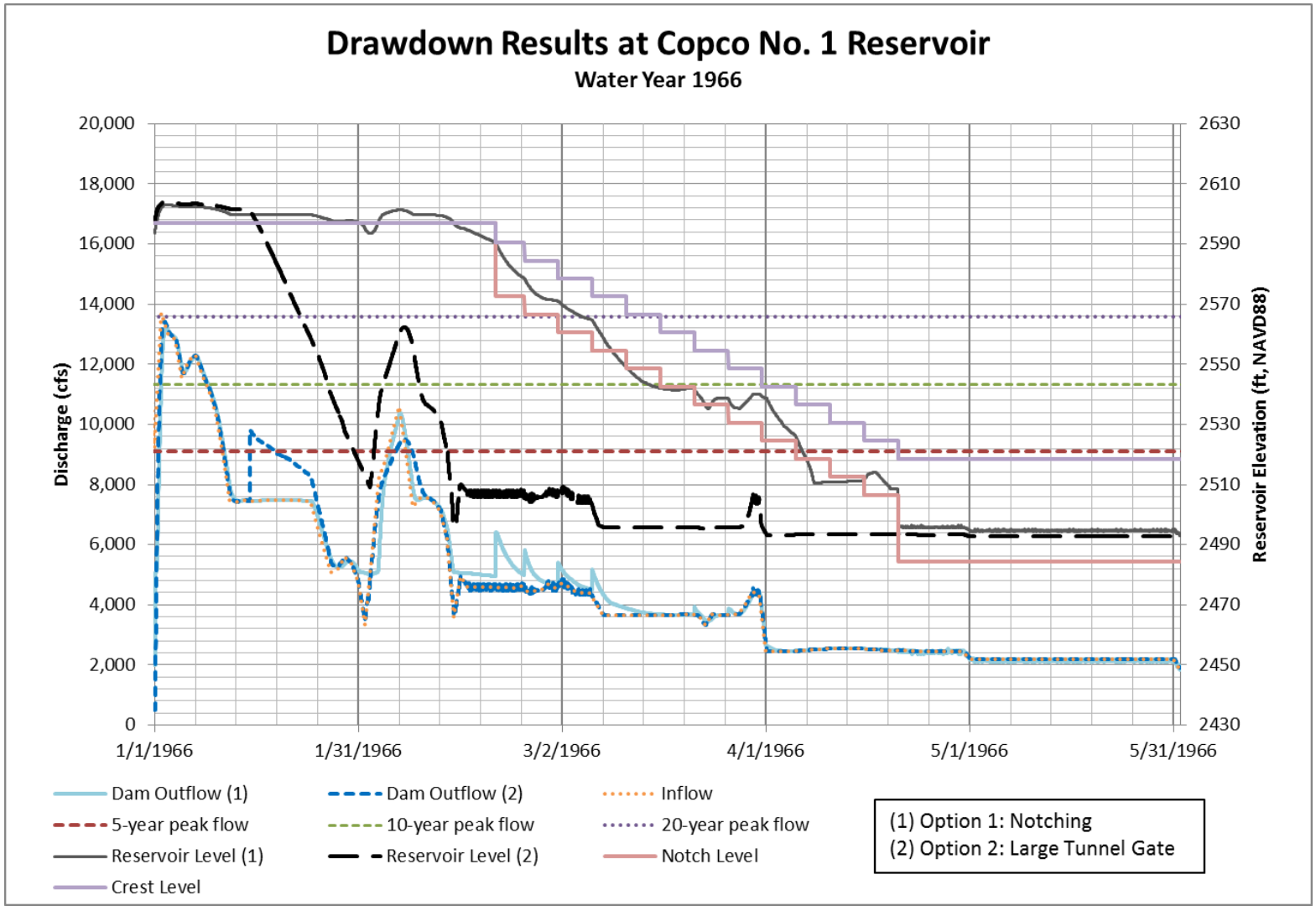


Figure 4.6-8 Copco No. 1 Reservoir Drawdown, Water Year 1966 (Wettest Year)

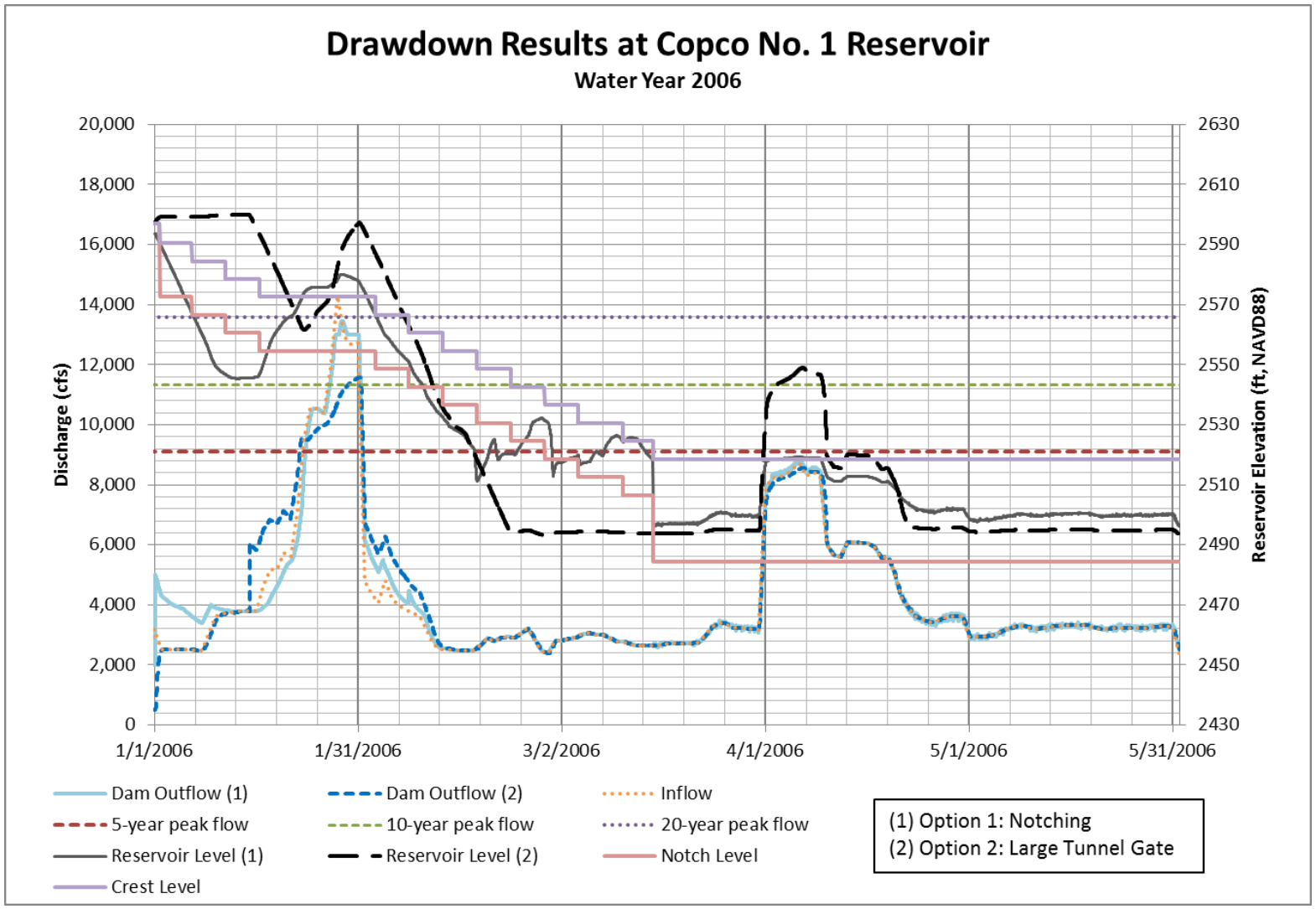


Figure 4.6-9 Copco No. 1 Reservoir Drawdown, Water Year 2006 (Wet Year)

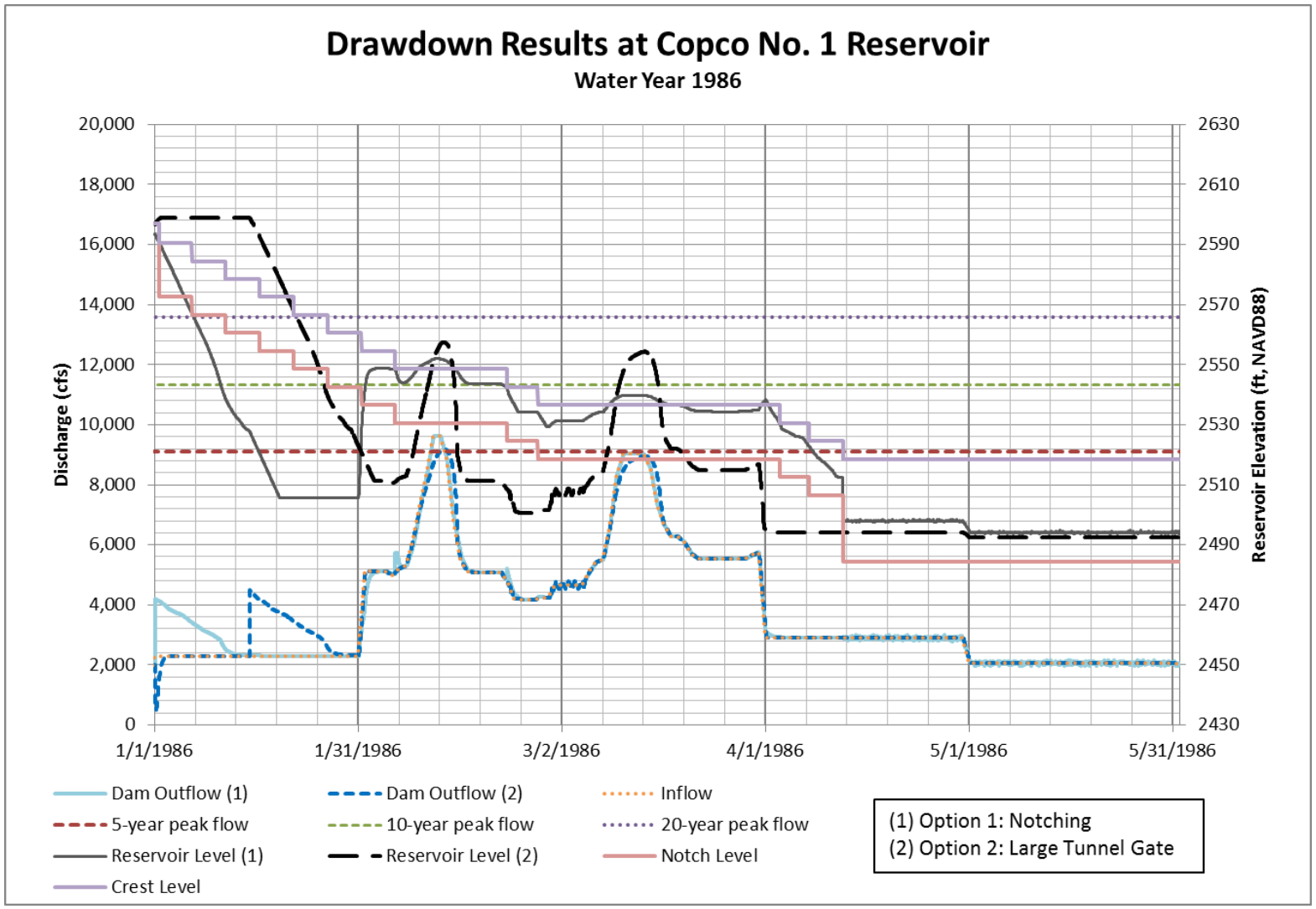


Figure 4.6-10 Copco No. 1 Reservoir Drawdown, Water Year 1986 (Wet Year)

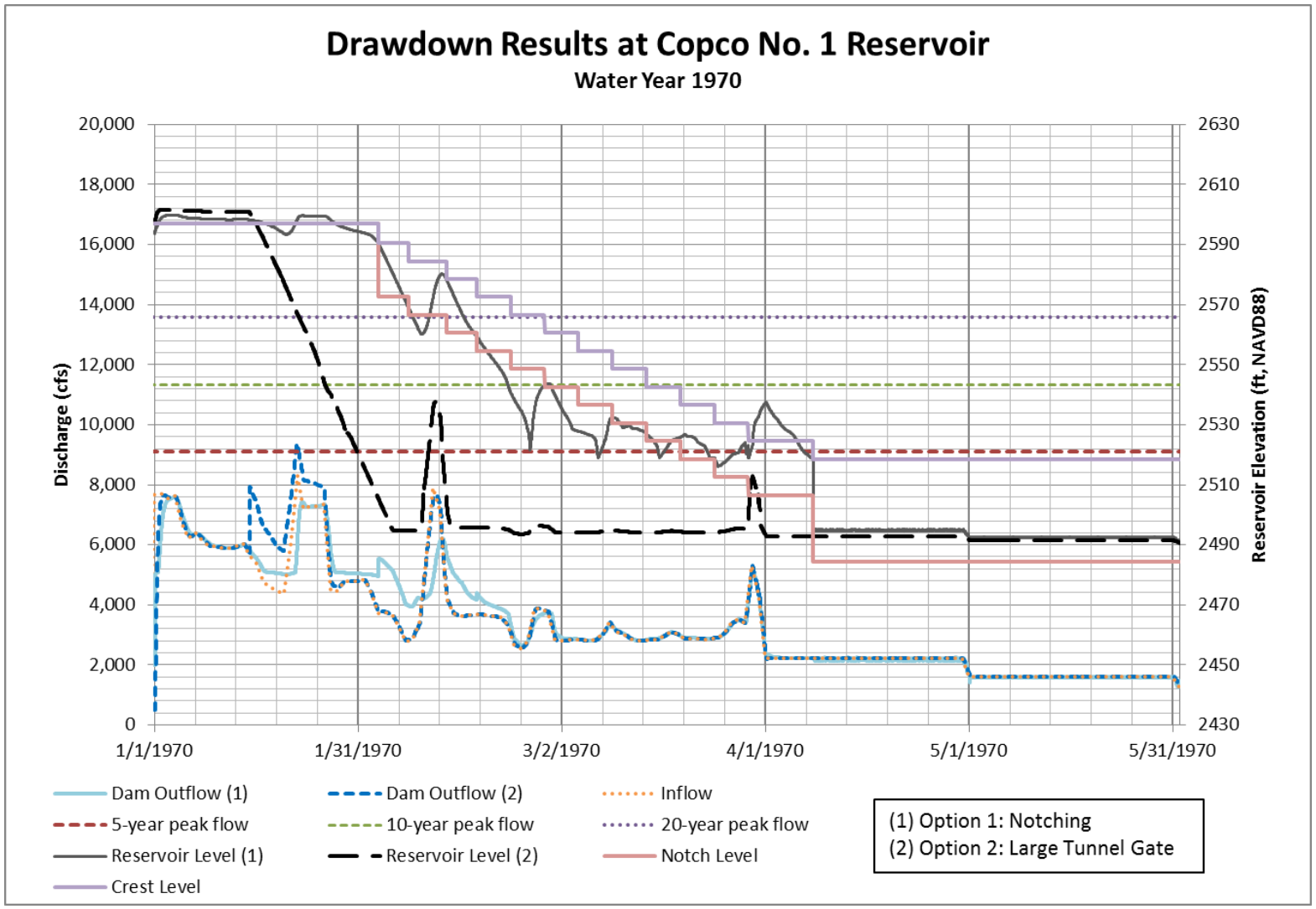


Figure 4.6-11 Copco No. 1 Reservoir Drawdown, Water Year 1970 (Above Normal Year)

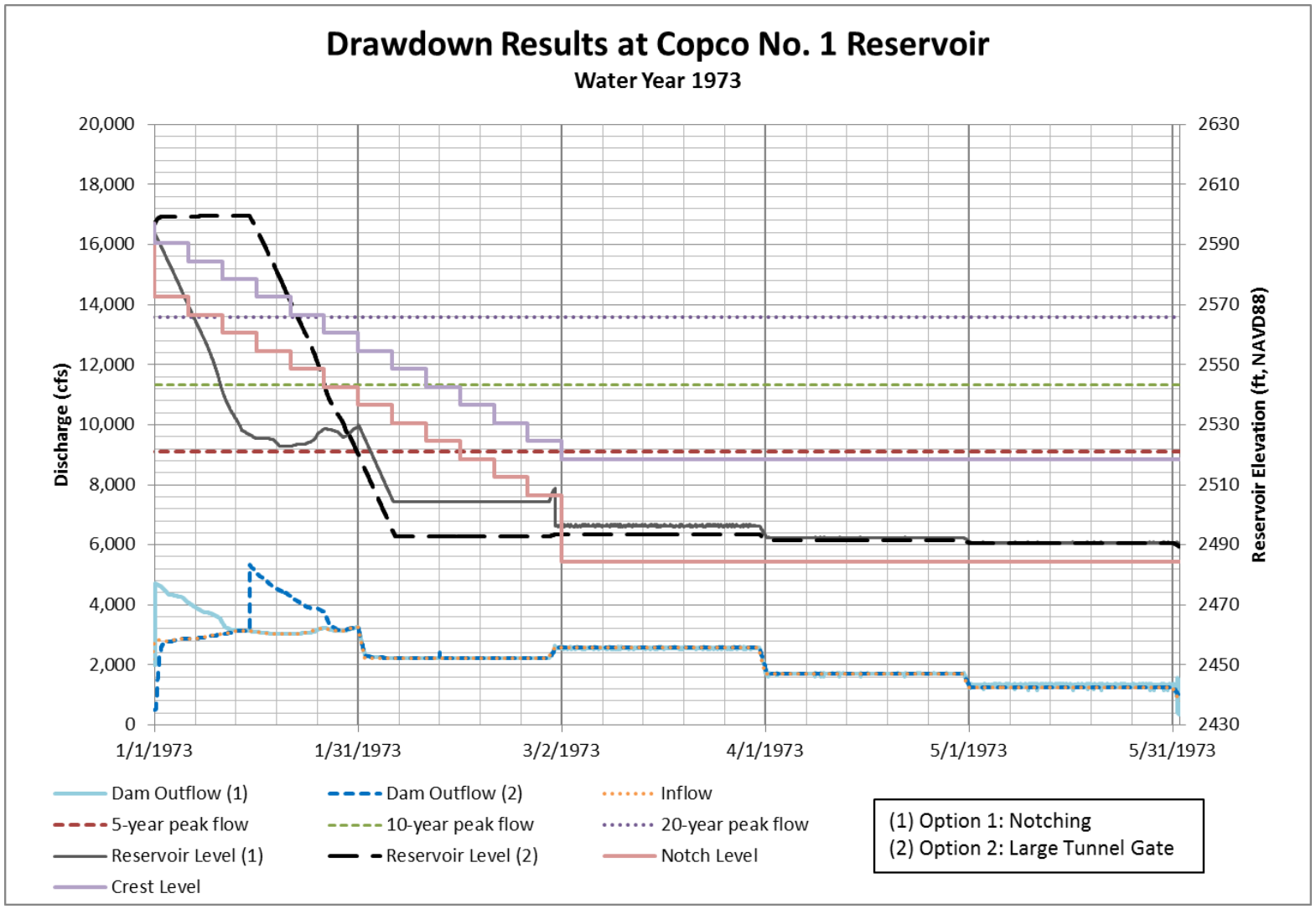


Figure 4.6-12 Copco No. 1 Reservoir Drawdown, Water Year 1973 (Median Year)

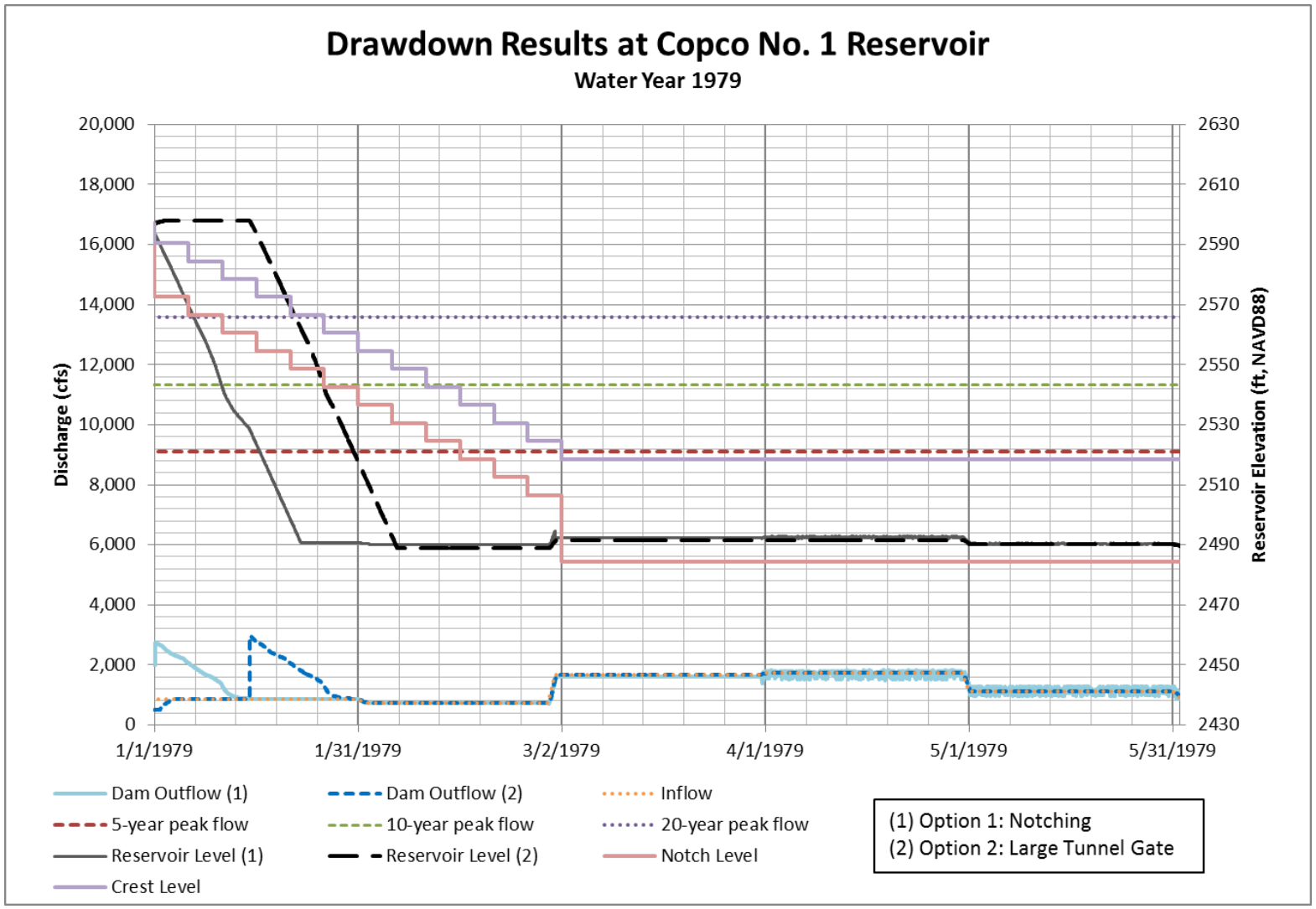


Figure 4.6-13 Copco No. 1 Reservoir Drawdown, Water Year 1979 (Dry Year)

4.6.4 Iron Gate Reservoir

Drawdown Procedure

Begin reservoir drawdown from normal operating elevation 2331.3 feet on January 1, 2021 by making controlled releases through the modified diversion tunnel. Limit reservoir drawdown to a maximum of 5 feet per day to maintain reservoir rim slope stability. Maximum additional discharge downstream of the dam due to drawdown activities is about 4,000 cfs. The total discharge capacity of the modified diversion tunnel with the reservoir at spillway crest elevation 2331.3 is about 10,000 cfs. For reference, the 5-year flow event downstream of Iron Gate Dam is 10,900 cfs.

Results

Due to their close proximity, KRRC modeled the Iron Gate Reservoir drawdown in conjunction with the Copco Lake drawdown. Figures 4.6-14 through 4.6-19 show results from the HEC-RAS analysis for the six representative years. There are different results at Iron Gate Reservoir depending on which drawdown option at Copco No. 1 Dam is incorporated. References to Options 1 and 2 in the plots in this section are the resulting effects at Iron Gate based on either Option 1 or 2 being implemented at Copco No. 1 Dam. Since KRRC proposes Option 2 for the Project, the remaining results discuss only Option 2.

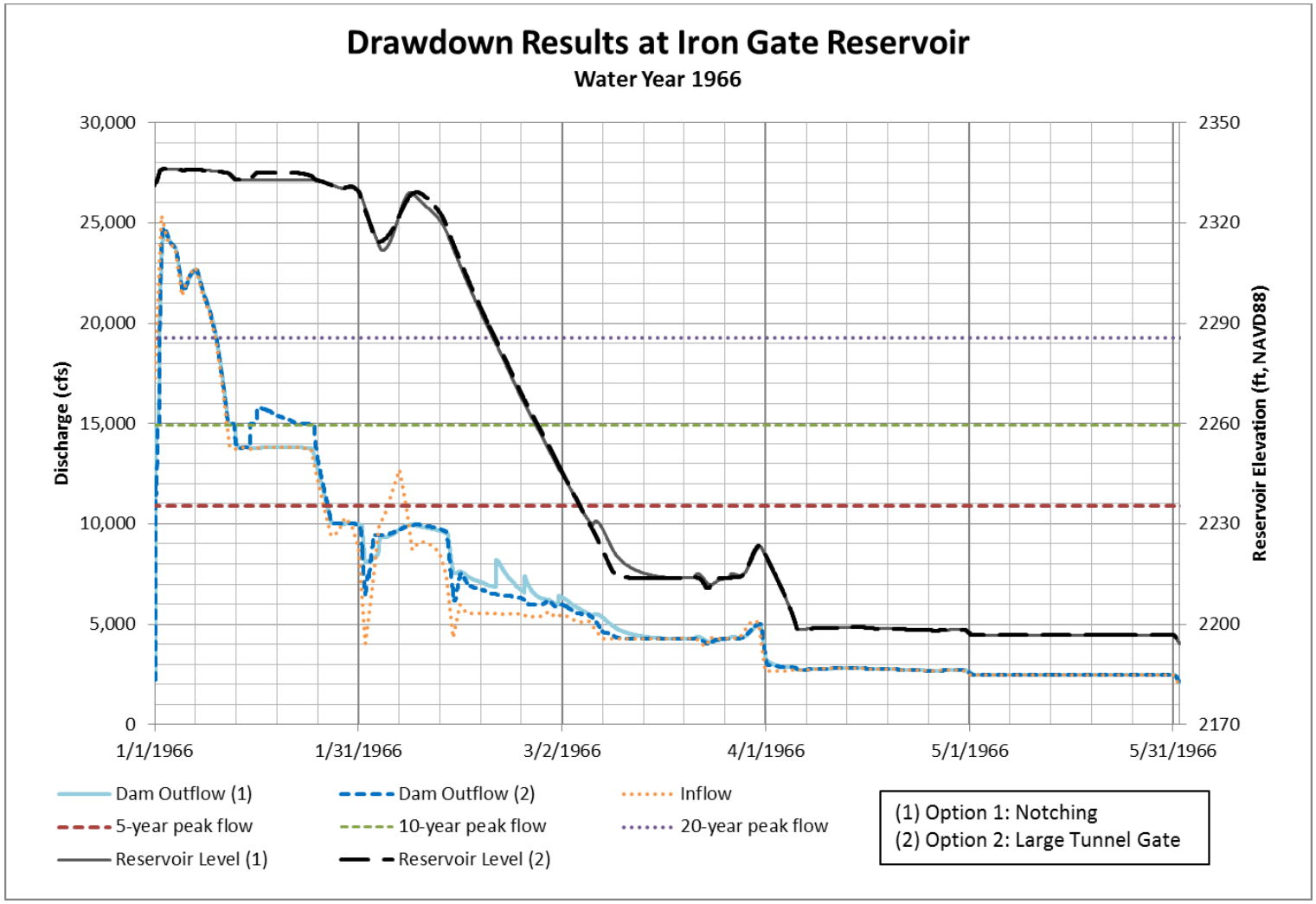
During the representative drier years (1973 and 1979, see Figures 4.6-18 and 4.6-19), the reservoir easily draws down by early February, and it did not refill after that point.

During the wetter years of 2006 and 1986 (see Figures 4.6-15 and 4.6-16), the reservoir draws down by the end of February, but partially refills later in the year when storms occurred. The majority of the accumulated sediment will mobilize during the initial drawdown, and subsequent reservoir filling and drawdown is expected to cause only moderate increases in high suspended sediment (relative to background) (USBR 2012c).

For the wettest year (1966, see Figure 4.6-14) the reservoir draws down by early March, but the probability of a storm of this magnitude occurring in the drawdown year is low.

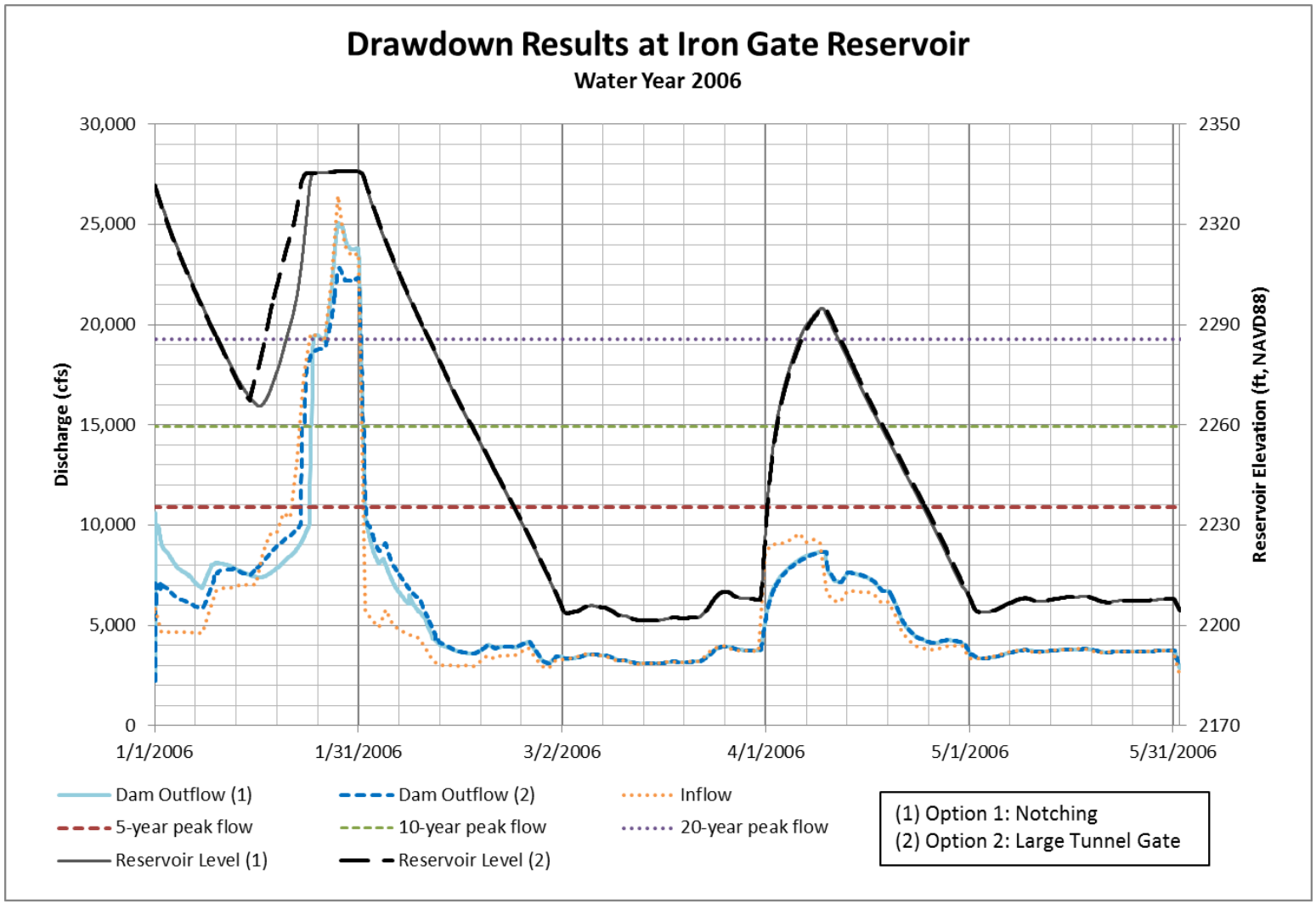
During the wetter years of 1966, 2006, 1986, and 1970 (see Figures 4.6-14 and 4.6-17), flows are higher than what will be expected via the spillway alone (i.e., without drawdown), but the increases are mainly limited to those periods when flows are below the 10-year flood elevation. As discussed above (see Figure 4.6-1), the peak inflows used in the model are occasionally greater than the measured USGS peak flow for that year. In those cases, the peak outflow from the reservoir during drawdown may exceed the peak flow recorded by USGS for that year. This is due to the use of larger inflows rather than due to an increase in flow in the river due to drawdown.

KRRC does not anticipate that sediment concentrations resulting from the proposed drawdown procedure and associated hydraulics will differ from those previously estimated (USBR 2012c).



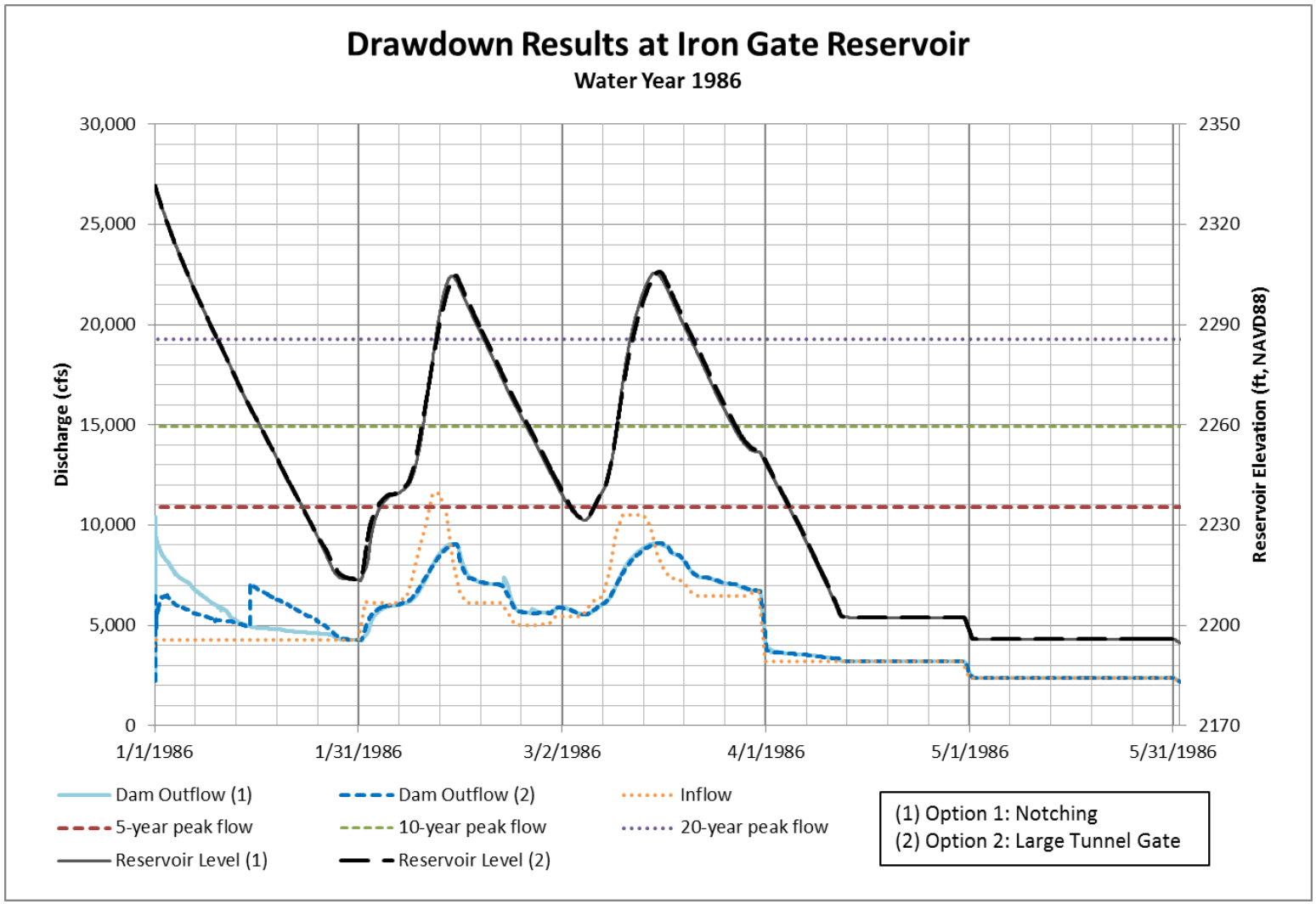
References to Options 1 and 2 in the plots are the resulting effects at Iron Gate based on either Option 1 or 2 being implemented at Copco No. 1 Dam.

Figure 4.6-14 Iron Gate Reservoir Drawdown, Water Year 1966 (Wettest Year)



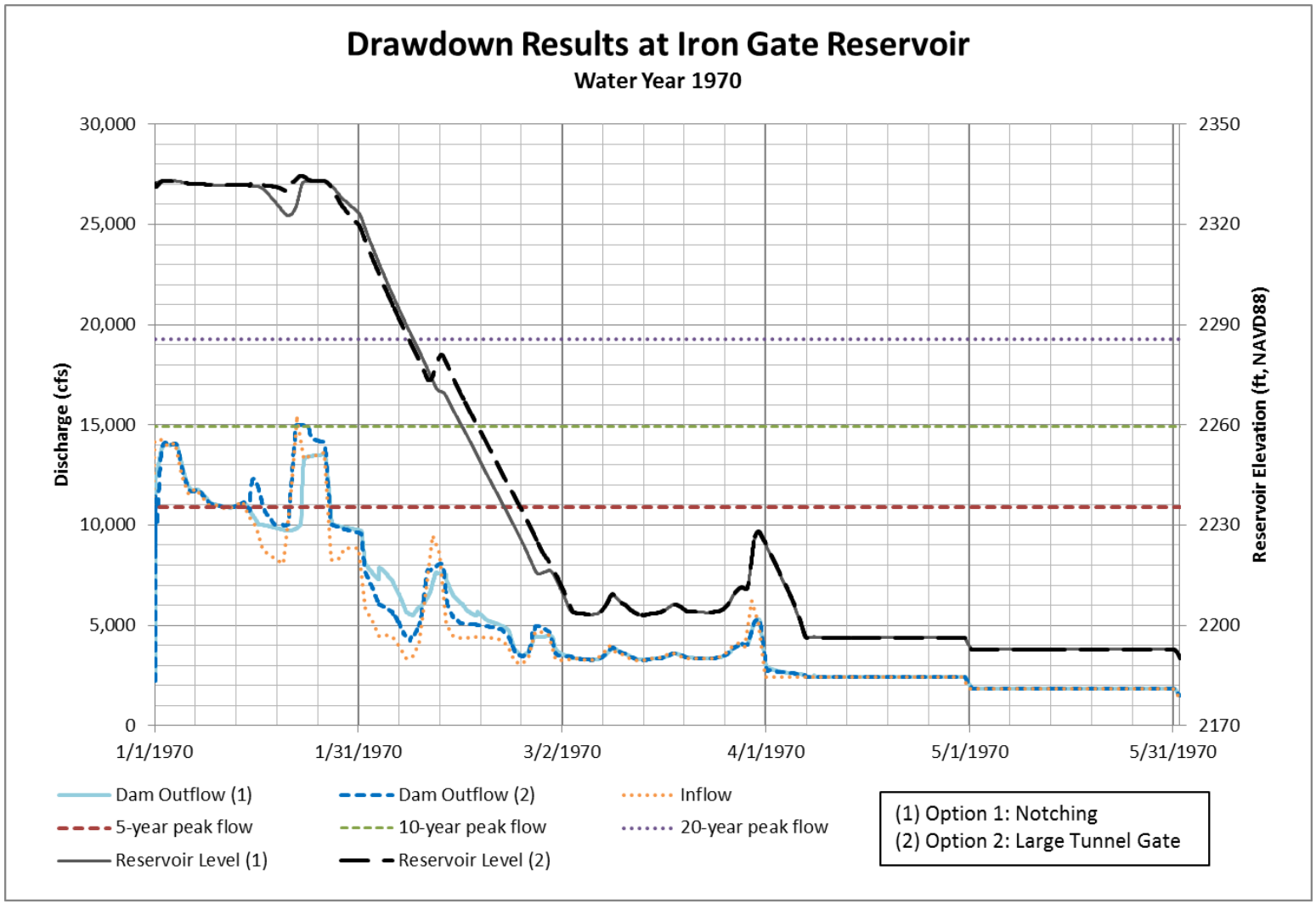
References to Options 1 and 2 in the plots are the resulting effects at Iron Gate based on either Option 1 or 2 being implemented at Copco No. 1 Dam.

Figure 4.6-15 Iron Gate Reservoir Drawdown, Water Year 2006 (Wet Year)



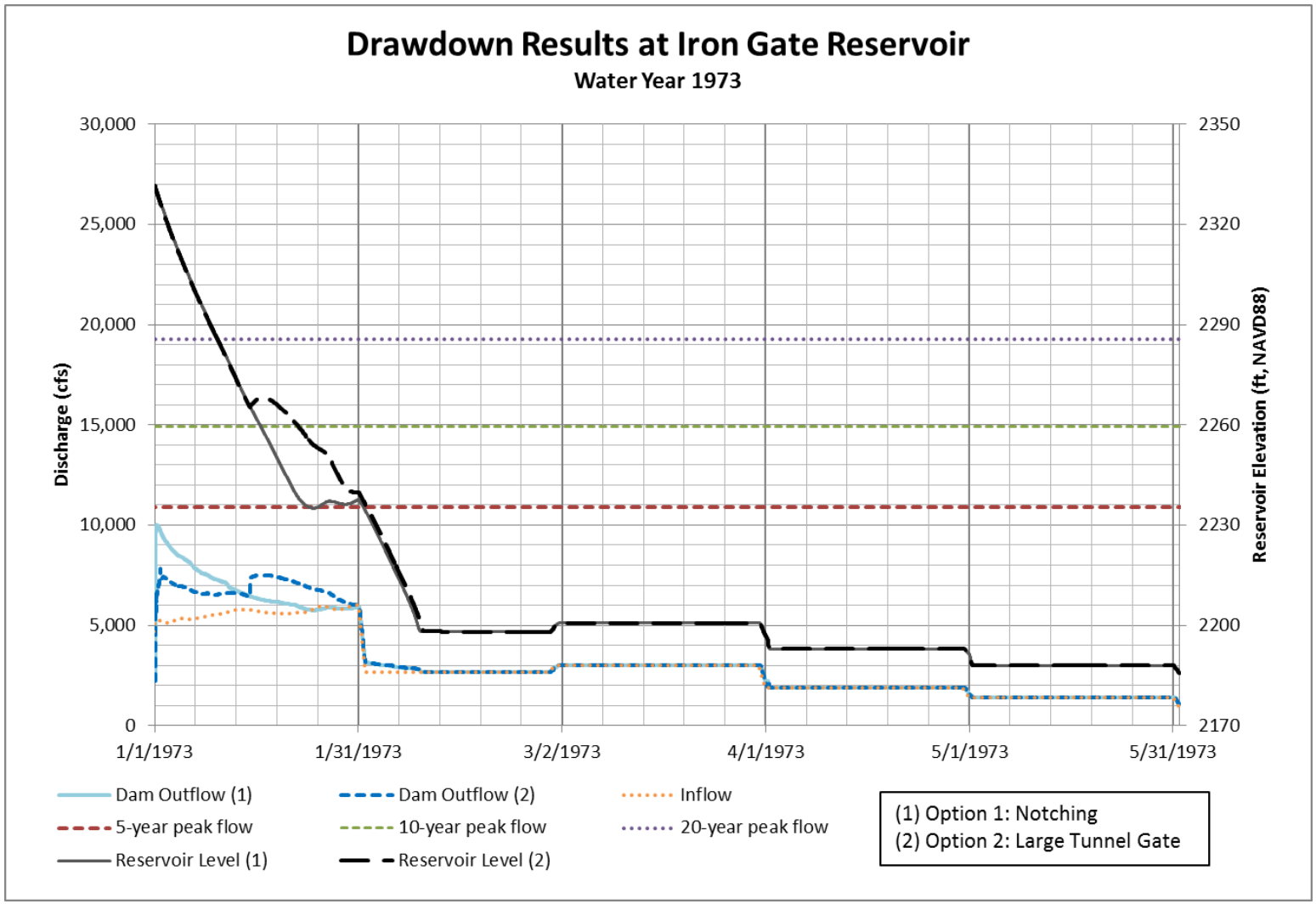
References to Options 1 and 2 in the plots are the resulting effects at Iron Gate based on either Option 1 or 2 being implemented at Copco No. 1 Dam.

Figure 4.6-16 Iron Gate Reservoir Drawdown, Water Year 1986 (Wet Year)



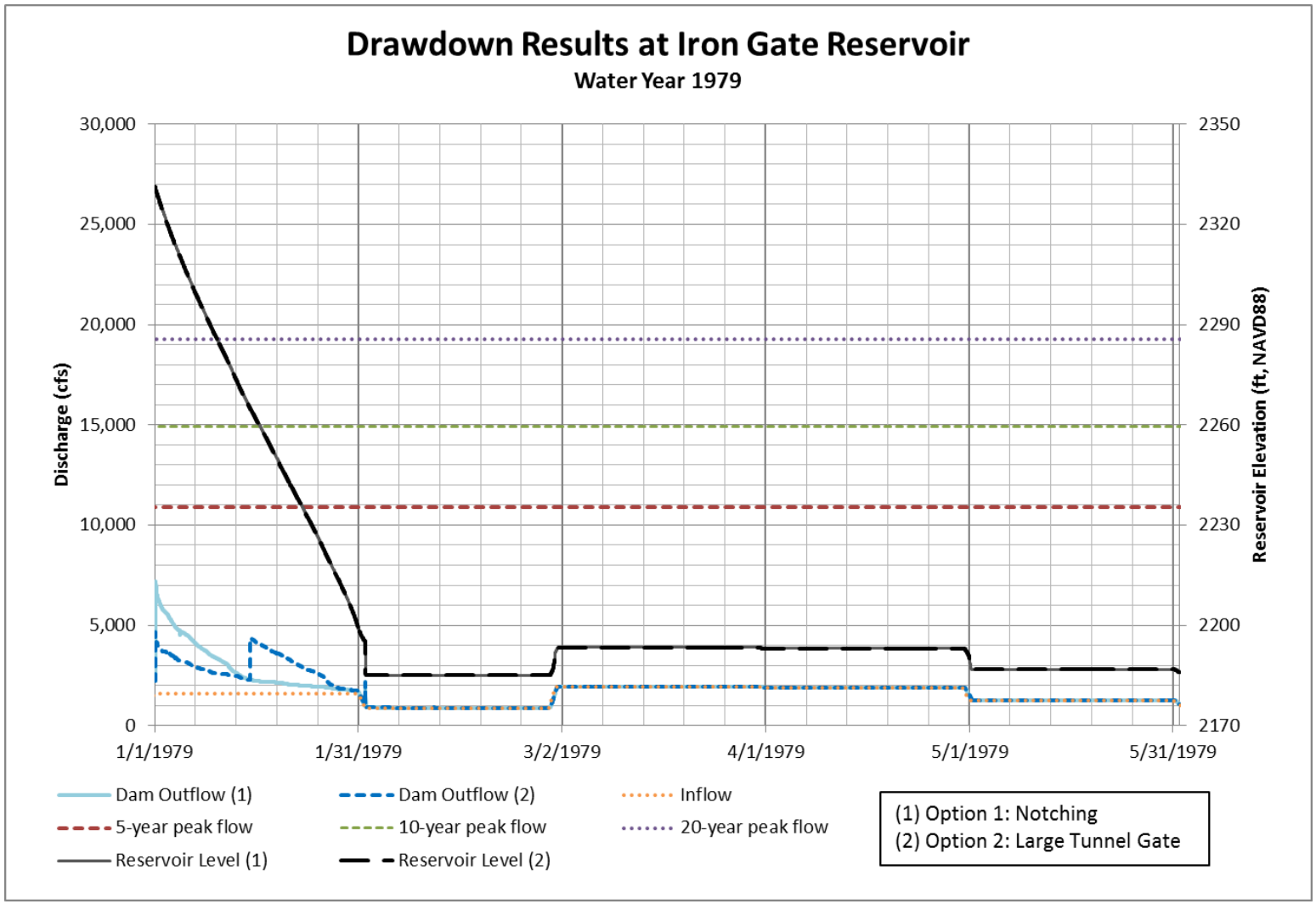
References to Options 1 and 2 in the plots are the resulting effects at Iron Gate based on either Option 1 or 2 being implemented at Copco No. 1 Dam.

Figure 4.6-17 Iron Gate Reservoir Drawdown, Water Year 1970 (Above Normal Year)



References to Options 1 and 2 in the plots are the resulting effects at Iron Gate based on either Option 1 or 2 being implemented at Copco No. 1 Dam.

Figure 4.6-18 Iron Gate Reservoir Drawdown, Water Year 1973 (Median Year)



References to Options 1 and 2 in the plots are the resulting effects at Iron Gate based on either Option 1 or 2 being implemented at Copco No. 1 Dam.

Figure 4.6-19 Iron Gate Reservoir Drawdown, Water Year 1979 (Dry Year)

4.6.5 Downstream of Iron Gate

KRRC analyzed the response of the river flows at Seiad Valley, Orleans, and Klamath USGS gauge station locations to the flows discharged during the reservoir drawdown. The analysis shows that the drawdown has negligible effect on peak downstream flows during wet and above normal years for several reasons:

- The proportion of flow contributed by the Klamath River at Iron Gate is smaller than the flows contributed by tributaries downstream.
- The drawdown distributes the flow over a longer time span than a typical storm event and provides attenuation in the reservoir once drawdown is underway.
- The capacity of the Iron Gate spillway, which is activated during storm events in the gauge record, is much higher (30,000 cfs and greater) than the capacity of the diversion tunnel being used to control drawdown (10,000 cfs maximum).

For normal years (based on flow rate), the analysis showed that the drawdown can increase flows downstream, especially when the recorded peak flow at Iron Gate is less than the discharge capacity available during drawdown. The increase in flow in normal water years is small compared to the flow magnitude and does not cause flows to exceed the 5-year return interval flow at Iron Gate.

KRRC completed the analysis using model output from the drawdown model described in Section 4.6.1 along with the recorded gauge data for the Iron Gate, Seiad Valley, Orleans, and Klamath USGS gauges and then comparing the hydrographs for the following water years:

- 1964 (normal)[18]
- 1965 (wettest year on record)[19]
- 1970 (above normal)
- 1974 (above normal)
- 1980 (normal)
- 1985 (normal)
- 1986 (wet)
- 1997 (wet)
- 2000 (normal)
- 2006 (wet)

The determination of wet, above normal, and normal water years was based on ranking the annual maximum 15-day volume of flow at the Keno gauge during the January to May months for the years 1961 to 2009 (similar to the rating described in Section 4.6.1).

[18] Water Year 1964 is model year 1965 due to the data shift described in Section 4.6.1.
[19] Water Year 1965 is model year 1966 due to the data shift described in Section 4.6.1.

Analysis Timing

During a storm event, the worst flooding occurs during the peak flow, the highest flow in the river channel. To understand the full effects the drawdown could have on downstream flows and floods, KRRC analyzed the effects of drawdown during peak flows of the flood events. For the analysis, KRRC aligned the timing of the drawdown peak discharge from the model with the peak recorded at the Iron Gate gauge in most of the analysis years. KRRC completed the alignment by altering the dates of the drawdown model output until the drawdown peak flow occurred on the same day as the recorded peak flow. KRRC used this approach because future flood events could occur with timing different than in the historical gauge record, and the worst-case flooding effects will occur with coincident peak flows. It is important to capture the effects that peak drawdown could have on the peak river flow when referring to flooding effects.

In most of the analysis years, the annual peak flow recorded at Iron Gate occurred concurrently with the annual peaks recorded at Seiad Valley, Orleans, and Klamath USGS gauges. In two of the normal years, 1985 and 2000, the annual peak at Iron Gate occurred during a separate and unrelated event from the peaks recorded at Seiad Valley and downstream. In these 2 years, the recorded annual peaks at Iron Gate occurred months later. Therefore, KRRC aligned the timing of the drawdown peak discharge from the model with the peak recorded at the Seiad Valley gauge for these 2 years.

Analysis Setup

The analysis involved comparing, on a daily basis, the recorded hydrograph for each year and each location to a synthetic hydrograph created using the drawdown model output. KRRC downloaded the daily flows and the annual peak flows for each gauge location from the USGS National Water Information System for the analysis years. To generate more representative hydrographs, KRRC substituted the recorded annual peak for the daily flow value on the day that the peak occurred. This generated the recorded hydrograph.

KRRC created the synthetic hydrographs as follows. For the Iron Gate USGS gauge location, KRRC used the drawdown model output to represent the flows during drawdown. For Seiad Valley, Orleans, and Klamath USGS gauge locations, KRRC created the synthetic hydrographs by taking the gauge record of each location, subtracting the flow recorded at the Iron Gate gauge on that day, and adding the flow from the drawdown model for the same day (after the date shift described above). KRRC then plotted the recorded and synthetic hydrographs for each gauge together to show the effect of drawdown.

Results

Table 4.6-2 and Figures 4.6-20 to 4.6-29 provide the results of the analysis.

The water operations model prepared by USBR (2012) generates the input flows to the drawdown model, but these flows are not the same as the USGS record flows (refer to Figure 4.6-1). In a number of years, the operations model has higher peak flows than occurred in the record (analyzed water years 1965, 1986, 1997, 2000, and 2006). This is because of the way the operations model interprets the operations rules as well as that the upstream facilities may not have been operated according to the same rules during the record event. This difference has an effect on the results of the analysis in this section, and KRRC

considered this when reviewing the results. As discussed below, the comparison between record flows downstream of Iron Gate and the modeled discharge during drawdown typically results in a decrease in flow; when increased peak flows are noted, they are mostly related to the difference between the record and modeled input flows at Keno Dam and not to drawdown.

The results of the analysis show that in wet and above normal years, drawdown typically decreases or does not change flows downstream of Iron Gate Dam. The largest percent increases occurred in 1997 and 2006 with flow increases at Iron Gate of 10% and 98%, respectively. Water year 1997 had 2% or less increases seen further downstream at Seiad Valley and Orleans, while 2006 had larger increases of 18% at Seiad Valley and 6% or less at Orleans and Klamath. For 1997, the increase at Iron Gate shifts the return interval from a 20-year event up to between a 20- and 50-year event. For 2006, the increase at Iron Gate shifts the return interval from between a 10- and 20-year to a 50-year event, and the increase at Seiad Valley in 2006 shifts the return interval from about a 20-year event to between a 20- and 50-year event.

Rather than these increases being the result of the drawdown operation, they are an artifact of the operations model input flows. The operations model shows higher flows in 1997 and 2006 than in the record (Figure 4.6-1) with an increase at Keno of 32% and 80%, respectively[20]. This means that the increase in flows shown in this analysis is related to the larger input flows from the operations model upstream, not from the effect of drawdown releases.

Even with the largest increases in flow at Iron Gate of 26% in 1964 and 40% in 2000, the drawdown releases remain below a 5-year event, well within the river channel capacity. Water year 2000 is also affected by the increase in inflows from the operations model as compared to the record, a 74% increase in 2000 at Keno. [21]

In all cases, the percent change in flows seen at Iron Gate decreases in the downstream direction. At Orleans, the largest change was a 7% increase in 2000 to a less than 2-year event, and at Klamath the largest change was a 4% increase in 2006 to an event having between a 10- and 20-year return period.

[20] Keno 1997 recorded peak flow is 9,200 cfs, but the operations model has a peak of 12,188 cfs. Keno 2006 recorded peak flow is 7,930 cfs, while the operations model has a peak of 14,307 cfs.
[21] Keno 2000 recorded peak flow is 4,200 cfs, while the operations model has a peak of 7,230 cfs.

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Table 4.6-2 Comparison of Flows Downstream of Iron Gate Dam with and without Drawdown

Water Year	Water Year Type	Iron Gate Peak Flow					Seiad Valley Peak Flow					Orleans Peak Flow					Klamath Peak Flow				
		Record (cfs)	With Drawdown (cfs)	% Increase ♦	Record Return Interval*	With Drawdown Return Interval*	Record (cfs)	With Drawdown (cfs)	% Increase ♦	Record Return Interval*	With Drawdown Return Interval*	Record (cfs)	With Drawdown (cfs)	% Increase ♦	Record Return Interval*	With Drawdown Return Interval*	Record (cfs)	With Drawdown (cfs)	% Increase ♦	Record Return Interval*	With Drawdown Return Interval*
1964	Normal	4,850	6,121	26%	2-yr	2-yr	20,100	21,371	6%	3-yr	3-yr	59,900	61,171	2%	2-yr	2-yr	162,000	163,271	1%	2-yr	2-yr
1965	Wettest on Record	29,400	24,236	-18%	80-yr	40-yr	165,000	165,598	0%	150-yr	151-yr	307,000	301,836	-2%	82-yr	77-yr	557,000	557,598	0%	89-yr	90-yr
1970	Above normal	14,900	15,000	1%	10-yr	10-yr	56,000	56,804	1%	11-yr	12-yr	175,000	175,804	0%	13-yr	13-yr	331,000	331,804	0%	12-yr	12-yr
1974	Above normal	18,700	15,000	-20%	18-yr	10-yr	126,000	122,300	-3%	72-yr	67-yr	279,000	275,300	-1%	57-yr	55-yr	529,000	525,300	-1%	70-yr	68-yr
1980	Normal	8,580	7,004	-18%	3-yr	2-yr	41,400	40,495	-2%	7-yr	6-yr	121,000	124,706	3%	6-yr	6-yr	234,000	233,095	0%	5-yr	5-yr
1985	Normal	7,970	7,703	-3%	3-yr	3-yr	13,800	15,783	14%	< 2-yr	< 2-yr	64,400	66,383	3%	2-yr	2-yr	149,000	150,983	1%	2-yr	2-yr
1986	Wet	13,900	9,341	-33%	8-yr	4-yr	43,100	41,210	-4%	7-yr	6-yr	278,000	276,110	-1%	57-yr	55-yr	459,000	457,110	0%	38-yr	37-yr
1997	Wet	20,500	22,526	10%	24-yr	32-yr	117,000	119,026	2%	60-yr	62-yr	258,000	260,026	1%	43-yr	45-yr	n/a †	n/a †	n/a †	n/a †	n/a †
2000	Normal	5,190	7,286	40%	2-yr	3-yr	11,300	14,486	28%	< 2-yr	< 2-yr	46,800	49,986	7%	2-yr	2-yr	141,000	139,783	-1%	2-yr	2-yr
2006	Wet	12,400	24,560	98%	6-yr	42-yr	74,000	86,966	18%	20-yr	29-yr	213,000	225,160	6%	23-yr	27-yr	342,000	354,966	4%	13-yr	15-yr

Notes:

♦ Flow increases in 1997, 2000, and 2006 are an artifact of the operations model input flows. The increase in flows is entirely or mostly related to larger input flows from the operations model upstream, rather than from the effect of drawdown releases.

* Return intervals are approximate whole years based on a regression of the data shown in Table 4.3-2.

† No daily data available at the Klamath gauge for Water Year 1997.

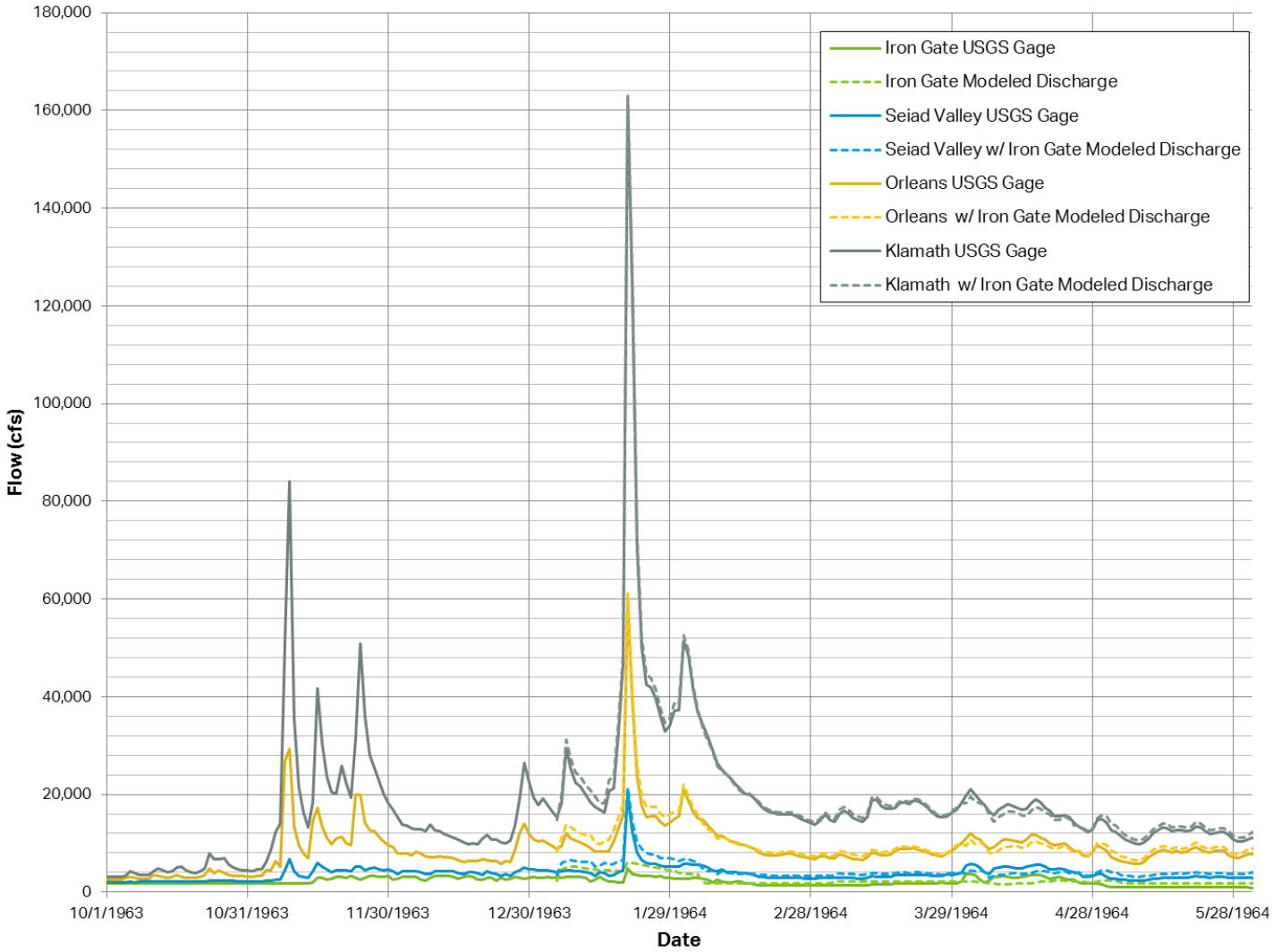

Figure 4.6-20 Comparison of Flows Downstream of Iron Gate Dam – Water Year 1964 (Model Year 1965)

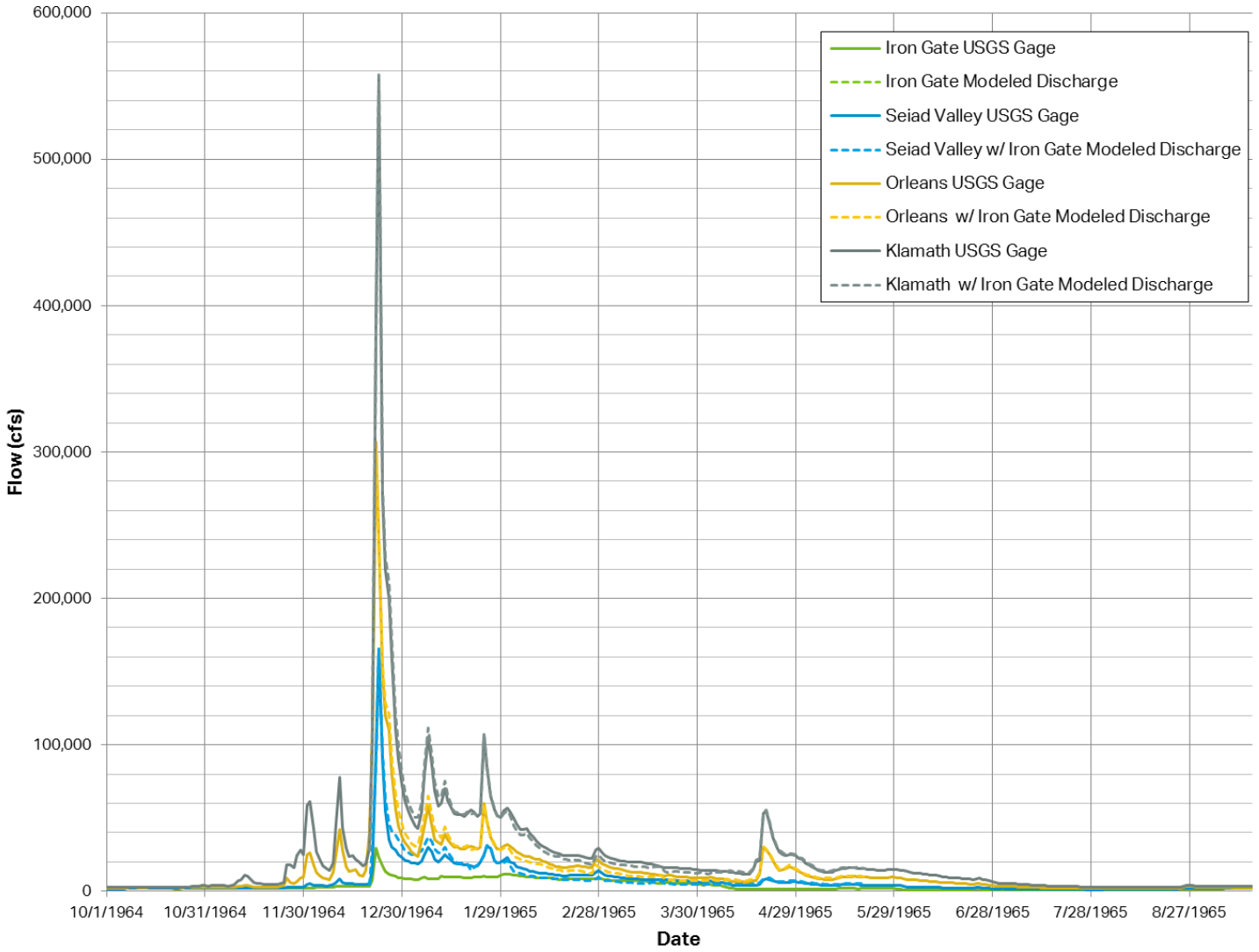

Figure 4.6-21 Comparison of Flows Downstream of Iron Gate Dam – Water Year 1965 (Model Year 1966)

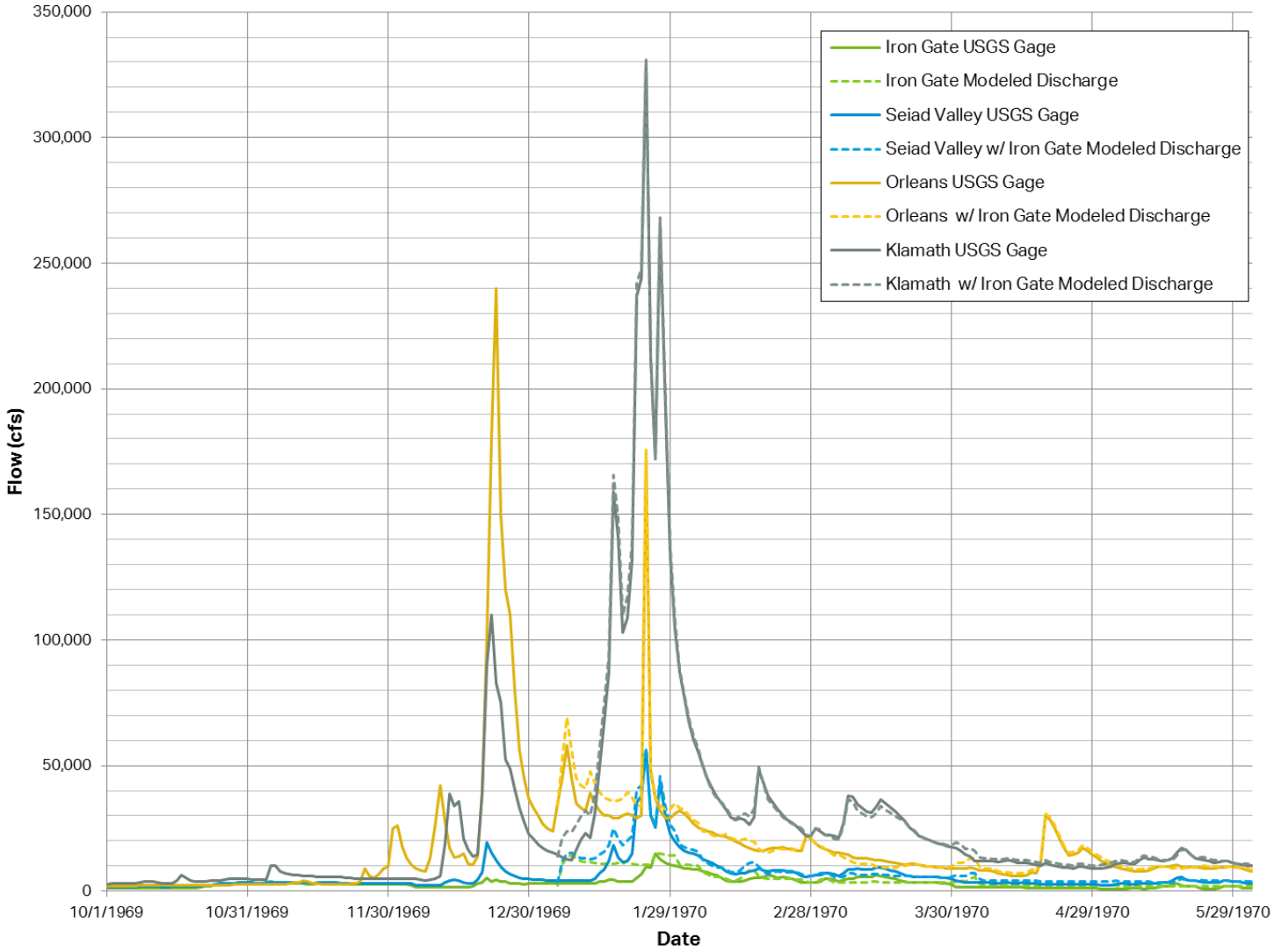

Figure 4.6-22 Comparison of Flows Downstream of Iron Gate Dam – Water Year 1970 (Model Year 1970)

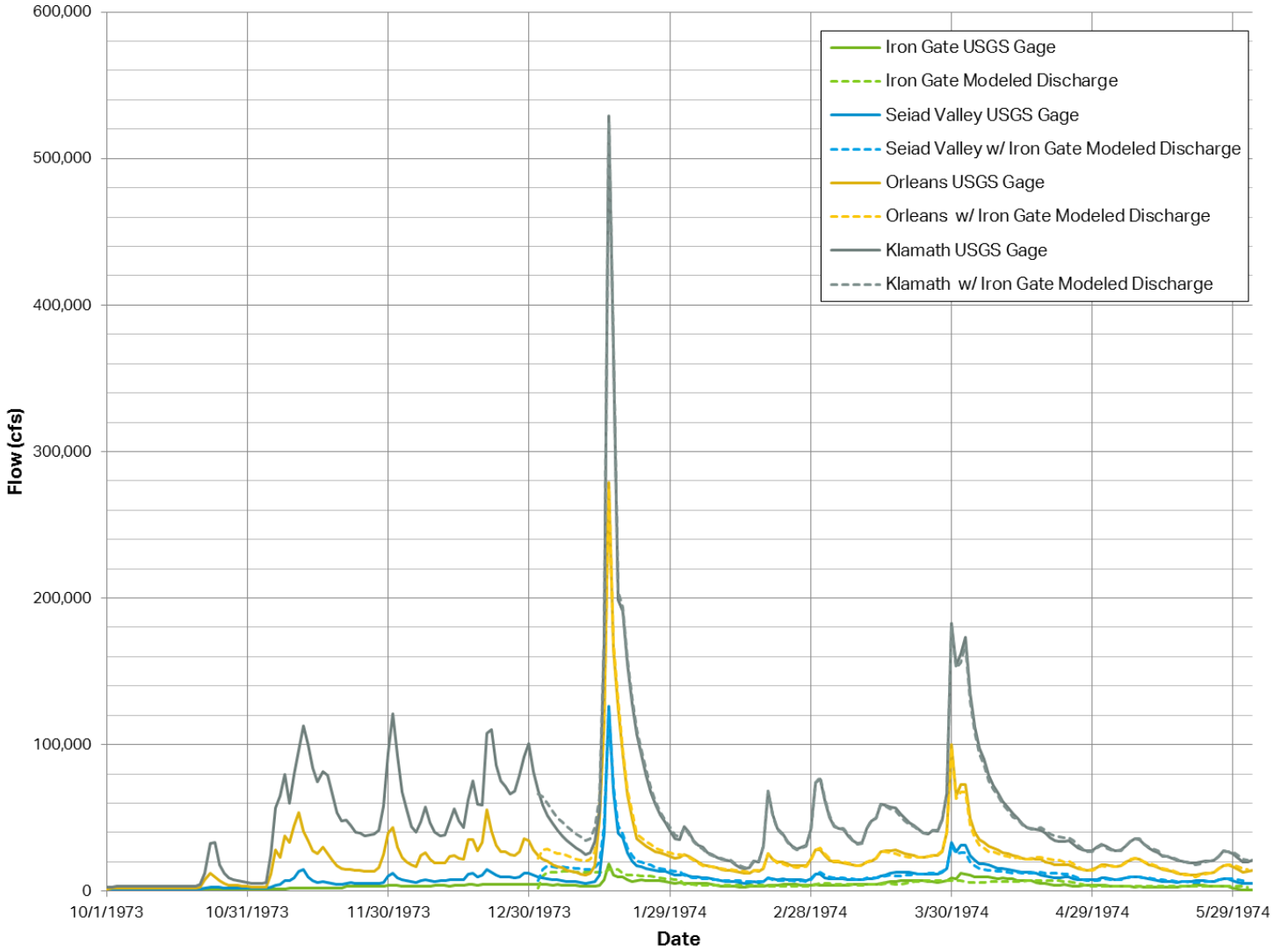

Figure 4.6-23 Comparison of Flows Downstream of Iron Gate Dam – Water Year 1974 (Model Year 1974)

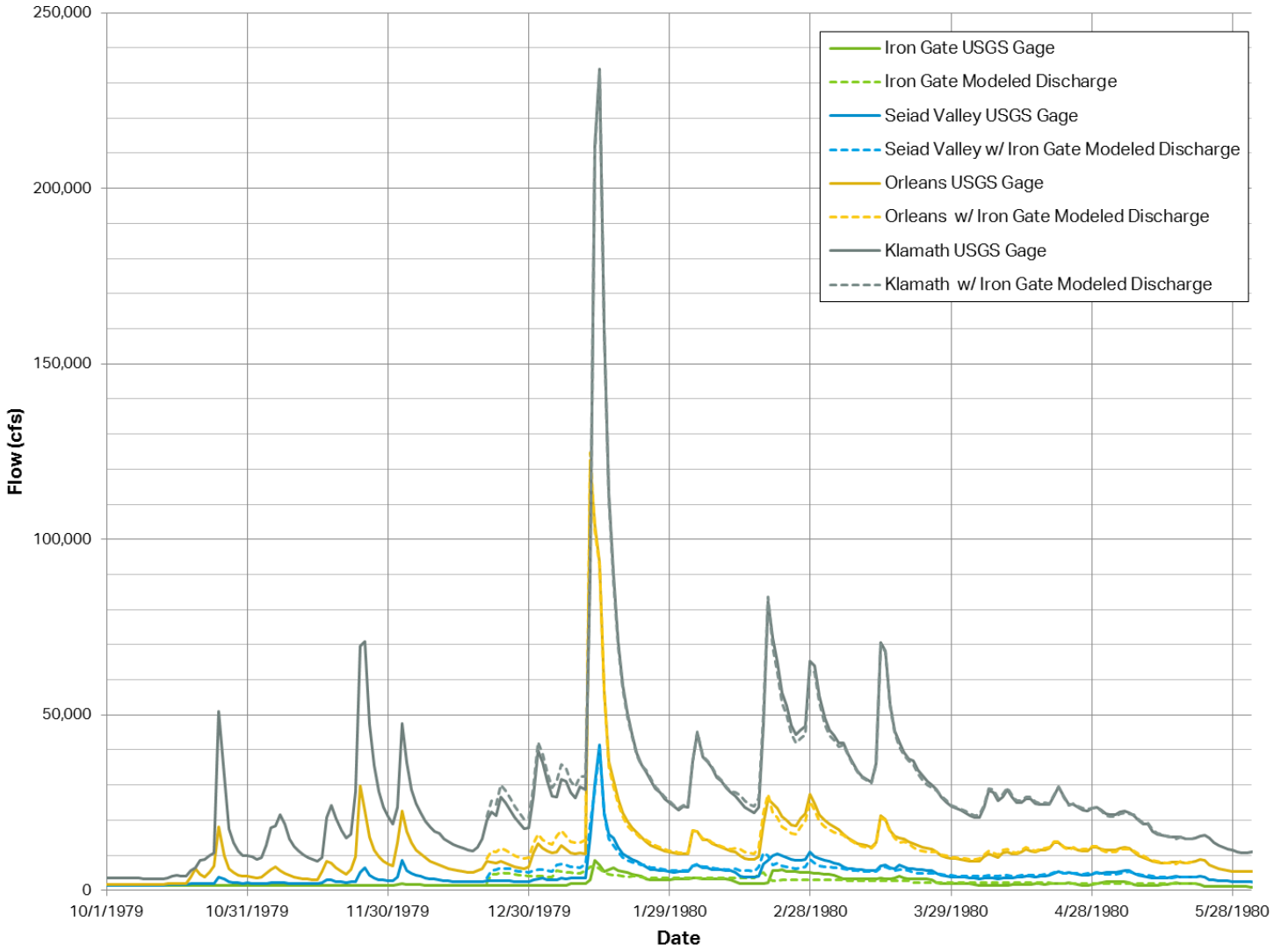

Figure 4.6-24 Comparison of Flows Downstream of Iron Gate Dam – Water Year 1980 (Model Year 1980)

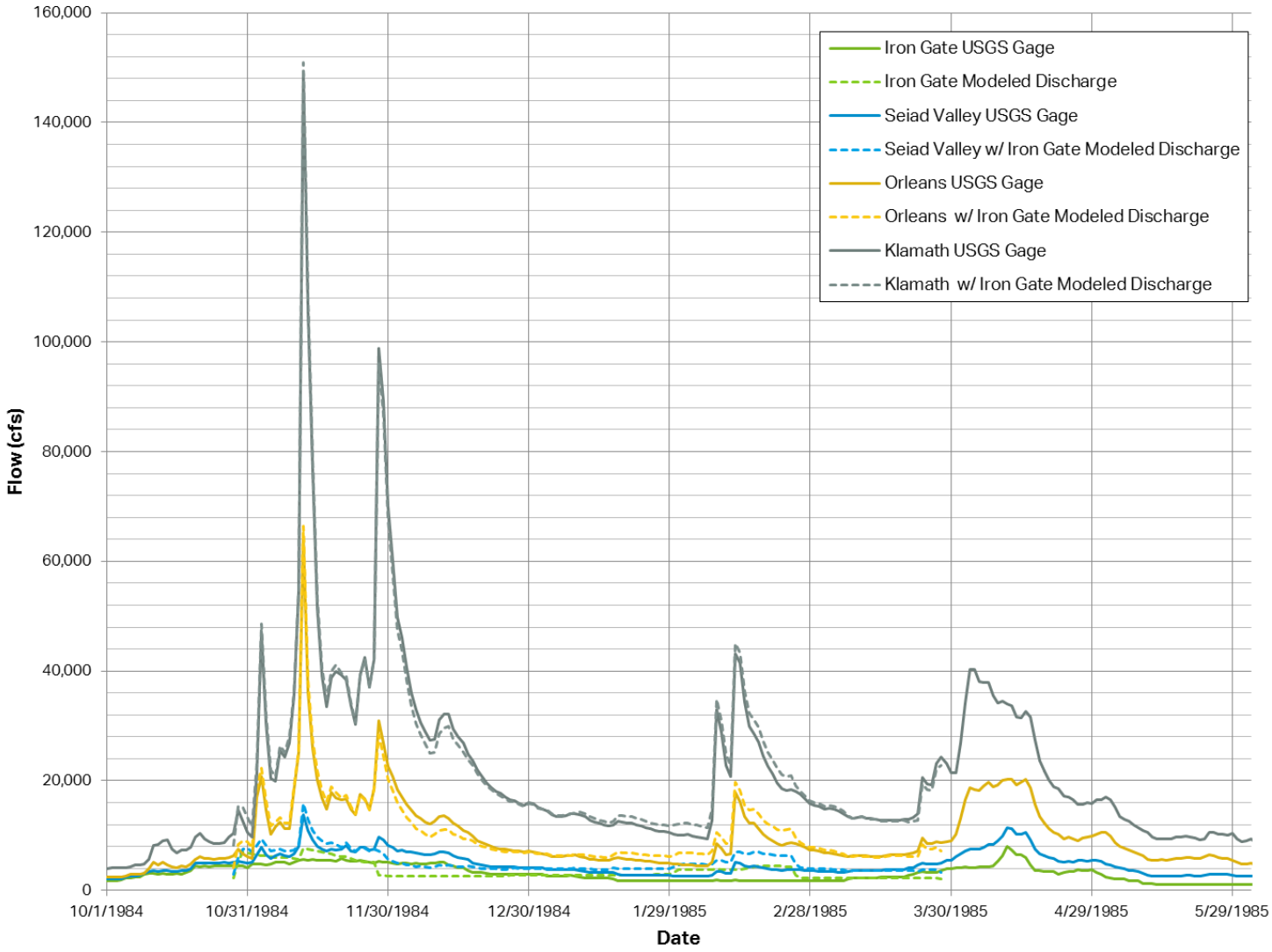

Figure 4.6-25 Comparison of Flows Downstream of Iron Gate Dam – Water Year 1985 (Model Year 1985)

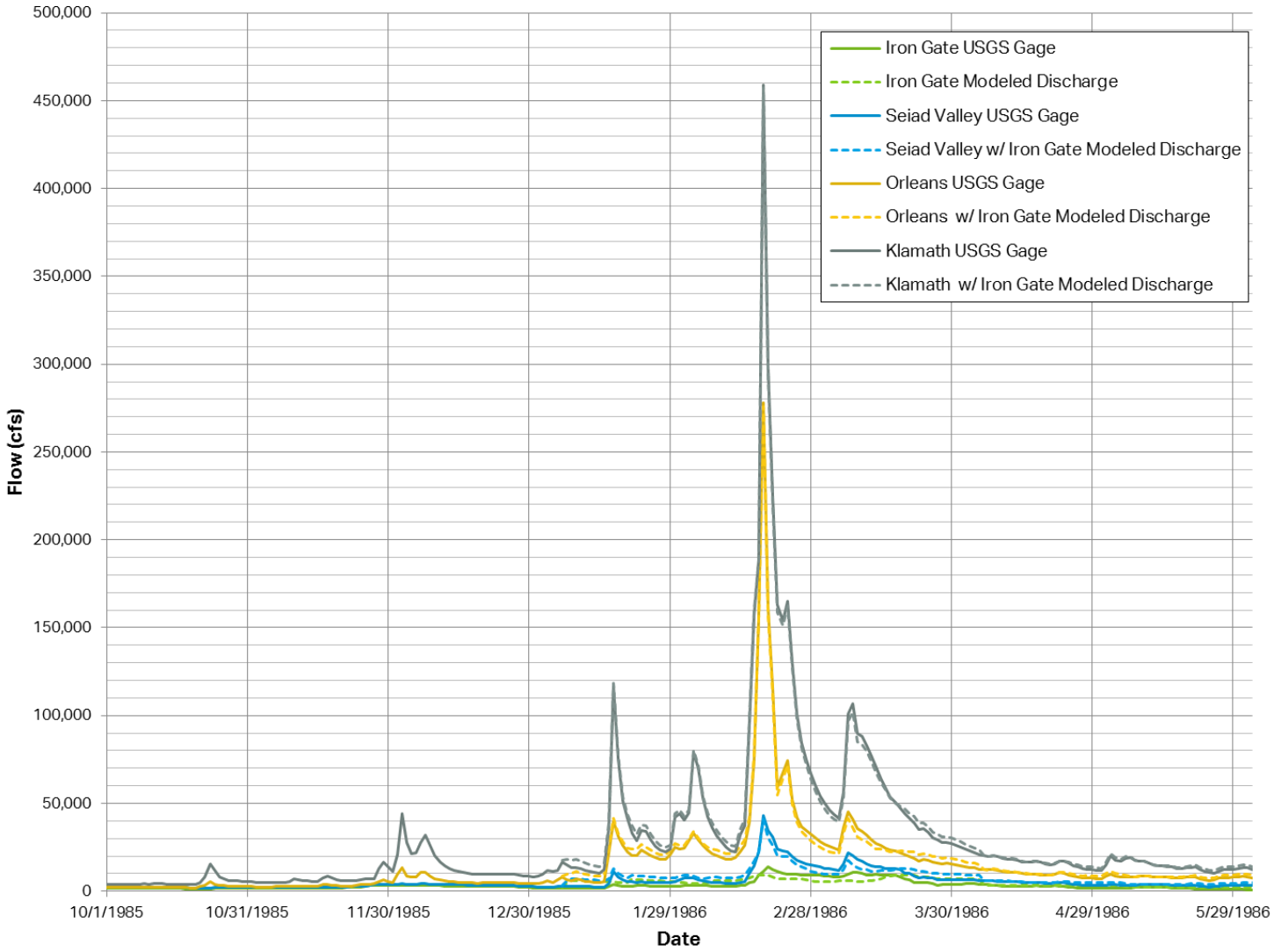

Figure 4.6-26 Comparison of Flows Downstream of Iron Gate Dam – Water Year 1986 (Model Year 1986)

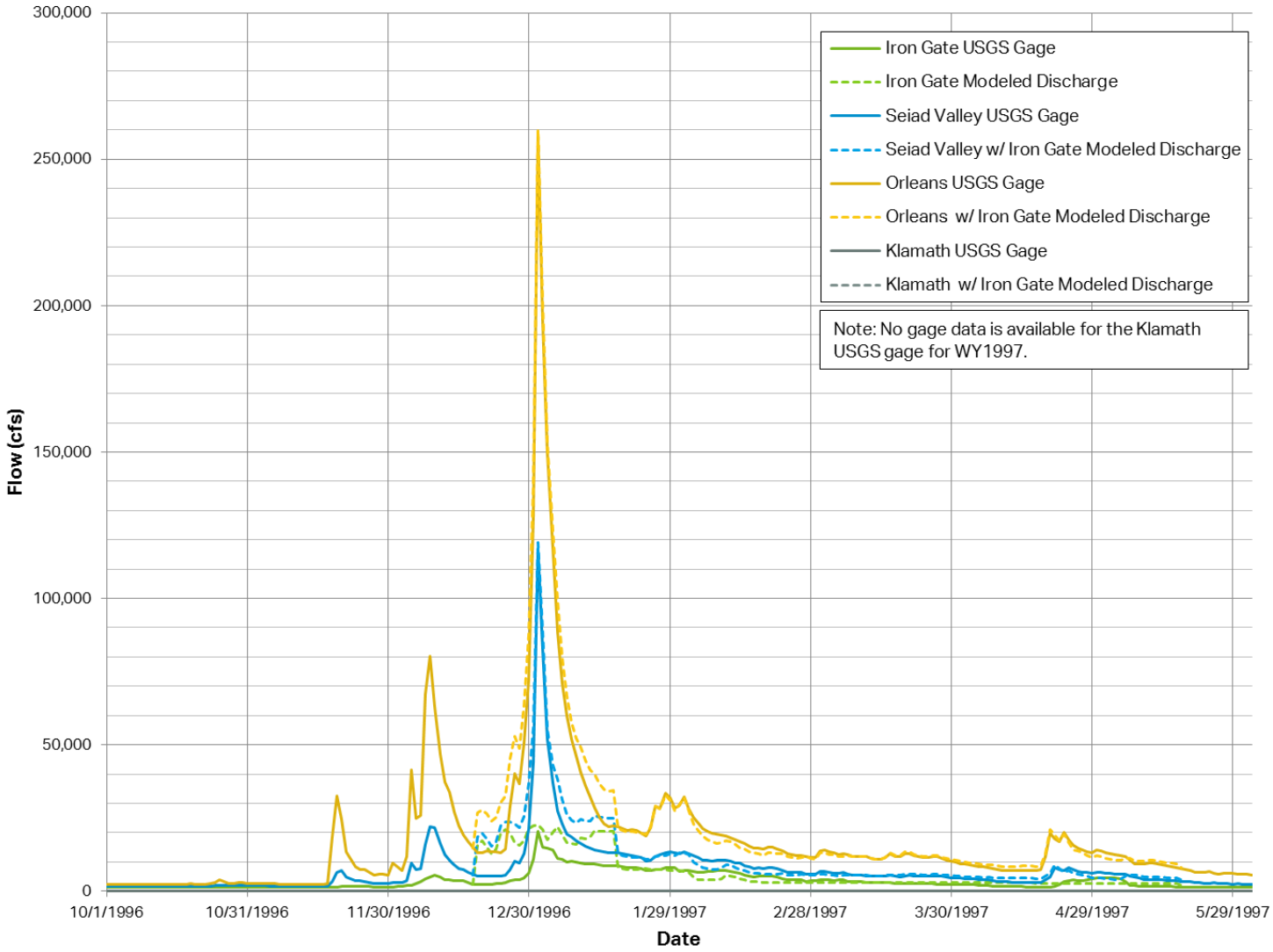

Figure 4.6-27 Comparison of Flows Downstream of Iron Gate Dam – Water Year 1997 (Model Year 1997)

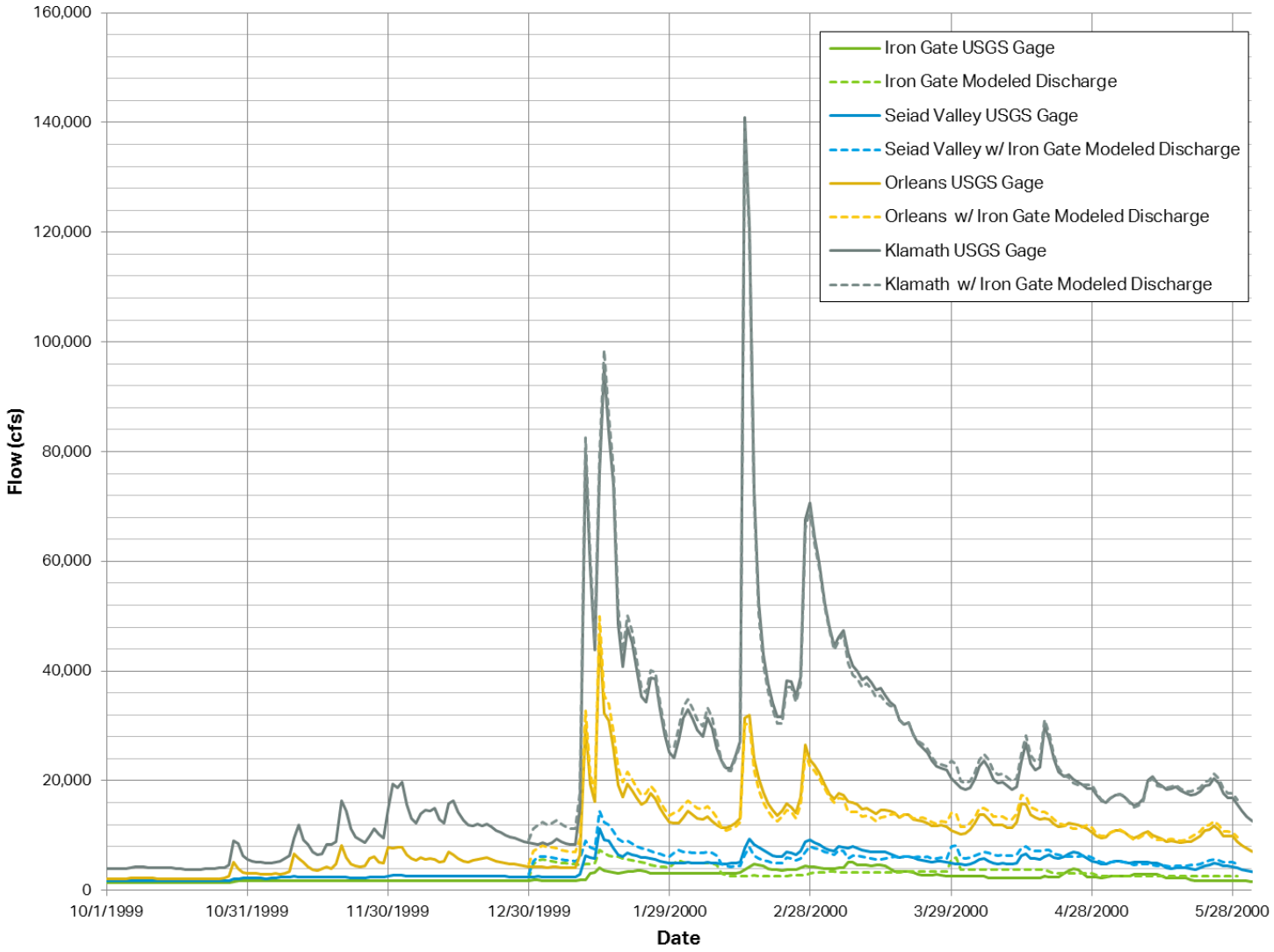

Figure 4.6-28 Comparison of Flows Downstream of Iron Gate Dam – Water Year 2000 (Model Year 2000)

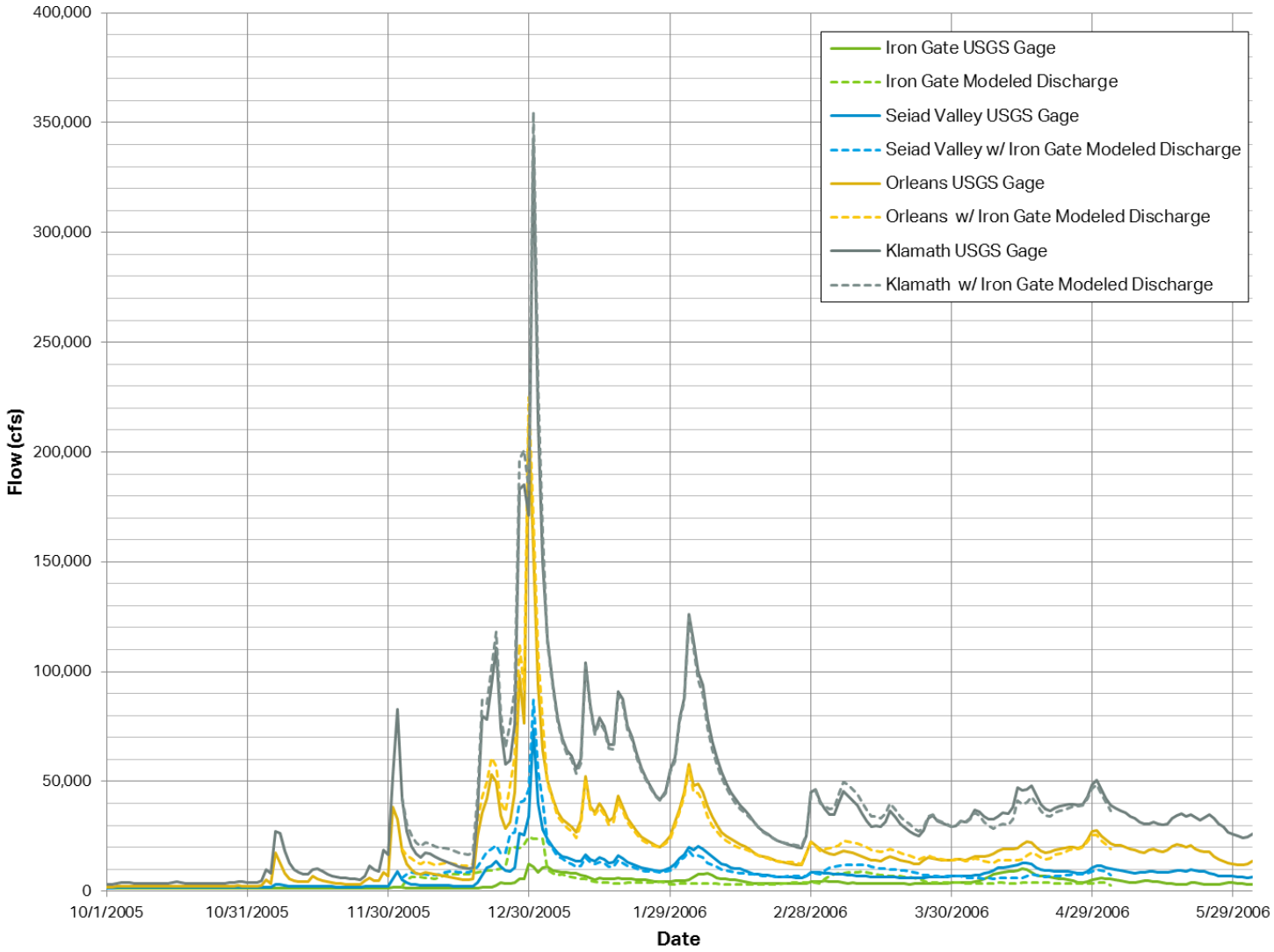

Figure 4.6-29 Comparison of Flows Downstream of Iron Gate Dam – Water Year 2006 (Model Year 2006)

4.7 Monitoring During Reservoir Drawdown

KRRC's contractor will monitor Iron Gate Dam and the embankment section of J.C. Boyle Dam during reservoir drawdown for any evidence of embankment instability. Shallow slumps may occur on the upstream slope, but such occurrences would not compromise the safety of the embankments. Monitoring will include daily visual observations of the upstream slope for signs of instability such as cracking or slumping. KRRC's contractor will install survey monuments and a minimum of two inclinometers in each embankment during the year prior to reservoir drawdown and will monitor them on a daily basis for evidence of deep failures within the upstream shell. KRRC's contractor will also install piezometers in the upstream shell (a minimum of 2) and the core (a minimum of 2) of the embankments for monitoring during reservoir drawdown to confirm that changes in pore pressure during drawdown are similar to or greater than assumed in the analyses (see Appendix D).

KRRC will monitor portions of the reservoir rim at each development, as appropriate, by daily visual observations for signs of any instability such as cracking or slumping. KRRC will install survey monuments and inclinometers in areas of particular sensitivity (e.g., near residences and cultural resources) and will monitor them on a daily basis for evidence of potential slope failure. After drawdown, KRRC will complete monthly visual observations for 12 months to monitor inclinometers and look for evidence of potential slope failure. If KRRC finds no evidence or trends showing slope instability after the monitoring discussed above, KRRC will complete no further slope stability monitoring. Should KRRC identify evidence or trends of slope movement, monthly monitoring shall continue for another 12 months, and KRRC shall complete an assessment to determine the likelihood of slope failure and possible mitigation measures.

Appendix L discusses monitoring during drawdown related to cultural resources.

4.8 Best Management Practices to Implement During Reservoir Drawdown

4.8.1 Blockage of Diversion Facilities

Diversion facility failure or blockage, particularly of the Iron Gate or Copco No. 1 diversion tunnels, during reservoir drawdown could impact the duration of drawdown. Failure modes of the diversion tunnels include: debris blocking the tunnel inlet, abutment instability and failure blocking the tunnel inlet, mechanical failure of the operating gate, and tunnel collapse. To avoid inlet blockages, Best Management Practices (BMPs) include installing large grates at the inlets and providing a mechanism to clear the grates using barge mounted equipment. Depending on the severity of the blockage or the mechanical failure, KRRC may suspend and delay reservoir drawdown to the following year after repairs are made.

Diversion facility failure or blockage of the Iron Gate diversion tunnel during dam removal could result in a condition where the dam no longer has an operable spillway. BMPs for this occurrence include conservative design criteria for the modification of the diversion tunnel to make inlet blockage, tunnel collapse, and

mechanical gate failure unlikely. In addition, by the time dam removal starts on June 1, the diversion tunnel will have been in full operation for 5 months demonstrating its operability.

Diversion facility failure or blockage of the Copco No. 1 diversion tunnel during dam removal will not prevent dam removal because flows that would have been diverted through the tunnel would flow through the spillway gates or over the lowered dam crest. Flow over the lowered crest at Copco No. 1 Dam would prevent access for further concrete removal; however, KRRC expects the lowered crest to be sufficient for overtopping flows, and does not present a safety hazard.

KRRC will update the existing Emergency Action Plans (EAPs) for the dams. The EAPs describe the notification process for impending catastrophic dam failure and include flood inundation mapping. KRRC will submit the EAP to the BOC for its independent review and recommendations.

4.8.2 Stability of Embankments

Instability of the upstream slope of the J.C. Boyle or Iron Gate embankment during reservoir drawdown could result in either loss of erosion protection or loss of freeboard due to a slope failure that encompasses a portion of the dam crest. In the case of shallow slumping that disrupts erosion protection, BMPs include stockpiling riprap materials during the season prior to reservoir drawdown for repairs. Likewise, in the unlikely event that a slope failure displaces a portion of the dam crest, BMPs include stockpiling embankment materials for emergency repairs of the crest of the embankments.

4.9 Stability of Reservoir Rim

KRRC performed a reservoir rim stability evaluation that is provided in Appendix E. When discussing reservoir rim stability during drawdown at the various reservoir locations, it is important to differentiate between the potential for deep-seated large landslides along the reservoir rim that could impact roads or property, and slides of material beneath the current water surface, which would only impact resources within the local limited slide footprint.

Minor, shallow slides of existing material beneath the existing reservoir water surfaces are possible during drawdown at each reservoir location (Appendix E). These minor slides would not extend outside of the current reservoir footprint and would only potentially impact resources within the limited slide footprint (e.g. cultural resources). Within Copco No. 1 Reservoir, some larger deeper slides are also possible beneath the existing reservoir water surface, where submerged higher bluffs exist along the original Klamath River channel. These shallow slides and potential slides along the river channel in Copco No. 1 Reservoir pose no threat to roads or property, however, these areas will be monitored during and post-drawdown to assess any potential impact to existing cultural resources.

Based on the evaluation included in Appendix E, the potential for deep-seated large landslides along the reservoir rim is low at both J.C. Boyle and Iron Gate Reservoirs. At Copco No. 1 Reservoir, however, while the majority of the reservoir rim is expected to remain stable during drawdown, certain segments along the reservoir rim have a potential for slope failure that could impact existing roads and/or private property. In

some areas, the impact could be relatively minor, while in other areas the impact could be greater. Based on the analysis in Appendix E, approximately 3,700 linear feet of slopes along Copco Road (approximately 10.7% of north shore length), and approximately 2,800 linear feet of slope adjacent to private property (approximately 8.7% of south shore length) require additional field investigation and analysis to gain a more refined understanding of slope stability in those areas. Up to eight parcels along the referenced-reservoir rim segments appear to have existing habitable structures that could potentially be impacted.

Additional field geologic data is required to confirm the potential for slope failure along the referenced-reservoir rim segments. KRRC expects to complete the additional field investigation in July and August of 2018, followed by completion of a series of material property laboratory tests. KRRC will use results from the field investigation and laboratory testing to update stability assessments in the rim segments of concern in fall 2018. Should additional study determine that there is a high probability of slope failure in any of these areas, KRRC will consider the following actions to offset potential impacts:

1. For segments along Copco Road:
   a) Re-align road segment away from rim slope
   b) Engineer structural slope improvements (e.g. drilled shafts or other structural elements that could be installed to resist slope movement)
2. For segments adjacent to property or structures:
   a) Move structure or purchase property
   b) Engineer structural slope improvements (e.g. drilled shafts or other structural elements that could be installed to resist slope movement)

4.10 Potential for Effects Downstream of the Project

The sections below discuss potential effects in the river channel downstream of Iron Gate Dam, including aggradation at tributaries, pool depths, lateral channel migration, water quality and slope instability. For a discussion of the effects on downstream flows, see Section 4.5.5 above.

4.10.1 Previous Modeling Results and Limitations

KRRC expects aggradation in the reach between Iron Gate Dam and Bogus Creek because this reach is immediately downstream of Iron Gate Dam and the relatively deep pools in this reach will fill with coarse sediment. This reach is artificially degraded because of the release of sediment-depleted, clear water flows from the dam.

USBR did not use the results of the two-dimensional model to quantify volumes of eroded reservoir sediment, sediment deposition in the downstream channel, or suspended sediment concentrations. USBR primarily used the two-dimensional model to help inform their revegetation plan for dam removal at Copco. USBR was interested in the general shape and location of the river channel post dam removal and the modeled shape and location corresponded well to the pre-dam maps. USBR eventually used the pre-dam maps to determine the most likely location of the post-dam removal channel.

4.10.2 Aggradation and Tributary Confluences

There are likely different responses for tributaries within the reservoir areas and for tributaries downstream of Iron Gate Dam. Within the reservoirs, previously deposited reservoir sediment may or may not be eroded during drawdown, depending upon the flows present in the tributaries and in the Klamath River. Should barriers form at these locations within the former reservoirs, KRRC will make efforts post-drawdown to remove the barrier and connect the tributary (see Section 6.1.3)

At tributaries downstream of Iron Gate Dam, there are several different possibilities for tributary response depending upon the relative balance of Klamath River flow, tributary flow, and sediment concentration. There are naturally-occurring, small depositional features at most tributary mouths along the Klamath River and having some deposition at these locations could take the form of a partial bar rather than fully blocking the tributary mouth and is not necessarily a negative impact.

4.10.3 Pool Depths

The reaches below Iron Gate Dam have all been unnaturally depleted of coarse and fine sediment due to the trapping of sediment within the reservoirs. Therefore, there has likely been some river bed degradation and river bed lowering caused by the depletion of coarse sediment. A return to pre-removal conditions in the pools downstream of the dams is not expected, nor desired. The pools are likely deeper and coarser than they would be under natural sediment supply conditions. There will be an immediate filling of pools after dam removal and an immediate fining of the river bed sediment. After one or two average floods, flows will remove most of the fine sediment from the pools and they will return to being dominated by a coarser substrate. However, the river will not recover full, pre-removal, pool depths and instead it will return to more natural pool depths. Numerical models are not able to reliably predict the pool-riffle formation and exact depths. USBR provided an estimate of the bed material response as part of the USBR (2012) report.

KRRC proposes a survey of the river bed downstream of Iron Gate Dam to Humbug Creek prior to dam removal, and every year after dam removal for the first 3 years. KRRC does not propose mechanical intervention in the main channel of the Klamath River at any substantial scale because the disturbance of the bed could cause more ecological impact than the sediment in the bed. Moreover, as mentioned above, KRRC does not believe that it is reasonable or prudent to want to recover pre-removal pool depths downstream of the dam.

4.10.4 Lateral Migration

Lateral migration is a natural part of all alluvial rivers and cannot be fully controlled throughout a large river. In fact, preventing lateral migration through bank protection can degrade the aquatic habitat of the river by causing channel bed degradation. That being said, the Klamath River is predominantly a bedrock-controlled river and naturally has very little migration and bank erosion. USBR (2012) compared mapping of terraces to one performed by Ayres (1999) and found very little difference in the plan form of the river over time. The risk of bank erosion would be higher when coarse sediment and large woody debris are introduced into the channel and deposits, which then forces the river to take a new path. An example of this process is the

Elwha River dam removals where several locations of bank erosion were observed after dam removal. The risk of bank erosion on the Klamath River is much smaller for a variety of reasons: there is much less coarse sediment in the reservoirs, the banks are mostly bedrock controlled, and there is no large source of woody debris upstream of the reservoirs because of operations at Link River and Keno Dams. For these reasons, no monitoring or adaptive management associated with downstream lateral migration is proposed.

4.10.5 Water Quality and Suspended Sediment

USBR (2012) performed simulations for a variety of water year types, some of which result in release of suspended sediment after March 15, and USBR discusses effects in that report. As discussed in Section 4.4, the updated approach to drawdown at Copco No. 1 significantly reduces the likelihood of a prolonged drawdown and high sediment concentrations. Due to the low probability of a prolonged drawdown, there is minimal risk of any associated negative effects from suspended sediment post-drawdown.

4.10.6 Water Quality and Sediment Contaminants

This summary is in reference to contaminant concentration analyses in Klamath River reservoir sediments and aquatic biota, and provides an evaluation of the results with respect to current USACE Sediment Evaluation Framework (SEF) for the Pacific Northwest (USACE, 2016) and U.S. Environmental Protection Agency (EPA) screening levels (SLs). The 2012 EIS/R summarizes sediment and aquatic biota testing completed by Camp Dresser and McKee (CDM) during or before 2011, a time period during which the Northwest Regional Sediment Evaluation Team (RSET) reviewed and finalized the freshwater contaminant screening levels. Although the 2009 SEF SLs and the EPA Regional Screening Levels (RSLs) were not the only thresholds considered in the 2011 analysis and result, an examination of previous results and conclusions with respect to the most recent SEF SLs and RSLs is necessary to ensure current science and regulatory standards are met.

The following review of the 2011 results under the 2016 SEF SLs and compliance with a Level 2B[22] evaluation confirms the conclusions presented in the 2012EIS/R that the reservoir sediments in each reservoir are suitable for unconfined, aquatic disposal and exposure and that contamination risks are unlikely and/or are either lower than with the dams still in place and/or lower than background levels. The marine SLs are relatively unmodified from the 2009 SEF, and the most recent freshwater SLs in the 2016 SEF are typically less protective than standards set forth by, e.g., EPA RSLs and ODEQ Bioaccumulation Screening Level Values (SLVs) for fish consumption. As a result, any revisions to the standards have negligible impact on previous conclusions.

Testing Summary

To assess the risk of contamination in biota and humans from the release of reservoir sediments, an evaluation of the sediments from each reservoir was completed in 2011 and generally followed the tiered

[22] A Level 2B assessment includes physical, chemical, biological, and other special evaluations completed to provide more empirical evidence regarding the potential for sediment contamination in the project area to have adverse effects on receptors (RSET 2016).

sediment evaluation framework presented in the 2009 SEF. The results and conclusions are summarized in the 2012 EIS/R and Klamath Dam Removal Overview Report for the Secretary of the Interior (SDOR). All steps required for a Level 2B evaluation were conducted, and they included a review of existing information (Level 1), screening assessment of sediment chemistry (Level 2A), bioassays and screening assessment of elutriate chemistry (Level 2B), and an additional examination of reservoir fish tissues. Additionally, concentrations were compared with the protective standards (i.e., low SLs) of the EPA RSLs and ODEQ SLVs for fish consumption. The contamination risk of concentrations in excess of the SLs was evaluated in consultation with several state and federal agencies and with respect to several contaminant exposure pathways from the sediments to biota and humans. The pathways included a "dams remain" option and four dam removal options: in the water column and in deposits in terrace and banks, the river bed, and near-shore marine environment. Additionally, values were compared with known background values for the area.

Previous Results

Based on the screening level evaluation, the previous analysis concluded that the risk of contamination to humans and freshwater, marine, and terrestrial biota along the four dam removal pathways was unlikely. In all but one case, contaminant concentrations above standards from the SLs, RSLs, or SLVs were at levels unlikely to cause adverse effects (see SDOR Figure 4.4.9-2). The one contaminant concentration determined to cause potential short-term minor to limited effect on freshwater biota was not a result of comparison with SEF SLs or EPA RSLs. With the exception of nickel in J.C. Boyle and Copco No. 1 and dieldrin in J.C. Boyle, the only contaminants reported in excess of the SEF standards were a result of the reporting limits (RLs) of the laboratory analysis in excess of the SLs, rather than detected concentrations of the contaminants in excess of the SLs. Exceedances based on reporting limits, rather than detected concentrations, included several polynuclear aromatic hydrocarbons (PAHs), phthalates, pesticides, and polychlorinated biphenyls (PCBs), but were generally not in excess of SL2 values.

The only exceedances of the EPA RSLs were the total carcinogenic RSLs for residential soils for arsenic and nickel in each reservoir. The EPA RSL threshold for lifetime exposure to humans to contaminated soils in residential settings for arsenic and nickel are 0.39 and 0.38 mg/kg, respectively, and, although exceeded, the exposure durations will be sufficiently low for exposure to be unlikely to lead to adverse effects. The results of the bioassays only indicated the potential for toxicity of reservoir sediments to benthic biota in J.C. Boyle reservoir, and CDM argued that increased toxicity in a dam removal scenario is unlikely given the dilution of the material. The lab results of contaminant testing for each reservoir are presented in EIS/R Appendix C and CDM (2011) Chapter 3 and Appendices A and B.

Current Screening Limit Standards and Reassessment of Results

KRRC reviewed previous results with respect to minor changes in SLs since 2011 and determined that the changes do not alter the previous conclusions. The updated SEF SLs in the current 2016 SEF Table 6-2 are generally similar to previous iterations of SEF SLs. The marine SLs are unchanged from the 2009 SEF with the exception of the pesticide dichlorodiphenyltrichloroethane (DDT), for which the SL was increased. The freshwater SL1 values from the 2016 SEF are generally similar to and typically higher than previous values, so the conclusions in the 2012 EIS/R regarding SEF SLs are still valid.

KRRC reassessed the concentrations of the metals arsenic, chromium, nickel, and silver, for which the 2016 SEF SLs are lower than those used by CDM. For arsenic, chromium, and nickel, the lowest freshwater screening levels used by CDM were lower than the SEF SL1 value, so there is no change in the samples designated as exceeding the SLs criteria. Silver was not previously found to exceed any SLs. The standards of the EPA RSLs for the total carcinogenic RSLs for residential soils for arsenic and nickel are more protective than the SEF values, and the RSL values have not changed in a way that alters previous evaluations.

In the 2016 SEF, PAH SLs are defined as summed quantities rather than SLs for each contaminant as with the previous SLs. The maximum PAH RL values from the 2011 analysis are sufficiently low to not exceed the total PAH SL value in the 2016 SEF when summed. For 19 analytes (e.g., some PCBs, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs)) measured during 2009-2010, RLs were greater than SLs, so it remains undetermined if concentrations exceed revised SLs. However, it was determined that these contaminants were unlikely to contribute to risk of contamination, and this argument is unaffected by any revisions to SLs. The results of the bioassays are not impacted by any new standards or SLs.

4.10.7 Flooding and Slope Instability

KRRC considers the potential for significant flooding and slope instability downstream of Iron Gate Dam due to and during reservoir drawdown activities to be low and equivalent to (or better than) the existing condition. This is primarily due to the discharge capacity of the modified Iron Gate diversion tunnel, which is equivalent to a 5-year flood event. If the reservoir refills and spills during an event much larger than the 5-year flood event, this larger event would cause increased downstream flows even without the drawdown because the reservoirs are not used for flood control. For non-flood event periods, flows in the downstream channel will not exceed a 5-year flooding event; therefore, KRRC does not expect reservoir drawdown to cause erosion or subsequent slope instability downstream of Iron Gate Dam. In fact, during reservoir drawdown, Iron Gate Reservoir will actually attenuate larger flood events resulting in lower flood discharges than would occur under existing conditions.

Since drawdown will not result in flooding or slope instability, KRRC does not propose reconnaissance of potentially inundated areas downstream of Iron Gate Dam.

Chapter 5: Dam Removal Approach

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5. DAM REMOVAL APPROACH

5.1 Introduction

The general strategy for dam removal assumes the natural release of sediment to the Klamath River from the three larger reservoirs (J.C. Boyle, Copco, and Iron Gate) will be initiated no earlier than January 1, 2021. KRRC will accomplish the reservoir drawdown and associated sediment release through regulated releases from the diversion facilities described in Section 4.2, to draw down the reservoirs in a controlled manner. Development removal, as defined by the KHSA, is to produce a free-flowing river at all four hydroelectric dam sites (J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate) by the specified December 31 completion date.

The proposed Project (Full Removal alternative) achieves the project objectives of free-flowing river conditions and volitional fish passage by the complete removal of dams (except for buried features), power generation facilities, water intake structures, canals, pipelines, and ancillary buildings. The Partial Removal alternative, which KRRC presents for purposes of environmental review, also achieves the objectives of free-flowing river conditions and volitional fish passage, but portions of each dam would remain in place, along with ancillary buildings and structures such as powerhouses, foundations, tunnels, and pipes. The Partial Removal alternative is discussed in this section as the Partial Removal Options (PROs). PROs that will not be buried will be sealed or fenced to prevent unauthorized entry and for public safety, and will likely involve long-term maintenance costs. KRRC will remove hazardous materials from each dam site and from any PRO if it were to be implemented during construction.

Quantity estimates for all features removed by the Project, including earth fill volumes, concrete volumes and weights of mechanical and electrical equipment, have been carefully prepared using detailed engineering drawings provided by PacifiCorp, which are believed to represent current, as-built conditions. Members of the engineering design team have examined each dam site by to confirm the existence of project features for which quantities have been prepared for this level of design. However, KRRC has conducted no independent surveys or measurements of dam embankments, concrete structures, or equipment to confirm the PacifiCorp data. KRRC will use new topographic and bathymetric surveys to confirm earthwork quantities.

The following sections define the removal limits, PROs, access roads, staging areas, disposal sites, likely demolition methods, and waste disposal requirements for each dam and hydropower development. Drawings have been prepared for each development to define the proposed removal limits for the dam and for each appurtenant feature in plan and cross-sectional view, and are included in Appendix B (CEII) and Appendix C (non CEII). Figure 5.1-1(C) shows an overview of the work areas and major access routes.

Figure 5.1-1 Project Limits of Work and Access (Appendix C)

The bulleted list below provides a roadmap for specific waste disposal items:

- Sections 5.2.3 (J.C. Boyle), 5.3.3 (Copco No. 1), 5.4.3 (Copco No. 2) and 5.5.3 (Iron Gate) summarize location and size of disposal sites. Figures 5.2-1(C), 5.3-1(C), and 5.5-1(C) show disposal site location and approximate grading. Figures 5.2-8 (C), 5.2-9 (C), 5.3-8 (C), 5.5-4 (C), and 5.5-5(C) provide additional detail (plan and profile) for the disposal sites.
- Sections 5.2.7, 5.3.7, 5.4.7 and 5.5.7 provide description of materials (quantity and type) being buried at each disposal site.
- Sections 5.2.3, 5.3.3, 5.4.3 and 5.5.3 summarize measures and monitoring associated with disposal site erosion.
- Sections 5.2.7, 5.3.7, 5.4.7 and 5.5.7 provide description of materials (quantity and type) that will be disposed of at local landfills, including an estimate of truck trips.
- Sections 5.2.7, 5.3.7, 5.4.7 and 5.5.7 provide description of material (quantity and type) that will be recycled.
- Description of hazardous material (quantity and type) that may be encountered, and plans for safe handling and disposal is provided in Appendix O3.

5.2 J.C. Boyle Dam and Powerhouse

5.2.1 Removal Limits

J.C. Boyle Dam is located within a relatively narrow canyon on the Klamath River at RM 230.6. Minimum requirements for a free-flowing condition and volitional fish passage on the Klamath River through the J.C. Boyle dam site require the complete removal of the embankment section and concrete cutoff wall to the bedrock foundation, to ensure long-term stability of the site and to prevent the development of a potential fish barrier at the site in the future. Table 5.2-1 summarizes and Figure 5.2-1 (C) shows features the Project will remove or potentially retain as PROs.

Figure 5.2-1 J.C. Boyle Dam Removal Features and Limits (Appendix C)

Table 5.2-1 J.C. Boyle Dam and Powerhouse, Removal Requirements

Feature	Full Removal	Partial Removal Options	Comments[1]
Embankment Dam, Cutoff Wall	Remove	Remove	
Spillway Gates and Crest Structure	Remove	Remove	
Concrete Box Diversion Culverts	Remove	Remove	
Fish Ladder and Diffusion Box	Remove	Remove	
Timber Bridge	Remove	Remove	
Steel Pipeline and Supports	Remove	Retain	PRO: Retain as footbridge, supports will remain in 100-year floodplain
Canal Intake (Screen) Structure	Remove	Retain	PRO: Seal openings, install security fence

Feature	Full Removal	Partial Removal Options	Comments[1]
Left Concrete Gravity Section	Remove	Retain	
Canal Headgate Structure	Remove	Retain	PRO: Retain as observation point
Power Canal (Flume)	Remove	Retain	PRO: Retain invert slab
Shotcrete Slope Protection	Retain	Retain	Removal would destabilize excavated rock slopes and increase potential for rock falls
Forebay Spillway Control Structure and Discharge Chute	Remove	Remove	
Tunnel Inlet Portal Structure	Remove	Remove	
Surge Tank	Remove	Remove	Potential future seismic stability
Penstocks, Supports, Anchors	Remove	Remove	Avoid maintenance, facilitate wildlife migration
Tunnel Portals	Plug	Plug	Plug with reinforced concrete
Powerhouse Gantry Crane	Remove	Remove	
Powerhouse (incl. mechanical and electrical equipment)	Remove	Retain	PRO: Substructure below roadway, seal openings
Powerhouse Hazardous Materials (transformers, batteries, insulation, petroleum products)	Remove	Remove	
Tailrace Flume Walls	Remove	Remove	
Tailrace Channel Area	Backfill	Backfill	
Canal Spillway Scour Area	Backfill	Backfill	Backfill to extent possible with concrete rubble from dam, canal, and powerhouse
Three 69-kV Transmission Lines, 2.8 mi total (incl. poles and transformers)	Remove	Remove	
Switchyard (incl. fencing, poles, and transformers)	Remove	Remove	
Buildings: office building (the Red Barn), maintenance shop, fire protection building, communications building, 2 residences, storage shed, reservoir level gauges house	Remove All	Retain	PRO: Retain some structures

1. PROs would involve long-term maintenance costs, including the preservation of any exposed items with coatings containing heavy metals (such as the penstocks).

Retention of the portions of the J.C. Boyle powerhouse below the roadway as a PRO would require the structure to be sealed. KRRC assumes the paint on the downstream face of the concrete structure contains heavy metals and would be carefully removed. Mechanical and electrical equipment could be left in place with all power connections to the outside removed; however, any oil in the turbine governor and hydraulic control systems, transformers, oil storage tanks, or other equipment would be removed. KRRC's contractor will also remove other potentially hazardous materials, such as batteries. The tailrace channel between the powerhouse and the river channel could be backfilled to the pre-construction contours if necessary, which

would eliminate the need to remove the concrete training walls. Retention of the lower portion of the powerhouse would not impact the 100-year floodplain.

5.2.2 Construction Access

Figures 5.1-1(C) and 5.2-1(C) show construction access roads and associated improvements that may be required for removal of J.C. Boyle Dam and Powerhouse. KRRC observed existing conditions of the highways, local roads, and structures in the field to identify deficiencies and determine if improvements are necessary for mobilization and/or hauling during construction and demolition activities. KRRC will complete access road improvements prior to associated construction and removal at the dam and powerhouse. The following sections summarize the assessment completed of each road or highway identified for use during construction, and specific improvements are identified, as appropriate.

The Dalles California Highway (US97)

The Dalles California Highway (US97) is classified as a rural principal arterial road that runs north-south in Oregon and intersects with Keno Worden Road. It is a two-lane undivided roadway with a posted speed limit of 65 mph. KRRC's contractor will use this stretch of highway for mobilization of construction equipment and as a haul route to carry demolished materials other than earth and concrete rubble from the dam and powerhouse site to approved commercial landfills. The alignment and pavement are in good condition and well maintained. KRRC does not propose improvements and upgrades to this highway for mobilization or hauling of materials for the Project. Pavement rehabilitation will likely not be needed during or post-construction. KRRC's contractor will obtain transportation permits, if required, from the Department of Transportation for mobilizing "wide-load" truck trailers with construction equipment. KRRC's contractor will obtain hauling permits if US97 is used for carrying oversize loads of materials removed from the site.



Figure 5.2-2 US97 and Keno Worden Rd

Oregon Route 66 (OR66, Green Springs Highway)

OR66 is a state highway classified as a rural minor arterial that runs east-west in Oregon and north of the Klamath River. It is a two-lane undivided roadway with posted limits of 35 to 45 mph. The highway's western terminus is at Oregon 99 near Ashland and its eastern terminus is at The Dalles California Highway (US97) and Oregon 140 near Klamath Falls. KRRC's contractor will use the segment of roadway between J.C. Boyle Dam/Powerhouse Access Road and US97 for mobilization and as a haul route for materials taken to commercial landfills. The pavement is in fair condition. KRRC does not propose improvements and upgrades to this highway for mobilization and hauling for the Project. Pavement rehabilitation will likely not be needed during or post-construction. This portion of OR66 includes Spencer Bridge (ODOT Bridge No. 19789).

Spencer Bridge

Spencer Bridge (OR66) is a 3-span continuous welded steel plate girder bridge that is approximately 558 feet long and 43 feet wide. It was built in 2005 for a HL-93 truck design load. The structure has a

reinforced concrete deck with two12-foot lanes and 8-foot shoulders. The structure is supported on two column bents founded on 6–foot-diameter shafts and seat type abutments. The west abutment is founded on 2–foot-diameter shafts and the east abutment is founded on a spread footing placed on compacted stone fill.



Figure 5.2-3 Spencer Bridge (OR66)

KRRC's contractor will use this structure for mobilization and as a haul route for materials taken to commercial landfills. The alignment and deck are in excellent condition and well maintained. KRRC does not propose improvements and upgrades to this structure for mobilization for the Project. Nor does KRRC propose temporary traffic control.

Keno Worden Road

Keno Worden Road is a county road classified as a rural minor collector and connects to The Dalles California Highway to the southeast and OR66 to the northwest in Oregon. It is a two-lane undivided roadway with posted speed limits of 20 to 35 mph. KRRC's contractor will use the roadway for mobilization and as a haul route for materials taken to commercial landfills. The existing pavement of Keno Warden Road is in fair condition. KRRC does not propose improvements and upgrades to this highway for mobilization and hauling for the Project. Pavement rehabilitation will likely not be needed during or post-construction.

Topsy Grade Road

Topsy Grade Road is a county road that runs east of and parallel to the Klamath River with the northeast terminus at OR66 just east of Spencer Bridge and becomes Copco Lake Road at the California/Oregon

border to the southwest. It is a two-way access road ranging in width between 14 feet and 18 feet. Most of the roadway is gravel and some short sections are asphalt, particularly near the Topsy Campground (managed by BLM) at J.C. Boyle Reservoir. KRRC's contractor will use the section of roadway between the Topsy Recreation Site and OR66 for mobilization and material hauling. KRRC does not propose improvements and upgrades to this roadway for the Project. KRRC's contractor may perform pavement rehabilitation during or post-construction. KRRC's contractor will use temporary traffic control for any pavement rehabilitation.



Figure 5.2-4 Topsy Grade Road – Causeway Road

Access Road from OR66 to J.C. Boyle Dam

The Access Road from OR66 to J.C. Boyle Dam is a private gravel road ranging in width between 16 to 18 feet and is owned and maintained by PacifiCorp. The pavement is in fair condition. KRRC's contractor will use this section of roadway for mobilization and material hauling. KRRC will improve parts of the road by regrading uneven or rutted areas. At the intersection with OR66, KRRC will perform tree removal and widening of the intersection on the access road approach, which will improve corner sight distance for

mobilization and hauling activities. In addition, KRRC will install advance signage to notify vehicles using OR66 of construction trucks entering/exiting at the intersection. KRRC's contractor will use temporary traffic control during tree removal and intersection widening. This road will be left in place and will be used by both the future land owner and BLM, who uses it to access their adjacent property.

J.C. Boyle Powerhouse Road

The Powerhouse Access Road is an access road that runs between the J.C. Boyle Powerhouse and Dam sites. The majority of this road is owned by BLM, while a short length is owned by PacifiCorp. The full length, however, is maintained by PacifiCorp. It is a two-way undivided gravel road 16 to 22 feet wide. The existing gravel road condition is fair. KRRC's contractor will use this section of roadway as a primary haul route to transport material from the powerhouse to the scour hole below the forebay, and to haul some excavated material from the dam to the tailrace. The average one-way haul distance from the powerhouse to the scour hole below the forebay is approximately 1.8 miles. The average one-way haul distance from the dam to the tailrace is approximately 4.2 miles. KRRC does not propose improvements and upgrades for this roadway for the Project. KRRC anticipates road maintenance in some areas during construction to ensure adequate accessibility, where the existing surface will be damaged due to construction vehicles. Temporary traffic control will not be required. This road will be left in place and will be used by both the future land owner and the public to access adjacent BLM property.

Timber Bridge

A private, PacifiCorp-owned timber bridge spans over the Klamath River just south of J.C. Boyle Dam. The structure is a single span rolled steel beam bridge that is 100–foot-long and 18 feet wide with a 16-foot travel lane. It was built in 2003 for a HS20-44 truck design load. It is used to access the power canal and powerhouse. The bridge has a timber deck supported on 4 beams that are welded to steel floor beam at the abutments. The floor beam is founded on 4 steel piles. The alignment and deck are in good condition and well maintained.

KRRC's contractor will not use the bridge for mobilization of construction access, and improvements and upgrades to this structure are not required. Temporary traffic control will not be required. KRRC's contractor will demolish this bridge post-construction, as described in Section 7.4.

Power Canal Access Road

The power canal access road runs between the dam and forebay spillway. The majority of this road is owned by BLM, while a short length is owned by PacifiCorp. The full length, however, is maintained by PacifiCorp. It is a gravel road immediately adjacent to the power canal and has a width of approximately 14 feet. The surface is in poor condition. KRRC's contractor will use this section of roadway for construction access until the power canal has been completely removed. Minor periodic roadway maintenance such as re-grading will likely be required to address roadway deterioration during construction. KRRC does not propose temporary traffic control. This road will be left in place for continued use by BLM.



Figure 5.2-5 Timber Bridge at J.C. Boyle

Disposal Access Road

The private, PacifiCorp-owned disposal access road runs between the dam and on-site disposal area just north of the dam. KRRC's contractor will use this road will be used for material hauling. The average one-way haul distance is approximately 0.4 mile. Improvements for this roadway include regrading uneven and rutted areas and widening in some segments to facilitate two-way traffic. KRRC does not propose temporary traffic control as this is not a public road. KRRC's contractor will demolish this road and restore it to native vegetation post-construction.

Right Abutment Access Road

The private, PacifiCorp-owned right abutment access road runs between the dam and Topsy Grade Road. It is a gravel road in fair condition. KRRC's contractor will use the roadway for mobilization and material hauling. KRRC does not propose improvements to the road and does not propose temporary traffic control. KRRC's contractor will demolish this road and restore it to native vegetation post-construction.



Figure 5.2-6 Power Canal Access Road

Penstock Access Roads

Several BLM-owned dirt roads extend from the J.C. Boyle Powerhouse Road up to various elevations along the penstocks. KRRC's contractor will use that these roads to access the penstocks for demolition and related material hauling. KRRC does not propose improvements to the roads for the Project. KRRC does not propose temporary traffic control. KRRC's contractor will demolish this road and restore it to native vegetation post-construction.



Figure 5.2-7 Right Abutment Access Road

5.2.3 Staging Areas, and Disposal Sites

Figure 5.2-1(C) shows construction staging areas and disposal sites for removal of J.C. Boyle Dam and Powerhouse within the limits of work on and are discussed in the following sections. The contractor will mobilize construction equipment to the site by about October 2020 to prepare the staging areas and prepare the right abutment disposal site for dam removal post-drawdown.

Staging Areas

Equipment staging areas (Figure 5.2-1(C)) will be located at the left abutment of the dam and near the forebay and downstream powerhouse. Identified staging areas include a 4.7 acre area and a 5.6 acre area on the left abutment of the dam, a 1.0 acre area at the forebay, and a 1.7 acre area at the powerhouse. The contractor will prepare staging areas by clearing vegetation and minor grading. The staging areas will be restored post-construction by minor grading and hydroseeding. See Section 6 for additional detail associated with restoration.

Disposal Sites

The contractor will permanently bury earth materials generated from removal of the J.C. Boyle development on-site in a portion of the original borrow pit located on the right abutment of the dam (see Figure 5.2-1(C)

and sections in Figures 5.2-8(C) and 5.2-9(C)) within the project area. Excavated embankment materials will be hauled along existing access roads to the northwest portion of the former borrow pit just north of the cleared transmission line corridor, covering an area of approximately 6 acres. KRRC's contractor will grade the disposed material as a hill (maximum fill height of about 35 feet) contoured to blend into the surrounding topography as shown in plan and section on Figure 5.2-1(C), Sheet 1. Preparation of the disposal site will include clearing of existing vegetation and stripping and stockpiling of what little topsoil is present. KRRC's contractor will excavate the top 12 inches of the downstream face of the dam and stockpile it near the disposal site for later use as topsoil for restoration of the disposal site. Special precautions will be required for work below the high voltage transmission lines, but adequate clearance is available. After final grading for drainage and aesthetics, KRRC's contractor will cover the disposal site with topsoil and hydroseed the area. Compaction other than by equipment travel will not be necessary. See Section 6 for additional detail associated with restoration. KRRC will complete erosion monitoring on an annual basis for 5 years following placement to assess whether significant erosion and slope deterioration has occurred. If significant erosion occurs, KRRC will repair the eroded area to the satisfaction of the appropriate regulatory agency.

Figure 5.2-8 J.C. Boyle Right Abutment Disposal Site Plan & Sections (Appendix C)

Figure 5.2-9 J.C. Boyle Forebay Spillway Scour Hole Backfill Plan & Sections (Appendix C)

Concrete rubble from the dam, flume, forebay, and powerhouse will be placed within the project property in the eroded scour hole below the forebay spillway structure (Figure 5.2-1(C), Sheet 8), and covered with 3 to 5 feet of rock and soil debris that has eroded and been moved downslope of the scour hole. KRRC's contractor will use the previously eroded rock and soil, which they will obtain from the slope below the scour hole, as top cover so that the restored scour hole will blend more naturally into the adjacent slopes. The scour hole, which is approximately 100 feet deep with near vertical side slopes, was eroded into a steep slope (1.3H:1V to as steep as 1H:1V) of talus and colluvium. Filling of the scour hole to match the original slope and maintain an adequate factor of safety for slope stability will not be feasible. The concrete rubble, which has a high shear strength, will be spread in lifts and track walked with a small bulldozer to a finished slope of 1.5H:1V. The finished slope will have a factor of safety of more than 1.3. The volume of available concrete rubble will fill the hole to within about 66 feet of the top of the hole (Figure 5.2-1(C), Sheet 8). The vertical slopes extending above the finished fill grade will be flattened to 1H:1V. The fill will be shaped to drain toward the center of the fill, which will be rock lined to provide for erosion protection. Use of the previously eroded rock and soil debris will allow similar vegetative cover to be used for restoration as is currently present on the slopes upstream and downstream of the scour hole.

Rebar, mechanical and electrical equipment from the dam, power canal and powerhouse, in addition to building material and demolished powerline material will be disposed of at an approved landfill near Klamath Falls. Table 5.2-3 lists tonnage and volume of these materials.

5.2.4 J.C. Boyle Dam and Powerhouse Removal

Dam Removal

Immediately following reservoir drawdown with the reservoir level below the spillway crest (see Section 4.2.1), KRRC's contractor will remove all three spillway gates and operators, the spillway bridge deck, the spillway piers, and the log boom in the dry. KRRC's contractor will retain the left abutment wall with fish ladder that supports the left side of the embankment for flood protection until after spring runoff when embankment removal could begin.

KRRC's contractor will maintain sufficient embankment freeboard at all times between the elevation of the excavated embankment surface and the reservoir to reduce the potential for flood overtopping and potential embankment failure. The freeboard requirement will be to provide 100-year flood protection for the time of year that embankment dam removal is occurring (see Section 4.4). KRRC will not start excavation of the J.C. Boyle embankment section until July 1, 2021, and will complete excavation by September 30, 2021 to minimize hydrologic risk.

Removal of the remaining features at the dam will be as follows:

1. At the beginning of embankment excavation, reservoir inflows will have reduced to a level that is below the crown of the diversion culverts (elevation 3765.2).
2. Remove dam embankment in July and August to no lower than elevation 3770.7 (about 30 feet above bedrock at upstream toe) to provide an upstream cofferdam (Figure 5.2-10 (B)) sufficient to ensure minimum 100-year flood protection (with freeboard) in September for flows up to about 3,500 cfs through left abutment. Remove riprap from upstream and downstream slopes as embankment is removed and temporarily stockpile for later use on downstream slope of upstream cofferdam. Remove embankment materials downstream of upstream cofferdam limits to final channel grade, including concrete cutoff wall. Remove the left abutment wall with fish ladder concurrent with dam removal.
3. Place excavated rockfill (from stockpile) on downstream face of upstream cofferdam as required for controlled breach of cofferdam embankment to bedrock elevation 3740.7 at upstream toe.
4. Remove the concrete spillway crest structure down to the top of the diversion culvert, and remove the canal intake structure and the left gravity wall in July, concurrently with the beginning of embankment removal (Figure 5.2-10 (B)).
5. Prior to September 30, 2021, but following breaching of the upstream cofferdam at Iron Gate Dam (to minimize downstream impacts), breach the J.C. Boyle upstream cofferdam by notching below reservoir level (expected to be below RWS elevation 3763.7). Breaching will occur with a reservoir head behind the cofferdam of about 20 feet. Achieve final reservoir drawdown by natural erosion of the armored cofferdam to the original streambed level. The cofferdam breach at J.C. Boyle could release up to 5,000 cfs.
6. Following the cofferdam breach, remove any remaining embankment materials from river channel in the wet (during low flow period) as required, and remove remaining diversion culvert concrete in the dry.

7. Remove all other features (buildings, paving on access roads, etc.) as required. Restore dam site and right abutment disposal site as required, including the placement of topsoil and seeding.

Portions of the dam and hydropower demolition must be performed within the in-stream construction window negotiated with the regulatory agencies. See Section 8.6 of this Definite Plan for information pertaining to the construction schedule and timing of the various activities.

Figure 5.2-10 J.C. Boyle Dam Removal (Appendix B)

Canal Removal

Removal of the power canal will likely be from the downstream end to the upstream end but the contractor could alter the approach. In portions of the canal that are two-walled, both walls and the invert slab will be demolished using mechanical methods (e.g. hydraulic shears or hoe-ramming). In portions of the canal that are single-walled, KRRC's contractor will demolish the wall and the invert slab, but shotcrete that may have been used to stabilize portions of the inside wall formed by exposed rock will be left in place. Removal of the shotcrete could destabilize the rock slope increasing the potential for rock falls during and after construction. KRRC's contractor will remove reinforcement from the concrete as the demolition proceeds upstream. KRRC's contractor will haul the concrete rubble and gravel underlying the invert slab downstream and place it in the forebay structure spillway scour hole (see Section 5.2.3.2). Following removal of the canal structure, KRRC's contractor will restore the excavated bench the canal was built on by grading the bench to drain, armoring portions of the bench where drainage from uphill areas will cross the bench, and removing vehicular access to the bench. The outer portion of the bench (current location of the access road), will be decompacted using tines on the back of a motor grader and hydroseeded. As an alternative, KRRC may maintain the current access road for fishing access, if requested by BLM and subject to arrangements that are satisfactory to BLM and KRRC. KRRC's contractor will regrade the forebay area to drain and to blend in with surrounding topography (see Figure 5.2-11). See Section 6 for additional detail associated with restoration.

Figure 5.2-11 J.C. Boyle Forebay Backfill Plan and Sections (Appendix C)

Powerhouse Removal

KRRC's contractor will remove the downstream powerhouse, as required, any time after decommissioning by constructing a cofferdam in the tailrace channel for removal operations in the dry. Removal of the remaining features at the powerhouse will be as follows:

1. Use sump pumps to dewater area, as required. Retain the cofferdam as partial backfill for tailrace channel.
2. Remove penstocks and plug tunnel openings.
3. Remove switchyard and warehouse building.
4. Backfill the tailrace channel by removing up to 5 feet of alluvial material from upstream and downstream of the tailrace channel (Figure 5.2-1(C), Sheet 9) that originally came from excavation of

the powerhouse and tailrace and placing the material in the channel by pushing using a bulldozer or placement using a large excavator.

5. Place a turbidity curtain along the downstream edge of the channel to minimize water quality impacts to the river during placement of the backfill.

Transmission Line and Switchyard Removal

Transmission line removal at J.C. Boyle includes demolishing the J.C. Boyle switchyard, demolishing overhead distribution lines and associated poles or towers, as applicable, and installation of new connections to maintain the power grid (see Figure 5.2-12).

KRRC's contractor will demolish approximately 2.8 miles of overhead transmission/distribution line and approximately 42 poles. Lines to be demolished include:

- 230 kV distribution lines between J.C. Boyle switchyard and J.C. Boyle Dam, including to the village houses near the dam
- 230 kV connections in the J. C. Boyle powerhouse area

Major switchyard demolition components include:

- Two (2) A-Frame Dead End Structures (typically ~60-80ft high)
- Two (2) large 230 kV Transformers
- Two (2) 230 kV Power Circuit Breakers
- One (1) 230 kV switchyard tie structure
- Approximately 600-ft of perimeter chain-link fence

PacifiCorp may salvage the transformers and other equipment for reuse at other facilities.

New connections include installation of two (2) new 230 kV strain transmission structures outside J.C. Boyle switchyard to tie the existing 230 kV transmission line north and south of J.C. Boyle switchyard together. Currently these lines loop in/out of J.C. Boyle, but continuity will be broken when the contractor removes the powerhouse and switchyard.

Figure 5.2-12 Project Transmission Line Removal (Appendix B)

5.2.5 Demolition Methods, Estimated Equipment and Workforce

KRRC proposes the following demolition methods, estimated equipment requirements, and estimated workforce requirements for planning purposes based on similar projects and engineering judgment. Alternative methods, equipment, and workforce that would also meet project requirements are possible and could be refined by KRRC's contractor.

Demolition Methods

KRRC's contractor will remove the spillway gates and traveling hoists by a large crane for loading onto highway trucks and heavy-haul trailers, with the reservoir drawn down below the spillway crest. The reinforced concrete spillway bridge deck and piers could be removed in pieces by hydraulic excavators, or in sections by conventional or diamond-wire sawcutting. KRRC's contractor will remove the upstream concrete stoplogs for the diversion by blasting if they cannot be pulled out of their slots by a crane under reservoir head.

KRRC's contractor will remove the lower portion of the concrete spillway section by hoe-ramming or by drilling and blasting in the dry. Drilling for blasting will include small- to mid-sized hydraulic track drills and perhaps air-track drills supported by 850 to 1,200 cubic feet per minute (CFM) air compressors. Considerable jack-leg and similar hand drilling will supplement the machine drilling for special shots. Reinforced concrete in deck, wall, and floor slabs for remaining features to be removed (including fish ladder, canal intake structure, power canal, forebay structures, and powerhouse) will be excavated by mechanical methods (e.g. hydraulic shears or hoe-ramming), or possibly in sections by conventional or diamond-wire sawcutting. KRRC's contractor will haul concrete rubble in 25 to 30 ton articulated off-road trucks or 12 to 15 ton tandem-axle highway trucks to the scour hole below the forebay. KRRC's contractor will haul mechanical and electrical equipment and miscellaneous items in a mixture of 12 to 15 ton tandem-axle highway trucks, 25-ton rock trailers, and conventional heavy-haul trailers to an approved off-site disposal area.

Conventional earthmoving equipment required to remove the embankment will consist of up to eight 25 to 30 ton articulated off-road trucks with two 4 CY excavators to reach the required average production rate of 400 CY per hour, or 16,000 CY per week (5 days per week, single shift) for removal of the dam embankment within 8 to 9 weeks. KRRC expects the contractor to use dozers for knockdown and grading at the disposal sites as well as to support higher production, mass excavation operations.

Estimated Equipment and Workforce Requirements

The estimated equipment that will be used for the removal of J.C. Boyle Dam and Powerhouse and for restoration of the reservoir area pre- and post- drawdown are shown in Table 5.2-2.

Table 5.2-2 J.C. Boyle Dam and Powerhouse, Estimated Equipment List

Name of Equipment	Pre-Drawdown	Post Drawdown
Crawler-mounted lattice boom crane, 150 to 200 ton, 160- to 200-foot boom		X
Rough terrain hydraulic crane, 35 to 75 ton		X
Hydraulic track excavators, 65,000 to 120,000 lb, with Cat H120 hoe-ram, thumb and shear attachments		X
Cat 966 or Cat 988 wheel-loaders, 4 CY bucket		X
Cat 740 articulated rear dump trucks, 30 ton (22 CY)	X	X
D-6 or D-8 standard crawler dozers	X	X

Name of Equipment	Pre-Drawdown	Post Drawdown
Front-end wheel loader, integrated tool carrier, 25,000 lb		X
Cat TL943 rough terrain telescoping forklift		X
Rough terrain telescoping manlift		X
Truck-mounted seed sprayer, 2500 gallon		X
On-highway, light duty diesel pickup trucks, ½ ton and 1 ton crew	X	X
On-highway flatbed truck with boom crane, 16,000 lb		X
On-highway truck tractors, 45,000 lb		X
Off-highway water tanker, 5,000 gallon		X
Engine generators, 6.5 KW to 40 KW, diesel or gasoline		X
Air compressors, 100 psi, 185 to 600 cfm, diesel		X
Hand-held drilling, cutting, and demolition equipment		X
Portable welders and acetylene torches		X
4-inch submersible trash pumps, electric		X

An estimated average workforce of 25 to 30 people will be required for the construction activities, for an estimated duration of 12 months from site mobilization to construction completion for either dam removal alternative. The peak workforce required during excavation of the dam embankment could reach 40 to 45 people.

5.2.6 Imported Materials

KRRC's contractor will import some materials to the site to support dam removal. The most likely materials to be imported include gravel surfacing from a commercial quarry for temporary haul roads (approximately 2,800 tons, 100 truck trips), seed and mulch materials, and minor quantities of ready-mix concrete and reinforcing steel from local commercial sources for tunnel plugs.

5.2.7 Waste Disposal

Table 5.2-3 shows estimated quantities of materials generated during removal of J.C. Boyle Dam and Powerhouse, numbers of truck trips, and approximate haul distances for waste disposal. KRRC's contractor will place excavated concrete in the scour hole below the emergency spillway. KRRC's contractor will primarily place excavated embankment materials in the right abutment disposal area. KRRC's contractor will separate reinforcing steel from the concrete prior to placement in the scour hole and haul it to a local recycling facility. KRRC's contractor will haul all mechanical and electrical equipment to a suitable commercial landfill or salvage collection point.

Table 5.2-3 Waste Disposal for Full Removal of J.C. Boyle Dam

Waste Material	In-Situ Quantity	Bulk Quantity [1]	Disposal Site	Peak Daily Trips [2]	Total Trips [3]
Earth	102,000 CY	123,000 CY	Onsite right abutment disposal area	5 units/160 trips (unpaved road)	5,600 trips (1 mile RT)
	7,100 CY	7,800 CY	Onsite powerhouse tailrace	5 units/160 trips (unpaved road)	360 trip (8 miles RT)[5]
Concrete at: Dam Power canal Powerhouse	 4,700 CY 33,300 CY 1,900 CY	 6,100 CY 43,200 CY 2,600 CY	Onsite forebay spillway scour hole	2 units/50 trips (unpaved road)	 120 trips (4 miles RT) 1,810 trips (2 miles RT) 270 trips (4 miles RT)
Rebar at: Dam Power canal Powerhouse	 200 tons 3,800 tons 100 tons	—	Landfill near Klamath Falls	2 units/10 trips (OR66)	 20 trips (44 miles RT) 380 trips (48 miles RT) 10 trips (52 miles RT)
Mech. and Elec at: Dam Power canal Powerhouse	 700 tons 300 tons 1,500 tons	—	Landfill near Klamath Falls	2 units/10 trips (OR66)	 90 trips (44 miles RT) 40 trips (48 miles RT) 200 trips (52 miles RT)
Building Waste	10 buildings 12,000 ft^2	2,700 CY	Landfill near Klamath Falls	2 units/10 trips (OR66)	270 trips (44 miles RT)
Power lines	2.8 miles of 69-kV	—	Landfill near Klamath Falls		

Notes:

1. Volumes increased 30 percent for concrete rubble, 20 percent for loose earth materials.
2. Peak daily trips for each site are based on the number of vehicles (units) shown, operating within one 8-hour shift.
3. Total trips of earthfill and concrete assume off-highway articulated trucks with a nominal load capacity of 22 CY. Total trips for hauling rebar using truck tractor-trailers is based on 10 tons per trip. Total trips for hauling mechanical and electrical items using truck tractor-trailers is based on 8 tons per trip. Total trips for building waste using truck tractor-trailers is based on 10 CY per trip.

Table 5.2-4 shows potential commercial landfills or salvage collection points and capacities. Appendix 03 discusses potential hazardous materials at J.C. Boyle Dam and Powerhouse and their disposal.

Table 5.2-4 Waste Disposal Facilities near J.C. Boyle Dam

Name of Facility	Location	Distance from Site	Remaining Capacity	Materials Accepted
Klamath County landfill	Klamath Falls, OR	20 miles	435,000 CY (2010)	construction and demolition waste, asbestos, contaminated soils, and recyclables

5.3 Copco No. 1 Dam and Powerhouse

5.3.1 Removal Limits

Copco No. 1 Dam is located within a narrow canyon on the Klamath River at RM 202.2. Minimum requirements for a free-flowing condition and volitional fish passage on the Klamath River through the Copco No. 1 Dam site requires the complete removal of the concrete gravity arch dam between the left abutment rock contact and the concrete intake structure on the right abutment, to approximate elevation 2463.5, or 20 feet below the existing streambed level at the dam (see Appendix G), to prevent the development of a potential fish barrier at the site in the future. Table 5.3-1 summarizes and Figure 5.3-1 (C) shows features the Project will remove or potentially retain as PROs.

Table 5.3-1 Copco No. 1 Dam and Powerhouse, Removal Requirements

Feature	Full Removal	Partial Removal Options	Comments [2]
Concrete Dam	Remove [1]	Remove [1]	
Spillway Gates, Deck, Piers	Remove	Remove	
Penstocks	Remove	Retain	PRO: Seal openings, install security fence
Powerhouse Intake Structure	Remove	Retain	PRO: Seal openings, install security fence
Gate Houses on Right Abutment	Remove	Possible	PRO: Likely to be removed for access and for large crane for dam removal.
Diversion Control Structure	Retain	Retain	PRO: Remove gate hoists, stems, and wire ropes, demolish unstable concrete
Tunnel Portals	Plug	Plug	Plug with reinforced concrete
Powerhouse (incl. mechanical and electrical equipment)	Remove	Retain	PRO: If retained will remain in 100 year floodplain
Powerhouse Hazardous Materials (transformers, batteries, insulation)	Remove	Remove	
Four 69-kV Transmission Lines (3.0 mi total) (incl. poles and transformers)	Remove	Remove	
Switchyard	Remove	Remove	
Warehouse and Residence	Remove	Remove	

Notes:

1. Remove to El. 2463.5 which is 20 feet below original channel bottom (see Appendix G).
2. PROs would involve long-term maintenance costs, including the preservation of any exposed items with coatings containing heavy metals (such as the penstocks).

Figure 5.3-1 Copco No. 1 and Copco No. 2 Dams Removal Features and Limits (Appendix C)

Retention of the Copco No. 1 Powerhouse as a PRO will require the structure to be sealed and fenced. KRRC assumes the paint on the east (upstream) face of the concrete structure contains heavy metals and would

be carefully removed. Mechanical and electrical equipment could be left in place with all power connections to the outside removed; however, any oil in the turbine governor and hydraulic control systems, transformers, oil storage tanks, or other equipment would be removed. KRRC's contractor will also remove other potentially hazardous materials, such as batteries and treated wood. KRRC's contractor could place rockflll or concrete rubble along the right river bank just upstream of the powerhouse to improve the flow conditions past the structure.

5.3.2 Construction Access

Figures 5.1-1(C) and 5.3-1(C) show construction access roads and associated improvements that may be required for removal of Copco No. 1 Dam and Powerhouse, and associated work. KRRC observed existing conditions of the highways, local roads, and structures in the field to identify deficiencies, and determine if improvements are necessary for mobilization and/or hauling during construction and demolition activities. KRRC will complete access road improvements prior to associated construction and removal at the dam and powerhouse.

The delivery of off-road construction equipment, including cranes, large excavators, loaders, and large capacity dump trucks will be by special tractor-trailer vehicles operating under "wide load" restrictions and at appropriate speeds.

Interstate 5 (I-5)

The Cascade Wonderland Highway (I-5) is classified as an interstate freeway that runs north-south through California and Oregon. The existing Henley Hornbrook interchange (Exit 789) provides access from the freeway to Copco Road. I-5 is a divided roadway with two-lanes on each direction with paved shoulders with a posted speed limit of 70 mph. KRRC's contractor will use I-5 for mobilization of construction equipment and as a haul route to carry demolished materials other than earth and concrete rubble from the dam and powerhouse site to approved commercial landfills. The alignment and pavement are in very good condition and well maintained. KRRC does not propose improvements and upgrades to this highway for mobilization or hauling of materials for the Project. Nor does KRRC propose temporary traffic control. KRRC's contractor will obtain transportation permits, if needed, from the Department of Transportation for mobilizing "wide-load" truck trailers with construction equipment or for hauling oversize materials removed from the site.

Copco Road

Copco Road is a county road that runs east-west along the Klamath River. Copco Road provides access to various local access roads that lead to Iron Gate Dam and Powerhouse, Copco No. 1 Dam and Powerhouse, and Copco No. 2 Dam and Powerhouse. Copco Road will be a primary hauling and access road for all three California dam sites for transporting materials and equipment. Construction area signs will be required to provide advance warnings to trucks and other road users to improve safety. In addition, KRRC proposes road maintenance in some areas during construction, where existing pavement is damaged due to construction trucks.

This report divides Copco Road into five sections for discussion of the existing conditions and proposed improvements needed for the Project.

Copco Road from I-5 to Ager Road (3.1 miles)

Copco Road from Interstate 5 to Ager Road is a County road and classified as a major collector. It is a two-way undivided road with pavement in good condition. KRRC does not propose improvements and upgrades to this highway for mobilization and hauling for the Project. KRRC's contractor may perform pavement rehabilitation during or post-construction. KRRC's contactor will use temporary traffic control for any pavement rehabilitation. This portion of Copco Road includes Cottonwood Creek Bridge.

Cottonwood Creek Bridge

Cottonwood Creek Bridge is a single span reinforced concrete slab bridge that is approximately 89 feet long and 32 feet wide. The structure has two 12-foot lanes and 4-foot shoulders. It was built in 1980 with an HS20-44 design loading. The structure is supported on pinned diaphragm abutments founded on spread footings. The alignment and deck are in good condition and well maintained. KRRC does not propose improvements and upgrades to this structure for mobilization for the Project. Temporary traffic control will not be required.

Copco Road from Ager Road to Lakeview Road (5 miles)

Copco Road from Ager Road to Lakeview Road is a County road and classified as a minor collector. It is a two-way undivided road with pavement in poor condition and a posted speed limit of 35 mph. KRRC does not propose improvements and upgrades to this highway for mobilization and hauling for the Project. KRRC's contractor may perform pavement rehabilitation during or post-construction. KRRC's contactor will use temporary traffic control for any pavement rehabilitation. This portion of Copco Road includes Dry Creek Bridge (Caltrans Bridge No. 2C0144).

Dry Creek Bridge

Dry Creek Bridge is a single span bridge that is approximately 24 feet long and 31 feet wide, and was built in 1960. It has timber beams and a timber deck with an asphalt overlay. The structure has two 14-foot lanes and no shoulders. The structure is supported by seat type abutments. No information is available regarding the foundation type.

The structural members of Dry Creek Bridge, which are over 55 years old, are inadequate to carry the current legal/permit loads as well as project mobilization and hauling trucks. KRRC's contactor will construct a temporary structure and detour over Dry Creek, north of the existing bridge, to allow for mobilization and hauling truck access. The type of temporary structure over the Dry Creek will be determined during the design phase. Temporary structure options include temporary railcar bridge, box culvert or pipe culvert. Alternatively, KRRC's contractor may implement bridge strengthening or bridge replacement. In the case of replacement, KRRC's contactor would still construct a temporary bridge as described above during the construction of the replacement bridge at the current location. See Figure 5.3-2 for the existing bridge

location and proposed detour. KRRC anticipates minimal impact to the existing traffic for the planned improvements. Impact to traffic will be limited to the traffic switch from the existing road alignment to the detour and temporary structure.

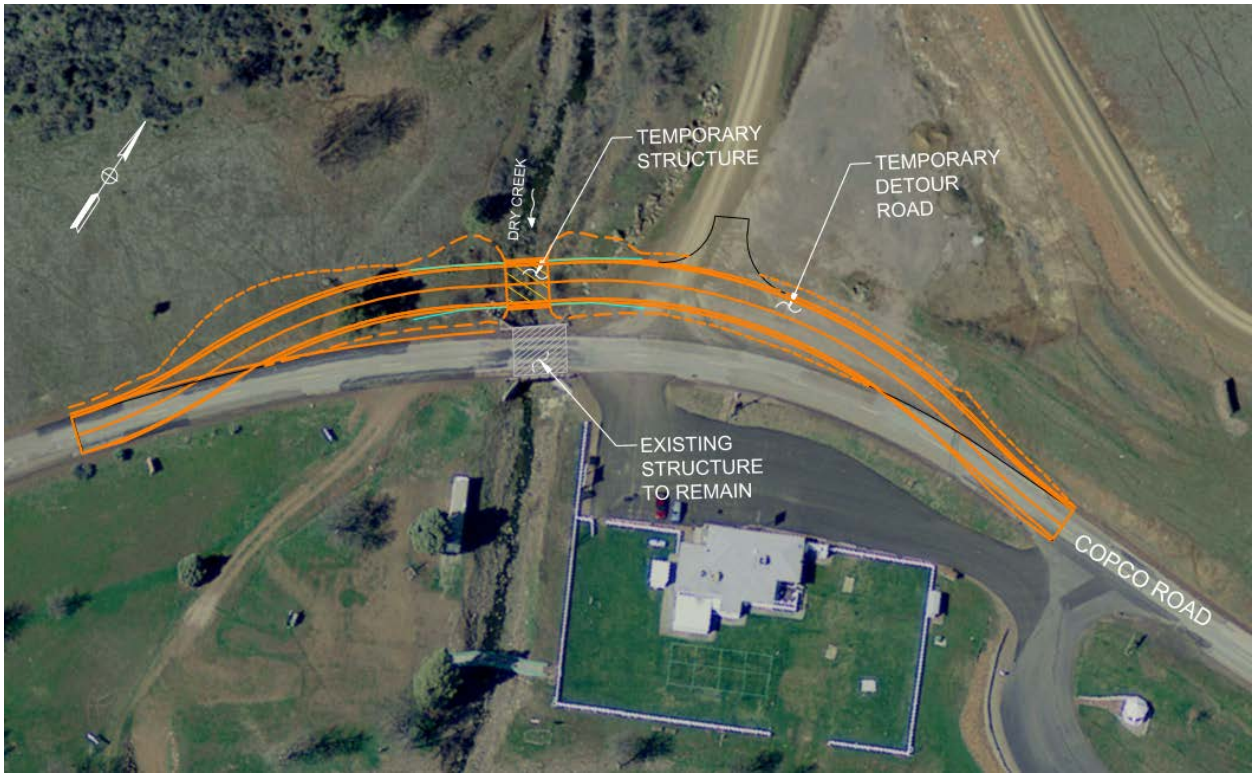

Figure 5.3-2 Copco Road Temporary Structure at Dry Creek

Copco Road from Lakeview Road to Daggett Road (9.6 miles)

Copco Road from Lakeview Road to Daggett Road is a County road classified as a minor collector and runs along the norths side of the Klamath River. It is a two-way undivided county road about 24 feet wide with posted speed limit of 35 mph. Pavement condition along this stretch is poor and will require pavement maintenance during construction. KRRC does not propose improvements and upgrades for this road prior to dam removal. KRRC's contractor may perform pavement rehabilitation during or post-construction. KRRC's contactor will use temporary traffic control for any pavement rehabilitation. This portion of Copco Road includes Brush Creek Bridge (Caltrans No. 2C0280) and Jenny Creek Bridge (Caltrans No. 2C0280).

Brush Creek Bridge

Brush Creek Bridge is a single span 18–inch-deep reinforced concrete slab bridge that is approximately 25 feet long and 24 feet wide. It was built in 1976 with an HS20-44 design loading. The structure has two12-foot lanes and no shoulders. The structure is supported on strutted abutments founded on spread footings. The alignment and deck are in fair condition and well maintained. KRRC does not propose

improvements and upgrades to this structure for mobilization for the Project. KRRC does not propose temporary traffic control. KRRC does not propose post-project erosion protection.

Jenny Creek Bridge

Jenny Creek Bridge is a single span precast pre-stressed deck bulb tee girder bridge that is approximately 114 feet long and 27 feet wide (Figure 5.3-3). It was built in 2008 with an HL-93 design loading. The deck has an asphalt overlay with two12-foot lanes with no shoulders. The structure is supported on seat type abutments founded on pile caps with steel H-piles. Abutment 2 has a portion of the previous abutment left in place in front of the new abutment.



Figure 5.3-3 Jenny Creek Bridge

The alignment and deck are in very good condition and well maintained. The bridge is suitable for the access and hauling requirements of the Project, but KRRC proposes replacing this bridge as a necessary long-term improvement to offset the effects of reservoir drawdown. Refer to Section 7.4.3.9 for more details.

Copco Road from Daggett Road to Copco Access Road (2.6 miles)

Copco Road from Daggett Road to Copco Access Road is classified as a minor collector with a roadway width of 14 to 22 feet. The surface starts out as asphalt and transitions to aggregate base 1.2 miles east of the Daggett Road intersection, and has very low traffic volume. KRRC does not propose improvements and upgrades prior to dam removal. KRRC's contractor may perform road surface maintenance during or post-construction. KRRC's contactor will use temporary traffic control for any road surface maintenance. This portion of Copco Road includes Fall Creek Bridge (Caltrans Bridge No. 2C0198).

Fall Creek Bridge

Fall Creek Bridge is a single span bridge with timber beams of unknown age and a concrete deck (Figure 5.3-4). The structure is supported on seat type abutments. No information is available regarding foundation type. Since the superstructure is timber beams of unknown age and the beams appear inadequate to carry the legal/permit loads as well as project mobilization and hauling trucks. KRRC proposes replacing this structure by a single span bridge of similar length and width as the existing structure. Alternatively, the contractor may implement other methods such as a temporary bridge over the existing bridge or structural strengthening of the existing bridge.

If KRRC opts for a new bridge, KRRC's contactor will construct it at the existing bridge alignment in two phases to maintain traffic during construction of the replacement bridge. Given the topographic constraints at the site, constructing the bridge in two phases will result in less hillside excavation and impacts than providing a parallel temporary bridge and detour during construction. In the first phase, KRRC's contactor will provide one-way traffic in the southern lane using flaggers, and KRRC's contactor will construct the new northern lane. In the second phase, KRRC's contactor will reverse the operation with one-way traffic in the northern lane and construction occurring on the new southern lane of the bridge. KRRC's contactor will separate traffic from work with K-rails. See Figure 5.3-5 for the existing bridge location. Impact to traffic will involve one-way controlled traffic during the bridge replacement.

If KRRC opts for a temporary bridge, KRRC's contractor will construct it over the existing bridge with placement of a longer temporary bridge supported landward of the existing bridge supports. Some graded fill placed on the roadway approaches may be necessary to transition from the existing bridge elevation to the slightly higher temporary bridge elevation. A temporary bridge will remain in place for the duration of construction, and KRRC's contractor will remove it along with any fill on the approach roadways, leaving the existing bridge in place, at the end of construction.



Figure 5.3-4 Fall Creek Bridge on Copco Road

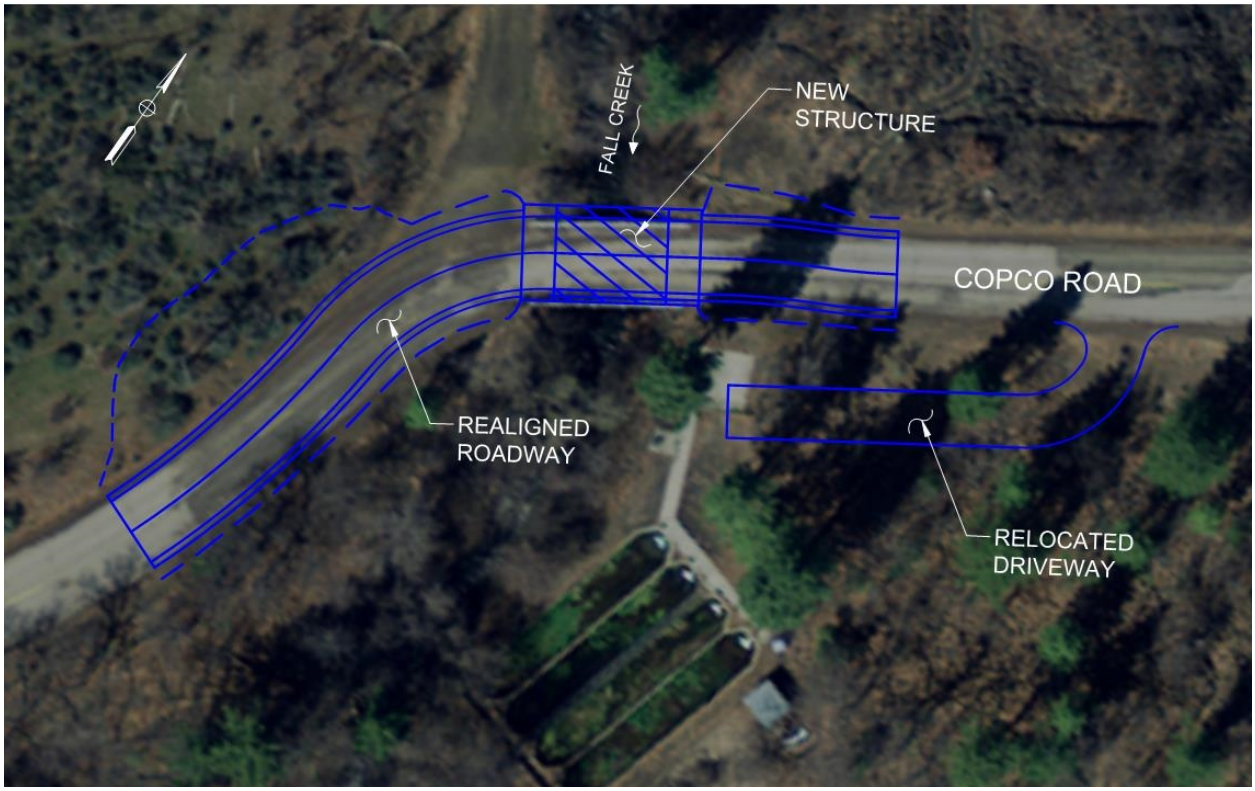

Figure 5.3-5 Fall Creek Bridge Replacement

Copco Road from Copco Access Road to Copco Road Bridge (5.9 miles)

Copco Road from Copco Access Road to Copco Road Bridge is classified as a minor collector with a roadway width of 12 feet. The road surface is primarily dirt and has very low traffic volume. KRRC's contractor will not use this portion of Copco Road for dam or powerhouse removal but will use it for construction access to various post construction improvements, such as culvert replacements and installing rock slope protection. See Section 7.4 for details. KRRC does not propose improvements and upgrades prior to dam removal. Nor does KRRC propose temporary traffic control. The east end of this segment of Copco Road crosses Copco Lake at Copco Road Bridge (Caltrans No. 2C0039).

Copco Road Bridge

Copco Road Bridge is a two-span cast-in-place post-tensioned concrete box girder bridge that is approximately 203 feet long and 25 feet wide (Figure 5.3-6). It was built in 1988 for a HS 20-44 truck design load. The structure has two 12-foot lanes and no shoulders. The structure is supported by a pier wall founded on a pile cap with steel H-piles that are grouted into rock. The abutments are diaphragm type founded on a pile cap with steel H-piles. KRRC's contractor will not use this structure for mobilization of construction equipment. The alignment and pavement are in very good condition and well maintained. KRRC does not propose improvements and upgrades to this structure for mobilization. Nor does KRRC propose temporary traffic control.



Figure 5.3-6 Copco Road Bridge

Copco Access Road

Copco Access Road is a private road between Copco Road and the dam that provides access to Copco No. 1 Dam and powerhouse sites and Copco No. 2 Dam site (Figure 5.3-7). The first approximate 0.1 mile of the road nearest Copco Road is on non-PacifiCorp private land, and the remaining approximate 0.9 miles is on PacifiCorp land. The road surface is primarily dirt with a roadway width of 14 feet up to the chain link gate, then past the gate the pavement type changes to asphalt concrete in good condition traversing through Copco No. 1 residential area. Past the residential area, the road surface changes to a dirt road with steep descending hilly terrain towards Copco No. 1 and Copco No. 2 dam sites. The Copco No. 1 Dam access portion is a dirt road with a hairpin bend. It appears landslides have occurred on the hillside above this hairpin bend. A second hairpin bend occurs on the segment down to Copco No. 2 Dam, and a third hairpin bend occurs if travelling between the top of Copco No. 1 Dam and the powerhouse.

The lower side of this access road is very steep with no barrier protection. KRRC proposes that this segment of the dirt/gravel road be regraded for construction access by clearing and grubbing the available space between the toe of the higher hillside and the existing edge of the dirt/gravel road to provide a wider road

section for construction and hauling trucks. KRRC assumes one-way traffic with turnouts for the access road. Turnarounds for haul trucks will be at the powerhouse and at the disposal site or the staging area. The average one-way haul distance from the base of the dam to the disposal site is 0.5 mile.

KRRC proposes construction area signage and some temporary traffic control devices to improve safety during construction. During mobilization, the contractor will off-load equipment in the staging area and the equipment will track down to the dam and powerhouse area. KRRC's contractor will demolish the portions of the road on PacifiCorp property and restore the area with native vegetation post-construction.

Barge access to the outlet of the diversion tunnel for construction of a new gate structure will occur from the right bank just upstream of the Copco No. 2 Dam.

Barge access to Copco Lake will occur at an existing boat ramp located at Copco Cove on the western shore (Figure 5.1-1(C)). Access to the boat ramp will require minor improvement of the Copco Cove access road for placing the barge-mounted crane on the reservoir. The boat ramp will also require extension into the reservoir to be able to remove the barge following removal of the spillway structure.

Ager Beswick Road

Ager Beswick Road between Copco Road to the east and Ager Road to the west is classified as a minor collector road with a posted speed limit of 25mph. It is a two-way undivided County road with pavement condition ranging from fair to good. KRRC's contractor will not use the road for hauling, but the contractor may use it for mobilization of a barge-mounted crane from the existing boat ramp at Mallard Cove on the southern shore. KRRC does not propose upgrades and improvements to this road prior to dam removal. Access to the boat ramp will require minor improvements to the access road off of Ager Beswick Road to enable placing a barge-mounted crane in the reservoir. The boat ramp will also require extension into the reservoir to be able to remove the barge following removal of the spillway structure. KRRC does not propose temporary traffic control.



Figure 5.3-7 Copco Access Road

5.3.3 Staging Areas and Disposal Sites

Figure 5.3-1(C) shows construction staging areas and a disposal site for removal of Copco No. 1 Dam and Powerhouse within the limits of work, and these are discussed in the following sections. KRRC's contractor will mobilize construction equipment to the site by about June 2020 to prepare the staging areas and disposal site, and construct the diversion tunnel improvements described in Section 4.2.

Staging Areas

The primary 2.3 acre staging area will be located on the right abutment near the existing switchyard as shown on Figure 5.3-1(C), Sheet 1. Two smaller staging areas are located in the same vicinity (0.6 acre across the road and 0.5 acre by the penstocks).

Disposal Sites

A single disposal site, located on the right abutment at the current location of a maintenance building and a vacant residence (Figure 5.3-1(C) and Figure 5.3-8(C)), will be used for concrete debris generated from the

removal of the dam and powerhouse. The disposal area covers an area of approximately 3.5 acres. KRRC's contractor will grade the disposal site as a hill (maximum fill height of about 55 feet) contoured to blend into the surrounding topography as shown in plan and section on Figure 5.3-1(C), Sheet 1. Preparation of the disposal area will include clearing of vegetation, demolition of the two structures, removal of transmission lines, and stripping and stockpiling of excavated topsoil for later use. After placement of the concrete debris (without rail and rebar), the on-site disposal area will be covered with topsoil and the excavated embankment material from Copco No. 2 Dam (see Section 5.4), graded, sloped for drainage, and hydroseeded. Compaction of materials placed in the disposal area other than by bulldozers spreading the materials and equipment travel will not be required. See Section 6 for additional detail associated with restoration. KRRC will complete erosion monitoring on an annual basis for 5 years following placement to assess whether significant erosion and slope deterioration has occurred. If significant erosion occurs, KRRC will repair the eroded area to the satisfaction of the appropriate regulatory agency.

Rebar, mechanical and electrical equipment, building materials and demolished powerline material will be disposed of at an approved landfill near Yreka, CA. Tonnage and volume of these materials are listed in Table 5.3-3.

Figure 5.3-8 Copco No. 1 & Copco No. 2 Disposal Site Plan & Sections (Appendix C)

5.3.4 Copco No. 1 Dam and Powerhouse Removal

Dam and Powerhouse Removal

KRRC's contractor will remove the spillway gates and operators, the spillway bridge deck, and the spillway piers in December 2020 as the reservoir is drawn down to below the spillway crest (completed January 1, 2021). With the reservoir drawn down to approximate elevation 2590, KRRC's contractor will use a barge-mounted crane to remove all 13 spillway gates and operators, spillway bridge deck, and spillway gate piers in the dry. The contractor will then remove the barge-mounted crane from the site.

As the reservoir is drawn down through the new large gate structure at the downstream end of the diversion tunnel, the following work will be performed:

1. Close the penstock gates and demolish the right abutment gate houses and mobilize large crane to the right abutment above the dam to provide construction access and support for dam removal.
2. Demolish the penstocks, remove the mechanical and electrical equipment from the powerhouse, and demolish the above grade portion of the powerhouse and prepare it for use as a part of construction access to the downstream side of the dam.
3. Excavate the dam in lifts (assumed to be 12-foot high) between abutments in the dry (Figure 5.3-9(B)). Drop concrete rubble to the base of the dam to form a temporary access between the dam base and the powerhouse. Haul concrete rubble by truck from the base of the dam to the disposal site on right abutment (Figure 5.3-1(C), Sheet 1).

4. Remove concrete powerhouse intake structure on the right abutment in the dry concurrent with dam demolition. Extend temporary access road to the dam toe upstream for removal of the concrete rubble from the intake structure.
5. Construct and maintain temporary cofferdams in the river channel as required for removal of the powerhouse and of the diversion control structure in the dry, during low flow period.
6. Demolish remaining portion of powerhouse and remove all rubble using trucks along access road. Use sump pumps to unwater low areas as required.
7. Remove cofferdams from river channel when no longer needed.
8. Plug upstream diversion tunnel intake.
9. Demolish new diversion gate structure and plug downstream portal of the diversion tunnel with concrete.
10. Restore dam site, staging area, and concrete disposal site. Place topsoil and seed where required.
11. Demobilize from site.

Portions of the dam and hydropower demolition must be performed within the in-stream construction window negotiated with the regulatory agencies. See Section 8.6 of this Definite Plan for information pertaining to the construction schedule and timing of the various activities.

Figure 5.3-9 Copco No. 1 Dam Removal (Appendix B)

Transmission Line and Switchyard Removal

Transmission line removal at Copco No. 1 includes demolishing the Copco No. 1 switchyard, demolishing overhead distribution and transmission lines and associated poles or towers, as applicable, and installation of new connections to maintain the power grid (see Figure 5.2-12).

KRRC's contractor will demolish approximately 3.7 miles of overhead transmission/distribution line and approximately 39 poles. Lines to be demolished include:

- 69 kV transmission lines between Copco No. 1 switchyard and Copco No. 1 powerhouse
- 69 kV transmission lines between Copco No. 1 switchyard and Copco No. 2 powerhouse, while maintaining poles with distribution underbuild
- Production lines in the general area of Copco No. 1 powerhouse
- Distribution lines supplying the two village houses near the dam
- 69 kV transmission lines between Copco No. 1 switchyard and Fall Creek hydro-electric plant; including removing transmission conductors (69 kV) on Poles "1X/001" and "2X/001" but keeping the distribution conductors intact
- Distribution lines between Copco No. 1 switchyard and Copco No. 2. Dam

Major switchyard demolition components include:

- Four (4) 69 kV Dead End Structures
- Two (2) 69 kV Circuit Breakers
- Four (4) 69 kV Disconnect Switches (on same structure as Circuit Breakers)
- All associated auxiliary equipment

New connections include relocation of existing poles in the proposed Copco disposal site to locations nearer the access road and reconnection of that distribution line.

5.3.5 Demolition Methods, Estimated Equipment and Workforce

KRRC proposes the following demolition methods, estimated equipment requirements, and estimated workforce requirements for planning purposes based on engineering judgment. Alternative methods, equipment, and workforce that will also meet project requirements are possible and could be refined by the selected contractor.

Demolition Methods

The concrete gravity arch dam was constructed with large (cyclopean) boulders placed in the concrete matrix, and reinforced throughout with an estimated 455 tons of 30-pound steel rails placed in horizontal mats and in vertical rows across construction joints (for an average weight of about 25 lb per CY of concrete). Dam demolition will likely be performed in horizontal lifts using conventional drilling and blasting methods. Drilling, using small air track or hydraulic track drills that could safely operate on the dam crest, will likely control overall production. Up to five drill crews will be required working two 8-hour shifts 5-days per week. KRRC assumes the need for redrilling where rail steel is encountered will impact production. KRRC estimates blasting an average of between three and six shots per day for up to 16 weeks.

KRRC assumes acetylene torches to cut rail steel in the dam. A large crawler-mounted crane will likely be used on the right abutment to help remove the rail steel from the dam. A sheet-pile or H-pile cofferdam will be constructed along the right bank of the river to isolate a portion of the dam toe and the powerhouse, providing an access road and a work pad to stage concrete rubble collection, loading, and hauling. Concrete rubble will likely be loaded into articulated off-road rock trucks having a haul capacity of 30 tons, using either a hydraulic track excavator or a front-end loader. Over 700 tons of concrete rubble could be removed per day using two trucks making 12 rounds each during one 8-hour shift, with nearly 70,000 tons (or 36,000 CY in-place volume) to be removed from the dam within approximately 16 weeks.

KRRC assumes removal of mass concrete in the right abutment intake structure in lifts, similar to the concrete in the dam, but at a slower rate due to the embedded penstock pipes and mechanical equipment. The contractor could remove the concrete rubble from the lift surface using a large crane, or from the bottom of the canyon using an extension of the lower haul road constructed for demolition of the dam, during the low flow period. KRRC's contractor will excavate reinforced concrete in the powerhouse deck, wall, and floor slabs by mechanical methods (e.g. hydraulic shears and hoe-ramming).

Estimated Equipment and Workforce Requirements

The estimated equipment that will be used for the removal of Copco No. 1 Dam and Powerhouse and for restoration of the reservoir area is shown in Table 5.3-2.

Table 5.3-2 Copco No. 1 Dam and Powerhouse, Estimated Equipment List

Name of Equipment	Pre-Drawdown	Post-Drawdown
Crawler-mounted lattice boom crane, 100 to 120 ton, 160- to 200-foot boom	X	X
Rough terrain hydraulic crane, 35 to 75 ton	X	X
Mid-size hydraulic excavator, 28,000 to 60,000 lb, 1 to 2 CY bucket	X	X
Cat 336 hydraulic track excavator, 80,000 lb, 3.5 CY bucket		X
Hydraulic track excavators, 65,000 to 120,000 lb, with Cat H120 hoe-ram, thumb and shear attachments		X
Cat 966 (52,000 lb, 5 CY bucket) or Cat 988 (65,000 lb, 6 CY bucket) articulated wheel-loaders		X
Cat 725 or Cat 730 articulated rear dump trucks, 30 ton (22 CY)	X	X
D-6 or D-7 standard crawler dozers	X	X
Front-end wheel loader, integrated tool carrier, 25,000 lb		X
Cat TL943 rough terrain telescoping forklift	X	X
Rough terrain telescoping manlift		X
Cat 140 motorgrader		X
Flexifloat sectional barges	X	X
Truck-mounted seed sprayer, 2500 gallon		X
On-highway, light duty diesel pickup trucks, ½ ton and 1 ton crew	X	X
On-highway flatbed truck with boom crane, 16,000 lb	X	X
On-highway truck tractors, 45,000 lb	X	X
Off-highway water tanker, 5,000 gallon		X
On-highway water truck, 4,000 gallon		X
Engine generators, 6.5 KW to 40 KW, diesel or gasoline	X	X
Air compressors, 100 psi, 185 to 600 cfm, diesel	X	X
Airtrack drill or hydraulic track drill		X
Hand-held drilling, cutting, and demolition equipment	X	X
Portable welders and acetylene torches	X	X
4-inch submersible trash pumps, electric	X	X
Light plants, 2,000 to 6,000 watt, 10 to 25 hp, diesel		X

An estimated average workforce of 30 to 35 people will be required for the construction activities, for an estimated duration of 19 months from site mobilization to construction completion. The peak workforce required during demolition of the concrete dam could reach 50 to 55 people.

5.3.6 Imported Materials

KRRC's contractor will need to import some materials to the site to support dam removal. The most likely materials to be imported include gravel surfacing from a commercial quarry for temporary haul roads (approximately 320 tons, 10 truck trips), sheetpile or H-piles for construction of cofferdams, topsoil (approximately 10,200 CY and 850 truck trips assuming 12 CY per truck or tractor trailer), seed and mulch materials, and minor quantities of ready-mix concrete and reinforcing steel from local commercial sources for tunnel plugs. Construction of the new gate structure in the year prior to dam removal will require importing mechanical equipment, and additional reinforcing steel and ready-mix concrete for lining the diversion tunnel and constructing the new gate structure.

5.3.7 Waste Disposal

Table 5.3-3 shows estimated quantities of materials generated during removal of Copco No. 1 Dam and Powerhouse, numbers of truck trips, and approximate haul distances for waste disposal. KRRC's contractor will place excavated concrete in the on-site disposal site. KRRC's contractor will separate rail and reinforcing steel from the concrete prior to placement in the disposal area and haul it to a local recycling facility. KRRC's contractor will haul all mechanical and electrical equipment to a suitable commercial landfill or salvage collection point.

Table 5.3-4 shows potential commercial landfills or salvage collection points and capacities. Appendix O3 discusses potential hazardous materials at Copco No. 1 Dam and Powerhouse and their disposal.

Table 5.3-3 Waste Disposal for Full Removal of Copco No. 1 Dam

Waste Material	In-Situ Quantity	Bulk Quantity [1]	Disposal Site	Peak Daily Trips [2]	Total Trips [3]
Concrete	75,900 CY	104,000 CY	On-site	2 units/50 trips (unpaved road)	4,430 trips (2 miles RT)[4]
Rebar	1,000 tons	—	Transfer station near Yreka	1 unit/5 trips (Copco Road)	100 trips (62 miles RT)
Mech. and Elec	1,100 tons	—	Transfer station near Yreka	1 unit/5 trips (Copco Road)	140 trips (62 miles RT)
Building Waste	2 buildings 1,300 ft^2	300 CY	Transfer station near Yreka	1 unit/5 trips (Copco Road)	30 trips (62 miles RT)
Power lines	3.0 miles of 69-kV	—	Transfer station near Yreka		

1. Volumes increased 30 percent for concrete rubble from reinforced concrete and 40 percent from mass concrete.
2. Peak daily trips for each site are based on the number of vehicles (units) shown, operating within one 8-hour shift.
3. Total trips of concrete assume off-highway articulated trucks with a nominal load capacity of 22 cubic yards. Total trips for hauling rebar using truck tractor-trailers is based on 10 tons per trip. Total trips for hauling mechanical and electrical items using truck tractor-trailers is based on 8 tons per trip. Total trips for building waste using truck tractor-trailers is based on 10 CY per trip.
4. Truck trips for concrete disposal will only travel on project lands and private roads. These trips will not occur on public roads.

Table 5.3-4 Waste Disposal Facilities near Copco No. 1 Dam

Name of Facility	Location	Distance from Site	Remaining Capacity	Materials Accepted
Yreka Transfer Station	Yreka, CA	30 miles	3,924,000 CY (2010)	Class III sanitary landfill accepting construction and demolition waste and mixed municipal waste, and Medium volume transfer station accepting metals and mixed municipal recyclable materials

5.4 Copco No. 2 Dam and Powerhouse

5.4.1 Removal Limits

Copco No. 2 Dam is located within a narrow canyon on the Klamath River at RM 201.8. Minimum requirements for a free-flowing condition and volitional fish passage on the Klamath River through the Copco No. 2 Dam site will require the removal of the concrete gated spillway structure and concrete end sill between the existing sidewalls. Table 5.4-1 summarizes and Figure 5.3-1 (C) shows features the Project will remove or potentially retain as PROs.

Table 5.4-1 Copco No. 2 Dam and Powerhouse, Removal Requirements

Feature	Full Removal	Partial Removal Options	Comments[1]
Concrete Dam	Remove	Remove	
Spillway Gates, Structure	Remove	Remove	
Power Penstock Intake Structure and Gate	Remove	Retain	PRO: Seal openings, install security fence
Tunnel Portals	Concrete Plug	Retain	PRO: Intake structure gate could be closed
Embankment Section and right sidewall	Remove	Remove	
Basin Apron and End Sill	Remove	Remove	
Remnant Cofferdam Upstream of Dam	Remove	Remove	
Wood-stave Penstock	Remove	Remove	
Concrete Pipe Cradles	Remove	Retain	
Steel Penstock, Supports, Anchors	Remove	Retain	PRO: Could be retained for historic purposes Seal openings, install security fence

Feature	Full Removal	Partial Removal Options	Comments[1]
Powerhouse (incl. mechanical and electrical equipment)	Remove	Retain	PRO: Could be retained for historic purposes Seal openings, install security fence
Powerhouse Hazardous Materials (transformers, batteries, insulation)	Remove	Remove	
Powerhouse Control Center Building, Maintenance Building, Oil and Gas Storage Building	Remove	Remove	
69-kV Transmission Line, 6.5 mi	Remove	Remove	
Switchyard	Retain Portions	Retain Portions	Portions must remain in service with 230-kV switchyard on north side of river
Tailrace Channel	Backfill	Backfill	
Copco Village (incl. Former Cookhouse/Bunkhouse, Modern Bunkhouse, Garage/Storage Building, Bungalow with Garage, 3 Modular Houses, 4 Ranch-Style Houses, and School house/Community Center)	Remove	Remove	

Note:

1. Partial removal options would involve long-term maintenance costs, including the preservation of any exposed items with coatings containing heavy metals (such as the penstocks).

Retention of the Copco No. 2 Powerhouse as a PRO would require the structure to be sealed and fenced. Mechanical and electrical equipment could be left in place with all power connections to the outside removed; however, any oil in the turbine governor and hydraulic control systems, transformers, oil storage tanks, or other equipment would need to be removed. KRRC's contractor will also remove other potentially hazardous materials, such as batteries and treated wood.

5.4.2 Construction Access

Figures 5.1-1(C) and 5.3-1(C) show construction access roads and associated improvements that may be required for removal of Copco No. 2 Dam, which will be the same as for Copco No. 1 Dam and Powerhouse, and are discussed in Section 5.3.2. Figure 5.3-1(C) shows the construction access roads for removal of Copco No. 2 Powerhouse and the wood-stave penstock within the limits of work, and these are discussed in the following sections. KRRC will complete access road improvements prior to associated construction and removal at the dam and powerhouse.

Copco Road

Copco Road from I-5 provides the primary access to Copco No. 2 Dam and Powerhouse. Refer to Section 5.3.2 for more details. The main haul and access road included in that section is applicable to

Copco No. 2 Dam. The average one-way haul distance from Copco No. 2 dam to the disposal site is approximately 0.3 mile.

The delivery of off-road construction equipment, including cranes, large excavators, and loaders will be by special tractor-trailer vehicles operating under "wide load" restrictions and at appropriate speeds. KRRC's contractor will off-load equipment used for dam removal in the staging area and the equipment will track down to the dam under their own power.

Daggett Road

Copco No. 2 Powerhouse and the wood-stave penstock are accessed from Copco Road via Daggett Road. Daggett Road is a PacifiCorp-owned private gravel access road with a roadway width of 12 to 14 feet. Approximately 0.25 miles from Daggett Road Bridge, the surface becomes primarily dirt at 10 to 12 feet wide, and has very low traffic volume. KRRC assumes one-way traffic with turnouts for the access roads, for an average haul distance of 0.5 mile from the powerhouse to the bridge. KRRC does not propose improvements and upgrades prior to dam removal. KRRC's contractor may perform road surface maintenance during or post-construction. Temporary traffic control will not be required because this is not a public road. This portion of Daggett Road includes Daggett Road Bridge.

The delivery of off-road construction equipment, including cranes, large excavators, and loaders will be by special tractor-trailer vehicles operating under "wide load" restrictions and at appropriate speeds. KRRC's contractor will off-load equipment used for removal of the powerhouse and wood-stave penstock in Copco Village and the equipment will track down to the powerhouse area and wood-stave penstock under their own power.

Daggett Road Bridge

Daggett Road Bridge is PacifiCorp-owned, private four span continuous steel bridge that utilizes rolled beams in the approach spans and a riveted steel plate girder for the main span. The structure has a timber deck and railings and is approximately 233 feet long and 14 feet wide. It has one 12-foot lane and no shoulders. The structure is supported on concrete pier walls at Bents 3 and 4 that are founded on what appears to be rock masonry footings. Bent 1 is composed of steel H-pile extensions with a steel cap. The abutments are seat type. The main span girder and Bents 3 and 4 were constructed in, approximately, 1924 and incorporated into the reconstructed structure in 1983. The reconstructed structure was built for a HS20 truck design load. The structure has been posted with load limits based upon an unknown analysis. No information is available regarding the foundations.

KRRC's contractor will use this structure for mobilization of construction equipment and for hauling of demolished materials to commercial landfills. Because the bridge has been posted with a reduced load limit that is less than the current legal/permit loads on bridges and the loads of vehicles that will use it for the Project, KRRC proposes replacing this structure with a bridge of similar length and width as the existing structure. Alternatively, the contractor may implement other methods such as a temporary bridge adjacent to the existing bridge or structural strengthening of the existing bridge.

KRRC's contactor will construct either a new bridge structure or a temporary bridge adjacent to the existing bridge on a revised alignment. KRRC's contactor will remove the old bridge only after completion of the new bridge structure. KRRC's contactor will realign the approach roadway slightly for the new bridge or temporary bridge location (Figure 5.4-1). Impacts to traffic will be limited to the traffic switch from the existing road alignment to the new one. A new bridge will be left in place post-construction for future property owner access. A temporary bridge will remain in place for the duration of construction and will be removed, leaving the existing bridge in place, at the end of construction, and the approach roadways will be restored to the existing alignments,

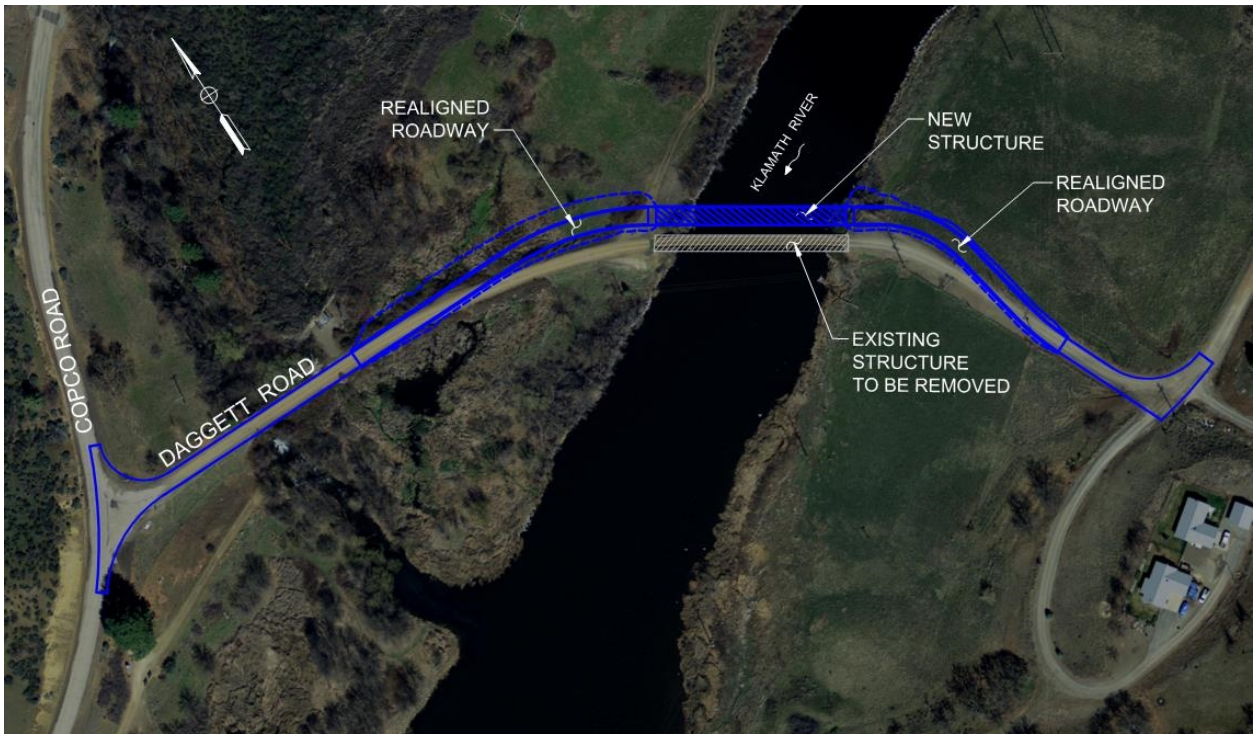

Figure 5.4-1 Daggett Road Bridge Replacement

5.4.3 Staging Areas and Disposal Sites

Staging areas and disposal sites for removal of Copco No. 2 Dam will be the same as for Copco No. 1 Dam and Powerhouse as shown on Figure 5.3-1 (C) and as discussed in Section 5.3.3. Figure 5.3-1(C), Sheet 2 shows the staging areas and disposal sites for removal of Copco No. 2 Powerhouse and the wood-stave penstock within the limits of work on, and these are discussed in the following sections.

Staging Areas

Equipment staging areas for dam removal will be the same as described for Copco No. 1 (see Section 5.3.3). Work areas for removal of the wooden lathe penstock and the powerhouse will be as shown on Figure 5.3-1(C), Sheets 2 and 3. An additional 0.9-acre staging area is located at the powerhouse.

Disposal Sites

KRRC's contractor will permanently bury concrete rubble generated from removal of Copco No. 2 Dam in the disposal site described in Section 5.3.3.2 for Copco No. 1. KRRC's contractor will use earth materials generated from removal of Copco No. 2 Dam as cover over the concrete rubble in the disposal site.

KRRC's contractor will permanently bury concrete rubble generated from removal of the Copco No. 2 Powerhouse in the powerhouse tailrace covering an area of about 1 acre. After placement of the concrete rubble (sans rail and rebar), the on-site disposal area will be covered with materials excavated from nearby areas that were graded around the powerhouse facilities during original construction, graded, sloped for drainage, and hydroseeded. Compaction of materials placed in the tailrace channel other than by bulldozers spreading the materials and equipment travel will not be required. KRRC will complete erosion monitoring on an annual basis for 5 years following placement to assess whether significant erosion and slope deterioration has occurred. If significant erosion occurs, KRRC will repair the eroded area to the satisfaction of the appropriate regulatory agency.

Rebar, mechanical and electrical equipment, building materials, demolished powerline material and woodstave material will be disposed of at an approved landfill near Yreka, CA. Tonnage and volume of these materials are listed in Table 5.4-3.

5.4.4 Copco No. 2 Dam and Powerhouse Removal

Dam Removal

Dam removal will begin on about May 1, 2021 by closing the caterpillar gate at the power penstock intake structure to stop releases to Copco No. 2 Powerhouse and cease power generation. KRRC's contractor will make controlled releases through the gated spillway (crest elevation 2476.5) during the low flow period to draw the reservoir down from RWS elevation 2486.5 to RWS elevation 2481.5 in one day using the two right-hand side spillway gates. Remove of the dam will include the following steps.

1. Remove equipment and concrete pad from dike crest to provide room for demolition equipment and for construction access.
2. Construct a temporary cofferdam within the river channel to isolate the two left-hand spillway bays and the power penstock intake structure (see Figure 5.4-2(B)). Remove the spillway gates, hoists, bridge deck, and concrete crest structure to elevation 2457.5 in the dry. Remove trash racks, caterpillar gate, and concrete structure, and construct tunnel plug in the dry. Restore left river bank. Remove temporary cofferdam and allow reservoir to stabilize at approximately RWS elevation 2463.5 through left-hand dam breach.

3. Construct a second temporary cofferdam within the river channel to isolate the three remaining spillway bays on the right-hand side (Figure 5.4-2 (B)). Remove the spillway gates, hoists, bridge deck, and concrete crest structure to elevation 2457.5 in the dry. Remove earth embankment. Remove temporary cofferdam.
4. Complete any remaining demolition work as required. Restore Dam site and on-site disposal area (shared with Copco No. 1 demolition) as required by October post-drawdown, including the placement of topsoil and seeding. Demobilize from site.

Portions of the dam and hydropower demolition must be performed within the in-stream construction window negotiated with the regulatory agencies. See Section 8.6 of this Definite Plan for information pertaining to the construction schedule and timing of the various activities.

Figure 5.4-2 Copco No. 2 Dam Removal (Appendix B)

Powerhouse and Wood-Stave Penstock

Removal of the wooden stave penstock and powerhouse will occur following closure of the caterpillar gate and shutdown of the powerhouse on about May 1, 2021, as follows:

1. Remove wood-stave penstock and concrete features and construct reinforced concrete tunnel plugs at the tunnel portal at each end of the wood-stave penstock.
2. Construct cofferdam in tailrace channel for removal of powerhouse in the dry during low flow period. Use sump pumps to unwater area. Leave cofferdam in place within tailrace channel and backflll to restore left river bank.

Transmission Line and Switchyard Removal

Transmission line removal at Copco No. 2 includes demolishing portions of the Copco No. 2 switchyard south of the river and demolishing overhead distribution and transmission lines and associated poles or towers, as applicable (see Figure 5.2-12). The Copco No. 2 switchyard north of the river will remain.

KRRC's contactor will demolish approximately 6.7 miles of overhead transmission/distribution line and approximately 40 poles. Lines to be demolished include:

- Distribution lines between Copco No.2 powerhouse line and Copco No. 2 Dam
- 69 kV transmission lines between Copco No. 1 switchyard and Copco No.2 powerhouse branch line
- 69 kV transmission lines between Copco No. 2 powerhouse and Iron Gate switchyard
- Production lines in the general area of Copco No. 2 powerhouse

Major switchyard demolition components include:

- Two (2) 115 kV / MV transformers. (secondary voltage not known)
- Five (5) medium voltage circuit breakers
- One (1) MV / 12 kV transformer (primary voltage not known)

- All associated auxiliary equipment

5.4.5 Demolition Methods, Estimated Equipment and Workforce

KRRC proposes the following demolition methods, estimated equipment requirements, and estimated workforce requirements for planning purposes based on engineering judgment. Alternative methods, equipment, and workforce that will also meet project requirements are possible and could be refined by the selected contractor.

Demolition Methods

KRRC's contactor will remove the spillway gates and traveling hoists by a large crane for loading onto highway trucks and heavy-haul trailers. KRRC's contactor could remove the reinforced concrete spillway bridge deck and piers in pieces by hydraulic excavators or in sections by conventional or diamond-wire sawcutting. Removal of the remainder of the spillway concrete structure will likely be performed using conventional drilling and blasting methods as each portion is dewatered. Drilling for blasting will include small- to mid-sized hydraulic track drills and perhaps air-track drills supported by 850 to 1,200 CFM air compressors. KRRC's contactor could use considerable jack-leg and hand drilling to supplement the machine drilling for special shots. The loading and hauling equipment will be similar to that employed at Copco No. 1, but with fewer active crews. KRRC's contactor will excavate reinforced concrete in deck, wall, and floor slabs for remaining features to be removed (including intake structure, gravity structure, sidewalls, apron, and powerhouse) by mechanical methods (e. g. hydraulic shears or hoe-ramming).

Estimated Equipment and Workforce

The estimated equipment that will be used for the removal of Copco No. 2 Dam and Powerhouse and for restoration of the reservoir area is shown in Table 5.4-2.

Table 5.4-2 Copco No. 2 Dam and Powerhouse, Estimated Equipment List

Name of Equipment	Pre-Drawdown	Post-Drawdown
Crawler-mounted lattice boom crane, 100 to 120 ton, 160- to 200-foot boom		X
Rough terrain hydraulic crane, 35 to 75 ton	X	X
Mid-size hydraulic excavator, 28,000 to 60,000 lb, 1 to 2 CY bucket	X	X
Cat 336 hydraulic track excavator, 80,000 lb, 3.5 CY bucket		X
Hydraulic track excavators, 65,000 to 120,000 lb, with Cat H120 hoe-ram, thumb and shear attachments		X
Cat 966 (52,000 lb, 5 CY bucket) or Cat 988 (65,000 lb, 6 CY bucket) articulated wheel-loaders		X
Cat 725 or Cat 730 articulated rear dump trucks, 30 ton (22 CY)		X
D-6 or D-7 standard crawler dozers		X
Front-end wheel loader, integrated tool carrier, 25,000 lb	X	X

Name of Equipment	Pre-Drawdown	Post-Drawdown
Cat TL943 rough terrain telescoping forklift	X	X
Rough terrain telescoping manlift	X	X
On-highway, light duty diesel pickup trucks, ½ ton and 1 ton crew	X	X
On-highway flatbed truck with boom crane, 16,000 lb	X	X
On-highway truck tractors, 45,000 lb	X	X
Off-highway water tanker, 5,000 gallon		X
On-highway water truck, 4,000 gallon	X	X
Engine generators, 6.5 KW to 40 KW, diesel or gasoline	X	X
Air compressors, 100 psi, 185 to 600 cfm, diesel	X	X
Airtrack drill or hydraulic track drill		X
Hand-held drilling, cutting, and demolition equipment	X	X
Portable welders and acetylene torches	X	X
4-inch submersible trash pumps, electric	X	X

An estimated average workforce of 25 to 30 people will be required for the construction activities, for an estimated duration of about 6 months from site mobilization to construction completion for either dam removal alternative. The peak workforce required during excavation of the dam and powerhouse could reach 35 to 40 people.

5.4.6 Imported Materials

KRRC assumes import of some materials to the site to support dam removal. The most likely material that may be required for construction will include gravel surfacing for temporary haul roads, soil cover for concrete waste disposal, seed and mulch materials, and minor quantities of ready-mix concrete and reinforcing steel from local commercial sources for tunnel plugs.

5.4.7 Waste Disposal

Table 5.4-3 shows estimated quantities of materials generated during removal of Copco No. 2 Dam and Powerhouse, numbers of truck trips, and approximate haul distances for waste disposal. Concrete rubble generated during dam removal will be placed within the same on-site disposal area on the right abutment (Figure 5.3-1(C), Sheet 1) used for Copco No. 1 Dam. KRRC's contactor will use excavated embankment material as topsoil to cover the on-site disposal area after grading and being sloped for drainage. KRRC's contactor will bury concrete rubble resulting from demolition of the powerhouse within the existing tailrace channel. KRRC's contactor will separate reinforcing steel from the concrete prior to placement in the disposal area or tailrace channel and haul it to a local recycling facility. KRRC's contactor will haul all mechanical and electrical equipment to a suitable commercial landfill or salvage collection point.

Table 5.4-4 shows potential commercial landfills or salvage collection points and capacities. Appendix O3 discusses potential hazardous materials at Copco No. 2 Dam and Powerhouse and their disposal.

Table 5.4-3 Waste Disposal for Full Removal of Copco No. 2 Dam

Waste Material	In-Situ Quantity	Bulk Quantity [1]	Disposal Site	Peak Daily Trips [2]	Total Trips [3]
Earth	1,800 CY	2,100 CY	On-site	2 units/50 trips (unpaved road)	100 trips (2 miles RT)[4]
Concrete at dam	6,600 CY	8,500 CY	On-site	2 units/50 trips (unpaved road)	390 trips (2 miles RT)[4]
Concrete at powerhouse	6,300 CY	8,100 CY	Onsite tailrace area	Dispose at site (no hauling)	0
Rebar at: Dam Powerhouse	 300 tons 100 tons	—	Transfer station near Yreka, CA	1 unit/5 trips (Copco Road)	30 trips (62 miles RT) 10 trips (56 miles RT)
Mech. And Elec at: Dam Powerhouse	 300 tons 1,900 tons	—	Transfer station near Yreka, CA	1 unit/5 trips (Copco Road)	40 trips (62 miles RT) 240 trips (56 miles RT)
Building Waste	XX buildings 10,6000 ft^2	2300 CY	Transfer station near Yreka, CA	1 unit/5 trips (Copco Road)	230 trips (56 miles RT)
Treated wood (wood-stave penstock)	700 tons		Landfill near Anderson, CA	1 unit/2 trips (Interstate 5)	70 trips(140 miles RT)
Power lines	6.5 miles of 69-kV	—	Transfer station near Yreka, CA		

Notes:

1. Volumes increased 30 percent for concrete rubble, 20 percent for loose earth materials.
2. Peak daily trips for each site are based on the number of vehicles (units) shown, operating within one 8 hour shift.
3. Total trips of earthfill or concrete assume off-highway articulated trucks with a nominal load capacity of 22 CY. Total trips for hauling rebar using truck tractor-trailers is based on 10 tons per trip. Total trips for hauling mechanical and electrical items using truck tractor-trailers is based on 8 tons per trip. Total trips for building waste using truck tractor-trailers is based on 10 CY per trip.
4. Truck trips for earth and concrete disposal will only travel on project lands and private roads. These trips will not occur on public roads.

Table 5.4-4 Waste Disposal Facilities near Copco No. 2 Dam

Name of Facility	Location	Distance from Site	Remaining Capacity	Materials Accepted
Yreka Transfer Station	Yreka, CA	30 miles	3,924,000 CY (2010)	Class III sanitary landfill accepting construction and demolition waste and mixed municipal waste, and Medium volume transfer station accepting metals and mixed municipal recyclable materials

5.5 Iron Gate Dam and Powerhouse

5.5.1 Removal Limits

Iron Gate Dam is located in a relatively narrow canyon on the Klamath River at RM 193.1. Minimum requirements for a free-flowing condition and volitional fish passage on the Klamath River through the Iron Gate Dam site require the complete removal of the zoned earthfill embankment, concrete cutoff walls, and fish trapping and holding facilities located on random fill downstream of the dam between the rock abutments to the bedrock foundation, to ensure long-term stability of the site and to prevent the development of a potential fish barrier in the future Table 5.5-1 summarizes and Figure 5.5-1 (C) shows features the Project will remove or potentially retain as PROs.

The lower portion of the outdoor-type powerhouse, if retained as a PRO will be within the 100-year floodplain. Retention of the Iron Gate Powerhouse as a PRO would require the structure to be sealed. Mechanical and electrical equipment could be left in place with all power connections to the outside removed; however, KRRC's contractor would remove any oil in the turbine governor and hydraulic control systems, transformers, oil storage tanks, or other equipment. KRRC's contractor would also remove other potentially hazardous materials, such as batteries and treated wood. The short tailrace channel between the powerhouse and the river channel could be backfilled to the pre-construction contours if necessary, effectively burying the remaining structure.

Table 5.5-1 Iron Gate Dam and Powerhouse, Removal Requirements

Feature	Full Removal	Partial Removal Options	Comments [1]
Embankment Dam, Cutoff Walls	Remove	Remove	
Penstock Intake Structure and Footbridge	Remove	Remove	
Penstock	Remove	Remove	
Water Supply Pipes and Aerator	Remove	Remove	
Spillway Structure	Retain	Retain	Bury to extent practicable
Powerhouse (incl. mechanical and electrical equipment)	Remove	Retain	PRO: Lower portion with openings sealed
Powerhouse Hazardous Materials (transformers, batteries, insulation)	Remove	Remove	
Powerhouse Tailrace Area	Backfill	Backfill	
Fish Facilities on Dam (fish ladder and trapping and holding facilities)	Remove	Remove	
Fish Hatchery	Retain	Retain	See Section 8.10
Switchyard	Remove	Remove	
69-kV Transmission Line, 0.5 mi	Remove	Remove	

Feature	Full Removal	Partial Removal Options	Comments [1]
Diversion Tunnel Intake Structure and Footbridge	Remove	Remove	
Diversion Tunnel Portals	Concrete Plug	Concrete Plug	
Diversion Tunnel Control Tower, Hoist, and Gate	Remove	Remove	

1. Partial removal options would involve long-term maintenance costs, including the preservation of any exposed items with coatings containing heavy metals (such as the penstocks).

Figure 5.5-1 Iron Gate Dam Removal Features and Limits (Appendix C)

5.5.2 Construction Access

Figure 5.5-1(C) shows construction access roads and associated improvements required for removal of Iron Gate Dam and Powerhouse within the limits of work, and these are discussed in the following sections. Section 5.3.2 discusses the conditions and improvements needed for Copco Road. KRRC observed existing conditions of the local roads and structures in the field to identify deficiencies and determine if improvements are necessary for mobilization and/or hauling during construction and demolition activities of the Iron Gate Dam and Powerhouse. The assessments are discussed in the following sections. KRRC will complete access road improvements prior to associated construction and removal at the dam and powerhouse.

The delivery of off-road construction equipment, including cranes, large excavators, loaders, and large capacity dump trucks will be by special tractor-trailer vehicles operating under "wide load" restrictions and at appropriate speeds.

Lakeview Road between Copco Road and the Disposal Site

Lakeview Road is a county gravel road approximately 24 feet wide, running between Copco Road and the disposal site just east of Iron Gate Reservoir (Figure 5.5-2). The road continues beyond the disposal site into the Iron Gate Estates subdivision. The posted speed limit is 20 mph. The gravel road surface is in stable condition and suitable for construction use. The road (with the powerhouse access road) could be used for one-way hauling traffic with turnouts and will have an average one-way haul distance of 1.4 miles from the dam to the center of the disposal site. KRRC does not propose improvements and upgrades for mobilization and hauling for the Project. KRRC's contractor may perform road surface maintenance during or post-construction. Temporary traffic controls will be required during roadway maintenance activities. This portion of Lakeview Road includes Lakeview Road Bridge (Caltrans Bridge No. 2C0255).

Lakeview Road Bridge

Lakeview Road Bridge is county-owned nine span simply supported rolled steel beam bridge constructed in 1960, and is approximately 272 feet long and 14.5 feet wide. It has a reinforced concrete deck with one 12-foot lane and no shoulders. The structure is posted with load limits following an investigation by the California Department of Transportation (Caltrans), Structure Maintenance and Investigation that was requested by the Siskiyou County Department of Public Works. The structure is supported on bents composed of timber pile extensions with timber or steel caps and timber abutments. No information is available regarding the foundations.

Because the bridge has been posted with a reduced load limit that is less than the current legal/permit loads on bridges and loads of vehicles that will use it for the Project, KRRC proposes replacing this structure for construction access. Alternatively, KRRC's contractor may implement other methods such as a temporary bridge adjacent to the existing bridge or structural strengthening of the existing bridge.

KRRC's contractor will construct either a new bridge or a temporary bridge of similar length and width on a revised alignment adjacent to the existing bridge (Figure 5.5-3). KRRC's contractor will remove the old bridge after completion of the new bridge only. KRRC's contractor will realign the approach roadway slightly for the new bridge or temporary bridge location. The impact to traffic will be limited to the switch from the existing road alignment to the new one. A temporary bridge will remain in place for the duration of construction, and KRRC's contractor will remove it, leaving the existing bridge in place, at the end of construction, and KRRC's contractor will restore the approach roadways to the existing alignments.



Figure 5.5-2 Lakeview Road

Powerhouse Access Road

The private PacifiCorp-owned powerhouse access road is located immediately to the east of the Lakeview Road bridge south abutment, and it runs east-west between Lakeview Road and the Iron Gate powerhouse. The road has a gravel surface between Lakeview Road intersection and the security swing gate. East of the security gate, the road is asphalt concrete about 14 feet wide and in good condition. KRRC's contractor will use this road as a haul route. KRRC does not propose improvements and upgrades for mobilization and hauling. KRRC's contractor may perform road surface maintenance during construction. Temporary traffic controls will be required during roadway maintenance activities. KRRC's contractor will provide additional signage and stop control along the access road approach to the Lakeview Road intersection during construction. KRRC's contractor will demolish this road and restore it to native habitat post-construction.

Left Abutment Access Road

This private PacifiCorp-owned access road runs between Lakeview Road and the left abutment of the dam. It is a gravel road about 24 feet wide. The road surface is in fair condition. KRRC's contractor will use this road as a haul route to the proposed disposal site. KRRC's contractor may perform periodic roadway maintenance during construction to ensure adequate access. Temporary traffic control will not be required as this is not a public road. KRRC's contractor will demolish this access road and ramps and restore the area to native habitat at the completion of dam removal.

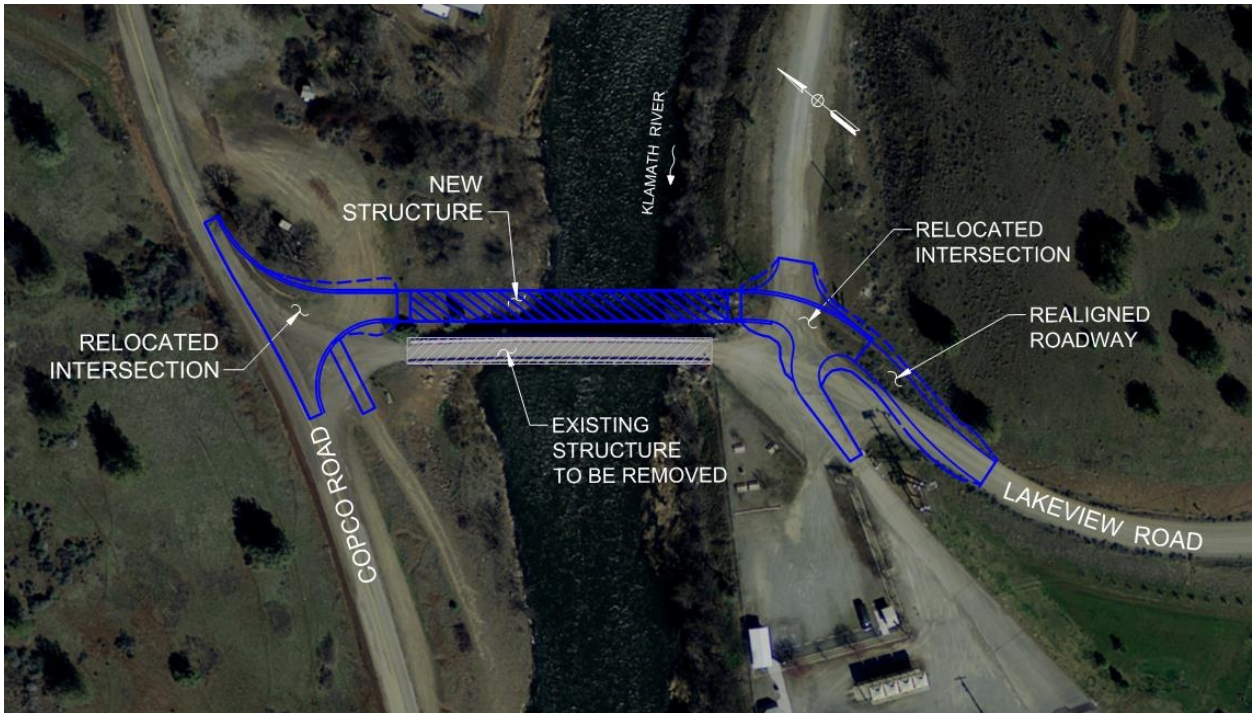

Figure 5.5-3 Lakeview Road Bridge Replacement

Upstream Left Abutment Access Road

The private PacifiCorp-owned original haul route from an upstream borrow area to the dam will be reopened once the reservoir has been drawn down. This will allow two-way traffic to the north side of the disposal site with an average haul distance of 0.9 mile from the dam to the disposal site. As the dam embankment excavation descends, the original ramps out of the canyon that were used during original construction may be able to be reused. KRRC's contractor will demolish this access road and ramps and restore the area to native habitat at the completion of dam removal.

Access Road from Long Gulch Recreation Facility to Lakeview Road

This private PacifiCorp-owned road is a gravel access road approximately 12 feet wide, running between Long Gulch Recreational Facility and Lakeview Road. The gravel road surface is in fair condition. KRRC's contractor will use the road for one-way hauling traffic during removal of the Long Gulch Recreation Facility. KRRC does not propose improvements and upgrades for mobilization and hauling. KRRC's contractor may perform road surface maintenance during construction. Temporary traffic controls will be required during roadway maintenance activities. KRRC's contractor will demolish this access road and restore the area to native habitat at the completion of dam removal.

Access Road from Overlook Point Recreation Facility to Copco Road

This private PacifiCorp-owned road is a gravel access road approximately 12 feet wide, running between Overlook Point Recreation Facility and Copco Road. The gravel road surface is in fair condition. KRRC's contractor will use the road for one-way hauling traffic during removal of the Overlook Point Recreation Facility. KRRC does not propose improvements and upgrades for mobilization and hauling. KRRC's contractor may perform road surface maintenance during construction. KRRC's contractor will provide temporary traffic controls during roadway maintenance activities. KRRC's contractor will demolish this access road and restore the area to native habitat at the completion of dam removal.

5.5.3 Staging Areas and Disposal Sites

Figure 5.5-1(C), Sheets 1 and 2 show construction staging areas and disposal sites for removal of Iron Gate Dam and Powerhouse within the limits of work, and these are discussed in the following sections. The contractor will mobilize construction equipment to the site by June 2020 to prepare the staging and disposal areas, and to construct the diversion tunnel improvements described in Section 4.2 for subsequent dam removal after drawdown.

Staging Areas

Figure 5.5-1(C), Sheet 2 shows staging areas for equipment or material staging, including 7.7 acres above the left abutment of the dam, 1.4 acres southwest of the disposal site, and 1.4 acres northeast of the disposal site. Also shown on Figure 5.5-1(C), Sheet 1 is 1.9 acres near the right abutment downstream of the dam (currently occupied by two PacifiCorp residences and some outbuildings) that could be used for construction offices. KRRC's contractor will prepare the staging areas by clearing vegetation and minor

grading and will restore them by minor grading and hydroseeding. See Section 6 for additional detail concerning restoration. Staging of mechanical and electrical debris will likely occur at the downstream toe of the dam in the parking area and the area of the fish collection facilities.

Disposal Sites

KRRC's contractor will permanently bury most of the earth materials and all of the concrete rubble generated from removal of the Iron Gate development on-site in a disposal site covering about 36 acres located on project property about 1 mile south of the dam. KRRC's contractor will grade the disposed material to conform to the existing topography as shown in Figure 5.5-1(C), Sheet 2 and Figure 5.5-4 (C). KRRC's contractor will place the disposed material to a maximum fill height of about 50 feet. KRRC's contractor will cover concrete rubble by a minimum of 3 feet of earth materials. Final grading of the disposal site will include relatively flat slopes (8H:1V to 5H:1V) to reduce the potential for erosion. Preparation of the disposal site requires clearing of vegetation and stripping and stockpiling of topsoil for later use for restoration of the disposal site. After final grading for drainage and aesthetics, KRRC's contractor will cover the disposal site with topsoil and hydroseeded. Compaction other than by equipment travel will not be necessary. See Section 6 for additional detail associated with restoration. KRRC will monitor erosion on an annual basis for 5 years following placement to assess whether significant erosion and slope deterioration has occurred. If significant erosion occurs, KRRC will repair the eroded area to the satisfaction of the appropriate regulatory agency.

Figure 5.5-4 Iron Gate Disposal Site Plan & Sections (Appendix C)

KRRC's contractor will place up to 200,000 CY of earth materials excavated from the dam in the existing concrete-lined side-channel spillway, chute, and flip-bucket terminal structure (located on the right abutment of the dam) to the extent practicable for restoration. Figure 5.5-1(C), Sheet 1 and Figure 5.5-5(C) show plan and section of the backfilled spillway. Finished grades of the backfill will be no steeper than about 4H:1V. Following backfilling, the uphill portion of the spillway excavation will still be visible. After final grading for drainage and aesthetics, KRRC's contractor will cover the disposal site with topsoil and hydroseeded. Compaction other than by equipment travel will not be necessary. See Section 6 for additional detail associated with restoration.

KRRC's contractor will dispose of rebar, mechanical and electrical equipment, building materials and demolished powerline material of at an approved landfill near Yreka, CA. Table 5.5-3 lists tonnage and volume of these materials.

Figure 5.5-5 Iron Gate Spillway Backfill Plan & Sections (Appendix C)

5.5.4 Iron Gate Dam and Powerhouse Removal

Dam and Powerhouse Removal

Dam removal will begin following spring runoff on June 1, 2021. KRRC's contractor will maintain sufficient freeboard to pass a 1% probable flood for that time of year (see Section 4.4) at all times between the

elevation of the excavated embankment surface and any remaining reservoir to reduce the potential for flood overtopping embankment. KRRC will not start excavation of the embankment section at Iron Gate Dam before June 1 (in-stream to begin on June 15), 2021, and will complete excavation by October 15, 2021 to minimize the risk of flood overtopping.

Dam removal will be as follows:

1. Drawdown reservoir, but maintain a minimum flood release capacity of approximately 7,700 cfs in June (RWS elevation 2254.3), to accommodate the passage of at least a 1% probable flood for that time of year.
2. Remove fish facilities near downstream toe of embankment (including fish ladder and holding tanks) and dam crest sheet piles in the dry.
3. Retain embankment dam crest at level needed for flood protection, and the existing access bridge to the gate control house for regulating tunnel releases.
4. Begin embankment excavation for dam removal (see Figure 5.5-6(B)), but maintain a minimum flood release capacity of approximately 7,000 cfs in July (RWS elevation 2242.3) and 3,000 cfs in August and September (RWS elevation 2194.3), to accommodate the passage of at least a 1% probable flood for that time of year.
5. Remove an estimated 150,000 CY (7,500 CY per day) in June, 285,000 CY (14,250 CY per day) in July, and 635,000 CY (16,000 CY per day) in August and early September leaving upstream cofferdam (Figure 5.5-6 (B)). Excavation assumes 2 shifts working 6 days per week. Temporarily stockpile rockfill during excavation for placement on downstream slope of cofferdam.
6. Provide access to gate control house between base of tower at elevation 2257.3 and deck at elevation 2341.3 (84 feet high — assume vertical stairway structure, or longer footbridge from spillway crest) throughout excavation for flow control.
7. Draw down reservoir to maximum extent (during minimum streamflow and with no upstream drawdown releases) by September 1, 2021. Place rockfill on downstream face of cofferdam (having a crest no lower than elevation 2194.3) for controlled breach of armored cofferdam embankment above the existing bedrock surface at elevation 2157.3.
8. Breach cofferdam at Iron Gate Dam prior to breach of cofferdam at J.C. Boyle Dam to minimize potential downstream impacts. Breach by notching below the reservoir level (expected to be below RWS elevation 2186.3. Maximum breach outflow from cofferdam at Iron Gate Dam is estimated to be approximately 5,000 cfs.
9. Following the cofferdam breach, remove any remaining embankment materials from river channel in the wet, during low flow period, as required.
10. Remove diversion tunnel intake structure (invert elevation 2175.3), topple gate control tower for removal (base elevation 2254.3), and plug tunnel and shaft portals with reinforced concrete. Topple and remove penstock intake structure, and plug openings. Remove water supply features for fish facilities.
11. Construct cofferdam in tailrace channel for removal of powerhouse. Use sump pumps to dewater area. Remove cofferdam when no longer needed.

12. Remove all other features (buildings, switchyard, etc.) as required. Restore dam site and right abutment disposal site as required, including the placement of topsoil and seeding. See Section 6 for additional detail associated with restoration.
13. Demobilize from site when construction activities are complete.

Portions of the dam and hydropower demolition must be performed within the in-stream construction window negotiated with the regulatory agencies. See Section 8.6 of this Definite Plan for information pertaining to the construction schedule and timing of the various activities.

Figure 5.5-6 Iron Gate Dam Removal (Appendix B)

Transmission Line and Switchyard Removal

Transmission line removal at Iron Gate includes demolishing portions of the Iron Gate switchyard and demolishing overhead distribution and transmission lines and associated poles or towers, as applicable (see Figure 5.2-12).

KRRC's contractor will demolish approximately 0.8 miles of overhead transmission/distribution line and approximately 10 poles. Lines to be demolished include:

- 69 kV transmission line between Iron Gate switchyard and distribution lines to remain in service
- 69 kV transmission lines between Iron Gate switchyard and Iron Gate hatchery tie-in
- Production lines in the general area of Iron Gate powerhouse
- Distribution lines supplying the two village houses near the dam

Major switchyard demolition components include:

- 69 kV/6.6 kV transformer
- 6.6 kV power circuit breaker
- Generator
- All associated auxiliary equipment

Iron Gate Hatchery located near the Klamath River downstream of Iron Gate Dam will require a new connection from PacifiCorp's Hornbrook Substation (5G19). Details for connection requirements are unknown at this stage.

5.5.5 Demolition Methods, Estimated Equipment and Workforce

KRRC assumes the following demolition methods, estimated equipment requirements, and estimated workforce requirements for planning purposes based on engineering judgment. Alternative methods,

equipment, and workforce that will also meet project requirements are possible and could be refined by the selected contractor.

Demolition Methods

Dam removal requires the modification and operation of the diversion tunnel for low-level releases to allow controlled reservoir drawdown, and a high excavation production rate for removal of the embankment during the summer, low-flow months (June through September). The Iron Gate production assessment takes into consideration the approximate lift area by elevation and how many concurrent excavation operations could be occurring at that elevation. At the top, the lift surface is narrow and long and this work will progress at the low end of the overall average production rate. As the excavation descends, the footprint will become wider and KRRC's contractor will add additional equipment to the equipment spread. The short and wide bottom lifts will also limit production, similar to the top. Consequently, KRRC's contractor will implement high (above average) production rates for the larger middle lifts. KRRC's contractor will likely complete the removal of the riprap as the embankment is excavated down. KRRC's contractor will stockpile some rockfill for later use as slope protection for the upstream cofferdam.

KRRC's contractor will likely use conventional earthmoving equipment consisting of excavators and off-road articulated or fixed-wheel haul units to reach the required average production rate of 16,000 CY per hour in August and September (Figure 5.5-6(B)). Key factors will be sizing the excavators to minimize the loading passes per haul unit, and selecting the maximum size haul units that can effectively negotiate the dam surface and haul route. KRRC's contractor will utilize shift work to achieve the desired daily production rates. The potential for acceleration of the construction schedule is limited, if required, and may only be obtained by adding additional excavation time (increasing to 6 or 7 days per week, and/or longer shifts). The Definite Plan assumes 6 days per week and 2 shifts per day for 12 shifts per week, and assumes an average of 10,000 CY per 10-hour shift, to remove the dam embankment within about 16 weeks. It is interesting to note that the original placement of 1,100,000 CY of embankment material was completed within only 18 weeks in 1961.

KRRC's contractor will likely excavate reinforced concrete in deck, wall, and floor slabs for any structures to be removed (including intake structures, control structures, fish handling facilities, and powerhouse) by mechanical methods (e.g. hydraulic shears or hoe-ramming). KRRC's contractor may remove any mass concrete using conventional drilling and blasting methods.

Estimated Equipment and Workforce Requirements

Table 5.5-2 summarizes the estimated equipment for the removal of Iron Gate Dam and Powerhouse and for restoration of the reservoir area.

Table 5.5-2 Iron Gate Dam and Powerhouse, Estimated Equipment List

Name of Equipment	Pre-Drawdown	Post-Drawdown
Crawler-mounted lattice boom crane, 150 to 200 ton, 160- to 200-foot boom		X
Rough terrain hydraulic crane, 35 to 75 ton	X	X
Hitachi hydraulic excavator, 180,000 to 240,000 lb, 6 to 8 CY bucket		X
Cat 336 hydraulic track excavator, 80,000 lb, 3.5 CY bucket		
Hydraulic track excavators, 65,000 to 100,000 lb, with Cat H120 hoe-ram, thumb and shear attachments		X
Cat 966 (52,000 lb, 5 CY bucket) or Cat 980 or Cat 988 (65,000 lb, 6 or 10 CY bucket) articulated wheel-loader	X	X
Cat 740 articulated rear dump trucks, 30 ton (22 CY) or Cat 770 fixed haul unit, 40 ton (30 CY)	X	X
D-7 or D-9 standard crawler dozers	X	X
Front-end wheel loader, integrated tool carrier, 25,000 lb		X
D-8 support and knockdown dozer		X
Front-end wheel loader, integrated tool carrier, 25,000 lb		X
Cat TL943 rough terrain telescoping forklift		X
Rough terrain telescoping manlift		X
Cat 14 or Cat 16 motorgrader	X	X
Flexifloat sectional barges	X	
Truck-mounted seed sprayer, 2500 gallon		X
On-highway, light duty diesel pickup trucks, ½ ton and 1 ton crew	X	X
On-highway flatbed truck with boom crane, 16,000 lb		X
On-highway truck tractors, 45,000 lb		X
Off-highway water tanker, 5,000 to 9,000 gallon		X
Wheel-mounted asphalt paver		X
Self-propelled rubber tire and drum vibratory compactor, 5 to 15 ton		X
Engine generators, 6.5 KW to 40 KW, diesel or gasoline		X
Air compressors, 100 psi, 185 to 600 cfm, diesel		X
Hand-held drilling, cutting, and demolition equipment		X
Portable welders and acetylene torches		X
4-inch submersible trash pumps, electric		X
Light plants, 2,000 to 6,000 watt, 10 to 25 hp, diesel		X

An estimated average workforce of 35 to 40 people will be required for the construction activities, for an estimated duration of 19 months from site mobilization to construction completion for either dam removal alternative. The peak workforce required during excavation of the dam embankment could reach 75 to 80 people.

5.5.6 Imported Materials

KRRC's contractor will import some materials to the site to support dam removal. The most likely materials to be imported include gravel surfacing from a commercial quarry for temporary haul roads (approximately 5,300 tons, 190 truck trips), seed and mulch materials, and minor quantities of ready-mix concrete and reinforcing steel from local commercial sources for tunnel plugs. Modification of the diversion tunnel will require importing mechanical equipment, and additional reinforcing steel and ready-mix concrete for lining the diversion tunnel and installing a new gate in the existing gate structure.

5.5.7 Waste Disposal

Table 5.5-3 shows estimated quantities of materials generated during removal of Iron Gate Dam and Powerhouse, numbers of truck trips, and approximate haul distances for waste disposal. KRRC's contractor will place excavated concrete in the on-site disposal area. KRRC's contractor will separate reinforcing steel from the concrete prior to placement in the disposal area and haul it to a local recycling facility. KRRC's contractor will haul all mechanical and electrical equipment to a suitable commercial landfill or salvage collection point.

Table 5.5-3 Waste Disposal for Full Removal of Iron Gate Dam

Waste Material	In-Situ Quantity	Bulk Quantity [1]	Disposal Site	Peak Daily Trips [2]	Total Trips [3]
Earth	155,00 CY 912,000 CY	170,000 CY 1,087,00 CY	Onsite spillway Onsite disposal area	12 units/800 trips (unpaved road)	8,640 trips (.5 mile RT) 48,640 trips (2 mile RT)
Concrete	15,800 CY	20,700 CY	Onsite disposal area	2 units/50 trips (unpaved road)	950 trips (2 miles RT)
Rebar	700 tons	—	Transfer station near Yreka, CA	1 unit/5 trips (Copco Road)	70 trips (54 miles RT)
Mech. And Elec	1,200 tons	—	Transfer station near Yreka, CA	1 unit/5 trips (Copco Road)	150 trips (54 miles RT)
Building Waste	4 buildings 2,700 ft^2	600 CY	Transfer station near Yreka, CA	1 unit/5 trips (Copco Road)	60 trips (54 miles RT)
Power lines	0.5 miles of 69-kV	—	Transfer station near Yreka, CA		

1. Volumes increased 30 percent for concrete rubble, 20 percent for loose earth materials.
2. Peak daily trips for each site are based on the number of vehicles (units) shown, operating within one 8-hour shift.
3. Total trips of earthfill assume off-highway articulated trucks with a nominal load capacity of 22 CY. Total trips of concrete assume off-highway articulated trucks with a nominal load capacity of 20 CY. Total trips for hauling rebar using truck tractor-trailers is based on 10 tons per trip. Total trips for hauling mechanical and electrical items using truck tractor-trailers is based on 8 tons per trip. Total trips for building waste using truck tractor-trailers is based on 10 CY per trip.

Table 5.5-4 shows potential landfills or salvage collection points and capacities. Appendix O3 discusses potential hazardous materials at Iron Gate Dam and Powerhouse and their disposal.

Table 5.5-4 Waste Disposal Facilities near Iron Gate Dam

Name of Facility	Location	Distance from Site	Remaining Capacity	Materials Accepted
Yreka Transfer Station	Yreka, CA	25 miles	3,924,000 CY (2010)	Class III sanitary landfill accepting construction and demolition waste and mixed municipal waste, and Medium volume transfer station accepting metals and mixed municipal recyclable materials

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Chapter 6: Reservoir and Other Restoration

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6. RESERVOIR AND OTHER RESTORATION

The purpose of this section is to summarize the proposed plan to stabilize remaining reservoir sediment post-drawdown and to restore the former reservoir areas at each development to native habitat. The full Reservoir Area Management Plan is provided in Appendix H.

6.1 Reservoir Restoration

As part of the 2012 EIS/R and 2013 Secretarial Determination of Record (SDOR, DOI and NMFS 2013), a Reservoir Area Management Plan (USBR 2011c) was developed by the USBR with assistance from the NMFS and agencies from the Department of the Interior. The document describes anticipated conditions in the reservoir areas after removal of the four dams based on extensive hydraulic modeling, sediment characteristics, and several reservoir drawdown scenarios. The 2011 Plan provides goals and objectives developed with a multi-disciplinary team of professionals for restoration of the former reservoir areas. The 2011 Plan was developed primarily with the intent to minimize invasive vegetation and stabilize the remaining accumulated sediments not eroded during drawdown to reduce the likelihood of future undesirable sediment releases.

As part of the ongoing design and compliance processes, the KRRC assembled a working group of regulatory, tribal, and consulting professionals representing expert knowledge from recent dam removal restoration plans to provide recommendations for updating the 2011 Plan. The group held workshops in August and October 2017, and recommended updating the goals and objectives of the 2011 Plan based on current knowledge of reservoir restoration and experience gained from recent dam removal and restoration plans. Table 6.1-1 provides preliminary updates to the goals and objectives that are incorporated into the current Reservoir Area Management Plan in Appendix H.

6.1.1 Measures to Manage Remaining Sediment

J.C. Boyle Reservoir, Copco Lake, and Iron Gate Reservoir were well documented prior to construction of the dams. Each reservoir had a topographic survey and numerous pictures of conditions prior to construction of each dam as well as construction photos for each dam. As a result, ideal vegetation communities and site potential are easily discernable and techniques for stabilizing remaining sediments are readily apparent.

The 2011 Plan focused on control of invasive exotic vegetation (IEV) species and revegetation of the reservoir areas with native grasses, shrubs and trees as the primary method for restoration. This approach is consistent with nearly all dam removal and reservoir restoration plans in the past 10 years where restoration efforts have emphasized revegetation of newly exposed floodplain areas with native plants while actively controlling IEV. To implement this plan and manage the remaining reservoir area sediments, KRRC proposes

a two-pronged approach that consists of revegetation and active habitat restoration with monitoring and adaptive management. The following sequence describes the activities and restoration features that will be implemented in the reservoir areas to manage remaining sediments not eroded during drawdown:

1. Pre-dam removal (1 to 2 years pre-drawdown): conduct pre-treatment of IEV species, collect seeds and grow-out of trees and shrubs by local nurseries.
2. Reservoir drawdown (January to March, year of drawdown): perform reservoir drawdown with natural erosion and evacuation of accumulated reservoir sediment deposits, stabilize sediments and exposed areas with hydroseeding.
3. Post-drawdown first summer/fall (dry season immediately after drawdown): conduct additional seeding application where needed for exposed areas and remaining reservoir deposits with grasses and ground cover, manual removal/treatment of IEV, and installation of riparian trees and shrubs.
4. Post-removal (year after dam removal is complete): maintain vegetation, continue to remove and treat IEV, install habitat features such as willow or log structures, as needed.
5. Establishment period (years 2 through 5 post-dam removal): continue monitoring and maintenance of vegetation, removal of IEV, fish passage monitoring, and enhancement of habitat features such as willow or log structures, as needed.
6. Long term (years 5 through 10 post-dam removal): continue monitoring and adaptive management, removal of IEV, and fish passage monitoring.

Table 6.1-1 Preliminary Goals, Objectives, and Restoration Activities for Reservoir Area Restoration

Period	Goal	Objective	Restoration Activity
Pre-construction Period	Prepare native plant materials for revegetation	Collect and propagate native plant seed and grow container plants	Identify potential seed collection, seed propagation, pole harvest cutting areas, and container plant grow contractors
			Perform surveys to identify and map seed collection and pole harvest areas
			Prepare seed collection, seed propagation, container plant growing, and pole harvest contract documents
			Award and monitor native plant and seed contracts
			Develop revegetation contract documents
	Reduce invasive exotic vegetation (IEV)	Reduce and minimize the local sources of IEV	Gather existing IEV data and perform EIV surveys
			Review potential herbicides and potential impact on fish and water quality
		Implement an IEV management program	Create management plan and review with stakeholders
			Procure local contractor to perform IEV removal
			Inspect and monitor IEV removal execution

Period	Goal	Objective	Restoration Activity
	Understand evolution of reservoir post-removal and response to restoration and reservoir management	Conduct studies to fill in data gaps from 2011 Plan	Sample sediment and perform tests to investigate wetting and drying characteristics, plant nutrient availability, and natural revegetation
			Perform revegetation pilot tests for native seed mixes
			Identify reference physical and ecological conditions in tributaries
Dam removal period (0 to 1 year)	Allow natural erosion and transport of reservoir deposits and dispersal in the ocean	Maximize erosion of reservoir deposits during drawdown	Allow erosion of reservoir deposits during drawdown
	Stabilize remaining reservoir sediments	Initiate native plant revegetation	Prepare and amend sediment based on pilot test plot results
			Install irrigation system
			Hydroseed sediment by planting zones
			Install pole cuttings, acorns, and container plants
	Restore volitional fish passage in mainstem and tributaries.	Monitor and rectify any non-natural fish passage barriers	Conduct field monitoring of mainstem/tributaries, fix non-natural barriers
	Minimize IEVs	Implement and monitor IEV removal during revegetation	Include criteria for IEV removal during revegetation implementation
			Bi-weekly inspections of revegetation areas to verify IEV compliance
Short-term (1 to 5 years after removal)	Restore natural ecosystem processes	Continue native plant revegetation, maintenance and monitoring	Monitor establishment and adaptively replace failed pole cuttings, acorns, and container plants
			Maintain irrigation system
			Re-seed poorly established areas
	Minimize IEV	Continue IEV monitoring and removal	Include criteria for IEV removal during establishment
			Perform monthly inspections to verify IEV removal compliance
	Restore volitional fish passage in mainstem and tributaries	Monitor and rectify any non-natural fish passage barriers	Conduct field monitoring of mainstem/tributaries, fix non-natural barriers
Long-term (5 to 10 years)	Restore natural ecosystem processes	Continue revegetation monitoring and adaptive management	Monitor establishment and adaptively replace failed pole cuttings, acorns, and container plants
	Minimize IEV	Continue IEV monitoring and removal	Perform quarterly site inspections and verify compliance

Period	Goal	Objective	Restoration Activity
	Restore volitional fish passage in mainstem and tributaries	Continue monitoring for non-natural fish passage barriers	Remove all non-natural fish passage barriers

The use of vegetation to stabilize reservoir sediments is a common practice and well documented approach to improve ecosystem processes. For instance, all of the dam removal and reservoir restoration plans that were reviewed as part of this work (Appendix H) had native vegetation establishment in reservoir areas as the primary component to provide long-term stabilization of exposed soils. Likewise, revegetation experiments, performed in 2008 by Ellen Mussman for the Elwha River dams, showed that vegetation reduced erosion of reservoir sediments by 33% and mulch could reduce erosion by as much as 99% (Mussman 2008).

KRRC also drew upon similar wildland restoration efforts found in wildfire area restoration, natural disaster areas (i.e. Mount St. Helens), and human-induced impacted areas since these altered and often barren landscapes are very similar to the remaining reservoir sediments. Establishment of native vegetation provides many important benefits for the stability of the remaining sediments in these disturbed areas. For instance, as described in *Repairing Damaged Wildlands: A Process-Oriented, Landscape-Scale Approach*, plants can reduce flow velocities, protect the soil surface from raindrop impact, increase soil stability, and increase the amount of water infiltrating into the soil (Whisenant 1999). A comprehensive update to the 2011 Plan is provided in Appendix H and outlines in detail the proposed revegetation for the reservoir areas. In addition, the updated plan outlines active restoration treatments that can be used to further improve sediment stability and long-term success for restoration.

To protect revegetation efforts and to replace the function of the reservoirs as natural barriers, cattle exclusion fencing is also included in the Reservoir Area Management Plan. It would prevent cattle access but would allow wildlife to pass. Based on the perimeters of the reservoirs, an approximate length of 34.5 miles may be required. Exclusion fencing will be placed, in accordance with applicable Federal, State, and county regulations and guidance, around the reservoir restoration areas where they abut grazing land. The portions of the reservoir perimeters that provide topographic (e.g., steep rocky terrain) or land use (e.g., residential areas, managed forests) barriers will not be fenced.

6.1.2 Measures to Monitor Remaining Sediment

Monitoring associated with the restoration aspects of the Project is designed to measure progress toward achieving the project goals, inform potential adaptive management and maintenance needs, and provide feedback into river and reservoir area conditions to determine if the sites are trending towards or away from achieving project goals. Based on the project goals and compliance with stated objectives, KRRC will use physical site characteristics as appropriate monitoring parameters to produce data to monitor and adaptively manage reservoir area restoration efforts.

After drawdown of the reservoirs and removal of the dams, the following actions are proposed to establish "baseline" or "initial conditions". The initial conditions reference data will be used for monitoring and adaptive management related to reservoir restoration:

1. Permanent ground photo points will be established throughout the reservoir areas that enable sufficient vantage points of critical areas within the reservoirs. Photos will be taken to provide initial conditions for monitoring data to develop informed maintenance and corrective actions. Each photo ground point will be monumented with 5/8-inch rebar and aluminum cap for long-term stability and documented with a northing, easting, and elevation using a survey-grade GPS.
2. High resolution vertical aerial photos, sub-meter accuracy, will be completed for the reservoir areas.
3. KRRC will collect Light Detection and Ranging (LiDAR) data for the reservoir areas after sediment evacuation and initial ground cover stabilization and use it to create initial conditions surface models.

Baseline data will provide a clear starting point for initial conditions in the project area to help evaluate reservoir restoration trends and trajectories. Appendix H contains the updated Reservoir Area Management Plan that has a comprehensive outline of parameters that will be monitored, which include: stability of remaining reservoir sediments, fish passage, invasive exotic vegetation, native plant revegetation, and restoration of natural ecosystem processes.

6.1.3 Measures to Restore the Klamath River within Reservoirs

Review of historical photos of the reservoir areas prior to dam construction and inundation show river processes and conditions of the Klamath River pre-dams. The Klamath River was predominantly a narrow, volcanic bedrock dominated canyon with a single-thread river. Isolated areas within the canyon are wider such as in Copco Lake and the upper portion of the J.C. Boyle Reservoir. In these wider valley sections, the gravel-bed river planform is controlled by the locally resistant topography constraints and contains floodplains and off-channel features such as remnant channels and wetlands. Furthermore, there is little evidence of large wood playing a significant role in channel planform and characteristics throughout the river.

The Klamath River in the reservoir areas is expected to re-occupy the historical channel alignment due to geological constraints and the erosion of fine sediments accumulated in the reservoir bottoms. This conclusion was reached from both a geomorphic evaluation and two-dimensional hydraulic modeling analysis by USBR 2012c. Since the Klamath River channel was not altered since construction of the dams, it is anticipated that the river will return to a natural gravel-bed river and behave similar to pre-dam conditions. One exception is that riparian vegetation, primarily willows, will not be established on the banks but will be planted with the revegetation efforts. Appendix H provides a detailed riparian revegetation plan that will be implemented to restore the Klamath River in the reservoir areas and restart natural river processes.

Critical to restoring natural ecosystem processes and restoring the Klamath River is habitat restoration on the floodplains and tributaries that flow into the Klamath River in the reservoir areas. The following

restoration techniques will be implemented in the reservoir areas as appropriate (see additional detail in Appendix H):

1. **Tributary Connectivity**: Light equipment and manual labor will be used to move materials and enhance access and longitudinal connectivity of the tributaries with the mainstem Klamath River. In addition, large wood may be added to tributaries to promote habitat complexity.
2. **Wetlands, Floodplain and Off-Channel Habitat Features**: Incorporating floodplain features into exposed floodplains such as wetlands, floodplain swales, and side channels.
   a) Wetland restoration strategies for the reservoir areas include preservation of existing wetlands, hydrologic connection of off-channel wetlands with the river, or creation of new wetlands at lower elevations corresponding to the post-dam removal surfaces and hydrologic regime.
   b) Floodplain swales that vary in size and depth, but will not extend below the anticipated baseflow elevation.
   c) Side channel restoration strategies include modifying inlet and outlet hydraulics, improving hydraulic complexity with structures or realignment, and delivery of water to higher floodplain surfaces.
3. **Floodplain Roughness**: KRRC will apply floodplain roughness as a strategy to exposed areas where frequent interaction with the river channel is anticipated. KRRC will create floodplain roughness using equipment to roughen the floodplain surface with microtopography and partially bury brush and woody debris in the soil.
4. **Bank Stability and Channel Fringe Complexity**: Introduce channel fringe complexity through the riparian revegetation and strategic addition of large wood.
5. **Large Wood Habitat Features**: Although historical photos do not show large wood as a predominant geomorphic feature, KRRC will use it to improve habitat and promote reservoir area conditions that restore natural ecosystem processes and protect vegetation during the initial years of establishment.

Appendix H contains maps and additional information on reservoir area restoration with these techniques and applicable locations for implementation.

6.2 Restoration Activities Outside of Reservoir

Areas disturbed by construction activities, but outside of the former reservoir areas (e.g. staging areas, spoil disposal areas, temporary access roads, etc.) will be revegetated similarly to revegetation described in Appendix H for upland planting zone areas.

Disturbed areas outside of the former reservoir areas include the following:

1. Disposal sites for placement of embankment or concrete material: These areas typically include between 10 to 50 feet of fill, and KRRC will grade the disposal sites to match existing topographic features in the vicinity and will include a cover depth of topsoil material suitable for revegetation. KRRC will preserve and protect existing native vegetation where feasible. KRRC will not perform

ripping within twice the canopy diameter distance from protected tree trunks to protect existing roots.

2. Staging areas and temporary access road areas adjacent to demolition of other work areas: The majority of these areas are at elevations appropriate for upland planting, although in some cases they include a variety of planting zones. Many of these areas are already compacted to a high degree due to their current use, but regardless, KRRC will decompact all staging and temporary access road areas adjacent to demolition of other work areas by deep ripping and disking to facilitate seed germination and plant establishment. KRRC will preserve and protect existing native vegetation , where feasible, both during their active use and during revegetation. KRRC will not allow ripping, equipment and vehicle parking, or material storage within twice the canopy diameter distance from protected tree trunks to protect their existing roots from crushing.
3. Hydropower infrastructure demolition areas: KRRC will demolish the majority of PacifiCorp buildings and other hydropower infrastructure as part of the Project. In each former development location, after removal of all demolition debris and man-made materials, KRRC will decompact the remaining disturbed areas by deep ripping and disking, and restore them to native habitat. These areas occur in a variety of planting zones and will be restored accordingly as described in Appendix H. KRRC will preserve and protect existing native vegetation , as feasible. KRRC will not perform ripping within twice the canopy diameter distance from protected tree trunks to protect existing roots.
4. Former recreation areas: KRRC will remove some of the existing recreation areas around the reservoir rims completely, or in part. KRRC will restore all disturbed former recreation areas to native habitats. Many of these areas are heavily compacted because of their current use, but regardless of the degree of compaction, KRRC will decompact all recreation areas by deep ripping and disking to facilitate seed germination and plant establishment. KRRC will preserve and protect existing native vegetation, as feasible, and will not perform ripping within twice the canopy diameter distance from tree trunks to protect existing roots.
5. J.C. Boyle canal demolition area: KRRC will demolish the J.C. Boyle canal along its entire length. The former canal area will likely be heavily compacted from previous canal construction activities, but regardless of the degree of compaction, KRRC will decompact the canal demolition area by deep ripping and disking to facilitate seed germination and plant establishment. In addition, as part of the demolition activity, KRRC will excavate earthen materials from the river-side of the former canal width up to 3 feet and place the materials throughout the former canal width to support vegetation growth.
6. J.C. Boyle spillway scour hole: KRRC will fill the J.C. Boyle scour hole using onsite material as described in detail in Section 5.2.3. Final grading will be sloped to drain and the top 5 feet of fill will include local native material appropriate for vegetation establishment. The majority of the final graded slope is located at elevations suitable for upland seeding and planting (summarized in Appendix H). In general, KRRC will match restoration objectives, species lists and monitoring requirements with those identified for upland planting zone in Appendix H. Adjacent slopes will be utilized as a reference site for refining species lists and coverage objectives in this location.

KRRC will implement short-term revegetation of these areas in compliance with the approved SWPPP/Erosion Control Plan. KRRC will perform long-term revegetation similarly as described for upland areas, however, KRRC will also decompact these areas by deep ripping and disking.

Chapter 7: Other Project Components

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7. OTHER PROJECT COMPONENTS

7.1 Overview

There are numerous project components that fall outside of the reservoir drawdown, dam removal, and reservoir restoration activities discussed in Sections, 4, 5 and 6. KRRC partially derived these additional project components from the previous list of mitigation measures found in the Detailed Plan (USBR 2012b) and the 2012 EIS/R. These components are incorporated into the Project as the most effective way to avoid or minimize impacts of the Project. KRRC will implement these components as part of the Project.

The numbered list below provides the work component categories and Table 7.1-1 provides an overview of each project component, with references to the 2012 EIS/R mitigation measure, where appropriate:

1. **Aquatic Resource Measures**: Surveys and other measures proposed to reduce project effects on aquatic resources
2. **Terrestrial Resource Measures**: Surveys and avoidance and minimization measures proposed to reduce project effects on terrestrial resources
3. **Road Improvements**: Road and bridge improvements to maintain a level of service comparable to existing conditions
4. **Yreka Water Supply Improvements**: Pipeline and diversion facility improvements to maintain a level of service comparable to existing conditions
5. **Recreation Facilities Removal and Development Plan**: Details on recreation facility removal and associated habitat restoration, as well as proposed recreation development
6. **Downstream Flood Control Improvements**: Flood control improvements will be constructed to maintain the current level of flood control
7. **Cultural Resources Plan**: details the plan for compliance with local, state, and federal laws for cultural and tribal resources
8. **Other Plans**: Management plans to provide a framework and initial requirements for traffic, water quality, groundwater, fire management, hazardous material management, emergency response, and noise and vibration

Table 7.1-1 Summary of Other Project Components[1]

Report Section	Project Component	Description	2012 EIS/R Mitigation Measure Reference
Aquatic Resources			
7.2	Mainstem spawning	Surveys and associated protection measures	AR-1

Report Section	Project Component	Description	2012 EIS/R Mitigation Measure Reference
7.2	Outmigrating juveniles	Sampling and associated protection measures	AR-2
7.2	Iron Gate Fish Hatchery	Delayed fish release to avoid poor water quality	AR-4
7.2	Suckers	Surveys and relocation	AR-6
7.2	Freshwater mussels	Surveys and relocation	AR-7
Terrestrial Resources			
7.3, 6	Habitat restoration plan	Plan to stabilize remaining sediments and restore reservoir and other disturbed areas	TER-1
7.3	Nesting bird surveys	Surveys and avoidance and minimization measures	TER-2
7.3	Bald and Golden Eagles	Surveys and avoidance and minimization measures	TER-3
7.3	Special-status plants	Surveys and avoidance and minimization measures	TER-4
7.3	Wetlands	Delineation and incorporation of wetland features into restoration plan, to the extent feasible	TER-5
7.3	Special status bats	Surveys and avoidance and minimization measures	TER-6
7.3	Northern Spotted Owl	Surveys and avoidance and minimization measures	-
Transportation			
7.4	Bridge and culvert relocations	Improve roads, bridges and culverts affected by the Project	TR-1
Water Supply			
7.5	Yreka water supply improvements	Relocate Yreka waterline and improve fish screens at diversion facility	-
Recreation			
7.6	Recreation facility removal and development plan	Removal of numerous existing recreation facilities, and restoration with native vegetation	REC-1
Downstream Flood Improvement			
7.7	Downstream Flood Control	Maintain existing flood protection	H-2
Fish Hatchery			
7.8	Fish Hatchery	Implement agency develop hatchery plan to meet fish production expectations	-
Cultural Resources			
7.9	Cultural Resources Plan	Framework for compliance with local, state, and federal cultural resources laws	CHR-1 to CHR-4
Management Plans			
App O	Traffic Management	Framework and initial requirements for traffic management. Final plan to be developed by contractor	-
App M	Water Quality	Water quality monitoring and analysis	-

Report Section	Project Component	Description	2012 EIS/R Mitigation Measure Reference
App N	Groundwater Well Management Plan	Well monitoring	GW-1
App O	Fire Management Plan	Framework and initial requirements for fire management. Final plan to be developed by contractor	PHS-2
App O	Hazardous Material Management	Framework and initial requirements for hazardous materials management. Phase 1 assessment to be completed in 2017	-
App O	Emergency response plan	Framework and initial requirements for emergency response. Final plan to be developed by contractor	H-1
App O	Noise and Vibration Control Plan	Framework and initial requirements for noise and vibration. Final plan to be developed by contractor	NV-1

1. 2012 EIS/R Mitigation Measures AR-3 and AR-5 were not incorporated in the Project because they were determined either to be unnecessary (AR-5) or infeasible (AR-3).

7.2 Aquatic Resources

Section 7.2 includes background information pertaining to basin-specific fish populations, disease, passage and related water quality data and information. In addition, Section 7.2.5 summarizes the proposed aquatic resource measures to protect and benefit relevant species that the KRRC will implement as part of the Project. A full discussion of the aquatic resource measures is included in Appendix I.

7.2.1 Klamath Population Status Updates

The following section is intended to provide recent context on trends and estimated abundances of anadromous fish populations inhabiting the Klamath Basin downstream of Iron Gate Dam. This information provides an update on population data presented in the 2012 EIS/R. The population review includes spring and fall run Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), and steelhead (*O. mykiss*). The discussion below contains the most recent 10 years of available population abundance metrics to provide additional context to the short-term trends.

Chinook Salmon

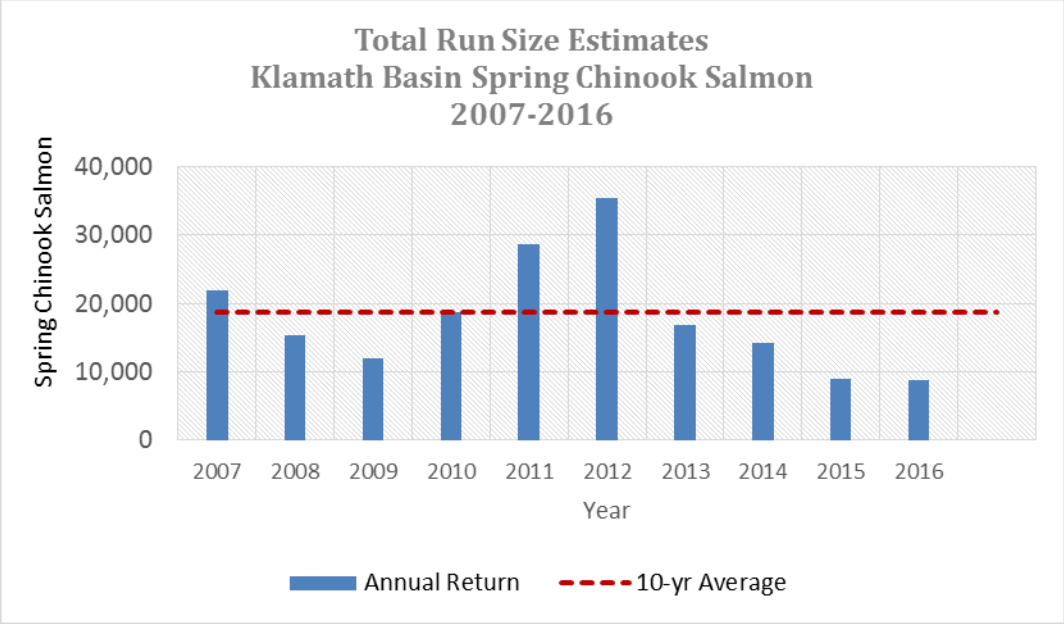
Chinook salmon that spawn upstream of the Klamath-Trinity Rivers confluence comprise the Upper Klamath and Trinity Rivers Chinook salmon Evolutionarily Significant Unit (ESU). Populations downstream of the confluence comprise the Southern Oregon /Northern California Coastal Chinook salmon ESU. Neither of these Chinook salmon ESUs are currently listed under the Endangered Species Act. While Chinook salmon continue to be the most abundant salmonid species in the Klamath Basin, recent declines in Chinook salmon populations have had widespread impacts and have led to restrictions on important tribal, commercial, and recreational fisheries that the ESUs have historically supported. Furthermore, recent

advances in understanding of genetic structure of Chinook salmon populations could potentially result in creation of a new ESU and may lead to the listing of Klamath River and Trinity River spring Chinook salmon under the ESA.

Spring Chinook Salmon

Historically, runs of spring Chinook salmon in the Klamath Basin likely numbered greater than 100,000 (Moyle et al. 2017), and likely outnumbered fall-run Chinook salmon (Spier 1930, Snyder 1931), but spring run Chinook salmon have been extirpated from a large portion of their historical range due to lack of accessible habitats (Hamilton et al. 2005). Since the 2012 EIS/R, the remaining naturally-produced populations of Klamath River spring Chinook salmon in the Salmon River and across the Upper Klamath and Trinity River (UKTR) ESU have continued a precipitous decline (CDFW 2016a).

Total run size estimates from 2007-2016 (Figure 7.2-1) including both naturally and hatchery-produced spring Chinook salmon in the Klamath River basin, including the Trinity River, have ranged from a maximum of 35,326 in 2012 to a minimum of 8,815 in 2016, with an average of 18,817.

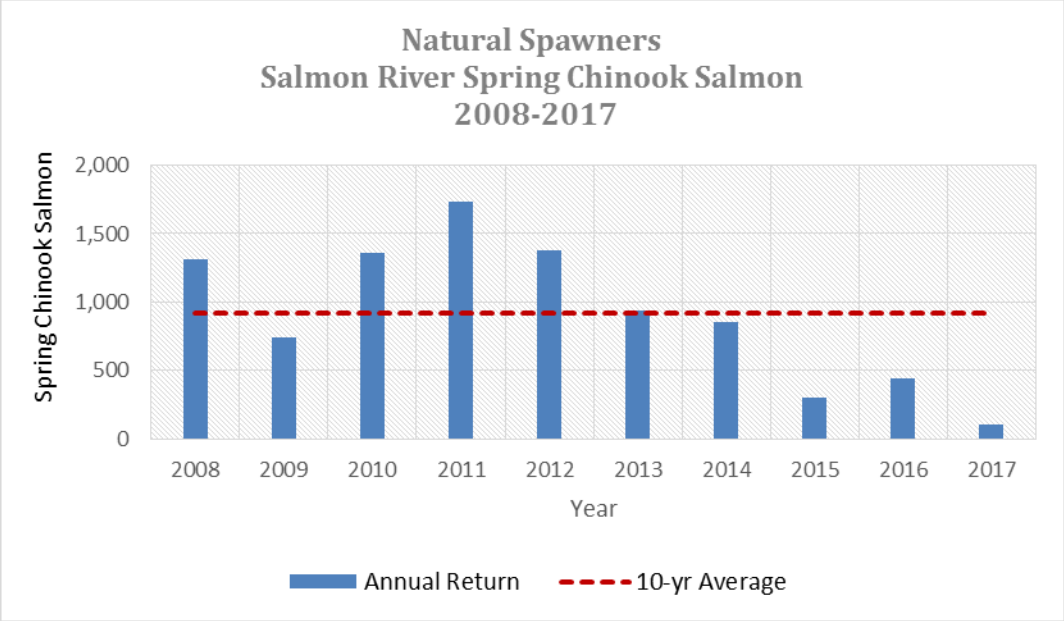


The recent 10-year average represented by the dotted red line is 18,817 fish.

Figure 7.2-1 Total run size estimates for Klamath Basin spring Chinook salmon from 2007-2016.

Only two viable naturally-spawned populations of wild spring Chinook salmon remain in the entirety of the Klamath Basin, one in the South Fork of the Trinity River, and the other in the Salmon River near Somes Bar, California. Summer holding pool adult counts have been conducted on the Salmon River annually for the past 23 years to estimate the total number of natural spring Chinook spawners available in that system. The contemporary effort includes snorkeling over 80 miles of the Salmon River mainstem, forks, and selected tributaries, and involves participation from federal and state agencies, tribes, watershed councils, and

volunteers (CalTrout 2017). These counts show downward trends over time with a maximum of 1,736 spring Chinook salmon in 2011 decreasing to a low of 110 spawners in 2017. The 10-year average is 918 spring Chinook salmon (Figure 7.2-2). The Salmon River represents the last remaining viable natural spawning population of spring Chinook salmon in the Klamath Basin above the confluence of the Trinity River, and the nearest population to historical habitat upstream of Iron Gate Dam.



The recent 10-year average represented by the dotted red line is 918 fish.

Figure 7.2-2 Estimated natural spring Chinook salmon spawners based on summer resting pool counts for the Salmon River from 2008-2017.

A 2013 status review of the UKTR Chinook salmon ESU conducted by NMFS in response to a petition for listing under the Endangered Species Act concluded that spring and fall run populations of Chinook salmon in the UKTR are included in a single ESU and that the ESU was at a low risk of extinction at the time of that determination (Williams et al. 2013). In their conclusions, the Biological Review Team included several concerns with Upper Klamath populations of spring Chinook salmon which provide additional insight into the overall status of the populations. The Biological Review Team concluded that the relatively few populations of spring Chinook salmon and the low number of spawners within those populations are limited by the availability and condition of currently accessible habitat. Deficient habitat restricts the expression of the spring run life history which typically provides diversity to the ESU. The Biological Review Team also stated that the low numbers of spring Chinook salmon are especially concerning given that the spring run life history was historically equal or larger than the fall run. In addition, the Biological Review Team suggested that the consequences of climate change may exert significant pressure on Chinook salmon populations in the UKTR unless habitat restoration and access to higher-elevation areas is achieved (Williams et al. 2013).

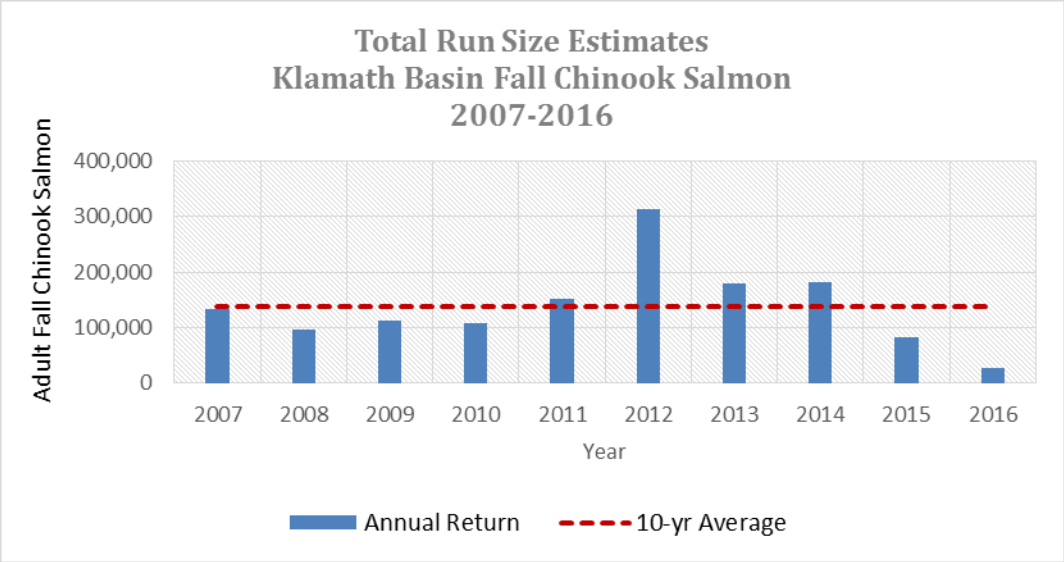
Recently published research by Prince et al. (2017) contests the current UKTR ESU configuration that defines spring and fall run Chinook salmon populations as a single ESU based on overall genetic structure

that is primarily defined by geography. This configuration suggests that differences in premature (spring) versus mature (fall) migration timing within the same species and geographic range are replaceable in time frames that are consistent with conservation planning. The newly published research indicates that premature migration is defined by a single genetic variation that diverged approximately 15 million years ago, and that if the premature migration life history is lost in spring Chinook salmon or summer steelhead, it may not be replaceable for perhaps millions of years.

In November 2017, the Karuk Tribe and the Salmon River Watershed Council submitted a petition to NMFS to either list the UKTR Chinook ESU as endangered or threatened, or to create a new ESU for Klamath River spring Chinook salmon based on this new information. Without restored access to historical habitats that support the spring run life history, populations of spring Chinook salmon are expected to remain at a fraction of historical estimates (Moyle et al. 2008). Due to exceptionally low population abundance and the spatial distribution of existing populations being primarily located in the Salmon and Trinity rivers, it is likely that some intervention will be necessary to re-establish spring Chinook salmon populations in the Upper Klamath Basin (Goodman et al. 2011).

Fall Chinook Salmon

Run sizes of hatchery and naturally produced fall Chinook salmon in the Klamath Basin vary considerably from year to year. Current estimates of spawning escapement and run size are monitored by a combination of state, federal, and tribal agencies using a variety of methods including redd and carcass surveys, weir counts, and mark-recapture studies. Over 300,000 fall Chinook returned to the Klamath Basin in 2012 representing the largest recorded run since monitoring began in 1978 (CDFW 2016b). Conversely, preliminary data suggest that only approximately 27,000 fall Chinook salmon returned to the basin in 2016, representing the smallest run size during the same time period. The 2015 fall Chinook returns totaled approximately 84,000 which is substantially less than the recent 10-year average of approximately 140,000 fish (Figure 7.2-3).



The recent ten-year average is represented by the dotted red line and is 138,878.

Figure 7.2-3 Total run size estimates for the fall Chinook salmon for the Klamath Basin from 2007-2016.

Critical stressors on natural fall run Chinook salmon populations in the basin include water quality and quantity in the mainstem and spawning tributaries. Downstream of Iron Gate Dam, the mainstem Klamath River undergoes seasonal changes in flows, water temperature, dissolved oxygen, and nutrients, as well occasional blooms of *Microcystis aeruginosa*. During outmigration, juvenile Chinook salmon are vulnerable to contracting disease from pathogens, including the bacterium *Flavobacterium columnare*, and myxozoan parasites *Parvicapsula minibicornis* and *Ceratomyxa shasta* (USBR and CDFG 2012).

More recent trends show that the abundance of natural spawners is also variable between years, but have declined sharply since a large return of adult fall Chinook in 2014 (Figure 7.2-4). Estimates of naturally spawned fall Chinook salmon are based on monitoring surveys that include the mainstem Klamath River, the Salmon River basin, the Scott River basin, the Shasta River basin, Bogus Creek, and miscellaneous Klamath River tributaries on and above the Yurok Reservation (CDFW 2016b).

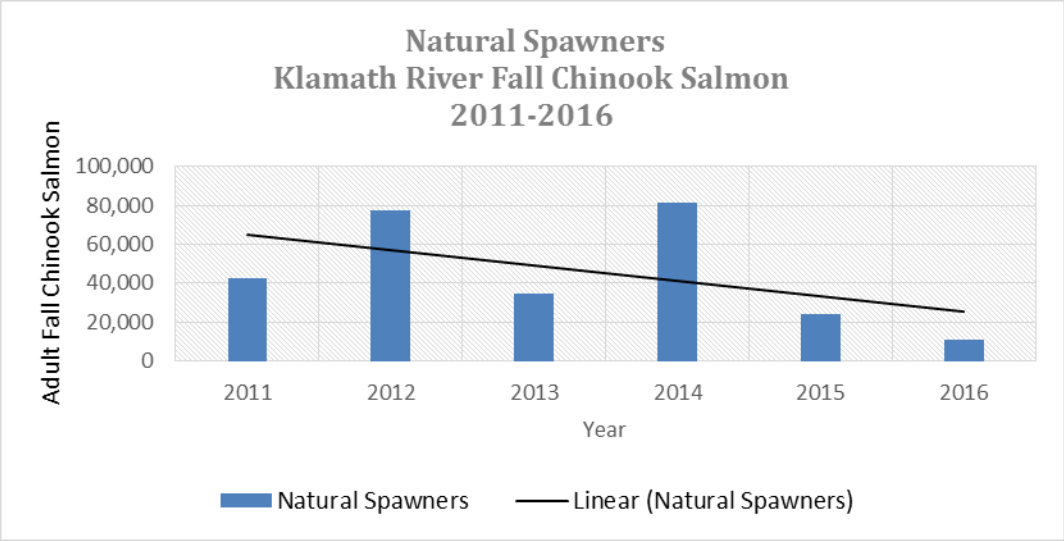


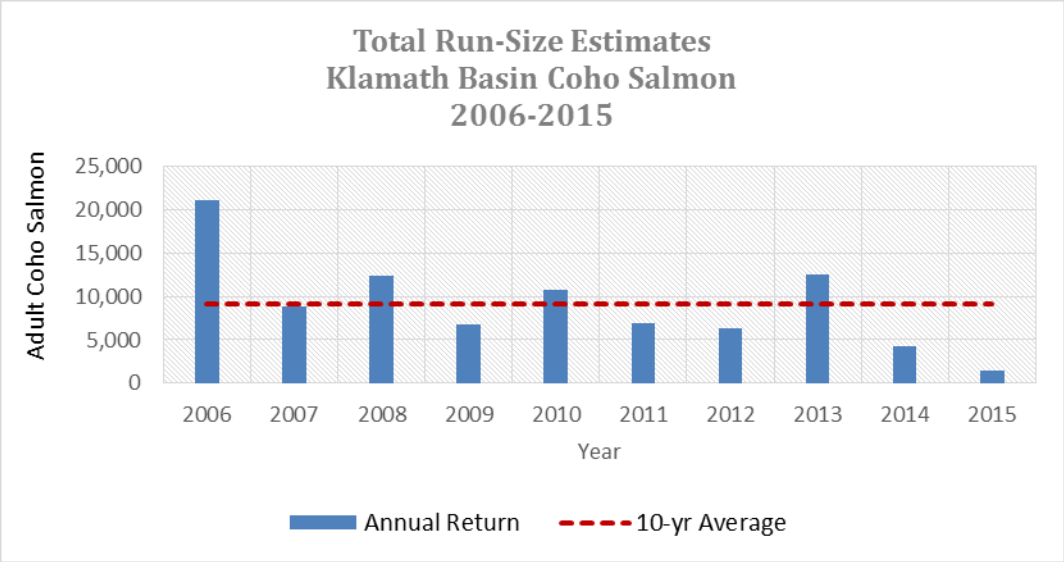
Figure 7.2-4 Natural fall Chinook salmon spawner estimates in the Klamath River and selected tributaries from 2011-2016.

In 2017, the predicted run size was estimated at approximately 12,000 natural spawners, the lowest prediction on record, and substantially less than the 40,700 natural spawner escapement goal. Fisheries managers closed all recreational fishing for Chinook salmon in the Klamath and Trinity rivers for 2017 and tribal and commercial fisheries were severely restricted as well.

Coho Salmon

Coho salmon in the Klamath Basin are a component of the Southern Oregon/Northern California Coast (SONCC) coho salmon ESU, which was listed as federally threatened in 1997. All nine coho salmon populations within the Klamath basin (i.e., Upper, Middle, and Lower Klamath River populations, Upper and Lower Trinity River populations, Scott, Shasta and Salmon River populations, and the South Fork of the Trinity River population) have declined relative to historical levels (NMFS 2014) some of these populations may not be viable, and all have a moderate or high estimated extinction risk (NMFS 2016).

Estimates for the total run size of naturally and hatchery produced coho salmon for the Klamath Basin between 2006-2015 have ranged from a high of 21,155 (2006) to a low of 1,431 (2015) (CDFW 2016c; Figure 7.2-5). Total run size estimates for 2016 and 2017 were not available at the time of this writing.



The dotted red line represents the recent 10-year average of 9,157 fish.

Figure 7.2-5 Total run size estimate for Klamath Basin coho salmon from 2006-2015.

Estimates of natural spawners in the Klamath River and select tributaries show the variability between different year classes, but illustrate how weak two of the three brood year classes have been with the exception of the 2013 brood year class (Figure 7.2-6). Estimates of naturally spawned coho salmon are based on monitoring surveys that include the mainstem Klamath River, the Salmon River basin, the Scott River basin, the Shasta River basin, Bogus Creek, and miscellaneous Klamath River tributaries below the Yurok Reservation (CDFW 2016c).

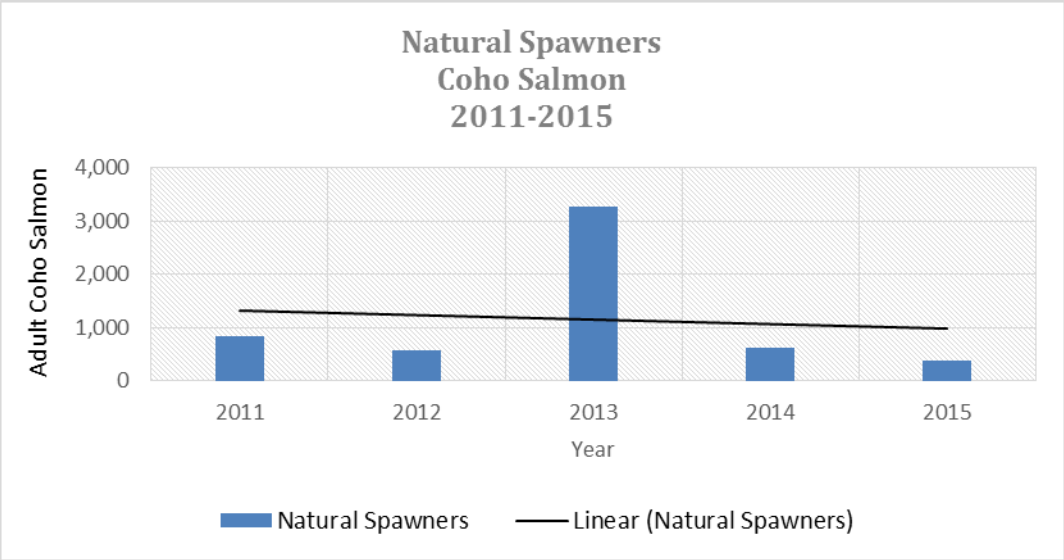
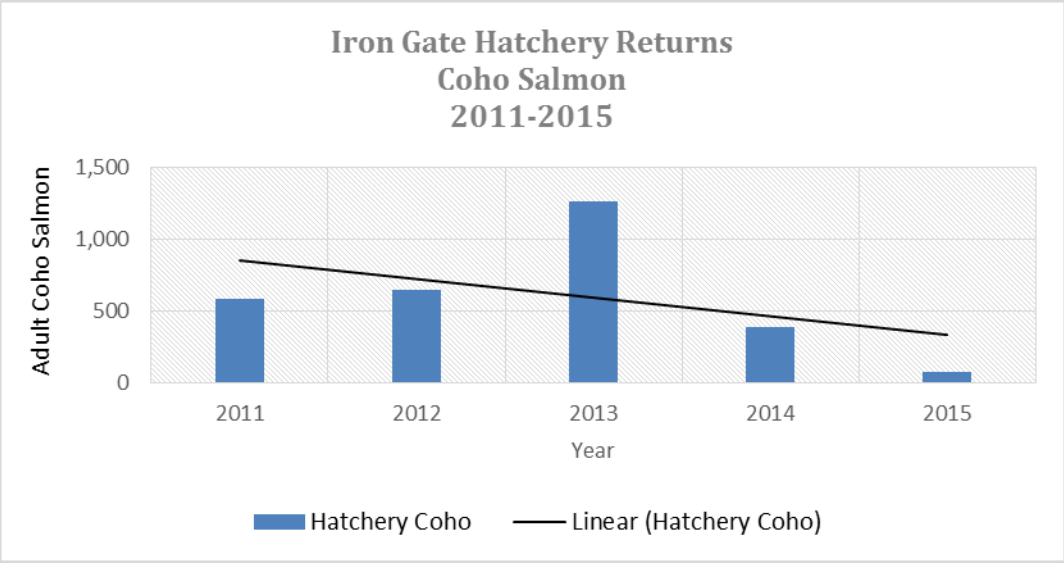


Figure 7.2-6 Estimates for coho salmon natural spawners in the mainstem Klamath River and selected tributaries from 2011-2015.

Hatchery coho production at Iron Gate Hatchery provides additional context to the status of populations within the Klamath River. The Iron Gate Hatchery coho program was initiated in the late 1960s to mitigate for impacts resulting from the construction of Iron Gate Dam, and currently operates to produce a program goal of 75,000 yearling coho salmon (California Hatchery Scientific Review Group 2012). The program currently operates under a Hatchery Genetics Management Plan finalized in 2014 to protect and conserve the genetic resources of the Upper Klamath River coho population unit (CDFW and PacifiCorp 2014).

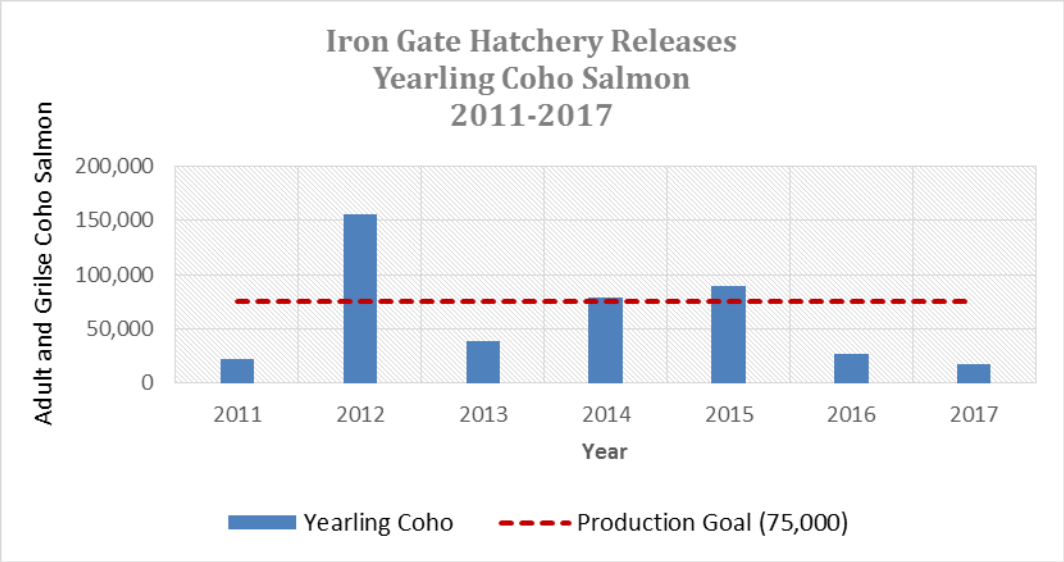
Adult returns to Iron Gate Hatchery between 2011 and 2015 display similar patterns to the estimates of natural spawners, with one year class (2013) substantially stronger than the other two year classes (Figure 7.2-7).



The count of hatchery coho includes adult and grilse (reproductively mature after one ocean year) salmon.

Figure 7.2-7 Returns of coho salmon to the Iron Gate Hatchery from 2011-2016.

Similarly, releases of yearling coho salmon from hatchery production at Iron Gate Hatchery between 2011-2017 have only met production goals in three out of the last seven years (Figure 7.2-8).



The red dotted line represents the IGH production goal of 75,000 yearling coho.

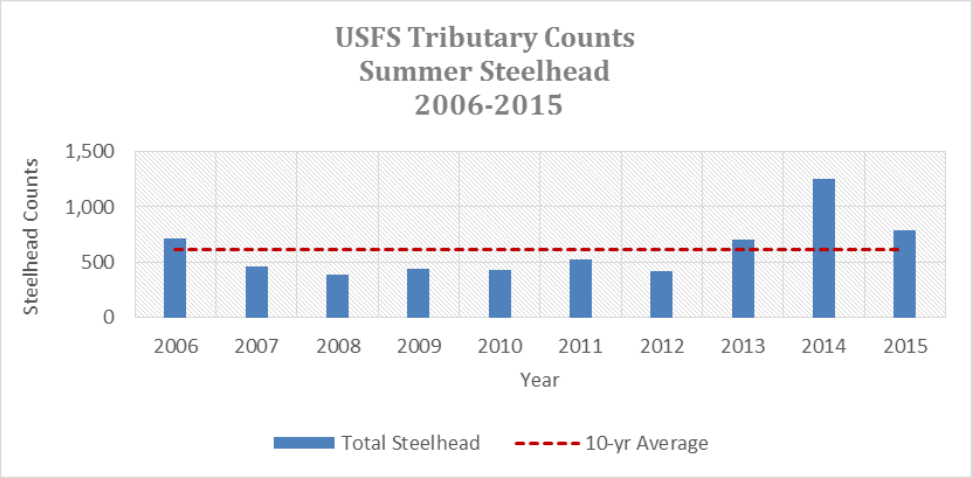
Figure 7.2-8 Yearling coho salmon releases from the Iron Gate Hatchery from 2011-2017.

Steelhead

Klamath Basin summer and winter steelhead populations comprise the Klamath Mountain Province ESU. In 2001, NMFS determined the Klamath River Basin steelhead were not warranted for listing under the ESA, despite declining populations (NMFS 2001). Recent research completed by Hodge et al. (2016) identified a total of 38 life history categories at maturity for steelhead in the Klamath River. Klamath River steelhead populations have declined despite having high life history diversity, a characteristic that typically increases population stability.

Recent data on Klamath River Basin steelhead populations outside of the Trinity River are limited. Recent trends in abundance of Klamath River steelhead populations were examined primarily using three datasets; summer steelhead counts from the Orleans and Happy Camp Ranger Districts on tributary streams located of U.S. Forest Service (USFS) lands; video monitoring results from Bogus Creek and the Shasta River; and Iron Gate Hatchery returns, although the Iron Gate Hatchery steelhead program has not operated since 2013 due to low adult returns.

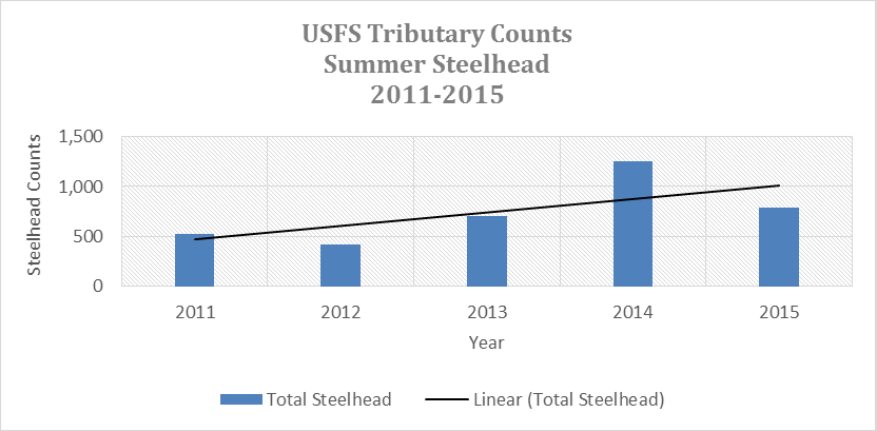
Since 1985, the Klamath Basin Collaborative Partnership has conducted summer steelhead holding counts on tributaries located on or adjacent to lands administered by the USFS Orleans and Happy Camp Ranger Districts in the middle Klamath River. Counts include adults and half pounders, and are a sum of the surveys conducted on Bluff Creek, Red Cap Creek, Camp Creek, Wooley Creek, Dillon Creek, Clear Creek, Elk Creek, Indian Creek, Thompson Creek, Grider Creek, and other small tributaries to the Klamath River located between Aikens Creek and Beaver Creek. Between 2006 and 2015, counts of adult and half pounder summer steelhead have ranged from a low of 384 to a high of 1255 with a recent 10-year average of 612 (Figure 7.2-9).



The dotted red line represents the recent 10-year average of 612 fish.

Figure 7.2-9 Summer steelhead counts on tributaries to the middle Klamath River from 2006-2015.

Between 2011 – 2015, summer steelhead counts in tributaries on USFS administered lands have shown a slight increase with the exception of 2012 (Figure 7.2-10). However, these summer steelhead populations likely represent only a fraction of their historical abundance (Moyle et al. 2017), and some populations such as Salmon River summer steelhead have declined significantly in the past several decades (Quiñones et al. 2013).



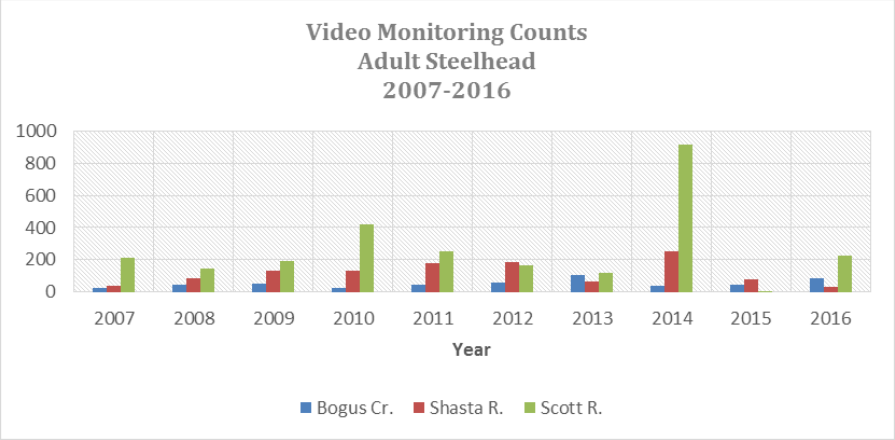
Note Wooley Creek was not surveyed in 2006, and Wooley and Dillon creeks were not surveyed in 2008.

Figure 7.2-10 Counts of holding summer steelhead on tributaries to the middle Klamath River from 2011-2015.

These data provide context to the recent trends of these populations on USFS administered lands in the middle Klamath River.

Video monitoring conducted in Bogus Creek and the Shasta and Scott rivers from 2007 to 2016 also provides context to the recent abundance of upper Klamath steelhead populations (Figure 7.2-11). Average

returns of adult steelhead counted by video were 53 (Bogus Creek), 117 (Shasta River), and 265 (Scott River) during the 10-year period (CDFW, unpublished data, 2017). However, in many years, video monitoring was terminated in December or January and did not capture the full or peak steelhead migration period. In years where video monitoring or a combination of video counts and SONAR counts covered the full migration period (2013 and 2016 for Bogus Creek and 2012, 2015, and 2016 for Shasta River), total steelhead counted averaged 94 for Bogus Creek and 194 for the Shasta River (CDFW, unpublished data, 2017).

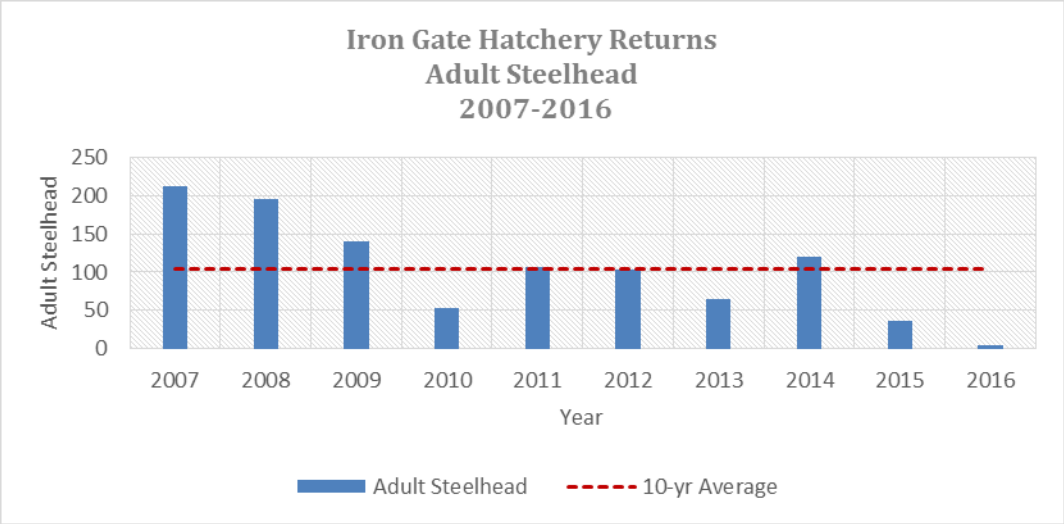


Note that most counts do not represent the peak of full steelhead migration periods.

Figure 7.2-11 Video counts of adult steelhead on Bogus Creek, Shasta River, and Scott River from 2007-2016.

Iron Gate Hatchery has produced steelhead since the early 1960s to mitigate for Iron Gate Dam impacts and to provide recreational fishing and harvest opportunities. Steelhead production has varied substantially over the years, with a high of approximately 643,000 yearlings in 1970 to a low of about 11,000 yearlings in 1997. The 200,000 yearling production goal was met in most years prior to 1991, but has not been achieved since then (California Hatchery Scientific Review Group 2012).

Adult steelhead returns to Iron Gate Hatchery typically ranged between 1,000 to 4,000 fish from the mid-1960s to the late 1980s. Returns declined substantially in 1990 and have steadily declined since (CDFW 2016d). Between 2007 and 2016, adult steelhead returns have ranged from a low of 4 (2016) to a high of 212 (2007) with a recent 10-year average of 104 fish (Figure 7.2-12). These returns have not been adequate to meet production goals for egg take and juvenile releases, and no steelhead have been produced at the Iron Gate Hatchery since 2012 (K. Pomeroy, CDFW, personal communication, 2017).



The dotted red line represents the recent 10-year average of 104 fish.

Figure 7.2-12 Adult steelhead returns to Iron Gate Hatchery from 2007-2016.

Summary

The Klamath River Basin historically supported robust and resilient populations spring and fall run Chinook salmon, coho salmon, and steelhead. The remaining populations of anadromous fish in the Klamath River are present at a fraction of their historical estimates, and have declined significantly in abundance and viability over the last century (NMFS 2009). Most recently, and since the development of 2012 EIS/R, these populations have continued to experience further declines in abundance. Coho salmon are the only anadromous salmonid in the Klamath Basin listed under the ESA, the nine coho populations in the basin continue to decline, with most of them being at a high risk of extinction. New research published on Chinook salmon suggests that it may be appropriate to create a separate ESU to distinguish spring-run Chinook from fall-run Chinook in the current Upper Klamath – Trinity River ESU, and that designation will almost assuredly place Klamath Basin spring Chinook salmon on the endangered species list. Fall Chinook salmon runs have demonstrated great variability in year to year run sizes over the last decade with historically large runs in 2012 and 2014, and record low returns in 2015 and 2016. Forecasted predictions for 2017 were for even smaller returns than the record setting low run of 2016, and have led to widespread restrictions on West Coast fisheries. Steelhead populations show variability from year to year and are more difficult to assess than those of coho and Chinook salmon. Some populations such as summer steelhead populations on USFS lands appear to be relatively stable with modest increases over the last few monitoring years, while other populations such as those in the Shasta River and Bogus Creek continuing to decline.

7.2.2 Understanding of Fish Diseases

Fish diseases are widespread in the mainstem Klamath River during certain time periods, and in certain years, disease prevalence has been shown to adversely affect productivity of Chinook (*Oncorhynchus tshawytscha*) and coho salmon (*O. kisutch*). Since 2012, researchers have focused on developing a better

understanding of the life cycle, habitat characteristics, and effects of the myxozoan parasite *Certonova shasta* (previously *Ceratomyxa shasta*; *C. shasta*), and *Parviscapsula minibicornis*, on anadromous salmonids. *P. minibicornis* and *C. shasta* share the same invertebrate host, *Manayunkia speciosa*, and environmental variables such as temperature and flow are expected to affect parasite abundances similarly (Bartholomew and Foott 2010). The following document focuses on *C. shasta* as an indicator of mortality as a result of myxozoan infection in the Klamath River.

Certonova Shasta

Life Cycle

The parasite *C. shasta* is endemic to the Klamath Basin and is assumed to have co-evolved with the salmonid species it infects (Som et al. 2016a). The myxozoan parasite has a complex life cycle that includes two hosts and two spore stages. Waterborne actinospores released from the freshwater polychaete worm, *M. speciosa*, infect adult and juvenile salmonids and develop into myxospores that are then released from salmonids and infect the polychaete host.

C. shasta actinospores are released from infected polychaetes into the water column as temperatures rise above 10°C in late March to early April (Bartholomew and Foott 2010). The actinospores are naturally buoyant and relatively short lived (days to weeks; Bjork 2010). Actinospores die unless they encounter a susceptible fish host. Fish become infected as the spores attach to the gills and travel through the bloodstream to reach the intestine. *C. shasta* infects the intestine of salmonids and can lead to necrosis of intestinal tissue that can be accompanied by a severe inflammatory reaction (enteronecrosis) and mortality (Bartholomew et al. 1989; Bartholomew et al. 2017). Myxospores develop within infected salmonids over a period of 18-25 days and are released into the environment at or soon after fish mortality (Benson 2014). Myxospores are denser than actinospores, allowing them to sink to the channel bed where they are consumed by suspension-feeding polychaetes (Bartholomew and Foott 2010). Consumption of myxospores infects polychaete worms, completing the *C. shasta* life cycle (Som et al. 2016a).

Habitat

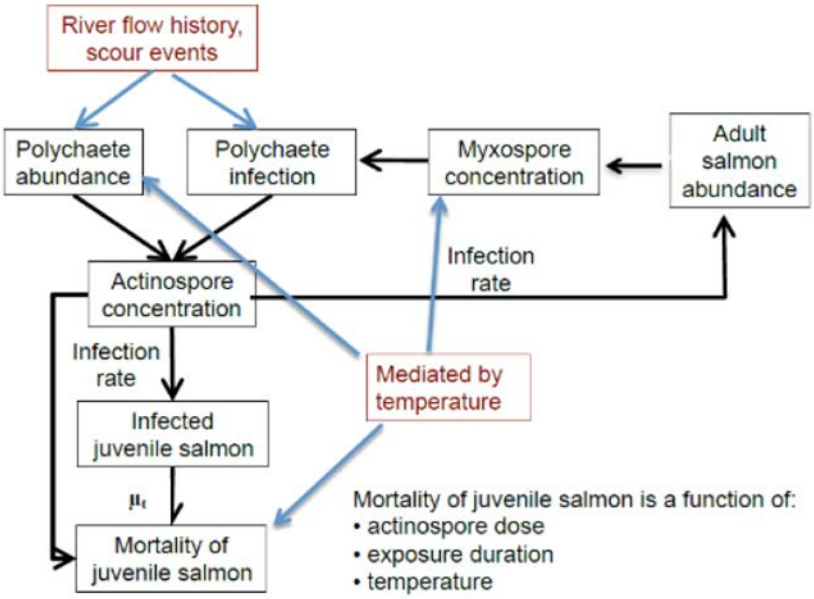
The polychaete worm *M. speciosa* is adapted to life as a semi-sessile benthic invertebrate and inhabits many types of macro and microhabitats. Inhabited macrohabitats include channel habitat such as riffle runs, pools, channel margins, and reservoir inflow zones. Identified microhabitats include channel bed sediment, freshwater sponge, aquatic vegetation, and periphyton (Stocking and Bartholomew 2007). Through laboratory and field studies, researchers have concluded higher flows could directly influence the distribution of polychaetes by restricting habitat use to stable substrates (Som et al. 2016b). However, the mobility of *M. speciosa* and the species' ability to persist after high flow events suggests *M. speciosa* is capable of moving to lower velocity, stable substrate habitats to avoid high flow effects (Alexander et al. 2014). Preliminary test results indicate that infected polychaetes are more likely to occur within a smaller range of peak flow depths and velocities than the general polychaete population, with infected polychaetes more associated with deeper and lower velocity depositional habitat (Som et al. 2016b).

Juvenile Salmonid Infection

Annual prevalence of the myxozoan parasite *C. shasta* has been documented in emigrating juvenile salmon populations during spring and early summer in the Klamath River (True et al. 2016). *C. shasta* in out-migrating juvenile salmonids has been well-studied (True 2013; True et al. 2013) and the processes that influence *C. shasta* impacts on Klamath River salmon are increasingly understood.

C. shasta infection of juvenile salmonids causes enteronecrosis, often resulting in death. Fish infected by *C. shasta* may experience enteronecrosis mortality, but are also prone to mortality caused by other pathogens such as *P. minibicornis*. Enteronecrosis may also weaken juvenile salmonids making them more susceptible to predation, and may compromise osmoregulatory systems that are essential for successful ocean entry. *C. shasta*-related mortality has been linked to population declines in fall Chinook salmon in the Klamath River (Fujiwara et al. 2011; True et al. 2013).

C. shasta infection rates of juvenile Chinook salmon are influenced by *C. shasta* spore densities, water temperature, flow rate, and juvenile salmonid residence time in areas of high spore densities (Ray et al. 2014). Figure 7.2-13 includes a conceptual model illustrating the variables and processes influencing *C. shasta* infection and juvenile salmonid mortality. *C. shasta* infections generally progress to clinical enteronecrosis over a 7-18-day period, depending on exposure and the time period fish spend in the infectious zone during their outmigration (True 2013). Mortality may occur between 13 days and 25 days post-exposure to *C. shasta* (Bartholomew et al. 2017).



Source: Foott et al. 2011 cited in Som et al. 2016

Figure 7.2-13 A conceptual model of variables and processes influencing C. shasta infection and mortality of juvenile Chinook salmon.

Studies over the last decade have focused on developing a better understanding of the parasite life cycle and the parasite's effects on juvenile salmonids in the Klamath River. Ray et al. (2014) evaluated in situ juvenile salmonid exposure using sentinel cages. Studies found that increasing parasite concentrations and water temperatures were positively associated with the proportion of juvenile fish that experienced infection and mortality. Spore concentration and water temperature were more important determinants of exposure and mortality of juvenile Chinook and coho salmon, than was river discharge. However, high velocities (Ray and Bartholomew 2013) and elevated flows may dilute spore densities and reduce transmission efficiency (Ray and Bartholomew 2013). Recent low water years associated with the 2013-2014 drought in California provided habitat conditions more favorable to *C. shasta* and *P. minibicornis* proliferation (True et al. 2015) compared to previous and subsequent higher flow years. Although high flow years may disrupt polychaete habitat, elevated flows may also redistribute polychaetes over a longer reach of the Klamath River (Bartholomew et al. 2017).

Table 7.2-1 includes a summary of juvenile Chinook salmon prevalence of infection over 10 years at the Kinsman rotary screw trap location (RM 147.6), located 45 river miles downstream from Iron Gate Dam (RM 193.1). The Kinsman trap is located between the Shasta River and the Scott River, a reach of the Klamath River often referenced as the "infectious zone" (True et al. 2015). The general pattern of annual parasite abundance in the Klamath River downstream from Iron Gate Dam remains relatively consistent from year to year, although the extent of the infectious zone and the magnitude of parasite densities change seasonally and annually (Bartholomew and Foott 2010; Bartholomew et al. 2017). Depending on river conditions (e.g., flow and water temperature) the infectious zone may extend from Iron Gate Dam to downstream of Seiad Valley (True 2013; Bartholomew et al. 2017). While high run-off years may reduce polychaete densities downstream of Iron Gate Dam, the redistribution of polychaetes by high flows may result in the downstream relocation of *C. shasta* 'hot spots' (Som et al. 2016c).

Table 7.2-1 Summary of estimates of annual-level C. shasta infection prevalence for wild and/or unknown origin juvenile Chinook salmon passing the Kinsman rotary screw trap site (RM 147.6).

Year	Origin	Prevalence of Infection	Infected Population Estimate Lower Confidence Limit	Infected Population Estimate	Infected Population Estimate Upper Confidence Limit
2005	All	0.41	0.26	0.38	0.47
2007	All	0.28	0.07	0.1	0.15
2008	All	0.6	0.43	0.51	0.58
2009	All	0.5	0.5	0.58	0.66
2010	Wild/Unknown	0.12/0.15	0.02	0.04	0.07
2011	Wild	0.2	0.07	0.11	0.17
2012	Wild/Unknown	0.06/0.00	0.04	0.08	0.14
2013	Wild	0.18	0.03	0.06	0.09
2014	Wild	0.67	0.12	0.18	0.26
2015	Wild/Unknown	0.66/0.96	0.2	0.29	0.39

Note: The lower and upper confidence limits account for the estimation uncertainty in abundance and weekly prevalence of infection rates.
Source: Som et al. (2016a).

Estimates of the annual proportion of infected Chinook salmon range from 2 percent to 66 percent (Som et al. 2016a). As the release of Iron Gate Hatchery juvenile Chinook salmon overlaps with the period of high infection potential, studies suggest that a high proportion of the Iron Gate Hatchery Chinook salmon stock can become infected with *C. shasta* (Som et al. 2016a). Infected juvenile fish that experience mortality lower in the Klamath River may become another source of myxospores to the lower Klamath River.

Spawner Influence on Prevalence of *C. shasta*

Returning adult salmon are exposed to myxospores when fish enter the Klamath River in the fall. Disease progression in adult fish is likely a function of temperature and infectious dose (Bartholomew and Foott 2010). Because adult fish have a low infection threshold, the prevalence of infection is high and infection rates may be high even in years of reduced infectious zone prevalence.

Adult salmonid carcasses play an important role in the lifecycle and prevalence of *C. shasta* in the infectious zone (Som et al. 2016a). Fall Chinook salmon returns to Iron Gate Hatchery and the blockage created by Iron Gate Dam, concentrate spawners and post-spawn carcass densities between Iron Gate Dam and the Shasta River confluence. Myxospore development occurs predominantly in decomposed carcasses rather than in recent post-spawned adults (Som et al. 2016a). Myxospore detection from carcasses ranges from 22 percent to 52 percent, however less than 13 percent of carcasses are significant contributors to myxospores production (produce >500,000 spores). Based on average adult returns to in the Shasta River to Iron Gate Dam reach, Chinook salmon carcasses potentially produce billions of myxospores. Myxospores remain viable in the channel bed sediments through the winter and early spring, and re-enter the water column over the winter when juvenile salmonids begin to emerge from the gravels.

Disease Reduction Benefits Associated with Dam Removal

Developments removal is expected to reduce fish disease in adult and juvenile salmon especially downstream from Iron Gate Dam. Among the salmon life stages, juvenile salmon tend to be most susceptible to *P. minibicornis* and *C. shasta* (Beeman et al. 2008). The main factors contributing to risk of infection by *C. shasta* and *P. minibicornis* include availability of habitat (pools, eddies, and sediment) and microhabitat characteristics (static flow and low velocities) for the polychaete intermediate host; polychaete proximity to spawning areas; increased planktonic food sources from Hydroelectric Reach reservoirs; water temperatures greater than 15°C (Bartholomew and Foott 2010); and juvenile salmonid residence time in the infectious zone (Som et al. 2016a).

Developments removal will restore natural channel processes including channel bed scour and sediment transport. Annual channel bed scour will disturb the habitat of the polychaete worm that hosts *C. shasta*

(FERC 2007). Reducing polychaete habitat will likely increase abundance of smolts by increasing outmigration survival, particularly for juvenile coho salmon (FERC 2007).

Dam removal will also broaden the distribution of adult pre-spawn fall Chinook salmon, reducing crowding and the concentration of disease pathogens that currently occurs in the reach between Iron Gate Dam and the Shasta River (Som et al. 2016a). A broader spawning distribution will also influence the distribution of post-spawn adult carcasses that contribute the bulk of the myxospores that enable the *C. shasta* life cycle within the infectious zone. Distributing adult carcasses over a longer reach of the Klamath River corridor will reduce myxospore densities likely leading to lower juvenile salmonid infection rates in the winter and spring rearing period (Som et al. 2016a). However, adult spawning upstream of the Klamath River dam sites could also expand habitat for *M. speciosa* and *C. shasta* effects. Both juvenile outmigrants and returning adult fish could be exposed to *C. shasta* over longer distances with dam removal.

In summary, water temperature and spore concentrations are positively correlated with infection and mortality of juvenile Chinook salmon and coho salmon. High spawner carcass concentrations downstream from Iron Gate Dam, contribute to high myxospore concentrations and the incidence of infection of juvenile fish. The timing of juvenile Chinook salmon from Iron Gate Hatchery and associated water temperatures may substantially contribute to the total myxospore load in the Klamath River. High spore concentrations in the Shasta River to Salmon River reach of the Klamath River, creates an "infectious zone" that increases outmigrating juvenile fish exposure to *C. shasta*. Developments removal is expected to reduce fish disease in adult and juvenile salmon especially downstream from Iron Gate Dam, by restoring natural channel processes (including channel bed scour and sediment transport), by broadening the distribution of adult pre-spawn fall Chinook salmon, and by broadening the distribution of post-spawn adult carcasses that contribute the bulk of the myxospores within the infectious zone.

7.2.3 Aquatic Resources Measures

The 2012 EIS/R identified significant short-term effects to the aquatic biological community. The 2012 EIS/R included aquatic resource (AR) measures to attempt to mitigate the possible short-term adverse effects of dam decommissioning. The Klamath River Renewal Corporation (KRRC) assembled an Aquatic Technical Work Group (ATWG) comprised of state and federal resource agencies, and tribal fisheries scientists in 2017 to review the 2010 EIS/R AR measures, determine the feasibility and effectiveness of those plans, and to provide input on refined proposed actions that would best meet the intent of the previous AR measures. The ATWG included fisheries scientists representing California Department of Fish and Wildlife (CDFW), Oregon Department of Fish and Wildlife (ODFW), U.S. Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration (NOAA Fisheries), Yurok Tribe, Hoopa Valley Tribe, Karuk Tribe, and the Klamath Tribes.

Through a series of nine meetings between April 28 and August 15, 2017, the KRRC and the ATWG reviewed recent similar dam removal projects and new scientific information that has been developed since the 2012 EIS/R to update the 2012 AR measures. Updated AR measures are proposed to be implemented as part of the Project. These measures are subject to consultation with aquatic resource agencies and negotiation of the final Biological Opinions for the Project.

During the reservoir drawdown year, reservoirs will be drawn down by the end of March, followed by volitional fish passage by October 1, and free-flowing river conditions at all four facilities by December 31. Project effects are anticipated to be short-term in nature, with long-term benefits ultimately outweighing the project impacts to the aquatic biological community. The aquatic effects will primarily occur from the release of reservoir sediment during reservoir drawdown. Information in Appendix I – Aquatic Resource Measures, includes a review the 2012 EIS/R AR measures, lessons learned from other large dam removal projects, and provides the rationale for revising the AR plans to reduce the short-term project effects on aquatic resources.

Mainstem Spawning – Monitoring and Adaptive Management Plan

A monitoring and adaptive management plan is proposed to reduce effects to mainstem spawning. Survey and restoration actions included in the adaptive management plan are summarized below:

- **Action 1:** KRRC will evaluate tributary-mainstem confluences, four sites in the Hydroelectric Reach and five sites in the 8-mile reach from Iron Gate Dam (RM 193.1) to Cottonwood Creek (185.1), for 2 years (see Table 3-1 for proposed schedule). Monitoring frequency will be variable based on the season and year. Additionally, any 5-year flow event of 10,895 cfs or greater on the Klamath River recorded at the USGS Klamath River Below Iron Gate Dam CA gage (#11516530) within the first two years following reservoir drawdown, will trigger a monitoring effort. If tributary confluence blockages are identified during monitoring, necessary means will be employed to remove the obstructions to ensure volitional passage for adult Chinook salmon, coho salmon, steelhead, and Pacific lamprey. The ATWG will also convene periodically during the 2-year monitoring period to review monitoring frequency to ensure volitional passage is maintained between the Klamath River and select tributaries.
- **Action 2:** KRRC will complete a spawning habitat evaluation of the Hydroelectric Reach and newly accessible tributaries following reservoir drawdown. A target of 44,100 yd^2 of mainstem spawning gravel will be required to offset the effects to 2,100 mainstem-spawning fall Chinook salmon redds. If mainstem spawning gravel availability is less than the target values following reservoir drawdown, KRRC will consult with the ATWG to plan and implement spawning gravel augmentation in the former Klamath River reservoirs and Hydroelectric Reach. A target of 4,700 yd^2 of tributary spawning gravel is required to offset the effects to 179 tributary-spawning steelhead redds. If tributary spawning gravel habitat is less than the target values following reservoir drawdown, KRRC will meet with the ATWG to prioritize additional habitat restoration actions (e.g., gravel augmentation, gravel retention treatments) that will be implemented by KRRC to increase the amount of tributary habitat available to compensate for the loss of steelhead redds.

The proposed actions are intended to ensure adult salmonid and Pacific lamprey access to mainstem and tributary spawning habitat in the Hydroelectric Reach and between Iron Gate Dam and Cottonwood Creek following dam decommissioning.

Outmigrating Juveniles – Survey and Protective Measures

Surveys and measures proposed to reduce effects on conditions for outmigrating juveniles are summarized below:

- **Action 1:** KRRC will sample and salvage overwintering juvenile coho salmon from the Klamath River between Iron Gate Dam (RM 193.1) and the Trinity River (RM 43.4) confluence prior to reservoir drawdown. Sampling and salvage sites will focus primarily on alcoves, side channels, and backwatered floodplain features adjacent to the mainstem Klamath River. Up to 500 juvenile coho salmon are anticipated to be caught and relocated to off-channel ponds in order to protect this small, but important life history strategy in ESA-listed coho salmon population.
- **Action 2:** KRRC, with input from the ATWG, will prepare a monitoring and adaptive management plan to monitor tributary-mainstem connectivity. Beginning in January of the drawdown year and continuing for 2 years, tributary-mainstem confluences, including four sites in the Hydroelectric Reach and five sites in the 8-mile reach from Iron Gate Dam (RM 193.1) to Cottonwood Creek (RM 185.1), will be monitored with a variable frequency based on the season and year (see Table 4-1 for proposed schedule). Additionally, any 5-year flow event of 10,895 cfs or greater on the Klamath River recorded at the USGS Klamath River Below Iron Gate Dam CA gage (#11516530) within the first two years following reservoir drawdown, will trigger a monitoring effort. If KRRC identifies tributary confluence blockages during monitoring, KRRC will employ necessary means to remove the obstructions to ensure volitional passage for juvenile Chinook salmon, coho salmon, steelhead, and Pacific lamprey. Juvenile salmonids are expected to benefit from the Project because it will restore access to at least 13.9 miles of key tributary rearing habitats in the Hydroelectric Reach and several recognized thermal refugia areas including Jenny and Fall creeks.
- **Action 3:** KRRC will prepare and implement a monitoring and adaptive management plan that will include detailed information related to monitoring juvenile salmonids and water quality conditions in 13 key tributary confluences between Iron Gate Dam (RM 193.1) and the Trinity River (RM 43.4). Tributary water temperatures and mainstem suspended sediment concentrations will be monitored by KRRC from March 1 to July 1 of the drawdown year. If water quality triggers are exceeded, KRRC and the ATWG will convene to evaluate the data and determine if juvenile salmonids will be salvaged from the tributary confluences and relocated to cool water tributaries, existing off-channel ponds, and/or to the Klamath River downstream from the Trinity River confluence.

The proposed actions are intended to reduce project effects on juvenile salmonids and Pacific lamprey during reservoir drawdown.

Iron Gate Fish Hatchery – Delayed Releases to Avoid Lethal Water Quality Conditions

Hatchery-reared yearling coho salmon to be released in the spring of 2021 could be held at Iron Gate Hatchery or at another facility by CDFW until water quality conditions in the mainstem Klamath River improve to sublethal levels. Based on the current Iron Gate Hatchery release schedules and suspended sediment predictions in the Klamath River following dam decommissioning, yearling coho salmon releases could be delayed approximately 2 weeks to avoid lethal water quality conditions. Water quality monitoring stations

established prior to reservoir drawdown will be used to determine when conditions in the mainstem Klamath River are suitable for the release of hatchery-reared coho salmon.

The proposed action is intended to reduce project effects on outmigrating hatchery-origin yearling coho salmon released from Iron Gate Hatchery. Whether the measure is ultimately adopted is within the discretion of CDFW, and KRRC will coordinate closely with CDFW on potential implementation of this measure.

Sucker – Survey and Protective Measures

Surveys and measures proposed to reduce effects to suckers are summarized below:

- **Action 1:** Lost River and shortnose suckers will be sampled in the Klamath River and in Hydroelectric Reach reservoirs in 2018, 2019, and 2020. River sampling will be completed in spring of 2019 and 2020, and reservoir sampling will be completed in fall of 2018 and 2019. Each sampling will require approximately 6 days for an estimated 24 days of sampling across the 2018 to 2020 period. The purpose of sampling is to document the abundance and genetics of Lost River and shortnose suckers in the Hydroelectric Reach. Captured fish will be marked with a passive integrated transponder (PIT) tag, fin clipped for genetic material, measured, and released. Recaptured fish will be used to estimate sucker abundance in the sampled reservoirs. Fin clips will be used to determine the genetics of the sampled fish. USFWS is currently developing genetic markers for Lost River and shortnose suckers.
- **Action 2:** Adult Lost River and shortnose suckers in reservoirs downstream from Keno Dam will be captured and relocated to isolated water bodies in the Klamath Basin. The proposed relocation of rescued suckers to isolated waterbodies is to ensure hybridized suckers do not mix with sucker populations designated as recovery populations in Upper Klamath Lake. An estimated 14 days will be required for salvage and release efforts. Due to the poor current understanding of Lost River and shortnose sucker populations in the reservoirs, we are unsure of the number of adult suckers inhabiting the reservoirs. Based on past study results (e.g., Desjardins and Markle 2000), we anticipate salvaging and translocating 100 adult Lost River and 100 adult shortnose suckers from each of the three Klamath River reservoirs (600 fish total). The number of translocated fish will not exceed 3,000 fish, which is the capacity of the currently identified recipient waterbody (Tule Lake). The proposed actions are intended to reduce project effects on Lost River and shortnose suckers inhabiting the Hydroelectric Reach reservoirs. The following sections provide additional detail on the proposed actions.

The proposed actions are intended to reduce project effects on Lost River and shortnose suckers inhabiting the Hydroelectric Reach reservoirs.

Freshwater Mussels – Survey and Protective Measures

Proposed surveys and other measures proposed to reduce effects to freshwater mussels are summarized below:

- **Action 1:** KRRC will complete a reconnaissance in 2019 to assess the distribution and density of freshwater mussels in the 8-mile long bedload deposition reach from Iron Gate Dam (RM 193.1) downstream to the Cottonwood Creek confluence (RM 185.1). The reconnaissance effort will determine if the mussel beds identified in the 2007-2010 surveys are still present, and estimate abundance of a subset of the mussel beds in the reach.
- **Action 2**: Based on the reconnaissance, KRRC will salvage and relocate a portion of the freshwater mussels located between Iron Gate Dam and Cottonwood Creek prior to drawdown to reduce project effects to the mussel community. Up to 20,000 mussels are planned for translocation to appropriate habitats in the Klamath River between the upstream extent of J.C. Boyle Reservoir (RM 234.1) and Keno Dam (RM 239.2).

The proposed actions are intended to reduce project effects on freshwater mussels located downstream from Iron Gate Dam.

7.3 Terrestrial Resources Measures

KRRC has consulted with state and federal regulatory agencies and stakeholders to develop the following measures that KRRC proposes to reduce potential impacts to terrestrial resources. KRRC will implement these measures as part of the Project.

- **Habitat Rehabilitation Plan:** Section 6 and Appendix H summarize the restoration plan for the Project.
- **Nesting Bird Surveys:** Appendix J discusses surveys in several sections including Northern Spotted Owl, Bald and Golden Eagles, and Special Status Wildlife Species. KRRC will implement avoidance and minimization measures to the extent feasible, including monitoring, exclusion, buffers, and construction planning to time activities for less sensitive times of the year.
- **Nesting Habitat of Bald and Golden Eagle and Other Migratory Birds:** Appendix J discusses surveys for bald and golden eagles and special status wildlife species. KRRC will implement avoidance and minimization measures to the extent feasible, including monitoring, buffers, and construction planning to time activities for less sensitive times of the year.
- **Special Status Plants:** Appendix J discusses surveys for special status plant species. KRRC will implement avoidance and minimization measures to the extent feasible, including propagation and establishment in new locations as part of the site restoration as described in Section 6 and Appendix H.
- **Wetlands at Reservoirs:** KRRC will comply with regulatory requirements for delineating and protecting wetlands, as described in Appendix J in the Wetlands and Vegetation Communities section. KRRC will evaluate all areas within the limits of construction for the presence of wetlands in the project area, including potential disposal areas. KRRC will confirm the acreages through the field surveys. The restoration plans for the reservoir and non-reservoir areas, described in Sections 6.1 and 6.2, respectively, include designs for wetland and riparian habitat restoration to result in no net loss of wetland or riparian habitat functions.

- **Special Status Bats:** The bats section of Appendix J describes the field surveys that KRRC has conducted and that KRRC plans for the remainder of 2018 and for 2019. KRRC will implement avoidance and minimization measures to the extent feasible, including monitoring, exclusion, seasonal restrictions on demolition, preservation of existing habitat, and development of alternative habitat.
- **Northern Spotted Owl:** Appendix J discusses survey protocols for the Northern Spotted Owl. KRRC will implement avoidance and minimization measures to the extent feasible, including seasonal restrictions on certain activities and a prohibition of aircraft or helicopter flights over sensitive areas as identified through the surveys. These restrictions will be incorporated into the project description and construction planning.

Appendix J discusses the full terrestrial resource work plans and planned avoidance and minimization measures.

7.4 Road Improvements

This section describes the proposed road improvements the KRRC will implement as part of the Project. Sections 5.2.2, 5.3.2, 5.4.2 and 5.5.2 discuss construction access assessments and related transportation improvements and maintenance. This Section 7.4 discusses proposed post-construction transportation improvements and maintenance. Table 7.4-1 provides a summary of the all pertinent road segments, bridges, and culverts and the associated improvements.

Several road, intersection, structure and culvert improvements are proposed as part of the Project to:

- Facilitate access for project-related vehicles and equipment associated with dam removal (Section 5)
- Provide safety measures for both public and project roads used during the dam removals
- Return roads used by project-related vehicles to the respective owners and users in a state that equals or exceeds existing condition/function

KRRC performed a site visit and desktop study to assess the state of road infrastructure expected to be used throughout the Project. Tables in Appendix K show the findings of this assessment.

KRRC completed a further assessment of which elements require improvement for either construction access or post-construction restoration. KRRC will implement the improvements at various phases throughout the Project. Some will require completion prior to the dam removals, and others will be contingent on a future assessment of road elements once reservoir drawdown or hauling activities are complete. There will also be some ongoing activities throughout the Project to maintain roads heavily trafficked by project construction vehicles.

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Table 7.4-1 Roadway and Access Improvements

Location	Improvements	Purpose		
		Construction Access	Post-Drawdown	Road Rehabilitation
J.C. Boyle				
The Dalles California Highway (US97)	• Potential pavement rehabilitation during or post-Project (Section 5.2.2)			X
Green Springs Highway (OR66)	• Potential pavement rehabilitation during or post-Project (Section 5.2.2)			X
Spencer Bridge	• None (Section 5.2.2)			
Keno Worden Road	• Potential pavement rehabilitation during or post-Project (Section 5.2.2)			X
Keno Access Road	• None (Section 5.2.2)			
Unnamed Culvert at Unnamed Road near J.C. Boyle Reservoir	• None (Section 7.4.3)			
Topsy Grade Road	• Potential pavement rehabilitation during or post-Project (Section 5.2.2)			X
Culvert at Unnamed Creek	• Potential sediment removal and downstream erosion protection (Section 7.4.3)		X	
J.C. Boyle Dam Access Road from OR66	• Regrading uneven or rutted areas (Section 5.2.2)	X		
Junction of OR66 and J.C. Boyle Dam Access Road	• Intersection widening (Section 5.2.2) • Tree removal (Section 5.2.2) • Signage (Section 5.2.2)	X		
J.C. Boyle Powerhouse Road	• None (Section 5.2.2)			
Timber Bridge	• Remove (Section 5.2.2)	X		
Power Canal Access Road	• Periodic roadway maintenance grading during construction (Section 5.2.2)	X		
J.C. Boyle Disposal Access Road	• Regrading (Section 5.2.2) • Minor widening (Section 5.2.2)	X		

Location	Improvements	Purpose		
		Construction Access	Post-Drawdown	Road Rehabilitation
J.C. Boyle Left Abutment Access Road	• None (Section 5.2.2)			
Copco and Iron Gate				
Interstate 5 (I-5)	• None (Section 5.2.2)			
Copco Road (I-5 to Ager Road)	• Potential pavement rehabilitation during or post-Project (Section 5.2.2)			X
Cottonwood Creek Bridge	• None (Section 5.2.2)			
Copco Road (Ager Road to Lakeview Road)	• Potential pavement rehabilitation during or post-Project (Section 5.2.2)			X
Dry Creek Bridge	• Replace or provide temporary bridge for construction access during Project (Section 5.2.2)	X		
Copco Road (Lakeview Road to Daggett Road)	• Roadway maintenance during construction (Section 5.2.2) • Potential pavement rehabilitation during or post-Project (Section 5.2.2)	X		X
Brush Creek Bridge	• None (Section 5.2.2)			
Unnamed Culverts between Brush Creek and Scotch Creek	• Potential rehabilitation or replacement post-construction (Section 7.4.3)			X
Scotch Creek Culvert	• Replace (Section 7.4.3)		X	
Camp Creek Culvert	• Replace with bridge or culvert (Section 7.4.3)		X	
Jenny Creek Bridge	• Replace (Section 7.4.3)		X	
Copco Road (Daggett Road to Copco Access Road)	• Potential road surface maintenance during or post-Project (Section 5.2.2)			X
Fall Creek Bridge	• Replace or provide temporary bridge for construction access during Project (Section 5.2.2)	X		
Copco Road (Copco Access Road to Copco Road Bridge)	• Potential road surface maintenance during or post-Project (Section 5.2.2)			X

Location	Improvements	Purpose		
		Construction Access	Post-Drawdown	Road Rehabilitation
Beaver Creek and E.F. Beaver Creek Culverts	• Potential erosion protection (Section 7.4.3)		X	
Raymond Gulch Culvert	• Potential erosion protection (Section 7.4.3)		X	
Copco Road Bridge	• Potential abutment erosion protection (Section 7.4.3)		X	
Copco Access Road	• Clear, grub and regrade (Section 5.2.2) • Minor widening into hillside if possible (Section 5.2.2) • Maintain after construction is complete to allow access for monitoring	X		
Copco Cove Access	• Minor works to enable barge mobilization (Section 5.2.2)	X		
Patricia Avenue	• None			
Culverts at Unnamed Creeks (Copco Lake)	• Potential erosion protection (Section 7.4.3)		X	
Ager Beswick Road	• None (Section 5.2.2)			
Mallard Cove Boat Ramp Access	• Minor works to enable barge mobilization (Section 5.2.2)	X		
Daggett Road	• Minor grading improvements (Section 5.2.2) • Potential road surface maintenance during and post-Project (Section 5.2.2)	X		X
Daggett Road Bridge	• Replace (Section 5.2.2)	X		
Lakeview Road (Copco Road to Iron Gate disposal site)	• Potential road surface maintenance during and post-Project (Section 5.2.2)			X
Lakeview Road Bridge	• Replace or provide temporary bridge for construction access during Project (Section 5.2.2)	X		
Iron Gate Powerhouse Access Road	• Signage • Potential road surface maintenance during construction (Section 5.2.2) • Remove after construction is complete and restore area to native vegetation (Section 5.2.2)	X		X

Location	Improvements	Purpose		
		Construction Access	Post-Drawdown	Road Rehabilitation
Iron Gate Left Abutment Access Road	• Remove after construction is complete and restore area to native vegetation (Section 5.2.2)	X		
Iron Gate Upstream Left Abutment Access Road	• Remove after construction is complete and restore area to native vegetation (Section 5.2.2)	X		

7.4.1 Construction Access Improvements

KRRC proposes various improvements to provide adequate access and haul routes associated with project construction. These all require completion prior to the commencement of dam removals. Sections 5.2.2, 5.3.2, 5.4.2, and 5.5.2 provide a detailed discussion.

7.4.2 Ongoing and Post-Project Maintenance Activities

Some roads will require ongoing maintenance at various points throughout the Project or post-Project to maintain an acceptable road surface. See Table 7.4-1 for a list of the road segments where KRRC proposes pavement rehabilitation or road surface maintenance during or post-Project. Pavement rehabilitation is for asphalt concrete paved roads and includes overlay or localized pavement replacement. Road surface maintenance is for gravel and dirt roads and includes minor regrading and gravel placement.

KRRC's contractor will conduct a baseline and a post-project pavement condition assessment to the determine extent of maintenance required. KRRC's contractor will provide temporary traffic control on public roads during roadway surface maintenance, and this will involve one-way traffic control with flaggers and construction area signs.

7.4.3 Long Term Road Infrastructure Improvements

KRRC proposes some improvements to maintain existing roads in their pre-project condition. The proposed improvements will restore any reduction in functionality of road infrastructure caused by a reduction in flood protection or a reduction in embankment or culvert stability following the drawdown of the reservoirs and dam removal. The reservoir drawdown creates the potential for creek bed levels to readjust down to their pre-dam state. This will, in some areas, cause incision into fine sediments that have settled during the operation of the reservoirs. Where road infrastructure was constructed atop these sediments, the erosion of sediments from beneath or near road elements could result in damage or failure.

KRRC will complete the construction of improvements at various stages throughout the Project depending on the timeline for completion requirements, but many will require implementation prior to drawdown. The following sections summarize proposed permanent improvements to roads and bridges included in the Project.

Spencer Bridge (OR66/Green Springs Highway)

The Spencer Bridge left abutment embankment was constructed with highly pervious, strong basalt material, and it is expected that the embankment will remain stable during and following the drawdown of J.C. Boyle Reservoir, but some minor erosion of the riprap outer layer, not affecting stability, could occur. KRRC will inspect the embankment following the drawdown, and any damage to the riprap outer layer will be repaired. KRRC anticipates the restored Klamath River channel to locate between the 2nd and 3rd bridge bents, both of

which were constructed on bedrock. KRRC does not anticipate scour at the bents following dam removal. Temporary traffic control will be required during these improvements.

Timber Bridge

A timber bridge spans the Klamath River immediately downstream of J.C. Boyle Dam. KRRC's contractor will remove this structure after dam removal. KRRC does not propose traffic control as the bridge is not a public road.

Topsy Grade Road Culvert at Unnamed Creek

Topsy Grade Road crosses an unnamed creek, roughly 1,900 feet to the east of the J.C. Boyle Dam. The road is found on an embankment roughly 400 feet long with three 24-inch culverts draining a watershed of roughly 5 square miles. Reservoir sediment currently covers and obscures the culverts. The culverts may have been constructed prior to J.C Boyle Dam, and if so, they will likely not be impacted by reservoir sediment sloughing. However, the J.C. Boyle as-built drawings indicate that the culverts do not align with the original thalweg of the creek. KRRC's contractor will monitor this location during and following drawdown. If erosion of reservoir sediments affects this culvert, KRRC's contractor will install riprap armor on the downstream face of the embankment and remove sediment and debris from the culverts, if needed, to protect the road embankment. See Figure 5.1-1(C) for the limits of work associated with these improvements. KRRC's contractor will provide minor temporary traffic control during these improvements.

Unnamed Culvert at Unnamed Road (near J.C. Boyle Reservoir)

Approximately 0.9 mile north of OR66, off Keno Access Road, an unnamed road crosses an unnamed creek. The road is found on an embankment, with two 36–inch-diameter corrugated metal pipe (CMP) culverts allowing drainage of the creek. The culverts are well above the reservoir water level, so KRRC does not anticipate they are built on reservoir sediments. The upstream and downstream ends have silt build-up. KRRC's contractor will monitor this location during and following drawdown. If erosion of reservoir sediments affects this culvert, KRRC's contractor will place riprap armor on the downstream face of the embankment and remove sediment and debris from the culvert, if needed, to protect the road embankment. KRRC's contractor will provide minor temporary traffic control during these improvements.

Copco Road Bridge

Copco Road Bridge crosses Copco Lake immediately north of the junction of Copco Road and Ager Beswick Road. Section 5.3.2.2 includes additional information on the bridge. Both drawdown and post-project flows have the potential to cause erosion at the abutments or central pier. KRRC will further evaluate this during the detailed design phase, KRRC's contractor will provide erosion protection at the abutments or pier, if needed. KRRC's contractor will provide minor temporary traffic control during these improvements.

Copco Road Culvert at Raymond Gulch

A 60–inch-diameter CMP culvert pipe passes beneath Copco Road at Raymond Gulch adjacent to Copco Lake. The culvert is elevated well above the reservoir level, and KRRC does not expect that it is built on reservoir sediments. KRRC's contractor will monitor this location during and following drawdown. If erosion of reservoir sediments affects this culvert, KRRC's contractor will place riprap armor on the downstream face of the embankment. KRRC's contractor will provide minor temporary traffic control during these improvements.

Copco Road Culverts at Beaver Creek

60–inch-diameter CMP culvert pipes pass beneath Copco Road at both Beaver Creek and East Fork Beaver Creek adjacent to Copco Lake. Both pipes are elevated well above the reservoir water level, and KRRC does not expect that it is built on reservoir sediments. KRRC's contractor will monitor this location during and following drawdown. If erosion of reservoir sediments affects this culvert, KRRC's contractor will place riprap armor on the downstream face of the embankment. KRRC's contractor will provide minor temporary traffic control during these improvements.

Patricia Avenue Culverts at Unnamed Creek (Copco Lake)

Patricia Avenue passes over two unnamed creeks near Copco Lake and the Copco Lake Fire Department. Beneath each crossing is a 60–inch-diameter CMP culvert. The drainage culverts are elevated well above the reservoir water, and KRRC does not expect that it is built on reservoir sediments. KRRC's contractor will monitor this location during and following drawdown. If erosion of reservoir sediments affects this culvert, KRRC's contractor will place riprap armor on the downstream face of the embankment. KRRC's contractor will provide minor temporary traffic control during these improvements.

Jenny Creek Bridge

Jenny Creek Bridge crosses the mouth of Jenny Creek at Iron Gate Reservoir. Section 5.3.2.2 includes further details of the bridge. The abutments are built on material deposited after the dam construction and the dam removal may cause significant erosion that could possibly undermine the abutments. KRRC's contractor will construct a new bridge on the upstream side of the existing structure, on a modified alignment, to preclude damage to the structure after the drawdown (Figure 7.4-1).

The new bridge will be a multi-span bridge long enough to span over the creek sediments and/or reservoir deposited material and the design will found the bent supports on native soil or rock. The design will place the abutment supports for the replacement structure away from the area that is susceptible to reservoir sediment erosion. This approach will minimize realignment of the existing Copco Road and potential impacts to right of way. KRRC's contractor will build the new bridge 'offline' so the impact to traffic will be limited to the traffic switch from the existing road alignment to the new realigned road.

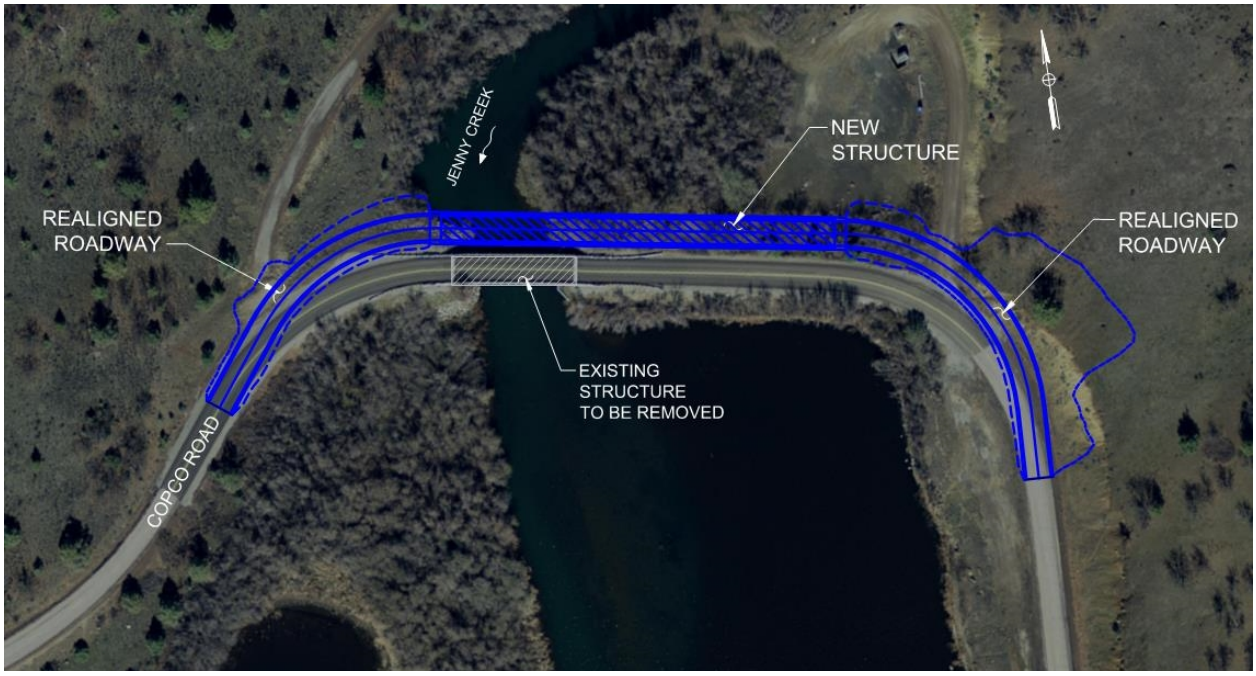

Figure 7.4-1 Copco Road Realignment and Jenny Creek Bridge Replacement

Copco Road Culverts at Camp Creek

A 10 foot diameter CMP arch culvert passes beneath Copco Road at Camp Creek adjacent Iron Gate Reservoir. KRRC anticipates erosion in this area following drawdown of the reservoir due to incision into reservoir sediments. Due to the difficulty in knowing exactly when the erosion will occur, KRRC will replace the culvert with a bridge, and provide suitable erosion protection to account for the potential drop in creek bed elevation, prior to drawdown. KRRC's contractor will construct a temporary structure and detour road just upstream of the culvert to maintain through-traffic during the work. Figure 7.4-2 shows a potential temporary detour alignment.

Copco Road Culvert at Scotch Creek

A 120–inch-diameter CMP culvert passes beneath Copco Road at Scotch Creek, adjacent to Iron Gate Reservoir. KRRC anticipates erosion in the vicinity of the culvert following drawdown of the reservoir due to incision into reservoir sediments. KRRC will replace the culvert, and provide suitable erosion protection to account for the potential drop in creek bed elevation, prior to drawdown. KRRC's contractor will construct a temporary structure and detour road just upstream of the culvert to maintain through-traffic during the work. Figure 7.4-3 shows a potential temporary detour alignment.

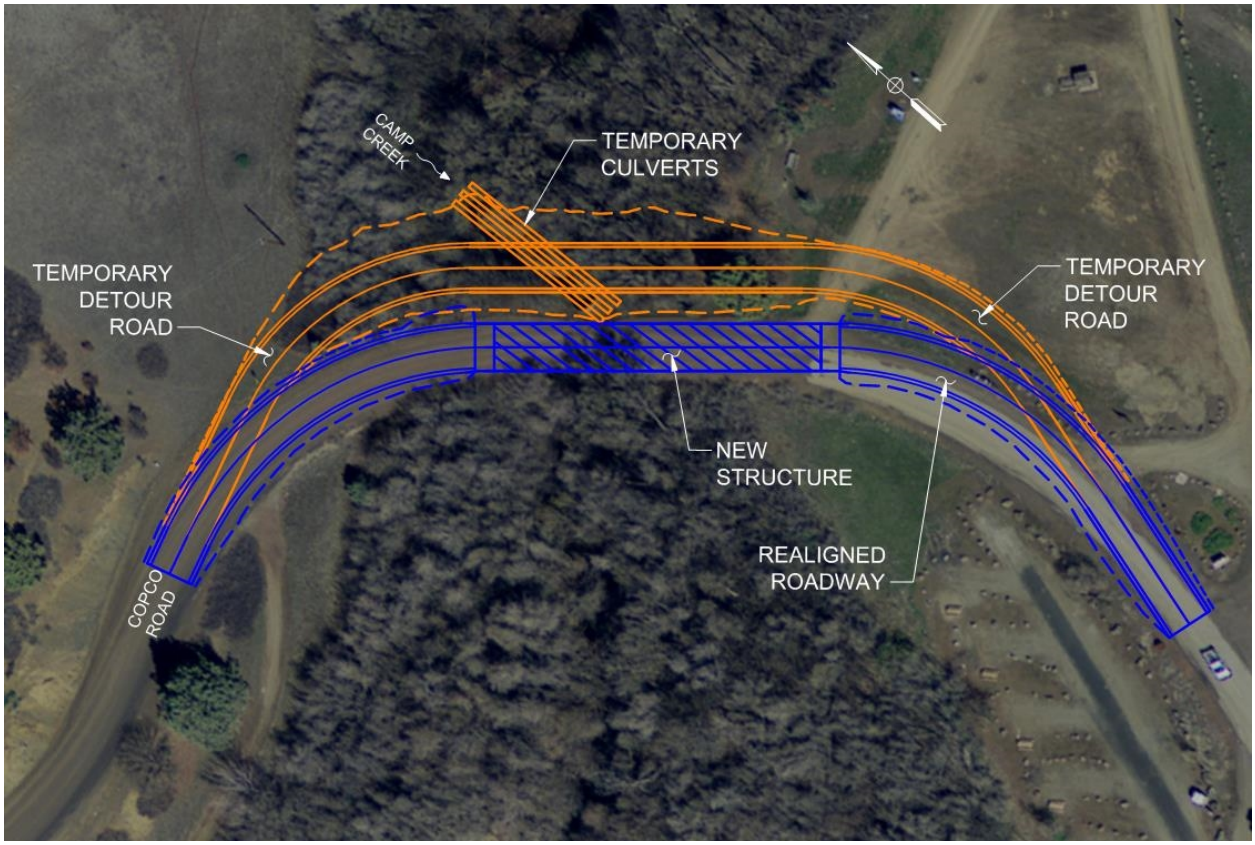

Figure 7.4-2 Temporary Culverts and Detour Road at Camp Creek

Copco Road Drainage Culverts between Brush Creek and Camp Creek

A number of culverts ranging in diameter from approximately 12–inch-to 18–inch-diameter pass beneath Copco Road between Brush Creek and Camp Creek. KRRC's contractor will monitor this location during and following drawdown. If erosion of reservoir sediments affects these culverts, KRRC's contractor will place riprap armor on the downstream faces of the embankments. KRRC's contractor will provide minor temporary traffic control during these improvements.

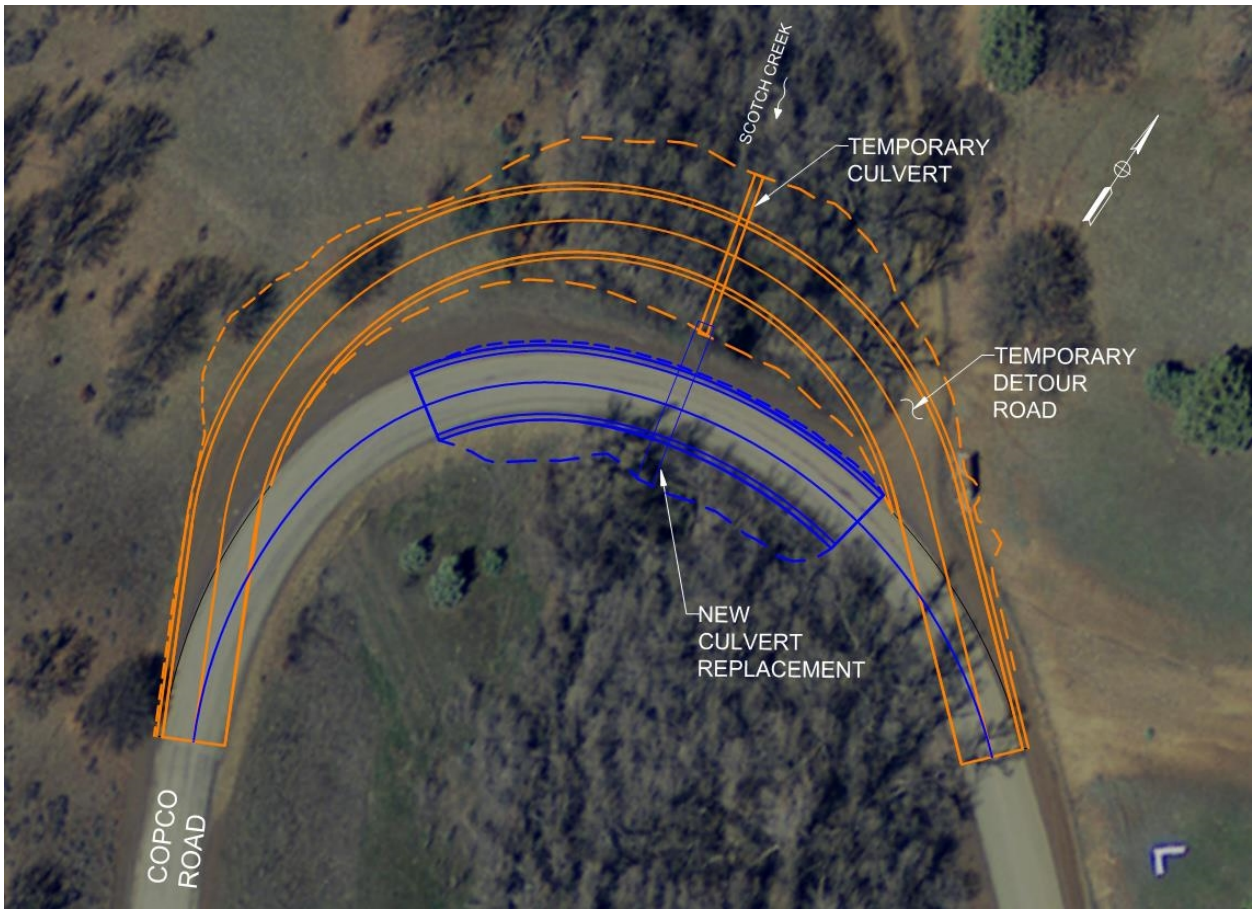

Figure 7.4-3 Temporary Culvert and Detour Road at Scotch Creek

7.5 Yreka Water Supply

This section describes the proposed improvements to the City of Yreka water supply the KRRC will perform as part of the Project. There are three options for the water supply pipeline, and the KRRC will select one for implementation in consultation with the City of Yreka. A 24-inch-diameter water supply pipeline for the City of Yreka, California, crosses the Klamath River near the upstream end of the reservoir impounded behind Iron Gate Dam. The 24-inch-diameter steel water supply pipeline crosses the Klamath River near the upstream end of Iron Gate Reservoir as shown on Figure 7.5-1 and is minimally buried in the reservoir bed. When KRRC's contractor removes Iron Gate Dam, high velocity river flows will expose the pipe, and it will likely sustain damage. During preparation of the Detailed Plan, USBR used a HEC-RAS model to estimate the hydraulic properties at the pipe crossing post-dam removal, and predicted scour ranged from 5 to 10 feet (USBR, 2012). KRRC will provide a replacement pipe crossing before dam removal and reservoir drawdown to ensure uninterrupted water supply for the City of Yreka.

The primary water intake for this water pipeline is at Dam A, located downstream of a PacifiCorp power plant near Fall Creek and diverts flow to a pumping station further downstream along Fall Creek. A secondary

intake at Dam B located on Fall Creek is used when the power plant is shut down and supplies water through a pipeline to the intake at Dam A. Based on the Detailed Plan (USBR, 2012), the existing flat panel fish screens for the water supply intakes at Dams A and B may not meet current regulatory agency screen criteria for anadromous fish. It appears that the fish screens have recently been updated, but their compliance with current regulatory agency screen criteria for anadromous fish still needs to be confirmed, and the screens will require updates, if found to be non-compliant.

7.5.1 Water Supply Pipeline

Existing Conditions

At the Klamath River crossing, the existing steel pipe is minimally buried in the reservoir bed. The published surface geology by USGS (Wagner and Saucedo 1987) on both sides of the Klamath River at the location of the existing Yreka Pipeline Crossing is mapped to be Western Cascade Volcanic (*Tv*) rock unit, predominantly Andesite with some basalt and dacite (Tv^a), Andesite and basalt intrusions and plugs (Ti^a) and Andesite tuff breccia (Tv^p) units. The as-built records of the existing pipeline (Piemme, Neill, and Bryan and Clair A. Hill Associates, 1968) indicate that the existing pipeline was constructed by directly laying the pipe on the then existing reservoir bed within a riprap berm. The static and static & surge hydraulic internal pressures at this location on the Klamath River are approximately 306 and 374 psi, respectively (Drawing GP-3, Piemme, Neill, and Bryan and Clair A. Hill Associates 1968).

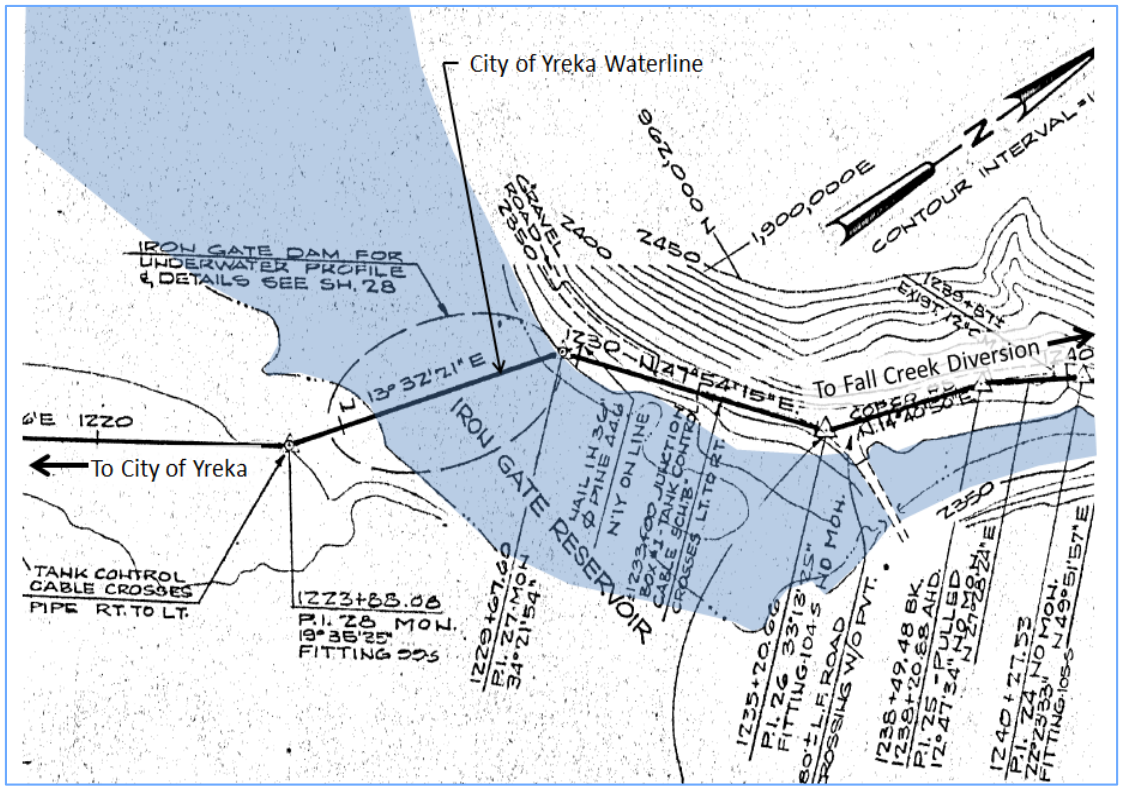

Figure 7.5-1 City of Yreka Pipeline Crossing

Proposed Modifications

Either KRRC or the City of Yreka will design the pipeline modifications, and either entity will construct the modifications, but KRRC will provide the funding.

KRRC has identified conceptual level buried and aerial relocation crossings of the pipeline across the Klamath River for feasibility and further evaluation. KRRC and City of Yreka desire the buried crossing should have adequate cover to compensate for the vertical scour during dam removal and the subsequent variations in the river flows and longitudinal profile. As the construction of the relocated crossing needs to happen prior to Iron Gate Dam removal, the cover over the pipe will likely have to exceed 12 feet. An open-cut construction approach would therefore, potentially require significant sediment and rock excavation under water and KRRC does not consider this a viable option. KRRC has identified three options for the reconstruction of the Klamath River crossing of the Yreka pipeline and are proposed as a range of potential actions to accomplish the objective of maintaining a pipeline to supply water to the City of Yreka. These potential actions are:

1. A new buried pipeline by micro-tunneling in the immediate vicinity of the existing waterline crossing
2. A new aerial pipeline on a dedicated utility pipe crossing in the immediate vicinity of the existing waterline crossing

3. A new buried pipeline and an aerial pipeline crossing on the existing timber traffic bridge along Daggett Road located approximately 2,000 feet upstream of the existing waterline crossing

Figure 7.5-2(C) shows the alignments for the three options, and detailed descriptions for each are presented below. KRRC will determine the preferred option in consultation with the City of Yreka.

Figure 7.5-2 Alignments for Klamath River Crossing (Appendix C)

Option 1 – Micro-tunneled Crossing

Option 1 consists of the installation of either a new 24-inch-diameter steel pipeline within a tunnel casing or a larger diameter carrier pipe constructed using a micro-tunnel construction approach. Figure 7.5-3 (C) shows the pipeline profile for this concept level alternative. The micro-tunnel will be approximately 550 feet long, at least 36-inch internal diameter, and will be at least 30 feet below the current bottom of Iron Gate Reservoir. The tunnel would be aligned parallel to, but offset approximately 25 feet downstream from the existing pipeline crossing to avoid damage to the existing pipe. The design would connect the new pipe to the existing pipeline on both the north and south sides of the Klamath River through new piping and fittings as shown in Figures 7.5-2(C) and 7.5-3(C). Based on the surface geology map and the rock outcrops observed at the site, portions of the entire micro-tunnel alignment will likely be through bedrock formations. Rock hardness and abrasiveness of the bedrock will have an impact on wear of cutting tools, which and type of the micro-tunnel equipment would impact the maximum drive length. Therefore, selection of the micro-tunnel diameter, type of the micro-tunnel equipment, and the actual elevation of the micro-tunnel crossing as well as the locations and depths of the driving and receiving shafts would depend on the subsurface profile and surface topography of the on-shore and off-shore ground surface. Based on the concept profile illustrated, the driving and receiving shafts would be approximately 58 feet and 56 feet deep, respectively.

Figure 7.5-3 Profiles for Klamath River Crossing (Appendix C)

To advance the final design, KRRC will complete a geotechnical subsurface investigation, topographic survey, and bathymetric survey of the site. Based on the subsurface investigation, KRRC will evaluate the location of the tunnel profile and selected to minimize the micro-tunneling installation risks and costs and to avoid or minimize and mitigate effects to cultural resources. Also, other types of trenchless approaches such as Direct Pipe, which is a hybrid method combining micro-tunneling and horizontal directional drilling (HDD) approaches, may become attractive alternatives with lower cost and/or risk. KRRC will complete on-shore borings at the proposed locations of the driving and receiving shafts and three off-shore borings to establish the subsurface profile along the tunnel alignment as part of the geotechnical explorations. These borings will extend to at least a depth 50 feet below the thalweg of the river (i.e., lowest elevation of the lake bed at the crossing location).

Option 2 – Aerial Crossing on New Utility Bridge

Option 2 is a prefabricated steel 7.5-foot-wide box truss bridge as was proposed in the Detailed Plan (USBR 2012b). This utility bridge would be just wide enough to accommodate the new 24-inch-diameter pipeline and an adjacent walkway for maintenance purposes. The height would provide a minimum of three feet of

freeboard above the eventual water surface for the 100-year flood in the river channel. KRRC selected three bridge spans, with a center span of 200 feet and end spans of 100 feet each to minimize the height of the two concrete support piers. Reinforced concrete abutments would support the two ends. This option includes founding the bridge abutments and piers upon drilled shafts backfilled with concrete.

This option would align the bridge parallel to, but offset from the existing pipeline to avoid damage to the existing pipeline during construction. Access into the river for bridge pier construction would be from clean, dumped gravel access pads placed in the river and extending from the banks. The gravel access pads would be removed after construction. Figures 7.5-2(C) and 7.5-3(C) show the proposed alignment and profile for Option 2, respectively.

If this option moves forward, as in Option 1, KRRC will complete a geotechnical subsurface investigation, topographic survey, and bathymetric survey of the site to advance the final design. The geotechnical explorations will include on-shore borings near the proposed locations of the bridge abutments and three off-shore borings near the proposed locations of the bridge support piers. These borings will extend to at least an elevation 50 feet below the thalweg of the river (i.e., lowest elevation of the lake bed at the crossing location).

Option 3 – Aerial Crossing on Daggett Road Bridge

Option 3 is construction of an aerial crossing using the existing timber traffic bridge along the Daggett Road located approximately 2,000 feet upstream of the existing waterline crossing as was proposed in the Detailed Plan (USBR 2012b). However, USBR did not evaluate the suitability of the existing timber bridge to house this 24-inch pipeline during the development of the Detailed Plan.

Option 3 would also require that the pipeline crosses Fall Creek. The existing Fall Creek culvert under the Daggett Road has very little cover; therefore, placing the pipeline crossing above the culvert within the road fill is not viable without significant regrade of Daggett Road. Installing the new pipeline below the existing culvert using either a trenchless construction approach or open-cut construction approach is possible. Figures 7.5-2(C) and 7.5-3(C) show the proposed alignment and profile for Option 3, respectively

Option 3 includes an approximate 300-foot-long aerial portion and an approximate 3,600-foot-long realigned buried pipe, and it will be installed using open-cut construction approach, including Fall Creek crossing. Option 3 adds significant length to the relocated pipeline alignment. KRRC will provide either a new bridge or temporary bridge at Daggett Road due to structural deficiency for construction access, and the new bridge design and construction could incorporate this new pipeline option in the design.

Connections to Existing Pipeline

In all three options, KRRC's or City of Yreka's contractor would connect the new pipeline to the existing buried pipeline at each end of the river crossing. The design may replace adequate additional length along the existing pipeline with welded steel pipe to provide sufficient length of restrained piping to resist any thrust forces arising from the bends. The contractor could install valves at each end to divert water from the old to the new pipe crossings. Making final connections and installing valves on the new pipe crossing would

involve a short water delivery outage. After completion of the new pipe crossing, the City of Yreka will operate the valves to divert flow from the old to the new pipe. The contractor may remove the old pipeline after reservoir drawdown.

Permissible Water Delivery Outage

A short water delivery outage will be required to make the final connections following construction of any of the new pipe crossings. Based on preliminary discussions with City of Yreka (Taylor, R., Personal Communications, August 15, 2017), the permissible outage period will be planned and limited to 12 hours and should preferably occur during the winter to avoid a disruption to the City of Yreka water supply. KRRC or City of Yreka will base the permissible outage period on the available storage capacity for Yreka, which should be able to meet demand for up to 60 hours in the winter and 18 hours in the summer, and up to an additional 27 hours with implementation of water rationing in the summer.

7.5.2 Water Supply Intake

Existing Conditions

The City of Yreka's water supply system diverts water from Fall Creek, a tributary to the Klamath River. The primary diversion, called Dam A, is located just downstream from the PacifiCorp Fall Creek powerhouse on a bypass reach from Fall Creek and consists of a low concrete dam with spillway notch and sluice gate. The dam provides head for diversion to a 24-inch-diameter supply pipe through a concrete headworks structure. The headworks structure has four 3-foot-wide bays. Removable fish screen panels screen up to three bays of the intake. Subsequent to the preparation of the Detailed Plan (USBR 2012b), the City of Yreka appears to have made some fish screen modifications, but their compliance to current regulatory agency screen criteria for anadromous fish needs to be determined. The bays at the headworks structure connect into a common channel leading to the gated supply pipeline. The City's water right and diversion capacity at the site is 15 cfs.

City of Yreka uses a secondary diversion point on Fall Creek whenever the power plant is shut down. This diversion, called Dam B, supplies water through a pipeline to bay 4 within the headworks structure at Dam A. A manually-operated slide gate is opened at Dam B to discharge water through the Dam B trash-racked intake and into the pipeline. A bulkhead is opened in bay 4 at Dam A so that water can flow into the dam forebay, then through the Dam A fish screens to the City of Yreka water supply pipeline. Electric power is not currently provided to Dam B.

Proposed Modifications

Either KRRC or the City of Yreka will design the fish screen modifications, and either entity will construct the modifications, but KRRC will provide the funding.

The existing screens for the water supply intakes at Dam A need to be evaluated to confirm that the current regulatory agency screen criteria from NMFS, USFWS, and CDFW, for anadromous fish are met. If the

existing fish screens are non-compliant, they will need to be updated. Dam B does not have a fish screen and is located about 100 feet downstream of the Fall Creek falls which are not passable by salmonids. Dam A is located in an artificially created bypass reach serving the powerhouse. Both streams feeding Dams A and B have little to no salmonid habitat. Ideally, both locations should be blocked to prevent anadromous fish migration into either of these reaches that contain limited viable habitat for redds or juveniles. If anadromous screens are required, the concepts presented in the Detailed Plan (USBR 2012b) for each intake will be used as described below.

The replacement fish screen at each dam location will consist of a cylindrical Tee screen having a diameter of 30 inches and a length of 128 inches. Each Tee screen will be sized for a design flow of 15 cfs. To meet the screen criteria, the Tee screen will provide an approach velocity not greater than 0.33 fps, and the screening cylinder at each end of the Tee will use stainless steel wedge or profile wire screen surfaces with 1.75-mm slot openings. Water flows through the screen cylinders, into the common screen header, and then into the intake bay. For cleaning, the cylinders rotate on their horizontal axis and are powered by internal geared propeller drives turned by water moving through the screen. Internal and external brushes remove trash from the screen surfaces as they rotate. The Tee screen is mounted onto a track frame and can be raised out of the water for maintenance and inspection using a battery-powered winch. During maintenance, a slide gate can be closed to stop flow from entering the intake or the flow can pass through the open slide gate and trash rack built into the screen track frame.

At Dam A, the contractor will remove the existing upstream slide gates/weirs and fish screen panels and seal bays 1, 2, and 4 by three steel bulkheads. The Tee screen will discharge through bay 3. The contractor will add a manually-operated 30- by 42-inch slide gate between bays 3 and 4 and opened when Dam B is used for diversions.

To install the Tee screen system for Dam A, the contractor will remove a small concrete deck over bay 3. KRRC assumes that all construction work at Dam A will be accomplished without the need for cofferdams. To accommodate the raising and lowering of the Tee screen, a new building enclosure will be required at Dam A with a roll-up door over the Tee screen. The contractor will demolish and replace the existing wood-frame building with a new 12- by 16-foot wood-frame building. The new building will have a second roll-up door on the opposite wall, similar to the existing building.

At Dam B, the contractor will modify the existing trash-racked intake to accommodate the cylindrical Tee screen system. The contractor will remove the existing trash racks and seal the bay with a steel bulkhead. The contractor will add an additional intake bay at the upstream end and cut a 2-footsquare opening through the upstream wall of the existing intake connecting the two bays. KRRC assumes that a cofferdam will be required in the stream at Dam B during construction, and that access improvements to the site will be required. The contractor will install the Tee screen and a 12-foot-long mounting track/frame at the new intake bay. The Tee screen would only be lowered into position when operation of the Dam B supply pipeline is required. A new fish screen at Dam B will require a new power line and drop connection.

7.6 Recreation Facilities Removal & Draft Plan

This section describes the proposed recreation facilities removal and the Draft Recreation Plan, which the KRRC will finalize in 2019 as part of the Project. PacifiCorp currently provides recreation facilities at J.C. Boyle Reservoir, Copco Lake, and Iron Gate Reservoir. There are no recreation facilities associated with Copco No. 2 Dam. The following descriptions are based on the information presented in the Detailed Plan (USBR 2012b) and are not anticipated to change significantly through detailed design. Confirmation of facility features and removal components will occur during the Project detailed design phase.

The Project includes the transfer of approximately 8,000 acres of real property located in Klamath County, Oregon and Siskiyou County, California to the respective states (or to a state designated third-party transferee) for public interest purposes such as fish and wildlife habitat restoration and enhancement, public education, and public recreational access. KRRC will accomplish these property transfers in accordance with the procedures set forth in Section 7.6.4 of the KHSA.

7.6.1 J.C. Boyle Reservoir

Developed recreation sites at J.C. Boyle Reservoir include campgrounds, day use areas, and boat launches (Figure 5.1-1(C)). The J.C. Boyle development also includes Spring Island boat access downstream of J.C. Boyle powerhouse (managed by BLM). The key elements of these recreation sites are summarized below, including a description of the recreation facilities available at these developed sites, and proposed removal requirements. Estimated annual use for 2014 was 15,500 recreation days for daytime visits and 1,700 recreation days for nighttime visits. Developed public recreation sites discussed in this section include the following:

- Pioneer Park (East and West units)
- Topsy Campground
- Spring Island River Access

Pioneer Park

Owned and managed by PacifiCorp, Pioneer Park consists of two separate day use areas on the western and eastern shoreline of J.C. Boyle Reservoir. Both sites have access from SR 66 and are located on each side (west and east) of the SR 66 Bridge over a narrow point of the reservoir.

Pioneer Park West has 12 picnic tables and 12 fire rings with grills. There are two portable toilets (one ADA-accessible), one trash receptacle, one trash dumpster, and informational signs at the site. The shoreline is used for fishing and an unimproved boat ramp is used primarily to launch car-top boats. The main access road into Pioneer Park West is 200 feet long and paved, but the undefined parking area is gravel and dirt and can accommodate approximately 25 vehicles without trailers.

Pioneer Park East has three interpretive signs with information regarding the Applegate Trail. The site had a concrete boat launch before the SR 66 bridge was replaced in 2005 by the Oregon Department of

Transportation (ODOT). A large stretch of gravel along the shoreline provides car-top boat launching and shoreline fishing opportunities. The access road to Pioneer Park East and the parking area are gravel. While undefined, the parking area can accommodate approximately 40 vehicles without trailers or 15 to 20 vehicles with trailers.

KRRC will remove all features, and the access roads and parking areas will regrade, seed, and plant the approximate 4.5-acre affected area as described in Section 6.2.

Topsy Campground

Owned and managed by BLM, Topsy Campground (or Recreation Site) is located on the southeastern shoreline of J.C. Boyle Reservoir and can be accessed via the Topsy Grade Road off of SR 66. The site consists of a campground, small day use area, and a boat launch. All roads within the campground are asphalt. User fees are collected by BLM at the site.

Topsy Campground has approximately 15 campsites, all of which have some degree of ADA-accessibility. All but two of the campsites have tent pads. Additionally, there are restroom facilities, an RV dump station, five water faucets, two drinking fountains, 14 trash receptacles, and one trash dumpster associated with the campground. These facilities are also shared by the day use and boat launch areas at the site. The small day use area provides two sites with a picnic table and grill, one of which is an ADA-accessible site. The boat launch has two concrete lanes, a concrete abutment, and a floating dock. There is also an ADA-accessible fishing pier with two benches. A paved parking area near the boat launch can accommodate three vehicles with trailers for day use parking.

KRRC will remove the boat launch, floating dock, and fishing pier, including approximately 68 cubic yards of concrete, and will regrade, seed, and plant the approximate 0.5-acre affected area as described in Section 6.2. BLM will retain the remainder of the campground for public use.

Spring Island River Access

Spring Island River Access is a Special Recreation Management Area owned and managed by BLM-Klamath Falls Field Office. It is a small riverside recreation day-use site located approximately 0.3 miles downstream of J.C. Boyle powerhouse at the upstream terminus of the Upper Klamath Wild and Scenic River section. The site has informational signage, paved parking and carry down boat launch, picnic tables, and vault toilets. It is the primary staging area for the Upper Klamath whitewater boating trip, a popular and well-known destination activity. It serves as a portal to the Upper Klamath WSR corridor, and is also used by visitors for fishing, wildlife viewing, and picnicking.

This site will be retained for public use.

7.6.2 Copco Lake

Developed recreation sites at Copco Lake include camping areas, day use areas, and boat launches (Figure 5.5-1(C)). The key elements of these recreation sites are summarized below, including a description of the recreation facilities available at these developed sites, and proposed removal requirements. Estimated annual use for 2014 was 3,300 recreation days for daytime visits and 0 recreation days for nighttime visits. Developed public recreation sites discussed in this section include the following:

- Mallard Cove
- Copco Cove

Mallard Cove

Located on the south shore of Copco Lake, off Ager-Beswick Road at Keaton Cove, Mallard Cove is owned and managed by PacifiCorp. The site consists of a day use/picnic area and a boat launch. While not an official campground, this site is also used for camping. The naturally wooded site has 8 wood-plank picnic tables, 12 cooking grills, and seven concrete fire rings or foundations. There is a toilet building with two vault toilets and two trash receptacles at the site. The boat launch has a 100-foot-long, 25-footwide single-lane concrete ramp. The site also has a 25-foot-long, 5-foot-wide dock made of composite decking and poly floats, with concrete abutment, located adjacent to the boat ramp, and a 20-foot-long, 5-foot-wide gangway with aluminum frame and pipe railing. There are six informational signs with concrete bases at the site. The access road and parking area are gravel. The parking area, while undefined, has eight concrete wheel-stops and parking for approximately 25 vehicles.

KRRC will remove all features, including approximately 106 cubic yards of concrete, and will regrade, seed, and plant the approximate 2.5-acre affected area as described in Section 6.2.

Copco Cove

Owned and managed by PacifiCorp, Copco Cove is located on the western shoreline of Copco Lake, off Copco Road. The site has a picnic area and a boat launch. While not an official campground, this site is also used for camping. The picnic area is naturally wooded and has two wood-plank picnic tables with one user-defined fire ring at each. The site has one portable toilet and one trash receptacle. The boat launch has an 80–foot-long, 25–foot-wide single-lane concrete ramp. While the boat ramp is in good condition, the approach is steep and maintaining a proper turning radius is difficult when there are other vehicles parked at the site. There is also a 14-foot-long, 5-foot-wide concrete boat dock adjacent to the boat ramp, with pipe railing. There are six informational signs with concrete bases at the site. The access road and parking area are gravel. There are approximately five spaces for vehicles in the undefined parking area.

KRRC will remove all features, including approximately 84 cubic yards of concrete, and will regrade, seed, and plant the approximate 2.3-acre affected area as described in Section 6.2.

7.6.3 Iron Gate Reservoir

Developed recreation sites at Iron Gate Reservoir include campgrounds, day use areas, and boat launches (Figure 5.5-1(C)). The key elements of these recreation sites are summarized below, including a description of the recreation facilities available at these developed sites, and proposed removal requirements. Estimated annual use for 2014 was 8,300 recreation days for daytime visits and 3,600 recreation days for nighttime visits. Developed public recreation sites discussed in this subsection include the following:

- Fall Creek (including Fall Creek Trail)
- Jenny Creek
- Wanaka Springs
- Camp Creek (including Dutch or Scotch Creek)
- Juniper Point
- Mirror Cove
- Overlook Point
- Long Gulch
- Iron Gate Fish Hatchery Public Use Areas

Fall Creek

Owned and managed by PacifiCorp, Fall Creek is located on the far northeast shore of Iron Gate Reservoir. The site is primarily a day use area, although some camping does occur. The site has two picnic tables, two cooking grills, two fire rings, and one user-defined fire ring. There is also one trash receptacle, an older single-vault toilet building (closed in 2002), and one portable toilet at the site. User-defined trails provide access to shoreline fishing opportunities. Parking at this site is undefined and generally occurs along the interior gravel road. Approximately eight vehicles could be accommodated at this site. A graveled boat launch is also provided. Large pine trees provide shade.

The recreation site at Fall Creek is located near the river channel and could be removed and restored or could be retained following the removal of Iron Gate Dam. A separate portion of the site is near the Fall Creek fish hatchery and provides access to the Fall Creek Trail, where visitors can hike up to Fall Creek Falls. The ultimate disposition of this facility is uncertain.

Jenny Creek

Located between Copco Road and Jenny Creek on the northern shoreline of Iron Gate Reservoir, Jenny Creek is owned and managed by PacifiCorp. The site provides primitive day use and camping opportunities. The site has six day-use/campsites, four of which are separated by boulders at the southern end of the parking area, while the remaining two are located along the shoreline of Jenny Creek. There are four steel frame/wood plank picnic tables and four user-defined fire rings at the site. Additionally, the site has two trash receptacles, a storage building, and a single-vault toilet building with a 25-foot-long wooden privacy screen. Several user-defined trails provide shoreline fishing access to Jenny Creek. There are two

informational signs with concrete bases at the site. The gravel parking area can accommodate approximately 20 vehicles.

There is also a large gravel parking area across from this site, on the shoreline of the reservoir that is used for shoreline fishing access. This parking area can accommodate about 12 vehicles, but is not considered to be part of the Jenny Creek recreation site.

The recreation site at Jenny Creek with adjoining parking area could be removed and restored or could be retained following the removal of Iron Gate Dam, as it provides a creekside setting for picnicking and bank fishing. However, the ultimate disposition of this facility is uncertain.

Wanaka Springs

Located on the north shore of Iron Gate Reservoir, Wanaka Springs is owned and managed by PacifiCorp. The naturally wooded site is used for day use and camping and consists of a small upper use area and a larger lower use area. The upper use area can be accessed by vehicle via a gravel road through the lower use area and has two wood-plank picnic tables, a concrete fire ring, a trash receptacle, and provides parking for about two vehicles. The lower use area has a large gravel parking area that can accommodate approximately 16 vehicles, three wood-plank picnic tables and one concrete picnic table, two concrete fire rings, a trash receptacle, two single-vault toilet buildings, and a portable toilet. A dirt pedestrian trail connects the upper and lower use areas and provides access to the vault toilets. Additionally, a dirt pedestrian trail provides access to a 25-foot-long, 5-foot-wide wooden dock with concrete pier and pipe railing, 15-foot-long gangplank, and a concrete walkway on the reservoir shoreline. There are three informational signs with concrete bases at the site.

KRRC will remove all features, including approximately 28 cubic yards of concrete, and will regrade, seed, and plant the approximate 4.5-acre affected area as described in Section 6.2.

Camp Creek

Camp Creek is located on Copco Road along the northern shoreline of Iron Gate Reservoir and is owned and managed by PacifiCorp. The site accommodates camping, day uses, and boat launching and is generally split into three use areas. The first use area is located on the shoreline and consists of developed campsites and a boat launch. The second use area is located across Copco Road from the first use area and is used as a day use area and for overflow camping and parking. The third use area is located on the shoreline to the northwest of the first use area and provides for day use activities, including ADA access to the shoreline, as well as overnight camping. There are seven informational signs with concrete bases at this site.

The first use area at Camp Creek has about 12 developed campsites each with a concrete picnic table, concrete fire ring, and a parking space. Three-foot boulders separate the campsites. There are two water faucets, a 10- by 16-foot concrete block well house, and six trash receptacles at this use area. There is also a boat launch with an 80-foot-long, 25-foot-wide single-lane concrete ramp, and a wooden walkway leading to a 25-footlong, 4-foot-wide boat dock with concrete abutment and piers, next to the boat ramp. The interior

access road is used for parking and can accommodate approximately six to eight vehicles. Additionally, there are two 20-foot-long, 5-foot-wide floating boat docks with composite decking and aluminum frames located to the north and south (on an existing jetty) of the boat launch, each with a 20-foot-long, 5-foot-wide gangplank with composite decking and aluminum frame rails. Each of these boat docks provides shoreline fishing opportunities.

The second use area at Camp Creek is located directly across Copco Road from the first use area. The site has three concrete picnic tables and two steel frame/wood plank picnic tables with concrete foundations, two timber shelters for shade, one concrete fire ring, and at least five user-defined fire rings. An RV dump station with estimated 2,000-gallon buried concrete tank, a 10- by 16-foot wood-frame double toilet building, a portable toilet, a trash receptacle, and a water faucet are located in this area and are shared facilities with the other use areas at Camp Creek. Overflow camping occurs at this site when the developed campsites in the first use area are full. Additionally, a large grassy area provides overflow parking for the first use area. There is space for approximately 60 vehicles in the overflow parking area. There is an interpretive display at this use area that provides a brief discussion of the Wilkes Expedition that stopped at this site in 1841.

The third use area at Camp Creek is located along the reservoir shoreline to the northwest of the first use area, and has been referred to as the "Scotch Creek" or "Dutch Creek" site. This area is small and has one steel pipe/wood plank picnic table and a concrete fire ring. There is a 50-foot-long, 4-foot-wide ADA-accessible concrete fishing pier with pipe railing, and a boat ramp for launching car-top boats at this use area. This site often receives use as a single campsite and is occasionally used as a group campsite.

KRRC will remove all features, including electric power lines on three poles and approximately 110 cubic yards of concrete, and will regrade, seed, and plant the approximate 4.5-acre affected area as described in Section 6.2. Additional earthwork includes the removal or regrading of an estimated 180-foot-long, 16-foot-wide, and 8-foot-high earth jetty, and the burial of approximately 75 boulders.

Juniper Point

Located on the northwestern shoreline of Iron Gate Reservoir, Juniper Point is owned and managed by PacifiCorp and provides approximately nine semi-primitive campsites. The camping area has eight steel frame/wood plank and wooden picnic tables, one concrete picnic table, fifteen concrete fire rings and foundations, two 4- by 4-foot concrete single-vault toilets (located across Copco Road from this site), and two trash receptacles. There is also an I-shaped boat dock at this site for shoreline fishing opportunities, which consists of a 25-foot-long concrete abutment, a 50-foot-long composite dock with poly floats and pipe railing, and a 20-foot-long composite gangplank with pipe railing. There are four informational signs with concrete bases at the site. The gravel access road into this site is very steep.

KRRC will remove all features, including approximately 19 cubic yards of concrete, and will regrade, seed, and plant the approximate 2.5-acre affected area as described in Section 6.2. Additional earthwork will include the removal or burial of approximately 50 boulders.

Mirror Cove

Mirror Cove, owned and managed by PacifiCorp, is located on the western shoreline of Iron Gate Reservoir. The site has a camping area and a boat launch. The camping area has ten campsites, with 12 concrete fire rings and eight picnic tables, accessible by gravel road. This site has one 10- by 16-foot vault toilet building with concrete steps located across Copco Road, a portable toilet in the parking area, and four trash receptacles. The boat launch at Mirror Cove has an 80-foot-long, 25-foot-wide concrete ramp with two lanes. Two 30-foot-long, 5-foot-wide composite gangplanks with aluminum frames and pipe railing lead to a 30-foot-long concrete boat dock and abutment with pipe railing adjacent to the boat ramp. There are seven informational signs with concrete bases at the site. The gravel parking area at this site can accommodate approximately 20 vehicles.

KRRC will remove all features, including approximately 89 cubic yards of concrete, and will regrade, seed, and plant the approximate 3.0-acre affected area as described in Section 6.2. Additional earthwork will include the removal or burial of approximately 120 boulders.

Overlook Point

Overlook Point, owned and managed by PacifiCorp, is located on the western shoreline of Iron Gate Reservoir. The site has one concrete picnic table and one steel frame/wood plank picnic table. There are also one portable toilet and two trash receptacles at this site. An 800foot-long, steep gravel road provides access to the site. Parking at this site is undefined, but can generally accommodate approximately six vehicles.

KRRC will remove all features, and will regrade, seed, and plant the approximate 2.0-acre affected area as described in Section 6.2.

Long Gulch

Long Gulch, owned and managed by PacifiCorp, is located on the southern shoreline of Iron Gate Reservoir. The site has a picnic area that is occasionally used for camping and a boat launch. The picnic area has two steel frame/wood plank picnic tables and two user-defined fire rings. The boat launch has an 80-foot-long, 25-foot-wide two-lane concrete ramp. The site has one portable toilet and two trash receptacles. The undefined gravel parking area at this site can accommodate approximately 16 vehicles.

KRRC will remove all features, including approximately 25 cubic yards of concrete, and will regrade, seed, and plant the approximate 1.0-acre affected area as described in Section 6.2.

Iron Gate Hatchery Public Use Areas

The Iron Gate fish hatchery is located downstream of Iron Gate Dam and is owned by PacifiCorp and operated by CDFW, with PacifiCorp currently providing funding for 100 percent of the fish hatchery's annual operating expenses. A public day use area is provided adjacent to the fish hatchery and an undeveloped boat launch is located across the river from the hatchery. Fishing is prohibited in this area and to 3,500 feet

downstream of the dam. The day use area has a covered picnic shelter, six picnic tables, three trash receptacles, a small visitor center/interpretive kiosk (providing information on dam construction, salmon, and regional wildlife), two flush toilets in restrooms, and an ADA-accessible trail to the river shoreline (near Bogus Creek). A gravel parking area provides spaces for approximately 20 vehicles. The undeveloped boat launch is used primarily to launch car-top boats (hand launch); however, the launch does receive some boat trailer use. The gravel shoulder along Copco Road provides undefined parking for the boat launch.

KRRC will not remove these recreation facilities.

7.6.4 Dispersed Recreation Sites in the Study Area

In addition to the developed recreation facilities in the study area, the undeveloped reservoir shorelines provide numerous dispersed recreational use opportunities, both for land-based and water-based activities. Many visitors and local residents use the reservoir shorelines for dispersed activities such as boating, fishing, swimming, sunbathing, and camping. Twenty-seven dispersed recreation sites or use areas on or adjacent to the reservoir or river shorelines were identified during a field inventory conducted in 2004. The majority (17) of dispersed sites were identified at J.C. Boyle Reservoir, while two were located at Copco Lake, and four were located at Iron Gate Reservoir. Many of the identified dispersed sites are located along roads on or near the reservoir shoreline, and appear to have been used for camping and day use activities, although camping is specifically prohibited at a few of the sites. Fires are limited seasonally at most dispersed sites in the study area. These sites do not have developed facilities such as picnic tables, grills, or boat launches. KRRC will not disturb or modify the dispersed recreational sites.

7.6.5 Draft Recreation Plan

The Draft Recreation Plan provided in Appendix Q identifies the types of recreation opportunities and facilities consistent with pre-hydropower development conditions that KRRC will develop to achieve the goals of the plan. The Draft Recreation Plan also describes the process envisioned by KRRC to evaluate these opportunities and identify the proposed facilities that will ultimately be recommended for implementation in the Final Recreation Plan.

Based on the anticipated removal of reservoir recreation sites and reduced whitewater rafting use under the Project, KRRC has identified the need to implement, in the Klamath River Basin, recreation facility upgrades and/or new facility developments to provide, at minimum, the types of facilities that are proposed in this Draft Recreation Plan. KRRC configured these proposed opportunities to offset the anticipated effects on recreation access associated with dam and associated reservoir removal.

Proposed Recreation Facilities

KRRC has identified two types of recreation access facilities that if developed will offset recreation access that will be eliminated by implementation of the Project – whitewater boat put-in/take-out sites and fishing access sites. KRRC also intends to collect input from stakeholders on new recreation opportunities beyond the new and upgraded access sites identified in this draft plan.

KRRC will develop these river access sites for whitewater boating to include at a minimum:

- An area near or along the adjacent roadway for the parking of trucks with trailers used to transport whitewater rafts, large passenger vans and buses for transporting commercial whitewater rafters,
- If necessary, an access road between any new parking areas and the adjacent existing roadway, and
- If necessary, developed paths from the area designated for parking to the river edge wide enough to support the portage of rafts.

KRRC will develop these river access sites for fishing to include at a minimum:

- An area near or on a road shoulder for the parking of personal vehicles,
- If necessary, an access road between any new parking areas and the adjacent existing roadway, and
- If necessary, developed trails from the area designated for parking to the river edge.

KRRC intends to continue to collect input on other recreation facilities in the Klamath River Basin from stakeholders that could be developed in addition to or potentially in place of the facilities identified for implementation in this draft plan to offset impacts on reservoir recreation and whitewater recreation access in the Hell's Corner Reach associated with implementation of the Project.

7.7 Downstream Flood Control Improvements

This section describes KRRC's proposed flood control improvements.

7.7.1 Habitable Structures

USBR developed a preliminary 100-year floodplain map from Iron Gate Dam to Happy Camp for both the current conditions (i.e. existing conditions with dams) and for the with-project conditions (i.e. altered conditions without dams). USBR calculated reach-averaged changes in water surface elevation (WSE) and depth between the with-project conditions and current conditions as indicated in Table 7.7-1 below, based on estimates of sediment deposition.

KRRC has categorized structures in the affected area below Iron Gate Dam as follows:

1. Within the preliminary 100-year floodplain for current conditions with dams, as determined by USBR
2. Within the preliminary altered 100-year floodplain without dams, as determined by USBR

The structures and their appropriate categories were field checked and some of the structures were re-classified. KRRC only categorized the structures in the reaches between Iron Gate Dam (RM 193.1) and Humbug Creek (RM 174.0). This is because the tributaries below Iron Gate increasingly dominate the flood

discharges as one travels downstream from Iron Gate, and the impact of dam removal on the 100-year flood is less than 0.5 foot[23] below Humbug Creek.

Table 7.7-1 Changes in River Stage with Dam Removal

River Reach	Average WSE Change (feet)
Iron Gate to Bogus Creek	1.65
Bogus Creek to Willow Creek	1.51
Willow Creek to Cottonwood Creek	0.90
Cottonwood Creek to Shasta River	0.72
Shasta River to Humbug Creek	0.58
Humbug Creek to Beaver Creek	0.45
Beaver Creek to Dona Creek	0.41
Dona Creek to Horse Creek	0.43
Horse Creek to Scott River	0.36
Scott River to Indian Creek	0.28
Indian Creek to Elk Creek	0.32
Elk Creek to Clear Creek	0.34

A total of 34 habitable structures are located within the preliminary 100-year floodplain for current conditions between Iron Gate Dam and Humbug Creek.[24] These 34 structures will be subject to an increased risk of flooding following dam removal when compared to existing flood elevations. An estimated 2 additional habitable structures would be subject to flooding during a 100-year event following dam removal when compared to the existing floodplain (see Figure 7.7-1). A total of 36 habitable structures would be located within the preliminary altered 100-year floodplain between Iron Gate Dam and Humbug Creek following dam removal. KRRC will work with the owners of these structures to move or elevate legally established structures, where feasible. FEMA will make the final determination of the future 100-year floodplain after dam removal, and the KRRC is coordinating with FEMA to initiate the map revision process.

Figure 7.7-1 Structures in 100-Year Floodplain Following Dam Removal (Appendix C)

7.7.2 River Crossings

An estimated three river crossings in the downstream reach between Iron Gate Dam and Humbug Creek could also be affected by the increase in flood depths: two pedestrian bridges and the Central Oregon and Pacific Railroad Bridge. Both pedestrian bridges are below the existing 100-year flood elevation, and there is

[23] FEMA, the agency that will determine the future floodplain extent, does not recognize changes in flood elevations less than 1 foot. Utilizing a 6-inch change in flood elevation is a conservative approach to determining which structures are affected.
[24] Note that the current FEMA mapped floodplain Zone A (effective 1/19/2011) is different from the floodplain modeled by Reclamation because the FEMA mapping was not prepared based on a detailed hydraulic study of the river.

a potential increase in scour depth at the railroad bridge. Pedestrian Bridge #1 is dilapidated and is not structurally safe. Pedestrian Bridge #2 and the railroad bridge are in good condition. KRRC proposes to remove Pedestrian Bridge #1, with the owners' permission. KRRC proposes to consult with the owner of Pedestrian Bridge #2 during the detailed design phase to determine whether this bridge should be removed or replaced, at KRRC's expense. KRRC proposes to perform more analysis to confirm the effects of scour on the railroad bridge. The following sections provide additional information on these proposals.

Pedestrian Bridge #1

Pedestrian Bridge #1 spans the Klamath River just upstream of the confluence with Cedar Gulch. The bridge is a cable suspension structure of unknown origin, with no connection to any approach roads. The bridge is in very poor condition. The bottom chord of the bridge is not high enough to pass neither the existing nor the anticipated 100-year flood following the removal of the dams. KRRC proposes to remove Pedestrian Bridge #1, with the owner's permission.



Figure 7.7-2 Pedestrian Bridge #1

Pedestrian Bridge #2

Pedestrian Bridge #2 is a cable suspension bridge that spans the Klamath River next to the Klamath River County Estates (KRCE). The structure is on the KRCE Campground private property on the north bank of the river. KRRC understands the structure was built by the previous owners of the campground and is maintained by the campground. The structure is in good condition and appears to be well maintained.

The bottom chord of the bridge is not high enough to pass the existing 100 year flood with any freeboard or the anticipated 100 year flood after the removal of the dams. KRRC will evaluate the structure during the detailed design phase. KRRC proposes to consult with the owner of Pedestrian Bridge #2 during the detailed design phase to determine whether this bridge should be removed or replaced, at KRRC's expense.



Figure 7.7-3 Pedestrian Bridge #2

Central Oregon and Pacific Railroad (CORP) Bridge

The CORP Railroad Bridge is a 7-span ballasted concrete bridge that spans the Klamath River between the Ager Road Bridge and Cottonwood Creek. The structure is supported on stone masonry seat type abutments and the bents are composed of steel H-pile extensions with reinforced concrete caps. No information is available regarding foundation type.

The Detailed Plan estimated the Project will result in approximately 1.2 feet of scour at the bridge. KRRC anticipates this is unlikely to affect the structural integrity of the bridge; however, KRRC will perform a more detailed assessment at detailed design to confirm this, and KRRC will make any needed improvements.



Figure 7.7-4 Rail Road Bridge

7.8 Fish Hatchery Plan

The existing Iron Gate fish hatchery (IGH) facilities are part of the Lower Klamath Project, and is operated by CDFW. KRRC proposes modifications or improvements to infrastructure and operation to the IGH facility as part of the hatchery plan for the Project. KRRC's obligations with respect to IGH and Fall Creek Hatchery (FCH), and those of PacifiCorp and other parties to the KHSA, are summarized as follows:

- The IGH facilities shall be transferred to the State of California at the time of transfer to the DRE of the Iron Gate Hydro Development or such other time agreed by the Parties, and thereafter operated by the CDFW with funding from PacifiCorp.

- PacifiCorp will fund 100 percent of hatchery operations and maintenance necessary to fulfill annual mitigation goals developed by the CDFW in consultation with NMFS. This includes funding the IGH

facility as well as funding of other hatcheries necessary (e.g. FCH) to meet ongoing mitigation goals following facilities removal.

- Funding will be provided for hatchery operations to meet mitigation requirements and will continue for eight years following the decommissioning of Iron Gate Dam.
- PacifiCorp will fund a study to evaluate hatchery production options that do not rely on the current IGH water supply.
- Based on the study results and with the approval of the CDFW and NMFS, PacifiCorp will provide one-time funding to construct and implement the measures identified as necessary to continue to meet agency-developed mitigation production objectives for a period of eight years following the decommissioning of Iron Gate Dam.

The KHSA establishes a framework to allow for CDFW's continued hatchery operations at a level determined by NMFS and CDFW to be sufficient for purposes of implementation of the Definite Plan. The KHSA also establishes a source of funding that is needed to achieve this objective. KRRC's role in accomplishing these objectives is to cooperate and facilitate the transfer of the IGH (and any improvement to be made to IGH or other hatcheries necessary to meet ongoing mitigation objectives) to CDFW, and to cooperate with CDFW in its implementation of the Definite Plan so as to facilitate ongoing hatchery operations for a period of eight years following the removal of Iron Gate Dam.

7.8.1 Existing IGH Facility and Operations

IGH was constructed in 1962 to mitigate for lost anadromous salmonid spawning and rearing habitat between Copco No. 2 Dam and Iron Gate Dam. The historic mitigation goals include a release of 6,000,000 Chinook salmon (5,100,000 fingerlings and 900,000 yearlings), 75,000 Coho salmon yearlings, and 200,000 steelhead trout yearlings, annually. The Southern Oregon Northern California Coast (SONCC) Coho salmon Evolutionarily Significant Unit (ESU), which includes Coho salmon produced at IGH, is listed as threatened under the California Endangered Species Act (CESA) and the federal Endangered Species Act (ESA). A Hatchery and Genetics Management Plan (HGMP) and Section 10(a)(1)(A) Enhancement of Survival Permit was issued to the CDFW in 2014 for the IGH Coho salmon artificial propagation program (Section 10(a)(1)(A) Permit 15755). Under the HGMP, the purpose of the Coho salmon program is to aid in the conservation and recovery of the Upper Klamath Population Unit of the SONCC Coho salmon ESU by conserving genetic resources and reducing short-term extinction risks prior to future restoration of fish passage above Iron Gate Dam. Adult steelhead returns declined dramatically during the 1990's for unknown reasons and IGH has produced no steelhead since 2012. Chinook returns continue to be variable but generally sufficient broodstock return to IGH to produce the mitigation goals.

The IGH spawning/trapping facility is located approximately ½ mile downstream of Iron Gate Dam, adjacent to the Bogus Creek tributary. The main hatchery complex includes an office, incubator building, rearing/raceway ponds, fish ladder with trap, settling ponds, visitor information center, and four employee residences (see Figure 7.8-1). The collection facility is located at Iron Gate dam and includes a fish ladder

consisting of 20 ten-foot weir-pools that terminates in a trap, a spawning building and six 30-foot circular holding ponds.

The IGH operates with a gravity fed, flow-through system that has five discharge points into the Klamath River. The IGH obtains its water supply from Iron Gate Reservoir. Two subsurface influent points at a depth of seventeen feet and seventy feet deliver water to IGH. Up to 50 cfs is diverted from the Iron Gate Reservoir to supply the 32 raceways and fish ladder.

The existing spawning facility discharges through the main ladder, and steelhead return line. An overflow line drains excess water from the aeration tower. The hatchery facility also has a discharge at the tail race that supplies the auxiliary ladder or fish discharge pipe, and two flow-through settling ponds for hatchery effluent treatment which converge to a single discharge point.

CDFW operates IGH. Per the license, PacifiCorp must fund at least 80 percent of operations and maintenance costs, but PacifiCorp currently funds 100 percent of those costs pursuant to the KHSA.

KRRC will demolish the existing fish collection facility located at the toe of Iron Gate Dam as part of the Project.

Due to the reservoir drawdown and dam removal, the existing water supply intake will become unusable, as its elevation will be above the water level post-draw down and high suspended sediment concentrations during drawdown. KRRC's contractor will demolish the water supply intake and associated infrastructure along with the dam and hydropower developments. These existing functions will be replaced by the reopening and operation of the Fall Creek Hatchery (FCH) by CDFW and by making improvements to IGH. The cost of these improvements will be borne by PacifiCorp, to the extent of its funding obligations under the KHSA.



Figure 7.8-1 Iron Gate Hatchery

7.8.2 Existing Fall Creek Hatchery

California Oregon Power Company built the FCH in 1919 as compensation for lost of spawning grounds due to the construction of Copco No. 1 Dam. Six of the original rearing ponds remain (two above Copco Road and four below the road). CDFW last used these ponds from 1979 through 2003 to raise 180,000 Chinook salmon yearlings, which they released into the Klamath River at Iron Gate Hatchery. Although the raceways remain and CDFW continues to run water through them, they have not produced fish since 2003 when CDFW moved all mitigation fish production to IGH. The facility has retained its water rights but will need substantial renovation to become operational.

7.8.3 Proposed Fish Hatchery Plan

NMFS and CDFW have determined the priorities for the proposed Fish Hatchery Plan. As a state and federally listed species in the Klamath River, coho production is the highest priority for NMFS and CDFW, followed by Chinook salmon, which support tribal, sport, and commercial fisheries. Steelhead production is the lowest priority. Due to limited available water and rearing capacity to meet Chinook yearling mitigation goals, and recent low steelhead returns, NMFS and CDFW have determined that steelhead production will be discontinued.

NMFS and CDFW have recommended and KRRC proposes a Fish Hatchery Plan a plan for hatchery operations for the 8-year period following dam removal. In order to implement this plan, IGH and FCH must be operational prior to drawdown of the Iron Gate Reservoir. The Fish Hatchery Plan will be implemented in a manner that is consistent with the North Coast Regional Water Quality Control Board (RWQCB) "Policy in Support of Restoration in the North Coast Region." The plan also requires CDFW to employ Best Management Practices to minimize discharge at IGH and FCH during hatchery operations.

Table 7.8-1 summarizes the NMFS/CDFW goals for fish production at IGH and FCH.

Table 7.8-1 Comparison of Previous Mitigation Goals and Revised NMFS/CDFW Production Recommendation

Species/Life Stage	1960's Mitigation Goal (at IGH)	Production Goal Post-Dam Removal	Release Dates
Coho Yearlings	75,000	75,000 at FCH	March 15 – May 1
Chinook Yearlings	900,000	115,000 at FCH	Oct 15 – Nov 20
Chinook Smolts	5,100,000	3,400,000 at IGH	April 1 – May 31
Steelhead	200,000	0	NA

Source: NOAA Fisheries and CDFW Technical Staff Recommendation for Klamath River Hatchery Operations in California Post-Dam Removal, May 31, 2018.

Improvements at IGH

PacifiCorp will transfer IGH to CDFW with funding provided by PacifiCorp under terms of the KHSA section 7.6.6 and 7.6.6 A. CDFW will continue to operate IGH. CDFW will retain operational components of IGH. To the extent necessary to maximize use of available water supplies, CDFW will implement water use efficiency improvements such as water aeration as it enters the pond headboxes, mid-raceway water aeration and water reuse. IGH will utilize a riparian water right and divert water from Bogus Creek to operate the hatchery incubation building, two 300-foot adult holding ponds configured from two existing raceways, three 400-foot raceways, and the auxiliary fish ladder and trap. IGH will use between 3.75 to 8.75 cfs from October through May (see Table 7.8-2) to rear a targeted goal of 3.4 million Chinook smolts for release in April through May of each year. Adult Coho salmon and Chinook salmon broodstock will be collected by CDFW using the existing auxiliary ladder and held at IGH in the adult trap and holding ponds. The Chinook salmon program will use a maximum of 4,000 adult Chinook broodstock fish to meet the production goals. The Coho salmon program will use a maximum of 270 adult broodstock fish to meet the conservation goals identified in the HGMP and Section 10(a)(1)(A) Permit 15755. A new spawning facility will be constructed at PacifiCorp expense that utilizes, to the extent possible, components of the spawning facility at Iron Gate Dam.

Table 7.8-2 Estimated Water Needs at IGH rearing 3.4 million Chinook smolts (cfs)

Facility	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Rearing Ponds	2.25	2.25	2.25	6.75	6.75	0.00	0.00	0.00	0.00	0.00	0.00	2.25
Hatchery Building	1.50	1.50	1.50	1.50	1.50	0.00	0.00	0.00	0.00	1.50	1.50	1.50
Spawning	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50
Adult Holding & Ladder	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.50	4.50	4.50
Total	**3.75**	**3.75**	**3.75**	**8.25**	**8.25**	**0.00**	**0.00**	**0.00**	**0.00**	**6.50**	**6.50**	**8.75**

Source: NOAA Fisheries and CDFW Technical Staff Recommendation for Klamath River Hatchery Operations in California Post-Dam Removal, May 31, 2018.

Water Needs

As shown in Table 7.8-2, the maximum amount of Bogus Creek water necessary to meet IGH needs is 8.75 cfs in December and 8.25 cfs in April and May. In April and May, the IGH hatchery incubation building requires 1.5 cfs of water for Coho egg incubation and fry rearing. The three raceways will need up to 2.25 cfs each (6.75 cfs total). The adult trap and two raceway holding ponds will need 2.25 cfs each (4.50 cfs total) during October, November, and December. Because anadromous salmonids currently use Bogus Creek as a natural spawning area, the water supply from Bogus Creek will need to be filtered and treated with ultra violet (UV) light to reduce the potential threat of disease introduction into the hatchery. Figure 7.8-2 shows the potential footprint options for the treatment system.

To reduce the potential adverse effects of diverting water from Bogus Creek on naturally produced Coho salmon, the pump station for the hatchery water supply will be constructed as far downstream towards the Klamath River confluence as practicable. This will reduce the length of Bogus Creek rearing habitat affected by water withdrawals downstream of the pump station. Figure 7.8-2 shows an envelope for the potential pump station location on Bogus Creek system.

Water availability

CDFW will operate the Bogus Creek water diversion to maintain a minimum of 50% of the instream flow in the creek at the point of diversion. Table 7.8-3 includes a summary of Bogus Creek flows based on available monitoring data from August 2013 to April 2018. This limited data set indicates that there are four months where hatchery water needs could exceed 50 percent of instream flow (October, November, April, and May). The Fish Hatchery Plan includes measures (discussed below) that will be implemented by CDFW to address these shortages, if they occur. Tables 7.8-4 through 7.8-7 further separate the first and second half of each of these four months and compare the maximum, minimum, and average Bogus Creek flows to IGH flow requirements. Cells highlighted in grey indicate time periods when flows are insufficient to meet total hatchery demand and maintain minimum (50 percent) creek flow. Flow deficient periods over the 2013-2018 data set include:

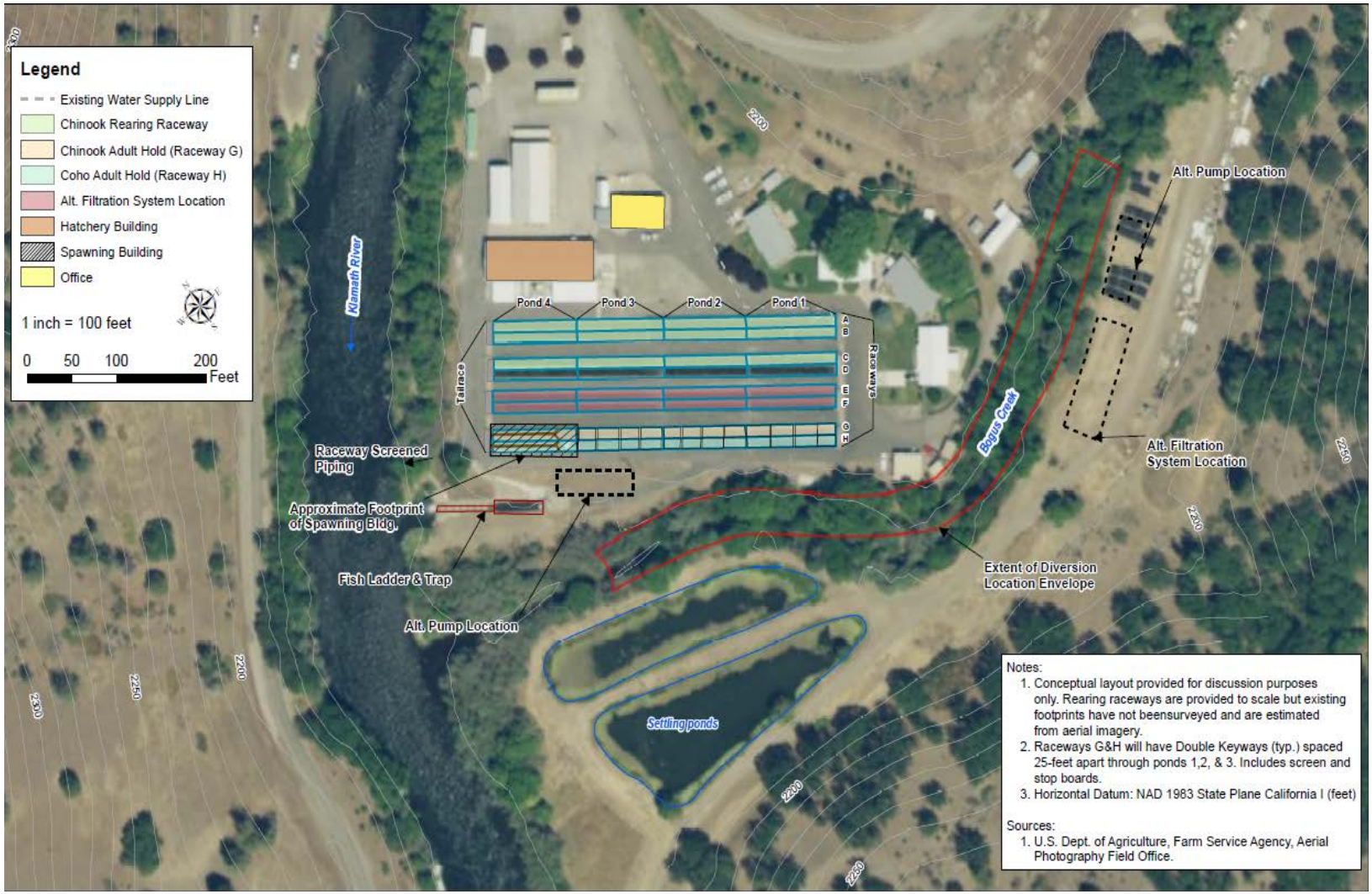

Figure 7.8-2 Conceptual Layout of Iron Gate Hatchery Improvements

- In April 2014, minimum and average Bogus Creek flows fall below the hatchery requirement for both the first and second halves of the month. In 2015 the minimum flow rate for the first half of the month falls below the hatchery requirement and the minimum and average flows fall below the requirement for the second half of the month.
- In May, minimum hatchery flows were not available in all years for the first half of the month and maximum, minimum, and average flows were insufficient in 2014 and 2015. In the second half of the May 2014, the maximum, minimum, and average creek flows are insufficient to meet hatchery requirements while maintaining 50 percent creek flow.
- In October, the first half of the month creek flows are insufficient to meet hatchery requirements for all four years and average flows do not meet the requirement in 2014 and 2016. In the second half of October, minimum and maximum flows in 2014 do not meet hatchery requirements.
- In November, the first half of the month shows that the 2013 minimum and average flows and the 2014 minimum flow did not meet hatchery requirements. In the second half of November, minimum flows were insufficient to meet hatchery requirements in 2013 and 2014.

Table 7.8-3 Observed minimum, maximum, and 4-year average flow in cfs by month in Bogus Creek from 8/8/2013 to 4/16/2018

Flow	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Minimum	12.14	13.90	17.35	8.23	7.20	3.57	2.19	1.77	1.78	7.40	10.96	14.89
Maximum	253.2	184.9	144.3	80.94	48.85	28.99	11.53	11.49	28.00	52.10	32.94	288.6
4-year Average	**32.92**	**39.26**	**37.30**	**28.97**	**18.92**	**9.94**	**5.46**	**5.72**	**8.98**	**16.99**	**20.80**	**27.79**

Note: Minimum and maximum values represent the absolute minimum and maximum values observed in each month.
Source: NOAA Fisheries and CDFW Technical Staff Recommendation for Klamath River Hatchery Operations in California Post-Dam Removal, May 31, 2018.

Table 7.8-4 April Juvenile Rearing Water Availability and Requirements

Year	1st Half April						2nd Half April						IGH Req (cfs)
	Total Flow (cfs)			50% of Flow (cfs)			Total Flow (cfs)			50% of Flow (cfs)			
	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	
2013	NA	NA	NA	NA	NA	NA	NA	NA	0.00	NA	NA	NA	8.25
2014	18.61	9.77	16.01	9.30	4.89	8.01	19.56	8.23	13.31	9.78	4.12	6.65	
2015	22.53	13.64	19.42	11.27	6.82	9.71	18.58	11.31	14.80	9.29	5.65	7.40	
2016	42.95	32.77	36.45	21.48	16.39	18.23	36.52	23.94	30.66	18.26	11.97	15.33	
2017	80.94	42.73	49.89	40.47	21.36	24.95	51.05	37.98	45.57	25.52	18.99	22.79	

Notes: 2013 to 2018 dataset begun in August 2013; Greyed cells indicate Bogus Creek flow less than IGH requirement for 50% of base flow.
Source: NOAA Fisheries and CDFW Technical Staff Recommendation for Klamath River Hatchery Operations in California Post-Dam Removal, May 31, 2018.

Table 7.8-5 May Juvenile Rearing Water Availability and Requirements

Year	1st Half May						2nd Half May						IGH Req (cfs)
	Total Flow (cfs)			50% of Flow (cfs)			Total Flow (cfs)			50% of Flow (cfs)			
	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	
2013	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.25
2014	16.33	10.15	13.23	8.16	5.07	6.61	8.25	12.64	12.64	4.13	6.32	6.32	
2015	16.33	9.95	13.15	8.16	4.98	6.58	30.36	30.36	30.36	15.18	15.18	15.18	
2016	23.39	10.10	19.28	11.69	5.05	9.64	19.14	19.14	19.14	9.57	9.57	9.57	
2017	48.85	9.52	37.78	24.43	4.76	18.89	39.58	39.58	39.58	19.79	19.79	19.79	

Notes: 2013 to 2018 dataset begun in August 2013; Greyed cells indicate Bogus Creek flow less than IGH requirement for 50% of base flow.
Source: NOAA Fisheries and CDFW Technical Staff Recommendation for Klamath River Hatchery Operations in California Post-Dam Removal, May 31, 2018.

Table 7.8-6 October Adult Holding Water Availability and Requirements

Year	1st Half October						2nd Half October						IGH Req (cfs)
	Total Flow (cfs)			50% of Flow (cfs)			Total Flow (cfs)			50% of Flow (cfs)			
	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	
2013	15.36	10.70	13.75	7.68	5.35	6.88	14.84	10.26	12.74	7.42	5.13	6.37	6.5
2014	21.42	9.79	12.83	10.71	4.89	6.42	26.27	15.35	17.40	13.13	7.68	8.70	
2015	20.03	13.63	17.03	10.01	6.81	8.51	22.06	16.75	20.01	11.03	8.37	10.01	
2016	33.38	7.40	12.97	16.69	3.70	6.49	52.10	14.62	25.12	26.05	7.31	12.56	
2017	19.01	8.87	14.29	9.51	4.44	7.14	30.96	17.58	22.84	15.48	8.79	11.42	

Notes: Greyed cells indicate Bogus Creek flow less than IGH requirement for 50% of base flow.
Source: NOAA Fisheries and CDFW Technical Staff Recommendation for Klamath River Hatchery Operations in California Post-Dam Removal, May 31, 2018.

Table 7.8-7 November Adult Holding Water Availability and Requirements

Year	1st Half November						2nd Half November						IGH Req (cfs)
	Total Flow (cfs)			50% of Flow (cfs)			Total Flow (cfs)			50% of Flow (cfs)			
	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	
2013	13.01	10.96	12.35	6.51	5.48	6.17	16.45	12.87	14.38	8.22	6.43	7.19	6.5
2014	16.89	12.75	13.87	8.44	6.38	6.94	25.50	12.72	15.23	12.75	6.36	7.62	
2015	24.12	19.78	21.45	12.06	9.89	10.73	23.36	20.91	22.14	11.68	10.45	11.07	
2016	28.61	28.61	28.61	14.31	14.31	14.31	28.61	28.61	28.61	14.31	14.31	14.31	
2017	29.92	23.57	24.87	14.96	11.79	12.43	32.94	23.49	26.53	16.47	11.75	13.27	

Notes: Greyed cells indicate Bogus Creek flow less than IGH requirement for 50% of base flow.
Source: NOAA Fisheries and CDFW Technical Staff Recommendation for Klamath River Hatchery Operations in California Post-Dam Removal, May 31, 2018.

In summary, there were periods in all 5 years of Bogus Creek flow data in each of the four months where IGH flow requirements were not met if 50 percent of flow was maintained in Bogus Creek. Hatchery flows were met more often in April and November than May and October. The first halves of May and October met the hatchery requirements less often. It was not expected that the first half of May would show less availability than the second half of the month. This may be explained by the short duration of the dataset or drought conditions between 2013 and 2017 that may not represent long-term conditions. For these reasons, KRRC considers this analysis conservative and is indicative of the need for additional Bogus Creek flow data prior to dam removal and implementation of operational strategies to reduce hatchery water use during these shoulder months while maintaining hatchery production.

Water rights for water diverted from Bogus Creek are already secured as a riparian right available to the owner of the property at the time of diversion.

Shoulder Month Water Conservation Measures

As Bogus Creek flow data show, there may be times in April, May, October and November (shoulder months) where Bogus Creek provides inadequate flow for IGH while also maintaining 50 percent of base flow in the creek. If shortages occur, CDFW will implement the following measures to maintain creek flow and hatchery production objectives.

- Adult hold in October and November: As shown in Table 7.8-2, 4.5 cfs is needed for adult holding in October and November to operate two adult hold ponds. Individual adults return at different times beginning in October and lasting through December. Consequently, operating two adult hold ponds in the early return period (October to mid-November) may not be necessary in most years. During periods of low creek flow, adult salmon will be selectively collected (i.e. green spawners returned to the river, ripe spawners retained) and held in numbers/densities consistent with available flow and temperature in Bogus Creek so that a minimum of 50% of instream flow is maintained. As a guideline, if October daily average flows in Bogus Creek are less than 8.5 cfs, water will not be

diverted for adult holding. When flows reach a daily average of 8.5 cfs, one adult hold raceway would be operated at 2.25 cfs, with 1.5 cfs for the hatchery building and 0.5 cfs for spawning, for a total facility water need of 4.25 cfs. When flows reach a daily average 13 cfs or greater (second half of October in most years), two adult hold raceways could be operated (4.5 cfs) for a total facility water need of 6.5 cfs (see Table 7.8-6). CDFW will not implement these water diversion rates unless a daily average maximum water temperature trigger of 14 degrees C in Bogus Creek is met for egg incubation purposes.

- Juvenile rearing in April and May: As shown in Tables 7.8-4 and 7.8-5, 8.25 cfs is needed in April and May for juvenile rearing and Coho egg/fry production for Fall Creek. If insufficient water is available in Bogus Creek, CDFW may employ early release strategies to maintain 50 percent of the creek's base flow. CDFW may also employ early release strategies if Bogus Creek and/or Klamath River water temperatures are above 18.3 degrees C (65 degrees F) for a prolonged period to assist with the survivability of juvenile fish. As with adult holding, CDFW will hold juvenile salmon in numbers/densities consistent with available flow and temperature in Bogus Creek. CDFW may also recirculate and reuse of a portion of the raceway tailwater to augment hatchery water supplies during low creek flow years, as further described below.

Water Aeration Needs

Since water used by IGH for post-dam removal operations will be pumped from Bogus Creek (Table 7.8-3), aeration at the head of the raceway ponds will be provided to dissipate unwanted gasses from the water supply. Aeration will off-gas the water and allow re-oxygenation. Additional mid-raceway aeration will also be needed to maintain dissolved oxygen levels near saturation.

Chinook Salmon Tagging and Marking

Application of Coded Wire Tags (CWTs) and adipose fin-clip marking will be conducted by CDFW at IGH as fish reach the minimum size for tagging (200 fish/lb). The mark and tag rate will be at the CDFW standard of 25%. CDFW anticipates tagging will occur between March and May. The existing tagging trailer is adequate to meet tagging and marking objectives for Chinook salmon.

Fish Feeding and Rearing

CDFW will feed fish a high-quality feed to optimize growth and improve health to meet a minimum marking/tagging size of 200 fish/lb on schedule. CDFW's feed storage will be at IGH, for both IGH and FCH. IGH will continue to use the existing bulk feed bins and cool room storage.

Filtration and UV

The new facility will filter and UV disinfect water from Bogus Creek used within the rearing facilities. Anadromous salmonids bring disease and pathogens to the supply water, and water used for rearing of fish in the raceways must be filtered and UV disinfected to avoid spreading disease to the hatchery and hatchery produced fish. The hatchery building currently has a filtration and UV system in place for egg rearing. The adult holding pond, trap, and ladder will not require treatment.

Specific design criteria for the treatment system are still under consideration. The filtering system will need to remove high Total Suspended Sediment (TSS) resulting from winter/spring storm events that can directly affect fish health, as well as remove low ambient TSS that can inhibit the effectiveness of the UV disinfection system. From 2008-2013, Bogus Creek exhibited average turbidity of 4.5 nephelometric turbidity units (NTU) equivalent to approximately 5- 11 mg/L TSS. On April 8, 2018, the Karuk Tribe measured Bogus Creek turbidity during a flushing flow event at Iron Gate Dam, where flow in Bogus Creek was greater than 100 cfs during a storm event. Turbidity in Bogus Creek was measured at 64 formazin nephelometric units (FNU). FNU is equivalent to NTU but uses a different method of measurement. The maximum turbidity in Bogus Creek resulting from a storm event is unknown and requires further monitoring.

To identify and evaluate the appropriate setting requirements and filtration technologies, the KRRC, NMFS, and CDFW will establish temporal TSS exposure goals for the rearing ponds and incubation that will include the 24-hour average, six-day average, 30-day average, 1-day maximum and instantaneous maximum. Exposure goals will be developed with an understanding of current IGH water quality criteria and through review of salmonid exposure to TSS in scientific literature (e.g. Newcombe and Jenson 1996; Bash, et. al.,2001). The KRRC's goal is to identify a treatment process capable of removing TSS to a level protective of fish that is also not reliant upon settling or flocculating agents or chemicals (e.g. alum and potassium permanganate). Options include:

- Slow sand filtration
- Rapid media filtration
- Membrane or alternative filtration technology

CDFW will adopt the UV disinfection requirements from other CDFW hatcheries and will include target pathogens, levels of disinfection, UV transmittance, the need for redundancy and lamp fouling. Independent of the treatment technology used, KRRC, CDFW, and NMFS anticipate that the new equipment footprint (filtration and UV) will be entirely constructed within the footprint of the existing IGH facility.

In 2018-2019, comprehensive sampling and bench-scale testing will be conducted to characterize the particulates and settling rates of Bogus Creek storm water; and possibly pilot-scale filtration tests and UV effectiveness using Bogus Creek water.

Adult Collection and Holding

CDFW will use the existing fish ladder and auxiliary trap at IGH located south of the rearing raceways for adult trapping (See Figure 7.8-2). Extending the existing ladder into the river with a slight turn down river, may create better attraction water for the returning adults. However, this extension will occur within the approach channel to the auxiliary fish ladder and this channel has been excavated to a depth of approximately 20-feet, which could complicate the extension.

Adult fish will enter the ladder and be trapped in the adult collection area. The adult trap and hold area will consist of the existing fish ladder, adult collection pond trap and a fish-lift with a fish return line to the river. A submersible pump in the Klamath River will be added with a 1.5-inch line running to the top of the fish ladder to add Klamath River water for added attraction.

Using a mechanical crowder, fish that have entered the trap will be pushed into the fish-lift, where they will be sorted and slid into a truck for transport to the G or H adult holding raceways, depending on species. From the truck, a portable slide will be used to dump the fish from the truck into the raceways.

The adult holding ponds (ponds 1-3 of raceways G and H, see Figure 7.8-2) will have head box and head screens and provide adequate aeration with water flowing through screens and over wooden dam boards placed in double keyways every 25 feet. These existing raceway ponds will continue to have the standard grade of 0.5-foot elevation decrease over each 100-foot of pond length.

CDFW will segregate adult Chinook and Coho, with Coho in ponds 1 through 3 of raceway H and Chinook in ponds 1 through 3 of raceway G. Coho will be contained in PVC numbered tubes in pond H1, moved to G 3 and through an access door, lifted within the tubes into the spawning house. A barrier will be needed to be attached on the outside wall of H, and on the North side of center wall, and then outside wall of G ponds, possibly a 4-foot chain link fence, to keep fish from jumping out of their ponds. This also allows for use of the mechanical crowder within H ponds. Slide gates will be needed where each of the flumes enters piping under the spawning house. Screens will also be required to keep fish out of the pipes. Keyways at 25-foot intervals will be required in each of the raceways for screens and checkboards. The center wall will be cut just above each 25-foot keyway section to provide a 46-inch portal slot to move fish from G or H pond and crowded to the end of H-3 where the fish will enter the through a hinged door to the spawning house. Each portal slot will need keyways for boards, or screen, to create a barrier, plus a steel support will be needed over each portal slot to provide a sturdy surface for the mechanical crowder that rides atop the pond walls. Raceway flow should be at the established 2.25 cfs, for a total of 4.5 cfs for the two raceways. Pumped water from Bogus Creek will require an aeration tower to remove excess carbon dioxide and other gasses that may be entrained in the water during pumping. Mid-pond aerators may be required in the holding ponds if dissolved oxygen falls below required concentration. If needed, portable aerators can be acquired and used.

Spawning House

Once in the spawning building, CDFW will sort the fish by gender, mark/unmarked, jacks and sexual maturation. They will then be placed into the adult holding ponds, or if needed, returned to the river through the fish return line. The spawning house will be located over pond 4 of raceways G and H. Pond 4 flows will continue under the facility to convey flow to the tailrace; however, flow will be conveyed in pipes to eliminate the need for periodic cleaning. The new spawning house will be laid out in the same manner as the existing spawning house below the dam. It is anticipated at this time that all internal components of the existing fish trap and spawning building will be reused at the new facility at IGH as much as possible, including:

- Auxiliary trap lift

- Sort apron
- Drug tank with submersible pump and UV disinfection
- Sort table
- Egg table
- Miscellaneous work table
- Storage closet
- KRP data area
- Electro-anesthesia (e-shock) tank
- Rinse sink
- Water hardening tank
- 2-1/2-foot wide conveyor belt
- Access door of sufficient height and width to allow entry into the facility by a forklift.

The structure will be located on a slab spanning ponds G4 and H4. In addition to the house, the slab will include a lift for Chinook and door for the Coho tubes, a trap lift and an access ramp for a forklift or other vehicular access. The house itself will include a sorting apron, an electric anesthesia tank (e-shock tank), sort table with sides that connect to the conveyor belt, spawning table, storage area, egg rinsing and water hardening station, rinse sink for egg processing, e-shock equipment area, and flume water supply area to hold processed adults. A garage door and person-door will be provided at the front of the building for ease of access and equipment. CDFW will sort Coho prior to the e-shock tank and prevented from entering the tank. CDFW will sort Chinook after they have been anesthetized in the tank.

The auxiliary trap door will open inward so wet fish may slide down the sorting apron. Chinook, not Coho, will fall into a basket and be anesthetized in the e-shock tank. Then fish will be lifted onto the wet sorting table where some will be moved to the right for lethal research sampling and put on conveyor belt used to transport the fish out of the spawning house; others will be put onto the spawning table to be euthanized, rinsed, spawned, then put onto right side table for research sampling and then placed onto the conveyor belt out of the spawning house. This conveyor belt will extend beyond the tailrace to the driveway for storage and/or disposal.

CDFW will take egg collection pans from the spawning table to the egg processing stations where they will be rinsed, disinfected and water hardened for 1 hour. Eggs will then go directly to the hatchery building for processing.

Ponds G4 and H4, over which the spawning house will span, measure 97 feet by 10 feet; therefore, the spawning house can be as large as 20 feet wide by approximately 100 feet long. However, if the pond walls cannot support the house slab, it may have to extend beyond them. The roof line of the existing facility at the dam measures 47 feet by 24 feet. The new facility can measure slightly narrower (20 feet vs. 24 feet) and longer, if necessary. If a 24-foot width is needed, an additional 2 feet can be obtained on each side of the ponds. The driveways between the raceways are approximately 14 feet wide. If 2 feet is taken from the

driveway between raceways F and G, the remaining 12 feet should be adequate for most truck traffic. Although the width of the drive needs to accommodate the feed truck with its side extension tubes.

Coho Eggs

Based on an annual evaluation of rearing conditions, a decision will be made by CDFW and NMFS as to whether Coho salmon eggs and fry will be hatched and reared at FCH, IGH, or a portion at each facility. Coho salmon at IGH will be hatched and reared within the hatchery building existing rearing tanks until they reach a size of approximately 300 fish per pound. Coho salmon will then be transported to FCH for rearing until release.

Chinook Eggs

During the first through third years of operation post dam removal and potentially beyond, CDFW will incubate Chinook salmon eggs collected from broodstock within the IGH hatchery building. The hatchery building has an adequate filtration and UV system; however, sediment pretreatment will be needed to remove high TSS during storm events in Bogus Creek to protect the hatchery building filter from fouling. When Chinook return to Fall Creek, CDFW may collect and incubate eggs at Fall Creek to raise the approximately 140,000 Chinook yearlings at FCH. The entire smolt production (3.4 million) will occur at IGH and egg rearing for smolts will occur exclusively at IGH.

IGH Fish Releases

In general, CDFW will release Chinook salmon smolts between April 1 and May 31. However, early release of smolts prior to April 1st may occur based on water quality and quantity thresholds. Bogus Creek water reliability and quality can diminish in late spring and can exhibit very low flows in dry years that would be insufficient to operate the hatchery. In response, CDFW and NMFS have identified physical and biological parameter at IGH that would trigger early release of fish to reduce or avoid hatchery related fish mortality. These release thresholds include Bogus Creek water availability, Bogus Creek water temperatures, and threat of disease epizootics in rearing ponds. CDFW and NMFS will establish numeric trigger thresholds to determine whether CDFW will release some or all fish early (e.g. Bogus Creek 24-hour average water temperature exceeds 18 to 19 degrees C; see Figure 7.8-3). CDFW would also utilize water reuse/recirculation as described below to extend release dates when Bogus Creek flow is low, but water temperature is sufficient to recirculate in the raceways without exceeding trigger thresholds.

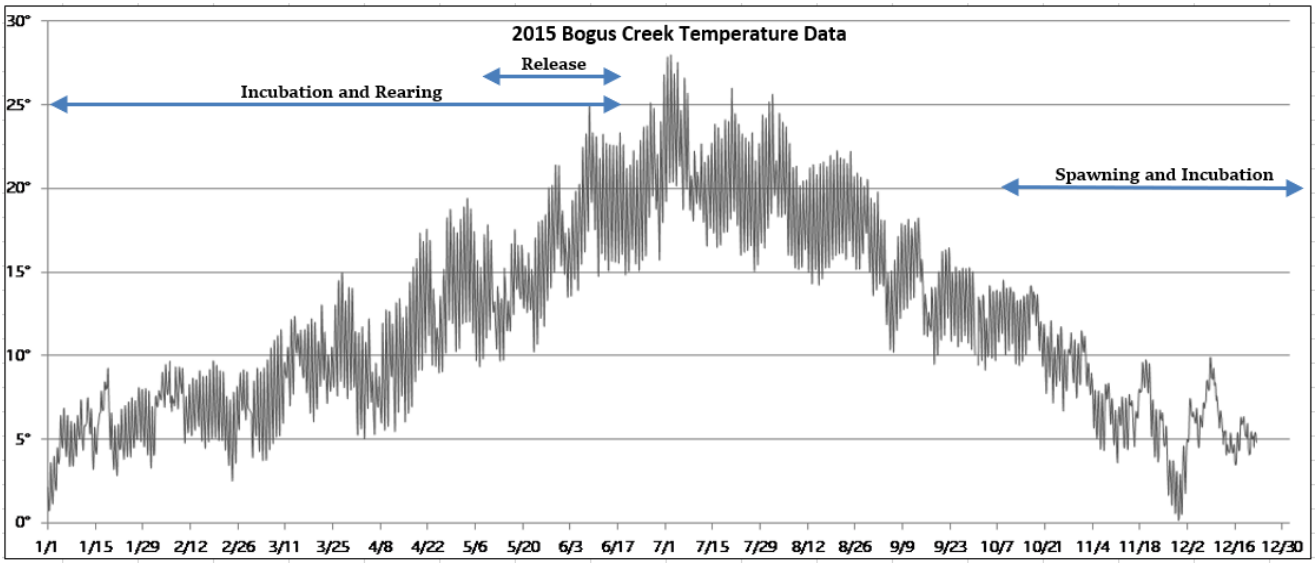

Figure 7.8-3 Bogus Creek Continuous Water Temperature for 2015 (CDFW)

Bogus Creek Flow to IGH

NMFS and CDFW will coordinate to minimize effects of Bogus Creek diversions on Coho salmon and their critical habitat. CDFW will monitor water diversion rates from Bogus Creek to ensure at least 50% of creek flow remains in the creek at the point of diversion. However, CDFW and NMFS will evaluate Bogus Creek to assess habitat below the proposed hatchery diversion to determine the minimum amount of in-stream flow necessary to provide connectivity in Bogus Creek, and to ensure anadromous salmonid spawning and rearing habitat. CDFW and NMFS will conduct hydraulic modeling and a geomorphic assessment in conjunction with habitat assessment to site the approximately 4,000 gpm pump station. This assessment will include:

- Assessment of Bogus Creek habitat: NMFS and CDFW will examine the anadromous fish spawning and rearing habitat in Bogus Creek below the proposed diversion at various low-flow levels to determine effects to habitat of various levels of water diversion.
- Monitoring of flow and TSS: KRRC will monitor flow and develop stage discharge relationships at key transects to determine if adequate fish passage conditions are provided. Data collection will begin in the spring and summer of 2018 and will continue as natural flow conditions in the stream vary. KRRC will monitor winter storm conditions in 2018/2019 to understand TSS concentration and sediment grain size distribution to optimize a sediment removal treatment system.
- Geomorphic and hydraulic assessment: Using an open channel model like HEC-RAS will provide depth and velocity predictions to determine the ideal location for the pump station including a starting water surface elevation at the Klamath River confluence to determine any backwater effects that could occur during high flow.

- Coordination between agencies: Following the habitat assessment, NMFS and CDFW will determine the appropriate flow level or percentage of diversion permitted each month given seasonal hatchery needs and fish development.
- Adjustments to diversions: Based on the results of Bogus Creek evaluation, NMFS and CDFW may coordinate to change the percentage of flow permitted diverted from Bogus Creek to IGH so it is protective of both Bogus Creek habitat and the hatchery program.
- Reporting: NMFS and CDFW will coordinate to determine reporting specifications for Bogus Creek diversions.

Settling Pond Operations and Permitting

CDFW will use the existing settling ponds for hatchery operations and does not anticipate modifications in layout or function. The North Coast RWQCB will continue to permit IGH discharge to the Klamath River as part of the existing 13267 Order modified with the proposed modifications to the facility.

Water Reuse/Recirculation

CDFW may reuse water (recirculation) from the rearing raceways if Bogus Creek flows are insufficient to meet minimum operational needs while balancing flow requirements in the creek. Depending upon Bogus Creek water temperatures and flow, CDFW will recirculate a portion of the raceway discharge back through the raceways reducing reliance on Bogus Creek. CDFW will couple recirculation with the early release thresholds described above to extend the rearing period. Water temperatures are below 19 degrees C in May (see Figure 7.8-3), rising above 20 degrees C in June and 25 degrees C in July and hatchery staff report that water can warm approximately 2 degrees C when passed through the raceways. KRRC and CDFW will further analyze Bogus Creek water as part of the design process to understand the effectiveness of recirculation given annual variations in flow and temperature during the early release period (April 1 and May 31).

Improvements at FCH

To raise yearling Coho and Chinook salmon, the FCH facility will be upgraded by modifying plumbing to accommodate the installation of circular tanks and a UV treatment system, including primary filtration similar to the UV system used at IGH (collectively the UV system). KRRC and CDFW anticipate modifications will occur within the existing facility footprint (see Figure 7.8-4) to minimize environmental and cultural resource disturbances. The FCH UV system will treat and disinfect the egg incubation water source only. KRRC and CDFW do not propose UV treatment for rearing at this facility. CDFW will need additional space not depicted on Figure 7.8-4 for the purposes of operations (e.g. a settling basin, vehicle parking, pertinent buildings, tagging trailer, etc.); these, except for the settling basin, can be accommodated on existing developed or disturbed areas around the hatchery and powerhouse. Use of these spaces will require coordination and concurrence with PacifiCorp. Non-consumptive water diversion from Fall Creek will support hatchery operations using a combination of the existing CDFW water right on Fall Creek and riparian rights, and the water will return to the creek at the settling pond location or fish ladder, minimizing adverse effects to Fall Creek aquatic resources. To protect the quality of the City of Yreka's water supply and prevent fish

pathogen introduction into the hatchery, fish will not be allowed upstream of both Dam A (main diversion point) or Dam B (alternate diversion point).

CDFW may divert up to 10 cfs of water from PacifiCorp's hydro-generation tail race canal supplied from either Dam A or B, below the City of Yreka's diversion facility. Water will be gravity fed and plumbed to each rearing location and all circular tanks, pending KRRC's confirmatory site survey. During periods when the powerhouse tail race is not flowing, hatchery water will be diverted from Dam B to Dam A. KRRC and CDFW will perform hydraulic analysis to assess depths and velocities in Fall Creek, which CDFW and NMFS will use to determine threshold criteria for resident and migrating Chinook and Coho salmon.

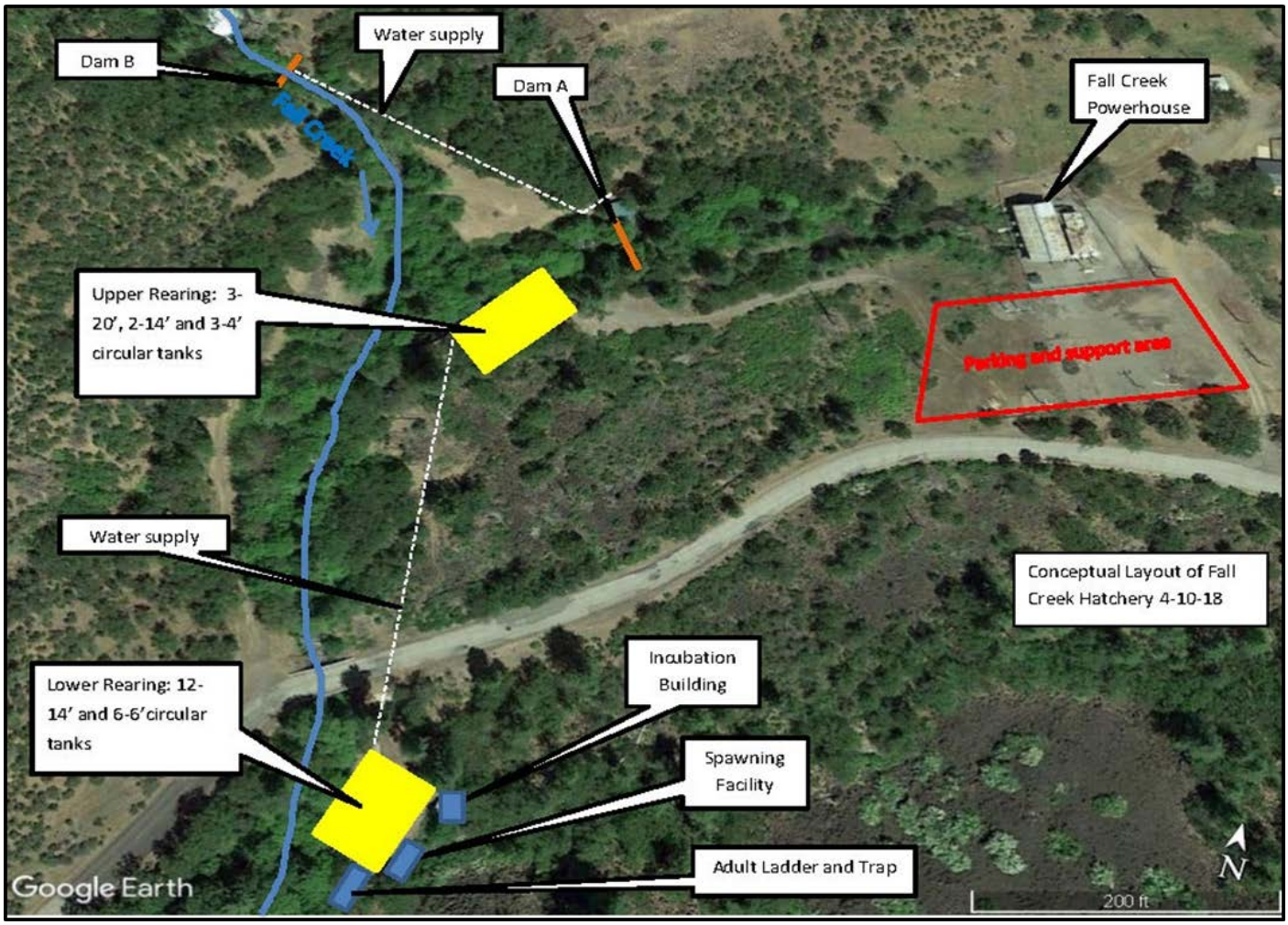

Figure 7.8-4 Conceptual Layout of Fall Creek Hatchery Improvements

Adult Collection and Holding

It is not anticipated that salmon will return to Fall Creek in sufficient numbers for broodstock until at least three years following dam removal (the first fish raised at FCH will return as three-year old's in 2024).

Between 2021 and 2024, or until fish return to FCH, spawning and egg collection will occur at IGH. CDFW and NMFS will develop a separate protocol to transfer eggs to FCH from IGH to reduce transportation mortality. Once FCH salmon returns begin to occur, CDFW and NMFS have identified two options to collect fish:

- Option 1: An adult ladder and trap will be constructed in the lower rearing location. Adult holding will include one or two new 14-foot diameter or smaller circular tank(s). A new fish ladder and trap will allow fish access to this tank(s).
- Option 2: Adult trapping will be at the mouth of Fall Creek using a new picket weir and trap. Once adults are trapped they will be transferred either by truck, or possibly by a Whooshh™ fish transfer system, to the new adult fish ladder and trap located in the lower rearing area.

The fish ladder and adult holding tanks will be supplied with water from the lower tanks (4.33 cfs) excluding periods of cleaning, feeding, and therapeutic use when water will be discharged to the settling pond. If pass through water from the lower tanks is insufficient to meet fish ladder and adult holding needs, CDFW may need to divert additional water (UV treatment not required) into the fish ladder.

Spawning

CDFW will manage spawning at FCH to meet the joint program goals at both IGH and FCH. When adult Chinook and Coho return to Fall Creek, CDFW will sort the adults for ripeness and spawned according to production goals for Chinook salmon and conservation goals described in the HGMP for Coho salmon.

A facility needs to be designed and constructed for future spawning operations at FCH. Migrating Coho and Chinook salmon will need 3-4 years to imprint, so a FCH spawning house is not an immediate necessity; however, the design should be developed now.

Egg Incubation

CDFW will incubate Coho salmon and Chinook salmon eggs in a new incubator building using eight vertical flow incubator stacks. Each stack will use up to 10 gpm, for a total of 80 gpm (0.18 cfs). CDFW will treat the incubator water using a 100 gpm in-line UV system. CDFW will discharge water from egg incubation to the settling pond.

Circular Tanks

Rearing at FCH will occur in the upper and lower ponds. For each location, circular tanks will be installed within the existing concrete rearing pond footprints. The upper ponds will consist of three 20-foot circular tanks, two 14-foot circular tanks, and three four-foot circular tanks. The lower ponds will consist of twelve 14-foot circular tanks, and six 6-foot circular tanks. The incubation building, fish ladder, adult capture and holding ponds and spawning house will be located adjacent to the lower raceways (Figure 7.8-4). CDFW will discharge water from the rearing ponds either to Fall Creek through the fish ladder or if treatment is needed, to the settling pond as described below.

Water Needs

CDFW will divert water from Dam A to provide 2.2 cfs to the upper rearing area, and 5.65 cfs to the lower rearing area. CDFW will divert up to 2.2 cfs for the fish ladder and adult capture area during the months of October through January. The maximum total flow of water required to operate the FCH is 9.24 cfs (Table 7.8-8) which occurs in November and includes additional water from unused tanks to operate the fish ladder and trapping area. The SWRCB has confirmed that CDFW's non-consumptive water right permit of 10 cfs is valid for hatchery operations.

Table 7.8-8 Estimated Water Needs at FCH rearing 115,000 Chinook yearlings and 75,500 Coho (cfs)

Facility	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Round Tanks	1.26	1.29	1.58	1.66	1.08	0.58	1.01	1.48	2.29	3.30	4.06	1.14
Hatchery Building	0.18	0.18	0.18	0.18	0	0	0	0	0	0.18	0.18	0.18
Spawning	0	0	0	0	0	0	0	0	0	0.67	0.67	0.67
Adult Holding & Ladder	4.33	0	0	0	0	0	0	0	0	4.33	4.33	4.33
Total	**5.77**	**1.47**	**1.76**	**1.84**	**1.08**	**0.58**	**1.01**	**1.48**	**2.29**	**8.48**	**9.24**	**6.32**

Source: NOAA Fisheries and CDFW Technical Staff Recommendation for Klamath River Hatchery Operations in California Post-Dam Removal, May 31, 2018.

Settling Pond

A settling pond will be constructed for FCH for post-use water treatment. However, the FCH footprint will not support a settling pond, so KRRC and CDFW identified two nearby sites, both located on Parcel B, for further evaluation as shown in Figure 7.8-5. These include:

1. A location approximately 1/2 mile downstream of the FCH lower raceways on the left Fall Creek overbank at the access road to the PacifiCorp electrical substation across from the City of Yreka chlorination facility.
2. A location also on the left Fall Creek overbank just north of and along Daggett Road, approximately 4,300 feet downstream of the of the lower FCH raceways. This site is also adjacent to the Klamath River. This site is located within the FEMA-designated approximate Zone A floodplain of the river.

Because these locations are offsite and downstream of the FCH, a conveyance pipeline with either minimum burial or at-grade, will be constructed to transport flows from the hatchery to the pond. Sufficient hydraulic head exists for gravity flow to all sites.

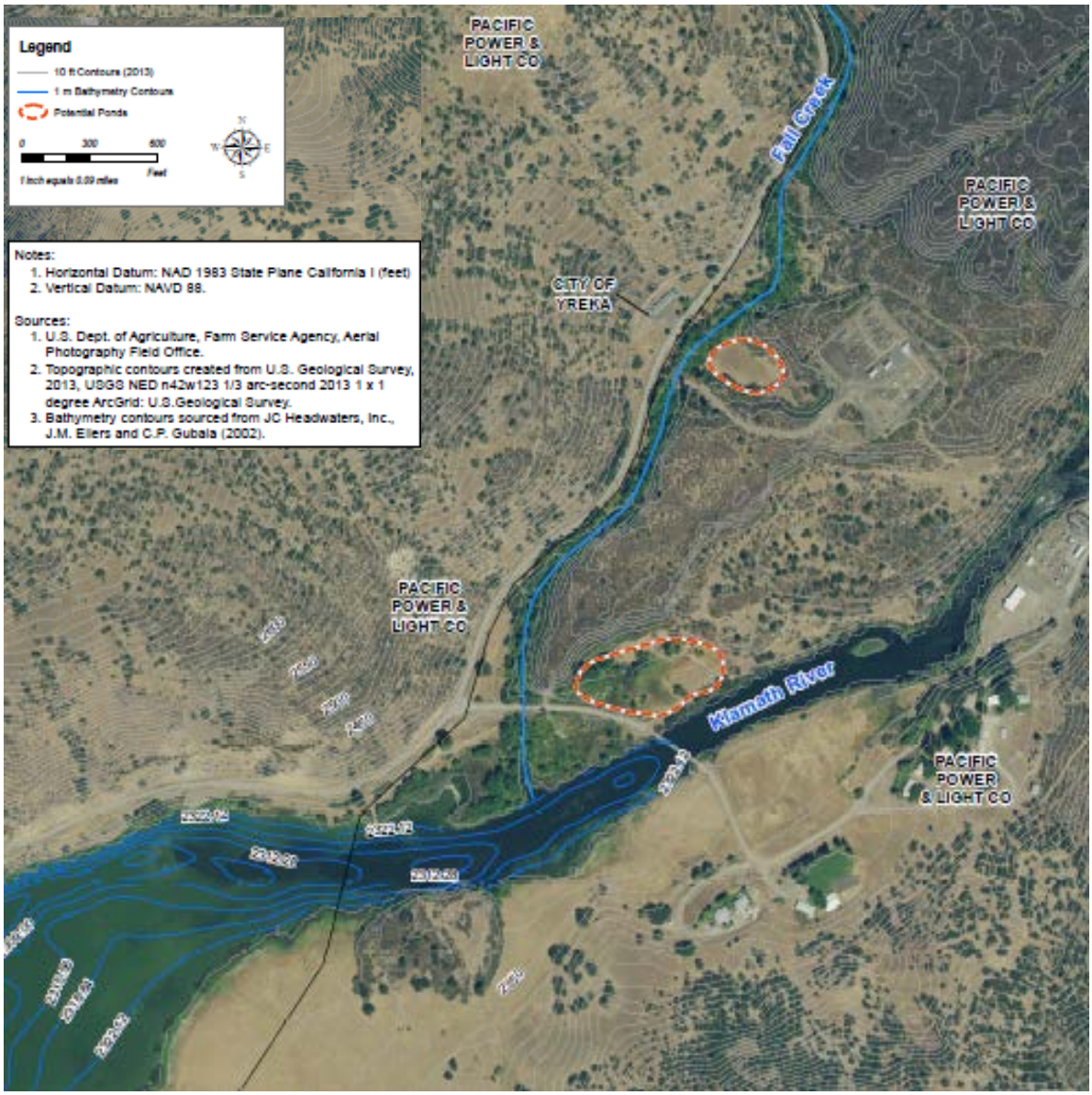

Figure 7.8-5 Potential Settling Pond Locations for FCH

The settling pond will treat water discharged from the incubation and spawning building at all times and from all circular tanks during cleaning, following feeding or use of therapeutics. Otherwise, CDFW will discharge water from the rearing tanks through the fish ladder located in the lower pond area. From the new pond location, CDFW will discharge water back to Fall Creek. At this time, KRRC and CDFW anticipate that the North Coast RWQCB will permit the discharge under the general NPDES permit for hatcheries with effluent discharge requirement phased in over eight years via a companion compliance order. Selection of a settling pond location and pond layout is pending cultural resources investigations and consultation with tribes with historic and cultural connection to the area.

Coded Wire Tags and Marking

CDFW will apply CWTs and perform adipose fin clip marking of the Chinook salmon yearlings reared at FCH at the CDFW standard 25% constant fractional mark rate and are proposed to be processed by hand using Mk IV CWT tagging machines. CDFW can complete hand processing these Chinook yearlings with two CWT machines in 7 to 15 days. CDFW will mark 100% of Coho salmon with a left maxillary clip by hand and can complete this in roughly 10 to 20 days.

FCH Fish Releases

CDFW and NMFS are still evaluating release strategy for Coho and Chinook salmon produced at the FCH. CDFW and NMFS plan release dates of October 15 through November 20 for Chinook salmon yearlings, and March 15 through May 1 for Coho salmon yearlings. Options include direct release at FCH or IGH.

General Hatchery Plan Assumptions

KRRC makes the following assumptions regarding technical criteria at both IGH and FCH:

- For the purposes of planning and designing hatchery operations, all hatchery production at IGH and FCH is limited to the eight years following dam removal. After eight years, the hatcheries will cease operations and be decommissioned.
- IGH and FCH must be operational prior to draw down per the Klamath Hydroelectric Settlement Agreement (KHSA 2016, see section 7.6.6.B).
- CDFW will employ Best Management Practices to minimize discharges at IGH and FCH.

7.9 Cultural Resources Plan

KRRC is preparing a Cultural Resources Plan. The tasks described in the Cultural Resources Plan in Appendix L provide FERC with a framework for understanding the cultural resources studies that KRRC has completed, those that are currently ongoing, and others that KRRC anticipates to comply with regulatory requirements under Section 106 of the NHPA as well as California's AB 52. The plan also provides the status of consultation completed to date by KRRC and PacifiCorp, acting as FERC's non-federal representatives, for carrying out consultation pursuant to Section 106 and the status of consultation with affected Indian Tribes and other tribal organizations. The plan also provides an update of the status of SWRCB's consultation with California Native American tribes under AB 52.

7.10 Other Plans

Several other plans are proposed and included in this Definite Plan to support the construction and management of effects from the Project. Table 7.10-1 provides a list of plans and their location in the appendices.

Table 7.10-1 Summary of Other Plans for Construction, Water Quality and Groundwater Management

Plan	Location in Definite Plan
Fire Management Plan	Appendix 01
Traffic Management Plan	Appendix 02
Hazardous Materials Management Plan	Appendix 03
Emergency Response Plan	Appendix 04
Noise and Vibration Control Plan	Appendix 05
Water Quality Monitoring Plan	Appendix M
Groundwater Well Management Plan	Appendix N

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Chapter 8: Project Costs and Schedule

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8. PROJECT COSTS AND SCHEDULE

This section provides a summary of the Estimate of Project Costs report, which is provided as Appendix P to this Definite Plan. The full report in Appendix P documents the estimated cost for the Project, which in addition to construction cost, includes costs for management, administration and legal support, environmental compliance and permitting, engineering design, procurement, mitigation and monitoring before, during and following construction, as well as construction management. The estimated project cost is based on the Definite Plan, in addition to ongoing coordination and consultation with project stakeholders and regulatory agencies.

8.1 Objectives

Section 7.2 of the Klamath Hydroelectric Settlement Agreement, as amended (KHSA) sets forth required elements of the Definite Plan, which include:

- A detailed estimate of the actual or foreseeable costs associated with: the physical performance of Facilities Removal[25] consistent with the Detailed Plan; each of the tasks associated with the performance of the [KRRC]'s obligations as stated in Section 7.1; seeking and securing permits and other authorizations; and insurance, performance bond, or similar measures, as set forth in Appendix L to this Settlement;
- The [KRRC]'s analysis demonstrating that the total cost of Facilities Removal is likely to be less than the State Cost Cap, which is the total of Customer Contribution and California Bond Funding as specified in Section 4[26]; and
- A detailed statement of the estimated costs of Facilities Removal.

The full report in Appendix P addresses these elements of the KHSA and documents both the engineer's opinion of construction cost, based on the project design elements and construction plan summary provided herein, as well document the total estimated project implementation cost. In addition to reporting the estimated project costs, Most Probable Low (MPL) and Most Probable High (MPH) estimates were prepared using a Monte Carlo analysis to account for uncertainties associated with the estimated project costs and identified project risks. The MPL and MPH estimates represent more optimistic and more conservative opinions of project costs, respectively.

8.2 Cost Categories

For organizational purposes, the project costs have been summarized using the following cost categories:

[25] "Facilities Removal" is defined in the KHSA as the "physical removal of all or part of each of the Facilities to achieve at a minimum a free-flowing condition and volitional fish passage, site remediation and restoration, including previously inundated lands, measures to avoid or minimize adverse downstream impacts, and all associated permitting for such actions."
[26] The State Cost cap is $450,000.000.

- **Project Oversight:** Support services providing administration, project management and controls, contract management, BOC, outreach, insurance and legal support.
- **Environmental Compliance and Permitting**: Environmental compliance support and permitting.
- **Engineering and Procurement:** Field studies, engineering design, and construction procurement for the various project work packages. Design and procurement estimates assume a Progressive Design-Build (PDB), performance security, construction delivery method for the large dam removal work package.
- **Construction Management:** Full construction management services for implementation of all project components.
- **Construction:**
  - Dam removals: Sequential removal of all four dams, including dam modifications, reservoir drawdown and removal of all associated dam infrastructure (including spillways, fish ladders, intake structures, penstocks, turbine units, electrical installations, buildings)
  - Reservoir area improvements: Removal, grading and shaping of portions of reservoir sediment, bank stability measures
  - Reservoir area restoration: Seeding, planting, weeding, monitoring and maintenance. Hydroseeding methods include by barge along the reservoir bank, by helicopter along steep slopes, by airplane along uneven large areas and by trailer mounted blower for areas easily accessible by truck
  - Yreka water supply improvements: Improvements to the City of Yreka's water supply intake and relocation of their water supply pipeline.
  - Transportation infrastructure: Improvements to, or replacement of, bridges, culverts and road resurfacing to mitigate any project or construction related impact
  - Recreation demolition: Demolition of existing recreation infrastructure and restoration of disturbed area to native vegetation
  - Recreation improvements: New recreation infrastructure (e,g, water access, day-use areas, etc.) to avoid or minimize project impacts
  - Downstream flood improvements: Improvements to existing structures and facilities to avoid or minimize adverse downstream flood-related impacts.
- **Anticipated Mitigation Measures**: Anticipated cultural resource measures, groundwater improvements, and water supply improvements required by regulatory agencies to mitigate project-related impacts.
- **Monitoring and Reporting:** Aquatic resource, terrestrial resource, water quality, and sediment monitoring and reporting.

Detailed summaries of methods, assumptions and results of the estimate development for the various cost categories and subcategories is provided in Section 3 of Appendix P.

8.3 Construction Procurement Approach

KRRC based estimates for the various cost categories on a PDB construction procurement of the large dam removal work package, which includes construction access road and bridge accommodations, dam modifications, dam and hydropower facility removal, recreation demolition and reservoir and other restoration. KRRC will use a qualifications-based selection approach and hire a PDB contractor in late 2018/early 2019, followed by the PDB's completion of the final design in 2019.

There is a possibility that smaller work packages, including downstream flood control improvements, City of Yreka water supply improvements and proposed recreation facilities, may be procured separately using a design-bid-build, or similar, procurement strategy. For these packages, final design will proceed in 2018 and 2019, with request for construction proposals being issued in mid- to late-2019.

8.4 Basis of Estimate

8.4.1 Construction Pricing

The construction estimates summarized herein are intended to capture the most current pricing for materials, wages and salaries, equipment, accepted productivity standards, and typical construction practices, procurement methods, current construction economic conditions, and site conditions for the current level of design. Detailed construction cost breakdowns for both Full Removal and Partial Removal alternatives are provided in Appendix P. Pay item cost detail worksheets, describing the calculation of individual cost estimate line items rates and prices are also provided in Appendix P.

Construction cost estimates were prepared based on less than complete designs, and have inherent levels of risk and uncertainties. Section 2.3 in Appendix P contains a detailed description of the methods and assumptions that were utilized to address Contractor direct costs, overhead, profit, risk markup, subcontractor markup, insurance markup and bond markup.

8.4.2 Consulting Services Pricing

Outside of construction costs, other implementation activities such as project oversight, field studies, design, permitting, mitigation measures and monitoring generally involve labor and associated other direct costs (ODCs). ODCs can include office space, travel, meals, postage, specialty reproduction, and vendor quotes for materials, supplies or services. For each of the implementation activities referenced above, KRRC developed independent estimates using standard labor rates and ODC values based on the latest understanding of the scope or work for the life of the Project. Details for each cost category are provided in Appendix P.

8.4.3 Escalation

KRRC based estimates on contemporary market information at the time of estimate preparation. As such it is necessary to include escalation to account for cost increases over the duration of the Project, particularly

as this Project spans multiple years. KRRC escalated each line item in the cost estimate based on scheduled construction and other implementation activities. KRRC utilized an escalation rate of 4% per year. This is based on cost index references and current cost trends observed in the industry, described in more detail in Appendix P.

8.4.4 Design and Construction Contingency

Design contingencies are intended to account for three types of uncertainties which directly affect the estimated cost of a project as it advances from the planning stage through final design. These include: (1) unlisted items, (2) design and scope changes, and (3) cost estimating refinements. Based upon the apparent completeness of the listed items for the dam removal estimates, the design contingency was set at ±10 percent of the construction cost, which is a typical value for a the level of design presented herein, particularly given the fact that a large percentage of the demolition work is means and methods driven, as opposed to detailed design.

The estimate of project costs includes a percentage allowance for construction contingencies to cover differences in actual and estimated quantities, unforeseeable difficulties at the site, changed site conditions, possible changes in plans, and other uncertainties during the construction period. The allowance is based on engineering judgment of the major pay items in the estimate, reliability of the data, adequacy of the estimated quantities, and general knowledge of the site conditions. KRRC used a value of ±20 percent of the construction cost for construction contingencies for the dam removal estimates, which is a typical value for this stage of project development.

KRRC applied the design and construction contingencies (total of 30%) discussed above as a percentage of the total construction cost, and added to the total estimate of project costs.

8.4.5 Monte Carlo Analysis

KRRC completed a Monte Carlo analysis to analyze uncertainties and risk, to be used as the basis for development of the MPL and MPH estimates.

The probabilistic range of costs for each estimate line item was determined with the use of '@Risk' Monte Carlo analysis software. The Monte Carlo analysis involves determining the impact and likelihood of occurrence of identified and quantified uncertainties and risks by running simulations to identify the range of possible outcomes for a number of scenarios - 10,000 scenarios in the case of this Project. A random sampling is performed in the simulation by using uncertain risk variable inputs to generate the range of outcomes with a confidence measure for each outcome.

Levels of probability are described from P1 to P100, where the number following the 'P' represents the percentage of most probable outcomes. For example, the P1 estimate amount will only cover the lowest 1% of the possible cost outcomes, whereas P100 will cover the maximum estimate amount determined from running the 10,000 scenarios. A P80 estimate covers the most likely final project cost in 80% of all scenarios, and is often used by the construction industry (Barreras 2011), including the USACE ("Per

regulation and guidance, the P80 confidence level is the normal and accepted cost confidence level"), to calculate the amount of conservative risk contingency to carry on a project.

Due to the unique nature of this Project and theKRRC, KRRC selected a conservative P90 to represent the MPH for the Project. The P90 estimate would cover the most likely final project cost in 90% of all scenarios. A P10 was selected to represent the MPL.

8.4.6 Ongoing Due Diligence

General

KRRC is undertaking additional due diligence on construction costs, measures to lower construction costs, and measures to manage construction risk. KRRC will complete additional engineering, select a design-build contractor, negotiate a construction agreement with the Contractor, establish a guaranteed maximum price for the work to be performed, implement its insurance programs, and establish the requirements for all bid bonds, payment bonds, and the performance bond. Many risks considered in the Monte Carlo analysis that deal with design and regulatory compliance will be mitigated or better understood when this process is completed, likely lowering the MPH significantly.

Independent Board of Consultants (BOC)

The FERC approved the BOC for the Lower Klamath Project on May 22, 2018. Among other things, FERC's letter of approval included a plan and schedule to obtain BOC review of the estimate of project costs and MPH estimates for the Full Removal alternative, adequacy of available funds for facilities removal, adequacy of the proposed contingency reserve, and adequacy of the proposed insurance and bonding arrangements. The five-member BOC FERC-approved list includes Dan Hertel, PE (Engineering Solutions, LLC), James Borg, PE (D&H Concepts, LLC), Craig Findlay, PhD, PE, GE (Findlay Engineering, Inc.), Mary Louise Keefe, PhD (R2 Resource Consultants, Inc.), Ted Chant, PE (Chant Limited) and Robert Muncil, ARM (Cool Insurance Agency, Inc.). KRRC plans to convene the BOC on or before August 1, 2018.

The Definite Plan will be further informed by the review and recommendations of the BOC. KRRC will incorporate recommendations of the BOC into a revised Definite Plan and Appendix P will be updated accordingly.

8.5 Estimate Results Summary

Tables 8.5-1 and 8.5-2 below summarize the estimate of project costs, for both Full Removal and Partial Removal of the four dams.

Similar to previous project estimates, the results show probabilistic MPL and MPH costs based on the results of Monte Carlo simulations. The right-hand column indicates the estimated project costs, whereas the forecast range from MPL to MPH indicate the range of probabilistic outcomes. The MPL is P10 (likely final

project cost in 10% of all scenarios) and the MPH is P90 (likely final project cost in 90% of all scenarios). Additional detail and cost breakdowns are provided in the full report in Appendix P.

Table 8.5-1 Results Summary - Full Removal

Cost Category	Forecast Range		Estimated Project Cost
	MPL	MPH	
Project Oversight			$29,581,000
Environmental Compliance & Permitting			$8,637,000
Engineering & Procurement			$15,632,000
Construction Management			$10,617,000
Construction	$202,108,000	$268,560,000	$227,980,000
Anticipated Mitigation Measures			$18,407,000
Monitoring & Reporting			$18,405,000
Design & Construction Contingency			$68,394,000
TOTAL	**$346,500,000**	**$507,100,000**	**$397,700,000**

Table 8.5-2 Results Summary - Partial Removal

Cost Category	Forecast Range		Estimated Project Cost
	MPL	MPH	
Project Oversight			$29,581,000
Environmental Compliance & Permitting			$8,637,000
Engineering & Procurement			$15,632,000
Construction Management			$10,617,000
Construction	$169,140,000	$229,250,000	$193,030,000
Anticipated Mitigation Measures			$18,407,000
Monitoring & Reporting			$18,405,000
Design & Construction Contingency			$57,909,000
TOTAL	**$313,500,000**	**$467,800,000**	**$352,200,000**

8.6 Construction Schedule

The estimate is based on the construction schedule and the construction plan described below. The schedule is predicated on the following:

- Construction of City of Yreka water supply improvements would be completed in 2020 (prior to drawdown) and may be under a separate contract from the PDB Contract for the dam removal work
- Construction of downstream flood control improvements would be completed in 2020 (prior to drawdown) and may be under a separate contract from the PDB Contract for the dam removal work

- Construction of the access road improvements would be completed in 2020 (prior to drawdown)
- An effective Date of Agreement (guaranteed maximum price) for the dam removal PDB Contractor on or before February 15, 2020
- Lineal and concurrent activities
- Equipment application and production
- The ability to drawdown J.C. Boyle, Copco No. 1 and Iron Gate reservoirs at the beginning of 2021
- Major earthworks and removal activities are assumed to be performed using two 10-hour shifts, six days per week
- In-stream construction window in Oregon is assumed to be from July 1 through September 30
- In-stream construction window in California is assumed to be from June 15 through October 15

The duration of many of the schedule activities are determined from the labor and equipment productivity associated with the estimate pay item sheets.

The access road, dam modification, water supply, and downstream flood control construction would be completed during an estimated 6- to 8-month period in 2020, since these activities require completion prior to drawdown and facility removal. Subsequent dam removal and associated construction would occur during approximately 8 months of work in 2021, with restoration related construction activities likely extending through 2022. Monitoring and reporting would extend for 5 years after construction completion. Figure 8.6-1 below shows a summary schedule for construction activities.

ID	Task Name	Duration	Start	Finish
1	**Supporting Construction**	**142 days**	**Wed 4/1/20**	**Thu 10/15/20**
2	Dry Creek Bridge	21 days	Wed 4/1/20	Wed 4/29/20
3	Fall Creek Bridge	66 days	Mon 4/20/20	Mon 7/20/20
6	Lakeview Bridge	65 days	Wed 4/22/20	Tue 7/21/20
7	Daggett Rd Bridge	98 days	Wed 4/22/20	Fri 9/4/20
8	Jenny Creek Bridge	108 days	Wed 4/22/20	Fri 9/18/20
11	Camp Creek Bridge	66 days	Thu 7/16/20	Thu 10/15/20
14	Scotch Creek Culvert	**29 days**	Fri 7/24/20	Wed 9/2/20
17	Recreation Areas	110 days	Wed 4/1/20	Tue 9/1/20
19	Flood Improvements	83 days	Wed 4/1/20	Sat 7/25/20
21	Yreka Water Supply	102 days	Thu 4/30/20	Sun 9/20/20
23	**Copco 1 Dam**	**355 days**	**Mon 6/15/20**	**Fri 10/22/21**
24	Dam Modifications	134 days	Mon 6/15/20	Thu 12/17/20
25	Dam Modifications	117 days	Wed 7/8/20	Thu 12/17/20
26	In-Water Dam Modifications	40 days	Mon 6/15/20	Fri 8/7/20
27	Drawdown	90 days	Tue 11/3/20	Mon 3/8/21
28	Dam Removal	253 days	Wed 11/4/20	Fri 10/22/21
29	Dam Demolition	137 days	Thu 4/15/21	Fri 10/22/21
30	Power House Demolition	116 days	Wed 11/4/20	Wed 4/14/21
31	Power Plant Demolition	24 days	Wed 11/4/20	Mon 12/7/20
32	Switch Yard Demolition	4 days	Wed 11/4/20	Mon 11/9/20
33	In-Water Dam Demolition	89 days	Tue 6/15/21	Fri 10/15/21
34	Transmission Line Demolition	34 days	Tue 6/15/21	Fri 7/30/21
35	**JC Boyle Dam**	**195 days**	**Fri 1/1/21**	**Thu 9/30/21**
36	Drawdown	22 days	Fri 1/1/21	Sun 1/31/21
37	Dam Removal	190 days	Fri 1/8/21	Thu 9/30/21
38	Dam Demolition	190 days	Fri 1/8/21	Thu 9/30/21
39	Dam Excavation	77 days	Wed 6/16/21	Thu 9/30/21
40	Forebay Demolition	164 days	Mon 1/18/21	Thu 9/2/21
41	Buildings Demolition	24 days	Wed 4/7/21	Mon 5/10/21
42	Penstock Demolition	151 days	Mon 1/18/21	Mon 8/16/21
43	Power House Demolition	159 days	Mon 1/18/21	Thu 8/26/21
44	In-Water Dam Demolition	20 days	Thu 7/1/21	Wed 7/28/21
45	Transmission Line Demolition	50 days	Mon 1/18/21	Fri 3/26/21
46	**Copco 2 Dam**	**120 days**	**Sat 5/1/21**	**Fri 10/15/21**
47	Dam Removal	120 days	Sat 5/1/21	Fri 10/15/21
48	Dam Demolition	107 days	Sat 5/1/21	Sat 9/25/21
49	Penstock Demolition	120 days	Mon 5/3/21	Fri 10/15/21
50	Power House Demolition	96 days	Mon 5/3/21	Mon 9/13/21
51	In-Water Dam Demolition	75 days	Tue 6/15/21	Sat 9/25/21
52	Power Plant Demolition	42 days	Mon 5/3/21	Tue 6/29/21
53	Transmission Line Demolition	32 days	Mon 5/3/21	Tue 6/15/21
54	**Iron Gate Dam**	**344 days**	**Mon 6/22/20**	**Thu 10/14/21**
55	Dam Modifications	56 days	Mon 6/22/20	Mon 9/7/20
56	Dam Modifications	56 days	Mon 6/22/20	Mon 9/7/20
57	In-Water Dam Modifications	23 days	Thu 8/6/20	Mon 9/7/20
58	Drawdown	43 days	Fri 1/1/21	Tue 3/2/21
59	Dam Removal	204 days	Mon 1/4/21	Thu 10/14/21
60	Fish Facility Demolition	111 days	Mon 1/4/21	Mon 6/7/21
61	Dam Demolition	95 days	Tue 6/1/21	Mon 10/11/21
62	Dam Excavation	82 days	Tue 6/1/21	Wed 9/22/21
63	Buildings Demolition	18 days	Tue 6/8/21	Thu 7/1/21
64	Penstock Demolition	88 days	Tue 6/15/21	Thu 10/14/21
65	Pipe Demolition	14 days	Fri 7/2/21	Wed 7/21/21
66	In-Water Dam Demolition	69 days	Wed 7/7/21	Mon 10/11/21
67	Power House Demolition	61 days	Tue 6/1/21	Tue 8/24/21
68	Power Plant Demolition	46 days	Tue 6/1/21	Tue 8/3/21
69	Transmission Line Demolition	5 days	Tue 6/1/21	Mon 6/7/21
70	**Restoration**	**347 days**	**Mon 2/1/21**	**Tue 5/31/22**
71	Fluvial sediment & habitat	89 days	Tue 6/15/21	Fri 10/15/21
72	Vegetation habitat	347 days	Mon 2/1/21	Tue 5/31/22
73	Aerial pioneer crop seeding	65 days	Mon 2/1/21	Fri 4/30/21
74	Salvage & plant existing riparian veg	108 days	Mon 2/1/21	Wed 6/30/21
75	Pole Cutting Installation 2021	86 days	Mon 2/1/21	Mon 5/31/21
76	Pole Cutting Installation 2022	86 days	Tue 2/1/22	Tue 5/31/22

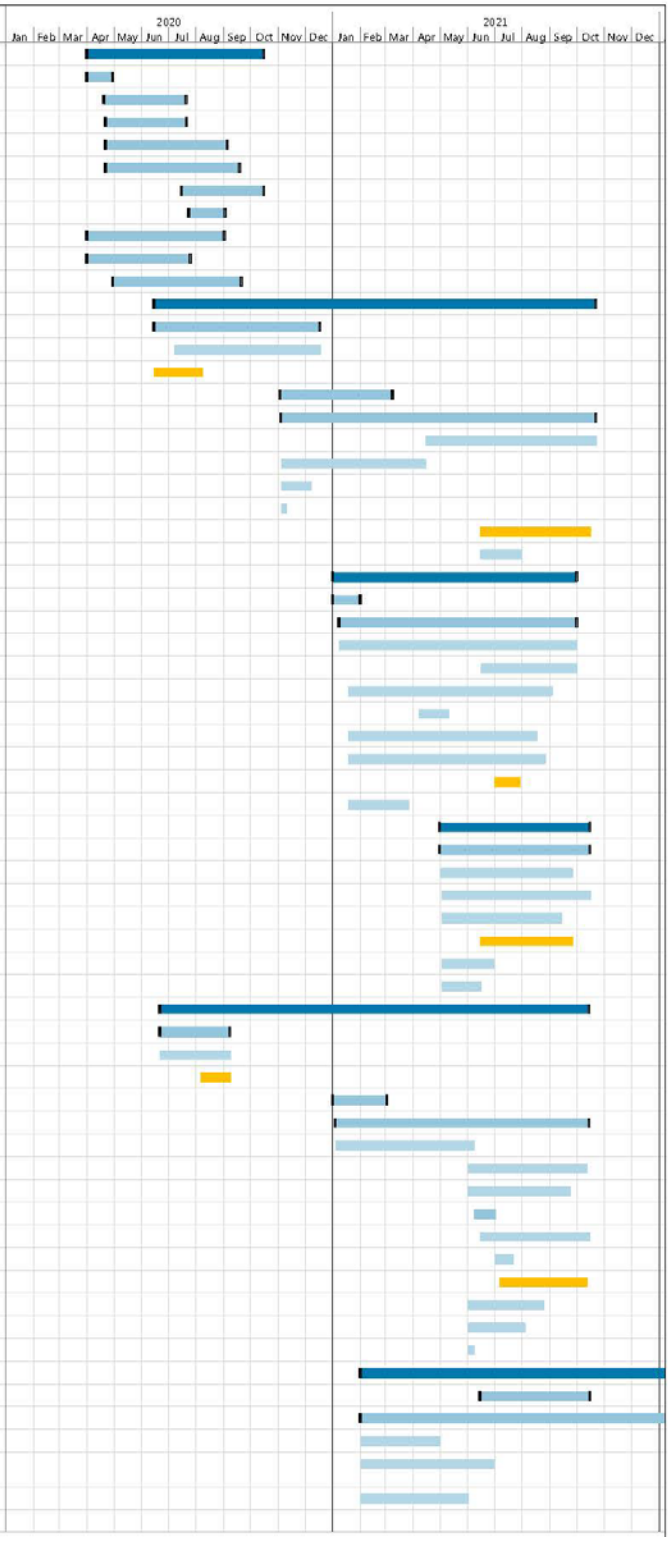

Figure 8.6-1 Summary Construction Schedule

Chapter 9: References

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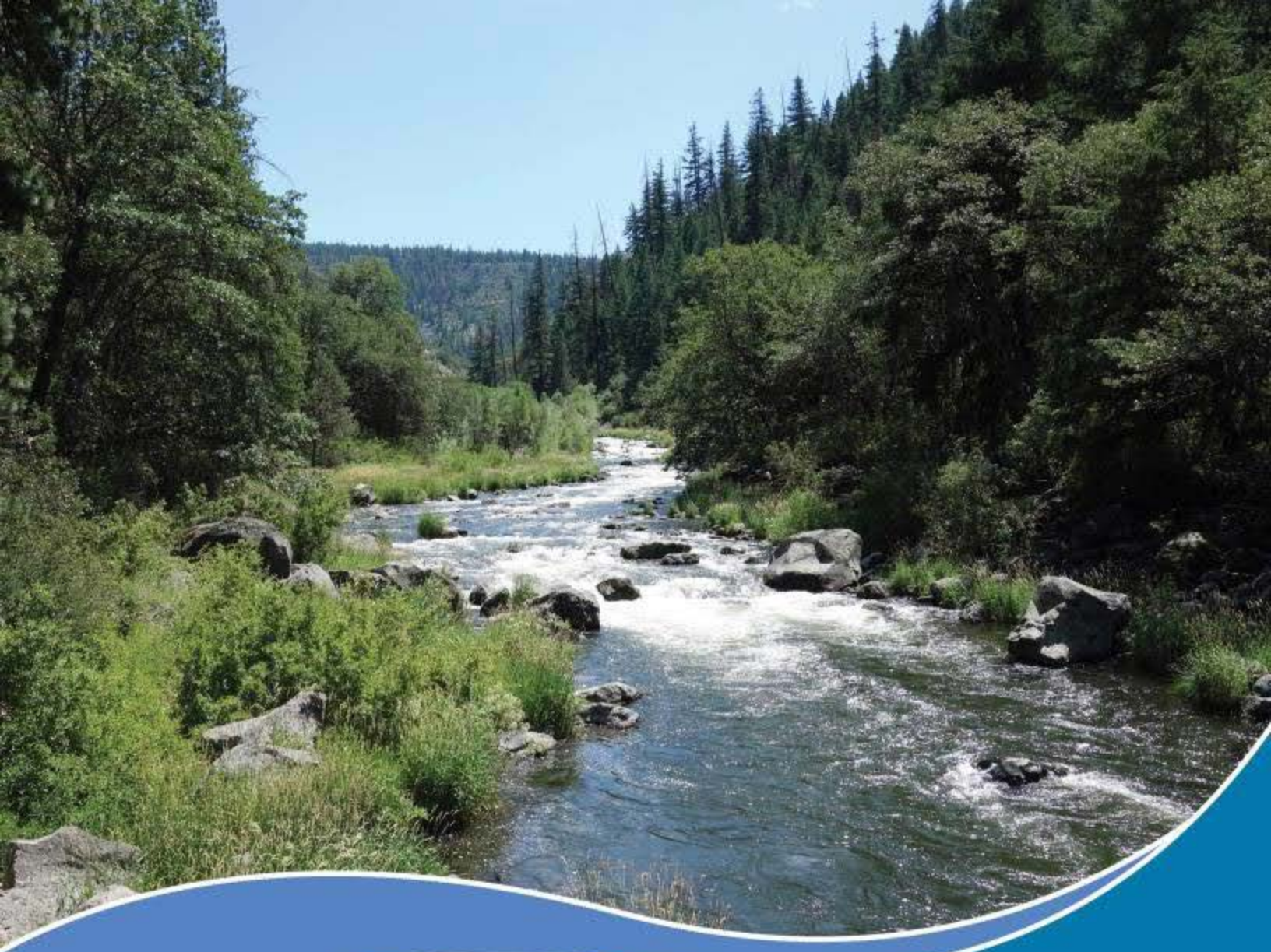

Definite Plan for the Lower Klamath Project

Appendix A – Risk Management Plan

KLAMATH RIVER RENEWAL CORPORATION

June 2018

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Attachment A Risk Register

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Acronyms and Abbreviations

BOC	Board of Consultants
CA	California
CEQA	California Environmental Quality Act
CMAR	Construction Manager at Risk
cfs	cubic feet per second
DB	Design-Builder
DSOD	California Division of Safety of Dams
DWR	Department of Water Resources
EAP	Emergency Action Plan
FERC	Federal Energy Regulatory Commission
ID	Identification
KRRC	Klamath River Renewal Corporation
NEPA	National Environmental Policy Act
PFMA	Potential Failure Modes Analysis
QA	Quality Assurance
QC	Quality Control

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Chapter 1: Plan Objectives and Background

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1. PLAN OBJECTIVES AND BACKGROUND

1.1 Plan Objectives

The implementation of any project comes with uncertainty and risk that can affect schedule, budget, and project performance. This is even more applicable to large, multi-disciplinary and high profile projects. Successful implementation includes planning to identify and manage those uncertainties and risks. Section 7.2 of the Klamath Hydroelectric Settlement Agreement (KHSA), as amended, sets forth the essential elements of a risk management plan to be included in and implemented as part of the Definite Plan. These elements include the following:

- Insurance, performance bond, or similar measures as required by Appendix L to the KHSA
- Accounting procedures that will result in the earliest practicable disclosure of any actual or foreseeable cost overrun
- Appropriate mechanisms to modify or suspend performance of any task subject to such cost overrun; and
- Measures to reduce risks of cost overruns, delays, or other impediments to dam removal

This plan addresses these requirements as follows:

- Section 2 identifies the insurance, bonds and other surety arrangements to be secured by the Klamath River Renewal Corporation (KRRC) in compliance with Appendix L to the KHSA
- Section 3 identifies KRRC's preferred progressive design-build project delivery method and plan for a competitive process for selecting its dam removal contractor, and negotiation of construction agreements
- Section 4 includes a design and construction risk register and measures to reduce risks of cost overruns, delays, or other impediments to dam removal

The objective of this Risk Management Plan is to provide a tool and processes to identify and quantify the design and construction risks that are particular to the Lower Klamath Project (Project), assign those risks to the appropriate party, develop design and construction risk management strategies to reduce or eliminate the risk, and to manage and re-evaluate the risks as we progress through the project lifecycle.

1.2 Project Background & Overview

The proposed Project is described in Sections 4 through 7 of the Definite Plan, and generally includes the decommissioning and full removal of four dam developments (Iron Gate, Copco No. 1 and No. 2, and J.C. Boyle) on the Klamath River approximately 200 miles from the Pacific Ocean in the states of Oregon and California by the KRRC. Figure 1.2-1 provides an overview of the Klamath River watershed and the locations of the four dams. The Project objectives are to restore free-flowing river conditions and volitional fish passage by the complete removal of dams, power generation facilities, water intake structures, canals, pipelines, and ancillary buildings. The Definite Plan also describes a partial removal alternative which is presented for purposes of environmental review. Under the partial removal alternative, the objectives of a free-flowing river conditions and volitional fish passage would be achieved, but portions of each dam would remain in place, along with ancillary buildings and structures such as powerhouses, foundations, tunnels, and pipes.

Prior to removal of the dams and hydropower facilities, the KRRC will drawdown the water surface elevation in each reservoir as low as possible to facilitate accumulated sediment evacuation and to create a dry work area for facility removal activities. In order to meet drawdown timing and duration, specific infrastructure modifications are required at Iron Gate and Copco No. 1 dams in advance of drawdown. In general, drawdown will begin on January 1 of the drawdown year, and will extend through March 15 of the same year.

After drawdown is accomplished, dam and hydropower facility removal will begin, and the KRRC will stabilize remaining reservoir sediments to the extent feasible. Full reservoir area restoration will begin after drawdown, and extend throughout the year, and possibly into the subsequent year. Vegetation establishment could extend several years.

Other key project components include measures to address aquatic and terrestrial resources, road and bridge improvements, relocation of the City of Yreka's pipeline across Iron Gate Reservoir and associated diversion facility improvements, flood improvements downstream, as well as demolition of various recreation facilities adjacent to the reservoirs.

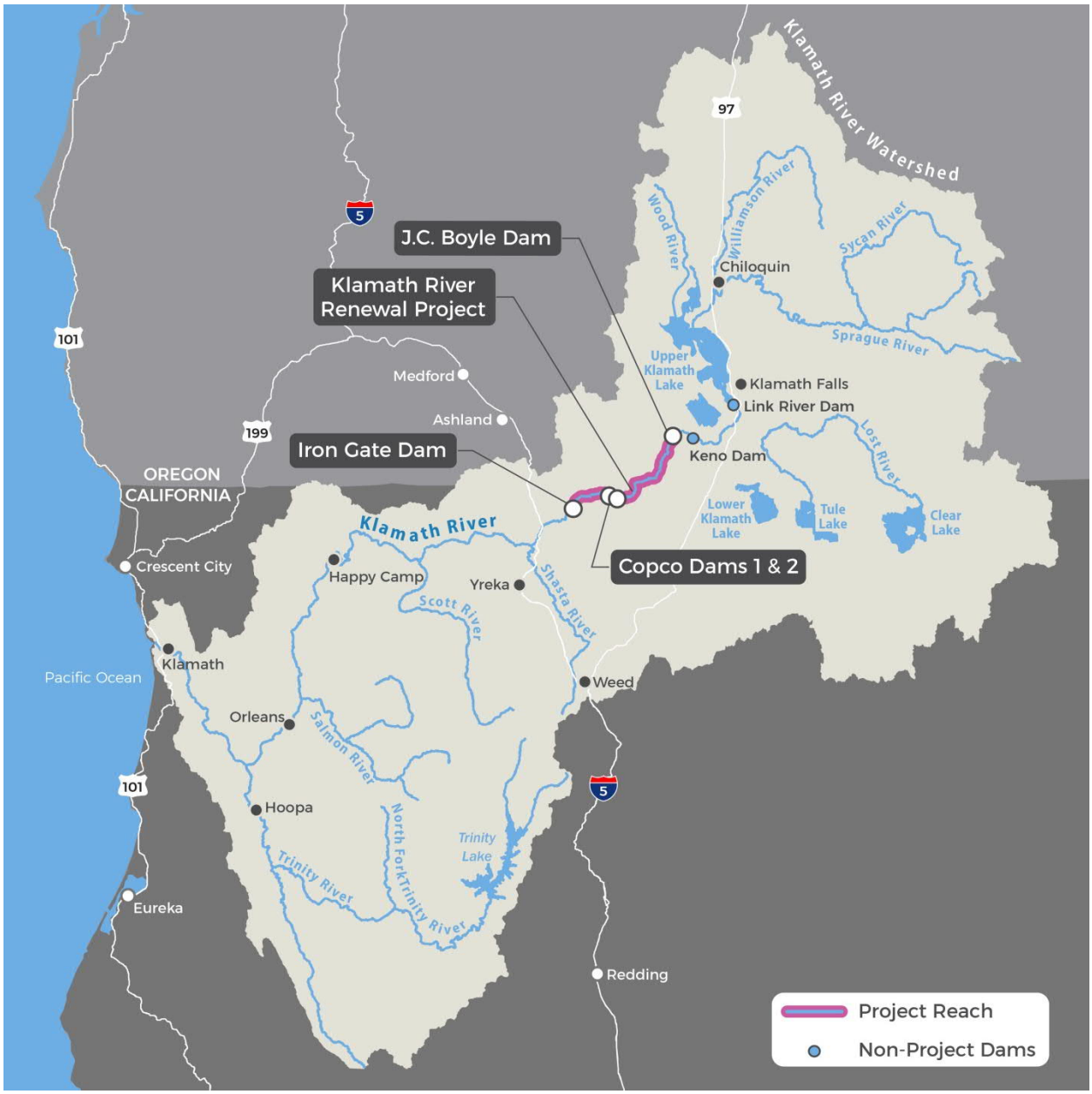

Figure 1.2-1 Klamath River Watershed and Facilities Locations

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Chapter 2: Insurance, Bonds and Other Surety Arrangements

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2. INSURANCE, BONDS AND OTHER SURETY ARRANGEMENTS

2.1 Overview

This section of the Risk Management Plan identifies the insurance, bonds and other surety arrangements that KRRC will maintain in fulfillment of its obligations under Appendix L of the KHSA and prudent business practices. KRRC developed this plan with specialized guidance and advice from Willis Towers Watson (Willis). Willis is a global firm that provides a wide range of insurance brokerage, reinsurance, and risk management consulting services1. Working with Willis as its insurance advisor, KRRC has established and will maintain a robust insurance program to minimize liability risks to the Project and to KRRC.

2.2 Insurance

2.2.1 Overview

KRRC will maintain two insurance programs, each of which will be designed to address different insurance needs and requirements over time. Prior to the commencement of dam removal activities, the insurance currently maintained by KRRC is best viewed as a corporate insurance program that is intended to address KRRC's general risks as a business entity (discussed below as the Corporate Insurance Program). The project-specific insurance needs and requirements in connection with the proposed Project cover a broader range of risks, and are directly responsive to the requirements of Appendix L to the KHSA (discussed below as the Project Insurance Program).

2.2.2 Timing

KRRC's Corporate Insurance Program is in place and is described below. KRRC's project-specific coverages will be established and implemented as part of the dam removal contractor procurement process. KRRC will incorporate these coverages in the RFP for KRRC's dam removal contractor and will be incorporated into the dam removal contract that is ultimately executed by KRRC and the dam removal contractor. KRRC has begun the process of introducing insurers to the Project, with an eye toward selecting the insurer or insurers that offer the best options for project coverage. This will be determined after the insurers have completed their review of the Project.

Once the scope, limits and providers of the project coverages have been finally determined, the actual insurance policies will be put in place in coordination with the beginning of the dam removal work to which

[1] Additional information regarding this firm may be found at https://www.willistowerswatson.com/en/about-us/overview

they relate, including certain preliminary site work. For example, insurance for design work will be in place at the time the dam removal contract becomes effective, as KRRC contemplates a design-build contract structure. Insurance for the actual removal activities may not be in place until removal work is ready to commence.

2.2.3 Corporate Insurance Program

KRRC intends its Corporate Insurance Program to address KRRC's general risks as a business entity and includes the following:

- $1,000,000 Commercial General Liability policy which is supplemented by a $5,000,000 Umbrella policy
- $10,000,000 Directors and Officers policy that protects the KRRC's board members
- Worker's Compensation and Employer's Liability policy with a $1,000,000 limit for the KRRC employee(s)
- Commercial Automobile policy with $1,000,000 in limits
- Commercial Property policy that covers the KRRC's scheduled property

KRRC's liability insurance policies name PacifiCorp, the State of Oregon, the State of California, and their respective officers, agents, employees, and members as additional insureds in accordance with the requirements of the Amended KHSA. Certificates of insurance evidencing that policies of insurance providing such provisions, coverages, and limits as set forth above are included as Appendix B.

2.2.4 Project Insurance Program

The Project Insurance Program will be an "owner controlled insurance program" or OCIP for purposes of securing certain project coverages. Under an OCIP, the owner establishes a Commercial General Liability and Umbrella insurance program in which contractors and subcontractors enroll for coverage, rather than requiring each contractor or subcontractor to procure insurance independently. The net result is a more comprehensive, seamless and efficient insurance program which precludes insurers from denying coverage based on a claim that a different insurer is responsible. By consolidating the risks into a single insurance program, this approach best removes cross-litigation costs caused by multi-party losses on a construction project. This is because the same policy essentially covers each contractor and subcontractor.

An OCIP also allows the project sponsor/owner to control and design the coverage it intends to procure and the cost of coverage. Specific decisions regarding which policies to purchase, when to purchase them, and what insurance limits to obtain are largely driven by the timing and structure of the dam removal. That said, KRRC sets forth below the current expectations regarding its project-specific insurance program.

While KRRC will base the final project-specific insurance requirements on KRRC's discussions with potential insurers and the development of the dam removal contractor RFP, KRRC expects to secure the following project-specific coverages:

- Commercial General Liability (CGL): KRRC will obtain primary Commercial General Liability coverage with limits of $2,000,000 per occurrence and $4,000,000 general aggregate. This policy will be dedicated to this Project. The policy will extend liability coverage to the dam removal contractor and all eligible subcontractors for their work at this Project. The policy will also respond to third-party damage from the construction activity after the Project. This tail coverage will last for ten years or to the statute of repose for the respective state of construction operations. This tail coverage will trigger once the Project has reached substantial completion.
- Umbrella Liability: The OCIP by an Umbrella Liability policy of $200,000,000 in limits will augment the liability coverage provided by KRRC's CGL policy. This policy will follow the terms and conditions of the underlying primary CGL. This Umbrella limit will cover all enrolled parties, which is an added value for smaller subcontractors that cannot afford such high limits.
- Worker's Compensation/Employer's Liability: KRRC will require that all contractors and subcontractors maintain at all times Worker's Compensation and Employer's Liability coverage. This coverage will be maintained in the amounts no less than the applicable statutory requirements for Worker's Compensation and $1,000,000 for Employer's Liability. Because this coverage is statutory, it is not efficient to include it in the OCIP, which each contractor and subcontractor will procure directly.
- Commercial Automobile Liability: KRRC will require that all contractors and subcontractors maintain auto liability insurance limits no less than $1,000,000 combined single limit per accident for bodily injury and property damage. This coverage will also be outside the OCIP and KRRC's contractors and subcontractors will procure it directly to cover all owned, leased and non-owned vehicles used in connection with the work.
- Builder's Risk/Inland Marine or Commercial Property Insurance: Builder's risk insurance is a type of insurance typically associated with vertical construction where an improvement is increasing in value and where the cost of restoration increases as the Project progresses, such as the construction of an office building. In procuring it for a dam removal project, a slightly unconventional analysis will apply to determining prudent limits of coverage. KRRC anticipates obtaining coverage for 100% of the replacement value of any salvaged material or property. KRRC will purchase builder's risk as a project-specific property coverage.
- Contractor's Pollution Liability (CPL): KRRC anticipates that coverage of up to $100,000,000 limits will be included as part of the project program. It will be a dedicated policy covering all contractors and subcontractors at the project site with no enrollment process.
- Fixed Site Pollution Liability: KRRC will acquire this coverage outside the OCIP and will go into effect when KRRC acquires title to the dam facilities and will be in an amount up to $100,000,000. It is the intent to underwrite this policy with the same insurers and in conjunction as the CPL policy to address any pre-existing environmental damages.

- Professional Liability/Errors and Omissions Insurance: This coverage will be required under the terms of KRRC's design contract procurement, whether on a stand- alone basis or as part of a design-build procurement. It will go into effect when KRRC retains the design professional. KRRC expects the coverage limits to be up to $25,000,000. In addition, KRRC will consider whether to purchase an Owner's Protective Professional Indemnity (OPPI) insurance policy as a back-stop to all the design professional's' liability available limits coverage. KRRC will make this decision based on the size, experience and financial strength of the selected design team and their respective insurance limits available to the Project. Coverage limits selected may be as high as 20-40% of the value of construction.

These policies name PacifiCorp, the State of Oregon, the State of California, and their respective officers, agents, employees, and members as additional insureds in accordance with the requirements of the KHSA. KRRC will provide certificates of insurance evidencing that policies of insurance providing such provisions, coverages, and limits as set forth above to PacifiCorp and the States before any contract for dam removal is effective and before dam removal work begins.

2.2.5 Independent Board of Consultants

The Board of Consultants (BOC) will review the forgoing insurance coverages. The BOC includes a member or members with expertise in insurance coverage and bonding for large and complex civil construction projects. KRRC will implement any further recommendations that the BOC may provide with respect to the foregoing insurance coverage.

2.2.6 Ongoing Evaluation

KRRC and Willis will review all policies of insurance on a not-less-than-annual basis to make sure that they are sufficient and cost effective relative to other insurance products and risk management tools as may subsequently become available.

2.3 Bonds

2.3.1 Requirements and Timing

Appendix L to the Amended KHSA addresses bonding requirements. Bond requirements include bid bonds, performance bonds (in an amount equivalent to original contract value) and payment bonds (in an amount equivalent to original contract value). These bonds will be secured in connection with awarding contracts to undertake decommissioning activities. One or more of KRRC's vendors and contractors will maintain these bonds (and/or parent company guaranty or standby letter of credit). KRRC will require that all bonds be obtained from financially sound surety companies.

2.3.2 Performance Bond

The performance bond securing the contractor's performance under the dam removal contract will be in the full amount of the dam removal contract. The contractor's surety company issuing the bond will determine the form of bond: however, AIA Form 312 is the predominant form in use at this time. To the extent alternate forms are used, they will be substantively similar.

2.3.3 Independent Board of Consultants

The BOC will review and approve its proposed bonding requirements. KRRC will implement any further recommendations that the BOC may provide with respect to bonding requirements. Because the performance bond backstops the dam removal contractor's performance, it cannot be issued until the dam removal contract is in place and will be issued at that time.

2.3.4 Ongoing Evaluation

As with insurance, KRRC and Willis will periodically review the amount and form of bonds (and/or parent company guaranty or standby letter of credit) to make sure that they are sufficient and cost effective relative to other products and risk management tools as may subsequently become available.

2.4 Specialty Corporate Indemnitor

2.4.1 Overview

Appendix L to the KHSA requires KRRC to identify and contract with a specialty corporate indemnitor (a Liability Transfer Corporation, or LTC) to protect the states of Oregon, California and PacifiCorp from potential liability that may be uninsurable or underinsured. KRRC will fulfill this requirement in consultation with the States and PacifiCorp and in connection with the design and implementation of the insurance program discussed above. KRRC will use this risk management tool to address certain risks not covered by KRRC's insurance Program. Parameters established by the KHSA to assess the sufficiency of a corporate indemnitor include:

- Appropriate capitalization (as agreed to by the States and PacifiCorp)
- Performance in projects of similar scope, magnitude, complexity and type
- Experience with federally regulated permitting processes
- Longevity in the industry

This requirement will be fulfilled in connection with the selection of the design-build contractor hired to implement the Definite Plan.

2.4.2 Structure and Timing

The LTC can be structured contractually, through third-party indemnities or potentially with additional special insurance products. The LTC may perform portions of the Project and will assume responsibility for various project risks, both during project execution and post-project (including the fulfillment of any long-term mitigation obligations established by the Definite Plan or regulatory approvals). The "gap" between the general responsibilities to be assumed by the general contractor and the program of required insurance has yet to be determined. Defining and filling this gap is an ongoing process, as KRRC seeks to better define construction costs, measures to lower construction costs, and measures to manage construction risk. KRRC expects to fulfill this requirement concurrently with the execution of the contract for dam removal.

2.4.3 Independent Board of Consultants

The BOC will review the potential and appropriate risks that may be transferred to a LTC. KRRC anticipates obtaining BOC guidance on this risk management tool concurrently with its efforts to identify a proposed contractor and negotiate a progressive design-build contract with a guaranteed maximum construction price. KRRC's final decision on how best to use this risk management tool is, however, subject to the approval of the states of Oregon, California and PacifiCorp, in consultation with the Federal Parties, whose approval may not be unreasonably withheld.

Chapter 3: Project Delivery Method

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3. PROJECT DELIVERY METHOD

3.1 Overview of Progressive Design-Build Delivery Method

KRRC is pursuing a competitive process for selecting its dam removal contractor, or design-builder. KRRC contemplates structuring the dam removal contract as a progressive design-build contract under which, after selection, the designated design-builder will then spend six to nine months studying the project area and designing its removal program before the final guaranteed maximum price is locked in. KRRC expects this design process to begin in the first quarter of 2019. When KRRC finalizes the cost of the dam removal work under the contract through the negotiation of a guaranteed maximum price, the circumstances that most often lead to cost overruns for which the owner remains responsible - unknown site conditions – while not eliminated will have been significantly narrowed even beyond where it is today. As a result, final pricing will be determined prior to KRRC's acceptance of the project license.

The progressive design-build contract KRRC expects to enter into will provide that one overall contractor will complete both design and deconstruction on an integrated basis and will assure that, absent contractually defined uncontrollable circumstances, the work will be performed with minimal cost overruns. Thus, any project costs incurred within the defined work scope that are in excess of the guaranteed price will be the responsibility of the project contractor, not KRRC.

In addition to committing to a guaranteed maximum price, the project contractor will agree to complete the Project and perform the work to specified technical standards by a guaranteed completion date. Proposers will be required to include detailed proposals on their proposed means and methods of dam removal, consistent with regulatory requirements. Means and methods that offer greater promise of lessening potential liability or lowering costs can be scored higher in determining the proposal offering the best value. Daily liquidated damages will be payable to KRRC for unexcused delays, and KRRC will not be responsible for any cost overruns except those caused by predetermined risks that are outside the project contractor’s ability to reasonably manage and control. A qualified construction-management entity will oversee the performance of the dam decommissioning and removal work under the project agreement.

This integrated project-delivery approach will be particularly useful for the Project because it will mitigate several elements of project-completion risk, in addition to the general price risk inherent in all construction projects. Integrated project delivery involves a self-selected team of highly qualified firms whose business interests are aligned, thus decreasing the risk of disputes among team members. By addressing multiple aspects of the work in a single contract, integrated project delivery also has the key advantage of creating one point of accountability for the Project, allowing KRRC to bring a claim against a single entity for any flawed work. Furthermore, considering that dam removal is a specialized area, integrated project delivery gives the prequalified entity the opportunity to make an innovative and cost-effective proposal to execute the work. Additional benefits of integrated project delivery include accelerated project delivery and improved project quality.

3.2 Risk Transfer

Risks transferred to the project contractor under the project agreement will include the risk of unexcused delays; unexpected work that the project contractor needs to perform to carry out the basic work scope; unavailability of materials; non-compliance with the decommissioning plan, applicable law and governmental approvals; intellectual property infringement; and the risk of exacerbating any existing hazardous substances or other pollution conditions. These risks are regarded in the industry as within the control of the project contractor team and are generally assumed contractually by the contractor without adding a risk premium to the contract price. KRRC will retain the risk of any delays caused by (i) uncontrollable circumstances (such as changes in law, force majeure, the discovery of cultural relics, and dam conditions unknown at the time the contract is entered into); (ii) any work scope changes directed by KRRC; and (iii) the inaccuracy of any information provided by KRRC to the project contractor that formed the basis of the decommissioning plan and that could not reasonably be verified by the project contractor.

3.3 Retained Risk; Project Contingency

If accurate information is supplied to the project contractor, no scope changes are requested by KRRC after contract execution, and no uncontrollable circumstances occur, the project contractor will be obligated to complete the Project for the guaranteed maximum price (which is based on competitively bid elements of the construction work) established at contract signing. On the other hand, if any of the risks retained by KRRC occur, KRRC as the project owner will bear the costs. Accordingly, the project budget will include an appropriate contingency reserve for any such risks, and KRRC will use insurance and other mechanisms to manage these risks.

Section 2.6 of Appendix P of the Definite Plan discusses contingency reserves, based on updated construction costs and are summarized here. A design contingency was set at 10% of the construction cost, which is a typical value for a level of design presented in the Definite Plan. In addition, KRRC used a value of 20% of the construction cost for construction contingencies for the dam removal estimates, which is a typical value for this stage of project development. KRRC applied the design and construction contingencies (total of 30%) as a percentage of construction cost and added to the overall estimate of project costs. Based upon current project cost estimates, KRRC applied design and construction contingencies of approximately $58 million and $68 million to the partial removal and full removal alternative estimates of project cost, respectively.

3.4 Contractor Selection Process

KRRC will choose the project contractor using a two-stage qualifications-based-selection (QBS) process. The first stage will involve a request for qualifications (RFQ), and the second stage will involve a request for proposals (RFP). QBS standards during the RFQ will include:

- Past performance of similar projects in scope, magnitude (complexity and size, such as but not limited to performance of work at multiple locations at the same time), and type (waterway work; environmentally regulated, etc.)
- Sufficient financial strength, including basic financial metrics such as corporate net worth and profitability
- Experience with federally regulated permitting processes
- Longevity in industry.

KRRC will invite three or four pre-qualified firms to make project submittals on a competitive proposal basis in response to a RFP issued by KRRC. KRRC will set forth the requirements for making project proposals in the RFP and will base them on the terms of the Definite Plan. KRRC will select the proposer submitting the best value proposal (best overall price and technical merit) to perform the work and enter into a comprehensive project agreement with KRRC. The states of California and Oregon and PacifiCorp will have the opportunity to review and comment on the selection process and resulting project agreement to assure that their interests are protected and that the project work will be properly carried out. KRRC may divide the work into two or three segments, contracted separately, as determined by KRRC to be in its best interests.

3.5 Performance Security; Indemnities

Section 2.3 addresses performance security and indemnities. The project contractor will furnish a conventional performance bond from a financially sound surety company, further assuring KRRC that the contractor will perform the project agreement as required. As an alternative, or in addition to a performance bond, KRRC may also ask the project contractor to provide a parent company guaranty or to furnish a standby letter of credit securing performance of the project agreement. KRRC will have the right to call upon any such guaranty or to draw on any such letter of credit if a project contractor fails to perform and use the proceeds to pay any non-performance damages it is owed under the project agreement. The project contractor will also indemnify KRRC for any loss or expense incurred by third parties resulting from an unexcused breach of the contract or any negligence or willful misconduct by the contractor. Each party, as is conventional in contracts of this nature, will waive the right to make a claim for punitive or consequential damages.

3.6 Construction Management

A qualified construction-management entity will provide oversight of the project contractor, including detailed design review and full construction-management services throughout the duration of the project agreement. The construction manager will participate in the contractor's design development meetings and will review all final design documents developed by the contractor. KRRC anticipates detailed reviews at the 60%, 90% and 100% completion levels, as well as review of final Construction Documents (plans, specifications, design report and cost estimate). The construction manager will be involved in recurring activities such as progress meetings, pay estimates, weekly progress reporting, and schedule updates. These recurring activities are the

basic machinery for transferring information, making decisions, and identifying potential risks during construction. The construction manager will meet weekly with the contractor to review the current status of completed work onsite. The contractor will prepare and KRRC will review and approve a written safety plan that the selected contractor would be required to follow, thus providing a uniform approach toward project safety.

3.7 Independent Board of Consultants

The BOC will review project documents as well as dam removal schedules, plans and specifications, staging sequence, and supporting engineering studies. KRRC will incorporate any recommendations with respect to the proposed project delivery method into its project documents, contractor selection process, and project management procedures.

Chapter 4: Design & Construction Risk Register

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4. DESIGN & CONSTRUCTION RISK REGISTER

4.1 Overview

This Section identifies construction risks (in the form of a risk register) and estimates their likelihood and consequences of occurrence, ranking those risks to determine which pose the greatest risk to the Project, and developing risk management strategies for the highest ranking risks. The risk register will be a living document prepared with the participation of the full project team (KRRC, consultants, stakeholders, etc.) eventually including the Design-Builder (DB) or Contractor. This draft plan is based on the Project as it has been described and developed in the Federal Energy Regulatory Commission (FERC) Definite Plan for Decommissioning (KRRC 2018) (Definite Plan).

The plan will be updated periodically by the full project team to add newly identified risks, and adjust risks that have been previously identified either upward or downward.

The risk register identifies design and construction risks as they are recognized throughout the duration of the Project. KRRC has assigned each identified risk its own unique Risk identification (ID) number and categorized into one of seven risk categories, which are described in further detail in Section 4.2. Risk ID numbers are not necessarily sequential, since they were derived from an initial broader list that may not have all moved forward. The register also includes specific information and data associated with each risk as follows:

- A description of the risk
- The root cause(s) of the risk
- The risk's relationship to the four phases of the Project
- The primary impact aspect of the risk
- The likelihood (probability) that the risk will occur
- A rating of the impact or consequence if the risk event occurred
- A risk score (rating) by combining the likelihood and related consequence
- A summary of risk management measures
- The assigned owner of the risk

As the risk register is further developed and implemented, responsible parties from the Owner and DB will be assigned to further define and implement risk management measures identified for each risk. As risks are avoided or mitigated, or as new relevant information is obtained, risk category, score and rating will be updated to reflect the latest information.

Since the risk register will evolve and KRRC will update it throughout the life of the Project, ongoing assessment and reporting will be necessary. Reporting and other continuing risk management activities are discussed in Section 4.8.

4.2 Risk Category

KRRC has categorized each risk into one of the following general categories:

1. Environmental – These are design and construction risks primarily related to environmental aspects of the Project. Environmental aspects and associated risks could involve existing or future biological, cultural or other environmental conditions/species, potential construction related effects such as air quality or noise, or potential downstream environmental effects.
2. Permitting – Risks that are primarily related to environmental compliance and permitting. This includes process-related considerations, requirements associated with compliance and acquisition of all necessary regulatory permits.
3. Design – These are risks primarily related to development of the project design and subsequent performance of associated Project features. Risks could involve performance failures as a result of incorrect assumptions or calculations, incomplete or inaccurate drawings and specifications, etc.
4. Procurement and Construction - Risks primarily related to the procurement of a DB or Contractor, and with actual construction of the Project including labor, equipment, material, existing conditions, subsurface conditions, site safety, etc. Procurement related risks could involve the procurement process and/or contract negotiation. Construction related risks could involve DB quality of work or production, as well as health and safety.
5. Operations and Maintenance - Risks primarily related to post-construction project performance and maintenance. The project team anticipates minimal long-term operations and maintenance requirements.
6. External - These are risks primarily related to events or conditions outside of the control of the Project, such as unforeseen site conditions, forces of nature (e.g. floods and wildfires), etc.
7. Organizational - These are risks primarily related to the project organization, governance and associated constraints such as financing/funding, access agreements, funding agreements, transfer agreements, etc.

4.3 Phases

Each identified risk will exist during particular phases of the Project. The Project phases include the following:

1. Planning: The period until KRRC selects a DB for implementation. Activities during the Planning phase include data collection, preliminary field investigations, preliminary design, permitting and regulatory consultation and application development, contract work packaging to define the

intended scopes of work to most efficiently achieve the project schedule and other project objectives, selection of the appropriate project delivery method for each contract work package, and procurement activities for selecting a DB for each work package. Such procurement activities will involve, depending on delivery method, development and preparation of the Requests for Qualifications and Proposals for a DB, evaluation of proposals, and negotiation of the associated contracts.

2. Design: Design is the period during which the detailed and final design of the Project is performed. Activities during this phase include field investigations for final design, final design, permitting activities, and regulatory review and approval of the final design documents.
3. Construction: The period during which construction activities to implement the final design actually take place. Activities during the Construction Phase include mobilization, preparation of the site, pre-reservoir drawdown construction activities, other early construction activities, dam and appurtenances demolition activities, followed by site restoration.
4. Post-Construction: The period following dam removal and site restoration.

The risk register shows each risk in relation to the four phases (see Figure 4.3-1 for example). Phases during which the risk could be realized are indicated by red, and earlier phases during which risk mitigation can be developed and implemented are indicated by yellow.

Risk ID	Risk Category	Phase	Risk Description	Root Cause(s)	Planning Phase	Design Phase	Construction Phase	Post-Construction Phase
19	Proc & Const	Construction	General changed field condition (geotechnical, existing utilities, hazardous materials, and biological resources) leads to redesign, project delays and/or cost overruns	Field condition differs from documented findings	M	M	A	
20	External	Construction	Wetter-than-expected weather during construction increases costs and causes delays	Climate change; Hydrology	M	M	A	

Note: M = period when management strategies are developed; A = period when risk may be actualized

Figure 4.3-1 Risk Register Phases Designation Example

4.4 Primary Aspect of Risk

For additional classification and subsequent data processing, KRRC categorized each identified risk as one of four primary risk aspects as follows:

1. Time: The consequence of the risk is greatest with respect to the project schedule.

2. Cost: The consequence of the risk is greatest with respect to the project budget.
3. Safety: The consequence of the risk is greatest with respect to the safety of workers and the public.
4. Environmental Impact: The consequence of the risk is greatest with respect to the environment.

Any risk will include more than one of the four aspects. The categorization by aspect is a tool to help assess the risk in these four different areas.

4.5 Risk Score and Rating

The risk score and rating is a function of the probability of the risk occurring and the consequence if the risk were to occur. Probability of occurrence is broken into five different categories to provide sufficient ranges of likelihood, as listed below:

- Probability Score of 5: Risk has a 60% or greater probability of occurrence, meaning it is very likely to occur
- Probability Score of 4: Risk has a 40 to 59% probability of occurrence, meaning it is likely to occur
- Probability Score of 3: Risk has a 20 to 39% probability of occurrence, meaning it is less likely to occur
- Probability Score of 2: Risk has a 10 to 19% probability of occurrence, meaning it is unlikely to occur
- Probability Score of 1: Risk has a less than 10% probability of occurrence, meaning it is very unlikely to occur

Consequence of the risk occurring is also broken into five different categories to provide sufficient ranges for the consequences of impact. Since impacts for various risks can apply to one or more aspects or categories, it can be difficult to quantify all risks using the same metric (e.g. cost increase in $, etc.). For that reason, engineering and management judgment is involved when assigning consequence of impact scores. A high level of coordination and collaboration among key project decision makers is necessary for assigning consequence of impact scores. Table 4.5-1 provides some general guidance on consequence of impact scores under aspect categories identified in Section 4.4.

The risk score is calculated by multiplying the probability of risk by the consequence of impact, and then categorizing or rating the risk as low, moderate, or high as shown on the risk score matrix in Table 4.5-2. As shown in the risk score matrix, any risk that has a consequence of impact score of 5 is categorized as a very high risk.

Table 4.5-1 Consequence of Impact Definition for Various Aspects

	CONSEQUENCE OF IMPACT				
PRIMARY ASPECT	Very Low (1)	Low (2)	Moderate (3)	High (4)	Very High (5)
Time	No or little impact to schedule	Schedule delay of less than 3 months	Schedule delay of 3 to <6 months	Schedule delay of 6 to 12 months	Schedule delay of more than 12 months
Cost	<$1M	$1M-$5M	$5M-$10M	$10M-$30M	$30M-50M
Safety	No or little impact to public safety	Number of individuals exposed to minor safety risk less than 5	Number of individuals exposed to minor safety risk greater than 5	Number of individuals exposed to serious safety risk less than 5	Number of individuals exposed to serious safety risk more than 5, or any life threatening risk (1 or more)
Environmental Impact	No significant impact to any environmental resource	Short-term impact that is insignificant	Short-term impact that is significant. Long-term impact that is insignificant.	Long-term significant impact to non-listed species	Long-term significant impact to fisheries or listed species

Table 4.5-2 Risk Score and Ranking Matrix

Probability of Occurrence	5 (60-100%)	5	10	15	20	25
	4 (40-59%)	4	8	12	16	20
	3 (20-39%)	3	6	9	12	15
	2 (10-19%)	2	4	6	8	10
	1 (1-9%)	1	2	3	4	5
		1	2	3	4	5
		Consequence of Impact				

4.6 Risk Status

As the Project develops and is implemented, the status of identified risks will be assigned using the following codes:

1. Open: risks that continue to pose a threat for the Project. These are risks that may or may not have occurred that will not expire until some future date
2. Managed: risks which have had risk management measures implemented such that the likelihood of occurrence or consequences of occurrence has been reduced to a level that the Project can accept in the event the risk occurs
3. Expired: risks that may, or may not, have occurred but no longer pose a threat to the Project. When a risk expires, the probability becomes zero thereby making the risk score zero

4.7 Risk Strategy

During development and implementation of the Project, KRRC will assign the risk strategy to identified risks using the following codes:

1. Manage: Risk management seeks to reduce the likelihood of the risk occurring and/or the consequence of the risk, should it occur.
2. Avoid: Avoidance of the risk eliminates the likelihood of the risk occurring and/or the consequence of the risk, should it occur.
3. Transfer: Transference of the risk makes the risk either partially or completely another party's responsibility.
4. Accept: Acceptance recognizes that the risk cannot be fully managed, avoided, or transferred.
5. Shared: Shared risk means that the liability associated with the risk can be partially transferred (as described above), but certain aspects of the risk remain with the KRRC and will need to be managed, avoided or accepted.

4.8 Continuing Risk Management

As mentioned above, KRRC will update the risk register throughout the life of the Project, involving ongoing assessment and reporting. The project team will manage and track the risk register through all phases of the Project.

Once KRRC selects a DB, they will be required to develop their own risk register, which will focus solely on the design and construction phases of the Project.

4.8.1 Risk Workshops

Subsequent to the initial identification of risks, KRRC will conduct a series of risk workshops at strategic points throughout the Project duration. The goal of these risk workshops will be to further update and refine risks, conduct evaluations and explore mitigation opportunities, while engaging new partners in the Project and the risk management process. Possible times for subsequent risk workshops may include:

- After the CEQA Draft Environmental Impact Report public review period ends
- After the Board of Consultants 2018 review of the Definite Plan is complete
- Upon engagement of Progressive Design-Builder for design work
- After key permits are issued (e.g. FERC Surrender order)
- Prior to first commencement of significant construction activities
- Midpoint of construction, or prior to significant phase(s) of construction

4.8.2 Monitoring and Control

During each risk management meeting, the attendees will review status, risk score and risk management opportunities for all risks active in the current project phase. Output of the risk management meeting shall be an updated risk register for distribution.

Responsibilities for meeting facilitation and reporting are as follows:

Phase	Responsible	Draft to PM	Final Version
Planning	Owner's Project Manager	-	✓
Design	DB/CMAR Project Manager	✓	-
	Owner's Project Manager	-	✓
Construction	DB/CMAR Project Manager	✓	-
	Owner's Project Manager	-	✓

Project monthly progress reports will include a list of open risks, the status of associated risk management actions, and any changes to action completion dates. A narrative will explain any significant exceptions to risk management action completion dates. KRRC will report any new risks.

KRRC will not delete expired risks (i.e. those that have occurred but no longer pose a threat to the Project) – these will remain on the risk register as closed items, or they will be transferred to a register of expired risks for record purposes.

Planning & Design Phases

At a minimum, KRRC will complete quarterly updates throughout the planning phase, with more frequent updates likely required during the detailed design and construction phases.

Construction Phase

KRRC will hold routine risk management meetings at least once every two months. The owners assigned to risks in the current project phase will attend these meetings.

4.8.3 Closing Risk Registers and Lessons Learned

Closing risk registers involves documenting all managed risks and final impacts on the overall Project. Impacts include, but are not limited to, impacts on project costs and schedule. KRRC will similarly document monitored but unmitigated risks. This information will be available for use on future projects, and can be used to adjust severity and probability indices, better define risk tolerance levels and improve risk management efforts.

The PM will prepare a Lessons Learned Report when the risk register is closed. The primary focus will be to identify activities which were highly effective, effective, partially effective, or not effective, and to recommend ways to improve overall effectiveness for risk management activities.

4.9 Risk Register

The current risk register is included as Appendix A. Each risk is categorized by project phase, and the root cause of each such risk is identified. The risk register identifies the primary aspects of each such risk, as well as probability, impact and weight, and provides an overall ranking for each risk. The risk register identifies a strategy for managing each risk, and risk management measures, where appropriate. Finally, the risk register identifies the risk owner and the status of each risk. As noted above, the risk register will evolve and be updated throughout the life of the Project, involving ongoing assessment and reporting.

Chapter 5: References

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5. REFERENCES

KRRC 2018. Definite Plan for the Lower Klamath Project, Klamath River Renewal Corporation. June 2018.

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Attachment A Risk Register

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Risk ID	Risk Category	Phase	Risk Description	Root Cause(s)	Planning Phase	Design Phase	Construction Phase	Post-Construction Phase	Primary Aspect of Risk	Probability (P)	Impact (I)	Risk Weight (P x I)	Overall Rating	Strategy	Risk Management Measure	Risk Owner	Risk Status
11	Proc & Const	Planning	Bid process or result (if traditional DB) or RFP selection (if progressive DB) is protested	DB(s) not selected protest bid	A				Time	2 Unlikely (10-19%)	3 Moderate	6	Med	Manage	Develop fair bid evaluation process that is clearly defined in RFP; Consider bid preparation stipend: Clearly define bid protest process in RFP.	Owner	Open
12	Proc & Const	Planning	Procurement process fails to result in a contract	Negotiation of contract terms or price fails	A				Time	1 Very Unlikely (1-9%)	3 Moderate	3	Low	Manage	Use prequalification process that values similar experience in reaching cost agreements; Develop fair bid evaluation process that is clearly defined in RFP.	Owner	Open
16	Organizational	Design	Engineer's estimate lower than GMP for PDB or low bids for traditional DBB on smaller work packages	Project perceived as risky; Lack of competition	M	A			Cost	3 Less Likely (20-39%)	4 High	12	Med	Manage	Robust Engineer's estimate to include Monte Carlo analyses; Independent review of Engineer's estimate, Include adequate contingency for project risk; Utilize project delivery method that provides Contractor's progress cost estimates to control budget (PDB or CMAR). Close coordination and transparency on costs and associated assumptions during progress cost estimated prepared by DB or CMAR; Provide contract exit strategy that Owner can terminate for convenience and implement alternate delivery approaches.	Owner	Open
17	Proc & Const	Design	DB Designer/Contractor dispute leads to schedule delays and cost increases	Designer does not have sufficient budget or 'skin in the game'.	M	A	A		Time	2 Unlikely (10-19%)	3 Moderate	6	Med	Manage	Consider contractual measures to maximize design/contractor collaboration such as require Designer to be a partner rather than a subcontractor and provisions that oblige Contractor to continue work even when dispute arises.	PDB	Open
18	Proc & Const	Design	Failure to agree to GMP during detailed design (if PDB or CMAR delivery method)	Disconnect between DB and Owner		A			Time	2 Unlikely (10-19%)	4 High	8	Med	Share	Robust Engineer's estimate to include Monte Carlo analyses; Independent review of Engineer's estimate, Include adequate contingency for project risk; Utilize project delivery method that provides Contractor's progress cost estimates to control budget (PDB or CMAR). Close coordination and transparency on costs and associated assumptions during progress cost estimated prepared by DB or CMAR; Provide contract exit strategy that Owner can terminate for convenience and implement alternate delivery approaches.	Owner / PDB	Open
19	Proc & Const	Construction	General changed field condition (geotechnical, existing utilities, hazardous materials, and biological resources) leads to redesign, project delays and/or cost overruns	Field condition differs from documented findings	M	M	A		Time	3 Less Likely (20-39%)	3 Moderate	9	Med	Manage	Comprehensive field investigation and documentation.	Owner	Open
20	External	Construction	Wetter-than-expected weather during construction increases costs and causes delays	Climate change; Hydrology	M	M	A		Time	2 Unlikely (10-19%)	4 High	8	Med	Accept	Consider defining anticipated rain days in contract as a number greater than average; Contract requirement for contractor plan for wetter-than-expected weather.	Owner / Force Majeure	Open
21	External	Construction	Flows higher than expected during instream construction window leads to schedule delays	Unanticipated river flows	M	M	A		Time	2 Unlikely (10-19%)	3 Moderate	6	Med	Accept	Rigorous flow analyses during planning/design; Set performance requirement in contract (define return period of flow that contractor required to be prepared for).	Owner / Force Majeure	Open
22	External	Construction	Fire in watershed increases erosion and sediment	Lightning; Accidental; Arson; Combined with storm		M	A	A	Cost	2 Unlikely (10-19%)	3 Moderate	6	Med	Accept	Fire Management Plan has been developed and Contractor will be required to prepare their own Fire Management Plan.	Owner / Force Majeure	Open
23	External	Construction	Fire in watershed during construction causes construction delays	Lightning; Accidental; Arson; combined with storm		M	A		Time	3 Less Likely (20-39%)	4 High	12	Med	Accept	Develop and implement emergency response plan for fire management.	Owner / Force Majeure	Open
24	External	Construction	Earthquake damages temporary construction	Earthquake occurs near project	M	M	A		Cost	1 Very Unlikely (1-9%)	2 Low	2	Low	Accept	Consider specifying a contract defined design earthquake for temporary construction.	Owner	Open
25	Design	Construction	Design errors or omissions lead to Project delays or cost overruns	Design error.		M	A		Cost	3 Less Likely (20-39%)	2 Low	6	Med	Transfer	Comprehensive design review; proactive QA/QC.	Owner's Eng	Open
26	Proc & Const	Construction	Construction errors (quality control)	EOR fails to properly inspect or direct work in the field; QC failures	M		A		Cost	3 Less Likely (20-39%)	3 Moderate	9	Med	Transfer	Clear contract requirements; Owner review and enforcement of Contractor QA/QC Plan and rigorous Owner audit and spot testing to confirm results	PDB	Open
27	Proc & Const	Construction	DB unable to obtain construction permits (e.g. County encroachment permits) in time for construction	Poor planning, insufficient communication, difficulty negotiating requirements		M	A		Time	2 Unlikely (10-19%)	4 High	8	Med	Share	Owner coordination with Contractor for proactive communication with Counties; Contingency planning for delayed start during first year of construction	PDB	Open
29	External	Construction	Quantity overruns on earthwork, concrete demolition, etc.	Existing as-built data, exploratory data not adequate or accurate	M	M	A		Time	3 Less Likely (20-39%)	2 Low	6	Med	Accept	Obtain new topographic and bathymetric data for use by Designer and Contractor; Rigorous QA by Owner on design calculations and assumptions related to earthwork volumes	Owner	Open

Risk ID	Risk Category	Phase	Risk Description	Root Cause(s)	Planning Phase	Design Phase	Construction Phase	Post-Construction Phase	Primary Aspect of Risk	Probability (P)	Impact (I)	Risk Weight (P x I)	Overall Rating	Strategy	Risk Management Measure	Risk Owner	Risk Status
31	Proc & Const	Construction	Public safety at construction site	Public safety measures insufficient to keep out public	M		A		Public Safety	1 Very Unlikely (1-9%)	5 Very High	5	High	Share	Development of appropriate health and safety qualifications, experience and other requirements during the procurement process, as well as active overview and enforcement of the Contractor's health and safety and site security plans. No public access to work areas.	Owner's Eng / PDB	Open
32	Design	Construction	Copco lake reservoir rim or local slope failure along access roads	Slope instability, inadequate access road condition assessment prior to construction. Design analyses unable to be made for all geologic conditions and slope geometries; insufficient data		M	A		Time	2 Unlikely (10-19%)	4 High	8	Med	Share	Comprehensive field investigation and design review; Develop plan to address slope failures along Copco Road if they were to occur during reservoir drawdown.	Owner / PDB	Open
33	Design	Construction	Failure of temporary cofferdams result in demolition delays	Conservative design of cofferdams; unanticipated foundation conditions		M	A		Time	2 Unlikely (10-19%)	2 Low	4	Low	Transfer	Comprehensive field investigation, review of original construction, and design review	PDB	Open
34	Design	Construction	Dam or similar structure fails during drawdown	Failure mode not investigated or analyzed properly		M	A		Public Safety	1 Very Unlikely (1-9%)	5 Very High	5	High	Transfer	Rigorous detailed design analysis surrounding dam safety during drawdown; Completion of the FERC Potential Failure Modes Analysis process; Close coordination with the FERC regional office and state dam safety authorities; Implement FERC Emergency Action Plan, as appropriate.	PDB	Open
35	Env	Construction	Release of hazardous material (other than from construction equipment) to river during construction	Contractor activities result in unanticipated release of hazardous material into river	M	M	A		Envir Impact	1 Very Unlikely (1-9%)	5 Very High	5	High	Transfer	Completion of the Phase 1 hazardous material assessments and follow-up evaluations, appropriate health and safety qualifications, experience and other requirements during the procurement process, implementation of BMPs to avoid or contain the release of hazardous material, as well as active overview and enforcement of the Contractor's Hazardous Material Management Plan.	PDB	Open
36	Design	Construction	Reservoir sediment more difficult to access than anticipated, causing construction delays (restoration)	Lack of material properties understanding	M	M	A		Cost	2 Unlikely (10-19%)	2 Low	4	Low	Share	Comprehensive investigation and testing during planning and detailed design phase (with DB or Contractor input).	Owner / PDB	Open
37	Env	Construction	Special-status species presence delays construction	Unanticipated species found onsite cause stop work	M	M	A		Envir Impact	2 Unlikely (10-19%)	4 High	8	Med	Manage	Pre-construction surveys; Design planning; Require work areas to be cleared prior to nesting season; Proactive surveys for nesting activity during nesting season; Proactive nesting mitigation measures during nesting season.	Owner / PDB	Open
38	Env	Construction	Bald and Golden Eagle present within restriction buffer that delays construction	Did not identify birds prior to construction	M	M	A		Time	2 Unlikely (10-19%)	4 High	8	Med	Transfer	Additional surveys to identify nest locations in the years leading up to construction; Implementation of the avoidance and minimization measures identified in the Definite Plan; Effective transfer of risk through Contract terms to Design-Builder.	PDB	Open
39	Env	Construction	Loss of significant freshwater mussels in 1st year of demolition	Suspended sediment and bedload movement.			A		Envir Impact	3 Less Likely (20-39%)	3 Moderate	9	Med	Manage	Obtain latest research on relocation techniques and bring in industry experts during detailed design; Implement risk management measures.	Owner / Force Majeure	Open
40	Permit	Construction	Construction mitigation permit requirements not satisfied	Limited environmental mitigation measures available do not meet time and budget constraints		M	A		Envir Impact	3 Less Likely (20-39%)	3 Moderate	9	Med	Transfer	Coordination between Designer, Contractor, and permitting agencies; Satisfy permit requirements.	Owner / PDB	Open
41	Env	Construction	Unanticipated non-burial related cultural resources (foundations, barns, etc.) discovered during reservoir drawdown or construction (beyond current allowance)	Non-burial cultural resource not disclosed or already known about	M		A		Cost	2 Unlikely (10-19%)	2 Low	4	Low	Manage	Identification of existing cultural resources to the extent feasible; Ongoing coordination with Native American groups and local historical societies; Development of treatment measures that would implemented following drawdown or during construction	Owner / Force Majeure	Open
42	Env	Construction	Known cultural resource damaged during construction	Mitigation measures fail to protect resource	M		A		Cost	2 Unlikely (10-19%)	3 Moderate	6	Med	Manage	Identification of existing cultural resources to the extent feasible; Ongoing coordination with tribes and local historical societies to assess potential damage and identify measures.	PDB	Open
43	Env	Construction	Unanticipated human burial sites, human remains, or funerary items discovered within reservoir areas during reservoir drawdown - requiring cessation of construction activities for a long duration.	Burial site not disclosed or already known about	M		A		Time	2 Unlikely (10-19%)	4 High	8	Med	Manage	Identification of existing cultural resources to the extent feasible; Ongoing coordination with Native American groups and local historical societies; Development of an Inadvertent Discovery Plan, Monitoring Plan, and NAGPRA Plan of Action, and rapid response plan to address the possibility of burial sites becoming exposed during drawdown.	Owner / Force Majeure	Open

Risk ID	Risk Category	Phase	Risk Description	Root Cause(s)	Planning Phase	Design Phase	Construction Phase	Post-Construction Phase	Primary Aspect of Risk	Probability (P)	Impact (I)	Risk Weight (P x I)	Overall Rating	Strategy	Risk Management Measure	Risk Owner	Risk Status
44	Env	Construction	Unanticipated human burial site discovered during other construction activities - requiring cessation of construction activities for a short time (beyond current allowance)	Burial site not disclosed or already known about	M	M	A		Time	2 Unlikely (10-19%)	3 Moderate	6	Med	Manage	Identification of existing cultural resources to the extent feasible; Ongoing coordination with Native American groups and local historical societies; Development of an Inadvertent Discovery Plan, Monitoring Plan, and NAGPRA Plan of Action to address the possibility of burial sites being discovered during construction.	Owner / Force Majeure	Open
45	Proc & Const	Construction	Reservoir drawdown impacts water quality more severely than anticipated causing project regulatory shutdown	Permit conditions and/or inadequate modeling of water quality; duration of drawdown extends past March due to extreme weather	M	M	A		Envir Impact	2 Unlikely (10-19%)	4 High	8	Med	Accept	Perform comprehensive water quality studies prior to construction; Implement risk management measures needed to comply with water quality requirements.	Owner's Eng / PDB	Open
46	Design	Construction	Reservoir drawdown and subsequent operation results in greater than anticipated erosion at bridges or along channel creating passage barrier	Local hydrodynamics result in greater than modeled erosion or scour	M	M	A	A	Cost	2 Unlikely (10-19%)	2 Low	4	Low	Accept	Comprehensive design review; Design additional scour protection for bridges if determined to be needed; Develop monitoring and mitigation plan for during and post reservoir drawdown.	Owner's Eng	Open
47	Proc & Const	Construction	Reservoir dewatering and subsequent operations have greater than anticipated effects on diversion intakes for irrigation/livestock	Greater than predicted suspended sediment and bedload movement	M	M	A	A	Cost	3 Less Likely (20-39%)	2 Low	6	Med	Share	Comprehensive field investigation and design review; Develop plan for monitoring/mitigating intakes during reservoir drawdown.	Owner / PDB	Open
48	Design	Construction	Reservoir dewatering and subsequent operation has greater than anticipated effects on groundwater wells	Difficult to investigate and analyze groundwater relationships		M	A	A	Cost	2 Unlikely (10-19%)	2 Low	4	Low	Share	Comprehensive field investigation and design review; Implement Groundwater Well Management Plan for evaluating changes in groundwater post-reservoir drawdown and proactively mitigate impacted wells.	Owner / PDB	Open
49	Env	Construction	Reservoir dewatering and subsequent operations have greater than anticipated effect on downstream channel aggradation/flooding	Evacuated coarse sediment is greater than anticipated leading to increased channel aggradation and associated flooding		M	A	A	Cost	3 Less Likely (20-39%)	3 Moderate	9	Med	Accept	Rigorous assessment on transport and flooding during detailed design; Monitoring post-drawdown; Raise awareness that active channel management program needed; Implement measures to manage channel aggradation and flood risk.	Owner	Open
50	External	Construction	Public safety risk in downstream channel during reservoir drawdown	Outreach and public safety measures insufficient to keep out public creating potential risk to public safety during drawdown (increased flows)	M	M	A		Public Safety	1 Very Unlikely (1-9%)	5 Very High	5	High	Manage	Comprehensive education and outreach plan; Detailed review and QA of safety program; Development of a Reservoir Dewatering Awareness Plan that will include procedures for notifying public of the schedule and anticipated flows for reservoir drawdown.	Owner / PDB	Open
51	Design	Construction	Slope failure blocks river or diversion intake	Upstream shell material less pervious than assumed in design; error in rapid-drawdown slope stability analyses; design analyses unable to be made for all geologic conditions and slope geometries; insufficient data	M	M	A		Envir Impact	2 Unlikely (10-19%)	5 Very High	10	High	Share	Comprehensive field investigation and design review; Develop slope monitoring plan for implementation during drawdown; Stockpile riprap for repairs of slope if local failures occur.	Owner / PDB	Open
52	Proc & Const	Construction	Copco No. 1 and/or Iron Gate Dam large gate procurements delay gate installation resulting in delay of reservoir drawdown	Design error; scheduling error; manufacturer requires additional information; construction error		M	A		Time	2 Unlikely (10-19%)	4 High	8	Med	Manage	Early detailed design; Early involvement of the Contractor to initiate gate procurement activities including input from the gate fabricator; Contractual milestones with liquidated damages; Early Contractor input including planning underwater work to modify/demo the existing Iron Gate Dam gate structure.	PDB	Open
53	Proc & Const	Construction	Copco. No.1 and Iron Gate Dam tunnel modifications are more difficult to construct causing schedule and cost overruns	Changed site condition or design omission	M	M	A		Time	3 Less Likely (20-39%)	2 Low	6	Med	Share	Comprehensive field investigation and design review; Early Contractor input as well as transparent Contractor progress cost estimates based on proven means and methods.	PDB	Open
54	Proc & Const	Construction	Copco No. 1 or Iron Gate Dam diversion gate malfunctions during drawdown resulting in delay of reservoir drawdown	Design or Construction error		M	A		Time	1 Very Unlikely (1-9%)	5 Very High	5	High	Transfer	Proactive QA/QC during design; Include backup systems for operating the gates in the design and construction including special inspections and testing of the gates prior to drawdown.	PDB	Open
55	External	Construction	Copco No. 1 and/or Iron Gate Dam diversion tunnel intake blocked by debris during drawdown reducing flow capacity	Debris within reservoir blocks intake		M	A		Envir Impact	2 Unlikely (10-19%)	3 Moderate	6	Med	Share	Maximizing the size of the intakes to match the size of the gates; Design debris grating for intake with ability to clear debris from grating.	Owner / PDB	Open
58	Proc & Const	Construction	Copco No. 1 concrete demolition production not adequate to meet project schedule	Inadequate equipment, staff, environmental issues, unfavorable weather			A		Time	2 Unlikely (10-19%)	3 Moderate	6	Med	Transfer	Contract requirements including milestones; Flexibility for 24-hr work 7 days per week; Obtain concrete cores for strength testing to inform DB assumptions regarding drilling and blasting; Early Contractor involvement to avoid shortages of labor and equipment.	PDB	Open
59	Proc & Const	Construction	Copco No. 2 cannot continue to generate power after January 2020	Insufficient water available in Klamath River or water quality too poor		M	A		Cost	2 Unlikely (10-19%)	3 Moderate	6	Med	Accept	Confirm allowable water quality for operation; Evaluate Klamath River flows for potential for too little water to better understand probability of occurrence.	Owner	Open

Risk ID	Risk Category	Phase	Risk Description	Root Cause(s)	Planning Phase	Design Phase	Construction Phase	Post-Construction Phase	Primary Aspect of Risk	Probability (P)	Impact (I)	Risk Weight (P x I)	Overall Rating	Strategy	Risk Management Measure	Risk Owner	Risk Status
60	Proc & Const	Construction	Iron Gate Dam 16.5-ft x 18-ft diversion gate cannot be installed due to as-built drawings of gate guides not matching existing conditions	Unable to survey gate slot until demo complete		M	A		Time	2 Unlikely (10-19%)	3 Moderate	6	Med	Share	Early gate fabrication and installation with sufficient float to allow time for gate modifications, if needed.	PDB	Open
63	Design	Construction	Iron Gate Dam embankment experiences slope failure of upstream shell during reservoir drawdown	Upstream shell material less pervious than assumed in design; error in rapid-drawdown slope stability analyses	M	M	A		Public Safety	1 Very Unlikely (1-9%)	4 High	4	Med	Share	Comprehensive field investigation and design review; Develop slope monitoring plan for implementation during drawdown; Stockpile riprap for repairs of slope if local failures occur.	Owner / PDB	Open
64	Proc & Const	Construction	Iron Gate Dam excavation production less than required to complete excavation by required date	Inadequate planning, equipment, staff, or unforeseen environmental issues, unfavorable weather			A		Public Safety	2 Unlikely (10-19%)	5 Very High	10	High	Transfer	Contractual milestones; Flexibility for 24-hr work 7 days per week; Higher cofferdams for planned breach; Early Contractor involvement to avoid shortages of labor and; Development and implementation by the Contractor of an effective FERC Emergency Action Plan (EAP).	PDB	Open
65	External	Construction	Iron Gate Dam or J.C. Boyle dam overtopped during excavation by storm water flows in excess of 100-year event resulting in dam failure	Climate change; increased variability in precipitation patterns	M	M	A		Public Safety	1 Very Unlikely (1-9%)	5 Very High	5	High	Accept	Require that the dam height during excavation not be less than needed to safely pass a 150-year event through the diversion tunnel; Completion of the FERC Potential Failure Modes Analysis process; Implement EAP, if necessary; Close coordination with the FERC regional office and state dam safety authorities.	Owner / Force Majeure	Open
66	Env	Construction	Iron Gate Hatchery shutdown due to inadequate water supply	New water supply or treatment facilities do not provide suitable supply for hatchery operations, resulting in lowered production	M	M	A	A	Envir Impact	3 Less Likely (20-39%)	3 Moderate	9	Med	Manage	Rigorous design of replacement supply; Pilot treatment technology; Proactive QA/QC during construction.	Owner	Open
68	Environmental	Post-Construction	Greater than anticipated effect on downstream biological resources	Effect of suspended sediment causes greater than anticipated impact to given species	M		A	A	Envir Impact	3 Less Likely (20-39%)	5 Very High	15	High	Manage	Develop appropriate aquatic resource measures through coordination with the regulatory agencies; Implement risk management measures to address effect on downstream resources.	Owner	Open
69	Environmental	Post-Construction	Limited recovery of fish species of concern	Fish recovery does not meet agency expectations	M	M	M	A	Envir Impact	2 Unlikely (10-19%)	2 Low	4	Low	Manage	Aquatic Resource (AR) measures included in Project.	Owner	Open
70	Environmental	Post-Construction	Bald and Golden Eagle net loss within 5 years of construction completion	Mitigation and rehabilitation measures provided insufficient protection				A	Envir Impact	3 Less Likely (20-39%)	4 High	12	Med	Accept	Proactively monitor species before and during construction; Implement additional risk management measures.	Owner	Open
71	Environmental	Post-Construction	Bat roosts do not meet success criteria requiring additional mitigation	Predictive model of bat roost effectiveness is incorrect	M	M	M	A	Envir Impact	2 Unlikely (10-19%)	1 Very Low	2	Low	Manage	Agency input into performance requirements in DB contract and design; Proactive QA/QC during construction.	Owner	Open
72	Environmental	Post-Construction	Habitat restoration goals not satisfied in field	Constructed project component does not meet agency expectations	M	M	M	A	Envir Impact	2 Unlikely (10-19%)	3 Moderate	6	Med	Transfer	Agency input into performance requirements in DB contract and design; Proactive QA/QC during construction.	PDB	Open
73	External	Post-Construction	Large seismic event up to design Maximum Credible Earthquake (MCE) occurs after project completion that results in blockage of Klamath River	Large seismic event causes catastrophic landslide or slope failure		M		A	Public Safety	1 Very Unlikely (1-9%)	2 Low	2	Low	Transfer	Develop clear design requirements for PDB contract; Work with dam safety authorities to set reasonable design criteria and associated durations.	Owner / Force Majeure	Open
78	Operational & Maintenance	Post-Construction	Unanticipated maintenance or repair required during regulatory monitoring and reporting period (e.g. plant establishment, tributary passage blockage, etc.)	Agency success criteria not met during post-construction period	M	M	M	A	Cost	3 Less Likely (20-39%)	3 Moderate	9	Med	Share	Development of management plans to clearly identify success criteria; Develop maintenance triggers and overall approval process; Comply with management plans.	Owner / PDB	Open
80	Proc & Const	Construction	J.C. Boyle Dam excavation production less than required to complete excavation by required date	Inadequate planning, equipment, staff, or unforeseen environmental issues, unfavorable weather			A		Public Safety	2 Unlikely (10-19%)	3 Moderate	6	Med	Share	Contractual requirements including milestones; Flexibility for 24-hr work 7 days per week; Higher cofferdams for planned breach; Early Contractor involvement to avoid shortages of labor and equipment.	PDB	Open
82	Env	Construction	Hydraulic oil or other hazardous material from construction equipment release to river during construction	Contractor mechanical equipment failure result in unanticipated release of hazardous material into river	M		A		Envir Impact	4 Likely (40-59%)	3 Moderate	12	Med	Transfer	Contractor required to develop a Spill Prevention, Control, Countermeasure (SPCC) Plan and active overview and enforcement of the SPCC Plan.	PDB	Open
87	Proc & Const	Construction	Plant pathogens reduce plants available for restoration work	Pathogens introduced at nurseries	M	M	A	A	Cost	3 Less Likely (20-39%)	2 Low	6	Med	Share	Contract requirements for nurseries and for care of plants; Quality Control/Quality Assurance.	PDB	Open
89	External	Construction	Reservoir ice impedes sediment flushing during reservoir drawdown	Ice on one or more reservoirs during drawdown might impede sediment erosion			A		Envir Impact	3 Less Likely (20-39%)	4 High	12	Med	Accept	None.	Owner / Force Majeure	Open
90	External	Construction	River channel locates in unexpected location during reservoir drawdown	Channel relocates on historic terrace rather than original channel			A		Cost	1 Very Unlikely (1-9%)	3 Moderate	3	Low	Accept	Contractor to develop a mitigation plan during design to move river into original channel.	Owner / Force Majeure	Open
91	External	Construction	Unknown fish passage barriers are found during drawdown	Unknown pre-existing barriers exposed during drawdown	M	M	A	A	Cost	4 Likely (40-59%)	1 Very Low	4	Med	Accept	Review of historic documents for evidence of barriers; Require Contractor to develop contingency plan to evaluate for barriers following reservoir drawdown and actions to remove barriers during dam removal.	Owner / Force Majeure	Open

Risk ID	Risk Category	Phase	Risk Description	Root Cause(s)	Planning Phase	Design Phase	Construction Phase	Post-Construction Phase	Primary Aspect of Risk	Probability (P)	Impact (I)	Risk Weight (P x I)	Overall Rating	Strategy	Risk Management Measure	Risk Owner	Risk Status
93	Permit	Planning	Western Pond Turtle becomes Federally listed during permitting process	Project effect on listed species	A	A	A		Time	4 Likely (40-59%)	3 Moderate	12	Med	Manage	Proactive coordination with appropriate regulatory agencies on likely requirements and associated field work; Address contingency in consultations.	Owner / Force Majeure	Open
95	Env	Construction	Unanticipated human burial site discovered between Iron Gate Dam and Humbug Creek during reservoir drawdown and post construction (beyond current allowance)	Burial site not disclosed or already known about exposed due to erosion of channel banks during elevated flows during drawdown.	M		A	A	Cost	3 Less Likely (20-39%)	2 Low	6	Med	Manage	Identification of existing cultural resources to the extent feasible; Ongoing coordination with Native American groups and local historical societies; Development of an Inadvertent Discovery Plan, Monitoring Plan, and NAGPRA Plan of Action, and rapid response plan to address the possibility of burial sites becoming exposed.	Owner / Force Majeure	Open
96	Env	Post-Construction	Weeds outcompete native plants and site restoration goals are not met	Proliferation of weeds	M	M	M	A	Cost	2 Unlikely (10-19%)	2 Low	4	Low	Share	Contract warranty period; Post-construction maintenance requirements in contract.	Owner / PDB	Open
97	Environmental	Construction	Northern spotted owl, bald eagle or golden eagle nests during construction period, requiring restrictions on construction timing and activity.	Bird creates new nest during construction.	M	M	A		Time	2 Unlikely (10-19%)	1 Very Low	2	Low	Accept	Monthly monitoring during breeding season.	Owner	Open
103	External	Planning	Differing Site Condition claim during Yreka Water Supply Pipeline Crossing Construction.	Adequate geotechnical subsurface information is not readily available. Unanticipated subsoil conditions are encountered or claimed to have been encountered during construction.	M	M	A		Cost	2 Unlikely (10-19%)	3 Moderate	6	Med	Manage	Conduct an adequate and thorough geotechnical exploration program in conformance with standard practice and describe subsoil conditions in terms of a geotechnical baseline report (GBR) and a geotechnical data report (GDR).	Owner	Open

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Appendix B Figures – CONTAINS CEII – REDACTED

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Appendix C Figures – Other

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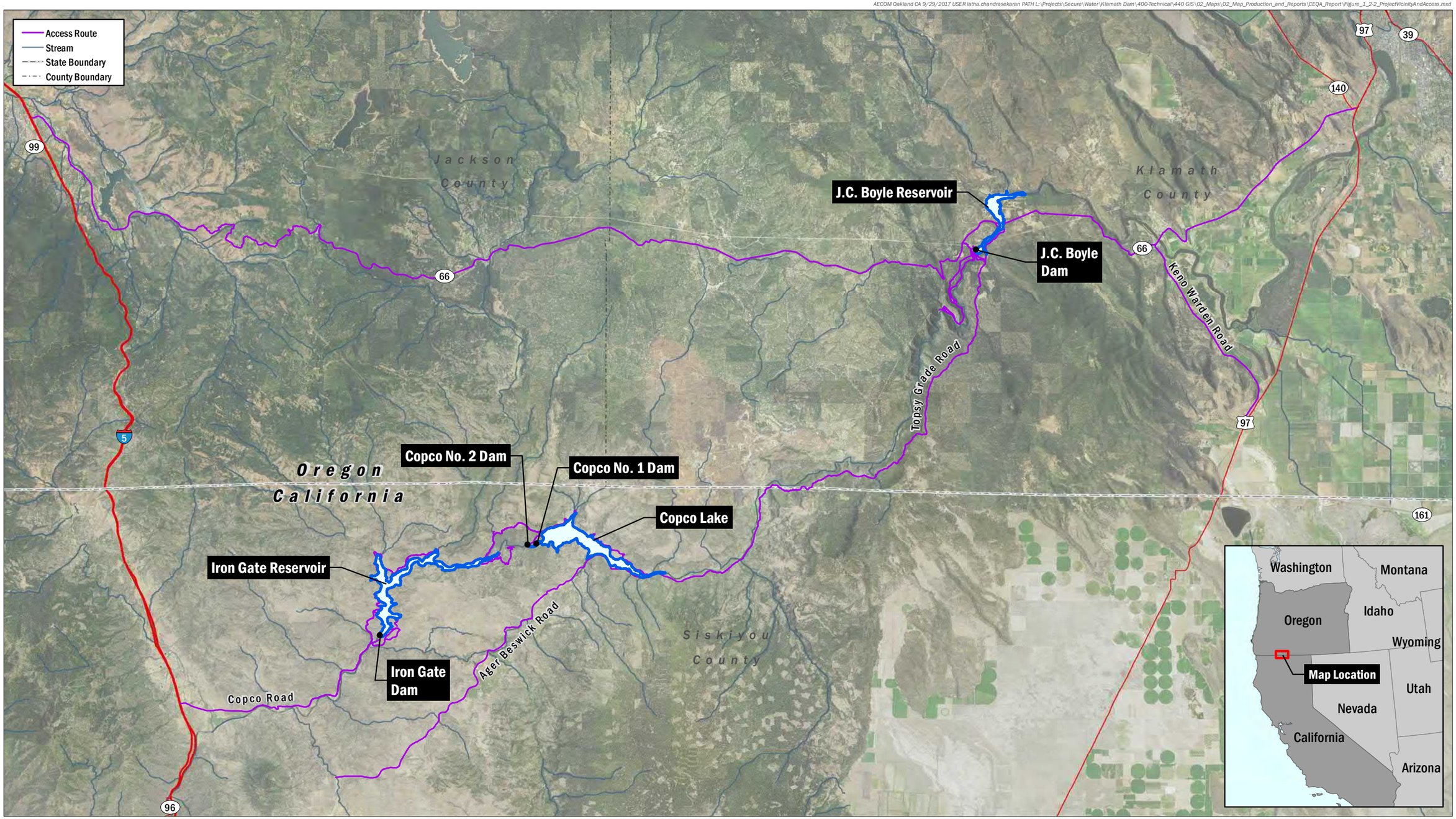

DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 9/29/2017

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FIGURE 1.2-2
Project Vicinity and Access

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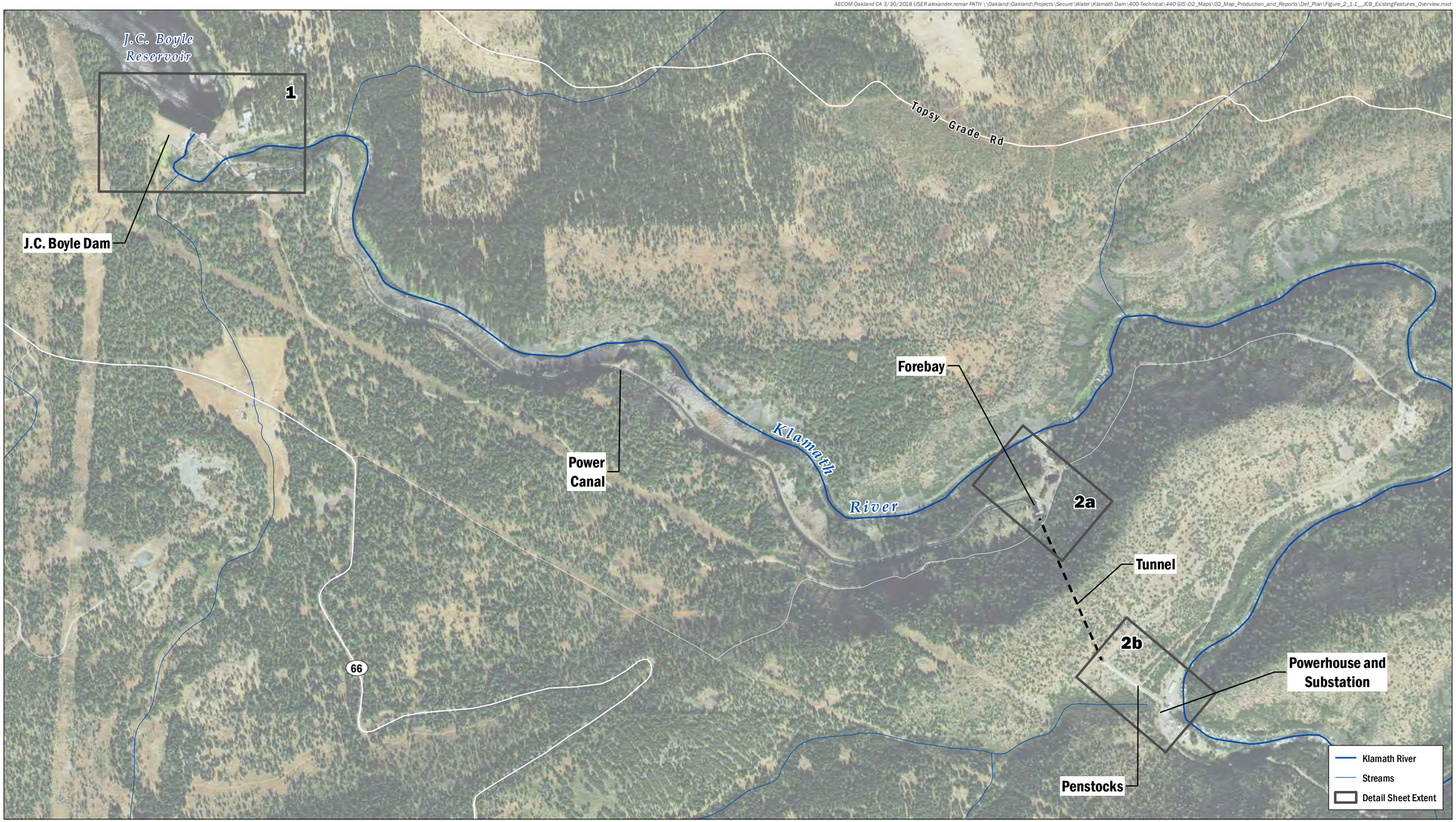

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DATA SOURCE
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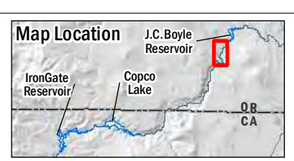

FIGURE 2.1-1

J.C. Boyle Dam Existing Features Overview Sheet

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NAIP, 2014; USGS (NED), 2015

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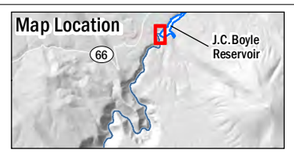

FIGURE 2.1-1

J.C. Boyle Dam Existing Features
Sheet 1 of 2

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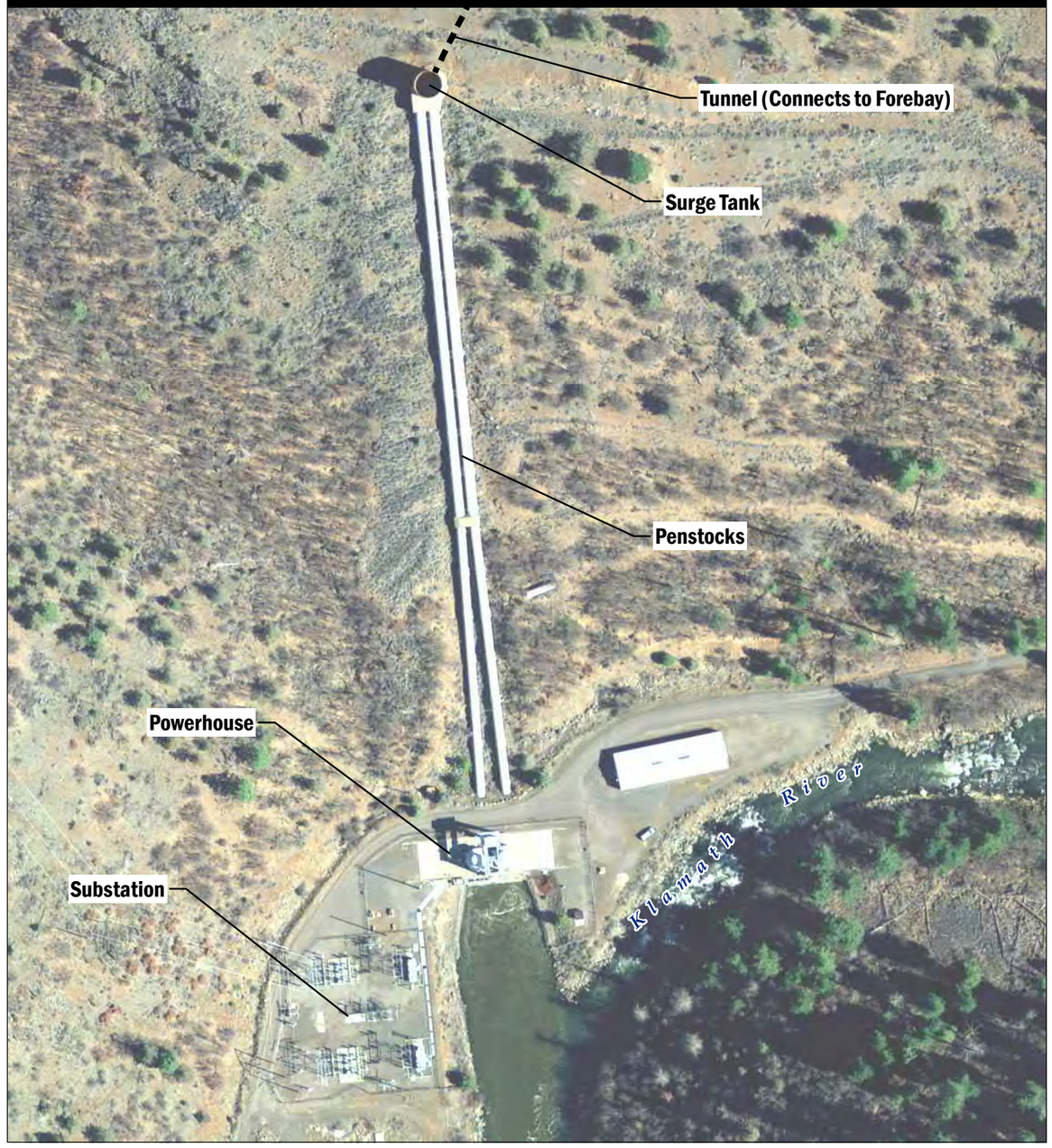
2A - FOREBAY AND SPILLWAY



2B - PENSTOCKS AND POWERHOUSE



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DATA SOURCE
NAIP, 2014; USGS (NED), 2015

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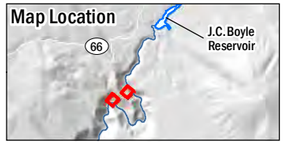

FIGURE 2.1-1

J.C. Boyle Dam Existing Features
Sheet 2 of 2

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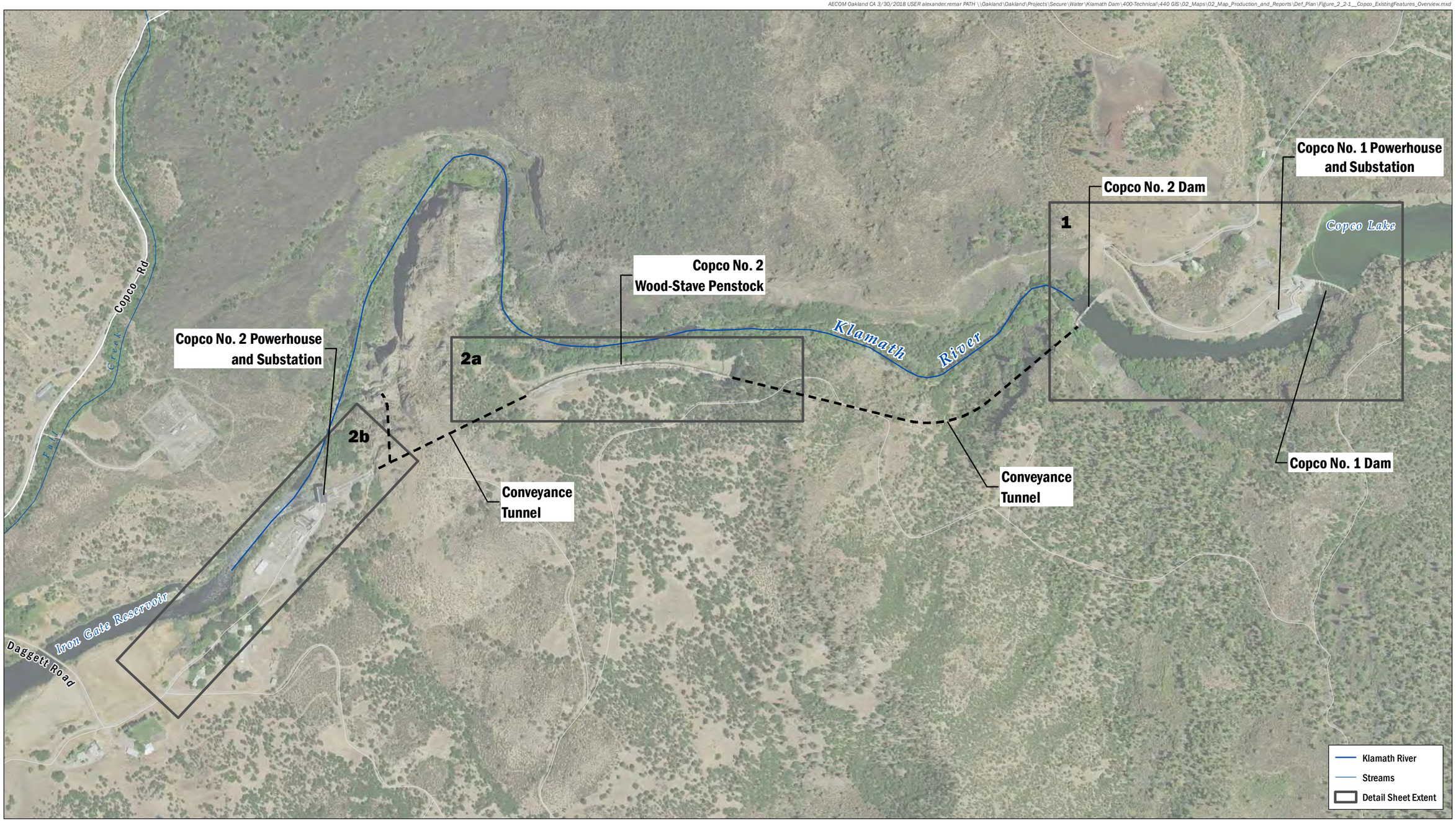

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Klamath River Renewal Corporation
Klamath River Renewal Project

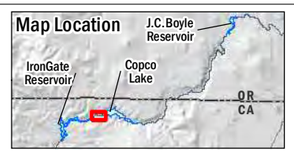


FIGURE 2.2-1

Copco No. 1 and Copco No. 2 Dams Existing Features Overview Sheet

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_2_2-1__Copco_ExistingFeatures_Sheet1.mxd



DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

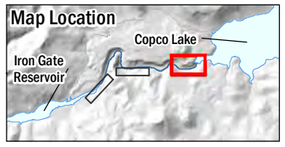


FIGURE 2.2-1

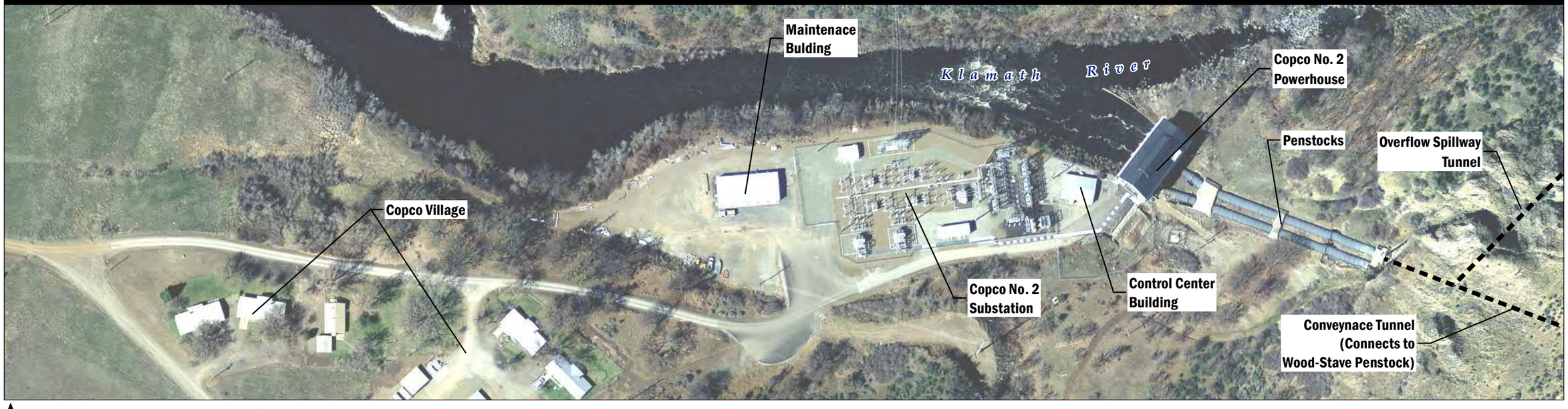
Copco No. 1 and Copco No. 2 Dams Existing Features
Sheet 1 of 2

AECOM Oakland CA 3/30/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_2_2-1__Copco_ExistingFeatures_Sheet2.mxd

2A - COPCO NO. 2 WOOD-STAVE PENSTOCK



2B - COPCO NO. 2 POWERHOUSE



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DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 3/30/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM

Klamath River Renewal Corporation

Klamath River Renewal Project

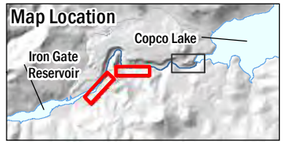
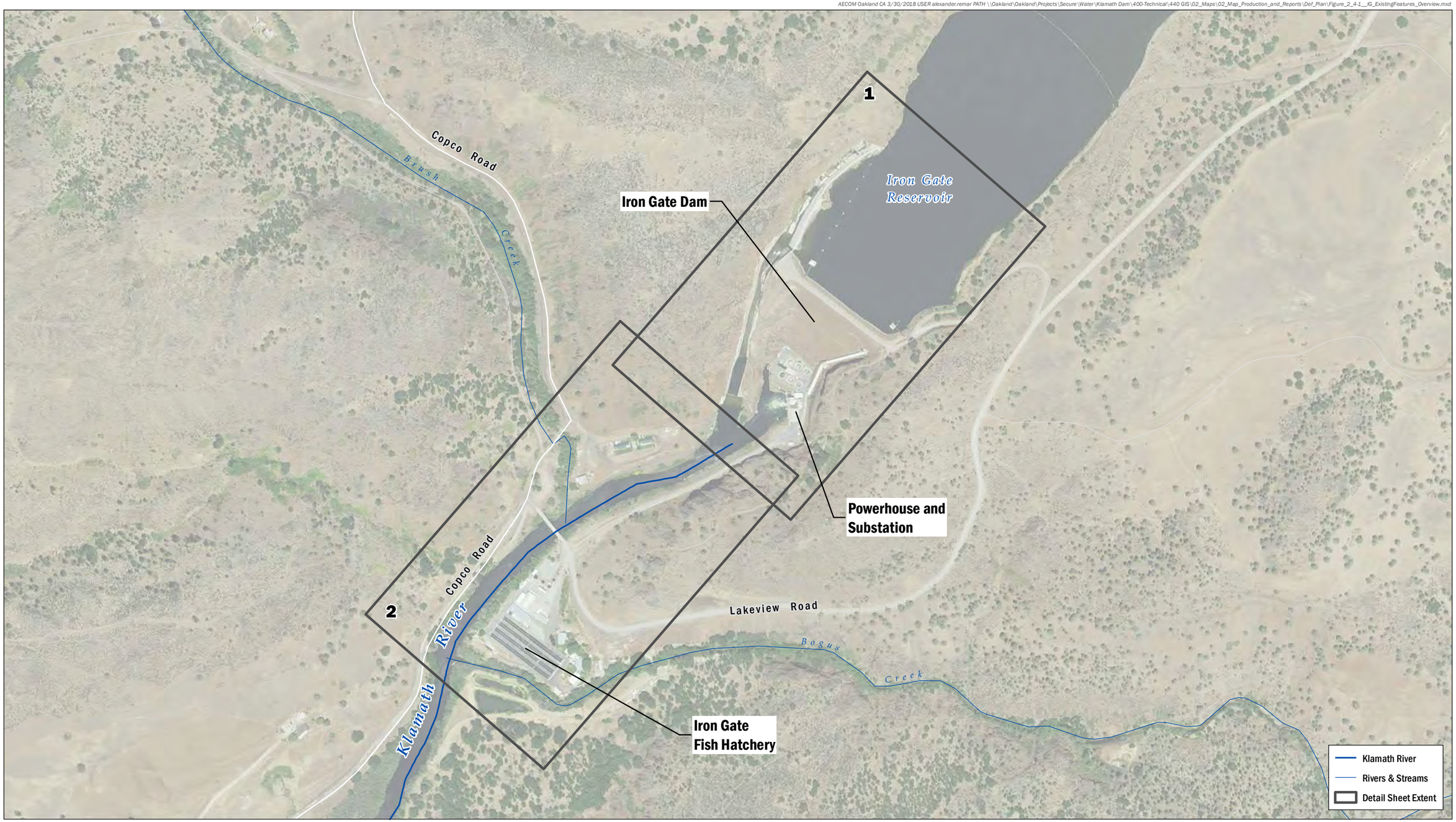


FIGURE 2.2-1

Copco No. 1 and Copco No. 2 Dams Existing Features
Sheet 2 of 2

AECOM Oakland CA 3/30/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_2_4-1__IG_ExistingFeatures_Overview.mxd



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DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 3/30/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

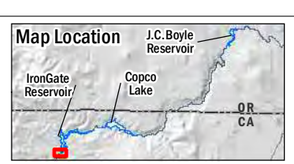
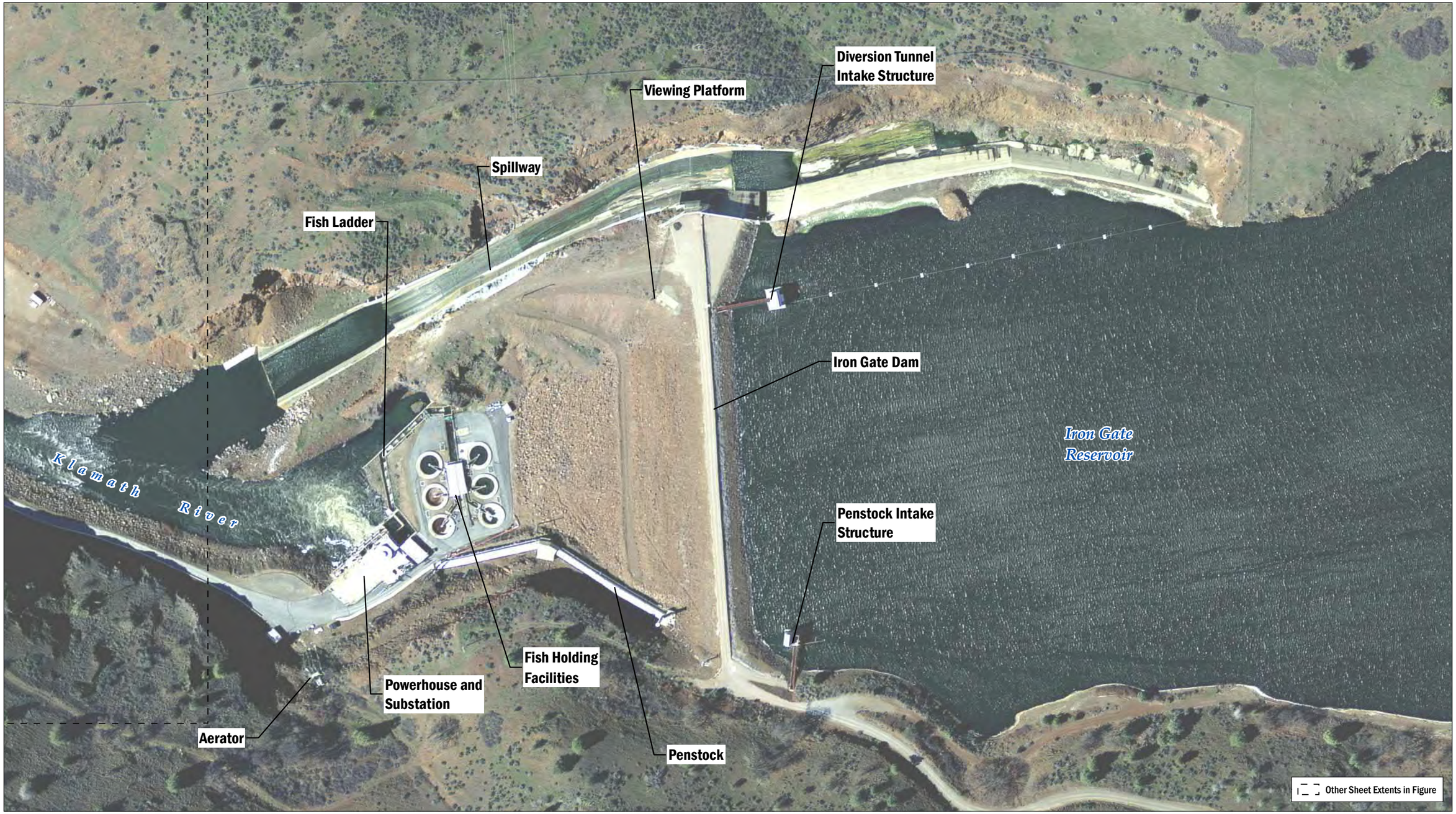


FIGURE 2.4-1

Iron Gate Dam Existing Features Overview Sheet

AECOM Oakland CA 3/30/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_2_4-1__IG_ExistingFeatures_Sheet1.mxd



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DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 3/30/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

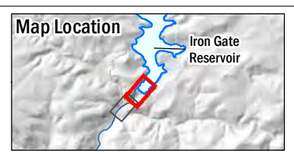

FIGURE 2.4-1
Iron Gate Dam Existing Features
Sheet 1 of 2

AECOM Oakland CA 9/29/2017 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\CEQA_Report\Figure_2_4-1__IG_ExistingFeatures_Sheet2.mxd



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DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 9/29/2017

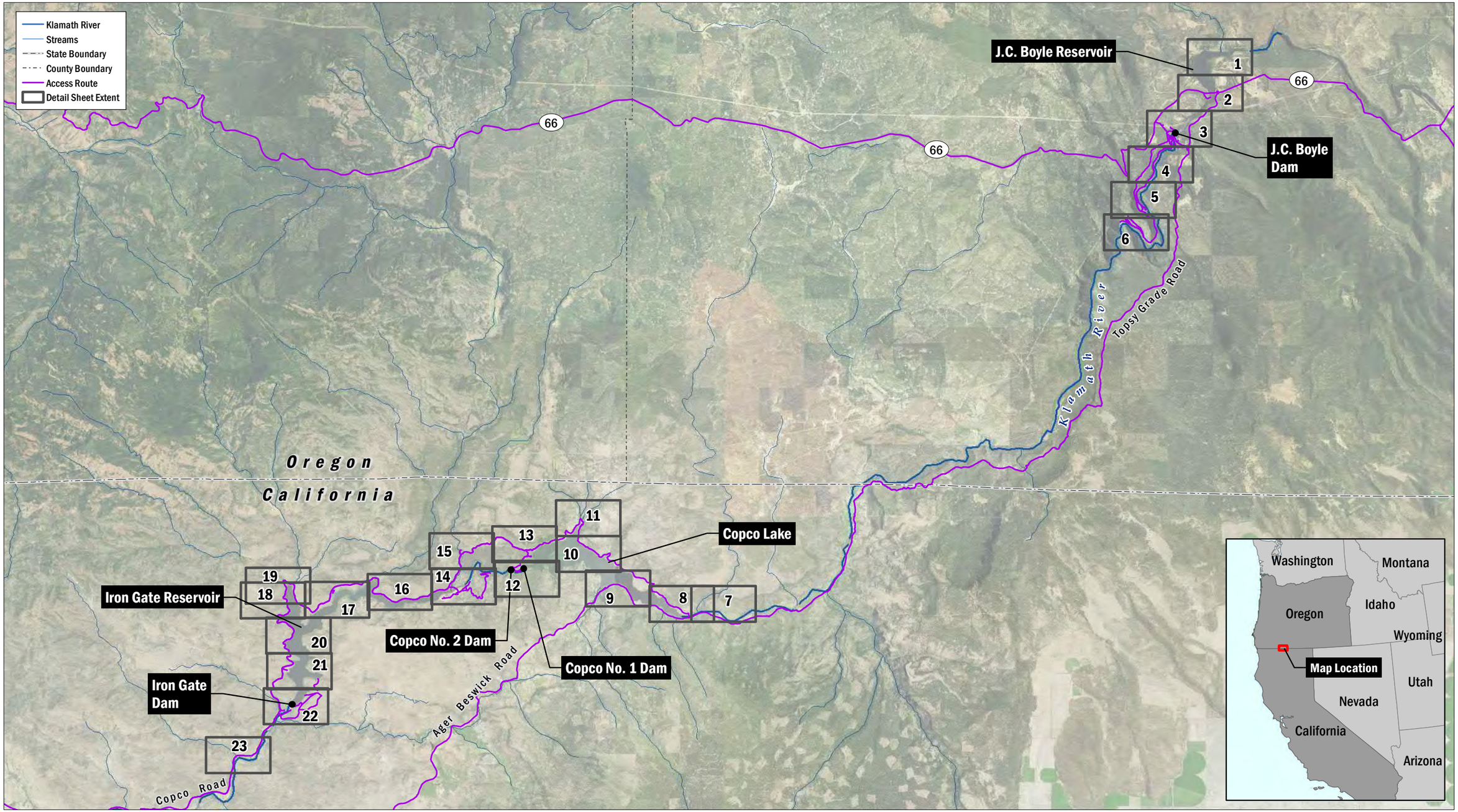
PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



FIGURE 2.4-1
Iron Gate Dam Existing Features
Sheet 2 of 2

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Overview.mxd



DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

FIGURE 5.1-1

Project Limits of Work and Access Overview Sheet

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd



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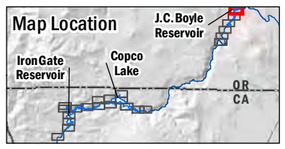
DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

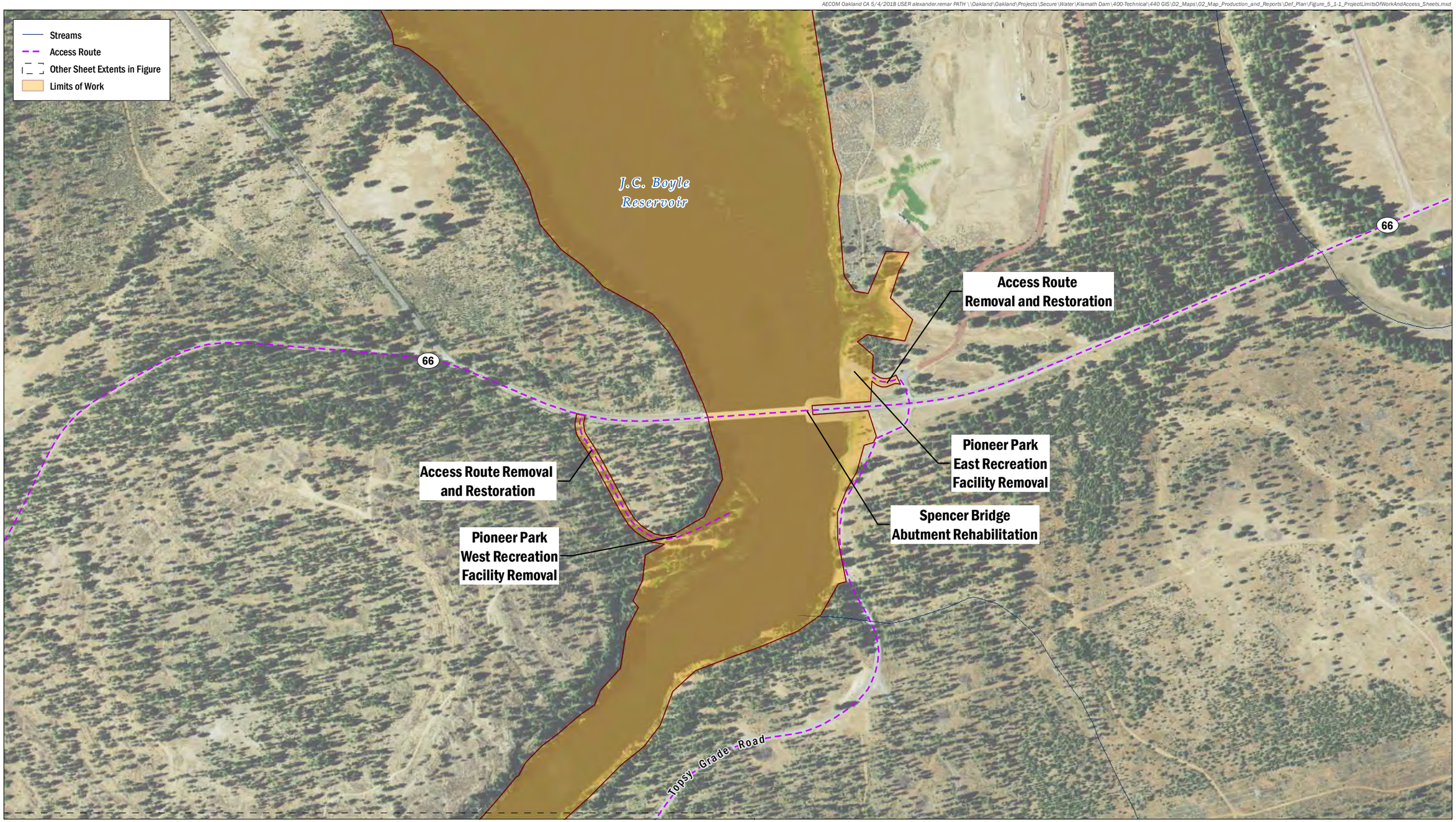


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 1 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd

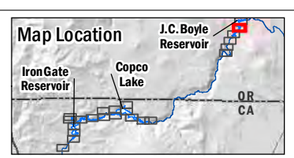


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

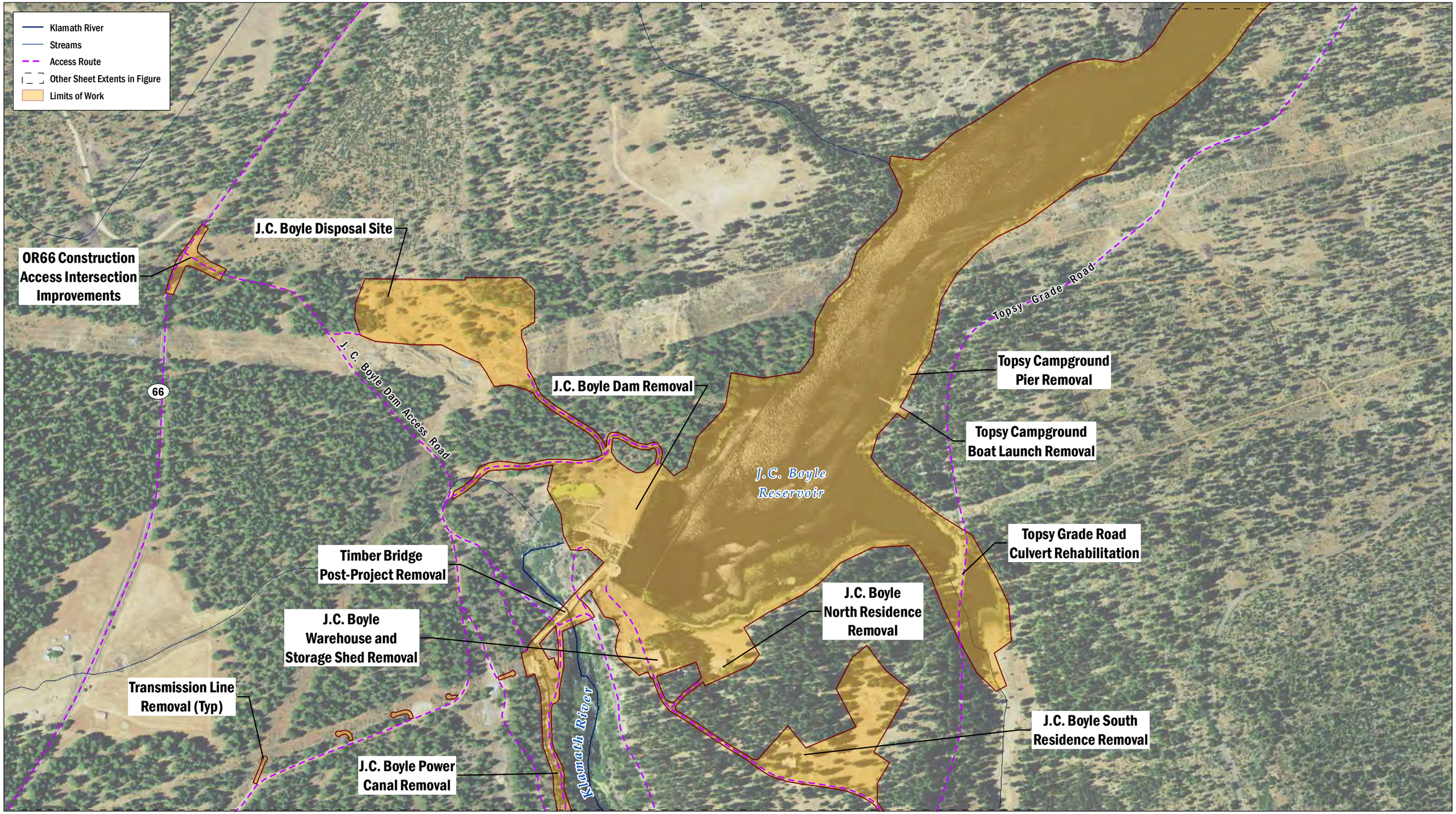


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 2 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd

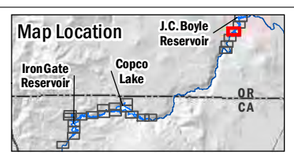


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

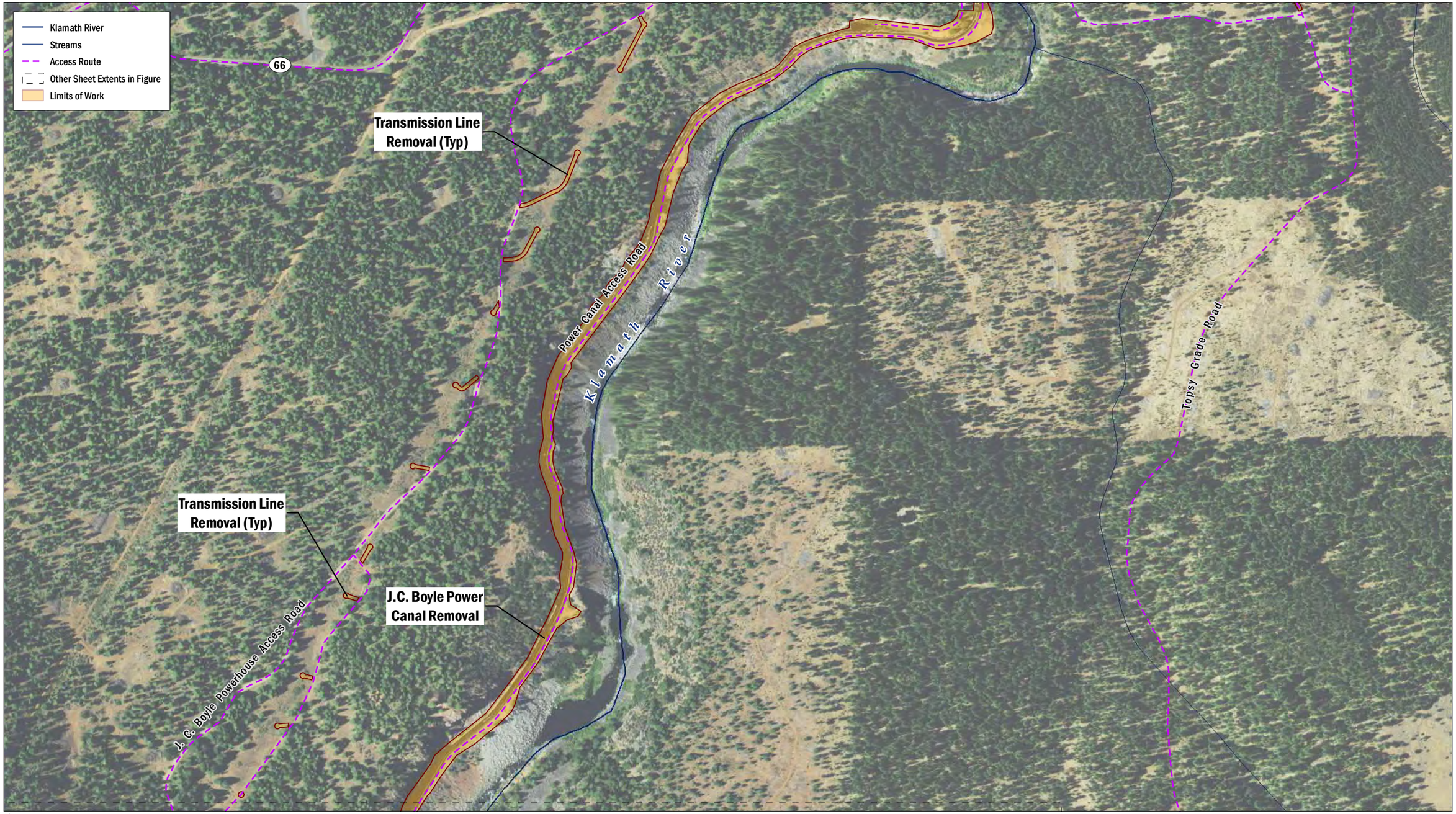


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 3 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd

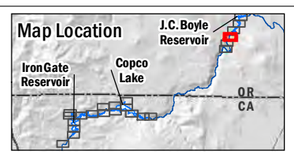


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

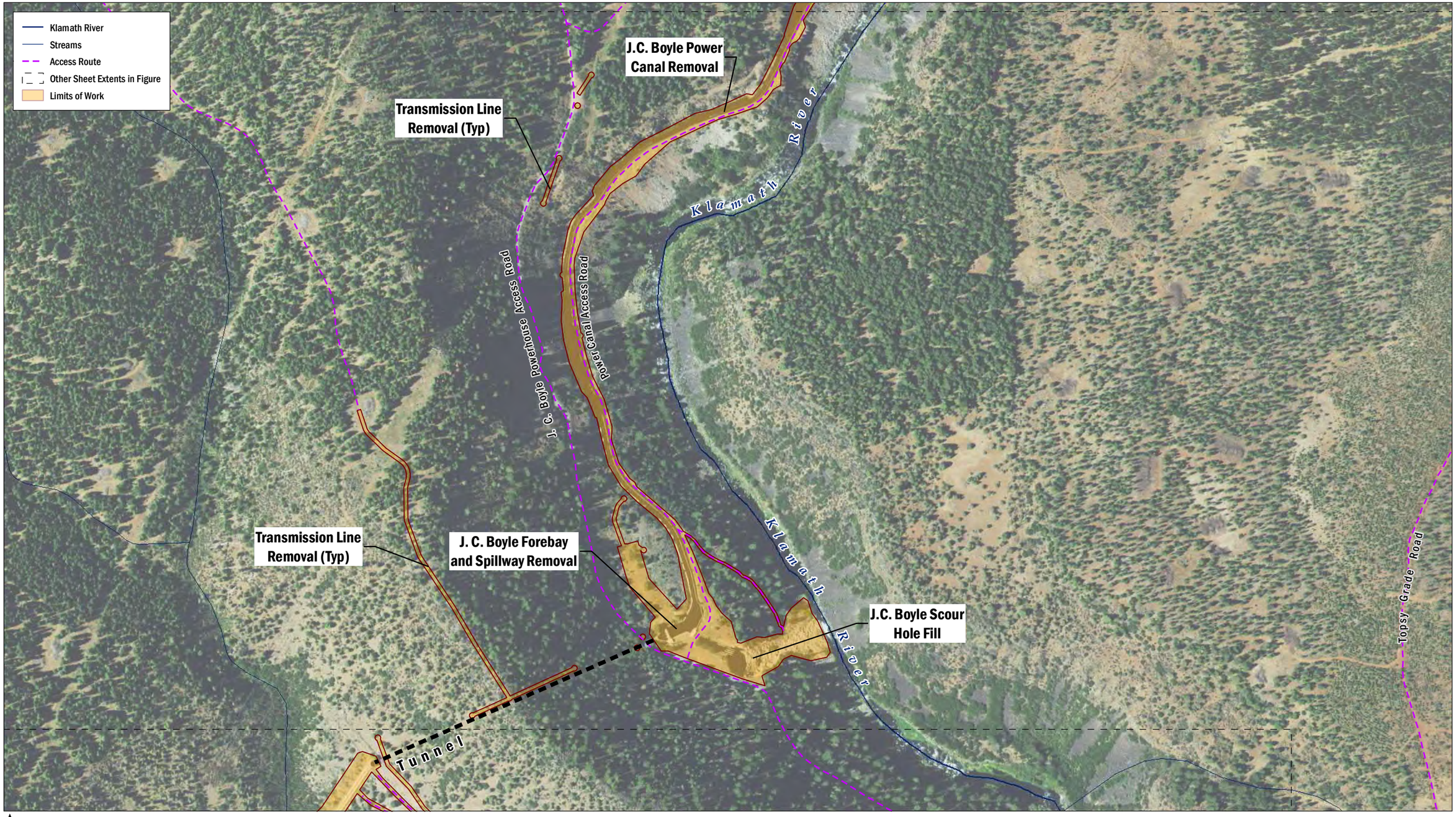


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 4 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd



DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
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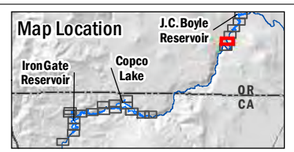
AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

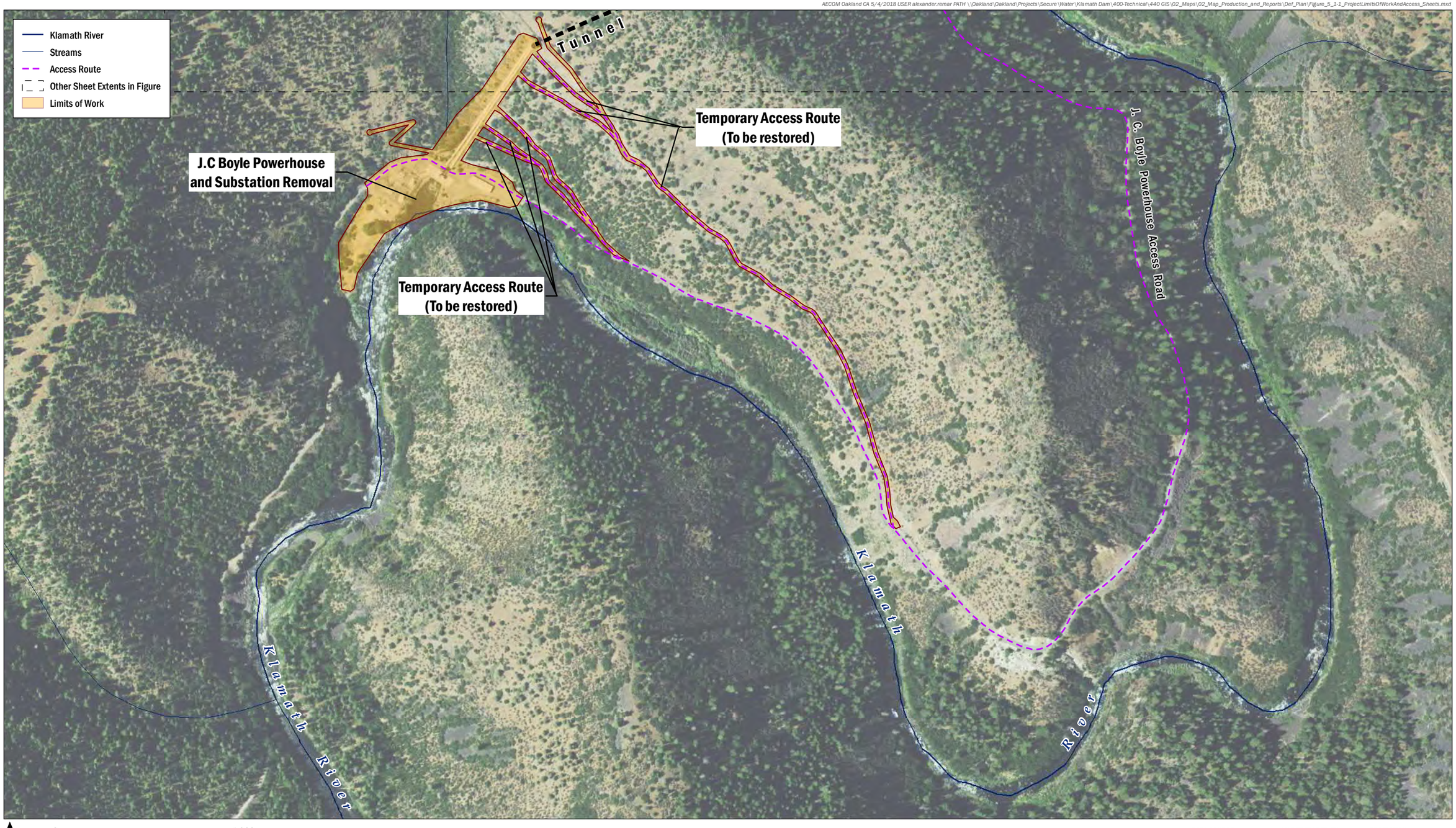


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 5 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd



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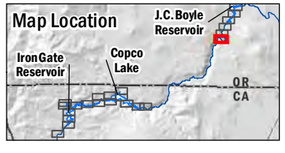
DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 6 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd



DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
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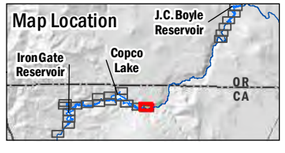
AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

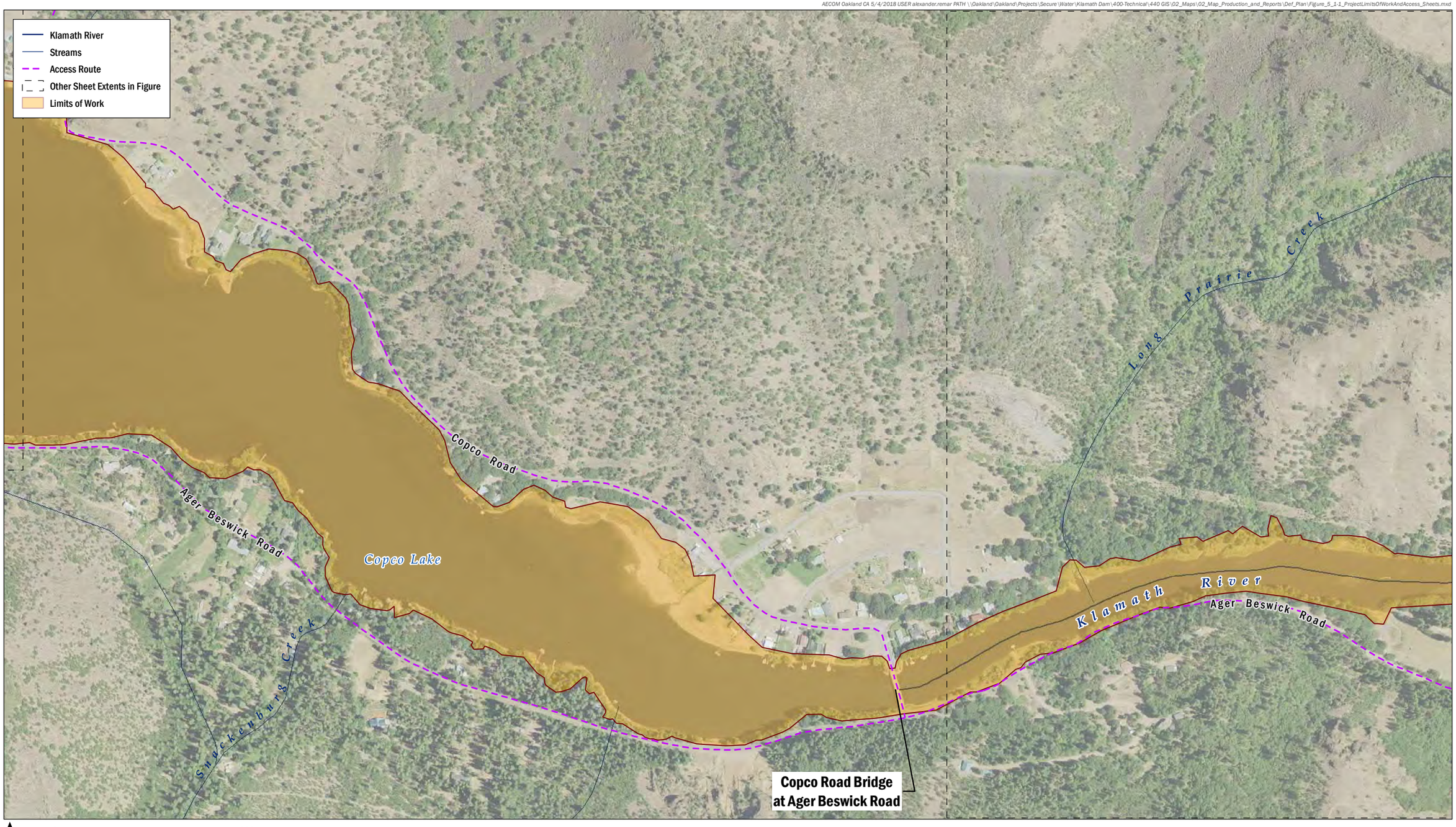


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 7 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd



DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

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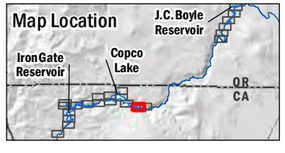
AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

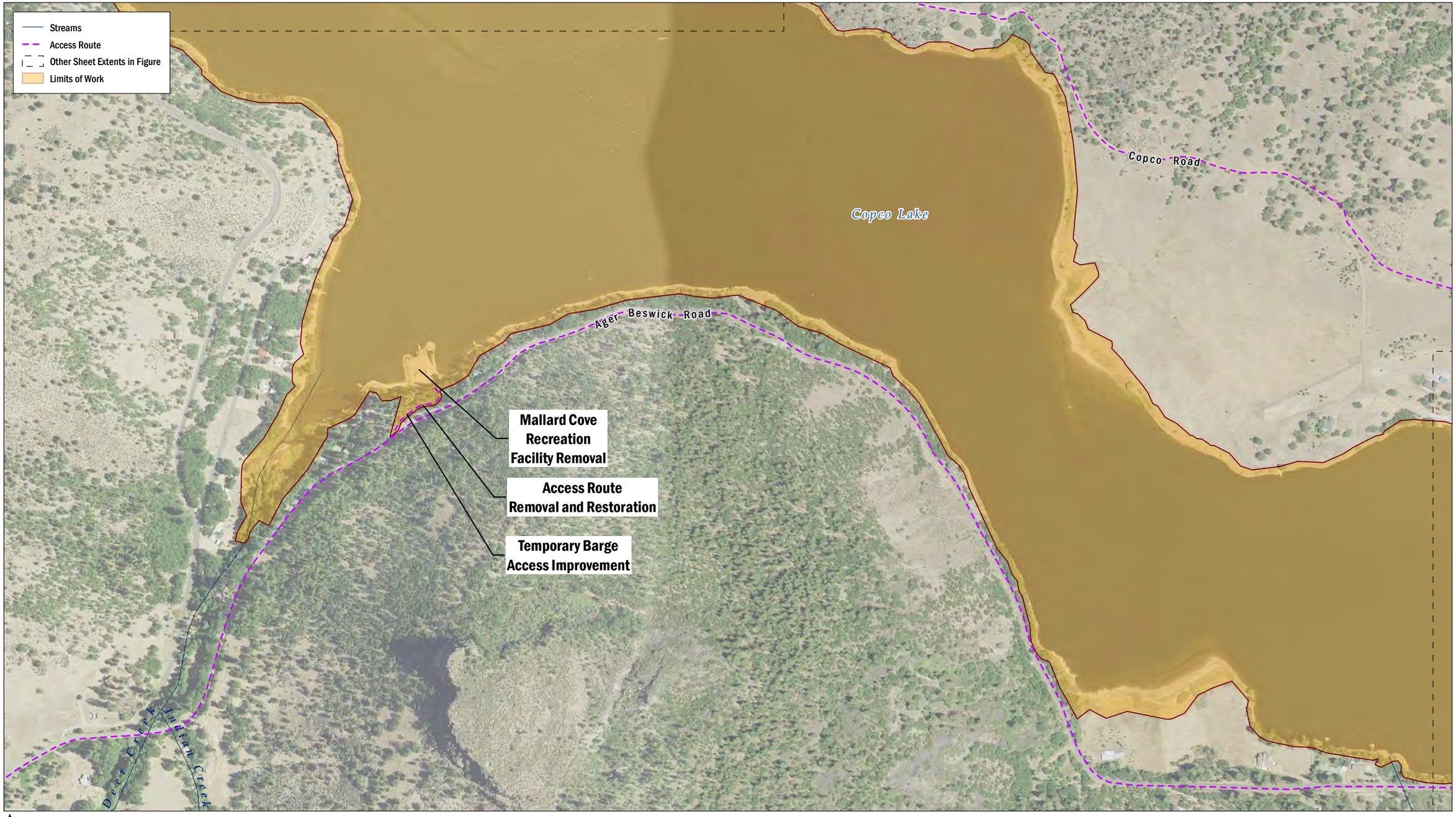


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 8 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd



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DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
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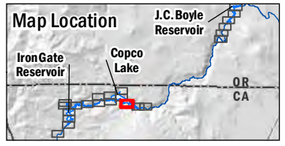
AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

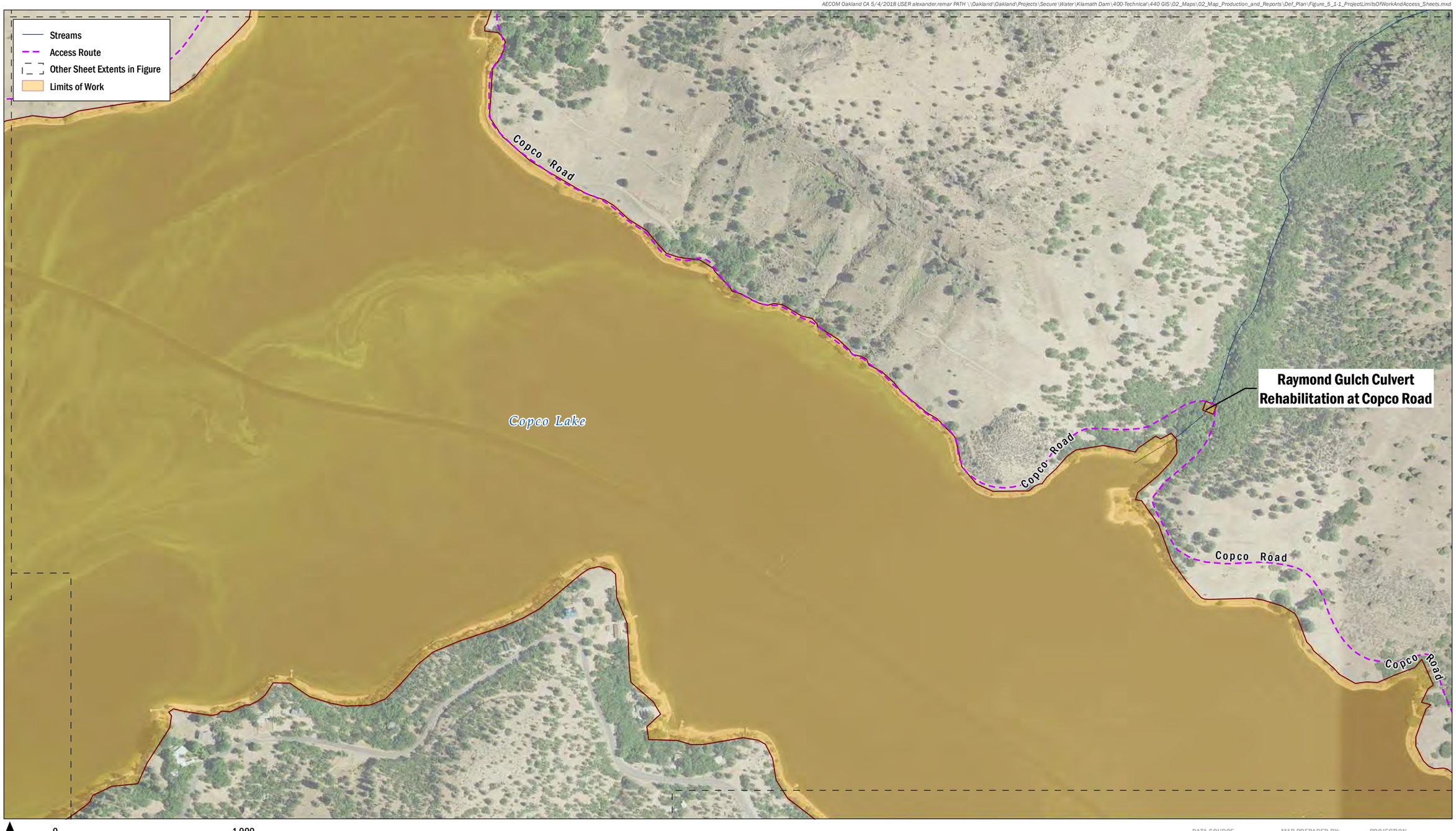


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 9 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd



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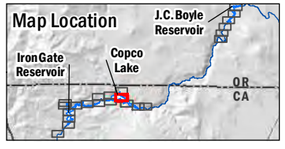
DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

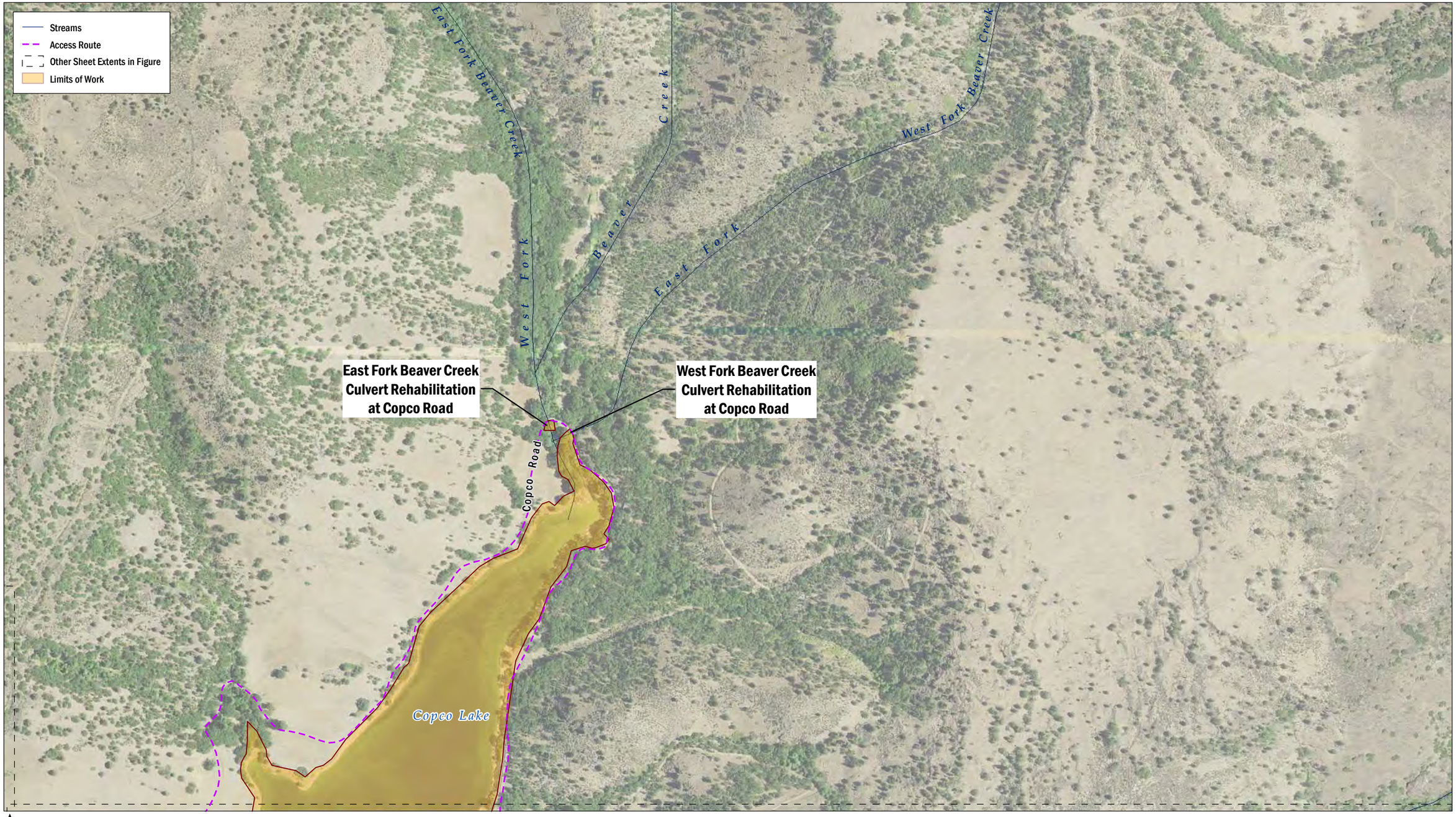


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 10 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd

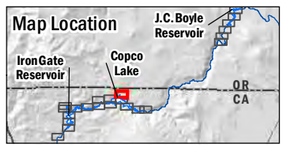


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

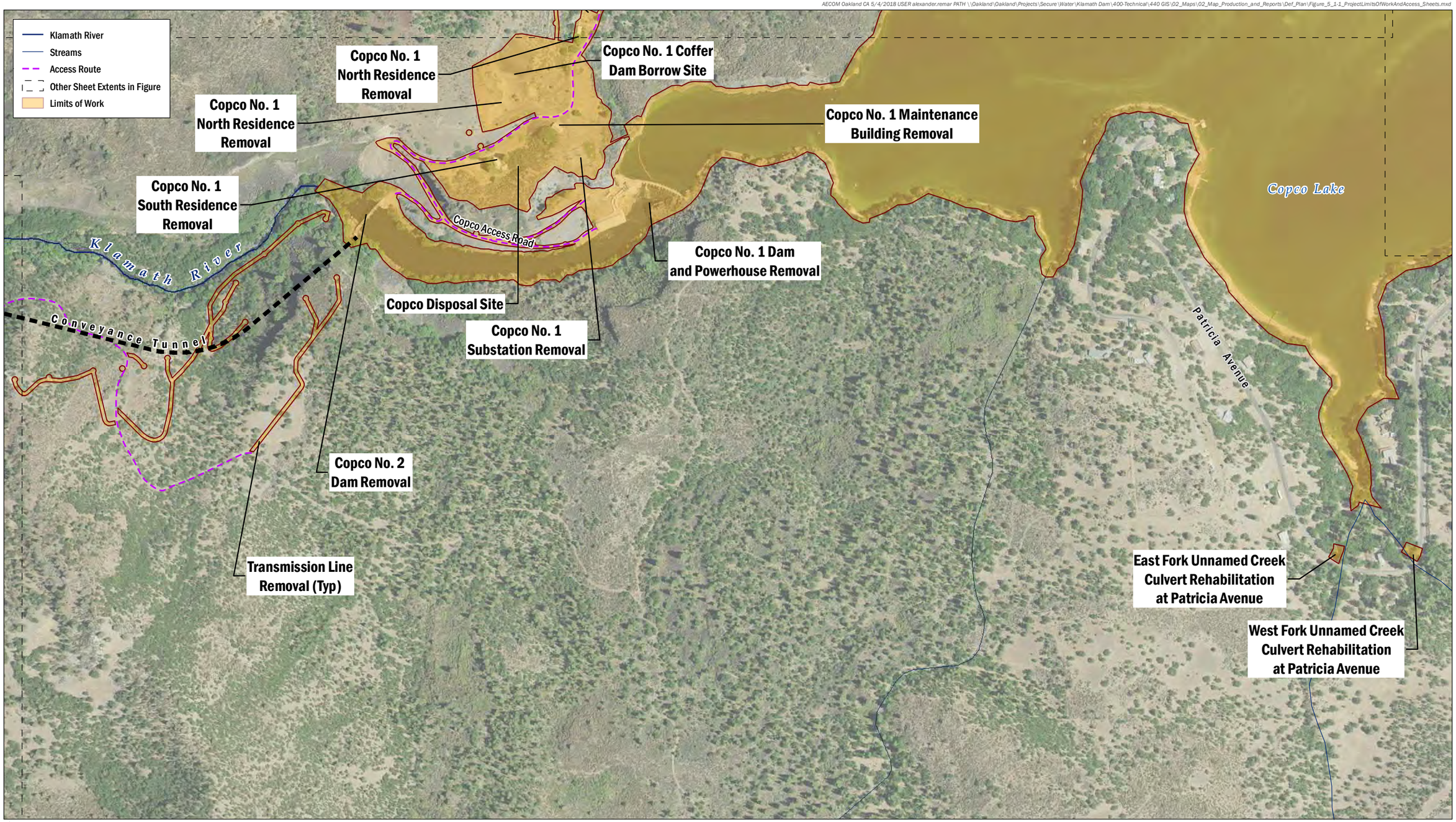


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 11 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd

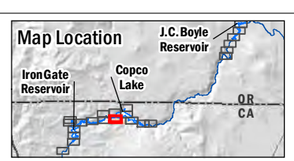


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

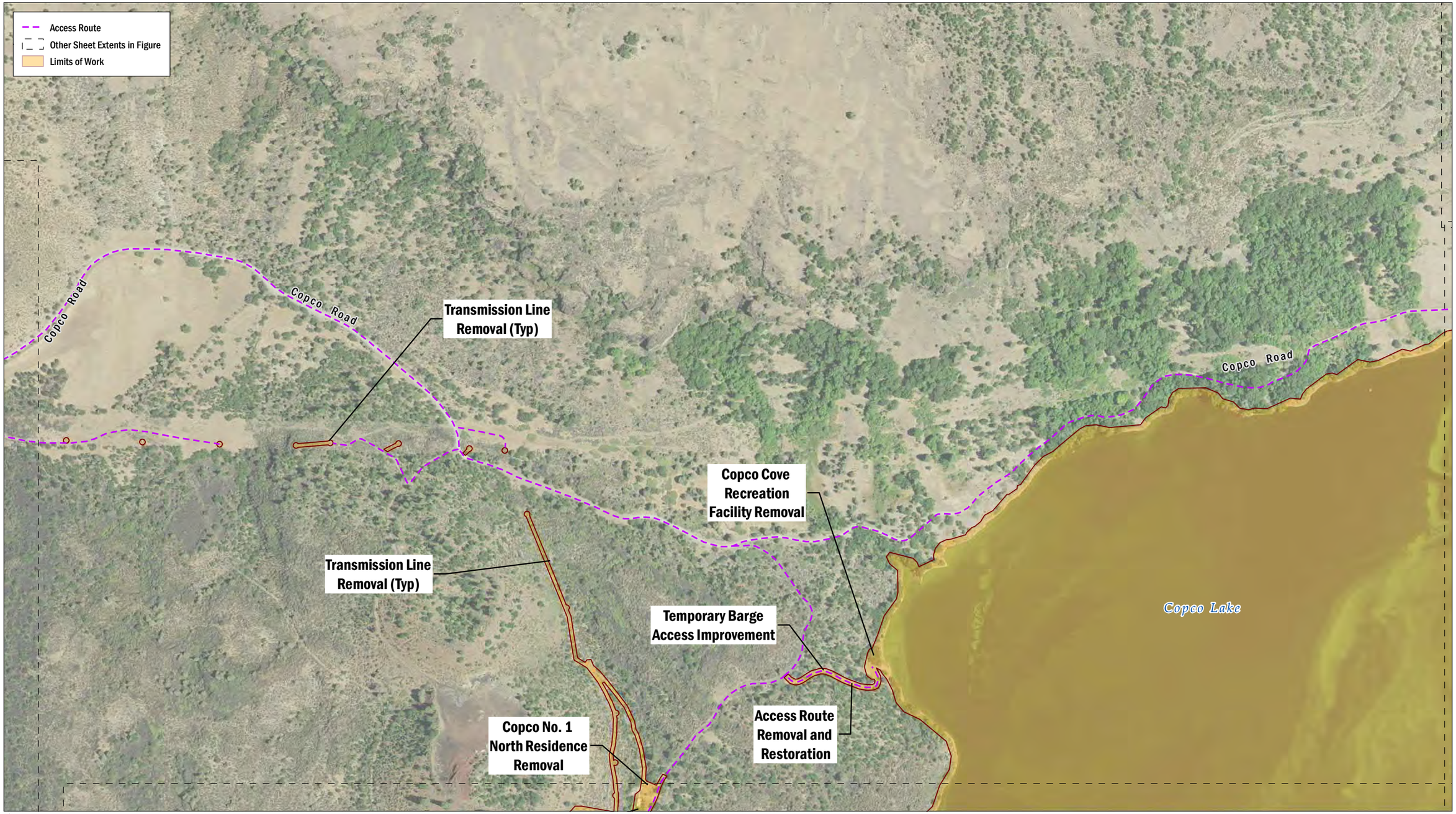


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 12 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd

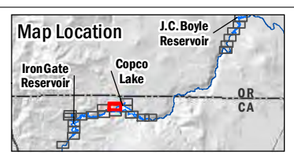


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

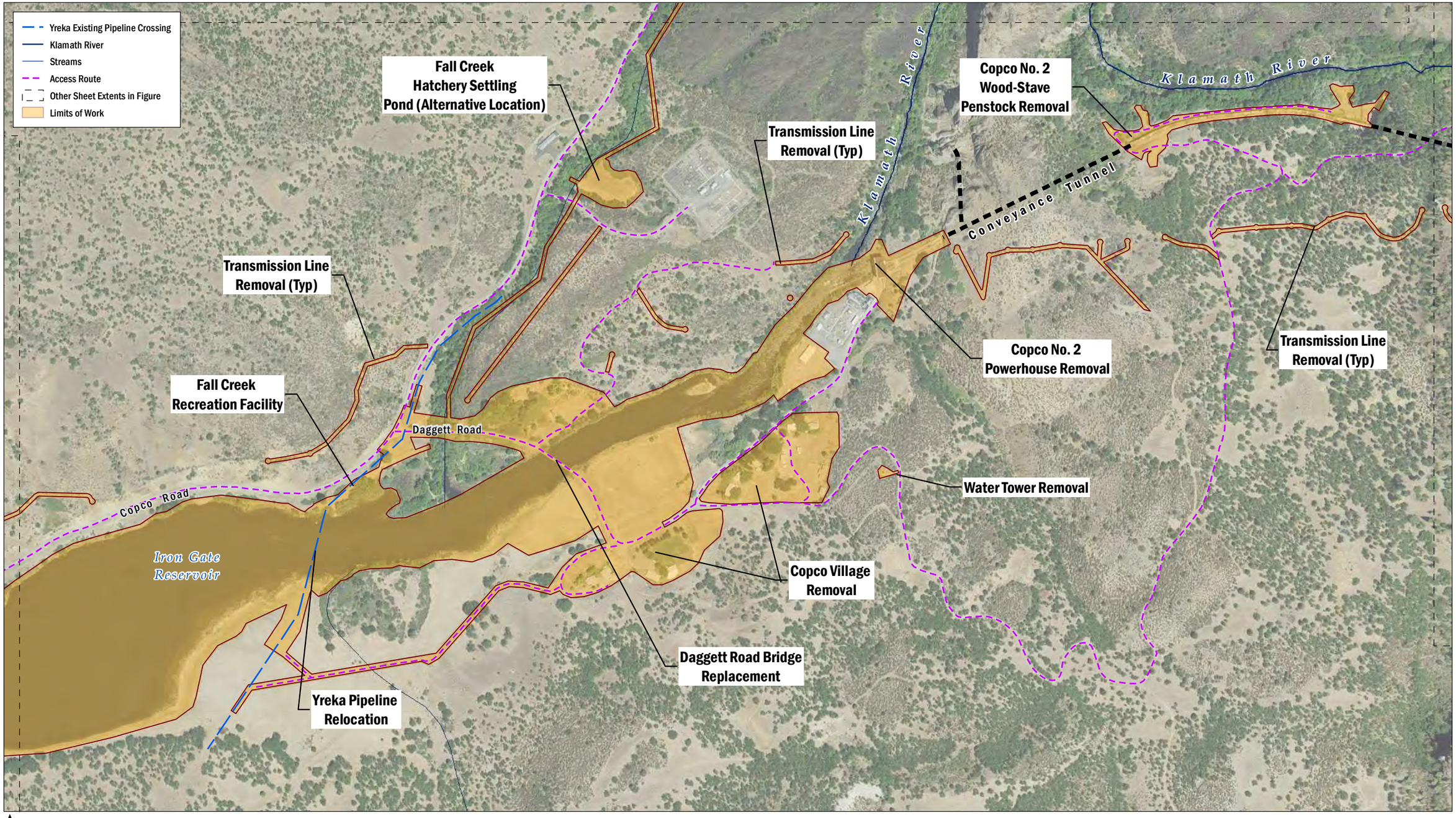


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 13 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd



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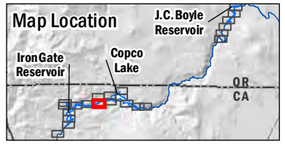
DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

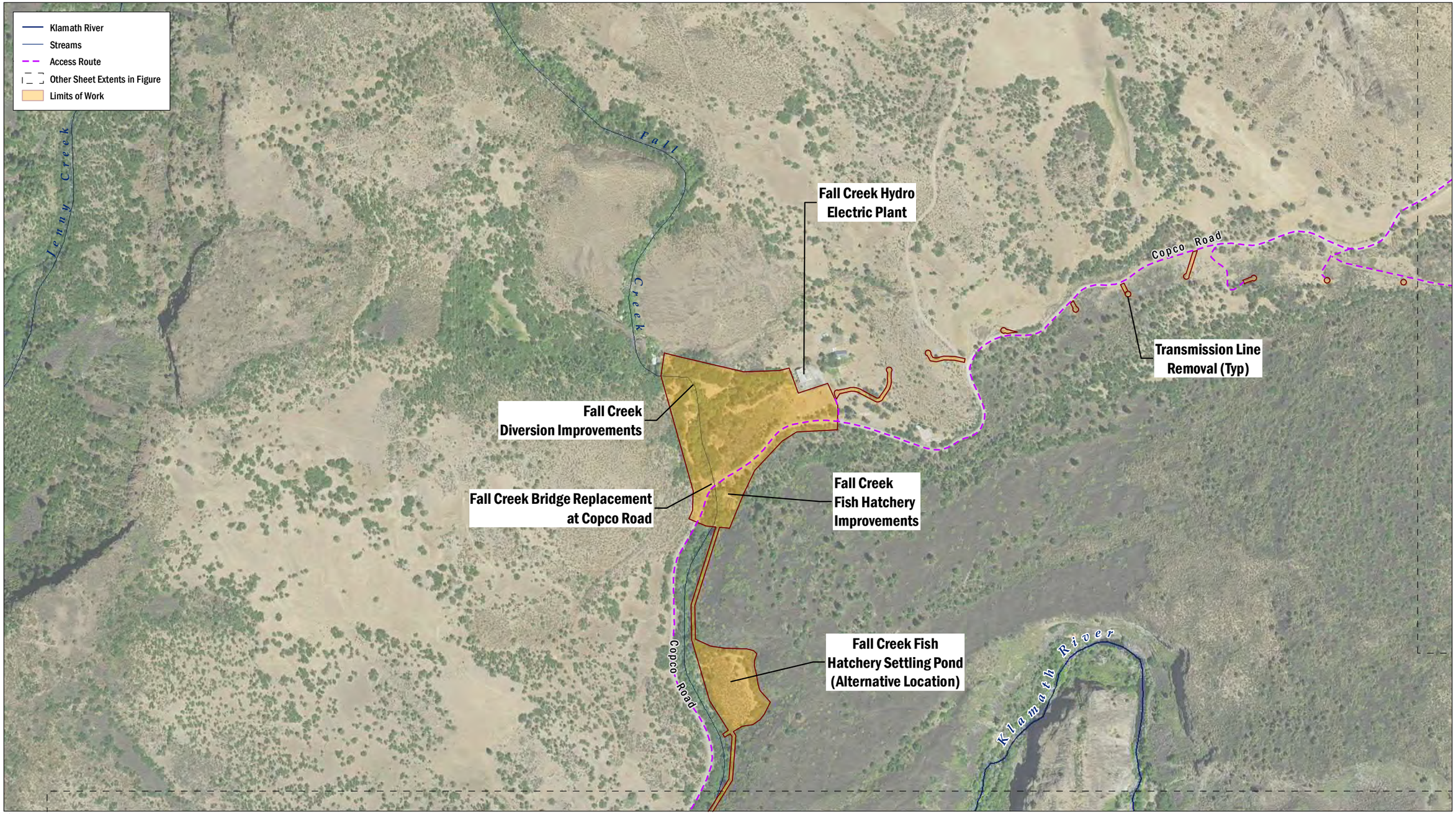


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 14 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd

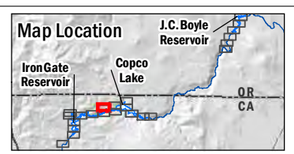


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

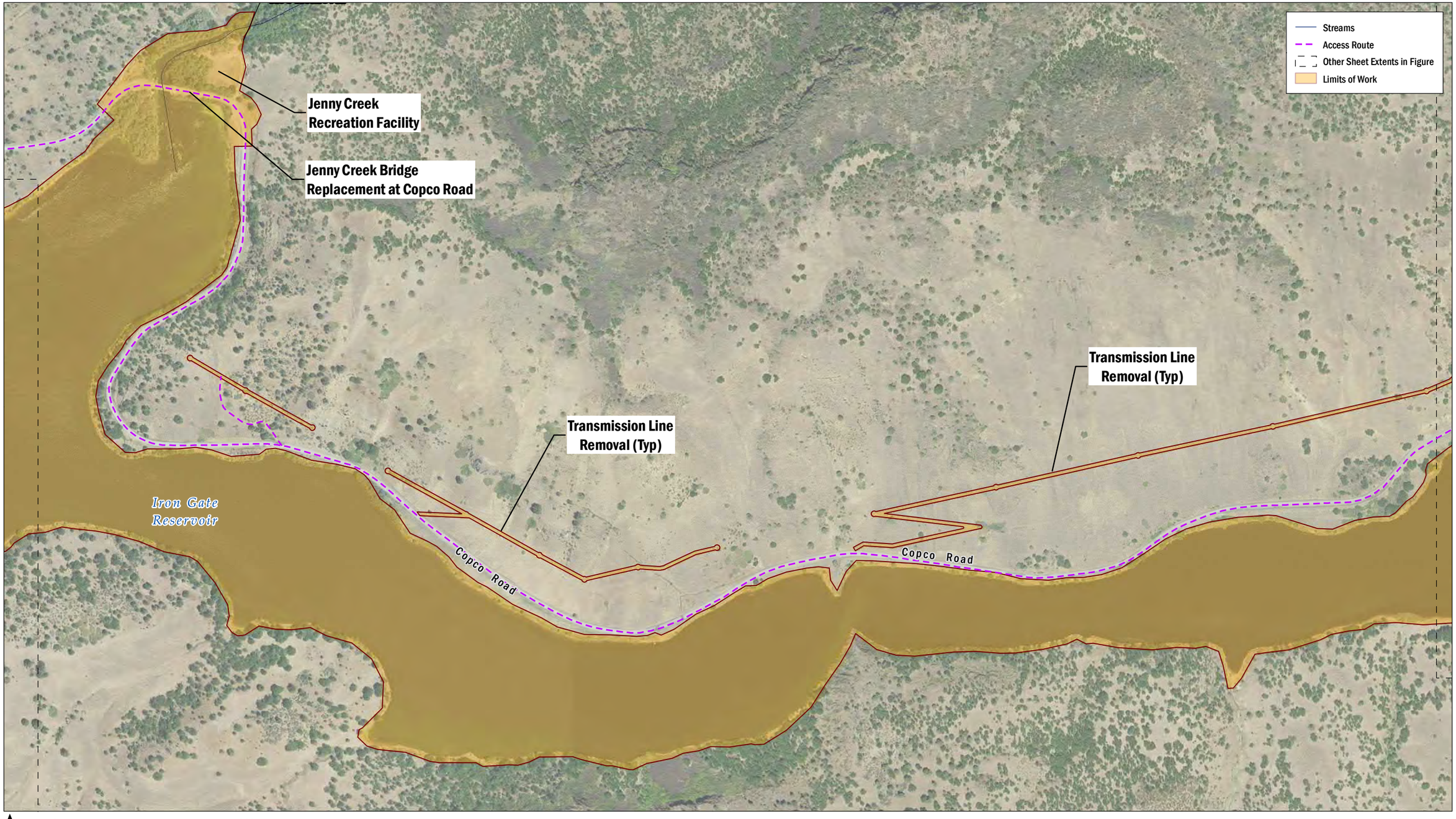


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 15 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd



DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
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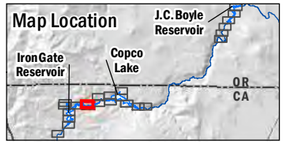
AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

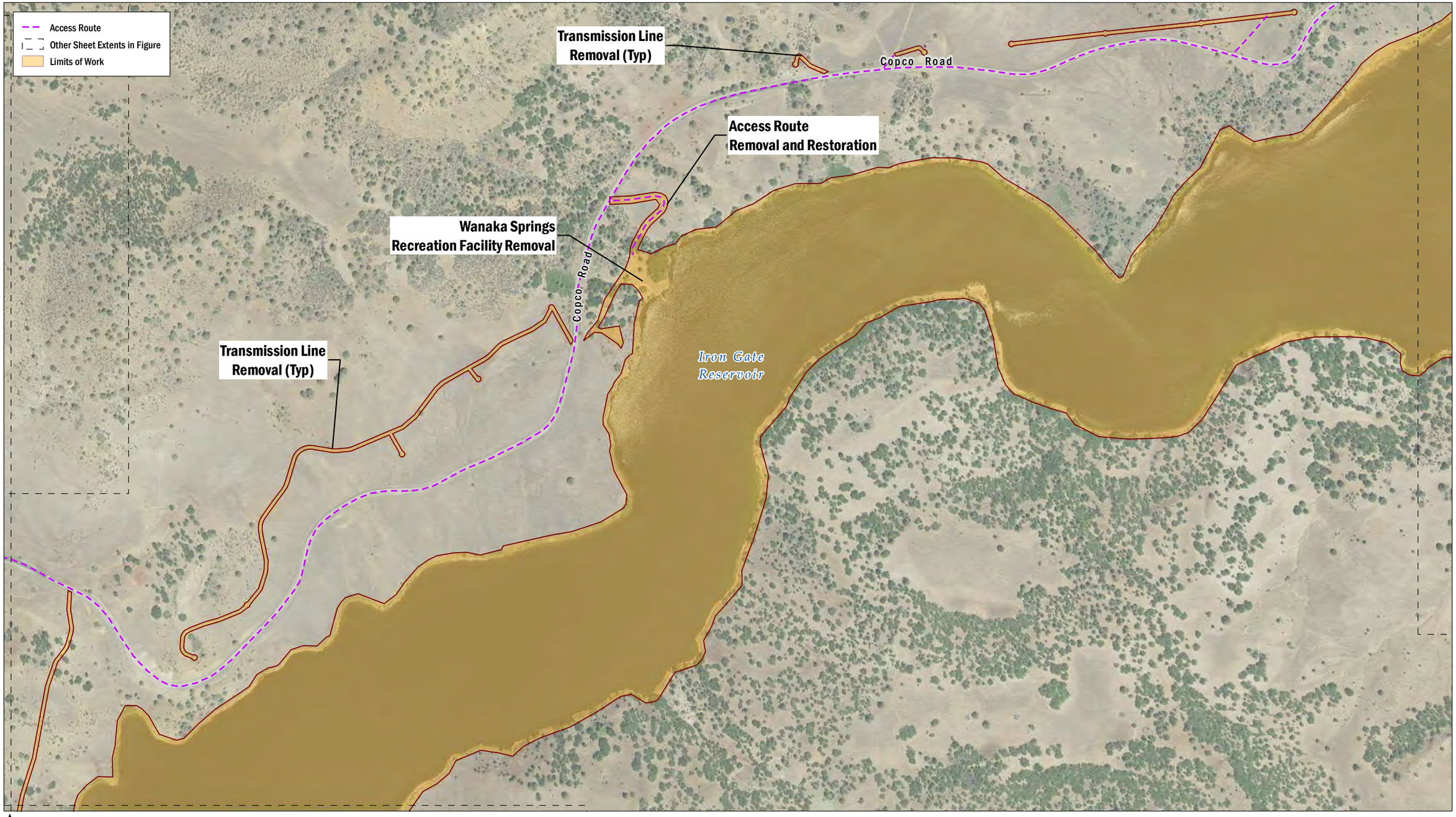


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 16 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd

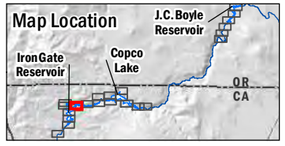


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

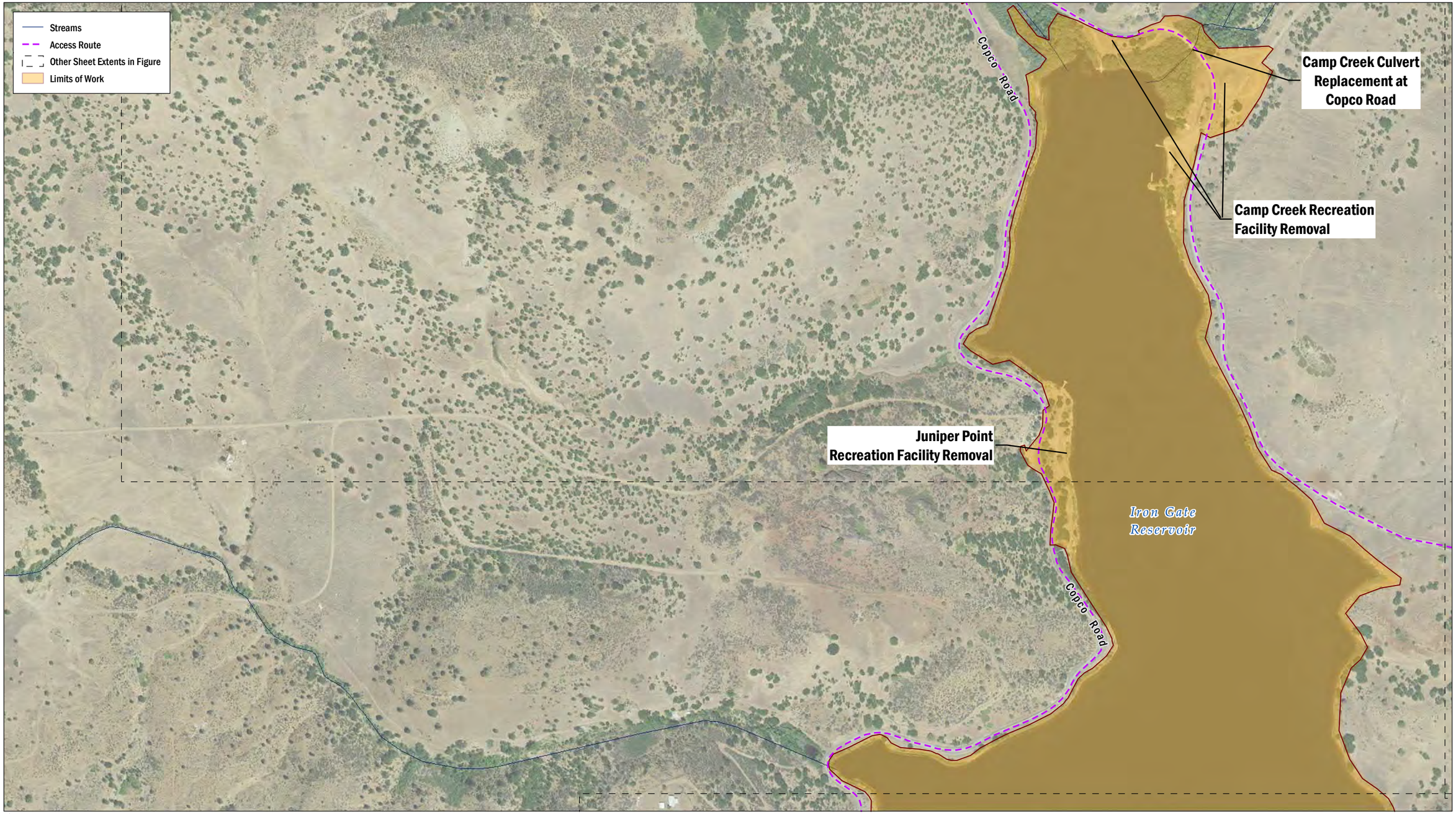


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 17 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd

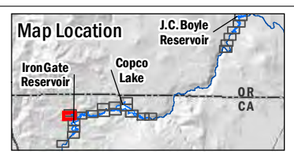


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

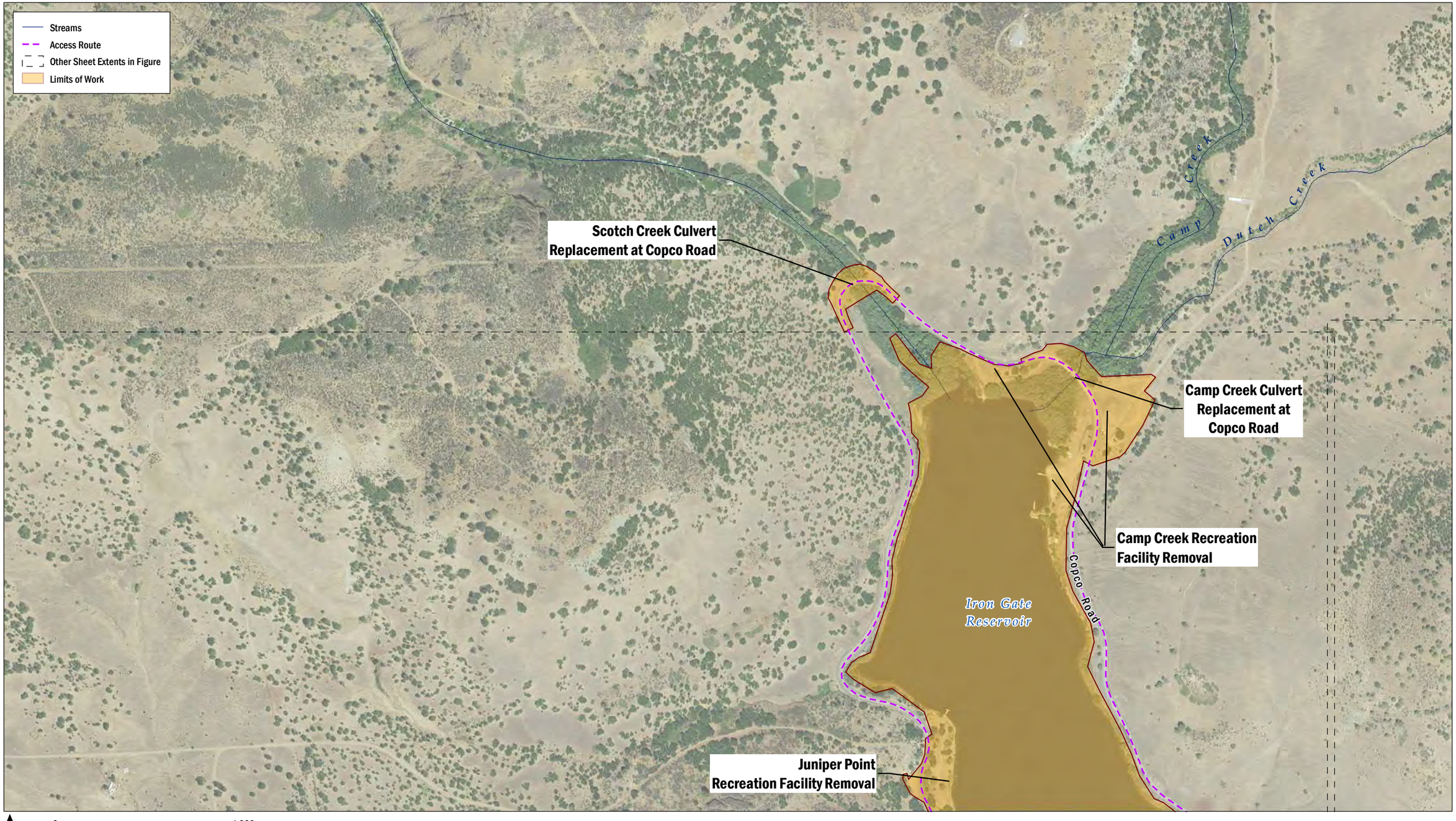


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 18 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd



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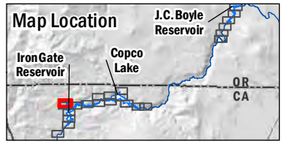
Feet

DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

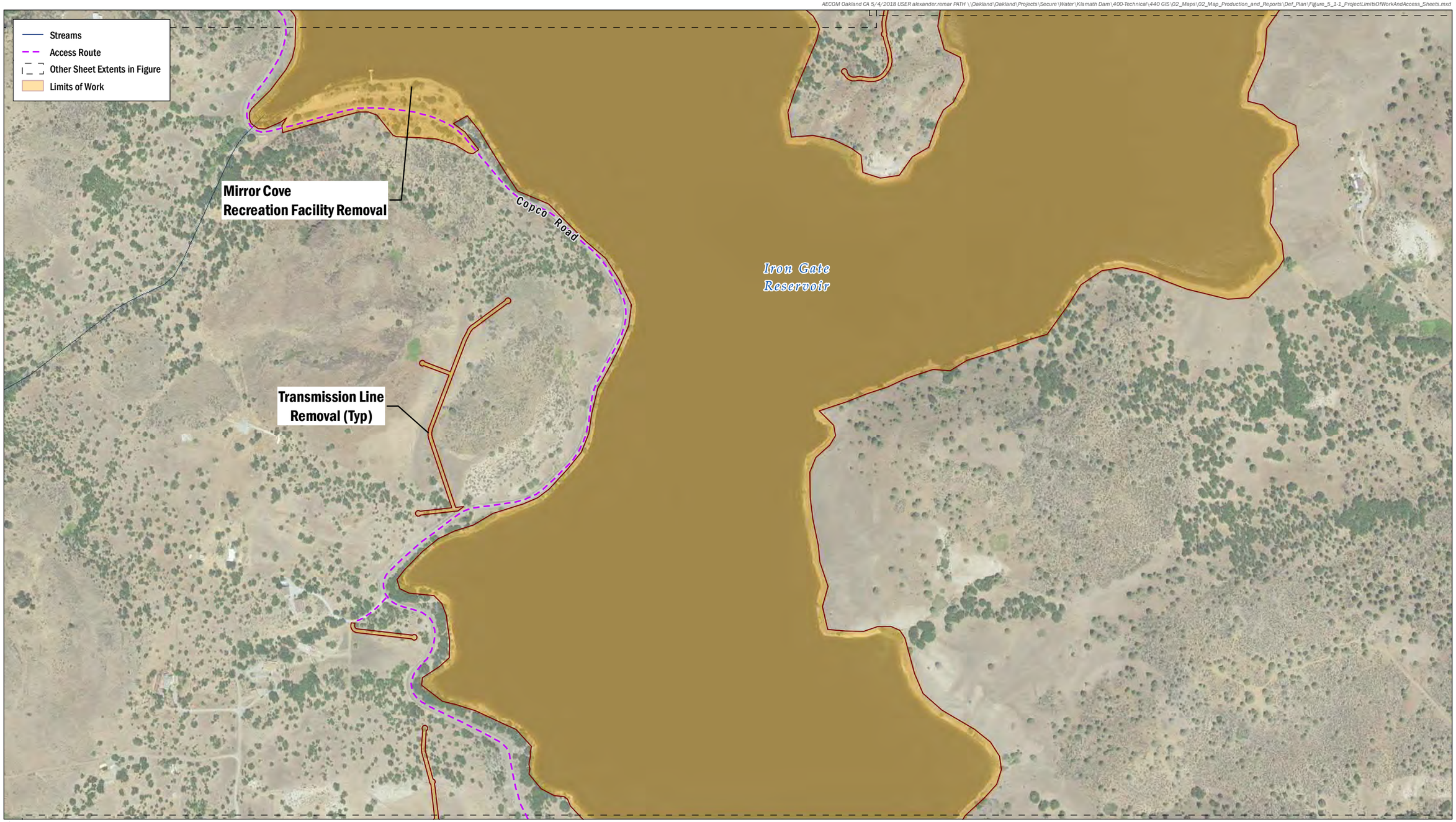


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 19 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd

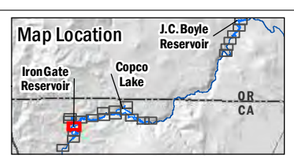


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

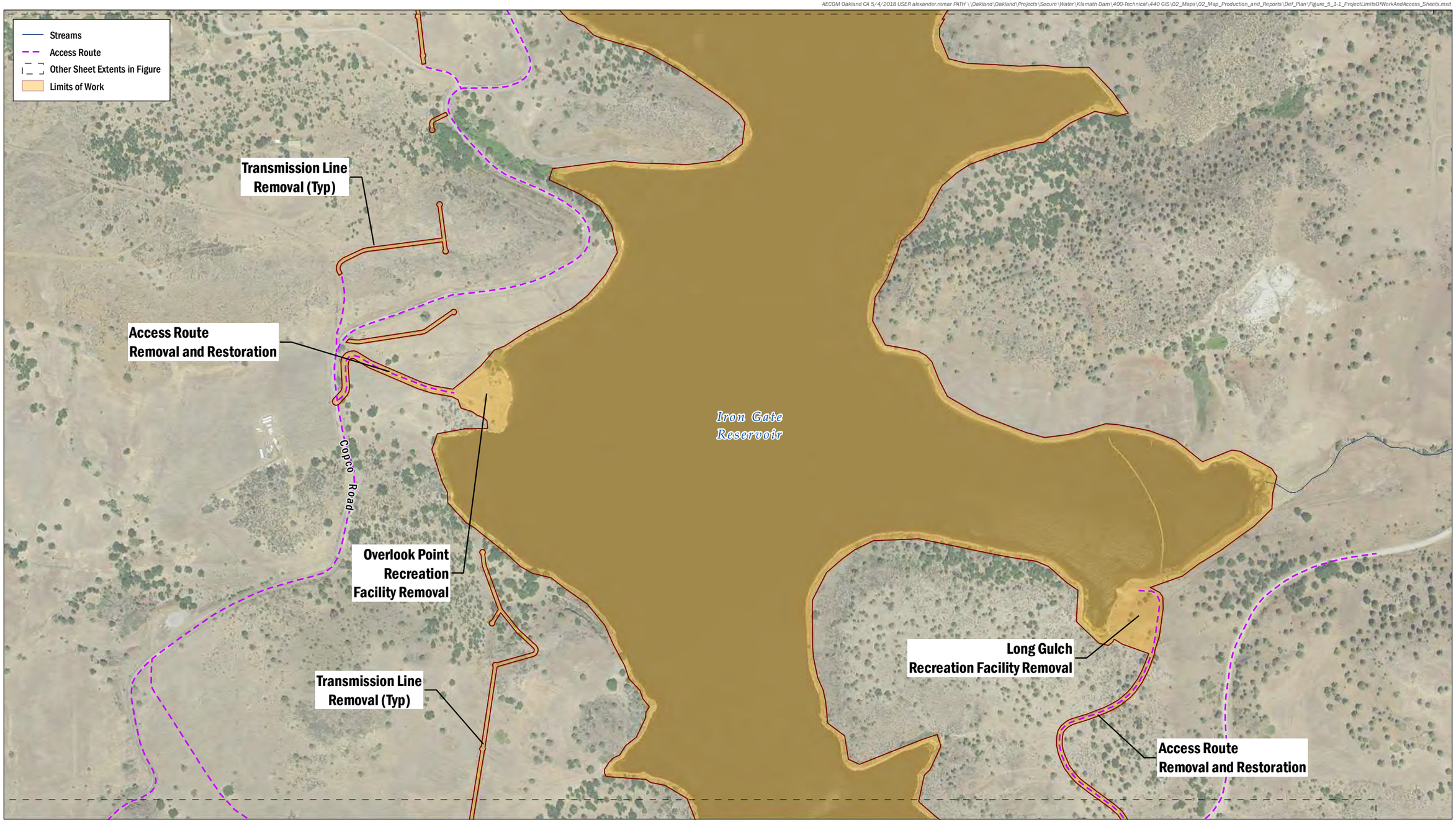


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 20 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd

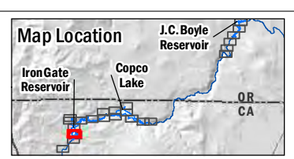


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

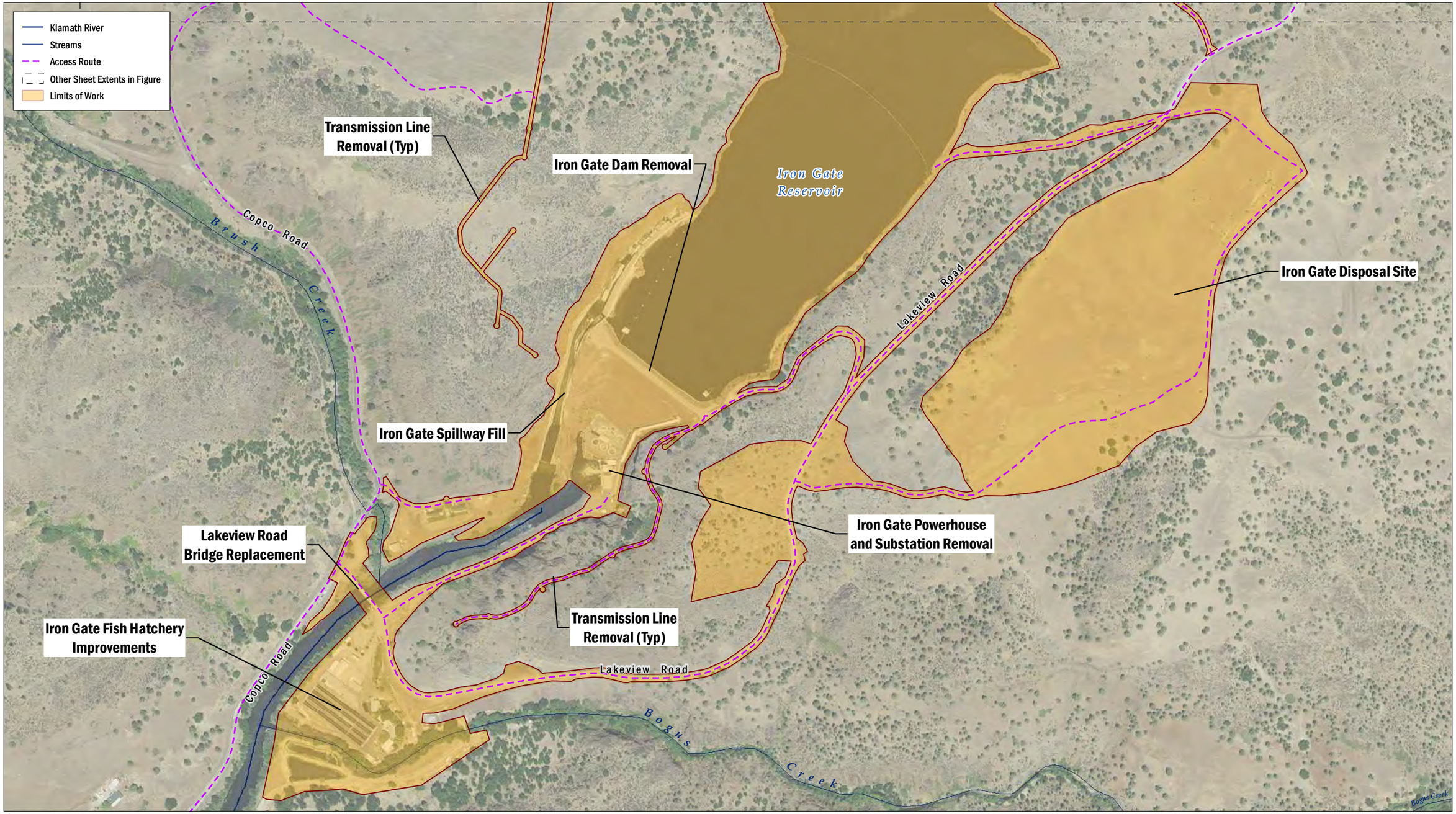


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 21 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd



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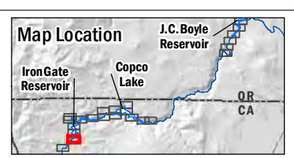
DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 22 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd



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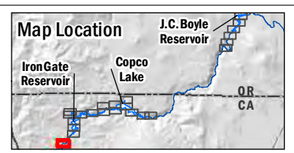
DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

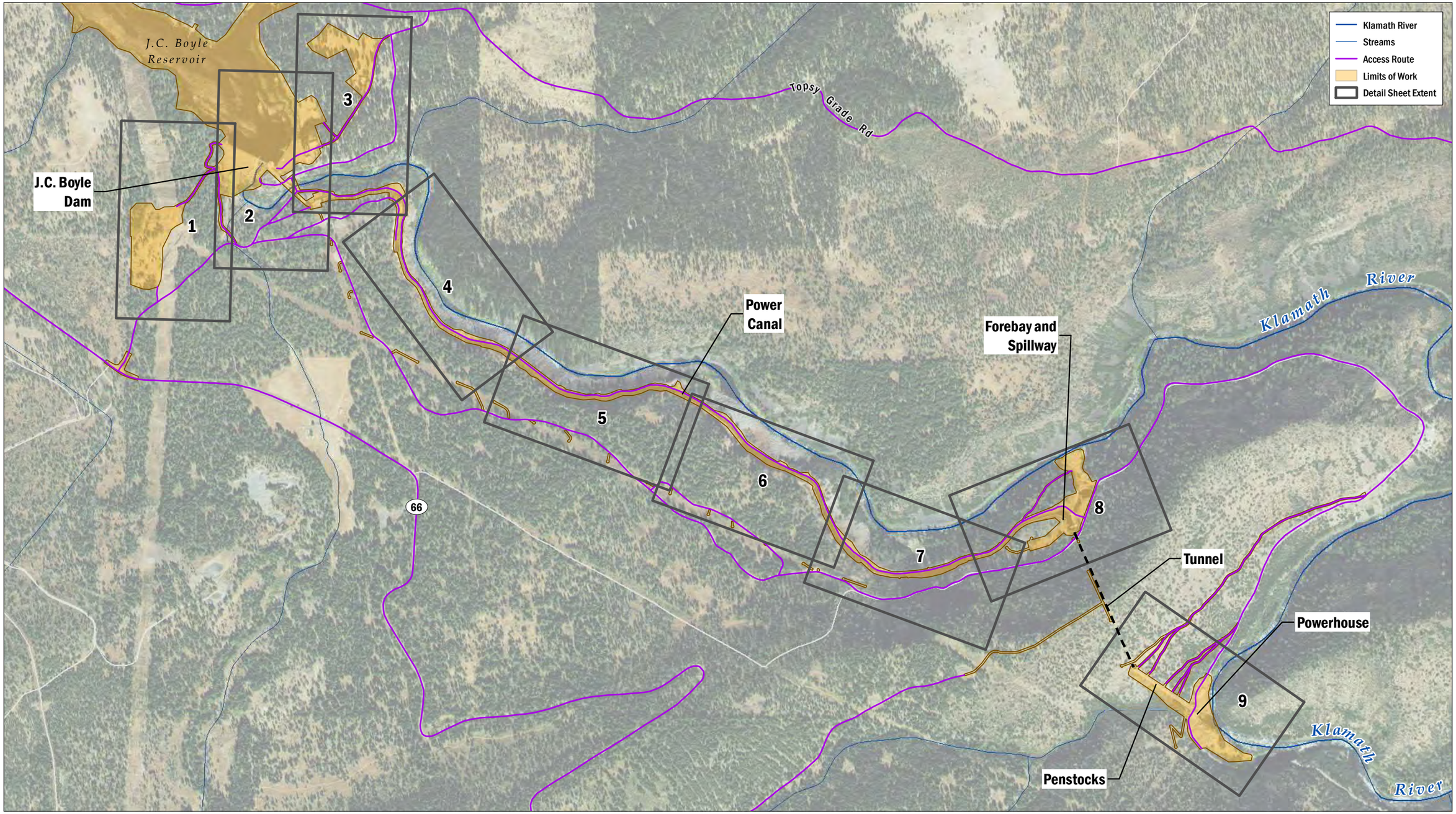


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 23 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_2-1_JCB_RemovalFeatureAndLimits_Overview.mxd



DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

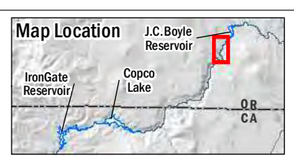
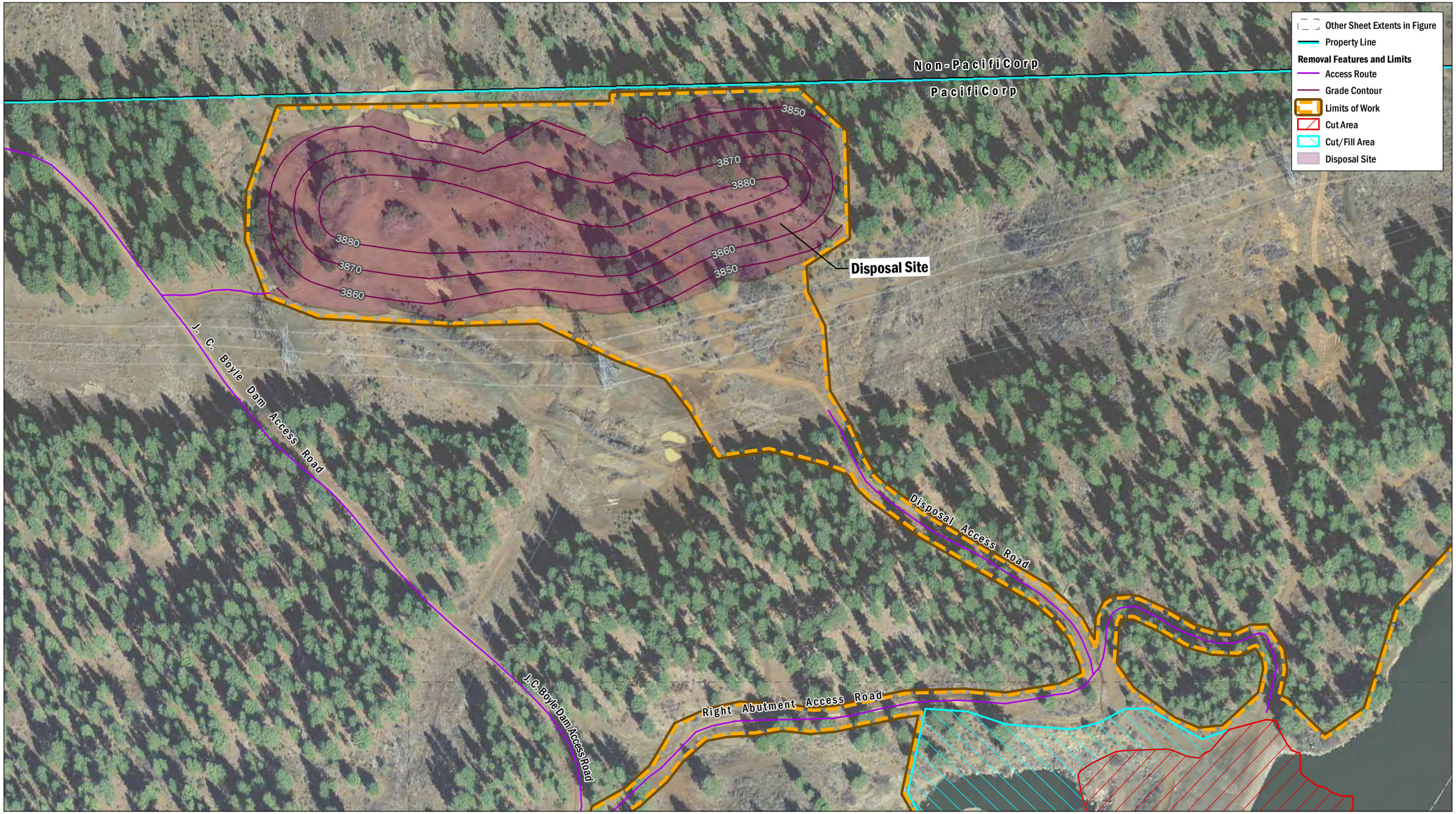


FIGURE 5.2-1

J.C. Boyle Dam Removal Features and Limits Overview Sheet

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_2-1_JCB_RemovalFeatureAndLimits_Sheets.mxd



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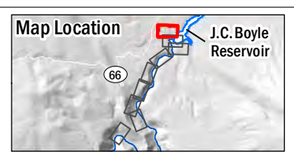
DATA SOURCE
NAIP, 2014; USGS (NED), 2015; PacifiCorp, 2005

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

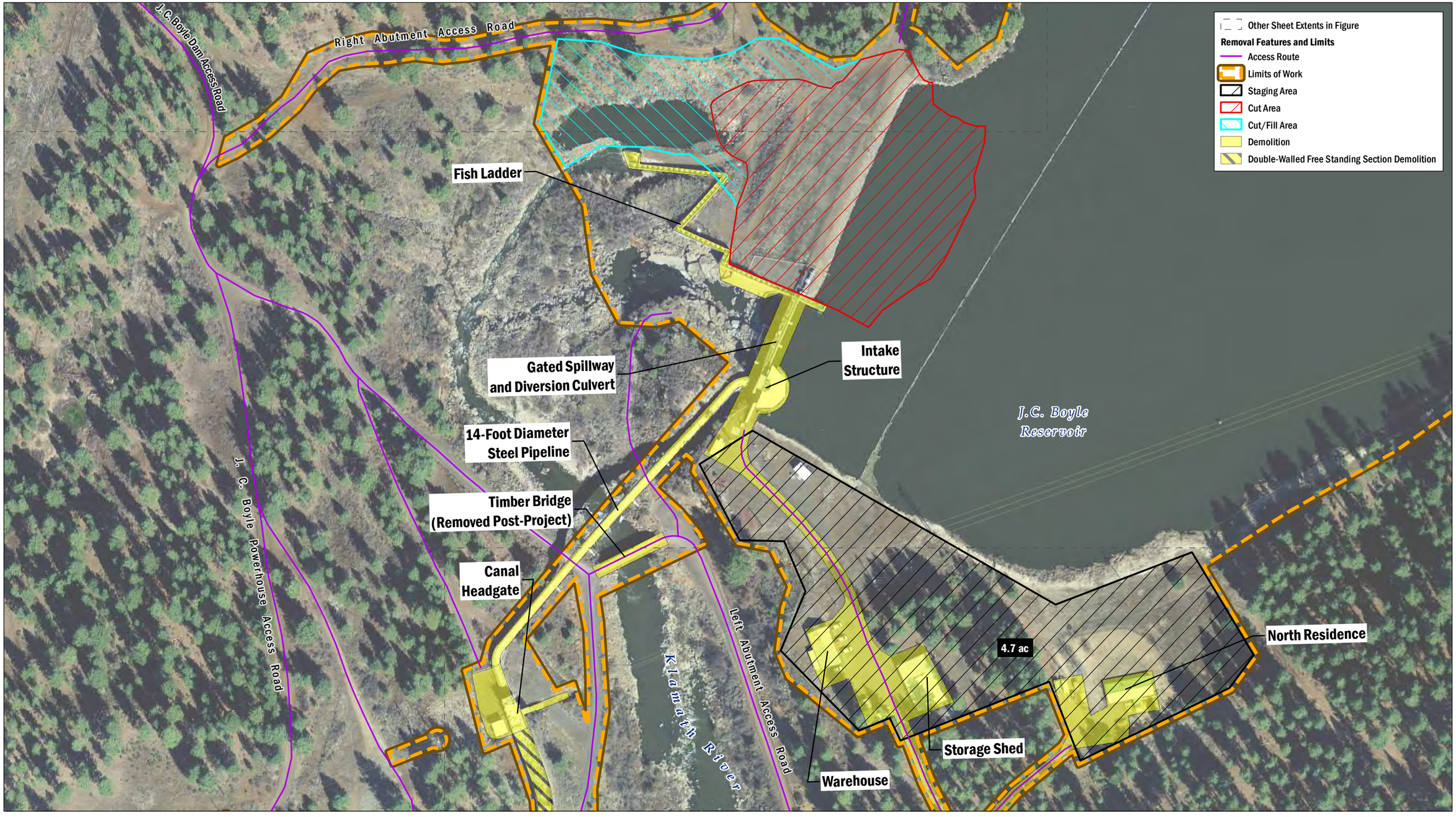
AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.2-1

J.C. Boyle Dam Removal Features and Limits
Sheet 1 of 9

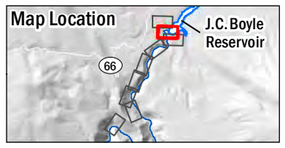


DATA SOURCE
NAIP, 2014; USGS (NED), 2015; PacifiCorp, 2005

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

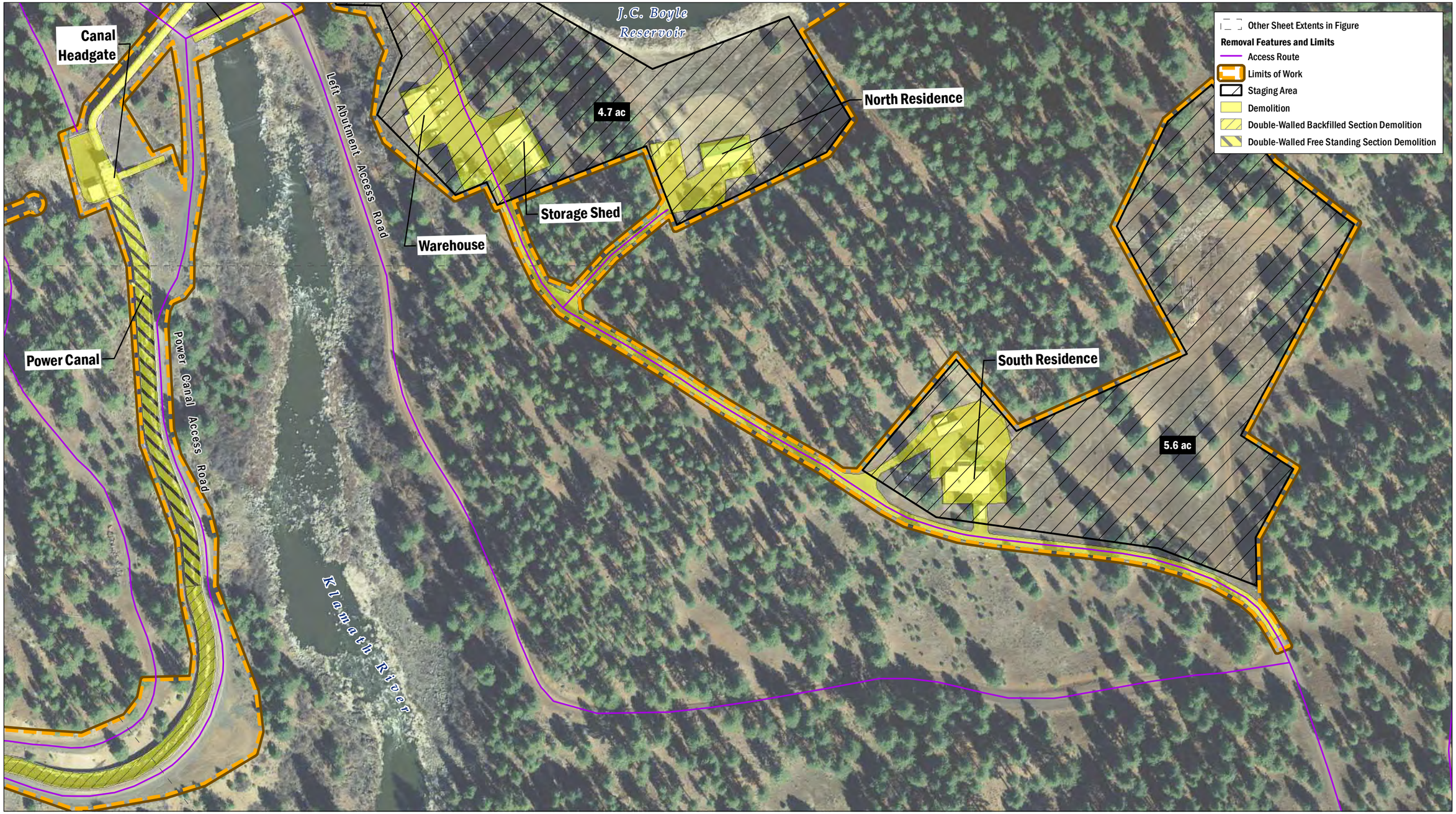


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.2-1

J.C. Boyle Dam Removal Features and Limits
Sheet 2 of 9

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_2-1_JCB_RemovalFeatureAndLimits_Sheets.mxd



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DATA SOURCE
NAIP, 2014; USGS (NED), 2015; PacifiCorp, 2005

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

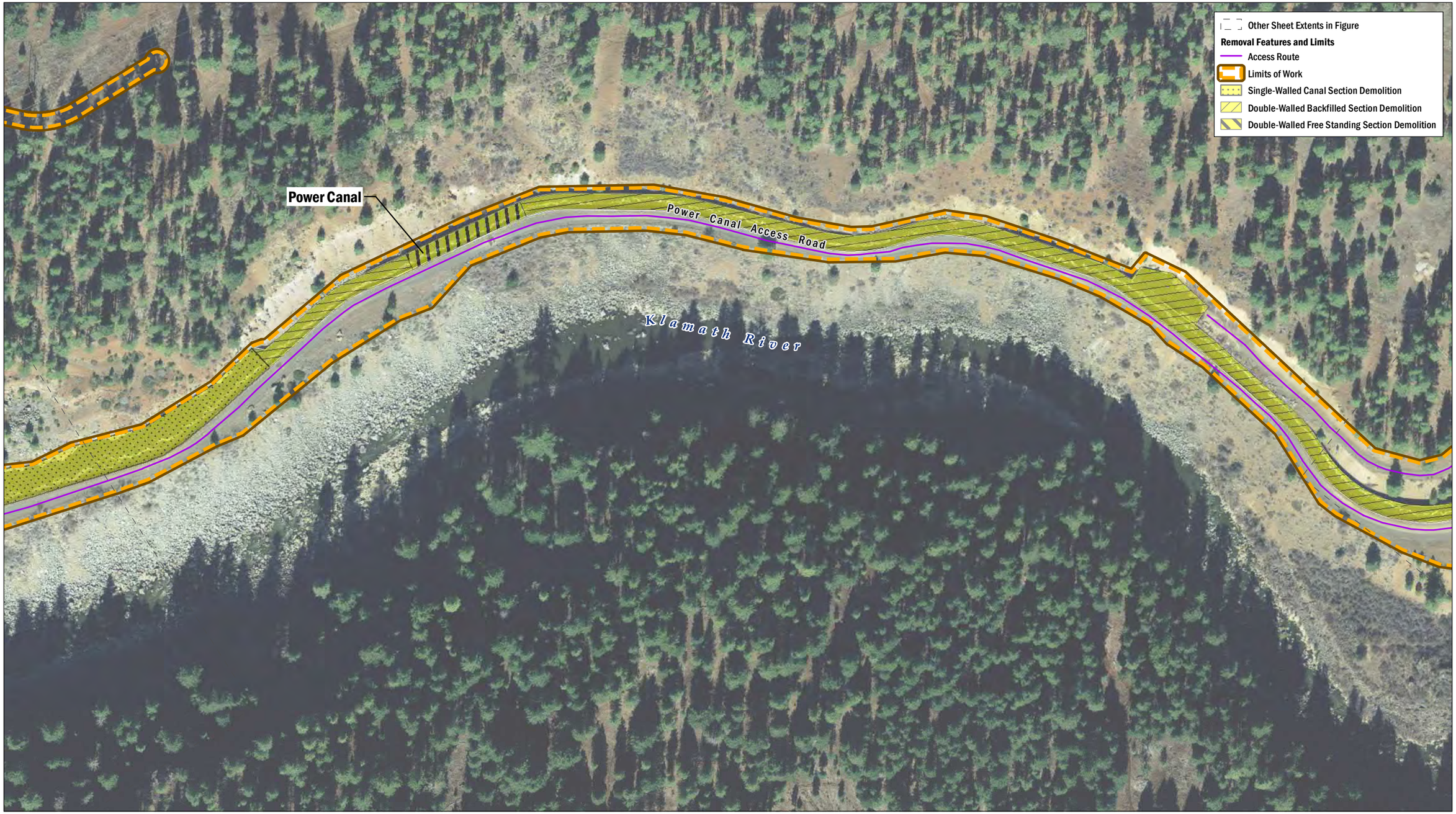


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.2-1

J.C. Boyle Dam Removal Features and Limits
Sheet 3 of 9

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_2-1_JCB_RemovalFeatureAndLimits_Sheets.mxd



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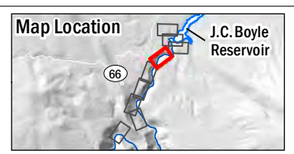
DATA SOURCE
NAIP, 2014; USGS (NED), 2015; PacifiCorp, 2005

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

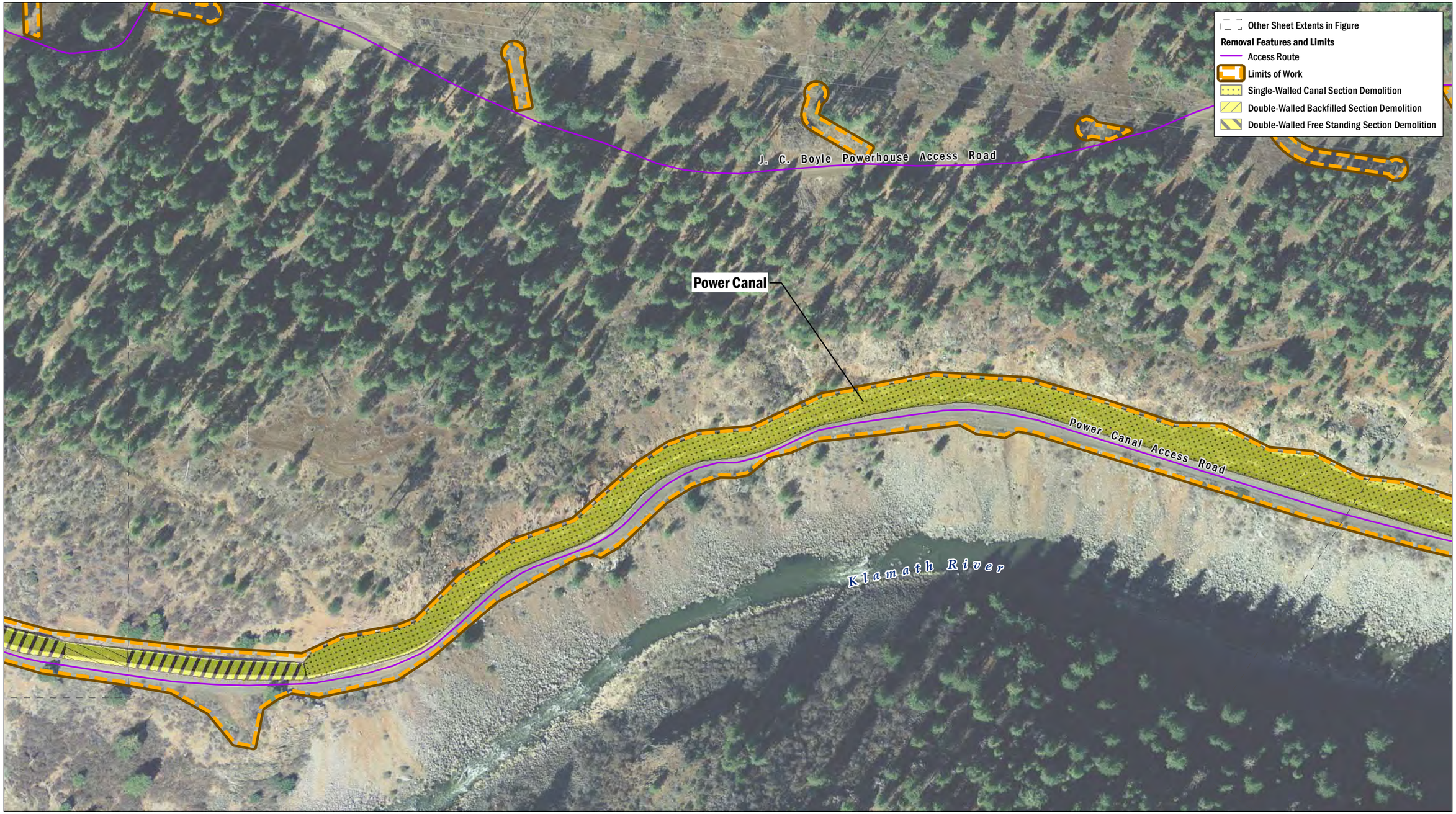


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.2-1

J.C. Boyle Dam Removal Features and Limits
Sheet 4 of 9

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_2-1_JCB_RemovalFeatureAndLimits_Sheets.mxd



0 300
Feet

DATA SOURCE
NAIP, 2014; USGS (NED), 2015; PacifiCorp, 2005

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

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Klamath River Renewal Corporation
Klamath River Renewal Project



Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.2-1

J.C. Boyle Dam Removal Features and Limits
Sheet 5 of 9

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_2-1_JCB_RemovalFeatureAndLimits_Sheets.mxd



0 300
Feet

DATA SOURCE
NAIP, 2014; USGS (NED), 2015; PacifiCorp, 2005

MAP PREPARED BY:
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PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.2-1

J.C. Boyle Dam Removal Features and Limits
Sheet 6 of 9

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_2-1_JCB_RemovalFeatureAndLimits_Sheets.mxd



0 300
Feet

DATA SOURCE
NAIP, 2014; USGS (NED), 2015; PacifiCorp, 2005

MAP PREPARED BY:
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PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

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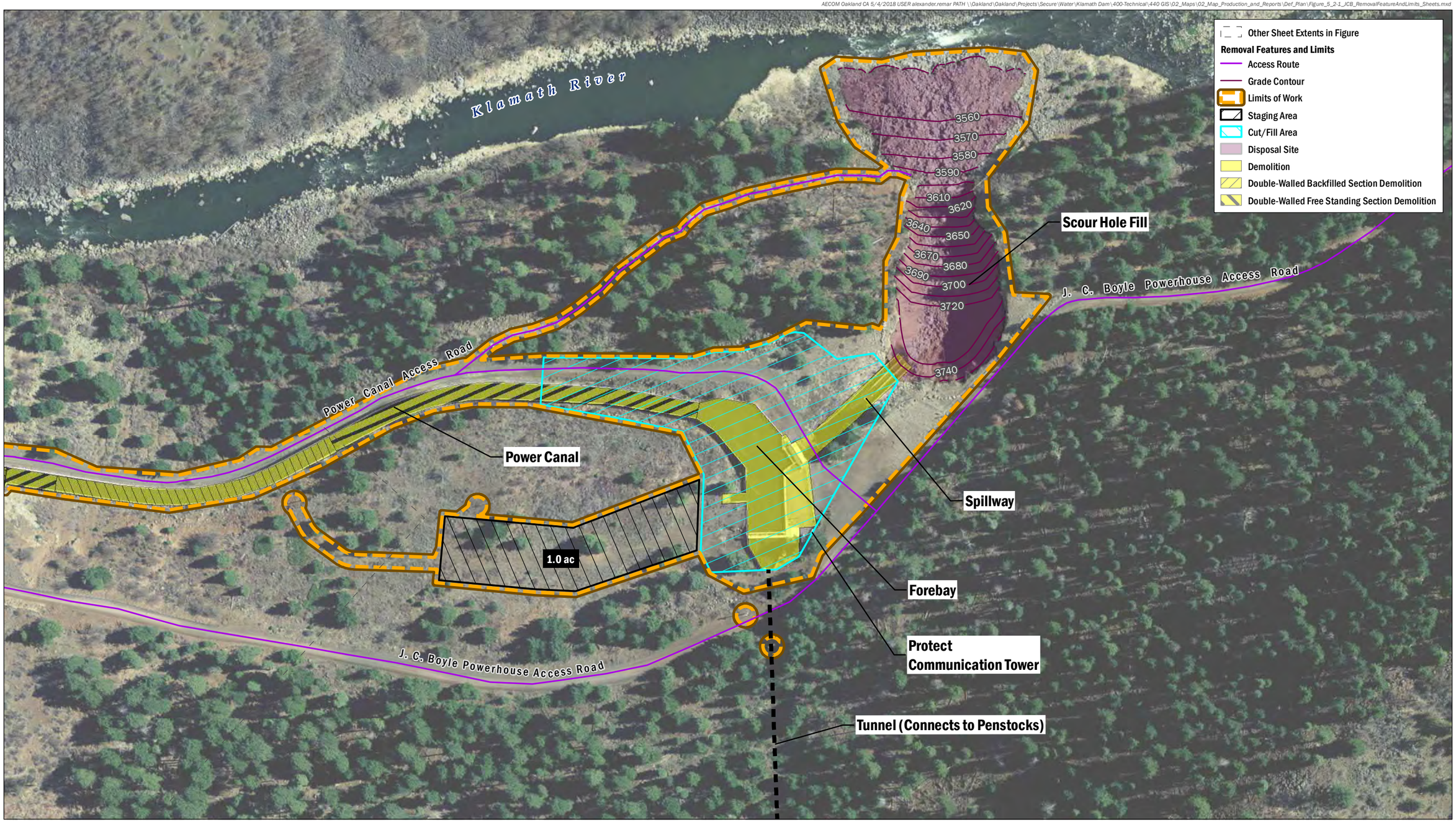
Klamath River Renewal Corporation
Klamath River Renewal Project



Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.2-1
J.C. Boyle Dam Removal Features and Limits
Sheet 7 of 9

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_2-1_JCB_RemovalFeatureAndLimits_Sheets.mxd



0 300
Feet

DATA SOURCE
NAIP, 2014; USGS (NED), 2015; PacifiCorp, 2005

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

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Klamath River Renewal Project

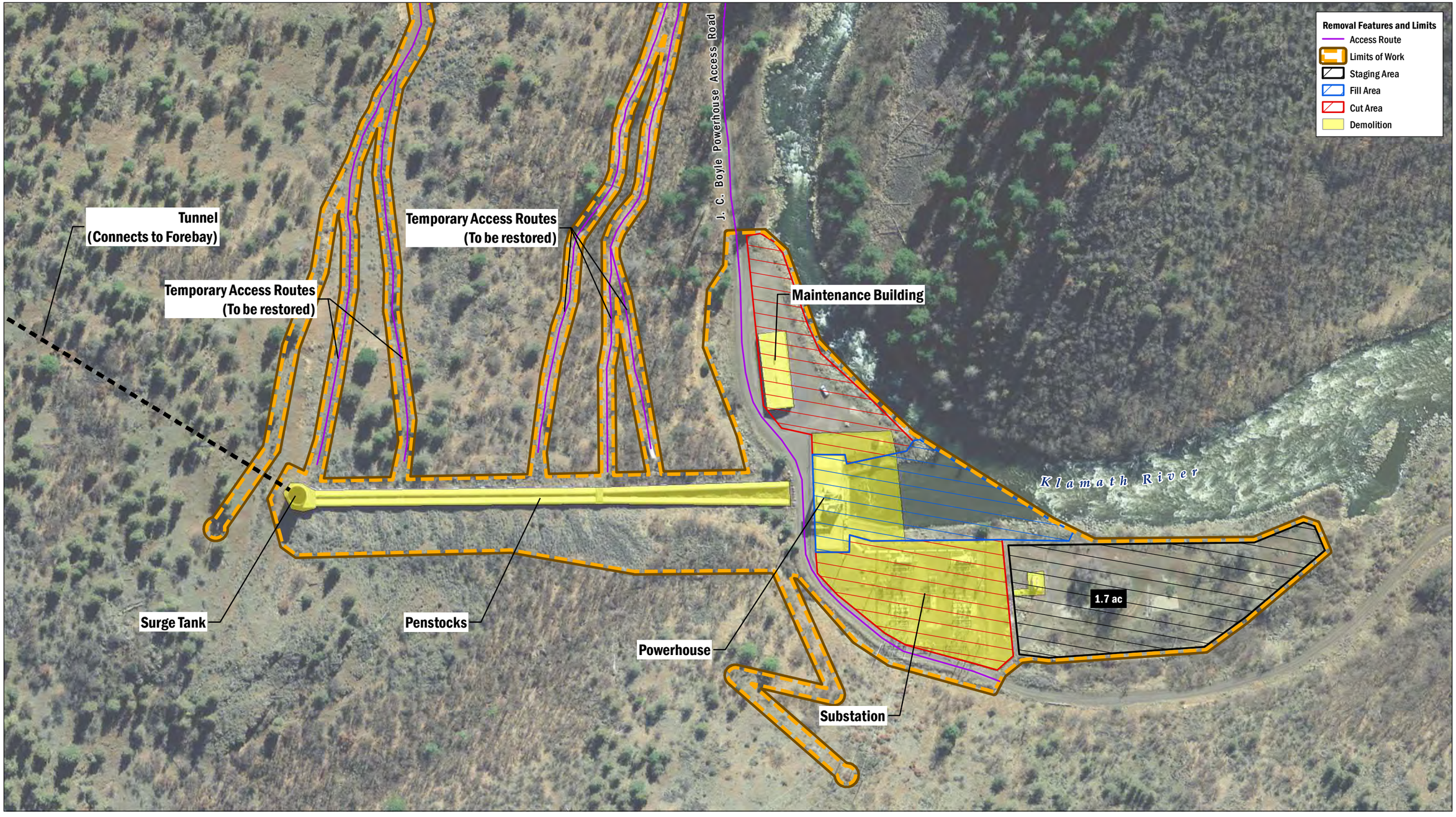


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.2-1

J.C. Boyle Dam Removal Features and Limits
Sheet 8 of 9

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_2-1_JCB_RemovalFeatureAndLimits_Sheets.mxd

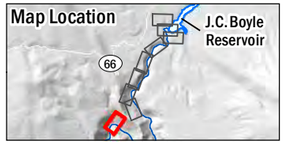


DATA SOURCE
NAIP, 2014; USGS (NED), 2015; PacifiCorp, 2005

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

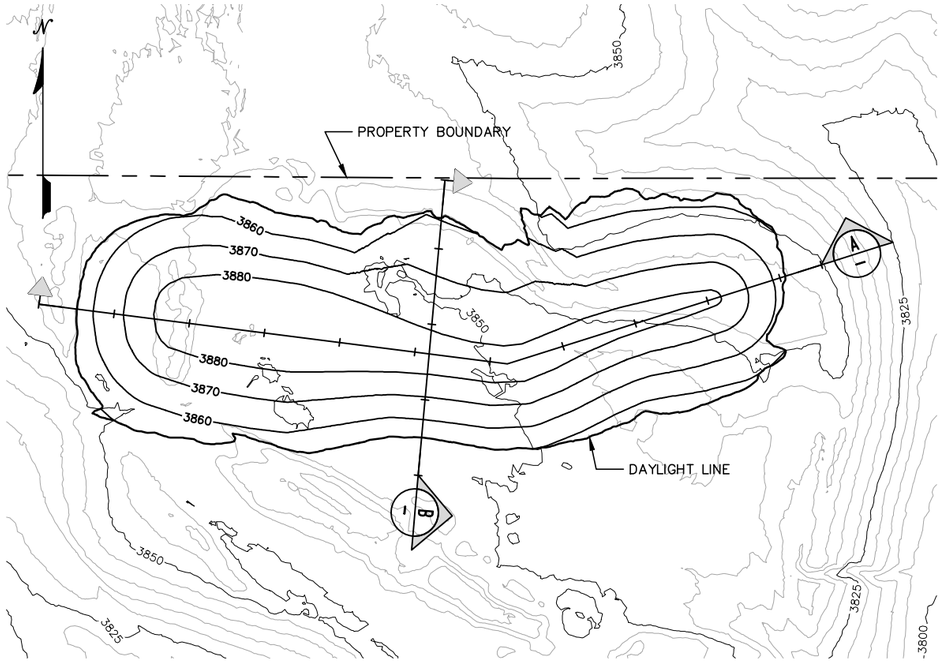
AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.2-1

J.C. Boyle Dam Removal Features and Limits
Sheet 9 of 9



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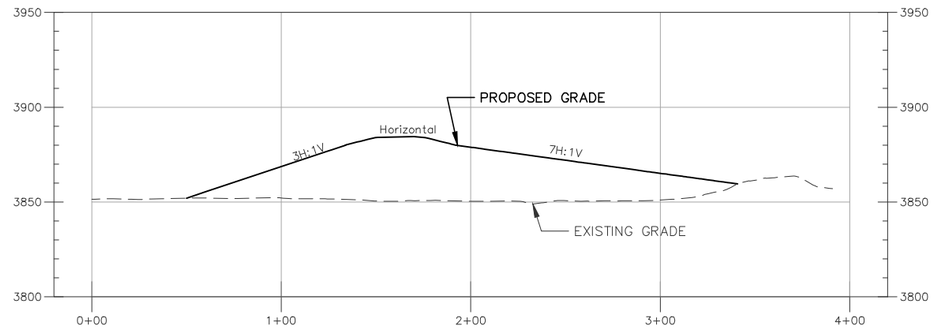
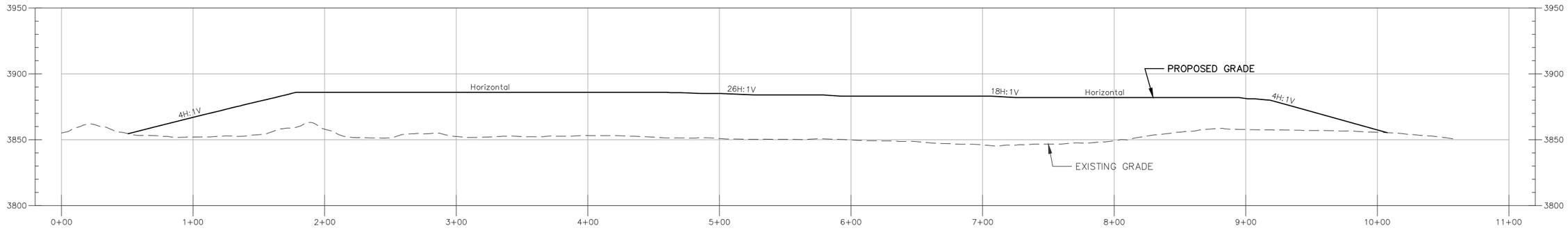
HORIZ 1"=200'



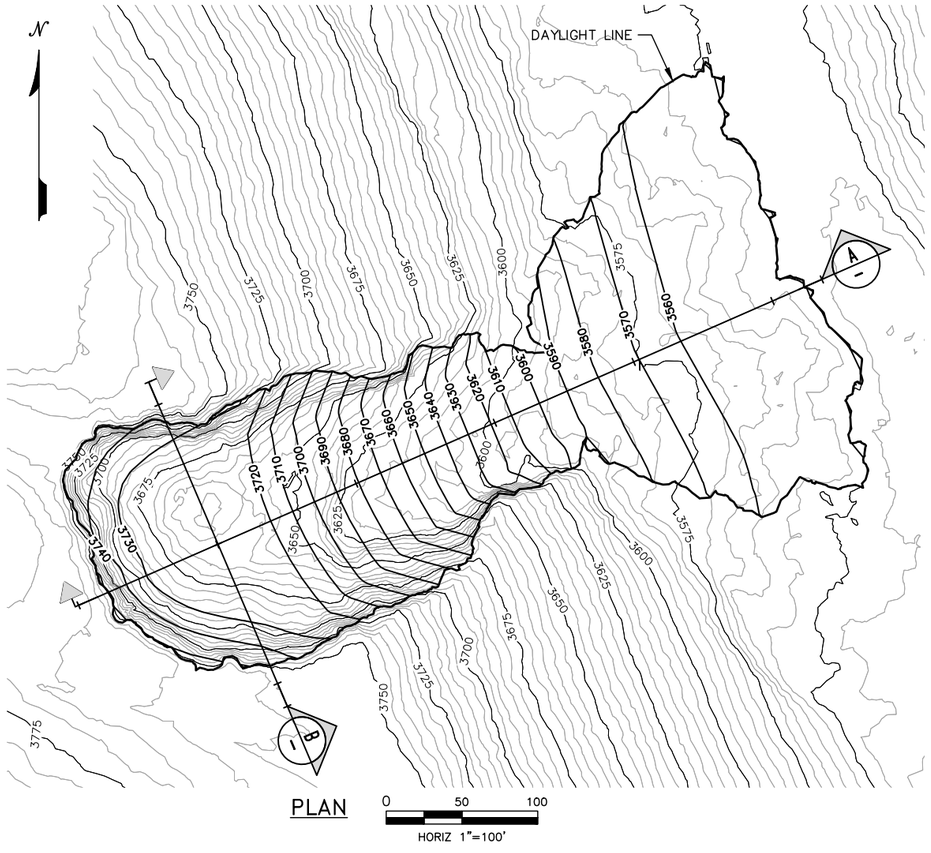
B — SECTION
HORIZ 1"=80', VERT 1"=80'



A — SECTION
HORIZ 1"=80', VERT 1"=80'

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

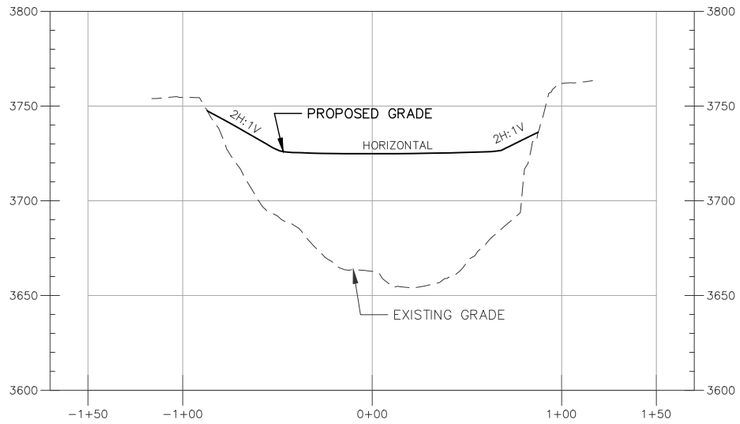
FIGURE 5.2-8
J.C. Boyle Right Abutment Disposal Site Plan & Sections



PLAN

0 50 100

HORIZ 1"=100'



B / — SECTION

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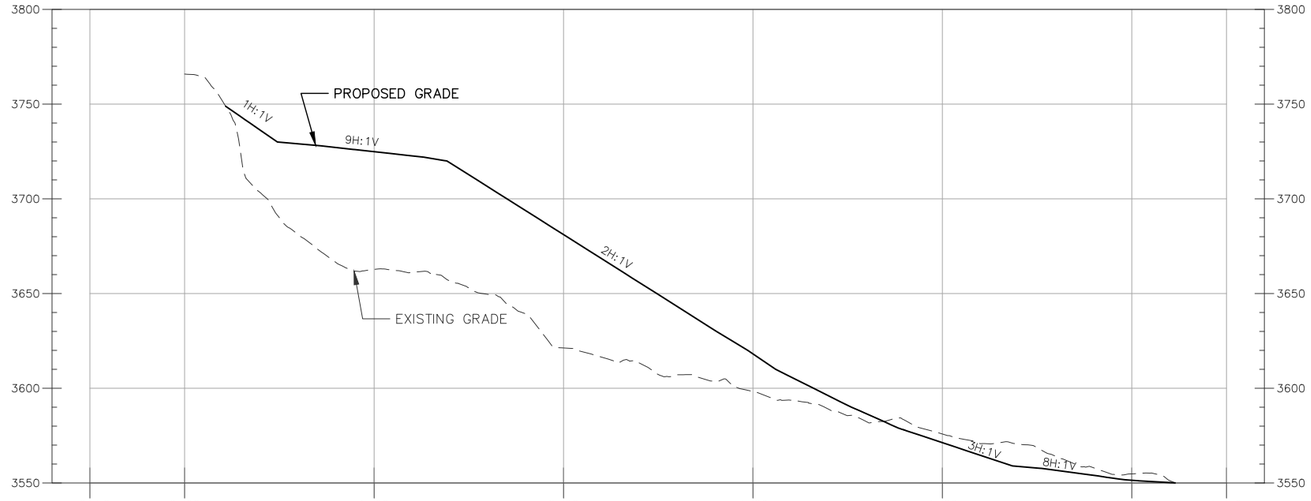


A / — SECTION

HORIZ 1"=80', VERT 1"=80'

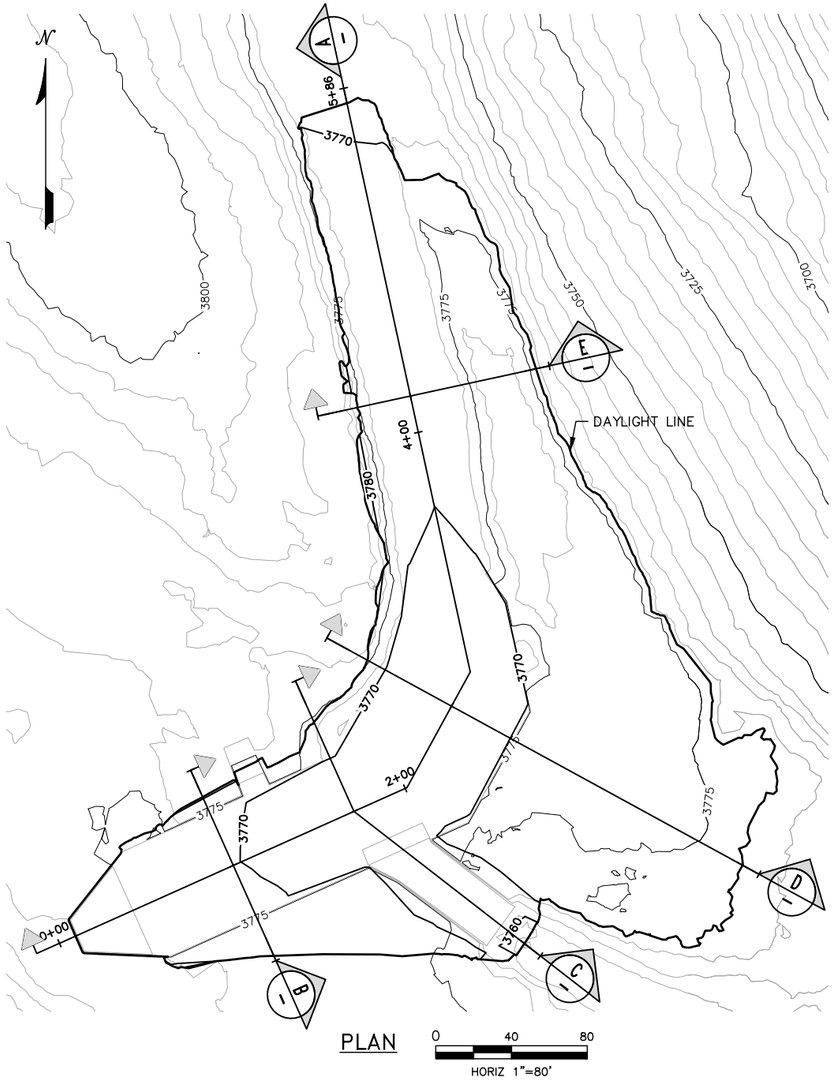
AECOM

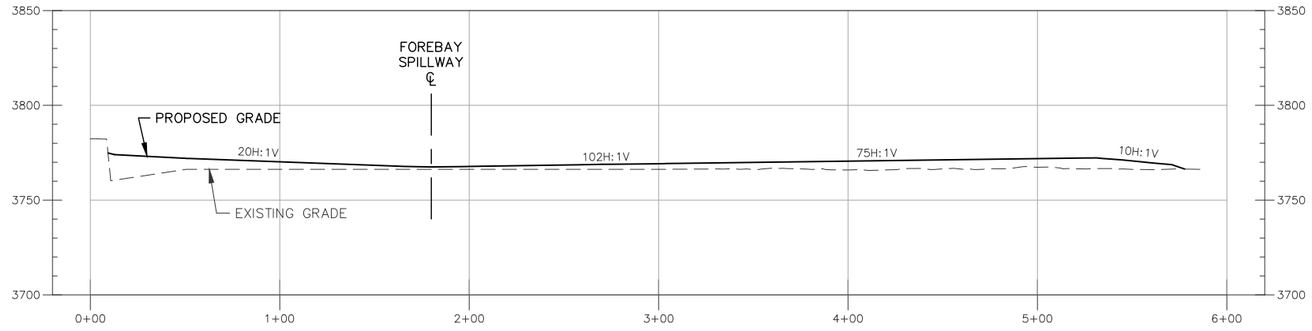
Klamath River Renewal Corporation

Klamath River Renewal Project

FIGURE 5.2-9

J.C. Boyle Forebay Spillway Scour Hole Backfill Plan & Sections





A — SECTION
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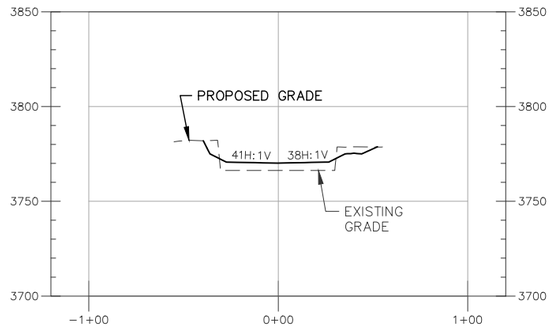

B — SECTION
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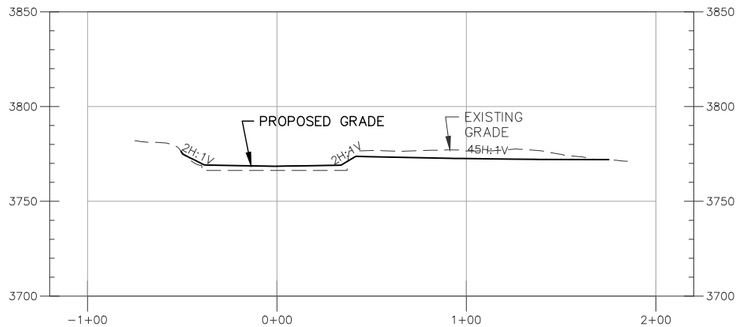
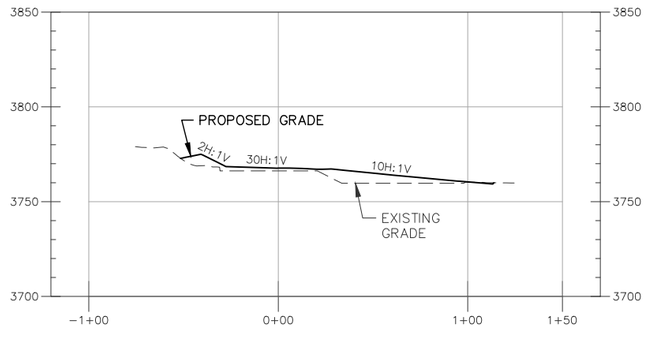
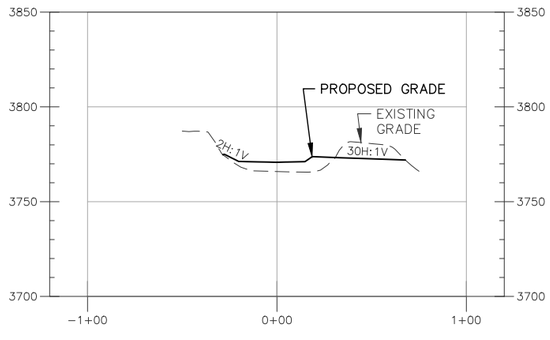


D — SECTION
HORIZ 1"=80', VERT 1"=80'



C — SECTION
HORIZ 1"=80', VERT 1"=80'



E — SECTION
HORIZ 1"=80', VERT 1"=80'

AECOM
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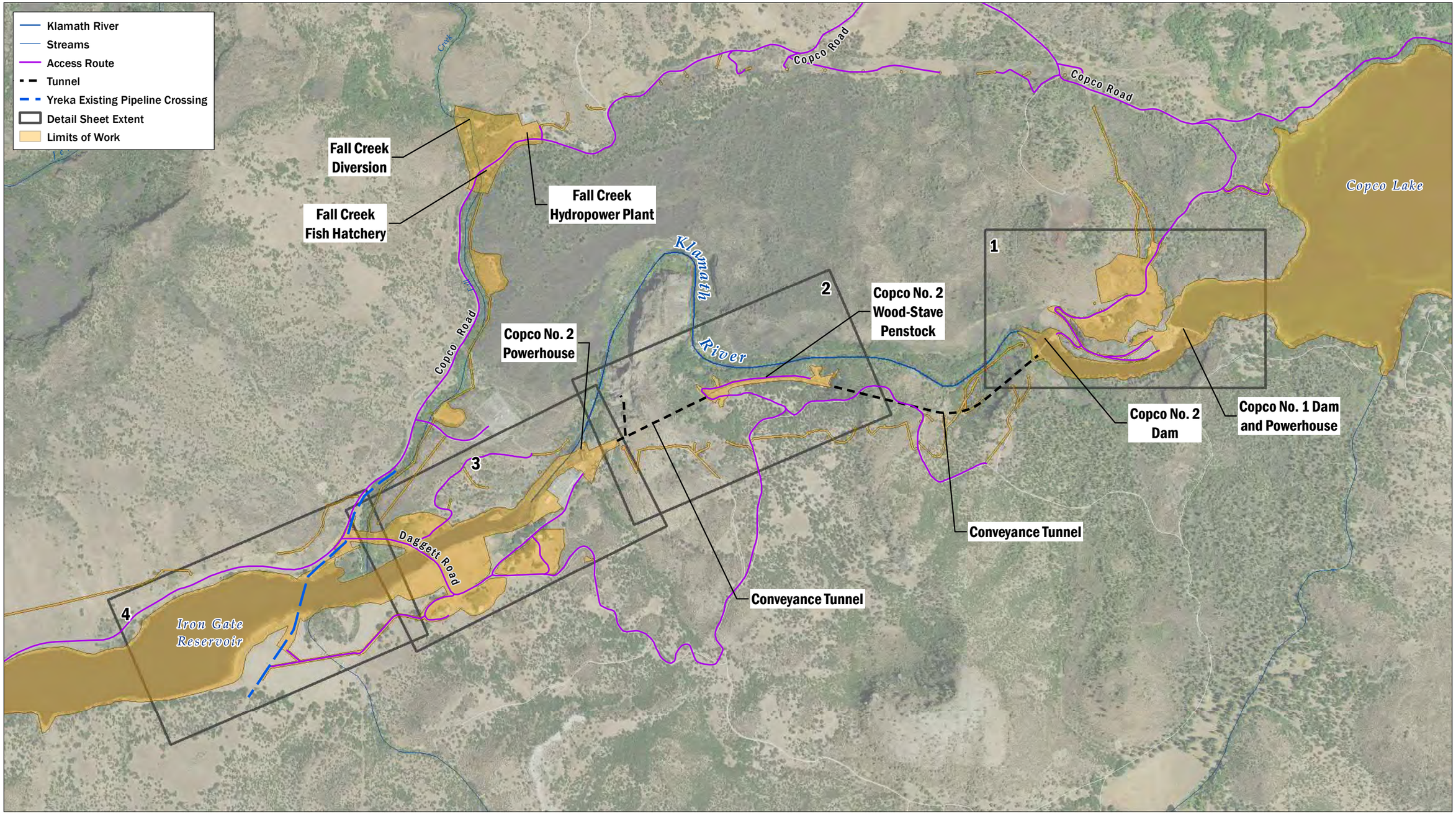
Klamath River Renewal Project

FIGURE 5.2-11
J.C. Boyle Forebay Backfill Plan & Sections

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_3-1_Copco_RemovalFeatureAndLimits_Overview.mxd



N

0 2,000
Feet

DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

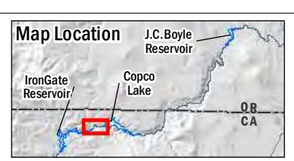
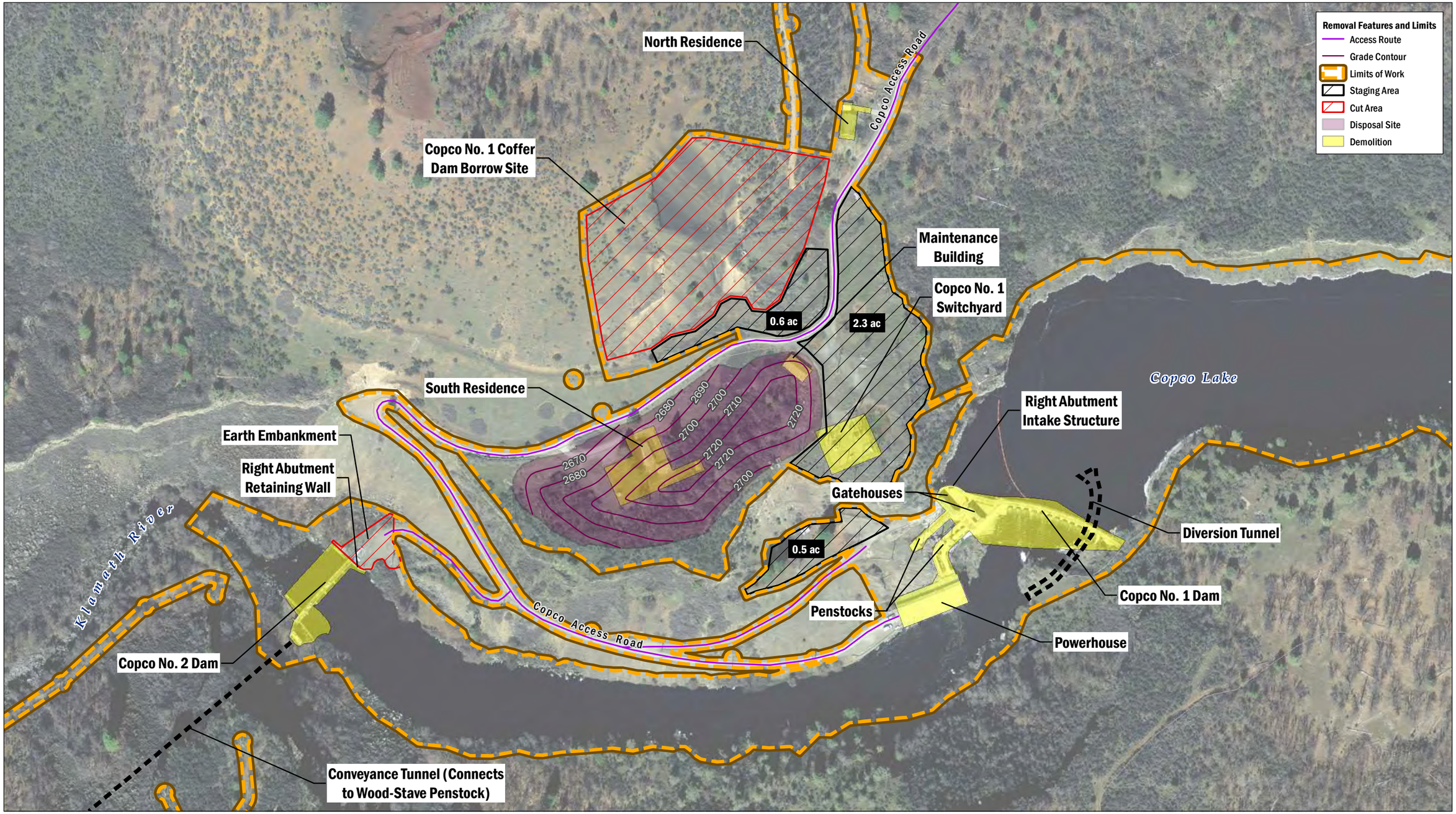


FIGURE 5.3-1

Copco No. 1 and Copco No. 2 Dams Removal Features and Limits Overview Sheet



N

0 400

Feet

DATA SOURCE: NAIP, 2014; USGS (NED), 2015; PacifiCorp, 2005

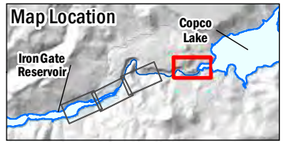
MAP PREPARED BY: AECOM Alex Remar, 5/4/2018

PROJECTION: NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM

Klamath River Renewal Corporation

Klamath River Renewal Project



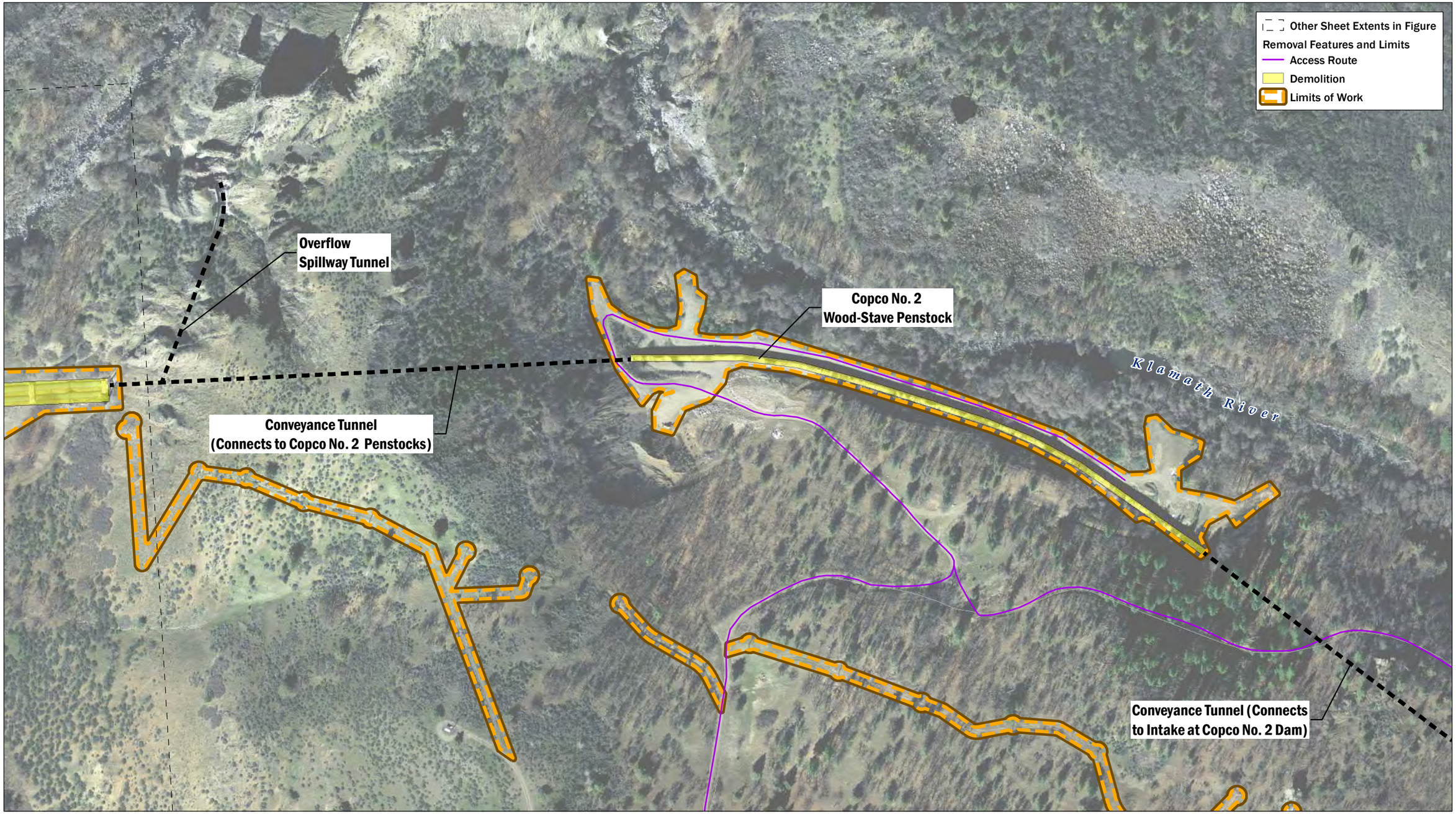
Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.3-1

Copco No. 1 and Copco No. 2 Dams Removal Features and Limits

Sheet 1 of 4

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_3-1_Copco_RemovalFeatureAndLimits_Sheet2.mxd



N

0 400

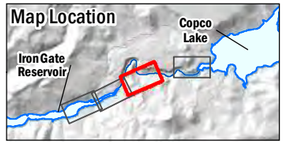
Feet

DATA SOURCE
NAIP 2014; USGS (NED), 2015; PacifiCorp, 2005

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

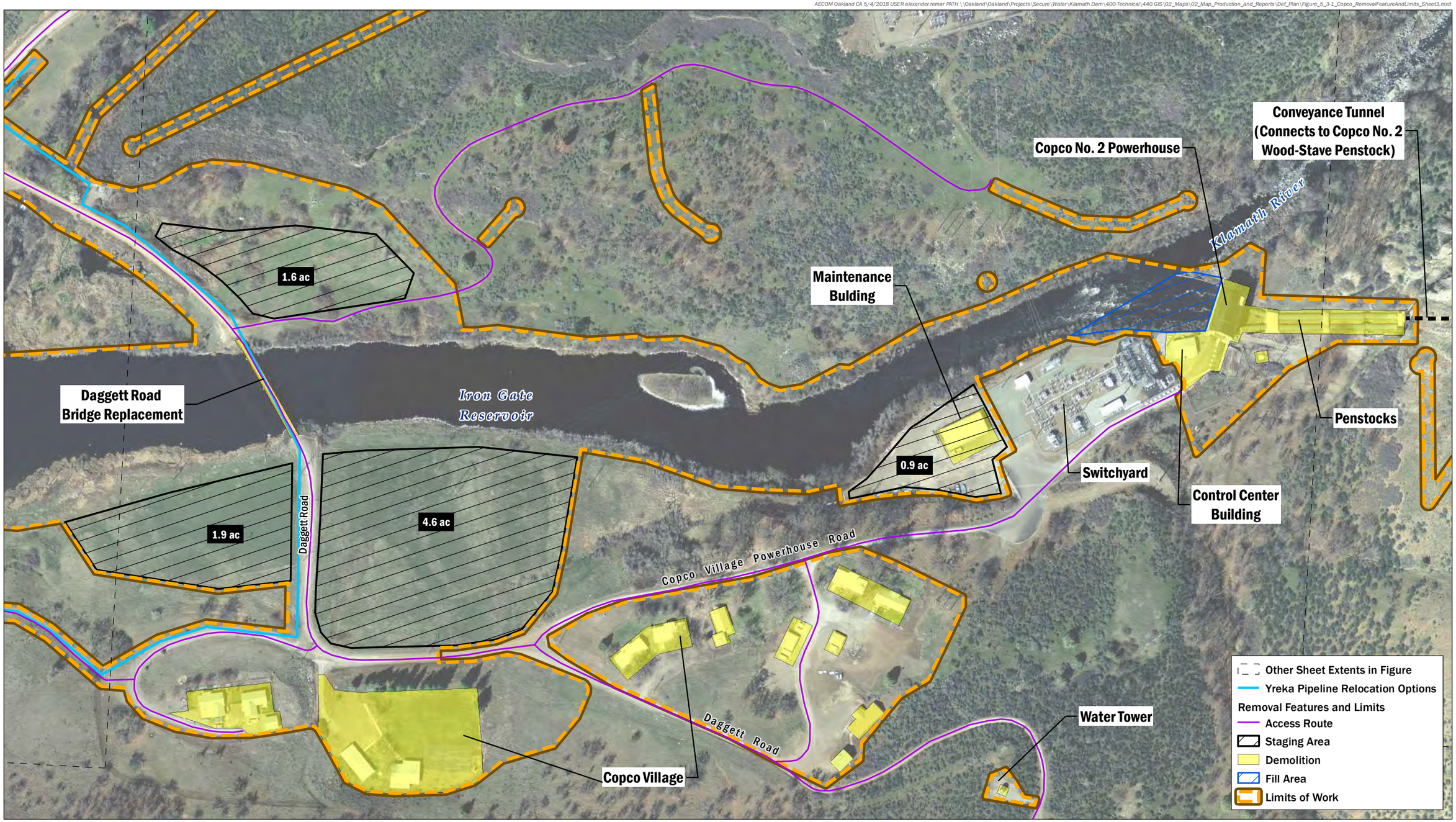


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.3-1

Copco No. 1 and Copco No. 2 Dams Removal Features and Limits
Sheet 2 of 4

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_3-1_Copco_RemovalFeatureAndLimits_Sheet3.mxd



DATA SOURCE
NAIP, 2014; USGS (NED), 2015; PacifiCorp, 2005

MAP PREPARED BY:
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PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

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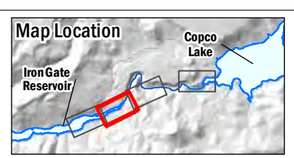
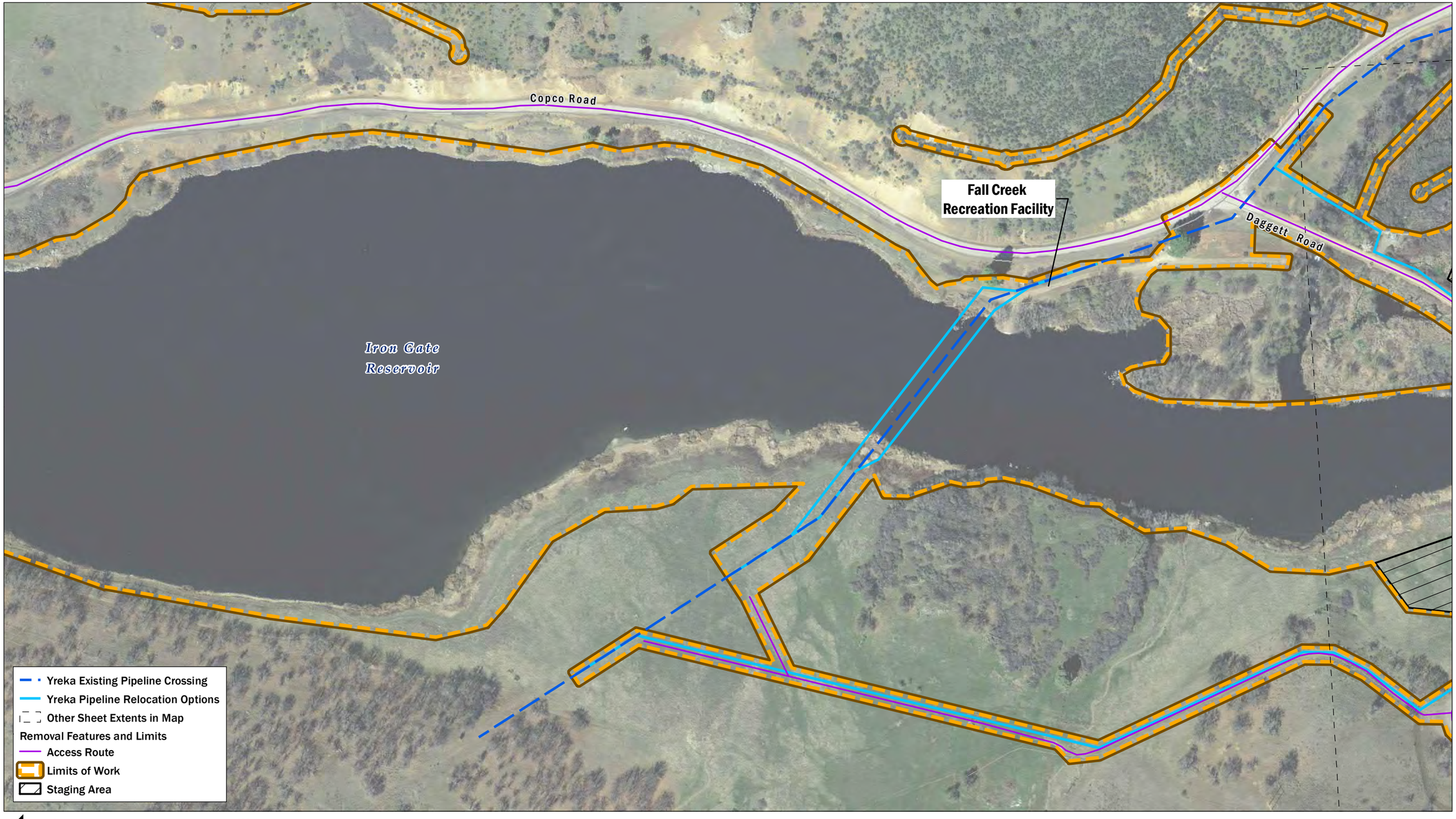


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.3-1

Copco No. 1 and Copco No. 2 Dams Removal Features and Limits
Sheet 3 of 4

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_3-1_Copco_RemovalFeatureAndLimits_Sheet4.mxd

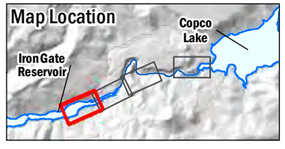


DATA SOURCE
NAIP, 2014; USGS (NED), 2015; PacifiCorp, 2005

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

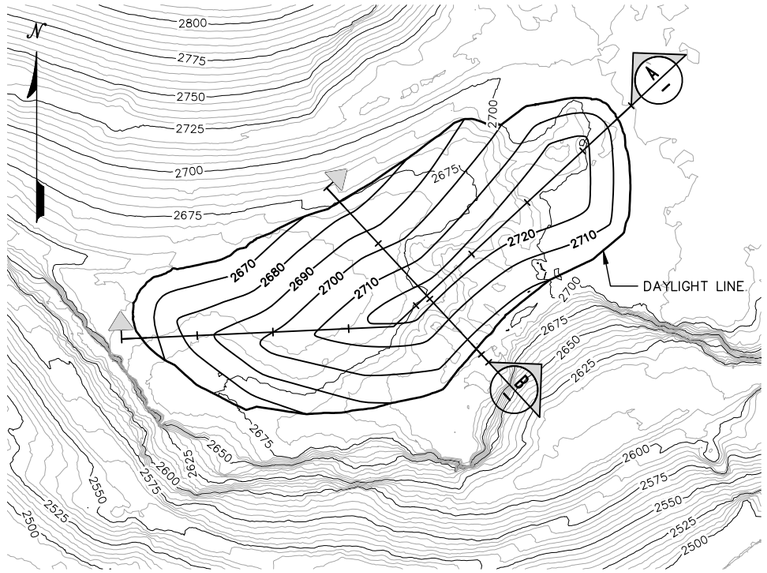
AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



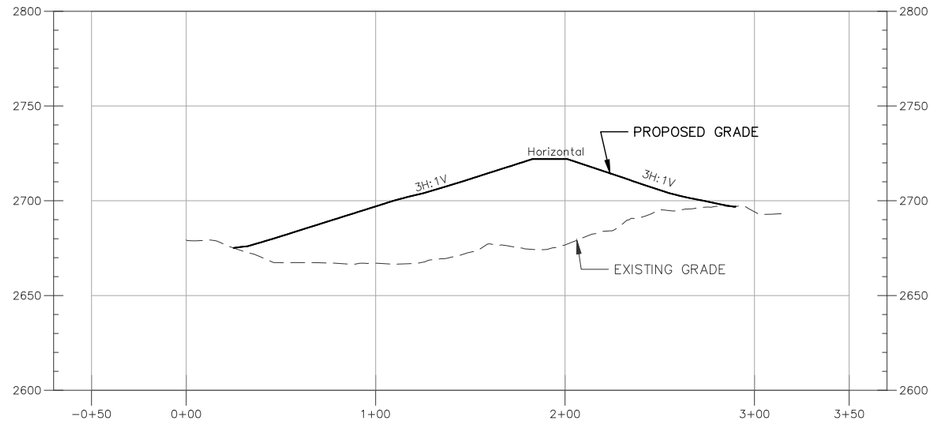
Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.3-1

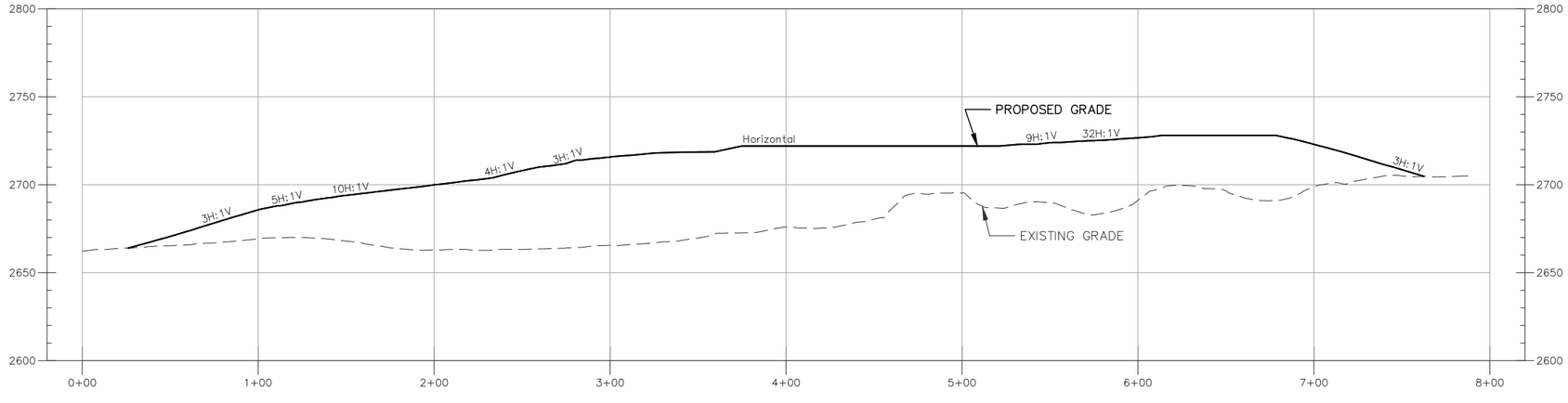
Copco No. 1 and Copco No. 2 Dams Removal Features and Limits
Sheet 4 of 4



PLAN 0 100 200
HORIZ 1"=200'

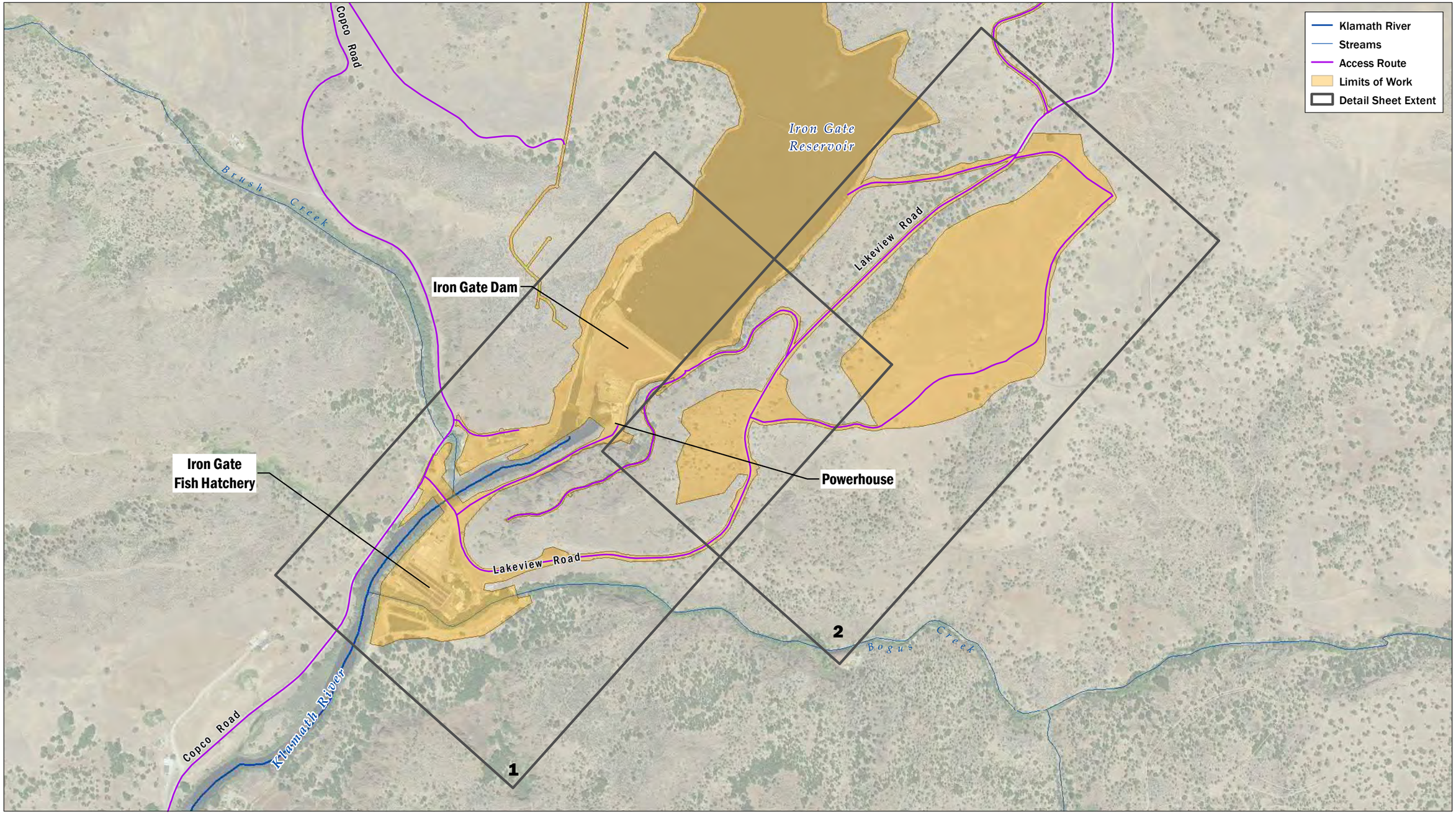


B — SECTION
HORIZ 1"=80', VERT 1"=80'



A — SECTION
HORIZ 1"=80', VERT 1"=80'

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_5-1_IG_RemovalFeatureAndLimits_Overview.mxd



DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

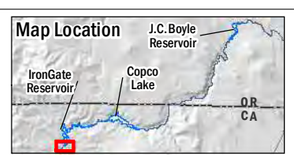
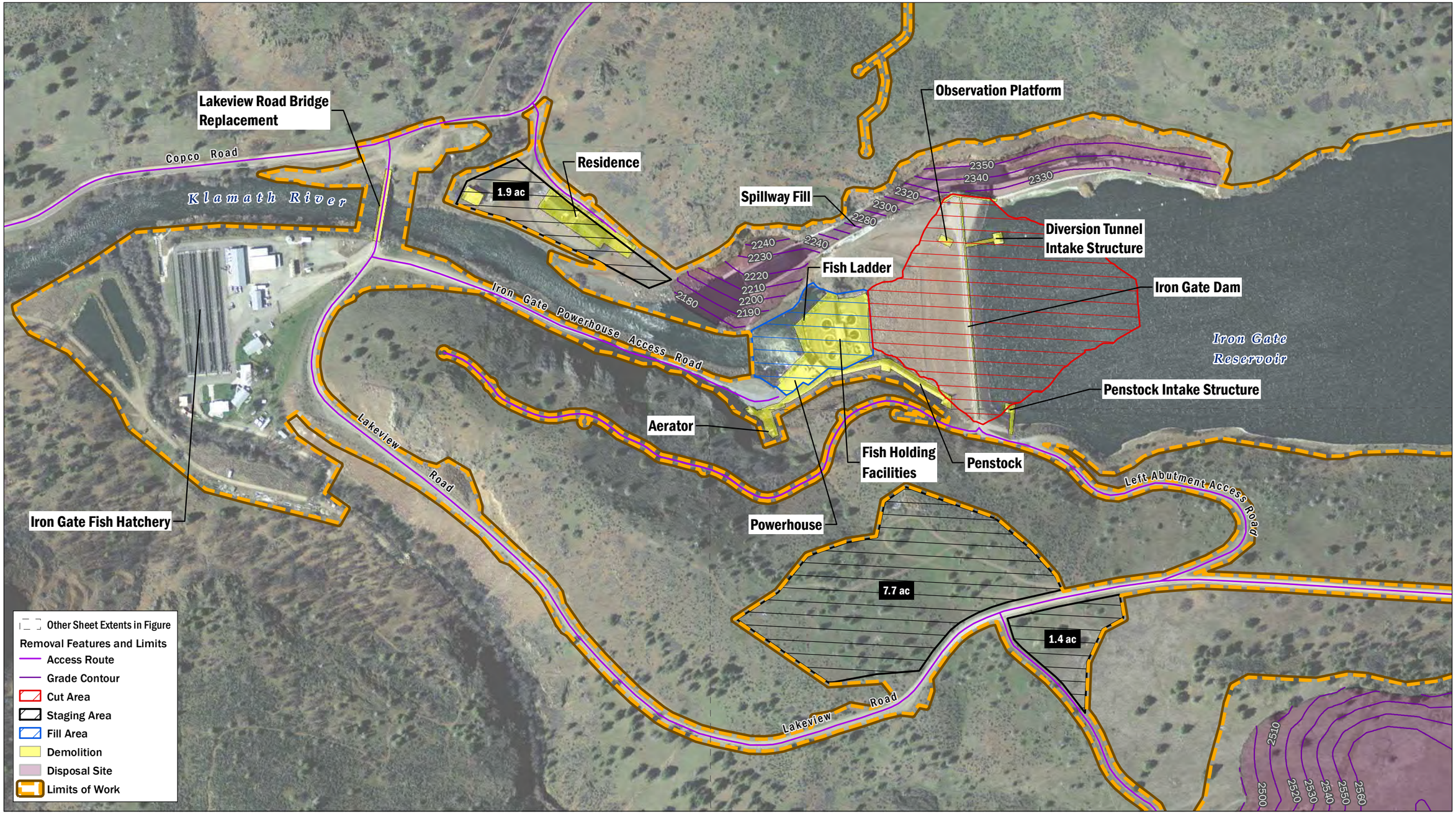


FIGURE 5.5-1

Iron Gate Dam Removal Features and Limits Overview Sheet

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_5-1_IG_RemovalFeatureAndLimits_Sheet1.mxd

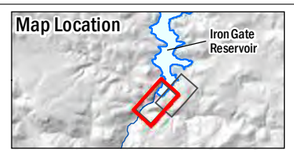


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

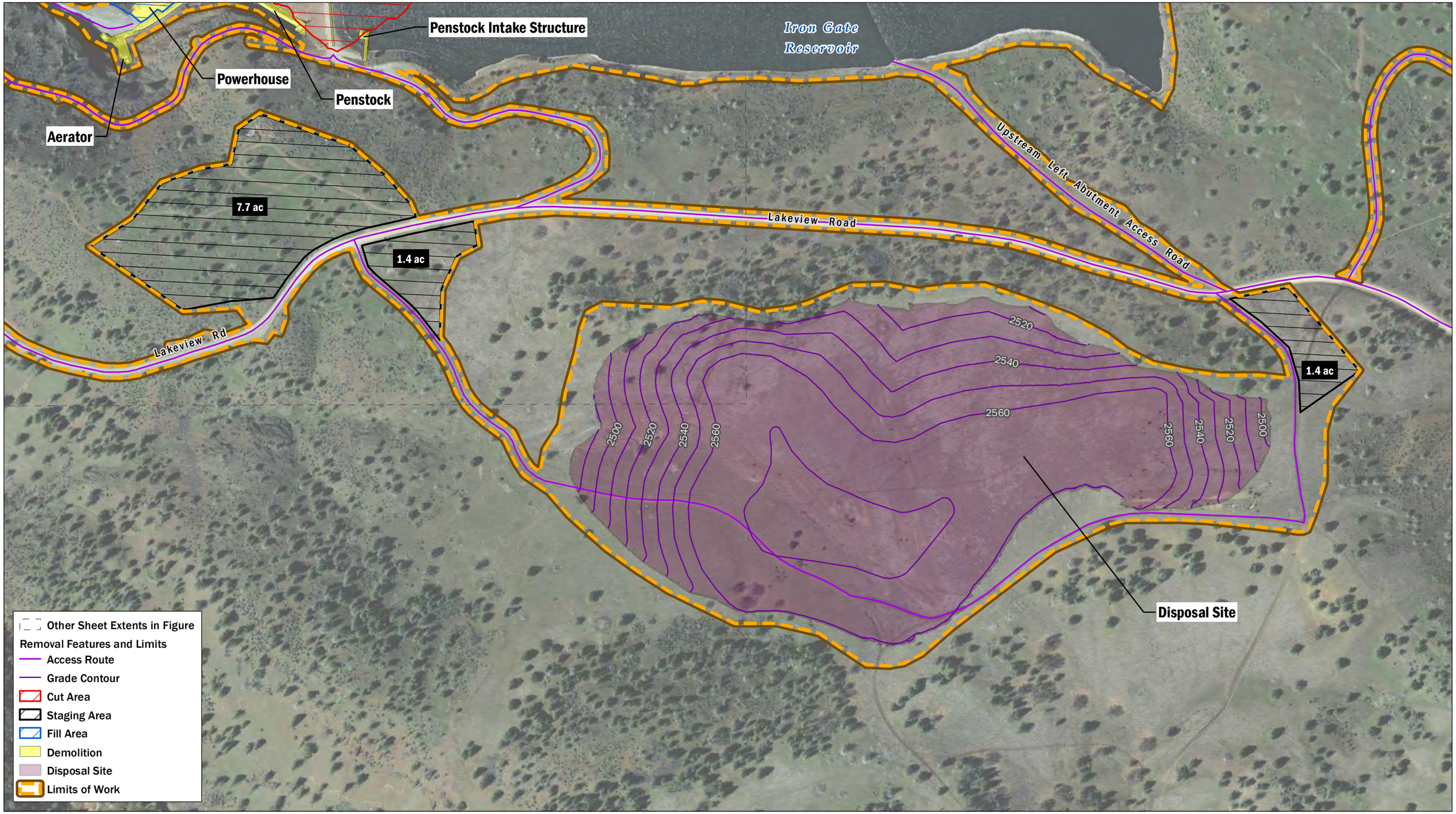


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.5-1

Iron Gate Dam Removal Features and Limits
Sheet 1 of 2

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_5-1_IG_RemovalFeatureAndLimits_Sheet2.mxd

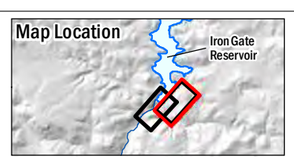


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

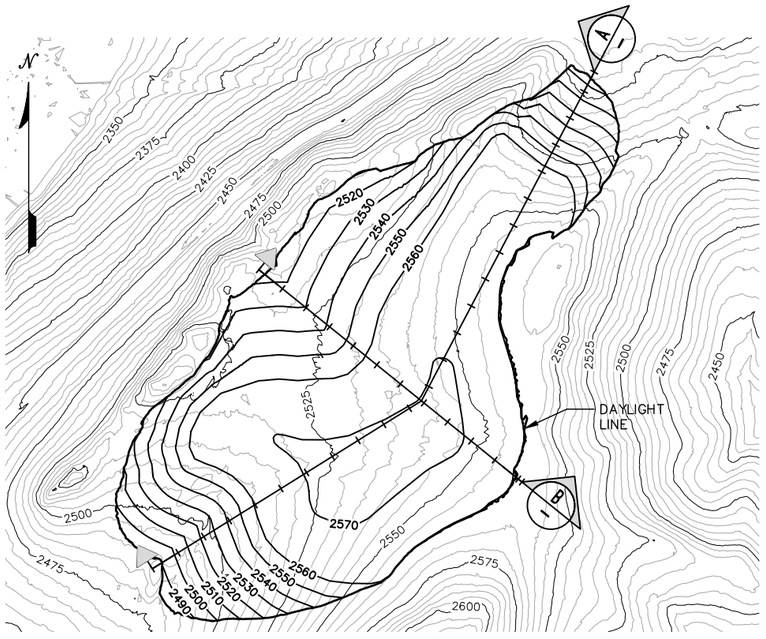
AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



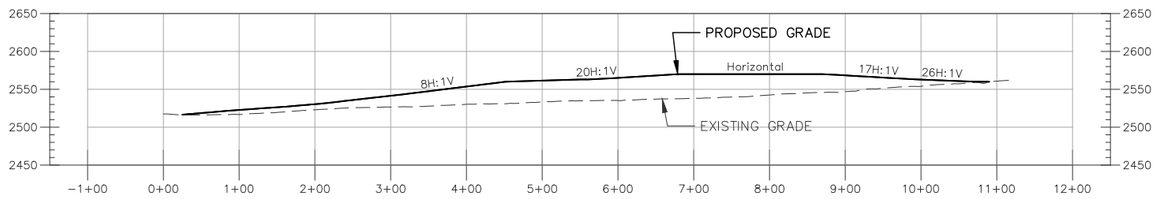
Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.5-1

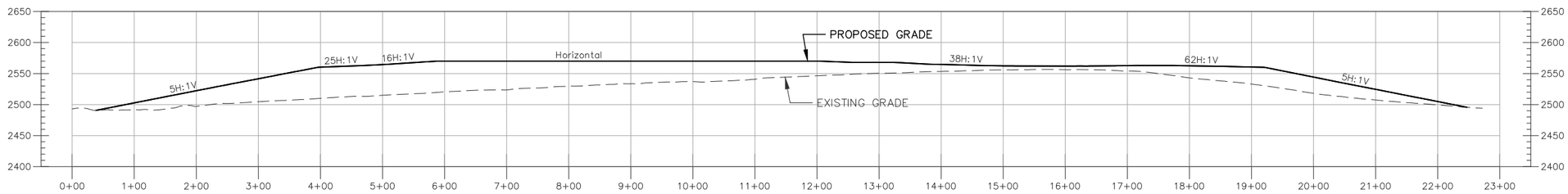
Iron Gate Dam Removal Features and Limits
Sheet 2 of 2



PLAN 0 250 500
HORIZ 1"=500'

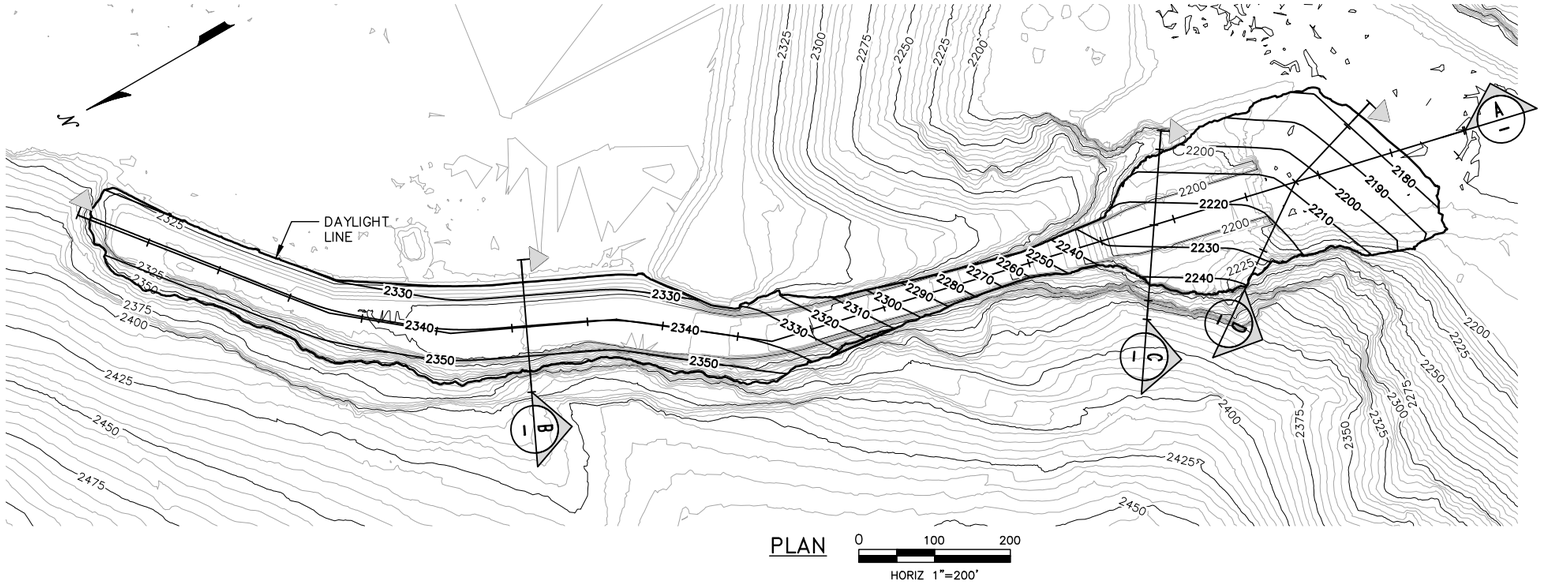


B — SECTION
HORIZ 1"=200', VERT 1"=200'

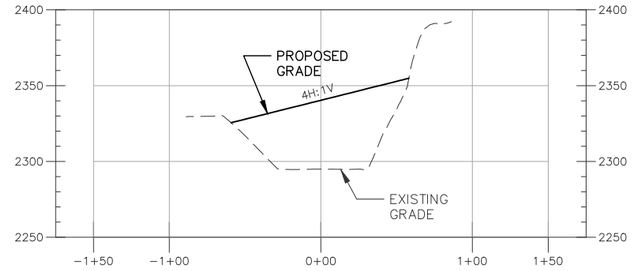


A — SECTION
HORIZ 1"=200', VERT 1"=200'

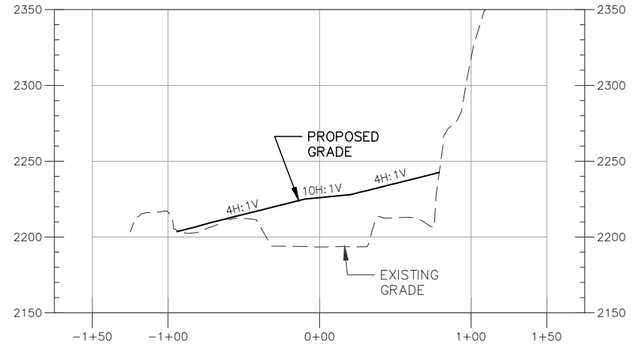
FIGURE 5.5-4
Iron Gate Disposal Site Plan & Sections



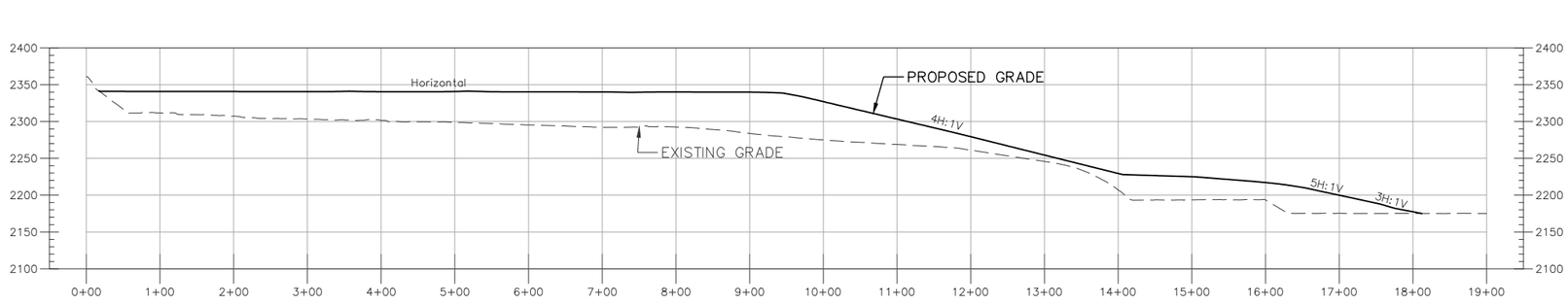
PLAN 0 100 200
HORIZ 1"=200'



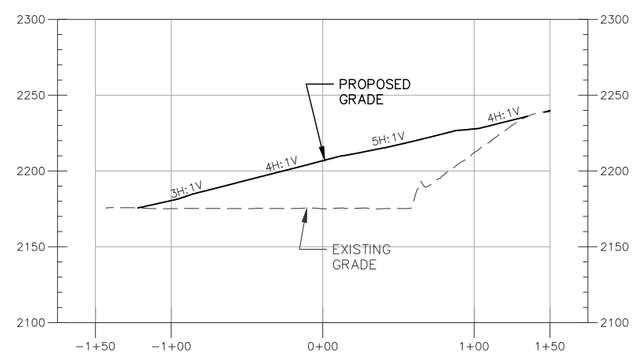
B — SECTION
HORIZ 1"=100', VERT 1"=100'



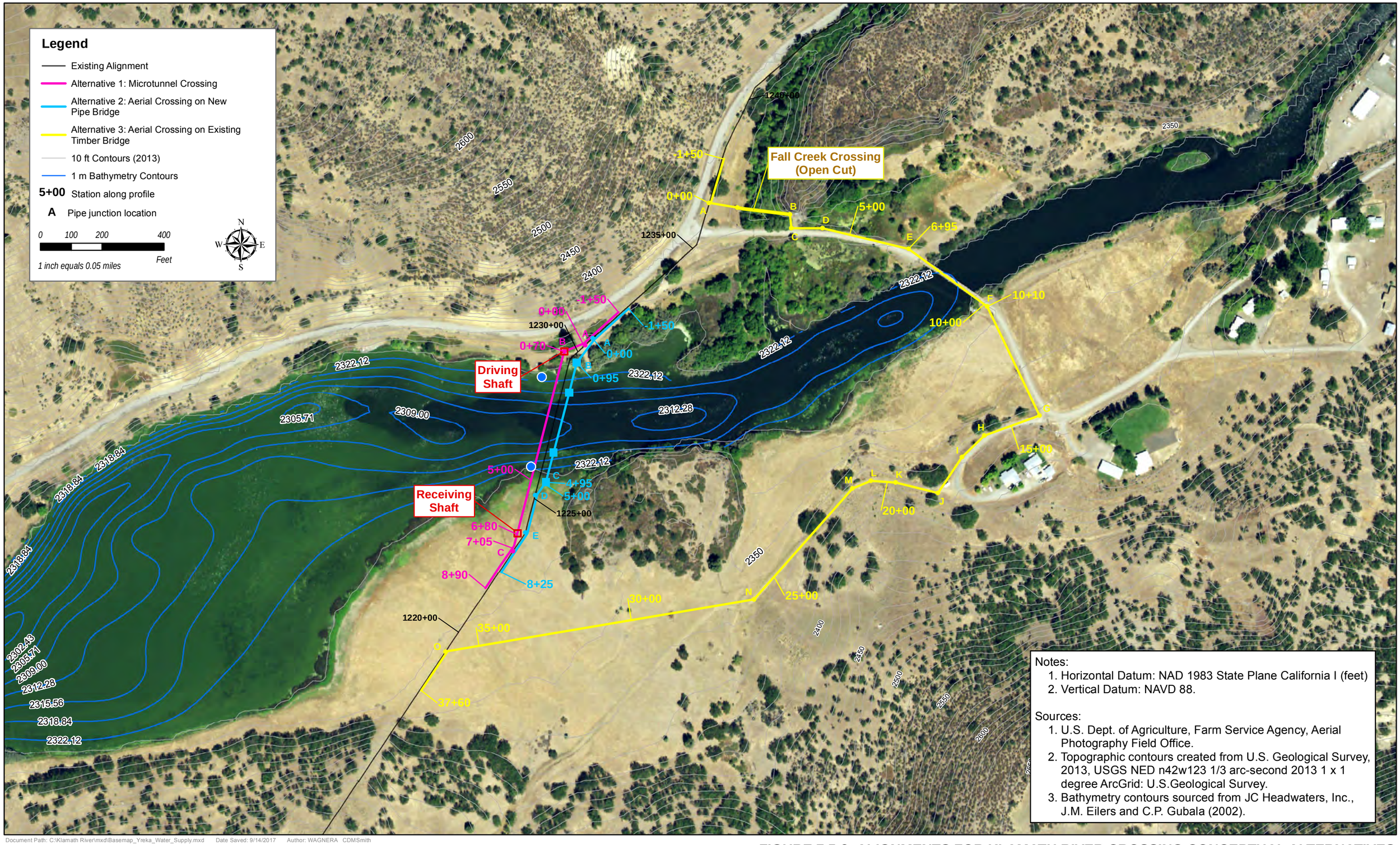
C — SECTION
HORIZ 1"=100', VERT 1"=100'



A — SECTION
HORIZ 1"=200', VERT 1"=200'

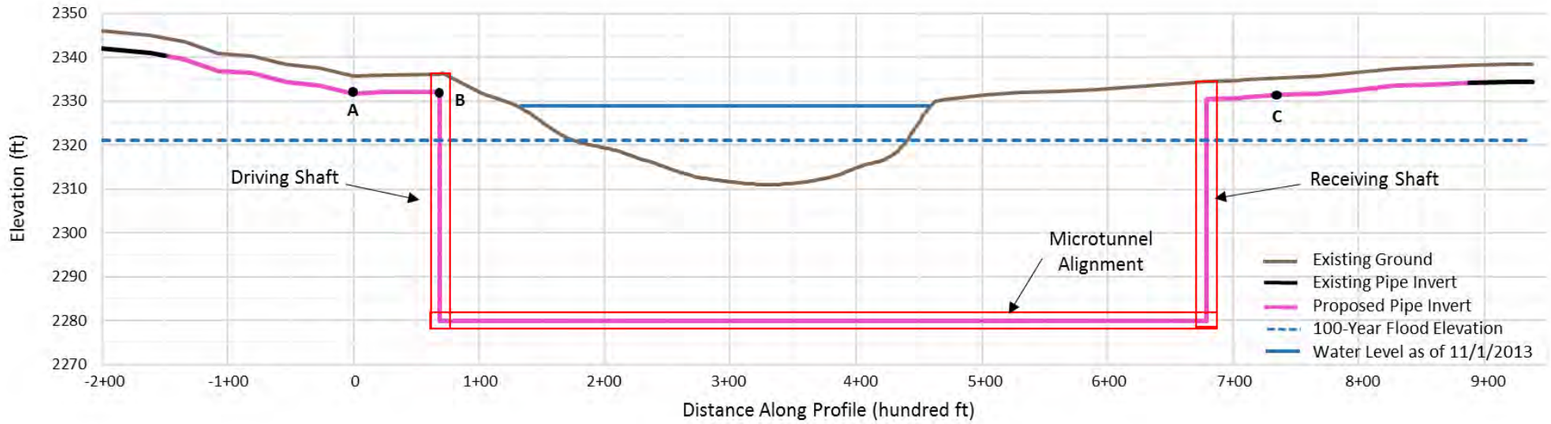


D — SECTION
HORIZ 1"=100', VERT 1"=100'



Document Path: C:\Klamath River\mxd\Basemap_Yreka_Water_Supply.mxd Date Saved: 9/14/2017 Author: WAGNERA CDMSmith

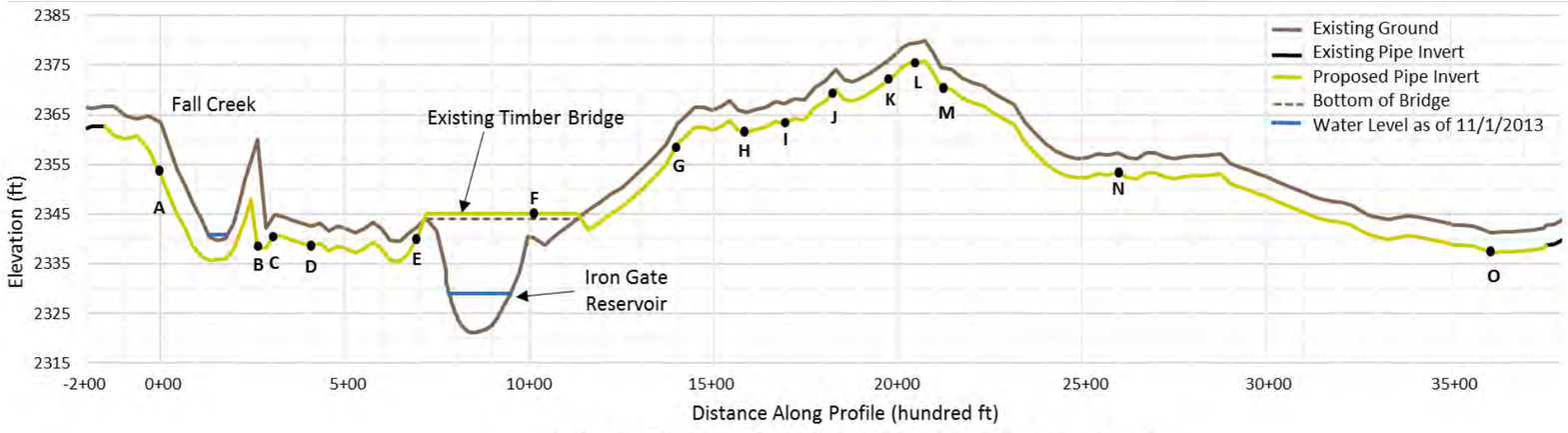
FIGURE 7.5-2: ALIGNMENTS FOR KLAMATH RIVER CROSSING CONCEPTUAL ALTERNATIVES
Klamath Dams Removal Project – Yreka Waterline Replacement
September 14, 2017



Profile for Alternative 1: Microtunnel



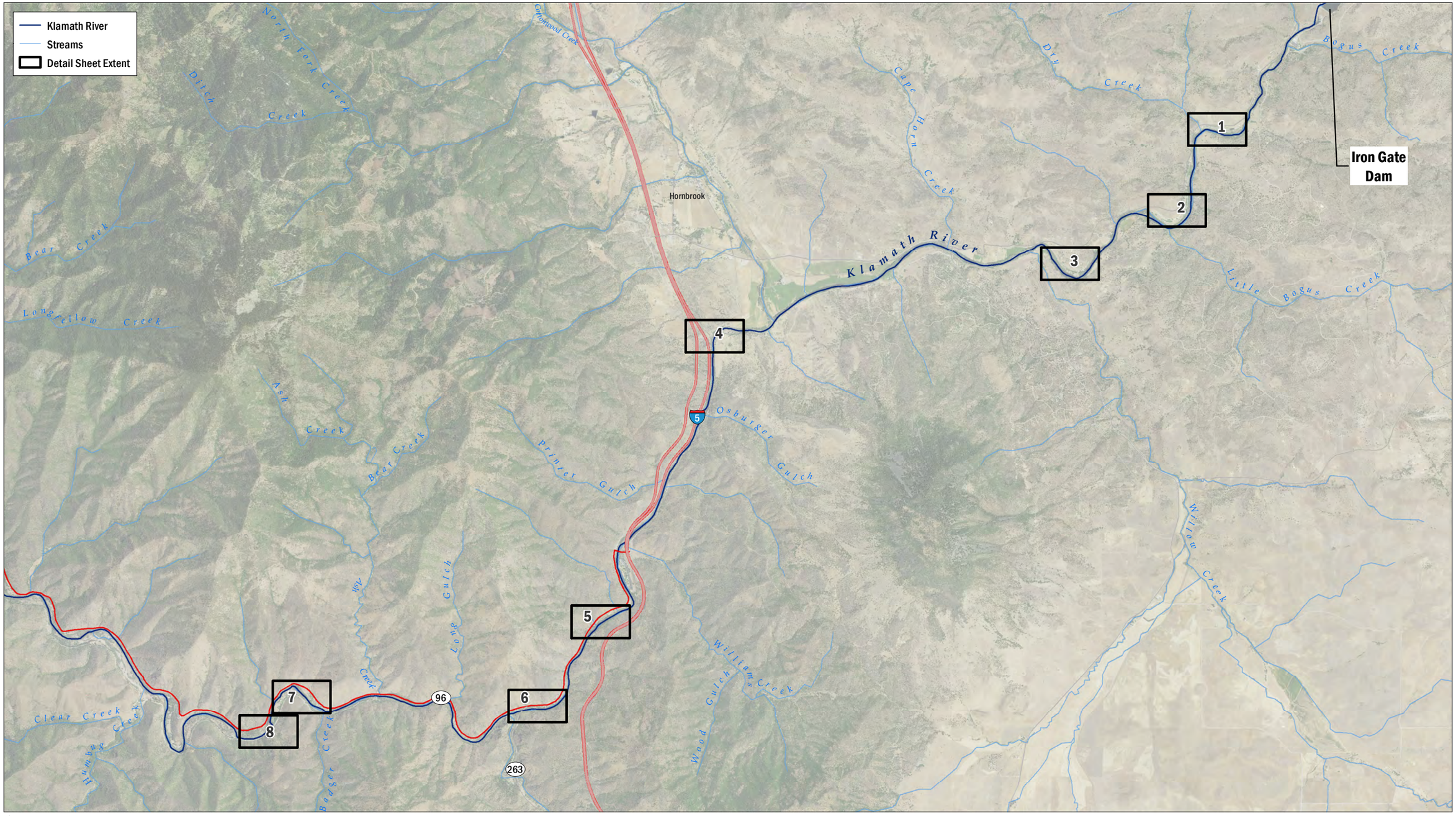
Profile for Alternative 2: Aerial Crossing on New Pipe Bridge



Profile for Alternative 3: Aerial Crossing on Existing Timber Bridge

FIGURE 7.5-3: PROFILES FOR KLAMATH RIVER CROSSING CONCEPTUAL ALTERNATIVES
Klamath Dams Removal Project – Yreka Waterline Replacement
September 14, 2017

AECOM Oakland CA 5/14/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_7_7-1_Floodproofing_Overview.mxd



N

0 2
Miles

DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/14/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

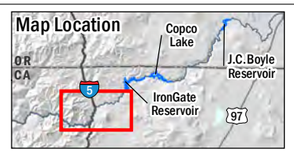
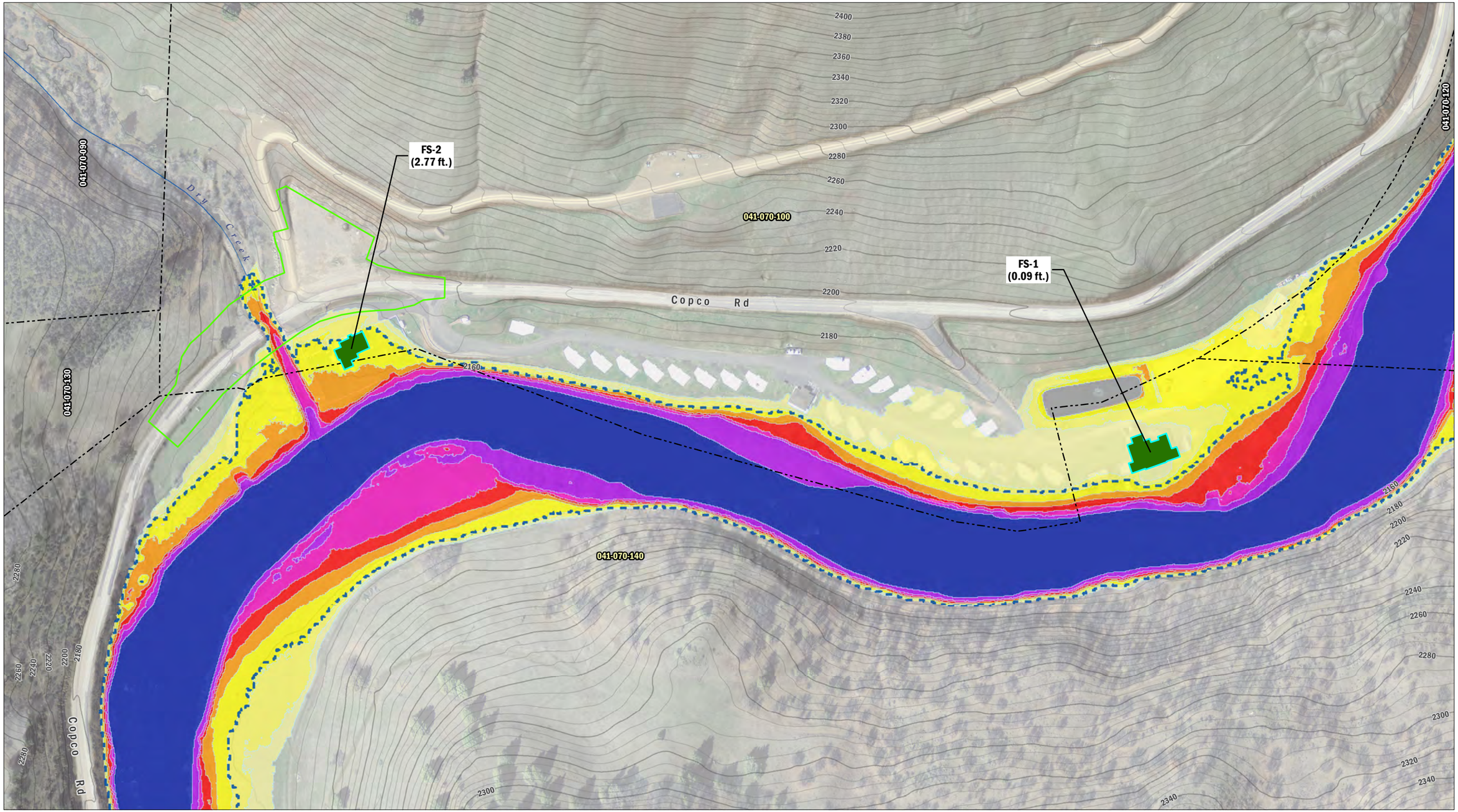


FIGURE 7.7-1

Structures in 100-Year Floodplain Following Dam Removal Overview Sheet

AECOM Oakland CA 5/14/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_7_7-1_Floodproofing_Sheets.mxd



N

0 400

Feet

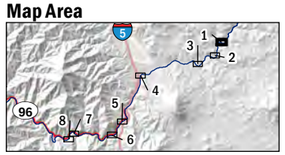
PacifiCorp, 2004; NAIP Imagery, 2014; AECOM, 2018; FEMA, 2011

AECOM

Klamath River Renewal Corporation

Klamath River Renewal Project

Map Area



Structure ID (avg. flood depth)

- Floodproofing Structures
- Parcels
- Limits of Work
- Pre-Dam Removal Flood Extent

Contours

- 5 ft.
- 20 ft.

Post-Dam Removal Flood Depths (ft.)

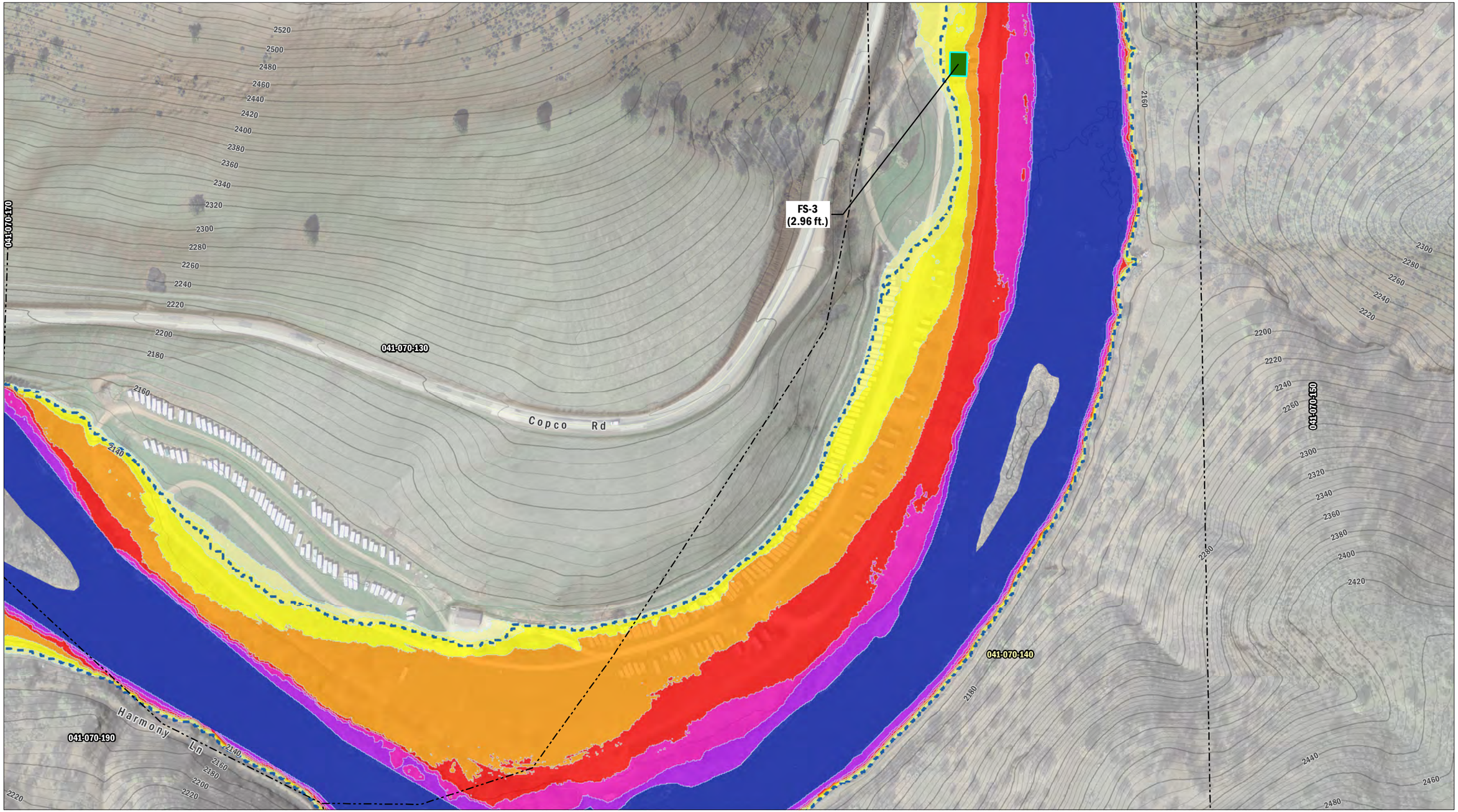
- 0 - 1
- 1.01 - 2
- 2.01 - 4
- 4.01 - 6
- 6.01 - 8
- 8.01 - 10
- 10.01 - 15
- 15.01 - 20
- > 20

Note: Parcel boundaries shown in this mapbook are data provided by Siskiyou County, CA, Klamath County, OR, PacifiCorp, and the Bureau of Land Management (BLM). There are inconsistencies among these datasets and between the datasets and LiDAR and aerial imagery. No ground-based parcel surveys have been completed; however, the County parcel data has been geo-rectified to align better with available LiDAR and aerial imagery data. APE and Sub Area 1 locations are based on field survey with GPS, LiDAR, and aerial imagery. Positions of the APE and Sub Area 1 with reference to parcel boundaries may be incorrect on the order of 10 to 50 feet.

FIGURE 7.7-1

Structures in 100-Year Floodplain Following Dam Removal

Sheet 1 of 8



N

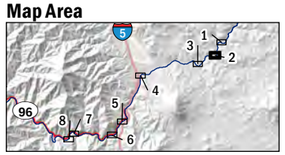
0 400

Feet

PacifiCorp, 2004; NAIP Imagery, 2014; AECOM, 2018; FEMA, 2011

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

Map Area



Structure ID (avg. flood depth)
Floodproofing Structures
Parcels
Pre-Dam Removal Flood Extent

Contours
5 ft.
20 ft.

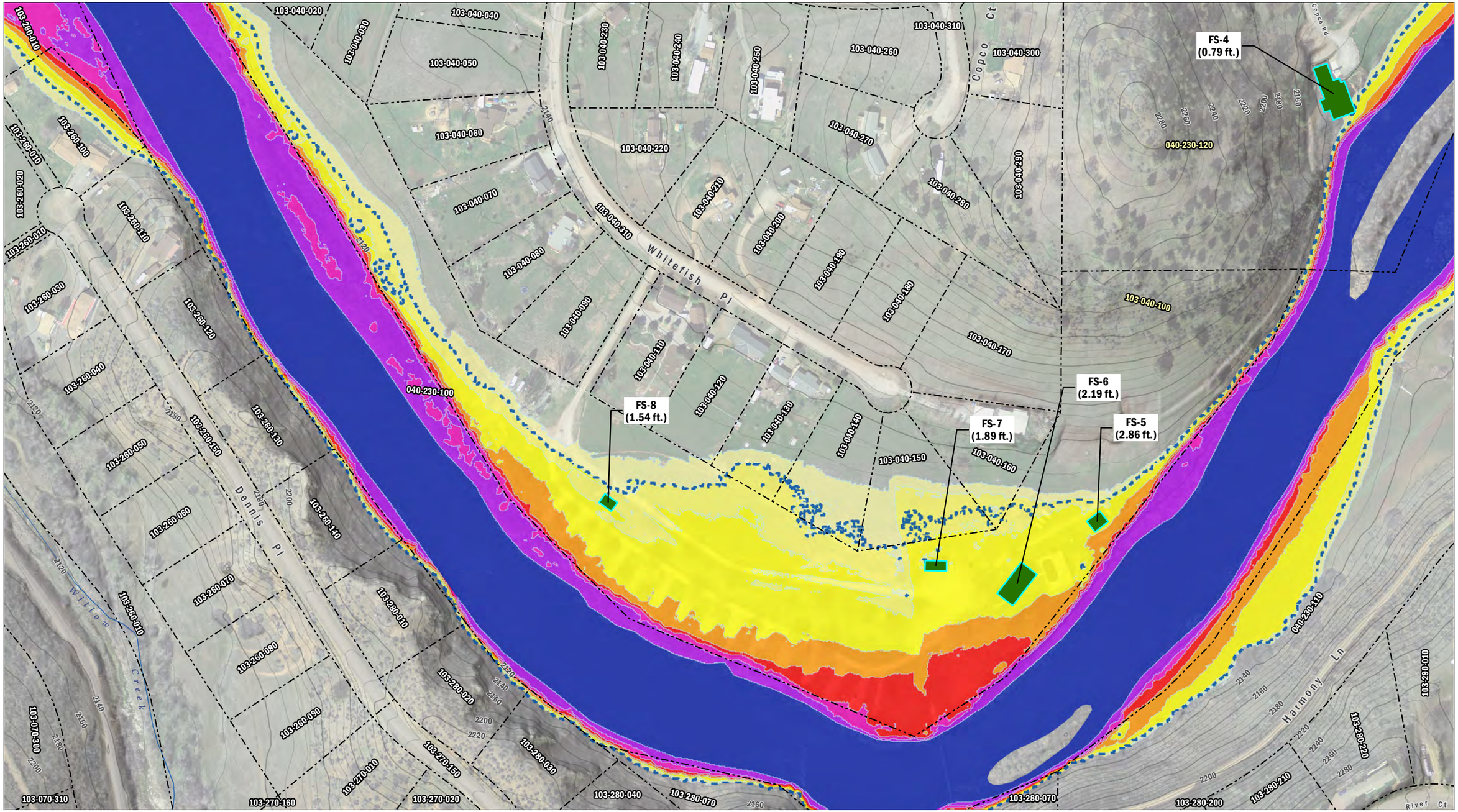
Post-Dam Removal Flood Depths (ft.)
0 - 1
1.01 - 2
2.01 - 4
4.01 - 6
6.01 - 8
8.01 - 10
10.01 - 15
15.01 - 20
> 20

Note: Parcel boundaries shown in this mapbook are data provided by Siskiyou County, CA, Klamath County, OR, PacifiCorp, and the Bureau of Land Management (BLM). There are inconsistencies among these datasets and between the datasets and LiDAR and aerial imagery. No ground-based parcel surveys have been completed; however, the County parcel data has been geo-rectified to align better with available LiDAR and aerial imagery data. APE and Sub Area 1 locations are based on field survey with GPS, LiDAR, and aerial imagery. Positions of the APE and Sub Area 1 with reference to parcel boundaries may be incorrect on the order of 10 to 50 feet.

FIGURE 7.7-1

Structures in 100-Year Floodplain Following Dam Removal

Sheet 2 of 8



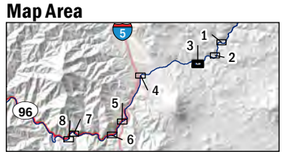
N

0 400
Feet

PacifiCorp, 2004; NAIP Imagery, 2014; AECOM, 2018; FEMA, 2011

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

Map Area



Structure ID (avg. flood depth)
Floodproofing Structures
Parcels
Pre-Dam Removal Flood Extent

Contours
5 ft.
20 ft.

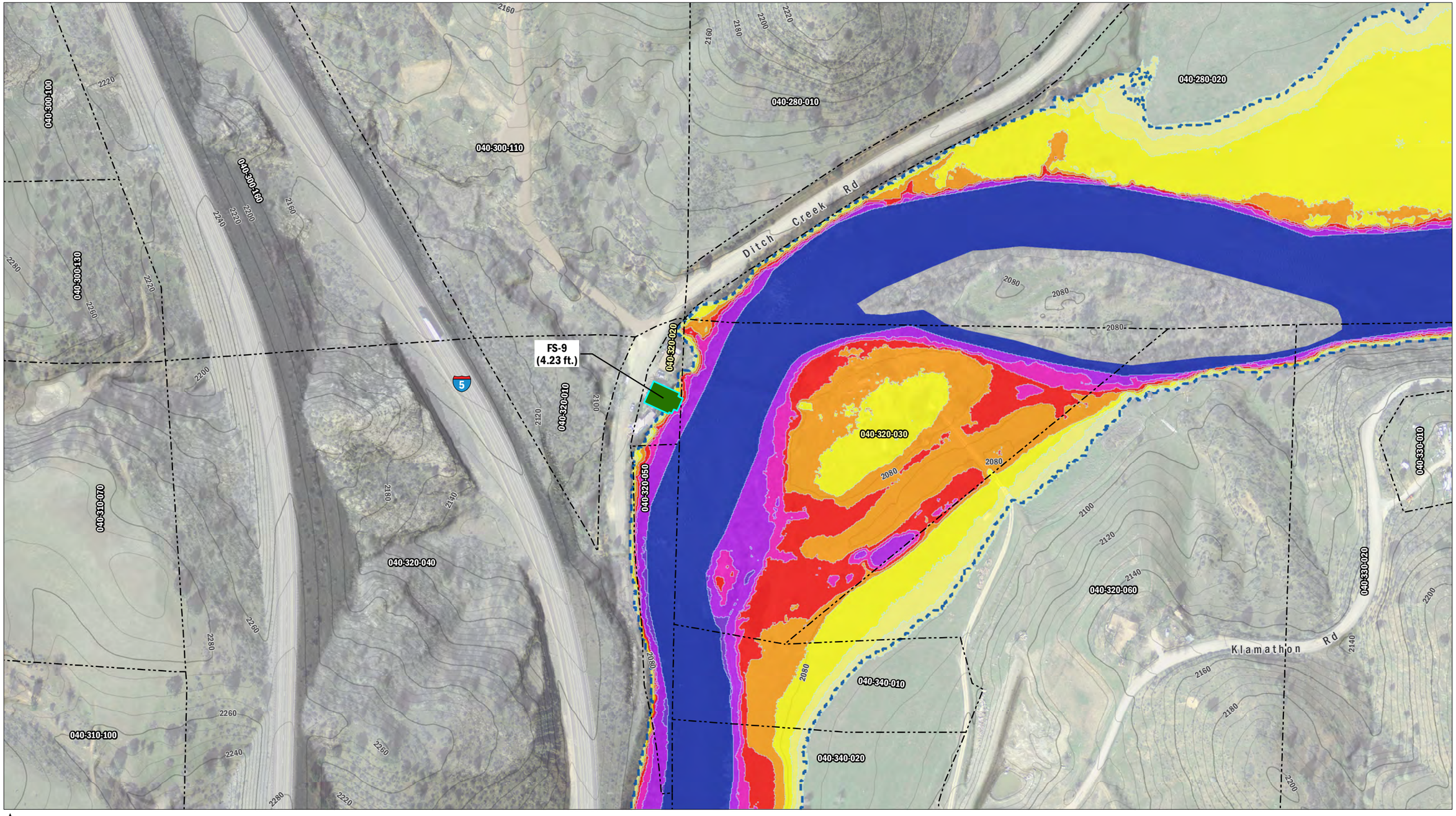
Post-Dam Removal Flood Depths (ft.)
0 - 1
1.01 - 2
2.01 - 4
4.01 - 6
6.01 - 8
8.01 - 10
10.01 - 15
15.01 - 20
> 20

Note: Parcel boundaries shown in this mapbook are data provided by Siskiyou County, CA, Klamath County, OR, PacifiCorp, and the Bureau of Land Management (BLM). There are inconsistencies among these datasets and between the datasets and LiDAR and aerial imagery. No ground-based parcel surveys have been completed; however, the County parcel data has been geo-rectified to align better with available LiDAR and aerial imagery data. APE and Sub Area 1 locations are based on field survey with GPS, LiDAR, and aerial imagery. Positions of the APE and Sub Area 1 with reference to parcel boundaries may be incorrect on the order of 10 to 50 feet.

FIGURE 7.7-1

Structures in 100-Year Floodplain Following Dam Removal
Sheet 3 of 8

AECOM Oakland CA 5/14/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_7_7-1_Floodproofing_Sheets.mxd



N

0 400

Feet

PacifiCorp, 2004; NAIP Imagery, 2014;
AECOM, 2018; FEMA, 2011

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

Map Area



Structure ID (avg. flood depth)
Floodproofing Structures
Parcels
Pre-Dam Removal Flood Extent

Contours
5 ft.
20 ft.

Post-Dam Removal Flood Depths (ft.)
0 - 1
1.01 - 2
2.01 - 4
4.01 - 6
6.01 - 8
8.01 - 10
10.01 - 15
15.01 - 20
> 20

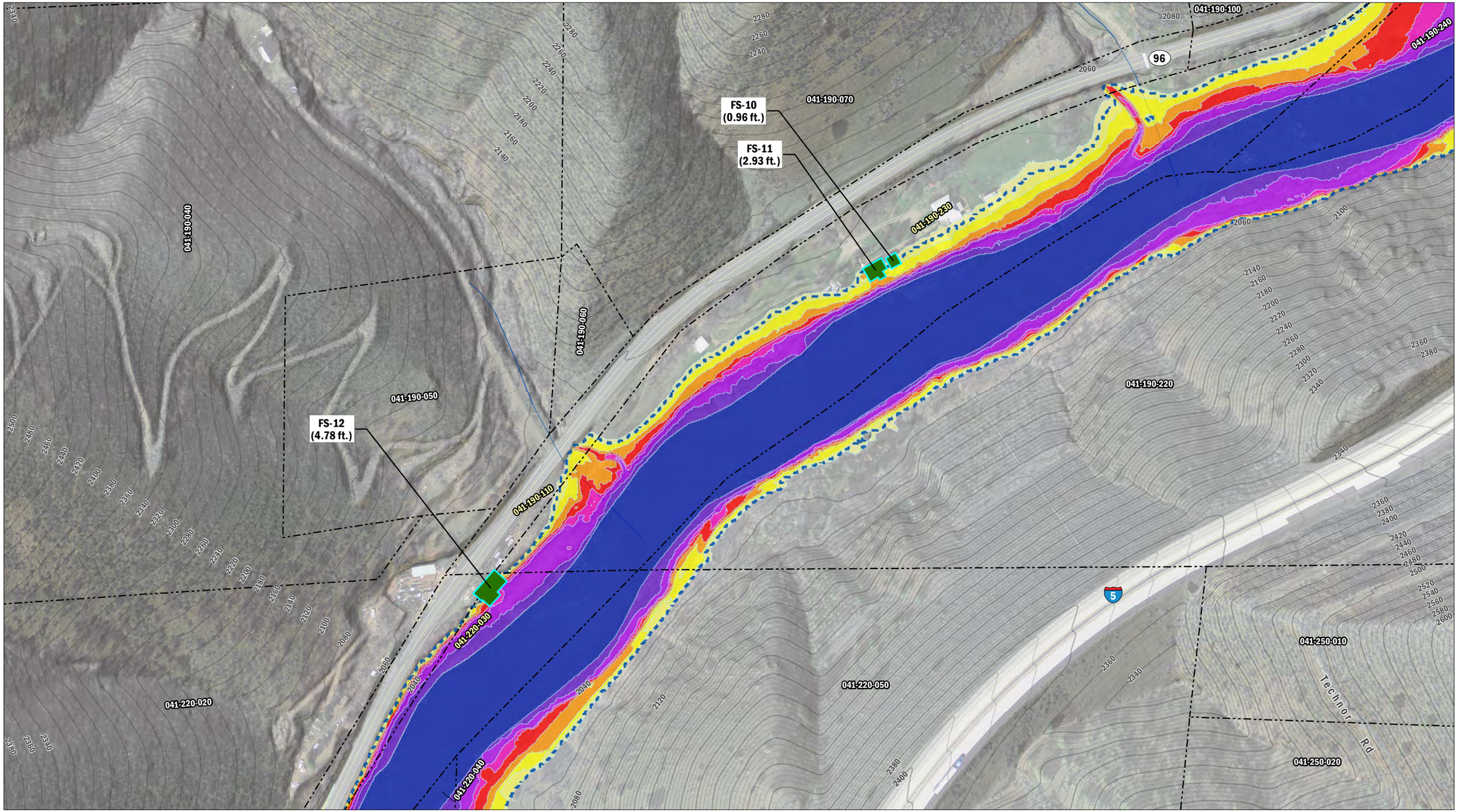
Note: Parcel boundaries shown in this mapbook are data provided by Siskiyou County, CA, Klamath County, OR, PacifiCorp, and the Bureau of Land Management (BLM). There are inconsistencies among these datasets and between the datasets and LiDAR and aerial imagery. No ground-based parcel surveys have been completed; however, the County parcel data has been geo-rectified to align better with available LiDAR and aerial imagery data. APE and Sub Area 1 locations are based on field survey with GPS, LiDAR, and aerial imagery. Positions of the APE and Sub Area 1 with reference to parcel boundaries may be incorrect on the order of 10 to 50 feet.

FIGURE 7.7-1

Structures in 100-Year Floodplain Following Dam Removal

Sheet 4 of 8

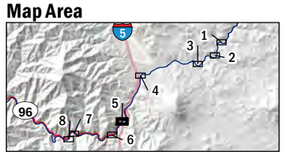
AECOM Oakland CA 5/14/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_7_7-1_Floodproofing_Sheets.mxd



PacifiCorp, 2004; NAIP Imagery, 2014; AECOM, 2018; FEMA, 2011

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

Map Area



Structure ID (avg. flood depth)
Floodproofing Structures
Parcels
Pre-Dam Removal Flood Extent

Contours
5 ft.
20 ft.

Post-Dam Removal Flood Depths (ft.)
0 - 1
1.01 - 2
2.01 - 4
4.01 - 6
6.01 - 8
8.01 - 10
10.01 - 15
15.01 - 20
> 20

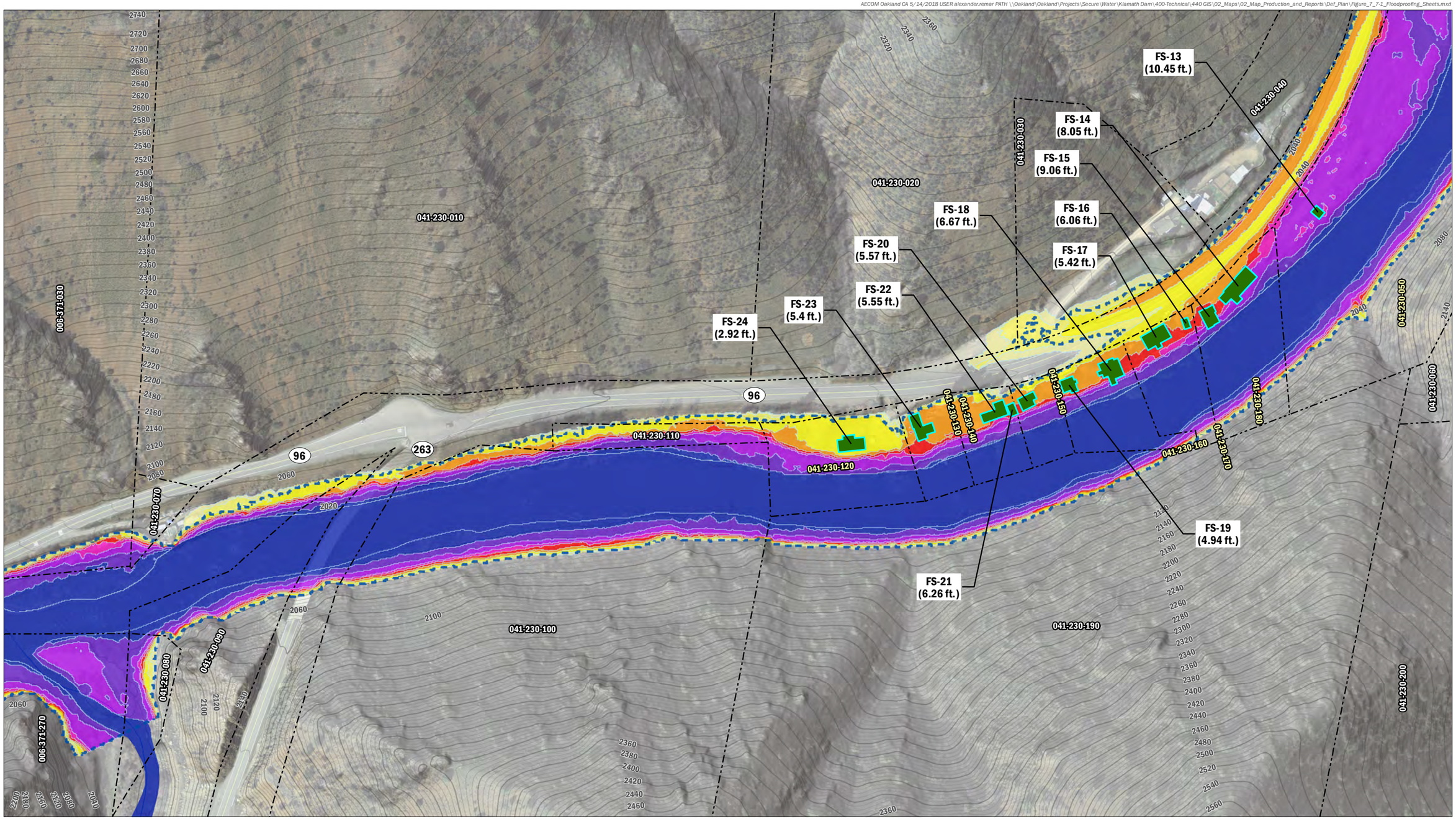
Note: Parcel boundaries shown in this mapbook are data provided by Siskiyou County, CA, Klamath County, OR, PacifiCorp, and the Bureau of Land Management (BLM). There are inconsistencies among these datasets and between the datasets and LiDAR and aerial imagery. No ground-based parcel surveys have been completed; however, the County parcel data has been geo-rectified to align better with available LiDAR and aerial imagery data. APE and Sub Area 1 locations are based on field survey with GPS, LiDAR, and aerial imagery. Positions of the APE and Sub Area 1 with reference to parcel boundaries may be incorrect on the order of 10 to 50 feet.

FIGURE 7.7-1

Structures in 100-Year Floodplain Following Dam Removal

Sheet 5 of 8

AECOM Oakland CA 5/14/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_7_7-1_Floodproofing_Sheets.mxd



N

0 400

Feet

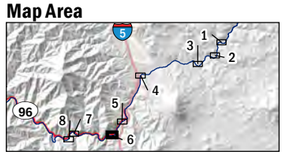
PacifiCorp, 2004; NAIP Imagery, 2014; AECOM, 2018; FEMA, 2011

AECOM

Klamath River Renewal Corporation

Klamath River Renewal Project

Map Area



Structure ID (avg. flood depth)

Floodproofing Structures

Parcels

Pre-Dam Removal Flood Extent

Contours

5 ft.

20 ft.

Post-Dam Removal Flood Depths (ft.)

0 - 1

1.01 - 2

2.01 - 4

4.01 - 6

6.01 - 8

8.01 - 10

10.01 - 15

15.01 - 20

> 20

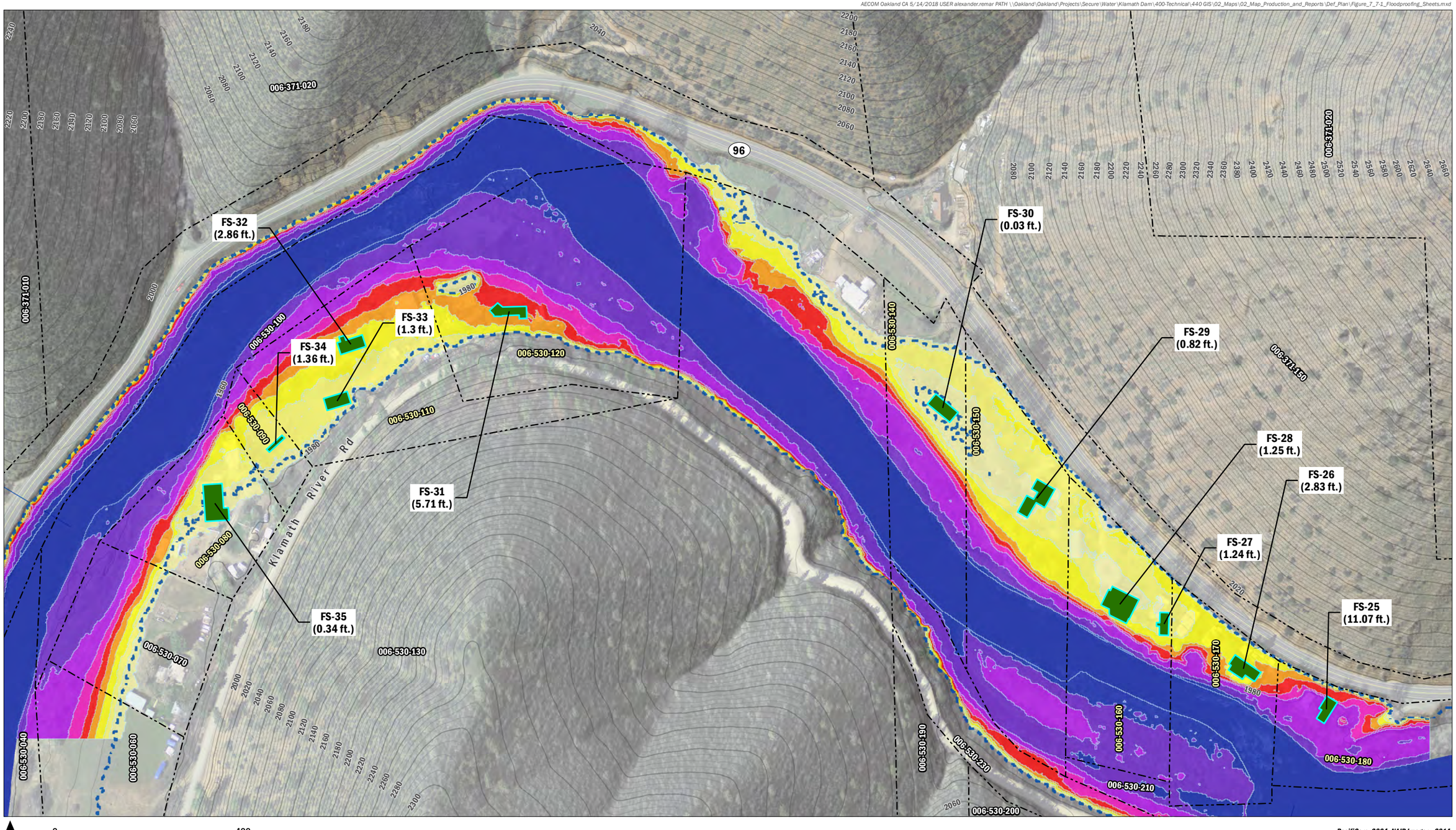
Note: Parcel boundaries shown in this mapbook are data provided by Siskiyou County, CA, Klamath County, OR, PacifiCorp, and the Bureau of Land Management (BLM). There are inconsistencies among these datasets and between the datasets and LiDAR and aerial imagery. No ground-based parcel surveys have been completed; however, the County parcel data has been geo-rectified to align better with available LiDAR and aerial imagery data. APE and Sub Area 1 locations are based on field survey with GPS, LiDAR, and aerial imagery. Positions of the APE and Sub Area 1 with reference to parcel boundaries may be incorrect on the order of 10 to 50 feet.

FIGURE 7.7-1

Structures in 100-Year Floodplain Following Dam Removal

Sheet 6 of 8

AECOM Oakland CA 5/14/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_7_7-1_Floodproofing_Sheets.mxd



N

0 400

Feet

PacifiCorp, 2004; NAIP Imagery, 2014;
AECOM, 2018; FEMA, 2011

AECOM

Klamath River Renewal Corporation

Klamath River Renewal Project

Map Area



Structure ID (avg. flood depth)
Floodproofing Structures
Parcels
Pre-Dam Removal Flood Extent

Contours
5 ft.
20 ft.

Post-Dam Removal Flood Depths (ft.)
0 - 1
1.01 - 2
2.01 - 4
4.01 - 6
6.01 - 8
8.01 - 10
10.01 - 15
15.01 - 20
> 20

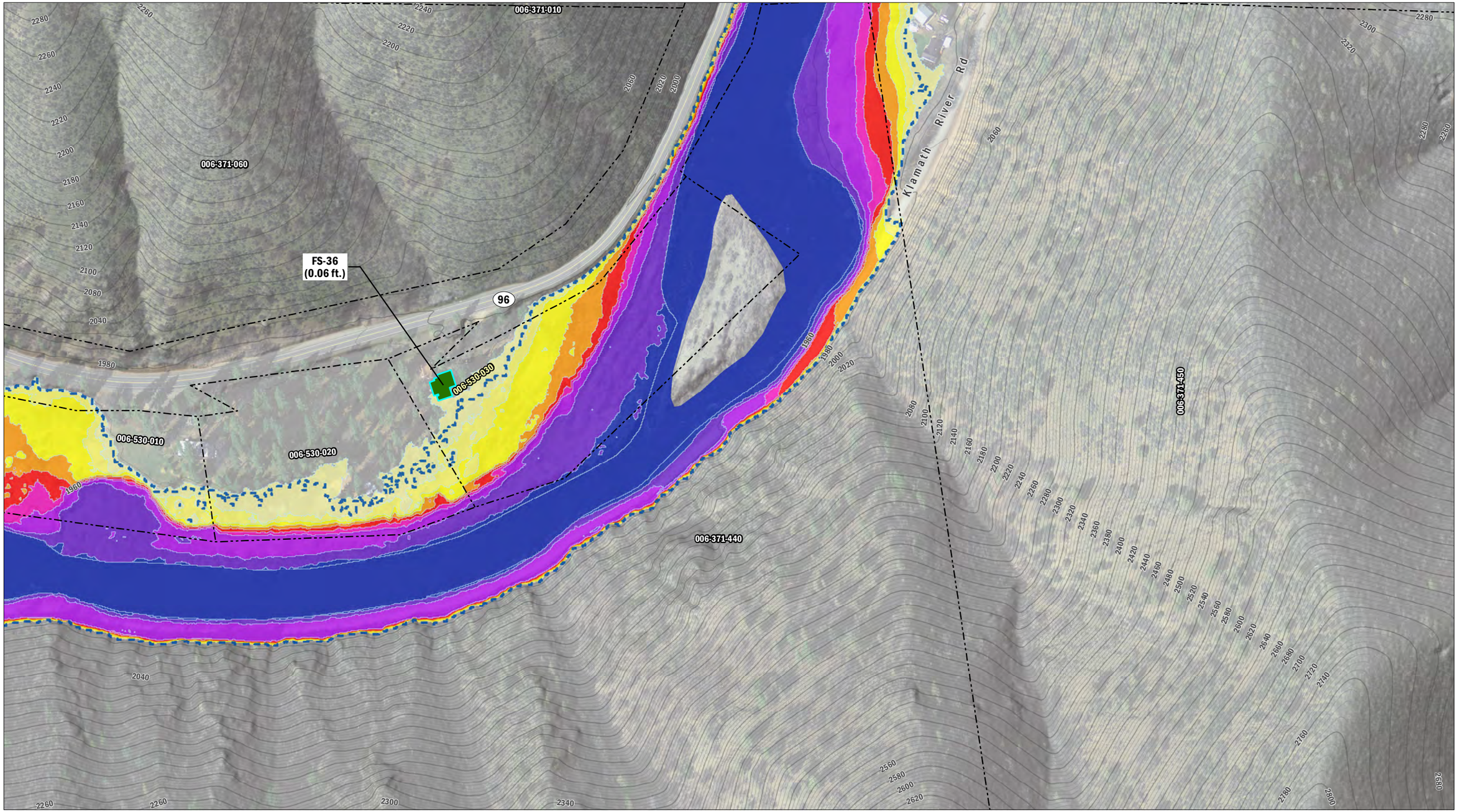
Note: Parcel boundaries shown in this mapbook are data provided by Siskiyou County, CA, Klamath County, OR, PacifiCorp, and the Bureau of Land Management (BLM). There are inconsistencies among these datasets and between the datasets and LiDAR and aerial imagery. No ground-based parcel surveys have been completed; however, the County parcel data has been geo-rectified to align better with available LiDAR and aerial imagery data. APE and Sub Area 1 locations are based on field survey with GPS, LiDAR, and aerial imagery. Positions of the APE and Sub Area 1 with reference to parcel boundaries may be incorrect on the order of 10 to 50 feet.

FIGURE 7.7-1

Structures in 100-Year Floodplain Following Dam Removal

Sheet 7 of 8

AECOM Oakland CA 5/14/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_7_7-1_Floodproofing_Sheets.mxd



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Feet

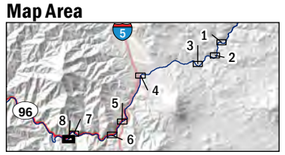
PacifiCorp, 2004; NAIP Imagery, 2014;
AECOM, 2018; FEMA, 2011

AECOM

Klamath River Renewal Corporation

Klamath River Renewal Project

Map Area



Structure ID (avg. flood depth)

Floodproofing Structures

Parcels

Pre-Dam Removal Flood Extent

Contours

5 ft.

20 ft.

Post-Dam Removal Flood Depths (ft.)

0 - 1

1.01 - 2

2.01 - 4

4.01 - 6

6.01 - 8

8.01 - 10

10.01 - 15

15.01 - 20

> 20

Note: Parcel boundaries shown in this mapbook are data provided by Siskiyou County, CA, Klamath County, OR, PacifiCorp, and the Bureau of Land Management (BLM). There are inconsistencies among these datasets and between the datasets and LiDAR and aerial imagery. No ground-based parcel surveys have been completed; however, the County parcel data has been geo-rectified to align better with available LiDAR and aerial imagery data. APE and Sub Area 1 locations are based on field survey with GPS, LiDAR, and aerial imagery. Positions of the APE and Sub Area 1 with reference to parcel boundaries may be incorrect on the order of 10 to 50 feet.

FIGURE 7.7-1

Structures in 100-Year Floodplain Following Dam Removal

Sheet 8 of 8

KLAMATH RIVER RENEWAL CORPORATION

Appendix D Dam Stability Analyses

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Project name:
Klamath River Renewal Project

Project ref:
60537920

To: Klamath River Renewal Coporation

From:
John Roadifer, Kanax Kanagalingam, Benjamin Choy

CC:

Date:
June 20, 2018

Technical Memorandum

Subject: Definite Plan for the Lower Klamath Project
Analysis of Stability of J.C. Boyle and Iron Gate Dams During Reservoir Drawdown

INTRODUCTION

AECOM prepared this technical memorandum in support of the design for the removal of the Iron Gate Dam and J.C. Boyle Dam, which are located on the Klamath River in northern California and southern Oregon, respectively. The purpose of this technical memorandum is to review existing geotechnical data related to the Iron Gate and J.C. Boyle embankments, characterize the materials in the embankments, and evaluate the stability of the upstream slopes of the embankments under various conditions of rapid drawdown of the reservoirs prior to dam removal.

Iron Gate Dam is a 189-foot high zoned earthfill embankment, as measured from the crest to the rock foundation. The crest of the dam is at El. 2343[1] feet. The crest of the dam is 20 feet wide, and the dam is approximately 740 feet long. The embankment upstream slopes are 2:1 (H:V) above El. 2328 feet, 2.5:1 from El. 2328 feet to 2300 feet, and 3H:1V below El. 2300 feet. The downstream slopes are 1.75:1 above El. 2323 feet and 2:1 below El. 2323 feet. The dam also features a 29-foot wide bench and a 10-foot wide bench at El. 2275 feet on the upstream side and downstream side, respectively. The dam consists of a central impervious clay core, an upstream and a downstream compacted pervious shell with filter zones and a downstream drain. A 10-foot thick layer of riprap protects the upstream slope of the dam against erosion. A 5-foot thick riprap layer is present on the downstream slope. In 2003, the dam crest was raised 5 feet from El. 2338 feet to 2343 feet by over-steepening the upstream and downstream slopes. To provide additional freeboard, a sheet pile was installed upstream of the dam centerline that extends five (5) feet above the dam crest to an El. of 2348 feet.

J.C. Boyle Dam consists of two portions: an earthfill embankment on the right side and a concrete spillway and gravity section on the left side. This technical memorandum evaluates the earthfill embankment portion of the dam. The earthfill embankment is a 68-foot high zoned earthfill embankment. The crest of the dam is at El. 3800 feet. The crest of the embankment is 15 feet wide and approximately 413 feet long. The upstream slopes are 2.5:1 (H:V) above El. 3780 feet and 3H:1V below El. 3780 feet. The downstream slopes are 2.5:1. The downstream slope also includes a 16-foot wide bench at El. 3768 feet. The internal zoning of the dam consists of a central impervious clay core, an upstream and a downstream compacted pervious shell consisting of sand and gravels. A filter blanket underlies the downstream shell. Erosion protection of the upstream slope is provided by a 3-foot thick riprap layer above El. 3680 feet. A 2-foot thick riprap layer below El. 3768 feet protects the downstream slope against erosion due to elevated tailwater.

EXISITNG DATA REVIEW

[1] All elevations in this memorandum are in the original datum unless otherwise indicated.

A review of existing available pertinent information for Iron Gate Dam and J.C. Boyle Dam were performed as part of this study to judge whether additional geotechnical investigation would have to be conducted for evaluating the dams for the rapid drawdown conditions. The reviewed information included design drawings, laboratory testing data for the borrow source materials, construction history, specifications, previous stability analyses, and post construction subsurface investigation. The results from the review indicate the followings:

- Representative analysis cross sections can be developed at the maximum section using the design drawings for both the Iron Gate Dam and the J.C. Boyle Dam.
- A reasonable material characterization of embankment materials, in particular the core and shell materials, can be developed using the information in the construction history, drawings, and specifications for the two dams. The source of materials, loose lift thickness and compaction efforts were discussed in those documents (California Oregon Power Company, 1960a and Unknown Publisher, Unknown Date). The results from a post-construction subsurface investigation conducted for J.C. Boyle Dam in 1994 (Black and Veatch, 1998) provide additional information for shell material characterization.
- Material properties necessary for performing slope stability and seepage analyses can be reasonably developed using the reviewed information. The reviewed information included laboratory shear strength and permeability tests conducted on the borrow source materials (California Oregon Power Company, 1960b and Unknown Date) and previous rapid drawdown analyses performed by others (Bechtel, 1968, Department of Water Resources, 1986, Black and Veatch, 1998, and PanGEO, 1998) .

The existing information for both dams are deemed sufficient to perform rapid drawdown analyses with targeted sensitivity analysis to address uncertainties associated with material properties as discussed later in this memorandum.

MATERIAL CHARACTERIZATION

Iron Gate Dam

Iron Gate Dam, which was built in 1961, is a zoned earth and rock fill dam. The dam consists of six (6) main zones: an upstream pervious shell (Zone I), a downstream pervious shell (Zone II), a central impervious core (Zone III), a transition (Zone IA) upstream of the core, a downstream chimney two-stage filter (Zone IV and Zone IVA) and drain (Zone V), and a downstream blanket filter (Zone IV) and drain (Zone V). The analysis section for rapid drawdown stability is the maximum cross section as shown on Figure 1.

The shell materials mainly consist of locally borrowed, pervious talus rock and gravel placed in 3-foot loose lifts, moisture conditioned, and compacted with four (4) passes of 72-inch vibratory roller (PanGEO, 2006). The weight of the roller was not indicated in the documents reviewed. The impervious core mainly consists of high plasticity clay from a local borrow source. The core material was placed in 8-inch loose lifts and compacted to not less than 95% of the maximum dry density as determined by ASTM D698 (California Oregon Power Company , 1960a and PanGEO, 2006). The upstream transition zone consists of graded talus rock and is approximately 20 feet in thickness. The downstream chimney and blanket filters consist of fine sand to gravel and were constructed in three (3) vertical layers (California Oregon Power Company, 1960a). Based on the design drawings, the thicknesses of the chimney and blanket filters are 20 feet and 5 feet, respectively. The downstream chimney and blanket drains consist of selected talus, gravel, or other excavations that is essentially free of materials smaller than the #100 sieve (California Oregon Power Company, 1960a). The dam was founded on basalt that is generally hard, blocky, heavily jointed, and moderately weathered (DSOD, 1986).

Iron Gate Dam Material Properties

The shear strength parameters of shell and core are very important for the rapid drawdown analysis. Shear strength parameters for the core material were developed mainly based on results from isotropic consolidated undrained triaxial tests (TX-ICU) conducted on samples obtained from borrow sources during borrow source evaluation (California Oregon Power Company, 1960b). The results of the triaxial tests are included in Attachment A. However, no laboratory shear strength tests are available for the shell and other embankment materials. Therefore, shear strength parameters for these materials were selected based on available information such as the type of construction, parameters used in previous analyses, and published data (NAVFAC, 1986 and EPRI, 1990). As mentioned above, the shell materials consist of talus rock and gravel, which were compacted during placement. Based on the published data, the effective friction angle for compacted gravelly

materials would be greater than 37 degrees. For this rapid drawdown analysis, the shell materials were conservatively assigned an effective friction angle of 35 degrees. In addition, transition zone, chimney filter and drain, and blanket filter and drain were compacted during placement. Therefore, these materials were also assigned an effective friction angle of 35 degrees. The bedrock is modeled as impenetrable in the slope stability model. Table 1 summarizes these engineering parameters (best estimate parameters) used in the slope stability analyses.

The unit weights for different embankment zones were selected based on the laboratory tests conducted on the samples collected from proposed borrow areas, compaction test results on samples collected during dam construction, previous analyses (DWR, 1986 and PanGEO, 2006), and published data (NAVFAC, 1986 and EPRI, 1990).

The permeability values for the core and shell materials were selected based on the results from the falling head permeability tests performed on samples from the core and shell material borrow sources during borrow source evaluation. The results of the falling head permeability tests are included in Attachment B. Permeability values of the filter, chimney drain, the blanket drain, the riprap, and the random fill were estimated based on the characteristics of the materials, published data, and engineering judgment. The permeability parameters were selected conservatively based on typical ranges (Holtz and Kovacs, 1981), which is included in Attachment C. Table 1 summarizes permeability parameters used in the seepage analysis.

Anistropic ratios (k_h/k_v) typically range from 1 to 4 for uniform soil deposits without significant interbedding or stratification but can be higher for soil deposits with significant stratification. An anisotropic ratio of 10 for the core is selected considering the nature of the materials and its placement method. For the shell and random fill, an anisotropic ratio of 2 was selected as typical anisotropic ratios for similar materials range from 1 to 2. Anisotropic ratio for the filter/drain and riprap is selected to be 1 as the materials are expected to drain freely in both directions.

Table 1. Material Properties Used for the Analyses of Iron Gate Dam

Material	Unit Weight (pcf)	Effective Stress		Total Stress		Horizontal Permeability, k_h (cm/s)[1,3]	k_h/k_v
		Cohesion, c' (psf)	Friction Angle, ϕ' (°)[1,2]	Cohesion, c (psf)	Friction Angle, ϕ (°)		
Core	130	0	22	300	16	1.00E-07	10
Shell	135	0	35	-	-	8.00E-03	2
Filter/ Drain/ Transition Zones	135	0	35	-	-	1.00E-02	1
Riprap	135	0	35	-	-	1.00E-02	1
Random Fill	135	0	25	-	-	8.00E-03	2

Note:
1. The parameter that was used for sensitivity analyses is provided in parenthesis.
2. For compacted sand and gravel materials, the friction angles are typically greater than 34 degrees (NAVFAC, 1986 and EPRI, 1990).
3. For clean coarse materials, permeability ranges from 10^{-3} cm/s to 1 cm/s per Holtz and Kovacs (1981).

J.C. Boyle Dam

The earthfill embankment of the J.C. Boyle Dam is a zoned earth fill dam built in 1958. The dam consists of two (2) major zones: a central impervious clay core (Zone 1) and the upstream and downstream pervious shells (Zone 2). A filter blanket with thickness of 12 inches was placed between the Zone 2 materials and its foundation for the whole downstream area. An 18-inch thick gravel drain zone was also installed over part of the downstream foundation. A waste rock fill was placed at the downstream toe of the dam. Ripraps are placed on both the upstream and downstream sides of the dam. For analysis purpose, the gravel drain is modeled as part of the filter blanket. The rapid drawdown analyses were performed on maximum cross section of J.C. Boyle Dam, which is shown on Figure 2.

The impervious clay core is constructed of selected clay materials, which are described as rust colored sandy clay with some pea gravel. The shell materials were constructed of a mixture of well graded gravel with sand and well graded sand. Based on the specifications, the embankment materials were to be constructed in 8-inch loose lift and compacted with a minimum of twelve (12) passes of sheepfoot rollers to obtain a minimum of 95% of the dry density which correspond to the optimum moisture content of the materials placed The filter blanket is approximately 12 inches thick and consists of well graded sandy gravel. The waste rock fill was constructed of gravel placed under water without compaction. Specific information regarding size and compaction effort is not available for the upstream and downstream ripraps and the gravel drain. The dam is mostly founded on basalt with the exception of the right abutment, which is founded on satisfactory overburden (Bechtel, 1968).

J.C. Boyle Dam Material Properties

The effective shear strength parameters for the core material are developed based on the results of direct shear tests performed on samples from core borrow sources during borrow source evaluation. The results show that the effective friction angle is greater than that of Iron Gate Dam's core. This is consistent with the material descriptions which suggest that the core in J.C. Boyle Dam consists of lower plasticity clay and pea gravel. The results of the direct shear test are included in Attachment D. The total stress shear strength parameters are not available from the direct shear tests. For the purpose of rapid drawdown slope stability analysis, those parameters were conservatively assumed the same as those of the Iron Gate Dam core. No laboratory shear strength data are available for the other embankment materials. Previous slope stability analyses performed by others selected the shear strength parameters based on the SPT blow count data (Black and Veatch, 1998). Review of available data suggests that the shell materials consist of up to 50% of gravel. The shear strength parameters that were previously selected did not account for the presence of high gravel percentage in the shell material. Considering the high gravel content, the borrow source, and how the shell material was placed and compacted, for the purpose of the rapid drawdown analysis a friction angle of 34 degrees (the previous analysis used a friction angle of 37 degrees) was assumed. The strength parameters of the riprap are conservatively assumed to be the same as the shell materials as the anticipated effect from the riprap on the overall stability performance is not significant due to its relative thickness to the shell. The bedrock is modeled as impenetrable in the slope stability model. Table 2 summarizes the best estimate engineering parameters used in slope stability analyses.

As no total strength parameters are available for the core materials, a sensitivity analysis is performed on the strength parameters for the core materials. Total cohesion of 100 psf and total friction angle of 12 degrees were conservatively selected considering very soft soil conditions for this sensitivity analysis. This sensitivity analysis also considers a lower effective friction angle of 19.4 degrees for the core materials, which was selected based on the lowest values from the direct shear tests. As the core is relatively thin compared to the shell, it is anticipated that reducing the strength parameters for the core materials will not significantly impact the analysis results. Table 2 includes the engineering parameters used in the sensitivity analysis in parenthesis.

Compaction tests performed on the samples from the core and shell borrow sources during borrow source evaluation were used as the basis for unit weight of the materials. The results of the compaction tests are included in Attachment E. The selection of the unit weight used in the rapid drawdown analysis is based on the compaction test results, published data (NAVFAC, 1986 and EPRI, 1990), and previous analyses. Table 2 summarizes the unit weights used in the slope stability analysis.

Falling head permeability tests performed on samples from the core borrow sources during borrow source evaluation were used as the basis for permeability values of the core material. The results of the permeability test are included in Attachment F. Permeability values for the shell materials and filter blankets are estimated based on results of the grain size analysis using the Kozemy-Carmen permeability correlations, characteristics of the materials, published data, and engineering judgement. The permeability of the riprap is assumed to be the same as the shell materials, whereas the permeability of the wasterock fill is assumed to be the same as the shell. Table 2 summarizes the best estimate engineering properties used in the seepage analyses.

Similar to Iron Gate Dam, anisotropic ratios of 10 and 2 are selected for the core and shell materials with the exception of riprap, respectively. An anisotropic ratio of 1 is selected for the ripraps.

In addition, a set of sensitivity analysis was performed based on typical permeability ranges for gravel and sand materials (Holtz and Kovacs, 1981). This set of sensitivity analysis conservatively assumes the lower permeability values within the

typical ranges for the shell, riprap, filter blanket, and waste rock fill. Table 2 includes the engineering parameters used in the sensitivity analysis in parenthesis.

Table 2. Material Properties Used for the Analyses of J.C. Boyle Dam

Material	Unit Weight (pcf)	Effective Stress		Total Stress		Horizontal Permeability, k_h (cm/s)[1,3]	k_h/k_v
		Cohesion, c' (psf)	Friction Angle, ϕ' (°)[1,2]	Cohesion, c (psf)[1]	Friction Angle, ϕ (°)[1]		
Core	120	0	27 (19)	300 (100)	16 (12)	1.71E-04	10
Shell	130	0	34	-	-	6.62E-01 (4.00E-03)	2
Upstream Riprap	140	0	34	-	-	1.04E-00 (4.00E-03)	1
Downstream Riprap	140	0	34	-	-	1.04E-00 (4.00E-03)	1
Filter Blanket	125	0	35	-	-	1.04E-00 (4.00E-03)	2
Waste Rock Fill	145	0	40	-	-	6.62E-01 (4.00E-03)	2

Note:
1. The parameter that was used for sensitivity analyses is provided in parenthesis.
2. For compacted sand and gravel materials, the friction angles are typically greater than 34 degrees (NAVFAC, 1986 and EPRI, 1990).
3. For clean coarse materials, permeability ranges from 10^{-3} cm/s to 1 cm/s per Holtz and Kovacs (1981).

PREVIOUS SLOPE STABILITY ANALYSIS PERFORMED BY OTHERS

Iron Gate Dam

After the construction of the Iron Gate dam, stability analyses of the dam were originally performed by the Division of Safety of Dams (DSOD) in 1962 (DWR, 1986). The slope stability analyses were performed for static, rapid drawdown, and pseudo-static loading conditions with assumed effective friction angles of 30 and 17 degrees with no cohesion for the shell and core, respectively. A minimum factor of safety of 1.67 was calculated for the rapid drawdown conditions. Bechtel Corporation analyzed stability of the embankment in 1968 using effective friction angles of 35 degrees for the shell and 22 degrees for the core. The rapid drawdown analysis performed as part of Bechtel's analyses calculated a minimum factor of safety of 1.99 (DWR, 1986). In 1986, DSOD reanalyzed the dam by assigning an effective friction angle of 35 degrees for the shell zones and drained zones, and calculated a minimum factor of safety of 2.00 for rapid drawdown. These stability evaluations were then updated in 1995 and 2004 to account for the then planned dam raises (Section 8 of STID, 2015). The existing dam incorporates the sheet-pile raised crest, and has an effective crest elevation of 2348.0 feet.

As the latest stability analysis, PanGEO performed the preliminary assessment of the stability of upstream slope under rapid drawdown conditions and presented the results in a technical memorandum (PanGEO, 2008).

J.C. Boyle Dam

Based on available information, two (2) rapid drawdown analyses were performed in 1968 and 1996 (Bechtel, 1968 and Black and Veatch, 1996). The 1968 analysis assumed a very conservative strength for the shell materials, in which the shear strength of the shell materials was assumed to be the same as the shear strength of the core materials (effective friction angle of 26 degrees). The phreatic surface used in the analysis was derived by a flow net analysis, which considered partial pore dissipation within the shell materials. The rapid drawdown analysis resulted in a factor of safety of 1.03. In 1994, three (3) borings were drilled on the downstream side of the dam to collect additional subsurface information for better material characterization for the shell materials. Based on the results of this subsurface investigation, the 1996 analysis assumed a higher shear strength for the shell material (effective friction angle of 37 degrees). No additional seepage analysis was

performed, and the phreatic surface from the 1968 analysis was assumed in the 1996 analysis. The rapid drawdown analysis resulted in a factor of 1.88.

CURRENT RAPID DRAWDOWN ANALYSIS

Sudden or rapid drawdown is the most critical condition controlling the lowering of the reservoir prior to dam removal because deep slides in the upstream slope of the dam during the drawdown could lead to dam failure. Rapid drawdown reduces the total stress on the upstream face and lowers the head driving seepage through the embankment. The shear stresses within the upstream slope increase which may lead to instability. In principle, the stability of the upstream slope can be evaluated using either total stress (undrained) or effective stress (drained) strength parameters. The rapid drawdown analysis approach used for this Project involves the following steps:

1. Develop analysis sections and material properties,
2. Establish a base case by performing conventional rapid drawdown stability analysis under instantaneous drawdown for two scenarios that provide the upper and lower bound for stability of the dams during rapid drawdown:
    a. The first scenario (least conservative bound) assumes full pore pressure dissipation within the pervious shell after drawdown from the steady state condition.
    b. The second scenario (most conservative bound) assumes no pore pressure dissipation within the pervious shell from after drawdown from the steady state condition.
3. Perform transient drawdown analysis for various drawdown rates:
    a. Seepage analysis to determine the location of the phreatic surface at different time steps during reservoir drawdown
    b. Slope stability analysis for each corresponding phreatic surface during reservoir drawdown.
4. Additional sensitivity analyses, if needed.

SEEP/W (Geo-Studio, 2016) presents a method for using uncoupled transient seepage analysis along with limit equilibrium to evaluate the stability of slopes affected by changing hydraulic boundary conditions such as the conditions during rapid drawdown. The latest version of the USBR Embankment Dam design standards (2011) recommends using the effective stress approach with pore pressures from uncoupled transient seepage analysis to analyze stability following rapid drawdown. For these reasons, a transient analysis was considered as listed above. Because the shells of the dams are constructed of pervious materials rapid drawdown of the reservoir level behind the dams will result in concurrent (but slower) lowering of the phreatic surface (groundwater level) in the upstream shell of the dams. To account for this, transient seepage analyses are required. The computer programs SEEP/W and SLOPE/W (Geo-Studio, 2016) were utilized for the seepage and slope stability. SEEP/W is a two-dimensional, finite element analysis software program that has the capability to analyze both steady-state and transient seepage conditions. Slope/W is used to perform limit equilibrium slope stability analyses. Slope/W uses the phreatic surface developed in SEEP/W as input to the stability analysis. The limit equilibrium slope stability calculations use Spencer's method, which satisfies both moment and force equilibrium simultaneously.

Acceptance Criterion

According to the Engineering Manual (EM-110-2-1902) of United States Army Corps of Engineers (USACE), the factor of safety for the rapid drawdown analyses of the upstream slope of the dam should be greater than the range of 1.1 to 1.3. Given, the importance of safety to both workers on site and the public downstream of the dams, the minimum rapid drawdown factor of safety for transient seepage analyses is selected to be 1.3.

Analysis Results

Rapid drawdown slope stability analyses were performed to calculate the minimum factors of safety for the following five (5) scenarios as described below:

1. Instantaneous drawdown from steady state condition with full pore pressure dissipation in the shell materials (least conservative bound).
2. Instantaneous drawdown from steady state condition with no pore pressure dissipation in the shell materials (most conservative bound).
3. Slow drawdown rate (3 ft/day for Iron Gate Dam and 2 ft/day for J.C. Boyle Dam)
4. Intermediate drawdown rate (6 ft/day for Iron Gate Dam and 5 ft/day for J.C. Boyle Dam)
5. Rapid drawdown rate (10 ft/day for Iron Gate Dam and 10 ft/day for J.C. Boyle Dam)

For Iron Gate Dam, the reservoir was drawn down from El. 2328 feet to El. 2202 feet. For J.C. Boyle Dam, the reservoir was drawn down from El. 3793 feet to El. 3762 feet. The results of the rapid drawdown slope stability analyses for Iron Gate Dam are summarized in Table 3. Table 3 also includes the results of the sensitivity analyses, which consider the potential lower bound strength for the shell materials. The results of rapid drawdown slope stability analyses for J.C. Boyle Dam are summarized in Table 4. Table 4 also includes the results of the sensitivity analyses, which consider the lower bounds for both the core strength and the shell permeability. The analysis results for the best estimate parameters are also shown on Figures 3 through 7 for Iron Gate Dam, and on Figures 8 through 12 for J.C. Boyle Dam. It should be noted that the plotted phreatic surfaces shown on the figures for the transient rapid drawdown analyses correspond to the phreatic surfaces at the specific time when the calculated factors of safety are minimum.

Table 3. Rapid Drawdown Slope Stability Analysis Results for Iron Gate Dam

Scenario	Factors of Safety for Best Estimate Parameters	
	Mid-Slope	Full-Slope
1. Instantaneous drawdown, full pore pressure dissipation	1.91	2.02
2. Instantaneous drawdown, no pore pressure dissipation within upstream shell	1.42	1.46
3. Slow drawdown rate (3 ft/day)	1.51	1.77
4. Intermediate drawdown rate (6 ft/day)	1.49	1.74
5. Rapid drawdown rate (10 ft/day)	1.48	1.70

Table 4. Rapid Drawdown Slope Stability Analysis Results for J.C. Boyle Dam

Scenario	Factor of Safety for Best Estimate for Core Strength		Factor of Safety from Sensitivity Analyses Using Potential Lower Bound Strength for Core	
	Mid-Slope	Full-Slope	Mid-Slope	Full-Slope
1. Instantaneous drawdown, full pore pressure dissipation	2.06 (2.06)	1.86 (1.86)	1.97 (1.97)	1.85 (1.85)
2. Instantaneous drawdown, no pore pressure dissipation within upstream shell	1.11 (1.12)	1.18 (1.18)	1.10 (1.10)	1.18 (1.18)
3. Slow drawdown rate (2 ft/day)	1.77 (1.76)	1.84 (1.74)	1.70 (1.70)	1.83 (1.73)
4. Intermediate drawdown rate (5 ft/day)	1.78 (1.76)	1.85 (1.66)	1.70 (1.69)	1.83 (1.66)

5. Rapid drawdown rate (10 ft/day)	1.78 (1.72)	1.85 (1.61)	1.75 (1.69)	1.82 (1.61)

Note: The values in parenthesis refer to the results of the sensitivity analysis using the lower permeability for the shell materials.

Conclusions

Rapid drawdown analysis results for the Iron Gate Dam and J.C. Boyle Dam indicate that the calculated factors of safety are greater than the selected minimum factor of safety of 1.3 for all cases analyzed except some cases instantaneous drawdown without any pore pressure dissipations for the J.C. Boyle Dam. However, in these cases, the minimum factors of safety are still within the range recommended by USACE. In addition, it should be noted that these cases conservatively assume no pore pressure dissipation within the upstream shell. Based on the analyses, reservoir drawdown could be as high as 10 feet/day. However, we recommend that reservoir drawdown be 5 feet/day, except as noted for J,C. Boyle Dam below.

It is our understanding that the demolition of J.C. Boyle Dam includes removal of concrete stoplogs within two diversion culverts. The removal of the concrete stoplogs (likely by blasting) will result in drawdown of approximately 10 feet for the first culvert and 8 feet for the second culvert within less than 24 hours. Although we conclude that the J.C. Boyle Dam will perform satisfactorily under these rapid drawdown conditions, we recommend a hold period of one week be implemented between removal of the stoplogs from the first culvert until the stoplogs from the second culvert are removed to allow for pore pressure dissipation.

The analysis results indicated that no slope instability would result during reservoir drawdown. However, there is a potential for shallow slumping along the upstream embankment slopes due to the potential strength loss of surficial materials during the drawdown. Therefore, we recommend frequent visual inspection during the reservoir drawdown process. If any shallow slumping is observed, riprap can be placed to provide additional resistance.

It is recommended that instrumentation should be installed to monitor the upstream slopes during reservoir drawdown for dam removal. The types of recommended instrumentation include survey monuments, inclinometers, and piezometers. Daily readings are recommended to closely monitor if there are any unanticipated slope movements or pore pressure accumulation. It is also recommended that the instrumentation be installed the year prior to reservoir drawdown. The piezometers would be monitored during reservoir drawdown to confirm that the transient phreatic surfacewithin the upstream shell of the dam falls as the reservoir elevation drops.

Limitations

AECOM represents that our services were conducted in a manner consistent with the standard of care ordinarily applied as the state of practice in the profession within the limits prescribed by our client. No other warranties, either expressed or implied, are included or intended in this technical memorandum.

Background information and other data have been furnished to AECOM by Pacific Corp and/or third parties, which AECOM has used in preparing this technical memorandum. AECOM has relied on this information as furnished, and is neither responsible for nor has confirmed the accuracy of this information.

The analyses and results presented in this report are for the current study only and should not be extended or used for any other purposes.

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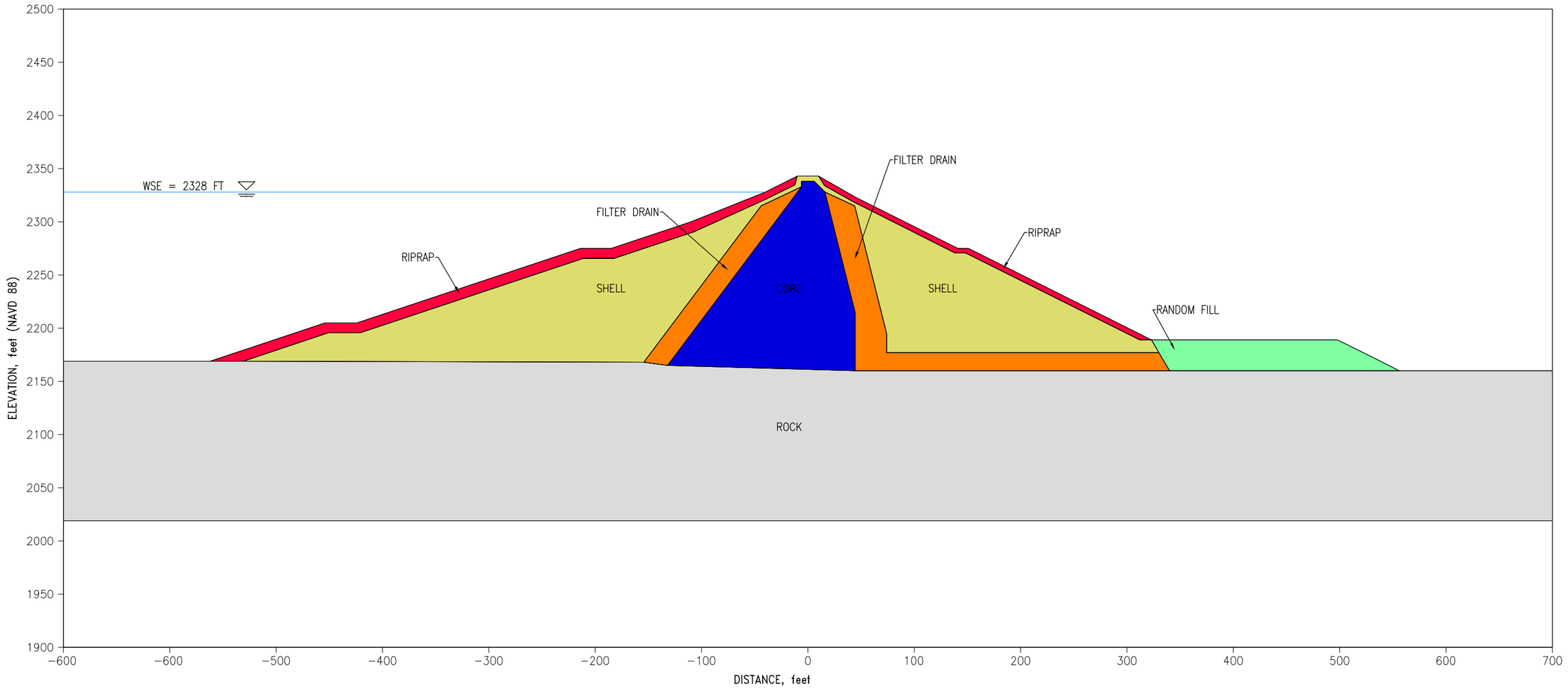
Figures



	PROJECT NUMBER 60537920	PREPARED BY KANAX KANAGALINGAM	KLAMATH RIVER DAM REMOVAL	ANALYSIS MODEL GEOMETRY IRON GATE DAM	FIGURE 1
	REVISION 0	CHECKED BY BENJAMIN CHOY			

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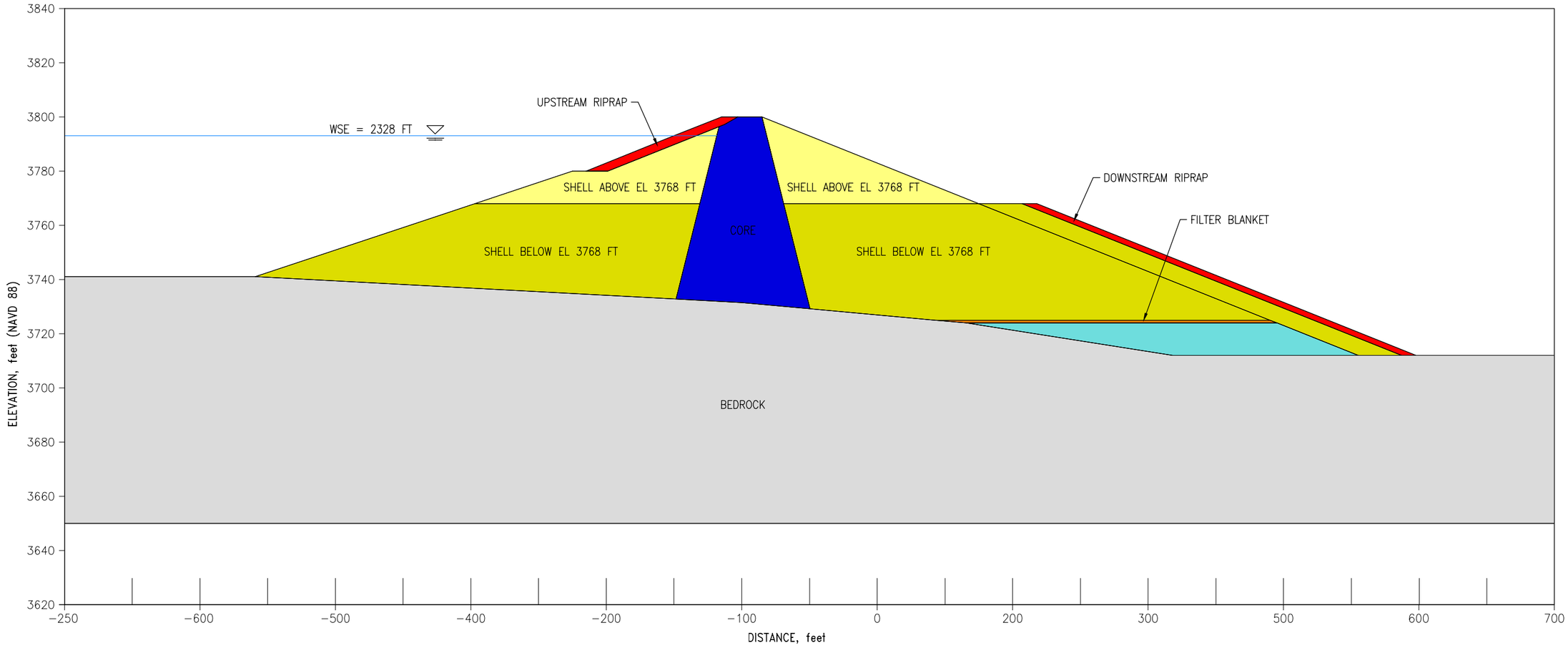
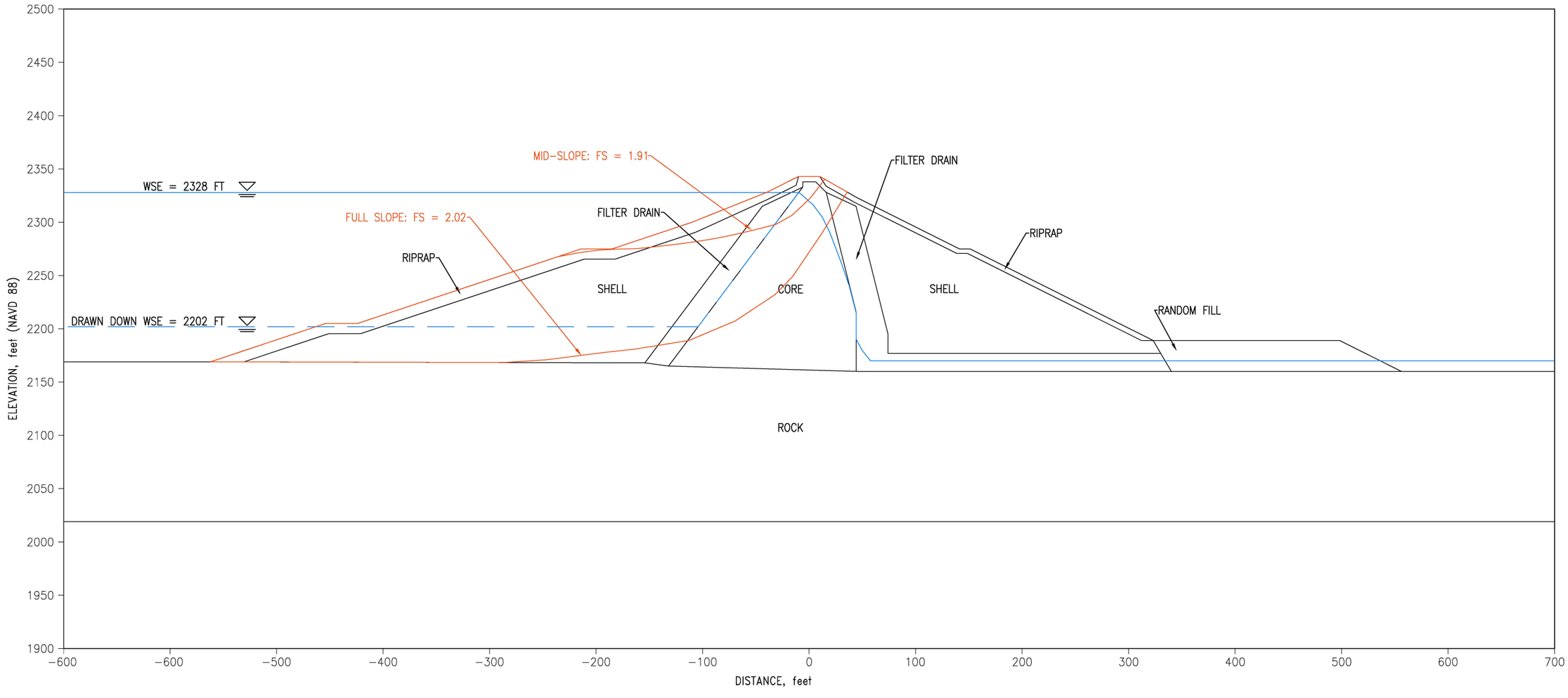


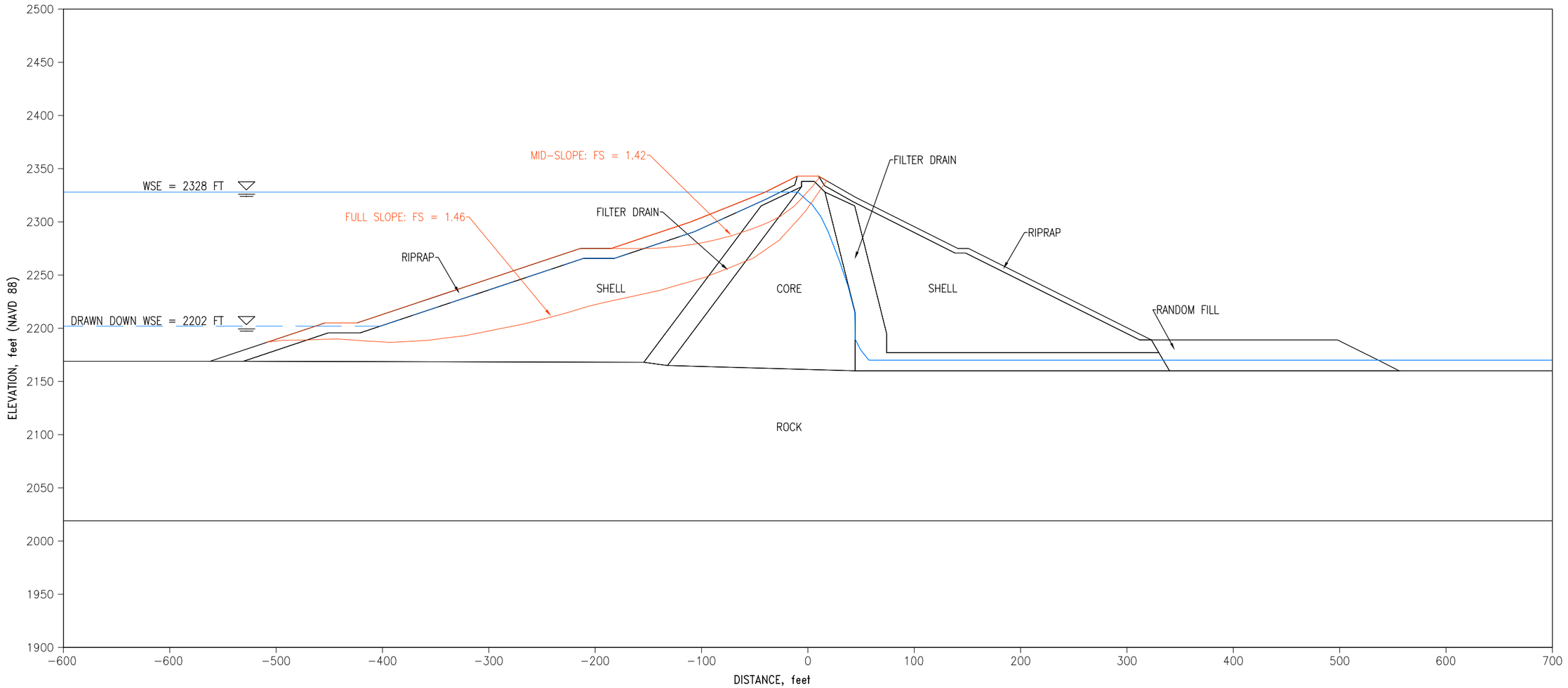
	PROJECT NUMBER 60537920	PREPARED BY BENJAMIN CHOY	KLAMATH RIVER DAM REMOVAL	FIGURE 2
	REVISION 0	CHECKED BY KANAX KANAGALINGAM	ANALYSIS MODEL GEOMETRY JC BOYLE DAM	

PLOT BY: BENJAMIN.CHOY – Sep 11, 2017 – 10:18:21am
DRAWING: K:\400-Technical\430 Engineering\3.2 Tech Assess\5. Embank Stability\JC Boyle\Figures\Figure 4.dwg



	PROJECT NUMBER 60537920	PREPARED BY KANAX KANAGALINGAM	KLAMATH RIVER DAM REMOVAL	RAPID DRAWDOWN STABILITY ANALYSIS IRON GATE DAM INSTANTANEOUS DRAWDOWN SCENARIO FULL PORE PRESSURE DISSIPATION	FIGURE 3
	REVISION 0	CHECKED BY BENJAMIN CHOY			

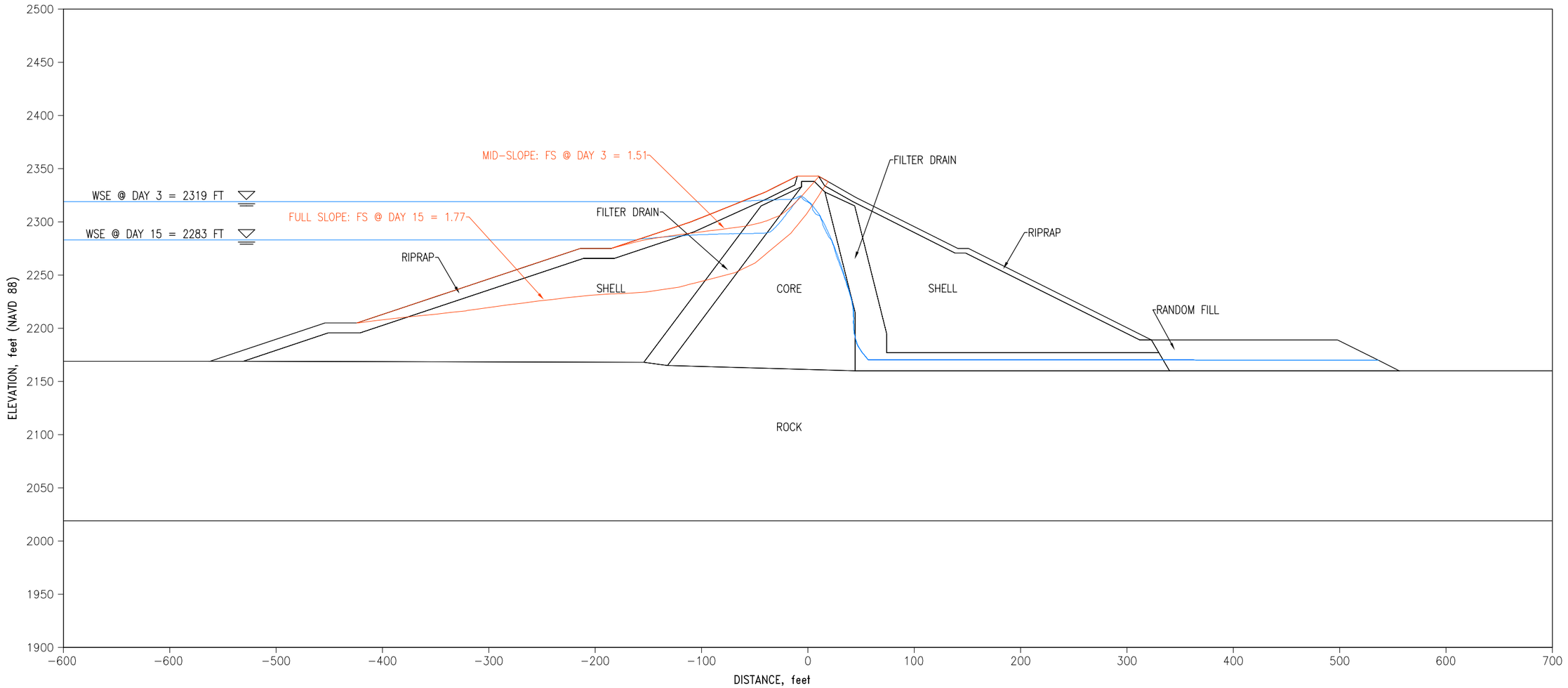
PLOT BY: BENJAMIN.CHOY – Sep 07, 2017 – 2:12:23pm
DRAWING: K:\400-Technical\430 Engineering\3.2 Tech Assess\5. Embank Stability\Iron Gate\Figures\Figure 5.dwg



PLOT BY: BENJAMIN.CHOY – Sep 07, 2017 – 2:19:24pm
DRAWING: K:\400-Technical\430 Engineering\3.2 Tech Assess\5. Embank Stability\Iron Gate\Figures\Figure 6.dwg

	PROJECT NUMBER 60537920	PREPARED BY KANAX KANAGALINGAM	KLAMATH RIVER DAM REMOVAL	RAPID DRAWDOWN STABILITY ANALYSIS IRON GATE DAM INSTANTANEOUS DRAWDOWN SCENARIO NO PORE PRESSURE DISSIPATION
	REVISION 0	CHECKED BY BENJAMIN CHOY		

FIGURE
4



	PROJECT NUMBER 60537920	PREPARED BY KANAX KANAGALINGAM	KLAMATH RIVER DAM REMOVAL	RAPID DRAWDOWN STABILITY ANALYSIS IRON GATE DAM SLOW DRAWDOWN SCENARIO 3 FT/DAY DRAWDOWN RATE
	REVISION 0	CHECKED BY BENJAMIN CHOY		FIGURE 5

PLOT BY: BENJAMIN.CHOY – Sep 07, 2017 – 2:22:05pm
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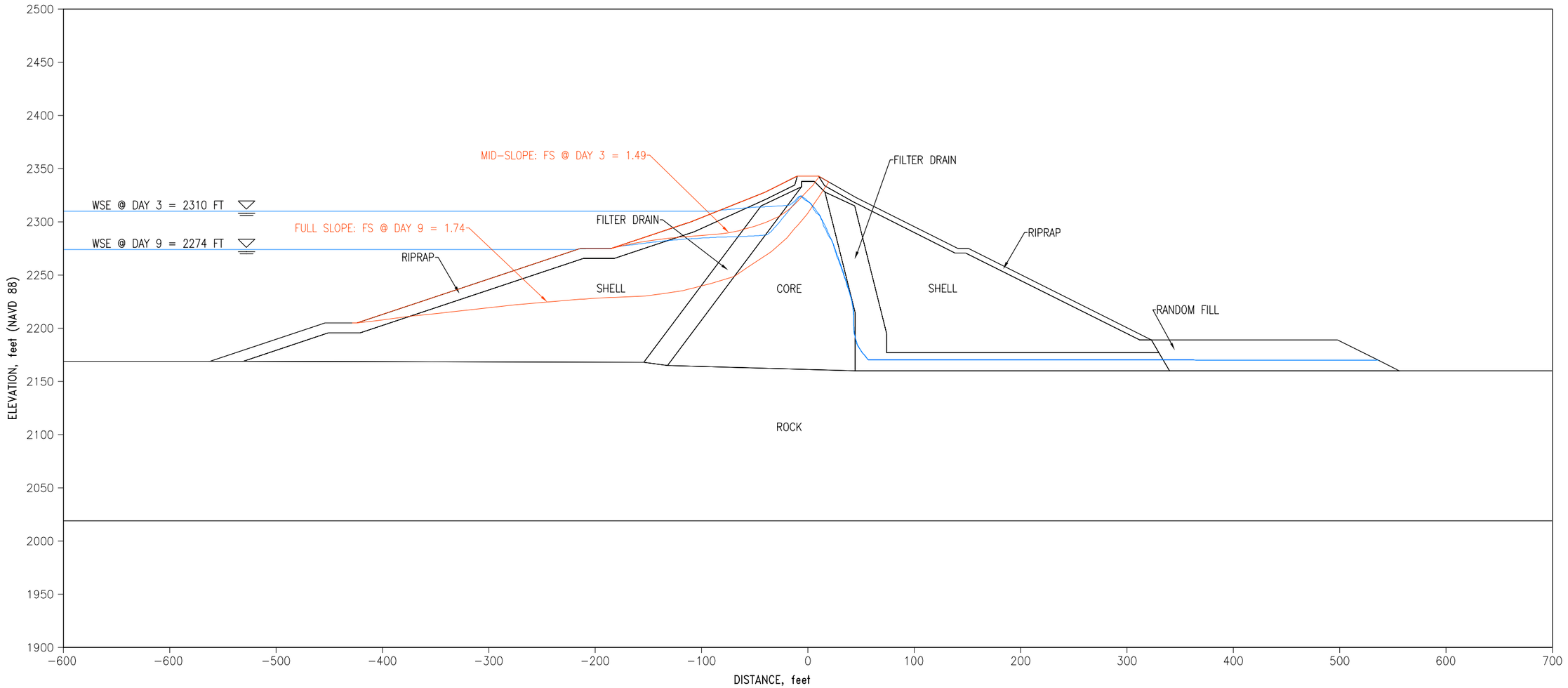
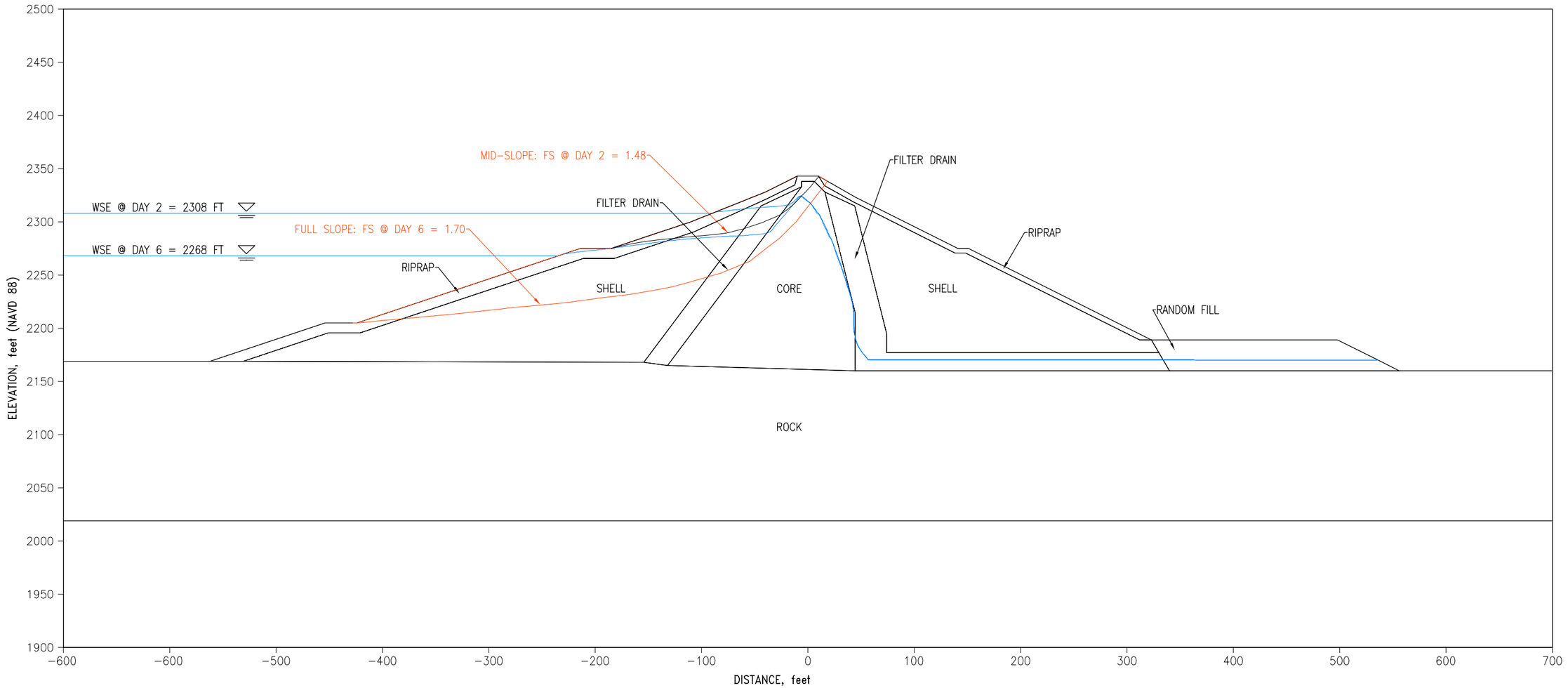


PLOT BY: BENJAMIN.CHOY – Sep 07, 2017 – 2:26:05pm
DRAWING: K:\400-Technical\430 Engineering\3.2 Tech Assess\5. Embank Stability\Iron Gate\Figures\Figure 8.dwg

	PROJECT NUMBER 60537920	PREPARED BY KANAX KANAGALINGAM	KLAMATH RIVER DAM REMOVAL	RAPID DRAWDOWN STABILITY ANALYSIS IRON GATE DAM SLOW DRAWDOWN SCENARIO 6 FT/DAY DRAWDOWN RATE
	REVISION 0	CHECKED BY BENJAMIN CHOY		FIGURE 6



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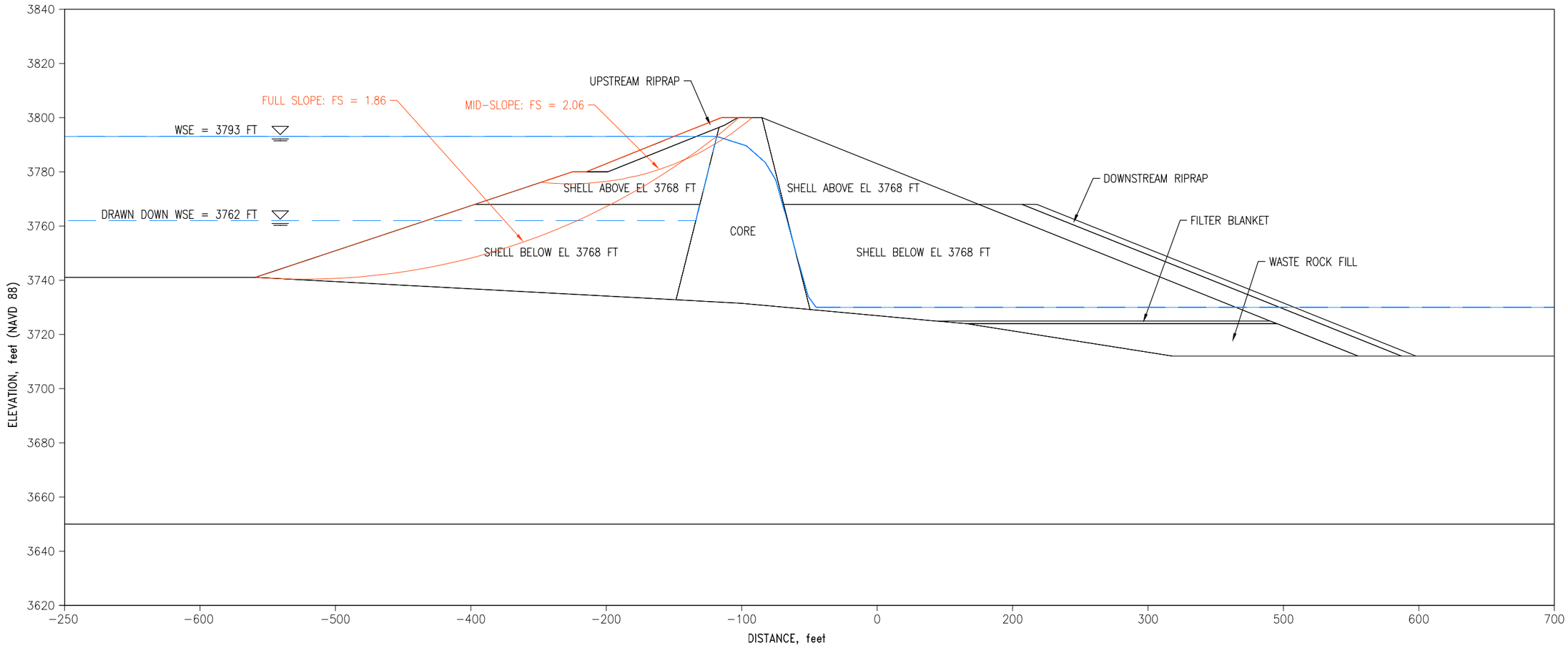
	REVISION 0	CHECKED BY BENJAMIN CHOY		FIGURE 7

PLOT BY: BENJAMIN.CHOY – Sep 07, 2017 – 2:29:50pm
DRAWING: K:\400-Technical\430 Engineering\3.2 Tech Assess\5. Embank Stability\Iron Gate\Figures\Figure 9.dwg



	PROJECT NUMBER 60537920	PREPARED BY BENJAMIN CHOY	KLAMATH RIVER DAM REMOVAL	RAPID DRAWDOWN STABILITY ANALYSIS JC BOYLE DAM INSTANTANEOUS DRAWDOWN SCENARIO FULL PORE PRESSURE DISSIPATION	FIGURE 8
	REVISION 0	CHECKED BY KANAX KANAGALINGAM			

PLOT BY: BENJAMIN.CHOY – Sep 11, 2017 – 10:26:44am
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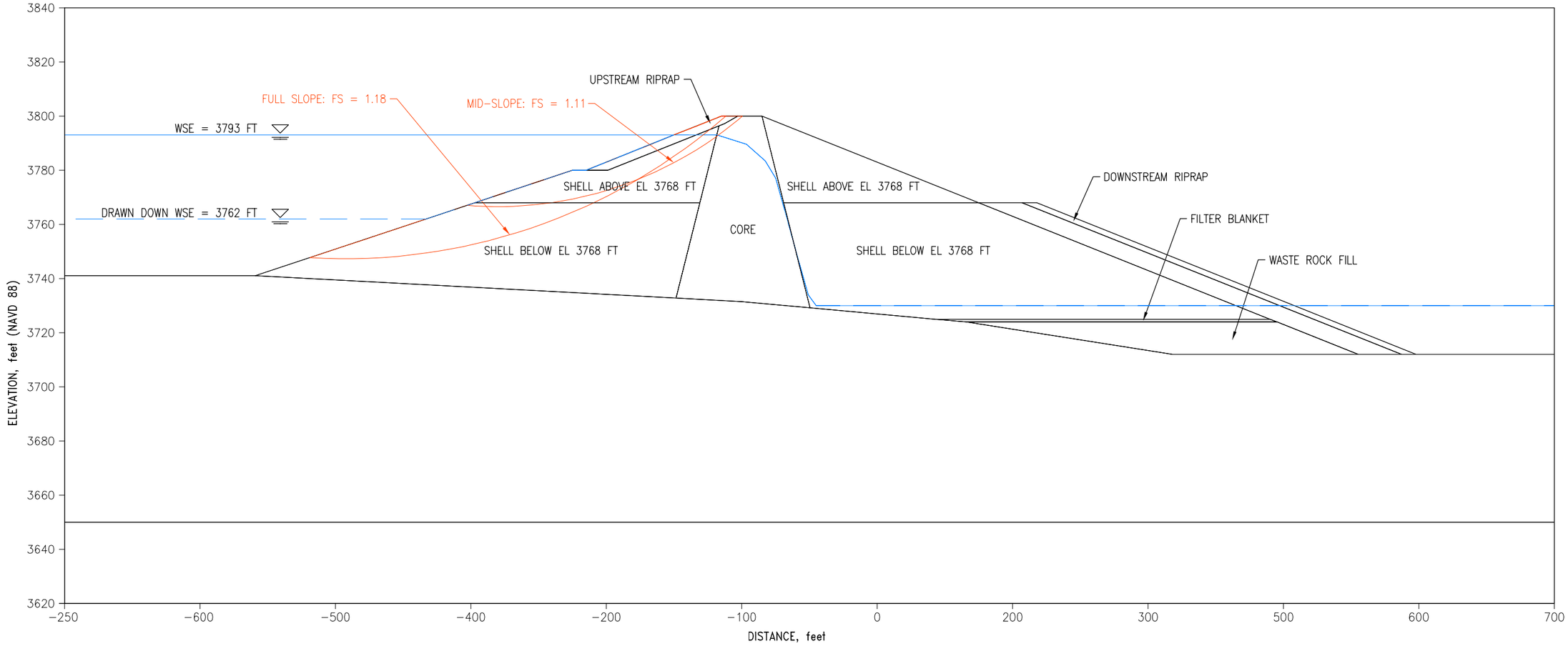

PLOT BY: BENJAMIN.CHOY – Sep 12, 2017 – 4:29:57pm
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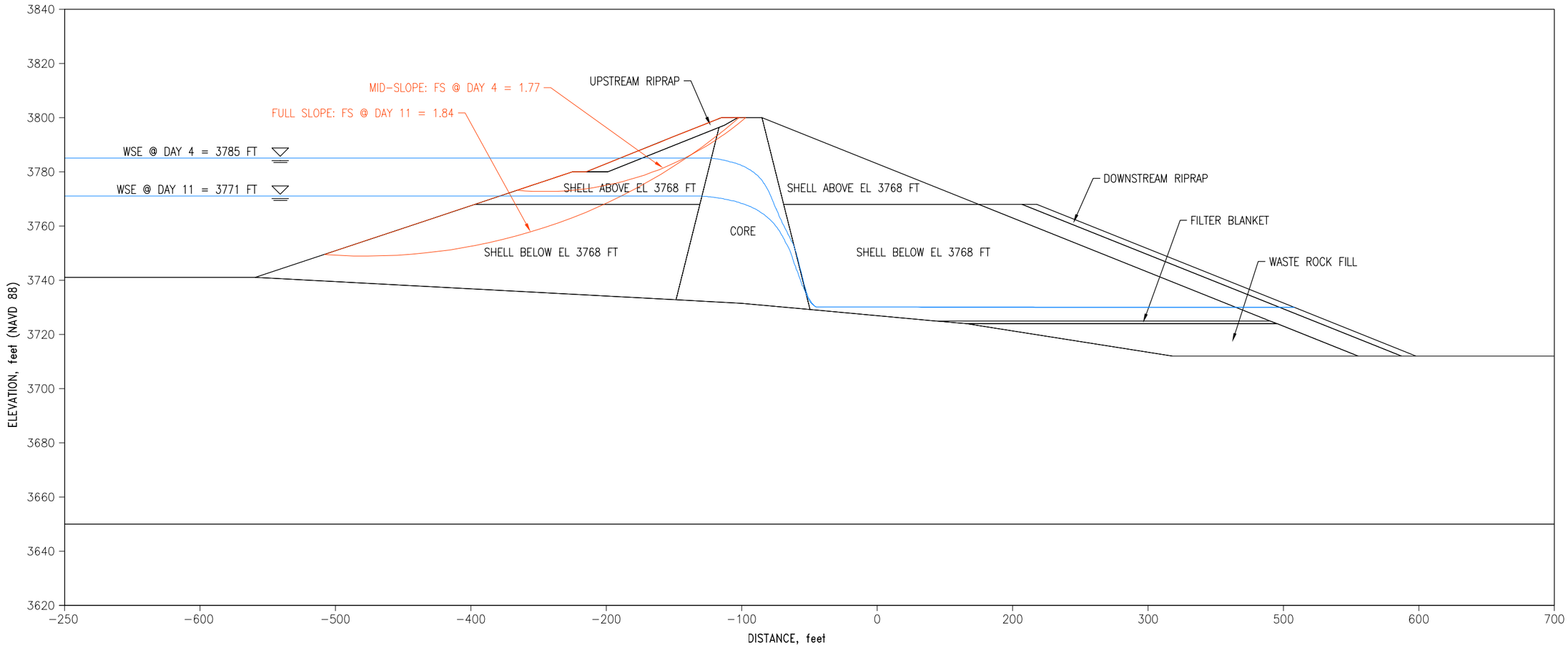
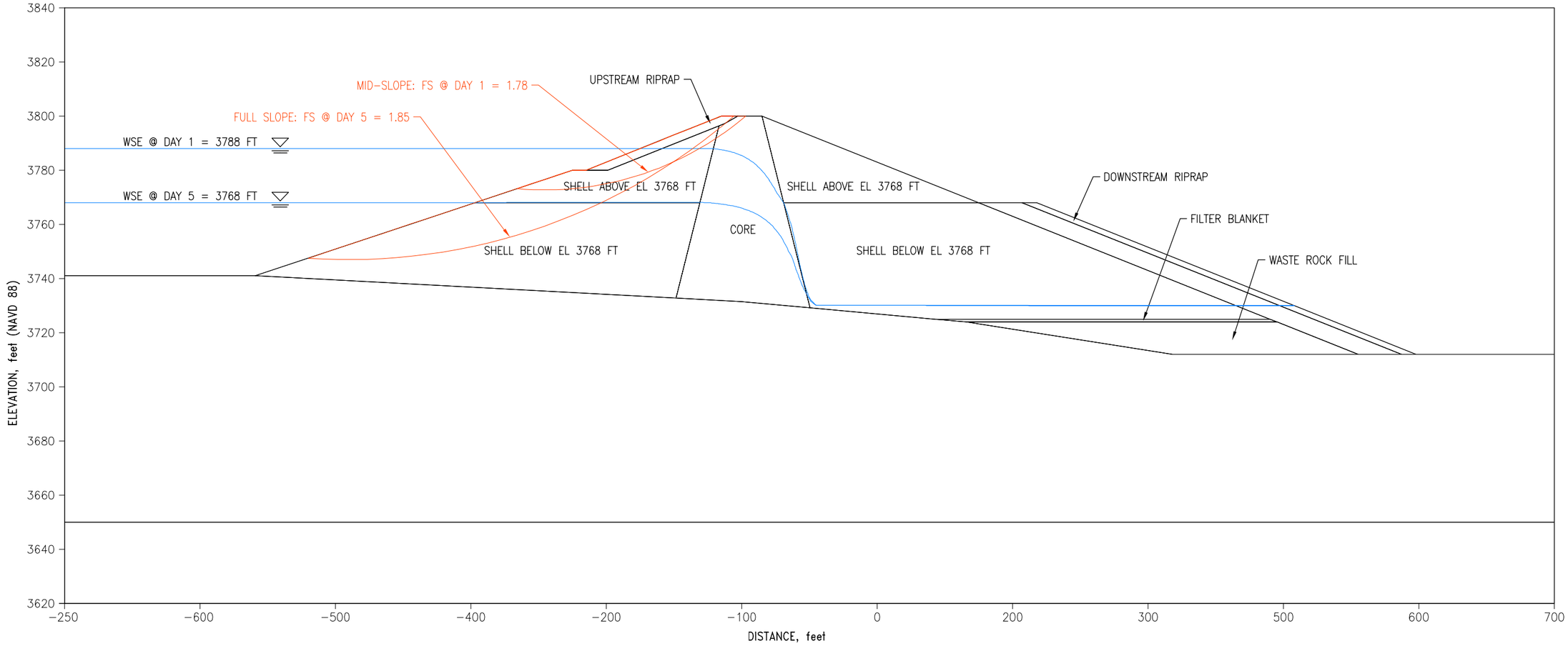
PROJECT NUMBER 60537920	PREPARED BY BENJAMIN CHOY	KLAMATH RIVER DAM REMOVAL	RAPID DRAWDOWN STABILITY ANALYSIS JC BOYLE DAM INSTANTANEOUS DRAWDOWN SCENARIO NO PORE PRESSURE DISSIPATION	FIGURE 9
REVISION 0	CHECKED BY KANAX KANAGALINGAM			



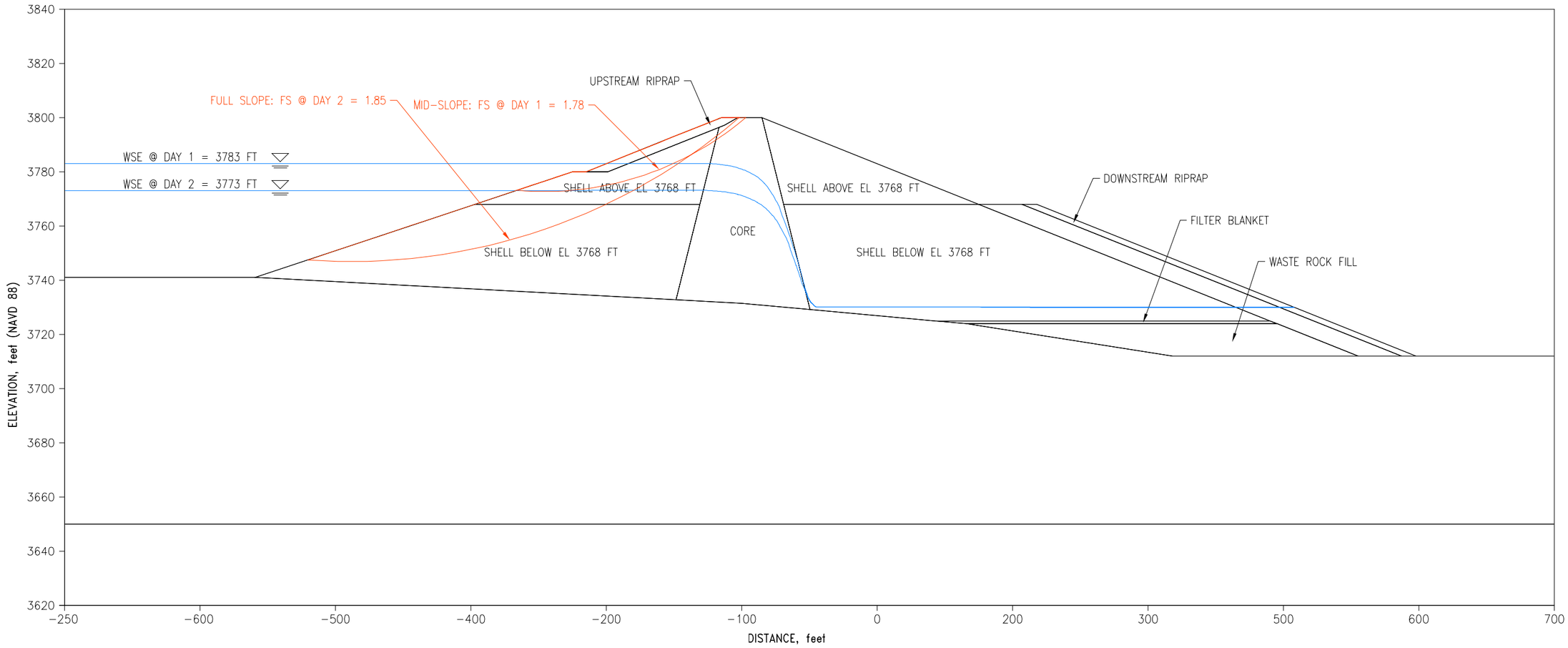
	PROJECT NUMBER 60537920	PREPARED BY BENJAMIN CHOY	KLAMATH RIVER DAM REMOVAL	RAPID DRAWDOWN STABILITY ANALYSIS JC BOYLE DAM SLOW DRAWDOWN SCENARIO 2 FT/DAY DRAWDOWN RATE	FIGURE 10
	REVISION 0	CHECKED BY KANAX KANAGALINGAM			

PLOT BY: BENJAMIN.CHOY – Sep 11, 2017 – 10:47:21am
DRAWING: K:\400-Technical\430 Engineering\3.2 Tech Assess\5. Embank Stability\JC Boyle\Figures\Figure 12.dwg



	PROJECT NUMBER 60537920	PREPARED BY BENJAMIN CHOY	KLAMATH RIVER DAM REMOVAL	RAPID DRAWDOWN STABILITY ANALYSIS JC BOYLE DAM SLOW DRAWDOWN SCENARIO 5 FT/DAY DRAWDOWN RATE	FIGURE 11
	REVISION 0	CHECKED BY KANAX KANAGALINGAM			

PLOT BY: BENJAMIN.CHOY – Sep 11, 2017 – 10:53:07am
DRAWING: K:\400-Technical\430 Engineering\3.2 Tech Assess\5. Embank Stability\JC Boyle\Figures\Figure 13.dwg



	PROJECT NUMBER 60537920	PREPARED BY BENJAMIN CHOY	KLAMATH RIVER DAM REMOVAL	RAPID DRAWDOWN STABILITY ANALYSIS JC BOYLE DAM SLOW DRAWDOWN SCENARIO 10 FT/DAY DRAWDOWN RATE	FIGURE 12
	REVISION 0	CHECKED BY KANAX KANAGALINGAM			

PLOT BY: BENJAMIN.CHOY – Sep 11, 2017 – 10:59:18am
DRAWING: K:\400-Technical\430 Engineering\3.2 Tech Assess\5. Embank Stability\JC Boyle\Figures\Figure 14.dwg

Attachment A Triaxial Test Results

CABLE, HANK

ABBOT A. HANKS, INC.
ESTABLISHED 1866

1300 SANSOME STREET • SAN FRANCISCO 11, CALIFORNIA • EXBROOK 7-2464

Engineers
Assayers
Chemists
Metallurgists
Spectrographers
Soils and Foundations
Consulting · Testing · Inspecting

File No. 1732.1
Lab. No. 46938

May 11, 1960

Mr. W. L. Warren
Assistant Chief Engineer
The California Oregon Power Company
216 West Main Street
Medford, Oregon

Re: Iron Gate Dam
Soil Samples

Dear Sir:

Enclosed are the findings from tests performed on soil samples marked Hole No. 1, which is the only sample for which all tests are complete. Tests of remaining samples are in various stages of completion.

As you may recall from your recent visit, there appeared to be a possibility that samples from Holes 2 and 3 had been mislabelled. It now appears that all samples marked Holes 2 and 3 are nearly identical, and we are performing further tests to distinguish between them. It is quite possible that these soils are exceptionally sensitive to seasoning period, owing to the porous nature of the parent rock, and that test results, particularly optimum moisture content, are influenced by the length of seasoning period. We have completed triaxial shear and consolidation tests on the sample labelled Hole No. 2, but are not yet certain that the samples were compacted at optimum moisture content and maximum density.

We shall advise you of results of our identification tests, and shall forward sets of test data as they are completed.

Very truly yours,

ABBOT A. HANKS, INC.

L. O. Long

L. O. Long

LOL:hms
Encls.
Reports to:
3-The California Oregon Power Company

Iron Gate Dam
Klamath River
File No. 1732.1

Abbot A. Hanks, Inc.
Lab. No. 46938
May 10, 1960

TEST RESULTS

Hole No. 1.
Specific Gravity: 2.77.

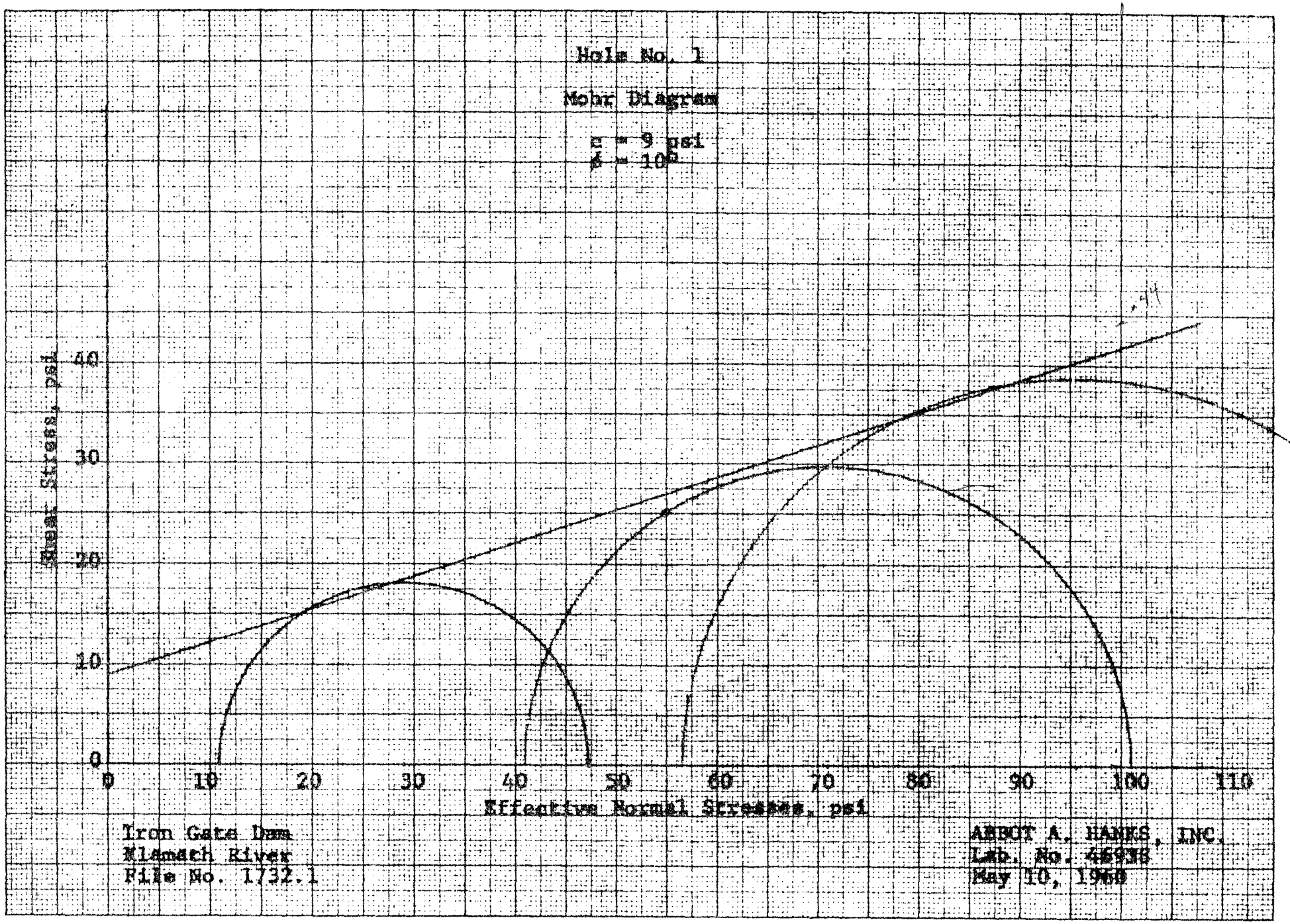
Triaxial Shear Test

	Sample A	Sample B	Sample C
Chamber Pressure, psi	15	50	80
Unit Dry Weight at Compaction, lb/ft^3	103.3	103.6	104.3
Moisture Content at Compaction, %	21.3	22.1	20.8
Unit Dry Weight at Test, lb/ft^3	103.0	108.6	110.5
Moisture Content at Test, %	23.7	21.6	20.4
Degree of Saturation at Test, %	97	100+	100
Maximum Deviator Stress, psi	36	60	77
Pore Pressure at Max. Deviator Stress, psi	4	9	23

Permeability Test
(Constant Head Test)

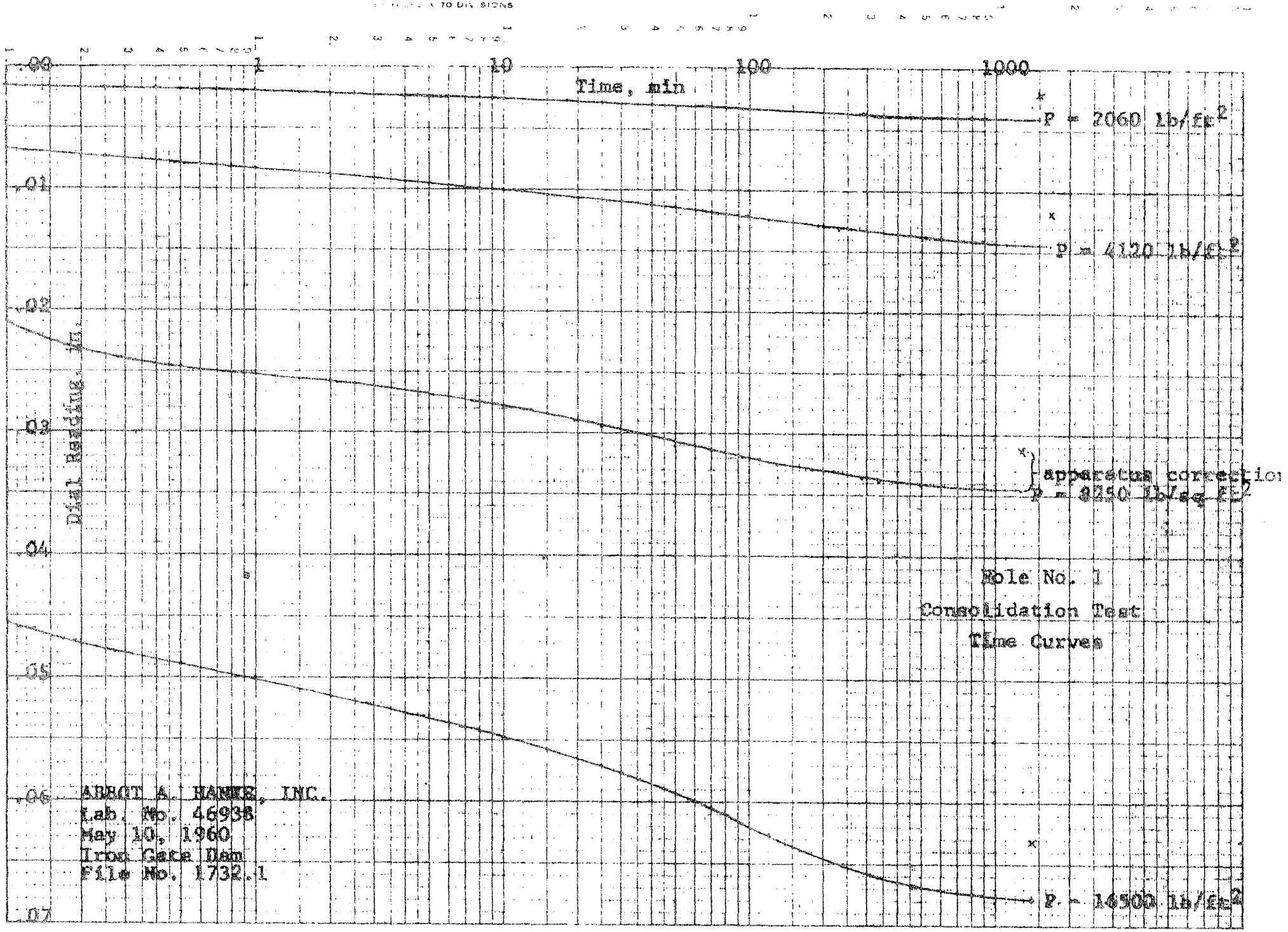
Unit Dry Weight at Compaction, lb/ft	100.6
Moisture Content at Compaction, %	23.6
Moisture Content at Test, %	24.4
Degree of Saturation at Test, %	95
Permeability coefficient, ft per yr	Less than .01
" " , cm/sec	Less than 10^{-8}

K&E 10 X 10 TO THE CM KEUFFEL & ESSER CO. 359-14G MADE IN U.S.A.

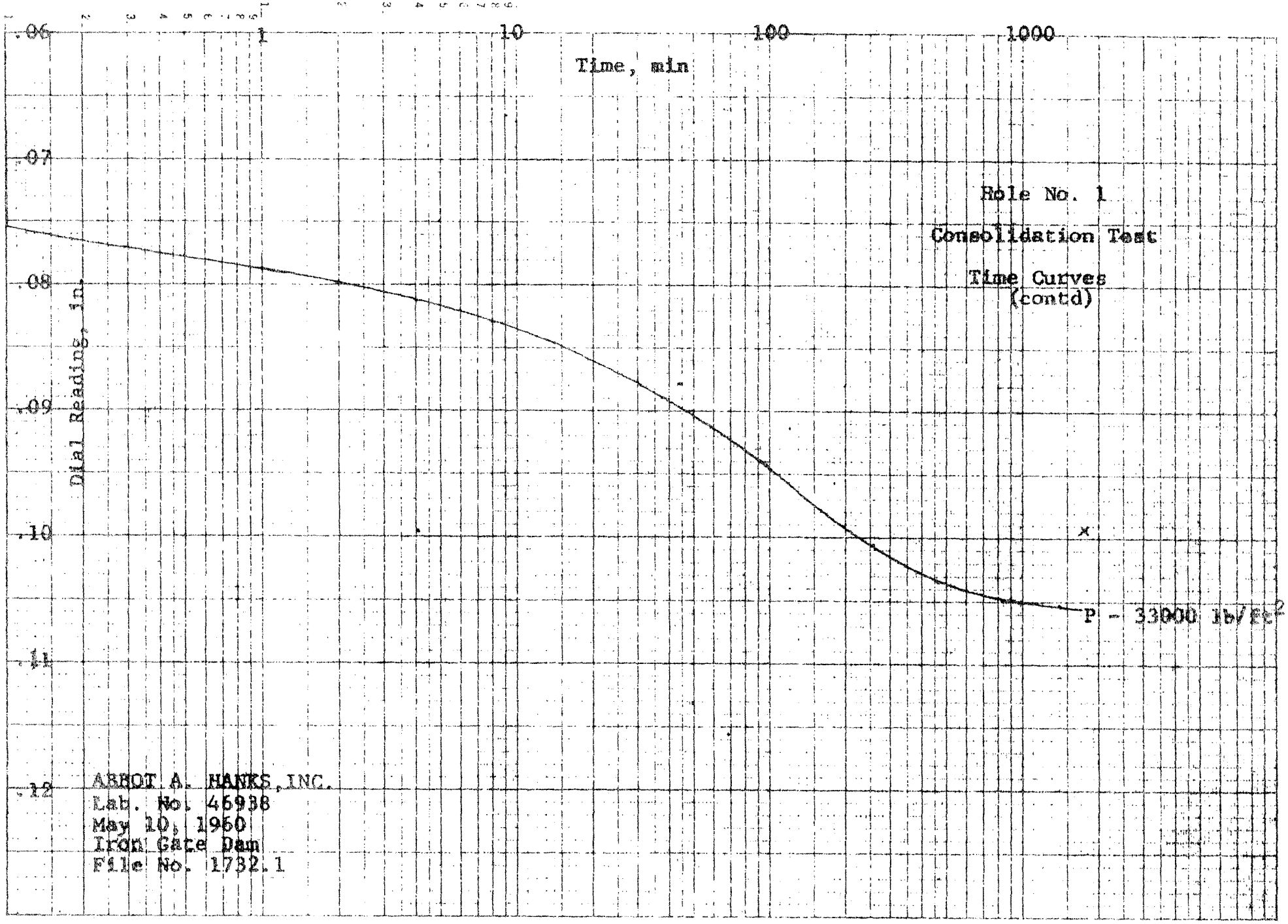


Trom Gate Dam
Klamath River
File No. 1732.1

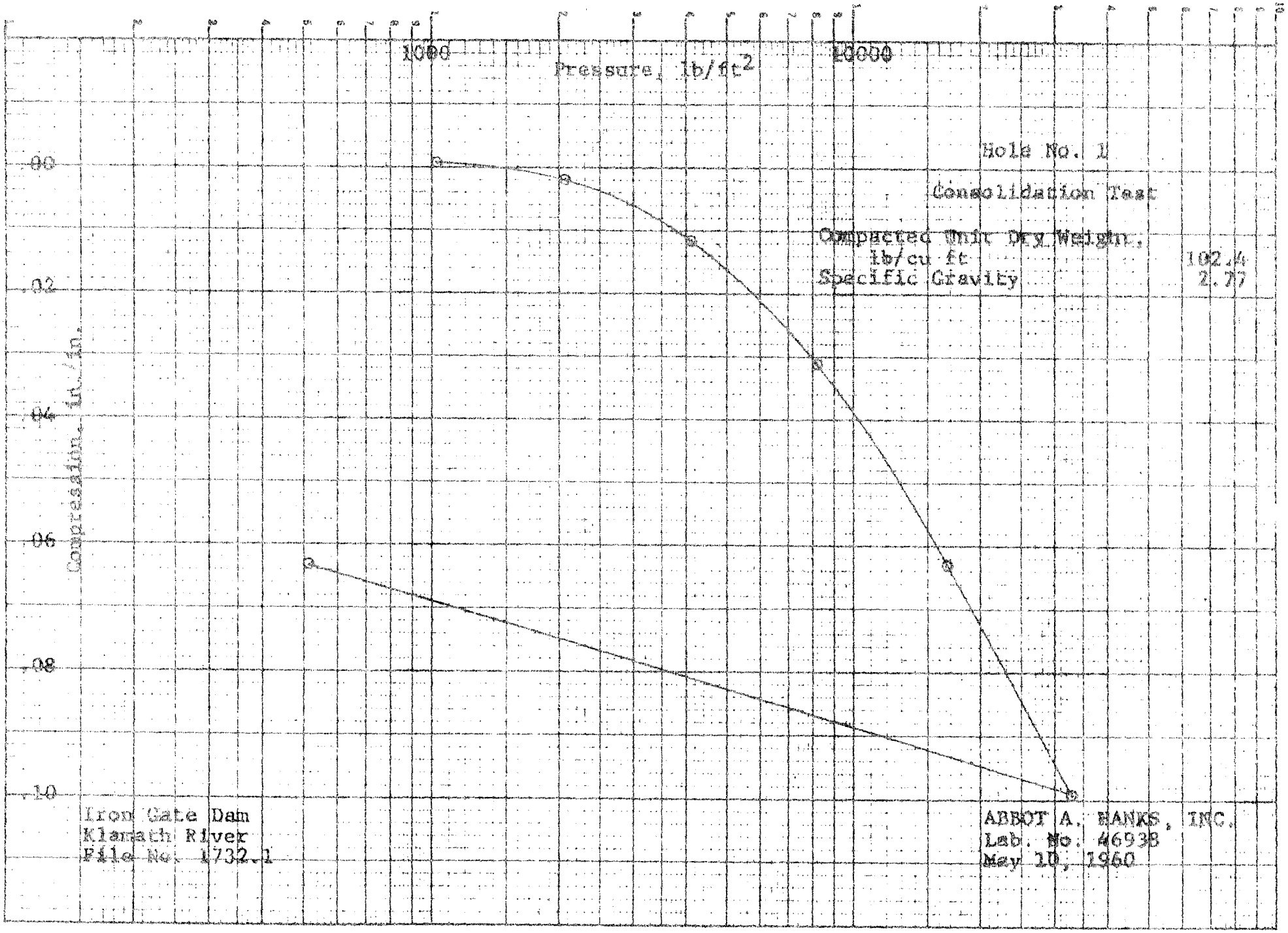
ABBOT A. HANKS, INC.
Lab. No. 46938
May 10, 1960

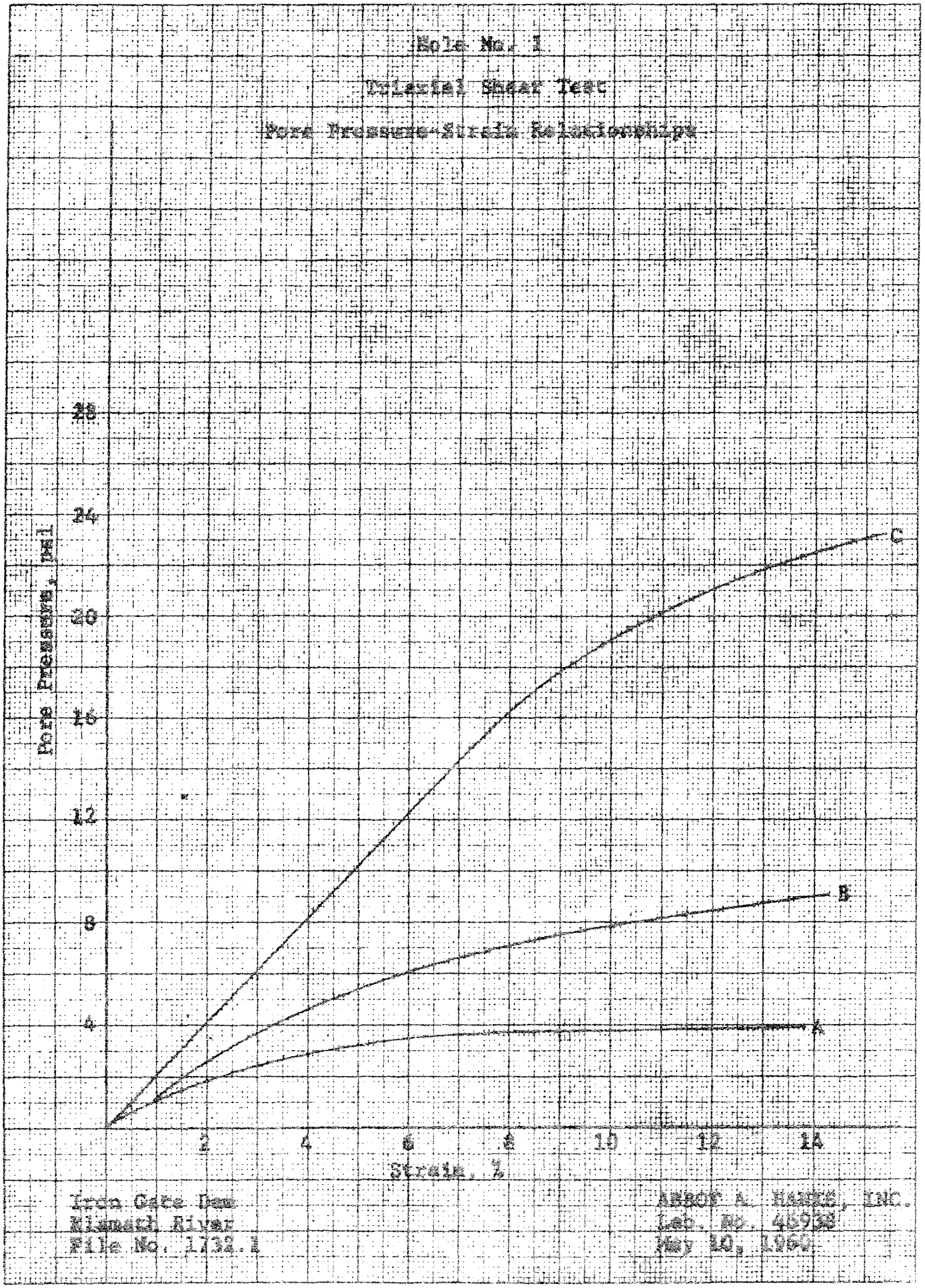

SEMI-LOGARITHMIC 359-91G
70 DIVISIONS
.00
.01
.02
.03
.04
.05
.06
.07
Dial Reading, in.
1
10
100
1000
Time, min
P = 2060 lb/ft²
P = 4120 lb/ft²
apparatus correction
P = 8250 lb/sq ft
P = 16500 lb/ft²
Hole No. 1
Consolidation Test
Time Curves
ARBOT A. HANKE, INC.
Lab. No. 46938
May 10, 1960
Iron Gate Dam
File No. 1732.1

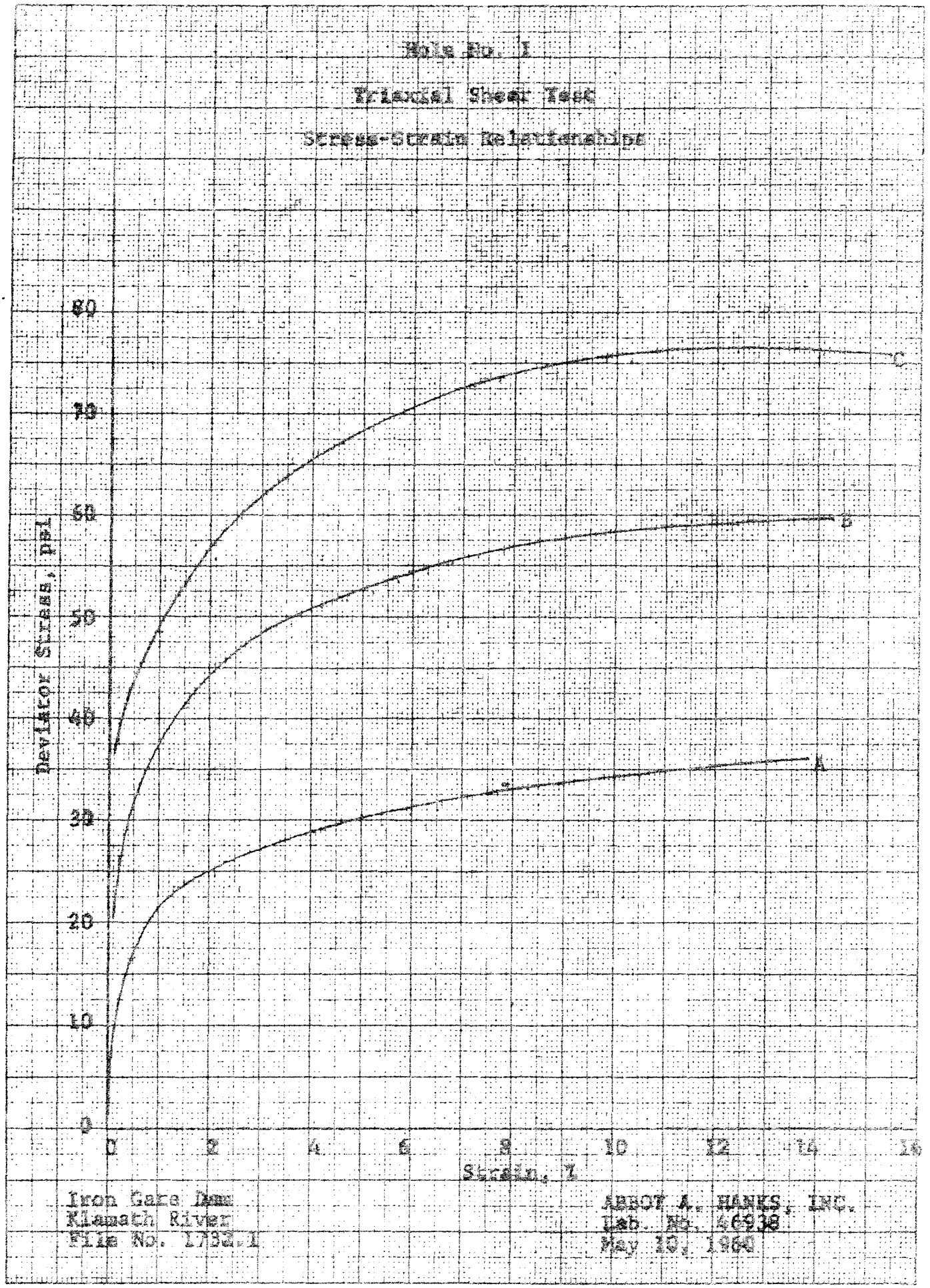
SEMI LOGARITHMIC 359-91G
KEUFFEL & ESSER CO.
LOG X 70 DIVISIONS



SEMI LOGARITHMIC 359-71
KEUFFEL & ESSER CO.
3 CYCLES X 70 DIVISIONS




Hole No. 1
Triaxial Shear Test
Pore Pressure-Strain Relationships
Pore Pressure, psi
28
24
20
16
12
8
4
2
4
6
8
10
12
14
Strain, %
C
B
A
Iron Gate Dam
Klamath River
File No. 1732.1
ARBOT A. HAMES, INC.
Lab. No. 46938
May 10, 1960



359-14G
10 X 10 TO THE CM.
KEUFFEL & ESSER CO.
MADE IN U.S.A.

BRANCH LABORATORY 1086 MARTIN AVENUE • SANTA CLARA • CHERRY 8 5262
BRANCH OFFICE 10 DE LUCA PLACE • SAN RAFAEL • GLENWOOD 4 8650
CABLE: HANK

ABBOT A. HANKS, INC.
ESTABLISHED 1866
1300 SANSOME STREET • SAN FRANCISCO 11, CALIFORNIA • EXBROOK 7 2464

Engineers
Assayers
Chemists
Metallurgists
Spectrographers
Soils and Foundations
Consulting · Testing · Inspecting

File No. 1732.1
Lab. No. 46938

June 29, 1960

Mr. W. L. Warren
Assistant Chief Engineer
The California Oregon Power Company
216 West Main Street
Medford, Oregon

Re: Iron Gate Dam
Soil Samples

Dear Mr. Warren:

Enclosed are results of triaxial tests that were performed on Sample No. 2 before it was noted that this sample required an exceptionally small compactive effort relative to the other samples submitted.

We are also enclosing miscellaneous test results not shown on previously submitted reports.

If you require additional tests of Sample No. 2, we should have a complete new sample of about 100 lb.

Very truly yours,

ABBOT A. HANKS, INC.

L. O. Long

LOL:hms
Encls.
Reports to:
15-The California Oregon Power Company

Iron Gate Dam
Klamath River
File No. 1732.1

Abbot A. Hanks, Inc.
Lab. No. 46938
July 1, 1960

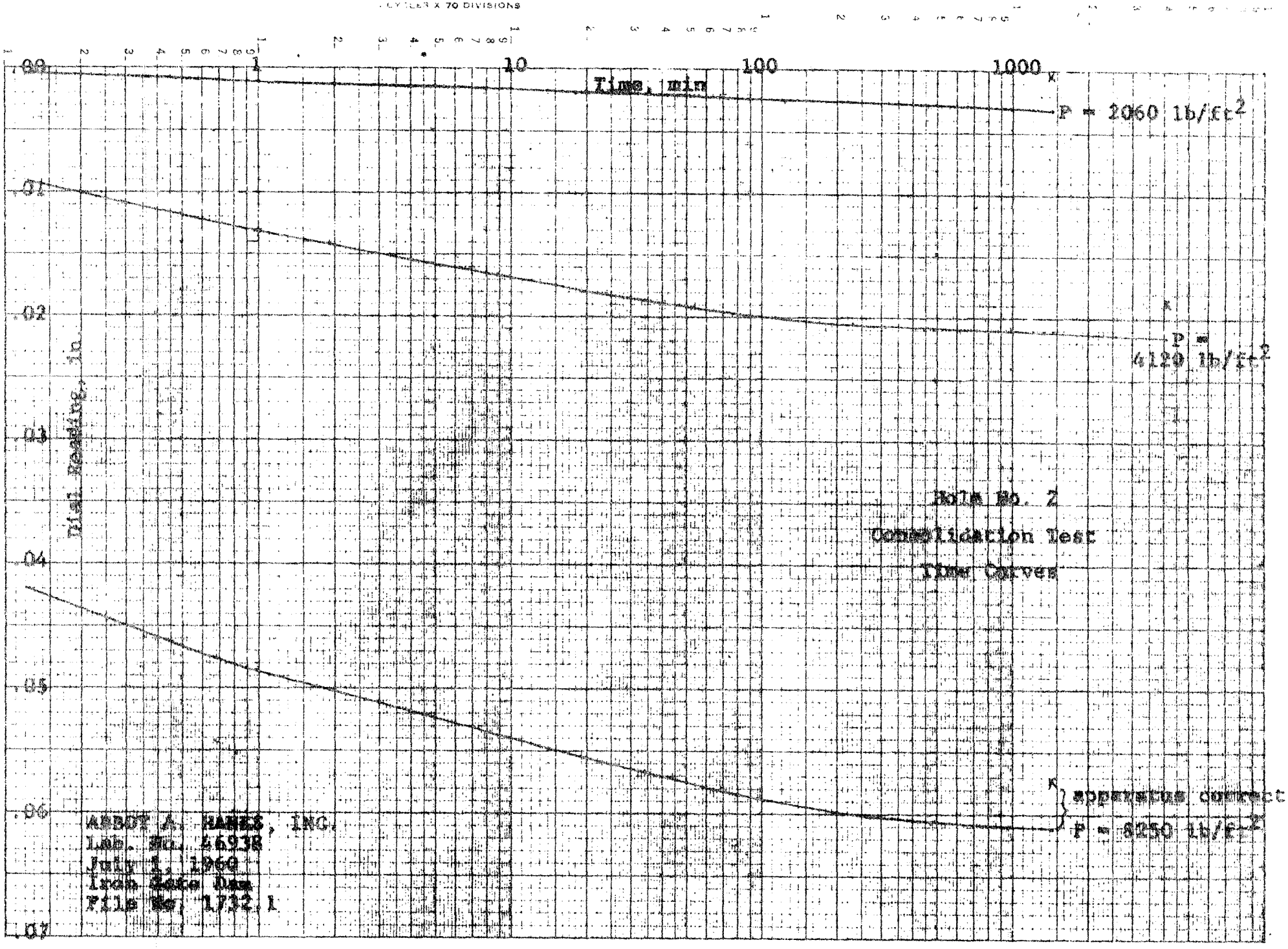
TEST RESULTS

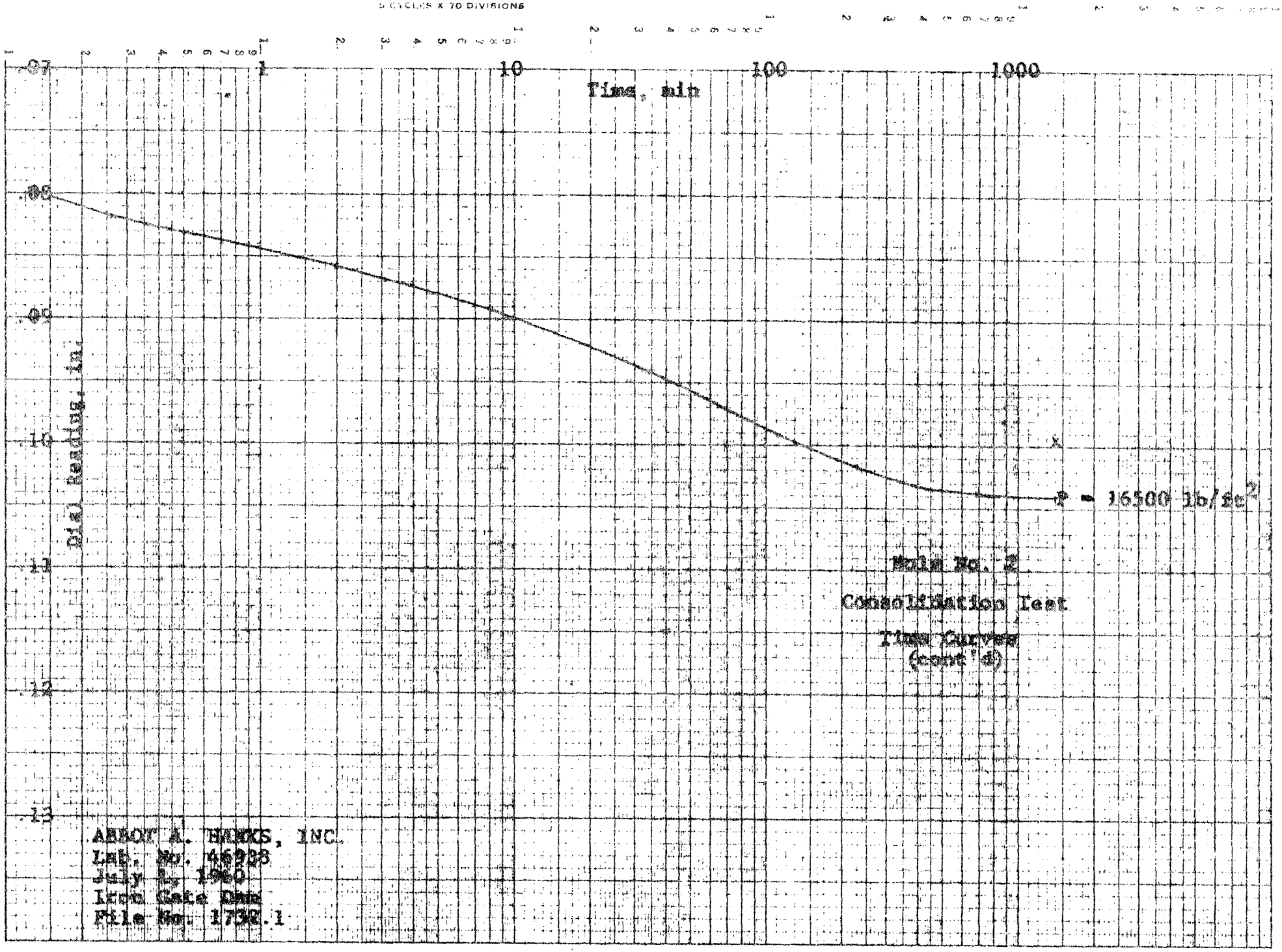
Hole No. 2.
Specific Gravity: 2.77.

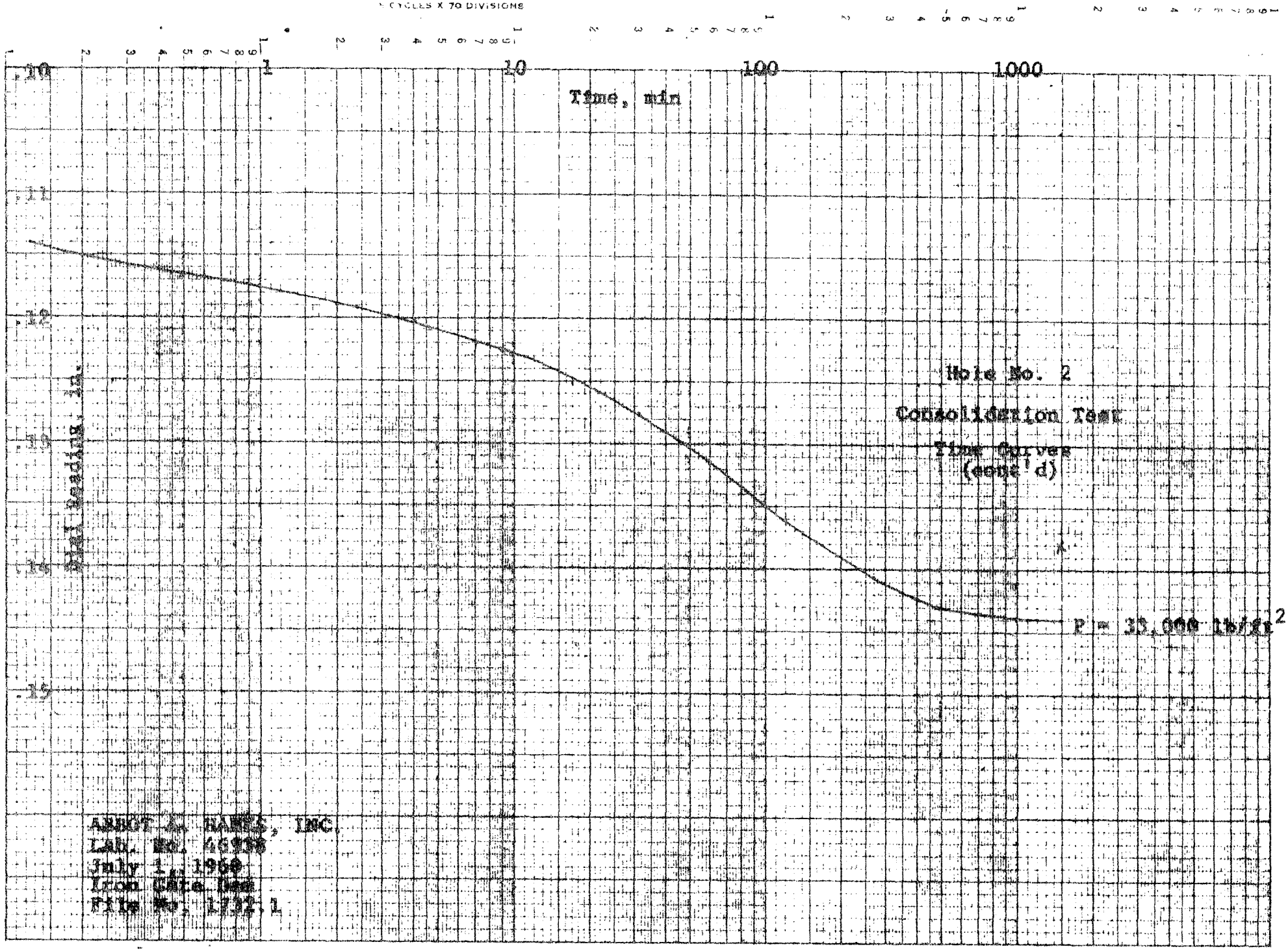
Triaxial Shear Test

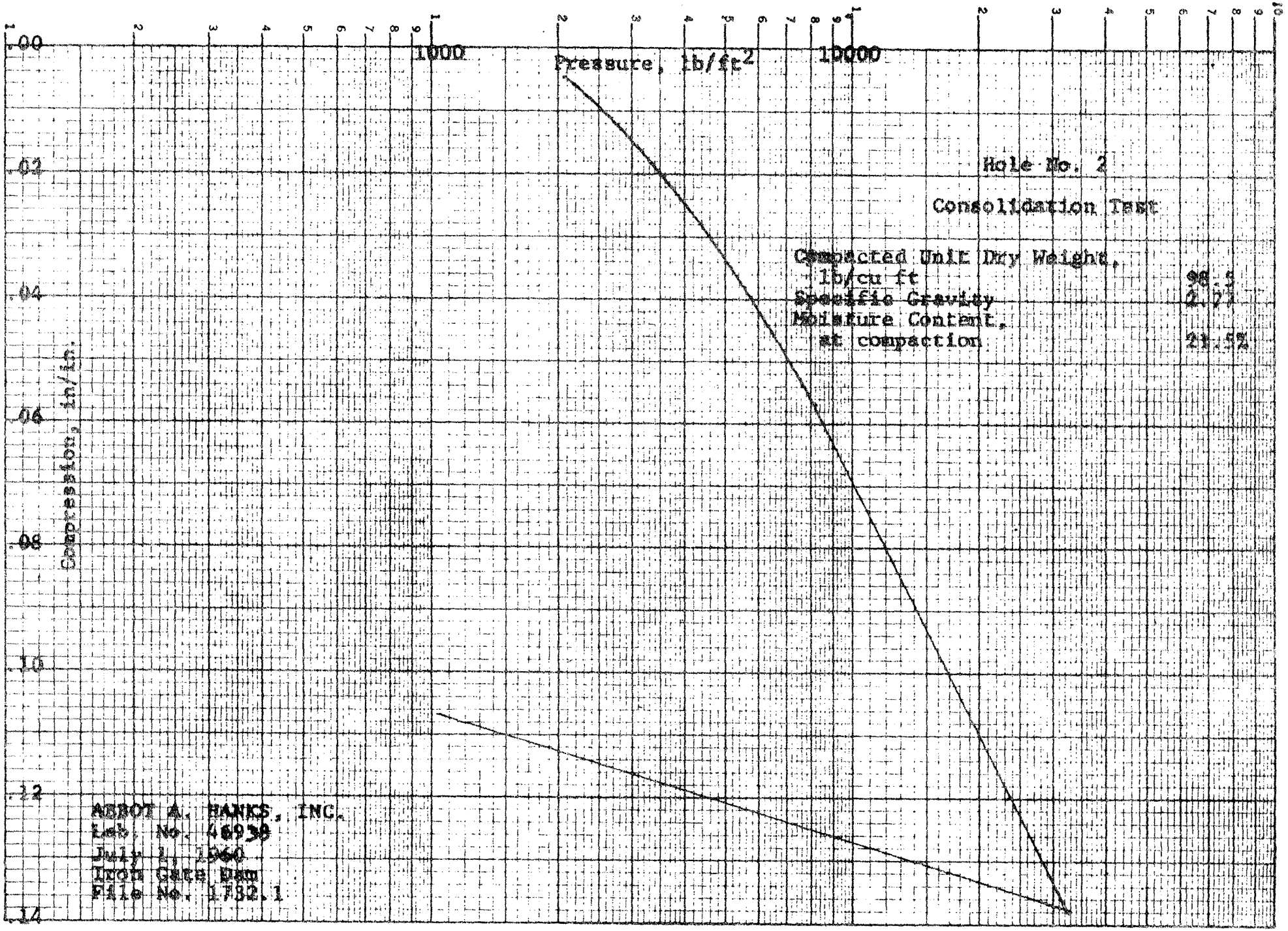
	Sample A	B	C	D
Chamber Pressure, psi	15	50	50	80
Unit Dry Weight at Compaction, lb/ft^3	98.0	95.1	98.8	99.3
Moisture Content at Compaction, %	21	21	21	21
Unit Dry Weight at Test, lb/ft^3	99.4	109.0	106.3	100.2
Moisture Content at Test, lb/ft^3	24.4	22.3	21.6	20.3
Degree of Saturation at Test, %	93	100+	97	93
Maximum Deviator Stress, psi	19	40	45	69
Pore Pressure at Maximum Deviator Stress, psi	8	26	24	15

~~Optimum moisture 21 21~~
~~max dry density 105.8 103~~


SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO.
X 70 DIVISIONS
1
2
3
4
5
6
7
8
9
1
10
100
1000
Time, min
P = 2060 lb/ft²
P = 4120 lb/ft²
P = 8250 lb/ft²
apparatus correcti
.00
.01
.02
.03
.04
.05
.06
.07
Dial Reading, in
Hole No. 2
Consolidation Test
Time Curves
ABBOT A. HANKS, INC.
Lab. No. 46938
July 1, 1960
Iron Gate Dam
File No. 1732.1


SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO.
5 CYCLES X 70 DIVISIONS
Time, min
Dial Reading, in.
P = 16500 lb/ft²
Hole No. 2
Consolidation Test
Time Curves
(cont'd)
ABBOT A. HANKS, INC.
Lab. No. 46933
July 5, 1960
Ireo Gate Dam
File No. 1732.1

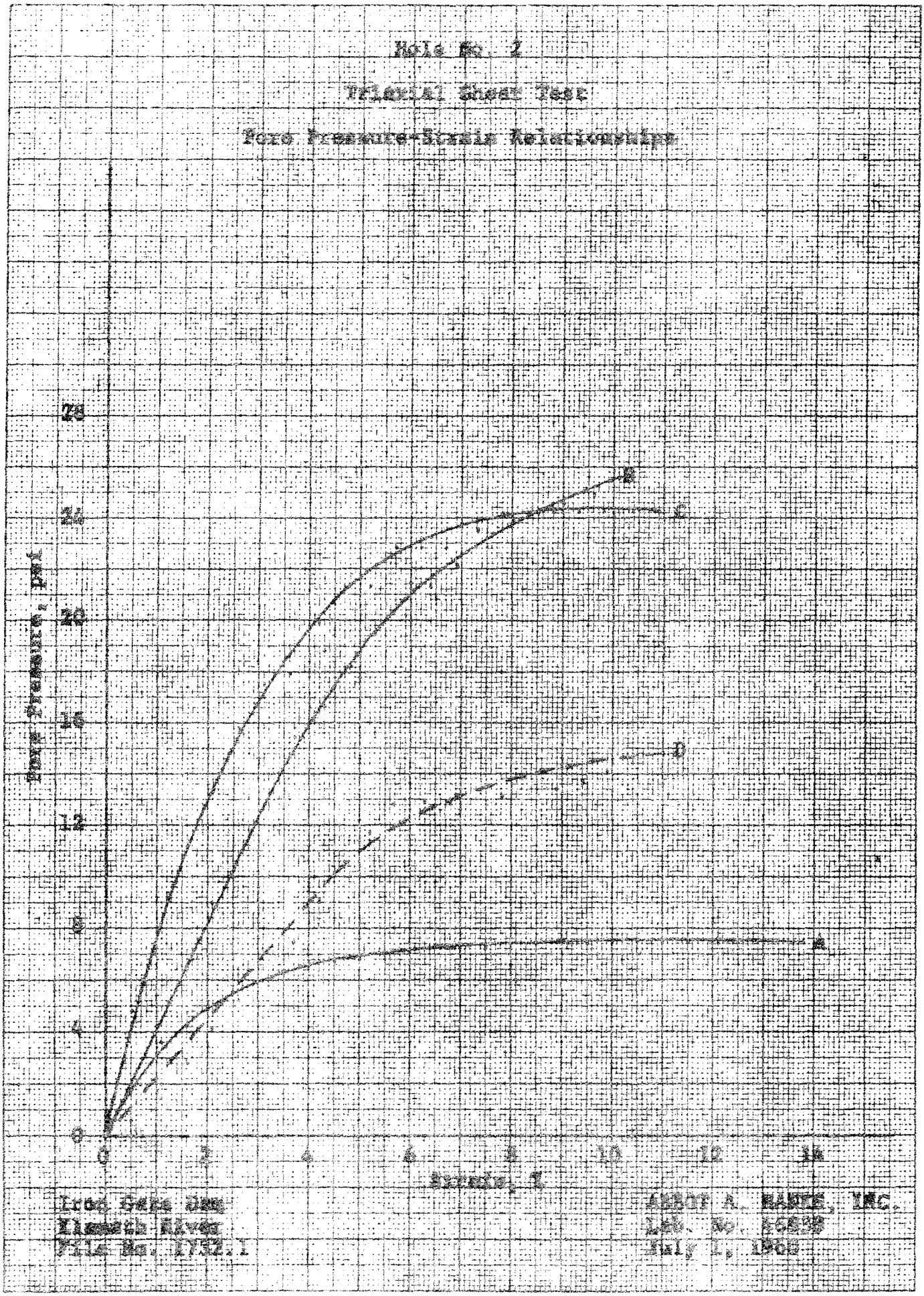

K+E SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO.
3 CYCLES X 70 DIVISIONS
Time, min
1
10
100
1000
.10
.11
.12
.13
.14
.15
Dial Reading, in.
Hole No. 2
Consolidation Test
Time Curves
(cont'd)
P = 32,000 lb/ft²
ABBOT A. HANKS, INC.
Lab. No. 46936
July 1, 1960
Iron Gate Dam
File No. 1732.1


K+E SEMI-LOGARITHMIC 359-71
KEUFFEL & ESSER CO.
3 CYCLES X 70 DIVISIONS
Pressure, lb/ft2
1000
10000
Compression, in/in.
.00
.02
.04
.06
.08
.10
.12
.14
Hole No. 2
Consolidation Test
Compacted Unit Dry Weight, lb/cu ft 98.4
Specific Gravity 2.71
Moisture Content, at compaction 21.5%
ABBOT A. HANKS, INC.
Lab. No. 46938
July 1, 1960
Iron Gate Dam
File No. 1732.1

Hole No. 2

Triaxial Shear Test

Pore Pressure-Strain Relationships



Trog Gate Dam
Klamath River
File No. 1752.1

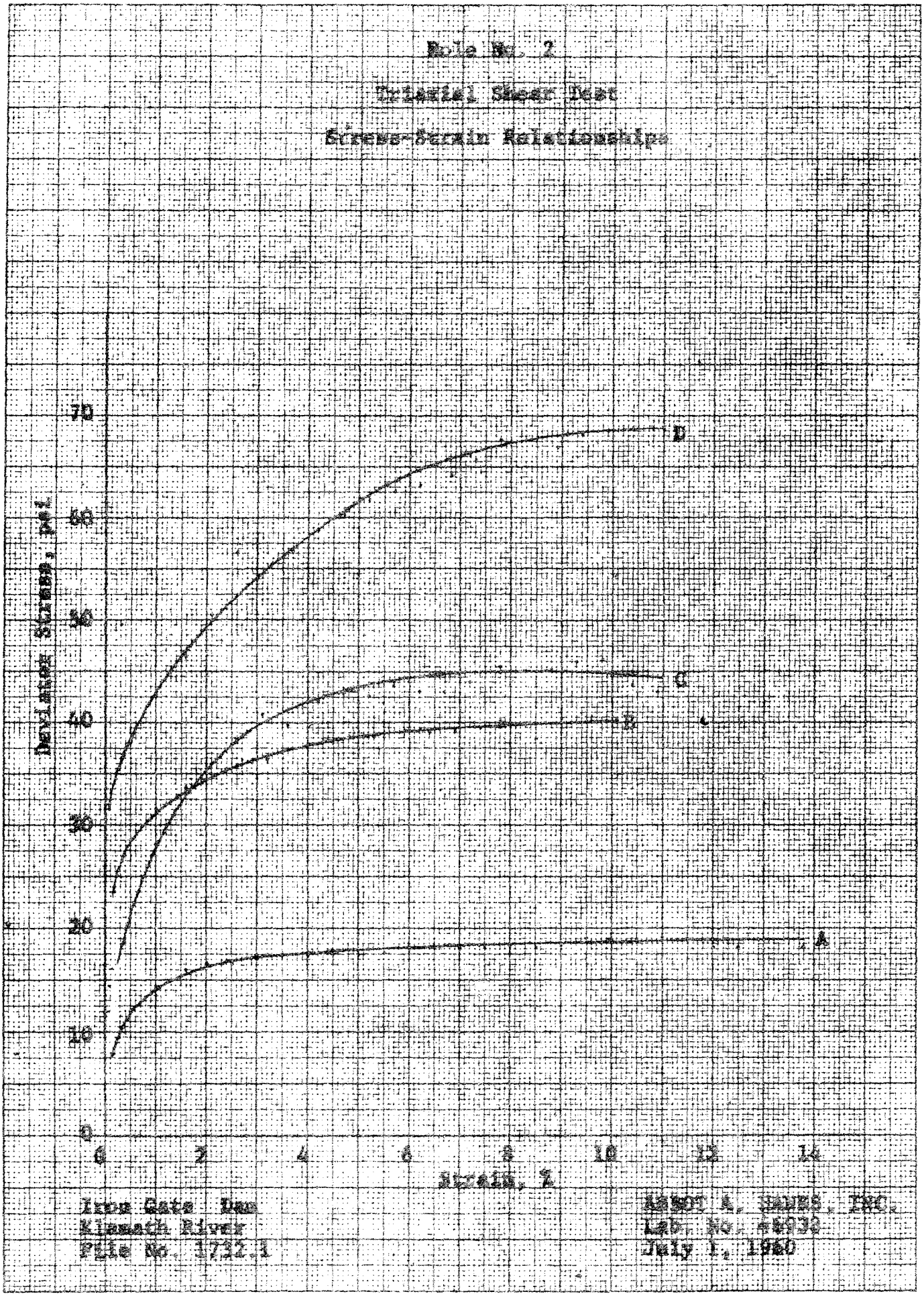
ABBOTT A. HANKS, INC.
Lab. No. 56829
July 1, 1960

K&E 10 X 10 TO THE CM. 359-14G KEUFFEL & ESSER CO. MADE IN U.S.A.

Hole No. 2

Triaxial Shear Test

Stress-Strain Relationships

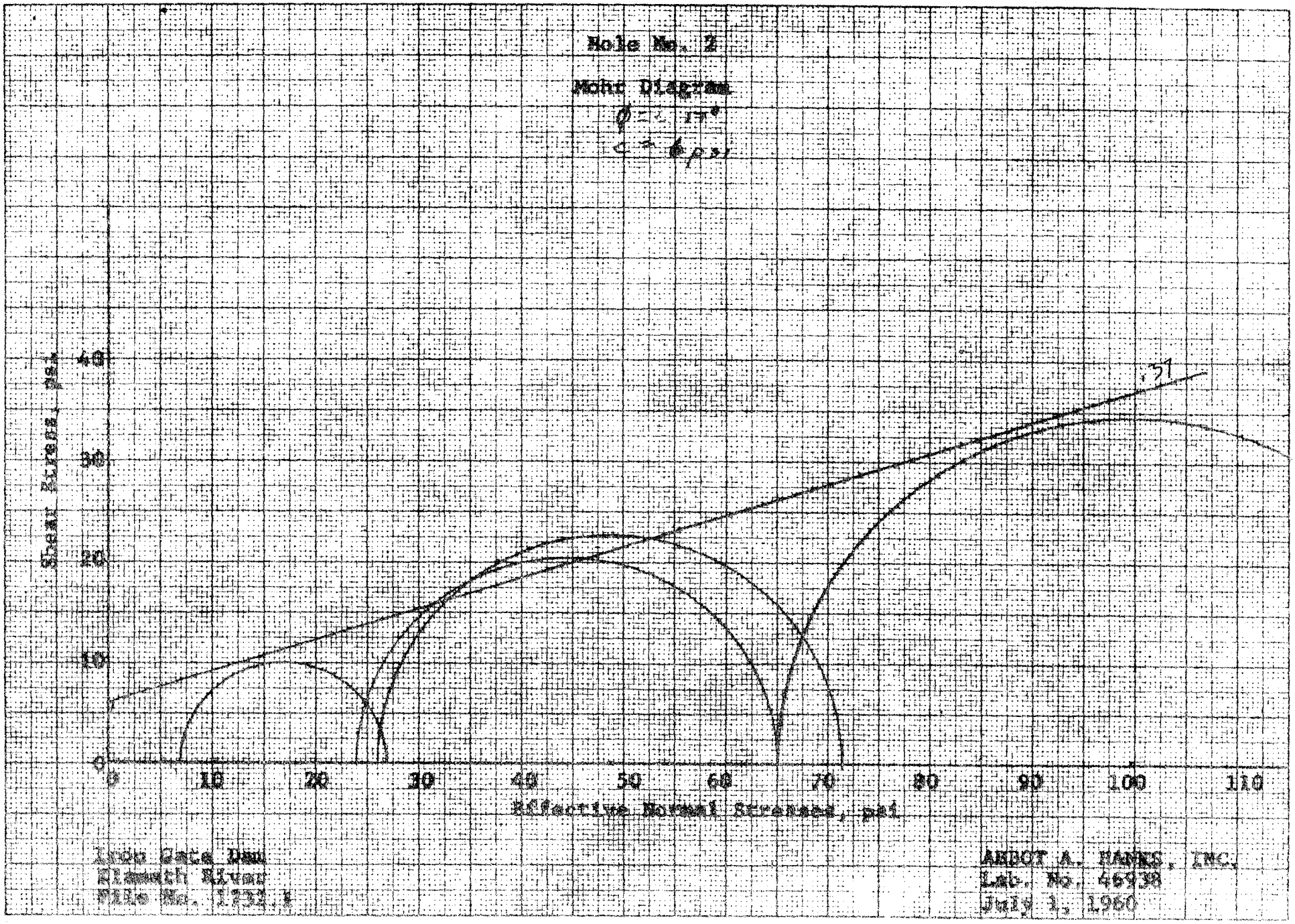


Iron Gate Dam
Klamath River
File No. 1732.1

ARBOT A. JAMES, INC.
Lab. No. 44932
July 1, 1960

K&E 10 X 10 TO THE CM. 359-14G KEUFFEL & ESSER CO. MADE IN U.S.A.

K&E 10 X 10 TO THE CM. KEUFFEL & ESSER CO. 359-14G MADE IN U.S.A.



Iron Gate Dam
Klamath River
File No. 1232.1

ABBOT A. HANKS, INC.
Lab. No. 46938
July 1, 1960

BRANCH LABORATORY: 1086 MARTIN AVENUE • SANTA CLARA • CHERRY 8-5262
BRANCH OFFICE: 10 DE LUCA PLACE • SAN RAFAEL • GLENWOOD 4-8650
CABLE: HANX

ABBOT A. HANKS, INC.
ESTABLISHED 1866
1300 SANSOME STREET • SAN FRANCISCO 11, CALIFORNIA • EXBROOK 7-2464

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Chemists
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Spectrographers
Soils and Foundations
Consulting · Testing · Inspecting

File No. 1732.1
Lab. No. 46938

June 3, 1960

Mr. W. L. Warren
Assistant Chief Engineer
The California Oregon Power Company
216 West Main Street
Medford, Oregon

Re: Iron Gate Dam
Soil Samples

Dear Mr. Warren:

Enclosed are the findings from tests performed on soil samples marked Hole No. 3.

Very truly yours,

ABBOT A. HANKS, INC.

Donald W Radbruch

Donald W. Radbruch

hms
Encls.
Reports to:
3-The California Oregon Power Company

Iron Gate Dam
Klamath River
File No. 1732.1

Abbot A. Hanks, Inc.
Lab. No. 46938
June 3, 1960

TEST RESULTS

Hole No. 3
Specific Gravity: 2.76

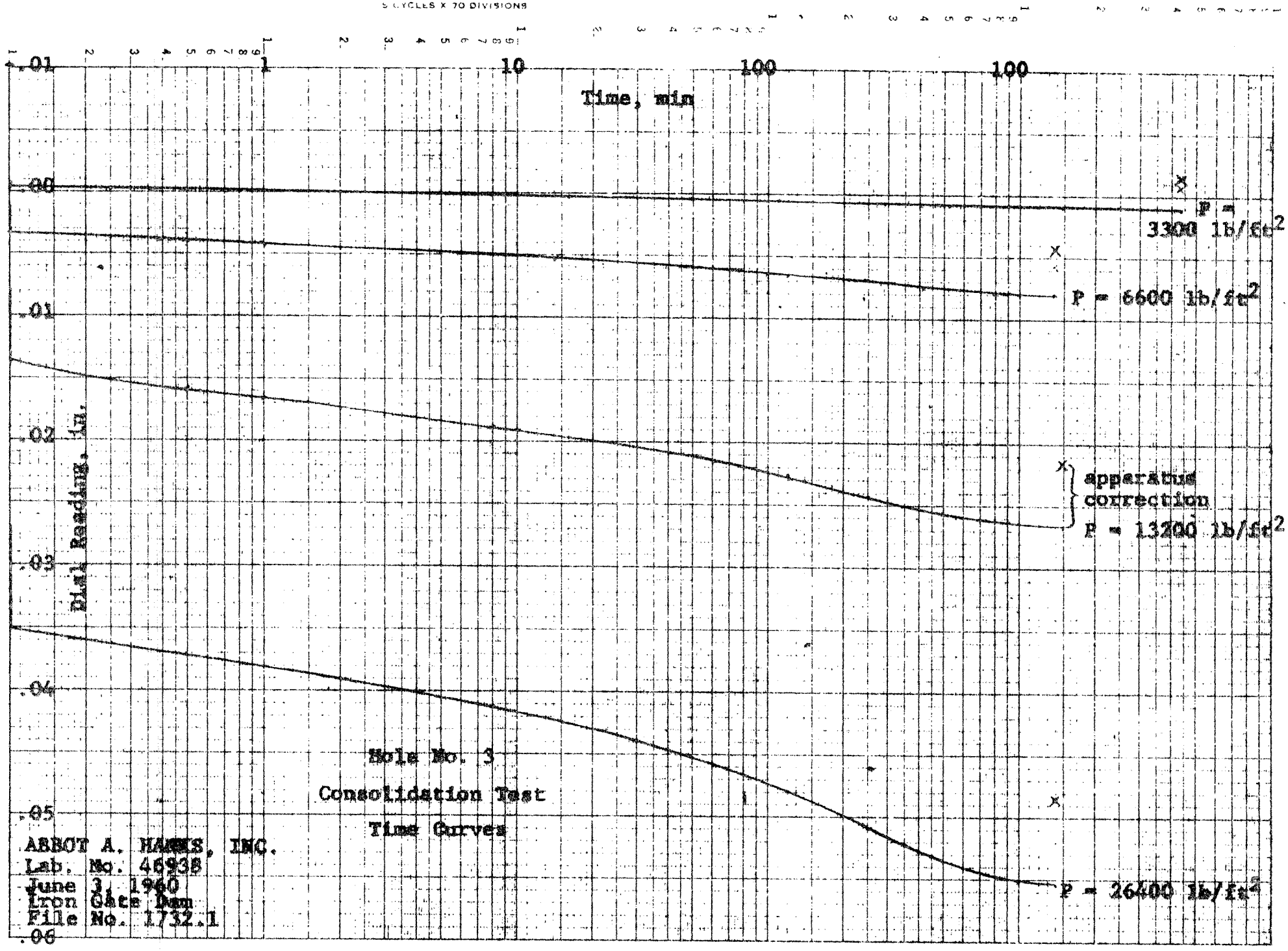
Triaxial Shear Test

	Samples A	B	C
Chamber Pressure, psi	15	50	80
Unit Dry Weight at Compaction, lb/ft^3	104.4	104.5	103.5
Moisture Content at Compaction, %	21.9	22.0	22.1
Unit Dry Weight at Test, lb/ft^3	105.3	107.5	109.2
Moisture Content at Test, lb/ft^3	24.0	22.4	23.5
Degree of Saturation at Test, %	100+	100+	100+
Maximum Deviator Stress, psi	34	59	79
Pore Pressure at Max. Deviator Stress, psi	2	5	2

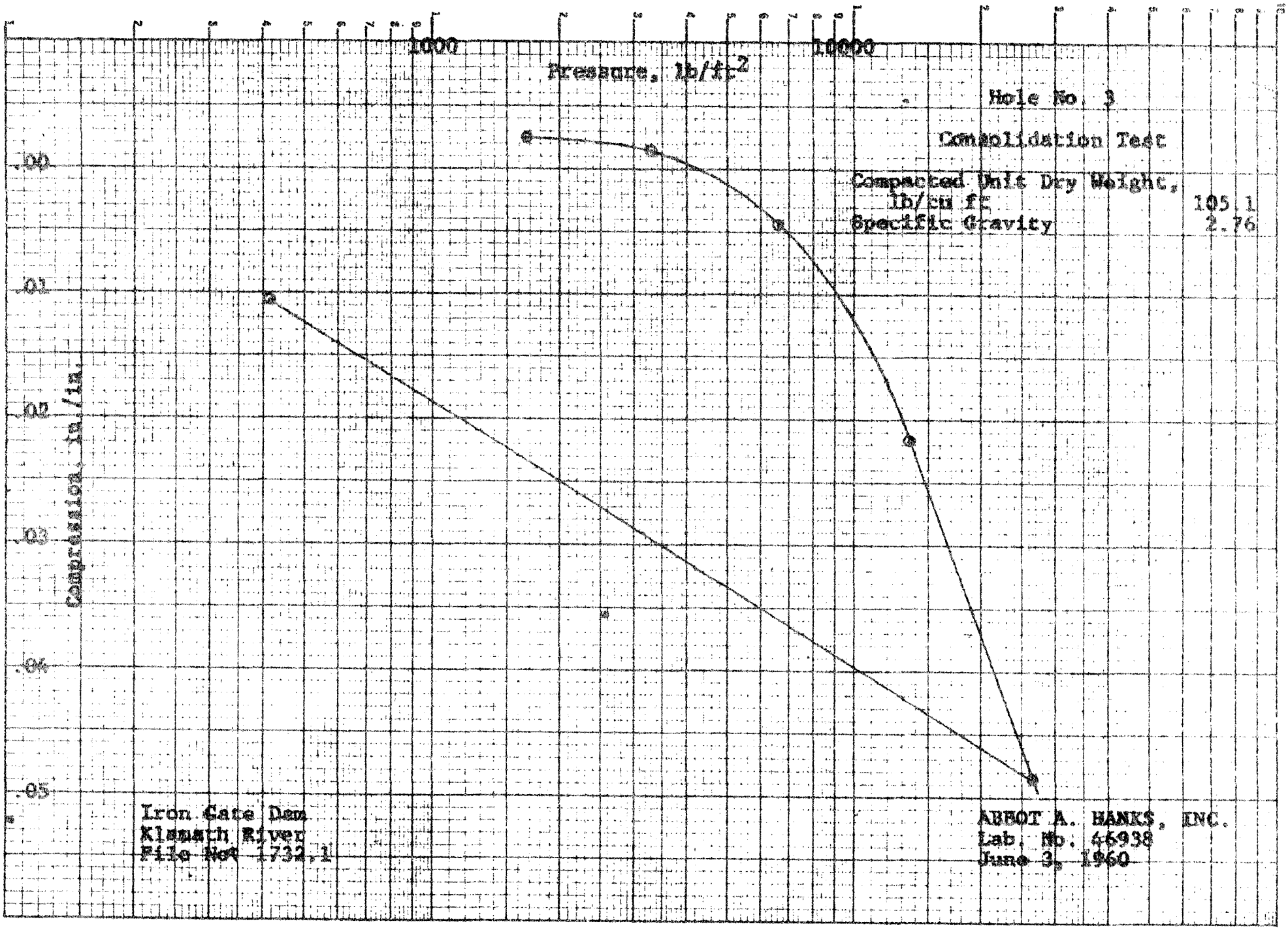
Permeability Test
(Constant Head Test)

Unit Dry Weight at Compaction, lb/ft^3	106.5
Moisture Content at Compaction, %	22.0
Moisture Content at Test, %	23.1
Degree of Saturation at Test, %	100+
Permeability Coefficient, ft per yr	Less than .01
" " , cm/sec	Less than 10^{-8}

~~Optimum moisture 15.3 15.5~~
~~Max. Dry density 111.6 111.5~~


SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO.
5 CYCLES X 70 DIVISIONS
Time, min
Dial Reading, in.
P = 3300 lb/ft²
P = 6600 lb/ft²
apparatus correction
P = 13200 lb/ft²
P = 26400 lb/ft²
Hole No. 3
Consolidation Test
Time Curves
ABBOT A. HAMMS, INC.
Lab. No. 46938
June 3, 1960
Iron Gate Dam
File No. 1732.1

K+E SEMI-LOGARITHMIC 359-71
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 70 DIVISIONS



Hole No. 3

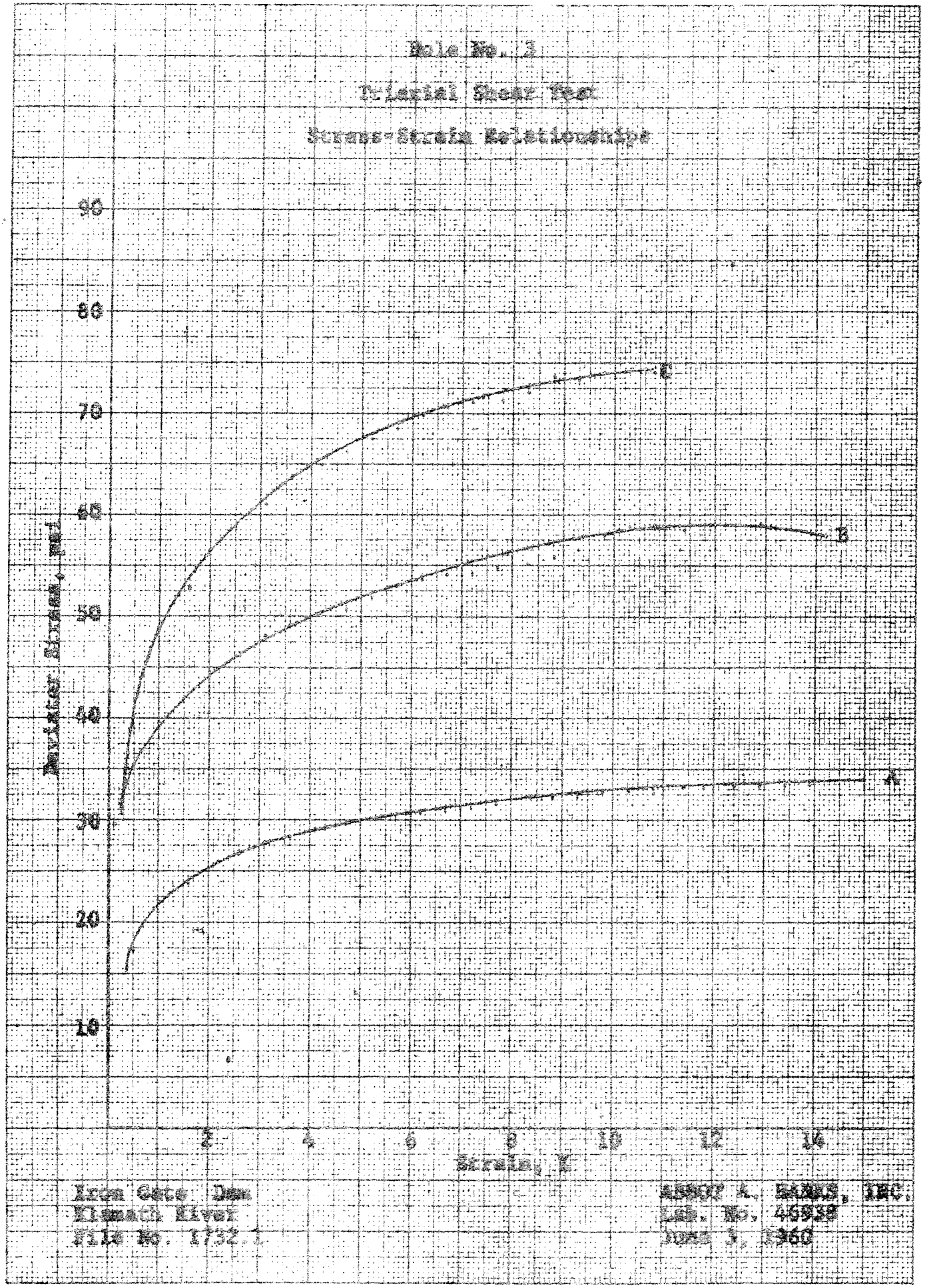
Consolidation Test

Compacted Unit Dry Weight, lb/cu ft 105.1

Specific Gravity 2.76

Iron Gate Dam
Klamath River
File No. 1732.1

ABBOT A. HANKS, INC.
Lab. No. 46938
June 3, 1960



Iron Gate Dam
Klamath River
File No. 1752-1

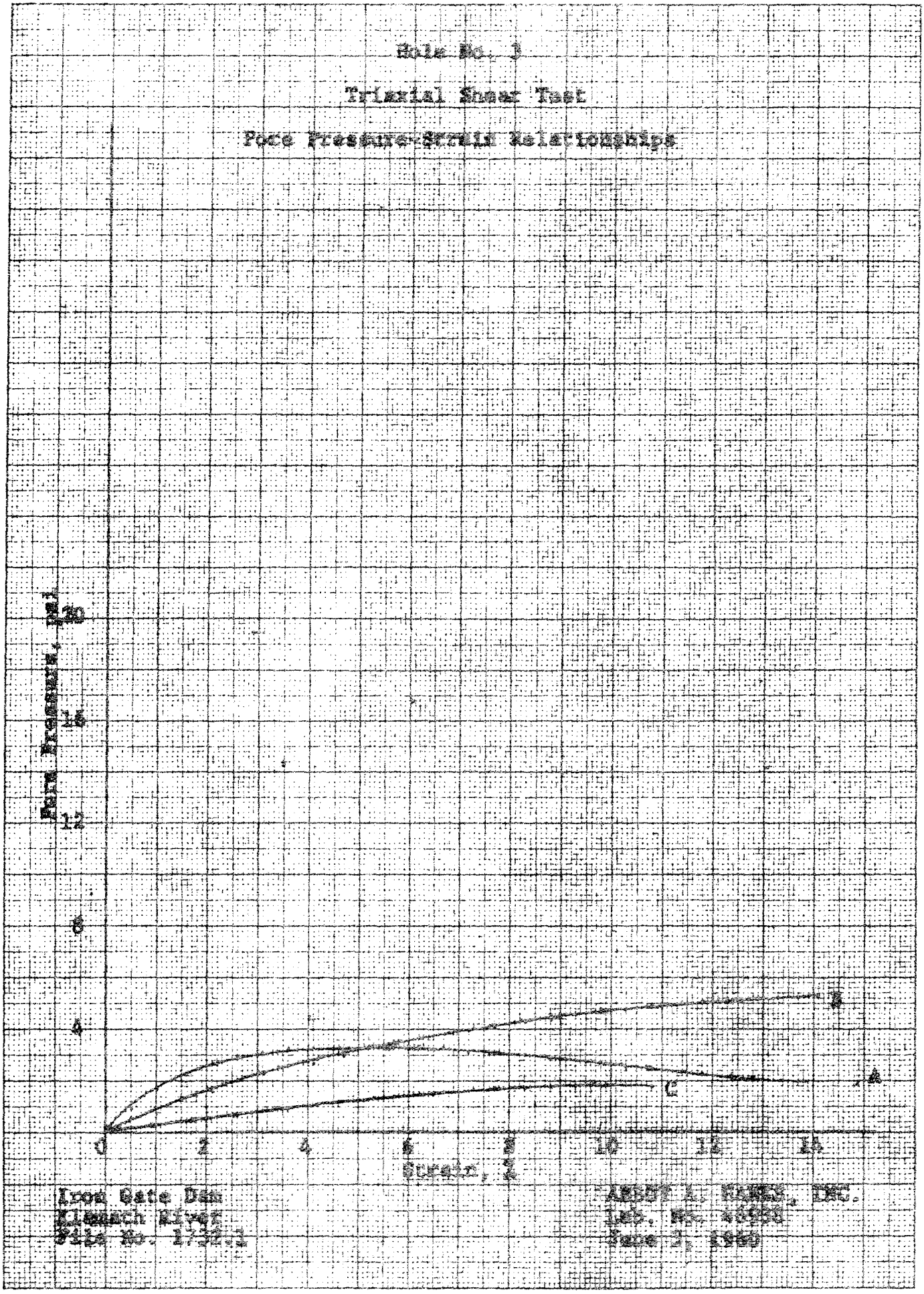
Albert A. Evans, Inc.
Lab. No. 45938
June 3, 1960

K&E 10 X 10 TO THE CM. KEUFFEL & ESSER CO. MADE IN U.S.A. 359-14G

Hole No. 3

Triaxial Shear Test

Pore Pressure-Strain Relationships

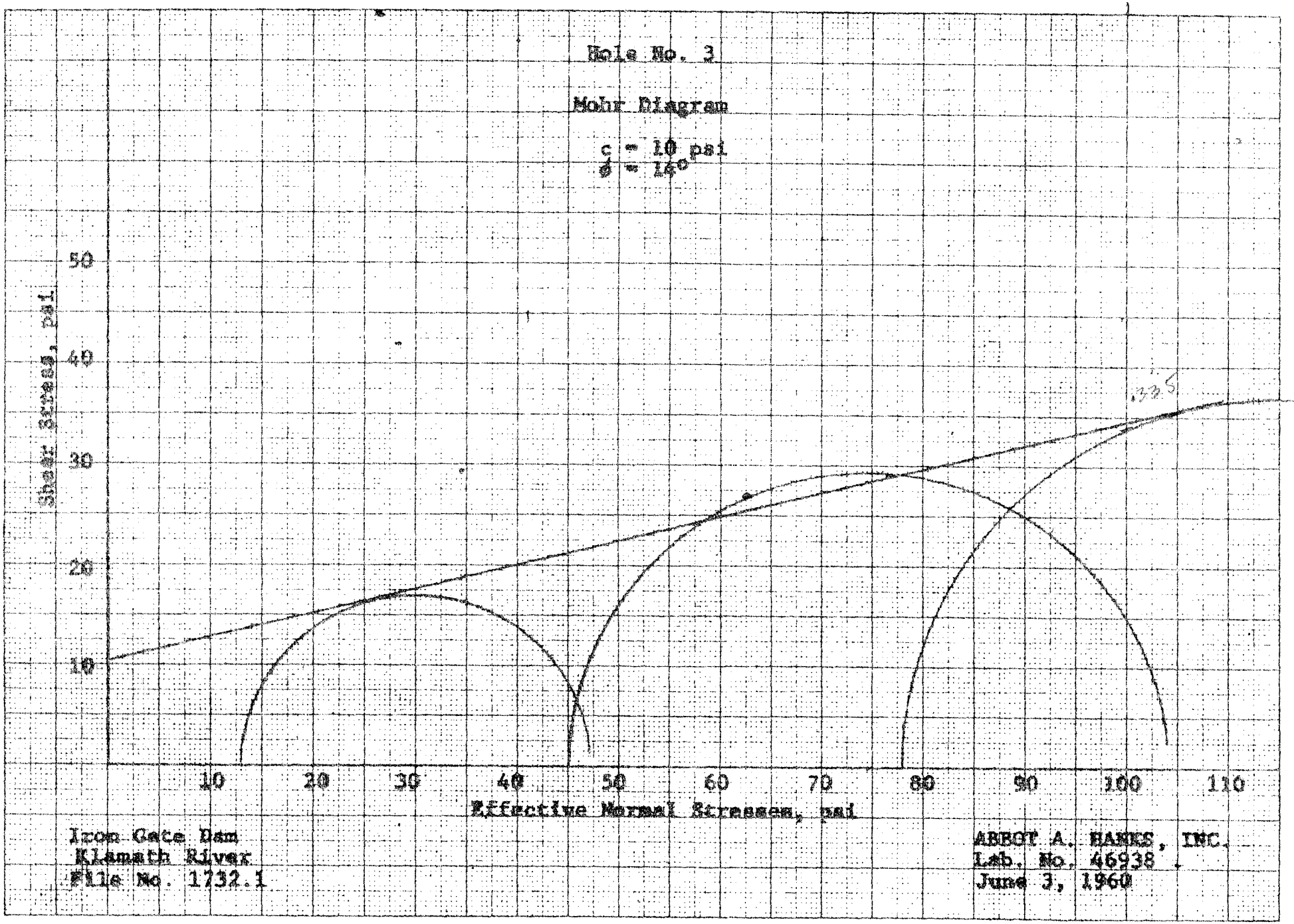


Iron Gate Dam
Klamath River
File No. 17-32.3

ARMOUR R. HANES, INC.
Lab. No. 46158
June 2, 1960

10 X 10 TO THE CM. 359-14G
KEUFFEL & ESSER CO. MADE IN U.S.A.

K&E 10 X 10 TO THE CM. KEUFFEL & ESSER CO. 359-14G MADE IN U.S.A.



Iron Gate Dam
Klamath River
File No. 1732.1

ABBOT A. HANKS, INC.
Lab. No. 46938
June 3, 1960

BRANCH LABORATORY 1056 MARTIN AVENUE • SANTA CLARA • CHERRY 5-5262
BRANCH OFFICE 10 DE LUCA PLACE • SAN RAFAEL • GLENWOOD 4-8650
CABLE HANX

ABBOT A. HANKS, INC.
ESTAB. 1869
1300 SANSOME STREET • SAN FRANCISCO 11 CALIFORNIA • EXBROOK 7-2464

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Chemists
Metallurgists
Spectrographers
Soils and Foundations
Consulting Testing Inspecting

File No. 1732.1
Lab. No. 46938

June 9, 1960

Mr. W. L. Warren
Assistant Chief Engineer
The California Oregon Power Company
216 West Main Street
Medford, Oregon

Re: Iron Gate Dam
Soil Samples

Dear Mr. Warren:

Enclosed are the findings from tests performed on soil samples marked Hole No. 4.

You will note that the permeability coefficient of the first sample is 3000 times the permeability coefficient of the second sample. We attribute this large difference to the differences in both density and moisture content at compaction. The second sample, compacted at 16% moisture content, appeared to be somewhat over optimum moisture.

Very truly yours,

ABBOT A. HANKS, INC.

Donald W Radbruch

Donald W. Radbruch

LOL:hms
Encls.
Reports to:
3-The California Oregon Power Company

Iron Gate Dam
Klamath River
File No. 1732.1

Abbot A. Hanks, Inc.
Lab. No. 46938
June 8, 1960

TEST RESULTS

Hole No. 4
Specific Gravity: 2.77

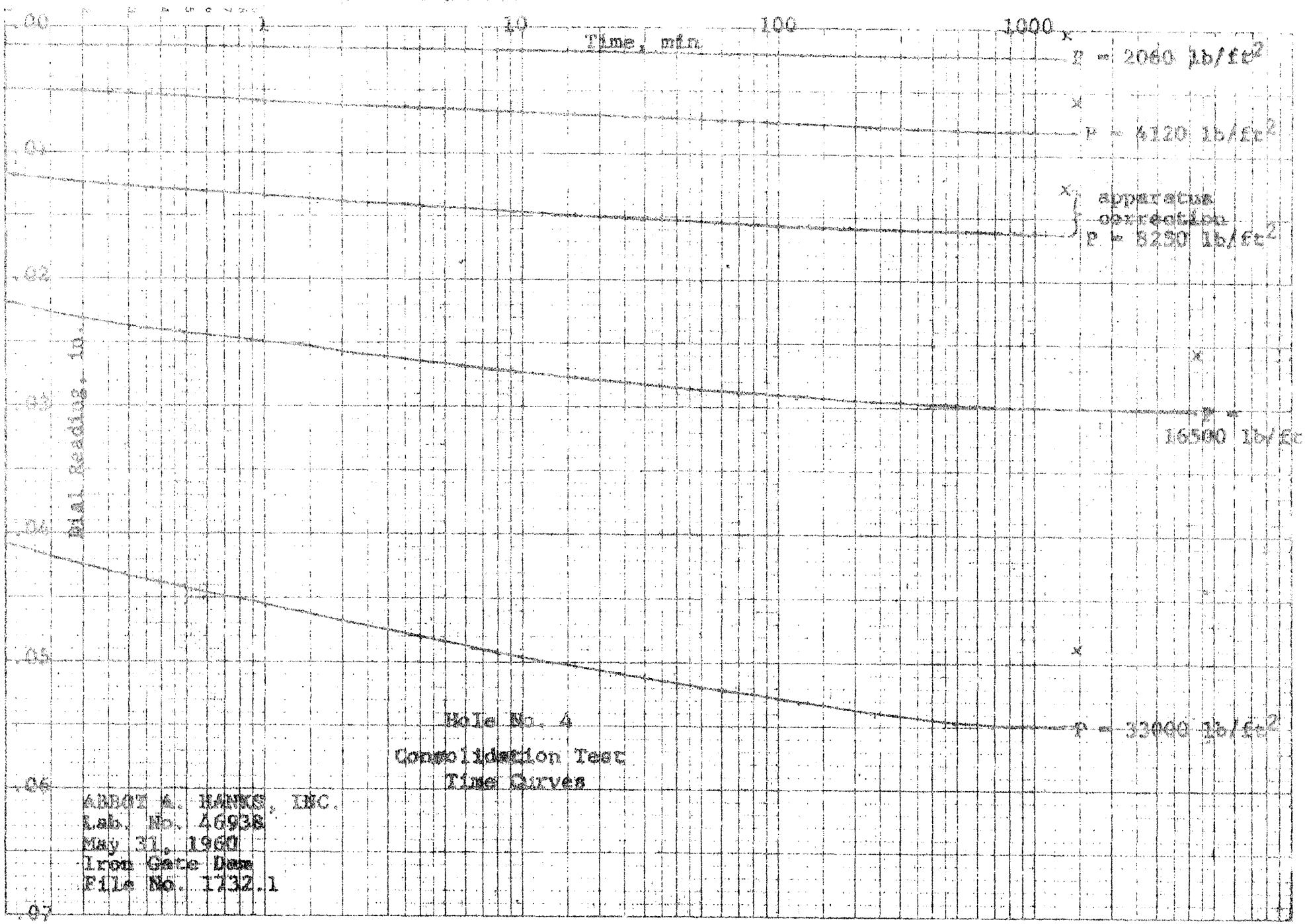
Triaxial Shear Test

	Sample A	Sample B	Sample C
Chamber Pressure, psi	15	50	80
Unit Dry Weight at Compaction, lb/ft^3	112.8	112.3	116.5
Moisture Content at Compaction, %	13.8	13.6	15.4
Unit Dry Weight at Test, lb/ft^3	112.8	114.2	119.4
Moisture Content at Test, lb/ft^3	16.5	17.6	16.0
Degree of Saturation at Test, %	87	96	100
Maximum Deviator Stress, psi	34	85	152
Pore Pressure at Max. Deviator Stress, psi	3	18	9

Permeability Tests (Constant Head Tests)

Unit Dry Weight at Compaction, lb/ft^3	113.3
Moisture Content at Compaction, %	14.3
Moisture Content at Test, %	20.4
Degree of Saturation at Test, %	100+
Permeability Coefficient, ft per yr	30-40
" " , cm/sec	3-4 x 10^{-5}
Unit Dry Weight at Compaction, lb/ft^3	116.2
Moisture Content at Compaction, %	16.0
Moisture Content at Test, %	17.0
Degree of Saturation at Test, %	97
Permeability Coefficient, ft per yr	.01-.04
" " , cm/sec	1-4 x 10^{-8}

~~optimum moisture~~ ~~14.5~~ ~~14-15~~ refact Lilton
~~max dry density~~ 115.2 ~~115~~

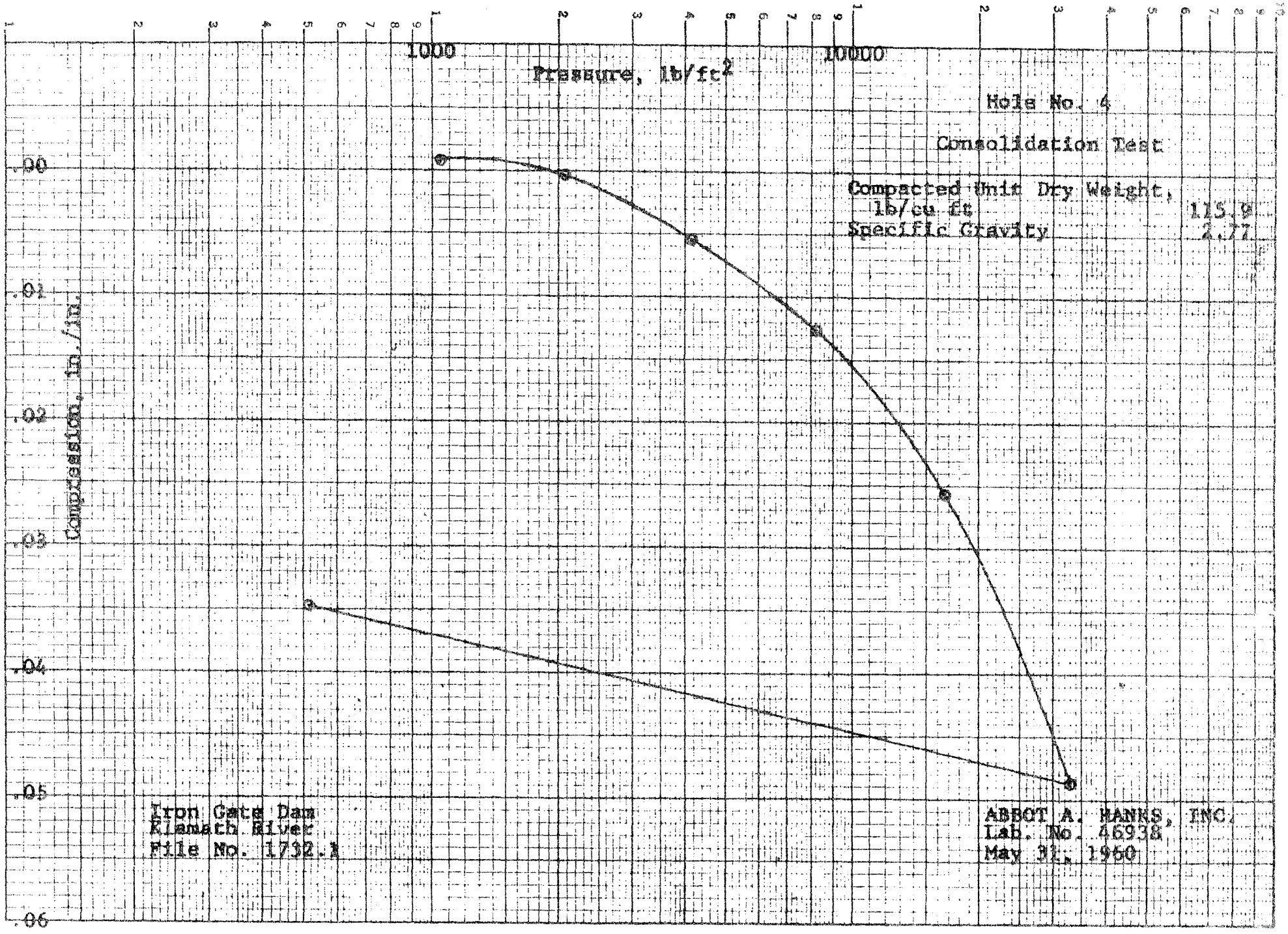


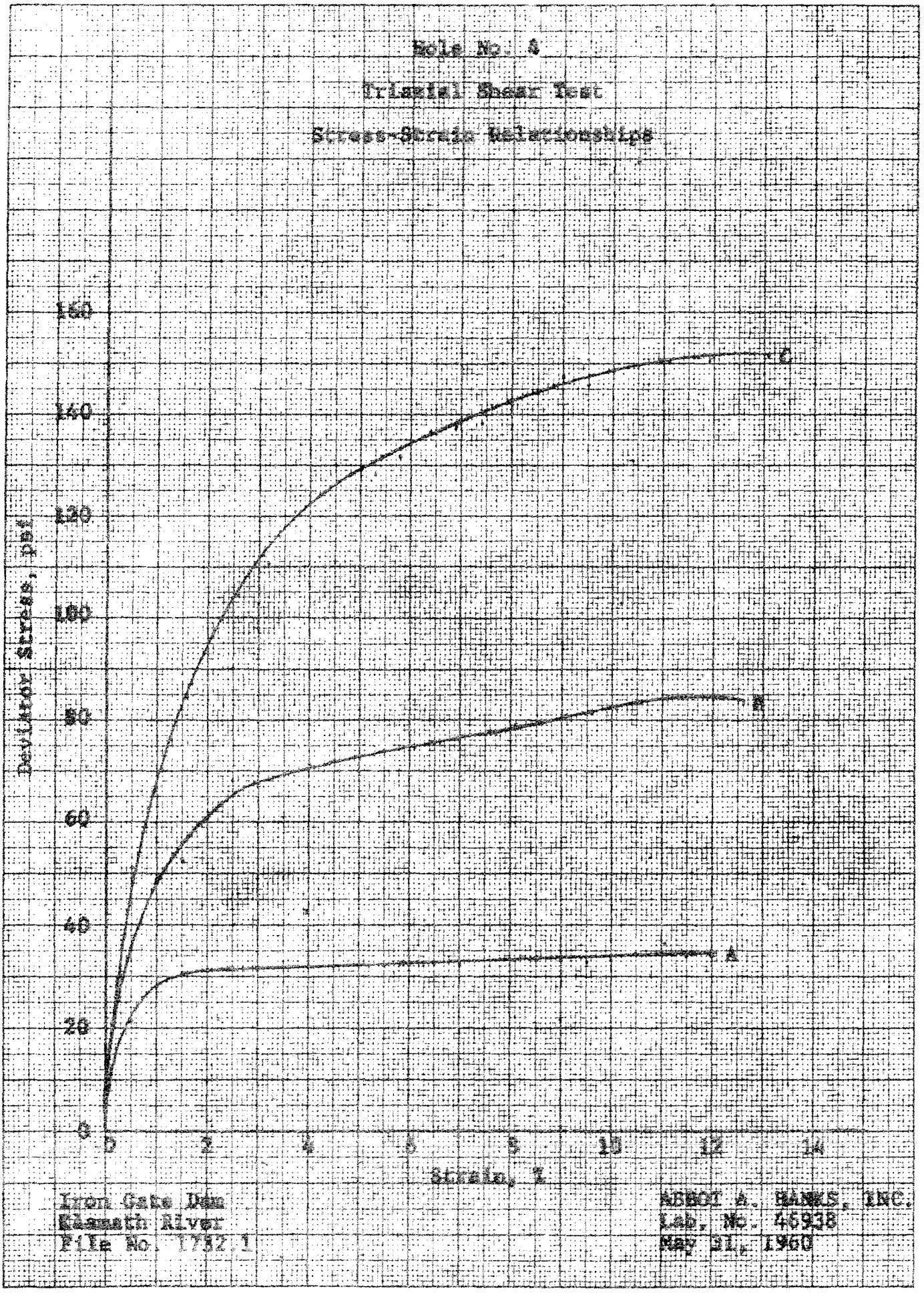
Hole No. 4

Consolidation Test
Time Curves

ABBOTT A. HANKS, INC.
Lab. No. 46938
May 31, 1960
Iron Gate Dam
File No. 1732.1

K&E SEMI-LOGARITHMIC 359-71G
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 70 DIVISIONS



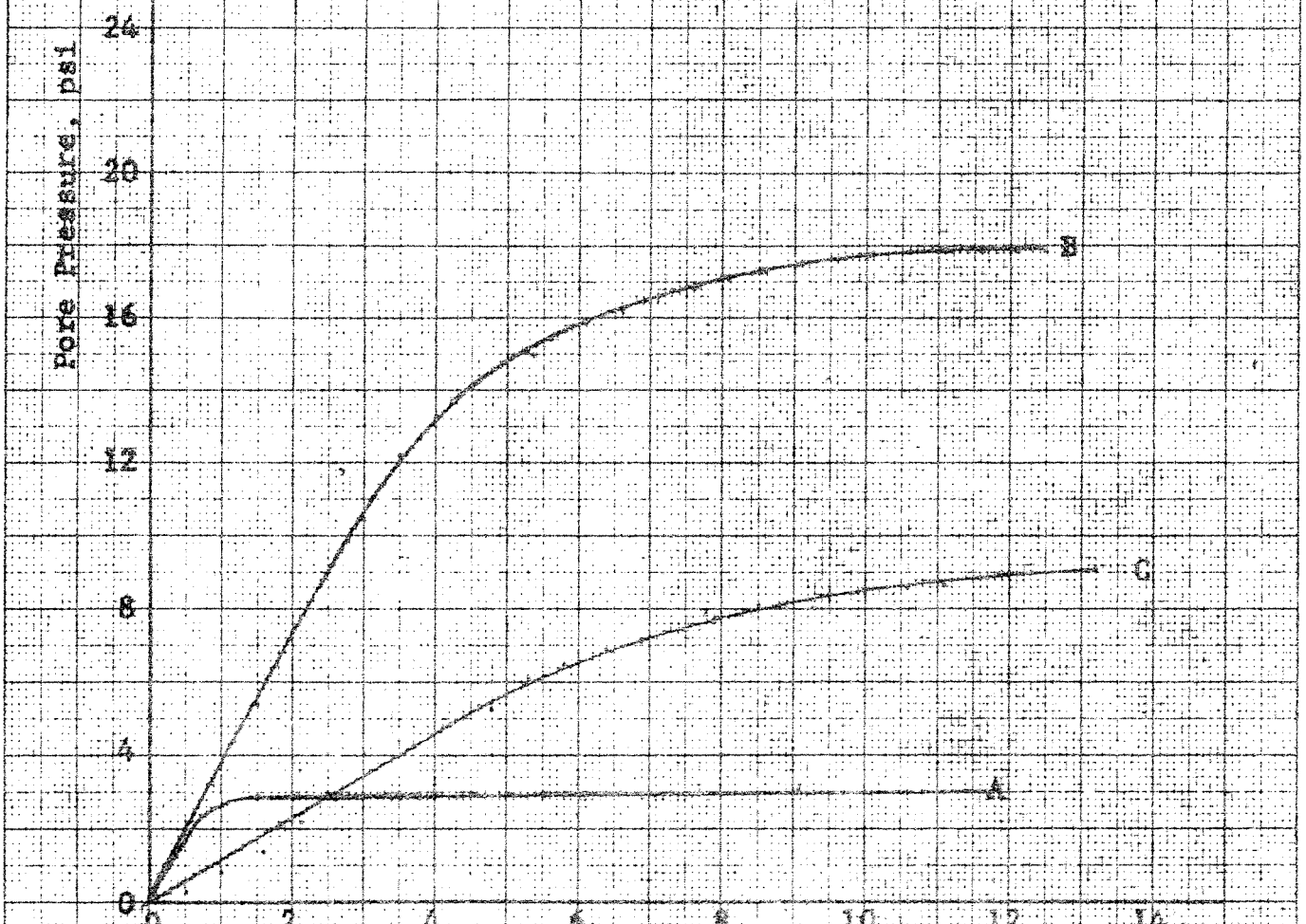


K&E 10 X 10 TO THE CM. 359-14G KEUFFEL & ESSER CO. MADE IN U.S.A.

Hole No. 4

Triaxial Shear Test

Pore Pressure-Strain Relationships

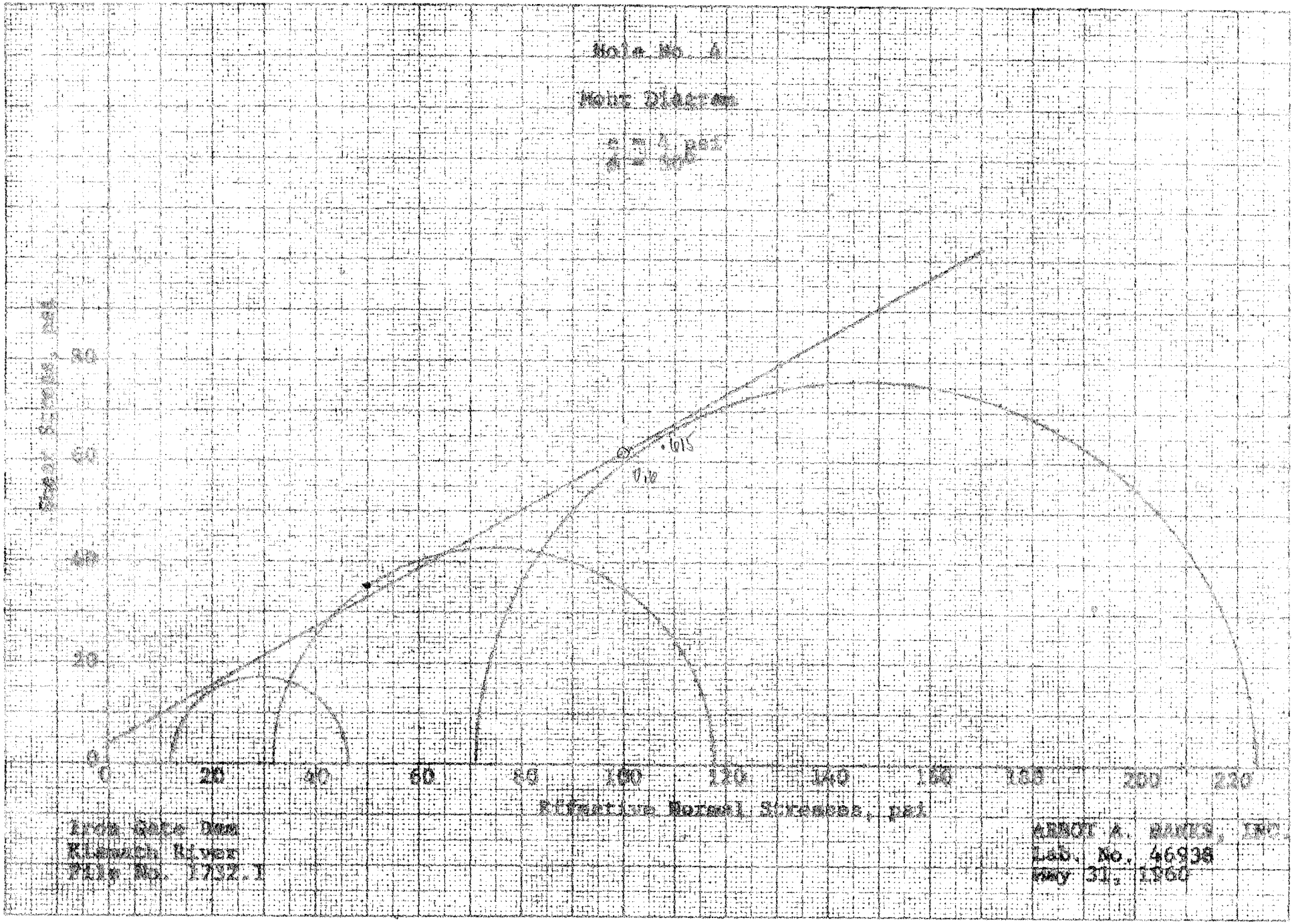


Iron Gate Dam
Klamath River
File No. 1732.1

ABBOT A. HANKS, INC.
Lab. No. 46938
May 31, 1960

10 X 10 TO THE CM. 359-14G
KEUFFEL & ESSER CO. MADE IN U.S.A.

K&E 10 X 10 TO THE CM. KEUFFEL & ESSER CO. 359-14G



BRANCH LABORATORY 1068 MARTIN AVENUE • SANTA CLARA • CALIFORNIA • [illegible]
BRANCH OFFICE 10 DE LUCA PLACE • SAN RAFAEL • CALIFORNIA • [illegible]
CABLE: HANKS

ABBOT A. HANKS, INC.

[illegible]
1500 SANSOME STREET • SAN FRANCISCO 11, CALIFORNIA • EXBROOK 2-2468

Engineers
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Chemists
Metallurgists
Spectrographers
Soils and Foundations
Consulting · Testing · Inspecting

File No. 1732.1
Lab. No. 46938

June 9, 1960

Mr. W. L. Warren
Assistant Chief Engineer
The California Oregon Power Company
216 West Main Street
Medford, Oregon

Re: Iron Gate Dam
Soil Samples

Dear Mr. Warren:

Enclosed are the findings from tests performed on soil samples marked Hole No. 7.

Very truly yours,

ABBOT A. HANKS, INC.

Donald W. Radbruch

Donald W. Radbruch

hms
Encls.
Reports to:
3-The California Oregon Power Company

Iron Gate Dam
Klamath River
File No. 1732.1

Abbot A. Hanks, Inc.
Lab. No. 46938
June 9, 1960

TEST RESULTS

Hole No. 7
Specific Gravity: 2.74

Triaxial Shear Test

	Samples A	B	C	D
Chamber Pressure, psi	15	50	80	80
Unit Dry Weight at Compaction, lb/ft^3	109.1	110.0	110.0	109.3
Moisture Content at Compaction, %	17.6	17.3	19.0	19.3
Unit Dry Weight at Test, lb/ft^3	106.7	111.5	114.7	114.8
Moisture Content at Test, lb/ft^3	22.6	19.3	18.7	19.8
Degree of Saturation at Test, %	100+	100	100	100+
Maximum Deviator Stress, psi	22	67	77	79
Pore Pressure at Max. Deviator Stress, psi	6	12	23	17

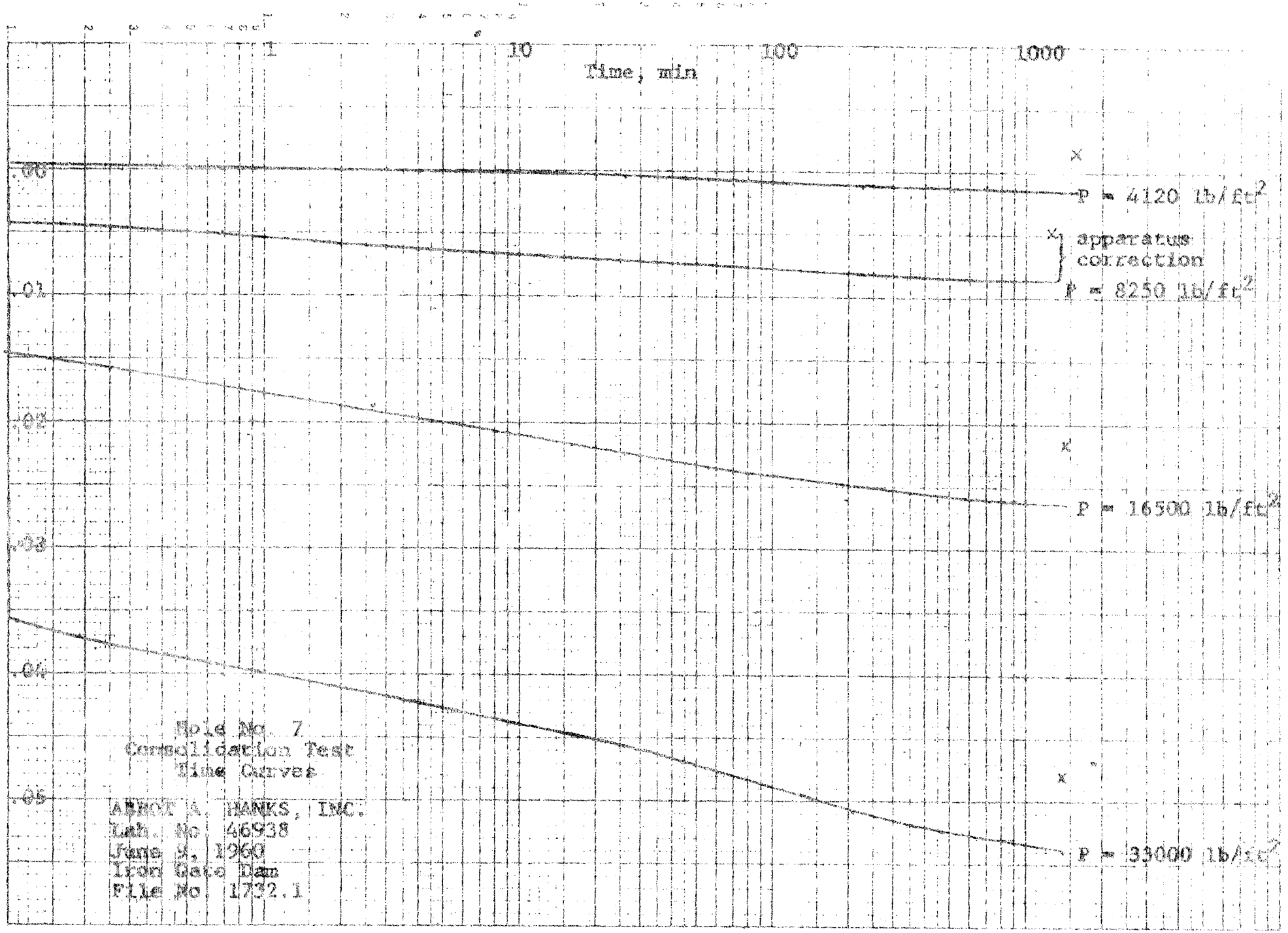
Permeability Test
(Constant Head Test)

Unit Dry Weight at Compaction, lb/ft^3	109.3
Moisture Content at Compaction, %	17.8
Moisture Content at Test, %	19.7
Degree of Saturation at Test, %	96
Permeability Coefficient, ft per yr	Less than .01
" " , cm/sec	Less than 10^{-8}

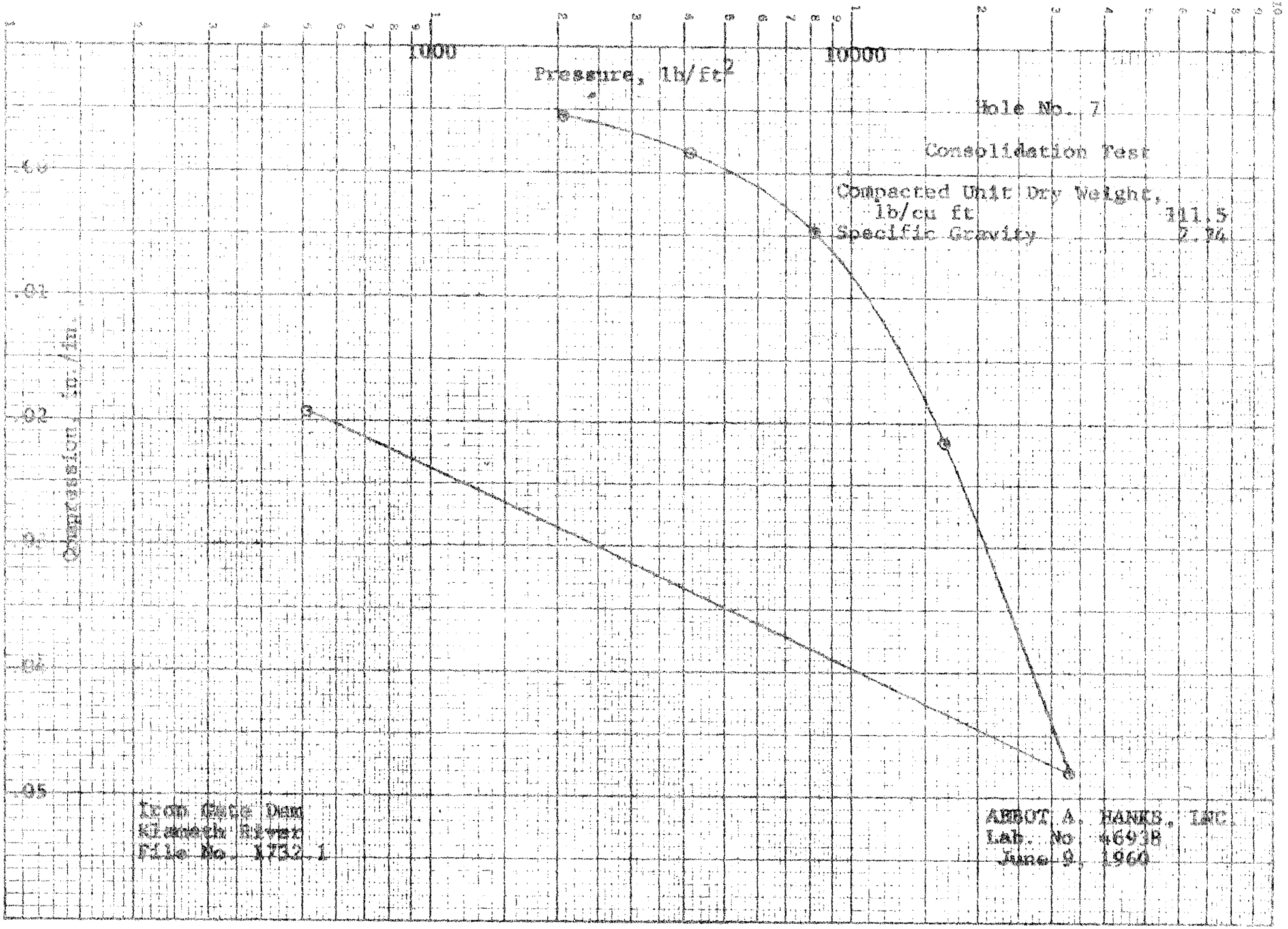
Report
~~Letter~~ & ~~Letter~~

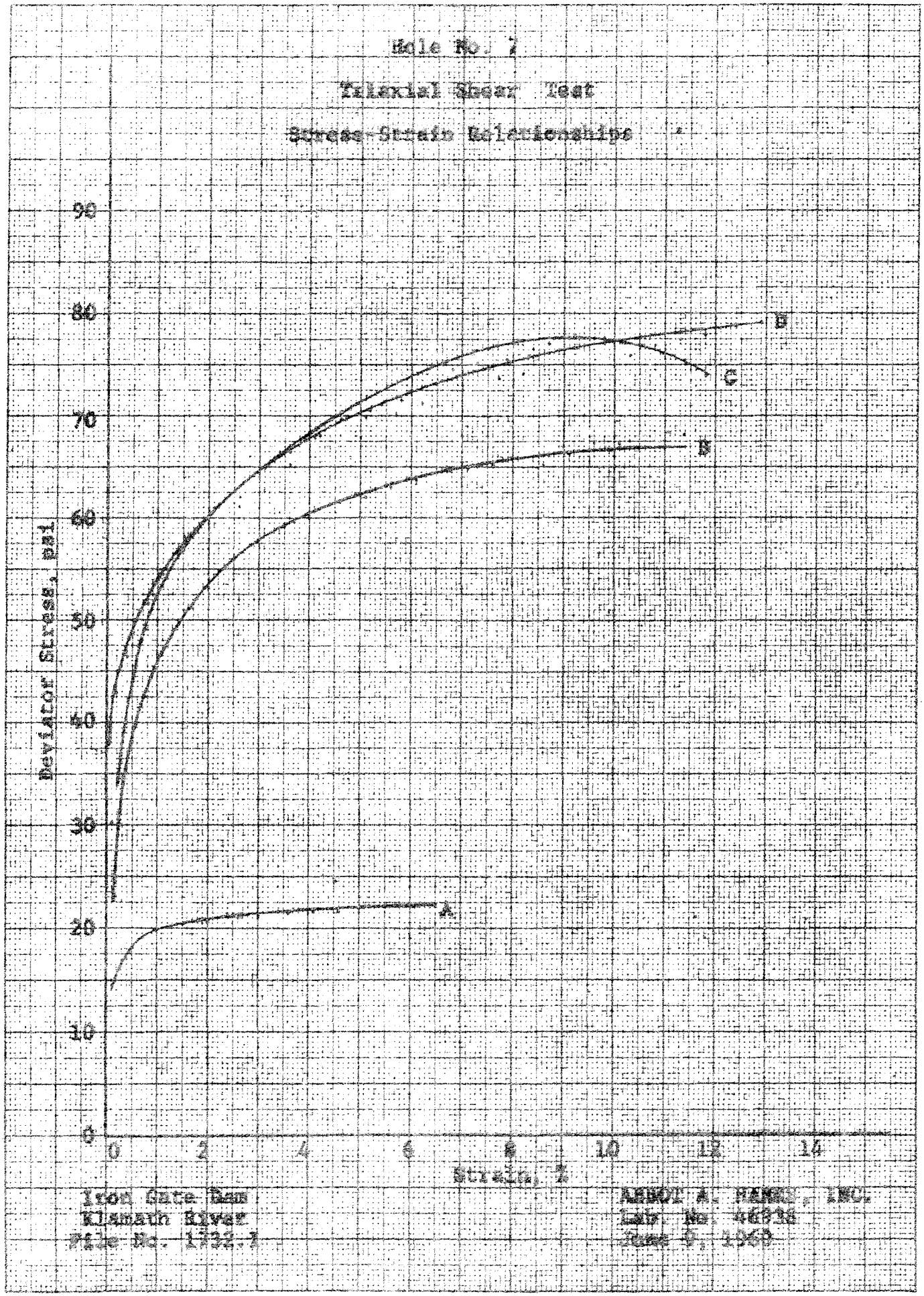
~~Optimum moisture~~ — 15.2 — 15

Max. ~~Dry density~~ — 117.6 — 116.0


SEMI-LOGARITHMIC 359 91C
5 X 70 DIVISIONS
1
10
100
1000
Time, min
.00
.01
.02
.03
.04
.05
P = 4120 lb/ft²
apparatus correction
P = 8250 lb/ft²
P = 16500 lb/ft²
P = 33000 lb/ft²
Mold No. 7
Consolidation Test
Time Curves
ANHOLT A. HANKS, INC.
Lab. No 46938
June 3, 1960
Iron Gate Dam
File No 1732.1

SEMI-LOGARITHMIC 359-71
KEUFFEL & ESSER CO.
3 CYCLES X 70 DIVISIONS




Hole No. 7
Triaxial Shear Test
Stress-Strain Relationships
Deviator Stress, psi
Strain, %
0
10
20
30
40
50
60
70
80
90
0
2
4
6
8
10
12
14
A
B
C
D
Iron Gate Dam
Klamath River
File No. 1732-1
ARBOR A. HARRIS, INC.
Lab. No. 46838
June 9, 1960

Hole No. 7

Triaxial Shear Test

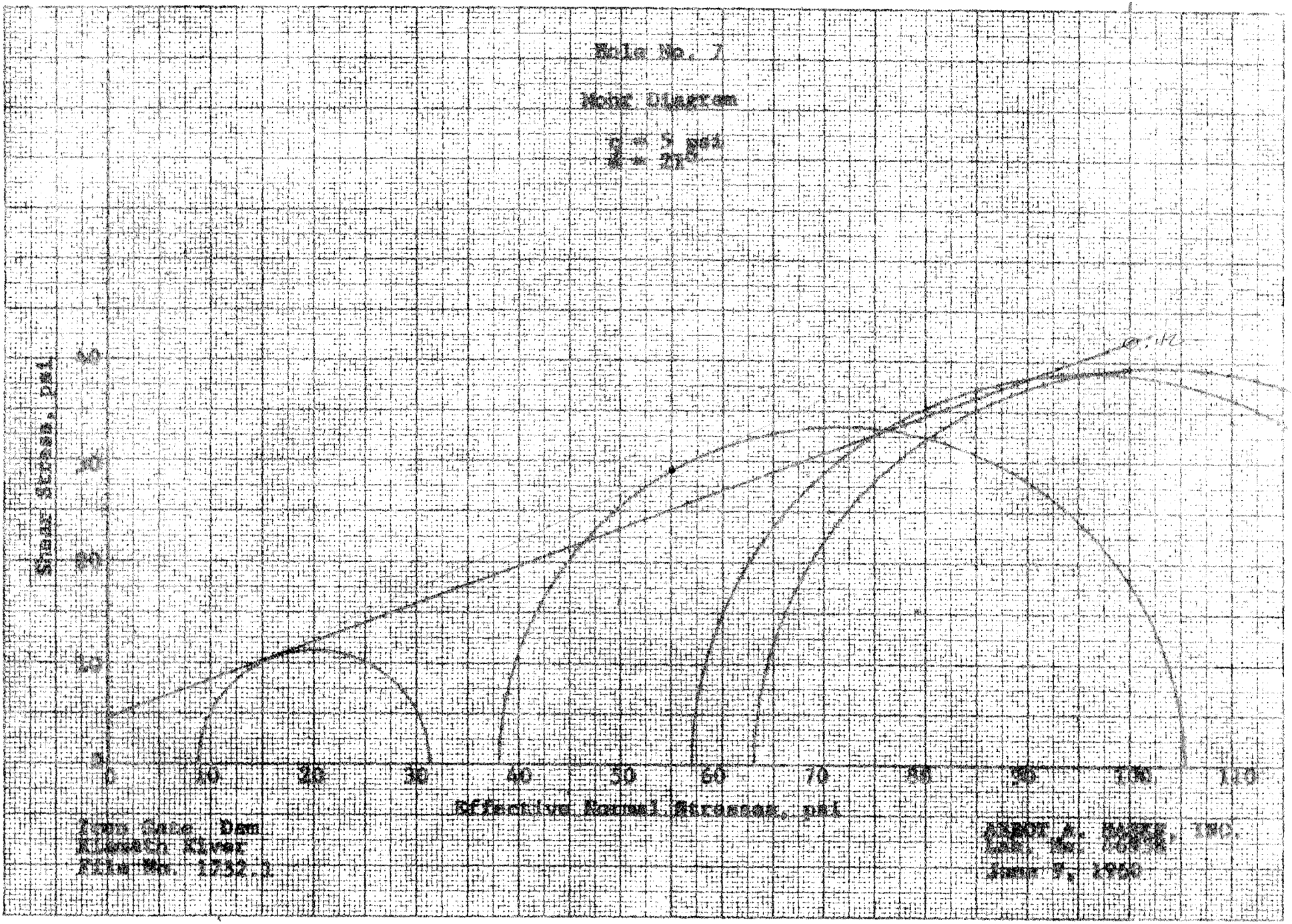
Pore Pressure-Strain Relationships

From Gate Dam
Klamath River
File No. 1752.1

ABBOT A. HAMES, INC.
Lab. No. 49936
June 9, 1960

K&E 10 X 10 TO THE CM. 359-14G
KEUFFEL & ESSER CO. MADE IN U.S.A.

K+E 10 X 10 TO THE CM. KEUFFEL & ESSER CO. 359-14G MADE IN U.S.A.



BRANCH LABORATORY 1050 MARION AVENUE • SANTA CLARA • CYPRESS 2-7200
BRANCH OFFICE 10 DE LUA PLACE • SAN RAFAEL • GLENWOOD 4-8050
CABLE HANK

ABBOT A. HANKS, INC.

Engineers
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Chemists
Metallurgists
Spectrographers
Soils and Foundations
Chemical Testing Inspection

1500 SANSOME STREET • SAN FRANCISCO 11, CALIFORNIA • EXBROOK 2-7181

File No. 1732.1
Lab. No. 46938

May 24, 1960

Mr. W. L. Warren
Assistant Chief Engineer
The California Oregon Power Company
216 West Main Street
Medford, Oregon

Re: Iron Gate Dam
Soil Samples

Dear Mr. Warren:

Enclosed are the findings from tests performed on soil samples marked Hole No. 8.

Very truly yours,

ABBOT A. HANKS, INC.

Donald W. Radbruch

Donald W. Radbruch

hms
Encls.
Reports to:
3-The California Oregon Power Company

Iron Gate Dam
Klamath River
File No. 1732.1

Abbot A. Hanks, Inc.
Lab. No. 46938
May 18, 1960

TEST RESULTS

Hole No. 8
Specific Gravity: 2.75

Triaxial Shear Test

	Sample A	Sample B	Sample C
Chamber Pressure, psi	15	50	80
Unit Dry Weight at Compaction, lb/ft^3	98.6	99.7	98.9
Moisture Content at Compaction, %	19.9	19.9	20.1
Unit Dry Weight at Test, lb/ft^3	95.4	100.6	102.9
Moisture Content at Test, lb/ft^3	28.4	26.1	25.0
Degree of Saturation at Test, %	98	100+	100+
Maximum Deviator Stress, psi	21	48	66
Pore Pressure at Max. Deviator Stress, psi	5	13	30

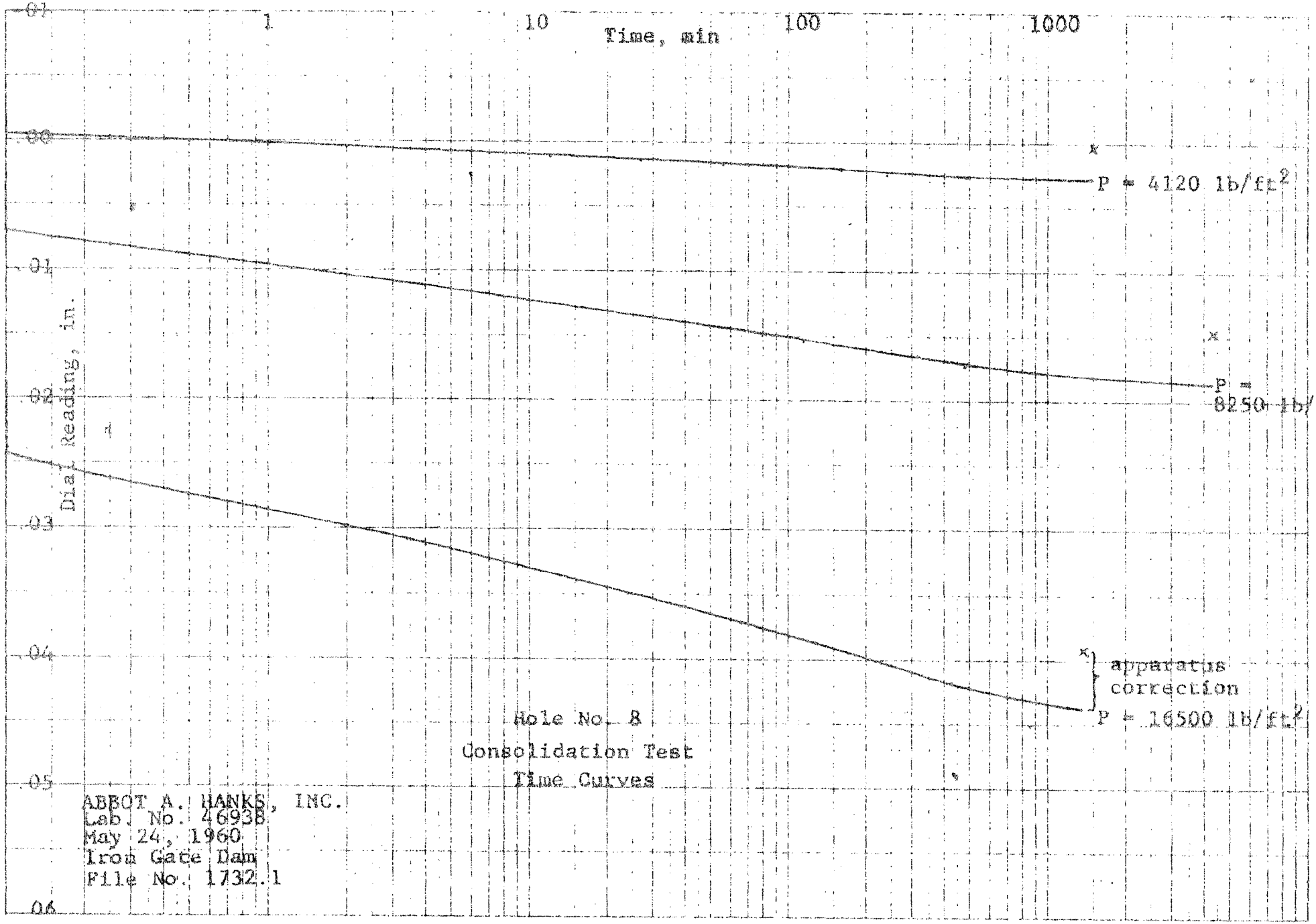
Permeability Test
(Constant Head Test)

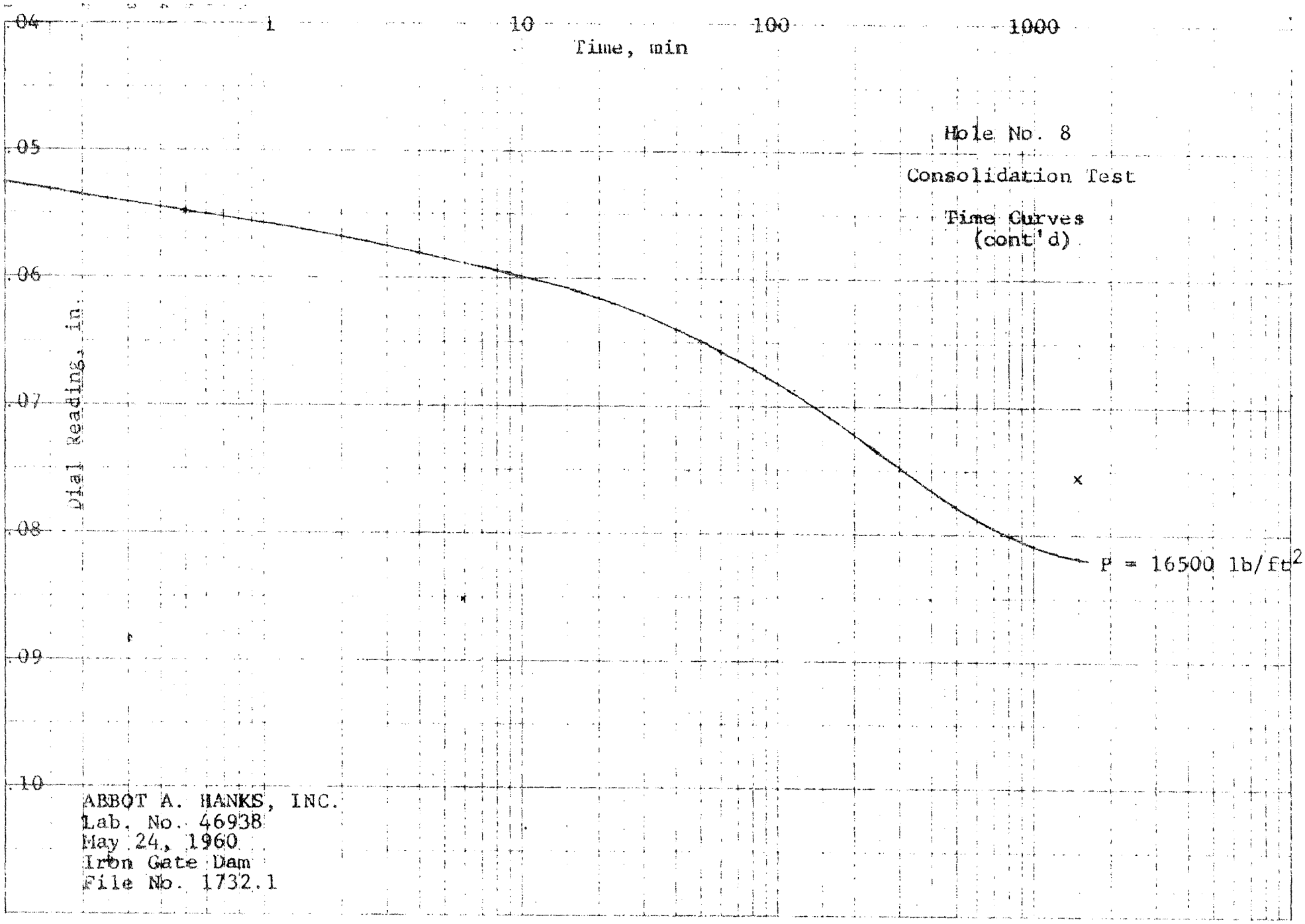
Unit Dry Weight at Compaction, lb/ft^3	100.8
Moisture Content at Compaction, %	21.1
Moisture Content at Test, %	25.4
Degree of Saturation at Test, %	100
Permeability Coefficient, ft per yr	Less than .01
" " , cm/sec	Less than 10-8

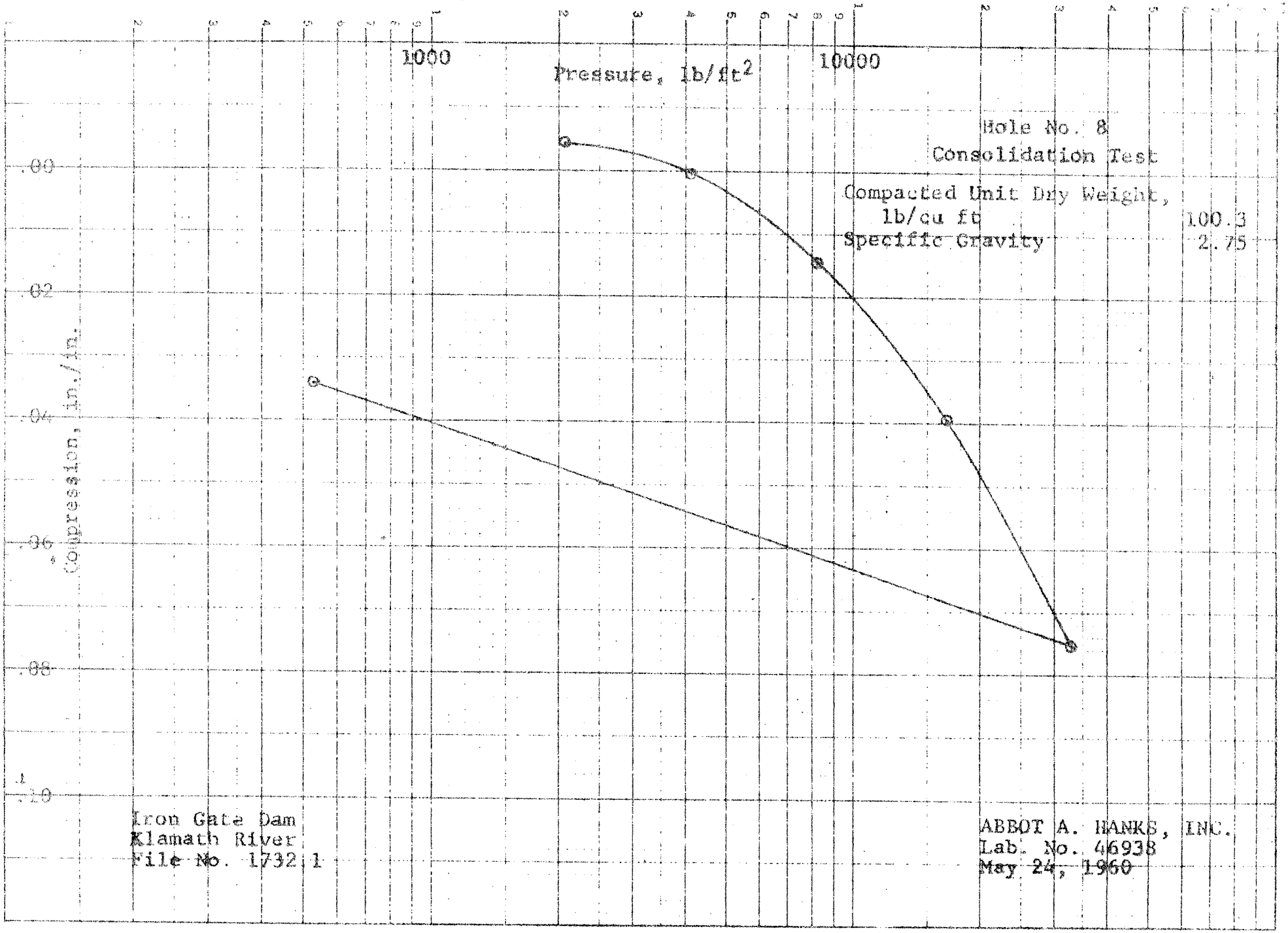
~~Report~~ ~~Letter~~

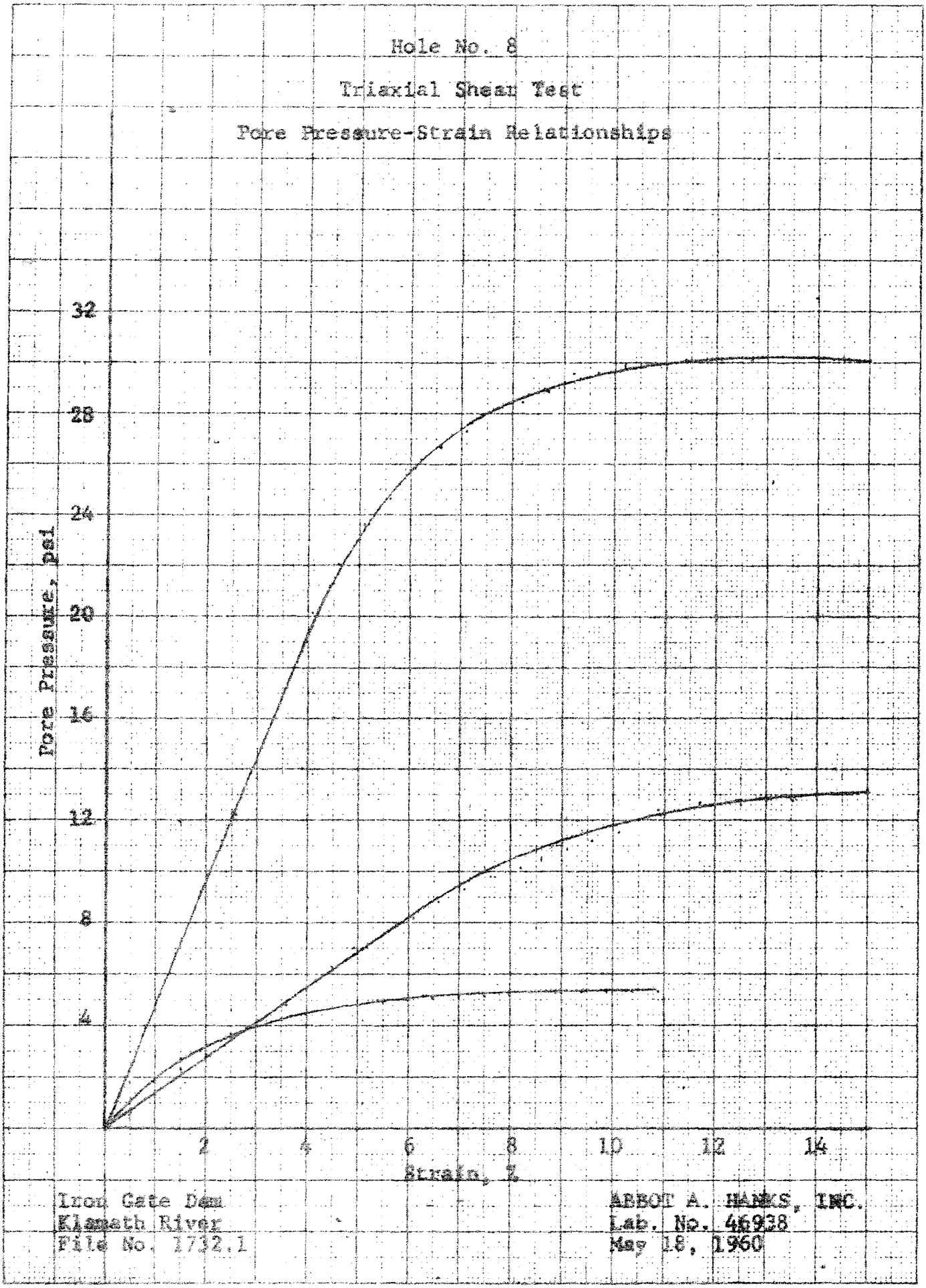
~~optimum moisture~~ 17.2 ~~17.8~~

~~max. dry density~~ ~~107.8~~ ~~100.0~~


1
10
100
1000
Time, min
Dial Reading, in.
P = 4120 lb/ft²
P = 8250 lb/ft²
P = 16500 lb/ft²
apparatus correction
Hole No. 8
Consolidation Test
Time Curves
ABBOT A. HANKS, INC.
Lab. No. 46938
May 24, 1960
Iron Gate Dam
File No. 1732.1


.04
.05
.06
.07
.08
.09
.10
1
10
100
1000
Time, min
Dial Reading, in.
Hole No. 8
Consolidation Test
Time Curves
(cont'd)
P = 16500 lb/ft2
ABBOT A. HANKS, INC.
Lab. No. 46938
May 24, 1960
Iron Gate Dam
File No. 1732.1


1000
Pressure, lb/ft2
10000
Hole No. 8
Consolidation Test
Compacted Unit Dry Weight, lb/cu ft 100.3
Specific Gravity 2.75
Compression, in./in.
.00
.02
.04
.06
.08
.10
Iron Gate Dam
Klamath River
File No. 1732.1
ABBOT A. HANKS, INC.
Lab. No. 46938
May 24, 1960

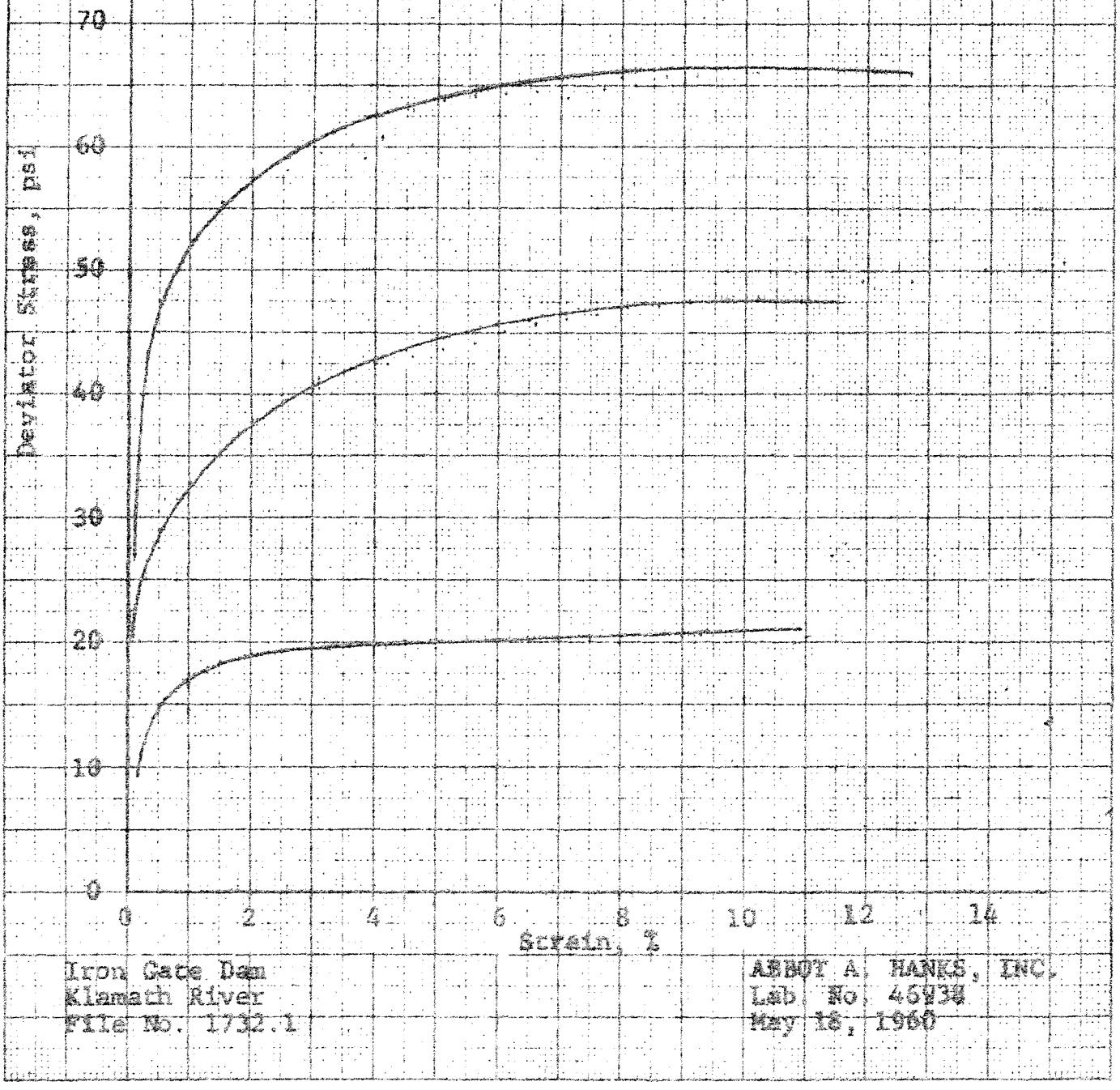


10 X 10 TO THE CM 359-143
KEUFFEL & ESSER CO

Hole No. 8

Triaxial Shear Test

Stress-Strain Relationships

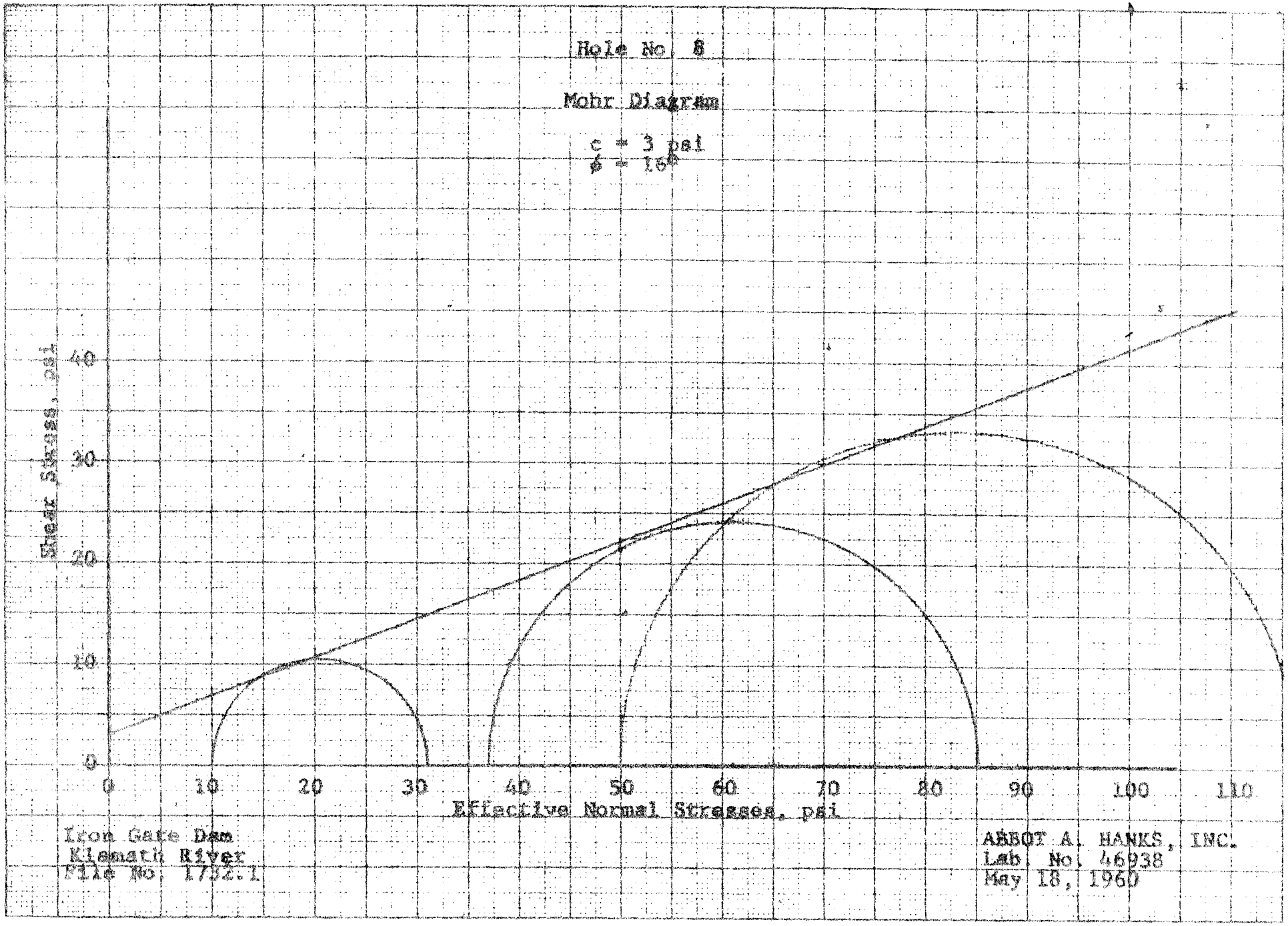


Iron Gate Dam
Klamath River
File No. 1732.1

ABBOT A. HANKS, INC.
Lab No. 45734
May 18, 1960

10 X 10 TO THE CM. 359-14G
KEUFFEL & ESSER CO.

...OX TO THE CM 359-14G
...KELFFEL & ESSER CO.



BRANCH LABORATORY 1086 MARTIN AVENUE • SANTA CLARA • CHERRY 8 5262
BRANCH OFFICE 10 DE LUCA PLACE • SAN RAFAEL • GLENWOOD 4 8650

CABLE HANX

ABBOT A. HANKS, INC.
ESTABLISHED 1895

Engineers
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Chemists
Metallurgists
Spectrographers
Soils and Foundations
Consulting · Testing · Inspecting

1300 SANSOME STREET • SAN FRANCISCO 11, CALIFORNIA • EXBROOK 7-2464

File No. 1732.1
Lab. No. 46938

May 19, 1960

Mr. W. L. Warren
Assistant Chief Engineer
The California Oregon Power Company
216 West Main Street
Medford, Oregon

Re: Iron Gate Dam
Soil Samples

Dear Sir:

Enclosed are the findings from tests performed on soil samples marked Hole No. 11.

Very truly yours,

ABBOT A. HANKS, INC.

Donald W Radbruch

Donald W. Radbruch

hms
Encls.
Reports to:
3-The California Oregon Power Company

Iron Gate Dam
Klamath River
Rile No. 1732.1

Abbot A. Hanks, Inc.
Lab. No. 46938
May 19, 1960

TEST RESULTS

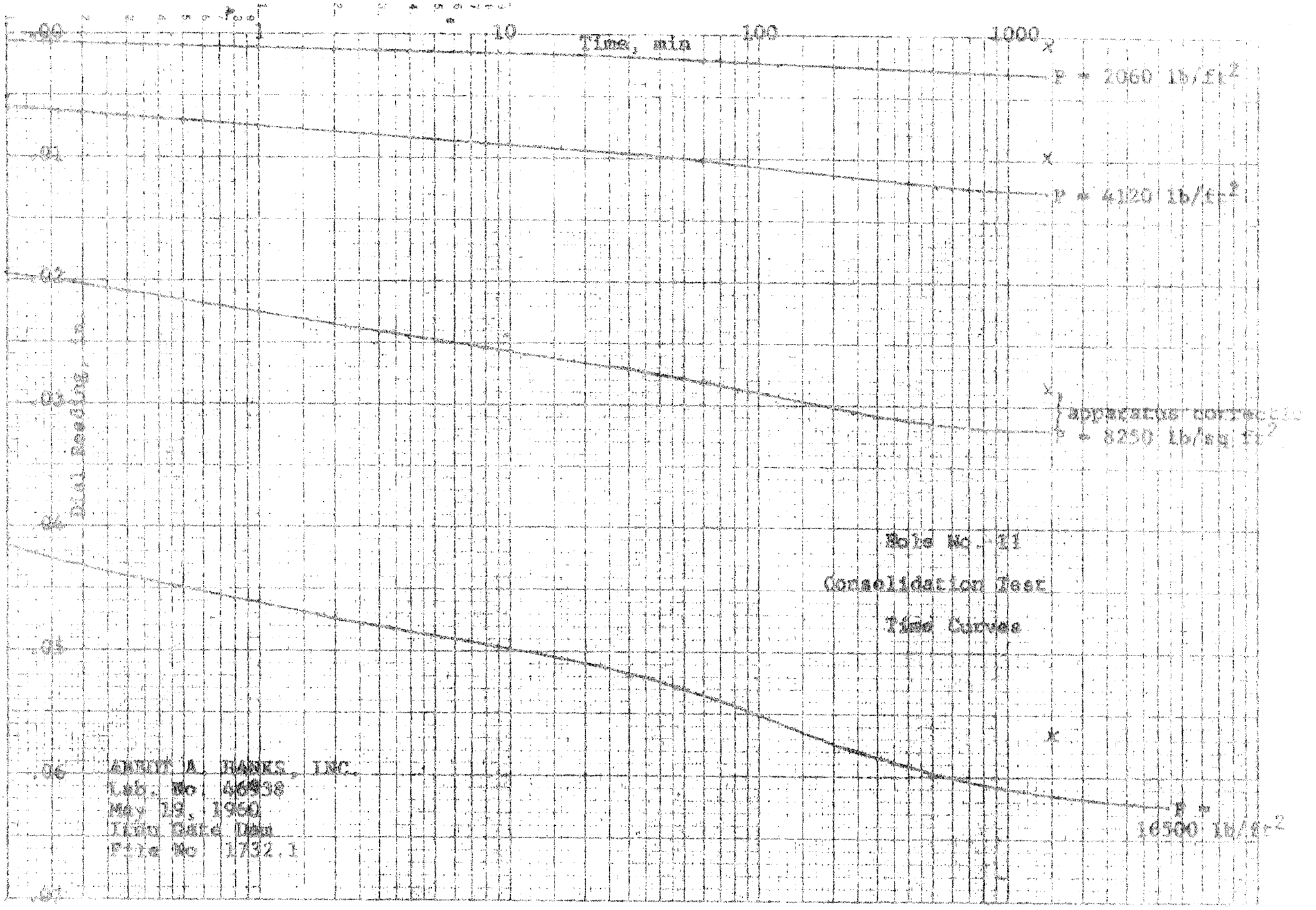
Hole No. 11
Specific Gravity: 2.75

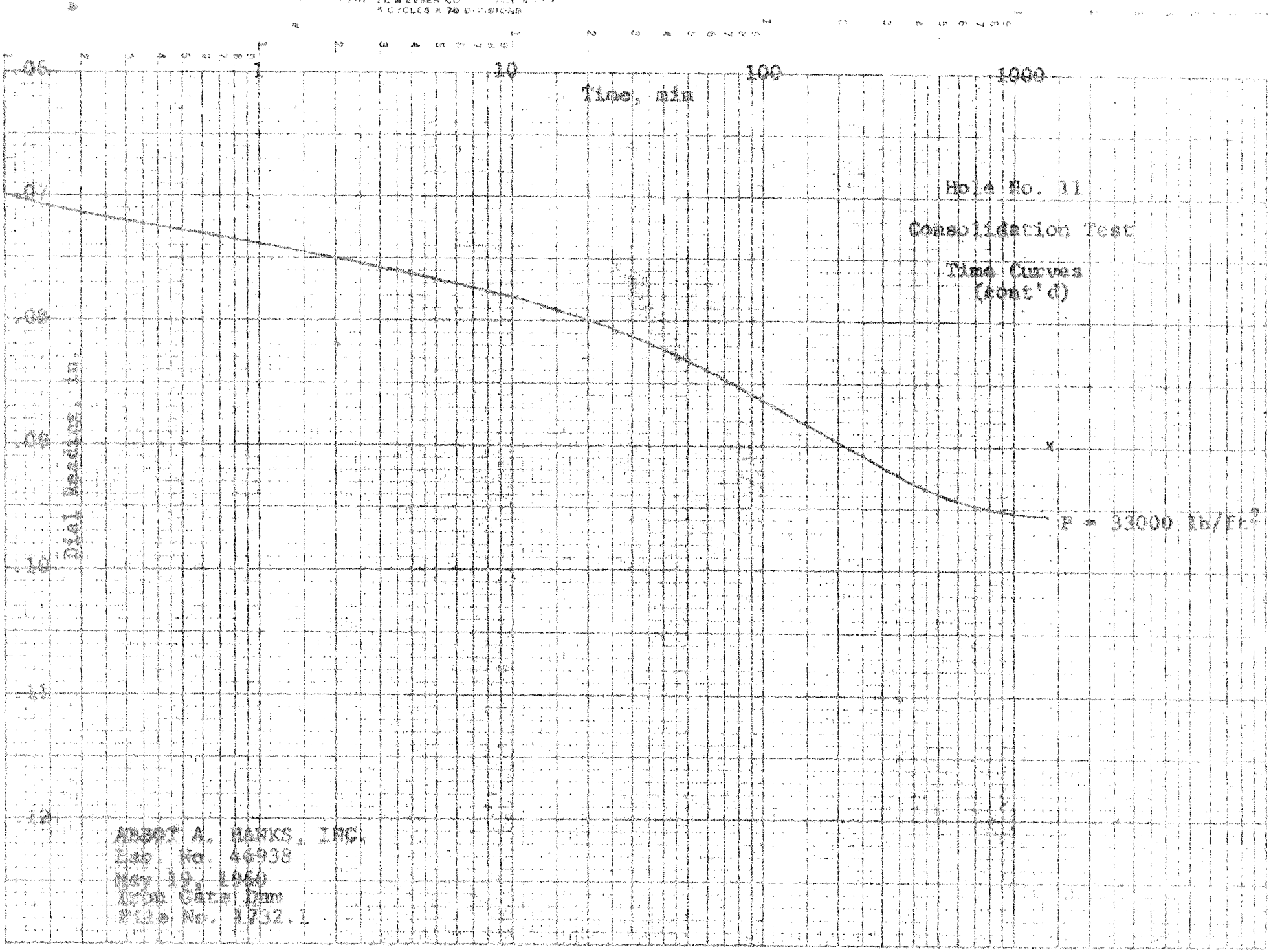
Triaxial Shear Test

	Sample A	Sample B	Sample C
Chamber Pressure, psi	15	50	80
Unit Dry Weight at Compaction, lb/ft^3	101.5	101.7	102.1
Moisture Content at Compaction, %	22.2	21.7	22.0
Unit Dry Weight at Test, lb/ft^3	102.3	105.1	107.6
Moisture Content at Test, lb/ft^3	25.0	22.9	21.7
Degree of Saturation at Test, %	100	100	100
Maximum Deviator Stress, psi	21	55	73
Pore Pressure at Max. Deviator Stress, psi	5	7	22

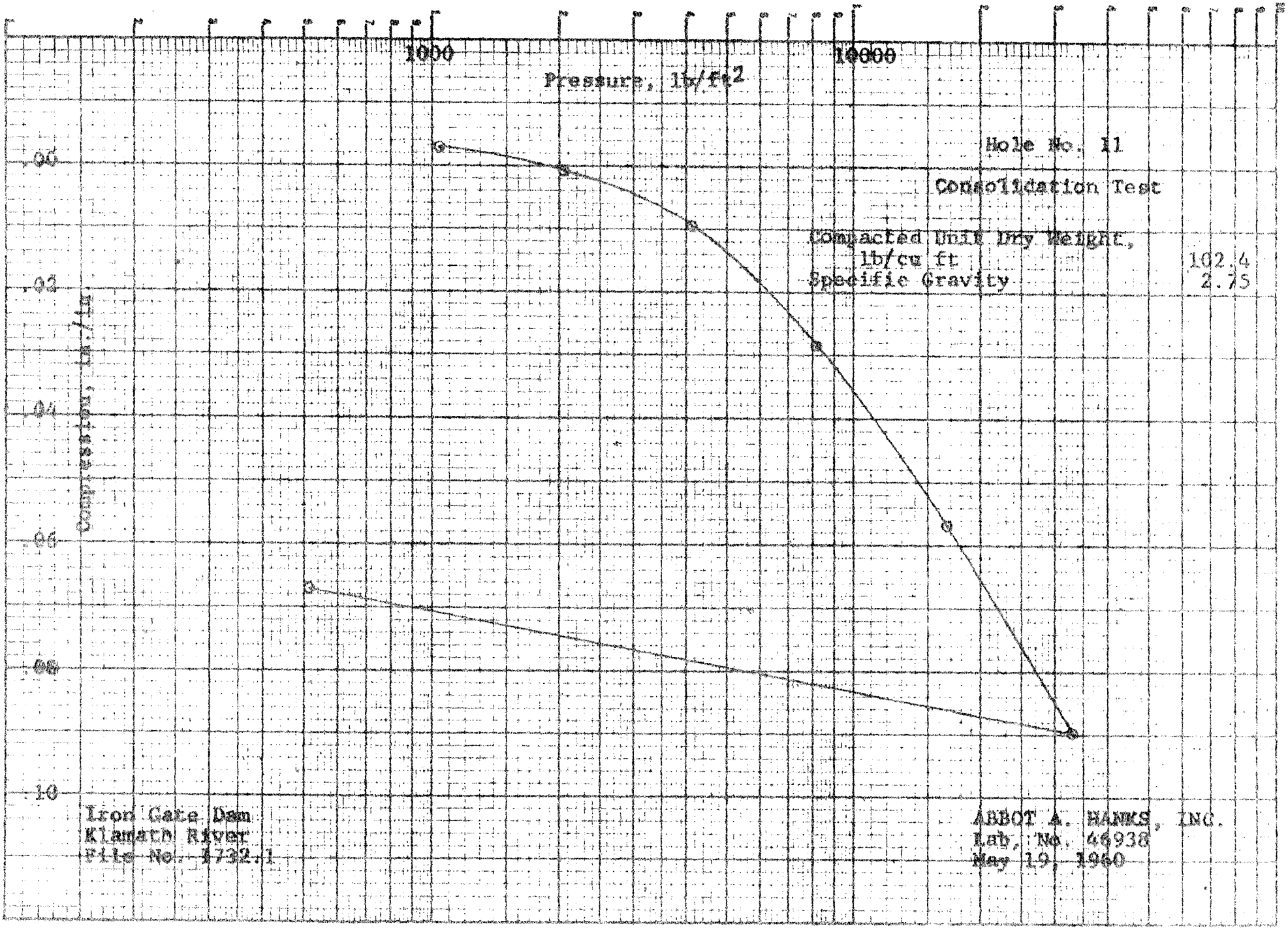
Permeability Test
(Constant Head Test)

Dry Density at Compaction, lb/ft^3	101.0
Moisture Content at Compaction, %	22.4
Permeability Coefficient, ft per yr	Less than .01
" " , cm/sec	Less than 10^{-8}


Time, min
1
10
100
1000
P = 2000 lb/ft²
P = 4120 lb/ft²
P = 8250 lb/sq ft
P = 16500 lb/ft²
Dial reading
Soil No. 21
Consolidation Test
Time Curves
ARMY M. BANKS, INC.
Lab. No 46838
May 19, 1950
Time Rate Data
File No 1732.1


162
SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO.
Time, min
1
10
100
1000
Dial Reading, in.
.06
.08
.10
.12
Hole No. 11
Consolidation Test
Time Curves
(cont'd)
P = 33000 lb/ft²
ABBOT A. HANKS, INC.
Lab. No. 46938
May 19, 1960
Arch Cache Dam
File No. 8732.1

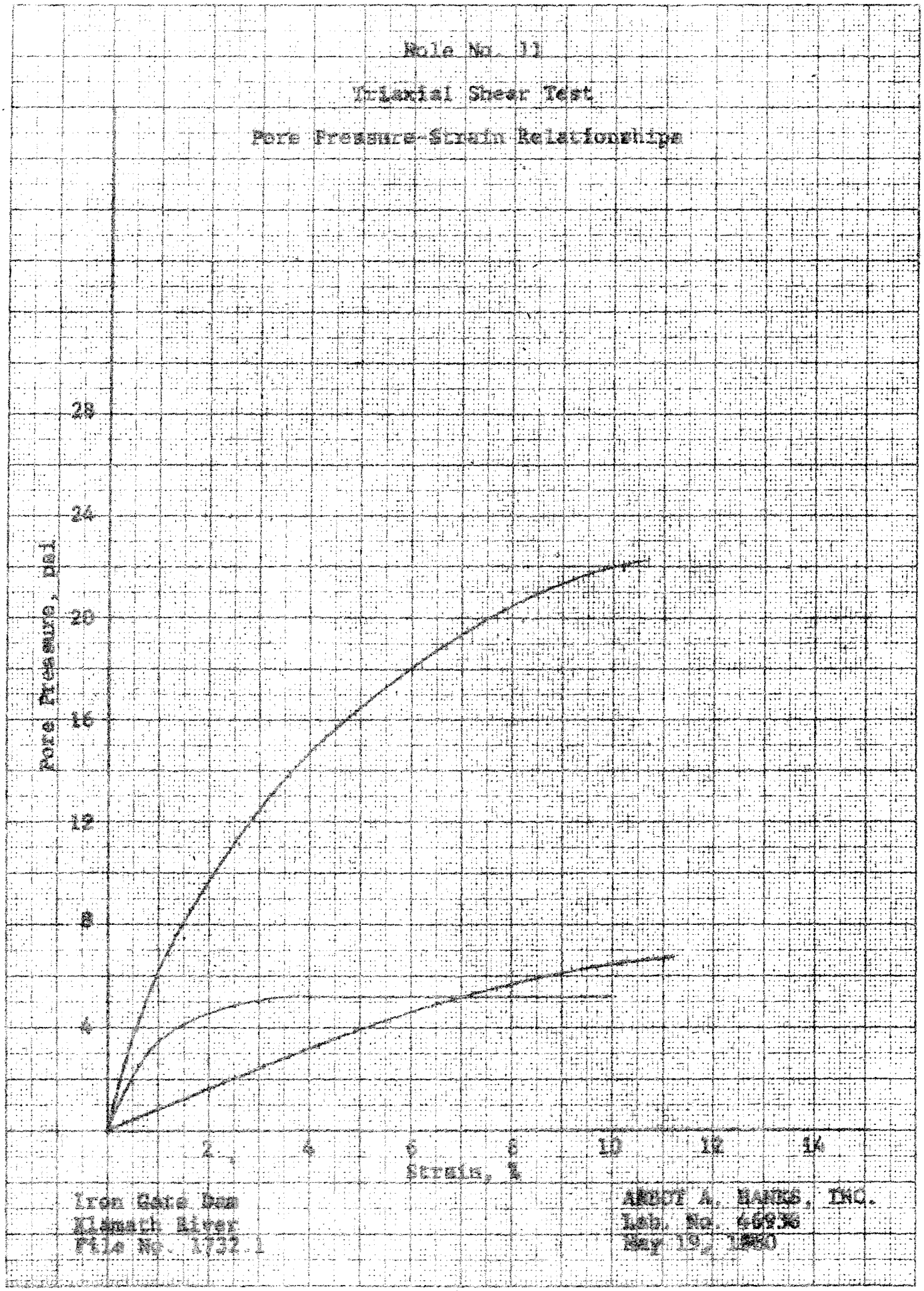
K-E SEMI-LOGARITHMIC 359-71
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 70 DIVISIONS



Hole No. 11

Triaxial Shear Test

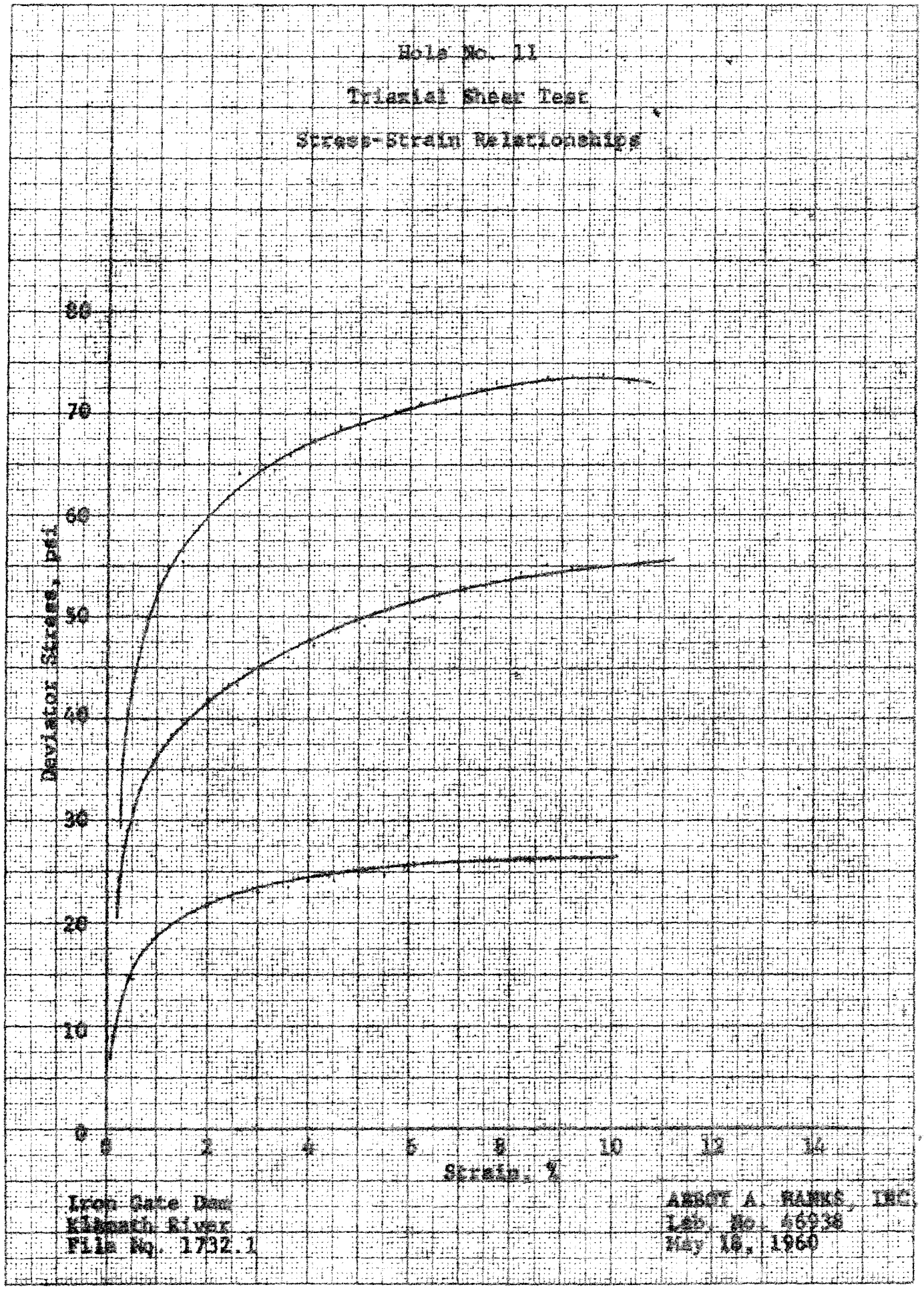
Pore Pressure-Strain Relationships



Iron Gate Dam
Klamath River
File No. 1732.1

ABBOTT A. HANKS, INC.
Lab. No. 469J6
May 19, 1950

K&E 10 X 10 TO THE C.M. 359 145
KEUFFEL & ESSER CO.

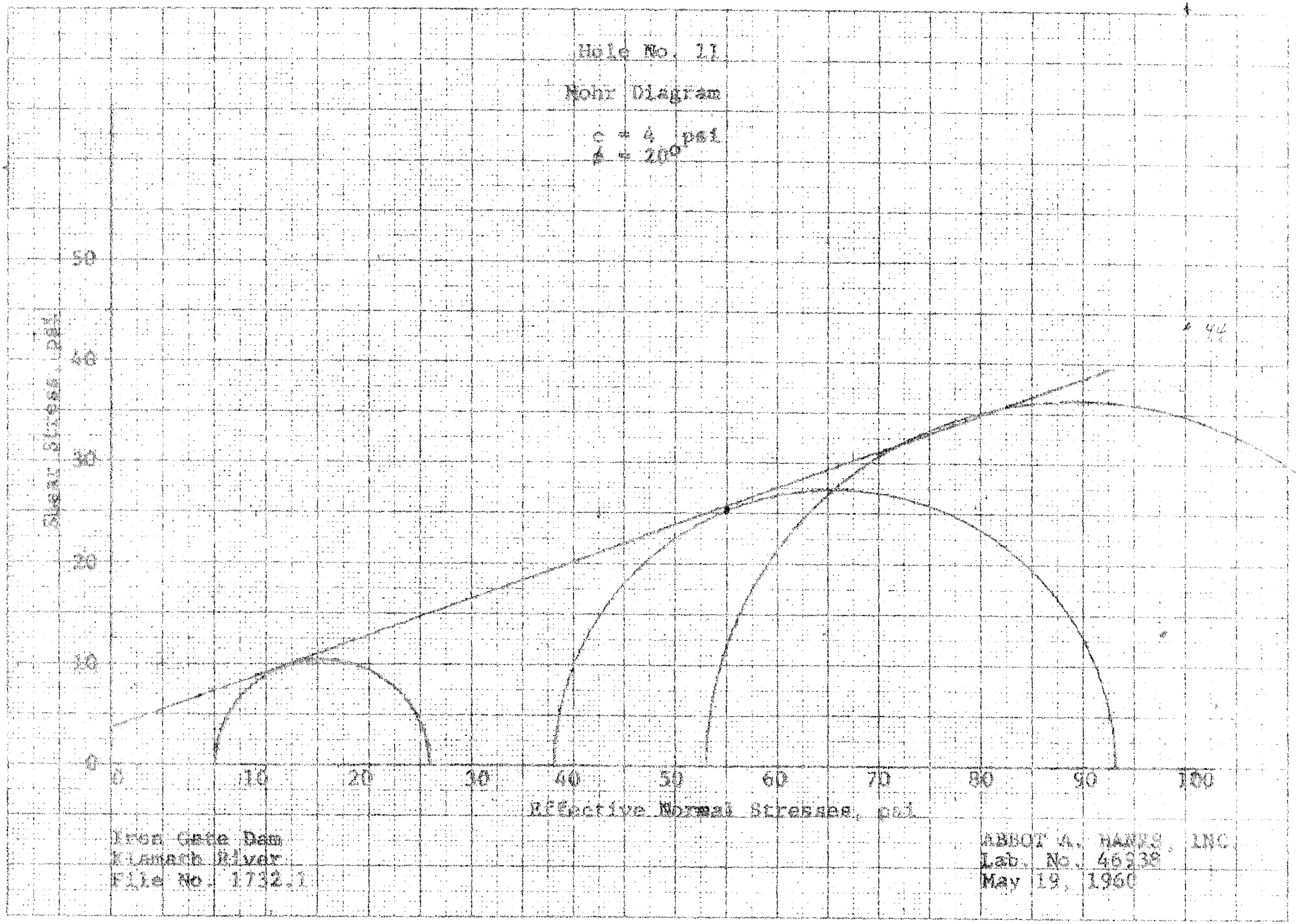


Iron Gate Dam
Klamath River
File No. 1732.1

ABBOT A. RANKS, INC.
Lab. No. 66938
May 16, 1960

K&E 10 X 10 TO THE CM. 359-14G
KEUFFEL & ESSER CO. MADE IN U.S.A.

K+E 10 X 10 TO THE CM 359-140
KEUFFEL & ESSER CO. MADE IN U.S.A.



Iron Gate Dam
Klamath River
File No. 1732.1

ABBOT A. HANKS, INC.
Lab. No. 46238
May 19, 1960

KEUFFEL & ESSER CO., N. Y. NO. 359-81G
Semi-Logarithmic, 4 Cycles X 10 to the inch.
MADE IN U. S. A.

#200 #100 #50 #30 #16 #8 #4 3/8" 1/2" 1" 2" 3"

100
80
60
40
20
0

Gradation Minus 3"

Total Sample

Gradation 3/8"

Fine Portion

Plus 4 Mesh

THE CALIFORNIA OREGON POWER COMPANY
IRON GATE DAM
GRAIN SIZE CURVE

NOTE: Curves obtained by dry shaking sample through nest of sieves.

0.2 0.1 0.08 0.04 #4 3/8" 1/2" 3"

KEUFFEL & ESSER CO., N. Y. NO. 359-81G
Semi-Logarithmic, 4 Cycles × 10 to the inch.
MADE IN U. S. A.

THE CALIFORNIA OREGON POWER COMPANY
IRON GATE DAM
GRAIN SIZE CURVE

NOTE: Curves obtained by dry shaking sample through nest of sieves.

Gradation Minus 3"

#50

#8

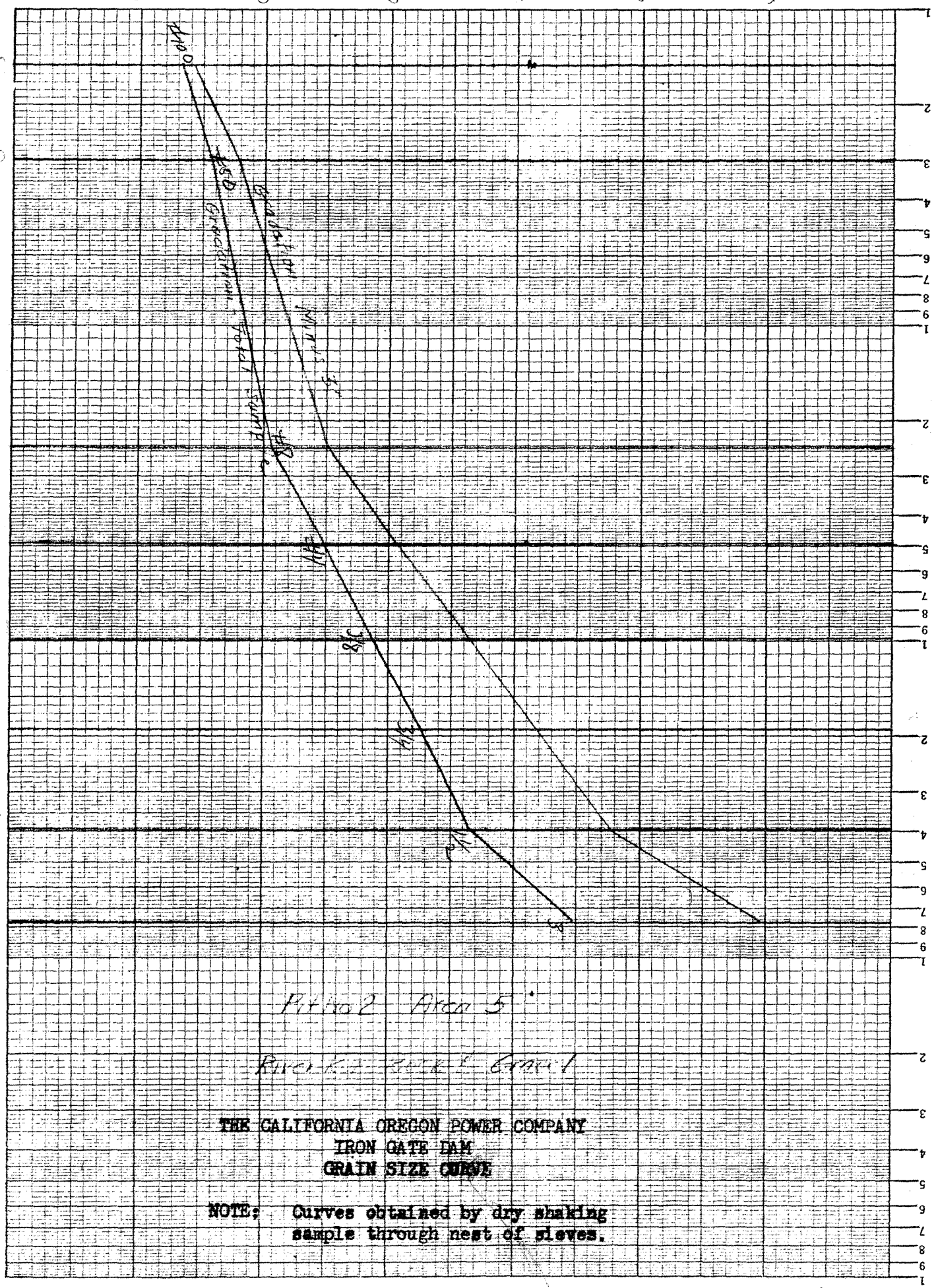
#4

3/8"

1/4"

100
80
60
40
20
0

00 50 8 4 3/8 1/4 1/2 3"



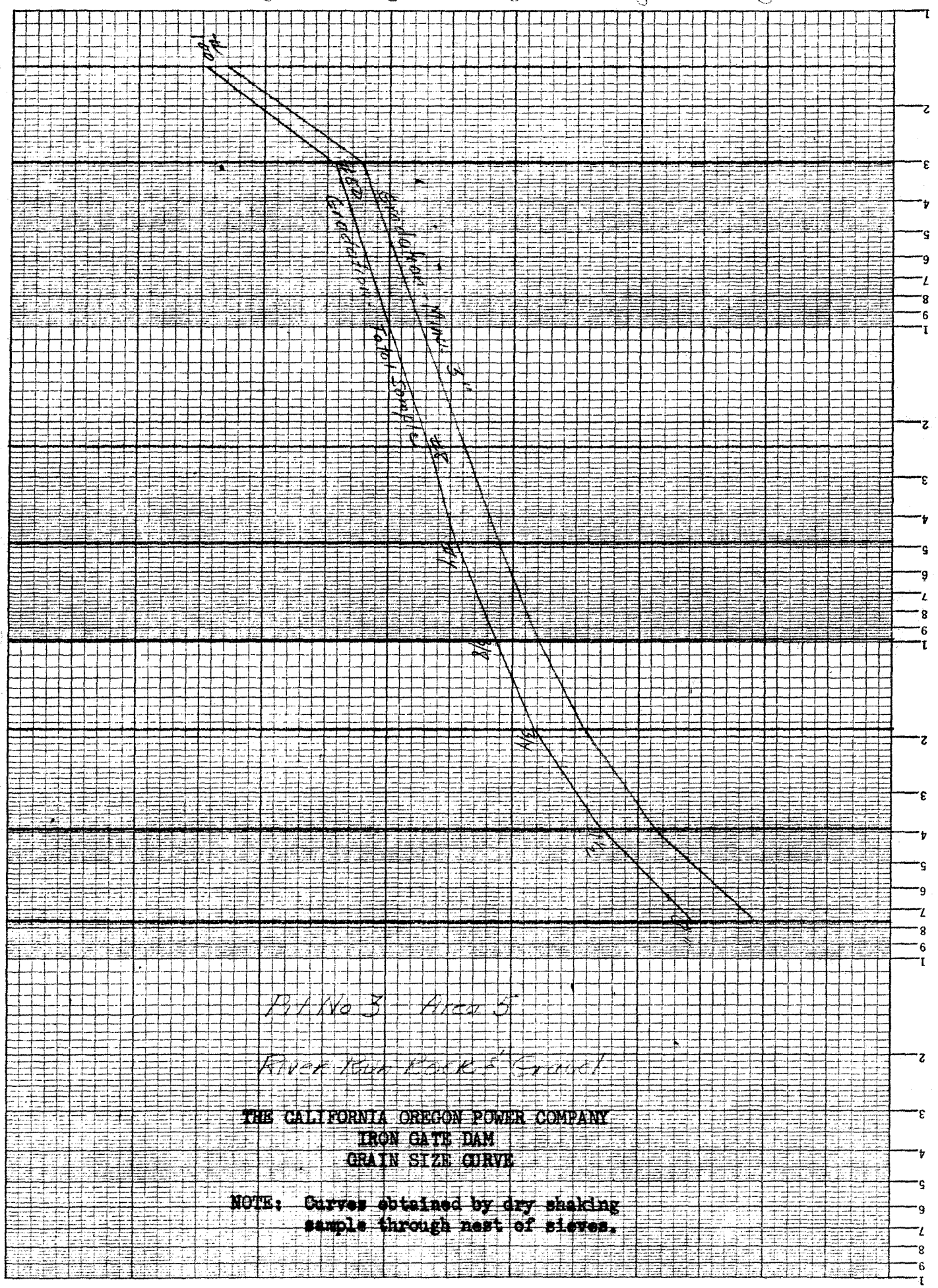
Period 2 Area 5

Rock Fill & Gravel

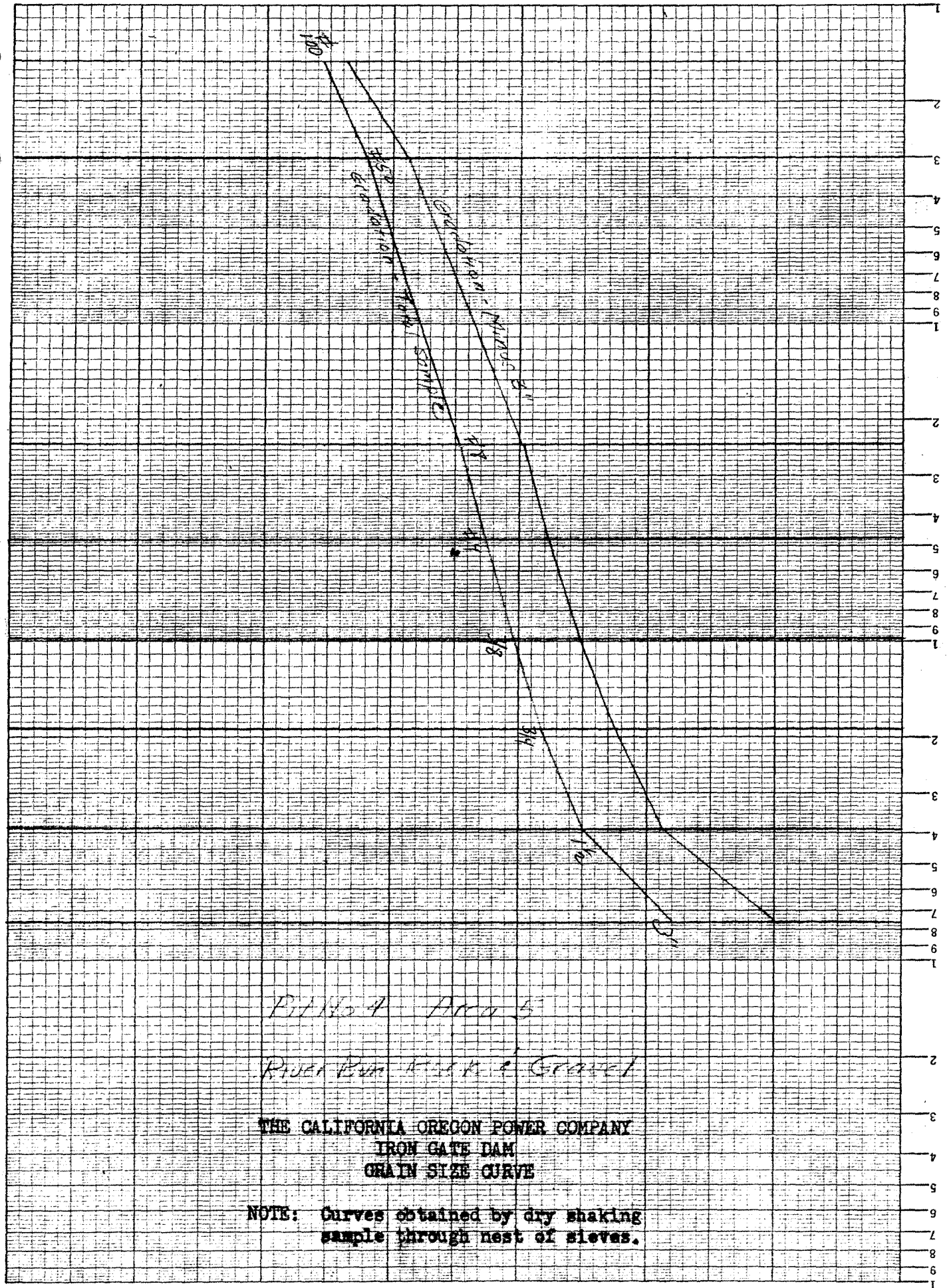
THE CALIFORNIA OREGON POWER COMPANY
IRON GATE DAM
GRAIN SIZE CURVE

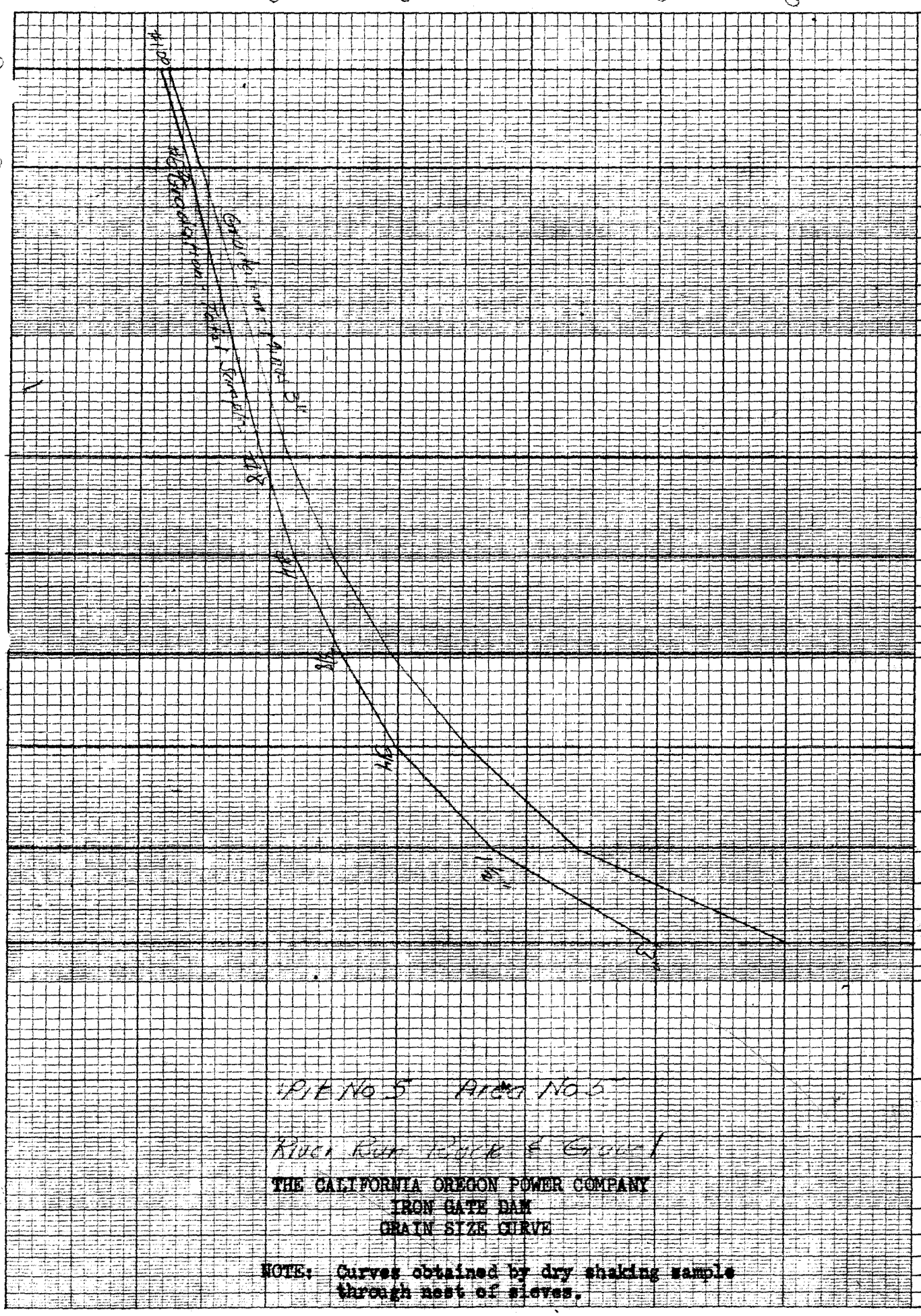
NOTE: Curves obtained by dry shaking sample through nest of sieves.

KEUFFEL & ESSER CO., N. Y. NO. 359-81G
Semi-Logarithmic, 4 Cycles × 10 to the inch.
MADE IN U. S. A.



KEUFFEL & ESSER CO., N. Y. NO. 359-81G
Semi-Logarithmic, 4 Cycles × 10 to the inch.
MADE IN U. S. A.


Coarse - Fine Separation
Fine Separation
Fine Separation



PIT No 5 AREA No 5

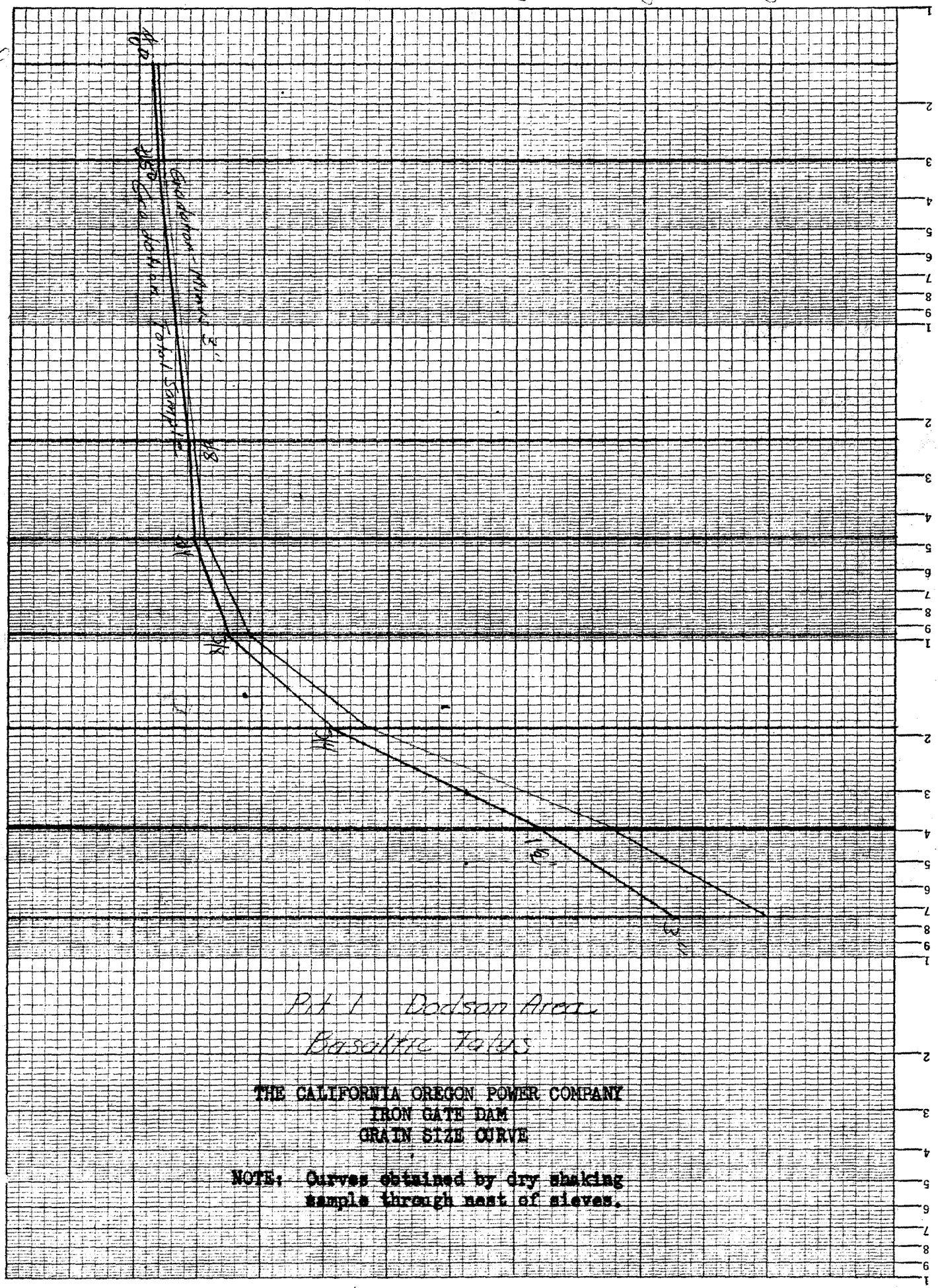
Rock Run Pit & Gravel

THE CALIFORNIA OREGON POWER COMPANY
IRON GATE DAM
GRAIN SIZE CURVE

NOTE: Curves obtained by dry shaking sample through nest of sieves.

KEUFFEL & ESSER CO., N. Y. NO. 359-81G
Semi-Logarithmic, 4 Cycles × 10 to the Inch.
MADE IN U. S. A.

CR.563 Sh. C

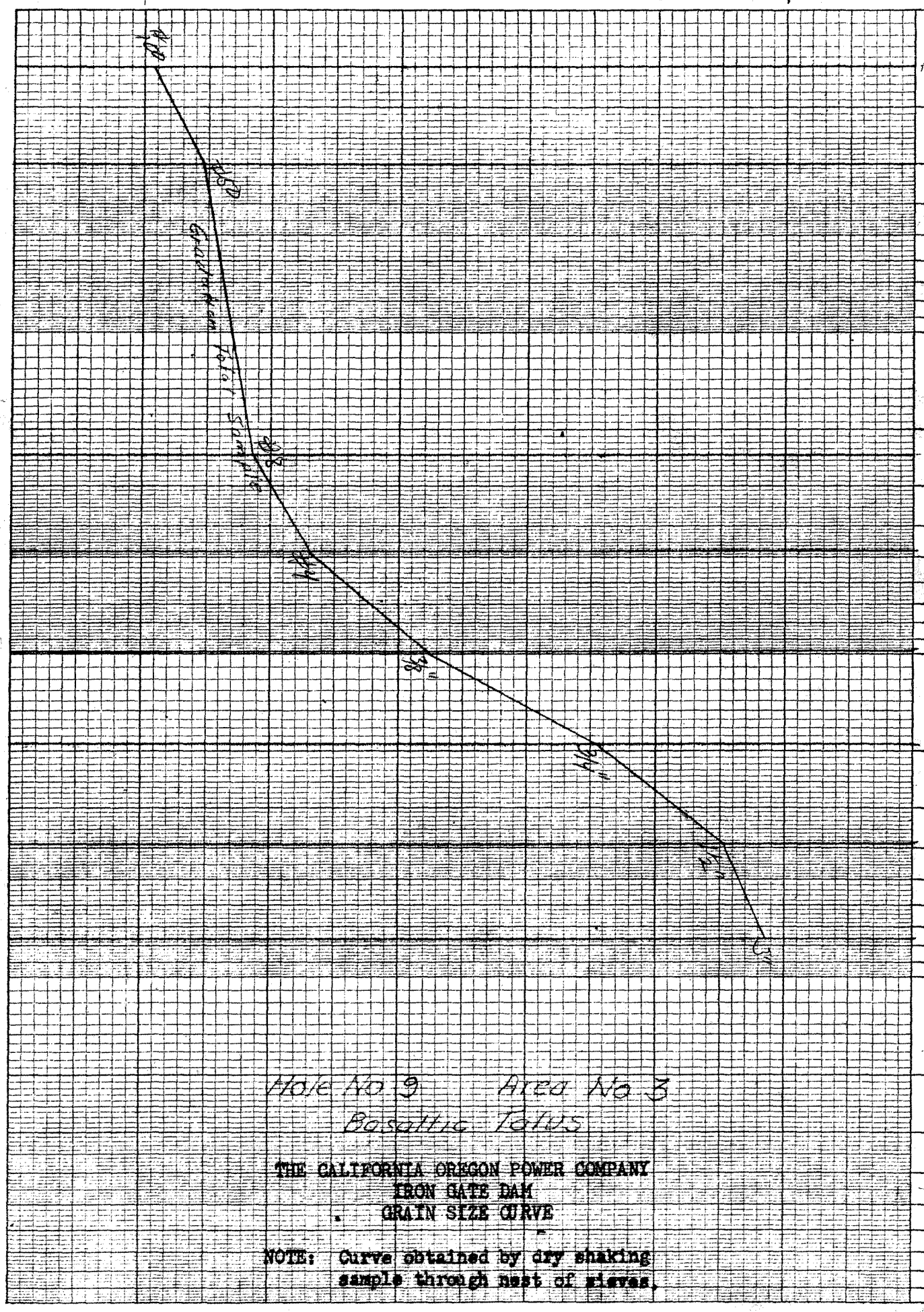


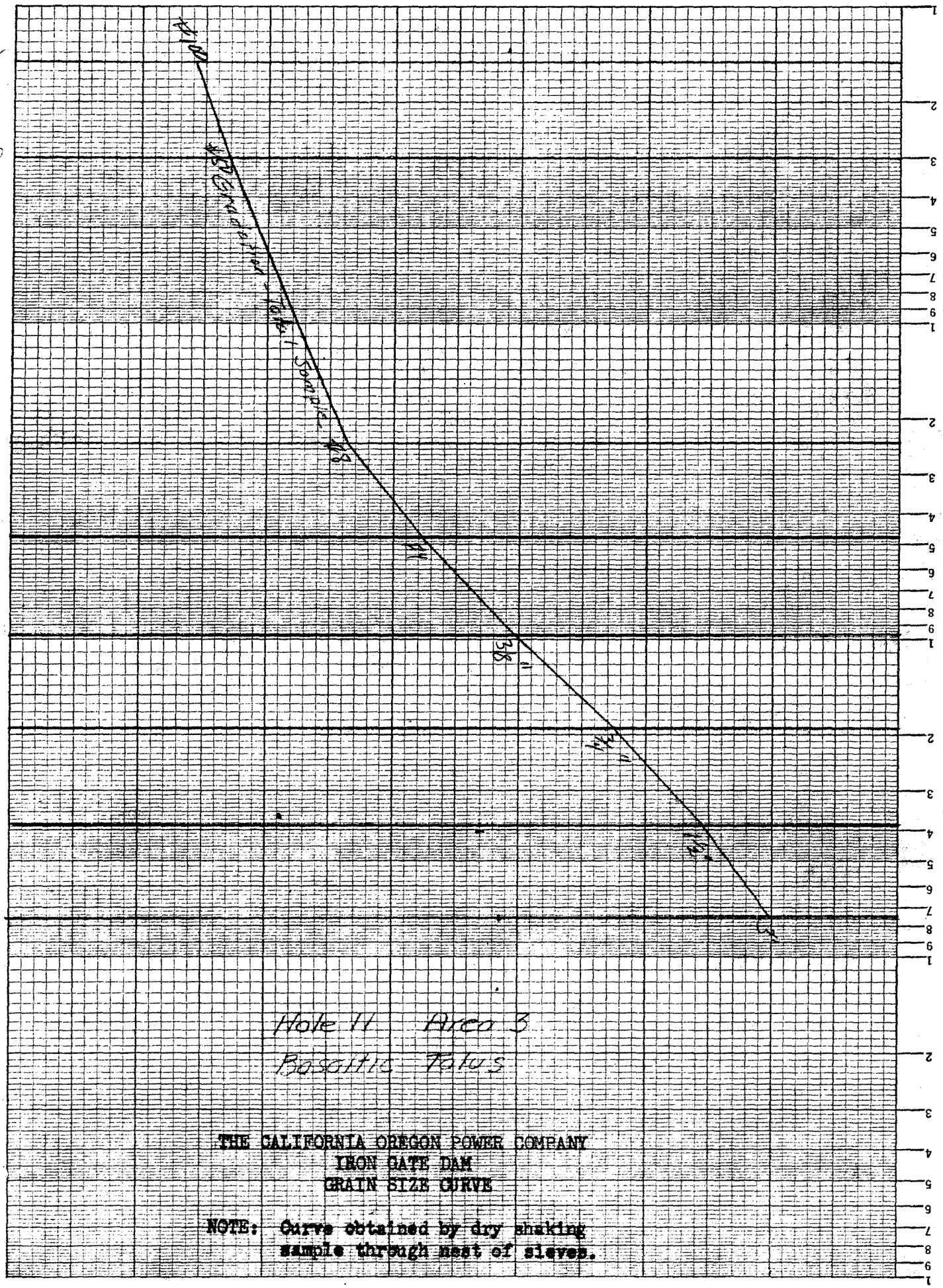
Pit 1 Dodson Area.
Basaltic Rocks

THE CALIFORNIA OREGON POWER COMPANY
IRON GATE DAM
GRAIN SIZE CURVE

NOTE: Curves obtained by dry shaking sample through nest of sieves.

KEUFFEL & ESSER CO., N. Y. NO. 358-81G
Semi-Logarithmic, 4 Cycles × 10 to the inch.
MADE IN U.S.A.


Hole No 9
Area No 3
Basaltic Talus
THE CALIFORNIA OREGON POWER COMPANY
IRON GATE DAM
GRAIN SIZE CURVE
NOTE: Curve obtained by dry shaking sample through nest of sieves.
KEUFFEL & ESSER CO., N. Y. NO. 359-81G
Semi-Logarithmic, 4 Cycles X 10 to the inch.
MADE IN U. S. A.



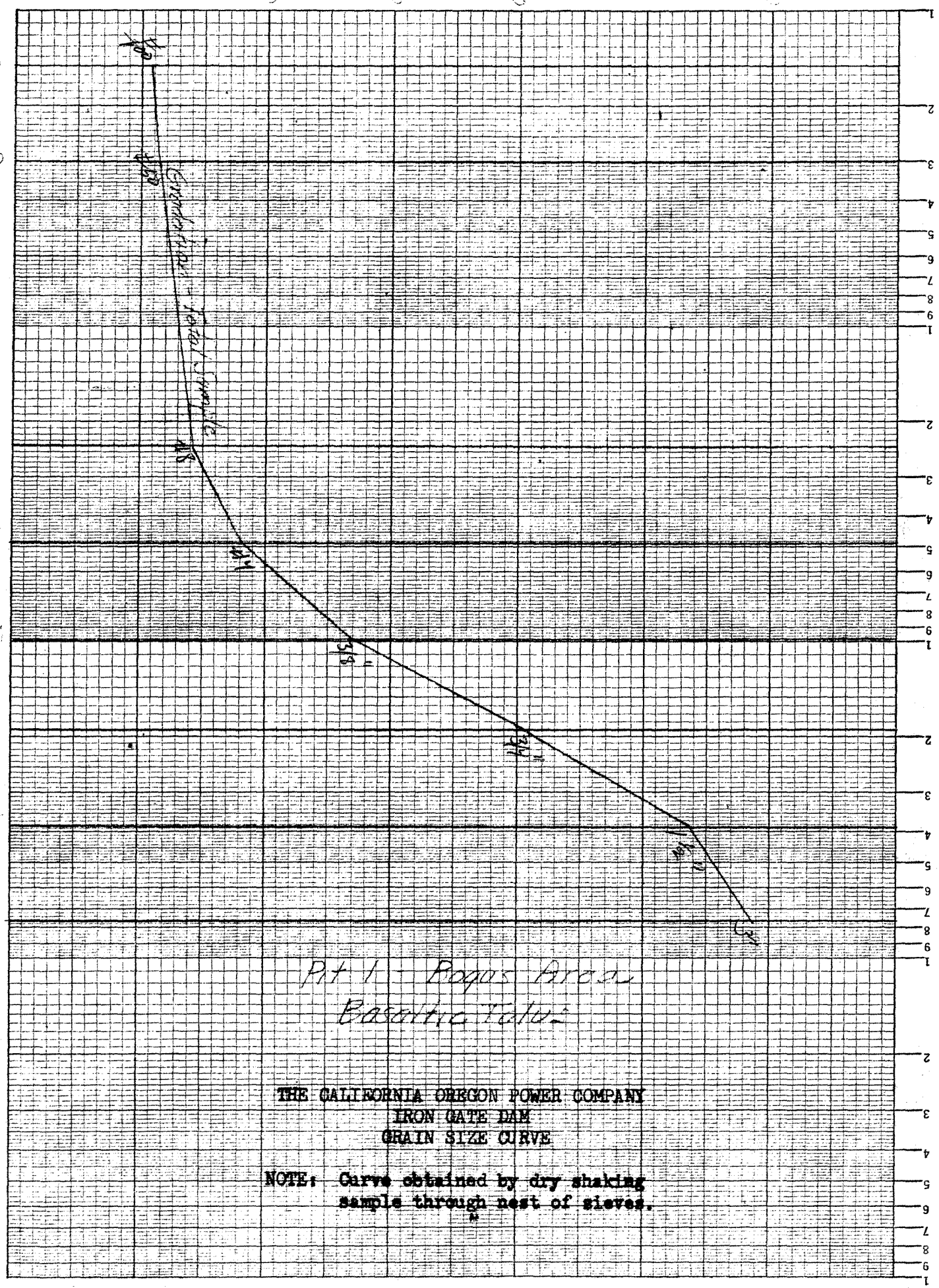
Hole 11 Area 3

Bauxitic Tuff

THE CALIFORNIA OREGON POWER COMPANY
IRON GATE DAM
GRAIN SIZE CURVE

NOTE: Curve obtained by dry shaking sample through nest of sieves.

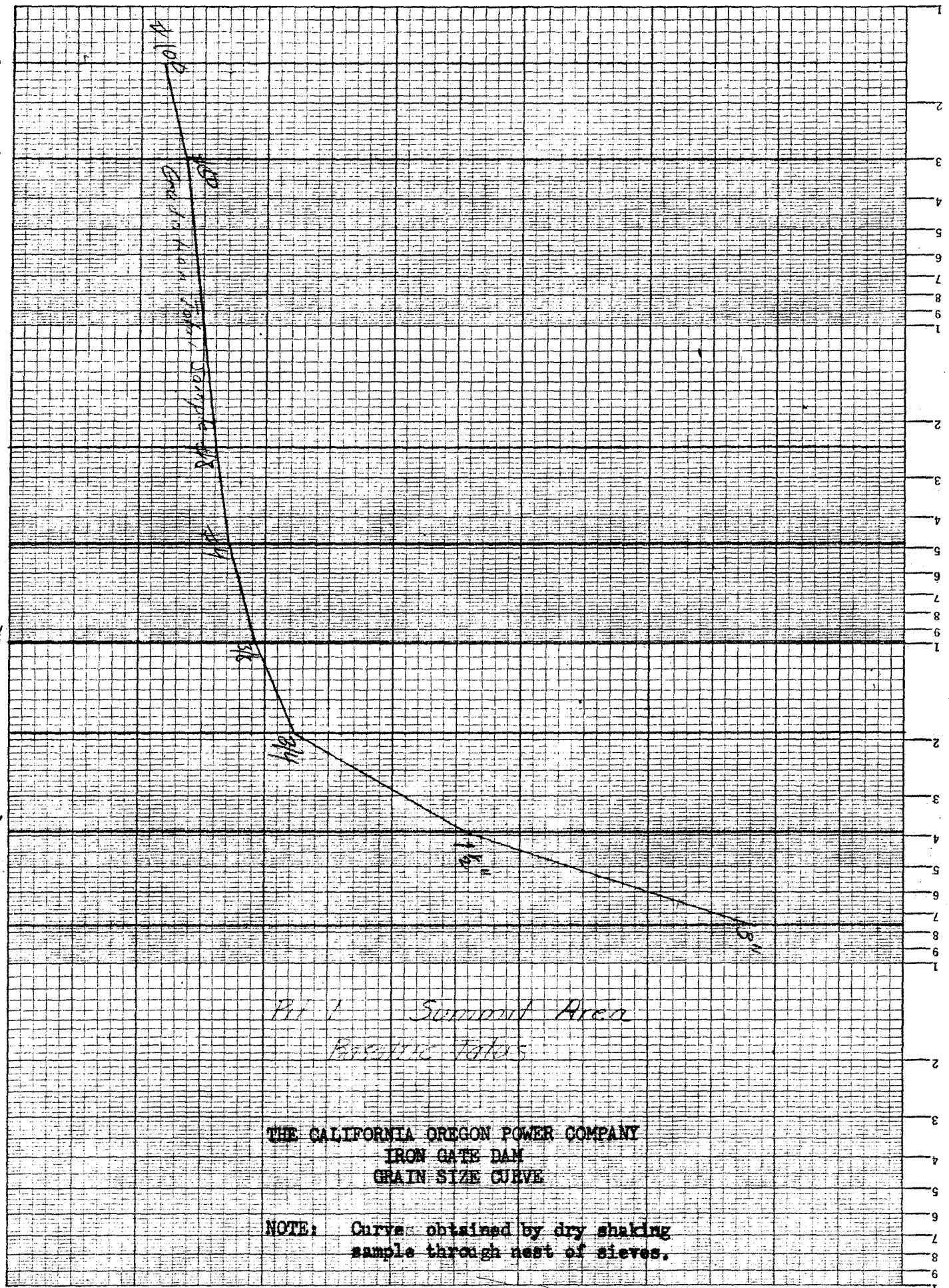
KEUFFEL & ESSER CO., N. Y. NO. 359-81G
Semi-Logarithmic, 4 Cycles × 10 to the inch.
MADE IN U.S.A.



THE CALIFORNIA OREGON POWER COMPANY
IRON GATE DAM
GRAIN SIZE CURVE

NOTE: Curve obtained by dry shaking sample through nest of sieves.

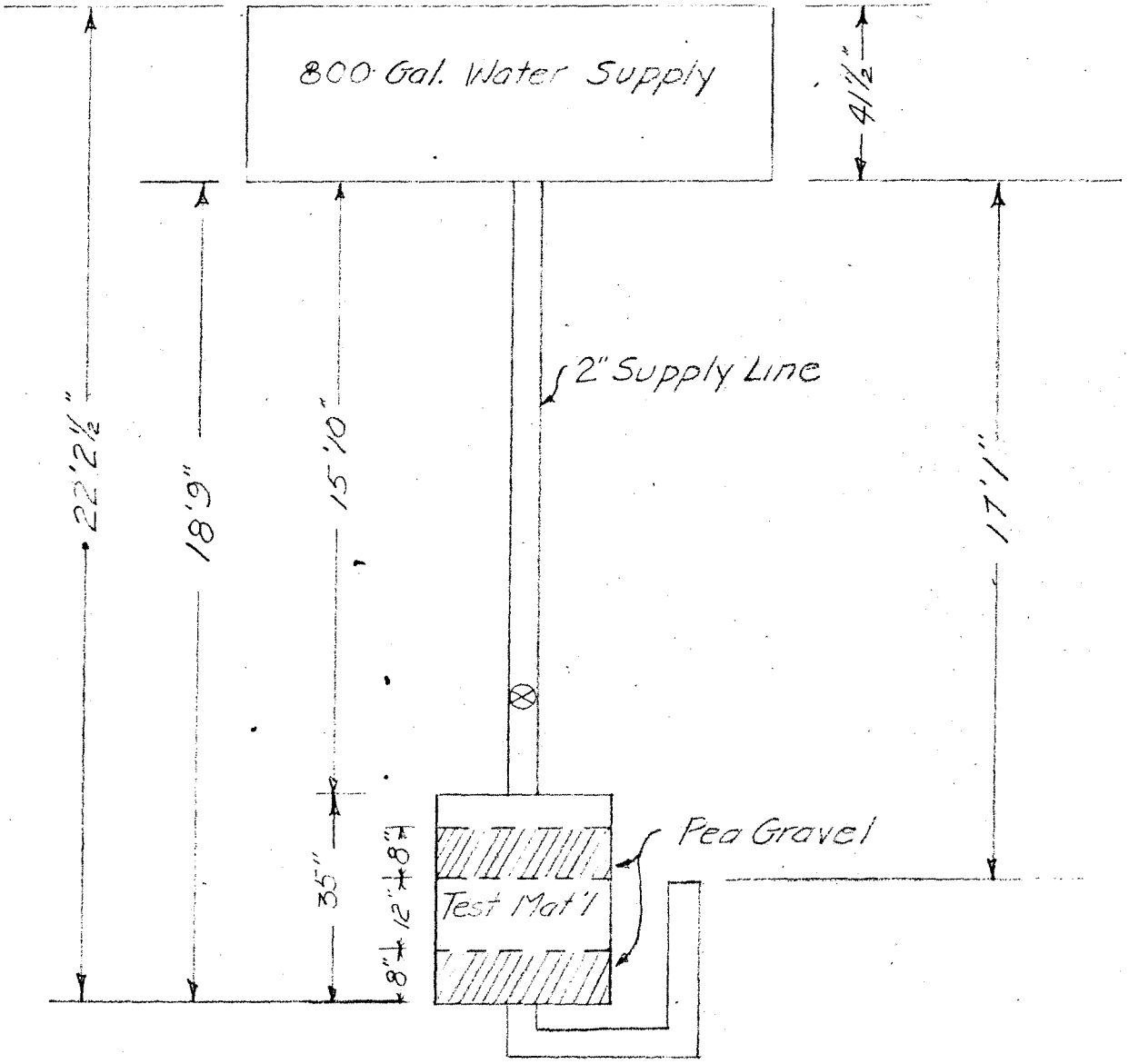
KEUFFEL & ESSER CO., N. Y. NO. 359-81G
Semi-Logarithmic, 4 Cycles × 10 to the Inch.
MADE IN U. S. A.



THE CALIFORNIA OREGON POWER COMPANY
IRON GATE DAM
GRAIN SIZE CURVE

NOTE: Curve obtained by dry shaking sample through nest of sieves.

KEUFFEL & ESSER CO., N. Y. NO. 359-81G
Semi-Logarithmic, 4 Cycles X 10 to the inch.
MADE IN U. S. A.



Permeability Test Method

No Scale.

Iron Gate Project

DRAWN BY				J. O.
TRACED BY				J. O. REQ.
CHECKED BY				MAP NO.
APPROVED BY	SEC.	TWP.	RANGE	AREA
SCALE	SCHOOL DIST.		ROAD DIST.	RURAL ☐ URBAN ☐
DATE 7-20-60	THE CALIFORNIA OREGON POWER COMPANY			C 8560

BRANCH LABORATORY 1086 MARTIN AVENUE • SANTA CLARA • CHERRY 8-5262
BRANCH OFFICE 61 JORDAN STREET • SAN RAFAEL • GLENWOOD 4-8650
CABLE HANX

ABBOT A. HANKS, INC.
ESTABLISHED 1868
1300 SANSOME STREET • SAN FRANCISCO 11, CALIFORNIA • EXBROOK 7-2364

Engineers
Assayers
Chemists
Metallurgists
Spectrographers
Soils and Foundations
Consulting · Testing · Inspecting

File No. 1732.2
Lab. No. 52348

August 8, 1961

The California Oregon Power Company
Iron Gate Project
Post Office Box 201
Hornbrook, California

Re: Iron Gate Dam - P. O. #39636
Soil Tests, Sample 16+00 300' L

Gentlemen:

Based on tests of four specimens compacted in the range of 81 to 82 lb per cu ft, it appears that the intergranular strength factors of the above sample in a consolidated shear test with pore pressures measured are as follows:

Friction angle	11½ - 15½ degrees
Cohesion	450 - 800 lb/sq ft.

This soil is a highly plastic, impervious clay. Consolidation was extremely slow, requiring 10 days to complete the consolidation and saturation of each 2 in. diameter by 4 in. length specimen. An extremely long seasoning period was also necessary to attain uniformity of moisture content prior to compaction of specimens at the specified moisture content.

We are proceeding with tests of Sample 12+00 400' L, and will submit details of all tests upon completion.

Very truly yours,

ABBOT A. HANKS, INC.

L. O. Long

LOL:hms
Reports to:
3-Iron Gate Project, Hornbrook, Calif.
1-The California Oregon Power Company, Medford, Ore.

BRANCH LABORATORY: 1086 MARTIN AVENUE • SANTA CLARA • CHERRY 8-5262
BRANCH OFFICE: 61 JORDAN STREET • SAN RAFAEL • GLENWOOD 4-8650

CABLE: HANX

ABBOT A. HANKS, INC.
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Engineers
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Chemists
Metallurgists
Spectrographers
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1300 SANSOME STREET • SAN FRANCISCO 11, CALIFORNIA • EXBROOK 7-2464

File No. 1732.2
Lab. No. 52348, 52871

October 20, 1961

Mr. M. L. Warren
Assistant Chief Engineer
The California Oregon Power Co.
216 Main Street
Medford, Oregon

Re: Iron Gate Project Samples

Dear Mr. Warren:

Attached are the findings from triaxial shear tests performed on soil samples marked "12+00, 400'L", and "16+00, 300'L".. The triaxial tests were performed in the same manner as described in our letter of June 29, 1960.

Complete saturation was not attained in the tests because, when confined under the higher lateral pressures, the specimens were virtually impermeable, and complete saturation could not be attained even by application of a high vacuum on the top of the specimens and a small positive pressure on the base.

You will note that we did not submit data for a specimen of sample 16+00, 300'L at 80 psi chamber pressure. The data for this specimen was not consistent with the remainder of the test data, and it appears likely that there was leakage of the membrane during the test. If you feel that a repetition

of the test at 80 psi would serve a useful purpose, we should be pleased to repeat the test.

We should be pleased to discuss any questions in connection with these tests.

Very truly yours,

ABBOT A. HANKS, INC.

L. O. Long

LOL:hms
Encls.
Reports to:
3-The California Oregon Power Co.

Iron Gate Project
The California Oregon Power Company
File No. 1732.2

Abbot A.Hanks, Inc.
Lab. No. 52348
October 17, 1961

TABLE NO. I

Sample: 16 + 00 300'L.
Soil Type: Dark yellow-brown clay.

Sample	A	B	C	D
Chamber Pressure, psi	15.5	15	50	50
Unit Dry Weight at Compaction, lb/ft^3	81.3	81.2	82.7	82.5
Moisture Content at Compaction, %	25.0	24.6	24.2	23.7
Unit Dry Weight at Test, lb/ft^3	76.8	74.7	84.7	84.7
Moisture Content at Test, %	42.3	36.8	--	35.3
Degree of Saturation at Test, %	94	80	--	97
Maximum Deviator Stress, psi	15	18	43	35
Pore Pressure at Maximum Deviator Stress, psi	6	4	1	2

Iron Gate Project
The California Oregon Power Company
File No. 1732.2

Abbot A. Hanks, Inc.
Lab. No. 52871
October 17, 1961

TABLE NO. II

Sample: 12 + 00, 400'L.
Soil Type: Very dusky red clay.

Sample	A	B	C
Chamber Pressure, psi	15	50	80
Unit Dry Weight at Compaction, lb/ft^3	88.6	86.7	86.9
Moisture Content at Compaction, %	24.5	23.5	24.5
Unit Dry Weight at Test, lb/ft^3	81.6	89.2	91.0
Moisture Content at Test, %	36.3	30.7	27.2
Degree of Saturation at Test, %	89	94	86
Maximum Deviator Stress, psi	16	48	81
Pore Pressure at Maximum Deviator Stress, psi	1	4	1

hms

10 X 10 TO THE CM. KEUFFEL & ESSER CO. 359-14G

Sample 16+00, 300'L

MOHR DIAGRAM

c = 3-5½ psi
ϕ = 11-15°



Iron Gate Dam
File No. 1732.2

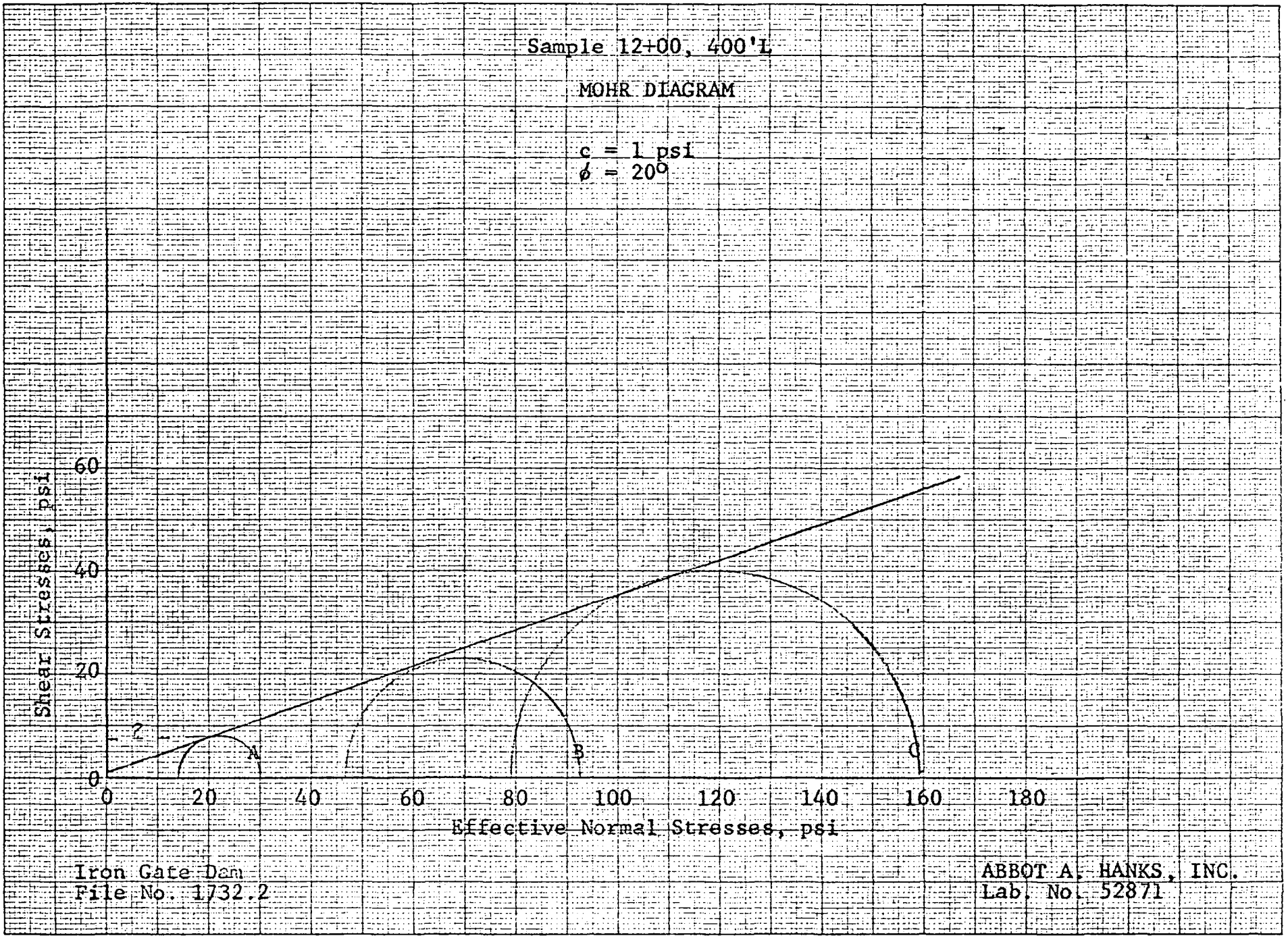
ABBOT A. HANKS, INC.
Lab. No. 52348

K&E 10 X 10 TO THE CM. KEUFFEL & ESSER CO. 359-14G

Sample 12+00, 400'L

MOHR DIAGRAM

c = 1 psi
ϕ = 20°



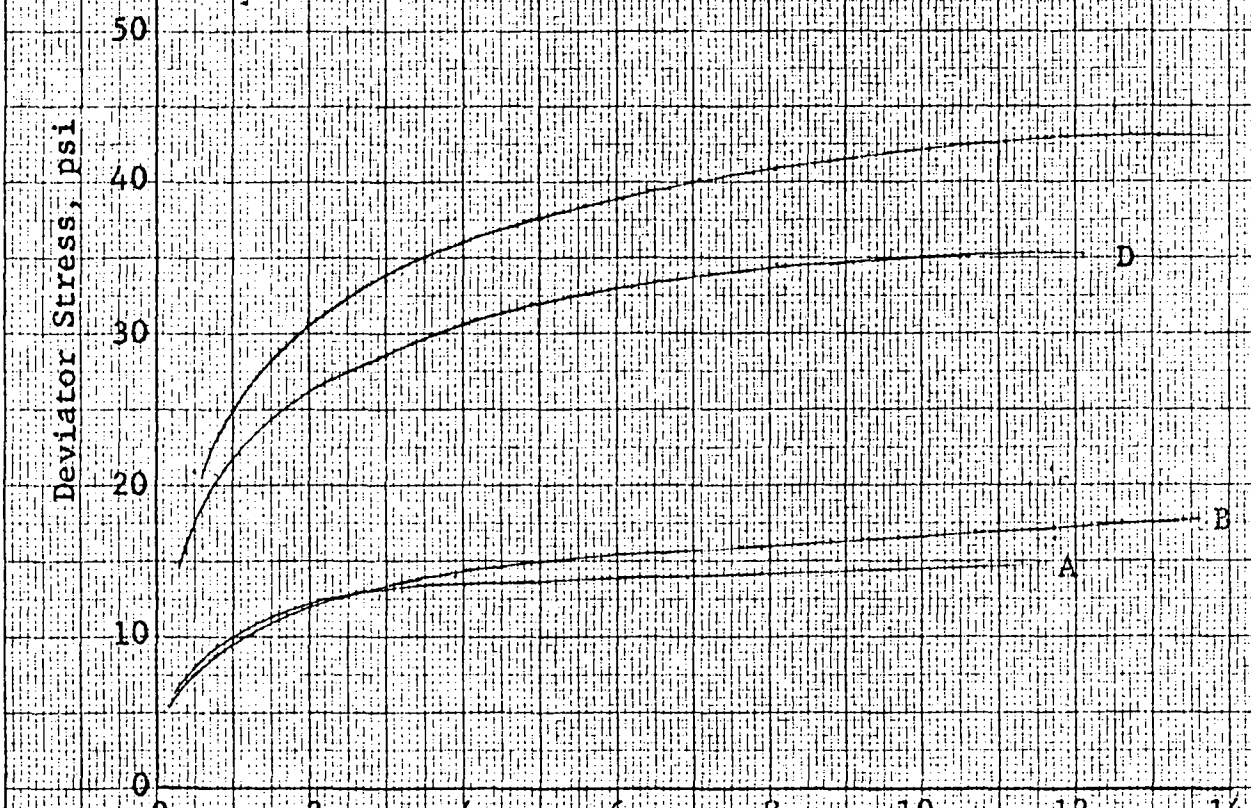
Iron Gate Dam
File No. 1732.2

ABBOT A. HANKS, INC.
Lab. No. 52871

Sample 16-00, 300'L

TRIAXIAL SHEAR TEST

Stress-Strain Relationships



Iron Gate Dam
File No. 1732.2

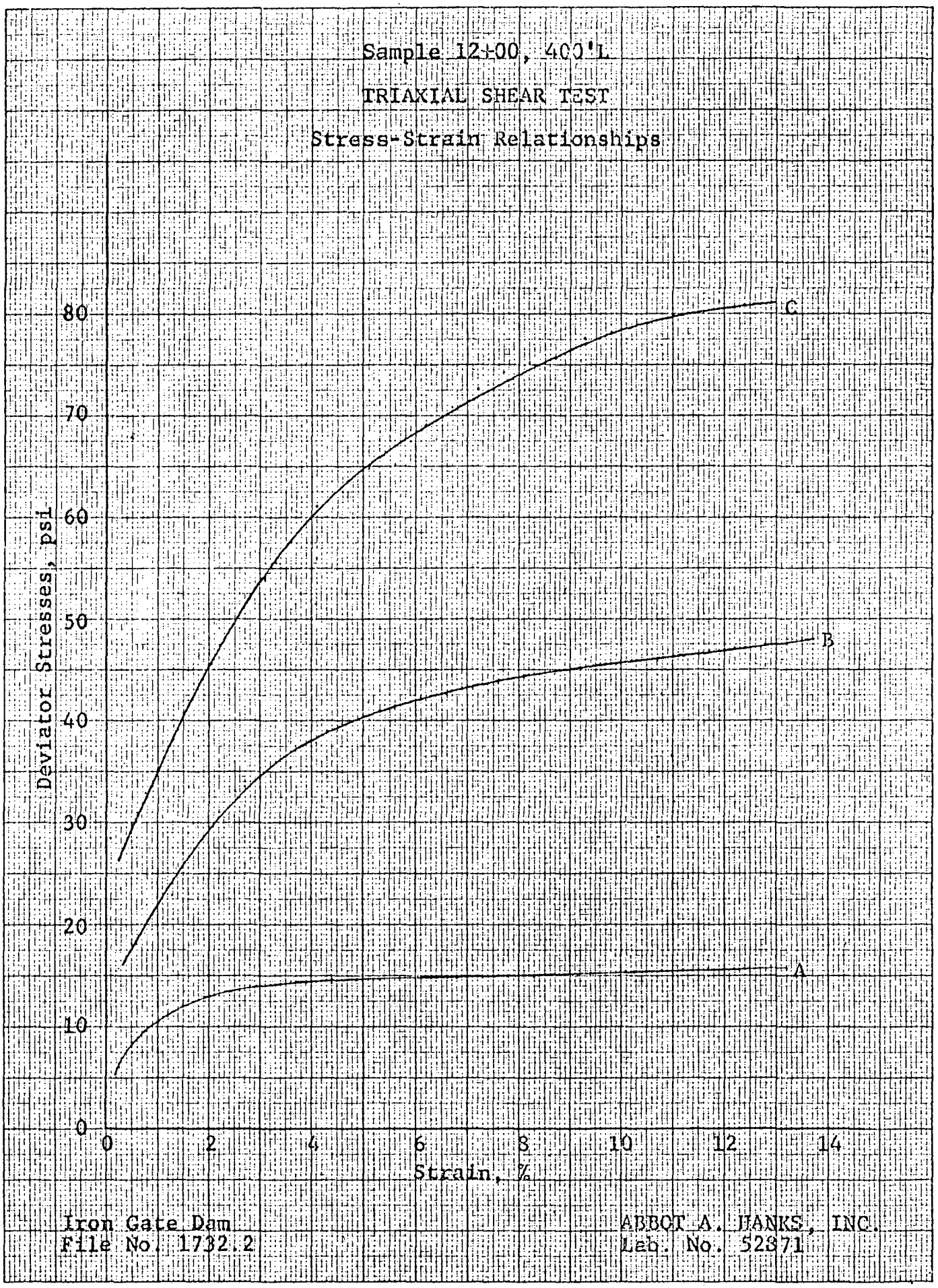
ABBOT A. HANKS, INC.
Lab. No. 52348

359-140
10 X 10 TO THE CM
KEUFFEL & ESSER CO.

Sample 12+00, 400'L

TRIAXIAL SHEAR TEST

Stress-Strain Relationships



Iron Gate Dam
File No. 1732.2

ABBOT A. HANKS, INC.
Lab. No. 52371

10 X 10 TO THE CM. 359-14G
KEUFFEL & ESSER CO.

Attachment B Falling Head Permeability Tests

Undrained, consolidated triaxial shear tests with pore pressure measurements, consolidation tests, and constant head permeability tests were performed on representative samples of material for each hole by Abbot A. Hanks Laboratory in San Francisco. Before each test the material was compacted to near optimum moisture and maximum dry density. The results of these tests are shown in Abbot A. Hanks report as Plate IV. For convenient reference, the permeability coefficient, the angle of internal friction and cohesion for the material from each hole are tabulated below:

HOLE NO.	COHESION p.s.i.		ANGLE OF INTERNAL FRICTION	PERMEABILITY FT/YEAR Less than	COEFFICIENT CM/SEC Less than
		psf			
1.	9	1300	10°	.01	10-8
2.	6	860	17°	-	-
3.	10	1440	14°	.01	10-8
4.	4	580	30°	.01 - .04	1-4 x 10-8
7.	5	720	21°	.01	10-8
8.	3	430	16°	.01	10-8
11.	4	580	20°	.01	10-8

844 psf) 128 (18° av.

The quantities of the impervious materials available in Areas "A" and "5", are estimated to be 264,000 cubic yards. The quantities in Area "1" are estimated to be 57,000 dubic yards. However, most of Area "1" will be inundated by backwater from the construction of the cofferdam so, in order to utilize this material, it will be necessary that it be stockpiled, which does not seem practical.

2. Pervious Shell Materials

Two types of pervious materials were investigated:

A. Gravels in the flood plain of the river in Areas "1" and "5"

B. Talus deposits of basaltic rock in Area "3", Bogus Creek Area, Summit Area and Dodson Area.

Sample Area "1"	% Passing #100 Sieve	% Moisture	Dry Density Lbs/cu ft	Wet Density Lbs/cu ft	Permeability Coefficient Ft/Day
Pit 2, 1-14' Depth	15	8	119.5	129.2	11.1
Pit 3, 3-12' "	21	7	128.5	138.2	17.6
Area "5"					
Pit 2, 2-16' Depth	9	9	129.5	141.5	12.6
Pit 3, 2-12' "	14	9	137.5	151.0	.59
Pit 4, 4-20' "	33	11	105.0	118.0	8.94
Pit 5, 4-16' "	3	9	125.0	137.0	3.95

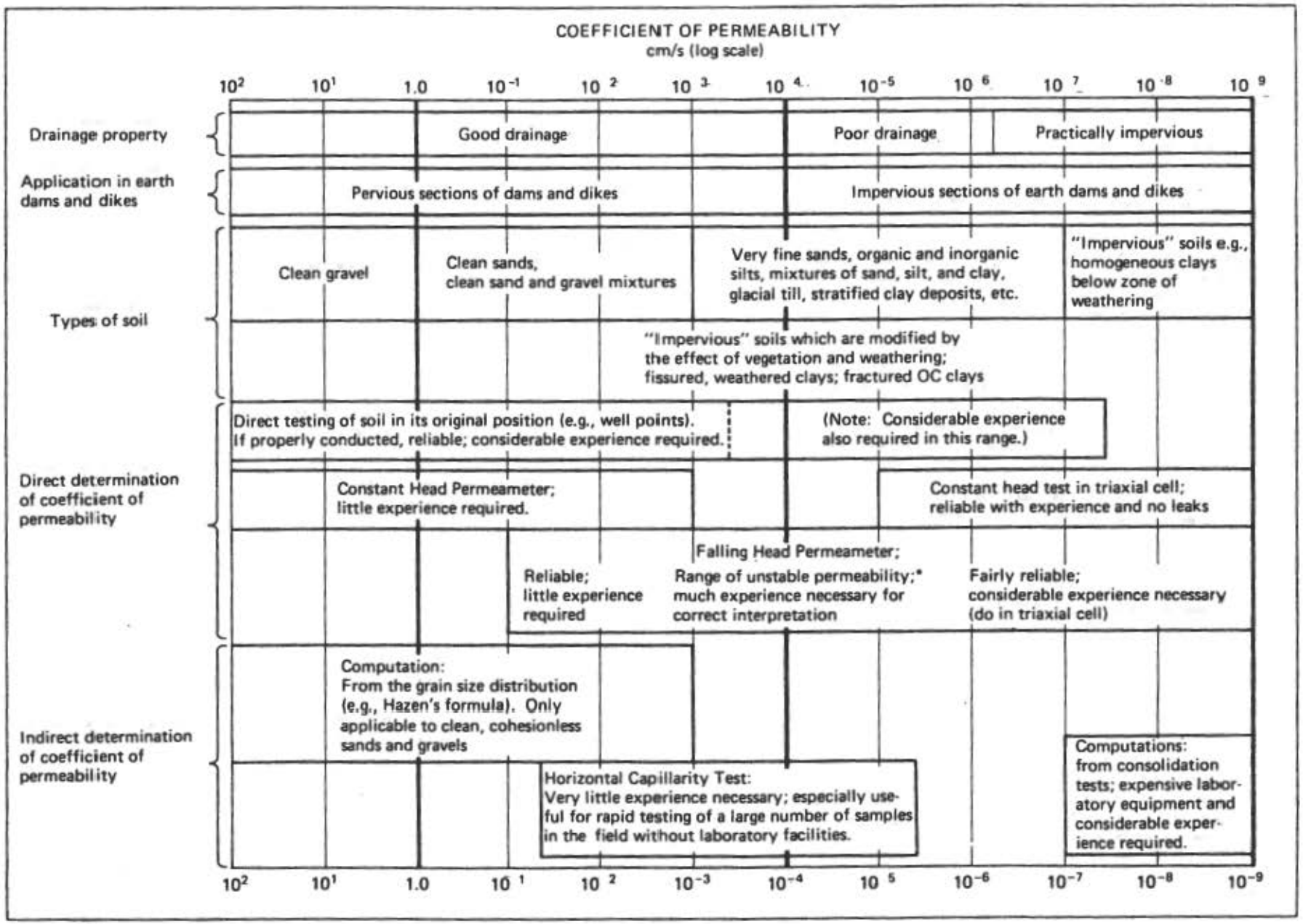
The estimated quantity of gravel materials in Area "1" is 90,000 cubic yards, which can be obtained without stockpiling the impervious material overlining the gravels, and in Area "5", is 381,000 cubic yards, making a total of 471,000 cubic yards.

Talus deposits.

The talus material was tested in a manner similar to that described in the section headed "Gravels". No settlement was noted after the permeability test on any of the samples of talus material. The results of the grain size distribution tests are shown on Drawing C-8563, Sheets 7 through 11, and attached hereto as Plate V. The results of the permeability tests are tabulated below:

Sample Area "3"	% Passing #100 Sieve	% Moisture	Dry Density Lbs/cu ft	Wet Density Lbs/cu ft	Permeability Coefficient Ft/Day
Hole 9, 0-12' Depth	7	8	125.2	135.5	21.2
Hole 11, 0-6' "	9	13	116.5	134.0	5.45
Dodson Area					
Pit 1, 0-10' Depth	2	7	118.5	127.2	19.2
Bogus Area					
Pit 1, 10' Depth	8	8	113.3	124.0	10.5
Pit 1, 0-9' "	2	9	112.2	122.5	25.9
Summit Area					
Pit 1, 0-7' Depth	4	9	117.5	128.5	9.65

Attachment C Typical Permeability Ranges



*Due to migration of fines, channels, and air in voids.

Attachment D Direct Shear Test Results

Direct shear tests were performed on each sample by Pittsburgh Laboratories. Results were unobtainable on Type 3 and Type 4 because of shear ring binding and mechanical interlocking of coarse sand particles. It is felt however that the shearing resistance of Types 3 and 4 is very similar to Types 2 and 3 and therefore may be used in design. The shear resistance of Types 1 and 2 are as follows:

Type No.	1	2	Avg.
Cohesion (Tons/sq/ft/)	.37	1.64	1.00
Angle of Internal Friction (ϕ)	34.4°	19.4°	26.9°

A stability analysis was made using approximate methods, the above average test values and the section shown on Plate V. This analysis indicates that a factor of safety of approximately 2.25 will be obtained.

The volume of the material available as determined from the drill holes is as follows:

Types 1, 2 and 3 - 96,000 cubic yards
" 4 - - - - - - 55,000 " "

Field observation indicates that additional material is available on the borders of the areas drilled which is similar to the material tested.

CONCLUSIONS:

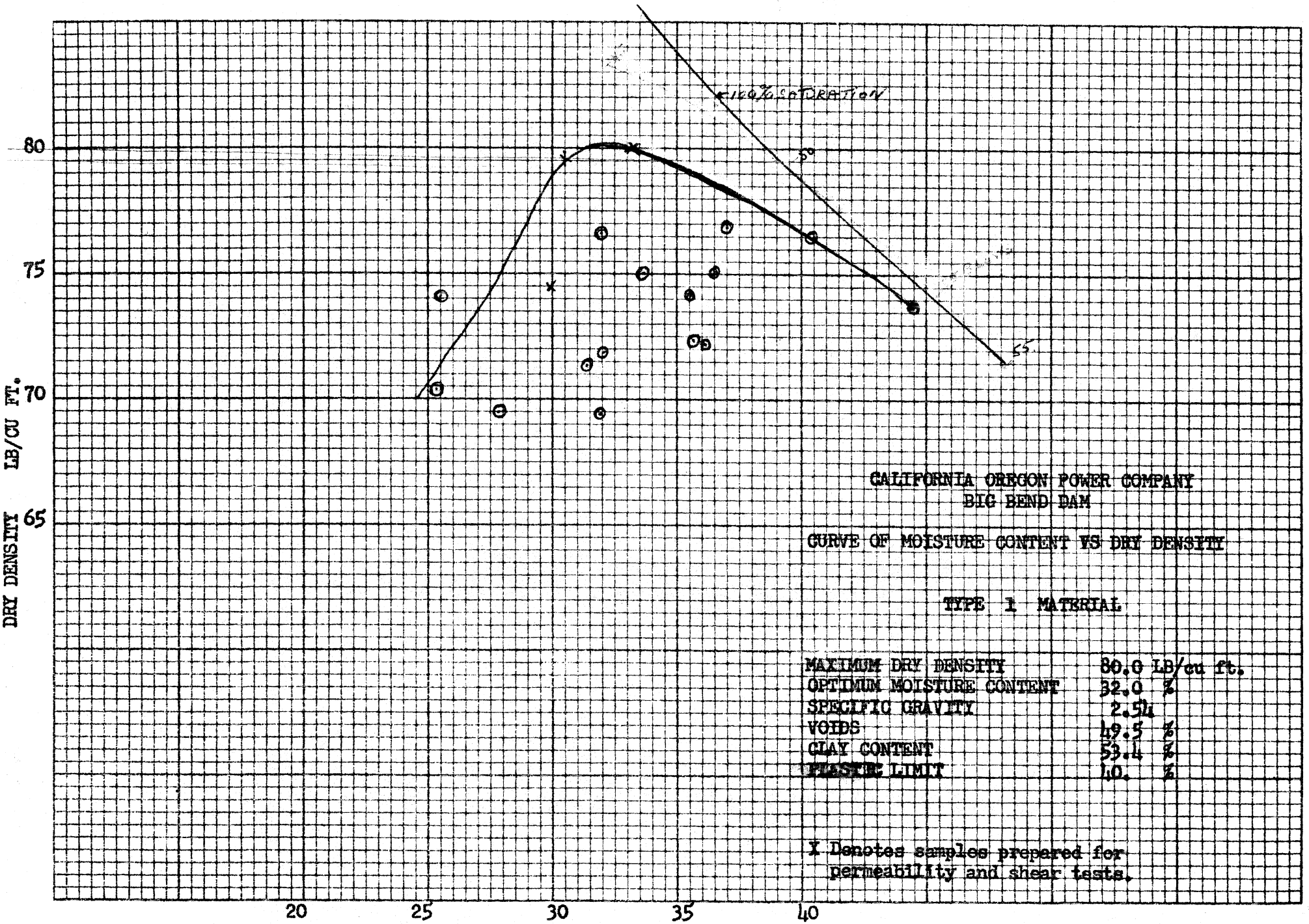
It is concluded that the earthen embankment of Big Bend Dam may be constructed of the materials which have been analyzed in this report to the approximate typical section as shown on Plate V, and to specifications attached hereto entitled "Earthwork Specifications for Big Bend Dam" and labelled "Appendix 1".

The impervious core of the embankment, Zone 1, should be constructed of the materials classified in this report as Types 1, 2 and 3. The moisture content of these materials is about 25% and the maximum dry density between 85 and 95 lbs per cubic foot. The "yardstick" for construction should be set for this section at 25% moisture and 90 lbs per cubic foot. As construction progress is made, the "yardstick" may be varied to more closely conform to field results.

Zone 2 of the embankment, the semi-pervious section, should be constructed of the material classified as Type 4. The optimum moisture content of this material is about 18% with a dry density, including the gravel, of 128 lbs per cubic foot. Again, as field results are obtained, this "yardstick" may be varied.

Attachment E Compaction Test Results

PLATE III - Sheet No. 1



CALIFORNIA OREGON POWER COMPANY
BIG BEND DAM

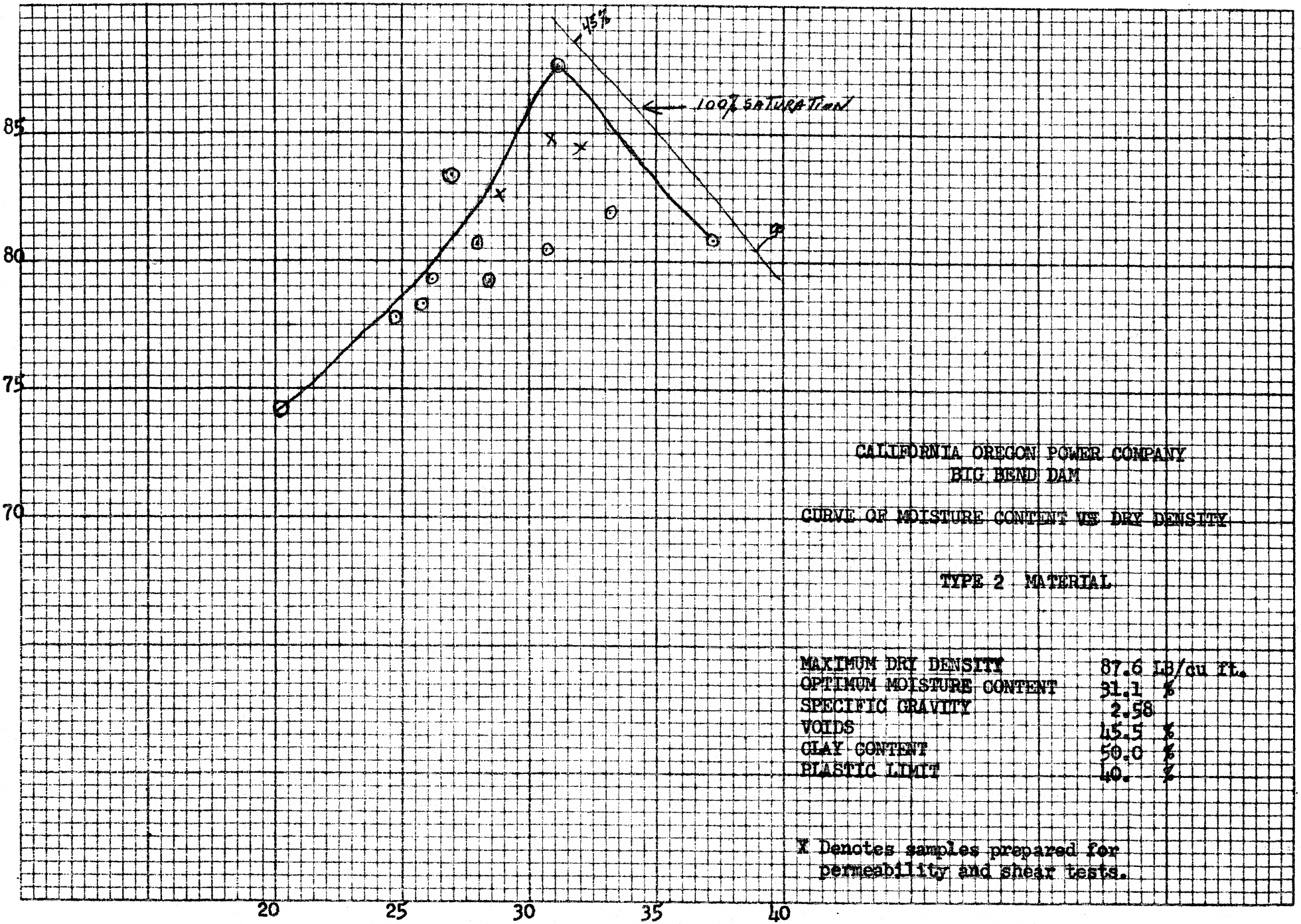
CURVE OF MOISTURE CONTENT VS DRY DENSITY

TYPE 1 MATERIAL

MAXIMUM DRY DENSITY	80.0 LB/cu ft.
OPTIMUM MOISTURE CONTENT	32.0 %
SPECIFIC GRAVITY	2.54
VOIDS	49.5 %
CLAY CONTENT	53.4 %
PLASTIC LIMIT	40. %

X Denotes samples prepared for permeability and shear tests.

No. 511-10 10 x 10 to 1"
The A. Hirsh Co., San Francisco
Made in U.S.A.



CALIFORNIA OREGON POWER COMPANY
BIG BEND DAM

CURVE OF MOISTURE CONTENT VS DRY DENSITY

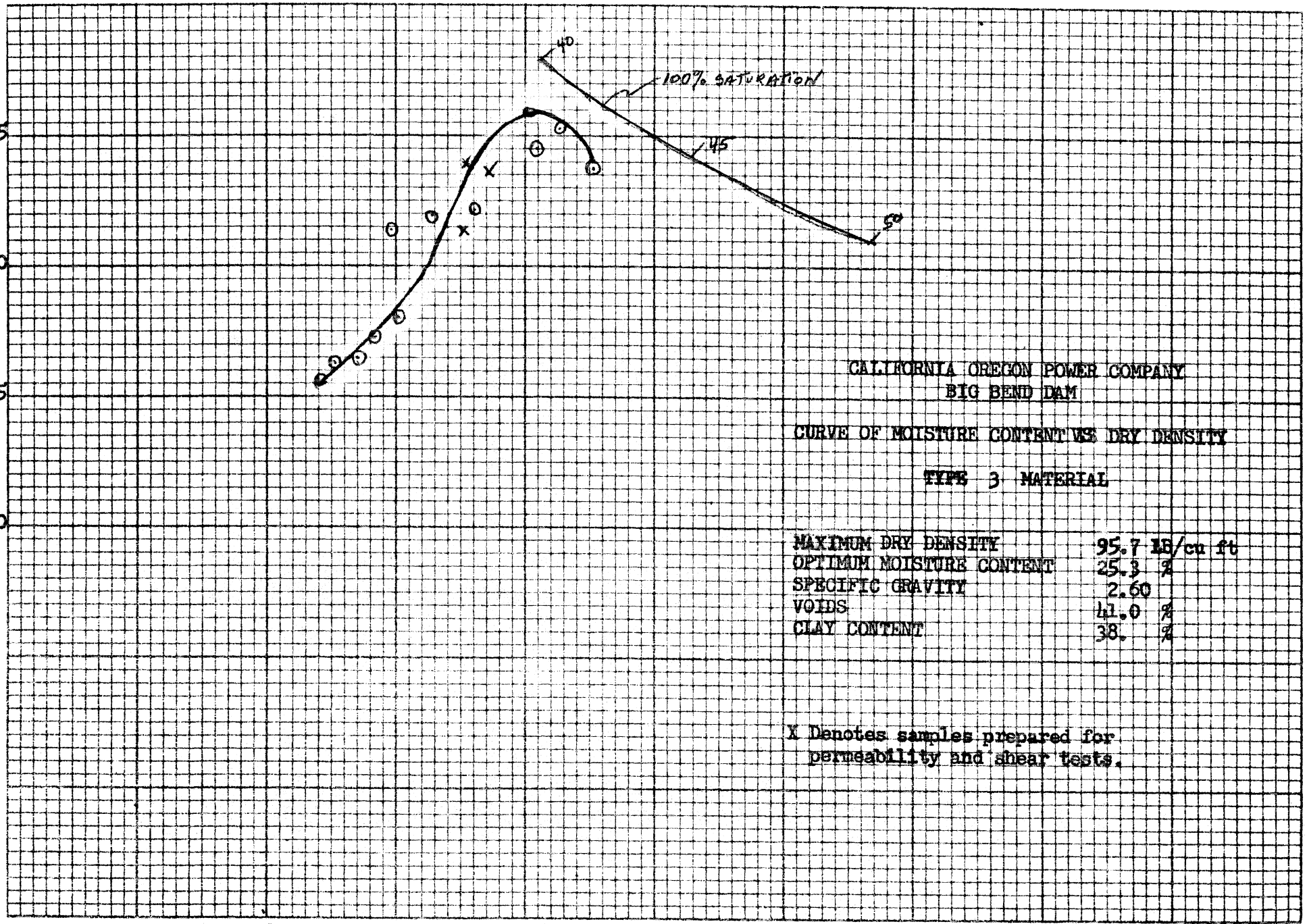
TYPE 2 MATERIAL

MAXIMUM DRY DENSITY	87.6 LB/cu ft.
OPTIMUM MOISTURE CONTENT	31.1 %
SPECIFIC GRAVITY	2.58
VOIDS	45.5 %
CLAY CONTENT	50.0 %
PLASTIC LIMIT	40. %

X Denotes samples prepared for permeability and shear tests.

PLATE III - Sheet No. 2

No. 511-10 10 x 10 to 1"
The Alvin Co., San Francisco
Made in U.S.A.



CALIFORNIA OREGON POWER COMPANY
BIG BEND DAM

CURVE OF MOISTURE CONTENT VS DRY DENSITY

TYPE 3 MATERIAL

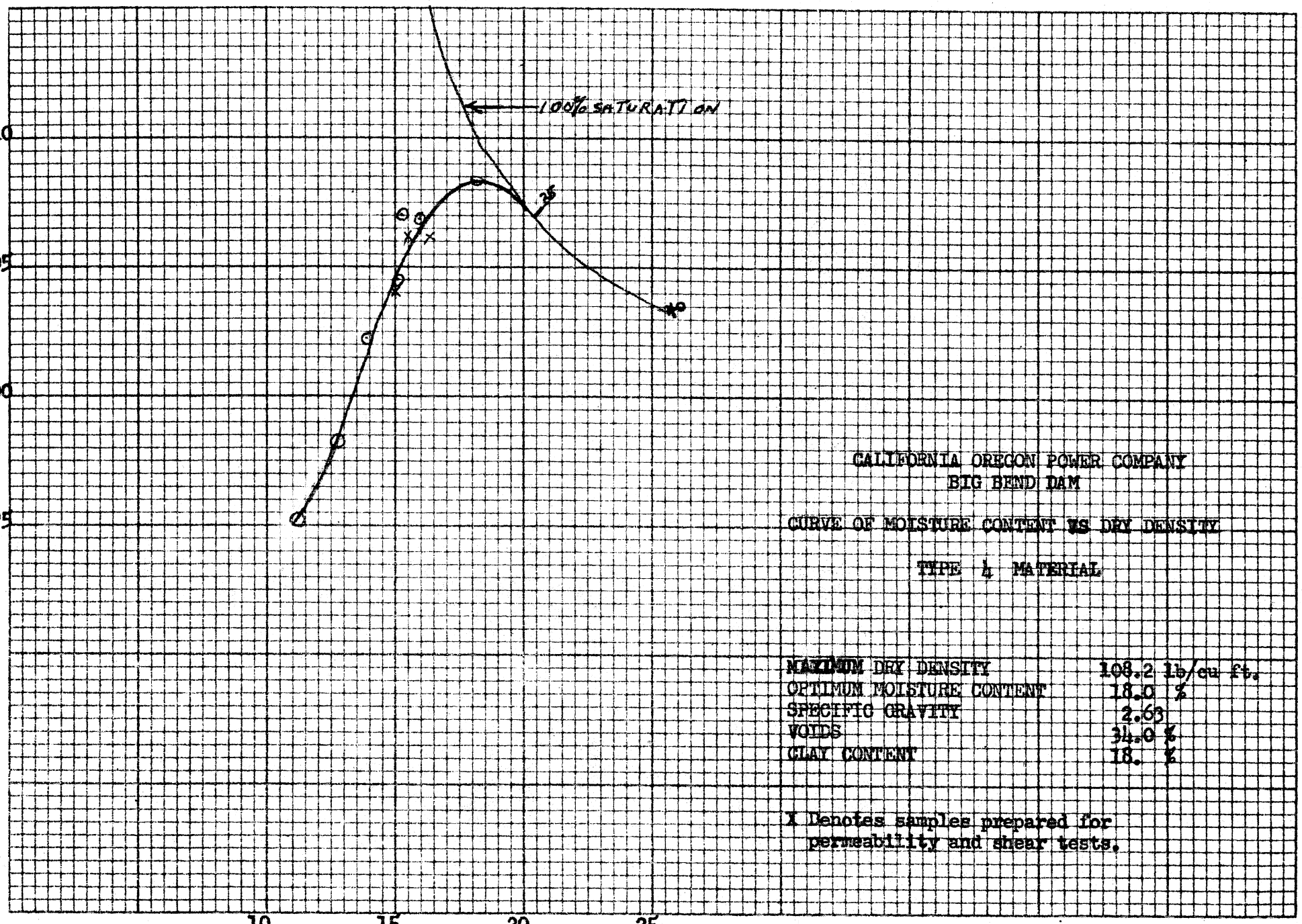
MAXIMUM DRY DENSITY	95.7 LB/cu ft
OPTIMUM MOISTURE CONTENT	25.3 %
SPECIFIC GRAVITY	2.60
VOIDS	41.0 %
CLAY CONTENT	38. %

X Denotes samples prepared for permeability and shear tests.

PLATE III - Sheet No. 3

No.811-10 10 x 15 to 1"
The Alliance Co., San Francisco
Made in U.S.A.

PLATE III - Sheet No. 4



CALIFORNIA OREGON POWER COMPANY
BIG BEND DAM

CURVE OF MOISTURE CONTENT VS DRY DENSITY

TYPE 4 MATERIAL

MAXIMUM DRY DENSITY	108.2 lb/cu ft.
OPTIMUM MOISTURE CONTENT	18.0 %
SPECIFIC GRAVITY	2.63
VOIDS	34.0 %
CLAY CONTENT	18. %

X Denotes samples prepared for permeability and shear tests.

No.911-10 12 x 10 to 1"
The A.Hirsch Co., San Francisco
Made in U.S.A.

Attachment F Permeability Test Results

	In Place Moisture	Clay Content (Percent)	Specific Gravity of Particles	% Finer than #4 Sieve
Avg.	19.7	35	2.64	51
Max.	26.9	48	2.72	63
Min.	14.5	24	2.58	39

Number of Samples - 14.

Note: Material passing the No. 4 sieve was not plastic. Could not roll 1/8" diameter thread due to sand grains. Specific gravity of the rock (larger than #4 sieve) = 2.64.

The curves showing the moisture content dry density relation of the material finer than the No. 4 sieve are shown on Plate III, Sheet #4. At an optimum moisture content of 18%, the dry density was 108.2 lb/cu ft. with 34% voids. When the material passing the No. 4 sieve and the larger material are combined, the theoretical density can be computed as follows:

$$Drs = \frac{Ds\ Dr}{P D_s + (1-P)\ Ds}$$

Where Drs = Theoretical density of combination
Ds = Density of soil
Dr = Density of rock
P = Percentage of rock (expressed as decimal)

$$Drs = \frac{(108.2)\ (62.4)\ (2.64)}{(.49)\ (108.2) + (.51)\ (165)} = 130 \text{ lb/cu ft.}$$

The above value is a theoretical quantity - which normally cannot be obtained in practice due to the interferance to compaction by the rock. A more practical equation is as follows:

$$Drs = (1-P)\ D_s + 0.9\ P\ Dr$$

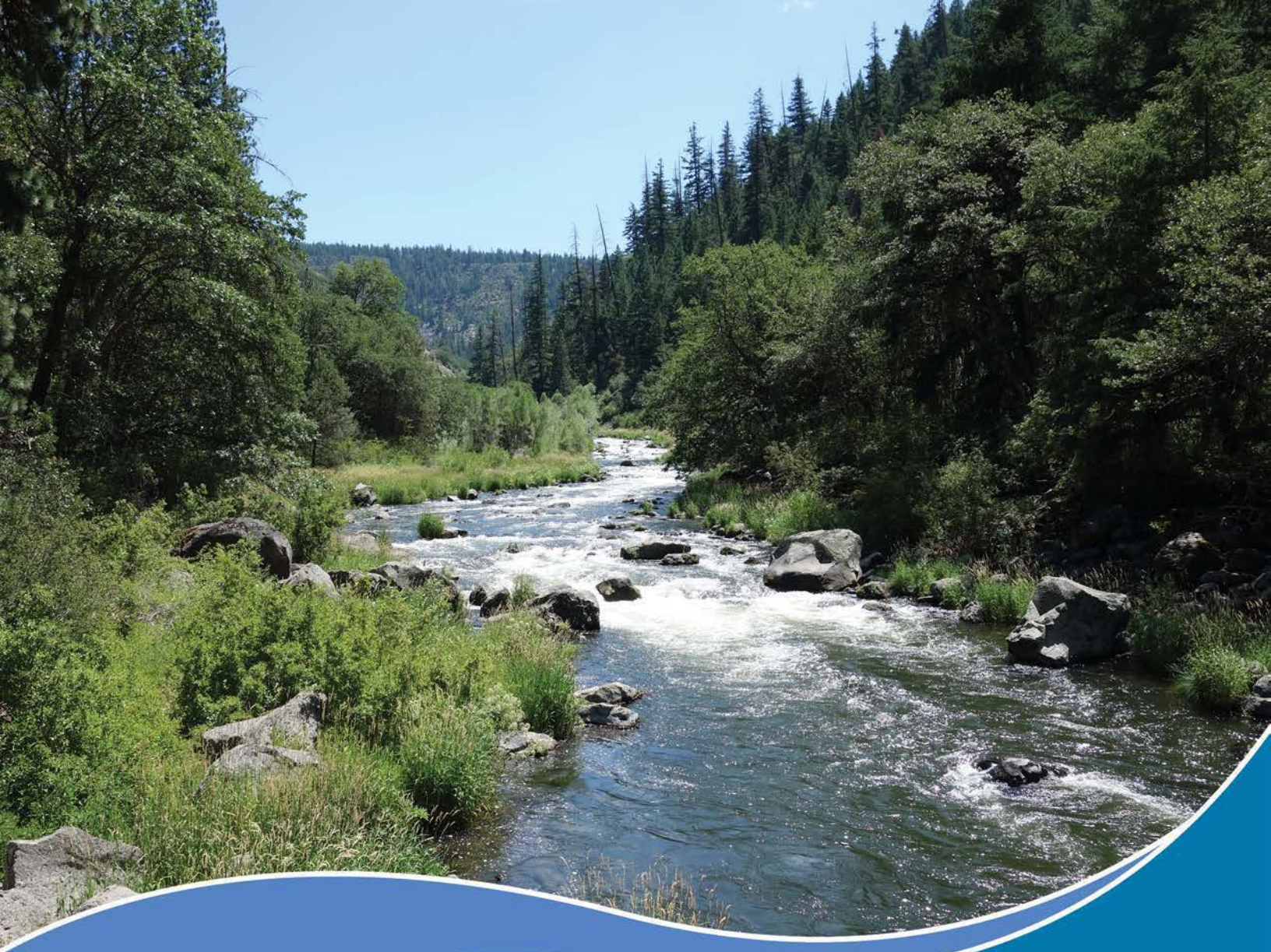
$$Drs = (1-.49)\ 108.2 + 0.9\ (.49)\ (165) = 128 \text{ lb/cu ft.}$$

II. Qualitative capillarity tests were performed on each of the four types of material. The test consisted of placing a 4" diameter by 4" high compacted sample of the material in a pan of water. In each case the sample of material became saturated in approximately 4 hours. After 48 hours, no sloughing or breakdown of the sample had taken place.

Permeability tests by the falling head method were performed on each type of material by Pittsburgh Testing Laboratories. The permeability was determined to be as follows:

Type 1	-	0.0000187	centimeters per second
" 2	-	0.0000155	" " "
" 3	-	0.000226	" " "
" 4	-	0.00000383	" " "

These co-efficients of permeability fall within the impervious sections of earth dams or dikes as classified by Casagrande and Padum, Harvard University. The permeability test on Type No. 4 material was performed on the material passing the No. 4 sieve. While this material seems to have the smallest permeability, the gravel content is so high (50%) as to make the overall material questionable as to watertightness.



Definite Plan for the Lower Klamath Project

Appendix E – Reservoir Rim Stability Evaluation

KLAMATH RIVER RENEWAL CORPORATION

June 2018

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Prepared for:

Klamath River Renewal Corporation

Prepared by:

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Acronyms and Abbreviations

DEM	Digital Elevation Model
EM	Engineering Manual
ICU-TX	Isotopically Consolidated Undrained Tri-Axial Strength Test
KRRC	Klamath River Renewal Corporation
MC	Modified California Sampler
pcf	Pounds-Force per Cubic Foot
psf	Pounds-Force per Square Foot
SPT	Standard Penetration Test
USACE	United States Army Corp of Engineers

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Chapter 1: Introduction

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1. INTRODUCTION

The purpose of this evaluation is to summarize relevant geologic background information, recent field reconnaissance and explorations, and any assessments or analyses completed to assess reservoir rim stability at J.C. Boyle, Copco No.1 and Iron Gate reservoirs.

When discussing reservoir rim stability during drawdown at the various reservoir locations, it is important to differentiate between the potential for deep-seated large landslides, which could impact residences and other resources adjacent to the rim, and shallower slides of material beneath the current water surface, which would only impact resources within the local limited slide footprint. The methodology used and amount of data available for the current analyses does not allow for the prediction of exactly where and how many of these shallow slides may occur. This evaluation largely discusses the potential for deep-seated landslides, which have the greatest potential to cause large impacts to resource areas. The methodology KRRC used for evaluation of reservoir rim stability included the following steps:

1. A desktop geologic study of the reservoir rims including a literature review of previous geologic studies of the area and a review of available aerial photography.
2. A geologic reconnaissance along the reservoir rims
3. Field investigations and laboratory testing of soil samples in areas with potential instabilities.
4. Analysis of cross-sections and material properties based on available data, geotechnical field investigations, and laboratory testing.
5. Rapid drawdown and other slope stability analyses. The rapid drawdown analysis assumed instantaneous drawdown unless determined that transient analysis was needed.
6. Develop a map showing areas of identified potential impacts.

Based on the United States Army Corp of Engineers (USACE) Slope Stability Engineering Manual (EM-110-2-1902) (USACE, 2003), Table 1-1 shows criteria developed for factors of safety. The following sections summarize geologic conditions and evaluations of the reservoir rims behind J.C. Boyle, Copco No. 1, and Iron Gate dams for potential instability during reservoir drawdown.

Table 1-1 Slope Stability Criteria

Case	Minimum Factor of Safety
Existing Conditions	1.11
Rapid Drawdown	1.15
Long-Term (post drawdown)	1.5
Historical Drawdown	1.11

Notes:

1. Case used as a check of the model. Anything over a factor of safety of 1.1 would be considered acceptable.

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Chapter 2: J.C. Boyle Reservoir

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2. J.C. BOYLE RESERVOIR

KRRC based the assessment presented in this section on preliminary bathymetric data. KRRC will perform additional geologic mapping and interpretation once recently collected bathymetric data is finalized.

2.1 Previous Investigations

Previous investigations are the subsurface geologic data related to J.C. Boyle Dam (Black & Veatch, 1998) and sediment sampling (Shannon & Wilson, 2006). Neither of these investigations were deep enough to provide useful information concerning rim stability. However, based on KRRC's 2017 geologic site reconnaissance and review of existing materials, KRRC determined no additional exploratory borings were required.

2.2 Geologic Characterization

The following discussion of geologic conditions at J.C. Boyle Reservoir is excerpted from PanGEO (2008). Topography for the area around the reservoir is gently sloping (less than 10%) to rolling terrain without many steep slopes other than on stratovolcanoes that are scattered around the region. Upstream and downstream of the dam, the Klamath River has cut a series of deep canyons into the volcanic rocks that mantle this part of northeastern California and southeastern Oregon. These canyons have slopes up to about 60 degrees. Bands of 30 and 40 degree slopes form NW-SE-oriented lineations in the topography; one of these bands forms the upstream boundary of the topographic bowl that the reservoir is located within.

Bedrock geology in the J.C. Boyle area is complex, characterized by inter-fingered volcanic deposits from a variety of sources less than 5 million years old that are part of the High Cascade stratovolcanic deposits. Common lithologies include hard, resistant basalt and basaltic andesite and less resistant volcaniclastic deposits. The area is characterized by several stratovolcanoes (Mount McLoughlin, Chase, Hamaker, Buck, and Surveyor Mountains) as well as dozens of smaller vents that erupted lavas and volcaniclastic materials. Younger alluvium and colluvium (at least 18,000 years old) are present on some of the slopes and as gently sloped terraces around the margins of the reservoir. An outcrop of very light grayish tan diatomite is present along the margin of the reservoir on the north side of the river by the prominent eastward bend. The outcrop is at least 10 feet high and located at the foot of a rounded hill mapped as glacial material. The diatomite is underlain by black sand and is possibly interbedded with volcaniclastic material.

Faulting is prominent in the J.C. Boyle Reservoir area. The faulting appears to display a normal sense of offset associated with the extensional tectonics of the Basin Range geomorphic province. The bowl topography of the reservoir area likely owes its configuration, in part, to being within a down-dropped basin. One prominent fault system is a fault that trends northwest through the northeast corner of the reservoir extent. The fault is down-dropped to the southwest, and the fault forms the southwest boundary of the hard rock canyon located upstream of the reservoir. To the northwest of the dam site, another fault system exists

along the east side and through the middle of a prominent hill. This fault appears to mark the west side of the down-dropped block that forms the reservoir basin, as the fault is down to the northeast.

Review of topographic data and reconnaissance of the reservoir slopes indicate that no landslides are present adjacent to the reservoir. Furthermore, the land surface surrounding the J.C. Boyle Reservoir is generally low gradient and underlain by competent materials.

2.3 Conclusions

The geologic reconnaissance of the J.C. Boyle Reservoir rim did not reveal obvious stability problems. Based on the results of the geologic reconnaissance, the historic performance of the slopes above the reservoir level, and the bathymetry, KRRC concluded that deep-seated large landslides are less likely. Therefore, stability analyses for the rim of J.C. Boyle Reservoir are deemed not required to support the preliminary design. Shallower slides could occur in the surficial soil deposits around the reservoir rim and on the reservoir slopes that are currently below the reservoir surface.

Chapter 3: Copco No. 1 Reservoir

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3. COPCO NO. 1 RESERVOIR

Copco No. 1 Dam and reservoir are mostly underlain by volcanic and volcaniclastic rock of the Western Cascades Volcanics group. Younger volcanic rock of the High Cascades Volcanics group is present at the dam site and at the western end of reservoir, as well as on parts of the canyon rim. Quaternary fluvio-lacustrine diatomaceous deposits are present around much of the reservoir rim and in the reservoir bed as terrace deposits with surfaces both above and below the modern reservoir level.

PanGEO (2006) suggests the slight possibility of drawdown-induced block sliding where hard strong volcanic flow rocks are underlain by saturated tuffaceous beds and bedding dips into the valley. Hammond (1983) reports several low to moderate dip angles of volcaniclastic beds into the valley, but there is no evidence of previous slope instability at these locations.

3.1 Historical Investigations and Reservoir Drawdowns

3.1.1 Historical Investigations

The available subsurface geologic data is limited to only the recent reservoir sediment sampling (Shannon & Wilson, 2006). For the investigation, Shannon & Wilson used a barge mounted CME-45 to continuously sample the reservoir sediments using either a pushed piston sampler or a driven MC sampler. No drilling was used to clean the hole between samples and casing was used when needed in a few locations. Twelve explorations were completed in the reservoir, which showed reservoir sediments ranging from 0.5 to 10 feet in thickness. These borings were examined and used to define the sediment thickness in the analysis profiles when applicable. No other useful investigations for rim stability were found.

3.1.2 Historical Reservoir Drawdowns

Copco No. 1 reservoir levels between November 1, 1978, and December 31, 2016, were reviewed by the KRRC for historical occurrences of reservoir drawdown. The three most significant drawdown events occurred in 1982, 2014, and 2015 (see Figure 3-1).

The maximum daily drawdown rate of 2 feet per day occurred in 2014 when the reservoir was drawn down nearly 14 feet. Based on inquiries made to PacifiCorp, slope failures were not observed in connection with the three reservoir drawdown events, although there was no specific effort made to determine whether slope failures occurred (email with Demian Ebert August 2, 2017).

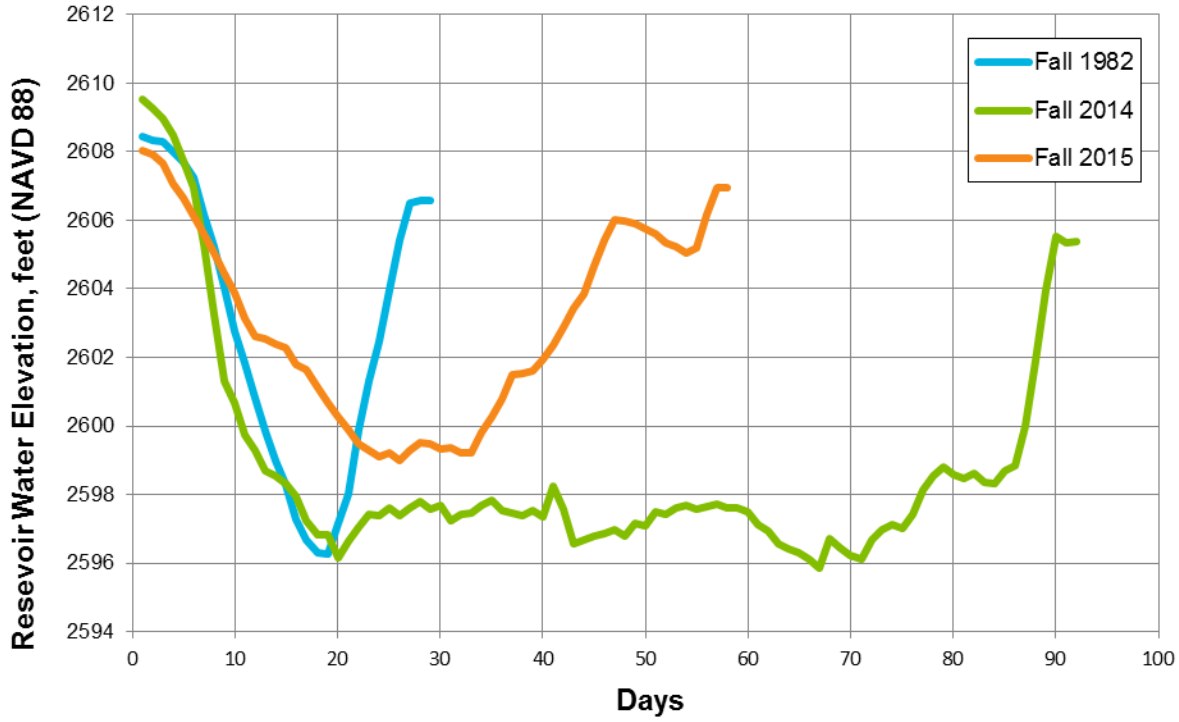

Figure 3-1 Copco Lake Maximum Historical Drawdown Events (1978 to 2016)

3.2 Project Investigations and Laboratory Testing

KRRC performed geologic mapping and a subsurface investigation with lab testing at Copco No. 1 reservoir to characterize and analyze the stability of the fluvio-lacustrine terrace deposits present around much of the rim of the reservoir and within the reservoir bed.

Access to the overland shoreline surfaces was not available, so KRRC performed drilling over water from a small platform barge using a CME-45 drill rig. Ten rotary wash borings were advanced into the reservoir bed between February 1 and 14, 2018, by Taber Drilling of West Sacramento. The boring depths ranged from 12 to 97 feet. Boring locations are shown on the geologic map (Figure 3-2). Table 3-1 summarizes the exploratory boring data, including depth and elevation of volcanic bedrock, where encountered. Boring logs are presented in Attachment B and a summary of the subsurface conditions are presented in Section 3.2.1.

KRRC obtained soil samples using standard penetration test (SPT) and 2.5-inch I.D. modified California (MC) drive samplers and 3-inch diameter thin-walled Shelby tubes. The tubes were advanced by direct push or with a hydraulically activated piston sampler (Osterberg). KRRC recorded blow counts at 6-inch intervals for drive samples and hydraulic gage down pressure necessary to advance Shelby tubes was noted.

Table 3-1 Summary of Exploratory Boring Data

Boring Id No.	Total Depth (feet)	Northing	Easting	Elevation (feet)	Depth to Rock (feet)
BC-01	30.4	2608898	6476516	2593.1	27.5
BC-02	64.6	2608331	6476958	2596.3	63
BC-02	96.5	2606643	6474657	2580.8	>96.5
BC-04	73.5	2604812	6472949	2593.1	69.5
BC-05	20.5	2604139	6474515	2597.8	17.5
BC-06	15.4	2605112	6476050	2574.9	7.5
BC-07	15.9	2605439	6477039	2577.8	15.5
BC-08	11.5	2605190	6480346	2582.4	-
BC-08a	85.2	2605249	6480346	2579.8	83.5
BC-09	70.5	2602526	6483561	2598.2	>71.5
BC-10	43	2604959	6472871	2575.1	39

KRRC sent samples to Cooper Testing Laboratory in Palo Alto, California. Lab testing performed included:

- Moisture Content (ASTM D2216)
- Moisture and Density (ASTM D7263B)
- Atterberg Limits (ASTM D4318)
- Grain Size Analyses with and without Hydrometer (ASTM D6913 & ASTM D7928)
- Percent Fines (ASTM D1140)
- Unconsolidated Undrained Triaxial Strength Test (ASTM D2850)
- Consolidated Undrained Triaxial Strength Test (ASTM D4767m)

The laboratory test results are provided in Attachment C and a summary of the laboratory test results received at the time of writing this report are shown in Section 3.4.1.

3.2.1 Summary of Subsurface Conditions from Borings

Borings encountered between 1 and 11 feet of very soft, recent lake sediments typically consisting of organic rich clayey sand to sandy clay/silt occasionally with coarse sand and small gravel clasts of weak, friable diatomite. The diatomite gravel was encountered at near shore borings and likely was derived from relatively recent bluff erosion along the shoreline.

Below the recent reservoir sediment, all the borings except BC-01 encountered alluvial terrace deposits and/or colluvium consisting of soft/loose to dense/stiff gravels, sands, and clays between 3 feet and 14 feet thick. Cobbles were observed in gravelly layers with a layer primarily of cobbles observed in BC-03.

Below the alluvial terrace deposits/colluvium or recent reservoir sediments, various forms of diatomite or diatomaceous clays were observed in all but borings BC-06 and BC-07, with thicknesses ranging from 6.5 feet in BC-09 to greater than 86 feet in BC-03. The various forms of diatomite encountered included diatomite rock, clayey diatomite, diatomaceous clay, and weakly cemented diatomite pieces.

Finally, below the diatomite or alluvial terrace deposits, volcanic bedrock was encountered consisting of basalt, andesite, cinders, volcaniclastic sandstone, and volcaniclastic/intrusive bedrock of various weathering and strength. While the strength of the volcanic bedrock varied, it was all considerably stronger than the materials above; no coring was performed to retrieve samples for strength testing since failure surfaces during reservoir drawdown are not likely to pass through the bedrock.

3.3 Geologic Characterization

3.3.1 Previous Mapping

Previously published mapping around Copco reservoir include:

- *Volcanic Formations Along the Klamath River Near Copco Lake, Siskiyou County,* PAUL E. HAMMOND, Department of Geology, Portland State University, Portland, Oregon; California Geology, May 1983.
- *Geology of the Macdoel Quadrangle,* HOWEL WILLIAMS , California Division of Mines and Geology Bulletin 151, November, 1949
- *Circular Soil Structures in Northeastern California*, PETER H. MASSON, California Division of Mines and Geology Bulletin 151, November, 1949
- *Geotechnical Report, Klamath River Dam Removal Project, California and Oregon, Project No. 07-153,* PanGEO Incorporated, prepared for Philip Williams & Associates, Ltd. And California State Coastal Conservancy, August, 2008
- *Geologic Map of the Weed Quadrangle,* D. L. Wagner and G. J. Saucedo, California Division of Mines and Geology, 1987)

These maps primarily show bedrock units, with surficial deposits typically not differentiated. Williams shows terrace deposits around Copco reservoir as diatomite and suggests it may have economic value. Wagner and Saucedo show the terrace deposits around Copco reservoir as lacustrine in origin. Hammond provides the most detailed descriptions of volcanic bedrock, but the area covered extends west only to the upstream end of Iron Gate reservoir, and mapping does not differentiate surficial deposits. Hammond also reports a maximum age for Copco basalt of 0.14 million years, based on Potassium/Argon isotope analysis of one sample. No other published ages of the Copco basalt are available.

3.3.2 Geologic and Surficial Mapping

Geologic reconnaissance along public right of ways and at Copco No. 1 dam site was performed several times during summer and fall of 2017. KRRC performed reconnaissance of the reservoir shoreline on October 4, 2017 using a boat and, to a lesser extent, during subsurface investigations in February, 2018.

KRRC used observations made during field investigations, preliminary results of subsurface investigation, and previously published maps to develop a geologic surficial map of Copco reservoir (Figure 3-2). Surficial deposits and landforms were identified on high-resolution topographic (LiDAR, 2010) and bathymetric (GMA, 2018) surface data for the shoreline and reservoir bed areas, respectively. This mapping focused on identifying the full extent of the quaternary lacustrine terrace deposits along the shoreline and any large, deep seated landslides or other areas of potential instability within the shoreline slopes.

Figure 3-2: Geologic Overview of Copco Lake (Attachment A)

Surficial Deposits

Previously undifferentiated surficial deposits around much of Copco reservoir include talus and rockfall debris, colluvium, alluvium and alluvial fans associated with tributary drainages, and older, likely Quaternary, fluvio-lacustrine terrace deposits, described below.

No large-scale landslides have been identified in either the terrestrial or submarine slopes around Copco reservoir by this or previous studies. PanGEO (2008) identified two small to medium-size inactive landslides on the north shore and concluded that these are not likely to be reactivated by reservoir lowering, due to their position above the reservoir rim. One notable feature is a large alluvial fan on the north side of the reservoir, just west of Spannus Gulch. PanGEO (2008) states that the location of this fan between tributary drainages suggests that the feature could be colluvial or landslide related, but if this is the case, the feature is likely ancient and inactive. Additionally, there is a notch in the bedrock at the head of this fan suggesting that the fan was once associated with Spannus Gulch, which now flows down a steeper, bedrock channel to the east. To confirm this interpretation, boring BC-09 was located offshore of the feature and results indicate it is a relatively thin alluvial fan deposit overlying Quaternary lacustrine deposits. For this study, KRRC identified one medium size slide deposit just above the reservoir level on the south shore. This feature appears rocky and is interpreted as a rock slide/fall deposit. Based on the limited extent below the water, low submarine relief and rocky nature of the deposit, it is very unlikely that this feature will be affected by reservoir drawdown.

Surficial deposits and landforms mapped during this study and shown on Figure 3-2 include:

- Active channel alluvium associated with pre-dam Klamath river (Qac)
- Flood plain deposits associated with the pre-dam Klamath river (Qfp)
- Alluvial fans (Qaf)
- Undifferentiated alluvium, usually associated with tributary drainages (Qa)
- Local accumulations of colluvium (Qc)

- Talus deposits (Qtl)
- Landslide deposits (Qls)
- Debris flow deposits (Qdf)
- Fluvio-lacustrine terrace deposits (Qtg, Qt, and Qtl), described below

Fluvio-Lacustrine Terrace Deposits

Fluvio-lacustrine terrace deposits surround much of the shoreline of Copco reservoir, extending to approximately 40 feet above the current reservoir level. These consist of diatomite, fine-grained diatomaceous reservoir sediment and dense, coarse-grained alluvial deposits. The terrestrial (onshore) extent of these deposits has been mapped (see Figure 3-2) by KRRC on modern topography and aerial imagery, based on field reconnaissance and modified from previous mapping by Williams (1949), Hammond (1983), and PanGEO (2008). The diatomite and lacustrine sediments were presumably deposited in a freshwater lake setting formed by volcanic damming of the Klamath River at or near the Copco No. 1 dam site by the 0.14 million-year-old Copco basalt.

Coarse-grained alluvial deposits were encountered on submarine terrace surfaces in borings (BC-03, BC-08/8a, and BC-10) and observed in shoreline deposits in the upstream half of the reservoir, occasionally interbedded with fine-grained lacustrine deposits. In the borings, these deposits ranged from 3 to 8 feet thick, likely representing river deposits after a partial volcanic dam breach with base level several tens of feet higher than that of the modern Klamath River. The degree of weathering and thickness of overlying soil suggest these deposits are geologically old, perhaps as little as a few thousand years younger than the emplacement of the Copco basalt. Upstream alluvial deposits, locally interbedded with diatomaceous lake sediments, are likely of similar age; however, surficial coarse-grained deposits may be much younger.

The most extensive on-shore deposits of diatomite are along the downstream south shore and along the Beaver Creek arm of the reservoir on the north shore where the deposits form a flat-lying to gently dipping surface, into which steep shoreline bluffs have been formed by modern shoreline erosion. Along much of the rest of the shoreline, the diatomite is present as a relatively thin wedge or prism, often with a modern colluvial/alluvial depositional capping layer. In this case, the maximum extent of the deposits was based on elevation and morphology. In other areas, bedrock was exposed at the shoreline and the diatomite was not observed on the slopes, presumably due to wave and/or hillslope and tributary channel erosion. The diatomite along the shoreline and at shallow depths in borings is generally a light gray to light tan colored material which is low density and weak to very weak. In the more extensive deposits, near-vertical bluffs have formed in the diatomaceous deposits as a result of undercutting due to wave erosion and failure of the weak material. In some places, this erosion has exposed volcanic bedrock at the base of the bluffs, indicated with thick black line on Figure 3-2.

Where the toe of the terrestrial diatomite terrace deposit lies above the current high lake level, the response of the slope to rapid drawdown are determined by the properties and geometry of the underlying volcanic and volcaniclastic strata. Where the toe of the terrestrial diatomite terrace deposit lies below the current high lake level, the response of the slope to rapid reservoir drawdown are determined by the properties of

the diatomite deposits, the thickness of the diatomite deposits, and the properties of the underlying material. Lacustrine diatomite deposits also exist completely below the current range of reservoir levels, and appear as prominent benches in the bathymetry. Along the south shore, this bench is mostly continuous and ranges between 100 and 300 feet wide. Along the north shore, the terrace bench is wider, with large peninsulas extending to the south with very steep to near vertical side slopes.

Mapped terrace deposits include:

- Quaternary alluvial terrace deposits, with gravels (Qtg)
- Quaternary fluvio-lacustrine terrace deposits, undifferentiated (Qt)
- Quaternary lacustrine deposits (Qtl)

The thickness of lacustrine diatomaceous sediments in borings further from the shoreline indicate that this material is likely present beneath surficial terrace and alluvial fan deposits in the upstream part of the reservoir bed and shoreline areas.

High Cascade Volcanics

Copco Basalt (Qb), a 0.14 million years old intracanyon flow unit (Hammond 1983), outcrops at the west end of the reservoir and likely underlies some of the western (downstream) submarine terrace deposits. This unit erupted from vents on both sides of the Klamath River, damming the river to form a lake that was approximately 35-40 feet higher than the modern reservoir (Hammond 1983). Other Quaternary basalt lava flows (QTb) unconformably overlie the older volcanics of the Western Cascades Group to form the generally flat-lying rim rock at the topo of the slopes around much of Copco No. 1 reservoir, but more prominent to the north.

Western Cascade Volcanics

Volcanic and volcaniclastic bedrock of the Western Cascade Volcanics around the rim include Spannus Ranch Andesite, undifferentiated intrusives, and several members of the Bogus Mountain volcaniclastic beds.

The Spannus Ranch Andesite consists mainly of pyroxene andesite flows with interbeds of lithic breccia (PanGEO 2008).

The Bogus Mountain Beds consist of interstratified tuff-breccia, volcaniclastic sandstone and tuffs, with thinner interbedded andesite flows. The strata tend to be greenish gray, and the tuffs and sandstones are fine to medium grained. One of the basal members of the Bogus Mountain Beds has been dated at roughly 23 million years old (Hammond, 1983).

For this mapping effort, the Western Cascade volcanics are not differentiated and are presented at Tertiary Volcanics (Tv)

3.4 Stability Analyses

This section presents the current results from material characterization, segment and cross section selection, and slope stability analyses. KRRC is still completing analyses and will update this evaluation once they are finalized. KRRC completed the following steps for the analyses:

1. Develop material properties
2. Complete generalized slope stability models assuming diatomite slopes with different slope heights and angles
3. Produce a map highlighting potential areas of instability using a Graphical Information System (GIS) model
4. Select segments
5. Create and analyze a conservatively representative cross section in segments with areas of potential instability

The section s below discuss further details of the analyses.

3.4.1 Material Characterization

Based on blow count data, field descriptions of soils, and laboratory test results, KRRC divided the subsurface materials into three layers, as summarized below. Attachment C provides the laboratory results and Table 3-2 shows the chosen analysis parameters . Attachment B provides blow counts and soil descriptions on the boring logs.

Diatomite

The diatomite consists of a low density material that is significantly weaker than the underlying bedrock materials. In addition, the material has a low permeability (about $1x10^{-6}$ cm/s) and will behave as an undrained material during reservoir drawdown, regardless of the drawdown rate. Several different types of diatomite were observed including a rock like diatomite (referred to as diatomite in the boring logs), diatomite that had more of an elastic silt like behavior (referred to as diatomite with elastic silt in the boring logs), and a weakly cemented diatomite. Properties of the diatomite with elastic silt were chosen to represent all the types of diatomite since it was the most common type observed. Table 3-2 and Figure 3-3 summarize strength testing of the diatomite.

Fluvio-Lacustrine Terrace Deposit with Gravel

In general, the fluvio-lacustrine terrace deposit with gravel is a relatively dense layer of alluvium, colluvium, or lacustrine deposit with significant amounts of gravel. The material generally has a relatively high permeability and will likely behave as a drained material during rapid drawdown. KRRC chose material properties based on lab data (as summarized in Table 3-2 below), blow counts, and material descriptions.

Recent Reservoir Sediments

The recent reservoir sediments generally consist of very soft silt, sand, or clay, which have been deposited since Copco Dam was constructed. KRRC chose material properties based on lab data (as summarized in Table 3-2 below), blow counts, material description, and testing of similar material from other reservoirs.

Volcanic Bedrock

Bedrock was encountered in eight of the ten borings completed. The rock consisted of basalt, andesite, volcanic sandstone, and volcanic cinder from the Copco/Quarternary Basalt and Bogus Mountain Beds formations. The rock is significantly stronger than the diatomite, fluvio-lacustrine terrace deposits, and recent reservoir sediments. The properties of the bedrock were chosen based on field descriptions and laboratory testing of two rock cores completed in Iron Gate Reservoir (see Section 4), and previous experience with similar rock. The strength parameters were calculated using Hoek-Brown (Hoek et. al., 2002) procedures.

Table 3-2 Summary of Material Properties for Slope Stability Analyses

Material	Mositure (%)	Dry Unit Weight (pcf)	Gravel (%)	Sand (%)	Fines (%)	LL	PI
Diatomite[1]	μ: 116.7 N: 22 σ: 40.3	μ: 43.1 N: 17 σ: 15.3	μ: 0.0 N: 7 σ: 0.0	μ: 0.6 N: 7 σ: 0.4	μ: 99.4 N: 7 σ: 0.4	μ: 111 N: 7 σ: 15	μ: 51 N: 7 σ: 40
Fluvio-Lacustrine Terrace Deposit with Gravel	μ: 30.3 N: 3 σ: 4.5	μ: 121.4 N: 2 σ: 5.4	μ: 42.2 N: 3 σ: 37.3	μ: 33.4 N: 3 σ: 27.8	μ: 24.4 N: 3 σ: 34.9	μ: 111 N: 2 σ: 2.8	μ: 51 N: 2 σ: 2.8
Recent Lake Sediments[2]	μ: 38.9 N: 2 σ: 5.9	μ: NA N: 0 σ: NA	μ: 3.5 N: 3 σ: 0.7	μ: 40.3 N: 3 σ: 10.6	μ: 56.1 N: 3 σ: 11.2	μ: 41 N: 2 σ: 10.6	μ: 16 N: 2 σ: 10.6

μ = Mean
N = Number of data points
σ = Standard deviation

1. Does not include weakly cemented diatomite gravel
2. One sample (BC-02, S-01) was removed from statistics due to it being an outlier (more gravelly than others)

Table 3-3 Summary of Material Properties for Slope Stability Analyses

Layer	Unit Weight (pcf)	Undrained (Total) Strength Parameters		Drained (Effective) Strength Parameters	
		Φ (deg.)	C (psf)	Φ' (deg.)	C' (psf)
Recent Reservoir Sediments	90	0	100	-	-
Fluvio-Lacustrine Terrace Deposits with Gravel (Qtg)	120	-	-	35	0
Diatomite (Lacustrine Terrace Deposits, Ql)	82	19.9	660	35.3	150
Volcanic Bedrock	135	-	-	34	1110

Notes:
Φ = friction angle
C = cohesion

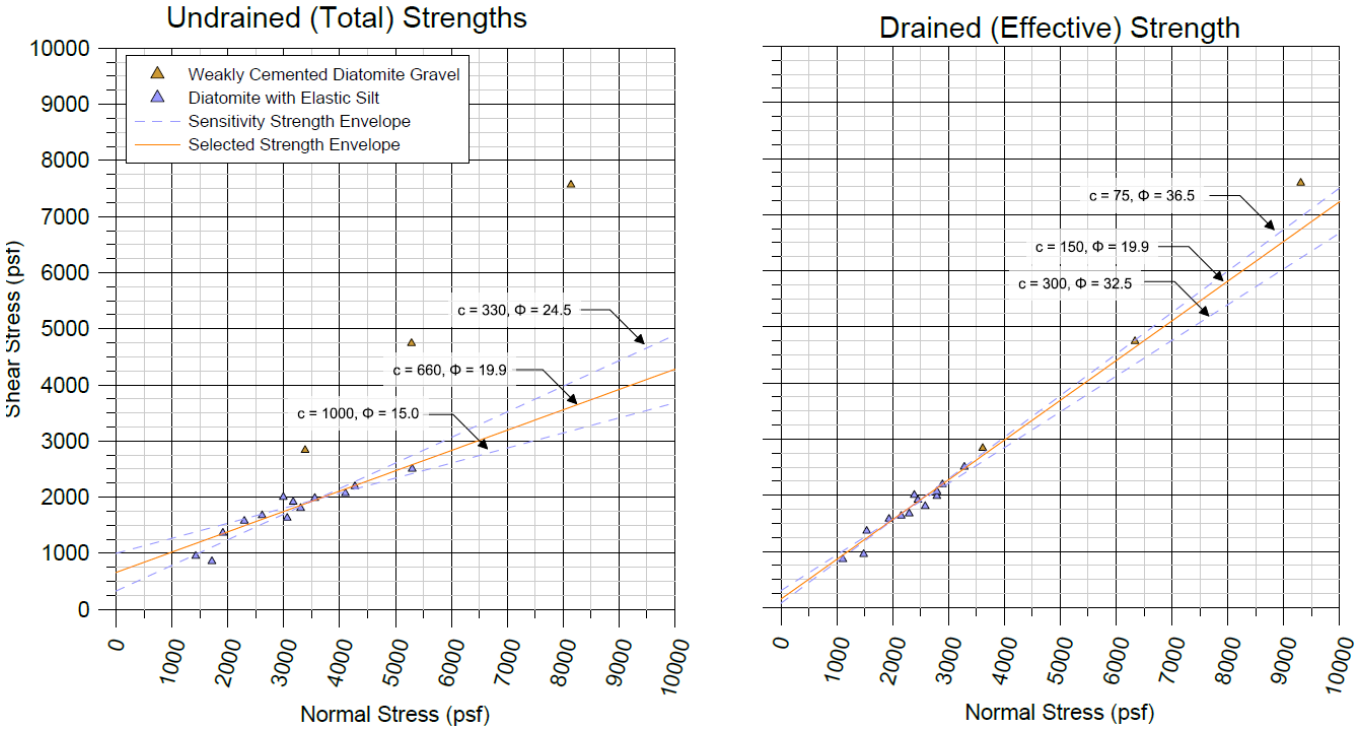

Figure 3-3 Selected Strength Envelopes

3.4.2 Segment and Cross Section Selection

To facilitate the rim stability analysis, KRRC separated the slopes within and around the reservoir rim into segments. Each segment is separated from the previous or following segment by a change in condition that could significantly change the slope stability analysis results. Some changes include a flattening or

steepening of the slope, an increase in the slope height, or the mapped extent of the diatomite limiting the slope.

To aid in segment and cross section selection, KRRC performed a GIS analysis using results from a generalized slope stability analysis using the strength parameters in Table 3-3 and the methodology described in Section 3.4.3. In the generalized analysis, KRRC evaluated diatomite slopes of various heights and inclinations, providing a set of slope heights and inclinations that had a potential for instability (factor of safety less than 1.15). KRRC used the slope heights and inclinations in the GIS analysis to produce a map highlighting areas of potential concern, which was then used in segment and cross section selection.

After completing the GIS analysis and selecting segments, cross sections were selected at the most critical portion of each segment, as appropriate. KRRC created cross sections mostly for segments that the GIS analysis showed to be potentially unstable, and KRRC chose a few locations where the GIS analysis showed segments as stable to confirm those results.

Table 3-4 provides a list of the segments selected and some general information about them along with the results of the GIS analysis. Figure 3-4 shows a plan view of the segments and the status of the segment after slope stability analyses, as discussed below.

Table 3-4 Segment Description and GIS Assessment Summary

Segment	Segment Summary				GIS Analysis Result
	Approximate Length (feet)	Average Height (feet)	Average Slope (Horz:Vert)	Segment Differentiation	
N1	2,200	12.5 (range = 0 to 27)	5.2:1 (steepest = 1.2:1)	At downstream edge: by the start of the slope (at the edge of the diatomite) At upstream edge: by a decrease in the slope angle	Stable
N2	2,115	44.8 (range = 20 to 56)	2.5:1 (steepest = 0.3:1)	At downstream edge: by the start of the slope At upstream edge: by a decrease in the slope angle and increase in the slope height	Further Analysis Req.
N3	1340	18.0 (range = 1 to 40)	2.5:1 (steepest = 0.6:1)	At downstream edge by a decrease in the slope height At upstream edge by an increase in the slope height	Stable
N4	1,145	52.0 (range = 33 to 60)	2.8:1 (steepest = 0.3:1)	At downstream edge by a decrease in the slope angle and an increase in the slope height At upstream edge by an increase in the slope angle	Further Analysis Req.
N5	805	49.6 (range = 36 to 54)	2.0:1 (steepest = 0.7:1)	At downstream edge by an increase in the slope angle At upstream edge by a decrease in the slope height	Further Analysis Req.
N6	565	23.9 (range = 6 to 37)	2.7:1 (steepest = 1.1:1)	At downstream edge by a decrease in the slope height At upstream edge by the end of the slope	Stable
N7	400	-	-	At downstream edge by the start of the slope At upstream edge by an increase in the slope height	Not Completed (Further Analysis Required)
N8	2,030	40.0 (range = 11 to 52)	3.4:1 (steepest = 0.5:1)	At downstream edge an increase in the slope height At upstream edge by a decrease in the slope angle	Stable
N9	2,245	37.6 (range = 11 to 51)	3.8:1 (steepest = 1.2:1)	At downstream edge a decrease in the slope angle At upstream edge by an decrease in the slope angle	Stable
N10	2,420	19.8 (range = 9 to 28)	3.3:1 (steepest = 0.7:1)	At downstream edge a decrease in the slope angle At upstream edge by an increase in the slope angle	Not Completed (Further Analysis Required)
N11	925	-	-	At downstream edge an increase in the slope angle At upstream edge by an increase in the slope height	Not Completed (Further Analysis Required)
N12	2,665	28.6 (range = 6 to 43)	2.9:1 (steepest = 0.7:1)	At downstream edge an increase in the slope height At upstream edge by the end of the slope (decrease in the slope angle)	Not Fully Completed (Further Analysis Required)
N13	1,445	20.1 (range = 3 to 28)	3.2:1 (steepest = 1.5:1)	At downstream edge the start of the slope At upstream edge by an increase in the slope angle	Stable

Segment	Segment Summary				GIS Analysis Result
	Approximate Length (feet)	Average Height (feet)	Average Slope (Horz:Vert)	Segment Differentiation	
N14	505	37.6 (range = 1 to 45)	2.4:1 (steepest = 0.2:1)	At downstream edge an increase in the slope angle At upstream edge by a decrease in the slope height (at the edge of the diatomite)	Further Analysis Req.
N15	970	5.6 (range = 0 to 18)	4.5:1 (steepest = 1.8:1)	At downstream edge by a decrease in the slope height (at the edge of the diatomite) At upstream edge by an increase in the slope height (at the edge of the diatomite)	Stable
N16	370	52.0 (range = 16 to 59)	2.4:1 (steepest = 0.9:1)	At downstream edge by an increase in the slope height (at the edge of the diatomite) At upstream edge by a decrease in the slope angle and decrease in the slope height	Further Analysis Req.
N17	1,210	22.7 (range = 2 to 45)	3.7:1 (steepest = 1.1:1)	At downstream edge by a decrease in the slope angle and decrease in the slope height At upstream edge by an increase in the slope height (at the edge of the diatomite)	Stable
N18	1,455	-	-	At downstream edge by the start of the slope (increase in the slope angle) At upstream edge by the end of the slope (decrease in the slope angle)	Not Completed (Further Analysis Required)
N19	985	24.9 (range = 17 to 40)	3.8:1 (steepest = 1.1:1)	At downstream edge by the start of the slope (increase in slope angle) At upstream edge by an increase in the slope angle	Stable
N20	1,015	35.3 (range = 11 to 44)	3.0:1 (steepest = 0.6:1)	At downstream edge by an increase in the slope angle At upstream edge by a decrease in the slope height (edge of the diatomite)	Further Analysis Required
N21	670	9.0 (range = 0 to 15)	5.1:1 (steepest = 0.9:1)	At downstream edge by a decrease in the slope height (edge of the diatomite) At upstream edge by the end of the slope (edge of the diatomite)	Stable
S1	665	70.5 (range = 46 to 87)	3.8:1 (steepest = 0.8:1)	At downstream edge by the start of the slope (at the edge of the diatomite) At upstream edge by a decrease in the slope height (due to an intermediate plateau)	Further Analysis Req.

Segment	Segment Summary				GIS Analysis Result
	Approximate Length (feet)	Average Height (feet)	Average Slope (Horz:Vert)	Segment Differentiation	
S2	555	41.8 (range = 29 to 52)	3.7:1 (steepest = 0.6:1)	At downstream edge by a decrease in the slope height (due to an intermediate plateau) At upstream edge by a decrease in the slope height	Stable
S3	1,020	47.6 (range = 22 to 55)	2.4:1 (steepest = 0.6:1)	At downstream edge by a decrease in the slope height (due to an intermediate plateau) At upstream edge by a decrease in the slope height	Further Analysis Req.
S4	1,190	23.5 (range = 6 to 39)	2.9:1 (steepest = 0.4:1)	At downstream edge by a decrease in the slope height At upstream edge by the end of the slope (decrease in the slope angle)	Further Analysis Req.
S5	445	16.0 (range = 3 to 28)	3.0:1 (steepest = 1.2:1)	At downstream edge by a decrease in the slope height At upstream edge by the end of the slope (decrease in the slope angle)	Stable
S6	1,080	23.5 (range = 5 to 31)	3.0:1 (steepest = 1:1)	At downstream edge by the start of the slope (increase in slope angle) At upstream edge by an increase in the slope height	Stable
S7	350	49.2 (range = 31 to 66)	2.3:1 (steepest = 0.7:1)	At downstream edge by an increase in the slope height At upstream edge by a decrease in the slope angle	Further Analysis Req.
S8	1,410	48.8 (range = 36 to 59)	3.5:1 (steepest = 0.9:1)	At downstream edge by a decrease in the slope angle At upstream edge by a decrease in the slope height	Stable
S9	1,365	28.2 (range = 3 to 51)	2.4:1 (steepest = 0.4:1)	At downstream edge by a decrease in the slope height At upstream edge by an increase in the slope height	Further Analysis Req.
S10	670	66.0 (range = 42 to 79)	2.4:1 (steepest = 0.6:1)	At downstream edge by an increase in the slope height At upstream edge by the edge of observed bedrock along the shoreline	Further Analysis Req.
S11	765	70.0 (range = 32 to 82)	3.6:1 (steepest = 0.8:1)	At downstream edge by the edge of observed bedrock along the shoreline At upstream edge by the start of an intermediate plateau (decrease in slope height)	Further Analysis Req.

Segment	Segment Summary				GIS Analysis Result
	Approximate Length (feet)	Average Height (feet)	Average Slope (Horz:Vert)	Segment Differentiation	
S12	2,445	16.7 (range = 4 to 42)	3.7:1 (steepest = 0.9:1)	At downstream edge by the start of an intermediate plateau (decrease in slope height) At upstream edge by the end of an intermediate plateau (increase in slope height)	Stable
S13	640	20.5 (range = 7 to 29)	2.7:1 (steepest = 1.3:1)	At downstream edge by the start of an intermediate plateau (decrease in slope height) At upstream edge by an increase in the slope angle	Stable
S14	1,945	39.5 (range = 28 to 51)	2.1:1 (steepest = 0.2:1)	At downstream edge by an increase in the slope angle At upstream edge by the end of an intermediate plateau (increase in slope height)	Further Analysis Req.
S15	460	56.3 (range = 10 to 64)	1.9:1 (steepest = 0.2:1)	At downstream edge by the end of an intermediate plateau (increase in slope height) At upstream edge by a decrease in the slope angle	Further Analysis Req.
S16	1,105	35.5 (range = 6 to 44)	2.9:1 (steepest = 1:1)	At downstream edge by a decrease in the slope angle At upstream edge by a decrease in the slope height	Stable
S17	950	12.5 (range = 3 to 19)	3.6:1 (steepest = 1.3:1)	At downstream edge by a decrease in the slope height At upstream edge by the end of the slope (decrease in slope angle)	Stable
S18	1,565	20.7 (range = 5 to 29)	2.8:1 (steepest = 0.2:1)	At downstream edge by the start of the slope (increase in slope height) At upstream edge by a decrease in the slope height (edge of the diatomite)	Further Analysis Req.
S19	1,945	7.3 (range = 0 to 16)	4.5:1 (steepest = 1.2:1)	At downstream edge by the end of the slope (decrease in the slope height) At upstream edge by the end of the slope (decrease in slope angle)	Stable
S20	3,370	18.7 (range = 0 to 30)	3.7:1 (steepest = 0.2:1)	At downstream edge by the start of the slope (increase in slope angle) At upstream edge by the end of the slope (edge of the diatomite)	Stable

3.4.3 Slope Stability Analysis Methodology

The slope stability of individual sections (and the initial generalized analyses) was analyzed using the software SLOPE/W (GeoStudio 2018) and Morgenstern-Price's procedure (with a half-sine function) for the calculation of factor of safety. KRRC used a circular slip surface without optimization for the analyses unless otherwise noted.

The different analyses performed for the sections are discussed below. The rapid drawdown analyses were performed for every section analyzed, while the other existing conditions, long-term (post drawdown), and historical drawdown analyses were only performed on sections that had a factor of safety less than 1.15, to confirm the validity of the model.

Rapid Drawdown

Rapid drawdown analyses were performed using a staged rapid drawdown analysis approach proposed by Duncan et. al. (1990). During rapid drawdown, the stabilizing effect of the reservoir on the slope is absent but the pore water pressures within the slope remain high in materials with low permeability. The high pore pressures in combination with the lack of the stabilizing effect from the reservoir can lead to significantly reduced slope stability.

The diatomite was modeled with undrained shear strength parameters in the analysis. This model approach is reasonable considering the fact that the diatomite would take long time to drain because it has a very low permeability of about $1x10^{-6}$ cm/s. The recent reservoir sediment was also modelled in a similar fashion, although that choice is inconsequential to the stability of the slope overall since it makes up only a small percentage of the slope.

The groundwater was initially set as a horizontal line at Elevation +2,605 feet (the same as the existing conditions) and then drawn down to a horizontal line at the existing thalweg ground surface.

Historical Drawdown

Based on the historical drawdown information shown in Figure 3-1, KRRC performed a rapid drawdown analysis using the same method as the rapid drawdown analyses above but with a water level drop from Elevation +2,610 to +2,596. KRRC used this analysis to verify the model due to the fact that no landslides were observed during any of the previous drawdown events.

Existing Conditions

KRRC performed the existing condition analyses to assess the current stability of the slope. This analysis serves as verification of the model since there are no reported active slope instabilities around Copco No. 1 reservoir. These analyses used the drained (effective) strength parameters for all materials and the groundwater was set as a horizontal line at Elevation +2,605 feet based on the water level in the reservoir at the time of drilling.

Long-Term (Post Drawdown)

KRRC performed the long-term analyses to assess the stability of the slope after all the excess pore pressures from drawdown have dissipated. This analysis was also done to validate the model since the slopes, particularly those submerged in the reservoir, were at least semi-stable before the reservoir was filled. These analyses used drained (effective) strength parameters for the diatomite and groundwater was set as a horizontal line at the existing thalweg ground surface.

3.4.4 Slope Stability Analysis Results

A summary of the results of the slope stability analyses are presented below. KRRC used a factor of safety of 1.15 as the pass/fail criteria due to the critical nature of some areas and the lack of specific data at most of these locations. Figure 3-4 shows a plan view of the current analysis results, and Figure 3-5 shows cross section results for the rapid drawdown analyses.

Sensitivity Analyses

The shear strength of the diatomite is the parameter that has the greatest influence on the slope stability analysis results. Therefore, sensitivity analyses will be performed by assuming different interpretations of the laboratory strength test results for samples of diatomite, as shown in Figure 3-3 and summarized in Table 3-5. Using the strengths shown, any sections with factors of safety between 1.15 and 1.3 will be analyzed and included in the final report.

Table 3-5 Summary of Strength Parameters of Diatomite Used for Sensitivity Analysis

Strength Type	Selected Strength		Lower Cohesion Fit		Lower Friction Angle Fit	
	C (psf)	Φ (degrees)	C (psf)	Φ (degrees)	C (psf)	Φ (degrees)
Drained (effective) Strengths	150	35.3	75	36.5	300	32.5
Undrained (total) Strengths	660	19.9	330	24.5	1000	15

Figure 3-4 Summary of Segment Extents and Current Results (Attachment A)

Figure 3-5 Rapid Drawdown Analysis Cross Sections (Attachment A)

Table 3-6 Stability Analysis Summary

Segment	GIS Analysis Result	Cross Section Details		Slope Stability Analysis Results			
		Maximum Slope (H:V)	Slope Height (feet)	Rapid Drawdown	Historical Drawdown	Existing Conditions	Long-Term Conditions
N2	Further Analysis Req.	In Progress					
N4	Further Analysis Req.	In Progress					
N5	Further Analysis Req.	In Progress					
N7	Not Completed (Further Analysis Req.)	In Progress					
N9	Stable (GIS Analysis Check)	In Progress					
N10	Not Completed (Further Analysis Req.)	1.8:1	65	2.01	-	-	-
N11	Not Completed (Further Analysis Req.)	1.1:1	54	1.71	-	-	-
N12	Not Fully Completed (Further Analysis Req.)	In Progress					
N14	Further Analysis Req.	In Progress					
N16	Further Analysis Req.	In Progress					
N18	Not Completed (Further Analysis Req.)	In Progress					
N20	Further Analysis Req.	In Progress					
S1	Further Analysis Req.	1.9:1 (0.4:1 bluff)	163 (97 from water level)	1.09	1.66	1.53	2.26
S2	Stable (GIS Analysis Check)	In Progress					
S3	Further Analysis Req.	1.6:1	53	1.0	2.87	2.87	1.75
S4	Further Analysis Req.	In Progress					
S7	Further Analysis Req.	In Progress					
S8	Stable (GIS Analysis Check)	In Progress					
S9	Further Analysis Req.	In Progress					
S10	Further Analysis Req.	1.1:1	72	1.03	2.56	2.68	1.62

Segment	GIS Analysis Result	Cross Section Details		Slope Stability Analysis Results			
		Maximum Slope (H:V)	Slope Height (feet)	Rapid Drawdown	Historical Drawdown	Existing Conditions	Long-Term Conditions
S11	Further Analysis Req.	1.9:1	159 (81 from water level)	0.99	1.89	1.38	2.18
S14	Further Analysis Req.	In Progress					
S15	Further Analysis Req.	In Progress					
S18	Further Analysis Req.	0.7:1	29	1.39	-	-	-

3.4.5 Future Analyses and Investigations

While the analyses discussed above are still preliminary, the results indicate that certain areas or segments may have the potential for slope instability as a result of the project activities. Some of these segments are below the current reservoir water surface, and slope failures within these segments would not impact existing roads or private property/structures. KRRC does not propose additional field investigations for these segments.

For other segments, slope failure could result in impacts to existing roads or private property/structures. For each of these segments, KRRC will complete a boring or borings during the summer of 2018. KRRC will use boring logs and laboratory data to update the stability analyses completed to date to better understand the potential for slope failure and any project actions that may be required to offset the impact.

In addition to field investigations above, KRRC may complete additional analyses along certain segments, as appropriate, including:

- Deformation analysis of select profiles, as necessary, to assess the impact area of potential slope failures
- Sensitivity analyses of the impact of variations in the strength of the diatomite on the slope stability analysis results (as mentioned above)
- Analyses of possible engineered solutions (retaining wall, etc.), as appropriate

3.5 Conclusions

When discussing reservoir rim stability during drawdown, it is important to differentiate between the potential for deep-seated large landslides along the reservoir rim that could impact roads or property, and slides of material beneath the current water surface, which would only impact resources within the local limited slide footprint.

Minor, shallow slides of existing material beneath the existing reservoir water surfaces are possible during drawdown. These minor slides would not extend outside of the current reservoir footprint and would only potentially impact resources within the limited slide footprint (e.g. cultural resources). Some larger deeper slides are also possible within Copco No. 2 reservoir where submerged higher bluffs exist along the original Klamath River channel. These shallow slides and potential slides along the river channel pose no threat to roads or private property; however, KRRC will monitor these areas during and post-drawdown to assess any potential impact to existing cultural resources.

The geologic assessment and slope stability analysis summarized above indicate that certain segments along the Copco No. 1 reservoir rim have a potential for slope failure that could impact existing roads and/or private property. In some areas, the impact could be relatively minor, while in other areas the impact could be greater. Based on the referenced analysis, approximately 3,700 linear feet of slopes along Copco Road (north shore segments S4, S9, S11 and S15), and approximately 2,800 linear feet of slope adjacent to

private property (along south shore – segments N9, N14, N16and N14) require additional field investigation and analysis to gain a more refined understanding of slope stability in those areas. Up to eight parcels along the referenced segments appear to have existing habitable structures that could potentially be impacted.

Additional field geologic data is required to confirm the potential for slope failure along the referenced reservoir rim segments. KRRC will complete the additional field investigation in July and August of 2018, followed by completion of a series of material property laboratory tests. KRRC will use results from the field investigation and laboratory testing to update stability assessments in the rim segments of concern in fall 2018. Should additional study determine that there is a high probability of slope failure in any of these areas, KRRC will consider the following actions to offset potential impacts:

1. For segments along Copco Road:
    a) Re-align of road segment away from rim slope
    b) Engineer structural slope improvements (e.g. drilled shafts or other structural elements that could be installed to resist slope movement)
2. For segments adjacent to property or structure:
    a) Move structure or purchase property
    b) Engineer structural slope improvements (e.g. drilled shafts or other structural elements that could be installed to resist slope movement)

Based on the low permeability of the diatomite, changing the drawdown rate would have minimal impact on the rapid drawdown stability analysis results. Therefore, KRRC is not proposing to limit the drawdown rate for drawdown of Copco No. 1 reservoir.

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Chapter 4: Iron Gate Reservoir

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4. IRON GATE RESERVOIR

4.1 Historical Investigations and Drawdowns

4.1.1 Historical Investigations

Historic subsurface geologic data at Iron Gate reservoir includes sediment sampling completed in 2006 (Shannon & Wilson, 2006). None of the borings for this previous investigation were deep enough to provide information useful for reservoir rim stability analysis.

4.1.2 Historical Drawdowns

Iron Gate Reservoir levels between January 1, 1979, and December 31, 2016, KRRC reviewed for historical occurrences of reservoir drawdown. The four most significant drawdown events occurred in the falls of 2004, 2014, 2015, and 2016 (see Figure 4-1).

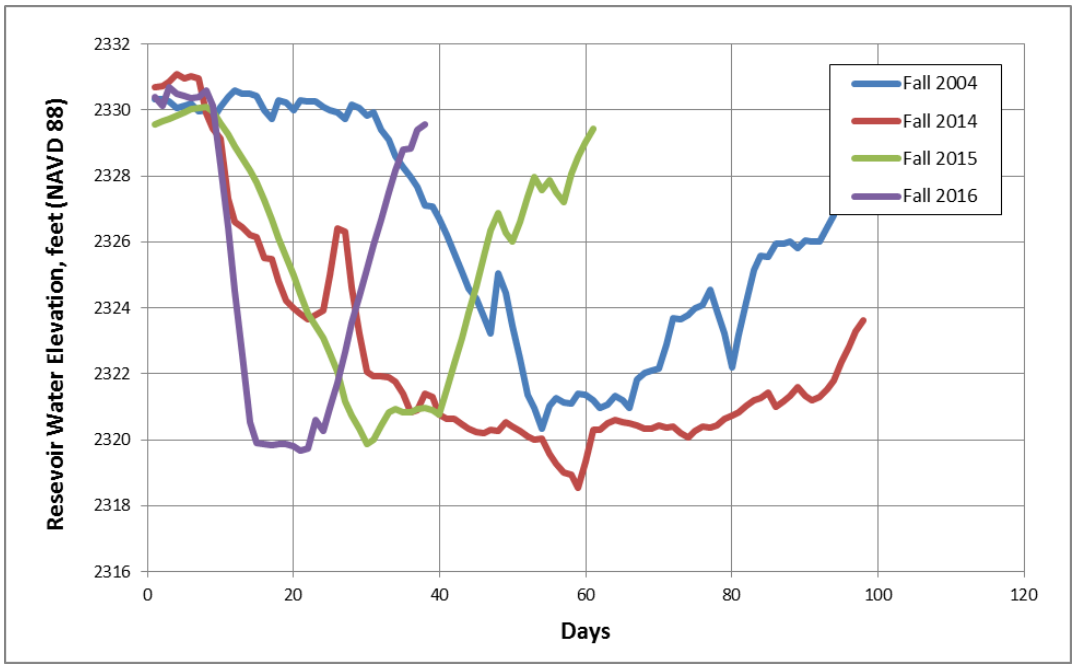

Figure 4-1 Iron Gate Reservoir Maximum Historical Drawdown Events (1979 to 2016)

The magnitude of the drawdowns ranged from about 9 feet to 14.5 feet. The maximum daily drawdown rate of 2 feet per day occurred in 2014. Based on inquiries made to PacifiCorp, there were no reported slope failures resulting from these drawdowns (email with Demian Ebert August 2, 2017).

4.2 Project Investigations

KRRC performed geologic mapping and subsurface investigations at Iron Gate Reservoir to characterize past landslides and for design of the replacement Yreka waterline.

Drilling within the reservoir area was performed over water from a small platform barge using a CME-45 drill rig for borings BI-01 and BI-03. Land-based drilling was performed with a truck-mounted CME-75 drill rig for BI-02. Taber Drilling of West Sacramento advanced the three rotary wash borings between February 20 and 23, 2018. The boring depths ranged from 22.2 to 67 feet. Figure 4-2 shows boring locations. Table 4-1 summarizes the exploratory boring data, including depth and elevation of volcanic bedrock, where encountered. Attachment A provides boring logs. KRRC obtained soil samples using standard penetration test (SPT) and 2.5-inch I.D. modified California (MC) drive samplers. KRRC recorded blow counts at 6-inch intervals for drive samples.

Table 4-1 Summary of Exploratory Boring Data (Iron Gate Reservoir)

Boring Name	Total Depth (feet)	Northing	Easting	Elevation (feet)	Depth to Rock (feet)
BI-01	22.2	2600814	6450534	2315.1	11.5
BI-02	67	2602024	6461383	2326.7	17.5
BI-03	35.1	2601812	6461399	2302.2	3.8

4.2.1 Summary of Subsurface Conditions

Boring BI-01 was completed to assess the rim stability around Iron Gate Reservoir. The boring encountered approximately 2 feet of recent lake sediment consisting of lean clay with organics which overlay approximately 9.5 feet of colluvium/residual soil consisting of lean clay. Below the colluvium/residual soil the boring encountered volcanic bedrock consisting of basalt and volcaniclastics.

Borings BI-02 and BI-03 were advanced as part of the design of the replacement Yreka waterline. While not directly related to rim stability, the results of these explorations were useful to develop estimates of rock strength for the analyses around Copco No. 1 reservoir. The two borings showed approximately 3.8 (BI-03) to 17.5 (BI-02) feet of alluvium (older and younger) consisting of lean clay with varying amounts of sand and gravel, clayey sand with gravel, and poorly graded gravel. Volcanic bedrock consisting of tuff breccia underlay the alluvium.

4.3 Geologic Characterization

4.3.1 Previous Mapping

Previously published geologic mapping of the Iron Gate Dam and lake area include:

- *Volcanic Formations Along the Klamath River Near Copco Lake, Siskiyou County,* PAUL E. HAMMOND, Department of Geology, Portland State University, Portland, Oregon; California Geology, May 1983.
- *Geology of the Macdoel Quadrangle,* HOWEL WILLIAMS , California Division of Mines and Geology Bulletin 151, November, 1949
- *Geotechnical Report, Klamath River Dam Removal Project, California and Oregon, Project No. 07-153,* PanGEO Incorporated, prepared for Philip Williams & Associates, Ltd. And California State Coastal Conservancy, August, 2008.
- *Geologic Map of the Weed Quadrangle,* D. L. Wagner and G. J. Saucedo, California Division of Mines and Geology, 1987)

PanGEO (2008) provide a thorough description of regional and local geology for Iron Gate area, including a geologic map compiled from Williams (1949) and Hammond (1983) that includes structural data from site reconnaissance in a 2008 Geotechnical Report for this project. Pertinent data is included in this evaluation.

4.3.2 Geologic and Surficial Mapping

Iron Gate Dam and its reservoir lie entirely within the Western Cascades geologic province. Hammond (1983) suggests that the volcaniclastic formation that he informally named the Beds of Bogus Mountain extends into the Iron Gate area (PanGEO 2008). Bedrock units include tuffaceous siltstones and sandstones, bouldery volcaniclastics and volcanic breccia, rhyolite tuff and tuff breccia, and pyroxene flow rocks. Geologic reconnaissance indicates generally shallow bedrock with a thin soil mantle. Surficial geologic units including landslide and alluvial deposits are not differentiated from the underlying volcanic rocks in previously published mapping.

PanGEO (2008) identified three possible landslide related features on the south rim of the reservoir (Figure 4-2), and characterized these as “weakly suggestive of old landslides ranging from small slumps only a few meters in size up to possible slides covering several square miles”. These existing features are considerations in the rim stability conclusions described in Section 4.4.

For this study, the KRRC reviewed the 2010 LiDAR-derived terrestrial digital elevation model (DEM), recently acquired high-resolution bathymetric survey data (GMA, 2018), and pre-dam stereoscopic aerial photographs (1944 and 1951) for the entire lake area. KRRC used these data to develop a detailed surficial geologic map (Figure 4-2). While some bedrock and structural data is included in this mapping, the primary intent is to identify larger surficial deposits along the lakeshore and in lake bed that could become unstable during drawdown. In addition to DEM and photo review, KRRC performed site reconnaissance along public roadways around the reservoir during the week of June 5, 2017, and the week of July 24, 2017. KRRC performed additional reconnaissance of the lake shoreline on October 5, 2017 using a small powered row boat. Based on preliminary reconnaissance, before bathymetric surveys were performed, boring BI-01 was located to investigate the toe zone of a possible landslide identified by PanGEO (2008). As noted in Section 4.2.1, the results of this boring did not indicate a slide deposit and encountered volcanic bedrock approximately 10 feet below the pre-dam surface.

Features previously identified by PanGEO as well as several other features with possible landslide morphology identified by the KRRC are delineated as shown on Figure 4-2. These features appear unchanged from 1944 and 1951 historical aerial photographs, and do not show indications of recent activity on the LiDAR/Bathymetric DEM. The morphology of the two larger features appears more consistent with differential erosion of different volcanic/volcaniclastic bedrock units or in the case of the western feature, possible volcanic flow collapse during or immediately after emplacement. The third, smallest potential landslide identified by PanGEO (2008) may represent a small, dormant slide, but the narrow width indicates a rather shallow slide surface that, if reactivated, does not pose a significant hazard.

The reservoir slopes in the area downstream of Jenny Creek exhibit some degree of bench and scarp morphology, sometimes associated with large, deep-seated landslides. The prevalence of outcrops with variable volcanic rock lithologies, the lack of indications recent activity, and consistent appearance on historic aerial photographs suggests that this morphology is most likely the result of bedrock structure, including volcanic flow rock emplacement, and differential weathering. Some of the bench surfaces may also be the result of past fluvial erosion.

One larger, likely landslide was identified along Copco Road within the peninsula between the east and west arms of the reservoir. KRRC based the identification on the presence of a subdued, 10- to 20-foot high break in slope that may represent the head scarp of a dormant, block-slide type feature. This feature does not have any indication of recent slope movement and is unchanged in historic aerial photos. As KRRC interprets the toe of this feature to lie in a small tributary drainage above the reservoir rim, it is very unlikely to be affected by drawdown.

Figure 4-2: Geologic Overview of Iron Gate Reservoir (Attachment A)

4.4 Conclusions

Much of the bedrock mapped around the rim of Iron Gate Reservoir consists of volcanic flow rock, rhyolite tuff and tuff breccia. The extent and morphology of these outcrops and general lack of surficial deposits suggest a shallow weathering profile that is interpreted to form generally stable reservoir slopes under drawdown conditions. Existing structural data (PanGEO 2008) and reconnaissance performed by the KRRC are in line with this interpretation.

Beds of Bogus Mountain are mapped at the very upstream end of the reservoir, but the outcrop pattern and structural measurements indicate the beds strike normal to the slope and dip gently to the east. PanGEO (2008) mapped volcaniclastic beds on the northwest arm of the reservoir, to the north and east of Juniper Point, dipping gently to the west. On the west facing, eastern slope of the reservoir, this orientation has the potential for structural block slide slope failure, however, the gentle slope, lack of historical movement and very low submarine relief indicate this type of failure is very unlikely in this area.

Shallower slides are likely to occur in the shallow surficial deposits around the reservoir rim and on the reservoir slopes that are currently below the reservoir surface. Small, shallow soil failures in the more deeply weathered volcaniclastic beds and in colluvial deposits present a minor hazard to Copco Road where the

road is immediately adjacent to the shore. These slope failures are likely to be shallow and local, but may possibly require minor repair to maintain full use of the roadway. Minor repair may include installation of riprap on slope adjacent to Copco Road and/or road surface rehabilitation.

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Chapter 5: References

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5. REFERENCES

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Attachment A Figures

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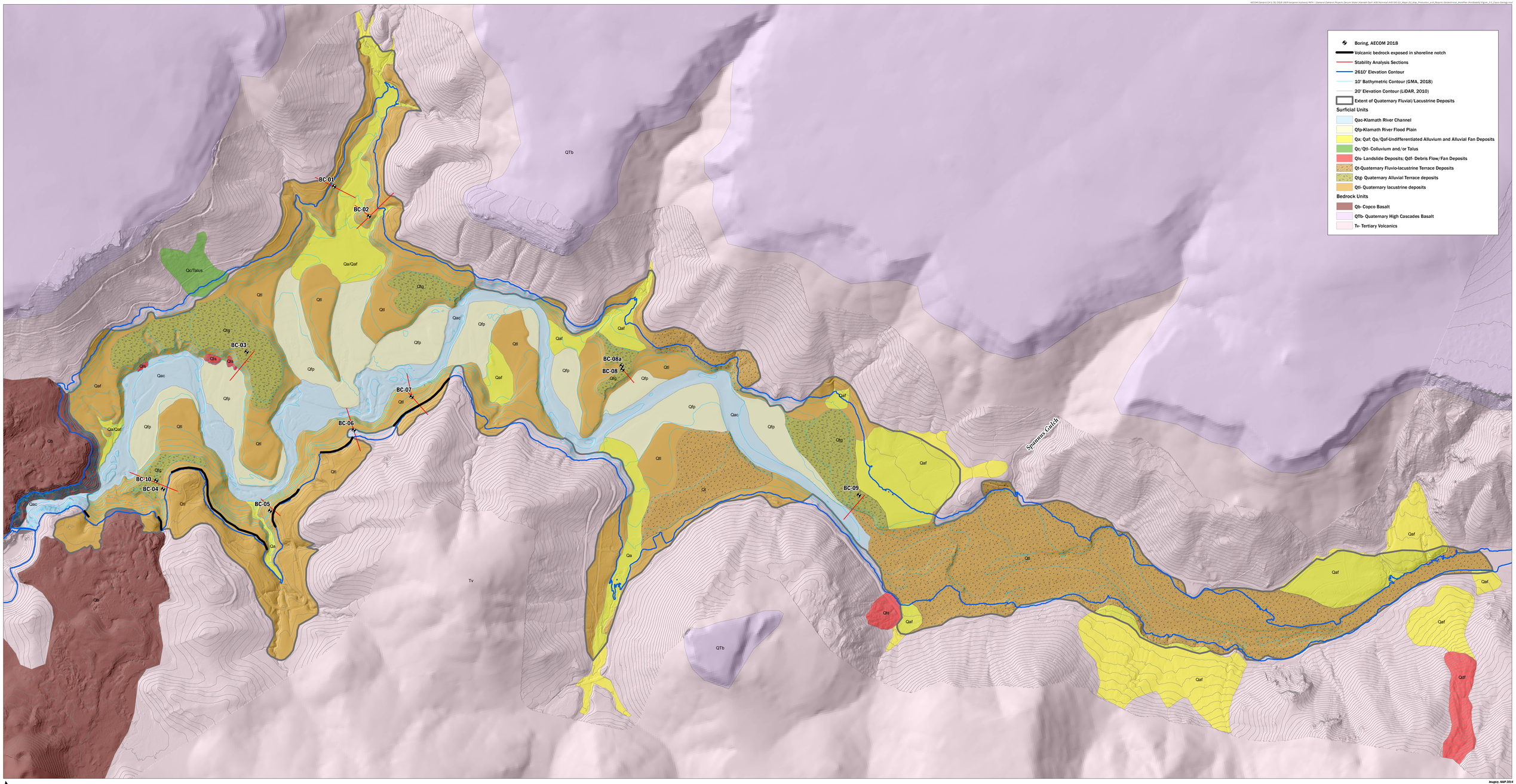

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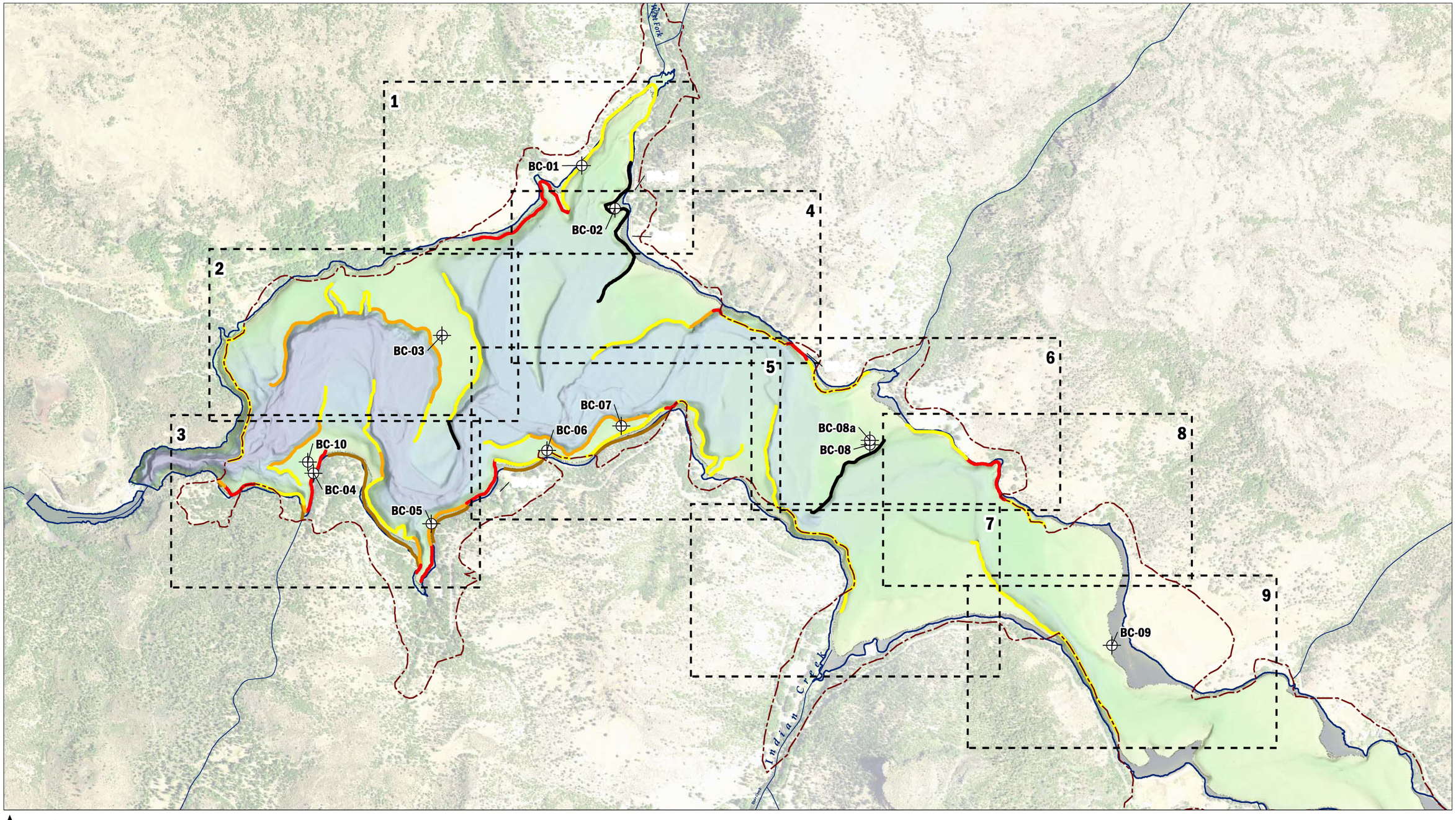
FIGURE 3-2
Geologic Overview of Copco Lake



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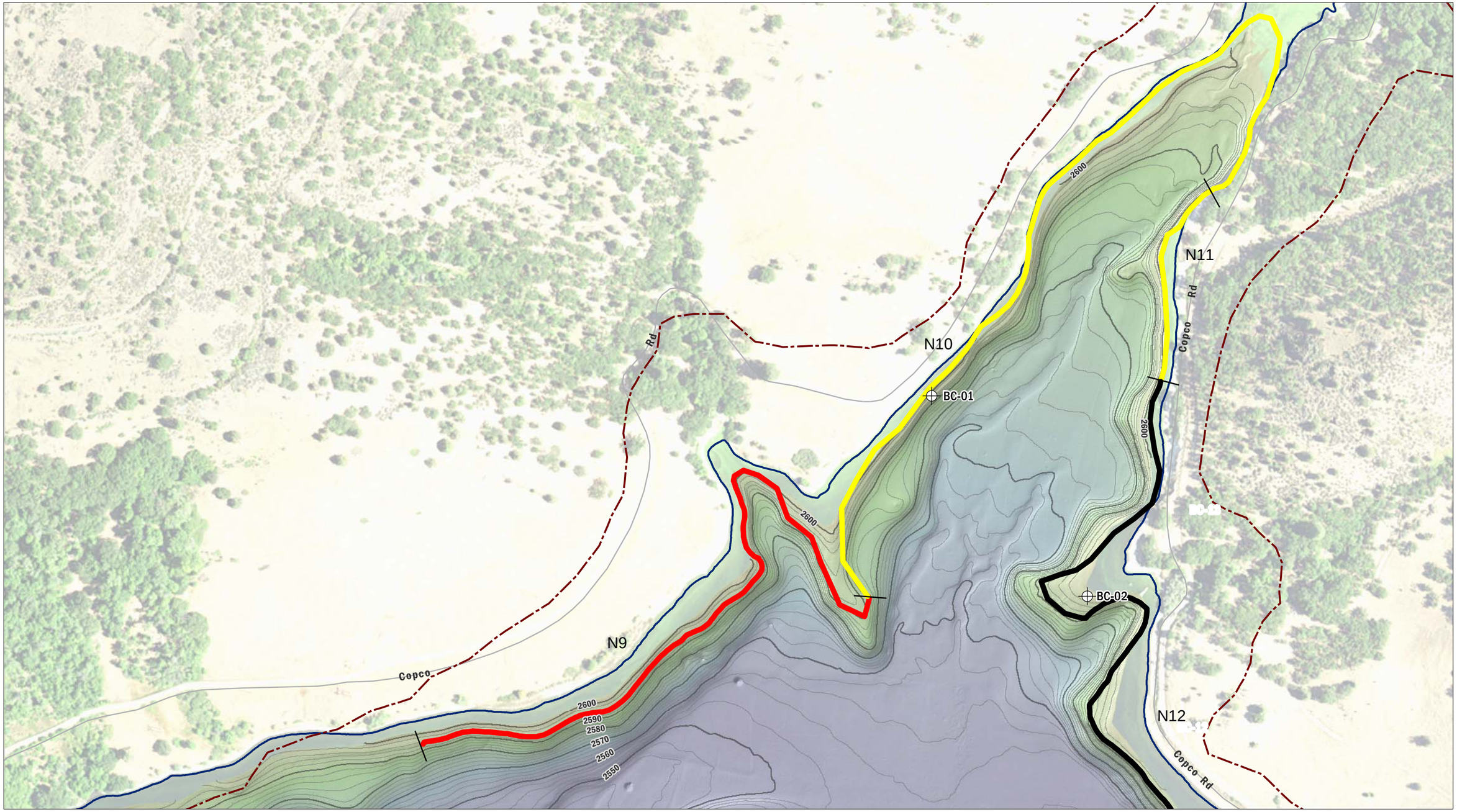
Borings
Mapbook Sheet Extent
Extent of Fluvio-Lacustrine Deposits
Volcanic Rock Exposed in Shoreline Notch
Current Reservoir Shoreline

Slope Failure Analysis Features
Incomplete Analysis
Stable Slope
Potentially Unstable Slope (failure contained within reservoir)
Potentially Unstable Slope

FIGURE 3-4
Copco Dam - Slope Failure Analysis
Overview Map



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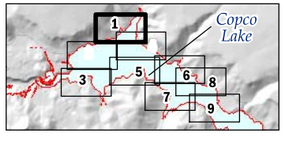


Borings
Extent of Fluvio-Lacustrine Deposits
Current Reservoir Shoreline

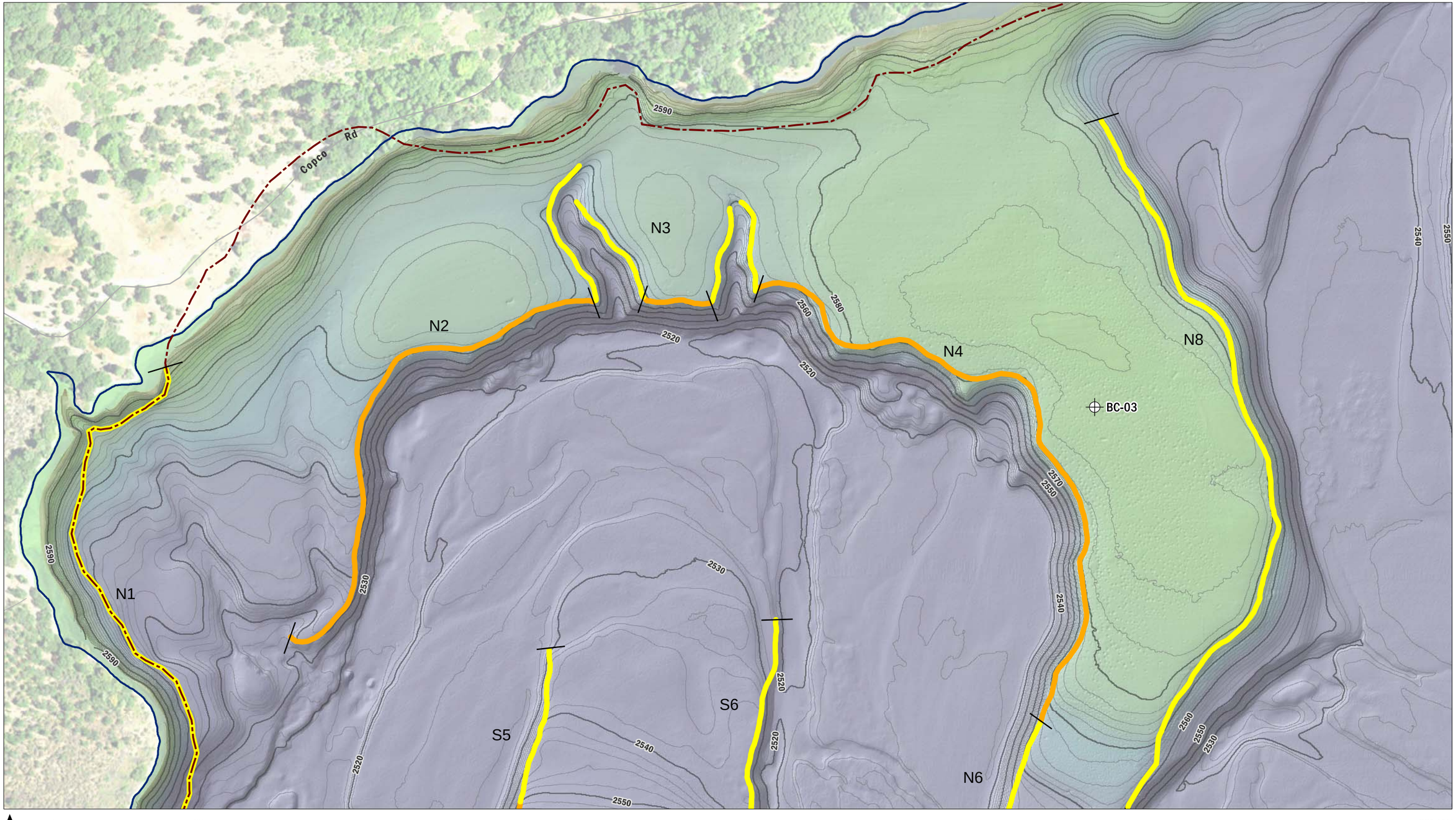
Slope Failure Analysis Features
Incomplete Analysis
Stable Slope
Potentially Unstable Slope

Bathymetric Contours
2 ft.
10 ft.

Segment Information
Segment Extents
N1 Segment Names

FIGURE 3-4

Copco Dam - Slope Failure Analysis
Sheet 1 of 9



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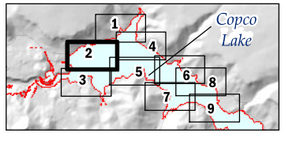


- Borings
- Extent of Fluvio-Lacustrine Deposits
- Current Reservoir Shoreline

Slope Failure Analysis Features
- Incomplete Analysis
- Stable Slope
- Potentially Unstable Slope (failure contained within reservoir)

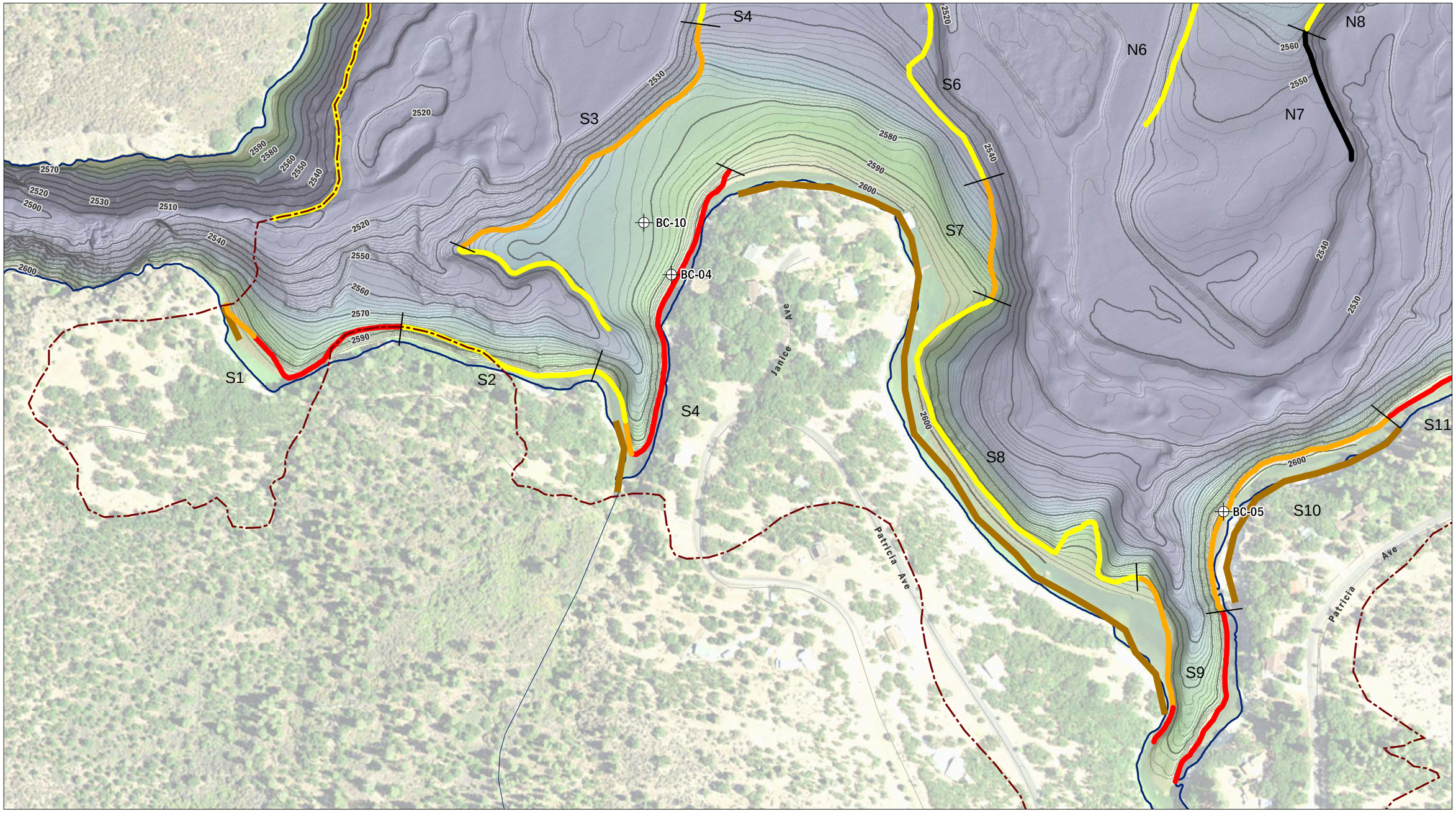
Bathymetric Contours
- 2 ft.
- 10 ft.

Segment Information
- Segment Extents
- N1 Segment Names

FIGURE 3-4

Copco Dam - Slope Failure Analysis

Sheet 2 of 9



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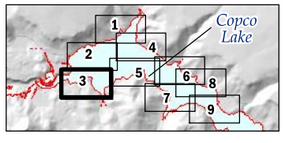


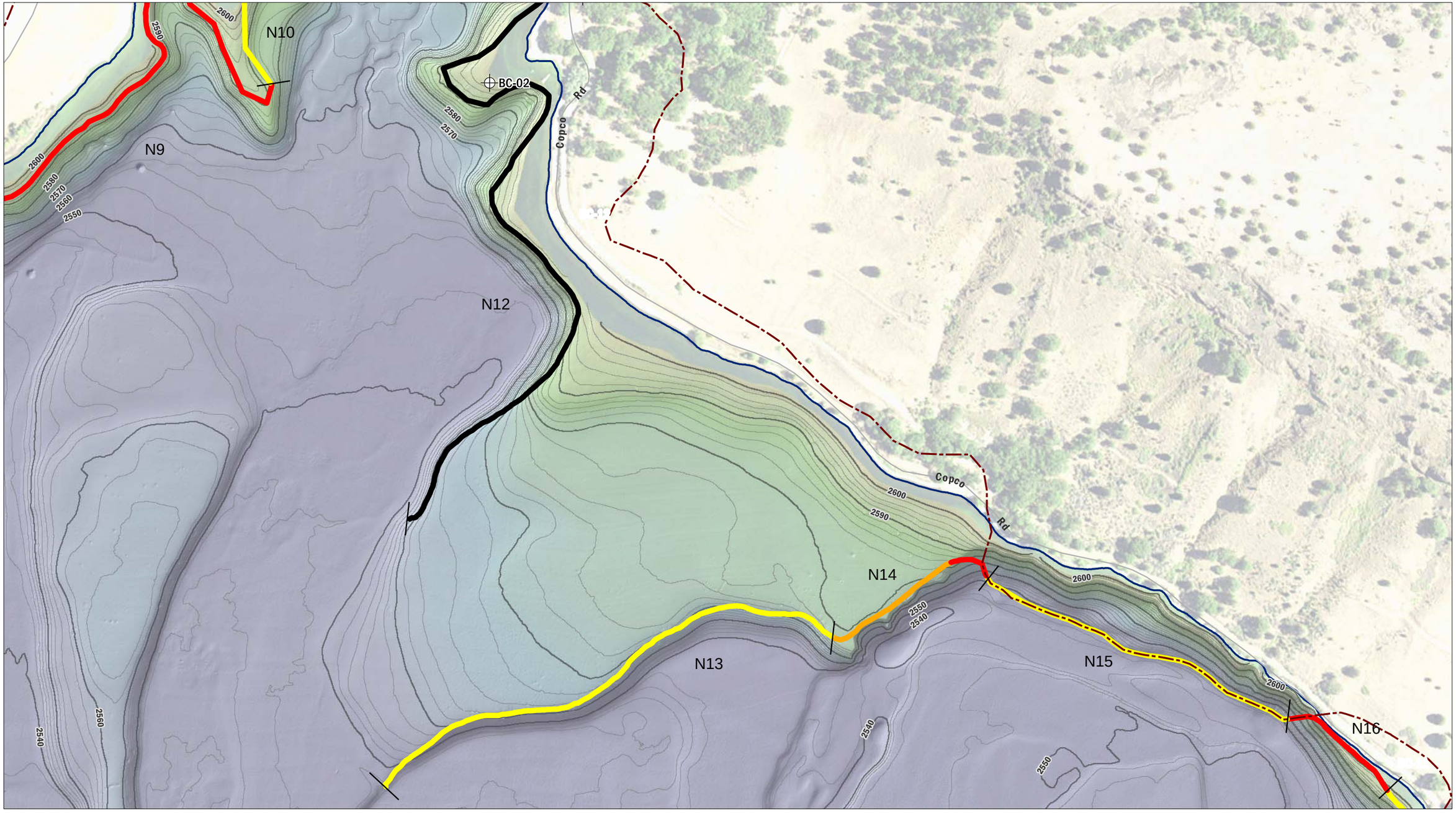
- Borings
- Extent of Fluvio-Lacustrine Deposits
- Volcanic Rock Exposed in Shoreline Notch
- Current Reservoir Shoreline

Slope Failure Analysis Features
- Incomplete Analysis
- Stable Slope
- Potentially Unstable Slope (failure contained within reservoir)
- Potentially Unstable Slope

Bathymetric Contours
- 2 ft.
- 10 ft.

Segment Information
- Segment Extents
- N1 Segment Names

FIGURE 3-4
Copco Dam - Slope Failure Analysis
Sheet 3 of 9



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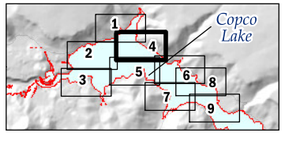


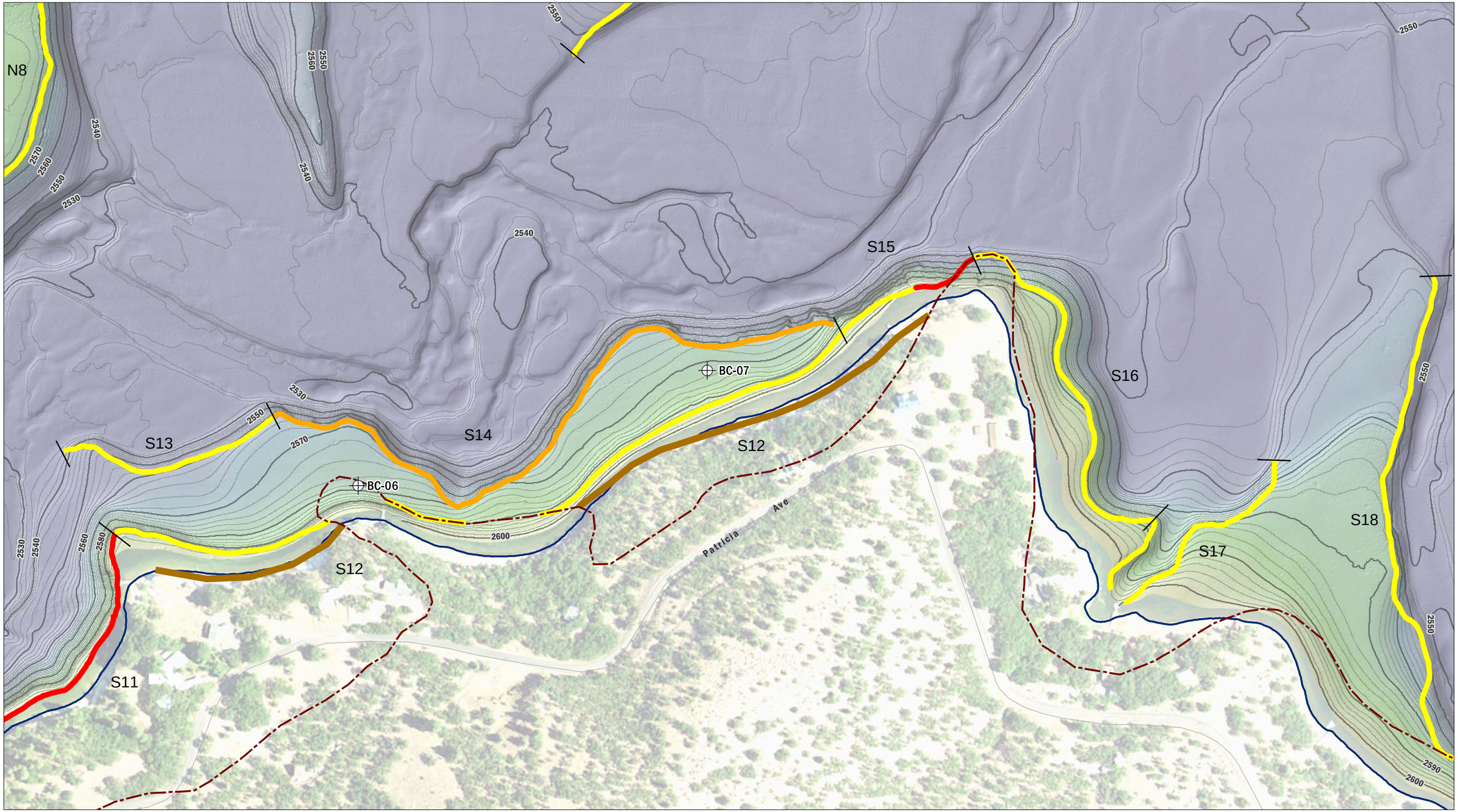
Borings
Extent of Fluvio-Lacustrine Deposits
Current Reservoir Shoreline

Slope Failure Analysis Features
Incomplete Analysis
Stable Slope
Potentially Unstable Slope (failure contained within reservoir)
Potentially Unstable Slope

Bathymetric Contours
2 ft.
10 ft.

Segment Information
Segment Extents
N1 Segment Names

FIGURE 3-4
Copco Dam - Slope Failure Analysis
Sheet 4 of 9



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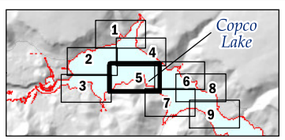


Borings

Extent of Fluvio-Lacustrine Deposits

Volcanic Rock Exposed in Shoreline Notch

Current Reservoir Shoreline

Slope Failure Analysis Features

Stable Slope

Potentially Unstable Slope (failure contained within reservoir)

Potentially Unstable Slope

Bathymetric Contours

2 ft.

10 ft.

Segment Information

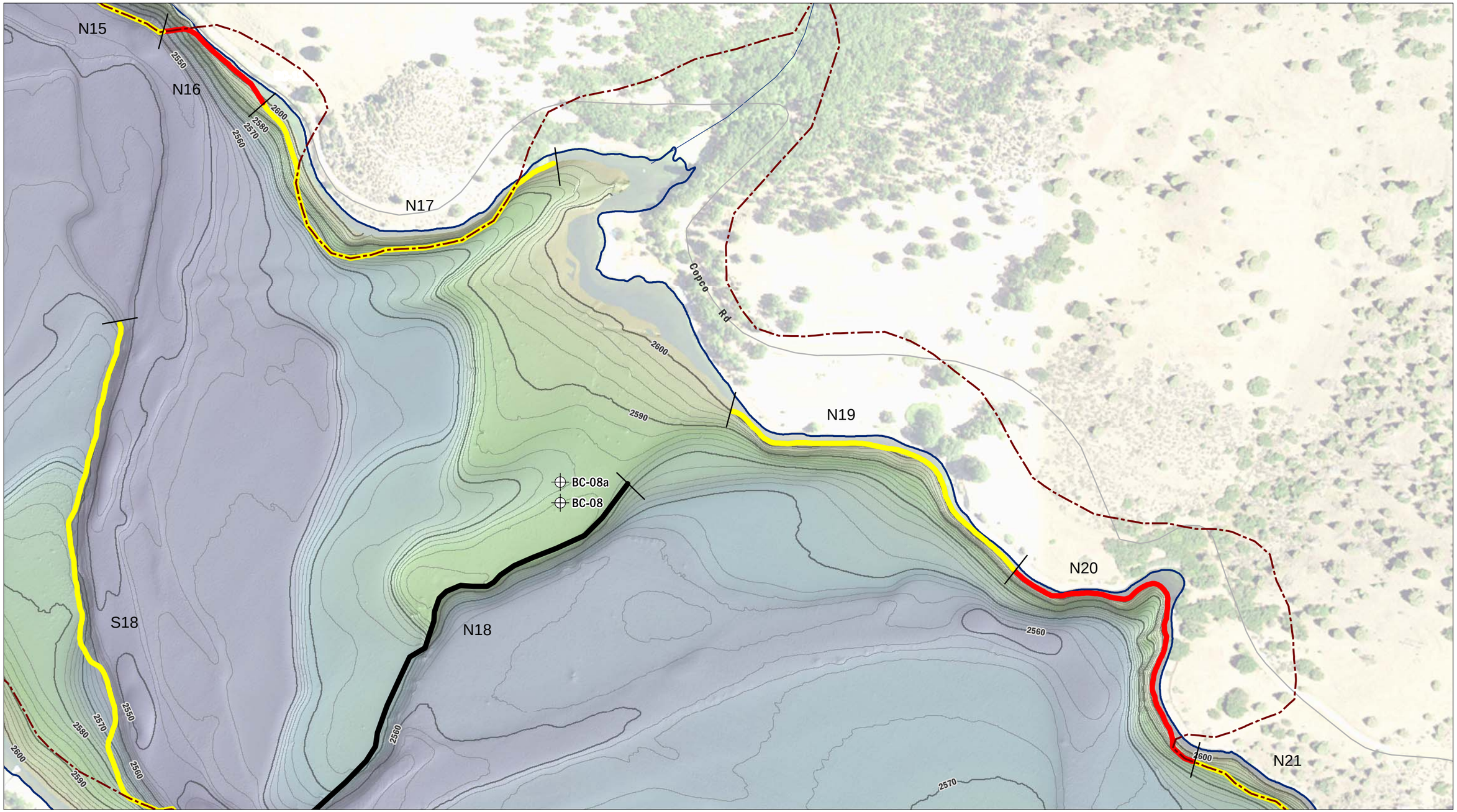
Segment Extents

N1 Segment Names

FIGURE 3-4

Copco Dam - Slope Failure Analysis

Sheet 5 of 9



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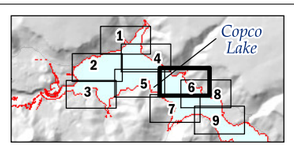

Borings
Extent of Fluvio-Lacustrine Deposits
Current Reservoir Shoreline

Slope Failure Analysis Features
Incomplete Analysis
Stable Slope
Potentially Unstable Slope

Bathymetric Contours
2 ft.
10 ft.

Segment Information
Segment Extents
N1 Segment Names

FIGURE 3-4

Copco Dam - Slope Failure Analysis
Sheet 6 of 9



Imagery: NAIP, 2014

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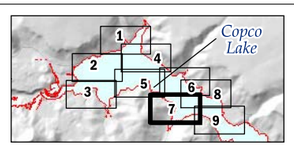
Klamath River Renewal Corporation
Klamath River Renewal Project



Extent of Fluvio-Lacustrine Deposits
Current Reservoir Shoreline

Slope Failure Analysis Features
Incomplete Analysis
Stable Slope

Bathymetric Contours
2 ft.
10 ft.

Segment Information
Segment Extents
N1 Segment Names

FIGURE 3-4

Copco Dam - Slope Failure Analysis
Sheet 7 of 9



Imagery: NAIP, 2014

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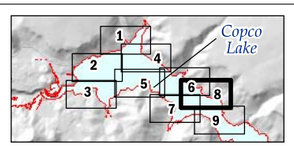
Klamath River Renewal Corporation
Klamath River Renewal Project



Extent of Fluvio-Lacustrine Deposits
Current Reservoir Shoreline

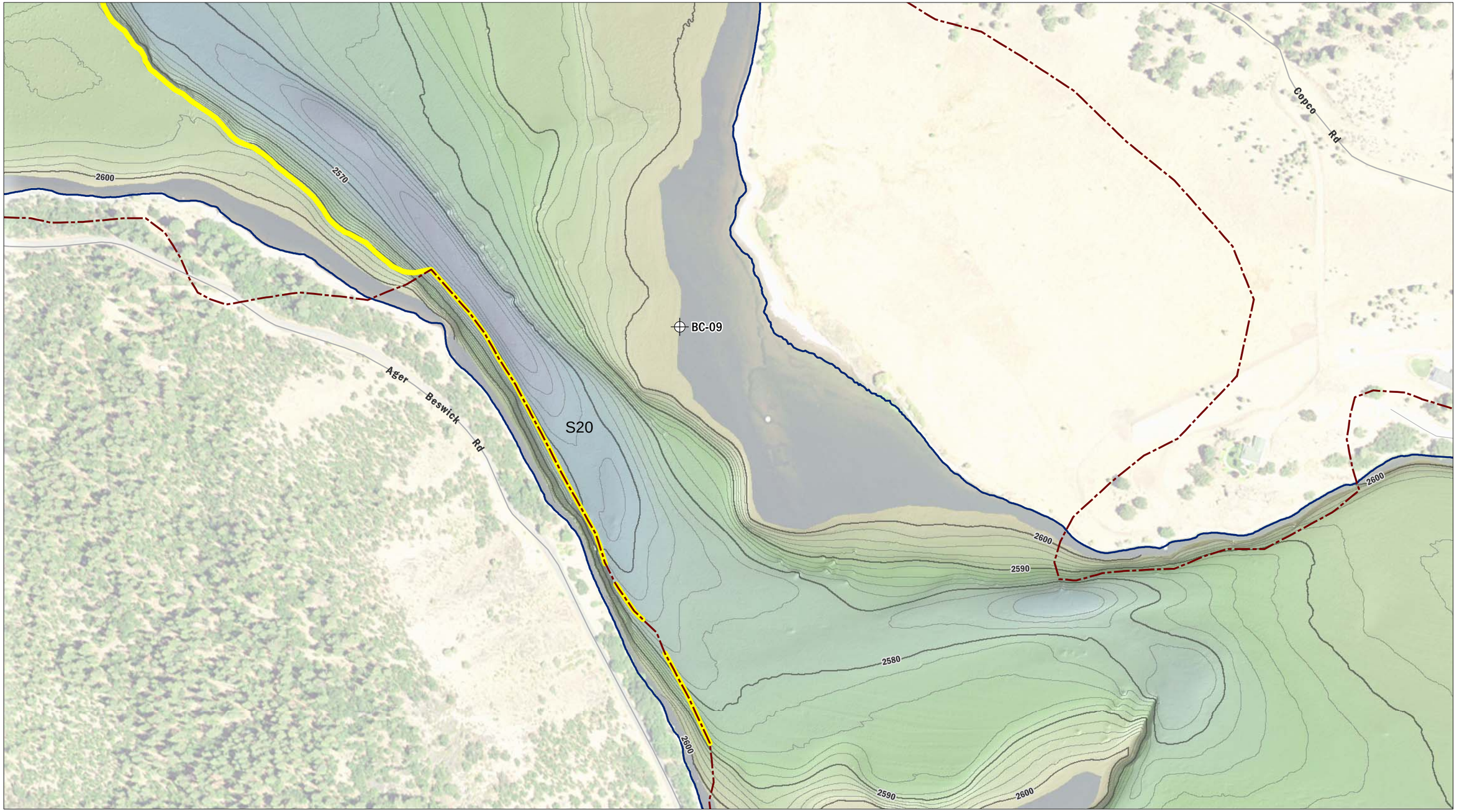
Slope Failure Analysis Features
Incomplete Analysis
Stable Slope
Potentially Unstable Slope

Bathymetric Contours
2 ft.
10 ft.

Segment Information
Segment Extents
N1 Segment Names

FIGURE 3-4

Copco Dam - Slope Failure Analysis
Sheet 8 of 9



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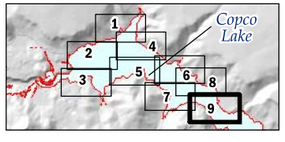


Borings
Extent of Fluvio-Lacustrine Deposits
Current Reservoir Shoreline

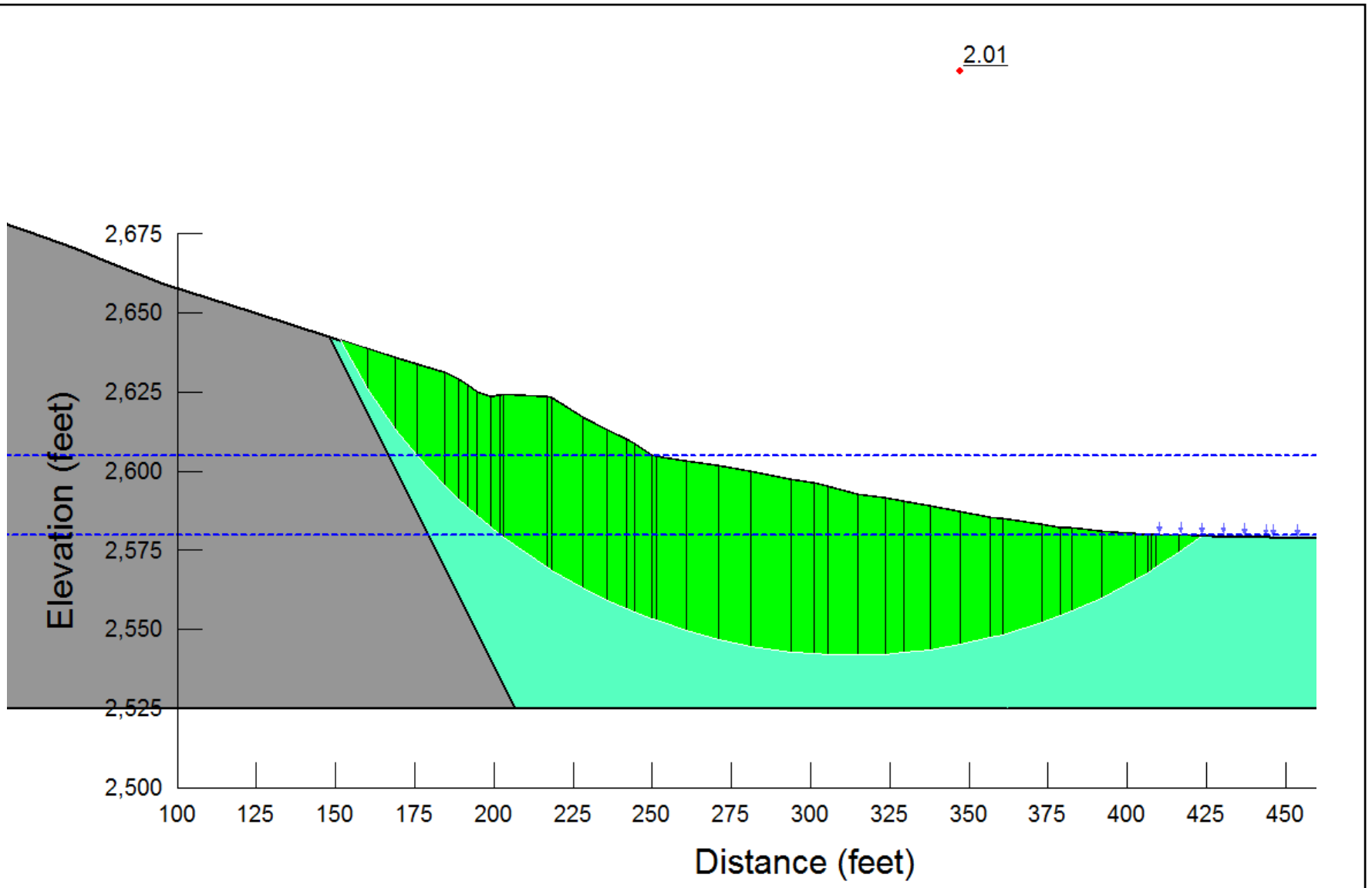
Slope Failure Analysis Features
Stable Slope

Bathymetric Contours
2 ft.
10 ft.

Segment Information
Segment Extents
N1 Segment Names

FIGURE 3-4

Copco Dam - Slope Failure Analysis
Sheet 9 of 9



Klamath River Renewal Corporation AECOM	Copco Reservoir Slope Stability Segment N10, Section 1 Rapid Drawdown Analysis	Figure 3-5a

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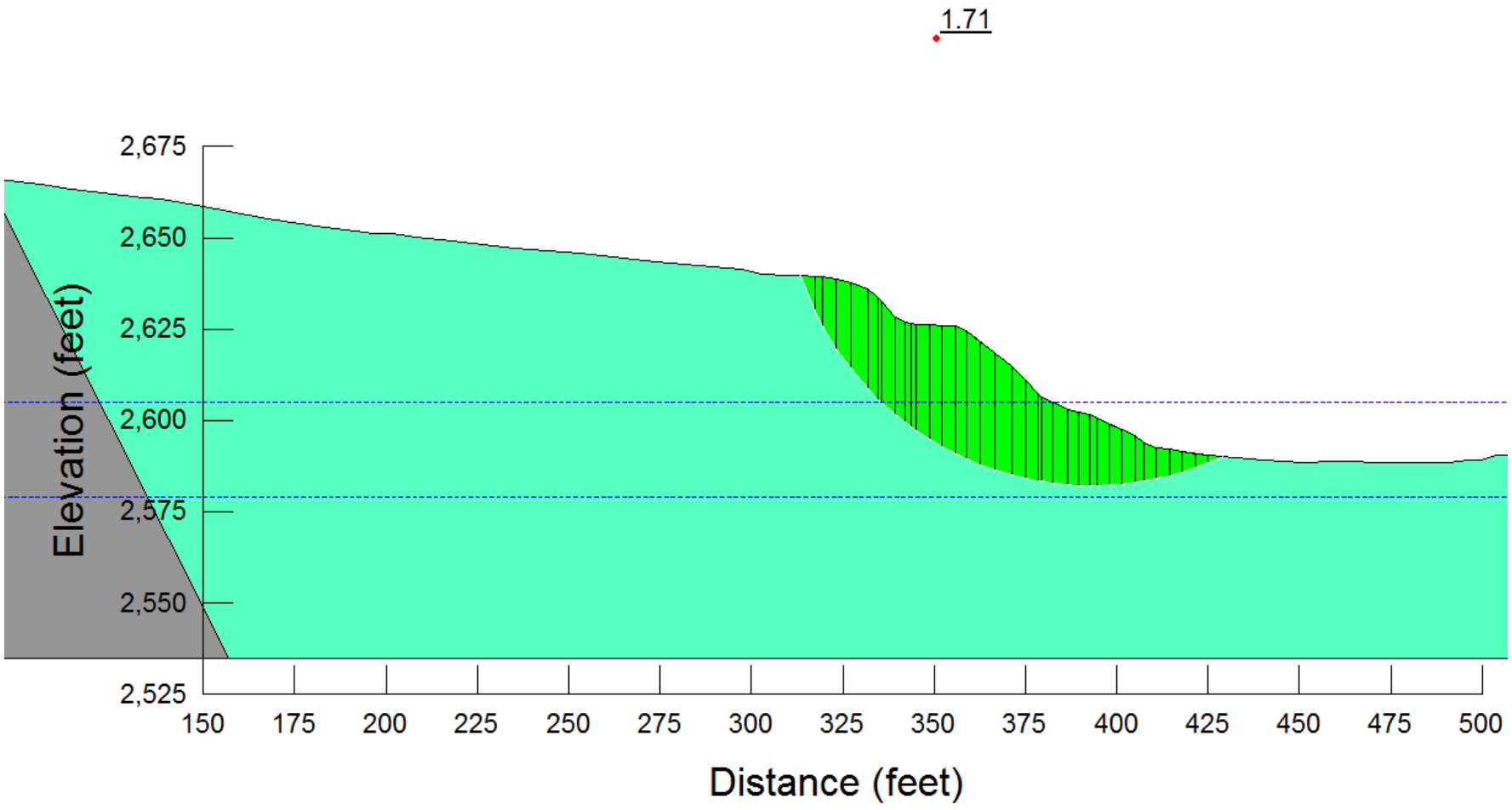

Klamath River Renewal Corporation AECOM	Copco Reservoir Slope Stability Segment N11, Section 1 Rapid Drawdown Analysis	Figure 3-5b

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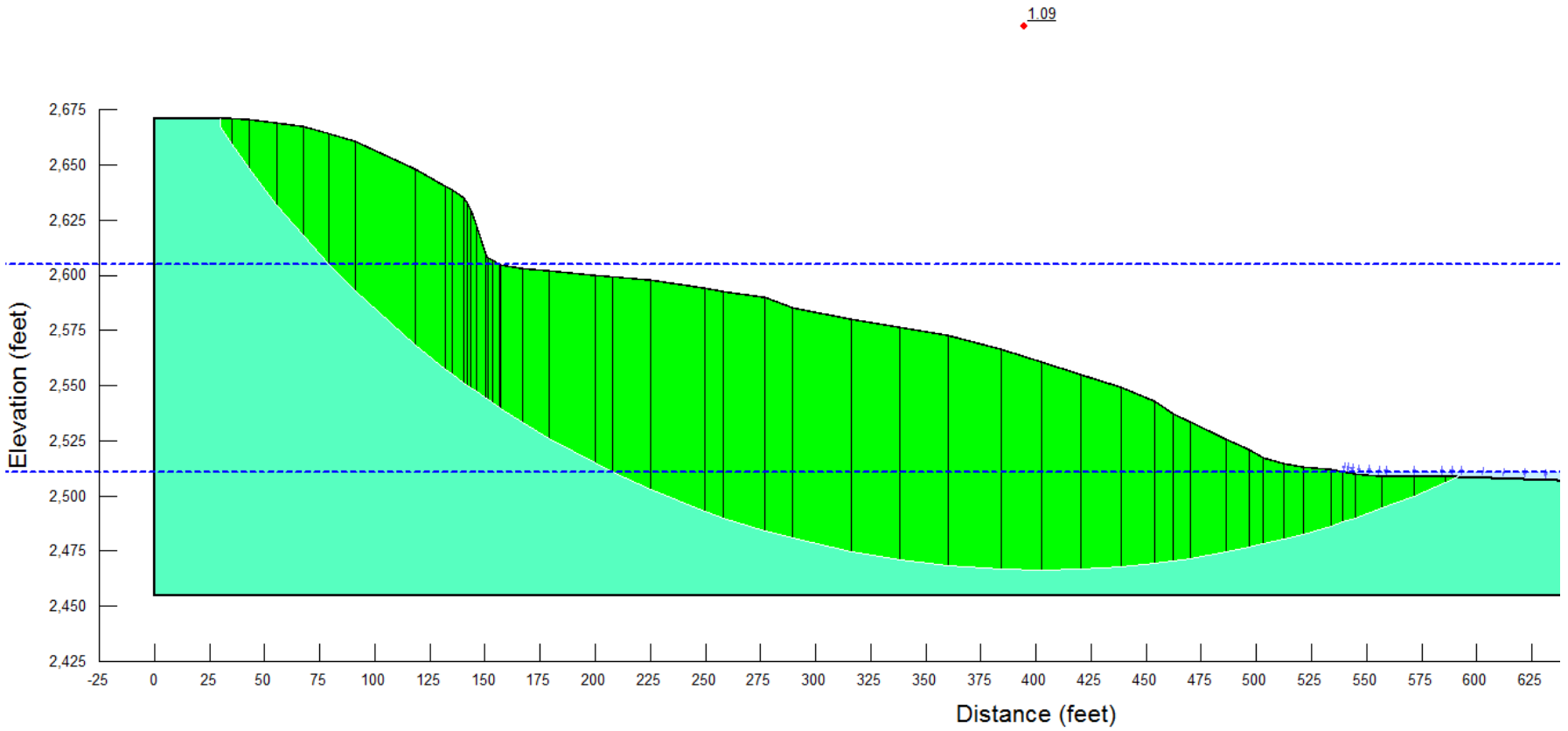

Klamath River Renewal Corporation AECOM	Copco Reservoir Slope Stability Segment S1, Section 1 Rapid Drawdown Analysis	Figure 3-5c

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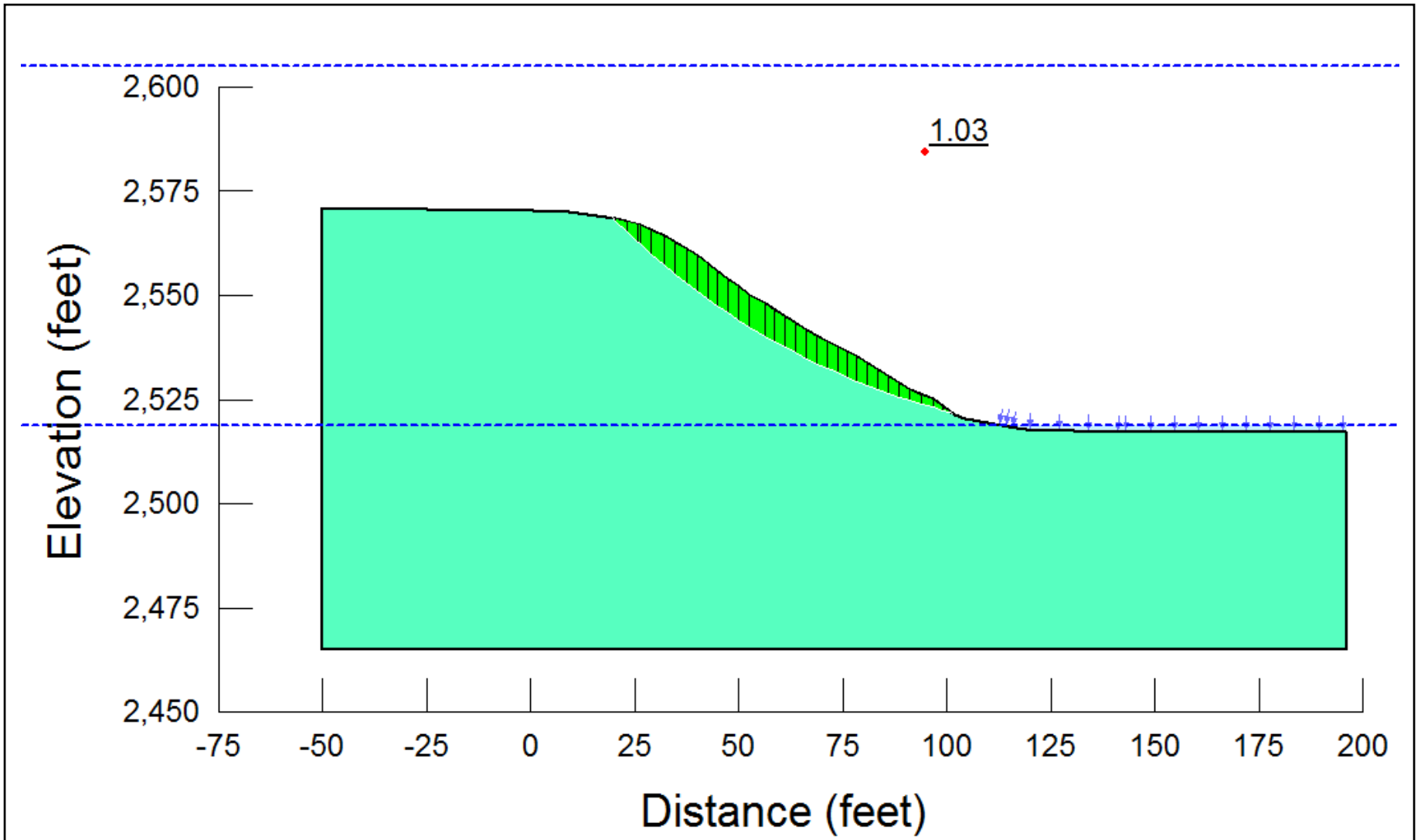

Klamath River Renewal Corporation AECOM	Copco Reservoir Slope Stability Segment S3, Section 1 Rapid Drawdown Analysis	Figure 3-5d

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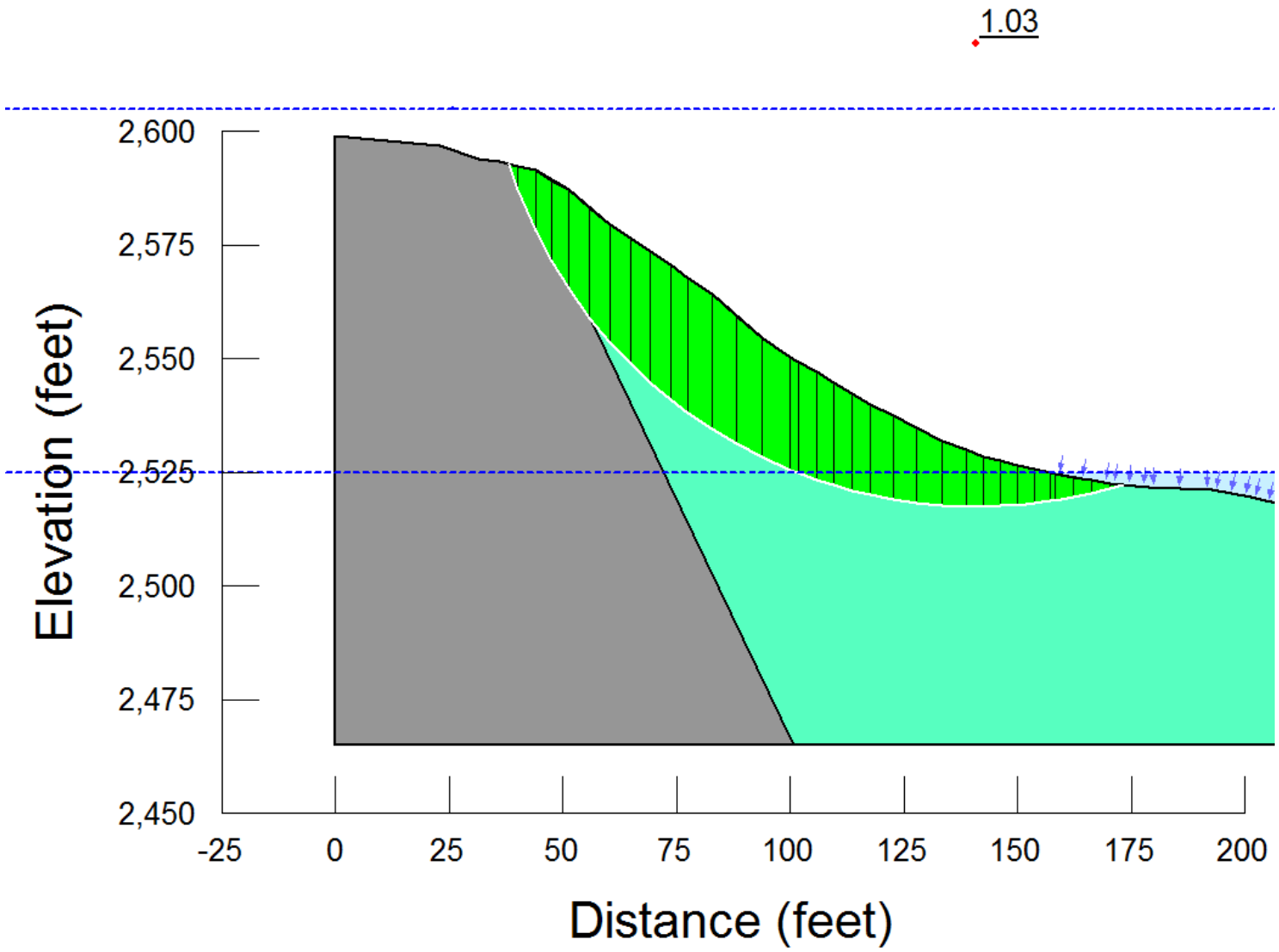

Klamath River Renewal Corporation AECOM	Copco Reservoir Slope Stability Segment S10, Section 1 Rapid Drawdown Analysis	Figure 3-5e

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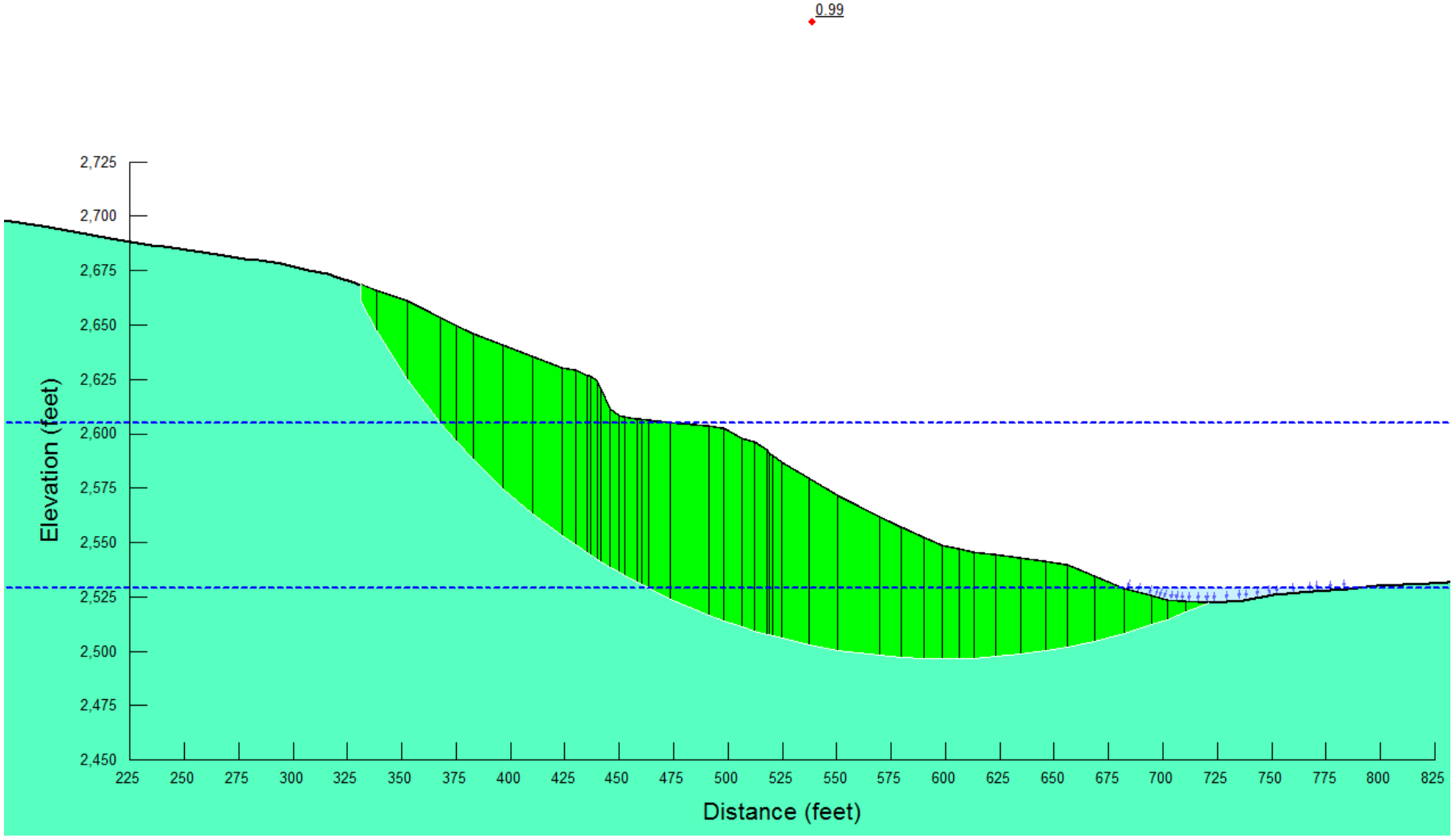

Klamath River Renewal Corporation AECOM	Copco Reservoir Slope Stability Segment S11, Section 1 Rapid Drawdown Analysis	Figure 3-5f

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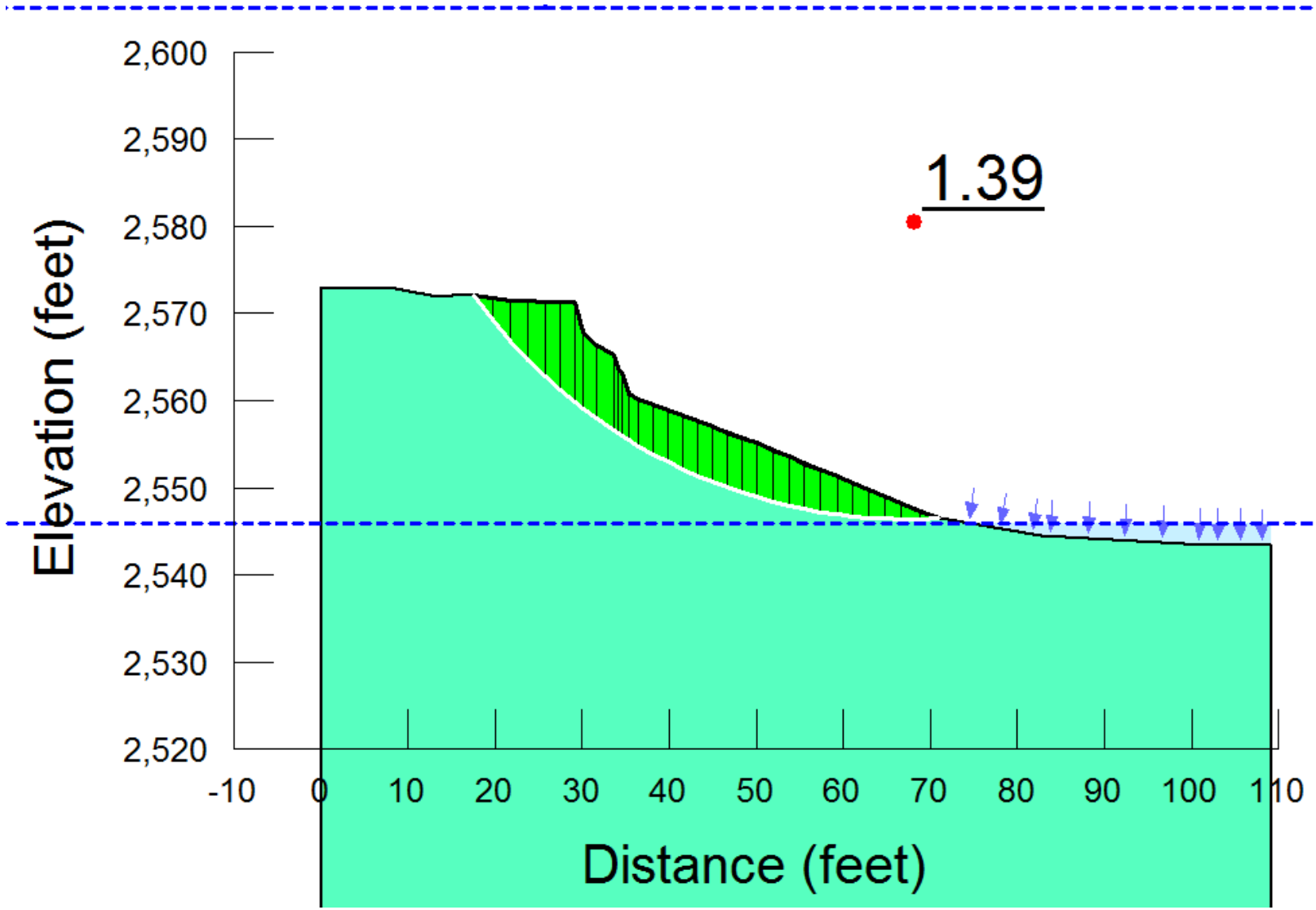

Klamath River Renewal Corporation AECOM	Copco Reservoir Slope Stability Segment S18, Section 1 Rapid Drawdown Analysis	Figure 3-5g

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\\AECOM\Oakland\CA-SLT-2018\GER\benjamin.kusmerick\ PATH: \\Oakland\Oakland\Projects\Secure Water\Klamath Dam\400 Technical\1400 GIS\02_Maps\02_Map_Production_prod_Reports\Geotechnical_Workflow_Rmd\ssslide\Figure_4-2_Iron Gate Geology.mxd

Tv
QTb
Qc
af
Qaf
Qfp
Qac
Qa/Qaf
Qafl/Qt
Qafl/Qc
Qafl/Qfp
Qls
Qls(?)
Qls (?)
BI-01
BI-02
BI-03
BI-04
Qb
Qt
Qa
Qc/af
Qfp/Qt
Qc/Talus

Boring, AECOM 2018
10' Bathymetric Contour (GMA, 2018)
20' Elevation Contour (LiDAR, 2010)

Surficial Units

- af-Artificial Fill
- Qac-Klamath River Channel
- Qt; Qfp/Qt; Qfp/Qaf; Qfp-Klamath River Flood Plain and Alluvial Terrace Deposits
- Qa; Qaf/Qt; Qaf; Qa/Qaf- Undifferentiated Alluvium, Alluvial Fan and Terrace Deposits
- Qafl/Qc-Mixed Alluvial Fan and Colluvial Deposits
- Qc; Qc/af; Qc/Qtl- Colluvium and/or Talus, af where disturbed.
- Qls- Landslide Deposits; Qdf- Debris Flow/Fan Deposits

Bedrock Units

- Qb- Copco Basalt
- QTb
- Tv- Tertiary Volcanics

Imagery, NAIP 2014

N

0 0.5
Miles

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

FIGURE 4-2
Geologic Overview of Iron Gate Reservoir

Attachment B Boring Logs

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Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Key to Log of Boring

Elevation feet	Depth, feet	SAMPLES: Type	SAMPLES: Number	SAMPLES: Sampling Resistance blows/6-in.	SAMPLES: Recovery (inches)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight (pcf)	Fines Content (% <200 Sieve)	REMARKS AND OTHER TESTS
1	2	3	4	5	6	7	8	9	10	11	12

COLUMN DESCRIPTIONS

1 **Elevation:** Elevation in feet referenced to specified datum.

2 **Depth:** Depth in feet below the ground surface.

3 **Sample Type:** Type of soil sample collected at depth interval shown; sampler symbols are explained below.

4 **Sample Number:** Sample identification number.

5 **Sampling Resistance:** Number of blows required to advance driven sampler 12 inches beyond first 6-inch interval, or distance noted, using a 140-lb hammer with a 30-inch drop; or down-pressure for pushed sampler.

6 **Recovery:** Percentage of driven or pushed sample length recovered; "NA" indicates data not recorded.

7 **Graphic Log:** Graphic depiction of subsurface material encountered; typical symbols are explained below.

8 **Material Description:** Description of material encountered; may include density/consistency, moisture, color, and grain size.

9 **Water Content:** Water content of soil sample measured in laboratory, expressed as percentage of dry weight of specimen.

10 **Dry Unit Weight:** Density of soil as measured in the laboratory, in pounds per cubic foot

11 **Fines Content** Percentage passing the #200 sieve as measured in the laboratory

12 **Remarks and Other Tests:** Comments and observations regarding drilling or sampling made by driller or field personnel.

TYPICAL MATERIAL GRAPHIC SYMBOLS

- Diatomite
- Diatomite with Elastic Silt
- Weakly Cemented Diatomite
- Fat Clay with varying amounts of sand and gravel; diatomaceous in some areas
- Lean Clay with varying amounts of sand and gravel; diatomaceous in some areas
- Organic Silt
- Clayey Sand
- Silty Sand with varying amounts of sand and gravel
- Clayey Gravel with varying amounts of sand
- Well Graded Gravel with varying amounts of sand
- Volcanic Clastics
- Volcanic Cinder
- Volcanic Sandstone
- Andesite
- Basalt

TYPICAL SAMPLER GRAPHIC SYMBOLS

- Modified California Sampler (2.5-inch outer diameter)
- Standard Penetration Test
- Shelby tube (thin walled 3-inch outer diameter)

OTHER GRAPHIC SYMBOLS

GENERAL NOTES

Project: Klamath River Dam Removal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Key to Log of Boring

KEY TO DESCRIPTIVE TERMS USED ON CORE LOGS

DISCONTINUITY DESCRIPTORS

a Dip of discontinuity, measured relative to a plane normal to the core axis.

b **Discontinuity Type:**

- F - Fault
- J - Joint
- Sh - Shear
- Fo - Foliation
- V - Vein
- B - Bedding

c **Aperture (inches):**

- W - Wide (0.5-2.0)
- MW - Moderately Wide (0.1-0.5)
- N - Narrow (0.05-0.1)
- VN - Very Narrow (<0.05)
- T - Tight (0)

d **Type of Infilling:**

- Bi - Biotite
- Cl - Clay
- Ca - Calcite
- Ch - Chlorite
- Ep - Epidote
- Fe - Iron Oxide
- H - Healed
- My - Mylonite
- CR - Crushed Rock
- Mn - Manganese
- No - None
- Py - Pyrite
- Qz - Quartz
- Sd - Sand
- Se - Serpentine
- Si - Silty
- Uk - Unknown

e **Amount of Infilling:**

- Su - Surface Stain
- Sp - Spotty
- Pa - Partially Filled
- Fi - Filled
- No - None

f **Surface Shape of Joint:**

- Pl - Planar
- Wa - Wavy
- St - Stepped
- Ir - Irregular

g **Roughness of Surface:**

- Slk - Slickensided [surface has smooth, glassy finish with visual evidence of striations]
- S - Smooth [surface appears smooth and feels so to the touch]
- SR - Slightly Rough [asperities on discontinuity surfaces are distinguishable and can be felt]
- R - Rough [ridges and side-angle steps are evident; asperities are clearly visible; surface feels very abrasive]
- VR - Very Rough [near-vertical steps and ridges occur on discontinuity surface]

ROCK FRACTURING

Description	Recognition
Intensely Fractured	Fractures spaced less than 2 inches apart
Highly Fractured	Fractures spaced 2 inches to 1 foot apart
Moderately Fractured	Fractures spaced 1 foot to 3 feet apart
Slightly Fractured	Fractures spaced 3 feet to 10 feet apart
Massive	Fracture spacing greater than 10 feet

ROCK WEATHERING / ALTERATION

Description	Recognition
Residual Soil	Original minerals of rock have been entirely decomposed to secondary minerals, and original rock fabric is not apparent; material can be easily broken by hand
Completely Weathered/Altered	Original minerals of rock have been almost entirely decomposed to secondary minerals, although original fabric may be intact; material can be granulated by hand
Highly Weathered/Altered	More than half of the rock is decomposed; rock is weakened so that a minimum 2-inch-diameter sample can be broken readily by hand across rock fabric
Moderately Weathered/Altered	Rock is discolored and noticeably weakened, but less than half is decomposed; a minimum 2-inch-diameter sample cannot be broken readily by hand across rock fabric
Slightly Weathered/Altered	Rock is slightly discolored, but not noticeably lower in strength than fresh rock
Fresh/Unweathered	Rock shows no discoloration, loss of strength, or other effect of weathering/alteration

ROCK STRENGTH

Description	Recognition	Approximate Uniaxial Compressive Strength (psi)
Extremely Weak Rock	Can be indented by thumbnail	35 - 150
Very Weak Rock	Can be peeled by pocket knife	150 - 700
Weak Rock	Can be peeled with difficulty by pocket knife	700 - 3,600
Moderately Strong Rock	Can be indented 5 mm with sharp end of pick	3,600 - 7,200
Strong Rock	Requires one hammer blow to fracture	7,200 - 14,500
Very Strong Rock	Requires many hammer blows to fracture	14,500 - 36,000
Extremely Strong Rock	Can only be chipped with hammer blows	>36,000

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-01

Date(s) Drilled	**2/5/2018 - 2/6/2018**	Logged By	**B. Kozlowicz**	Checked By	**D. Simpson**
Drilling Method	**Rotary Wash**	Drill Bit Size/Type	**4-inch Tricone**	Total Depth of Borehole	**30.4 feet**
Drill Rig Type	**Barge Mounted CME-45**	Drilling Contractor	**Taber Drilling**	Surface Elevation	**2597.1**
Groundwater Level(s)	**12.3 feet above ground surface (2/5 at 15:15)**	Sampling Method(s)	**2.5-inch ID Mod Cal, SPT**	Hammer Data	**Auto hammer (140 lb, 30-inch drop)**
Borehole Backfill	**Bentonite cement grout to 10 feet bgs**	Location		Coordinates	**N 2608898 E 6476516**

Elevation feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	0										
			S01	1 1 0 (1)	1.8		SILT WITH SAND AND GRAVEL (ML), very soft, very dark gray to black (2.5Y 3/1 to 2.5/1), fine to coarse grained sand, subangular to rounded gravel, sand and gravel consists of diatomite clasts. [Recent Lake Sediment]				Sampler fell 18 inches on last blow
2595											Advance 6-inch casing to 6 feet with hammer (hard/stiff at about 3.5 feet)
	5										
			S02	4 3 4 (7)	1.5		Becomes soft, dark olive brown (2.5Y 3/3) to very dark grayish brown (2.5Y 3/2) with trace gravel	43			Advance 6-inch casing to 8 feet with hammer LL = 33 PL = 25 PI = 8
2590											
	10						DIATOMITE, light olive brown (2.5Y 5/4), highly weathered, extremely weak, highly fractured, friable [Lacustrine Diatomaceous Terrace (Ql)]				
			S03	7 6 6 (12)	1.2			99		46	2/5/18 16:45 EOD 2/6/18 8:30 BOD Advance 6-inch casing to 11 feet with hammer
2585											
	15										
2580											
	20										
			S04	3 2 5 (7)	1.4		Becomes soft with iron staining on irregular subvertical fractures	93	99		LL = 85 PL = 51 PI = 34 1% Sand 99% Fines
2575											
	25										

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-01

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
2570	25						BASALT, black (10Y 2.5/1), highly to completely weathered, friable				Cuttings become dark greenish gray sandy clay; slower drilling
			S05	31 50/6"	0.6						
	30		S06	50/5"	0.4		**TOTAL DEPTH = 30.4 FEET**				
2565											
	35										
2560											
	40										
2555											
	45										
2550											
	50										
2545											

AECOM

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-02

Date(s) Drilled	**2/5/2018**	Logged By	**B. Kozlowicz**	Checked By	**D. Simpson**
Drilling Method	**Rotary Wash**	Drill Bit Size/Type	**4-inch Tricone**	Total Depth of Borehole	**64.6 feet**
Drill Rig Type	**Barge Mounted CME-45**	Drilling Contractor	**Taber Drilling**	Surface Elevation	**2599.6**
Groundwater Level(s)	**9.4 feet above ground surface (2/5 at 9:00)**	Sampling Method(s)	**2.5-inch ID Mod Cal, SPT, 3-inch Shelby Tube**	Hammer Data	**Auto hammer (140 lb, 30-inch drop)**
Borehole Backfill	**Bentonite cement grout to 10 feet bgs**	Location		Coordinates	**N 2608331 E 6476958**

Elevation feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	0						SANDY LEAN CLAY (CL), very soft, very dark gray (2.5Y 3/1) to black (2.5Y 2.5/1), trace fine rounded gravel [Recent Lake Sediment]				
			S01	2 10 12 (22)	1.7		CLAYEY GRAVEL WITH SAND (GC), stiff/medium dense, very dark grayish brown (10YR 3/2), subangular to rounded fine to coarse gravel up to 2 inches in diameter, fine to coarse sand [Fluvio-Lacustrine Terrace Deposit with Gravel (Qtg)]		28		52% Gravel 20% Sand 28% Fines Advanced 6-inch casing to 3.8 feet with hammer
2595	5										
			S02	5 5 10 (15)	0.2		← Black angular basalt cobble				
			S03	18 10 10 (20)	1.2						Drove sampler for extra 6 inches (last three blowcounts reported) Advanced 6-inch casing to 8.8 feet with hammer
2590	10		S04	11 9 9 (18)	0.8		DIATOMITE, olive to olive yellow (5Y 4/3 to 2.5Y 6/6), moderately to highly weathered, extremely weak, highly fractured, with sub-horizontal bedding and irregular sub-vertical fractures, friable [Lacustrine Diatomaceous Terrace (Ql)]				
							← Becomes light yellowish brown (2.5Y 6/4), extremely weak/clayey, moderately fractured				
2585	15		S05	4 4 6 (10)	1.2			84	99		LL = 105 PL = 59 PI = 46 1% Sand 99% Fines
							DIATOMITE WITH ELASTIC SILT, greenish gray (10Y 5/1), soft to extremely weak, highly fractured, friable [Lacustrine Diatomaceous Terrace (Ql)]				
2580	20		S06	200 psi	2.3			148		32	About 50% WCR TX-ICU
2575	25			3							

AECOM

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-02

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	25		S07	2 3 (5)	1.4						
											About 25% to 50% WCR
2570	30										
2565	35		S08	200 to 500 psi	2.1			149		33	TX-ICU
2560	40						Increase in plasticity, soft, olive (5Y 5/3) and very dark gray to black (2.5Y 2.5/1 to 2.5Y 3/1) in ~2.5-inch beds, sub-horizontal bedding				Cuttings become very dark gray
2555	45		S09	3 3 4 (7)	1.5			178	100		LL = 187 PL = 85 PI = 102 1% Sand 99% Fines
2550	50										

AECOM

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-02

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
2545	55	S10		2 3 5 (8)	1.5			171		30	
2540	60						BASALT, black (10Y 2.5/1), slightly weathered, strong; recovered as angular gravel up to 1-inch in diameter [Copco/Quaternary Basalt (Qb)]				Harder drilling, small black basalt chips in cuttings
2535	65	S11		50/3"	0.3		**TOTAL DEPTH = 64.6 FEET**				
2530	70										
2525	75										
2520	80										

AECOM

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-03

Sheet 1 of 4

Date(s) Drilled	**2/6/2018 - 2/7/2018**	Logged By	**B. Kozlowicz**	Checked By	**D. Simpson**
Drilling Method	**Rotary Wash**	Drill Bit Size/Type	**4-inch Tricone**	Total Depth of Borehole	**96.5 feet**
Drill Rig Type	**Barge Mounted CME-45**	Drilling Contractor	**Taber Drilling**	Surface Elevation	**2584.6**
Groundwater Level(s)	**24.3 feet above ground surface (2/6 at 12:00)**	Sampling Method(s)	**2.5-inch ID Mod Cal, SPT, 3-inch Shelby Tube, HQ Core Barrel**	Hammer Data	**Auto hammer (140 lb, 30-inch drop)**
Borehole Backfill	**Bentonite cement grout to 10 feet bgs**	Location		Coordinates	**N 2606643 E 6474657**

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Sampling Resistance	SAMPLES Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	0						ORGANIC SILT WITH SAND (OL), very soft, very dark grayish brown (2.5Y 3/2) [Recent Lake Sediment]	35	67		Sampler settled to 1-foot; drove sampler for extra 6 inches (last three blowcounts reported) LL = 48 PL = 25 PI = 23
			S01	1 2 3 (5)	2		LEAN CLAY WITH SAND (CL), soft, black (5Y 2.5/2), fine grained sand, trace rounded gravel, small angular rock fragements, and fine rootlets [Colluvium/Resdiual Soil]				
2580	5		S02	4 3 2 (5)	0.6		Without gravel	25		80	3% Gravel 29% Sand 68% Fines Advanced 6-inch casing to 4 feet (stiff from 3 feet)
							Subrounded gravel up to 2.5-inch in diameter with clayey infill [Fluvio-lacustrine Terrace Deposits with Gravel (Qtg)]				Hard chattering drilling Switch to rock core bit with SPT sampler
2575	10		R1		0.1						
			S03	6 3 2 (5)	0.1		DIATOMITE, olive brown to dark grayish brown (2.5Y 4/3 to 2.5Y 4/2), massive, extremely weak, bedding/fractures not present [Lacustrine Diatomaceous Terrace (Ql)]				Faster drilling from 10.5 to 11.5 feet Return fluid becomes olive
2570	15		R2		0.2						Advanced 6-inch casing to 14 feet with hammer
			S04	6 4 5 (9)	1						Switch back to tricone bit
2565	20										
							DIATOMITE WITH ELASTIC SILT, dark grayish brown (2.5Y 4/2), massive/soft to very soft [Lacustrine Diatomaceous Terrace (Ql)]				
2560	25			3				80	100		LL = 69

AECOM

Report: GEO_10B1_OAK; File: BORING LOGS.GPJ; 6/21/2018 BC-03

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-03

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	25		S05	3 4 (7)	1.3						PL = 59 PI = 10 100% Fines
2555	30										
2550	35										
2545	40		S06	200 to 400 psi	2.5			85		27	TX-ICU
								90		25	TX-ICU
							Increase in plasticity, soft, dark greenish gray (10Y 4/1), 1 to 2-inch beds/lenses of very dark gray to black clay				
2540	45										Cutting very dark greenish gray
2535	50										

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-03

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
2530	55										
2525	60										
2520	65		S07	5 5 7 (12)	1.5						2/6/18 16:25 EOD 2/7/18 8:30 BOD Cuttings greenish black
2515	70										
2510	75										
2505	80		S08	100 psi	0						

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-03

Sheet 4 of 4

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
2500	85		S09		0.25						
2495	90		S10		1			120		16	TX-ICU
2490	95		S11	7 5 5 (10)	0.3						Driller out of rods
							TOTAL DEPTH = 96.5 FEET				
2485	100										
2480	105										
2475	110										

AECOM

Report: GEO_10B1_OAK; File: BORING LOGS.GPJ; 6/21/2018 BC-03

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-04

Date(s) Drilled	**2/1/2018**	Logged By	**B. Kozlowicz**	Checked By	**D. Simpson**
Drilling Method	**Rotary Wash**	Drill Bit Size/Type	**4-inch Tricone**	Total Depth of Borehole	**73.5 feet**
Drill Rig Type	**Barge Mounted CME-45**	Drilling Contractor	**Taber Drilling**	Surface Elevation	**2595.1**
Groundwater Level(s)	**11.8 feet above ground surface (2/1)**	Sampling Method(s)	**2.5-inch ID Mod Cal, SPT, 3-inch Shelby Tube**	Hammer Data	**Auto hammer (140 lb, 30-inch drop)**
Borehole Backfill	**Bentonite cement grout to 10 feet bgs**	Location		Coordinates	**N 2604812 E 6472949**

Elevation feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
2595	0						SILTY SAND (SM), very loose, very dark brown (10YR 2/2), trace subangular diatomite gravel up to 0.75 inches in diameter [Recent Lake Sediment]				6-inch casing settles to 1.5 feet
									44		5% Gravel 51% Sand 44% Fines Sampler advanced 1 foot on first blow and 2.5 feet on second blow
			S01	1 0 1 (1)	2		Becomes organic rich and softer/looser with increased nonplasctic fines				
2590	5										Advanced 6-inch casing to 5.5 feet with hammer
							SANDY LEAN CLAY (CL), very loose/very soft, very dark brown (10YR 2/2), trace fine gravel and coarse organics [Recent Lake Sediment]				
									58		3% Gravel 39% Sand 58% Fines Drove sampler for extra 6 inches (last three blowcounts reported)
			S02	2 3 3 (6)	2						
2585	10										Advanced 6-inch casing to 11 feet (resistance at 11 feet)
							WEAKLY CEMENTED DIATOMITE GRAVEL, medium dense, light olive brown (2.5Y 5/4), angular diatomite gravel, weakly cemented and friable with sub-horizontal bedding and sub-vertical fractures [Lacustrine Diatomaceous Terrace (Ql)]		41		Advanced 6-inch casing to 12.5 feet with hammer 9% Gravel 50% Sand 41% Fines
			S03	4 11 18 (29)	1.3						
			S04	400 psi	2			61		59	TX-ICU
								54		65	TX-ICU
2580	15										100 percent WCR
			S05	400 psi	2.5			105		42	TX-ICU
2575	20						DIATOMITE WITH ELASTIC SILT, soft to completely weathered, light greenish gray (5GY 7/1) [Lacustrine Diatomaceous Terrace (Ql)]				
			S06	200 to 400 psi	2.5			155		32	TX-ICU
	25										

AECOM

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-04

Elevation feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
2570	25										Lost circulation to 27.5 feet
			S07	2 3 5 (8)	1.8		Becomes mottled with very pale brown (10YR 8/3) and light greenish gray (5GY 7/1) with 10 degree bedding				Drove sampler for extra 6 inches (last three blowcounts reported) About 50% WCR
2565	30										
			S08	200 to 500 psi	1.5			117	99	37	TX-ICU LL = 60 PL = 24 PI = 36 1% Sand 99% Fines About 75% WCR
2560	35										
							Becomes with 0.25-inch very dark gray (5Y 3/1) 10-degree beds (varves?) and vertical dark gray (5Y 4/1) stained fractures				
2555	40										
			S09	1 1 1 (2)	2						About 50% to 75% WCR
2550	45										
2545	50										
			S10	200 to 400 psi	2.5			161		31	TX-UU

AECOM

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-04

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
2540	55							154		32	TX-ICU
2535	60						DIATOMITE, highly to completely weathered, pale yellow to olive yellow (2.5Y 6/6 to 2.5Y 8/4) with orange oxidation stain/mottling; fine grained vitreous gypsum xtals along very dark gray (5Y 3/1) sub-vertical fractures [Lacustrine Diatomaceous Terrace (Ql)]				
			S11	2 2 2 (4)							
2530	65										
2525	70						ANDESITE(?); moderatly to highly weathered, medium strong, fine to medium grained [Bogus Mountain Beds]				Hard drilling, very dark gray to black volcanic fragments in cuttings
			S12	30 50/5"							
							TOTAL DEPTH = 73.5 FEET				
2520	75										
2515	80										

AECOM

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-05

Sheet 1 of 1

Date(s) Drilled	**2/2/2018, 2/8/2018**	Logged By	**B. Kozlowicz**	Checked By	**D. Simpson**
Drilling Method	**Rotary Wash**	Drill Bit Size/Type	**4-inch Tricone**	Total Depth of Borehole	**20.5 feet**
Drill Rig Type	**Barge Mounted CME-45**	Drilling Contractor	**Taber Drilling**	Surface Elevation	**2601.1**
Groundwater Level(s)	**8.2 feet (2/2 at 11:00) and 6.6 (2/8 at 12:15) feet above ground surface**	Sampling Method(s)	**2.5-inch ID Mod Cal, SPT, 3-inch Shelby Tube**	Hammer Data	**Auto hammer (140 lb, 30-inch drop)**
Borehole Backfill	**Bentonite cement grout to 10 feet bgs**	Location		Coordinates	**N 2604139 E 6474515**

Elevation feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
2600	0		S01	0 0 0 (0)	0.7		SILTY SAND WITH GRAVEL (SM), very loose, very dark grayish brown (2.5Y 3/2), greenish gray clayey diatomite gravel clasts up to 1-inch in diameter, nonplastic fines [Recent Lake Sediment]				Sampler advanced 2 feet under hammer weight Advanced 6-inch casing to 5 feet with hammer
2595	5		S02	4 10 20 (30)			← Clayey gravel made up of mostly Diatomite clasts up to 0.75 inches in diameter LEAN CLAY (CL), very stiff, very dark gray to very dark greenish gray (10Y 3/1 to 2.5Y 3/1), low to medium plasticity fines, trace highly to completely weathered clasts of diatomite [Fluvio-Lacustrine Terrace Deposit with Gravel (Qtg)]				Drove sampler for extra 6 inches (last three blowcounts reported) Advanced 6-inch casing to 8.5 feet (refusal) 2/2/18 EOD 2/8/18 BOD
2590	10		S03	2 1 1 (2)	1.5		DIATOMITE WITH ELASTIC SILT, extremely weak/very soft, greenish gray (5GY 6/1), 20-degree bedding and 90-degree fractures [Lacustrine Diatomaceous Terrace (Ql)] ← Fine roots				
2585	15		S04	200 to 400 psi	2.2		← Becomes medium stiff to stiff with olive yellow (2.5Y 6/6) with angular clasts, friable	135 30		35 93	TX-ICU TX-ICU Harder drilling with yellowish to reddish brown rock chips in cuttings
2580	20		S05	32 50/5"			VOLCANIC SANDSTONE, yellowish brown(10YR 5/6), highly to completely weathered, very weak, locally clayey **TOTAL DEPTH = 20.5 FEET**				
	25										

Report: GEO_10B1_OAK; File: BORING LOGS.GPJ; 6/21/2018 BC-05

AECOM

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-06

Sheet 1 of 1

Date(s) Drilled	**2/2/2018**	Logged By	**B. Kozlowicz**	Checked By	**D. Simpson**
Drilling Method	**Rotary Wash**	Drill Bit Size/Type	**4-inch Tricone**	Total Depth of Borehole	**15.4 feet**
Drill Rig Type	**Barge Mounted CME-45**	Drilling Contractor	**Taber Drilling**	Surface Elevation	**2577.8**
Groundwater Level(s)	**29.2 feet above ground surface (2/2 at 13:00)**	Sampling Method(s)	**2.5-inch ID Mod Cal, SPT**	Hammer Data	**Auto hammer (140 lb, 30-inch drop)**
Borehole Backfill	**Bentonite cement grout to 10 feet bgs**	Location		Coordinates	**N 2605112 E 6476050**

Elevation feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
2577.8	0						[Recent Lake Sediment]				Advanced 6-inch casing to 5 feet with hammer from 2 to 5 feet
2575							LEAN CLAY WITH SAND (CL), stiff, olive gray to dark olive gray (5Y 4/2 to 5Y 3/2), fine grained sand, low to medium plasticity fines, trace fine angular volcanic gravel and wood debris/roots [Colluvium]				
	5		S01	5 9 14 (23)	1.5						
2570							VOLCANIC SANDSTONE, dark greenish gray to black (5GY 4/1 to GLEY1 2.5/N), moderately to slightly weathered [Bogus Mountain Beds]				Harder drilling with gravelly cuttings
	10		S02	50/4"	0.3						Hard, slow drilling
2565											
	15		S03	50/4"							
							TOTAL DEPTH = 15.4 FEET				
2560											
	20										
2555											
	25										

AECOM

Report: GEO_10B1_OAK; File: BORING LOGS.GPJ; 6/21/2018 BC-06

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-07

Sheet 1 of 1

Date(s) Drilled	**2/2/2018 - 2/3/2018**	Logged By	**B. Kozlowicz**	Checked By	**D. Simpson**
Drilling Method	**Rotary Wash**	Drill Bit Size/Type	**4-inch Tricone**	Total Depth of Borehole	**15.9 feet**
Drill Rig Type	**Barge Mounted CME-45**	Drilling Contractor	**Taber Drilling**	Surface Elevation	**2581.3**
Groundwater Level(s)	**26.2 feet above ground surface (2/2 at 15:30)**	Sampling Method(s)	**2.5-inch ID Mod Cal**	Hammer Data	**Auto hammer (140 lb, 30-inch drop)**
Borehole Backfill	**Bentonite cement grout to 10 feet bgs**	Location		Coordinates	**N 2605439 E 6477039**

Elevation, feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	0						[Recent Lake Sediments]				
2580			S01	0 0 0 (0)	2		FAT CLAY WITH SAND (CH), medium stiff, very dark gray (10YR 3/1), fine to medium grained sand, medium to high plasticity fines, trace rootlets [Colluvium/Residual Soil]				Sampler advanced 2 feet under weight of hammer Advanced 6-inch casing to 2 feet
			S02	5 7 8 (15)	1		← Wood/roots up to 1-inch in size	34	65	88	LL = 60 PL = 24 PI = 36
	5										15% Gravel 20% Sand 65% Fines 2/2/18 16:15 EOD 2/3/18 8:30 BOD
2575											Advanced 6-inch casing to 5 feet with hammer Angular diatomite gravel and wood fibers in cutting to about 13 feet
			S03	2 5 4 (9)	0.6		CLAYEY SAND (SC), loose, very dark grayish brown (10YR 3/2), medium to coarse grained sand; medium plasticity fines; trace fine gravel with some diatomite clasts [Colluvium/Residual Soil]				
	10										Advanced 6-inch casing to 10 feet with hammer
2570							POORLY GRADED SAND WITH SILT (SP-SM), loose to medium dense, coarse grained sand, dark greenish gray (10Y 4/1) subrounded to rounded diatomite gravel up to 1-inch in diameter in shoe [Colluvium/Residual Soil]		8		27% Gravel 65% Sand 8% Fines
			S04	9 9 7 (16)	1.5						
	15		S05	20 50/4"			← With shell hash				Hole caving; advanced 6-inbch casing to 14 feet with hammer
2565							VOLCANIC SANDSTONE, very weak, light olive brown to strong brown (2.5Y 5/4 to 7.5YR 5/8), highly to completely weathered, with irregular 5 to 10-degree bedding [Bogus Mountain Beds]				
							TOTAL DEPTH = 15.9 FEET				
	20										
2560											
	25										

AECOM

Report: GEO_10B1_OAK; File: BORING LOGS.GPJ; 6/21/2018 BC-07

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-08

Sheet 1 of 1

Date(s) Drilled	**2/3/2018**	Logged By	**B. Kozlowicz**	Checked By	**D. Simpson**
Drilling Method	**Rotary Wash**	Drill Bit Size/Type	**4-inch Tricone**	Total Depth of Borehole	**11.5 feet**
Drill Rig Type	**Barge Mounted CME-45**	Drilling Contractor	**Taber Drilling**	Surface Elevation	**2586.2**
Groundwater Level(s)	**22.2 feet above ground surface (2/3 at 14:00)**	Sampling Method(s)	**2.5-inch ID Mod Cal, SPT**	Hammer Data	**Auto hammer (140 lb, 30-inch drop)**
Borehole Backfill	**Bentonite cement grout to 10 feet bgs**	Location		Coordinates	**N 2605190 E 6480346**

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	0						ORGANIC SILT TO ORGANIC CLAY (OL/OH), very soft, dark olive gray (5Y 3/2) with coarse organic debris				Advanced 6-inch casing to 3 feet with hammer past 1 foot
2585							FAT CLAY WITH SAND, stiff, black (5Y 2.5/2), fine grained sand, medium plasticity fines, trace angular to subrounded gravel up to 1.5 inches in diameter [Colluvium/Residual Soil]				
			S01	4 8 11 (19)	1.3			31			LL = 56 PL = 24 PI = 32
	5						WELL GRADED GRAVEL WITH SAND (GW), very dense, very dark grayish brown to black (10YR 3/2 to 10YR 2/1), broken rounded gravel up to 1.5 inches in diameter, medium to coarse grained sand, trace low plasticity fines [Fluvio-Lacustrine Terrace Deposit with Gravel (Qtg)]				Very hard drilling with volcanic rock chips in cuttings; switched to 2 7/8-inch drag but Blow counts affected by large particles
2580			S02	22 29 37 (66)	0.7						
	10										
2575							**TOTAL DEPTH = 11.5 FEET**				
	15										
2570											
	20										
2565											
	25										

AECOM

Report: GEO_10B1_OAK; File: BORING LOGS.GPJ; 6/21/2018 BC-08

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-08a

Sheet 1 of 4

Date(s) Drilled	**2/14/18**	Logged By	**B. Kozlowicz**	Checked By	**D. Simpson**
Drilling Method	**Rotary Wash**	Drill Bit Size/Type	**4-inch Tricone**	Total Depth of Borehole	**85.2 feet**
Drill Rig Type	**Barge Mounted CME-45**	Drilling Contractor	**Taber Drilling**	Surface Elevation	**2583.5**
Groundwater Level(s)	**25.3 feet above ground surface (2/14 at 10:00)**	Sampling Method(s)	**2.5-inch ID Mod Cal, SPT**	Hammer Data	**Auto hammer (140 lb, 30-inch drop)**
Borehole Backfill	**Bentonite cement grout to 10 feet bgs**	Location		Coordinates	**N 2605249 E 6480346**

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	0						ORGANIC SILT (OL), very soft, very dark brown (10YR 2/2) [Recent Lake Sediment]				
2580											
	5	S01		9 20 50/4" (70/10")	2		CLAYEY SAND TO SANDY LEAN CLAY, loose/medium dense, black (10YR 2/1), fine to medium grained sand, medium plasticity fines, trace fine rounded gravel [Colluvium/Residual Soil]				Sampler sank to 4 feet; drove sampler for extra 18 inches (last three blowcounts reported, previous blows were 2-2-7)
		S02		50/5"	0.4		CLAYEY GRAVEL WITH SAND (GC), very dense, dark yellowish brown to very dark gray (10YR 4/6 to 10YR 3/1), subangular to rounded gravel and cobbles up to 3 inches in diameter in a sandy lean clay to clayey sand matrix [Fluvio-Lacustrine Terrace Deposit with Gravel (Qtg)]				Hard chattering drilling from 7 to 11 feet Advanced 6-inch casing to 8 feet with hammer
2575											
	10						DIATOMITE, light yellowish brown (2.5Y 6/4), extremely weak, with irregular 45 to 90-degree fractures with some iron staining and 0 to 15-degree fractures [Lacustrine Diatomaceous Terrace (Ql)]				Fast smooth drilling with olive brown diatomite cuttings
2570											
	15										Advanced casing to 15 feet with hammer
2565		S03		3 4 5 (9)	1.2						
	20										
2560											
	25										

AECOM

Report: GEO_10B1_OAK; File: BORING LOGS.GPJ; 6/21/2018 BC-08a

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-08a

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	25										
2555											
	30						DIATOMITE WITH ELASTIC SILT; olive gray (5Y 4/2) and greenish black (10Y 2.5/1), very soft/extremely weak, 0.25 to 0.5-inch alternating beds [Lacustrine Diatomaceous Terrace (Ql)]				Cuttings become greenish gray
2550		S04		2 4 4 (8)	0						
	35										
2545											
	40										
2540											
	45										
2535											Cuttings become olive gray and greenish gray
	50										
2530											

AECOM

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-08a

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	55	S	S05	2 2 3 (5)	1.5			179	99		LL = 200 PL = 88 PI = 112 1% Sand 99% Fines
2525											
	60										
2520											
	65										
2515											
	70										
2510											
	75	S	S06	1 2 4 (6)							
2505											
	80										

AECOM

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-08a

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
2500											Harder drilling
	85		S07	50/3"	0.1		BASALT, black (10Y 2.5/1), slightly weathered, strong; recovered as angular gravel up to 1-inch in diameter [Copco/Quaternary Basalt (Qb)]				Tricone refusal
							TOTAL DEPTH = 85.2 FEET				
2495	90										
2490	95										
2485	100										
2480	105										
2475	110										

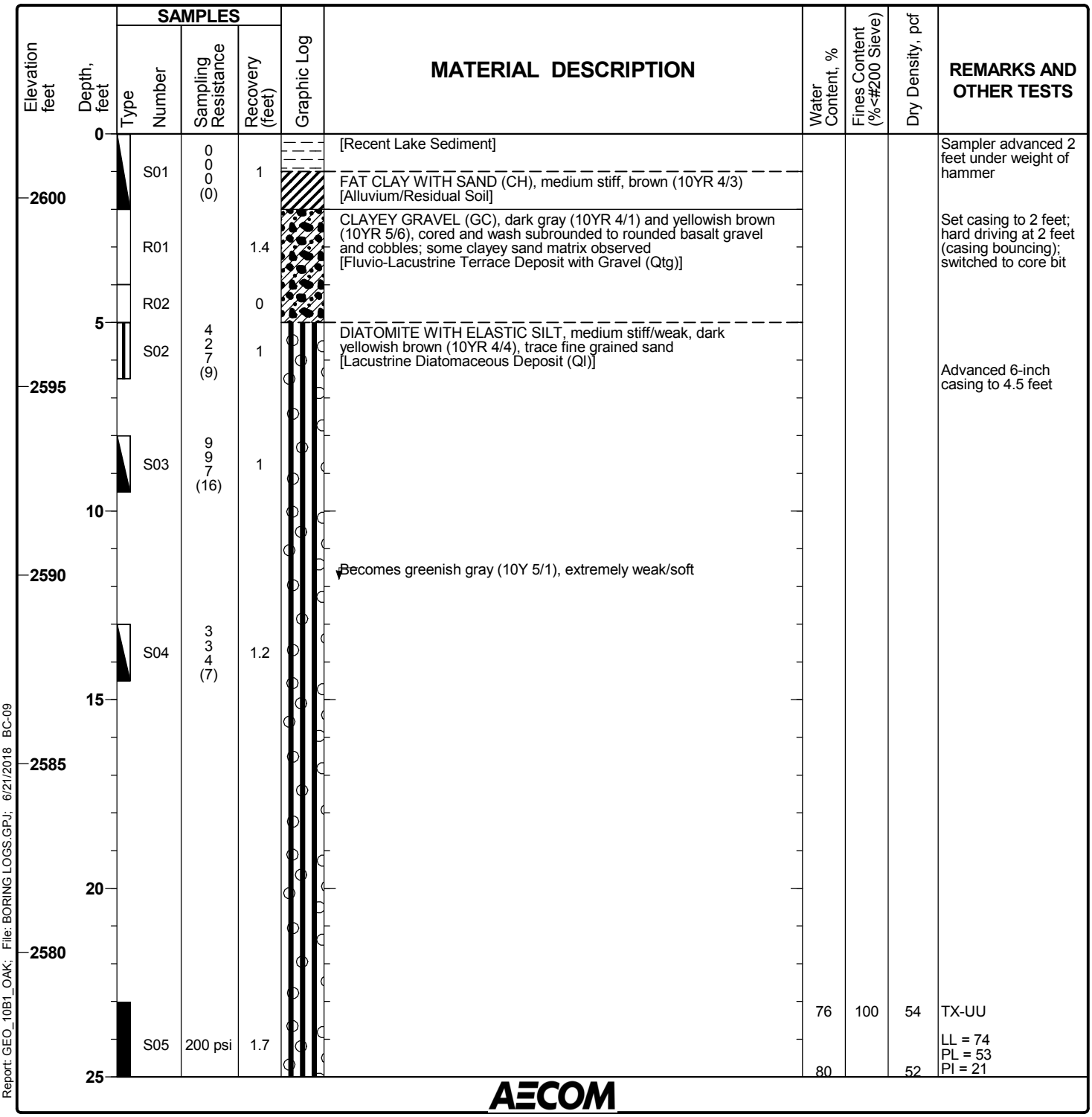
AECOM

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-09

Sheet 1 of 3

Date(s) Drilled	**2/13/2018**	Logged By	**B. Kozlowicz**	Checked By	**D. Simpson**
Drilling Method	**Rotary Wash**	Drill Bit Size/Type	**4-inch Tricone**	Total Depth of Borehole	**70.5 feet**
Drill Rig Type	**Barge Mounted CME-45**	Drilling Contractor	**Taber Drilling**	Surface Elevation	**2601.7**
Groundwater Level(s)	**5.8 feet above ground surface (2/13 at 9:00)**	Sampling Method(s)	**2.5-inch ID Mod Cal, SPT, 3-inch Shelby Tube, HQ Core Barrel**	Hammer Data	**Auto hammer (140 lb, 30-inch drop)**
Borehole Backfill	**Bentonite cement grout to 10 feet bgs**	Location		Coordinates	**N 2602526 E 6483561**



AECOM

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-09

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
2575	25										100% Fines TX-ICU
	30										
2570			S06	3 3 4 (7)	0						
	35										
2565			S07	3 3 5 (8)	1.8						Sampler advanced an additional 6 inches by pushing
	40										
2560											
	45										
2555											
	50										
2550											

AECOM

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-09

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	55		S08	200 psi	0						
2545											
	60										
2540											
	65										
2535											
	70		S09	200 to 400 psi	2.5			92 96		47 46	TX-ICU TX-ICU
							TOTAL DEPTH = 70.5 FEET				
2530											
	75										
2525											
	80										
2520											

AECOM

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-10

Sheet 1 of 2

Date(s) Drilled	**2/7/2018 - 2/8/2018**	Logged By	**B. Kozlowicz**	Checked By	**D. Simpson**
Drilling Method	**Rotary Wash**	Drill Bit Size/Type	**4-inch Tricone**	Total Depth of Borehole	**43.0 feet**
Drill Rig Type	**Barge Mounted CME-45**	Drilling Contractor	**Taber Drilling**	Surface Elevation	**2578.2**
Groundwater Level(s)	**29.3 feet above ground surface (2/7 at 14:40)**	Sampling Method(s)	**2.5-inch ID Mod Cal, SPT, 3-inch Shelby Tube**	Hammer Data	**Auto hammer (140 lb, 30-inch drop)**
Borehole Backfill	**Bentonite cement grout to 10 feet bgs**	Location		Coordinates	**N 2604959 E 6472871**

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	0						[Recent Lake Sediment]				Set 6-inch casing to 4 feet (very soft to 2.5 feet)
2575							WELL GRADED GRAVEL WITH SAND (GW), dense, dark brown (10YR 3/3), subangular to rounded gravel up to 3 inches in diameter consisting of various volcanic lithologies [Fluvio-Lacustrine Terrace Deposit with Gravel (Qtg)]				
	5										Hard, chattering drilling
2570											
	10		S01	25 26 19 (45)	1.5				1		85% Gravel 15% Sand Advanced 6-inch casing to 9 feet with hammer
2565											Tricone bit refusal; rock core barrel used to advance
	15		S02	10 5 5 (10)	0.4		DIATOMITE WITH ELASTIC SILT, olive (5Y 5/3), medium stiff/extremely weak, with trace oxidation [Lacustrine Diatomaceous Terrace (Ql)]				Clayey diatomite curring; switched back to tricone bit Advanced 6-inch casing to 14 feet with hammer
2560											
	20										
2555											
	25			5			Becomes light olive brown (2.5Y 5/4) and olive brown (5Y 5/3)				

AECOM

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-10

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	25		S03	4 6 (10)	1.3		with 0.1 to 0.5 inch 10-degree bedding and some oxidation stains				
2550											
	30										
2545											
	35										
2540											
	40		S04	200 to 400 psi	0.9		VOLCANIC CINDER, very dark brown (10YR 2/2), very weak/dense to very dense, medium to coarse grained weakly welded sand, friable with corestones and weakly expressed 10 to 15-degree bedding [Bogus Mountain Beds]				Harder drilling
			S05	6 20 37 (57)	1.5		ANDESITE/TUFF, reddish brown (5YR 5/3), strong brown (7.5YR 5/6), and dusky purple, highly to completely weathered, very weak, coarse grained [Bogus Mountain Beds]				
2535							**TOTAL DEPTH = 43.0 FEET**				
	45										
2530											
	50										
2525											

AECOM

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BI-01

Sheet 1 of 1

Date(s) Drilled	**2/20/2018**	Logged By	**K. Zeiger**	Checked By	**B. Kozlowicz**
Drilling Method	**Rotary Wash**	Drill Bit Size/Type	**4-inch Tricone**	Total Depth of Borehole	**22.2 feet**
Drill Rig Type	**Barge Mounted CME-45**	Drilling Contractor	**Taber Drilling**	Surface Elevation	
Groundwater Level(s)	**11.8 feet above ground surface (2/20)**	Sampling Method(s)	**2.5-inch ID Mod Cal, SPT**	Hammer Data	**Auto hammer (140 lb, 30-inch drop)**
Borehole Backfill	**Neat cement grout to the ground surface**	Location		Coordinates	**N 2600814 E 6450534**

Elevation feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	0						LEAN CLAY WITH ORGANICS (CL), very soft, wet, dark red brown (5YR 3/4), twigs and roots [Recent Lake Sediment]				
			S-1	0 0 0 (0)	2		LEAN CLAY (CL), stiff, dry, dark red brown (5YR 3/4), trace rootlets, CaCO3 ribbons, developed soil texture [Colluvium/Residual Soil]				
	5		S-2	4 7 8 (15)	1.5						
	10		S-3	6 8 13 (21)	1						
			S-4	50/4"	0.3		BASALT, dark red brown (5YR 2.5/2), fresh, strong [QUARTERNARY VOLCANICS]				
	15		S-5	50/3"	0.1		VOLCANIC CLASTICS, mottled dark gray (2.5Y 4/1) and light yellow brown (2.5Y 6/4), slightly weathered, moderately strong, coarse grained with quartz phenocrysts [MIOCENE VOLCANICS]				
	20		S-6	50/3"	0.2		**TOTAL DEPTH = 22.2 FEET**				
	25										

AECOM

Report: GEO_10B1_OAK; File: BORING LOGS.GPJ; 6/21/2018 BI-01

Project: Klamath River Dam Removal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Boring BI-02

Sheet 1 of 5

Date(s) Drilled	**2/22/2018 - 2/23/2018**	Logged By	**K. Zeiger**	Checked By	**B. Kozlowicz**
Drilling Method	**Rotary Wash, HQ-3 Rock Core**	Drill Bit Size/Type	**4-inch solid stem auger, 3-7/8 inch tricone, 4-inch #2 diamond coring bit**	Total Depth of Borehole	**67.0 feet**
Drill Rig Type	**Truck mounted CME 75**	Drilling Contractor	**Taber Drilling**	Approx. Ground Surface Elevation	**2334.3 NAVD 88**
Groundwater Level	**4.8 feet (15:00 2/22)**	Sampling Methods	**2.5-inch ID Mod Cal, Rock Core**	Hammer Data	**Auto hammer (140 lbs, 30-inches)**
Borehole Backfill	**Neat cement to ground surface**	Borehole Location	**Iron Gate Reservoir**	Coordinate Location	**N 2602023 E 6461382**

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES: Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
2334	0								FAT CLAY WITH SAND (CH), stiff, very dark brown (7.5YR 2.5/3), moist, low plasticity fines, 10 percent rounded gravel up to 1-inch in diameter [Alluvium]						4-inch solid stem auger
	1														
2332	2														
	3														
2330	4														
	5											6		14:30	LL = 78 PL = 28 PI = 50
	6								← 2-inch rounded clasts with trace decomposed rootlets		S-1	8 13	1.3		11% Gravel 21% Sand 68% Fines
2328	7														
	8														
2326	9														
	10								SANDY FAT CLAY (CH), stiff, dry, brown (7.5YR 4/3), low plasticity fines, fine grained sand, trace rounded gravel up to 0.25 inches in diameter, CaCO3 ribbons [Older Alluvium/Residual Soil]			5		14:40	LL = 58 PL = 28 PI = 30
2324	11										S-2	7 12	1.5		5% Gravel 33% Sand 62% Fines
	12														
2322	13														

Report: GEO_CORE+SOIL_NO PACK_WITH LITH; File: ROCK CORES.GPJ; 6/21/2018 BI-02

Project: Klamath River Dam Removal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Boring BI-02

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES: Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	13														
	14														First water at 14.0 feet; after 20 minutes at 4.8 feet
2320															
	15								SANDY FAT CLAY (CH), loose, brown (7.5YR 5/4), fine grained sand, low plascticity fines, trace rounded gravel up to 1-inch in diameter [Older Alluvium]			6		15:00	LL = 51 PL = 27 PI = 24
	16										S-3	6 7	1.5		8% Gravel 40% Sand 53% Fines 4-inch casing to 14 feet Switch to rotary wash
2318															
	17														
	18		1		NA		1 2		TUFF BRECCIA, green gray (10Y 6/1), highly to completely weathered, extremely weak, intensely fractured with angular breccia clasts up to 1-inch, fine to medium grained matrix [Miocene Volcanics - Bogus Mountian Beds]					1549	Refusal with tricone bit; switched to HQ rock core
2316					NA										
	19								1: 60, J, N, No, No, Pl, SR 2: 10, J, MW, No, No, Wa, SR						Clayey volcanics cuttings
		1		18	NA	0	NR							[21]	
	20														100% fluid return
2314					NA										
	21														
					NA									1601	
	22						1		← Becomes moderately to slightly weathered, moderately strong, moderately fractured Rough, irregular fractures likely mechanical along weathered					1610	
2312					2		2		contacts of breccia clasts 1: 10, J, T, No, No, Wa, SR						
	23	2		100		48*	3 3		2: 20-80, J, N, No, No, Ir-St, R 3: 10, J, MW, No, No, Wa, SR					[22]	*Does not meet soundness criteria for RQD calculation
					3		1								
	24						4		4: 20, J, N, No, No, Wa, SR						
2310					1		m		← Run break					1618	
	25						1		1: 30, J, N, No, No, Wa, SR					1622	
					2										
	26	3		100		100	2 1		2: 5, J, T, H + ?, Pa, Wa, ?					[21]	
2308					1		1								
	27						m		← Run break					1629	
					1									1634	
	28						1		1: 5, J, N, No, No, Wa, SR						
2306					0										
	29						m								

Report: GEO_CORE+SOIL_NO PACK_WITH LITH; File: ROCK CORES.GPJ; 6/21/2018 BI-02

Project: Klamath River Dam Removal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Boring BI-02

Sheet 3 of 5

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES: Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	29								TUFF BRECCIA, green gray (10Y 6/1), moderately to slightly weathered, moderately strong, moderately fractured with angular breccia clasts up to 1-inch, medium grained matrix [Miocene Volcanics - Bogus Mountian Beds] (continued)						Broken while placing in the box
		4		100	1	100	2		2: 10-15, J, N, No, No, Wa-St, R					[30]	
2304	30				1										100% fluid return
							2								
	31				0										
	32						m							1644	
2302					1		1		1: 10, J, N, No, No, Wa, SR					1647	
	33														
					2		1								
	34		2				2		2: 40, J, N, No, No, St, SR						
2300		5		100	1	96								[31]	
	35						3		3: 30, J, T, H+?, No, No, Wa?						
					1										
							4		4: 10, J, N, No, No, Wa-St, SR						
	36														
2298					0										
	37													1657	
					1									1701	
							1		1: 10, J, N, No, No, Wa-St, R						
2296	38						1								
					1										
	39						2		2: 15, J, T, No, No, Wa, SR						
		6		100	1	100								[26]	
	40														
2294					1										
	41						3		3: 30, J, N, No, No, Wa-Pl, SR						
					0										
	42													1712	
2292														1206	EOD 2/22/2018 BOD2/23/2018
					1		1		1: 10, J, N, No, No, Wa, SR						
	43						2		2: 10-30, J, T, No, No, Wa, SR						
					4										
	44														
2290		7		100	1	96	1							[43]	
	45														

Report: GEO_CORE+SOIL_NO PACK_WITH LITH; File: ROCK CORES.GPJ; 6/21/2018 BI-02

Project: Klamath River Dam Removal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Boring BI-02

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES: Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	45				1		3		TUFF BRECCIA, green gray (10Y 6/1), moderately to slightly weathered, moderately strong, moderately fractured, angular breccia clasts up to 1-inch, fine to medium grained matrix [Miocene Volcanics - Bogus Mountian Beds] (continued) 3: 10-30, J, MW, No, No, Wa-Ir, SR-R						100% fluid return
	46														
2288					1										
			3				4		4: 30, J, N, No, No, Wa-Pl, SR						
	47													1213	
									Becomes strong, slightly fractured					1216	
					0										
	48														
2286					0										
							1		1: 20, J, MW, H+Ca, F, Wa, ?						
	49						2		2: 15, J, N, No, No, Wa-St, R						
		8		100	1	100								[25]	
	50														
2284					0										
	51														
					1		2								
	52													1228	
														1232	
2282					0										
	53														
					0										
	54														
2280							1								
		9		100	1	98								[23]	
	55								1: 30, J, N, No, No, St, R						
					0		m								Mechanical fractures from placing in box
	56														
2278							m								
					1		2								
	57								2: 20, J, N, No, No, Wa-St, SR					1245	
														1250	
					1		1		1: 20, J, N, No, No, Wa, SR						
	58														
2276					0										
	59														
		10		100	1	96	2		2: 10, J, N, No, No, Wa-St, R					[20]	
	60														100% fluid return
2274					0										
	61														

Report: GEO_CORE+SOIL_NO PACK_WITH LITH; File: ROCK CORES.GPJ; 6/21/2018 BI-02

Project: Klamath River Dam Removal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Boring BI-02

Sheet 5 of 5

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES: Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	61		4		1		m m 3		TUFF BRECCIA, green gray (10Y 6/1), moderately to slightly weathered, strong, slightly fractured, angular breccia clasts up to 1-inch, fine to medium grained matrix [Miocene Volcanics - Bogus Mountian Beds] (continued) 3: 6, J, N, No, No, Wa, SR					1305	
	62													1311	Mechanically broken from placement in box
2272					0										
	63						1		1: 30, V, N-T, H+Ca, Fi, Wa, ?						
					1										
	64						2		2: 10, J, N, No, No, Wa-St, SR-R						
2270		11		100	0	72								[19]	
	65														
					1		3		3: 60, J/V, MW, Ca, Pa, Wa-Pl, SR						
	66														
2268					3		4 4 m		4: 60-70, J/V, N, H+Ca, Fi, Wa, ?						
	67													1327	
									TOTAL DEPTH = 67.0 FEET						
	68														
2266															
	69														
	70														
2264															
	71														
	72														
2262															
	73														
	74														
2260															
	75														
	76														
2258															
	77														

Report: GEO_CORE+SOIL_NO PACK_WITH LITH; File: ROCK CORES.GPJ; 6/21/2018 BI-02

Project: Klamath River Dam Removal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Boring BI-03

Sheet 1 of 3

Date(s) Drilled	**2/21/2018**	Logged By	**K. Zeiger**	Checked By	**B. Kozlowicz**
Drilling Method	**Rotary Wash, HQ-3 Rock Core**	Drill Bit Size/Type	**4-inch solid stem auger, 3-7/8 inch tricone, 4-inch #2 diamond coring bit**	Total Depth of Borehole	**35.1 feet**
Drill Rig Type	**Barge mounted CME 45**	Drilling Contractor	**Taber Drilling**	Approx. Ground Surface Elevation	**2302.2 NAVD 88**
Groundwater Level	**25.3 feet above ground surface (2/21)**	Sampling Methods	**2.5-inch ID Mod Cal, Rock Core**	Hammer Data	**Auto hammer (140 lbs, 30-inches)**
Borehole Backfill	**Neat cement to ground surface**	Borehole Location	**Iron Gate Reservoir**	Coordinate Location	**N 2601812 E 6461399**

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES: Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
2302	0								POORLY GRADED GRAVEL WITH CLAY (GP-GC), dark green gray (N 4/1), wet, loose, subangular to subrounded gravel up to 0.25-inch in diameter [Alluvium]						Advanced 5-inch casing to 3 feet
	1														
2300	2														
	3														
2298	4								TUFF BRECCIA, green gray (5G 6/1). highly weathered, weak to very weak, fine to medium grained matrix with angular to subrounded clasts up to 0.75 inches [Miocene Volcanics - Bogus Mountian Beds]		S-1	12 50/2.5"	0.7	10:10	LL = 51 PL = 27 PI = 24 61% Gravel 30% Sand 9% Fines Advanced 5-inch casing to 4 feet
	5														
2296	6	1		4	6+ 6+ 6+	0	1 2 3 4 2 5 4 4		Becomes moderately weathered, weak, intensely fractured to locally crushed Most rough, irregular fractures likely mechanical due to weathering on clasts/matrix boundaries 1: 60, J, N, No, No, St, R 2: 40, J, T, No, No, St, R 3: 50-60, J, T, No, No, St, R 4: 30, J, MW, No, No, St, R 5: 10, J, N, No, No, St, R					1059 [13]	Refusal with tricone bit; switched to HQ-3
2294	8						6 4		6: 40, J, N, No, No, Wa, SR						
	9				6+		7		7: 70, J, T, No, No, Wa, SR						
	10				NA		5							1120	
2292	11	2		5	NA 4	14*	NR 1 2 3 3		1: ~10, J, N, No, No, Wa, SR 2: 30, J, N-T, No, No, Wa-St, SR 3: 40-50, J, N, No, No, Wa-St, SR-R					1143 [19]	LL = 58 PL = 28 PI = 30 5% Gravel 33% Sand 62% Fines
2290	12				5		4 3 4 2		4: 20, J, MW, No, Wa, St, SR-R						Does not meet soundness criteria for RQD calculation
	13														

Report: GEO_CORE+SOIL_NO PACK_WITH LITH; File: ROCK CORES.GPJ; 6/21/2018 BI-03

Project: Klamath River Dam Removal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Boring BI-03

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES: Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	13						5		TUFF BRECCIA, green gray (5G 6/1), moderately weathered, weak, intensely fractured to locally crushed, fine to medium grained matrix with angular to subrounded clasts up to 0.75 inches						
					5		2		[Miocene Volcanics - Bogus Mountian Beds] (continued)						
	14						2		5: 30, J, N, No, No, Wa-Pl, SR						
2288							1								
					5		2								
	15						2							1159	
														1215	LL = 51 PL = 27 PI = 24
					3		1		1: 35, J, N, No, No, St, R Becomes slightly fractured, moderately strong						
	16														8% Gravel 40% Sand 53% Fines Packer test #1 from 15.1 to 35.1
2286															
					0										
	17						2		2: 30, J, N, No, No, Wa, SR						Does not meet soundness criteria for RQD calculation
		3		5	1	100*								[23]	
	18						3		3: 20, J, T, No, No, Wa, SR						
2284					1										
	19														
					0										
	20						1		Becomes highly fractured 1: 10, J, MW, No, No, Wa, SR					1228	
2282							2		2: 25, J, T, No, No, Wa-St, SR-R					1239	
					3		3		3: 10, J, MW, No, No, Wa, SR-R						
	21						3								
					2		2		Becomes moderately fractured						
	22														
2280															
		4		5	1	86*								[18]	
	23						3								
					0										
	24														
2278							3								
					1										
	25													1256	
														1301	
					0										
	26						1								
2276							2		Moderately to highly weathered, weak to very weak, fractures 1, 2, 3 are likely mechanical 1: 15, J, T, No, No, Wa, SR 2: 40, J, T, No, No, Wa-St, SR 3: 5-10, J, MW, No, No, Wa, SR 4: 80, J, N, No, No, Wa-Ir, SR 5: 30, J/V, T, Ca, Pa, Pl-Wa, SR Crushed zone 6: 65, J, MW, Sd, Pa, Wa, SR						Clayey coating 26.5-27.2 is from when return hose got disconnected during run
					5		3								
	27						3								
		5		5	5	48*	3							[15]	
	28						4								
							5								
2274					6+		6								
	29														

Report: GEO_CORE+SOIL_NO PACK_WITH LITH; File: ROCK CORES.GPJ; 6/21/2018 BI-03

Project: Klamath River Dam Removal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Boring BI-03

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES: Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	29				0				TUFF BRECCIA, green gray (5G 6/1), moderately weathered, moderately strong, moderately fractured, fine to medium grained matrix with angular to subrounded clasts up to 0.75 inches						
	30								[Miocene Volcanics - Bogus Mountian Beds] (continued)					1321	
2272					2		1		Becomes intensely fractured 1: 5, J, N, No, No, Pl-Wa, SR					1327	
	31						1 2 2		2: 20, J, N-MW, No, No, Wa, SR						
					4		3								
	32						1		3: 35, J, N, Ca+Sd, Pl, S						
2270		6		5	0	54*								[15]	
	33														Does not meet soundness criteria for RQD calculation
					3		4		4: 30, J, N, No, No, Pl, SR						
	34						3								
2268					4		5		Becomes highly weathered, weak, crushed along a fracture? 5: 65, J, MW-W, Fe+Sd, Su+Pa, Pl, SR-R with ~0.75-inch Fe						
							6		stained highly weathered rind 6: 10-20, J, T, No, No, Wa-Lr, SR						
	35													1347	
									TOTAL DEPTH = 35.1 FEET						
	36														
2266															
	37														
	38														
2264															
	39														
	40														
2262															
	41														
	42														
2260															
	43														
	44														
2258															
	45														

Report: GEO_CORE+SOIL_NO PACK_WITH LITH; File: ROCK CORES.GPJ; 6/21/2018 BI-03

Attachment C Laboratory Testing Results

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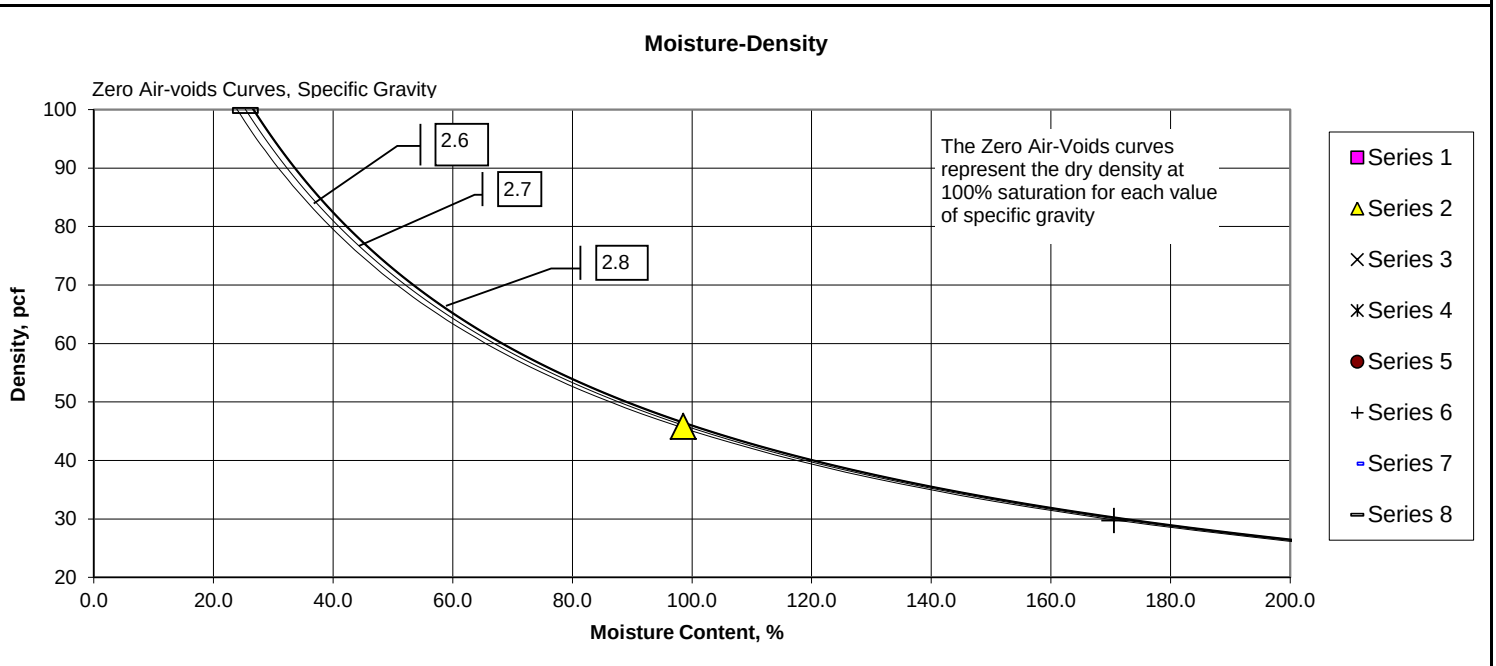
Moisture-Density-Porosity Report
Cooper Testing Labs, Inc. (ASTM D7263b)

CTL Job No:	020-251a	**Project No.**	60537920	**By:**	RU
Client:	AECOM	**Date:**	06/13/18		
Project Name:	Klamath River Dam Removal Project	**Remarks:**			

Boring:	BC-01	BC-01	BC-01	BC-02	BC-02	BC-02	BC-03	BC-03
Sample:	S-02	S-03	S04	S05	S09	S10	S-01	S-02
Depth, ft:	6.5	12.5-13	21.5	14.5	44.5	54.8-55.3	1	5.5-6.0
Visual Description:	Dark Olive Gray Sandy SILT	Light Yellowish Brown Sandy CLAY	Gray Elastic SILT	Gray Elastic SILT	Gray Elastic SILT	Black CLAY	Dark Olive Brown Sandy Lean CLAY	Dark Olive Brown Sandy CLAY w/ Gravel
Actual G_s								
Assumed G_s		2.70				2.70		2.70
Moisture, %	43.1	98.6	92.9	83.7	177.8	170.6	34.7	25.4
Wet Unit wt, pcf		91.0				80.3		125.2
Dry Unit wt, pcf		45.8				29.7		99.9
Dry Bulk Dens.ρb, (g/cc)		0.73				0.48		1.60
Saturation, %		99.3				98.3		99.4
Total Porosity, %		72.8				82.4		40.8
Volumetric Water Cont,Θw,%		72.3				81.0		40.6
Volumetric Air Cont., Θa,%		0.5				1.4		0.2
Void Ratio		2.68				4.68		0.69
Series	1	2	3	4	5	6	7	8

Note: All reported parameters are from the as-received sample condition unless otherwise noted. If an assumed specific gravity (Gs) was used then the saturation, porosities, and void ratio should be considered approximate.

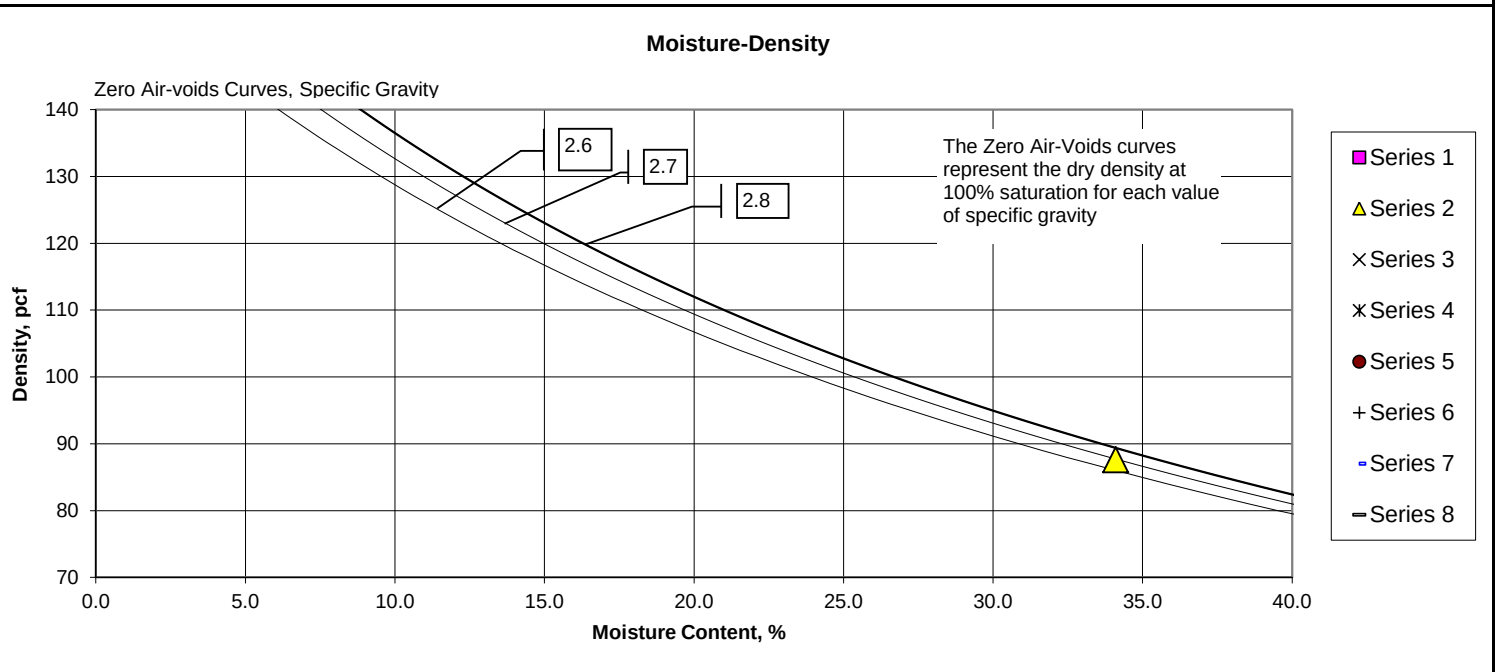


Moisture-Density-Porosity Report
Cooper Testing Labs, Inc. (ASTM D7263b)

CTL Job No:	020-251b	**Project No.**	60537920	**By:**	RU
Client:	AECOM	**Date:**	06/13/18		
Project Name:	Klamath River Dam Removal Project	**Remarks:**			

Boring:	BC-03	BC-07	BC-08	BC-08A	BI-02	BI-02	BI-02	BI-03
Sample:	S05	S-02	S-01	S05	S1	S2	S3	S-1
Depth, ft:	24.5	4-4.5	3	54	5	10	15	3.5
Visual Description:	Light Olive Brown Elastic SILT	Very Dark Olive Brown Sandy Fat CLAY w/ Gravel	Dark Reddish Brown Sandy Fat CLAY	Light Olive Brown Elastic SILT	Dark Reddish Brown Sandy Fat CLAY	Yellowish Brown Sandy Fat CLAY	Yellowish Brown Sandy Fat CLAY	Olive Gray Poorly Graded GRAVEL w/ Silt & Sand
Actual G_s								
Assumed G_s		2.70						
Moisture, %	80.3	34.1	31.4	178.6	27.8	28.7	38.4	12.0
Wet Unit wt, pcf		117.5						
Dry Unit wt, pcf		87.6						
Dry Bulk Dens.ρb, (g/cc)		1.40						
Saturation, %		99.5						
Total Porosity, %		48.1						
Volumetric Water Cont,Θw,%		47.8						
Volumetric Air Cont., Θa,%		0.2						
Void Ratio		0.93						
Series	1	2	3	4	5	6	7	8

Note: All reported parameters are from the as-received sample condition unless otherwise noted. If an assumed specific gravity (Gs) was used then the saturation, porosities, and void ratio should be considered approximate.



COOPER TESTING LABORATORY

#200 Sieve Wash Analysis
ASTM D 1140

Job No.:	020-251	**Project No.:**	60537920	**Run By:**	MD
Client:	AECOM	**Date:**	6/14/2018	**Checked By:**	DC
Project:	Klamath River Dam Removal Project				

Boring:	BC-02	BC-03	BC-04	BC-04				
Sample:	S-01	S-01	S-01	S02				
Depth, ft.:	1-2	1	1.5	7				
Soil Type:	Dark Olive Brown Clayey GRAVEL w/ Sand	Dark Olive Brown Sandy Lean CLAY	Dark Olive Brown Clayey SAND	Dark Olive Brown Sandy CLAY				
Wt of Dish & Dry Soil, gm	1247.4	707.6	696.3	656.3				
Weight of Dish, gm	175.6	175.8	172.4	173.0				
Weight of Dry Soil, gm	1071.8	531.8	523.9	483.3				
Wt. Ret. on #4 Sieve, gm	556.7	16.7	22.3	15.6				
Wt. Ret. on #200 Sieve, gm	774.5	177.4	291.7	205.6				
% Gravel	**51.9**	**3.1**	**4.3**	**3.2**				
% Sand	**20.3**	**30.2**	**51.4**	**39.3**				
% Silt & Clay	**27.7**	**66.6**	**44.3**	**57.5**				

Remarks: As an added benefit to our clients, the gravel fraction may be included in this report. Whether or not it is included is dependent upon both the technician's time available and if there is a significant enough amount of gravel. The gravel is always included in the percent retained on the #200 sieve but may not be weighed separately to determine the percentage, especially if there is only a trace amount, (5% or less).

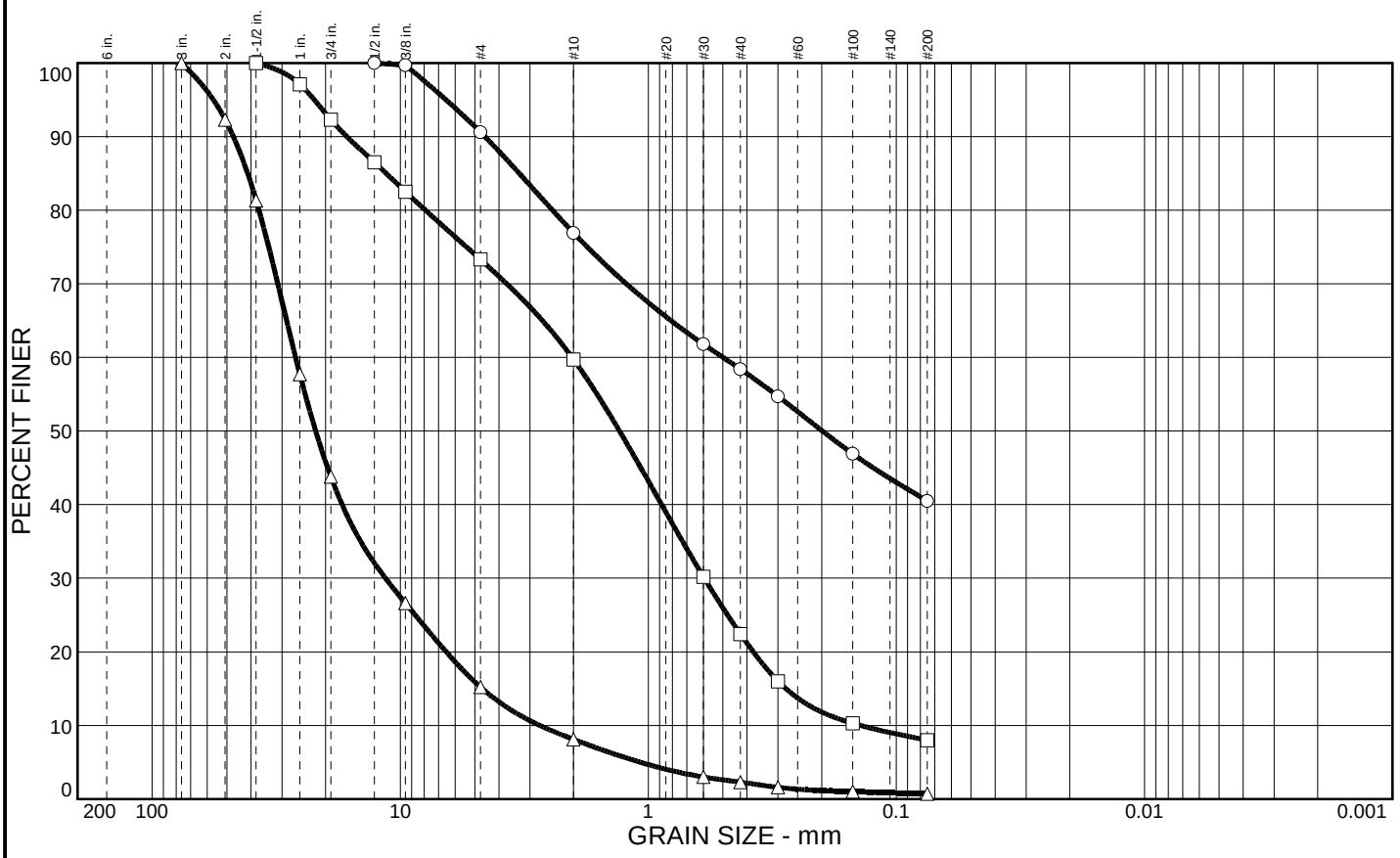
#200 Bulk Sieve Wash Analysis
ASTM D 1140m

Job No.:	020-251	**Project No.:**	60537920	**Run By:**	MD
Client:	AECOM	**Date:**	6/14/2018	**Checked By:**	DC
Project:	Klamath River Dam Removal Project				

Boring:	BC-07							
Sample:	S-02							
Depth, ft.:	4-4.5							
Soil Type:	Very Dark Olive Brown Sandy Fat CLAY w/ Gravel							
Bulk Sample wt. lb.	218.0							
Wt of Dish & Dry Soil <#4,gm	389.5							
Weight of Dish, gm	171.0							
Weight of Dry Soil <#4, gm	218.5							
Wt. Ret. on #4 Sieve, lb	33.1							
Wt. Ret. on #200 Sieve, gm	52.3							
% Gravel	**15.2**							
% Sand	**20.3**							
% Silt & Clay	**64.5**							

Remarks: As an added benefit to our clients, the gravel fraction may be included in this report. Whether or not it is included is dependent upon both the technician's time available and if there is a significant enough amount of gravel. The gravel is always included in the percent retained on the #200 sieve but may not be weighed separately to determine the percentage, especially if there is only a trace amount, (5% or less).

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		9.4	50.1	40.5					
□		26.7	65.3	8.0					
△		84.8	14.5	0.7					

SIEVE inches size	PERCENT FINER ○	□	△
3			100.0
2			92.3
1.5"		100.0	81.3
1"		97.1	57.7
3/4"		92.3	43.8
1/2"	100.0	86.5	
3/8"	99.7	82.5	26.6
GRAIN SIZE			
D_{60}	0.500	2.03	26.4
D_{30}		0.595	11.5
D_{10}		0.139	2.74
COEFFICIENTS			
C_c		1.25	1.82
C_u		14.56	9.65

SIEVE number size	PERCENT FINER ○	□	△
#4	90.6	73.3	15.2
#10	76.9	59.7	8.1
#30	61.8	30.2	3.0
#40	58.4	22.4	2.3
#50	54.7	16.0	1.6
#100	46.9	10.3	1.0
#200	40.5	8.0	0.7

SOIL DESCRIPTION

○ Reddish Brown Clayey SAND

□ Dark Olive Brown Well-Graded SAND w/ Silt & Gravel

△ Dark Olive Brown Well-Graded GRAVEL

REMARKS:

○

□ Due to the small sample size, relative to the largest particle size, this data should be considered to be approximate.

△

○ Source: BC-04 Sample No.: S-03 Elev./Depth: 11-12.5'

□ Source: BC-07 Sample No.: S-04 Elev./Depth: 13'

△ Source: BC-10 Sample No.: S-01 Elev./Depth: 9.5'

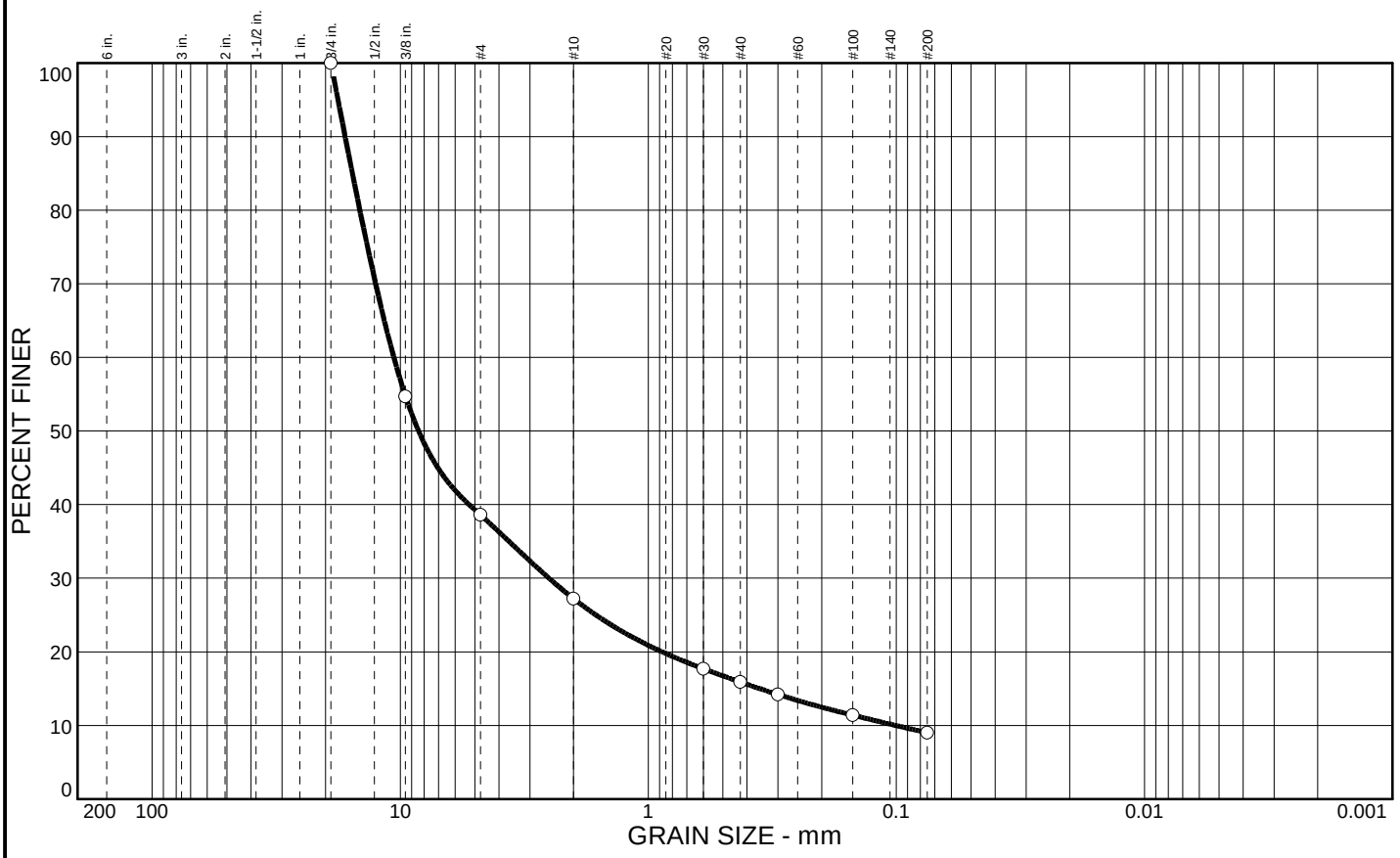
COOPER TESTING LABORATORY

Client: AECOM

Project: Klamath River Dam Removal Project - 60537920

Project No.: 020-251 Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		61.4	29.6	9.0		GP-GM		26	41

SIEVE inches size	PERCENT FINER ○		
3/4"	100.0		
3/8"	54.7		
GRAIN SIZE			
D_{60}	10.6		
D_{30}	2.52		
D_{10}	0.101		
COEFFICIENTS			
C_c	5.92		
C_u	105.44		

SIEVE number size	PERCENT FINER ○		
#4	38.6		
#10	27.2		
#30	17.7		
#40	15.9		
#50	14.2		
#100	11.4		
#200	9.0		

SOIL DESCRIPTION

○ Olive Gray Poorly Graded GRAVEL w/ Silt & Sand

REMARKS:

○

○ Source: BI-03 Sample No.: S-01 Elev./Depth: 3.5'

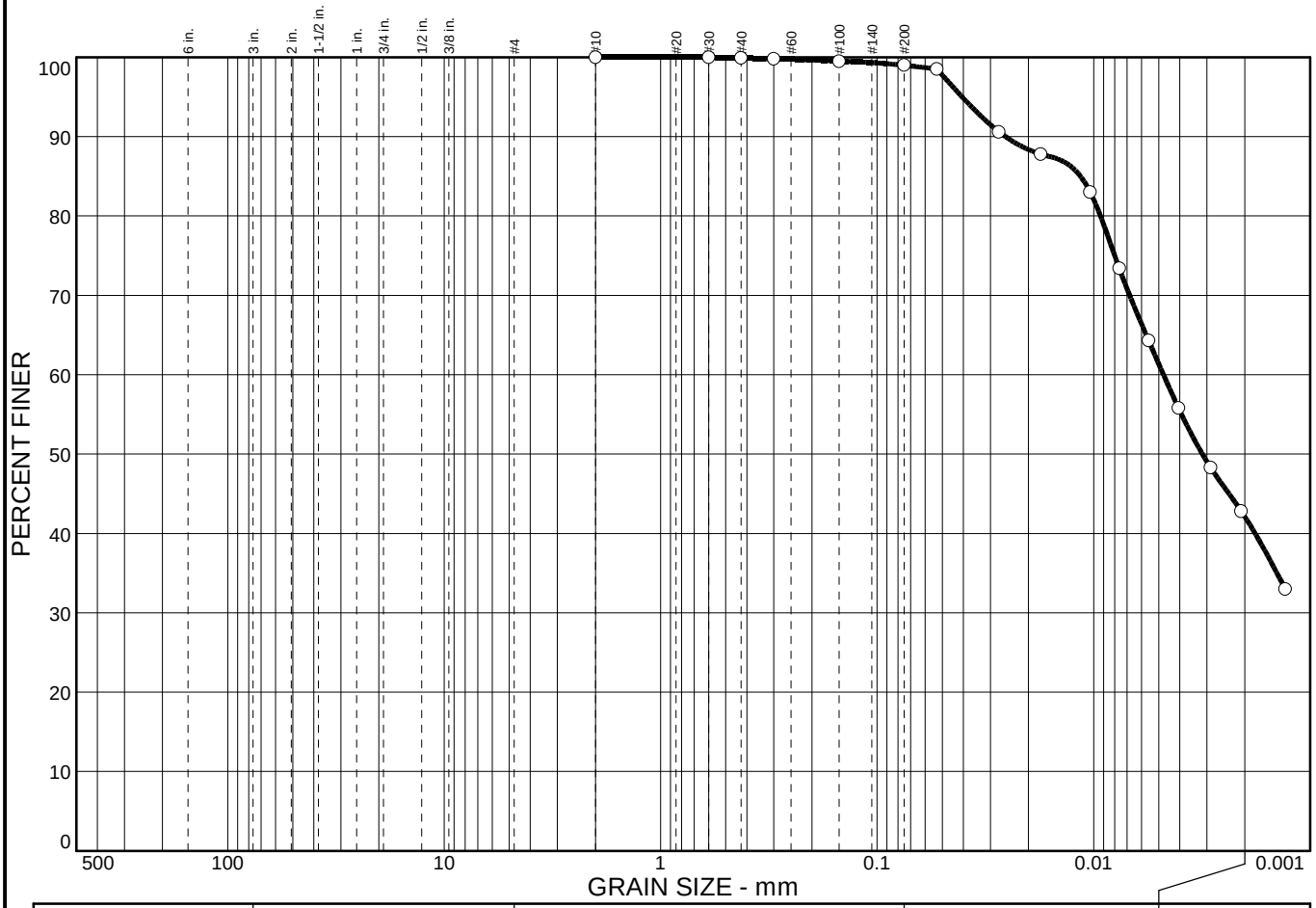
COOPER TESTING LABORATORY

Client: AECOM

Project: Klamath River Dam Removal Project - 60537920

Project No.: 020-251 Figure

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	1.0	56.9	42.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#30	100.0		
#40	99.9		
#50	99.8		
#100	99.5		
#200	99.0		
#270	98.5		
0.0274 mm.	90.6		
0.0176 mm.	87.8		
0.0104 mm.	83.0		
0.0076 mm.	73.4		
0.0056 mm.	64.3		
0.0041 mm.	55.8		
0.0029 mm.	48.3		
0.0021 mm.	42.8		
0.0013 mm.	33.0		

* (no specification provided)

Soil Description

Olive Gray Elastic SILT

Atterberg Limits

PL= 51 LL= 85 PI= 34

Coefficients

D_{85}= 0.0115 D_{60}= 0.0048 D_{50}= 0.0031
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= MH AASHTO=

Remarks

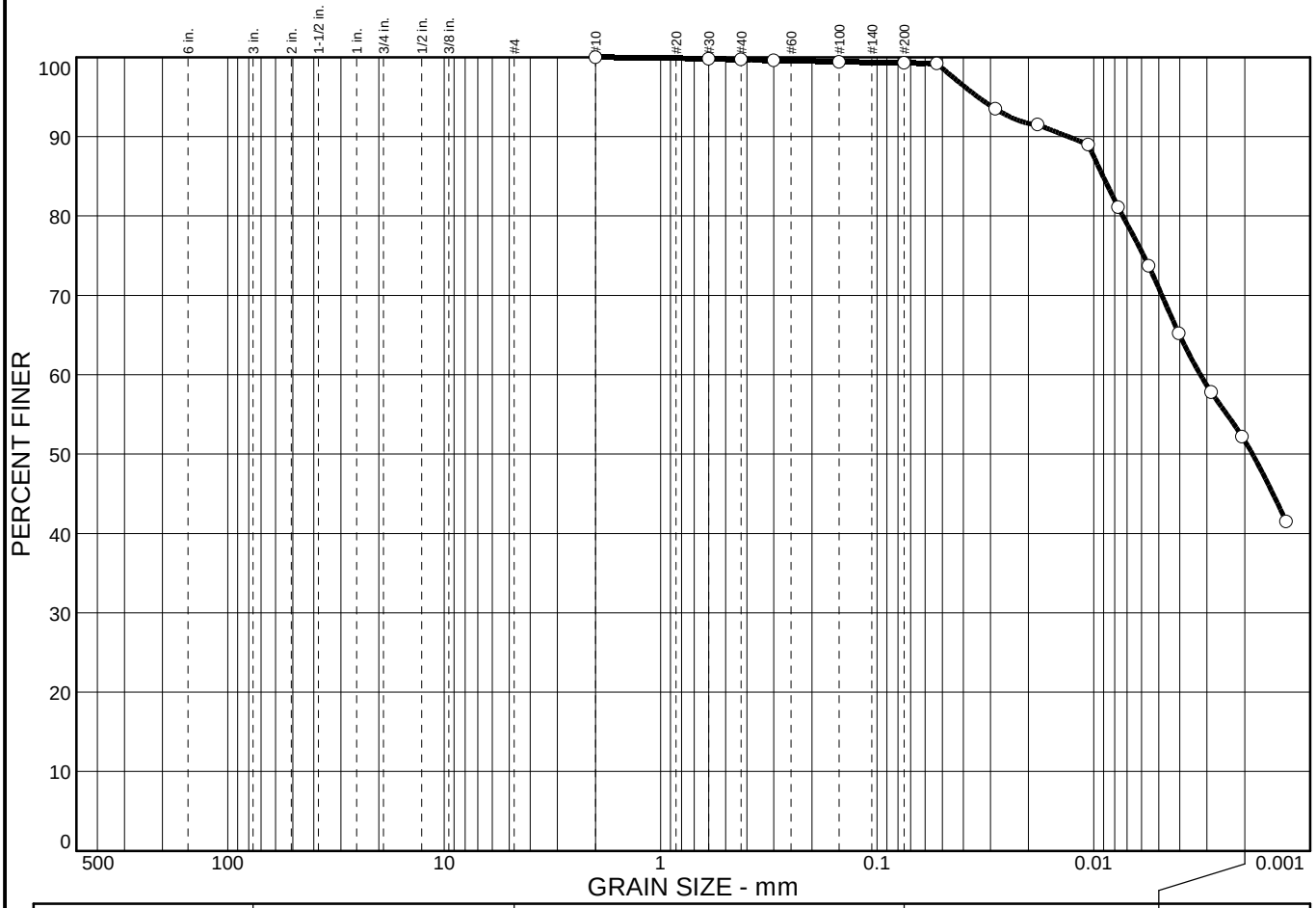
Sample No.: S-04 **Source of Sample:** BC-01 **Date:** 6/5/18
Location: **Elev./Depth:** 21.5'

COOPER TESTING LABORATORY

Client: AECOM
Project: Klamath River Dam Removal Project - 60537920

Project No: 020-251 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	0.7	47.7	51.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#30	99.8		
#40	99.7		
#50	99.6		
#100	99.4		
#200	99.3		
#270	99.2		
0.0285 mm.	93.5		
0.0182 mm.	91.5		
0.0106 mm.	89.0		
0.0077 mm.	81.1		
0.0056 mm.	73.7		
0.0040 mm.	65.2		
0.0029 mm.	57.8		
0.0021 mm.	52.2		
0.0013 mm.	41.5		

* (no specification provided)

Soil Description

Gray Elastic SILT

Atterberg Limits

PL= 59 LL= 105 PI= 46

Coefficients

D_{85}= 0.0090 D_{60}= 0.0032 D_{50}= 0.0018
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= MH AASHTO=

Remarks

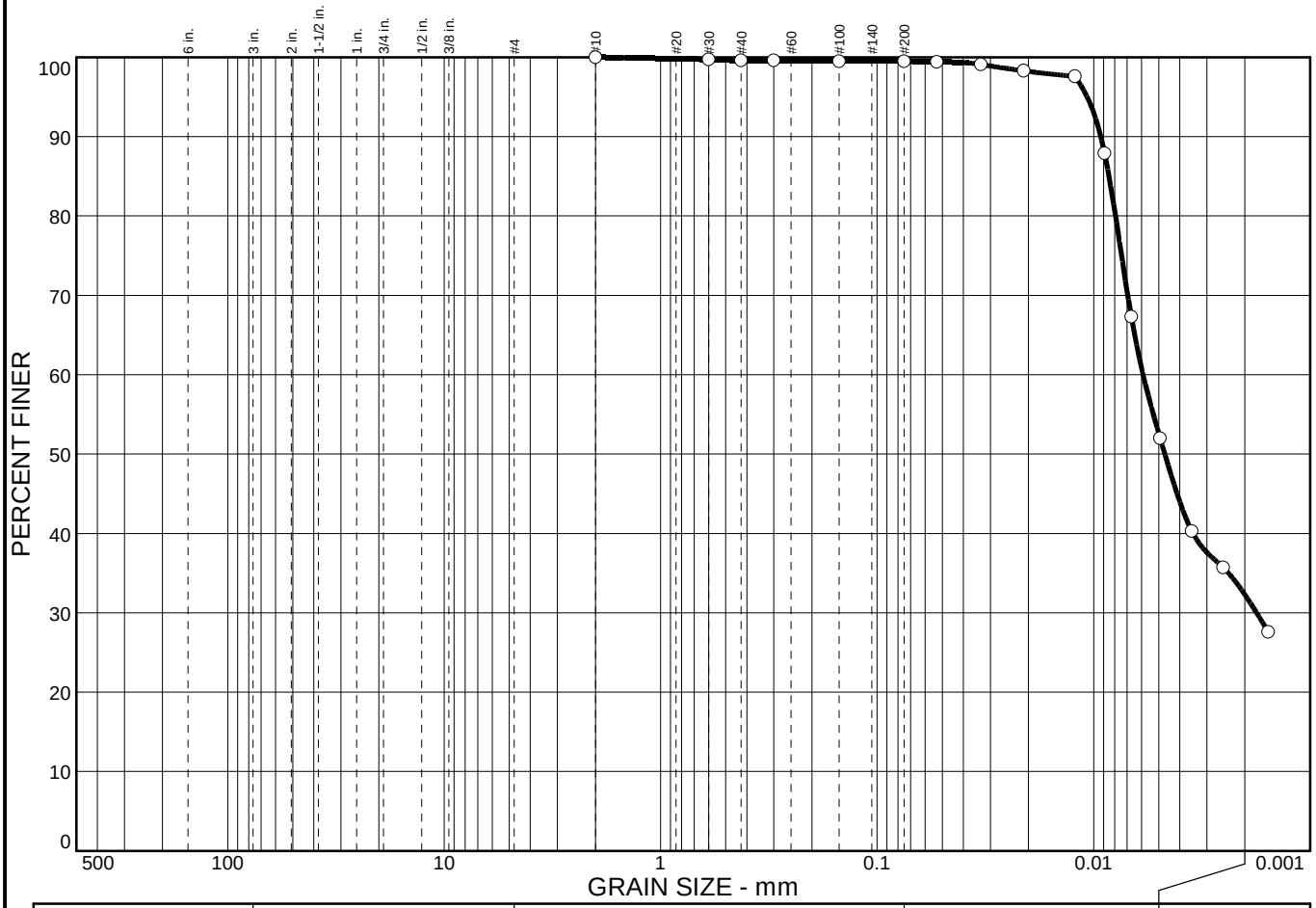
Sample No.: S-05 **Source of Sample:** BC-02 **Date:** 6/5/18
Location: **Elev./Depth:** 14.5'

COOPER TESTING LABORATORY

Client: AECOM
Project: Klamath River Dam Removal Project - 60537920

Project No: 020-251 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	0.5	67.2	32.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#30	99.7		
#40	99.6		
#50	99.6		
#100	99.5		
#200	99.5		
#270	99.4		
0.0331 mm.	99.1		
0.0210 mm.	98.3		
0.0122 mm.	97.6		
0.0089 mm.	87.9		
0.0067 mm.	67.3		
0.0049 mm.	52.0		
0.0035 mm.	40.3		
0.0025 mm.	35.7		
0.0016 mm.	27.6		

* (no specification provided)

Soil Description

Gray Elastic SILT

Atterberg Limits

PL= 85 LL= 187 PI= 102

Coefficients

D_{85}= 0.0085 D_{60}= 0.0059 D_{50}= 0.0047
D_{30}= 0.0018 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= MH AASHTO=

Remarks

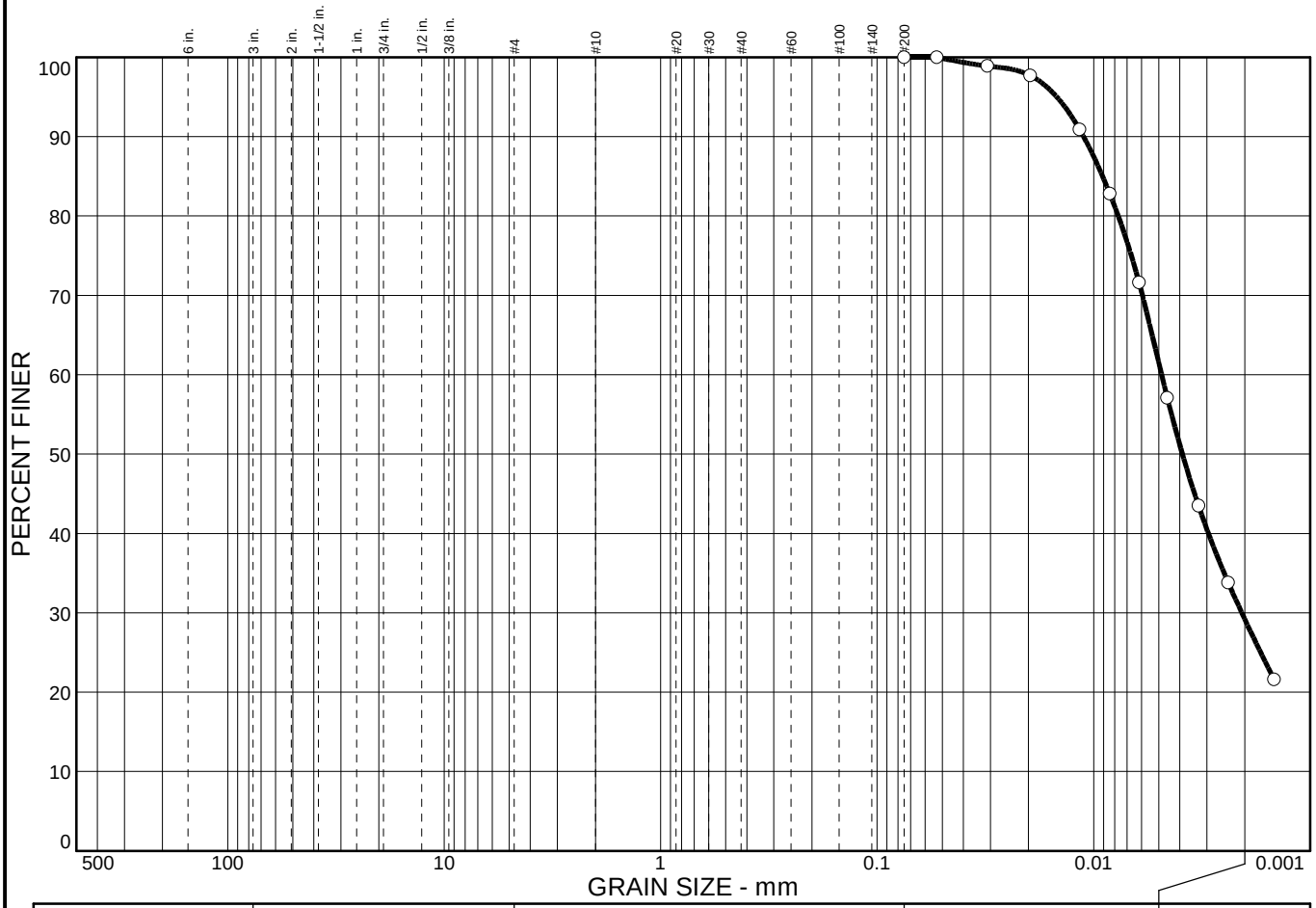
Sample No.: S-09 **Source of Sample:** BC-02 **Date:** 6/5/18
Location: **Elev./Depth:** 44.5'

COOPER TESTING LABORATORY

Client: AECOM
Project: Klamath River Dam Removal Project - 60537920

Project No: 020-251 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	0.0	70.9	29.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	100.0		
#270	100.0		
0.0309 mm.	98.9		
0.0196 mm.	97.7		
0.0116 mm.	90.9		
0.0084 mm.	82.8		
0.0062 mm.	71.6		
0.0046 mm.	57.1		
0.0033 mm.	43.5		
0.0024 mm.	33.8		
0.0015 mm.	21.6		

* (no specification provided)

Soil Description

Light Olive Brown Elastic SILT

Atterberg Limits

PL= 59 LL= 69 PI= 10

Coefficients

D_{85}= 0.0091 D_{60}= 0.0049 D_{50}= 0.0039
D_{30}= 0.0021 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= MH AASHTO=

Remarks

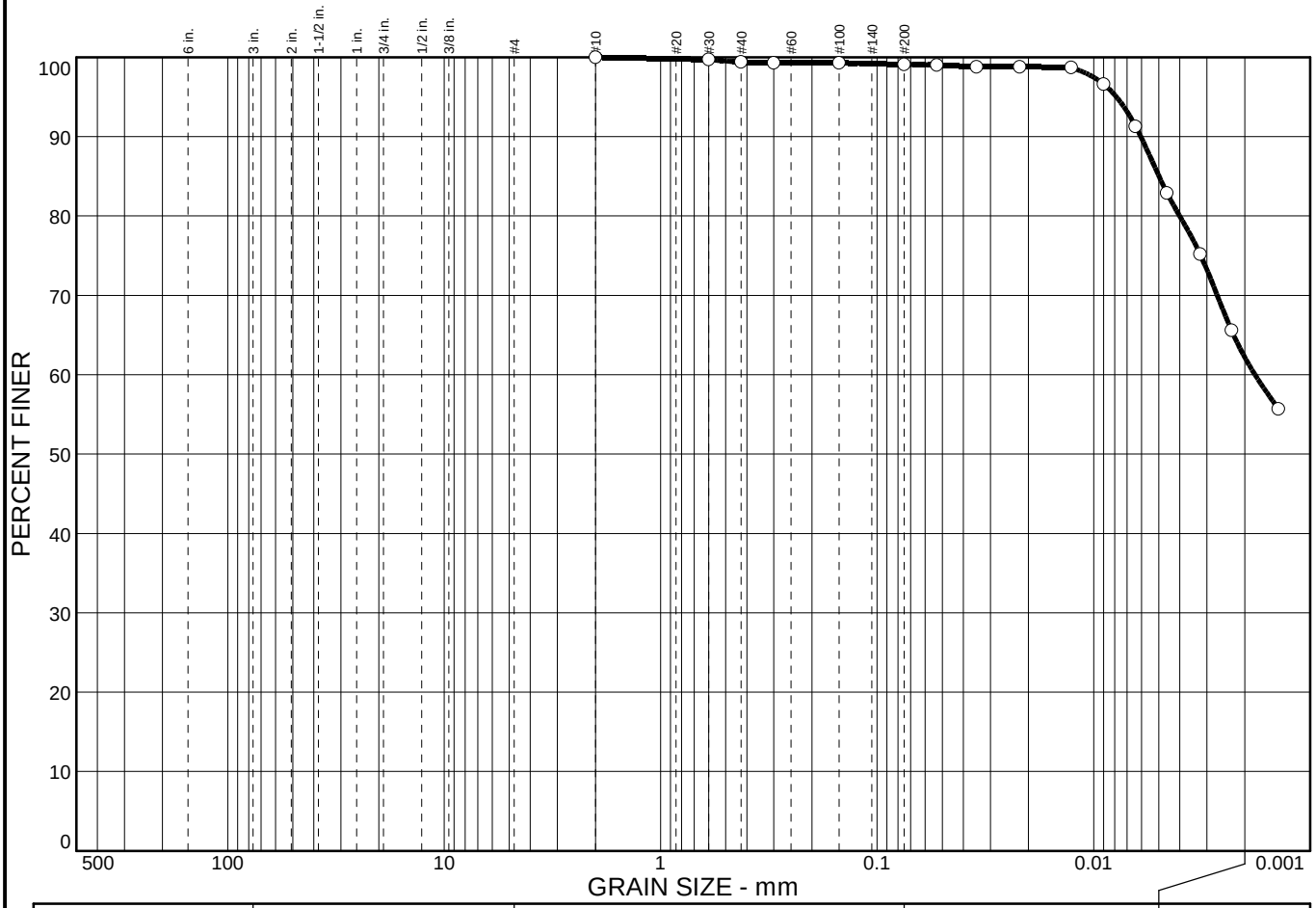
Sample No.: S-05 **Source of Sample:** BC-03 **Date:** 6/5/18
Location: **Elev./Depth:** 24.5'

COOPER TESTING LABORATORY

Client: AECOM
Project: Klamath River Dam Removal Project - 60537920

Project No: 020-251 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	0.9	37.0	62.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#30	99.7		
#40	99.4		
#50	99.3		
#100	99.3		
#200	99.1		
#270	99.0		
0.0347 mm.	98.8		
0.0219 mm.	98.8		
0.0127 mm.	98.7		
0.0090 mm.	96.6		
0.0064 mm.	91.3		
0.0046 mm.	82.9		
0.0032 mm.	75.2		
0.0023 mm.	65.6		
0.0014 mm.	55.7		

* (no specification provided)

Soil Description

Pale Brown Mottled Gray Elastic SILT

Atterberg Limits

PL= 85 LL= 120 PI= 35

Coefficients

D_{85}= 0.0050 D_{60}= 0.0018 D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= MH AASHTO=

Remarks

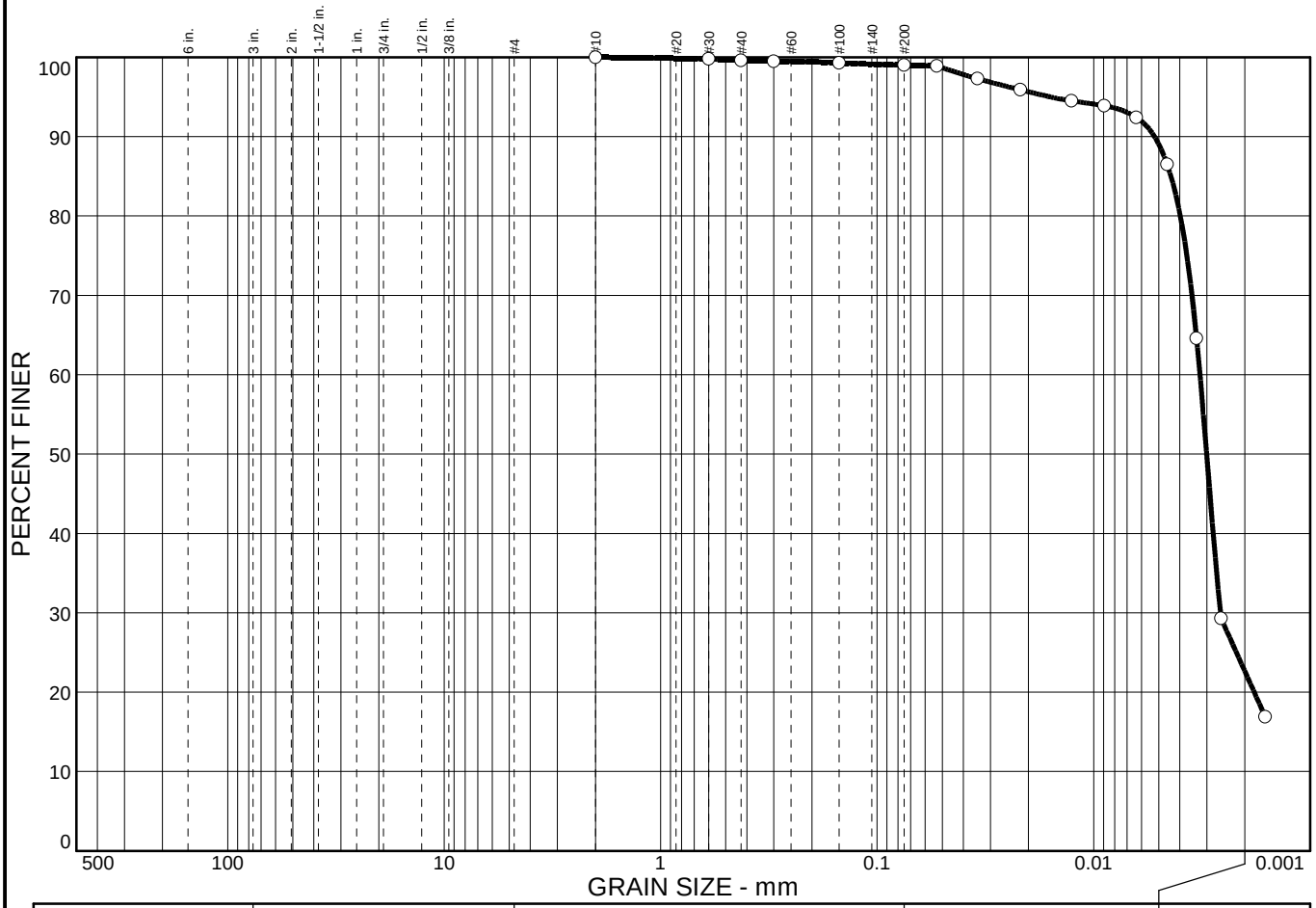
Sample No.: S-08 **Source of Sample:** BC-04 **Date:** 5/16/18
Location: **Elev./Depth:** 32.5(Tip-16")

COOPER TESTING LABORATORY

Client: AECOM
Project: Klamath River Dam Removal Project - 60537920

Project No: 020-251 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	1.0	76.4	22.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#30	99.8		
#40	99.6		
#50	99.5		
#100	99.3		
#200	99.0		
#270	98.9		
0.0343 mm.	97.3		
0.0218 mm.	95.9		
0.0126 mm.	94.5		
0.0089 mm.	93.9		
0.0063 mm.	92.4		
0.0046 mm.	86.5		
0.0034 mm.	64.6		
0.0026 mm.	29.3		
0.0016 mm.	16.9		

* (no specification provided)

Soil Description

Light Olive Brown Elastic SILT

Atterberg Limits

PL= 88 LL= 200 PI= 112

Coefficients

D_{85}= 0.0044 D_{60}= 0.0032 D_{50}= 0.0030
D_{30}= 0.0026 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= MH AASHTO=

Remarks

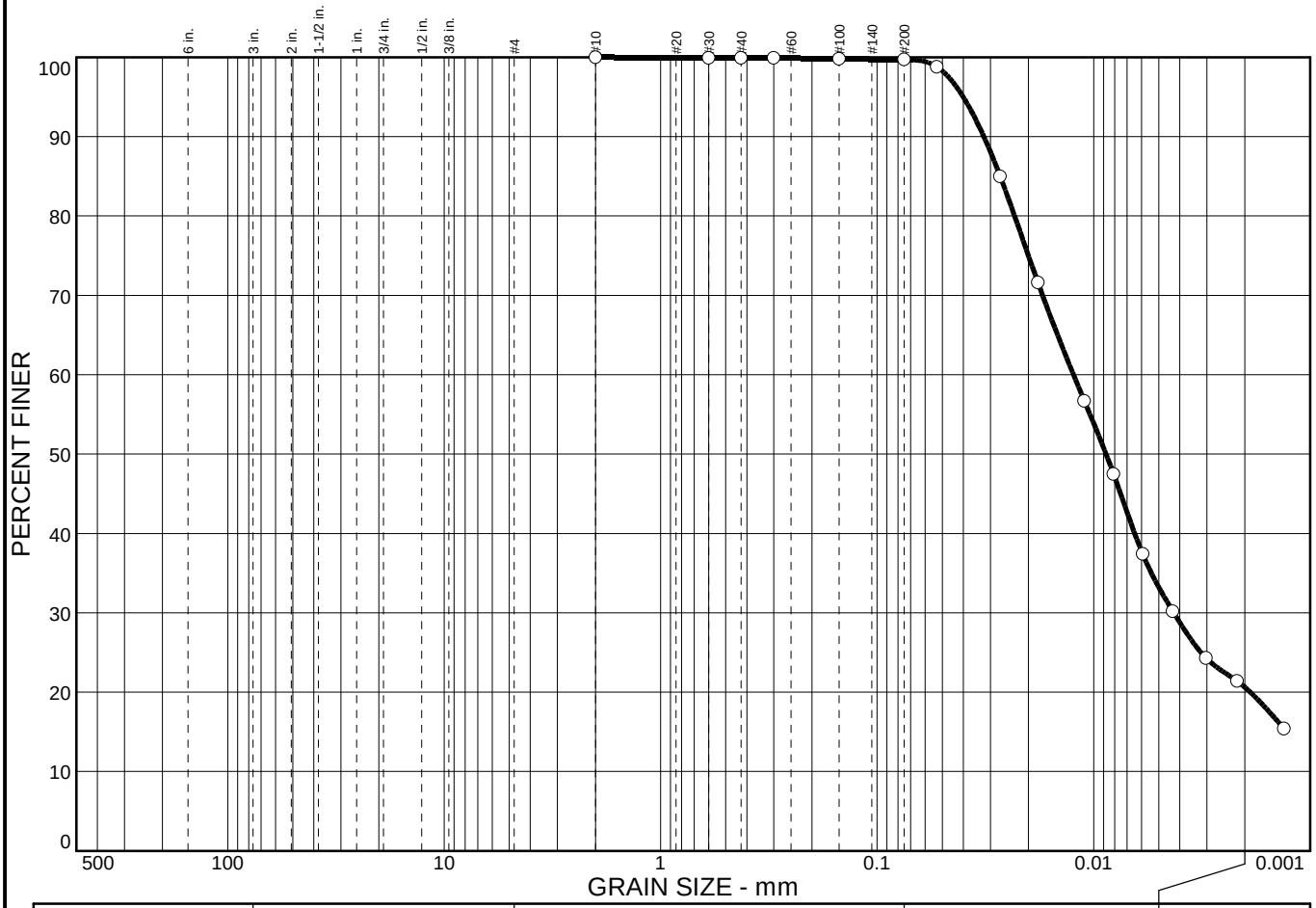
Sample No.: S-05 **Source of Sample:** BC-08A **Date:** 6/5/18
Location: **Elev./Depth:** 54'

COOPER TESTING LABORATORY

Client: AECOM
Project: Klamath River Dam Removal Project - 60537920

Project No: 020-251 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	0.3	79.1	20.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#30	99.9		
#40	99.9		
#50	99.9		
#100	99.8		
#200	99.7		
#270	98.8		
0.0270 mm.	85.0		
0.0181 mm.	71.6		
0.0110 mm.	56.7		
0.0081 mm.	47.5		
0.0059 mm.	37.4		
0.0043 mm.	30.2		
0.0030 mm.	24.3		
0.0022 mm.	21.4		
0.0013 mm.	15.4		

* (no specification provided)

Soil Description

Dark Gray Elastic SILT

Atterberg Limits

PL= 53 LL= 74 PI= 21

Coefficients

D_{85}= 0.0270 D_{60}= 0.0124 D_{50}= 0.0088
D_{30}= 0.0043 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= MH AASHTO=

Remarks

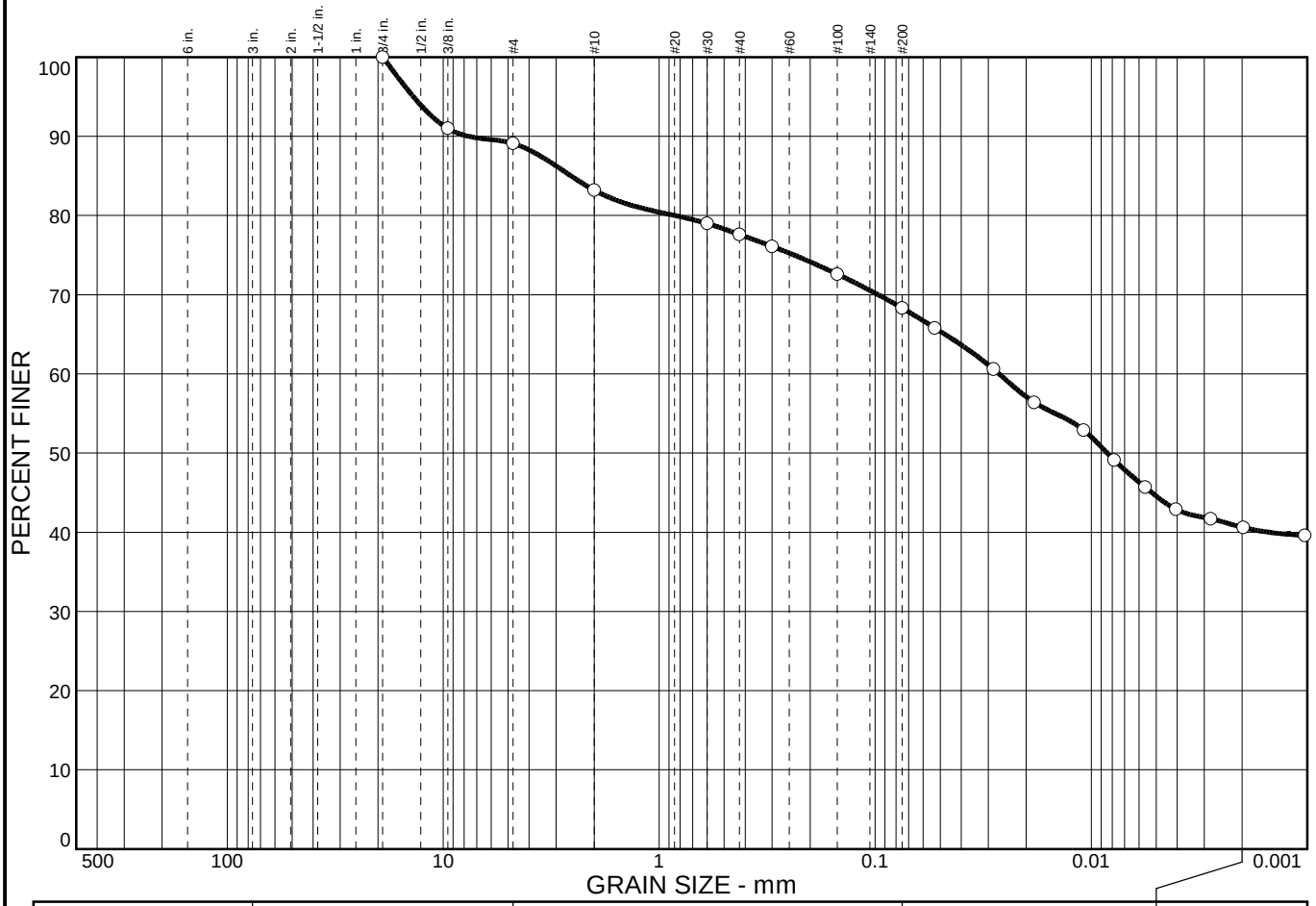
Sample No.: S-05 **Source of Sample:** BC-09 **Date:** 6/5/18
Location: **Elev./Depth:** 23(Tip-5")

COOPER TESTING LABORATORY

Client: AECOM
Project: Klamath River Dam Removal Project - 60537920

Project No: 020-251 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	10.9	20.8	27.7	40.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
3/8 in.	91.0		
#4	89.1		
#10	83.2		
#30	79.0		
#40	77.6		
#50	76.1		
#100	72.6		
#200	68.3		
#270	65.8		
0.0284 mm.	60.6		
0.0184 mm.	56.4		
0.0108 mm.	52.9		
0.0078 mm.	49.1		
0.0056 mm.	45.7		
0.0041 mm.	42.9		
0.0028 mm.	41.7		
0.0020 mm.	40.6		
0.0010 mm.	39.6		

* (no specification provided)

Soil Description

Dark Reddish Brown Sandy Fat CLAY

Atterberg Limits

PL= 28 LL= 78 PI= 50

Coefficients

D_{85}= 2.56 D_{60}= 0.0267 D_{50}= 0.0084
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

Remarks

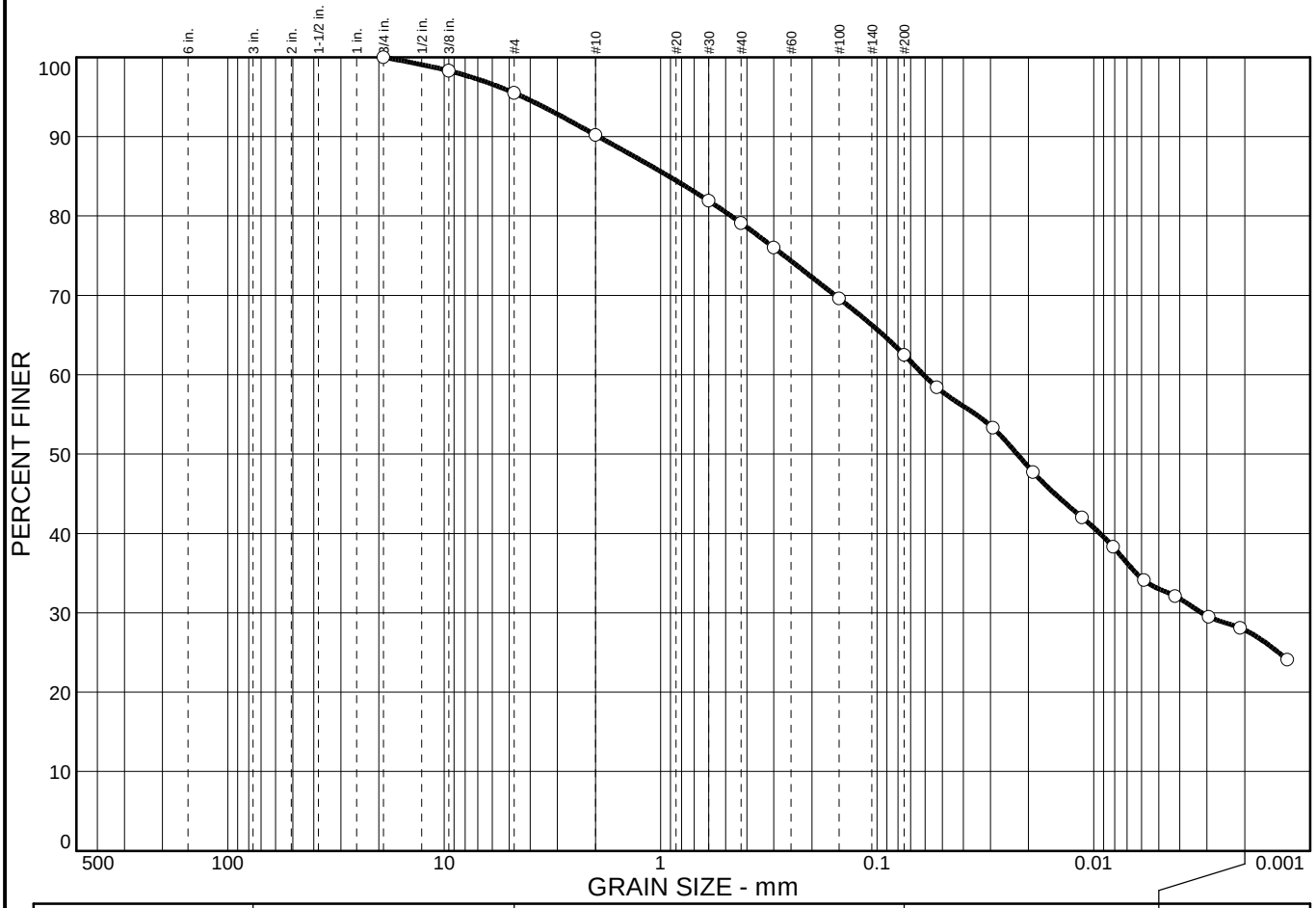
Sample No.: S-01 **Source of Sample:** BI-02 **Date:** 6/6/18
Location: **Elev./Depth:** 5'

COOPER TESTING LABORATORY

Client: AECOM
Project: Klamath River Dam Removal Project - 60537920

Project No: 020-251 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	4.5	33.0	34.7	27.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
3/8 in.	98.3		
#4	95.5		
#10	90.2		
#30	81.9		
#40	79.1		
#50	76.0		
#100	69.6		
#200	62.5		
#270	58.4		
0.0292 mm.	53.3		
0.0190 mm.	47.7		
0.0113 mm.	42.0		
0.0081 mm.	38.3		
0.0059 mm.	34.1		
0.0042 mm.	32.1		
0.0029 mm.	29.5		
0.0021 mm.	28.1		
0.0013 mm.	24.1		

* (no specification provided)

Soil Description

Yellowish Brown Sandy Fat CLAY

Atterberg Limits

PL= 28 LL= 58 PI= 30

Coefficients

D_{85}= 0.917 D_{60}= 0.0612 D_{50}= 0.0226
D_{30}= 0.0032 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

Remarks

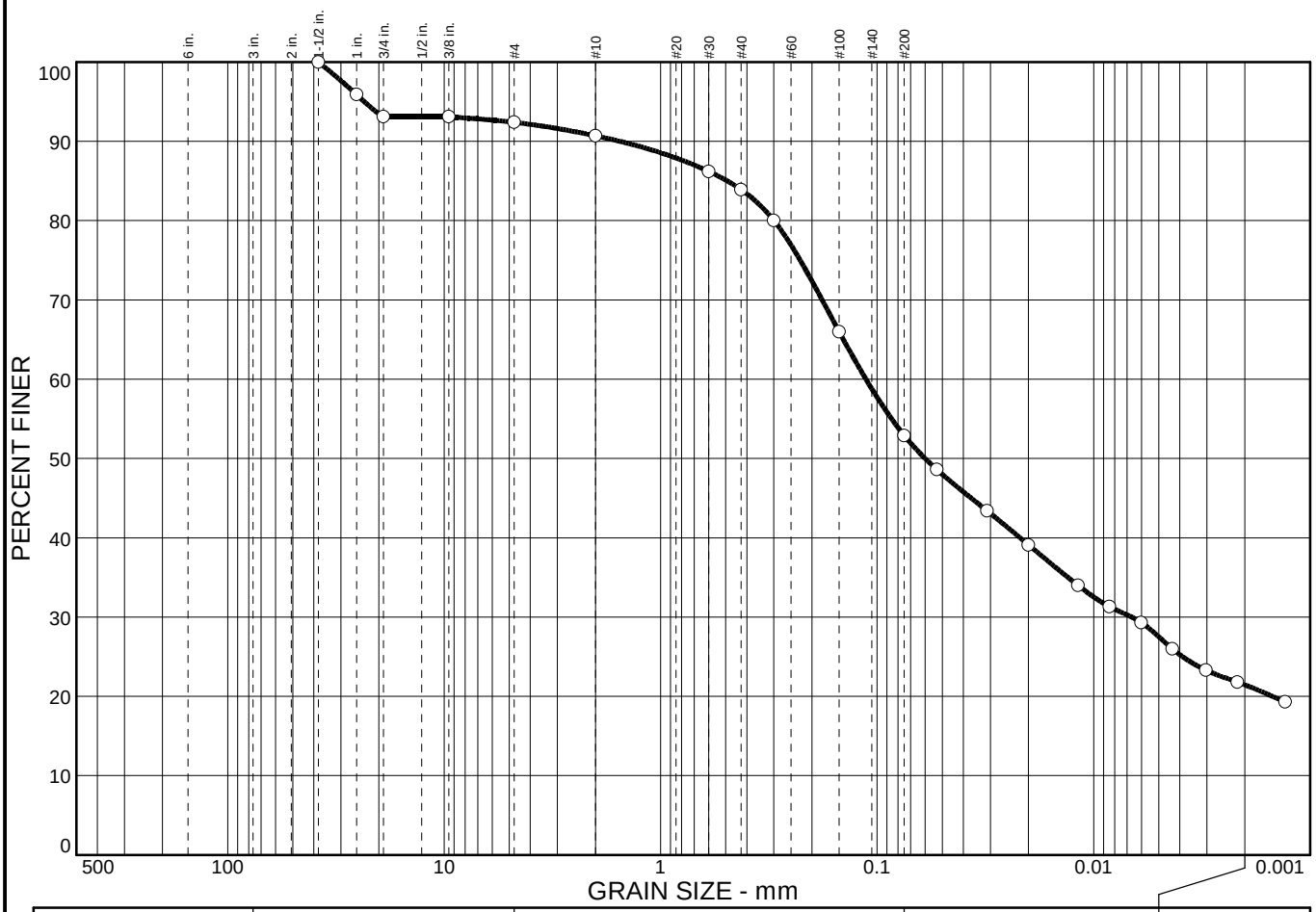
Sample No.: S-02 **Source of Sample:** BI-02 **Date:** 6/6/18
Location: **Elev./Depth:** 10'

COOPER TESTING LABORATORY

Client: AECOM
Project: Klamath River Dam Removal Project - 60537920

Project No: 020-251 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	7.6	39.5	31.5	21.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5 in.	100.0		
1 in.	95.9		
3/4 in.	93.1		
3/8 in.	93.1		
#4	92.4		
#10	90.7		
#30	86.2		
#40	83.9		
#50	80.0		
#100	66.0		
#200	52.9		
#270	48.6		
0.0311 mm.	43.4		
0.0200 mm.	39.1		
0.0118 mm.	34.0		
0.0084 mm.	31.3		
0.0060 mm.	29.3		
0.0043 mm.	26.0		
0.0030 mm.	23.3		
0.0022 mm.	21.8		
0.0013 mm.	19.3		

* (no specification provided)

Soil Description

Yellowish Brown Sandy Fat CLAY

Atterberg Limits

PL= 27 LL= 51 PI= 24

Coefficients

D_{85}= 0.492 D_{60}= 0.113 D_{50}= 0.0601
D_{30}= 0.0067 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

Remarks

Due to the small sample size, relative to the largest particle size, this data should be considered to be approximate.

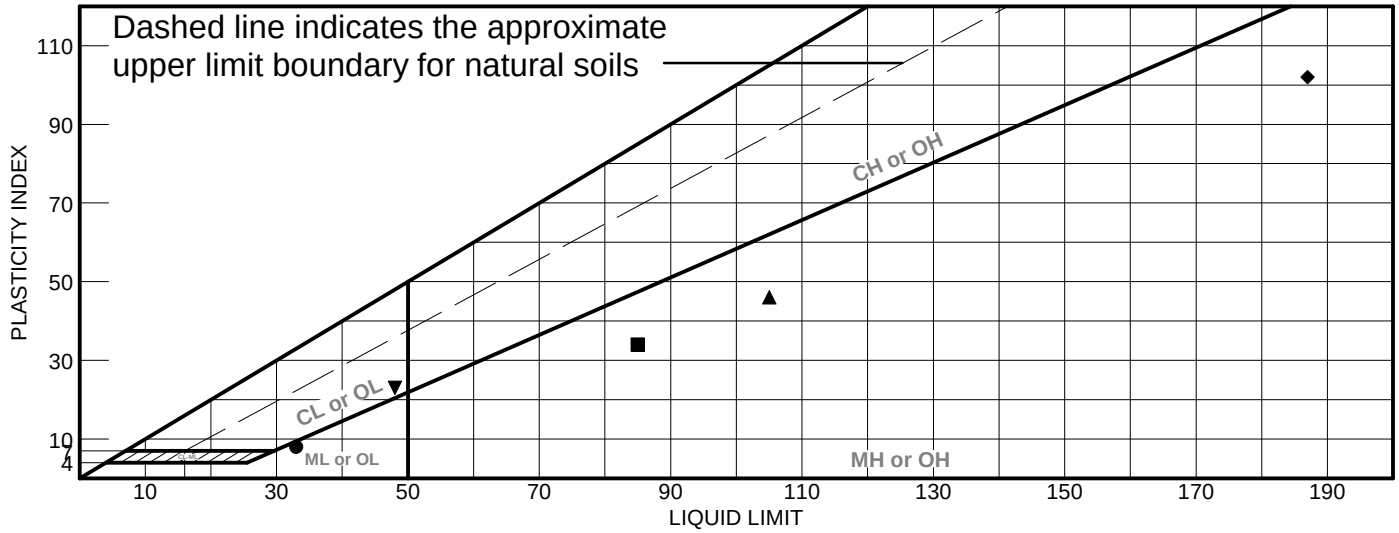
Sample No.: S-03 **Source of Sample:** BI-02 **Date:** 6/6/18
Location: **Elev./Depth:** 15'

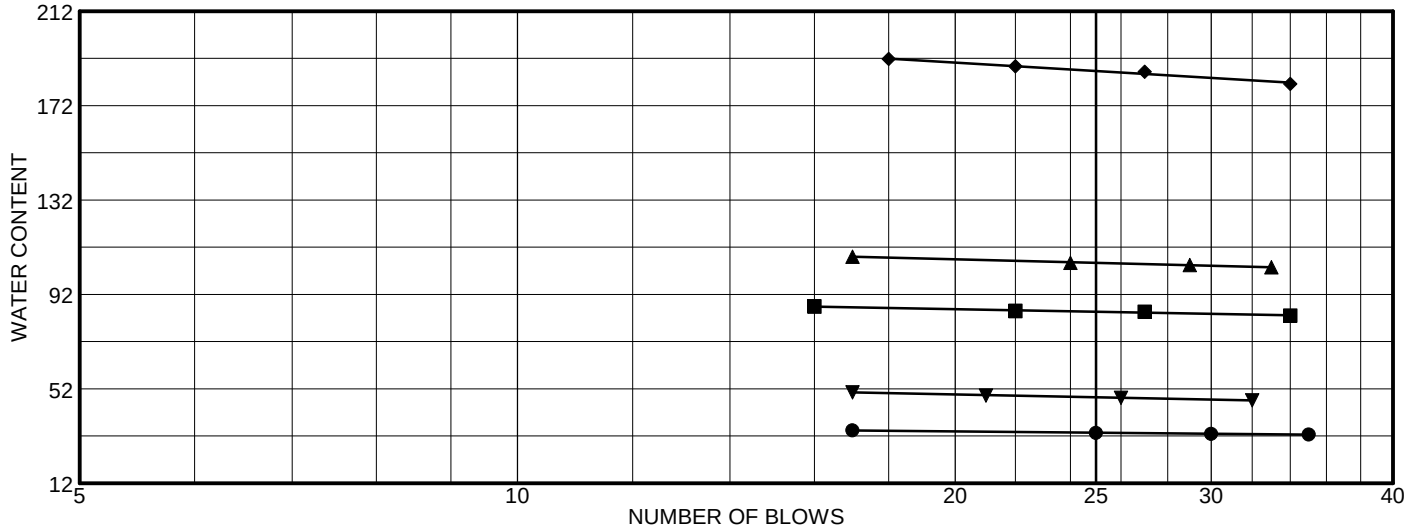
COOPER TESTING LABORATORY

Client: AECOM
Project: Klamath River Dam Removal Project - 60537920

Project No: 020-251 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Dark Olive Gray Sandy SILT	33	25	8			
■	Olive Gray Elastic SILT	85	51	34	99.9	99.0	MH
▲	Gray Elastic SILT	105	59	46	99.7	99.3	MH
◆	Gray Elastic SILT	187	85	102	99.6	99.5	MH
▼	Dark Olive Brown Sandy Lean CLAY	48	25	23			

Project No. 020-251 **Client:** AECOM

Project: Klamath River Dam Removal Project - 60537920

●	**Source:** BC-01	**Sample No.:** S-02	**Elev./Depth:** 6.5'
■	**Source:** BC-01	**Sample No.:** S-04	**Elev./Depth:** 21.5'
▲	**Source:** BC-02	**Sample No.:** S-05	**Elev./Depth:** 14.5'
◆	**Source:** BC-02	**Sample No.:** S-09	**Elev./Depth:** 44.5'
▼	**Source:** BC-03	**Sample No.:** S-01	**Elev./Depth:** 1'

Remarks:

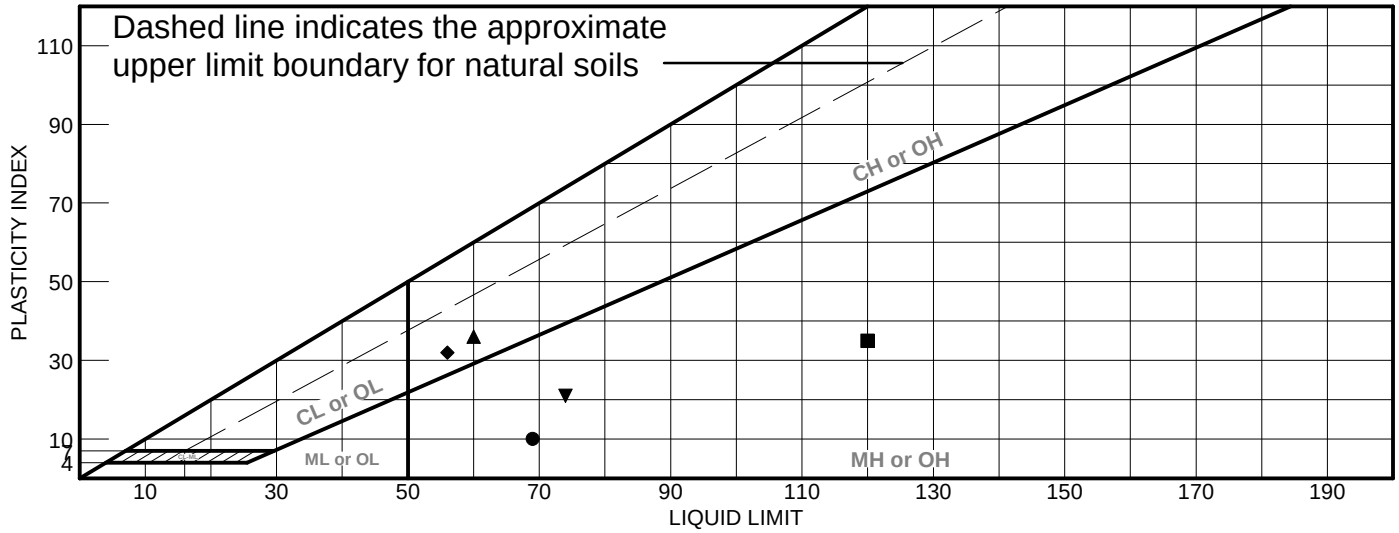
●
■
▲
◆
▼

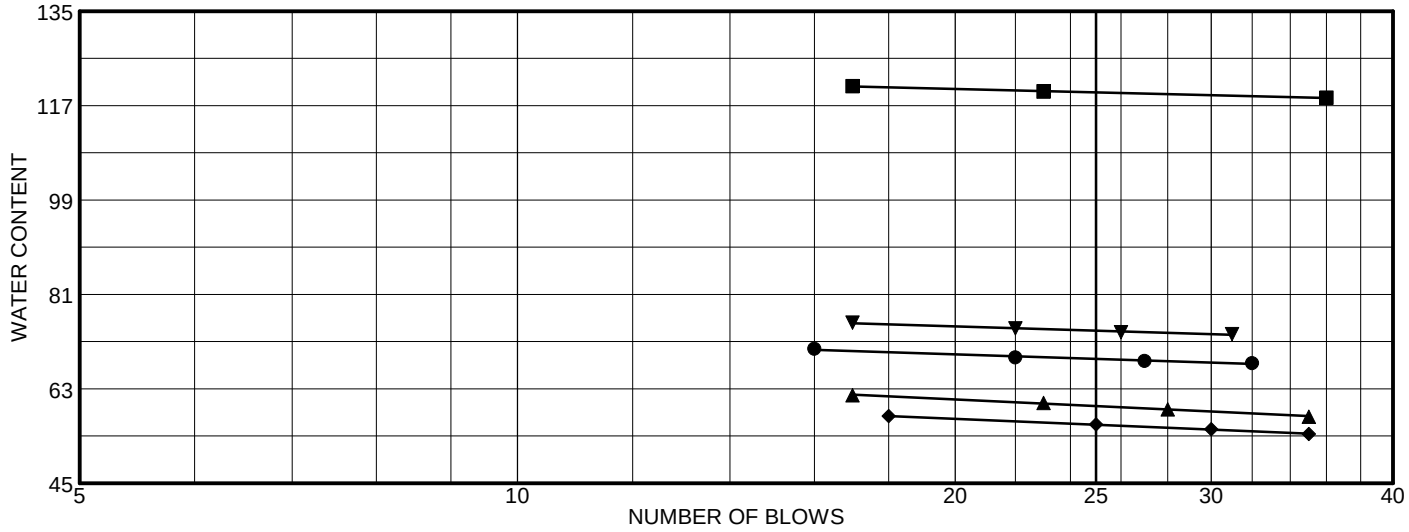
LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Light Olive Brown Elastic SILT	69	59	10	100.0	100.0	MH
■	Pale Brown Mottled Gray Elastic SILT	120	85	35	99.4	99.1	MH
▲	Very Dark Olive Brown Sandy Fat CLAY w/ Gravel	60	24	36			
◆	Dark Reddish Brown Sandy Fat CLAY	56	24	32			
▼	Dark Gray Elastic SILT	74	53	21	99.9	99.7	MH

Project No. 020-251 **Client:** AECOM

Project: Klamath River Dam Removal Project - 60537920

●	**Source:** BC-03	**Sample No.:** S-05	**Elev./Depth:** 24.5'
■	**Source:** BC-04	**Sample No.:** S-08	**Elev./Depth:** 32.5(Tip-16")
▲	**Source:** BC-07	**Sample No.:** S02	**Elev./Depth:** 4-4.5'
◆	**Source:** BC-08	**Sample No.:** S-01	**Elev./Depth:** 3.0'
▼	**Source:** BC-09	**Sample No.:** S-05	**Elev./Depth:** 23(Tip-5")

Remarks:

●

■

▲

◆

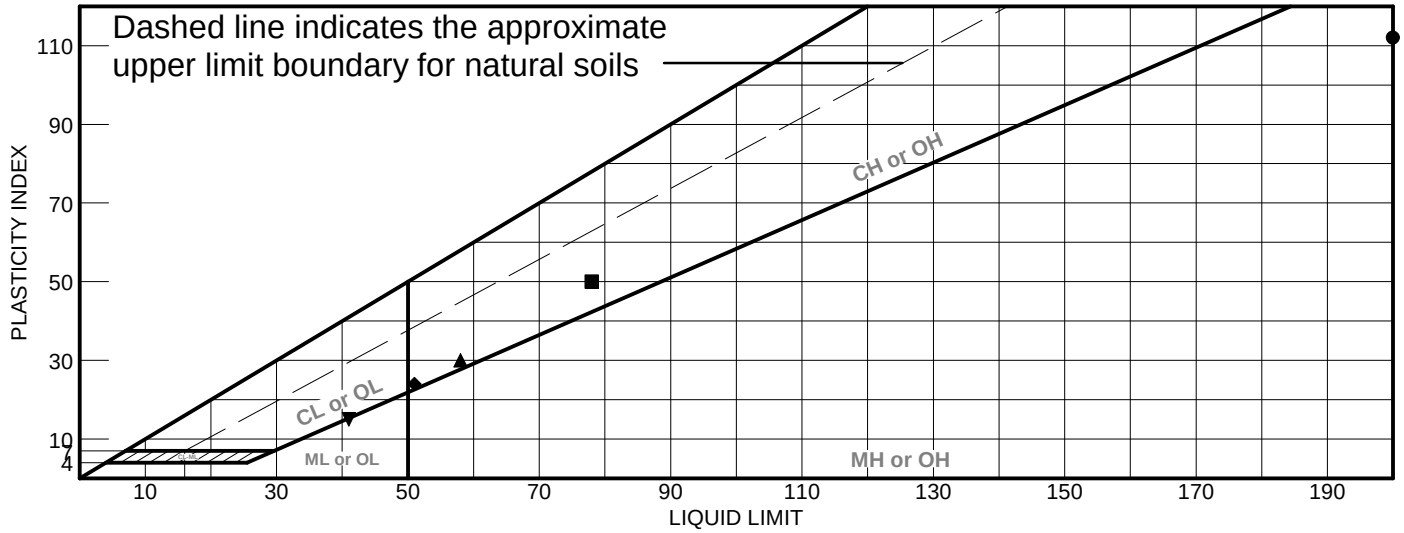
▼

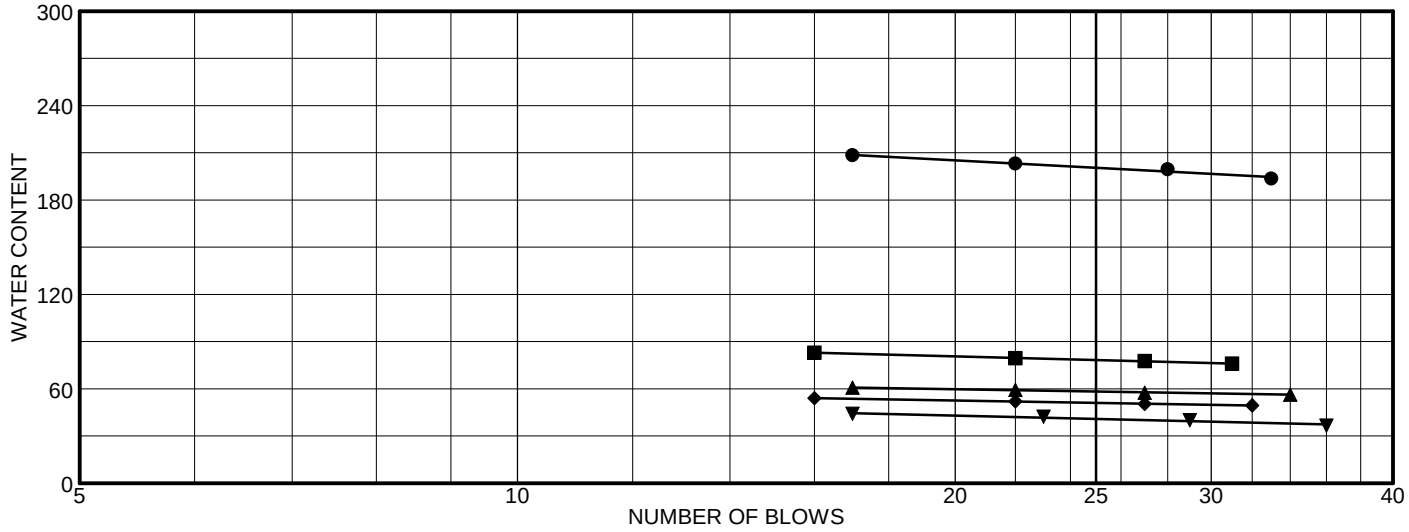
LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Light Olive Brown Elastic SILT	200	88	112	99.6	99.0	MH
■	Dark Reddish Brown Sandy Fat CLAY	78	28	50	77.6	68.3	CH
▲	Yellowish Brown Sandy Fat CLAY	58	28	30	79.1	62.5	CH
◆	Yellowish Brown Sandy Fat CLAY	51	27	24	83.9	52.9	CH
▼	Olive Gray Poorly Graded GRAVEL w/ Silt & Sand	41	26	15	15.9	9.0	GP-GM

Project No. 020-251 **Client:** AECOM

Project: Klamath River Dam Removal Project - 60537920

●	**Source:** BC-08A	**Sample No.:** S-05	**Elev./Depth:** 54'
■	**Source:** BI-02	**Sample No.:** S-01	**Elev./Depth:** 5'
▲	**Source:** BI-02	**Sample No.:** S-02	**Elev./Depth:** 10'
◆	**Source:** BI-02	**Sample No.:** S-03	**Elev./Depth:** 15'
▼	**Source:** BI-03	**Sample No.:** S-01	**Elev./Depth:** 3.5'

Remarks:

●

■

▲

◆

▼

LIQUID AND PLASTIC LIMITS TEST REPORT

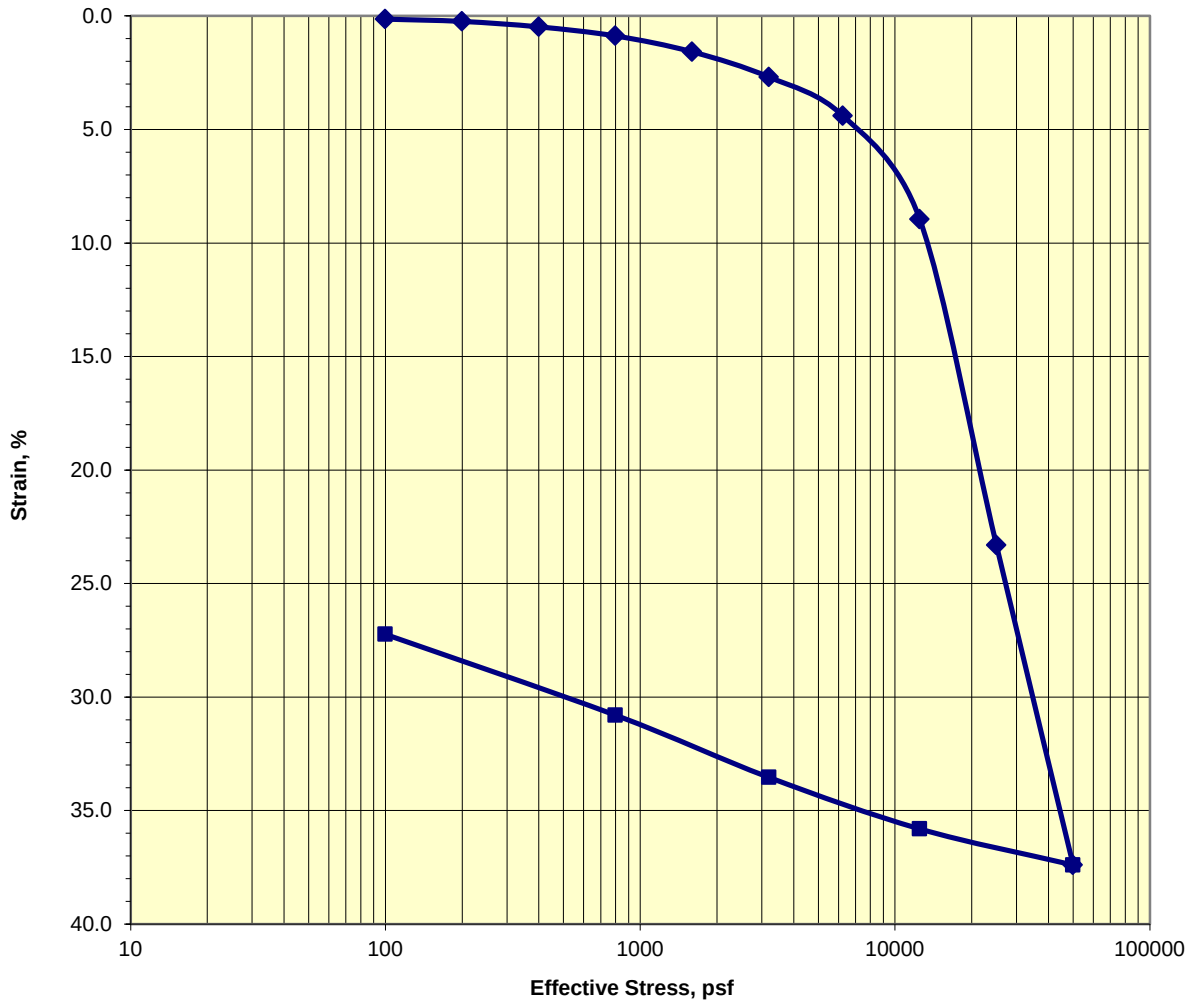
COOPER TESTING LABORATORY

Figure

Consolidation Test
ASTM D2435

Job No.:	020-251	**Boring:**	BC-04	**Run By:**	MD
Client:	AECOM	**Sample:**	S-08	**Reduced:**	PJ
Project:	60537920	**Depth, ft.:**	32.5(Tip-2")	**Checked:**	PJ/DC
Soil Type:	Pale Brown Mottled Gray Elastic SILT			**Date:**	6/1/2018

Strain-Log-P Curve

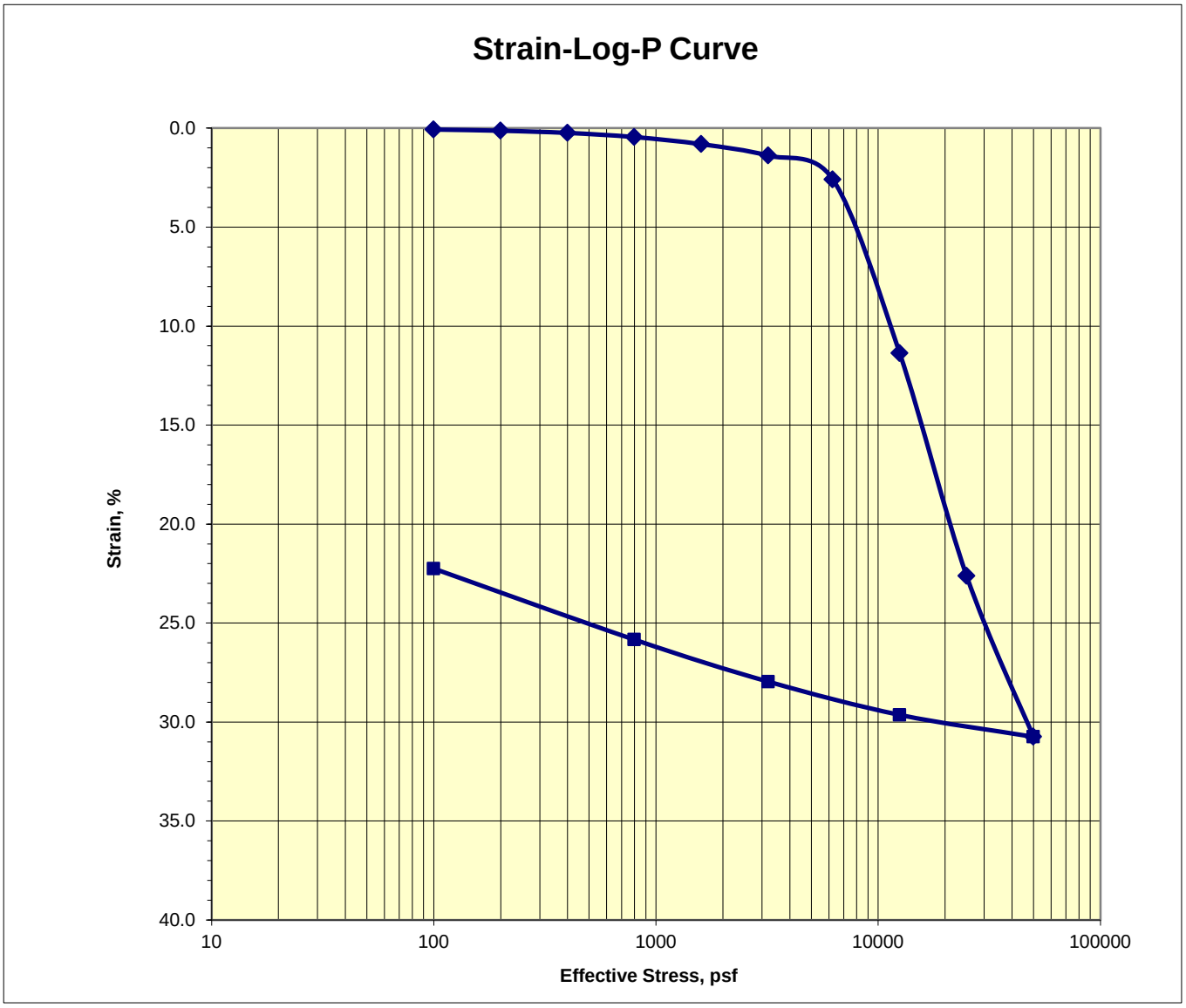


Assumed Gs 2.6	Initial	Final
Moisture %:	149.5	104.4
Dry Density, pcf:	32.1	43.7
Void Ratio:	4.058	2.715
% Saturation:	95.8	100.0

Remarks:

Consolidation Test
ASTM D2435

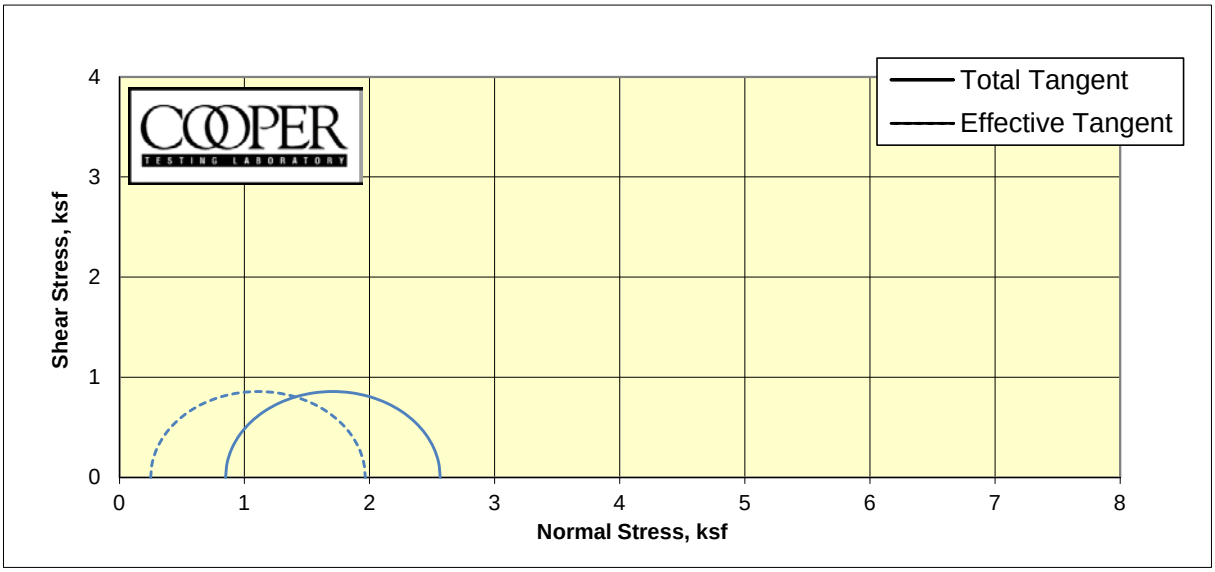
Job No.:	020-251	**Boring:**	BC-09	**Run By:**	MD
Client:	AECOM	**Sample:**	S-09	**Reduced:**	PJ
Project:	60537920	**Depth, ft.:**	68-70.5(Tip-20")	**Checked:**	PJ/DC
Soil Type:	Dark Greenish Gray CLAY (Silty)			**Date:**	6/1/2018

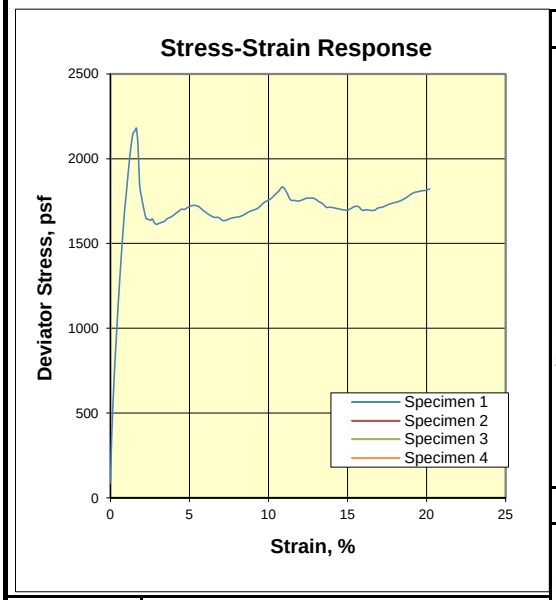


Assumed Gs 2.6	Initial	Final
Moisture %:	88.4	60.3
Dry Density, pcf:	48.6	63.2
Void Ratio:	2.340	1.568
% Saturation:	98.2	100.0

Remarks:

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767





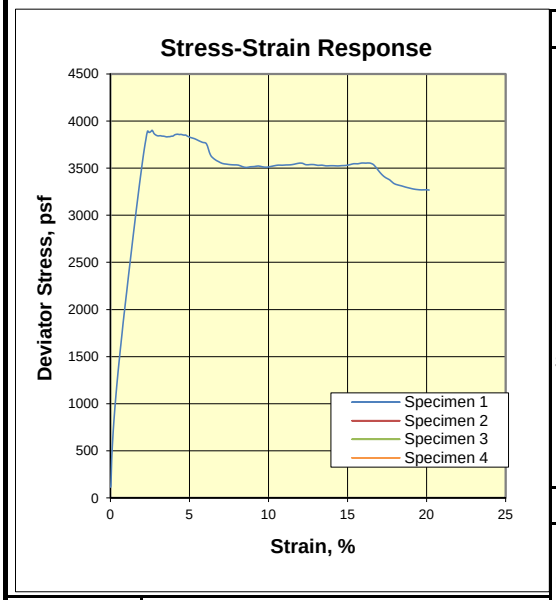
CTL Number:	020-251
Client Name:	AECOM
Project Name:	Klamath River Dam Removal Project
Project Number:	60537920
Date:	5/30/2018 By: MD/DC
Total C	#DIV/0! ksf
Total phi	#DIV/0! degrees
Eff. C	#DIV/0! ksf
Eff. Phi	#DIV/0! degrees

Specimen	1	2	3	4
Boring	BC-02			
Sample	S-06			
Depth	19.5(Tip-2")			
Visual Description	Gray CLAY (Silty)			
MC (%)	147.5			
Dry Density (pcf)	31.6			
Saturation (%)	92.6			
Void Ratio	4.139			
Diameter (in)	2.86			
Height (in)	6.07			
	Final			
MC (%)	147.6			
Dry Density (pcf)	33.6			
Saturation (%)	100.0			
Void Ratio	3.838			
Diameter (in)	2.79			
Height (in)	6.02			
Cell Pressure (psi)	86.4			
Back Pressure (psi)	80.5			
	Effective Stresses At:			
Strain (%)	5.0			
Deviator (ksf)	1.716			
Excess PP (psi)	4.2			
Sigma 1 (ksf)	1.966			
Sigma 3 (ksf)	0.250			
P (ksf)	1.108			
Q (ksf)	0.858			
Stress Ratio	7.869			
Rate (in/min)	0.0005			

©

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767



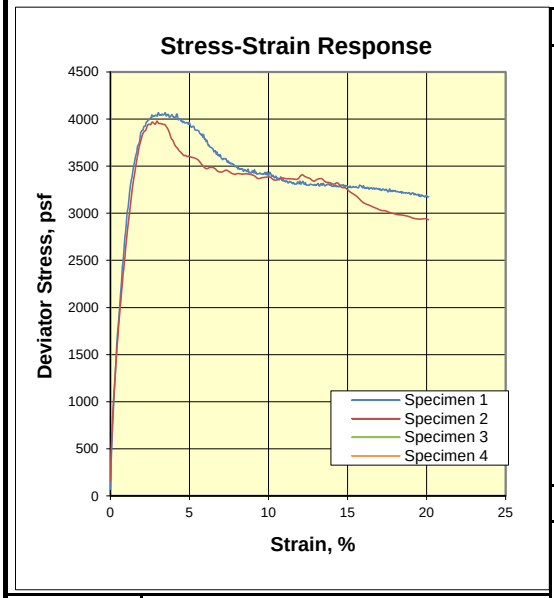


CTL Number:	020-251
Client Name:	AECOM
Project Name:	Klamath River Dam Removal Project
Project Number:	60537920
Date:	5/14/2018 By: MD/DC
Total C	#DIV/0! ksf
Total phi	#DIV/0! degrees
Eff. C	#DIV/0! ksf
Eff. Phi	#DIV/0! degrees ©

Specimen	1	2	3	4
Boring	BC-02			
Sample	S-08			
Depth	34.5(Tip-6")			
Visual Description	Pale Brown CLAY (Silty)			
MC (%)	148.8			
Dry Density (pcf)	32.7			
Saturation (%)	96.6			
Void Ratio	4.158			
Diameter (in)	2.87			
Height (in)	6.07			
	Final			
MC (%)	148.5			
Dry Density (pcf)	33.6			
Saturation (%)	100.0			
Void Ratio	4.010			
Diameter (in)	2.84			
Height (in)	6.02			
Cell Pressure (psi)	88.8			
Back Pressure (psi)	80.1			
	Effective Stresses At:			
Strain (%)	5.0			
Deviator (ksf)	3.832			
Excess PP (psi)	5.0			
Sigma 1 (ksf)	4.368			
Sigma 3 (ksf)	0.536			
P (ksf)	2.452			
Q (ksf)	1.916			
Stress Ratio	8.153			
Rate (in/min)	0.0005			

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767



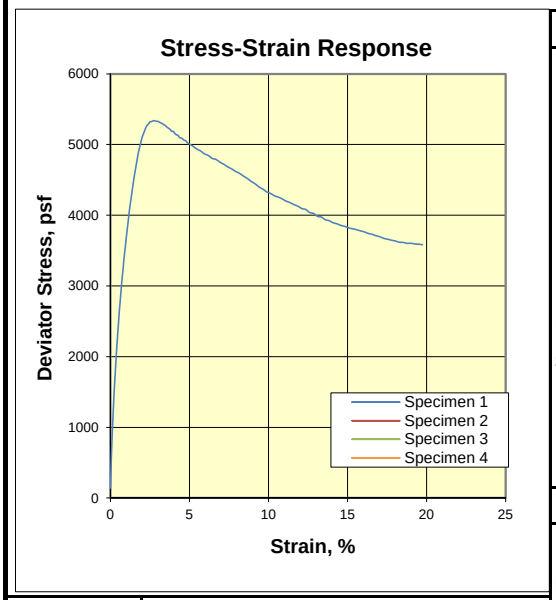


CTL Number:	020-251
Client Name:	Klamath River Dam Removal Project
Project Name:	60537920
Project Number:	43237
Date:	5/17/2018 By: MD/DC
Total C	#DIV/0! ksf
Total phi	#DIV/0! degrees
Eff. C	#DIV/0! ksf
Eff. Phi	#DIV/0! degrees ©

Specimen	1	2	3	4
Boring	BC-03	BC-03		
Sample	S-06	S-06		
Depth	39.5-42(Tip-11")	39.5-42(Tip-4")		
Visual Description	Dark Gray CLAY (Silty)	Dark Gray CLAY		
MC (%)	84.9	90.1		
Dry Density (pcf)	50.2	47.7		
Saturation (%)	99.0	97.6		
Void Ratio	2.230	2.402		
Diameter (in)	2.87	2.87		
Height (in)	6.06	6.08		
	Final			
MC (%)	83.0	87.9		
Dry Density (pcf)	51.4	49.4		
Saturation (%)	100.0	100.0		
Void Ratio	2.158	2.285		
Diameter (in)	2.85	2.83		
Height (in)	6.02	6.04		
Cell Pressure (psi)	90.5	91.6		
Back Pressure (psi)	79.5	81.2		
	Effective Stresses At:			
Strain (%)	5.0	5.0		
Deviator (ksf)	3.966	3.607		
Excess PP (psi)	5.3	5.0		
Sigma 1 (ksf)	4.775	4.386		
Sigma 3 (ksf)	0.809	0.779		
P (ksf)	2.792	2.582		
Q (ksf)	1.983	1.804		
Stress Ratio	5.901	5.632		
Rate (in/min)	0.0005	0.0005		

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767



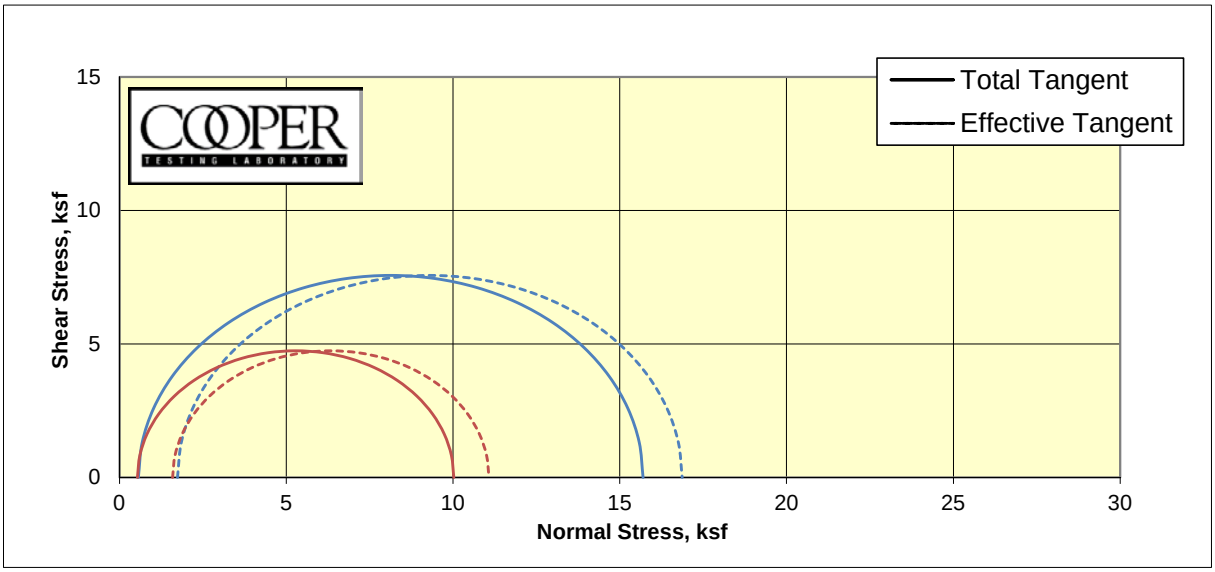


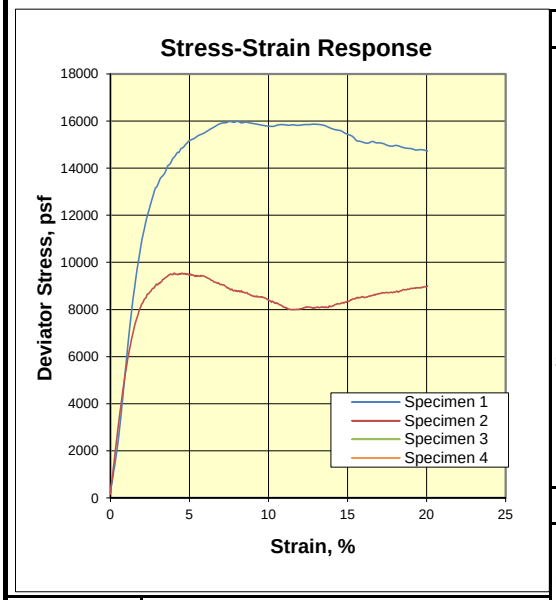
CTL Number:	020-251
Client Name:	AECOM
Project Name:	Klamath River Dam Removal Project
Project Number:	60537920
Date:	5/21/2018 By: MD/DC
Total C	#DIV/0! ksf
Total phi	#DIV/0! degrees
Eff. C	#DIV/0! ksf
Eff. Phi	#DIV/0! degrees

©

Specimen	1	2	3	4
Boring	BC-03			
Sample	S-10			
Depth	90(Tip-13")			
Visual Description	Dark Gray CLAY			
MC (%)	119.8			
Dry Density (pcf)	35.8			
Saturation (%)	88.1			
Void Ratio	3.533			
Diameter (in)	2.87			
Height (in)	6.08			
	Final			
MC (%)	116.3			
Dry Density (pcf)	40.3			
Saturation (%)	100.0			
Void Ratio	3.023			
Diameter (in)	2.69			
Height (in)	6.16			
Cell Pressure (psi)	99.9			
Back Pressure (psi)	80.5			
	Effective Stresses At:			
Strain (%)	5.0			
Deviator (ksf)	5.012			
Excess PP (psi)	14.0			
Sigma 1 (ksf)	5.788			
Sigma 3 (ksf)	0.777			
P (ksf)	3.283			
Q (ksf)	2.506			
Stress Ratio	7.452			
Rate (in/min)	0.0005			

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767



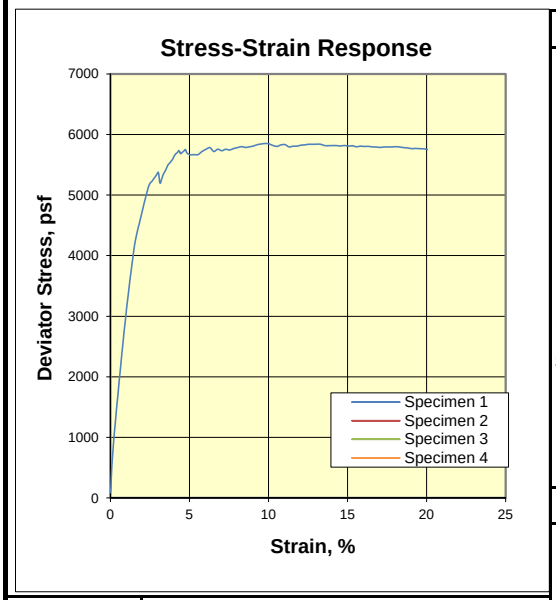


CTL Number:	020-251
Client Name:	AECOM
Project Name:	Klamath River Dam Removal Project
Project Number:	60537920
Date:	6/6/2018 By: MD/DC
Total C	#DIV/0! ksf
Total phi	#DIV/0! degrees
Eff. C	#DIV/0! ksf
Eff. Phi	#DIV/0! degrees ©

Specimen	1	2	3	4
Boring	BC-04	BC-04		
Sample	S-04	S-04		
Depth	12.5-14(Tip-15")	12.5-14.5(Tip-4")		
Visual Description	Brown Weathered Rock	Dark Brown Clayey GRAVEL (Weathered Rock)		
MC (%)	60.8	53.9		
Dry Density (pcf)	59.2	65.0		
Saturation (%)	90.8	93.7		
Void Ratio	1.740	1.497		
Diameter (in)	2.87	2.86		
Height (in)	6.06	6.06		
	Final			
MC (%)	61.4	54.7		
Dry Density (pcf)	62.5	67.0		
Saturation (%)	100.0	100.0		
Void Ratio	1.597	1.422		
Diameter (in)	2.80	2.82		
Height (in)	6.04	6.04		
Cell Pressure (psi)	83.2	82.9		
Back Pressure (psi)	79.2	79.1		
	Effective Stresses At:			
Strain (%)	5.0	5.0		
Deviator (ksf)	15.130	9.485		
Excess PP (psi)	-8.1	-7.3		
Sigma 1 (ksf)	16.872	11.080		
Sigma 3 (ksf)	1.741	1.594		
P (ksf)	9.306	6.337		
Q (ksf)	7.565	4.743		
Stress Ratio	9.688	6.949		
Rate (in/min)	0.0005	0.0005		

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767





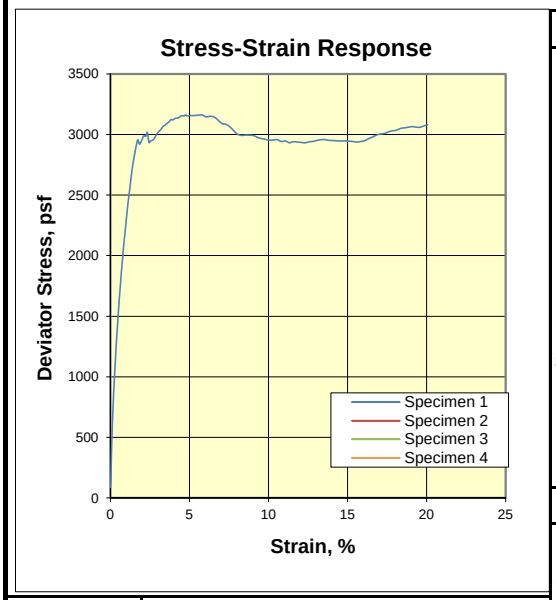
CTL Number:	020-251
Client Name:	AECOM
Project Name:	Klamath River Dam Removal Project
Project Number:	60537920
Date:	5/14/2018 By: MD/DC
Total C	#DIV/0! ksf
Total phi	#DIV/0! degrees
Eff. C	#DIV/0! ksf
Eff. Phi	#DIV/0! degrees

©

Specimen	1	2	3	4
Boring	BC-04			
Sample	S-5			
Depth	17.5(Tip-6")			
Visual Description	Light Gray CLAY			
MC (%)	104.7			
Dry Density (pcf)	42.1			
Saturation (%)	94.2			
Void Ratio	3.000			
Diameter (in)	2.87			
Height (in)	6.08			
	Final			
MC (%)	105.4			
Dry Density (pcf)	43.8			
Saturation (%)	100.0			
Void Ratio	2.846			
Diameter (in)	2.82			
Height (in)	6.07			
Cell Pressure (psi)	84.0			
Back Pressure (psi)	80.2			
	Effective Stresses At:			
Strain (%)	5.0			
Deviator (ksf)	5.677			
Excess PP (psi)	-1.6			
Sigma 1 (ksf)	6.450			
Sigma 3 (ksf)	0.774			
P (ksf)	3.612			
Q (ksf)	2.838			
Stress Ratio	8.336			
Rate (in/min)	0.0005			

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767



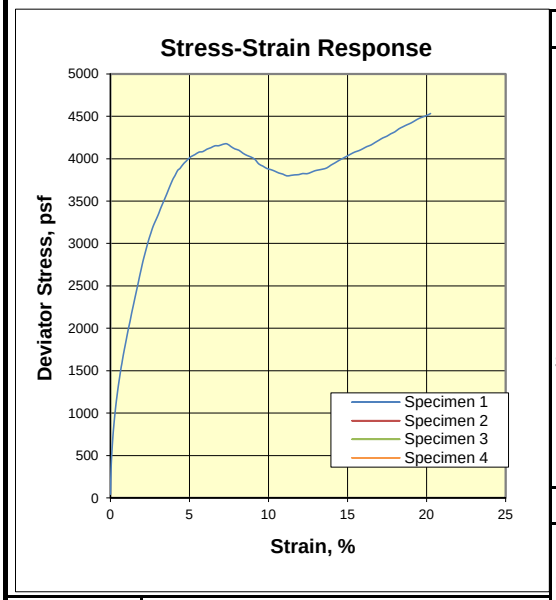


CTL Number:	020-251
Client Name:	AECOM
Project Name:	Klamath River Dam Removal Project
Project Number:	60537920
Date:	5/30/2018 By: MD/DC
Total C	#DIV/0! ksf
Total phi	#DIV/0! degrees
Eff. C	#DIV/0! ksf
Eff. Phi	#DIV/0! degrees ©

Specimen	1	2	3	4
Boring	BC-04			
Sample	S-06			
Depth	22.5(Tip-2")			
Visual Description	Greenish Gray CLAY (Silty)/ SILT (slightly plastic)			
MC (%)	154.6			
Dry Density (pcf)	31.7			
Saturation (%)	97.4			
Void Ratio	4.127			
Diameter (in)	2.87			
Height (in)	6.07			
	Final			
MC (%)	152.8			
Dry Density (pcf)	32.6			
Saturation (%)	100.0			
Void Ratio	3.974			
Diameter (in)	2.83			
Height (in)	6.05			
Cell Pressure (psi)	85.0			
Back Pressure (psi)	80.1			
	Effective Stresses At:			
Strain (%)	5.0			
Deviator (ksf)	3.153			
Excess PP (psi)	2.5			
Sigma 1 (ksf)	3.511			
Sigma 3 (ksf)	0.358			
P (ksf)	1.935			
Q (ksf)	1.576			
Stress Ratio	9.796			
Rate (in/min)	0.0005			

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767



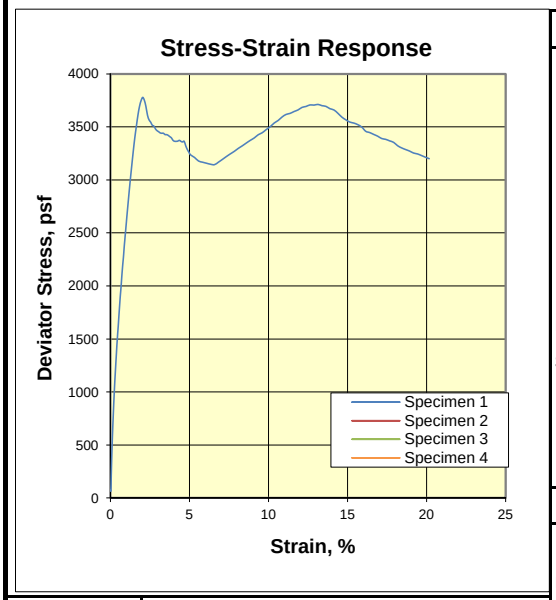


CTL Number:	020-251
Client Name:	AECOM
Project Name:	Klamath River Dam Removal Project
Project Number:	60537920
Date:	5/17/2018 By: MD/DC
Total C	#DIV/0! ksf
Total phi	#DIV/0! degrees
Eff. C	#DIV/0! ksf
Eff. Phi	#DIV/0! degrees ©

Specimen	1	2	3	4
Boring	BC-04			
Sample	S-08			
Depth	32.5(Tip-10")			
Visual Description	Pale Brown Mottled Gray Elastic SILT			
MC (%)	117.2			
Dry Density (pcf)	36.9			
Saturation (%)	89.7			
Void Ratio	3.397			
Diameter (in)	2.87			
Height (in)	6.08			
	Final			
MC (%)	115.5			
Dry Density (pcf)	40.5			
Saturation (%)	100.0			
Void Ratio	3.004			
Diameter (in)	2.76			
Height (in)	6.01			
Cell Pressure (psi)	86.8			
Back Pressure (psi)	80.0			
	Effective Stresses At:			
Strain (%)	5.0			
Deviator (ksf)	4.005			
Excess PP (psi)	4.2			
Sigma 1 (ksf)	4.390			
Sigma 3 (ksf)	0.385			
P (ksf)	2.388			
Q (ksf)	2.003			
Stress Ratio	11.403			
Rate (in/min)	0.0005			

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767



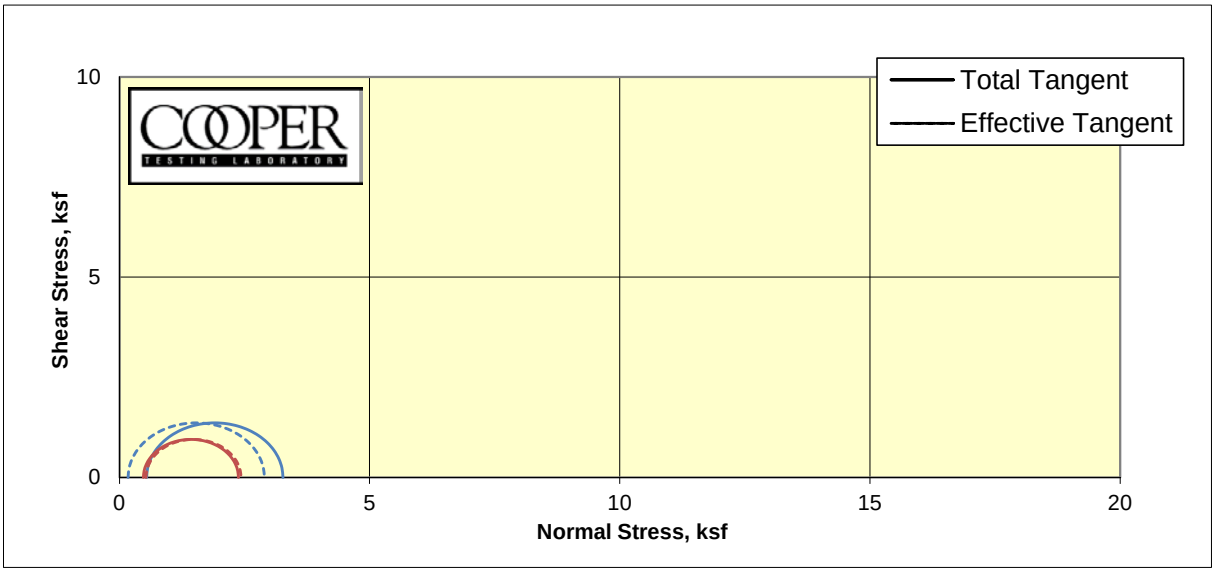


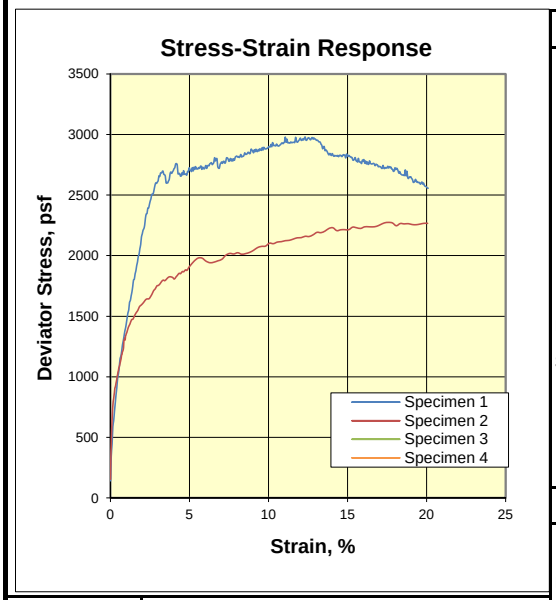
CTL Number:	020-251
Client Name:	AECOM
Project Name:	Klamath River Dam Removal Project
Project Number:	60537920
Date:	5/25/2018 By: MD/DC
Total C	#DIV/0! ksf
Total phi	#DIV/0! degrees
Eff. C	#DIV/0! ksf
Eff. Phi	#DIV/0! degrees

©

Specimen	1	2	3	4
Boring	BC-04			
Sample	S-10			
Depth	52.5(Tip-4")			
Visual Description	Bluish Gray CLAY (Silty)/ SILT (slightly plastic)			
MC (%)	153.6			
Dry Density (pcf)	32.1			
Saturation (%)	97.9			
Void Ratio	4.156			
Diameter (in)	2.87			
Height (in)	6.08			
	Final			
MC (%)	151.2			
Dry Density (pcf)	33.0			
Saturation (%)	100.0			
Void Ratio	4.007			
Diameter (in)	2.84			
Height (in)	6.03			
Cell Pressure (psi)	90.6			
Back Pressure (psi)	80.6			
	Effective Stresses At:			
Strain (%)	5.0			
Deviator (ksf)	3.260			
Excess PP (psi)	6.3			
Sigma 1 (ksf)	3.784			
Sigma 3 (ksf)	0.523			
P (ksf)	2.154			
Q (ksf)	1.630			
Stress Ratio	7.229			
Rate (in/min)	0.0005			

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767



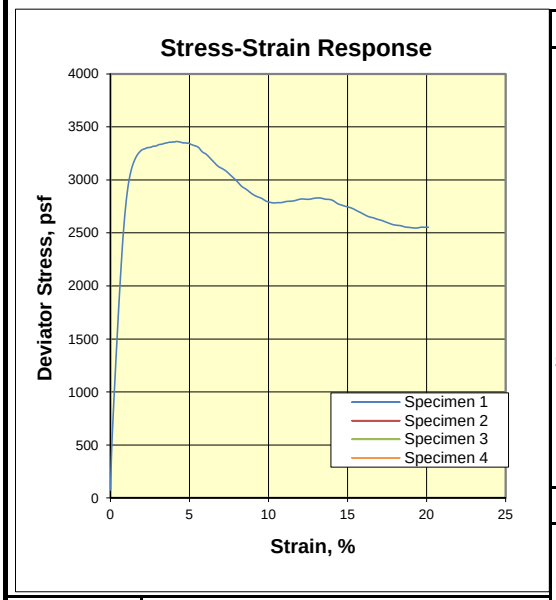


CTL Number:	020-251
Client Name:	AECOM
Project Name:	Klamath River Dam Removal Project
Project Number:	60537920
Date:	5/24/2018 By: MD/DC
Total C	#DIV/0! ksf
Total phi	#DIV/0! degrees
Eff. C	#DIV/0! ksf
Eff. Phi	#DIV/0! degrees ©

Specimen	1	2	3	4
Boring	BC-05	BC-05		
Sample	S-04	S-04		
Depth	14.5(Tip-16")	14.5(Tip-1")		
Visual Description	Olive CLAY (Silty)/SILT (slightly plastic)	Olive Mottled Yellow Clayey SAND/ Sandy CLAY		
MC (%)	135.1	30.0		
Dry Density (pcf)	35.4	92.8		
Saturation (%)	97.0	99.2		
Void Ratio	3.760	0.816		
Diameter (in)	2.87	2.87		
Height (in)	5.83	6.09		
	Final			
MC (%)	135.4	29.8		
Dry Density (pcf)	36.2	93.4		
Saturation (%)	100.0	100.0		
Void Ratio	3.656	0.805		
Diameter (in)	2.85	2.87		
Height (in)	5.80	6.07		
Cell Pressure (psi)	84.2	84.1		
Back Pressure (psi)	80.4	80.8		
	Effective Stresses At:			
Strain (%)	5.0	5.0		
Deviator (ksf)	2.725	1.900		
Excess PP (psi)	2.6	-0.4		
Sigma 1 (ksf)	2.899	2.431		
Sigma 3 (ksf)	0.173	0.531		
P (ksf)	1.536	1.481		
Q (ksf)	1.363	0.950		
Stress Ratio	16.726	4.577		
Rate (in/min)	0.0005	0.0005		

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767



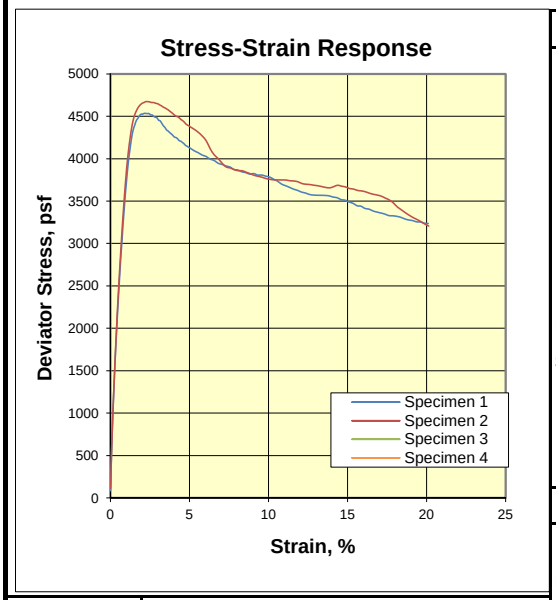


CTL Number:	020-251
Client Name:	AECOM
Project Name:	Klamath River Dam Removal Project
Project Number:	60537920
Date:	5/30/2018 By: MD/DC
Total C	#DIV/0! ksf
Total phi	#DIV/0! degrees
Eff. C	#DIV/0! ksf
Eff. Phi	#DIV/0! degrees ©

Specimen	1	2	3	4
Boring	BC-09			
Sample	S-05			
Depth	23(Tip-5")			
Visual Description	Dark Gray Elastic SILT			
MC (%)	79.5			
Dry Density (pcf)	51.9			
Saturation (%)	97.1			
Void Ratio	2.130			
Diameter (in)	2.87			
Height (in)	6.07			
	Final			
MC (%)	79.4			
Dry Density (pcf)	53.0			
Saturation (%)	100.0			
Void Ratio	2.065			
Diameter (in)	2.85			
Height (in)	6.04			
Cell Pressure (psi)	86.8			
Back Pressure (psi)	80.3			
	Effective Stresses At:			
Strain (%)	5.0			
Deviator (ksf)	3.348			
Excess PP (psi)	2.2			
Sigma 1 (ksf)	3.969			
Sigma 3 (ksf)	0.621			
P (ksf)	2.295			
Q (ksf)	1.674			
Stress Ratio	6.396			
Rate (in/min)	0.0005			

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767



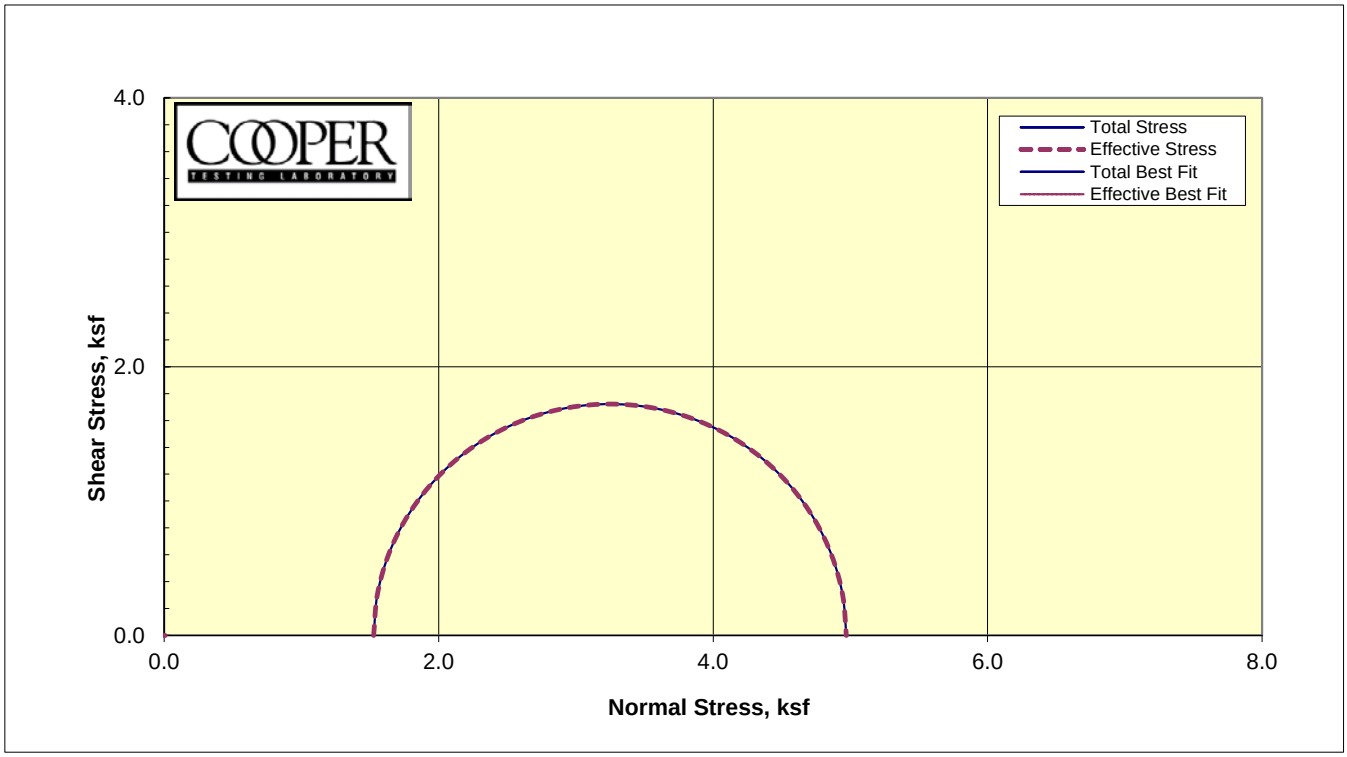


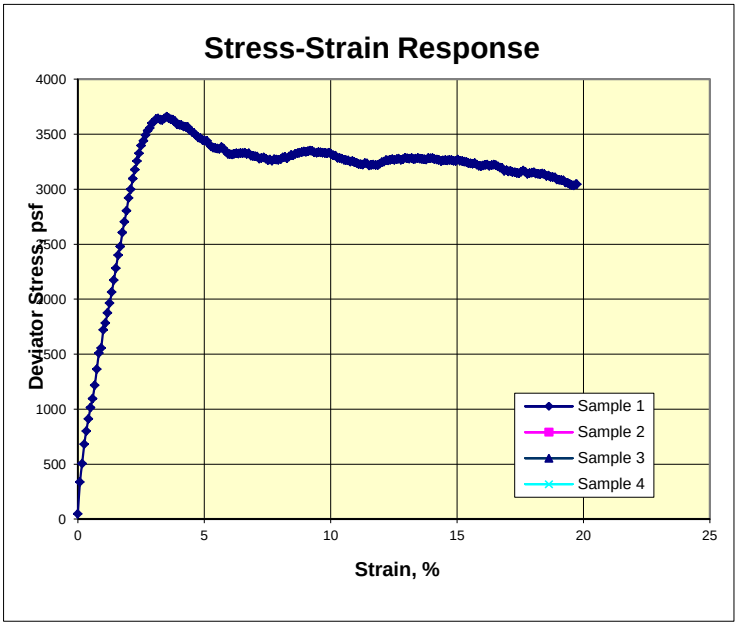
CTL Number:	020-251
Client Name:	AECOM
Project Name:	Klamath River Dam Removal Project
Project Number:	60537920
Date:	6/6/2018 By: MD/DC
Total C	#DIV/0! ksf
Total phi	#DIV/0! degrees
Eff. C	#DIV/0! ksf
Eff. Phi	#DIV/0! degrees ©

Specimen	1	2	3	4
Boring	BC-09	BC-09		
Sample	S-09	S-09		
Depth	68-70.5(Tip-10")	68-70.5(Tip-4")		
Visual Description	Dark Greenish Gray CLAY (Silty)/ SILT (slightly plastic)	Dark Greenish Gray CLAY (Silty)/ SILT (slightly plastic)		
MC (%)	92.0	95.5		
Dry Density (pcf)	47.2	46.1		
Saturation (%)	98.2	98.5		
Void Ratio	2.436	2.520		
Diameter (in)	2.87	2.87		
Height (in)	6.06	6.06		
	Final			
MC (%)	90.6	93.7		
Dry Density (pcf)	48.4	47.2		
Saturation (%)	100.0	100.0		
Void Ratio	2.355	2.436		
Diameter (in)	2.84	2.85		
Height (in)	6.03	6.02		
Cell Pressure (psi)	94.2	94.1		
Back Pressure (psi)	80.1	79.7		
	Effective Stresses At:			
Strain (%)	5.0	5.0		
Deviator (ksf)	4.134	4.387		
Excess PP (psi)	9.1	9.6		
Sigma 1 (ksf)	4.860	5.084		
Sigma 3 (ksf)	0.726	0.697		
P (ksf)	2.793	2.891		
Q (ksf)	2.067	2.194		
Stress Ratio	6.693	7.293		
Rate (in/min)	0.0005	0.0005		

Triaxial Unconsolidated-Undrained

(ASTM D2850m)





Sample:	1	2	3	4
MC, %	160.5			
Dry Dens, pcf	30.5			
Sat. %	95.9			
Void Ratio	4.519			
Diameter in	2.87			
Height, in	6.08			
	Final			
MC, %	163.5			
Dry Dens, pcf	31.1			
Sat. %	100.0			
Void Ratio	4.414			
Diameter, in	2.84			
Height, in	6.08			
Cell, psi	49.1			
BP, psi	38.5			
	Effective Stresses At:			
Strain, %	5.0			
Deviator ksf	3.444			
Excess PP	0.000			
Sigma 1	4.970			
Sigma 3	1.526			
P, ksf	3.248			
Q, ksf	1.722			
Stress Ratio	3.256			
Rate in/min	0.0588			
Total C	N/A	ksf		
Total Phi	N/A	Degrees		
Eff. C	N/A	ksf		
Eff. Phi	N/A	Degrees		

Job No.: 020-251 **Date:** 5/24/2018

Client: AECOM BY:MD/DC

Project: 60537920

Sample 1) BC-04_S-10 @ 52.5(Tip-18") Bluish Gray CLAY (Silty)

Sample 2)

Sample 3)

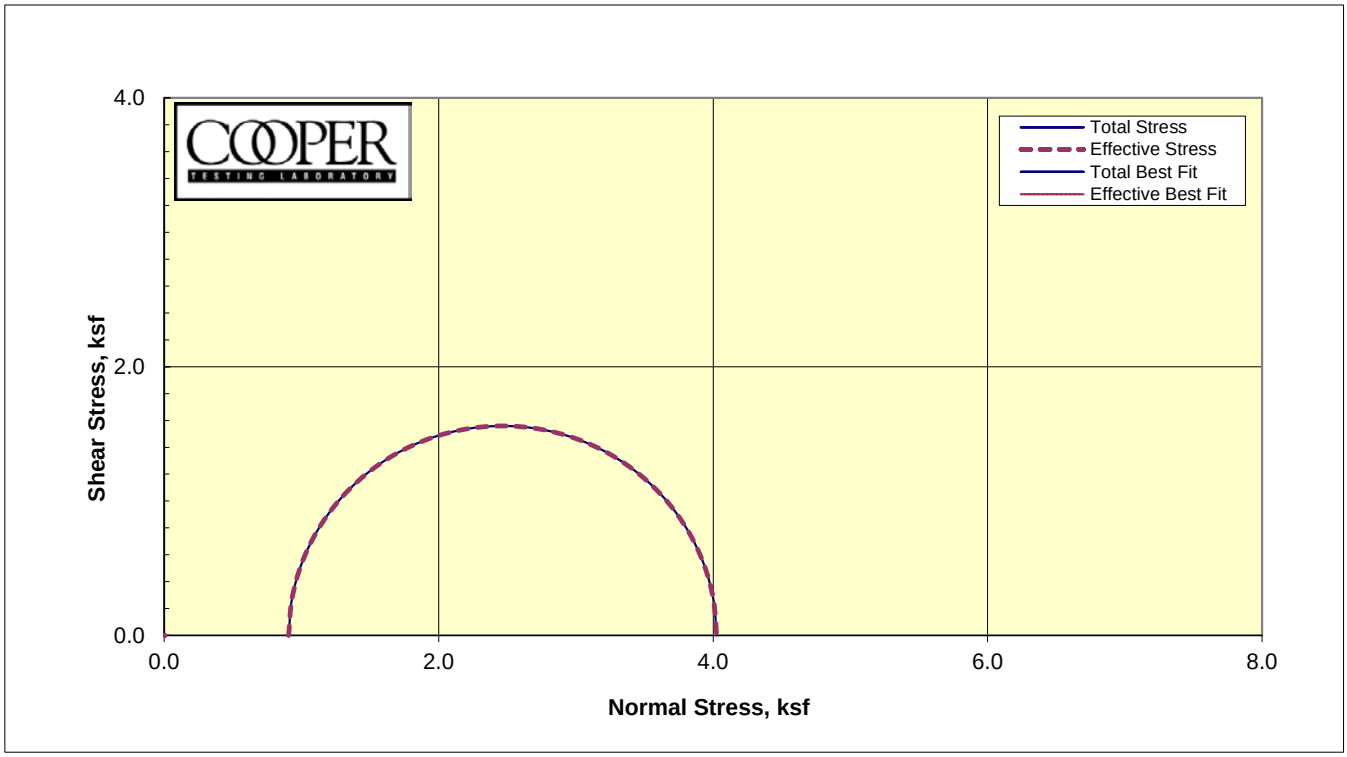
Sample 4)

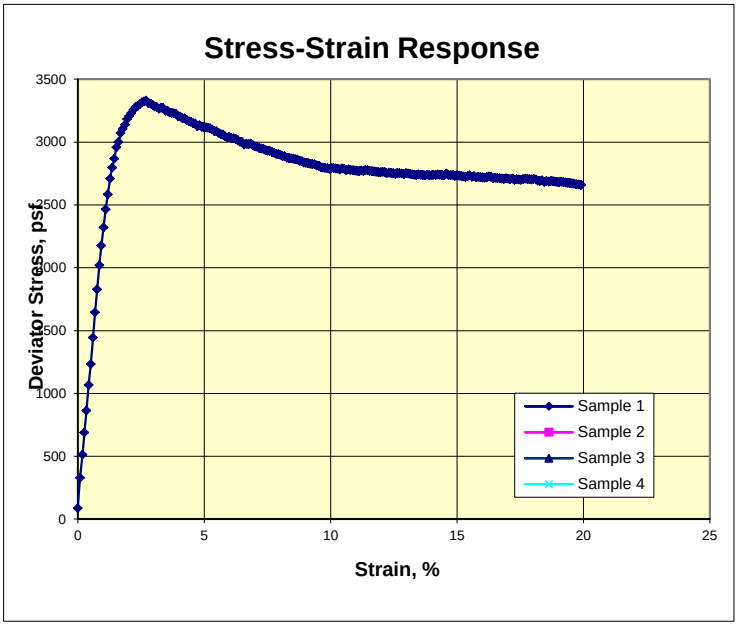
REMARKS: Strengths picked at 5% strain.

*Sample was back-pressure saturated prior to shear.

Triaxial Unconsolidated-Undrained

(ASTM D2850m)





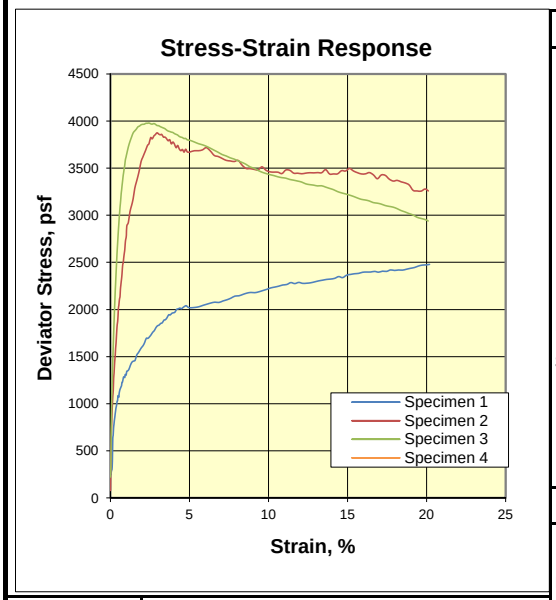
Sample:	1	2	3	4
MC, %	76.3			
Dry Dens, pcf	54.0			
Sat. %	97.1			
Void Ratio	2.121			
Diameter in	2.87			
Height, in	6.05			
	Final			
MC, %	76.6			
Dry Dens, pcf	54.9			
Sat. %	100.0			
Void Ratio	2.068			
Diameter, in	2.85			
Height, in	6.03			
Cell, psi	54.8			
BP, psi	48.5			
	Effective Stresses At:			
Strain, %	5.0			
Deviator ksf	3.118			
Excess PP	0.000			
Sigma 1	4.025			
Sigma 3	0.907			
P, ksf	2.466			
Q, ksf	1.559			
Stress Ratio	4.437			
Rate in/min	0.0588			
Total C	N/A	ksf		
Total Phi	N/A	Degrees		
Eff. C	N/A	ksf		
Eff. Phi	N/A	Degrees		

Job No.:	020-251	**Date:**	5/25/2018
Client:	AECOM		BY:MD/DC
Project:	60537920		
Sample 1)	BC-09_S-05 @ 23(Tip-13") Dark Gray Elastic SILT		
Sample 2)			
Sample 3)			
Sample 4)			

REMARKS: Strengths picked at 5% strain.
*Sample was back-pressure saturated prior to shear.

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767





CTL Number:	020-232
Client Name:	AECOM
Project Name:	Klamath
Project Number:	60537920
Date:	9/25/2017 By: MD/DC
Total C	0.470 ksf
Total phi	17.2 degrees
Eff. C	0.470 ksf
Eff. Phi	28.4 degrees ©

Remarks: The sample was delivered as singular 13" x 16" block. The specimens were trimmed into a brass tube 2" x 4". The orientation of the outcrop block was unknown. All samples were trimmed in the same approximate orientation. The material is highly structured and cemented. It disperses when exposed to water. All three specimens behaved differently during shear.

Specimen	1	2	3	4
Boring	Outcrop #1	Outcrop #1	Outcrop #1	
Sample				
Depth				
Visual Description	Pale Brown Siltstone (Diatomite)	Pale Brown Siltstone (Diatomite)	Pale Brown Siltstone (Diatomite)	
MC (%)	8.2	7.1	5.9	
Dry Density (pcf)	53.1	56.9	58.0	
Saturation (%)	10.2	9.7	8.4	
Void Ratio	2.176	1.961	1.907	
Diameter (in)	1.86	1.86	1.85	
Height (in)	4.00	4.00	4.00	
	Final			
MC (%)	78.4	73.5	71.9	
Dry Density (pcf)	54.1	56.5	57.3	
Saturation (%)	100.0	100.0	100.0	
Void Ratio	2.116	1.984	1.942	
Diameter (in)	1.85	1.87	1.87	
Height (in)	3.96	3.98	3.98	
Cell Pressure (psi)	124.0	135.0	144.9	
Back Pressure (psi)	119.7	119.8	120.4	
	Effective Stresses At:			
Strain (%)	2.0	2.0	2.0	
Deviator (ksf)	1.596	3.571	3.959	
Excess PP (psi)	3.5	10.2	14.0	
Sigma 1 (ksf)	1.708	4.282	5.488	
Sigma 3 (ksf)	0.111	0.712	1.529	
P (ksf)	0.909	2.497	3.509	
Q (ksf)	0.798	1.785	1.980	
Stress Ratio	15.338	6.018	3.589	
Rate (in/min)	0.0003	0.0003	0.0003	

POINT LOAD TEST RESULTS
BI-02 and BI-03

Test Number	Test Order	Depth of Test	Boring Number	Date	Depth Interval		Rock Type[1]	Diameter (D)		Distance Between Contact Points (cm)	Distance Between Contact Points (in)	Length - Contact Points to End of Sample, L (in)	L/D[2]	Test Type[3]	Failure Load, P (kN)[4]	Uncorrected Point Load, I_S (Mpa)[5]	Size Correction Factor, F[6]	Point Load, $I_{S(50)}$ (MPa)[7]	Uniaxial Compressive Strength, s_c (Mpa)[8]	Uniaxial Compressive Strength, psi	Weathering	Notes
					Bottom	Top		(mm)	(in)													
BI02-1-22.1	1	22.1	BI-02	4/11/2018	22.6	21.9	Volcanic Breccia	59.94	2.36	6.00	2.36	1.97	0.83	d	0.51	0.14	1.09	0.15	3	504	MW/SW	Bottom 3.5" broke on preexisting fracture plane prior to test. Sample broke on preexisting fracture plane during testing.
BI02-2-28.2	2	28.2	BI-02	4/11/2018	28.6	27.9	Volcanic Breccia	59.94	2.36	6.00	2.36	3.54	1.50	d	1.99	0.55	1.09	0.60	14	1968	MW/SW	Fractured between platens (see photo)
BI02-3-32.8	3	32.8	BI-02	4/11/2018	33.4	32.2	Volcanic Breccia	59.94	2.36	6.00	2.36	7.01	2.97	d	2.59	0.72	1.09	0.78	18	2561	MW/SW	Fractured between platens (see photo). Other breaks from rock core falling on table after testing.
BI02-4-37.4	4	37.4	BI-02	4/11/2018	37.7	37.2	Volcanic Breccia	59.94	2.36	6.00	2.36	2.68	1.13	d	2.53	0.70	1.09	0.76	17	2502	MW/SW	Fractured between platens (see photo)
BI02-5-42.8	5	42.8	BI-02	4/11/2018	43.1	42.5	Volcanic Breccia	59.94	2.36	6.00	2.36	3.86	1.63	d	2.00	0.56	1.09	0.60	14	1978	MW/SW	Fractured between platens (see photo). 1" long fracture propagated along the length of sample from the point load application.
BI02-7-55	7	55.0	BI-02	4/11/2018	55.4	54.7	Volcanic Breccia	59.94	2.36	6.00	2.36	3.74	1.58	d	1.41	0.39	1.09	0.43	10	1394	MW/SW	Fractured between platens (see photo). Platen penetrated into rock 3mm at failure.
BI02-8-57.3	8	57.3	BI-02	4/11/2018	57.6	57.0	Volcanic Breccia	59.94	2.36	6.00	2.36	3.23	1.37	d	1.5-2.0		1.09				MW/SW	Peak load not recorded. One of the broken halfs was retested in test BI02-9-57.1.
BI02-9-57.1	9	57.1	BI-02	4/11/2018	57.6	57.0	Volcanic Breccia	59.94	2.36	6.00	2.36	1.69	0.72	d	1.80	0.50	1.09	0.54	12	1780	MW/SW	Fractured between platens (see photo)
BI02-10-64.2	10	64.2	BI-02	4/11/2018	64.7	63.7	Volcanic Breccia	59.94	2.36	6.00	2.36	6.10	2.59	d	1.05	0.29	1.09	0.32	7	1038	MW/SW	Fractured between platens (see photo)
BI03-11-10.3	11	10.3	BI-03	4/11/2018	10.5	10.1	Volcanic Breccia	59.94	2.36	6.00	2.36	2.17	0.92	d	0.60	0.17	1.09	0.18	4	593	MW	Fractured between platens (see photo)
BI03-12-17.2	12	17.2	BI-03	4/11/2018	17.4	17.0	Volcanic Breccia	59.94	2.36	6.00	2.36	2.17	0.92	d	0.56	0.16	1.09	0.17	4	554	MW	Fractured between platens (see photo)
BI03-13-21.3	13	21.3	BI-03	4/11/2018	21.5	21.0	Volcanic Breccia	59.94	2.36	6.00	2.36	2.56	1.08	d	0.76	0.21	1.09	0.23	5	752	MW	Fractured between platens (see photo)
BI03-14-29.8	14	29.8	BI-03	4/11/2018	30.1	29.5	Volcanic Breccia	59.94	2.36	6.00	2.36	3.54	1.50	d	0.73	0.20	1.09	0.22	5	722	MW	Fractured between platens (see photo)
BI03-15-32.7	15	32.7	BI-03	4/11/2018	33.5	32.0	Volcanic Breccia	59.94	2.36	6.00	2.36	8.58	3.64	d	0.77	0.21	1.09	0.23	5	761	MW	Fractured between platens (see photo)

Notes:

[1] Based on Drill Logs
[2] ASTM D5731 calls for L/D > 0.5 for diametral test.
[3] d = diametral, a = axial, b = block, ir = irregular lump
[4] Reading from testing apparatus
[5] $I_S = P/D^2$ (ASTM D5731 - for diametral test)
[6] $F = (D/50)^{0.45}$ (ASTM D5731 - for diametral test)
[7] $I_{S(50)} = I_S \times F$ (ASTM D5731)
[8] $s_c = I_S \times K$; I_s is uncorrected point load index; K=24.5 for ~60 mm diameter cores (ASTM D5731)

F	Fresh
SW	Slightly Weathered
MW	Moderately Weathered
HW	Highly Weathered
CW	Completely Weathered

Point Load Strength Test

ASTM D 5731 - 08

COMPANY WITH QUALITY SYSTEM CERTIFIED BY DNV GL = ISO 9001 =

Tonon USA
Engineering, Measurements and Testing, LLC

Web: tononeng.com

Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-1
Report Date	5/17/2018
Drill Hole and Depth	BI-02; 48.9-50.3 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date Received: 4/24/2018	Date Opened: 4/24/2018	Date Tested: 4/30/2018

Distance, D		Load, P		Corrected Point Load Index $(D/50)^{0.45}$ P/D^2		Direction of Loading	
mm	in	kN	lbf	MPa	psi	A	B
60.86	2.40	0.74	166.352	0.22	31.66	1	
62.20	2.45	1.65	370.92	0.47	68.24		1
47.58	1.87	0.98	220.304	0.42	61.40	1	
79.15	3.12	3.23	726.104	0.63	91.95		1
82.44	3.25	3.00	674.4	0.55	80.18		1
39.71	1.56	0.86	193.328	0.49	71.31	1	

Average Point Load Strength in Direction A	0.38 MPa	54.79 psi
Average Point Load Strength in Direction B	0.55 MPa	80.12 psi

Point Load Strength Anisotropy Index
1.46

A = Parallel to core axis

B = Orthogonal to core axis

Performed by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

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E-mail: fulvio@tononeng.com

Uniaxial Compression Test without Stress-Strain Curves and Moduli
ASTM D7012 - 14e1

COMPANY WITH QUALITY SYSTEM CERTIFIED BY DNV GL = ISO 9001 =

Tonon USA:
Engineering, Measuraments and Testing, LLC

Web: tononeng.com

Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-1-1
Report Date	5/17/2018
Drill hole and Depth	BI-02; 27-27.9 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Stress Rate	0.5 MPa/s	
Diameter of Specimen	60.54 mm	2.38 in
Height of Specimen	97.72 mm	3.85 in
Load at Peak	16.69 kN	3,752 lbf
Unconfined Compressive Strength	5.80 MPa	841 psi
Type of Failure	Non-Structural	

Note: The provided sample had a height-to-diameter ratio less than 2

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/30/2018

Photo Before Test



Photo After Test



Tested by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

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2028 E Ben White BLVD #240-2660
Austin, TX 78741

Laboratory Director: Dr. Fulvio Tonon, P.E., Ph.D.
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Picture of the sample upon arrival at Tonon USA Laboratory: no core piece allowed preparation of a specimen with a height-to-diameter ratio between 2 and 2.5.

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Tonon USA:
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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-1-2
Report Date	5/17/2018
Drill hole and Depth	BI-02; 48.9-50.3 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Stress Rate	0.5 MPa/s	
Diameter of Specimen	60.85 mm	2.40 in
Height of Specimen	127.87 mm	5.03 in
Load at Peak	34.80 kN	7,823 lbf
Unconfined Compressive Strength	11.97 MPa	1,736 psi
Type of Failure	Non-Structural	

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/30/2018

Photo Before Test

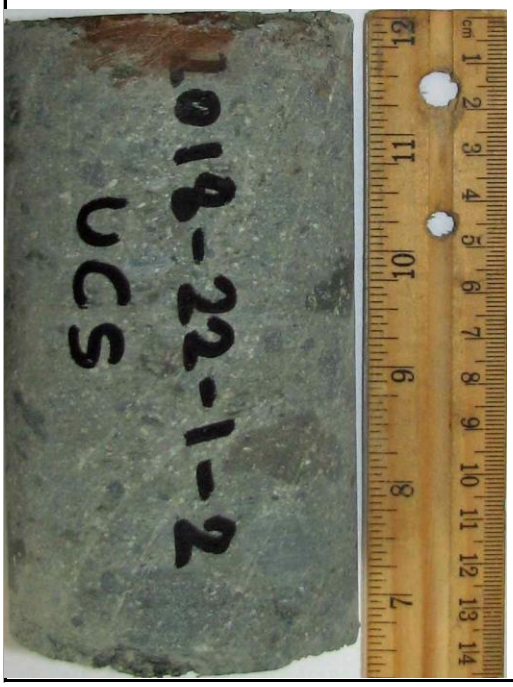

Photo After Test



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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-1-3
Report Date	5/17/2018
Drill hole and Depth	BI-02; 55.4-56.3 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Stress Rate	0.5 MPa/s	
Diameter of Specimen	60.68 mm	2.39 in
Height of Specimen	128.33 mm	5.05 in
Load at Peak	45.59 kN	10,248 lbf
Unconfined Compressive Strength	15.77 MPa	2,288 psi
Type of Failure	Non-Structural	

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/30/2018

Photo Before Test

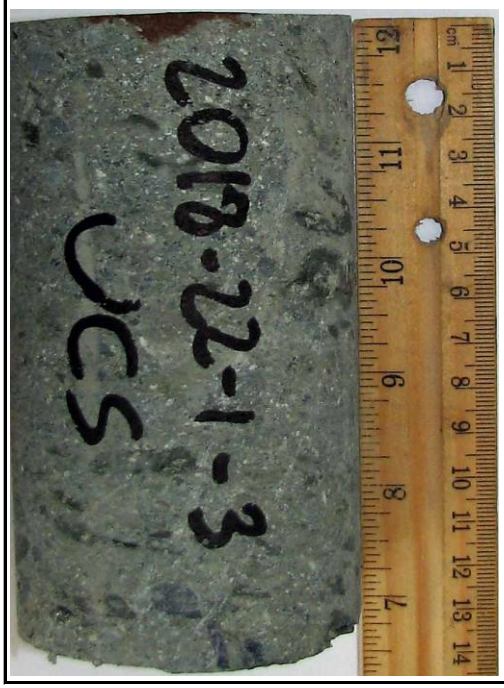
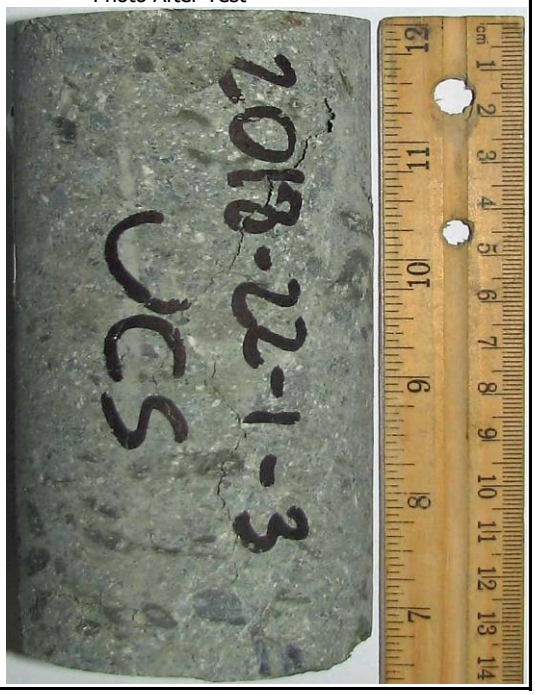


Photo After Test



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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-1-4
Report Date	5/17/2018
Drill hole and Depth	BI-03; 17.4-18.4 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Stress Rate	0.5 MPa/s	
Diameter of Specimen	60.59 mm	2.39 in
Height of Specimen	129.81 mm	5.11 in
Load at Peak	4.39 kN	987 lbf
Unconfined Compressive Strength	1.52 MPa	221 psi
Type of Failure	Non-Structural	

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 5/4/2018

Photo Before Test



Photo After Test



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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-1-5
Report Date	5/17/2018
Drill hole and Depth	BI-03; 21.5-22.9 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Stress Rate	0.5 MPa/s	
Diameter of Specimen	60.58 mm	2.39 in
Height of Specimen	125.67 mm	4.95 in
Load at Peak	6.99 kN	1,571 lbf
Unconfined Compressive Strength	2.43 MPa	352 psi
Type of Failure	Non-Structural	

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/30/2018

Photo Before Test

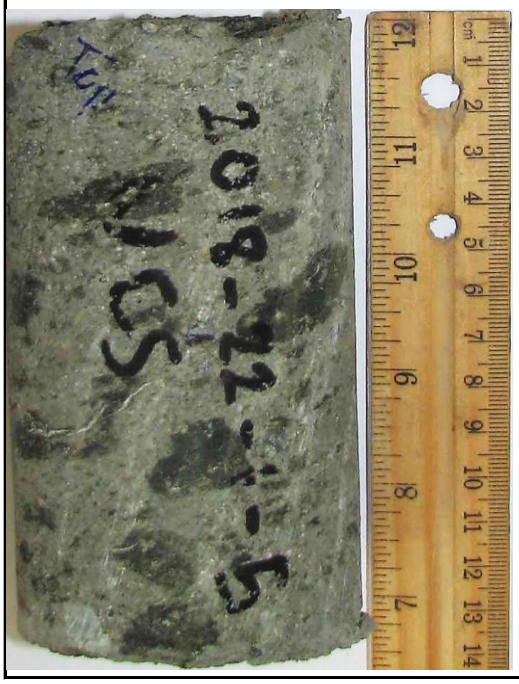
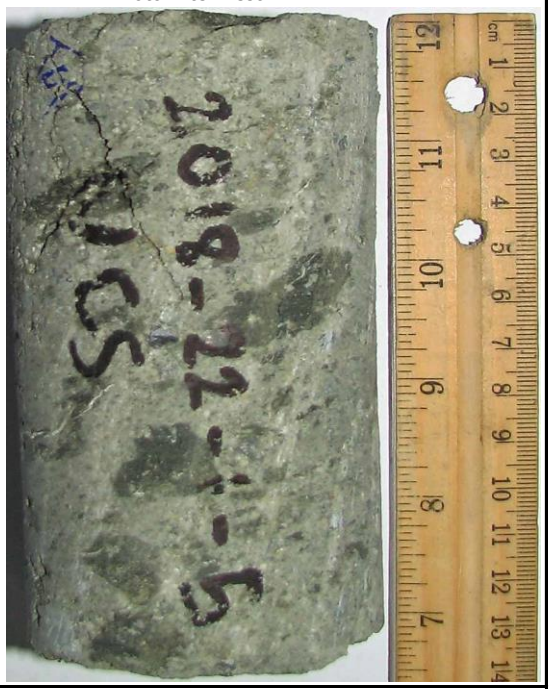


Photo After Test



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Brazilian Tensile Strength Test

ASTM D3967 - 16

COMPANY WITH QUALITY SYSTEM CERTIFIED BY DNV GL = ISO 9001 =

Tonon USA:
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Web: tononeng.com

Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-2-1
Report Date	5/17/2018
Drill Hole and Depth	BI-02; 47-48.9 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Rate of loading (0.05-0.35 MPa/s or 500-3,000 psi/min)	0.11 MPa/sec	957 psi/min
Diameter (D)	60.94 mm	2.40 in
Thickness (t)	22.88 mm	0.90 in
Maximum Load (P)	6.53 kN	1,468 lbf
Tensile strength (flat platens) $\sigma_t = 2P/\pi tD$	N/A	N/A
Tensile strength (curved platens) $\sigma_t = 1.272P/\pi tD$	1.90 MPa	275 psi
Direction of Loading	Orthogonal to the Borehole Axis	
Type of Failure	Non-Structural	
Conformance to dimensional Requirements $0.2 \le \frac{t}{D} \le 0.75$	$\frac{t}{D} =$ 0.38	OK

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/30/2018

Photo Before Test



Photo After Test



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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-2-2
Report Date	5/17/2018
Drill Hole and Depth	BI-02; 52-54.7 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Rate of loading (0.05-0.35 MPa/s or 500-3,000 psi/min)	0.11 MPa/sec	957 psi/min
Diameter (D)	60.84 mm	2.40 in
Thickness (t)	24.67 mm	0.97 in
Maximum Load (P)	5.25 kN	1,180 lbf
Tensile strength (flat platens) $\sigma_t = 2P/\pi tD$	N/A	N/A
Tensile strength (curved platens) $\sigma_t = 1.272P/\pi tD$	1.42 MPa	206 psi
Direction of Loading	Orthogonal to the Borehole Axis	
Type of Failure	Non-Structural	
Conformance to dimensional Requirements $0.2 \le \frac{t}{D} \le 0.75$	$\frac{t}{D} =$ 0.41	OK

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/30/2018

Photo Before Test



Photo After Test



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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-2-3
Report Date	5/17/2018
Drill Hole and Depth	BI-03; 18.4-20.1 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Rate of loading (0.05-0.35 MPa/s or 500-3,000 psi/min)	0.11 MPa/sec	957 psi/min
Diameter (D)	60.74 mm	2.39 in
Thickness (t)	26.84 mm	1.06 in
Maximum Load (P)	1.51 kN	339 lbf
Tensile strength (flat platens) $\sigma_t = 2P/\pi tD$	N/A	N/A
Tensile strength (curved platens) $\sigma_t = 1.272P/\pi tD$	0.38 MPa	54 psi
Direction of Loading	Orthogonal to the Borehole Axis	
Type of Failure	Non-Structural	
Conformance to dimensional Requirements $0.2 \le \frac{t}{D} \le 0.75$	$\frac{t}{D} =$ 0.44	OK

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/30/2018

Photo Before Test



Photo After Test



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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-2-4
Report Date	5/17/2018
Drill Hole and Depth	BI-03; 22.9-24.2 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Rate of loading (0.05-0.35 MPa/s or 500-3,000 psi/min)	0.11 MPa/sec	957 psi/min
Diameter (D)	60.26 mm	2.37 in
Thickness (t)	33.83 mm	1.33 in
Maximum Load (P)	0.55 kN	124 lbf
Tensile strength (flat platens) $\sigma_t = 2P/\pi tD$	N/A	N/A
Tensile strength (curved platens) $\sigma_t = 1.272P/\pi tD$	0.11 MPa	16 psi
Direction of Loading	Orthogonal to the Borehole Axis	
Type of Failure	Non-Structural	
Conformance to dimensional Requirements $0.2 \le \frac{t}{D} \le 0.75$	$\frac{t}{D} =$ 0.56	OK

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/30/2018

Photo Before Test



Photo After Test



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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-3-1
Report Date	5/17/2018
Drill Hole and Depth (ft)	BI-02; 27-27.9 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date Received: 4/24/2018	Date Opened: 4/24/2018	Date Tested: 4/30/2018

Diameter	Length	Weight	Bulk Density	Bulk Density
(mm)	(mm)	(g)	(kN/m^3)	(pcf)
60.54	97.72	637.28	22.22	141.42

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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-3-2
Report Date	5/17/2018
Drill Hole and Depth (ft)	BI-02; 48.9-50.3 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date Received: 4/24/2018	Date Opened: 4/24/2018	Date Tested: 4/30/2018

Diameter	Length	Weight	Bulk Density	Bulk Density
(mm)	(mm)	(g)	(kN/m^3)	(pcf)
60.85	127.87	891.59	23.51	149.67

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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-3-3
Report Date	5/17/2018
Drill Hole and Depth (ft)	BI-02; 55.4-56.3 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date Received: 4/24/2018	Date Opened: 4/24/2018	Date Tested: 4/30/2018

Diameter	Length	Weight	Bulk Density	Bulk Density
(mm)	(mm)	(g)	(kN/m^3)	(pcf)
60.68	128.33	882.58	23.32	148.46

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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-3-4
Report Date	5/17/2018
Drill Hole and Depth (ft)	BI-03; 17.4-18.4 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date Received: 4/24/2018	Date Opened: 4/24/2018	Date Tested: 4/30/2018

Diameter	Length	Weight	Bulk Density	Bulk Density
(mm)	(mm)	(g)	(kN/m^3)	(pcf)
60.59	129.81	830.07	21.75	138.44

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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-3-5
Report Date	5/17/2018
Drill Hole and Depth (ft)	BI-03; 21.5-22.9 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date Received: 4/24/2018	Date Opened: 4/24/2018	Date Tested: 4/30/2018

Diameter	Length	Weight	Bulk Density	Bulk Density
(mm)	(mm)	(g)	(kN/m^3)	(pcf)
60.58	125.67	783.13	21.20	134.96

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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-4-1
Report Date	5/17/2018
Drill Hole and Depth	BI-02; 27-27.9 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date Received: 4/24/2018	Date Opened: 4/24/2018	Date Tested: 4/27-30/2018

Method A: Caliper

Diameter (mm)	Length (mm)	Initial Weight (g)	Dry Weight (g)
		202.50	193.13

Moisture Content (%)	**Unit Weight (kN/m^3)**	**Unit Weight (pcf)**	**Dry Unit Weight (kN/m^3)**	**Dry Unit Weight (pcf)**
4.85				

Method B: Buoyancy

Weight (g)	Saturated Weight (g)	Suspended Weight (g)	Dry Weight (g)

Moisture Content (%)	**Unit Weight (kN/m^3)**	**Unit Weight (pcf)**	**Dry Unit Weight (kN/m^3)**	**Dry Unit Weight (pcf)**

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Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-4-2
Report Date	5/17/2018
Drill Hole and Depth	BI-02; 48.9-50.3 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date Received: 4/24/2018	Date Opened: 4/24/2018	Date Tested: 4/27-30/2018

Method A: Caliper

Diameter (mm)	Length (mm)	Initial Weight (g)	Dry Weight (g)
		180.47	169.63

Moisture Content (%)	**Unit Weight (kN/m^3)**	**Unit Weight (pcf)**	**Dry Unit Weight (kN/m^3)**	**Dry Unit Weight (pcf)**
6.39				

Method B: Buoyancy

Weight (g)	Saturated Weight (g)	Suspended Weight (g)	Dry Weight (g)

Moisture Content (%)	**Unit Weight (kN/m^3)**	**Unit Weight (pcf)**	**Dry Unit Weight (kN/m^3)**	**Dry Unit Weight (pcf)**

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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-4-3
Report Date	5/17/2018
Drill Hole and Depth	BI-02; 55.4-56.3 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date Received: 4/24/2018	Date Opened: 4/24/2018	Date Tested: 4/27-30/2018

Method A: Caliper

Diameter (mm)	Length (mm)	Initial Weight (g)	Dry Weight (g)
		175.36	165.73

Moisture Content (%)	**Unit Weight (kN/m^3)**	**Unit Weight (pcf)**	**Dry Unit Weight (kN/m^3)**	**Dry Unit Weight (pcf)**
5.81				

Method B: Buoyancy

Weight (g)	Saturated Weight (g)	Suspended Weight (g)	Dry Weight (g)

Moisture Content (%)	**Unit Weight (kN/m^3)**	**Unit Weight (pcf)**	**Dry Unit Weight (kN/m^3)**	**Dry Unit Weight (pcf)**

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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-4-4
Report Date	5/17/2018
Drill Hole and Depth	BI-03; 17.4-18.4 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date Received: 4/24/2018	Date Opened: 4/24/2018	Date Tested: 4/27-30/2018

Method A: Caliper

Diameter (mm)	Length (mm)	Initial Weight (g)	Dry Weight (g)
		84.27	74.93

Moisture Content (%)	**Unit Weight (kN/m^3)**	**Unit Weight (pcf)**	**Dry Unit Weight (kN/m^3)**	**Dry Unit Weight (pcf)**
12.46				

Method B: Buoyancy

Weight (g)	Saturated Weight (g)	Suspended Weight (g)	Dry Weight (g)

Moisture Content (%)	**Unit Weight (kN/m^3)**	**Unit Weight (pcf)**	**Dry Unit Weight (kN/m^3)**	**Dry Unit Weight (pcf)**

Performed by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

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2028 E Ben White BLVD #240-2660
Austin, TX 78741

Laboratory Director: Dr. Fulvio Tonon, P.E., Ph.D.
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E-mail: fulvio@tononeng.com

Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-4-5
Report Date	5/17/2018
Drill Hole and Depth	BI-03; 21.5-22.9 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date Received: 4/24/2018	Date Opened: 4/24/2018	Date Tested: 4/27-30/2018

Method A: Caliper

Diameter (mm)	Length (mm)	Initial Weight (g)	Dry Weight (g)
		177.06	160.77

Moisture Content (%)	**Unit Weight (kN/m^3)**	**Unit Weight (pcf)**	**Dry Unit Weight (kN/m^3)**	**Dry Unit Weight (pcf)**
10.13				

Method B: Buoyancy

Weight (g)	Saturated Weight (g)	Suspended Weight (g)	Dry Weight (g)

Moisture Content (%)	**Unit Weight (kN/m^3)**	**Unit Weight (pcf)**	**Dry Unit Weight (kN/m^3)**	**Dry Unit Weight (pcf)**

Performed by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

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Laboratory Director: Dr. Fulvio Tonon, P.E., Ph.D.
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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-5-1
Report Date	5/17/2018
Drill Hole and Depth	BI-02; 51.3-51.7 ft
Rock Type	Volcanic Breccia
Formation	N/A
Surface Condition	Cut by Slab Saw

Apparatus, Pin R.-H.	West Cerchar, 55/56	
Direction of Scratch	Perpendicular to Core Axis	
Pin Wear (mm)	0.156	0.145
	0.142	0.124
	0.144	0.133
	0.162	0.129
	0.150	0.140
Average (mm)	0.143	
CAIs	**1.43**	
CAI	**1.89**	
Classification	**Medium Abrasiveness**	

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/30/2018

Photo After Test



Tested by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

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Austin, TX 78741

Laboratory Director: Dr. Fulvio Tonon, P.E., Ph.D.
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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-5-2
Report Date	5/17/2018
Drill Hole and Depth	BI-03; 25.1-26.1 ft
Rock Type	Volcanic Breccia
Formation	N/A
Surface Condition	Cut by Slab Saw

Apparatus, Pin R.-H.	West Cerchar, 55/56	
Direction of Scratch	Perpendicular to Core Axis	
Pin Wear (mm)	0.046	0.037
	0.083	0.069
	0.104	0.090
	0.087	0.098
	0.100	0.093
Average (mm)	0.081	
CAIs	**0.81**	
CAI	**1.28**	
Classification	**Medium Abrasiveness**	

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/30/2018

Photo After Test



Tested by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

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Project Name	Klamath River Dam Removal
Project location	Klamath River
Client	Klamath River Renewal Corporation
Client's Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-7-1
Report Date	5/17/2018
Borehole and Depth	BI-02; 51.7-52 ft
Studied by	Lidia Scavo and Fulvio Tonon
Reviewed by	Gloria Tonon-Kozma

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 5/17/2018

A sample from borehole BI-02; 51.7-52 ft was analyzed under the polarized microscope to determine its mineralogical composition from a 25 X 40 mm (0.9 X 1.58 in) thin section.

Visual inspection of the sample suggests an igneous origin.

ROCK NAME: **BRECCIATED-ALTERED BASALT** (according to EN 12670).



Fig. 1 - Aspect of the studied sample (hand specimen).

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Hand specimen – Visual inspection: It is a mafic, greenish and dusty material with a very weak behavior. It is composed of a dark and very fine groundmass with phenocrysts that are millimetric in size, and light to dark colored.

According to the Rock-Color Chart of the Geological Society of America, the groundmass color is Grayish Green (5G 5/2), and the phenocrysts are Grayish Green (10G 4/2) to Light Bluish Gray (5B 7/1).

The rock fizzes under hydrochloric acid, and it can be scratched by a metal tip.

Probable Origin: It is an altered Plagioclase-rich basaltic rock.

Mineralogy: Plagioclase, Clay Minerals, Olivine, Opaque Minerals, Volcanic Glass, Carbonates

Textures: The rock has a porphyric texture with a very fine and dark groundmass, in which there are Plagioclase crystals, rare Olivine crystals, Opaque Minerals, and many alteration Clay Minerals (predominantly Phyllosilicates such as Chlorite).
Plagioclase is the most common mineral phase: crystals are quite large and well zoned. Because of their golden color, clay minerals can be hardly distinguished from the groundmass, except for Chlorite that can be locally seen in amorphous greenish individuals.
Opaque Minerals are mainly made up of Oxides of the Hematite group.
Spotted Carbonates may be also identified.

Alteration and Mineral Suturing Condition: The rock is highly altered: even the largest phenocrysts show traces of intense alteration acted upon by clayey minerals; Plagioclase crystals are intensively fractured. These fractures are commonly filled with secondary clayey material in a "quasi-stylolithic" pattern.

Discontinuities: The rock shows a very pervasive fracture system: many of these fractures have not been filled with secondary mineralization, and they predominantly cross the groundmass. Fractures crossing phenocrysts are instead filled with clay minerals.

Description of Individual Minerals:

Minerals	Mineral Content (%)	Mohs Hardness	Grain Size (mm)	Description and Comments
Plagioclase	33.3	6	1.10	As individual crystals
Chlorite	1.67	2.5	0.05	Very variable in size, alteration single crystals
Oxides	6.67	5.5	0.02-0.8	Spotted Hematite individuals
Glass	50	5	Sub-micrometric	Makes up the groundmass
Clay	8.33	4	Sub-micrometric	Phyllosilicates, unresolvable at a microscopic scale
Weighted Average:		4.2	-	

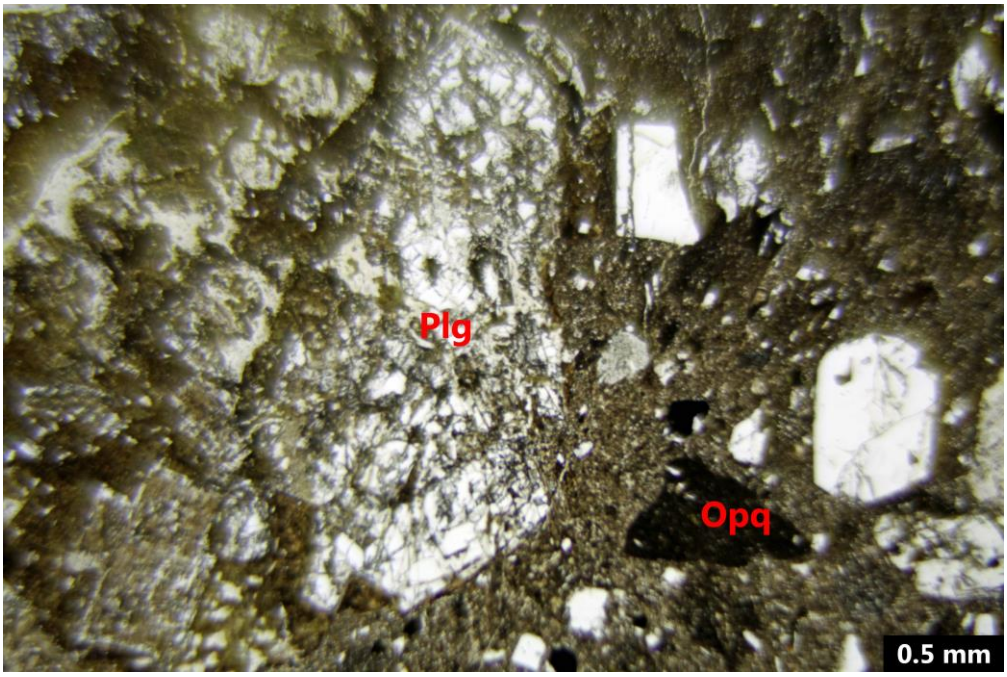

Fig. 2 - Plane polarized light. Field of view = 4 mm wide (magnification 4X). A view of the studied sample, showing an altered Plagioclase (Plg) crystal near to a big Hematite crystal (Opq).

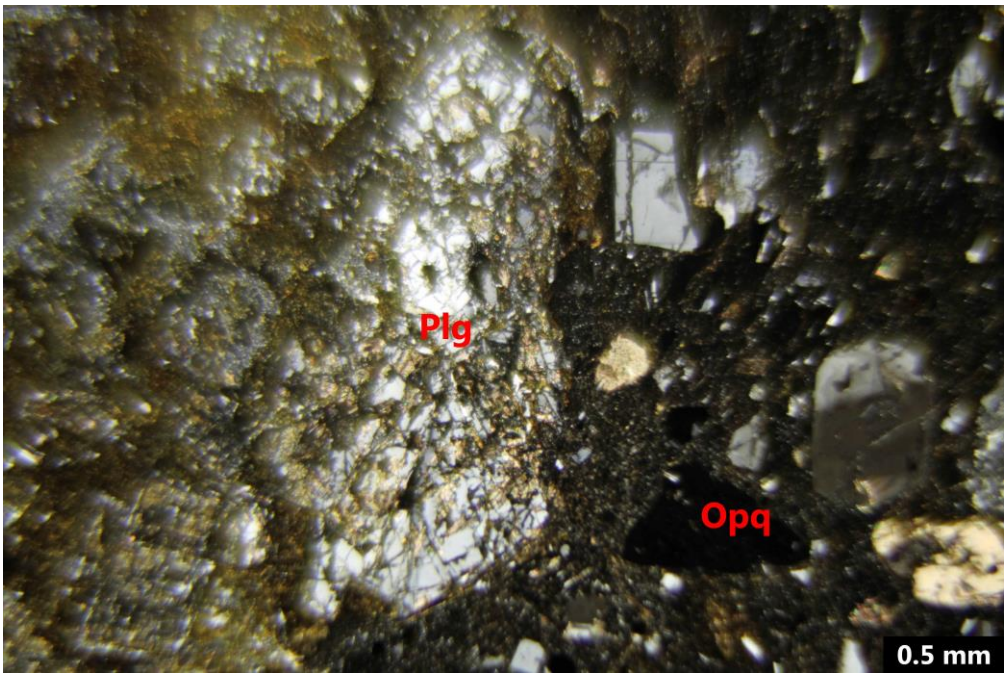

Fig. 3 - Cross polarized light. Field of view = 4 mm wide (magnification 4X). Same as Figure 2, but under crossed polars.

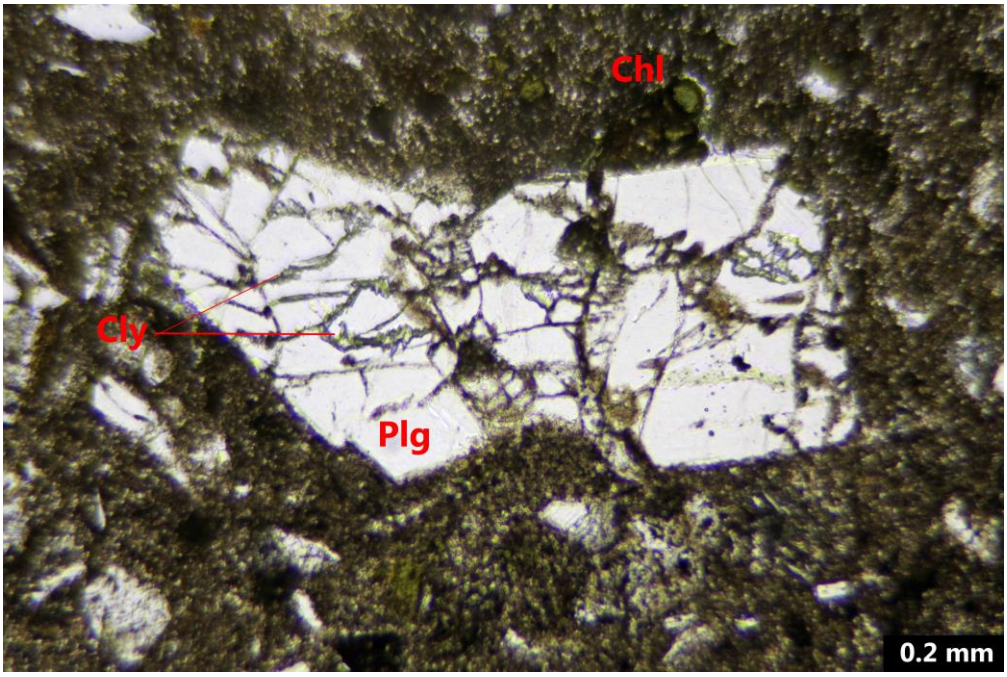

Fig. 4 - Plane polarized light. Field of view = 1.7 mm wide (magnification 10X). A detail of a Plagioclase grain, crossed by many fractures, all filled with Clay Minerals (Cly). Some Chlorite individuals (Chl) may be identified in the upper part of the picture.

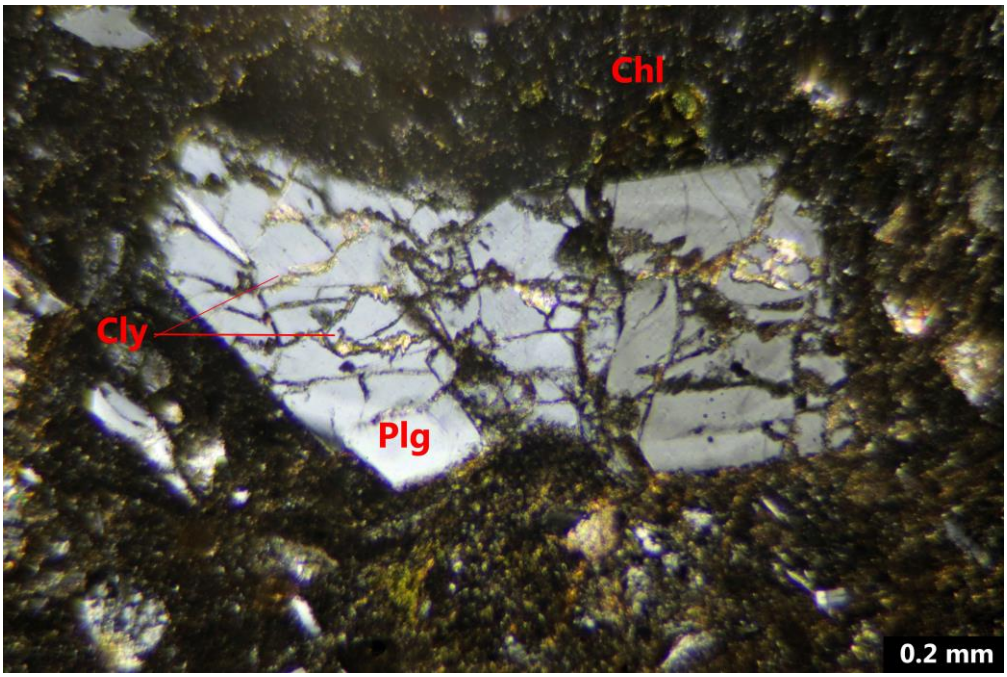

Fig. 5 - Cross polarized light. Field of view = 1.7 mm wide (magnification 10X). Same as Figure 4, but under crossed polars.

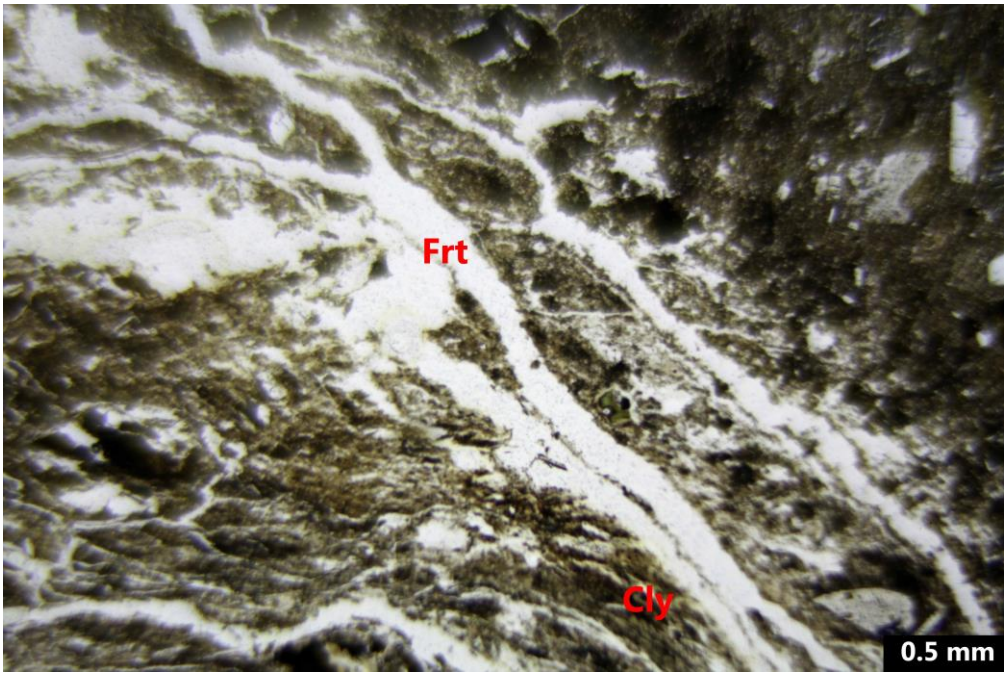

Fig. 6 - Plane polarized light. Field of view = 4 mm wide (magnification 4X). A selected area of the section with a well-developed fracture system (Frt).

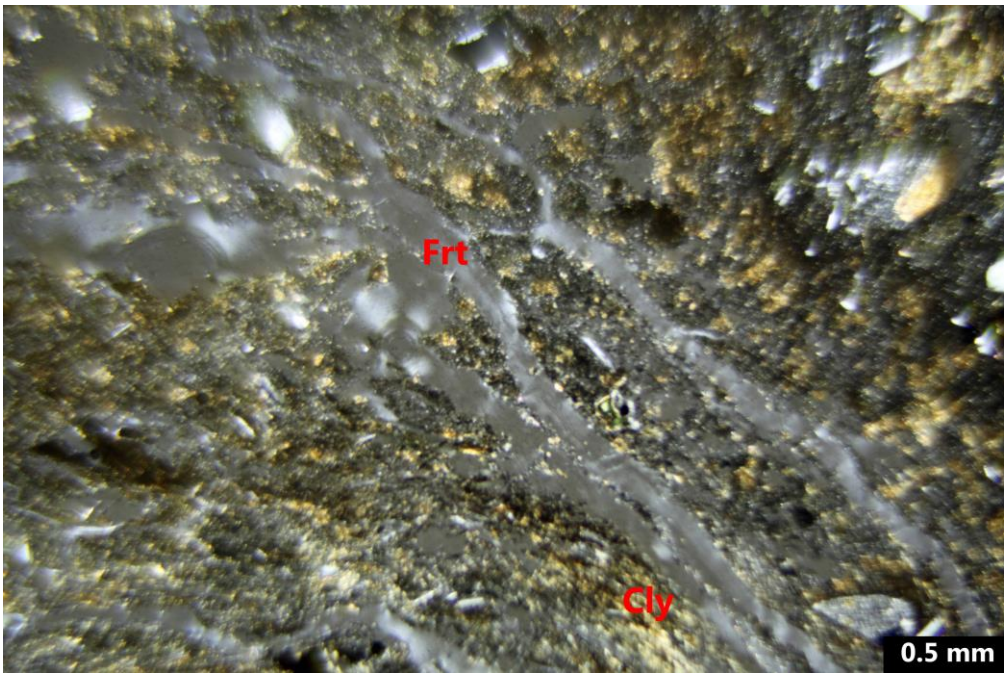

Fig. 7 - Cross polarized light. Field of view = 4 mm wide (magnification 4X). Same as Figure 6, but under crossed polars.

Project Name	Klamath River Dam Removal
Project location	Klamath River
Client	Klamath River Renewal Corporation
Client's Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-7-2
Report Date	5/17/2018
Borehole and Depth	BI-03; 20.8-21 ft
Studied by	Lidia Scavo and Fulvio Tonon
Reviewed by	Gloria Tonon-Kozma

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 5/17/2018

A sample from borehole BI-03; 20.8-21 ft was analyzed under the polarized microscope to determine its mineralogical composition from a 25 X 40 mm (0.9 X 1.58 in) thin section.

Visual inspection of the sample suggests an igneous origin.

ROCK NAME: **ALTERED VOLCANIC BRECCIA** (according to EN 12670).



Fig. 1 - Aspect of the studied sample (hand specimen).

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Hand specimen – Visual inspection: It is a greenish mafic rock. It appears to be very weak, and it shows a dusty appearance. It is composed of a dark green groundmass with spotted whitish to bluish phenocrysts.

According to the Rock-Color Chart of the Geological Society of America, the groundmass color is Grayish Green (5G 5/2); clasts have colors ranging from Dark Greenish Gray (4G 4/1) to Light Bluish Gray (5B 7/1). The matter also shows alterations that are Dark Greenish Yellow (10Y 6/6).

The rock fizzes under hydrochloric acid, and it can be scratched by a metal tip.

Probable Origin: It is an altered volcanic breccia.

Mineralogy: Plagioclase, Volcanic Glass, Pyroxene, Chlorite, Clay Minerals, Opaque Minerals, Carbonates.

Textures: It is a mafic porphyritic rock with a chaotic structure: no preferred orientation may be identified.
Plagioclase is the most common constituent mineral: its crystals range from sub-millimetric in size to glassy and are usually well shaped. Zonation is irregular.
Some of the clasts are made up of extraneous volcanic clasts; they can be easily identified because of their color variation when compared to the rest of the thin section: these clasts display a different mafic content.
Secondary mineral phases are made up of rare Augite-Pyroxene, Chlorite, Carbonates and Opaque Minerals.
Very common, but not resolvable at a microscopic observation scale, are Volcanic Glass and Clay Minerals. Clay Minerals also represent the main alteration substance of the rock, which affects both the groundmass and the clasts.

Alteration and Mineral Suturing Condition: The sample shows a substaintial clayey alteration, with clear Chlorite individuals associated with very fine-grained Clay Minerals. Spotted secondary Carbonates can be found as fracture filling material.
Crystals in this thin section have well defined rims, but they are also affected by pervasive fractures both within the crystals and all around their boundaries.

Discontinuities: The rock is heavily fractured, with two classes of discontinuities: a first one made up of empty cracks crossing the groundmass and the crystals, and a second one made up of Carbonate-filled fractures, sometimes surrounding single crystals or clasts.

Description of Individual Minerals:

Minerals	Mineral Content (%)	Mohs Hardness	Grain Size (mm)	Description and Comments
Plagioclase	28.33	6	0.6	As single individuals or as the main part of many external clast groundmass
Chlorite	1.67	2	0.3	As individuals of secondary crystallization
Opaque Minerals	5	5.5	0.1	Spotted individuals of Hematite
Glass	41.67	5	Sub-micrometric	Makes up the groundmass
Pyroxene	1.67	5.5	0.2	Rare sub-euhedral crystals
Carbonates	5	4	0.06	As fracture filling material
Clay Minerals	16.67	2	Sub-micrometric	Phyllosilicates of secondary alteration
Weighted Average:		4.3	-	

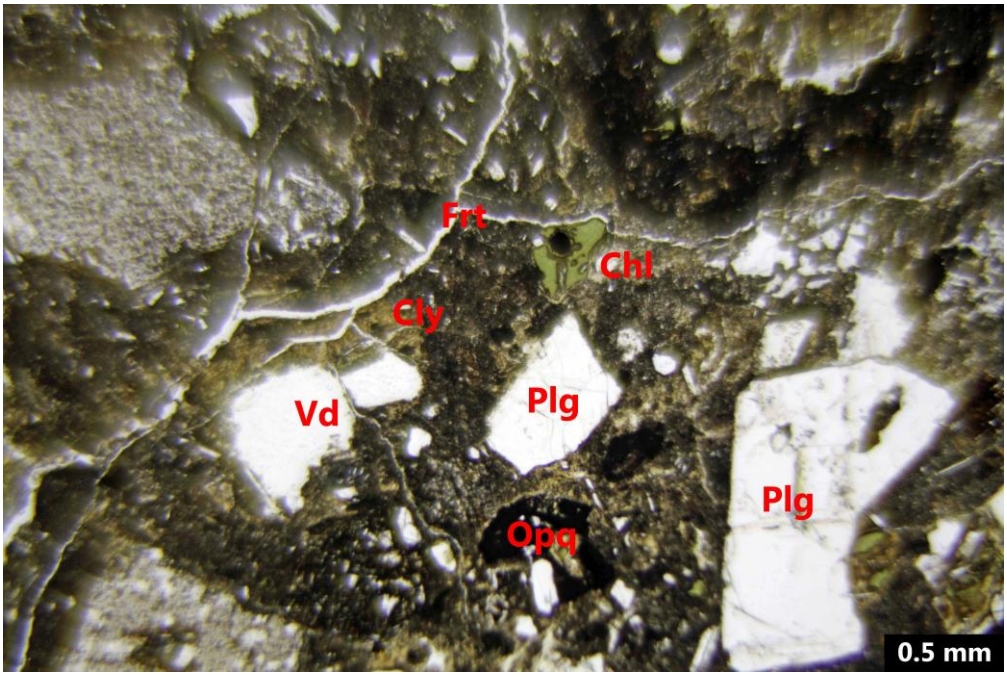

Fig. 2 - Plane polarized light. Field of view = 4 mm wide (magnification 4X). A view of the studied sample. The most common minerals are: Plagioclase (Plg), Clay Minerals (Cly), Opaque Minerals (Opq), and Chlorite (Chl). Also highlighted here are some structural features, such as fractures (Frt) and voids (Vd).

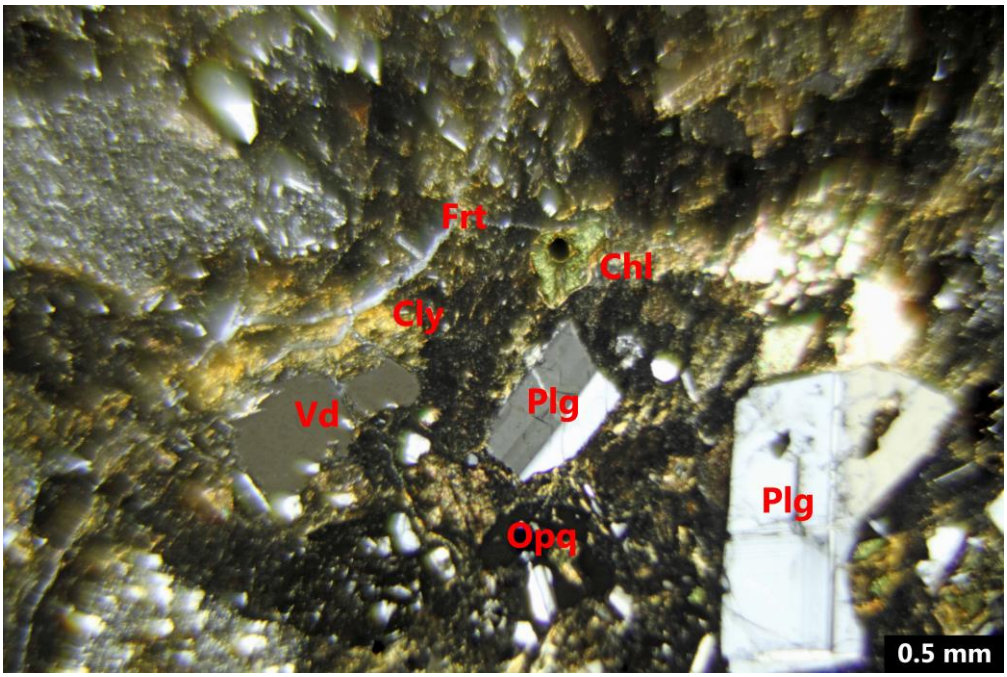

Fig. 3 - Cross polarized light. Field of view = 4 mm wide (magnification 4X). Same as Figure 2, but under crossed polars.

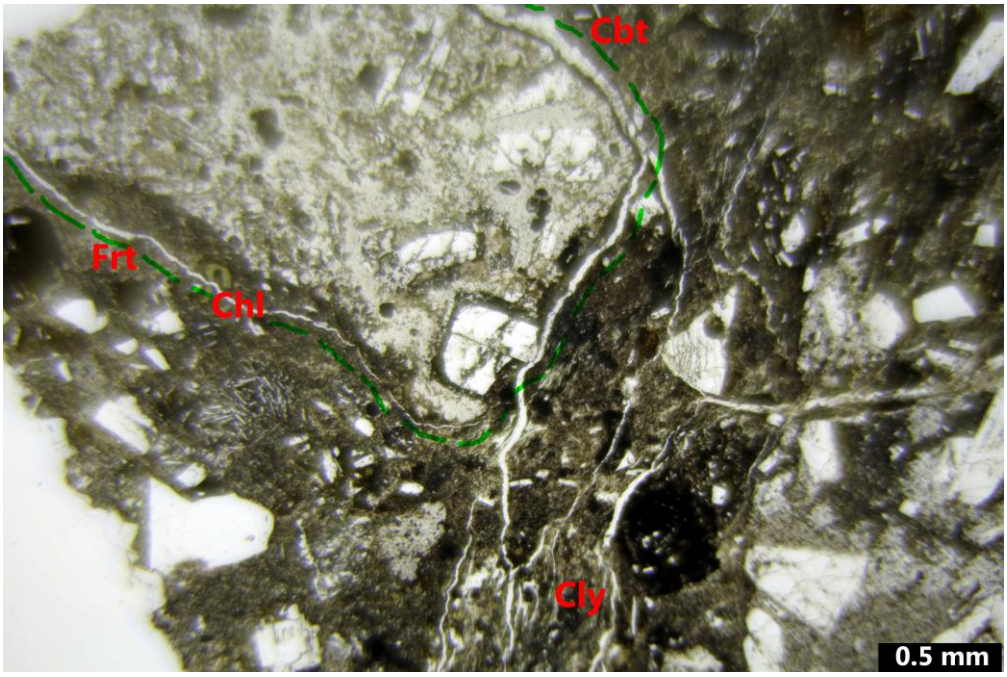

Fig. 4 - Plane polarized light. Field of view = 4 mm wide (magnification 4X). A view of a volcanic clast. A common feature of all the clasts in this thin section is the presence of fractures surrounding clast boundaries (follow the green dashed line). In this case the fracture is filled with secondary Carbonates (Cbt).

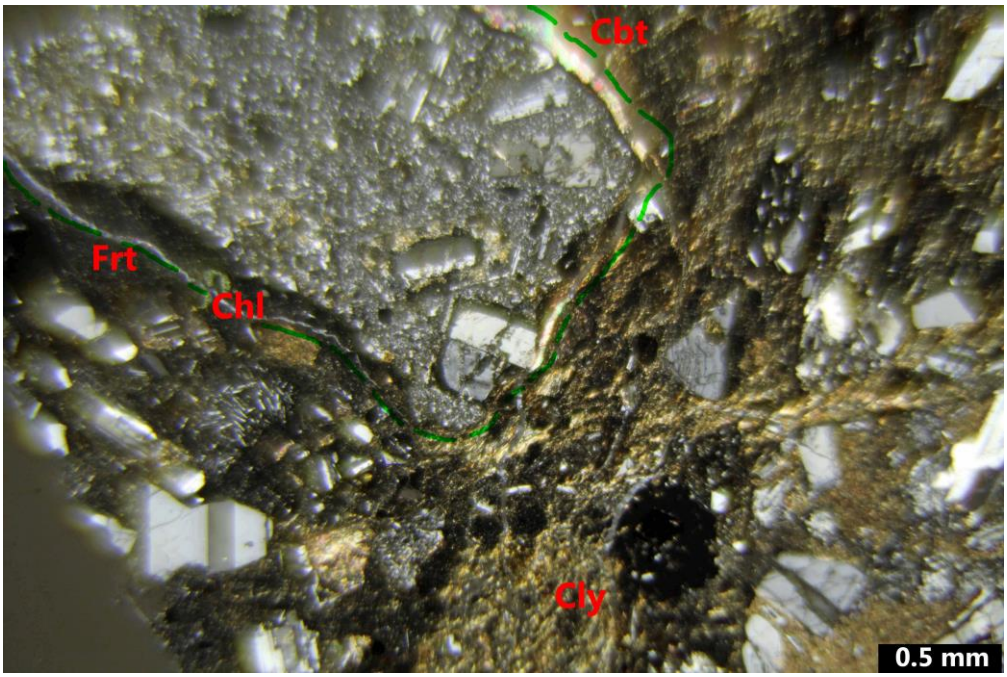

Fig. 5 - Cross polarized light. Field of view = 4 mm wide (magnification 4X). Same as Figure 4, but under crossed polars.

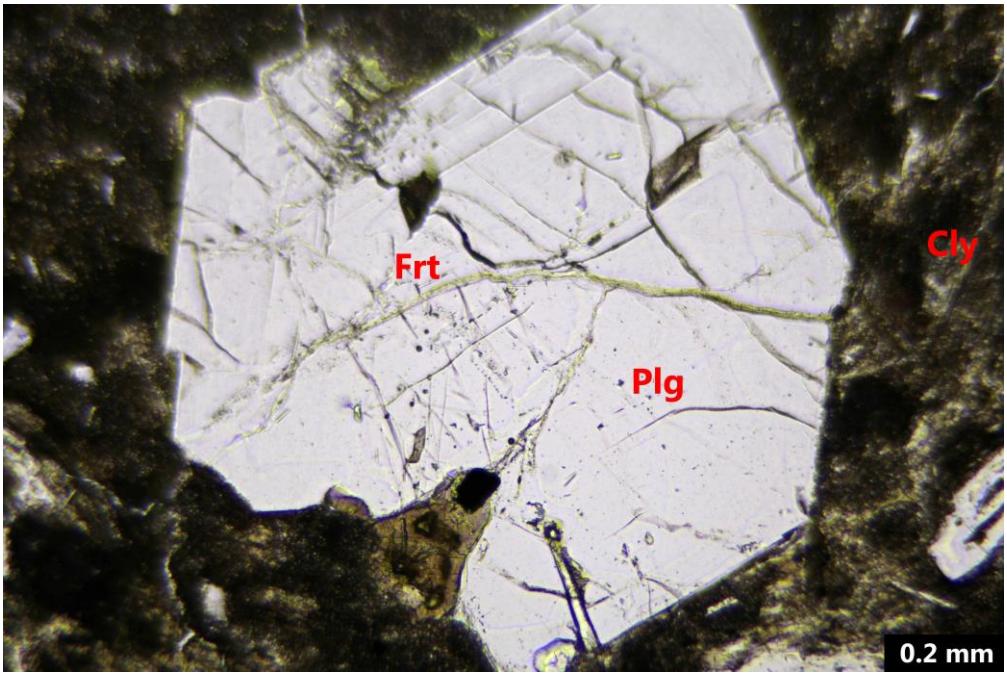

Fig. 6 - Plane polarized light. Field of view = 1.7 mm wide (magnification 10X). A detail of a Plagioclase crystal, showing grain alteration and suturing features: fractures cross the crystal and are also filled with Clay Minerals.

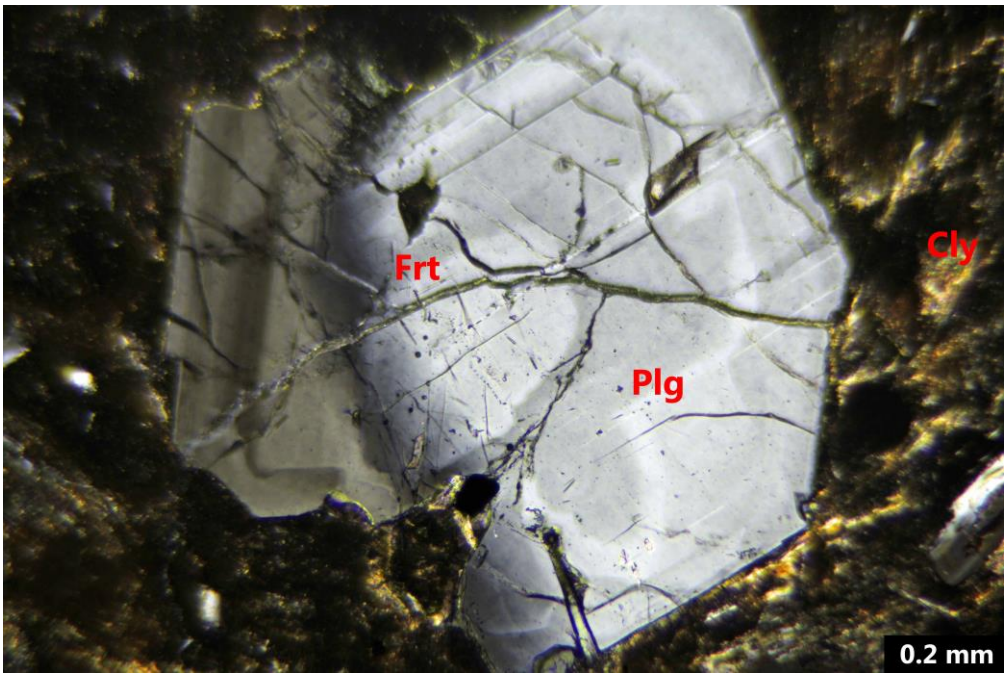

Fig. 7 - Cross polarized light. Field of view = 1.7 mm wide (magnification 10X). Same as Figure 6, but under crossed polars.

Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-8-1
Report Date	5/17/2018
Drill Hole and Depth	BI-02; 27-27.9 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/24/2018

Mohs Hardness
3

Performed by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-8-2
Report Date	5/17/2018
Drill Hole and Depth	BI-02; 48.9-50.3 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/24/2018

Mohs Hardness
3

Performed by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-8-3
Report Date	5/17/2018
Drill Hole and Depth	BI-02; 55.4-56.3 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/24/2018

Mohs Hardness
3

Performed by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-8-4
Report Date	5/17/2018
Drill Hole and Depth	BI-03; 17.4-18.4 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/24/2018

Mohs Hardness
3

Performed by: Dr. Fulvio Tonon, P.E., Ph.D.

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Laboratory Director:Dr. Fulvio Tonon, P.E., Ph.D.
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E-mail: fulvio@tononeng.com

Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-8-5
Report Date	5/17/2018
Drill Hole and Depth	BI-03; 21.5-22.9 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/24/2018

Mohs Hardness
3

Performed by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

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Laboratory Director:Dr. Fulvio Tonon, P.E., Ph.D.
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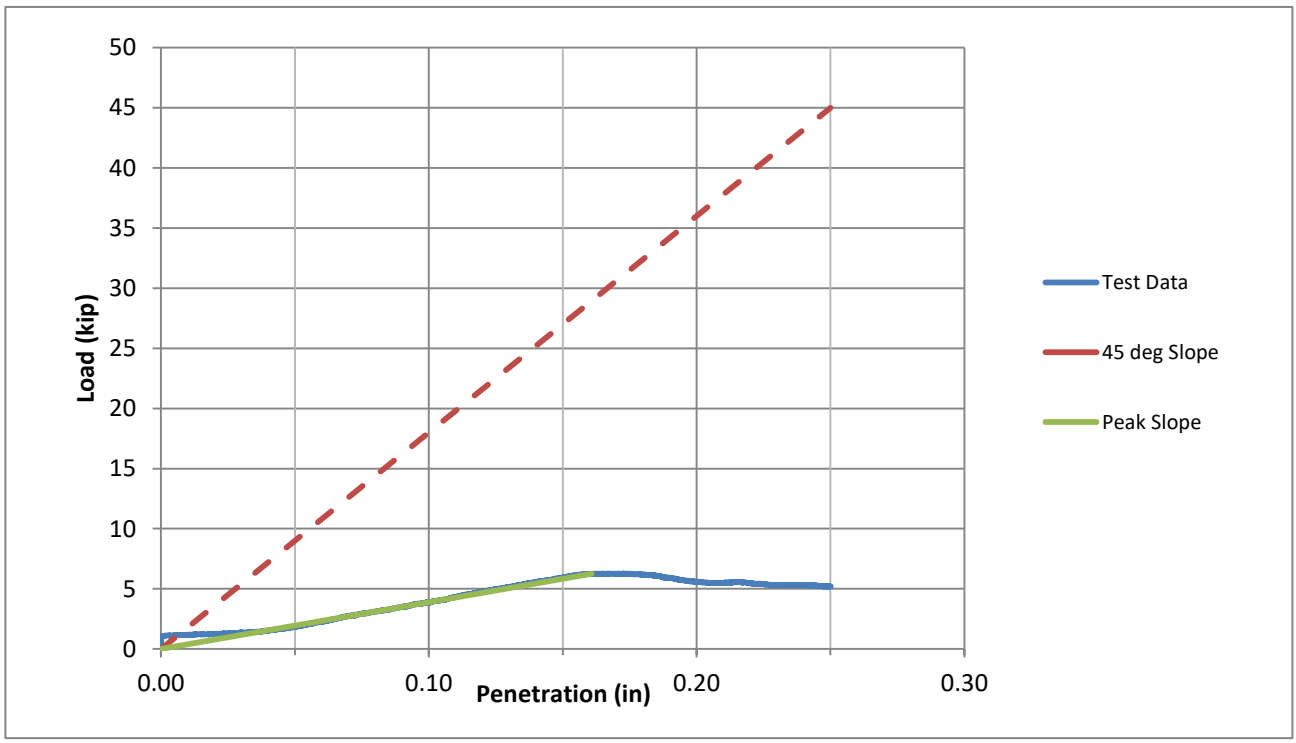
Project Name	Klamath River Dam Removal	Penetration rate	0.001 in/sec			
Location	Klamath River	Diameter of specimen	60.65	mm	2.39	in
Client	Klamath River Renewal Corporation	Height of specimen	64.62	mm	2.54	in
Client Project No.	60537920	Load at peak	27.81	kN	6,251	lbf
Registry No.	2018-22	45 Degree (Standard) Index	175			
Report No.	2018-22-8-1	Peak Slope Index	39			
Report Date	5/17/2018					
Drill Hole and Depth	BI-02; 50.3-51.3 ft					
Rock Type	Volcanic Breccia					
Geologic Unit	N/A					
Moisture Condition	As-received					

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 5/4/2018



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Laboratory Director: Dr. Fulvio Tonon, P.E., Ph.D.
Phone: +1-512-200-3051
E-mail: fulvio@tononeng.com



Photo After Test

Performed by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

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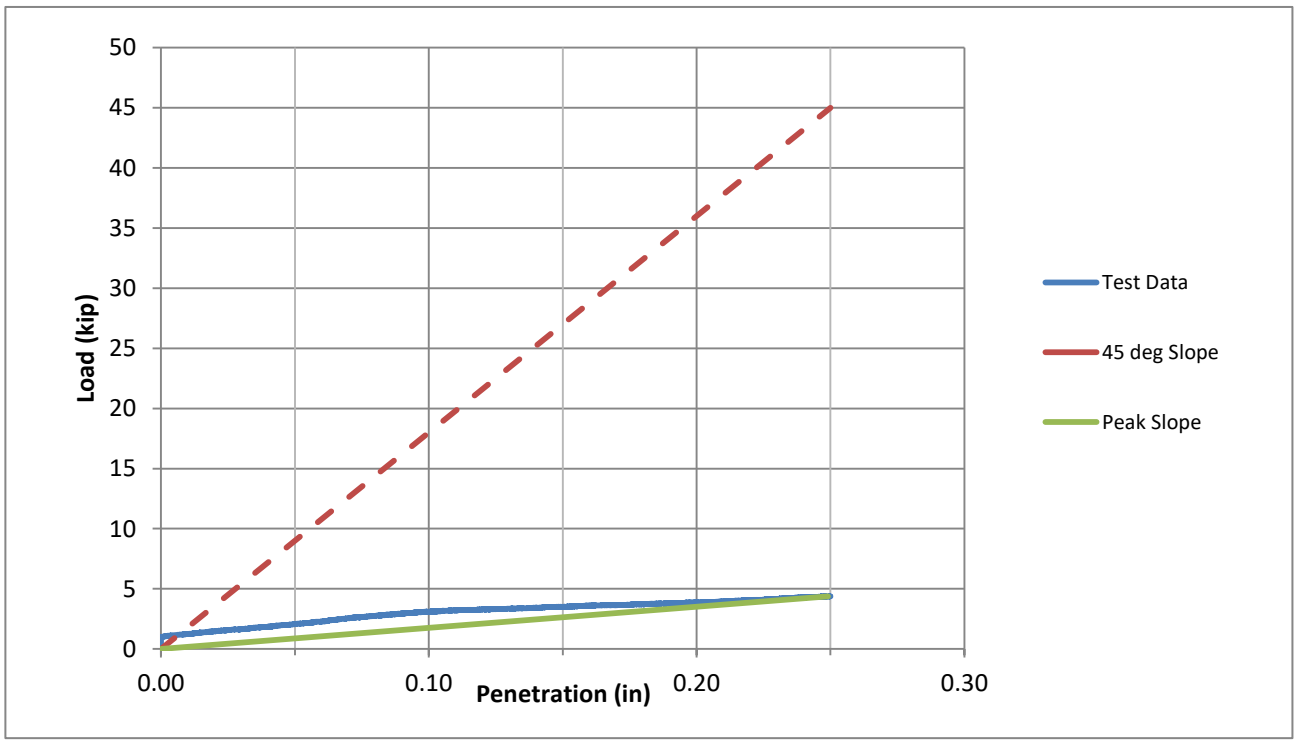
Laboratory Director: Dr. Fulvio Tonon, P.E., Ph.D.
Phone: +1-512-200-3051
E-mail: fulvio@tononeng.com

Project Name	Klamath River Dam Removal	Penetration rate	0.001 in/sec			
Location	Klamath River	Diameter of specimen	60.4	mm	2.38	in
Client	Klamath River Renewal Corporation	Height of specimen	67.53	mm	2.66	in
Client Project No.	60537920	Load at peak	19.46	kN	4,373	lbf
Registry No.	2018-22	45 Degree (Standard) Index	175			
Report No.	2018-22-8-2	Peak Slope Index	18			
Report Date	5/17/2018					
Drill Hole and Depth	BI-03; 24.2-25.1 ft					
Rock Type	Volcanic Breccia					
Geologic Unit	N/A					
Moisture Condition	As-received					

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 5/4/2018



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Austin, TX 78741

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Photo After Test

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Checked by: Gloria Tonon-Kozma, P.E.

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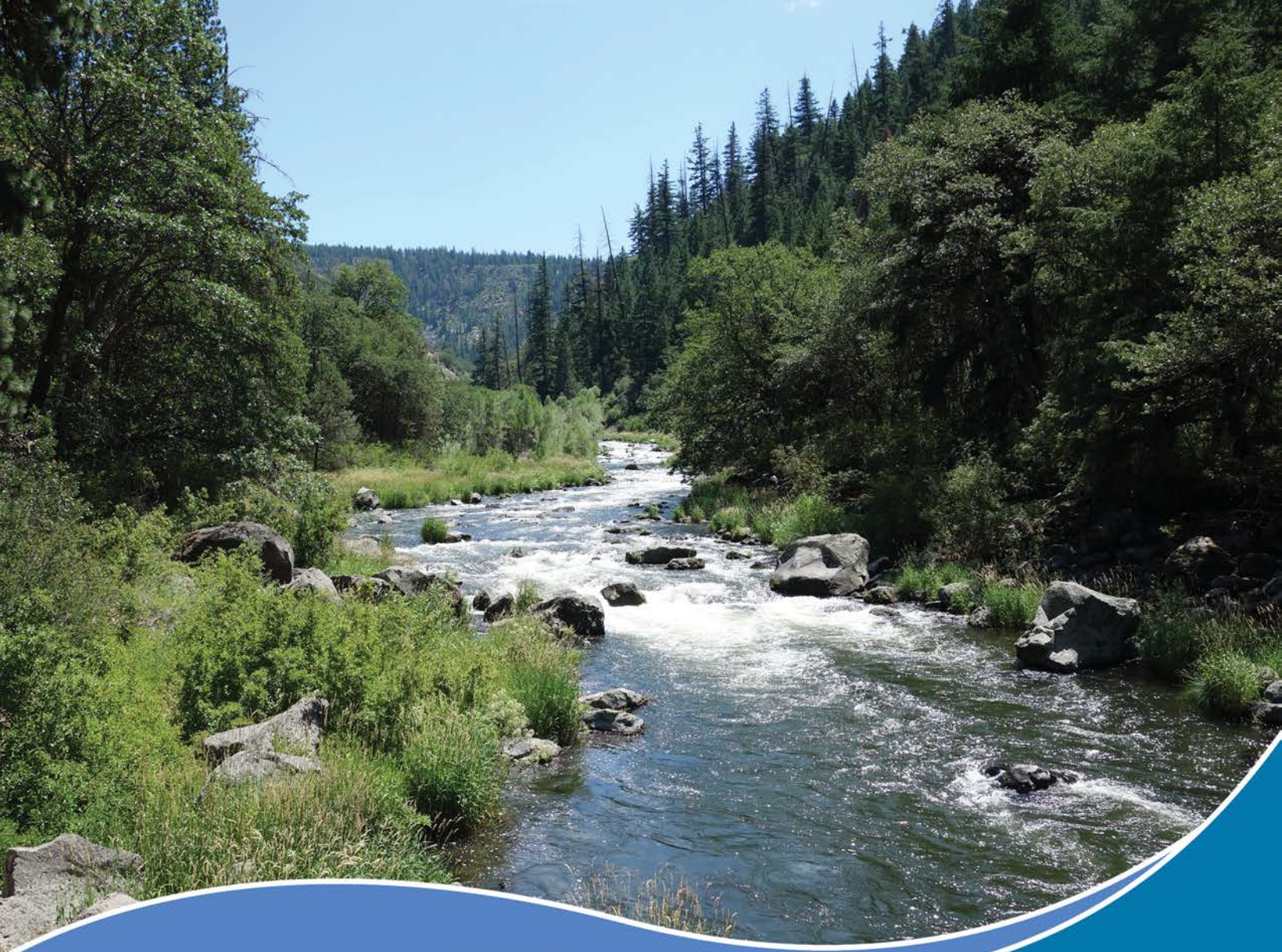

Definite Plan for the Lower Klamath Project

Appendix F - Reservoir Drawdown Modeling Output

KLAMATH
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CORPORATION

June 2018

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Prepared for:

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KLAMATH RIVER RENEWAL CORPORATION

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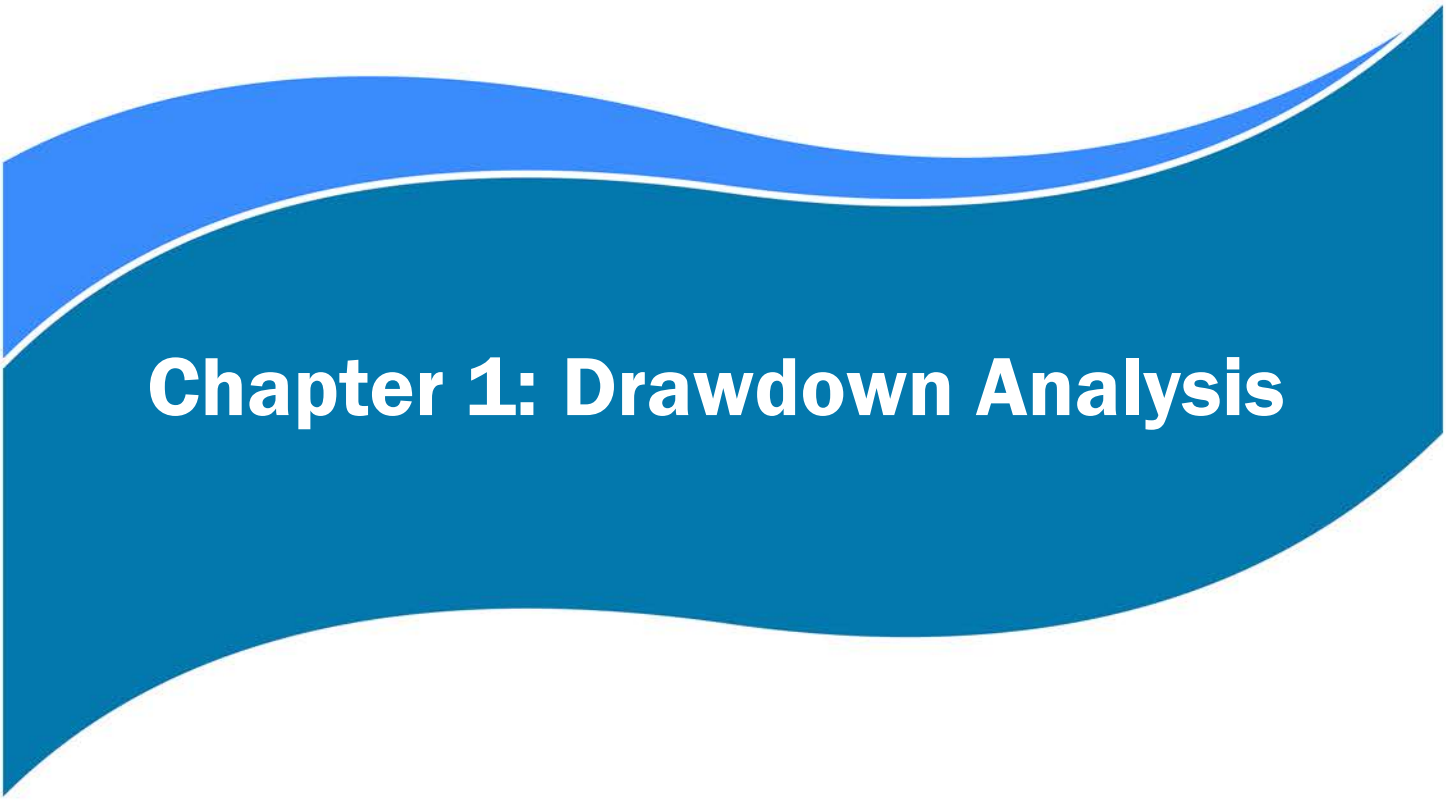

Chapter 1: Drawdown Analysis

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1. DRAWDOWN ANALYSIS

KRRC conducted detailed analysis of the proposed drawdown using the USACE Hydrologic Engineering Center River Analysis System (HEC-RAS) model (version 5.0.3). KRRC used the model to calculate flows and water levels due to the drawdown of J.C. Boyle Reservoir, Copco Lake, and Iron Gate Reservoir. For modeling stability purposes, KRRC divided the Klamath River into two modeling reaches. Reach 1 covers the J.C. Boyle Reservoir and extends from approximately 1 mile upstream of J.C. Boyle Reservoir to approximately 0.4 miles downstream of J.C. Boyle Dam. Reach 2 extends from approximately 1.5 miles upstream of Copco Lake to approximately 0.6 miles downstream of Iron Gate Dam.

The HEC-RAS model requires inputs for topography/bathymetry, inflow rates, and rating curves for dam outlets. The following sections discuss input sources and data.

1.1 Topography/Bathymetry

KRRC generally obtained the cross-section bathymetry in the HEC-RAS model from the SRH1-D model provided by the U.S. Bureau of Reclamation (USBR). The data were representative of Scenario 8 in USBR (2012). The bathymetry data extended from above J.C. Boyle to the ocean; however, KRRC only used the data for Reach 1 and Reach 2 as described above.

Stage-storage relationships were determined using output from the HEC-RAS model for each of the three large reservoirs, Iron Gate Reservoir, Copco Lake, and J.C. Boyle Reservoir. KRRC compared the HEC-RAS storage curves to the stage-storage curves provided in Attachment B of the Detailed Plan (USBR 2012b). The results from the initial model output showed higher capacities than specified in the Detailed Plan. Therefore, KRRC adjusted (shifted up) the cross-section elevations upstream of each of the dams until the stage-storage relationships in the HEC-RAS model matched the stage-storage curves from the Detailed Plan.

1.2 Inflow Rate

Inflow data based on the Klamath Basin Restoration Agreement (KBRA) flows were used as upstream river flows (Keno flows) [1] for both J.C. Boyle and Copco No. 1. KRRC obtained these flows from the SRH1-D model input files (USBR 2012c). The data were compared to the measured flows at the USGS gage at Keno (gage no. 11509500, Klamath River at Keno, OR). Definite Plan Section 4.6.1 provides a comparison between the USGS measured data at Keno and the SRH1-D data used in the model. Flow was increased upstream of Iron Gate dam using the "Copco to Iron Gate Gains" from the SRH1-D input file to account for tributary inflow.

[1] The 2013 Joint Biological Opinion for USBR's Klamath Project (NMFS and USFWS 2013) modified the flows from the 2010 KBRA. The 2013 Joint Biological Opinion slightly increases the annual average water supply by about 9 thousand acre feet when compared with the KBRA Flows, and it maintains higher minimum summer flows in dry years. The changes to flows in January and February (during drawdown) are negligible. The small changes to flows in the 2013 Joint Biological Opinion will not affect the drawdown of the reservoirs, nor the level of flows released during drawdown. NMFS and USFWS are working on a new Joint Biological Opinion to be released in 2019, which may again alter flows released by USBR's Klamath Project.

KRRC simulated water years 1961 through 2009 in the model. KRRC determined the maximum 15-day total flow volume for each water year so that the years could be ranked based on hydrologic conditions (Table 1-1).

Table 1-1: Water Years between 1961 and 2009 ranked by SRH1-D Keno Flow Volume

Water Year	Maximum 15-day Flow Volume between January and May (acre-feet)	Rank
1966*	5,194,887	1
1997	4,572,024	2
1972	4,529,358	3
2006	4,138,916	4
1996	3,965,633	5
1983	3,940,625	6
1986	3,239,955	7
1974	3,166,176	8
1999	3,061,339	9
1982	2,927,194	10
1970	2,897,662	11
1971	2,845,658	12
1989	2,813,797	13
1978	2,723,380	14
1969	2,563,472	15
1984	2,516,746	16
1998	2,471,870	17
1993	2,384,182	18
1975	2,361,555	19
1985	1,710,804	20
2000	1,633,487	21
1968	1,622,059	22
1995	1,540,547	23
1980	1,394,132	24
1973	1,390,825	25
1964	1,294,327	26
2008	1,194,776	27
1976	1,177,407	28

Water Year	Maximum 15-day Flow Volume between January and May (acre-feet)	Rank
2004	1,075,804	29
1963	1,054,977	30
2007	1,054,187	31
1962	1,044,193	32
1987	1,019,283	33
1967	948,459	34
1988	900,774	35
1965	874,920	36
2003	801,979	37
1979	772,021	38
1990	711,287	39
1981	695,542	40
2002	674,728	41
2001	634,014	42
2009	627,011	43
1961	620,286	44
1977	586,748	45
1994	416,661	46
1991	396,980	47
2005	377,839	48
1992	370,748	49

* Corresponds to water year 1965 in historical flow record.

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Chapter 2: J.C. Boyle Reservoir

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2. J.C. BOYLE RESERVOIR

The drawdown procedure included in the HEC-RAS model for J.C. Boyle is summarized below:

1. Simulations started on January 1, 2021 by making releases through the gated spillway (crest elevation 3785.2) and the power intake (invert elevation 3771.7). The three spillway gates and the gate for the power intake were set fully open. The maximum flow through the power intake is about 2,800 cubic feet per second (cfs). About 25 percent of years have an average flow in January greater than 2,800 cfs and almost 40 percent have a maximum flow greater than 2,800 cfs. Flows above about 2,800 cfs go over the spillway.
2. After two weeks (set to January 14), KRRC assumed that the concrete stoplogs on the first 9.5- by 10-foot diversion culvert will be removed and the culvert will open.
3. Drawdown would continue using the single diversion culvert until the end of January.
4. On February 1, the second 9.5- by 10-foot diversion culvert will be opened by removing the concrete stoplogs.
5. The power intake gate was closed once the reservoir was drawn down below the power intake invert or when the second bay of the diversion culvert was opened, whichever was earlier.

2.1 Results

Figures 2-1 through 2-49 show results from the simulations of J.C. Boyle. Because of the small size of the J.C. Boyle Reservoir, the reservoir will refill partially or completely during a storm until dam removal is complete. The capacity of the two diversion culverts for water levels below the spillway elevation is about 5,700 cfs. The historical hydrology record shows about 15 percent of the years have a maximum January or February flow that exceeds 5,000 cfs and would result in reservoir refilling and associated flows over the spillway.

During representative drier years (for example 1973 and 1979), the reservoir was easily drawn down in January, and it did not refill after that point.

During the wetter years (for example 2006 and 1986), J.C. Boyle Reservoir was completely drawn down early (January to mid-February), but quickly refilled later in the year when storms occurred. The majority of the accumulated sediment would mobilize during the initial drawdown, and subsequent reservoir filling and drawdown is expected to cause only moderate increases in high suspended sediment (relative to background) (USBR 2012c).

For all water years, any increase in peak flows with drawdown compared to peak flows without drawdown is small due to the relatively limited amount of attenuation associated with the existing reservoir.

KRRC does not anticipate that sediment concentrations resulting from the proposed drawdown procedure and associated hydraulics would differ from those previously estimated (USBR 2012c).

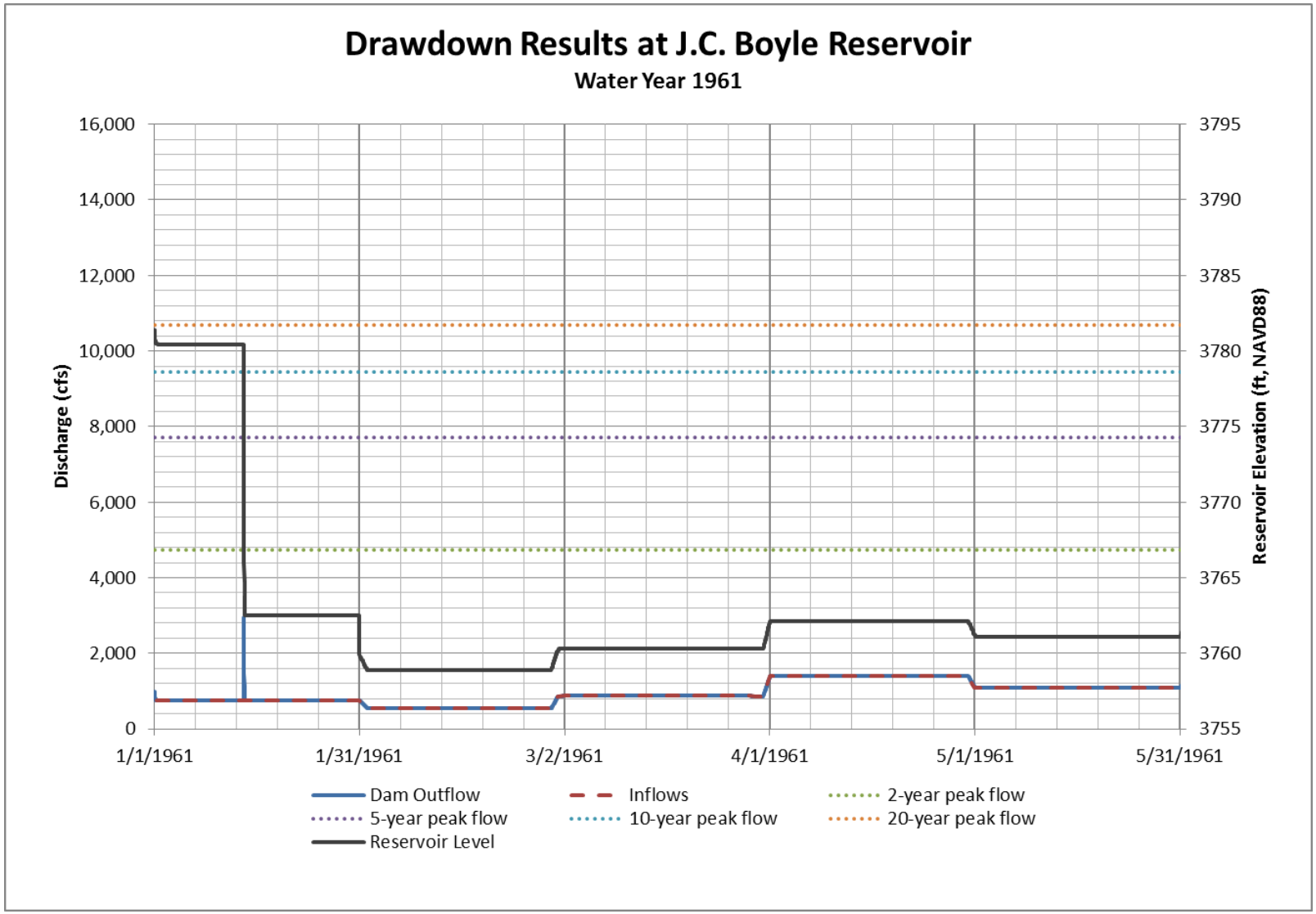

Figure 2-1 J.C. Boyle Reservoir Drawdown, Water Year 1961

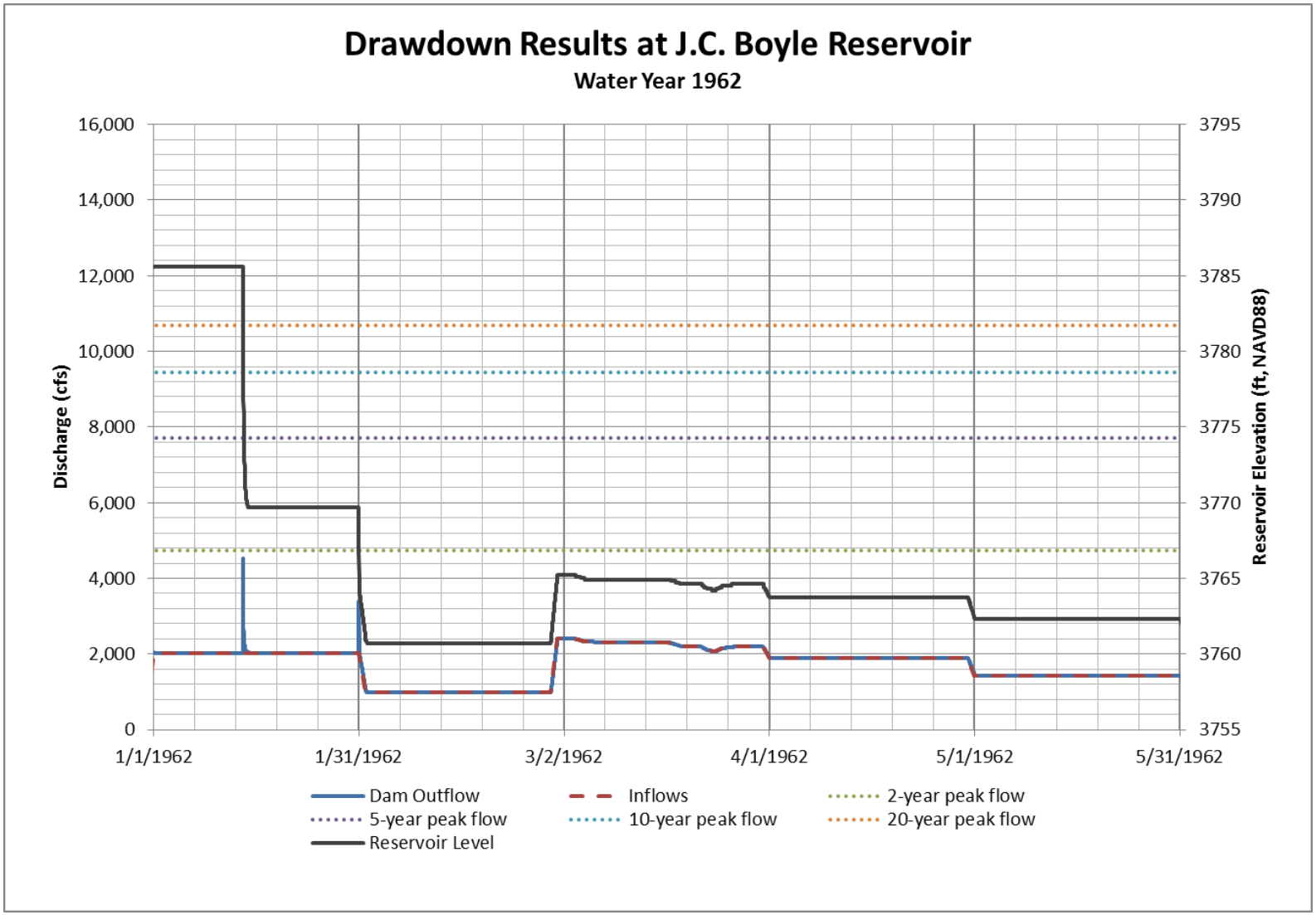

Figure 2-2 J.C. Boyle Reservoir Drawdown, Water Year 1962

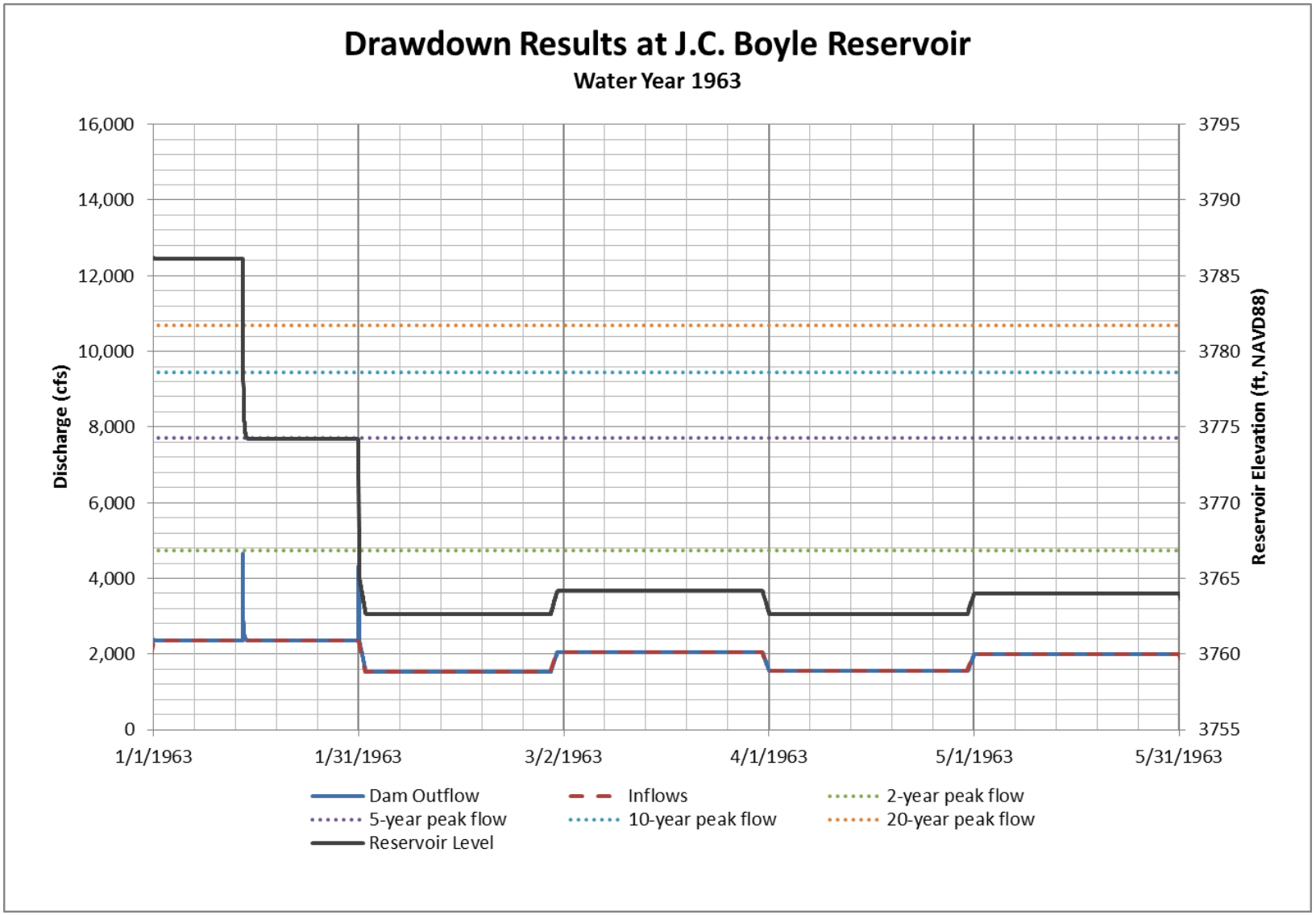

Figure 2-3 J.C. Boyle Reservoir Drawdown, Water Year 1963

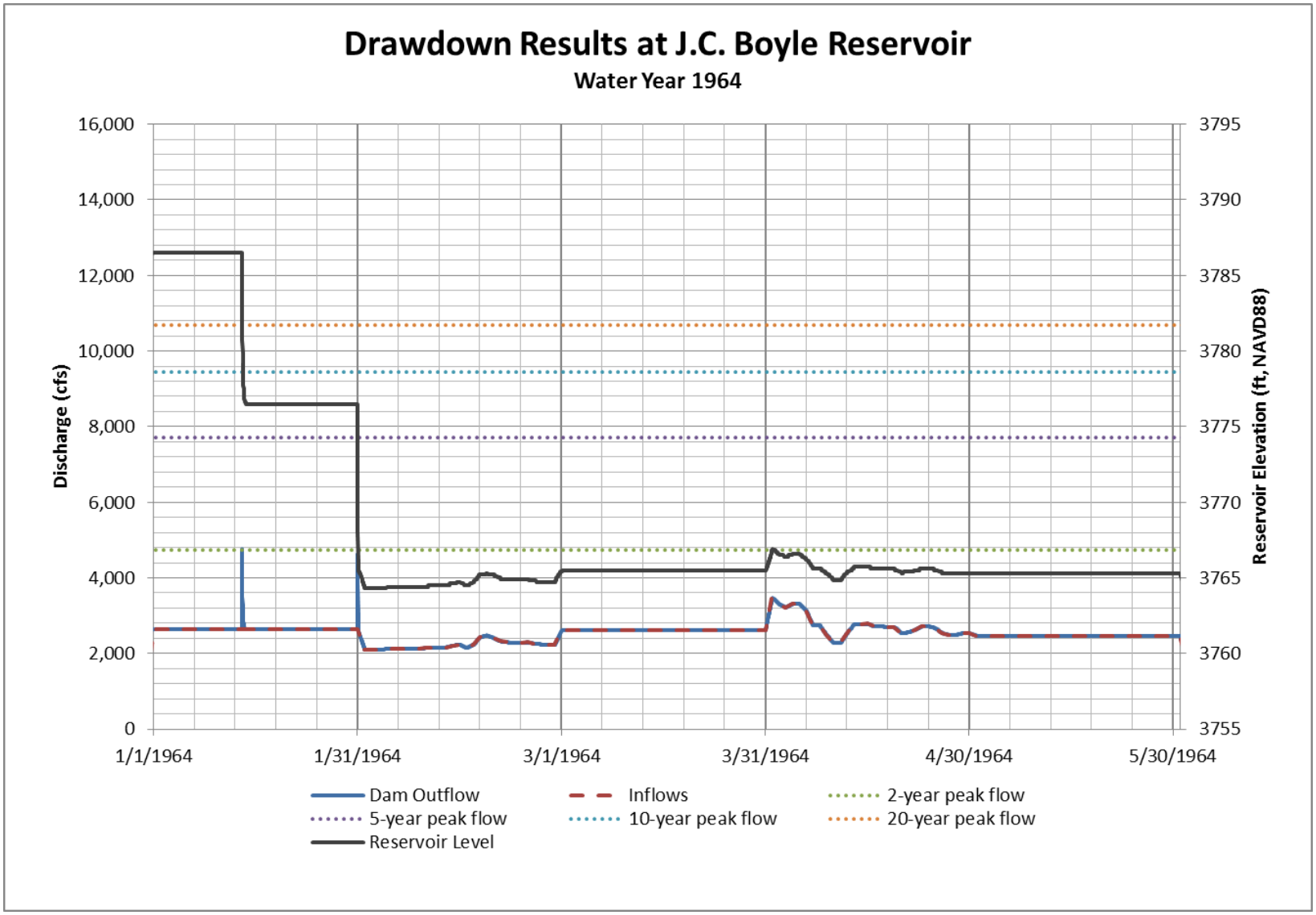

Figure 2-4 J.C. Boyle Reservoir Drawdown, Water Year 1964

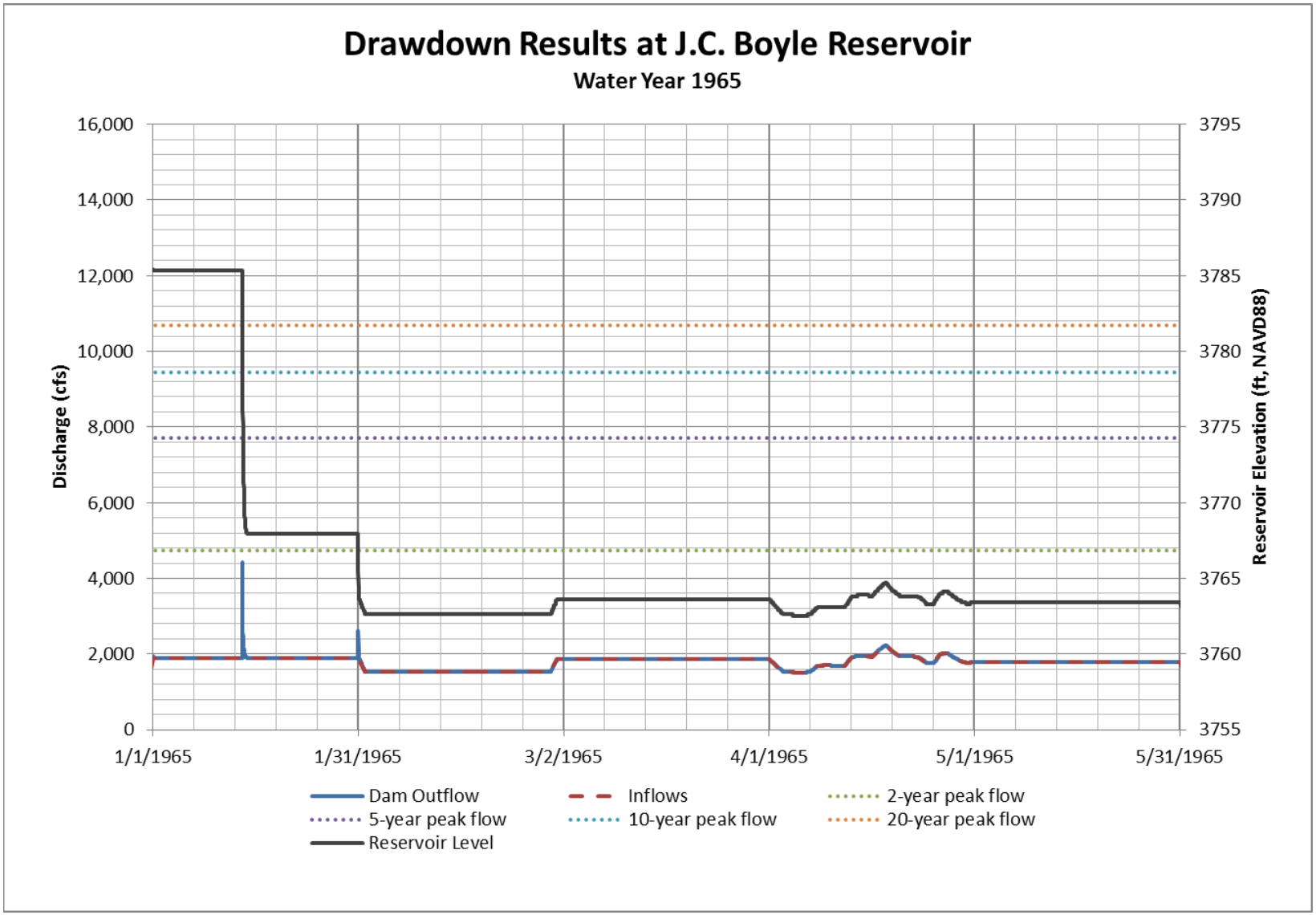

Figure 2-5 J.C. Boyle Reservoir Drawdown, Water Year 1965

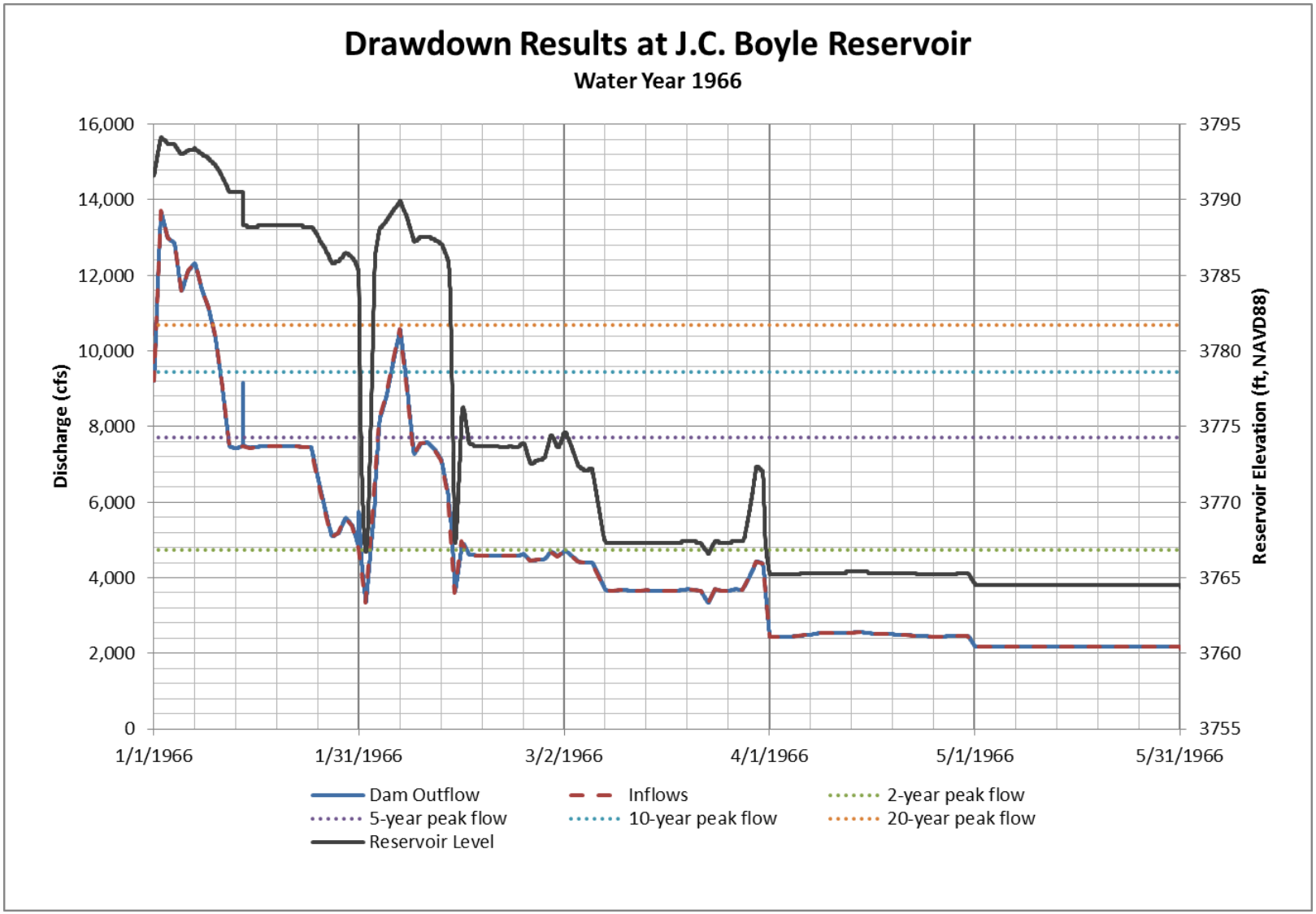

Figure 2-6 J.C. Boyle Reservoir Drawdown, Water Year 1966 (Wettest Year)

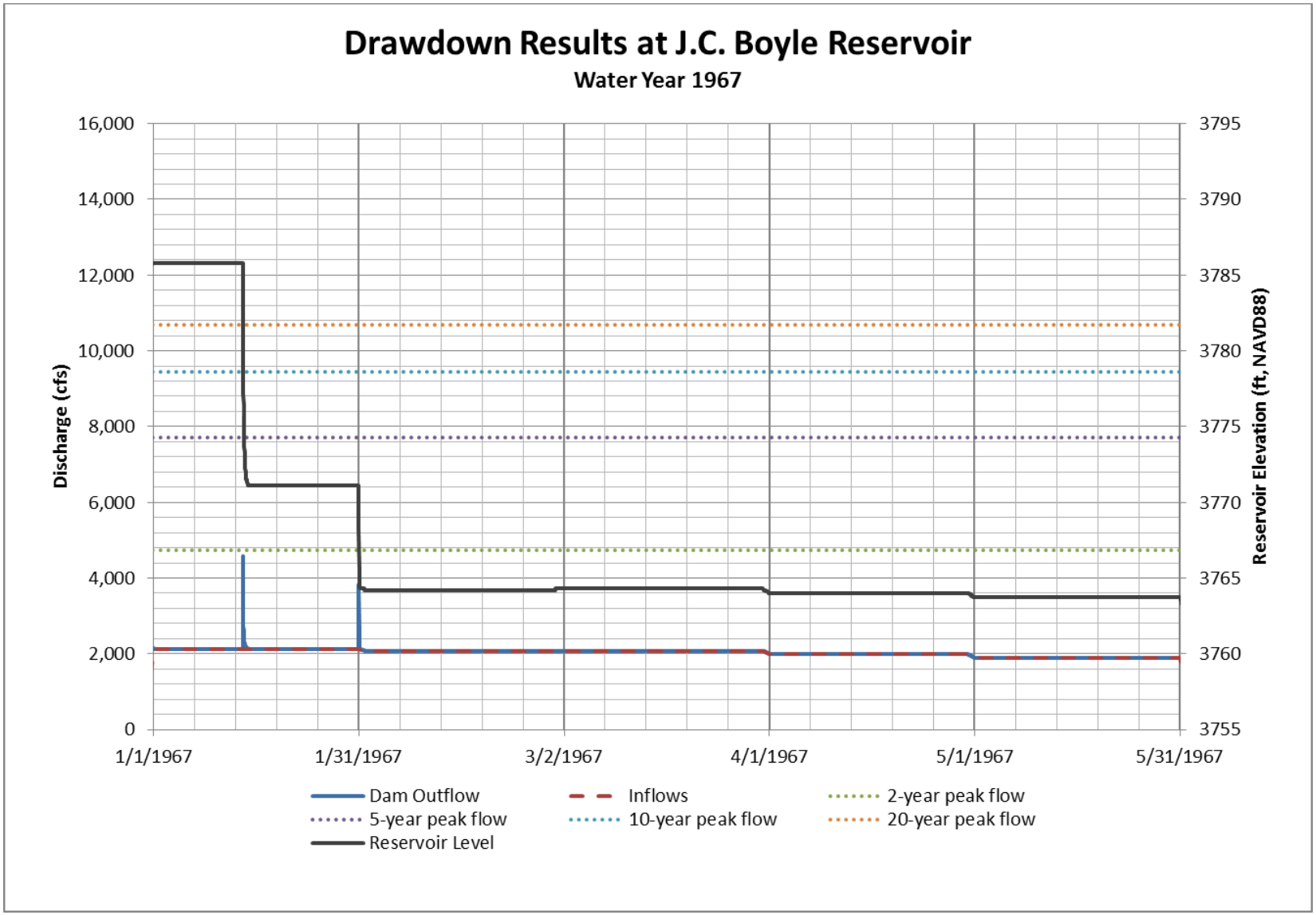

Figure 2-7 J.C. Boyle Reservoir Drawdown, Water Year 1967

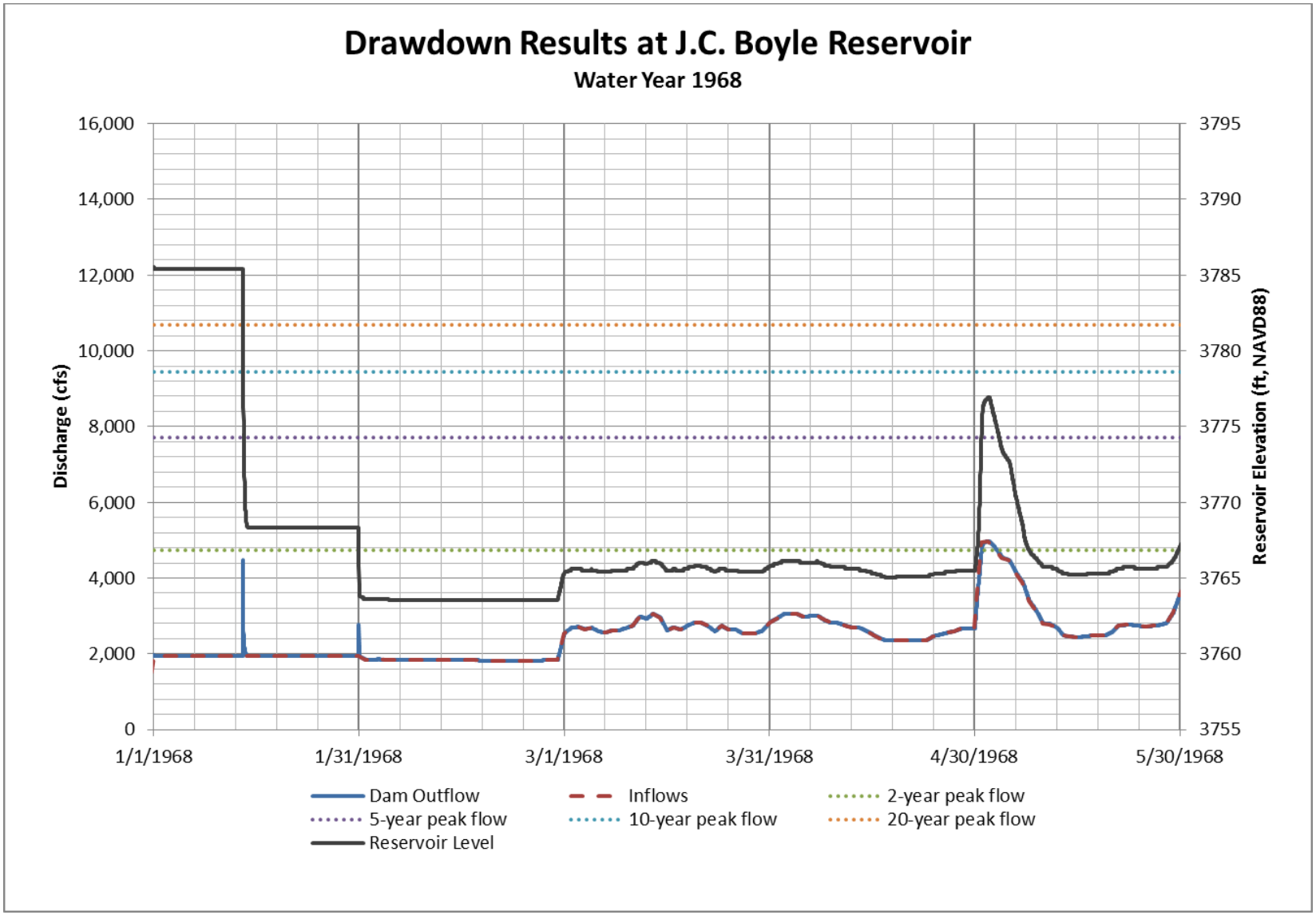

Figure 2-8 J.C. Boyle Reservoir Drawdown, Water Year 1968

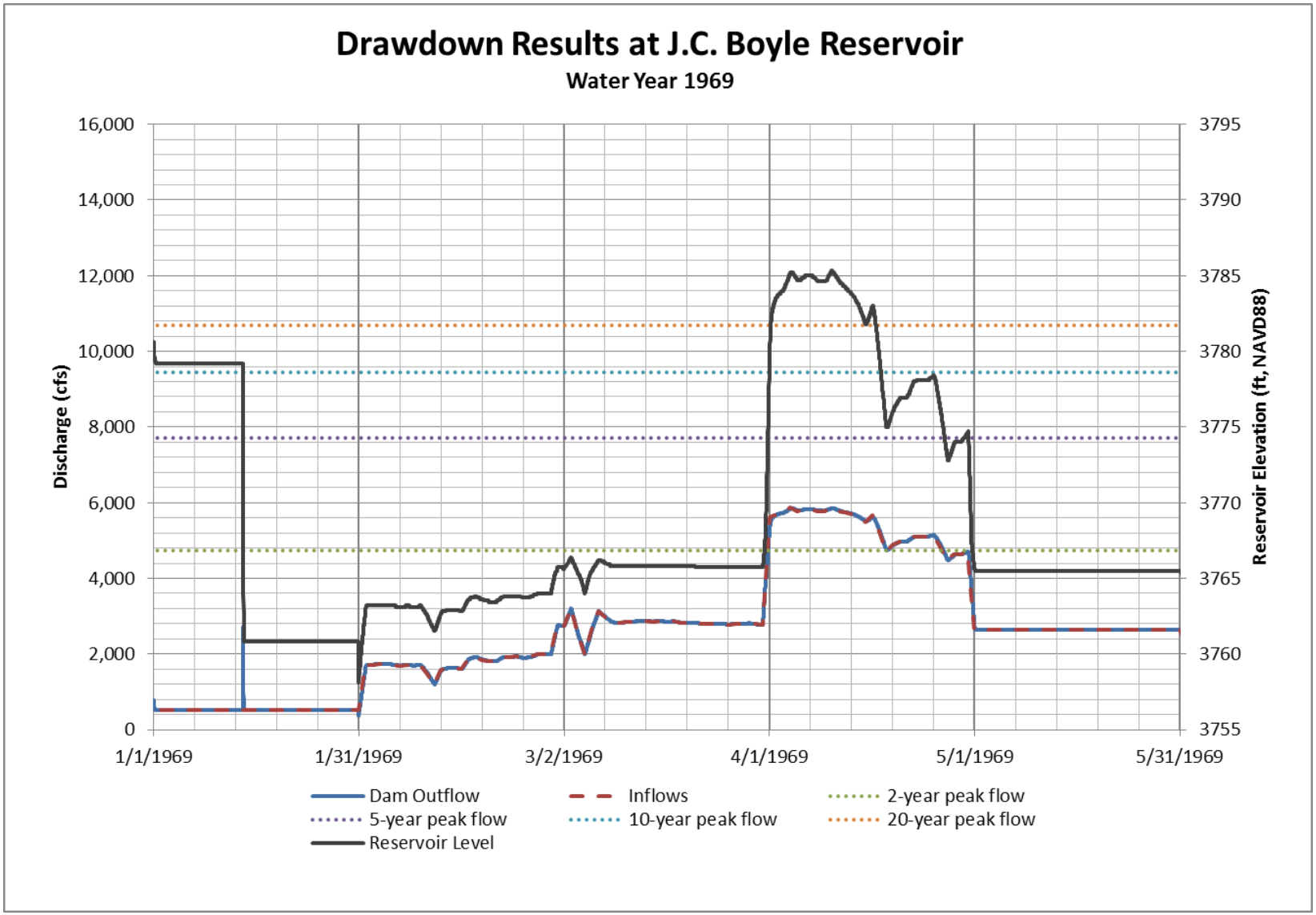

Figure 2-9 J.C. Boyle Reservoir Drawdown, Water Year 1969

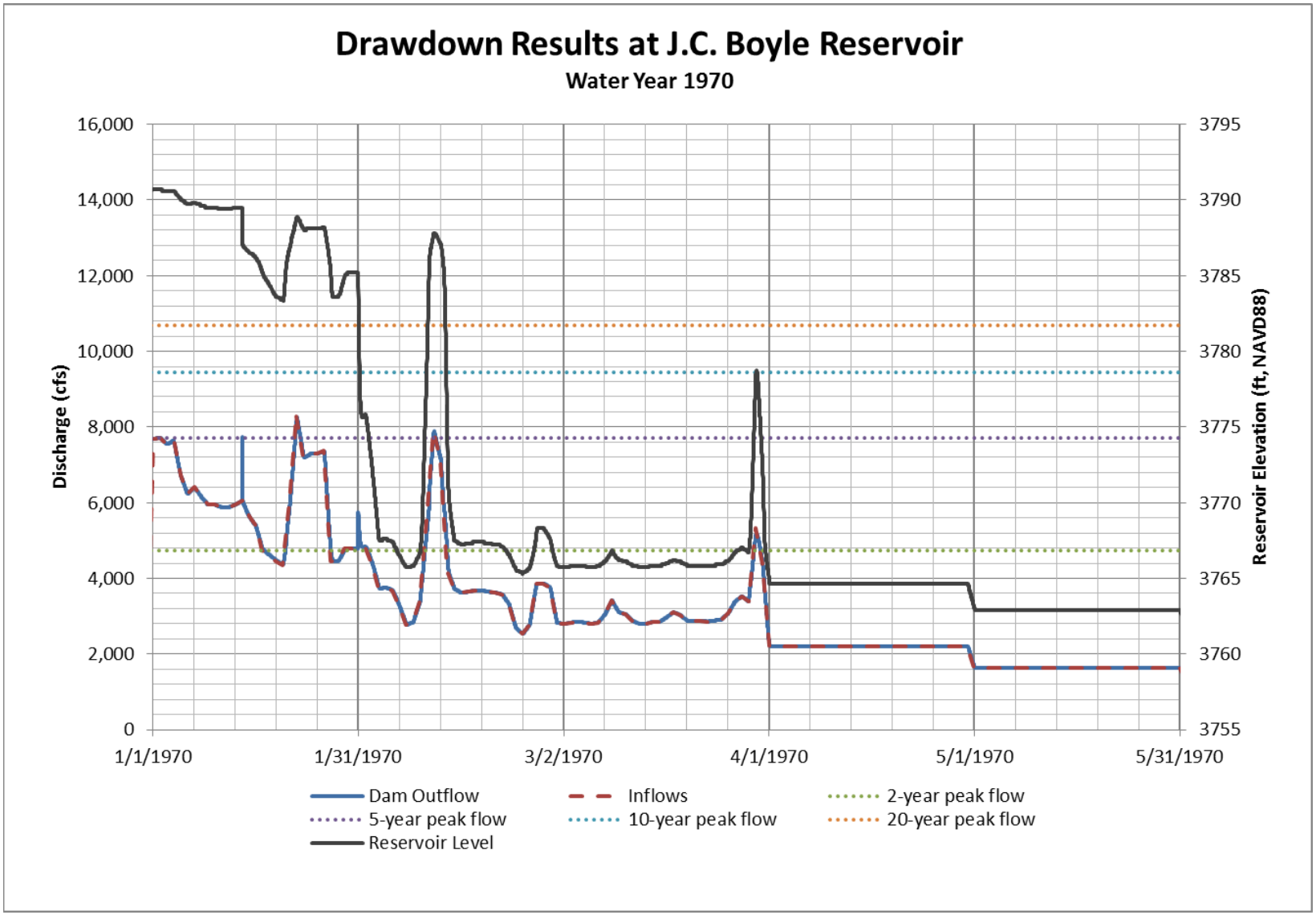

Figure 2-10 J.C. Boyle Reservoir Drawdown, Water Year 1970 (Above Normal Year)

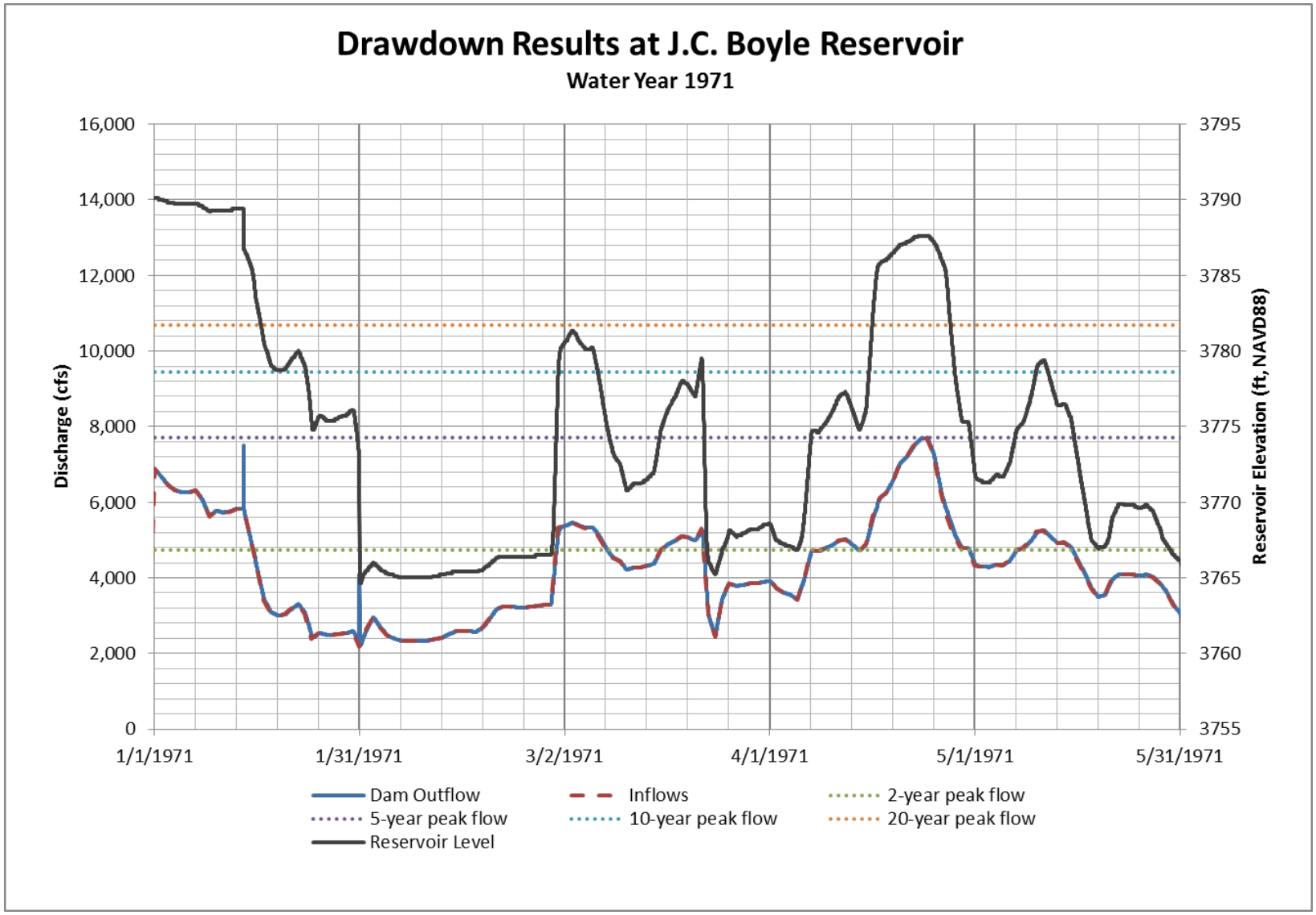

Figure 2-11 J.C. Boyle Reservoir Drawdown, Water Year 1971

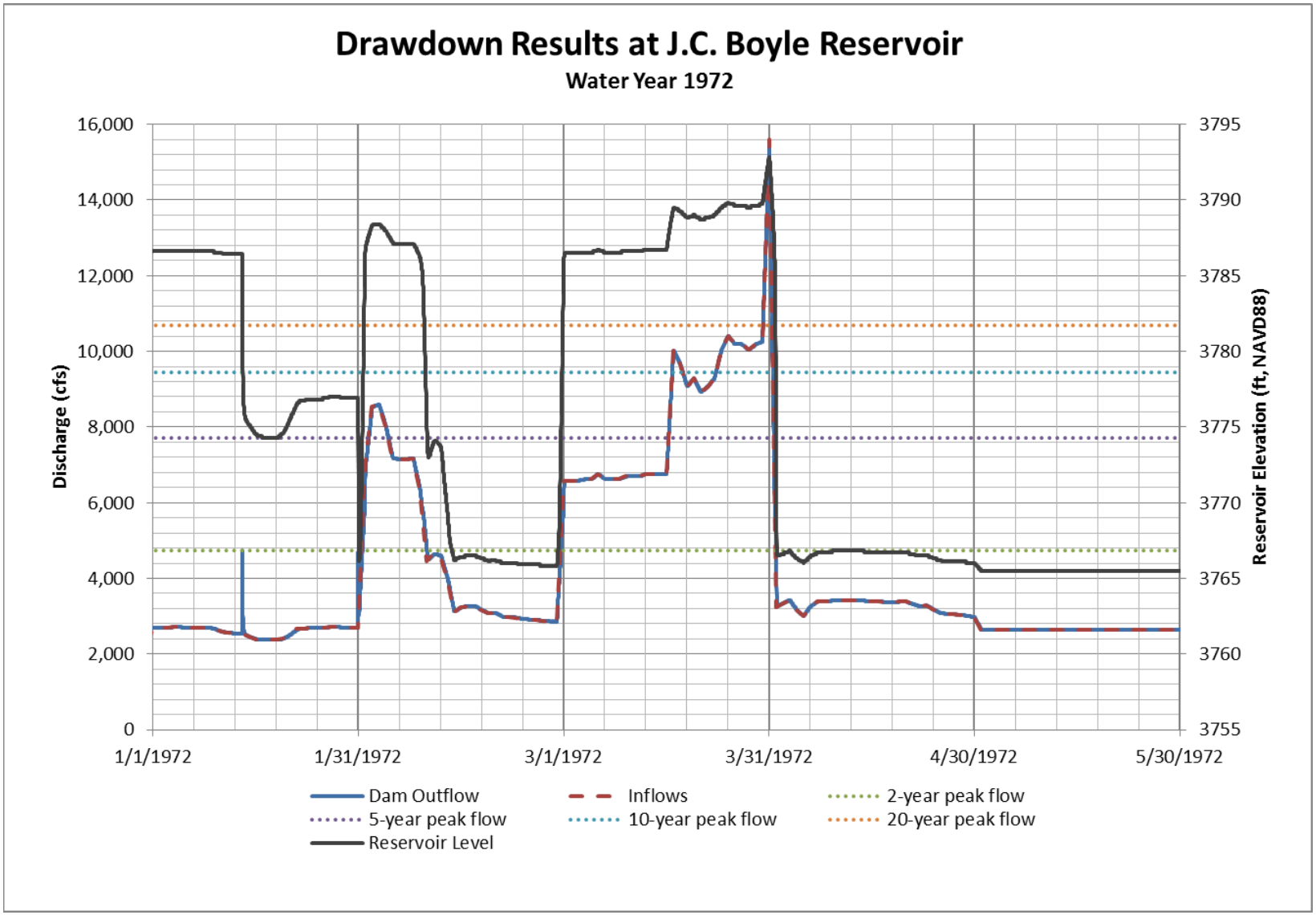

Figure 2-12 J.C. Boyle Reservoir Drawdown, Water Year 1972

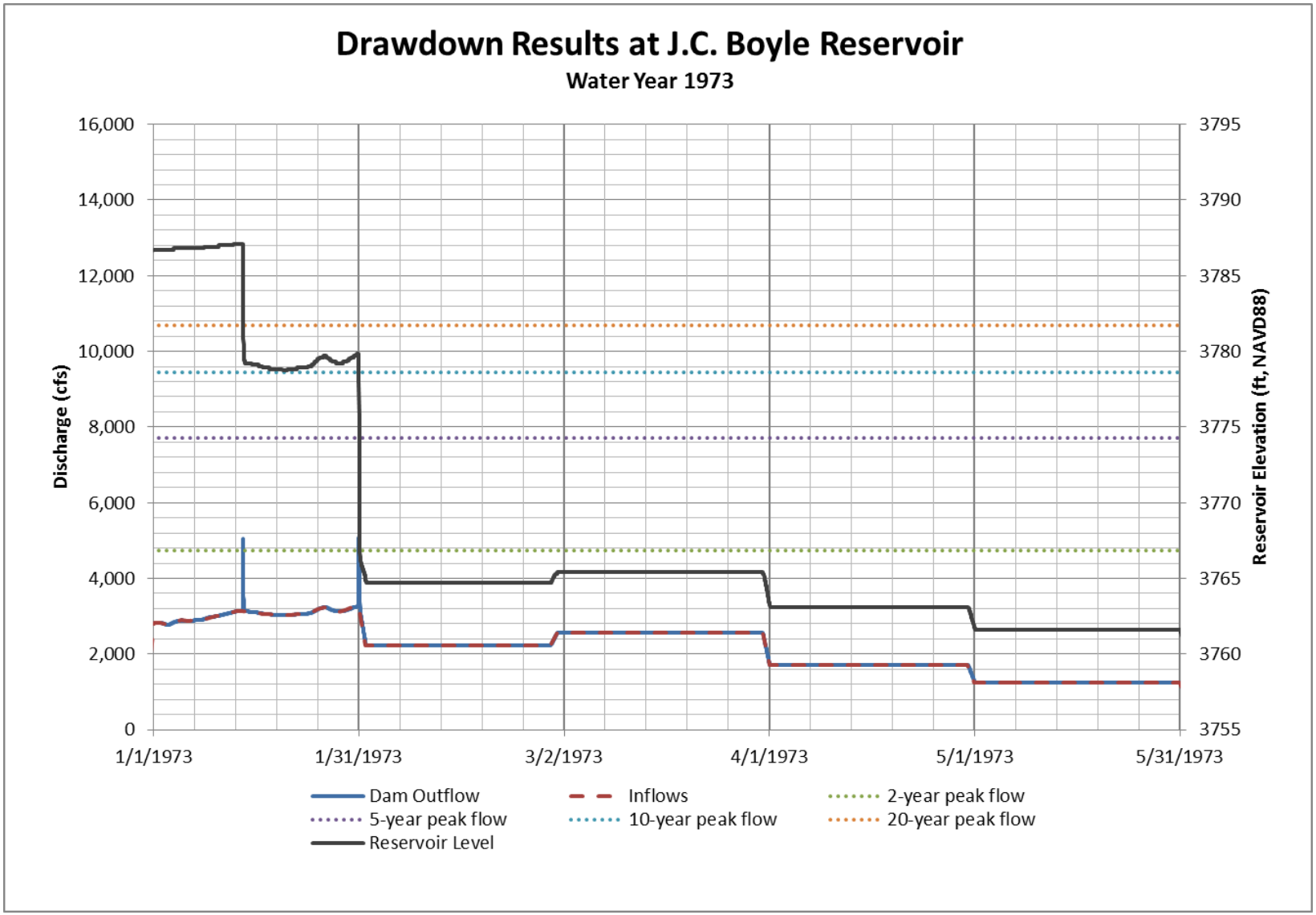

Figure 2-13 J.C. Boyle Reservoir Drawdown, Water Year 1973 (Median Year)

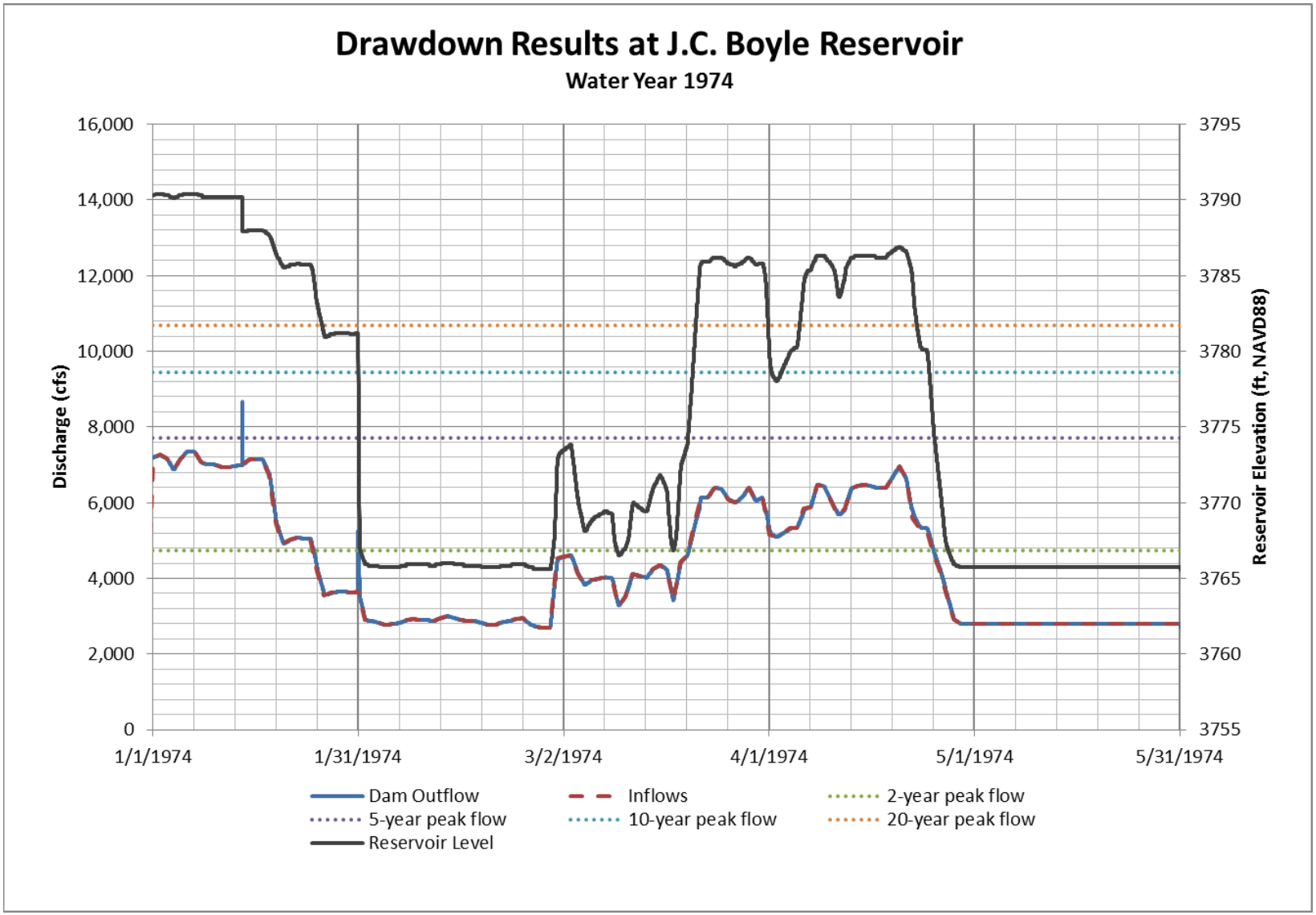

Figure 2-14 J.C. Boyle Reservoir Drawdown, Water Year 1974

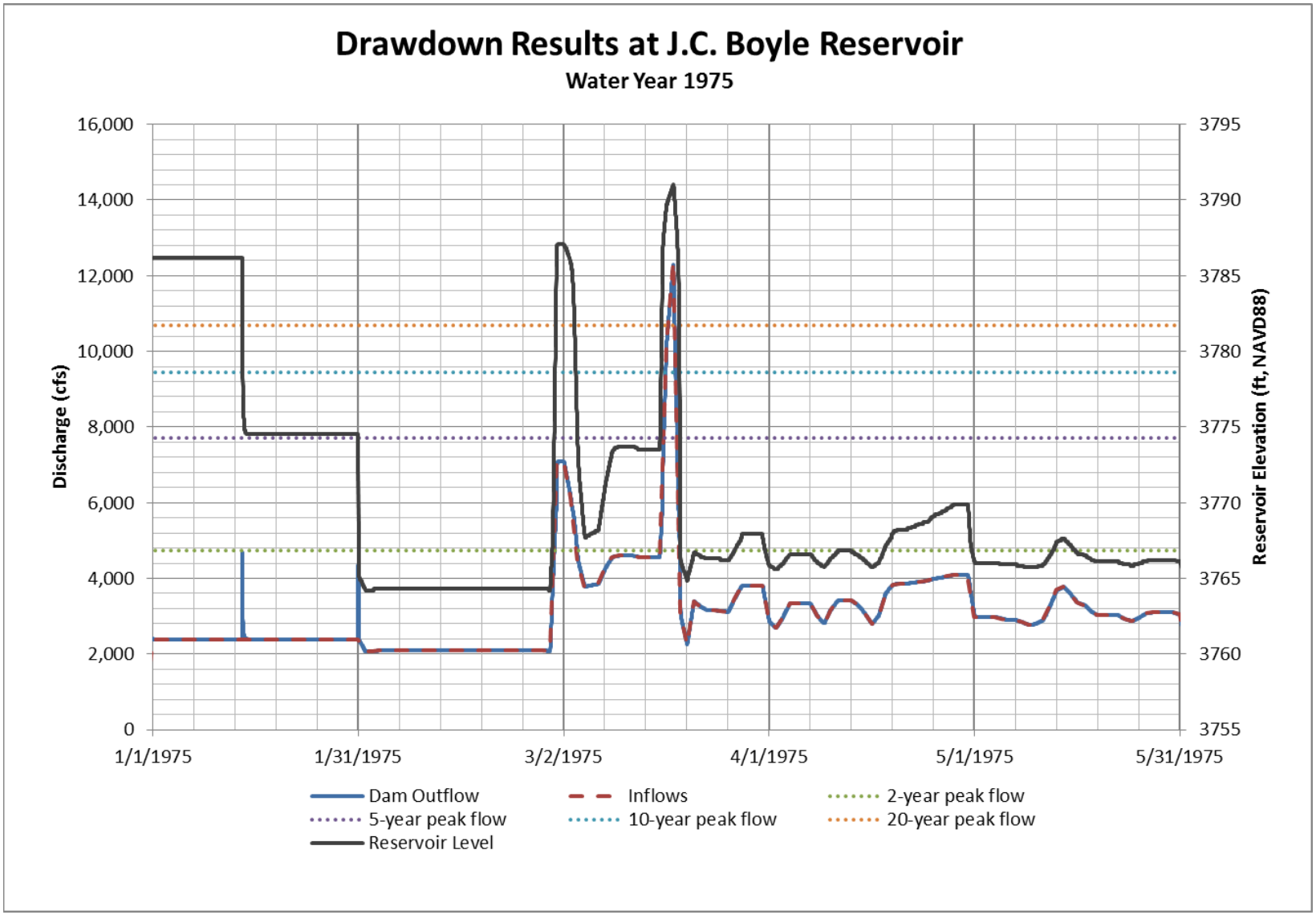

Figure 2-15 J.C. Boyle Reservoir Drawdown, Water Year 1975

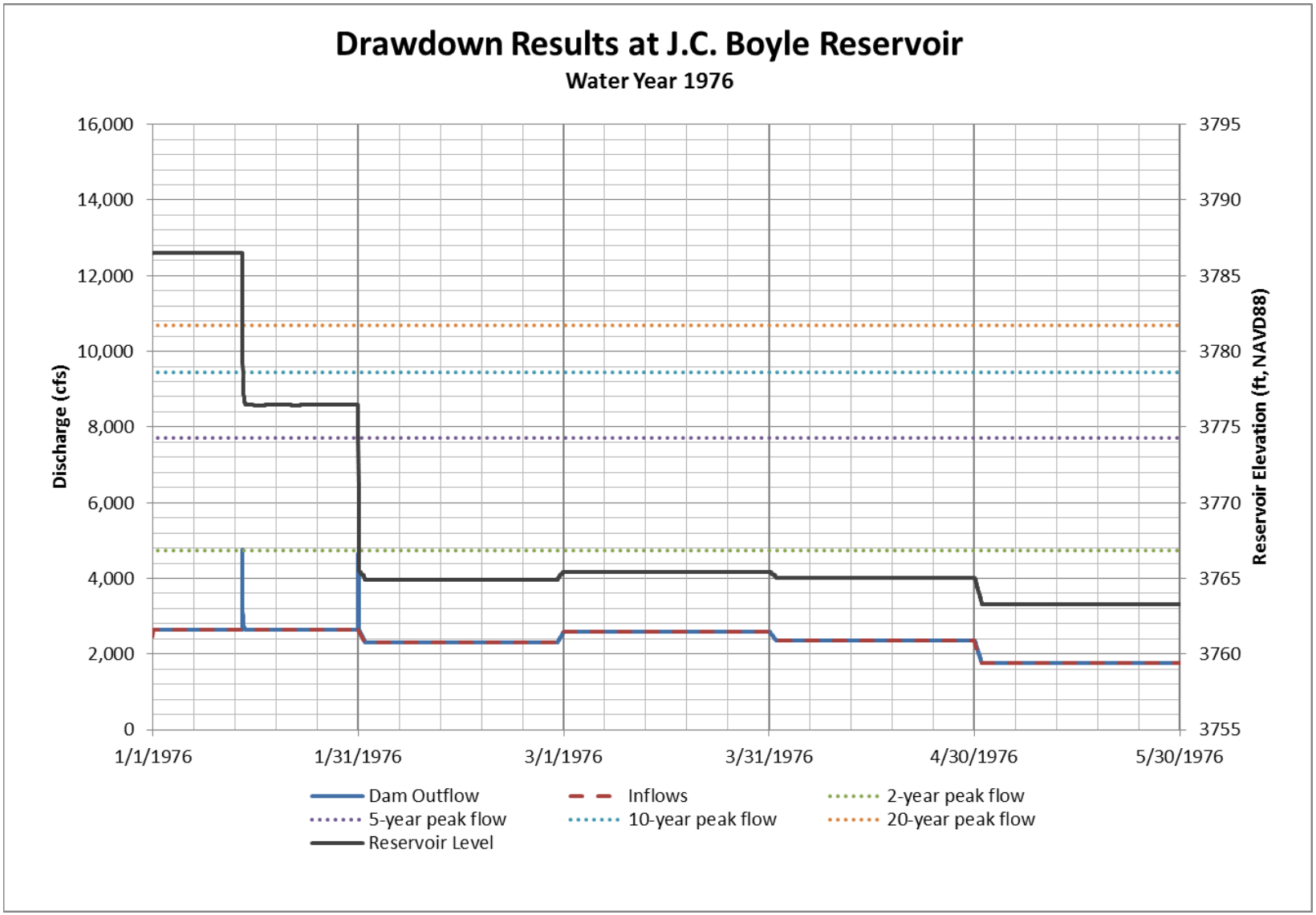

Figure 2-16 J.C. Boyle Reservoir Drawdown, Water Year 1976

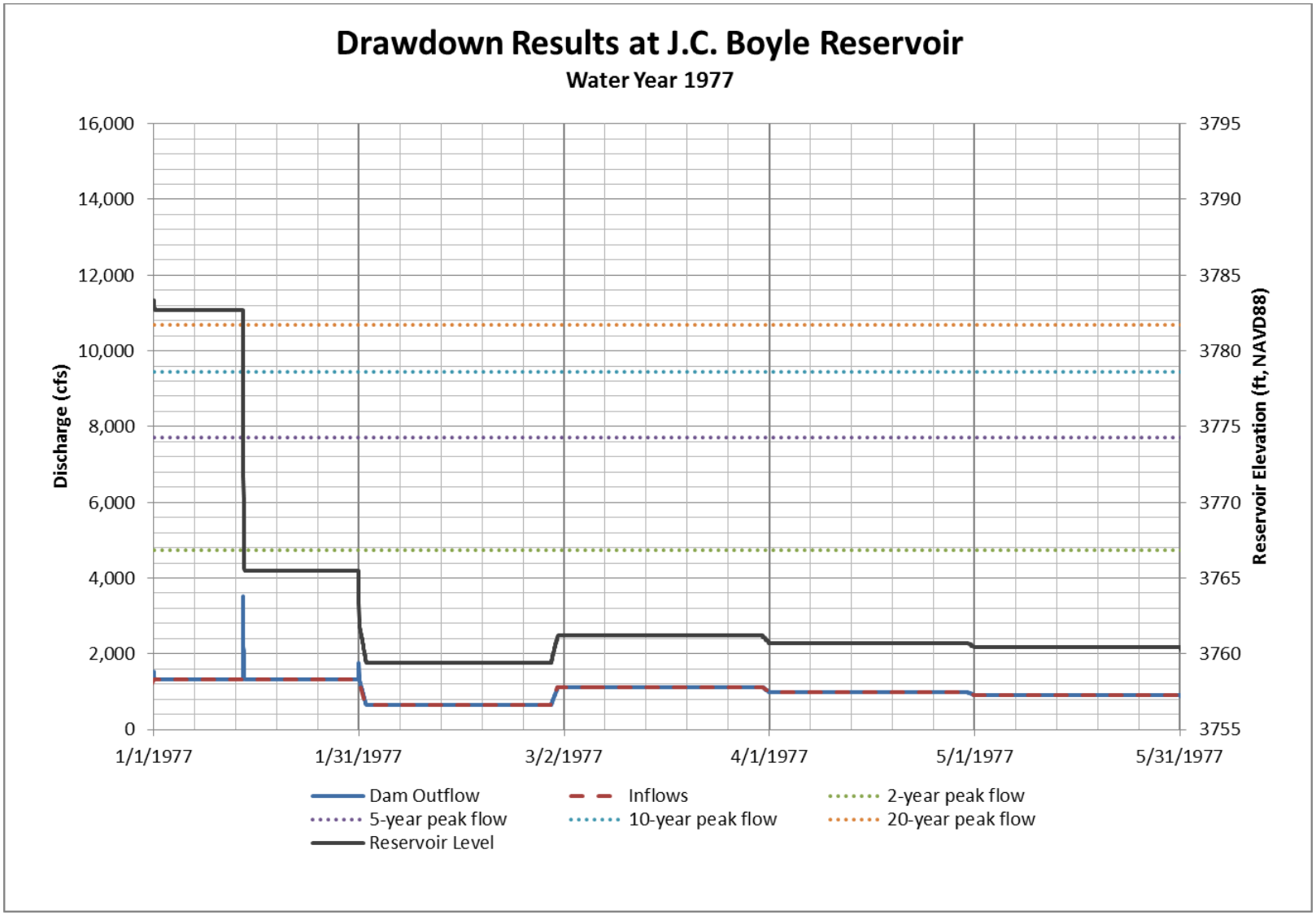

Figure 2-17 J.C. Boyle Reservoir Drawdown, Water Year 1977

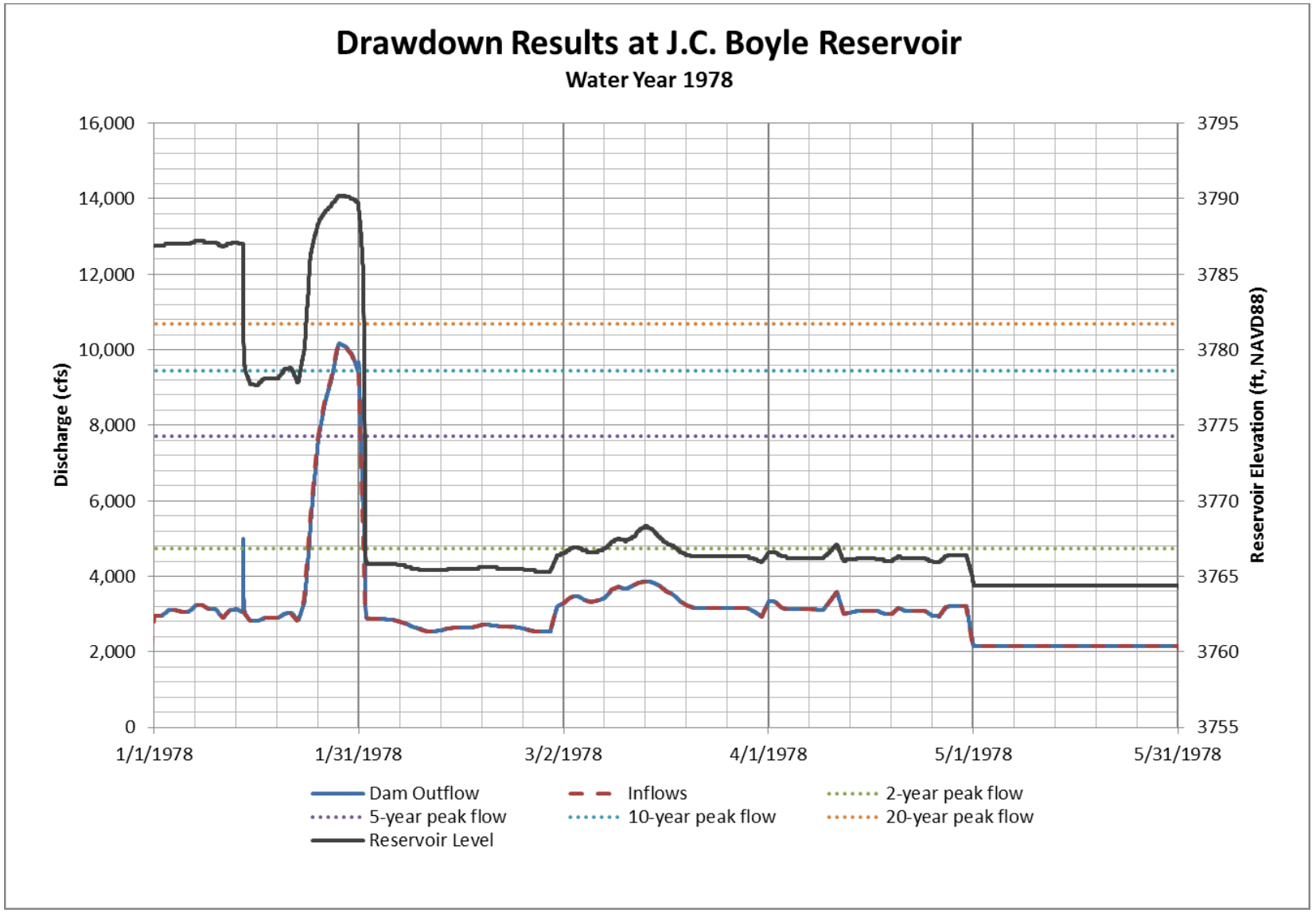

Figure 2-18 J.C. Boyle Reservoir Drawdown, Water Year 1978

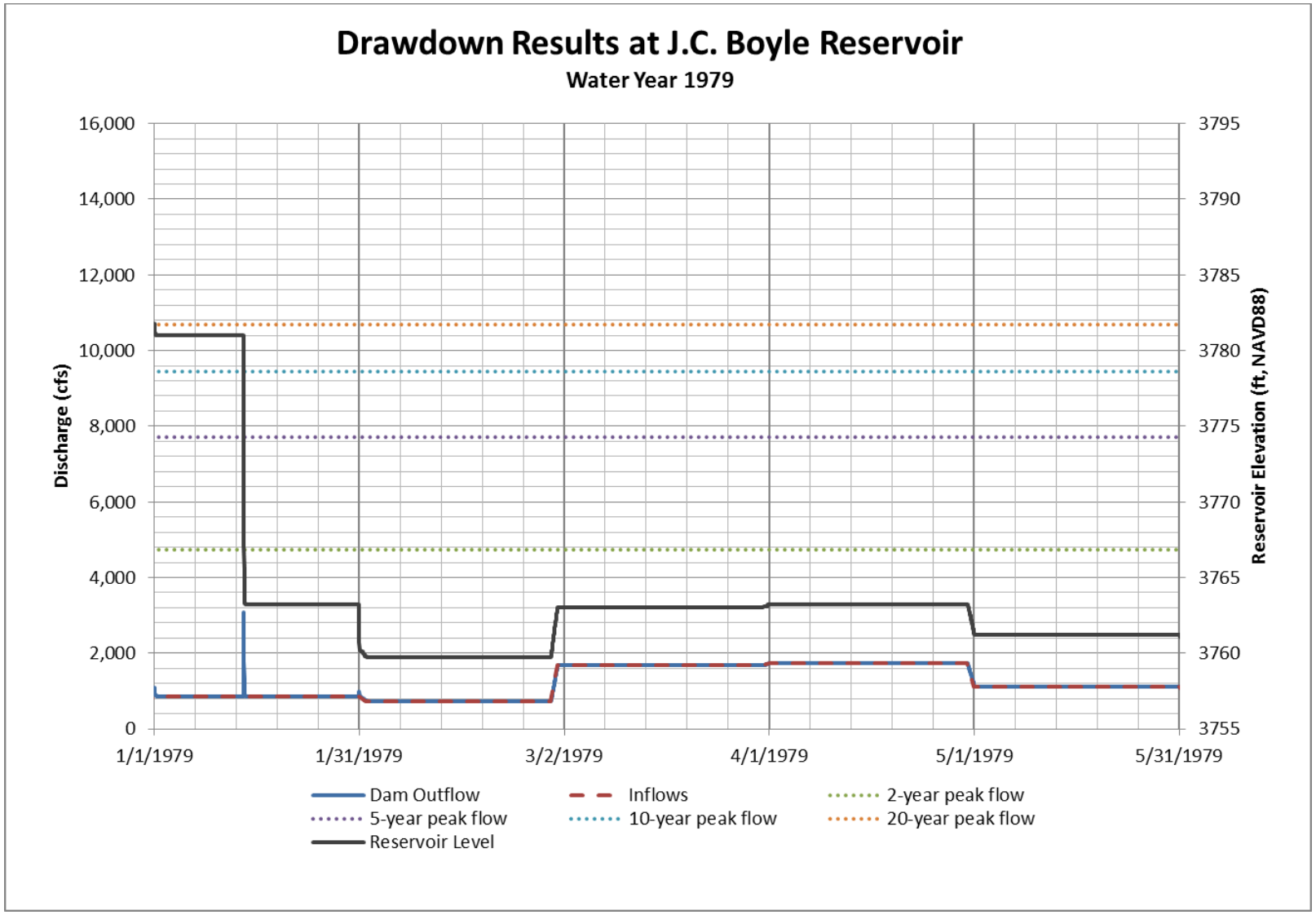

Figure 2-19 J.C. Boyle Reservoir Drawdown, Water Year 1979 (Dry Year)

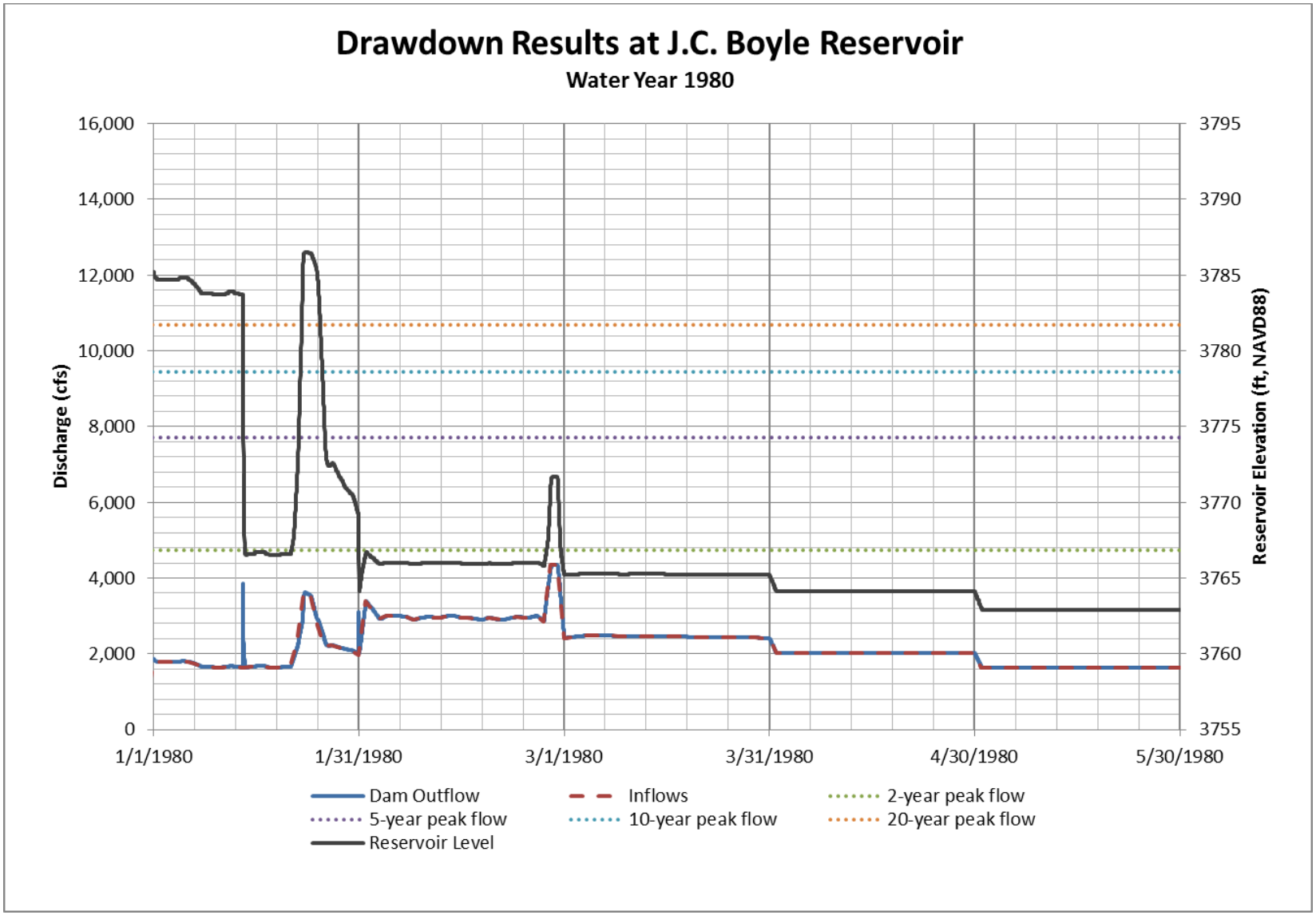

Figure 2-20 J.C. Boyle Reservoir Drawdown, Water Year 1980

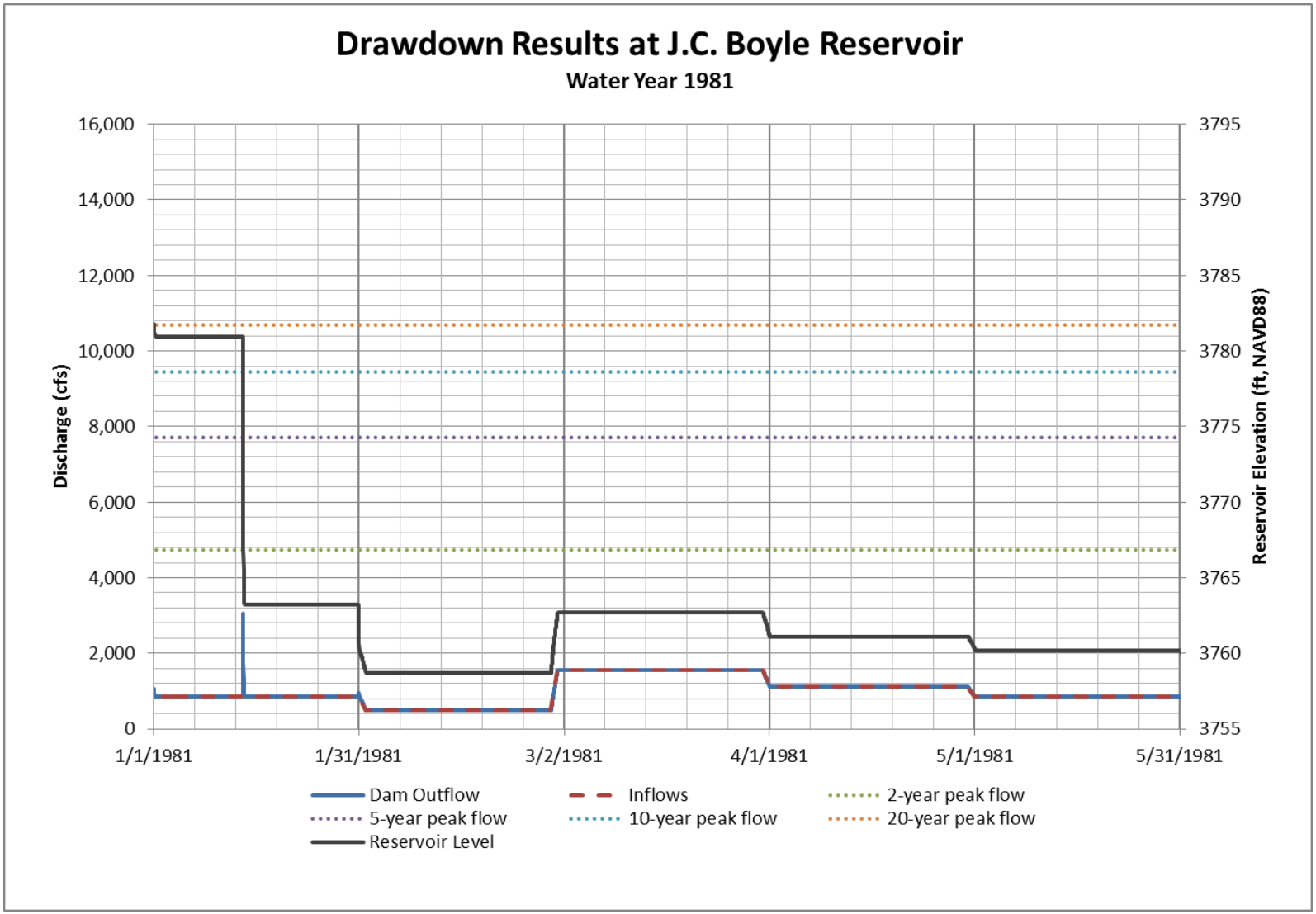

Figure 2-21 J.C. Boyle Reservoir Drawdown, Water Year 1981

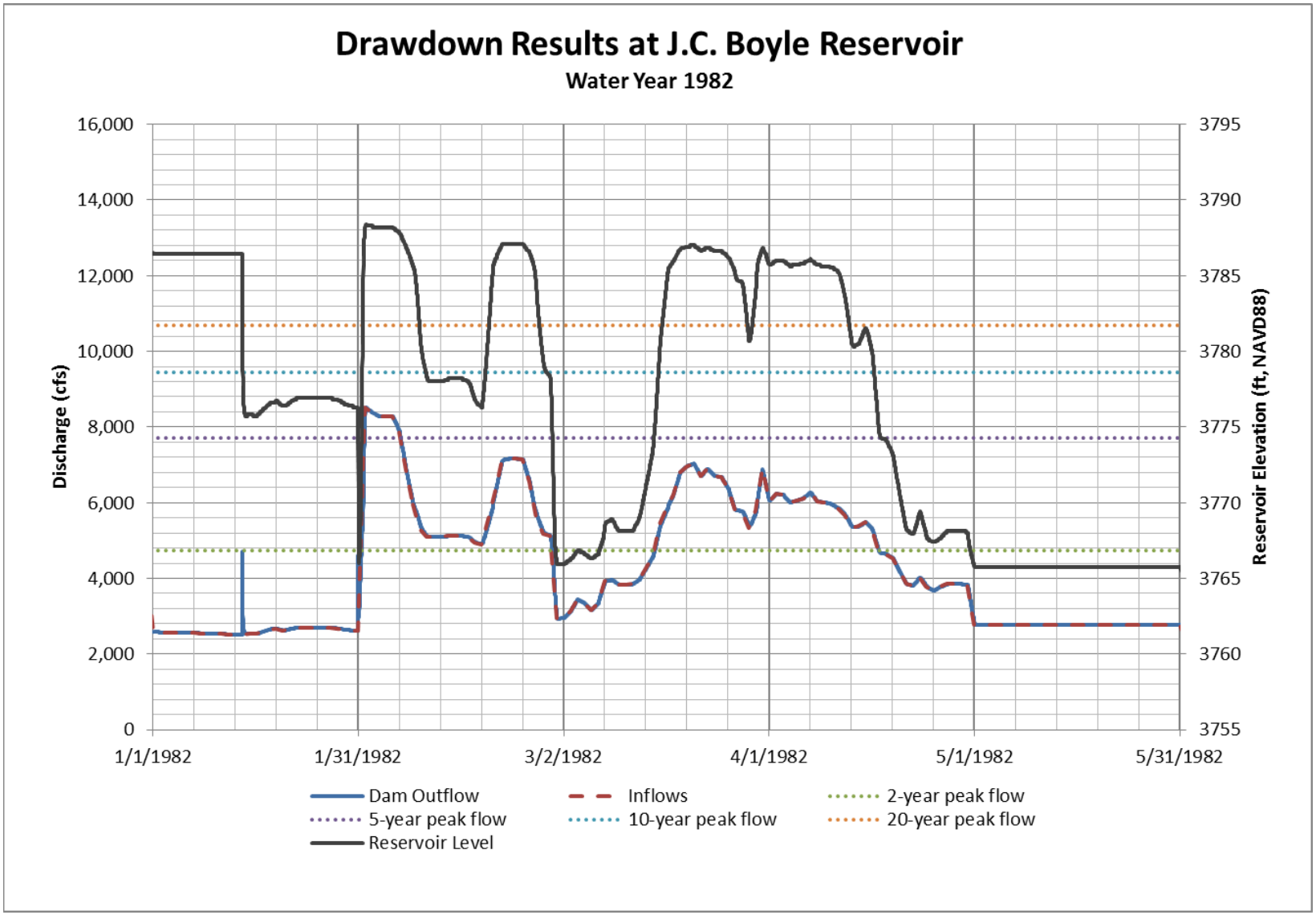

Figure 2-22 J.C. Boyle Reservoir Drawdown, Water Year 1982

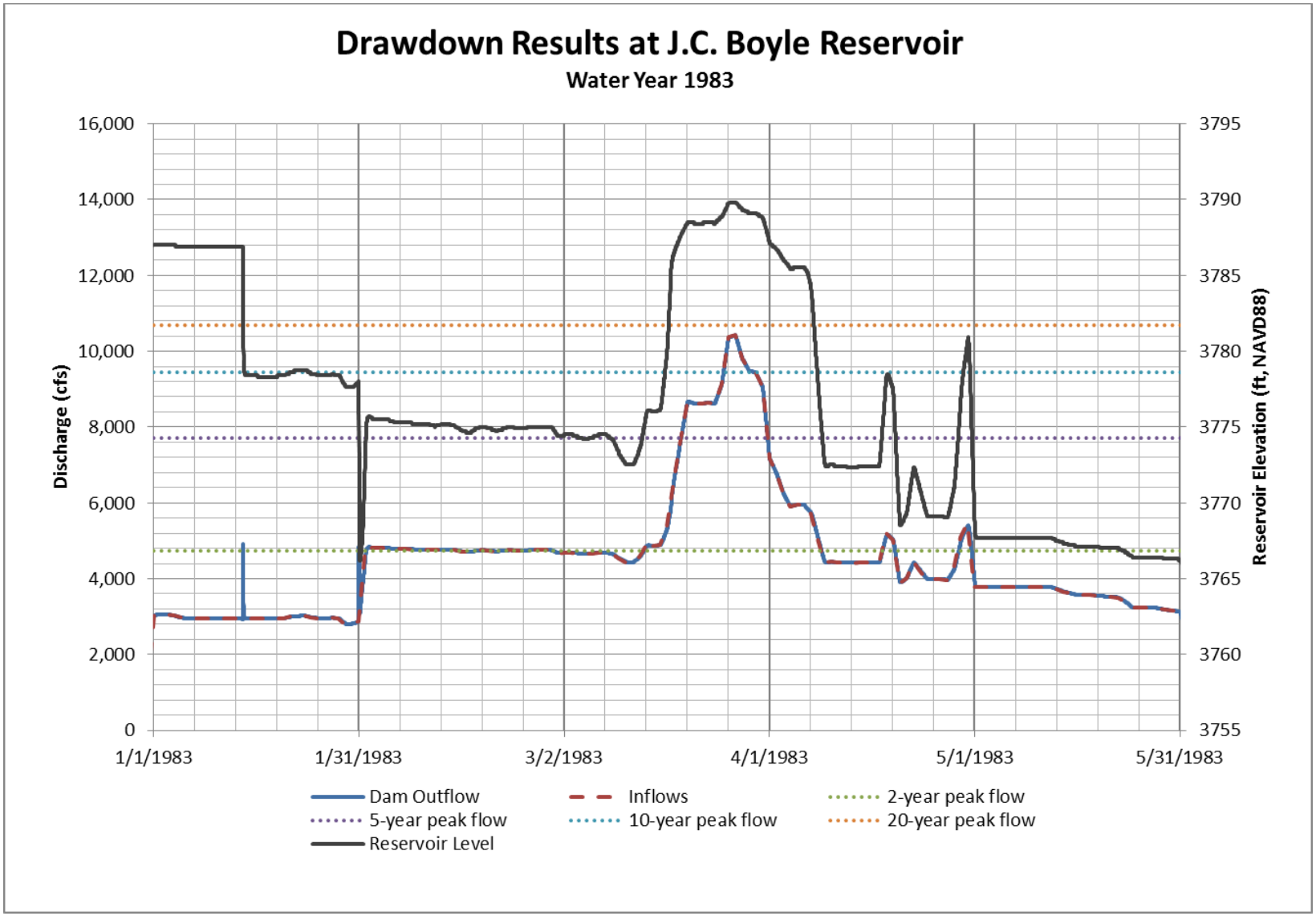

Figure 2-23 J.C. Boyle Reservoir Drawdown, Water Year 1983

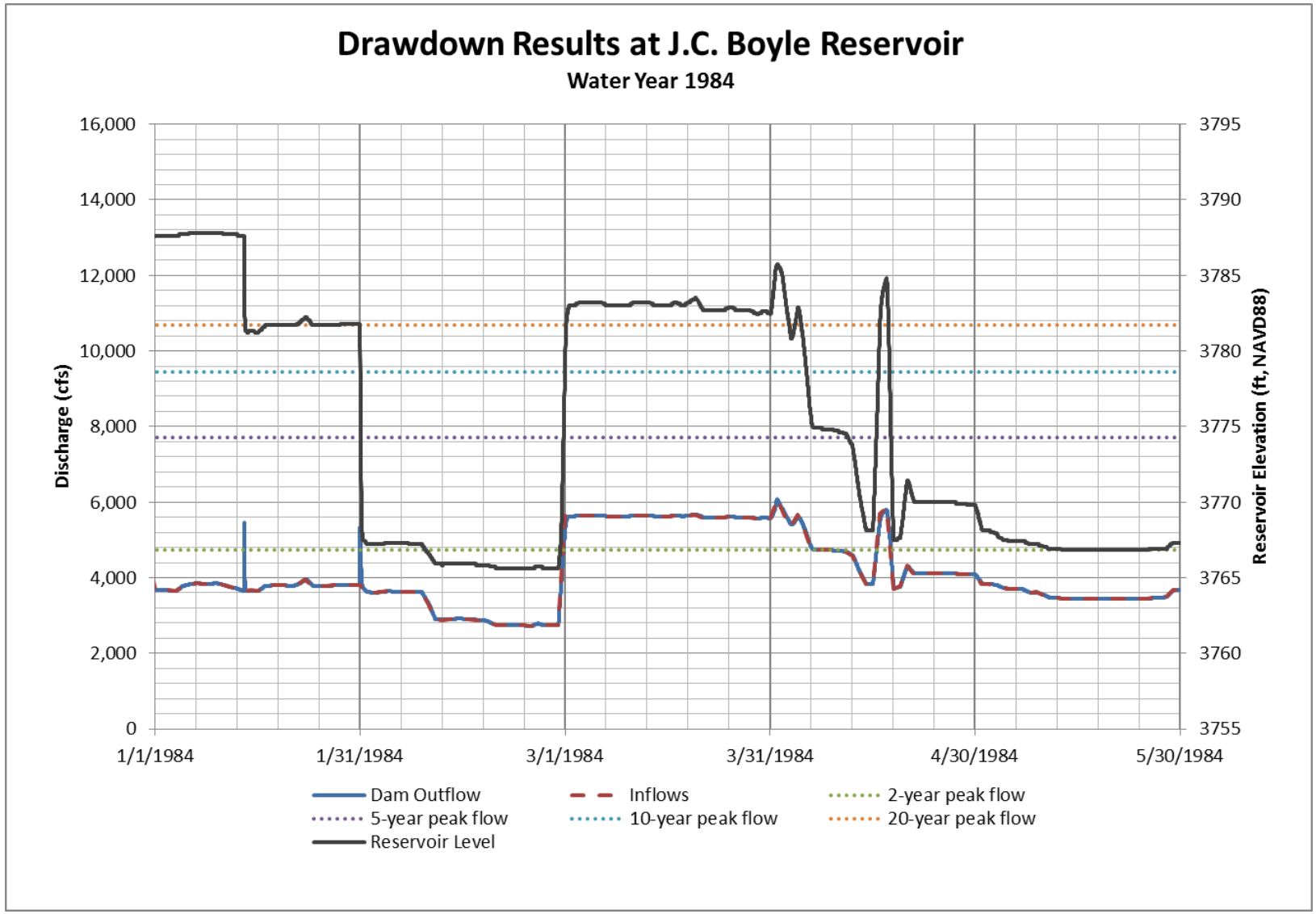

Figure 2-24 J.C. Boyle Reservoir Drawdown, Water Year 1984

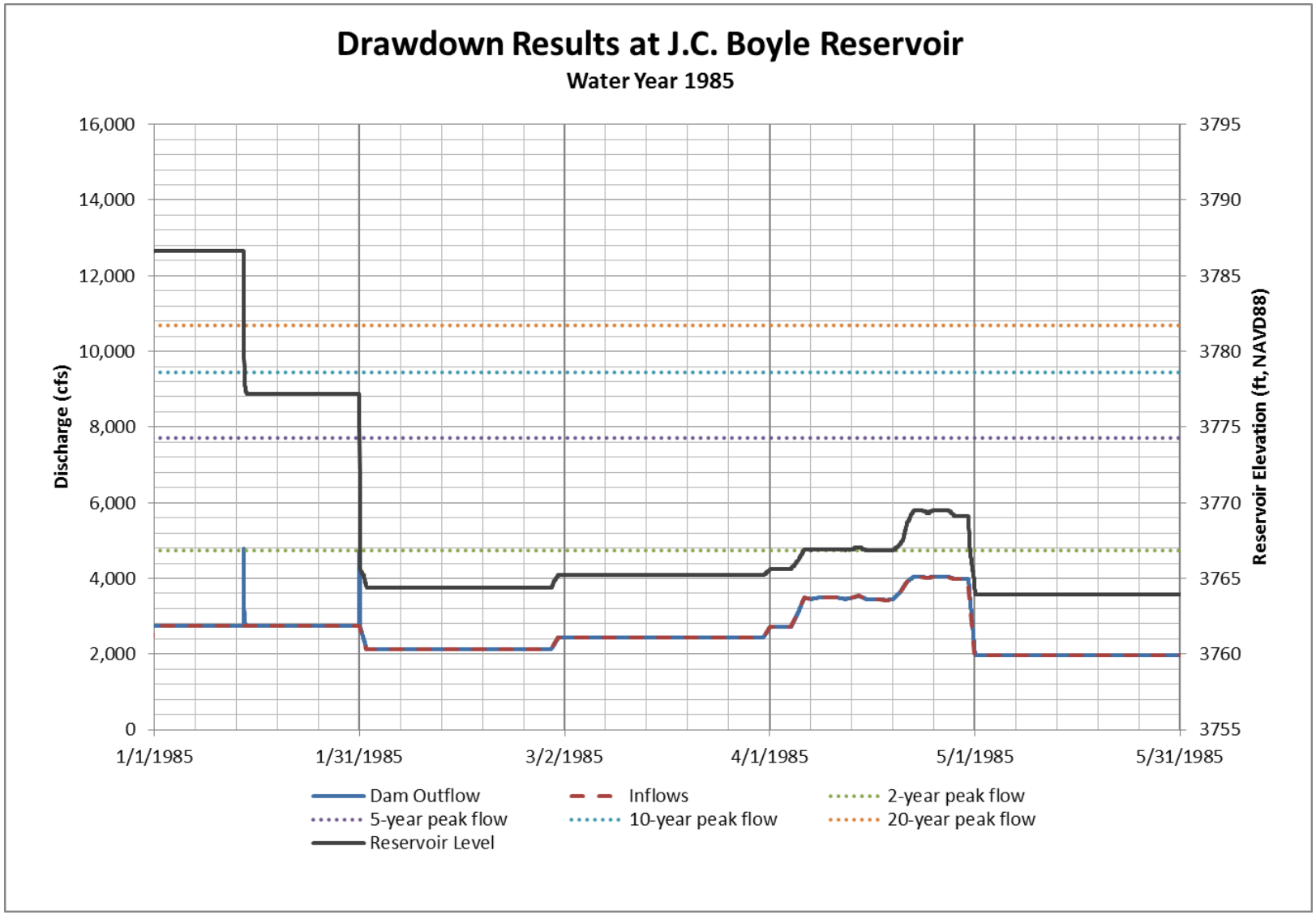

Figure 2-25 J.C. Boyle Reservoir Drawdown, Water Year 1985

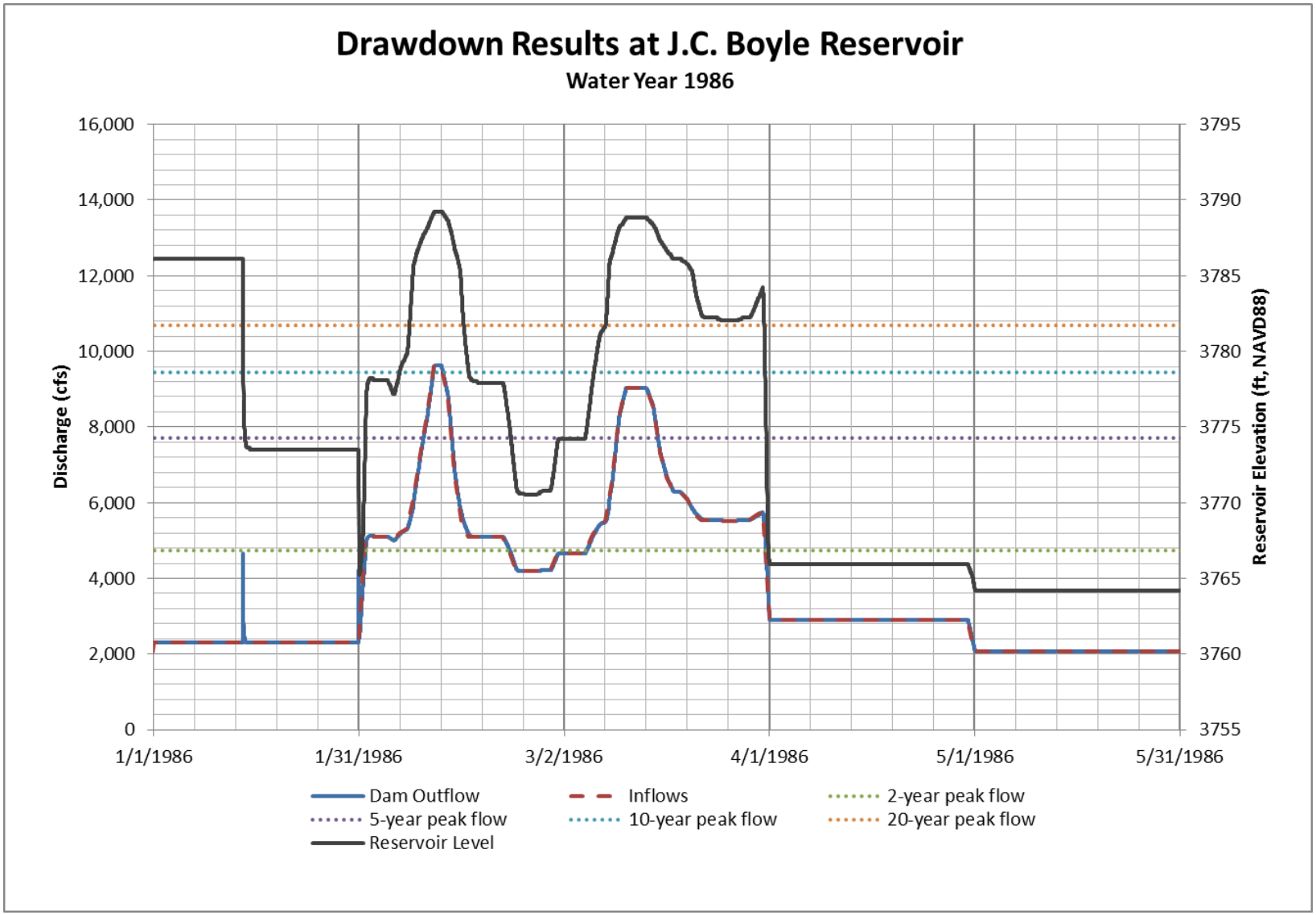

Figure 2-26 J.C. Boyle Reservoir Drawdown, Water Year 1986 (Wet Year)

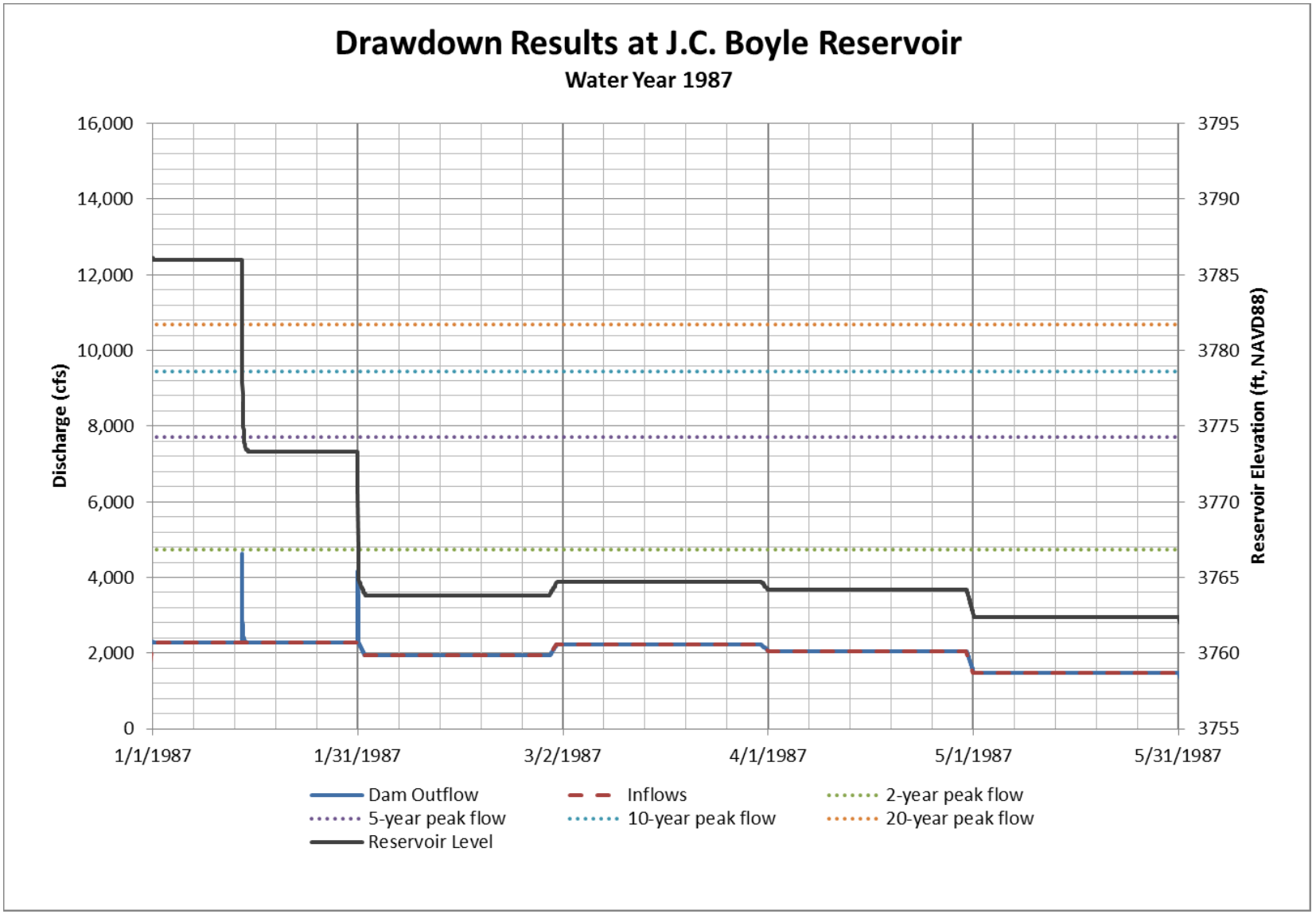

Figure 2-27 J.C. Boyle Reservoir Drawdown, Water Year 1987

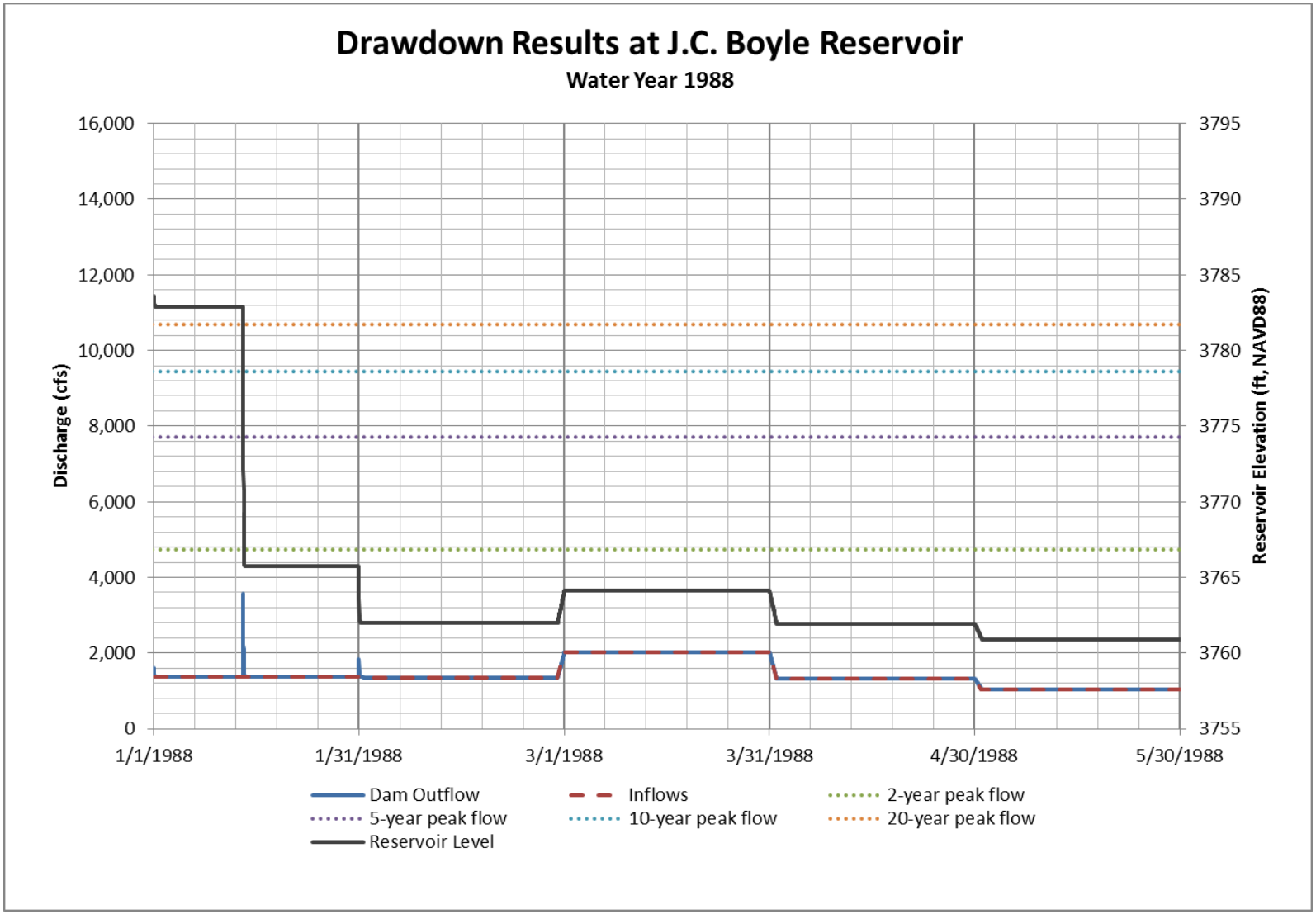

Figure 2-28 J.C. Boyle Reservoir Drawdown, Water Year 1988

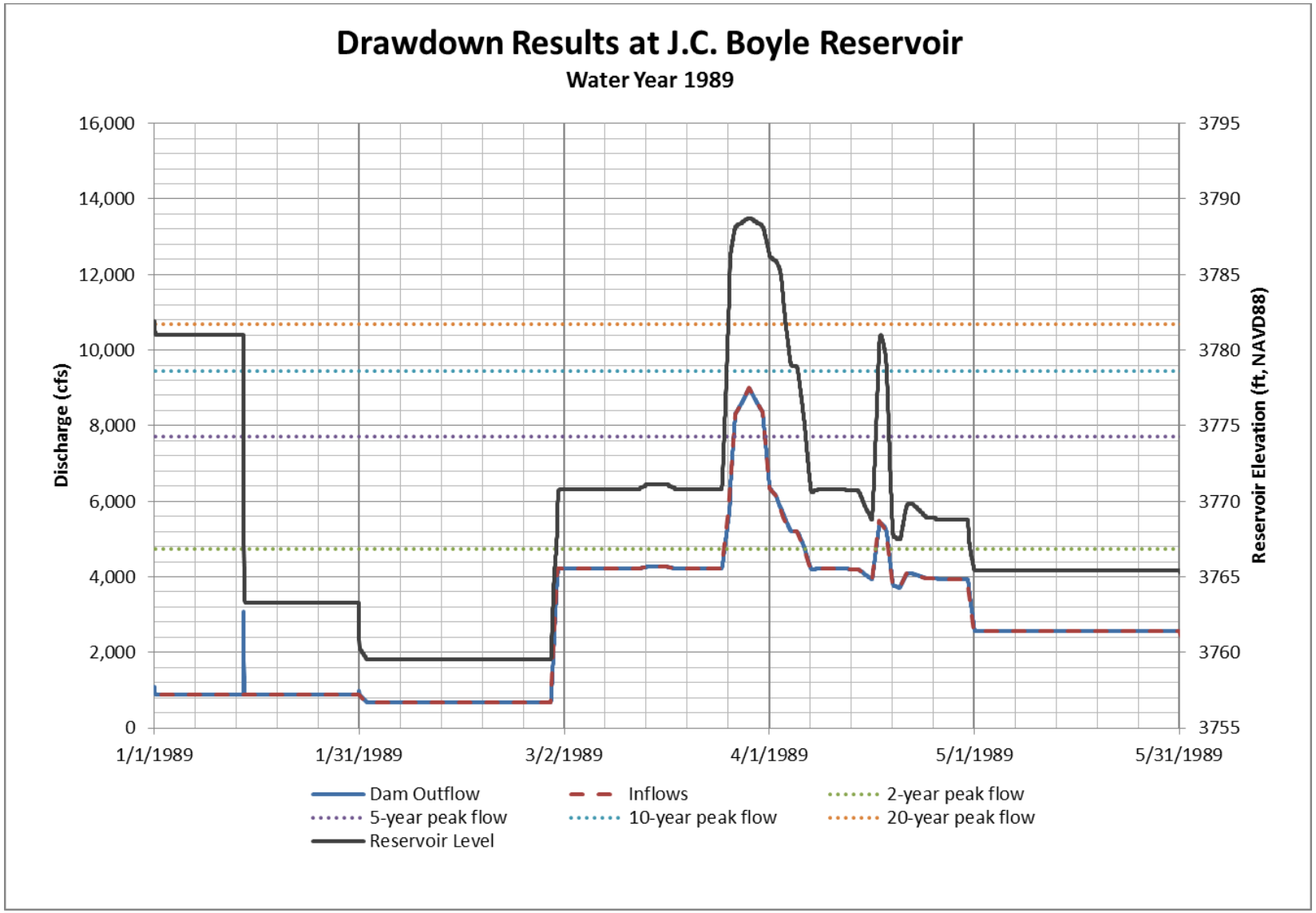

Figure 2-29 J.C. Boyle Reservoir Drawdown, Water Year 1989

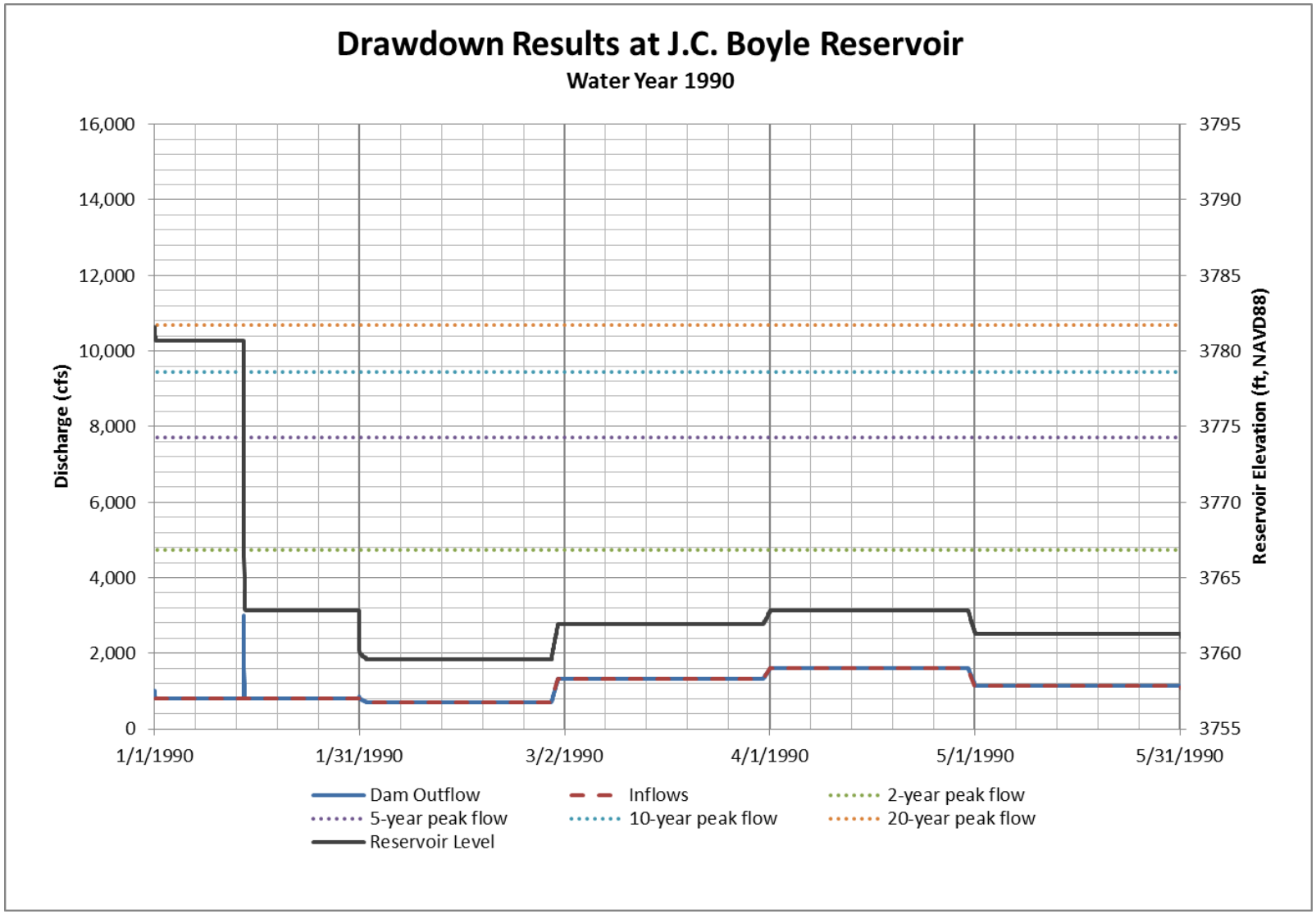

Figure 2-30 J.C. Boyle Reservoir Drawdown, Water Year 1990

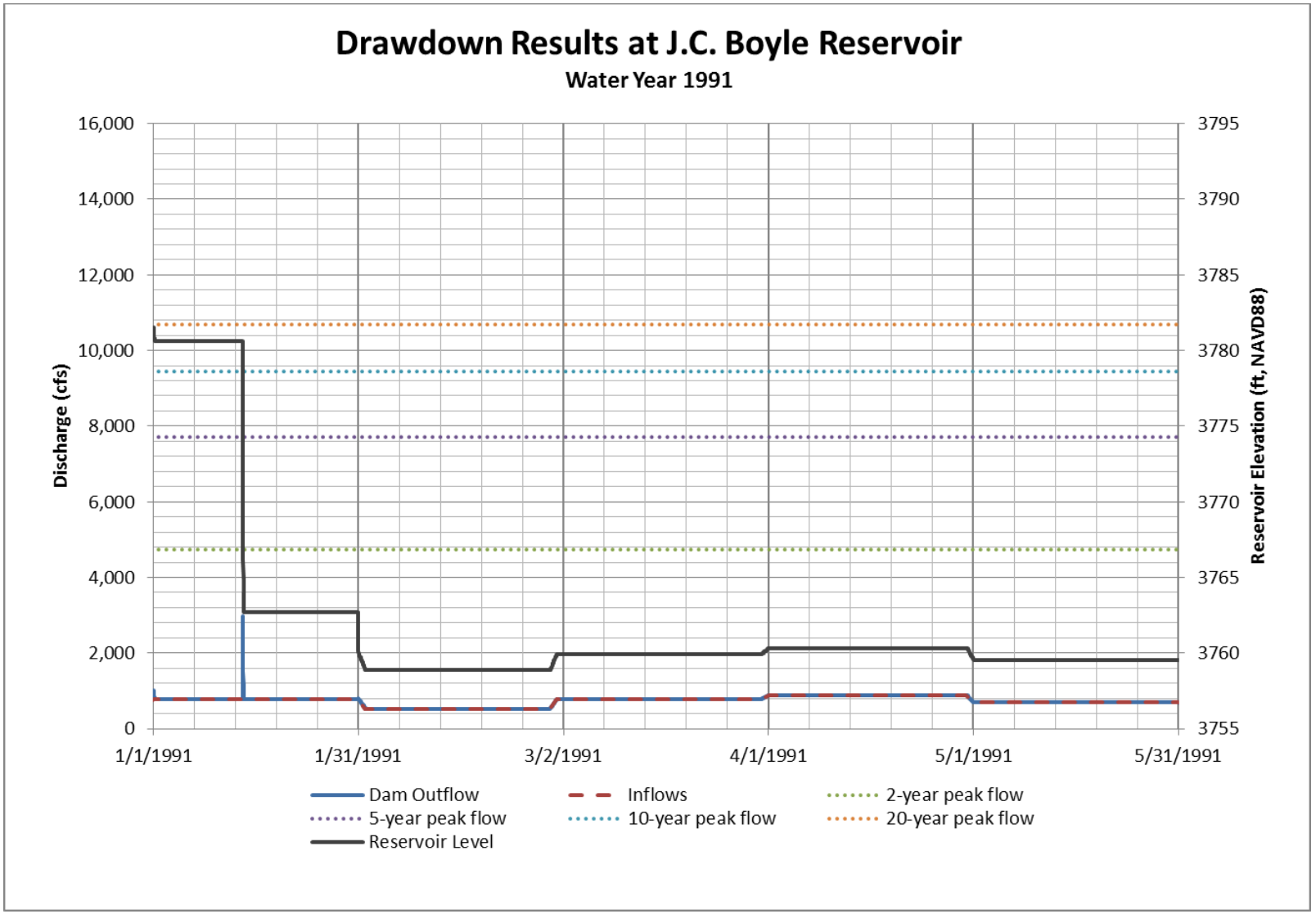

Figure 2-31 J.C. Boyle Reservoir Drawdown, Water Year 1991

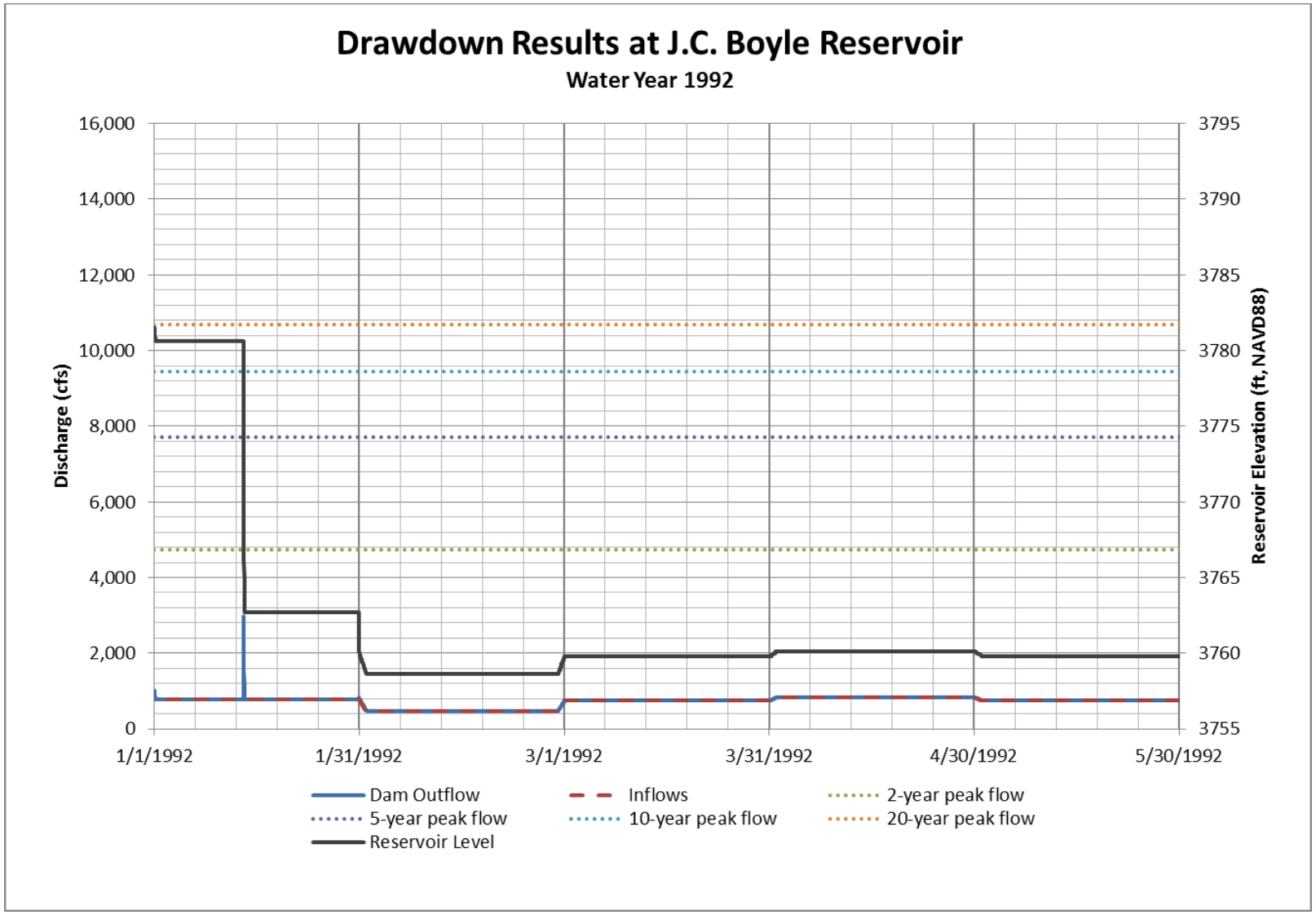

Figure 2-32 J.C. Boyle Reservoir Drawdown, Water Year 1992

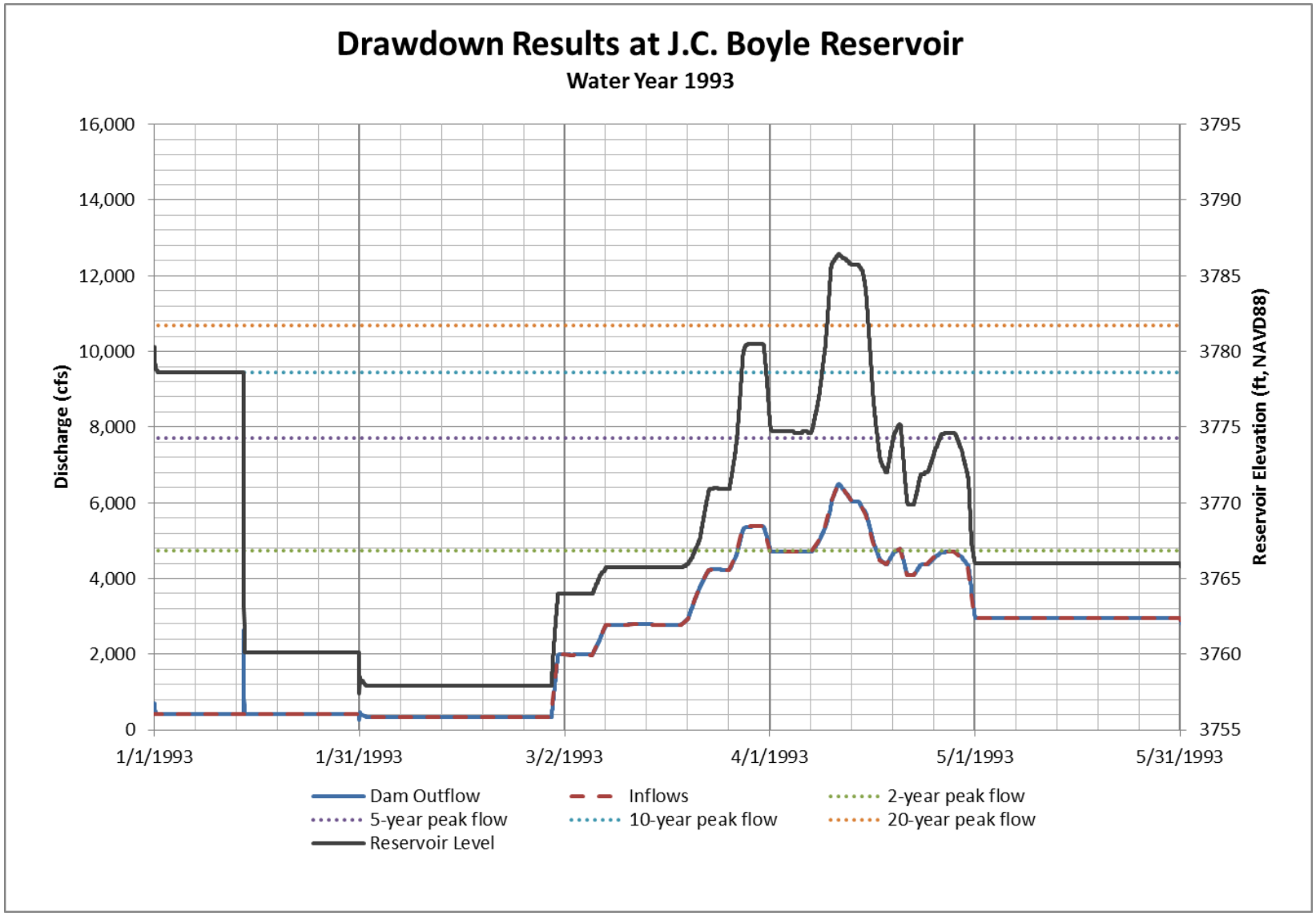

Figure 2-33 J.C. Boyle Reservoir Drawdown, Water Year 1993

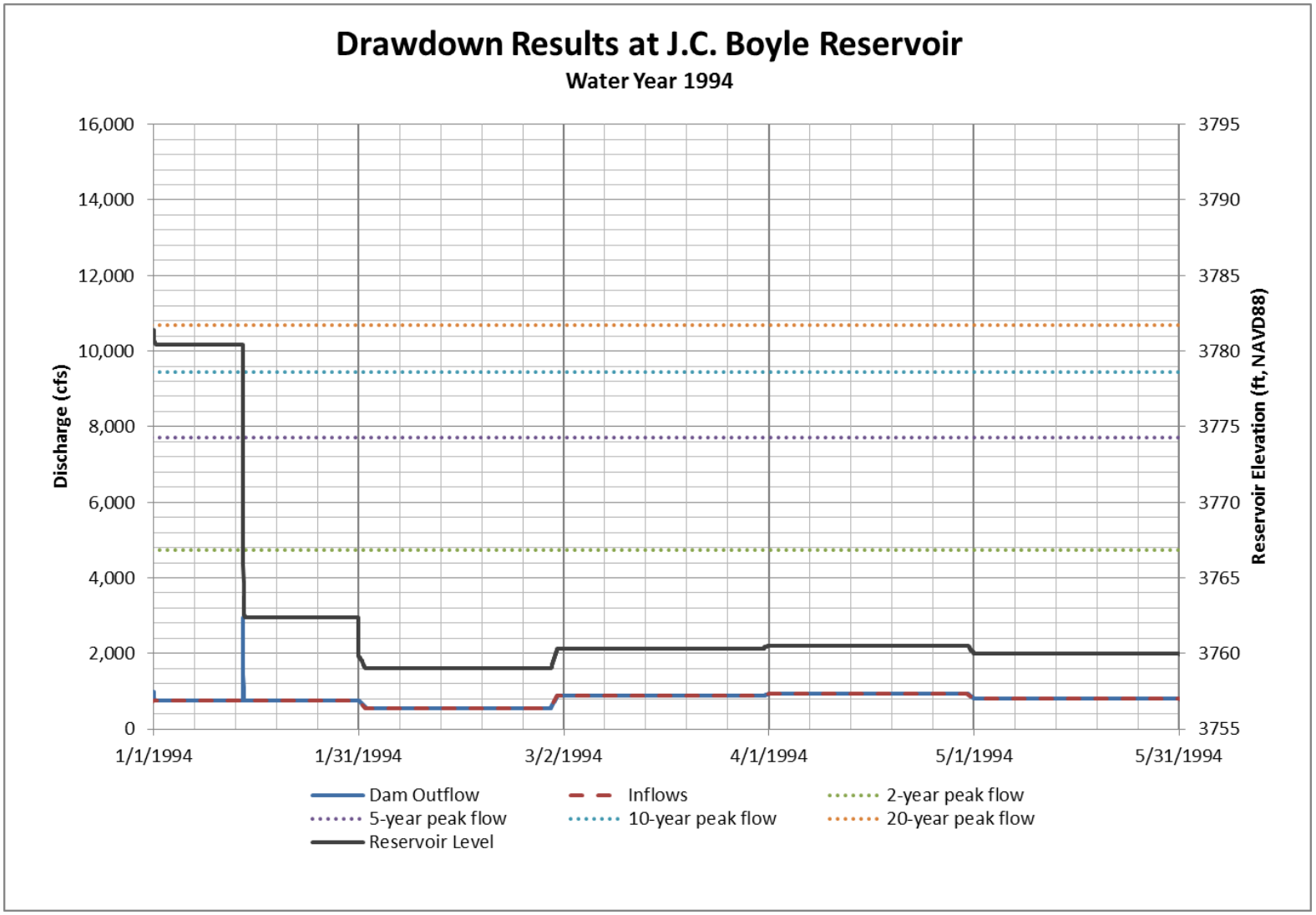

Figure 2-34 J.C. Boyle Reservoir Drawdown, Water Year 1994

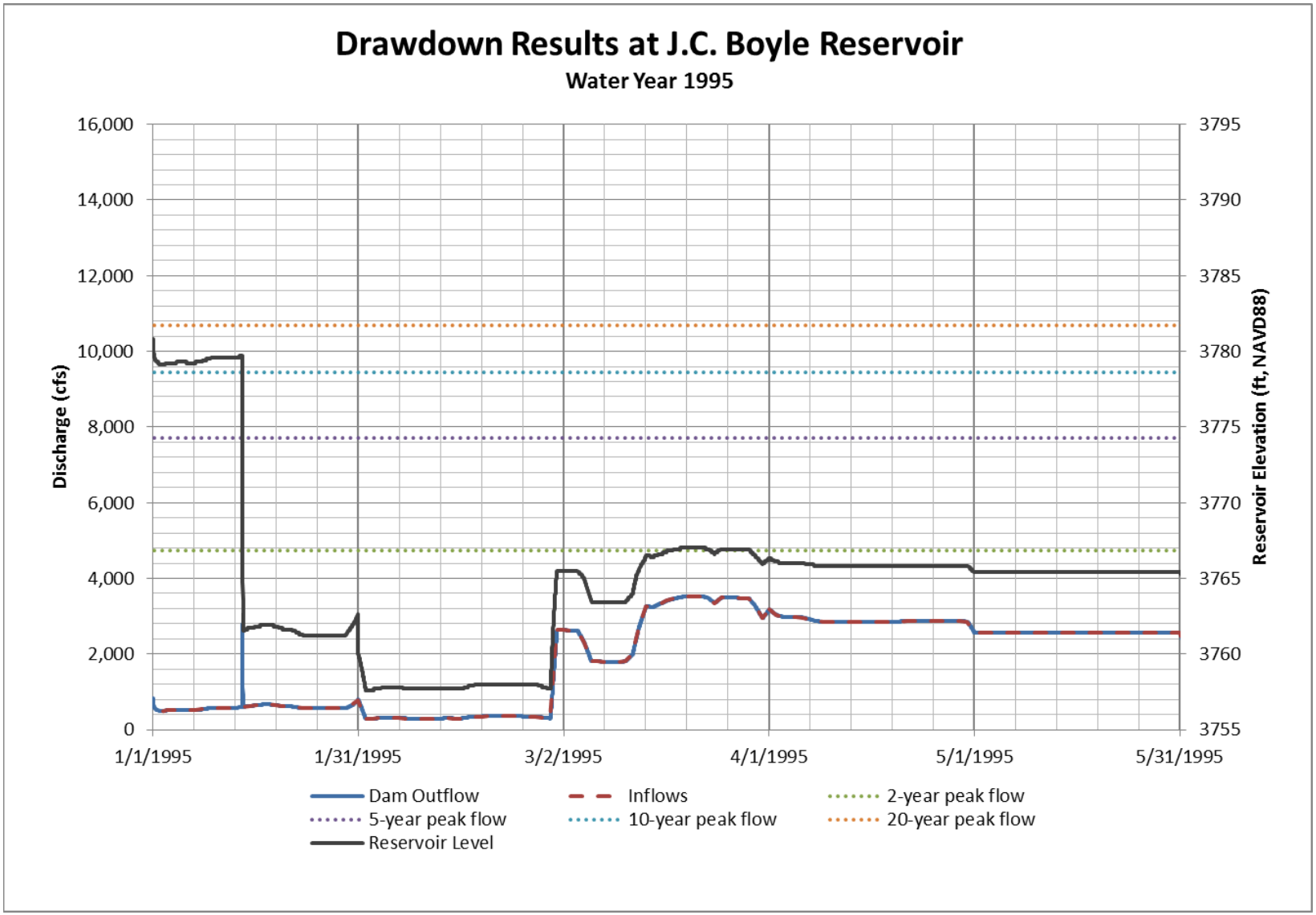

Figure 2-35 J.C. Boyle Reservoir Drawdown, Water Year 1995

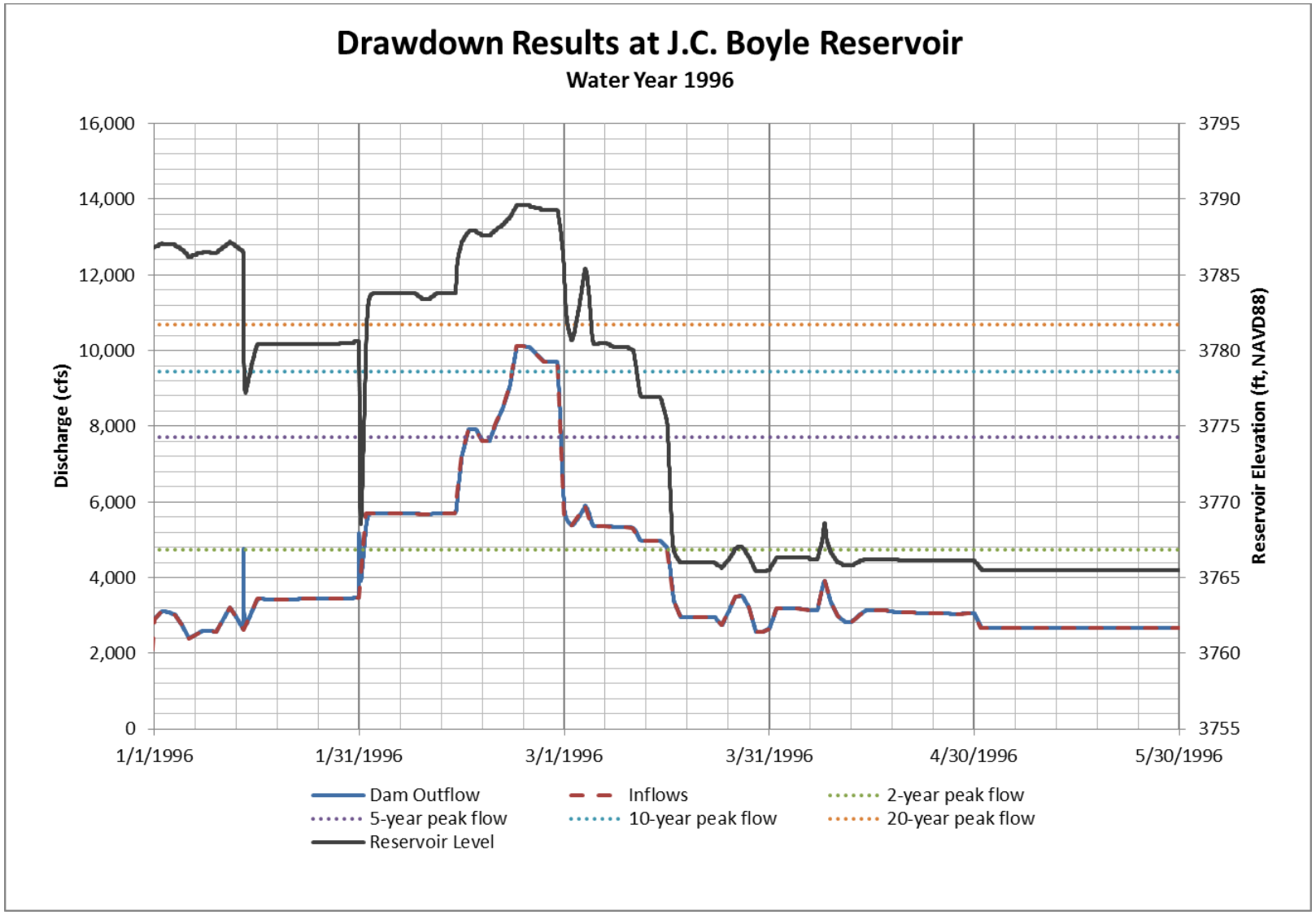

Figure 2-36 J.C. Boyle Reservoir Drawdown, Water Year 1996

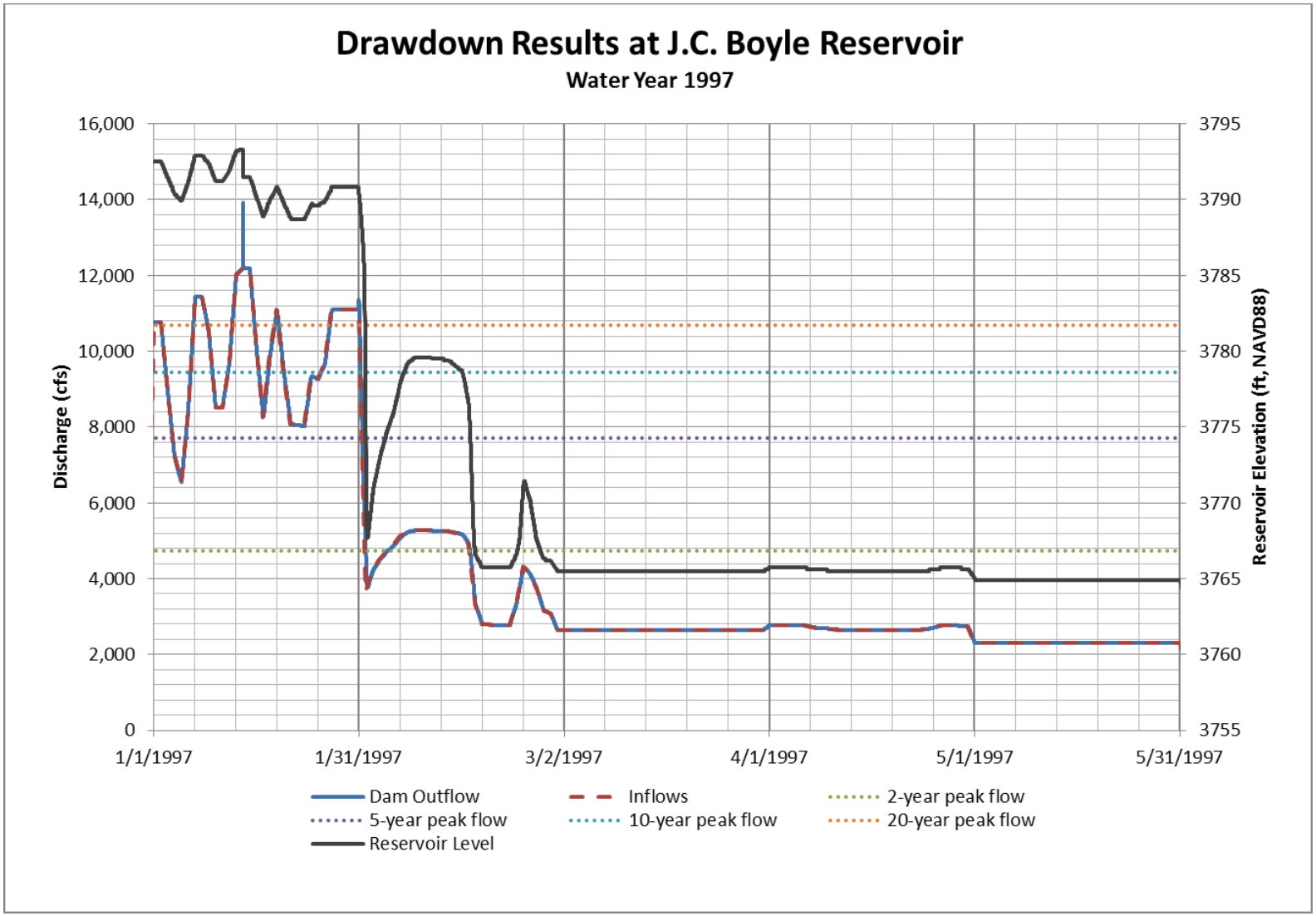

Figure 2-37 J.C. Boyle Reservoir Drawdown, Water Year 1997

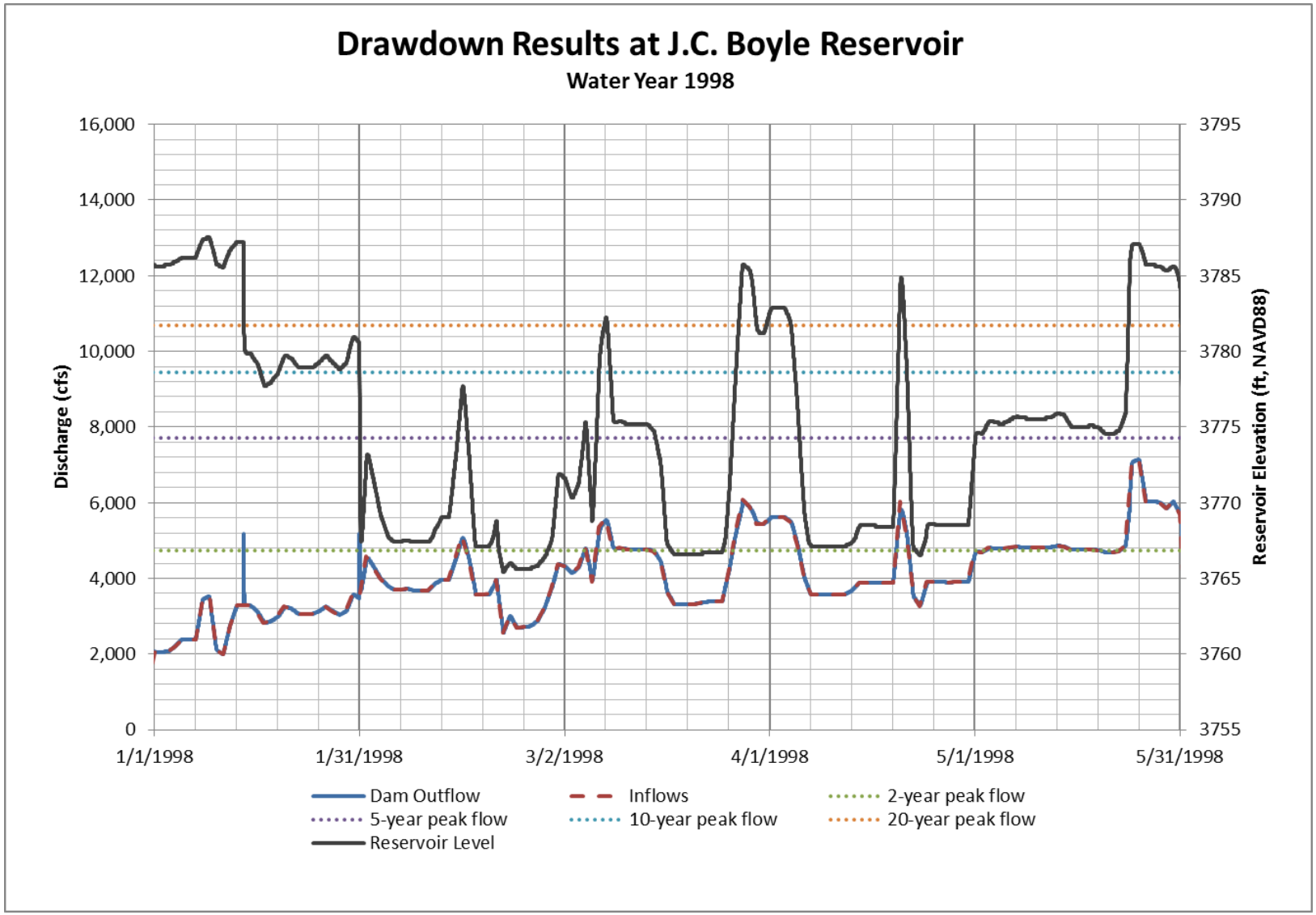

Figure 2-38 J.C. Boyle Reservoir Drawdown, Water Year 1998

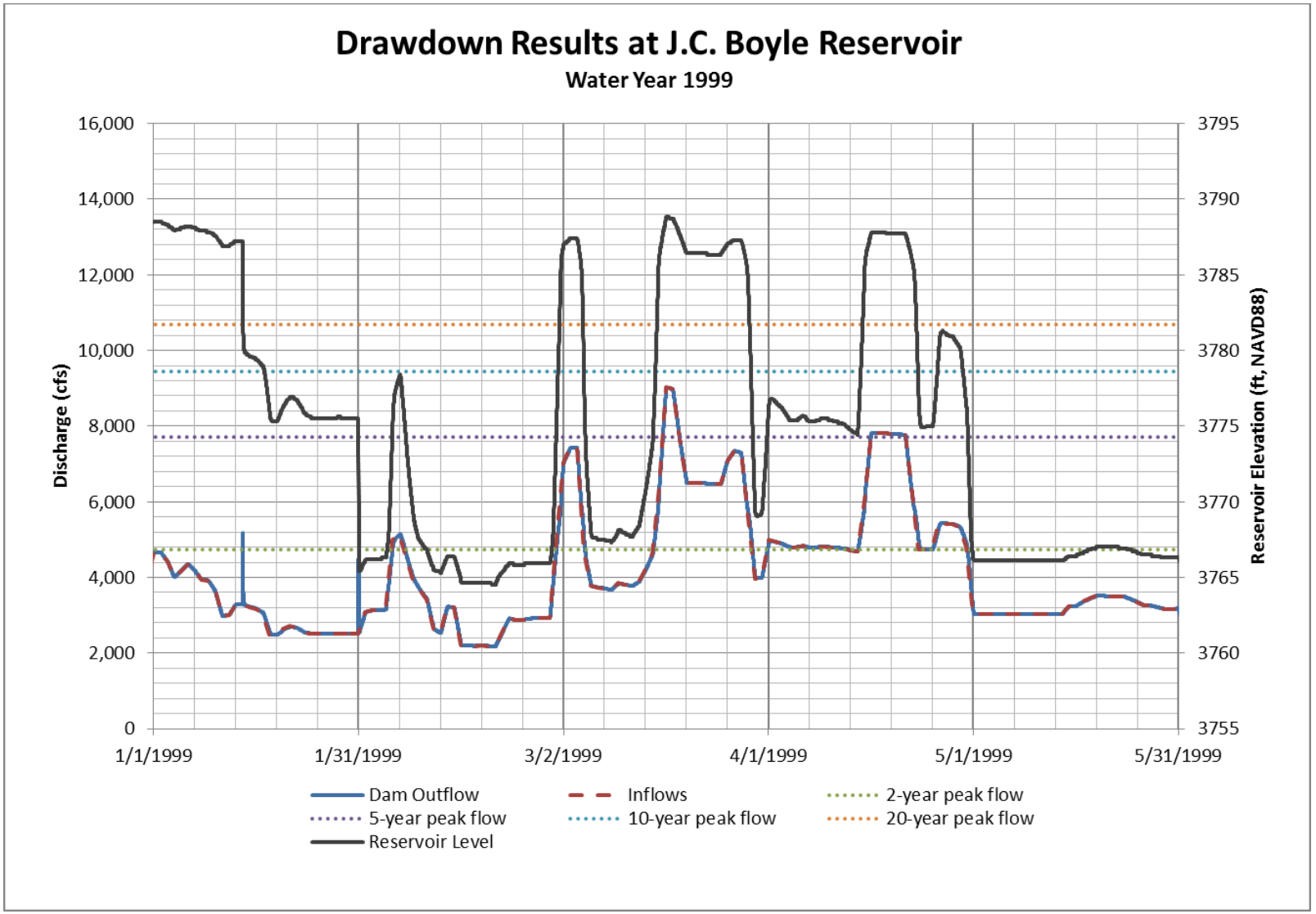

Figure 2-39 J.C. Boyle Reservoir Drawdown, Water Year 1999

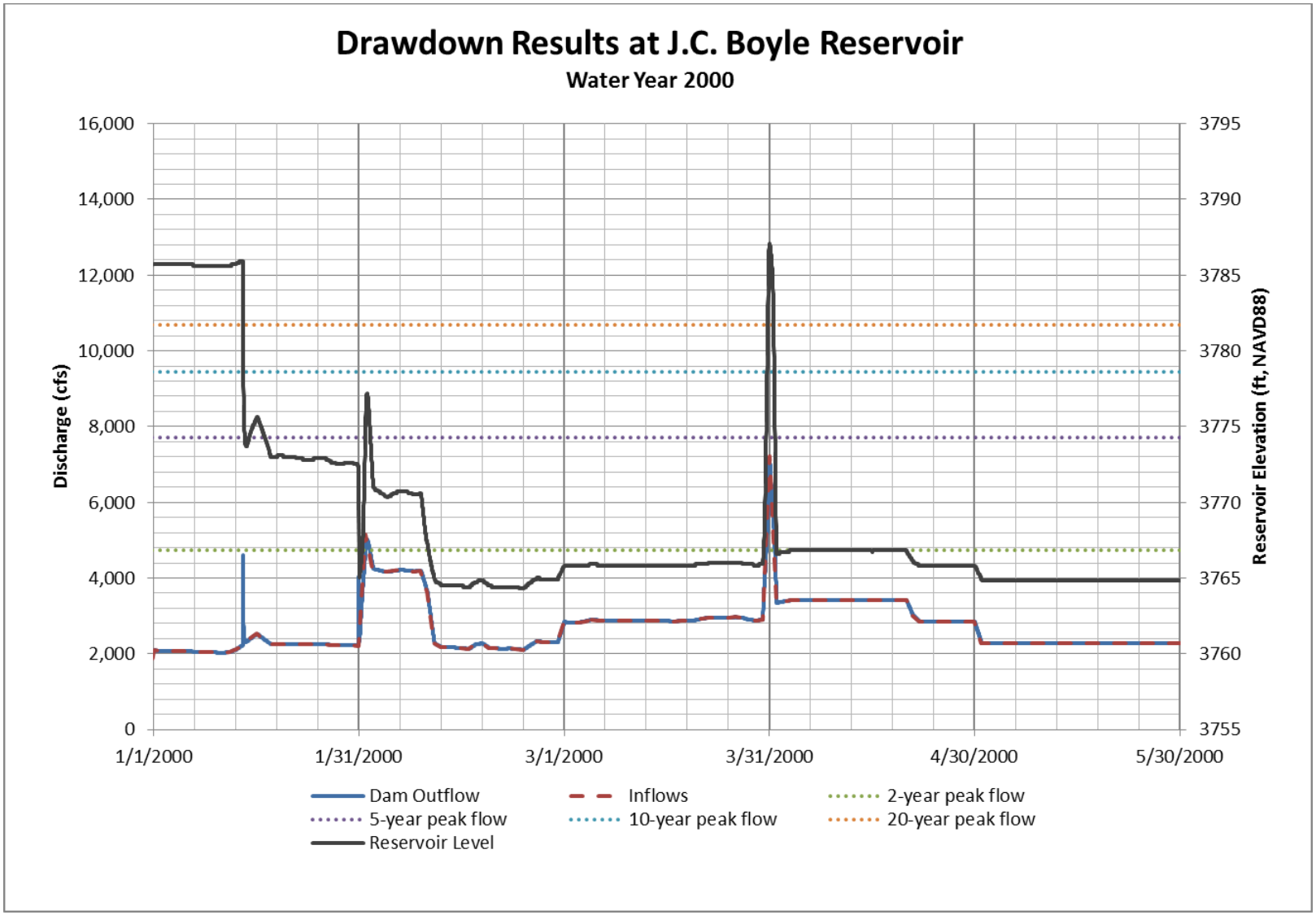

Figure 2-40 J.C. Boyle Reservoir Drawdown, Water Year 2000

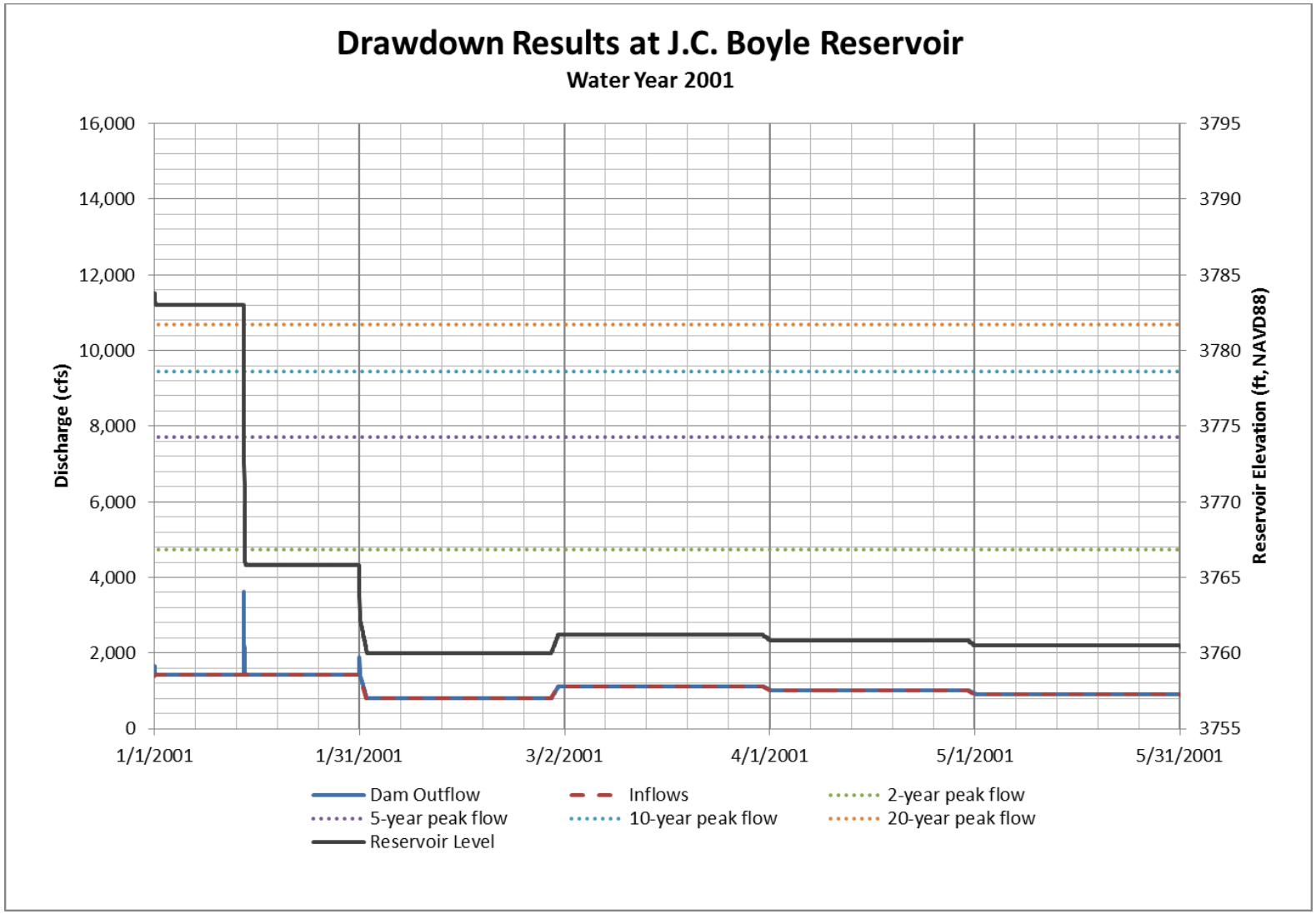

Figure 2-41 J.C. Boyle Reservoir Drawdown, Water Year 2001

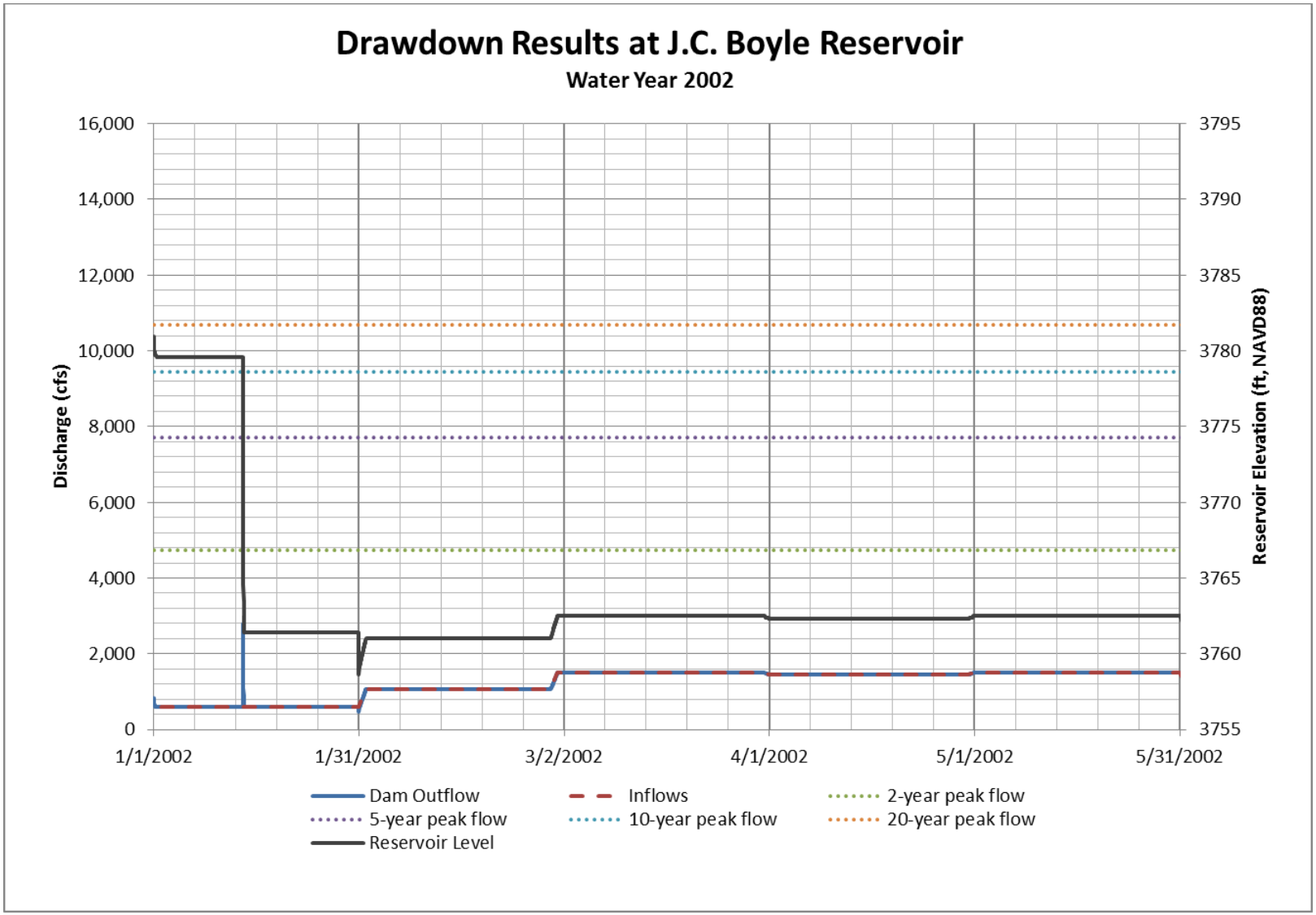

Figure 2-42 J.C. Boyle Reservoir Drawdown, Water Year 2002

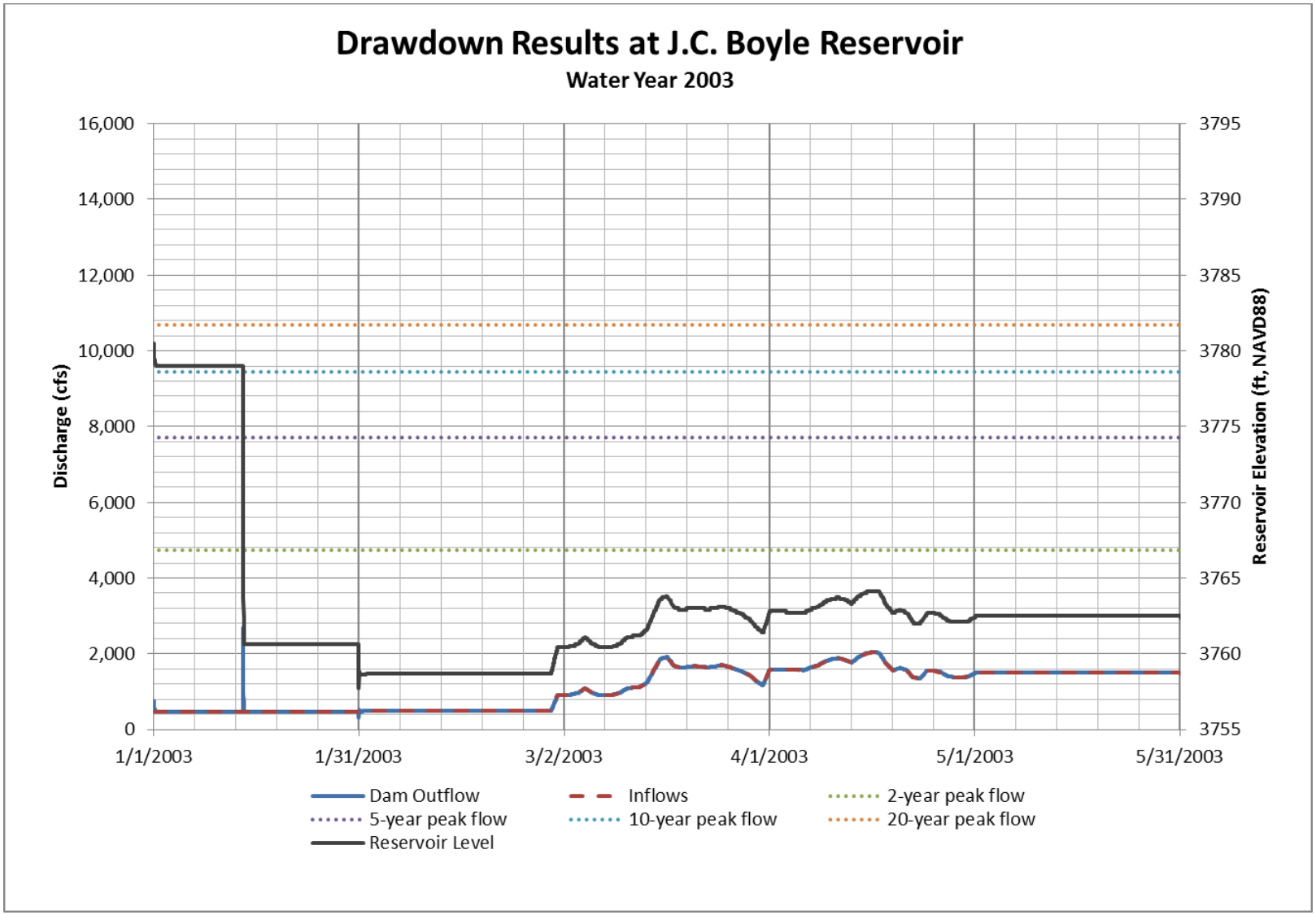

Figure 2-43 J.C. Boyle Reservoir Drawdown, Water Year 2003

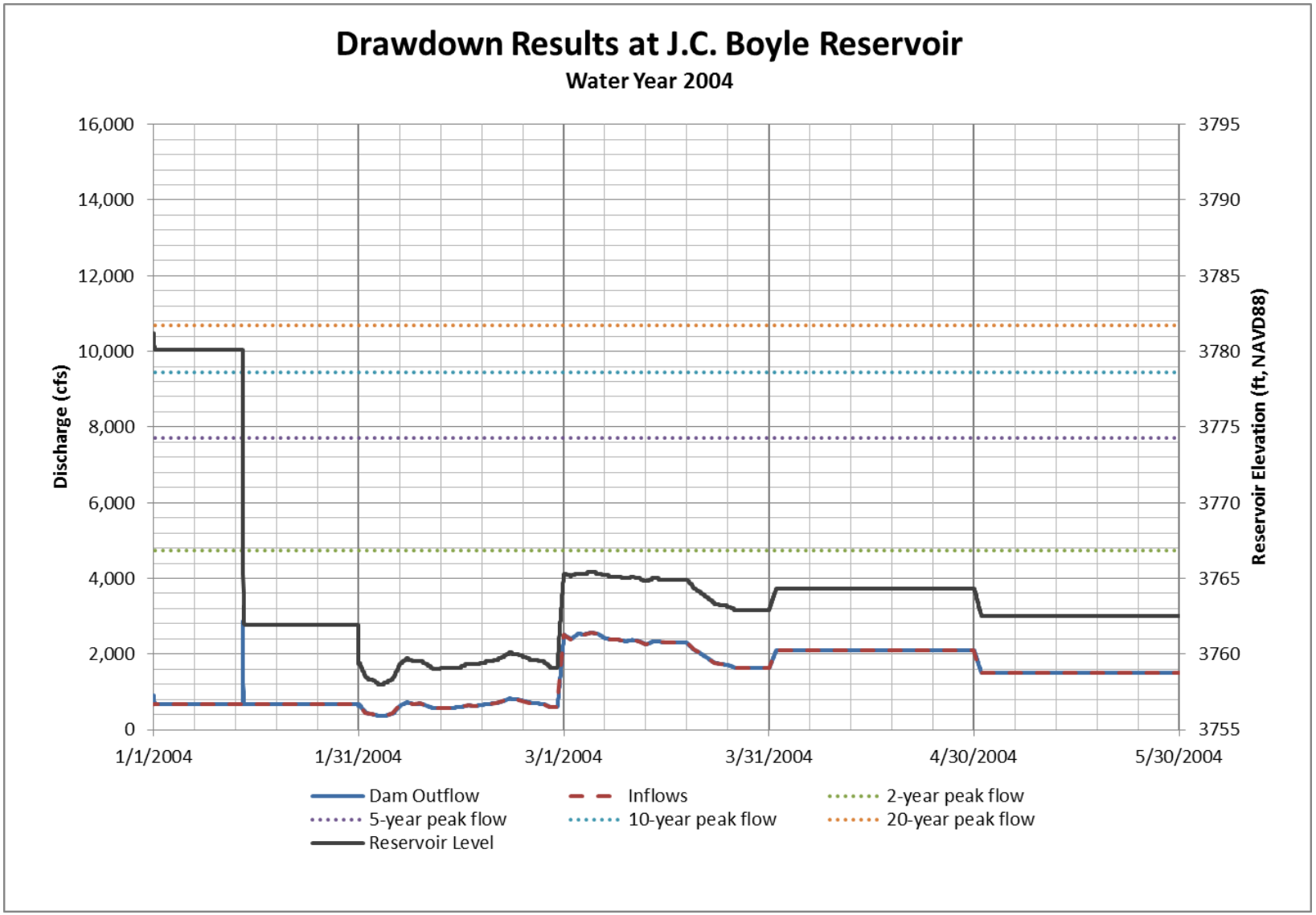

Figure 2-44 J.C. Boyle Reservoir Drawdown, Water Year 2004

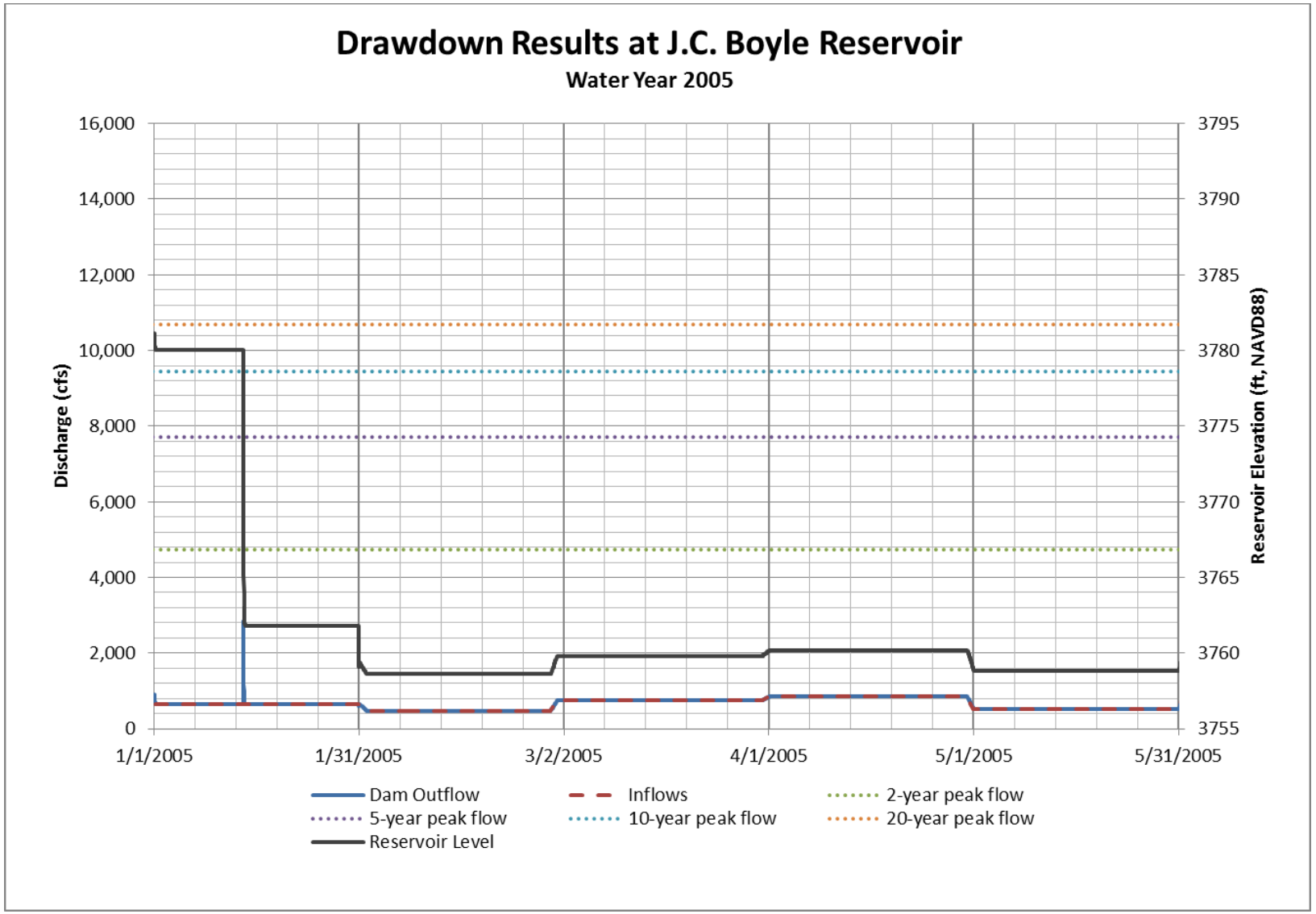

Figure 2-45 J.C. Boyle Reservoir Drawdown, Water Year 2005

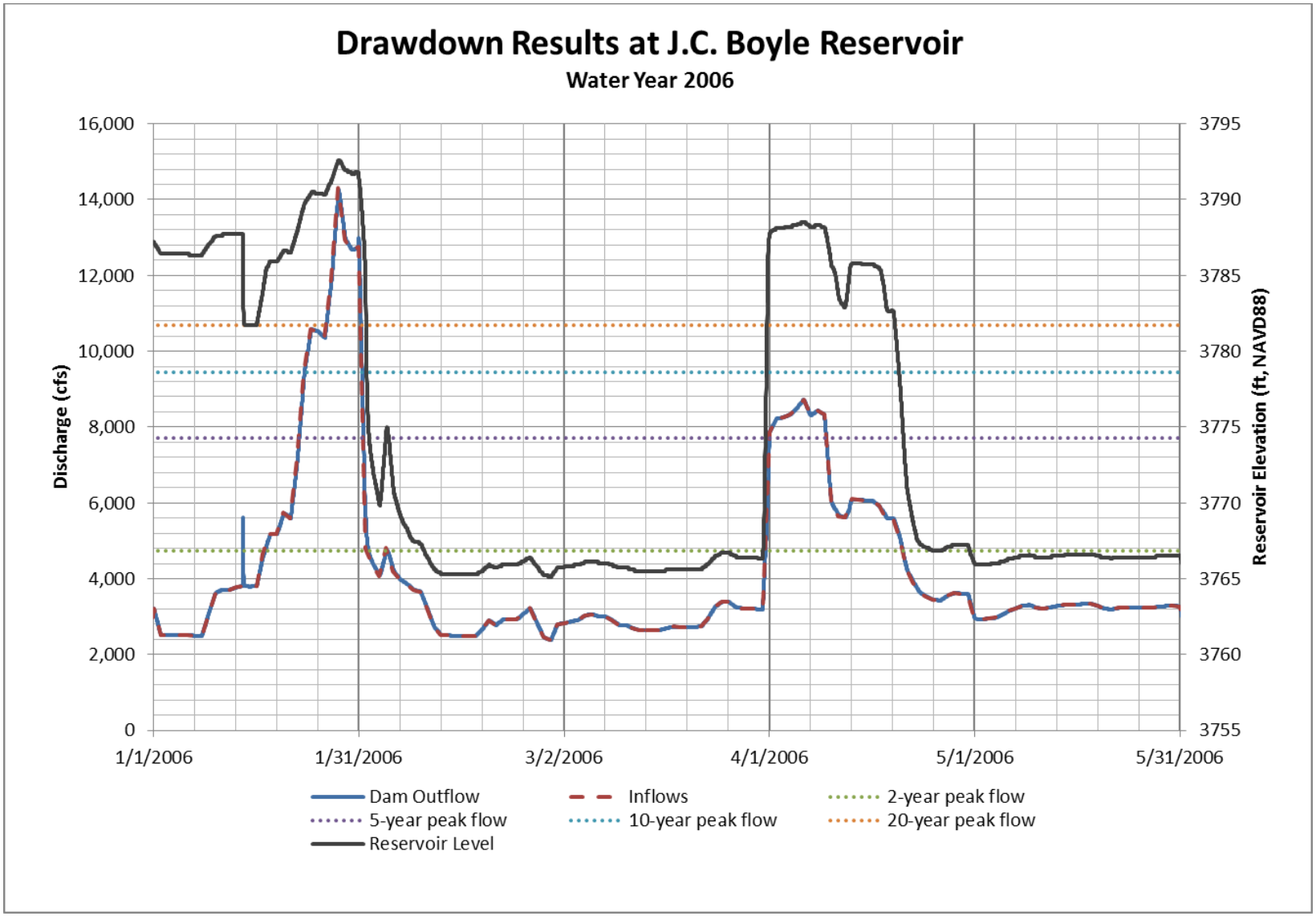

Figure 2-46 J.C. Boyle Reservoir Drawdown, Water Year 2006 (Wet Year)

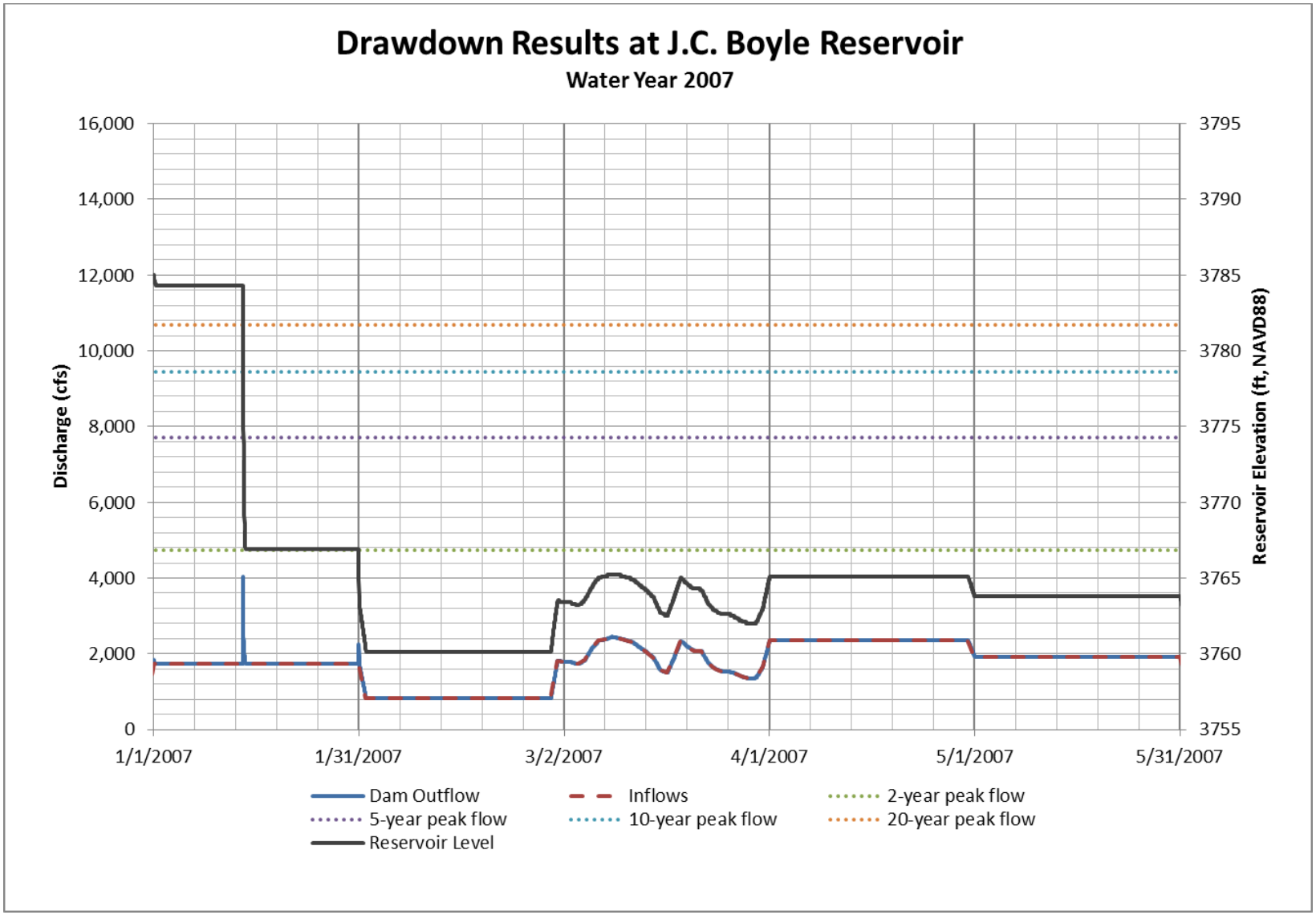

Figure 2-47 J.C. Boyle Reservoir Drawdown, Water Year 2007

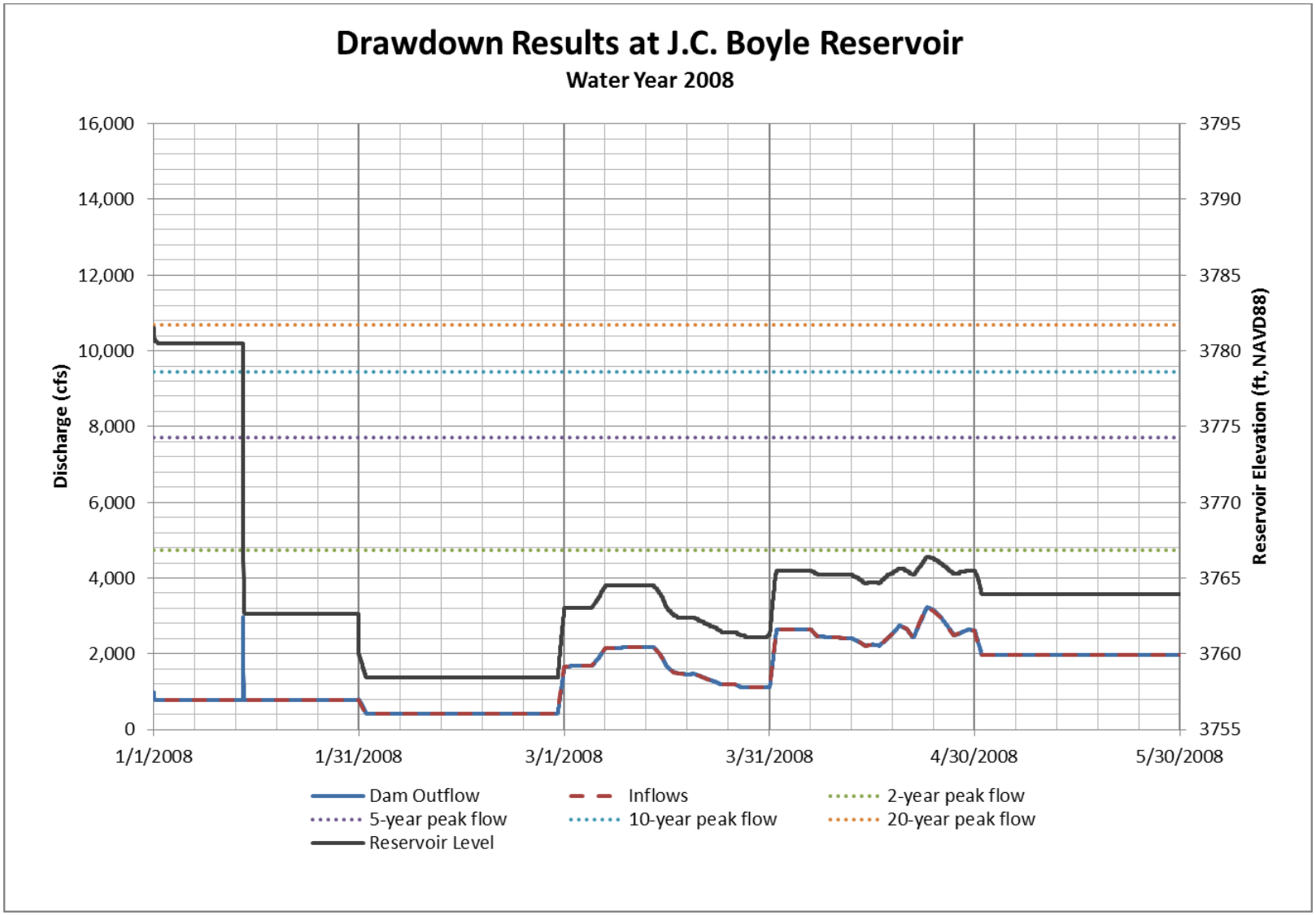

Figure 2-48 J.C. Boyle Reservoir Drawdown, Water Year 2008

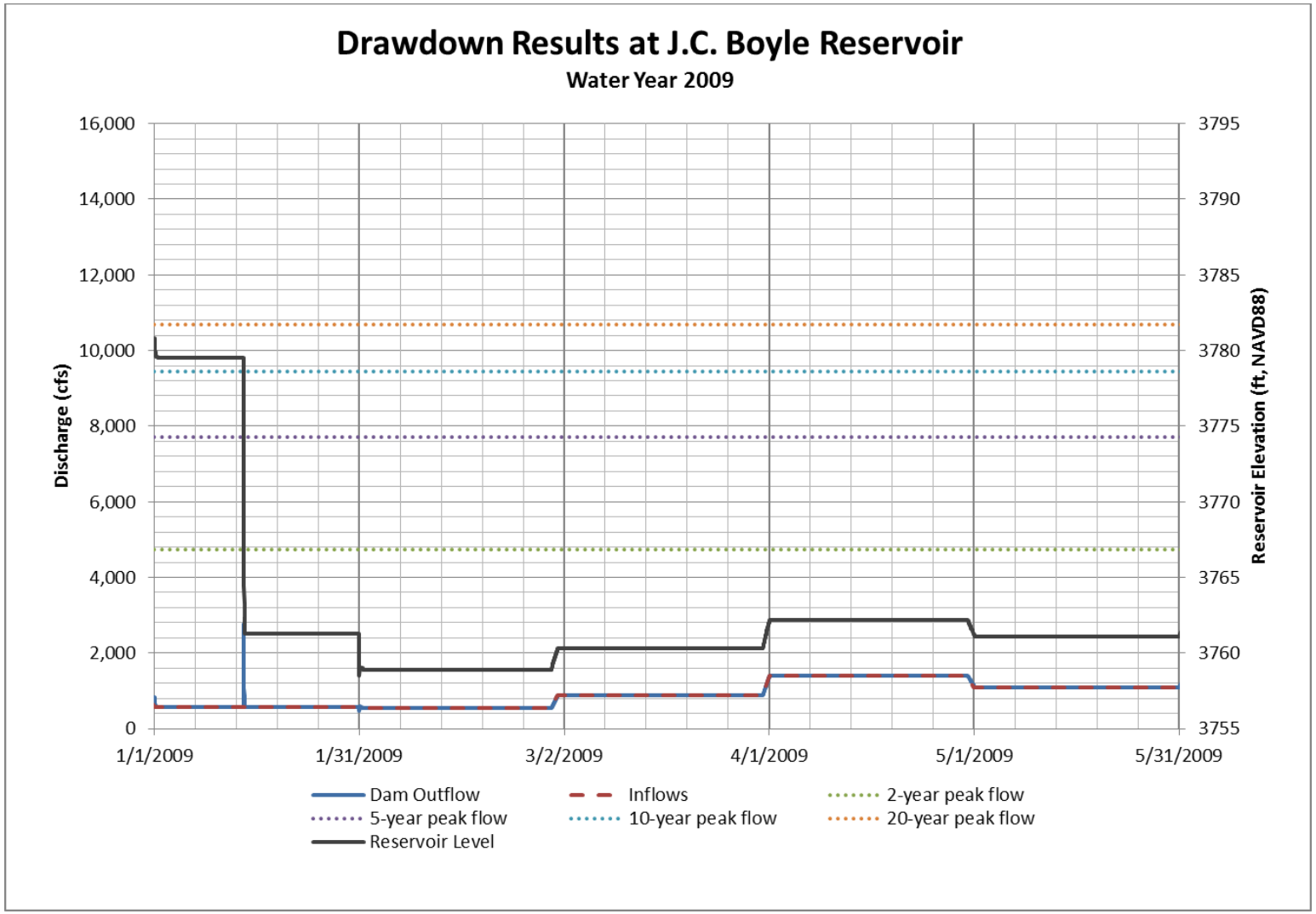

Figure 2-49 J.C. Boyle Reservoir Drawdown, Water Year 2009

Chapter 3: Copco 1 Reservoir

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3. COPCO 1 RESERVOIR

KRRC analyzed two options for reservoir drawdown at Copco No. 1: Option 1 includes dam notching and Option 2 does not include dam notching. KRRC proposes Option 2 as the proposed action, but KRRC also analyzed Option 1 because it was the method originally proposed in the Detailed Plan. In general, Option 1 with notching performs worse than Option 2 in terms of minimizing peak flows and drawdown duration, particularly in wet years. Therefore, KRRC proposes Option 2 for Copco No. 1 drawdown. The following discusses drawdown of Copco Lake separately for the two tunnel modification options described in Definite Plan Section 4.2.2.

3.1 Option 1 (for comparison only) - Diversion Tunnel Modified to Restore Capacity and Dam Notching

The drawdown procedure at Copco Lake for Option 1 is summarized below:

1. For modeling purposes, KRRC assumes that by January 1, 2021 (the start of the simulation), following the two-month initial drawdown period beginning November 1, 2020, the water level would be at the spillway crest.
2. The model assumes the three 6-foot gates on the diversion tunnel to be open at the start of the simulation.
3. Until completion of the last notch, the model assumes that the 6-foot gates will be closed down to limit the maximum rate of drawdown to 5 feet per day. Once the last notch was complete, the model assumes that the 6-foot gates will be left open.
4. In order to fully draw down the reservoir, the model includes notching the concrete dam with a series of 13 notches: an initial 24.5-foot notch, followed by 11 18-foot deep notches (measured from lowered dam crest to notch elevation; sequentially lowering the notches in 6-foot increments), then a final notch of 22 feet down to the channel bed elevation. The model lowers the dam crest in 6-foot lifts as the notching progressed. The bottom width of all notches was 8 feet. The elevation of the first notch was at 2572.5 feet. The elevation of the final notch was at elevation 2484.5 (regardless of water year) with the lowered dam crest at elevation 2518.5.
5. To simplify the model, KRRC assumed that the Contractor will lower the dam crest at the same time as the completion of the notch. Construction of the notch did not begin until the water level dropped to the level of where the dam crest will be once the lowering was complete (18 feet above the notch elevation). KRRC assumed that the lowered crest will need to be above the water level for construction to continue. KRRC assumed the minimum time needed before starting the next notch is 5 days. This would allow for completion of 13 notches by March 1, assuming no construction delays.
6. Maximum additional discharge downstream of the dam due to drawdown activities is about 7,700 cfs with about 2,800 cfs through the notch (assuming an 18-foot-deep notch with a bottom width of 8 feet adjacent to the 2 previous notches 12 feet and 6 feet deep) and the rest through the diversion

tunnel. The additional flow due to drawdown decreases as the reservoir level drops in the notch. For reference, the 10-year, 20-year, 50-year, and 100-year flow events downstream of Copco No. 1 are about 11,300 cfs, 13,500 cfs, 16,560 cfs, and 18,950 cfs, respectively.

3.2 Option 2 (proposed action) – Diversion Tunnel Modified to Increase Capacity

The drawdown procedure at Copco Lake for Option 2 is summarized in the numbered list below:

1. For modeling purposes, KRRC assume that by January 1, 2021 (the start of the simulation), following the two-month initial drawdown period beginning November 1, 2020, the water level would be at the spillway crest.
2. The model assumes that the large gate on the 14- by 16-foot diversion tunnel will not be opened until January 15 to allow for drawdown of Iron Gate reservoir prior to making additional releases from Copco Lake. The only releases from Copco Lake between January 1 and January 15 will be over the spillway.
3. On January 15, 2021, the model assumes the gate on the diversion tunnel opens.
4. The model assumes that the diversion tunnel gate will be closed down to limit the maximum rate of drawdown to 5 feet per day. Once the reservoir level reached the top of the diversion tunnel, the model assumes that the drawdown rate is no longer limited.
5. Maximum additional discharge downstream of the dam due to drawdown activities is about 6,000 cfs when the gate is opened on January 15. During other times, the increase is generally 1,000 to 2,000 cfs. The total discharge capacity of the new gate structure with the reservoir at the spillway crest elevation of 2597.0 feet is nearly 12,000 cfs. As water levels increase above the spillway crest, KRRC assumes closure of the gate to limit the total discharge to 13,000 cfs to avoid high water levels that could impact power production at Copco No. 2 powerhouse.
6. For reference, the 10-year, 20-year, 50-year, and 100-year flow events downstream of Copco No. 1 are 11,300 cfs, 13,500 cfs, 16,560 cfs, and 18,950 cfs, respectively.

3.3 Results

Figures 3-2 through 3-50 show the drawdown results for Copco No. 1 for both drawdown options.

In general, Option 1 with notching performs worse than Option 2 in terms of minimizing peak flows and drawdown duration, particularly in wet years. Therefore, KRRC proposes Option 2 for Copco No. 1 drawdown, and the remainder of the results discussion will focus on Option 2.

As discussed above, construction of a notch did not begin until the water surface elevation was at the elevation of the next notch crest (18 feet above the current notch invert). The Contractor could start the next notch at a higher elevation (for example, 1 foot below the notch crest being constructed). However, if a higher water surface elevation was used the notch crest could not be lowered 6 feet unless the water surface elevation dropped. Figure 3-1 shows the length of time that high water levels delay the first and last

notch. There is a 30 percent chance that the last notch would be delayed at least one week and a 10 percent chance that it would be delayed 7 weeks or more. The delay is usually caused by storms that occur after most of the notches have been constructed and result in an overtopping of the notch crest.

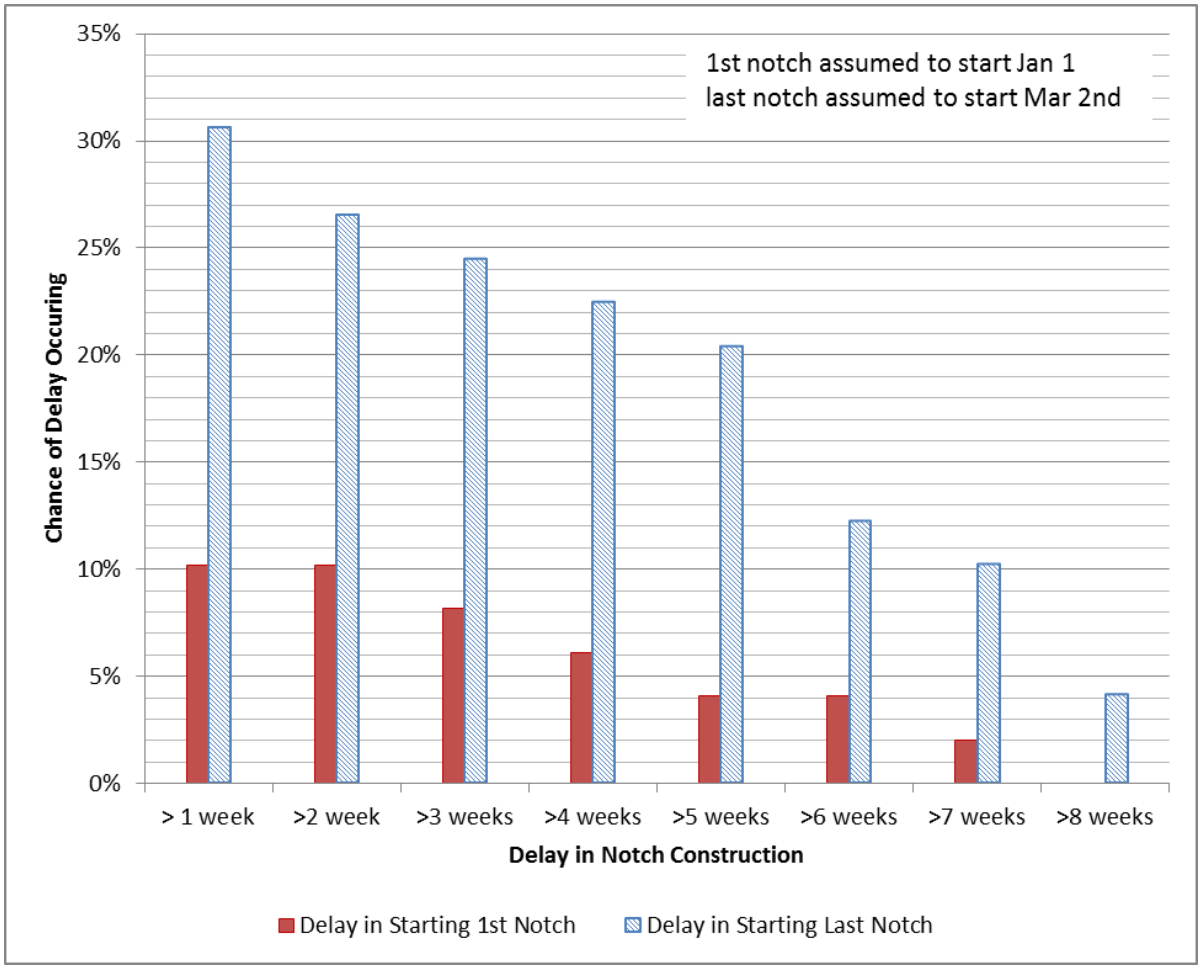


Figure 3-1 Graph Showing the Chance of a Delay in the Construction of the First and Last Notches in Copco No. 1 Dam

During representative dry years (e.g., 1973 and 1979), the reservoir was easily drawn down by the end of February, and does not refill after that point.

For Option 2 during the wetter years (e.g., 1966, 2006, 1986, and 1970), the reservoir was completely drawn down by the end of February, but in some cases partially refilled later in the year when storms occurred. The majority of the accumulated sediment would mobilize during the initial drawdown, and subsequent reservoir filling and drawdown is expected to cause only moderate increases in high suspended sediment (relative to background) (USBR 2012c).

Also during the wetter years, flows are higher than what would be expected via the spillway alone (i.e., without drawdown), but the increases are limited to those periods when flows are below the 10-year flood elevation.

KRRC does not anticipate that sediment concentrations resulting from the proposed drawdown procedure and associated hydraulics would differ from those previously estimated (USBR 2012c).

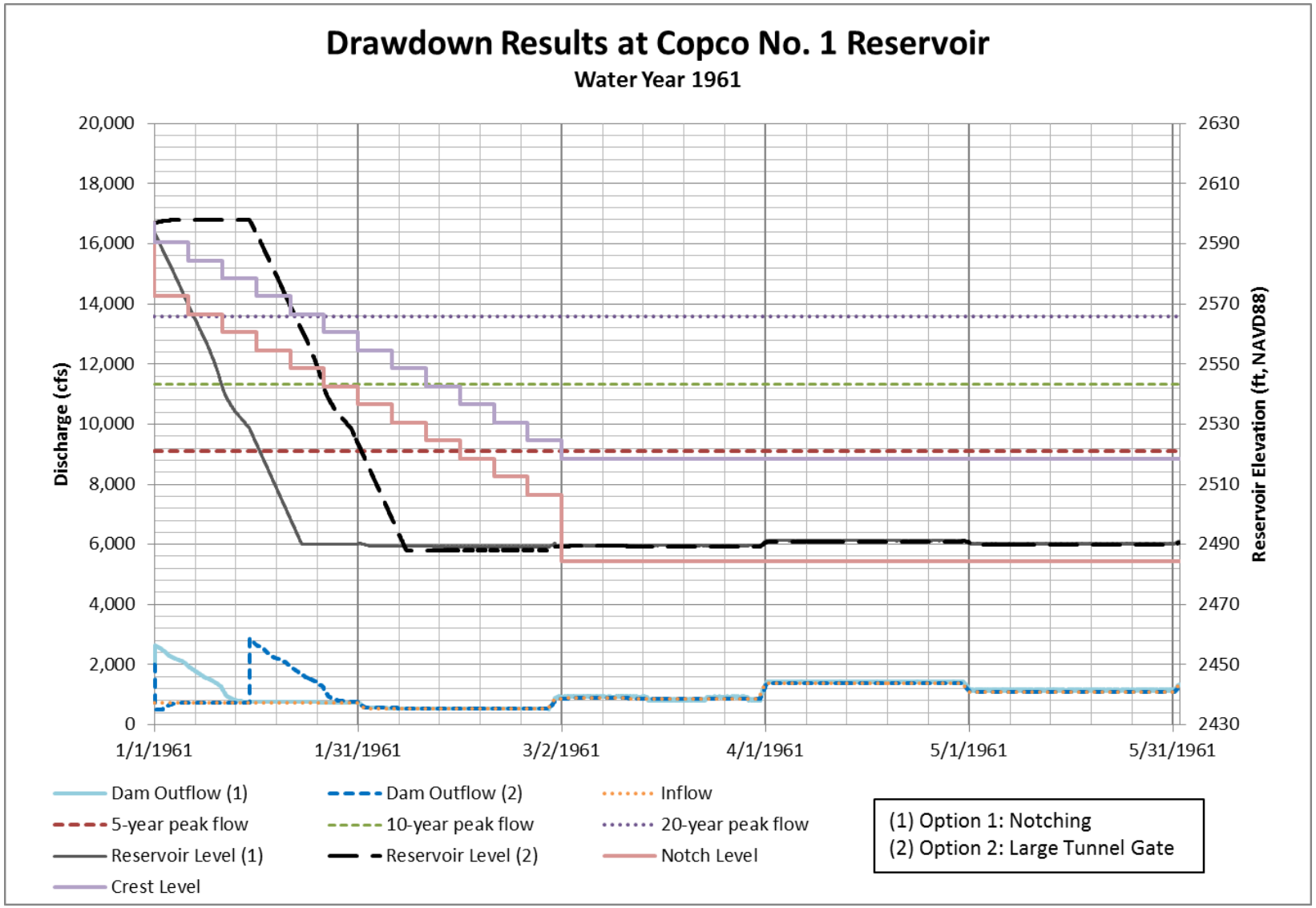


Figure 3-2 Copco No. 1 Reservoir Drawdown, Water Year 1961

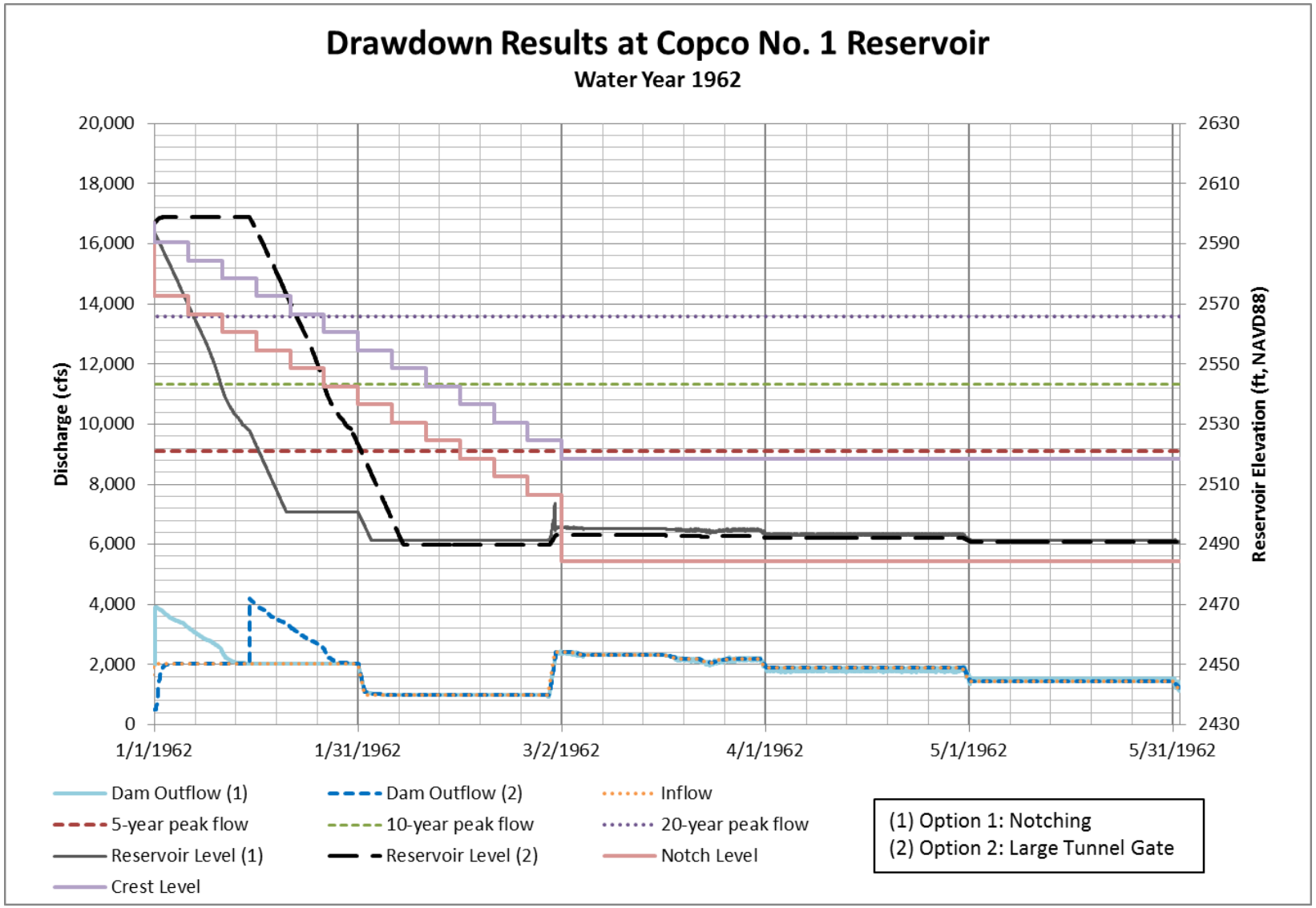
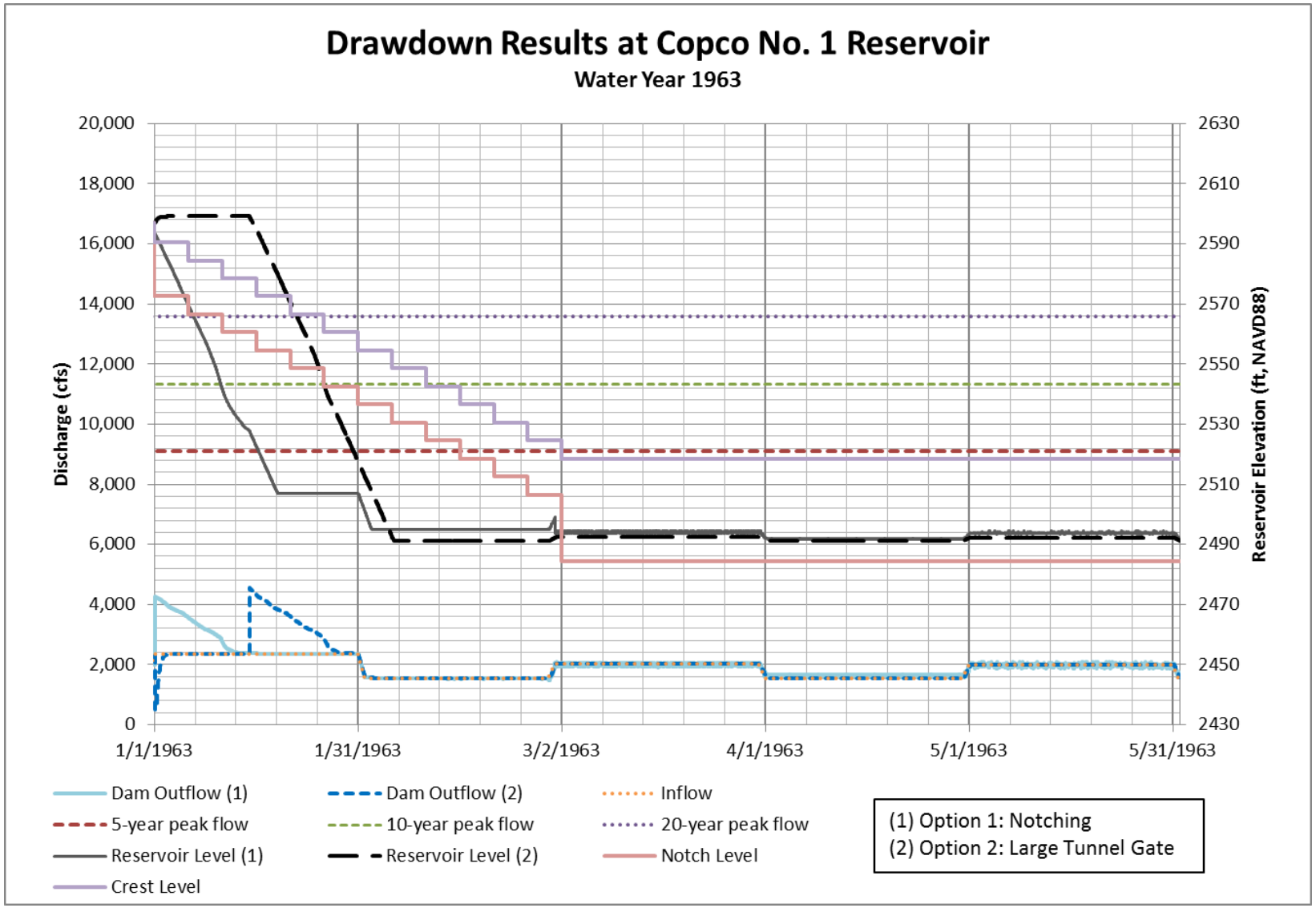


Figure 3-3 Copco No. 1 Reservoir Drawdown, Water Year 1962



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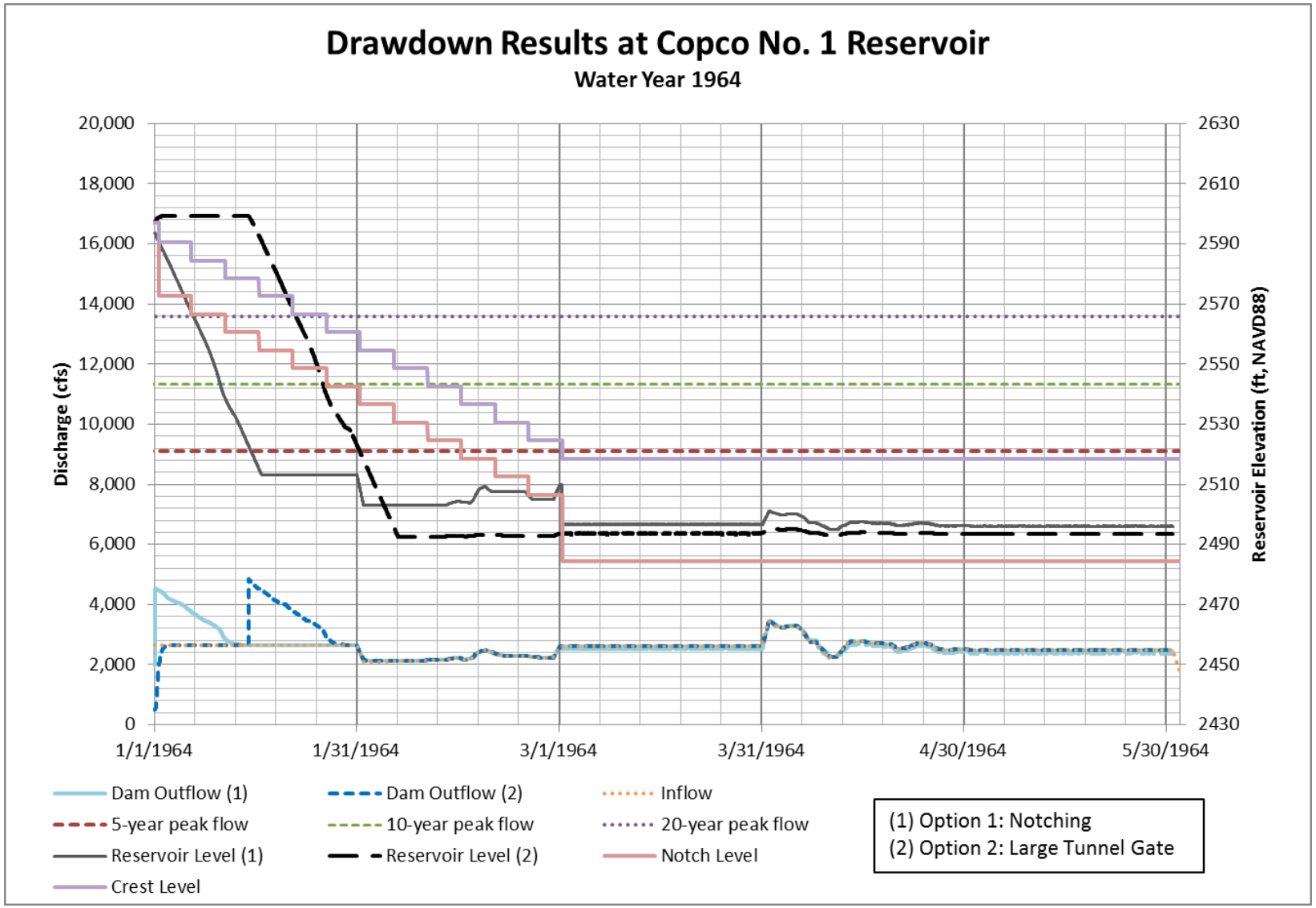

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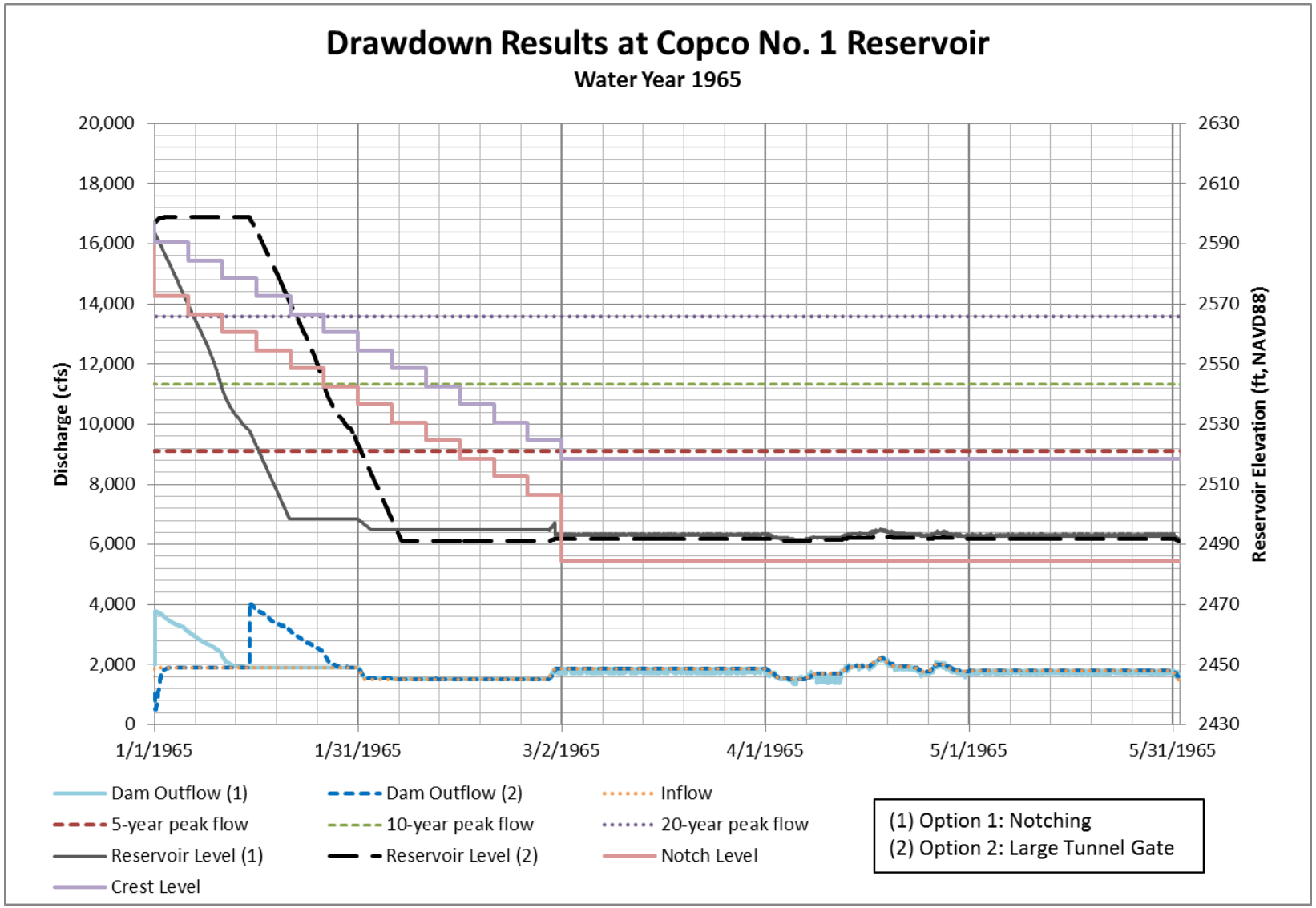

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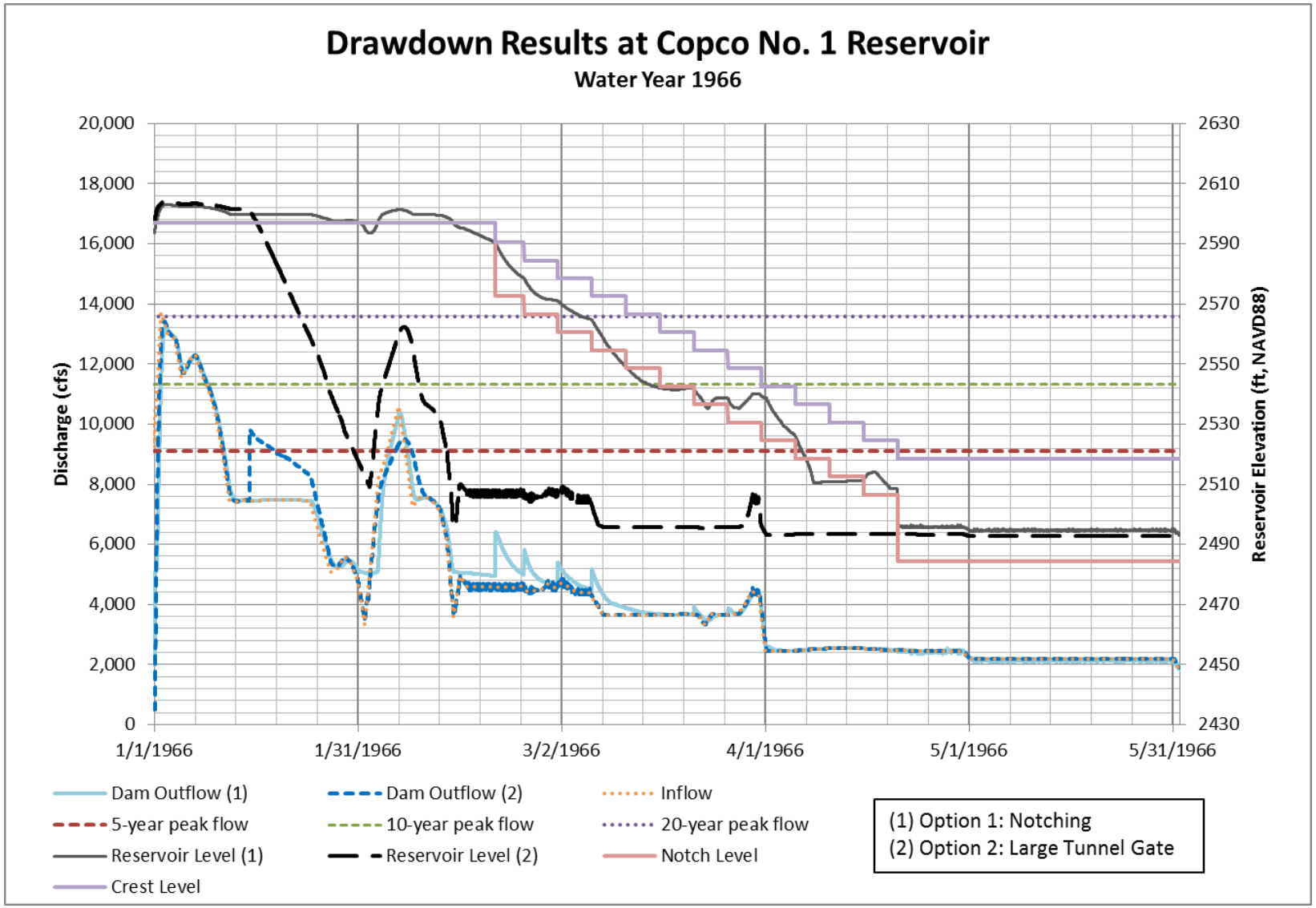

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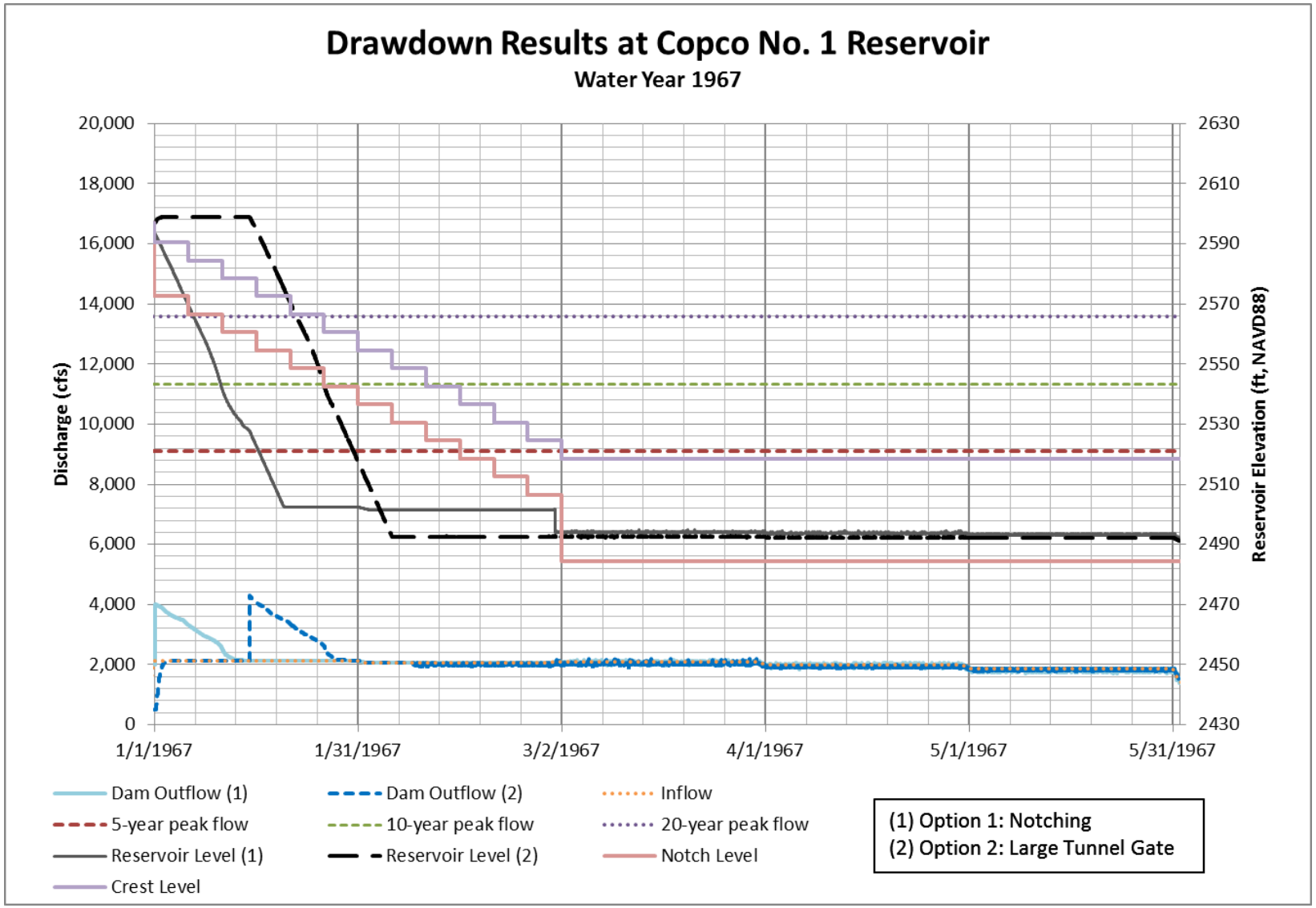

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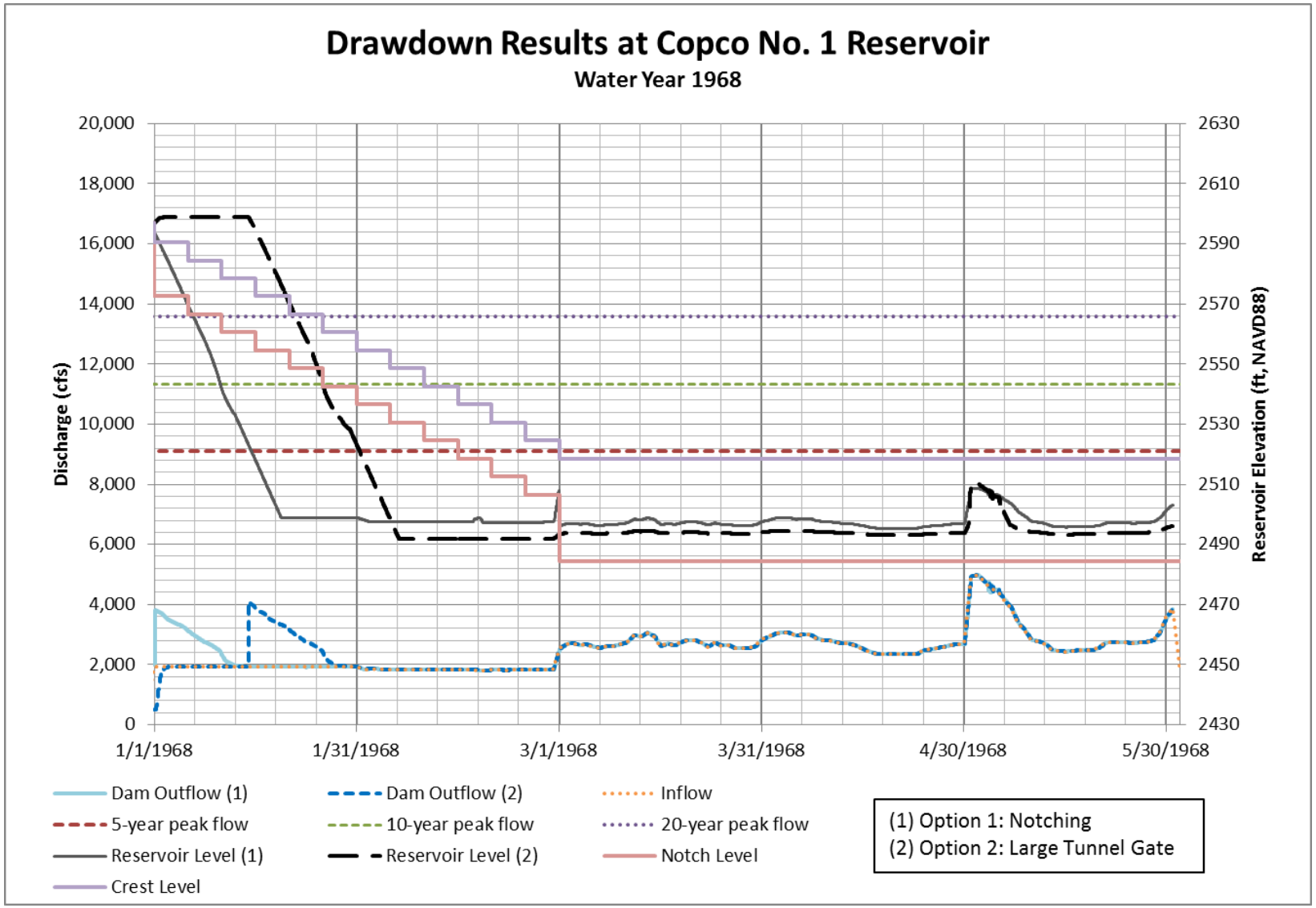

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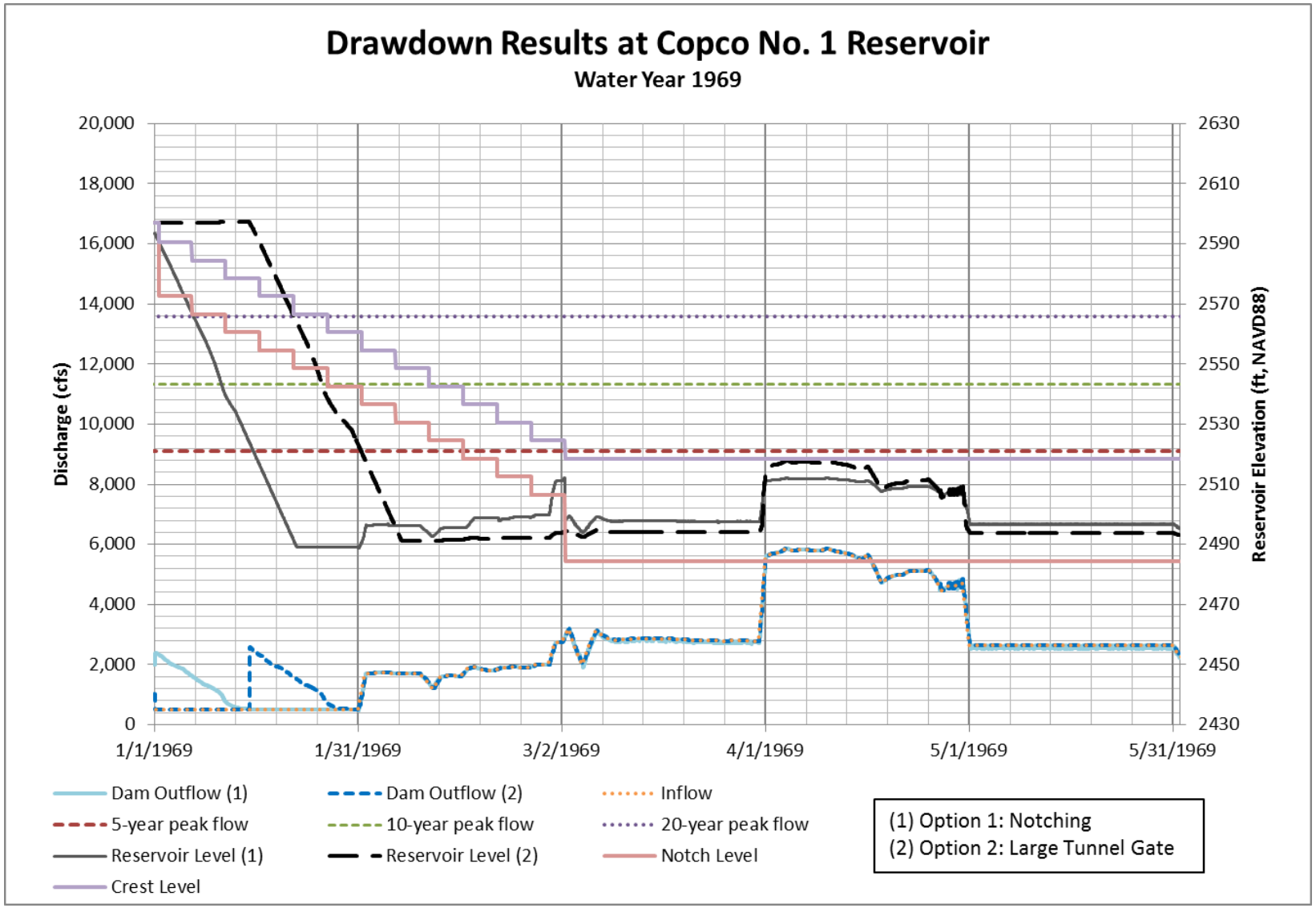

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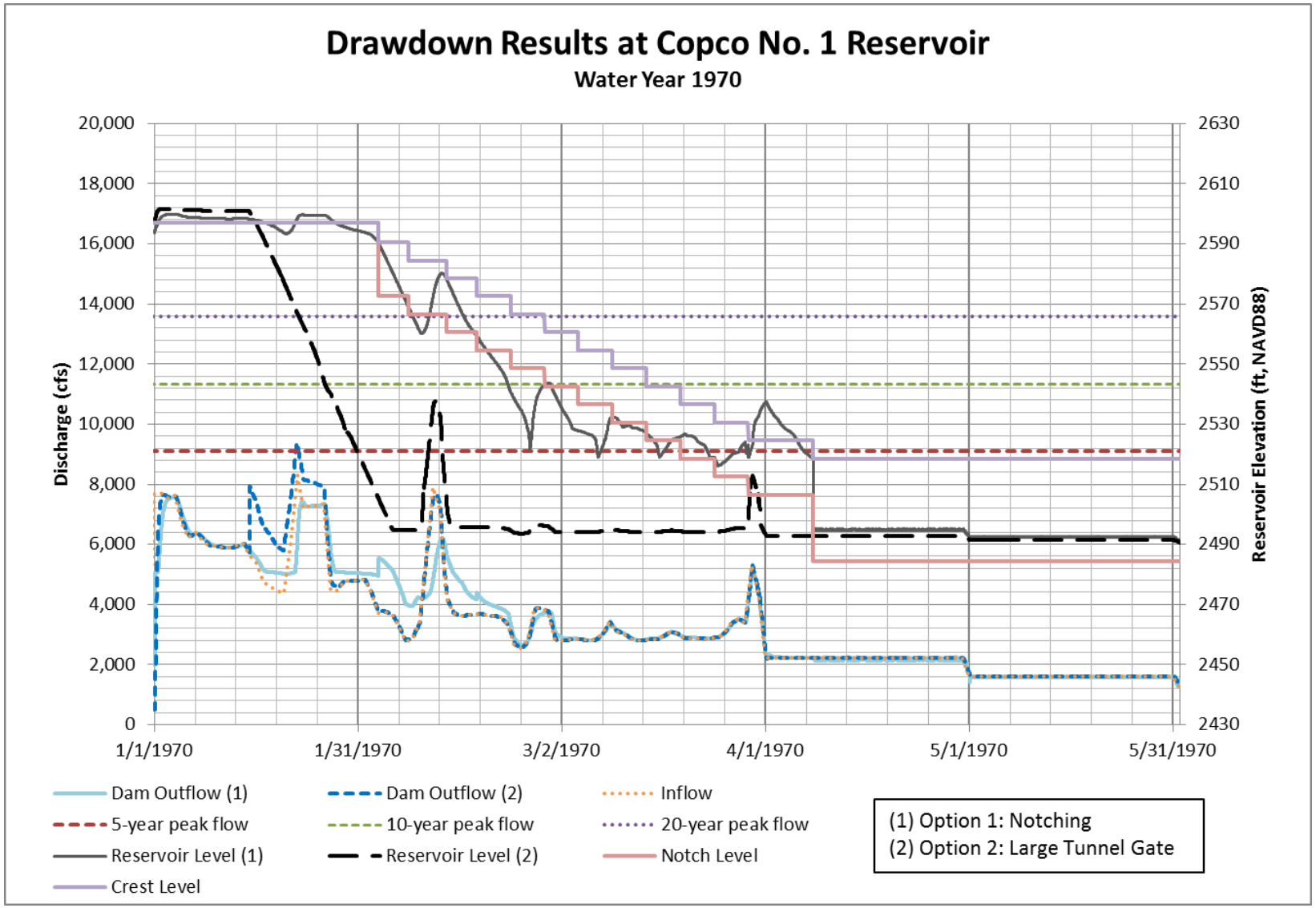

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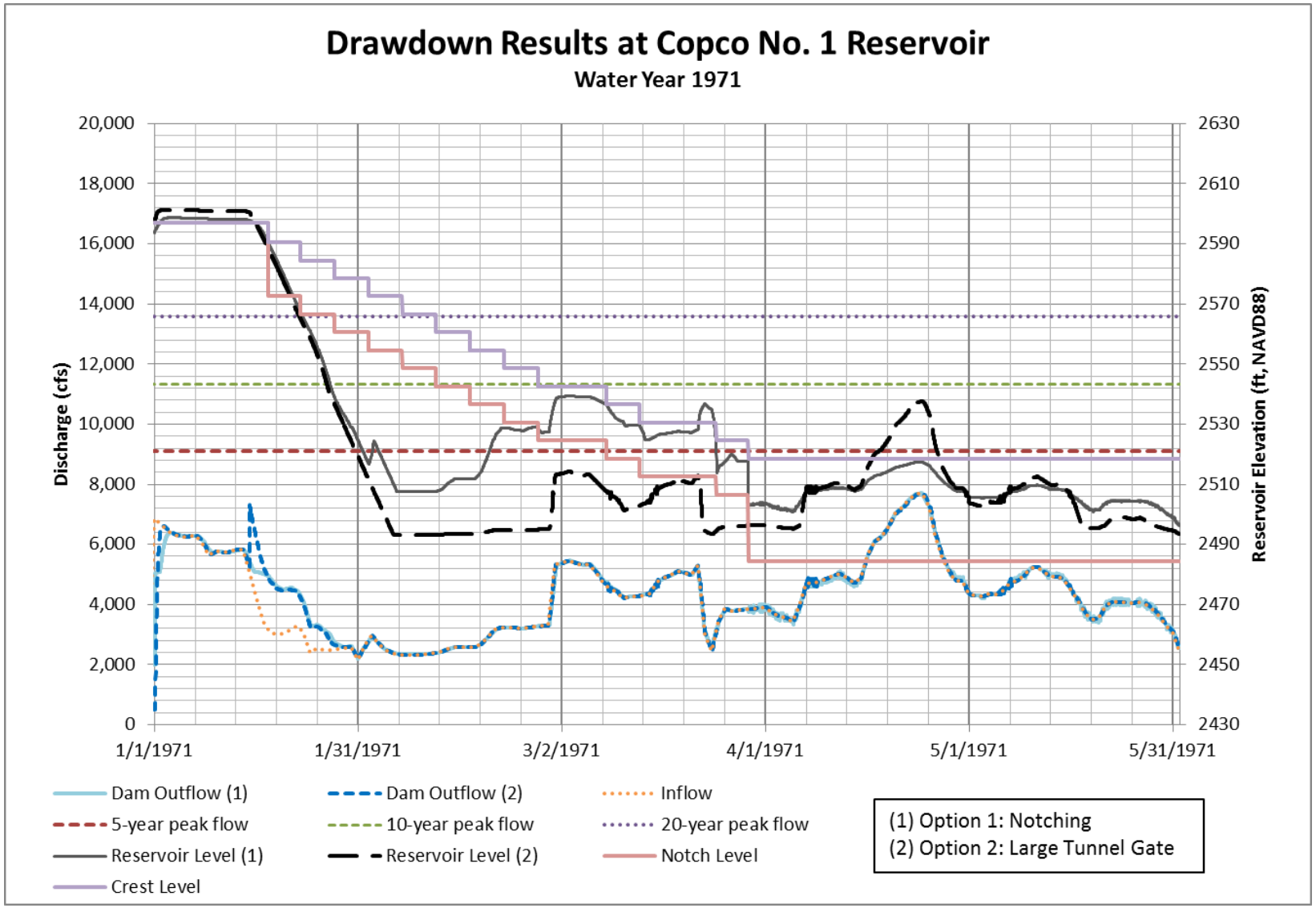

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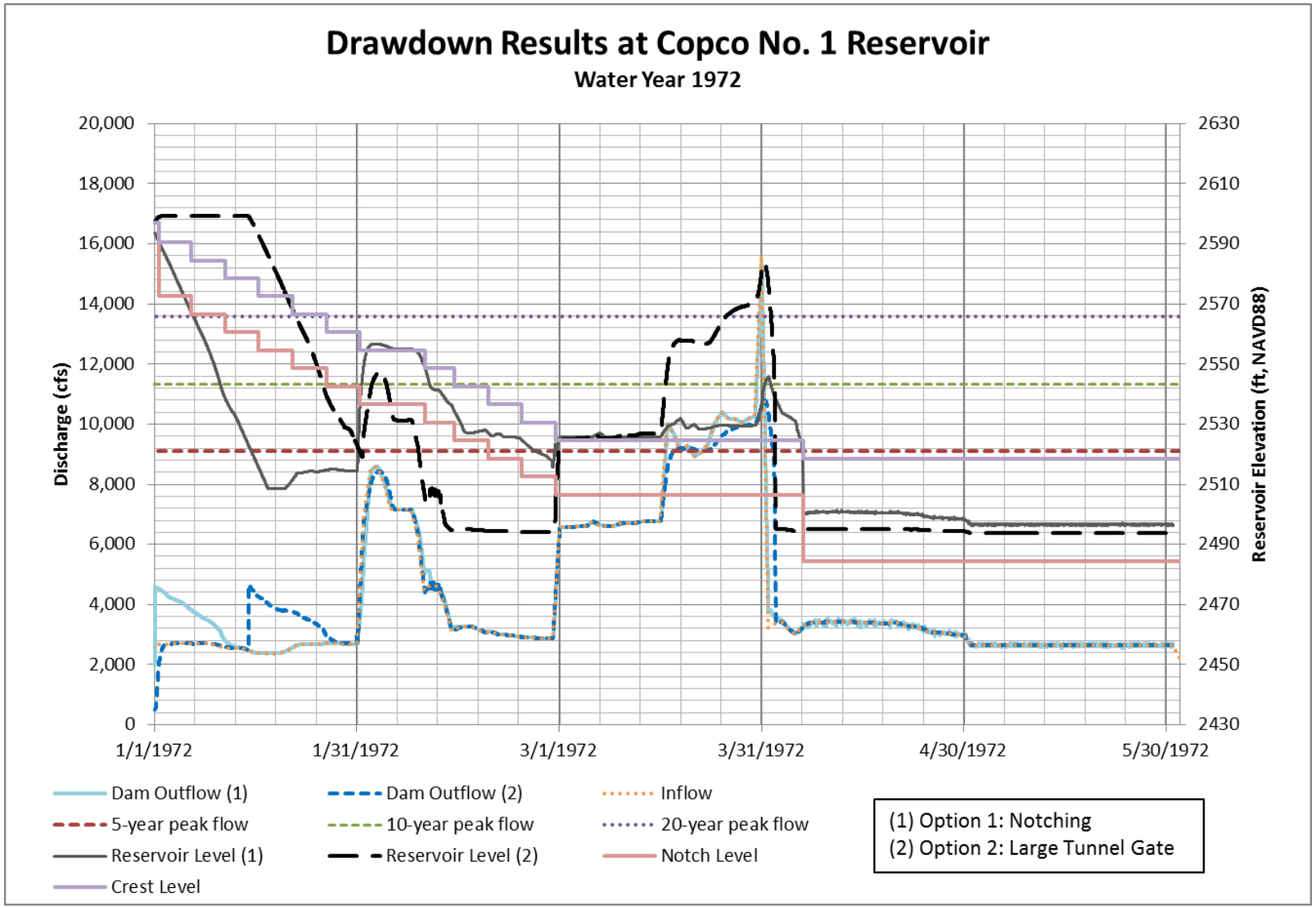

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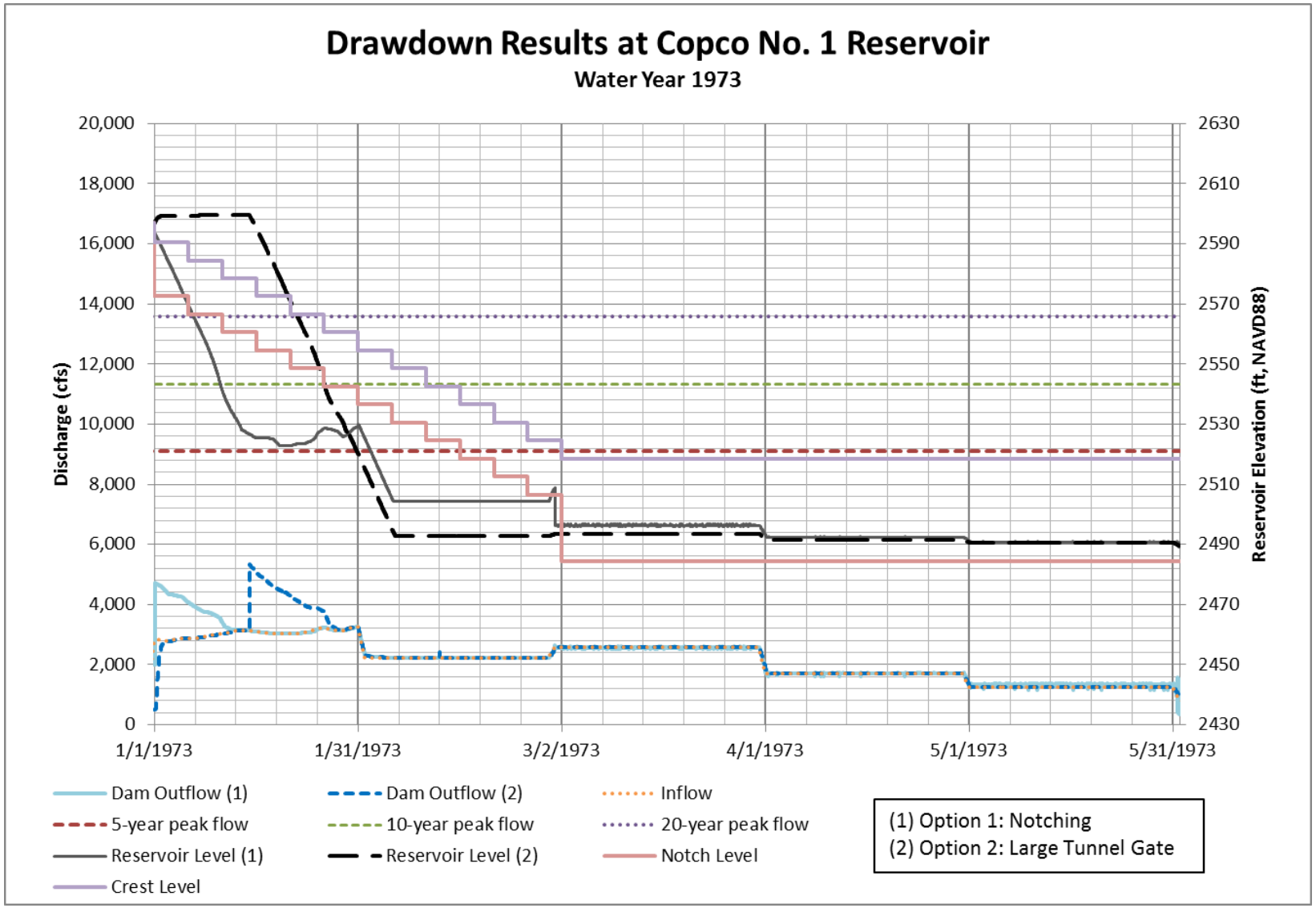

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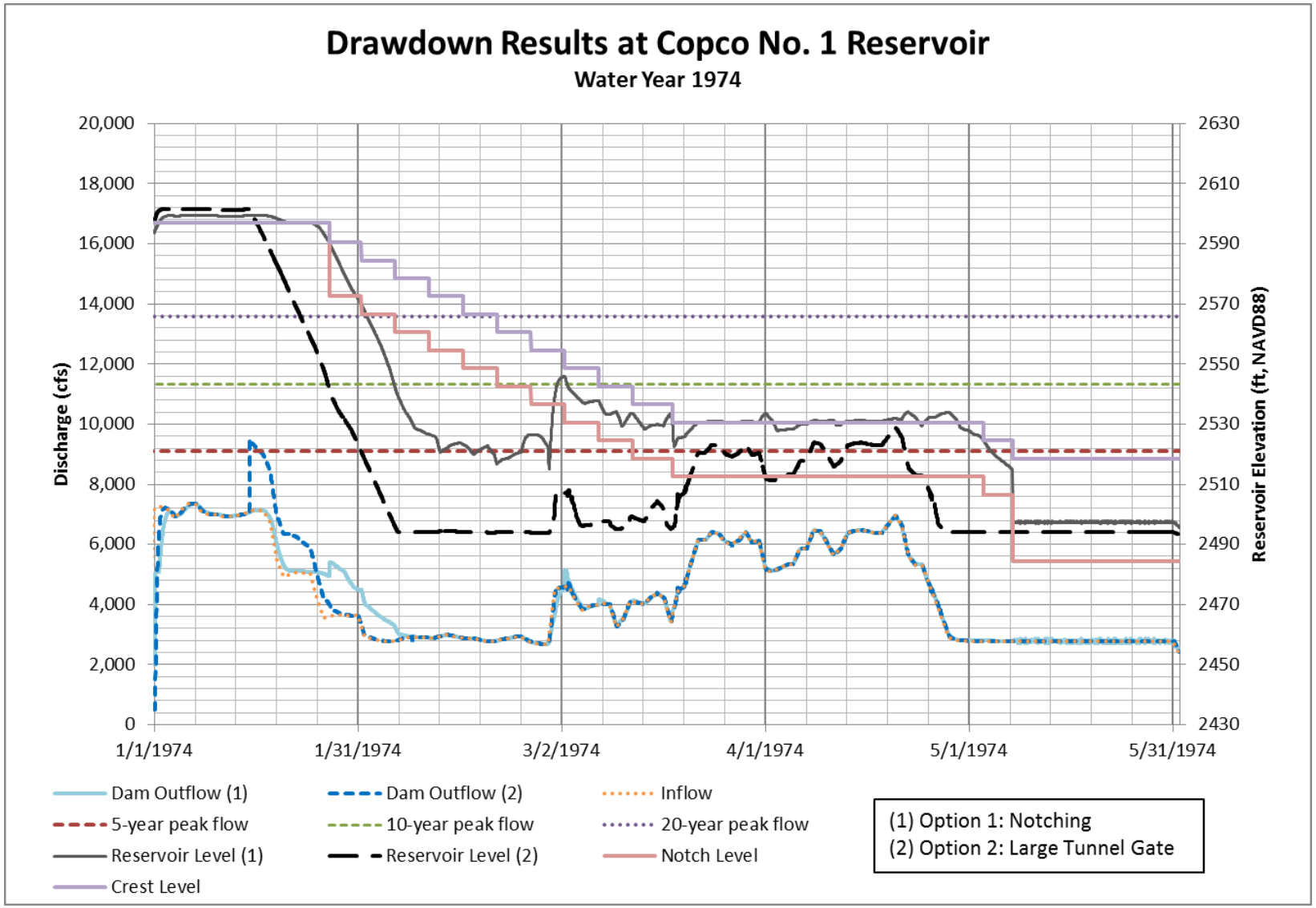

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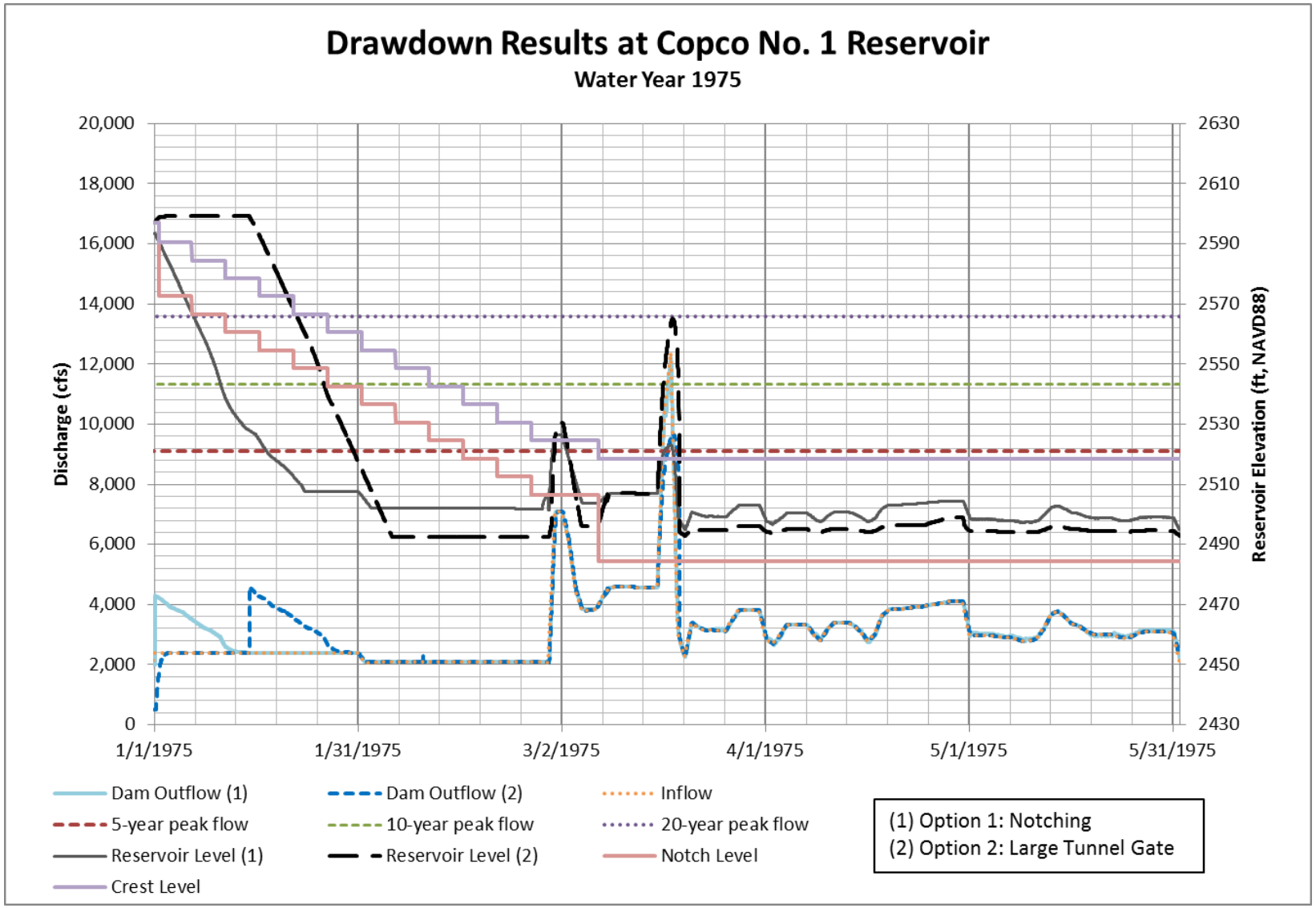

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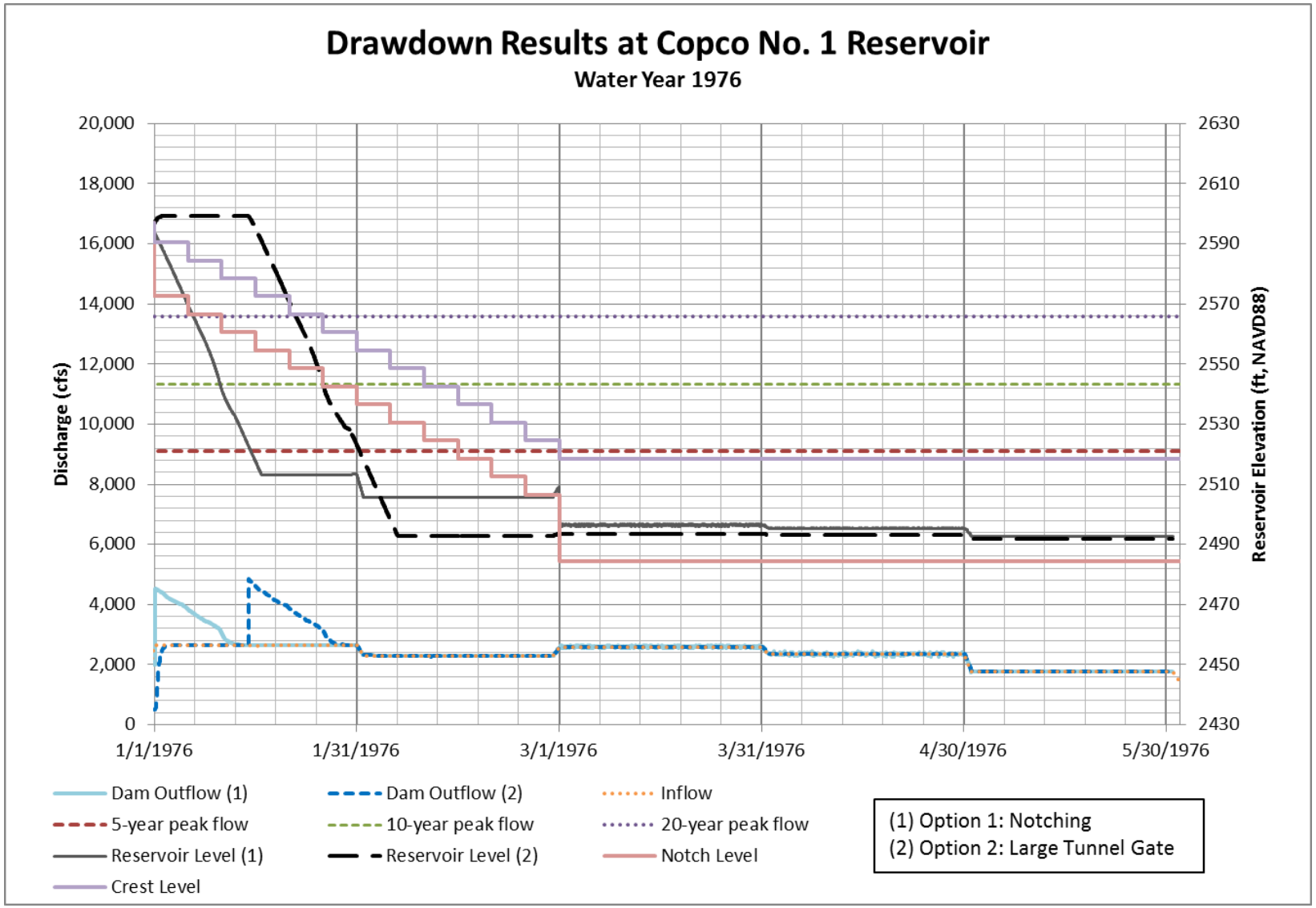

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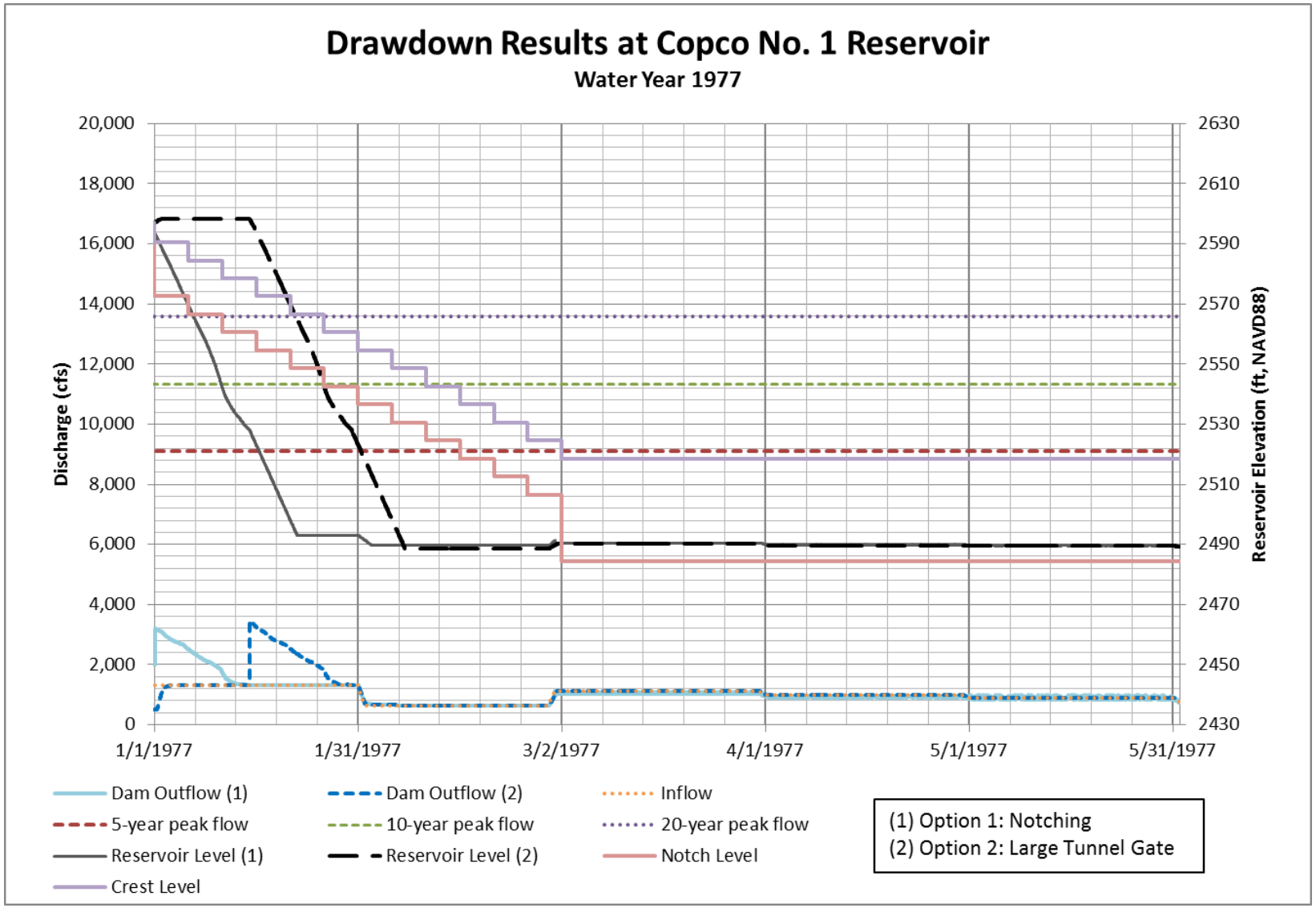

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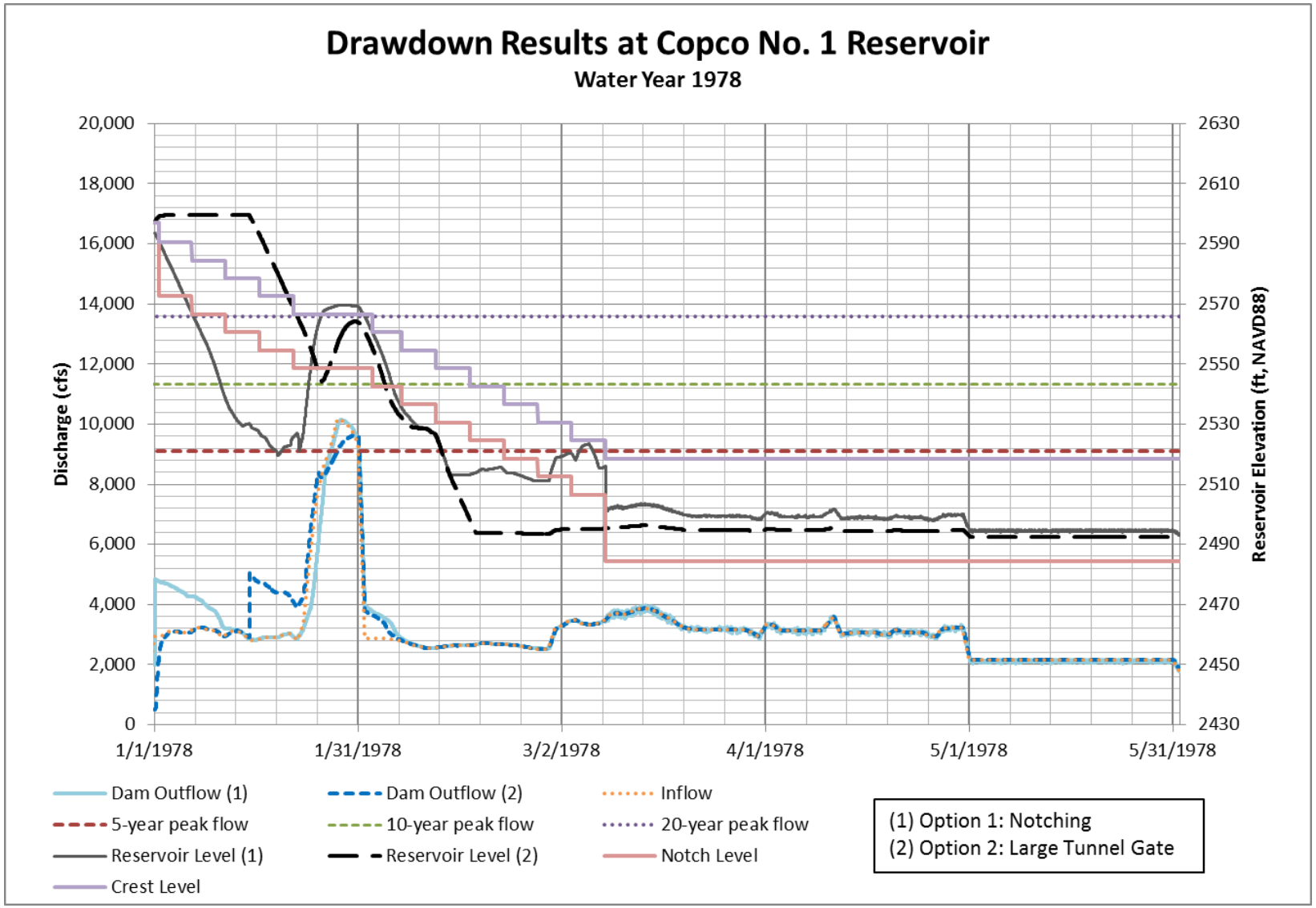

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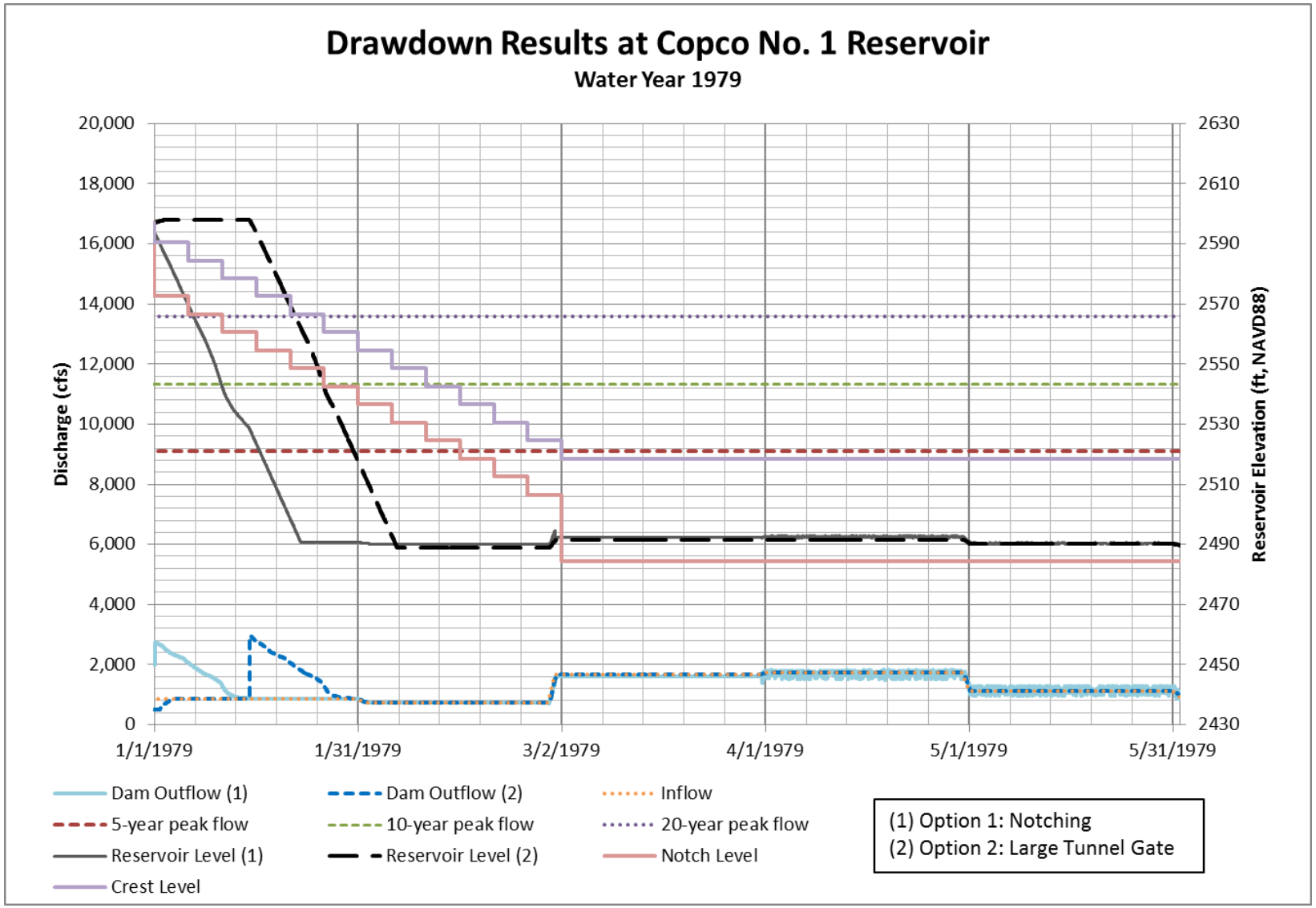

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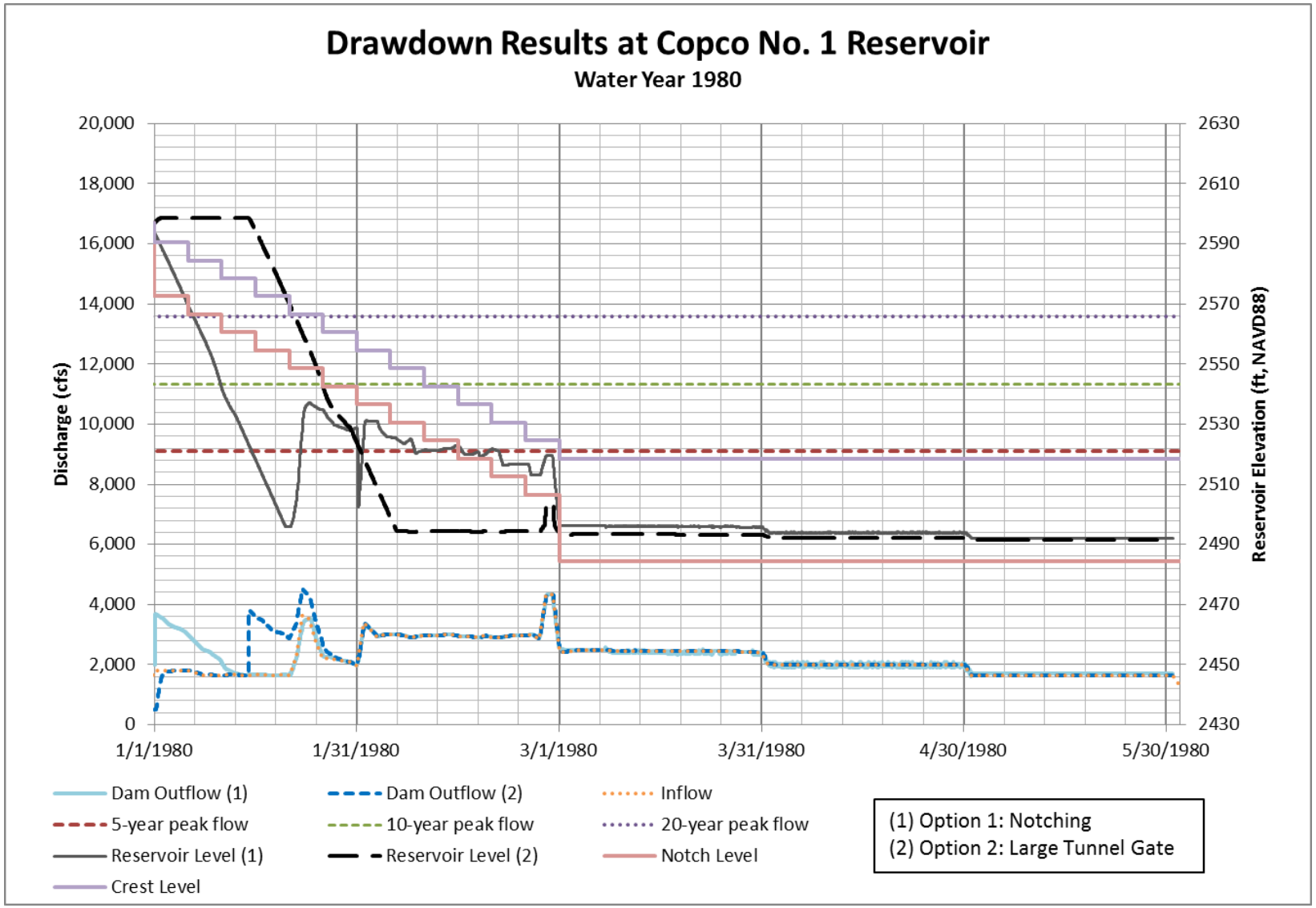

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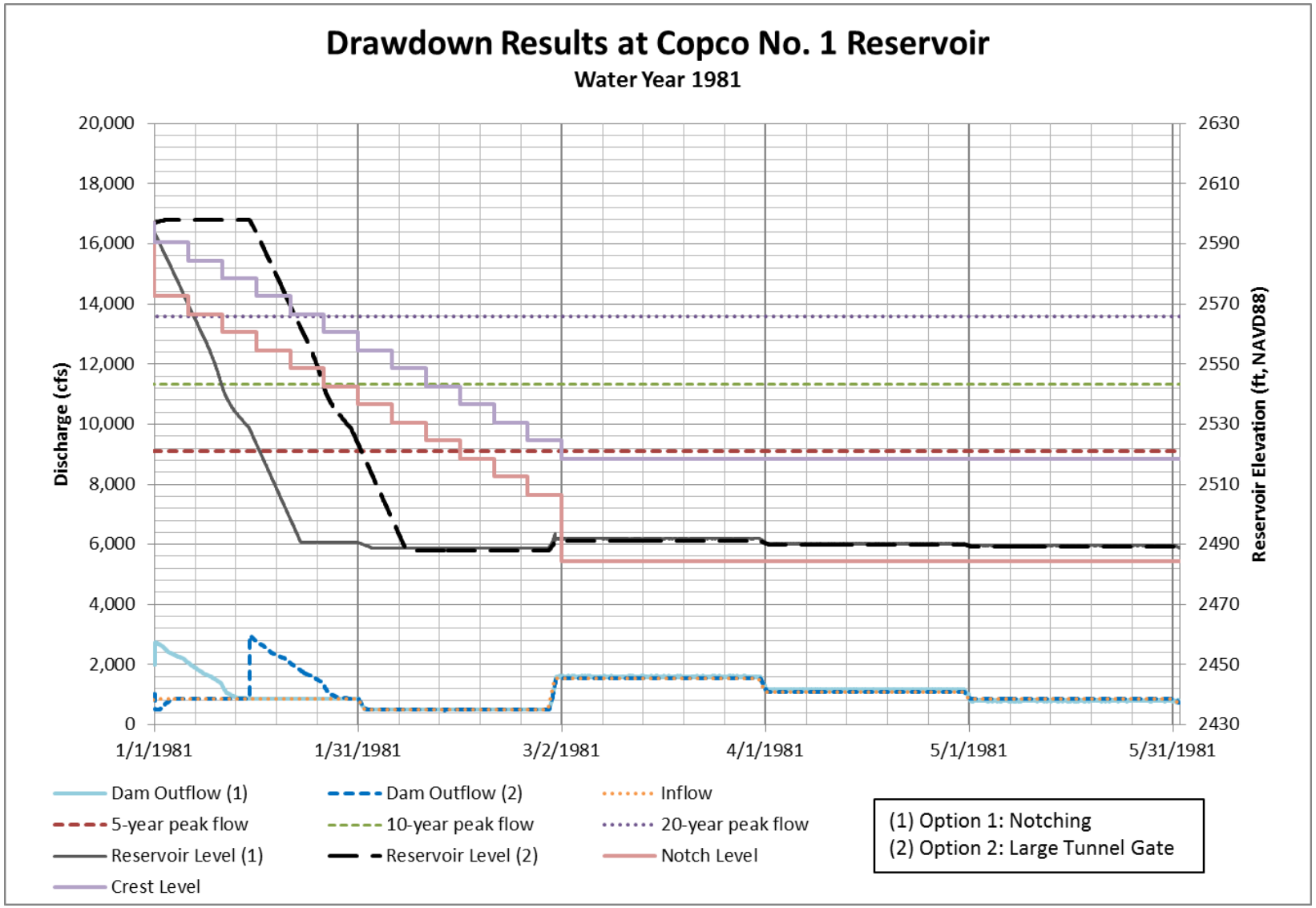

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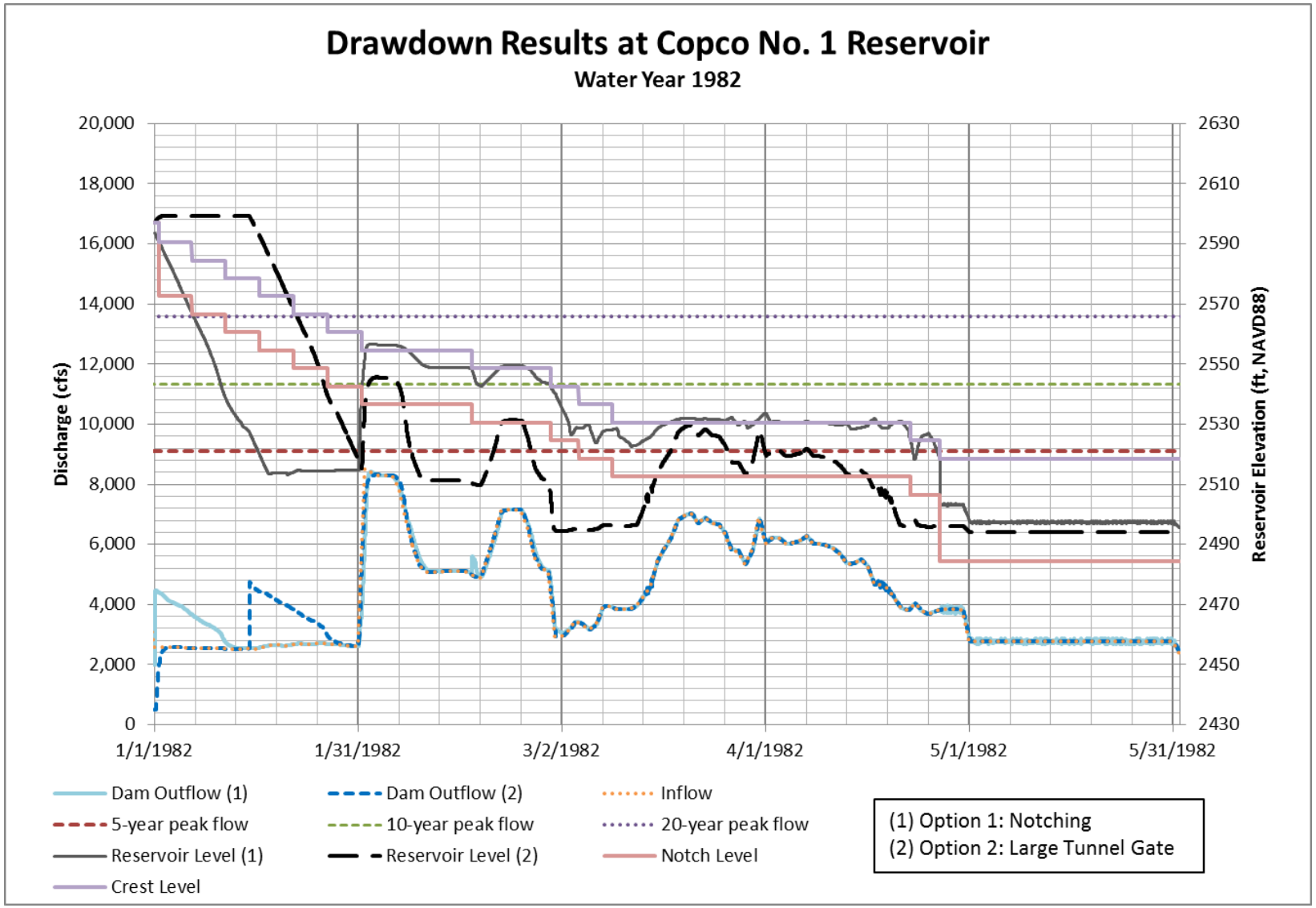

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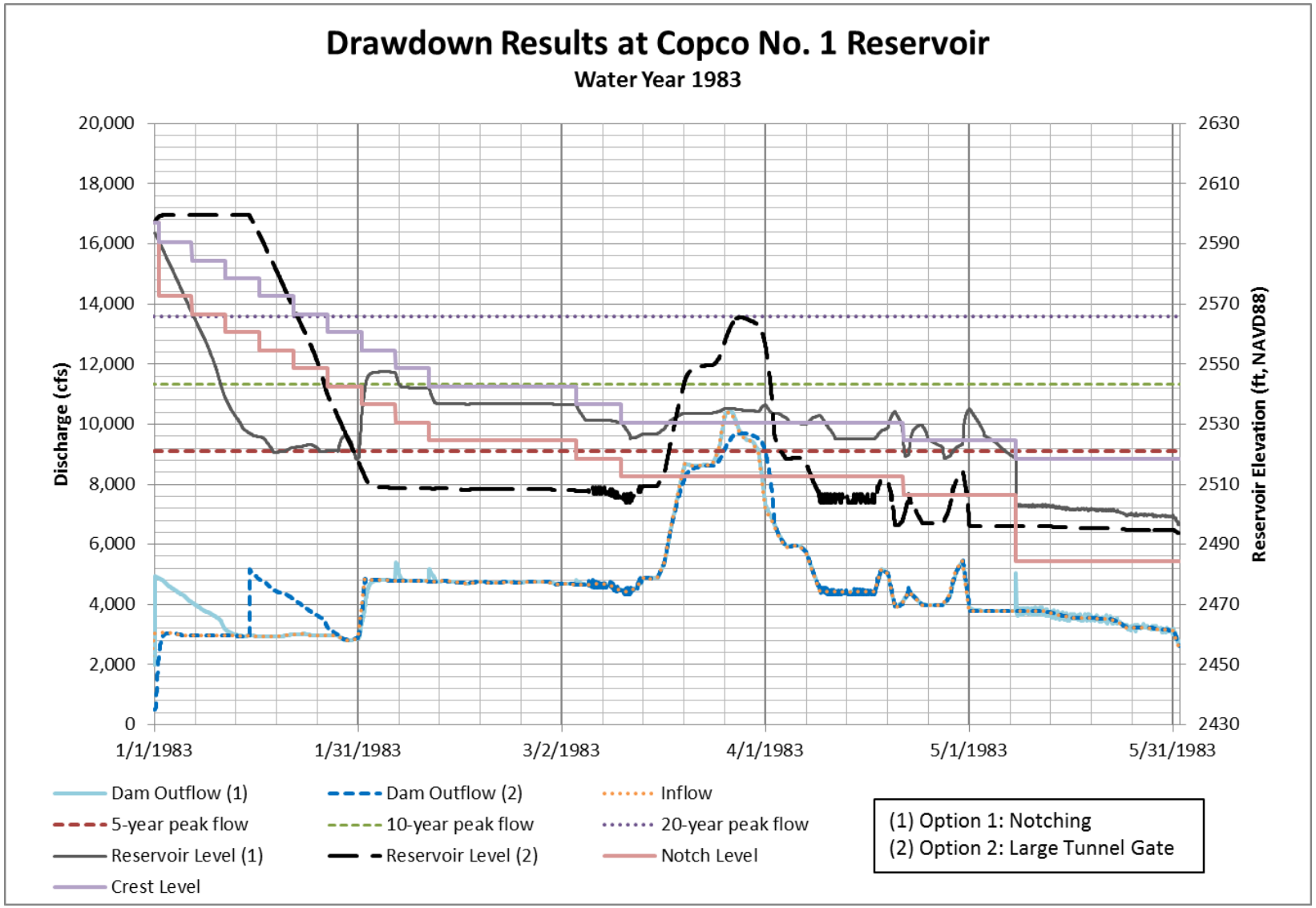

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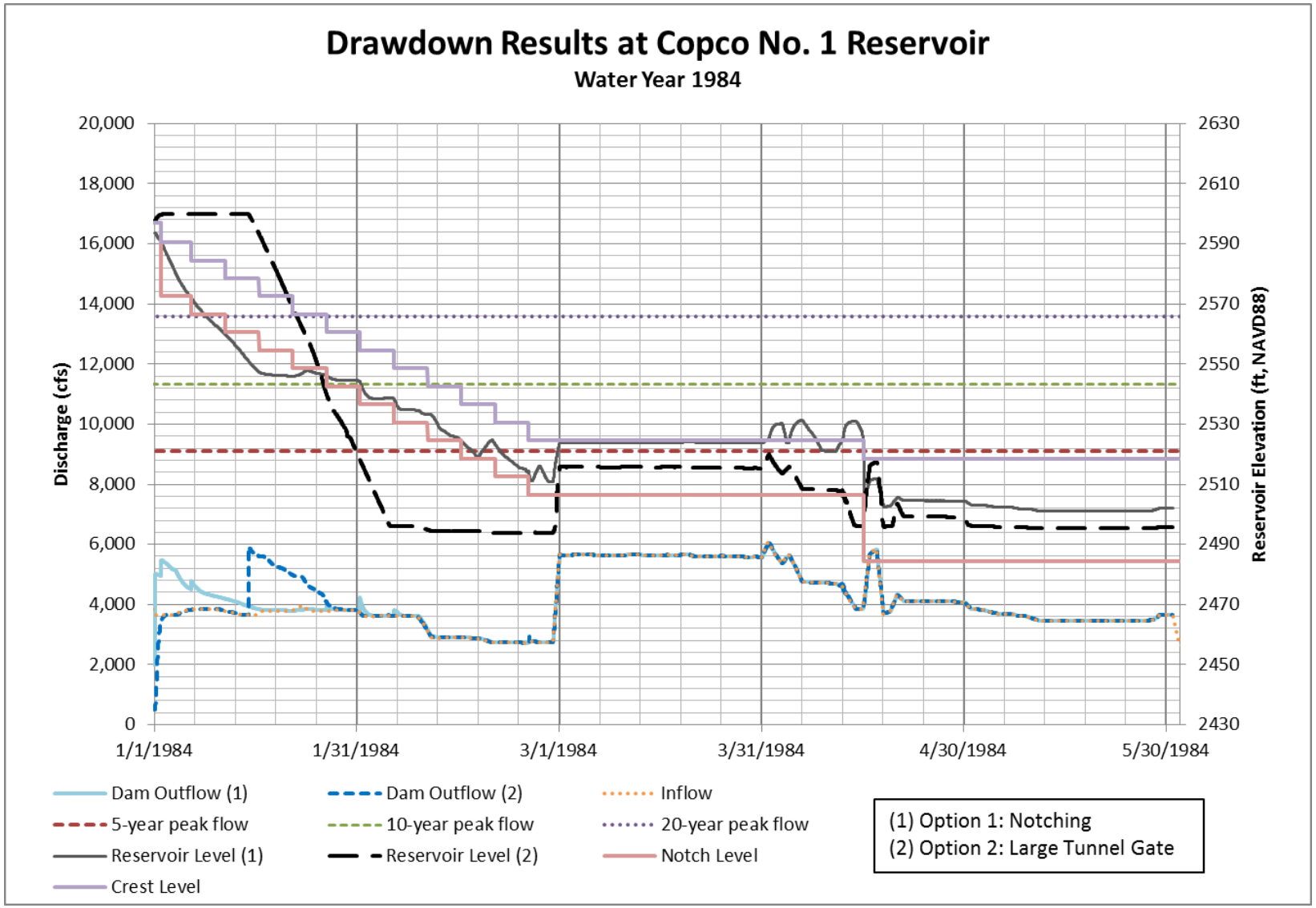

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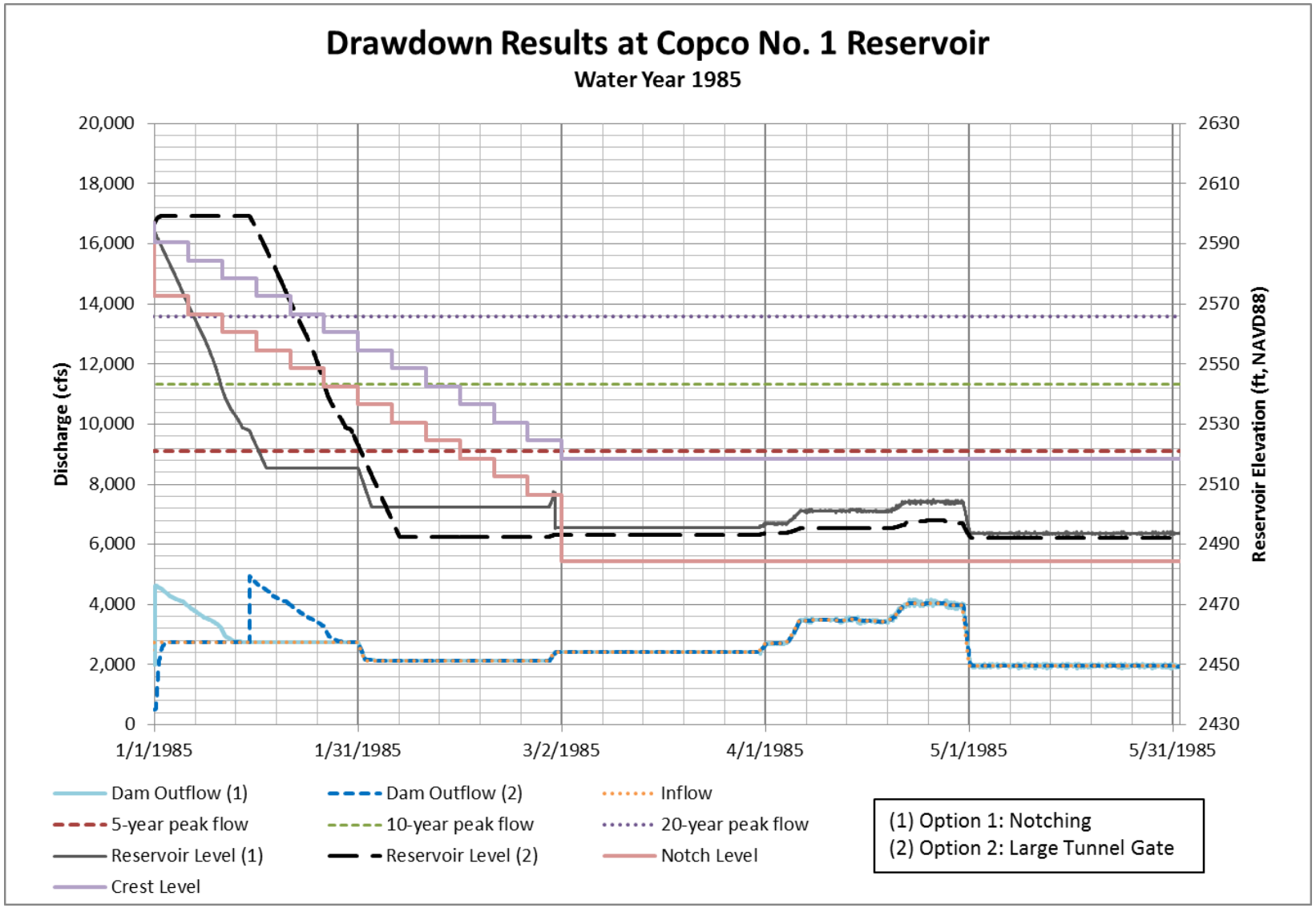


Figure 3-26 Copco No. 1 Reservoir Drawdown, Water Year 1985

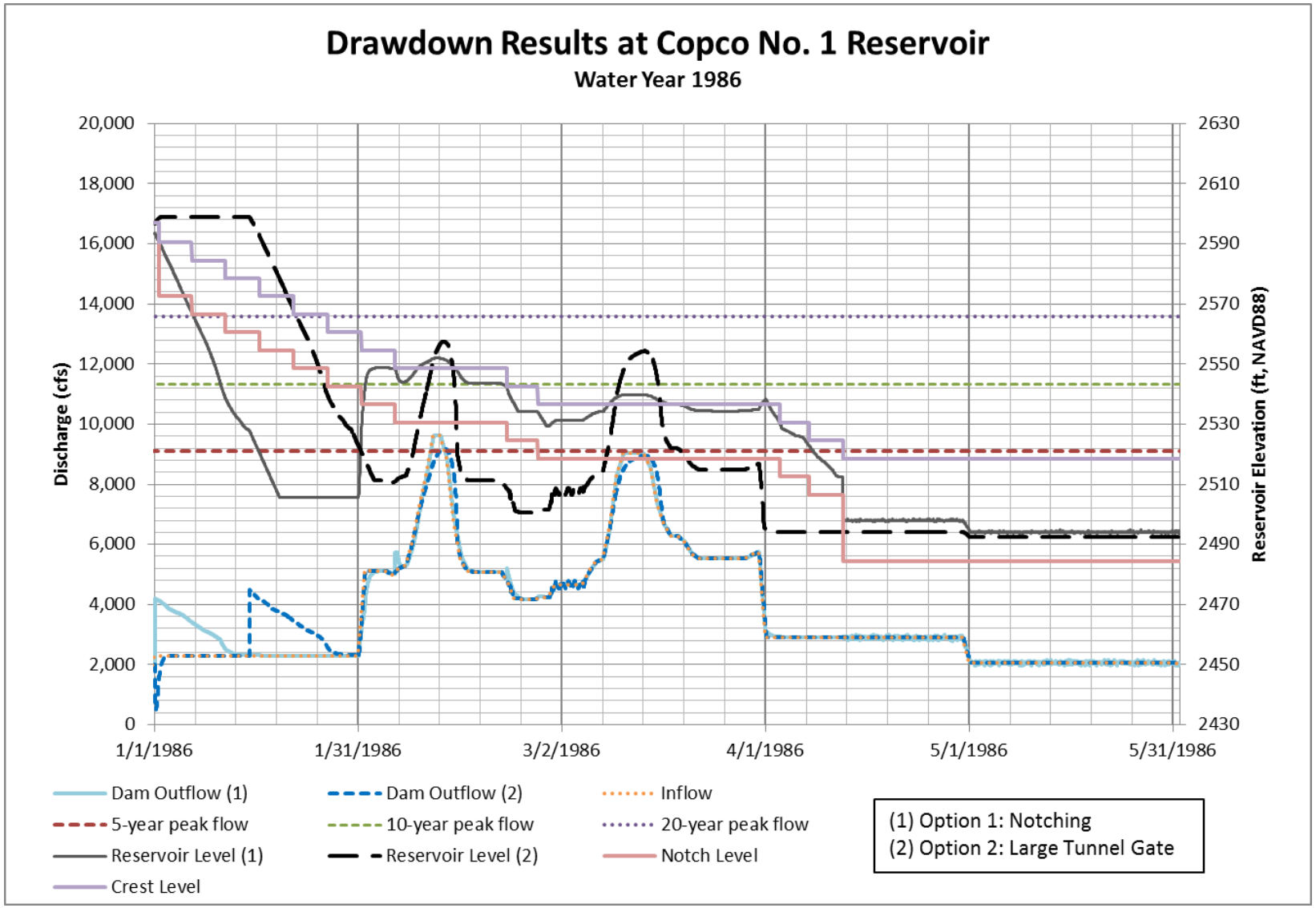
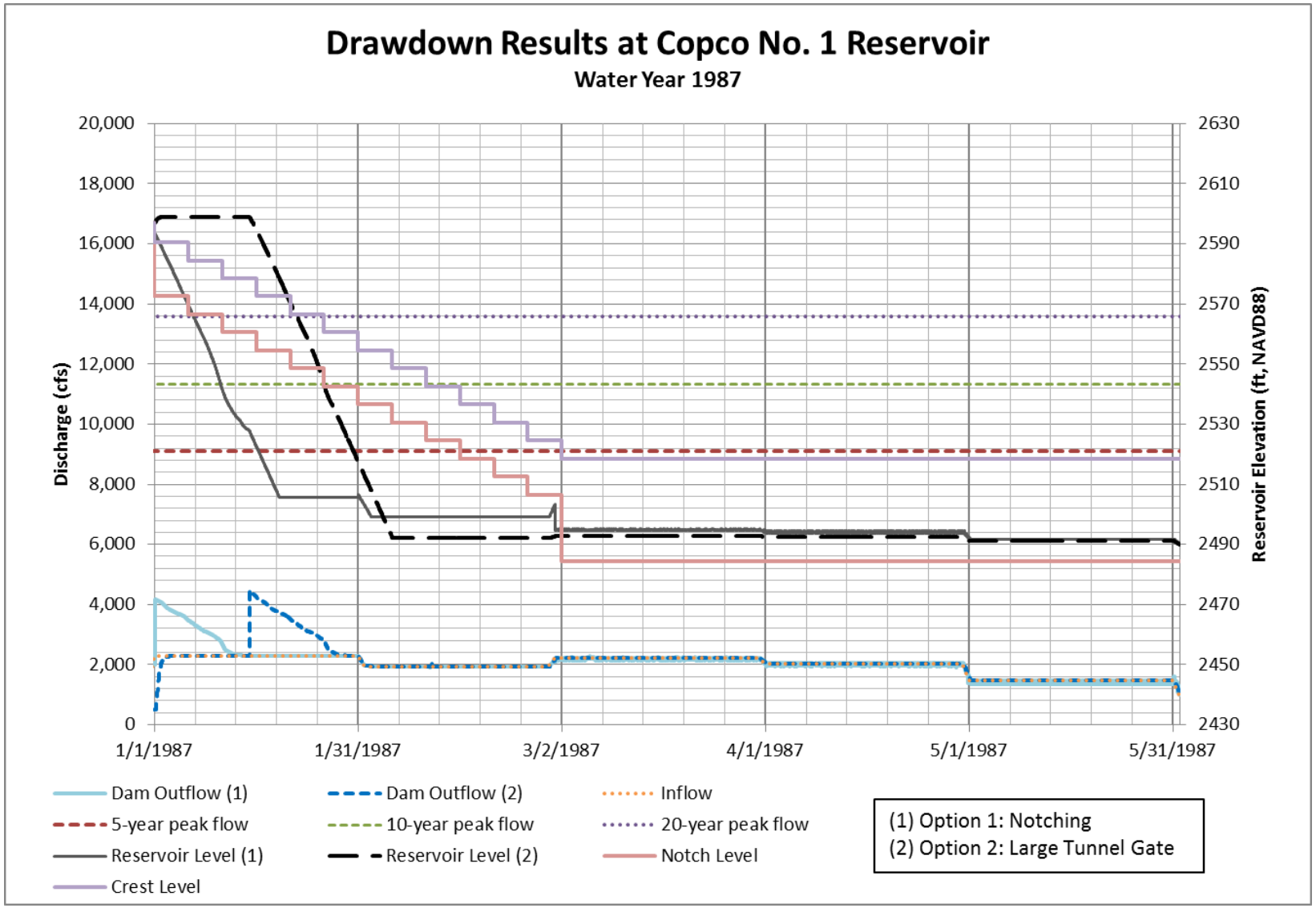


Figure 3-27 Copco No. 1 Reservoir Drawdown, Water Year 1986



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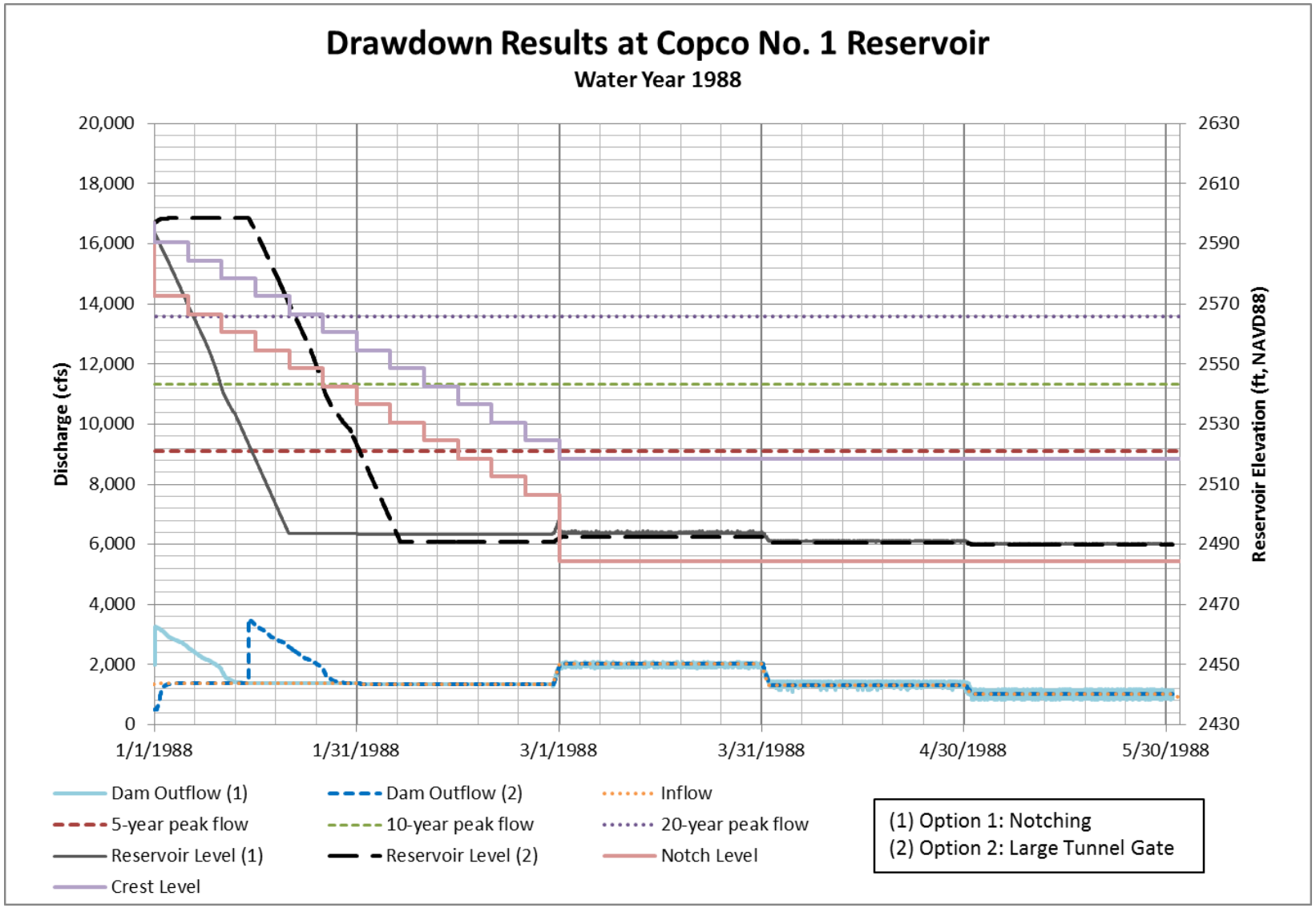

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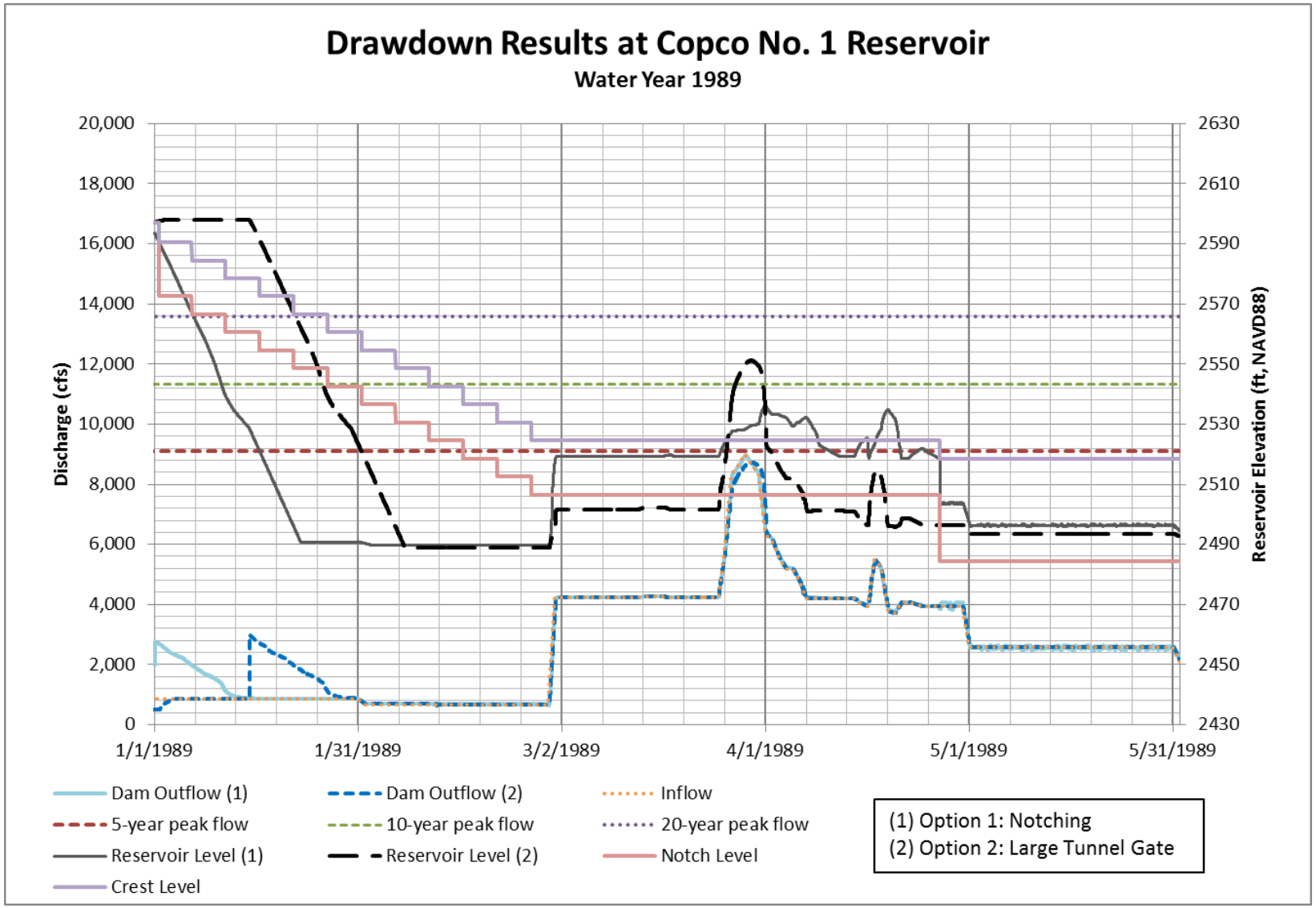

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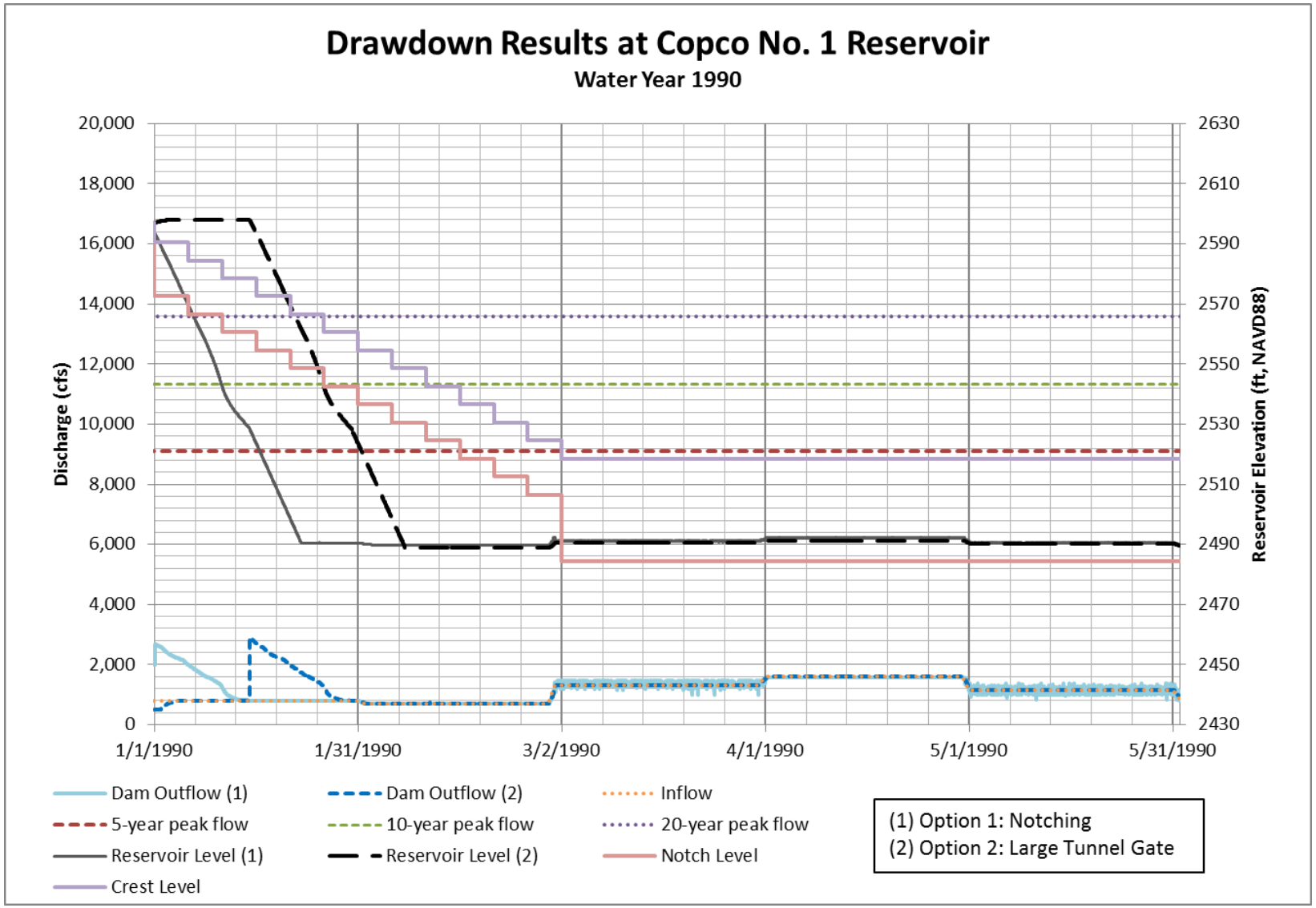

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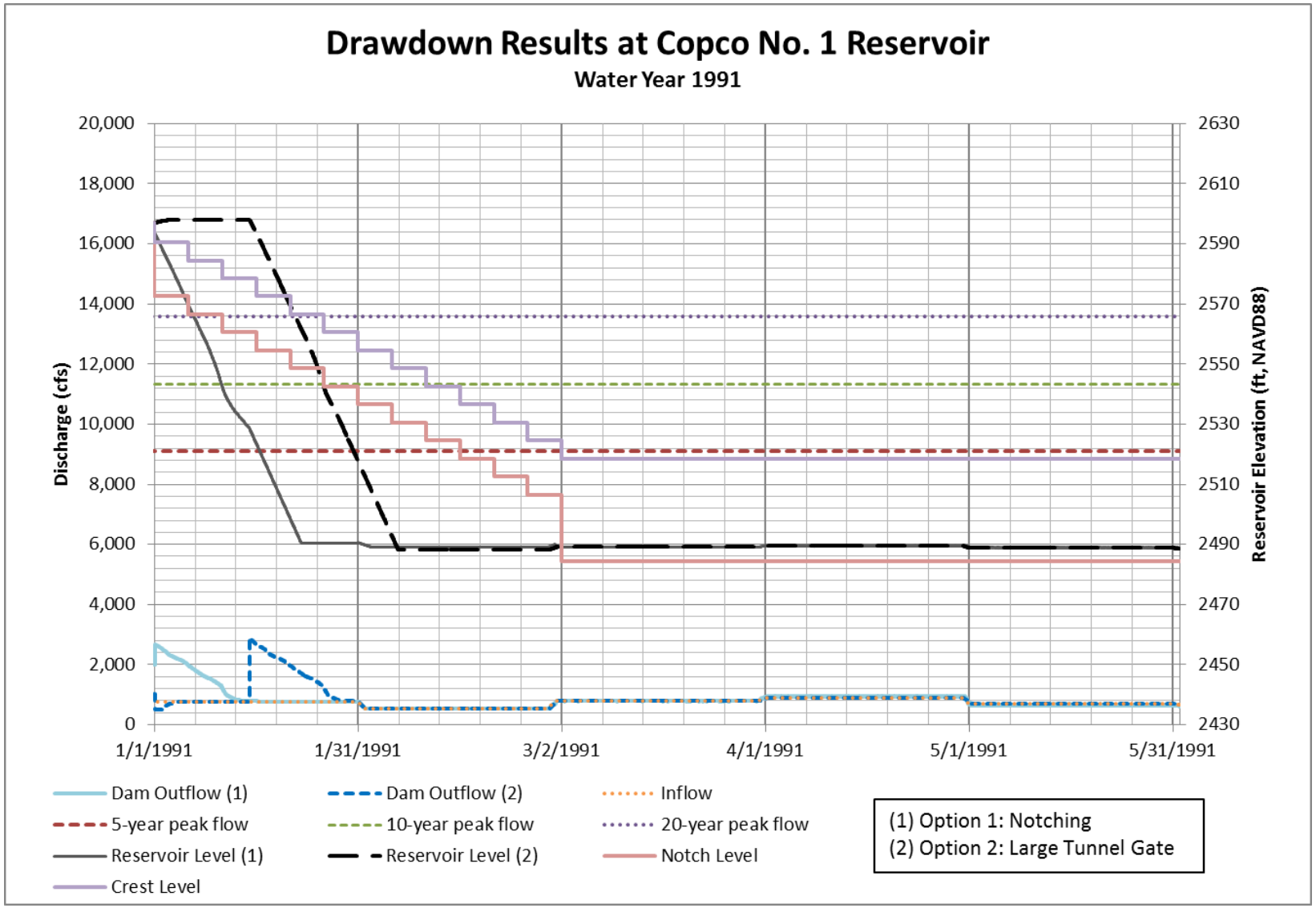

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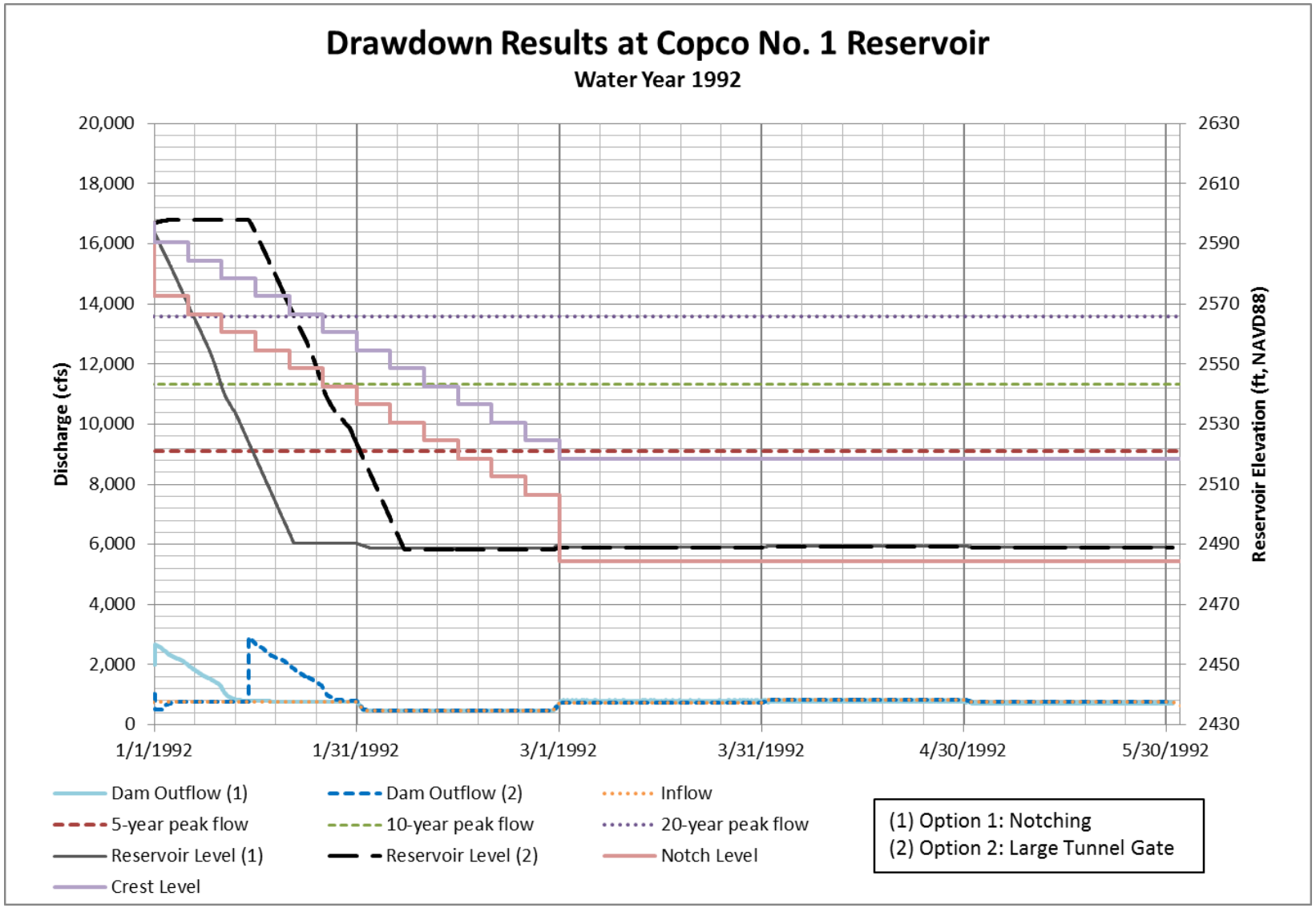

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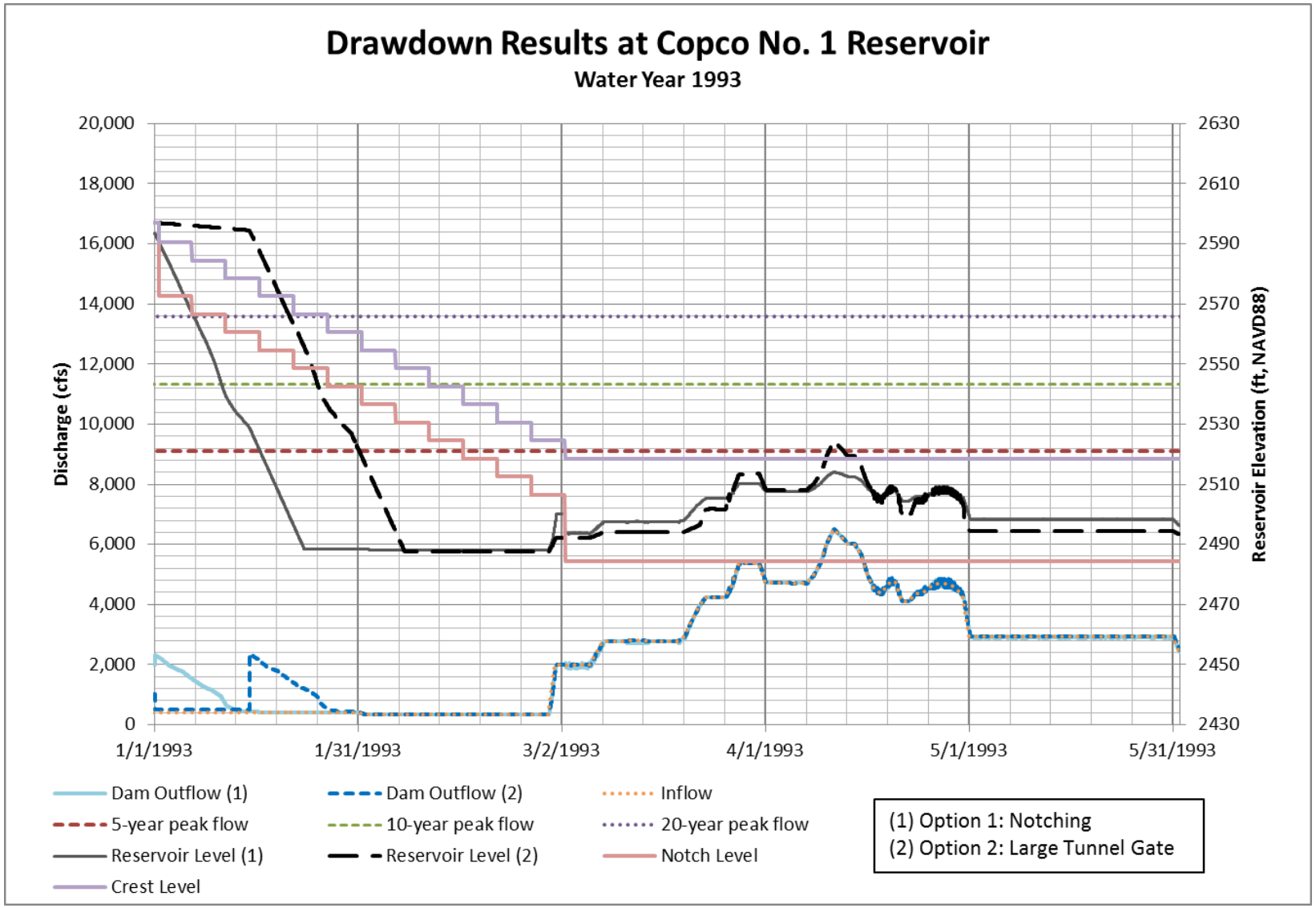

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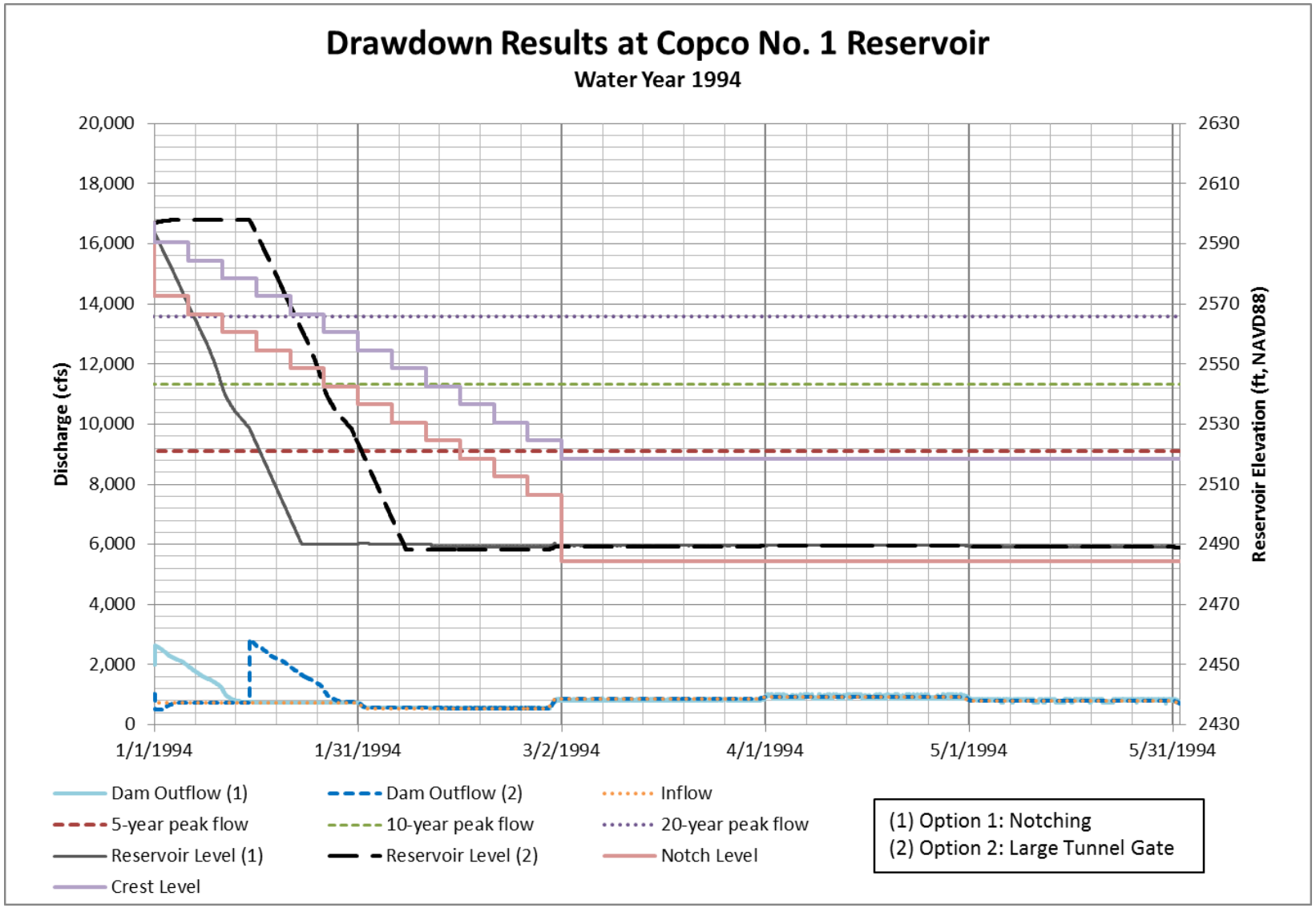

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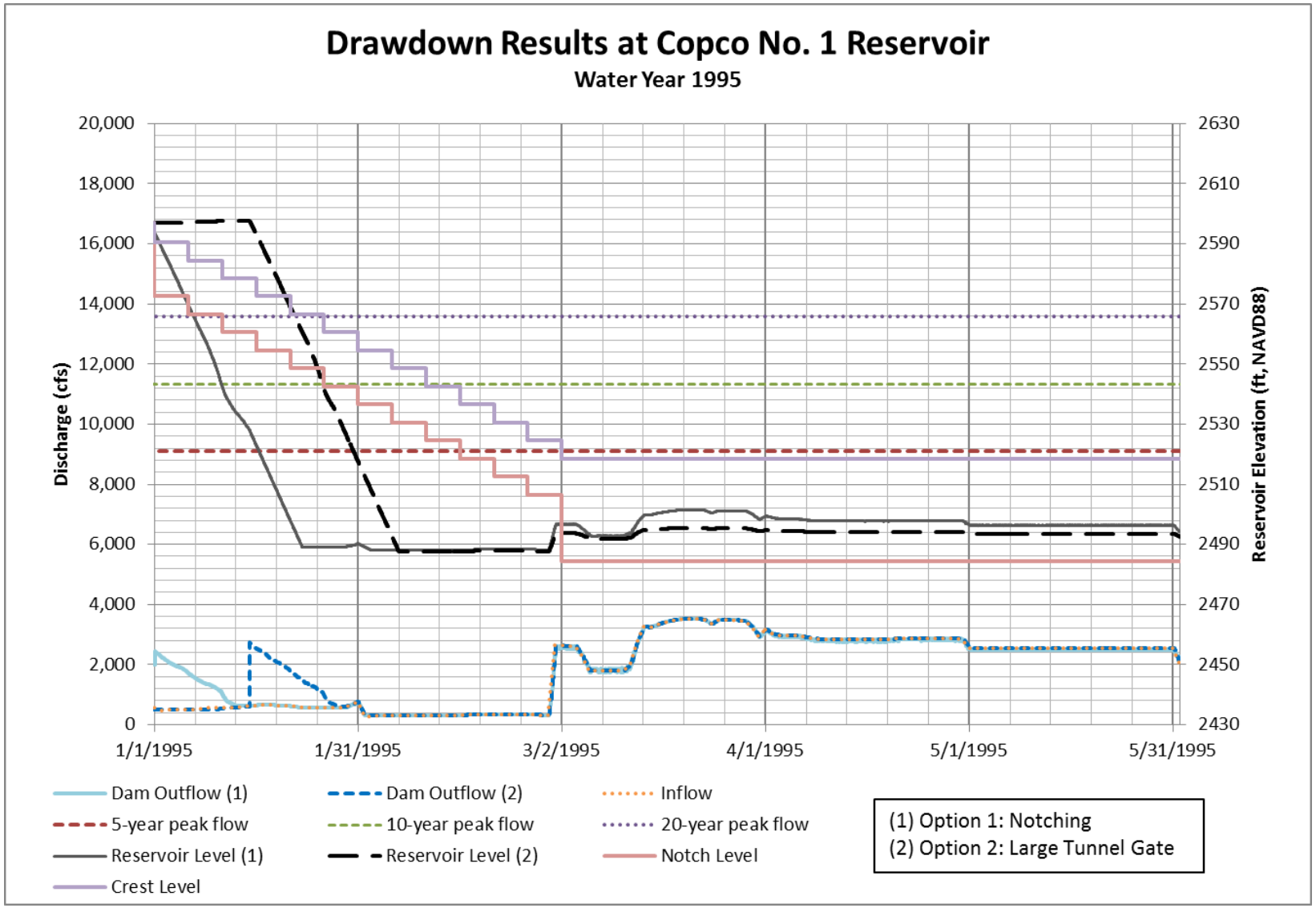


Figure 3-36 Copco No. 1 Reservoir Drawdown, Water Year 1995

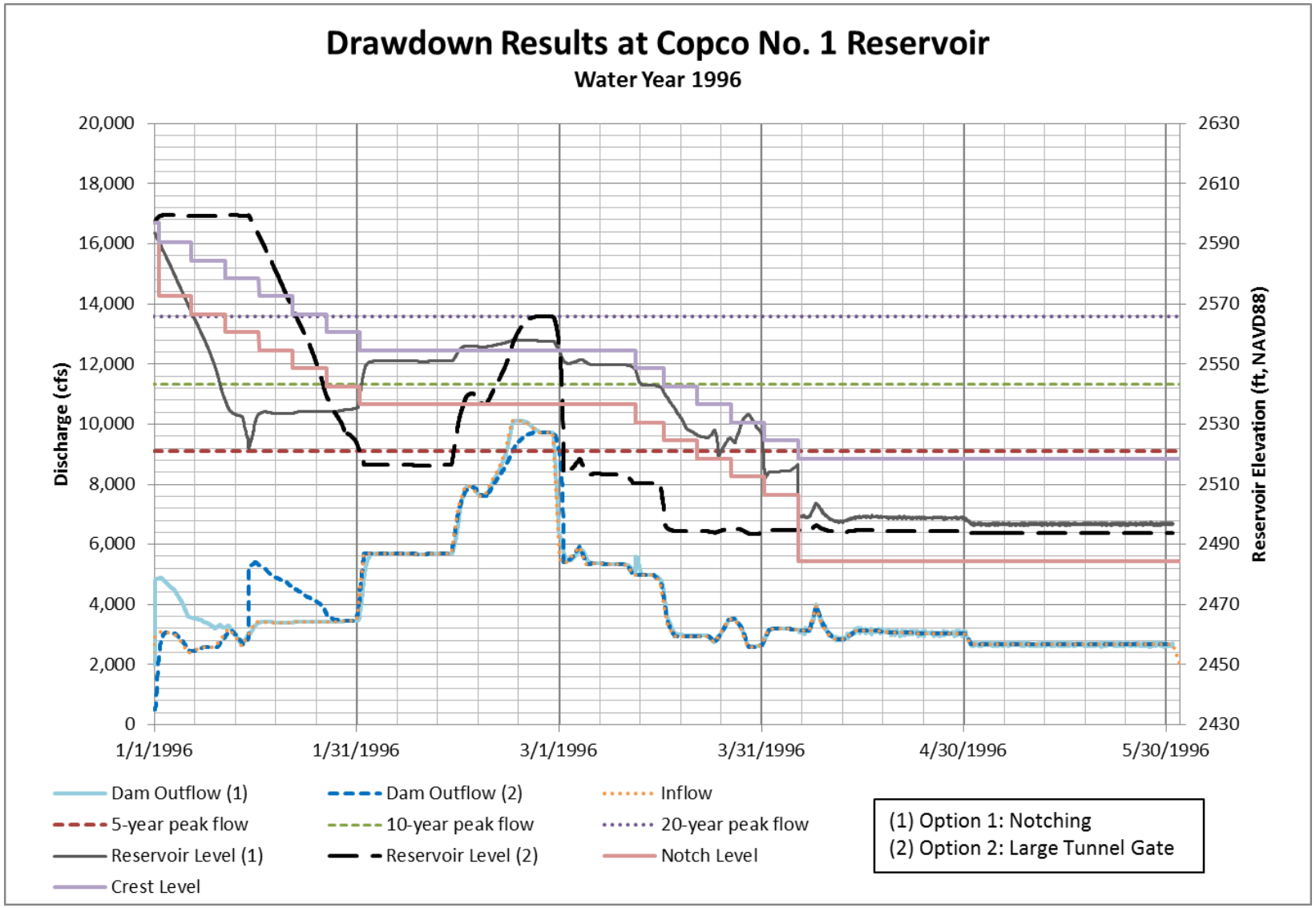


Figure 3-37 Copco No. 1 Reservoir Drawdown, Water Year 1996

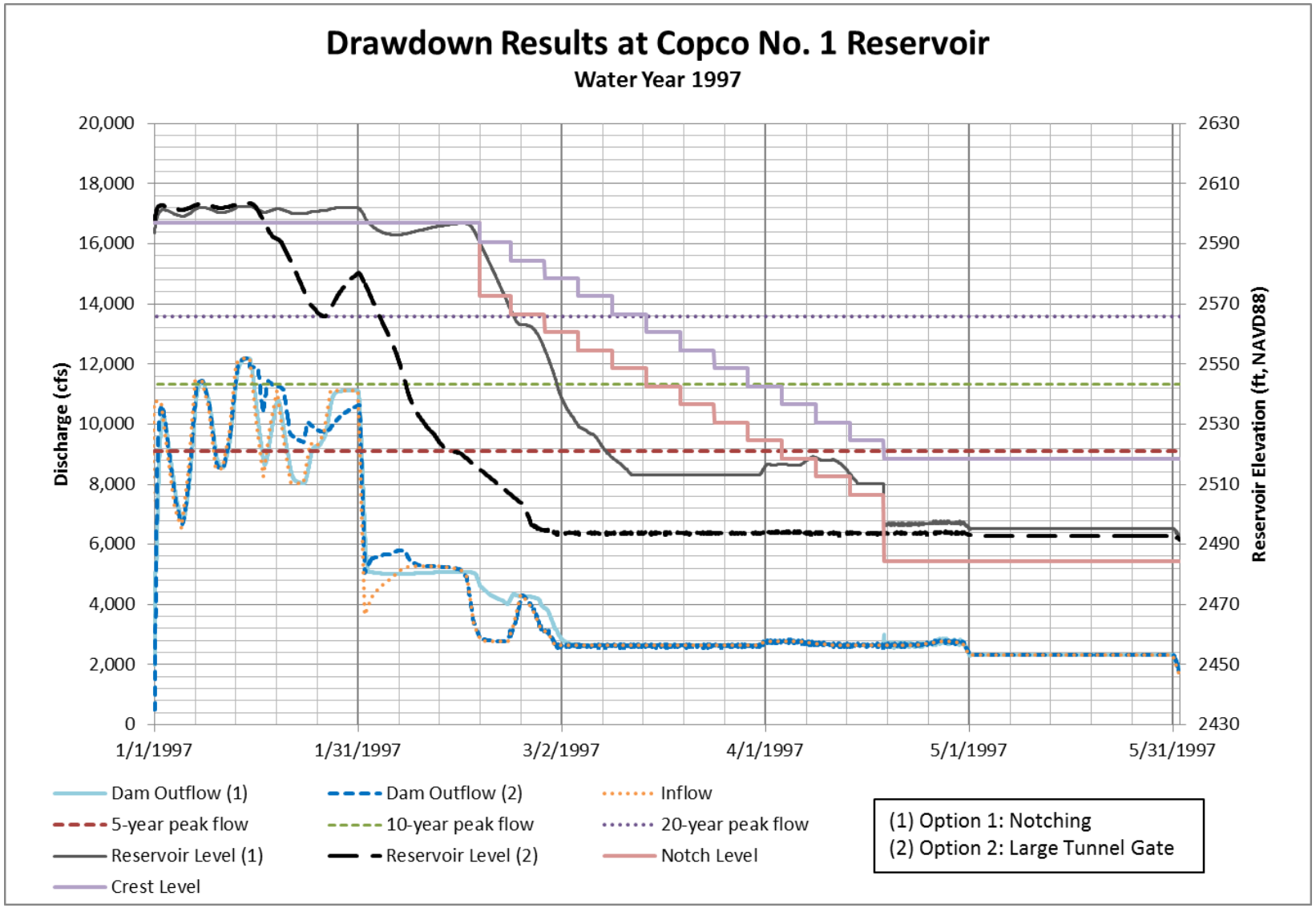


Figure 3-38 Copco No. 1 Reservoir Drawdown, Water Year 1997

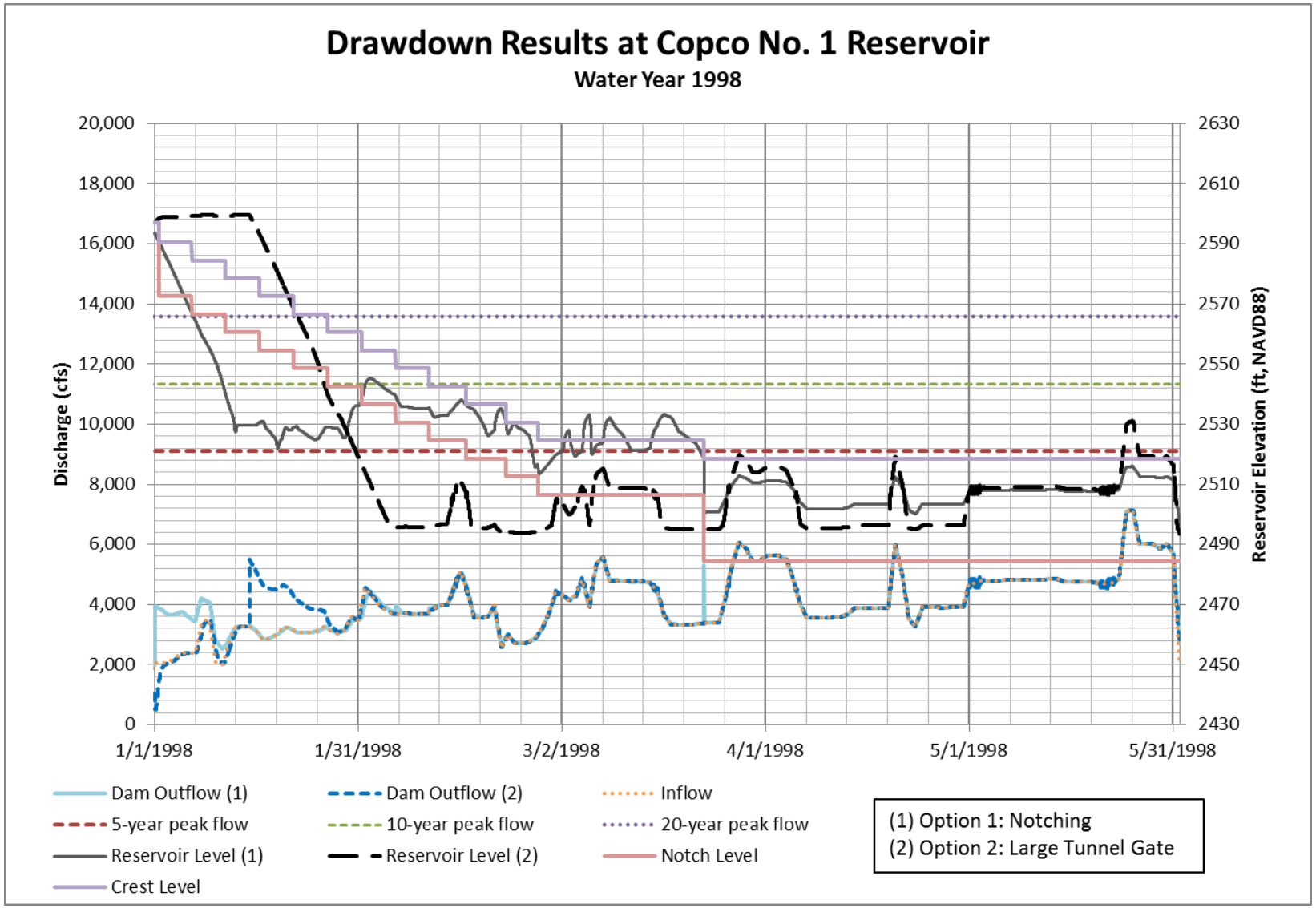


Figure 3-39 Copco No. 1 Reservoir Drawdown, Water Year 1998

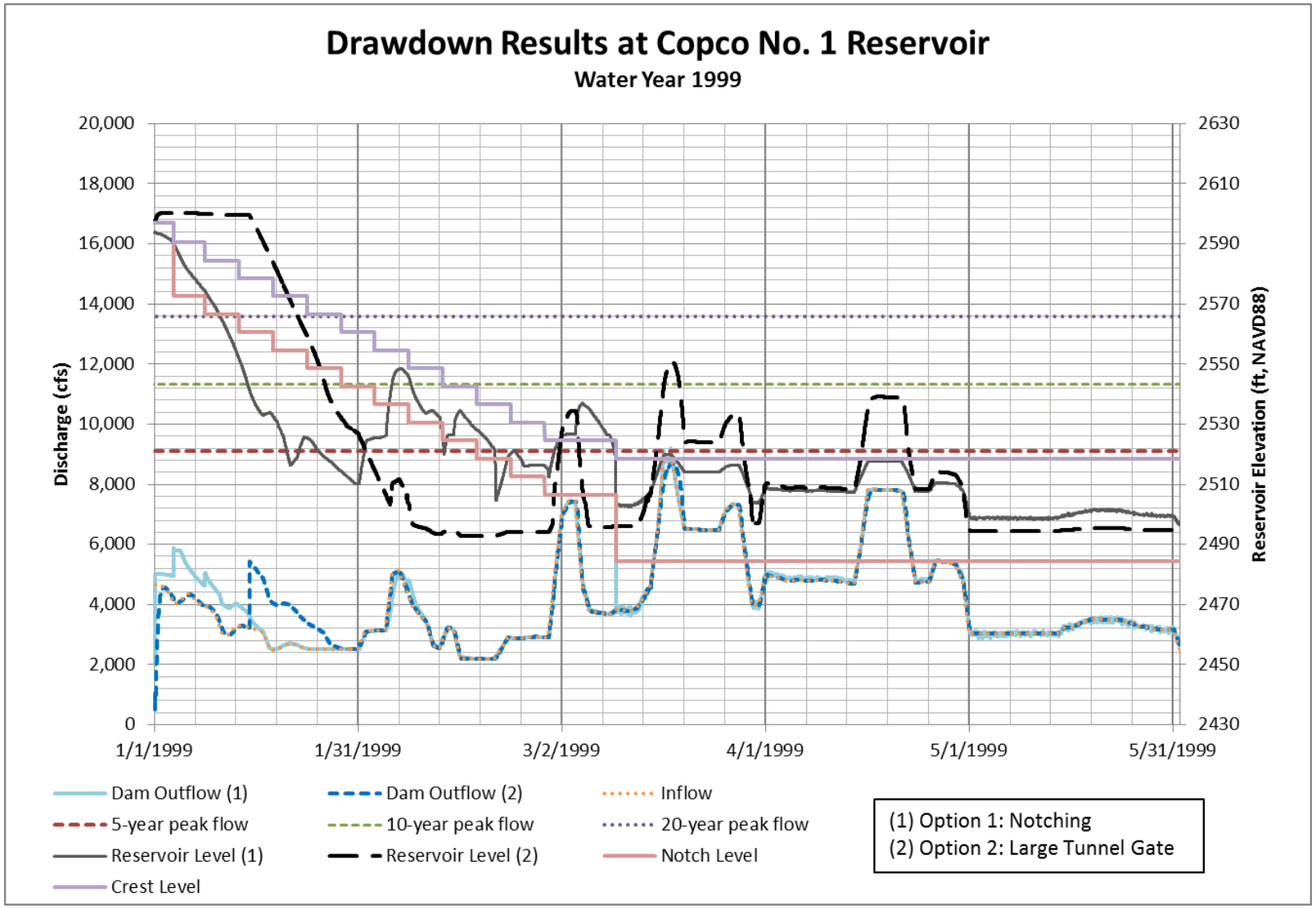


Figure 3-40 Copco No. 1 Reservoir Drawdown, Water Year 1999

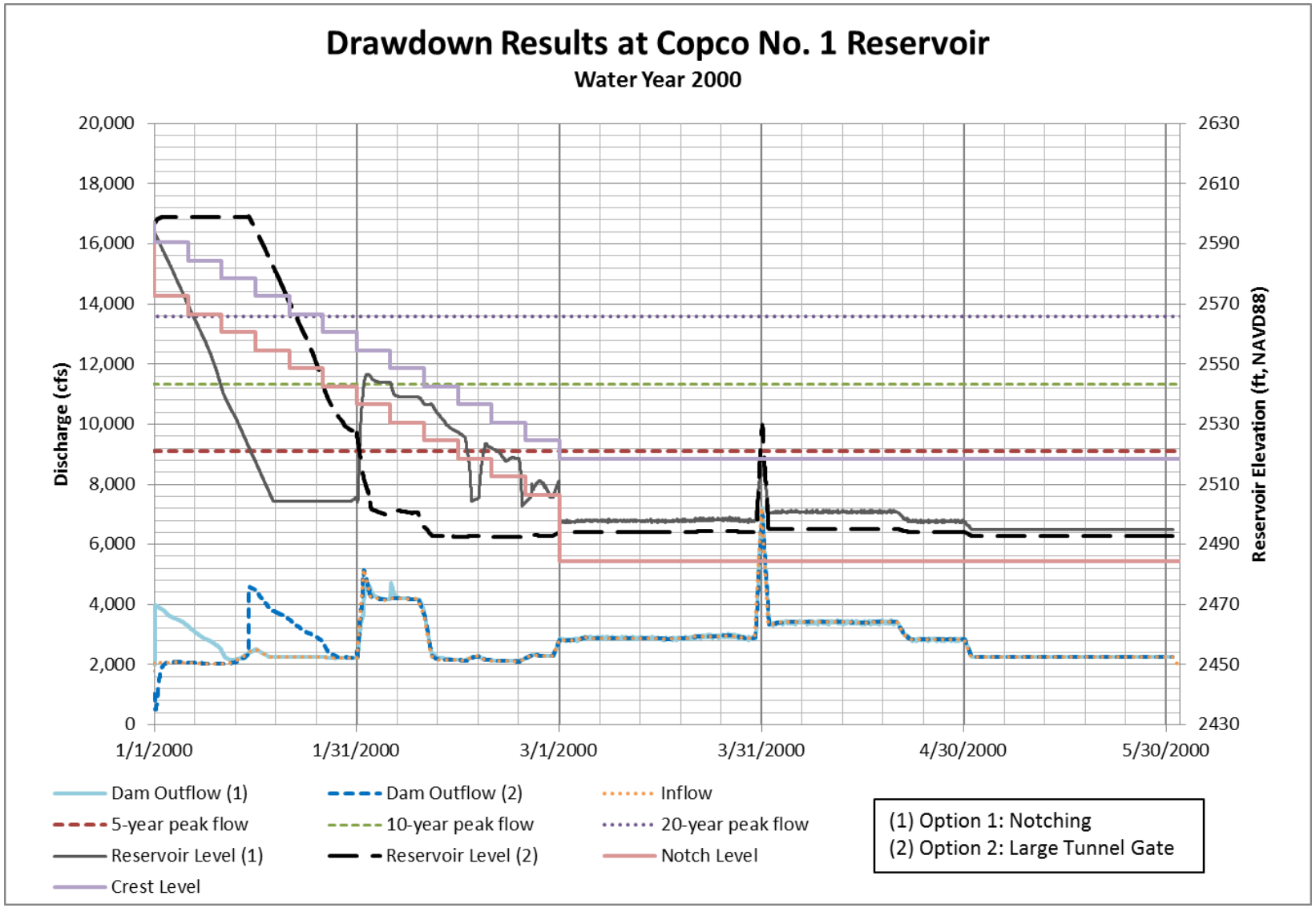


Figure 3-41 Copco No. 1 Reservoir Drawdown, Water Year 2000

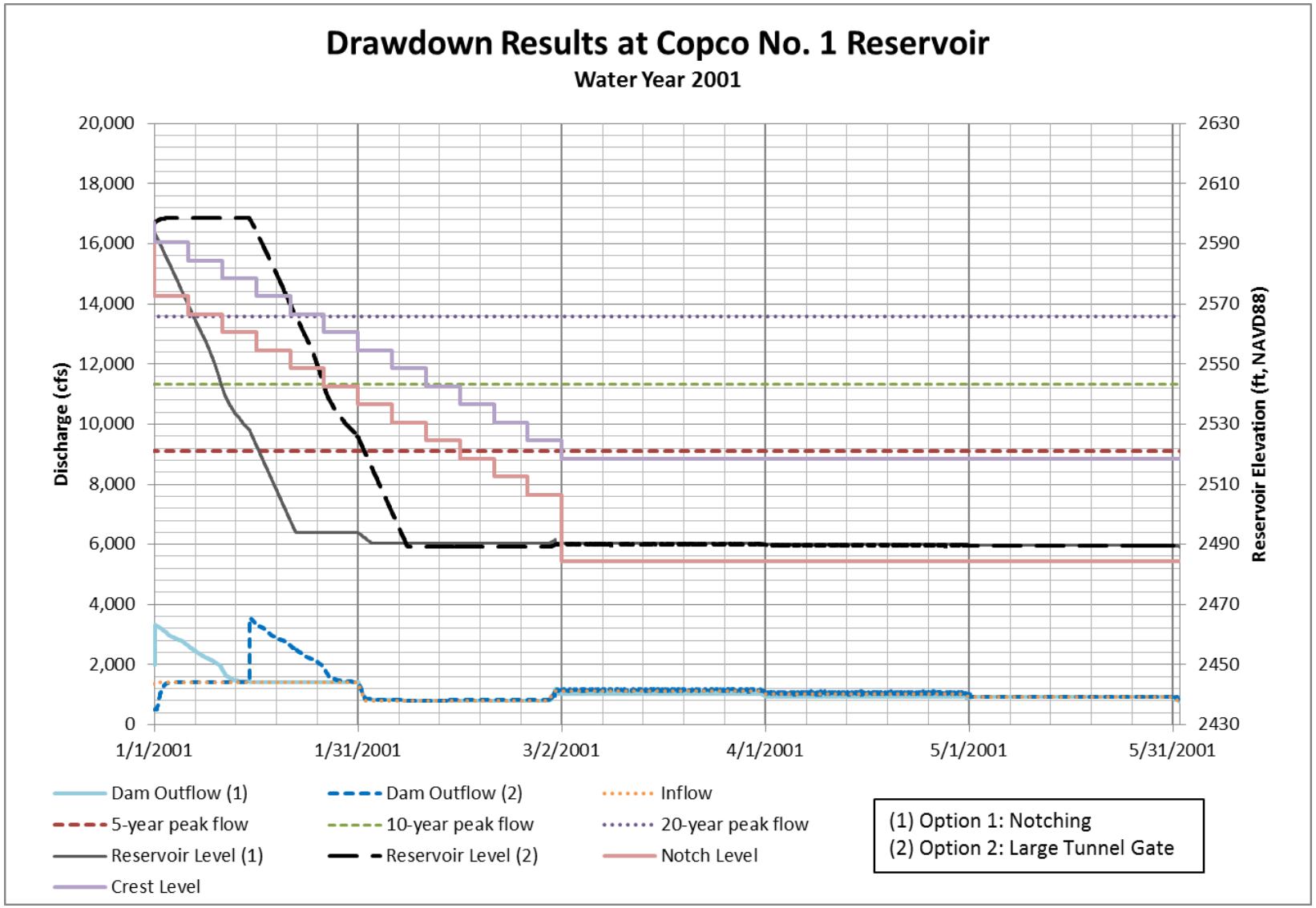
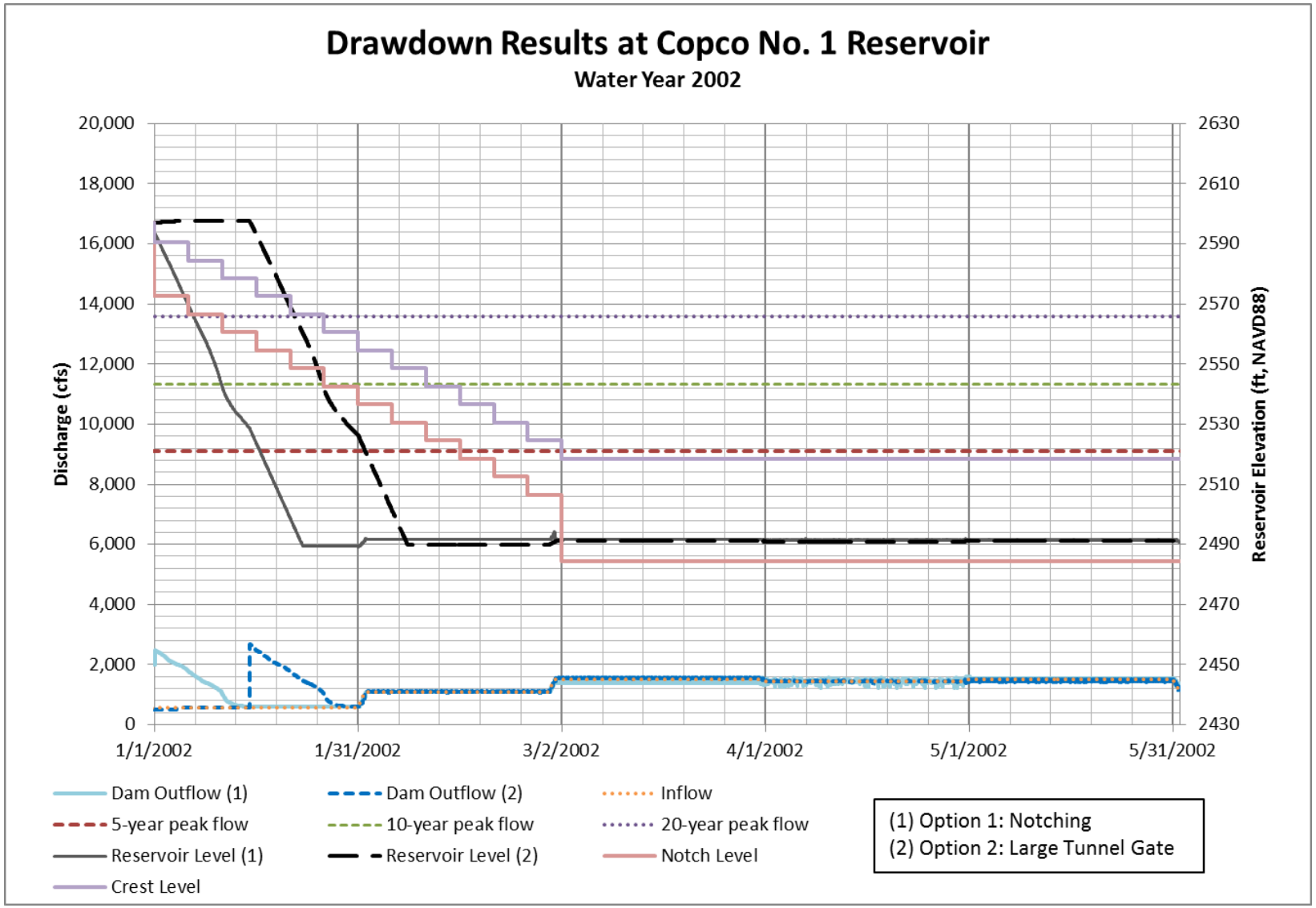


Figure 3-42 Copco No. 1 Reservoir Drawdown, Water Year 2001



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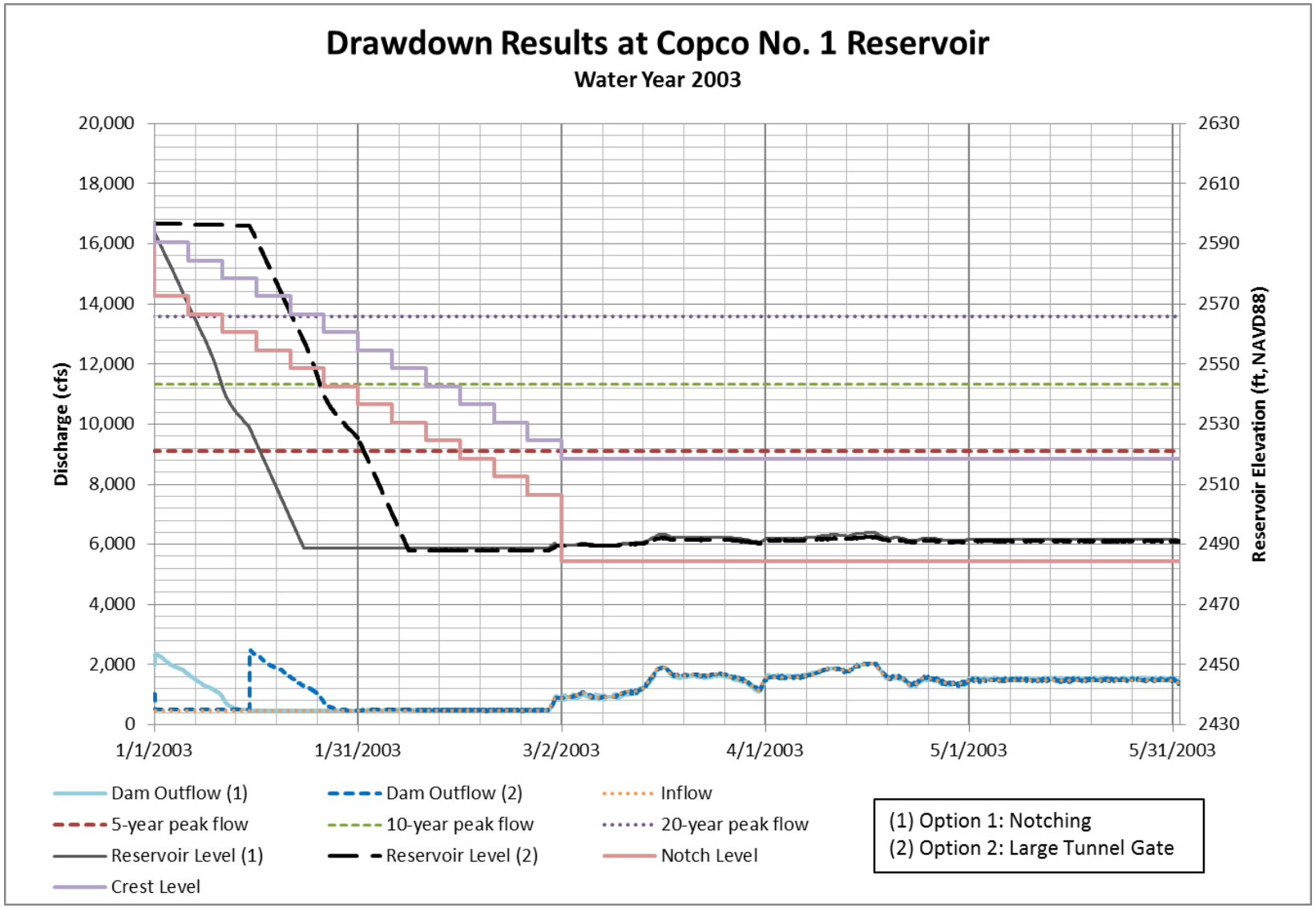

Figure 3-44 Copco No. 1 Reservoir Drawdown, Water Year 2003

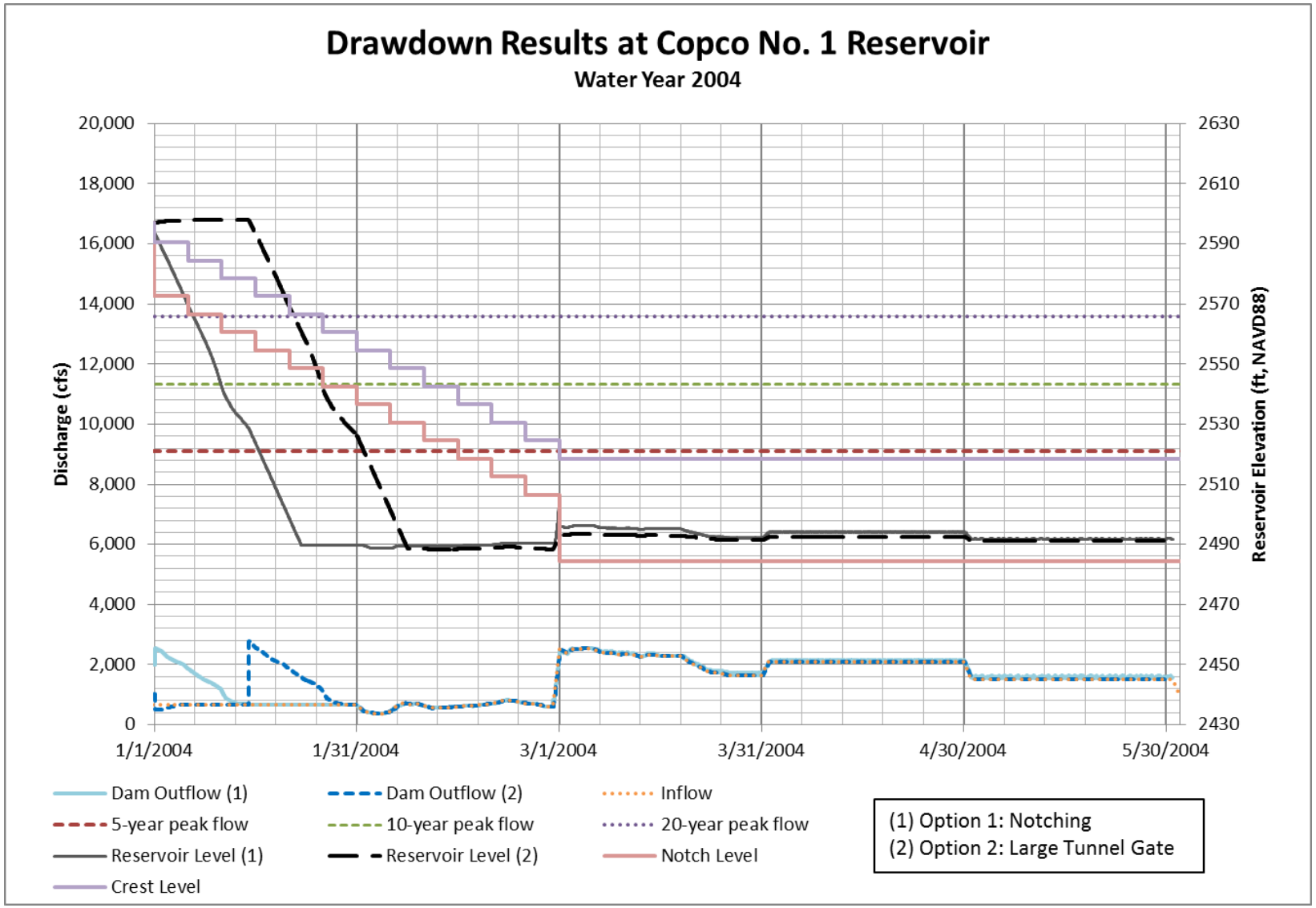

Figure 3-45 Copco No. 1 Reservoir Drawdown, Water Year 2004

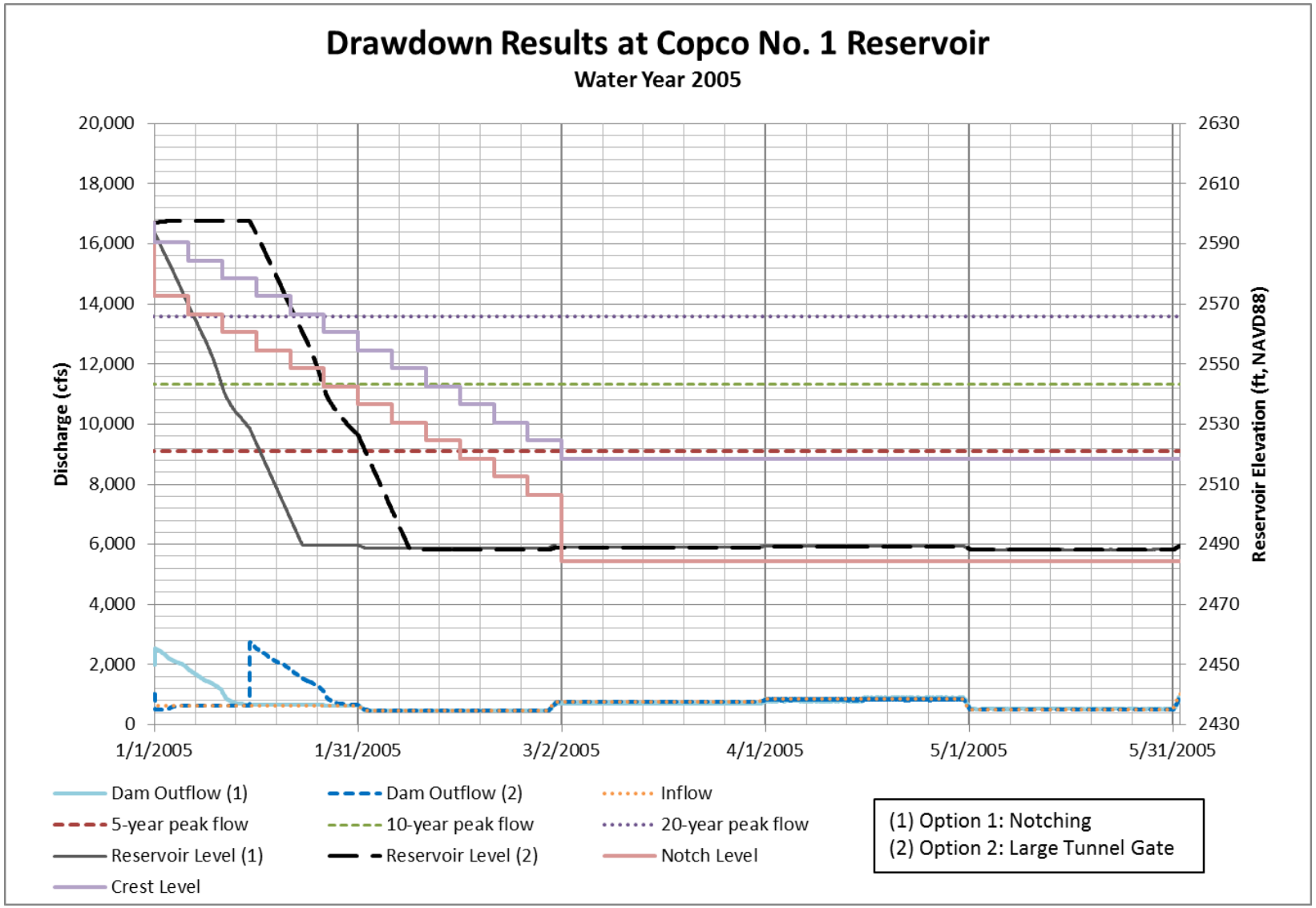

Figure 3-46 Copco No. 1 Reservoir Drawdown, Water Year 2005

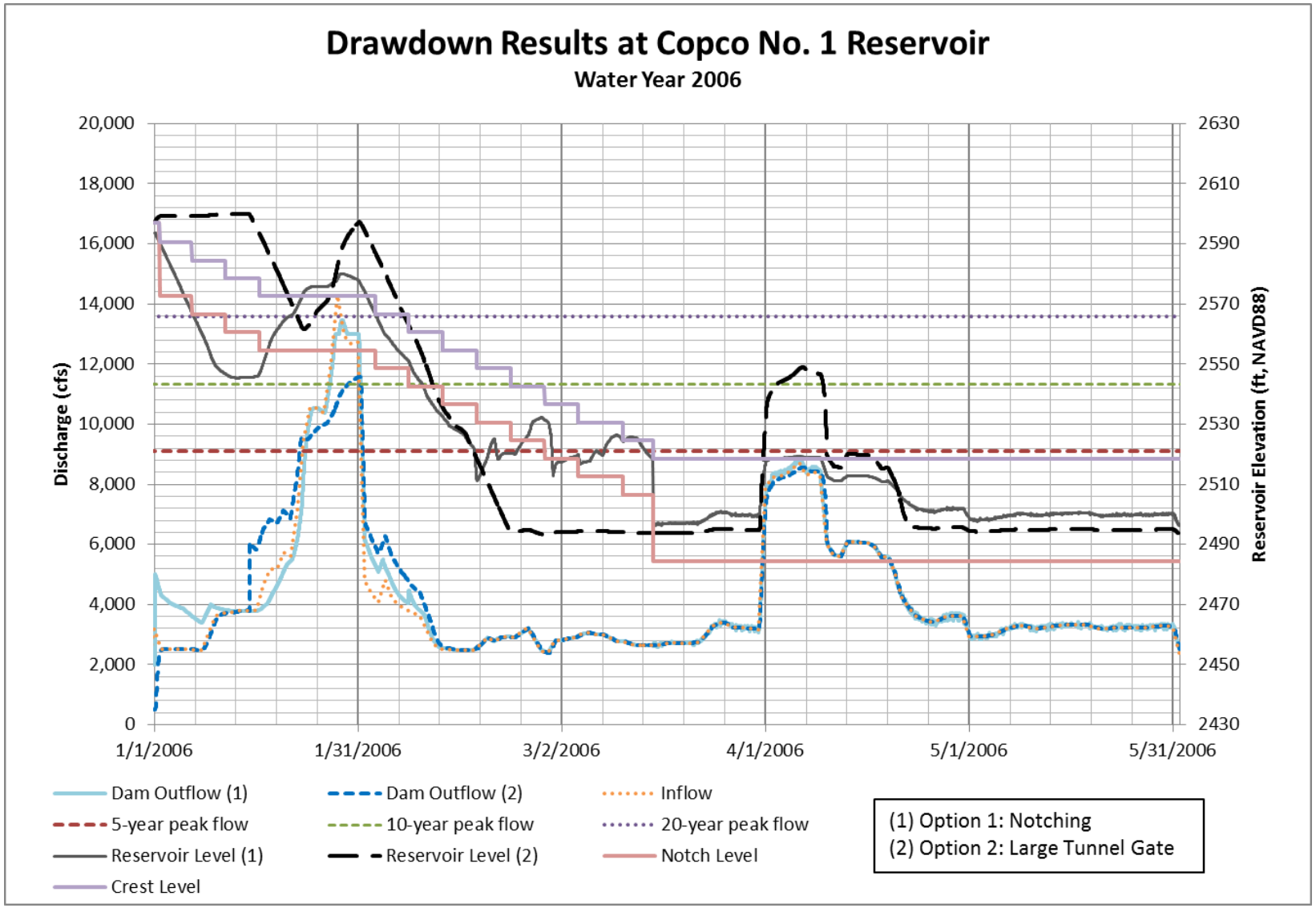

Figure 3-47 Copco No. 1 Reservoir Drawdown, Water Year 2006

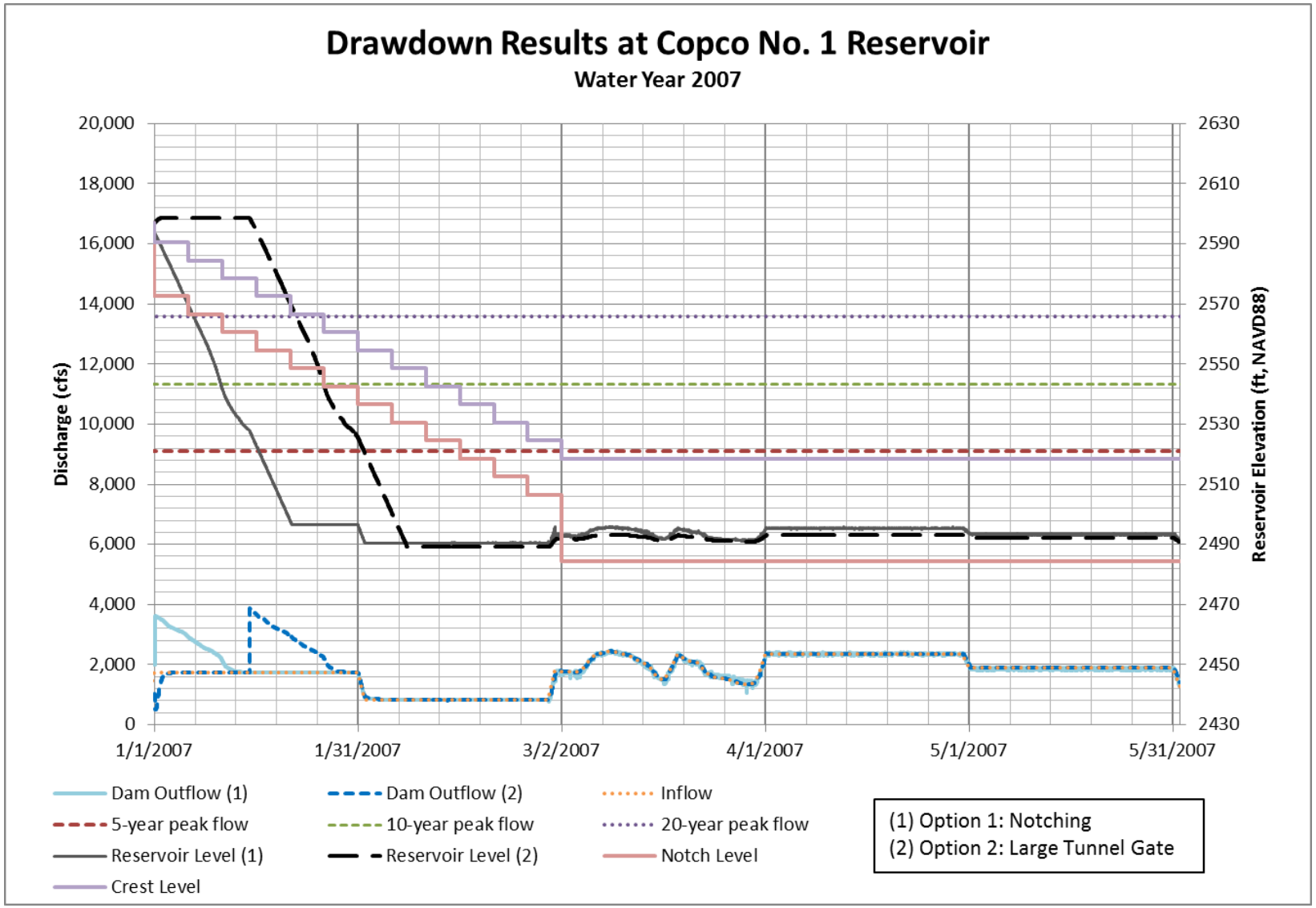

Figure 3-48 Copco No. 1 Reservoir Drawdown, Water Year 2007

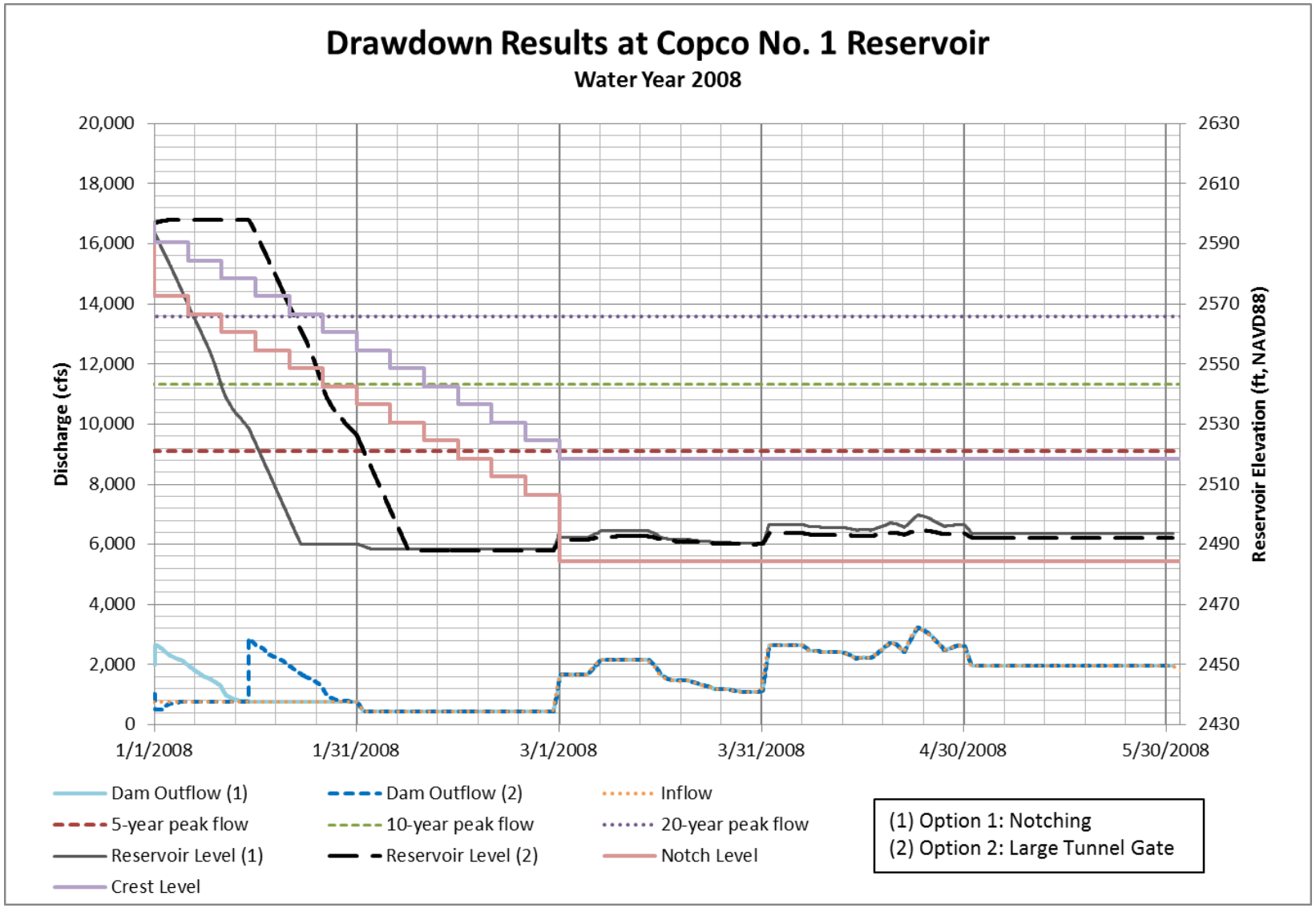

Figure 3-49 Copco No. 1 Reservoir Drawdown, Water Year 2008

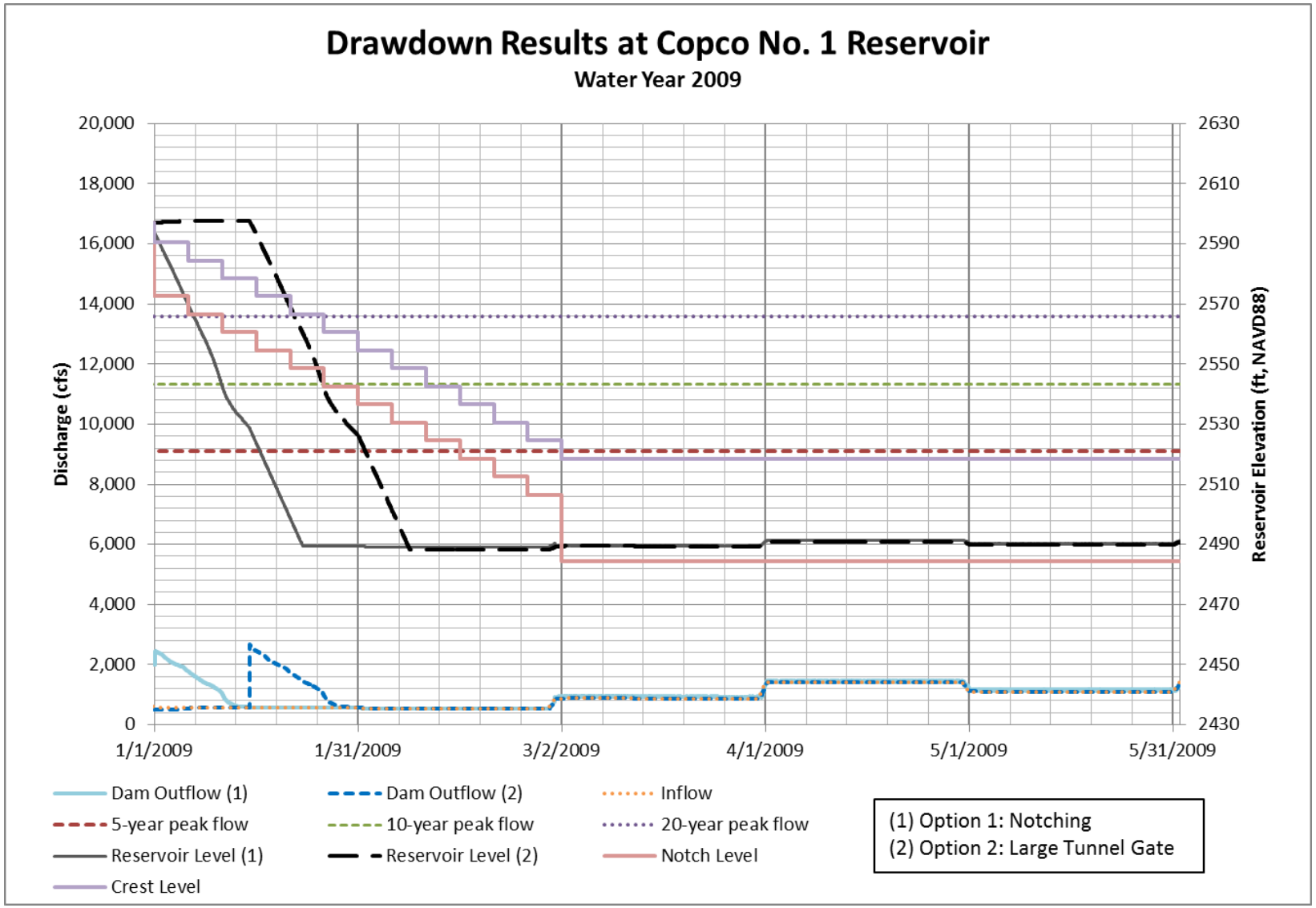

Figure 3-50 Copco No. 1 Reservoir Drawdown, Water Year 2009

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Chapter 4: Iron Gate Reservoir

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4. IRON GATE RESERVOIR

Reservoir drawdown at Iron Gate will begin from normal operating elevation 2331.3 feet on January 1, 2021 by making controlled releases through the modified diversion tunnel. Reservoir drawdown will be limited to a maximum of 5 feet per day to maintain embankment and reservoir rim slope stability. The maximum additional discharge downstream of Iron Gate Dam due to drawdown activities is about 4,000 cfs. The total discharge capacity of the modified diversion tunnel with the reservoir at spillway crest elevation 2331.3 is about 10,000 cfs. For reference, the 5-year flow event downstream of Iron Gate Dam is 10,900 cfs.

4.1 Results

Figures 4-1 through 4-49 show results for drawdown of Iron Gate Reservoir. Due to their close physical proximity, KRRC modeled the Iron Gate Reservoir drawdown in conjunction with the Copco Lake drawdown. There are different results at Iron Gate Reservoir depending on which drawdown option at Copco No. 1 Dam is chosen. References to Options 1 and 2 in the plots are the resulting effects at Iron Gate based on either Option 1 or 2 being implemented at Copco No. 1 Dam. Since KRRC proposes Option 2 for the Project, the remaining results discuss only Option 2.

During representative drier years (for example1973 and 1979), Iron Gate Reservoir was easily drawn down by early February, and it did not refill after that point.

During the wetter years such as 2006 and 1986, the model shows Iron Gate Reservoir almost completely drawn down by March 1, but it partially refilled later in the year when storms occurred. The majority of the accumulated sediment will mobilize during the initial drawdown, and subsequent reservoir filling and drawdown is expected to cause only moderate increases in high suspended sediment (relative to background) (USBR 2012c).

For the wettest year, 1966, the model shows the reservoir draws down by early March, but the probability of a storm of this magnitude occurring in the drawdown year is low.

During the wetter years (for example 1966, 2006, 1986, and 1970), flows are higher than what would be expected via the spillway alone (i.e., without drawdown), but the increases are mainly limited to those periods when flows are below the 10-year flood elevation. KRRC does not anticipate that sediment concentrations resulting from the proposed drawdown procedure and associated hydraulics would differ from those previously estimated (USBR 2012c).

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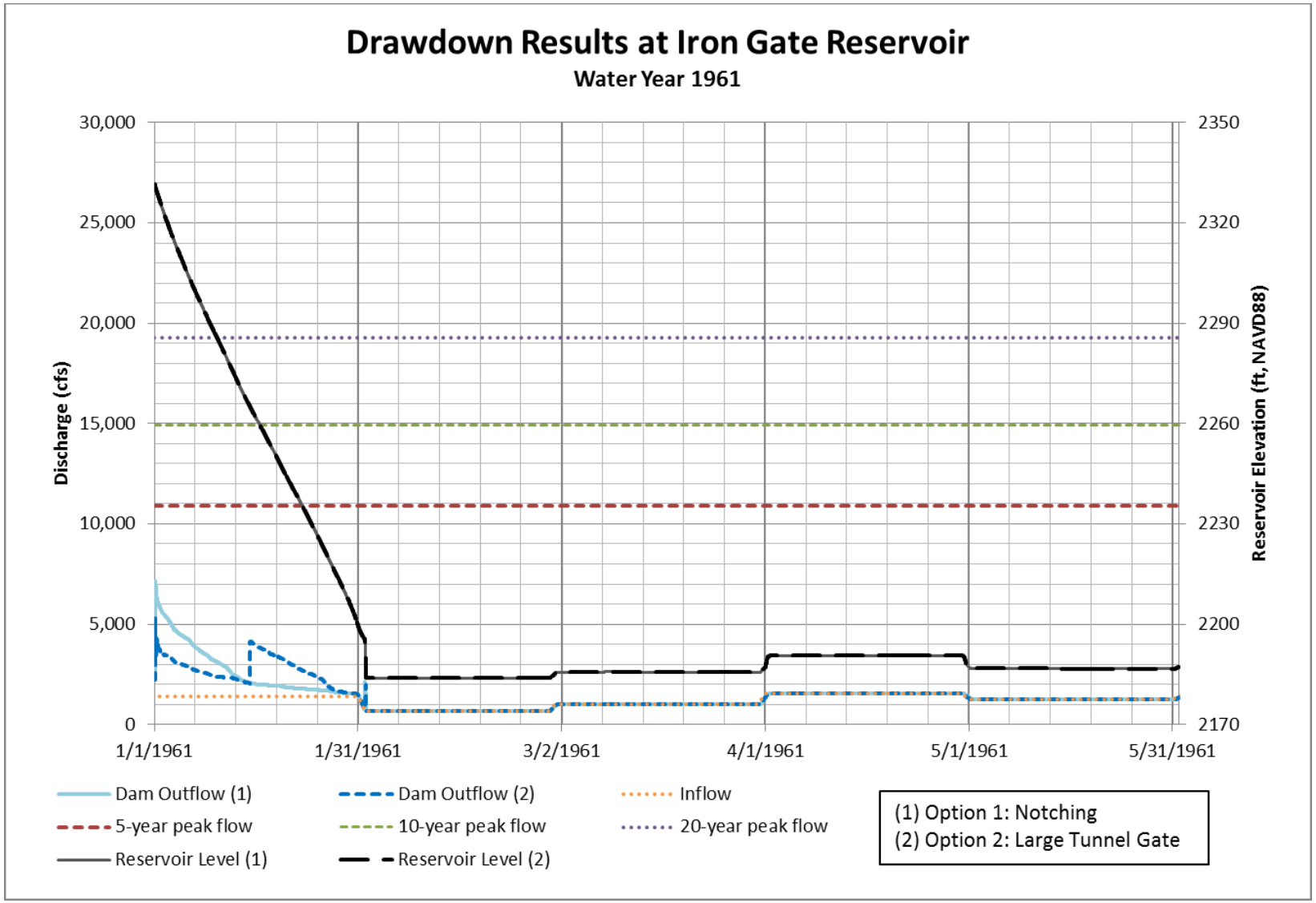

Figure 4-1 Iron Gate Reservoir Drawdown, Water Year 1961

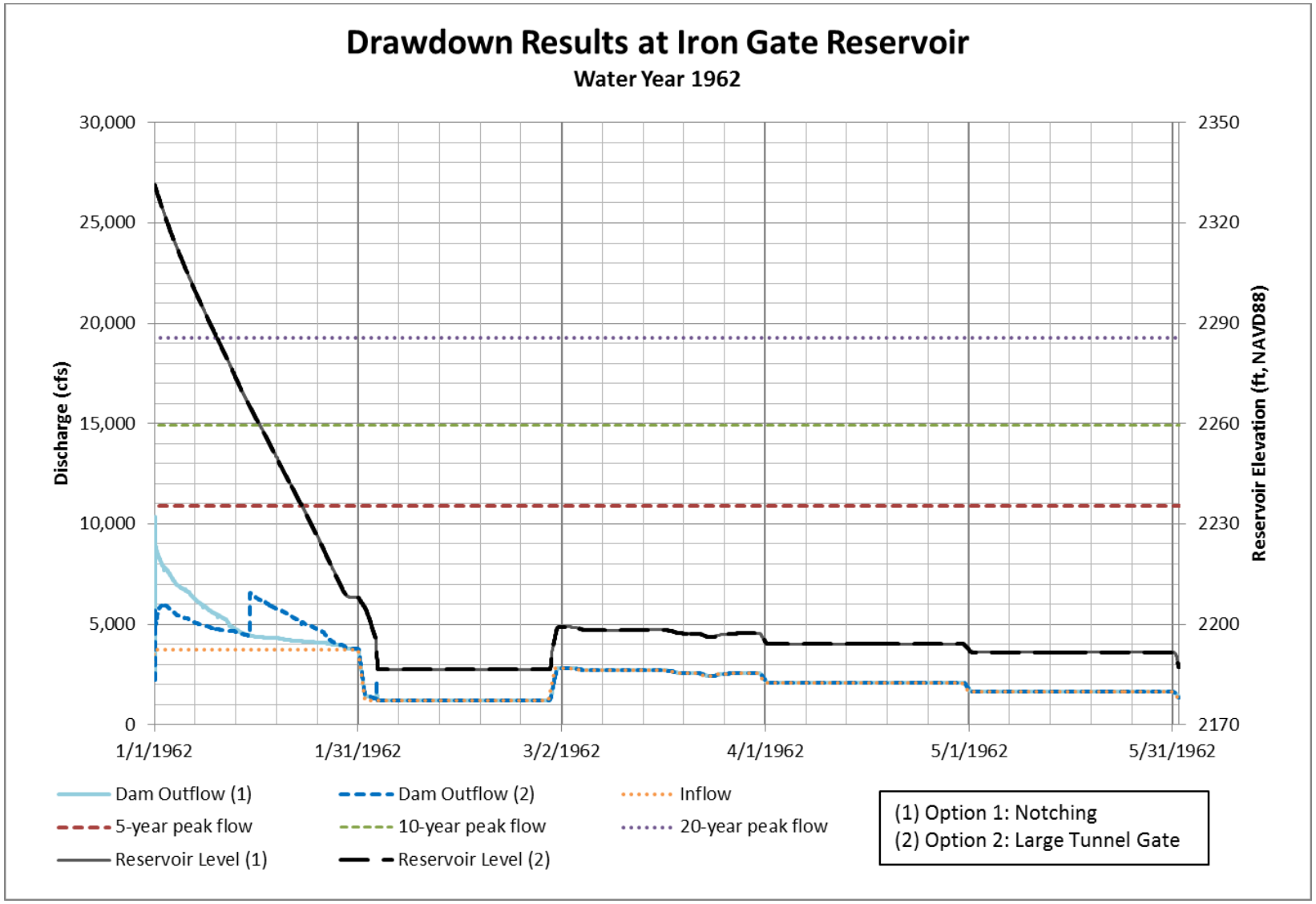

Figure 4-2 Iron Gate Reservoir Drawdown, Water Year 1962

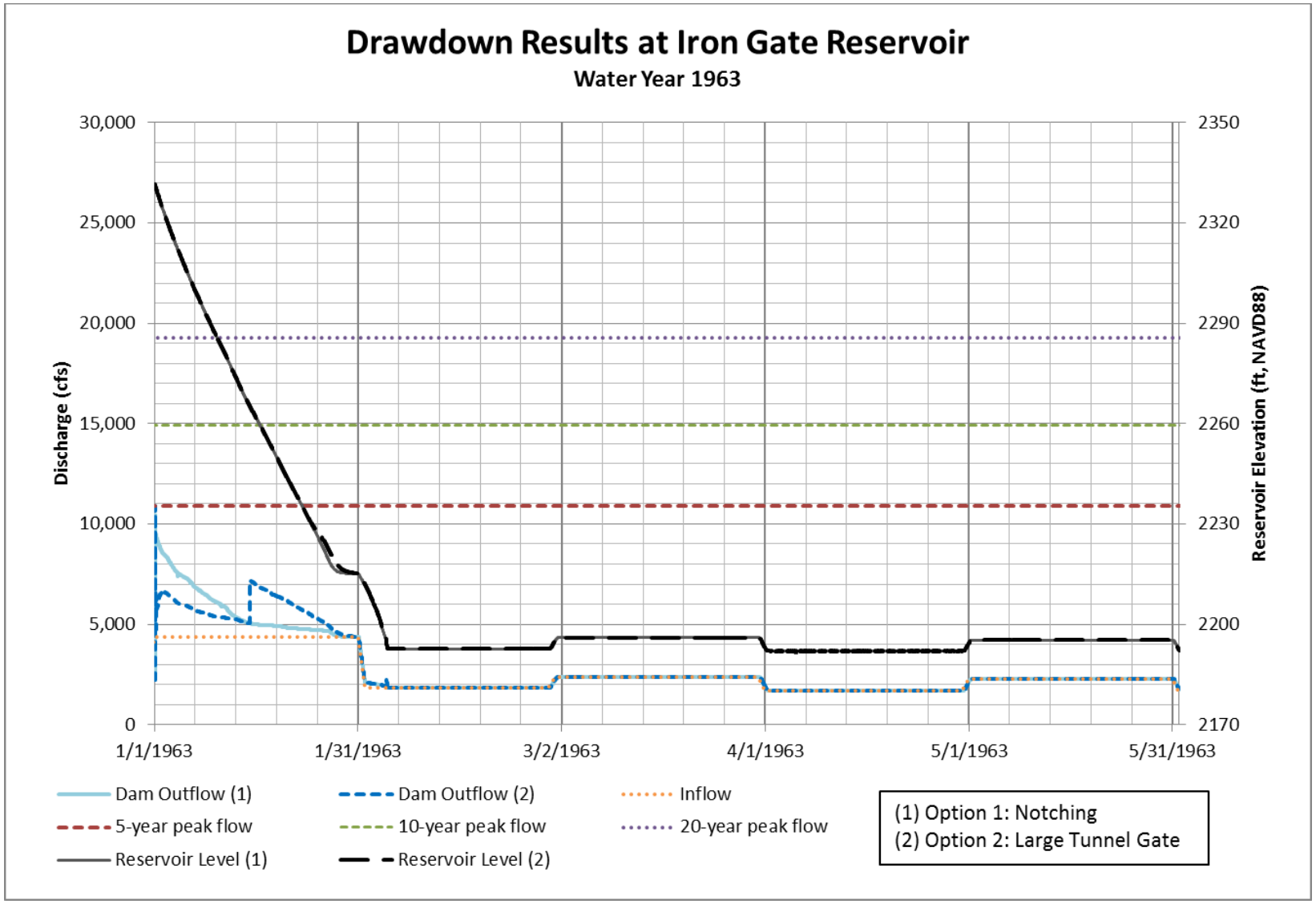

Figure 4-3 Iron Gate Reservoir Drawdown, Water Year 1963

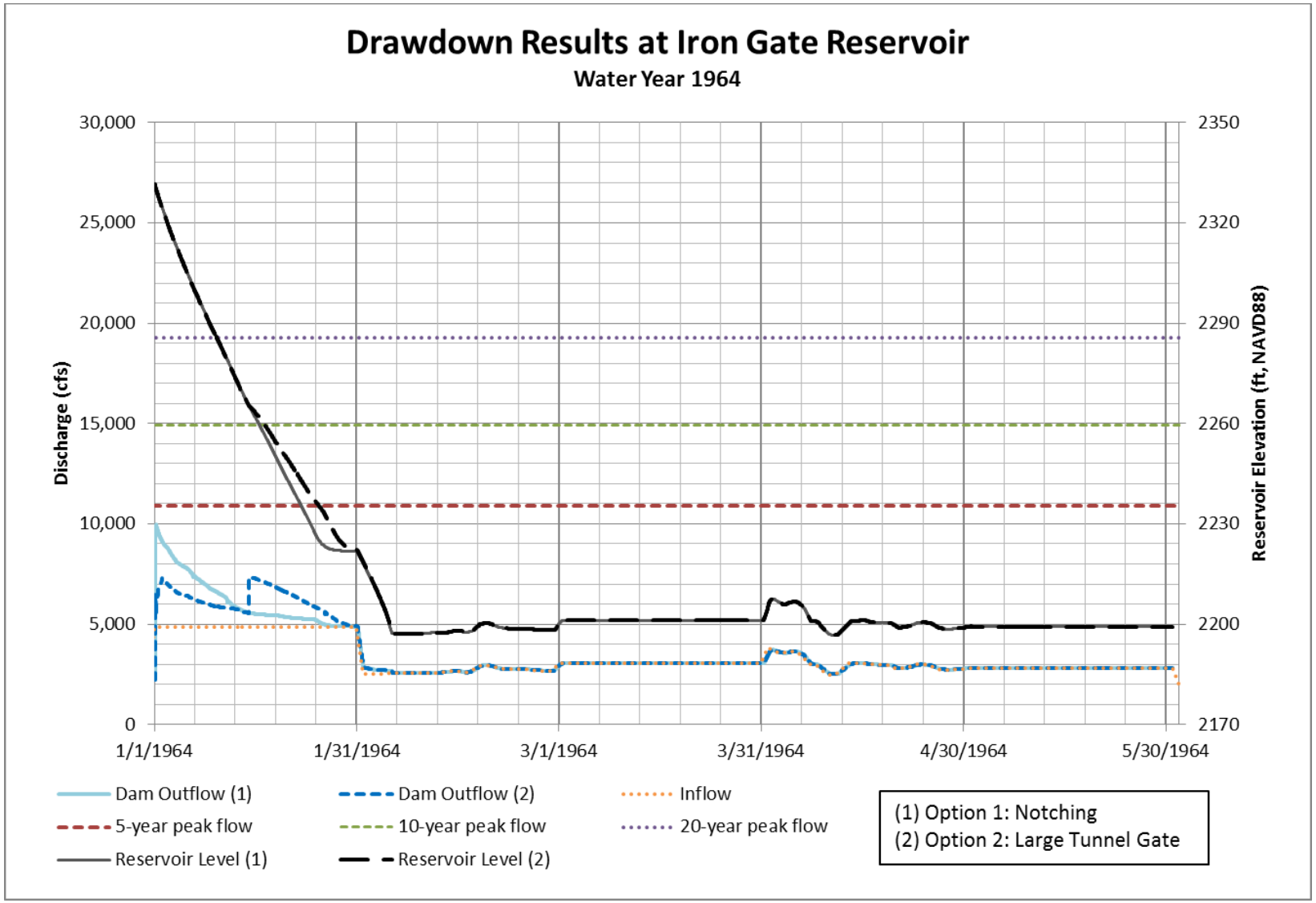

Figure 4-4 Iron Gate Reservoir Drawdown, Water Year 1964

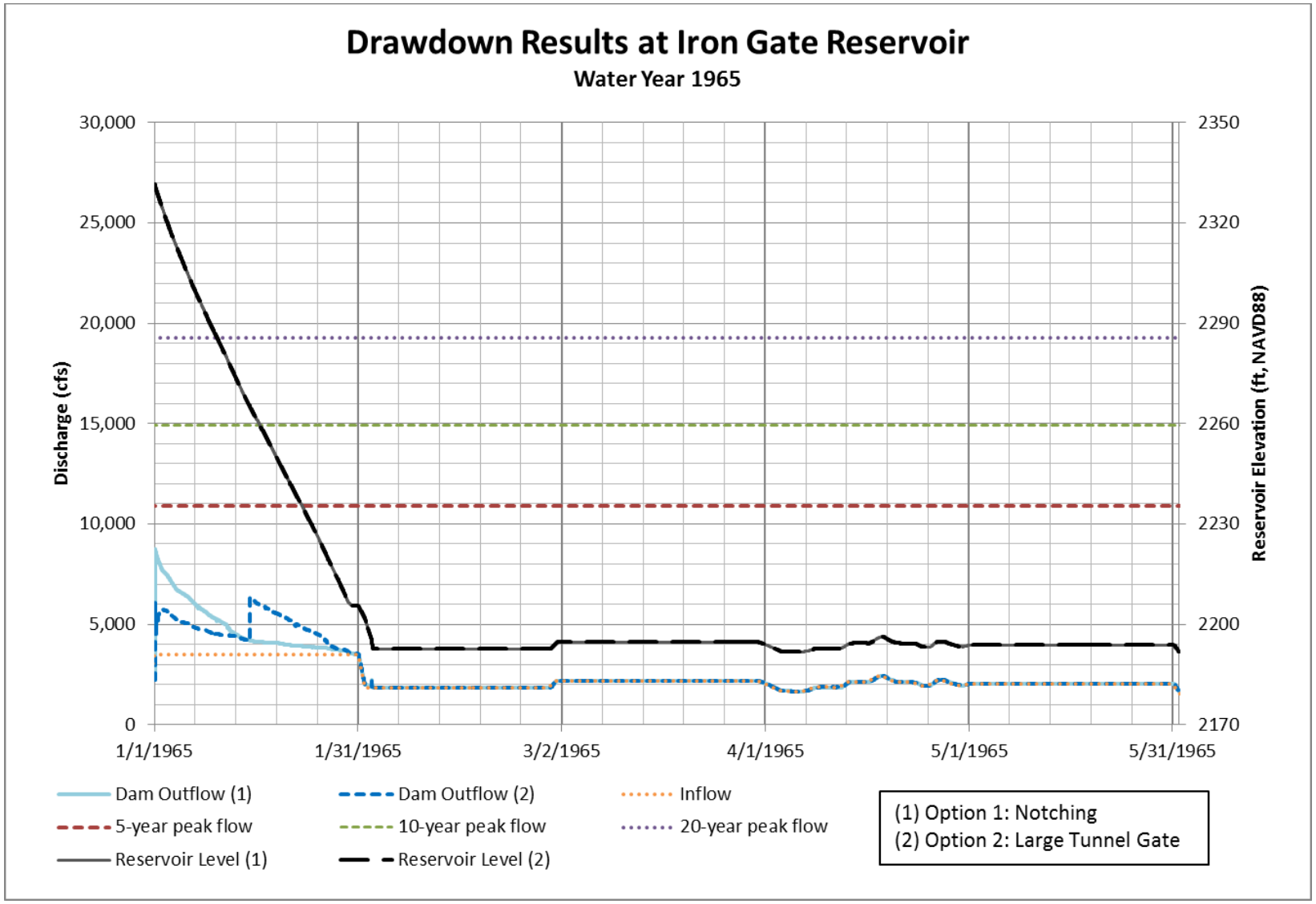

Figure 4-5 Iron Gate Reservoir Drawdown, Water Year 1965

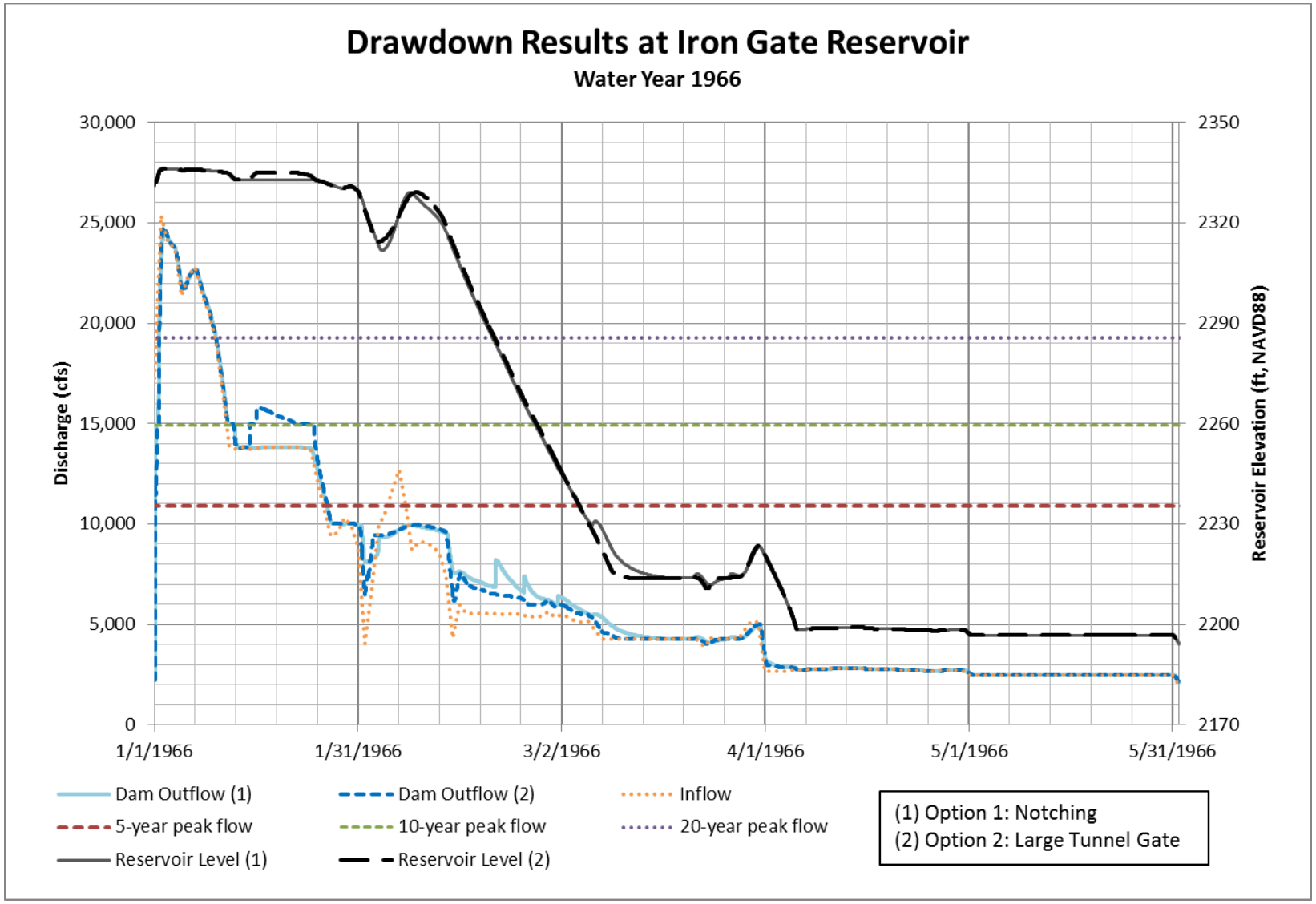

Figure 4-6 Iron Gate Reservoir Drawdown, Water Year 1966

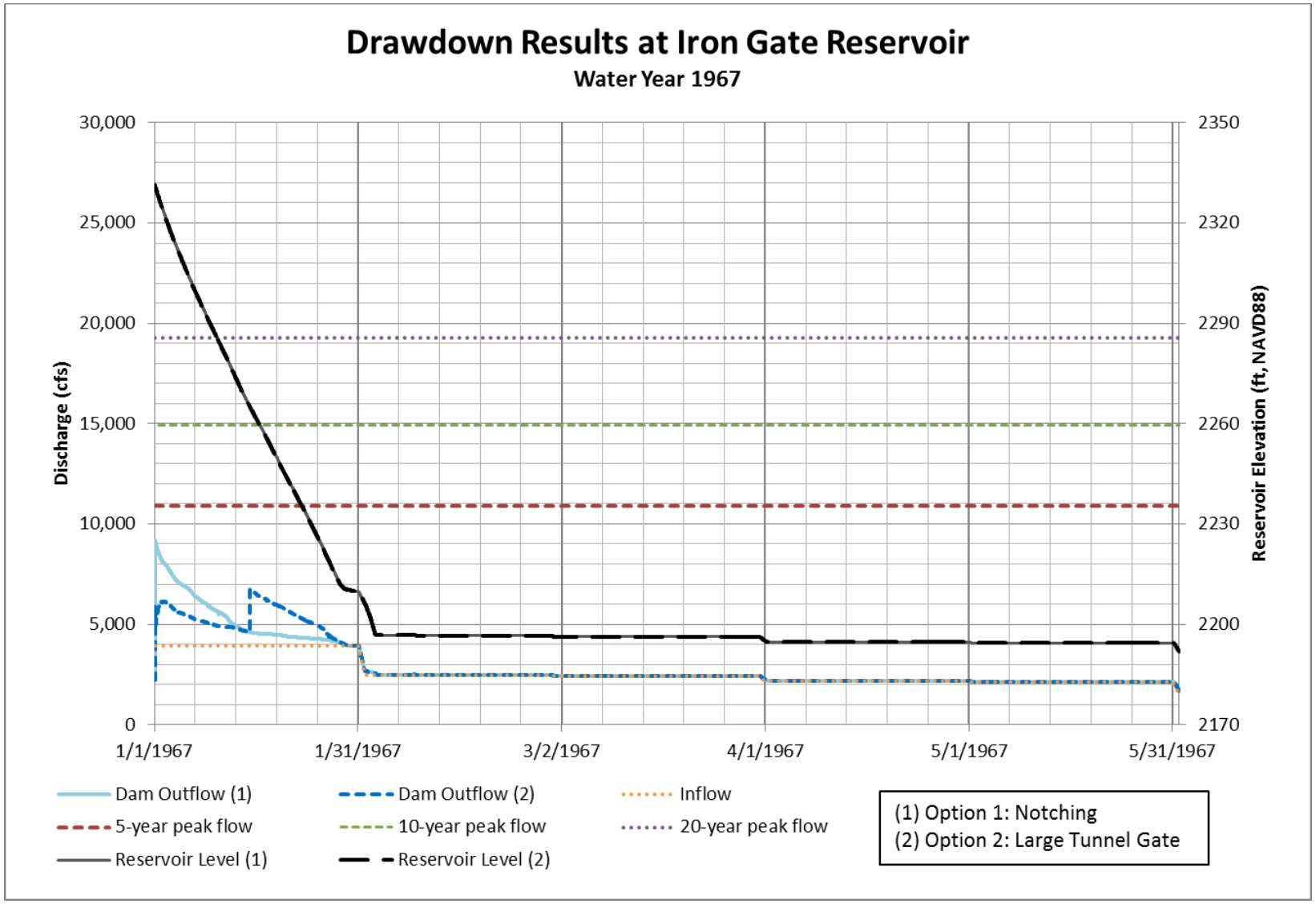

Figure 4-7 Iron Gate Reservoir Drawdown, Water Year 1967

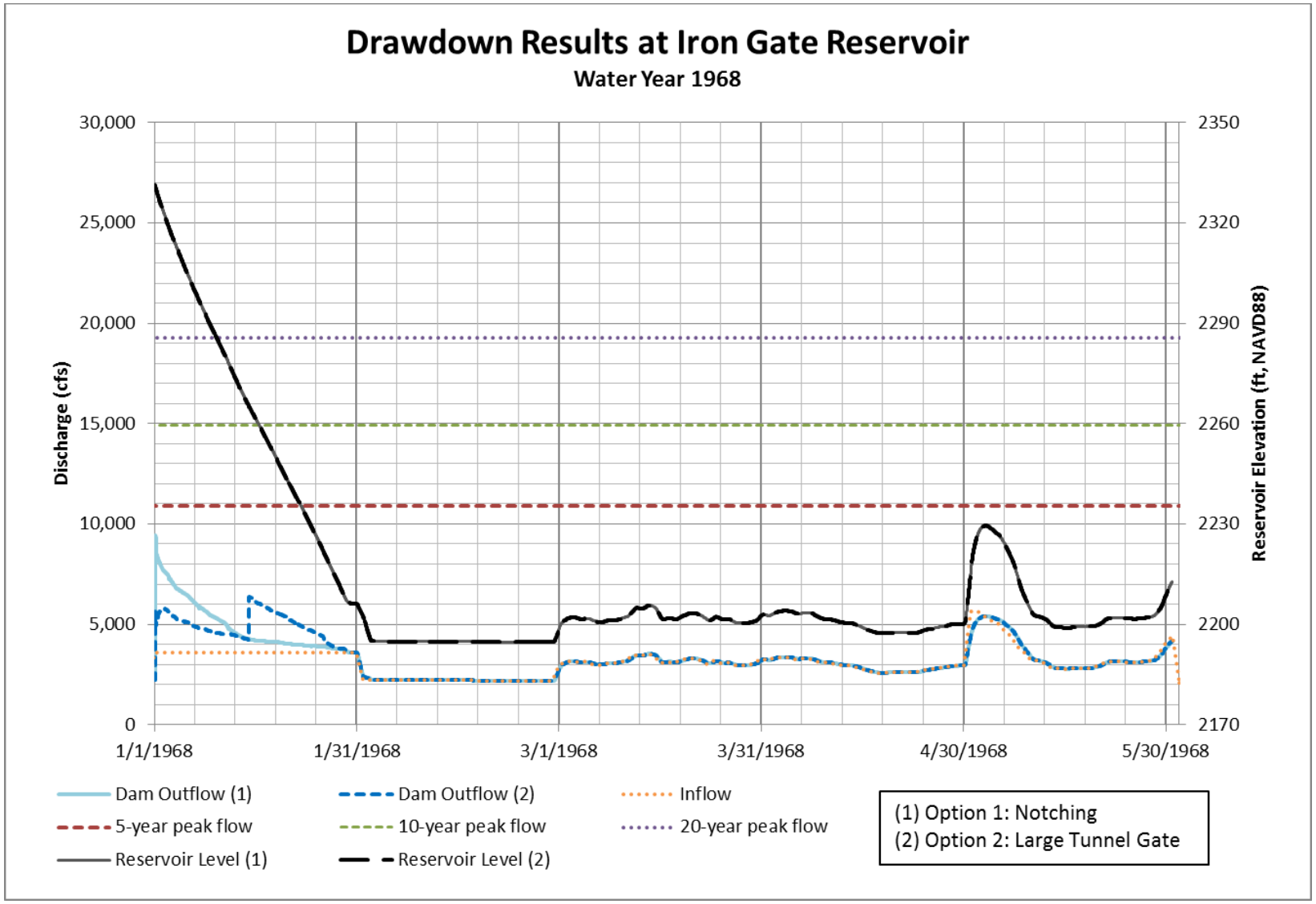

Figure 4-8 Iron Gate Reservoir Drawdown, Water Year 1968

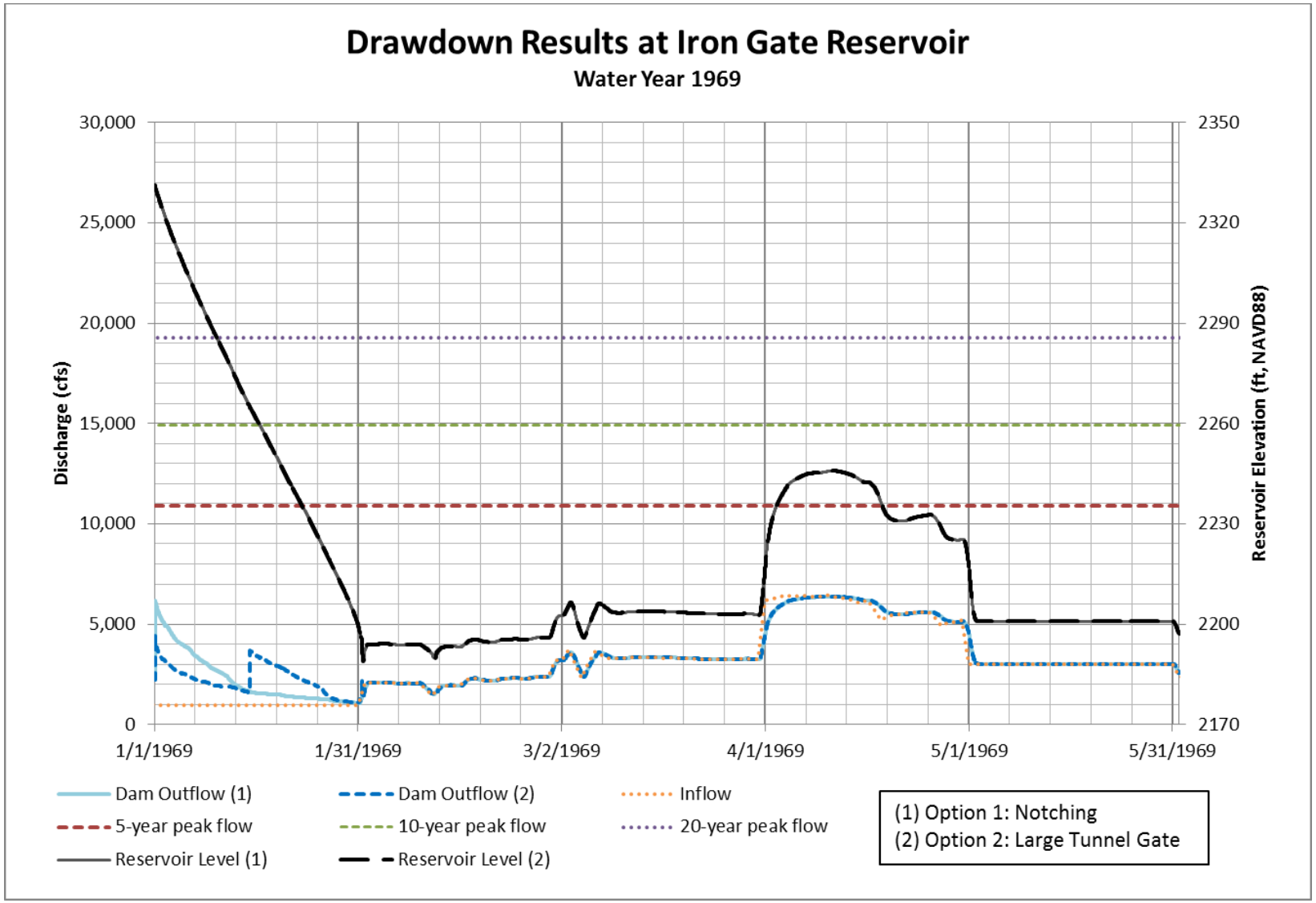

Figure 4-9 Iron Gate Reservoir Drawdown, Water Year 1969

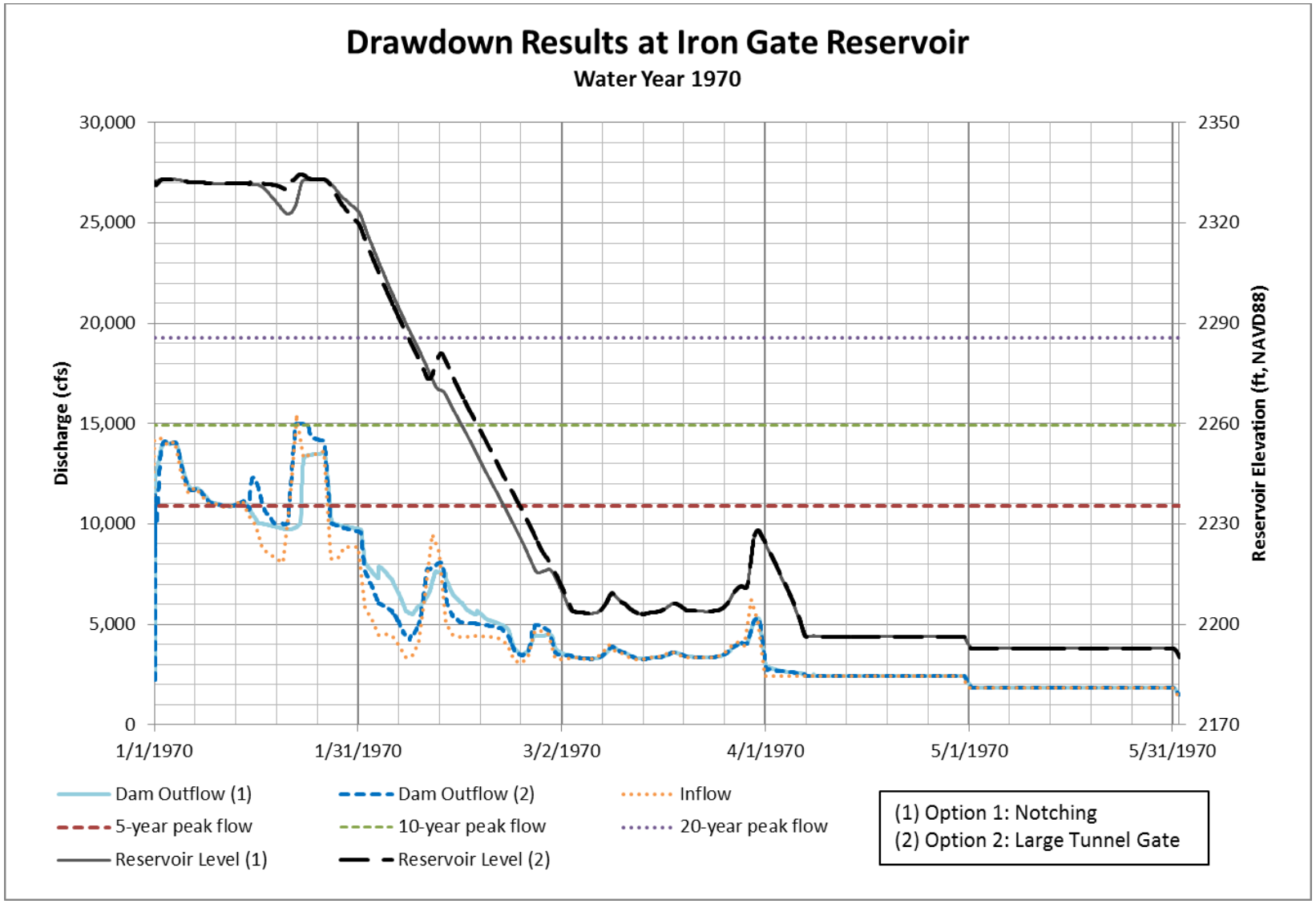

Figure 4-10 Iron Gate Reservoir Drawdown, Water Year 1970

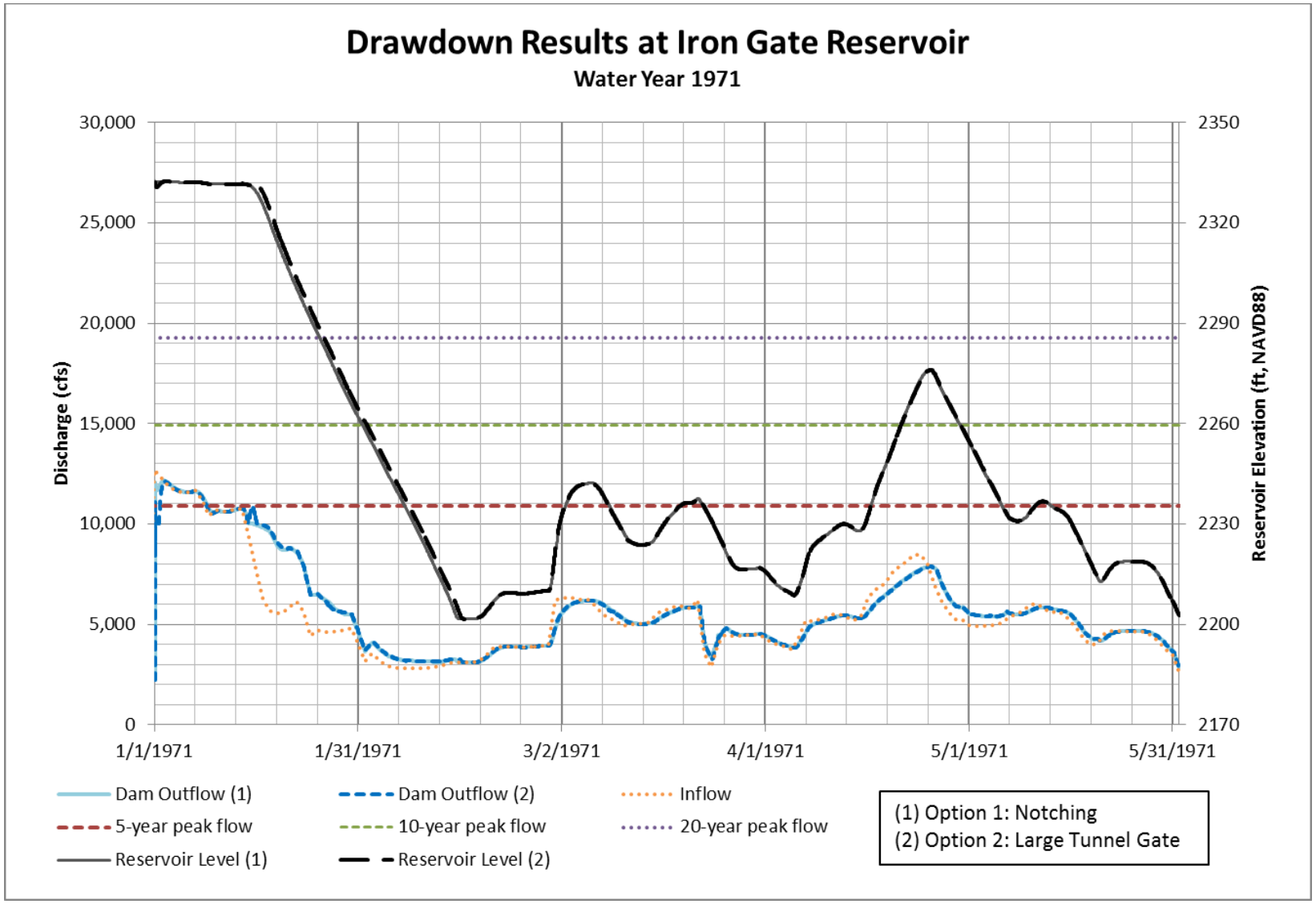

Figure 4-11 Iron Gate Reservoir Drawdown, Water Year 1971

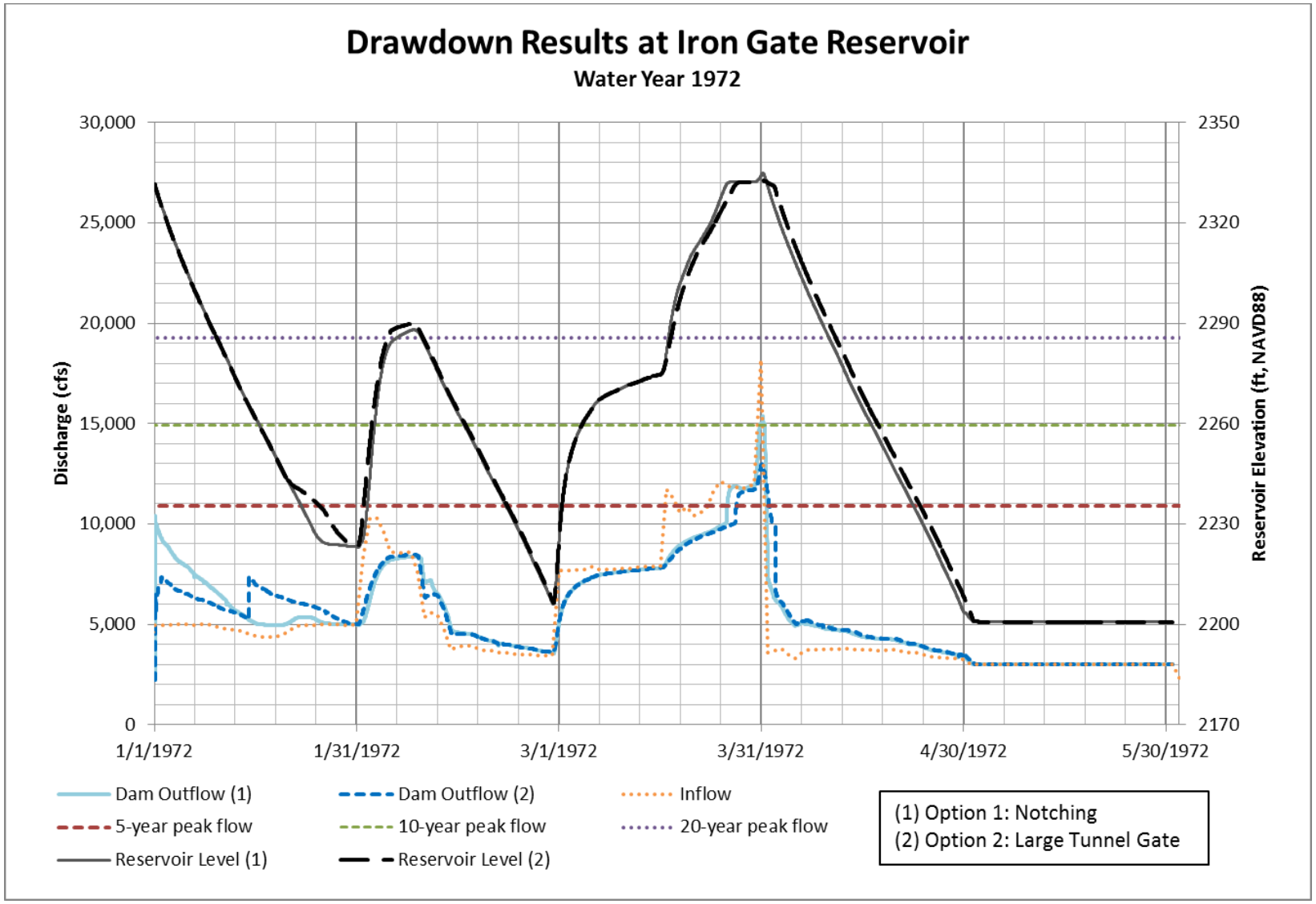

Figure 4-12 Iron Gate Reservoir Drawdown, Water Year 1972

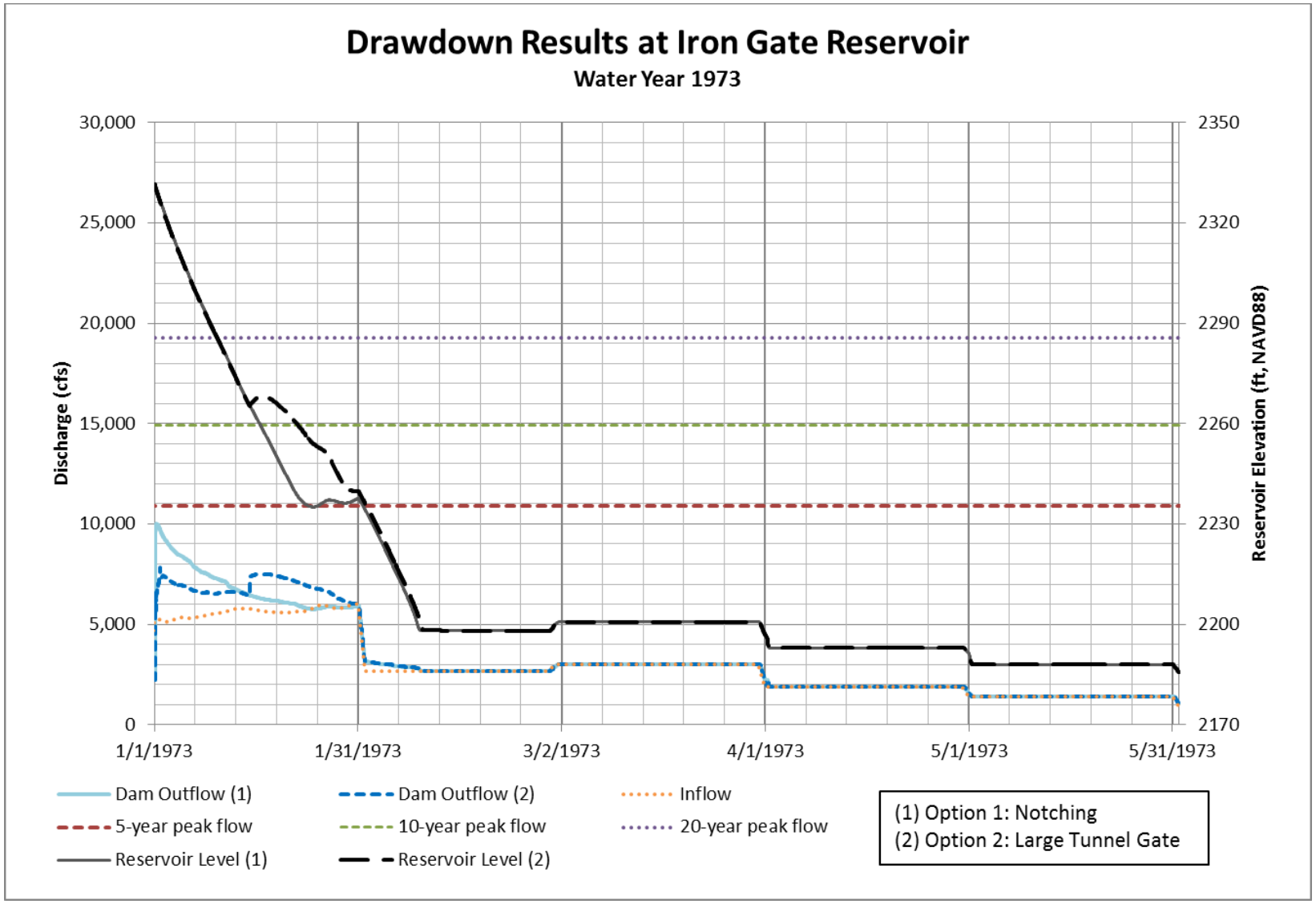

Figure 4-13 Iron Gate Reservoir Drawdown, Water Year 1973

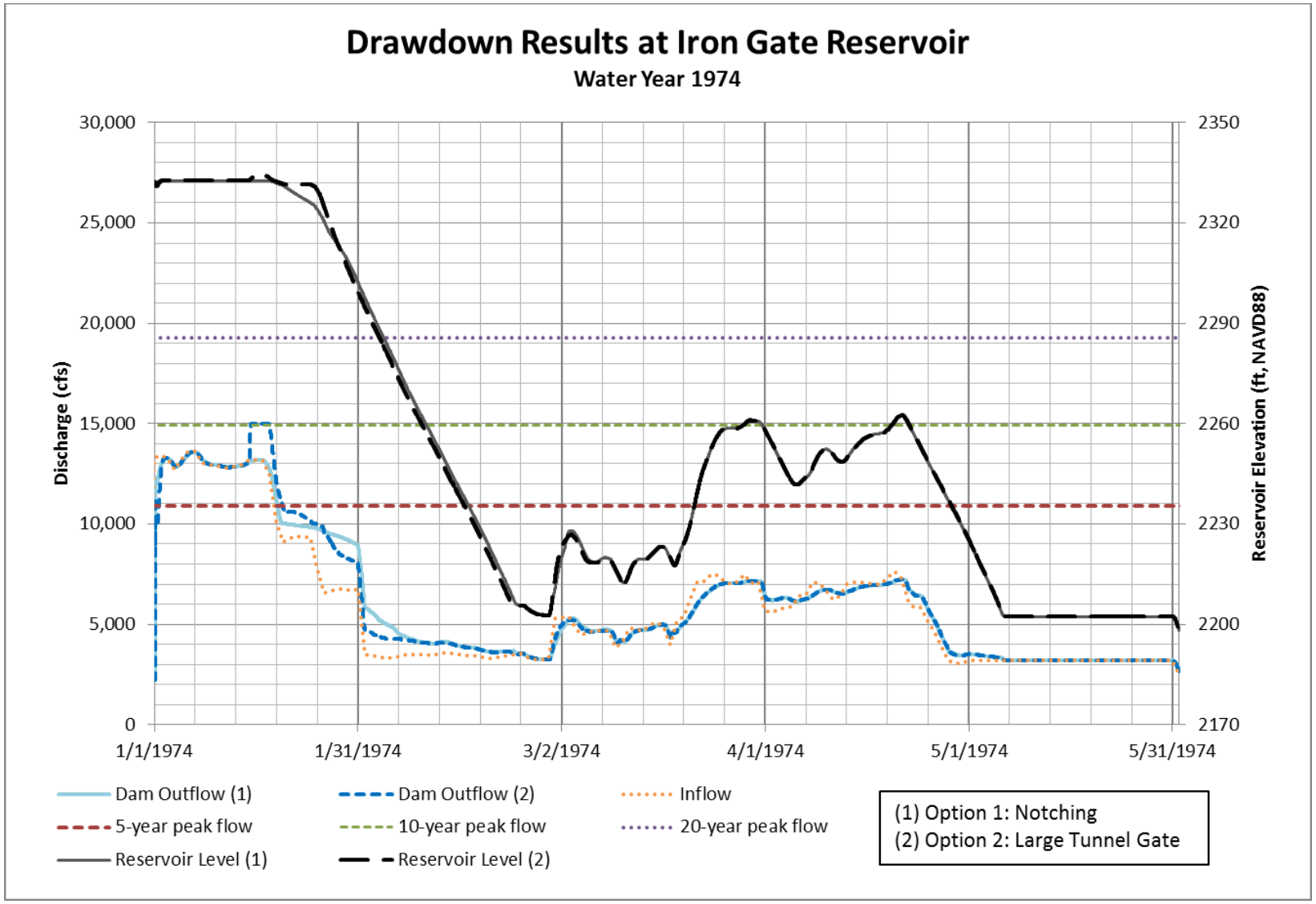

Figure 4-14 Iron Gate Reservoir Drawdown, Water Year 1974

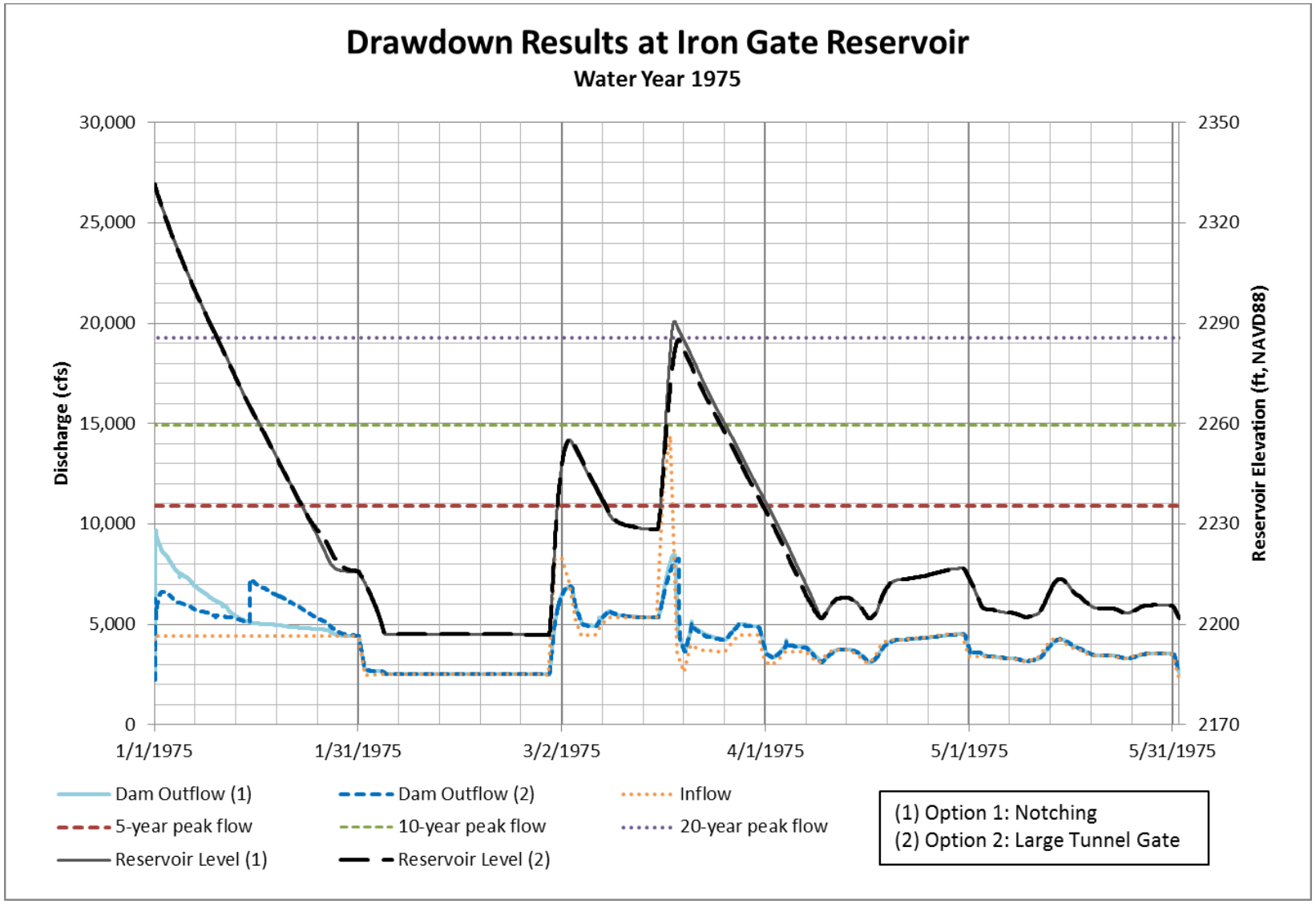

Figure 4-15 Iron Gate Reservoir Drawdown, Water Year 1975

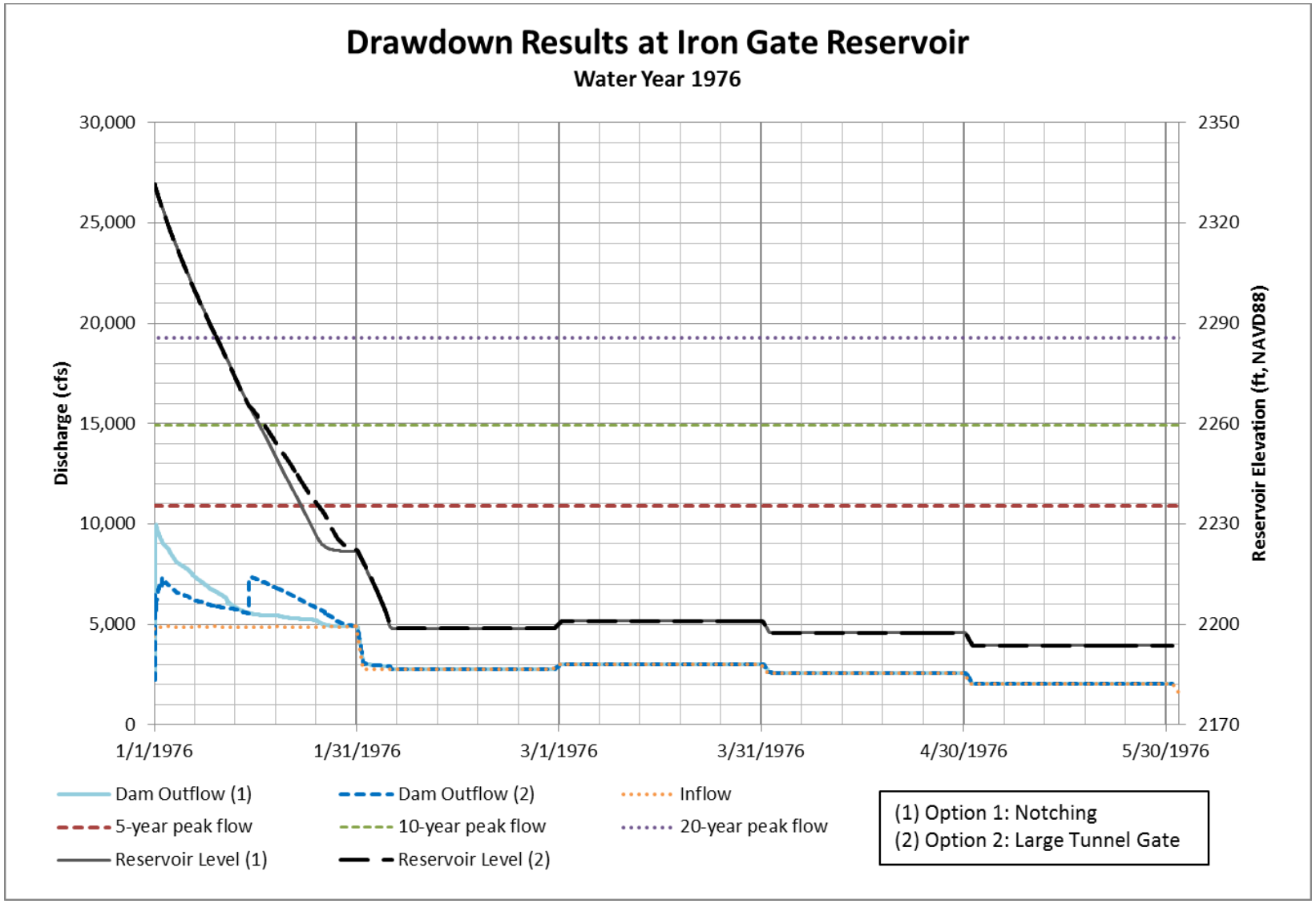

Figure 4-16 Iron Gate Reservoir Drawdown, Water Year 1976

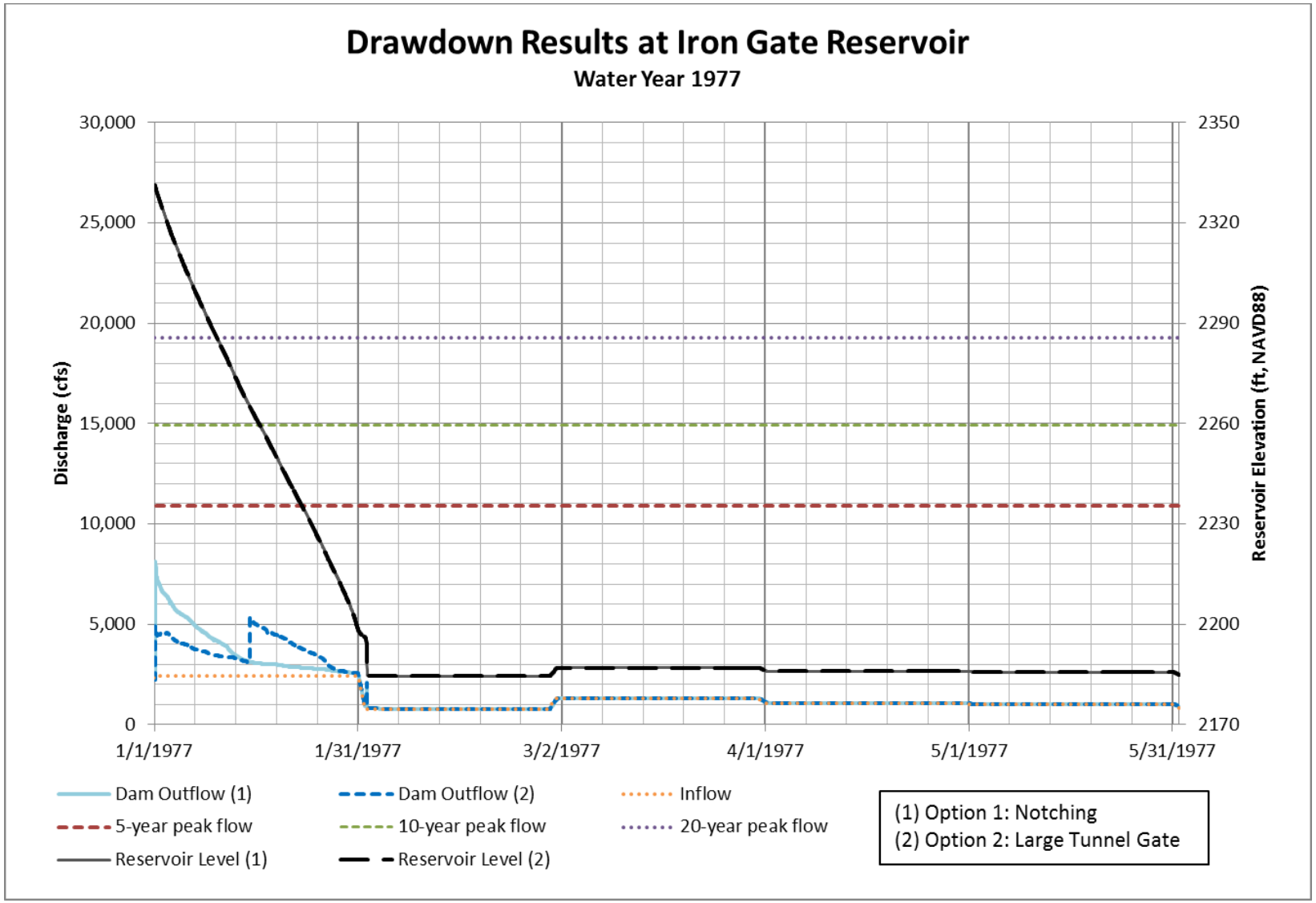

Figure 4-17 Iron Gate Reservoir Drawdown, Water Year 1977

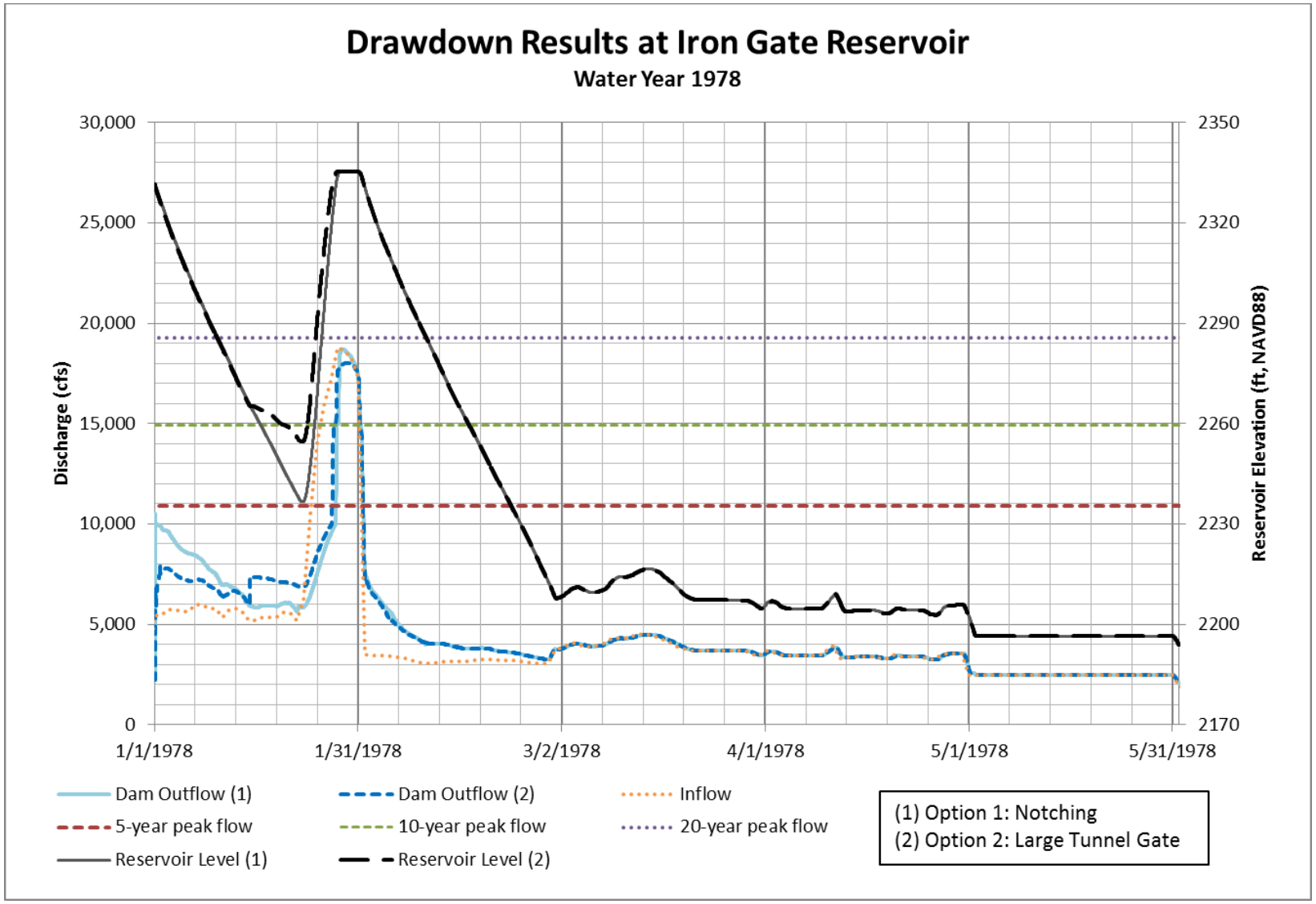

Figure 4-18 Iron Gate Reservoir Drawdown, Water Year 1978

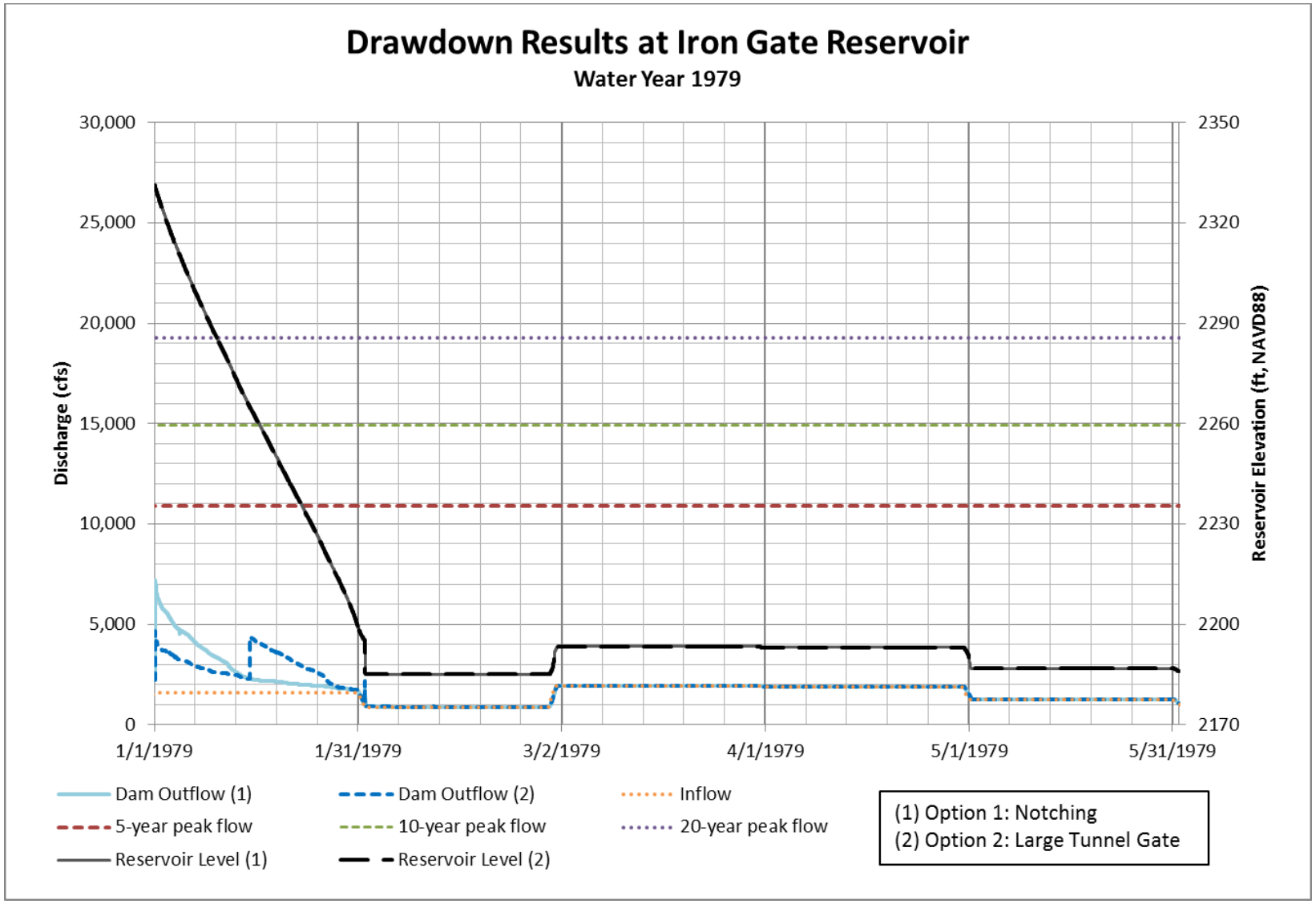

Figure 4-19 Iron Gate Reservoir Drawdown, Water Year 1979

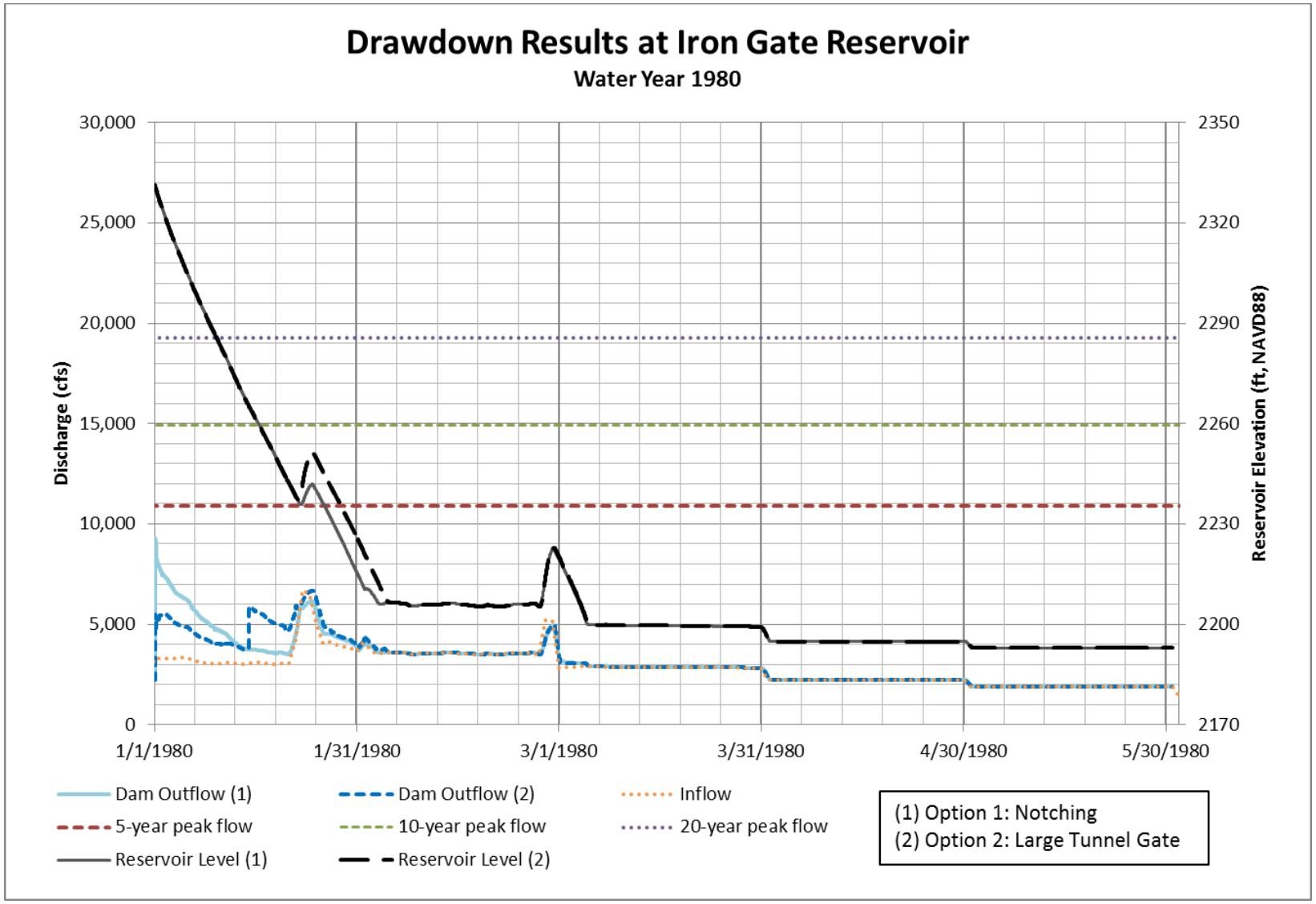

Figure 4-20 Iron Gate Reservoir Drawdown, Water Year 1980

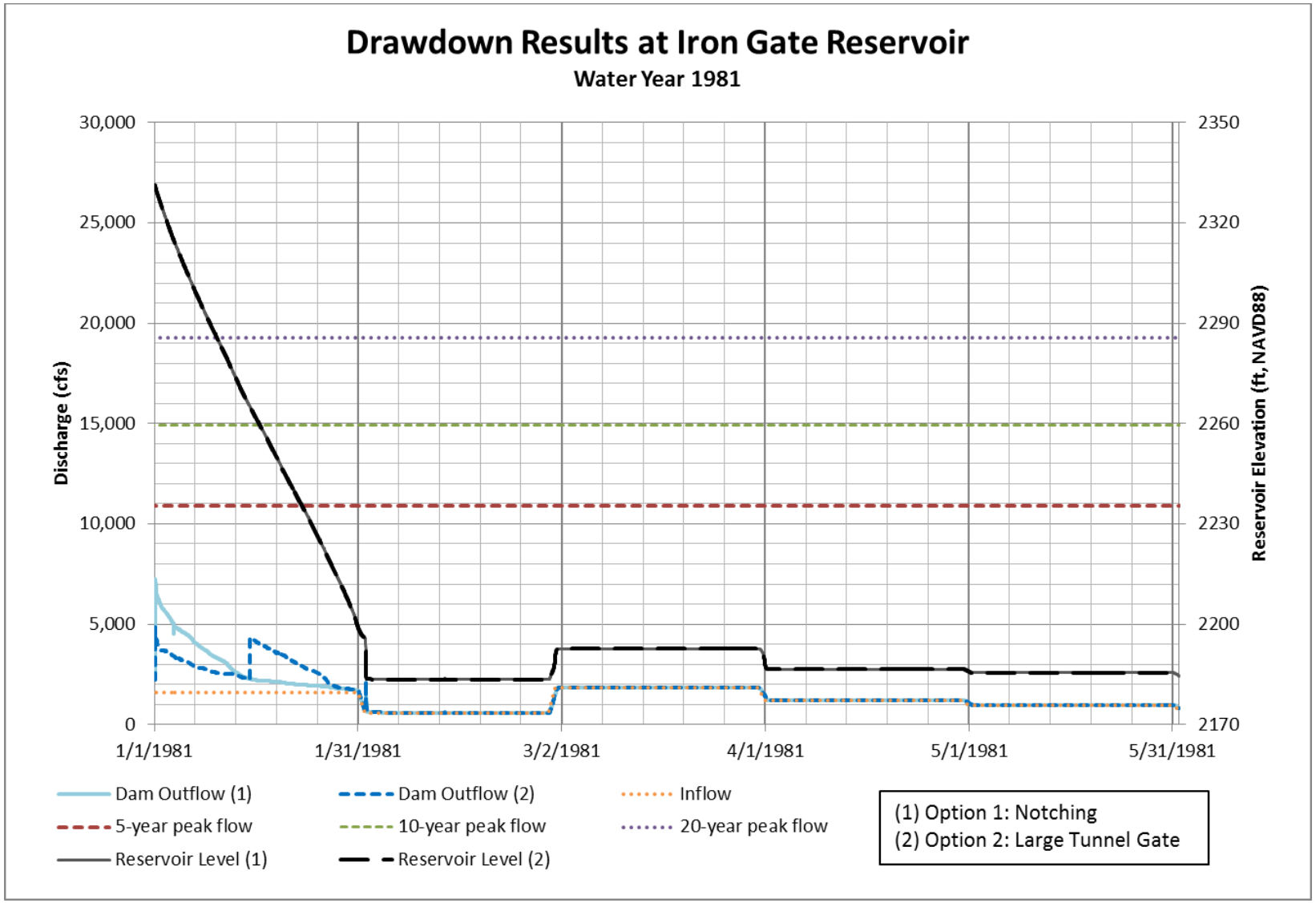

Figure 4-21 Iron Gate Reservoir Drawdown, Water Year 1981

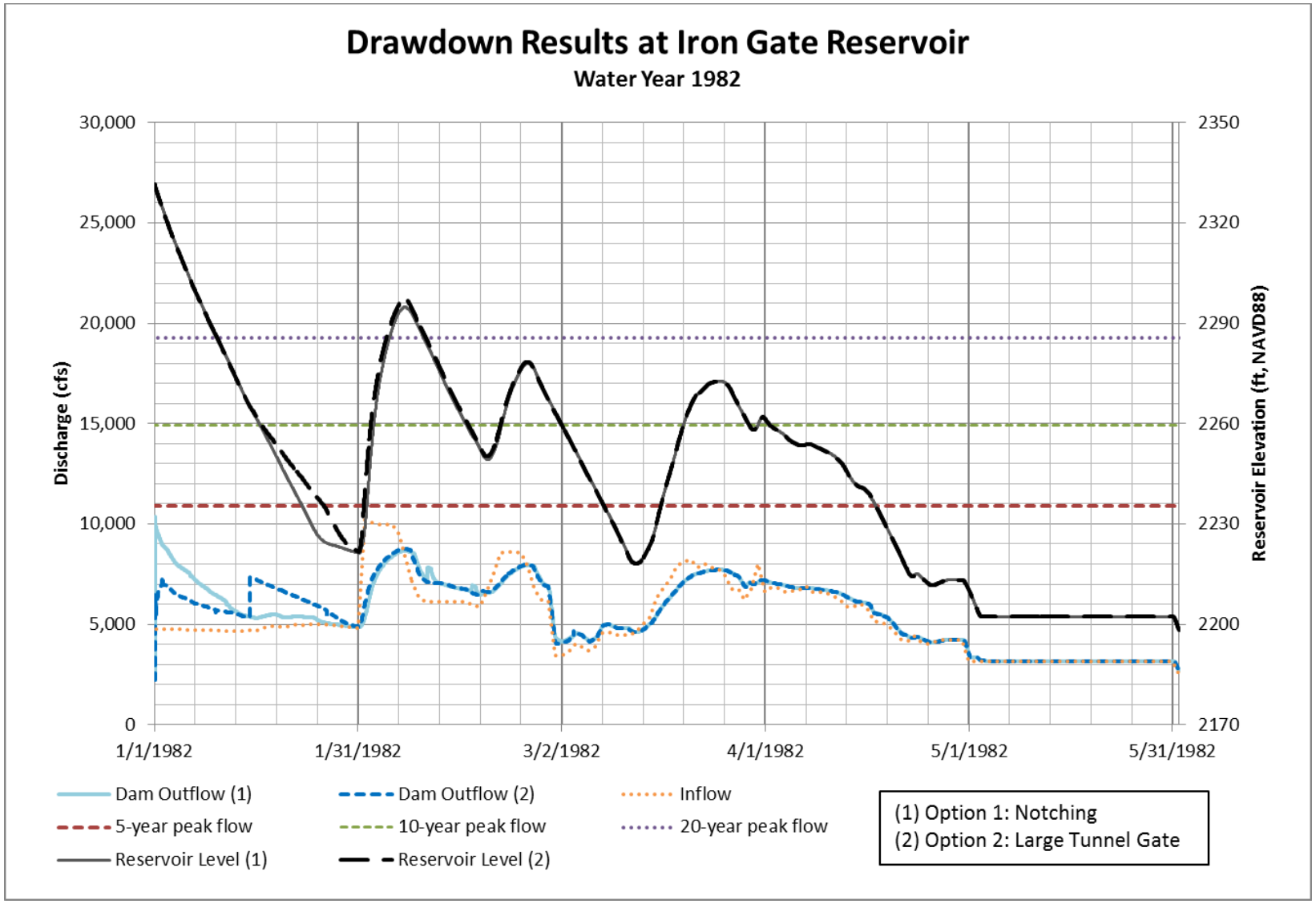

Figure 4-22 Iron Gate Reservoir Drawdown, Water Year 1982

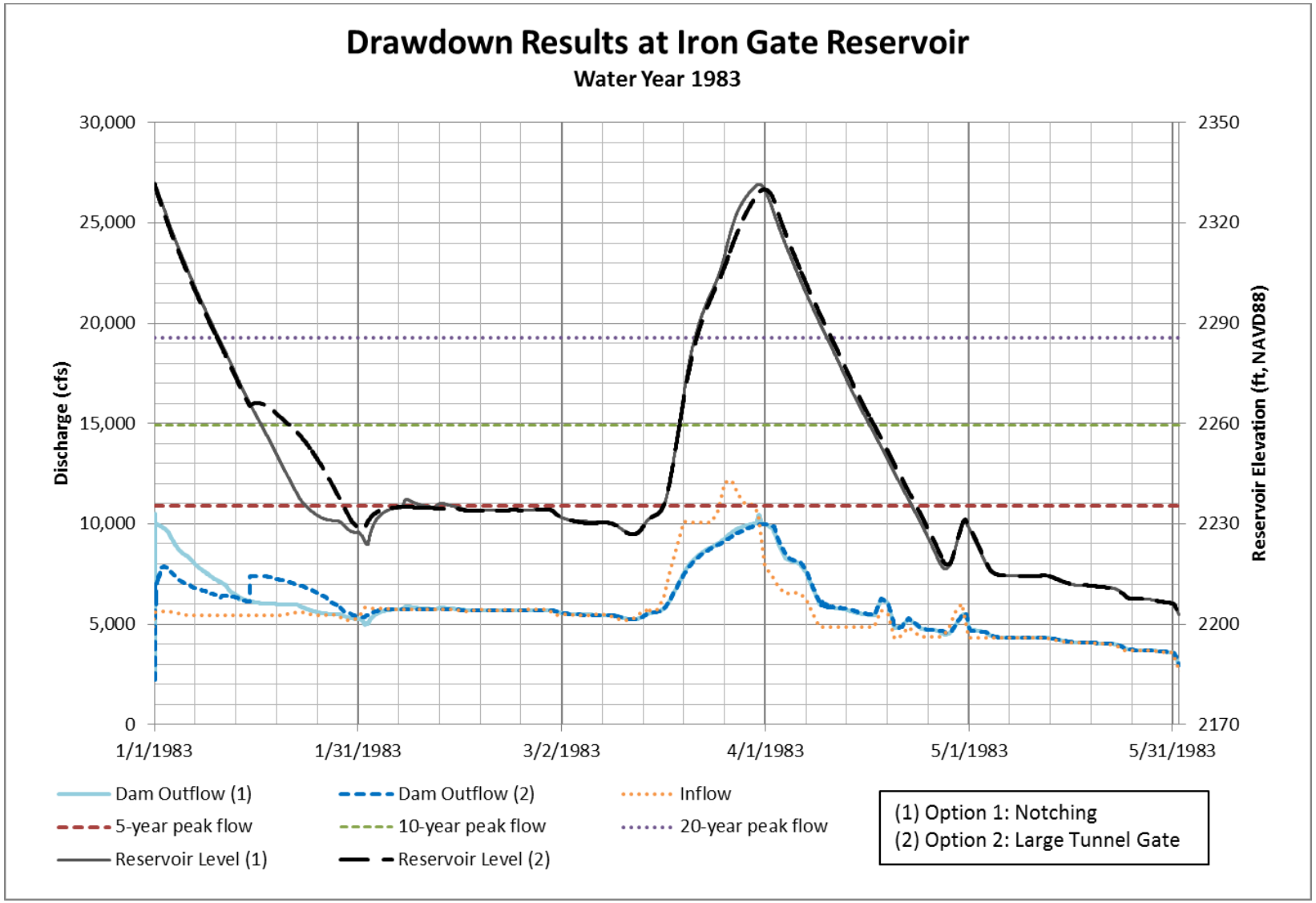

Figure 4-23 Iron Gate Reservoir Drawdown, Water Year 1983

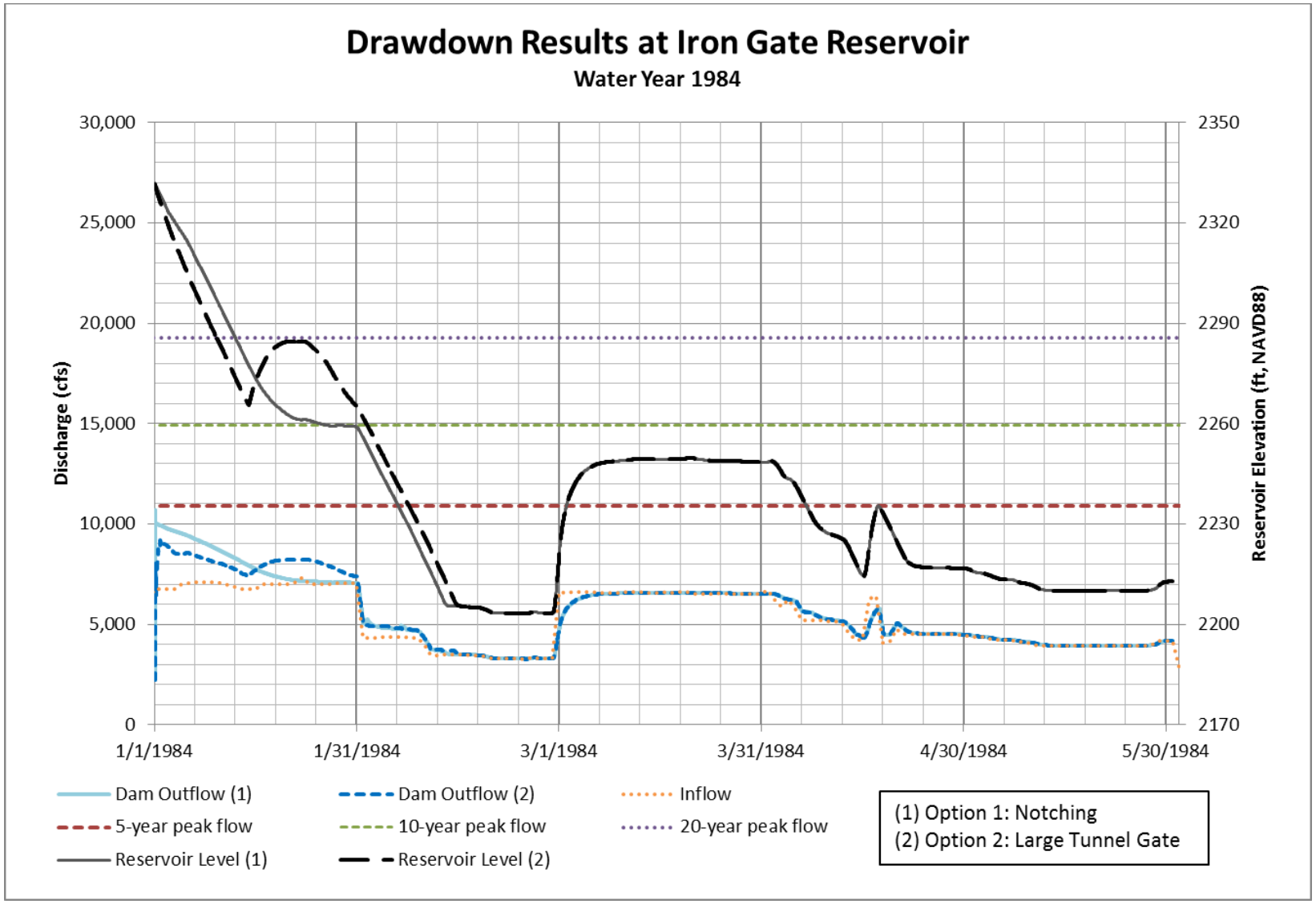

Figure 4-24 Iron Gate Reservoir Drawdown, Water Year 1984

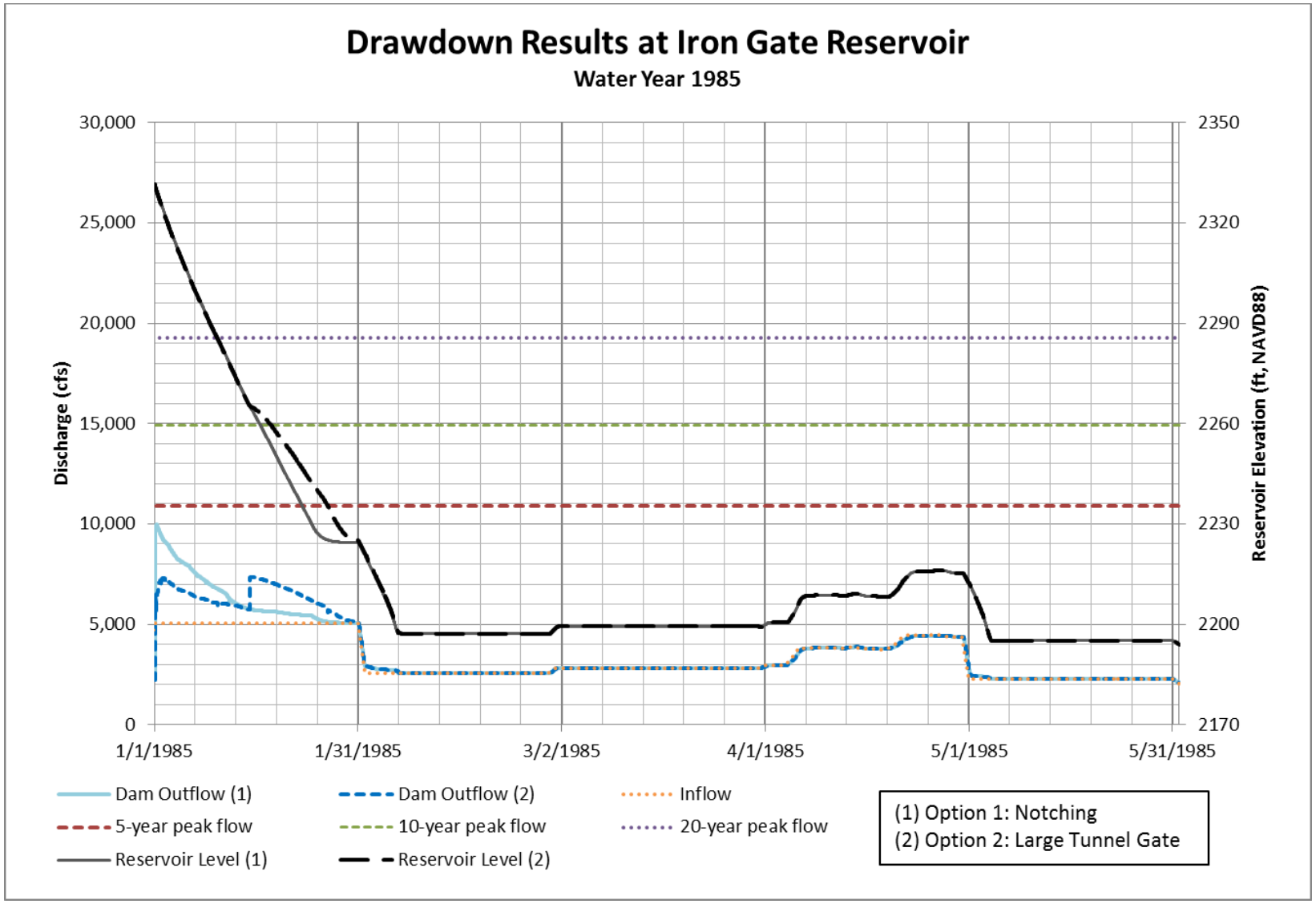

Figure 4-25 Iron Gate Reservoir Drawdown, Water Year 1985

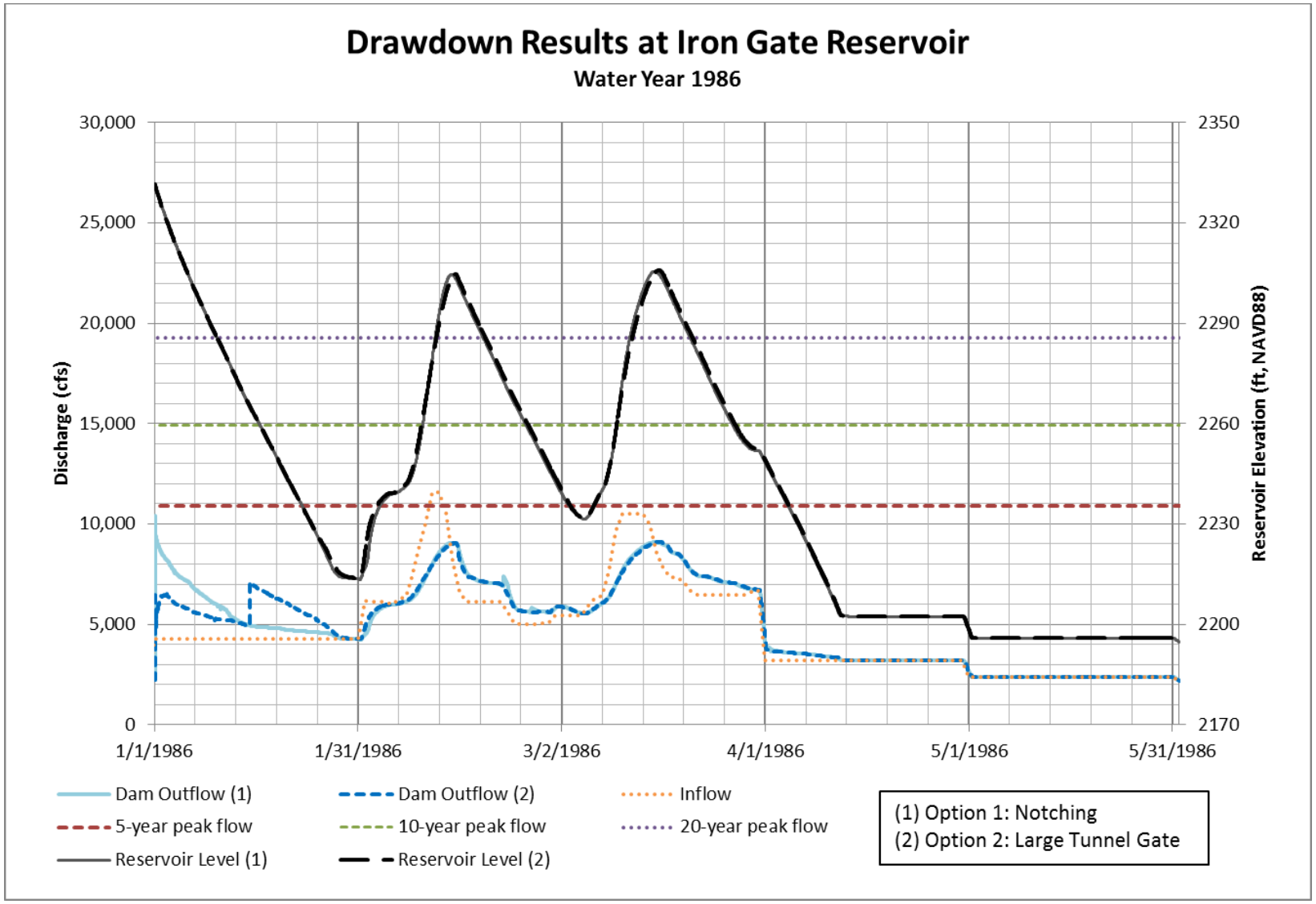

Figure 4-26 Iron Gate Reservoir Drawdown, Water Year 1986

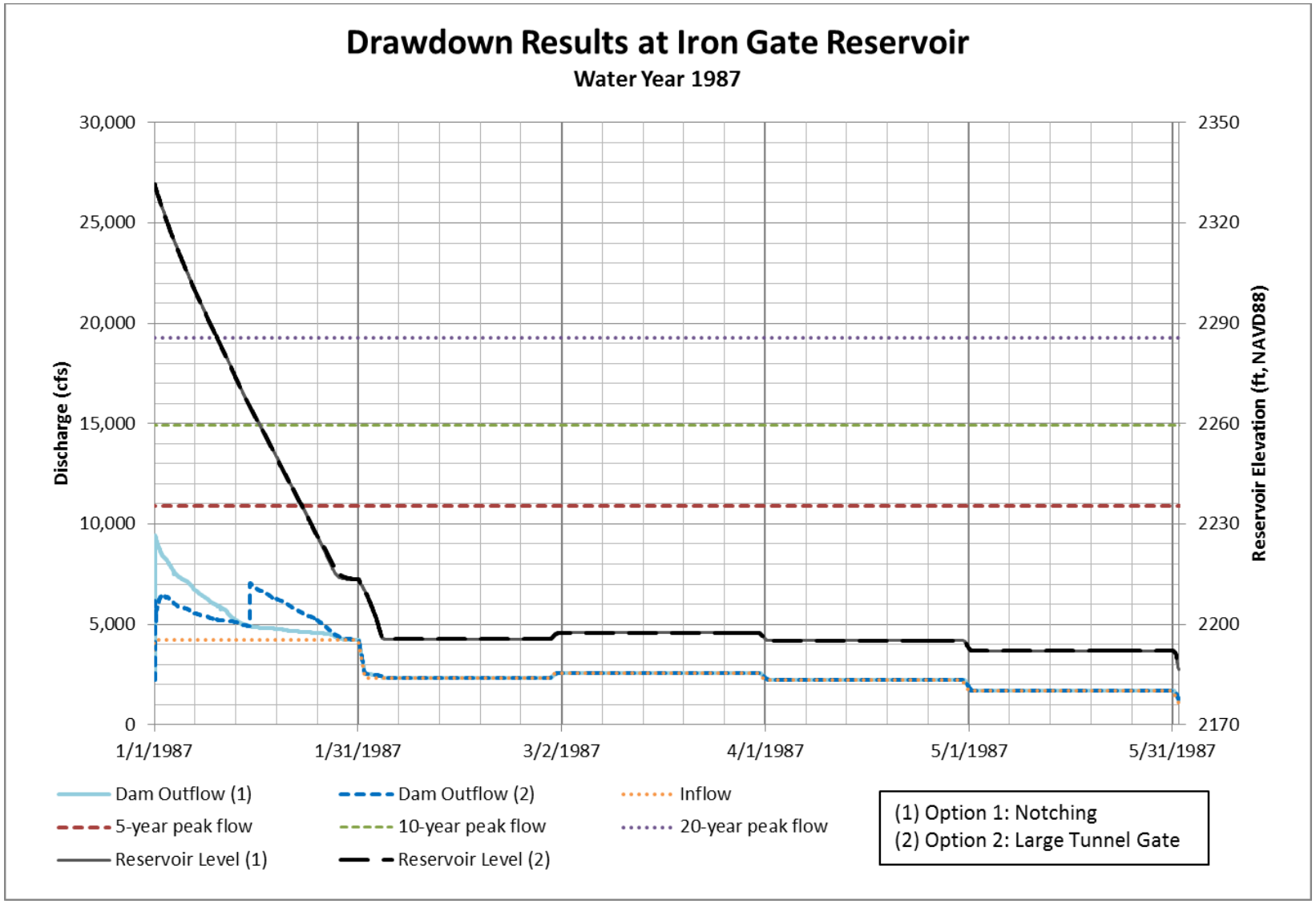

Figure 4-27 Iron Gate Reservoir Drawdown, Water Year 1987

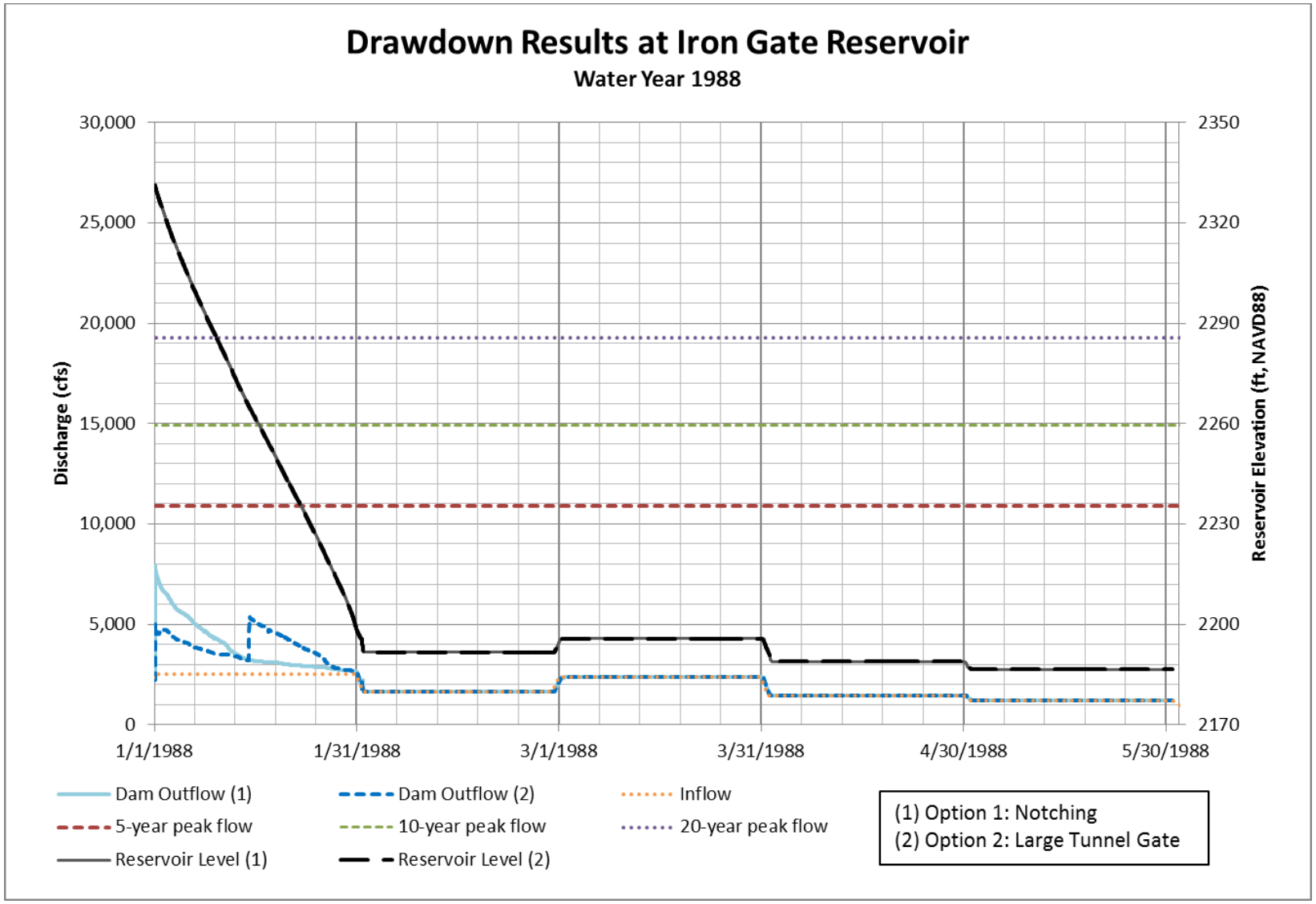

Figure 4-28 Iron Gate Reservoir Drawdown, Water Year 1988

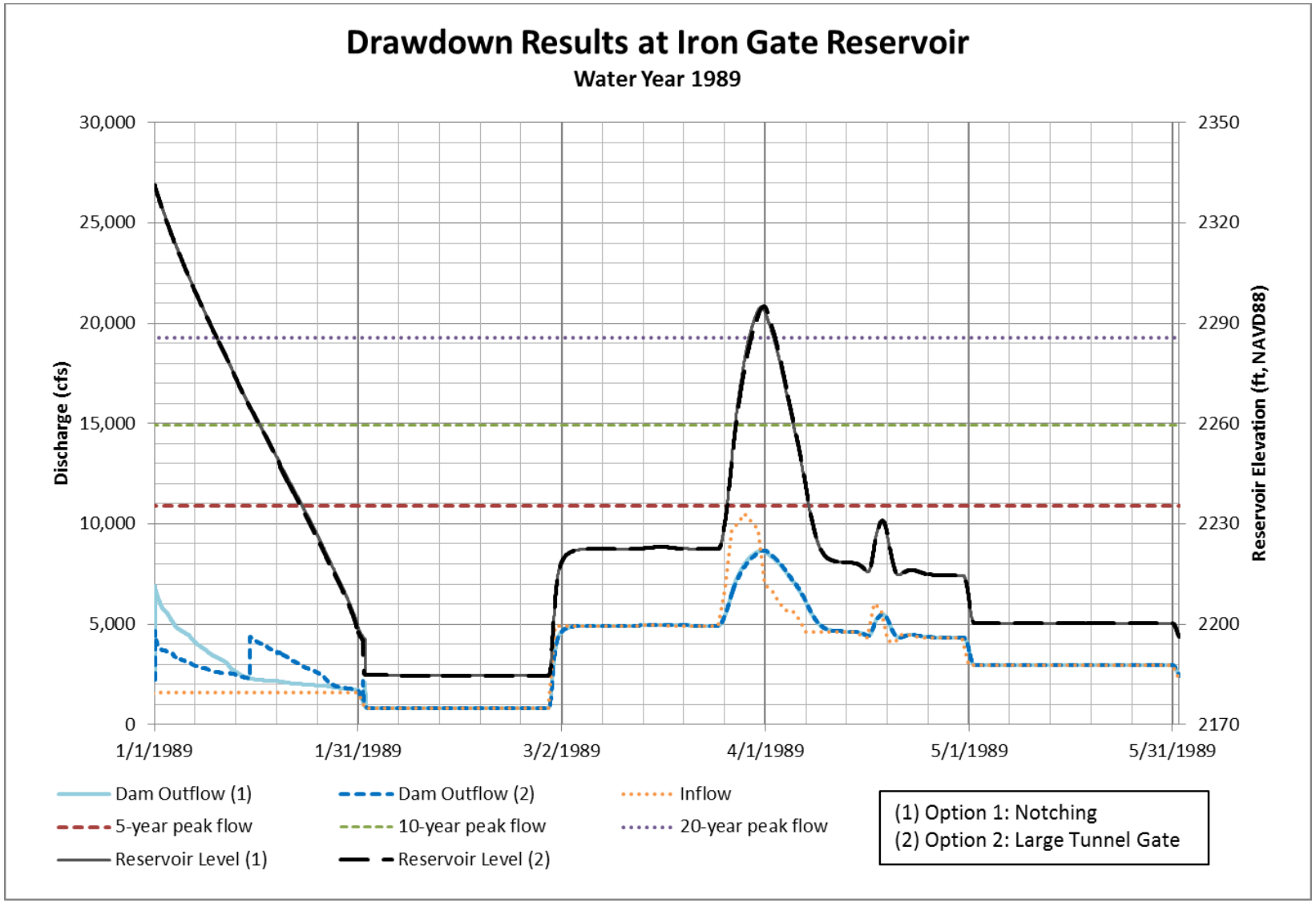

Figure 4-29 Iron Gate Reservoir Drawdown, Water Year 1989

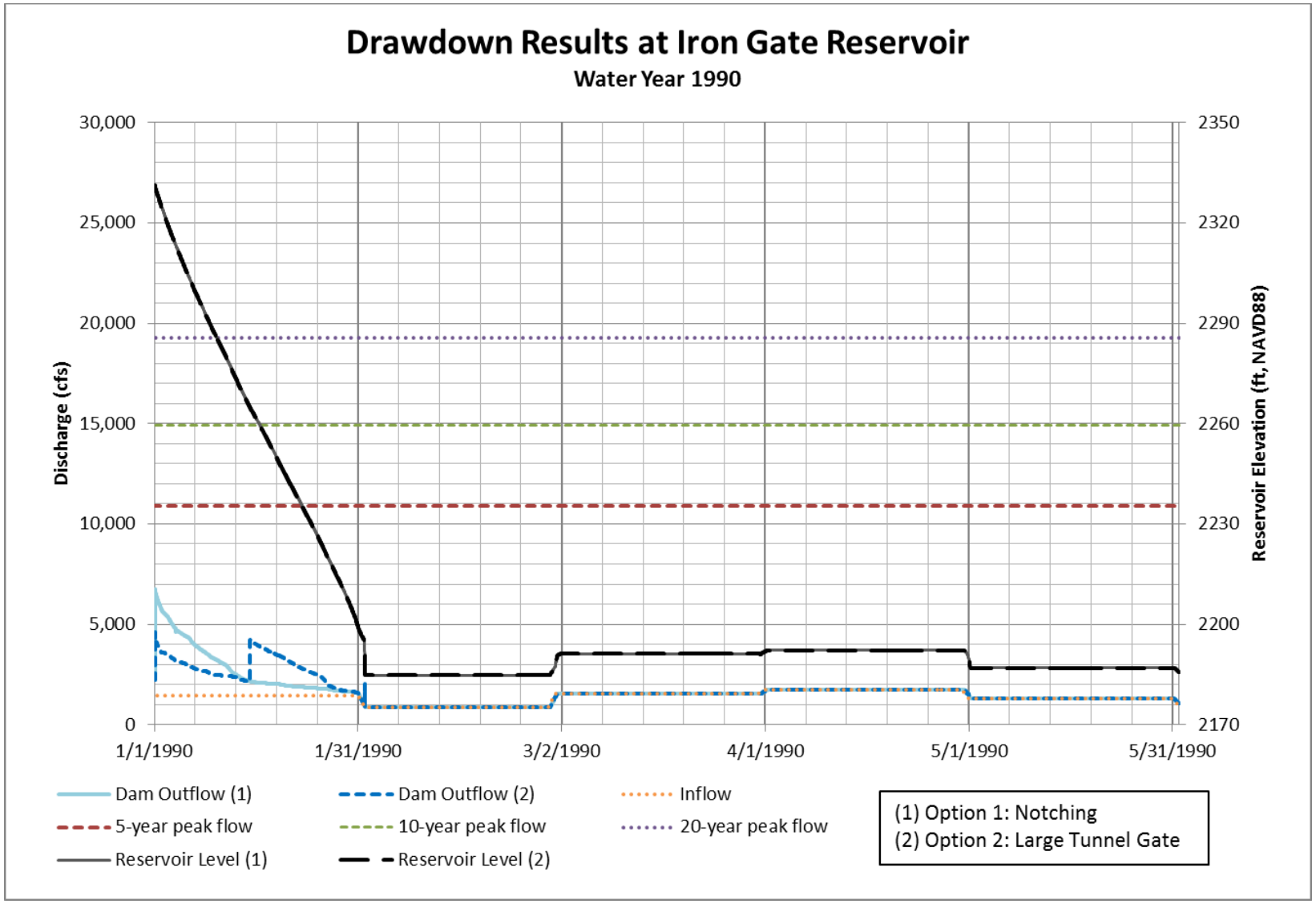

Figure 4-30 Iron Gate Reservoir Drawdown, Water Year 1990

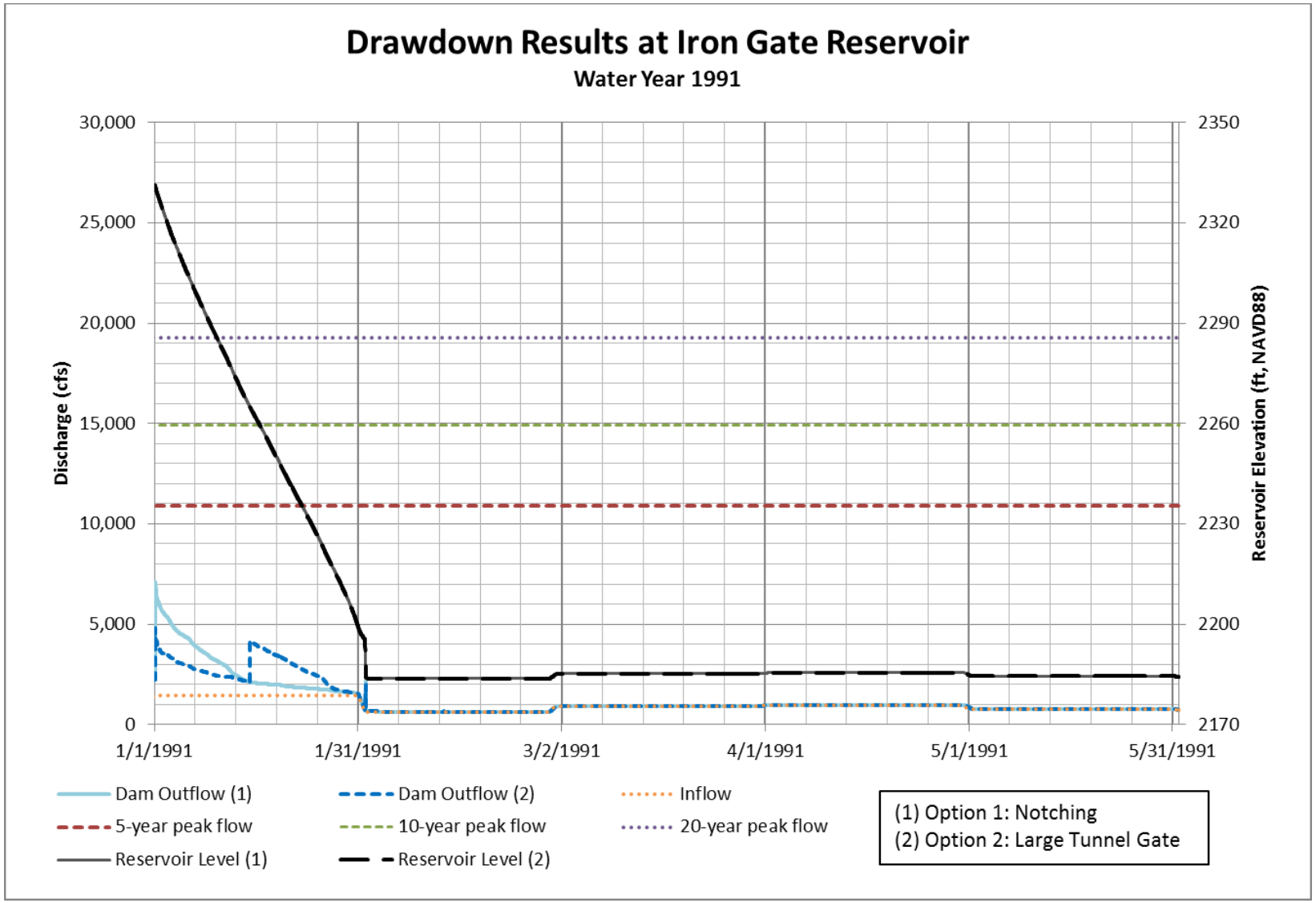

Figure 4-31 Iron Gate Reservoir Drawdown, Water Year 1991

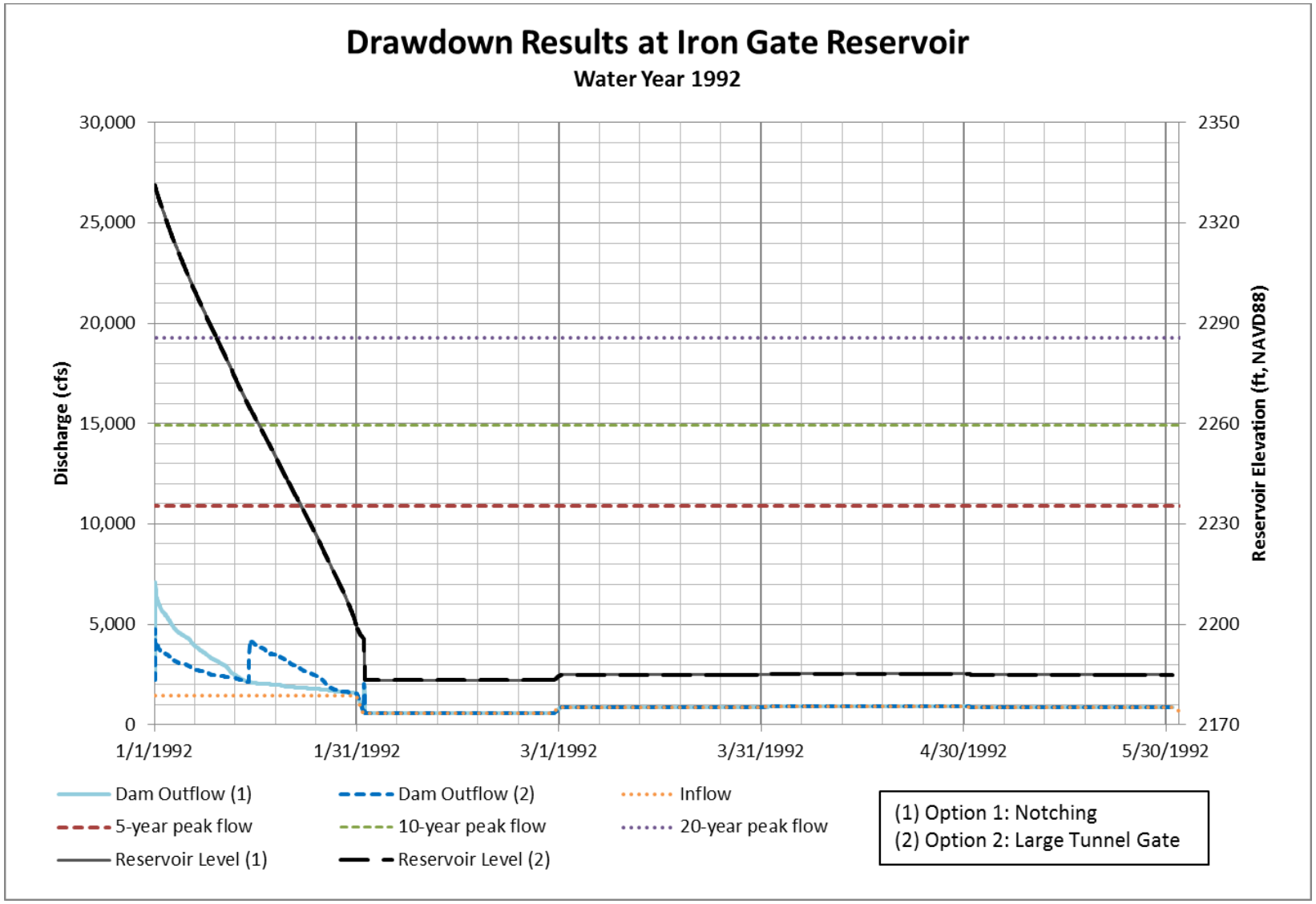

Figure 4-32 Iron Gate Reservoir Drawdown, Water Year 1992

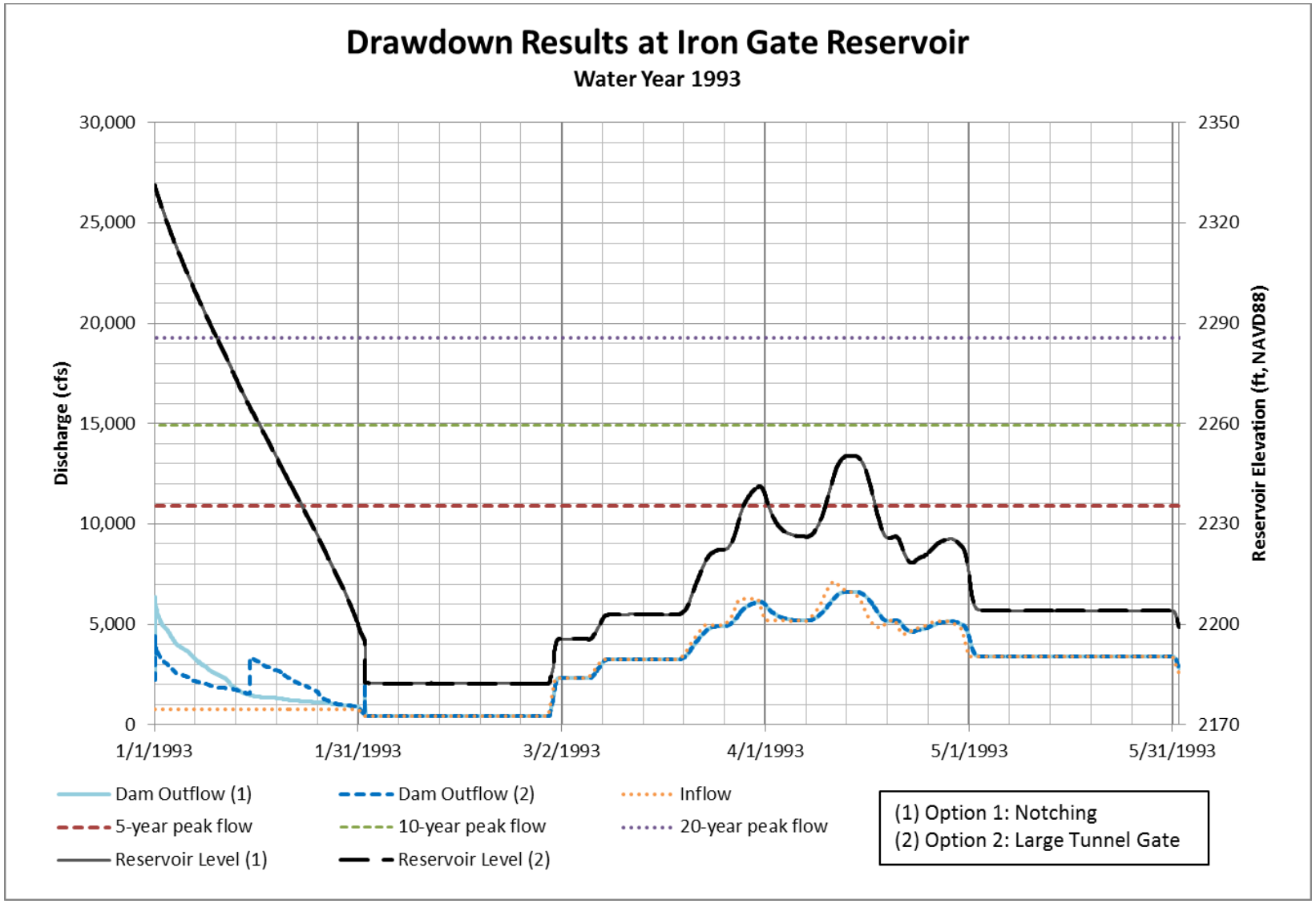

Figure 4-33 Iron Gate Reservoir Drawdown, Water Year 1993

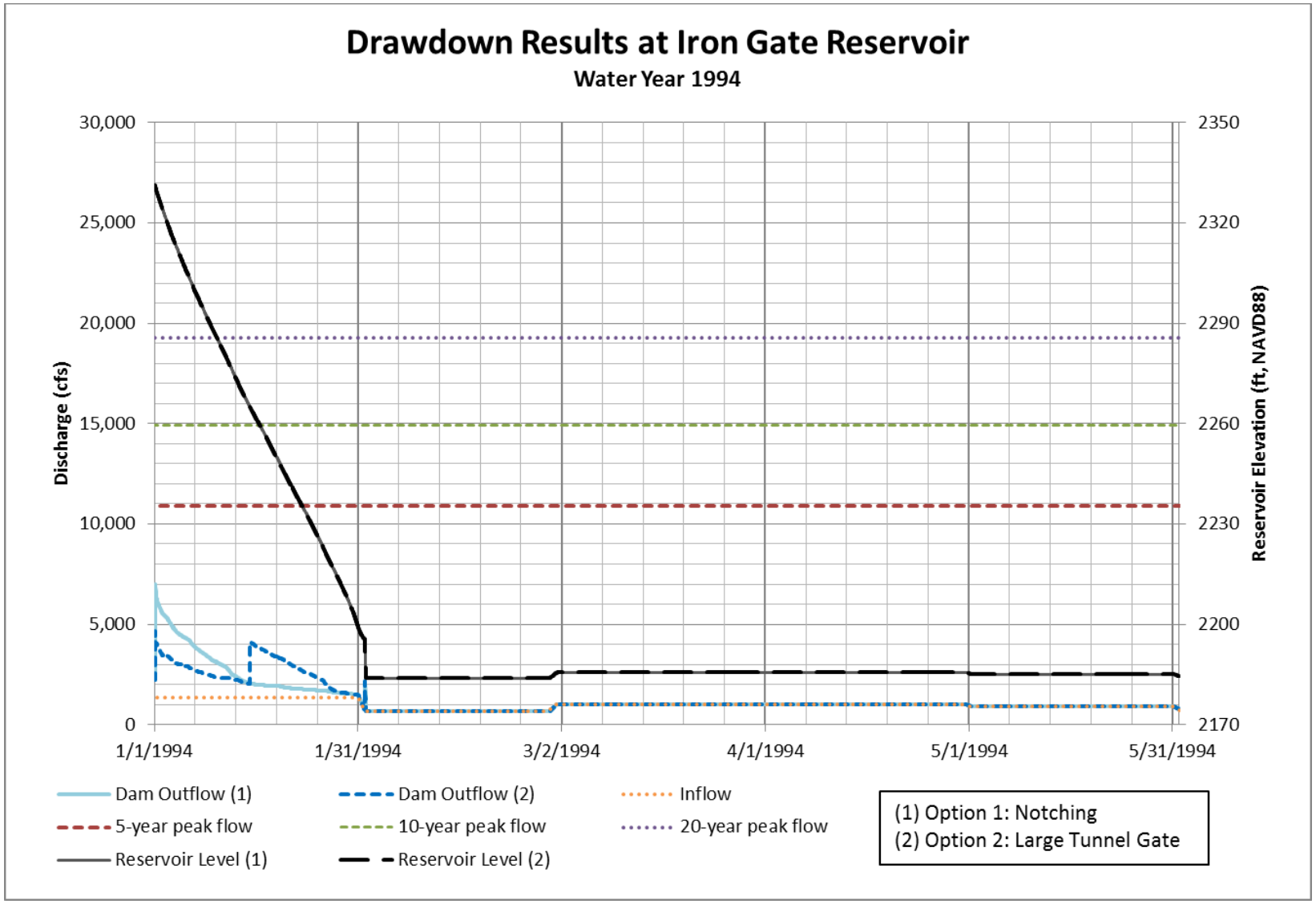

Figure 4-34 Iron Gate Reservoir Drawdown, Water Year 1994

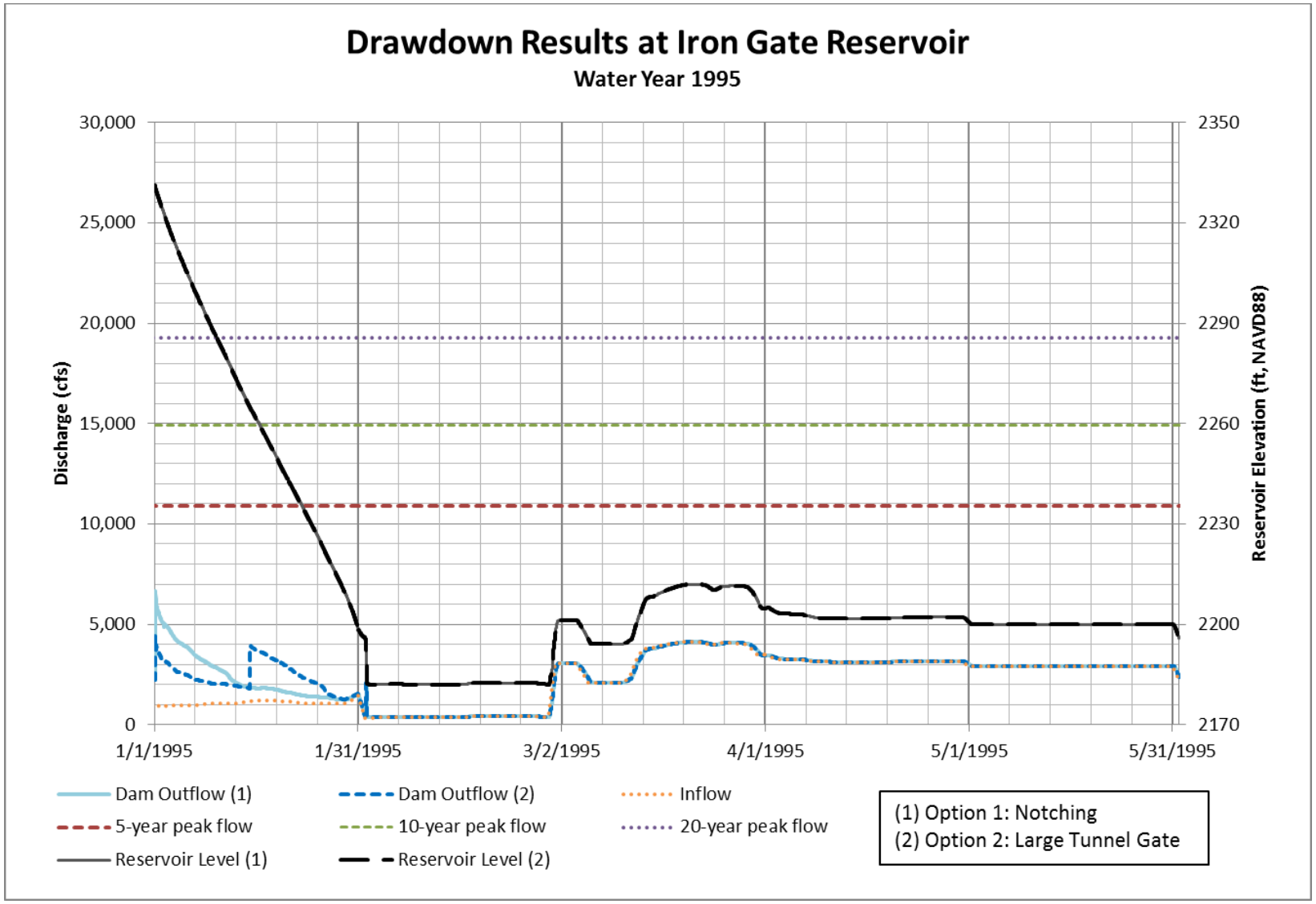

Figure 4-35 Iron Gate Reservoir Drawdown, Water Year 1995

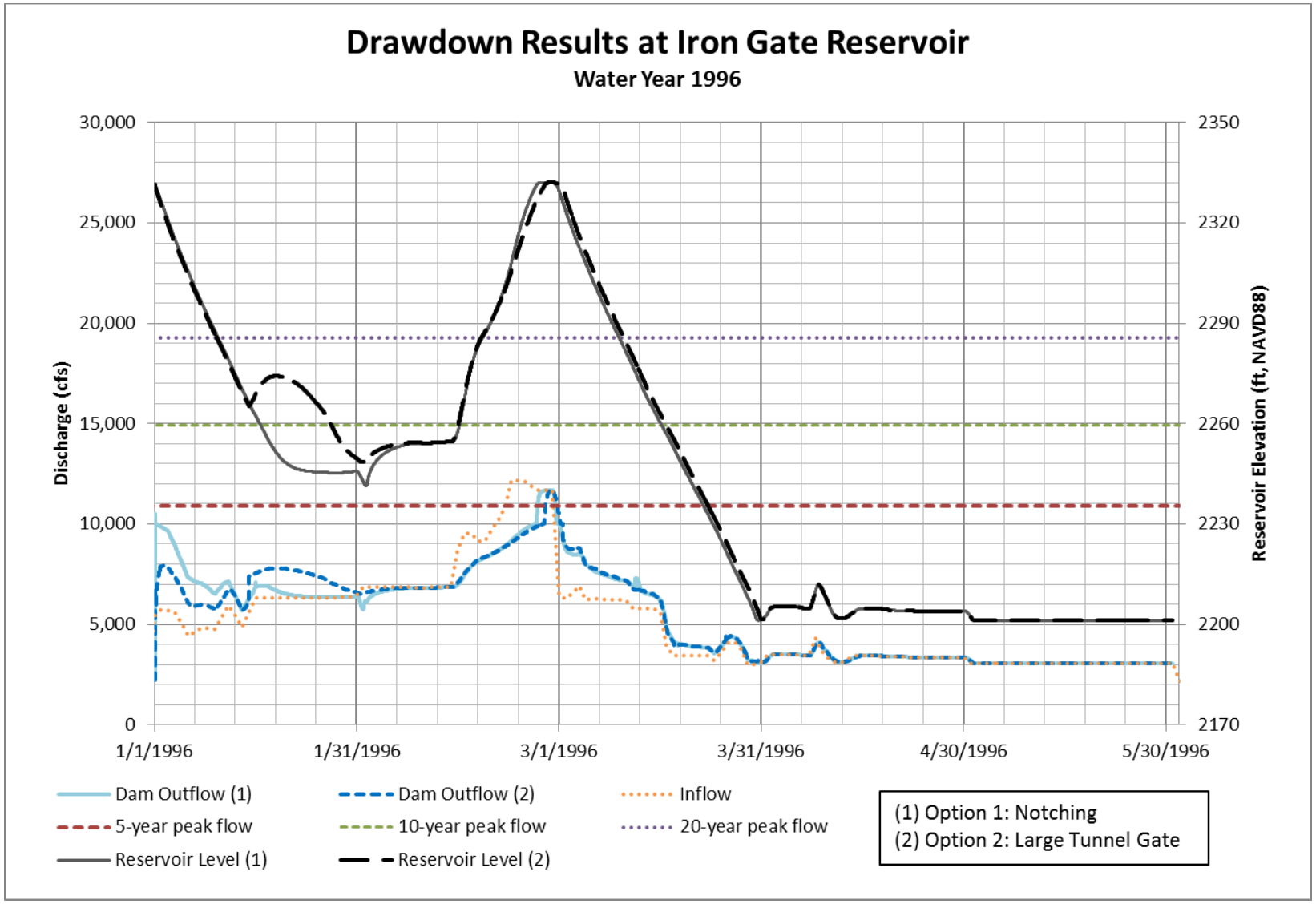

Figure 4-36 Iron Gate Reservoir Drawdown, Water Year 1996

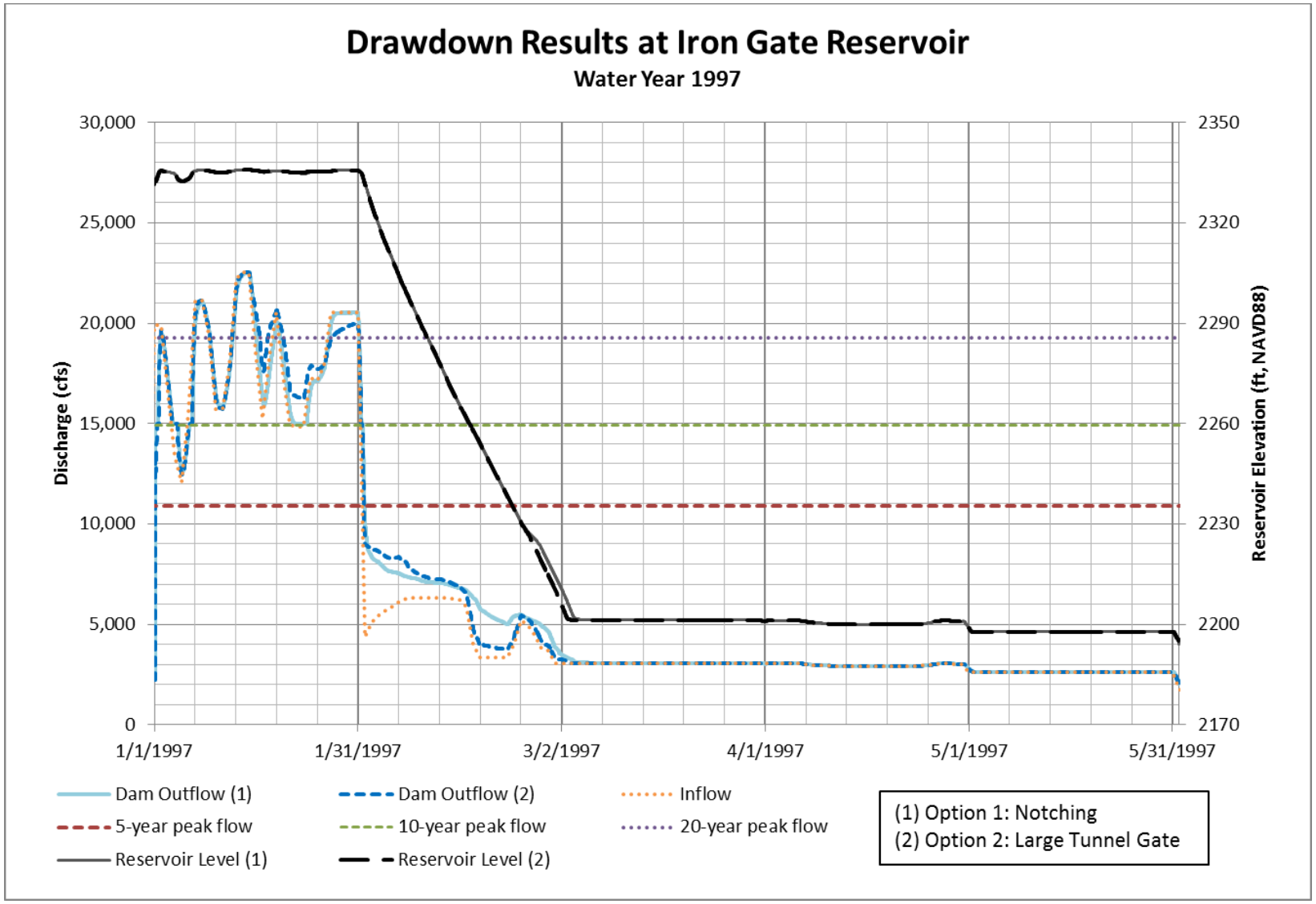

Figure 4-37 Iron Gate Reservoir Drawdown, Water Year 1997

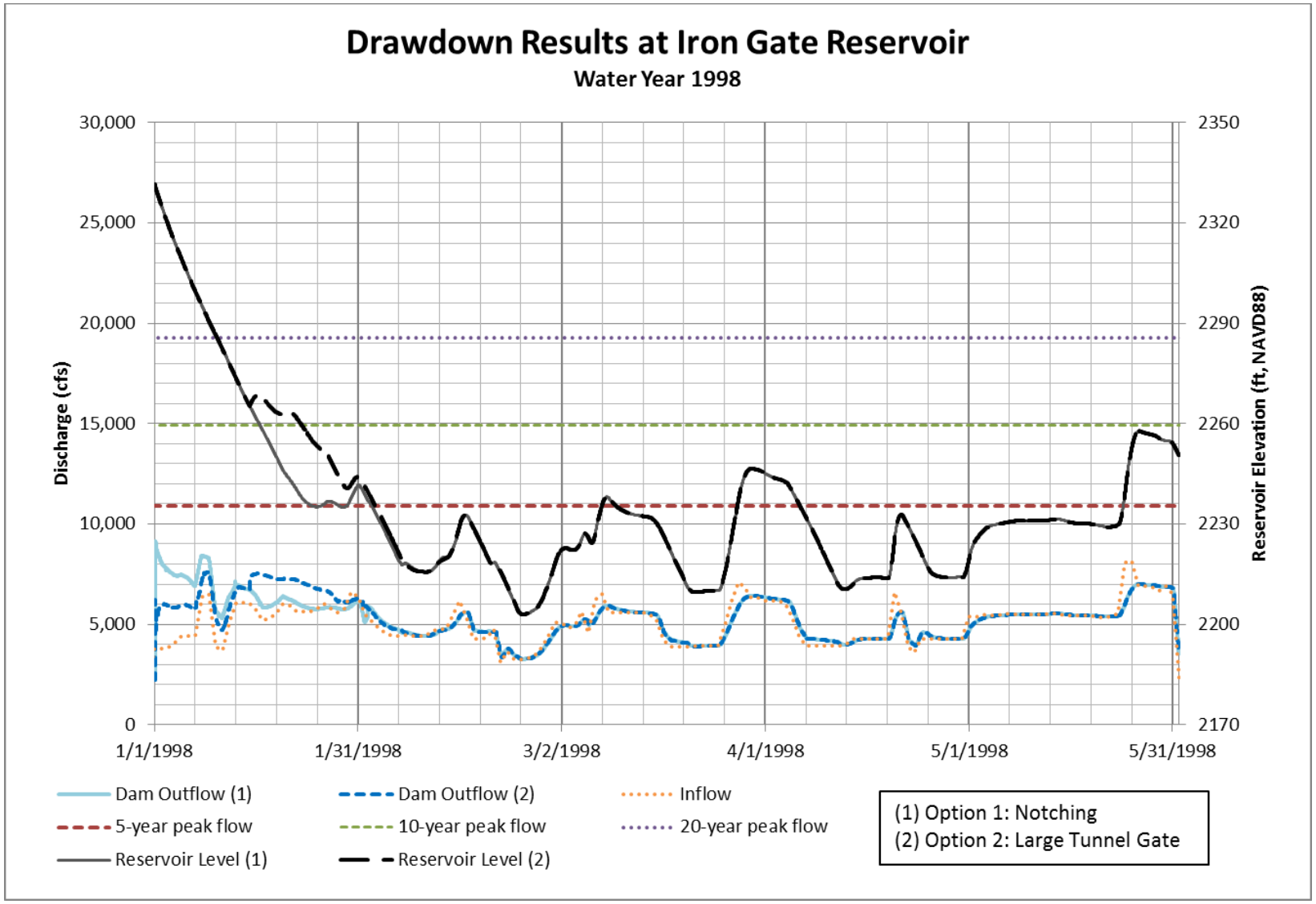

Figure 4-38 Iron Gate Reservoir Drawdown, Water Year 1998

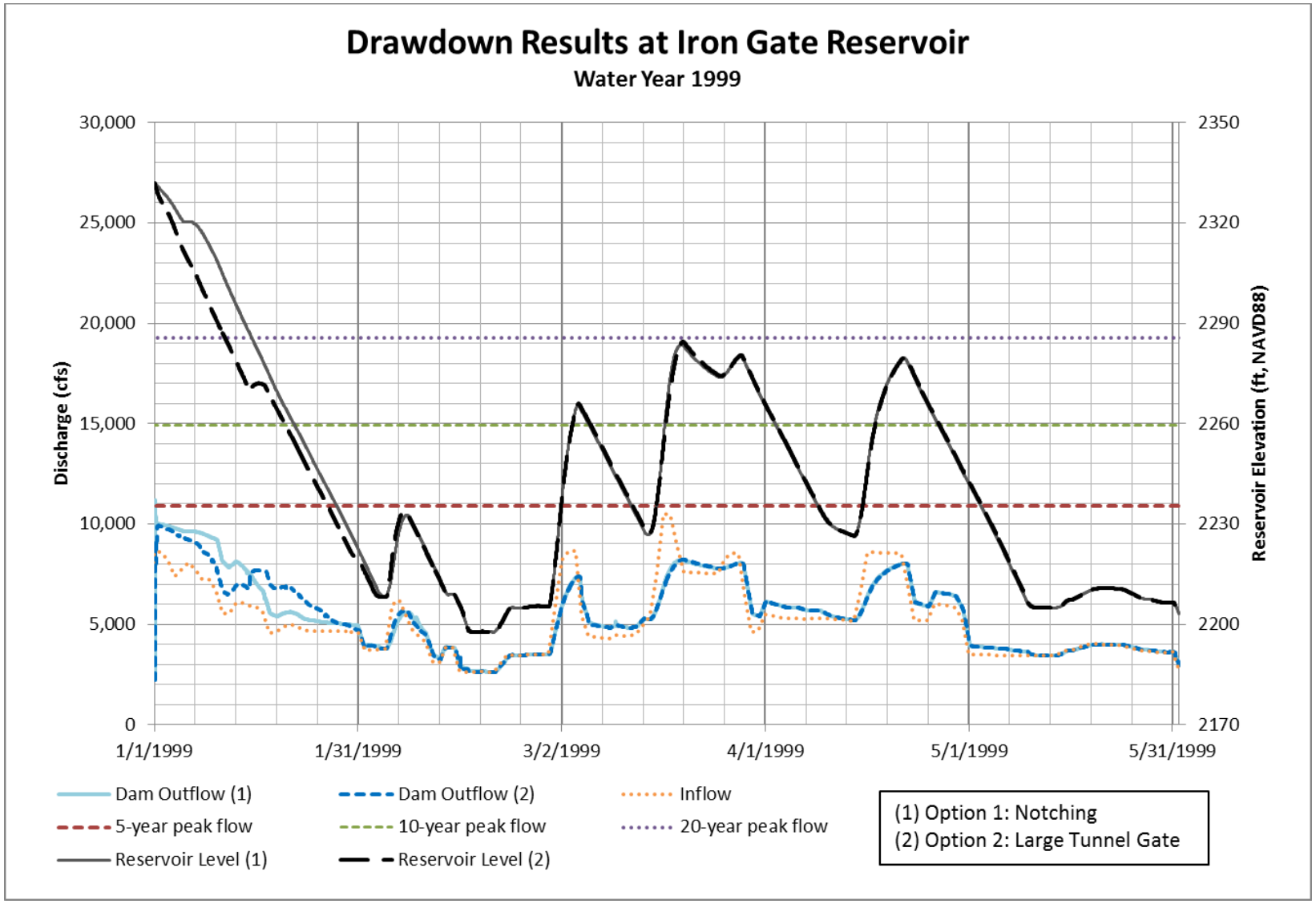

Figure 4-39 Iron Gate Reservoir Drawdown, Water Year 1999

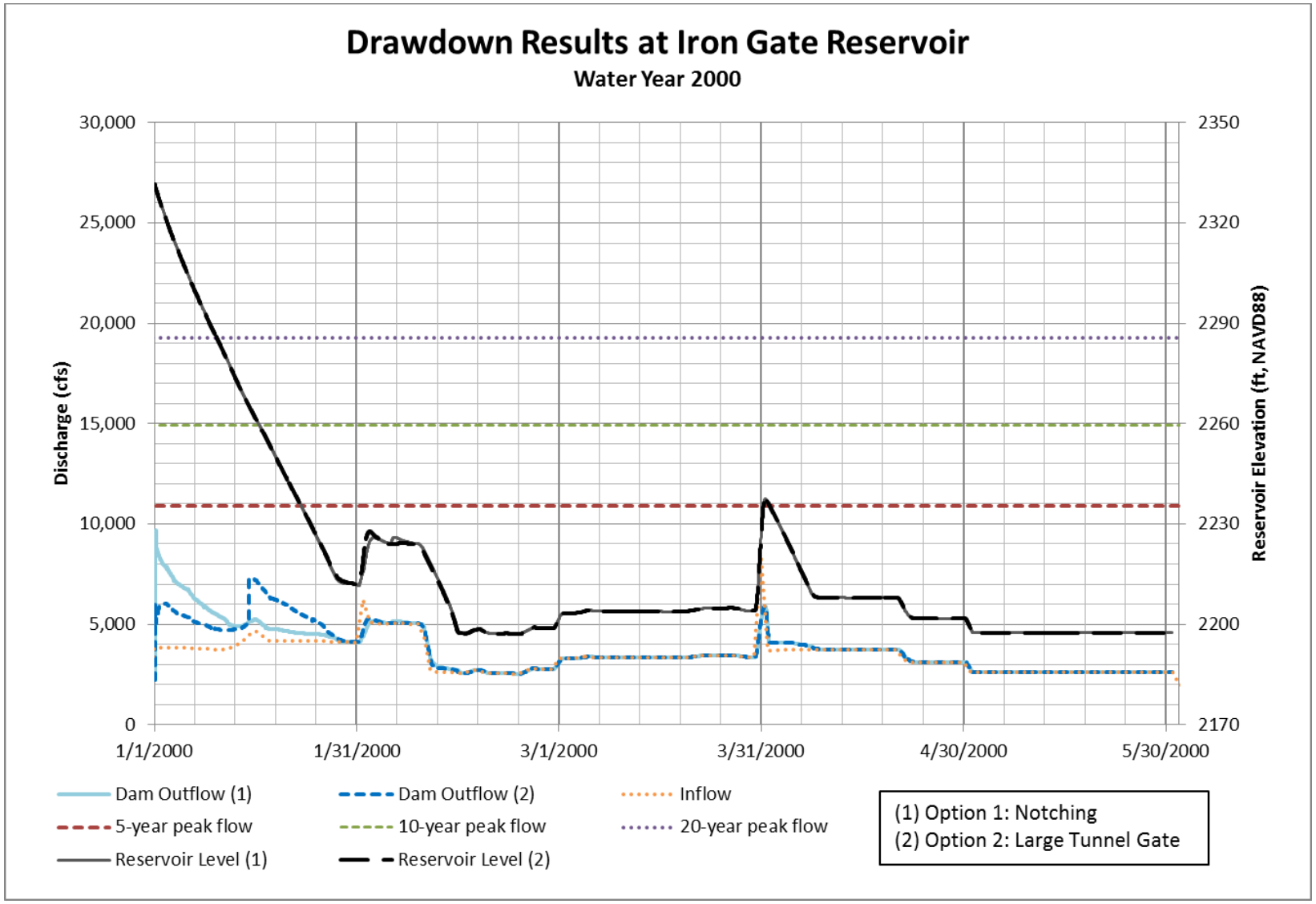

Figure 4-40 Iron Gate Reservoir Drawdown, Water Year 2000

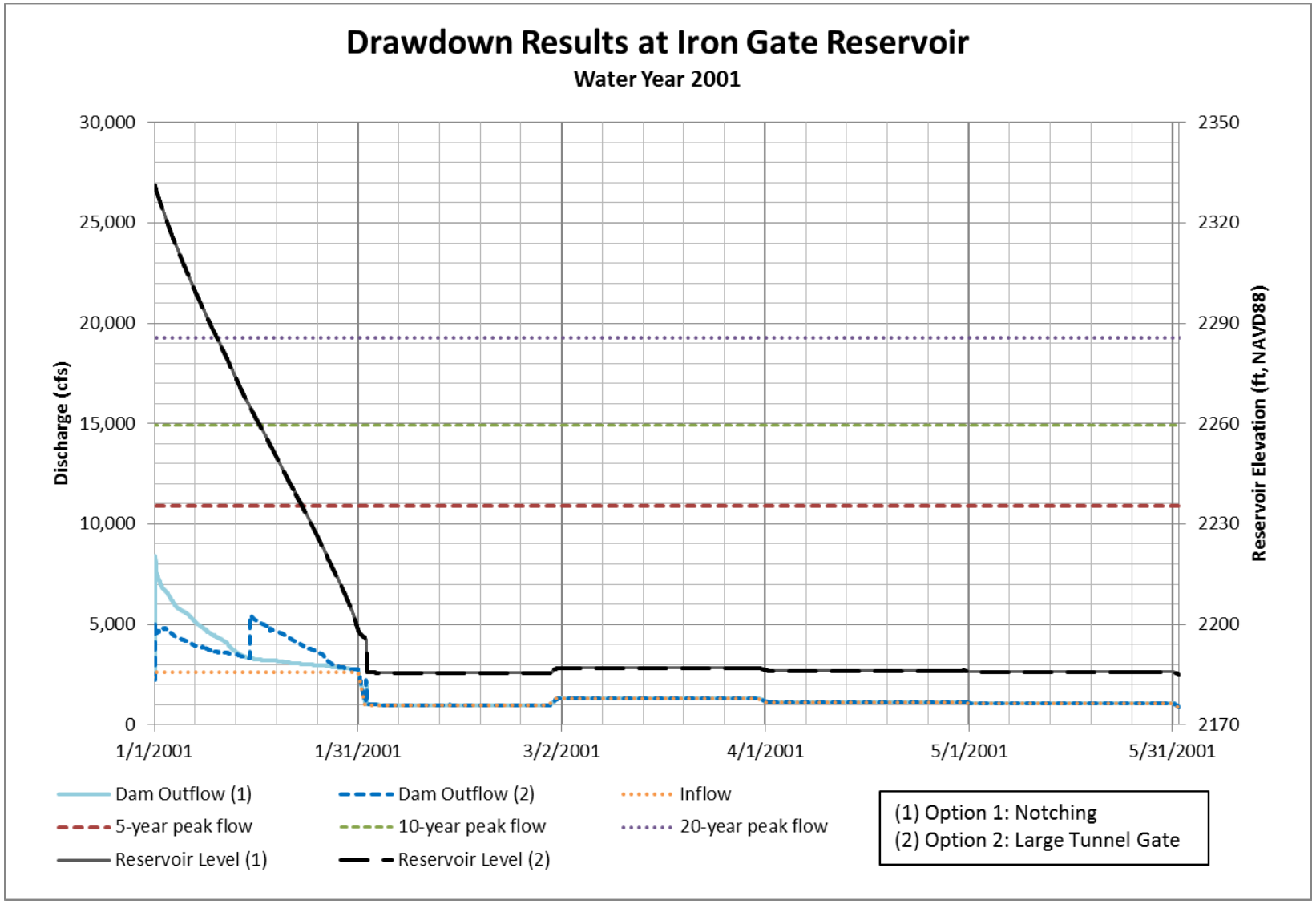

Figure 4-41 Iron Gate Reservoir Drawdown, Water Year 2001

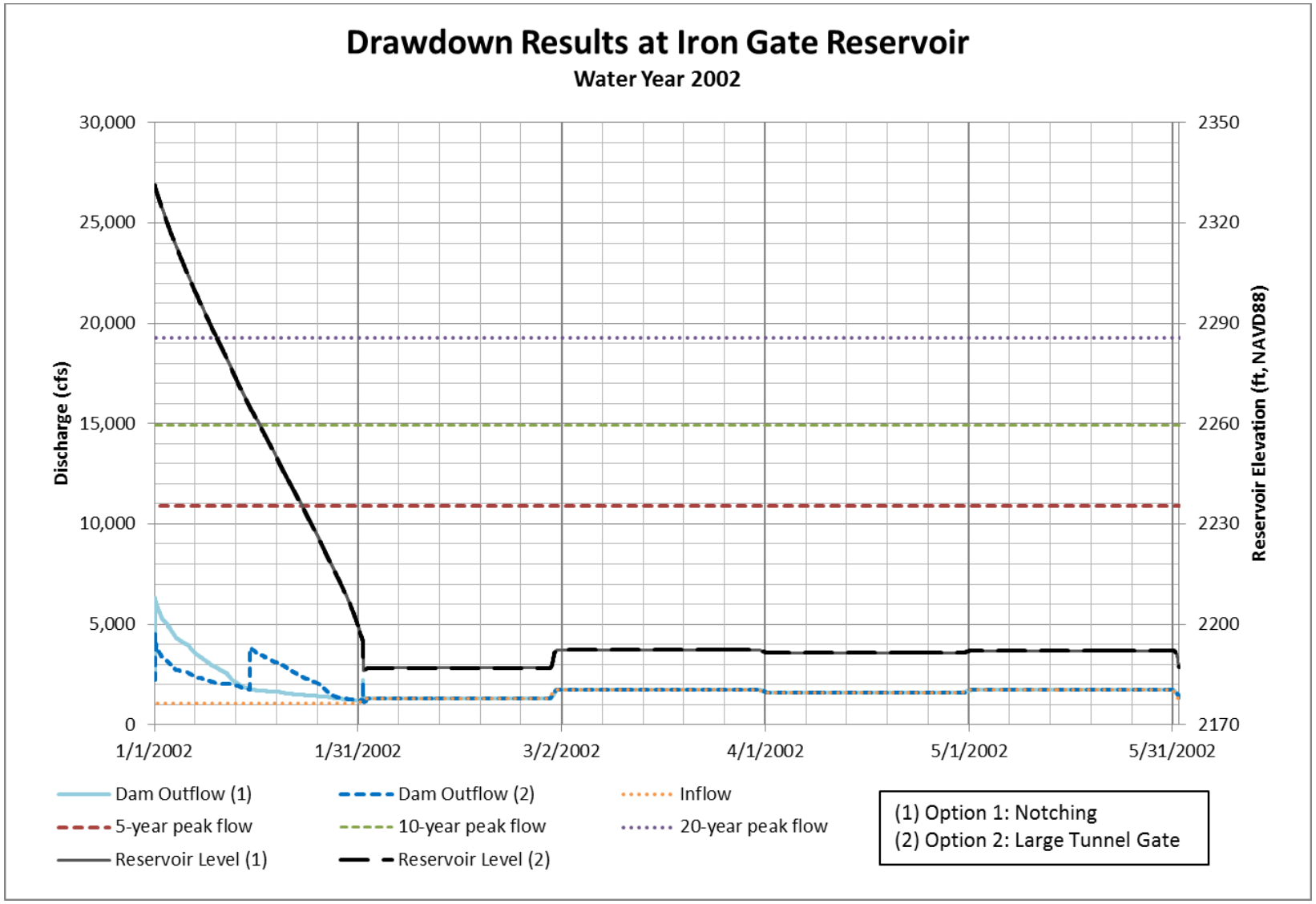

Figure 4-42 Iron Gate Reservoir Drawdown, Water Year 2002

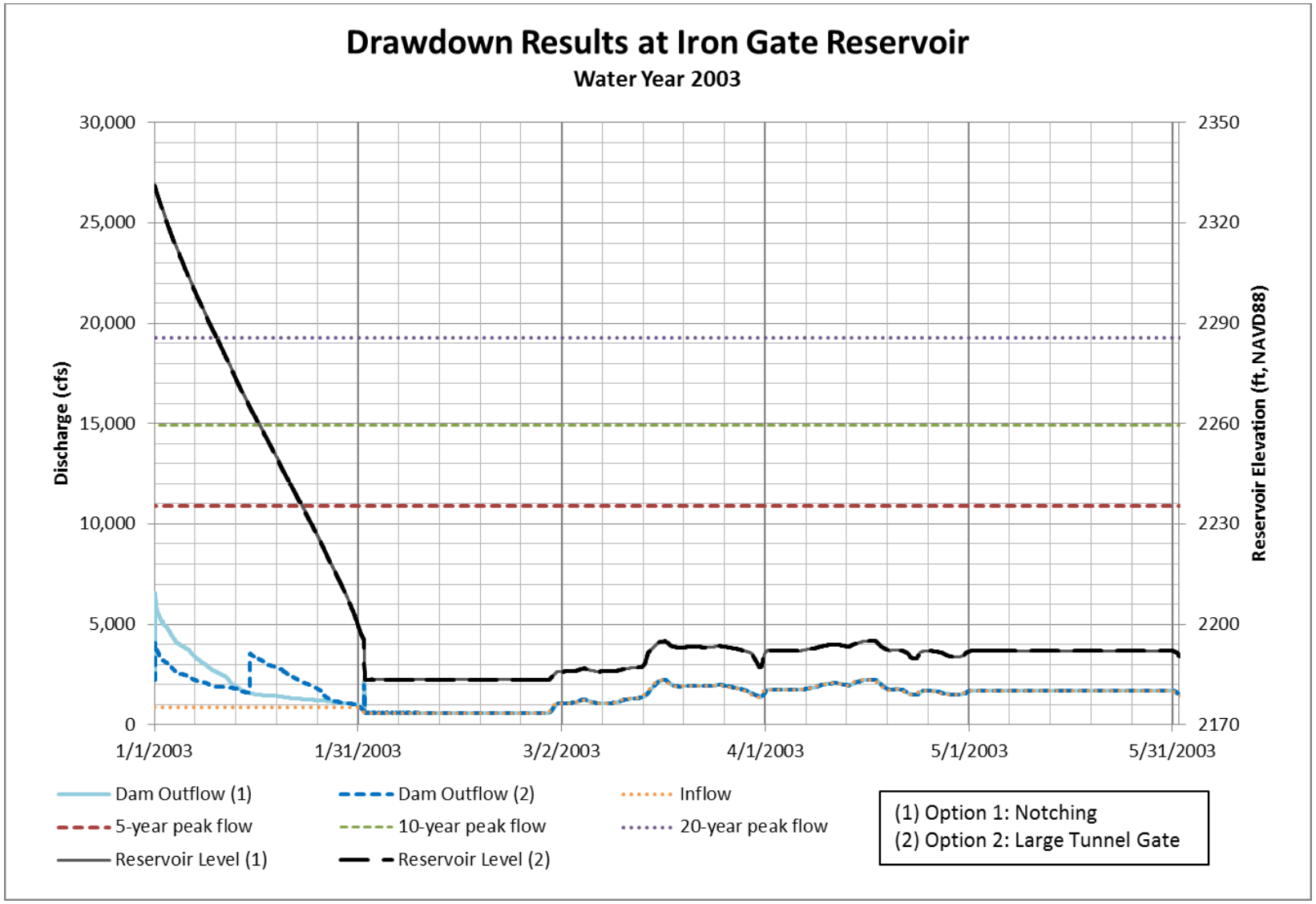

Figure 4-43 Iron Gate Reservoir Drawdown, Water Year 2003

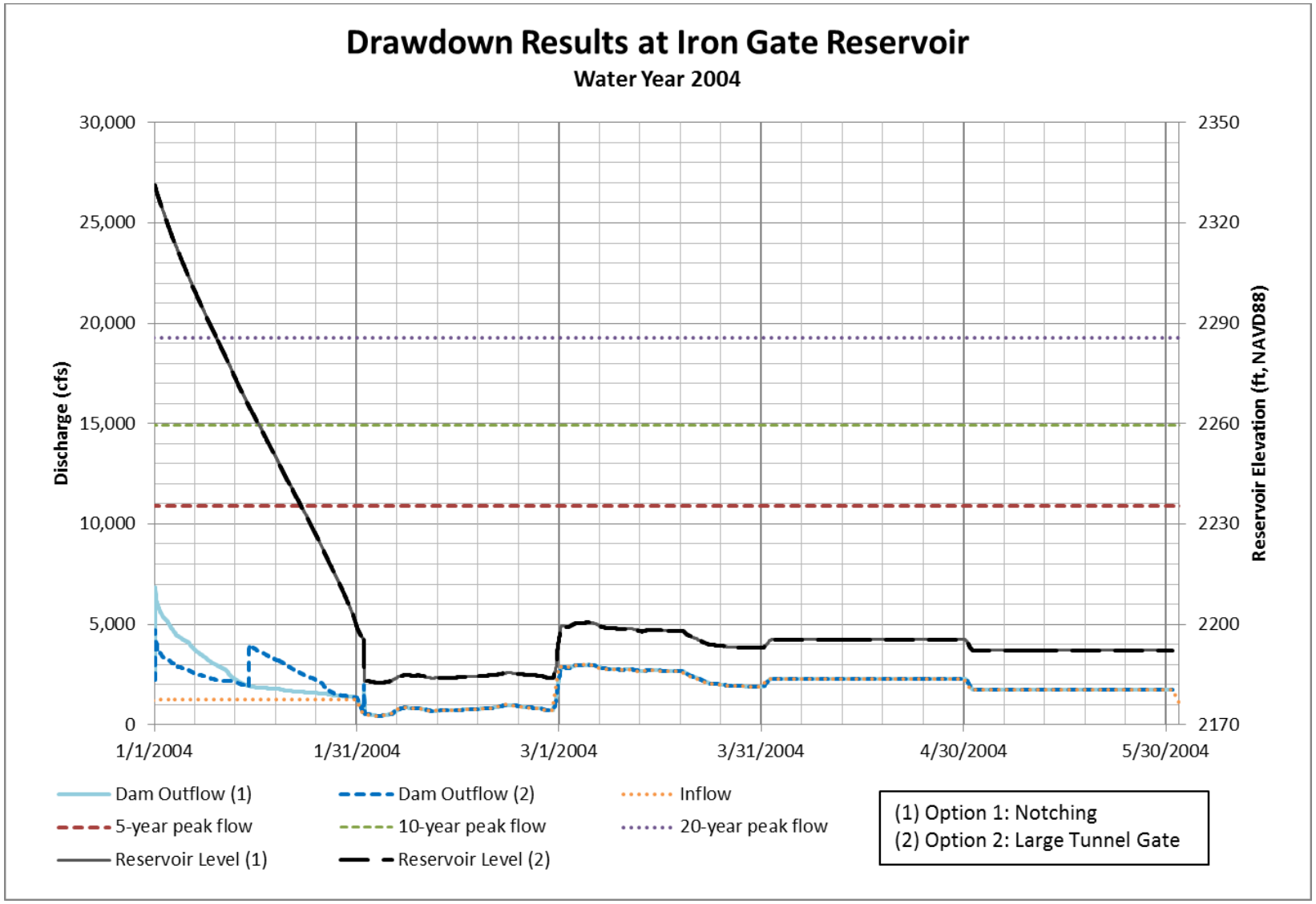

Figure 4-44 Iron Gate Reservoir Drawdown, Water Year 2004

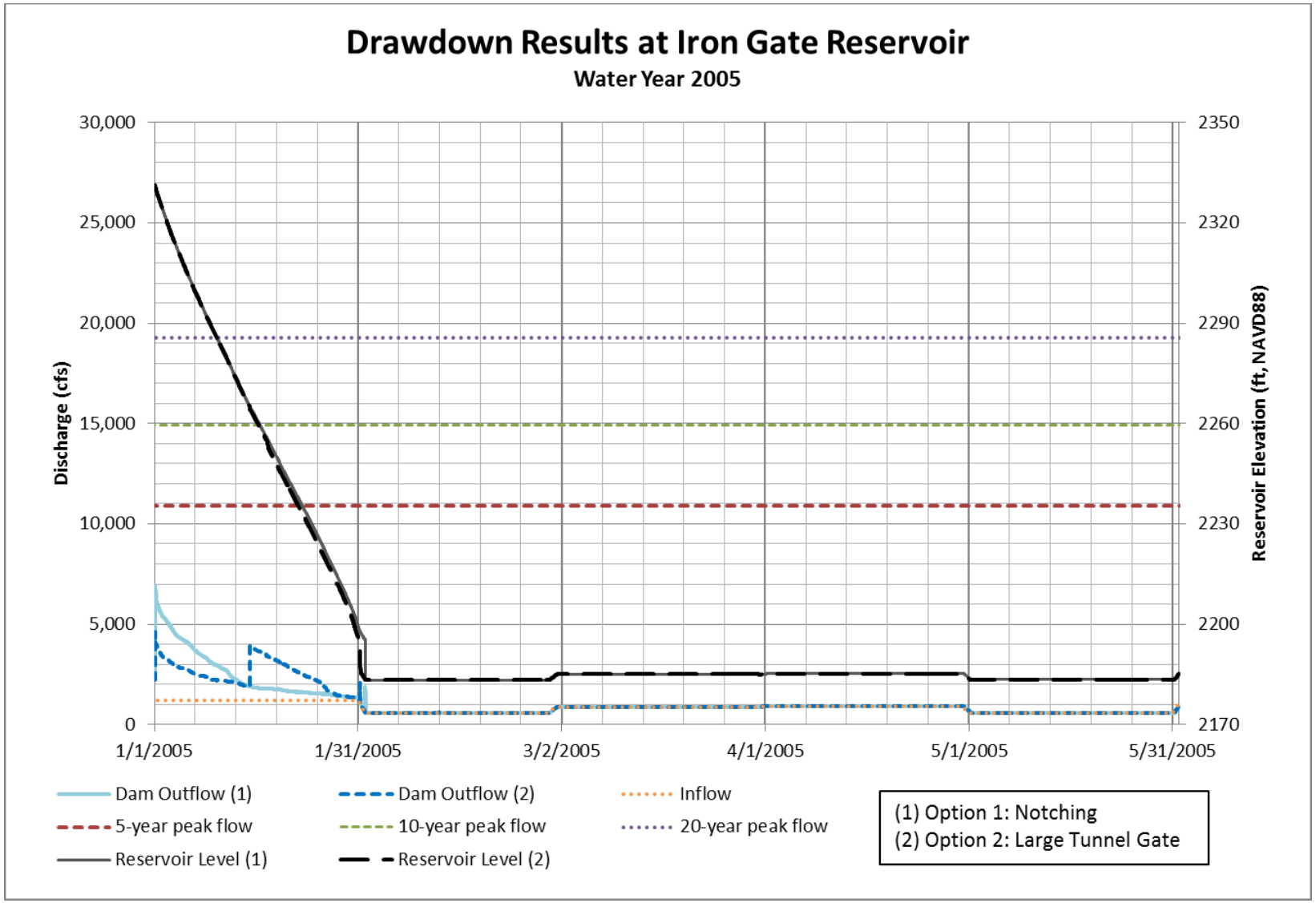

Figure 4-45 Iron Gate Reservoir Drawdown, Water Year 2005

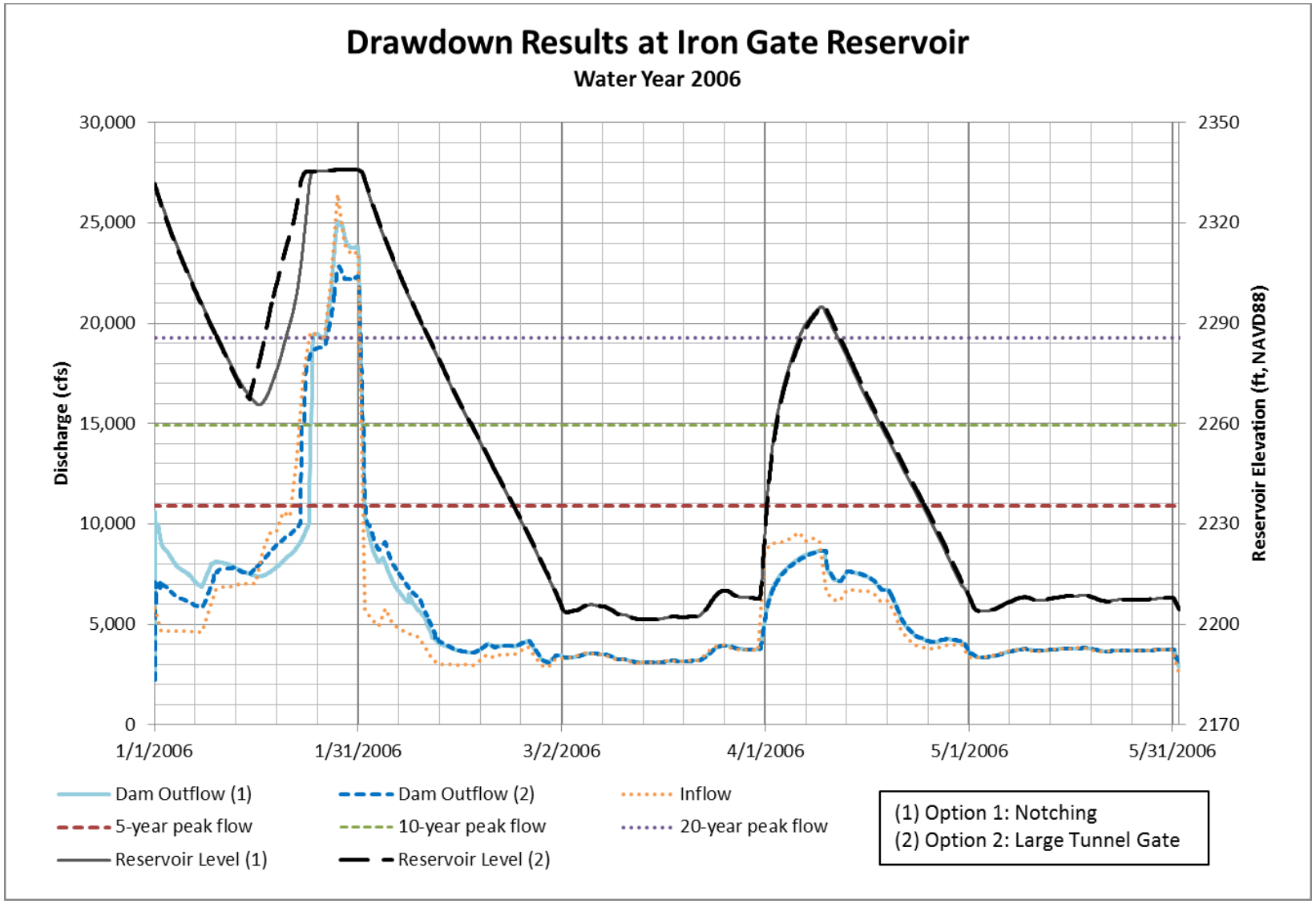

Figure 4-46 Iron Gate Reservoir Drawdown, Water Year 2006

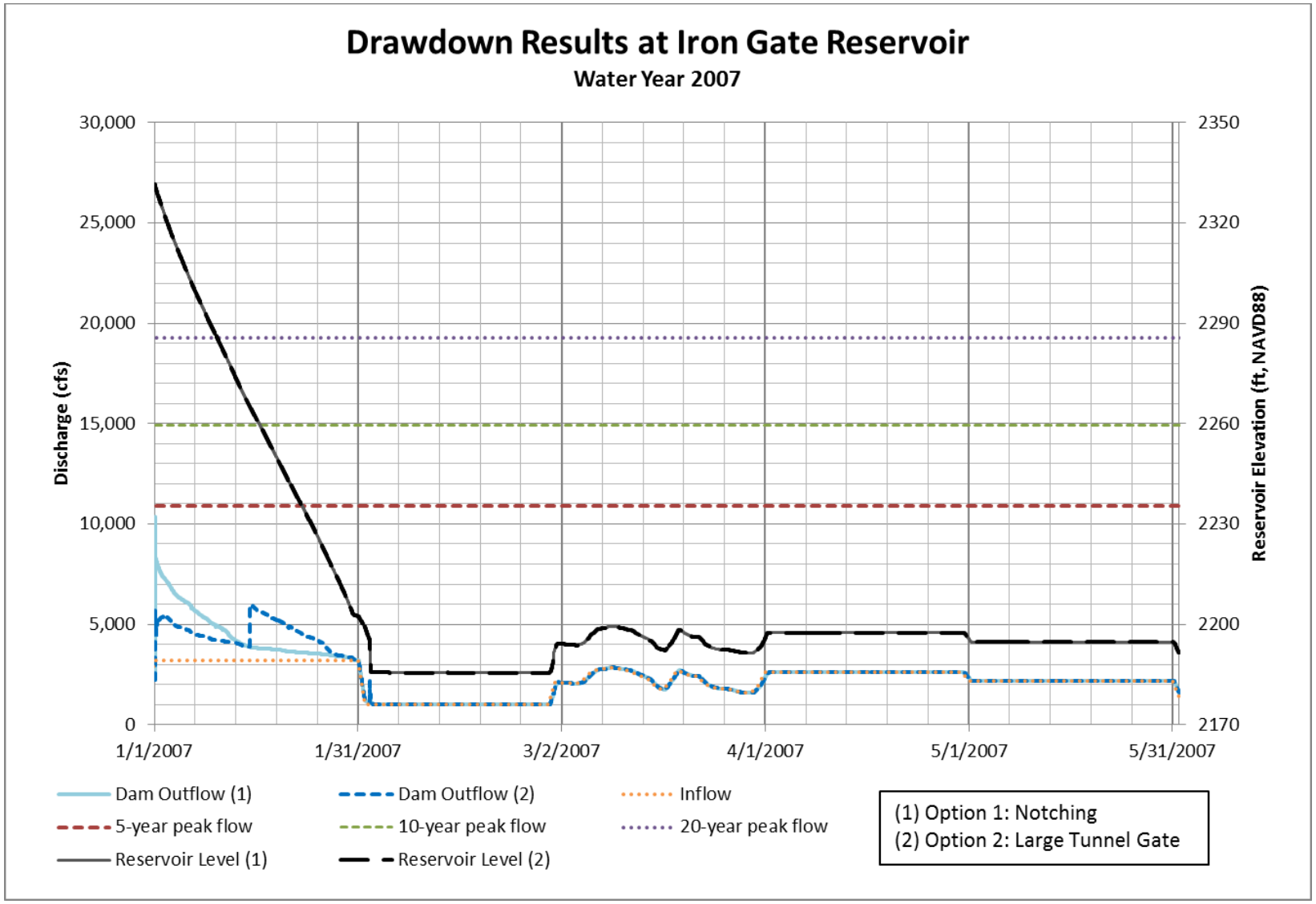

Figure 4-47 Iron Gate Reservoir Drawdown, Water Year 2007

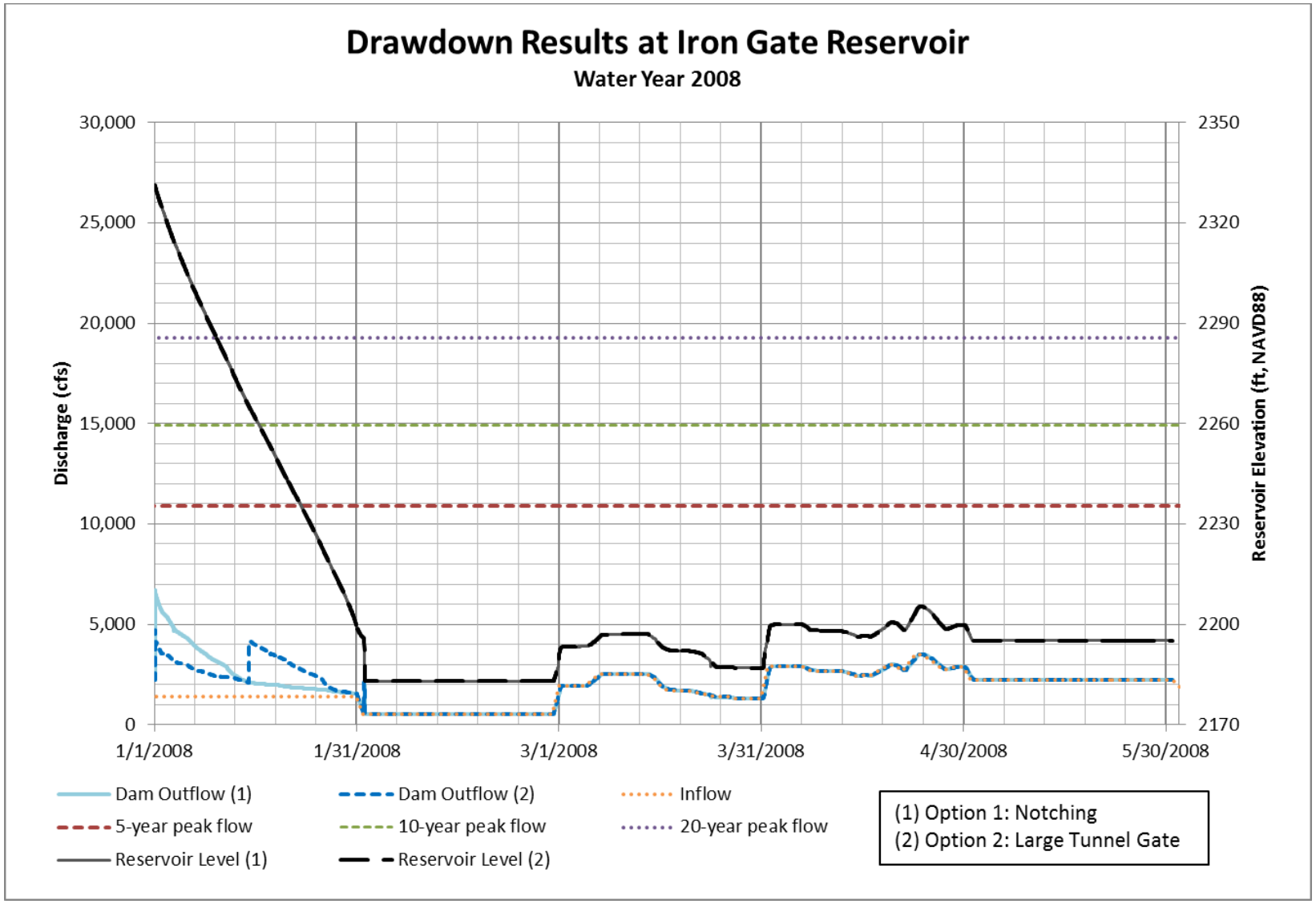

Figure 4-48 Iron Gate Reservoir Drawdown, Water Year 2008

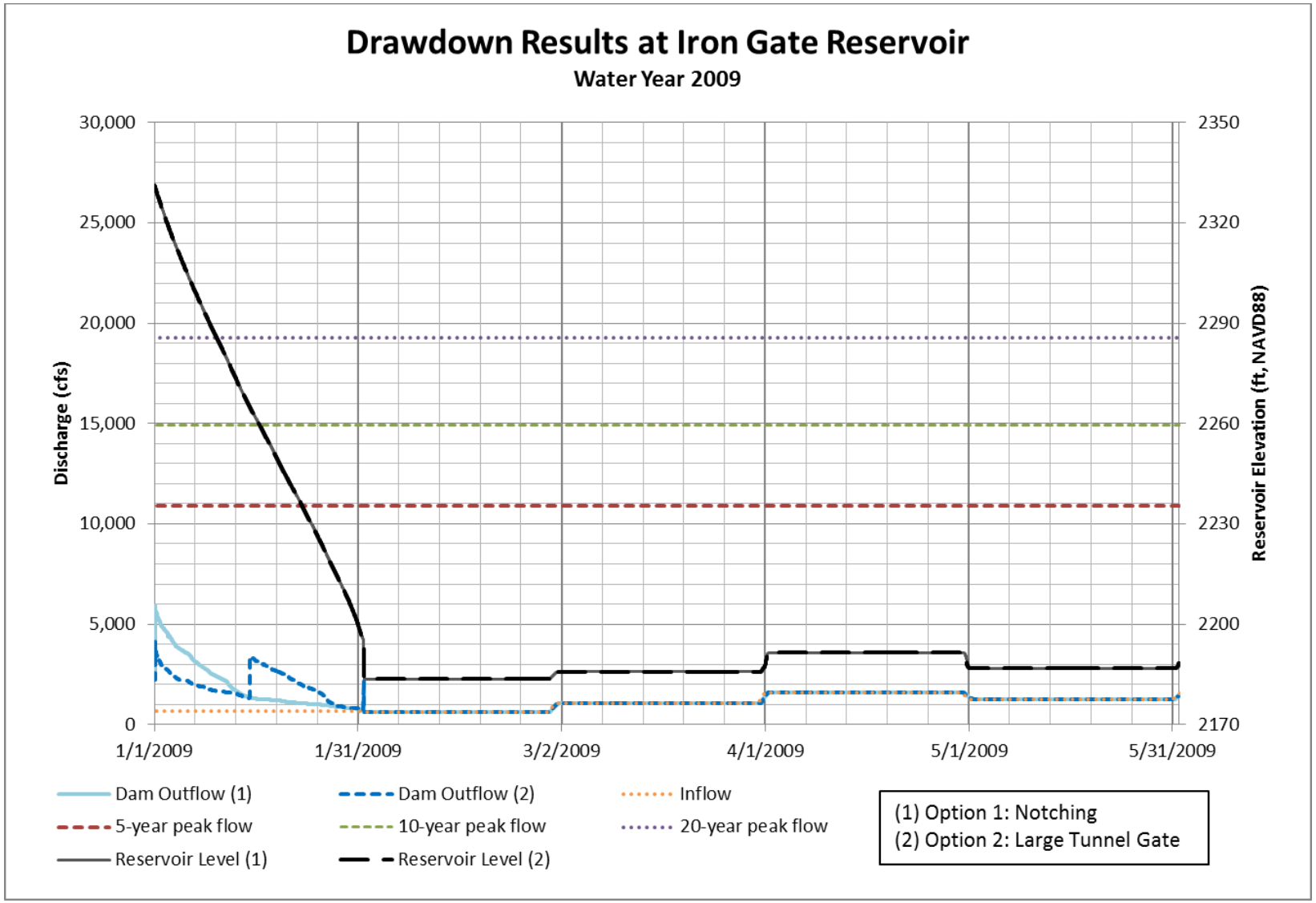

Figure 4-49 Iron Gate Reservoir Drawdown, Water Year 2009

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Chapter 5: Flood Frequency Analysis

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5. FLOOD FREQUENCY ANALYSIS

Figures 5-1 and 5-2 show the linear correlation between flows measured at the USGS gauges at J.C. Boyle and Copco as compared to the measured flows at Keno. KRRC used these relationships to extend the historical record of flows at J.C. Boyle and Copco prior to performing the flood frequency analysis. Figures 5-3, 5-4, and 5-5 show the results of the flood frequency analysis at J.C. Boyle, Copco, and Iron Gate, respectively.

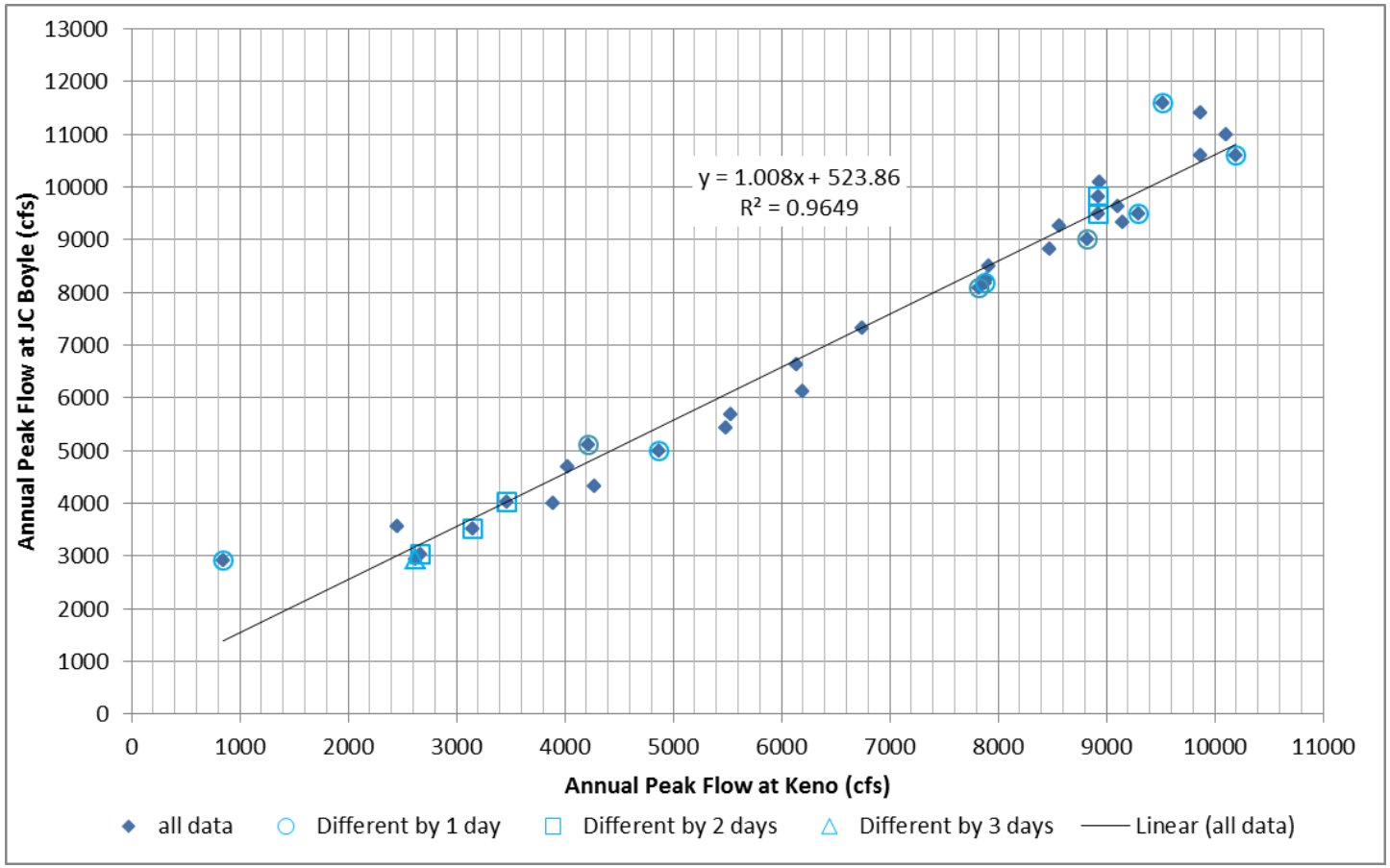

Figure 5-1 Linear Correlation between Flows at J.C. Boyle versus Flows at Keno

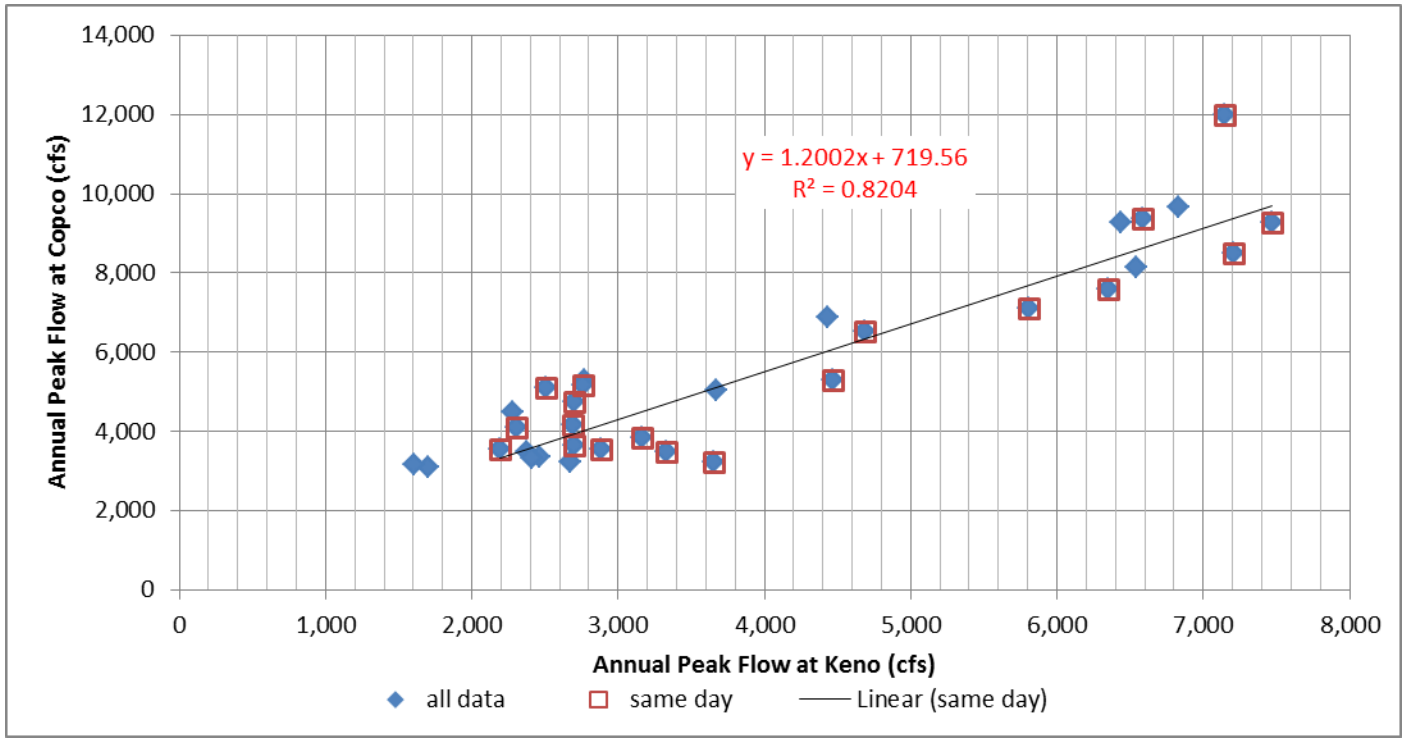

Figure 5-2 Linear Correlation between Flows at Copco versus Flows at Keno

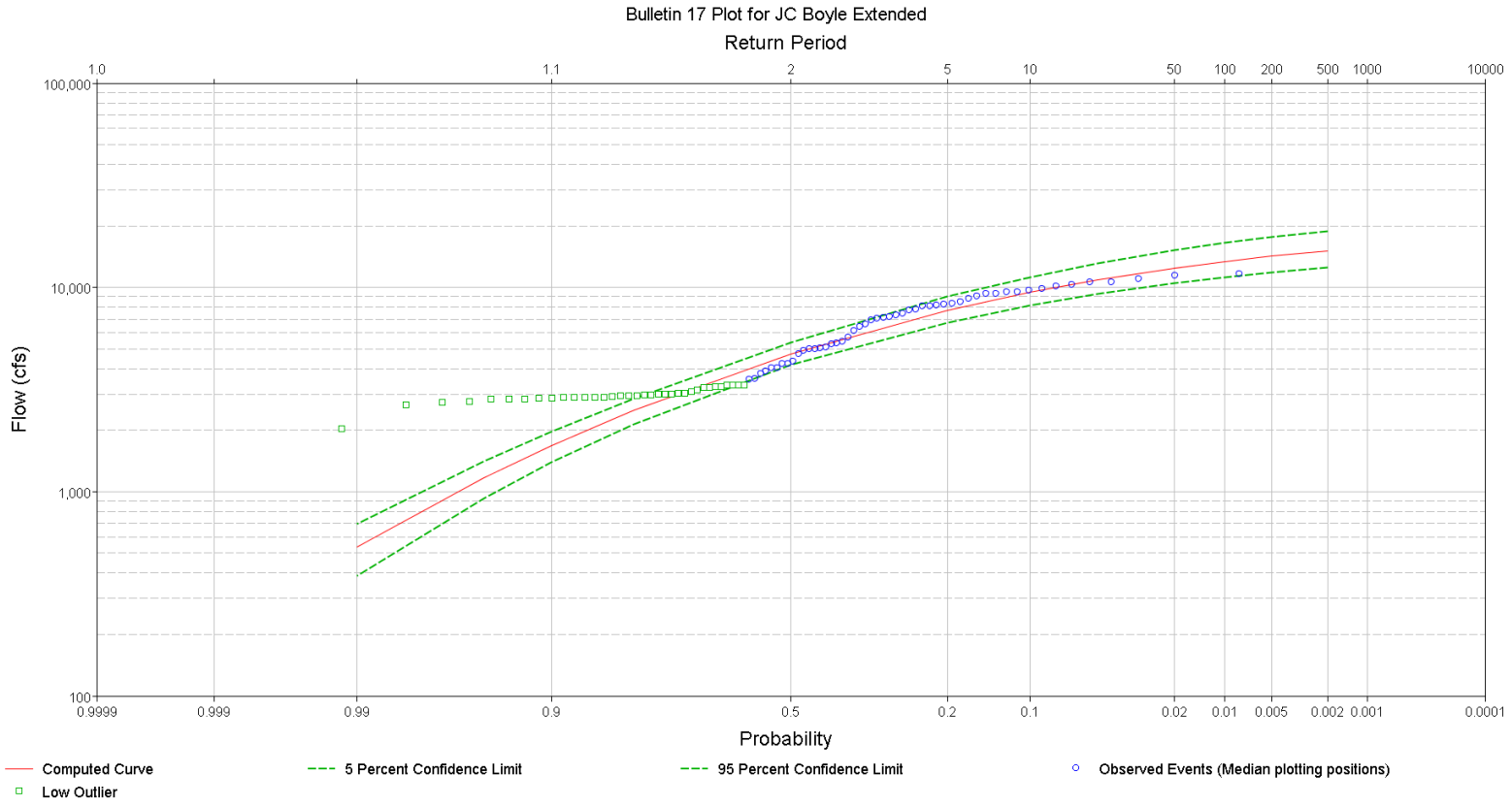

Figure 5-3 Flood Frequency Curve, J.C. Boyle

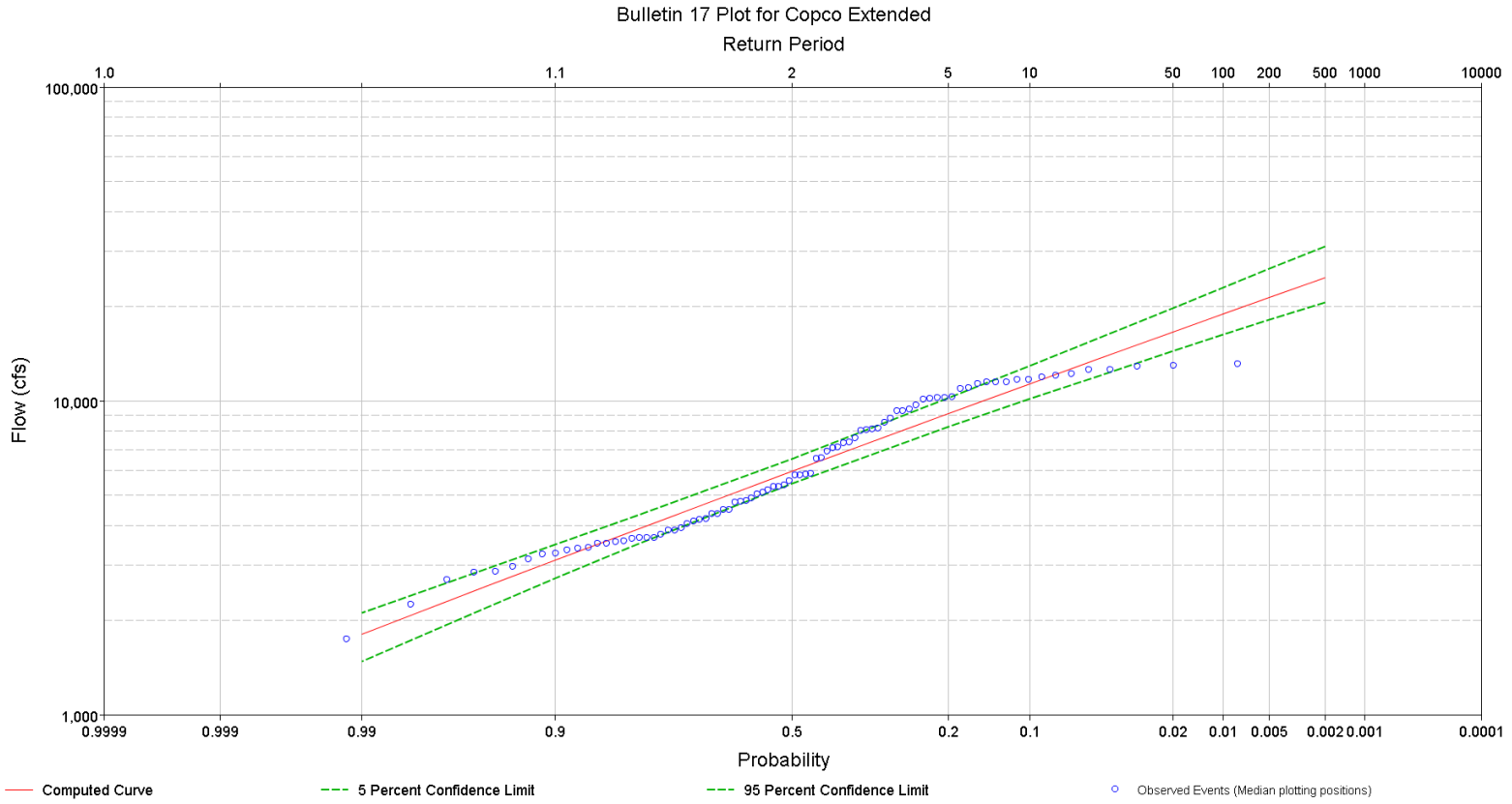

Figure 5-4 Flood Frequency Curve, Copco 1

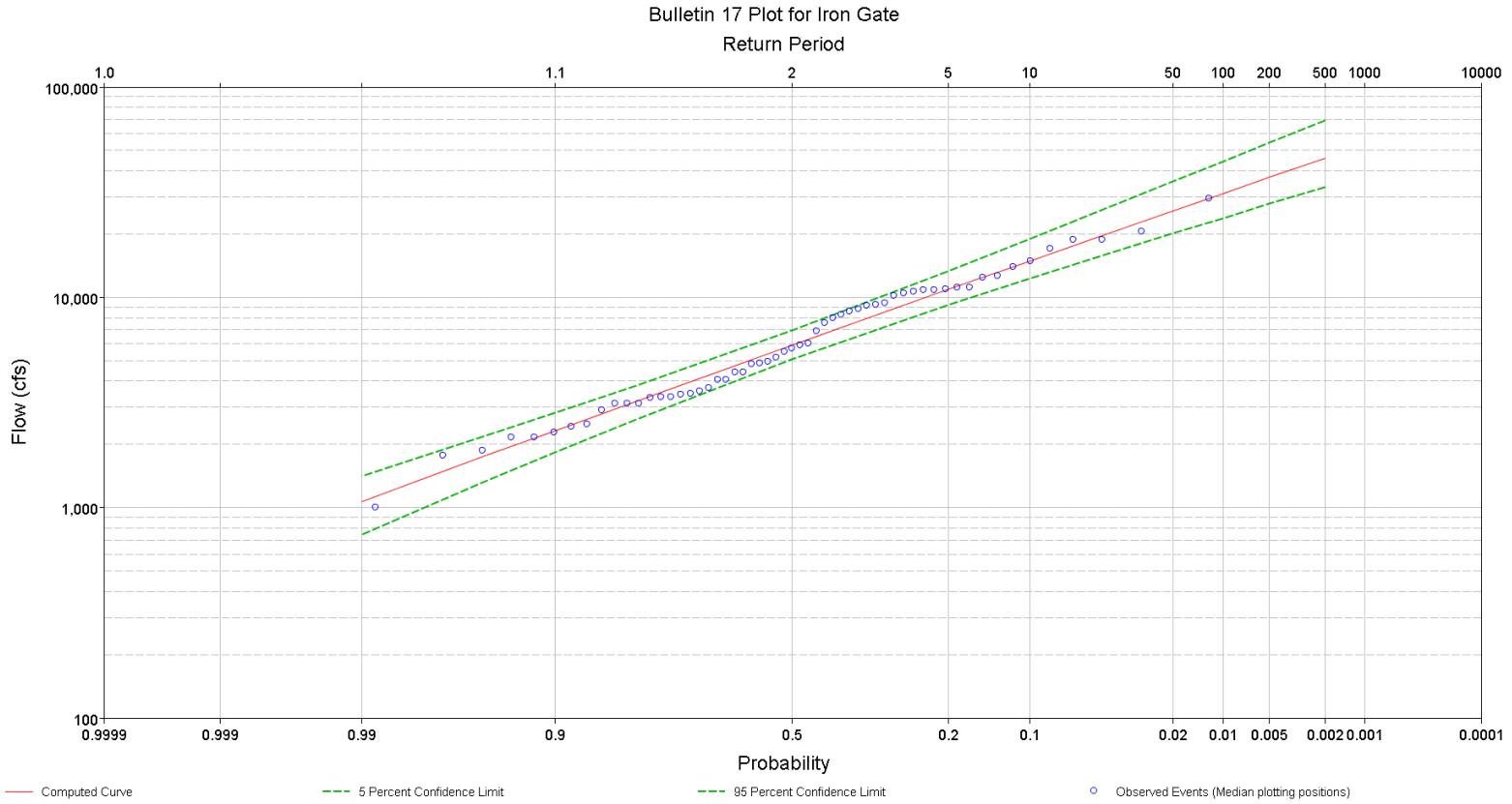

Figure 5-5 Flood Frequency Curve, Iron Gate

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Appendix G Copco Foundation Removal

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Klamath River Renewal Project

Project ref:
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From:
Phillip Mineart, Shannon Leonard

Date:
June 20, 2018

To: Klamath River Renewal Coporation

CC:

Technical Memorandum

Subject: Definite Plan for the Lower Klamath Project
Analysis of Copco No. 1 Foundation Removal

1.0 Introduction

During construction of Copco No. 1 Dam, approximately 100 feet of alluvium was removed below channel grade and backfilled with concrete. When the dam is demolished, the depth of the foundation removal needs to be sufficient so that river bed sediment mobilization through natural channel processes does not expose the concrete and create a fish passage barrier or prevent bedload movement in the active bed layer. The KRRC performed a scour analysis to determine a conservative depth of bed material mobilized by the restored river to recommend a depth of foundation removal for the Project.

Copco No. 1 dam has captured most of the coarse sediment that either entered the river or was mobilized between J.C. Boyle Dam and Copco No. 1 Dam. Any sediment downstream of Copco No. 2 Dam that was mobilized by storm flows, therefore, was not replaced by the inflowing upstream of sediment. This has likely resulted in the removal of sediment downstream of Copco No. 2, especially the finer sediment, and possibly a steepening of the slope. The removal of Copco No. 1 and Copco No.2 will release any sediment that has been retained in the reservoirs and more importantly will allow any bedload sediment mobilized upstream of Copco No. 1 to move through the Copco reach. Over time the slope of the stream should return to the pre-project condition. This may result in a slope that is different than the existing slope downstream of the dams.

The concrete needs to be removed to a depth below pre-dam channel grade sufficient to allow the passage of bedload during storm events. This requires an estimate of the future grade at Copco No. 1and the depth or thickness of the bedload transport layer below grade. The equilibrium slope is used to estimate the future stream bed elevation at the dam based on extending that grade from the bedrock controls in the channel downstream of Copco No. 2 Dam. Presumably the stream slope will return to its pre-project slope; however, if the particle size distribution in the future contains more fines and less coarse material, than pre-dam bed material (e.g., Lake Ewauna continues to retain coarse material) the slope could be shallower than pre-dam slope resulting in a somewhat lower post-project bed elevation at the dam. The “active layer thickness” was calculated to estimate the depth required to allow bedload transport.

2.0 Future Stream Grade at Copco No. 1 (Equilibrium Slope)

The equilibrium slope is the slope at which the shear stress on the bed during the design condition just equals the critical shear stress needed to initiate sediment motion. The calculation of critical shear stress typically requires the selection of a representative particle size of the stream bed material. The median particle size (i.e., d50) is often used though larger sizes such as the d75 or higher have been used. An alternative approach is to use a probabilistic approach.

The representative particle size approach assumes that when the shear stress exceeds the critical shear stress of the representative particles size 100% of the sediment smaller than the representative size is in motion and 0% of the larger particles are. In streams with relatively uniform particle sizes this is usually sufficient (e.g., sand bed stream); however, in streams such as the Klamath River with widely varying particles sizes it does not represent actual conditions very well.

The equilibrium slope was calculated using the method developed by Gessler (1967) as descried in Ferro and Porto (2011) and Porto and Gessler (1999). Rather than using a representative particle size, a representative particle size distribution is used. An assumption behind the method is that an armored layer will form, and the method calculates a probability that a given size particle in the distribution remains in the armored layer. A representative particle size is then calculated that results in the same bed stability as the particles that are likely to make up the armor layer. That is, instead of picking a representative particle size a priori, a value is calculated that is representative of the particles likely to make up the armor layer based on the particle distribution and their corresponding critical shear stresses.

Input data needed for the analysis include: stream characteristics (flow, depth, and slope) and particle size distribution. A 2-year flow was assumed for the design flow event. This is assumed to be representative the long term average flow for movement of sediment. Based on the frequency analysis discussed in Section 4.3 of the main body of the Definite Plan, a flow of 6,000 cfs was used. There is no bathymetry data between the Copco No. 1 and Copco No. 2 dams, so stream characteristics from the HEC-RAS model (discussed in Section 4 of the Definite Plan) for the reach downstream of Copco No. 2 Dam were used. The depth of flow downstream of the Copco No. 1 Dam was between 6 and 7 feet for the 2-year event.

Particle Size Distribution

Particle size distribution data for sediments downstream of Copco No. 1 and Copco No. 2 dams were not available. However, the USBR sediment transport study (USBR 2012) provides a figure (Figure 5-18 in USBR 2012) showing values for the d16, d50 and d84 particle sizes for a station near the Copco Dams (RM 198 in that report) and above Copco Lake (RM 206-208 in that report). Table 1 below lists the values estimated from that figure.

Table 1. Particle Size Data near Copco Dams

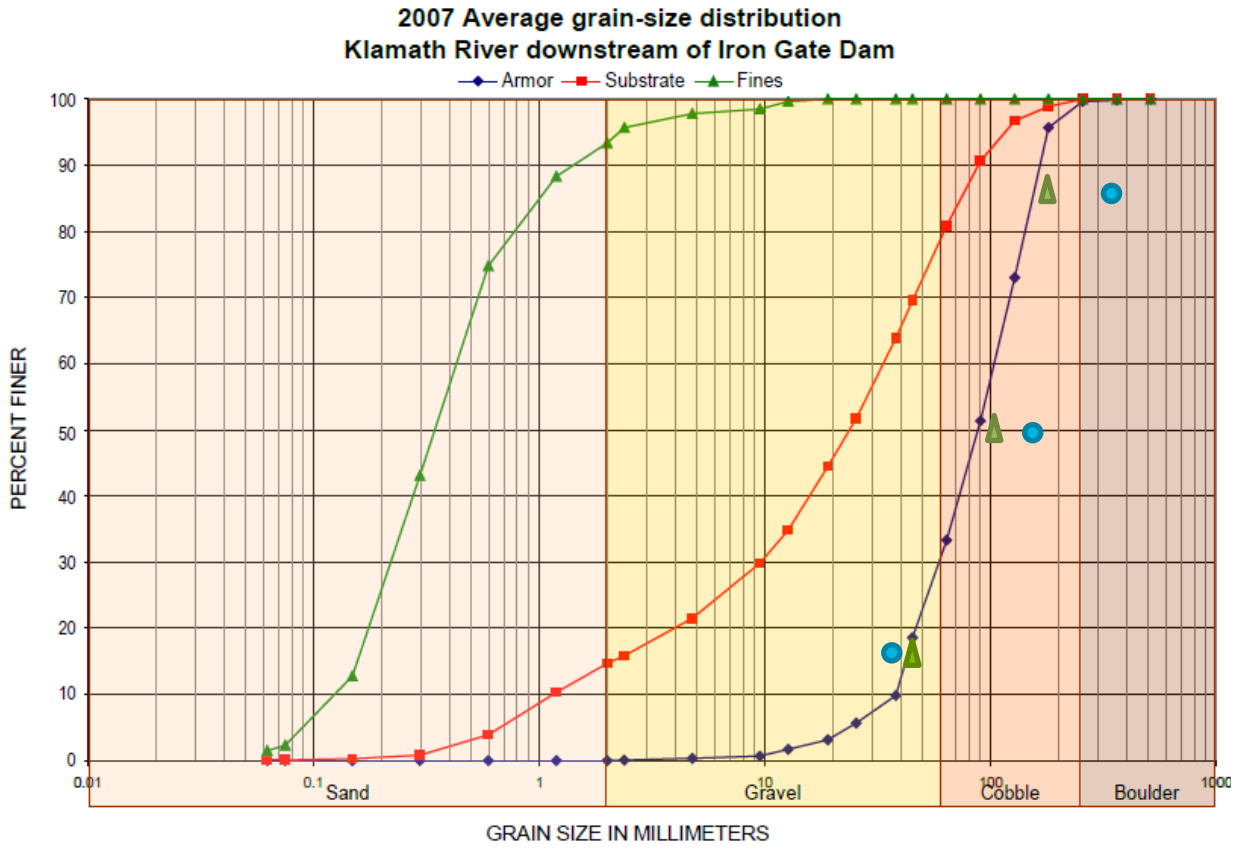
Site[1]	D16	D50	D84
RM 198	22	80	130
	28	120	320
	31	160	400
	62	220	520
Average	35.75	145	342.5
RM 206-208	7	42	81
	26	51	98
	27	60	105
	40	100	200
	42	105	200
	61	110	205
	63	120	220
	64	130	310
	91	190	
Average	46.8	100.9	177.4

Source: Figure 5-18 USBR Sediment Study (USBR 2012); Note: Adjacent values may not be from the same sample

[1] Site river miles are as reported in USBR 2012c. Corresponding revised river miles in this report are 201.8 and 210.3-212.3, respectively.

Note that since the values were plotted by river mile versus particle diameter, it is not possible to group the data by sample; that is, it is not known which d16 value goes with which d50 and which d84. Therefore, the average values for each particle size were used.

To use a probabilistic method for calculating equilibrium slope, a particle size distribution is needed. Several distributions are presented in Holmquist-Johnson and Milhous (2010), the closest located below Iron Gate Dam at RM 187[1]. The USBR data and the Holmquist-Johnson and Milhous distributions are plotted together in Figure 1. The USBR data generally follows the same distribution as the armor layer reported in Holmquist-Johnson and Milhous. The particle size distribution for the armor layer was used in the analysis below except for sizes greater than d75 which were approximated by a curve going through the USBR data.



RM198 (blue circles), RM206-208 (green triangles). River miles are as reported in USBR 2012c. Corresponding revised river miles in this report are 201.8 and 210.3-212.3, respectively.

Figure 1. Particle Size Distribution Data from Holmquist-Johnson and Milhous (2010) Compared to USBR data collected near Copco Dams

[1] As reported in that paper. Corresponding revised river mile is about 190.1.

Methods

The calculation of equilibrium slope proceeded using the following steps (see Ferro and Porto 2011 for details on the calculations):

1. The bed shear stress was calculated for the 2-year event as:

$$\tau_0 = \gamma h S \qquad \text{Equation 1}$$

Where:

τ_0 = boundary (bed) shear stress
γ = specific weight of water
h = depth of flow
S = bed slope

2. The particle distribution was divided into 20 increments of 5% each
3. For each increment the critical shear stress was calculated using Shields relationship
4. The probability of a particle not be removed (i.e., remaining in the armor layer) is calculated using the relationship:

$$q_i = \left\{1 - exp\left[-a\left(\frac{\tau_{ci}}{\tau_0}\right)^b\right]\right\}^n \qquad \text{Equation 2}$$

Where:

q_i = probability particle i will remain in the armor layer (i.e., will not be removed)
a, b, n = empirical coefficients equal to: 0.5641, 2.0386, and 0.7612, respectively.
τ_{ci} = critical shear stress for particle i

τ_0 = bed shear stress

5. Calculate the average stability of the armor layer. The most stable layer is when q_{bar} = 0.5:

$$q_{bar} = \frac{\int_{D_{min}}^{D_{max}} q^2 p_0 dD}{\int_{D_{min}}^{D_{max}} q p_0 dD} \qquad \text{Equation 3}$$

Where:

q_{bar} = average stability of armor layer
D_{max}, D_{min} = maximum and minimum particle size
q = stability of particle
p_0 = relative weight of particle in original distribution (= 0.05 in these calculation, i.e., distribution divided into 20 equal increments)
D = particle diameter

6. Calculate the average particle size in the armor layer the corresponds to an average stability of 0.5 (which is the most stable layer), = 0.27m for stream below Copco based on particle size distribution in Figure 1
7. Calculate the critical shear stress of the armor layer based on particle size in step 6.
8. Find the slope that corresponds to a bed shear stress equal to the critical shear stress from step 7.

Results

Based on the armor particle size distribution and the average water depth from the HEC-RAS model developed for the drawdown study (Section 4), the minimum equilibrium slope is 0.0093. Applying this slope starting at a bedrock grade control located about 1200 feet downstream from Copco No. 2 Dam the elevation at the dam is 2474.5 feet. This is about 10 feet below estimated pre-dam channel grade at Copco No. 1 dam.

The original slope and grade was estimated from Copco No. 2 drawings G-3444, D-3722, and F-4261 and drawings 6043-CD-4 and F-1475 for Copco No. 1. Drawing F-1109 for Copco No. 1 also provided information on original grades but was not consistent with the other drawings so was not used. Based on this data, the original slope before construction was 0.013, slightly steeper than estimated above (note, the drawings show a much steeper slope below Copco No.2 than between Copco No.1 and No.2, 0.013 is the average)

The depth of water varies in the HEC-RAS model. If the shallowest water depth is used rather than the average, the equilibrium slope could be as high as 0.012. In this case the projected grade at Copco No. 1 Dam would be about 2 feet below estimated pre-dam channel grade.

3.0 Active Layer Thickness

The thickness of the active layer was estimated using Technical Supplement 14B Scour Calculations of the National Engineering Handbook (NRCS 2007). The active layer thickness is:

$$T = \frac{D_x}{(1-e)P_x}$$ **Equation 4**

Where:

D_x = the size of the smallest non-transportable particle present in the streambed
P_x = the fraction of bed material of a size equal to or coarser than D_x
e = the porosity of the bed material, assumed equal to 0.43

The smallest non-transportable particle in the bed was calculated using the relationship below:

$$\mathbf{D_x = K\left(\frac{yS_e}{\Delta s_g}\right)^a \left(\frac{u_*}{\nu}\right)^b}$$ **Equation 5**

Where:

y = flow depth
S_e = energy slope
Δs_g = relative submerged density of bed-material sediment 1.65
U_* = shear velocity
ν = kinematic viscosity of water
a, b, K = 0,1,17 (from Table TS14B-4 in NRCS 2007)

The values for flow depth and shear velocity were taken from the equilibrium slope calculations. The energy slope was assumed equal to the equilibrium slope.

With the above assumptions the minimum transportable particle size varied from 0.0189 to 0.219 m (0.621 to 0.719 feet) for storm events from 2-year to 100-year. The depth of the active layer varied from 5.8 to 7.5 feet.

The above analysis did not account for the presence of immobile boulders in the river. The presence of boulders will decrease the bed load transport in the river relative to what is estimated from sediment transport relationships. The over-estimation could be by several times. Neglecting the impacts of boulders on the sediment transport will result in an over estimation on the thickness of the active layer. The amount of overestimation is dependent upon the size and spatial density

of boulders in the river. Therefore, the estimation of active later thickness should be considered conservative and the actual thickness could be much less.

4.0 Depth of Removal for Cutoff Wall and Foundation

Based on the equilibrium slope and active layer thickness results, the cutoff wall should be removed to a minimum of 8 feet below grade (for the active layer thickness) and up to 18 feet below grade (for the equilibrium slope and the active layer thickness). The recommended removal depth is 20 feet below the pre-dam stream bed to elevation 2463.5 feet.

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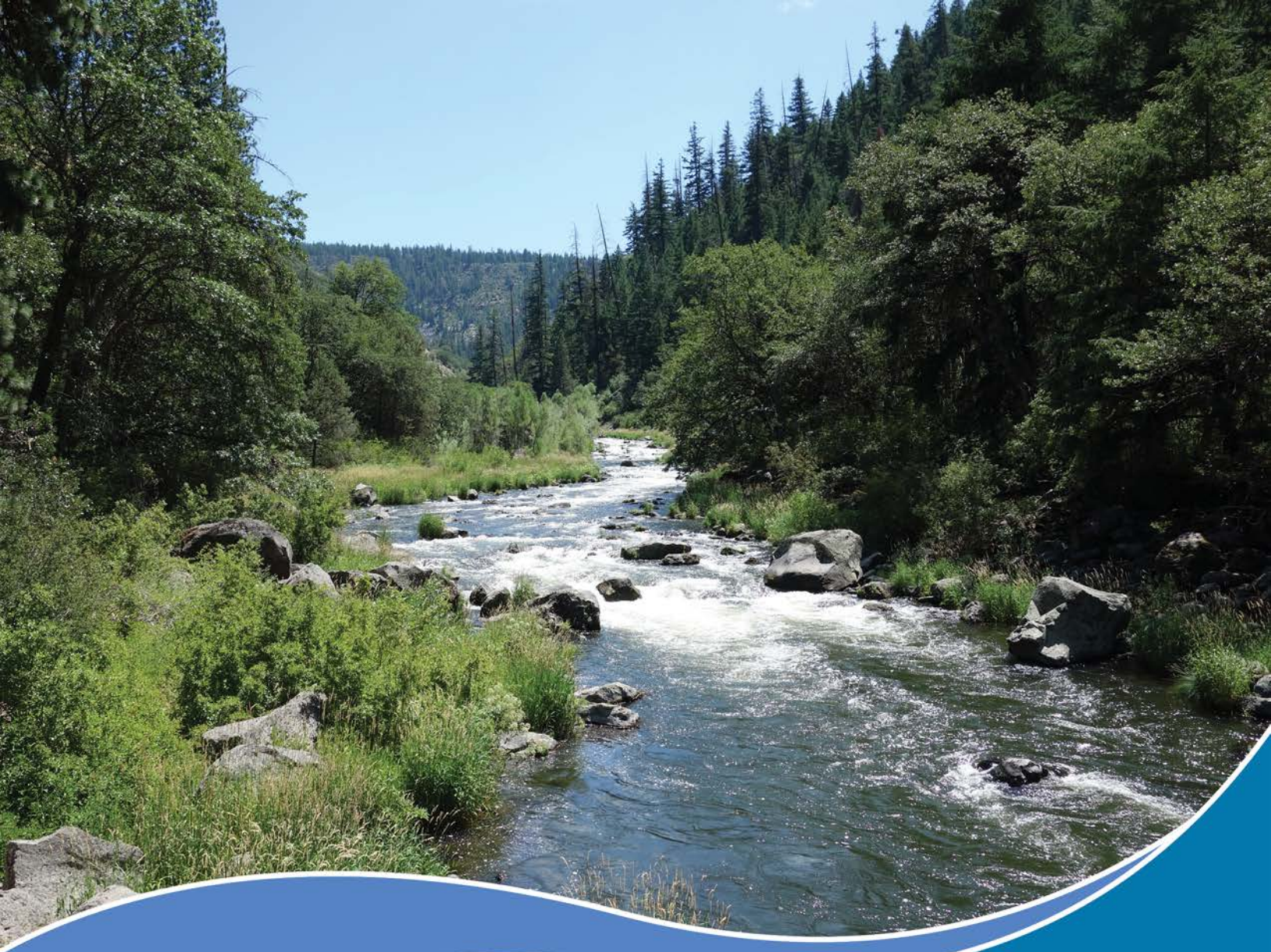

Definite Plan for the Lower Klamath Project

Appendix H – Reservoir Area Management Plan

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CORPORATION

June 2018

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Acronyms and Abbreviations

1D	one-dimensional
2D	two-dimensional
BLM	Bureau of Land Management
Cal IPC	California Invasive Plant Council
CDFW	California Department of Fish and Wildlife
cm	centimeters
CY	cubic yards

EIS/R	Environmental Impact Statement/Report
FERC	Federal Energy Regulatory Commission
ft	foot/feet
ft^3	cubic foot
GIS	geographic information system
GPS	global positioning system
H:V	horizontal to vertical ratio
IEV	invasive exotic vegetation
IPM	Integrated Pest Management
KBMP	Klamath Basin Monitoring Program
KHSA	Klamath Hydroelectric Settlement Agreement
kPa	kilopascals
KRRC	Klamath River Renewal Corporation
KRWG	Klamath Restoration Work Group
lbf/ft^2	pound-force/square foot
lbf/in^2	pound-force/square Inch
lbs	pounds
LW	large wood
NMFS	National Marine Fisheries Services
ODFW	Oregon Department of Fish and Wildlife
O.C.	On center
Pa	Pascals
PLS	pure live seed
PNA	plant nutrient availability
Q100	100-year
Q2	2-year
RM	river miles
RWQCB	Regional Water Quality Control Board
RWZ	Rocky wake zone
SDOR	Secretarial Determination of Record
USBR	US Bureau of Reclamation
USDA	US Department of Agriculture
USGS	U.S. Geological Survey

Chapter 1: Introduction and Purpose

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1. INTRODUCTION AND PURPOSE

The Klamath Hydroelectric Settlement Agreement (KHSA) signed in 2010 and updated in 2016 establishes the framework to decommission and remove four dams (Iron Gate, Copco No. 1, Copco No. 2, and J.C. Boyle) on the Klamath River as shown on Figure 1-1. Upon approval by the Federal Energy Regulatory Commission (FERC) of a license transfer application filed by PacifiCorp and the Klamath River Renewal Corporation (KRRC), and further approval by the FERC of a surrender application filed by KRRC, the dams, power generation facilities, water intake structures, canals, pipelines, and ancillary building will be removed (the Project) by the KRRC as licensee. As the Project is implemented, the reservoir areas will become exposed and require restoration and stabilization of bare sediment deposits for long-term water quality and ecological benefits, and restoration of natural river functions and processes.

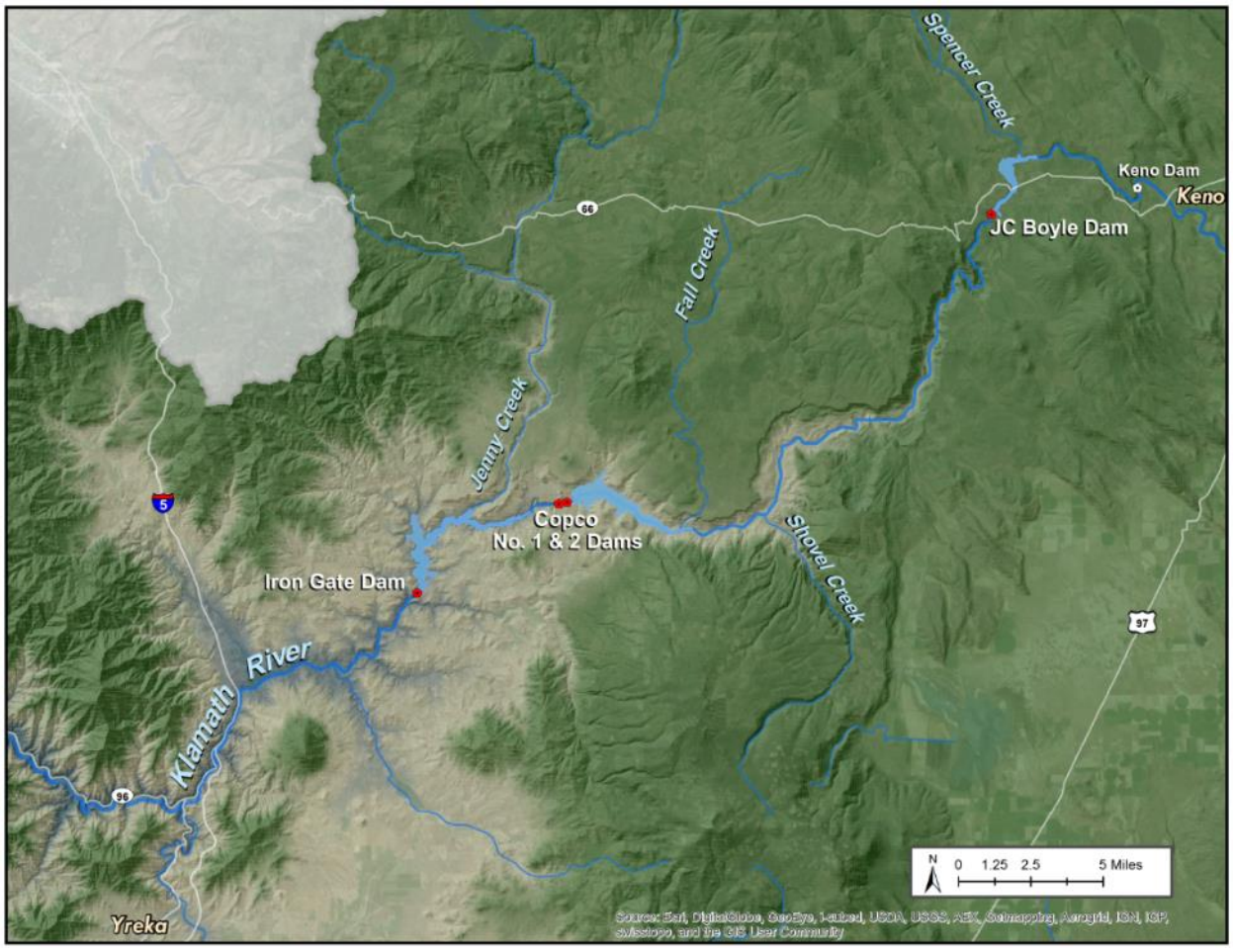

Figure 1-1 Vicinity map showing locations of Klamath River dams

As part of the 2012 Environmental Impact Statement/Report (EIS/R) and 2013 Secretarial Determination of Record (SDOR), a Reservoir Area Management Plan (USBR, 2011c) (the 2011 Plan) was developed by the Bureau of Reclamation (USBR) with assistance from the National Marine Fisheries Services (NMFS), Bureau of Land Management (BLM) and the EIS/R project team. The 2011 Plan describes anticipated conditions in the reservoir areas after removal of the four dams based on hydraulic modeling, sediment characteristics, and reservoir drawdown scenarios.

The 2011 Plan was developed primarily with the intent to minimize invasive vegetation and stabilize remaining reservoir sediments to reduce the likelihood of future sediment releases. Numerous dam removals and reservoir restoration projects have been completed since the 2011 Plan with valuable lessons learned. Likewise, additional testing has been performed with the reservoir sediments and current restoration techniques that can be incorporated into the Project to improve reservoir restoration success. Hence, this Reservoir Area Management Plan (RAMP) incorporates current restoration practices and techniques. The primary purposes of updating the 2011 Plan through this RAMP is threefold:

1. Update the goals and objectives to better match current stakeholder and regulatory requirements;
2. Include current knowledge base and lessons learned from other dam removal and restoration projects; and
3. Include details and information that were not fully developed in the 2011 Plan.

The remainder of this report follows the outline below:

1. Project goals and objectives;
2. Historical and existing conditions in the reservoir areas;
3. Anticipated reservoir conditions after dam removal;
4. Reservoir area restoration; and
5. Monitoring and adaptive management.

Chapter 2: Reservoir Area Management Goals and Objectives

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2. RESERVOIR AREA MANAGEMENT GOALS AND OBJECTIVES

KRRC convened a working group of, regulatory, tribal, and consulting professionals, the Klamath Restoration Work Group (KRWG) to provide expert knowledge and recommendations for updating the 2011 Plan. The KRRC Technical Representative led the KRWG. KRRC held two workshops in 2017 and a consensus recommendation was to update the goals and objectives based on current knowledge of restoration and experience from recent dam removal and restoration plans. Table 2-1 provides a summary of goals and objectives of this RMAP.

Table 2-1 Updated goals, objectives, and restoration activities for reservoir restoration

Period	Goal	Objective	Restoration Activity
Pre-construction Period	Prepare native plant materials for revegetation.	Collect and propagate native plant seed and grow container plants.	Identify potential seed collection, seed propagation, pole harvest cutting areas, and container plant grow contractors.
			Perform surveys to identify and map seed collection and pole harvest areas.
			Prepare seed collection, seed propagation, container plant growing, and pole harvest contract documents.
			Award and monitor native plant and seed contracts.
			Develop revegetation contract documents.
	Reduce invasive exotic vegetation (IEV).	Reduce and minimize the local sources of IEV.	Gather existing IEV data and perform IEV surveys.
			Review potential herbicides and potential impact on fish and water quality.
		Implement an IEV management program	Create management plan and review with stakeholders.
			Procure local contractor to perform IEV removal.
			Inspect and monitor IEV removal execution.
	Understand likely evolution of reservoirs post-removal and responses to restoration and reservoir management.	Conduct studies to fill in data gaps from 2011 Reservoir Area Management Plan	Sample sediment and perform tests to investigate wetting and drying characteristics, plant nutrient availability, and natural revegetation potential.
			Perform revegetation pilot tests for native seed mixes.
			Identify reference physical and ecological conditions in tributaries.

Period	Goal	Objective	Restoration Activity
	Maximize reservoir area restoration for ecological uplift.	Develop comprehensive restoration plan for post-removal reservoir conditions.	Actively promote erosion of reservoir deposits during drawdown, use available techniques such as barge mounted hydraulic monitors or boats.
			Modify and enhance site specific restoration actions based on site conditions after drawdown.
			Identify culturally significant areas that are off limits to disturbance.
			Develop final engineering plans for implementation.
Dam removal period (0 to 1 year)	Allow natural erosion and transport of reservoir deposits and dispersal in the ocean.	Maximize erosion of reservoir deposits during drawdown.	Prepare and amend sediment based on pilot test plot results.
	Evaluate active restoration options (post-removal) for habitat development.	Determine locations amenable to site specific restoration actions.	Install irrigation system.
			Hydroseed sediment by planting zones.
			Install pole cuttings, acorns, and container plants.
	Stabilize remaining reservoir sediments.	Initiate native plant revegetation.	Conduct field monitoring of mainstem/tributaries, fix non-natural barriers.
			Include criteria for IEV removal during revegetation implementation.
			Bi-weekly inspections of revegetation areas to verify IEV compliance.
			Actively promote erosion of reservoir deposits during drawdown, use available techniques such as barge mounted hydraulic monitors or boats.
	Restore volitional fish passage in mainstem and tributaries.	Monitor and rectify any non-natural fish passage barriers.	Conduct field monitoring of mainstem/tributaries, fix non-natural barriers.
	Minimize IEV.	Implement and monitor IEV removal during revegetation.	Include criteria for IEV removal during revegetation implementation.
			Bi-weekly inspections of revegetation areas to verify IEV compliance.
Short-term (1 to 5 years after removal)	Restore natural ecosystem processes.	Continue native plant revegetation, maintenance and monitoring	Monitor establishment and adaptively replace failed pole cuttings, acorns, and container plants.
			Maintain irrigation system.
			Re-seed poorly established areas.
	Implement process-based river and tributary restoration actions where applicable.	Increase quantity and quality of in-stream and off-channel habitat for aquatic species.	Construct in-stream habitat features based on engineered designs that are appropriate for the system.
			Construct off-channel wetlands, side channels, and alcoves where appropriate.
			Enhance mid-channel gravel bars.

Period	Goal	Objective	Restoration Activity
	Minimize IEV	Continue IEV monitoring and removal.	Include criteria for IEV removal during establishment.
			Perform monthly inspections to verify IEV removal compliance.
	Restore volitional fish passage in mainstem and tributaries.	Monitor and rectify any non-natural fish passage barriers.	Conduct field monitoring of mainstem/tributaries, fix non-natural barriers.
Long-term (5 to 10 years)	Restore natural ecosystem processes.	Continue revegetation monitoring and adaptive management.	Monitor establishment and adaptively replace failed pole cuttings, acorns, and container plants.
	Monitor and maintain restoration features.	Ensure habitat restoration features are functioning as planned.	Field based monitoring throughout reservoir areas where restoration features were installed.
	Minimize IEV.	Continue IEV monitoring and removal.	Perform quarterly site inspections and verify compliance.
	Restore volitional fish passage in mainstem and tributaries.	Continue monitoring for non-natural fish passage barriers.	Remove all non-natural fish passage barriers.

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Chapter 3: Historical and Existing Conditions

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3. HISTORICAL AND CURRENT CONDITIONS

Conditions at the J.C. Boyle, Copco No. 1, and Iron Gate reservoirs were well documented prior to construction of the dams. Topographic surveys were conducted prior to dam construction and there are photos of pre-dam conditions and the construction of each dam. The following sections describe the physical and ecological conditions of each reservoir area prior to dam construction and the current reservoir conditions. The Copco No. 2 reservoir area is relatively small and is not discussed in this updated plan as it will readily transition back to pre-dam conditions without active restoration.

3.1 J.C. Boyle

KRRC subdivides discussion of the J.C. Boyle Reservoir into two reaches based on valley morphology and geomorphic features mapped prior to dam construction in 1958. The Canyon Reach extends from J.C. Boyle Dam to Highway 66 bridge (U.S. Geological Survey [USGS] river miles [RM] 230 to 231) and the Upstream Reach runs from the Highway 66 bridge to the upstream extent of the J.C. Boyle Reservoir (RM 231 to 233) (Figure 3-1).

3.1.1 Historical Conditions

In the Canyon Reach, the Klamath River was historically incised several tens to hundreds of feet into the surrounding volcanic bedrock to form a deep, narrow valley (Figure 3-1). The narrow valley contained limited space for sediment storage, and accordingly there are no mapped historical geomorphic features (USBR, 2011c). The Klamath River was single threaded with significant exposures of bedrock on the river bed and banks that limited channel adjustment. There is little evidence of bedform development, and most in-channel sediment visible in photos is boulder- or cobble-sized (e.g., Figure 3-2 and Figure 3-3). Rapids that were likely bedrock-controlled are visible upstream of RM 230 and downstream of the Highway 66 bridge (Figure 3-2). At RM 230, an unnamed tributary enters from river left, and the historical valley widens (Figure 3-1). The narrow width of the 2-year and 100-year flood extents demonstrates the confined nature of the Canyon Reach (Figure 3-1). Ponderosa pines occupied upland hillsides adjacent to the river, but the bedrock banks of the riparian corridor were sparsely vegetated primarily with shrubs and grasses. There is little photographic evidence of large wood (LW) accumulations in the channel, which is consistent with low tree recruitment and the high velocities and lack of accommodation space that restricted sediment accumulation and created exposed bedrock in the reach.

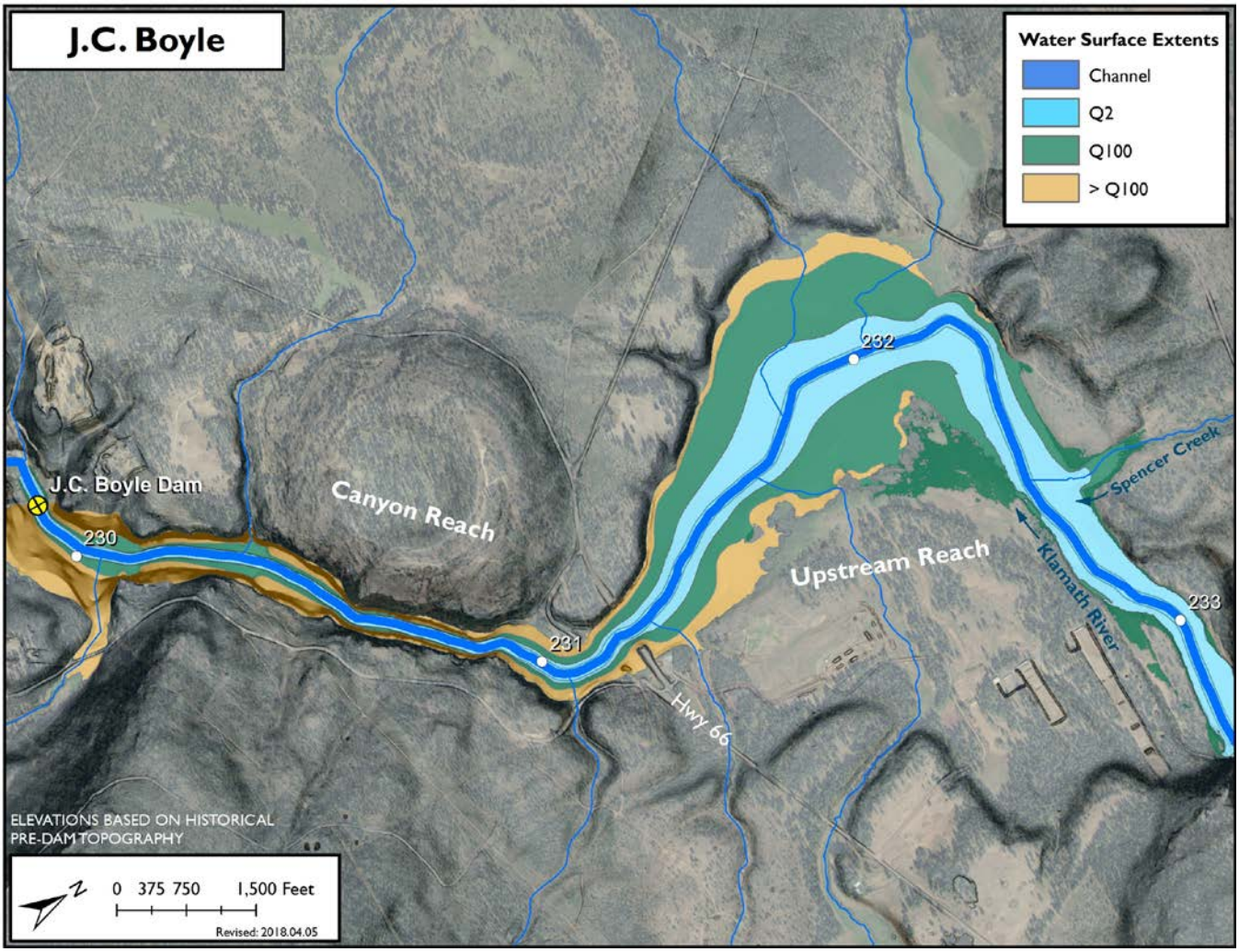


Figure 3-1 Slopeshades of bare earth LiDAR overlaid with aerial imagery and historical topography of J.C. Boyle Reservoir area with flood inundation boundaries for the 2-year (Q2) and 100-year (Q100) floods. Reach designations and river miles are noted.

The Upstream Reach occupies a wide, low relief area as the river abruptly exits the steep, narrow bedrock canyon upstream of RM 233 (Figure 3-1). Bedrock control is visible on river right approximately 1,000 feet (ft) upstream of RM 232 where the Klamath River abruptly turns south, but otherwise the pre-dam channel was primarily alluvial. The valley geometry promoted sediment accumulation and there were alluvial fans and terraces mapped on both sides of the Klamath River (USBR, 2011c). A nearly 1 mile wide alluvial fan and terrace was mapped on river-right around RM 232 and was likely formed by distributary deposition from several unnamed tributaries that would have migrated across the deposit surface. The primary tributary, Spencer Creek, enters the reservoir from the north 0.5 miles downstream of RM 233 and was associated with a mapped floodplain and alluvial fan (USBR, 2011c). The Klamath River actively modified its channel as suggested by the extensive mapped floodplains and the vegetated and unvegetated bars, including a large semi-vegetated, mid-channel bar upstream of the Highway 66 Bridge (Figure 3-2). Most of the current

reservoir was shallowly inundated during high flows (Figure 3-1) as a result of the low floodplain gradient and the small bank heights of the historical river. Ponderosa pine forest dominated upland areas in the Upstream Reach, but woody vegetation was sparse to non-existent in the areas of the mapped geomorphic features. These areas were cleared of trees for agricultural use and wood production. No LW was visible in the active channel. Wetland conditions were likely supported in Spencer Creek, which had a multi-threaded distributary character in its lower sections.



Highway 66 bridge crosses the Klamath River in current location. Flow is top to bottom. Dam location is out of frame to the bottom left.

Figure 3-2 Aerial photo of J.C. Boyle Reservoir area (1952) prior to dam construction

3.1.2 Current Conditions

Current conditions in the J.C. Boyle Reservoir vary considerably between the two reaches. The reservoir is narrow with low sinuosity in the Canyon Reach with reservoir water depths increasing from approximately 10 ft at the Highway 66 bridge to maximum values around 35 ft at the unnamed tributary junction 1,000 ft upstream from the dam. In the Upstream Reach, water depths are near zero for all but the historical channel footprint where depths are typically 10 to 15 ft with maximum values of 20 ft within the deep pool at the river right bedrock control.

J.C. Boyle Dam impounds an estimated 990,000 ± 300,000 cubic yards (CY) of fine-grained sediment, a large fraction of which is dead algae and other organic material (USBR, 2011c). Most of the sediment volume is stored in the Canyon Reach, where sediment thicknesses increase from 0 to 2 ft at the Highway 66 Bridge to maximum values of 20 ft near the dam (USBR, 2011c). The sediment in this reach is, on average, 50% silt, clay 40%, and 10% sand. The accumulated reservoir sediment deposit in the Upstream

Reach is primarily confined to the historical channel where it is typically less than 4 ft thick except for a 1,000 ft section around RM 231.75 where thicknesses of 8 to 10 ft filled the local low topography. Little to no reservoir sediment is stored outside of the historical channel in the Upstream Reach. As expected, the Upstream Reach sediment is coarser than downstream and is approximately 55% sand, 25% silt, and 20% clay on average (USBR, 2011c). In the Upstream Reach, the reservoir sediments are underlain by a 0 to 2 ft thick layer of coarser Quaternary alluvial gravel and sand, which is in turn underlain by fine-grained, but resistant, weathered Tertiary volcanics (USBR, 2010). Intact organic fragments (e.g., roots, twigs, bark, and wood) were only found at the pre-reservoir contact in three of the cores (USBR, 2010). The accumulated in-situ reservoir sediment in both reaches has high moisture content over 100% with low cohesion, low strength, and high erodibility (USBR, 2011c). The measured friction angle for the reservoir sediments from a sediment core near the dam site is approximately 30 degrees.

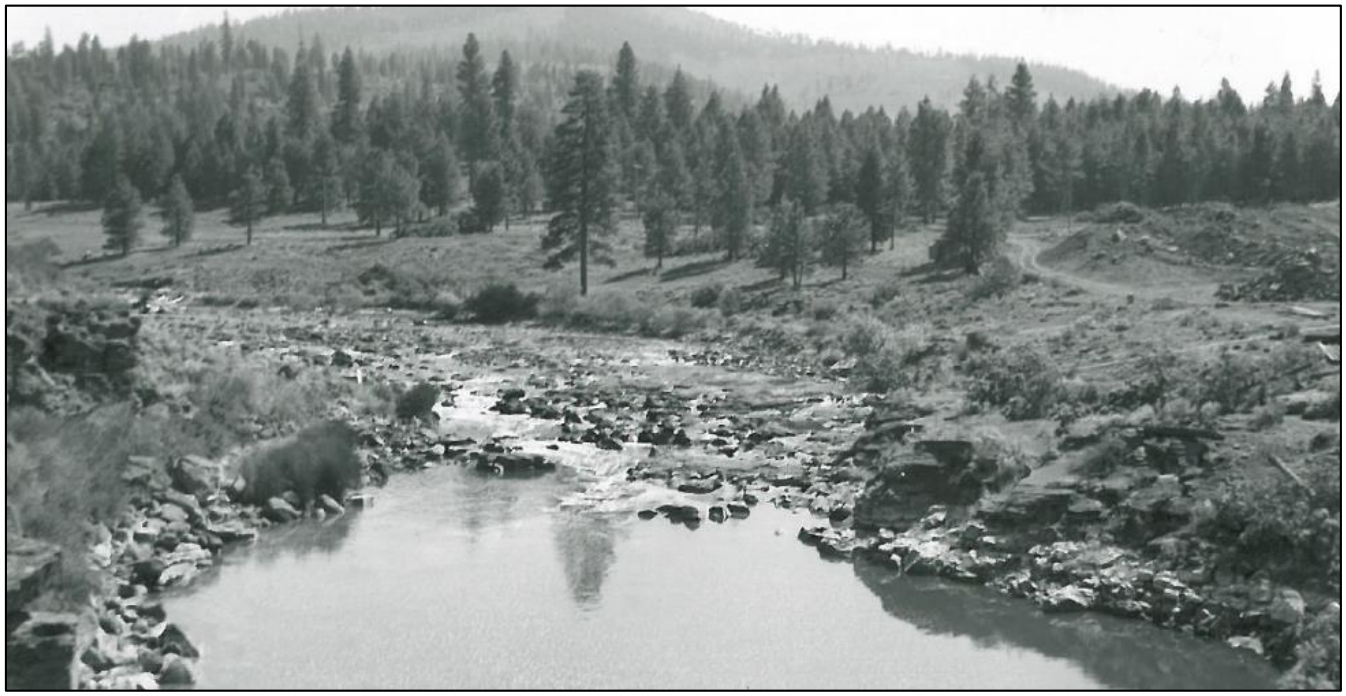


Figure 3-3 View looking upstream at location where J.C. Boyle Dam was constructed in 1957 with view of historical vegetation and geomorphology

Upland vegetation type and distribution around both reaches of the J.C. Boyle Reservoir is similar to pre-dam conditions and is dominated by ponderosa pine. Wetland conditions exist at the mouths of the Upstream Reach tributaries, notably Spencer Creek. The wide, shallow reservoir margins of the Upstream Reach experience seasonal fluctuations in water level. Assorted native grasses were observed, primarily along the river right bank of the Upstream Reach reservoir (USBR, 2011c). Conifers were mapped along the full margin of the reservoir, with the highest concentrations along the west bank of the Upstream Reach. Rushes and reed canary grass were mapped primarily along the river left/east bank of the Upstream Reach. Willow species were largely absent except for a few places near Highway 66.

At J.C. Boyle, average daily minimum temperatures are below freezing from November until May, and average daily maximum temperatures are over 80 deg. F. in July and August (Figure 3-4). Ice often forms on the reservoir during winter. Extreme warm temperatures do not typically exceed 100 deg. F. Precipitation is greatest during the winter months. Average monthly precipitation amounts in July and August, when temperatures are hottest, are 0.34 and 0.45, respectively.

3.2 Copco No. 1

KRRC subdivides discussion of the Copco No. 1 Reservoir into two reaches based on valley morphology and geomorphic features mapped prior to dam construction in 1918. The Downstream Reach extends from Copco No. 1 Dam to the historical Deer Creek confluence at RM 205, and the Upstream Reach extends from RM 205 to the upstream extent of the reservoir near RM 208 (Figure 3-5).

3.2.1 Historical Conditions

Historically, the Klamath River within the Copco No. 1 was a sinuous, bedrock meandering river inset within lithified fluvio-lacustrine bedrock. The channel was single-threaded except where flow was split by bedrock islands at RM 202, 203, and 204 (Figure 3-5). The historical valley bottom was relatively wide compared to reaches of the Klamath River downstream of the dam (e.g., historical Iron Gate reservoir valley) and upstream of the reservoir. The wide and flat valley morphology was the result of aggradation caused by the damming of the ancestral Klamath River by the Copco basalt, a 140,000 year old lava flow (Hammond, 1983). The dam was built into this volcanic unit, which continues to constrict the Klamath River and form the canyon walls downstream of RM 202. These lava flows created an ancestral lake approximately 130 ft deep at its maximum (35 to 40 ft above modern lake level) that occupied approximately 5 miles of the Copco valley upstream of RM 202. Tens of feet of diatomite, which is a porous and friable biochemical sedimentary rock formed from the lithification of silica diatom shell accumulations, was deposited while the lava dam was intact to create a relatively flat ancestral lake bed in a similar footprint to the current reservoir. Diatomite is similar to chalk, but is formed from silica, rather than carbonate, and is typically coarser grained in the silt to sand size class (0.01 to 0.2 mm).

The Klamath River incised into the ancestral lake bed after the lava dam was breached and formed the bedrock meandering valley visible in the historical pre-dam topography. This pre-dam topography was characterized by the flat ancestral lake bed, which is perched up to 50 ft above the historical channel, and asymmetric channel-valley cross-sections, which comprise steep to vertical diatomite banks on the outsides of bend and more gradual alluvium-draped slip-off slopes on the insides of the meanders, morphology which is indicative of vertical and lateral erosion proceeding in tandem (e.g., RM 202.5 in Figure 3-5). The diatomite, which is fine-grained but resistant to erosion and capable of supporting vertical slopes where it is exposed on the outsides of bends, likely underlies much of the historical valley floor with maximum thicknesses (measured from tops of bluffs to ancestral valley floor) on the order of 10–100 ft in the downstream-most reaches. Diatomite bluffs ten or more feet in height were present on the outsides of meander bends upstream until at least RM 205 (Figure 3-5, Figure 3-6). The grade of the historical Klamath River in the reservoir area appeared to be controlled by bedrock outcrops, likely the Copco basalt, at the

narrow entrance to Ward's Canyon, several hundred feet upstream of the Copco No. 1 Dam location (Figure 3-7).

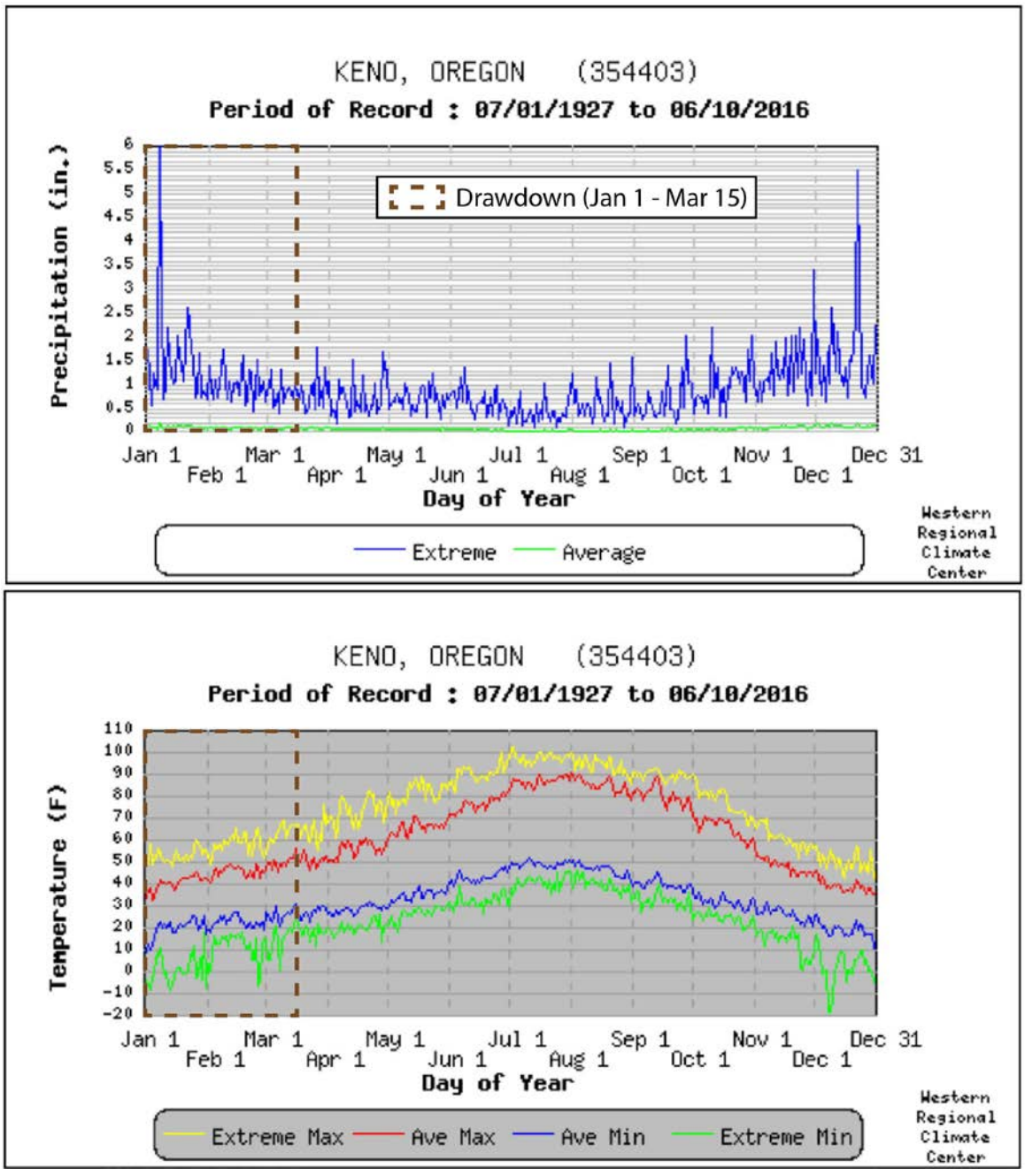


Figure 3-4 Daily temperature (top) and precipitation (bottom) data from nearby Keno, Oregon weather station. Data from Western Regional Climate Center.

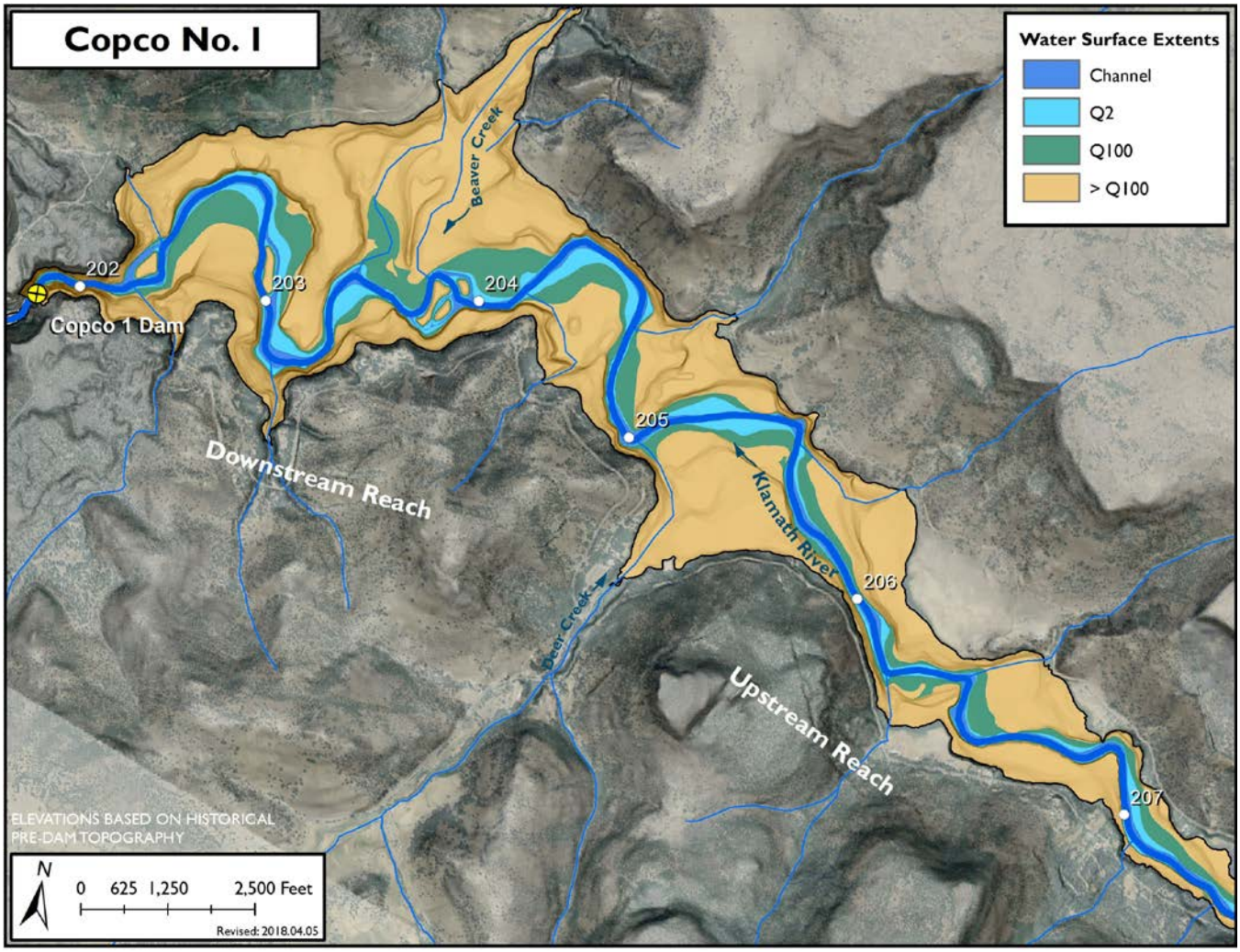
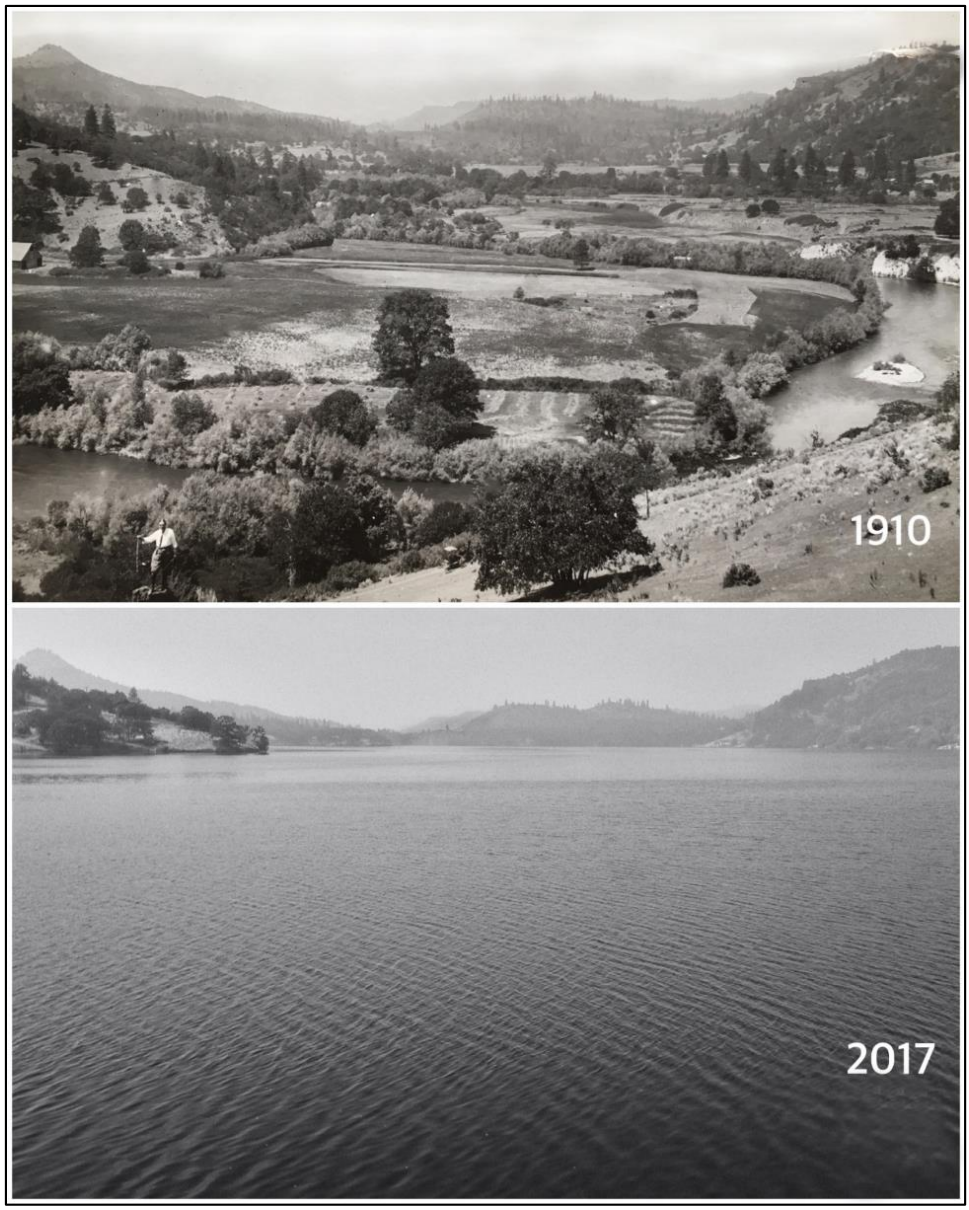


Figure 3-5 Slopeshades of bare earth LiDAR overlaid with aerial imagery and historical topography of Copco Reservoir area with flood inundation boundaries for the 2-year (Q2) and 100-year (Q100) floods.

The historical channel was actively inundating and modifying its narrow floodplain and eroding its diatomite banks as evidenced by the mapped flood inundation boundaries and the presence of a large cut-off meander loop of the mainstem Klamath River occupied by historical Beaver Creek at the time of dam construction (Figure 3-5). Swales, side channels, remnant meanders, and additional floodplain complexity are noted on the 1906 topographic map (Figure 3-8) and visible in the bathymetry (Figure 3-9). However, the large areal extent of the reservoir that is not inundated by the Q100 demonstrates the degree of valley confinement in the reach (Figure 3-5). The degree of alluviation in the historical channel is uncertain. Sand and trace gravel deposits were observed in several of the cores (USBR, 2010), and the channel was eroding diatomite to actively meander, which implies abrasion by sediment tools (Sklar and Dietrich, 2004). Point bars are not noted in historical photos or descriptions, and it is not clear if the vegetated mid-channel island (RM 204.5) visible at the right side of Figure 3-6 is composed of alluvium, diatomite, or a combination.



1910 is prior to dam construction (top photo) showing existing vegetation and land use in the reservoir area. Bedrock/valley fill is exposed in the right bank. A sequence of two mapped alluvial terraces are located on river left in the center of the photograph and bottom photo shows current conditions in 2017.

Figure 3-6 Historical photo of Copco Lake area, 1910 and 2017

The valley bottom was inhabited by humans prior to dam construction and orchards and ranchlands covered much of the land surface with evidence of widespread land clearing. Oak, juniper, and pine groves are visible in photos (Figure 3-6) and marked on the survey maps (Figure 3-8). Riparian vegetation along the mainstem, tributaries, smaller side-channels, and floodplain swales consisted primarily of willows, tule, and brush. Upland vegetation was a mix of oak, pine, juniper, and fir. Prior to dam construction, it appears the valley bottom was cleared of larger trees (e.g., pine) for agricultural purposes.



Figure 3-7 1910 photo looking downstream into Wards Canyon prior to dam construction. Bedrock grade control is visible in the center of the photo.

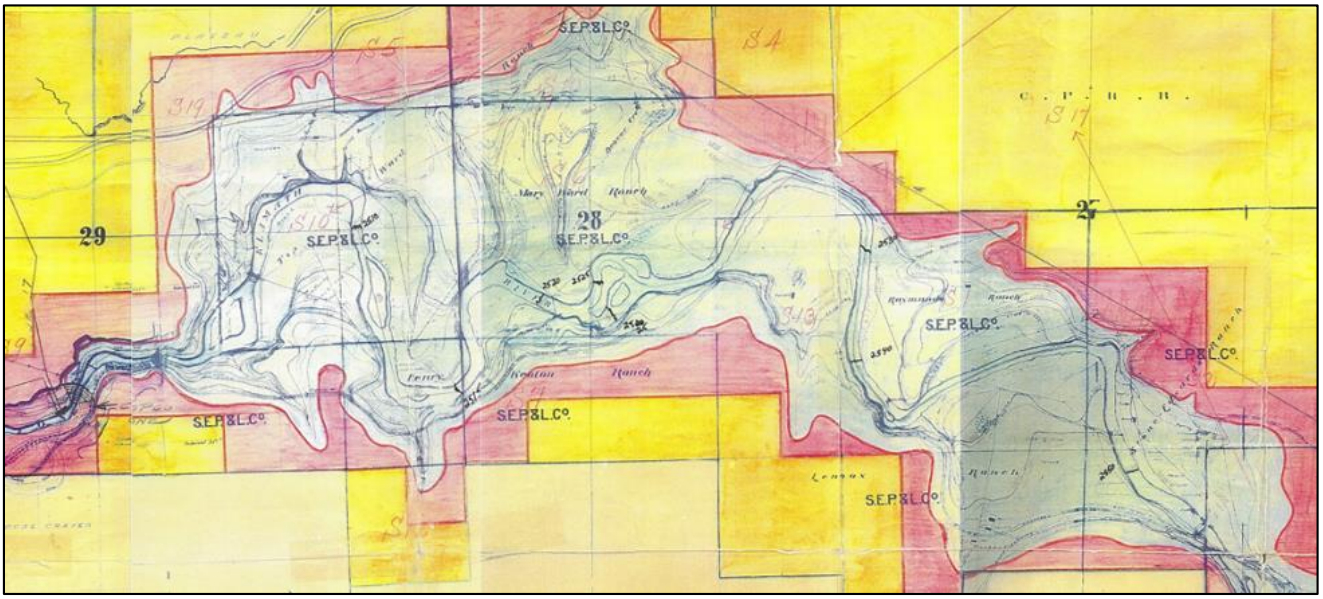


Figure 3-8 Topographic survey and field notes from 1906 survey of Copco Lake area.

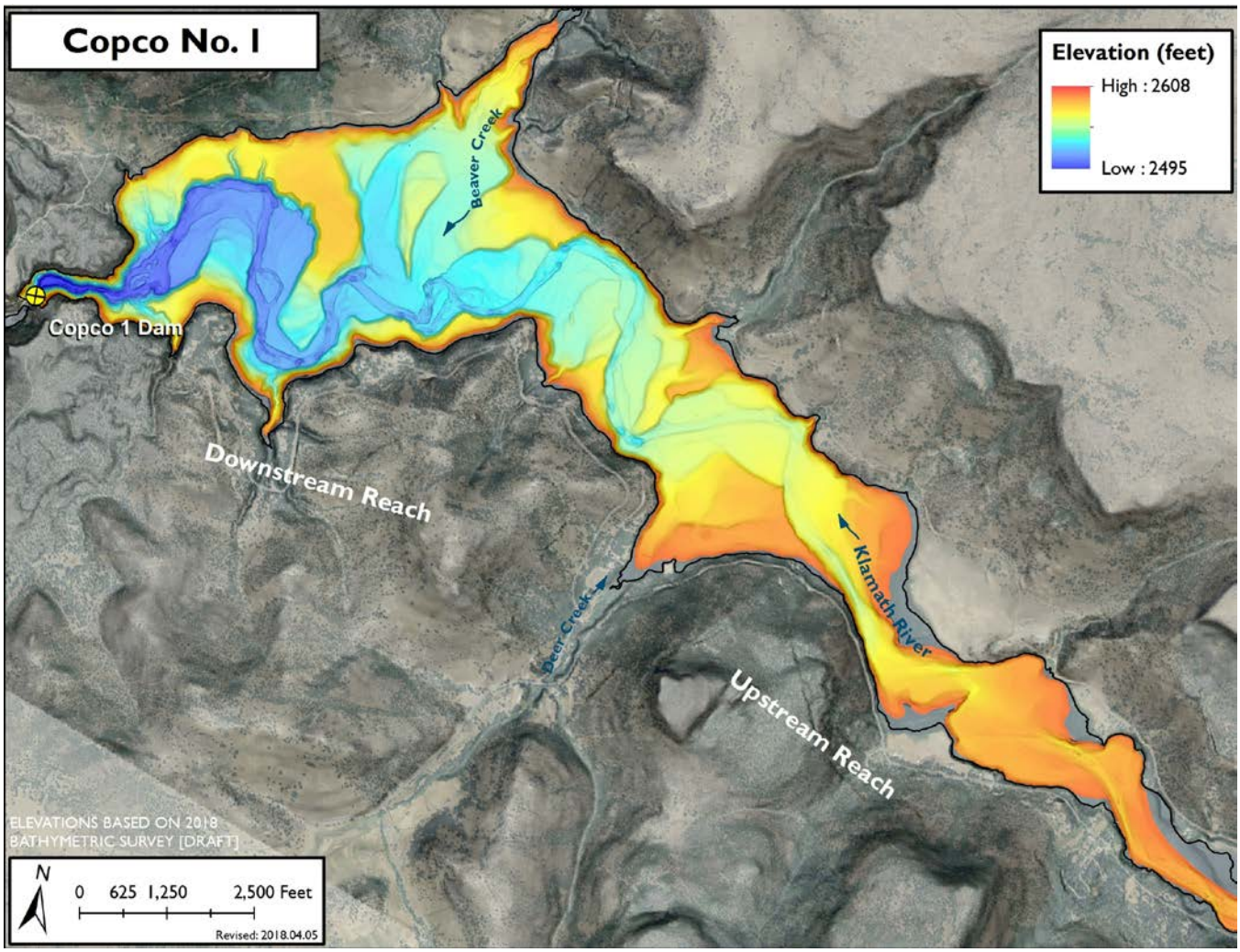


Figure 3-9 Slopeshades of bare earth 1 m LiDAR overlaid with aerial imagery and 2018 1-m bathymetry of Copco Reservoir area.

3.2.2 Current Conditions

Current physical conditions in the Copco No. 1 Reservoir generally vary with distance upstream from the dam and additional cross-sectional variability is due to the historical meandering valley geometry. Reservoir width and maximum depths decrease with distance upstream from the dam with maximum depths located in the historical channel of 100 ft and 60 ft at the dam site and at RM 200, respectively. In the Downstream Reach, shallower depths are present on the ancestral lake bed surfaces. Upstream of RM 201, depths are relatively uniform and are 10 ft or less. Bedrock cliffs, some formed by post-dam erosion of volcaniclastic rocks and diatomite, line portions of the reservoir margin.

Copco No. 1 Dam impounds an estimated 7.44 million ± 1.50 million CY of fine-grained sediment that contains a significant fraction of dead algae and other organic material (USBR, 2011c). Sediment thicknesses decrease longitudinally with distance upstream from the dam and decrease laterally with increasing elevation above the historical channel (USBR, 2011c). Maximum deposit thicknesses are 10 to 12 ft immediately upstream from the dam. Deposit thicknesses are 6 to 10 ft in the historical floodplain (i.e., the Q100 footprint) downstream of RM 206. In the Downstream Reach, the reservoir sediment is, on average 55% clay, 35% silt, and 10% sand (USBR, 2011c), and is underlain at the pre-dam contact by varying concentrations of fluvial sand and trace gravels (USBR, 2010) and a thick layer of fine-grained, but resistant, diatomite. In the Upstream Reach, the coarser reservoir sediment comprises approximately 30% clay, 45% silt, and 25% sand on average (USBR, 2011c) and is similarly underlain by varying concentrations of fluvial sand and trace gravels (USBR, 2010) and a thinner layer of diatomite. Intact organic fragments (e.g., roots, twigs, bark, and wood) were only found at the pre-reservoir contact in a single core (USBR, 2010). The in-situ reservoir sediments in both reaches have high moisture contents of nearly 300% with low cohesion, low strength, and high erodibility (USBR, 2011). The measured friction angle from a sediment core approximately 1 mile upstream from the dam is approximately 27 degrees.

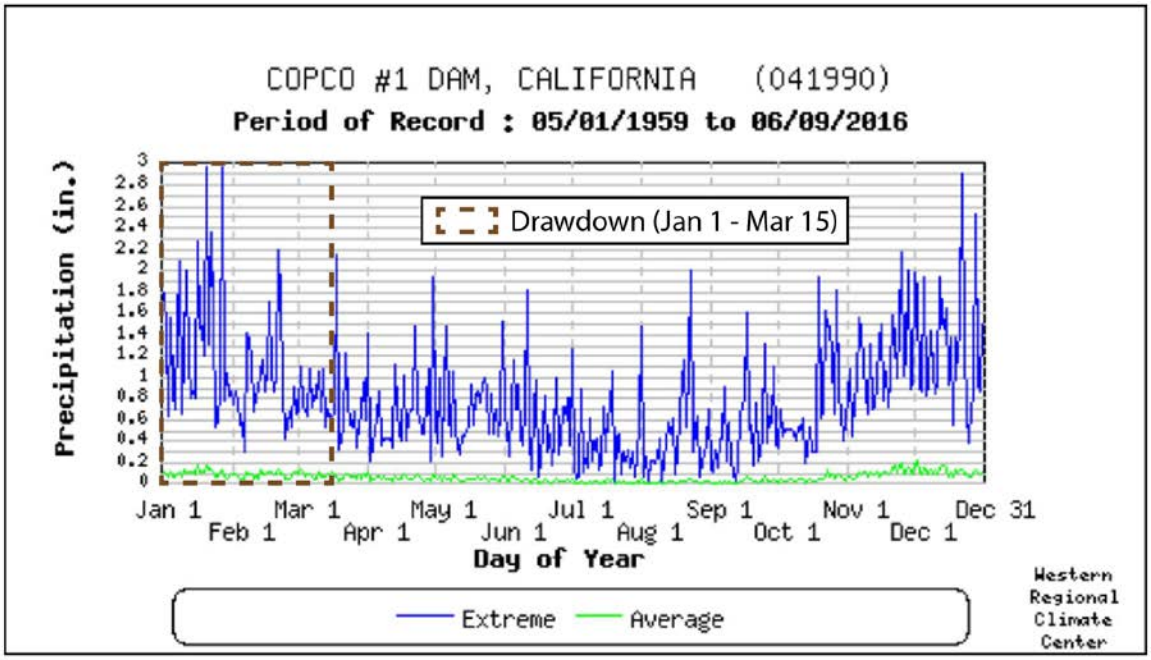
Climate conditions at Copco No. 1 (Figure 3-10) are warmer than J.C. Boyle. Average daily minimum temperature is similarly below freezing from November to May, but temperatures do not reach as low as at J.C. Boyle. The average maximum daily temperature is hotter with temperatures above 90 deg. for July and August. Precipitation is greater in the winter and summers are typically dry. Mean monthly precipitation amounts in July and August, when temperatures are hottest, are 0.88 and 0.36 inches, respectively.

3.3 Iron Gate

KRRC subdivides discussion of the Iron Gate Reservoir into two reaches based on the location of primary tributaries and geomorphic features mapped prior to dam construction in 1962. The Downstream Reach extends from Iron Gate Dam to upstream of the Camp Creek confluence/Mirror Cove arm of the reservoir near RM 195, and the Upstream Reach extends upstream from RM 195 to the upstream extent of the reservoir at RM 199 (Figure 3-11).

3.3.1 Historical Conditions

Prior to dam construction, the Klamath River was a single-thread channel with low to moderate sinuosity that occupied a deep, narrow, and symmetric valley incised into a complex set of intrusive rock, Tertiary volcaniclastic rocks, and younger basaltic and andesitic lava flows that outcrop in many of the ridges adjacent to the channel. Much of the channel bed was composed of coarse sediment that was sourced from adjacent hillslopes and bedrock exposures and formed rapids in the steep and swift reach. Physical conditions (e.g., cross-sectional valley geometry, channel dimensions and characteristics) in the Iron Gate reach were relatively uniform longitudinally, except locally at tributary junctions. Several larger tributaries (Fall Creek, Jenny Creek, and Camp Creek) contributed appreciable sediment to the mainstem and mapped geomorphic features were coincident with the confluences (USBR, 2011c). Figure 3-12 shows construction of the Iron Gate Dam and conditions upstream of the dam.



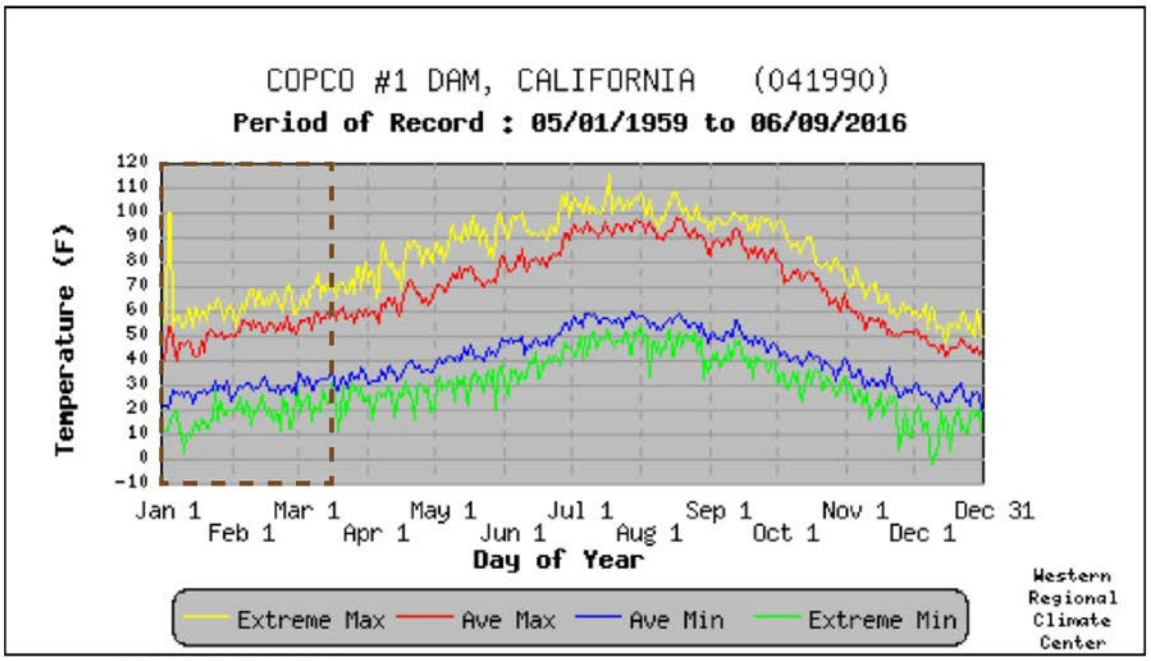


Figure 3-10 Daily temperature (top) and precipitation (bottom) data from Copco #1 Dam, California weather station. Data from Western Regional Climate Center.

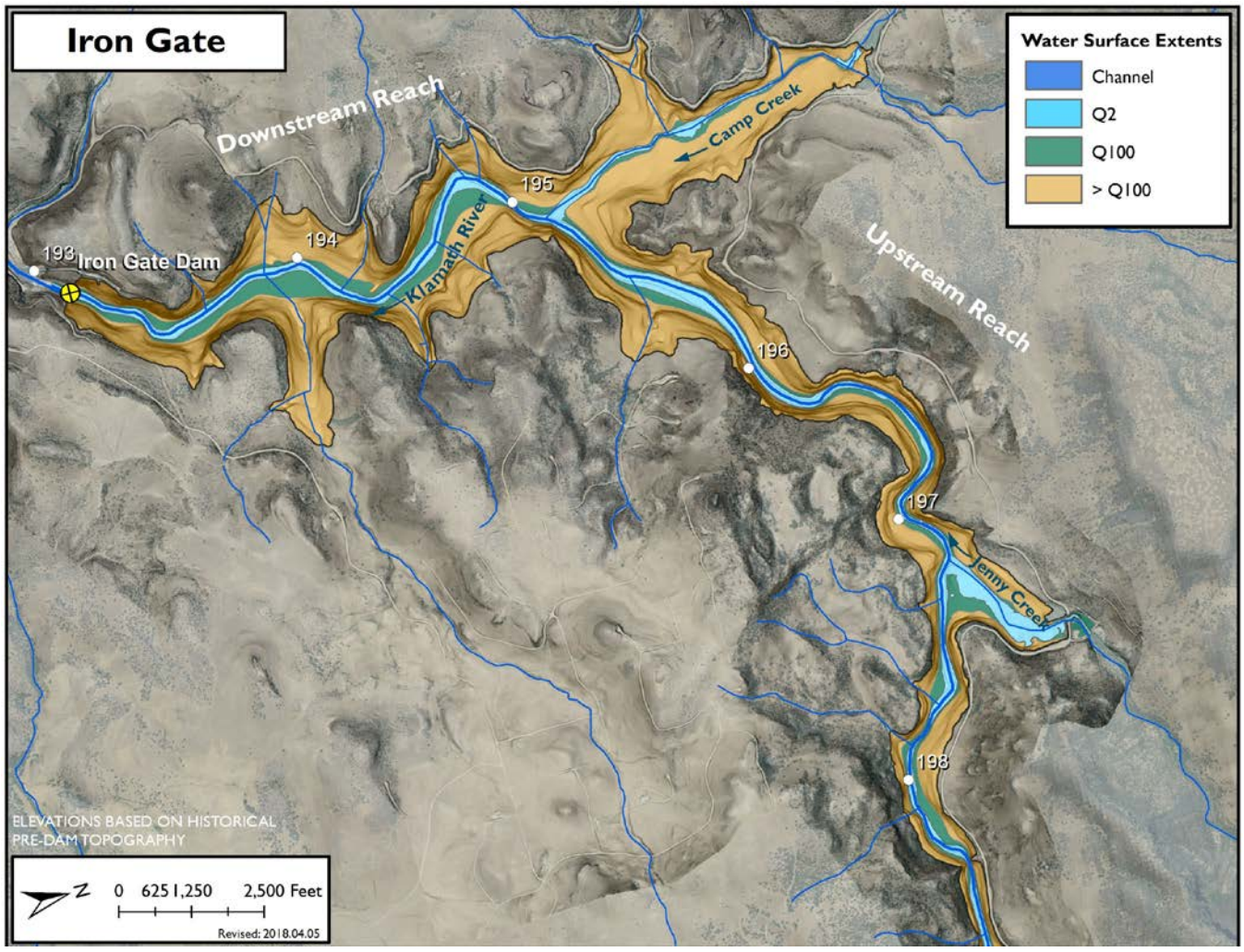


Figure 3-11 Slopeshades of bare earth LiDAR overlaid with aerial imagery and historical topography of Iron Gate Reservoir area with flood inundation boundaries for the 2-year (Q2) and 100-year (Q100) floods.

In the Downstream Reach, Camp Creek, which flows into the present-day Mirror Cove, likely contributed a considerable amount of sediment to the mainstem (USBR, 2010), and there was a large alluvial fan at the historical confluence (Figure 3-13). Camp Creek is vertically incised nearly 10 ft into the fan surface. Downstream of the Camp Creek confluence at RM 195, there was an increased frequency of mapped alluvial terraces, fans, floodplain, and unvegetated bars along the mainstem channel (USBR, 2011c), and the width of the Q100 inundation extent increased accordingly (Figure 3-11). These geomorphic features were longitudinally extensive, but typically limited to 1 to 2 channel widths in lateral extent due to the confined nature of the valley. Rapids were visible in photos at several locations coincident with the wider 100-year floodplains. Anthropogenic disturbance, including mining and road construction, is visible in the bathymetry on the river-left floodplains at RM 194 and RM 195 (Figure 3-13).



Figure 3-12 Photo of Iron Gate Dam during construction and showing reservoir area.

In the Upstream Reach, geomorphic features were largely absent from RM 195 to RM 198, with a notable exception at the confluence with Jenny Creek, which likely contributed a substantial amount of sediment (USBR, 2010), judging by its large contributing area and the volume of sediment it deposited in Iron Gate Reservoir. The channel and floodplain were narrow and topographically confined as indicated by the narrow flood extent widths (Figure 3-11). Near RM 199 and downstream of the Fall Creek confluence, the valley bottom widened, and there was a sequence of mapped alluvial fans and terraces (USBR, 2011c). Prior to dam construction, upland vegetation consisted of grasses with dominant tree species of oak and juniper. Tree concentrations were sparse on southern aspects and considerably thicker on northern aspects and in tributary valleys. A narrow band of willows, tule, and other species lined the riparian zone.

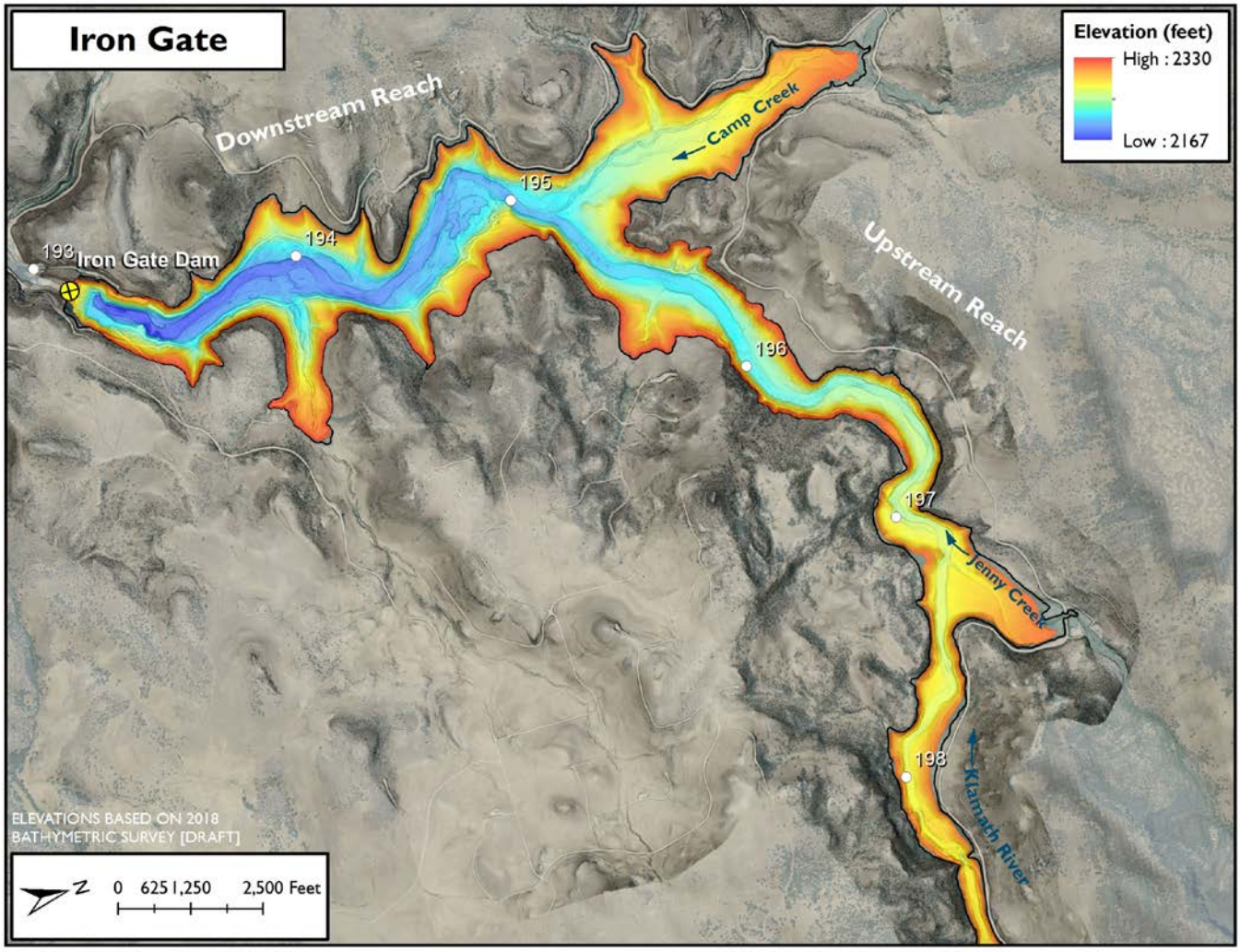


Figure 3-13 Slopeshades of bare earth 1-m LiDAR overlaid with aerial imagery and 2018 30 cm bathymetry of Iron Gate Reservoir area. River miles and reach designations are noted.

3.3.2 Current Conditions

The Iron Gate Reservoir geometry is consistent with inundation of a cross-sectionally uniform, deep, and narrow canyon, whereby reservoir width and water depth decrease with distance upstream from the dam, except at tributary valleys where the reservoir widens into coves. Iron Gate Reservoir is the deepest of the three reservoirs with maximum water depths of 150 ft near the dam (Figure 3-13).

Iron Gate Dam impounds an estimated 4.71 million ± 1.30 million CY of fine-grained sediment, which has the highest clay content and thinnest deposits of the three reservoirs and a high concentration of dead algae and organic matter (USBR, 2011c). Sediment thicknesses are deeper in the historical channel than the historical floodplain and current reservoir margins. Maximum sediment thickness is 4 to 5 ft and decreases with distance upstream from the dam. Mirror Cove has relatively uniform sediment thicknesses of 2 to 3 ft.

The maximum sediment thicknesses of 5 to 6 ft are located at the Jenny Creek confluence and indicate the relative significance of the creek as a sediment source. Accumulated reservoir sediment is approximately 60% clay, 25% silt, and 15% sand in the Downstream Reach and approximately 35% clay, 45% silt, and 20% sand in the Upstream Reach (USBR, 2011c). Reservoir deposits are underlain by fine-grained weathered Tertiary volcaniclastic material with varying concentrations of gravel and sand (USBR, 2010). At the reservoir – pre-reservoir contact, six cores had a layer of decaying organic matter and intact organic fragments (e.g., vertical roots, grasses, twigs, bark) in the upper portion of the pre-reservoir material (USBR, 2010). In locations of some mapped geomorphic features, such as the Jenny Creek confluence and alluvial terraces in the Downstream Reach, layers of Quaternary alluvial gravel and sand are interbedded between the reservoir sediments and Tertiary volcanics (USBR, 2010). The accumulated in-situ reservoir sediments have high moisture contents of nearly 200% in the Upstream Reach and nearly 300% in the Downstream Reach with low cohesion, low strength, and high erodibility (USBR, 2011c). The measured friction angle from a sediment core located at RM 195.5 is approximately 32 degrees (USBR, 2011c).

Upland vegetation is similar to historical conditions and consists of grass covered land with oaks and junipers. Vegetation is generally sparse around the reservoir margins. Higher concentrations of native grasses and shrubs are mapped around the full margin of the reservoir (see Appendix C, USBR, 2011c). Rushes and invasive yellow star thistle are more abundant on the banks of southern aspect slopes, whereas oak are on the banks of northern aspect slopes based on site surveys and observations (USBR, 2011c). Willows are primarily found on the margins of Mirror Cove and on the banks upstream of Fall Creek (USBR, 2011c).

Temperature and rainfall patterns at Iron Gate are expected to be adequately described by the data from the Copco No. 1 Dam weather station (Figure 3-10) information and description.

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Chapter 4: Anticipated Reservoir Conditions

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4. ANTICIPATED RESERVOIR CONDITIONS AFTER DRAWDOWN

KRRC proposes drawdown of all three reservoirs for the months of January, February and March to take advantage of high flows that will maximize erosion of stored sediments and minimize downstream impacts to aquatic resources. This section provides an overview of the general conditions expected in the reservoirs after drawdown and focuses on the characteristics of the residual reservoir sediments and expected revegetation. Each reservoir has distinct features and characteristics, so additional information and description of the likely response of the individual reservoir areas are also discussed below for each reservoir. Table 4-1 summarizes historical water features in each of the reservoirs.

Table 4-1 Summary of mainstem river, side channel, tributaries and area currently inundated in each reservoir

Location	Mainstem River Length* (mi)	Side Channel Length* (mi)	Tributary Length* (mi)	Number of Tributaries*	Inundated Reservoir Area (acres)	Exposed Reservoir Area (acres)
J.C. Boyle	3.3	-	0.2	10	347	222
Copco No. 1	6.9	1.2	1.5	18	972	863
Iron Gate	6.8	-	2.5	52	942	840
Total	**17.0**	**1.2**	**4.2**	**80**	**2,261**	**1,925**

**USFWS 2009*

4.1 Conditions Common to All Reservoirs

KRRC's contractor will simultaneously draw down the J.C. Boyle, Copco No. 1, and Iron Gate reservoirs, and the accumulated sediment will naturally erode and evacuate from the reservoir areas to the extent possible. The accumulated sediment is predominantly silt, clay, and organic material that is over 80% water and highly erodible. USBR used both one-dimensional (1D) and two-dimensional (2D) sediment transport models to predict likely sediment transport and river conditions in the reservoirs after dam removal. USBR estimated that approximately 50% of the stored sediment in the reservoirs will be eroded during drawdown for a median water year with a range of 41% to 65% for dry and wet years, respectively (USBR, 2011c).

The 2011 Plan (USBR, 2011c) summarizes the previous hydraulic modeling completed by USBR and responses of the reservoir areas to drawdown. Forecasted steps in the evolution of the reservoir deposits include initial erosion of reservoir deposits during drawdown, slumping of saturated sediment deposits toward the river channel due to low shear strength and draining of water from the pore spaces in the deposits, and drying, consolidation, cracking and hardening of remaining deposits (USBR, 2011c). Next steps in the process include the establishment of herbaceous vegetation, erosion of the floodplain deposits during storms, and the gradual weathering of the deposit (USBR, 2011c).

KRRC based discussion herein of the conditions anticipated at the individual reservoirs after drawdown on previous studies and analysis documented by USBR (2011c) and the results from experimental testing of reservoir sediments and revegetation completed in 2017 and 2018. Testing focused on 1) changes in reservoir sediment properties when exposed to cycles of wetting and drying, and 2) evaluation of reservoir sediments as growth medium and the success of specific revegetation species. Section 8.1documents the methodology, results, and implications of this experimental testing.

4.2 J.C. Boyle

KRRC expects the geomorphic evolution of the J.C. Boyle Reservoir in response to dam removal to be relatively minor and straightforward. The accumulated reservoir sediments are limited primarily to the historical channel and are thickest in the confined Canyon Reach. Lacking alternative flow pathways in the confined lower reach, the river will readily scour out the reservoir sediment down to the bedrock prominent in the historical river channel bed. Narrow, but potentially several feet thick, deposits may persist outside the channel banks. The Upstream Reach will be exposed early during drawdown because the water depths are shallow. KRRC anticipates the channel here to preferentially erode its historical channel bed and leave the broad (approximately 1,000 ft wide) deposits on the channel margins relatively intact. KRRC does not anticipate significant slumping of these deposits during drawdown because of shallow depths (< 2 ft) and low topographic slopes (< 0.1 ft/ft). These deposits will reduce in height and volume by up to 50% as the material dries and consolidates. Water levels in the J.C. Boyle Reservoir are sensitive to river flows because of the small size of the reservoir. As a result, high flow events can inundate and modify the deposits in the period between the onset of drawdown and removal of the dam. A 5-year event, for example, will increase reservoir elevations by more than 20 ft (USBR, 2011b). There are only a few tributaries on these marginal deposits, and some are ephemeral, so KRRC expects little subsequent evacuation after removal of the dam. Given the low relief of the Upstream Reach, high flow events will periodically inundate and modify the remnant reservoir surfaces. The modeled 100-year flood inundates nearly the entire Upstream Reach (Figure 3-1). It is uncertain if pre-dam bedforms, such as the large mid-channel bar (Figure 3-2), will be reestablished post-drawdown.

The Canyon Reach is highly confined and will have relatively little upland or floodplain area available for revegetation. This geometry should efficiently evacuate the reservoir sediments, and the coarser pre-dam substrate will be exposed readily and support revegetation with woody riparian species in some locations. Drawdown in the Upstream Reach will expose a large low-gradient area of relatively thin reservoir sediments. The existing wetlands in the Upstream Reach, e.g., at the Spencer Creek confluence, may disappear after drawdown, but the seedbank germination study results suggest that wetlands may re-establish naturally, albeit in a new location closer to the historical channel. The sediments at J.C. Boyle contain the lowest amount of clay and the highest amount of arsenic of the three reservoirs, and they will be best suited for planting of native grassy vegetation and trees (e.g., Douglas fir, ponderosa pine, Oregon white oak) that are currently growing in the reservoir vicinity. Each planting zone species assemblage successfully established in the moist J.C. Boyle sediments, and the upland species were able to grow in the desiccated samples, albeit with frequent irrigation and moderate temperatures. Air temperatures at J.C. Boyle typically fluctuate diurnally above and below freezing during the winter months when drawdown is scheduled to occur. As a

result, the sediments will drain and dry with warmer daytime temperatures but freeze at night. These conditions, which will persist for months in the Upstream Reach, will be challenging for young plants, particularly those with shallower root systems. Dried sediment thickness will only be on the order of a foot thick, so the roots of plants that establish in the sediments will have access to the historical floodplain surface and materials. The sediments and hydrologic conditions in the historical materials may be more suitable for plant establishment, although it is unknown how reservoir inundation may have modified these characteristics.

4.3 Copco No. 1

KRRC expects the reservoir sediments in the sinuous historical channel footprint to erode during drawdown, and large areal extents of residual sediments several feet in thickness will persist on the low gradient upland surfaces of the historical lake bed. KRRC proposes to begin the drawdown of the 2,609-ft elevation Copco Reservoir water surface on November 1, prior to drawdown of Iron Gate and J.C. Boyle reservoirs, at a rate 2 ft/day. Beginning January 1, drawdown rate will increase to a maximum of 5 ft/day.

The low-gradient, historical lake bed surfaces (elevation approximately 2,580 ft), which extend throughout the Downstream Reach, will be exposed in mid-January under all modeled hydrologic scenarios. These deposits will not be subjected to secondary inundation during large flow events in the period between drawdown and dam removal, except potentially in far upstream portions of the reservoir. These flat surfaces will not be accessible from the river. KRRC anticipates reservoir deposits on these low gradient upper surfaces (except at the edges of vertical bluffs) will be relatively stable and not subject to appreciable slumping or hydraulic erosion. The gradients on these surfaces are typically less than 2 degrees, as measured from the current high resolution bathymetric data, and are well below even the lowest estimates (6 degrees) for the aerial angle of repose for the reservoir sediments.

Larger tributaries, such as Deer Creek and Beaver Creek, can begin to rework their delta deposits and contribute bedload to the mainstem upon aerial exposure. The Deer Creek confluence (elevation approximately 2,560 ft) will be fully exposed in mid-January for dry and median years but as late as late-February for wet years and the notching drawdown option. The dynamic Beaver Creek confluence area (elevation approximately 2,540 ft) will be exposed in mid- to late-January for median to dry years and sometime in February for wet years, depending on the timing of flow events. Large events following aerial exposure will increase the amount of sediment reworking by the mainstem and tributaries. Increases in reservoir water surface elevation due to, for example, a 5-year flood are in the range of 5 to 15 ft.

Copco No. 1 Reservoir sediment thicknesses vary with pre-existing valley topography such that the lower elevation historical channel contains deeper deposits than higher elevation terraces and ancestral lake bed. USBR predicted the spatial patterns of erosion by two-dimensional morphodynamic modeling of Copco Reservoir during drawdown (USBR, 2011b). Erosion in excess of 5 ft was concentrated within the sinuous historical channel and in the cut-off meander bend, which will be re-occupied by Beaver Creek following drawdown. The model predicts nearly zero erosion outside of the historical channel. The model does not simulate fluvial bank erosion or bank failure, nor does it incorporate erosion from tributaries, springs, or

concentrated surface runoff from hillslopes. Therefore, the spatial extent of modeled erosion is potentially a minimum prediction, and it is likely that more material will naturally evacuate from other areas during drawdown. The 2D modeling used the formulation for the erosion rate of fine-grained cohesive sediments and measured parameter values from Simon et al. (2010) to simulate erosion under easier to erode and harder to erode scenarios (Table 8-9). The model is far more sensitive to the modeled hydrology than the variation in the erosion rate parameters. The hard to erode τ_C and k values used were more than an order of magnitude lower and higher, respectively, than the maximum values measured in the wetting-drying experiments (Table 8-6). However, given the large proportion of sediment eroded during the drawdown period and its location in the historical channel, the modeling results do not change with the new shear strength data. Hardened, resistant sediment is more likely located in upland and higher elevation floodplain areas less affected by initial drawdown and erosion by the Klamath River.

Given the high relative elevation, low gradient, and large width of ancestral lake bed and upland surfaces, reservoir deposits 2 to 6 ft thick and hundreds of feet in lateral extent may persist at elevations tens of feet above the mainstem active channel post-drawdown. Tributaries and springs may erode these deposits in some places, and the remaining sediments will undergo the physical changes associated with desiccation. The volume reduction during consolidation may lower the surfaces up to 50% of the deposit thickness, and KRRC expects cracks to form. These cracks may concentrate flow from surface runoff in the future and be foci of subsequent erosion of the deposit by rilling and gullying.

The historical Copco No. 1 valley topography was created by a complex sequence geologic and geomorphic events and a diversity of landforms and materials will be exposed following drawdown. The pre-dam valley relief was high in the Downstream Reach with elevation differences in excess of 50 ft between the channel bed and the higher elevation, low-gradient ancestral lake bed. These steep 5 to 50 ft tall banks on the outside banks of the meander bends and the material underlying much of the historical valley bottom are composed of fine-grained and porous diatomite. However, the diatomite, which is mechanically capable of supporting tall vertical bluffs when dry, has been inundated for 100 years, and the pores are likely now filled with water. The drawdown rates of 5 feet per day (0.2 inches per hour) likely exceed the hydraulic conductivity of the diatomite, and the combination of steep and tall valley geometry with saturated porous rock could lead to slope failure during drawdown. The effect of saturation on diatomite mechanical strength and the result of dewatering with drawdown are poorly constrained, but on-going data collection and analysis by KRRC are investigating the stability of the diatomite. The products of diatomite slope failure could persist in the valley bottom and potentially alter the course, but probably not dramatically, of the Klamath River away from the historical alignment and cause increased lateral erosion of diatomite bluffs. KRRC does not anticipate significant vertical incision into the historical valley floor post-drawdown because of the presence of bedrock grade control at the entrance to Ward's Canyon upstream of Copco No. 1 dam. As such, KRRC expects access by the Klamath River to its historical floodplain to only be limited by the presence of residual reservoir sediments in riparian areas.

The sediment texture at Copco Reservoir is on average much finer than that at J.C. Boyle and ranges from clay to silty clay loam on a USDA texture triangle, and the size grades from fine texture near the dam to the coarsest texture at the upstream portion of the reservoir. Textural gradations will be reflected in the vegetation palette, which will include a larger proportion of native perennial bunch grasses, trees and shrubs

in the upstream area where coarser, well-aerated soils will be able to support these deep rooting species. Each planting zone species assemblage successfully established in the moist Copco sediments, and the riparian bank and riparian floodplain species were able to grow in the desiccated samples, albeit with frequent irrigation and moderate temperatures. Air temperatures at Copco typically fluctuate diurnally above and below freezing during the winter months when drawdown is scheduled to occur. As a result, the sediments will drain and dry with warmer daytime temperatures but freeze at night, a combination that will be challenging for young plants. Irrigation may not be possible in the ancestral lake bed uplands and many other upland portions of the Copco valley given the large areal extents and distance from surface water sources. Access to the upland areas must be from the road, rather the channel.

4.4 Iron Gate

At Iron Gate, KRRC anticipates the Klamath River to efficiently evacuate the majority of the reservoir sediment because the reservoir deposit layers are thin, the reservoir water depths are large, drawdown will be more rapid, and the historical channel occupied a narrow pre-dam valley with steep adjacent hillslopes (USBR, 2011c). KRRC proposes to begin drawdown of the 2,330-ft elevation reservoir water surface on January 1. At maximum drawdown rates of 5 ft/day, Fall Creek (approximately 2,310 ft) will be completely exposed in the first week of drawdown and modification of the local deposits by Fall Creek are expected during subsequent storm events. The Jenny Creek delta (minimum elevation approximately 2,270 ft) will have full aerial exposure by mid-February for wet and above-normal years and mid-January for median and dry years (USBR, 2011b) and will experience reworking during subsequent high flows. The Jenny Creek delta has the thickest and coarsest deposits in the Iron Gate Reservoir and will function as a source of bedload to the mainstem. The Mirror Cove confluence area (elevation approximately 2,230 ft) won't be exposed until the end of January for median and dry years and the beginning of March for wet years USBR, 2011b), although upstream portions of Mirror Cove and its tributaries will rework their deposits (maximum sediment thickness 5 ft) at all stages of drawdown.

Most of the historical roads and the railroad along the Downstream Reach of Iron Gate (Figure 3-13) are not exposed until reservoir levels are below 2,230 ft. Assuming maximum drawdown rates, the road will not be exposed until the end of January for median and dry years and the beginning of March for wet years (USBR, 2011b). Several weeks will likely be required before reservoir sediment has stabilized and the certainty of road stability has been verified. Until that point, the floodplain in the Downstream Reach of Iron Gate and Mirror Cove may be inaccessible.

Drawdown operation at Iron Gate will be impacted not only by hydrology but also by releases from Copco and the discharge capacity of the diversion tunnel. KRRC's contractor will control the discharge capacity by a new slide gate, and values of 11,000 cfs, approximately a 5-year recurrence interval flood, are used in models of drawdown. A flow of this magnitude occurring after the onset of drawdown but before dam removal will result in an increase in the reservoir water surface elevation by up to 90 ft, which will backwater Klamath River nearly to the Fall Creek confluence and inundate the historical roads, most of Mirror Cove, and the Jenny Creek delta. This secondary inundation could persist for days to weeks depending the elevation and magnitude of the event and potentially re-saturate or erode residual sediments. Fine-grained sediments will

be subject to potential breakdown from an additional cycle of wetting and drying. Secondary inundation is not expected in normal or dry years when flow events do not exceed the discharge capacity of the diversion tunnel.

Reservoir sediments do not exceed 5 ft in thickness except at the Jenny Creek delta, so KRRC expects residual sediment persisting after drawdown to reduce in thickness to less than 3 ft. Given the relatively more rapid drawdown proposed at Iron Gate and steep side slopes, reservoir deposit erosion from slumping should be more efficient (USBR, 2011c). There are several mapped low relief terraces, fans, and historical floodplains in the valley bottom (particularly in the Downstream Reach) on which larger areal extents of sediment may be stable (Table 8-1). The greatest uncertainties relate to the deposit erosion by tributaries, particularly the Camp-Scotch-Dutch Creek complex in Mirror Cove. The valley is wider in Mirror Cove relative to the size of the historical tributaries, and therefore, KRRC expects a larger areal extent of sediment relative to the mainstem areas to remain after drawdown. These deposits are only 2 to 3 ft thick, however, and will consolidate upon drying.

Challenging access into the Iron Gate canyon will limit active revegetation and restoration efforts. Germination and plant growth was successful in the reservoir sediments, but growing conditions were idealized relative to those in the restoration time period which go from below freezing temperatures during drawdown to hot and dry summer. Irrigation is logistically challenging with the steep canyon walls, which limit both groundwater and surface water access. The sediment texture at Iron Gate Reservoir is the finest of all three reservoirs with clay content up to 78% at the IG2 sampling site. Similar to other reservoirs, the sediment textural gradient progresses from finest near the dam to the coarsest at the upstream end of the reservoir and at the Jenny Creek confluence. This gradation will be reflected in the vegetation palette that will include a larger proportion of native perennial bunch grasses, trees and shrubs in the upstream area where coarser, well-aerated soils will be able to support these deep rooting species.

Chapter 5: Reservoir Area Restoration

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5. RESERVOIR AREA RESTORATION

This section provides an overview of the anticipated timeline and restoration plan for each reservoir area along with detailed descriptions for restoration actions. Restoration actions consist of strategic, physical alterations of the reservoir areas including grading and installation of large wood features, as well as revegetation techniques to maximize ecological recovery of the reservoir areas.

5.1 Restoration Time Periods

The 2011 Plan (USBR, 2011c) was developed with an emphasis on stabilizing remaining sediment in the reservoir areas after drawdown to minimize the potential for future, large-scale sediment releases in the Klamath River. In addition to sediment stabilization, the Klamath Restoration Working Group recommended additional actions for the reservoir areas to develop wildlife and aquatic habitat while at the same time restoring natural river function and processes. This RAMP seeks to combine revegetation practices with physical habitat restoration techniques to re-instigate sustainable river function and natural processes. To further describe restoration actions and critical time stages, the following time periods are defined:

1. **Pre-dam removal period** (1–2 years pre-drawdown) activities include: seed collection, seed propagation, IEV control, sediment testing, grow experiments.
2. **Reservoir drawdown period** (January to March, year of drawdown) activities include: reservoir drawdown with natural erosion and assisted evacuation of reservoir sediment deposits, initial stabilization of sediments and exposed areas with aerial seeding, salvage and plant existing wetland and riparian vegetation, evaluation of restoration sites.
3. **Dam removal period** (spring, summer and fall immediately after drawdown) activities include: additional seed application in problematic areas and in remaining unseeded reservoir deposits, irrigation system installation in bank riparian areas, IEV control, active restoration of identified floodplain areas by grading, large wood installation, and habitat features.
4. **Post-dam removal period** (after dam removal is complete) activities include: additional seeding in difficult and underperforming areas, IEV control, continued installation of pole cuttings and seed plantings, maintenance of existing and previously planted vegetation, modification and adaptive improvements to installed habitat features, and installation acceptance inspections to commence a 5-year monitoring period.
5. **Plant establishment period** (Year One, after completion of revegetation) activities include: continued monitoring and maintenance of vegetation, irrigation system maintenance, removal of IEV, fish passage monitoring, and enhancement and/or augmentation of habitat features as needed.
6. **Maintenance and monitoring period** (Years Two to Five, after completion of revegetation) activities will include: regular monitoring and report preparation, re-seeding and re-planting as necessary, IEV control, fish passage monitoring, irrigation system repair, and adaptive management and maintenance of physical habitat features.

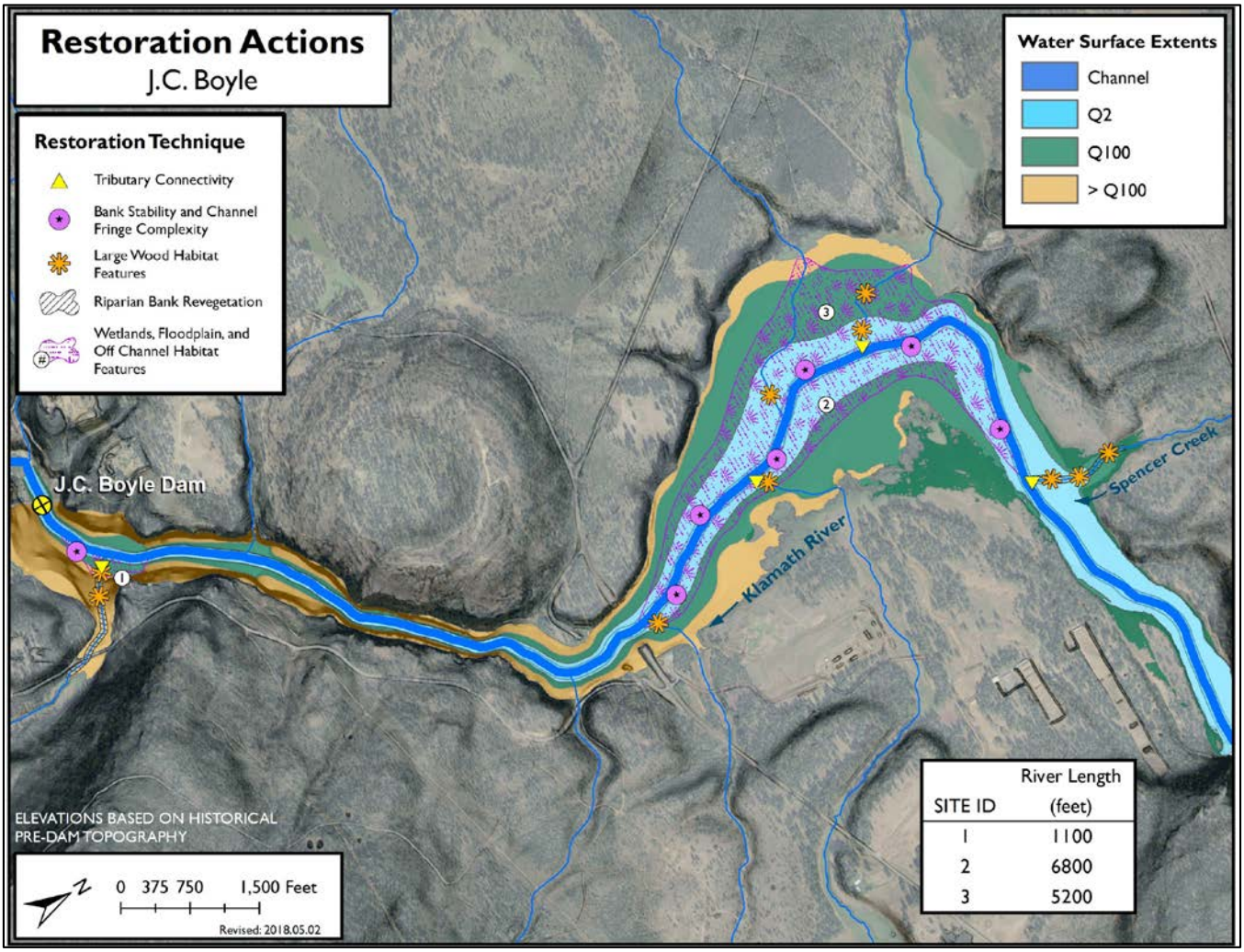
Table 5-1 details the restoration timeline with major tasks KRRC's contractor will implement in relationship to the reservoir drawdown and dam removal activities. A five-year monitoring period is incorporated in the timeline including an intensive one-year plant establishment period that will consist of close attention to monitoring and control of IEV, adaptive re-seeding and re-planting of vegetation in under-performing areas, and careful management of the riparian bank zone irrigation system.

Table 5-1 Restoration Timeline

RESTORATION PERIOD:	Pre-Dam Removal (DR)			DD	DR	Post-DR	Plant Establ.	Maintenance & Monitoring			
Monitoring Period:	Preparation			Construction			Y1	Y2	Y3	Y4	Y5
Calendar Year:	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	
Task:											
Seed Collection											
Seed Propagation											
Prepare Construction PS&E for Pilot Growing Tests											
Pilot Growing Tests with Monitoring and Data Gathering											
Restoration PS&E Preparation											
Invasive Exotic Vegetation Control											
Construction and Dam Removal (DR)											
Drawdown (DD)											
Site Mass Ggrading at Reservoir Restoration Areas											
Bank Stability and Channel Fringe Actions											
Install Large Wood for Habitat (Ground/Aerial)											
Tributary Connectivity in Reservoir Areas											
Aerial Pioneer Crop Seeding (Repeated)											
Salvage & Planting of Exist. Ripar/Wetland Vegetation											
Pole Cutting Installation											
Cross-rip Compacted Areas in Disturbed Uplands											
Pioneer Crop Mowing and/or Rolling											
Permanent Seed Mix Broadcasting by Vegetation Zone											
Irrigation Installation and Maintenance											
Plant Maintenance											
Key Inspections											
Installation of Deer Fence Enclosures in Selected Areas											
Performance Criteria Monitoring											
Deer Fence and Irrigation Removal											

5.2 J.C. Boyle Reservoir Restoration Overview

Figure 5-1 provides an overview map of the reservoir area with proposed restoration locations and techniques. This map shows the historical channel location, water surface inundation limits for the 2-year and 100-year peak flows based on pre-dam topographic surface, and areas above the 100-year water surface elevation contained within the existing reservoir extents.



Historical topography of J.C. Boyle Reservoir area with flood inundation extents for the 2-year (Q2) and 100-year (Q100) floods are shown for context. Length of river bordering the wetlands, floodplain, and off-channel habitat features restoration sites is included.

Figure 5-1 Map of historical Klamath River centerline, tributaries, and locations of potential restoration actions in JC Boyle Reservoir.

After drawdown, the existing reservoir will have two distinct areas as described in Sections 3 and 4. Little or no opportunity exists for restoration actions in the rocky reach downstream of the Highway 66 Bridge.

Upstream of the bridge, a large and relatively well-connected floodplain will support wetlands and off-channel habitat features. Therefore, at JC Boyle, the KRRC will conduct floodplain shaping and excavation of stored sediments to create areas for floodplain and wetland development along with habitat features that promote process-based restoration of the floodplain areas, and the KRRC will monitor and improve tributary connectivity to ensure volitional fish passage. The KRRC will strategically place LW on the floodplain and within the tributaries to maximize development of natural habitat features. The KRRC will limit habitat enhancement at the Spencer Creek confluence area to LW placement, using a helicopter, due to the probability of culturally significant resources and desire to minimize ground disturbance. The KRRC will construct bank stability measures where appropriate and install channel fringe complexity features in strategic locations to provide habitat only and will not hinder natural formative processes. All proposed restoration efforts will work in concert with the revegetation plans in the reservoir area to maximize the potential long-term habitat benefits.



Figure 5-2 Spencer Creek, a large tributary to JC Boyle Reservoir, provides a good opportunity as a reference site for the restored wetland and riparian zones at JC Boyle after drawdown.

The revegetation approach at JC Boyle Reservoir will be similar to other reservoirs; however, the KRRC will adjust the seed mix and planting palettes to reflect its higher elevation, shallower reservoir depth and different plant communities around the reservoir. KRRC will perform IEV control before the restoration implementation begins. Spencer Creek, which drains into the reservoir, will serve as a reference site for the revegetation portion of the restoration.

Because of the striking topographical contrast between the two reaches of the reservoir, there will be a large difference in the revegetation approach. The Upstream Reach above the Hwy 66 bridge has mostly gentle slopes and includes large and broad riparian floodplains that will have favorable hydrology for riparian and wetland habitat restoration, while the Canyon Reach downstream of the bridge passes through a narrow rocky gorge with minimal restoration opportunities.



Figure 5-3 The Canyon Reach of JC Boyle provides little opportunities for restoration because of its steep rock walls and bedrock river bottom that limit areas for vegetation to restore.

The development of broad segments of emergent wetlands and bank wetlands, as well as bank and floodplain riparian habitats on both banks of the Upstream Reach, will restore a high quality, well-functioning floodplain. Together, the wetland and riparian habitats may constitute up to 50% of the restored areas around the JC Boyle Reservoir; the largest percentage of the three reservoirs in these habitats. Because of the very gradual slope in parts of the Upstream Reach, this reservoir will also have a wider Rocky Wake Zone (RWZ). Because of the shallow depth and very gentle slope, in many areas, the RWZ will have finer remaining substrate left and restoration will be feasible without additional soil import.

The Canyon Reach will not be able to support much vegetation because the bedrock riverbed and the constricting rock wall bank conditions will result in high water velocities, expedited removal of any fine sediment, and very little suitable growing substrate along the narrow banks. KRRC's contractor will implement revegetation by seeding only areas with suitable growing substrate.

5.3 Copco No. 1 Reservoir Restoration Overview

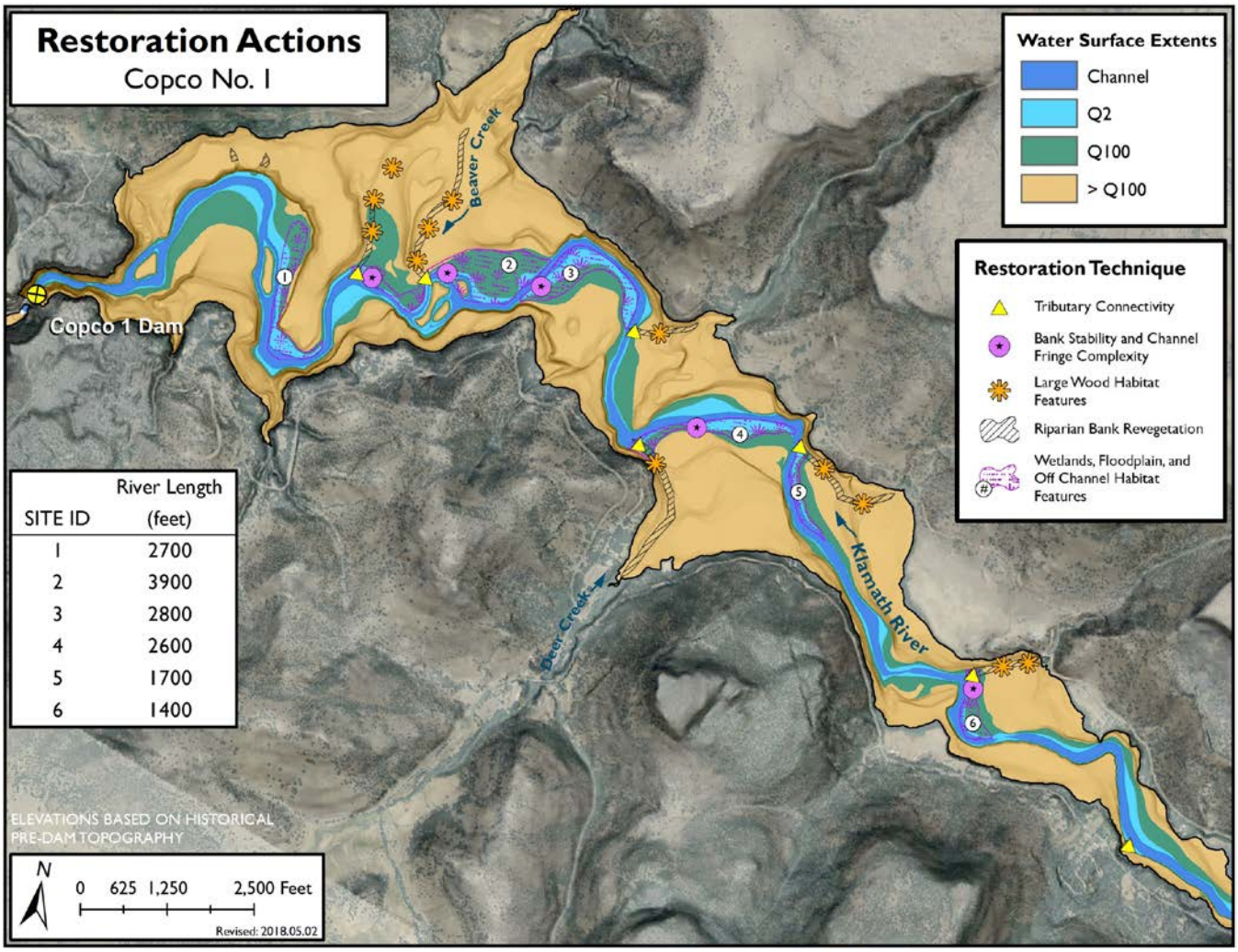
Copco No. 1 reservoir area has the largest potential for active restoration due to the meandering nature of the river in this reach along with the wider canyon. Hydraulic modeling of the pre-dam topographic surface shows that the river was better connected with the adjacent floodplain at the downstream end of the reservoir and not well connected in the upper half of the reservoir during typical 2-year recurrence interval peak flows (Figure 5-4) along with proposed restoration locations and habitat features. This map shows the historical channel location, water surface inundation limits for the 2-year and 100-year peak flows based on pre-dam topographic surface, and areas above the 100-year water surface elevation contained within the existing reservoir extents. The majority of the area currently inundated is higher than the 100-year floodplain after drawdown and only a narrow band of area is contained in the 2-year floodplain.

During drawdown, KRRC will use barge mounted pressure sprayers to maximize the amount of stored sediment to evacuate the floodplain areas and minimize the amount of depositional sediment on the historical floodplains to promote river inundation on the historical floodplain during high flow events. After drawdown, the KRRC will excavate six areas identified for excavation of remaining sediments and grade those areas to historical floodplain elevation to create wetlands, connected floodplain areas, and off-channel habitat features. These areas are primarily within the historical 2-year floodplain and create ideal locations for restoration.

In addition to the floodplain grading areas, the KRRC will monitor and improve tributary connectivity to ensure volitional fish passage. The KRRC will strategically place LW on the floodplain and within the tributaries to maximize development of natural habitat features as designated. The KRRC will install bank stability and channel fringe complexity features in strategic locations to provide habitat only and will not hinder natural formative processes. All proposed restoration efforts will work in concert with the revegetation plan in the reservoir area to maximize the potential long-term habitat benefits.

The KRRC will focus the revegetation approach at Copco No. 1 on restoration of the wetland and riparian habitats, which will comprise approximately 25% of the restored area around the reservoir, the second largest area after JC Boyle. The KRRC will adjust the seed mix and planting plan to reflect the reservoir's

higher elevation than Iron Gate, and different plant communities surrounding the reservoir. The KRRC will perform IEV control early in the revegetation process at Copco No. 1.



Historical topography of Copco No. 1 Reservoir area with flood inundation extents for the 2-year (Q2) and 100-year (Q100) floods are shown for context. Length of river bordering the wetlands, floodplain, and off-channel habitat features restoration sites is included.

Figure 5-4 Map of historical Klamath River centerline, tributaries, and locations of potential restoration actions in Copco No. 1 Reservoir.

The KRRC will use main tributaries, Beaver, Raymond, Spannaus, Long Prairie, and Deer Creeks for wetland and riparian habitat restoration at their confluence with the Klamath River, and will modify their streambeds to provide volitional fish passage. The Copco Reservoir is far more developed that the other two reservoirs, with 86% of the surrounding land being privately owned. The KRRC will use denser seeding and planting, and frequent monitoring in areas with large IEV infestations to safeguard the newly restored areas. Uplands

below RWZ will be the largest restored vegetation zone, approximately 60% of the restored area around Copco.



Figure 5-5 Copco vegetation is denser than at Iron Gate, especially on north facing slopes.

5.4 Iron Gate Reservoir Restoration Overview

The historical Klamath River in the Iron Gate reservoir area had very little floodplain connectivity due to the configuration of the narrow, confining canyon. Figure 5-7 shows the 2-year and 100-year inundation limits based on hydraulic modeling and pre-dam topography. The modeling shows that few areas exist for river-floodplain interaction and the primary areas of potential restoration are at the confluences with larger tributaries. However, KRRC identified culturally significant resources at the confluence areas which limit the amount of restoration that can be done in these areas.

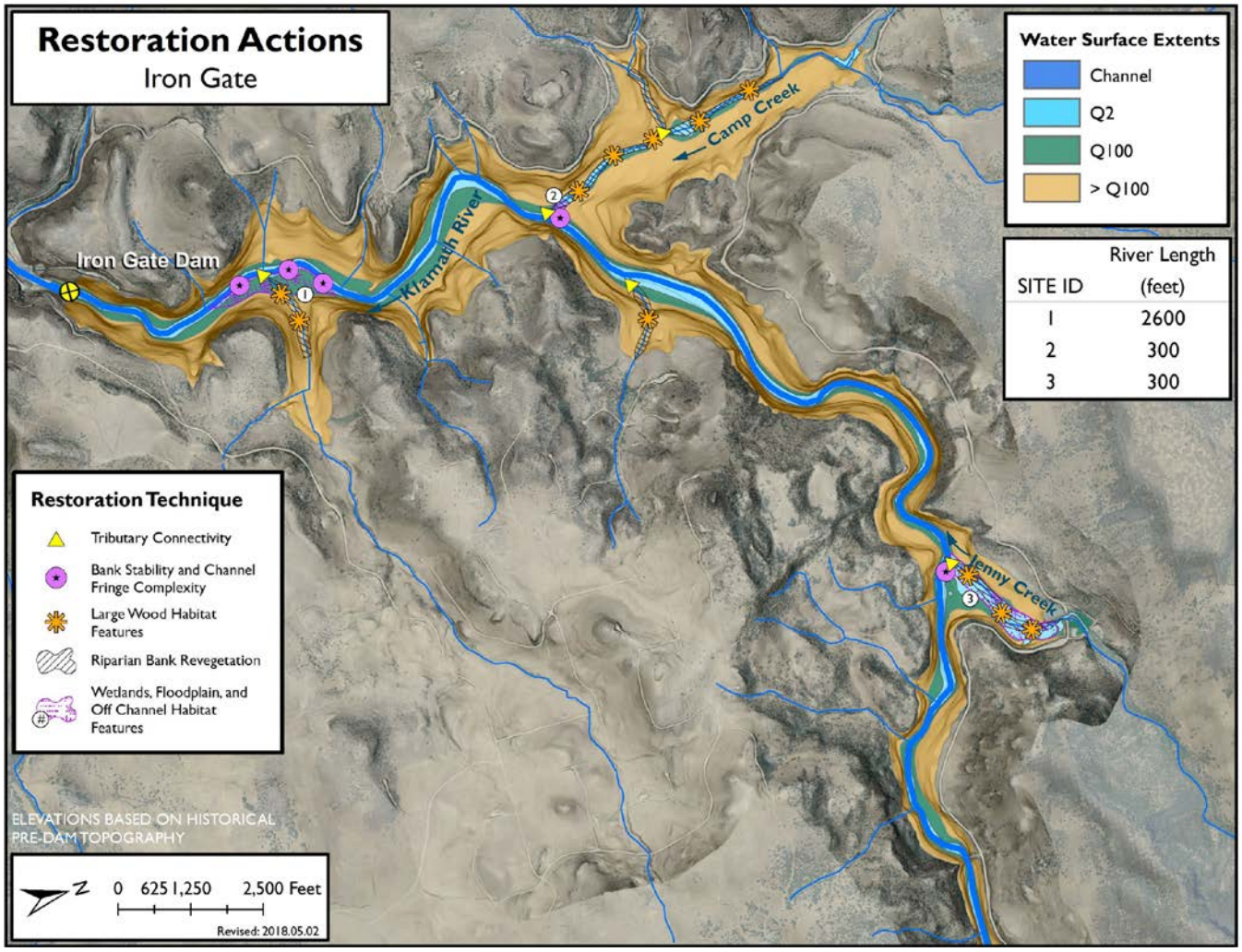


Figure 5-6 Long Prairie Creek joins the reservoir just upstream of the town and provides an opportunity for wetland and riparian habitat restoration at its confluence with the river.

The KRRC identified three areas where wetlands, floodplain, and off-channel habitat features can be restored. The KRRC will excavate the areas to historical ground and grade the areas to maximize interaction with flows from the river and will add habitat features in those areas. Thee KRRC will augment several areas with LW and will ensure tributary connectivity for volitional fish passage in the tributaries. The KRRC will coordinate any restoration modifications around culturally significant resource areas to ensure minimal or no ground disturbance.

The Klamath River passing through the Iron Gate area has formed a very deep and narrow channel with steep rocky banks, providing little opportunity for the restoration or extensive wetland or riparian habitats. As a result, the KRRC will restore nearly 85% of the reservoir area bed after drawdown as uplands with Uplands below Rocky Wake Zone as the dominant planting zone. The KRRC will restore these areas similar to the other reservoirs with native grasses such as annual hairgrass, small fescue, squirreltail grass, blue wildrye,

and California brome and with woody upland species such as western juniper, Oregon white and California black oaks. The KRRC will perform IEV control prior to drawdown at Iron Gate.



Historical topography of Iron Gate Reservoir area with flood inundation extents for the 2-year (Q2) and 100-year (Q100) floods are shown for context. Length of river bordering the wetlands, floodplain, and off-channel habitat features restoration sites is included.

Figure 5-7 Map of historical Klamath River centerline, tributaries, and locations of potential restoration actions in Iron Gate Reservoir.

5.5 Description of Restoration Actions

The KRRC will use both revegetation techniques and physical site modifications to initiate process-based restoration and long-term habitat formation to restore the reservoir areas post drawdown. The KRRC considered historical documentation of the reservoir areas before dam construction and reservoir area

inundation, past performance of similar dam removal and restoration projects, and current restoration practices, to develop an effective technique useful for the reservoir areas as described below.



Figure 5-8 Steep banks and narrow valley of Iron Gate Reservoir limit opportunities for wetland and riparian habitat restoration.

The 2011 Plan (USBR, 2011c) focused on control of invasive exotic plant species and revegetation of the reservoir areas with native grasses, shrubs and trees as the primary method for restoration. This approach is consistent with nearly all dam removal and reservoir restoration plans in the past 10 years wherein restoration efforts have emphasized revegetation of newly exposed floodplain areas with native plants while actively controlling invasive exotic vegetation. The following subsections describe the approach in this RAMP to restore the project area; specifically, the proposed sediment evacuation, revegetation process, the acquisition of native plant materials, the invasive exotic vegetation control, and the revegetation methodology.

5.5.1 Reservoir Drawdown Sediment Evacuation

A primary objective during the reservoir drawdown period is to maximize natural erosion of stored sediments. This objective has two purposes: 1) reduce the amount of un-natural, stored sediment remaining on the historical floodplain and reservoir area surfaces and 2) minimize the potential for future sediment releases

in the Klamath River. For a median water year, hydraulic modeling predicted that approximately half of the stored sediment would naturally erode and vacate the reservoir area (USBR, 2011b). The existing sediment in the reservoir area is highly erodible and has a high water content. To further maximize the amount of sediment eroded during drawdown, KRRC's contractor will use additional manual augmentation during drawdown as described below.



Figure 5-9 Jenny Creek, the largest Iron Gate Reservoir tributary creek also provides the best opportunity for floodplain restoration at its confluence with Klamath River.

The KRRC will use sediment jetting with a barge mounted water jet (Figure 5-10) that has been used on past dam removal projects to maximize stored sediment erosion at the Copco No. 1 and Iron Gate reservoirs. The Contractor will develop a detailed plan for use of sediment jetting.

During reservoir drawdown, some areas near existing roads will provide easy access for machinery, such as bulldozers and excavators, and in those areas, the Contractor will grade and then transport the sediment. The KRRC will designate culturally sensitive areas prior to drawdown to ensure these areas are not entered with machinery. The Contractor will perform area grading between January and April of the drawdown year and will only grade depositional surface sediment and will not extend below the historical ground surface prior to dam construction. The Contractor will develop plans for this grading for approval prior to drawdown.

5.5.2 Tributary Connectivity

As KRRC's contractor lowers reservoir water surfaces during drawdown and beyond, tributaries will be further exposed creating longer reaches of free-flowing water conditions. Figure 5-11 shows where Iron Gate reservoir was drawn down in 2018 approximately 20 ft and how Jenny Creek interacts with the drawdown. The newly exposed tributaries will flow over depositional areas of fine sediment that will likely transport these sediments downstream; however, some larger sediment and debris may create fish passage barriers or un-natural discontinuities in the longitudinal profile. To rectify this, the KRRC will use light equipment and manual labor will be able to move materials and enhance access and longitudinal connectivity of the tributaries with the mainstem Klamath River. In addition, the KRRC may add LW to tributaries to promote habitat complexity as further described below.



Figure 5-10 Sediment jetting on Mill Pond reservoir using a barge and excavator with pump and spray nozzles to maximize stored sediment erosion during reservoir drawdown (photo from Envirocon)

Another aspect of tributary connectivity is volitional fish passage. Many of the tributaries have road crossing at the current reservoir water surface with culverts and stream crossings that do not allow volitional fish passage. In addition, there are historical tributary crossings that area currently within the reservoir inundation zone and will likely create fish passage barriers. The KRRC will prepare an inventory of fish passage barriers in the tributaries after reservoir drawdown and will rectify as many of these as funding allows.



Figure 5-11 Jenny Creek tributary on Iron Gate reservoir with reservoir drawn down approximately 20 ft showing deposition and small delta where it intersects with reservoir in 2018

5.5.3 Wetlands, Floodplain and Off-Channel Habitat Features

Incorporating natural features, such as surface undulations, into newly exposed floodplains is a restoration strategy that promotes ecosystem diversity and natural processes. Based on historical pictures, it appears that three main types of floodplain features could be supported on the newly exposed floodplain areas: wetlands, floodplain swales, and side channels. Likewise, floodplain roughness features can be supported to further instigate natural processes while enhancing wildlife habitat.

Wetlands are depressional or low-lying features with standing water or saturated soils for a portion of the growing season sufficient to support wetland vegetation such as willows, sedges and rushes. Wetlands provide a wide range of ecological functions such as water quality improvement, flood attenuation, and habitat for both terrestrial and aquatic organisms. Including wetlands in restoration will help address several limiting factors including water quality and lack of habitat diversity for wildlife. Wetland restoration strategies for the reservoir areas include preservation of existing wetlands, hydrologic connection of off-channel wetlands with the river, or creation of new wetlands at lower elevations corresponding to the post-dam removal surfaces and hydrologic regime.

Floodplain swales are small depressional areas incorporated into the floodplain that provide microsites where floodplain vegetation can establish at slightly lower elevations (closer to the water table) than

adjacent floodplain surfaces. Floodplain swales also provide storage for flood water and sediment at variable flows, in addition to broadening the range of ecological niches available on the floodplain surface to support different life stages (and behaviors) of plant, bird, amphibian, and many other terrestrial wildlife species. To maximize diversity, floodplain swales vary in size and depth, but do not extend below the anticipated baseflow elevation.

Side channel restoration is a strategy to improve instream habitat diversity. Side channels provide off-channel habitat for juvenile rearing and high flow refugia for other aquatic species. Like floodplains, side channels exchange water, sediment and nutrients between the main channel and off-channel areas thus supporting diverse vegetation communities. Side channel restoration strategies include modifying inlet and outlet hydraulics, improving hydraulic complexity with wood structures or realignment, and delivery of water to higher floodplain surfaces.



Figure 5-12 Example of existing floodplain features upstream of Copco No. 1 reservoir (i.e., wetland area)

Floodplain roughness is a technique applied to newly exposed areas where frequent interaction with the river channel is anticipated. Floodplain roughness helps address the initial geomorphic limiting factor on the newly exposed areas - lack of established, stable vegetation. Floodplain roughness also reduces browse pressure by making access more difficult, particularly for geese which require unobstructed runways for landing and takeoff. Installation of roughness features creates complexity and microsites on new floodplain surfaces to trap and protect seed and other plant propagules, and to provide resistance to erosion by reducing velocities and limiting rill formation. Floodplain roughness is created using equipment to roughen the floodplain surface with microtopography and partially bury brush, limbs, and wood in the soil. Microtopography creates variation in the constructed floodplain surface ranging from 0.5 ft above to 0.5 ft below the design floodplain surface. Brush and wood increases IN soil moisture retention creates protective microsites for establishing seed and plants and promotes soil development by introducing organic material as illustrated in Figure 5-17.

5.5.4 Bank Stability and Channel Fringe Complexity

Lack of initial roughness along channel margins results in higher than normal near-bank velocity and shear stress. This increase in active channel margin energy negatively affects aquatic species by requiring increased energy for migration and holding while also transporting desired gravels and depositional features downstream. Velocity shadows created by bankline complexity (i.e. vegetation, rootwads, etc.) and LW create zones of complex hydraulic interactions that provide resting zones, feeding seams, cover and velocity refugia during high flow. Reaches that will benefit from these treatments are typically single thread, like the Klamath River, where the channel is laterally confined. In addition, bank roughness can improve bank stability and reduce un-natural erosion that degrades water quality. Channel fringe complexity is best improved through the strategic addition of LW as described in the following section and the establishment of riparian vegetation. Likewise, KRRC's contractor will not implement this restoration technique where it will disrupt natural, process-based channel and floodplain evolution within the reservoir areas.



Figure 5-13 Example of restored floodplain area six months after construction in an arid climate showing new vegetation and wood roughness elements that provide habitat complexity and immediate, large scale roughness

5.5.5 Large Wood Habitat Features

Large wood (LW) is a naturally occurring element in the Klamath Basin that hydraulically influences the movement of debris and sediment, causing local scour and deposition as well as hydraulic energy dissipation similar to rock outcrops. LW obstructions lead to flow mechanics that result in a fining of stream substrate particles. Suspended sediment particles can drop out of the water column due to flow deceleration caused by LW skin roughness, form drag and turbulent energy dissipation around LW obstructions, hydraulic jumps over LW steps, and a general decline in water surface slope and energy gradient due to physical blockage of flow and backwater effects caused by LW obstructions (Buffington, 1995). LW can be used to disperse flow energy (Buffington and Montgomery, 1999), stabilize channel banks and bed forms (Bilby, 1984), increase aquatic habitat (Bryant and Sedell, 1995), narrow a stream and reduce the width to depth ratio (Sedell and Froggatt, 1984), cause localized deposition, form pools (Bilby and Ward, 1989), and route

flood water. Although historical photos do not show LW as a predominant geomorphic feature, it can be used to improve habitat and promote reservoir area conditions that restore natural ecosystem processes and protect vegetation during the initial years of establishment.

Ground-Based Equipment Placement

Use of track hoes (Figure 5-14) and industrial log moving equipment are typical methods for moving and placing wood to build LW habitat structures along river and floodplain areas. KRRC's contractor will use these standard methods for construction in specific areas of the reservoirs based on accessibility and amount of residual reservoir sediment remaining. In culturally sensitive areas, KRRC's contractor will not use ground-based equipment to install LW.



Figure 5-14 Example of LW structure being built for habitat benefits using ground-based equipment

Helicopter Placement

For access to difficult sites or culturally sensitive areas, and to minimize overall site impacts, LW can be efficiently placed using a helicopter. A standard twin rotor helicopter (Figure 5-15) can lift loads in excess of 10,000 lbs. that is roughly equivalent to log lengths over 80 ft with diameters of 24 inches or greater that are ideal for floodplain and tributary stream habitat forming features. Use of a helicopter also enables better preservation of limbs and rootwads with the LW that can help increase the amount of habitat created and the long-term stability of the wood. It is planned that helicopter log placement will take place in areas that are difficult to access and in areas that will potentially disturb culturally significant areas if wood is placed by ground-based equipment.

The following sections contain additional details for each reservoir area and likely restoration actions. KRRC developed restoration actions for each reservoir with consideration to historical context of the reservoir areas prior to dam construction, past performance of similar dam removal and restoration projects, and current restoration practices to determine techniques suitable for improving habitat conditions in the reservoir areas. KRRC envisions that the proposed restoration actions will be evaluated at the time of reservoir drawdown to adapt to conditions that are exposed in the reservoir areas. It is likely that some areas will be slightly modified to fit the surrounding terrain and may be limited by machinery access. Likewise, the areas identified represent the largest footprint that will likely be disturbed.

5.5.6 Revegetation

The reservoir area revegetation process will consist of six distinct periods listed above and described in more detail below. The aquatic and wildlife habitat restoration process will be closely dependent on the dam removal schedule and will be subject to changes that may be triggered by construction implementation or permitting and access issues.



Figure 5-15 Example of LW being transported and placed with a twin rotor helicopter

Pre-Dam Removal Period (from 2 Years before Drawdown to Drawdown)

In the years before drawdown, the KRRC will focus its revegetation activities on acquisition and close review of existing data about the reservoirs, invasive exotic species mapping and control, collection and propagation of native plant seed in preparation for restoration implementation. The KRRC will conduct an on-site pilot growing test on sediments extracted from the reservoirs in order to determine the initial performance of the seeded vegetation on the substrate under actual field conditions. The KRRC will also survey listed plant and IEV, identify and biologically survey restoration reference sites, test plot growing experiments to determine the best prescriptions for successful establishment of desired species, test sediment, prepare contingency plans, and coordinate with relevant agencies.

Drawdown Period (Drawdown Year - January to March)

The KRRC will aerially seed pioneer seed mixes with a variety of riparian and upland common native and non-native sterile species and mycorrhizal inoculant on all of the exposed reservoir basins during and/or immediately after the drawdown. The KRRC will apply these mixes as the reservoir water level drops and before the exposed sediments dry and form a surface crust, to facilitate expedited seed germination through retained residual soil moisture. The KRRC will re-seed any seeded areas that are re-inundated by larger storm events during the drawdown after flood waters recede. The exposed sediment will not be initially seeded with valuable, less common native species because it may not be able to reliably support native vegetation as it will not immediately possess typical topsoil characteristics; specifically, the soil microbiota component will be missing and many minerals such as iron, manganese, arsenic and vanadium will be at levels toxic to plant life because of their solubility when submerged. Once they are oxidized, within days after drawdown, their plant availability and toxicity will be greatly reduced (Wallace, 2017). Additionally, soil test results have indicated that most of the sediment samples are acidic, have a high clay content, high

shrinkage and swelling factor, high organic content, no soil structure, and are at a high risk of compaction. The KRRC will use the pioneer plant seeding in order to develop soil structure, facilitate the conversion of sterile sediment into productive topsoil for native vegetation through the re-introduction of soil microorganisms into the sediment, and for erosion control. The KRRC will support natural movement of sediment out of the reservoir basins during drawdown by jetting sediment out of key riparian floodplain areas that will be essential for the correct hydrological function and connectivity to the river. The KRRC will transplant existing riparian and wetland plants that can be easily salvaged from the rim of the reservoirs to these newly formed riparian and wetland bank areas. Riparian and wetland zone specific seed mixes, tree and shrub seed, acorns, and pole cuttings will be installed in the riparian and wetland bank zones depending on feasibility and other factors such as weather, water level in the river, availability, and access.

Dam Removal Period (Drawdown Year - March through December)

The KRRC will continue the drawdown period restoration activities in the riparian and wetland bank zones into the dam removal period, including the harvesting and salvaging of existing live riparian and wetland vegetation. The KRRC will continue this work potentially into late May or early June. The KRRC will salvage existing riparian flora that will eventually die as a result of the drawdown as an inexpensive source of viable pole cuttings and mature, locally ecotypic rooted plant material. The KRRC will establish woody riparian species in riparian areas to perform many key ecological functions, provide shaded aquatic riverine habitat for fish, maintain cool water temperatures, and increase natural bank stability and function. To expedite the riparian bank zone development, the KRRC will install irrigation systems along key segments of the river banks where the riparian zone width will warrant this expense. Vegetation zones above the riparian bank zone will have only minimal activities occurring during the spring and summer seasons. The KRRC will monitor cover crop growth and establishment and supplement seeding or local irrigation in areas of poor performance or in case of drought. The KRRC will roll or mow the cover crop in the late fall and broadcast zone-specific seed mixes over the drying and disintegrating cover crop.

Post-Dam Removal Period (First Year after Dam Removal)

During the second year of revegetation, the KRRC will re-seed areas that failed to establish and will collect and install additional pole cuttings. The KRRC will maintain previously seeded and planted areas with intensive weed removal efforts and irrigation system upkeep. The KRRC will install deer fence enclosures in selected floodplain areas. In cases where cover crop mulch has moved/degraded or otherwise exposed bare soil, the KRRC will supplement seeding to help prevent excessive soil erosion. The KRRC will perform inspections during this period to confirm restoration work installation acceptance and an official start of the plant establishment period.

Plant Establishment Period (Year One after Completion of Revegetation)

The most important activities during plant establishment will be IEV control, herbivore control, and irrigation system maintenance. The Contractor will develop a Weed Control Plan with the key objective to limit IEV cover. The KRRC will monitor compliance the Weed Control Plan. The KRRC will monitor IEV and the implementation of timely control measures to control high and medium priority invasive exotic vegetation

(e.g., Himalayan blackberry, yellow star thistle, Russian knapweed, and others listed in Table 5-4). The KRRC will control low priority IEV species only if they interfere with the successful establishment of native vegetation.

Maintenance and Monitoring Period (Years Two to Five after Completion of Revegetation)

The maintenance and monitoring period will consist of activities that will keep revegetation efforts on track to achieve performance criteria set for each monitoring year. It will consist of re-seeding/re-planting of native vegetation (as necessary), invasive plant management, herbivore control, irrigation maintenance and other activities as situations arise (e.g., implementation of erosion repairs). KRRC will base specific activities on the monitoring results and activity thresholds. For purposes of monitoring the revegetation plan success and achieving natural conditions, KRRC will develop performance criteria with the regulatory agencies for upland, riparian floodplain, riparian bank, and wetland zones, as well as for invasive exotic plant management. The general monitoring approach will be to observe the vegetation re-establishment trend, compare it to conditions expected for early-successional habitats in reference areas, and take corrective action when necessary to steer the development trend. KRRC will monitor plant species and cover, the density of woody riparian vegetation, acres of wetlands, and noxious weed levels. Monitoring will occur for a total of five years (one year of plant establishment period and four years of maintenance and monitoring period) or until the performance criteria have been met.

Plant Material Procurement

The KRRC will revegetate the reservoir areas during and after drawdown and dam removal as determined by the monitoring protocols. Although some degree of natural revegetation development will occur, the revegetation approach will use a combination of seeding, pole-cutting installation, tree and shrub seed planting (acorns, samaras, etc.), and salvage/ transplanting of existing vegetation to accelerate the natural succession to stable native plant communities. The KRRC will divide the former reservoir area beds into upland, floodplain riparian, bank riparian, and wetland planting zones and will employ different implementation techniques and plant species will be employed in each zone based on hydrology, sediment texture, slope aspect and other characteristics. Revegetation of each of the proposed planting zones is described in detail below in subsection 5.2.5.

Native Plant Seed Collection and Propagation

The KRRC will seed native grasses, sedges, rushes, forbs and shrubs in all revegetation zones, possibly with addition of a very small amount of sterile wheat to enhance the initial erosion protection function of the herbaceous vegetation. To revegetate the large reservoir beds of the four dams the KRRC will require large quantities of seed, on the order of 200,000 lbs. of pure live seed (PLS).



Figure 5-16 Bluebunch wheatgrass (*Elymus spicatus*) is a perennial native bunchgrass that is common in the uplands above the reservoirs

The most efficient method for acquiring seed for the revegetation will be early collection of native seed from the project vicinity, and subsequent large-scale seed propagation. Because the Project needs a large amount of seed, and the procurement, collection and growing processes are time consuming, the KRRC is beginning this work in 2018. The KRRC will implement these tasks throughout the pre-dam removal, drawdown, dam removal and post dam removal periods.

Collected seed will be grown by specialty commercial growers to produce large amounts of native seed. To achieve good native vegetation coverage, successfully combat invasive vegetation, and effectively prevent soil erosion, KRRC's contractor will seed approximately 80 lbs of pure live seed (PLS) per acre in several steps resulting in the need for about 200,000 lbs. PLS for the 2,500 acres of the project area. To obtain this amount of seed, KRRC's contractor will gather 175 pounds of wild collected seed each of the four years before the 2022 fall season. It is expected that on average 7 lbs. of PLS/acre of wild collected seed will produce at least 2,000 lbs. PLS/acre in agricultural settings on specialized seed propagation farms. The commercial growers will plant native seed on approximately 25 acres, resulting in about 50,000 lbs. The commercial grower will clean and store the seed in climate controlled warehouses and in some cases pre-treat it. The KRRC contacted several large-scale growers and will engage one or more of them in the near future to propagate the native seed. The growers will collect native plant seed from existing vegetation around the reservoirs and within the larger Upper Klamath Basin Watershed. Vegetation inventories were completed around the reservoirs in 2009 and 2010 as part of the EIS/R preparation (USBR, 2011c). The KRRC will conduct a new seed collection areas reconnaissance survey utilizing the previous inventories, and including key tributaries, and other areas within the Upper Klamath River Watershed with an elevational range similar to that around the reservoirs (2,300'–3,800'). The seed collection contractors will implement seed collection in a way that will not cause damage to the existing plant populations or parent plants. During seed collection activities by seed collection contractors, the KRRC will conduct several random inspections to ensure compliance with the specification limiting damage to parent plants. Time, budget or availability constraints may make it necessary to acquire some seed and plant materials from commercial seed companies or nurseries. KRRC will source commercially only species common in similar environmental conditions in the adjacent watersheds, or species that will not be able to reproduce in the project area. The KRRC will conduct investigations of conditions and timing to improve initial germination rate of seed material as part of pre-project test plot revegetation experiments described below in Section 5.6.4.

The KRRC will rely only on mycorrhizal inoculants to promote the long-term growth of seeded native species in the project area. The KRRC will not use fertilizers in the revegetation process unless necessary as determined by soil analyses in areas of poor vegetation establishment. Previously identified (USBR 2011a), and other important species suitable for the reservoir areas' seeding are listed in Table 5-2. The KRRC will use these species as the backbone of the revegetation for the Project and will collect other native species to be used in some planting zones based on suitable soil texture, slope aspect, local topography and hydrology as described below, or as backup species in case native seed collection of keystone species does not produce sufficient amounts of seed (Table 5-2).

The KRRC will collect Oregon white oak (*Quercus garryana*) and California black oak (*Quercus kelloggii*) acorns in the fall after dam removal, for cold stratification through the winter and early spring, and installation in mid- to late spring during the post-dam removal period in the riparian zones and mesic parts of the upland zones if feasible. The KRRC will collect and install additional acorns in the fall of the post-dam removal year. The KRRC will collect and plant seeds of other native woody species based on availability (Table 5-2 below).

Table 5-2 Seeded species Proposed for Collection and Propagation

Common name	Scientific name	Life Form
bigleaf maple	*Acer macrophyllum*	large deciduous tree
common yarrow	*Achillea millefolium var. lanulosa*	perennial herb
Spanish lotus	*Acmispon americanus [Lotus purshianus]*	annual herb
spike bentgrass, spike redtop	*Agrostis exarata*	perennial grass
white alder	*Alnus rhombifolia*	deciduous tree
western serviceberry	*Amelanchier alnifolia*	small deciduous tree
mugwort	*Artemisia douglasiana*	perennial herb
Oregon grape	*Berberis aquifolium*	small evergreen shrub
devil's beggartick	*Bidens frondosa*	annual herb
California brome	*Bromus carinatus*	perennial grass
incense cedar	*Calocedrus decurrens*	large coniferous tree
water sedge	*Carex aquatilis*	perennial herb
slender beak (wheat) sedge	*Carex athrostachya*	perennial herb
Nebraska sedge	*Carex nebrascensis*	perennial herb
woolly sedge	*Carex pellita [lanuginosa]*	perennial herb
clustered field sedge	*Carex praegracilis*	perennial herb
awlfruit sedge	*Carex stipata*	perennial herb
buckbrush	*Ceanothus cuneatus*	evergreen shrub
deerbrush	*Ceanothus integerrimus*	semi-deciduous shrub
birchleaf mountain mahogany	*Cercocarpus betuloides*	semi-deciduous shrub
western water hemlock	*Cicuta douglasii*	perennial herb
smooth dogwood	*Cornus glabrata*	large deciduous shrub
red-osier dogwood	*Cornus sericea*	large deciduous shrub
turkey mullein	*Croton [Eremocarpus] settiger*	annual herb

Common name	Scientific name	Life Form
tufted hairgrass	*Deschampsia caespitosa*	perennial grass
annual hairgrass	*Deschampsia danthonioides*	annual grass
saltgrass	*Distichlis spicata*	perennial grass
needle spikerush	*Eleocharis acicularis*	perennial herb
common spikerush	*Eleocharis macrostachya [palustris]*	perennial herb
bluebunch wheatgrass	*Elymus [Pseudoregneria] spicatus*	perennial grass
squirreltail grass	*Elymus elymoides*	perennial grass
blue wildrye	*Elymus glaucus*	perennial grass
common rabbitbrush	*Ericameria [Chrysothamnus] nauseosa var. leiosperma*	semi-deciduous shrub
common woolly sunflower	*Eriophyllum lanatum*	perennial herb
western goldenrod	*Euthamia occidentails*	perennial herb
small fescue	*Festuca [Vulpia] microstachys*	annual grass
Idaho fescue	*Festuca idahoensis*	perennial grass
red buckthorn	*Frangula [Rhamnus] rubra*	evergreen shrub
Oregon ash	*Fraxinus latifolia*	deciduous tree
meadow barley	*Hordeum brachyantherum ssp. b.*	perennial grass
California barley	*Hordeum brachyantherum ssp. californicum*	perennial grass
Baltic rush	*Juncus balticus*	perennial herb
toad rush	*Juncus bufonius*	perennial herb
common rush	*Juncus effusus var. pacificus*	perennial herb
sword-leaved rush	*Juncus ensifolius*	perennial herb
western rush	*Juncus occidentalis*	perennial herb
iris-leaved rush	*Juncus xiphioides*	perennial herb
junegrass	*Koeleria macrantha*	perennial grass
rice cutgrass	*Leersia oryzoides*	perennial grass
Great Basin wildrye	*Leymus cinereus*	perennial grass
creeping (beardless) wildrye	*Leymus triticoides*	perennial grass
silvery lupine	*Lupinus argenteus*	perennial herb
chick lupine	*Lupinus microcarpus*	annual herb
field mint	*Mentha arvensis*	perennial herb
seep monkey flower	*Mimulus guttatus var. guttatus*	Annual herb
mat muhly	*Muhlenbergia richardsonis*	perennial grass
watercress	*Nasturtium officinale*	perennial herb
knotgrass	*Paspalum distichum*	perennial grass
hot rock penstemon	*Penstemon deustus*	perennial herb
royal penstemon	*Penstemon speciosus*	perennial herb
varied leaf phacelia	*Phacelia heterophylla var. virgata*	perennial herb
Lewis' mock orange	*Philadelphus lewisii*	deciduous shrub
ponderosa pine	*Pinus ponderosa*	coniferous tree
pine (Sandberg) bluegrass	*Poa secunda*	perennial grass

Common name	Scientific name	Life Form
water pepperweed	*Polygonum hydropiperoides*	perennial herb
Klamath plum	*Prunus subcordata*	small deciduous tree
chokecherry	*Prunus virginiana var. demissa*	small deciduous tree
Douglas fir	*Pseudotsuga menziesii var. menziesii*	coniferous tree
antelope brush	*Purshia tridentata*	Deciduous shrub
Oregon white oak	*Quercus garryana*	deciduous tree
California black oak	*Quercus kelloggii*	deciduous tree
fragrant (three-leaf) sumac	*Rhus aromatica [trilobata]*	deciduous shrub
whitestem gooseberry	*Ribes inerme*	deciduous shrub
plateau (desert) gooseberry	*Ribes velutinum*	deciduous shrub
California rose	*Rosa californica*	deciduous shrub
Pacific blackberry	*Rubus ursinus*	deciduous shrub, vine
California dock	*Rumex californicus*	perennial herb
narrow-leaf willow	*Salix exigua*	deciduous shrub
red willow	*Salix laevigata*	large deciduous tree
arroyo willow	*Salix lasiolepis*	deciduous tree
shining willow	*Salix lucida ssp. lasiandra*	deciduous tree
blue elderberry	*Sambucus nigra ssp. caerulea [mexicana]*	large deciduous shrub
hardstem bulrush	*Schoenoplectus [Scirpus] acutus*	perennial herb
broadfruit bur reed	*Sparganium eurycarpum*	perennial herb
rigid hedge nettle	*Stachys ajugoides var. rigida*	Perennial herb
Lemmon's needlegrass	*Stipa [Achnatherum] lemmonii*	perennial grass
western needlegrass	*Stipa [Achnatherum] occidentalis var. occidentalis*	perennial grass
common snowberry	*Symphoricarpos albus*	deciduous shrub
creeping snowberry	*Symphoricarpos mollis*	deciduous shrub
tomcat clover	*Trifolium willdenovii*	annual herb
common cattail	*Typha latifolia*	perennial herb
stinging nettle	*Urtica dioica ssp. holosericea*	perennial herb
California grape	*Vitis californica*	deciduous vine
rough cockleburr	*Xanthium strumarium*	annual herb

Pole Cuttings

The KRRC will engage with restoration contractors to harvest and store live pole cuttings for the Project. The restoration contractor will plant live pole cuttings in the bank wetland, bank riparian and parts of floodplain riparian zones to expedite the recovery of these habitats to natural succession. In existing riparian areas along the Iron Gate, Copco and JC Boyle reservoir edges that contain robust populations of willows and other native riparian species suitable for pole cuttings harvest or whole plant salvaging and transplantation the restoration contractors will cut some of these parent plants to the ground approximately one to two years before dam removal, to increase the number of new stems and suckers available to harvest, and to extend their survival time after drawdown. The restoration contractors will be engaged to harvest and store pole

cuttings for the Project. The restoration contractors will harvest native species listed in Table 5-3 for pole cuttings, as close to planting period (winter to early spring) as possible, maintain the pole cuttings until planting time, and install the pole cuttings in the riparian areas as soon as access is feasible. If there is a need to ship the pole cuttings off-site for storage, the restoration contractors will ensure the pole cuttings are refrigerated and held for a maximum of 3 months to ensure viability (Tilley and John, 2012), (Logar and Scianna et al., 2005). The restoration contractor will plant the pole cuttings between February and March, if possible, and year-round with sufficient supplemental irrigation, or on high ground water table, if necessary.



Figure 5-17 Sandbar willow is an important riparian bank shrub that provides shade over water surface, reducing temperatures. The background tree is Oregon ash.

Table 5-3 Primary Pole Cutting Species to be Collected and Stored

Common name	Scientific name	Lifeform
western serviceberry [2]	*Amelanchier alnifolia*	small deciduous tree
smooth dogwood [3, 12]	*Cornus glabrata*	large deciduous shrub
red-osier dogwood [1, 8]	*Cornus sericea*	large deciduous shrub
black cottonwood [5, 11, 12]	*Populus balsamifera ssp. trichocarpa*	large deciduous tree
fragrant (three-leaf) sumac [6]	*Rhus aromatica [trilobata]*	deciduous shrub
California rose [11, 12]	*Rosa californica*	deciduous shrub
Pacific blackberry [7]	*Rubus ursinus*	deciduous shrub, vine
narrowleaf willow [1, 9, 7, 12]	*Salix exigua*	large deciduous shrub
red willow [1, 4]	*Salix laevigata*	large deciduous tree
arroyo willow [1, 12]	*Salix lasiolepis*	small deciduous tree
shining willow [1, 12]	*Salix lucida*	small deciduous tree
common snowberry [1, 10]	*Symphoricarpos albus*	deciduous shrub

Footnotes:

1 Source: Burgdorf, 2007. 2 Source: USDA, 2002. 3 Source: CNPS, 2014a. 4 Source: CNPS, 2014b. 5 Source: USDA, 2018. 6 Source: Taylor, 2004. 7 Source: WSU, 2003. 8 Source: CNPS, 2014c. 9 Source: Tilley and Loren, (2012). 10 Source: Darris, (2002). 11 Source: Holzworth and Batchelor, (1984). 12 Shaded rows indicate keystone species.

Invasive Exotic Vegetation Control

The KRRC will integrate the control of IEV with the revegetation work. The focus of this RAMP is on extensive seeding of diverse native species and a robust monitoring schedule for early detection and control of IEV as described below in Section 6.1.4. The KRRC will begin active control of IEV in the project areas several years

before drawdown and will continue until the required performance criteria are met. The KRRC will use revegetation and weed control to accelerate succession and help reduce the amount of open space available for exotic species establishment.

The KRRC will evaluate all methods of invasive species control for both their benefits and their risks to the surrounding ecosystems. The KRRC will control IEV through manual weed pulling, mowing or cutting, mechanical eradication by tilling in larger areas, grazing, shading (covering ground with paper or black plastic), and solarization (covering ground with clear plastic). The KRRC will apply herbicides as a last resort and upon approval, application of herbicides will be used if necessary, either by brushing (stumps and cut stems), wicking and/or spraying. The benefits and constraints of each technique are summarized below:

- Hand pulling. The KRRC will use this method on a limited basis for controlling small IEV infestations, emerging infestations or infestations at the fringes of a large patch as hand pulling is typically more effective on annual species and species that are not rhizomatous.
- Mowing or cutting. The KRRC will use this method for invasive annuals and to reduce seed production in biennials and perennials to prevent seed set, exhaust the nutrient reserves, and reduce plant vigor, and reduce the buildup of thatch, as is common in infestations of medusahead and goat grass, so that native species seed has access to light for germination. The KRRC will use this method in areas where there are extensive solid stands of invasive species to avoid damage to native species.
- Tilling and Disking. The KRRC will use this method as an agricultural weed eradication method in solid stands of invasive species, in order to disrupt and bury the plant or to separate the root from the plant after soil dries out to have the largest impact. The KRRC will use this method only in level heavily infested areas where erosion is not a concern and culturally significant resources are not expected.
- Grazing. The KRRC will use this method of control of invasive vegetation palatable for cattle, sheep and goats and the timing, quantity and will select the type of livestock to address different invasive species.
- Solarization. This technique can kill not only the plant but the seeds of most plant species. (Moyes et al., 2005) and involves heating the soil by capturing the radiant energy from the sun, by air-tightly covering the infested ground with plastic for at least 4-6 weeks. The KRRC will use this technique only in areas where there are large swathes of invasive vegetation and during the warm season.
- Herbicides –The KRRC will use this method only when other methods prove to be ineffective or could potentially cause more harm than benefit within the environment. The KRRC will use only herbicides that have been approved for use by the BLM, California Department of Fish and Wildlife (CDFW), Oregon Department of Fish and Wildlife (ODFW), Regional Water Quality Control Board (RWQCB), U.S. Fish and Wildlife Service (USFWS) and NMFS in both California and Oregon. The KRRC will evaluate the effect of all potential herbicides on aquatic species. If herbicide application becomes the necessary method for effective IEV removal, the KRRC will consider only those application methods with the least side-effects to native vegetation and wildlife and will base application methods on plant reproduction, structure, and growth.

After a close review of available documentation on the past extent of IEV in the project area prepared by PacifiCorp's consultants and the BLM, the KRRC determined that the information is dated, and that surveys reflecting the current condition are needed in order to effectively eradicate IEV in the project area to the maximum extent feasible. The KRRC will survey an area from the existing water line to the project boundary to obtain information on the exact location of each invasive species and information on the diversity of invasive species in the limits of work, and develop a GIS based IEV map set for the project area in order to prepare an effective and targeted IEV eradication plan. The KRRC began IEV surveys in the project area in the fall of 2017. Based on California Department of Fish and Wildlife (CDFW) definition, and for the purposes of this Project: "*Invasive species are organisms that are not native to an environment, and once introduced, they establish, quickly reproduce, spread, and cause harm to the environment, economy, or human health*" (REF). Table 5-4 lists previously observed, and potentially occurring IEV species in the project area, and their state, county, and other agency invasiveness ratings. The KRRC will coordinate closely with the objectives of the various agencies with jurisdiction over the project area, because they will most likely steward this land in the long term. Based on Table 5-4 a final IEV control target species list will be developed consisting of plants with the largest potential to (1) spread quickly, (2) take over extensive areas, (3) compete for resources with native species, and (4) cause any other environmental damage. The KRRC will review the IEV control target species list and refine with the resource agencies and other stakeholders involved in the Project to form the backbone of the IEV removal plan which will span from the pre-dam removal period to the end of the KRRC long-term maintenance and monitoring period. The KRRC will adaptively manage IEV removal throughout the revegetation process as discussed.

Table 5-4 Invasive exotic plant species present in the project area with a potential to re-establish.

Scientific Name	Common Name	CDFA[1]	ODA[2]	Cal-IPC[3]	Klamath County[4]	Siskiyou County[5]	Klamath NF[6]	# of Agencies[7]	Priority[8]
Chondrilla juncea	skeleton weed	AW	B & T	Moderate	A	CA-A	High	5	High
Centaurea diffusa	diffuse knapweed	AW	B	Moderate	A	CA-A	High	4	High
Centaurea virgata ssp. squar.	squarrose knapweed	NR	A & T	Moderate	A	CA-A	High	4	High
Euphorbia esula	leafy spurge	AW	B & T	NR	B	CA-A	High	4	High
Onopordum acanthium	Scotch thistle	AW	B	High	B	CA-A	High	4	High
Acroptilon repens	Russian knapweed	BW	NR	Moderate	A	CA-A	High	3	High
Carduus acanthoides	plumeless thistle	AW	NR	limited	A	NR	High	3	High
Centaurea stoebe ssp.micr.	spotted knapweed	NR	B	High	B	CA-A	High	3	High
Cytisus scoparius	Scotch broom	BW	B	High	A	CA-C	High	3	High
Lepidium latifolium	perennial pepperweed	BW	B & T	High	B	NR	High	3	High
Lythrum salicaria	purple loosetrife	BW	B	High	A	NR	High	3	High
Carduus nutans	musk thistle	AW	B	Moderate	B	CA-A	High	2	High
Fallopia japonica	Japanese knotweed	BW	NR	Moderate	A	NR	High	2	High
Linaria dalmatica	Dalmatian toadflax	NR	B	Moderate	B	CA-A	High	2	High
Onopordum tauricum	Taurian thistle	AW	A	NR	NR	NR	High	2	High

Scientific Name	Common Name	CDFA[1]	ODA[2]	Cal-IPC[3]	Klamath County[4]	Siskiyou County[5]	Klamath NF[6]	# of Agencies[7]	Priority[8]
Sonchus arvensis	field sowthistle	AW	NR	NR	NR	NR	High	2	High
Tamarix parviflora	small flower tamarisk	NR	NR	High	NR	NR	High	2	High
Anchusa officinalis	alkanet	NR	B & T	NR	NR	NR	NR	1	Medium
Bromus madritensis ssp. rubens	foxtail brome	NR	NR	High	NR	NR	NR	1	Medium
Bromus tectorum	cheatgrass	NR	NR	High	NR	NR	NR	1	Medium
Centaurea solstitialis	yellow starthistle	CW	B	High	B	CA-C	Moderate	1	Medium
Cirsium ochrocentrum	Beaumont thistle	AW	NR	NR	NR	NR	NR	1	Medium
Convolvulus arvensis	field bindweed	CW	B & T	NR	NR	NR	NR	1	Medium
Crupina vulgaris	bearded creeper	AW,Q	B	Limited	NR	NR	NR	1	Medium
Dipsacus fullonum	teasel	NR	B	Moderate	A	NR	NR	1	Medium
Elymus caput-medusae	medusahead	CW	B	High	C	NR	NR	1	Medium
Foeniculum vulgare	fennel	NR	NR	Moderate	NR	NR	High	1	Medium
Halogeton glomeratus	saltlover	AW	B	Moderate	NR	NR	NR	1	Medium
Isatis tinctoria	dyer's woad	BW	B	Moderate	A	CA-B	Moderate	1	Medium
Linaria vulgaris	butter and eggs	NR	B	Moderate	A	NR	NR	1	Medium
Phalaris arundinacea	reed canary grass	NR	B & T	Not Listed	NR	NR	NR	1	Medium
Rubus armeniacus	Himalayan blackberry	NR	B	High	NR	NR	NR	1	Medium
Salvia aethiops	Mediterranean sage	BW	B	Limited	B	NR	High	1	Medium
Tribulus terrestris	puncture vine	CW	B	Limited	B	NR	High	1	Medium
Xanthium spinosum	spiny clotbur	NR	B	None	A	NR	NR	1	Medium
Aegilops cylindrica	goatgrass	BW	B	Watch	NR	NR	NR	0	Low
Avena barbata	slender oat	NR	NR	Moderate	NR	NR	NR	0	Low
Brassica nigra	black mustard	NR	NR	Moderate	NR	NR	NR	0	Low
Bromus diandrus	ripgut grass	NR	NR	Moderate	NR	NR	NR	0	Low
Cirsium arvense	Canada thistle	BW	B	Moderate	B	CA-B	Moderate	0	Low
Cirsium vulgare	bull thistle	NR	B	Moderate	C	CA-C	Low	0	Low
Conium maculatum	poison hemlock	NR	B	Moderate	B	NR	Low	0	Low
Festuca arundinacea	tall fescue	NR	NR	Moderate	NR	NR	NR	0	Low
Hirschfeldia incana	summer mustard	NR	NR	Moderate	NR	NR	NR	0	Low
Hordeum murinum	foxtail barley	NR	NR	Moderate	NR	NR	NR	0	Low
Hypericum perforatum	Klamath weed	CW	B	Limited	B	NR	Low	0	Low
Lepidium draba	hoary cress	BW	NR	Moderate	B	NR	Moderate	0	Low
Leucanthemum vulgare	oxeye daisy	NR	NR	Moderate	NR	NR	NR	0	Low
Marrubium vulgare	white horehound	NR	B	Limited	NR	NR	NR	0	Low
Mentha pulegium	pennyroyal	NR	NR	Moderate	NR	NR	NR	0	Low
Persicaria wallichii	Himalayan knotweed	BW	NR	Watch	NR	NR	NR	0	Low

Scientific Name	Common Name	CDFA[1]	ODA[2]	Cal-IPC[3]	Klamath County[4]	Siskiyou County[5]	Klamath NF[6]	# of Agencies[7]	Priority[8]
Rumex acetosella	common sheep sorrel	NR	NR	Moderate	NR	NR	NR	0	Low
Torilis arvensis	field hedge parsley	NR	NR	Moderate	NR	NR	NR	0	Low

Footnotes: (Lighter cells indicate a high priority to the corresponding agency)

1. California Department of Food and Agriculture (CDFA): California Noxious Weed List (CDFA, 2016); Ratings descriptions as follows:

"A" A pest of known economic or environmental detriment and is either not known to be established in California or it is present in a limited distribution that allows for the possibility of eradication or successful containment. If found entering or established in the state, A-rated pests are subject to state (or commissioner when acting as a state agent) enforced action involving eradication, quarantine regulation, containment, rejection, or other holding action.

"B" A pest of known economic or environmental detriment and, if present in California, it is of limited distribution. At the discretion of the individual county agricultural commissioner they are subject to eradication, containment, suppression, control, or other holding action.

"C" A pest of known economic or environmental detriment and, if present in California, it is usually widespread. If found in the state, they are subject to regulations designed to retard spread or to suppress at the discretion of the individual county agricultural commissioner. There is no state enforced action other than providing for pest cleanliness.

"Q" An organism or disorder suspected to be of economic or environmental detriment, but whose status is uncertain because of incomplete identification or inadequate information.

"W" This notation indicates that a plant is included in the CCR Section 4500 list of California State Noxious Weeds.

2. Oregon Department of Agriculture (ODA) Noxious Weed Policy and Classification System (ODA, 2017). (Equivalent to the Pacific Northwest Invasive Plant Council (PNW-IPC)). Ratings descriptions as follows:

A A weed of known economic importance which occurs in the state in small enough infestations to make eradication or containment possible; or is not known to occur, but its presence in neighboring states make future occurrence in Oregon seem imminent. Recommended action: Infestations are subject to eradication or intensive control when and where found.

B A weed of economic importance which is regionally abundant, but which may have limited distribution in some counties. Recommended action: Limited to intensive control at the state, county or regional level as determined on a site specific, case-by-case basis. Where implementation of a fully integrated statewide management plan is not feasible, biological control (when available) shall be the primary control method.

T A designated group of weed species that are selected and will be the focus for prevention and control by the Noxious Weed Control Program. Action against these weeds will receive priority.

3. California Invasive Plant Council (CAL-IPC). The Cal-IPC Plant Inventory (Cal-IPC, 2018). Ratings descriptions as follows:

High These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment.

Moderate These species have substantial and apparent-but generally not severe-ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance.

Limited These species are invasive but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.

Alert An Alert is listed on species with High or Moderate impacts that have limited distribution in California, but may have the potential to spread much further.

Watch	These species have been assessed as posing a high risk of becoming invasive in the future in California.

4. Klamath County Board of Commissioners (KCBC). Noxious Weeds in Klamath County for the year 2018 (KCBC, 2018). Ratings descriptions as follows:

A	A weed of known economic importance which occurs in the county in small enough infestations to make eradication/containment possible, or if not known to occur, but its presence in neighboring counties make future occurrence in Klamath County seem imminent.
B	A weed of economic importance which in some parts of the county is abundant, but may have limited distribution in other parts of the county. Where implementation of a fully integrated county wide management plan is infeasible, biological control shall be the main control approach.
C	A weed which in most parts of the county is abundant. While not subject to enforcement regulations, these species can cause similar economic and ecological impacts as other noxious weed species. Education and control recommendations will be the main approach.

5. Siskiyou Department of Agriculture (SDA). Identification and Characteristics of Invasive Noxious Weed Infestations. (SDA, 2015). Ratings:

A	"A" Rated: A pest of known economic or environmental detriment and is either not known to be established in California or it is present in a limited distribution that allows for the possibility of eradication or successful containment. A-rated pests are prohibited from entering the state. A-rated pests are subject to state (or commissioner) enforced action involving eradication, quarantine regulation, containment, rejection, or other holding action.
B	"B" Rated: A pest of known economic or environmental detriment and it is of limited distribution. Subject to state endorsed holding action and eradication to provide for containment. At the discretion of the individual county agricultural commissioner they are subject to eradication, containment, suppression, control, or other holding action.
C	"C" Rated: A pest of known economic or environmental detriment and is usually widespread. They are subject to regulations designed to retard spread or to suppress at the discretion of the individual county agricultural commissioner. There is no state enforced action other than providing for pest cleanliness.

6. U.S. Forest Service (USFS-KNF): Klamath National Forest Noxious Weed and Non-native Invasive Plant List (KNF, 2013). Ratings descriptions as follows:

High	These species are currently either limited in distribution, highly invasive, or not present on the KNF. Treatment may vary by location.
Moderate	These species are generally common, and are treated on a case by case basis depending on location (Wilderness and Research Natural Area (RNA) increase the priority for treatment).
Low	These species are either widespread throughout the KNF, or are not considered to be highly invasive in our area. Usually not treated unless located in a high priority area, such as Wilderness or RNA.

7. Number of Agencies Considering Plant a High Priority for Eradication
8. Invasive Exotic Vegetation (IEV) Survey and Control Priority

Integrated Pest Management in the project area will consist of the following key elements:

- Prevent invasive exotic weeds from establishing through use of weed-free plant materials and straw. KRRC will employ experienced seed production companies and will provide seed analysis for each collected and propagated species indicating seed purity, weed and hard seed amounts. KRRC will inspect any containerized plants or transplants for presence of invasive weeds. KRRC will allow only certified weed free straw.
- Regular monitoring to facilitate early detection of emerging invasive exotic weeds. Monitoring will consist of bi-weekly surveys of the areas and tagging or immediate removal of invasive weeds during the establishment period (Year One), and less frequent surveys (monthly) in later years. See section 6.1.3 for further details about this schedule.

- Utilize appropriate and cost-effective strategies to reduce or eliminate weed populations. Typical methods include cultural, biological, mechanical, and chemical control methods.
- KRRC's contractor will use chemical herbicides only when they offer an effective method for control and eradication of noxious weeds and when all other methods have failed. Herbicides will be applied by a certified applicator and in accordance with all applicable laws and regulations.
- Establish a program of monitoring and observation to determine the effectiveness of the applied weed control methods.

KRRC's contractor will use the following best management practices to control the emergence and limit the spread of invasive exotic weeds:

- Planning and scheduling - Coordinate weed management with all aspects of the revegetation and dam removal management activities to prevent introduction of any new weed species into the project area and limit existing weed species to no greater occurrence than currently present on nearby reference sites. Weed populations maps that were created in 2003 by PacifiCorp consultants will be updated, and weed areas close to revegetation areas, limits of work, and access roads will be treated before work begins to reduce the risk of spreading the weeds.
- Training – Require or encourage weed awareness and prevention efforts among staff and contractors through contract requirements of incentives. Distribute Weed Control Guidelines that will be prepared by the restoration contractor based on the construction specifications requirements.
- Cleaning machinery – Control the spread of weeds to newly exposed ground through cleaning of construction equipment.
- Expedite revegetation with native plants.
- Implement appropriate weed control methods – Methods available for weed control depend upon the severity of the infestation and the lifecycle stage at which the weed is observed. Mechanical and chemical methods are available to control many weeds, although caution must be exercised that mechanical control methods do not contribute to the spread of invasive exotics. Chemical control will adhere to label requirements. Herbicides must be on regulatory agencies approved chemical list.
- Assign weed severity priority – As weeds are identified in the limits of work, they will be classified according to the California Invasive Plant Council (Cal IPC) and Oregon Department of Agriculture. Weed control will be prioritized based on classification and potential to interfere with revegetation efforts.
- Monitor to identify and eradicate any invasive exotic species impeding achievement of the revegetation objectives – The Weed Control Plan will require strict adherence to the monitoring schedule and regularly planned weed removal activities.
- Evaluate effectiveness – A continual process of active management ensures the success of the weed control program.
- Revisit and reestablish goals or methods to achieve the objective – Methods will be adjusted in the event that either the Weed Control Plan and Guidelines prove inadequate to limit the spread of the

weeds present to the baseline condition, or new species are introduced requiring the development of a new weed control strategy and plan.

This adaptive approach to weed management is illustrated below in Section 6, which further discusses adaptive management and monitoring of the sites.

Irrigation

The project area lies in an inland area on the California/Oregon border with very high evapotranspiration rates and an extended dry season with little or no precipitation in the late spring, summer, and early fall. The KRRC will provide only the Bank Riparian Zone with an irrigation system in order to establish robust vegetation in that zone for the re-establishment of ecological functions in and along the river. The two planting zones below the Riparian Bank Zone (Bank Wetland and Emergent Wetland) will be able to draw sufficient amounts of water from the river and irrigation runoff. The KRRC will intermittently irrigation planting zones above the Riparian Bank Zone with a temporary irrigation system that will be setup only if initial restoration efforts are unsuccessful because of lack of water or extended drought. This temporary system will consist of aluminum latch lateral irrigation pipe with sprinkler risers. The KRRC will initially provide the seed of woody plants (oak acorns, juniper berries, pine nuts, Oregon ash samaras and shrub seeds) in planting areas above the Riparian Bank Zone with water through biodegradable, paper mache derived, donut shaped containers that will be installed in the ground and, surround the seed (Figure 5-19).



Figure 5-18 Aluminum Latch Pipe and Sprinklers

The KRRC will install independent irrigation systems in the Riparian Bank Zone. The KRRC will install a "permanent" irrigation system that is a surface mounted PVC pipe with tall irrigation risers and large throw rotary gear sprinkler heads for the duration of the KRRC maintenance and monitoring period. The KRRC will design the irrigation system with proper sprinkler spacing and pipe sizing to prevent erosion and runoff while matching the infiltration rate of the existing soil. The irrigation system will draw water from the river by portable, skid mounted, gas powered pumps set up on the bank of the river in heavy duty shallow plastic basins to prevent spills. In addition to pumps, the irrigation system will consist of main and lateral PVC lines, isolation, quick coupling and control valves, in-line filters, irrigation controllers and other accessories. Irrigation sprinklers will be installed on 4'-6' high risers braced in three directions with #4 rebar and spaced at a distance of 50'-80' and will provide full, head-to-head irrigation coverage. Irrigation heads will be installed at the boundary between the Bank Riparian and Floodplain Riparian Zones to allow for partial irrigation of the Floodplain Riparian Zone without full head-to-head

coverage. Their throw, arc and angle will be fully adjustable to facilitate quick field adjustments. The precipitation rate of the nozzles used in the irrigation heads will closely match the soil infiltration and site evapotranspiration rates. Irrigation lines will be schedule 40 PVC pipe installed on the surface of the ground and anchored with U-shape bent #3 rebar staples. Pipes will be sized to maintain flow and pressure required for proper performance of each sprinkler head, while maintaining pipe water velocities below five feet per second, reducing risk of pipe damage and friction losses. Selected pipes will be sufficiently oversized to accommodate future expansion of the irrigation system into adjacent riparian areas upstream and downstream of the primary floodplain areas if this is necessary in order to provide water to these areas because of extended drought.



Figure 5-19 Irrigation cocoon installed around the base of a tree seedling.

Irrigation system control valves may be both remotely and manually operable and will be designed to operate each individual lateral branch of the system. This will enable the maintenance contractor to run laterals independently as necessary during irrigation events to accommodate areas with warmer aspects with larger amount of water. Valves will be grouped together and installed inside a locking valve box or series of boxes near the irrigation pump to facilitate easy central operation. An in-line filter with cleanable stainless steel #200 mesh screen elements will be installed on the main line downstream of the pump before it branches out. The filter will be important for reliable functioning of the irrigation head nozzles and even water distribution. Additional pre-filtering of river water will be also provided through the submersible suction basket anchored in a still area of the river. A metal wire mesh cage with openings small enough to prevent small fish entry will house the suction basket. The irrigation controllers will be either removable or mounted directly on top of control valves and will be adequately sized for the required number of irrigation valves. They will be either battery or ambient light powered and will allow for independent schedule setting of each individual irrigation valve. Other potential irrigation accessories important for smooth operation of the

system will be quick couplers to allow for hose watering of selected areas, low point drainage valves for irrigation system winterization, pressure gages, and air relief valves. The irrigation system will be well designed both for potential flooding events and for vandalism or theft.



Figure 5-20 Carmel River riparian bank zone irrigation system

Revegetation Planting Zones

The project area will be divided into the following nine distinct planting zones based on expected hydrology:

1. Emergent Wetland
2. Bank Wetland
3. Bank Riparian
4. Floodplain Riparian
5. Uplands below Rocky Wake Zone
6. Rocky Wake Zone
7. Uplands above Rocky Wake Zone
8. Upland Stockpiles
9. Undisturbed Uplands

The KRRC will determine the distribution and planform of the planting zones within the project area by local hydrology, soils data, flood water surface elevations, historical maps and photographs, and reference site information. Initially, at the time of winter drawdown, KRRC's contractor will seed the project area with pioneer species capable of dealing with the poor soil conditions, inclement weather, and complex hydrology at the time of aerial seeding. The pioneer seed mix will contain common native plant species, sterile wheat, and mycorrhizal inoculant. The pioneer seed mix will be developed based on site pilot growing experiments to ensure quick erosion control, expedient reconstruction of topsoil microbiology, effective adaptation to

initial sediment toxicity, and good invasive vegetation suppression. The KRRC will broadcast planting zone specific permanent seed at the end of the dam removal period, in the fall of the drawdown year. The KRRC will adaptively perform several repeat seedings as necessary during the first two years after drawdown in order to increase native vegetation coverage in underperforming areas.

The KRRC will select native species for the planting zones based on plants known to be native in the project area, expected to establish readily, and anticipated to thrive within their planting zones. The KRRC will conduct small-scale test plot growing experiments to determine the most effective species selection for each planting zone, seeding rate, timing, and other factors in order to meet the goals of the Project. Planting material collected on-site will be used as transplants or as nursery stock to propagate additional seed or plants in the required amounts.



Figure 5-21 Existing emergent wetland zone with hardstem bulrush below Iron Gate Dam.

Emergent Wetland Zone

The emergent wetland zone will consist of restoration areas of low water velocities that occur approximately between the base flow water surface elevation and 2-ft water depth as they occur in several segments of the river near the reservoirs (Figure 5-21). These zones will be adjusted on a case by case basis and depending on local topography and modelled water velocities. Many emergent wetland areas within the drawdown areas are expected to support river imported wetland vegetation propagules readily. Emergent wetland areas may re-vegetate naturally and relatively quickly where hydrology is favorable, however, this may include the risk of invasive exotic plant colonization of the same habitats earlier and faster, and the substantial cost associated with the invasives' removal and replacement with native species. Potential invasive species can include reed canarygrass and tall fescue at the upper edges, tamarisk, pennyroyal, and purple loosestrife. Active revegetation of emergent wetland areas will consist of relocation of existing emergent vegetation from the rim of the reservoirs to suitable newly formed emergent wetland habitats with slower moving water. Wetland species such as common cattail, hardstem bulrush, broad fruit burr-reed, sedges, rushes, and spikerushes will be transplanted and installed using transplants and ballast buckets Figure 5-22 and Figure 5-24) made of coir fabric, and weighed down with cobbles to reduce their buoyancy and potential to be washed out during high flows. This will happen during or immediately after drawdown, in late winter or early spring. To prevent desiccation and die-off of the existing reservoir rim vegetation before relocation, small areas with high densities of existing emergent wetland vegetation will be bermed off with clayey soil and irrigated to maintain a pool of water or saturated soil until transplantation. The salvaged plants will be planted 20' on center (O.C.) along the banks of the river. The

following spring, once the plants have established, propagules will be harvested from installed salvaged plants and planted 10' O.C., between the plants from the prior year. The native wetland plant species proposed for the emergent wetland zone are listed in Table 5-5.

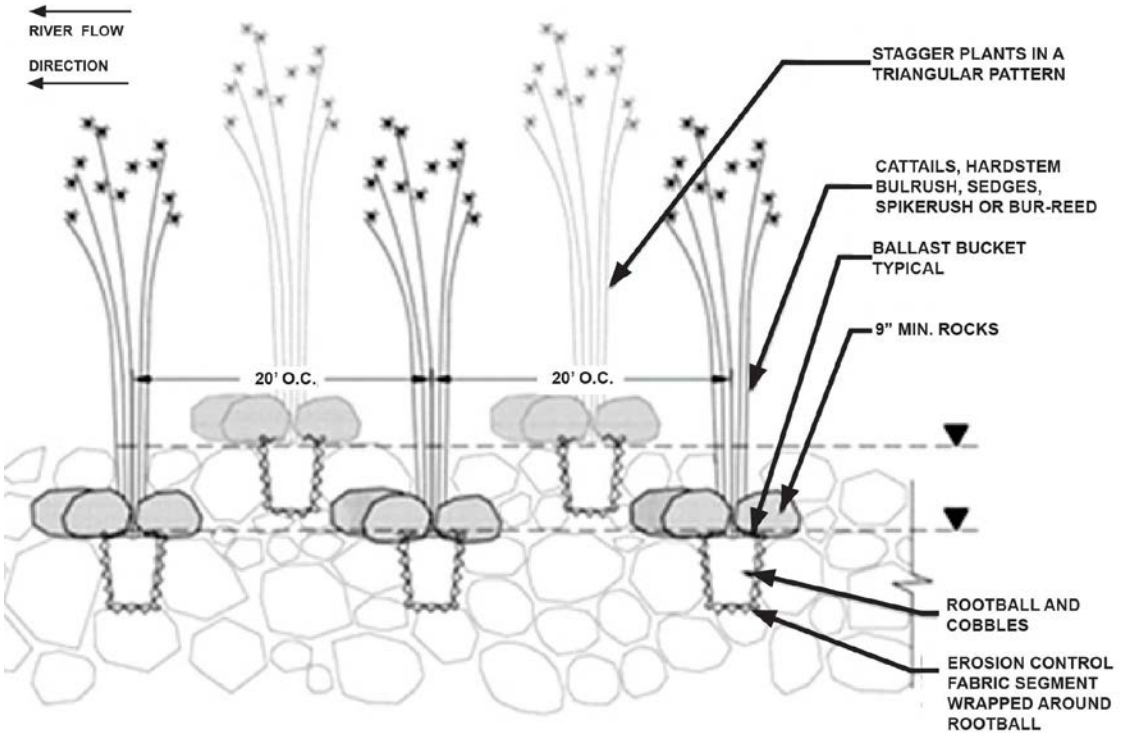


Figure 5-22 Coir fabric and cobble ballast buckets with emergent wetland vegetation.

Table 5-5 Native plant species proposed for the Emergent Wetland Zone

Common name	Scientific name	Lifeform
devil's beggartick *	*Bidens frondosa*	annual herb
water sedge	*Carex aquatilis*	perennial herb
Nebraska sedge *	*Carex nebrascensis*	perennial herb
woolly sedge *	*Carex pellita [lanuginosa]*	perennial herb
awlfruit sedge *	*Carex stipata*	perennial herb
western water hemlock	*Cicuta douglasii*	perennial herb
needle spikerush	*Eleocharis acicularis*	perennial herb
common spikerush	*Eleocharis macrostachya [palustris]*	perennial herb
Baltic rush *	*Juncus balticus*	perennial herb
iris-leaved rush *	*Juncus xiphioides*	perennial herb
rice cutgrass *	*Leersia oryzoides*	perennial grass
watercress *	*Nasturtium officinale*	perennial herb

Common name	Scientific name	Lifeform
water pepperweed *	*Polygonum hydropiperoides*	perennial herb
hardstem bulrush *	*Schoenoplectus [Scirpus] acutus*	perennial herb
broadfruit bur reed *	*Sparganium eurycarpum*	perennial herb
common cattail *	*Typha latifolia*	perennial herb

* keystone species



Figure 5-23 Bank wetland area at J.C. Boyle Reservoir

Bank Wetland Zone

Bank wetland zones will be delineated as areas suitable for plant growth approximately between the base flow and 2-year flood event water surface elevations (Q_2), similar to where they currently occur within the project boundary (Figure 5-23). These zones will be adjusted on a case by case basis and depending on local topography.

Many bank wetland areas within the reservoir basins after drawdown are expected to support existing and river imported wetland vegetation propagules more readily than the species seeded in the riparian seed mix. The seed bank germination study indicated a high degree of viability and variability of wetland species seed in the reservoir deposit (see USBR, 2011b), even after many years or even decades under water. This suggests wetland areas may re-vegetate naturally and relatively quickly where hydrology is favorable, however, because of the critical importance of this zone for the health of the river, the anadromous fish, and the high risk of invasive exotic plant establishment in this zone, it will be revegetated by seeding, transplanting of salvaged vegetation, pole cutting and ballast bucket installation. The proposed layout is shown in Figure 5-25 and the anticipated native wetland species are listed in Table 5-6. All of these plants are already present in the project area.

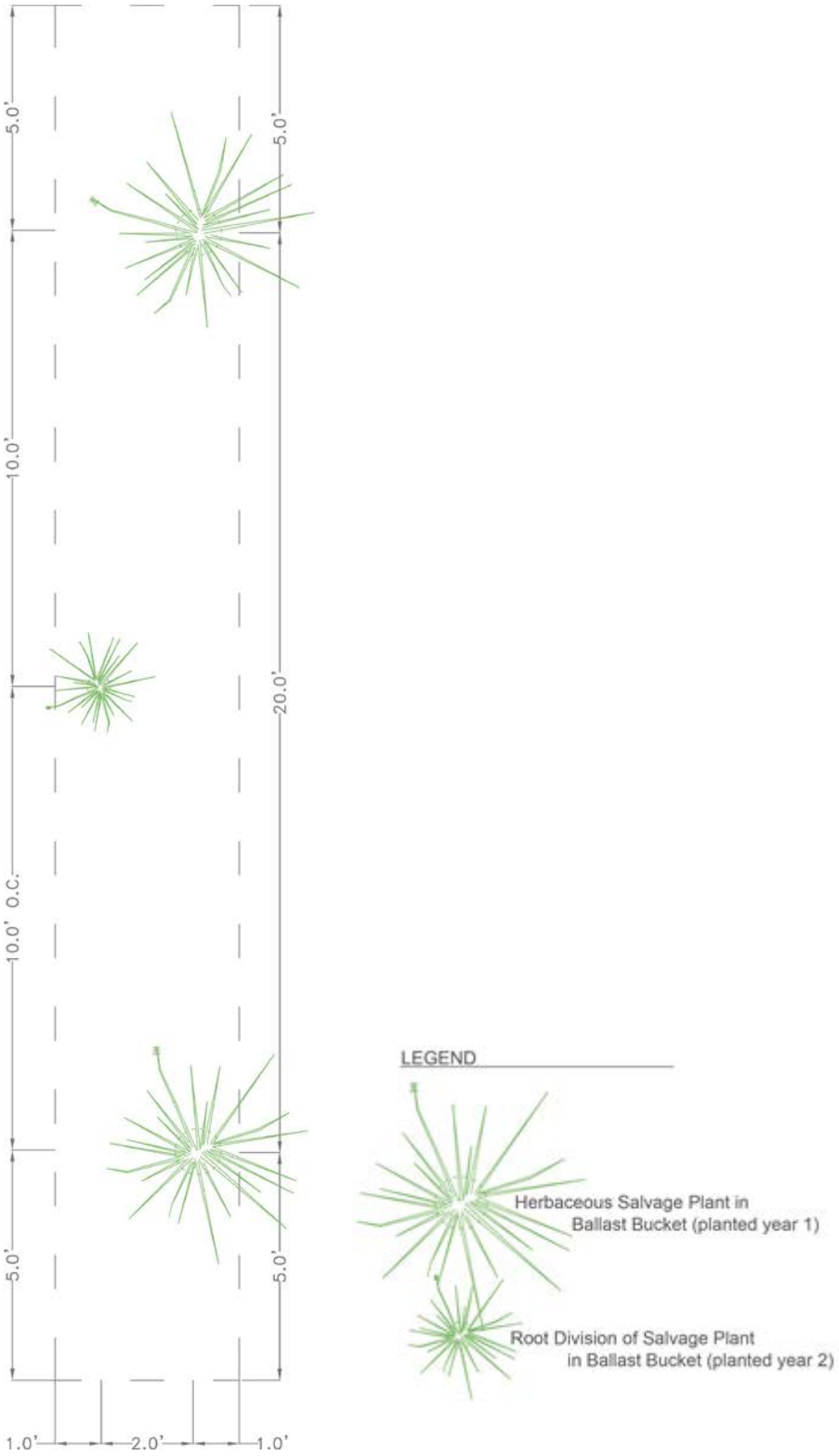


Figure 5-24 Emergent wetland typical plant layout.

Bank wetland areas will be very susceptible to non-native exotic plant invasions. A number of wetland invasives already occur in the project area and are listed in Table 5-4. The most widespread invasive exotic species present along the banks of the reservoirs are reed canarygrass (*Phalaris arundinacea*), pennyroyal (*Mentha pulegium*), and teasel (*Dipsacus fullonum*).

After reservoir drawdown, a re-assessment of areas selected for installation of salvaged riparian plants and pole cuttings will be performed in the field. The best suitable areas for the planting of pole cuttings, and for the transplanting of reservoir rim riparian trees, will be identified along the banks of the Klamath River based on environmental factors such as sediment depth, accessibility, soil texture, local topography, slope, aspect, and hydrology described in detail below.

Four pole cuttings and one transplant from the existing reservoir rim vegetation also be installed every 100 SF. This will occur in the initial stage of planting in the early spring after drawdown. Plant layout for all cuttings will be performed by the contractor's crews marking each planting spot with a pin flag for an overall review by a restoration ecologist. In the early spring of the following year, an additional one pole cutting per 100 SF will be laid out and installed (Figure 5-25).

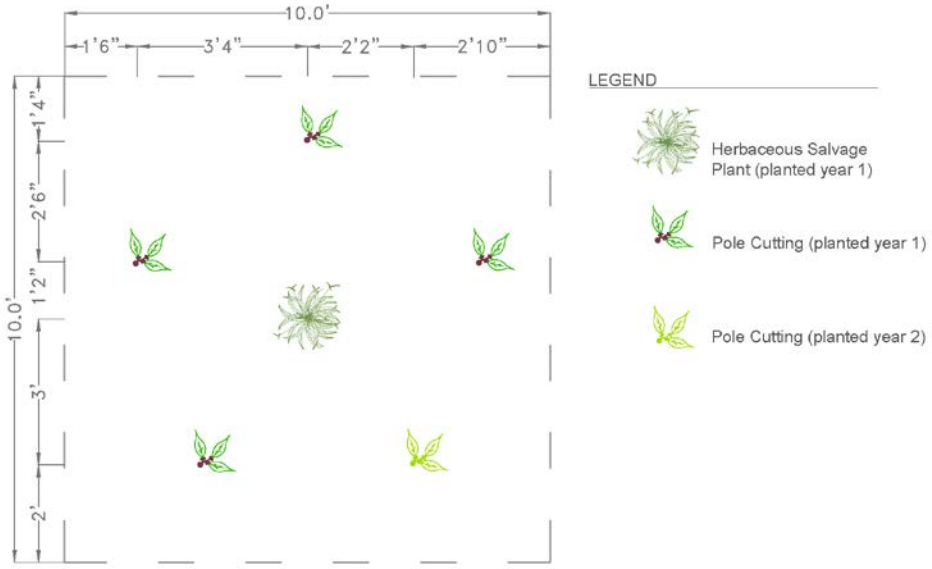


Figure 5-25 Bank Wetland Typical Layout

Table 5-6 Native plant species proposed for the Bank Wetland Zone

Common name	Scientific name	Lifeform
white alder *	*Alnus rhombifolia*	deciduous tree
mugwort	*Artemisia douglasiana*	perennial herb
slender beak (wheat) sedge	*Carex athrostachya*	perennial herb
Nebraska sedge	*Carex nebrascensis*	perennial herb
woolly sedge	*Carex pellita [lanuginosa]*	perennial herb
awlfruit sedge *	*Carex stipata*	perennial herb
common spikerush *	*Eleocharis macrostachya [palustris]*	perennial herb
common horsetail *	*Equisetum arvense*	fern-like herb
western goldenrod	*Euthamia occidentails*	perennial herb
Baltic rush	*Juncus balticus*	perennial herb
common rush	*Juncus effusus var. pacificus*	perennial herb
sword-leaved rush *	*Juncus ensifolius*	perennial herb
western rush *	*Juncus occidentalis*	perennial herb
iris-leaved rush	*Juncus xiphioides*	perennial herb
seep monkeyflower	*Mimulus guttatus var. guttatus*	Annual herb
knotgrass	*Paspalum distichum*	perennial grass
narrow-leaf willow	*Salix exigua*	deciduous shrub
arroyo willow	*Salix lasiolepis*	deciduous tree
shining willow	*Salix lucida ssp. lasiandra*	deciduous tree
rigid hedge nettle	*Stachys ajugoides var. rigida*	Perennial herb
stinging nettle *	*Urtica dioica ssp. holosericea*	perennial herb
rough cockleburr *	*Xanthium strumarium*	annual herb

** keystone species.*

Bank Riparian Zone



Figure 5-26 Bank Riparian Zone on the Klamath River below Copco Dam. Sandbar willow at the water's edge, Oregon ash and black oak beyond

While the bank riparian zone will not be the largest in area compared to other planting zones, it will be the most critical zone for rapid re-establishment of riparian habitat, short-term stability of the channel and banks, and for long-term establishment of an important transitional area between the riverine features and floodplain habitat areas. It will extend approximately from the 2-3-year (Q_2-Q_3) to the 25-year (Q_{25}) flood water surface elevations (Q-lines) of the Klamath River and its tributaries occurring within the project boundary, excluding wetland areas. Its quick establishment will promote and restart a number of important ecological processes and greatly contribute to the creation of quality fish habitat in the river. The zone will extend in a continuous corridor paralleling both banks of the Klamath River. The bank riparian zone native plant species will be selected based on their adaptations to the edaphic and climatic conditions of Upper Klamath River Valley, their ability to survive fluctuating water tables, their preferred root depth to the water table, their flood inundation duration tolerance, and capability to resist exposure to high velocity flows. The riparian restoration planting palette will include both common and less common but ecologically desirable species. The existing riparian vegetation in the limits of work and its vicinity were used as the basis for the riparian vegetation palette. Revegetation plants in this zone will consist of native grasses, forbs, perennial herbs, riparian trees and shrubs, and are listed below in Table 5-7. Planting densities within the riparian-bank areas will be variable but will be on average approximately 2,673 woody plants per acre, or 5 pole cuttings and 1 transplant per 100 sq. ft. Similar to the bank wetland zone, one out of the 5 pole cuttings will be installed in the following spring, one year after drawdown (Figure 5-27).

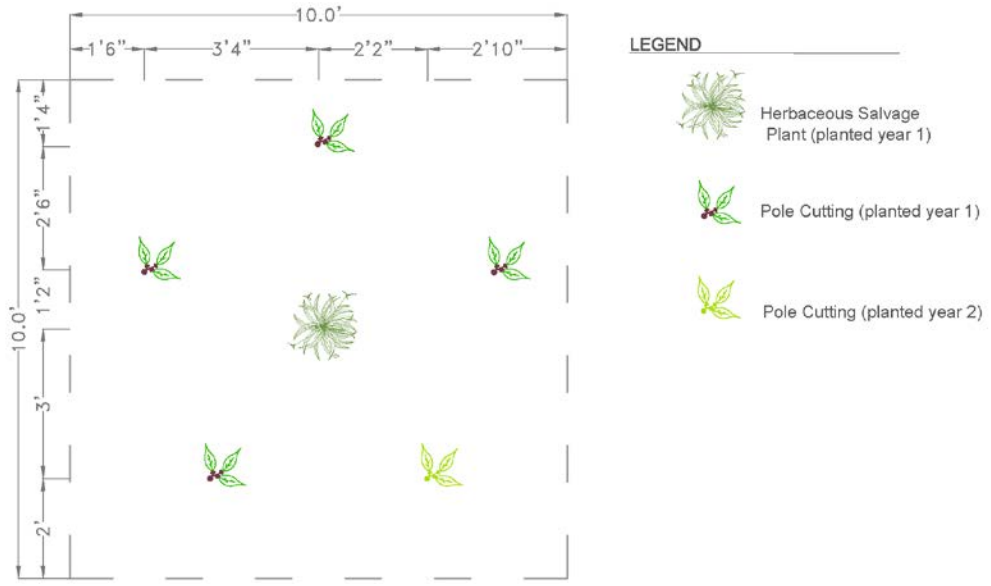


Figure 5-27 Bank Riparian typical plant layout.

Table 5-7 Bank Riparian Zone Proposed Species

Common name	Scientific name	Lifeform	Propagule
bigleaf maple	*Acer macrophyllum*	large deciduous tree	seed
spike bentgrass, spike redtop*	*Agrostis exarata*	perennial grass	seed
mugwort*	*Artemisia douglasiana*	perennial herb	seed, transplants
slender beak (wheat) sedge	*Carex athrostachya*	perennial herb	seed, transplants
clustered field sedge*	*Carex praegracilis*	perennial herb	seed, transplants
smooth dogwood*	*Cornus glabrata*	large deciduous shrub	cuttings
red-osier dogwood	*Cornus sericea*	large deciduous shrub	cuttings
tufted hairgrass*	*Deschampsia caespitosa*	perennial grass	seed
annual hairgrass	*Deschampsia danthonioides*	annual grass	seed
blue wildrye	*Elymus glaucus*	perennial grass	seed
small fescue	*Festuca [Vulpia] microstachys*	annual grass	seed
Oregon ash*	*Fraxinus latifolia*	medium deciduous tree	seed
meadow barley*	*Hordeum brachyantherum ssp. b.*	perennial grass	seed
toad rush	*Juncus bufonius*	perennial herb	seed
sword-leaved rush	*Juncus ensifolius*	perennial herb	seed, transplants
western rush*	*Juncus occidentalis*	perennial herb	seed, transplants
creeping (beardless) wildrye*	*Leymus triticoides*	perennial grass	seed, transplants
field mint*	*Mentha arvensis*	perennial herb	seed, transplants

Common name	Scientific name	Lifeform	Propagule
Lewis' mock orange*	*Philadelphus lewisii*	deciduous shrub	cuttings
black cottonwood*	*Populus balsamifera ssp. trichocarpa*	large deciduous tree	cuttings
California black oak*	*Quercus kelloggii*	large deciduous tree	seed
California rose*	*Rosa californica*	deciduous shrub	cuttings
Pacific blackberry*	*Rubus ursinus*	deciduous shrub, vine	cuttings
California dock	*Rumex californicus*	perennial herb	seed, transplants
narrowleaf willow*	*Salix exigua*	large deciduous shrub	cuttings
red willow*	*Salix laevigata*	large deciduous tree	cuttings
arroyo willow*	*Salix lasiolepis*	small deciduous tree	cuttings
shining willow*	*Salix lucida*	small deciduous tree	cuttings
common snowberry	*Symphoricarpos albus*	deciduous shrub	cuttings
California grape*	*Vitis californica*	deciduous vine	seed

**keystone species*

A large factor in the correct placement of the bank riparian planting zone will be the modeled hydraulics and the anticipated topography of the banks after drawdown. Key storm event water surface elevations will be used to determine the accurate extent and boundaries of this planting zone after drawdown. The 3, 5, 10, 25, 50 and 100-year storm water surface elevations will be modeled and in some areas sediment movement will be assisted with high pressure hosing to restore riparian bank and floodplain connectivity with the river. The bank riparian zone species that will be re-introduced in this zone are listed in Table 5-8.

Herbivore protection will be needed to increase the successful establishment of riparian-bank species. It may include screens, fencing, chemical deterrents, or overplanting. Herbivore protection is vital to successful establishment of planted cuttings and seedlings, since young plant cuttings and transplants will be highly susceptible to mortality from herbivory before root and shoot systems can sufficiently establish and are also often preferred browse material. The herbivores known from the project area are elk, deer, beaver, and black-tailed jackrabbit (TR, 2004).

Although estimates of groundwater depths and fluctuations are not currently available, the water table is expected to be relatively shallow (within the reach of the roots) in proximity to the newly established river channel. Other areas may have terraces along the river channel that are higher than they once were because of reservoir sediment. It may not be possible in all cases to plant pole cuttings of riparian species with immediate connection to groundwater. Supplemental overhead irrigation of riparian vegetation will be provided in the form of temporary, surface mounted irrigation system that will draw water from the river as described in detail in the Irrigation section above.

Floodplain Riparian Zone

Floodplain riparian zones will be delineated as those areas suitable for revegetation that occur approximately between the 25-year (Q_{25}) and 100-year (Q_{100}) flood water surface elevations of the Klamath River and its related tributaries and seeps occurring within the project boundary, excluding all wetland areas. These zones will be additionally adjusted on a case by case basis and depending on after drawdown topography.

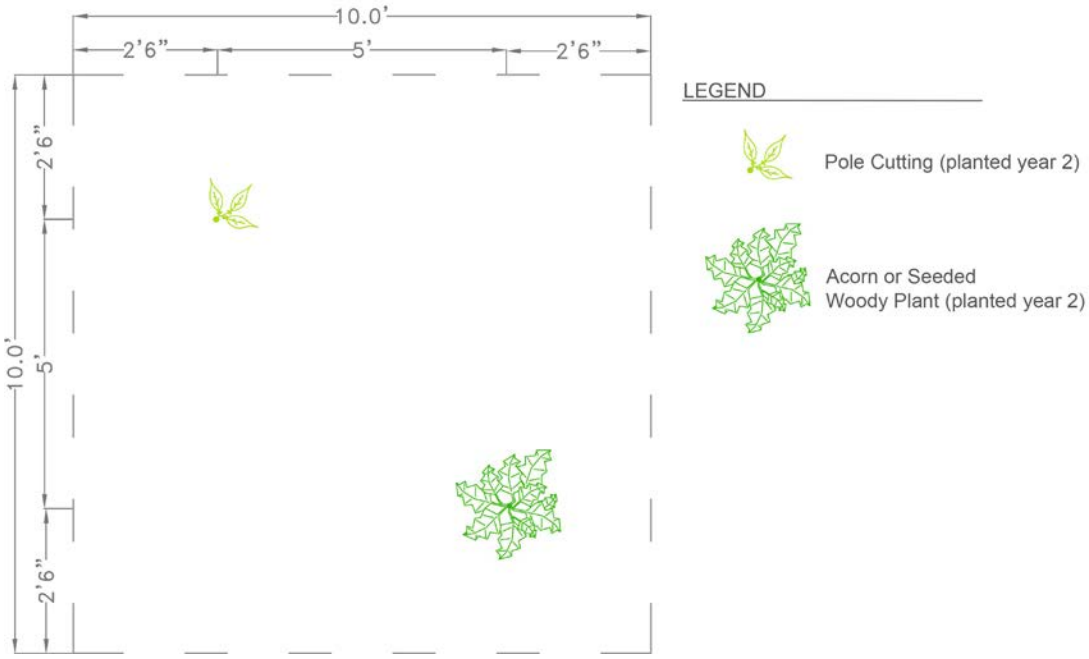


Figure 5-28 Floodplain Riparian typical plant layout.

Floodplain riparian zones will be seeded with a mix that will consist of seeds of native grasses, forbs and shrubs that will be collected and propagated for several years before the revegetation. California black oak and Oregon white oak acorns and willow and cottonwood pole cuttings, will be planted in selected areas within this zone based on environmental factors such as soil texture, slope aspect and ground water depth. For every 100 SF, 1 pole cutting will be installed the first year. One acorn or other seed of a woody tree or shrub will be installed every 100 SF after the establishment of the aerial seeding (Figure 5-28). Acorns stay viable only for approximately six months and will be either planted shortly after their collection in October and November or cold stratified and planted early in the spring. Bigleaf maple, western serviceberry, chokecherry, blue elderberry, fragrant sumac, whitestem gooseberry, snowberry and incense cedar are other potential candidate shrub and tree species for this zone. Additional, smaller planting zones may be introduced in the riparian floodplain zone based on the post-drawdown topographic complexity in order to encourage the formation of typical floodplain environments such as oxbows, floodplain depressions, overflow channels, seasonal wetlands and others. The riparian floodplain zone species are listed in Table 5-8. The average planting density on the riparian floodplain will be approximately 800 woody trees or shrubs

per acre. Supplemental overhead irrigation of parts of the riparian floodplain zone may be provided in the form of temporary, surface mounted irrigation system that will draw water from the river.

Table 5-8 Floodplain Riparian Zone Proposed Species

Common name	Scientific name	Lifeform
bigleaf maple	*Acer macrophyllum*	large deciduous tree
Spanish lotus	*Acmispon americanus*	annual herb
spike bentgrass, spike redtop	*Agrostis exarata*	perennial grass
western serviceberry *	*Amelanchier alnifolia*	small deciduous tree
mugwort	*Artemisia douglasiana*	perennial herb
Oregon grape	*Berberis aquifolium*	small evergreen shrub
California brome *	*Bromus carinatus*	perennial grass
incense cedar	*Calocedrus decurrens*	large coniferous tree
bluebunch wheatgrass	*Elymus [Pseudoroegneria] spicatus*	perennial grass
squirreltail grass	*Elymus elymoides*	perennial grass
blue wildrye *	*Elymus glaucus*	perennial grass
small fescue	*Festuca [Vulpia] microstachys*	annual grass
Idaho fescue	*Festuca idahoensis*	perennial grass
California barley	*Hordeum brachyantherum sspp. californicum*	perennial grass
junegrass	*Koeleria macrantha*	perennial grass
Great Basin wildrye	*Leymus cinereus*	perennial grass
creeping (beardless) wildrye *	*Leymus triticoides*	perennial grass
silvery lupine *	*Lupinus argenteus*	perennial herb
chick lupine	*Lupinus microcarpus*	annual herb
ponderosa pine	*Pinus ponderosa*	coniferous tree
pine (Sandberg) bluegrass *	*Poa secunda*	perennial grass
black cottonwood *	*Populus balsamifera ssp. trichocarpa*	large deciduous tree
chokecherry *	*Prunus virginiana var. demissa*	small deciduous tree
Oregon white oak *	*Quercus garryana*	large deciduous tree
California black oak *	*Quercus kelloggii*	large deciduous tree
fragrant (three-leaf) sumac	*Rhus aromatica [trilobata]*	deciduous shrub
whitestem gooseberry	*Ribes inerme*	deciduous shrub
California rose *	*Rosa californica*	deciduous shrub
Pacific blackberry	*Rubus ursinus*	deciduous shrub, vine
blue elderberry *	*Sambucus nigra ssp. caerulea [mexicana]*	large deciduous shrub
Lemmon's needlegrass	*Stipa [Achnatherum] lemmonii*	perennial grass
western needlegrass	*Stipa [Achnatherum] occidentalis var. occidentalis*	perennial grass
common snowberry *	*Symphoricarpos albus*	deciduous shrub
creeping snowberry *	*Symphoricarpos mollis*	deciduous shrub

Common name	Scientific name	Lifeform
tomcat clover *	*Trifolium willdenovii*	annual herb

* keystone species.

Uplands below Rocky Wake Zone

Upland areas below Rocky Wake Zone will be areas suitable for revegetation that will extend from the post-removal 100-year flood water surface elevation to the lower end of the Rocky Wake Zone. These uplands will be the only formerly submerged areas where upland vegetation will be seeded on the sedimentary substrate. The restoration process will be the same as for the planting zones below; the pioneer seed mix with mycorrhizal inoculant will be aerially seeded in the early spring of 2021, and broadcast seeding of the native ecotypic permanent seed will be implemented in the fall. Because of the fine clayey texture of the sediment, the permanent seed mix for this upland zone will include species that are better adapted to highly conductive, low permeability soils. These species will be different from species that grow in the upland, coarser soil areas just above the reservoirs that will be used for the restoration of the current upland areas disturbed by the project activities. Typically, perennial bunch grasses, shrubs and trees dominate on well drained, coarse-textured soils, while primarily annual grasses and forbs thrive in clayey soils.



Figure 5-29 Grasses are an important component of the Upland Planting Zone. Their cover varies greatly with slope aspect.

Table 5-9 Uplands below Rocky Wake Zone Proposed Species

Common name	Scientific name	Lifeform
common yarrow *	*Achillea millefolium var. lanulosa*	perennial herb
California brome *[1]	*Bromus carinatus*	grass
buckbrush *	*Ceanothus cuneatus*	evergreen shrub
deerbrush *	*Ceanothus integerrimus*	semi-deciduous shrub
Douglas fir	*Pseudotsuga menziesii var. menziesii*	coniferous tree
birchleaf mountain mahogany	*Cercocarpus betuloides*	semi-deciduous shrub
turkey mullein	*Croton [Eremocarpus] settiger*	annual herb
bluebunch wheatgrass *	*Elymus [Pseudoroegneria] spicatus*	perennial grass
squirreltail *	*Elymus elymoides*	perennial grass
blue wildrye	*Elymus glaucus*	perennial grass
common rabbitbrush *	*Ericameria [Chrysothamnus] nauseosa var. leiosperma*	semi-deciduous shrub
common woolly sunflower	*Eriophyllum lanatum*	perennial herb
small fescue *	*Festuca [Vulpia] microstachys*	annual grass
Idaho fescue *	*Festuca idahoensis*	perennial grass
red buckthorn	*Frangula [Rhamnus] rubra*	evergreen shrub
California barley *	*Hordeum brachyantherum ssp. californicum*	perennial grass
junegrass *	*Koeleria macrantha*	perennial grass
hot rock penstemon	*Penstemon deustus*	perennial herb
royal penstemon	*Penstemon speciosus*	perennial herb
varied leaf phacelia	*Phacelia heterophylla var. virgata*	perennial herb
ponderosa pine	*Pinus ponderosa*	coniferous tree
Sandberg bluegrass *	*Poa secunda*	perennial grass
Klamath plum *	*Prunus subcordata*	small deciduous tree
antelope brush *	*Purshia tridentata*	Deciduous shrub
Oregon white oak	*Quercus garryana*	deciduous tree
California black oak	*Quercus kelloggii*	deciduous tree
fragrant (three-leaf) sumac *	*Rhus aromatica [trilobata]*	shrub
plateau (desert) gooseberry	*Ribes velutinum*	deciduous shrub
western needlegrass *	*Stipa [Achnatherum] occidentalis*	perennial grass

* keystone species

The revegetation seed mix listed above will be seeded in the fall of the first year and adjusted to include site specific species for each reservoir and applied to all topographically suitable areas, as well as stable slope areas (i.e., areas determined to be safe from further erosion and not in need of sediment removal) upon completion of all required earthwork. Repeated supplemental seeding will be applied in underperforming areas as necessary until good coverage is achieved.



Figure 5-30 Tree cover in existing upland areas around the reservoirs varies considerably in response to slope aspect. Grasslands dominate on south-facing slopes. Woodlands and scrub dominate on north-facing slopes

California black oak, Oregon white oak acorns, and other woody species seed will be planted in selected upland areas suitable for revegetation. They will be installed as soon as the weather begins to cool down and spring seeded areas become accessible to the restoration contractor's equipment and personnel. It is anticipated that this will occur in October of the drawdown/dam removal year. Fresh acorns will be harvested and planted immediately. Seeds of other woody species will be planted as appropriate based on environmental factors such as soil texture, slope aspect, local topography and hydrology as described below. The planting density in this zone will be four seeded woody plants per acre. Seed will be initially irrigated by the biodegradable donut-shape water bowl (Figure 5-31) made from recycled paper pulp (Cocoon).



Figure 5-31 Cardboard basin (Cocoon) tree planting of incense cedar

Water will be slowly delivered from the Cocoon filled with water through wicks placed near the seed. After the first season, trees will be self-sufficient and will be watered only supplementally with water trucks in case of extended drought or excessively hot weather. Proposed upland

planting zone species are listed in (Table 5-9) and will be planted at an average density of four woody plants per acre.

Rocky Wake Zone

Rocky Wake Zone will be an area of approximately 213 acres around the reservoirs where long term wake and wave action at the elevational range between the reservoir full and typical annual low water surface elevations (6'-7' range) resulted in gradual erosion and washing away of soil and fine textured sediment. Typically, only gravel, cobbles, boulders and bedrock is left. After drawdown, these areas could form a "bathtub ring" marking the original extent of the reservoirs with a continuous barren zone. Clean soil salvaged from the demolition of the dams, and sediment removed during the grading of the riparian floodplain areas will be imported over large segments of this zone and spread to a depth of 12" to provide substrate for vegetation. In some areas, the banks are very steep or form sheer cliffs. In these cases where soil cannot be safely kept on the existing grade without substantial erosion protection or other engineering measures, the rocky wake zone areas will not be restored. They will become a part of their existing rugged surroundings. During the initial aerial seeding with pioneer seed mixes, the Rocky Wake Zone will be avoided to the extent feasible because there will be no growing substrate to support the seed. The topsoil import in the Rocky Wake Zone will begin in the spring of 2021, and the soil covered areas will be seeded with the permanent seed mix in the late fall of 2021. The planting densities will be the same as in the Uplands below Rocky Wake Zone planting zone; four seeded woody plants per acre with irrigation cocoons. The risk of invasive species will be higher than in the Uplands Zone, because the Rocky Wake Zone is adjacent to the existing upland zones, where there is a large invasive species seed bank and a high percentage of invasive species dominated areas.

Disturbed Uplands

The Disturbed Uplands Planting Zone will be areas totaling approximately 136 acres that currently lie above the reservoirs and consist of existing developed areas proposed for demolition, and recreational areas that will be abandoned and removed after drawdown. Because the majority of these areas will not be ready for seeding until the end of the Dam Removal Period, they will not be included in the initial pioneer aerial seeding. They will be broadcast-seeded with the permanent native seed mix later, in the fall of 2021 and some in 2022. Soil preparation will vary based on past uses and activities. Areas with highly compacted soil, the result of the past presence of paving, vehicular traffic, intensive recreational activities or other human uses will be cross ripped to a depth of 24" before fall seeding in order to loosen the soil and improve its structure. It is assumed that 75% of the disturbed upland areas will need decompaction. Compacted areas under existing large trees and in their vicinity will not be ripped in order to protect the tree roots. The invasive exotic vegetation pressure will be intense in these areas because they are typically surrounded by areas heavily infested with non-native species such as cheatgrass, yellow star thistle, medusahead grass, goatgrass, and many others. The invasive exotic vegetation control will start early, several years before drawdown.



Figure 5-32 Erosion within the Rocky Wake Zone at Iron Gate Reservoir

Upland Stockpiles

The Upland Stockpile Zone (51 acres) will consist of areas where overburden material generated by the removal of the dams and other demolished structures in the project area will be deposited. It is assumed that the topsoil covering the stockpile areas will be heavily compacted. It will be cross-ripped to a depth of 24" or as feasible in preparation for seeding. The Upland Stockpile Zone will be seeded with the permanent native seed mix similar to plant list in table Table 5-10 in the fall of 2021 or as soon as the stockpiles become available for seeding in order to prevent their erosion. Because of the coarse debris within the core of the stockpiles and their sloping sides, these areas will be very well drained and dry during the long hot summers in the project area. Supplemental irrigation will be provided at least during several initial years of establishment in order to maintain vegetation in good condition. Similarly as with other upland zones, a very close attention will have to be paid to invasive species.

Undisturbed Uplands

The Undisturbed Uplands Planting Zone will consist of 148 acres of areas above the reservoirs that may be only minimally disturbed by the eradication of invasive exotic vegetation. They will go through active weed removal for at least three years before drawdown. Potential bare and disturbed patches resulting from invasive species removal will be reseeded both with the pioneer and the permanent native seed mixes. The majority of these areas will have existing native vegetation and only 30% is expected to need restoration.

Table 5-10 Uplands Above Rocky Wake Zone Seed Mix

Common name	Scientific name	Lifeform
common yarrow *	*Achillea millefolium var. lanulosa*	perennial herb
California brome *[1]	*Bromus carinatus*	grass
buckbrush *	*Ceanothus cuneatus*	evergreen shrub
deerbrush *	*Ceanothus integerrimus*	semi-deciduous shrub
Douglas fir	*Pseudotsuga menziesii var. menziesii*	coniferous tree
birchleaf mountain mahogany	*Cercocarpus betuloides*	semi-deciduous shrub
turkey mullein	*Croton [Eremocarpus] settiger*	annual herb
bluebunch wheatgrass *	*Elymus [Pseudoroegneria] spicatus*	perennial grass
squirreltail *	*Elymus elymoides*	perennial grass
blue wildrye	*Elymus glaucus*	perennial grass
common rabbitbrush *	*Ericameria [Chrysothamnus] nauseosa var. leiosperma*	semi-deciduous shrub
common woolly sunflower	*Eriophyllum lanatum*	perennial herb
small fescue *	*Festuca [Vulpia] microstachys*	annual grass
Idaho fescue *	*Festuca idahoensis*	perennial grass
red buckthorn	*Frangula [Rhamnus] rubra*	evergreen shrub
California barley *	*Hordeum brachyantherum ssp. californicum*	perennial grass
junegrass *	*Koeleria macrantha*	perennial grass
hot rock penstemon	*Penstemon deustus*	perennial herb
royal penstemon	*Penstemon speciosus*	perennial herb
varied leaf phacelia	*Phacelia heterophylla var. virgata*	perennial herb
ponderosa pine	*Pinus ponderosa*	coniferous tree
Sandberg bluegrass *	*Poa secunda*	perennial grass
Klamath plum *	*Prunus subcordata*	small deciduous tree
antelope brush *	*Purshia tridentata*	Deciduous shrub
Oregon white oak	*Quercus garryana*	deciduous tree
California black oak	*Quercus kelloggii*	deciduous tree
fragrant (three-leaf) sumac *	*Rhus aromatica [trilobata]*	shrub
plateau (desert) gooseberry	*Ribes velutinum*	deciduous shrub
western needlegrass *	*Stipa [Achnatherum] occidentalis*	perennial grass

* keystone species

1. Fast and prolific growth after seeding then gradually surrenders to other natives, protects habitat from initial exotic spp. invasion (GS pers. conv. Erin Lonergan, USFS botanist)

5.5.7 Cattle Exclusion Fencing

Areas around the reservoirs currently have open-range with cattle able to move freely around the reservoir areas. To protect revegetation efforts and to replace the function of the reservoirs as natural barriers, the

KRRC is proposing to use cattle exclusion fencing around the reservoir areas after drawdown. The proposed fencing will be a wildlife friendly design that excludes open-range cattle while allowing the natural movement of deer, turtles, and other wildlife. An approximate length of 34.5 miles of fence may be required to fully isolate the reservoir areas. The KRRC will place exclusion fencing, in accordance with applicable Federal, State, and county regulation and guidance, around the reservoir restoration areas where they abut grazing land. The KRRC will not fence areas of the reservoir perimeters that provide natural topographic (e.g., steep rocky terrain) or land use (e.g., residential areas, managed forests) barriers.

5.6 Data Gaps and Informational Studies

Several data gaps were identified in the 2011 Plan and the KRRC is gathering additional information and performing studies to maximize the likelihood for successful restoration. These data gaps are identified below and the KRRC has already addressed several of them using data collected in 2017 and others will be addressed later in 2018.

5.6.1 Revegetation Species

Optimization of revegetation effectiveness will depend on identification of the ideal revegetation species mix for each drawdown planting zone (i.e., upland, floodplain, riparian, and wetland) in each reservoir. Detailed proposed lists of native plant species appropriate for revegetation of each planting zone are provided in appropriate subsections above. These lists are based on past botanical surveys in the project area, early greenhouse growing experiments that were combined with the wetting-drying experiments (see Section 8.1), plant nutrient availability analyses, and knowledge of the cultural preferences of each native species, such as water, light and soil texture requirements. The KRRC will further refine these lists based on the proposed future vegetation surveys, and on the results from pilot test growing experiments that will be conducted for several years starting in the fall of 2018. Through these tests, the KRRC will determine optimal conditions for seed germination and identify best native species that will be capable of germinating on wet reservoir sediment under potentially freezing conditions during the January – March drawdown period.

5.6.2 Availability of Revegetation Materials

The KRRC will harvest pole cuttings from willows in riparian areas around the reservoirs where it will be transplanted to newly formed riparian areas. By thinning the willows' canopies, they will be better adapted for transplantation because their evapotranspiration will be substantially reduced. The KRRC will avoid areas with known habitat for sensitive species, such as the willow flycatcher (*Empidonax traillii*), and areas where sufficient water will be available for the riparian vegetation after drawdown during pole cutting collection and vegetation salvage.

The KRRC will salvage and transplant existing riparian and wetland vegetation currently growing in a narrow strip around the reservoirs, outside of areas where it can potentially survive after drawdown, to complement other reservoir revegetation efforts. Plant community inventories were completed around the reservoirs in 2009 and 2010 as part of the EIS/R preparation (USBR, 2011c), however, these lack sufficient detail

regarding wetland and riparian species. The KRRC will conduct an updated vegetation inventory in 2018 and 2019. The KRRC will estimate the number of salvageable trees based on the inventory result and expects that a sufficient number of riparian trees will be available to supplement pole cutting installation.

To identify seed sources, the KRRC will conduct reconnaissance surveys in 2018 in areas within the upper Klamath River watershed that are within an elevational range of 500 ft below the Iron Gate Reservoir through 500 ft above the JC Boyle Reservoir. The KRRC will map the seed collection areas using global positioning system (GPS) and provide the maps to seed collection contractors that will begin work in late summer of 2018. The KRRC will conduct IEV surveys in 2018 to determine the extent of infestation within portions of the project area above the reservoirs. The KRRC will identify riparian vegetation around the reservoirs perimeters to inform the salvage potential of existing vegetation, the removal of invasive weeds, and more accurately characterize achievable vegetative conditions for restoration. The KRRC will perform new vegetation surveys in 2018 to provide a more recent and thorough baseline for the restoration approach

Specialized native seed propagation contractors will annually collect and propagate native seed in the project vicinity within the upper Klamath River watershed over a four-year period on large fields in farm settings to provide sufficient amounts of seed for both pioneer and permanent seeding.

5.6.3 Reference Site Selection

Establishment and good documentation of physical and ecological reference conditions is important for developing target conditions and performance criteria for restoration of various habitats in the project area. Existing vegetation surveys were completed along the margins of each reservoir in 2009 and 2010 (USBR, 2011c), but these studies were relatively coarse and were conducted over a short period of time. The KRRC will update and expand those surveys to include several reference areas for each planting zone at each reservoir. The KRRC will survey the reference sites for species diversity, vegetation cover, tree and shrub density and invasive exotic vegetation cover.

5.6.4 On-site Pilot Growing Test

The effectiveness of the restoration implementation will depend on correct selection of the best combination of plant species for each vegetation zone. A basic list of potential plants for revegetation of different drawdown zones in the reservoirs has been previously compiled by USBR (USBR, 2011c). However, KRRC selected plants with the implicit assumption that the existing vegetation present around the reservoirs will grow in fine, high organic matter, poorly drained sediment with absent soil biota that is diametrically different from the coarse, shallow and poor soil in the areas surrounding the reservoirs. During the pre-dam removal period the KRRC will update the species list for each vegetation zone in response to the information provided by the new vegetation surveys, the results from wetting-drying and growing experiments in the greenhouse (Section 8.1), plant nutrient availability analyses of the reservoir sediment samples, and test plot growing experiments at the project area.

The KRRC will implement project area test plot growing experiments in 2018 to examine the soundness of the restoration approach, and to refine the optimal seed mix for each vegetation zone in each unique reservoir setting. The KRRC will set up test plots near the reservoirs in locations with representative environmental conditions. The KRRC pilot experiment will be made up of twelve to sixteen 10'W x 10'L x 24"D test plots, each plot testing one of three-four treatments for four planting zones and zone seed mixes. The set of plots for each planting zone will be built to mimic the hydrology of that zone. Construction of these plots will include plastic liners to mimic wetland areas and raised beds with good drainage to approximate soil conditions in future upland areas. All plots will be irrigated. The test sites will be fenced to prevent predation by deer, theft and vandalism. The experimental design of the test plots will include different environmental parameters, such as reservoir sediment texture, surface treatment, cover crop seed mixes, irrigation, and hydrology. KRRC will use surface grab collected reservoir sediments to grow species of seed mixes from every vegetation zone. Sediment extracted from the bottom of the reservoirs (the anticipated growing substrate) will be placed in each plot to a depth of 2' (this will result in about a 1.2' thickness after the previously observed average shrinkage and drying of 60%. Scientists will regularly visit the site to monitor the experiment and to gather data for use in the vegetation species selection and restoration plan. The KRRC will finalize the seed mixes within each vegetation zone based on the test plot results.

Chapter 6: Monitoring and Adaptive Management

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6. MONITORING AND ADAPTIVE MANAGEMENT

Dam removal is a rapidly evolving science and the study of dam removal effectiveness on river processes is expanding with each new dam removal. The KRRC reviewed several dam removal monitoring and adaptive management plans as summarized in Table 6-1. These plans utilized a range of protocols and various levels of effort to monitor the projects. Common themes from these plans include monitoring for at least 2 years after dam removal with a focus on physical processes and vegetation. The KRRC is proposing that monitoring and adaptive management take place for 5 years after drawdown as described in the following sections.

Table 6-1 Summary of dam removal monitoring and adaptive management plans

Dam Removal	Description
Elwha & Glines Canyon Dams on the Elwha River, Washington	The Elwha and Glines Canyon dams were removed in 2012 and 2014, respectively. Monitoring was proposed for six years post removal. The monitoring strategy consisted of physical processes and vegetation (Chenowith et al., 2011).
Savage Rapids Dam on the Rogue River, Oregon	Savage Rapids Dam was removed in 2009. Monitoring was proposed for two years post removal. The proposed effectiveness monitoring strategy consisted of three protocols: biological, physical, hydrological measurements (Bountry et al., 2013).
Gold Ray Dam on the Rogue River, Oregon	Gold Ray Dam was removed in 2010. Monitoring was proposed for four years but stopped after two years due to funding cuts. The proposed effectiveness monitoring strategy consisted of multiple protocols including biological, physical processes, vegetation and habitat.
Condit Dam on the White Salmon River, Washington	Condit Dam was removed in 2011. An Environmental Monitoring Plan proposed two years post removal monitoring consisting of water quality, sediment transport, slope stability, and vegetation monitoring (Wilcox et al., 2014).
Milltown Dam on the Clark Fork River, Montana	Milltown Dam was removed in 2009. Monitoring was planned for 15 years and consisted of physical processes and changes to the channel/floodplain, vegetation, water quality, and habitat (Evans, 2014).
San Clemente Dam on the Carmel River, California	San Clemente Dam was removed in 2015. A monitoring plan comprised of multiple years of monitoring protocols focused on channel geomorphology, structure stability and persistence, and vegetation establishment (AECOM personal communications, 2017).

6.1 Monitoring Metrics and Protocols for Reservoir Areas

Monitoring associated with restoration of the reservoir areas is designed to measure progress toward achieving the project goals, inform potential adaptive management and maintenance needs, and provide feedback into river and reservoir area conditions to determine if sites are trending towards or away from achieving project goals. Physical site characteristics have been identified as appropriate monitoring metrics

using standard field techniques to produce data compatible with standard protocols derived from previously developed dam removal monitoring and adaptive management plans.

After drawdown of the reservoirs and removal of the dams, the KRRC proposes the following actions to establish "baseline" or "initial conditions". The KRRC will use the initial condition reference data for monitoring and adaptive management related to reservoir restoration:

1. The KRRC will establish permanent ground photo points throughout the reservoir areas that enable sufficient vantage points of critical areas within the reservoirs. The KRRC will take photos to provide initial conditions for monitoring data to develop informed maintenance/corrective actions. The KRRC will monument each photo ground point will be monumented with 5/8" rebar and aluminum cap for long-term stability and documented with a northing, easting, and elevation using a survey-grade GPS.
2. The KRRC will complete high resolution aerial photos, sub-meter accuracy, for the reservoir areas.
3. The KRRC will collect LiDAR for the reservoir areas after sediment evacuation and initial ground cover stabilization to create initial conditions surface models.

The KRRC will use the baseline data to provide a clear starting point for initial conditions in the project area to help evaluate reservoir area restoration trends and trajectories. Project goals are described below along with desired future conditions for each goal that can be monitored. KRRC proposes a five-year monitoring plan.

6.1.1 Reservoir Sediment Stabilization

During an average water year, the KRRC expects that approximately 50% of the reservoir sediments will remain in the reservoir area on the floodplain and surrounding slopes after drawdown. To reduce potential water quality degradation from un-natural, episodic fine sediment releases, the KRRC will vegetate the remaining sediments. The KRRC will construct habitat features to promote natural river processes that may create minor areas of erosion, but overall the remaining sediments will be stabilized. The KRRC will monitor sediment stability using visual inspection (aerial and ground photos) and LiDAR as summarized in Table 6-2.

Table 6-2 Summary of reservoir sediment stability monitoring metrics

Project Goal	Monitoring Technique	Monitoring Metrics	Frequency
Stabilize remaining reservoir sediments	Visual inspection with photo points and physical measurements	Areal extent and limits of erosion	Yearly
Stabilize remaining reservoir sediments	LiDAR flight of reservoir areas	Surface model volume change	Yearly
Minimize invasive exotic vegetation and establish native vegetation cover	Visual inspection, aerial photos and ground-based photo points	Area of invasive vegetation	2 times per year
		Area of native vegetation cover	2 times per year

6.1.2 Reservoir Sediment Evolution Monitoring

The KRRC will conduct mapping of geomorphic features and sedimentary facies in the reservoirs to monitor reservoir sediment evolution following drawdown and identify the need for additional restoration actions. Fine-grained reservoir sediments not evacuated during initial drawdown are potential sources of suspended sediment that could be released during subsequent storm events if not stabilized and impact water quality. Deposit stabilization through active (e.g., planting and irrigating) revegetation techniques or erosion control measures (e.g., deposit excavation, erosion control mats) may be applicable where thick, fine-grained deposits persist in upland regions subject to overland flow and gully erosion and where revegetation efforts have been unsuccessful. In valley bottom and riparian locations where deposits are the thickest, dried and hardened residual reservoir sediments may physically obstruct flood waters from accessing the floodplain. In such cases, the KRRC will manually remove the obstructing deposits to increase floodplain connectivity. Restoration actions for deposit excavation may be triggered where sediment accumulations of specified threshold dimensions persist in riparian areas for more than a year after drawdown.

To document reservoir sediment evolution, the KRRC will map geomorphic features and sedimentary facies in the field and use remote analyses of bathymetric and LiDAR surfaces, aerial photos, and photo points. The KRRC will use viewshed GIS analysis to refine and optimize the locations of permanent ground photo points for monitoring and evaluate the ability to see post-drawdown features of interest (e.g., floodplains, regions with thick deposits) from specific vantage points prior to drawdown. The KRRC will compare the location and spatial extent of historical and post-drawdown geomorphic features of interest (e.g., channel banks, floodplains, and terraces) to modeled flood inundation extents (e.g., Figure 3-1, Figure 3-5, Figure 3-11). The KRRC will monitor residual reservoir sediment including the description of spatial extent and thickness, sediment texture and structure, and interpretation of the reservoir depositional environment and post-drawdown erosional environment (e.g., evolution by hillslope and gully processes or mainstem flooding). The KRRC will use field mapping to opportunistically target riparian and floodplain areas and locations where remote analysis has identified bare sediments and where erosion has exposed complete stratigraphic sections in the sediments. Estimates of residual sediment volumes will benefit from revised estimates of sediment thickness using the 30 centimeters (cm) resolution bathymetry and drill core data collected in 2018 along with historical topography and the previously collected sediment core data described in USBR (2011c).

The KRRC will conduct field inspection activities each year around April 1, and remote analysis will precede, and thereby inform, field mapping by several weeks. This timeline ensures both that the majority of large storms for the water year will have already occurred and that there will be sufficient time to prepare materials for permitting restoration actions during the “in water” work window to mitigate problematic residual reservoir deposits. The KRRC will use results of field and remote analyses to generate maps of residual reservoir sediments and geomorphic features that can be compared with surface run-off models and modeled flood inundation extents and can highlight possible locations for restoration actions.

6.1.3 Volitional Fish Passage Restoration

A goal of dam removal is to restore longitudinal river connectivity and natural river form and function that results in volitional fish passage. Experience from past dam removals show that potential fish passage barriers could exist beneath the reservoir water surface, that are not known now due to inundation caused by the dams. For example, there are often temporary structures built upstream of dams to control and bypass water during dam construction, and these structures often remain after dam construction and can create fish passage barriers once reservoirs are reverted to free-flowing systems. To address this uncertainty, the KRRC will enact a visual inspection and monitoring protocol as summarized in Table 6-3.

Table 6-3 Summary of volitional fish passage monitoring metrics

Project Objective	Monitoring Technique	Monitoring Metrics	Frequency
Restore fish passage to natural conditions	Visual inspection with ground photo points and physical measurements	Required fish jump height	After wet season, yearly
Restore fish passage to natural conditions	Visual inspection with ground photo points and physical measurements	Un-natural or man-made obstructions	After wet season, yearly

6.1.4 Revegetation, Invasive Exotic Vegetation Control and Natural Ecosystem Processes Restoration

To determine the progress and success of revegetation, invasive exotic vegetation control, and efforts to restore natural ecosystem processes, the KRRC will regularly monitor the project area for compliance with established performance criteria. The general approach to this monitoring will be to quantitatively record the progress, compare it to established performance criteria/reference site conditions, and take corrective action if and when necessary to guide further ecological succession on a trajectory to a fully functioning natural ecosystem. The key monitoring activities are summarized in Table 6-4.

Performance Criteria

For the purposes of monitoring, to determine the revegetation plan success, and to ascertain the degree of natural ecosystem processes re-establishment, the KRRC is proposing the following performance criteria for all native vegetation planting zones. The KRRC will refine these criteria once reference sites are identified and biometrically quantified.

Relative Vegetation Cover:

The relative vegetation cover for each project planting zone will be the following percentages of the average of the relative vegetation cover of approved reference sites for each monitoring year:

- Y1–70%

- Y2–75%
- Y3–80%
- Y4–85%
- Y5–90%

Rock outcrops, scree, and gravel covered areas and areas otherwise unable to support vegetation, will be excluded from the relative vegetation cover calculations.

Table 6-4 Summary of reservoir revegetation and invasive exotic vegetation monitoring metrics

Project Goal	Monitoring Technique	Monitoring Metrics	Frequency
Establish native vegetation cover	Visual inspection, aerial photography-based GIS desktop analysis, and ground based photo points	Relative vegetation cover	once per year
	ground based botanical surveys of selected sampling areas or along predetermined point intercept transects and photo points	Plant species diversity	once per year
	GPS identification of tree and shrub textural signatures to facilitate GIS desktop, field verification and data correction for complex/ambiguous areas, photo-documentation of tree and shrub growth, health and vigor from established on-the-ground photo point stations	Number of surviving trees and shrubs per acre	once per year
Minimize invasive exotic vegetation	GPS identification of textural signatures of IEV species, production of high resolution, drone generated aerial photo, a quantitative GIS based determination of relative percent cover, field verification and data correction, on the ground marking of IEV designated for removal, Daubenmire frame surveys along pre-determined transects for species not recognizable on aerial photography, photo-documentation of IEV cover from established on-the-ground photo point stations.	Invasive Exotic Vegetation Cover	Y1 – 20x/year Y2 – 10x/year Y3 – 5x/year Y4 – 4x/year Y5 – 2x/year

Plant Diversity:

The plant diversity for each project planting zone will be the following percentages of approved reference sites for each monitoring year:

- Y1–60%
- Y2–65%
- Y3–70%
- Y4–75%
- Y5–80%

Number of Surviving Trees and Shrubs per Acre:

The number of surviving trees and shrubs per acre will be the following percentages of the trees originally planted from seed for each monitoring year:

- Y1–90%
- Y2–85%
- Y3–80%
- Y4–75%
- Y5–70%

Naturally recruited native woody species shall count at 50%.

Invasive Exotic Vegetation Cover:

Percent relative cover by medium and low priority IEV shall be less than the average of the relative medium and low priority IEV cover in two nearby approved reference areas as follows:

- Y1–25%
- Y2–40%
- Y3–55%
- Y4–70%
- Y5–90%

No high priority invasive plants (as listed in Table 5-4 of this report) will be present in the limits of work.

Revegetation Monitoring Methodology

The KRRC will perform annual revegetation monitoring for five years after installation acceptance or until the performance criteria have been met. During the first monitoring year that will coincide with the Plant Establishment Period, IEV control will be crucial. During the plant establishment period, the KRRC will

perform monthly monitoring during the cold season from November 1 through March 1, and bi-weekly monitoring the rest of the year, totaling approximately 20 visits. For the remaining four years of the 5-year monitoring period that will coincide with the Maintenance and Monitoring Period, the frequency of KRRC monitoring and maintenance will gradually decrease. In Year Two, the KRRC will conduct bi-monthly monitoring surveys will be conducted during the cool season from November 1 through March 1, and monthly surveys the rest of the year. In Year Three the KRRC will make 5 visits, one visit between November and April and four bi-monthly visits the rest of the year. In Year Four, visits will be bi-monthly from April through November, totaling 4 visits for the year. During the anticipated final year of monitoring and maintenance, the KRRC will make two visits, one in the spring and the other in the fall. During only one monitoring visit each year (approximately at the same time) the KRRC will gather data on performance criteria compliance needed to prepare the annual monitoring report. In the remaining monitoring visits, the KRRC will focus on identification of IEV populations and monitoring of restoration contactor compliance with the requirements of the plant establishment and maintenance contracts. The KRRC will base tasks for the maintenance period on the monitoring results, and performance criteria thresholds and will consist of re-seeding/re-planting of native vegetation (as necessary), invasive plant management, herbivore control, irrigation maintenance and other activities as situations arise (e.g., implementation of erosion repairs). Monitoring will be conducted by qualified plant biologists with expertise in local native plant ecology and invasive species control, and will include the following tasks:

Relative vegetation cover determination:

- A walking visual inspection to document the progress of native vegetation establishment in selected sampling areas or transects in each planting zone.
- GPS identification of textural signatures of sample bare ground areas and different types of vegetation to facilitate GIS desktop analysis of aerial photography for woody and larger aerial cover species and relative vegetation cover determination.
- Production of high resolution, drone generated aerial photos with sub-meter accuracy to be used as the basis of GIS desktop analysis to accurately determine vegetation cover for herbaceous and woody species in the project area.
- Photo-documentation of revegetation progress from established on-the-ground photo point stations.

Plant species diversity:

- Botanical surveys in selected sampling areas or point intercept surveys along pre-determined transects in each planting zone.
- GPS identification of sample textural signatures for different types of vegetation to facilitate GIS desktop analysis of aerial photography.
- Photo-documentation of revegetation progress from established on-the-ground photo point stations.

Number of surviving trees and shrubs per acre:

- GPS identification of textural signatures of tree and shrub species to facilitate GIS desktop analysis of aerial photography to determine the number of surviving trees and shrubs per acre in the project area.
- On the ground field verification and data correction for complex or ambiguous areas.
- Photo-documentation of tree and shrub growth, health and vigor from established on-the-ground photo point stations.

Invasive exotic vegetation cover:

- GPS identification of textural signatures of IEV species where feasible to facilitate GIS desktop analysis of aerial photography to determine the invasive exotic vegetation cover, species and extent.
- Production of high resolution, drone generated aerial photography with sub-meter accuracy for GIS desktop analysis.
- A quantitative GIS based determination of relative percent cover of IEV species within the limits of work, and a list of IEV species with recommendations on priority and method of removal.
- On the ground field verification and data correction for complex or ambiguous GIS areas.
- On the ground marking of IEV designated for removal by maintenance contractor.
- Daubenmire frame surveys along pre-determined transects for herbaceous species not recognizable on drone generated aerial photography.
- Photo-documentation of IEV cover from established on-the-ground photo point stations. Numbered photo point locations, camera focal length, and directions will be established during the initial inspection and comparative photos from the same photo points, in the same directions, and same camera settings will be taken in subsequent inspections.

The KRRC will prepare and submit an annual monitoring report by December 31 of monitoring Year One through Five. Each annual report will cover both the geomorphic and revegetation monitoring scheduled for that monitoring year.

If any scheduled revegetation monitoring inspection reveal that any of the monitoring criteria have not been met, the monitoring report for that year will include an evaluation of the potential factors that may be hindering project revegetation and propose a plan for improving performance. Suggestions for improving performance may include specific recommendations for removal of invasive exotic species or for an adaptive plan for supplemental native plantings.

Natural Ecosystem Processes Restoration Monitoring

Long-term restoration of the reservoir areas aims to restore a naturally functioning ecosystem that is sustainable without human intervention on a regular basis. This long-term goal is achieved primarily through establishment of vegetation throughout the reservoir areas and especially along the river and its tributaries. A healthy, vibrant, self-sustainable riparian corridor where target plant species recruit from naturally produced seed will help improve water quality, reduce thermal load (i.e., provides shaded aquatic riverine habitat), stabilize banks and sediment, slow and filter water, provide fish and wildlife habitat, and provide

needed organic matter. Site monitoring to assess the achievement of this goal will be looking at monitoring metrics described above and determine if the reservoir areas are trending towards a restored natural ecosystem. KRRC will develop and implement corrective actions to improve the trend if it is not progressing toward a restored naturally functioning and self-sustaining ecosystem.

6.2 Framework for Adaptive Management Actions Based on Monitoring

Restoration of natural rivers is an evolving science and requires building in mechanisms to deal with uncertainty. Adaptive management is a comprehensive approach to natural resource management activities where feedback between observation and corrective action is emphasized to address uncertainty, as illustrated in the CDFW adaptive management diagram in Figure 6-1. Through this structured effort, a decision-making framework allows the project monitoring metrics to be interpreted and to take corrective actions as necessary. Likewise, monitoring provides the data necessary for tracking ecosystem health, for evaluating progress towards restoration goals and objectives (i.e., performance measures), and for evaluating and updating problem statements, goals and objectives, conceptual models, and restoration actions. Table 6-5 summarizes a simple framework for making decisions and actions based on monitoring of project metrics.

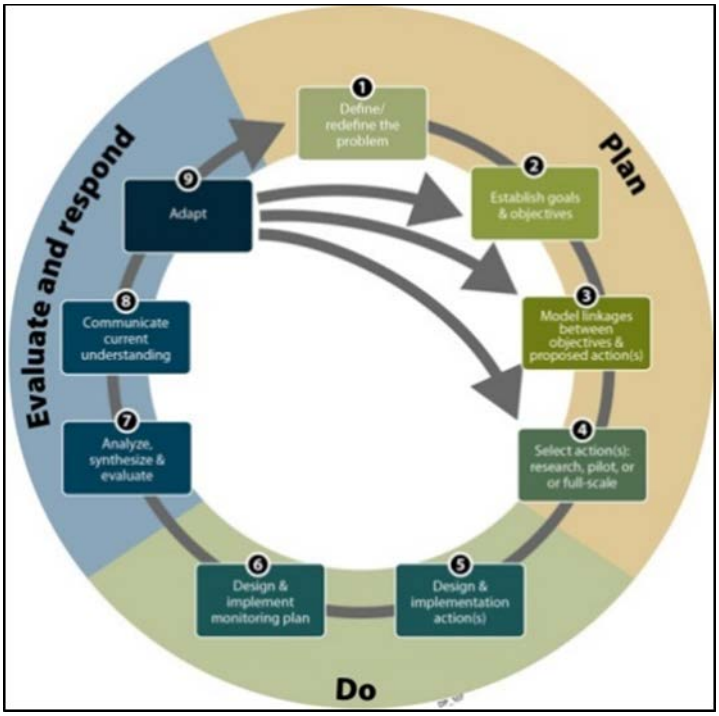

Figure 6-1 CDFW adaptive management diagram

Table 6-5 Monitoring decision making framework

Conclusion Categories	Decisions and Actions
Conclusion 1 - Project is meeting objectives based on values of monitoring metric and criteria.	• Evaluate the monitoring program (continue, reduce, or eliminate some metrics)
Conclusion 2 - Project is trending towards objectives based on values of monitoring metric and criteria.	• Evaluate the monitoring program (continue, reduce, eliminate some metrics) • Confer with project team to evaluate whether rates of progress toward objectives are appropriate

Conclusion Categories	Decisions and Actions
Conclusion 3 - Project is not meeting (or trending away from) objectives based on monitoring values of performance criteria.	• Evaluate causes • Confer with project team to assess the monitoring program to determine if appropriate data area being collected to assess and evaluate causes • Evaluate whether performance criteria metrics are appropriate • Develop a plan to address problems • Implement the plan and monitor results

The monitoring plan will include key monitoring attributes that will provide a feedback loop of the trends and trajectory of the restoration efforts used to determine maintenance needs for the Project. The project team will notify the regulatory agencies if monitoring demonstrates values outside of outlined thresholds as described in Table 6-6 below. If a monitoring metric is a "Pass", then there is no action required. If, however, the monitoring metric is a "Fail", then the project team will make an evaluation of the failure and a determination of potential maintenance and/or corrective actions dependent upon the severity and type of failure.

Table 6-6 Monitoring data trends, conclusions and responses for selected metrics

Metric	Thresholds	Decision Pathway	Corrective Action	Monitoring Technique
Longitudinal Stream Continuity	• No unnatural structures	• No unnatural structures (Pass) • Man-made or unnatural structure observed (Fail)	• Remove historical structure if it is problematic	Visual Inspection by Photo Points Physical Survey may be warranted if metric is found to be outside of threshold.
Fish Passage	• No unnatural barriers exceeding 6 inches • No unnatural channel headcut exceeding 6 inches	• No jump height barriers exceeding 6" (Pass) • Barriers/headcut present (Fail)	• Remove or rectify barrier • Restore and stabilize streambed through headcut	Visual Inspection by Photo Points Physical Survey may be warranted if metric is found to be outside of threshold.
Sediment Stability	• No significant sediment erosion or outside normal bank erosion	• No erosion threatening structures (Pass) • Bank erosion threatening structures (Fail)	• Perform stabilization actions to limit/reduce extent of erosion • Perform survey to evaluate trends in instability	Visual Inspection by Photo Points** Physical Survey may be warranted if metric is found to be outside of threshold.
Vegetation coverage	• % relative vegetation cover • Plant diversity • Tree and shrub survival % • % cover invasive exotic vegetation	• Low vegetation cover • Low plant diversity	• Additional vegetation seeding planting • Seeding additional species • Seeding add'l trees and shrubs • IEV eradication	On the ground physical surveys, Photo Points, GIS based analysis of aerial photography,

6.3 Data Storage and Reporting

6.3.1 Data Storage

KRRC and Klamath Basin Monitoring Program (KBMP), or their designated representative will store and maintain monitoring data. Data will be maintained in standard database(s) and will be made available to entities as requested and available on the KBMP website (kbmp.net). Data tables and observation forms will be standardized to avoid redundant data and to ensure consistent data formats among sampling events.

6.3.2 Data Analysis and Reporting

After each monitoring event, KRRC will analyze survey data. KRRC will prepare a brief site action memorandum and provide it to KBMP; the memo will include:

- Overview of site conditions,
- Monitoring metric conclusions based on metrics target thresholds, and
- Any maintenance or corrective actions recommended.

At the end of each monitoring season, an annual memorandum will be prepared that includes:

- Summary of each monitoring event site action memorandum,
- Monitoring metric conclusions based on metrics target thresholds observed over the monitoring season, and
- Any recommended maintenance or corrective actions.

KRRC will make these annual memos at the end of each calendar year. If significant issues or concerns are identified, KRRC will recommend future actions with sufficient time for planning and permitting prior to the "in water" work window. Lastly, KRRC will generate a final monitoring report to summarize monitoring data collected and adaptive management actions taken over the five years of monitoring including:

- Metrics for which data were collected; including any adjustments made to monitoring program,
- Summary of all monitoring data collected using tables and figures to depict observed trends over three years of monitoring,
- Individual Monitoring Metric Conclusions based on target thresholds observed over three years,
- Narrative discussions to explain results in the context of projects goals, success criteria, and performance standards, and
- Final recommended maintenance and corrective actions.

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Chapter 7: References

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Chapter 8: Supplementary Information

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8. SUPPLEMENTARY INFORMATION

8.1 Experiments to Inform Restoration Decisions

The following sections detail the experimental methodology, results, and implications of two experiments that were completed in 2017 and 2018 to address existing restoration data gaps: 1) Investigation of the physical responses of reservoir sediments to wetting-drying, and 2) Grow tests to evaluate the suitability of reservoir sediments as a growth medium and identify species likely to succeed in revegetation efforts.

8.1.1 Reservoir Sediment Characteristics

Results of Previous Studies

Testing of reservoir sediment characteristics can provide insight into the expected evolution of the material during and following drawdown. Previous analyses (J.C. Headwaters, 2003; Shannon and Wilson, 2006, USBR, 2010; Strauss, 2010; Simon et al., 2010), which are summarized in USBR (2011b and 2011c), examined the physical and behavioral properties, including grain size, Atterberg limits, water content, cohesion, shear strength, erodibility, and changes associated with desiccation (drying). Important results include the high clay content particularly in the downstream reaches of each reservoir, high water content, low material strength, and high erodibility of the fresh, moist reservoir sediments and the significant increase in material strength and decrease in erodibility of the sediments once dried (Simon et al., 2010). Critical shear stress, τ_c, for moist sediments (67 to 82% water content by weight) was 0.58 to 1.1 Pascals (Pa) (0.012 to 0.023 pound-force/square foot [lbf/ft^2]), similar to stresses required to entrain sand, and values increased to 5.9 to 56 Pa (0.123 to 1.17 lbf/ft^2) for dried sediments (48 to 67% water content), similar to stresses required to transport gravel and cobbles. Reservoir sediments from J.C. Boyle were observed to decrease in porosity and in thickness and volume by 40% and 66%, respectively, when air dried, and significant crack development occurred in concert with the decrease in volume (USBR, 2011c). These experiments informed predictions of the response of the accumulated reservoir sediments after drawdown. Specifically, the mechanically weak saturated sediments will erode rapidly during drawdown, but, upon drying in the summer after drawdown, the material will stabilize, the undisturbed reservoir surface elevations will be reduced, and cracks will form.

USBR (2011b) simulated sediment evacuation and suspended sediment concentrations during drawdown using a 1D model for all reservoirs. They demonstrated that the rate of erosion of reservoir sediments was primarily a function of hydrology during drawdown and the low-level outlet capacity of the dams. The range in reservoir sediment volume eroded varied from 41% to 66% depending on if a representative hydrograph from a dry or wet year, respectively, was simulated. These 1D model simulations used the median values for τ_c (0.2 Pa) and the erodibility coefficient, *k*, measured by Simon et al. (2010). Model sensitivity analyses using the 25th and 75th percentile moist values (Simon et al., 2010) for τ_c (0.03 and 1.2 Pa, respectively) showed negligible effect (USBR, 2011b). For the 1D modeling, an above water angle of repose of 15 degrees

was used (USBR, 2011b). However, values vary from 6 degrees (10H:1V, Shannon and Wilson, 2006), 18 degrees (2H:1V) PanGeo (2008), and 32 degrees from the drill core friction angle (Strauss, 2010). Sensitivity analyses using lower values of 5 and 10 degrees showed increased the duration of moderately elevated suspended sediment concentrations as result of sand deposition from Copco Reservoir in Iron Gate and subsequent remobilization. Effects on eroded sediment volume were not reported. A single value of angle of repose will not be representative of all grain sizes in the reservoir sediments or the increase in stable angle with desiccation of sand and fine-grained cohesive sediments.

Measurements of friction slopes and shear strengths were used to calculate stable sediment thicknesses as a function of slope and measured cohesion (Table 8-1) using an infinite slope assumption and the US Army Corps of Engineers Slope Stability Engineering Manual (see summary in USBR, 2011b). The minimum measured cohesion value was 0.7 pound-force/square Inch (lbf/in^2), but given the difficulty measuring this quantity on the saturated sediments, a lower cohesion value is more reasonable. Results suggest that slopes with gradients below 10% should be stable with more than 4 to 8 ft of reservoir sediments. Greater slopes and thicknesses are predicted to lead to slope failure or slumping.

Table 8-1 Stable depth (ft) of reservoir sediments as a function of slope and cohesion for saturated and draining sediments from USBR (2011b).

Slope	Stable Depth for Different c' values			
	c' (lbf/in^2)			
	0.2	0.35	0.7	1
0.1	4.6	8.1	16.2	23.1
0.2	2.4	4.2	8.3	11.9
0.3	1.7	2.9	5.8	8.3
0.4	1.3	2.3	4.7	6.7

Sediment Sampling and Experimental Methodology

Additional testing of reservoir sediments was undertaken in winter 2018 to build upon these previous analyses. Sediments were monitored during desiccation, and experimental treatments targeted changes in physical properties of the sediment when exposed to cyclical periods of wetting and drying as would be experienced in the fall following drawdown. Samples (approximately 1 cubic foot [ft^3] each) were collected with a grab sampler from the uppermost 9 inches of substrate in 25 locations in total among the three reservoirs (Figure 8-1, Figure 8-2, Figure 8-3). Samples were placed into 15-inch by 23-inch containers to a depth of 4 to 5 inches and tested in a greenhouse environment. Control over environmental conditions in the greenhouse was limited by the thermostat and sprinkler characteristics and therefore do not simulate conditions at the reservoirs exactly. Greenhouse temperatures typically varied between 50 to 70 deg. F with extremes approaching 90 deg. F, and relative humidity ranged from 30 to 60%. Sample measurements included deposit dimensions and weight, time-lapse photography of volume changes and crack geometry

development, infiltration rate, and shear strength, which was measured with a Torvane sampler and correlates with critical shear stress and the erodibility coefficient (see Simon et al., 2010). Samples were monitored during desiccation over a period of weeks until sample weight had stabilized (i.e., samples had fully dried out). Once dried, ¼ inch holes were drilled in the base of the sample containers to promote free draining, and samples were periodically rained on with an average application of 1.1 inches from the sprinkler system at a rate 1.65 inches per hour for a period of approximately 40 minutes. These rainfall events are similar to a 100-year event for this duration at the Copco climate station. Sample weight and shear strength were measured at the conclusion of rainfall events. Shear strength (τ_f, kPa) was compared to fractional sample weight $F = W/W_0$, where W is the measured sample weight (lbs) and W_0 is the initial weight (lbs) prior to desiccation.

Measured shear strength values were used to estimate variations in predicted erosion rates of reservoir sediments with desiccation using a simplified model. Critical shear stress (τ_c, Pa) and the erodibility coefficient (k, cm³/N-s) are calculated from shear strength (τ_f, kPa) using empirical relationships from Simon et al., (2010): $\tau_c = 0.2151\tau_f^{1.5006}$ and $k = 0.7534\tau_f^{-0.6023}$. We use the rewritten form of the Ariathurai and Arulanandan (1978) excess shear stress relation for erosion rate (ε, m/s) of cohesive sediments from Partheniades (1965), $\varepsilon = k(\tau - \tau_c)$ for $\tau > \tau_c$ to explore the sensitivity of erosion rate to shear strength. Substituting the shear strength relationships for τ_c and k_d (Simon et al., 2010) shows that $\varepsilon = 0.8\tau_f^{-0.6}(\tau - 0.2\tau_f^{1.5})$ or $\varepsilon \propto \tau_f^{-0.6}\tau^1$. That is, the shear stress needed to cause erosion is a function of $\tau_f^{1.5}$, and for a given shear stress in excess of this critical value, erosion rate varies linearly with excess shear stress and with approximately the inverse square root of shear strength.

Results of Sediment Testing

Data collected during the drying of the samples confirmed many of the observations from previous studies. Wetting-drying tests were performed on paired samples from JCB1, CP2, and IG1, which are located near their respective dams where sediment deposits are thickest (Figure 8-1, Figure 8-2, Figure 8-3). Desiccation, which occurred solely through evaporative processes rather than gravity draining, resulted in significant reductions in fractional sample weight, F, and volume of up to 80% and 65%, respectively, over a period of one to two months (e.g., Figure 8-7, Figure 8-8, Figure 8-9 and Table 8-2, Table 8-3, Table 8-4). Over the first several weeks of drying, cracks several inches in width formed through the full thickness of the deposit and the sediment pulled back from the sides of the container (Figure 8-4, Figure 8-5, and Figure 8-6).

The increases in shear strength, (τ_f, kPa) were dramatic (Table 8-5, Table 8-6, Table 8-7) with reductions in fractional sample weight and tightly follow a negative power law (Figure 8-7, Figure 8-8, Figure 8-9). Shear strength increased rapidly after samples reached about 50% of the initial saturated weight, which occurred after several weeks. Maximum shear strength values were over two orders of magnitude greater than early, saturated measurements (Table 8-8). Samples eventually dried and hardened to the extent that the Torvane sampler could not be inserted into the sediment, and further measurements were not possible. Therefore, maximum shear strength values are potentially even higher than measured.

The maximum measured shear strength values were used to calculate changes in critical shear stress and the erodibility coefficient (Table 8-8). Critical shear stress increased by 2 to 3 orders of magnitude and were an order of magnitude greater than the maximum values, equivalent to values able to erode cobbles, that were measured by Simon et al. (2010) and used to model reservoir erosion (USBR, 2011b). Using the simple relationship for boundary shear stress for steady, normal flow, $\tau = \rho g H S$, a 2 to 3 order of magnitude increase in the depth-slope product would be required to initiate erosion in the dried sediment compared to the fresh, moist sediments. The decreases in erodibility, k, suggest decreases in erosion rate with desiccation by a factor of 6 to 30 for a given shear stress in excess of critical applied to the dried sediments (Table 8-8).

The effects of experimental rainfall events are visible in the shear strength and drying. While most of the rainfall was lost as surface runoff, some water entered the deposits resulting in maximum increases in *F* of 0.12 (approximately 6 lbs) at CP2b (Figure 8-8D). After wetting, reductions in shear strength were variable and generally ranged from 50 to 75 kPa. Wetted shear strength values were still two orders of magnitude greater than initial measurements (Figure 8-7 and Figure 8-8). The maximum decrease in shear strength was 200 kPa (see January 26 event in Figure 8-7D). Changes in deposit dimensions were negligible in response to rainfall events. An important response to cyclical wetting and drying was the disintegration and fracturing of the deposits into smaller fragments and dust. Most strikingly in the IG1 samples, new cracks and fractures appeared after each sequence of wetting and drying. In the IG1 samples, which had the highest clay content of the three wetting-drying samples, considerable disintegration occurred with additional watering even after seeding and root development (see Section 8.1.2).

Infiltration rates from single-ring infiltration tests were low (on the order of 10^{-2} inches per hour) on partially dried intact sediment surfaces. These rates are consistent with infiltration rates calculated from laboratory analyses of sediment texture (Wallace, 2017) using the Soil Water Characteristics model v. 6.02.74 (Keith Saxton, US Department of Agriculture [USDA]). On fully dried samples, water ponded in sediment depressions during greenhouse irrigation tests where rainfall rates were approximately 1.25 to 1.65 inches per hour. This observation provides an inferred upper limit on the infiltration rate. However, during single-ring irrigation tests on the dried samples, infiltration rates were very high, several inches per hour. These rates were influenced heavily by the presence of thin cracks in the deposit. The bulk infiltration rates for the reservoir sediment deposits were dominated by preferential flow paths along cracks and were much higher than expected from the high clay content of the sediments and reduction in porosity with desiccation.

Implications of Sediment Testing Results for Reservoir Evolution

The results presented above suggest additional complexities and potentially some deviations from the general reservoir response patterns described by USBR (2011c). Much of the water in the highly saturated sediment will drain rapidly with open-air exposure resulting in initial mass loss significantly greater than that measured in the greenhouse. Desiccation, and concomitant increases in shear strength, are expected to be more rapid in the field because of gravity draining even if temperatures were lower than in the greenhouse, where over a month of drying was required for the shear strength to increase over 50 kPa.

The remaining water content, however, could take weeks to evaporate out of the high clay content sediments, depending on meteorological and topographical conditions. Deeper sediments in thicker deposits will require longer to dry and stabilize if they are insulated from direct sunlight and the atmosphere by overlying sediment. Therefore, even though the surface sediments are dried and hard, the deposits could be deceptively unsupportive of heavy machinery in the weeks after drawdown, and the timing for such stability of the deposits remains poorly constrained. The dried material is firm but brittle, and surface-normal pressure (e.g., during tilling, soil compaction tests) resulted in fracture, rather than plastic deformation, of the sample deposits in the greenhouse. Field deposits will not have the shallow, hard boundary of the sample bin, so fracture behavior may differ somewhat. In situ sediment consolidation and strength was greater (and water content lower) at sediment depths of 6 to 10 ft (USBR, 2011b), so exposed basal sediments may not slump and erode as readily as surface sediments during drawdown.

Secondary erosion of the residual reservoir deposits is affected by the large increases in shear strength with desiccation, the prevalence of cracks, and the continued disintegration in response to wetting and drying cycles. Dried blocks tested in the lab retained high mechanical strength (critical shear stress values in excess of those required to transport cobbles) and may not readily erode (via rainsplash) nor reduce considerably in strength from rainfall alone. The low porosity and low infiltration rates of intact surfaces hindered the re-saturation of the deposits even with long durations of rainfall, such that high shear strength was retained. The prevalence of cracking will encourage gully erosion because the low infiltration rates will intensify surface run off and flow concentration in cracks. Gullies will incise and widen with time. The availability of erosive tools (i.e., sand and gravel) to abrade the fine-grained deposits may be an important factor encouraging gully erosion. Gullies closer to coarse sediment sources (e.g., near the steep hillslopes at Copco and Iron Gate) may have more effective secondary erosion than areas lacking those sediment sources (e.g., Upstream Reach of J.C. Boyle). The disintegration of sediments in response to wetting and drying cycles is effectively a reduction in the grain size of the sediment aggregates. Therefore, while the sediments retain high shear strength, they will be broken down smaller size classes that are more easily transported than the shear strength values suggest. Furthermore, the attrition rates of sediment aggregates are expected to be very high if mobilized, and the material will disintegrate rapidly. Flow routing and accumulation GIS analysis, particularly at Copco, could be used to predict locations where secondary erosion from hillslope runoff and gully erosion may be expected to occur. Such locations will be the first to naturally excavate reservoir sediments and expose historical soils in upland, terrace, and floodplain environments. Inasmuch as native vegetation might prefer the historical soils over reservoir sediments, these areas could be hubs for more targeted revegetation efforts.

The continued disintegration of the dried sediments to easily erodible fine particles and aggregates in response to wetting and drying suggests that the exposed reservoir sediments may be unstable post drawdown despite the initial increases in the shear strength. There is potential for the bare sediments to produce elevated suspended sediment concentrations during fall rain events if not stabilized with vegetation. The disintegration in response to wetting-drying was most dramatic in the IG1 samples, which suggests that high clay content enhances this effect. Therefore, we may expect this behavior to be a larger factor in deposit evolution in Iron Gate Reservoir and in the downstream portions of each reservoir. Vegetation was successful in reducing disintegration for the CP2 sample.

Infiltration results have important implications for surface run-off responses to precipitation, moisture availability for revegetation, deposit evolution by gully erosion, and associated river suspended sediment concentrations. High intensity rainfall (e.g., rainfall rates in the greenhouse, but also likely smaller events) will largely run off the intact sediment surfaces and flow preferentially in cracks and gullies. High surface runoff will reduce the amount of moisture absorbed into the low porosity, hardened surface sediments, and therefore less moisture will be available in the shallow subsurface for plant uptake relative to more mature soils with similar characteristics that lack the crack development. Infiltration will be dominated by preferential flow in cracks, and crack densities should be sufficient for the effective infiltration rate for the sediment body to be high.

Wetting and Drying Test Data and Figures

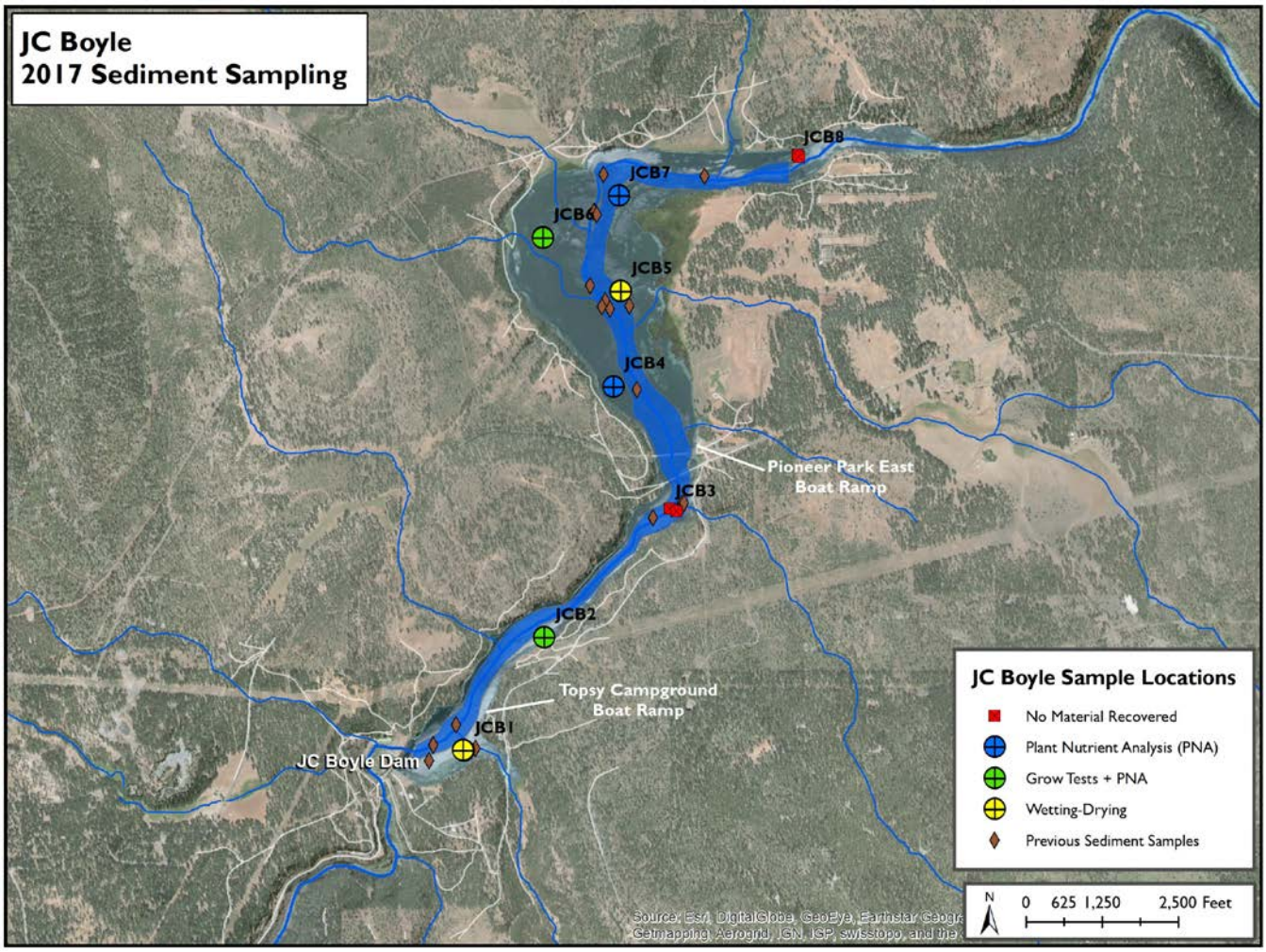


Figure 8-1 Sediment sampling locations at J.C. Boyle for wetting-drying, grow tests, and plant nutrient availability analysis.

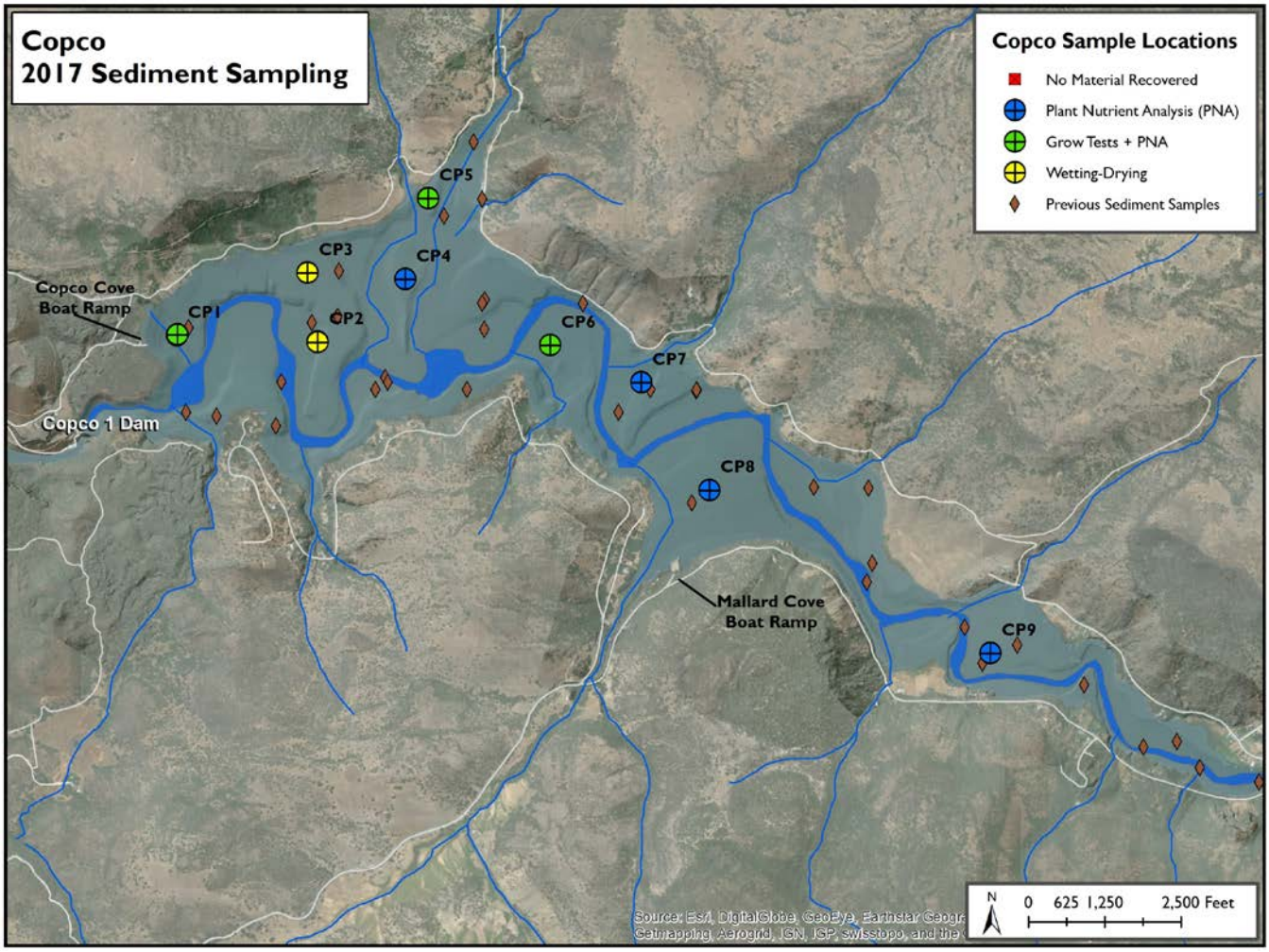


Figure 8-2 Sediment sampling locations at Copco for wetting-drying, grow tests, and plant nutrient availability analysis.

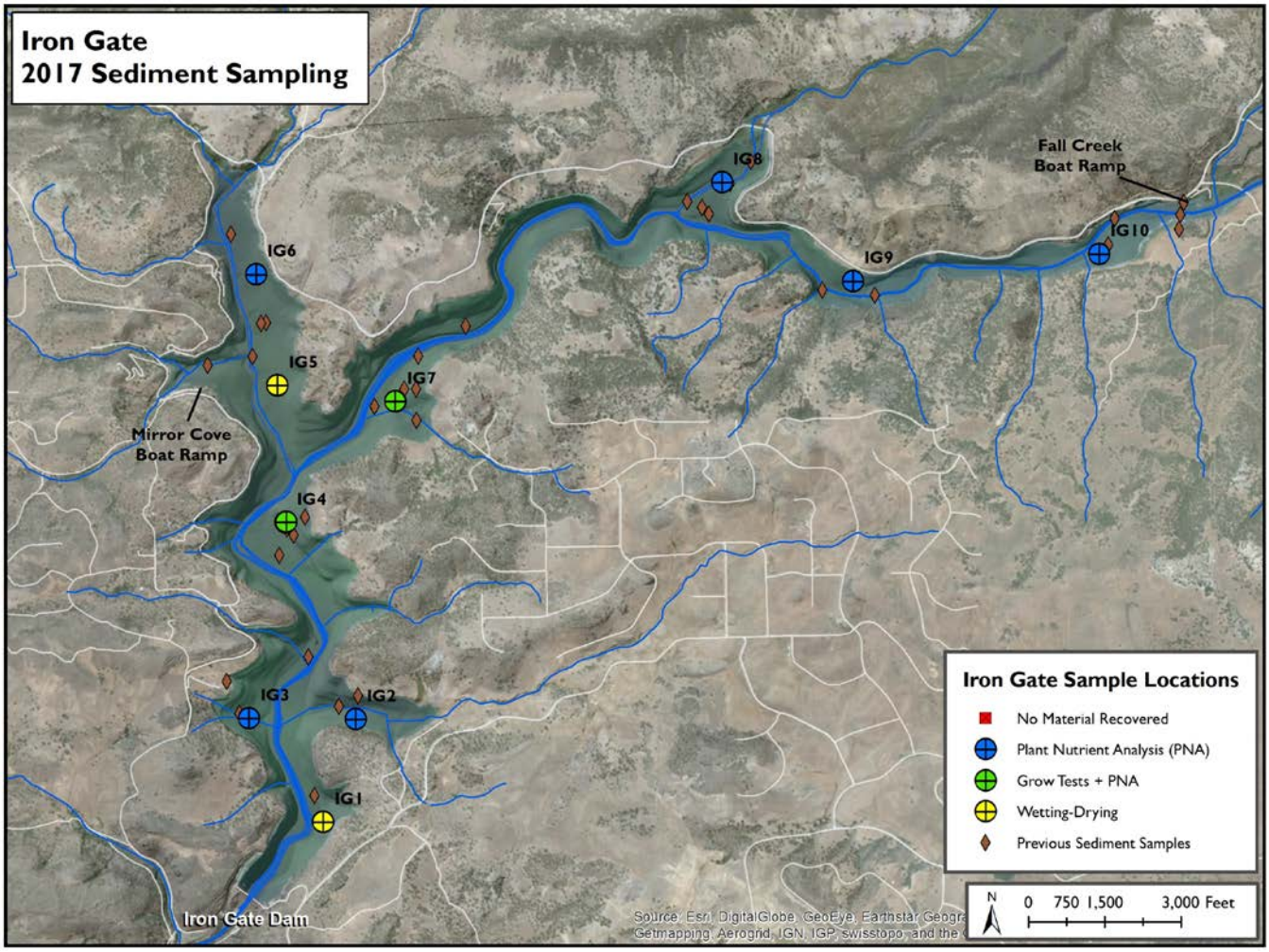
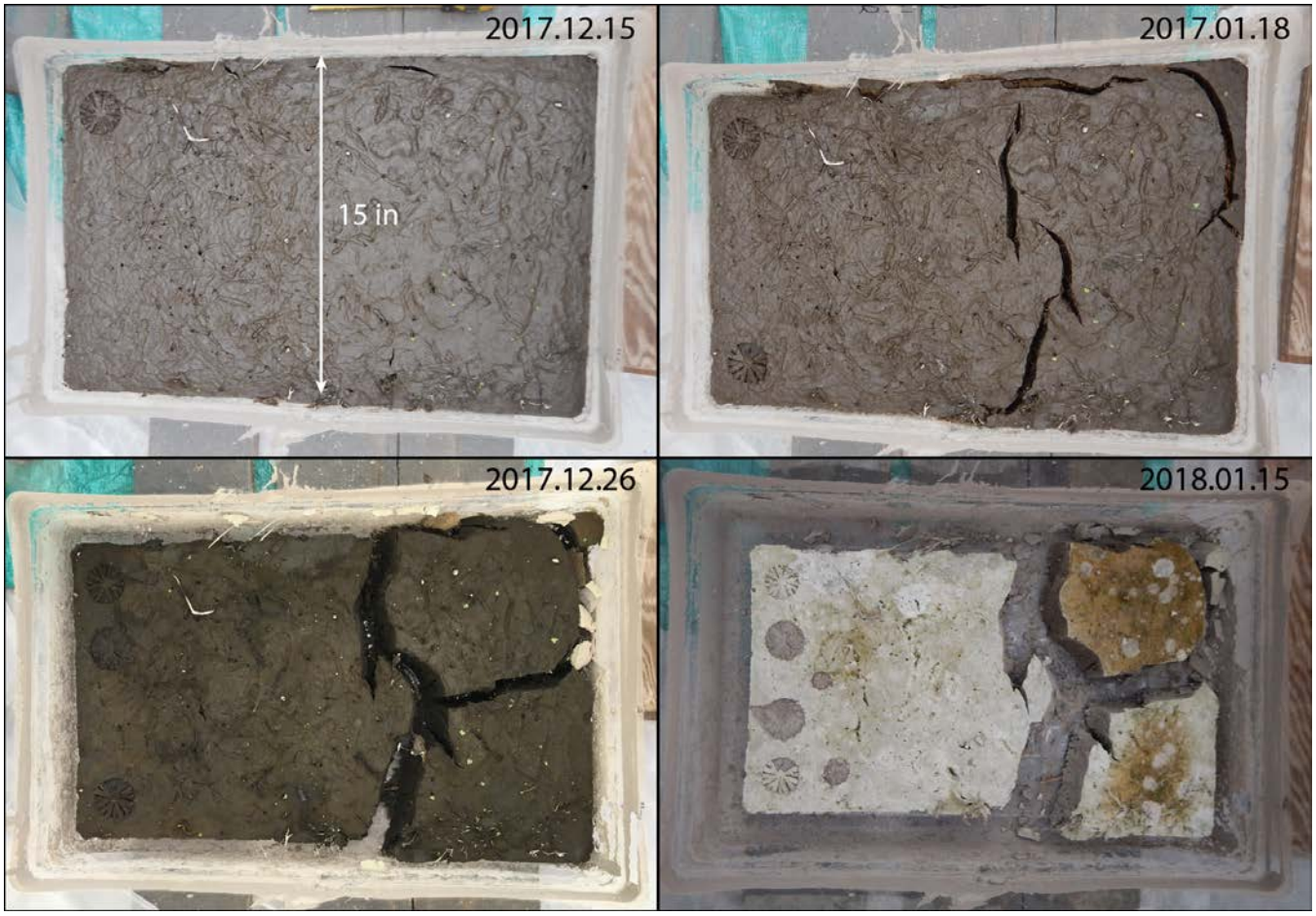
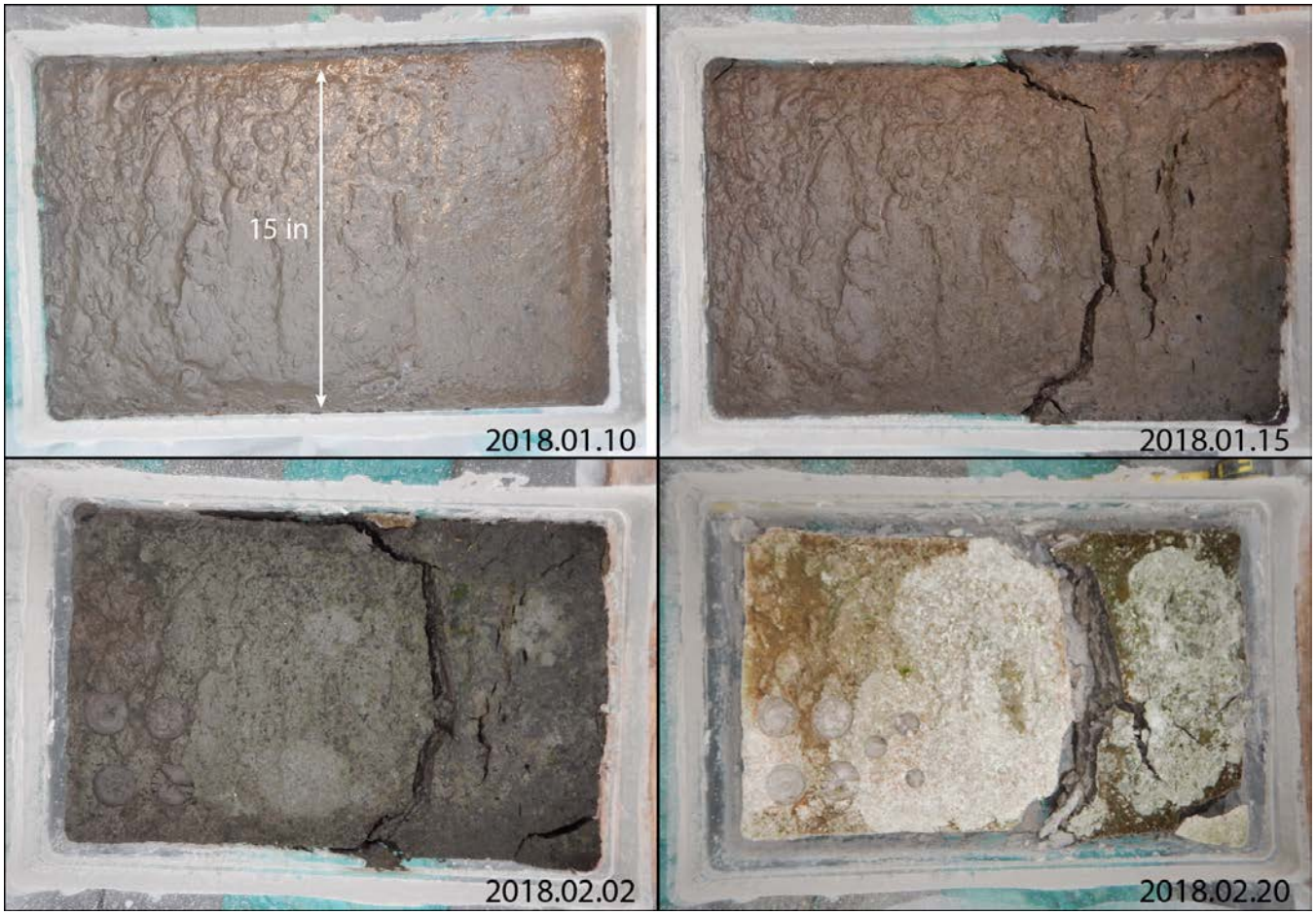


Figure 8-3 Sediment sampling locations at Iron Gate for wetting-drying, grow tests, and plant nutrient availability analysis.



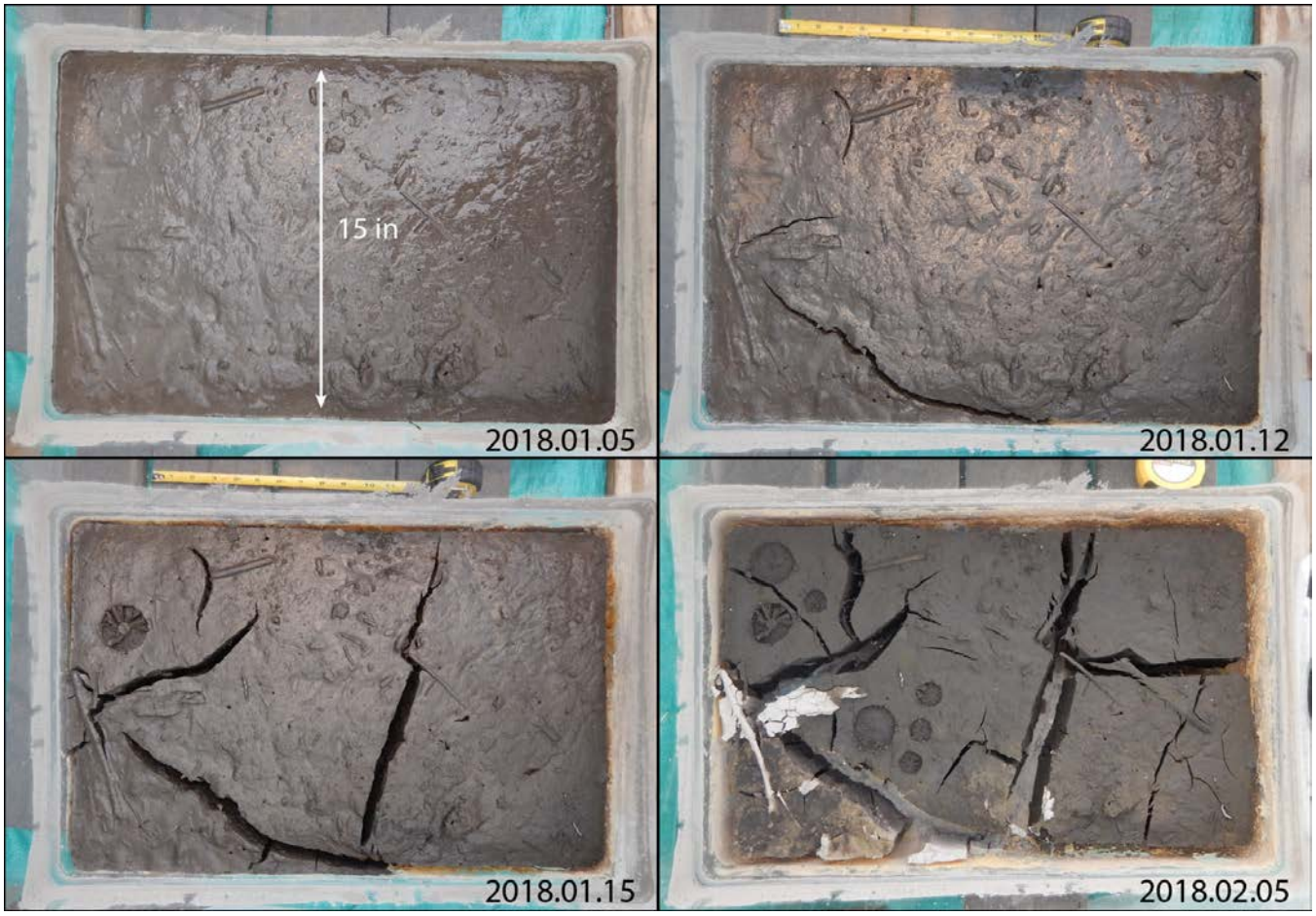
Locations of Torvane measurements are visible on the left side of the deposits.

Figure 8-4 Photos of desiccation and cracking of the J.C. Boyle sediment sample JCB1a.



Locations of Torvane measurements are visible on the left side of the February photos.

Figure 8-5 Photos of desiccation and cracking of the Copco sediment sample CP2a.



Locations of Torvane measurements are visible on the left side of the deposits.

Figure 8-6 Photos of desiccation and cracking of the Iron Gate sediment sample IG1a.

Table 8-2 Summary of physical changes during desiccation for J.C. Boyle samples.

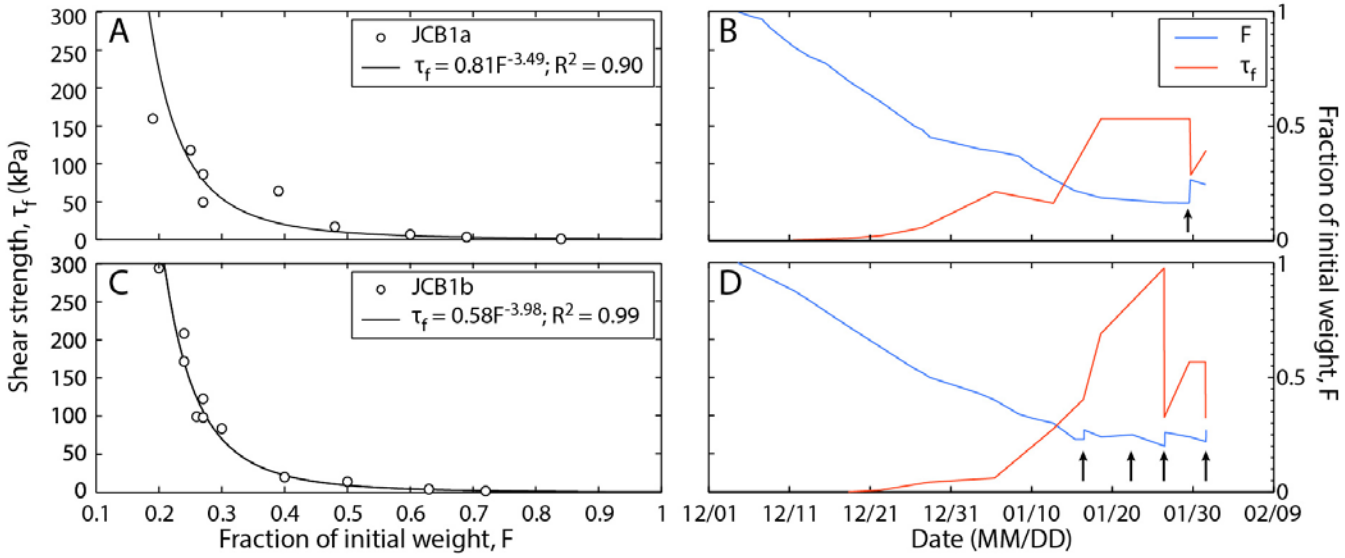
Quantity	JCB1a			JCB1b		
	Moist	Dry	% of Initial	Moist	Dry	% of Initial
Volume (cu. ft)	0.8	0.22	28	0.90	0.22	25
Thickness (in)	3.9	2.0	51	4.0	2.0	50
Weight (lbs)	46	8	17	47	10	21
Max crack width (in)		3			2.25	

Table 8-3 Summary of physical changes during desiccation for Copco samples.

Quantity	CP2a			CP2b		
	Moist	Dry	% of Initial	Moist	Dry	% of Initial
Volume (cu. ft)	0.82	0.32	39	0.82	0.33	40
Thickness (in)	4.1	2.0	49	4.1	2.0	49
Weight (lbs)	51	13	25	51	13	25
Max crack width (in)		2.2			1.3	

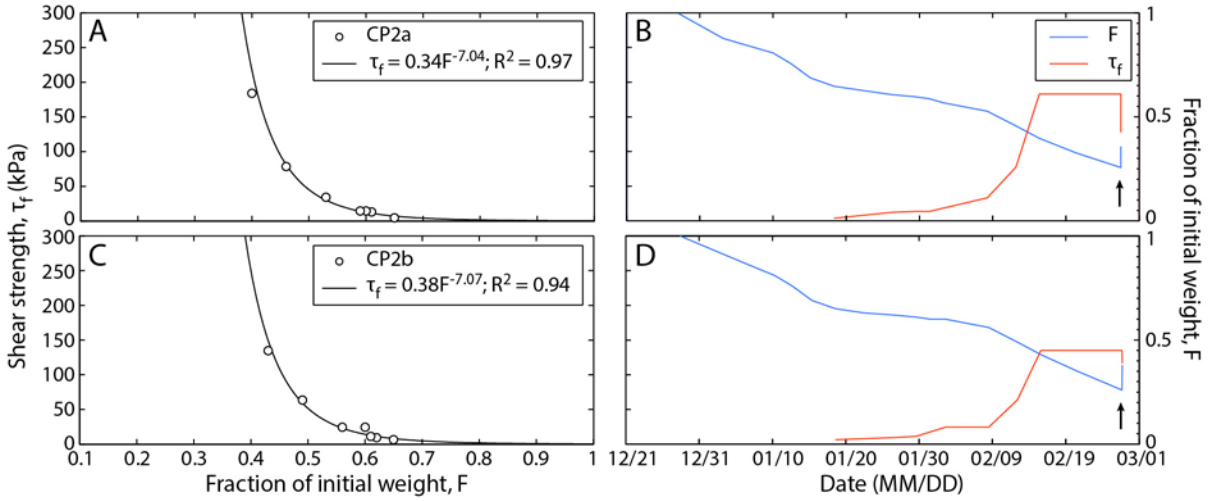
Table 8-4 Summary of physical changes during desiccation for Iron Gate samples.

Quantity	IG1a			IG1b		
	Moist	Dry	% of Initial	Moist	Dry	% of Initial
Volume (cu. ft)	0.95	0.31	33	0.92	0.28	30
Thickness (in)	4.1	2.3	56	3.9	2.0	51
Weight (lbs)	51	15	29	51	13	25
Max crack width (in)		2.0			2.2	



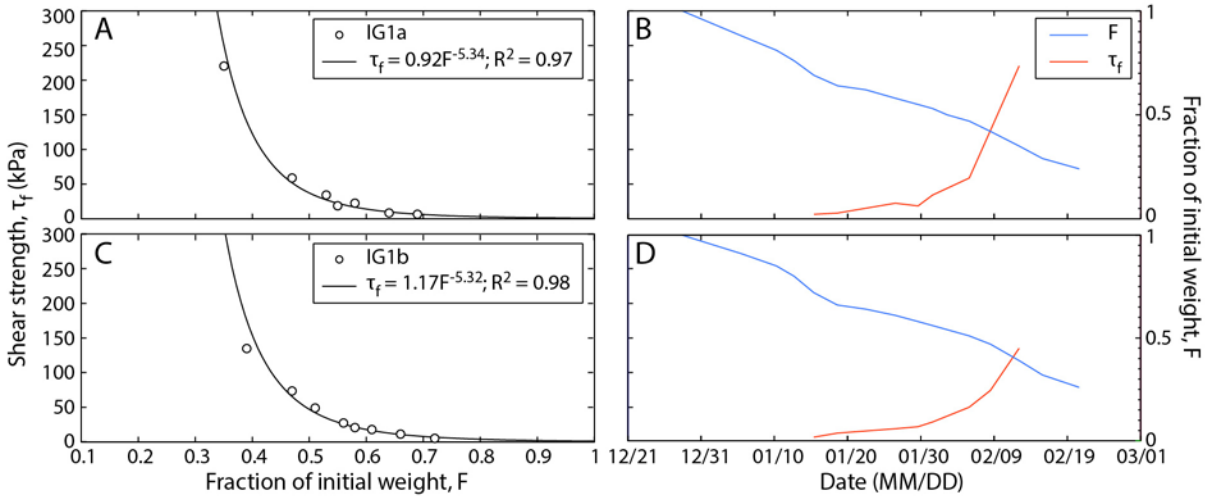
A,C) Shear strength, τf (kPa) vs. fraction of initial weight, F, with power law trendlines. B,D) Changes in τf (red line, left axis) and F (blue line, right axis) vs. time. Vertical arrows mark irrigation events that increased sample weight.

Figure 8-7 Shear strength and drying data for J.C. Boyle samples JCB1a (A,B) and JCB1b (C,D).



A,C) Shear strength, τf (kPa) vs. fraction of initial weight, F, with power law trendlines. B,D) Changes in τf (red line, left axis) and F (blue line, right axis) vs. time. Vertical arrows mark irrigation events that increased sample weight.

Figure 8-8 Shear strength and drying data for Copco samples CP2a (A,B) and CP2b (C,D).



A,C) Shear strength, τf (kPa) vs. fraction of initial weight, F, with power law trendlines. B,D) Changes in τf (red line, left axis) and F (blue line, right axis) vs. time.

Figure 8-9 Shear strength and drying data for Iron Gate samples IG1a (A,B) and IG1b (C,D).

Table 8-5 Results from desiccation of J.C. Boyle sediment samples

Quantity	JCB1a		JCB1b	
	Moist	Dry	Moist	Dry
Shear strength (τ_f, kPa)	0.59	159	1.57	294
Critical shear stress (τ_c, Pa; lbf/ft^2)	0.10 (0.002)	434 (9.06)	0.43 (0.009)	1090 (22.8)
Erodibility (k)	1.04	0.04	0.57	0.02

Shows moist and dry measurements of shear strength (τ_f) in kPa and calculated values of critical shear stress (τ_c) in Pa and lbf/ft^2 and the erodibility coefficient (k) from the Simon et al., (2010) relationships. Moist values are likely maximum values as material was too soft to sample with the Torvane at the outset of the experiments. Dry values are maximum values prior to wetting cycles.

Table 8-6 Results from desiccation of Copco sediment samples

Quantity	CP2a		CP2b	
	Moist	Dry	Moist	Dry
Shear strength (τ_f, kPa)	4.90	184	6.28	184
Critical shear stress (τ_c, Pa; lbf/ft^2)	2.34 (0.049)	538 (11.2)	3.39 (0.071)	538 (11.2)
Erodibility (k)	0.29	0.03	0.25	0.03

Shows moist and dry measurements of shear strength (τ_f) in kPa and calculated values of critical shear stress (τ_c) in Pa and lbf/ft^2 and the erodibility coefficient (k) from the Simon et al., (2010) relationships. Moist values are likely maximum values as material was too soft to sample with the Torvane at the outset of the experiments. Dry values are maximum values prior to wetting cycles.

Table 8-7 Results from desiccation of Iron Gate sediment samples

Quantity	IG1a		IG1b	
	Moist	Dry	Moist	Dry
Shear strength (τ_f, kPa)	6.47	221	5.30	135
Critical shear stress (τ_c, Pa; lbf/ft^2)	3.55 (0.074)	707 (14.8)	2.62 (0.055)	338 (7.05)
Erodibility (k)	0.245	0.029	0.276	0.039

Shows moist and dry measurements of shear strength (τ_f) in kPa and calculated values of critical shear stress (τ_c) in Pa and lbf/ft^2 and the erodibility coefficient (k) from the Simon et al., (2010) relationships. Moist values are likely maximum values as material was too soft to sample with the Torvane at the outset of the experiments. Dry values are maximum values prior to wetting cycles.

Table 8-8 Summary results from desiccation of sediment samples

Sample	$\Delta\tau_f$ (kPa)	$\Delta\tau_c$ (Pa)	Max(k)/min(k)
JCB1a	159	434	29.2
JCB1b	294	1089	23.4
CP2a	184	536	9.7
CP2b	135	334	6.3
IG1a	221	704	8.4

Sample	$\Delta\tau_f$ (kPa)	$\Delta\tau_c$ (Pa)	Max(k)/min(k)
IG1b	135	335	7.0

Shows maximum increases in shear strength ($\Delta\tau_f$, kPa) and in critical shear stress ($\Delta\tau_c$, Pa), and proportional decrease in the erodibility coefficient (max(k)/min(k)) from beginning to end of the experiments.

Table 8-9 Cohesive sediment parameter values for 2D morphodynamic modeling of Copco Reservoir drawdown and evolution under three scenarios

Scenario	Critical shear stress (τ_c, Pa)	Erodibility coefficient (k, cm³/N-s)
Easy-erode	0.2	20.0
Medium-erode	0.25	2.0
Hard-erode	2.0	0.5

Source: USBR (2011b) using data from Simon et al. (2010).

8.1.2 Reservoir Revegetation and Grow Tests

A primary component of this RAMP is revegetation of the former reservoir areas. Successful revegetation is essential for stabilizing reservoir deposits, establishing critical habitat, and restoring natural ecosystem functions. General long-term revegetation patterns will be influenced by local topographic conditions (e.g., aspect, elevation), subsurface hydrology, and sediment texture. West and south facing slopes receive more solar radiation, have higher evapotranspiration, and will be hotter and drier than north and east facing slopes. South and west facing slopes are more appropriate for juniper woodland or three-leaf sumac scrub habitats while north and east facing slopes will better support ponderosa pine and Douglas fir woodlands. Similarly, areas at the bottom of the valley slopes will be cooler and more mesic than areas higher up or on steeper slopes. Species such as big-leaf maple, California black oak and Oregon ash will be more successful in more mesic and moisture preserving environments while juniper woodland will be more appropriate on steeper, xeric slopes. Areas with lower solar radiation will support species that prefer wetter, cooler environments (e.g., riparian and mesic communities) while areas of higher solar radiation will be more appropriate for species that are more tolerant of hot, dry xeric conditions with high evapotranspiration rates.

On fine substrates, native annual grasses and forbs with shallow root systems tend to be the first pioneers in primary succession (Grubb, 1986). Coarse soils are favored by native perennial grasses (bunch grasses) that grow deep root systems that allow them to persist for years. Large trees and shrubs tend to pioneer newly-formed, coarse-textured substrates (Grubb, 1986). On fine sediments, native annual grasses may provide short-term resistance to invasion by exotic annual grasses, but long-term resistance requires the establishment of woody species. On coarse sediments, trees and shrubs will establish readily. However, riparian deciduous species, such as red alder, willows and cottonwood, will not perform well on deep layers of coarse sediments perched above the water table. These riparian trees are true phraetophytes and require permanent constant contact with the ground water table. Many riparian trees can grow their roots at a rate that maintains pace with normal recession of the ground water table in riparian areas after the peak of the spring snowmelt.

Large areal extents of reservoir sediments are likely to persist after drawdown, and the success of revegetation efforts will be largely determined by the ability to grow plants in the reservoir sediments. Reservoir sediments differ from native soils, so testing has been undertaken to evaluate revegetation options.

Results of Previous Testing

A seedbank study of reservoir sediments was conducted in 2010 (USBR, 2011c) to evaluate the natural availability of viable seed material in the reservoir deposits. Samples from each reservoir were placed in greenhouse with 12 hours of supplemental daylight, temperatures between 70 and 95 deg. F, and irrigated with 0.1 inches daily from a sprinkler system (USBR, 2011c). The seedbank germination study found that most of the extant seeds that successfully germinated were native wetland-type species, and the highest germination densities were from sediment proximal to existing wetlands along reservoir perimeters (USBR, 2011c). Wetland seeds are better adapted to the anoxic conditions in the reservoir substrate than species from other ecogeomorphic areas or "planting zones" (i.e., upland, riparian bank, riparian floodplain). Some existing perimeter wetlands are expected to vanish with the changing hydrologic conditions (e.g., lowering water table) post-drawdown. These results suggest that some natural wetland succession is possible post-drawdown at springs and tributaries historically or currently associated with wetlands, but upland and riparian vegetation will need to be actively revegetated.

Grow Test Experimental Methodology

Revegetation "grow tests" and plant nutrient availability (PNA) lab analyses were undertaken in Winter 2018 to evaluate reservoir sediments as a growth medium and to identify the ideal seed mix for a cover crop and for each planting zone in each unique reservoir setting. Surface grab samples (2 ft^3 per location) of reservoir sediments were collected in the same field effort as the sediments for the wetting drying experiments. In a greenhouse environment, fully saturated reservoir sediment was distributed into four (one for each planting zone) freely draining 10 inch by 10 inch sample containers to a depth of approximately 6 to 7 inches (Figure 8-11Figure 8-10). Seeds were placed on the surface of the moist sediments in a 6 x 6 grid (36 seed locations per container, multiple seeds per location depending on seed species) and supplemented with mycorrhizal inoculant. The species lists for each planting zone is presented in Table 8-6. For the first two weeks, the sediment surface was moisturized daily with a spray bottle, and greenhouse conditions were maintained at approximately 55 deg. F and 55% relative humidity. After two weeks, a greater (0.1 to 0.25 inch) but less frequent (twice per week) irrigation amount was applied to the plants with a sprinkler system, and a greater temperate range mimicking natural diurnal cycles (55 to 70 deg. F) was imposed. After several weeks, temperatures were increased to over 100 deg. F with the same irrigation schedule. Control over environmental conditions was limited in the greenhouse, and the ability to simulate, for example, realistic freezing temperatures and low intensity rainfall was not possible.



Each bin corresponds to a planting zone (clockwise from top left): riparian bank, riparian floodplain, cover, upland. The experimental set up was identical for each of the three grow test reservoir samples.

Figure 8-10 Grow test sample layout for J.C. Boyle sample JCB6 immediately after seed placement (left) and after six weeks (right).

Grow tests were also performed on the fully desiccated sediment from the concluded wetting and drying experiments to evaluate the effectiveness of secondary revegetation in the fall. Attempts were made to till one of the sediment samples by hand using a 1/8 inch screw. The high strength and brittleness made tilling the deposit without fracturing the deposit all the way through a challenge. Instead, the footprints of the Torvane tests (n >= 7 per sample) were considered representative of "tilled" sediment. Samples were irrigated for 5 minutes, and 0.2 to 0.4 ounces of each seed mixture were distributed loosely across each sediment surface. Imbedding seeds was not an experimental option given the high strength of the dried sediment. JCB1a, JCB1b, and IG1a were seeded with the Upland seed mixture, IG1b and CP2a were seeded with the Riparian Floodplain seed mixture, and CP2b was seeded with the Riparian Bank seed mixture. Samples were irrigated daily with approximately 0.4 to 0.5 inches of rainfall with an average intensity of 1.3 to 1.5 inches per hour. This rainfall represents an approximately 10-year event based on climate data from the Copco #1 Dam weather station (Western Regional Climate Center). After 2 weeks, irrigation was applied for 20 to 30 minutes twice per week at a rate of 2.5 inches per hour. After 8 weeks, temperatures in the greenhouse were increased, with daily maximums over 100 degrees, to mimic summer conditions. The irrigation regime was kept constant.

The suitability of the reservoir sediments as a growth medium was also assessed with a plant nutrient availability (PNA) analysis. Physical and chemical characteristics of the reservoir sediment samples were tested by a soils lab to identify any chemical deficiencies or excesses that could inhibit plant growth. Four to six cups of material were extracted from several locations in each surface grab sample and composited into a single sample for the analysis. A first round of samples (JCB4, JCB7, CP4, CP7, CP8, CP9, IG2, IG3, IG6,

IG8, IG9) were composited and packaged in Ziploc bags on the research vessel and sent to the lab in December. A second round (JCB2, JCB6, CP1, CP5, CP6, IG4, IG7) was packaged and analyzed in January from sediments that had been stored for several weeks in the sealed polycarbonate sample bins in a storage unit.

Results of Grow Tests

Results from the grow tests demonstrate the ability of the reservoir sediments to support plant growth for species from each planting zone. Successful germination and plant growth occurred in 76%, 71%, 80%, and 81% of the seed locations for riparian bank, riparian floodplain, upland, and cover seed mixtures, respectively. Results (e.g., Table 8-10) allowed for identification of species that were unsuccessful in growing in the reservoir sediments. In general, clustered field sedge, creeping wildrye, chick lupine, western needlegrass, and silverleaf scorpionweed has low growth success.

Most of the seeds germinated in a period of one to two weeks. After four weeks, species growth was healthy, and species mortality was undetectable. The volume of each deposit decreased with time even with the irrigation. Initial deposit surface dimensions were approximately 10 by 10 inches with a thickness of 6 inches. After six weeks, the samples had pulled back from the sides of the container resulting in 7- by 7-inch surface dimensions, and the thickness decreased to 3 inches. Plant growth was initially unaffected by the change in deposit volume. Cracks did not development in the interior of the deposit surfaces and was at most minor along the deposit edges. Presumably the material strength increased considerably with decreases in deposit volume given the patterns observed during wetting-drying experiments. Despite changes in volume and material strength, root development was extensive and visible in the sides of the deposits, in some cases extending through the full deposit thickness. There were no systematic differences in plant growth for the different planting zones or the reservoirs. After eight weeks of plant growth, some of the sample sediments dried out, and the densely packed plants began to die. The porosity and available pore water were expected to steadily drop with desiccation, and the water demand of the growing plants was expected to increase. The irrigation rate was not increased to accommodate the decreasing soil water supply and increased demand. The initial seed density at the start of the experiments was higher than expected in the field, and that density increased as the deposit contracted. Complete mortality occurred in several weeks after temperatures were increased to over 100 deg. F without an increase in irrigation frequency or intensity. A subsequent reduction in temperature to 80 deg. F and reseeding was unsuccessful on these samples.

On the seeded wetting-drying samples, germination and growth were most successful on the fresh sediment surfaces found in narrow cracks and in the footprints of the Torvane tests (Figure 8-11). Germination was less successful for seeds on the majority of the undisturbed sediment surfaces, which had a film of fungus, not introduced experimentally, that caused the discolorations visible in the photos of the dried samples (Figure 8-4 and Figure 8-5). Some germination did occur on the undisturbed surfaces, but it took an extra week or two relative to the disturbed and fresh sediment surfaces. Plant growth was healthy on all samples until the daily maximum temperatures were allowed to increase to over 100 degrees, at which point there was some plant mortality, particularly in the IG1 samples, which had the highest clay content and appeared to desiccate more rapidly between irrigation events.



Plant growth is visible in cracks and the round Torvane scars.

Figure 8-11 Grow test on wetting-drying sample JCB1b taken two weeks after seeding with the upland seed mixture.

The PNA test results were similar amongst samples from the three reservoirs. In general, the samples are moderately acidic, fine-textured, low in calcium, and high in magnesium and organic matter. The average pH of the samples ranged from 6.2 to 6.5, which is slightly more acidic than the optimum range of 6.5 to 7.5. The sediments have been submerged in an anaerobic environment, so they contain high levels of iron, manganese, and vanadium due to microbial respiration (Wallace, 2017).

However, there were some systematic variations in metal concentrations between samples from the first (December 2017) and second (January 2018) rounds of lab analyses. The 2018 sample concentrations were greater than 2017 concentrations by a factor of 2 to 10 depending on the metal. Plant extractable concentrations of most of the analyzed elements (e.g., phosphorus, potassium, iron, manganese, zinc, copper, magnesium, sodium, sulfur, arsenic, barium, cobalt, lead, nickel, and vanadium) depend strongly on the degree of aeration of the sediment, whereby higher concentrations are associated with lower degrees of aeration. This suggests that the 2017, which were stored in Ziploc bags for a period of 2 weeks were more aerated than the samples stored in the storage unit for a period of 5 weeks. This is perhaps because standing water was present in the storage unit samples, so the degree of aeration was lower than those sediments mixed and bagged on the research vessel.

Implications of Grow Test Results for Reservoir Revegetation

The grow test results suggest that the reservoir sediments are a suitable medium for plant growth and that soil supplements, while potentially helpful, are not needed. The majority of the species in each planting zone mixture were successfully able to germinate and grow. The development of root systems will increase infiltration rates in uncracked sediment, stabilize disintegrated sediments, and accelerate soil development.

Planting and growing conditions in the greenhouse were an idealized representation of some of the factors affecting plant growth in the field. Minimum temperatures in the greenhouse were near 50 deg. F and cannot mimic the cold and below-freezing temperatures possible at the reservoirs during the drawdown when many of the seeds will be planted. Colder conditions in the field, particularly at J.C. Boyle, are harsh on young plants, and germination rates will potentially be lower. Summers around the reservoirs are hot and dry. At the Copco #1 Dam weather station, average maximum monthly temperatures exceed 89 deg. F and average total monthly precipitation less than 0.6 inches for July, August, and September (Figure 3-10). In similar simulated conditions in the greenhouse, plant growth in the wetting-drying samples, which received greater irrigation, was successful, whereas the grow test samples, which received less irrigation were not. Furthermore, the drastic changes in the sediment when desiccated (e.g., increase in sediment shear strength, reduction in porosity, reduction in concentrations of certain essential plant extractable elements) will be concurrent with high temperatures and dry conditions. The twice-per-week lower intensity irrigation failed to resaturate the grow test samples once they had been fully desiccated desiccated, and reseeded plant growth was unsuccessful, even with temperatures reduced to 80 deg. F. These environmental conditions and their effect on the reservoir sediments will severely limit the survival of plants established in the reservoir sediments in the spring after drawdown.

Revegetation will resume with cooler conditions and return of rainfall in the fall. The decrease in sediment strength observed after wetting should help with seed germination but to what degree is unknown. Root development during the spring may improve infiltration rates in the unfractured sediments, relative to the wetting-drying experimental samples, and help initiate soil development and increase soil moisture in the shallow subsurface. Plant growth was possible in the wetting-drying grow tests, but rainfall amounts were similar to 10-year events for that time duration and were applied daily. As such, they represent considerably more water than expected from natural precipitation. However, most the rainfall was lost as run-off, so infiltration is perhaps more similar to lower intensity, longer duration events that may occur in fall. Where feasible, irrigation will be a beneficial supplement to natural precipitation.

The wetting-drying grow test results suggest that fresh and disrupted (e.g., tilled) surfaces are more favorable for plant germination and growth. The initial sediment surface morphology of both types of grow tests was more uniform than expected in the reservoirs, where sediments will have experienced some degree of slumping and erosion. Microtopography may be more prone to desiccation between rainfall events than smooth surfaces, but the grow tests results suggest that microtopography on the reservoir sediment surfaces may create small depressions and surface roughness that can catch seeds and increase the soil surface area to which the seeds are exposed. Germination may be more successful as a result. Crack density and microtopography as a result of slumping should be sufficient in the post-reservoir surface to not require tilling of the sediment surface.

Subsurface conditions and hydrology will be more favorable for plant growth in the field than in the experimental set up. The thickness of the experimental sediment deposits varied from 2 to 3 inches in the dried wetting-drying samples and 3 to 7 inches in the dry and moist grow test samples, respectively. Roots for the planted species are capable of penetrating deeper than the sample thicknesses to access moisture that is not present in near-surface sediments during dry periods. The degree to which this effect will compensate for certain more idealized environmental conditions in the greenhouse is unknown.

The PNA analysis did not reveal any major chemical deficiencies or excesses that would inhibit germination and plant growth in the reservoir sediments. The high iron, manganese, and vanadium concentrations are more suitable for aquatic, rather than upland, species growth. Plant-available arsenic concentrations at J.C. Boyle are comparable to the arsenic limits for herbaceous and woody plants but should not impact grassy species and other arsenic-tolerant plants. Plant extractable chemical concentrations, as opposed to total concentrations, of these metals are expected to decrease following drawdown with exposure to the atmosphere. The desiccated reservoir sediments will have lower concentrations of these potentially problematic elements than the fresh reservoir sediments, but germination will be more difficult in the dried sediments, which will be considerably firmer and have less available pore water. Therefore, seeding moist, rather than dried, sediment should have greater success, with the caveat that growth will be sensitive to colder air temperatures. The grow test results support this approach and suggest that the high metal concentrations do not have a noticeable impact on plant growth.

Grow Test Data and Figures

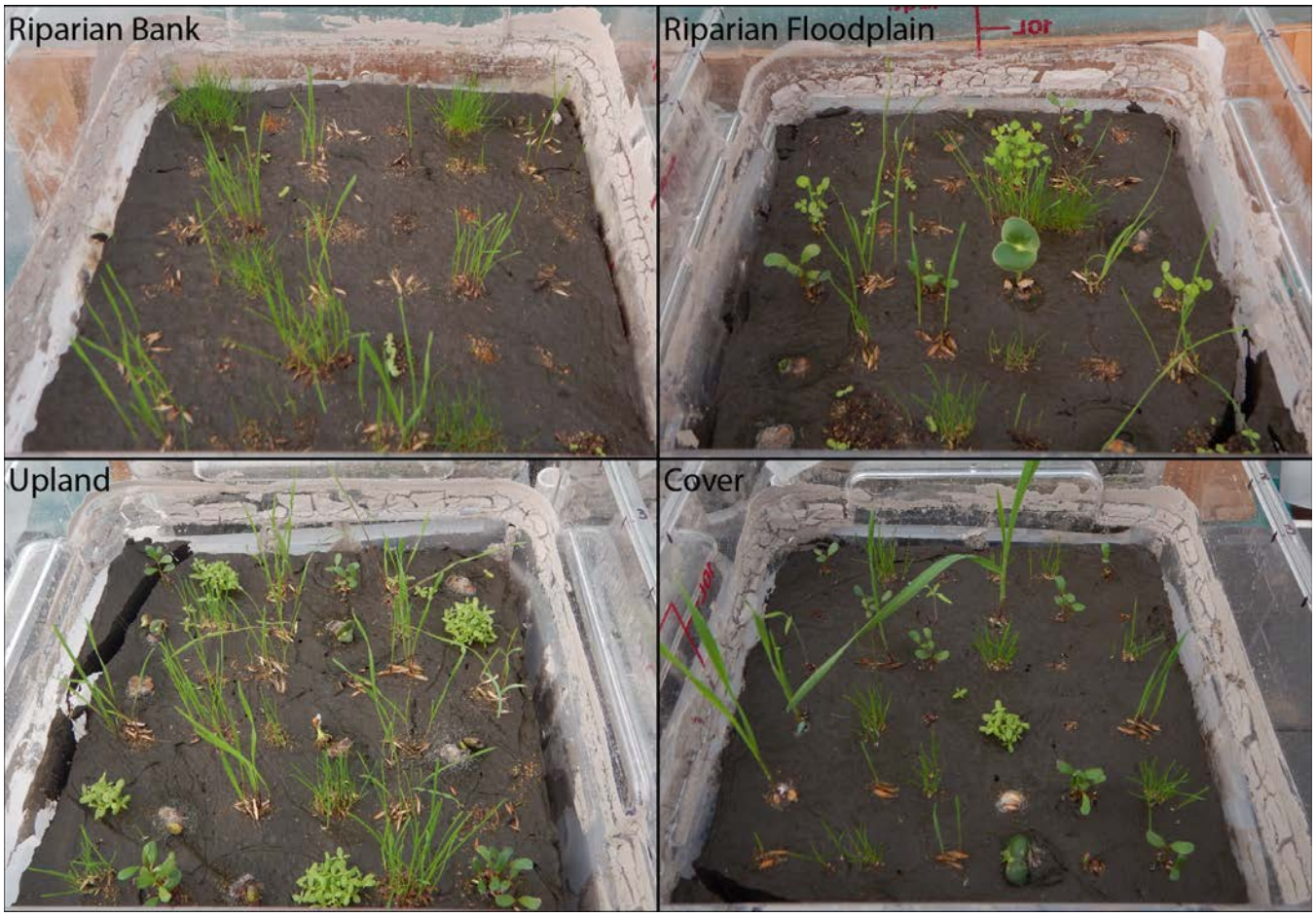
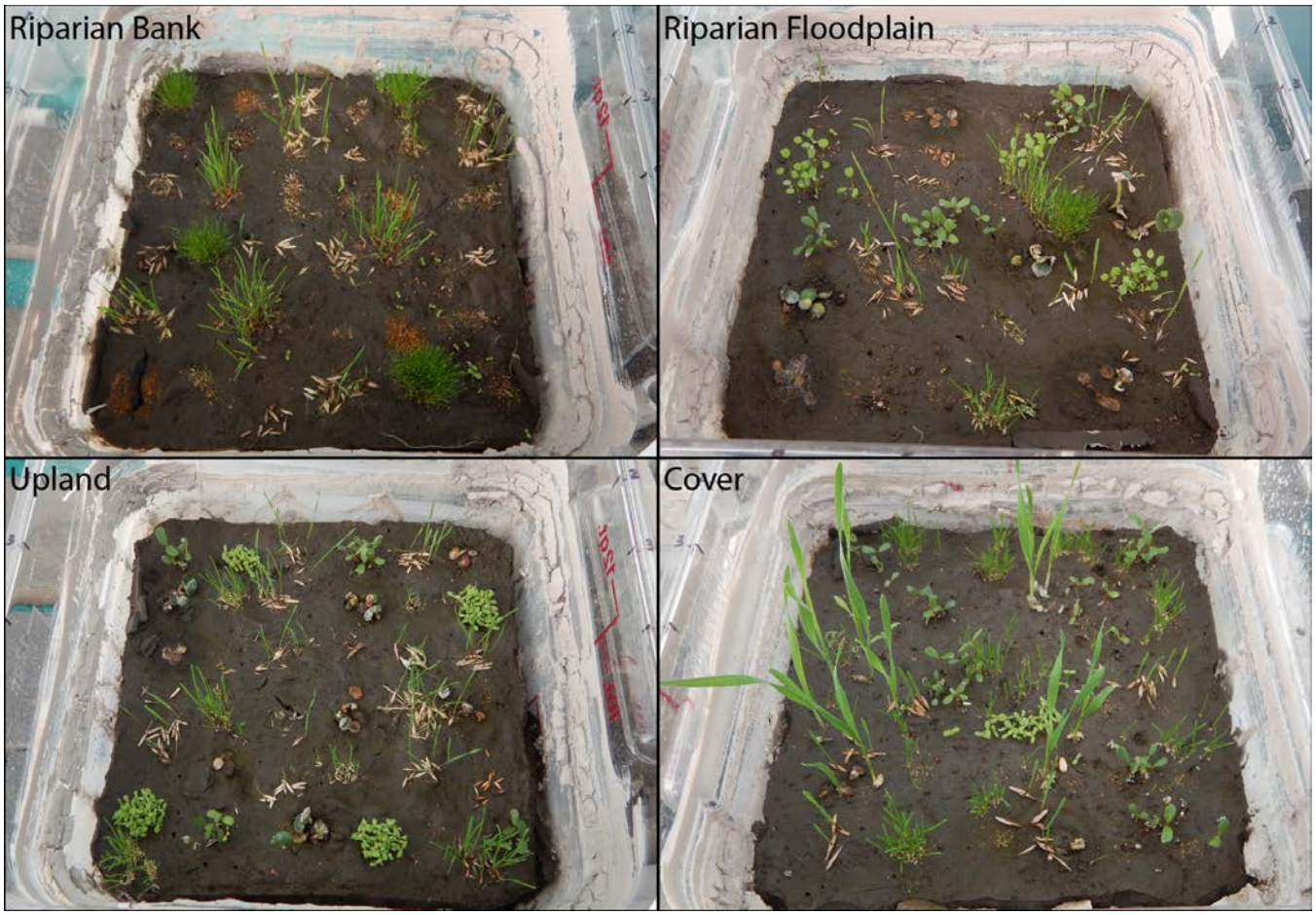
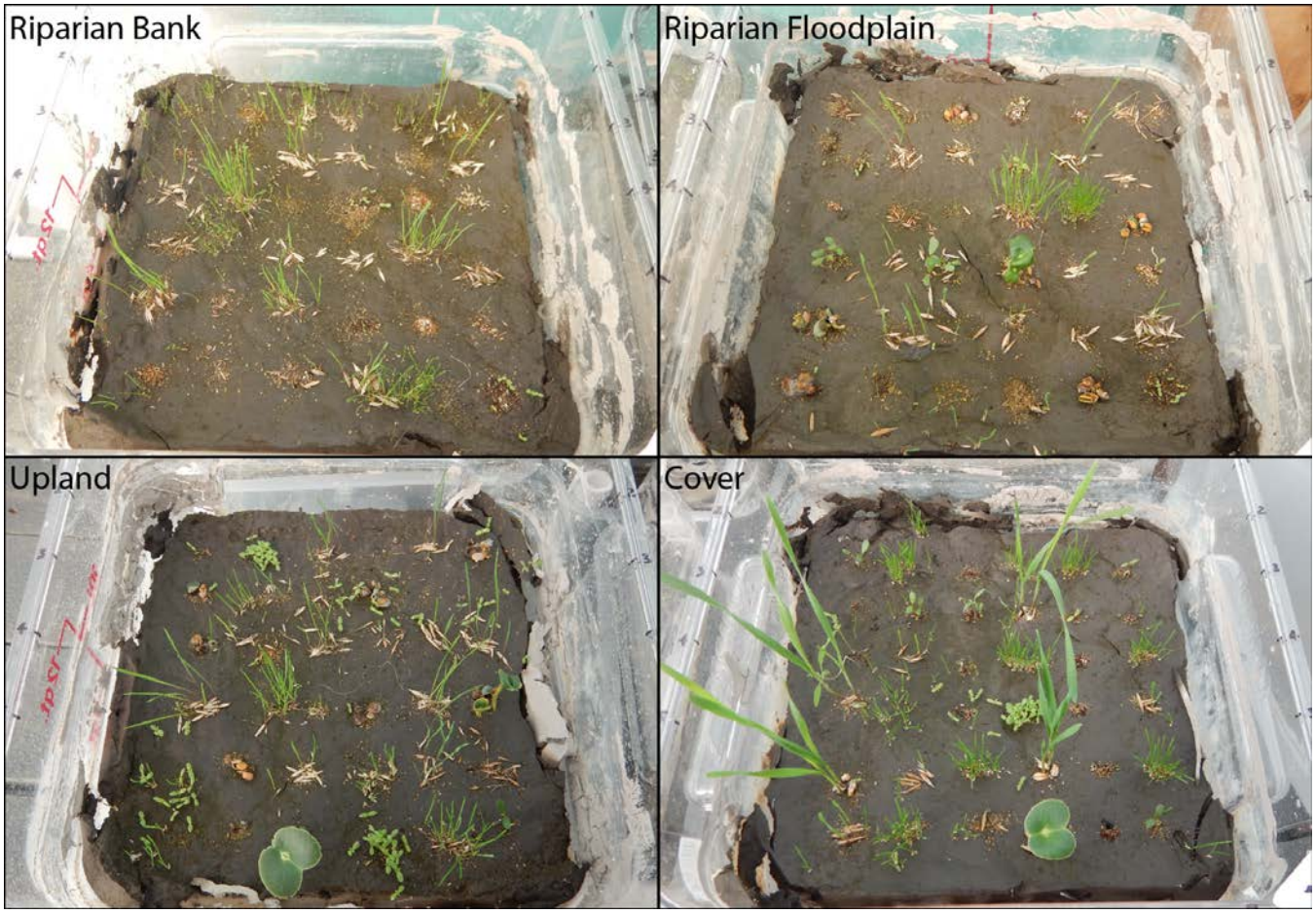


Figure 8-12 Photos of grow tests for J.C. Boyle sediment sample JCB6 taken three weeks after seed placement.



Species in the seed mixtures correspond to post-removal vegetation zones (riparian bank, riparian floodplain, and upland) and a cover crop mixture. Inside length of sample containers is approximately 10 inches.

Figure 8-13 Photos of grow tests for Copco sediment sample CP6 taken three weeks after seed placement.



Species in the seed mixtures correspond to post-removal vegetation zones (riparian bank, riparian floodplain, and upland) and a cover crop mixture. Inside length of sample containers is approximately 10 inches.

Figure 8-14 Photos of grow tests for Iron Gate sediment sample IG4 taken three weeks after seed placement.

Table 8-10 Species list and grow test results for each planting zone.

Species	Seed locations per sample	Plant count - J.C. Boyle JCB6	Plant count - Copco CP6	Plant count - Iron Gate IG4	Average number of plants per location
Riparian Bank					
Agrostis exarata	4	130	150	80	30
Carex praegracilis	4	0	0	21	2
Deschampsia danthonioides	4	7	24	23	5
Elymus [Leymus] triticoides	4	2	0	3	0

Species	Seed locations per sample	Plant count - J.C. Boyle JCB6	Plant count - Copco CP6	Plant count - Iron Gate IG4	Average number of plants per location
Hordeum brachyantherum ssp. *brachyantherum*	4	16	38	23	6
Juncus bufonius	4	30	15	26	6
Artemisia douglasiana	4	17	18	24	5
Festuca [Vulpia] microstachys	3	28	35	32	11
Deschampsia caespitosa	4	29	37	15	7
Elymus glaucus	1	3	3	2	3
Riparian Floodplain					
Leymus triticoides	4	7	3	0	1
Artemisia douglasiana	4	25	12	32	6
Trifolium willdenovii	3	17	30	3	6
Acmispon americanus [Lotus purshianus]	3	14	21	10	5
Lupinus microcarpus var. *densiflorus*	3	1	2	6	1
Lupinus microcarpus var. *microcarpus*	3	0	0	2	0
Stipa [Achnatherum] occidentalis var. *occidentalis*	4	6	0	0	1
Elymus [Pseudoroegneria] spicatus	1	5	3	5	4
Elymus glaucus	2	8	10	8	4
Hordeum brachyantherum sspp. *Brach*	1	5	6	6	6
Bromus carinatus	1	3	5	3	4
Poa secunda	1	15	15	6	12
Festuca [Vulpia] microstachys	1	20	15	15	17
Koeleria macrantha	1	10	8	5	8
Leymus cinereus	1	3	3	6	4
Agrostis exarata	1	20	35	40	32
Elymus elymoides	1	4	5	3	4
Hordeum brachyantherum ssp. *californicum*	1	5	3	6	5
Upland					
Acmispon americanus [Lotus purshianus]	4	23	22	4	4
Lupinus microcarpus var. *densiflorus*	4	2	3	6	1
Lupinus microcarpus var. *microcarpus*	4	1	0	7	1
Elymus [Pseudoroegneria] spicatus	4	21	25	25	6
Achillea millefolium var. *lanulosa*	4	50	85	60	16
Poa secunda	3	45	60	29	15
Stipa [Achnatherum] occidentalis var. *occidentalis*	3	0	1	2	0
Festuca [Vulpia] microstachys	2	18	30	20	11

Species	Seed locations per sample	Plant count - J.C. Boyle JCB6	Plant count - Copco CP6	Plant count - Iron Gate IG4	Average number of plants per location
Elymus elymoides	2	12	11	11	6
Hordeum brachyantherum ssp. *californicum*	2	10	18	9	6
Koeleria macrantha	2	16	11	4	5
Elymus glaucus	1	5	3	5	4
Bromus carinatus	1	4	3	0	2
Cover					
Acmispon americanus	7	21	41	11	3
Phacelia hastata	5	0	1	5	0
Phacelia tanacetifolia	4	3	6	7	1
Triticale sterile	2	2	7	4	2
Elymus x Triticum	2	1	5	5	2
Bromus carinatus	5	10	16	21	3
Deschampsia elongata	8	75	145	140	15
Achillea millefolium	1	10	20	25	18
Lupinus microcarpus var. *densiflorus*	1	1	0	1	1

Notes: Data were collected three weeks after seed placement. The seed locations per sample are out of a potential 36 locations available in each sample bin.

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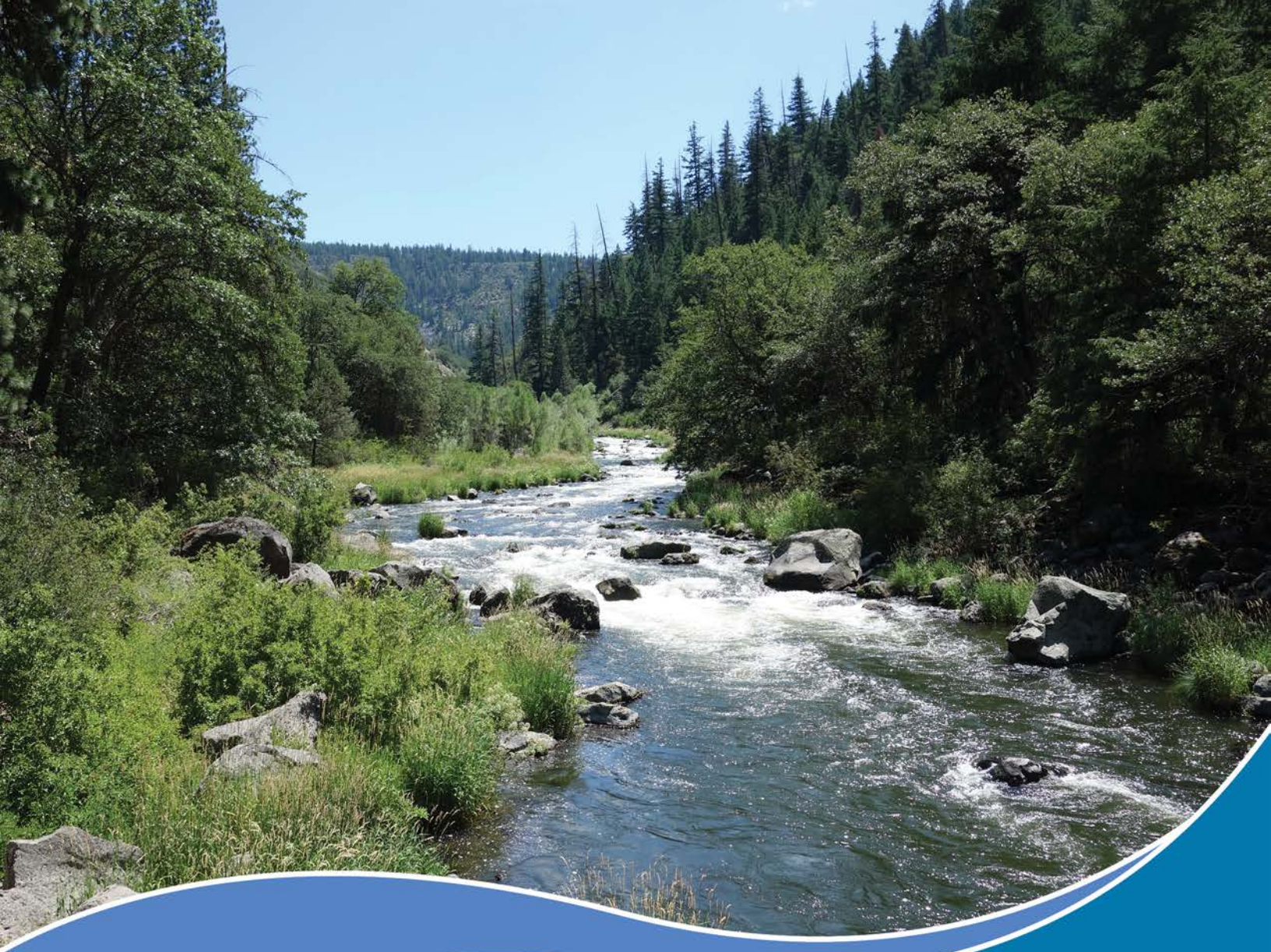

Definite Plan for the Lower Klamath Project

Appendix I - Aquatic Resources Measures

KLAMATH
RIVER RENEWAL
CORPORATION

June 2018

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KLAMATH RIVER RENEWAL CORPORATION

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Acronyms

AR	aquatic resource
ATWG	Aquatic Technical Work Group
CDFW	California Department of Fish and Wildlife
cfs	cubic feet per second
DPS	distinct population segment
EIS/R	Environmental Impact Statement/ Environmental Impact Report
ESU	evolutionary significant unit
km	kilometers
KRRC	Klamath River Renewal Corporation
mi	miles
NMFS	National Oceanic and Atmospheric Administration
ODFW	Oregon Department of Fish and Wildlife
PIT	passive integrated transponder
Rkm	river kilometer
RM	river mile
SONCC	Southern Oregon/Northern California Coastal
USBR	U.S. Bureau of Reclamation
USFWS	U.S. Fish and Wildlife Service ,
USGS	U.S. Geological Survey
yd^2	square yards

Executive Summary

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Executive Summary

The Klamath River Renewal Corporation (KRRC) convened an Aquatic Technical Work Group (ATWG) comprised of agency and tribal fisheries scientists to review the aquatic resource (AR) mitigation measures included in the Klamath Facilities Removal Final Environmental Impact Statement/ Environmental Impact Report (2012 EIS/R; U.S. Bureau of Reclamation (USBR) and California Department of Fish and Game (CDFW) 2012), determine the appropriateness of the 2012 AR measures, and develop updated AR measures in accordance with ATWG input.

Through a series of nine meetings with the ATWG between April 28 and August 15, 2017, review of recent similar dam removal projects, and new scientific information that has been developed since the 2012 EIS/R, updated AR measures are proposed to be implemented as part of the removal of four dams on the Lower Klamath River (Project). The three key periods of time during the reservoir drawdown year include: (1) reservoir drawdown completed by the end of March, (2) volitional fish passage by October 1, and (3) free-flowing river conditions at all four facilities by December 31. While these time periods are referenced throughout Appendix I, the term "the Project" refers to these three time periods and is used more generally in the document to describe the Project and Project effects.

The proposed AR measures are adapted from the AR measures included in the 2012 EIS/R. The AR measures are now proposed as part of the Project include:

Mainstem Spawning

KRRC will develop and implement a monitoring and adaptive management plan to offset reservoir drawdown effects on mainstem spawning of anadromous salmonids and Pacific lamprey. Tributary-Klamath River confluences in the Hydroelectric Reach (i.e., the Klamath River and tributaries from Iron Gate Dam [river mile (RM) 193.1] to the upstream extent of J.C. Boyle Reservoir [RM 234.1]) and in the Iron Gate Dam to Cottonwood Creek (RM 185.1) reach will be monitored by KRRC for 2 years following the start of reservoir drawdown to ensure fish passage between tributaries and the Klamath River. KRRC-led monitoring of the four tributary confluences in the Hydroelectric Reach will occur from April 1 in the year of reservoir drawdown through March 31 in the year that is two years post-drawdown. KRRC-led monitoring of the five tributary confluences in the 8-mile reach from Iron Gate Dam to Cottonwood Creek will occur from January 1 of the year of reservoir drawdown, through December 31 in the year following the drawdown year. Tributary confluences in both reaches will be monitored by KRRC at variable frequencies depending on the season and the drawdown year (see Section 3.1.1). Monitoring will also be triggered in response to a 5-year or greater flow event on the Klamath River at the USGS Klamath River Below Iron Gate Dam CA gage (#11516530). KRRC and the ATWG will also convene periodically during the 2-year monitoring period to review monitoring frequency to ensure volitional passage is maintained between the Klamath River and select tributaries. If present, confluence obstructions will be actively removed by KRRC during the 2-year monitoring period to ensure volitional passage for adult Chinook salmon, coho salmon, steelhead, and Pacific lamprey.

KRRC will complete a spawning habitat evaluation on the Klamath River and four tributaries in the Hydroelectric Reach. If spawning habitat post-reservoir drawdown does not meet target metrics, KRRC will convene with ATWG to determine appropriate spawning gravel augmentation locations and methods on the mainstem Klamath River in the Hydroelectric Reach. If tributary spawning gravel habitat is less than the target values following reservoir drawdown, KRRC and the ATWG will convene to prioritize additional habitat restoration actions (e.g., gravel augmentation, gravel retention treatments) that KRRC will undertake to increase the amount of tributary habitat available to compensate for the loss of steelhead redds.

Outmigrating Juveniles

KRRC has planned three actions to offset reservoir drawdown effects on outmigrating juvenile anadromous salmonids and Pacific lamprey. First, KRRC will complete a sampling, salvage, and relocation effort to relocate juvenile salmonids, particularly yearling coho salmon, from the Klamath River between Iron Gate Dam and the Trinity River confluence during the late-fall or winter prior to reservoir drawdown.

Secondly, KRRC will develop an adaptive management plan to assess and restore tributary-mainstem connectivity in the Hydroelectric Reach and the 8-mile reach from Iron Gate Dam downstream to Cottonwood Creek (same task as described above in Mainstem Spawning). KRRC monitoring of the of the four tributary confluences in the Hydroelectric Reach will occur from April 1 in the year of reservoir drawdown through March 31 in the year that is two years post-drawdown. KRRC monitoring of the five tributary confluences in the 8-mile reach from Iron Gate Dam to Cottonwood Creek will occur from January 1 of the year of reservoir drawdown, through December 31 in the year following the drawdown year. KRRC will monitor tributary confluences in both reaches at variable frequencies depending on the season and the drawdown year (see Section 4.1.2). Monitoring will also be triggered in response to a 5-year or greater flow event on the Klamath River at the USGS Klamath River Below Iron Gate Dam CA gage (#11516530). KRRC and the ATWG will also convene periodically during the 2-year monitoring period to review monitoring frequency to ensure volitional passage is maintained between the Klamath River and select tributaries. If present, KRRC will actively remove confluence obstructions during the 2-year evaluation period to ensure volitional passage for juvenile Chinook salmon, coho salmon, steelhead, and Pacific lamprey.

The third component of the outmigrating juveniles measure will include KRRC monitoring water quality conditions at 13 key tributary confluences downstream from Iron Gate Dam. KRRC and the ATWG will coordinate on a weekly basis from January through June in the year of reservoir drawdown and will convene during that time period if tributary water temperatures reach 17°C (7-day average of the daily maximum values) and Klamath River suspended sediment concentration exceeds 1,000 mg/L, or if observed behaviors of juvenile salmonids inhabiting tributary confluences necessitate salvage. If the tributary water temperature trigger of 19°C (7-day average of the daily maximum values) and Klamath River suspended sediment concentration trigger of 1,000 mg/L (7-day sustained daily maximum) are met, or if juvenile salmonids inhabiting tributary confluences exhibit stressed behavior, a salvage effort will be completed. Based on ATWG guidance, KRRC may conduct a multi-day salvage effort for juvenile fish at the Shasta and Scott rivers and single day salvage efforts at each other tributary confluence area by a 4-person crew and 2 transport trucks. The KRRC salvage effort will be coordinated with the ATWG and will reflect water quality

conditions in the tributary confluences, outmigrating juvenile salmonid numbers and observed behavior, and other environmental conditions (e.g., weather and streamflow forecast) as necessary.

Iron Gate Fish Hatchery

To reduce the number of hatchery-reared juvenile coho salmon exposed to high suspended sediment levels, coho salmon will be released from Iron Gate Hatchery (CDFW) into the Klamath River later than the typical release schedule. Water quality monitoring stations established by KRRC prior to reservoir drawdown will be used by KRRC to determine when conditions in the mainstem Klamath River are suitable for the release of hatchery-reared coho salmon.

Suckers

The Project will result in lethal effects to Lost River and shortnose suckers inhabiting the Klamath River reservoirs. Since the two sucker species are lake-type suckers, suckers inhabiting the Hydroelectric Reach reservoirs will not persist following the Project. KRRC will conduct an adaptive management plan that includes sampling, salvage, and relocation of Lost River and shortnose suckers in the Hydroelectric Reach reservoirs. KRRC will translocate suckers to appropriate recipient waterbodies that will ensure the translocated suckers, which are of unknown genetic composition, will not mix with Lost River and shortnose sucker recovery populations in Upper Klamath Lake. KRRC will salvage and relocate up to a maximum of 3,000 suckers to the receiving waters. During the course of these actions, KRRC does not anticipated that the entire populations of suckers residing in the Hydroelectric Reach reservoirs will be recovered.

Freshwater Mussels

Freshwater mussels located in the 8-mile long reach from Iron Gate Dam downstream to the Cottonwood Creek confluence, are anticipated to experience high mortality due to suspended sediment concentrations and bedload deposition. The KRRC will prepare a reconnaissance, salvage, and translocation plan for up to 20,000 mussels located in the deposition reach. During the course of these actions, KRRC does not anticipate that the entire population of mussels residing below Iron Gate Dam will be recovered.

AR measures that were included in the 2012 EIS/R that are not proposed as part of the Project based on consultation with the ATWG and additional information gained from recent dam removal projects include:

AR-3 Fall Pulse Flows – Increasing flows during the fall prior to reservoir drawdown was intended to promote Chinook salmon and coho salmon migration into spawning tributaries to reduce the effect of reservoir drawdown on spawning grounds. Due to water availability uncertainty and typical fall flows, the use of fall pulse flows would likely be ineffective in reducing the effects of suspended sediment on migrating and spawning salmon, steelhead, and green sturgeon.

AR-5 Pacific Lamprey – The 3-km reach of the Klamath River downstream from Iron Gate Dam was proposed for Pacific lamprey ammocoete salvage and relocation in the 2012 EIS/R. Recent surveys have found very low ammocoete abundances between Iron Gate Dam (RM 192.9) and the Shasta River confluence (RM

179.3). Based on the assessment completed by KRRC and reviewed by ATWG, project effects to Pacific lamprey ammocoetes in the 3 km reach downstream from Iron Gate Dam are anticipated to be minimal, and therefore, no action is recommended for Pacific lamprey ammocoetes.

Chapter 1: Introduction

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1. INTRODUCTION

In 2012, the Department of the Interior developed the 2012 EIS/R (USBR and CDFG 2012) to disclose the potential effects of the Project. The 2012 EIS/R identified significant short-term effects to the aquatic biological community. The 2012 EIS/R included AR plans to attempt to mitigate the possible short-term adverse effects of the Project. In 2017, KRRC assembled the Aquatic Technical Work Group (ATWG) comprised of resource agencies, and tribal fisheries scientists in 2017 to review the previous AR measures, determine the feasibility and effectiveness of those plans, and to provide input on refined proposed actions that will best meet the intent of the previous AR mitigation measures. The ATWG included fisheries scientists representing CDFW, Oregon Department of Fish and Wildlife (ODFW), U.S. Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration (NMFS), Yurok Tribe, Hoopa Valley Tribe, Karuk Tribe, and The Klamath Tribes.

Through a series of nine meetings between April 28 and October 26, 2017, KRRC and the ATWG reviewed recent similar dam removal projects and new scientific information that has been developed since the 2012 EIS/R to update the 2012 AR measures. Updated AR measures are proposed to be implemented as part of the removal of four dam developments located on the Klamath River (Project). These measures are subject to consultation with aquatic resource agencies and negotiation of the final Biological Opinions for the Project.

During the reservoir drawdown year, reservoirs will be drawn down by the end of March, followed by volitional fish passage by October 1, and free-flowing river conditions at all four facilities by December 31. project effects are anticipated to be short-term in nature, with long-term benefits ultimately outweighing the Project's impacts to the aquatic biological community. The aquatic effects of the Project will primarily occur from the release of reservoir sediment during reservoir drawdown. The purpose of Appendix I is to provide background on the 2012 EIS/R AR measures, information gained from other large dam removal projects, and provide KRRC's and the ATWG's rationale for the revised AR measures included in the Definite Plan.

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Chapter 2: Dam Removal Benefits and Effects

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2. DAM REMOVAL BENEFITS AND EFFECTS

This section identifies benefits that have been observed after other dam removal projects in the Pacific Northwest and the Project's anticipated long-term benefits to the Klamath River ecosystem.

2.1 Fisheries Benefits of Recent Dam Removals in the Pacific Northwest

Removal of large dams from rivers in the western United States, has been completed to, among other things, restore access and connectivity to historical habitats which can provide a multitude of benefits to native fish communities including increases in species richness (Catalano et al. 2007; Burroughs et al. 2010; Kornis et al. 2015) and life-history diversity (Hitt et al. 2012; Pess et al. 2014).

Several recent studies from the Pacific Northwest that provide an overview of the fish passage benefits associated with restoring access to historical habitat through dam removal efforts are summarized below.

Following the installation of a fish ladder at Landsburg Dam in 2003, both Chinook salmon and coho salmon voluntarily recolonized 33 kilometers (km) of upstream habitat in the Cedar River, Washington, after more than 100 years of extirpation. The total density of salmonids roughly doubled in the mainstem closest to the dam 3 years after ladder installation (Kiffney et al. 2009), while dispersal of anadromous fish into tributary habitats occurred more slowly over the next 5 years (Burton et al. 2013). Both the proportion of all redds found in upstream reaches and the proportion of upstream spawners that were born in those reaches increased over time, demonstrating the successful transition from recolonization to self-sustaining upstream populations (Anderson et al. 2015).

Tule fall Chinook salmon were translocated to upstream reaches of the White Salmon River, Washington in the same year as the removal of the Condit Dam in 2011. Translocations were intended to circumvent the disruption of downstream spawning habitat by temporary sediment flows resulting from dam breaching, while natural migration was allowed in subsequent years. Roughly 10 percent of the Chinook population spawned upstream of the former dam site in the year following removal and both total escapement in the river and the proportion of returning fish born in upstream reaches is increasing over time (Engle et al. 2013; Hatten et al. 2015; Allen et al. 2016).

In the Elwha River, Washington, the Elwha Dam and Glines Canyon Dam limited anadromy to the lower Elwha River. Removing the Elwha and Glines Canyon dams provided access to an additional 40 miles of mainstem river habitat as well as tributaries. In 2012, Chinook salmon had access to the area above Elwha Dam for the first time in a century. A total of 203 Chinook redds (396 live and dead adults) were

documented upstream of Elwha Dam, with the former Aldwell Reservoir (river kilometer [Rkm] 7.9-12.4) and the main stem Middle Elwha from Rkm 17.2-18.1 (above the former Elwha Dam site) accounting for 44 percent of the redd locations, respectively, in 2012. In 2013, based on SONAR estimates (Denton et al. 2014), the total escapement of Chinook salmon (4,243 adults) approximately doubled over the 20-year average. This doubling resulted in observations of Chinook salmon spawning in all habitats, including the Middle Elwha, with the majority of redds (73 percent) located above the former Elwha Dam (McHenry et al. 2017; Liermann et al. 2017).

At two dam removal sites on the Rogue River in southern Oregon, fall run Chinook salmon used spawning habitat that was formerly inaccessible under reservoirs in the first fall following dam removal. The conversion of former reservoir habitat to riverine habitat, and associated bedload/gravel movement, improved spawning habitat quality in the former reservoir sites. At the former Savage Rapids Dam site, 91 redds were documented within the extent of the former reservoir the first full fall after dam removal. At the former Gold Ray Dam site, 37 redds were documented within the bounds of the former reservoir in 2010, and over twice that many redds were identified within the former reservoir in 2011 (ODFW 2011).

From these previous studies, scientists have found that Chinook and coho salmon exploration of new habitat is an innate component of salmon breeding behavior. Coho salmon movement upstream of a former passage barrier on the Cedar River led to juvenile movement and dispersal which was recognized as an important component of the colonization process (Anderson et al. 2013). Ensuring juvenile passage in the watershed is necessary for juvenile imprinting and the future broadening of adult spawner returns throughout reconnected historical habitats. Additionally, hatchery-origin Chinook salmon have been found to have higher stray rates relative to their wild counterparts (Burton et al. 2013) and as the concept applies to the Klamath River, Iron Gate Hatchery-influenced fall Chinook salmon may rapidly recolonize the Klamath River upstream of Iron Gate Dam. In short, restoring access to lost habitat is a critical conservation strategy (Anderson and Quinn 2007 cited in T. Williams, NMFS, and personal communication 2017).

Beyond the benefits of recolonization for fish populations themselves, recolonization of previously inaccessible reaches also restores the flow of marine-derived nutrients to upstream portions of the watershed resulting in an overall boost to ecosystem nutrient budgets and productivity (Tonra et al. 2015).

2.2 Anticipated Project Benefits on the Klamath River Basin Aquatic Resources

The Project will provide long-term ecosystem benefits to the Klamath River Basin. The following anticipated long-term benefits discussion is based on the 2012 EIS/R and *the Klamath Dam Removal Overview Report for the Secretary of the Interior: An Assessment of Science and Technical Information* (NMFS 2013).

2.2.1 Access to Historical Habitat

Iron Gate Dam located at RM 193.1 blocks access to the Upper Klamath Basin for three anadromous salmonid species, Pacific lamprey, and freshwater mussels. Facilities removal will restore access to

approximately 81 miles of suitable riverine, side channel, and tributary habitat in the Klamath River Hydroelectric Reach (i.e., the Klamath River and tributaries from Iron Gate Dam (RM 193.1) to the upstream extent of J.C. Boyle Reservoir (RM 234.1), and 49 tributaries accounting for over 420 miles of historical aquatic habitat throughout the basin upstream of Iron Gate Dam. More specifically, the Project will allow access to historical habitat (Table 2-1) totaling approximately 76 miles for coho salmon, 300 miles for Chinook salmon (Huntington 2004), and 420 miles for steelhead (Huntington 2004; 2006). In addition to increasing the quantity of available habitat, unique habitats will also be accessible with the Project. Groundwater-fed areas throughout the Upper Klamath Basin (Table 2-2) are resistant to water temperature increases caused by changes in climate (Hamilton et al. 2011), potentially buffering climate change effects to coldwater salmonids.

Table 2-1 Potential historical habitat availability by species with removal of the Klamath River Hydroelectric Reach dams

Species	Potential Historical Habitat Availability (mi)
Chinook salmon	300
Coho salmon	76
Steelhead	420
Pacific lamprey	>420

Table 2-2 Estimated volume of groundwater discharge (springs) into upper Klamath River systems

River System	Section	Groundwater Flow (cfs)
Lower Williamson River and Tributaries	Mouth of Williamson River up to Kirks Reef	350
Wood River and Tributaries	Crooked Creek Confluence to Headwaters	490
Sevenmile Creek and Tributaries	Crane Creek Confluence to Headwaters	90
Sprague River	South Fork Sprague River to Sprague River	202
Upper Klamath Lake	Spring in Upper Klamath Lake Including Malone, Crystal, Sucker, and Barclay	350
Klamath River	Keno Dam to J.C. Boyle Powerhouse	285
Klamath River and Fall Creek	J.C. Boyle Powerhouse to Iron Gate Dam	128
Total		1,895

NMFS 2013
cfs – cubic feet per second

Historical anadromous fish population estimates suggest the potential productivity of the Klamath Basin upstream from Iron Gate Dam (RM 193.1). Hamilton et al. (2011) summarized previous spawning surveys

and population estimates. The Klamath River and tributaries upstream from Iron Gate Dam historically supported up to 149,000 spawning fall Chinook salmon and up to 30,000 spawning steelhead (Table 2-3).

Table 2-3 Historical and potential production estimates for fall Chinook salmon, coho salmon, and steelhead in the Klamath River Basin

Reach	Species	Median Estimate	Estimate Range	Note
Lower Klamath Basin to Copco Dam	Fall Chinook Salmon		168,000[4] – 175,000[5]	Estimates based on historical spawning escapement and spawning surveys.
	Coho	15,400[4]	20,000[5] – 70,000[5]	
	Steelhead	300,000[5]	221,000[4] – 750,000[5]	
Iron Gate Dam to Copco Dam	Fall Chinook Salmon	2,301[3]	1,113[6] – 18,925[5]	Based on historical spawning data and spawning habitat potential.
	Steelhead	1,144[3]		
Copco Dam to Upper Klamath Lake	Fall Chinook Salmon	10,000[1]	2,2920[2] – 19,207[3]	Based on historical spawning data and spawning habitat potential.
	Steelhead	9,550[3]		

1. FERC 2007
2. Fortune et al. 1966
3. Chapman 1981
4. CDFG 1965
5. Coots 1977
6. FERC 1963

Chinook Salmon

The Project will benefit fall Chinook salmon by restoring access to over 300 miles of historical habitat (Table 2-1) in the Klamath Basin upstream from Iron Gate Dam (e.g., improving water quality, increasing flow variability downstream from Iron Gate Dam, and reducing disease). Over time, Chinook salmon returns upstream of Keno Dam could be substantial, although fish passage at Keno Dam and habitat quality improvements in the Upper Klamath Basin will be necessary to realize recovery potential.

Table 2-4 Estimated Klamath River mainstem, side channel, and tributary habitat under the Hydroelectric Reach reservoirs

Reservoir	Mainstem Habitat (mi)	Side Channel Habitat (mi)	Tributary Habitat (mi)
Iron Gate	6.81	-	2.49
Copco	6.87	1.24	1.51
J.C. Boyle	3.32	-	0.19
Total	17.00	1.24	4.18

Source: Cunanan 2009

mi - miles

Coho Salmon

After implementation of the Project, coho salmon are expected to rapidly recolonize habitat upstream of Iron Gate Dam, as observed after barrier removal at Landsburg Dam in Washington (Kiffney et al. 2009) and the Elwha River dams in Washington (Liermann et al. 2017). Assuming coho salmon distribution will extend up to Spencer Creek after dam removal; coho salmon from the upper Klamath River population will reclaim approximately 76 miles of habitat: approximately 53 miles in the mainstem Klamath River and tributaries (DOI 2007; NMFS 2007) and approximately 22.4 miles currently inundated by the reservoirs (Cunanan 2009).

Coho salmon colonization of the Klamath River between Keno and Iron Gate dams by the upper Klamath coho salmon population would likely improve the viability of SONCC coho salmon by increasing abundance, diversity, productivity and spatial distribution.

Steelhead

The Project will restore access to over 420 miles of historical steelhead habitat upstream of Iron Gate Dam (Huntington 2004; 2006). Because of their ability to navigate steeper gradient channels and spawn in smaller, intermittent streams (Platts and Partridge 1978), and their ability to withstand a wide range of water temperatures (Cech and Myrick 1999; Spina 2007), steelhead distribution in the basin could expand to a greater degree (over 420 miles; Huntington 2004; 2006) than that of any other anadromous salmonid species. FERC (2007) concluded that restoring fish passage would help to reduce the adverse effects to steelhead associated with lost access to upstream spawning habitats. Hamilton et al. (2011) also concluded that restored access to historical habitat above the dams would benefit steelhead runs.

Lamprey

Pacific lamprey is the only anadromous lamprey species in the Klamath Basin, although five other resident lamprey species are also present in the system. Access to habitat upstream of Iron Gate Dam as a result of the Project, could benefit Pacific lamprey by increasing their range and distribution in the Klamath River Basin, providing additional spawning and rearing habitat upstream and downstream of Iron Gate Dam, and increasing their abundance. The Project is anticipated to expand the current range of Pacific lamprey to areas upstream of Iron Gate Dam (FERC 2007). Restoration of natural hydrologic conditions will improve rearing conditions for lamprey ammocoetes that are currently affected by periodic peaking flows that dewater habitat and strand ammocoetes.

2.2.2 Water Quality and Water Temperature

The Project will decrease residence time from several weeks to less than a day, resulting in improved water quality and a more natural temperature regime. Reservoir removal will also increase the benefits of tributaries and springs such as Fall, Shovel, and Spencer creeks and Big Springs, that will flow directly into the mainstem Klamath River, creating patches of cooler water (see Table 2-2) that could be used as temperature refugia by fish during summer and fall, as well as providing slightly warmer winter water

temperatures conducive to the growth of salmonids (Hamilton et al. 2011). The Project would result in a 2-10°C decrease in water temperatures during the fall months and a 1-2.5°C increase in water temperatures during spring months (PacifiCorp 2004a; Dunsmoor and Huntington 2006; NCRWQCB 2010a).

Elimination of the thermal lag currently caused by the existing reservoirs, will result in water temperatures more in sync with historical fish migration and spawning periods for the Klamath River, warming earlier in the spring, and cooling earlier in the fall compared to existing conditions (Hamilton et al. 2011). Warmer springtime temperatures would result in fry emerging earlier (Sykes et al. 2009), encountering favorable temperatures for growth sooner than under existing conditions, which could support higher growth rates and encourage earlier emigration downstream, thereby reducing stress and disease (Bartholow et al. 2005; FERC 2007). In addition, fall Chinook salmon spawning in the mainstem during fall would no longer be delayed (reducing pre-spawn mortality), and adult migration would occur in more favorable water temperatures than under existing conditions. For example, groundwater inputs in the J.C. Boyle Bypass Reach are anticipated to account for 30 to 40 percent of the total summer flow following dam removal. Groundwater inputs will have a positive effect on water temperature, benefiting both anadromous and resident fish and other aquatic organisms in the Klamath River.

In addition to restoring a more natural thermal regime, the Project will result in overall increases in dissolved oxygen, increased diel variability in dissolved oxygen, and lower microbial oxygen demand due to decreased organic load. The conversion of an additional 22.4 miles of reservoir habitat to riverine and riparian habitat will improve water quality by restoring the nutrient cycling and aeration processes provided by a natural channel.

2.2.3 Hydrograph

With the Project, Klamath River flows will mimic the natural hydrograph. Fish migration patterns, riparian plant community processes, and sediment and debris transport mechanisms are anticipated to benefit from a more natural hydrograph.

2.2.4 Disease

Fish diseases are widespread in the mainstem Klamath River during certain time periods, and in certain years disease prevalence has been shown to adversely affect survival and productivity of Chinook and coho salmon. High infection rates by the myxozoan parasite *Ceratonova shasta* (*C. shasta*) have been documented in emigrating juvenile salmon populations during spring and early summer in the Klamath River (True et al. 2016 *cited in* USFWS 2016), which have been linked to population declines in fall Chinook Salmon (Fujiwara et al. 2011; True et al. 2013). Fish infected by *C. shasta* are also prone to mortality caused by other pathogens such as *Parvicapsula minibicornis*, to predation, and compromised osmoregulatory systems that are essential for successful ocean entry (S. Foott personal communication *cited in* USFWS 2016).

C. shasta infection rates of juvenile Chinook salmon are influenced by *C. shasta* spore densities, water temperature, and juvenile salmonid residence time in area of high spore densities. Table 2-5 includes a

summary of juvenile Chinook salmon prevalence of infection over 10 years at the Kinsman rotary screw trap location (RM 147.6), located 45 river miles downstream from Iron Gate Dam (RM 193.1). The Kinsman trap is located between the Shasta River and the Scott River, a reach of the Klamath River often referenced as the "infectious zone" (USFWS 2016).

Table 2-5 Summary of estimates of annual-level *C. shasta* infection prevalence for wild and/or unknown origin juvenile Chinook salmon passing the Kinsman rotary screw trap site (RM 147.6).

Year	Origin	Prevalence of Infection	Infected Population Estimate
2005	All	0.41	0.38
2007	All	0.28	0.10
2008	All	0.6	0.51
2009	All	0.5	0.58
2010	Wild/Unknown	0.12/0.15	0.04
2011	Wild	0.2	0.11
2012	Wild/Unknown	0.06/0.00	0.08
2013	Wild	0.18	0.06
2014	Wild	0.67	0.18
2015	Wild/Unknown	0.66/0.96	0.29

Source: USFWS 2016

Prevalence of Infection references annual summaries of weekly collections aimed to monitor weekly disease rates. The Infected Population Estimate references estimates for the prevalence of C. shasta *infections in the population of juvenile Chinook salmon.*

The lower and upper confidence limits account for the estimation uncertainty in abundance and weekly prevalence of infection rates

The Project is expected to reduce fish disease impacts to adult and juvenile salmon especially downstream from Iron Gate Dam. Among the salmon life stages, juvenile salmon tend to be most susceptible to *P.minibicornis* and *C. shasta* (Beeman et al. 2008). The main factors contributing to risk of infection by *C. shasta* and *P. minibicornis* include availability of habitat (pools, eddies, and sediment) and microhabitat characteristics (static flow and low velocities) for the polychaete intermediate host; polychaete proximity to spawning areas; increased planktonic food sources from Hydroelectric Reach reservoirs; water temperatures greater than 15°C (Bartholomew and Foott 2010); and juvenile salmonid residence time in the infectious zone (USFWS 2016).

The Project will restore natural channel processes including channel bed scour and sediment transport. Annual channel bed scour will disturb the habitat of the polychaete worm that hosts *C. shasta* (FERC 2007). Reducing polychaete habitat will likely increase abundance of smolts by increasing outmigration survival, particularly for juvenile coho salmon FERC 2007).

The Project will also broaden the distribution of adult pre-spawn fall Chinook salmon, reducing crowding and the concentration of disease pathogens that currently occurs in the reach between Iron Gate Dam and the Shasta River (USFWS 2016). Lastly, a broader spawning distribution will also influence the distribution of post-spawn adult carcasses that contribute the bulk of the myxospores that enable the *C. shasta* life cycle within the infectious zone. Distributing adult carcasses over a longer reach of the Klamath River corridor will reduce myxospore densities likely leading to lower juvenile salmonid infection rates in the winter and spring rearing period (USFWS 2016).

2.2.5 Nuisance Algae

The Project will eliminate optimal growing conditions for toxin-producing nuisance algal species, alleviating the transport of high seasonal concentrations of algal toxins to the Klamath River downstream from Iron Gate Dam. Nuisance algae reduction will also decrease the associated bioaccumulation of microcystin in fish tissue for species downstream from the Hydroelectric Reach. While some microcystin may be transported downstream from large blooms occurring in Upper Klamath Lake, the levels are anticipated to be lower than those currently experienced due to the prevalence of seasonal in-reservoir blooms. Overall, bioaccumulation of algal toxins in fish tissue are expected to decrease in the Klamath River downstream from Iron Gate Dam and will be beneficial.

2.2.6 Sediment and Debris Transport

In the long term, restoration of sediment and debris transport through the Hydroelectric Reach will decrease substrate size and increase the supply of wood debris, an important structural component that influences aquatic habitat diversity. Bedload sediment movement and transport are vital to create and maintain functional aquatic habitat. The river will eventually drive enhanced habitat complexity due to a more natural flow and reconnected bedload transport regime that will mean the restoration of spawning gravels and early rearing habitat downstream from Iron Gate Dam. Pools will likely return to their pre-sediment release depth within one year (USBR 2012), and the river is predicted to revert to and maintain a pool-riffle morphology providing suitable habitat for fall-run Chinook salmon.

In summary, the Project will have long-term ecosystem benefits. Primary ecosystem benefits that will be realized include restored access to historical habitat upstream of Iron Gate Dam for aquatic organisms (Huntington 2004; 2006); a more natural hydrograph, temperature regime (PacifiCorp 2004; Dunsmoor and Huntington 2006), and nutrient cycling; reduced prevalence of aquatic diseases such as *C. shasta* (Bartholow et al. 2004; Federal Energy Regulatory Commission [FERC] 2007; U.S. Fish and Wildlife Service [USFWS] 2016) and nuisance algae, and restored sediment transport and debris loading (USBR and CDFG 2012).

2.3 Anticipated Short-term Effects of the Project

Short-term effects from the Project to the biological community include high suspended sediment concentrations (Greig et al. 2005, Levasseur et al. 2006; USBR 2011), high bedload transport and

deposition, and low dissolved oxygen concentrations (Reclamation and CDFG 2012). The Project's short-term effects are anticipated to impact both mobile and sedentary organisms (e.g., freshwater mussels and lamprey ammocoetes), with the greatest effects on sedentary organisms that are unable to seek refuge from poor water quality. The following sections provide more details on anticipated short-term reservoir drawdown effects presented in the 2012 EIS/R (USBR and CDFG 2012).

2.3.1 Suspended Sediment Effects

The Project could release up to 1.2 - 2.9 million metric tons of fine sediment (sand, silt, and finer) downstream from Iron Gate Dam (RM 193.1) over a two-year period (USBR 2011). Suspended sediment concentrations are expected to exceed 1,000 mg/l for weeks, with the potential for peak concentrations exceeding 5,000 mg/l for hours or days depending on hydrologic conditions during reservoir drawdown (USBR and CDFG 2012). The downstream transport of this sediment, currently stored in reservoir deposits, is anticipated to affect downstream habitats as both suspended sediment and bedload. Biological effects may impact salmonids and Pacific lamprey through gill abrasion and clogging, decreased forage efficiency, and other behavioral effects like delayed migration timing. Deposition of suspended sediments is anticipated to impact salmonid spawning grounds by smothering incubating eggs (Greig et al. 2005; Levasseur et al. 2006), impeding intergravel flow thereby affecting egg and fry development, and impacting fry emergence due to gravel clogging. Fine sediment deposition in slower off-channel habitats may also block connectivity between the Klamath River and off-channel habitats such as mainstem side channels, important habitats for juvenile fish rearing and coho salmon spawning.

2.3.2 Bedload Effects

Bedload mobilized by the Project is anticipated to affect the Klamath River between Iron Gate Dam (RM 193.1) and Cottonwood Creek (RM 185.1). Bedload deposition is anticipated to result in the burial of spawning habitat, freshwater mussel beds, and lamprey ammocoete rearing areas. Dam-released sediment will also increase the proportion of sand in the channel bed, thereby decreasing salmonid fry and lamprey ammocoete survival. The bed material within the reservoirs and from Iron Gate Dam to Cottonwood Creek is expected to have a high content (30 to 50 percent) of sand immediately following reservoir drawdown until a flushing flow moves the sand sized material out of the reach (USBR 2012). A sufficient flushing flow of at least 6,000 cfs and lasting over several days to weeks is expected to be necessary to return the Klamath River bed composition to one dominated by cobble and gravel with a sand content less than 20 percent. After the flushing flow, the river bed is expected to maintain fractions of sand, gravel, and cobble similar to natural conditions, and be sufficient to support biological communities that use the former effected reach.

2.3.3 Dissolved Oxygen Effects

Release of reservoir sediments is also anticipated to result in depressed dissolved oxygen concentrations that will affect the biological community in the affected reach. Due to high organic concentration of the reservoir sediments, dissolved oxygen depletion is anticipated to result from the microbial breakdown of released organics. Direct effects of low dissolved oxygen levels include fish mortality, reduced growth and

impaired development, reduced swimming performance, altered behavior, and reduced reproductive potential. Mobile fish will likely seek out areas of higher dissolved oxygen and improved water quality downstream of the affected reach, in tributaries and tributary confluence areas with the Klamath River, and in areas with faster flowing water with a higher rate of oxygen transfer at the water-air interface. Less mobile organisms are unable to move from impaired water quality so are more susceptible to low dissolved oxygen effects.

2.3.4 Effects Analysis

Hydraulic and sediment modeling was completed to predict flow and sediment transport characteristics in part to predict potential biological effects associated with the Project (USBR 2011; Section 8 and 9). Modeling results are very sensitive to watershed hydrology, both in flow magnitude and runoff pattern (USBR 2011). To account for the range of potential effects that could occur during the Project, two scenarios were analyzed with the goal of predicting the potential impacts to fish that have either a 50 percent (effects likely to occur) or 10 percent (unlikely to occur, or worst-case) probability of occurring (USBR and CDFG 2012; Vol. I, Section 3.3).

Due to the uncertainties associated with biological response to the anticipated high suspended sediment concentrations levels and low dissolved oxygen over extended time periods, KRRC evaluated the 2012 EIS/R worst-case scenario effects for developing the updated AR plans. The 2012 EIS/R considered the potential short-term (less than 2 years) and long-term (more than 2 years) effects to Klamath River aquatic species. Short-term effects were determined to be either significant or less-than-significant for the species covered by the AR plans. The 2012 EIS/R anticipated that mitigation would reduce short-term effects for fall Chinook salmon and Lost River and shortnose suckers (from significant to less-than-significant), but mitigation would not reduce effects to less than significant levels for the other species. The Project as analyzed in the 2012 EIS/R was anticipated to have long-term benefits for all aquatic species (except green sturgeon) including those determined to have significant short-term effects (2012 EIS/R Vol. I, pp. 3.3-129 to 3.3-177).

Chapter 3: Mainstem Spawning

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3. MAINSTEM SPAWNING

The objective of the mainstem spawning measure is to address the short-term project effects on anadromous fish that migrate and spawn in the mainstem Klamath River and its tributaries during the two years following drawdown. The 2012 EIS/R AR-1 plan focused on trapping and hauling adult migratory anadromous salmonids and Pacific lamprey and relocating fish to areas of the basin less affected by project effects. The updated measure, based on the 2012 EIS/R AR-1, proposed as part of the Project includes implementation of a monitoring and adaptive management plan to monitor and ensure habitat connectivity and spawning habitat availability. The adaptive plan includes: 1) monitoring and ensuring tributary-mainstem connectivity at select tributaries in the Hydroelectric Reach and in the 8-mile long bedload deposition reach between Iron Gate Dam (RM 193.1) and Cottonwood Creek (RM 185.1); and 2) survey/quantification of spawning habitat in the Klamath River and tributaries in the Hydroelectric Reach from Iron Gate Dam to Keno Dam, and augmenting spawning gravel if existing spawning habitat is less than the area needed to support 2,100 Chinook redds on the mainstem and 179 steelhead redds in Hydroelectric Reach tributary streams. The measure as currently proposed represents the best available actions and opportunities to offset potential impacts to Chinook salmon and coho salmon spawning redds from reservoir drawdown, and to reduce effects to migrating adult steelhead and Pacific lamprey affected by reservoir drawdown.

3.1 Proposed Measure

Based on a review of the 2012 EIS/R AR-1 presented in Section 3.2, input from the ATWG, and recent fisheries literature, the KRRC concluded that an updated measure is necessary to offset the anticipated short-term effects of the Project on mainstem spawning Chinook and coho salmon, as well as migrating adult steelhead and Pacific lamprey. The updated measure requires KRRC to develop and implement a monitoring and adaptive management plan with on-going input from the ATWG. The plan includes monitoring and ensuring tributary-mainstem connectivity and spawning habitat availability. The monitoring and adaptive management plan has two specific actions.

- Action 1: KRRC will evaluate tributary-mainstem confluences, four sites in the Hydroelectric Reach and five sites in the 8-mile reach from Iron Gate Dam (RM 193.1) to Cottonwood Creek (185.1), for 2 years (see Table 3-1 for proposed schedule). Monitoring frequency will be variable based on the season and year. Additionally, any 5-year flow event of 10,895 cfs or greater on the Klamath River recorded at the USGS Klamath River Below Iron Gate Dam CA gage (#11516530) within the first two years following reservoir drawdown, will trigger a monitoring effort. If tributary confluence blockages are identified during monitoring, necessary means will be employed to remove the obstructions to ensure volitional passage for adult Chinook salmon, coho salmon, steelhead, and Pacific lamprey. The ATWG will also convene periodically during the 2-year monitoring period to review monitoring frequency to ensure volitional passage is maintained between the Klamath River and select tributaries.

- **Action 2:** KRRC will complete a spawning habitat evaluation of the Hydroelectric Reach and newly accessible tributaries following reservoir drawdown. A target of 44,100 yd^2 of mainstem spawning gravel will be required to offset the effects to 2,100 mainstem-spawning fall Chinook salmon redds. If mainstem spawning gravel availability is less than the target values following reservoir drawdown, KRRC will consult with the ATWG to plan and implement spawning gravel augmentation in the former Klamath River reservoirs and Hydroelectric Reach. A target of 4,700 yd^2 of tributary spawning gravel is required to offset the effects to 179 tributary-spawning steelhead redds. If tributary spawning gravel habitat is less than the target values following reservoir drawdown, KRRC will meet with the ATWG to prioritize additional habitat restoration actions (e.g., gravel augmentation, gravel retention treatments) that will be implemented by KRRC to increase the amount of tributary habitat available to compensate for the loss of steelhead redds.

The proposed actions are intended to ensure adult salmonid and Pacific lamprey access to mainstem and tributary spawning habitat in the Hydroelectric Reach and between Iron Gate Dam and Cottonwood Creek following the Project. The following sections provide additional detail on the proposed actions.

3.1.1 Action 1: Tributary-Mainstem Connectivity

The following sections provide information on the monitoring and adaptive management plan pertaining to tributary-mainstem connectivity.

Tributary-Mainstem Connectivity Monitoring

To ensure that spawning habitat is accessible during and following reservoir drawdown, fish passage monitoring, and adaptive actions will occur at the confluence areas of key Klamath River tributaries and side channels upstream and downstream of Iron Gate Dam (Table 3-1). Tributary confluences in the Hydroelectric Reach may be affected by sediment deposits and debris obstructions as the reservoirs are drawn down. Tributary deltas may create fish passage barriers that will limit upstream migration of anadromous salmonids and Pacific lamprey. Monitoring frequency will be variable based on the season and year (Table 3-1). Additionally, any 5-year flow event or 10,895cfs or greater on the Klamath River recorded at the USGS Klamath River Below Iron Gate Dam CA gage (#11516530) within the first two years following reservoir drawdown will trigger a monitoring effort.

Table 3-1 Mainstem Spawning Measure monitoring frequency for tributaries in the Hydroelectric Reach and Iron Gate Dam (IGD) to Cottonwood Creek reach for the drawdown year and post-drawdown year.

Monitoring Reach	Monitoring Period	Monitoring Frequency
Hydroelectric Reach 4 tributaries	Drawdown Year (2021-2022)	
	April 1 – June 30	Bi-weekly
	July 1 – September 30	Monthly
	October 1 – December 31	Weekly
	2nd Year (2022-2023)	

Monitoring Reach	Monitoring Period	Monitoring Frequency
	January 1 – March 31	Weekly
	April 1 – June 30	Bi-weekly
	July 1 – September 30	Monthly
	October 1 – December 31	Bi-weekly
IGD to Cottonwood Creek 5 tributaries	Drawdown Year (2021-2022)	
	January 1 – March 31	Weekly
	April 1 – June 30	Bi-weekly
	July 1 – September 30	Monthly
	October 1 – December 31	Weekly
	2nd Year (2022-2023)	
	January 1 – March 31	Weekly
	April 1 – June 30	Bi-weekly
	July 1 – September 30	Monthly
	October 1 – December 31	Bi-weekly

Based on hydraulic and sediment transport modeling completed by USBR (Section 9.2.1.4; 2011), sediment deposition during reservoir drawdown is predicted from Bogus Creek (RM 192.6) downstream to Cottonwood Creek (RM 185.1). From Bogus Creek downstream to Willow Creek (RM 188.0), approximately 1.5 feet of sediment deposition is anticipated. From Willow Creek downstream to Cottonwood Creek, deposition of less than 1 foot is expected. Areas downstream of Cottonwood Creek are expected to have only minor deposition with deposits less than 0.25 feet (USBR 2011). No additional deposition is predicted in the Bogus Creek to Cottonwood Creek reach following the Project.

Species that could be potentially affected by obstructed tributary connections include steelhead and Pacific lamprey during the winter and spring of the drawdown year, and Chinook salmon and coho salmon in the fall of the drawdown year. Further, depending on erosion rates of reservoir sediments, tributary confluence areas in the reservoir areas may not have volitional fish passage conditions during and following drawdown.

Tributary confluences to be monitored by KRRC in the 2-year period following reservoir drawdown include Bogus Creek, Dry Creek, Little Bogus Creek, Willow Creek, and Cottonwood Creek. Tributaries in the Bogus Creek to Cottonwood Creek reach were selected as they are recognized as influential tributaries (e.g., historical fisheries importance or important freshwater sources) in the mid-Klamath River (Soto et al. 2008). Hydroelectric Reach tributaries to be monitored include Spencer Creek (RM 233.4), Shovel Creek (RM 212.0), Fall Creek (RM 199.8), and Jenny Creek (RM 197.4). These tributaries were selected based on having historical or potential habitat for adult salmonids (Huntington 2006).

Tributary confluences will be evaluated for 2 years in both reaches to identify project-related tributary confluence obstructions. Obstructions will be actively removed during the 2-year monitoring period to ensure volitional passage for adult Chinook salmon, coho salmon, steelhead, and Pacific lamprey

Tributary Connectivity Maintenance

Tributary confluences in both reaches will be monitored at variable frequencies depending on the season and year (see Table 3-1). Tributary obstructions that limit fish passage will be remedied through appropriate manual or mechanical means necessary to address obstructions. Example removal methods may include removing sediment using hand tools or hydraulic equipment. Removed gravels and large woody debris will be placed in the Klamath River downstream of the tributary confluence. Removed fine sediments will be placed on the adjacent floodplain or outhauled for disposal. The removal effort will be to the extent necessary to ensure volitional passage for adult and juvenile Chinook salmon, coho salmon, steelhead, and Pacific lamprey.

3.1.2 Action 2: Spawning Habitat Evaluation

The following sections provide information on the monitoring and adaptive management plan pertaining to mainstem and tributary spawning habitat availability.

Spawning Habitat Target Metrics

Spawning gravel area targets for Chinook salmon and steelhead were developed based on typical spawning redd dimensions for the two species and the anticipated loss of Chinook salmon redds and adult steelhead due to reservoir drawdown. Fortune et al. (1966) used 21 square yards (yd^2) and 26 yd^2 of suitable gravel per Chinook salmon redd and steelhead redd, respectively, to calculate spawning potential in areas of the Klamath River and selected tributaries upstream of Iron Gate Dam (Table 3-2). Based on an anticipated loss of 2,100 Chinook salmon redds downstream from Iron Gate Dam and a 21 yd^2 area per redd, 44,100 yd^2 of spawning gravel is necessary to offset the loss of 2,100 Chinook salmon redds. Based on recent winter steelhead counts, an estimated 358 adult steelhead representing 179 spawning redds will be affected by reservoir drawdown and sediment release. Applying Fortune et al. (1966) steelhead redd dimensions, 4,700 yd^2 of tributary spawning habitat will be needed to offset the loss of 358 winter steelhead.

Table 3-2 Anticipated redd loss due to project effects for fall Chinook salmon and winter steelhead, surface area per redd, and the anticipated spawning habitat area needed to address redd loss for fall Chinook salmon and steelhead adult production

Metric	Fall Chinook Salmon	Winter Steelhead
Anticipated redd loss due to reservoir drawdown and sediment release	2,100	179[1]
Surface area per spawning redd (yd^2)	21	26
Spawning habitat area to address redd loss (yd^2)	44,100	4,700

[1] Updated anticipated winter steelhead loss based on peak steelhead return of (631 in 2001) to Iron Gate Hatchery between 2000-2016 (CDFW 2016). Expected mortality calculated using the methodology contained in the 2012 EIS/R (631*0.80*0.71=358). The 358 adult steelhead were converted to 179 redds that would be lost due to adult steelhead mortality.

Spawning Habitat Monitoring

To quantify the available spawning habitat upstream of Iron Gate Dam, KRRC will implement field surveys and remote sensing following reservoir drawdown. Boat or aerial surveys will be conducted on the mainstem Klamath River between Iron Gate Dam (RM 193.1) and Keno Dam (RM 239.2) during the summer following reservoir drawdown to determine the amount of mainstem spawning habitat in the Hydroelectric Reach suitable for immediate spawning.

Tributary streams will be walked from their mouths to the first natural fish passage barrier to estimate amount of available spawning habitat following reservoir drawdown (Table 3-3). The area of available spawning habitat will be estimated from the mouth to the first natural barrier. If artificial (manmade) fish passage barriers are located during the tributary reach reconnaissance, they will be noted as potential restoration actions to increase the availability of tributary spawning habitat.

Table 3-3 Hydroelectric Reach tributaries to be assessed for existing spawning habitat

Tributary	Tributary Confluence Location at the Klamath River (RM)	Tributary Length to First Barrier (mi)
Jenny Creek	197.4	1.0
Fall Creek	199.8	1.2
Shovel Creek	212.0	2.7
Spencer Creek	233.4	9.0

Response to Spawning Habitat Availability

KRCC will prepare a report summarizing the spawning habitat surveys and outline and prioritize actions to augment spawning habitat if the existing spawning habitat amounts to less than the 44,100 yd^2 of mainstem and 4,700 yd^2 of tributary spawning habitat targets in the Hydroelectric Reach. KRRC will consult with the ATWG for input on potential spawning gravel augmentation locations in the mainstem and on other tributary habitat restoration actions in tributaries to increase the availability of spawning habitat. Currently, if existing spawning habitat does not meet targets, spawning gravel augmentation will be completed in the mainstem Klamath River between Shovel Creek (RM 212.0) and the upstream extent of Copco Reservoir (RM 209.0). Mainstem gravel will be added at a rate of 7.0 cy (21 yd^2 x 1 ft depth) per compensatory mainstem redd. KRRC anticipates augmented gravel will to be redistributed with subsequent high flows, broadening potential spawning habitat over larger areas of the treated mainstem reaches. Tributary spawning habitat restoration actions to be completed in Jenny Creek, Shovel Creek, Fall Creek, and/or Spencer Creek could include removal of artificial fish passage barriers, or placement of large woody debris to trap and retain spawning gravels. Spawning gravel augmentation will be prioritized based on anticipated spawning habitat benefits.

In summary, the updated measure includes development and implementation of a monitoring and adaptive management plan overseen by KRRC with consultation by the ATWG. The plan will direct the evaluation of tributary-mainstem connectivity in the Hydroelectric Reach and the Klamath River deposition reach between

Iron Gate Dam and Cottonwood Creek. Tributary confluences will be monitored for 2 years following the start of reservoir drawdown and tributary confluence obstructions that block fish passage will be addressed over the 2-year period. Mainstem and tributary spawning habitat in the Hydroelectric Reach will be monitored post-reservoir drawdown and will be augmented with supplemental spawning gravel or enhanced through additional restoration actions (e.g., large wood placement to retain spawning gravels) if spawning habitat area metrics are not met by existing habitat conditions following reservoir drawdown.

3.2 Summary of the Affected Species, Project Benefits and Effects, Recent Fisheries Literature, the 2012 EIS/R AR-1, and the Proposed Measure

The following sections review the components of the 2012 EIS/R AR-1, anticipated project effects and benefits on measure species, and recent fisheries literature relative to mainstem spawning. This information is presented in support of the updated measure.

3.2.1 Affected Species

Species identified in the measure include:

- Coho salmon *(Oncorhynchus kisutch)* – Southern Oregon/Northern California Coastal (SONCC) evolutionary significant unit (ESU): Federally Threatened; California Threatened; Tribal Trust Species
- Chinook salmon *(O. tshawytscha)* – Upper Klamath-Trinity Rivers ESU - Fall Run: California Species of Special Concern; Tribal Trust Species
- Chinook salmon *(O. tshawytscha)* – Upper Klamath-Trinity Rivers ESU – Spring Run: California Species of Special Concern; Tribal Trust Species
- Steelhead *(O. mykiss)* – Klamath Mountains Province distinct population segment (DPS) – Summer Run: California Species of Special Concern; Tribal Trust Species
- Steelhead *(O. mykiss)* – Klamath Mountains Province DPS – Winter Run: Tribal Trust Species
- Pacific lamprey *(Entosphenus tridentatus)*: California Species of Special Concern; Tribal Trust Species

3.2.2 Anticipated Project Effects on Measure Species

Short-term effects of the project (from both suspended sediment and bedload movement) were predicted to result in high mortality of fall Chinook salmon and coho salmon embryos and pre-emergent alevin within redds that are constructed in the mainstem Klamath River downstream from Iron Gate Dam (RM 193.1) in the fall of prior to reservoir drawdown (USBR and CDFG 2012). Approximately 2,100 fall Chinook salmon redds and approximately 13 SONCC coho salmon redds were predicted to be affected during reservoir drawdown. Additionally, steelhead and Pacific lamprey migrating within the mainstem Klamath River after December 31 prior to the reservoir drawdown year are anticipated to be directly affected by suspended

sediment. Table 3-4 includes the likely and worst-case effects to adult anadromous fish species downstream from Iron Gate Dam.

Table 3-4 2012 EIS/R anticipated effects summary for migratory adult salmonids and Pacific lamprey

Species	Life Stage	Likely Effects	Worst Effects
Coho Salmon	Adult Spawning	Loss of 13 redds (0.7-26%)[1]	Loss of 13 redds (0.7-26%)[1]
Chinook Salmon - Fall	Adult Spawning	Loss of 2,100 redds (8%)[1]	Loss of 2,100 redds (8%)[1]
Steelhead - Summer	Migrating Adults	No anticipated mortality	Loss of 0-130 adults (0-9%)[1]
Steelhead - Winter	Migrating Adults	Loss of up to 1,008 adults (14%)[1]	Loss of up to 1,988 adults (28%)[1]
Pacific Lamprey	Adult Migration and Spawning	High mortality (36%)[2]	High mortality (71%)[2]

Source: USBR and CDFG 2012
[1] Range of potential year class loss based on the average number of redds associated with the evaluated population(s).
[2] The 2012 EIS/R predicted Pacific lamprey mortality based on mortality models developed for suspended sediment impacts to salmonids. Model output did not include the number of predicted Pacific lamprey mortalities.

The following sections include descriptions of species-specific effects adapted from the 2012 EIS/R (USBR and CDFG 2012; Vol. I, pp. 3.3-129 to 3.3-168).

Coho Salmon

The wide distribution and use of tributaries by both juvenile and adult coho salmon will likely protect the population from the worst effects of the Project. However, direct mortality is anticipated for redds and smolts from the upper Klamath River, mid-Klamath River, Shasta River, and Scott River population units. No mortality is anticipated for the Salmon River, Trinity River, and Lower Klamath River populations under the most likely or worst-case scenarios. Based on substantial reduction in the abundance of a year class in the short-term, the effect of the Project was found to be significant for the coho salmon from the Upper Klamath River, Mid-Klamath River, Shasta River, and Scott River population units.

Based on spawning surveys conducted from 2001 to 2005 (Magneson and Gough 2006), 6 to 13 redds could be affected during reservoir drawdown. The anticipated loss of redds from the Upper Klamath River coho salmon population unit was based on the peak count of redds surveyed in all years (13 redds counted in 2001). Mainstem Upper Klamath River coho redd surveys completed between 2001 and 2016 yielded 6 redds on average and no redds in 2009. A total of 38 mainstem redds were documented between 2001-2005, with two-thirds of those redds being found within 12 miles of the dam (NMFS 2010). Many of the

redds anticipated to be affected by the Project are thought to be from returning hatchery fish (NOAA 2010). To preserve existing genetic characteristics and to reduce the threat of demographic extinction, under the Iron Gate Hatchery's hatchery genetic management plan (HGMP), all adult coho salmon not used as broodstock have been returned to the Klamath River to spawn naturally since 2010. Many of these hatchery-origin adult coho salmon stray into Bogus Creek and the Shasta River to spawn while the remainder are thought to spawn in the Klamath River below Iron Gate Dam. Therefore, based on the range of escapement estimates in Ackerman et al. (2006), 13 redds could represent anywhere from 0.7 to 26 percent of the naturally returning spawners in the Upper Klamath River Population Unit, and likely much less than 1 percent of the natural and hatchery returns combined (Magneson and Gough 2006; USFWS, unpublished data, 2017).

Chinook Salmon – Fall Run

Fall Chinook salmon use the mainstem Klamath River for spawning, rearing, and as a migratory corridor. Direct mortality is predicted for fall Chinook salmon redds and some smolts. The effect of suspended sediment concentrations on juvenile fall Chinook salmon from the Project is expected to be relatively minor because of variable life histories, the large majority of age-0 juveniles that remain in tributaries until later in the spring and summer, and because many of the fry that out-migrate to the mainstem come from tributaries in the mid-or lower Klamath River, where suspended sediment concentrations resulting from the Project are expected to be lower due to dilution from tributaries.

Suspended sediment is predicted to result in 100 percent mortality of fall Chinook salmon eggs and fry spawned in the mainstem Klamath River during the fall prior to the reservoir drawdown year. Much of the overall effect on fall Chinook salmon will depend on the relative proportion of mainstem spawners during the fall prior to the reservoir drawdown year. Based on redd surveys using a mark and re-sight methodology from 1999 through 2009 (Magneson and Wright 2010), an average of 2,100 redds from hatchery and naturally returning adults are constructed in the mainstem Klamath River from Iron Gate Dam downstream to the Shasta River confluence and represents approximately 8 percent of the total, basin-wide escapement (USBR and CDFG 2012).

Steelhead – Summer and Winter

High suspended sediment concentrations resulting from the Project are anticipated to affect winter steelhead migrating during the winter and spring of the drawdown year, particularly for the portion of the population that spawns in tributaries upstream of the Trinity River (RM 43.4). For that portion of the population, effects are anticipated on adults, run-backs, half-pounders, any juveniles rearing in the mainstem, and out-migrating smolts. However, the broad spatial distribution of steelhead in the Klamath Basin and their flexible life history suggests that some steelhead will avoid the most serious effects of the Project by remaining in tributaries for extended rearing, rearing farther downstream where suspended sediment concentrations should be lower due to dilution, and/or moving out of the mainstem into tributaries and off-channel habitats during winter to avoid periods of high suspended sediment concentrations.

Additionally, the life history variability observed in steelhead means that, although numerous year classes will be affected, not all individuals in any given year class will be exposed to project effects. Some portion of the progeny of those adults that spawn successfully will also rear in tributaries long enough to not only avoid the highest suspended sediment concentrations but may also not return to spawn for up to 2 years, when suspended sediment resulting from the Project should be greatly reduced. The high incidence of repeat spawning among summer steelhead, ranging from 40 to 64 percent (Hopelain 1998) should also increase that population's resilience to project effects. Project modeling results suggest the loss of up to 1,988 winter steelhead redds and up to 130 summer steelhead redds (however, see updated steelhead population data in Section 3.2.3).

Pacific Lamprey

The Project will have short-term effects on Pacific lamprey related to high suspended sediment concentrations, bedload sediment transport and deposition, and impaired water quality (particularly low dissolved oxygen levels). Overall, because multiple year classes of Pacific lamprey rear in the mainstem Klamath River at any given time, and since adults will migrate upstream over the entire year, including the reservoir drawdown period when effects from the Project will be most pronounced, effects on Pacific lamprey adults and ammocoetes are anticipated to be substantial. However, because of their wide spatial distribution and varied life history, most of the population, (which is distributed from at least California along the Pacific Rim to Japan; Goodman and Reid 2012), will not be affected by the Project. In addition, Pacific lamprey are considered to have low fidelity to their natal streams (FERC 2006) and may not enter the mainstem Klamath River if environmental conditions are unfavorable during the reservoir drawdown period. Migration into the Trinity River and other lower Klamath River tributaries may also increase during the reservoir drawdown period because of poor water quality in the upper Klamath River. Low site fidelity and a prevalence of tributary ammocoetes also increases the potential for Pacific lamprey recolonization of mainstem habitats following the Project.

3.2.3 2012 EIS/R AR-1

The 2012 EIS/R AR-1 (Vol. I, pp. 3.3-242 to 3.3-243) directed the capture and relocation of adult spawning condition salmonids and Pacific lamprey to mitigate project effects. A weir and trap system was proposed for installation directly upstream of the Shasta River (RM 179.3), where the mainstem Klamath River is narrow enough to effectively trap migrating salmonids. This location was also specified to ensure that fish returning to key tributaries downstream of, and including the Shasta River, would not be interrupted. The weir was proposed to be installed at the beginning of the fall migration and fished past the initial dam drawdown period until high flows would require the trap be dismantled. Trap operation would occur intermittently to allow volitional passage of fish upstream of the trap location and would coincide with pulses of fish moving through the system. Trapped fish would then be transported and released either into under-seeded tributaries downstream of Iron Gate Dam (e.g., Scott River [RM 145.1]), or into tributaries or the mainstem Klamath River upstream of J.C. Boyle Reservoir (RM 234.1) if consistent with post-Project management goals.

If necessary, additional surveys in the mainstem Klamath River downstream of Shasta River were proposed to locate coho salmon spawning in the mainstem. Any identified adult coho salmon and Chinook salmon, steelhead, or Pacific lamprey could be captured using dip nets, electrofishing, or seines and transported to tributary habitat. Spawning surveys would be conducted in December prior to reservoir drawdown, immediately prior to the first release of sediment associated with the project.

3.2.4 KRRC's and ATWG's Review of AR-1 for Feasibility and Appropriateness

KRRC assessed the feasibility and appropriateness of AR-1 through multiple planning meetings held with the ATWG between May and August 2017. During these meetings, new information on Klamath River fisheries was presented and information on other dam removal projects conducted in the western United States was reviewed to understand how the aquatic ecosystem might respond as discussed above. Major concerns discussed by KRRC and ATWG regarding the 2012 AR-1 included:

- Feasibility of a weir and trap system during high flows and winter conditions.
- High anticipated mortality associated with trapping, handling, hauling, and releasing adult spawning condition fall Chinook salmon and coho salmon.
- Impacts to wild fish populations inhabiting streams used to relocate captured fish.
- Adult coho salmon location at time of the reservoir drawdowns.
- Chinook salmon with a high hatchery influence will be most affected by the reservoir drawdowns.
- 2012 EIS/R baseline population estimates and effects uncertainty.

The following sections provide additional information regarding AR-1 feasibility and appropriateness, based on fisheries literature and ATWG input.

Weir and Trap System Feasibility

The 2012 EIS/R proposed weir and trap location was above the Shasta River confluence (RM 179.3) with the Klamath River. AR-1 guidance anticipated that the weir would be removed periodically to allow for passage of coho salmon and fall Chinook salmon above the weir to the upper Klamath River and its tributaries, and Iron Gate Hatchery (RM 192.6). KRRC and the ATWG concluded that fall rains will increase river flows and will require weir and trap removal from the river. Periods of increasing flow would also likely correspond with the greatest quantities of fish moving into the upper Klamath River. The weir system would likely not be operational during the reservoir drawdown period when winter-spring steelhead and Pacific lamprey migration increases with high flows. Therefore, the weir system would be ineffective at mitigating effects to migrating winter steelhead and Pacific lamprey during periods of high flows.

KRRC and the ATWG concluded that it would likely be infeasible to trap and haul the large number of fish that could be encountered in the upper Klamath River in an efficient, safe, and cost-effective manner, and that if fish were relocated into tributary streams downstream of Iron Gate Dam prior to reservoir drawdown, there was a high probability that many of those fish would re-enter the Klamath River and spawn in the affected area. The number of returning coho salmon and fall Chinook salmon in the fall prior to reservoir

drawdown will depend on several factors including year class strength, ocean conditions, ocean and lower river fisheries, and Klamath River water quality conditions during the spawning migration. While the number of fish that return to Iron Gate Hatchery (RM 192.6) vary widely, the average number of fish returning to the Klamath River upstream of the Shasta River confluence (RM 179.3) is substantial (Table 3-5) and would make trapping efforts intensive. For example, to trap the typically small numbers of natural origin coho salmon or winter steelhead upstream of the Shasta River confluence, there would be substantial effort to handle and sort large numbers of spawning condition hatchery fall Chinook salmon that may not be relocated. Given poor water quality conditions typical during the late summer migration, intensive fish handling, sorting, and transport could result in significant stress and mortality of the target species, as described below.

Ultimately, KRRC concluded that trapping using a weir style system, handling, and hauling a substantial portion of the typical returns to the upper Klamath River would be ineffective. There have also not been similar efforts conducted on other large dam removal projects to provide more certainty with this action.

Table 3-5 Fall Chinook salmon, coho salmon, and winter steelhead return metrics for Iron Gate Hatchery from 2000 to 2016

Return Metric	Fall Chinook Salmon	Coho Salmon	Winter Steelhead
Maximum Return	72,474	2,573	631[1]
Average Return	20,229	855	242
Minimum Return	8,176	70	4

Source: CDFW 2016

[1] The peak winter steelhead return to Iron Gate Hatchery from 2000 to 2016 was 631 fish. Using the 2012 EIS/R calculation method, 80 percent of fish returning to Iron Gate Hatchery migrate upstream after December 15th. Under the worst-case scenario, 71 percent of mortality is predicted to occur due to the Project. The 2012 EIS/R used a dataset published in 1994 (Busby et al. 1994) that included larger winter steelhead returns than have occurred over the last 27 years.

Mortality Associated with Trapping, Handling, Hauling, and Releasing Adult Spawning-condition Fall Chinook Salmon and Coho Salmon

KRRC and the ATWG concluded that spawning condition coho salmon and Chinook salmon will begin to reach the proposed weir location at RM 179.3 in late summer and early fall when water quality conditions are generally poor, and fish are susceptible to pre-spawn mortality due to stress and/or disease. Fish would potentially be more susceptible to disease and parasites associated with low flows, high water temperatures, and fish crowding. Given the expected condition of pre-spawn fish and poor water quality, the added stress associated with trapping, handling, hauling, and releasing captured fish is expected to result in high mortality of translocated fish.

Fish condition at the time of trapping influences mortality potential (Keefer et al. 2010). Primary injury and mortality events prior to fish transport are often associated with debris accumulation in the trap box, fish reaction to anesthesia, handling stress, and over-crowding in the trap box. Fish in overcrowded transport

tanks may expire due to low oxygen concentrations and warm water temperatures. In a trap and haul study on the San Joaquin River in California, adult fall Chinook salmon were trapped and transported in November. Of the 119 fish that were handled, 4 percent of fish died prior to transport and 8 percent died during transport (Bigelow et al. 2013). A trap and haul study that evaluated effects on adult, sexually mature fall Chinook salmon reported mortality of 19 percent (Geist et al. 2016), substantially higher than a comparison experiment using adult rainbow trout (Mesa et al. 2013 *cited in* Geist et al. 2016). In a study of transport and pre-spawn mortality of adult fall Chinook salmon in the Willamette River, Keefer et al. (2010) found that adult spring Chinook salmon that were captured, transported, and out-planted above barrier dams in the Willamette River, Oregon suffered mean mortality of 48 percent, ranging from 0 to 93 percent for individual release groups. Mortality rates strongly correlated with fish condition and water temperature.

Delayed post-release, pre-spawn mortality has also been detected in other projects, with mortality likely related to transport stress rather than water quality or disease issues which would manifest in more rapid (hours) or longer term (weeks) mortality, respectively (Mann et al. 2011).

In summary, KRRC concluded the potential handling mortality and reduced spawning success associated with an intensive trap and haul program could result in significant losses of fall Chinook salmon and coho salmon and counter the expected benefits of a trap and haul effort.

Impacts to Wild Fish Populations Inhabiting Relocation Streams

KRRC and the ATWG expressed concerns regarding the relocation of fall Chinook salmon and coho salmon that are highly influenced by Iron Gate Hatchery genetics to tributaries potentially inhabited by wild fish with limited hatchery influence. KRRC and the ATWG also concluded that there would be few viable options for recipient tributary streams based on genetics and disease concerns.

The 2012 EIS/R AR-1 was in part intended to assist in the reintroduction of anadromous salmonids upstream of Iron Gate Dam. Contrary to ODFW's draft reintroduction plan (2008), ODFW is currently developing a reintroduction strategy for anadromous fish in the Upper Klamath Basin that is expected to rely primarily on natural recolonization of the Klamath River and associated tributaries upstream of Iron Gate Dam (T. Wise, ODFW, personal communication). CDFW is likewise concerned with introducing coho and Chinook salmon of unknown genetics and disease condition into wild populations that spawn in the Klamath River and tributaries.

Chinook salmon exhibit substantial population genetic structure across the species' geographic range including the Klamath River Basin (Kinziger et al. 2013). Chinook salmon in the Klamath River Basin exhibit a complex genetic structure defined primarily by basin geography. The Iron Gate Hatchery (RM 192.6) has a profound influence on Klamath River fall Chinook salmon in the vicinity of the hatchery. Kinziger et al. (2013) found the proportion of naturally spawning fall Chinook salmon of Iron Gate Hatchery origin decreased with distance from the hatchery. Natural origin Chinook sampled in Bogus Creek (RM 192.6), Shasta River (RM 179.3), and the Scott River (RM 145.1) had decreasing proportions of hatchery genetics with increasing distance from the hatchery. Fall Chinook salmon spawning between Iron Gate Dam (RM 193.1) and the Shasta River (RM 179.3) exhibit the greatest introgression of Iron Gate Hatchery fish genes.

The influence of Iron Gate Hatchery genetics on fall Chinook salmon is greatly diminished by the Scott River (RM 145.1).

In light of these considerations, relocating fall Chinook salmon from downstream of Iron Gate Dam to Klamath River tributaries would have been restricted to tributaries between Iron Gate Dam and the Shasta River to minimize genetic effects to tributary populations. However, moving fish with a higher proportion of hatchery-influenced genetics farther from the hatchery had the potential to extend the hatchery's introgressive influence to downstream fall Chinook salmon populations that are outside of the direct influence of Iron Gate Hatchery (Kinziger et al. 2013). Additionally, streams between Iron Gate Dam (RM 193.1) and the Shasta River (RM 179.3) that support fall Chinook spawning are currently limited by water availability and quality during the fall spawning migration period.

In summary, KRRC and the ATWG concluded that relocating fall Chinook salmon and coho salmon of unknown genetic composition to the Klamath River upstream of Iron Gate Dam or to under-seeded tributaries near Iron Gate Dam presents an unacceptable genetic risk (and possibly disease risk) to other populations potentially dominated by wild fish.

Adult Coho Salmon Location at Time of the Reservoir Drawdowns

KRRC and the ATWG concluded that since coho salmon primarily spawn in Klamath River tributaries, adult coho salmon will largely be unaffected by poor water quality conditions associated with reservoir drawdown in the mainstem Klamath River. Additionally, it is likely that the small numbers of coho that do spawn in the mainstem river are mostly of Iron Gate Hatchery origin (NOAA 2014). Expected mortality associated with trapping, handling, hauling, and releasing adult coho salmon would stress fish that would not be affected by reservoir drawdown if these fish were instead allowed to reach their spawning tributaries (e.g., Bogus Creek). The reservoir drawdown schedule was also in part developed to account for coho salmon entry into tributaries to minimize project effects. Attempting to capture small numbers of mainstem spawning coho salmon would likely impact greater numbers of coho than would be impacted by project activities.

Overall, KRRC and the ATWG concluded a trap and haul program as prescribed in the 2012 EIS/R would negatively affect coho salmon that would otherwise migrate to their native tributary streams in the upper Klamath River.

2012 EIS/R Baseline Population Estimates and Project Effects Uncertainty

Effects to adult fish outlined in the 2012 EIS/R included approximations and assumptions that were based on limited data on Klamath River anadromous salmonids and Pacific lamprey populations; incorporated a conservative analysis of fish avoidance behavior to the anticipated water quality conditions; and in part included a worst-case scenario analysis of project effects on adult salmonids and Pacific lamprey. The following sections provide updated population information for winter steelhead and Pacific lamprey and identifies project effects uncertainties that should be considered in updating the effects determinations.

Steelhead Population Update

Steelhead data for the Klamath River Basin upstream of the Trinity River are limited. Population data for winter steelhead in the 2012 EIS/R were based on Iron Gate Hatchery returns published in 1994 (Busby et al. 1994). In a strong return year based on the 1994 dataset, 3,500 adult winter steelhead returned to Iron Gate Hatchery (USBR and CDFG 2012). The 2012 EIS/R analysis estimated that there would be 71 percent mortality to 80 percent of those fish based on run timing and effects of suspended sediment. Using updated winter steelhead counts for the Iron Gate Hatchery from 2000 to 2016 (Table 3-2), the peak and average numbers of adult winter steelhead returning to Iron Gate Hatchery were 631 and 242 steelhead, respectively Although returns to Iron Gate Hatchery may not be indicative of broader trends in adult winter steelhead returns to the Klamath River, these data do provide an updated metric for estimating anticipated effects of the Project on adult steelhead. Using the same methodology to establish the anticipated mortality to winter steelhead as contained in the 2012 EIS/R, but applied to the 2000-2016 steelhead return data, effects to steelhead would result in a loss of 358 and 138 steelhead on a peak and average year, respectively.

Video monitoring conducted in Bogus Creek and the Shasta River by CDFW between 2007 and 2016 provides additional context to the recent abundance of upper Klamath steelhead populations. Average returns of adult steelhead counted by video were 53 and 102 steelhead for Bogus Creek and the Shasta River, respectively, during the 10-year period. However, many of those years video monitoring was terminated in December or January and did not capture the full steelhead migration period. In years where video monitoring or a combination of video counts and SONAR counts covered the full migration period (2013 and 2016 for Bogus Creek and 2012, 2015, and 2016 for Shasta River) total steelhead counted averaged 94 for Bogus Creek and 194 for the Shasta River (CDFW, unpublished data, 2017). Likewise, no steelhead have been produced at Iron Gate Hatchery since 2012 (K. Pomeroy, CDFW, personal communication, 2017). *Pacific Lamprey Population Update*

Recent genetic analysis of Pacific lamprey suggests no significant population structure exists across populations or regions, indicating a high degree of historical gene flow even across expansive distances of the northern Pacific Rim (Goodman and Reid 2012). Weak population structure and low site fidelity minimize the short-term effects to Pacific lamprey identified in the 2012 EIS/R. Because the metapopulation is now believed to be relatively undifferentiated across the species' range, the percentage of adult and larval Pacific lamprey that will be affected by the Project relative to the population as a whole will be insignificant.

Project Effects Uncertainty

Studies suggest that high suspended sediment concentrations (Newcombe and Jensen 1996; Chapman et al. 2014; Kjelland et al. 2015) and low dissolved oxygen concentrations (Bjorn and Reiser 1991; Washington Department of Ecology [WDOE] 2002; Carter 2005) affect adult salmonid behavior. Adult salmonid behavioral changes to high suspended sediment concentrations include avoidance of turbid waters in homing adult anadromous salmonids. Physiological effects of high turbidity include physiological stress and respiratory impairment, damage to gills, reduced tolerance to disease and toxicants, reduced survival, and direct mortality (Newcombe and Jensen 1996). Concentration and duration of elevated

suspended sediment, as well as other factors including water temperature, disease, and river flow, influence the effect of suspended sediment on salmonids.

The effects of low dissolved oxygen levels, eutrophication, or turbidity on natural populations of Pacific lamprey adults and ammocoetes are unknown. Adult steelhead and Pacific lamprey entering the Klamath River during reservoir drawdown and dam removal would encounter poor water conditions and would be expected to avoid poor water quality by either entering tributary streams or using habitats less affected by high suspended sediment concentrations (e.g., tributary confluences or off-channel areas). For instance, in 2012 during dam deconstruction on the Elwha River, a high proportion (44 percent) of Chinook salmon redds were documented in two clear water tributaries (Indian Creek and Little River), while surveys conducted following dam removal activities (2014-2016) resulted in over 95 percent of Chinook redds constructed in the mainstem river. The high proportion of tributary spawning by fall Chinook salmon in 2012 suggests that these streams provided refugia from the effects of dam removal (McHenry et al. 2017). There is increasing evidence that fish will modify their behavior to avoid areas of high suspended sediment concentrations levels immediately following dam removal, thereby reducing the impact of reduced water quality on their populations. This is consistent with ecological and evolutionary theories that predict that fish evolve behaviors to avoid episodic events resulting is poor water quality, such as landslides, fires, and other naturally occurring processes.

The approach presented in the 2012 EIS/R to determine the anticipated effects assumed that fish would not exhibit any of these behavioral responses and instead suffer mortality by voluntarily remaining in areas that had lethal concentrations of suspended sediment for extended periods of time.

Effects to fall Chinook salmon are muted by the fact that any cohort is made up of several age classes of spawners. Grilse and adult returns the year following dam removal will be comprised of age-2, 3, 4, and 5 fish that will be in the ocean during the Project. Benefits of the Project that are expected to be evident the first year following dam removal include increased mainstem and tributary spawning habitat, reduction in disease-induced mortality, and reduction or elimination of redd-superimposition in spawning areas downstream of Iron Gate Dam (N. Hetrick, USFWS, personal communication, 2017). The improved conditions for fall Chinook salmon following the Project will bolster multiple age classes in the short and long-term, producing larger overall adult run sizes even with the anticipated short-term effects of the Project.

3.3 Measure Summary

The Project is anticipated to have significant short-term effects, but long-term benefits for fall Chinook salmon, coho salmon, winter steelhead, and Pacific lamprey. The 2012 EIS/R AR-1 included installing a weir and trap system on the Klamath River immediately upstream from the Shasta River confluence. The trap was proposed to be operated periodically to trap and haul fish for release into under-seeded tributaries upstream and downstream from Iron Gate Dam. The ATWG highlighted several concerns associated with the 2012 EIS/R AR-1, including trapping feasibility, handling mortality, potential genetic and disease effects of relocated fish on wild populations, disruption of adult coho salmon migration to spawning tributaries, and uncertainty of anticipated effects of the Project on adult salmonids and Pacific lamprey. The ATWG stated

that these concerns could result in the 2012 EIS/R AR-1 being ineffective at reducing the Project's impacts and potentially introducing additional risks to adult anadromous salmonids and Pacific lamprey populations. Therefore, the ATWG determined that additional options in the proposed measure are warranted.

The proposed measure includes the development and implementation of a monitoring and adaptive management plan to offset Project effects on mainstem spawning. Proposed actions include a 2-year tributary confluence monitoring effort that begins in January of the drawdown year and addressing sediment and debris obstructions that block volitional passage between the Klamath River and key tributaries. The second action includes a spawning habitat evaluation on the Klamath River and tributaries in the Hydroelectric Reach following reservoir drawdown, or approximately March of the drawdown year. If existing spawning habitat conditions do not meet target metrics in the mainstem Klamath River, then spawning gravel augmentation will be completed. If the existing spawning habitat conditions do not meet target metrics in the key tributaries in the Hydroelectric Reach, then the ATWG will be consulted to identify priority restoration activities to increase tributary spawning habitat availability (e.g., large woody debris placement for gravel retention).

Chapter 4: Juvenile Outmigration

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4. JUVENILE OUTMIGRATION

The objective of the measure is to address project effects on juvenile anadromous fish in the Klamath River downstream from Iron Gate Dam. The 2012 EIS/R AR-2 focused on trapping and hauling juvenile anadromous salmonids and Pacific lamprey from 13 key tributaries prior to juvenile entry into the mainstem Klamath River during the Project. Trapped fish would have been trapped, hauled and released into the Klamath River downstream from the Trinity River confluence where suspended sediment concentrations will be diluted by tributary inputs to sublethal concentrations. The proposed measure, based on the 2012 EIS/R AR-2, includes three actions: (1) sampling and salvaging yearling coho salmon from key locations in the Klamath River from Iron Gate Dam (RM 193.1) to the Trinity River confluence (RM 43.4) and relocating captured fish to constructed off-channel ponds prior to reservoir drawdown; (2) monitoring and ensuring tributary-mainstem connectivity; and (3) monitoring juvenile salmonids and water quality conditions at the 13 key tributaries, and salvaging and relocating juvenile salmonids if water quality thresholds are exceeded. The proposed actions are the best opportunities based on available science to offset the effects of reservoir drawdown on juvenile anadromous fish.

4.1 Proposed Measure

Based on a review of the 2012 EIS/R AR-2 presented in Section 4.2, input from the ATWG, and recent fisheries literature, the KRRC concluded AR-2 should be modified to offset the anticipated short-term effects of the Project on outmigrating juvenile fish. The proposed measure includes three actions targeting juvenile salmonids.

- **Action 1:** KRRC will sample and salvage overwintering juvenile coho salmon from the Klamath River between Iron Gate Dam (RM 193.1) and the Trinity River (RM 43.4) confluence prior to reservoir drawdown. Sampling and salvage sites will focus primarily on alcoves, side channels, and backwatered floodplain features adjacent to the mainstem Klamath River. Up to 500 juvenile coho salmon are anticipated to be caught and relocated to off-channel ponds in order to protect this small, but important life history strategy in ESA-listed coho salmon population.
- **Action 2:** KRRC, with input from the ATWG, will prepare a monitoring and adaptive management plan to monitor tributary-mainstem connectivity. Beginning in January of the drawdown year and continuing for 2 years, tributary-mainstem confluences, including four sites in the Hydroelectric Reach and five sites in the 8-mile reach from Iron Gate Dam (RM 193.1) to Cottonwood Creek (RM 185.1), will be monitored with a variable frequency based on the season and year (see Table 4-1 for proposed schedule). Additionally, any 5-year flow event of 10,895 cfs or greater on the Klamath River recorded at the USGS Klamath River Below Iron Gate Dam CA gage (#11516530) within the first two years following reservoir drawdown, will trigger a monitoring effort. If KRRC identifies tributary confluence blockages during monitoring, KRRC will employ necessary means to remove the obstructions to ensure volitional passage for juvenile Chinook salmon, coho salmon, steelhead, and Pacific lamprey. Juvenile salmonids are expected to benefit from the Project because it will restore

access to at least 13.9 miles of key tributary rearing habitats in the Hydroelectric Reach and several recognized thermal refugia areas including Jenny and Fall creeks.

- Action 3: KRRC will prepare and implement a monitoring and adaptive management plan that will include detailed information related to monitoring juvenile salmonids and water quality conditions in 13 key tributary confluences between Iron Gate Dam (RM 193.1) and the Trinity River (RM 43.4). Tributary water temperatures and mainstem suspended sediment concentrations will be monitored by KRRC from March 1 to July 1 of the drawdown year. If water quality triggers are exceeded, KRRC and the ATWG will convene to evaluate the data and determine if juvenile salmonids will be salvaged from the tributary confluences and relocated to cool water tributaries, existing off-channel ponds, and/or to the Klamath River downstream from the Trinity River confluence.

The proposed actions are intended to reduce project effects on juvenile salmonids and Pacific lamprey during reservoir drawdown. The following sections provide additional detail on the proposed actions.

4.1.1 Action 1: Mainstem Salvage of Overwintering Juvenile Salmonids

The following sections provide information pertaining to mainstem salvage of overwintering juvenile salmonids, particularly yearling coho salmon.

Reconnaissance

KRRC will sample up to 15 sites between Iron Gate Dam (RM 193.1) and the Trinity River (RM 43.4) during December one year prior to the start of reservoir drawdown to determine the presence and relative abundance of yearling coho salmon. While low numbers of yearling coho salmon (<500) are expected to be encountered, these fish will be particularly vulnerable to the effects of elevated suspended sediment concentrations from reservoir drawdown and represent a small, but important life history strategy in the ESA-listed coho salmon population (T. Soto, Karuk Tribe, personal communication, 2017). Juvenile coho salmon overwintering downstream of the Trinity River will not be targeted for sampling or salvage efforts as water quality conditions associated with the reservoir drawdown period are expected to be similar to existing conditions (USBR and CDFG 2012). Sites upstream of the Trinity River that will be sampled include alcoves, side channels, and backwatered floodplain areas that do not have sufficient tributary inflows to provide refuge from expected high SSC in the mainstem Klamath River during reservoir drawdown. Priority will be given to sites closer to Iron Gate Dam where SSC are expected to be highest. Final site selection for the reconnaissance effort will be determined in consultation with ATWG.

Overwintering Juvenile Salmonids Salvage and Relocation

Following KRRC's reconnaissance effort, an overwintering yearling coho salmon relocation effort will be conducted by KRRC in December prior to reservoir drawdown. KRRC salvage efforts will take place as close to scheduled drawdown as possible to avoid capturing coho salmon that are migrating to overwintering habitats located in tributary streams or in the lower Klamath River below the Trinity River confluence. The number of sites will be based on the results of the 2019 reconnaissance effort although it is anticipated that up to 15 sites will be seined and trapped. A two-day effort with a 4-person crew and transport truck is

anticipated at each site. A minimum of two weeks will be allocated to the salvage and relocation effort. The expected total catch of overwintering juvenile coho salmon in mainstem and off-channel habitats of the Klamath River is expected to be less than 500 individuals based on previous sampling efforts conducted by the Yurok Tribe and Karuk Tribe (Hillemeier et al. 2009). Seined and trapped juvenile coho salmon would be transported to existing off-channel ponds located on Seiad Creek (RM 131.9), West Grider Creek (RM 131.8), Horse Creek/ Middle Creek (RM 116.0), Stanshaw Creek (RM 77.1), and Camp Creek (RM 57.4) or other natural beaver ponds or floodplain channels that are located in close proximity to the salvage sites and that are unaffected by elevated SSCs in the mainstem Klamath River. Coho salmon will be relocated to the off-channel habitat located closest to the salvage site and will be transported by using aerated buckets with lids or by transport truck if necessary. Other native fish captured during the seining and trapping effort, such as juvenile steelhead and juvenile Chinook salmon will be relocated into tributary streams adjacent to the salvage locations. Fish relocated to off-channel ponds will be allowed to volitionally move between ponds and tributary streams. Final relocation sites will be identified after the completion of the reconnaissance effort and in consultation with the ATWG.

4.1.2 Action 2: Tributary-Mainstem Connectivity Monitoring

The following sections provide information on KRRC's monitoring and adaptive management plan pertaining to tributary-mainstem connectivity.

Tributary-Mainstem Connectivity Monitoring

To ensure that rearing habitat is accessible following reservoir drawdown, KRRC will complete fish passage monitoring and adaptive actions at the confluence areas of key Klamath River tributaries and side channels upstream and downstream of Iron Gate Dam for a 2-year period beginning with reservoir drawdown (see Table 4-1 for proposed schedule). Tributary confluences in the Hydroelectric Reach may be affected by sediment deposits and debris obstructions as the reservoirs are drawn down. Tributary deltas may create fish passage barriers that will limit upstream migration of anadromous salmonids and Pacific lamprey.

Based on hydraulic and sediment transport modeling completed by USBR (Section 9.2.1.4; 2011), sediment deposition during reservoir drawdown is predicted from Bogus Creek (RM 192.6) downstream to Cottonwood Creek (RM 185.1). From Bogus Creek (RM 192.6) downstream to Willow Creek (RM 188.0), approximately 1.5 feet of sediment deposition is anticipated. From Willow Creek downstream to Cottonwood Creek, deposition of less than 1 foot is expected. Areas downstream of Cottonwood Creek are expected to have only minor deposition with deposits less than 0.25 feet (USBR 2011). No additional deposition is predicted in the Bogus Creek to Cottonwood Creek reach following the Project.

Species that will be potentially affected by obstructed tributary connections include outmigrating Chinook salmon, coho salmon, steelhead and Pacific lamprey during and following reservoir drawdown. Further, depending on erosion rates of reservoir sediments, tributary confluences in the reservoir areas may not meet fish passage conditions following drawdown.

Tributary confluences to be monitored in the 2-year period following reservoir drawdown include Bogus Creek (RM 192.6), Dry Creek (RM 190.9), Little Bogus Creek (RM 189.8), Willow Creek (RM 188.0), and Cottonwood Creek (185.1). Tributaries in the Bogus Creek to Cottonwood Creek reach were selected as they are recognized as influential tributaries (e.g., historical fisheries importance or important freshwater sources) in the mid-Klamath River (Soto et al. 2008). Hydroelectric Reach tributaries to be monitored include Spencer Creek (RM 233.4), Shovel Creek (RM 212.0), Fall Creek (RM 198.9), and Jenny Creek (RM 197.4). These tributaries were selected based on having historical or potential habitat for adult salmonids (Huntington 2006).

Tributary confluences will be monitored according to the schedule presented in Table 4-1. If present, confluence obstructions will be actively removed by KRRC during the 2-year evaluation period to ensure volitional passage for juvenile Chinook salmon, coho salmon, steelhead, and Pacific lamprey. In addition to the monitoring effort outlined in Table 4.1, the tributary confluences will also be monitored by KRRC after any flow that is greater than a 5-year flow event that occurs during the first two years following reservoir drawdown.

Table 4-1 Outmigrating Juveniles Measure monitoring frequency for tributaries in the Hydroelectric Reach and Iron Gate Dam (IGD) to Cottonwood Creek reach for the drawdown year and post-drawdown year.

Monitoring Reach	Monitoring Period	Monitoring Frequency
Hydroelectric Reach 4 tributaries	Drawdown Year (2021-2022)	
	April 1 – June 30	Bi-weekly
	July 1 – September 30	Monthly
	October 1 – December 31	Weekly
	2nd Year (2022-2023)	
	January 1 – March 31	Weekly
	April 1 – June 30	Bi-weekly
	July 1 – September 30	Monthly
	October 1 – December 31	Bi-weekly
IGD to Cottonwood Creek 5 tributaries	Drawdown Year (2021-2022)	
	January 1 – March 31	Weekly
	April 1 – June 30	Bi-weekly
	July 1 – September 30	Monthly
	October 1 – December 31	Weekly
	2nd Year (2022-2023)	
	January 1 – March 31	Weekly
	April 1 – June 30	Bi-weekly
	July 1 – September 30	Monthly
	October 1 – December 31	Bi-weekly

Tributary Connectivity Maintenance

KRRC will monitor tributary confluences in both reaches at variable frequencies depending on the season and time period (see Table 4-1). Project-related tributary obstructions that limit fish passage will be remedied by KRRC through appropriate manual or mechanical means necessary to address obstructions. Example removal methods may include removing sediment using hand tools or hydraulic equipment. Removed gravels and large woody debris will be placed in the Klamath River downstream of the tributary confluence. Removed fine sediments will be placed on the adjacent floodplain or outhauled for disposal. The removal effort will be to the extent necessary to ensure volitional passage for adult and juvenile Chinook salmon, coho salmon, steelhead, and Pacific lamprey.

4.1.3 Action 3: Rescue and Relocation of Juvenile Salmonids and Pacific Lamprey from Tributary Confluence Areas

The following sections provide information on the monitoring and adaptive management plan pertaining to salvage and relocation of juvenile salmonids and lamprey ammocoetes from tributary confluence areas.

Tributary and Mainstem Water Monitoring and Juvenile Fish Salvage

KRRC will develop a monitoring and adaptive management plan that will include monitoring juvenile salmonids and water quality conditions in 13 key tributary confluences between Iron Gate Dam (RM 193.1) and the Trinity River confluence (RM 43.4). Tributaries to be monitored include Bogus Creek (RM 192.6), Dry Creek (RM 190.9), Cottonwood Creek (RM 185.1), Shasta River (RM 179.3), Humbug Creek (RM 173.9), Beaver Creek (RM 163.3), Horse Creek (RM 149.5), Scott River (RM 145.1), Tom Martin Creek (RM 144.6), O'Neil Creek (RM 139.1), Walker Creek (RM 135.2), Grider Creek (RM 132.1), and Seiad Creek (RM 131.9).

Water temperatures in tributary streams will be monitored between March 1 and July 1 of the drawdown year. SSC will be measured continuously following drawdown at water quality stations throughout the mainstem Klamath River including Iron Gate Dam, Seiad Valley, and Orleans. A standing weekly call with the ATWG will be established beginning in January of the year of reservoir drawdown. On a weekly basis, the ATWG will evaluate current water quality conditions in the Klamath River downstream of Iron Gate Dam and tributaries, recent observations of fish behavior from agency and tribal biologists and technicians, and upcoming hydrologic and meteorological forecasts. If key tributary water temperatures reach 17 °C (7-day average of the daily maximum values) and Klamath River SSCs remain elevated above 1,000 mg/L, or if observed behaviors of juvenile salmonids inhabiting tributary confluences necessitate salvage, the ATWG will convene to organize the logistics for juvenile salvage and relocation efforts. The ATWG may also deem that a salvage effort is necessary based on the presence of large numbers of juvenile salmonids at tributary confluence areas if observations of fish behavior indicate that stress coupled with forecasted conditions are likely to lead to high mortality of juvenile fish.

The salvage effort will include capturing fish from confluence areas, loading them to aerated transport trucks, and relocating them to cool water tributaries or off-channel ponds including, but not limited to the Seiad Creek complex (RM 131.9). The Seiad Creek complex includes constructed off-channel ponds and connected cool water tributary channels. The complex provides juvenile salmonids with a variety of habitats that they can choose to use. If the number of salvaged fish exceeds the capacity of the Seiad Creek complex, juvenile salmonids may also be relocated to Beaver Creek (RM 163.3), Cade Creek (RM 110.9), Elk Creek (RM 107.2), Tom Martin Creek (RM 144.6), and Sandy Bar Creek (RM 77.8) as well as constructed off-channel ponds located on West Grider Creek (RM 131.8), Camp Creek (RM 57.4), and Stanshaw Creek (RM 77.1). Juvenile Chinook salmon, steelhead, and Pacific lamprey ammocoetes may be transported to the mainstem Klamath River below the confluence of the Trinity River if suitable tributary habitat is unavailable closer to the salvage sites, or if the estimated carrying capacity of those tributary sites has been reached. A multi-day salvage effort will be conducted at the confluence of the Shasta and Scott rivers and single day salvage efforts will be conducted at other tributary confluence areas by a 4-person crew and 2 transport trucks during the March 1 to July 1 monitoring period. Multiple salvage and transport days may be necessary at the Shasta and Scott River confluences based on juvenile salmonid abundance in the two tributaries.

4.2 Summary of the Affected Species, Project Benefits and Effects, Recent Fisheries Literature, the 2012 EIS/R AR-2, and the Proposed Measure

The following sections review the components of the 2012 EIS/R AR-2, anticipated project effects and benefits on measure species, and recent fisheries literature relative to juvenile salmonid outmigration. This information is presented in support of the proposed measure.

4.2.1 Affected Species

Species identified in the measure include:

- Coho salmon *(Oncorhynchus kisutch)* – Southern Oregon/Northern California Coastal (SONCC) evolutionary significant unit (ESU): Federally Threatened; California Threatened; Tribal Trust Species
- Chinook salmon *(O. tshawytscha)* – Upper Klamath-Trinity Rivers ESU - Fall Run: California Species of Special Concern; Tribal Trust Species
- Chinook salmon *(O. tshawytscha)* – Upper Klamath-Trinity Rivers ESU – Spring Run: California Species of Special Concern; Tribal Trust Species
- Steelhead *(O. mykiss)* – Klamath Mountains Province distinct population segment (DPS) – Summer Run: California Species of Special Concern; Tribal Trust Species
- Steelhead *(O. mykiss)* – Klamath Mountains Province DPS – Winter Run: Tribal Trust Species
- Pacific lamprey *(Entosphenus tridentatus)* - California Species of Special Concern; Tribal Trust Species

4.2.2 Anticipated Project Effects on Measure Species

Short-term effects of the Project are expected to result in mostly sublethal, and in some cases lethal, impacts to a portion of the juvenile Chinook salmon, coho salmon, steelhead, and Pacific lamprey that are outmigrating from tributary streams to the Klamath River during late winter and early spring of the drawdown year. Deleterious short-term effects are expected to be caused by high suspended sediment concentrations and low dissolved oxygen levels in the Klamath River from Iron Gate Dam (RM 193.1) downstream to Orleans (RM 59.0). Under the worst-case scenario, lost juvenile production in the Upper Klamath River, Middle Klamath River, Shasta River, and Scott River, includes the loss of up to: 669 fall Chinook salmon smolts, 6,536 coho smolts, 11,207 age-1 steelhead, 9,412 age-2 steelhead (USBR and CDFG 2012). Table 4-2 includes the 2012 EIS/R analysis of the likely and worst-case effects to anadromous outmigrating juveniles downstream from Iron Gate Dam.

Table 4-2 2012 EIS/R anticipated effects summary for outmigrating juvenile salmonids and Pacific lamprey ammocoetes

Species	Life Stage	Likely Effects	Worst Effects
Coho Salmon	Outmigrating Smolts	Loss of 2,668 (3%)	Loss of 6,536 (8%)
Chinook Salmon - Fall	Type III Smolts	Loss of 0-189 (<0.02%)	Loss of 0-669 (<0.07%)
Steelhead	Age-1+ Rearing[1]	Loss of up to 8,200 (14%)	Loss of up to 11,207 (19%)
	Age-2+ Rearing	Loss of up to 6,893 (13%)	Loss of up to 9,412 (18%)
Pacific Lamprey	Ammocoetes	High mortality (52%)[2]	High mortality (71%)[2]

Source: USBR and CDFG 2012

[1] Under existing conditions there is 20 percent mortality predicted for Age-1+ rearing.
[2]The 2012 EIS/R predicted Pacific lamprey mortality based on mortality models developed for suspended sediment impacts to salmonids. Model output did not include the number of predicted Pacific lamprey mortalities.

The following sections include descriptions of species-specific effects as analyzed in the 2012 EIS/R (USBR and CDFG 2012; Vol. I, pp. 3.3-129 to 3.3-168).

Coho Salmon

The wide distribution and use of tributaries by both juvenile and adult coho salmon will likely protect the population from the worst effects of the Project. However, direct mortality is anticipated for redds and smolts from the upper Klamath River, mid-Klamath River, Shasta River, and Scott River population units. No mortality is anticipated for the Salmon River, Trinity River, and Lower Klamath River populations under the most likely or worst-case scenarios. Based on substantial reduction in the abundance of a year class in the short-term, the effect of the Project was found to be significant for the coho salmon from the Upper Klamath River, Mid-Klamath River, Shasta River, and Scott River population units.

Age-1 juveniles that have either successfully over-summered or moved from tributaries into the mainstem in fall could be exposed to much higher suspended sediment concentrations in the mainstem during the winter of facility removal than under existing conditions, and may suffer mortality rates of up to 52 percent under a worst-case scenario (USBR and CDFG 2012). However, many juveniles in the mainstem Klamath River appear to migrate to the lower river to rear and may avoid adverse conditions in the mainstem by using tributary or off-channel habitats during winter, thus reducing their exposure and potential mortality (Hillemeier et al. 2009; Soto et al. 2009), consistent with the observation that juvenile salmonids avoid turbid conditions (Sigler et al. 1984; Servizi and Martens 1992). This strategy may be even more pronounced under elevated suspended sediment concentrations expected as a result of the Project. Overall, it is not known how many juveniles rear in the mainstem during winter, but it is assumed to be a small (<1 percent) proportion of any of the coho salmon populations (USBR and CDFG 2012).

Coho salmon smolts from the cohort prior to reservoir drawdown are expected to outmigrate to the ocean beginning in late February, although the majority of coho smolts typically outmigrate to the mainstem Klamath during April and May (Wallace 2004). During migrant trapping studies from 1997 to 2006 in tributaries upstream of and including Seiad Creek (Horse Creek, Seiad Creek, Shasta River, and Scott River), 44 percent of coho smolts were captured from February 15 to March 31, and 56 percent from April 1 through the end of June (Courter et al. 2008).

Smolts outmigrating from the tributaries described above prior to April 1, are likely to suffer up to 60 percent mortality under the 2012 EIS/R worst-case scenario (USBR and CDFG 2012). Based on modeled population estimates presented in Courter et al. (2008), the anticipated 60 percent mortality would represent a loss of up to 6,536 smolts from the Upper Klamath River, Shasta River, Scott River, and Middle-Klamath River coho populations.

Smolts outmigrating after April 1 would be exposed to lower suspended sediment concentrations and may experience only slightly worse physiological stress and reduced growth rates compared with existing conditions, even under the worst-case scenario (USBR and CDFG 2012).

Chinook Salmon – Fall Run

Fall Chinook salmon use the mainstem Klamath River for spawning, rearing, and as a migratory corridor. Effects of suspended sediment concentrations on juvenile fall Chinook salmon from the Project are expected to be relatively minor because of varied life histories. During juvenile salmonid outmigration trapping conducted at Big Bar (RM 49.7) on the Klamath River between 1997-2000, very few Chinook were captured outmigrating through the lower river before the beginning of June (USFWS 2001). The large majority of age-0 juveniles (Type I outmigrants) remain in tributaries until later in the spring and summer when water quality conditions are expected to be improved relative to late winter and early spring. Type II outmigrants typically rear in tributaries before outmigrating to the mainstem Klamath River and estuary in fall (Sullivan 1989). Additionally, many of the fry that outmigrate to the Klamath River originate in tributaries in the mid or lower Klamath River, where suspended sediment concentrations resulting from the Project are expected to be lower due to dilution from tributaries (USBR and CDFG 2012). Based on trapping data from Big Bar,

approximately 63 percent of Chinook smolts are Type I outmigrants and 37 percent are Type II outmigrants (USFWS 2001).

A small proportion of juvenile Chinook salmon typically remain to rear in the spawning tributaries until outmigrating in late winter and early spring as yearlings (Type III outmigrants). Although fish exhibiting this life history trait would be most susceptible to the effects of suspended sediment concentrations, these fish represent a very small proportion (<1 percent of all production) of the Klamath River fall Chinook salmon population (USFWS 2001). Based on outmigrant trapping in the mainstem Klamath River at Big Bar, only 31 Type III outmigrating smolts were captured over 4 years, representing approximately 0.1 percent of the total catch. Based on yearly abundance estimates, this equates to approximately 943 total Type III smolts per year (USFWS 2001). Under the 2012 EIS/R worst-case scenario, mortality rates of up 71 percent are predicted during the Project, equating to 669 smolts, or approximately 0.07 percent of the total fall Chinook salmon smolt production. Type I and Type II juvenile outmigrants are expected to experience only sublethal effects (USBR and CDFG 2012).

Steelhead – Summer and Winter

Juvenile steelhead rear in the mainstem Klamath River, Klamath River tributaries, and the estuary. Since most (>90 percent) juvenile steelhead smolt at age-2, those juveniles leaving tributaries to rear in the mainstem will be exposed to elevated suspended sediment concentrations resulting from the Project through both winter and spring (USBR and CDFG 2012). Based on captures in tributaries and the mainstem, approximately 40 percent of the population rears in tributaries until age-2 (USFWS 2001) and will only be susceptible to mainstem water quality conditions during outmigration. The approximately 60 percent of the rearing population that outmigrates from tributaries as age-0 or age-1 fish, and rears for extended periods in the mainstem upstream of Trinity River, would likely be exposed to much higher suspended sediment concentrations than under existing conditions, with mortality rates up to 100 percent under the worst-case scenario (USBR and CDFG 2012).

Despite these anticipated mortality rates, the broad spatial distribution of steelhead in the Klamath Basin and their flexible life histories suggest that some steelhead will avoid the most serious effects of the Project by remaining in tributaries for extended rearing, rearing farther downstream where suspended sediment concentrations is expected to be lower due to tributary dilution, and/or moving out of the mainstem into tributaries and off-channel habitats to avoid periods of high suspended sediment concentrations. From past studies, many of these juveniles avoid conditions in the mainstem by using tributary and off-channel habitats during winter, which would reduce their exposure to poor water quality during the Project (Hillemeier et al. 2009; Soto et al. 2009), consistent with the observation that juvenile salmonids avoid turbid conditions (Sigler et al. 1984; Servizi and Martens 1992). Most smolts outmigrate in the fall, so many juveniles should already be in the estuary or ocean when initial pulses in sediment occur after December 31 prior to reservoir drawdown, or they may migrate out of the mainstem later in the winter after suspended sediment concentrations decrease.

Life history variability observed in steelhead means that, although numerous year classes will be affected, not all individuals in any given year class will be exposed to project effects. Some portion of the progeny of

those adults that spawn successfully in winter and spring of the reservoir drawdown year would also rear in tributaries long enough to not only avoid the highest suspended sediment concentrations but may also not return to spawn for up to 2 years, when suspended sediment resulting from the Project should be greatly reduced. The high incidence of repeat spawning among summer steelhead, ranging from 40 to 64 percent (Hopelain 1998), should also increase that population's resilience to project effects.

Pacific Lamprey

The Project would likely have short-term effects on Pacific lamprey related to suspended sediment concentrations, bedload sediment transport and deposition, and impaired water quality (particularly dissolved oxygen). Overall, because multiple year classes of Pacific lamprey rear in the mainstem Klamath River at any given time, and since adults will migrate upstream over the entire year, including January of the reservoir drawdown year when effects from the Project will be most pronounced, effects on Pacific lamprey adults and ammocoetes are anticipated to be substantial. However, because of their wide spatial distribution and varied life history, most of the population, (which is distributed from at least California along the Pacific Rim to Japan [Goodman and Reid 2012]), would not be affected by the Project. Effects of suspended sediment on lamprey ammocoetes are not well understood and for the 2012 EIS/R analysis were based on using the same anticipated effects for juvenile salmonids. This likely overestimates any effects to lamprey ammocoetes since their preferred rearing strategy is to burrow in fine sediments mixed with organic matter. While some of the actions listed in the proposed measure below have the potential to benefit Pacific lamprey ammocoetes, (i.e., tributary connectivity and habitat restoration) no specific actions have been developed to specifically target Pacific lamprey for relocation from the areas affected by bedload or high suspended sediment concentrations. Additional discussion of Pacific lamprey ammocoetes effects is provided in Pacific Lamprey Ammocoetes.

4.2.3 2012 EIS/R AR-2

The 2012 EIS/R AR-2 (2012 EIS/R, Vol. I, pp 3.3-243 to 3.3-245) included water quality monitoring to evaluate Klamath River suspended sediment concentrations. If pre-determined water quality thresholds were triggered, a network of 17 screw traps located on 13 key tributaries would have been operated to capture downstream migrants prior to their entry into the mainstem Klamath River. Captured juveniles would have been transported and released at sites downstream of the Trinity River or other locations with suitable water quality.

4.2.4 KRRC and the ATWG's Review of AR-2 for Feasibility and Appropriateness

KRRC and the ATWG assessed the feasibility and appropriateness of the 2012 EIS/R AR-2 through multiple planning meetings held between May and August 2017. During these meetings, new information on Klamath River fisheries was presented and information on other dam removal projects conducted in the western United States was reviewed to understand how the aquatic ecosystem might respond as discuss above. Major concerns discussed by KRRC and the ATWG regarding the 2012 AR-2 included:

- Trapping feasibility and efficiency.

- Potential mortality associated with trapping, handling, hauling, and releasing juvenile salmonids.
- Potential imprinting and straying issues.
- 2012 EIS/R baseline population estimates and effects uncertainty.

The following sections provide additional information regarding 2012 EIS/R AR-2 feasibility and appropriateness based on fisheries literature and ATWG input.

Trapping Feasibility and Efficiency

A wet winter season, such as experienced between January and May 2017, could prevent the installation and operation of rotary screw traps in any of the prospective tributaries due to persistent high flows. Additionally, capture efficiencies for juvenile salmonids in rotary screw traps is highly variable and depends on many factors such as stream width, depth, flow conditions, and time of day of operation. Capture efficiencies of juvenile salmonids using rotary screw traps are typically very low, and would result in a small proportion of the downstream migrants being captured for relocation and release. For example, trapping efficiencies on various salmonids calculated by the USGS during monitoring efforts for the recent Condit Dam removal on the White Salmon River in Washington State ranged from 0 - 10.6 percent (Allen and Connolly 2011). Trapping efforts for juvenile Chinook salmon on Blue Creek in the Klamath Basin by the Yurok Tribe resulted in trapping efficiencies ranging from 0.5 - 51.3 percent, but trapping efficiencies of greater than 10 percent were not achieved until stream flows dropped in mid-June (Antonetti and Partee 2013). By mid-June, water quality conditions in the Klamath River following dam removal are expected to have returned to background condition and further remediation actions are not expected to be necessary (USBR and CDFG 2012).

KRRC and the ATWG concluded the level of effort, cost, and likely low capture efficiencies do not support the installation of screw traps for capturing outmigrating juvenile fish during the Project. KRRC and the ATWG also concluded the concurrent operation of 17 screw traps during spring high flows is not feasible or safe given potential flow conditions and the remoteness of some tributaries.

Potential Mortality Associated with Trapping, Handling, Hauling, and Releasing Juvenile Salmonids

KRRC and the ATWG concluded that although mortality on juvenile salmonids associated with trap and haul operations are typically low, these numbers are based on a variety of environmental factors and logistical considerations and can be highly variable (Serl and Morrill 2010). Transporting juvenile salmonids causes stress in smolts (Barton et al. 1980; Specker and Schreck 1980; Matthews et al. 1986), which may reduce survival if fish are directly released into natural environments (Kenaston et al 2001). In some cases, the mortality associated with screw trapping, handling, trucking, and releasing may exceed the expected mortality associated with the Project. For instance, under the worst-case scenario, high suspended sediment concentrations and low total DO could result in the direct mortality of up to 669 fall Chinook salmon smolts, less than 1 percent of production (USBR and CDFG 2012). Mortality associated with trapping, handling, transport, and release efforts could potentially result in a similar or greater loss of fall Chinook salmon smolts. The ATWG suggested that outmigrating juvenile fish are well-adapted to avoid lethal sediment

concentrations and will likely employ avoidance behaviors to minimize exposure to lethal suspended sediment concentrations and DO levels. KRRC and the ATWG concluded that large scale efforts aimed at trapping, handling, and releasing juvenile salmonids were likely to cause unnecessary harm to juvenile salmonids.

Potential Imprinting and Straying Issues

KRRC and the ATWG expressed concerns regarding how handling and transport of juvenile salmonids may affect imprinting processes resulting in future straying of returning adults. Juvenile imprinting is influenced by natal stream water chemistry and the juvenile fish's physiological state during rearing and outmigration (Keefer and Caudill 2014). Juvenile fish with extended freshwater residency times, or long-distance migrations, almost certainly experience multiple imprinting events that contribute to homing success of adult spawners. Transporting juvenile fish has been shown to disrupt this 'sequential imprinting' process, and several studies on coho salmon (Solazzi et al. 1991) and Atlantic salmon (Gunnerød et al. 1988; Heggberget et al. 1991) have shown that adult homing success is inversely related to transport distance from rearing sites (Keefer and Caudill 2014).

Therefore, the capture, transport, and release of juvenile fish downstream of the Trinity River could compromise the imprinting process for relocated juvenile fish. Insufficient imprinting to natal streams or the loss of spatially distinct imprinting events during outmigration could potentially increase adult straying rates during future returns and result in the loss of genetic integrity in distinct populations. Future, elevated stray rates could result in a more homogenous distribution of fish returning to the lower Klamath River and also hinder the natural recolonization of areas upstream of Iron Gate Dam.

Overall, the ATWG concluded a screw trap-based trapping program as prescribed in the 2012 EIS/R would be a costly, potentially dangerous effort with uncertain benefits. Tributary trapping could also negatively affect juvenile salmonids by disrupting imprinting processes, causing higher mortality than allowing fish to volitionally leave tributaries, and potentially increasing future returning adult stray rates.

The proposed salvage and transport of juvenile salmonids may experience similar imprinting and straying issues as those outlined for the 2012 EIS/R AR-2. However, the proposed measure is anticipated to address a smaller number of juvenile salmonids and the fish that are transported would otherwise likely perish. Given the potential mortality of juvenile fish remaining in adverse water quality conditions in tributary confluences, the lesser risk of elevated stray rates was deemed an acceptable risk by the ATWG.

2012 EIS/R Baseline Population Estimates and Project Effects Uncertainty

Effects to juvenile fish outlined in the 2012 EIS/R included approximations and assumptions that were based on limited data on Klamath River anadromous salmonids and Pacific lamprey populations; incorporated a conservative analysis of fish avoidance behavior to the anticipated water quality conditions; and in part included a worst-case scenario analysis of project effects on adult salmonids and Pacific lamprey. The following sections provide updated population information for coho salmon and Pacific lamprey, and project effects uncertainty that should be considered in updating the effects determinations.

Coho Salmon Smolt Population Estimates and Outmigration Timing

KRRC reviewed updated smolt trapping data collected by USFWS and CDFG between 2010 and 2015 on the upper mainstem Klamath River and 2010-2016 on the Scott and Shasta Rivers to determine the typical outmigration timing for age-1+ coho salmon smolts. KRRC also reviewed travel time data to see how quickly juvenile fish typically outmigrate in the spring to avoid long exposure to background suspended sediment concentrations effects.

For rotary screw traps and frame nets operated at the Bogus, I-5, and Kinsman sites on the mainstem Klamath River between 2010 and 2015, 63 percent of age-1+ coho migrated after Julian week 13 (last week in March) (Gough et al. 2015; David et al. 2016; and David et al. 2017). Between 2010 and 2016, 93 percent of age-1+ coho salmon captured by rotary screw trap on the Shasta River outmigrated after the end of March, and on the Scott River, 70 percent of age-1+ coho salmon smolts outmigrated after the end of March during the same time period (Jetter and Chesney 2016). Peak outmigration timing beginning in early April on the Shasta River, typically coincides with decreased flows marked by the start of the irrigation season and is consistent with findings from previous studies (Chesney et al. 2009; Adams 2013; Adams and Bean 2016) from CDFW 2016.

Once in the Klamath River, coho salmon smolts appear to move downstream rather quickly. For example, Wallace (2004) reported that numbers of coho salmon smolts in the Klamath River estuary peaked in May, the same month as peak outmigration from the tributaries (Stillwater Sciences 2010). Radio telemetry studies conducted on wild and hatchery coho salmon smolts in the Klamath River between 2006 and 2009 found a wide variety of travel times for coho salmon smolt outmigrating from Iron Gate Dam to the gaging station near the Klamath River estuary (Beeman et al. 2012). The minimum travel time was 3.77 days and the maximum travel time to reach the estuary was 54.44 days with median values over the 4-year study ranging between 15.11 and 25.93 days. However, the longest residence time for any single reach was from the Iron Gate Dam release site to the Shasta River as tagged fish remained near the release site until they were ready to begin the downstream migration to the Pacific Ocean. Once fish passed the Shasta River, travel times in any individual reach were less than 2 days and coho salmon smolts usually took less than 1 week to fully migrate to the gaging station near the Klamath River estuary (Beeman et al. 2012). Courter (2008) assumed that all fish from a given cohort would migrate to the estuary in 2 weeks, and this assumption is also consistent with travel rates documented by Stutzer et al. (2006). Assuming that juvenile fish outmigrating from tributary streams will either outmigrate rapidly to the Klamath River estuary or will move between clean water tributary areas, it is anticipated that no outmigrating smolts will be exposed to suspended sediment for greater than seven contiguous days.

Minimum travel times presented in Beeman et al. (2012) indicate that juvenile coho salmon could migrate downstream of the highest suspended sediment concentrations effects zone fairly quickly. The 2012 EIS/R analysis assumed coho salmon smolts would be exposed to high suspended sediment concentrations for 20 days during the highest suspended sediment concentrations period (prior to April 1). This assumption resulted in a very high mortality estimate for coho salmon smolts (USBR and CDFG 2012).

Further, because smolt abundance data from all tributaries within the Upper Klamath, Middle Klamath, Salmon River, and Lower Klamath River populations were not available for the 2012 EIS/R analysis, smolt production estimates modeled by Courter et al. (2008) were used to predict the number of smolts emigrating to the Klamath River from each population. Modeled smolt production estimates were based on tributary habitat conditions and smolt production data for other populations. Recent trends in adult returns to tributaries, the Klamath River, and Iron Gate Hatchery indicate that coho salmon populations continue to decline, and that these modeled estimates are likely higher than current actual population sizes.

In a study of juvenile coho salmon use of thermal refugia along the Klamath River, juvenile coho began to enter thermal refugia as water temperature reached 19°C, numbers of coho salmon present increased up to about 22°C to 23°C, and then declined dramatically as temperatures exceeded 23°C (Sutton and Soto 2012). These results suggest that 23°C is the upper thermal tolerance limit, with either lethal effects to juvenile coho salmon or temperature- related stress.

By updating the current understanding of coho salmon population estimates and typical juvenile coho salmon outmigration timing from Klamath River, Shasta River, and Scott River coho salmon populations, and by adjusting the potential duration of exposure to reflect typical downstream migration rates, anticipated effects to age-1+ coho salmon smolts may result in substantially lower coho salmon smolt mortality estimates, and in most cases, only result in sub-lethal effects.

Pacific Lamprey Population Update

Recent genetic analysis of Pacific lamprey suggests no significant population structure exists across populations or regions, indicating a high degree of historical gene flow even across expansive distances of the northern Pacific Rim (Goodman and Reid 2012). Weak population structure and low site fidelity may reduce the short-term effects to Pacific lamprey identified in the 2012 EIS/R. Because the metapopulation is now believed to be relatively undifferentiated across the species' range, the percentage of adult and larval Pacific lamprey that will be affected by the Project relative to the population as a whole will be insignificant.

Project Effects Uncertainty

Studies suggest that high suspended sediment concentrations (Newcombe and Jensen 1996; Chapman et al. 2014; Kjelland et al. 2015) and low dissolved oxygen concentrations (Bjorn and Reiser 1991; Washington Department of Ecology 2002; Carter 2005) affect salmonid behavior. Juvenile salmonid response to high suspended sediment concentrations includes behavioral changes such as avoidance of turbid waters, and physiological responses such as stress and respiratory impairment, damage to gills, reduced tolerance to disease and toxicants, reduced survival, and direct mortality (Newcombe and Jensen 1996). Concentration and duration of elevated suspended sediment, as well as other factors including water temperature, disease, and river flow, influence the effect of sediment on salmonids.

The effects of low dissolved oxygen levels, eutrophication, or turbidity on natural populations of Pacific lamprey ammocoetes are unknown. Juvenile salmonids and juvenile Pacific lamprey emigrating from tributaries to the Klamath River that encounter poor water conditions are expected to avoid poor water

quality by either remaining in tributary streams or using habitats less affected by high suspended sediment concentrations (e.g., tributary confluences and off-channel areas). Many juveniles in the mainstem Klamath River appear to migrate to the lower river to rear and may avoid adverse conditions in the mainstem by using tributary or off-channel habitats during winter, thus reducing their exposure and potential mortality (Hillemeier et al. 2009; Soto et al. 2009), consistent with the observation that juvenile salmonids avoid turbid conditions (Sigler et al. 1984; Servizi and Martens 1992).

The approach presented in the 2012 EIS/R to determine the anticipated effects to outmigrating juveniles assumed that fish would not exhibit any of these behavioral responses and instead suffer mortality by voluntarily remaining in areas that had lethal suspended sediment concentrations for extended periods of time.

4.3 Additional Information Related to Suspended Sediment Concentration Effects on Outmigrating Juvenile Salmonids

4.3.1 Introduction

The following additional information is on the effects of suspended sediment concentrations on outmigrating juvenile salmonids, which is intended to be addressed through implementation of the proposed measure. This information includes a review of recent juvenile salmonid outmigration data for the Klamath River and select tributaries, comparing outmigration periods to anticipated suspended sediment concentrations from USBR sediment modeling, and assessing potential juvenile salmonid avoidance behaviors related to high suspended sediment concentrations.

Results of KRRC's additional analysis suggest juvenile Chinook salmon, coho salmon, and steelhead generally outmigrate from tributaries to the Klamath River after peak suspended sediment concentrations are anticipated to occur. However, early outmigrating juvenile Chinook salmon and coho salmon from the Shasta River and Scott River are most susceptible to anticipated suspended sediment concentrations associated with reservoir drawdown. Fish may reduce their exposure to high suspended sediment levels by seeking clear water tributary confluences, entering clear water tributaries and off-channel ponds, and expediting their downstream migration. Measures to further reduce suspended sediment impacts to early outmigrating salmonids include implementing an adaptive monitoring and salvage plan.

4.3.2 Klamath River and Tributaries Updated Screw Trap Data and Suspended Sediment Effects

The following section provides an overview of the screw trap and suspended sediment concentration analysis KRRC completed to assess potential reservoir drawdown effects to outmigrating juvenile salmonids.

Screw Trap Data

Screw trap data provided by USFWS, CDFW, Yurok Tribe, and Karuk Tribe (referenced as "acquiring entity") were reviewed and summarized by KRRC. The screw trap data analysis focused on 2008 to 2015, and provides an updated data set extending the period of record for screw trap data reviewed in preparation of the 2012 EIS/R (Reclamation and CDFG 2012). Screw trap data from the Klamath River and tributaries to the Klamath River (Table 4-3) were reviewed to assess juvenile salmonid outmigration timing and relative abundance. Reported data include both juvenile outmigration population estimates and trap catch numbers. Outmigration estimates were generally provided by the acquiring entities for juvenile fall Chinook salmon due to the sufficient abundance and trap catch of individuals in the mainstem and tributaries. Outmigration estimates are computed by multiplying the number of caught fish by a correction factor that approximates trap efficiency. Compared to trap catch numbers, outmigration estimates are a better representation of the potential number of outmigrating juvenile salmonids from the watershed upstream from the trap location.

Trap catch represents the actual number of fish captured during trap operation. Trap catch numbers do not include a correction for stream flow or trap efficiency so trap catch numbers are a less reliable predictor of outmigration timing and population size. Trap catch is reported for Chinook salmon, coho salmon, and steelhead. Coho salmon and steelhead catches were generally insufficient for calculating outmigration population estimates. Trap catch data are reviewed to provide a relative indication of juvenile salmonid outmigration timing and magnitude, but data are less reliable for predicting juvenile abundance compared to population estimates. Population estimates and trap catch data are reported by Julian Week to improve data comparability over time and to also compare trap data with suspended sediment concentrations. Figure 4-1 includes a map with highlighted trap and water and suspended sediment modeling stations.

Table 4-3 Juvenile outmigration trap information and reporting data for Klamath River and Tributary Traps.

Reach	Trap Location	Trap Type	Acquiring Entity	Reporting Data
Upper Klamath River	Mainstem downstream from Bogus Creek[1] (RM 191.2)	Net frame	USFWS	Chinook (age-0) estimates Coho (age-0 and age-1+) catch Steelhead (age-0 and age-1+) catch
	Shasta River[2] (Confluence at RM 179.3)	RST*	CDFW	Chinook (age-0) estimates Coho (age-0 and age-1+) estimates Steelhead (age-0 and age-1+) estimates
	Mainstem at Kinsman Creek (RM 147.6)[1]	RST	USFWS	Chinook (age-0) estimates Coho (age-0 and age-1+) catch Steelhead (age-0 and age-1+) catch
	Scott River[2] (Confluence at RM 145.1)	RST	CDFW	Chinook (age-0) estimates Coho (age-0 and age-1+) estimates Steelhead (age-0 and age-1+) estimates
Middle Klamath River	Salmon River[3] (Confluence at RM 66.4)	RST	Karuk Tribe	Chinook (age-0+) catch Coho (age-0+) catch Steelhead (age-0+) catch

Reach	Trap Location	Trap Type	Acquiring Entity	Reporting Data
	Trinity River[4] (Confluence at RM 43.4)	RST	USFWS	Chinook (age-0+) catch Coho (age-0+) catch Steelhead (age-0+) catch
Lower Klamath River	Blue Creek[5] (Confluence at RM 16.0)	RST	Yurok Tribe	Chinook (age-0) estimates Coho (age-0 and age-1+) catch Steelhead (age-0 and age-1+) catch

*Rotary screw trap
[1]Gough et al. 2015; [2]Jetter et al. 2016; [3]Karuk Tribe, unpublished data, 2017; [4]Harris et al. 2016; [5]Yurok Tribe, unpublished data, 2017

4.3.3 Suspended Sediment Concentration Analysis

Reclamation provided KRRC with the suspended sediment modeling output summarized in Reclamation's (2011) hydrology, hydraulics, and sediment report. KRRC replicated Reclamation's summary suspended sediment concentration graphs associated with sediment modeling for representative dry (2001), median (1976), and wet (1984) years at the four reporting stations: Iron Gate Dam, Seiad Valley, Orleans, and Klamath (see Figure 4-1 and Figure 4-2). Reservoir drawdowns are planned to begin January 1 of the dam removal year. Suspended sediment concentrations rise to an early to mid-February peak and then decline through the fall. Concentrations are generally highest for dry year scenario with other scenarios having lower relative suspended sediment concentration values (Table 4-4). Suspended sediment concentrations generally decrease in a downstream direction as inflows from clear water tributaries dilute suspended sediment concentrations in the Klamath River.

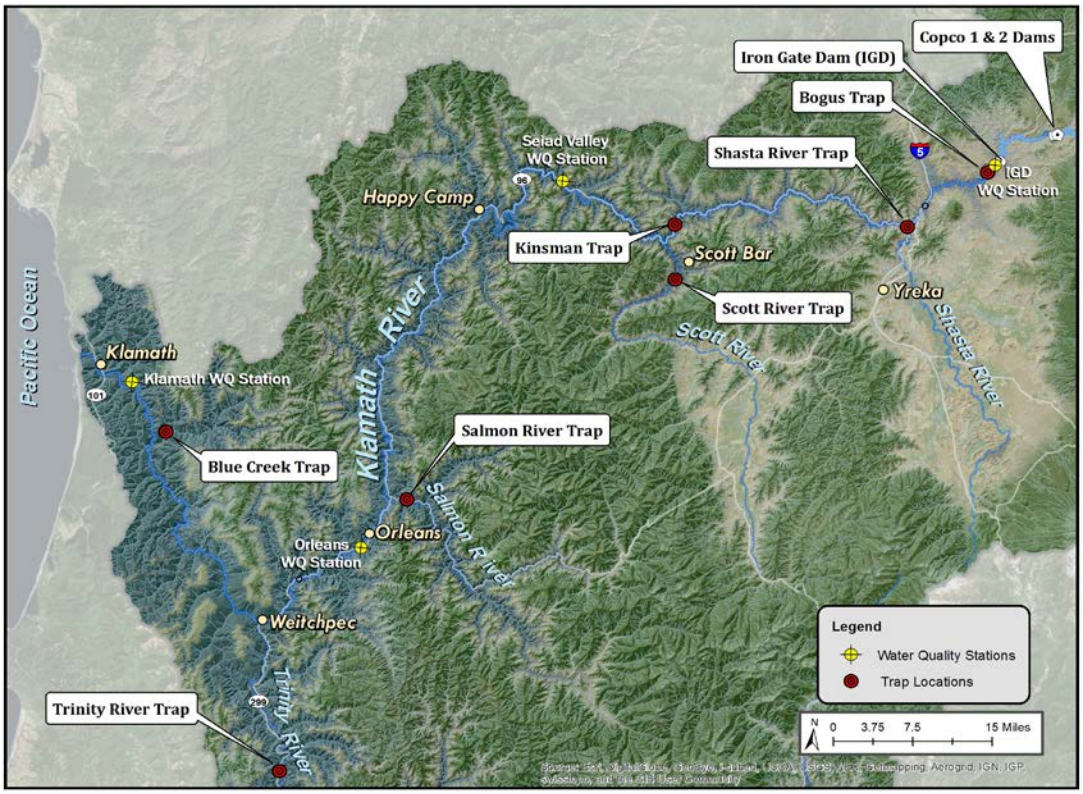


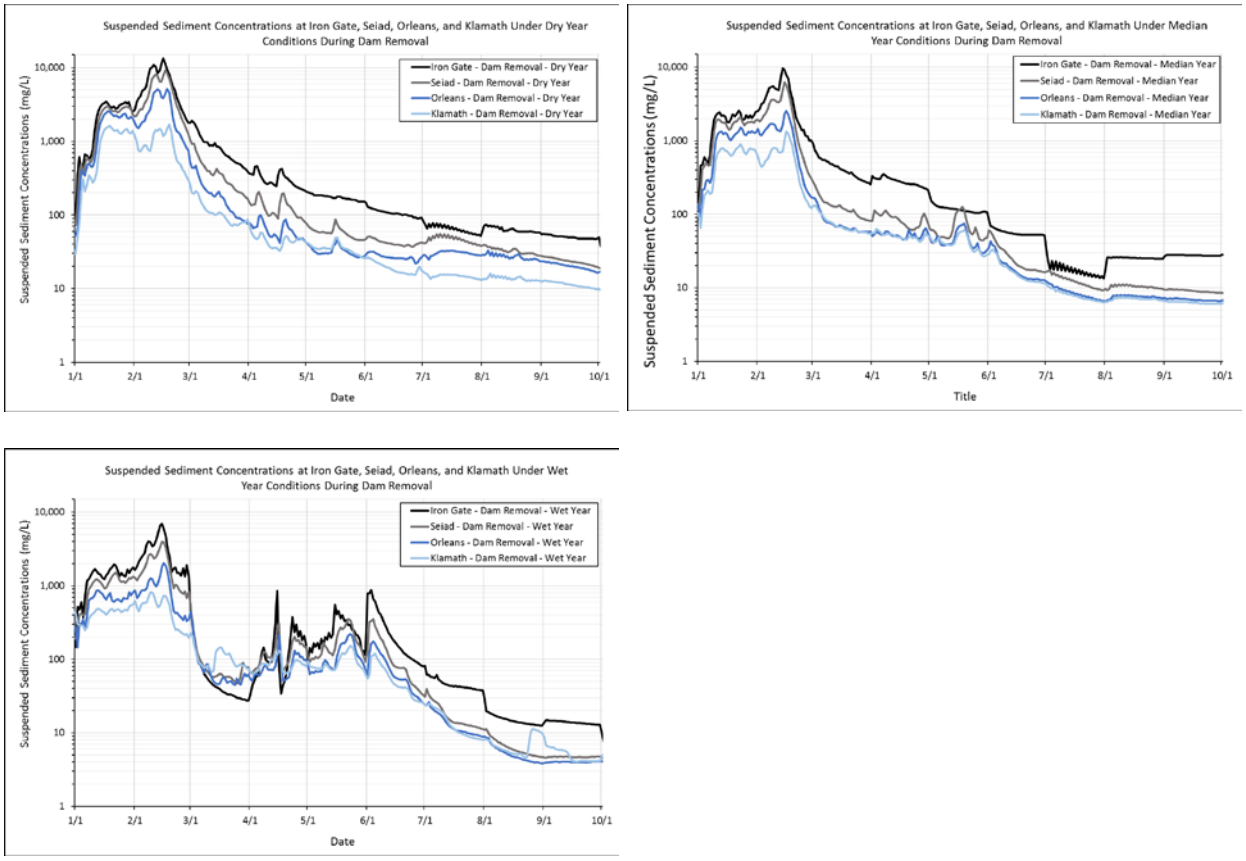
Figure 4-1 Screw trap and suspended sediment modeling stations on the Klamath River.

Juvenile Salmonid Suspended Sediment Exposure

The following sections present information on juvenile salmonid outmigration rates in the Klamath River and suspended sediment exposure effects.

Juvenile Salmonid Outmigration Travel Time

In order to better predict potential effects of elevated suspended sediment concentrations on outmigrating juvenile salmonids, KRRC reviewed past studies and analyzed Klamath River juvenile salmonid outmigration rates and timing. Past Klamath River studies found juvenile salmonid outmigration rates are influenced by tributary and Klamath River water temperatures, smolt growth rates, and other environmental cues.



Modeling output is presented for the Klamath River at Iron Gate, Seiad Valley, Orleans, and Klamath modeling stations. Graphs include dry year (2001, upper left), median year (1976, upper right), and wet year (1984, lower left).

Figure 4-2 Modeled suspended sediment concentrations associated with reservoir drawdown and dam removal.

Table 4-4 Suspended sediment modeling output stations and summary results.

Suspended Sediment Modeling Station	Approximate Location (river mile)	Wet Year / Dry Year Peak SSC (mg/L)	Wet Year / Dry Year Cumulative Days with SSC above 1,000 mg/L	Wet Year / Dry Year Cumulative Days with SSC above 3,000 mg/L
Iron Gate Dam	193.1	6,988 / 13,385	54 / 57	12 / 33
Seiad Valley	131.9	3,999 / 9,223	41 / 50	4 / 19
Orleans	59.0	2,046 / 5,157	11 / 45	0 / 11
Klamath	2.5	819 / 1,670	0 / 28	0 / 0

Note: Suspended sediment concentrations related to juvenile salmonid mortality are also included for reference. A 2-week exposure to 1,000 mg/L concentration is associated with predicted 0-20 percent mortality, and 2-week exposure to 3,000 mg/L is associated with 20-40 percent mortality.

Wallace (2004) reported coho salmon smolts in the Klamath River estuary peaked in May, the same month as peak outmigration from the tributaries (Stillwater Sciences 2010). Radio telemetry studies conducted on wild and hatchery coho salmon smolts in the Klamath River between 2006 and 2009 found a wide range of travel times for coho salmon smolts outmigrating from Iron Gate Dam to the gaging station near the Klamath River estuary (Beeman et al. 2012). The minimum and maximum travel time were 3.8 and 54.4 days, respectively, with median values over the 4-year study ranging between 15.1 and 25.9 days. However, the longest residence time for any single reach was from the Iron Gate Dam release site to the Shasta River as tagged fish remained near the release site until they were ready to begin the downstream migration to the Klamath estuary. Once fish passed the Shasta River, travel times in any individual reach were less than 2 days and coho salmon smolts usually took less than 1 week to fully migrate to Klamath estuary (Beeman et al. 2012). Courter (2008) assumed that all fish from a given cohort would migrate to the estuary in 2-weeks, and this assumption is also consistent with travel rates documented by Stutzer et al. (2006). Based on the literature review, a 2-week outmigration period is believed to be a conservative period for juvenile salmonid exposure to elevated suspended sediment concentrations in the Kamath River. We also anticipate that outmigrating salmonids will have access to, and will choose to use clean water locations such as clear water tributary confluences, off-channel ponds and tributaries, and spring seeps during their outmigration, reducing exposure times. Additionally, suspended sediment concentrations will be substantially diluted by tributary inputs including the Trinity River (RM 43.4).

Juvenile Salmonid Suspended Sediment Exposure Effects

Newcombe and Jensen (1996) created “look-up tables” to predict response severity to suspended sediment exposures of varying durations and concentrations. Predicted severity-of-ill effects scores or indices were developed from empirical data gathered from numerous dose-response studies. Based on review of these data, juvenile salmonids exposed to concentrations of approximately 1,100 mg/L for 2-weeks have a severity-of-ill-effects score of 10, and may experience mortality rates between 0 and 20 percent. Expected mortality rates increase to between 20-40 percent as suspended sediment concentrations approach 3,000 mg/L.

While these predicted severity scores are helpful for evaluating the potential effects to juvenile fish, there is considerable variability between the effects to different species under different conditions as documented in the numerous studies synthesized by Newcombe and Jensen (1996). For instance, the authors reviewed an unpublished study where coho fry that were exposed to suspended sediment at a concentration of 5,471 mg/L for 96 hours in water at 18.7°C sustained a mortality rate of 10 percent, while similarly exposed steelhead experienced no mortality.

Servizi and Martens (1992) found that a stress response is dependent on a combination of factors including magnitude, frequency, and duration of exposure, as well as environmental factors such as particle size and water temperature. For example, effects to juvenile steelhead and coho salmon held in 18.7°C water, may have exacerbated the effects of suspended sediment on coho since temperatures of 19°C are considered suboptimal and juvenile coho salmon typically begin to seek cold water refugia at that threshold (Stenhouse et al. 2012). Likewise, Noggle (1978) found seasonal differences in salmonid tolerance to suspended sediment. In Noggle’s study, bioassays conducted in summer produced lethal concentrations and 50

percent mortality (LC50) of exposed fish at less than 1,500 mg/l, while bioassays in autumn produced LC50 values in excess of 30,000 mg/l. Servizi and Martens (1991) found that underyearling coho salmon survived higher concentrations of suspended sediment at 7°C (22,700 mg/L) than at either 1°C or 18°C.

Based on literature reviewed in Newcombe and Jensen (1996), a 2-week exposure period to suspended sediment concentrations above 1,000 mg/L may result in up to 20 percent mortality of exposed fish, while a 2week exposure to levels over 3,000 mg/L may result in 20-40 percent mortality of exposed fish. For comparison, parasite infection rates of outmigrating juvenile Chinook salmon from the upper Klamath River may be upwards of 60 percent in some years (Som et al. 2016).

Outmigration and Suspended Sediment Concentration Results

The following section presents a review of select screw trap data and suspended sediment concentration results compiled by KRRC. All outmigration and suspended sediment data are presented by Julian week (Table 4-5). Outmigration histograms represent weekly average number of outmigrants based on the sampled time period, generally 2008 to 2015. Salmon River outmigrant data are presented for two representative years rather than as multi-year averages due to limited data availability. Juvenile outmigration variability plots presented in section 4.4, illustrate the plasticity of outmigration timing. Outmigration timing is influenced by flows, water temperature, and other environmental factors.

Table 4-5 Julian week correspondence with months of the year

Julian Week	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1-9	X	X										
9-17			X	X								
17-26					X	X						
26-35							X	X				
35-44									X	X		
44-52											X	X

Upper Klamath River

Outmigration trap data for the Klamath River, Shasta River, and Scott River and suspended sediment concentrations for the Iron Gate Dam and Seiad Valley reporting stations are presented in the following section. Because the outmigration traps are located between Iron Gate Dam and the Seaid Valley reporting stations, juvenile salmonids entering the Klamath River closer to Iron Gate Dam will experience the highest concentrations while fish entering or moving downstream in the Klamath River closer to Seaid Valley will experience suspended sediment concentrations diluted by tributary and spring inputs. Inclusion of both reporting stations provide the range of modeled concentrations anticipated to affect the upper Klamath River reach.

Graphs also include 1,000 mg/L and 3,000 mg/L mortality thresholds outlined in the previous report section. Fish outmigrating when the modeled suspended sediment concentrations exceed the mortality thresholds, may experience mortality likelihoods associated with the respective thresholds.

Klamath River – Bogus Trap Results

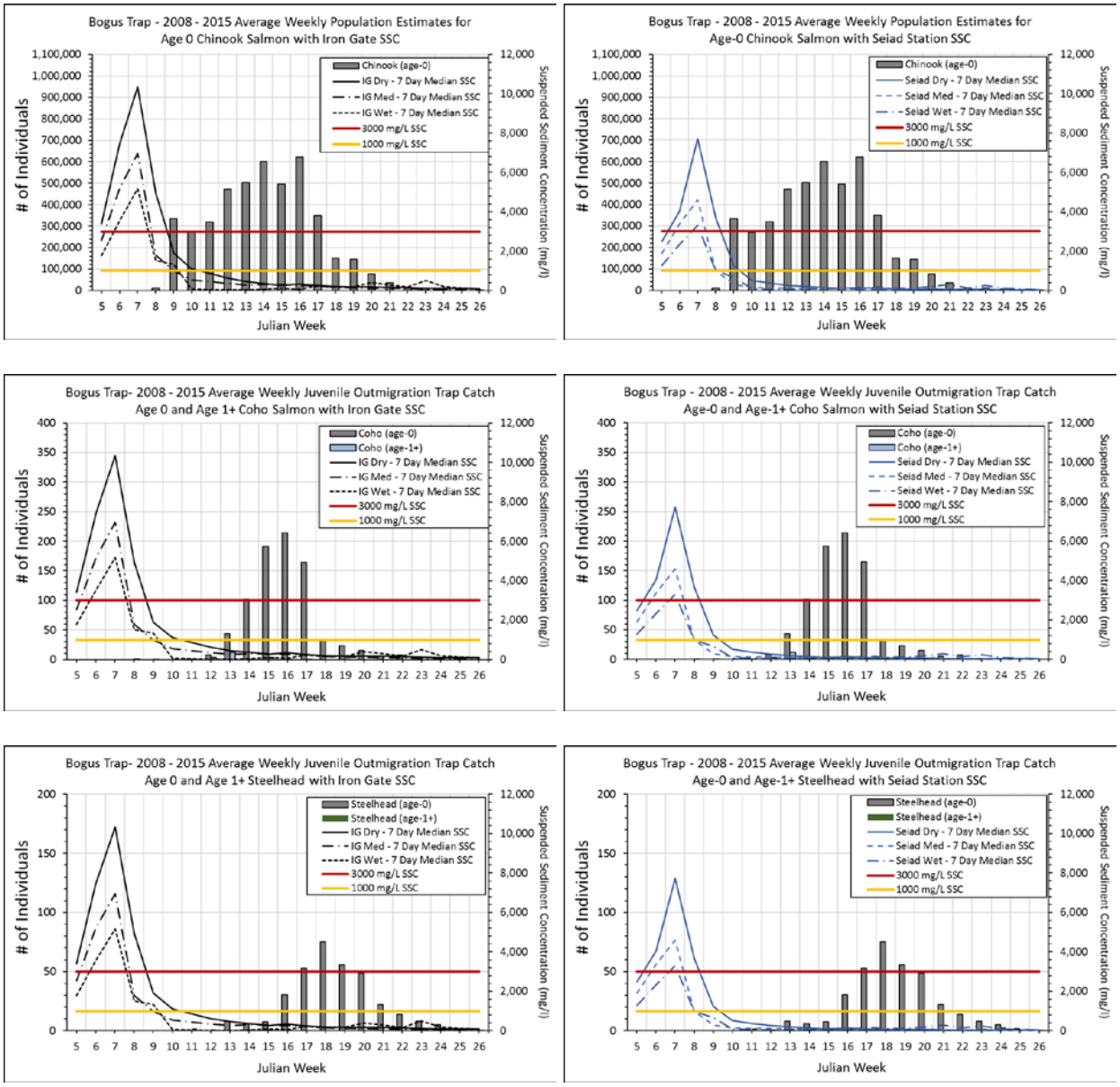
USFWS maintains the Bogus Creek trap located on the Klamath River downstream from Bogus Creek. The net frame trap samples outmigrants from Bogus Creek and the mainstem Klamath River. The Chinook salmon (age-0) outmigration window based on the sample period is from late February through June with an average peak in early to mid-April (Figure 4-3). On average, only the earliest outmigrants would experience suspended sediment concentrations above the 1,000 mg/L and 3,000 mg/L thresholds. Based on the reviewed trap data, most of the outmigrating juvenile Chinook salmon will move past the Bogus Creek trap location after the peak suspended sediment concentrations.

Trap catch results for outmigrating coho salmon and steelhead suggest these species tend to outmigrate from Bogus Creek and the mainstem Klamath River upstream of the Bogus trap later than Chinook salmon juveniles. Peak coho salmon and steelhead outmigrations are from early to mid-April, after suspended sediment concentrations have dropped below 1,000 mg/L.

Shasta River Trap Results

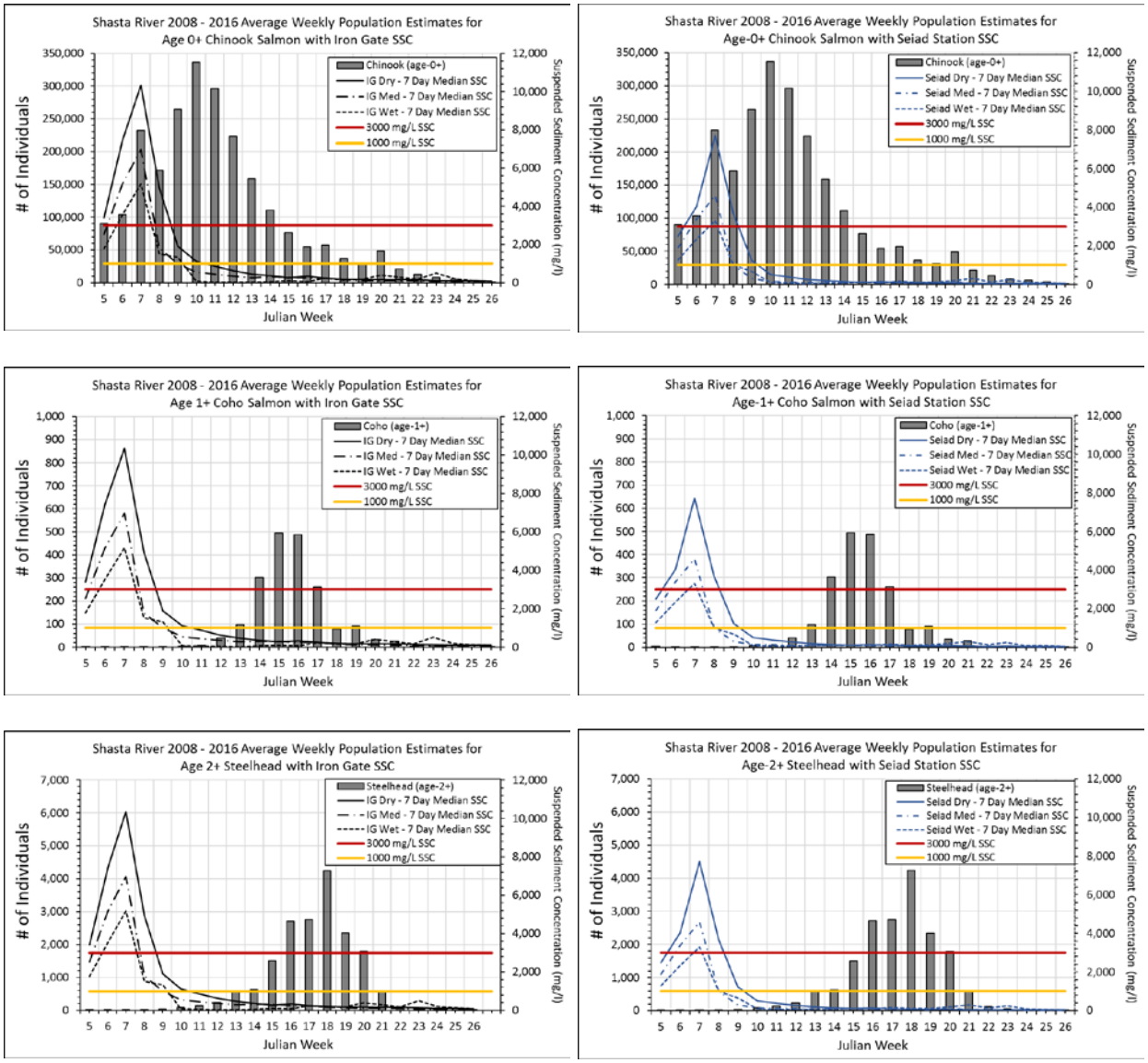
CDFW maintains the Shasta River rotary screw trap located near the Shasta River-Klamath River confluence. Chinook salmon (age-0+) outmigration from the Shasta River tends to occur earlier than in downstream tributaries and the mainstem Klamath River (Figure 4-4). On average, the outmigration begins in January and peaks in early March, overlapping with anticipated declining peak suspended sediment concentrations. Early Chinook salmon outmigrants entering the Klamath River would experience elevated sediment through mid-March. Results suggest the early portion of the Chinook salmon outmigration will be subjected to potentially lethal suspended sediment due to the concentration and exposure duration.

Population estimates for outmigrating coho salmon and steelhead suggest these species tend to outmigrate from the Shasta River later than Chinook salmon juveniles. Peak coho salmon and steelhead outmigrations are from mid to late April and are likely influenced by declining flows and rising water temperatures associated with onset of irrigation season. Coho salmon and steelhead outmigration patterns suggest that most fish outmigrate after suspended sediment concentrations have dropped below 1,000 mg/L.



The left column of plots includes modeled suspended sediment concentrations at the Iron Gate Dam station, the right column includes the modeled suspended sediment concentrations at the Seaid Valley station Outmigrating Chinook salmon appear to be the most vulnerable to peak suspended sediment concentrations. Coho and steelhead outmigrants are expected to outmigrate after peak suspended sediment concentrations.

Figure 4-3 Bogus trap on the Klamath River outmigration plots include Chinook salmon age-0 outmigration estimate (top), coho salmon age-0 and age-1+ trap catch (middle), and steelhead age-0 and age-1+ trap catch (bottom).



The left column of plots includes the modeled suspended sediment concentrations at the Iron Gate Dam station, the right column includes the modeled suspended sediment concentrations at the Seaid Valley station. Outmigrating Chinook salmon appear to be the most vulnerable to peak suspended sediment concentrations in the Klamath River. Coho salmon and steelhead outmigrants are expected to outmigrate after peak suspended sediment concentrations are below 1,000 mg/L.

Figure 4-4 Shasta River trap outmigration plots include Chinook salmon age-0+ outmigration estimate (top), coho salmon age-1+ outmigration estimate (middle), and steelhead age-2+ outmigration estimate (bottom).

Klamath River – Kinsman Trap Results

USFWS maintains the Kinsman Creek trap located on the Klamath River just upstream of the Kinsman Creek-Klamath River confluence and approximately 2.5 miles upstream of the Scott River-Klamath River confluence. The timing and magnitude of juvenile Chinook salmon in the Kinsman trap suggest the influence of early outmigrants from the Shasta River. Over the period of record reviewed by KRRC, the Kinsman trap does not begin operation until the beginning of March and likely misses the early Shasta River outmigrants entering the Klamath River (Figure 4-5). Therefore, early outmigrating Chinook salmon in the Klamath River would be subjected to elevated suspended sediment concentrations. However, the peak of the Chinook salmon migration reaches the Kinsman trap location after peak sediment concentrations.

Trap catch results for outmigrating coho salmon and steelhead suggest these species tend to outmigrate from areas upstream of the Kinsman trap later than Chinook salmon juveniles. Coho salmon and steelhead outmigrate through the summer and mainly outmigrate after suspended sediment concentrations are projected to drop below 1,000 mg/L.

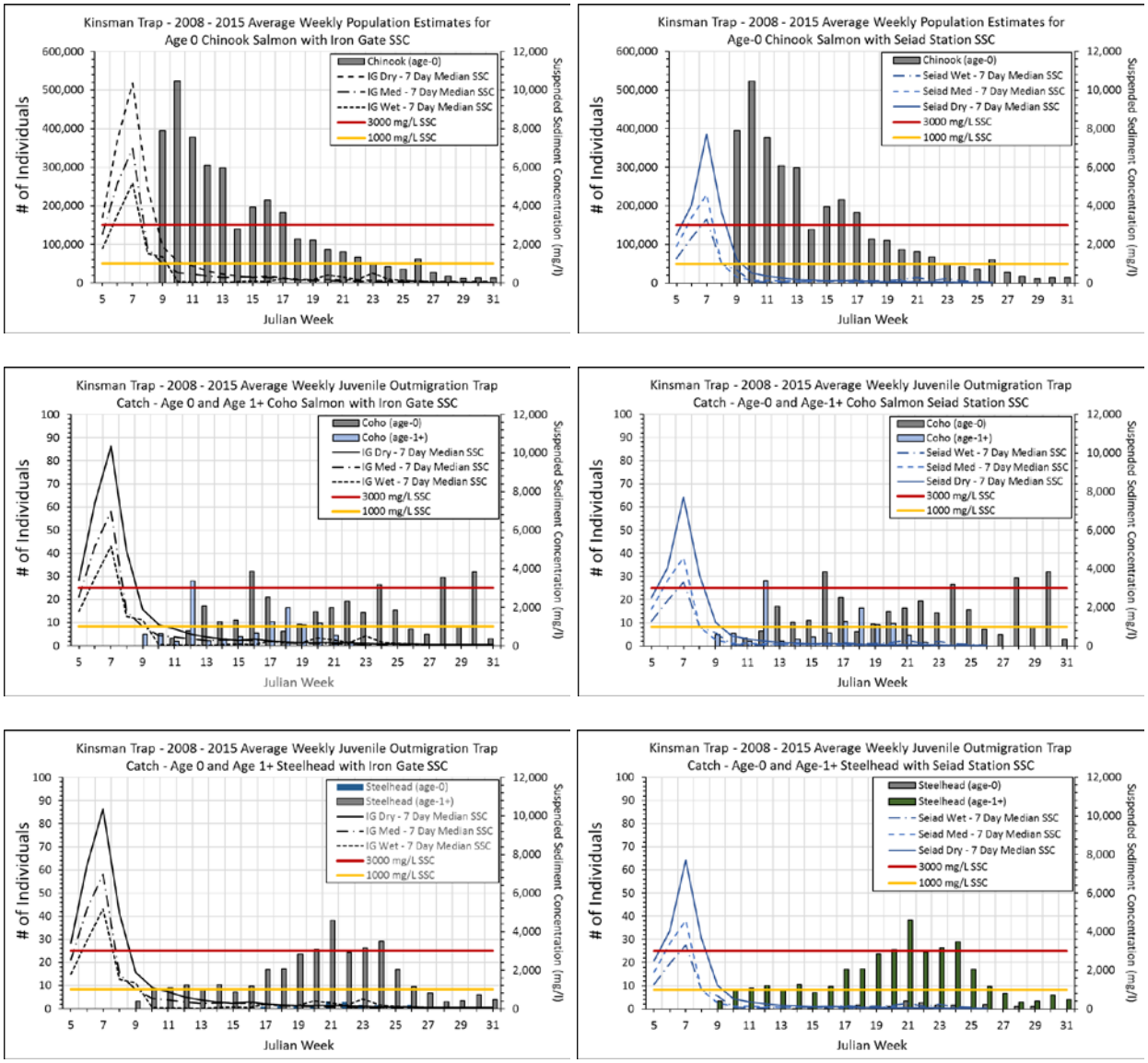
Scott River Trap Results

CDFW maintains the Scott River rotary screw trap located 4.75 miles upstream of the Scott River-Klamath River confluence. Chinook salmon (age-0+) outmigration from the Scott River occurs in mid-April (Figure 4-6) and is more similar to the mainstem Klamath River outmigrants than to the outmigration timing for the Shasta River. The Scott River Chinook salmon outmigration, on average, occurs over a longer period of time with lower abundance relative to the Shasta River Chinook outmigration. Few Chinook salmon outmigrate during the period of peak suspended sediment concentrations.

Population estimate results for outmigrating coho salmon and steelhead suggest these species' outmigration periods overlap with outmigrating Scott River Chinook salmon more so than the level of species overlap in the Shasta River. Although at lower abundance levels relative to Scott River Chinook salmon, Scott River coho and steelhead juvenile outmigration amounts to several thousand fish. The earliest outmigrating fish (late February to early March) will likely be subjected to elevated suspended sediment concentrations as sediment levels taper from the peak. Coho and steelhead outmigration patterns suggest that most fish may outmigrate after suspended sediment concentrations have dropped below 1,000 mg/L.

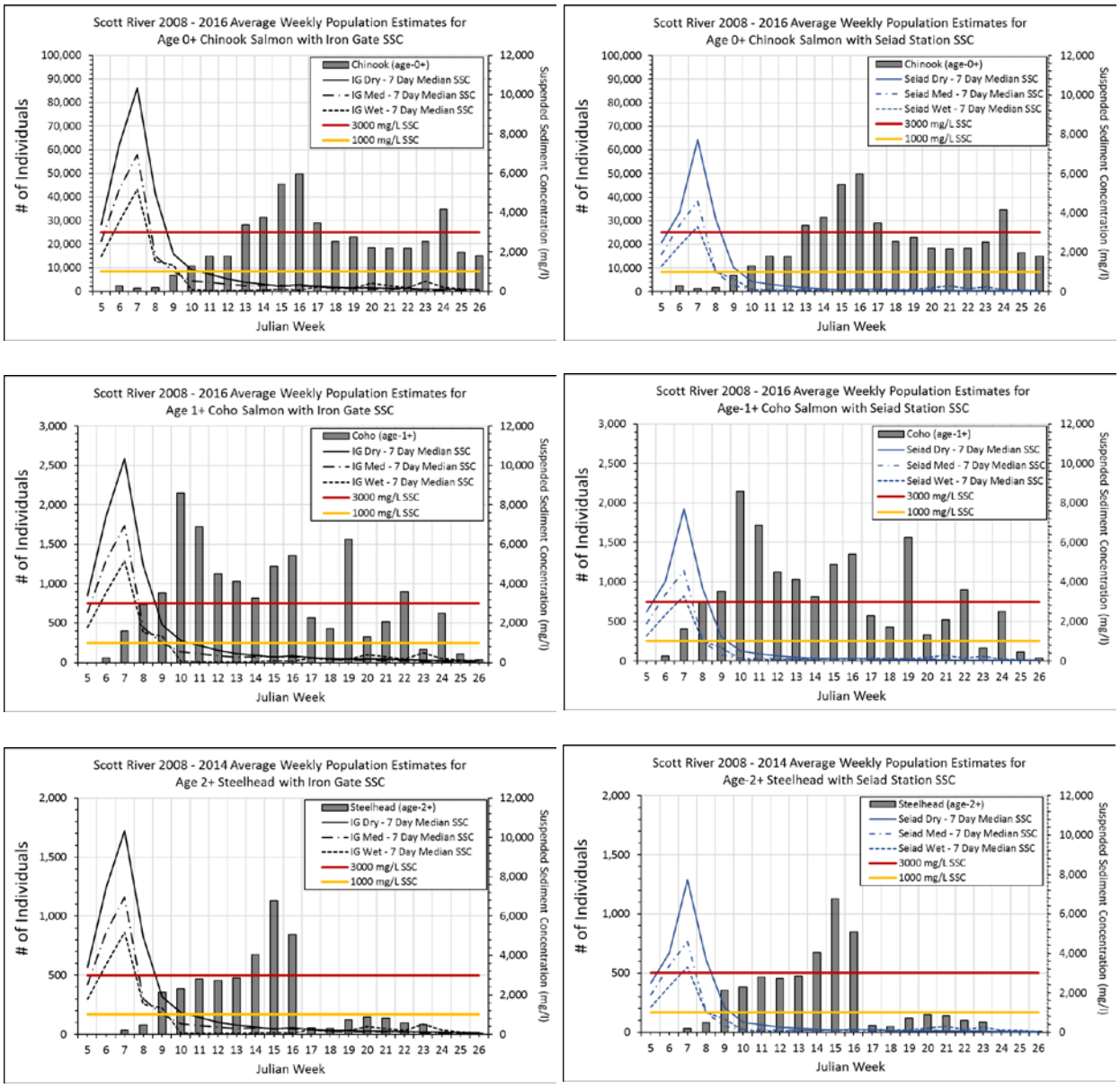
Middle Klamath River

Data are provided for two traps in the middle Klamath River.



The left column of plots includes the modeled suspended sediment concentrations at the Iron Gate Dam suspended station; the right column includes the modeled suspended sediment concentrations at the Seaid Valley station. Outmigrating Chinook salmon appear to be the most vulnerable to peak suspended sediment concentrations. Most coho and steelhead outmigrants are expected to outmigrate after peak suspended sediment concentrations.

Figure 4-5 Kinsman trap on the Klamath River outmigration plots clockwise from upper left include Chinook salmon age-0 outmigration estimate (top), coho salmon age-0 and age-1+ trap catch (middle), and steelhead age-0 and age-1+ trap catch (bottom).



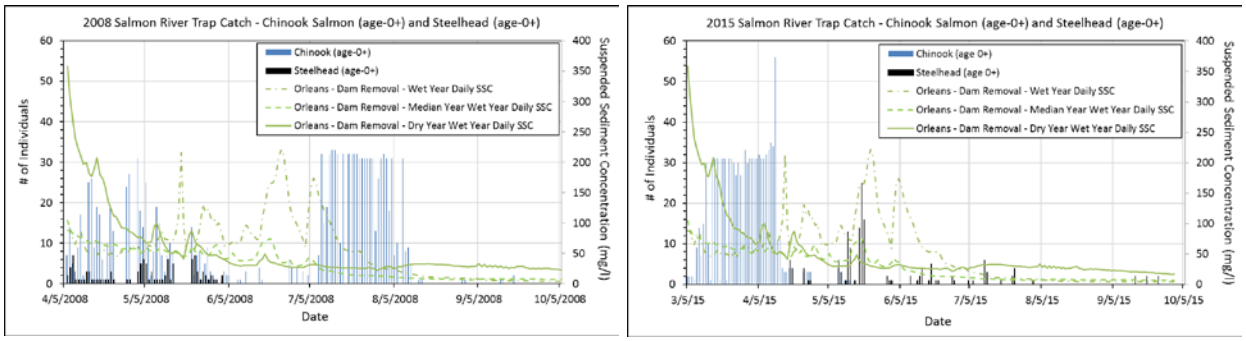
The left column of plots includes the modeled suspended sediment concentrations at the Iron Gate Dam station; the right column includes the modeled suspended sediment concentrations at the Seaid Valley station. Outmigrating coho salmon appear to be proportionally more vulnerable to peak suspended sediment concentrations, with approximately 25 percent of the average outmigrants subjected to concentrations above 1,000 mg/L.

Figure 4-6 Scott River trap outmigration plots clockwise from upper left include Chinook salmon age-0+ outmigration estimate (top), coho salmon age-1+ outmigration estimate (middle), and steelhead age-2+ outmigration estimate (bottom).

Salmon River Trap Results

The Karuk Tribe maintains a screw trap on the Salmon River at RM 0.96. The Salmon River joins the Klamath River at RM 66.4. Suspended sediment concentrations for the Orleans modeling station and Chinook (age-0+) and steelhead (age 0+) trap catch data for 2008 and 2015 are presented in Figure 4-7. The presented years 2008 and 2015 are representative of the outmigration timing for Chinook and steelhead on the Salmon River. The second grouping of Chinook salmon outmigrants from July through September in 2008 is characterized by larger juveniles compared to the earlier April to June outmigration period. The 2015 trap catch data suggest a dominant early juvenile Chinook salmon outmigration and few later outmigrants. There were low numbers of outmigrating juvenile steelhead in both years. Coho salmon outmigrants were not included in the analysis due to low trap catch numbers.

Anticipated suspended sediment concentrations at the Orleans station are below the 1,000 mg/L and 3,000 mg/L mortality thresholds and most Chinook salmon and steelhead juveniles migrate to the lower Salmon River when anticipated suspended sediment concentrations in the Klamath River are less than 500 mg/L. Based on the timing of juvenile Chinook salmon and steelhead entry into the Klamath River and the anticipated suspended sediment concentrations at entry, we do not expect outmigrating fish from the Salmon River to experience lethal conditions. We also anticipate outmigrants will reach the Klamath estuary in less than a week, minimizing their exposure to suspended sediment concentrations.



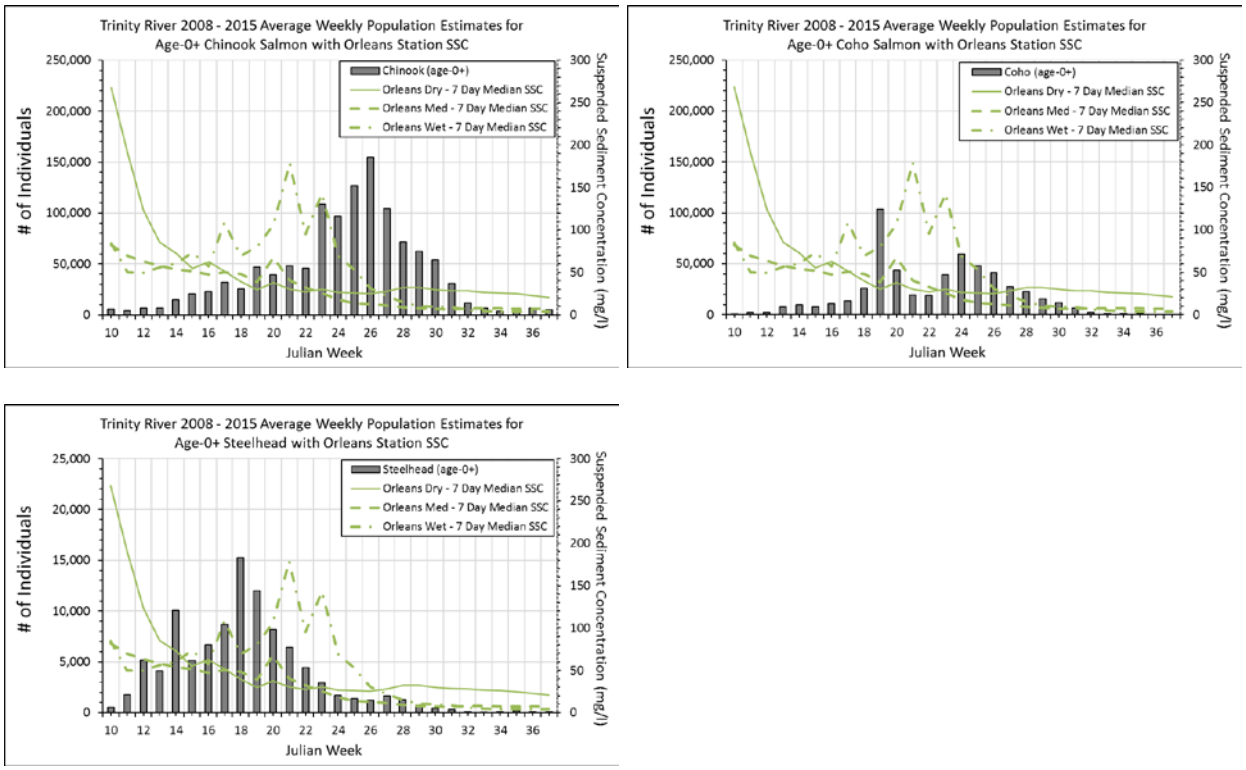
Anticipated suspended sediment concentrations from the Orleans station are also presented. Suspended sediment concentrations during the outmigration period are less than the mortality thresholds of 1,000 mg/L and 3,000 mg/L.

Figure 4-7 Salmon River trap catch outmigration plots for Chinook salmon (age-0+) and steelhead (age-0+) for 2008 (left) and 2015 (right).

Trinity River near Willow Creek Trap Results

USFWS and Yurok Tribe maintain a screw trap on the Trinity River at RM 21.1. The Trinity River joins the Klamath River at RM 43.4. Suspended sediment concentrations for the Orleans modeling station and Chinook salmon (age-0+), coho salmon (age-0+), and steelhead (age 0+) population estimates based on 2008 to 2015 screw trap data are presented in Figure 4-8. Steelhead peak outmigration is earlier than Chinook and coho salmon outmigration timing. The outmigration values include both hatchery and naturally-produced juveniles and age-0 smolts comprise the majority of the sampled outmigrants.

Anticipated suspended sediment concentrations at the Orleans station are below the 1,000 mg/L and 3,000 mg/L mortality thresholds and most fish migrate through the lower Trinity River when Klamath River suspended sediment concentrations are less than 300 mg/L. Based on outmigration timing to the Klamath River (assuming juvenile fish continue to outmigrate to the Klamath River after they bypass the Trinity River trap location) and the anticipated suspended sediment concentrations at entry, we do not expect outmigrating fish from the Trinity River to experience lethal conditions in the Klamath River. We also anticipate outmigrants will reach the Klamath estuary in less than a week, minimizing their exposure to elevated suspended sediment.



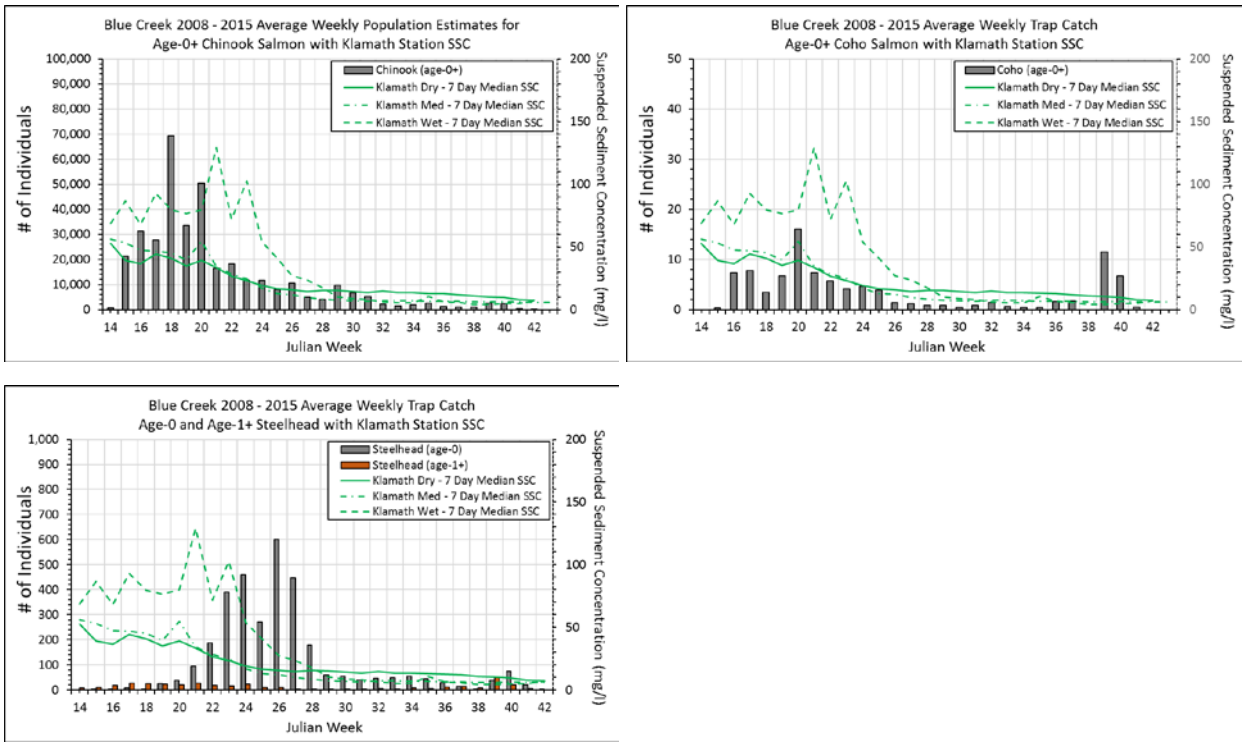
Anticipated suspended sediment concentrations from the Orleans station are also presented. Suspended sediment concentrations during the outmigration period are less than the mortality thresholds of 1,000 mg/L and 3,000 mg/L.

Figure 4-8 Trinity River trap outmigration plots for Chinook salmon age-0+ (upper left), coho salmon age-0+ (upper right), and steelhead age-0+ (lower left).

Lower Klamath River

The Yurok Tribe maintains a screw trap at RM 2.0 on Blue Creek, the largest tributary to the lower Klamath River. Blue Creek supports the largest anadromous fish populations in the lower Klamath River sub-basin, and the tributary is considered to be a salmon stronghold by the Yurok Tribe (Antonetti and Partee 2013). Blue Creek joins the Klamath River at RM 16.0. Suspended sediment concentrations for the Klamath modeling station and population estimates for Chinook salmon (age-0+), and trap catch data for coho salmon (age-0+), and steelhead (age-0 and age-1+) for 2008 through 2015 are presented in Figure 4-9.

Anticipated suspended sediment concentrations at the Klamath station are below the 1,000 mg/L and 3,000 mg/L mortality thresholds. Outmigration timing for juvenile salmonids is generally during anticipated elevated suspended sediment concentrations less than 300 mg/L. We do not anticipate negative effects from suspended sediment concentrations on outmigrating juvenile salmonids in the Lower Klamath River based on low sediment concentrations and the close proximity of Blue Creek to the Klamath estuary.



Anticipated suspended sediment concentrations from the Klamath station are also presented. Suspended sediment concentrations during the outmigration period are less than the mortality thresholds of 1,000 mg/L and 3,000 mg/L.

Figure 4-9 Blue Creek trap outmigration plots include Chinook salmon age-0+ outmigration estimate (upper left), coho salmon age-0+ trap catch (upper right), and steelhead age-0 and age-1+ trap catch (lower left).

Outmigration and Dissolved Oxygen

The release of organic-based sediments during reservoir drawdown is anticipated to affect dissolved oxygen levels in the Klamath River downstream from Iron Gate Dam (Stillwater Sciences 2011). The highest predicted oxygen demand levels will be associated with peak suspended sediment concentrations that are anticipated to occur during February of the drawdown year. Despite the relatively high predicted biological oxygen demand, dissolved oxygen concentrations downstream from Iron Gate Dam are anticipated to generally remain greater than 5 mg/L. Exceptions include predicted concentrations in February of the dam removal year for median (1976) and typical dry year (2001) hydrologic conditions, which exhibit minimum values of 3.5 mg/L and 1.3 mg/L, respectively.

For all water year types (wet, median, dry), the predicted dissolved oxygen minimum values would occur by approximately RM 188-190 (~3-5 miles downstream from Iron Gate Dam) and would return to at least 5 mg/L by approximately RM 175-177 (2 to 4 miles below the Shasta River confluence. The North Coast Basin Plan water quality objective for dissolved oxygen is expressed as percent saturation; at 90 percent saturation, the water quality objective for November through April, assuming average February (2009) water temperatures, would be 9.6-10.6 mg/l. Based on the spreadsheet model results, recovery to the North Coast Basin Plan water quality objective of 90 percent saturation would occur generally within the reach from Seiad Valley (RM 131.9) to the mainstem confluence with Clear Creek, or within a distance of 62-93 miles downstream from Iron Gate Dam, for all water years.

Dissolved oxygen monitoring during dam removal projects is complicated by the harsh in-stream conditions influenced by high suspended sediment concentrations. The U.S. Geological Survey monitored dissolved oxygen levels associated with the drawdown of Fall Creek Reservoir in the Willamette Basin. The Fall Creek monitoring included a water quality monitoring station downstream from the dam, and a second station at Jasper approximately 10 miles downstream from Fall Creek Dam. The Fall Creek Outflow station at the dam detected a decrease in dissolved oxygen concurrent with the sediment release, although the extent of the depletion was unknown due to equipment fouling (Schenk and Bragg 2014). Collected dissolved oxygen data suggested a decline from approximately 12.5 mg/L to between 6 mg/L and 7 mg/L during the first 5 hours following the drawdown. Dissolved oxygen levels trended upward over the course of the of the following 4 days until returning to background levels 6 days after the onset of drawdown (Schenk and Bragg 2014). Dissolved oxygen levels at the downstream Jasper station did not experience a large, rapid decrease in dissolved oxygen during the drawdown, suggesting the drawdown effects on dissolved oxygen were isolated to less than 10 miles of Fall Creek and the Middle Fork Willamette River.

Outmigration and Suspended Sediment Summary

Reservoir drawdown and dam removal sequencing was developed to minimize effects on Klamath River anadromous fish. A review of recent juvenile salmonid outmigration data collected from 2008 to 2015/2016, provides an updated understanding of juvenile salmonid outmigration timing on the Klamath River and select tributaries. Comparing outmigration timing and anticipated reservoir drawdown-influenced suspended sediment concentrations in the Klamath River is informative for predicting potential sediment effects to juvenile salmonids entering the Klamath River during the winter and early spring coincident with reservoir drawdowns. The data review suggests potential sediment effects to early outmigrating juvenile salmonids in the Shasta and Scott rivers. However, juvenile outmigration timing suggests a high degree of plasticity when fish outmigrate from tributaries to the Klamath River. Environmental conditions including stream flow, water temperature, food availability, and other biological and environmental cues influence outmigration timing. The adaptive monitoring and salvage plan included in the measure is also intended to reduce sediment effects on outmigrating salmonids.

4.3.4 Juvenile Salmonid Suspended Sediment Avoidance Behavior Review

KRRC reviewed literature pertaining to juvenile salmonid avoidance behaviors in response to elevated suspended sediment. In summary, the high levels of suspended sediment in the Klamath River during

reservoir drawdown are anticipated to be problematic for outmigrating juvenile salmonids during peak concentrations. However, as concentrations decline over time and with distance from Iron Gate Dam, juvenile salmonids are expected to employ behavioral adaptations to reduce exposure effects.

Avoidance Behavior

The reservoir drawdown period will be marked by poor water quality caused by high suspended sediment concentrations. Juvenile salmonids inhabiting the Klamath River are expected to employ coping strategies to survive poor conditions. Juveniles may use clear water tributary junctions, clear water off-channel ponds and tributaries, spring seeps, or increase their use of the benthic zone (Bash et al. 2001; Kjelland et al. 2015), or the upper portion of the water column (Servizi and Martens 1992). We expect juvenile fish to actively seek these areas as they move downstream from natal tributaries into the Klamath River. Factors affecting the ability of juvenile salmonids to find clear water areas include the frequency and output of clear water sources, the magnitude of suspended sediment in the Klamath River, and the developmental stage of juvenile fish (Sedell et al. 1990). Younger fish are generally more susceptible to high suspended sediment concentrations than older fish.

For juvenile salmonids rearing in the mainstem Klamath River at the time of reservoir drawdown, gradually increasing suspended sediment levels may promote more rapid downstream movement of juvenile fish as they seek cleaner water (Berg and Northcote 1985). Redding and Schreck (1987) found juvenile coho and steelhead exposed to 4,000 mg/L exhibited a physiological stress response, but tested fish were able to compensate for the high suspended sediment concentrations within a few days. Fish exposed to 2,000 - 4,000 mg/L of sediment exhibited physiological changes indicative of sublethal stress, but the tested sediment levels also caused modified feeding behavior and lowered the disease resistance of tested fish (Redding and Schreck 1987). Physiological responses were moderate compared to cortisol levels in fish severely stressed by confinement and handling (Redding and Schreck 1983 cited in Redding and Schreck 1987), suggesting that minimizing handling in favor of allowing juvenile fish to make choices on their outmigration may result in lower juvenile salmonid mortality.

Exposure to Organics-based Suspended Sediment

Salmonid suspended sediment studies generally evaluate the effects of mineralized sediment on salmonids. Sockeye smolts were less susceptible to high levels of Frasier River sediments than they were to lower levels of angular ash particles associated with the Mount St. Helens eruption (Newcomb and Flagg cited in Servizi and Martens 1987). Compared to gill abrasion effects caused by mineralized sediment, organic-based suspended sediment may cause problematic effects related to low dissolved oxygen levels (Sorenson et al. 1977 cited in Bash et al. 2001), but organic sediments may be less abrasive compared to suspended mineralized sediments.

4.3.5 Summary of Additional Information on Potential Project Effects on Juvenile Outmigration

Juvenile salmonids exhibit outmigration timing plasticity that reflects their response to instream conditions influenced by stream flow, water temperature, food availability, and other biological and environmental cues. We would anticipate that juveniles will delay entry into the Klamath River when they experience adverse conditions, and fish will choose to outmigrate in response to tributary condition decline and mainstem river condition improvement. Based on the reviewed outmigration data, juveniles outmigrate from tributaries over several weeks from late winter through summer, with juvenile Chinook salmon being the earliest outmigrants from upper Klamath River tributaries. If juvenile fish remain in upper Klamath River tributaries through early to mid-March, they will experience substantially lower suspended sediment concentrations upon entry into the Klamath River. The mid-March time period precedes the start of irrigation season (beginning of April) in the Shasta River, when tributary conditions begin to decline due to reduced instream flows and rising water temperatures (Jetter et al. 2016).

KRRC's data review suggests juvenile salmonids are capable of outmigrating from Iron Gate Dam to the Klamath estuary in less than 2 weeks. Clear water sources in the form of tributary confluences, off-channel ponds, and spring seeps will serve as moderate to high water quality stepping stones in an otherwise harsh aquatic environment. As juveniles migrate downstream, not only will they encounter pockets of improved water quality, but suspended sediment concentrations will also decline with tributary inputs. Water quality conditions downstream of the Trinity River confluence are anticipated to be near background levels as the Trinity River and other tributaries dilute suspended sediment concentrations. It is expected that fish exposed to high suspended sediment concentrations to outmigrate more rapidly, further reducing the exposure duration.

If suspended sediment concentrations remain elevated above 1,000 mg/L for any 2-week period during the outmigration, there may be up to 20 percent mortality of exposed fish. However, this conclusion should be considered in light of documented evidence of juvenile coho and steelhead survival at suspended sediment concentrations exceeding 2,000 mg/L (Redding et al. 1997). Likewise, it is unlikely fish will be continuously exposed to high suspended sediment concentrations over 14 days as they will have access to clear water refuges and will experience improving water quality conditions as they move downstream.

Based on juvenile salmonid outmigration data, anticipated suspended sediment concentrations during reservoir drawdown, and expected juvenile salmonid avoidance behaviors, an adaptive strategy that includes monitoring and salvaging juvenile fish as a last resort, is a prudent approach to reducing sediment effects on juvenile salmonids.

4.4 Juvenile Salmonid Outmigration Variability Plots

4.4.1 Introduction

KRRC prepared outmigration variability plots for trap data from the Klamath River and select tributaries. The plots provide an indication of the variability of outmigration timing by species and trap location. Outmigration variability is related to flow, water temperature, food resources, and other biological and environmental cues. The following sections review outmigration variability based on recent juvenile outmigration data.

4.4.2 Upper Klamath River – Bogus Net Frame and Kinsman Trap Results

Population estimates developed from Bogus net frame and Kinsman rotary screw trap catch data were aggregated for the 2008 to 2015 period. Variability plots were developed to assess outmigrant population variability for each location over the 10-year period (Figure 4-10). Weekly population estimates tended to be the most variable in the middle portion of the outmigration period when years with large population estimates created data outliers. Chinook salmon were the most abundant of the three analyzed species.

4.4.3 Upper Klamath River – Shasta River and Scott River Trap Results

Population estimates developed from Shasta River and Scott River rotary screw trap catch data were aggregated for the 2008 to 2016 period (Shasta River coho analysis from 2009 to 2016). Variability plots were developed to assess outmigrant population variability for each location over the 11-year period (Figure 4-11). Weekly population estimates tended to be the most variable in the middle portion of the outmigration period for age 0+ Chinook salmon. Chinook salmon were the most abundant of the three analyzed species.

4.4.4 Middle Klamath River –Trinity River Trap Results

Population estimates developed from Trinity River rotary screw trap catch data were aggregated for the 2008 to 2015 period. Variability plots were developed to assess outmigrant population variability for the trap location over the 10-year period (Figure 4-12). Weekly population estimates tended to be the most variable for coho salmon due to their overall small population size.

4.4.5 Lower Klamath River – Blue Creek Trap Results

Population estimates developed from Blue Creek rotary screw trap catch data were aggregated for the 2008 to 2015 period. Variability plots were developed to assess outmigrant population variability for the trap location over the 10-year period (Figure 4-13). Population estimates were generated for age 0+ Chinook salmon and age 0+ steelhead. Estimates were not generated for coho due to low catch. Chinook salmon had larger population estimates relative to steelhead.

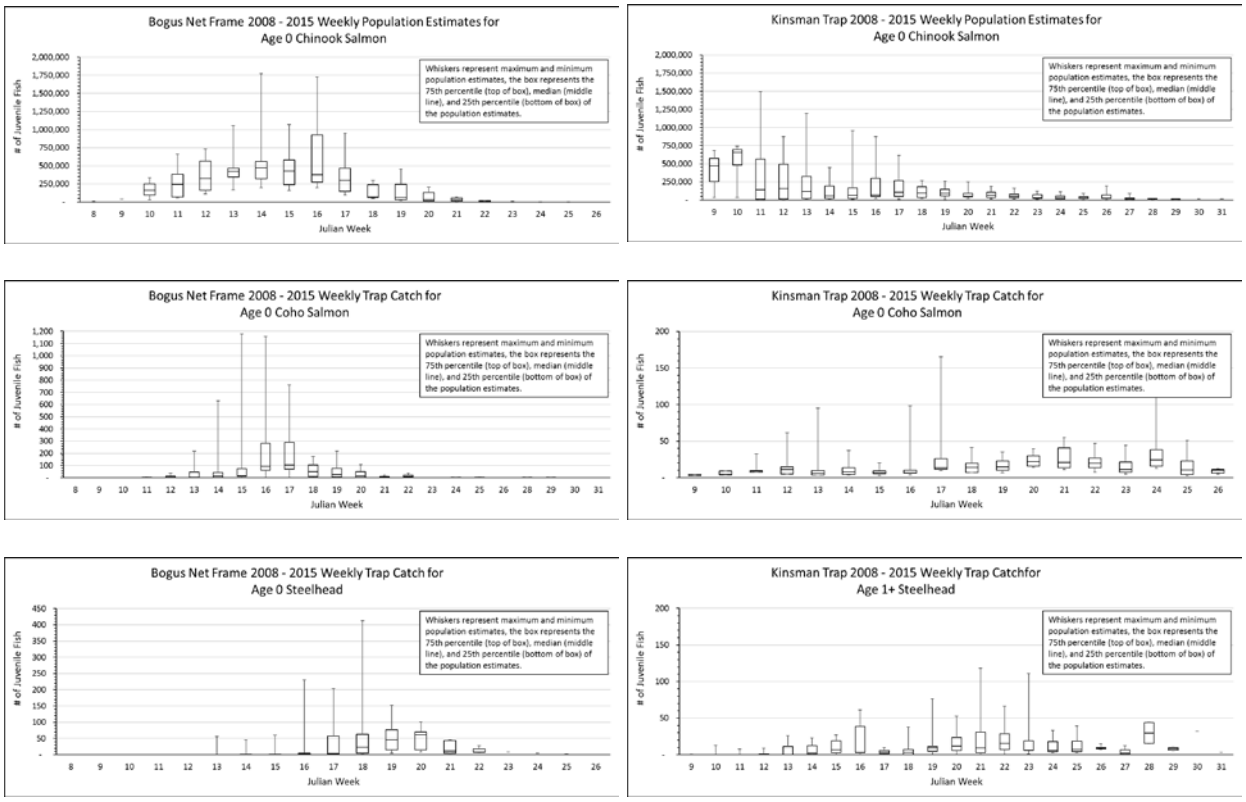


Figure 4-10 Chinook salmon, coho salmon, and steelhead weekly population estimates and trap catch results for the Bogus net frame and Kinsman rotary screw trap on the Klamath River.

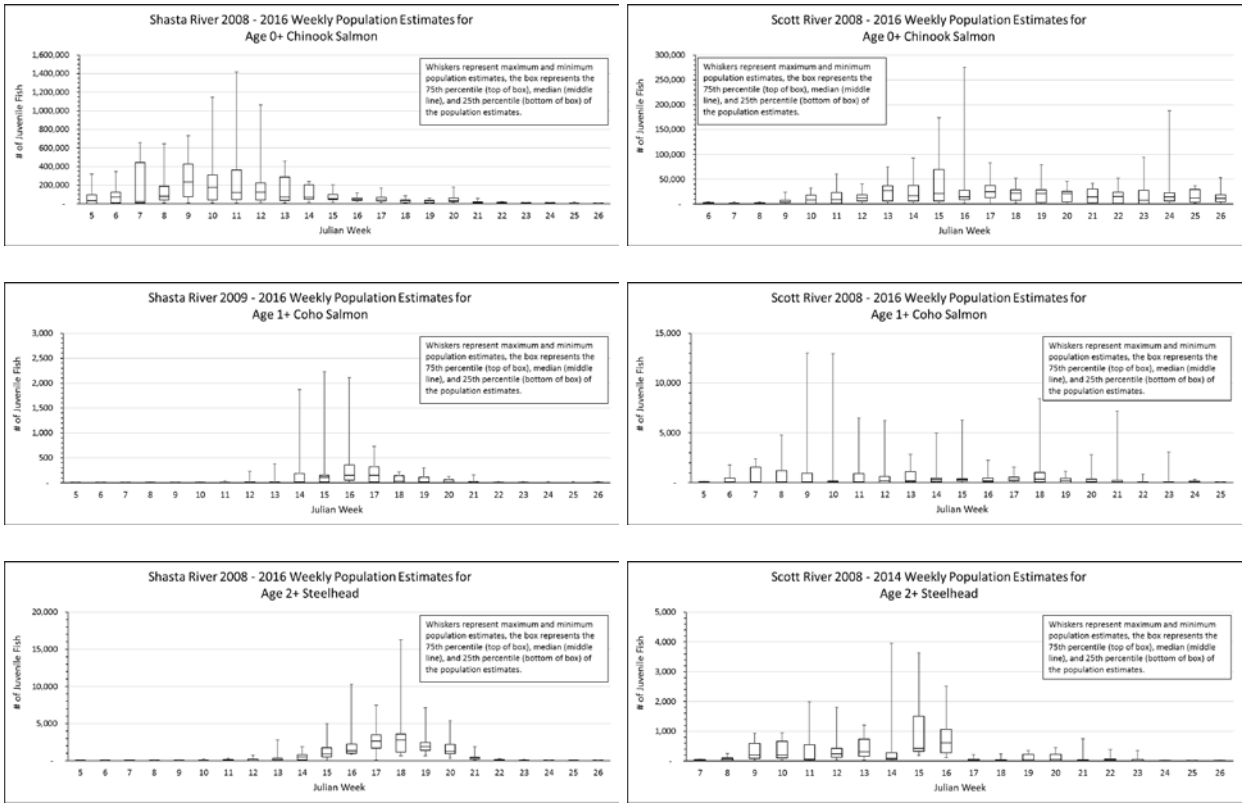


Figure 4-11 Chinook salmon, coho salmon and steelhead weekly population estimates for the Shasta River and Scott River traps.

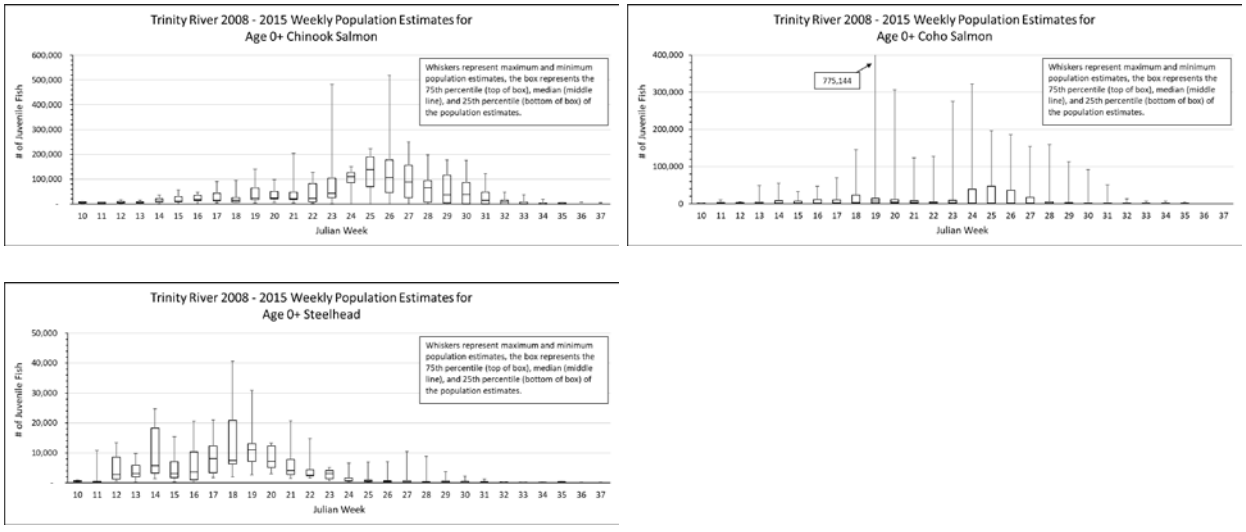


Figure 4-12 Chinook salmon, coho salmon and steelhead weekly population estimates for the Trinity River trap.

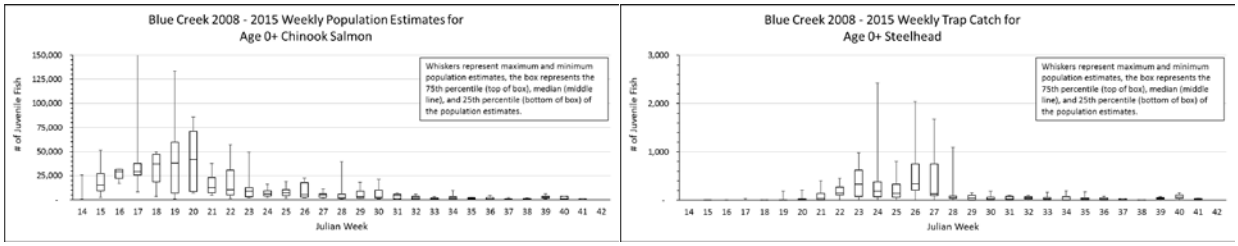


Figure 4-13 Chinook salmon and steelhead weekly population estimates for the Blue Creek trap.

4.5 Summary

The Project is anticipated to have significant short-term effects, but long-term benefits, for fall Chinook salmon, coho salmon, winter steelhead, and Pacific lamprey. KRRC's proposed outmigrating juveniles measure includes three primary actions; salvaging mainstem overwintering juvenile salmonids prior to reservoir drawdown; maintaining tributary-mainstem connectivity to ensure volitional fish passage between tributaries and the Klamath River; and developing a water quality monitoring network, trigger thresholds, and plan for salvaging and relocating juvenile fish from tributary confluence areas to cool water tributaries, nearby off-channel ponds, or in the Klamath River downstream of the confluence of the Trinity River. KRRC's proposed three-pronged approach is anticipated to offset the short-term effects to outmigrating juvenile salmonids.

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Chapter 5: Fall Pulse Flows

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5. FALL PULSE FLOWS

The objective of AR-3 in the 2012 EIS/R was to address reservoir drawdown and project effects on anadromous fish that migrate and spawn in the mainstem Klamath River and its tributaries. Specifically, the 2012 EIS/R AR-3 focused on increasing fall flows to encourage outmigration of post-spawned green sturgeon from the lower Klamath River and estuary to the Pacific Ocean, and increase fall Chinook salmon, coho salmon, and steelhead spawning in tributaries downstream from Iron Gate Dam. In 2012, the fall pulse flows were anticipated to reduce the effects of elevated suspended sediment concentrations on anadromous fish inhabiting the Klamath River.

However, KRRC and the ATWG have concluded that the use of fall pulse flows would likely be ineffective in reducing the effects of suspended sediment on migrating and spawning salmon, steelhead, and green sturgeon based on a review of the best available science regarding Klamath River fisheries and project effects. In particular, the uncertainty of storage water availability on the mainstem Klamath River prior to reservoir drawdown, and the natural (unregulated) hydrology of most Klamath River tributaries make implementation and success of this measure unpredictable. The measure would therefore be either infeasible and/or unnecessary to implement depending on the meteorological conditions prior to the Project. Therefore, KRRC will not implement fall pulse flows to offset the suspended sediment effects related to the Project.

5.1 Summary of the Affected Species, Project Benefits and Effects, Recent Fisheries Literature, and the 2012 EIS/R AR-3

The following sections review the components of the 2012 EIS/R AR-3, anticipated project effects and benefits on AR-3 species, and recent fisheries literature relative to juvenile salmonid outmigration.

5.1.1 Affected Species

Species identified in the measure include:

- Coho salmon *(Oncorhynchus kisutch)* – Southern Oregon/Northern California Coastal (SONCC) ESU: Federally Threatened; California Threatened; Tribal Trust Species
- Chinook salmon *(O. tshawytscha)* – Upper Klamath-Trinity Rivers ESU - Fall Run: California Species of Special Concern; Tribal Trust Species
- Steelhead *(O. mykiss)* – Klamath Mountains Province DPS – Summer Run: California Species of Special Concern; Tribal Trust Species
- Steelhead *(O. mykiss)* – Klamath Mountains Province DPS – Winter Run: Tribal Trust Species

- Green sturgeon *(Acipenser medirostris)* - Northern DPS: Tribal Trust Species

5.1.2 Anticipated Project Effects on AR-3 Species

Short-term project effects (from both suspended sediment and bedload movement) were predicted to result in high mortality of fall Chinook salmon and coho salmon embryos and pre-emergent alevin within redds that are constructed in the mainstem Klamath River downstream from Iron Gate Dam in the fall prior to reservoir drawdown (USBR and CDFG 2012). The 2012 EIS/R analysis predicted that approximately 2,100 fall Chinook salmon redds and approximately 13 SONCC coho salmon redds would be affected during reservoir drawdown. Migrating steelhead within the mainstem Klamath River after December 31 prior to reservoir drawdown are also anticipated to be directly affected by suspended sediment related to reservoir drawdown. Additionally, any adult green sturgeon remaining in the lower Klamath River and estuary could be exposed to elevated suspended sediment concentrations which could result in major stress to affected fish, although the effects of the Project are expected to be the same as under existing conditions (USBR and CDFG 2012). Table 5-1 includes the likely and worst-case effects to adult anadromous fish species downstream from Iron Gate Dam from the 2012 EIS/R.

Table 5-1 2012 EIS/R anticipated effects summary for migratory adult salmonids and green sturgeon

Species	Life Stage	Likely Effects	Worst Effects
Coho Salmon	Adult Spawning	Loss of 13 redds (0.7-26%)[1]	Loss of 13 redds (0.7-26%)[1]
Chinook Salmon - Fall	Adult Spawning	Loss of 2,100 redds (8%)[1]	Loss of 2,100 redds (8%)[1]
Steelhead - Summer	Migrating Adults	No anticipated mortality	Loss of 0-130 adults (0-9%)
Steelhead - Winter	Migrating Adults	Loss of up to 1,008 adults (14%)[1]	Loss of up to 1,988 adults (28%)
Green Sturgeon	Holding Adults	Sublethal effects	Sublethal effects

Source: USBR and CDFG 2012
[1] Range of potential year class loss based on the average number of redds associated with the evaluated population(s).

The following sections include an overview of the 2012 EIS/R analysis of species-specific effects (USBR and CDFG 2012; Vol. I, pp. 3.3-129 to 3.3-168).

Coho Salmon

The wide distribution and use of tributaries by both juvenile and adult coho salmon will likely protect the population from the worst effects of the increased sediment during implementation of the Project. However, the 2012 EIS/R anticipated direct mortality of redds and smolts from the upper Klamath River, mid-Klamath River, Shasta River, and Scott River population units. No mortality was anticipated for the Salmon River, Trinity River, and Lower Klamath River populations under the most likely or worst-case scenarios. Based on

substantial reduction in the abundance of a year class in the short-term, the effect of the Project was found to be significant for the coho salmon from the Upper Klamath River, Mid-Klamath River, Shasta River, and Scott River population units.

Based on spawning surveys conducted from 2001 to 2005 (Magneson and Gough 2006), 6 to 13 redds were anticipated to be affected during reservoir drawdown. The anticipated loss of redds from the Upper Klamath River coho salmon population unit was based on the peak count of redds surveyed in all years (13 redds counted in 2001). Mainstem Upper Klamath River coho redd surveys completed between 2001 and 2016 (not completed in 6 years) yielded 6 redds on average and no redds in 2009. A total of only 38 mainstem redds were documented between 2001-2005, with two-thirds of those redds being found within 12 miles of the dam (NOAA 2010). Many of the redds anticipated to be affected by the Project are thought to be from returning hatchery fish (NOAA 2010). Based on the range of escapement estimates in Ackerman et al. (2006), the 2012 EIS/R concluded that 13 redds would represent anywhere from 0.7 to 26 percent of the naturally returning spawners in the upper Klamath River Population Unit, and likely much less than 1 percent of the natural and hatchery returns combined (Magneson and Gough 2006).

Chinook Salmon – Fall Run

Fall Chinook salmon use the mainstem Klamath River for spawning, rearing, and as a migratory corridor. Direct mortality is predicted for fall Chinook salmon redds and some smolts. The effect of suspended sediment concentrations on juvenile fall Chinook salmon from the Project was expected to be relatively minor because of variable life histories, the large majority of age-0 juveniles that remain in tributaries until later in the spring and summer, and because many of the fry that out-migrate to the mainstem come from tributaries in the middle or lower Klamath River, where suspended sediment concentrations resulting from the Project are expected to be lower due to dilution from tributaries.

Suspended sediment was predicted to result in 100 percent mortality of fall Chinook salmon eggs and fry spawned in the mainstem Klamath River during the fall prior to reservoir drawdown. Much of the overall effect on fall run Chinook salmon was anticipated to depend on the relative proportion of mainstem spawners during the fall prior to reservoir drawdown. Based on redd surveys using a mark and re-sight methodology from 1999 through 2009 (Magneson and Wright 2010), an average of 2,100 redds from hatchery and naturally returning adults were constructed in the mainstem Klamath River and represented approximately 8 percent of total, basin-wide escapement (USBR and CDFG 2012).

Steelhead – Summer and Winter

High suspended sediment concentrations resulting from the Project were anticipated to affect winter steelhead migrating during the winter and spring of reservoir drawdown, particularly for the portion of the population that spawns in tributaries upstream of the Trinity River. For that portion of the population, effects are anticipated on adults, run-backs, half-pounders, any juveniles rearing in the mainstem, and out-migrating smolts. However, the broad spatial distribution of steelhead in the Klamath Basin and their flexible life history suggests that some steelhead will avoid the most serious effects of the Project by remaining in tributaries for extended rearing, rearing farther downstream where suspended sediment concentrations

should be lower due to dilution, and/or moving out of the mainstem into tributaries and off-channel habitats during winter to avoid periods of high suspended sediment concentrations.

Additionally, the life history variability observed in steelhead means that, although numerous year classes will be affected, not all individuals in any given year class will be exposed to project effects. Some portion of the progeny of those adults that spawn successfully would also rear in tributaries long enough to not only avoid the highest suspended sediment concentrations, but may also not return to spawn for up to 2 years, when suspended sediment resulting from the Project should be greatly reduced. The high incidence of repeat spawning among summer steelhead, ranging from 40 to 64 percent (Hopelain 1998) should also increase that population's resilience to project effects. Project modeling results suggests the loss of up to 1,988 winter steelhead redds and up to 130 summer steelhead redds.

Green Sturgeon

Under the 2012 EIS/R most-likely-to-occur scenario and worst-case scenario, the Project was anticipated to have no effect relative to existing conditions on adult green sturgeon (USBR and CDFG 2012; Vol. I, p. 3.3-164). Because green sturgeon are distributed downstream of Ishi Pishi Falls (river mile [RM 66]) in the lower Klamath River (McCovey 2008), and generally do not enter the lower Klamath River until April, green sturgeon are likely to experience lower project-related suspended sediment concentrations. Tributary inputs between Iron Gate Dam and Ishi Pishi Falls will dilute suspended sediment concentrations, and green sturgeon entering the system later in spring will be subjected to near background water quality conditions as project effects diminish into summer. Green sturgeon also emigrate from the Klamath River in the fall (Benson et al. 2007) and are not expected to experience high suspended sediment concentrations associated with the early stages of the Project.

Green sturgeon in the Klamath River spawn on average of every four years, although males occasionally spawn every two years (McCovey 2010), and therefore up to 75 percent of the mature adult population (as well as 100 percent of sub-adults) are likely to be in the ocean during the spring and summer of reservoir drawdown and avoid effects associated with the Project. Green sturgeon are long-lived (>40 years) and are able to spawn multiple times (Klimley et al. 2007), so effects on two year classes may have little influence on the population as a whole (USBR and CDFG 2012).

5.1.3 2012 EIS/R AR-3

The 2012 EIS/R AR-3 (Vol. I, pp. 3.3-245 and 3.3-246) described the potential for augmented fall flows in the mainstem Klamath River downstream from Iron Gate Dam to encourage the outmigration of post-spawned green sturgeon from the lower Klamath River and to potentially increase the proportion of fall Chinook salmon, coho salmon, and steelhead spawning in tributaries. Green sturgeon outmigration from the Klamath River and increased tributary spawning by anadromous salmonids would reduce the number of fish exposed to elevated suspended sediment concentrations in the Klamath River as a result of the Project.

The 2012 EIS/R AR-3 suggested that water releases from the Klamath River Hydroelectric Reach reservoirs would mimic the natural hydrograph during a wet year prior to the dam deconstruction project, and flows

would be consistent with previous recommendations intended to recover endangered and threatened fishes in the Klamath River (National Research Council 2004). During a dry year, water balancing would need to be considered to meet the needs of other basin programs and ecological goals. The 2012 EIS/R AR-3 also stated that increasing fall flows would likely be most successful if elevated mainstem flows coincided with elevated tributary flows. Synchronized mainstem and tributary flows would create a large enough pulse of water to encourage upstream mainstem migration and unhindered access into tributary streams.

The 2012 EIS/R AR-3 also specified that spawning surveys could be conducted prior to reservoir drawdown to monitor the measure's effectiveness.

5.1.4 KRRC's and the ATWG's Review of AR-3 for Feasibility and Appropriateness

KRRC assessed the feasibility and appropriateness of the 2012 EIS/R AR-3 through multiple planning meetings held with the ATWG between May and August 2017. During these meetings, new information on Klamath River fisheries was presented and information on other dam removal projects conducted in the western United States was reviewed to understand how the aquatic ecosystem might respond to the Project. The ATWG's major concerns regarding the 2012 EIS/R AR-3 included:

- Uncertainty of water availability during fall prior to reservoir drawdown.
- Tributary flows influencing tributary spawning.
- Water needs during reservoir drawdown for sediment evacuation.
- Adult coho salmon locations at the time of the reservoir drawdowns.
- Green sturgeon outmigration timing.

Each of the ATWG's concerns are discussed in greater detail below.

Uncertainty of Water Availability Prior to Reservoir Drawdown

The ATWG is concerned that the extra water needed to create the fall pulse flows prior to reservoir drawdown may not be available depending on the water year, water rights, and other basin program needs. Given these concerns, water availability creates uncertainty and executing the measure may not be feasible. The ATWG concluded that the current operation plans in place for USBR's Klamath Project have been analyzed under a biological opinion (NOAA and USFWS 2013) and are sufficient to describe water releases throughout the year to meet biological goals in the basin.

Tributary Flows Influencing Tributary Spawning

The ATWG concluded that the proportion of tributary spawning by coho salmon and Chinook salmon is dictated by flows in natal tributaries and not by flow conditions in the mainstem Klamath River. Since many of the primary spawning tributaries are unregulated, fall flows will be determined by the meteorological conditions that occur during the fall prior to reservoir drawdown and thus cannot be predetermined. The

ATWG found that while some water leasing options could be pursued in the Shasta River, water leasing in other tributaries is unlikely based on a lack of existing water leasing agreements and therefore, tributary flows may have minimal influence on the number of spawning fish in the Klamath River. The ATWG also observed that efforts to use pulse flows in the past have been unsuccessful in moving large numbers of fish into the river or into tributary streams.

In summary, KRRC and the ATWG concluded that the prescribed fall pulse flows would have little or no effect on tributary streamflow and would not likely result in any additional tributary spawning during a dry year, and therefore should not be implemented as part of the Project.

Water Needs for Sediment Evaluation During Reservoir Drawdown

The ATWG expressed concerns that using available water volume for fall pulse flows could increase or extend the deleterious effects of elevated suspended sediment concentrations to other aquatic organisms in the Hydroelectric Reach and downstream from Iron Gate Dam due to insufficient water during reservoir drawdown. By using available water prior to reservoir drawdown, the ATWG expressed concern that less water during reservoir drawdown would result in less sediment being evacuated in the first year, causing prolonged sediment effects beyond the Project.

As such, KRRC and the ATWG concluded that using available storage water in the fall prior to reservoir drawdown could worsen or extend the deleterious effects of elevated suspended sediment concentrations on Klamath River focal species and stored water would be better used to evacuate as much sediment as possible during the Project.

Adult Coho Salmon Locations at Time of Reservoir Drawdown

KRRC and the ATWG concluded that since natural origin coho salmon primarily spawn in Klamath River tributaries, adult coho salmon will largely be unaffected by poor water quality conditions associated with reservoir drawdown in the mainstem Klamath River. Coho salmon peak spawning typically occurs in November and December after fall freshets contribute to tributary flows (USBR and CDFG 2012). Additionally, the low numbers of coho salmon that spawn in the mainstem Klamath River are mostly of hatchery origin (NOAA 2014).

KRRC and the ATWG therefore found that project effects to adult coho salmon will be minimal as the majority of coho salmon spawning takes place in tributaries, and that the implementation of fall pulse flows would not likely result in any further tributary spawning by natural origin coho salmon.

Green Sturgeon Outmigration Timing

KRRC and the ATWG found that while green sturgeon outmigration timing from the lower Klamath River and estuary is correlated to increasing streamflow and decreasing water temperatures, these conditions would likely occur naturally prior to reservoir drawdown and additional releases of water are unnecessary to promote outmigration. Benson et al. (2007) stated that outmigration of any holding green sturgeon occurred

during the first significant rainfall, usually in November and December. A green sturgeon tagging program in the lower Klamath River, has found no green sturgeon in either the Klamath River or Trinity River after mid-December (Barry McCovey, Yurok Tribe, personal communication, 2017).

KRRC and ATWG concluded that streamflow will naturally increase with fall rains, and no additional flow augmentation will be necessary to ensure that green sturgeon will outmigrate from the lower Klamath River and estuary prior to the Project.

2012 EIS/R Baseline Population Estimates and Project Effects Uncertainty

Effects to adult fish outlined in the 2012 EIS/R (Vol. II, Appendix E) included approximations and assumptions that were based on limited data on Klamath River anadromous salmonids and green sturgeon; incorporated a conservative analysis of fish avoidance behavior to the anticipated water quality conditions; and in part included a worst-case scenario analysis of project effects on adult Chinook and coho salmon, and green sturgeon. Additionally, the 2012 EIS/R effects determination assumed that fish would not exhibit behavioral responses to poor water quality, and instead would experience high mortality by voluntarily remaining in areas that had lethal concentrations of suspended sediment for extended periods of time.

Project Effects Uncertainty

Studies suggest that high suspended sediment concentrations (Newcombe and Jensen 1996; Chapman et al. 2014; Kjelland et al. 2015) and low dissolved oxygen concentrations (Bjorn and Reiser 1991; Washington Department of Ecology [WDOE] 2002; Carter 2005) affect adult salmonid behavior. Adult salmonid behavioral changes to high suspended sediment concentrations include avoidance of turbid waters in homing adult anadromous salmonids. Physiological effects of high turbidity include physiological stress and respiratory impairment, damage to gills, reduced tolerance to disease and toxicants, reduced survival, and direct mortality (Newcombe and Jensen 1996). Concentration and duration of elevated suspended sediment, as well as other factors including water temperature, disease, and river flow, influence the effect of suspended sediment on salmonids.

Very little information is available on the effects of suspended sediment on sturgeon, and most life stages of sturgeon are more resilient to poor water quality than salmonids (USBR and CDFG 2012).

Adult steelhead and Pacific lamprey entering the Klamath River during reservoir drawdown and dam removal would encounter poor water conditions and would be expected to avoid poor water quality by either entering tributary streams or using habitats less affected by high suspended sediment concentrations (e.g., tributary confluences or off-channel areas). For instance, in 2012 during dam deconstruction on the Elwha River, a high proportion (44 percent) of Chinook salmon redds were documented in two clear water tributaries (Indian Creek and Little River), while surveys conducted following dam removal activities (2014-2016) resulted in over 95 percent of Chinook redds constructed in the mainstem river. The high proportion of tributary spawning by fall Chinook salmon in 2012 suggests that these streams provided refugia from the effects of dam removal (McHenry et al. 2017). There is increasing evidence that fish will modify their behavior to avoid areas of high suspended sediment concentrations immediately following dam removal,

thereby reducing the impact of reduced water quality on their populations. This is consistent with ecological and evolutionary theories that would predict that fish would evolve behaviors to avoid episodic events resulting is poor water quality, such as landslides, fires, and other naturally occurring processes.

5.2 Summary of Rationale for Eliminating AR-3

The 2012 EIS/R AR-3 included fall pulse flows to promote adult Chinook salmon and coho salmon migration into tributary streams for spawning, and to encourage the outmigration of green sturgeon from the lower Klamath River and estuary in advance of the project. The 2012 EIS/R anticipated that these migratory behaviors in response to the fall pulse flows to reduce the effects of high suspended sediment concentrations on anadromous species in the mainstem Klamath River.

However, KRRC and the ATWG concluded that fall pulse flows would be difficult to execute due to unknown water availability and water needs of other water users in the basin. Additionally, the best available science suggests that higher mainstem flows would not improve tributary flow conditions unless higher tributary flows occurred concurrently with the mainstem pulse flows, or if water leasing could be undertaken on key tributaries. Chinook salmon, coho salmon, and green sturgeon have also evolved with the variable hydrology of the Klamath River and are likely to migrate into tributaries (Chinook and coho salmon) or to the Pacific Ocean (green sturgeon) with the onset of fall rain and increased flows which will precede the Project. Finally, implementing the fall pulse flows could also diminish available storage that could be used to maximize reservoir sediment flushing during reservoir drawdown. For these reasons, KRRC does not propose AR-3 as part of the Project.

Chapter 6: Iron Gate Hatchery Management

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6. IRON GATE HATCHERY MANAGEMENT

Under the Klamath Hydroelectric Project license, CDFW operates the Iron Gate Hatchery with funding from PacifiCorp. Under Section 7.6.6 of the KHSA, PacifiCorp will transfer the hatchery to CDFW at the time it transfers the Iron Gate Development to the KRRC. PacifiCorp will fund the operation of the hatchery for eight years after decommissioning of Iron Gate Development. CDFW will operate the hatchery; KRRC, PacifiCorp, and CDFW will enter into an agreement to implement these responsibilities.

The objective of the Iron Gate Hatchery management measure is to address reservoir drawdown and project effects on hatchery-produced Chinook salmon and coho salmon smolts that will be released from Iron Gate Hatchery during the spring of the reservoir drawdown year during periods of high suspended sediment concentration which are potentially lethal to outmigrating juvenile salmonids. The 2012 EIS/R AR-4 focused on delaying the release timing for hatchery produced smolts, or trucking hatchery smolts to downstream reaches of the Klamath River less affected by suspended sediment concentrations.

KRRC will cooperate with CDFW, which will implement this measure, so that Iron Gate Hatchery-reared yearling coho salmon scheduled to be released in the spring of the drawdown year would be held at Iron Gate Hatchery or at another facility (depending on Iron Gate Hatchery's operational capacity) until water quality conditions in the mainstem Klamath River improve to sublethal levels. Based on the current Iron Gate Hatchery release schedules and suspended sediment predictions in the Klamath River following dam removal, yearling coho salmon releases could be delayed to avoid lethal water quality conditions. Water quality monitoring stations established prior to reservoir drawdown will be used to determine when conditions in the mainstem Klamath River are suitable for the release of hatchery-reared coho salmon. CDFW, which will operate Iron Gate Hatchery, will implement this measure pursuant to the terms of the Iron Gate Hatchery Agreement and Section 7.6.6 of the KHSA.

6.1 Summary Affected Species, Anticipated Project Benefits and Effects, Recent Fisheries Literature, and Proposed Measure

The following sections review the components of the 2012 EIS/R AR-4, anticipated project effects and benefits on measure species, and recent fisheries literature relative to juvenile salmonid outmigration. This information is presented in support of the proposed measure.

6.1.1 Affected Species

Species that the measure is intended to address include:

- Coho salmon *(Oncorhynchus kisutch)* – SONCC ESU: Federally Threatened; California Threatened; Tribal Trust Species
- Chinook salmon *(O. tshawytscha)* – Upper Klamath-Trinity Rivers ESU - Fall Run: California Species of Special Concern; Tribal Trust Species

6.1.2 Anticipated Project Effects on Measure Species

The 2012 EIS/R concluded that short-term effects of the project would result in mostly sublethal, and in some cases lethal, impacts to a portion of the juvenile Chinook salmon, coho salmon, steelhead, and Pacific lamprey that are outmigrating from tributary streams to the Klamath River during late winter and early spring of 2020 (USBR and CDFG 2012). Deleterious short-term effects were expected to be caused by high SSC levels and low dissolved oxygen concentrations in the Klamath River from Iron Gate Dam downstream to Orleans. The 2012 EIS/R concluded that hatchery-produced Chinook and coho salmon smolts released from the Iron Gate Hatchery into this reach could suffer from high mortality if they are released during periods of high SSC levels as a result of the Project. Iron Gate Hatchery production goals include 75,000 yearling coho salmon, 900,000 yearling Chinook salmon, and 5,100,000 Chinook salmon smolts (CDFW and PacifiCorp 2014). Table 6-1 includes the production goals and typical release schedules for Iron Gate Hatchery. Table 6-2 includes the actual production for 2001 to 2017 (K. Pomeroy, CDFW, personal communication, 2017).

Table 6-1 Current Iron Gate Hatchery production goals and release schedules

Species	Release Type	Production Goal	Release Schedule
Coho Salmon	Yearling	75,000	March-April
Chinook Salmon - Fall	Yearling	900,000	November
Chinook Salmon - Fall	Smolt	5,100,000	May-June

Table 6-2 Iron Gate Hatchery actual annual production totals for 2001 to 2017

Release Year	Chinook	Coho	Steelhead	Total
2001	5,849,147	46,254	31,898	5,929,300
2002	5,880,294	67,933	141,362	6,091,591
2003	5,595,997	74,271	192,771	5,865,042
2004	5,777,904	109,374	148,991	6,038,273
2005	6,212,640	74,716	195,698	6,485,059
2006	7,046,755	89,482	83,034	7,221,277
2007	6,348,474	118,487	21,208	6,490,176
2008	6,394,875	53,950	18,461	6,469,294
2009	4,749,470	118,340	29,683	4,899,502

Release Year	Chinook	Coho	Steelhead	Total
2010	5,380,185	121,000	22,500	5,525,695
2011	4,882,247	22,236	21,034	4,927,528
2012	6,180,447	155,840	51,948	6,390,247
2013	5,091,396	39,402	-	5,132,811
2014	5,422,994	79,585	-	5,504,593
2015	4,738,180	89,500	-	1,035,004
2016	4,612,598	27,568	-	4,642,182
2017	1,431,471	17,102	-	429,805
Total	91,595,074	1,305,040	958,588	89,077,379
Max	7,046,755	155,840	195,698	7,221,277
Ave	5,387,946	76,767	79,882	5,239,846
Min	1,431,471	17,102	18,461	429,805

6.1.3 2012 EIS/R AR-4

The 2012 EIS/R AR-4 (Vol. I, p. 3.3-246) included two potential actions that could be implemented to reduce the impacts of high SSC levels on hatchery Chinook and coho salmon smolts as a result of the Project. The first action is to delay the coho salmon yearling release until later in the spring (e.g., early to mid-May) in order to avoid peak SSC levels associated with the Project. The 2012 EIS/R anticipated that avoiding the peak SSC levels would reduce smolt mortality.

The 2012 EIS/R AR-4 provided an alternative action to the delayed smolt release approach, which included allowing sub-yearling and yearling smolts to imprint at the hatchery and then truck them to Klamath River release locations downstream of the Trinity River where tributary flows are anticipated to reduce SSC levels to near background. The timing of the releases would have been consistent with normal hatchery release schedules.

The 2012 EIS/R AR-4 suggested that the implementation of this measure is contingent on the hatchery remaining open and having a suitable water supply during the Project.

6.1.4 KRRC's and ATWG's Review of AR-4 for Feasibility and Appropriateness

The KRRC assessed the feasibility and appropriateness of AR-4 through multiple planning meetings held with the ATWG between May and August 2017. During these meetings, new information on Klamath River fisheries and hatchery management was presented and information on other dam removal projects

conducted in the western United States was reviewed to understand how the aquatic ecosystem might respond as discussed above. The ATWG's major concerns regarding the 2012 EIS/R AR-4 included:

- Iron Gate Hatchery water supply uncertainty during and after the Project.
- Potential mortality associated with hauling and releasing juvenile salmonids.
- Potential Chinook and coho salmon juvenile imprinting and adult straying issues.

The following sections provide additional information regarding AR-4 feasibility and appropriateness, based on fisheries literature and ATWG input.

Iron Gate Hatchery Water Supply Uncertainty

The ATWG voiced concerns that the current water supply for the Iron Gate Hatchery is located in Irong Gate Reservoir which will no longer be operational following the Project. Additionally, high suspended sediment concentrations in the Klamath River during reservoir drawdown will require an alternative water source(s) or filtration of river water for use in the hatchery, as the water quality will not be sufficient for hatchery operation.

Potential Mortality Associated with Hauling and Releasing Juvenile Salmonids

The ATWG expressed concerns that long trucking distances could result in stress and handling mortality of transported fish and that truck or equipment malfunction could also result in smolt losses during transport. Studies confirm that transporting juvenile salmonids causes stress in smolts (Barton et al. 1980; Specker and Schreck 1980; Matthews et al. 1986), which may reduce survival when fish are released (Kenaston et al. 2001).

The ATWG concluded therefore that transporting hatchery Chinook and coho salmon smolts long distances downstream from Iron Gate Hatchery could lead to high mortality rates.

Potential Chinook and Coho Salmon Juvenile Imprinting and Adult Straying Issues

The ATWG observed that how juvenile salmonids are handled and transported may affect imprinting processes resulting in future straying of returning adults. Juvenile imprinting is influenced by natal stream water chemistry and the juvenile fish's physiological state during rearing and outmigration (Keefer and Caudill 2014). Juvenile fish with extended freshwater residency times, or long-distance migrations, almost certainly experience multiple imprinting events that contribute to homing success of adult spawners. Transporting juvenile fish has been shown to disrupt this 'sequential imprinting' process, and several studies on coho salmon (Solazzi et al. 1991) and Atlantic salmon (Gunnerød et al. 1988; Heggberget et al. 1991) have shown that adult homing success is inversely related to transport distance from rearing sites (Keefer and Caudill 2014).

Therefore, the ATWG concluded that release of juvenile fish downstream of the Trinity River could compromise the imprinting process for relocated juvenile fish. Insufficient imprinting to natal streams or the loss of spatially distinct imprinting events during outmigration could potentially increase adult straying rates

during future returns and result in the loss of genetic integrity in distinct populations. Future, elevated stray rates could result in a more homogenous distribution of fish returning to the lower Klamath River and also hinder the natural recolonization of areas upstream of Iron Gate Dam.

The ATWG found that releasing hatchery-reared fish downstream of the Trinity River could jeopardize future hatchery returns to the upper Klamath River and could increase straying rates that could negatively affect wild populations.

6.2 Summary

The 2012 EIS/R AR-4 included two strategies for addressing short-term project effects to hatchery-produced Chinook and coho salmon smolts. The two strategies included either delaying the release of Chinook salmon smolts and coho salmon yearlings, or the transport of these fish from Iron Gate Hatchery to the Lower Klamath River where the fish would be released into reaches less affected by poor water quality associated with the Project. Delaying the release of yearling coho salmon is not expected to require a substantial change in the typical hatchery release schedule and may only require a two-week delay in the release schedule. KRRC therefore recommends to CDFW that the release schedule be delayed to that limited extent. However, KRRC does not propose the trucking option because of concerns about potential juvenile stress and mortality, as well as increased stray rates of returning adults due to insufficient juvenile imprinting.

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Chapter 7: Pacific Lamprey Ammocoetes

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7. PACIFIC LAMPREY AMMOCOETES

The objective of the 2012 EIS/R AR-5 was to monitor the distribution and abundance of Pacific lamprey ammocoetes downstream of Iron Gate Dam. The 2012 EIS/R AR-5 involved capturing and relocating Pacific lamprey ammocoetes from the Klamath River starting at, and extending 2 miles downstream from Iron Gate Dam (RM 193.1). Relocating lamprey ammocoetes from this reach was expected to offset some of the potential effects of high suspended sediment concentrations and low dissolved oxygen levels during reservoir drawdown.

However, the KRRC does not intend to implement AR-5 as part of the Project. Based on the best available information on lamprey ammocoete presence in the Klamath River downstream from Iron Gate Dam, it is expected that Project effects to Pacific lamprey ammocoetes in the 2-mile reach downstream from Iron Gate Dam (RM 193.1) will be minimal.

7.1 Summary of the 2012 EIS/R AR-5, Project Benefits and Effects, and Recent Fisheries Literature

The following sections review the components of the 2012 EIS/R AR-5, anticipated project effects and benefits on Pacific lamprey ammocoetes, and recent fisheries literature relative to Pacific lamprey ammocoetes that support KRRC's decision not to include AR-5 as part of the Project.

7.1.1 Affected Species

Species intended to be addressed in the 2012 EIS/R AR-5 include:

- Pacific lamprey *(Entosphenus tridentatus):* California Species of Special Concern; Oregon Sensitive Species, Tribal Trust Species

7.1.2 Anticipated Project Effects on AR-5 Species

The short-term effects of the Project (high suspended sediment concentrations and low dissolved oxygen) are anticipated to result in high rates of ammocoete mortality, although there is uncertainty in how resilient ammocoetes are to extended periods of high suspended sediment concentrations and low dissolved oxygen (Goodman and Reid 2012). The 2012 EIS/R (Reclamation and CDFG 2012; Vol. II, Appendix E, pp. E52-E56) analysis applied the effects of suspended sediment on salmonids to predict effects on Pacific lamprey ammocoetes, with the assumption that effects on Pacific lamprey ammocoetes are equivalent to or less severe than on salmonids. However, the best available science indicates that this overestimates effects to lamprey ammocoetes since their preferred rearing strategy is to burrow in fine sediments mixed with organic matter. In general, most life stages of Pacific lamprey appear to be more resilient to poor water quality conditions (such as suspended sediment) than salmonids (Zaroban et al. 1999). Table 7-1 includes the

anticipated effects to Pacific lamprey ammocoetes presented in the 2012 EIS/R (Reclamation and CDFG 2012).

Table 7-1 2012 EIS/R anticipated effects summary for Pacific lamprey ammocoetes in the 2-mile reach of the Klamath River downstream from Iron Gate Dam

Species	Life Stage	Likely Effects	Worst Effects
Pacific Lamprey	Ammocoete Rearing	High mortality (52%)[1]	High mortality (71%)[1]

Source: USBR and CDFG 2012

The Project will have short-term effects on Pacific lamprey ammocoetes related to suspended sediment concentrations, bedload sediment transport and deposition, and impaired water quality (particularly low dissolved oxygen levels). Short-term effects on Pacific lamprey ammocoetesin the Klamath River are anticipated to be substantial because multiple year classes of Pacific lamprey rear in the mainstem Klamath River at any given time, and since adults will migrate upstream over the entire year, including January of the reservoir drawdown year when effects from the Project will be most pronounced. However, most of the population (which spans nearly the entire northern Pacific Rim), would not be affected by the Project because of the species' wide spatial distribution and varied life history. In addition, Pacific lamprey are considered to have low fidelity to their natal streams (FERC 2006), and may not enter the mainstem Klamath River if environmental conditions are unfavorable during the reservoir drawdown period. Migration into the Trinity River and other lower Klamath River tributaries may also increase during reservoir drawdown because of poor water quality in the upper Klamath River. Low site fidelity and a prevalence of tributary ammocoetes also increases the potential for Pacific lamprey recolonization of mainstem habitats following the Project.

The 2-mile reach of the Klamath River downstream from Iron Gate Dam (RM 193.1) was the focus of the proposed lamprey relocation efforts proposed in the 2012 EIS/R (Reclamation and CDFG 2012). However, at the time of the 2012 EIS/R, lamprey ammocoete presence downstream from Iron Gate Dam was unknown. Recent surveys have found very low numbers or absence of lamprey ammocoetes in the Klamath River between Iron Gate Dam and the Scott River (approximately 47 river miles; Goodman and Hetrick 2017). The low ammocoete density in this reach is presumably related to flow management, poor water quality, lack of sandy fines, and high deposition rates of organic material (Goodman and Reid 2015). Kostow (2002) also found Pacific lamprey ammocoete distributions can be patchy, perhaps due to environmental conditions, and Petersen (2006) related tribal eelers' belief that the effects of the dams on anadromous fish returns may affect marine-derived nutrients that sustain ammocoetes.

Tribal elders and eelers with the Yurok and Karuk Tribes were interviewed as part of a traditional ecological knowledge (TEK) project investigating the importance of Pacific lamprey to the lower Klamath River tribes (Petersen 2006). Eelers noted the dramatic reduction in Pacific lamprey since European-American settlement and specifically over the last 50 years. The construction of Iron Gate Dam, mining, forest fire suppression, commercial logging, other forestry practices including herbicide application, road building, rotenone treatments (see Jackson et al. 1996 for similar treatments in the Columbia Basin), periodic high

magnitude floods, and changing ocean conditions were frequently identified by these sources as reasons for Pacific lamprey declines in the basin (Petersen 2006). Of these impacts, loss of the natural flow regime on the Klamath River was highlighted as having the most detrimental effect on Pacific lamprey spawning and ammocoete rearing habitats. Dewatering of channel margin ammocoete rearing habitats downstream from Iron Gate Dam caused by hydropower ramping were also suspected in the decline of Pacific lamprey (Petersen 2006).

The Project will address some of the limiting factors that are believed to currently affect Pacific lamprey across their geographic region and in the Klamath River basin. Increasing connectivity across the river network and restoring connectivity between the Klamath River and tributaries in the Hydroelectric Reach will provide access to more Pacific lamprey spawning and rearing habitats (Schultz et al. 2014). Restoring more natural flow and temperature regimes, and transport of fine sediments downstream of Iron Gate Dam, will improve ammocoete rearing habitat conditions. Ammocoete rearing habitats are believed to be important for maintaining recruitment to the population as these areas provide pheromone-based migratory cues for spawning adults (Stone et al. 2002; Li et al. 2003) and may preserve lamprey population persistence (Jolley et al. 2016).

7.1.3 2012 EIS/R AR-5

The 2012 EIS/R AR-5 directed the capture and relocation of Pacific lamprey ammocoetes from preferred habitats in the reach of the Klamath River starting at, and extending 2 miles downstream from Iron Gate Dam. Relocating lamprey ammocoetes from this reach was expected to offset some of the potential effects of high suspended sediment concentrations and low dissolved oxygen levels during reservoir drawdown.

The 2012 EIS/R AR-5 included the following actions.

- Identify preferred habitat areas where dissolved oxygen levels would be particularly low, including pools, alcoves, backwaters, and channel margins that experience low water velocities and sand and silt deposition from the reach within 2 miles downstream from Iron Gate Dam.
- Conduct reconnaissance level surveys to assess if enough ammocoetes are present in this reach to warrant protection.
- The salvage operation, if implemented, would be conducted utilizing a specialized backpack electrofishing unit to capture ammocoetes. Captured individuals would be transported to suitable locations (with current low occurrences of lamprey) within tributaries upstream or upstream of Keno Dam.

7.1.4 KRRC's and the ATWG's Review of AR-5 for Feasibility and Appropriateness

The KRRC assessed the feasibility and appropriateness of AR-5 through multiple planning meetings held with the ATWG between May and August 2017. During these meetings, current information on Klamath River fisheries was presented and information on other dam removal projects conducted in the western United

States were reviewed to understand how the aquatic ecosystem might respond as discuss above. The ATWG's major concerns regarding the 2012 EIS/R AR-5 included:

- Pacific lamprey ammocoete absence in the prescribed 2012 EIS/R salvage reach.
- Potential effects of relocated Pacific lamprey ammocoetes on endemic lamprey species.
- Effects to the Pacific lamprey metapopulation.

The following sections provide additional information regarding feasibility and appropriateness of the 2012 EIS/R AR-5 based on supplemental information provided in the 2012 EIS/R, current fisheries research literature, and input from the ATWG.

Pacific Lamprey Ammocoetes Absence from Salvage Reach

Recent sampling efforts conducted by the Karuk Tribe and USFWS in the proposed salvage reach (2 miles downstream from Iron Gate Dam) found very few or no ammocoetes in sampled habitats (Goodman and Hetrick 2017; T. Soto, Karuk Tribe, personal communication, 2017). At 37 sites sampled in the Klamath River, ammocoetes were detected at an expected catch per unit effort at all locations except those within proximity to Iron Gate Dam (Goodman and Hetrick 2017). Goodman and Reid (2015) documented the 47-mile reach of the Klamath River from Iron Gate Dam to the Scott River as a zone containing few ammocoetes, presumably due to flow management, poor water quality, lack of sandy fines, and high deposition rates of organic material. Since river conditions and river management have not changed since these recent ammocoete surveys were completed, Pacific lamprey ammocoete habitation in the 2-mile reach downstream of Iron Gate Dam is unlikely. The ATWG concluded that further allocation of resources to sample ammocoetes from this reach is not warranted.

Effects of Relocated Pacific Lamprey Ammocoetes on Endemic Lamprey Ammocoetes

Currently, five other resident species of lamprey occur in the Klamath Basin. Although Pacific lamprey likely historically occupied the Upper Klamath Basin (Goodman and Reid 2015) and tribal knowledge relates that Pacific lamprey occupied habitats beyond the upstream limit of steelhead occupation (Petersen 2006), there are uncertainties regarding the historical overlap of Pacific lamprey and endemic lamprey species (ODFW 2008). The ATWG suggested that it would be difficult or impossible to differentiate larval lamprey ammocoetes of a variety of species during a field relocation effort. With this in mind, the ATWG expressed concerns regarding the potential effects of relocating non-target ammocoetes to areas upstream of Keno Dam or into Klamath River tributaries as the 2012 EIS/R AR-5 specified. Potential effects on endemic lamprey species could include competition for habitat and food, and disease transmission from relocated lamprey ammocoetes to existing populations. ODFW's 2008 draft of *A Plan for the Reintroduction of Anadromous Fish in the Upper Klamath Basin* sought a passive reintroduction strategy for Pacific lamprey. ODFW's current strategy is likely to follow a similar passive reintroduction process (T. Wise, ODFW, personal communication, 2017). The ATWG concluded that relocating salvaged lamprey ammocoetes from the mainstem Klamath River could pose significant risks to other endemic lamprey species.

Pacific Lamprey Metapopulation

Recent genetic analysis of Pacific lamprey suggests no significant population structure exists across populations or regions, indicating a high degree of historical gene flow even across expansive distances of the northern Pacific Rim (Goodman and Reid 2012). Klamath Basin Pacific lampreys are part of a more geographically-widespread interbreeding population that exhibits little basin-specific site fidelity (Goodman and Hetrick 2017). Because the metapopulation is now believed to extend potentially across the species' range, the percentage of the metapopulation's adult and larval Pacific lamprey that will be affected by the Project will be insignificant. The ATWG concluded that the potential loss of Pacific lamprey ammocoetes during the Project would be a temporary impact to the population and ammocoete mortality would constitute a minimal impact to the metapopulation.

7.2 Summary of Rationale for Eliminating AR-5

The Klamath River from Iron Gate Dam downstream to the Scott River (47 river miles) is referred to as a zone of low Pacific lamprey ammocoete densities. Recent sampling efforts conducted after the release of the 2012 EIS/R have detected few or no ammocoetes in this reach. Based on these sampling efforts and concerns regarding Pacific lamprey ammocoete relocation, KRRC does not propose AR-5 as part of the Project. Pacific lamprey are expected to benefit from the Project over the long-term due to the restoration of access to historical habitat upstream of Iron Gate Dam, fine sediment transport and local fining of channel bed sediments downstream of Iron Gate Dam, and improved water quality conditions.

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Chapter 8: Suckers

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8. SUCKERS

The objective of the suckers measure is to address reservoir drawdown and project effects on Lost River and shortnose suckers inhabiting the Hydroelectric Reach reservoirs by salvaging suckers from the reservoirs and relocating the salvaged suckers to waterbodies outside of the affected area. The 2012 EIS/R AR-6 focused on trapping and hauling Lost River, shortnose, and Klamath smallscale suckers. Lost River and shortnose suckers will be released into Upper Klamath Lake, and Klamath small smallscale suckers released into Spencer Creek, a tributary to the Klamath River in the Hydroelectric Reach. Based on a review of the information provided herein, the KRRC concluded that revisions to AR-6 are necessary to address anticipated short-term effects of the Project. The measure proposed as part of the Project includes a step-wise adaptive process for sampling, salvaging, and releasing Lost River and shortnose suckers into waterbodies that will not be affected by project effects.

8.1 Proposed Measure

Based on a review of the 2012 EIS/R AR-6 presented in Section 8.2 below, input from the ATWG, and recent Lost River and shortnose suckers literature, KRRC concluded that revisions to AR-6 is necessary to offset the anticipated short-term effects of the Project on Lost River and shortnose suckers. The proposed measure includes sampling, and salvaging and releasing suckers into designated waterbodies that are isolated from sucker recovery populations in Upper Klamath Lake. The proposed measure has two actions.

- **Action 1:** Lost River and shortnose suckers will be sampled in the Klamath River and in Hydroelectric Reach reservoirs in 2018, 2019, and 2020. River sampling will be completed in spring of 2019 and 2020, and reservoir sampling will be completed in fall of 2018 and 2019. Each sampling will require approximately 6 days for an estimated 24 days of sampling across the 2018 to 2020 period. The purpose of sampling is to document the abundance and genetics of Lost River and shortnose suckers in the Hydroelectric Reach. Captured fish will be marked with a passive integrated transponder (PIT) tag, fin clipped for genetic material, measured, and released. Recaptured fish will be used to estimate sucker abundance in the sampled reservoirs. Fin clips will be used to determine the genetics of the sampled fish. USFWS is currently developing genetic markers for Lost River and shortnose suckers.
- **Action 2:** Adult Lost River and shortnose suckers in reservoirs downstream from Keno Dam will be captured and relocated to isolated water bodies in the Klamath Basin. The proposed relocation of rescued suckers to isolated waterbodies is to ensure hybridized suckers do not mix with sucker populations designated as recovery populations in Upper Klamath Lake. An estimated 14 days will be required for salvage and release efforts. Due to the poor current understanding of Lost River and shortnose sucker populations in the reservoirs, we are unsure of the number of adult suckers inhabiting the reservoirs. Based on past study results (e.g., Desjardins and Markle 2000), we anticipate salvaging and translocating 100 adult Lost River and 100 adult shortnose suckers from each of the three Klamath River reservoirs (600 fish total). The number of translocated fish will not

exceed 3,000 fish, which is the capacity of the currently identified recipient waterbody (Tule Lake). The proposed actions are intended to reduce project effects on Lost River and shortnose suckers inhabiting the Hydroelectric Reach reservoirs. The following sections provide additional detail on the proposed actions.

8.1.1 Action 1: Reservoir and River Sampling

Lost River and shortnose suckers will be sampled in the Hydroelectric Reach reservoirs and the Klamath River in 2018, 2019, and 2020. Sampling in both the reservoirs and the Klamath River is anticipated to improve the number of fish encounters since suckers may not spawn every year (Buettner 2000) and the current population demographics are unknown.

River sampling will be completed in spring of 2019 and 2020, and reservoir sampling will be completed in fall of 2018 and 2019. The intent of the sampling is to document the abundance and genetics of Lost River and shortnose suckers in the Hydroelectric Reach. Sampling will include placing trammel nets in the reservoirs (reservoir sampling) and in Klamath River segments upstream of the reservoirs (river sampling) to determine the abundance and genetics of suckers in the Hydroelectric Reach. Electrofishing or other means of trapping suckers may also be employed if trammel netting is ineffective. Captured fish will be identified by species and sex, marked with a PIT tag (Burdick 2013), fin clipped for genetic material, measured, and released. Recaptured fish will be used to estimate sucker abundance, and fin clips will be used to determine the genetics of the sampled fish. Each sampling will require approximately 6 days for an estimated 24 days of sampling across the 2018 to 2020 period. Summary reports will be prepared following each sampling effort and the ATWG will meet to review the sampling data and determine if additional sampling is necessary. Collected data will be stored in a database managed by USFWS or USGS.

Primers will need to be developed from the genetic markers that USFWS's Abernathy Fish Technology Center identifies for Lost River and shortnose suckers. Genetic analysis of the sampled suckers will be used by managers to understand the genetics of Lost River and shortnose sucker populations in the Hydroelectric Reach. Genetic information will in part be used to determine appropriate salvaged suckers' release locations.

8.1.2 Action 2: Sucker Salvage and Relocation

Adult Lost River and shortnose suckers in reservoirs downstream from Keno Dam will be captured and relocated to isolated water bodies in the Klamath Basin using similar methods as outlined for the sampling. The proposed relocation of rescued suckers to isolated waterbodies is to ensure hybridized suckers do not mix with sucker populations designated as recovery populations in Upper Klamath Lake. An estimated 14 days will be required for salvage and release efforts. We anticipate salvaging and translocating 100 adult Lost River and 100 adult shortnose suckers from each of the three Klamath River reservoirs (600 fish total). The number of translocated fish will not exceed 3,000 fish, which is the capacity of the currently identified recipient waterbody (Tule Lake). During the course of these actions, it is not anticipated that the entire populations of suckers residing in the Hydroelectric Reach reservoirs will be recovered.

In summary, the proposed measure includes two actions to sample and then salvage and relocate Lost River and shortnose suckers from the Hydroelectric Reservoirs to Tule Lake.

8.2 Summary of Affected Species, Anticipated Project Benefits and Effects, Recent Fisheries Literature, the 2012 EIS/R AR-6, and the Proposed Measure

The following sections review anticipated project effects on Lost River and shortnose suckers, current sucker literature, and the 2012 EIS/R AR-6.

8.2.1 Affected Species

Species intended to be addressed in the 2012 EIS/R AR-6 include:

- Lost River sucker *(Deltistes luxatus)*: Federally Endangered; California Endangered and Fully Protected; Oregon Endangered; Tribal Trust Species
- Shortnose sucker *(Chasmistes brevirostris):* Federally Endangered; California Endangered and Fully Protected; Oregon Endangered; Tribal Trust Species
- Klamath smallscale sucker *(Catostomus rimiculus)*

8.2.2 Anticipated Project Effects on Measure Species

The Project will result in the loss of Lost River and shortnose sucker reservoir populations as the lake-type habitat these sucker species inhabit will be restored to free-flowing riverine conditions. Although sucker populations in the Hydroelectric Reach reservoirs are generally unknown (Buettner et al. 2006), past sampling efforts have documented larval and adult suckers in Topsy Reservoir (J.C. Boyle Dam; Desjardins and Markle 2000), Copco Reservoir (Copco 1 Dam; Beak Consultants 1987; Desjardins and Markle 2000), and Iron Gate Reservoir (Desjardins and Markle 2000). Table 8-1 includes the likely and worst-case effects to Lost River and shortnose suckers in the Hydroelectric Reach reservoirs.

Table 8-1 2012 EIS/R anticipated effects summary for Lost River and shortnose suckers

Species	Life Stage	Likely Effects	Worst Effects
Lost River & Shortnose Suckers	All	Loss of reservoir populations	Loss of reservoir populations

Source: USBR and CDFG 2012

The following section includes a description of species-specific effects adapted from the 2012 EIS/R (Reclamation and CDFG 2012; Vol. I, pp. 3.3-166 to 3.3-168) and other literature.

Lost River Suckers and Shortnose Suckers

Lost River and shortnose suckers are endemic to the Upper Klamath Basin (Moyle 2002). The Lost River sucker historically occurred in Upper Klamath Lake (Williams et al. 1985) and its tributaries, and the Lost River watershed, Tule Lake, Lower Klamath Lake, and Sheepy Lake (Moyle 1976). Shortnose suckers historically occurred throughout Upper Klamath Lake and its tributaries (Williams et al. 1985; Miller and Smith 1981). The present distribution of both species includes Upper Klamath Lake and its tributaries (Buettner and Scoppettone 1990), Clear Lake Reservoir and its tributaries (USFWS 1993), Tule Lake, Lost River up to Anderson-Rose Dam (USFWS 1993), and the Klamath River downstream to Copco Reservoir and probably to Iron Gate Reservoir (USFWS 1993). Shortnose sucker occur in Gerber Reservoir and its tributaries, but Lost River sucker do not.

The Project will eliminate existing reservoir habitat used by Lost River and shortnose suckers. The Lost River and shortnose suckers that have been observed in the Hydroelectric Reach reservoirs are believed to be fish that originated in Upper Klamath Lake and moved down through Lake Euwana and the Hydroelectric Reach (Buettner and Scoppettone 1991; Markle et al. 1999; Desjardins and Markle 2000). The populations are not thought to represent a viable, self-supporting populations (Buettner et al. 2006; USFWS 2012), and no longer interact with Upper Klamath Lake populations. The Hydroelectric Reach habitat is not designated critical habitat for either species, and Hydroelectric Reach populations are not part of the species' recovery units (USFWS 2012).

8.2.3 2012 EIS/R AR-6

The 2012 EIS/R AR-6 (Vol. I, pp. 3.3-247 to 3.3-248) directed a multi-step process that included a telemetry study to determine sucker locations in the Hydroelectric Reach reservoirs, followed by salvaging Lost River and shortnose suckers during the reservoir drawdowns, and releasing the salvaged suckers into Upper Klamath Lake. If deemed feasible prior to the Project, the 2012 EIS/R AR-6 called for Klamath smallscale suckers to be collected in a 2-mile reach downstream from J.C. Boyle Dam and transported for release into Spencer Creek immediately downstream of the Spencer Creek hook-up road (upper limits for sucker in Spencer Creek; Reclamation and CDFG 2012).

8.2.4 KRRC's and the ATWG's Review of AR-6 for Feasibility and Appropriateness

The KRRC assessed the feasibility and appropriateness of AR-6 through multiple planning meetings held with the ATWG between May and August 2017. During these meetings, current information on Klamath River fisheries was presented and information on other dam removal projects conducted in the western United States were reviewed to understand how the aquatic ecosystem might respond as discussed above. Major concerns of the ATWG regarding the 2012 EIS/R AR-6 include:

- Genetic integrity of salvaged suckers and effects on recipient populations.
- Relocation site availability.
- Klamath small scale sucker salvage.

- Designated critical habitat and sink populations.
- Telemetry study feasibility and benefit.
- 2012 EIS/R baseline population estimates and effects uncertainty.

The following sections provide additional information regarding these concerns, AR-6 feasibility and appropriateness based on fisheries literature and ATWG input.

Genetic Integrity of Salvaged Suckers and Effects on Recipient Populations

Klamath reservoir sucker populations have not been formally studied since the late 1990s (see Beak Consultants 1987; 1988; Desjardins and Markle 2000). Current population sizes, age class distribution, and genetic composition of Lost River and shortnose suckers are unknown, although genetic introgression between Lost River and shortnose suckers and Klamath smallscale suckers is suspected (Beak Consultants 1987; Markle et al. 1999). USFWS is concerned that the potential relocation of hybridized Lost River and shortnose suckers into Upper Klamath Lake could compromise the genetic integrity of recovery unit populations in Upper Klamath Lake. As Klamath smallscale suckers are very rare in Upper Klamath Lake (one has been found in Upper Klamath Lake; Markle et al. 1999), hybridized Lost River-Klamath smallscale suckers or shortnose-Klamath smallscale suckers in Upper Klamath Lake would create a novel sucker hybrid not known to exist in designated critical habitat (i.e., Klamath Basin upstream from Keno Dam). However, Markle et al. (1999) found more genetic similarity between Lost River suckers and Klamath smallscale suckers, and shortnose suckers and Klamath largescale suckers, although there also geographic-related differences among individuals within the respective species (e.g., Lost River suckers from Lost River and the Upper Klamath subbasins had meristic differences). Markle et al. (1999) concluded that Klamath Basin suckers are part of a species complex, or syngameon, defined as groups of interbreeding species that maintain their ecological, morphological, genetic, and evolutionary integrity in spite of hybridization (Templeton 1989 *cited in* Markle et al. 1999). In these hybrid species complexes, species integrity may be maintained by selection.

Based on the unknown genetic composition of suckers in the Hydroelectric Reach, KRRC and the ATWG concluded that relocating salvaged suckers to Upper Klamath Lake could threaten recovery populations and alternative release locations are necessary.

Relocation Site Availability

Salvaged sucker relocation sites must be isolated from Lost River and shortnose sucker populations inhabiting critical habitat or recovery areas to maintain the genetic integrity and health of recovery populations. Although it is unlikely that Lost River and shortnose suckers would have disease and parasite loads different from suckers in Upper Klamath Lake, such concerns further require the separation of salvage fish from recovery populations in the Upper Klamath Basin.

Tule Lake is the most likely relocation site for salvaged suckers. Tule Lake is an agricultural sump that is maintained by agricultural return flow. USFWS currently uses Tule Lake as a relocation site for Lost River and shortnose suckers salvaged from other areas in the basin, and the lake currently has the capacity for an

additional 3,000 relocated suckers (J. Rasmussen, USFWS, personal communication, 2017). Management of Tule Lake is complicated by multiple user groups and the periodic need to draw down the reservoir for sediment maintenance. USFWS is currently investigating other potential sucker relocation sites in the Upper Klamath Basin.

KRRC will coordinate with USFWS the release of salvaged suckers into Tule Lake or another isolated waterbody during the fall of 2020 salvage. USFWS will determine if/when suckers are translocated from Tule Lake to Upper Klamath Lake. USFWS' decision will in part depend on a better understanding of Hydroelectric Reach sucker genetics.

Klamath Smallscale Sucker Salvage

Klamath smallscale sucker is a riverine sucker species that historically inhabited the Klamath River below the Keno reef, and the adjacent Rogue River basin (Markle et al. 1999). The species is not known to inhabit Upper Klamath Lake or Upper Klamath Basin tributaries. Klamath smallscale sucker salvage would require sorting and releasing Klamath smallscale suckers at different locations than Lost River and shortnose suckers since the listed suckers are lake-type suckers (Buettner and Scoppettone 1991). ODFW also expressed concern with releasing salvaged Klamath smallscale suckers into Spencer Creek due to competition with the existing Spencer Creek sucker population (T. Wise, ODFW, personal communication, 2017). Although included in the 2012 EIS/R AR-6, Klamath smallscale sucker is not a federal or state listed species, and is not recognized as a tribal trust species. Therefore, KRRC and the ATWG agreed that Klamath smallscale sucker be removed from consideration in the proposed measure.

Designated Critical Habitat and Sink Populations

Hydroelectric Reach reservoirs and Klamath River downstream from Keno Dam were not designated as critical habitat by USFWS (2012). The sucker populations inhabiting the Klamath reservoirs are part of the Upper Klamath Lake Recovery Unit, however, they are sink populations that will likely never be viable and therefore are not actively managed for recovery (USFWS 2012). USFWS does not consider the preservation of the Hydroelectric Reach reservoirs or the sucker populations within them to be a requirement for Lost River and shortnose sucker species recovery.

Telemetry Study

Based on research in Upper Klamath Lake and past studies in the Klamath River reservoirs, USFWS and the U.S. Geological Survey (USGS) are in support of a multi-stage sampling and salvage effort that would use passive integrated transponder (PIT) tag technology to mark suckers. Lost River and shortnose suckers would be netted during a two-year sampling effort prior to reservoir drawdown (2018 and 2019) and marked to estimate population sizes and demographics for suckers in the Hydroelectric Reach reservoirs. Sampling would occur in the reservoirs in the fall and in reaches of the Klamath River upstream of the reservoirs in the spring. Fall sampling would focus on shallow areas in the reservoirs and spring sampling would target sucker spawning migrations as fish leave the reservoirs and enter river reaches for spawning (Janney et al. 2009; Hewitt et al. 2014). Genetic material collected during the sampling phase would be used to develop genetic

profiles of reservoir suckers and inform the sucker relocation effort. Suckers would be relocated during salvage efforts in the spring and fall of prior to drawdown. Based on this information, we have concluded the proposed PIT tag study will be more informative and less costly to implement relative to the originally proposed telemetry study.

2012 EIS/R Baseline Population Estimates

Desjardins and Markle (2000) provided the most comprehensive population estimates for suckers in the Hydroelectric Reach reservoirs. The number of adult shortnose suckers was estimated to be highest in Copco Reservoir (n=165), followed by J.C. Boyle (n=50), and then Iron Gate (n=22). Larger and older individuals dominated Copco and Iron Gate reservoirs and little size structure was detected. J. C. Boyle tended to have smaller adult shortnose suckers and many size classes were present. It appeared that recruitment of young-of-the-year suckers only occurred in J.C. Boyle with downstream reservoirs recruiting older individuals, perhaps those that had earlier recruited to J.C. Boyle Reservoir.

No new baseline population data have been produced for suckers inhabiting the Hydroelectric Reach reservoirs since the issuance of the 2012 EIS/R. However, anecdotal evidence (B. Tinniswood, ODFW, personal communication, 2017) suggests more suckers may inhabit the reservoirs than previously anticipated (e.g., Buettner and Scoppettone 1991; Beak Consultants 1987). USFWS's Abernathy Fish Technology Center, Longview, Washington, is also currently undertaking a genetic analysis of Lost River, shortnose, and other basin sucker species to identify genetic markers that may be used to differentiate suckers in the future. The Abernathy lab is anticipated to produce a report on sucker genetics by summer or fall of 2018.

8.3 Summary

The Project is anticipated to have significant short-term effects on Lost River and shortnose suckers in the Hydroelectric Reach. Because the reservoirs will be restored to free-flowing historical conditions and the special-status suckers are lake-type suckers, individuals of these species that remain in the Hydroelectric Reach following dam removal are not expected to survive. The 2012 EIS/R AR-6 included a telemetry study to assess potential sucker locations in the Hydroelectric Reach, followed by a sucker salvage effort to remove fish from the reservoirs and transport them to Upper Klamath Lake for release. The ATWG and KRRC have concerns with the 2012 EIS/R AR-6, including the genetic integrity of Hydroelectric Reach suckers, relocation site availability, the need to salvage Klamath smallscale suckers, and the feasibility and benefit of the proposed telemetry study. Therefore, KRRC and the ATWG determined that revisions to AR-6 were warranted.

The proposed measure, includes two primary actions including reservoir and river sampling, and sucker salvage and release into appropriate waterbodies selected by fisheries managers. The proposed measure is anticipated to maximize the survival of Lost River and shortnose suckers currently inhabiting the Hydroelectric Reach. The number of translocated fish will not exceed 3,000 fish, which is the capacity of the currently identified recipient waterbody (Tule Lake). During the course of these actions, it is not anticipated that the entire populations of suckers residing in the Hydroelectric Reach reservoirs will be recovered.

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Chapter 9: Freshwater Mussels

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9. FRESHWATER MUSSELS

The objective of the freshwater mussels measure is to address reservoir drawdown and project effects on freshwater mussels located in the Klamath River in the Hydroelectric Reach and downstream from Iron Gate Dam (RM 193.1). The 2012 EIS/R AR-7 focused conducting a freshwater mussel relocation pilot study followed by the salvage and relocation of freshwater mussels prior to reservoir drawdown. Salvaged mussels were to be held in a temporary location for later placement following reservoir drawdown, and placed in locations that will not be affected by the reservoir drawdown. Based on a review of the information discussed in greater detail below, KRRC and the ATWG concluded that a moderate scale freshwater mussel relocation effort is warranted. The proposed measure includes a freshwater mussel reconnaissance in 2019 followed by a limited freshwater mussel salvage prior to reservoir drawdown. Specifically, KRRC will salvage freshwater mussels from the 8-mile long Iron Gate Dam (RM 193.1) to Cottonwood Creek (RM 185.1) reach and translocate these mussels to the Klamath River between the upstream extent of J.C. Boyle Reservoir (RM 234.1) and Keno Dam (RM 239.2).

9.1 Proposed Measure

Based on a review of the 2012 EIS/R AR-7 presented in Section 9.2 below, input from the ATWG, and current freshwater mussels literature, the KRRC concluded that revisions to AR-7 are necessary to offset the anticipated short-term effects of the Project on freshwater mussels. The proposed measure includes a reconnaissance, salvage, and relocation of freshwater mussels from the 8-mile reach between Iron Gate Dam and the Cottonwood Creek confluence with the Klamath River. The monitoring and adaptive management plan has two specific actions.

- **Action 1:** KRRC will complete a reconnaissance in 2019 to assess the distribution and density of freshwater mussels in the 8-mile long bedload deposition reach from Iron Gate Dam (RM 193.1) downstream to the Cottonwood Creek confluence (RM 185.1). The reconnaissance effort will determine if the mussel beds identified in the 2007-2010 surveys are still present, and estimate abundance of a subset of the mussel beds in the reach.
- **Action 2**: Based on the reconnaissance, KRRC will salvage and relocate a portion of the freshwater mussels located between Iron Gate Dam and Cottonwood Creek prior to drawdown to reduce project effects to the mussel community. Up to 20,000 mussels are planned for translocation to appropriate habitats in the Klamath River between the upstream extent of J.C. Boyle Reservoir (RM 234.1) and Keno Dam (RM 239.2).

The proposed measure is intended to reduce project effects on freshwater mussels located downstream from Iron Gate Dam. The following sections provide additional detail on the proposed measure actions.

9.1.1 Action 1: Freshwater Mussel Reconnaissance

The KRRC will prepare a reconnaissance plan to assess freshwater mussels in the Iron Gate Dam to Cottonwood Creek reach in 2018. Habitat conditions will also be evaluated from the upstream extent of J.C. Boyle Reservoir (RM 234.1) upstream to Keno Dam (RM 239.2) to determine the habitat capacity for translocated mussels. An existing freshwater mussel data set (base data for Davis et al. 2013), compiled by the Karuk Tribe, USFWS, and other collaborators from 2007 to 2010 for the Klamath River downstream from Iron Gate Dam, will be reviewed and used to plan the reconnaissance. The reconnaissance will confirm mussel beds identified in the 2007-2010 surveys and estimate abundance at a subset of the mussel beds locations. Habitat metrics in the potential translocation reach will be evaluated to maximize translocation success. The freshwater mussel reconnaissance and translocation reach habitat assessment are anticipated to take 5 days.

9.1.2 Action 2: Freshwater Mussel Salvage and Relocation

The KRRC will coordinate and implement a freshwater mussel salvage plan with freshwater mussel specialists. Based on the reconnaissance, a portion of the freshwater mussels located between Iron Gate Dam and Cottonwood Creek will be salvaged and relocated to reduce project effects to the freshwater mussel community. The freshwater mussel salvage and translocation effort is anticipated to require 10 days. The percentage of the existing mussel beds that will be salvaged and translocated is predicated on the available habitat in the Klamath River from the upstream extent of J.C. Boyle Reservoir to Keno Dam, and the abundance of mussels between Iron Gate Dam and Cottonwood Creek. Approximately 15,000 to 20,000 mussels are planned for translocation. During the course of these actions, it is not anticipated that the entire population of mussels residing below Iron Gate Dam will be recovered.

9.2 Summary of the Affected Species, Anticipated Project Benefits and Effects, Recent Literature, 2012 EIS/R AR-7, and Proposed Measure

The following sections review the components of the 2012 EIS/R AR-7, anticipated project effects and long-term benefits on freshwater mussels, and current freshwater mussel literature.

9.2.1 Affected Species

Species intended to be addressed in the 2012 EIS/R AR-7 include:

- Oregon floater *(Anodonta oregonensis)*
- California floater *(A. californiensis)*
- Western ridged mussel *(Gonidea angulata)*
- Western pearlshell mussel *(Margaritifera falcata)*

9.2.2 Anticipated Project Effects on Measure Species

Short-term effects of the Project (prolonged exposure to high suspended sediment levels and bedload movement) are predicted to be deleterious to freshwater mussels in the Hydroelectric Reach and in the lower Klamath River downstream from Iron Gate Dam (Reclamation and CDFG 2012). Substantial freshwater mussel population reductions are expected due to sediment effects and possibly low dissolved oxygen levels. The change in hydrological properties following project implementation may also disrupt the current distribution of freshwater mussels downstream from Iron Gate Dam (Davis et al. 2013). Table 9-1 includes the likely and worst-case effects on freshwater mussel species in the Klamath River.

Table 9-1 2012 EIS/R anticipated effects summary for freshwater mussels

Species	Life Stage	Likely Effects	Worst Effects
California Floater Oregon Floater Western Ridged Western Pearlshell	All	Substantial reduction in populations	Substantial reduction in populations

Source: USBR and CDFG 2012

The following sections include descriptions of anticipated effects to freshwater mussels based on information 2012 EIS/R (Reclamation and CDFG 2012; Vol. 1, pp. 3.3-173 to 3.3-175) as well as additional information from additional freshwater mussel studies, some of which were completed after the publication of the 2012 EIS/EIR.

Freshwater Mussels

Available studies have evaluated Klamath River Basin freshwater mussel age structure, growth rates, and size distribution (*G. angulata*; Tennant 2010); population distribution and habitat use (Krall 2010; Davis et al. 2013; May and Pryor 2015); and habitat associations (Westover 2010; Davis et al. 2013). Klamath River mussels are long lived (from 10 to more than 100 years, depending on species) and may not reach sexual maturity until 4 years of age or more. *Anodonta* species are found primarily downstream from Iron Gate Dam, and likely benefit from the stable hydrology and fine sediment deposits attributed to hydroregulation below the dam (Davis et al. 2013). *G. angulata* is the most abundant freshwater mussel in the Klamath River and the species is widely distributed between Iron Gate Dam and the Trinity River (Westover 2010; Davis et al. 2013). *M. falcata* is the least abundant freshwater mussel found in the Klamath River and seems to be mostly found downstream from the confluence of the Salmon River (Westover 2010; Davis et al. 2013).

Freshwater mussel tolerance of high suspended sediment, low dissolved oxygen, and bedload deposition are not well understood. Vannote and Minshall (1982) evaluated freshwater mussels in an aggrading river system in Idaho and concluded that *G. angulata* appear to be better adapted for aggrading rivers based on siphon positions, shell morphology, and foot placement in the underlying substrate. *M. falcata* seemed to be less adapted for aggrading rivers due to a less developed siphon for filtering water. *M. falcata* also rarely

burrow into substrate more than 25-40 percent of the valve length which may increase the mussel's susceptibility to scour (Vannote and Minshall 1982). *G. angulata* migrate vertically in the channel bed and are capable of maintaining position near the channel bed surface (Vannote and Minshall 1982). *M. falcata* are not known to migrate and are therefore more susceptible to sediment burial. *Anodonta* species are likewise susceptible to sediment scour and burial due to their thinner shells. Mussels that are dislodged from their normal vertical position and fall onto their sides may not regain the normal position and may perish (Vannote and Minshall 1982).

Mussels play important roles in aquatic ecosystems. Mussels influence water quality, nutrient cycling, and habitat and are also known as "ecosystem engineers" that actively modify their environment (Xerces Society 2009; Lopes-Lima et al. 2016; Lummer et al. 2016). They filter fine sediment and organic particles, create byproducts that are food items for macroinvertebrates, and comprise the greatest proportion of animal biomass in some waterbodies (Xerces Society 2009). In the Klamath River Basin, freshwater mussels filter and sequester toxins including toxigenic algae microsystins (Kann et al. 2010) and mercury (Bettaso and Goodman 2010). Filtration of waterborne toxins may result in bioaccumulation in freshwater mussels leading to human consumption risks (Bettaso and Goodman 2010; Kann et al. 2010).

The Project is anticipated to result in high suspended sediment levels and bedload deposition in the 8 miles of the Klamath River between Iron Gate Dam and Cottonwood Creek. Extremely poor water quality due to high suspended sediment concentrations is expected in the first 2 miles of the Klamath River downstream from Iron Gate Dam (Reclamation and CDFG 2012). Fine sediment effects on freshwater mussels include gill clogging, possible growth reduction, and impairment to mussel larval stages (Lummer et al. 2016). Due to both the anticipated deleterious high suspended sediment concentrations and low dissolved oxygen levels, freshwater mussels downstream from Iron Gate Dam may experience substantial mortality with the most significant impacts anticipated to mussels located immediately downstream from Iron Gate Dam.

Over the long-term, freshwater mussels are expected to benefit from the Project through the conversion of Hydroelectric Reach reservoirs to gravel bed rivers which will restore freshwater mussel habitat, reduce water quality and water temperature impairments related to the reservoirs, and restore access for anadromous and resident host fish species that will distribute freshwater mussel larvae throughout the Klamath River upstream from Iron Gate Dam. However, due to the long time freshwater mussels take to reach sexual maturity, the recolonization and/or growth of existing freshwater mussel populations upstream of Iron Gate Dam may be slow and may not be readily noticeable for some time.

9.2.3 2012 EIS/R AR-7

The 2012 EIS/R AR-1 (Vol. I, pp. 3.3-248 to 3.3-249) directed the salvage of freshwater mussels from the Hydroelectric Reach and downstream from Iron Gate Dam. Salvaged mussels were to be relocated to suitable instream habitat unaffected by high suspended sediment concentrations, or could be placed in temporary facilities and returned to the Klamath River following the Project. A salvage and relocation pilot study was also suggested to assess salvage feasibility and relocated mussel survival. Based on the pilot study results, a detailed salvage and relocation plan was to be developed.

9.2.4 KRRC's and the ATWG's Review of AR-7 for Feasibility and Appropriateness

The KRRC assessed the feasibility and appropriateness of AR-7 through multiple planning meetings held with the ATWG between May and August 2017. During these meetings, current information on Klamath River fisheries was presented and information on other dam removal projects conducted in the western United States was reviewed to understand how the aquatic ecosystem might respond, as discussed above. The ATWG's concerns regarding the 2012 AR-7 included:

- Unfamiliarity with successful freshwater mussel relocation efforts.
- Disease transmission concerns.

The following sections provide additional information regarding AR-7 feasibility and appropriateness, based on fisheries literature and ATWG input.

Unfamiliarity with Successful Freshwater Mussel Relocation Efforts

The ATWG was unfamiliar with successful freshwater mussel translocation efforts. Anecdotal information discussed during the ATWG planning meeting (Yreka, CA, May 23, 2017) alluded to low translocation success for the Elwha Dam Removal Project and highway construction projects. Additional information was acquired by the KRRC on the Elwha Dam Removal Project freshwater mussel (*M. falcata*) translocation. For that project, freshwater mussels were translocated to two sites and remained in one site prior to the dam removal project (P. Crain, U.S. Park Service, personal communication, 2017). The relocated freshwater mussels had high survival following the translocation and prior to the dam removals. Subsequent events that impacted the translocated mussels resulted in high mussel mortality. The events included raccoon predation due to shallow habitat at the first translocation site, and excessive sediment deposition at a side channel translocation site. The third monitored site was an artificial outfall channel from the water treatment facility that went dry due to inadvertent project operations. Mussels that remained in the Elwha River downstream from Elwha Dam are suspected to have experienced high mortality due to excessive sediment deposition following dam removal, followed by channel scour during the post-dam sediment sorting process.

Freshwater mussel translocation project monitoring results are not well represented in the fisheries literature. Unpublished freshwater mussel translocation monitoring manuscripts were reviewed to better understand the range of potential translocation success. Fernandez (2013) described the translocation success of 265 individual *M. falcata* in coastal southwest Washington. Between 55 percent and 95 percent of the transplanted *M. falcata* were accounted for in the translocation sites between one and three years following the translocation.

A review of translocation projects found mean mortality of relocated mussels was 49 percent based on an average recovery rate of 43 percent (Cope and Waller 1995). Cope and Waller (1995) found that survival of relocated mussels was generally poor and the factors influencing the survival of relocated mussels were poorly understood. For mussel relocation to be successful, more consideration must be given to habitat characterization at both the source and translocation sites. Olden et al. (2010) and Germano et al. (2015)

offer considerations for successful freshwater organism and wildlife translocation efforts, respectively Luzier and Miller (2009) offer suggestions and considerations for freshwater mussel translocations.

Disease Transmission Concerns

The role of freshwater mussels in freshwater disease transmission is not well understood. Freshwater mussels are known to provide habitat for polychaete worms, one of the hosts in the life *C. shasta*. Polychaetes have been infrequently collected from freshwater mussel shells in the Hydroelectric Reach of the Klamath River (PacifiCorp 2004). Mussels may serve as a vector for other fish pathogens like *Flavobacterium columnare* and *Ichthyophthirius multifiliis* that are endemic to the Klamath River Basin (K. Kwak, CDFW, personal communication 2017).

Freshwater mussels inhabit the Klamath River upstream from Iron Gate Dam (Byron and Tupen 2017) and in tributaries upstream (Byron and Tupen 2017) and downstream from Iron Gate Dam (Davis et al. 2013; Howard et al. 2015; May and Pryor 2015), disease transmission may be less of a concern.

9.3 Summary

The Project is anticipated to have significant short-term effects, but long-term benefits for freshwater mussels. The 2012 EIS/R AR-7 included a freshwater mussel salvage and relocation pilot study followed by an informed salvage and relocation plan prior to the Project. The proposed measure includes completing a reconnaissance of existing freshwater mussels from Iron Gate Dam to Cottonwood Creek and potential relocation habitat between the upstream extent of J.C. Boyle Reservoir and Keno Dam. KRRC will salvage and relocate freshwater mussels prior to the reservoir drawdown. It is not anticipated that the entire population of mussels residing below Iron Gate Dam will be recovered.

Chapter 10: References

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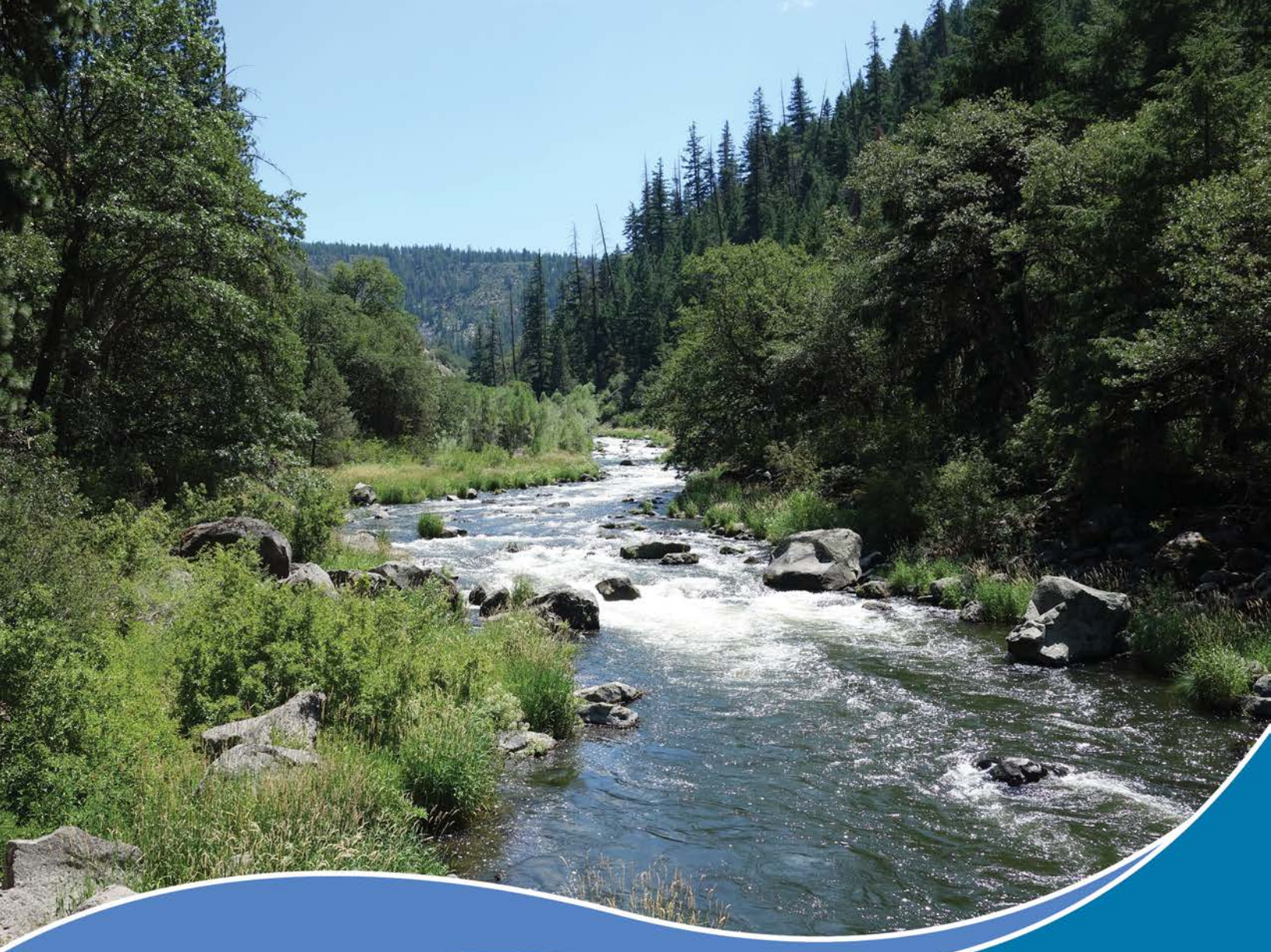

Definite Plan for the Lower Klamath Project

Appendix J - Terrestrial Resource Measures

KLAMATH
RIVER RENEWAL
CORPORATION

June 2018

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Attachments

Attachment A Northern Spotted Owl Figures
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Acronyms

BA	Biological Assessment
BLM	Bureau of Land Management,
BO	Biological Opinion
CDFW	California Department of Fish and Wildlife
CESA	California Endangered Species Act
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CWHRS	California Wildlife Habitat Relations System
DBH	diameter at breast height
EIS/R	Environmental Impact Statement/Environmental Impact Report
GIS	geographic information system
IPaC	Information for Planning and Consultation
MBTA	Migratory Bird Treaty Act
mph	miles per hour
NCASI	National Council for Air and Stream Improvement, Inc.
NED	National Elevation Dataset
NISIMS	National Invasive Species Information Management System
NMFS	NOAA National Marine Fisheries Service
NSO	Northern Spotted Owl
ODA	Oregon Department of Agriculture

ODFW	Oregon Department of Fish and Wildlife
ODSL	Oregon Department of State Lands
ONHP	Oregon Natural Heritage Program
ORBIC	Oregon Biodiversity Information Center
ORWAP	Oregon Rapid Wetland Assessment Protocol
RHS	Relative Habitat Suitability
USFWS	U.S. Fish and Wildlife Service
USFS	U.S. Forest Service
USGS	U.S. Geological Survey

Chapter 1: Northern Spotted Owl Measures

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1. NORTHERN SPOTTED OWL MEASURES

1.1 Objectives

The primary objective of the Northern Spotted Owl (NSO) *(Strix occidentalis)* measures is to identify any NSO activity centers (including any nesting sites) within the project area. As FERC's designated non-federal representative pursuant to 50 CFR § 402.08, KRRC is developing a Biological Assessment to evaluate effects on NSO and other federally listed species. KRRC is coordinating with the U.S. Fish and Wildlife Service (USFWS) and NOAA National Marine Fisheries Service (NMFS) on the development of the draft Biological Assessment. The first step is to conduct surveys in suitable habitats as described below. If KRRC identifies NSO activity centers within the project area, the design plans and/or construction methods or sequencing will be modified to avoid and minimize potential effects on NSO.

The 2012 Final EIS/R (USBR and CDFW 2012) TER-2 described measures to reduce project impacts on nesting birds including NSO. The 2012 EIS/R recommended surveys to identify the locations of active nests and then to incorporate that information into the project design and construction planning to avoid impacts. This measure has been incorporated as part of the Project and will be implemented as described in the following sections. The objective of the proposed TER-2 is to identify, document, and confirm spotted owl presence, and use of areas that may be directly or indirectly disturbed by project construction activities including noise. KRRC will use that information to develop a plan in coordination with the USFWS and California Department of Fish and Wildlife (CDFW) to provide avoidance and minimization measures for NSO and NSO habitat and use.

1.2 Methods

Study methods include a desktop evaluation, selection of calling stations, and field surveys. Initially biologists compiled existing data on known NSO occurrences and spatial information on habitat suitability to select calling stations. KRRC conducted a field reconnaissance survey in October 2017 to view and refine calling station locations. The methodology for NSO surveys is based on the 2012 USFWS NSO Survey Protocol (USFWS 2012b).

1.2.1 Desktop Evaluation

KRRC conducted a desktop review of existing databases (including California Natural Diversity Database [CNDDB] and the Oregon Biodiversity Information Center [ORBIC]) to identify known NSO detections and activity centers in the project area. During PacifiCorp surveys in 2002-2003, NSO presence was documented

near J.C. Boyle Reservoir and southeast of Copco No. 1 Reservoir (PacifiCorp 2004). Figures A-1 and A-2, respectively, show these detections.

In addition to the 2002-2003 PacifiCorp protocol surveys, information was obtained from USFWS, U.S. Department of the Interior, Bureau of Land Management (BLM), and U.S. Forest Service (USFS) biologists, and the National Council for Air and Stream Improvement, Inc. (NCASI), a nonprofit research institute focusing on issues of concern to timber and other forest products companies. There were no NSO detections during NCASI surveys in 2002 and 2003, and NCASI no longer surveys for NSO in the project area (Verschuyl, pers. comm., 2017).

BLM (Hayner 2017) confirmed there are no known NSO territories within the 1-mile noise disturbance buffer from potential blasting at the J.C. Boyle Dam (described below) or within 0.5 miles of the limits of work. USFS (Freeling 2017) confirmed a known NSO activity center located approximately 1.3 miles southeast of the eastern end of Copco Lake and over 5 miles southeast of the Copco No. 1 Dam and powerhouse. Based on CNDDB records, this activity center has been monitored by USFS since 1988. Surveys over the years have confirmed NSO nesting activity, and adults and young have been banded by USFS biologists.

Therefore, based on the desktop evaluation, no NSO activity centers have been documented within the disturbance distances established in the Biological Assessment (i.e., 1 mile from blasting at dams, 0.5 miles from limits of work) (Biological Assessment (BA), U.S. Bureau of Reclamation [USBR] 2011) for the anticipated construction activities. KRRC will confirm this through field surveys, as described below.

The J.C. Boyle powerhouse is located within designated critical habitat for NSO. KRRC does not anticipate effects on designated critical habitat at the J.C. Boyle facilities because removal of the facilities will not involve the removal of forest cover and will provide opportunities for habitat restoration. Removal of mature trees will occur at the proposed disposal site at J.C. Boyle, which does not provide suitable NSO habitat, as described below. The proposed disposal site is not located within designated critical habitat for NSO.

1.2.2 Selection of Calling Stations

USFWS provided KRRC with a Relative Habitat Suitability (RHS) model, which uses 2012 vegetation information (Galloway 2017). The RHS model indicates "highly suitable habitat" for NSO occurs adjacent to the J.C. Boyle powerhouse and approximately 1 mile away from the J.C. Boyle Reservoir. BLM also provided 2014 NSO habitat suitability data for the J.C. Boyle project area. Based on a review of historical aerial photography, timber harvest has been conducted in several locations within the project area. Ongoing habitat alteration due to logging is not reflected in the USFWS or BLM habitat suitability data. It is likely that this alteration has reduced the habitat suitability for NSO within the noise disturbance areas.

Based on the habitat suitability information and verified during the field reconnaissance described below, suitable NSO habitat is not present within 1 mile of the Copco or Iron Gate Dams and facilities. Suitable habitat includes mature or old-growth forests containing large diameter trees with multiple canopy layers in areas with high canopy closure and complex structure. Based on the USFWS RHS, the nearest suitable habitat is approximately 3 miles southeast of the Copco No. 1 Dam and over 5 miles from Iron Gate Dam.

To develop proposed calling stations, KRRC evaluated aerial imagery with topographic contours against the habitat suitability information and the limits of work, with haul and access roads and the boundaries of staging and disposal areas defined to the extent possible. Information on construction equipment and details regarding activities such as the potential for blasting (i.e., where it will occur, frequency, duration, and season) was used to outline potential calling stations based on the noise disturbance distances established in the BA. KRRC also considered Activities such as grading or other use of heavy machinery that may occur during restoration of the reservoir areas.

KRRC conducted a focused field reconnaissance in October 2017 by CDM Smith biologists and USFWS biologist Bob Carey to evaluate proposed calling stations. During the reconnaissance, these biologists visited each of the proposed calling stations and noted the habitat present, ambient noise and acoustics, topography, and accessibility for nighttime surveys. Based on the findings of the field reconnaissance, KRRC revised calling station locations as appropriate to cover existing suitable habitat and to ensure adequate coverage of all suitable habitat. Figures 1-3 in Attachment A show calling stations.

The boundaries of the proposed disposal site at J.C. Boyle Dam are still being refined, although KRRC has identified the general location. A portion of the approximately six-acre disposal site is disturbed; however, trees will be removed from a forested area consisting of approximately 2 acres. During the field reconnaissance in October 2017, KRRC noted that trees that may be removed at the disposal site consist primarily of Ponderosa pines ranging between approximately 16 to 30 inches diameter at breast height (DBH), with a majority of trees between 18 and 22 inches DBH. During the field reconnaissance in October 2017, it was noted that the forested habitat that occurs within a portion of the disposal site and surrounding the disposal site consists of an open canopy (30-40 percent cover; much less than the 70 percent or more cover that NSO prefer) with a lack of complex, multi-layered understories and mature forest habitat structure preferred by NSO. Therefore, the disposal site and vicinity is not suitable NSO habitat. However, the NSOs surveys, which KRRC has begun for the 2018 NSO breeding season, will confirm whether there is NSO use in the area.

During the field reconnaissance conducted in October 2017, KRRC also evaluated the habitat in the vicinity of the known NSO activity center southeast of the Copco Reservoir. In this area, the habitat consists of relatively young deciduous-oak woodland in the lower elevations with relatively open mixed forest at the higher elevations. Suitable NSO habitat at the higher elevations is outside the noise disturbance distance from Ager-Beswick Road that runs along the south side of the Copco Reservoir. The nearest NSO detection documented in the CNDDB is over one mile from the bridge that crosses the east end of Copco Lake. The NSO activity center itself is farther to the southeast. In addition, most of the NSO detections documented in the CNDDB are within a drainage and not within line-of-sight to the Project. Because suitable habitat is located outside the noise disturbance buffer from proposed project activities, KRRC will not conduct NSO surveys in the Copco area.

Habitat modification is defined as activities that occur in spotted owl nesting, roosting, or foraging habitat that reduce the canopy or other elements of spotted owl habitat at the stand-level (USFWS 2012b). KRRC does not anticipate project activities that may remove individual or small groups of trees or other vegetation, such as widening existing roads, to rise to the level of NSO habitat modification, given the lack of suitable

nesting, roosting, or foraging habitat within the areas where those activities will be conducted. KRRC used a distance of 1.3 miles in California and 1.2 miles in Oregon for analyzing effects to nesting spotted owls from habitat modification such as timber harvest. Since the Project will not result in NSO habitat modification, avoiding noise disturbance is the focus of the surveys KRRC will complete during the 2018 NSO breeding season.

KRRC will apply the following NSO disturbance distances developed for the 2012 BA and 2012 Joint Preliminary Biological Opinion (2012 Preliminary BO) prepared for dam removal as proposed in 2012:

- Blasting: 1,760 yards (1 mile)
- Hauling on open roads: 440 yards (0.25 mile)
- Heavy equipment: 440 yards (0.25 mile)
- Rock crushing: 440 yards (0.25 mile)
- Helicopter: 880 yards (0.5 mile)
- Fixed Wing Aircraft: 440 yards (0.25 mile)

Based on the desktop evaluation and field reconnaissance, KRRC determined that NSO protocol surveys will focus on suitable habitat around J.C. Boyle Dam and associated facilities, the disposal site, and haul and access roads. KRRC will not perform NSO protocol surveys for facilities associated with Copco No. 1 Dam, Copco No. 2 Dam, and Iron Gate Dam and associated reservoirs based on the lack of suitable habitat for NSO.

The survey area encompasses the disposal site at J.C. Boyle due to its proximity to suitable habitat. KRRC may use a noise attenuation evaluation to evaluate the need for avoidance and minimization measures in accordance with the USFWS 2006 guidance (USFWS 2006) and agency input (Reilly 2017). KRRC has not yet evaluated noise attenuation from topography and other physical features as well as the duration of anticipated noise activities in certain areas.

1.2.3 Protocol Surveys

The 2012 BA and Measure NSO in the 2012 Preliminary BO called for protocol-level surveys to be conducted within suitable nesting and roosting habitats that occur within the NSO noise disturbance buffer around proposed construction activities. As described above, KRRC does not anticipate the Project to result in modification of NSO habitat. Therefore, KRRC will conduct protocol surveys for noise-only disturbance consistent with the 2012 USFWS NSO Survey Protocol.

For noise-only disturbance, 1 year of protocol surveys is underway during the 2018 nesting season in suitable habitat within the noise disturbance areas shown in Figures 1 to 3 in Attachment A and as refined based on the field reconnaissance, noise attenuation evaluation, or other information. Figures 1 to 3 in Attachment A show the proposed survey locations on a habitat suitability model generated by USFWS, a habitat suitability model generated by BLM, and on an aerial photo showing the existing vegetation. KRRC only applied the BLM habitat suitability model to BLM lands within the project area.

KRRC is conducting NSO protocol surveys with a team of at least two biologists, with at least one spotted owl surveyor meeting the qualifications outlined in the USFWS NSO Survey Protocol developed in 2012. Visits are spaced out over the breeding season from March through August. KRRC conducted at least three of the visits before the end of June 2018.

Survey methods include nighttime spot calling and daytime stand searches. If KRRC detects a spotted owl during the night survey, the biologist will return to the area during the daytime as soon as possible (preferably within 48 hours) and conduct a follow-up visit to verify status as needed. KRRC noted details of field efforts, including the methods used, weather conditions, and identified occupancy/nesting status, on field forms consistent with the 2012 USFWS NSO Survey Protocol.

Calling stations are shown in Figures 1 to 3 in Attachment A. Calling routes and stations were confirmed in the field to achieve complete coverage of all habitat within the survey area such that surveyors are able to hear responding owls within the entire survey area. KRRC determined the spacing of calling stations by the topography and acoustical characteristics of the area (e.g., background noise such as creeks); stations are spaced between 0.25 and 0.5 mile apart.

To summarize, KRRC is conducting NSO surveys as follows:

- KRRC is conducting six (6) disturbance-only protocol surveys in the J.C. Boyle project area during the 2018 breeding season.
- KRRC is conducting surveys in suitable habitat within the 1-mile noise-disturbance area surrounding the J.C. Boyle Dam as shown in Figure 2 in Attachment A. This includes the disposal site due to its proximity to suitable habitat. KRRC is also conducting surveys in suitable habitat surrounding the J.C. Boyle powerhouse, as shown in Figure 3 in Attachment A. As described above, suitable NSO habitat is outside the noise disturbance buffer in the Copco project area; therefore, KRRC is not conducting surveys in the Copco project area.
- Six survey visits are underway between March 15 and August 31, 2018, with at least three visits before the end of June. KRRC covers the project area in a span of 7 days for a complete visit. Complete visits are spaced at least 7 calendar days apart.
- Calling stations are at least 0.25 to 0.50 miles apart. Calling stations are shown in Figures 1 to 3 in Attachment A and may be revised further based on field conditions. KRRC identified a total of 18 calling stations: 11 within the 1-mile noise disturbance area around the J.C. Boyle Dam and 7 within 0.5 miles of the limits of work downstream of the J.C. Boyle Dam.
- KRRC is using nighttime spot calling surveys, with a minimum of 10 minutes spent at each calling station. KRRC will conduct follow-up daytime surveys if a spotted owl is detected during the nighttime spot calling surveys.
- KRRC is not conducting surveys under inclement weather, including rain, heavy fog, high wind speed (> 12 mph), or at high noise levels (e.g., stream noise, tree drip after rain event, machine/road noise).

KRRC will provide survey results to USFWS, CDFW, and ODFW following completion. Based on the findings, KRRC may conduct additional protocol surveys in 2019 (the next consecutive year following the 2018 surveys) in coordination with USFWS, CDFW, and ODFW.

1.3 Avoidance and Minimization Measures

KRRC will implement the following measures as part of the Project:

Measure NSO 1: KRRC will use the results of the 2018 field surveys to modify the design and/or construction plans and timing as appropriate, with an overall goal of preventing or minimizing impacts. KRRC will evaluate locations of the individual components of the Proposed Action, noise disturbances, and habitat geographic information system (GIS) layers to determine whether or not additional measures are needed.

Measure NSO 2: KRRC will conduct protocol-level surveys within suitable nesting, roosting, and foraging habitat (assessed by using best available GIS information, aerial photos, and coordination with the USFWS) as described above. If KRRC observes no nesting, no seasonal restriction will be required during project implementation. If KRRC observes nesting during the protocol surveys, a seasonal restriction (March 1–September 30) will be followed or a restriction buffer will be applied surrounding the nest to minimize the disturbance. Limited operating periods can be waived in the event of nest failure as confirmed by a biologist.

Measure NSO 3: To prevent direct injury of young resulting from aircraft, no helicopter flights will occur within or at an elevation lower than 0.8 km (0.5 mi) of suitable nesting and roosting habitat during the entire breeding season unless the protocol level surveys identify no activity centers, or it is determined in coordination with USFWS that there would be no effect on an NSO activity center.

Measure NSO 4: No component of suitable nesting, roosting, foraging, or dispersal habitat will be modified or removed during the removal of transmission lines or installation or removal of fencing.

1.4 References

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Chapter 2: Bald Eagle and Golden Eagle Measures

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2. BALD EAGLE AND GOLDEN EAGLE MEASURES

2.1 Objectives

Bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. § 668), the Migratory Bird Treaty Act (16 U.S.C. §§ 701-12), and are fully protected under California law. Bald eagles are listed as endangered under the California Endangered Species Act (CESA). Bald eagles are not listed in the State of Oregon.

The 2012 EIS/R (Section 3.5) TER-3 described measures to reduce project impacts on bald and golden eagles. The 2012 EIS/R recommended surveys to identify the locations of active nests and then to incorporate that information into the project design and construction planning to avoid impacts. KRRC has incorporated the proposed TER-3 into the Project and will implement it as described in the following sections. The objective of TER-3 is to identify, document, and confirm eagle presence, and eagle use of areas that may be directly or indirectly disturbed by project construction. KRRC will use that information to develop a plan in coordination with the USFWS and CDFW to provide avoidance and minimization measures for bald and golden eagles on eagle nesting, roosting, and foraging activities.

2.2 Existing Information

The Upper Klamath Basin is known to support bald eagle and golden eagle populations and provides suitable habitat for eagle nesting, roosting, and foraging.

2.2.1 Bald Eagle

The upper Klamath Basin supports a high number of nesting bald eagles and historically supports one of the largest wintering populations of bald eagles in the coterminous United States (Shuford et al. 2004). In previous years, up to 117 bald eagle pairs nest and 1,100 individuals winter in the Klamath Basin (PacifiCorp 2004). Bald eagle nesting trees are known to exist in and near the project area and bald eagles often use the same nests in multiple years. In addition, eagles may have more than one nest within an active territory and they may alternate their use of the nests between years.

Based on recent monitoring of bald and golden eagle nests and territories in the Klamath region, there are a minimum of four bald eagle nests within 0.5 miles of J.C Boyle Reservoir and one bald eagle nest within 0.5 miles of the Copco Lake (BLM 2017; USFWS 2017). Table 2-1 provides a summary of all known nests within 2-miles of the limits of work.

Oregon Cooperative Fish and Wildlife Research Unit conducted bald eagle nest surveys in the Klamath River area on March 27, 2002, and May 29, 2002 (PacifiCorp 2004). They recorded six known nests within and near the project area, with distances to the nearest facility ranging from approximately 0.7 miles to 7.1 miles (two near J.C. Boyle Reservoir, three near J.C. Boyle peaking reach, and one near Copco Lake). Aerial surveys conducted in 2003 found a new nest located approximately 540 feet southeast of Copco No. 1 Dam.

PacifiCorp has documented additional bald eagle observations at the Iron Gate, Copco, and J.C. Boyle Reservoirs, and at other locations along the middle and lower Klamath River. At least 32 individual sightings of bald eagles in flight, perched, or foraging were recorded during targeted avian surveys in 2002 (see Attachment B), and numerous incidental sightings occurred during general wildlife and facility surveys and other field studies (PacifiCorp 2004). These observation data are useful in establishing that nesting and foraging habitat are present within and near the project area. By agency request, exact nesting locations were not published in the PacifiCorp 2004 report. To continue to protect eagle nests, KRRC will not provide exact locations in this report.

2.2.2 Golden Eagle

Golden eagles are known to have historically nested on cliffs near the project area (USBR and CDFW 2012). Golden eagles also nest within pine, juniper and oak trees and suitable habitat is present in the project area. Golden eagles have historically nested on cliffs from J.C. Boyle bypass reach to Iron Gate Reservoir. During PacifiCorp surveys, golden eagles were observed in several locations, including Copco Lake and Iron Gate Reservoir and J.C. Boyle powerhouse, but no nests were found (PacifiCorp 2004). Natural densities for this species in southern Oregon and northern California are low (PacifiCorp 2004).

2.3 Methods

Study methods include desktop analysis, a GIS viewshed analysis, and field surveys. Initially biologists compiled existing data on bald and golden eagles and conducted a desktop analysis to locate known nests and territories. KRRC conducted a field reconnaissance survey in July 2017. KRRC will use the viewshed analysis to refine the survey area and additional field surveys are planned as described below.

2.3.1 Desktop Analysis

The desktop analysis includes a review of existing data. These data are compiled from:

1. Federal and state agency databases (CNDDB and ORBIC) and datasets from the USFWS, ODFW, and CDFW (collectively, the wildlife agencies) and the BLM;
2. Previous biological survey data such as the PacifiCorp 2004 report; and
3. Reports of surveys completed at or near the project area.

In addition to the above sources, KRRC has contacted regional experts, including Frank Isaacs of the Oregon Eagle Foundation. Mr. Isaacs conducted aerial helicopter surveys in 2002 and 2003 to document eagle nests, perching sites, and foraging sites, and to determine occupancy and productivity of territories in the Klamath Basin. If additional information becomes available through contacts with regional experts it will be included in future reports.

Another component of the desktop analysis is an evaluation of aerial imagery and topography correlated with the results of the field reconnaissance. To refine the survey area, KRRC conducted a viewshed analysis in ArcGIS (ESRI, Version 10.4.1) to generate visibility extents using a NED (National Elevation Dataset) topographic surface and observer points derived from the limits of work. This analysis calculates all locations that are simultaneously visible from any observer point distributed along the limits of work. It considers topography but not vegetation.

Because the project area's geometry is complex, there are potentially tens of thousands of observer points that could be used in the generation process. To limit the number of observer points to a feasible number, the analysis estimated observer points approximately every 20 feet along the limits of work, while retaining the limit's geometry. From each of these observer points, a hypothetical observer could look in any direction – any topographical feature that's within the view of this observer will be included in the viewshed.

To refine the survey area to areas where eagles are more likely to be affected by project activities, and also to comply with recommended avoidance buffers for bald eagles (Jackman and Jenkins 2004), KRRC proposes limiting the surveys to those viewshed areas within 0.5 mile of the limits of work. This 0.5-mile buffer will be extended to the area within the viewshed for up to 2 miles where construction or demolitions will occur (Pagel et al. 2010). The variance will account for differences in the level of impact among locations within the limits of work. Proposed construction activities associated with the removal of the dams and facilities, creation of disposal sites, and use of haul and access roads will be mostly limited to the areas where facilities are or will be located. Much of the project area includes the associated reservoirs, where little construction work is currently anticipated. KRRC defined the survey area based on the nature and timing of proposed construction activities, the location of known eagle nests and use areas, and further evaluation of the viewshed, prior to initiating 2018 surveys.

2.3.2 Field Surveys

KRRC is conducting bald and golden eagle surveys concurrently in 2018 by qualified avian biologists. To meet the project schedule, all eagle surveys will be complete by the end of 2018. The surveys are focusing on areas with suitable nesting, roosting, or foraging habitat for bald and golden eagles. The main goal of the surveys is to determine where nest sites are distributed within the survey area and to determine baseline eagle use and behavior at nests and other key habitat features so that any disturbances that may occur during construction can be recognized and corrective actions can be taken. Field surveys are employing a variety of techniques and multiple survey windows to capture seasonal activity.

2017 Surveys

KRRC conducted a field reconnaissance survey July 24-26, 2017. Surveyors assessed habitats in the project area by vehicle and on foot, noted bird activity, and attempted to locate known nests (based on data received to-date) within a 0.5-mile radius of the project area. Biologists spent one day at each dam and associated facilities and reservoir. The reconnaissance survey primarily assessed habitat and site conditions, and was not a focused eagle nest survey.

2018 Surveys

The 2018 bald and golden eagle survey protocol was informed by the desktop analysis, information obtained during the 2017 reconnaissance survey, and established protocols including:

- Bald Eagle Nest Survey and Reporting Guide: Reporting Observations at Nest Sites in Oregon (Isaacs 2009),
- Protocol for Evaluating Bald Eagle Habitat and Populations in California (Jackman and Jenkins 2004), and
- Interim Golden Eagle Inventory and Monitoring Protocols (Pagel et al. 2010).

In the field, surveyors are gathering information on eagle nesting behavior and habitat use within the survey area that could potentially be directly or indirectly affected by project activities. This information will provide a pre-construction baseline for monitoring eagles during project activities to assess whether such activities will adversely affect eagle behavior or habitat use.

A synthesized field survey to encompass bald and golden eagle nesting habitat use will include:

1. Breeding season surveys (late January through July 2018).
    a) KRRC conducted an initial nest search in late January and early February 2018, early in the breeding season when eagles are most likely to be found at nest sites, to determine occupancy. KRRC conducted this inventory and monitoring survey early in the season during courtship when the adults are mobile and conspicuous.
    b) KRRC conducted a second survey in early June 2018 to observe any changes in eagle behavior or mid-late season nesting activity.
    c) During these breeding season surveys, biologists have conducted at least 2 ground observation periods lasting at least 4 hours or more as necessary to designate a survey area unoccupied. Ground observers will survey from observation points for a minimum of 4 hours, unless observations yield eagle presence, or eagle behavior indicates eggs or young, or observation suggests the observer is disturbing the birds.
2. KRRC will conduct additional surveys during the early nesting season of the year prior to drawdown to determine continued activity and to observe eagle activity patterns to establish a baseline of normal behavior, prior to construction.

Based on accessibility, KRRC is conducting surveys on foot, with terrestrial vehicles and potentially by boat. KRRC may use motorized vehicles to transport KRRC biologists to the vicinity of nest site, but close access

will be by foot to avoid disturbing nesting eagles if they are present. During the June 2018 survey, KRRC conducted helicopter surveys concurrently with ground-based surveys. During the aerial surveys, two biologists inspected suitable habitat such as treetops and cliffs for eagle nests. The biologists searched for historical/known nests to determine current nesting status, and searched for new nests based on observed eagle activity and locations of known or suspected territories. Biologists use binoculars and spotting scopes when surveying for nest occupancy. KRRC recorded detailed data based on the guidelines and datasheets provided in the protocols.

2.4 Preliminary Results

2.4.1 Desktop Analysis

GIS specialists mapped known bald and golden eagle nests (based on data received as of July 2017) within 2 miles of the project area and generated an initial viewshed analysis from the edge of the limits of work (Figure 1 in Attachment B). The areas in green are within the viewshed; any area in green is potentially visible to an observer standing at a point on the perimeter of the limits of work. This analysis is based on topography and does not account for environmental conditions, distance, trees, or other potential obstructions, which will result in additional visual blinding beyond what is suggested by the viewshed analysis. A 2-mile buffer around the limits of work encompasses an area of approximately 112 square miles. The viewshed analysis reduced this to approximately 57 square miles, approximately half of the original size. When more precise data delineating active work areas are available, the analysis will be re-run and used to refine the survey area prior to 2019 surveys.

2.4.2 Field Surveys

During the July 2017 reconnaissance survey, KRRC located three of the four known nests within a 0.5-mile radius of the project area. Of the three located, one juvenile bald eagle was observed near nest BE1-36 (Table 2-1). KRRC presumed this nest active for this year. Biologist observed substantial whitewash and prey remains (fish bones) under the nest. The other two nests surveyed did not have conspicuous indications that they were active; KRRC did not observe whitewash, prey remains, or juveniles. However, as there is high potential that bald eagles had already fledged prior to the survey date, some active nests may have been missed, especially if eagles used alternate or unknown nests. An additional nest location (BE3-1) within 0.5-miles of J. C. Boyle was provided after the reconnaissance survey was completed (Hayner 2017). KRRC surveyed this nest in 2018. Table 2-1 provides a summary table of known bald and golden eagle nests within 2-miles of the limits of work.

2.5 Avoidance and Minimization Measures

KRRC will use the results of the surveys described above to develop an eagle avoidance and minimization plan in coordination with USFWS that identifies procedures and protocols for avoiding and minimizing potential impacts to eagles. With implementation of the avoidance and minimization measures described below, KRRC does not anticipate that there will be a take of bald or golden eagles.

KRRC will implement the following measures to avoid or reduce the Project's potential impacts on bald and golden eagles:

- KRRC completed the survey of eagle use patterns prior to construction activities as described above. KRRC conducted surveys by a qualified avian biologist and included any facilities to be removed or modified to determine bird use patterns. KRRC conducted surveys during the time of year most likely to detect eagle usage.
- During the early nesting season of the year prior to drawdown, KRRC will conduct additional focused surveys for bald and golden eagle nests within the survey area using the survey plan outlined in Section 2.3.2.2. KRRC will conduct at least one pre-construction survey within 2 weeks prior to beginning ground disturbing activities.
- Wherever possible, clearing, cutting, and grubbing activities shall be conducted outside the eagle breeding period (January 1 through August 31);
- If active nests are present within 2 miles of limits of work, KRRC will establish a 0.5-mile restriction buffer in coordination with the resource agencies to ensure nests are not disturbed. If active eagle nests are present within 0.5 miles of limits of work, KRRC's contractor will halt construction activities until coordination with the resource agencies (i.e., USFWS and CDFW or ODFW depending on where the nest is located) determines construction can resume. If a nest is not within line of sight of project activities, meaning that trees or topographic features physically block the eagle's view of construction activities, the buffer could be reduced to 0.25 miles. Further reduction of buffers or limited activity inside of buffers could occur in coordination with biological monitors and the USFWS, if it is determined that the activities would not jeopardize nesting success.

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Table 2-1 Summary of Bald and Golden Eagle Nests within 2 Miles of the Limits of Work (2017 Data)

Reservoir	Name	Species	Distance	History	July 2017 Reconnaissance[3]
J.C. Boyle	BE1-31	Bald Eagle	Within 0.5-mile	Active between 2004-2007. 1 nestling observed in 2013. Active but failed in 2014.[1]	Nest located, no activity or sign of recent activity observed.
J.C. Boyle	BE1-32	Bald Eagle	Within 0.5-mile	Active between 2006-2010; one fledged in 2010; unoccupied in 2011; active 2012; nest down in 2013. [1]	Nest appears to have been rebuilt since the last survey, nest located, no activity or sign of recent activity observed.
J.C. Boyle	BE1-36	Bald Eagle	Within 0.5-mile	Active between 1998-2010, 2 fledged chicks in 2013, occupied in 2014. [1]	Nest located, bald eagle juvenile observed nearby, abundant whitewash and prey remains at base of nest; presumed active this year.
J.C. Boyle	BE3-1	Bald Eagle	Within 0.5-mile	Nest observed in 1995, no additional data.[2]	Nest location data received after reconnaissance, nest was not surveyed.
J.C. Boyle	BE1-30	Bald Eagle	Within 2-miles	Potentially occupied in 1982, nest down in 1990.[1]	Not surveyed.
J.C. Boyle	BE1-33	Bald Eagle	Within 2-miles	Active 1983-1986, nest down 2005. [1]	Not surveyed.
J.C. Boyle	BE1-34	Bald Eagle	Within 2-miles	Active intermittently between 1987-2002, unoccupied 2011-2014. [1]	Not surveyed.
J.C. Boyle	BE1-35	Bald Eagle	Within 2-miles	1997-1999, nest down in 2005.[1]	Not surveyed.
J.C. Boyle	GE1-6	Golden Eagle	Within 2-miles	No data, unverified nest.[1]	Not surveyed.
J.C. Boyle	GE3-1	Golden Eagle	Within 2-miles	Active 2011 and 2012, no verified nesting.[2]	Not surveyed.
Iron Gate	BE2-1	Bald Eagle	Within 2-miles	Active between 1986-1997.[1]	Not surveyed.
Copco	BE2-3	Bald Eagle	Within 0.5-mile	2002 - new nest.[1]	Searched for nest, but access was limited. Nest was not found.
Copco	BE2-0	Bald Eagle	Within 2-miles	Active between 1993-1997.[1]	Not surveyed.

[1] Nest location and history sourced from Willy 2017.
[2] Nest location and history sourced from Heyner 2017.
[3] Data collected during reconnaissance surveys in July 24-26, 2017.

Chapter 3: Special Status Wildlife Species Measures

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3. SPECIAL STATUS WILDLIFE SPECIES MEASURES

3.1 Objectives

KRRC is conducting surveys in spring and summer 2018 to identify the special status wildlife species and their habitats that are present in the project area. These surveys will provide a baseline understanding of the presence and use of the project area by special status wildlife species and habitats, and enable KRRC to efficiently plan construction sequencing and conduct pre-construction surveys that may be necessary to avoid impacts on those species and their habitats from the Project. Findings of the 2018 special status wildlife surveys will be used for project design and construction planning and, in coordination with USFWS, CDFW, and Oregon Department of Fish and Wildlife (ODFW), to develop special status wildlife species avoidance and mitigation measures to be incorporated into any regulatory approvals that may be necessary for the Project. KRRC will conduct additional focused field surveys as required.

For the purposes of this section, special status wildlife species include federal and state threatened, endangered, proposed, and candidate species, California Species of Special Concern, Oregon Natural Heritage Program (ONHP) List 1 and 2 species, and Oregon Sensitive species. KRRC is also considering BLM and USFS Sensitive Species, Assessment Species, Tracking Species, and Survey and Manage species, where BLM and USFS lands occur in the project area; however, not all of these species are of regulatory concern. Northern spotted owls, bald eagles, golden eagles, bats, and special status plants are covered under separate sections in this appendix and are not included here.

3.2 Existing Information

KRRC has identified several special status wildlife species as occurring in the project area. PacifiCorp conducted comprehensive surveys of the project area in 2002 and 2003 and the findings were compiled in 2012 EIS/R (Section 3.5). PacifiCorp documented several special status wildlife species within 0.25 mile of the PacifiCorp facilities, reservoirs, and river reaches (PacifiCorp 2004, Attachment A). Information on special status wildlife species occurrences has also been obtained from USFWS, CDFW, ODFW, BLM, and USFS (Godwin 2017, Harris 2017, Henderson 2017, and Wray 2017). Most of the special status wildlife species are birds, some of which are year-round residents while others are migratory, utilizing the project area for nesting or for overwintering. In addition, a small number of invertebrate, amphibian, reptile, and mammal special status wildlife species have potential to occur in the project area, based on PacifiCorp surveys and information from ORBIC, CNDDB, and the USFWS Information for Planning and Consultation (IPaC) database.

Table 3-1 lists the special status wildlife species that KRRC identified as having potential to occur in the Klamath River watershed. The list includes species with a range of regulatory protections and associated permitting considerations, and generally does not include species that are not federally or state listed and that are identified as lower priority on state sensitive species lists (e.g., Oregon Natural Heritage Program list 3 or 4) or other federal or state watch lists.

Table 3-1 presents summary information on each species' habitat and occurrence in the project area and identifies the proposed survey effort. KRRC based proposed survey efforts on regulatory requirements, occurrence information, and a preliminary determination of the potential for impacts from project implementation, using best professional judgement and input from the resource agencies.

3.3 Methods

3.3.1 Field Reconnaissance

KRRC conducted a field reconnaissance in July 2017. During the field reconnaissance, biologists visited proposed limits of work, focusing on areas with documented occurrences of special status wildlife species based on previous biological survey data, reports completed at or near the project area (e.g., surveys conducted by PacifiCorp in 2001-2003), and additional existing information as outlined above.

Biologists gathered qualitative information on habitats present, determined access for surveys and other information to aid in planning for 2018 surveys. Biologists also noted evidence of changes to existing conditions since the PacifiCorp surveys were conducted, including wildfires, development, agriculture and grazing, and logging activities that may have altered the habitats present.

3.3.2 General Wildlife Surveys

General wildlife surveys are underway, concurrent with vegetation and habitat mapping efforts. During the spring and summer of 2018, biologists are recording observations of birds and other wildlife heard or seen, including sign and other evidence of wildlife presence and use (e.g., courtship activities, breeding, nesting, dens and burrows, feeding, family groups). Findings of these surveys will provide a baseline understanding of the special status wildlife and habitats in the project area, facilitating efficient pre-construction surveys focused on specific locations of suitable habitat identified during the baseline surveys.

As part of the ongoing survey efforts, biologists are noting special status bird species that are using the reservoirs and limits of work, including dams and associated facilities, disposal sites, and haul and access roads around each. Using a boat, biologists are surveying reservoir shorelines and open water, noting all species seen or heard, their approximate number and behavior (e.g., roosting, loafing, foraging, courtship, mating, incubating eggs, feeding young).

KRRC established transects to cover terrestrial areas within 0.25 miles of dams and structures to be removed, disposal sites, and haul and access roads. Biologists are walking the length of each transect, noting species seen or heard and their behavior, as described above. KRRC is conducting night surveys for northern spotted owls, based on input from USFWS, CDFW, and ODFW, and entail calling from established survey stations along roads or walking transects and using a digital caller to elicit responses. These surveys are underway during both the spring and summer breeding season of 2018 (Section 1 discusses spotted owl surveys).

Based on input from USFWS, CDFW, and ODFW, focused surveys for amphibian and reptile species are not being conducted with the exception of surveys for western pond turtle (see "Other Focused Surveys" below). Rather, field surveys will identify suitable habitat for these species to determine if and to what extent suitable habitat will be modified or destroyed by project activities. KRRC will note amphibians and reptiles observed during the special status wildlife species surveys for birds and turtles.

KRRC is not conducting mammal trapping or other focused survey methods. KRRC will note any mammals or mammal sign, den sites, or excavated burrows observed during special status wildlife species surveys. (Section 4 discusses the survey plan for bats.)

3.3.3 Nest Surveys

All migratory birds are covered by the Migratory Bird Treaty Act (MBTA). Some species of birds may return to the same nesting site every year (e.g., Osprey nesting platform), while others may utilize a specific location (e.g., sandhill crane returning to the same wetland to nest and rear young).

KRRC conducted nest site surveys in May 2018. For some birds (e.g., raptors), nest surveys considered the viewshed analysis described under the Bald and Golden Eagle Measures (Section 2 of this Appendix) in identifying priority areas for surveys.

Nest site surveys focused on special status bird species that may return to the same nest locations (e.g., osprey, peregrine falcon, sandhill crane). The objective of bird nest site surveys is to identify and map any nest trees, heron colonies, cliff nests, nests on structures, or other types of nests that may be removed or disturbed by construction.

For osprey nests, biologists surveyed all nest platforms, transmission line towers, and reservoir and river shorelines for nests within 0.75 miles of limits of work, defined as the potential area within which construction activities may affect active nests (USBR and CDFW 2012, Section 3.5). KRRC will check nest sites identified in 2018 for occupancy in the year that construction activities are planned to commence. In coordination with the resource agencies (i.e., USFWS throughout the project area and in California, KRRC will consult with CDFW and in Oregon, KRRC will consult with ODFW), osprey nests within 0.75 miles of the limits of work may be removed or blocked from use following the breeding season in the year prior to drawdown. KRRC will closely monitor osprey nesting activity during the breeding season of the year prior to drawdown and the year of drawdown. Nests and nest platforms will be blocked and nesting material may be removed within both the limits of work and a disturbance buffer based on the proposed construction activities,

vegetation and line of sight conditions, and other factors that contribute to the potential for nesting disturbance.

KRRC surveyed reservoir and river shorelines within 0.25 miles of limits of work for heron colonies in May 2018. KRRC will survey reservoir and river shorelines in spring of the year prior to drawdown for active heron colonies. If KRRC finds an active heron colony, a spatial buffer may be established in coordination with the resource agencies.

KRRC surveyed cliffs within 1 mile of limits of work in May 2018 for peregrine falcon nests. KRRC will survey these areas again in spring of the year prior to drawdown. If KRRC finds an active peregrine falcon nest, a spatial buffer may be established in coordination with the resource agencies.

KRRC surveyed documented nesting habitat for sandhill crane at J.C. Boyle Reservoir in May 2018 and will conduct an additional survey prior to construction (i.e., spring of the year prior to drawdown). KRRC will use a boat as needed to access these areas. If KRRC finds sandhill crane nesting, a spatial buffer may be established in coordination with the resource agencies.

During surveys, KRRC notes all species seen or heard, their approximate number and behavior (e.g., roosting, loafing, foraging, courtship, mating, incubating eggs, feeding young). KRRC records GPS coordinates for all active nests and spatial buffers established as needed in coordination with the resource agencies.

3.3.4 Other Focused Surveys

Several additional species with potential to occur in the project area have been identified by USFWS, CDFW, and/or ODFW as warranting additional consideration based on their status or potential status (i.e., species have been petitioned for listing on the federal and/or state level). These species include western pond turtle, foothill yellow-legged frog, Cascades frog, Siskiyou Mountains salamander, and tricolored blackbird. These species are discussed in the following sections.

Western Pond Turtle

Western pond turtles are known to occur at project reservoirs. U.S. Geological Survey (USGS) conducted visual surveys of basking turtles at J.C. Boyle Reservoir in the mid- to late-1990s and recorded turtle use (Wray 2017). A petition for federal listing is currently being considered by USFWS, and a decision regarding listing is expected by 2021. The 2001-2003 PacifiCorp surveys also noted the presence of western pond turtles at project reservoirs (PacifiCorp 2004).

Impacts on western pond turtles from project implementation are uncertain and depend on factors that are hard to predict, including the amount of sediment moved during drawdown. In early 2018, KRRC conducted a desktop analysis of western pond turtle habitat and overwintering requirements and the potential for impacts on pond turtles during drawdown. Following review and input from the resource agencies and other experts on the results of the analysis, ODFW recommended additional pond turtle surveys. KRRC is

coordinating with ODFW, USFWS, and CDFW on a preliminary scope for a study to determine 1) the abundance of western pond turtles in the J.C. Boyle Reservoir area and 2) where western pond turtles are overwintering in the J.C. Boyle Reservoir area. The study may include mark/recapture surveys, temperature monitoring and/or radio telemetry to determine overwintering locations. KRRC will conduct the study beginning in the late summer/fall through the spring of 2018 or 2019.

Foothill Yellow-legged Frog

The foothill yellow-legged frog is under review for federal listing and is a candidate for listing in California. Foothill yellow-legged frogs are not known to occur in the project reservoirs or tributary streams within the project area (PacifiCorp 2004). PacifiCorp surveys conducted in 2003 along the mainstem Klamath River and in stream segments directly adjacent to the mainstem channel did not detect foothill yellow-legged frogs, suggesting the species was extirpated from the project area. Farther downstream of the dams, foothill yellow-legged frogs are known to inhabit the lower reaches and tributaries of the Klamath River. In June 2009, float surveys along 3.5 km of the mainstem Klamath River downstream of the Blue Creek confluence found adults, juveniles, and egg masses. Egg masses were stranded on the bank, potentially due to wake disturbance from jet boats (Bettaso, pers. comm., 2017).

The findings of previous surveys indicate the species does not occur in the reservoirs but may be present several miles downstream. Because drawdown activities will occur prior to the main foothill yellow-legged frog breeding season, seasonal flows and sediment transport associated with drawdown are unlikely to affect egg masses or tadpoles downstream of the dams. KRRC is coordinating with USFWS, CDFW, and ODFW to determine the potential for impacts to the species. If, after further review and evaluation, it is determined that there is a high probability of take of the species as defined by CESA during the project implementation in California, focused surveys will be conducted during spring and summer of the year prior to drawdown for the purpose of estimating population information as needed for a California Incidental Take Permit.

Cascades Frog

The Cascades frog is under review for federal listing and is a candidate for listing in California. The species inhabits lakes, ponds, wet meadows, and streams at moderate to high elevations in the Cascades Range and is documented in the CNDDB within the Klamath National Forest. The species was not detected during PacifiCorp surveys (PacifiCorp 2004). Due to the presence of non-native predators such as bullfrogs and introduced sport fishes in the reservoirs, Cascades frog is unlikely to occur. Therefore, KRRC does not propose to complete focused surveys for this species. The KRRC has coordinated this decision with the resource agencies.

Siskiyou Mountains Salamander

The Siskiyou Mountains salamander is a California threatened species that is documented in the CNDDB along tributaries to the Klamath River in the Klamath National Forest. The species was not detected during PacifiCorp surveys (PacifiCorp 2004). The species is associated with rocky, forested areas and, specifically, stabilized talus in old-growth stands. The forests within the project area are heavily managed by timber

harvest and do not provide suitable habitat for the Siskiyou Mountains salamander. Therefore, KRRC does not propose to conduct focused surveys. The KRRC has coordinated this decision with the resource agencies.

Tricolored Blackbird

The tricolored blackbird is under review for federal listing and is a candidate for listing in California. In February 2018, CDFW recommended listing the tricolored blackbird as threatened under CESA. The species forms large nesting colonies, most typically in dairy silage fields or other agricultural areas near wetlands. The species will use emergent-marsh habitat and may occur transiently in such habitats within the project area. However, there are no agricultural fields that typically support tricolored blackbird colonies in the project area. Therefore, KRRC does not anticipate nesting within the project area. KRRC is noting observations of the species during wildlife surveys in 2018, particularly within emergent wetland habitats. If KRRC finds nesting tricolored blackbirds in the project area during 2018 surveys, KRRC will survey the nesting location again in spring of the year prior to drawdown. If KRRC finds tricolored blackbirds nesting at that time, a disturbance buffer may be established in coordination with the resource agencies.

Willow Flycatcher

Willow flycatchers have been documented in the project area (PacifiCorp 2004, Attachment A). Willow flycatcher is a California endangered species. KRRC does not propose protocol surveys for willow flycatcher; however, surveys will be conducted in willow-dominated riparian/meadow communities to identify potential habitat for willow flycatcher. If it is determined that there would be impacts on potential willow flycatcher habitat from project implementation in areas where presence is uncertain or cannot be assumed, KRRC will conduct protocol surveys for willow flycatcher in spring of the year prior to drawdown in coordination with the resource agencies.

3.3.5 Pre-construction Nesting Bird Surveys

Prior to project activities that involve clearing of vegetation or other habitat, KRRC will conduct targeted, pre-construction bird surveys for all birds protected by the MBTA to avoid or minimize nesting disturbance. KRRC will conduct nesting surveys within 2 weeks before the start of construction activities that occur during nesting bird season (February through July). Biologists will search for nests in potential bird nesting habitat within 300 feet of limits of work. KRRC will map active nests and an activity restriction buffer may be established in coordination with the resource agencies to minimize disturbance from construction activities. Construction planning will include efforts to limit activities that would disturb vegetation to the non-breeding season.

KRRC will remove and discard cliff swallow nests along dam faces or structures during the non-nesting season to discourage swallows from returning to nest within the limits of work.

3.3.6 Construction Monitoring

KRRC will conduct biological monitoring during construction. KRRC will develop a detailed construction monitoring plan in coordination with the resource agencies.

3.4 Avoidance and Minimization Measures

The Project incorporates the following specific elements that will avoid or reduce potential impacts on migratory birds and their nests during construction:

- KRRC will conduct removal or trimming of any trees or other vegetation for construction outside of the nesting season (January 1 through August 20). This will include removal or trimming of trees along access roads and haul routes and within disposal sites. Where clearing, trimming, and grubbing work cannot occur outside the migratory bird nesting season, a qualified avian biologist will survey limits of work to determine if any migratory birds are present and nesting in those areas as described in Section 3.3.6.
- For raptors (other than eagles), KRRC will remove inactive nests before nesting season begins, to the greatest extent practicable and to the extent allowed under applicable laws and regulations. KRRC will conduct any nest removals in close coordination with CDFW, ODFW, and USFWS. KRRC will implement deterrent actions such as placing traffic cones or other exclusionary devices in nests or on nest platforms to prevent nesting in the year of construction. KRRC will remove all deterrents as soon as possible after construction activities have progressed to a point beyond the disturbance buffer for that species. KRRC will confirm buffer distances with the resource agencies for each species and location.
- If an active nest of a migratory bird species is located, a restriction buffer may be established by the biological monitor as appropriate. The buffer size established by the biological monitor will consider the species, noise effects, line of sight, and other site-specific considerations of the specific nest. KRRC may reduce the buffer size or allow certain project activities within the buffer if the biological monitor confirms that the activity is not disturbing the nest.
- KRRC may remove osprey nests within 0.75 miles of limits of work or block them from use following the breeding season in the year prior to drawdown if such removal is consistent with applicable federal and state law. Osprey nests that are removed may be replaced following construction or relocated to suitable areas outside of the project area.
- KRRC will conduct biological monitoring during construction. KRRC will develop a detailed construction monitoring plan in coordination with the resource agencies and will include the following measures:
    - Before any ground-disturbing work (including vegetation clearing and grading) begins in the construction area, a qualified biologist will conduct a mandatory biological resources awareness training for all construction personnel and the construction foreman. This training will inform the crews about special status species that could occur on site. The training will consist of a brief

discussion of the biology and life history of the species; how to identify each species, including all life stages; the habitat requirements of these species; their status; measures being taken for the protection of these species and their habitats; and actions to be taken if a species is found within the project area during construction activities. KRRC will issue species identification cards to shift supervisors; these cards will have photos, descriptions, and actions to be taken upon sighting of special-status species during construction. Upon completion of the training, all employees will sign an acknowledgment form stating that they attended the training and understand all protection measures. KRRC will give an updated training to new personnel and in the event that a change in special-status species occurs.

- KRRC's contractor will fence construction areas, including staging areas and access routes, with orange plastic snow fencing to demarcate work areas. The approved biologist will confirm the location of the fenced area prior to habitat clearing, and KRRC's contractor will maintain the fencing throughout the construction period. KRRC will implement additional exclusion fencing or other appropriate measures in coordination with the resource agencies to prevent use of limits of work by special-status species during construction.
- To prevent entrapment of wildlife that do enter limits of work during construction, all excavated, steep-walled holes or trenches in excess of two feet deep will be inspected by a biologist or construction personnel approved by the resource agencies at the start and end of each working day. If no animals are present during the evening inspection, plywood or similar materials will be used to immediately cover the trench, or it will be provided with one or more escape ramps set at no greater than 1,000-foot intervals and constructed of earth fill or wooden planks. KRRC's contractor will inspect trenches and pipes for entrapped wildlife each morning prior to onset of activity. Before KRRC's contractor fills such holes or trenches, they will be thoroughly inspected for entrapped animals. KRRC's contractor will allow any animals so discovered to escape voluntarily, without harassment, before activities resume, or removed from the trench or hole by a qualified biologist approved by the resource agencies and the animals will be allowed to escape unimpeded. A biologist approved by the resource agencies will be responsible for overseeing compliance with protective measures during clearing and construction activities within designated areas throughout the construction activities.
- If the design includes coffer dams, KRRC will monitor them immediately following closure and prior to the start of construction activities for the presence of special status species such as western pond turtles. If individuals are detected within enclosed spaces, they will be captured and removed by qualified biologists.

- General Requirements for Construction Personnel include the following:
  - KRRC's contractor will clearly delineate the limits of work and prohibit any construction-related traffic outside these boundaries.
  - KRRC's contractor will require construction crews to maintain a 20-miles per hour (mph) speed limit on all unpaved roads to reduce the chance of wildlife being harmed if struck by construction equipment.

- KRRC's contractor will dispose of all food-related trash items such as wrappers, cans, bottles, and food scraps generated during construction or permitted operations and maintenance activities of existing facilities in closed containers only and removed at least once a week from the site. KRRC's contractor will fence the identified sites for trash collection to minimize access by wildlife.
- KRRC's contractor will not allow deliberate feeding of wildlife.
- KRRC's contractor will not allow pets in the limits of work.
- KRRC's contractor will not allow firearms in the limits of work.
- If vehicle or equipment maintenance is necessary, KRRC's contractor will perform it in designated staging areas.
- Any worker who inadvertently injures or kills a federally- or state-listed species, bald eagle, or golden eagle, or finds one dead, injured, or entrapped will immediately report the incident to the construction foreman or biological monitor.
- The construction foreman or biological monitor will notify the resource agencies within 24 hours of the incident.

3.5 References

Bettaso, Jamie, Wildlife Biologist, USFS. 2017. Personal communication with Jennifer Jones, KRRC, November 16, 2017.

Godwin, Steve. 2017. Wildlife Biologist, BLM, Medford office. Personal communication with Jennifer Jones, KRRC, June 21, 2017.

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USBR and CDFW. 2012. Klamath Facilities Removal. Final Environmental Impact Statement/Environmental Impact Report (EIS/R). U.S. Bureau of Reclamation and California Department of Fish and Wildlife, December.

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Table 3-1 Special Status Species with Potential to Occur in the Project Area (Terrestrial or Semi-Aquatic Species Only)

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Invertebrates					
Franklin's bumble bee	*Bombus franklini*	Petitioned for federal listing	Generalist forager of wildflowers such as lupine, California poppy, and horsemint. Found only in southern Oregon/northern California between the coast and Sierra-Cascade ranges.	Not found during PacifiCorp surveys. Documented occurrences in meadows in Siskiyou County (CNDDB 2017).	Focused surveys are not proposed. Observations during general wildlife surveys and vegetation mapping will be noted.
Conservancy fairy shrimp	*Branchinecta conservatio*	FE	Vernal pools	Not found during PacifiCorp surveys. Not listed on CNDDB search (2017); identified on IPaC (2017).	Vernal pools are not expected to be present. If noted during vegetation or wildlife surveys, focused surveys for vernal pool species will be conducted as appropriate based on the potential for impacts from project implementation.
Vernal pool fairy shrimp	*Branchinecta lynchi*	FT	Vernal pools	Not found during PacifiCorp surveys. Not listed on CNDDB search (2017); identified on IPaC (2017).	Vernal pools are not expected to be present. If noted during vegetation or wildlife surveys, focused surveys for vernal pool species will be conducted as appropriate based on the potential for impacts from project implementation.
Vernal pool tadpole shrimp	*Lepidurus packardi*	FE	Vernal pools	Not found during PacifiCorp surveys. Not listed on CNDDB search (2017); identified on IPaC (2017).	Vernal pools are not expected to be present. If noted during vegetation or wildlife surveys, focused surveys for vernal pool species will be conducted as appropriate based on the potential for impacts from project implementation.
Klamath pebblesnail	*Fluminicola sp. 5*	ONHP List 1	Medium rivers in cold and relatively pristine hard-subhabitats with little disturbance	ORBIC occurrence at confluence of Spencer Creek and J.C. Boyle Reservoir/Klamath River and just east of powerhouse (ORBIC 2017).	Focused surveys are not proposed. Observations during general wildlife surveys and vegetation mapping will be noted.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Klamath Rim pebblesnail	*Fluminicola sp.6*	ONHP List 1	Small, cold, spring runs with shallow water and gravel-cobble substrate	ORBIC occurrence at Klamath River 0.3 miles east of J.C. Boyle powerhouse (ORBIC 2017).	Focused surveys are not proposed. Observations during general wildlife surveys and vegetation mapping will be noted.
Blue Mountains juga (snail)	*Juga sp. 2*	ONHP List 1	Freshwater	ORBIC occurrence near Rock Creek (ORBIC 2017).	Focused surveys are not proposed. Observations during general wildlife surveys and vegetation mapping will be noted.
Scale lanx (snail)	*Lanx klamathensis*	ONHP List 1	Freshwater	ORBIC occurrence near Rock Creek (ORBIC 2017).	Focused surveys are not proposed. Observations during general wildlife surveys and vegetation mapping will be noted.
Siskiyou (= Chase) sideband	*Monadenia chaceana*	BLM, ONHP List 1, tracked on CNDDB	Lower reaches of major drainages, in talus and rock slides, under rocks and woody debris in moist conifer forests, in caves, and in shrubby areas in riparian corridors. Rocks and large woody debris serve as refugia during the summer and late winter seasons.	Not documented during PacifiCorp surveys. Historic occurrence 0.25 miles below Copco Dam in lava rockslide (CNDDB 2017). May occur in large piles of rocks (termed “derrick pile” by KNF) (Henderson 2017).	Focused surveys are not proposed. Observations during general wildlife surveys and vegetation mapping will be noted.
Amphibians					
Tailed frog	*Ascaphus truei*	CSSC	Perennial, cold, fast-flowing mountain streams with dense vegetation cover, or streams in steep-walled valleys in non-forested areas.	Widespread in tributary streams in the lower Klamath River (Green Diamond Resource Company 2006).	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Western toad	*Anaxyrus boreas*	BLM, OSS	Breeds from February to early May in ponds, the edges of shallow lakes, and in slow-moving streams. Adults are common near marshes and small lakes but may also be found in dry forests, shrubby areas, and meadows.	Documented during PacifiCorp surveys along J.C. Boyle peaking reach, along the north shore of Iron Gate Reservoir, and along Klamath River near river mile 185 (between the confluence of Bogus and Cottonwood Creeks). One occurrence near Frain Ranch, Klamath River Canyon (ORBIC 2017).	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Northern red-legged frog	*Rana aurora*	OSS, CSSC	Breeds in quiet low-velocity habitats, such as wetlands, ponds, and disconnected side channel habitats in coastal areas of the Lower Klamath River. Usually breeds January through March (Lannoo 2005).	Documented by CDFW as breeding in coastal areas of the Lower Klamath River.	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Foothill yellow-legged frog	*Rana boylii*	Petitioned for federal listing, BLM, OSS, CSSC, CC	Streams and rivers with cobble-size or larger substrate. Breeds generally between late April and June (Lannoo 2005).	Known to CDFW to breed in the Lower Klamath River Mainstem and major tributaries. ORBIC occurrence downstream of J.C. Boyle Reservoir (ORBIC 2017).	Observations during general wildlife surveys will be noted. Based on an initial evaluation of known occurrences and potential for impacts from project activities, focused surveys are not proposed. However, focused surveys may be conducted to obtain population estimate information as needed for a California Incidental Take Permit if found warranted based on further evaluation and agency input.
Cascades frog	*Rana cascadae*	Petitioned for federal listing, OSS, CSSC, CC	Montane aquatic habitats such as mountain lakes, small streams, and ponds in meadows; open coniferous forests.	Documented occurrence in Klamath National Forest (CNDDB 2017). Unlikely to occur in project reservoirs due to the presence of non-native predators such as bullfrogs and introduced sport fishes.	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Oregon spotted frog	*Rana pretiosa*	FT, BLM, OSS, CSSC	Highly aquatic and generally avoids dry uplands. It is rarely found far from permanent quiet water. Usually occurs in vegetated shallows or among grasses or sedges along the margins of streams, lakes, ponds (including those behind beaver dams), oxbows, springs, and marshes.	Not found during PacifiCorp surveys. Not listed on CNDDB search (2017); identified on IPaC (2017). Unlikely to occur in project reservoirs due to the presence of non-native predators such as bullfrogs and introduced sport fishes.	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Siskiyou Mountains salamander	*Plethodon stormi*	OSS, CT	Mixed conifer habitat of dense, pole-to-mature size, trees and stabilized rock talus. Active above ground only during spring & fall rains.	Documented occurrences along Klamath River in Klamath National Forest (CNDDB 2017). Not likely to occur in the project area due to lack of old growth forests with rock talus.	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Southern torrent salamander	*Rhyacotriton variegatus*	OSS, CSSC	Uppermost portions of cold, well shaded permanent streams with a loose gravel substrate, springs, headwater seeps, waterfalls, and moss covered rock rubble with flowing water.	Widespread in tributary streams in the lower Klamath River (Green Diamond Resource Company 2006).	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Cope's giant Salamander	*Dicamptodon copei*	OSS	Streams and rivers in moist coniferous forests. Sometimes found in clear, cold mountain lakes and ponds	Not known to occur in project area.	Focused surveys are not proposed due to unlikelihood of occurrence. Observations during general wildlife surveys and vegetation mapping will be noted.
Reptiles					
Western pond turtle	*Actinemys marmorata*	Petitioned for federal listing, BLM, OSS, ONHP List 2, CSSC	Prefers quiet water in small lakes, marshes, and sluggish streams and rivers; requires basking sites.	Documented during PacifiCorp surveys at Keno, J.C. Boyle, Copco, and Iron Gate Reservoirs, along J.C. Boyle bypass reach, along J.C. Boyle peaking reach in California, and along Klamath River from Iron Gate Dam to Shasta River. Also documented at Iron Gate Reservoir and along Klamath River (ORBIC, CNDDB 2017).	Observations of the species and habitat will be noted during wildlife surveys and vegetation mapping. An additional study may include mark/recapture surveys, temperature monitoring and/or radio telemetry to determine overwintering locations.
Western painted turtle	*Chrysemys picta bellii*	OSS	Ponds, marshes, lakes, ditches, quiet streams with sandy or muddy bottoms and aquatic vegetation.	Not known to occur in project area.	Focused surveys are not proposed due to unlikelihood of occurrence. Observations during general wildlife surveys and vegetation mapping will be noted.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Northern sagebrush lizard	*Sceloporus graciosus graciosus*	BLM, ONHP List 4	Inhabits sagebrush, chaparral, juniper woodlands, and dry conifer forests.	Documented during PacifiCorp surveys in the rocky riparian shrub habitat of Keno reach, along J.C. Boyle peaking reach, near J.C. Boyle powerhouse intake canal, and near the edge of a forested wetland along Iron Gate Reservoir.	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Sharptail snake	*Contia tenuis*	BLM	Inhabits moist sites in chaparral, conifer forests, and deciduous forests, but primarily occurs in oaks and other deciduous tree woodlands, particularly in the forest edges.	Known to occur along upper J.C. Boyle peaking reach west of Frain Ranch in Douglas-fir habitat but not detected by PacifiCorp during its surveys.	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
California mountain kingsnake	*Lampropeltis zonata*	BLM, OSS, ONHP List 4	Inhabits thick vegetation along watercourses, farmland, chaparral, deciduous, and mixed-coniferous forests; specifically associated with moist river valleys and dense riparian vegetation.	Documented during PacifiCorp surveys along Copco Road and in close proximity to J.C. Boyle powerhouse intake canal. Also known to occur along J.C. Boyle peaking reach. Documented in Klamath River Canyon and east of J.C. Boyle powerhouse (ORBIC 2017).	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Common kingsnake	*Lampropeltis getula*	BLM, OSS, ONHP List 4	Occurs in pine forests, oak woodlands, and chaparral in, under, or near rotting logs and usually near streams; associated with well-illuminated rocky riparian habitat with mixed deciduous and coniferous trees.	Documented during PacifiCorp surveys along J.C. Boyle peaking reach in oak/woodland and mixed conifer woodland and along Copco Road.	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Birds					

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Common loon	*Gavia immer*	CSSC	May over-winter on project reservoirs or occur in aquatic habitat associated with large bodies of water like the project reservoirs while migrating from sub-arctic freshwater breeding grounds to coastal and near-shore pelagic marine habitat along the Pacific coast.	Documented during PacifiCorp surveys at Iron Gate Reservoir.	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
American white pelican	*Pelecanus erythrorhynchos*	BLM, OSS, ONHP List 2, CSSC. Nesting colonies afforded special protection by CDFW	Nests at lakes and marshes and uses almost any lake outside of the breeding season; have a restricted range in southern Oregon and along the California border, where they are found to be associated with only a few large bodies of inland water.	Documented during PacifiCorp surveys on all project reservoirs, with the highest number occurring on Keno Impoundment, and along Link River, Keno reach, J.C. Boyle bypass reach, and on Klamath River between Iron Gate Dam and Shasta River.	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Double-crested cormorant	*Phalacrocorax auritus*	CWL, Nesting colonies afforded special protection by CDFW	Colonial nester on coastal cliffs, rocks, offshore islands, and along lake margins.	Documented during PacifiCorp surveys at Keno and J.C. Boyle Dams. Documented nesting colonies near mouth of Klamath River (CNDDB 2017).	Wildlife surveys will note presence and nesting colonies to identify potential for impacts from project implementation.
Black-crowned night heron	*Nycticorax nycticorax*	Nesting colonies afforded special protection by CDFW	Found in riparian habitats and in wetland sites.	Documented during PacifiCorp surveys primarily along Keno reach, but also along Link River, at Keno Impoundment, and along Klamath River from Iron Gate Dam to Shasta River. Communal roost used by night herons and other heron species in a group of willow trees near the East Side powerhouse adjacent to Link River.	Wildlife surveys will note presence and nesting colonies to identify potential for impacts from project implementation.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Snowy egret	*Egretta thula*	BLM, ONHP List 2, Nesting colonies afforded special protection by CDFW	Inhabits emergent wetlands associated with freshwater marshes and along the periphery of large water bodies. The northern limit of the species range includes southern Oregon.	Documented during PacifiCorp surveys near Link River Dam, at Keno Dam, and along Keno reach.	Wildlife surveys will note presence and nesting colonies to identify potential for impacts from project implementation.
Great egret	*Casmerodius albius*	BLM, Nesting colonies afforded special protection by CDFW	Nests in willows and other trees; forages in shallow water, wetlands, and fields. Range includes Klamath basin and eastern Siskiyou County. Known to occur in the study area.	Documented during PacifiCorp surveys at J.C. Boyle and Keno Impoundments, Keno Canyon reach, J.C. Boyle bypass and peaking reaches, and Link River.	Wildlife surveys will note presence and nesting colonies to identify potential for impacts from project implementation.
Great blue heron	*Ardea herodias*	Nesting colonies afforded special status protection by CDFW	Forages mostly in slow-moving or calm salt, fresh, or brackish water in a variety of habitats, including rocky shores, coastal lagoons, saltwater and freshwater marshes, mudflats, bays, estuaries, along the margins of rivers, lakes, and irrigation canals, and in flooded fields. Nesting colonies are typically found in groves of large trees, often in mixed colonies with other herons, egrets, and cormorants.	Documented during PacifiCorp surveys at all reservoirs and most study area reaches. Known colony documented along the south side of Copco Lake (Harris 2017). No known rookeries at J.C. Boyle (Wray 2017). Several rookeries documented along the Klamath River (CNDDB 2017).	Wildlife surveys will note presence and nesting colonies to identify potential for impacts from project implementation.
White-faced ibis	*Plegadis chihi*	BLM, ONHP List 4, CWL, Nesting colonies afforded special protection by CDFW	Breeds in freshwater marshes and lakes, and estuaries, and nests near the water on mats of vegetation and twigs; usually occurs in isolated con-specific flocks. Does not typically overwinter in Oregon but is a fairly common visitor in the Klamath Wildlife Area during the spring and summer.	Documented during PacifiCorp surveys along Link River and at Keno Impoundment and J.C. Boyle Reservoir.	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Bufflehead	*Bucephala albeola*	BLM, ONHP List 4	Typically breeds around isolated mountain lakes; nesting habitat includes mixed conifer forest and ponderosa pine forests with sparse to moderate tree canopy closure close to lakes and ponds. Nests in cavities, including artificial nest boxes. May be found in open water and riverine habitat throughout southern Oregon after the breeding season.	Documented during PacifiCorp surveys primarily from January until April along the Link River, at Keno Impoundment and Copco and Iron Gate Reservoirs.	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Barrow's goldeneye	*Bucephala islandica*	ONHP List 4, CSSC	Tends to breed along high-elevation mountain lakes and winter in coastal areas. Potential nesting habitat includes forests with sparse to moderate tree canopy closure next to rivers and reservoirs.	Documented during PacifiCorp surveys along Keno Impoundment, in an inundated drainage ditch off of Copco Lake, and on Iron Gate Reservoir. Common winter migrant on the Link River and Keno Impoundment (R. Larson, USFWS).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Trumpeter swan	*Cygnus buccinator*	OSS, FP	Relatively shallow (less than 6 feet deep), undisturbed bodies of freshwater with abundant aquatic plants.	Not documented in project area.	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Osprey	*Pandion haliaetus*	CWL	Nests in all forested vegetation types with large trees near water, as well as on platforms erected in less optimal habitat.	A minimum of 16 active osprey nests, both artificial nesting platforms and natural sites, are found along the shores of the project reservoirs and river reaches. Documented during PacifiCorp surveys along the Keno reach, along the J.C. Boyle bypass reach, along the J.C. Boyle peaking reach, at J.C. Boyle, Copco, and Iron Gate Reservoirs, along Fall Creek, and along Klamath River from Iron Gate Dam to Shasta River. Several occurrences along lower Klamath River (CNDDB 2017).	Wildlife surveys will note presence and nest sites to identify potential for impacts from project implementation.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Northern harrier	*Circus cyaneus*	CSSC	Nests and forages in grasslands and emergent wetlands. Permanent residents in the project area and common at the Klamath Wildlife Area.	Documented during PacifiCorp surveys in the low-lying marshland and agricultural fields east of Keno Impoundment and along Klamath River from Iron Gate Dam to Shasta River. Not listed on CNDDB for project area (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Golden eagle	*Aquila chrysaetos*	BGEPA, BLM, CSSC, FP, CWL	Breeds in open mountain and hill habitats, nests on cliff ledges, and forages in grasslands and open conifer forests and woodlands with sparse to open tree canopy closure. Eagles use two to three nests during a lifetime.	Historical records exist of several golden eagle nests on cliffs from J.C. Boyle bypass reach to Iron Gate Reservoir. Documented during PacifiCorp surveys at J.C. Boyle powerhouse, along the lower section of J.C. Boyle peaking reach, along Copco and Iron Gate Reservoirs, and Copco bypass reach.	Wildlife surveys will note presence and nest sites to identify potential for impacts from project implementation. See eagle measures.
Bald eagle	*Haliaeetus leucocephalus*	BGEPA, OSS, ONHP List 4, CE, FP	Nests in large conifers within several miles of water; forages in rivers and lakes for fish and waterfowl; requires large snags for perching and conifers for night roosts.	Documented during PacifiCorp surveys at all project reservoirs and in all project reaches throughout the project area. Also documented on Upper Klamath River, on the Klamath River near OR-CA border (ORBIC 2017), and along lower Klamath River (CNDDB 2017).	Wildlife surveys will note presence and nest sites to identify potential for impacts from project implementation. See eagle measures.
Cooper's hawk	*Accipiter cooperii*	CWL	Inhabits riparian deciduous forest, montane hardwood oak woodland, montane hardwood oak-juniper, montane hardwood oak-conifer, juniper woodland, mixed conifer forest, ponderosa pine forest, and lodgepole pine with any level of tree canopy closure.	Documented during PacifiCorp surveys along J.C. Boyle bypass and peaking reaches, and along Klamath River from the Iron Gate Dam to Shasta River. Not listed on CNDDB for project area (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Northern goshawk	*Accipiter gentilis*	BLM, OSS, ONHP List 4, CSSC	Inhabits forested communities with at least 60 percent canopy cover and trees greater than 6 inches in diameter, except oak woodland, oak-conifer woodland, and oak-juniper woodland; forages over large home ranges.	Documented during PacifiCorp surveys flying over J.C. Boyle peaking reach. Documented near tributaries of lower Klamath River (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Sharp-shinned hawk	*Accipiter striatus*	CWL	Inhabits riparian deciduous forest, montane hardwood oak woodland, montane hardwood oak juniper, montane hardwood oak-conifer, juniper woodland, mixed conifer forest, ponderosa pine forest, and lodgepole pine with any level of tree canopy closure and tree diameters ranging from 6 to 24 inches.	Documented during PacifiCorp surveys in oak habitat along J.C. Boyle bypass and peaking reaches, and along Klamath River from Iron Gate Dam to Shasta River. Not listed on CNDDB for project area (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Swainson's hawk	*Buteo swainsoni*	BLM, OSS, ONHP List 4, CT	Dwells in open country and typically inhabits sagebrush, annual grassland, juniper woodland, montane hardwood oak-juniper, and riparian deciduous forest with sparse to open tree canopy closure. The species' range generally lies east of the project area and includes the plains of the Great Basin in southeast Oregon and eastern northern California.	Documented during PacifiCorp surveys flying over agricultural fields southeast of Keno Impoundment. Not listed on CNDDB for project area (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation. Focused surveys are not proposed.
Merlin	*Falco columbarius*	BLM, ONHP List 2, CWL	Uses a variety of forested and open habitats. Ranges throughout North America and travels great distances during migration from breeding grounds in northern Canada and Alaska to wintering habitat through the contiguous United States south to Central America.	Documented during PacifiCorp surveys at J.C. Boyle Reservoir and along J.C. Boyle peaking reach. Not listed on CNDDB for project area (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Prairie falcon	*Falco mexicanus*	CWL	Uses cliffs for nesting and plateau grasslands for foraging.	Documented during PacifiCorp surveys near Keno campground and boat ramp, above J.C. Boyle bypass reach, near Copco Lake, and flying over Klamath Wildlife Refuge. Several occurrences listed as sensitive (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
American peregrine falcon	*Falco peregrinus anatum*	BLM, ONHP List 2, FP	Breeds at suitable nest sites on cliffs and rocky outcroppings. Uses a variety of habitats, including open grassland areas, forest stands, and reservoirs throughout the project area.	The project area is in a management area designated for peregrine falcon recovery. Known to occur along Keno Impoundment and the J.C. Boyle bypass reach but not documented during PacifiCorp surveys. Several occurrences listed as sensitive (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Long-billed curlew	*Numenius americanus*	OSS, CWL	Sparse, short grasses, including shortgrass and mixed-grass prairies as well as agricultural fields.	Not documented in project area.	Wildlife surveys will note any nesting activity to identify potential for impacts from project implementation.
Yellow rail	*Coturnicops noveboracensis noveboracensis*	OSS	Shallow marshes, and wet meadows; in winter, drier fresh-water and brackish marshes, as well as dense, deep grass, and rice fields.	Not documented in project area.	Wildlife surveys will note any nesting activity to identify potential for impacts from project implementation.
Mountain quail	*Oreortyx pictus*	BLM, ONHP List 4	Inhabits open forests, chaparral, and juniper woodlands with dense undergrowth offering suitable refuge; breeds in higher elevation areas; migrates on foot up to 40 miles to lower elevation winter grounds.	Documented during PacifiCorp surveys at J.C. Boyle Reservoir, along the J.C. Boyle bypass reach and peaking reaches, along Fall Creek, and along Klamath River from the Iron Gate Dam to Shasta River.	Wildlife surveys will note any nesting activity to identify potential for impacts from project implementation.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Greater sandhill crane	*Grus canadensis tabida*	BLM, OSS, ONHP List 4, CT, FP	Nests in marshes and wet meadows, and occasionally in pastures and irrigated hayfields. A primary requirement for suitable nesting habitat is the presence of surrounding water or undisturbed habitat.	Documented during PacifiCorp surveys east of Keno Impoundment and along J.C. Boyle Reservoir. PacifiCorp located an active nest with two eggs in it in the emergent wetland bordering J.C. Boyle Reservoir. Several occurrences in the Lower Klamath Lake NWR (CNDDB 2017).	Wildlife surveys will note any nesting activity to identify potential for impacts from project implementation.
Caspian tern	*Sterna caspia*	OSS	Nests in tightly packed colonies on undisturbed islands, levees, and shores along inland water bodies during the summer breeding season. Forages over water.	Documented during PacifiCorp surveys on all project reservoirs as well as along Link River, Keno and J.C. Boyle bypass reaches, and along the Klamath River from Iron Gate Dam to Shasta River. Not listed on CNDDB for project area (CNDDB 2017).	Wildlife surveys will note any nesting activity to identify potential for impacts from project implementation.
Forster's tern	*Sterna forsteri*	BLM, ONHP List 4	Breeds at lakes and marshes and on mud or sand flats near water; forages over water.	Documented during PacifiCorp surveys along Link River, along Keno and J.C. Boyle bypass and peaking reaches, and at all project reservoirs. Not listed on CNDDB for project area (CNDDB 2017).	Wildlife surveys will note any nesting activity to identify potential for impacts from project implementation.
Black tern	*Chlidonias niger*	BLM, ONHP List 4, CSSC	Nests in emergent vegetation along the shoreline periphery of freshwater lakes, wetlands, and marshes along rivers and ponds; forages in wet meadows, pastures, agricultural fields, and water.	Documented during PacifiCorp surveys at Keno and J.C. Boyle Reservoirs. Not listed on CNDDB for project area (CNDDB 2017).	Wildlife surveys will note any nesting activity to identify potential for impacts from project implementation.
Marbled murrelet	*Brachyramphus marmoratus*	FT, OT, ONHP List 2, CE	Spends most of the time in the marine environment foraging in nearshore areas. Uses old-growth forests (coast Redwood forests in California) for nesting.	Known to occur within National Forest lands and Green Diamond Resource Company managed lands near the coast. Critical habitat has been designated near the mouth of the Klamath River.	Focused surveys are not proposed due to unlikelihood of occurrence. Observations during general wildlife surveys and vegetation mapping will be noted.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Flammulated owl	*Otus flammeolus*	BLM, OSS, ONHP List 4	Nests in abandoned woodpecker nest cavities in open forests with a ponderosa pine component.	Documented during PacifiCorp surveys along J.C. Boyle bypass and peaking reaches.	Wildlife surveys will note any nesting activity to identify potential for impacts from project implementation.
Great gray owl	*Strix nebulosa*	BLM, OSS, ONHP List 4, CE	Inhabits mixed conifer, ponderosa pine, and riparian mixed forest stands with trees greater than 11 inches in diameter providing at least 60 percent canopy cover within at least 984 feet of a natural or manmade opening greater than 10 acres. Breeds in tree cavities, typically near suitable open grassland foraging habitat.	Documented during PacifiCorp surveys east of Fall Creek near Jenny Creek. Not listed on CNDDB for project area; nearest location is 24 miles west of Iron Gate Dam (CNDDB 2017). Rarely detected south of Highway 66 by BLM (Godwin 2017).	Wildlife surveys will note any nesting activity to identify potential for impacts from project implementation. Focused surveys are not proposed due to unlikelihood of occurrence.
Northern spotted owl	*Strix occidentalis caurina*	FT, OT, ONHP List 1, CT, CSSC	Inhabits ponderosa pine forest, mixed conifer forest, and conifer forest with trees greater than 11 inches in diameter. Prefers old-growth forests with multi-layered tree canopies. Critical habitat occurs within the project area near the J.C. Boyle Powerhouse, upstream of Copco Lake and south of the Klamath River and along portions of the lower Klamath River.	Documented during PacifiCorp surveys near J.C. Boyle Reservoir and along J.C. Boyle peaking reach. Several occurrences within the project area (CNDDB 2017, ORBIC 2017). Known to occur within National Forest lands and Green Diamond Resource Company managed lands near the coast. Critical habitat has been designated near the J.C. Boyle Powerhouse.	Protocol surveys are proposed (see separate northern spotted owl measures).
Yellow-billed cuckoo	*Coccyzus americanus*	FT, BLM, CE	Riparian forest nester, along the broad, lower flood-bottoms of larger river systems.	Not found during PacifiCorp surveys. Not listed on CNDDB search (2017); identified on IPaC (2017).	Focused surveys are not proposed due to unlikelihood of occurrence. Observations during general wildlife surveys and vegetation mapping will be noted.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Vaux's swift	*Chaetura vauxi*	CSSC	Found in mixed conifer, ponderosa pine, lodgepole pine, riparian deciduous, montane hardwood oak woodland, montane hardwood oak-conifer, and montane hardwood oak-juniper forests with trees greater than 11 inches in diameter.	Documented during PacifiCorp surveys at J.C. Boyle, Copco, and Iron Gate Reservoirs, along the J.C. Boyle bypass and peaking reaches, along Fall Creek, and along Klamath River from Iron Gate Dam to Shasta River. Not listed on CNDDB for project area (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Black swift	*Cypseloides niger*	OSS, ONHP List 2, CSSC	Suitable nesting habitat is limited to cliffs near water courses. Breeding sites are widely distributed in Oregon and California; none known in Klamath or northern Siskiyou Counties.	Not documented during PacifiCorp surveys. Documented along Klamath River near Orleans (CNDDB 2017).	Observations during general wildlife surveys will be noted.
Pileated woodpecker	*Drycopus pileatus*	BLM, ONHP List 4	Occurs in all forest and woodland cover types with moderate to dense tree canopy closure. Requires large snags 25 inches or more in diameter for excavating suitable nest cavities.	Documented during PacifiCorp surveys along Keno reach, at J.C. Boyle Reservoir, along J.C. Boyle bypass and peaking reaches, and along Fall Creek.	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Acorn woodpecker	*Melanerpes formicivorus*	BLM, OSS, ONHP List 4	Nests in cavities in snags of deciduous tree species, particularly oak snags at least 17 inches in diameter.	Several nesting colonies documented during PacifiCorp surveys in oak, oak-juniper, and oak/conifer habitats, primarily at Copco Lake. Also documented during PacifiCorp surveys at J.C. Boyle and Iron Gate Reservoirs, along J.C. Boyle peaking reach, along Copco bypass reach, along Fall Creek, and along Klamath River from Iron Gate Dam to Shasta River.	Wildlife surveys will note presence, nesting activity, and granary trees to identify potential for impacts from project implementation.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Lewis' woodpecker	*Melanerpes lewis*	BLM, OSS, ONHP List 2	Associated with oak woodlands and mixed oak conifer habitat, but also can be found in a variety of open forest stands including ponderosa pine and cottonwood-dominated riparian areas.	Documented during PacifiCorp surveys in upland habitats along J.C. Boyle peaking reach, in riparian habitats at Iron Gate Reservoir, and along Klamath River from Iron Gate Dam to Shasta River. Documented in Klamath River Canyon (ORBIC 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
White-headed woodpecker	*Picoides albolarvatus*	BLM, OSS, ONHP List 2	Nests in cavities typically in ponderosa pine at least 18 inches in diameter. Occurs in lodgepole pine, ponderosa pine, and Klamath mixed conifer forests with trees greater than 11 inches in diameter.	Documented during PacifiCorp surveys along J.C. Boyle bypass reach. Not listed on CNDDB for project area (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Black-backed woodpecker	*Picoides arcticus*	BLM, OSS, Petitioned for CA listing	Recently burned coniferous forest in the Sierra Nevada and Cascades to the Siskiyou Mtns; areas with dense standing dead trees, and less commonly in unburned forests.	Not documented during PacifiCorp surveys or listed on CNDDB or ORBIC for the project area. May occur based on information from USFWS Yreka office (May 23, 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
American three-toed woodpecker	*Picoides tridactylus*	OSS	Montane coniferous forests with large stands of dead and dying conifers, including areas disturbed by fire.	Not documented during PacifiCorp surveys or listed on CNDDB or ORBIC for the project area.	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Olive-sided flycatcher	*Contopus cooperi*	BLM, OSS, ONHP List 4	Typically found in coniferous forests with tall trees providing suitable perch sites.	Documented during PacifiCorp surveys along Link River, at Keno, J.C. Boyle and Iron Gate Reservoirs, and along Keno and J.C. Boyle peaking reaches. Not listed on CNDDB for project area (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Willow flycatcher	*Empidonax traillii*	BLM, CE	Associated with dense riparian willow thickets.	Documented during PacifiCorp surveys in some of the denser willow patches along Link River, at J.C. Boyle, Copco, and Iron Gate Reservoirs, along the J.C. Boyle peaking reach, and along Klamath River from Iron Gate Dam to Shasta River. Also documented at Iron Gate Reservoir at Jenny Creek (CNDDB 2017).	In addition to noting presence and nesting activity, surveys will be conducted in suitable habitat to quantify and map potential habitat and identify potential for impacts from project implementation.
Purple martin	*Progne subis*	BLM, OSS, ONHP List 2, CSSC	Riparian and wetland forests, as well as Klamath mixed conifer forest, ponderosa pine forest, montane hardwood oak woodland, montane hardwood oak-conifer, and montane hardwood oak-juniper with sparse to moderate tree canopy closure (<60 percent). Range is patchy and may include portions of the study area.	Documented during PacifiCorp surveys above the upper falls at Fall Creek.	Wildlife surveys will note presence and nesting activity/colonies to identify potential for impacts from project implementation.
Red-necked grebe	*Podiceps grisegena*	OSS	Breeds on shallow freshwater lakes, bays of larger lakes, marshes, and other inland bodies of water. Winters on open ocean or on large lakes.	Not documented in project area.	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Black-capped chickadee	*Parus atricapillus*	CWL	Nests in a variety of woodland habitats wherever suitable, small nest cavities can be found.	Documented during PacifiCorp surveys along Link River and at Copco and Iron Gate Reservoirs.	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Pygmy nuthatch	*Sitta pygmea*	BLM	Typically found in ponderosa pine forests with less than 70 percent canopy closure.	Documented during PacifiCorp surveys at Keno Impoundment and J.C. Boyle Reservoir.	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Yellow warbler	*Dendroica petechia*	CSSC	Found in riparian deciduous forest, riparian shrub, scrub-shrub wetland, and forested wetland. Breeds in riparian habitat throughout North America and winters south from Mexico through South America.	Documented during PacifiCorp surveys throughout the project area at all project reservoirs and in all project reaches. Incidental occurrence documented with Willow flycatcher at Copco/Iron Gate Reservoirs (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Yellow-breasted chat	*Icteria virens*	BLM, OSS, CSSC	Found in the brushy understory of deciduous and mixed woodlands; breeds in brushy vegetation, typically willow thickets, along rivers and streams.	Documented during PacifiCorp surveys primarily in wetland and riparian habitats along J.C. Boyle peaking reach, at Copco Lake, along Fall Creek, and along Klamath River from Iron Gate Dam to Shasta River. Incidental occurrence documented with Willow flycatcher at Copco/Iron Gate Resevoirs (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Northern waterthrush	*Parkesia noveboracensis*	ONHP List 2	Nests in dense riparian willow thickets.	ORBIC occurrence at Grizzly Butte along Klamath River (ORBIC 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Tricolored blackbird	*Agelaius tricolor*	Petitioned for federal listing, BLM, CSSC, CC	Highly colonial species; requires open water, protected nesting substrate, and foraging area with insect prey within a few km of the colony. Historically found in large wetland complexes; nesting colonies are now typically found in agricultural areas such as dairy silage fields with wetlands.	Not documented during PacifiCorp surveys or listed on CNDDB or ORBIC for the project area. Nearest occurrences just north of Keno (Wray 2017). No agricultural fields typically used by the species for nesting colonies are present in the project area.	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Mammals					
Townsend's big-eared bat	*Corynorhinus townsendii*	BLM, OSS, ONHP List 2, CSSC	Generally found in open forests and a variety of habitats; the availability of suitable roost sites (rock crevices, cliff ledges, and human-made structures) limits distribution and occurrence.	Known from J.C. Boyle peaking reach but not documented during PacifiCorp surveys. One occurrence in project area listed as sensitive by ORBIC (2017). Documented occurrences along Klamath River near Somes Bar (CNDDB 2017).	See bat measures.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Yuma myotis	*Myotis yumanensis*	BLM, ONHP List 4	Generally found in open forests and a variety of habitats; the availability of suitable roost sites (rock crevices, cliff ledges, and human-made structures) limits distribution and occurrence.	Documented during PacifiCorp surveys roosting in J.C. Boyle forebay spillway house, in transformer bays at Copco No. 1 powerhouse, and in rafters at Iron Gate south gatehouse. Also known from J.C. Boyle peaking reach. One occurrence outside project area (CNDDB 2017).	See bat measures.
California myotis	*Myotis californicus*	OSS	Wide tolerance of habitat including forested regions of the Pacific Northwest, humid coastal forests and montane forests.	Not documented in project area. Range overlaps with project area.	See bat measures.
Fringed myotis	*Myotis thysanodes*	BLM, OSS	Oak and pinyon woodlands appear to be the most commonly used vegetative associations. Roost sites may be in caves, mines, and buildings.	Not documented in project area. Range overlaps with project area.	See bat measures.
Hoary bat	*Lasiurus cinereus*	OSS	May prefer trees at the edge of clearings, but have also been found in trees in heavy forests, open wooded glades, and shade trees along urban streets and in city parks.	Not documented in project area. Range overlaps with project area.	See bat measures.
Long-legged myotis	*Myotis volans*	OSS	Roosts in trees, rock crevices, fissures in stream banks, and buildings. Caves and mines are used at night.	Not documented in project area. Range overlaps with project area.	See bat measures.
Pallid bat	*Antrozous pallidus*	BLM, CSSC, OSS	Variety of structures for day and night roosting, including live trees and snags, a rock crevice, and buildings.	Not documented in project area. Range overlaps with project area.	See bat measures.
Silver-haired bat	*Lasionycteris noctivagans*	OSS	Prefer temperate, northern hardwoods with ponds or streams nearby. The typical day roost for the bat is behind loose tree bark.	Not documented in project area. Range overlaps with project area.	See bat measures.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
American pika	*Ochotona princeps*	OSS	Restricted to rocky talus slopes, primarily the talus-meadow interface. Often they occur above treeline up to limit of vegetation but also can be found at lower elevations in rocky areas within forests or near lakes. Occasionally they inhabit mine tailings or even piles of lumber or scrap metal.	Not documented in project area.	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Western gray squirrel	*Sciurus griseus*	BLM, ONHP List 4	Found in a variety of forested habitat types including mixed conifer forest, ponderosa pine forest, lodgepole pine, montane hardwood oak woodland, montane hardwood oak-conifer, and montane hardwood oak juniper with trees greater than 6 inches in diameter.	Documented during PacifiCorp surveys at J.C. Boyle Reservoir and Copco Lake, along J.C. Boyle peaking reach, and along Copco bypass reach.	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Ringtail	*Bassariscus astutus*	BLM, OSS, ONHP List 4, FP	Uses a mixture of forest and shrublands or other habitats that provide vertical structure near rocky or riparian areas. Range overlaps the study area. The species is known to occur in the study area.	Not documented during PacifiCorp surveys. Documented in Klamath River Canyon (ORBIC 2017). Not listed on CNDDB for project area (CNDDB 2017).	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Fisher- West Coast DPS	*Martes pennanti (Pekania pennanti)*	BLM, OSS, ONHP List 2, CC, CSSC	Mature, closed canopy forests with some deciduous trees; intermediate to large tree stages of conifer forests and riparian deciduous forests both with high tree canopy closure. Habitats in the study area include lodgepole pine, Klamath mixed conifer forest, ponderosa pine forest, riparian deciduous forest, montane hardwood oak-conifer with trees >11 inches DBH. Range overlaps the study area.	Not documented during PacifiCorp surveys. ORBIC occurrences along Klamath River near Rock Creek (ORBIC 2017). Documented along lower Klamath River (CNDDB 2017). Has been documented in the Upper Klamath Basin within the last two years (T. Collom, ODFW, personal communication, April 29, 2011).	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Sierra Nevada red fox	*Vulpes vulpes necator*	FC, OSS, CT	High elevation, open conifer woodlands and mountain meadows near treeline. Range includes the Sierra Nevada and southern Cascade mountains of eastern California, into southern Oregon and western Nevada.	Not documented in project area.	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Wolverine	*Gulo gulo*	FPT, OT, CT, FP	Found in the north coast mountains and the Sierra Nevada. Found in a wide variety of high elevation habitats.	Documented occurrence outside of project area (CNDDB 2017).	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
American badger	*Taxidea taxus*	CSSC	Most abundant in drier open stages of most shrub, forest, and herbaceous habitats, with friable soils.	Documented occurrences outside of project area (CNDDB 2017).	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Canada lynx	*Lynx canadensis*	FT, ONHP List 2	Generally occurs in boreal and montane regions dominated by coniferous or mixed forest with thick undergrowth, but also sometimes enters open forest, rocky areas, and tundra to forage for abundant prey.	Not found during PacifiCorp surveys. Not listed on CNDDB search (2017); identified on IPaC (2017).	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Gray wolf	*Canis lupus*	FE, CE, ONHP List 2	Habitat generalists, historically occupying diverse habitats including tundra, forests, grasslands, and deserts. Primary habitat requirements are the presence of adequate ungulate prey, water, and low human contact.	Not found during PacifiCorp surveys. Not listed on CNDDB search (2017); identified on IPaC (2017).	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort

Notes:
*Information on occurrence in the project area is based on PacifiCorp surveys (PacifiCorp 2004a) and information obtained from Oregon Biodiversity Information Center (ORBIC), California Natural Diversity Database (CNDDB), USFWS Information for Planning and Conservation (IPaC) databases (2017), and input for federal and state resource agencies. Please see Table 3.5-1 for a list of species observed during the July 2017 site reconnaissance.

Key:

BGEPA	Federal Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management sensitive species -species that could easily become endangered or extinct; and/or Survey and Manage Species
CC	Candidate listing by California Department of Fish and Wildlife
CDFW	California Department of Fish and Wildlife
CE	California Endangered
CSSC	California Department of Fish and Wildlife Species of Special Concern -not listed under the Federal or California Endangered Species Act but are believed to: 1) be declining at a rate that could result in listing, or 2) historically occurring in low numbers and having current known threats to their persistence
CT	California Threatened
CWL	California Department of Fish and Wildlife Watch List
FC	Federal Candidate Species
FE	Federal Endangered
FP	Fully protected under the California Fish and Game Code
FT	Federal Threatened
OC	Candidate listing by Oregon Department of Fish and Wildlife (ODFW)
OE	Listed as endangered by ODA or ODFW
ONHP List 1	Oregon Natural Heritage Program (ONHP) threatened with extinction or presumed to be extinct throughout their entire range
ONHP List 2	threatened with extirpation or presumed to be extirpated from the State of Oregon
ONHP List 3	more information is needed before status can be determined, but may be threatened or endangered in Oregon or throughout their range
OHNP List 4	of conservation concern but not currently threatened or endangered
OT	Listed as threatened by ODFW
OSS	Oregon Sensitive or Sensitive- Critical Species, East Cascades, West Cascades, and Klamath Mountains Ecoregions
USFWS	United States Fish and Wildlife Service

Chapter 4: Bats Measures

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4. BATS MEASURES

4.1 Objectives

The objectives of the bat survey are to document and confirm roosting locations and determine bat roost patterns at dam structures and associated facilities. KRRC will use the information collected during surveys to identify where roost structures can be retained and protected, if practicable, and will inform the development of bat exclusion and structure demolition plans prior to construction, as well as replacement habitat design.

The 2012 EIS/R (Section 3.5) TER-6 describes measures to reduce impacts on special status bats. The 2012 EIS/R recommended surveys to identify the locations of active bat roosts in facilities that may be affected by the dam removal. KRRC has incorporated this measure into the Project and will be implemented as described in the following sections. KRRC has incorporated the recommended avoidance and minimization measures into the Project's design and construction planning. This Section describes the initial phase of this process.

4.2 Existing Information

Based on a review of California and Oregon occurrence records, presence of suitable habitat, species range overlap, and previous survey results, eight bat species have potential to occur in the project area. Table 4-1 lists these species.

Yuma myotis have been previously documented at structures within the project area (PacifiCorp 2004). Townsend's big-eared bat and *Yuma myotis* have been previously documented in the Klamath Basin outside of the project area, in maternity roosts at Hoover Ranch and Salt Caves (approximately 6 miles east of Copco Reservoir and 9 miles downstream from the J.C. Boyle powerhouse) (Cross et al. 1998; PacifiCorp 2004). Of 24 facility sites visually-surveyed in June 2003, 6 had roosting bats, and 10 had evidence of recent bat use (PacifiCorp 2004, Attachment A).

4.3 Methods

4.3.1 Data Review

Recently-published data and literature, along with a current list of species with potential to occur obtained in coordination with ODFW, CDFW, BLM, USFS, and USFWS (Table 4-1), have been reviewed to complement

and update the information cited in the 2012 EIS/R (USBR and CDFW 2012, Section 3.5). Coordination with local bat experts is ongoing as of December 2017.

4.3.2 Bat Roost Surveys

KRRC will conduct bat roost surveys for 2 years prior to construction activities. KRRC will conduct roost surveys cautiously to avoid disturbing bats at roost sites. An initial site reconnaissance and daytime visual inspection of buildings and bridges within the areas where removal or improvements will occur for the Project was conducted during the summer 2017 maternity season and is further described in the Preliminary Results section. KRRC planned a follow-up survey was planned during the 2017 maternity season to conduct dusk emergence surveys and pre-dawn re-entry surveys, but the survey was cancelled due to lack of right-of-entry to PacifiCorp property for the specific survey task. KRRC will consider the need to assess significant roosting habitat outside of buildings as project activities are further developed and refined. If determined to be potentially affected by noise or vibrations, significant roosting habitat in the vicinity of major project disturbances (such as trees planned for removal) will be evaluated during survey efforts, or as otherwise dictated by the project schedule.

KRRC is using the data review, ongoing coordination with regional bat experts, and conditions observed during the initial 2017 reconnaissance survey and daytime visual inspections to inform the design of and need for future survey efforts outside of the maternity season. Table 4-2 provides recommendations for future surveys based on the 2017 reconnaissance survey. These recommended surveys are underway in 2018 to identify which species occupy the habitat throughout the year, understand how the habitat is utilized throughout the year, and quantify habitat usage. These 2018 surveys include dusk emergence surveys and pre-dawn re-entry surveys, using night vision and acoustic detection as appropriate. KRRC is implementing acoustic monitoring as needed to determine bat roost patterns. KRRC tailored the number and location of emergence/re-entry surveys and acoustic monitoring surveys to the size of each structure and the species which have the potential to occupy it. KRRC is conducting the emergence surveys when weather conditions are suitable for the evening emergence of bats (e.g., temperatures are warm enough and rain and wind are minimal).

Townsend's big-eared bat (*Corynorhinus townsendii*) is extremely sensitive to disturbance, and there is a high probability of roost abandonment, reproductive failure, and/or fatality from disturbance. Accordingly, when KRRC surveys roosts during the maternity and hibernation seasons, KRRC uses specialized survey techniques for any structures that are suspected to be occupied by this species. Survey methodologies for Townsend's big-eared bat were developed on a case-by-case basis and are dependent on the current level of disturbance, site conditions, types of roost structures present, and season. For structures with the possibility of occupancy by the species, KRRC is only conducting exterior surveys to determine use of structures during their maternity season (April 15-August 31, 2018), to the extent possible. KRRC is conducting interior surveys, whether conducted after non-detection surveys during the maternity season, or conducted outside of the maternity season, in a manner to avoid disturbing roosting bats.

KRRC will use the information obtained during the surveys to (1) determine which facilities need to be removed or modified outside of the bat roosting and breeding period, (2) inform the design of bat exclusion methods where needed, and (3) determine the appropriate design and placement of artificial bat roosts. KRRC will consider and implement the Western Bat Working Group species-specific survey methodologies (http://wbwg.org/matrices/survey-matrix/) as appropriate.

The first year of winter hibernacula surveys that KRRC conducted in February-March 2018 were limited to structures at Copco 1 and 2 due to access constraints. KRRC is conducting additional roost surveys in May and June 2018. KRRC is conducting hibernacula surveys so as not to cause disturbance to hibernating bats. KRRC is conducting spring and fall migration surveys in approximately April/May and September/October, 2018. The level of survey effort throughout 2018-2019 will continue to be informed and modified according to the ongoing planning and development of the project design, findings of each consecutive focused survey, and in coordination with CDFW and ODFW. KRRC will conduct additional site-specific surveys prior to demolition or modification of structures to confirm that bats have successfully been excluded or are otherwise not present (see Section 4.5, Avoidance and Minimization Measures)

4.4 Preliminary Results

KRRC conducted a general site reconnaissance and daytime visual inspections of most project structures during the 2017 maternity season, from July 24-26, 2017 at J.C. Boyle, Copco No. 1 and No. 2, and Iron Gate. Qualified bat biologists conducted daytime visual inspections of each facility to be removed or modified for indications of bat use (e.g., occupancy, guano, staining, smells or sounds). KRRC inspected the exterior and interior of most structures. When bats were found, the species were identified visually to the extent possible. In order to minimize disturbance to roosting bats during the maternity season, KRRC limited interaction with live bats to brief viewing to confirm presence only. Table 4-2 summarizes initial survey findings and future survey plans. Recommendations for future surveys are informed by habitat suitability, the presence of bats or bat sign, and the presence of entry and exit points.

KRRC did not inspect five structures at Copco Village due to time constraints. For houses that are currently inhabited, KRRC limited the inspection to the exterior. KRRC plans interior inspections of these structures for future site visits. Because the tunnels near the Copco No. 1 and Iron Gate powerhouses were not accessible during the site reconnaissance, a qualified bat biologist will accompany future tunnel inspections to assess the habitat suitability inside of the tunnels, if possible, and/or bat use will be assessed using dusk emergence surveys and pre-dawn re-entry surveys.

4.5 Avoidance and Minimization Measures

If surveys indicate a facility is utilized as a bat roost, then one or more of the following measures will be employed to minimize disturbance and mortality to roosting bats:

- KRRC's contractor will remove the facility or modify it outside the bat roosting and breeding period where feasible (i.e. November 1 to March 1). If the facility is used as winter hibernacula (November 1 to March 1), then KRRC's contractor will remove the facility or modify it when it is determined to be unoccupied.
- Bat exclusion methods to seal-up facility entry sites (e.g., blocking and netting or installing sonic bat deterrence equipment) will occur during the fall migration period. KRRC will conduct humane bat exclusion by, or under the supervision of, a qualified bat biologist with experience in conducting exclusions and possessing a California Scientific Collecting Permit. KRRC will develop a bat exclusion plan and provide a copy to CDFW prior to initiation of exclusion activities for their information, technical expertise, and experience. The plan will include proposed exclusion methods for each structure and data describing the numbers of bats that have been observed emerging from the structures. Exclusion devices will be in place for at least 7 days to ensure all bats have had adequate time to exit. If climatic conditions occur that may deter roost exit (rain, cold temperatures, high winds, full moon, etc.), additional time will be added to the minimum number of nights the exclusion device is to remain in place. KRRC will monitor exclusion devices to ensure proper function.
- If demolition at a time when a structure is unoccupied and complete bat exclusion are both found to be infeasible at a given structure, KRRC will coordinate with USFWS and CDFW or ODFW, as appropriate to carefully remove the occupied bat habitat at a time when it will have the least impact on the bats present and in a manner that avoids bat injury and mortality.
- To reduce impacts on bats from the permanent loss of roosting habitat, KRRC will give preference to on-site and in-kind replacement roosting habitat. KRRC may retain facilities occupied by significant bat roosts, to the extent practicable.
- For those facilities that cannot be retained, KRRC will construct free-standing replacement bat roosts in coordination with bat specialists and the resource agencies. The size and design of each artificial bat roost will be informed by the features of the facility being utilized by roosting bats, the type of roost, and the size of the roost. Critical design elements will include access, ventilation, and thermal conditions. The total number of artificial bat roosts will depend on the total number of facilities with significant bat roosts to be demolished. Replacement roost structures will be in place prior to demolition of the existing facility. Experienced contractors will perform the installation of bat roosts. The structures will meet the specifications of Bats in American Bridges (Keeley and Tuttle 1999) and California Bat Mitigation Techniques, Solutions, and Effectiveness (H.T. Harvey and Associates 2004).
- KRRC will develop success criteria for replacement roost structures in coordination with bat specialists and the USFWS and CDFW or ODFW, as appropriate. Post-construction monitoring of the replacement roosts will occur seasonally (four times/year) until the earliest of the following: (1) up to five years after completion of project activities; (2) transfer of relevant Parcel B lands to the States and/or third parties; or (3) until the mitigation can be considered successful. After three years, adaptive management (i.e., reduced or discontinued monitoring of structures that have met criteria, or enhancement of structures that are not meeting criteria) will be applied as appropriate. KRRC will coordinate with the USFWS and CDFW or ODFW, as appropriate, to develop adaptive management strategies and determine that success criteria have been met.

4.6 References

Cross, S.P., H. Lauchstedt, M. Blankenship. 1998. Numerical status of Townsend's Big-eared Bats at Salt Caves in the Klamath River Canyon and other selected sites in Southern Oregon, 1997. Southern Oregon University, Ashland, Oregon.

Johnson, D., G. Tatarian, E. Pierson. 2004. California Bat Mitigation Techniques, Solutions, and Effectiveness. Prepared for California Department of Transportation and California State University Sacramento Foundation. Project Number 2394-01. December 29, 2004.

PacifiCorp. 2004. Terrestrial Resources Final Technical Report Klamath Hydroelectric Project FERC No. 2082. February 2004.

USBR and CDFW. 2012. Klamath Facilities Removal. Final Environmental Impact Statement/Environmental Impact Report (EIS/R). U.S. Bureau of Reclamation and California Department of Fish and Wildlife, December.

Table 4-1 Bat species with potential to occur in the project area

Common Name	Scientific Name	Status[1]	Suitable Habitat[2]	Known Occurrences within Project Area	Range Overlap?
Pallid bat	*Antrozous pallidus*	BLM, CSSC, OSS, USFS, WBWG-H	1) Buildings, bridges, and tree bark/hollows. 2) Caves, mines and cliffs/rock crevices.	None	Yes
Townsend's big-eared bat[3]	*Corynorhinus townsendii*	BLM, CSSC, OSS, USFS, WBWG-H	1) Caves, mines. 2) Buildings, bridges. 3) Tree bark/hollows.	Known from J.C. Boyle peaking reach. Not documented during PacifiCorp surveys (PacifiCorp 2004). Multiple observations in Rock Creek-Klamath River watershed (exact location not given; ORBIC 2017). Occurrences along Klamath River near Somes Bar (CNDDB 2017).	Yes
Silver-haired bat	*Lasionycteris noctivagans*	OSS, WBWG-M	1) Tree bark/hollows. 3) Bridges.	None	Yes
California myotis	*Myotis californicus*	OSS, WBWG-L	1) Buildings, cliffs/rock crevices. 2) Bridges, caves, mines, tree bark/hollows.	None	Yes

Common Name	Scientific Name	Status[1]	Suitable Habitat[2]	Known Occurrences within Project Area	Range Overlap?
Hoary bat	*Lasiurus cinereus*	OSS, WBWG-M	1) Tree foliage.	None	Yes
Fringed myotis	*Myotis thysanodes*	BLM, OSS, USFS, WBWG-H	1) Caves, mines, tree bark/hollows. 2) Buildings, bridges, cliffs/rock crevices.	None	Yes
Long-legged myotis	*Myotis volans*	OSS, WBWG-H	1) Tree bark/hollows. 2) Buildings, bridges, caves, mines.	None	Yes
Yuma myotis	*Myotis yumanensis*	BLM, WBWG-L	1) Buildings, bridges. 2) Caves, mines, tree bark/hollows. 3) Cliffs/rock crevices.	Documented during PacifiCorp surveys roosting in J.C. Boyle forebay spillway house, in transformer bays at Copco No. 1 powerhouse, and in rafters at Iron Gate south gatehouse (PacifiCorp 2004)	Yes

[1] USFS US Forest Service sensitive species not listed or proposed for listing under the federal Endangered Species Act for which population viability is a concern, as evidenced by significant current or predicted downward trends in population numbers or density, or significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.
BLM Bureau of Land Management sensitive species are species that could easily become endangered or extinct.
CSSC California Department of Fish and Wildlife Species of Special Concern are species not listed under the federal or California Endangered Species Act but are believed to: 1) be declining at a rate that could result in listing, or 2) historically occur in low numbers and have current known threats to their persistence.
OSS Oregon Sensitive or Sensitive-Critical Species, East Cascades, West Cascades, and Klamath Mountains Ecoregions.
WBWG Western Bat Working Group High (H), Medium (M), or Low (L) Priority for funding, planning and conservation actions in Ecoregion 5 (http://wbwg.org/matrices/species-matrix/).
[2] 1 = used frequently; 2 = used sometimes; 3 = used rarely (Johnson et al. 2004).
[3] PacifiCorp (2004) treated this as two subspecies; however, *Corynorhinus townsendii* is currently listed as one species.

Table 4-2 Initial findings (July 2017) and recommendations for future surveys

Building Name	Suitability for Roosting[1]	Live Bats Present?	Evidence of Bats Found?	Survey Recommendation
J.C. Boyle Dam and Facilities				

Building Name	Suitability for Roosting[1]	Live Bats Present?	Evidence of Bats Found?	Survey Recommendation
Red Barn	High	No	Yes - found dead bats outside of the building and inside the attic (badly dessicated - likely *Myotis* sp.). Abundant guano in attic.	Determine seasonal use. Next survey in winter 2017-2018.
Truck Shop	High	No	No	Emergence/re-entry survey.
HazMat	Low	No	No	No additional survey needed.
Well House	Low	No	No	No additional survey needed.
Fire System Control	Moderate-High	No	Yes - small amounts of guano.	Emergence/re-entry survey.
Dam Communications	Moderate	No	No	No additional survey needed.
Fish Screen House	Moderate	No	No	No additional survey needed.
Headgate Control	Moderate	No	No	Emergence/re-entry survey.
Headgate structure/concrete canal	Low	No	No	No additional survey needed.
Concrete Spillway (along canal)	Moderate	No	Yes - small amounts of guano.	No additional survey needed.
Spillway Gatehouse	High	Yes	Yes - occupied by several hundred bats.	Determine seasonal use. Next survey in winter 2017-2018.
M+K building	High	No	Yes - small amounts of guano.	Determine seasonal use. Next survey in winter 2017-2018.
Copco No. 1 and No. 2 Dams and Facilities				
Schoolhouse	Low	No	No	No additional survey needed.
House 19038 (next to schoolhouse)	High	No	Yes - abundant guano in crawlspace.	Determine seasonal use. Next survey in winter 2017-2018.
Vacant House 1 (tan)	High	Yes	Yes - small numbers of bats present under wood panels outside.	Determine seasonal use. Next survey in winter 2017-2018.
Vacant House 2 (blue)	High	Yes	Yes - small numbers of bats present under wood panels outside.	Determine seasonal use. Next survey in winter 2017-2018.

Building Name	Suitability for Roosting[1]	Live Bats Present?	Evidence of Bats Found?	Survey Recommendation
Vacant House 3 (yellow)	High	Yes	Yes - large colony in garage behind wood window framing, whole structure is being heavily used.	Determine seasonal use. Next survey in winter 2017-2018.
Vacant House 4 (peach)	High	Yes	Yes - colony between flashing & fascia board all around roof edge. Pups present.	Determine seasonal use. Next survey in winter 2017-2018.
Cookhouse	Moderate	Yes	Yes - bats present in awning over side door outside, no sign inside.	Determine seasonal use. Next survey in winter 2017-2018.
Bunkhouse	Moderate	No	Yes - guano on bed. Night roosting suspected from staining around outside lighting.	Emergence/re-entry survey.
Copco No. 1 Dam - C12 gatehouse	High	No	Yes - abundant guano/staining inside & out, dead bat (Myotis sp.) found outside on windowsill.	Emergence/re-entry survey.
Copco No. 1 powerhouse	High	Yes	Yes - several dozen bats clustered on wall above Transformer 3781; abundant staining/guano on basement level.	Determine seasonal use. Next survey in winter 2017-2018.
Tunnel outside of Copco No. 1 powerhouse	High	Unknown	Not inspected	Emergence/re-entry survey. Accompany future tunnel inspection.
Copco No. 2 Diversion Dam	Low	No	No	No additional survey needed.
Vacant House #21601 (light yellow house)	High	Yes	Yes - ~200 bats roosting in attic.	Determine seasonal use. Next survey in winter 2017-2018.
Shed (next to power station)	High	No	None found in main portion of shed. Back area of building was inaccessible.	Emergence/re-entry survey.
Vacant House (light blue)	Moderate	No	Yes - dead bat found in bathroom sink. No guano/staining inside. Attic vents are closed. No points of entry found.	No additional survey needed.

Building Name	Suitability for Roosting[1]	Live Bats Present?	Evidence of Bats Found?	Survey Recommendation
Tin Pumphouse (across from light blue house)	Low	No	No	No additional survey needed.
Tin Pumphouse at entrance to Copco Village	Moderate	No	Yes - small amount of guano outside. Multiple points of entry. Inside inaccessible.	Emergence/re-entry survey.
Copco No. 2 powerhouse	High	No	Yes - many dead bats on ground level (on floor, in storage room, control room) and dead pups at bottom of stairs on lower level. More sign/activity found at ground level.	Determine seasonal use. Next survey in winter 2017-2018.
Control Room at Copco No. 2 powerhouse	-	Unknown	Not inspected	Daytime inspection during future survey.
Shop next to powerstation at Copco No. 2	-	Unknown	Not inspected	Daytime inspection during future survey.
Occupied House next to Vacant House 4	-	Unknown	Not inspected	Daytime inspection during future survey.
Equipment shed (in front of bunkhouse/cookhouse)	-	Unknown	Not inspected	Daytime inspection during future survey.
Waste storage/wood shop by gas pumps (near houses/bunkhouse/cookhouse)	-	Unknown	Not inspected	Daytime inspection during future survey.
Iron Gate Dam and Facilities				
Gatehouse for low-level outlet (upstream side of dam)	Moderate	No	Yes - night roosting evidence outside. No sign found inside.	No additional survey needed.
Tunnel near Iron Gate powerhouse	High	Unknown	Not inspected	Emergence/re-entry survey. Accompany future tunnel inspection.
Iron Gate Powerhouse intake	High	Yes	Yes - from ground level, bats can be heard through grating below. Entry via open grate on outside. Two dead bats, abundant guano on plastic sheeting on floor inside.	Determine seasonal use. Next survey in winter 2017-2018.
Iron Gate Emergency Spill Equipment shed	Low	No	No	No additional survey needed.

Building Name	Suitability for Roosting[1]	Live Bats Present?	Evidence of Bats Found?	Survey Recommendation
Iron Gate Hydro Resources office/powerhouse	High	No	Yes - heavily used night roost by light fixture under stairwell (abundant staining on concrete wall). Sign of significant roost inside concrete shaft (heavy staining/guano). Confined space entry to bottom level of powerhouse, did not inspect.	Emergence/re-entry survey.
Bathroom/storage building near powerhouse	Moderate	No	No - multiple potential entry/exit points.	Emergence/re-entry survey.
Spawning building	Moderate	No	Yes - small amount of guano. Potential night roosting outside.	No additional survey needed.
2 storage trailers (parked next to each other)	Low	No	No	No additional survey needed.
Barn/garage at Iron Gate Village	High	Yes	Yes - bats present in rafters/ceiling, abundant guano.	Determine seasonal use. Next survey in winter 2017-2018.
Residence 1 (occupied) blue/gray	High	No	No (inspected outside only - inside/attic not accessed).	Daytime interior (attic) inspection during future survey.
Residence 2 (occupied) tan w/green roof	High	Yes	Yes - ~15 bats present behind clock on back porch. Attic access likely through loose screen over vent. Outside inspection only - inside/attic not accessed.	Daytime interior (attic) inspection during future survey.

[1]"Low" suitability for roosting was assigned to well-sealed structures with no points of entry/exit, and generally lacking cavities, crevices, and other external or internal features generally preferred by bats, such as roof spaces, soffits, fascias, weather boarding, spaces between roof felt/membrane and tiles/slates, window frames, cavity walls, flashing, and the like.

Chapter 5: Special Status Plants Measures

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5. SPECIAL STATUS PLANTS MEASURES

5.1 Objectives

Special status plants include those species with federal status (federally listed as threatened, endangered, or proposed and candidate species), state threatened, endangered, or candidate species, Oregon Natural Heritage Program Lists 1 and 2, and California Rare Plant Rank 1 and 2. KRRC will develop measures to avoid or minimize potential impacts for special status plants located within areas potentially subject to ground disturbance.

The 2012 EIS/R (Section 3.5) TER-4 described measures to reduce impacts on special status plants. The 2012 EIS/R recommended surveys to identify the locations of special status plants that may be affected by the dam removal project. KRRC has incorporated this measure into the Project and will be implemented as described in the following sections. Where occurrences of special status plants cannot be avoided, minimization measures such as propagation and establishment in new locations will be incorporated into the restoration plans. Other minimization measures may be developed in coordination with the USFWS, CDFW, and ODFW. This section describes the initial phase of this process.

5.2 Existing Information

PacifiCorp conducted focused surveys for special status plants from May through July 2002 at representative cross sections of all the major habitats and topographic features in the study area, particularly in areas with a high potential for supporting special status plants. Several sites were revisited later in 2002 and in 2003 (PacifiCorp 2004, Attachment A).

In addition to the findings of the PacifiCorp surveys, special status plant occurrences in the project area were identified through the following information sources: ORBIC, CNDDB, and the USFWS IPaC database.

KRRC obtained additional information on the occurrence of special status plants in the project area from USFWS (Yreka), BLM (Klamath Falls), and USFS (Klamath National Forest).

Table 5-1 presents the list of special status plants that have potential to occur in or near the limits of work. This is a preliminary list of species with potential to occur; KRRC may obatain additional information through further coordination with resource agencies.

5.3 Methods

KRRC conducted a field reconnaissance in July 2017. During the field reconnaissance, biologists visited proposed limits of work to assess the potential for suitable habitat for special status plants. The biologists considered existing information from biological survey data and reports completed at or near the project area (e.g., surveys conducted by PacifiCorp in 2001-2003), and data obtained from a desktop review of existing databases (CNDDB, ORBIC, and California Native Plant Society).

During the field reconnaissance, KRRC gathered qualitative information on habitats present and determined access for surveys. KRRC noted the potential presence of wetlands and other sensitive natural communities within the limits of work for future investigation during the spring and summer of 2019. Biologists also examined whether changes to existing conditions since the PacifiCorp surveys were conducted, including wildfires, development, agriculture and grazing, and logging activities.

Focused surveys are underway in 2018. KRRC completed the first survey in early to mid-May. KRRC will complete the second survey in mid-July. KRRC will conduct an additional survey in mid-April 2019 to encompass the range in bloom times for species with the potential to occur in the project area.

KRRC is conducting focused surveys for special status plants in areas where ground disturbing activities will occur for the Project. Surveys are following the CDFW "Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities," as described further below. In areas outside of ground disturbing activities but along reservoir shorelines and other areas where changes in hydrology and geomorphology will occur due to the Project, KRRC will focus surveys on the locations of known and potential occurrences of special status plants as shown in Table 5-1.

KRRC biologists will familiarize themselves with the morphological and habitat characteristics of the species with potential to occur within the project area. To the extent feasible, KRRC will visit reference populations prior to field surveys or field survey crews will include at least one member who has seen the target species growing in their natural habitat. Surveys will coincide with plant bloom times, as shown in Table 5-1.

In accordance with the CDFW protocol, KRRC is conducting floristic surveys where ground disturbing activities will occur for the Project, identifying every plant taxon that occurs to the taxonomic level necessary to determine rarity and listing status. Floristic surveys are underway in 2018 at proposed disposal sites (including a 100-meter buffer around each) and within 10 meters of access and haul roads. Within proposed disposal sites, biologists walk parallel transects spaced 5 to 10 meters apart; transect spacing is varied as needed based on visibility and type of habitat present.

KRRC records GPS coordinates of all observed special status plants found such that a protection plan may be developed in coordination with the regulatory agencies. If special status plants cannot be avoided during construction, the restoration plan will evaluate the potential for seed collection and propagation at local nurseries for replanting and/or as part of a seed mix to be used during restoration activities. Relocation of special status plants is not recommended by agency personnel.

5.4 Summary of Special Status Plant Survey Methods

In summary, special status plant surveys are underway in 2018 and entail the following:

- Detailed floristic surveys for special status plants within the areas where ground disturbing activities will occur for the Project following the CDFW "Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities"
- Focused surveys for the special status plants listed in Table 5-1 in areas such as reservoir shorelines where changes in hydrology and geomorphology will occur due to the Project.

5.5 Avoidance and Minimization Measures

- If any special status plants are found to occur within areas where ground disturbing activities will occur for the Project, and it is determined that the special status plants cannot be preserved in place, a combination of relocation, propagation, and establishment of new populations in designated conservation areas within the project area may be implemented, as determined in coordination with the resource agencies.
- The restoration plans being developed for both reservoir and non-reservoir areas will include provisions for the establishment of special status plants, if any are found within the project area.
- To minimize the potential for invasive plants to recolonize and infest disturbed areas, measures will be implemented to clean construction vehicles and equipment where feasible to remove pathogens, invasive plant seeds, or plant parts and dispose of them in an appropriate disposal facility.

5.6 References

PacifiCorp. 2004. Final Technical Report. Klamath Hydroelectric Project (FERC Project No. 2082), Terrestrial Resources. PacifiCorp, Portland, Oregon. February.

USBR and CDFW. 2012. Klamath Facilities Removal. Final Environmental Impact Statement/Environmental Impact Report (EIS/R). U.S. Bureau of Reclamation and California Department of Fish and Wildlife, December.

Table 5-1 Preliminary List of Special Status Plants with Potential to Occur in or near the Limits of Work

Species	Status	Habitat	Location of Documented Occurrence(s)	Bloom Time	Proposed Survey Effort
Greene's mariposa-lily *Calochortus greenei*	BLM, OC, ONHP List 1, CNPS List 1B	Occurs primarily in annual grassland, wedgeleaf ceanothus chaparral, and oak and oak-juniper woodlands.	Several locations around Iron Gate Reservoir	May through July	Within limits of work in suitable habitat
Bristly sedge *Carex comosa*	ONHP List 2	Marshes, lake shores, and wet meadows.	East shore of J.C. Boyle Reservoir in 2 locations (east of Dam and south of Highway 66); also west of Dam	May- September	Along reservoir margins and within limits of work in suitable habitat
Mountain Lady's Slipper *Cypripedium montanum*	ONHP List 4, CNPS List 4	Dry, open conifer forests, more often in moist riparian habitats	J.C. Boyle peaking reach (location details unknown)	March- August	Within limits of work in suitable habitat
Gentner's fritillary *Fritillaria gentneri*	FE, CNPS List 1B	Cismontane woodland, chaparral. Mixed hardwood-conifer vegetation dominated by Oregon oak.	Habitat present in the reach along Copco and Iron Gate Reservoirs. No known locations.	Late March to early April; April- May at higher elevations	Within limits of work in suitable habitat
Bolander's sunflower *Helianthus bolanderi*	BLM, ONHP List 3	Occurs in yellow pine forest, foothill oak woodland, chaparral, and occasionally in serpentine substrates or wet habitats.	South of Iron Gate Reservoir near proposed disposal site, J.C. Boyle peaking reach (location details unknown)	June-October	Within limits of work in suitable habitat
Bellinger's meadow-foam *Limnanthes floccosa ssp. bellingerana*	BLM, OC, ONHP List 1, CNPS List 1B	High elevation vernal pools located in shallow soiled rocky meadows in spots that are at least partially shaded in the spring.	J.C. Boyle peaking reach (location details unknown)	April-June	Within limits of work in suitable habitat
Detling's silverpuffs *Microseris laciniata* ssp. *detlingii*	CNPS List 2	Chaparral and grassy openings among Oregon white oak trees.	One location on west side of Iron Gate Reservoir	May-June	Within limits of work in suitable habitat

Species	Status	Habitat	Location of Documented Occurrence(s)	Bloom Time	Proposed Survey Effort
Egg Lake monkeyflower *Mimulus pygmaeus*	CNPS List 4	Occurs in damp areas or vernally moist conditions in meadows and open woods.	East of J.C. Boyle Reservoir in 2 locations (north of Highway 66 and southeast of Dam); west of Dam in two locations in damp mudflats; also west of canal near access road in one location	May- August	Along reservoir margins and within limits of work in suitable habitat
Holzinger's orthotrichum moss *Orthotrichum holzingeri*	CNPS List 1B.3	Found on vertical calcareous rock surfaces and at the bases of Salix bushes just above rock that is frequently inundated by seasonally high water in dry coniferous forests.	Just upstream of Iron Gate Reservoir on Jenny Creek.		Where in-stream work will occur at Jenny Creek at bridge
Red-root yampah *Perideridia erythrorhiza*	BLM, OC, ONHP List 1	Occurs in moist prairies, pastureland, seasonally wet meadows, and oak or pine woodlands, often in dark wetland soils and clay depressions.	Along 3 drainages into west side of J.C. Boyle Reservoir and in 2 locations west of canal near access road	Mid July - August	Along reservoir margins and within limits of work in suitable habitat
Howell's yampah (Howell's false caraway) *Perideridia howelii*	ONHP List 4	Moist meadows, stream banks.	One location along drainage southeast of J.C. Boyle Reservoir; one location along north side of Copco Lake north of road	July- August	Along reservoir margins and within limits of work in suitable habitat
Yreka phlox *Phlox hirsuta*	FE, CE, CNPS List 1B	Open areas on dry serpentine soils and is found at elevations ranging from 2,500 to 4,400 feet.	Not known to occur near limits of work. No suitable ultramafic soils occur within 0.5 miles of limits of work (NRCS 2017).	March- April	None- suitable soils not present within limits of work

Species	Status	Habitat	Location of Documented Occurrence(s)	Bloom Time	Proposed Survey Effort
Strapleaf willow *Salix ligulifolia*	ONHP List 3	Riverbanks, wetlands, floodplains	One location west of J.C. Boyle Dam in a boulder flood channel in dam release zone	March- June	Along reservoir margins and within limits of work in suitable habitat
Fleshy sage *Salvia dorrii* var. *incana*	CNPS List 3	Occurs in silty to rocky soils in great basin scrub, pinyon, and juniper woodland.	3 locations around Iron Gate Reservoir	May- July	Within limits of work in suitable habitat
Pendulous bulrush *Scirpus pendulus*	BLM, ONHP List 2, CNPS List 2	Occurs along streambanks and in wet meadows.	One location along Fall Creek	June-August	Along reservoir margins and within limits of work in suitable habitat
Lemmon's silene *Silene lemmonii*	ONHP List 3	Open pine woodlands	J.C. Boyle peaking reach to J.C. Boyle Reservoir (location details unknown)	Spring-Summer	Within limits of work in suitable habitat
Western yellow cedar *Callitropsis nootkatensis*	Petitioned for federal listing, CNPS List 4.3	Wet to moist sites, from the coastal rainforests to rocky ridgetops near the timberline in the mountains.	Not documented during PacifiCorp surveys or listed on CNDDB or ORBIC for the project area. May occur based on information from USFWS Yreka office (May 23, 2017).		Within limits of work in suitable habitat

Key:

BLM	Bureau of Land Management sensitive species -species that could easily become endangered or extinct.
CE	California Endangered
CNPS List 1A	California Native Plant Society (CNPS)-Presumed extinct in California.
CNPS List 1B	rare, threatened, or endangered in California and elsewhere.
CNPS List 2	rare, threatened, or endangered in California, but more common elsewhere.
CNPS List 3	on the review list -more information needed
CNPS List 4	on the watch list -limited distribution
FE	Federal Endangered
OC	Candidate listing by Oregon Department of Agriculture (ODA)
ONHP List 1	Oregon Natural Heritage Program (ONHP) threatened with extinction or presumed to be extinct throughout their entire range
ONHP List 2	threatened with extirpation or presumed to be extirpated from the State of Oregon
ONHP List 3	more information is needed before status can be determined, but may be threatened or endangered in Oregon or throughout their range
ONHP List 4	of conservation concern but not currently threatened or endangered

Chapter 6: Vegetation Communities and Wetlands Measures

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6. VEGETATION COMMUNITIES AND WETLANDS MEASURES

6.1 Objectives

This section describes the proposed approach for mapping vegetation communities and assessing wetlands prior to the start of construction activities. The purpose of vegetation community and wetlands mapping is to identify the location and extent of wetlands and other natural communities, including rare natural communities that may be affected by the Project. KRRC will also use vegetation community mapping to identify suitable habitat for special status species (plants and wildlife). KRRC will also identify communities dominated by invasive plant species to aid in developing procedures to avoid or minimize their spread to areas without invasive plant infestations.

Based on the information in the 2004 PacifiCorp report, the 2012 EIS/R (Section 3.5) identified potential impacts on 244.4 acres of wetland and riparian habitat and TER-5 to provide compensatory mitigation. However, the 2012 EIS/R also identified that PacifiCorp estimated that 272 acres of wetland and riparian habitat would become re-established in the event of dam removal (as defined in Appendix I). If the Project does not result in a net loss of wetland and riparian habitat, then KRRC will not prepare a compensatory mitigation plan. The Project will comply with regulatory requirements in delineating wetlands and evaluating potential impacts to acreage and functions. The Project's design and construction planning will incorporate avoidance and minimization measures to the maximum extent practicable. The restoration plans for the reservoir and non-reservoir areas will both include design for wetland and riparian habitat restoration as appropriate to result in no net loss of wetland or riparian habitat functions.

6.2 Existing Information

6.2.1 Vegetation Communities

PacifiCorp mapped existing vegetation cover types/wildlife habitat within a primary study area of 0.25 miles surrounding the reservoirs, facilities, and river reaches. Vegetation community maps are found in PacifiCorp (2004).

The vegetation classification system was based on the California Wildlife Habitat Relations System (CWHRS) and refined through coordination with the Terrestrial Resources Work Group, consisting of representatives from several state and federal agencies. The classification scheme, including the dominant species of each

cover type, is described in PacifiCorp (2004) Additional data, including the species frequency and abundance for the sampled vegetation cover types, are provided in the PacifiCorp (2004).

Preliminary vegetation polygons were delineated by PacifiCorp in 2001 using aerial and infrared photography and other mapped information. The minimum mapping unit for upland types was approximately 1 acre (0.4 hectare [ha]). More unique types such as riparian areas and wetlands were delineated as small as possible (approximately 0.1 acre and 0.4 ha, respectively). Polygon delineations and vegetation cover maps were field verified in 2001 (PacifiCorp 2004).

Further characterization of each cover type was conducted in 2002 (PacifiCorp 2004). This characterization consisted of sampling randomly selected polygons (295 of the 2,900 polygons in the study area), with greater emphasis on wetlands and riparian habitats. Sampling consisted of estimates of areal foliar cover by cover class for each species in each of the vegetation layers (i.e., tree, shrub, and herb layer); the areal cover and height of each vegetation layer in the plot; the aspect; and the slope. The number of living trees was tallied and the tree DBH was recorded. The amount of dead wood in the plot was assessed by collecting data on coarse woody debris, snags, and wood cover for pieces greater than 4 inches (10 centimeters [cm]) in diameter.

Since the 2012 EIS/R was published, there have not been any significant changes in habitats within the limits of work. Based on a review of historical aerial photography conducted by CDM Smith in 2018, timber harvest has been conducted in several locations within 0.5 miles of the limits of work in the J.C. Boyle portion of the project area. These timber harvests have occurred since the PacifiCorp habitat and species surveys were conducted in 2001-2003. The analysis of historical imagery noted that logging and forest thinning occurred in late summer/fall of 2003 and between 2003 and 2005 in the vicinity of the J.C. Boyle Reservoir and east of the Klamath River canyon between the J.C. Boyle Dam and the powerhouse. Although these habitat alterations have the potential to reduce habitat suitability for some species, they are located outside of the limits of work and are not on PacifiCorp land. KRRC did not identify major wildfires or other significant habitat alterations in the project area since the PacifiCorp surveys.

The following sections describe the vegetation communities observed within the proposed limits of work and areas surrounding the reservoirs during the July 2017 site reconnaissance.

J.C. Boyle

The J.C. Boyle Reservoir is approximately 420 acres of open water situated within Klamath mixed conifer forest dominated by ponderosa pine (*Pinus ponderosa*), with Douglas-fir (*Pseudotsuga menziesii*) also common. North of Highway 66, the reservoir supports a broad, shallow emergent marsh along both edges supporting a large community of bulrush (*Schoenoplectus* spp.) and aquatic vegetation including pondweeds (*Potamogeton* spp.) and coontail (*Ceratophyllum demersum*) along the eastern shoreline. Sportsmen's Park is located just east of this marsh and provides limited access. South of Highway 66, the reservoir is relatively narrow with forested upland slopes and some flatter areas that support wetland patches of bulrush, cattail (*Typha* spp.), and rushes (*Juncus* spp.) along the shoreline.

Developed areas associated with the dam and power facilities consist of annual grasses dominated by cheatgrass (*Bromus tectorum*) and other non-native species. Vegetation around recreational areas consist primarily of scattered ponderosa pine and Douglas-fir.

The proposed J.C. Boyle disposal site is located adjacent to a high-power transmission line corridor. A portion of the site was likely used as a borrow site during dam construction. The majority of the area is heavily disturbed and consists of bare ground used for ATV recreation. KRRC also observed evidence of cattle grazing. Several depressions support dense stands of coyote willow (*Salix exigua*) in some areas, while others are sparsely vegetated with herbaceous vegetation including cudweed (*Gnaphalium palustre*), Bach's calicoflower (*Downingia bacigalupii*), and Bermuda grass (*Cynodon dactylon*).

A portion of the proposed disposal site is located within a deep ravine that supports a dispersed mixed chaparral/sagebrush scrub community consisting of antelope bitterbrush (*Purshia tridentata*), deerbrush (*Ceanothus integerrimus*), big sagebrush (*Artemisia tridentata*), gray rabbitbrush (*Chrysothamnus nauseosus*), greenleaf manzanita (*Arctostaphylos patula*), and serviceberry (*Amelanchier alnifolia*). Herbaceous species observed in this area include nettleleaf horsemint (*Agastache urticifolia*), parched willowherb (*Epilobium brachycarpum*), needle navarretia (*Navarretia intertexta*), lupine (*Lupinus argenteus*), yarrow (*Achillea millefolium*), bull thistle (*Cirsium vulgare*), cheatgrass, and other non-native grasses. KRRC noted a narrow drainage channel t the bottom of the ravine. The channel was dry during the July 2017 site reconnaissance.

Downstream of the J.C. Boyle Dam, the Klamath River runs through a narrow canyon with steep, forested slopes and exposed rock cliffs and talus slopes in many areas. Reed canarygrass (*Phalaris arundinacea*) dominates the Klamath River shoreline downstream of the dam. Water from the reservoir is conveyed through an approximately 2.2-mile long power canal located along a bench cut in the face of the river canyon. The canal is a concrete flume approximately 17-feet wide and 12-feet high and single-walled in places, supporting patches of arroyo willow (*Salix lasiolepis*) and other riparian vegetation on the uphill side of the channel in some areas along its route to the forebay.

Vegetation on the slopes surrounding the J.C. Boyle powerhouse, including the former access roads to the penstocks, consists of an open forest of Oregon oak and conifers with mixed chaparral/sagebrush vegetation.

Copco

The Copco No. 1 Dam is situated in a narrow canyon adjacent to exposed rock faces. The dam impounds an approximately 1,000-acre reservoir. Much of the reservoir shoreline is steeply sloped and consists of open Oregon oak (*Quercus garryana*) and western juniper (*Juniperus occidentalis*) woodland, with large expanses of annual and perennial grassland on the slopes north of the reservoir dominated by invasive yellow star-thistle (*Centaurea solstitialis*) and medusahead (*Taeniatherum caput-medusae*). Denser mixed oak-conifer forests are found along the slopes south of the reservoir. There is evidence of cattle grazing around the reservoir, and KRRC noted feral horses during the July 2017 reconnaissance.

Riparian habitat dominated by coyote willow and shining willow (*Salix lucida*) is primarily found where stream channels enter the reservoir. An area of seeps and springs supports a dense willow and hardwood forest along the slope on the northwest shore of the reservoir. Patches of emergent vegetation, including bulrush, cattail, and rushes, exist in areas where the shoreline topography supports areas of shallow water.

Copco No. 2 Dam is situated approximately 1/4-mile downstream of Copco No. 1 Dam, creating a narrow reservoir with steep sides. The north slope of this reach is developed with access roads to Copco No. 1 Dam, the powerhouse at the base of Copco No. 1 dam, and to Copco No. 2 Dam. The northern slope is vegetated with yellow star-thistle, non-native grasses, and scattered native forbs including giant blazing-star (*Mentzelia laevicaulis*). Exposed basalt outcrops form cliff faces on the northern slope. The southern slope is forested with willows, oaks, and conifers.

The proposed Copco disposal site is located on the slope north of Copco No. 2 Reservoir. The site is developed with a house and other structures. The topography of the site suggests it was used as a borrow site for dam construction. Vegetation at the site consists of yellow star-thistle, medusahead and other non-native grasses, weedy species such as mullein (V*erbascum thapsus*), and scattered sagebrush shrubs such as rabbitbrush. Two mature eastern arborvitae (*Thuja occidentalis*) trees and irrigated lawn surround the house.

Downstream of Copco No. 2 Dam, the river winds through a horseshoe-shaped canyon with steep exposed cliff faces along the northern slope. The large wooden Copco No. 2 penstock is located on a terrace above the south shore of the river. Vegetation along the southern bank is dominated by willows and white alder (*Alnus rhombifolia*). KRRC observed Himalayan blackberry (*Rubus armeniacus*), and poison oak (*Toxicodendron diversilobum*) in the understory.

Water leaking from the Copco No. 2 penstock supports wetland vegetation in several locations, including broadleaf cattail (*Typha latifolia*), water smartweed (*Polygonum amphibium*), and beggarstick (*Bidens frondosa*). Culverts drain these ponded areas down to the river. Open disturbed sites dominated by invasive yellow star-thistle are located along the penstock, including a large flat area at the eastern end that was likely created during the penstock construction.

Copco No. 2 powerhouse is situated along the southern bank of the river upstream of the Daggett Road crossing. Several residences and other structures are also located in this area, known as Copco Village. Vegetation is disturbed with irrigated lawns surrounding the structures.

The confluence of Fall Creek and the Klamath River is located just downstream of Copco Village and supports a willow riparian and emergent wetland vegetation community. The City of Yreka water supply line is located in this vicinity. Wetland vegetation includes hardstem bulrush and reed canarygrass. KRRC noted several weedy species including teasel (*Dipsacus fullonum*), curly dock (*Rumex crispus*), lambsquarters (*Chenopodium album*), and oxeye daisy (*Leucanthemum vulgare*) on the southern bank of the Klamath River in the vicinity of the City of Yreka water supply line.

Iron Gate

Iron Gate Reservoir consists of approximately 944 acres situated within open oak and juniper woodlands, similar to those found at Copco Lake. The reservoir shorelines are less steep than those of Copco Lake. Annual grasslands are dominated by invasive yellow star-thistle and medusahead, and there is evidence of cattle grazing in many areas. A single-lane bridge crosses the Klamath River downstream of the dam and provides access to the powerhouse and fish hatchery. Several structures, including two residences, are located on the north side of the river and are surrounded by irrigated lawns.

Several day-use sites and campgrounds are located around the reservoir. Vegetation within these areas consists primarily of Oregon oak, western juniper, willows, and chaparral/sagebrush scrub. KRRC onserved a few mature black cottonwood (*Populus balsamifera* ssp. *trichocarpa*) and weeping willow (*Salix babylonica*). Dense willow riparian communities consisting of coyote and shining willow are associated with the mouths of Jenny, Scotch, and Camp creeks. Emergent wetland vegetation in these areas consists of hardstem bulrush, cattails, rushes, and other species.

The proposed Iron Gate disposal site consists of annual grassland dominated by yellow star-thistle and medusahead, with scattered forbs including barestem buckwheat (*Eriogonum nudum*), sunflower (*Helianthus* sp.), turkey mullein (*Eremocarpus setigerus*), and wild onion (Allium sp.). The site also supports open Oregon oak and western juniper woodlands, and chaparral communities dominated by wedgeleaf ceanothus (*Ceanothus cuneatus*) with three-leaf sumac (*Rhus trilobata*) also observed. The site appears to be used for target shooting and there is evidence of cattle grazing. The site may have been used as a borrow area during construction of the dam. A shallow drainage swale that runs south toward Bogus Creek was dry during the July 2017 site reconnaissance.

6.2.2 Invasive Species

As noted above, KRRC observed large infestations of invasive yellow star-thistle and medusahead adjacent to the Copco Lake and Iron Gate Reservoir and other disturbed areas. KRRC also observed Himalayan blackberry in localized areas, including along the Klamath River near the Copco No. 2 penstock. Reed canarygrass was dominant along most reaches of the Klamath River within the project area.

KRRC obtained additional information on invasive species in the J.C. Boyle project area from the BLM National Invasive Species Information Management System (NISIMS) database. Spatial data show large infestations of medusahead around the J.C. Boyle Reservoir, yellow star-thistle in the vicinity of the J.C. Boyle powerhouse, Scotch thistle (*Onopordum acanthium*) around the J.C. Boyle Dam, and common St. Johnswort (*Hypericum perforatum*) along the Klamath River canyon between the J.C. Boyle Dam and powerhouse. Other invasive species mapped in the J.C. Boyle area include diffuse knapweed (*Centaurea diffusa*), bull thistle, Canada thistle (*Cirsium arvense*), Scotch broom (*Cytisus scoparius* var. *scoparius*), Dyer's woad (*Isatis tinctorial*), and smallflower tamarisk (*Tamarix parviflora*).

6.2.3 Wetlands and Other Waters

Wetlands and riparian communities were mapped and field verified in 2002 during the vegetation community mapping described above (PacifiCorp 2004). PacifiCorp further characterized wetlands and riparian communities in 2002 to collect information on the species composition, general structural characteristics, and relative condition of existing wetland and riparian plant communities. This assessment considered the distribution of channel geomorphic types and hydrologic data. Riparian/wetland transects were established and sampled in 2002 and 2003. Data included plant cover, height, and tree and shrub regeneration estimates within 1-m by 4-m plots. Qualitative information on recreation, livestock, and wildlife use and erosion/deposition was also collected. These methods are described in PacifiCorp (2004).

PacifiCorp evaluated pre-construction and post-dam construction wetland and riparian conditions. The study concluded that, in general, the distribution of wetland and riparian habitat consisted of long, thin bands running along the historic Klamath River channel. In comparison, somewhat wider, but more widely scattered patches of these vegetation types exist along the present-day project reservoir shorelines. The analysis concluded that the area of wetland and riparian habitat is somewhat greater along the J.C. Boyle Reservoir under current conditions and that there is less area along the Copco Lake and Iron Gate Reservoir as compared to historical conditions (PacifiCorp 2004). KRRC anticipates that wetland and riparian areas similar to those that previously existed will become re-established along the restored Klamath River following restoration. In addition, KRRC expects the tributary riparian habitats to extend farther downstream as the currently drowned stream channels are restored. In addition to simple area considerations, the functions of wetlands and riparian areas along the river would be different from those on the fringes of a reservoir. As part of the permitting process, KRRC biologists will conduct a functional assessment of existing wetlands potentially affected by the Project and those expected to be restored by the Project.

KRRC did not conduct wetland surveys or focused delineations during the July 2017 site reconnaissance. Emergent wetlands are found along the fringes of the reservoirs in many places, and willow riparian habitat was observed to be primarily associated with streams and drainages that flow into the reservoirs. Each reservoir has several tributary streams and ephemeral drainages that could potentially contain wetlands.

At the J.C. Boyle disposal site, KRRC observed several depressions to support coyote willow, sedges, and rushes, indicating the potential presence of wetlands in some areas. KRRC noted a narrow drainage channel at the bottom of the deep ravine in the J.C. Boyle disposal area. The channel was dry during the July 2017 site reconnaissance. The reservoir is relatively narrow and shallow and contains many areas where the reservoir edge slopes gently toward the former river channel. These shallow reservoir areas have developed emergent wetland vegetation.

There were no potential wetlands within the disposal site at the Copco Dams. As described above, the Copco Lake is relatively steep-sided, but there are places where a narrow fringe of emergent wetland vegetation has become established. On the north side of the Copco Lake there are only a couple of streams that support riparian vegetation at the reservoir edge. There is more riparian vegetation along the south side of the Copco Lake, but it is also mixed with residential development and is not as strongly associated with tributary stream channels.

Downstream of the Copco No. 2 Dam, a large wooden penstock is located on a terrace above the south shore of the river. Water leaking from the Copco No. 2 penstock supports wetland vegetation in several locations, including broadleaf cattail (*Typha latifolia*), water smartweed (*Polygonum amphibium)*, and beggarstick (*Bidens frondosa*). Culverts drain these ponded areas down to the river. Open disturbed sites dominated by invasive yellow star-thistle are located along the penstock, including a large flat area at the eastern end that was likely created during penstock construction.

Narrow patches of emergent wetland vegetation along the edges of Iron Gate Reservoir consists of hardstem bulrush, cattails, rushes, and other species. Dense willow riparian communities consisting of coyote and shining willow are associated with the mouths of Jenny, Scotch, and Camp creeks on Iron Gate Reservoir. Road crossings of some of these riparian areas along Iron Gate are within the limits of work.

A shallow drainage swale that runs south toward Bogus Creek through the Iron Gate disposal site was dry during the July 2017 site reconnaissance. KRRC will evaluate the Iron Gate disposal site closely for wetland characteristics.

6.3 Methods

Surveys of vegetation communities, including wetlands and riparian habitats, and special status plants will initially focus on verifying the existing information collected by PacifiCorp and described above. Outside the limits of work, surveys will entail spot-checking of PacifiCorp mapping. KRRC will conduct more detailed surveys of wetlands and special status plants within the limits of work.

6.3.1 Field Reconnaissance

KRRC conducted a field reconnaissance in July 2017. During the field reconnaissance, KRRC biologists visited proposed limits of work to gather qualitative information on habitats present, determine access for future surveys, and identify proposed survey transects and/or survey points on aerial photos. Biologists noted areas with the potential to support wetlands and other sensitive natural communities within the limits of work. KRRC biologists also looked for evidence of changes to existing conditions since the PacifiCorp surveys were conducted, including wildfires, development, agriculture and grazing, and logging activities.

6.3.2 Vegetation Communities

Eight vegetation cover types were mapped by PacifiCorp (2004), and each cover type was further sub-classified. The results of the 2004 mapping are available in the PacifiCorp Terrestrial Resources report.

During the field reconnaissance survey, KRRC noted that current conditions did not match the 2004 PacifiCorp mapping data in some places. KRRC will update vegetation community maps as needed to reflect existing conditions. KRRC will conduct initial verification through comparison with current aerial photography to produce updated maps.

Field verification will include visual observation of representative portions of each vegetation community within 0.25 miles of the limits of construction around the dams and facilities, access and haul roads, and disposal sites. Surveyors will traverse the areas on foot and/or by boat to verify that the vegetation classification described in the PacifiCorp 2004 report is still accurate. Biologists will use binoculars in areas with limited access such as along steep slopes adjacent to roads.

KRRC will produce a crosswalk table that compares the classification system used in the 2004 report to other classifications (e.g., Manual of California Vegetation) to align the PacifiCorp data with current regulatory requirements. KRRC will also identify communities dominated by invasive plant species.

6.3.3 Wetlands

KRRC will delineate wetlands within the limits of construction around the dams and facilities, access and haul roads, and disposal sites in accordance with the 1987 U.S. Army Corps of Engineers (USACE) Wetland Delineation Manual and applicable Regional Supplements (i.e., Western Mountains, Valleys, and Coast Region and Arid West). Additionally, KRRC will use the Oregon Rapid Wetland Assessment Protocol (ORWAP) to assess functional values of wetlands.

PacifiCorp's mapping of wetlands and riparian habitats adjacent to reservoirs and/or associated with streams but outside the direct limits of work will be field verified by traversing the areas on foot and/or by boat, using binoculars as needed. KRRC will map previously unidentified wetlands and riparian habitats observed adjacent to reservoirs but outside the limits of work and described consistent with the PacifiCorp vegetation classification system described above. KRRC will map the boundaries of wetlands outside of the limits of work based on observed changes in vegetation, topography, and hydrology, but these areas will not be formally delineated.

6.4 Survey Plan Summary

KRRC's mapping of vegetation communities and wetlands will be complete by 2019 and will entail the following:

- Desktop verification of the PacifiCorp vegetation community mapping based on comparison with current aerial photography for the project area. KRRC will produce new maps for field verification.
- Field verification of PacifiCorp mapping of a representative portion of each vegetation community within 0.25 miles of the limits of construction around the dams and facilities, access and haul roads, and disposal sites.
- Map areas dominated by invasive species within the project area.
- Delineation of wetlands and riparian habitats within areas that will be affected by ground disturbing activities in accordance with regulatory requirements.

- Field verification of PacifiCorp mapping of wetlands and riparian habitats adjacent to reservoirs and/or associated with streams but outside the areas that will be affected by ground disturbing activities.
- Map previously unidentified wetlands and riparian habitat noted adjacent to reservoirs but outside areas that will be affected by ground disturbing activities.

6.5 Avoidance and Minimization Measures

The Project will comply with regulatory requirements in delineating wetlands and sensitive vegetation communities and evaluating potential impacts to acreage and functions. The project design and construction planning will incorporate avoidance and minimization measures to the maximum extent practicable.

- KRRC will incoirporate the results of the wetland delineation into the project design to avoid and minimize direct impacts on wetlands to the maximum extent practicable. Potential measures might include redesign of the construction footprint where ground disturbing activities will occur or location of access and staging areas, or redesign of fill slopes to avoid wetland areas.
- KRRC's contractor will fence wetland areas adjacent to the areas where ground disturbing activities will occur with orange plastic snow fencing to demarcate work areas and prevent inadvertent impacts.
- The restoration plans developed for both reservoir and non-reservoir areas will include provisions for the establishment of wetland and riparian areas and other sensitive vegetation communities within the project area to result in no net loss of habitat acreage and functions.
- KRRC will monitor wetlands and other sensitive vegetation communities established in restored areas for up to five years or as required by permit requirements. KRRC will identify specific performance measures in the restoration plans and approved by the regulatory agencies.

To reduce potential impacts on water quality in wetlands and other surface waters during construction (for example, the wetlands around the confluence of Fall Creek and the Klamath River), KRRC will implement the following construction best management practices.

- KRRC's contractor will implement Pollution and erosion control measures to prevent pollution caused by construction operations and to reduce contaminated stormwater runoff.
- KRRC's contractor will keep oil-absorbing floating booms onsite and will respond immediately to aquatic spills during construction.
- KRRC's contractor will keep vehicles and equipment in good repair, without leaks of hydraulic or lubricating fluids. If such leaks or drips do occur, KRRC's contractor will clean them up immediately. KRRC's contractor will confine equipment maintenance and/or repair to one location at each project construction site. KRRC's contractor will control runoff in this area to prevent contamination of soils and water.
- KRRC's contractor will implement dust control measures, including wetting disturbed soils.

- KRRC's contractor will implement a Storm Water Pollution Prevention Plan to prevent construction materials (fuels, oils, and lubricants) from spilling or otherwise entering waterways or water bodies.

6.6 References

California Department of Fish and Wildlife (CDFW). 2017. Notification of Lake or Streambed Alteration. Available at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=3773&inline.

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USBR and CDFW. 2012. Klamath Facilities Removal. Final Environmental Impact Statement/Environmental Impact Report (EIS/R). U.S. Bureau of Reclamation and California Department of Fish and Wildlife, December.

KLAMATH RIVER RENEWAL CORPORATION

Attachment A

Northern Spotted Owl Figures

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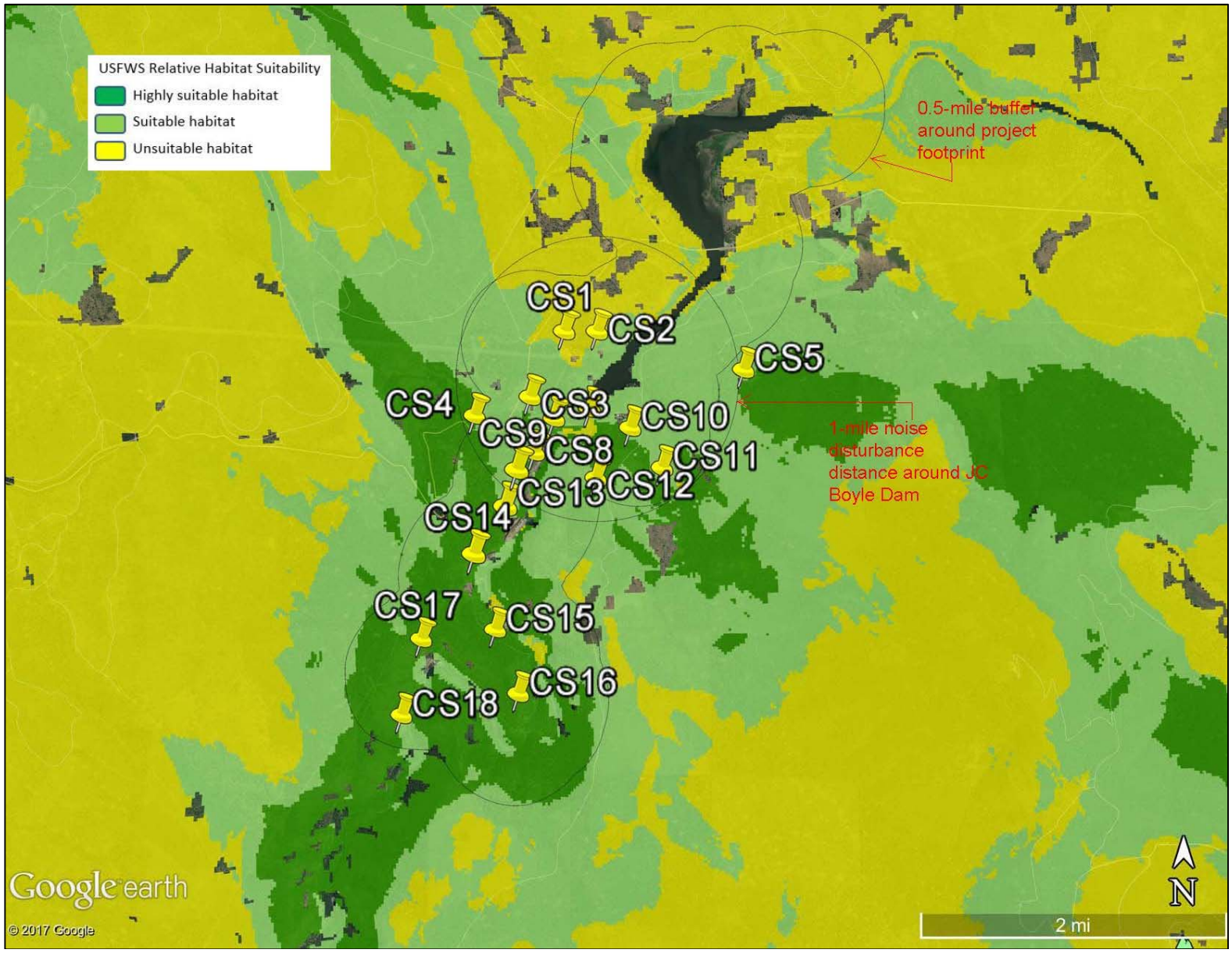
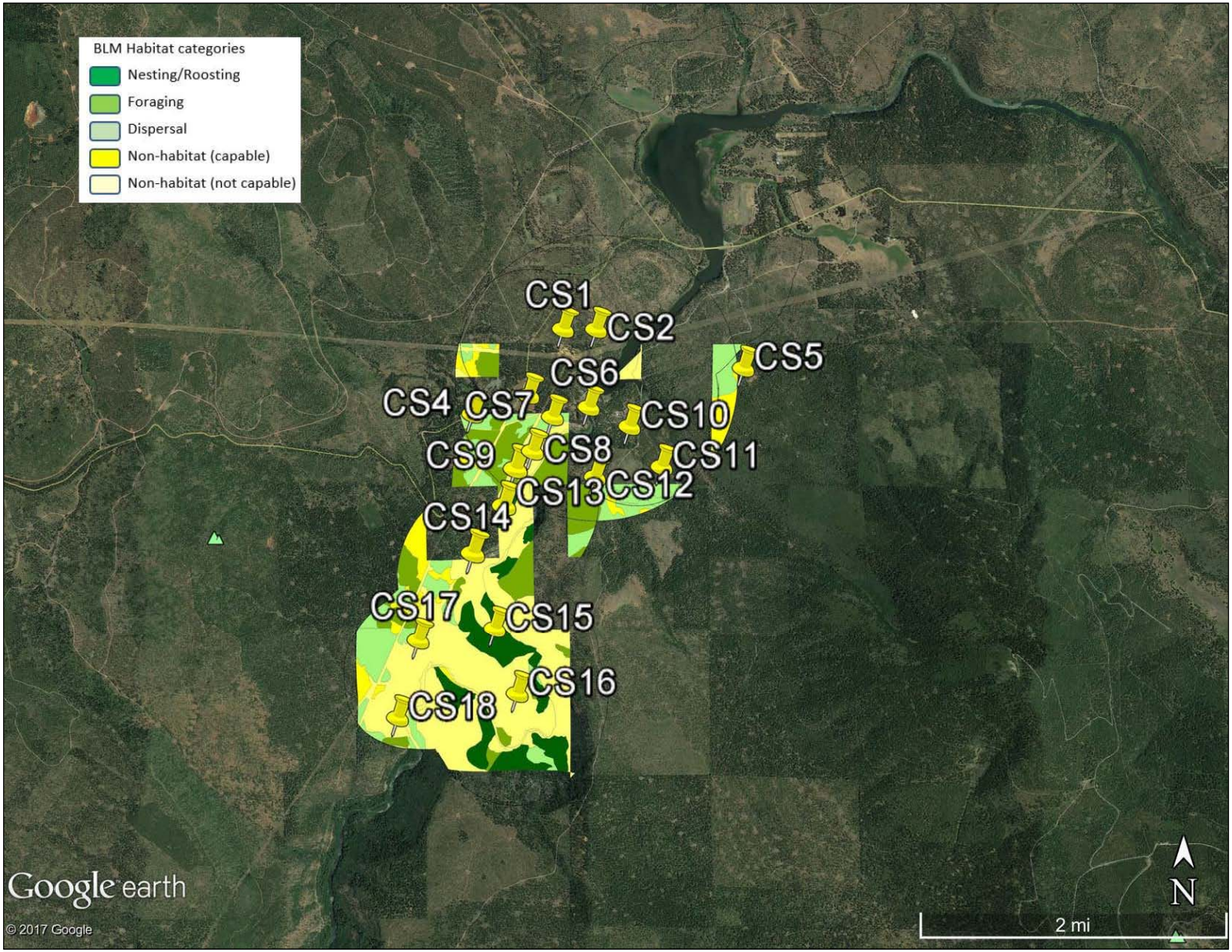


USFWS Habitat Layer

Klamath River Renewal Corporation
Klamath River Renewal Project

FIGURE 1: PRELIMINARY NSO CALLING STATIONS (USFWS HABITAT LAYER)

JC Boyle Project Area
Sheet 1 of 3

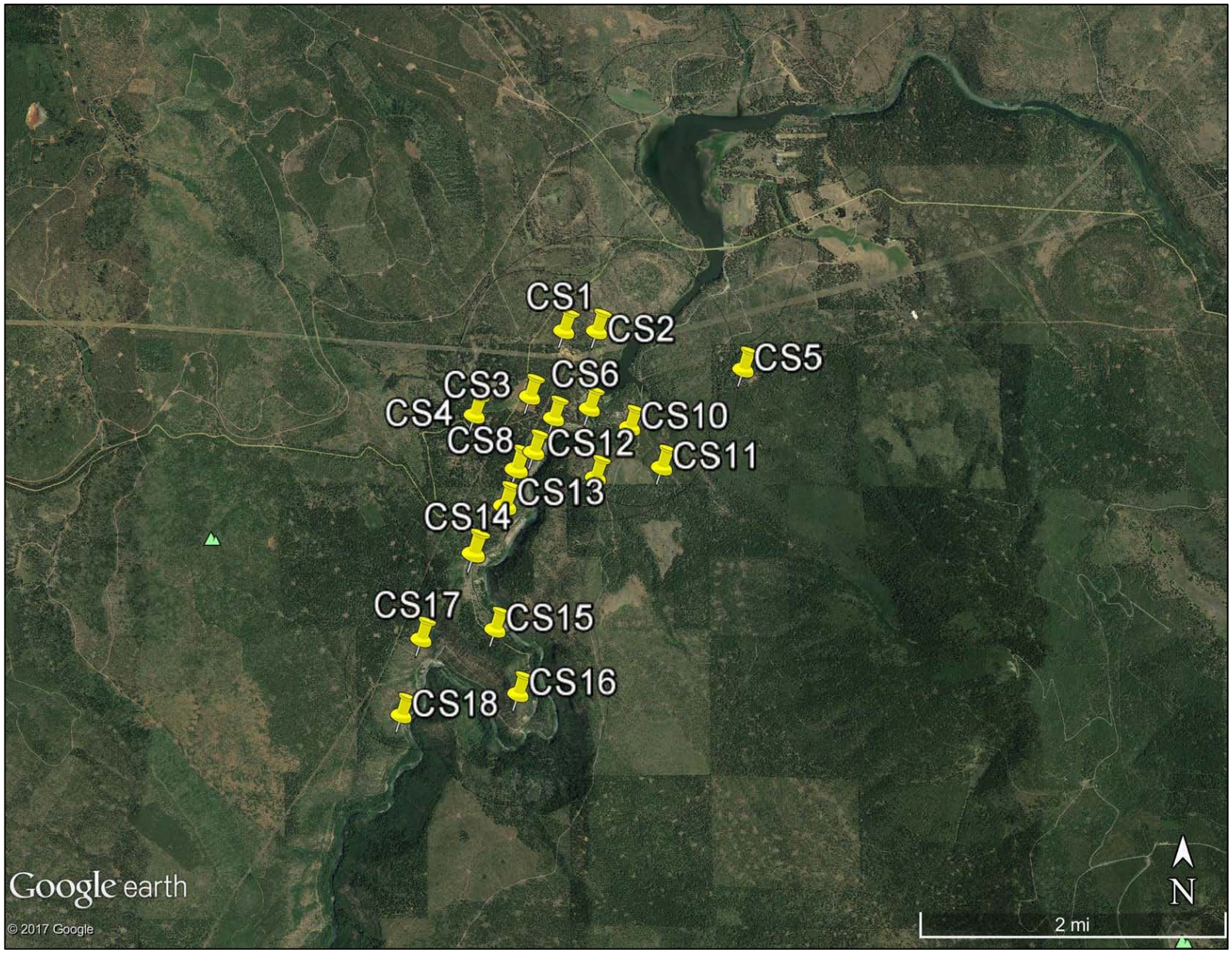


BLM Habitat Layer

Klamath River Renewal Corporation
Klamath River Renewal Project

FIGURE 1: PRELIMINARY NSO CALLING STATIONS (BLM HABITAT LAYER)

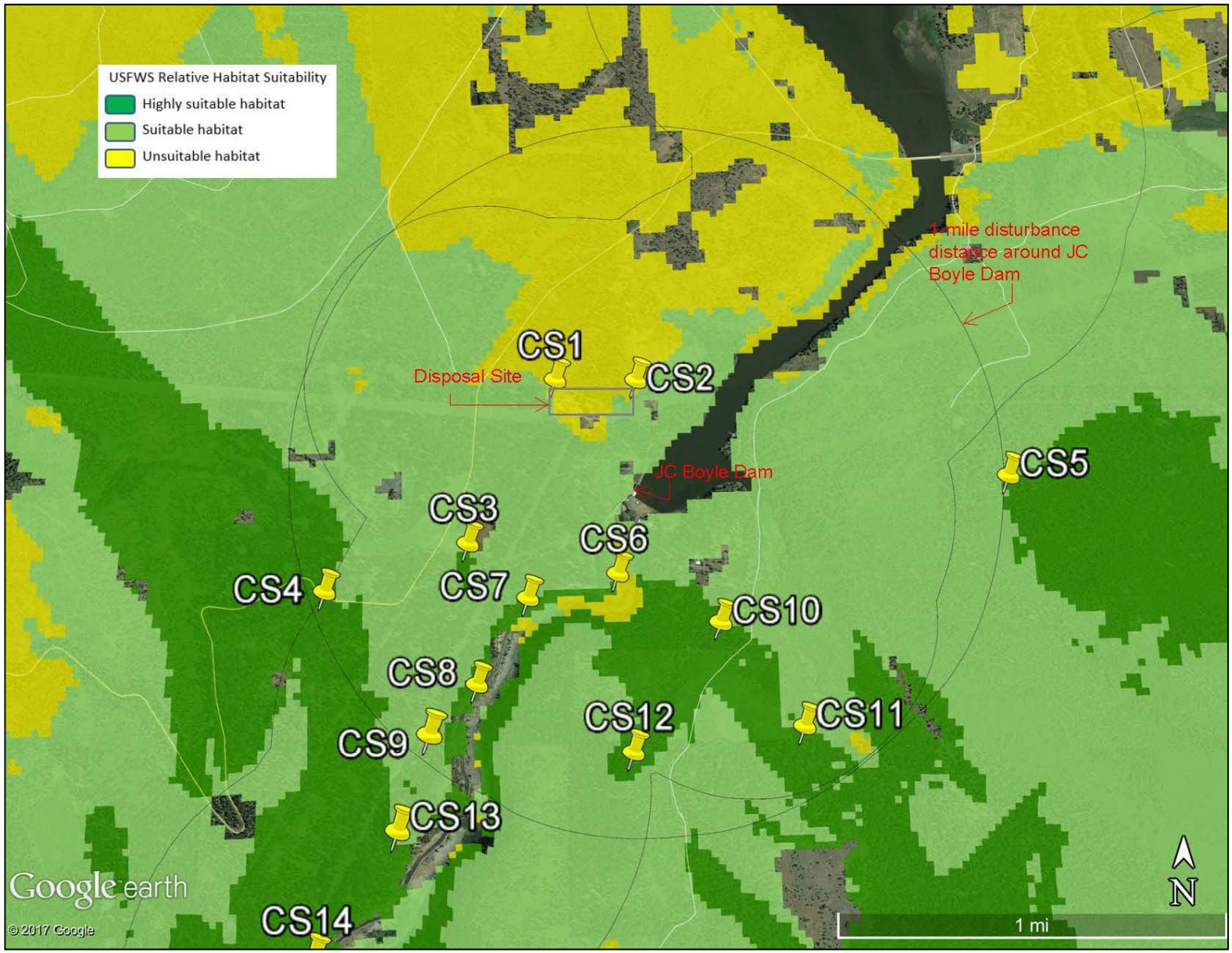
JC Boyle Project Area
Sheet 2 of 3



Klamath River Renewal Corporation
Klamath River Renewal Project

FIGURE 1: PRELIMINARY NSO CALLING STATIONS

JC Boyle Project Area
Sheet 3 of 3

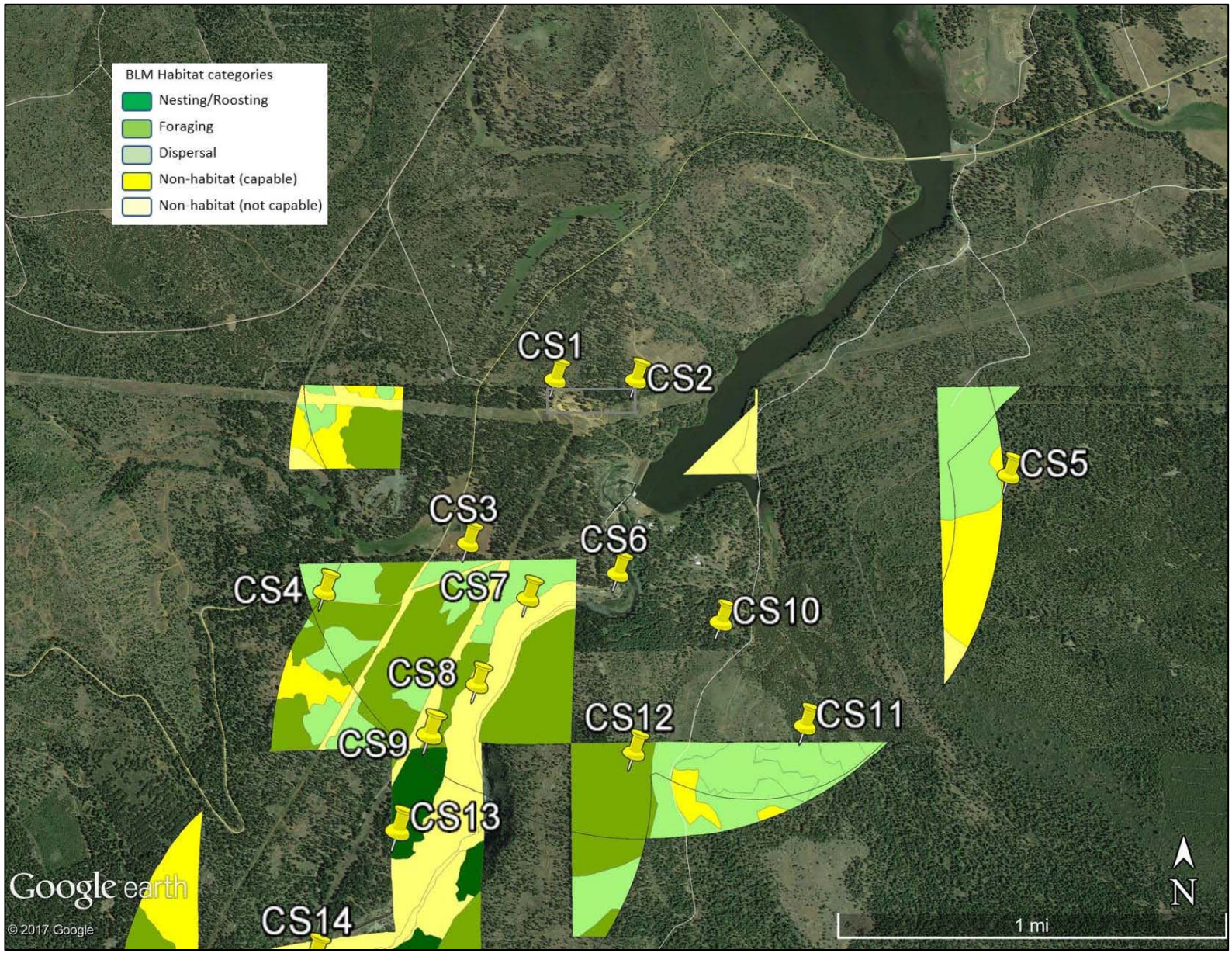


USFWS Habitat Layer

Klamath River Renewal Corporation
Klamath River Renewal Project

FIGURE 2: PRELIMINARY NSO CALLING STATIONS (USFWS HABITAT LAYER)

JC Boyle Dam
Sheet 1 of 3

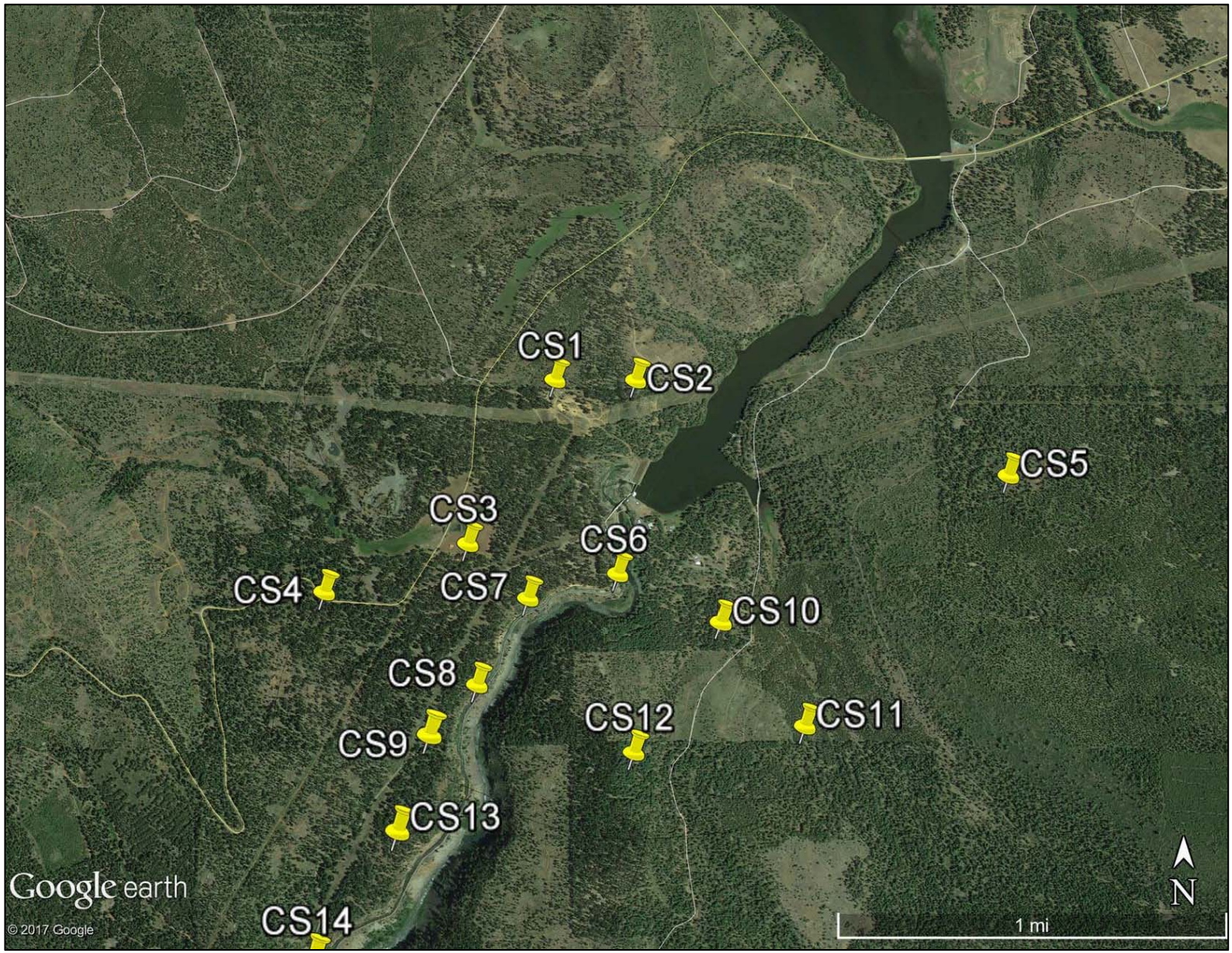


BLM Habitat Layer

Klamath River Renewal Corporation
Klamath River Renewal Project

FIGURE 2: PRELIMINARY NSO CALLING STATIONS (BLM HABITAT LAYER)

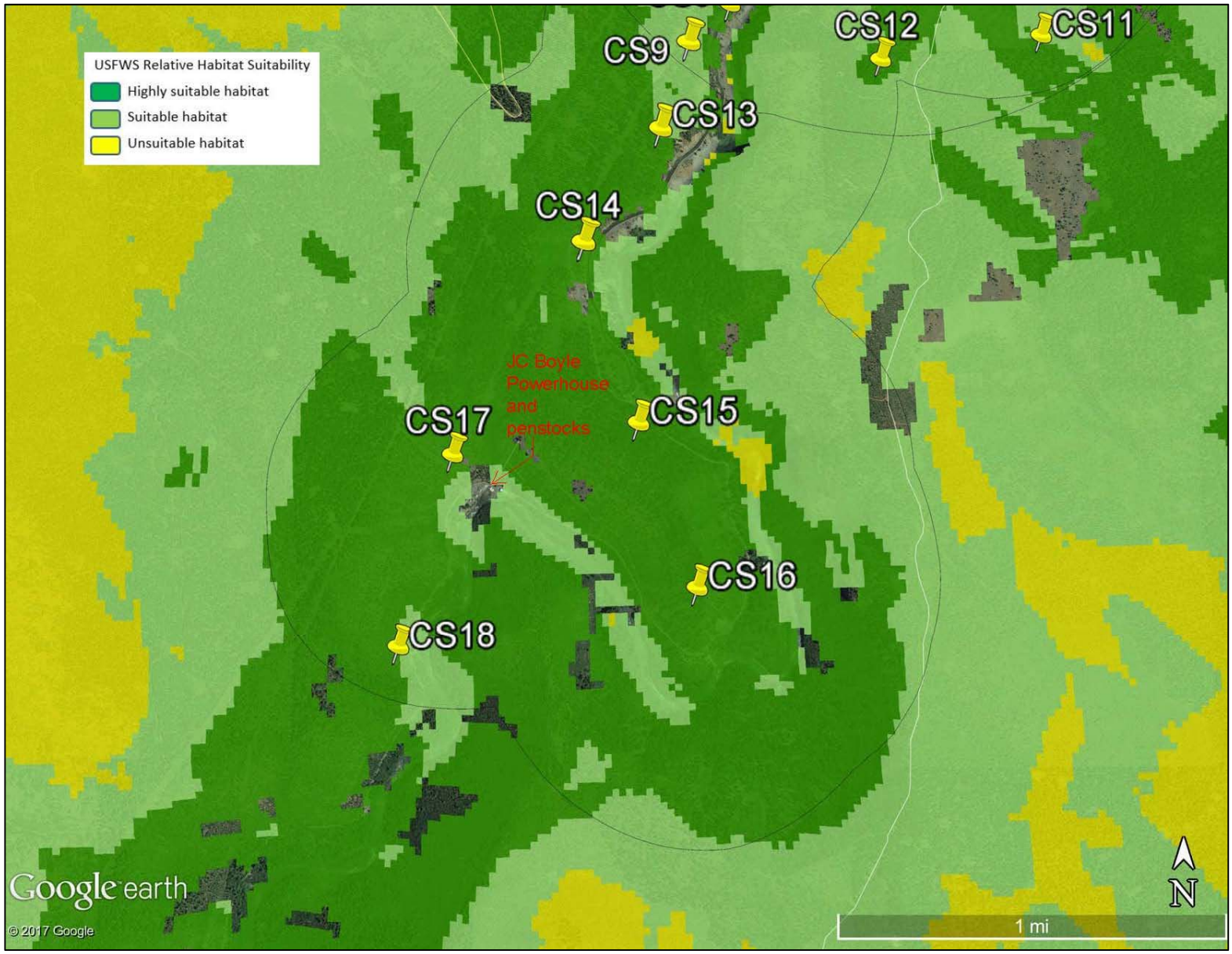
JC Boyle Dam
Sheet 2 of 3



Klamath River Renewal Corporation
Klamath River Renewal Project

FIGURE 2: PRELIMINARY NSO CALLING STATIONS

JC Boyle Dam
Sheet 3 of 3

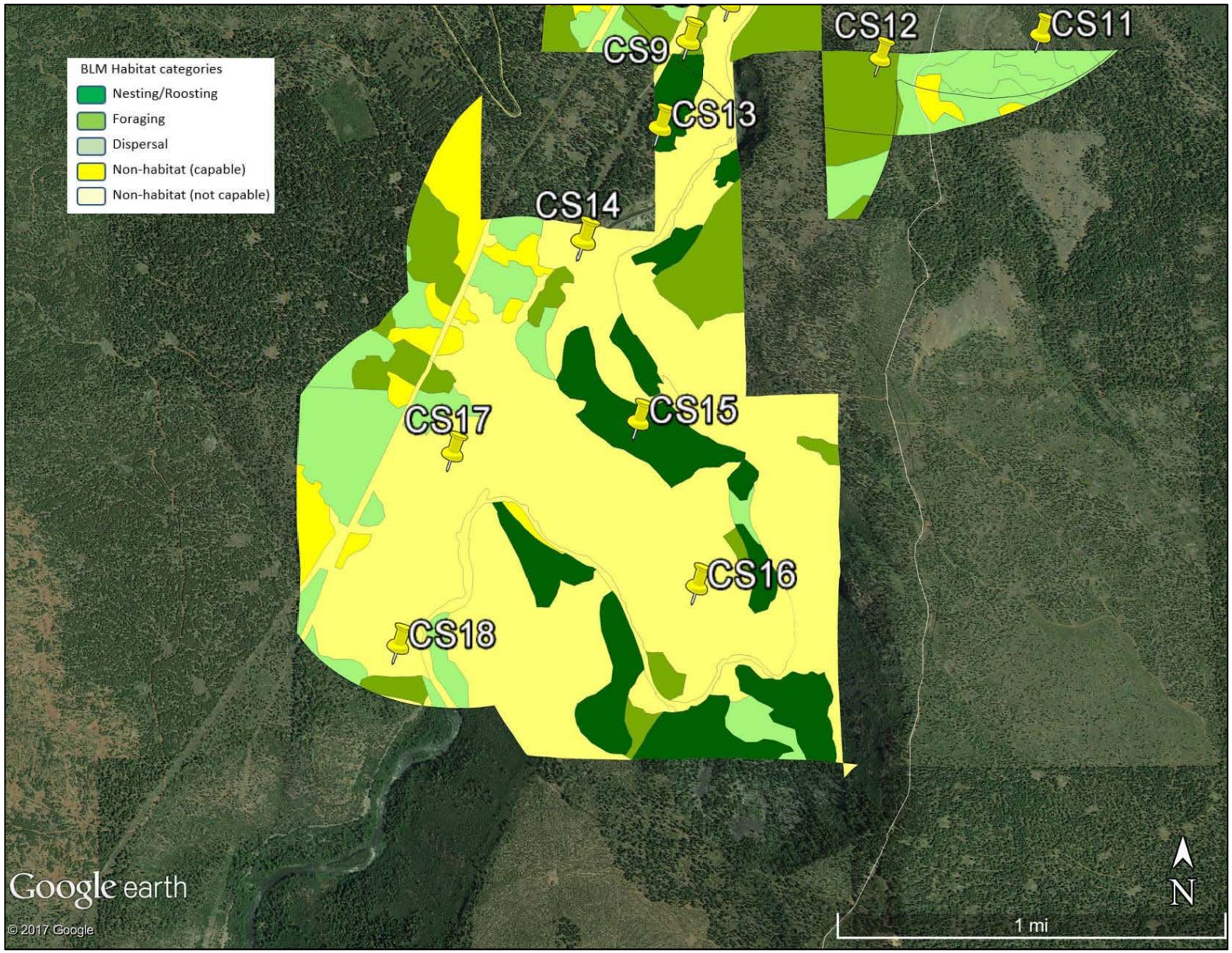


USFWS Habitat Layer

Klamath River Renewal Corporation
Klamath River Renewal Project

FIGURE 3: PRELIMINARY NSO CALLING STATIONS (USFWS HABITAT LAYER)

JC Boyle Powerhouse and Penstocks
Sheet 1 of 3

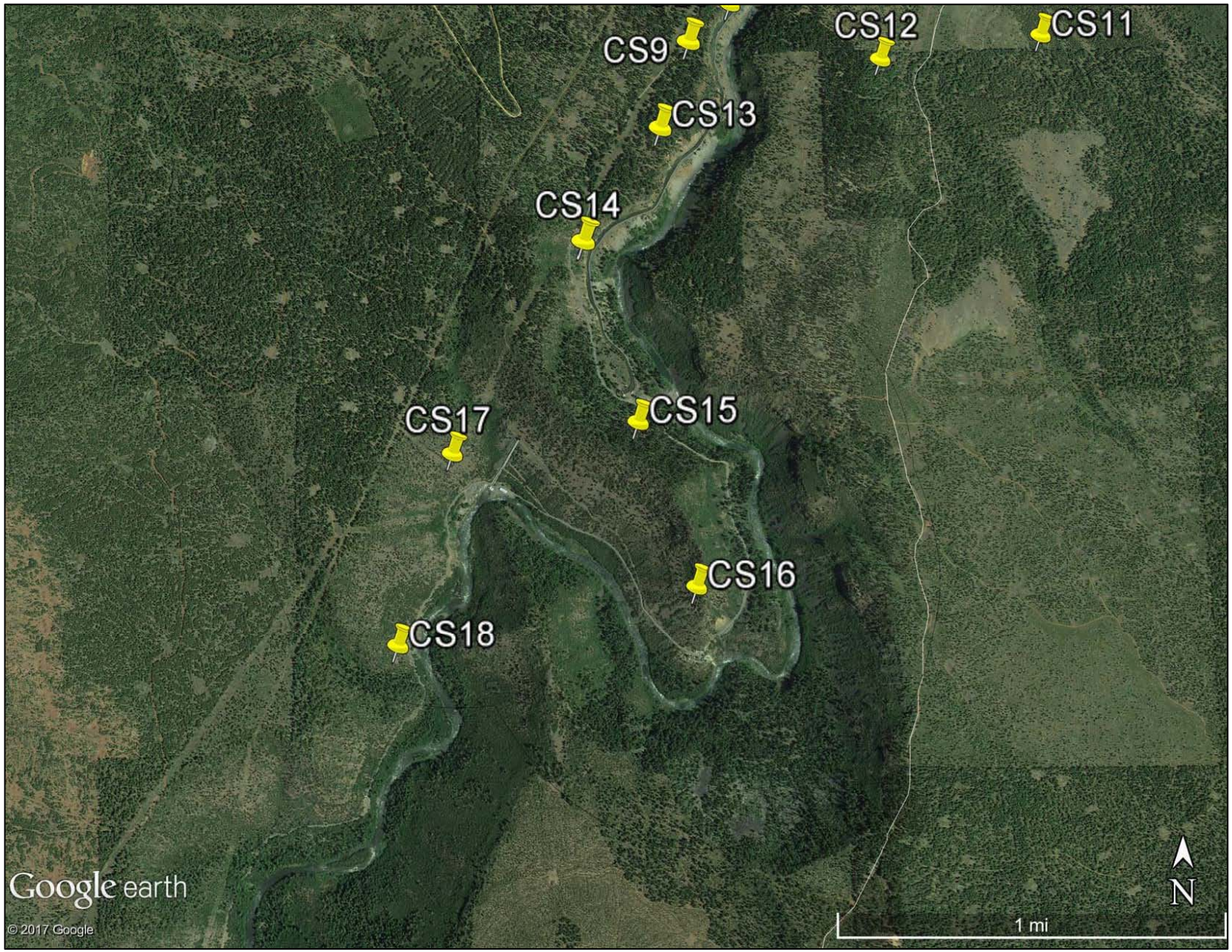


BLM Habitat Layer

Klamath River Renewal Corporation
Klamath River Renewal Project

FIGURE 3: PRELIMINARY NSO CALLING STATIONS (BLM HABITAT LAYER)

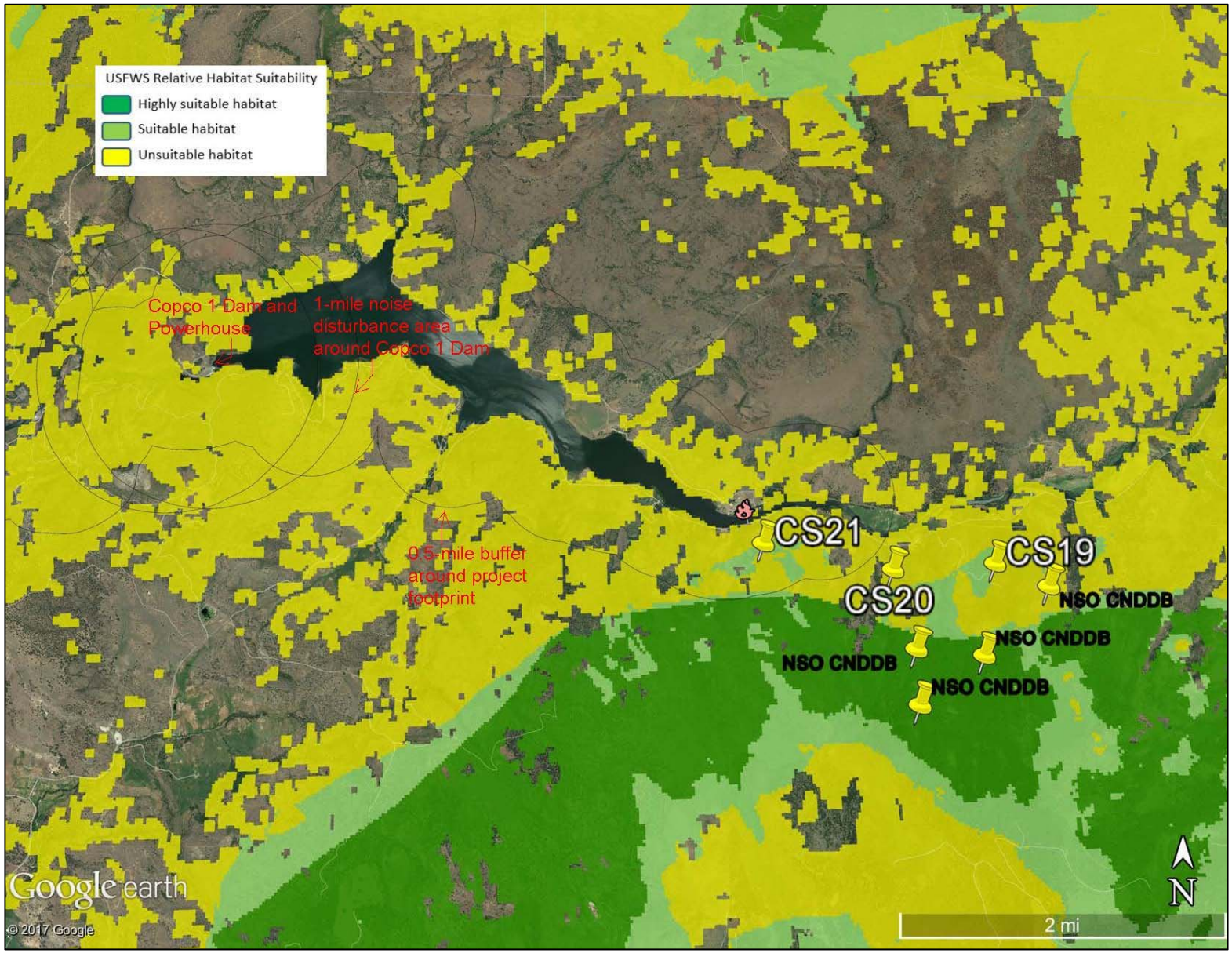
JC Boyle Powerhouse and Penstocks
Sheet 2 of 3



Klamath River Renewal Corporation
Klamath River Renewal Project

FIGURE 3: PRELIMINARY NSO CALLING STATIONS

JC Boyle Powerhouse and Penstocks
Sheet 3 of 3

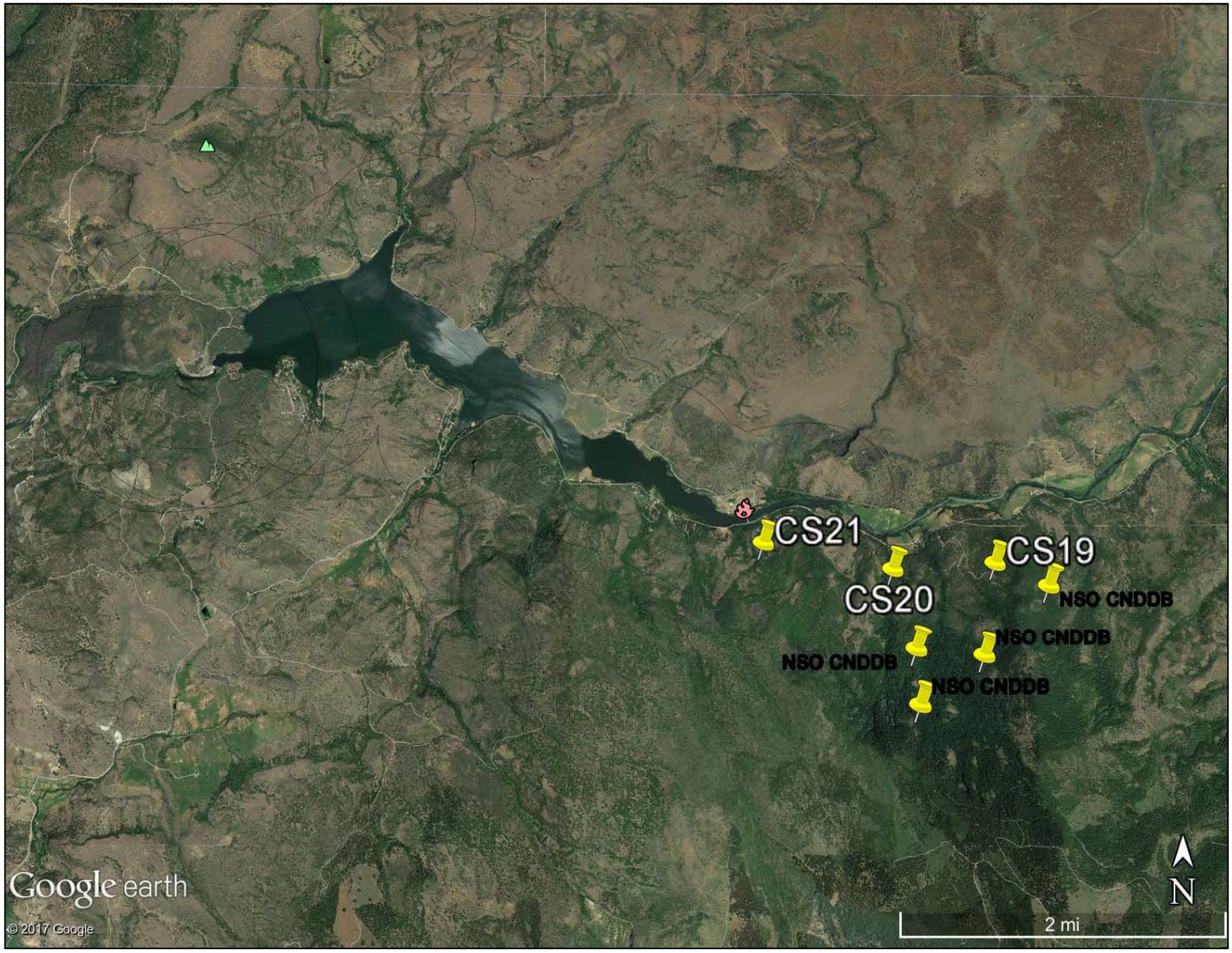


USFWS Habitat Layer

Klamath River Renewal Corporation
Klamath River Renewal Project

FIGURE 4: PRELIMINARY NSO CALLING STATIONS (USFWS HABITAT LAYER)

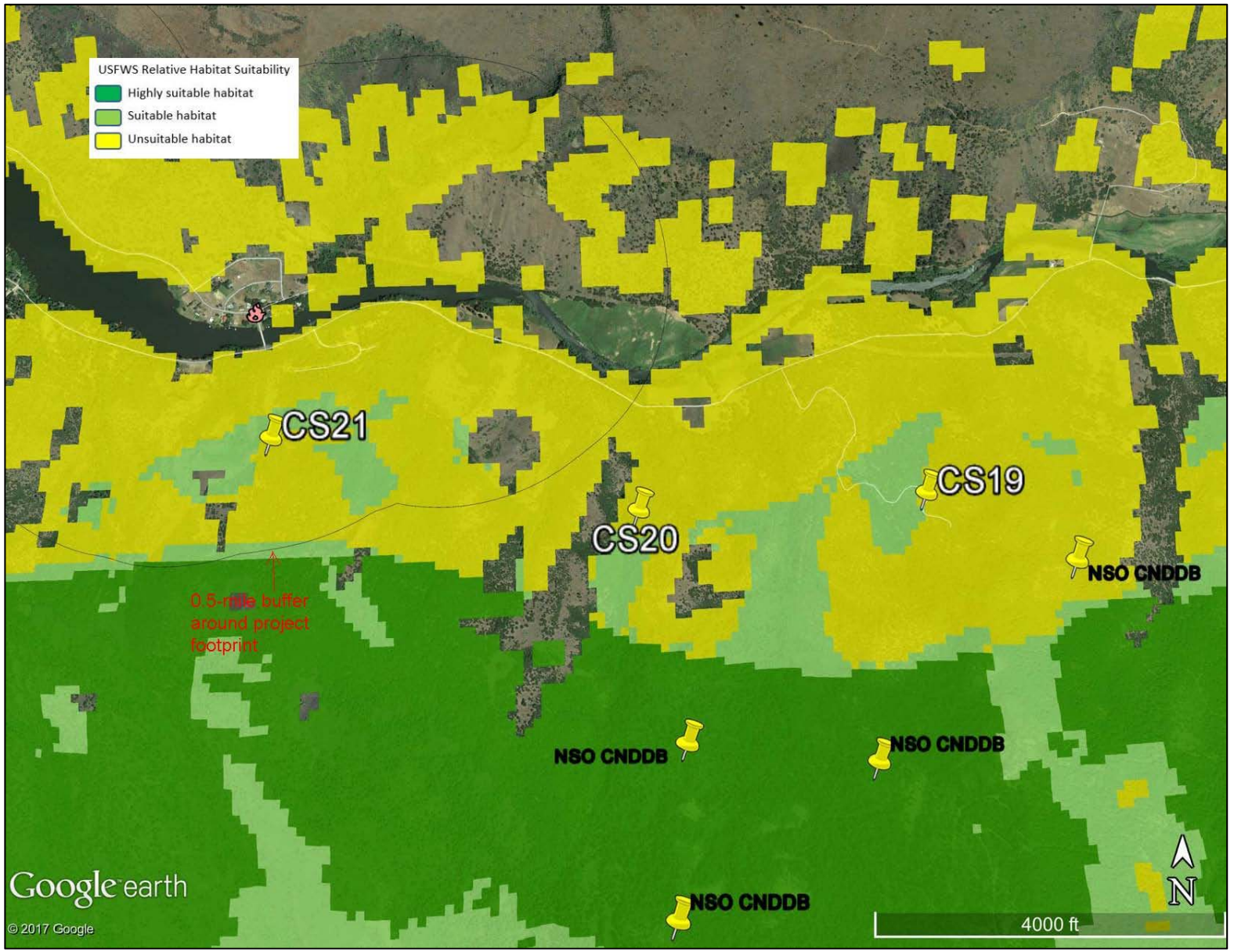
Copco Reservoir
Sheet 1 of 2



Klamath River Renewal Corporation
Klamath River Renewal Project

FIGURE 4: PRELIMINARY NSO CALLING STATIONS

Copco Reservoir
Sheet 2 of 2

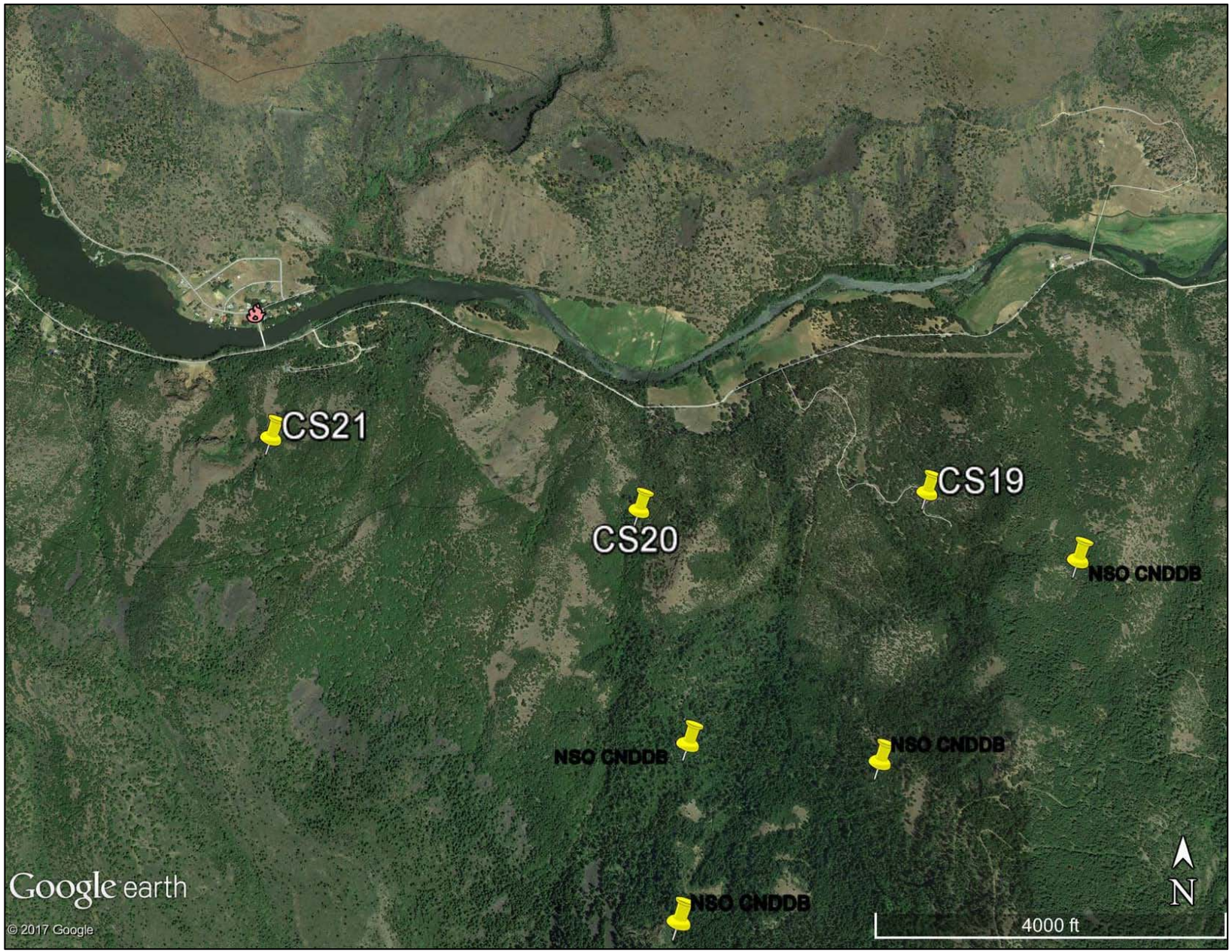


USFWS Habitat Layer

Klamath River Renewal Corporation
Klamath River Renewal Project

FIGURE 5: PRELIMINARY NSO CALLING STATIONS (USFWS HABITAT LAYER)

Copco Reservoir – Upstream End
Sheet 1 of 2



Klamath River Renewal Corporation
Klamath River Renewal Project

FIGURE 5: PRELIMINARY NSO CALLING STATIONS

Copco Reservoir – Upstream End
Sheet 2 of 2

KLAMATH RIVER RENEWAL CORPORATION

Attachment B

Viewshed Analysis Figures and Eagles Table

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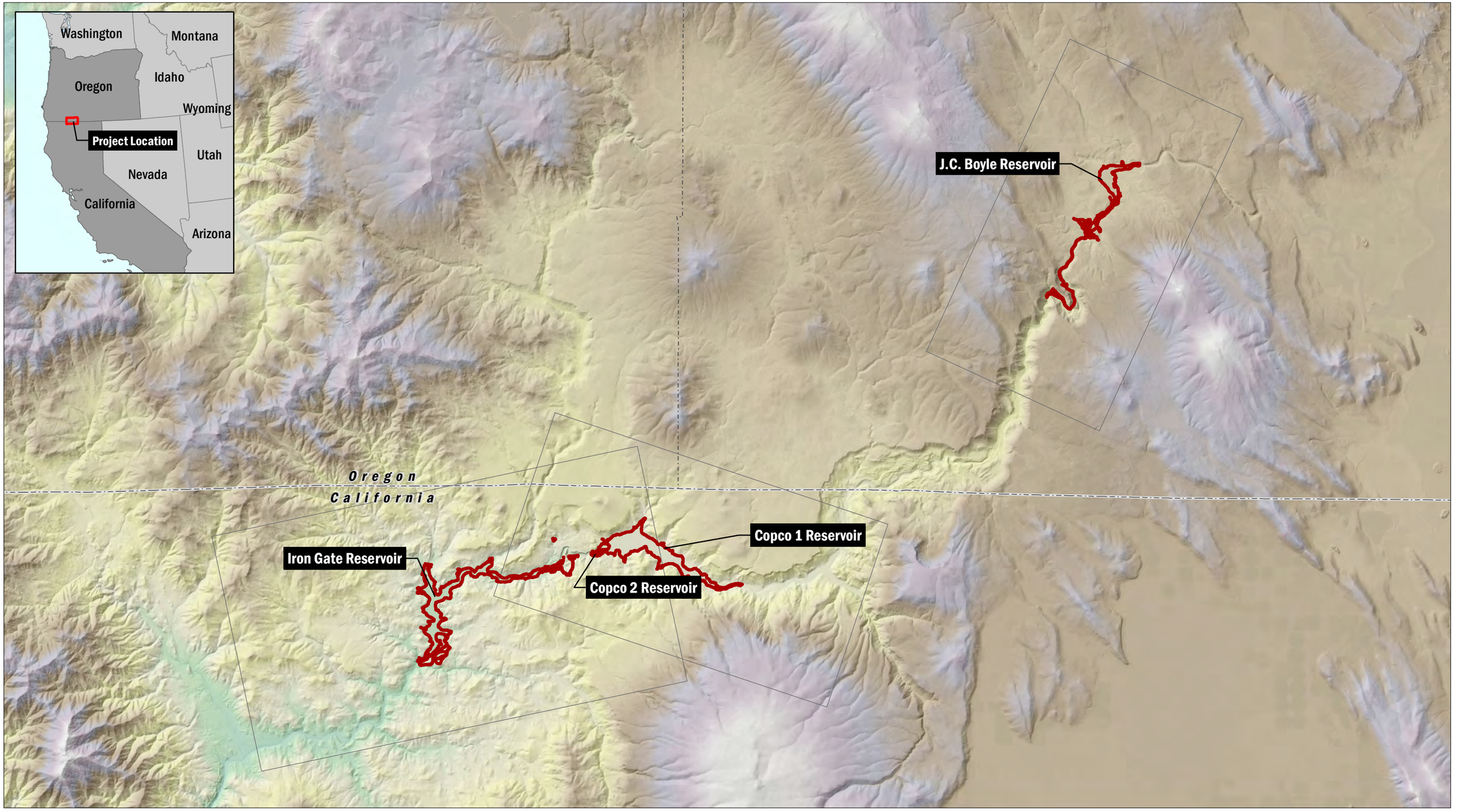


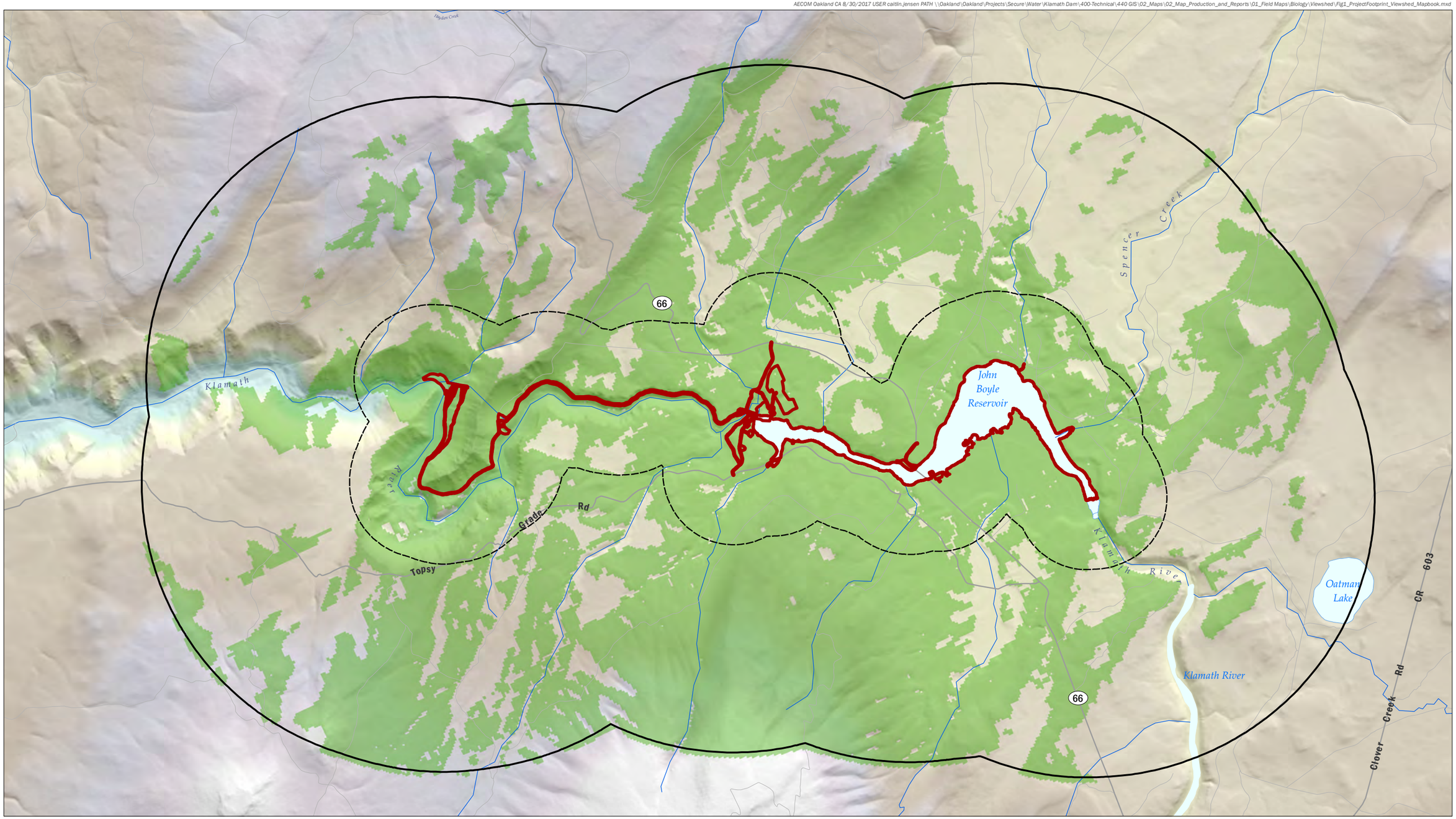
AECOM

Klamath River Renewal Corporation

Klamath River Renewal Project

FIGURE 1: PRELIMINARY PROJECT FOOTPRINT VIEWSHED

Overview



0 0.5 Miles

USGS National Elevation Dataset, published 2013

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

- 0.5-Mile Buffer
- 2-Mile Buffer
- Project Footprint
- Viewshed from Project Footprint

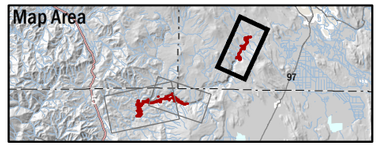
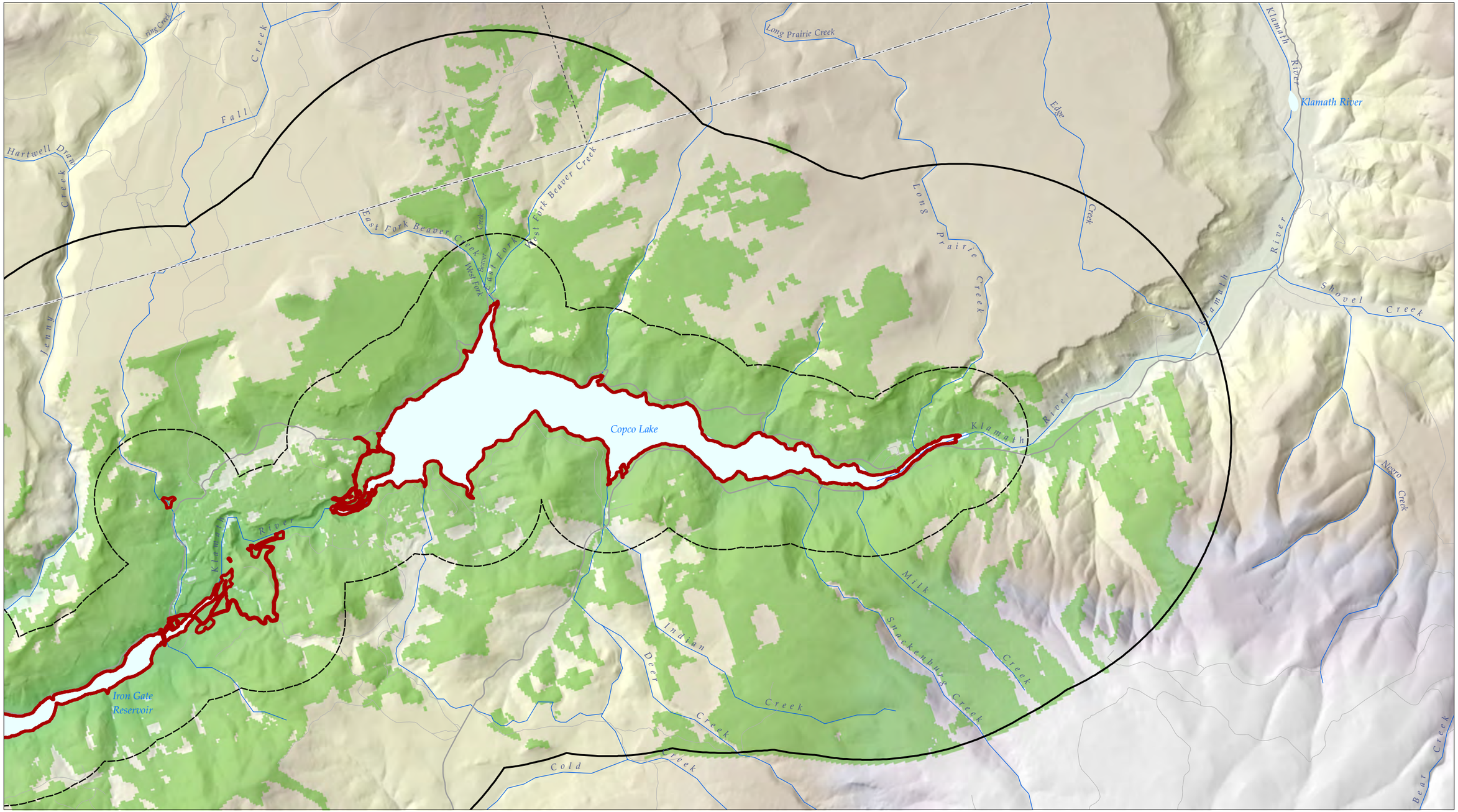


FIGURE 1: PRELIMINARY PROJECT FOOTPRINT VIEWSHED

J.C. Boyle Reservoir

Sheet 1 of 3

AECOM Oakland CA 8/30/2017 USER caitlin.jensen PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\01_Field Maps\Biology\Viewshed\Fig1_ProjectFootprint_Viewshed_Mapbook.mxd



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USGS National Elevation Dataset, published 2013

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

- 0.5-Mile Buffer
- 2-Mile Buffer
- Project Footprint
- Viewshed from Project Footprint

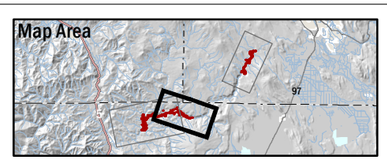

FIGURE 1: PRELIMINARY PROJECT FOOTPRINT VIEWSHED

Copco 1 and 2 Reservoirs

Sheet 2 of 3

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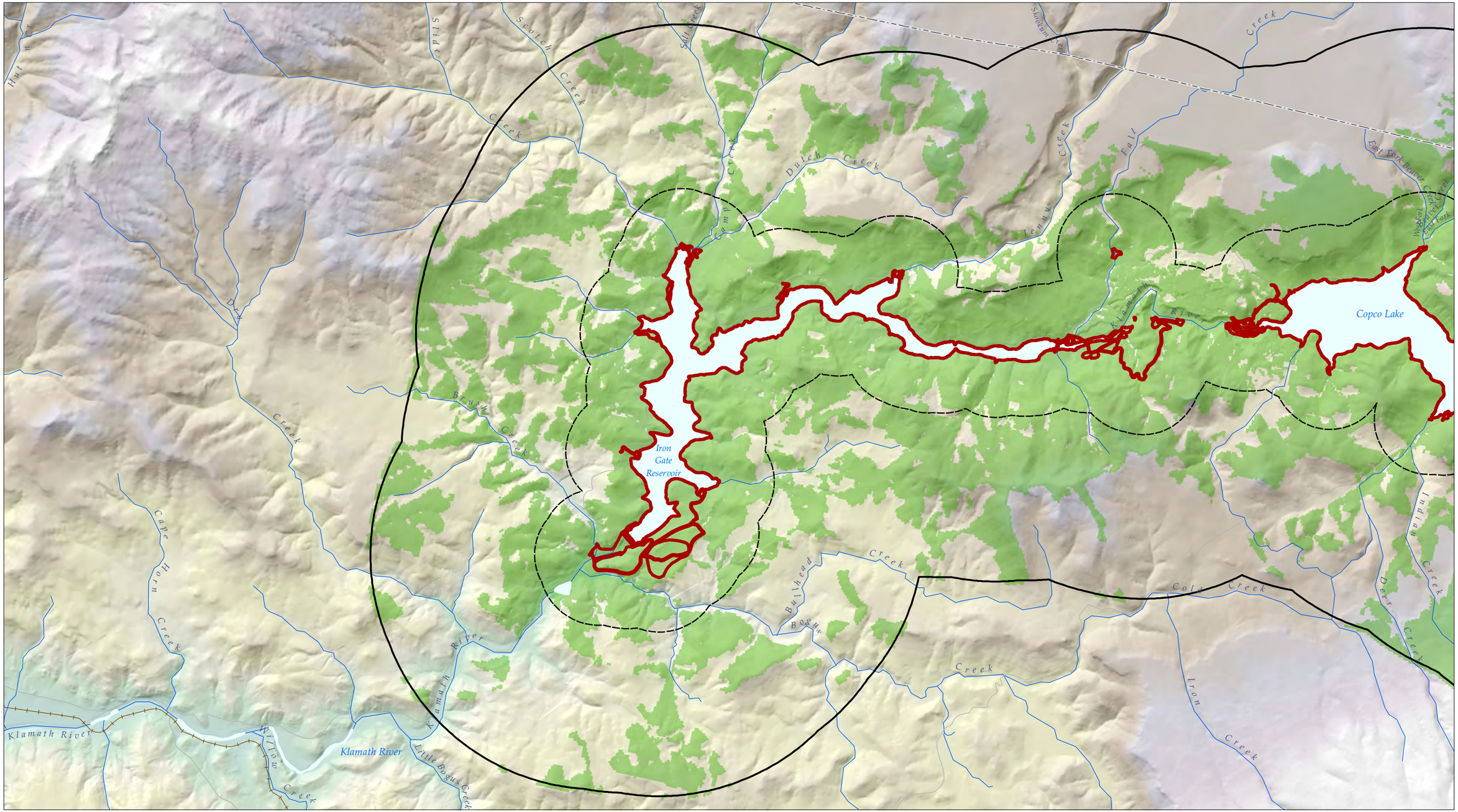

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USGS National Elevation Dataset, published 2013

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Klamath River Renewal Corporation

Klamath River Renewal Project

- 0.5-Mile Buffer
- 2-Mile Buffer
- Project Footprint
- Viewshed from Project Footprint

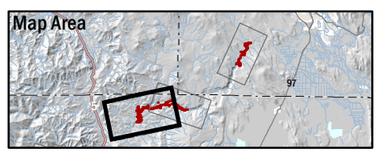

FIGURE 1: PRELIMINARY PROJECT FOOTPRINT VIEWSHED

Iron Gate Reservoir

Sheet 3 of 3

Table 5A-12. Number of bald eagles detected during field surveys.

Habitat Type*	Iron Gate-Shasta	Iron Gate Reservoir	Fall Creek	Copco Bypass	Copco Reservoir	J.C. Boyle Peaking Reach	J.C. Boyle Bypass	J.C. Boyle Reservoir	Keno Canyon	Keno Reservoir	Link River	Total
Plot Surveys	*(n=18)*	*(n=38)*	*(n=16)*	*(n=4)*	*(n=37)*	*(n=72)*	*(n=22)*	*(n=20)*	*(n=18)*	*(n=23)*	*(n=18)*	*(n=286)*
Unidentified Habitat						1						**1**
Flyover					5	3	1			1		**10**
Lacustrine Unconsolidated Bottom		1			1			1				**10**
Montane Hardwood Oak					2							**2**
Ponderosa Pine								1				**1**
Riparian/Wetland Forest		1								1		**2**
Riparian/Wetland Scrub-shrub								1				**1**
Sagebrush								1				**1**
Facility Surveys	*(n=1)*	*(n=3)*	*(n=4)*	*(n=3)*		*(n=1)*	*(n=2)*		*(n=1)*		*(n=3)*	*(n=18)*
All Habitats				1								**1**
Reservoir Surveys		*(n=6)*			*(n=6)*			*(n=5)*		*(n=6)*	*(n=1)*	*(n=24)*
All Habitats					4			1		3		**8**
Total		**2**		**1**	**12**	**4**	**1**	**5**		**5**		**37**

*Detections were not recorded in habitat types not included in table.

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KLAMATH RIVER RENEWAL CORPORATION

Appendix K Road and Bridge Structure Data and Long-Term Improvements

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Access Roads and Haul Routes of Significance

Name of Road	Dam	County / State	Divided	Surface	Condition	Posted Speed (mph)	Haul or Access	Notes	Recommended Improvements	Temporary Traffic Control (Y/N)
The Dalles California Highway (US 97)	J.C. Boyle	Klamath, Oregon	Undivided	HMA	Good	65	Haul	Two lane State highway system, AC paved road with a soft shoulder. Proposed haul route to transport materials from J.C. Boyle Dam.	Improvements and upgrades to this highway for mobilization or hauling of materials are not anticipated for the Project. Pavement rehabilitation is unlikely during or post-construction.	Y (during pavement rehab only)
Green Springs Highway (OR66)	J.C. Boyle	Klamath, Oregon	Undivided	HMA	Fair	35-45	Haul	Soft shoulder for most part and a few locations with HMA.	Improvements and upgrades to this highway for mobilization and hauling are not anticipated for the Project. Pavement rehabilitation is unlikely during or post-construction.	Y (during pavement rehab only)
Keno Worden Road	J.C. Boyle	Klamath, Oregon	Undivided	HMA	Fair	35	Haul	Most of the segment is a soft gravel shoulder. Steep side slopes in some areas. Rolling terrain. Overhead utility poles found along a portion the road.	Improvements and upgrades to this highway for mobilization and hauling are not anticipated for the Project. Pavement rehabilitation is unlikely during or post-construction.	Y (during pavement rehab only)
Topsy Grade Road	J.C. Boyle	Klamath, Oregon	Undivided	AB with some asphalt	Good	n/a	Haul	Gravel road from OR66 becoming HMA for a portion alongside the Topsy Campground.	It is anticipated that the section of roadway between the Topsy Recreation Site and OR66 will be used for mobilization and material hauling. Improvements and upgrades to this roadway are not anticipated for the Project. Pavement rehabilitation may be required during or post-construction. Temporary traffic control will be used for any pavement rehabilitation.	Y (during repair/regrading)
J.C. Boyle Dam Access Road from OR66	J.C. Boyle	Klamath, Oregon	Undivided	Gravel	Fair	n/a	Haul		Improvements such as regrading uneven or rutted areas will be required on parts of the road. At the intersection with OR66, tree removal and widening of the intersection on the access road approach will improve corner sight distance for mobilization and hauling activities.	N
J.C. Boyle Right abutment access road	J.C. Boyle	Klamath, Oregon	Undivided	AB	Poor	n/a	Haul		None.	N
J.C Boyle Disposal Access Road	J.C. Boyle	Klamath, Oregon	Undivided	Dirt	Fair	n/a	Haul		Regrade uneven or rutted areas of road surface. Minor widening in parts to allow two-way traffic.	N
Power Canal Access Road to powerhouse	J.C. Boyle	Klamath, Oregon	Undivided	AB	Poor	n/a	Access	Very narrow road immediately adjacent to concrete flume. Side slopes on river side are very steep or nearing vertical. To be used for access only, not hauling. Not recommended as a two-way haul route unless concrete flume has been completely removed. Used for construction access only after the power canal has been completely removed.	Minor periodic roadway maintenance such as re-grading may be required to address roadway deterioration during construction.	N
J.C. Boyle Powerhouse Road	J.C. Boyle	Klamath, Oregon	Undivided	AB	Fair	n/a	Haul	Access road from forebay to powerhouse.	None.	N
Interstate 5 (I-5)	Copco 1,2, Iron Gate	Siskiyou, California	Divided	Asphalt	Very good	70	Haul	Rolling and mountainous terrain .	None.	N
Copco Road from I-5 to Ager Road	Copco 1,2 and Iron Gate	Siskiyou, California	Undivided	HMA	Good	n/a	Haul	From I5 to Ager Road.	Improvements and upgrades to this highway for mobilization and hauling are not anticipated for the Project. Pavement rehabilitation may be required during or post-construction.	Y (during pavement rehab only)
Copco Road from Ager Road to Lakeview Road	Copco 1,2 and Iron Gate	Siskiyou, California	Undivided	HMA	Poor	35	Haul	From Ager Rd to Lakeview Rd. Poorly striped. No striped shoulder.	Improvements and upgrades to this highway for mobilization and hauling are not anticipated for the Project. Pavement rehabilitation may be required during or post-construction.	Y (during pavement rehab only)
Copco Road from Lakeview Road to Daggett Road	Copco 1,2 and Iron Gate	Siskiyou, California	Undivided	HMA	Poor	35	Haul	From Lakeview Rd to Daggett Road. Poorly striped. No striped shoulder.	Improvements and upgrades for this road prior to dam removal are not anticipated. Pavement rehabilitation may be required during or post-construction.	Y (during pavement rehab only)
Copco Road from Daggett Road to Copco Access Road	Copco 1	Siskiyou, California	Undivided	asphalt then transitions to AB at 1.2 Mi. E. of Daggett Road	Fair	n/a	Haul	Very low traffic.	Improvements and upgrades prior to dam removal are not anticipated for the Project. Road surface maintenance may be required during or post-construction.	Y (during road surface maintenance only)

Access Roads and Haul Routes of Significance										
Name of Road	**Dam**	**County / State**	**Divided**	**Surface**	**Condition**	**Posted Speed (mph)**	**Haul or Access**	**Notes**	**Recommended Improvements**	**Temporary Traffic Control (Y/N)**
Copco Road between Copco 1 Access Road to Copco Road Bridge/Ager Beswick Road	Copco 1	Siskiyou, California	Undivided	Dirt/ HMA	Poor	n/a	Access	Road surface is primarily dirt and has very low traffic volume. One mile of road is asphalt pavement.	It is anticipated that this portion of Copco Road will not be used for dam or powerhouse removal but will be used for construction access to various post construction improvements, such as culvert replacement and installing rock slope protection. Improvements and upgrades prior to dam removal are not anticipated. Road surface maintenance may be required during or post construction.	N
Copco Access Road between dam and Copco Road	Copco 1	Siskiyou, California	Undivided	Dirt	Fair	n/a	Haul	Dirt road with a hairpin bend. Landslides have occurred on the hillside above the hairpin bend. The lower side of access road is very steep with no barrier protection.	It is anticipated that this segment of the dirt/gravel road will need to be regraded by clearing and grubbing the available space between the toe of the higher hillside and the existing edge of the dirt/gravel road to provide a wider road section for construction and hauling trucks. One-way traffic with turnouts are assumed for the access road. Turnarounds for haul trucks will be at the powerhouse and at the disposal site of the staging area.	Y
Copco 1 Ager Beswick Road Barge Access	Copco 1	Siskiyou, California	Undivided	HMA	Fair-good	25	Access	Two-way undivided County road from Copco Bridge to Ager Rd intersection.	The road is not anticipated to be used for hauling but may be used for mobilization of a barge-mounted crane from the existing boat ramp at Mallard Cove on the southern shore. Upgrades and improvements to this road prior to dam removal are not anticipated for the Project. Access to the boat ramp is likely to require minor improvements to the access road off of Ager Beswick Road to enable placing a barge-mounted crane in the reservoir. The boat ramp is also likely to require extension into the reservoir to be able to remove the barge following removal of the spillway structure.	N
Daggett Road	Copco 2	Siskiyou, California	Undivided	Dirt/AB	Poor	n/a	Haul	Located just behind a gate off of Copco Road. This is a pinch point on the Daggett Road that connects to Copco Road. This is a potential haul route to transport demolished materials from Copco 2 powerhouse.	"One way" roadside sign along with advance warning signs will be needed to provide warning to truck drivers. Periodic road maintenance will be required during construction on Daggett Road leading to Copco 2 powerhouse. Approach roadways to Daggett Road Bridge will be realigned to new, relocated Daggett Road Bridge.	Y ("one-way" signs)
Lakeview Road between Copco Road and Disposal Site	Iron Gate	Siskiyou, California	Undivided	Gravel	Fair	20	Haul	One way hauling traffic.	Improvements and upgrades for mobilization and hauling are not anticipated. Minor road surface maintenance may be required during or post-construction.	Y (during roadway maintenance)
Powerhouse access road	Iron Gate	Siskiyou, California	Undivided	Gravel (before gate)/ asphalt (past gate)	Good	n/a	Haul	From the bridge it is a gravel road up to the gate, after the gate it is an AC paved road to the Iron Gate Powerhouse. A large stockpile area is available on the right side of Lakeview Road bridge that can be used during construction. Access road can be used for hauling material from the Iron Gate powerhouse.	Roadway maintenance to ensure adequate accessibility during construction. This road will not be needed following hauling and demobilization activities.	Y (during roadway maintenance)
Left abutment access road	Iron Gate	Siskiyou, California	Undivided	Gravel	Fair	n/a	Haul	Runs between Lakeview Road and left abutment of dam. The road is swing gate controlled and can be used as a haul route to remove materials from the Iron Gate dam structure to disposal site.	Periodic maintenance to ensure accessibility during construction. Road will be removed after dam removal activities.	N
Upstream Left abutment access road	Iron Gate	Siskiyou, California	Undivided	Gravel	Fair	n/a	Haul	The original haul route from the upstream borrow area to the dam would be reopened for construction. This would allow two-way traffic to the north side of the disposal area.	Periodic maintenance to ensure accessibility during construction. Road will be removed after dam removal activities.	N
Access Road from Long Gulch Recreational Facility to Lakeview Road (Disposal Site)	Iron Gate	Siskiyou, California	Undivided	Gravel	Fair	n/a	Haul	One way hauling traffic.	Maintenance to ensure adequate accessibility during construction. This road will not be needed following hauling and demobilization activities.	N
Access Road from Overlook Point Recreational Facility to Copco Road	Iron Gate	Siskiyou, California	Undivided	Gravel	Fair	n/a	Haul	One way hauling traffic.	Maintenance to ensure adequate accessibility during construction. This road will not be needed following hauling and demobilization activities.	N

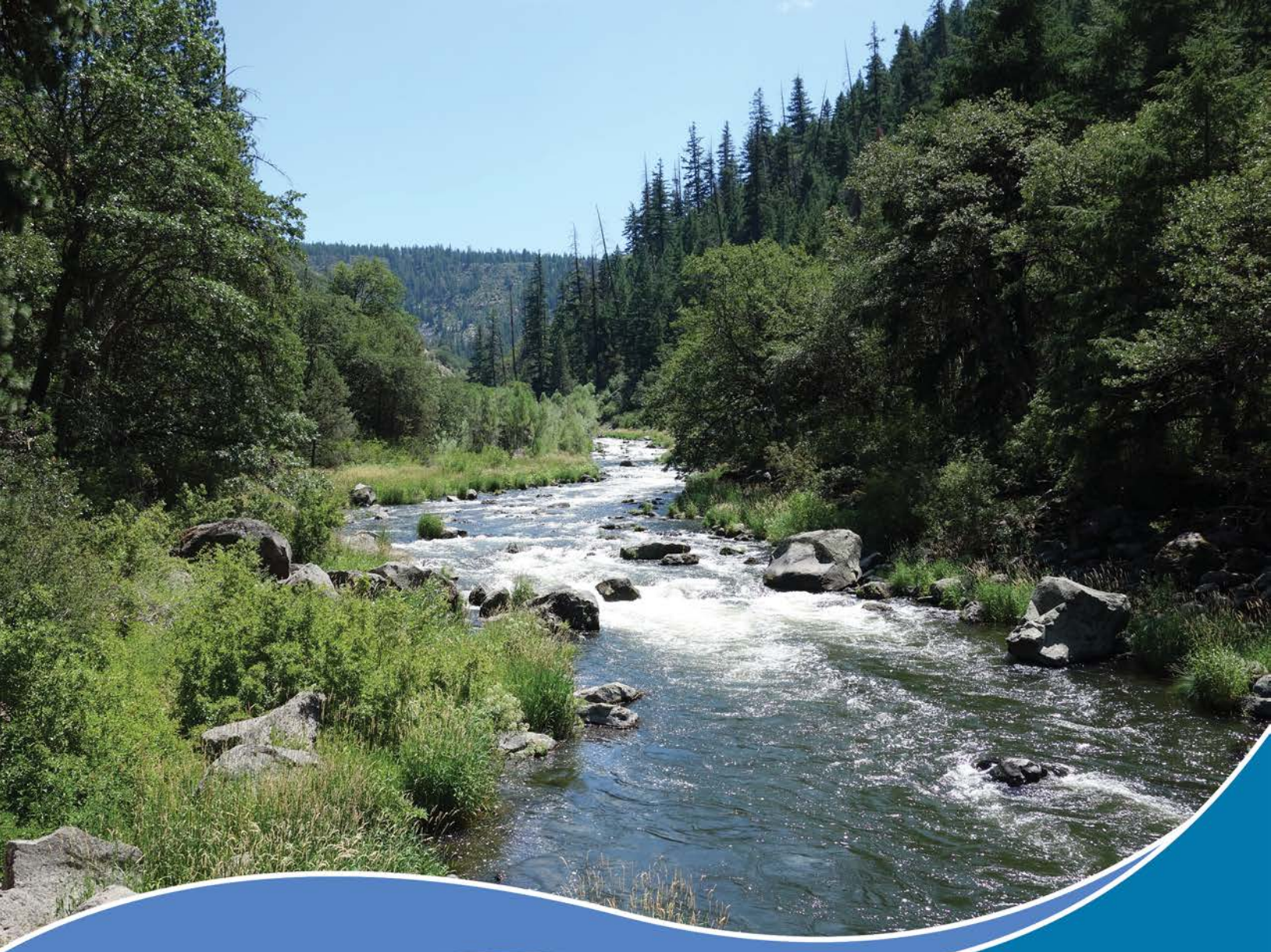
Intersection Field Observations					
Intersection	**Dam**	**Control**	**Notes**	**Improvements**	**Temporary Traffic Control (Y/N)**
Dalles California highway (US 97) / Keno Worden Road	J.C. Boyle	1-way stop	T-intersection; approximately 200ft from level rail road crossing controlled by flashing lights and gates.	None.	N
Keno Worden Road / Green Springs Hwy (OR66)	J.C. Boyle	1-way stop	T-intersection; continue on Route 66 from Keno Worden Road to go J.C. Boyle Dam.	None.	N
Green Springs Hwy (OR66 - Oregon) / Topsy Grade Rd	J.C. Boyle	2-way stop	Topsy Grade Rd paved approximately 150ft before intersection. Adequate signage and striping.	None.	N
Green Springs Hwy (OR66) / Dam Access Road	J.C. Boyle	1-way stop	Located on the north side of dam. Inadequate intersection signage and configuration, near curve in mainline. Needs improvements.	Minor widening and tree removal to improve sight distance and accommodate truck turning. Provide temporary advance warning signs to notify of trucks entering/exiting OR66 at the intersection.	Y (during widening and tree removal)
Copco Road / Copco 1 access road	Copco 1	None	AB intersection, not stop controlled, low volume of traffic.	None.	N
Copco Road / Quail Lane	Copco 1	None	Intersection to Copco Br. No stop sign, no striping, low volume intersection, low speed.	None.	N
Copco Road / Ager Beswick Road	Copco 1	n/a	Intersection to Copco Br. No stop sign, no striping, low volume intersection, low speed.	None.	N
Patricia Ave / Ager Beswick Road	Copco 1	1-way stop	Poor striping and pavement markings, tree blocking sight distance.	Remove Tree	N
Copco Road / Daggett Road	Copco 2	n/a	Poor AC pavement on Daggett Rd at intersection, low volume, no stop sign, no stop bar, OK sight distance. Should add stop control prior to dam removals. Gate located 200ft from intersection.	Provide stop sign and stop bar.	Y
Copco Road / Fall Creek Road	Copco 2	n/a	AB intersection, not stop controlled, low volume.	Regrade to conform with new Fall Creek Bridge immediately east of intersection.	Y (during regrading and bridge construction)
Copco Road / Lakeview Road	Iron Gate	n/a	No signage, poor AC pavement at intersection, should add stop control prior to dam removals.	Provide stop sign and stop bar.	Y (area near bridge replacement, may need flaggers during new bridge construction)
Lakeview Road / Powerhouse Access	Iron Gate	1-way stop	AB Intersection, no striping. 5 legs at intersection. Should reconfigure and improve stop control prior to construction.	Provide stop sign at powerhouse access road approach.	Y (area near bridge replacement, may need flaggers during new bridge construction)

Structure Field Observations													
Bridge Name	**Dam**	**Road**	**Bridge No.**	**As-Builts**	**Year Built**	**Haul or Access**	**Deck Width**	**Lane 1 Width**	**Lane 2 Width**	**Span**	**Notes**	**Recommended Improvements**	**Temporary Traffic Control (Y/N)**
Spencer bridge	J.C. Boyle	Green Springs Hwy (OR66), Oregon	19789	Yes	2005	Haul	42.54'	12'	12'	3 spans @ 557.74' total	Reinforced concrete deck on continuous steel plate girders, excellent condition. Also include 8' shoulder on each side.	Assess eastern embankment and abutment after reservoir drawdown. May need outer layer riprap repair based on assessment of erosion following the drawdown.	N
Timber bridge	J.C. Boyle	JC Boyle Dam Access	n/a	Partial		Access	18'	16'	None	100'	Wood deck on rolled beams, fair condition	No construction access improvement. Private bridge. Demolish post-construction.	N
Concrete bridge	J.C. Boyle	Unnamed Road over Spencer Creek									Noted the gabion walls next to the bridge are in good condition. No railing on the bridge.	None, not impacted by the project.	N
Unknown cattle bridge	Copco 1	Private Access									Unknown cattle bridge - 2.3mi upstream from Copco bridge	None.	N
Copco Road bridge	Copco 1	Copco Rd - Ager Beswick Rd	2C0039	Yes	1988	Haul	24.67'	12'	12'	202.5'	4' deep CIP PS concrete box	Drawdown and post-project flows have potential to cause erosion at the abutments or central pier. Further evaluation during the detailed design phase. Erosion protection may be required at the abutments or pier.	Y (during construction of improvements)
Daggett Road bridge	Copco 2	Daggett Rd		Partial	1983	Haul	14'	12'		42', 72', 58' 61'	Timber deck on steel girders	Construction access improvements on private road. Existing structure will be replaced by a bridge of similar length and width as existing structure. The new structure will be constructed adjacent to the existing bridge on a revised alignment and the old bridge removed after completion of the new structure.	N
Fall Creek Bridge	Copco 2	Copco Rd	2C0198	No	1969	Access	25'	12'	12'		AC on deck in poor condition, wood railing in poor condition. Connection only to power plant/grid station.	Construction access improvement on County Road. Structure will be replaced by a single span bridge of similar length and width as the existing structure.	Y (Staging involves constructing half of bridge, using half of existing bridge for one-way reversible traffic control in Stage 1. Move traffic with one-way reversible traffic control on new half of bridge while constructing final half in Stage 2.)
Lakeview Road bridge	Iron Gate	Lakeview Rd	2C0255	No, but have Inspection Report	1960	Haul	14.4'	12'		9 spans @ 24.9' Total = 272'	Reinforced concrete deck on steel simply supported beams. Bents are timber pile extensions with timber or steel caps. Overall width is 17'. Posted load limits	Construction access improvements on County Road. Structure will be replaced for construction access. The new bridge will be similar in length and width and constructed on a revised alignment adjacent to the existing bridge.	Y (traffic control during pavement conform work at approach roadways)
Camp Creek Bridge (replace existing culvert)	Iron Gate	Copco Road	n/a	No	n/a	Haul	n/a	n/a	n/a	n/a	Existing 10' Arched CMP pipe culvert to be replaced by a bridge.	Permanent long term improvement. Due to difficulty in knowing when erosion would occur, it is expected that replacement of the culvert with a bridge will be necessary. A temporary structure and detour road upstream of the culvert would be constructed to maintain traffic during the works.	Y
Jenny Creek bridge	Iron Gate	Copco Rd	2C0280	Yes, but only GP & FP	2008	Haul	27.33'	12'	12'	113.5'	PC PS deck bulb tee girders, AC in good condition, MBGR in good condition	Permanent long term improvement. The abutments are built on material deposited after the dam construction and the dam removal may cause significant erosion that could possibly undermine the abutments. A new bridge would be constructed on the upstream side of the existing structure, on a modified alignment, to preclude damage to the structure after drawdown.	Y (during pavement conform work at approach roadways to new bridge)
Brush Creek bridge	Iron Gate	Copco Rd	2C0224	Yes	1976	Haul	24.5'	12'	12'	25'	18" concrete slab bridge	None, this bridge is located on the haul route (Copco Rd) and potential for some minor pavement rehabilitation post-project condition. Post project erosion is not expected to impact abutments.	Y (during pavement rehab)
Dry Creek bridge (Fish Hook)	Iron Gate	Copco Rd	2C0144	No	1960	Haul	30.75'	14'	14'	24.5'	Timber deck and girders with AC overlay	Construction access improvement on County Road. Temporary bridge for construction duration and associated traffic. Existing bridge to remain as is.	Y
Pedestrian bridge - private	Klamath River	None		No		n/a					Deteriorated, not in use. Should be removed.	Demolish. The bridge spans the Klamath River just upstream of the confluence with Cedar Gulch. The bridge is a cable suspension structure of unknown origin, with no connection to any approach roads. The bridge is in very poor condition. The bottom chord of the bridge is not high enough to pass the anticipated 100-year flood following removal of the dams.	N
Campground Pedestrian bridge	Klamath River	None		No		n/a					Well maintained. In flood plain	Demolish. The bottom chord of the bridge is not high enough to pass the anticipated 100-year flood following removal of the dams. An evaluation of the structure will be performed during the detailed design phase to determine whether removal or replacement will be required.	N

Structure Field Observations													
Bridge Name	**Dam**	**Road**	**Bridge No.**	**As-Builts**	**Year Built**	**Haul or Access**	**Deck Width**	**Lane 1 Width**	**Lane 2 Width**	**Span**	**Notes**	**Recommended Improvements**	**Temporary Traffic Control (Y/N)**
Railroad bridge	Klamath River	None		No		n/a					Central Oregon and Pacific RR Bridge	Possible scour mitigation post-project.	N
Cottonwood Creek Bridge	Klamath River	Copco Rd	2C0257	No	1980	Haul	32'	12'	12'	89'	Purple permit capacity for all trucks	None.	N

Culvert Field Observations								
Description	**Dam**	**Road**	**No. of Pipes**	**Culvert Size(s)**	**Type of Pipe**	**Notes**	**Recommended Improvements**	**Temporary Traffic Control (Y/N)**
Topsy Grade Road at Unnamed Creek	J.C. Boyle	Topsy Grade Rd	3	24" each	Unknown (possibly CMP)	PacifiCorp staff confirmed there is a pipe culvert connecting both sides of the road and conveying water through the culvert. As built plans indicate 3-24" culverts. Pipe type unknown.	Potentially some minor post project improvements including removal of sediment and/or debris, redirection of flows through the culvert to the original downstream side, and erosion protection of downstream embankment. Needs for these improvements will be confirmed following drawdown and associated monitoring.	Y (during erosion protection installation)
Unnamed Road at Unnamed Drainage	J.C. Boyle	Unnamed	2	36" each	CMP	Both sides of culverts silted. Located well above lake water level.	Possible rock slope protection on downstream embankment. Culvert clean up to remove silt and some vegetation. Need for these minor improvements would be confirmed following drawdown.	Y (during erosion protection installation culvert cleanup)
Copco Road at Beaver Creek	Copco 1	Copco Rd	1	60"	CMP	Length of pipe is about 30 feet long with 1.5 feet cover under the Copco Rd. The gravel/dirt road is about 13 feet wide and is in a fairly stable condition.	Culvert is located above reservoir level and is not expected to be built on reservoir sediments. Minor improvements such as, the addition of riprap armor to the face of the embankments may be required if erosion of reservoir sediments affects this culvert. Improvements to be confirmed following drawdown of Copco Lake and associated monitoring.	Y (during erosion protection installation)
Copco Rd at East Fork Beaver Creek	Copco 1	Copco Rd	1	60"	CMP	Length of pipe is about 30 feet long with 1.5 feet cover under the Copco Rd. The gravel/dirt road is about 13 feet wide and is in a fairly stable condition.	Culvert is located above reservoir level and is not expected to be built on reservoir sediments. Minor improvements such as, the addition of riprap armor to the face of the embankments may be required if erosion of reservoir sediments affects this culvert. Improvements to be confirmed following drawdown of Copco Lake and associated monitoring.	Y (during erosion protection installation)
Copco Road at Raymond Gulch	Copco 1	Copco Rd	1	60"	CMP	Length of pipe is about 20 feet long with 0.5 feet cover under the Copco Rd. The gravel/dirt road is about 11 feet wide and is in a fairly stable condition.	Culvert is located above reservoir level and is not expected to be built on reservoir sediments. Minor improvements such as, the addition of riprap armor to the face of the embankments may be required if erosion of reservoir sediments affects this culvert. Improvements to be confirmed following drawdown of Copco Lake and associated monitoring.	Y (during erosion protection installation)
Patricia Avenue at West Fork Unnamed Creek	Copco 1	Patricia Ave	1	36"	CMP	The culvert is located beneath Patricia Avenue. The AC paved road is about 20 feet wide and is in a good condition. Posted speed limit is 25mph.	Culvert is located above reservoir level and is not expected to be built on reservoir sediments. Minor improvements such as, the addition of riprap armor to the face of the embankments may be required if erosion of reservoir sediments affects this culvert. Improvements to be confirmed following drawdown of Copco Lake and associated monitoring.	Y (during erosion protection installation culvert cleanup)
Patricia Avenue at East Fork Unnamed Creek	Copco 1	Patricia Ave	1	36"	CMP	The culvert is located under Patricia Avenue. The AC paved road is about 20 feet wide and it is in good condition. Posted speed limit is 25mph.	Culvert is located above reservoir level and is not expected to be built on reservoir sediments. Minor improvements such as, the addition of riprap armor to the face of the embankments may be required if erosion of reservoir sediments affects this culvert. Improvements to be confirmed following drawdown of Copco Lake and associated monitoring.	Y (during erosion protection installation culvert cleanup)
Culvert at Deer Creek	Copco 1	Ager Beswick Rd	Unknown	Unknown	Unknown	The location is covered with heavy vegetation, so unable to take measurement of the culvert. The AC paved road is about 22 feet wide and in very good condition. Posted speed limit is 30mph.	Culvert is located above reservoir level so no impact is anticipated and no improvement required.	N

Culvert Field Observations								
Description	**Dam**	**Road**	**No. of Pipes**	**Culvert Size(s)**	**Type of Pipe**	**Notes**	**Recommended Improvements**	**Temporary Traffic Control (Y/N)**
Culvert at Indian Creek	Copco 1	Ager Beswick Rd	Unknown	Unknown	Unknown	The location is covered with heavy vegetation, so unable to take measurement of the culvert. The AC paved road is about 22 feet wide and in very good condition. Posted speed limit is 30mph.	Culvert is located above reservoir level so no impact is anticipated and no improvement required.	N
Daggett Road at Fall Creek	Copco 2	Daggett Rd	1	10ft	CMP	Length of pipe is about 32 feet long with 3 feet cover under Daggett Road. The gravel road is about 16 feet wide and is located just behind a gate off of Copco Road. This is a pinch point on the Daggett Road that connects to Copco Road. This is a potential haul route to transport materials from the Copco 2 Power House.	One way control roadside sign with advance warning signs may be needed to provide caution to truck drivers.	Y
Copco Road at Scotch Creek	Iron Gate	Copco Rd	1	10ft	CMP	10ft pipe visually seen but not able to access due to heavy vegetation. Road width at culvert is 22ft.	Some erosion is anticipated in the vicinity of the culvert following drawdown of the reservoir due to incision into reservoir sediments. Culvert will likely need to be replaced and provided with a suitable erosion protection to account for the potential drop in creek bed elevation. A temporary structure and detour road would be constructed immediately upstream of the culvert to maintain traffic during replacement.	Y
Copco Road 200' east of Scotch Creek drainage	Iron Gate	Copco Rd	2	18", 12"	CMP		Assessment of the condition of these pipes would be performed after completion of dam removals and hauling to assess whether any damage occurred during construction. Rehabilitation or replacement would be performed if necessary.	Y (during pipe replacement/repair)
Small cross culverts between Brush Creek and Scotch Creek	Iron Gate	Copco Rd	Multiple	12"-18"	CMP	Pipes spaced every 200' to 300'.	Assess post project for damage due to construction traffic loads over pipe. May require pipe repair or replacement.	Y (during pipe replacement/repair)
Copco Rd at Camp Creek - replace culvert with bridge - see structures table	Iron Gate	Copco Rd	1	10'	CMP arched	Water in culvert.	Significant erosion is anticipated in this area following drawdown of the reservoir due to incision into reservoir sediments. Due to difficulty in knowing exactly when the erosion would occur, it is expected that replacement of the culvert with a bridge will be necessary. Replace with a single span bridge along existing alignment. Provide temporary detour road upstream during replacement.	Y (during replacement)



Definite Plan for the Lower Klamath Project

Appendix L - Cultural Resources Plan

KLAMATH
RIVER RENEWAL
CORPORATION

June 2018

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Prepared for:

Klamath River Renewal Corporation

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Acronyms and Abbreviations

ACHP Advisory Council on Historic Preservation
ADI Areas of Direct Impacts
AIR Additional Information Request
APE Area of Potential Effects
BCE Before the Common Era
BLM Bureau of Land Management
BMF Bedrock Milling Features
CA California
CDFG California Department of Fish and Game
CEQA California Environmental Quality Act
CRWG Cultural Resource Working Group
CRHR California Register of Historical Resources

EIS/R Environmental Impact Statement/Report
ETH Ethnographic
FIC Field Inventory Corridor
HABS Historic American Building Survey
HAER Historic American Engineering Record
HPMP Historic Properties Management Plan
HIS Historic
KHHD Klamath Hydroelectric Historic District
KRRC Klamath River Renewal Corporation
MUL Multiple
NAGPRA Native American Graves Protection and Repatriation Act
NAHC Native American Heritage Commission
NEPA National Environmental Policy Act
NRHP National Register of Historic Places
NHPA National Historic Preservation Act
OARRA Oregon Archaeological Records Remote Access
OR Oregon
PA Programmatic Agreement
PRE Prehistoric
RM River mile
SCR Sensitive Cultural Resources
SHPO State Historic Preservation Officers
SOHS Southern Oregon Historical Society
SWRCB State Water Resource Control Board
TCP Traditional Cultural Property
TCR Tribal Cultural Resources
TCRe traditional cultural riverscape
THPO Tribal Historic Preservation Officers
UNK Unknown
USACE United States Army Corps of Engineers
USFS United States Forest Service
USGS United States Geologic Survey

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Chapter 1: Introduction

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1. INTRODUCTION

Klamath River Renewal Corporation (KRRC) is preparing the necessary documentation of compliance with all local, state, federal and tribal laws, including those for cultural and tribal resources. This Cultural Resources Plan (Plan) provide the Federal Energy Regulatory Commission (FERC) with a framework for understanding the cultural resources studies that KRRC has completed, those that are currently ongoing, and others that are anticipated to achieve regulatory requirements under Section 106 of the National Historic Preservation Act of 1966 (NHPA) as codified in 36 CFR Part 800. As requested in FERC's July 2017 Additional Information Request (AIR), the Plan also provides the status of informal consultation completed to date by KRRC and PacifiCorp, acting as FERC's non-federal representative under 36 CFR § 800.2(c)(4), in an effort to identify and evaluate cultural resources and develop measures to avoid, minimize, or mitigate potential adverse effects to historic properties (AIR #28). This consultation effort includes affected federally recognized and non-federally recognized tribes with regard to the identification and National Register of Historic Places evaluation of Traditional Cultural Properties; the Klamath Riverscape as a cultural landscape and/or Traditional Cultural Property (TCP); and the management, disposition, and treatment of human remains (AIR #29). The Plan also lays out how KRRC intends to coordinate Section 106 compliance with the cultural resource requirements of the California Environmental Quality Act (CEQA) and the California State Water Resources Control Board's (SWRCB) tribal consultations required under California Assembly Bill (AB) 52. AB 52 compliance is a requirement for the SWRCB's consideration of KRRC's application for a water quality certification under Section 401 of the Clean Water Act.

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Chapter 2: Plan Overview

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2. PLAN OVERVIEW

KRRC developed this Cultural Resources Plan to guide the multifaceted phases of cultural resources compliance actions planned for the Lower Klamath Project (Project). Foremost among these tasks is identification of historic properties in the Project's Area of Potential Effects (APE). Historic properties are cultural resources listed or eligible for listing in the National Register of Historic Places (NRHP). The Advisory Council on Historic Preservation (ACHP) regulations define the APE as the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist. The scale and nature of an undertaking influences the geographic scale of an APE, which may be different for different kinds of effects caused by the undertaking (36 CFR § 800.16(d)). Once defined, the APE will become the primary focus of the Project's cultural and tribal resources studies.

Additional resource identification efforts, effects determinations, and potential mitigation measures also are needed to meet Section 106 requirements, including an assessment of the completeness of previous cultural resource inventories conducted within the APE and particularly in the Areas of Direct Impacts (ADI) from dam removal. Anticipated effects to cultural and tribal resources include, but are not limited to, removal of historic project facilities, including the four dams; disturbances associated with road construction, disposal sites and staging activities; erosion and exposure associated with reservoir drawdown and enhanced river flows; and potential vandalism and theft to re-exposed sites. Cultural resources identification efforts for the Project, including pre-drawdown surveys for portions of the ADI not previously inventoried are underway. Planning efforts are also occurring for drawdown, dam removal, and post-drawdown events. These include developing field inventory and site monitoring procedures to ensure the consideration of effects on anticipated (based on the historic record) and unanticipated cultural and tribal resources.

Previous cultural resources surveys conducted by PacifiCorp in the early 2000s for the Klamath Hydroelectric Project (FERC License No. 2082) relicensing encompassed existing developments on the main stem Klamath River, including the four developments that will be removed by the Project. The PacifiCorp cultural resources study (PacifiCorp 2004) documented hundreds of cultural resources sites within a then-defined Field Inventory Corridor (FIC), although not all identified cultural resources have official NRHP eligibility determinations. The eligibility of many cultural resources within the ADI for the Project requires reevaluation because their eligibility under the Klamath Hydroelectric Project relicensing was never formalized through consultation with the California and Oregon State Historic Preservation Officers (SHPOs), or because other components of the sites were not considered in the original evaluations. New cultural and tribal resources sites identified through ongoing and future survey efforts will also require NRHP evaluation determinations, particularly for those resources within the ADI. Following evaluation and effects assessment, the Project anticipates developing mitigation measures for historic properties that will be adversely affected by the Project.

PacifiCorp completed a NRHP evaluation report of the Klamath Hydroelectric Project, comprised of seven generation facilities and their related resources located along the Klamath River and its tributaries in

Klamath County, Oregon, and Siskiyou County, California. That report included the four developments planned for removal (J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate) as part of the Project. The Fall Creek powerhouse, located on a tributary of the Klamath River, just north of Copco No. 2 was also evaluated at that time. A historic context statement (Kramer 2003a) and Determination of Eligibility Report (Kramer 2003b) were developed for the Klamath River Hydroelectric Project District (P-47-004015), noting its NRHP eligibility under Criterion A for its association with the industrial and economic development of southern Oregon and northern California (Kramer 2003b). The California and Oregon SHPOs have not concurred with this eligibility recommendation. Updating these recommended evaluations and achieving their formal eligibility determinations remains an important element to be completed as part of this Cultural Resource Plan.

As part of the 2004 relicensing effort, PacifiCorp sponsored tribal ethnographic studies, prepared by the Klamath, Shasta, Karuk, and Yurok Tribes, which combined ethnography with extensive oral interviews to identify traditional cultural properties/sensitive cultural resources (TCPs/SCRs). PacifiCorp also provided for an investigation of the feasibility of nominating Klamath River corridor as a traditional cultural riverscape/traditional cultural property (TCRe/TCP). The NRHP evaluation of the TCPs, SCRs, and the TCRe was not formalized through consultation with the California and Oregon SHPOs and the associated federal agencies and remains a task for implementation under the Project.

KRRC will prepare a draft Historic Properties Management Plan (HPMP) for the Project which will include management, treatment, protection, and mitigation measures for historic properties, as described in greater detail in Section 8 below and consistent with FERC's "Guidelines for the Development of Historic Properties Management Plans for FERC Hydroelectric Projects" (2002). The HPMP will include an Inadvertent Discovery Plan, which will outline protocols regarding unanticipated finds, as well as a Monitoring Plan to provide general protocols for monitoring historic properties and other select areas that will benefit from monitoring during and following dam removal. Measures to manage, treat, protect, and mitigate historic properties developed under the Section 106 consultation process will be coordinated with the applicable measures developed under the SWRCB's AB 52 consultations.

Finally, both Native American and European American human burial sites have been previously identified in the Project's limit of work. These include individual graves, burials in prehistoric village sites, and prehistoric and historic-period cemeteries along the Klamath River corridor. Adverse effects to human burial sites have been identified as a key concern of tribes, and possible downstream erosion and enhanced river flows may cause degradation of soil and exposure of human burials. Before dam removal occurs, a Plan of Action and protocols for treatment of human burials will be developed by KRRC.

Since the Project meets many of the requirements of 36 CFR § 800.14, a Programmatic Agreement (PA) will be completed during the Section 106 process. The PA will be developed in consultation with the Cultural Resources Working Group (CRWG) and FERC.

Chapter 3: Ongoing Consultations

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3. ONGOING CONSULTATIONS

3.1 Informal Consultation (NHPA)

FERC designated KRRC as its designated non-federal representative, pursuant to Section 106 of the NHPA (54 U.S.C § 300101 et seq.) and the ACHP's regulations at 36 C.F.R. § 800.2(c)(4). In January 2018, KRRC initiated informal consultation with affected tribes and other tribal organizations as FERC's designated non-federal representative, pursuant to Section 106 of the NHPA (54 U.S.C § 300101 et seq.) and the ACHP regulations at 36 C.F.R. § 800.2(c)(4). Twenty-five federally and non-federally recognized Tribes located in northern California and southern Oregon received invitation letters to participate in the informal consultation process and included tribes previously identified by FERC during its tribal consultation efforts as well as by the California Native American Heritage Commission (NAHC) List and Oregon Commission on Indian Services. The invitation was extended to federally recognized tribes consistent with 36 CFR 800.2(c)(2) and non-federally recognized tribes pursuant to 36 CFR 800.2(c)(5). Currently eight tribes have accepted participation in the ongoing informal consultation with KRRC: Karuk Tribe, Klamath Tribes, Modoc Tribe of Oklahoma, Quartz Valley Indian Reservation, Shasta Indian Nation, Shasta Nation, Cher'Ae Heights of the Trinidad Rancheria, and the Yurok Tribe. KRRC held a project introduction meeting with the participant Tribes on April 6, 2018 in Yreka, California. This meeting provided a project overview, reviewed the previous cultural resource studies, discussed the informal consultation process, and provided an overview and invitation to the tribes to participate in the CRWG (see below). Additional meetings and consultation efforts pursuant to Section 106 with tribes and other interested parties will continue.

Among the topics requiring tribal consultation are the delineation of the APE, the identification and evaluation of TCPs, the proposed Klamath Cultural Riverscape, and the management and disposition of cultural and human remains. KRRC is preparing a cultural resources work plan to guide the Section 106 process through the course of the Project. This work plan includes the written definition of a preliminary APE; a discussion of the integration of the proposed Klamath Cultural Riverscape into the APE; draft protocols for inadvertent discoveries; and an outline for a Plan of Action and appropriate treatment of human remains, funerary objects, sacred objects, and objects of cultural patrimony.

3.2 California Consultations

KRRC is participating in related tribal cultural resources consultation efforts being conducted by the SWRCB for the Project. SWRCB is conducting their consultation as part of CEQA review for KRRC's application for a Water Quality Certification for the Project pursuant to Assembly Bill 52 (AB 52). AB 52 requires California state and local agencies to consider a proposed action's impacts to Tribal Cultural Resources (TCRs) as part of the agency's review of the proposed action under the CEQA. A TCR is defined as a site, feature, place, cultural landscape, sacred place, or object with cultural value to a California Native American tribe. California Native American tribes are those tribes registered with the California NAHC, regardless of whether the tribes are federally-recognized. KRRC's tribal resources lead has participated in meetings and

teleconferences held between the SWRCB and the tribes engaged in the AB 52 consultation. As this California AB 52 tribal consultation process will overlap in part with the Section 106 consultation, KRRC will make efforts to coordinate and integrate the two processes to the extent feasible and as appropriate.

Chapter 4: Cultural Resources Working Group

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4. CULTURAL RESOURCES WORKING GROUP

KRRC has established a CRWG to provide a collaborative and interactive process for data sharing, participation, and discussion among the applicants, tribes, and resource agencies during the Section 106 consultation process. The CRWG is comprised of representatives from federal agencies with administered lands in the project APE (U.S. Forest Service and Bureau of Land Management; Figure 4-1), as well as California and Oregon SHPOs and tribes (Table 4-1). Other invited parties include the Bureau of Reclamation and United States Army Corps of Engineers (USACE) who have currently elected not to participate. KRRC expects membership of the CRWG to expand as consultation proceeds.

The goals of the CRWG include: (1) definition of the project APE; (2) preparation of a Programmatic Agreement and other guidance documents; (3) overall guidance on the scope and level of effort required for inventory and evaluation of historic, archaeological, and tribal resources; (4) assessment of effects to Historic Properties; (5) identification and implementation of mitigation measures. In addition, KRRC will consult with the CRWG in the development of a HPMP.

The CRWG held an initial meeting on September 5, 2017, the purpose of which was to provide working group members with background information on the Project, status of cultural resources inventory and evaluation efforts, and allow for the identification and discussion of the CRWG's goals and objectives. Subsequent to that meeting, KRRC developed a preliminary APE for the Project.

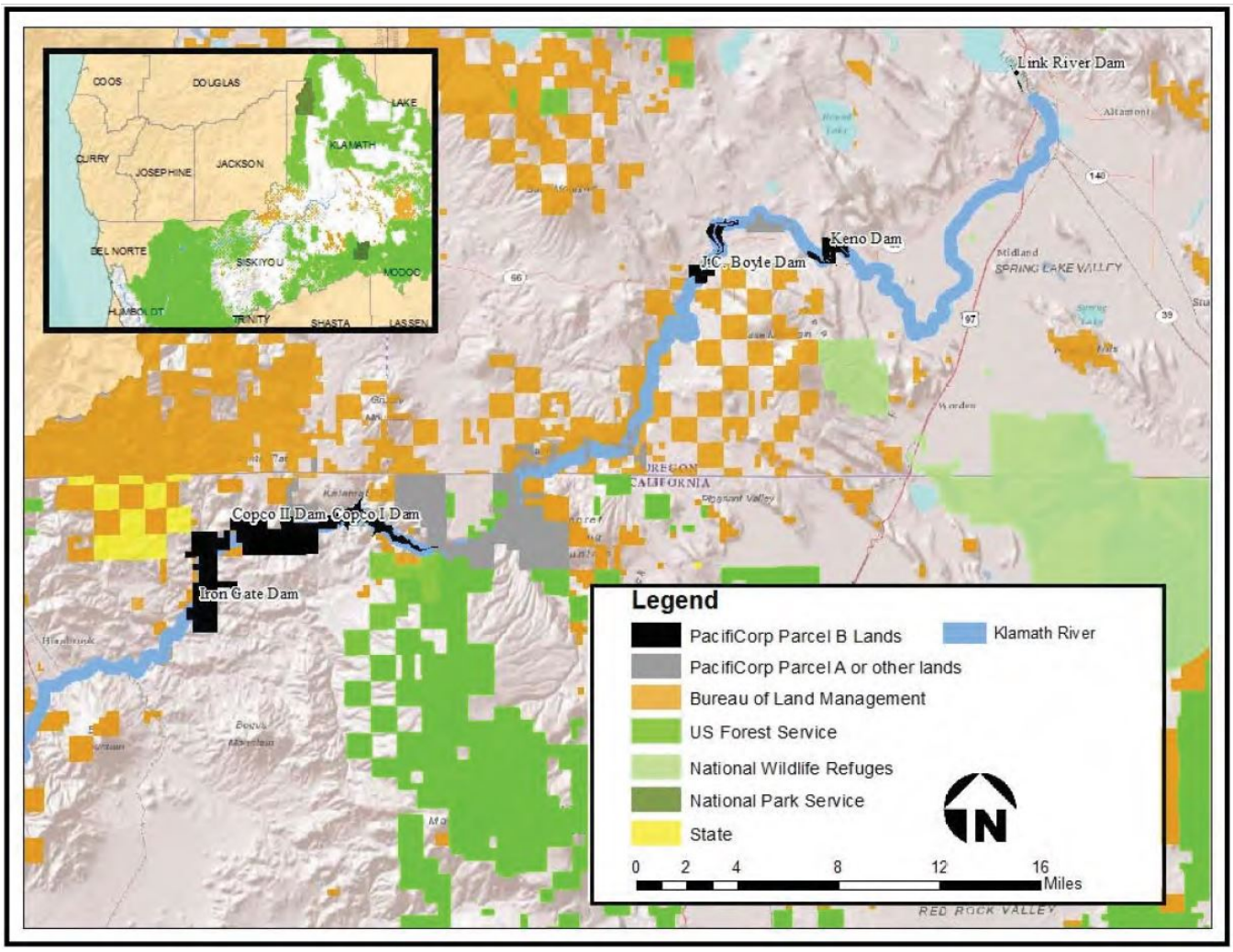
KRRC hosted a second meeting on December 14, 2017 to review the KRRC's draft APE. A third CRWG meeting occurred on March 15, 2018 to provide an update on Section 106 consultation, the project schedule, anticipated field work dates, next steps in SHPO consultation, and outlining the process for developing the Section 106 agreement document. KRRC plans to hold the next CRWG meeting in August 2018.

Table 4-1 Current Participants - Cultural Resources Working Group

Agency/Entity	Status
KRRC	Applicant
PacifiCorp	Applicant
AECOM	Technical Representative
CDM Smith	Technical Representative
USDA Forest Service, Klamath National Forest	Federal
Bureau of Land Management, Klamath Falls, Oregon and Redding, California Field Offices	Federal
California Office of Historic Preservation	State of California

Agency/Entity	Status
Oregon State Historic Preservation Office	State of Oregon
Cher'Ae Heights of Trinidad Rancheria	Tribe
Karuk Tribe	Tribe
Klamath Tribes	Tribe
Modoc Tribe of Oklahoma	Tribe
Quartz Valley Indian Reservation	Tribe
Shasta Indian Nation	Tribe
Shasta Nation	Tribe
Yurok Tribe	Tribe

KRRC also anticipates outreach to local municipalities, museums and historical societies, and other entities that may have an interest in the consideration and treatment of historic properties. KRRC will send letters to these parties to seek and consider their views concerning the identification, evaluation, and treatment of historic properties.



Source: 2012 EIS/R (USBR and CDFW 2012)

Figure 4-1 Land ownership in the project vicinity

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Chapter 5: Definition of the Area of Potential Effects

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5. DEFINITION OF THE AREA OF POTENTIAL EFFECTS

Implementing regulations of the NHPA require federal undertakings to determine the scope of identification efforts (36 CFR § 800.4(a)). This is accomplished in part by determining and documenting the APE (36 CFR § 800.4(a)(1)). The APE means the "geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist." Furthermore, the APE "is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking" (36 CFR § 800.16(d)). Inclusion of land within an APE does not mean that an undertaking would affect any or all cultural resources in that area. Defining an APE provides both the lead federal agency and consulting parties with a basis for understanding the geographic extent of anticipated impacts of a proposed project, which is necessary to determine whether the project may adversely affect historic properties.

As the lead federal agency for the Project, FERC defines the APE, in consultation with other federal agencies, tribes, SHPOs, THPOs, KRRC, PacifiCorp, and other consulting parties. KRRC and PacifiCorp, in collaboration with the CRWG members and tribes are in the process of developing a preliminary APE and will continue to refine the APE as a part of the Section 106 process. The KRRC is currently receiving comments from the participants in the Section 106 process and will engage in additional consultation to address agency/entity concerns.

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Chapter 6: Resource Identification

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6. RESOURCE IDENTIFICATION

6.1 Records Search Update

As part of the Klamath Hydroelectric Relicensing (FERC 2007) and Klamath River Dam Removal (USBR 2012) studies, PacifiCorp (2004) and Cardno ENTRIX (2012) completed cultural resources records searches to collect information of previous archaeological research and historical information. These earlier record searches provided baseline resource data for the respective project areas through 2012. In 2017, KRRC completed an updated records search and literature review for the Project to add information for the intervening 5-year period, or through 2017. The cumulative results of the 2017 KRRC records searches are summarized first, followed by State-specific summaries.

The 2017 KRRC records search area extended from the outlet of the Klamath River at the southern end of Upper Klamath Lake in Klamath County, Oregon (RM 255) downstream to the confluence of Klamath River and Humbug Creek in Siskiyou County (RM 174), for a total of 81 river miles. The section of river below Iron Gate Dam (the downstream-most Project development) was included in the initial records search since this area lies within the altered 100-year floodplain following dam removal, where cultural resources have the potential to be affected. The records search area encompassed a 0.5-mile wide zone, extending on either side of the shorelines of Lake Ewauna, Link River, J.C. Boyle Reservoir, Copco Lake, and Iron Gate Reservoir, or from the center point of the Klamath River in areas where a flowing river exists. The records search identified 502 previously recorded cultural resources, comprised of a broad range of archaeological sites, built environment resources, isolated finds, and a few locations of an undetermined resource type (Table 6-1).

In response to the delineation of a preliminary APE, KRRC initiated an expanded records search in 2018 for an area encompassing a 0.5-mile wide zone on either side of the Klamath River from below Humbug Creek to the mouth of the river at the Pacific Ocean, in California. KRRC will incorporate results of the 2018 expanded records search for California into future reports and are not reflected in the discussion and tables provided below.

The 2017 records search identified 290 previously recorded archaeological sites, including 170 sites in Oregon and 120 sites in California. Collectively, these sites consist of 162 prehistoric resources, 19 of which have documented ethnographic associations or uses. Also recorded are 83 historic-period archaeological sites and 44 sites with both prehistoric and historic-period components. These latter sites, termed multiple component sites, include at least eight locations that have documented ethnographic use. The final archaeological site consists of a resource of unknown temporal association.

Table 6-1 Summary of Previously Recorded Cultural Resources for Oregon and California (2017 Records Search).

Resource Type	Component Type					
	Prehistoric	Historic	Multiple	Ethnographic Only	Unknown	Total
Archaeological Site	162	83	44	–	1	290
Ethnographic	–	–	–	1	–	1
Built Environment	–	24	3	–	–	27
Isolated Find	158	17	–	–	1	176
Undetermined	–	–	–	–	8	8
Total	320	124	47	1	10	502

One resource has been recorded as an ethnographic location that figures prominently in an important legend in Shasta Indian oral history.

A group of 27 built environment resources, comprised of manufactured structures, features, and facilities, have been previously recorded, including 15 in Oregon and 12 in California. The built environment resources include intact structures, such as log cabins and sheds; power facilities, including powerhouses; bridges; boardwalks; cemeteries; a lumberyard; a commercial sawmill; and other constructed features.

Eight resources of undetermined resource type or age have been reported in California. While the physical location for these sites has been recorded, other information such as the types of artifacts and/or features present is unavailable.

The final resource type consists of a group of 176 isolated finds, which typically represent locations with five or fewer artifacts or single features. These finds include 108 isolates in Oregon and 68 isolates in California. The isolated finds encompass 158 prehistoric resources, 17 historic-period isolates, and 1 feature of unknown age.

6.1.1 Oregon Records Search

Within the State of Oregon, the 2017 records search area included the length of the Klamath River from its outlet at Upper Klamath Lake at Link River Nature Trailhead (RM 255) south to the Oregon/California Stateline (RM 214), for a total length of roughly 41 river miles. This river stretch also included the Link River and Lake Ewauna. The records search area encompassed a 0.5-mile wide zone, extending on either side of the shorelines of Lake Ewauna, Link River, and J.C. Boyle Reservoir, or from the center point of the Klamath River in areas where the river remains free flowing.

In April 2017, KRRC reviewed records on file at the Oregon SHPO to determine the extent of previously recorded cultural resources and past investigations within Oregon records search area. This records search was conducted using the Oregon Archaeological Records Remote Access (OARRA) GIS database maintained by the Oregon SHPO. This database contains all cultural resources reports and resource forms approved by SHPO and provides information on the location of previously recorded archaeological sites, cultural resource surveys, National Register properties, and cemeteries. In addition, KRRC also reviewed the separate Oregon SHPO online Oregon Historic Sites Database to collect information regarding built environment resources located within the records search area.

In July 2017, KRRC conducted a records search at the BLM Klamath Falls Resource Area office in Klamath Falls, Oregon. KRRC examined cultural resources files for government lands in Klamath County, Oregon, for recent project reports and copies were made of relevant reports and resource records. In October 2017, KRRC visited the Southern Oregon Historical Society (SOHS) Library in Medford, Oregon to examine the John C. Boyle papers, maps, and photograph collection pertaining to the Klamath River area.

In addition to these office visits, KRRC researched online newspaper archives, including the National Digital Newspaper Program archives provided by the Library of Congress and National Endowment for the Humanities (chroniclingamerica.loc.gov); GeneaologyBank newspaper archives provided by NewsBank, Inc. (geneaologybank.com); the California Digital Newspaper Collection repository provided by University of California, Riverside (cdnc.ucr.edu); and newspaper archives provided by Ancestry.com. KRRC also reviewed copies of the Klamath County Historical Society Klamath Echoes for relevant site and historic context information.

In May 2017, KRRC requested and received cultural sources data from PacifiCorp, including GIS shapefiles with previous survey and resource locations, as well as a copy of the final cultural resources technical report for Klamath Hydroelectric Relicensing Project (PacifiCorp 2004).

Previous Cultural Resources Studies

The 2017 Oregon records search and literature review identified 119 previous cultural resources investigations as having been conducted within the records search area, with five of these studies (Kramer 2003a, 2003b; Cardno ENTRIX 2012; PacifiCorp 2004; Daniels 2006) completed specifically for the Project. Collectively, these reports provide a broad range of reference materials derived from pedestrian surveys, archaeological testing and evaluation, prehistoric and historic-period context documents, and professional studies. Most reports (n=79) detail the results of cultural resources surveys or survey/excavation work conducted across the records search area. Twenty-three reports consist of archaeological, ethnographic, or historical overviews that include the Klamath River area. An additional 10 reports describe archaeological excavations and one report focuses on an archaeological survey and provides a cultural overview. Also included are two archaeological research designs, one scope of work, one Ph.D. dissertation, and two professional papers.

Previously Recorded Cultural Resources

The 2017 Oregon records search identified 296 previously recorded cultural resources, consisting of 170 archaeological sites, 18 built environment resources, and 108 isolated finds (Tables 6-2). By component type, these resources include 206 prehistoric, 65 historic-period, 24 multiple (prehistoric and historic-period), and 1 resource of unknown temporal association.

Table 6-2 Oregon - Previously Recorded Resources by Resource Type and Component

Resource Type	Component Type				
	Prehistoric	Historic	Multiple	Unknown	Total
Archaeological Site	113	35	21	1	170
Built Environment	–	15	3	–	18
Isolated Find	93	15	–	–	108
Total	206	65	24	1	296

Archaeological Sites

Archaeological sites represent roughly 57 percent of the previously recorded resources in Oregon. The sites consist of 113 prehistoric, 35 historic-period, 21 multiple components, and 1 unknown component property. The prehistoric component sites include housepit villages; lithic scatters; bedrock milling features (BRMs); lithic scatters with associated cultural features; one toolstone quarry; peeled trees; village sites and lithic scatters with human burials; a rockshelter with human burials; a cremation site; and rock art sites.

The historic-period archaeological sites include late-nineteenth or early-twentieth century properties associated with the development of agriculture including abandoned ditches or other features such as homesteads; logging; public works (hydroelectric); transportation (railroad berms); and recreation. Agricultural-related sites include settlements (homesteads) with or without features, irrigation ditches, rock walls, cairns, and artifact scatters. Logging-related sites include a portable sawmill location and artifact scatters. Homesteads include the remains of Hoover's 41 Ranch and artifact scatters. The former locations of a dam and powerhouse near Keno represent public works sites. Transportation-related sites consist of an abandoned segment of the Weyerhaeuser Railroad grade and other railroad berms. Also related to transportation is Robber's Rock, a large boulder, historically used as a hiding spot for stagecoach thieves.

The multiple component sites comprise both prehistoric and historic-period archaeological components. Prehistoric components associated with these sites include housepit villages, a housepit village with a documented historic-period boat landing, lithic scatters, and a rock art panels with both prehistoric and historic elements. Historic-period components comprise historic homesteads or ranches and artifact scatters, and water conveyance ditches.

One peeled tree represents an unknown component of either prehistoric or historic-period use.

Information regarding the NRHP eligibility of the archaeological sites is based on recommendations provided by Cardno ENTRIX (2012), or by eligibility information noted on site records that were updated since preparation of the Cardno ENTRIX study. Overall, 38 archaeological sites are considered NRHP-eligible, 53 sites are potentially eligible for listing, 8 sites are not eligible, and 71 sites are either unevaluated or have undetermined NRHP eligibility status.

Built Environment Resources

The Oregon records search identified 18 properties with built environment resources, including 15 historic-period and 3 multiple component locations. Collectively, the built environment resources are associated with the historic themes of commerce, settlement, transportation, public works, and recreation or tourism.

The commerce-themed resources include the Weyerhaeuser Company Mill Complex, a water tower, and a lumberyard. Settlement-related sites include a log cabin, a shed, a split rail fence, the Frain Ditch, the Way Ranch Complex, the Topsy/Frain School, Way Cemetery, Spencer Cemetery, and grave and structural remains at Hoover's 41 Ranch. Transportation-related resources include a bridge and an associated boat dock. Public works resources include two hydroelectric powerhouses, comprised of the westside and eastside plants at Klamath Falls. Recreation or tourism is represented by a group of boardwalks for wildlife viewing. The final built environment resource consists of a New Age rock medicine wheel.

NRHP eligibility information for these resources indicates that eight are NRHP-eligible properties, including the Way Station/Ranch Complex, Topsy/Frain School, Frain Ranch, the westside and eastside powerhouses, a lumberyard with nine features near Lake Ewauna, Hoover's 41 Ranch, and the Weyerhaeuser Company Mill Site. Three built environment resources have been assessed as not eligible, including a bridge and dock, a water tower, and boardwalks associated with wildlife viewing. Four built environment resources are unevaluated and three other resources are classified as undetermined concerning NRHP eligibility.

Isolated Finds

The Oregon records search identified 108 isolated finds, consisting of 93 prehistoric and 15 historic-period resources. Prehistoric isolates include 5 ground stone tools, 1 ground stone tool with debitage, 1 exposure of multiple ground stone tools, 27 single flakes, 36 locations with multiple flakes, 18 flaked stone tools, 4 flaked stone tools with debitage, and 1 flaked stone tool with a battered stone tool. The ground stone tools include pestles, a mano, a metate fragment, bowl mortar fragments, and unspecified objects. The flaked stone tools include chert cores, flake tool, and scrVCrs; obsidian projectile points and fragments, bifaces and fragments, and a flake tool; and one uniface of unspecified material. Debitage comprises obsidian, chert, and basalt flakes.

The historic-period isolates consist of one metal watering can, two bottle glass fragments, one automobile body, one blazed tree, one dump of oyster shell, seven debris scatters or dumps, and two areas containing multiple dumps possibly associated with logging.

6.1.2 California Records Search Results

Within the State of California, the 2017 KRRC records search area included the length of the Klamath River from the Oregon/California Stateline (RM 214), downstream to Humbug Creek (RM 174), for a total length of roughly 40 river miles. The section of river below Iron Gate Dam (the downstream-most project development) was included in the records search since this 18-mile-long area lies within the altered 100-year floodplain following dam removal, where the Project has the potential to affect cultural resources. The records search area included a 0.5-mile wide zone, extending on either side of the shorelines of Copco Lake and Iron Gate Reservoir, or from the center point of the Klamath River in areas where the river remains free flowing.

In 2017, KRRC completed two records searches for the Project in California. In April 2017, KRRC conducted a review of the records housed at the Northeast Information Center at California State University, Chico. Research included gathering archaeological site forms, survey and excavation reports, maps, and other records. Survey and site locations were hand-plotted onto United States Geologic Survey (USGS) topographic maps at the Northeast Information Center. Archival research of historic registers included the California Historic Landmarks, NRHP, California Register of Historical Resources (CRHR), and California Points of Historical Interest, California Inventory of Historic Resources, and the California State Historic Resources Inventory. Also in April 2017, KRRC visited the Klamath National Forest office and the Siskiyou County Museum, both in Yreka, California. Klamath National Forest Heritage Program Manager Jeanne Goetz conducted a search of records for Forest Service lands within or near the records search area and provided appropriate archaeological site record forms.

In addition to these office visits, KRRC searched online newspaper archives, including the National Digital Newspaper Program archives provided by the Library of Congress and National Endowment for the Humanities (chroniclingamerica.loc.gov); GeneaologyBank newspaper archives provided by NewsBank, Inc. (geneaologybank.com); the California Digital Newspaper Collection repository provided by University of California, Riverside (cdnc.ucr.edu); and newspaper archives provided by Ancestry.com.

KRRC contacted the NAHC in June 2017, to secure a review of the Sacred Lands file for a 0.5-mile wide area on either side of the Klamath River corridor, extending from the California-Oregon state line downstream to the Pacific Ocean. In a June 14, 2017 letter, the NAHC stated that there was a positive result, with the recommendation to contact the Karuk Tribe, the Yurok Tribe, and Shasta Nation. The NAHC also provided a consultation list of tribes with traditional lands or cultural places located within the boundaries of Del Norte, Humboldt, and Siskiyou counties.

Previous Cultural Resources Studies

The 2017 California records search and literature review identified that 58 previous cultural resources investigations have been conducted within the records search area, with 5 of these studies (Kramer 2003a, 2003b; Cardno ENTRIX 2012; Durio 2003; PacifiCorp 2004) completed specifically for the Project. Fourteen of these studies are archaeological, ethnographic, or historical overviews, while eight reports describe archaeological excavations. Two studies involved cultural resources monitoring, while the remaining 34 projects involved archaeological survey or inventory. Overall, an estimated 8,189 acres of federal, state,

and/or private land have been surveyed within the records search area, although survey acreage information was not available for all projects covered in the reports.

Previously Recorded Cultural Resources

The 2017 California record searches identified 206 previously recorded cultural resources, consisting of 120 archaeological sites, 1 ethnographic property, 9 built environment resources, 68 isolated finds, and 8 resources of an undetermined resource type (Tables 6-3). By component type, these resources include 114 prehistoric, 59 historic-period, 23 multiple (prehistoric and historic-period), 1 ethnographic property, and 9 resources whose temporal association is unknown.

Table 6-3 California - Previously Recorded Resources by Resource Type and Component

Resource Type	Component Type					
	Prehistoric	Historic	Multiple	Ethnographic	Unknown	Total
Archaeological Site	49	48	23	0	–	120
Ethnographic	–	–	–	1	–	1
Built Environment	–	9	–	–	–	9
Isolate	65	2	–	–	1	68
Undetermined	–	–	–	–	8	8
Total	114	59	23	1	9	206

Archaeological Sites

Archaeological sites represent roughly 60 percent of the previously recorded resources. The sites consist of 49 prehistoric, 48 historic-period, and 23 multiple components. Identified prehistoric period sites include housepit villages; campsites; lithic scatters; lithic scatters with associated cultural features; toolstone quarries; a possible vision quest site with multiple features; and a human burial site.

The historic-period archaeological sites consist of late-nineteenth or early-twentieth century properties associated with the development of agriculture, including settlements or features such as homesteads; logging; mining; commercial; public works (hydroelectric); and transportation. Agricultural-related sites include settlements (homesteads) with or without features, irrigation ditches, rock walls, piled rock in agricultural fields, and artifact scatters.

Logging-related sites focus on elements of the former Klamathon townsite, including the town and lumber mill and the associated Pokegama log chute and ditch flume. Mining related sites, located in the Klamath River area below Hornbrook, include two quartz mines and four placer mines with ditches and/or tailings. The collective Beswick Hotel, ranch, and Klamath Hot Springs area represent the single commercial property. An extensive refuse scatter associated with the Copco No. 1 Village is the sole public works site. Finally, transportation-related sites consist of an abandoned segment of the Klamath Lake Railroad, a

collapsed trestle and segment of railroad grade, a segment of Topsy Road, a road leading to Horseshoe Ranch, and a segment of the California-Oregon Stage Road.

The multiple component sites include both prehistoric and historic-period components. Prehistoric components associated with these sites include housepit villages, a housepit village with a documented historic-period cemetery, lithic scatters, a toolstone quarry, and a rockshelter. Historic-period components comprise mining camps and/or tailing, agricultural-related resources such as historic ranches and artifact scatters, and a possible commercial property associated with a former saloon.

A group of eight sites, termed the Pollock Sites, represent unknown site components. Currently, the only information available for these sites relates to their location, which is noted along the Klamath River between Klamathon and Humbug Creek.

Information regarding the National Register eligibility of the archaeological sites is based on recommendations provided by Cardno ENTRIX (2012), or by eligibility information noted on new or updated site records that were not part of the Cardno ENTRIX study. Of the 120 archaeological sites, one property is listed in the National Register as a contributor to a district, one site is determined individually eligible, three sites are contributors to a district determined eligible, 29 sites appear eligible for listing, two sites might become eligible for listing when more historical research is performed; four sites have been found ineligible; and the remaining 80 sites have not been evaluated for NRHP eligibility.

Ethnographic Resource

The records search identified one resource that figures prominently in an important legend in Shasta Indian oral history. This resource appears eligible for listing in the National Register.

Built Environment Resources

The 2017 California records search identified nine historic-period built environment resources associated with the historic themes of commerce, settlement, transportation, and public works. The single commerce-themed resource includes a former service station converted to residence (Klamath Kamp). Two settlement-related sites have been recorded, consisting of a post-1930s duplex residence with associated structures and the Frank Wood cabin, a late 1890s to 1950s era homesite. Transportation-related sites consist of a one-lane, wooden and steel beam truss bridge over the Klamath River (Ash Creek Bridge), and a two-lane, concrete, T-beam Bridge over the Klamath River (Bridge 02-0015). Public works sites include four recorded elements of the Klamath Hydroelectric Project, including Copco No. 1 hydroelectric powerhouse and dam; Copco No. 2 hydroelectric powerhouse; Fall Creek hydroelectric powerhouse; and the Copco No. 2 wooden stave penstock. The Fall Creek Powerhouse coincides with the reported location of an ethnographic Shasta Indian village; however, this component of the site has not been archaeologically recorded.

Besides these nine built environment resources, standing historic-period structures have been identified at several archaeological sites, including a ranch house and bunkhouse at the Beswick Hotel site (CA-SIS-513-H) and a shed at Copco II Ranch (CA-SIS-2239-H). The historic Spannaus Barn was noted at prehistoric/ethnographic site CA-SIS-2574, but was not recorded as an element of the site.

NHRP eligibility information for these nine sites indicates that the two Klamath River bridges have been determined eligible for listing. The four hydroelectric-related sites were noted by Cardno ENTRIX (2012) as appearing eligible for separate listing, but these sites have also been documented as contributing elements to the Klamath Hydroelectric Historic District (Kramer 2003b), which has yet to be concurred upon by the California and Oregon SHPOs. Also recommended as NRHP-eligible is the Frank Wood cabin. The final two resources, composed of a residence and a former service station, have been noted as not eligible for the NRHP.

Isolated Finds

The 2017 California records search identified 68 isolated finds, including 65 prehistoric resources, 2 historic-period isolates, and 1 isolated feature of unknown age. Prehistoric isolates include one small rock cairn, one bedrock milling feature, one location with two possible cupule boulders, one incised cobble, one piece of possible ground stone, one unifacial mano, one cobble mortar, one basalt maul, three obsidian biface fragments, one chert biface fragment, one basalt core, nine chert cores, one jasper core, two chert flake tools, one chert barbed projectile point, one chert projectile point midsection, one chert scraper, and four obsidian unifaces. Forty-one isolate locations were found to contain debitage, ranging from 1 flake to as many as 13 flakes in a single location. Debitage includes obsidian, chert, and basalt. Eleven isolates contain both tools and debitage.

The historic-period isolates consist of one rusted horseshoe and the remains of a wagon. The isolate of unknown age is described as a rocky depression.

6.1.3 Archaeological Districts

FERC Relicensing Study Proposed Archaeological Districts, California and Oregon

As part of the Klamath Hydroelectric Project relicensing study (FERC 2007), five areas of multiple prehistoric sites were identified along the same section of the Klamath River that was considered as a potential National Register District (PacifiCorp 2004:3-198-199; FERC 2007:3-544). This district included four groups of multiple sites in Oregon located at the head of Link River and the mouth of Upper Klamath Lake, Teeter's Landing, Spencer Creek/mouth of upper Klamath River Canyon, and near Frain Ranch. In California, a cluster of three villages near Fall Creek, in the Copco Lake area, comprised the fifth potential district group (Table 6-4). The National Register eligibility of these districts has not been finalized.

A historic-period archaeological district was also considered for the Frain Ranch, in Oregon (PacifiCorp 2004:3-200). Due to their association with early homesteading and the beginning of ranching and agriculture within the upper Klamath River, four Frain ranch area sites were envisioned for this district. The National Register eligibility of this district has not been finalized.

Table 6-4 FERC Relicensing Study Proposed Archaeological Districts

District Type	Area
Prehistoric	Link River area and mouth of Upper Klamath Lake, OR
	Teeter's Landing, OR
	Spencer Creek/mouth of upper Klamath River Canyon, OR
	Near Frain Ranch, OR
	Fall Creek Villages, near Copco Lake, CA
Historic	Frain Ranch, OR

Upper Klamath River Stateline Archaeological District, California

The newly designated Upper Klamath River Stateline Archaeological District (Bureau of Land Management 2016) is located along the upper Klamath River, in California. The district encompasses three pre-contact village sites (contributing) and one lithic scatter (non-contributing). Archaeological research indicates site use in the district extended from circa 1,000 years Before the Common Era (BCE) or earlier to possibly as late as 1840 BCE (BLM 2016). The district was determined eligible for the National Register at the local level of significance under Criterion D in the areas of Prehistoric Archaeology, Native American Ethnic Heritage, Commerce, Economics, Religion, and Politics/Government. The California SHPO and the Keeper of the National Register have concurred with the district's eligibility.

Klamath River Canyon Archaeological District, Oregon

An archaeological study conducted in the upper reaches of the Klamath River Canyon in 2008 by Central Washington University (McCutcheon and Dabling 2008) examined the NRHP eligibility of 19 prehistoric and historic-period sites located along the river corridor between the California/Oregon Stateline and J.C. Boyle Dam. NRHP eligibility recommendations were provided using information gathered during field visits, preparation of updated site records, and the assessment of a site's research potential and integrity; no new subsurface testing was conducted, although previous excavations had been conducted at some of the sites. Thirteen of the 19 sites were recommended NRHP eligible under Criterion D, while the remaining six sites were assessed as unevaluated resources, requiring additional data to make a determination. Recommendations included consideration of an Archaeological District nomination for the NRHP-eligible resources as a way to provide a broader context to evaluate the archaeological record of the Klamath River Canyon (McCutcheon and Dabling 2008). Documentation and nomination of such a district has not been completed.

Klamath River Hydroelectric Project District

The Klamath Hydroelectric Project comprises seven hydroelectric generation facilities and their related resources located along the Klamath River and its tributaries in Klamath County, Oregon and Siskiyou County, California. Beginning at the Link River Dam, in Klamath Falls, Oregon, the project boundary

continues southwest along the Klamath River to include the Keno Dam Complex and the J.C. Boyle Complex in Oregon. Within California, the Klamath Hydroelectric Project boundary includes the Fall Creek, Copco No. 1 and Copco No. 2 complexes, and terminating at Iron Gate Dam. The Klamath Hydroelectric Project facilities were constructed between 1903 and 1958 by the California Oregon Power Company (COPCO) and its predecessors and are now owned and operated by PacifiCorp under FERC License Nos. 2082 (Kramer 2003a, b) and 14803.

The proposed Klamath River Hydroelectric Project District (P-47-004015) includes the hydroelectric facilities and various diversion dams; support structures; linear elements such as flumes, canals, and tunnels; and other related buildings and structures. A historic context statement (Kramer 2003a) and Determination of Eligibility (Kramer 2003b) developed for the Klamath Hydroelectric Project notes its eligibility to the National Register as a District under Criterion A for its association with the industrial and economic development of southern Oregon and northern California (Kramer 2003b). The California and Oregon SHPOs have not concurred with this eligibility recommendation. Table 6-5 identifies key features of the hydroelectric complexes located in Oregon and California that are part of the Klamath River Renewal Project and their National Register eligibility recommendation.

Table 6-5 Summary of National Register Eligibility Recommendations for the Klamath Hydroelectric District Facilities/Components

Facility/Description	Date	National Register Eligibility Recommendation and Reference	
		Kramer 2003b	EIS/R 2012
J.C. Boyle Complex			
Dam	1956-1958	Historic Contributing	Historic Contributing
Communications Building	Ca. 1995	Non-Contributing	Non-Contributing
Fire Protection Building	Ca. 1995	Non-Contributing	Non-Contributing
Red Barn	Ca. 1958, altered 1978	Non-Contributing	Non-Contributing
Maintenance Shop	1991	Non-Contributing	Non-Contributing
Residence 1	Ca. 1985	Non-Contributing	-
Residence 2	Ca. 1985	Non-Contributing	-
Water Conveyance Features	1958		Potentially Contributing
Steel Pipe	1958	Historic Contributing	Historic Contributing
Flume Headgate	2002	Non-Contributing	Non-Contributing
Open flume/Concrete	1958	Historic Contributing	Historic Contributing
Headgate Structure	1958	Historic Contributing	Historic Contributing
Forebay/spillgates	1958	Historic Contributing	Historic Contributing
Spillway House	Ca. 1958	Historic Contributing	Historic Contributing
Tunnel	1958	Historic Contributing	Historic Contributing
Surge Tank	1958	Historic Contributing	-

Facility/Description	Date	National Register Eligibility Recommendation and Reference	
		Kramer 2003b	EIS/R 2012
Penstocks	1958	Historic Contributing	Historic Contributing
Powerhouse	1958	Historic Contributing	Historic Contributing
Substation	1958	Historic Contributing	Historic Contributing
Residential Site	Ca. 1950/1995	Non-Contributing	-
Armco Warehouse	1957	Historic Contributing	Historic Contributing
Copco No. 1 Complex			
Dam	1912-1918, 1921-1922	Historic Contributing	Historic Contributing
Gatehouse 1	1918	Historic Contributing	Historic Contributing
Gatehouse 2	1922	Historic Contributing	Historic Contributing
Gate Hoist System/Rails	1918	Historic Contributing	Historic Contributing
Single and Double Penstocks	1912-1918	Historic Contributing	Historic Contributing
Powerhouse	1918	Historic Contributing	Historic Contributing
Copco Guesthouse (remains)	1917, 1980s	Historic Contributing	-
House/Garage 1	ca.1922	Historic Contributing	-
House/Garage 2 (21600 Copco Rd)	ca.1922	Historic Contributing	-
Garage/Warehouse	ca.1922	Historic Contributing	-
Copco No. 2 Complex			
Dam	1925	Historic Contributing	Historic Contributing
Water Conveyance Features	1925	Historic Contributing	Historic Contributing
Headgate	1925 (rebuilt)	Historic Contributing–	Historic Contributing
Tunnel Intake	1925	Historic Contributing	Historic Contributing
Concrete-lined Tunnel	1925	Historic Contributing	Historic Contributing
Wood Stave Pipeline	1925	Historic Contributing	Historic Contributing
Concrete Tunnel	1925	Historic Contributing	Historic Contributing
Steel Penstocks	1925	Historic Contributing	Historic Contributing
Timber Cribbing	1925	Historic Contributing	Historic Contributing
Coffer Dam	1925	Historic Contributing	Historic Contributing
Powerhouse	1925, 1996	Historic Contributing	Historic Contributing
Control Center/Office	ca. 1980	Non-Contributing	-
Maintenance Building	1991	Non-Contributing	-
Oil and Gas Shed		Historic Contributing	-

Facility/Description	Date	National Register Eligibility Recommendation and Reference	
		Kramer 2003b	EIS/R 2012
Cookhouse/Bunkhouse	ca. 1925	Historic Contributing	-
Modern Bunkhouse	ca. 1960	Non-Contributing	-
Garage/Accessory Building	ca. 1960	Non-Contributing	-
Ranch Housing	ca. 1965		
Ranch House 1	ca. 1965	Non-Contributing	-
Ranch House 2	ca. 1965	Non-Contributing	-
Ranch House 3	ca. 1965	Non-Contributing	-
Bungalow Housing	ca. 1925		
Bungalow/Garage 1	ca. 1925	Historic Contributing	-
Bungalow/Garage 2	ca. 1925	Historic Contributing	-
Bungalow/Garage 3	ca. 1925	Historic Contributing	-
Modular Residences	1985		
Modular 1	1985	Non-Contributing	-
Modular 2	1985	Non-Contributing	-
Modular 3	1985	Non-Contributing	-
School House/Comm.Center	1965	Non-Contributing	-
Iron Gate Dam Complex			
Dam	1960-1962	Non-Contributing	Historic Contributing
Spillway	ca. 1980	Non-Contributing	Historic Contributing
Diversion Tunnel	1960-1962	Non-Contributing	Historic Contributing
Water Conveyance System	1960-1962		Historic Contributing
Water Way/Trash Racks	1960-1962	Non-Contributing	Historic Contributing
Pipeline	1960-1962	Non-Contributing	Historic Contributing
Penstock	1960-1962	Non-Contributing	Historic Contributing
Powerhouse	1960-1962	Non-Contributing	Historic Contributing
Communication Building	ca. 1980	Non-Contributing	Historic Contributing
Restroom Building	ca. 1980	Non-Contributing	Historic Contributing
Dam Fisheries Facilities			Historic Contributing
Holding Tanks	1962	Non-Contributing	Historic Contributing
Spawning Building	1962	Non-Contributing	
Fish Ladder	1962	Non-Contributing	
Aerator	1962	Non-Contributing	
Fish Hatchery	1965, ca.1994		

Facility/Description	Date	National Register Eligibility Recommendation and Reference	
		Kramer 2003b	EIS/R 2012
Hatchery Building	1962	Non-Contributing	
Warehouse	1962	Non-Contributing	
Office	1962	Non-Contributing	
Workers Housing 1	1962	Non-Contributing	
Workers Housing 2	1962	Non-Contributing	
Workers Housing 3	1962	Non-Contributing	
Workers Housing 4	1962	Non-Contributing	
Fish Rearing Ponds	1962	Non-Contributing	
Fish Ladder	1962	Non-Contributing	
Visitors Center	1962	Non-Contributing	

6.1.4 Ethnographic Information and TCPs

KRRC's review of ethnographic information for the Project identified TCPs and other culturally sensitive areas along and near the Klamath River based on ethnographic inventory reports prepared by the Klamath Tribes (Deur 2003), Shasta Nation (Daniels 2003, 2006), Karuk Tribe (Salter 2003), and Yurok Tribe (Sloan 2003) for the FERC 2007 Relicensing FEIS.

The Klamath Tribes identified 11 TCPs in the Klamath Basin area, and noted adverse effects to tribal fisheries resulting from impediment of anadromous fish passage due to Klamath River dams (Deur 2003).

The Shasta Nation report (Daniels 2003, 2006) presents a list of village sites recorded in the ethnographic literature, a list of locations that the Shasta Nation consider TCPs, and another inventory of 11 locations, drawn from the first two listings, that are eligible for the National Register.

The Karuk (Salter 2003) and Yurok (Sloan 2003) ethnographic reports draw upon oral interviews, other writings, ethnographical literature, and a review of natural and cultural resources within the Klamath River to discuss each tribe's traditional and historical relationships with the river and its resources to subsistence, material and spiritual culture, and identity.

In response to AIR #29, Section 106 consultation with federally recognized and non-federally recognized tribes occurred beginning in January 2018, after FERC's tribal outreach effort. The KRRC will continue to consult with tribes. KRRC's Section 106 informal tribal consultation efforts will focus on tribal input regarding identification and NRHP evaluation of TCPs, the proposed Klamath Cultural Riverscape (discussed below), and the management , disposition, and treatment of human remains (discussed in Section 8.4.2 below).

Klamath Cultural Riverscape

The Klamath River Inter-Tribal Fish and Water Commission incorporated information from the tribal ethnographic studies, in addition to information provided by the Hoopa Valley Tribe, into an integration report (King 2004) that focused on the Klamath River. The entire length of the river was identified as a type of cultural or ethnographic landscape, termed the Klamath Cultural Riverscape, due to the relationship between the Klamath Tribes, Shasta, Karuk, Hoopa, and Yurok Tribes and the river and its resources (Gates 2003; King 2004). The characteristics that contribute to the riverscape's cultural character include natural and cultural elements such as the river itself; its anadromous and resident fish; its other wildlife and plants; and its cultural sites, uses, and perceptions of value by the tribes (King 2004). Gates (2003) and King (2004) recommended the Klamath Cultural Riverscape as eligible for the National Register based on its association with broad patterns of tribal environmental stewardship, spiritual life, and relationships between humans and the non-human world. The riverscape and/or ethnographic reports and eligibility determination have not been submitted by a Federal agency to the Oregon and California SHPOs for National Register eligibility concurrence (USBR and California Department of Fish and Game (CDFG)[1] 2012: Vol. 1, 3.13-29).

Further research and consultations to define and update the riverscape cultural landscape as a historic property is identified as a Cultural Resources mitigation measure for the Project. The Klamath Cultural Riverscape is an ongoing topic of discussion for the CRWG and informal Section 106 tribal consultation efforts.

6.1.5 Historical Landscape Analysis

As part of the 2017 records search, KRRC conducted a historical landscape analysis to identify locations where post 1850s era settlement and resource developments occurred within the records search area. The materials for this study included the review of the General Land Office (GLO) records, including California plat maps (1856, 1876, 1880, and 1881) and surveyor's notes; Oregon plat maps (1858, 1874, 1881, 1900, and 1917) and surveyor's notes; a variety of published and manuscript resources (Beckham 2006; Boyle 1976; Kramer 2003a, b; PacifiCorp 2004; USDI 1989); and USGS maps available at http://historicalmaps.arcgis.com/usgs. Other map searches included the David Rumsey collection, Northwestern California map collection at Humboldt State University, Library of Congress digital collections, and Online Archive of California. Historical landscape information was digitized into a GIS format.

KRRC is currently completing the review of the J.C. Boyle Collection (MI 165306) housed at the Southern Oregon Historical Society in Medford, Oregon. This archive contains photo albums, newspaper clippings, maps, manuscripts, financial records, and Copco annual reports belonging to Copco Engineer J. C. Boyle, and pertaining predominately to construction of Copco No. 1 dam and reservoir. This archive is a valuable source of information concerning the pre-inundation historical landscape of the Copco No. 1 area and will provide important information regarding cultural and historical resources that may be anticipated during reservoir drawdown. In addition, archival and historical landscape research is currently underway at local

[1] California Department of Fish and Game is now known as the California Department of Fish and Wildlife.

County repositories and historical societies to provide information regarding cultural and historical resources that may be anticipated during reservoir drawdown.

6.1.6 Data Gap Analysis

Subsequent to the completion of the combined record searches, KRRC will examine compiled data and assess it to identify missing information such as gaps in survey coverage, resource recordation, and the status of NRHP eligibility determinations for cultural resources potentially subject to effects during project implementation activities.

6.2 Resource Identification

6.2.1 Pre-Removal Resource Inventory

In response to AIR #28, beginning in July 2017, KRRC initiated cultural resources identification efforts focused on areas within the limits of work that were not subject to previous pedestrian inventory for cultural and historical resources. To date, this new inventory has included three local waste disposal sites currently planned to accommodate concrete rubble and loose earth materials associated with dam removal. The disposal sites include one area for J.C. Boyle Dam (see Figure 5.2-1(C), Sheet 1 in Appendix C), a combined site for Copco No. 1 and Copco No. 2 Dams (see Figure 5.3-1 (C), Sheet 1 in Appendix C), and one area for Iron Gate Dam (see Figure 5.5-1(C), Sheet 2 in Appendix C).

6.2.2 Disposal Site Inventories

J.C. Boyle Disposal Site

The J.C. Boyle Dam disposal site encompasses a 6-acre area located near the current right dam abutment (see Figure 5.2-1(C), Sheet 1 in Appendix C of Definite Plan). This area was included within the cultural resources inventory conducted by PacifiCorp for the Klamath Hydroelectric Project Relicensing study (PacifiCorp 2004). Therefore, KRRC did not undertake a new cultural resources inventory. The PacifiCorp survey did not identify any archaeological sites, isolated finds, or built environment resources within the disposal area.

Copco No. 1 and Copco No. 2 Disposal Site

The Copco No.1 and Copco No. 2 disposal site is located between the two dams, on the northern hillslope above the Klamath River (Figure 5.3-1(C), Sheet 1 in Appendix C of Definite Plan). This area also was included within the cultural resources inventory conducted by PacifiCorp for the Klamath Hydroelectric Project Relicensing study (PacifiCorp 2004). Therefore, KRRC did not undertake a new cultural resources inventory. The PacifiCorp survey did not identify any archaeological sites or isolated finds within the disposal area.

Two extant buildings are located within the Copco No.1 and Copco No. 2 disposal site, consisting of a ca. 1922 residential building and a small garage. These buildings are associated with the Copco No. 1 complex of Klamath Hydroelectric Project. PacifiCorp prepared a Determination of Eligibility for the Klamath Hydroelectric Project (Kramer 2003b) that documents its regional significance and eligibility for listing in the National Register of Historic Places under Criterion A for its association with the industrial and economic development of southern Oregon and northern California.

Copco No. 1 was the first project developed on the river by the California-Oregon Power Company and was placed into service in 1918 and further expanded in 1922 (Kramer 2003b:8). The Copco No. 1 complex includes seven features consisting of the Copco No. 1 dam, water conveyance system (two penstocks), powerhouse, the remains of a guesthouse, two residential buildings and associated garages surviving from the original worker's housing village, and a separate garage/warehouse (Kramer 2003b:8). PacifiCorp evaluated the seven features, constructed between the period of 1912 and 1922, as contributing elements to the NRHP-eligible Klamath Hydroelectric Project (Kramer 2003b).

Iron Gate Disposal Site

The Iron Gate disposal site encompasses an approximately 36-acre area located approximately 750-feet east of Iron Gate Dam, within a small basin that overlooks Iron Gate Reservoir to the northwest (Figure 5.5-1 (C), Sheet 2 in Appendix C of Definite Plan). An area within the western portion of the disposal site, totaling approximately 9 acres, was included within the cultural resources inventory conducted by PacifiCorp for the Klamath Hydroelectric Project Relicensing study (PacifiCorp 2004). The PacifiCorp survey did not identify any archaeological sites, isolated finds, or built environment resources within the disposal area.

To provide 100 percent coverage of the disposal area, in July 2017, KRRC conducted a cultural resources inventory of the remaining acres. KRRC conducted the inventory using a standard systematic pedestrian survey that employed transects spacing of 15 m (65 ft.). The survey convention included a buffer of 46 m (150 ft.) around the footprint of the proposed disposal site. The inventory identified one historic-period archaeological site (LKP-RB-1) and one historic-period isolated find (LKP-EN1-IF).

Other Areas

In addition to the Disposal Site inventories conducted in July 2017, KRRC is currently undertaking a data gap analysis to identify other land-based areas within the limits of work (e.g. haul routes), which includes areas where soils are most likely to be disturbed during construction, that were not previously inventoried for cultural resources, including archaeological, historical, and built environment resources. Such areas will be subject to pedestrian survey to provide 100 percent coverage of direct impact areas associated with the limits of work.

The CRWG may identify additional survey areas located outside the limits of work for pedestrian survey as part of its ongoing efforts to define the Project APE, as well as based on recommendations derived during informal consultation with tribes and consulting parties. The limits of work will continue to be refined during the Section 106 consultation process and as project planning continues.

6.2.3 During and Post-Removal Resource Inventory

Measures to resolve adverse effects to cultural and historical resources developed for the 2012 EIS/R will likely be integrated into the PA as a conclusion to the Section 106 process. In addition cultural resources surveys in the reservoir drawdown zones to identify historic and significant properties, will need to be completed after project approvals are received. In consultation with the CRWG and the approval of FERC, the PA will create a consultation process for considering these surveys. KRRC is in the process of developing a proposed program for implementation during dam removal, which includes cultural resources surveys based on archival research, historical landscape analyses, and tribal consultation. In addition, KRRC will conduct post-demolition surveys of areas outside of the reservoir footprints (i.e., hydropower infrastructure areas, former recreation areas) where revegetation will occur.

6.2.4 General Inventory and Resource Recordation Methods

Archaeological Inventory

Any archaeological inventory to be conducted for the Project will include 100 percent, intensive-level survey of designated areas. The inventory will employ a standard systematic pedestrian survey following the appropriate Oregon and California survey and reporting standards, tailored if appropriate to meet any specific federal land management agency guidelines. Inventory of parcels will employ standard transect spacing of 15 m (65 ft.) or less. The survey convention for elements such as staging areas, borrow areas, substations, and other facilities will include a buffer of 46 m (150 ft.) around the footprint of the proposed activity.

KRRC will conduct surveys in accordance with the Guidelines for Conducting Field Archaeology in Oregon, published by the Oregon State Historic Preservation Office (SHPO 2007), and, in California, by the guidelines provided by the California Department of Historic Preservation. KRRC will complete all inventory efforts on federal lands under the supervision of field supervisors authorized under agency-specific cultural resources permits. All inventory methods will follow those prescribed by United States Forest Service (USFS) and Bureau of Land Management (BLM) protocols, dependent upon the lands being surveyed, and will be conducted by field supervisors and archaeological technicians that fully meet qualifications and standards dependent upon appropriate land management agency permitting requirements

KRRC expects that two categories of cultural resources will be identified: archaeological sites and isolated finds. An archaeological site in Oregon is defined as 10 or more artifacts (including lithic debitage) or a feature likely to have been generated by patterned cultural activity within a surface area reasonable to that activity (a form of density measure). An isolated find in Oregon is defined as one (1) to nine (9) artifacts discovered in a location that appears to reflect a single event, loci, or activity. The presence of any feature advances the find into a site status. KRRC will follow similar guidelines in California, where a strict written policy is not provided. Alternatively, on lands managed by federal agencies, KRRC will follow the policies of those agencies.

Previously recorded sites present within the areas to be inventoried will be relocated, if possible, and re-recorded, as necessary. KRRC will give newly identified sites a temporary field number and plot them onto a USGS field map; UTM coordinates will be recorded using a GPS instrument. KRRC will not permanently flag identified resources or otherwise mark them in the field, unless requested by land management agencies.

All above-ground resources, such as buildings, within or adjacent to (within 100 feet of) the survey areas that are 50 years of age or older, or of indeterminate age, will be noted, and their location and information provided to the Built Environment study team for documentation on an appropriate site record. KRRC will consider visual effects to above-ground resources beyond the pedestrian survey area in a separate study.

Built Environment Inventory

Fieldwork methodology will consist of two phases of identification and evaluation, and will focus on two distinct resource categories – hydroelectric (Phase I) and non-hydroelectric (Phase II) facilities. A reconnaissance level effort will make a preliminary evaluation of all historic-era resources and determine whether they meet the NRHP criteria for evaluation, retain integrity, whether they were constructed over 45 years ago (before 1973), and if they meet any NRHP criteria considerations. KRRC chose the 45-year criterion to take into account that effects that could be present during the full course of project activities.

KRRC will typically conduct fieldwork with teams of two architectural historians, who will drive publicly accessible rights-of-way and record resources in a systematic manner. For those resources that would clearly not have views of the Project due to vegetation, landform, or surrounding development, KRRC will collect only location information, as the resource will be considered outside the APE. For those resources inventoried in the APE, KRRC will collect specific information, at least two or more photographs taken, and each resource noted on a field map with recorded by GPS. For those properties that clearly lack historic integrity, or that is a type of resource that is not indicative of broad patterns of history or related to historical events (Criterion A), not associated with significant person or people (Criterion B), and/or is of a common type, style, or method of construction that does not exhibit high artistic values or represent a significant and distinguishable entity whose components may lack individual distinction (Criterion C), no additional information will be collected and a "not eligible" recommendation will be made. In order to apply the criteria, KRRC will use information collected during fieldwork to revise the historic context for the APE and provide an initial basis from which to evaluate the relative importance of identified resources. KRRC will also conduct additional secondary and archival research on common resource types so that a more comprehensive historic context of these resources within the APE can be developed and used for a comparative analysis and an assessment of significance. This assessment will consider whether the resource retains significance at the local, state, or national levels. Further, the analysis will take into account the relative rarity of a resource type and likewise adjust considerations related to that resource's historical integrity. For those resources that retain integrity, are 45 years old or older, and may be eligible under any of the NRHP criteria for evaluation, the resource will be listed as "unevaluated" and subject to Phase II analysis. This analysis will include detailed recordation and full evaluation.

In addition to field recordation, KRRC will undertake research to better understand the resource's history. This will include SHPO/USFS/BLM files, historic maps (such as GLO, Metsker's, and Sanborn, newspapers,

and other applicable resources such as census records, genealogical records, biographical encyclopedias, city directories, and family histories. After taking into account the overall integrity and historical significance of the resource, KRRC will make a final recommendation concerning a resource's NRHP eligibility.

Built Environment HABS/HAER/HALS Recordation

KRRC anticipates that mitigation for impacts on the hydroelectric facility buildings and structures will involve some level of Historic American Building Survey (HABS) and Historic American Engineering Record (HAER), documentation. HABS/HAER recordation has been previously determined to be an important mitigation measure in compliance with NHPA Section 106 provisions.

Chapter 7: Resource Evaluation

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7. RESOURCE EVALUATION

7.1 Archaeological Evaluation

To date, the evaluation of cultural resources identified within the limits of work (and subject to potential direct effects) has occurred based on survey-level data or from subsurface testing work (Phase II investigations) conducted by other parties (not KRRC). The 2004 PacifiCorp report identified three levels of NRHP eligibility for identified sites: eligible, potentially eligible, and not eligible. Eligible sites include those resources that were designated as historic properties on the basis of sufficient existing information about them to draw that conclusion. Potentially eligible sites include those that require more intensive, subsurface investigations to obtain information necessary to determine if they are or are not eligible for the NRHP under Criterion D. Those sites identified as not eligible lack attributes necessary for their inclusion in the NRHP. Neither the California nor Oregon SHPOs has concurred with the NRHP evaluations offered in the previous Klamath River cultural resources reports (Cardno ENTRIX 2012; PacifiCorp 2004). KRRC, working through the CRWG, is facilitating SHPO review of the previous eligibility recommendations to reach NRHP eligibility determinations under the Section 106 process. Once eligibility concurrence is reached, the list of potentially eligible and any yet unevaluated properties will be screened against areas of direct impacts to develop an inventory of affected sites that require evaluation through Phase II testing. Because most individual sites have not yet been identified for evaluation, site-specific methods will be developed later.

The TCPs identified in the tribal ethnographic reports (Section 6.1.4 above) may or may not have archaeological components with information potential and have been evaluated as NHRP-eligible based on other cultural values including associations under Criterion A. Section 106 consultation performed by the FERC, as supported by KRRC, will assist in verifying the NRHP eligibility of TCPs and how TCPs will be integrated into project planning and compliance.

TCRs identified by Tribes as a part of the AB52 consultation process may be disclosed to the SWRBC. If this information is shared with the KRRC, the KRRC will coordinate the evaluation of TCRs for the NRHP with the CRWG and FERC as a part of the Section 106 consultation process.

7.2 Evaluation of Historic Built Environment Resources

The evaluation of historic built environment resources will include an update to the Klamath Hydroelectric Project Request for Determination of Eligibility to include Iron Gate Dam as a historic property and to identify contributing elements to the Klamath Hydroelectric Historic District (KHHD). In addition, an estimated 50 non-hydroelectric historic structures (including buildings, bridges, and other built environment facilities) identified during inventory efforts will require evaluation for eligibility to the NRHP. KRRC will perform built environment evaluation studies to Oregon and California standards. Two historical resources reports for both hydroelectric and non-hydroelectric resources, will be prepared that include information on the

resources located in the respective states. The reports will identify the APE, apply the NRHP Criteria for Evaluation, assess project effects, and make recommendations to avoid and minimize effects and mitigate adverse effects. This task will also include a reassessment of those built environment resources that were not 50 years old at time of previous evaluation; and a complete analysis of cultural resources within 100-year flood plain below Iron Gate Dam to Humbug Creek.

Chapter 8: Management Plans and Agreement Documents

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8. MANAGEMENT PLANS AND AGREEMENT DOCUMENTS

KRRC will produce a number of management plans and agreements to support the Project's Section 106, CEQA, and AB 52's compliance efforts. The documents currently planned include a HPMP, Programmatic Agreement, Inadvertent Discovery Plan, Plan of Action for the treatment of human remains, and a Cultural Resources Monitoring Plan. KRRC may add other plans based on recommendations made by the CRWG and Tribes.

8.1 Historic Properties Management Plan and Programmatic Agreement

FERC, with the assistance of KRRC, will prepare and implement a PA for the Project. KRRC will prepare HPMP to assure compliance with the federal and state laws and regulations that govern historic, cultural, and tribal resources. In preparing the PA and HPMP, KRRC will consult, as appropriate, with FERC and the CRWG. KRRC will continue to consult with FERC and the CRWG as appropriate through the Project's implementation until the expiration of the PA.

On the federal level, the relevant statutes include: (1) Section 106 of the NHPA; (2) National Environmental Policy Act (NEPA); and (3) the Native American Graves Protection and Repatriation Act (NAGPRA). Section 106 requires federal agencies to take into account the effects of their undertakings on historic properties, engage consulting parties, and to provide the ACHP with reasonable opportunity to comment. A "historic property" is "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in the NRHP. This term includes artifacts, records, and remains that are related to and located within such properties" (36 CFR § 800.16(l)). The term also includes "properties of traditional religious and cultural importance to an Indian tribe . . . and that meet the National Register criteria" (Ibid). Section 106 also requires consultation with relevant SHPOs, THPOs, Indian Tribes, representatives of local governments, individuals and organizations with a demonstrated interest in the Project, and the public (36 CFR § 800.2(c)).

NEPA requires federal agencies to determine whether an action may "significantly affect the quality of the human environment." Among other things, agencies must consider the "unique characteristics of the geographic area such as proximity to historic or cultural resources (40 CFR § 1508.27(b)(8)." NEPA also encourages agencies to the fullest extent possible, prepare environmental documents concurrently with and integrated with environmental impact analyses and related surveys and studies required by the NHPA (40 CFR § 1502.25(a)).

NAGPRA establishes the ownership of cultural items excavated or discovered on federal or tribal land lies with the lineal descendants and culturally affiliated Indian tribes and Native Hawaiian organizations and, among other things, establishes procedures for the inadvertent discovery or planned excavation of Native American cultural items on federal or tribal lands.

As discussed above, KRRC and PacifiCorp have initiated informal Section 106 consultation consistent with FERC's direction and convened a CRWG that includes FERC, other federal agencies, SHPOs, THPOs, Indian Tribes, as well as other consulting parties that will consider the identification and evaluation of cultural resources as well as the avoidance, minimization, and resolution of adverse effects to historic properties. This informal consultation will establish the groundwork for a PA that KRRC will submit for FERC's approval. The PA and HPMP will be completed prior to FERC's Surrender Order. The HPMP will be appended to the PA, once the agreement is finalized. The PA will be effective for the duration of FERC's jurisdictional authority (i.e. the effective duration of FERC's License Surrender Order) which, if so ordered, is currently estimated to end in 2025.

KRRC will also work with FERC, as well as other federal agencies, SHPOs, Tribes, and consulting parties (which include state-recognized tribes who engage in the State Water Board's AB 52 consultation process) to develop and integrate effect avoidance, minimization, and mitigation measures into the HPMP. KRRC will also implement avoidance, minimization, and mitigation measures developed in the ongoing AB 52 consultation led by the SWRCB. Since these measures are tailored to compliance with California laws and regulations, KRRC may develop comparable measures consistent with Oregon's laws and regulations that govern cultural resources, if applicable. KRRC will work with FERC, other federal agencies, SWRCB, tribes, SHPOs, THPOs, and consulting parties to consider and incorporate these measures into the HPMP and PA as appropriate.

8.2 Programmatic Agreement

As the designated non-federal representative, KRRC will prepare a PA for FERC's consideration that is designed to assist with compliance of Section 106 of the NHPA consistent with 36 CFR § 800.14. The PA will consist of a signed, formal agreement between KRRC, lead and cooperating federal and/or state agencies, the California and Oregon SHPOs, THPOs, Indian Tribes, and consulting parties, and will outline all measures necessary for full compliance with NHPA. These will include but will not be limited to protocols for the identification and evaluation of historic properties, permitting requirements, treatment of historic properties, monitoring requirements, inadvertent discovery protocols, curation, and treatment of human remains. KRRC, in consultation with the federal agencies, SHPOs, THPOs, Indian tribes, and consulting parties will draft a PA suitable for review and consideration by FERC. KRRC will assist with revising the PA following consultation and review by the CRWG and incorporate any necessary revisions to the HPMP (discussed in greater detail in Section 8.2). Finalization of the PA, which includes obtaining necessary signatures for acceptance of the PA, will be the responsibility of FERC. The PA will be effective for the duration of FERC's jurisdiction over the Project.

8.3 Historic Properties Management Plan

KRRC will prepare an HPMP to identify mitigation measures and other protective measures to be implemented before and during drawdown and dam removal activities to protect historic, cultural, and tribal resources during the Project's implementation. KRRC will ask FERC and other applicable federal agencies to approve the HPMP before the commencement of any ground disturbance or reservoir draw down activities. At a minimum, the HPMP will incorporate protocols to address the following: (1) identification and evaluation of historic properties; (2) the avoidance, minimization, and mitigation measures to be implemented;(3) the inadvertent discovery of historic, cultural, and tribal resources; (4) the inadvertent discovery human remains and associated grave artifacts; and (5) the monitoring of cultural resources during KRRC's implementation of the Project. The process to amend the HPMP in the event that additional information is obtained during the Project's implementation will be provided in the PA. Other protocols developed during the Section 106 consultation process will be implemented in the HPMP.

8.3.1 Identification and Evaluation of Historic Properties

The HPMP will address historic properties identified to date within the APE, as well as those historic properties potentially identified during project implementation. The HPMP will include the protocols for the phased identification of (1) resources encountered following dewatering activities; (2) resources on properties (if any) where access is not granted until after permitting, (3) resources (including human remains) found as inadvertent discoveries, and/or (4) resources found during cultural resource monitoring. The HPMP will guide treatment measures to avoid, minimize, and mitigate adverse effects to historic properties through the course of the Project. The HPMP will also identify classes of historic properties, relevant research, and potential data gaps in research for classes of properties present in the APE. The HPMP may include other historic property identification and evaluation considerations developed over the course of the Section 106 consultation process.

8.3.2 Effect Avoidance, Minimization, and Mitigation Measures

KRRC will develop the HPMP, which will include a discussion of measures to avoid, minimize, and/or mitigate adverse effects to historic properties. KRRC will implement feasible mitigation recommendations developed during the SWRCB's AB 52 process. Additional avoidance, minimization, and mitigation measures will be identified through the Section 106 consultation process. These additional measures may include but are not limited to mitigation and monitoring, to address reasonably foreseeable direct, indirect and/or cumulative adverse effects that may result from drawdown and dam removal. Wherever feasible, avoidance and preservation in place will be the preferred treatment for historic properties located within the APE. Avoidance may include design changes and/or use of fencing or barricades to limit access to identified historic properties during dam removal and restoration activities.

In cases where avoidance and minimization are not feasible, resource-specific treatment protocols will be drafted as necessary to resolve adverse effects to historic properties adversely affected by the Project. The process for the development of treatment protocols will be outlined in the HPMP and will be consistent with

the Secretary of the Interior's Standards for Archaeological Documentation, Historical Documentation, and Architectural and Engineering Documentation; the ACHP Section 106 Archaeology Guidance; and other guidance from the appropriate SHPOs and/or THPOs, as applicable. Additional standards and guidelines may be identified by FERC and/or the CRWG during the Section 106 process. For effects to archaeological sites that will be mitigated through data recovery, mitigation protocols will include but not be limited to a research design that articulates research questions; data needed to address research questions; methods to be employed to collect data; laboratory methods employed to examine collected materials; and proposed disposition and curation of collected materials and records.

Mitigation protocols for direct effects to historic properties eligible for listing in the NRHP under criteria other than or in addition to criterion D will articulate the context for assessing the properties significance, an assessment of the character-defining features that make the property eligible for listing in the NRHP, and an assessment of how the proposed mitigation measures will resolve the effects to the property. Additional mitigation protocols may be developed during the Section 106 consultation process.

8.4 Inadvertent Discovery Program

KRRC will develop a plan for resolving post-review discoveries. Drawdown of the reservoirs proposed as part of the Project could potentially expose previously recorded and unidentified cultural resources, including archaeological resources and human remains. KRRC will prepare an Inadvertent Discovery Plan that will address the inadvertent discovery of resources protected under federal and state law. KRRC will develop the Inadvertent Discovery Plan during agency and tribal consultations and incorporate feedback from the tribes engaged in such consultations as feasible.

The Inadvertent Discovery Plan will include measures that will be implemented in and downstream of the reservoirs if archaeological materials, human remains, or other cultural resources are discovered during drawdown activities. The Inadvertent Discovery Plan will comply with applicable federal and state laws and regulations regarding cultural resources and human remains. The Inadvertent Discovery Plan will address such situations occurring once reservoir drawdown has commenced and throughout the dam removal and restoration process. The discussion below provides a basis and framework for KRRC's Inadvertent Discovery Plan for the Project and may be adjusted and/or supplemented during the Section 106 consultation process.

8.4.1 Inadvertent Discovery of Cultural Resources

KRRC will develop and implement procedures for its personnel and contractors if historic properties are discovered or unanticipated effects on historic properties occur in conjunction with the drawdown of the reservoirs. KRRC will develop these procedures prior to the initiation of dam removal in accordance with 36 CFR § 800.13(a)(2)(b) (Post-review Discoveries).

As noted above, KRRC will provide instruction to environmental monitors regarding the historic, cultural, and tribal resources that could be discovered during project activities. In addition, all KRRC personnel involved in project field activities will be instructed on site discovery, avoidance, and protection measures that will be triggered in the event of an inadvertent discovery, including information on the federal and state statutes and regulations protecting cultural and tribal resources.

KRRC will develop and implement procedures that address situations where unanticipated cultural resources are encountered on private, non-federal public, or federal lands. The procedures will also include the appropriate agency and tribal contacts and consultations in the event of an inadvertent discovery. Applicable federal, tribal, and state laws may govern the procedures.

If previously unidentified cultural resources are discovered during the implementation of the Project, KRRC will immediately implement the Inadvertent Discovery Plan.

8.4.2 Inadvertent Discovery of Human Remains

KRRC will prepare written protocols that will be incorporated into the Inadvertent Discovery Plan specifically for the discovery of human remains in coordination with the CRWG and with Native American tribes (both the tribes engaged in the Section 106 process and the tribes that engaged in the State Water Board's AB 52 consultation process). The protocol will require signature by FERC as the Federal agency official for purposes of Section 106, and a copy of the protocol will be provided to the consulting tribes.

The protocol for the treatment of human remains will include: (1) planned treatment, care, and handling of human remains, funerary objects, sacred objects, and objects of cultural patrimony; (2) information on the kinds of objects that are considered to be funerary objects, sacred objects, and objects of cultural patrimony; (3) specific information used to determine custody/ownership of the remains; (4) the methods to be used for archaeological recording, analysis, and reporting of human remains, funerary objects, sacred objects, and objects of cultural patrimony; (5) the steps to be followed to contact relevant Native American tribal officials at the time of excavation or inadvertent discovery of human remains, funerary objects, sacred objects, and objects of cultural patrimony; (6) the kind of traditional treatment, if any, to be used for human remains, funerary objects, sacred objects, objects of cultural patrimony; and (7) the planned disposition of human remains, funerary objects, sacred objects, and objects of cultural patrimony.

KRRC will utilize the following as a basis and framework to develop the protocol:

- Human remains and associated grave goods may be discovered during various phases of project's planning and implementation. In all cases, human remains encountered during project activities will be treated in a respectful manner and in accordance with the protocol.
- If human remains and/or associated grave goods are discovered as a result of project activities, project activities near the find will cease to the extent feasible. Project activities will be not be allowed within 200 feet of the discovery until authorization is provided through implementation of the approved treatment protocols unless such a restriction is not feasible (e.g., the infeasibility of

halting reservoir drawdown). One exception to this general principle is the conduct of controlled archaeological investigations, which will be subject to specific requirements outlined in the protocol.

- Human remains and/or associated grave goods will be secured and protected to the extent feasible until appropriate disposition has been determined, in accordance with the protocol and applicable federal, state, and local statutes and regulations. Specific procedures to be followed in the event of a discovery will depend on the ownership status of the lands where the human remains and associated grave goods are discovered.
- The provisions of the NAGPRA will govern inadvertent discoveries of Native American human remains on federal or tribal lands. The federal land management agency, in consultation with FERC, as the lead agency, will be responsible for compliance with the NAGPRA and its implementing regulations for all NAGPRA-related inadvertent discoveries and discovery situations on federal or tribal lands. FERC and any relevant land management agency (e.g., BLM) will consult with the relevant Native American tribe(s) or other ethnic groups related to the human remains identified to determine the treatment and disposition measures consistent with the applicable federal laws, regulations, and policies.
- If human remains are encountered on state or private lands, the appropriate County Coroner will be contacted. All human remains will be treated according to the provisions of the applicable federal, state laws, regulations, or policies, as determined through consultation with the appropriate SHPO, federally- or state-recognized Native American tribe, or other ethnic groups related to the human remains.
- In California, treatment of human burials found on State or private lands are covered under the Public Resources Code, Division 5, Parks and Monuments (Division 5 added by Stats. 1939, Ch. 94.), Chapter 1.75. Native American Historical, Cultural, and Sacred Sites, and the California Native American Graves Protection and Repatriation Act of 2001 (Chapter 5 of Part 2 of Division 7 of the Health and Safety Code).
- In Oregon, treatment of human burials found on State or private lands are covered under Oregon Revised Statute (ORS) 97.745. If human remains are encountered, the state police, Oregon SHPO, the Commission on Indian Services, and the appropriate Native American tribe(s) (which are determined by the Commission on Indian Services) need to be immediately contacted.

8.5 Cultural Resources Monitoring Plan

KRRC will develop a Cultural Resources Monitoring Plan as part of the HPMP for implementation during drawdown and dam removal efforts proposed as part of the Project. The Cultural Resource Monitoring Plan will establish general protocols for monitoring when ground disturbing work is occurring in close proximity to historic properties or where work is occurring in areas where there is a high probability of encountering cultural resources. The Cultural Resources Monitoring Plan may include other areas that will benefit from monitoring, including known archaeological sites and those areas determined to show a high probability for buried cultural deposits. Monitoring will, as appropriate, include field inspection by personnel under the direct supervision of a person meeting the Secretary of the Interior's Professional Qualifications standards

and will consult with federally- and state-recognized tribes for tribal monitors, as appropriate. The Cultural Resources Monitoring Plan will address the management and protection of historic properties in the APE to avoid Project-related effects from drawdown, dam removal, and restoration activities. Cultural resources, human remains, or funerary objects discovered during the monitoring of project activities will be treated in accordance with the protocols described in the Inadvertent Discovery Plan.

8.6 Looting and Vandalism Prevention Plan

KRRC will develop a Looting and Vandalism Prevention Plan to reduce the risk of looting or vandalism during the implementation of the Project to the extent that the Project's implementation creates additional risk of looting or vandalism. If looting and vandalism occur to sites in California, KRRC will consult with federal agencies, SHPOs, THPOs, tribes engaged in the Section 106 process and tribes participating in the AB 52 consultation with SWRCB.

The Looting and Vandalism Prevention Plan will include training of KRRC monitors and personnel about looting and vandalism of tribal, cultural, and historic resources. It will also include an established communications protocol and reporting process to law enforcement and other relevant federal, state, and local agencies upon discovery of evidence that looting or vandalism is or has occurred. Public access to the reservoirs will be restricted during drawdown for safety reasons, as well as protecting against the potential looting and vandalism of protected tribal, cultural, or historic resources.

KRRC will also include in the Looting and Vandalism Plan other protective measures, including appropriate restrictions to public access to known or inadvertently discovered historic, tribal, or cultural resources as appropriate and feasible on a case by case basis. Specific measures that will be considered include fencing, posting of signs, strategic plantings, strategic routing of roads, boating access points and trails, or other means that are feasible and necessary to protect unauthorized looting or vandalism of resources protected under federal and state law. Additional measures may be identified during the Section 106 consultation process with FERC and the CRWG.

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Chapter 9: References

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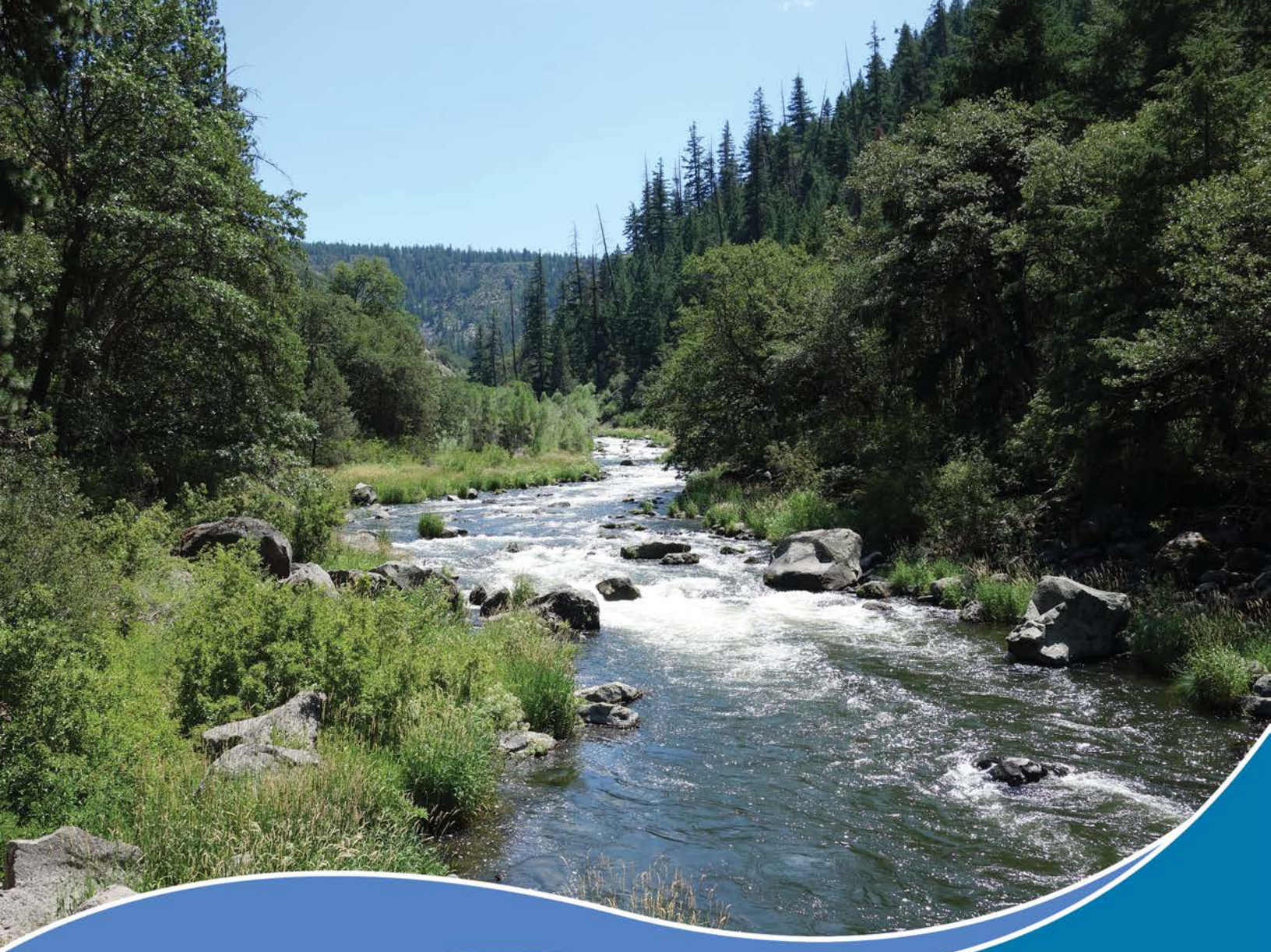

Definite Plan for the Lower Klamath Project

Appendix M - Water Quality Monitoring Plan

KLAMATH
RIVER RENEWAL
CORPORATION

June 2018

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Acronyms

COD chemical oxygen demand
DO dissolved oxygen
EIS/R Environmental Impact Statement/Environmental Impact Report

EPA	U.S. Environmental Protection Agency
IMs	Interim Measures
IM-15	Interim Measure 15 - Water Quality Monitoring
KBMP	Klamath Basin Monitoring Program
mg/L	milligrams per liter
NTUs	Nephelometric Turbidity Units
ODEQ	Oregon Department of Environmental Quality
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
SEF	Sediment Evaluation Framework
SLs	screening levels
SLVs	Screening Level Values
SSC	suspended sediment concentrations
SWAMP	Surface Water Ambient Monitoring Program
WQ Plan	Water Quality Monitoring Plan
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
USGS	US Geological Services

Chapter 1: Introduction

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1. INTRODUCTION

This Water Quality Monitoring Plan (WQ Plan) describes the proposed water quality monitoring activities prior to, during, and following completion of the Project. In general, the monitoring plan covers the following elements:

- Assessment of Klamath River water quality parameters (e.g. dissolved oxygen, temperature, turbidity, conductivity, suspended sediment, nutrients) collected prior to, during, and following dam removal.
- Sampling and analysis for the presence of blue-green algae related toxins (microcystin) during and following dam removal.
- Toxicity assessment of residual reservoir sediments, and sediments deposited downstream of the project reservoirs in the Klamath River and estuary following dam decommissioning.

This WQ Plan presents a general overview of the water quality monitoring that is presently being conducted in the Klamath River through Interim Measure 15 - Water Quality Monitoring (IM-15), the KRRC's approach to augment this monitoring before, during, and after dam decommissioning, and the KRRC's approach to sampling and analyzing the river and estuary waters and sediments.

KRRC will revise this draft document to be consistent with the water quality monitoring requirements in the final Clean Water Act Section 401 Water Quality Certifications from California and Oregon. Draft 401 Water Quality Certifications from both states are currently under public review and public comments are expected through mid-July 2018. The information collected under this WQ Plan will assist the KRRC in making adaptive management decisions during and following dam decommissioning to lessen impacts to aquatic resources by implementing aspects of the KRRC's Aquatic Resource Measures (Section 7.2 of the Definite Plan).

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Chapter 2: Background

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2. BACKGROUND

2.1 Klamath Interim Measure 15 Water Quality Monitoring

The amended KHSA includes provisions for the interim operation of the Lower Klamath Project (FERC Project 14803) by PacifiCorp prior to decommissioning and included several Interim Measures (IMs) to mitigate conditions created by the dams and to collect baseline information prior to the beginning of dam removal drawdown Activities. The KHSA includes IM-15 that requires PacifiCorp to fund water quality monitoring from Upper Klamath Lake to the Klamath River estuary at the Pacific Ocean. The water quality monitoring under IM-15 entered its tenth year in 2018 and PacifiCorp has an obligation to continue IM-15 monitoring until the dam decommissioning phase of the Project begins. IM-15 contains the following water quality monitoring elements:

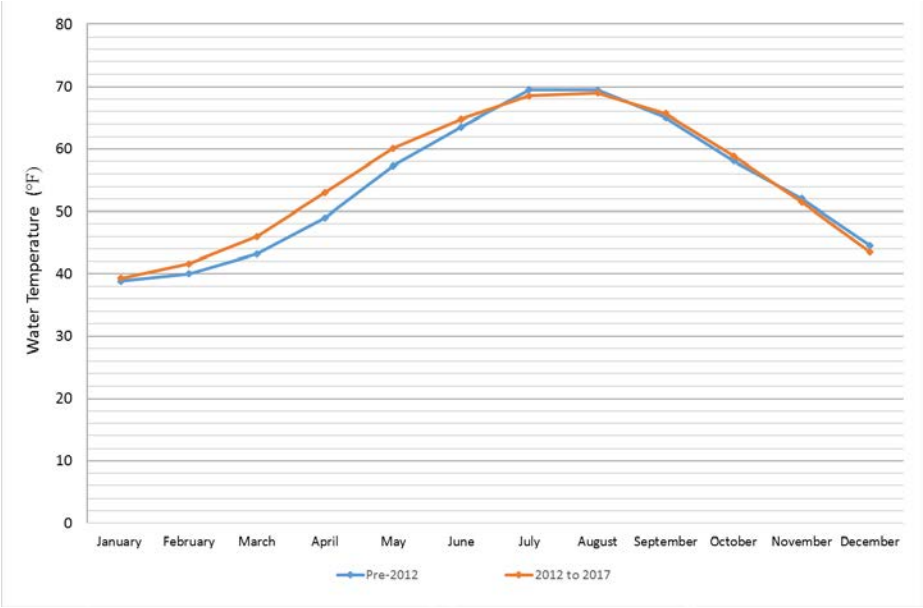
- Cyanobacteria and cyanotoxin grab sampling for public health protection at 18 locations from Upper Klamath Lake to the estuary, including nine locations downstream of Iron Gate Dam in the Klamath River.
- Water quality monitoring at 18 sites on the Klamath River from Link River Dam to the estuary. Additional water quality monitoring is conducted at the mouth of the four major Klamath River tributaries (Shasta, Scott, Salmon, and Trinity).
- Hourly sonde data collection at six locations between Iron Gate Dam and the community of Klamath for temperature, dissolved oxygen, pH, and electrical conductivity.
- Seasonal (May-October), monthly, and bimonthly) discrete grab sampling conducted for nutrients, including total nitrogen and phosphorus, nitrate and nitrite, ammonia, particulate and organic phosphorus and dissolved carbon.

The above monitoring is conducted by the U.S. Bureau of Reclamation (USBR), PacifiCorp, and the Yurok and Karuk tribes and is funded by PacifiCorp. The Klamath Basin Monitoring Program (KBMP), a consortium of in-basin regulatory and resource agencies and interested stakeholders, maintains the water quality monitoring data collected under IM-15. KBMP's Klamath River monitoring data and location maps can be found at http://www.kbmp.net. KRRC intends to utilize the existing KBMP data set, augmented by new data collected before, during, and after dam decommissioning, as the WQ Plan data set.

2.1.1 Water Quality Trends

Water quality monitoring in the Klamath Basin has continued since the publication of the Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report, 2012 (2012 EIS/R). Data compiled from real-time continuous monitoring of parameters such as water temperature, dissolved oxygen (DO), pH, conductivity, and turbidity at a point on the Klamath River just below Iron Gate Dam was analyzed for trends, some of which is presented below. This location provides an overview of water quality in the river as it exits the last dam of the Lower Klamath Project. Water quality in the area generally continues to follow

the trends evaluated in the 2012 EIS/R. Figure 2-1 shows the average monthly water temperature in the Klamath River below Iron Gate Dam from 2006 to 2011 and 2012 to 2017, where data was available. In general, water temperature below Iron Gate Dam is warmer in spring months (March through May) than it was in the past, differing by up to 4 percent in April. Figure 2-2 presents the average DO recorded from 2006 to 2017 for the months of June through October, when available. Typically, during the summer and early fall, water temperature in the river is higher and issues with DO occur. During these months, DO was recorded higher in June, July, and October, but lower in August and September compared to previous years. The average monthly pH from 2012 onward was recorded at higher values than those between 2006 and 2011; though similar from May to October, see Figure 2-3. This information suggests that there would be no changes to the conclusion made in the 2012 EIS/R.



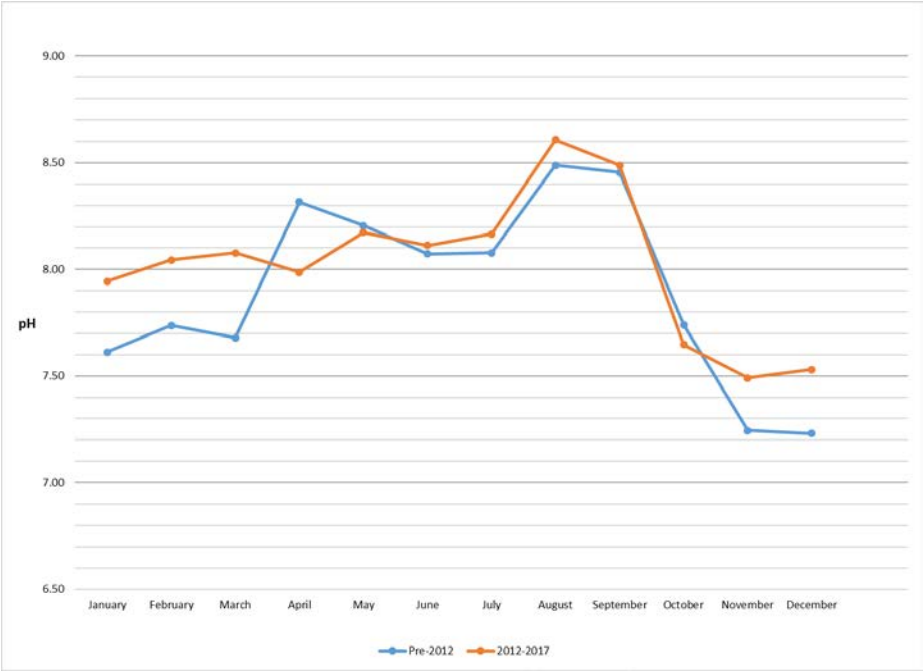
Source: Karuk Tribe 2017

Figure 2-1 Monthly Average Water Temperature in the Klamath River below Iron Gate Dam



Source: Karuk Tribe 2017

Figure 2-2 Average Percent DO in the Klamath River below Iron Gate Dam between June and October



Source: Karuk Tribe 2017

Figure 2-3 Monthly pH in the Klamath River below Iron Gate Dam

2.1.2 Contaminants in Sediment

In 2011, an evaluation of the sediments from each reservoir was completed to assess the risk of contamination in biota and humans from the release of reservoir sediments. Results of this evaluation were compared to the 2009 U.S. Army Corps of Engineers (USACE) Sediment Evaluation Framework (SEF) for the Pacific Northwest and U.S. Environmental Protection Agency (EPA) screening levels (SLs). Freshwater contaminant screening levels were updated and finalized in the 2016 SEF and are typically less protective than standards set forth by EPA SLs and Oregon Department of Environmental Quality (ODEQ) Bioaccumulation Screening Level Values (SLVs) for fish consumption. The marine SLs are relatively unmodified from the 2009 SEF. KRRC reviewed the results from the 2011 evaluation under the 2016 SEF SLs and compliance with a level 2B evaluation (see Section 4.7.5 of the Definite Plan for a full discussion). This reevaluation confirmed the conclusions presented in the 2012 EIS/R that the reservoir sediments in each reservoir are suitable for unconfined, aquatic disposal and that contamination risks from reservoir sediment are unlikely and/or are either lower than with the dams still in place and/or lower than background levels.

2.1.3 Algae in the Klamath Hydroelectric Reach

There are two dominant algal communities within the Hydroelectric Reach in the Klamath Basin, phytoplankton and periphyton. Blue-green algae and cyanobacteria are the predominant phytoplankton in Copco 1 and Iron Gate reservoirs and frequently reach nuisance levels in the summer and fall, often producing toxins (i.e. microcystin) at levels that are potentially harmful to humans and animals. Phytoplankton accumulation from the reservoirs occurs in portions of the Klamath River below Iron Gate Dam and can contribute to nuisance levels of blue-green algae, under certain conditions. Cyanobacteria and green algae are the dominate periphyton (i.e., attached algae) in the riverine portions of the Klamath River. The growth and prevalence of nuisance algal blooms of blue-green algae and other species are generally determined by the nutrient concentration, primarily nitrogen and phosphorus, and water temperature within the river. Continued monitoring of nutrients, algae, and algal toxins show the continuation of trends observed and presented in the 2012 EIS/R. A study published in 2015 (Otten et al. 2015) used a variety of genetic approaches to track the source of toxic algae found in the Klamath River below Iron Gate Dam, in addition to 15 other sampling locations throughout the Klamath River. The study concluded that microcystin producing algal populations originate within Copco 1 and Iron Gate reservoirs rather than imported from upstream sources (e.g. Upper Klamath Lake). The relative significance of contributions of the reservoirs and upstream sources is complex and disputed. The KRRC does not state a position on the relationship or relative significance of such sources. To the extent that these reservoirs are a source, the Project will remove the source.

In 2016, the Oregon Heath Authority released the updated Public Health Advisory Guidelines for Harmful Algae Blooms in Freshwater Bodies. This updated the criteria for issuing and lifting a public health advisory. Criteria for issuing a public health advisory is dependent on visible scum (photos and water testing), cell counts (greater than or equal to 100,000 cells per milliliter [cells/mL] for combined species or 40,000 cells/mL for microcystin), and/or toxicity levels (greater than or equal to 10 micrograms per liter for microcystin). Public health advisories can be lifted only after the initial cell count or toxin results are reported

below the threshold. The Yurok Tribe also updated their advisory threshold guidelines after the 2012 EIS/R. These updated Level 1 thresholds are equal to those issued by the Oregon Health Advisory for combined species (100,000 cells/mL) but are much lower for microcystin cell count (1,000 cells/mL) and microcystin toxin concentrations (0.8 micrograms per liter). Despite the changes to the guidelines for posting public health advisories for toxic algae blooms, the most recent monitoring data shows that health advisory postings remain common place at Copco 1 and Iron Gate reservoirs and on the Klamath River below Iron Gate Dam.

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Chapter 3: Water Quality Monitoring Plan

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3. WATER QUALITY MONITORING PLAN

3.1 Rationale for Water Quality Monitoring Plan

KRRC anticipates impacts from the Project on aquatic resources in the lower Klamath River through the release of reservoir sediment. The 2012 EIS/R for dam removal anticipated that the reservoir sediments, composed largely of organic silt and clay size particles would exhibit high chemical oxygen demand (COD) and high suspended sediment concentrations (SSC) downstream of Iron Gate Dam. The highly turbid water and low dissolved oxygen caused by sediment release will result in stress and mortality to fish and other aquatic organisms in the mainstem Klamath River during reservoir drawdown. KRRC plans to conduct pre-, concurrent, and post-dam removal water quality monitoring (one year before and three years following dam removal) to assess the impacts of dam removal on the aquatic environment from J.C. Boyle Dam to the estuary. The KRRC will also collect water quality samples at Keno Dam upstream from the Project to assess baseline river conditions.

3.2 Monitoring Locations

Table 3-1 and Figure 3-1 present the locations and characteristics of the project water quality monitoring stations that will operate 12 months of the year at least one year prior to dam removal and up to three years following dam removal. Each monitoring location is also an existing IM-15 monitoring site, thus enabling KRRC to augment previously collected data. KRRC will collect water quality and discharge data at each site, as discussed in the next section.

KRRC was informed by the IM-15 monitoring entities that all locations require strengthening of the sonde holding mechanism to withstand winter conditions (currently, IM-15 data collection activities are ceased from approximately November through April). KRRC is working with the Karuk tribe, Yurok tribe and US Geological Services (USGS) to complete the necessary improvements prior to the beginning of pre-drawdown monitoring activities. KRRC will augment the IM-15 monitoring during the pre-drawdown monitoring period by upgrading and operating the stations during the winter months. Once drawdown is initiated, KRRC will operate the monitoring stations year-round and IM-15 monitoring will cease.

KRRC removed the Walker Bridge site along the Klamath River at River Mile 156.3 from the list due to access approval issues. If access issues are resolved, KRRC may add the site back into the list of monitoring sites.

The Klamath River site above Shovel Creek is located approximately 3 river miles downstream from the California/Oregon stateline and KRRC is considering it as a possible location for a stateline monitoring

station. The site is currently monitored under IM-15. The final location of the stateline monitoring location may change including moving this monitoring to the JC Boyle Powerplant location at RM 219.7. The stateline monitoring location, specifics and duration of operation will be defined in consultation with will ODEQ and California SWRCB.

Table 3-1 Monitoring Locations

Location	River Mile	Current Monitoring Entity	Existing Sonde	USGS Gage Station
Klamath River below Keno Dam	233.4	USBR and PacifiCorp	n	y
Klamath River below J.C. Boyle Powerplant	219.7	PacifiCorp	n	y
Klamath River above Shovel Creek (near Stateline)*	206.42	PacifiCorp	n	n
Klamath River below Iron Gate Dam	189.7	PacifiCorp	y	y
Klamath River below Seiad	128.5	Karuk Tribe	y	y
Klamath River at Orleans (USGS)	59.1	Karuk Tribe	y	y
Klamath River near Klamath	6.0	Yurok Tribe	y	y

3.3 Water Quality Monitoring Parameters and Frequency

Table 3-2 lists the water quality parameters KRRC will monitor at each of the monitoring locations. KRRC will collect time-series water quality and stream discharge data, in accordance with the Water Quality Certifications, to assess water quality impacts of the Project. Discrete water quality samples will also be collected to support the suspended sediment load quantification, characterize constituent concentrations that cannot be measured using sondes, and to validate the sonde time-series data.

Table 3-2 Water Quality Monitoring Parameters

Constituent	Frequency	Type of Data
Temperature	Hourly, 12 months per year	Time-Series
Dissolved Oxygen	Hourly, 12 months per year	Time-Series
pH	Hourly, 12 months per year	Time-Series
Conductivity	Hourly, 12 months per year	Time-Series
Turbidity	Hourly, 12 months per year	Time-Series
SSC	Up to 24 samples pre-drawdown; weekly during drawdown, monthly following drawdown for 36 months or until TSS equals background at Keno	Discrete (Auto-Sampler)

Constituent	Frequency	Type of Data
SSC	4 storm events pre-drawdown; every two weeks during and after drawdown or until TSS equals background at Keno	Depth-width integrated sample
Chemical Oxygen Demand	Monthly, daily during drawdown	Discrete
Total Nitrogen	Monthly	Discrete
Total Phosphorous	Monthly	Discrete
Microcystin Cell Count	Monthly	Discrete

KRRC will collect sonde turbidity data as Nephelometric Turbidity Units (NTUs). However, impacts to aquatic resources from reservoir sediments have been quantified in milligrams per liter (mg/L) of SSC. The KRRC collected reservoir sediment samples in 2017 and plans to have the USGS conduct a series of laboratory tests to develop a SSC versus turbidity relationship for the reservoir sediments. This relationship will assist in making adaptive management decisions during and following dam removal and in understanding the impacts to aquatic resources. KRRC will develop a laboratory protocol for the SSC/turbidity relationship analysis that identifies the accuracy and reliability of this relationship along with any uncertainties and specific field verification testing during dam decommissioning.

KRRC will characterize chemical Oxygen Demand and nutrient concentrations to assess the impacts of reservoir sediment decomposition, and other biological activities, on the dissolved oxygen concentrations in the river.

KRRC will quantify cell counts of microcystin producing blue-green algae to determine attainment of existing heath related water quality standards.

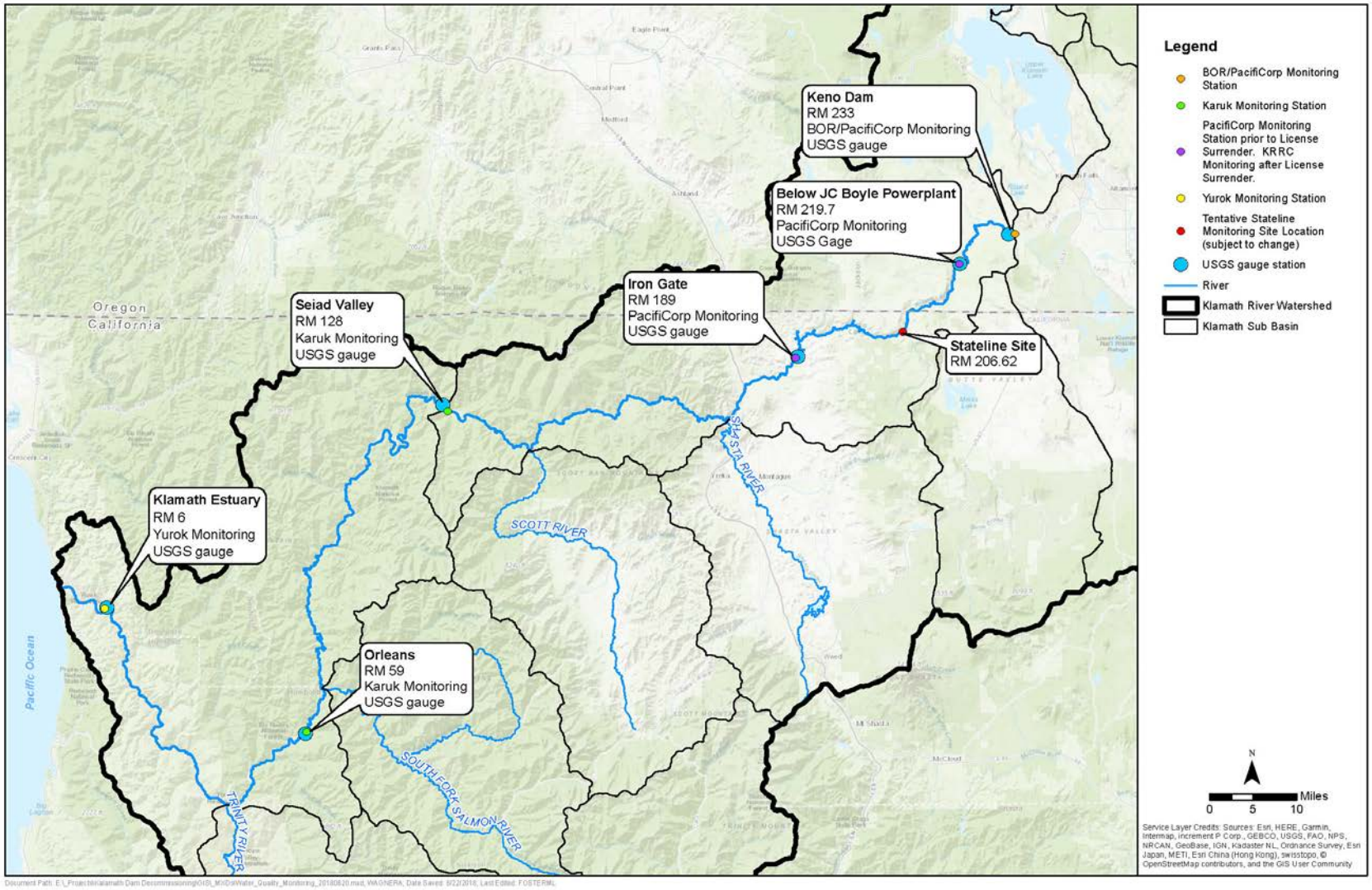

Figure 3-1 Water Quality Monitoring Locations

3.4 Riverbed Sediment Sampling and Analysis

During the Secretarial Determination process, USBR collected 75 five sediment cores in 2009 from the three reservoirs that will be removed as part of the Project and analyzed sediments for 501 anthropogenic and naturally occurring chemicals and compounds. USBR assessed whether significant risk existed for humans or aquatic biota via five contaminate exposure pathways. The data analysis was done in collaboration with the states of Oregon and California, as well as the EPA. The USBR concluded that no chemicals or compounds were detected in reservoir sediments at concentrations exceeding human health screening levels, and no other preclusions to releasing the reservoir sediments during dam decommissioning to the freshwater or marine environment were identified for human or aquatic biota exposure (USBR 2012d).

The above finding aside, the draft California Section 401 Water Quality Certification requires characterization of sediment quality in reservoir and riverbed sediments upstream and downstream of the project reservoirs, and in the Klamath estuary. KRRC will develop a sediment characterization plan in consultation with Oregon and California regulatory agencies to satisfy the requirements of the Section 401 Water Quality Certifications for both states with consistent sampling and testing protocols and procedures.

All sampling, analysis, and evaluation of sediments for the presence of toxic compounds will follow the procedures and protocols defined in the USACE Sediment Evaluation Framework for the Pacific Northwest, July 2016 (RSET 2016).

3.5 Plan Implementation and Schedule

The KRRC will implement this Plan in accordance with the sampling schedules and frequencies defined herein and for up to three years following dam removal. Monitoring activities will continue until the State Water agencies are satisfied that attainment of Basin Plan water quality standards occurs, or after the specified time period (3 years) expires for post-construction monitoring stated within the California and Oregon 401 Water Quality Certifications, whichever occurs first.

KRRC will implement the WQ Plan in accordance with the State Water Resources Control Board's Surface Water Ambient Monitoring Program (SWAMP). KRRC will develop a project-specific Quality Assurance Project Plan (QAPP) to describe the monitoring protocols and will include detailed mapping and figures depicting site locations, characteristics and equipment configurations. The QAPP will define:

- Monitoring entities (i.e. Yurok and Karuk tribes, USGS, USBR) and their specific roles and responsibilities
- Monitoring program design details and data collection protocols
- Data management activities and data storage
- Data quality objectives and quality assurance/quality control (QA/QC)
- Regulatory, stakeholder, and public reporting of the collected data.

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Chapter 4: References

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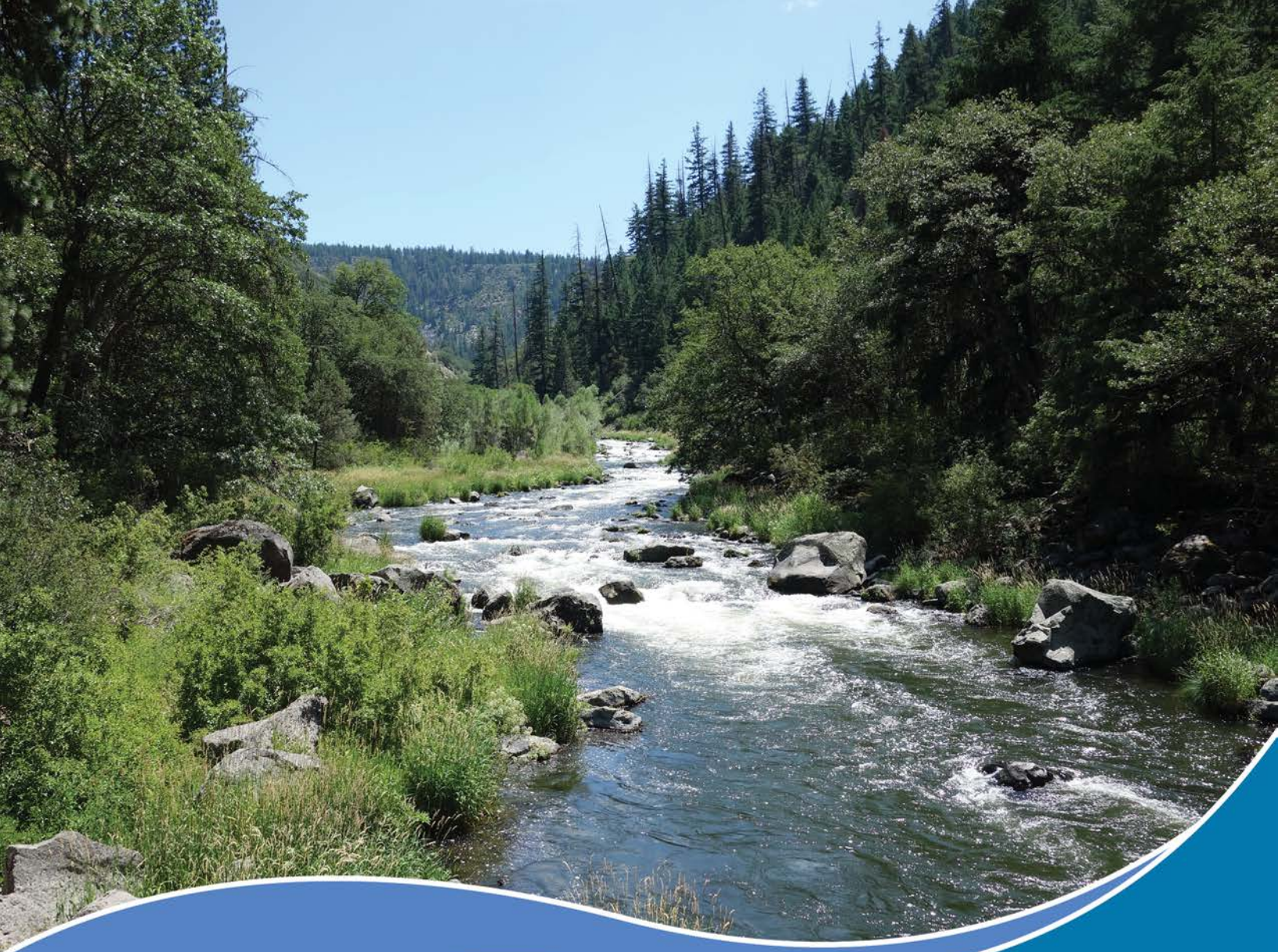

Definite Plan for the Lower Klamath Project

Appendix N – Groundwater Well Management Plan

KLAMATH
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CORPORATION

June 2018

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Acronyms and Abbreviations

CDFW California Department of Fish and Wildlife
DWR California Department of Water Resources
OWRD Oregon Water Resources Department
USBR United States Bureau of Reclamation

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Chapter 1: Introduction and Purpose

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1. INTRODUCTION

The Project may impact groundwater levels in the immediate vicinity of the reservoirs. The United States Bureau of Reclamation (USBR) performed a desktop review of wells located within a 2.5-mile radius of the three main reservoirs (Iron Gate, Copco, and J.C. Boyle) of the Project and reported these well locations in the 2012 Final Environmental Impact Statement/Environmental Impact Report for dam decommissioning (USBR and CDFW 2012). The USBR concluded that additional monitoring work would be required before, during, and following dam decommissioning to better understand reservoir removal effects on the surrounding groundwater wells.

This Groundwater Well Management Plan identifies groundwater wells that the Project may adversely impact. If the Project adversely impacts groundwater wells, KRRC will take steps (e.g., well deepening) to return the production rate of any affected domestic or irrigation groundwater supply well to conditions prior to dam decommissioning. There are five steps in this plan:

1. Database Search and Agency Coordination
2. Outreach to land owners and residents
3. Installation of groundwater monitoring wells
4. Groundwater monitoring
5. Post-Dam removal outreach/notification of findings
6. Proposed actions to improve production rate

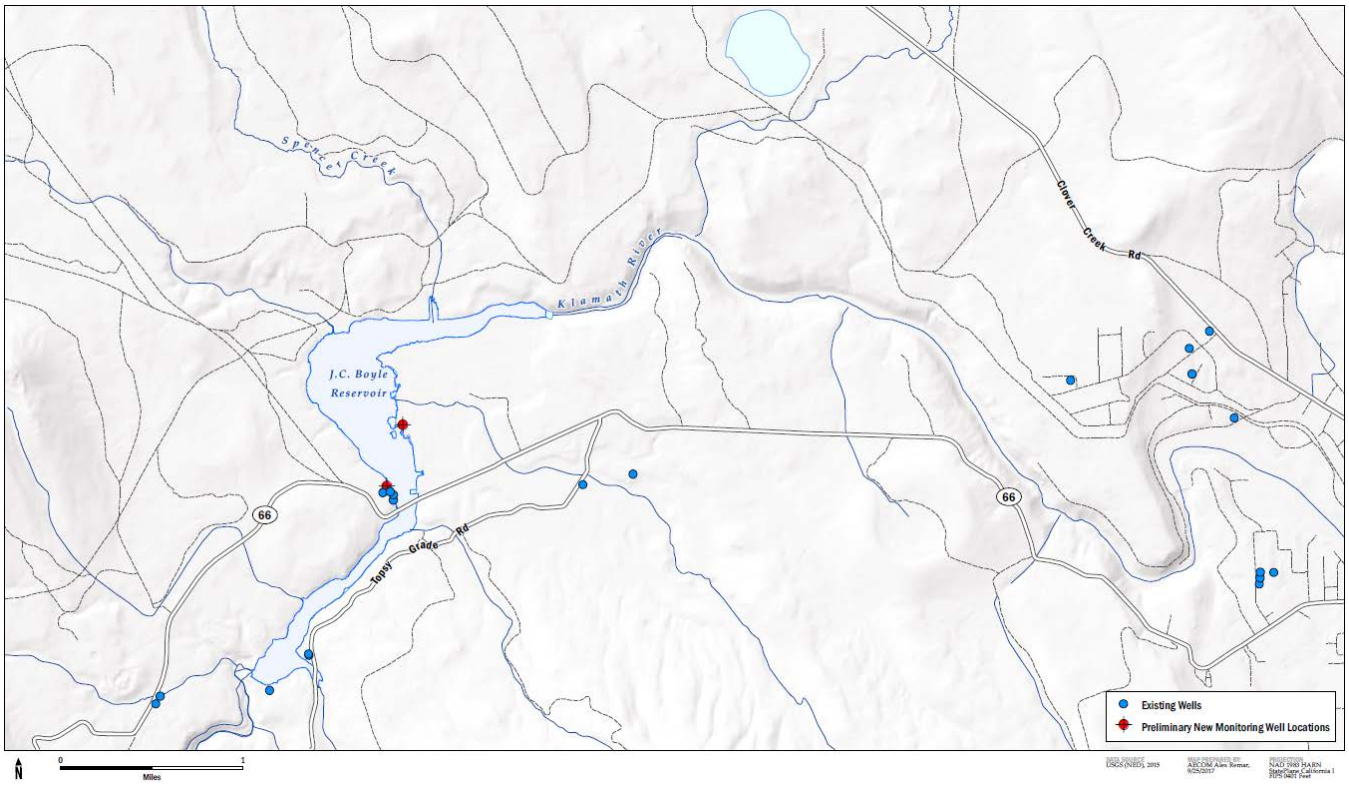

Figure 1 Identified Groundwater Wells within 2.5 Miles of J.C. Boyle Reservoir

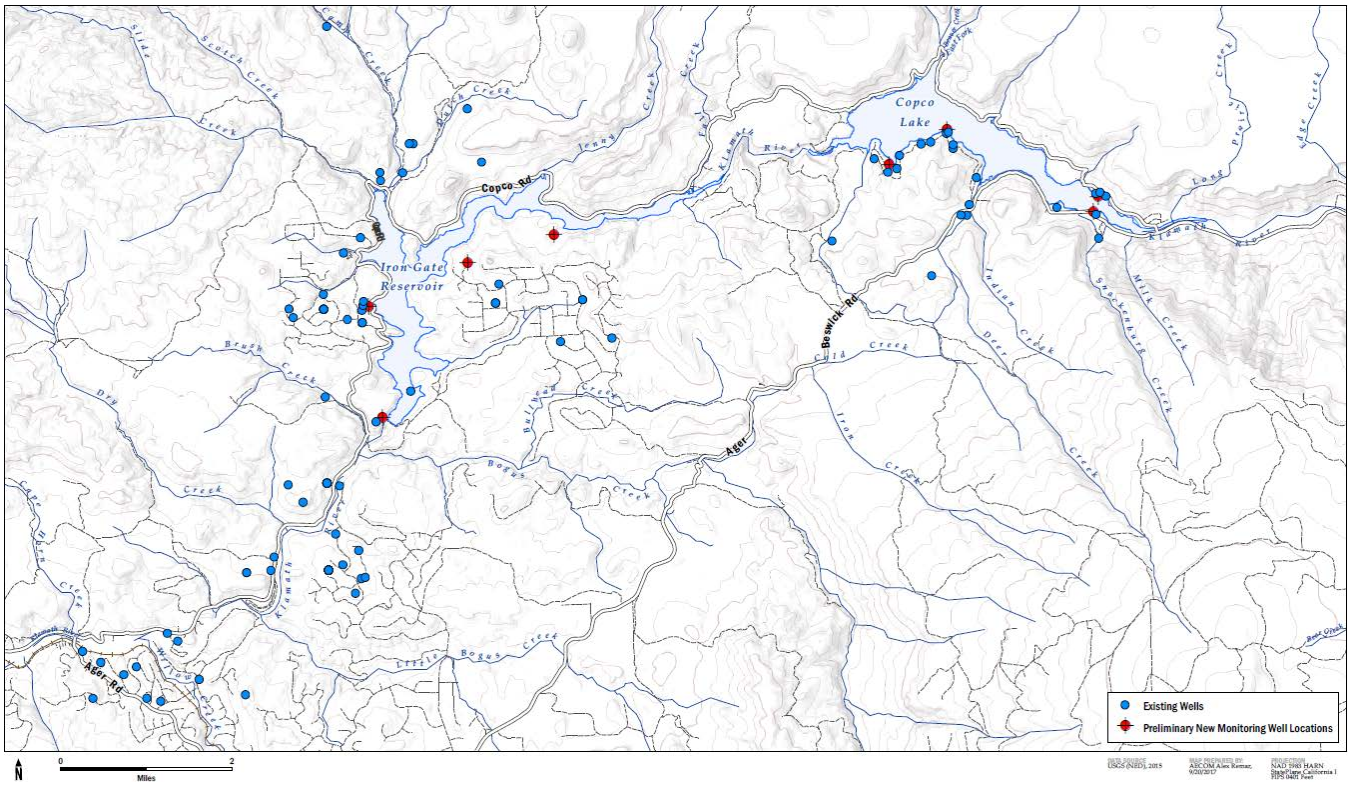

Figure 2 Identified Groundwater Wells within 2.5 Miles of Copco Lake and Iron Gate Reservoir

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Chapter 2: Management Plan

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2. MANAGEMENT PLAN

The following sections summarize the five steps in this plan:

1. Database Search and Agency Coordination
2. Outreach to land owners and residents
3. Installation of groundwater monitoring wells
4. Groundwater monitoring
5. Post-Dam removal outreach/notification of findings
6. Proposed actions to improve production rate

2.1 Database Search and Agency Coordination

The KRRC reviewed USBR's database that identifies 124 existing wells located within a 2.5-mile radius of the project reservoirs. The KRRC attempted to verify the location of these wells and identified any new wells within this radius installed since 2012. The KRRC contacted Siskiyou County, the California Department of Water Resources (DWR), and Oregon Water Resources Department (OWRD) about the accessibility of their groundwater well data bases.

Siskiyou County did not provide any specific information on well locations or ownership due to insufficient staff resources. County staff stated that there are no shared water systems at the California reservoirs[1], so KRRC assumed that all reservoir residents utilize groundwater for domestic use. (Rick Dean, personal communication, July 27, 2017). Siskiyou County recommended that the KRRC contact DWR to verify previously recorded well locations and to identify any potential new well records.

The KRRC contacted DWR and was told that DWR's policy does not allow the sharing of well ownership information (Benjamin Brezing, personal communication, August 8, 2017). .

The KRRC contacted OWRD and was directed to use their public database to download well logs for those surrounding J.C. Boyle (Mary Grainey, personal communication, August 23, 2017). Of the 17 well logs that KRRC identified and downloaded using the OWRD database search, only one provided a specific location..

Given the gaps in information discernable from these data bases,, the KRRC has proposed a broad land owner outreach program as described below.

[1] KRRC has since learned from residents that there is a shared spring water supply near Copco Lake that supplies a portion of the residences there.

2.2 Outreach to Land Owners and Residents

KRRC retained the locations reported by USBR in 2012 for further analysis. To fully understand and update this information, the KRRC will undertake an outreach effort in 2018-2019 to all residents and landowners within 2.5 miles of the project reservoirs to inquire about their groundwater wells.

The KRRC will develop and send an information and questionnaire mailer to property owners, residents, and businesses within 2.5 miles of each project reservoir in 2018. The mailer will include a request to monitor the well for water level prior to, during, and following dam decommissioning. The KRRC will also use its planned public meetings and meetings targeted at reservoir land owners to "spread-the-word" about the proposal to identify wells for monitoring within 2.5 miles of the reservoirs. The KRRC will identify as many well owners as possible that are willing to participate in the monitoring program. Initial information requested by the questionnaire will include:

- Description of the well monitoring program
- Request to participate in the well monitoring program
- Specific information requests:
  - Property address and well location
  - Current depth to groundwater
  - Physical parameters of the well (casing size, well depth, screen interval, pump size)
  - Historical groundwater well problems (quantity and quality)

2.3 Installation of Groundwater Monitoring Wells

The KRRC will identify a sufficient number of residential wells within the proximity of each reservoir to monitor the effects of reservoir drawdown on the groundwater aquifer (sentinel wells). Wells near the reservoirs (less than ¼ mile) are preferred, as the groundwater recharge effect from the reservoir decreases with distance from the reservoir. If an insufficient number of well owners agree to participate in the groundwater monitoring activity, the KRRC will install a minimum of 10 sentinel monitoring wells around the three reservoirs. KRRC will install the monitoring wells between residents and the reservoirs on PacifiCorp land. KRRC proposes to install up to four monitoring wells each at Iron Gate Reservoir and Copco Lake and two wells at J.C. Boyle Reservoir. Figures 1 and 2 show proposed monitoring well locations.

2.4 Groundwater Monitoring

KRRC will monitor sentinel wells belonging to participating landowners including any monitoring wells installed by the KRRC pre- and post-dam decommissioning to identify seasonal fluctuations in groundwater levels and any groundwater level changes that may be attributable to reservoir removal. KRRC will also monitor sentinel wells for general water quality parameters including pH, conductivity, and major anions and

cations. To establish baseline conditions, the KRRC plans to monitor sentinel wells monthly for a minimum of one year prior to dam decommissioning. Following dam decommissioning, KRRC will conduct groundwater monitoring monthly for up to one year or until such time that post-project groundwater levels and general water quality parameters have been determined (no discernable water level declines or changes in quality over a four-month period) or they mirror baseline conditions.

During the drawdown period, KRRC will install data loggers in the sentinel wells to continuously record groundwater levels and pH and conductivity. If KRRC identifies changes attributable to reservoir removal to water levels or quality that might indicate potential supply problems, the KRRC proposes to take the actions described in Section 2.6 to restore temporary and/or long-term water supplies.

2.5 Post-Dam Removal Outreach/ Notification of Findings

The KRRC will compile and summarize in writing the groundwater data collected prior to, during, and following dam decommissioning. KRRC will use these data to identify any trends or changes in groundwater water levels and quality that may be attributable to reservoir removal. The KRRC will prepare a report of findings and identify any areas where groundwater wells are determined to be vulnerable to groundwater levels or water quality declines resulting from reservoir removal. The KRRC will make the report available to all well owners in the study area. Well owners will have the opportunity to request an evaluation of their well to determine if there are changes in groundwater water levels and quality attributable to reservoir removal.

2.6 Proposed Actions

If the data collected during or following dam decommissioning indicates a loss of supply or adverse water quality to any potable or irrigation well, and that these circumstances are attributable to reservoir removal, then the KRRC will provide temporary water supplies until long-term measures such as motor replacement, well deepening, or full well replacement are identified and implemented as needed to return the production rate of any affected domestic or irrigation groundwater supply well to conditions prior to dam decommissioning .

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Chapter 3: References

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3. REFERENCES

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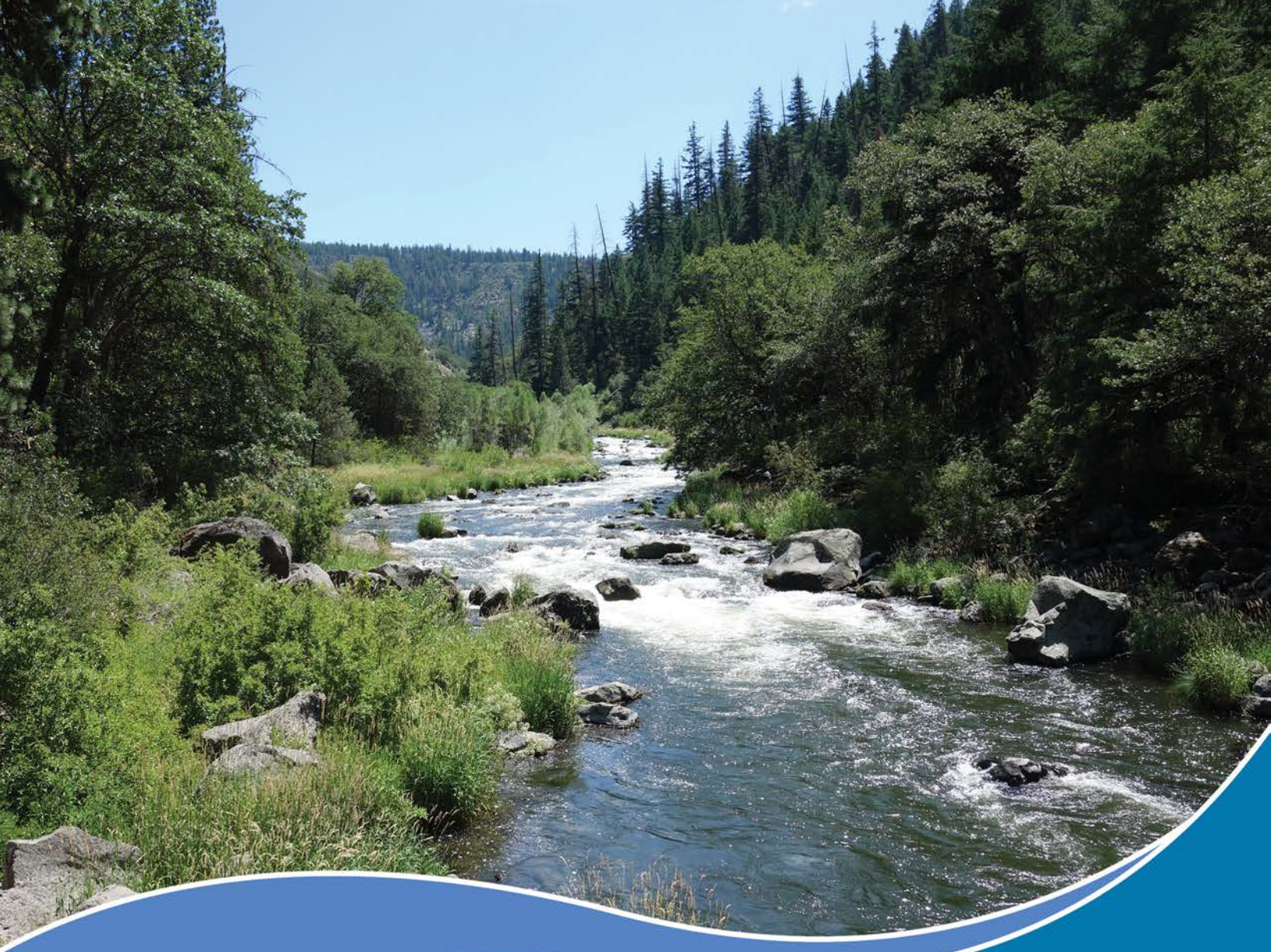

Definite Plan for Decommissioning

Appendix O1 – Fire Management Plan

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June 2018

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Acronyms

BLM	U.S. Bureau of Land Management
Cal Fire SU	Cal Fire Siskiyou Unit
CCR	California Code of Regulations
CFR	Code of Federal Regulations
FDL	Fire Danger Level
FMP	Fire Management Plan
FPD	Fire Protection District
KLD	Klamath-Lake District
KRRC	Klamath River Renewal Corporation
LIFC	Lakeview Interagency Fire Center
ODF	Oregon Department of Forestry
OAR	Oregon Administrative Rules
ORS	Oregon Revised Statutes
PALs	Predicted (or Designated) Activity Levels
PDM	Power-Driven Machinery
PRC	California Public Resources Code
SCOFMP	South Central Oregon Fire Management Partnership
USFS	U.S. Forest Service

Chapter 1: Need for Fire Management

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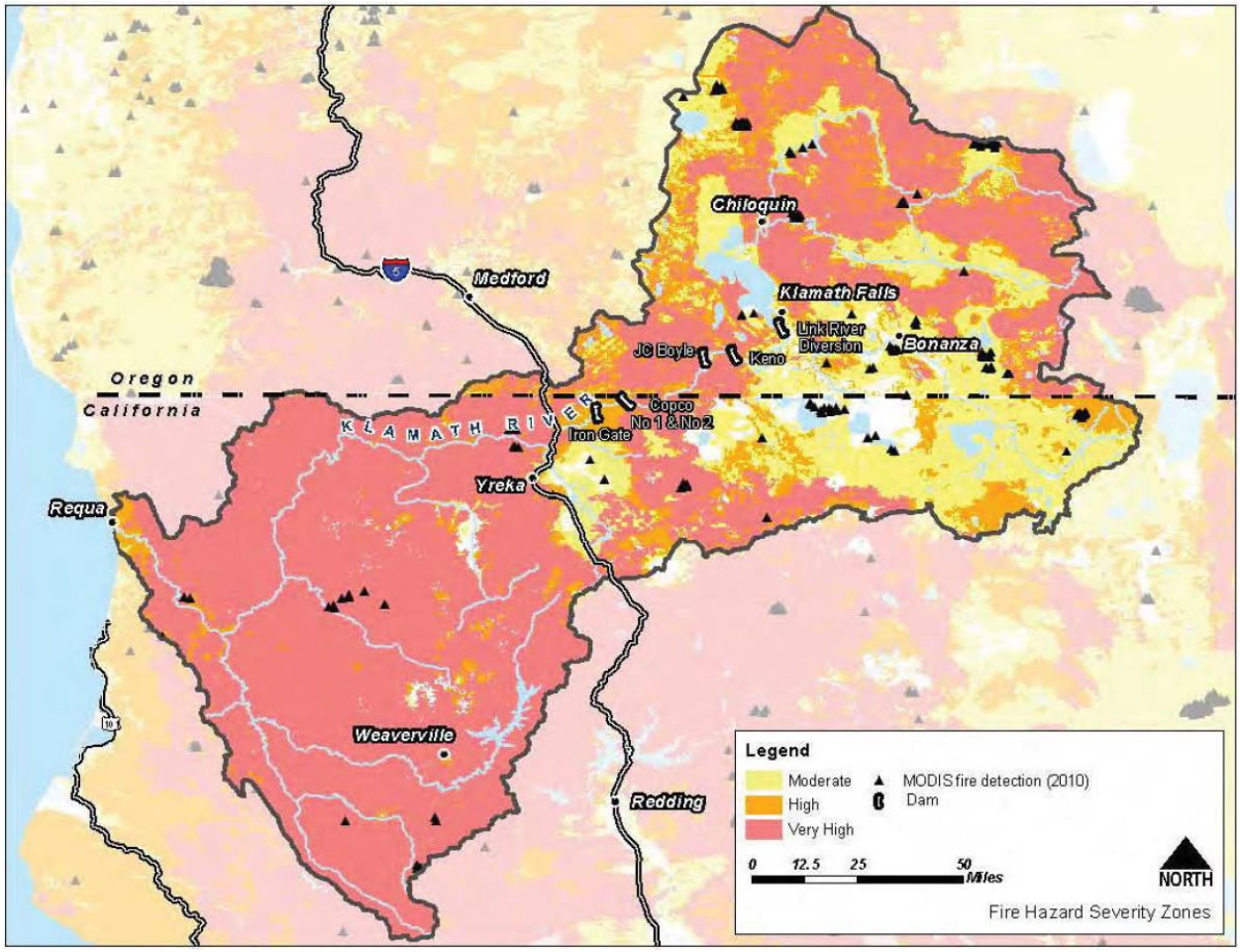
1. NEED FOR FIRE MANAGEMENT

KRRC developed this Fire Management Plan (FMP) to address fire prevention and response methods including fire precaution, pre-suppression, and suppression measures to support implementation of the Definite Plan for the Lower Klamath Project (Definite Plan) proposed by the Klamath River Renewal Corporation (KRRC) for physical removal of four dam developments (Iron Gate, Copco No. 1, Copco No. 2, and J.C. Boyle), hereinafter the Project. The FMP requires that areas of construction and deconstruction work involving activities that could result in open sparks or flame be cleared of dried vegetation or wetted-down to prevent wildfires. The FMP also requires fire suppression equipment be on-site at all times and emergency contact numbers be posted, in case of a fire. With the removal of the reservoirs as a source of water for fighting wildfires, the Fire Management Plan also provides measures for potential alternative sources of water for firefighting.

The areas surrounding the four Klamath River dams are at risk of wildfires particularly during the dry season, and the risk of triggering a fire associated with construction and demolition activities necessitates the development and implementation of a fire management plan such as this FMP to prevent and respond to fires. California Department of Forestry and Fire Protection (Cal Fire) categorizes the fire threat in the region as high to very high (Cal Fire, 2007). Fire hazard mapping using the MODerate-resolution Imaging Spectroradiometers by the US Forest Service Remote Sensing Application Center (USFS 2010) shows the distribution of fire threats in the Klamath basin (Figure 1-1), and Klamath County has identified Wildland Urban Interfaces (WUI), where fire damage hazards are high (Wildland Fire Technologies, 2016). There is a ranking system associated with WUIs and J.C. Boyle Dam, which is partially located in the Keno WUI Community, has a WUI rating of High, the highest value in Klamath County.

Construction and dam removal activities potentially increase the risk of fire if not properly managed. Activities of concern include accidental spills of flammable material, spark generation in vegetated open space, use of equipment and machinery that generates heat such as welding, grinding, and use of generators. Agencies dealing with fire prevention and suppression in the region have developed regulations and management methods to combat the increased risk of fire associated with construction activities. KRRC developed the FMP in accordance with the standards of, and in consultation with the local, state, and federal fire suppression agencies. The following sections describe the relevant agencies, their jurisdictions and regulatory requirements, and the FMP components to ensure the safe execution of the Project.



Source: USBR 2012

Figure 1-1 Map of fire hazard in the Klamath River basin generated using the MODerate-resolution Imaging Spectroradiometers by the USFS.

Chapter 2: Fire Suppression Agencies

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2. FIRE SUPPRESSION AGENCIES

The FMP requires coordination with multiple city, county, state, and federal fire suppression agencies including USDA Forest Service (USFS), Bureau of Land Management (BLM), the Oregon Department of Forestry (ODF) Klamath-Lake District (KLD), Cal Fire - Siskiyou Unit (Cal Fire SU), local districts of Klamath and Jackson Counties in Oregon and Siskiyou County in California, and local city and volunteer fire stations (Table 2-1). Fire safety and suppression resources are available from the various agencies in the event of a fire.

Table 2-1 Fire protection agencies in the project vicinity

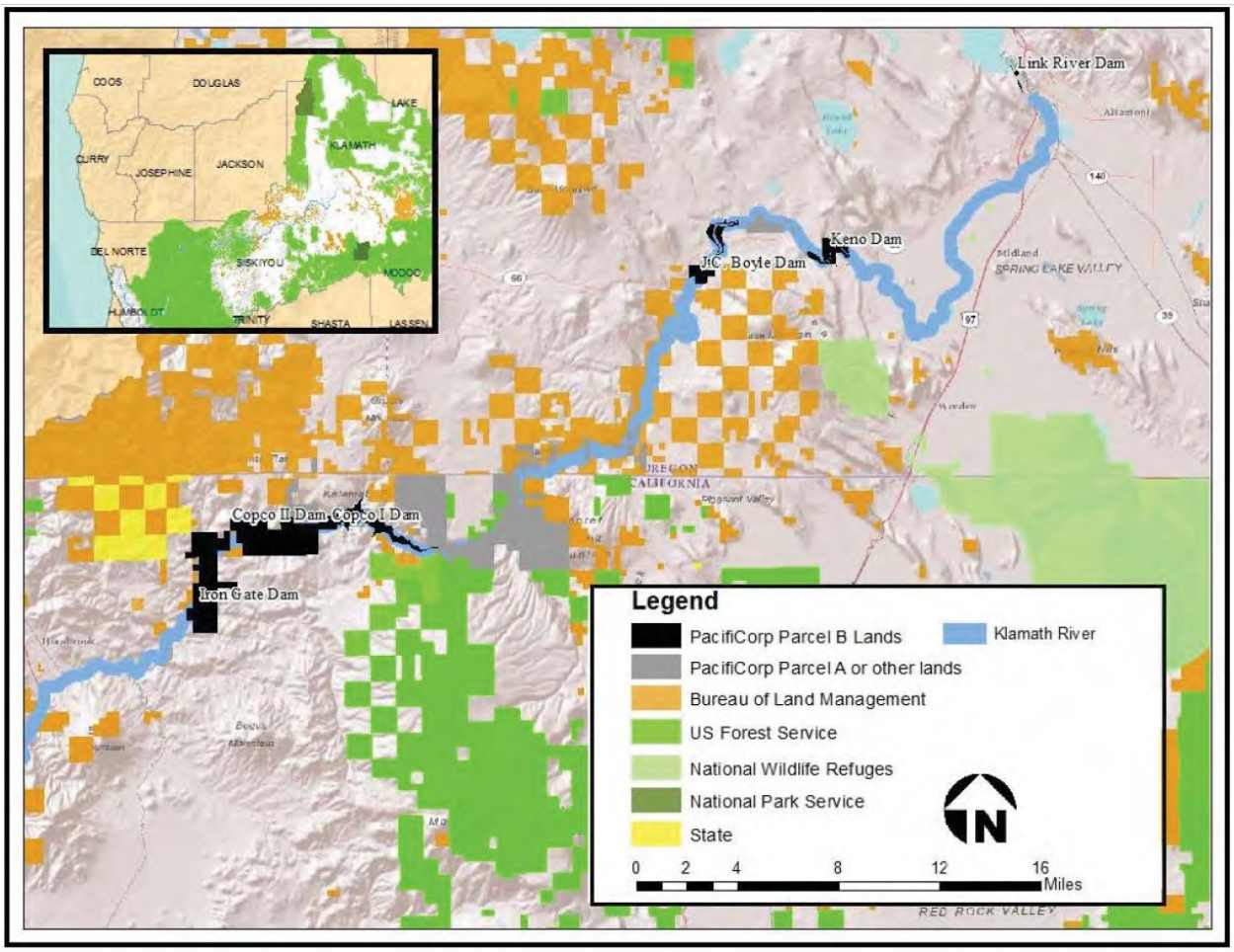
Agency	Type	Jurisdiction
USDA Forest Service	Federal	National Forests, federally managed land
Bureau of Land Management	Federal	BLM lands, federally managed land
Cal Fire	State of California	State Resource Lands, California
Oregon Department of Forestry	State of Oregon	State Resource Lands, Oregon, BLM land in Klamath River Canyon
Klamath County Fire District	Local, County of Klamath	Unincorporated County Lands and the City of Klamath Falls
Colestin Rural Fire District	Local, County of Jackson	County Fire District in Jackson County, Oregon
Siskiyou County Fire Protection Districts: Copco Lake, Hornbrook, Montague, South Yreka, Tulelake, Etna, Ft. Jones, Weed	Local, County	Unincorporated County Lands throughout Siskiyou County, California
Mount Shasta Fire Department	Local, City of Mount Shasta	Mt. Shasta Municipal Boundaries
Yreka Fire Department	Local, City of Yreka	City of Yreka Municipal Boundaries

Source: USBR and CDFW 2012

The USFS and BLM are the two federal agencies responsible for fire support and suppression in the Project vicinity. Both agencies provide wildfire protection primarily on land under their direct ownership and management but will provide support and assistance to other agencies when requested. Federal land near the Project limit of work is primarily limited to several BLM parcels along the Klamath River downstream of J.C. Boyle Dam and along Iron Gate and Copco reservoirs (Figure 2-1). BLM land near the Project limit of work in Oregon, including the Klamath River Canyon, is managed for fire by ODF KLD.

The Oregon and California State forestry and fire prevention agencies (ODF and Cal Fire) are the primary fire protection providers in the unincorporated areas in the Project limit of work. ODF and Cal Fire enforce their respective state laws and regulations and coordinate fire support with the local agencies. Cal Fire operates and works with local city, county, and volunteer fire departments. Fire management in Siskiyou County is operated as the Cal Fire SU. The Iron Gate and Copco developments are located within the Siskiyou County Unit Shasta Valley Battalion 2 area, and the Klamath River flows through Battalion 3. Cal Fire stations in the project vicinity include the City of Yreka and Hornbrook, which is located 10 miles west of Iron Gate Dam. The J.C. Boyle development in Oregon is under the jurisdiction of ODF KLD. The ODF KLD is a member of the South Central Oregon Fire Management Partnership (SCOFMP), which is a cooperative group of agencies including USFS, BLM, US Fish and Wildlife, and Crater Lake National Park. The SCOFMP shares resources to manage fire in the region, which primarily comprises Klamath and Lake Counties. Dispatch responsibilities for the SCOFMP are with the Lakeview Interagency Fire Center (LIFC).

The city-operated fire stations in the region include the Yreka and Mount Shasta Fire Departments in California. Many county fire stations are present throughout the project vicinity, and are associated with Klamath and Jackson counties in Oregon and Siskiyou County in California (Table 2-1).



Source: USBR and CDFW 2012

Figure 2-1 Land ownership in the project vicinity. Figure from EIS/R (2012).

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Chapter 3: Regulations and Requirements

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3. REGULATIONS AND REQUIREMENTS

KRRC developed this FMP to meet the regulations and requirements set forth by the fire suppression agencies in the Project vicinity (Figure 2-1). Most of the dam deconstruction and reservoir management will take place on private land. ODF and Cal Fire handle state regulations for fire management with regard to various construction related activities. BLM and USFS manage their respective lands, and those regulations only need to be met for construction taking place on federal land. There are several BLM parcels along the Klamath River adjacent to and in the Project limits of work. In Oregon, ODF KLD manages the BLM lands east of the Cascades crest and west of Hwy 97 and regulates them for fire according to ODF rules. This area includes the Klamath Canyon project area. In California, a few BLM parcels are located near the Copco project footprint. In these locations, BLM generally defers to restrictions corresponding to the Predicted (or Designated) Activity Levels (PALs) set by the USFS Klamath National Forest and relies on Cal Fire for direct protection responsibilities (Brodhead, L., personal communication 2017.08.29). For logging operations on BLM land in California, contractual fire prevention and suppression measures vary between projects but must typically conform to general Cal Fire and USFS regulations and the input from a BLM Authorized Agent assigned to the contract (Brodhead, L., personal communication 2017.08.29). The USFS owns land that is near Copco reservoir but outside of the project footprint. Therefore, the FMP does not address specific USFS fire prevention and suppression requirements outlined in the Code of Federal Regulations (CFR).

3.1 Oregon Department of Forestry – Klamath Lake Unit

Oregon law prescribes regulations and minimum requirements for fire prevention and suppression that are applicable in each ODF Fire Protection District during fire season. In Oregon, fire season is declared by each ODF district and is typically between early June and mid- to late-October. Table 3-1 lists the laws and requirements for all ODF districts.

ODF districts west of the Cascades crest have industrial operations requirements and restrictions that correspond to four adjective classes Industrial Fire Precautionary Levels (IFPL). A different system is in place for ODF districts east of the Cascades crest, such as the ODF KLD. Construction operations must follow the regulations in Table 3-1 for all levels of fire danger during fire season. Additional restrictions are enforced when fire hazard is classified as “extreme.” ODF does not have general restrictions or requirements when work is performed outside of the fire season.

If required by Oregon law ORS 477.625, KRRC’s contractor will obtain a permit for Power-Driven Machinery (PDM) from the ODF state forester for construction activities that involve heavy machinery. Fire prevention requirements under the PDM permit are dependent on the Fire Danger Level (FDL) and requirements for fire

prevention and suppression preparedness relate to the type of machinery and fire hazard. The PDM permit requirements are more restrictive during "Extreme" adjective class FDL and include the suspension of the operation of tracked machinery between the hours of 1 pm and 8 pm ((ORS 477.625(1a), OAR 629-043-0026(5)). The Project will use tracked equipment and, if a PDM permit is required, such use will be subject to these restrictions during extreme fire danger. ODF typically informs PDM permit holders of changes in fire hazard and operation requirements. PDM permits expire at each new calendar year and KRRC's contractor will renew a PDM as necessary.

The ODF forester can grant waivers from the fire prevention and suppression requirements, including the PDM permit, in some instances. Waivers may be granted for favorable weather conditions, topographic setting, and/or alternate methods and equipment proposed by the operator that provide equal or better fire prevention and suppression.

Table 3-1 2017 ODF fire season minimum requirements

Category	Reference	Requirement
No Smoking	ORS 477.510	No smoking while working or traveling in an operation area
Hand Tools	ORS 477.655, OAR 629-043-0025	Supply hand tools for each operation site - 1 tool per person with a mix of pulaskis, axes, shovels, hazel hoes. Store all hand tools for fire in a sturdy tool box clearly identified as containing firefighting tools. Supply at least one box for each operation area. Crews of 4 or less are not required to have a fire tools box as long as each person has a shovel, suitable for fire-fighting and available for immediate use while working on the operation.
Fire Extinguishers	ORS 477.655, OAR 629-43-0025	Each internal combustion engine used in an operation, except power saws, shall be equipped with a chemical fire extinguisher rated as not less than 2A:10BC (5 pound).
Power Saws	ORS 477.640, OAR 629-043-0036	Power saws must meet Spark Arrester Guide specifications - a stock exhaust system and screen with < .023 inch holes. The following shall be immediately available for prevention and suppression of fire: • One gallon of water or pressurized container of fire suppressant of at least eight ounce capacity • One round pointed shovel at least 8 inches wide with a handle at least 26 inches long • The power saw must be moved at least 20' from the place of fueling before it is started.
Fire Tools, Extinguishers for Trucks	ORS 477.655, OAR 629-043-0025	Equip each truck driven in forest areas for industrial purposes with: • One round pointed shovel at least 8 inches wide, with a handle at least 26 inches long • One axe or Pulaski with 26 inch handle or longer • One fire extinguisher rated not less than 2A:10BC (5 pound).

Category	Reference	Requirement
Spark Arresters and Mufflers	ORS 477.645, OAR 629-043-0015	All non-turbo charged engines must meet Spark Arrester Guide specifications except: • Fully turbo charged engines. • Engines in motor vehicles operating on improved roads equipped with an adequate muffler and exhaust system. • Engines in light trucks (26,000 GVW or less) that are equipped with an adequate muffler and an exhaust system. • Engines in heavy trucks (greater than 26,000 GVW) that are equipped with an adequate muffler and exhaust system. • If a truck engine is not fully turbo-charged, then the exhaust must extend above the cab and discharge upward or to the rear, or to the end of the truck frame. • Water pumping equipment used exclusively for fighting fire. • Engines of 50 cubic inch displacement or less, except ATV's and motorcycles, shall be equipped with an adequate muffler and an exhaust system. • Engines in ATV's and motorcycles must be equipped with an adequate muffler and exhaust system or an approved screen, which completely encloses exhaust system. • Power saws. (See power saw requirements)
Pump, Hose, and Water Supply	ORS 477.650, 477.625, OAR 629-043-0026, 629-43-0020	Supply a pump, hose and water supply for equipment used on an operation. • Pump must be maintained ready to operate and capable to provide a discharge of not less than 20 gallons per minute at 115 psi at pump level. Note: Volume pumps will not produce the necessary pressure to effectively attack a fire start. Pressure pumps are recommended. • Water supply shall be a minimum of 300 gallons if a self-propelled engine. Water supply shall be a minimum of 500 gallons if not self-propelled (pond, stream, tank, sump, etc.) • One water supply is adequate as long as the operator can deliver water to the fire within 10 minutes • Provide enough hose (500 feet minimum) not less than 3/4" inside diameter to reach areas where power driven machinery has worked. Note: Should a fire occur, the operator must be able to position the water supply in a location where enough hose is available to reach the area worked by power driven machinery. This includes mobile equipment as well as motorized carriages and their moving lines. Moving lines are defined as main lines and haul back lines. This can be achieved in many ways, including the practice of having a water tank and hose attached to a piece of equipment, like a skidgen or skidder, that can get the water to the fire. • Water supply, pump, and at least 250' of hose with nozzle must be maintained as a connected, operating unit ready for immediate use.

Category	Reference	Requirement
Fire Watch Service	ORS 477.665, OAR 629-043-0030	Each operation area is to have a fire watch. Fire watch shall be on duty during any breaks (up to 3 hours) and for three hours after all power-driven machinery used by the operator has been shut down for the day. The ODF KLD has specific fire watch duration prescriptions based on Fire Danger Level adjective class. • Low = 1 hr fire watch • Moderate = 2 hrs • High to Extreme = 3 hrs Fire watch shall: • Be physically capable and experienced to operate firefighting equipment. • Have facilities for transportation and communications to summon assistance. • Observe all portions of the operation on which activity occurred during the day. Upon discovery of a fire, Fire watch personnel must: First report the fire, summon any necessary firefighting assistance, describe intended fire suppression activities and agree on a checking system; then, after determining a safety zone and an escape route that will not be cut off if the fire increases or changes direction, immediately proceed to control and extinguish the fire, consistent with firefighting training and safety.
Operation Area Fire Prevention	ORS 477.625, OAR 629-043-0026	• Keep all power driven machinery free on excess flammable material which may create a risk of fire. • Avoid line-rub on rock or woody material, which may result in sparks or sufficient heat to cause ignition of a fire. • Disconnect main batteries from powered components (other than what may be necessary to retain computer memory) through a shut-off switch or other means or leave equipment on ground cleared of flammable material.

Source: ODF 2010, 2017

3.2 Cal Fire – Siskiyou Unit

California law prescribes regulations and minimum requirements for fire prevention and suppression that are applicable during fire season in all lands within the Cal Fire jurisdiction. The California Public Resources Code (PRC) requires preventative fire measures (Table 3-2) that are imposed during the time where a Burn Permit is required under PRC-4423. For Zone B, which includes northern California counties, this period usually begins May 1 and persists until proclamation of the termination of fire season by the fire director. Cal Fire does not require a permit for the use of equipment and heavy machinery on a construction site. State forest and fire laws may be enforced by USFS, BLM, NPS, and certain county fire departments in addition to Cal Fire personnel. The California Code of Regulations (CCR) has specific and generally applicable regulations that pertain to fire prevention and suppression, e.g., requirements for smoking during fire season, but no associated permits are required. The CCR, PRC, and FRC regulations pertaining to

construction sites and logging operations in California and the associated best management practices are described in detail in the Cal Fire Industrial Operations Fire Prevention Field Guide (1999).

Table 3-2 California Public Resources Code Fire precautionary measures*

Category	Reference	Requirement
Fire Causing Equipment	PRC-4427	No person shall use or operate any motor, engine, boiler, stationary equipment, welding equipment, cutting torches, tarpots, or grinding devices from which a spark, fire, or flame may originate, which is located on or near any forest-covered land, brush-covered land, or grass-covered land, without doing both of the following: a. First clearing away all flammable material, including snags, from the area around such operation for a distance of 10 feet. b. Maintain one serviceable round point shovel with an overall length of not less than 46 inches and one backpack pump water-type fire extinguisher fully equipped and ready for use at the immediate area during the operation. This section does not apply to portable powersaws and other portable tools powered by a gasoline-fueled internal combustion engine.
Use of Internal Combustion Engines	PRC-4428	No person shall use or operate any vehicle, machine, tool or equipment powered by an internal combustion engine operated on hydrocarbon fuels, in any industrial operation located on or near any forest, brush, or grass-covered land between April 1 and December 1 of any year, or at any other time when ground litter and vegetation will sustain combustion permitting the spread of fire, without providing and maintaining, for firefighting purposes only, suitable and serviceable tools. a. A sealed box of tools shall be located, within the operating area, at a point accessible in the event of fire. This fire toolbox shall contain: one backpack pump-type fire extinguisher filled with water, two axes, two McLeod fire tools, and a sufficient number of shovels so that each employee at the operation can be equipped to fight fire. b. One or more serviceable chainsaws of three and one-half or more horsepower with a cutting bar 20 inches in length or longer shall be immediately available within the operating area, or, in the alternative, a full set of timber-felling tools shall be located in the fire toolbox, including one crosscut falling saw six feet in length, one double-bit ax with a 36-inch handle, one sledge hammer or maul with a head weight of six, or more, pounds and handle length of 32 inches, or more, and not less than two falling wedges. c. Each rail speeder and passenger vehicle shall be equipped with one shovel and one ax, and any other vehicle used on the operation shall be equipped with one shovel. Each tractor used in such operation shall be equipped with one shovel.

Category	Reference	Requirement
Fire Fighting Tools	PRC-4429	In an area of any industrial or other operations on or near any forest-covered land or brush-covered land, there shall be provided and maintained at all times, in a specific location, for firefighting purposes only, a sufficient supply of serviceable tools to equip 50% of the able-bodied personnel for fighting fires. • Tools shall be included shovels, axes, saws, backpack pumps, and scraping tools. • One serviceable headlight adaptable for attachment to at least one-half of the tractor-bulldozers used on the operation. • A sufficient number of canteens and flashlights to equip a third of the able-bodied personnel.
Water Pumps	PRC-4430	The use or operation of any steam-operated engine or machine equipment, located on or near forest-covered land or brush-covered land, requires • One adequate force pump or water under pressure equivalent to a pump, and not less than 200 feet of hose not less than one inch in diameter for each steam-operated engine or equipment. • The pump or water pressure shall be capable of applying a minimum of 40 pounds pressure at the nozzle on 200 feet of hose, such nozzle to be 0.25 inch or larger in diameter. • If two steam-operated engines or steam equipment are customarily operated within 100 feet of each other, only one engine or piece of equipment need be equipped with pump and hose.
Gas Powered Saws	PRC-4431	No person shall use or operate or cause to be operated any portable saw, auger, drill, tamper, or other portable tool powered by a gasoline-fueled internal combustion engine on or near any forest-covered land, brush-covered land, or grass-covered land, within 25 feet of any flammable material, without providing and maintaining at the immediate locations of use or operation of the saw or tool, for firefighting purposes one serviceable round point shovel, with an overall length of not less than 46 inches, or one serviceable fire extinguisher. The type and size of fire extinguisher necessary to provide at least minimum assurance of controlling fire caused by use of portable power tools under various climatic and fuel conditions shall be specified in regulations issued by the Director of Forestry and Fire Protection. The required fire tools shall at no time be farther from the point of operation of the power saw or tool than 25 feet with unrestricted access for the operator from the point of operation.

Category	Reference	Requirement
Spark Arresters	PRC-4442	a. No person shall use, operate, or allow to be used or operated, any internal combustion engine which uses hydrocarbon fuels on any forest-covered land, brush-covered land, or grass-covered land unless the engine is equipped with a spark arrester maintained in effective working order or the engine is constructed, equipped, and maintained for the prevention of fire. b. Spark arresters affixed to the exhaust system of engines or vehicles shall not be placed or mounted in such a manner as to allow flames or heat from the exhaust system to ignite any flammable material. c. A spark arrester is a device constructed of nonflammable materials specifically for the purpose of removing and retaining carbon and other flammable particles over 0.0232 of an inch in size from the exhaust flow of an internal combustion engine that uses hydrocarbon fuels or which is qualified and rated by the United States Forest Service. d. Engines used to provide motor power for trucks, truck tractors, buses, and passenger vehicles, except motorcycles, are not subject to this section if the exhaust system is equipped with a muffler. e. Turbocharged engines are not subject to this section if all exhaust gases pass through the rotating turbine wheel, there is no exhaust bypass to the atmosphere, and the turbocharger is in effective mechanical condition.
Exclusion of Outdated, Handheld Internal Combustion Equipment	PRC-4443	No person shall use, operate, or cause to be operated on any forest-covered land, brush-covered land, or grass-covered land any handheld portable, multi-position, internal-combustion engine manufactured after June 30, 1978, which is operated on hydrocarbon fuels, unless it is constructed and equipped and maintained for the prevention of fire.

** Measures are applicable during any times of the year when burning permits are required unless otherwise stated.*

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Chapter 4: Contacts

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4. CONTACTS

KRRC's contractor will be in frequent contact with the pertinent fire suppression agencies during construction to discuss fire hazards, prevention, suppression, and contingency plans. KRRC's contractor and a designated Safety Officer will identify the nearest local fire stations to the current operation areas and ensure the emergency contact information for each agency is posted at the project site and available to fire watch personnel and on-site workers.

In Oregon, the primary contact agency is ODF KLD. KRRC's contractor will contact the ODF KLD Unit Forester and Stewardship Forester during development of detailed, site-specific fire management plans to identify fire management resources in the Project vicinity. ODF KLD will be the first agency contacted in the event of a fire on the Oregon portion of the Project.

In California, the primary contact agency is Cal Fire SU. KRRC's contractor will contact the Cal Fire SU Prevention Specialist during development of detailed, site-specific fire management plans to identify resources in the Project vicinity. Cal Fire SU will be the first agency contacted in the event of a fire on the California portion of the Project.

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Chapter 5: Fire Management Plan

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5. FIRE MANAGEMENT PLAN

5.1 Responsibilities

KRRC's contractor will designate an individual as "Safety Officer" to be available and on-call 24 hours a day, 7 days a week in the event of a fire at the project site. The Safety Officer will be the primary on-site communication linkage to ODF and Cal Fire foresters and will be responsible for managing all on-site fire prevention and suppression documentation, including the contact information for local emergency services, such as local fire departments and hospitals. The Safety Officer will be responsible for instructing other workers in the required fire prevention and suppression measures, including the use of fire suppression equipment and the protocols in the event of a fire, and for communicating current fire hazards and any changes in prevention and suppression methods on a daily basis. KRRC's contractor will clearly post a table of emergency contact agencies, their jurisdictions, and phone numbers at each project site. The Safety Officer will ensure that all fire suppression equipment is well-maintained and located in proper position within the construction site.

In the event of a fire, the Safety Officer will immediately contact LIFC dispatch and ODF KLD in Oregon or Cal Fire SU in California and subsequently any other pertinent fire suppression agencies and the Federal Energy Regulatory Commission local office as appropriate. The Safety Officer will then initiate fire suppression protocols and command fire control activities on the site until relieved by fire suppression professionals. The goal is to immediately and aggressively extinguish any fire that occurs during the Project without sacrificing the safety of workers. If the Safety Officer judges equipment on-site incapable of suppressing the fire, the Safety Officer will initiate an evacuation of the project site.

KRRC's contractor and Safety Officer will work with ODF KLD and Cal Fire SU foresters to develop broad scale contingency plans for fire containment within their respective jurisdictions in the Project areas. KRRC's contractor will meet regularly with ODF KLD and Cal Fire SU foresters to discuss Project progress and updates as they pertain to fire prevention and suppression. The Safety Officer will continuously evaluate the location, condition, and importance of existing fuel breaks and will alert the relevant fire suppression agencies if fuel breaks need to be modified. KRRC's contractor and Safety Officer will identify the location of water resources for fire suppression, and KRRC's contractor will inform the ODF KLD and Cal Fire SU foresters of any modifications to existing water resources due to dam removal activities, e.g., the drawdown of the reservoirs.

5.2 Fire Prevention and Suppression Measures and Equipment

This FMP includes fire prevention and response methods that are consistent with the policies and standards of the various local, county, state, and federal jurisdictions. KRRC's contractor will take precautionary, pre-suppression, and suppression measures to ensure public safety in the Project vicinity and comply with the

fire season regulations and requirements set forth by ODF (Table 3-1) and Cal Fire (Table 3-2). KRRC's contractor will work closely with the ODF KLD Unit Forester and Stewardship Forester and the Cal Fire SU Forester to develop effective communication links, evolving plans for fire prevention and suppression, and suppression actions in the event of a fire. ODF KLD will likely assign a Stewardship Forester to the Project for the duration of the Project.

If required by ORS 477.625, KRRC's contractor will obtain an ODF PDM permit. Operation hours of tracked machinery are limited by the PDM permit during extreme fire danger, and KRRC's contractor will suspend operation of these machines between the hours of 1 pm to 8 pm when required. KRRC's contractor will take additional measures to keep machinery and the work area clear of excess flammable material. If acquired, KRRC's contractor will renew the PDM permit annually, if needed, until Project completion. California does not have restrictions on the hours of operation of equipment and machinery.

A fire watch will take place on work breaks and following the completion of each work day to monitor the Project limit of work for fire. The Safety Officer will train the fire watchman in the appropriate responses in the event of a fire. ODF KLD prescribes fire watch duration based on FDL. Low fire danger requires a 1-hour fire watch, medium requires 2 hours, and high and extreme require 3 hours. ODF alerts all PDM permit holders of upcoming changes in FDL.

A primary feature of this FMP is preparedness for fire prevention and response in compliance with Oregon and California state regulations (Table 3-1 and Table 3-2, respectively). All construction vehicles and crews will be outfitted with the appropriate type and number of fire suppression tools, including but not limited to shovels, axes, and fire extinguishers. All vehicles and machinery will be equipped with functional spark arresters and/or mufflers, where applicable, and KRRC's contractor will routinely clean spark arrester ports. Gas powered saws, if operated at the Project, will maintain the fire suppression equipment prescribed by Oregon and California. Water pumping systems conforming to the Oregon and California requirements for water volume, hose dimensions, and pumping rates will be located on-site to suppress fires. The Safety Officer will develop best management practices for smoking in accordance with ORS and CCR regulations.

KRRC's contractor and Safety Officer will conduct work using best management practices in addition to compliance with all federal, state, and local laws. KRRC's contractor will establish communication lines to the various fire suppression agencies, particularly ODF KLD and Cal Fire SU. KRRC's contractor will maintain all equipment to the working standards of the manufacturer and keep them clean of flammable material and debris. This includes ensuring that the batteries and hydraulic and fuel lines are in good condition. Equipment will be stored overnight in locations cleared of flammable material. KRRC's contractor will clear work areas of dried vegetation to reduce risk of fire.

5.3 Additional Areas of Concern

Local and regional weather patterns and antecedent moisture conditions can significantly impact fire hazards and fire behavior. Lightning is a leading cause of wildfire in Siskiyou County, and most of the larger fires are categorized as wind-driven fires (Siskiyou County, 2016). Current and antecedent temperature and

precipitation conditions directly influence the amount and condition of fuels. KRRC's contractor will consult with ODF KLD and Cal Fire SU foresters about anticipated weather conditions that may increase fire hazards and frequently update operations and fire response plans to changing environmental conditions. It is possible for favorable weather conditions to result in ODF KLD foresters granting waivers of certain fire prevention and suppression requirements.

KRRC's contractor will consult local and state fire management plans where available and communicate with local and state fire suppression agencies to identify existing resources and infrastructure in the Project areas that are at risk in the event of a fire.

Table 5-1 Fire services in the project vicinity

County	Fire Protection Services
Siskiyou County, CA	Fire protection is provided by 9 incorporated cities fire protection districts: Yreka, Fort Jones, Etna, Weed, Mt. Shasta, Dorris, Dunsmuir, Montague, and Tulelake. Other nearby fire protection districts and stations in Siskiyou County include Copco Lake Fire Protection District, Hornbrook Fire Protection District, Butte Valley Fire Protection District, Mayten Fire Protection District, and Grenada Fire Protection District. (Siskiyou County, 2016)
City of Yreka, CA	Fire services are provided by the Yreka Fire Volunteer Department (City of Yreka 2010d; City of Yreka 2010e).
Klamath County, OR	Klamath County is served by 17 fire districts including Klamath County Numbers 1 through 5, Keno, Chiloquin, Central Cascades, Crescent, Oregon Outback, Chemult, Bonanza, Bly, Malin, and Merrill (Klamath County, 2016).
Jackson County, OR	Fire protection services provided by Jackson County include Ashland and Medford Fire and Rescue Stations and Jackson County Fire District Stations. Nearby services are provided by Colestin Rural Fire Protection District and Greensprings Rural Fire District.

5.4 Fire Suppression Resources

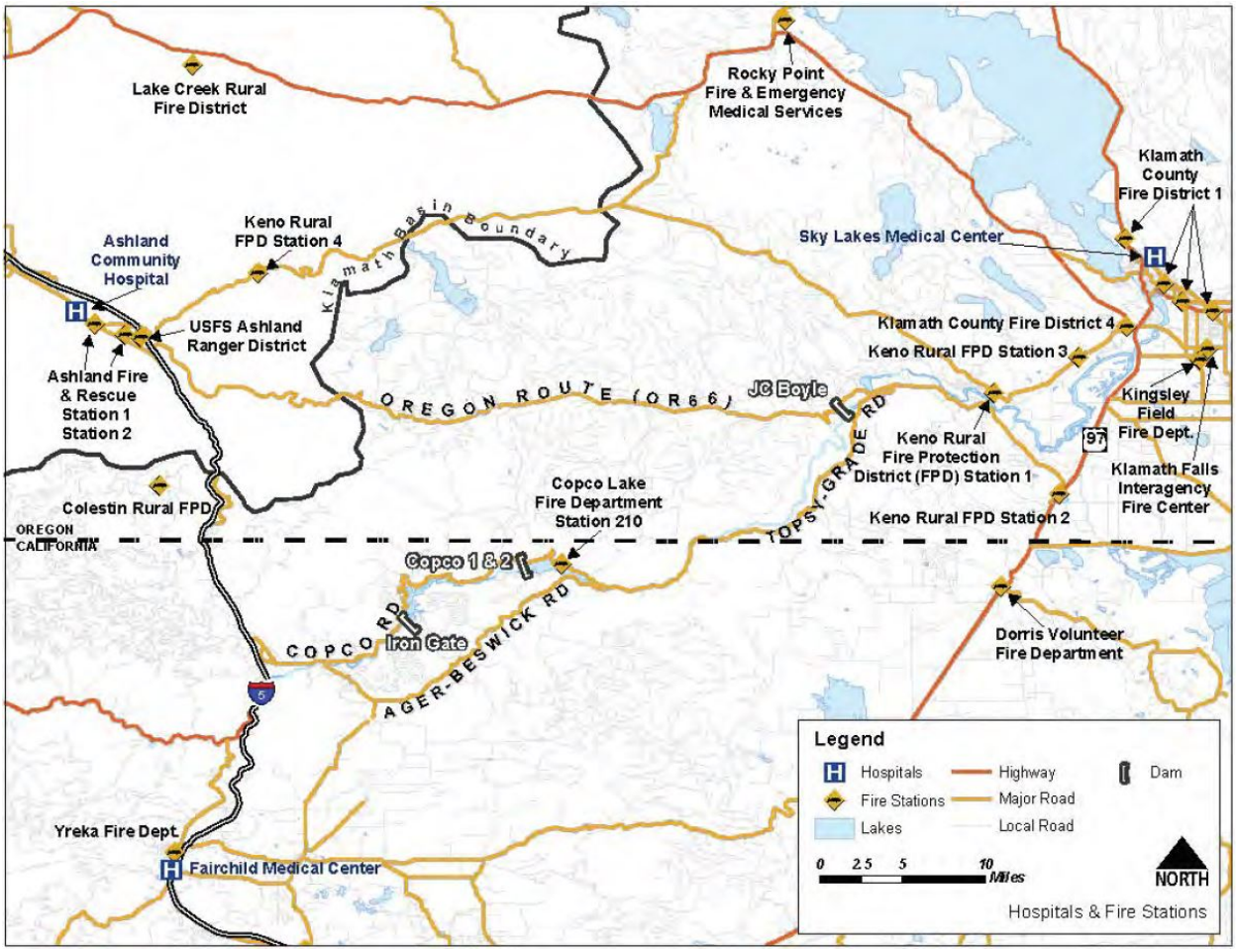
KRRC's contractor will work with local and state fire agencies to locate necessary fire suppression infrastructure and emergency resources. Several of the fire suppression agencies have fire management and suppression plans that identify resources at risk and resources for fire suppression within their respective jurisdictions and outline protocols that would be initiated in the event of a fire. SCOFMP has developed a plan and set of operation protocols for fire support in the area (South Central Oregon Fire Management Partnership, 2015). Klamath County has a Community Wildfire Protection Plan document and companion database to support wildfire prevention and suppression planning efforts in the county (Wildland Fire Technologies, 2016). Cal Fire SU has a Unit Strategic Fire Plan that describes fire prevention goals and resources and guides fire management and fire suppression tactics (Siskiyou County, 2016).

KRRC's contractor and Safety Officer will provide the location of nearby fire stations, hospitals, access roads, evacuation routes, and water sources (Figure 5-1) to all employees. Due to the rural nature and the low

concentration of roads in the area, most roads are used as evacuation routes in the event of fire or other emergencies. The Safety Officer will ensure that water tanks intended for fire suppression are full during operation hours and the fire watch period at the end of each work day. KRRC's contractor will identify the location of and access to the closest water sources in the event fire suppression tanks need to be refilled during fire suppression. The Safety Officer will communicate with local fire suppression agencies to identify water sources (e.g., fire hydrants, reservoirs, rivers) and access points proximal to the operation areas, and supplement scarce water resources with water storage tanks as needed.

In the California Project vicinity, Cal Fire SU provides fire suppression resources and coordinates with additional local fires suppression entities (Table 5-1). It has a Cal Fire- and USFS-staffed Emergency Command Center located at the Siskiyou Unit Headquarters in Yreka that handles dispatching services for Cal Fire, USFS, 30 local government departments, and 5 ambulance companies (Siskiyou County, 2016). The Cal Fire SU is divided into 4 battalions, and the Project limit of work is in Battalion 2 (Shasta Valley), which has Cal Fire stations in Yreka and Hornbook. For the Copco and Iron Gate dams, the closest fire stations in the area are the Copco Lake Fire Department Station 210, which services the area surrounding the Copco 1 reservoir, and the Yreka Fire Department. Jackson County, Oregon, has several nearby fire districts, including Ashland and Jackson County Fire Districts and Colestin Rural Fire District that can provide additional fire suppression resources.

In the Oregon Project vicinity, ODF KDL is primarily responsible for organizing fire prevention and suppression; and stations and districts that service Oregon are in Table 5-1. ODF KLD operates within the SCOFMP and shares resources and responsibilities with the other agencies therein. LIFC handles dispatch responsibilities for SCOFMP. Klamath County has 17 fire districts and 30 fire stations. Jackson County has several nearby fire districts also capable of providing fire suppression resources, including Greensprings Rural Fire District, Jackson County Fire Districts, and Ashland fire stations. For J.C. Boyle Dam, the closest station is the Keno Rural Fire Protection District (FPD) Station 1.



Source: USBR 2012

Figure 5-1 Map of hospitals, fire stations, and major fire routes near the Klamath Dams

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Chapter 6: Water Supply Assessment Post-Dam Removal

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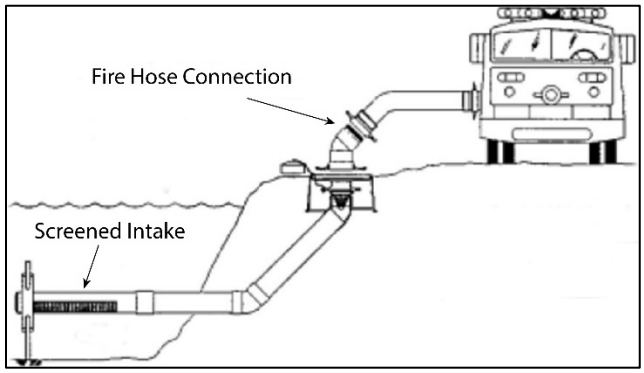
6. WATER SUPPLY ASSESSMENT POST-DAM REMOVAL

The reservoirs provide a source of water for helicopter fire suppression crews fighting fires in the Project vicinity, and this resource will be reduced following removal of the dams and drawdown of the reservoirs. Following removal, helicopter crews will be able to extract water from the Klamath River (both the current channel and the channel reaches to be exposed in the current reservoirs following drawdown), Ewauna Lake, and Upper Klamath Lake (USBR and CDFW 2012). However, most helicopter water tanks require 3 feet of water depth to be filled, so helicopters will be able to use only certain portions of the Klamath River. Response and travel times between water tank fills for helicopter crews are expected to increase following reservoir drawdown (USBR and CDFW 2012). Fire suppression efforts near J.C. Boyle will not experience significant increases in travel time given that Ewauna and Upper Klamath Lakes are located approximately 13 miles away. With typical fire-fighting helicopter speeds between 90 and 140 mph (Jarrell, J., personal communication 2017.09.25), increases in round-trip travel time will be a maximum of 15 minutes after removal of J.C. Boyle. Analysis of aerial photos shows the presence of deep pools with suitable conditions for helicopter filling in the currently free-flowing reaches of the Klamath River around three reservoirs, particularly in the reaches between Copco and J.C. Boyle reservoirs and downstream of Iron Gate Dam. Maximum travel time increases to utilize the Klamath River for refilling are also expected to be on the order of 15 minutes, and potentially even less if pools are present in the former reservoirs post-removal.

To compensate for the loss of reservoir water supply, KRRC will develop additional water supplies and access points for fire suppression following the removal of the dams. Flows in the Klamath River and tributaries will not change post-removal, so firefighting crews can still use the river as a water supply. The potential of pool features for helicopter water filling will be evaluated in the field and used to generate a map of resources that can be used by air-based firefighting crews. To assist ground-based firefighting efforts, this FMP proposes the development of sites for installation of permanent dry hydrants from which water trucks and fire engines could draw directly from the Klamath River and larger tributaries. Dry hydrants are passive, unpressurized systems with a screened intake placed in the channel above the channel bed in a location of satisfactory depth (during dry conditions), flow rate, and channel stability and an above-ground fire hose connection to which truck-mounted pumps can be connected (Figure 6-1). Dry hydrants are commonly used as water supply for fighting fires in rural areas. Typical dry hydrants and fire truck pumps can supply over 1,500 gallons per minute, which is sufficient for rapid filling of typical water tankers and firefighting apparatus.

Potential sites for the dry hydrants were selected that leverage existing, permanent infrastructure (e.g., fire stations, bridges, roads, boat launches), offer proximity and ease of access to current or anticipated post-removal Klamath River or tributary channels, and are within PacifiCorp or state-owned property boundaries. Bridges and crossings are desirable given the increased certainty of access to water post-removal and the

ability to utilize the structure for mounting the dry hydrant rather than excavating earthen material for pump installation.



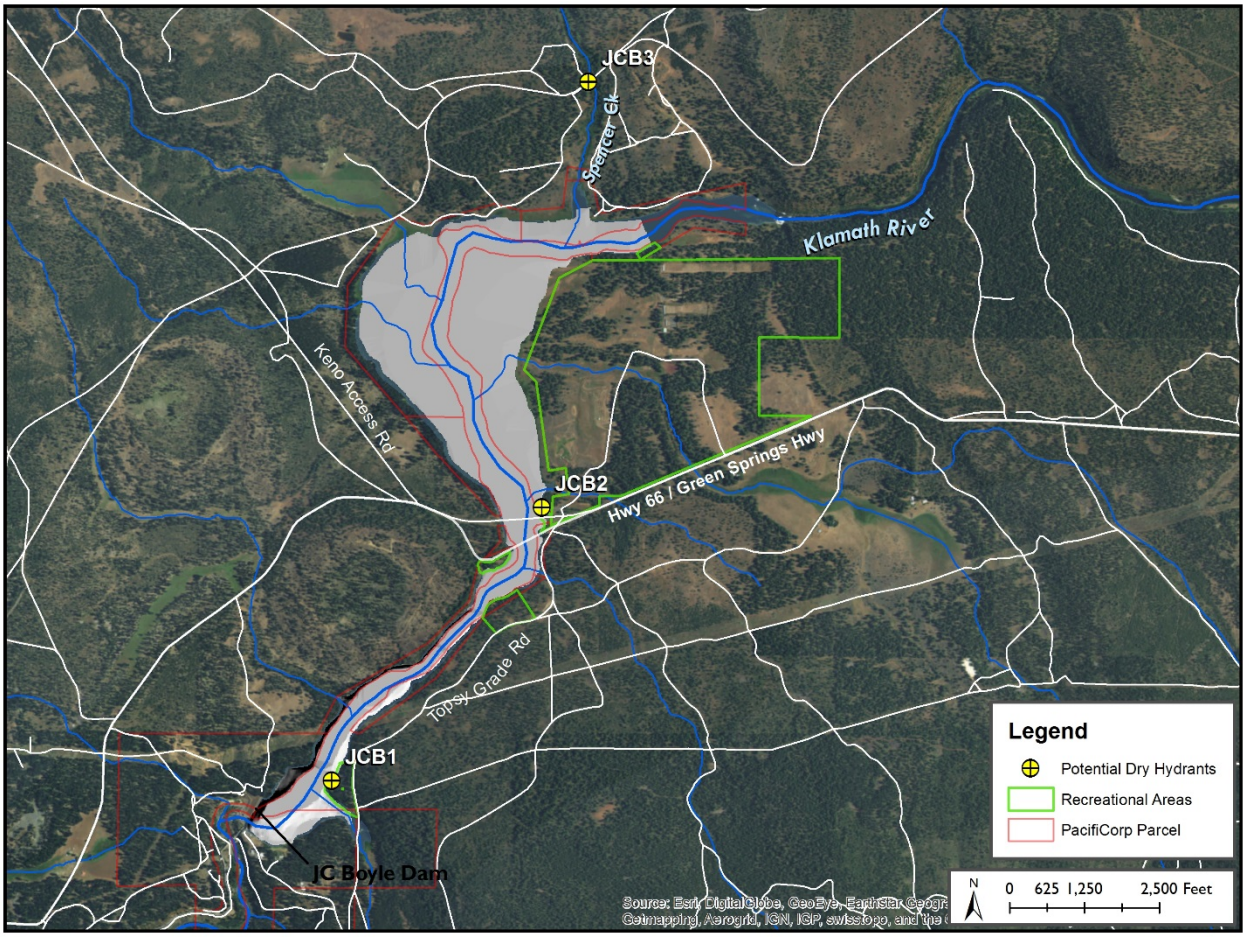
Adapted from ettfire.com

Figure 6-1 Diagram of dry hydrant system

At J.C. Boyle, three potential dry hydrant locations were identified (Figure 6-2). JCB1 is sited at Topsy Campground along Topsy Grade Road, where the valley is wider and more accessible. JCB2 is located on Highway 66 and could utilize the bridge for dry hydrant placement. JCB3 is located at a bridge over Spencer Creek, which maintains sufficient flow rate in the summers for dry hydrant pumping.

At Copco and the reach of the Klamath River upstream of Copco Lake, eight potential dry hydrant sites were identified (Figure 6-3). Access to the mainstem Klamath River upstream of Copco No. 1 after removal will be limited if the channel reoccupies the historical alignment as predicted. The historical Klamath River had a sinuous planform, and the mainstem will likely be either far from existing roads or difficult to access because of steep, high relief bluffs particularly near the Copco No. 1 Dam site.

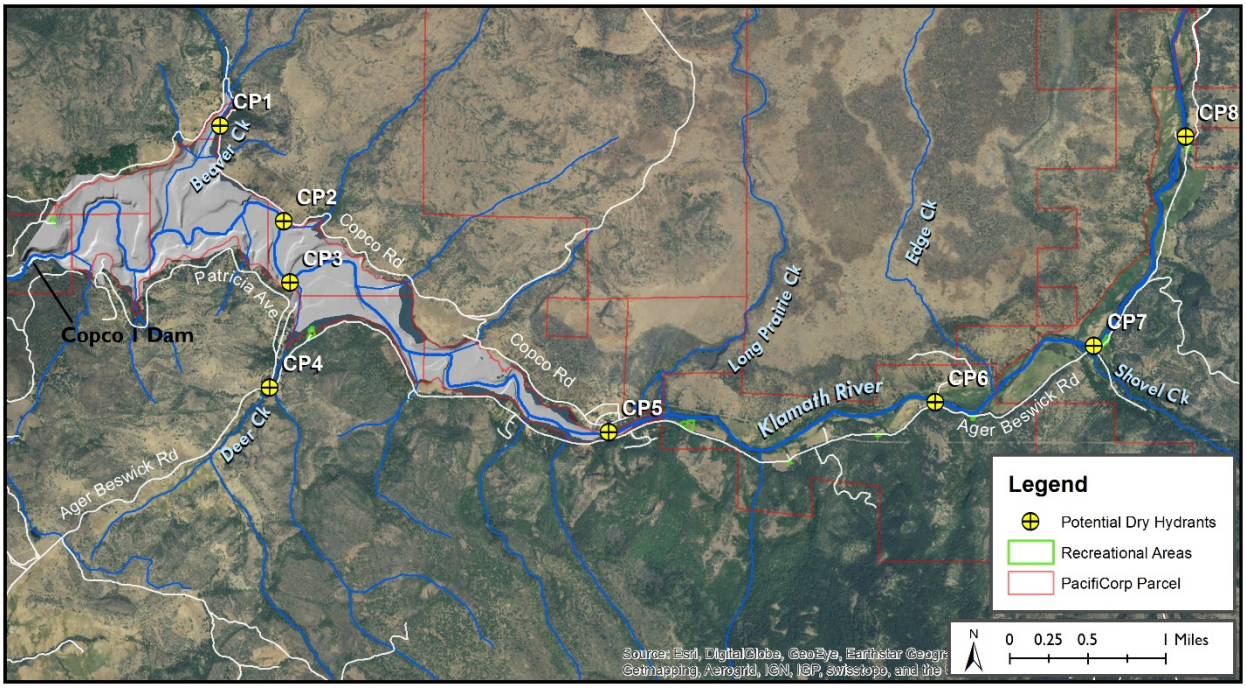
CP1 is located along Copco Road adjacent to where Beaver Creek is expected to run post-removal, but, if flow is sufficient, could be moved to where Copco Road crosses Beaver Creek upstream of the confluence with East Beaver Creek. CP2 is along the historical Klamath River and Copco Road downstream of Raymond Gulch at a location where the valley topography is locally expected to be less steep. CP3 is located near the historical confluence of the Klamath River and Deer Creek off Patricia Avenue, where historic topography is locally less steep and a Copco Lake Fire Station is nearby. CP4 is sited where Ager Beswick Road crosses Deer Creek. CP5 is at the Copco Road bridge over the Klamath River at the eastern margin of the reservoir and is situated adjacent to the Copco Lake Fire Department Station A. CP6 is located on a bridge over the Klamath River upstream of the current influence of the dam that is accessible off Ager Beswick Road. CP7 is located on a small bridge over the Klamath River off Ager Beswick Road and immediately upstream of the Shovel Creek confluence. CP8 is located at a fishing access area off Ager Beswick Road where a rapid holds grade to maintain a deeper pool for water extraction.



Historical topographic surface beneath the reservoir and historic Klamath River centerline are shown for reference.

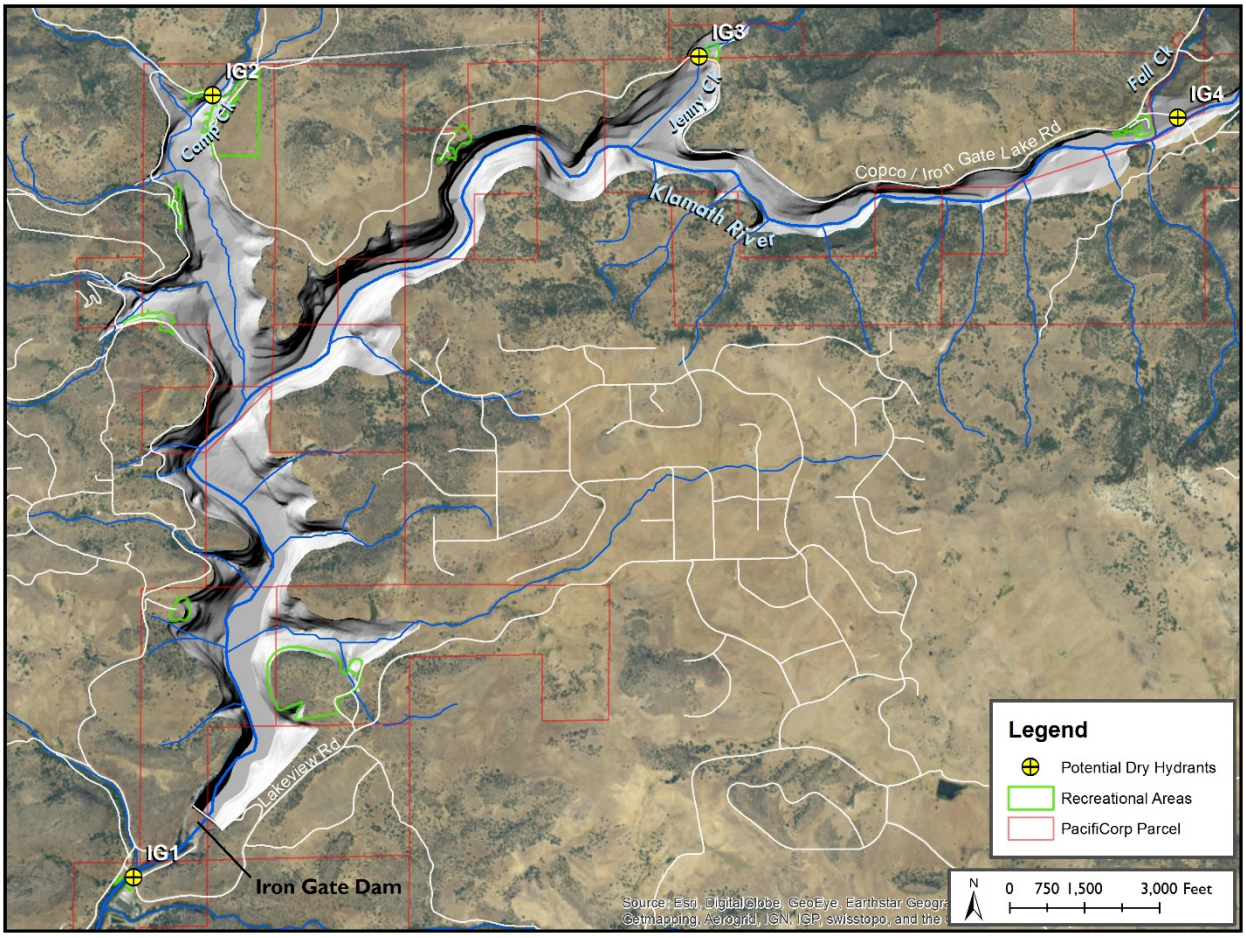
Figure 6-2 Locations of potential dry hydrants for J.C. Boyle Reservoir

At Iron Gate, four potential dry hydrant locations were identified (Figure 6-4). IG1 is sited at the Lakeview Rd bridge crossing over the Klamath River, downstream of Iron Gate dam and adjacent to the Iron Gate hatchery. IG2 is located in the vicinity of the Camp Creek campground where Copco Road crosses Camp Creek. IG3 is located at the bridge where Copco Road crosses Jenny Creek. IG4 is sited at the Daggett Road bridge crosses the Klamath River, which is adjacent to the Fall Creek confluence and Copco Road.



Historical topographic surface beneath the reservoir and historic Klamath River centerline are shown for reference.

Figure 6-3 Locations of potential dry hydrants for Copco Lake



Historical topographic surface beneath the reservoir and historic Klamath River centerline are shown for reference.

Figure 6-4 Locations of potential dry hydrants for Iron Gate Reservoir

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Chapter 7: References

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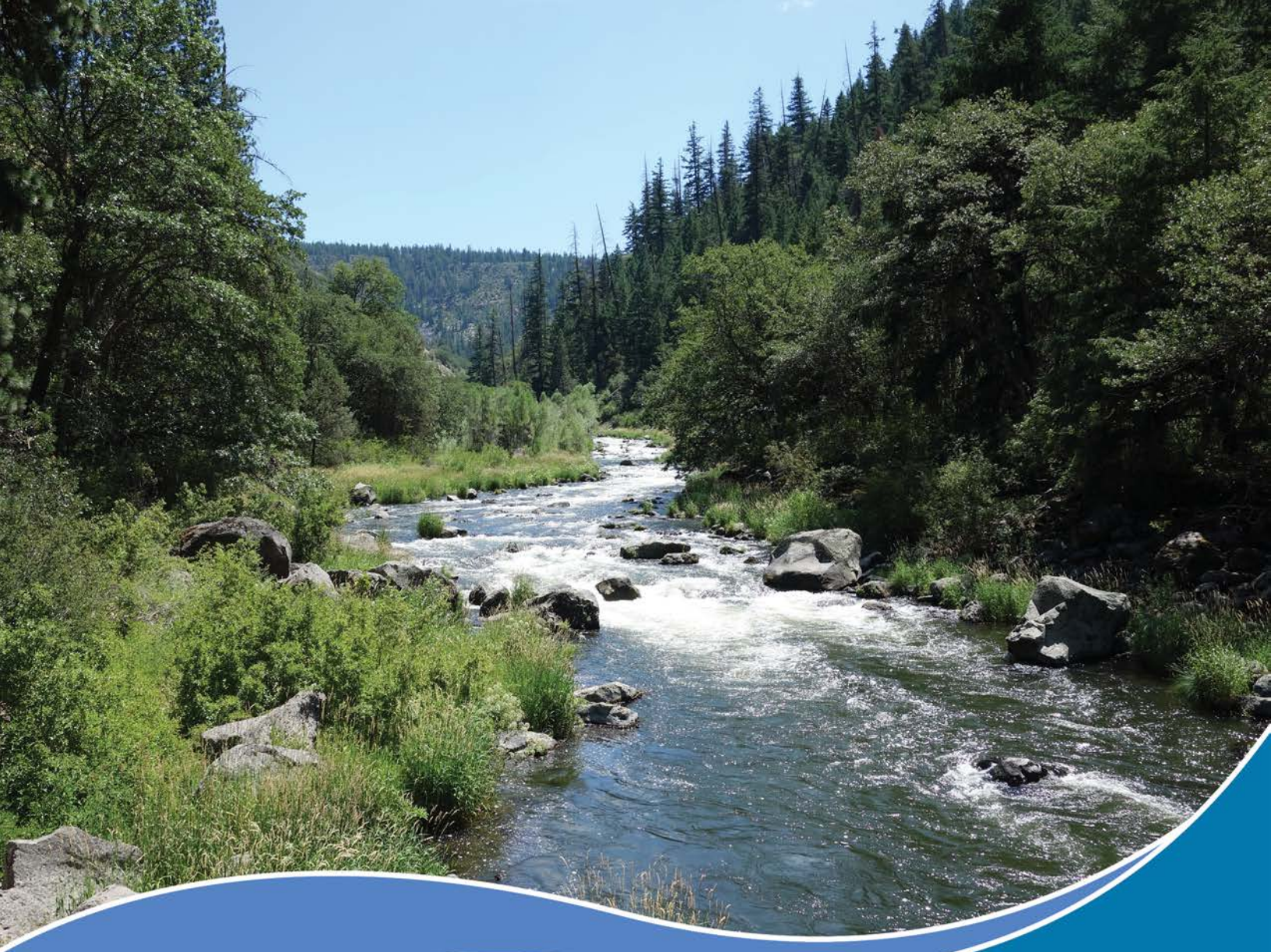

Definite Plan for Decommissioning

Appendix O2 – Traffic Management Plan

KLAMATH
RIVER RENEWAL
CORPORATION

June 2018

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Acronyms

Caltrans	California Department of Transportation
CHP	California Highway Patrol
KRRC	Klamath River Renewal Corporation
ODOT	Oregon Department of Transportation
OR	Oregon Route
TMP	Traffic Management Plan

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Chapter 1: Need for Traffic Management Plan

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1. NEED FOR TRAFFIC MANAGEMENT PLAN

KRRC prepared this Traffic Management Plan (TMP) for the implementation of the Definite Plan for the Lower Klamath Project (Definite Plan) proposed by the Klamath River Renewal Corporation (KRRC) for physical removal of the four dam developments (Iron Gate, Copco No. 1. Copco No. 2, and J.C. Boyle) (the Project). The TMP is a specialized program tailored to minimize impacts by applying a variety of techniques such as *Public Information, Motorist Information, Incident Management and Construction Strategies.* The major objectives of the TMP are to maintain efficient and safe movement of vehicles through the construction zone covered by activities in the Definite Plan and to provide public awareness of potential impacts to traffic on both haul routes and access roads to the four dam developments.

Construction activities can create additional traffic delays and safety concerns on the affected highways and roadways. Planning work activities and balancing traffic demand with highway capacity is more critical during construction or maintenance. To prevent unreasonable traffic delays resulting from planned work during implementation of the Definite Plan, KRRC developed this TMP, and KRRC's contractor will implement it, to maintain acceptable levels of service, traffic circulation and safety on the state and county highway and roadway system.

This TMP outlines the structure and key requirements that will be incorporated by the KRRC's contractor into a final traffic management plan. The final traffic management plan will be informed by KRRC's contractor's specific means and methods for construction, which could refine the approach to access and traffic management. The final traffic management plan will meet applicable regulatory permit requirements, as well as applicable state and local ordinances, as appropriate. In developing the final traffic management plan, the Contractor will coordinate with the following agencies:

- Oregon Department of Transportation (ODOT)
- California Department of Transportation (Caltrans)
- Klamath and Siskiyou Counties
- Oregon State Police
- California Highway Patrol (CHP)

1.1 Access Summary

Throughout the construction and demolition contemplated in the Definite Plan, various roads in the vicinity of the four developments will experience some changes to traffic conditions, with the potential to impact other road users. The KRRC anticipates changes to traffic conditions could result from the following activities:

- Delivery of construction equipment
- Short haul of deconstructed dam materials (concrete and soil) for near-site disposal
- Long haul of deconstructed dam, hydropower and other materials for off-site disposal
- Delivery of rehabilitation materials
- Road, bridge and culvert improvements
- Worker access
- Fish hauling, as applicable

The proposed haul routes for each development are summarized in Table 1.1-1, and generally shown in Definite Plan Figure 1.2-2(C). Definite Plan Section 5 (Dam Removal Approach) and Section 7.4 (Road Improvements) provide additional details concerning access and associated road improvements.

Table 1.1-1 Primary Access Route Summary

Development	Interstate Access	Regional Access	Local Access
J.C. Boyle	Interstate 5 (in Oregon) and US97	Oregon Route (OR) 66	Topsy Grade Road, Keno Worden Road
Copco No.1 and Copco No. 2	Interstate 5 (in California)	Copco Road	Ager-Beswick Road, Patricia Ave.
Iron Gate	Interstate 5 (in California)	Copco Road	Lakeview Road, Daggett Road

1.2 Management Strategies

This section describes strategies KRRC proposes to minimize construction-related traffic delays and maintain safe movement of vehicles during implementation of the Definite Plan. These strategies are of a general nature and are intended to reduce the overall level of congestion. KRRC's contractor will include more detailed techniques for management of potential traffic impacts in the final traffic management plan. The proposed management strategies are grouped into the following four broad categories: (1) public information; (2) motorist information; (3) incident management; and (4) construction strategies. The numbered list below summarizes each category of management strategy and associated details.

1. **Public Information:** KRRC's contractor will adopt various methods to ensure the public have easy access to information regarding any current or upcoming interruptions to the local or state road network. Proposed methods, at a minimum, will include the use of telephone hotlines, a Traveler Information System via the Project website, local community outreach (meetings, newsletters, etc.), press release(s), and local news media, as appropriate.
2. **Motorist Information:** KRRC's contractor will develop a motorist information system to provide advance notice to motorists of potential traffic delays throughout the project sites and associated access routes. Proposed methods will include portable changeable message signs, stationary mounted signs, and highway advisory radio.

3. **Incident Management:** KRRC's contractor will devise an incident management procedure to outline traffic procedures to be adopted in the case of an incident on a road or highway. The procedure will be developed in collaboration with local and state agencies (listed above), and in accordance with local and state requirements.
4. **Construction Strategies:** KRRC's contractor will incorporate the following construction strategies into the final traffic management plan:

    a) **Roadway Closures**: During construction, some longer-term (more than a day) road closures will occur, though only on minor dam access roads where no public interruption would occur. Some short duration road closures will occur on more frequented roads, to enable bridge, culvert and road upgrades or replacements. KRRC's contractor will consider road users when these closures are scheduled and appropriate public and motorist information regarding detours will be issued in due course.
    b) **Traffic Handling and Stage Construction**: During construction, KRRC's contractor will provide signage and traffic control where Project generated traffic will impact road users. KRRC's contractor will determine the extent of signage and traffic control through consideration of the changes to road conditions caused by the activities and the amount of public traffic using the roads. KRRC's contractor will develop more detailed signage and traffic control plans as part of the final traffic management plan.
    c) **Construction Access to Work Zones**: KRRC's contractor will locate informational signs along the roads directly adjacent or leading to construction work zones, to direct construction traffic and notify other motorists of their presence. Where possible, KRRC's contractor will plan trip schedules to minimize impacts, i.e. avoiding peak traffic times. KRRC's contractor will control ingress and egress of construction trucks when exiting and entering the work areas to and from the respective highways.
    d) **Haulage**: Various waste materials will originate from the deconstruction of the four developments. The majority of waste volume, the embankment dam fill and concrete, will be disposed of onsite, requiring minimal haulage. KRRC's contractor will haul some materials such as reinforcing steel, mechanical and electrical equipment and other building waste to local recycling facilities or dump sites. KRRC's contractor will schedule haul trips to minimize interruption on the road network, such as by avoiding peak hour times. In addition, KRRC's contractor will use signage to give other motorists notice of truck haulage activities.
    e) **Emergency Detour Plan**: KRRC's contractor will identify emergency service routes within the project area, as appropriate, during detailed design, in coordination with state and local jurisdictions. These emergency detour routes will likely serve hospitals, fire/police stations, emergency shelters, command centers, and other facilities that provide essential services in times of emergencies. The KRRC does not anticipate material impacts on emergency serviced routes, though the potential for minor impacts due to increased traffic will nevertheless be considered.
    f) **Traffic Safety Effects**: The KRRC has identified potential traffic safety hazards from truck hauling, including, the use of blind or sharp corners and turnouts, slow vehicles conflicting with roadway speed limits, and visibility reduction due to dust. KRRC's contractor will manage these by adopting appropriate best practice signage, traffic management systems and dust control

measures. KRRC's contractor will perform a risk assessment of all intersections and roadways as part of the final traffic management plan.

g) **Pedestrians and Bicycles**: KRRC's contractor will identify areas where pedestrians and cyclists could potentially share roads with construction vehicles. KRRC's contractor will install appropriate signage to notify both construction vehicle drivers and non-motorized users of each other's potential presence on the roads. If an unacceptable level of risk to non-motorized users is deemed to persist, KRRC's contractor will arrange appropriate detours to allow continued movement for such users.

Chapter 2: References

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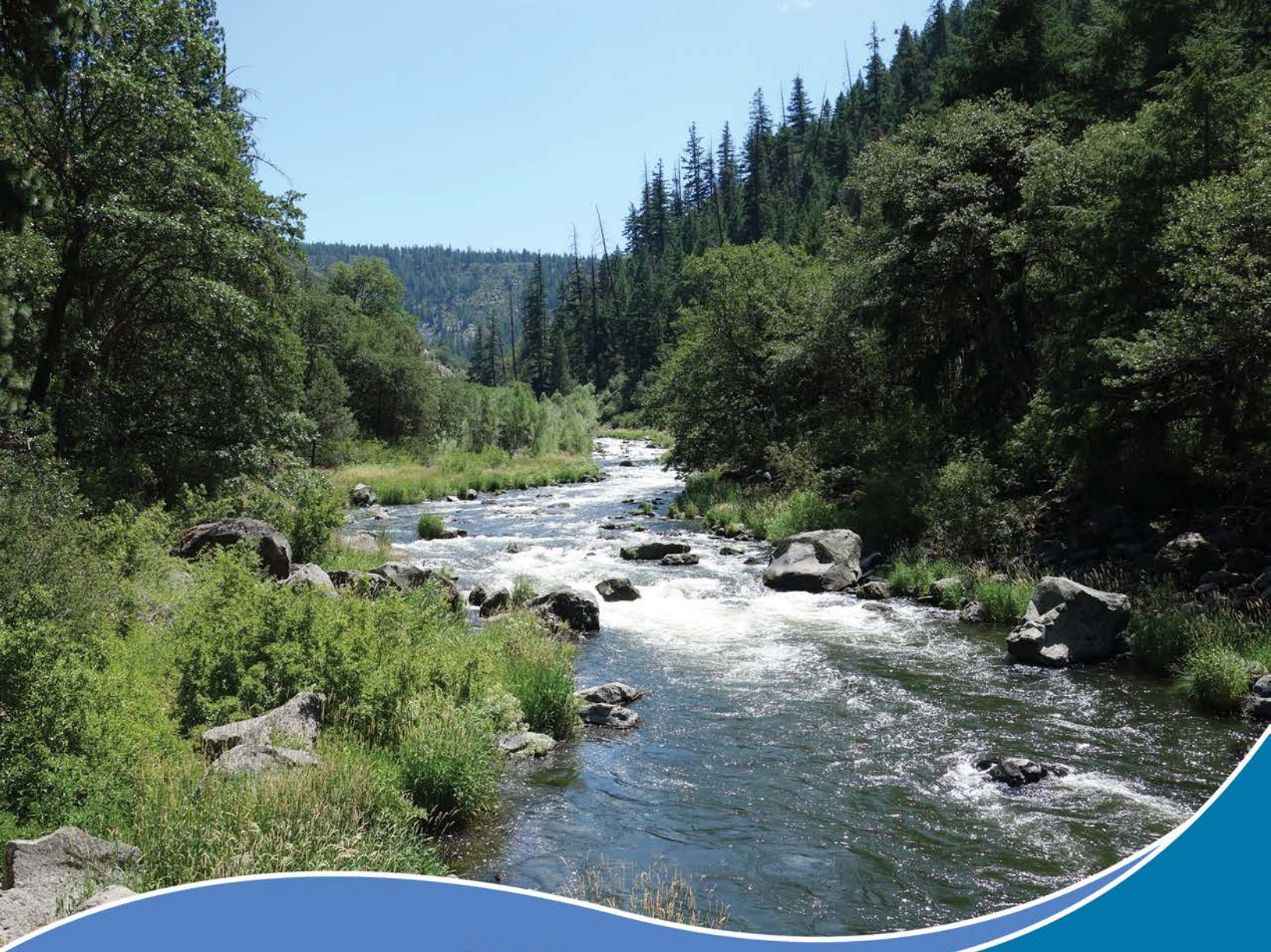

Definite Plan for the Lower Klamath Project

Appendix 03 – Hazardous Materials Management Plan

KLAMATH RIVER RENEWAL CORPORATION

June 2018

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Acronyms

ACM	Asbestos Containing Material
EPA	Environmental Protection Agency
ESA	Environmental Site Assessment
HMMP	Hazardous Materials Management Plan
KRRC	Klamath River Renewal Corporation
LBP	lead based paint
PCBs	polychlorinated biphenyls

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Chapter 1: Hazardous Materials Management Plan

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1. HAZARDOUS MATERIALS MANAGEMENT PLAN

This Hazardous Materials Management Plan (HMMP) was developed to address the management of hazardous materials during implementation of the Definite Plan proposed by the Klamath River Renewal Corporation (KRRC) for physical removal of four developments (Iron Gate, Copco No. 1, Copco No. 2, and J.C. Boyle), hereinafter, the Project. PacifiCorp, EDR, or local agencies provided all data KRRC used to develop this HMMP. KRRC will update the HMMP, as appropriate, following the planned Phase I-Environmental Site Assessment (ESA) visits and interviews and the Phase II Site Investigation, if needed after the Phase I ESA.

The following structures have been reported at each of the four developments.

- J.C. Boyle Dam and Powerhouse: This facility consists of a reservoir, combination embankment and concrete dam, gated spillway, diversion culvert, water conveyance system, and powerhouse, completed in 1958. Current structures at the site include an office building (known as the Red Barn), a maintenance shop, a fire protection building, a communications building, two (2) occupied residences near the dam, and a large warehouse near the powerhouse.
- Copco No. 1 Dam and Powerhouse: This facility consists of a reservoir, concrete dam, gated spillway, diversion tunnel, intake structure, and powerhouse constructed between 1911 and 1922. Current structures at the site include an occupied residence with small garage, a vacant house, and a maintenance building.
- Copco No. 2 Dam and Powerhouse: This facility consists of a reservoir, concrete diversion dam, embankment section, gated spillway, water conveyance system, and powerhouse completed in 1925. Current structures at the site include a control center building, a maintenance building, and an oil and gas storage building.
- Iron Gate Dam and Powerhouse: This facility consists of a reservoir, embankment dam, ungated side-channel spillway, diversion tunnel, intake structures, and powerhouse completed in 1962. Current structures at the site include a communications building, restroom building, and two (2) occupied residences.

Asbestos Containing Material (ACM), lead based paint (LBP), and polychlorinated biphenyls (PCBs) may be present in building materials based on the years construction activity occurred at each of the four developments. Prior to removal, KRRC or KRRC's contractor will sample and test for ACM, LBP, and PCBs at all structures that are to be removed. KRRC's contractor will handle and dispose of any abated material with asbestos, lead, and or PCBs which exceed hazardous waste criteria levels as hazardous waste at approved hazardous waste facilities in accordance with applicable federal and state regulations. KRRC's contractor will dispose of remaining materials as non-hazardous construction debris.

KRRC's contractor will manage all hazardous materials removed from the developments (i.e., paints, oils, and welding gases) by returning to the vendor, recycling, or managing and disposing of such materials as hazardous waste at an approved hazardous waste facility in accordance with applicable federal and state regulations. If not data exists, KRRC's contractor will test transformer oils for PCBs. Prior to disposal, KRRC's contractor will decontaminate any tanks which contained hazardous materials.

KRRC's contractor will handle universal hazardous waste (i.e., lighting ballasts, mercury switches, and batteries) in accordance with applicable federal and state universal waste regulations.

Table 1 shows the types of hazardous materials that may be present at each development.

Table 1 Anticipated Types of Hazardous Waste

Type of Waste	J.C. Boyle	Copco No. 1	Copco No. 2	Iron Gate
Asbestos	X	X	X	X
Batteries	X	X	X	X
Bearing and hydraulic control system oils	X	X	X	X
Treated wood	X	X	X	X
Coatings containing heavy metals	X	X	X	X
Contaminated soils	?	?	?	?
PCBs	?	?	?	?
Oil and fuel tanks	X	X	X	X
Hazardous materials storage	X		X	
Septic system	X		X	X
Gas cylinders	X			
Mercury containing fixtures		?	?	
Creosote treated wood			X	

KRRC's contractor will include any additional hazardous materials identified during the Phase I site visits and Phase II investigations, if any, in an updated hazardous materials management plan.

1.1 J.C. Boyle

According to the Detailed Plan (USBR 2012), potential hazardous materials at the J.C. Boyle Dam and Powerhouse include asbestos, batteries, bearing and hydraulic control system oils, treated wood, and coatings containing heavy metals in the powerhouse and on the exterior surfaces of the steel penstock pipes, surge tank, bulkhead gate, generator gantry crane, and other painted equipment, which will require specialized abatement and disposal. Contaminated soils may exist at the locations of painted exterior

equipment and would require remediation. Asbestos may be found in ceiling and floor tiles, roofing materials, and electrical wiring insulation. Although all transformers have tested negative for PCBs, some residual PCBs may exist in closed systems such as transformer bushings. Equipment containing over 37,500 gallons of various types of oils and fuels has been identified at the site. The Red Barn administration complex includes a hazardous materials building for the storage of materials regulated by the Environmental Protection Agency (EPA), and a fueling facility containing above-ground gasoline (1,000 gallon) and diesel (500 gallon) tanks which meet state and federal requirements. Underground septic systems in use within the Red Barn complex of office and maintenance buildings and two residences will be removed. KRRC's contractor will follow applicable federal, state, and local regulations, including those for spill prevention and containment, in the transportation and disposal of all waste materials. Table 2 lists the reported material and quantities for J.C Boyle from the Hazardous Materials Inventories provided by PacifiCorp.

Table 2 Hazardous Materials Inventory – J.C. Boyle

Hazardous Class	Common Name	Quantities (Average daily)	Storage Container
Flammable and Combustible Liquids	Gasoline	500 gallons	AST
Flammable and Combustible Liquids	Diesel Fuel No. 2	300 gallons	AST
Flammable Gases	Acetylene	200 cubic feet	Cylinder
Nonflammable Gases	Argon, Liquid	200 cubic feet	Cylinder
Flammable and Combustible Liquids	Gear Oil	20 gallons	Plastic Drum
Flammable and Combustible Liquids	Hydraulic oil	30 gallons	Plastic Drum
Corrosives (Liquids and Solids)	Lead Acid Batteries	10,840 pounds	Glass bottle or Jug
Flammable and Combustible Liquids	Used Oil	20 gallons	Steel Drum
Flammable and Combustible Liquids	Paint	15 gallons	Cans
Nonflammable Gases	Nitrogen	1,200 cubic feet	Cylinder
Flammable Gas	Propane	300 gallon	AST

1.2 Copco No. 1

According to the Detailed Plan, potential hazardous materials at Copco No. 1 Dam and Powerhouse include asbestos, batteries, bearing and hydraulic control system oils, treated wood, and coatings containing heavy metals in the powerhouse and on the exterior surfaces of the steel penstock and air vent pipes, as well as on other painted equipment, which will require specialized abatement and disposal. Contaminated soils may exist at the locations of painted exterior equipment and would require remediation. Asbestos may be found

in electrical wiring insulation and possibly in other building materials. Mercury may exist in older light switches. Although all transformers have tested negative for PCBs, some residual PCBs may exist in closed systems such as transformer bushings. Equipment containing nearly 12,000 gallons of various types of oils has been identified at the Copco No. 1 site. KRRC's contractor will follow applicable federal, state, and local regulations, including those for spill prevention and containment for the transportation and disposal of all waste materials. Table 3 lists the reported material and quantities for Copco No. 1 from the Hazardous Materials Inventories provided by PacifiCorp.

Table 3 Hazardous Materials Inventory – Copco No. 1

Hazardous Class	Common Name	Quantities	Storage Container
Flammable Gas	Liquefied Petroleum Gas	171 gallons	AST - Cylinder
Flammable and Combustible Liquids	Governor Oil (hydraulic oil)	1,500 gallons	Tank inside building
Flammable and Combustible Liquids	Transformer Oil	11,000 gallons	Tank inside building
Corrosives (Liquids and Solids)	Lead Acid Batteries	66 gallons	Glass bottle or Jug
Nonflammable Gases	Nitrogen	150 cubic feet	Cylinder
Flammable Gases	Liquefied Petroleum Gas	499 gallons	Cylinder

1.3 Copco No. 2

According to the Detailed Plan, potential hazardous materials at Copco No. 2 Dam and Powerhouse include creosote-treated wood-stave (redwood) penstock and treated wood, asbestos, batteries, bearing and hydraulic control system oils, and coatings containing heavy metals in the powerhouse and on the exterior surfaces of the steel penstock and air vent pipes, which will require specialized abatement and disposal. Contaminated soils may exist at the locations of painted exterior equipment and would require remediation. Asbestos may be found in electrical wiring insulation and possibly in other building materials. Mercury may exist in older light switches. Although all transformers have tested negative for PCBs, some residual PCBs may exist in closed systems such as transformer bushings. Equipment containing over 18,000 gallons of various types of oils and fuels has been identified at the site. The administration and control center includes a building for the storage of EPA-regulated materials, and a fueling facility containing above-ground gasoline (1,000 gallon) and diesel (500 gallon) tanks which meet state and federal requirements. Underground septic systems in use for seven residences near the powerhouse will be removed. KRRC's contractor will follow applicable federal, state, and local regulations, including those for spill prevention and containment for transportation and disposal of all waste materials. Table 4 lists the reported material and quantities for Copco No. 2 from the Hazardous Materials Inventories provided by PacifiCorp.

Table 4 Hazardous Materials Inventory – Copco No. 2

Hazardous Class	Common Name	Quantities	Storage Container
Flammable and Combustible Liquids	Diesel Fuel No. 2	375 gallons	AST
Flammable Gas	Liquefied Petroleum Gas	250 gallons	AST - Cylinder
Flammable and Combustible Liquids	Transformer Oil	12,778 gallons	AST
Flammable and Combustible Liquids	Gasoline	500	AST
Nonflammable Gases	Oxygen	500 cubic feet	Cylinder
Flammable and Combustible Liquids	Governor and Bearing Oil (hydraulic oil)	3,600 gallons	Steel drum, Plastic/Non-metallic drum
Flammable Gases	Acetylene	300 cubic feet	Cylinder
Nonflammable Gases	Nitrogen	750 cubic feet	Cylinder
Nonflammable Gases	Argon, Liquid	700 cubic feet	Cylinder
Flammable and Combustible Liquids	Oil base paint	50 gallons	Cans
Corrosives (Liquids and Solids)	Lead Acid Batteries	64 gallons	Glass bottle or Jug

1.4 Iron Gate

According to the Detailed Plan, potential hazardous materials at Iron Gate Dam and Powerhouse include asbestos, batteries, bearing and hydraulic control system oils, treated wood, and coatings containing heavy metals in the powerhouse and on the exterior surfaces of the steel penstock and air vent pipes, and other painted equipment, which will require specialized abatement and disposal. Contaminated soils may exist at the locations of painted exterior equipment and would require remediation. Asbestos may be found in electrical wiring insulation and possibly in other building materials. Although all transformers have tested negative for PCBs, some residual PCBs may exist in closed systems such as transformer bushings. Equipment containing nearly 5,000 gallons of various types of oils has been identified at the site. Underground septic systems in use for the restroom and two residences near the dam will be removed. KRRC's contractor will follow applicable federal, state, and local regulations, including those for spill prevention and containment, for transportation and disposal of all waste materials. Table 5 lists the reported material and quantities for Iron Gate from the Hazardous Materials Inventories provided by PacifiCorp.

Table 5 Hazardous Materials Inventory – Iron Gate

Hazardous Class	Common Name	Quantities	Storage Container
Nonflammable Gases	Nitrogen	1,850 cubic feet	Cylinder
Flammable and Combustible Liquids	Governor and Bearing Oil (hydraulic oil)	1,400 gallons	Tank Inside Building
Flammable and Combustible Liquids	Transformer Oil	3,500 gallons	Other
Corrosives (Liquids and Solids)	Lead Acid Batteries	102 gallons	Other

Chapter 2: References

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2. REFERENCES

USBR 2012. U.S. Bureau of Reclamation. *Detailed Plan for Dam Removal – Klamath River Dams – Klamath Hydroelectric Project – FERC License No. 2082 – Oregon-California*. July 2012.

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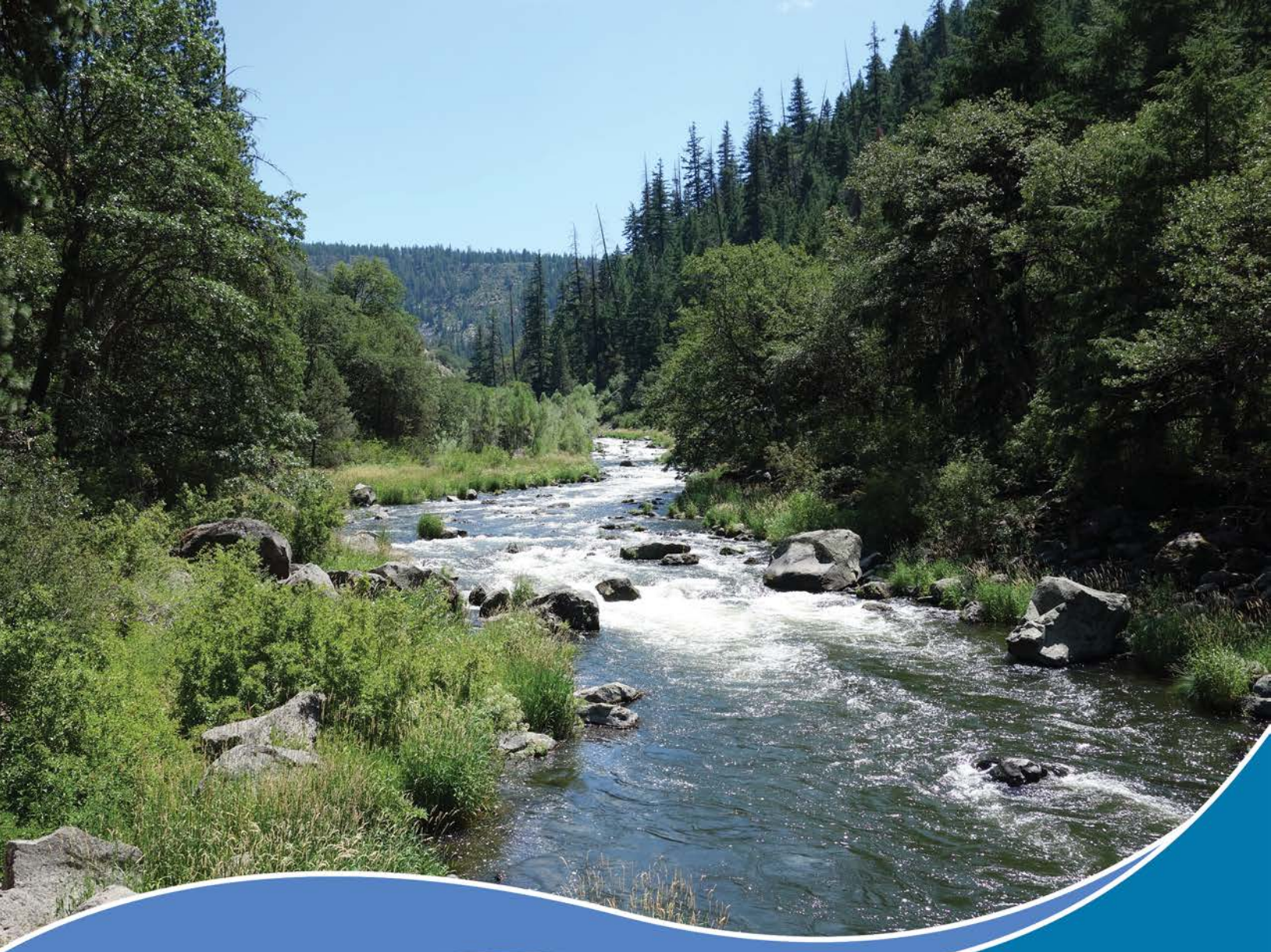

Definite Plan for the Lower Klamath Project

Appendix 04 – Emergency Response Plan

KLAMATH RIVER RENEWAL CORPORATION

June 2018

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Acronyms

CLOMR conditional letter of map revision
DSOD California Division of Safety of Dams
EOP Emergency Operations Plan
ERP Emergency Response Plan
FERC Federal Energy Regulatory Commission
KRRC Klamath River Renewal Corporation
LOMR letter of map revision
MSDS Material Safety Data Sheet
SPCC Spill Prevention Control and Countermeasures

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Chapter 1: Emergency Response Plan

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1. EMERGENCY RESPONSE PLAN

This Emergency Response Plan (ERP) was developed to support implementation of the Definite Plan for the Lower Klamath Project (Definite Plan) proposed by the Klamath River Renewal Corporation (KRRC) for physical removal of the four developments (Iron Gate, Copco No. 1, Copco No. 2, and J.C. Boyle), hereinafter the Project. The Detailed Plan (USBR 2012) had proposed mitigation measure H-1 to develop and implement an Emergency Response Plan to provide adequate notification to agencies and the public of the potential changes in timing and magnitude of flooding below Iron Gate; the KRRC is instead proposing this ERP as part of the Definite Plan.

KRRC's contractor will develop written procedures to help prevent incidents, to assure preparedness in the event incidents occur, and to provide a systematic and orderly response to emergencies. KRRC's contractor will closely coordinate this ERP with the Contractor's Health and Safety Plan, Spill Prevention and Response Plan, Fire Management Plan, and PacifiCorp's Emergency Action Plan for each development.

This ERP applies to all personnel working on the project site. Prior to commencing construction activities, the Contractor's Health and Safety lead will review emergency response procedures with all personnel assigned to the project site, as appropriate.

Applicable emergency scenarios include, but are not limited to, the following:

- Medical, including injury or illness
- Fire
- Traffic incident
- Hazardous material spill
- Downstream hydraulic change planning
- Dam or tunnel failure
- Catastrophic emergency (e.g. earthquake, high wind event, etc.)
- Security threat

The sections below discuss each type of emergency scenario and its associated response plan.

1.1 General Requirements

This ERP includes the following list of general emergency requirements.

1. KRRC's contractor will post emergency service cards in all offices within the project limit of work and in all construction vehicles. KRRC's contractor will post maps to clinics and hospitals by all land-line phones. Emergency service cards will list emergency phone numbers for the local fire department,

ambulance services, life flight medical helicopters, local police department, local medical clinic, nearest hospital, and KRRC contractor's construction manager, onsite supervisor, and Safety Officer.

2. This ERP, as well as the steps to take in an emergency, will be posted and readily accessible at each of the developments within the project limit of work.
3. An adequate number of site personnel (minimum of one per dam site) will have current certification cards in First Aid and CPR.
4. Each development on the project site will be equipped with a First Aid cabinet, trauma kit, AED, and stretcher basket.
5. In the event of an emergency, all personnel will clear the radio for "Emergency Use Only" by calling "May-Day, May-Day, please clear the radio for emergency use."
6. Should an offsite emergency response team be required, the Contractor's on-site supervisor or the KRRC construction manager will designate an on-site employee to meet and escort the response team to the injury or emergency location.
7. Medical personnel/facilities on the project site: This will be specifically determined before the start of construction.
8. Emergency response plan procedures and documentation are subject to annual KRRC audits and shall be reviewed and/or updated annually.

1.2 Medical Emergency

In the event of an onsite medical emergency, KRRC contractor's onsite supervisor and the KRRC construction manager shall be notified immediately with details concerning the location, name of injured person(s) and a brief description of the situation. First aid action will be initiated immediately, as necessary, through the use of trained onsite first aid providers. The injured shall not be left unless absolutely necessary to quickly notify the jobsite office and then return. Injured person(s) shall not be moved unless they are in immediate danger of further injury. KRRC's contractor will develop written procedures for medical emergencies that include standard reporting forms to document the emergency.

The following hospitals are located within the project vicinity:

1. Sky Lakes Medical Center
   2865 Daggett Ave, Klamath Falls, OR 97601
   (541) 882-6311
2. Fairchild Medical Center
   444 Bruce St, Yreka, CA 96097
   (530) 842-4121
3. Asante Ashland Community Hospital
   280 Maple St, Ashland, OR 97520
   (541) 201-4000

1.3 Fire Management

Refer to the Fire Management Plan in Appendix 01 - Fire Management Plan for procedures and contacts related to managing fire emergencies.

1.4 Traffic Incident or Emergency

In the event of a traffic incident or emergency onsite, or along construction access routes currently in use by KRRC's contractor, the onsite supervisor and the KRRC construction manager shall be notified immediately with details concerning the location, name of injured person(s), if any, and a brief description of the situation. An incident management procedure will be devised to outline traffic procedures to be adopted in the event of an incident on a road or highway. If medical attention is required, protocols outlined above in 1.2 for "Medical Emergencies" shall be followed. KRRC's contractor onsite supervisor will notify the local authorities of a traffic incident or emergency, as appropriate.

1.5 Hazardous Material Spill Management

The Contractor shall develop a separate Spill Prevention and Response Plan, which shall comply with all governmental approvals and applicable local, state and federal laws and regulations. In the event of an onsite hazardous material spill, KRRC contractor's onsite supervisor and the KRRC construction manager shall be notified immediately with details concerning the location, type of material and a brief description of the situation. The Spill Prevention and Response Plan shall include detailed procedures and documentation forms to prevent and respond to spills. Topics or requirements to be provided in the final plan include, but are not limited to, the following:

1. Identification and location of staging and material stockpiles in areas that will prevent spills from entering the river channel
2. All hazardous materials shall be stored in a clearly identified and protected area, and all hazardous materials brought onsite will have a Material Safety Data Sheet (MSDS), which will be provided to the Contractor's Health and Safety lead.
3. Vehicles or equipment operated adjacent to a lake, river, stream or other water body shall be checked and maintained daily to prevent leaks of materials. If a leak is discovered, the leak will be stopped and the equipment will be removed from the project site for repair.
4. Required equipment/vehicle maintenance, refueling and lubrication will be performed at a pre-determined, protected location. If this is not possible, the activity will be completed at least 100 feet from any water body.
5. All aboveground storage tanks containing fuel or oil stored onsite in excess of 1,320 gallons will require a site-specific Spill Prevention Control and Countermeasures (SPCC) Plan.
6. All workers will receive training on the Project Spill Response and Reporting Procedures

In the event of a hazardous materials spill, the MSDS will be referenced to identify safe handling and cleanup procedures. Attempts to handle a hazardous materials spill will only be undertaken if doing so presents no exposure or risk of danger or contamination to personnel. Cleanup of all hazardous material spills will commence as soon as is safely possible following any spill. If a spill requires a hazardous waste cleanup operation and specially trained crew, the Contractor's Health and Safety lead will ensure properly trained personnel conduct the cleanup and remediation. This is not anticipated for cleanup of spills of common construction materials.

1.6 Downstream Hydraulic Change Planning

Prior to dam removal, the KRRC or KRRC's contractor will inform the National Weather Service River Forecast Center of any planned major hydraulic change (removal of one or more of the dams) to the Klamath River that could potentially affect the timing and magnitude of flooding below Iron Gate. The River Forecast Center is the federal agency that provides official public warning of floods. As needed, the River Forecast Center would update their hydrologic model of the Klamath River to incorporate these hydraulic changes so that changes to the timing and magnitude of flood peaks would be included in their forecasts. As currently occurs, flood forecasts and flood warnings would be publicly posted by the River Forecast Center for use by federal, state, county, tribal, and local agencies, as well as the public, so timely decisions regarding evacuation or emergency response could be made.

Contact Information for the California Nevada River Forecast Center:

US Dept. of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
California Nevada River Forecast Center
3310 El Camino Avenue, Room 227
Sacramento, CA 95821-6373
916-979-3056
Webmaster Email: cnrfc.webmaster@noaa.gov

During the detailed design phase, the KRRC or KRRC's contractor will submit a conditional letter of map revision (CLOMR) report to FEMA of a planned major hydraulic change to the Klamath River that could affect the 100-year flood plain. Subsequently, the KRRC or KRRC's contractor will submit a letter of map revision (LOMR) to FEMA, to provide recent hydrologic/hydraulic modeling and updates to the land elevation mapping. This information will be provided to FEMA so they can update their 100-year flood plain maps downstream of Iron Gate Dam (as needed), so flood risks (real-time and long-term) can be evaluated and responded to by agencies, the private sector, and the public.

1.7 Dam or Tunnel Failure

In the event of a tunnel failure during construction activities or drawdown, the immediate area shall be evacuated and the KRRC contractor's onsite supervisor and the KRRC construction manager shall be notified immediately. In the event tunnel failure results in partial or full blockage of flow, KRRC or KRRC's contractor will notify the Federal Energy Regulatory Commission (FERC) and other regulatory agencies, as required,, and the KRRC or KRRC's contractor will develop a plan to mitigate any associated impacts. The plan will be developed within five (5) calendar days of the tunnel failure, and will be sent to the FERC for review and approval and to other regulatory agencies, as required.

In the event of a dam failure, or an imminent dam failure, during construction activities or drawdown, the immediate area shall be evacuated and KRRC contractor's onsite supervisor and the KRRC construction manager shall be notified immediately. KRRC's contractor onsite supervisor shall contact 911, local law enforcement, local fire departments, the Klamath and Siskiyou County emergency services, the FERC local Office of Dam Safety, and the California Division of Safety of Dams (DSOD) immediately.

County Emergency Services, FERC's local Office of Dam Safety and DSOD contact information is provided below:

1. Siskiyou County Office of Emergency Services
   806 South Main Street
   Yreka, CA 96097
   530-841-2155
2. Klamath County Emergency Management
   2543 Shasta Way
   Klamath Falls, OR 97601
   541-851-3741
3. FERC Local Office of Dam Safety
   805 SW Broadway
   Fox Tower - Suite 550
   Portland, OR 97205
   503-552-2715
4. DSOD: Specific contact and phone numbers for working and non-working hours shall be coordinated with DSOD prior to finalization of the Emergency Action Plan by the contractor. The current project contact at DSOD is Nekane Hollister at 916-227-4627.

Klamath County, Oregon, has an Emergency Operations Plan that outlines procedures to ensure protection of life and property during a dam failure. The government and private agencies involved as well as their roles and responsibilities in response to a dam failure are defined therein. Flood inundation maps are available in the office of the Klamath County Emergency Manager. KRRC's contractor will review this document during preparation of the final ERP.

During preparation of the written procedures to implement this ERP, KRRC's contractor shall review PacifiCorp's Emergency Action Plans for each development. These plans will contain useful information on emergency contacts and protocol.

1.8 Catastrophic emergency (e.g., earthquake, extreme weather event, etc.)

In the event of a catastrophic emergency, KRRC contractor's onsite supervisor and the KRRC construction manager shall be notified immediately with details concerning the location, name of any injured person(s) and a brief description of the situation at any damaged structure or facility. It is imperative that each employee is accounted for. The designated supervisor will perform a physical headcount of all on-site personnel as soon as possible.

When evacuation is determined necessary, the following procedures shall be followed:

1. Employees will leave any buildings and the site area or as advised and report to the designated emergency staging area. The emergency staging area for the various project sites will be clearly identified in KRRC contractor's written emergency response procedures. When evacuating, employees should walk, remain quiet, and follow all other emergency instructions.
2. When evacuating work areas, employees should close doors behind them, but not lock doors unless otherwise instructed.
3. Employees working with electrically operated machines or equipment should switch the equipment off or unplug it prior to leaving the work area.
4. After evacuation is completed, the KRRC expects the police and other emergency personnel will prevent entrance to the effected site area.
5. When the catastrophic emergency is over, KRRC contractor's project manager or KRRC construction manager, in conjunction with the Safety Officer, will advise employees when it is safe to return to the site.

1.9 Security Threat

Security threats to any facility within the project site will be immediately communicated to KRRC contractor's onsite supervisor and the KRRC construction manager. Based on the information or type of threat received, a response will be initiated by KRRC contractor's onsite supervisor that may include any of the following:

1. Cessation of all work activity and mustering of site personnel
2. Notification of local law enforcement agencies
3. Notification of the Federal Bureau of Investigation

Chapter 2: References

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2. REFERENCES

USBR 2012b. U.S. Bureau of Reclamation. *Detailed Plan for Dam Removal – Klamath River Dams – Klamath Hydroelectric Project – FERC License No. 2082 – Oregon-California*. July 2012.

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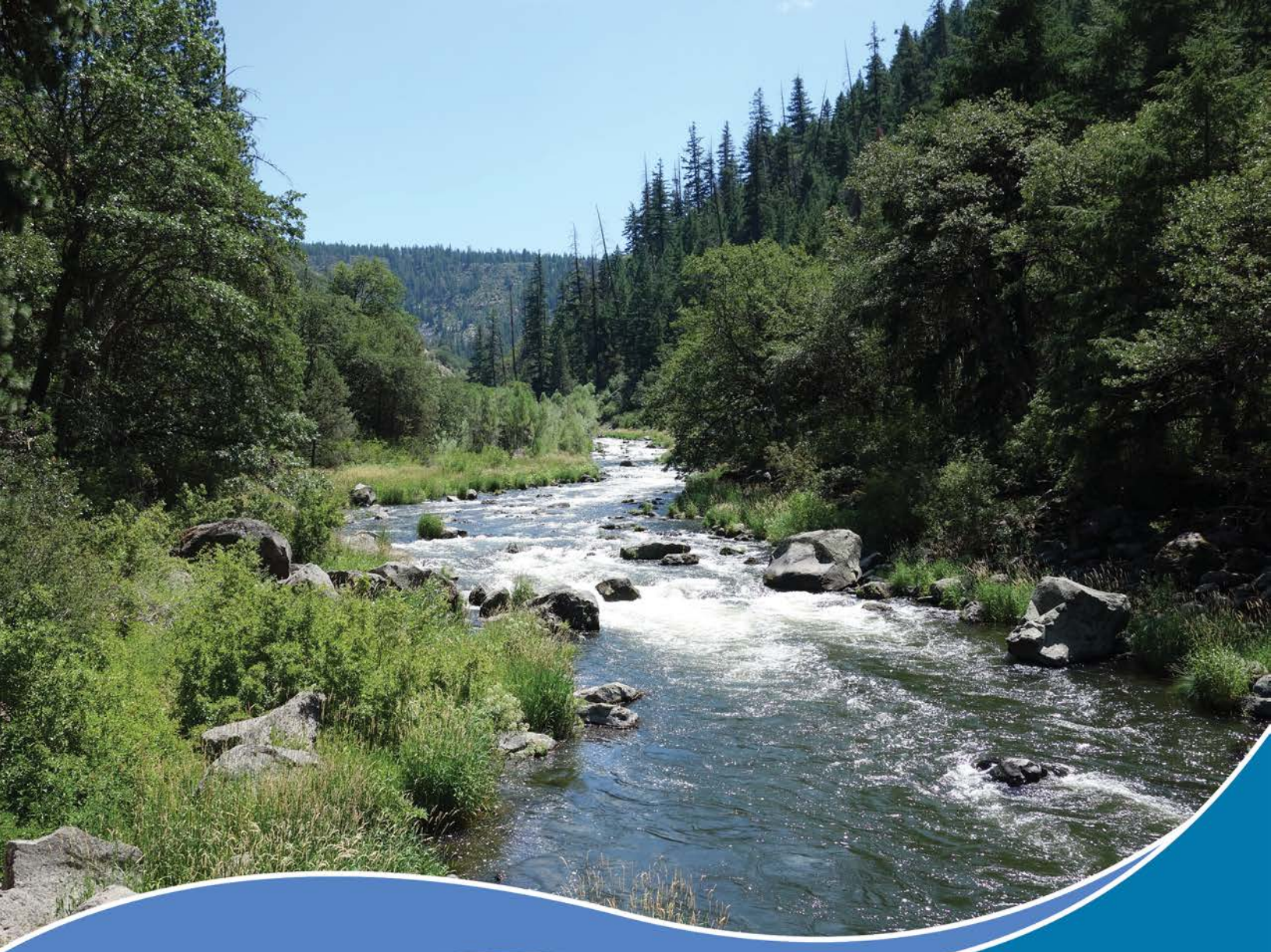

Definite Plan for the Lower Klamath Project

Appendix O5 – Noise and Vibration Control Plan

KLAMATH RIVER RENEWAL CORPORATION

June 2018

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Acronyms

KRRC Klamath River Renewal Corporation
NVCP Noise and Vibration Control Plan

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Chapter 1: Noise and Vibration Control Plan

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1. NOISE AND VIBRATION CONTROL PLAN

The purpose of this Noise and Vibration Control Plan (NVCP) is to address and reduce increases in day and night time noise levels resulting from construction activities during implementation of the Definite Plan for the Lower Klamath Project (Definite Plan) proposed by the Klamath River Renewal Corporation (KRRC) for physical removal of the four dam developments (Iron Gate, Copco No. 1, Copco No. 2, and J.C. Boyle), hereinafter the Project. KRRC's contractor will develop a final NVCP to document the KRRC's noise and vibration objectives based on regulatory and industry guidelines as relevant to specific activities to be completed under the Definite Plan. The final NVCP will address KRRC's contractor staff roles and responsibilities for noise and vibration control, define noise intensive activities and timing, identify sensitive receptors, evaluate construction noise levels, and outline a monitoring program for noise and vibration.

KRRC's contractor will incorporate the following measures into the final NVCP to reduce effects to sensitive receptors associated with noise and vibration. Measures include, but are not limited to, the following:

- KRRC's contractor shall maintain equipment in compliance with federal, state and local noise standards (e.g., exhaust mufflers, acoustically attenuating shields, shrouds, or enclosures)
- KRRC's contractor shall schedule truck loading, unloading, and hauling operations to reduce daytime and nighttime noise impacts to the extent feasible
- Construction activities will be conducted or phased so that noise generated during construction will not exceed thresholds or durations identified by the appropriate regulatory authorities
- KRRC's contractor shall employ appropriate blasting techniques to minimize noise and vibration to the extent feasible
- Equipment and trucks used for the Project shall employ the best available noise control techniques to the extent feasible
- Stationary sources shall be located as far from adjacent noise-sensitive receptors as reasonably possible and shall be enclosed if feasible
- Where feasible, temporary portable sound barriers will be deployed where construction noise would cause noise levels at sensitive receptor locations to exceed an applicable criteria threshold
- KRRC or KRRC's contractor shall notify nearby residents of hours and duration of construction activities
- At least two weeks prior to the anticipated start of construction at a particular location, KRRC or KRRC's contractor will notify all property owners within 1,000 feet of that location that construction activities are about to commence
- KRRC's contractor shall have a complaint hotline for local residents, and shall promptly address noise and vibration complaints

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PDF p.262, report p. 7-8

First paragraph: “beds that will be salvaged and translocated is predicated on the available habitat in the Klamath River downstream from the Trinity River confluence (RM 43.4), and between J.C. Boyle Dam (RM 230.6) and Copco Reservoir (RM 209.0), and the abundance of mussels between Iron Gate Dam…”

Deleted: between Seiad Valley (RM 131.9) and Somes Bar (RM 66.4),

1. FRESHWATER MUSSELS

The objective of the freshwater mussels measure is to address reservoir drawdown and project effects on freshwater mussels located in the Klamath River in the Hydroelectric Reach and downstream from Iron Gate Dam (RM 193.1). The 2012 EIS/R AR-7 focused conducting a freshwater mussel relocation pilot study followed by the salvage and relocation of freshwater mussels prior to reservoir drawdown. Salvaged mussels were to be held in a temporary location for later placement following reservoir drawdown, and placed in locations that will not be affected by the reservoir drawdown. Based on a review of the information discussed in greater detail below, KRRC and the ATWG concluded that a moderate scale freshwater mussel relocation effort is warranted. The proposed measure includes a freshwater mussel reconnaissance in 2019 followed by a limited freshwater mussel salvage prior to reservoir drawdown. Specifically, KRRC will salvage freshwater mussels from the 8-mile long Iron Gate Dam (RM 193.1) to Cottonwood Creek (RM 185.1) reach and translocate these mussels to one or more appropriate locations in the Klamath River downstream from the Trinity River confluence (RM 43.4), and between J.C. Boyle Dam (RM 230.6) and Copco Reservoir (RM 209.0). The translocation sites will be determined following the 2019 reconnaissance and discussion with the ATWG.

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1.1 Proposed Measure

Based on a review of the 2012 EIS/R AR-7 presented in Section 9.2 below, input from the ATWG, and current freshwater mussels literature, the KRRC concluded that revisions to AR-7 are necessary to offset the anticipated short-term effects of the Project on freshwater mussels. The proposed measure includes a reconnaissance, salvage, and relocation of freshwater mussels from the 8-mile reach between Iron Gate Dam and the Cottonwood Creek confluence with the Klamath River. The monitoring and adaptive management plan has two specific actions.

- **Action 1:** KRRC will complete a reconnaissance in 2019 to assess the distribution and density of freshwater mussels in the 8-mile long bedload deposition reach from Iron Gate Dam (RM 193.1) downstream to the Cottonwood Creek confluence (RM 185.1). The reconnaissance effort will determine if the mussel beds identified in the 2007-2010 surveys are still present, and estimate abundance of a subset of the mussel beds in the reach.

- **Action 2**: Based on the reconnaissance and discussions with ATWG, KRRC will salvage and relocate a portion of the freshwater mussels located between Iron Gate Dam and Cottonwood Creek prior to drawdown to reduce project effects to the mussel community. Up to 20,000 mussels are planned for translocation to appropriate habitats in the Klamath River downstream from the Trinity River confluence (RM 43.4), and between J.C. Boyle Dam (RM 230.6) and Copco Reservoir (RM 209.0). Translocation sites will be located in areas that are anticipated by KRRC to experience minimal changes in channel bed elevation due to sediment deposition associated with the Project.

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The proposed measure is intended to reduce project effects on freshwater mussels located downstream from Iron Gate Dam. The following sections provide additional detail on the proposed measure actions.

1.1.1 Action 1: Freshwater Mussel Reconnaissance

The KRRC will prepare a reconnaissance plan to assess freshwater mussels in the Iron Gate Dam to Cottonwood Creek reach in 2018. Habitat conditions will also be evaluated downstream from the Trinity River confluence, and between J.C. Boyle Dam and Copco Reservoir to determine the habitat capacity for translocated mussels. An existing freshwater mussel data set (base data for Davis et al. 2013), compiled by the Karuk Tribe, USFWS, and other collaborators from 2007 to 2010 for the Klamath River downstream from Iron Gate Dam, will be reviewed and used to plan the reconnaissance. The reconnaissance will confirm mussel beds identified in the 2007-2010 surveys and estimate abundance at a subset of the mussel beds locations. Habitat metrics in the potential translocation reach will be evaluated to maximize translocation success. The freshwater mussel reconnaissance and translocation reach habitat assessment are anticipated to take 5 days.

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1.1.2 Action 2: Freshwater Mussel Salvage and Relocation

The KRRC will coordinate and implement a freshwater mussel salvage plan with freshwater mussel specialists. Based on the reconnaissance, a portion of the freshwater mussels located between Iron Gate Dam and Cottonwood Creek will be salvaged and relocated to reduce project effects to the freshwater mussel community. The freshwater mussel salvage and translocation effort is anticipated to require 10 days. The percentage of the existing mussel beds that will be salvaged and translocated is predicated on the available habitat in the Klamath River downstream from the Trinity River confluence, and between J.C. Boyle Dam and Copco Reservoir, and the abundance of mussels between Iron Gate Dam and Cottonwood Creek. Approximately 15,000 to 20,000 mussels are planned for translocation. During the course of these actions, it is not anticipated that the entire population of mussels residing below Iron Gate Dam will be recovered.

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1.2 Summary of the Affected Species, Anticipated Project Benefits and Effects, Recent Literature, 2012 EIS/R AR-7, and Proposed Measure

The following sections review the components of the 2012 EIS/R AR-7, anticipated project effects and long-term benefits on freshwater mussels, and current freshwater mussel literature.

1.2.1 Affected Species

Species intended to be addressed in the 2012 EIS/R AR-7 include:

- Oregon floater *(Anodonta oregonensis)*
- California floater *(A. californiensis)*
- Western ridged mussel *(Gonidea angulata)*
- Western pearlshell mussel *(Margaritifera falcata)*

1.2.2 Anticipated Project Effects on Measure Species

Short-term effects of the Project (prolonged exposure to high suspended sediment levels and bedload movement) are predicted to be deleterious to freshwater mussels in the Hydroelectric Reach and in the lower Klamath River downstream from Iron Gate Dam (Reclamation and CDFG 2012). Substantial freshwater mussel population reductions are expected due to sediment effects and possibly low dissolved oxygen levels. The change in hydrological properties following project implementation may also disrupt the current distribution of freshwater mussels downstream from Iron Gate Dam (Davis et al. 2013). Table 9-1 includes the likely and worst-case effects on freshwater mussel species in the Klamath River.

Table 9-1 2012 EIS/R anticipated effects summary for freshwater mussels

Species	Life Stage	Likely Effects	Worst Effects
California Floater Oregon Floater Western Ridged Western Pearlshell	All	Substantial reduction in populations	Substantial reduction in populations

Source: USBR and CDFG 2012

The following sections include descriptions of anticipated effects to freshwater mussels based on information 2012 EIS/R (Reclamation and CDFG 2012; Vol. 1, pp. 3.3-173 to 3.3-175) as well as additional information from additional freshwater mussel studies, some of which were completed after the publication of the 2012 EIS/EIR.

Freshwater Mussels

Available studies have evaluated Klamath River Basin freshwater mussel age structure, growth rates, and size distribution (*G. angulata*; Tennant 2010); population distribution and habitat use (Krall 2010; Davis et al. 2013; May and Pryor 2015); and habitat associations (Westover 2010; Davis et al. 2013). Klamath River mussels are long lived (from 10 to more than 100 years, depending on species) and may not reach sexual maturity until 4 years of age or more. *Anodonta* species are found primarily downstream from Iron Gate Dam, and likely benefit from the stable hydrology and fine sediment deposits attributed to hydroregulation below the dam (Davis et al. 2013). *G. angulata* is the most abundant freshwater mussel in the Klamath River and the species is widely distributed between Iron Gate Dam and the Trinity River (Westover 2010;

Davis et al. 2013). *M. falcata* is the least abundant freshwater mussel found in the Klamath River and seems to be mostly found downstream from the confluence of the Salmon River (Westover 2010; Davis et al. 2013).

Freshwater mussel tolerance of high suspended sediment, low dissolved oxygen, and bedload deposition are not well understood. Vannote and Minshall (1982) evaluated freshwater mussels in an aggrading river system in Idaho and concluded that *G. angulata* appear to be better adapted for aggrading rivers based on siphon positions, shell morphology, and foot placement in the underlying substrate. *M. falcata* seemed to be less adapted for aggrading rivers due to a less developed siphon for filtering water. *M. falcata* also rarely burrow into substrate more than 25-40 percent of the valve length which may increase the mussel's susceptibility to scour (Vannote and Minshall 1982). *G. angulata* migrate vertically in the channel bed and are capable of maintaining position near the channel bed surface (Vannote and Minshall 1982). *M. falcata* are not known to migrate and are therefore more susceptible to sediment burial. *Anodonta* species are likewise susceptible to sediment scour and burial due to their thinner shells. Mussels that are dislodged from their normal vertical position and fall onto their sides may not regain the normal position and may perish (Vannote and Minshall 1982).

Mussels play important roles in aquatic ecosystems. Mussels influence water quality, nutrient cycling, and habitat and are also known as "ecosystem engineers" that actively modify their environment (Xerces Society 2009; Lopes-Lima et al. 2016; Lummer et al. 2016). They filter fine sediment and organic particles, create byproducts that are food items for macroinvertebrates, and comprise the greatest proportion of animal biomass in some waterbodies (Xerces Society 2009). In the Klamath River Basin, freshwater mussels filter and sequester toxins including toxigenic algae microsystins (Kann et al. 2010) and mercury (Bettaso and Goodman 2010). Filtration of waterborne toxins may result in bioaccumulation in freshwater mussels leading to human consumption risks (Bettaso and Goodman 2010; Kann et al. 2010).

The Project is anticipated to result in high suspended sediment levels and bedload deposition in the 8 miles of the Klamath River between Iron Gate Dam and Cottonwood Creek. Extremely poor water quality due to high suspended sediment concentrations is expected in the first 2 miles of the Klamath River downstream from Iron Gate Dam (Reclamation and CDFG 2012). Fine sediment effects on freshwater mussels include gill clogging, possible growth reduction, and impairment to mussel larval stages (Lummer et al. 2016). Due to both the anticipated deleterious high suspended sediment concentrations and low dissolved oxygen levels, freshwater mussels downstream from Iron Gate Dam may experience substantial mortality with the most significant impacts anticipated to mussels located immediately downstream from Iron Gate Dam.

Over the long-term, freshwater mussels are expected to benefit from the Project through the conversion of Hydroelectric Reach reservoirs to gravel bed rivers which will restore freshwater mussel habitat, reduce water quality and water temperature impairments related to the reservoirs, and restore access for anadromous and resident host fish species that will distribute freshwater mussel larvae throughout the Klamath River upstream from Iron Gate Dam. However, due to the long time freshwater mussels take to reach sexual maturity, the recolonization and/or growth of existing freshwater mussel populations upstream of Iron Gate Dam may be slow and may not be readily noticeable for some time.

1.2.3 2012 EIS/R AR-7

The 2012 EIS/R AR-1 (Vol. I, pp. 3.3-248 to 3.3-249) directed the salvage of freshwater mussels from the Hydroelectric Reach and downstream from Iron Gate Dam. Salvaged mussels were to be relocated to suitable instream habitat unaffected by high suspended sediment concentrations, or could be placed in temporary facilities and returned to the Klamath River following the Project. A salvage and relocation pilot study was also suggested to assess salvage feasibility and relocated mussel survival. Based on the pilot study results, a detailed salvage and relocation plan was to be developed.

1.2.4 KRRC's and the ATWG's Review of AR-7 for Feasibility and Appropriateness

The KRRC assessed the feasibility and appropriateness of AR-7 through multiple planning meetings held with the ATWG between May and August 2017. During these meetings, current information on Klamath River fisheries was presented and information on other dam removal projects conducted in the western United States was reviewed to understand how the aquatic ecosystem might respond, as discussed above. The ATWG's concerns regarding the 2012 AR-7 included:

- Unfamiliarity with successful freshwater mussel relocation efforts.
- Disease transmission concerns.

The following sections provide additional information regarding AR-7 feasibility and appropriateness, based on fisheries literature and ATWG input.

Unfamiliarity with Successful Freshwater Mussel Relocation Efforts

The ATWG was unfamiliar with successful freshwater mussel translocation efforts. Anecdotal information discussed during the ATWG planning meeting (Yreka, CA, May 23, 2017) alluded to low translocation success for the Elwha Dam Removal Project and highway construction projects. Additional information was acquired by the KRRC on the Elwha Dam Removal Project freshwater mussel (*M. falcata*) translocation. For that project, freshwater mussels were translocated to two sites and remained in one site prior to the dam removal project (P. Crain, U.S. Park Service, personal communication, 2017). The relocated freshwater mussels had high survival following the translocation and prior to the dam removals. Subsequent events that impacted the translocated mussels resulted in high mussel mortality. The events included raccoon predation due to shallow habitat at the first translocation site, and excessive sediment deposition at a side channel translocation site. The third monitored site was an artificial outfall channel from the water treatment facility that went dry due to inadvertent project operations. Mussels that remained in the Elwha River downstream from Elwha Dam are suspected to have experienced high mortality due to excessive sediment deposition following dam removal, followed by channel scour during the post-dam sediment sorting process.

Freshwater mussel translocation project monitoring results are not well represented in the fisheries literature. Unpublished freshwater mussel translocation monitoring manuscripts were reviewed to better

understand the range of potential translocation success. Fernandez (2013) described the translocation success of 265 individual *M. falcata* in coastal southwest Washington. Between 55 percent and 95 percent of the transplanted *M. falcata* were accounted for in the translocation sites between one and three years following the translocation.

A review of translocation projects found mean mortality of relocated mussels was 49 percent based on an average recovery rate of 43 percent (Cope and Waller 1995). Cope and Waller (1995) found that survival of relocated mussels was generally poor and the factors influencing the survival of relocated mussels were poorly understood. For mussel relocation to be successful, more consideration must be given to habitat characterization at both the source and translocation sites. Olden et al. (2010) and Germano et al. (2015) offer considerations for successful freshwater organism and wildlife translocation efforts, respectively Luzier and Miller (2009) offer suggestions and considerations for freshwater mussel translocations.

Disease Transmission Concerns

The role of freshwater mussels in freshwater disease transmission is not well understood. Freshwater mussels are known to provide habitat for polychaete worms, one of the hosts in the life *C. shasta*. Polychaetes have been infrequently collected from freshwater mussel shells in the Hydroelectric Reach of the Klamath River (PacifiCorp 2004). Mussels may serve as a vector for other fish pathogens like *Flavobacterium columnare* and *Ichthyophthirius multifiliis* that are endemic to the Klamath River Basin (K. Kwak, CDFW, personal communication 2017).

Freshwater mussels inhabit the Klamath River upstream from Iron Gate Dam (Byron and Tupen 2017) and in tributaries upstream (Byron and Tupen 2017) and downstream from Iron Gate Dam (Davis et al. 2013; Howard et al. 2015; May and Pryor 2015), disease transmission may be less of a concern.

1.3 Summary

The Project is anticipated to have significant short-term effects, but long-term benefits for freshwater mussels. The 2012 EIS/R AR-7 included a freshwater mussel salvage and relocation pilot study followed by an informed salvage and relocation plan prior to the Project. The proposed measure includes completing a reconnaissance of existing freshwater mussels from Iron Gate Dam to Cottonwood Creek and potential translocation habitat on the Klamath River downstream from the Trinity River confluence, and between J.C. Boyle Dam and Copco Reservoir. KRRC will salvage and relocate freshwater mussels prior to the reservoir drawdown. It is not anticipated that the entire population of mussels residing below Iron Gate Dam will be recovered.

Deleted: relocation

Deleted: between the upstream extent of J.C. Boyle Reservoir and Keno Dam



Definite Plan for the Lower Klamath Project

Appendix P – Estimate of Project Costs

KLAMATH
RIVER RENEWAL
CORPORATION

June 2018

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KLAMATH RIVER RENEWAL CORPORATION

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Acronyms and Abbreviations

BOC	Board of Consultants
CA	California
CADD	Computer Aided Design and Drafting
CEQA	California Environmental Quality Act
DB	Design-Builder
EIS	Environmental Impact Statement
EIR	Environmental Impact Report
ENR	Engineering News Record
FERC	Federal Energy Regulatory Commission
FY	Fiscal Year
G&A	General and Administrative
GHG	Green House Gas
GIS	Geographic Information System
KRRC	Klamath River Renewal Corporation
Lbs	pounds
LVPP	Looting and Vandalism Protection Program

m^3	cubic meters
MPE	Most Probable Estimate
MPH	Maximum Probable High
MPL	Minimum Probable Low
MW	Mega Watt
MWh	Mega Watt hour
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
OC	On center
ODC	Other Direct Cost
OR	Oregon
PDB	Progressive Design-Builder
PLS	Pure live seed
RPS	Renewal Portfolio Standard
SF	Square Feet
SWRCB	State Water Resource Control Board
TCP	Traditional Cultural Properties
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USGS	United States Geological Survey

Chapter 1: Introduction

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1. INTRODUCTION

This report documents the estimated project cost for the Lower Klamath Project (Project), which in addition to construction cost, includes costs for management, administration and legal support, environmental compliance and permitting, engineering design, procurement, mitigation and monitoring before, during and following construction, as well as construction management. The estimated project cost is based on the preliminary design presented in the Definite Plan for the Lower Klamath Project (KRRC 2018) (the Definite Plan), in addition to ongoing coordination and consultation with Project stakeholders and regulatory agencies.

1.1 Report Objectives

Section 7.2 of the Klamath Hydroelectric Settlement Agreement, as amended (KHSA) sets forth required elements of the Definite Plan, which include:

- A detailed estimate of the actual or foreseeable costs associated with: the physical performance of Facilities Removal[1] consistent with the Detailed Plan; each of the tasks associated with the performance of the [Klamath River Renewal Corporation (KRRC)]'s obligations as stated in Section 7.1; seeking and securing permits and other authorizations; and insurance, performance bond, or similar measures, as set forth in Appendix L to this Settlement;
- The [KRRC]'s analysis demonstrating that the total cost of Facilities Removal is likely to be less than the State Cost Cap, which is the total of Customer Contribution and California Bond Funding as specified in Section 4[2]; and
- A detailed statement of the estimated costs of Facilities Removal.

This report addresses these elements of the KHSA and documents both the engineer's opinion of construction cost, based on the project design elements and construction plan summary provided in the Definite Plan, and the total estimated project implementation cost. In addition to reporting the estimated project costs, Most Probable Low (MPL) and Most Probable High (MPH) estimates were prepared using a Monte Carlo analysis to account for uncertainties associated with the estimated project costs and identified project risks. The MPL and MPH estimates represent more optimistic and more conservative opinions of project costs, respectively.

[1] "Facilities Removal" is defined in the KHSA as the "physical removal of all or part of each of the Facilities to achieve at a minimum a free-flowing condition and volitional fish passage, site remediation and restoration, including previously inundated lands, measures to avoid or minimize adverse downstream impacts, and all associated permitting for such actions."
[2] The State Cost cap is $450,000.000.

1.2 Project Scope

The proposed Project (also referred to as the Full Removal alternative) is described in Sections 1, 4, 5, 6 and 7 of the Definite Plan. The Project involves the physical removal of each of the four dam developments (Iron Gate, Copco No. 1 and No. 2, and J.C. Boyle) to achieve at a minimum a free-flowing condition and volitional fish passage, site remediation and restoration, including previously inundated lands, measures to avoid or minimize adverse downstream impacts, and all associated permitting for such actions. Table 1-1 provides an overview of the four dam developments. The Project is located on the Klamath River approximately 200 miles from the Pacific Ocean in the states of Oregon and California (see Figure 1-1). The Definite Plan also describes a "Partial Removal" alternative which is presented for purposes of environmental review. Under the Partial Removal alternative, the objectives of free-flowing river conditions and volitional fish passage will be achieved, but portions of each dam will remain in place, along with ancillary buildings and structures such as powerhouses, foundations, tunnels, and pipes. Section 5 of the Definite Plan discusses the details of infrastructure to remain under this alternative.

Prior to removal of the dams and hydropower facilities, KRRC's contractor will draw down the water surface elevation in each reservoir as low as possible to facilitate accumulated sediment evacuation and to create a dry work area for development removal activities. A number of infrastructure modifications will be necessary to facilitate drawdown. In general, drawdown will begin on January 1 of the drawdown year, and will extend through mid-March of the same year.

Table 1-1 Existing Dam Development Overview

Dam (Sate)	Description	Year Built	Capacity/ Average Annual Production	Max. Surface Area of Reservoir (acres)	Reservoir Storage Capacity (acre-feet)	Dam Type	Dam Height/Length (feet)
J.C. Boyle (OR)	Reservoir, dam, fish ladder, power canal, two turbines and powerhouse	1958	98 MW/ 329,000 MWh	420	3,495 (total) 1,724 (active)	Earthfill	68/ 693
Copco No. 1 (CA)	Reservoir, dam, two turbines and powerhouse	1918	20 MW/ 106,000 MWh	1,000	46,900 (total) 6,235(active)	Concrete	126/ 415
Copco No. 2 (CA)	Division dam, small impoundment, two turbines and powerhouse	1925	27 MW/ 135,000 MWh	40	73 (total) negligible (active)	Concrete	33/ 278
Iron Gate (CA)	Reservoir, dam, one turbine, powerhouse and fish hatchery	1962	18 MW/ 116,000 MWh	944	58,800 (total) 3,790 (active)	Earthfill	173/ 740

After drawdown is accomplished, remaining reservoir sediments will be stabilized to the extent feasible and dam and hydropower facility removal will begin. Full reservoir area restoration will begin after drawdown, extend throughout the year, and possibly extend into the subsequent year. Vegetation establishment could extend several years.

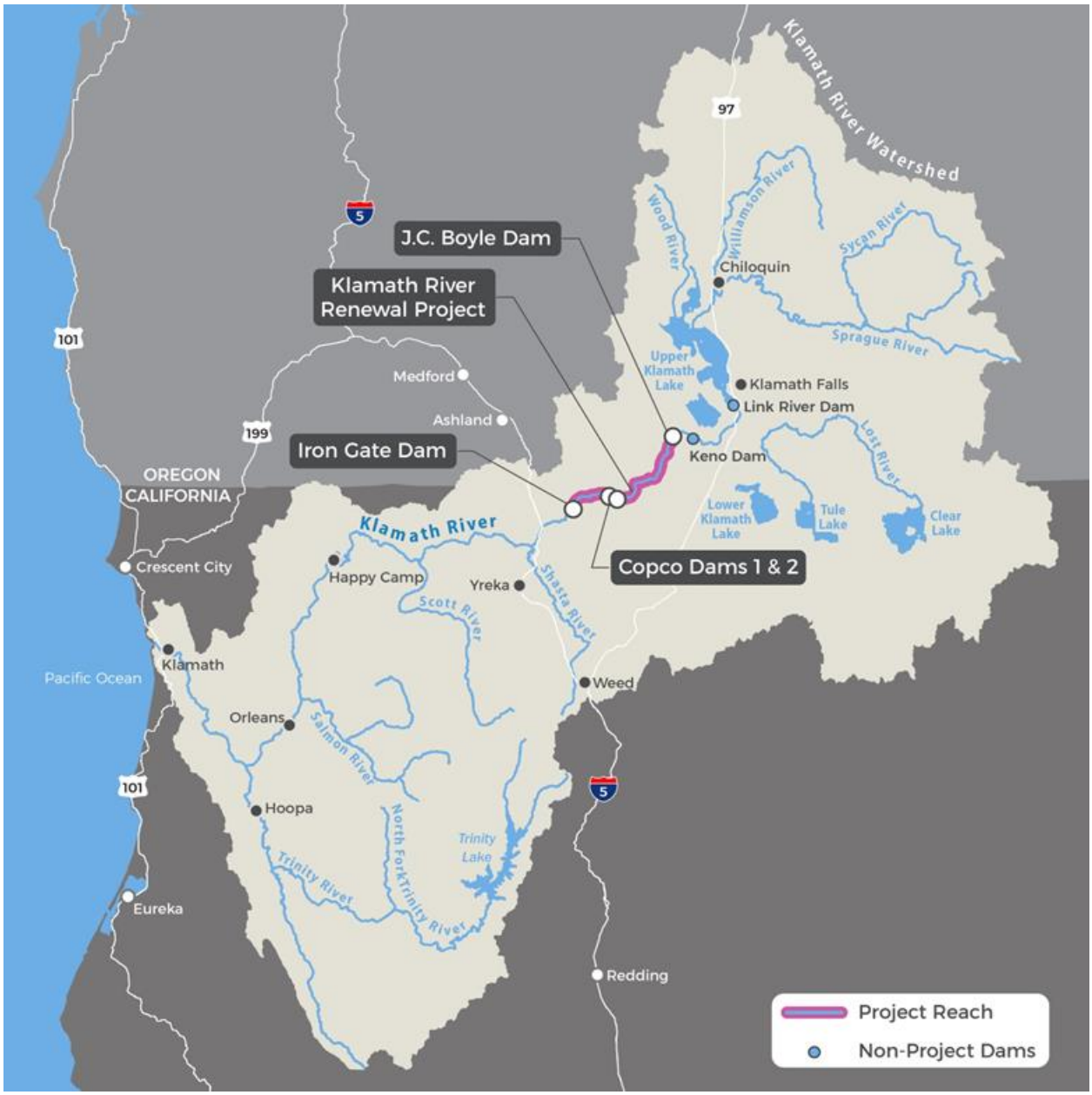

Figure 1-1 Klamath River Watershed and Facilities Locations

Other key project components include measures to reduce Project-related effects to aquatic and terrestrial resources, road and bridge improvements, relocation of the City of Yreka's pipeline across Iron Gate Reservoir and associated diversion facility improvements, as well as demolition of various recreation facilities adjacent to the reservoirs. This estimate does not include costs associated with design and

construction of any hatchery improvements associated with the Project (as described in the Definite Plan), and as per the KHSA, these will be funded separately by PacifiCorp.3

1.3 Limitations

The opinion of estimated project costs presented in this report is based on information in the Definite Plan, ongoing coordination and consultation with project stakeholders and regulatory agencies, and market conditions at the time of preparation of the estimate. The construction cost was estimated with the use of a combination of built-up unit prices and statistical unit prices from published and internally developed and maintained historical databases factored for location, contractor markups, and other project-specific criteria. Logic, methods, and procedures for developing costs are typical for the construction industry.

Various limitations need to be considered in the use of both built-up and statistical unit prices. These limitations include the potential for changes in technology, methods, and construction applications; the impact of short-term economic cycles; and the time-lag of reporting databases. Any estimate of unit prices is not intended to predict the outcome of hard dollar results from open and competitive bidding.

AECOM represents that the services were conducted in a manner consistent with the standard of care ordinarily applied as the state of practice in the profession, given the amount of design information available at the time of estimate preparation. No other warranties, either expressed or implied, are included or intended.

Other implementation costs presented in this report, outside of the preliminary design and construction activities, should be considered preliminary, due to the fact that:

- Permitting coordination is currently ongoing. The understanding of anticipated mitigation, monitoring and reporting requirements should be considered preliminary until feedback is received from the agencies on the draft permit applications. KRRC will obtain additional clarity on mitigation, monitoring and reporting once the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) processes are complete.
- KRRC has not yet selected a Progressive Design-Builder (PDB) to finalize the dam removal designs and subsequently complete the associated construction. The current understanding and effort associated with PDB field studies and final design should be considered preliminary until that selection process is complete.

KRRC is undertaking additional due diligence on construction costs, measures to lower construction costs, and measures to manage construction risk. These measures include risk management, selection of a PDB to perform the work, and negotiation of a PDB contract with a guaranteed maximum price for construction. Many risks considered in the Monte Carlo analysis that deal with design and regulatory compliance will be managed or better understood when this process is completed, likely lowering the MPH. These results of these inquiries will be further informed by the review and recommendations of a FERC approved

[3] See Section 7.6.6 of the KHSA.

independent Board of Consultants (BOC) for the Lower Klamath Project. Among other inquires, the BOC will be convened to review and provide recommendations regarding the adequacy of available funding and reasonableness of updated cost estimates for the most probable cost and maximum cost for the Full Removal alternative, and the assumptions made to calculate those estimates. KRRC will incorporate the recommendations of the BOC into a revised Definite Plan.

1.4 Results Summary

Tables 1-2 and 1-3 below summarize the estimate of project costs, for both Full Removal and Partial Removal of the four dams.

Similar to previous project estimates, the results show probabilistic MPL and MPH costs based on the results of Monte Carlo simulations. The right-hand column indicates the estimated project costs, whereas the forecast range from MPL to MPH indicate the range of probabilistic outcomes. The MPL is P10 (likely final project cost in 10% of all scenarios) and the MPH is P90 (likely final project cost in 90% of all scenarios). Details on these methods are described further in Section 2.7 (Monte Carlo Analysis) of this report.

Table 1-2 Results Summary - Full Removal

Cost Category	Forecast Range		Estimated Project Cost
	MPL (P10)	MPH (P90)	
Project Oversight			$29,581,000
Environmental Compliance & Permitting			$8,637,000
Engineering & Procurement			$15,632,000
Construction Management			$10,617,000
Construction	$202,108,000	$268,560,000	$227,980,000
Anticipated Mitigation Measures			$18,407,000
Monitoring & Reporting			$18,405,000
Design & Construction Contingency			$68,394,000
TOTAL	**$346,500,000**	**$507,100,000**	**$397,700,000**

Table 1-3 Results Summary - Partial Removal

Cost Category	Forecast Range		Estimated Project Cost
	MPL (P10)	MPH (P90)	
Project Oversight			$29,581,000
Environmental Compliance & Permitting			$8,637,000
Engineering & Procurement			$15,632,000
Construction Management			$10,617,000
Construction	$169,140,000	$229,250,000	$193,030,000
Anticipated Mitigation Measures			$18,407,000
Monitoring & Reporting			$18,405,000
Design & Construction Contingency			$57,909,000
TOTAL	**$313,500,000**	**$467,800,000**	**$352,200,000**

Chapter 2: Basis of Estimate

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2. BASIS OF ESTIMATE

2.1 Cost Categories

For organizational purposes, the project costs have been summarized using the following cost categories:

- **Project Oversight:** Support services providing administration, project management and controls, contract management, Board of Consultants (BOC), outreach, insurance and legal support.
- **Environmental Compliance and Permitting**: Environmental compliance support and permitting.
- **Engineering and Procurement:** Field studies, engineering design, and construction procurement for the various project work packages. Design and procurement estimates assume a PDB, performance security, construction delivery method for the large dam removal work package.
- **Construction Management:** Full construction management services for implementation of all project components.
- **Construction:**
  - Dam removals: Sequential removal of all four dams, including dam modifications, reservoir drawdown and removal of all associated dam infrastructure (including spillways, fish ladders, intake structures, penstocks, turbine units, electrical installations, buildings)
  - Reservoir area improvements: Removal, grading and shaping of portions of reservoir sediment, bank stability measures
  - Reservoir area restoration: Seeding, planting, weeding, monitoring and maintenance. Hydroseeding methods include by barge along the reservoir bank, by helicopter along steep slopes, by airplane along uneven large areas and by trailer mounted blower for areas easily accessible by truck
  - Yreka water supply improvements: Improvements to the City of Yreka's water supply intake and relocation of their water supply pipeline.
  - Transportation infrastructure: Improvements to, or replacement of, bridges, culverts and road resurfacing to mitigate any project or construction related impact
  - Recreation demolition: Demolition of existing recreation infrastructure and restoration of disturbed area to native vegetation
  - Recreation improvements: New recreation infrastructure (e,g, water access, day-use areas, etc.) to avoid or minimize project impacts
  - Downstream flood improvements: Improvements to existing structures and facilities to avoid or minimize adverse downstream flood-related impacts.

- **Anticipated Mitigation Measures**: Anticipated cultural resource measures, groundwater improvements, and water supply improvements that may be required by regulatory agencies to mitigate Project-related impacts.
- **Monitoring and Reporting:** Proposed aquatic resource, terrestrial resource, water quality, and sediment monitoring and reporting.

2.2 Construction Procurement Approach

KRRC based estimates for the various cost categories on a PDB construction procurement of the large dam removal work package, which includes construction access road and bridge accommodations, dam modifications, dam and hydropower facility removal, recreation demolition and reservoir and other restoration. KRRC will use a qualifications-based selection approach and hire a PDB contractor in late 2018/early 2019, followed by the PDB's completion of the final design in 2019.

There is a possibility that smaller work packages, including downstream flood control improvements, City of Yreka water supply improvements and proposed recreation facilities, may be procured separately using a design-bid-build, or similar, procurement strategy. For these packages, final design will proceed in 2018 and 2019, with request for construction proposals being issued in mid- to late-2019.

2.3 Construction Pricing

The construction estimates summarized herein are intended to capture the most current pricing for materials, wages and salaries, equipment, accepted productivity standards, and typical construction practices, procurement methods, current construction economic conditions, and site conditions for the current level of design. Detailed construction cost breakdowns for both Full Removal and Partial Removal alternatives are provided in Attachment A. Pay item cost detail worksheets, describing the calculation of individual cost estimate line items rates and prices are provided in Attachment B.

Construction cost estimates were prepared based on less than complete designs, and have inherent levels of risk and uncertainties (as discussed in Section 2.7). The following sections discuss the various aspects and assumptions associated with construction pricing for the Project.

2.3.1 Construction Pricing - Direct Costs

Experienced construction cost estimators developed direct cost construction pricing using logic, methods, and procedures for pricing that are typical for the construction industry. Unit rates were established using input from RS Means database, Equipment Watch database and Davis Bacon Wage Determination database. Overall prices were established by taking location, access and construction operation into consideration.

KRRC used the latest Davis Bacon Wage Determination for labor rates and fringes. The area used is based on Siskiyou County, California. The Project is located in a remote location which will require per diem for all employees. This consideration is included within the Contractor's overhead cost and associated percentage

KRRC based equipment costs on the latest understanding of the equipment required to complete the work. Unit prices include equivalent/similar pieces of equipment with present day rates from Equipment Watch Blue Book, and include equipment mobilization. In selecting the rates, Redding, California was used as the nearest available location. Equipment hourly rates include fuel, which is a factored rate of $3.00/gallon based on average retail prices from nearby gas stations. KRRC estimated equipment and material sales tax at 7.75% based on recent sales tax data in Siskiyou County.

The major features and/or items in the estimate, such as the dam modifications, dam removal, and reservoir restoration are fairly well defined. KRRC estimated costs for these items using crew and equipment work-item analysis to develop unit costs, and then multiplying these by the quantity measurement to arrive at work item subtotals. Crew and equipment work-item analysis spreadsheets are presented in Attachment B.

KRRC used vendor quotes for materials such as gates for drawdown, pipelines, instrumentation, and hydroseeding. KRRC based costs for some of the smaller items of work within the estimate on the experience and judgment of the estimator using historical data from similar types of construction, factored for location, size, and other Project-specific criteria.

2.3.2 Construction General Requirements

As discussed in more detail below, the following markups were applied into the contractor's direct costs to account for general requirements:

- PDB Contractor's overhead at 15%
- PDB Contractor's profit and risk at 8%
- PDB Contractor's markup on subcontractors at 10%
- PDB Contractor's insurance at 1%
- PDB Contractor's bond at 1%

Contractor Overhead

KRRC calculated construction overhead for this Project using a slightly higher percentage than normal due to the remoteness of the Project, including establishing and maintaining workers' accommodation facilities, travel compensation, per diem payments and labor rate market conditions caused by the size of the Project in the remote location.

Construction overhead includes salaried payroll costs (salary, insurance, taxes, and fringe benefits) for management, supervisory, administrative, and safety employees. These employees include the Contractor's jobsite project management, documentation control, submittal preparation, surveying, field engineering, and

quality assurance costs. Recurring jobsite overhead expenses such as office rentals, utility bills, and maintenance expenses for jobsite facilities are also included in the general requirements, as are non-recurring expenses such as the bonds and insurance, purchase of office, engineering, and safety equipment, and outside engineering and surveying expenses.

The Contractor overhead percentage (15% percentage of direct construction cost) amounts to approximately $30M over the construction duration. This is approximately equivalent to the following from the estimate of project costs (Full Removal):

- PDB Contractor's project management 2019 $3M
- PDB Contractor's project management 2020-2021 $10M
- Establish and maintain workers accommodations $6M
- Offices & facilities for PDB Contractor $4M
- Offices & facilities for contract manager $4M
- Temporary facilities $3M

Contractor Profit and Risk Markups

KRRC derived a profit and risk markup on direct construction costs of 8% by using the United States Army Corps of Engineers (USACE) Profited Weight Guidelines following the steps listed below. Figure 2-1 shows the calculation summary using the reference guidelines. The resulting amount included in the estimated project cost for Contractor's profit and risk compensation is approx. $17M.

- Risk: Where the work involves no risk or the degree of risk is very small, the weighting is 0.03; as the degree of risk increases, the weighting increase up to a maximum of 0.12. Lump sum items will have, generally, a higher weighted value than unit price items for which quantities are provided. Considerations include the portion of work to be done by subcontractors, nature of work, where work is to be performed, reasonableness of negotiated costs, amount of labor included in costs, whether negotiation is before or after performance of work, etc.
- Difficulty: If the work is most difficult and complex, the weighting is 0.12 and is proportionately reduced to .03 on the simplest jobs. This factor is tied in to some extent with the degree of risk. Considerations include the nature of the work, schedule, by whom it is done, where it is done, etc.
- Size of Job: Jobs not in excess of $100,000 are weighted at 0.12. Jobs estimated between $100,000 and $5,000,000 are proportionally weighted from 0.12 to .05. Jobs from $5,000,000 to $10,000,000 are weighted at 0.04 and work in excess of $10,000,000 at 0.03.
- Duration: Jobs in excess of 24 months are weighted at 0.12. Jobs of lesser duration are proportionately weighted to a minimum of .03 for jobs not to exceed 30 days. The period applies to only the change -- not the contract duration.
- Investment: Weighted from 0.03 to 0.12 on the basis of below average, average, and above average. Considerations include the amount of subcontracting, mobilization payment item, Government-furnished property, method of making progress payments, etc.

- Government Assistance: Weighted from 0.12 to 0.03 on the basis of average to above average. Considerations include use of Government-owned property, equipment and facilities, expediting assistance, etc.
- Subcontracting: Weighted inversely proportional to the amount of subcontracting. Where 80% or more of the work is to be subcontracted, the weighting is to be 0.03 and such weighting proportionally increased to 0.12 where all the work is performed by the Contractor's own forces.

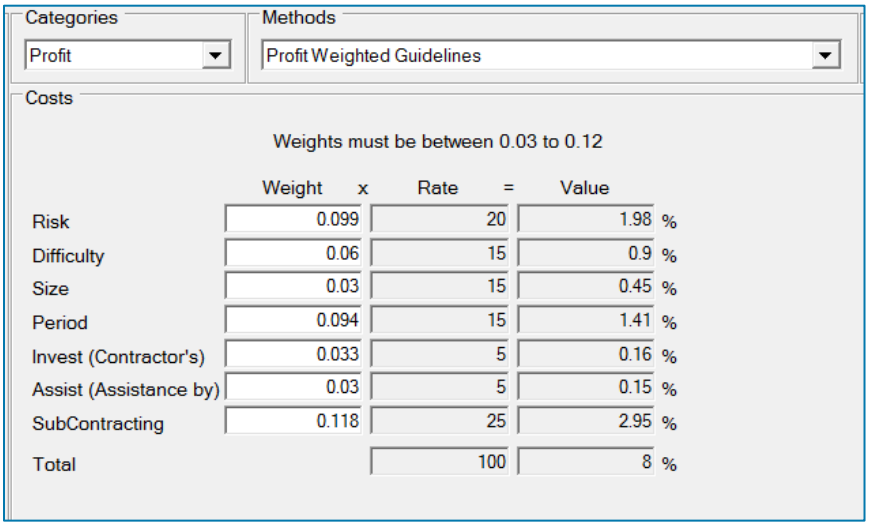


Figure 2-1 Contractor Profit and Risk Calculation Summary

Risks identified on the risk register as transferred to the PDB Contractor are assumed to be covered within this amount. No allowance for risks categorized as transferred to the PDB Contractor are included in other project contingencies.

Subcontractor Markups

KRRC selected a subcontractor markup of 10% as derived by using industry standard construction subcontract requirements on similar projects.

Insurance Markups

KRRC selected an insurance markup of 1% of direct construction cost as derived by using industry standard insurance requirements on similar projects. Insurance markup can vary to account for work complexity, procurement lead time, etc. However, since the project scope is primarily demolition, KRRC considers a 1% insurance markup appropriate.

Bond Markups

KRRC selected a bonding markup of 1% of direct construction cost as derived by using industry standard bond requirements on similar projects.

2.3.3 Quantities

Detailed quantity takeoffs made for the earthworks items (excavation, fill and erosion protection) were computer-generated (and independently checked) using the surfaces presented in the drawings, and represent neat-line quantities. Earthwork volumes (cut, fill, balance) and other quantities are provided in Section 5 and associated figures of the Definite Plan.

2.3.4 Construction Schedule

KRRC based the estimate on the construction schedule and the construction plan described in the Definite Plan. As discussed in the plan, the schedule is predicated on the following:

- Construction of City of Yreka water supply improvements will be completed in 2020 (prior to drawdown) and may be under a separate contract from the PDB Contract for the dam removal work
- Construction of downstream flood control improvements will be completed in 2020 prior to drawdown) and may be under a separate contract from the PDB Contract for the dam removal work
- Construction of the access road improvements will be completed in 2020 (prior to drawdown)
- An effective Date of Agreement (guaranteed maximum price) for the dam removal PDB on or before February 15, 2020
- Lineal and concurrent activities
- Equipment application and production
- The ability to drawdown J.C. Boyle, Copco No. 1 and Iron Gate reservoirs at the beginning of 2021
- Major earthworks and removal activities are assumed to be performed using two 10-hour shifts, six days per week
- In-stream construction window in Oregon is assumed to be from July 1 through September 30
- In-stream construction window in California is assumed to be from June 15 through October 15

The duration of many of the schedule activities are determined from the labor and equipment productivity associated with the estimate pay item sheets.

The access road, dam modification, water supply, and downstream flood control construction will be completed during an estimated 6- to 8-month period in 2020, since these activities require completion prior to drawdown and facility removal. Subsequent dam removal and associated construction will occur during 8 months of work in 2021, with restoration related construction activities likely extending through 2022. Monitoring and reporting will extend for 5 years after construction completion.

2.4 Consulting Services Pricing

Outside of construction costs, other implementation activities such as project oversight, field studies, design, permitting, mitigation measures and monitoring generally involve labor and associated other direct costs (ODCs). ODCs can include office space, travel, meals, postage, specialty reproduction, and vendor quotes for

materials, supplies or services. For each of the implementation activities referenced above, KRRC developed independent estimates using standard labor rates and ODC values based on the latest understanding of the scope or work for the life of the Project. Details for each cost category are provided in Section 3. KRRC used a standard labor rate sheet for an environmental/engineering consulting firm, as shown below in Table 2-1, to develop the majority of the other implementation costs listed above. In some cases, KRRC used specialty rates to develop estimates for specialty activities such as project oversight and legal support.

Table 2-1 Environmental/Engineering Labor Rate Sheet

Labor Classification	Hourly Rate	Labor Classification	Hourly Rate
Senior Technical Advisor	$285.00	Field Technician	$75.00
Principal	$285.00	Junior Field Technician	$55.00
Project Manager	$230.00	Certified Industrial Hygienist	$165.00
Principal Engineer	$200.00	Senior Data Management	$130.00
Senior Engineer	$180.00	Data Management	$85.00
Engineer	$145.00	Senior GIS/CADD/Graphics	$120.00
Junior Engineer	$100.00	GIS/CADD/Graphics	$90.00
Principal Scientist/Planner	$180.00	Technical Editor	$105.00
Senior Scientist/Planner	$160.00	Community Relations Specialist	$110.00
Scientist/Planner	$120.00	Project Controls/Procurement	$95.00
Junior Scientist/Planner	$95.00	Administrative Assistant	$75.00
Senior Field	$110.00	Clerical/Support	$65.00

The hourly rates set forth in this schedule of fees and charges is valid from January 1, 2017 through December 31, 2017. The Hourly Rates are adjusted annually on January 1 of each subsequent year. The new Schedule of Fees and Charges will apply to existing and new assignments. For work extends beyond December 31, 2017 a 3% annual escalation on hourly rates will apply.

2.5 Escalation

KRRC based estimates on contemporary market information at the time of estimate preparation. As such it is necessary to include escalation to account for cost increases over the duration of the Project, particularly as this Project spans multiple years. KRRC escalated each line item in the cost estimate based on scheduled construction and other implementation activities.

KRRC used an escalation rate of 4% per year. This is based on cost index references and current cost trends observed in the industry. As shown in the below Engineering News Record (ENR) Historic Cost Index (Table 2-2), the last few years have seen a consistent uptrend in escalation, including the beginning of 2018. Considering this trend, along with other published historical data and professional judgment, it is reasonable to expect escalation to average out at around 4% per year over the duration of the Project.

Table 2-2 ENR Historic Cost Index

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL AVG	AVERAGE ANNUAL INCREASE
1990	4680	4685	4691	4693	4707	4732	4734	4752	4774	4771	4787	4777	4732	
1991	4777	4773	4772	4766	4801	4818	4854	4892	4891	4892	4896	4889	4835	2.177%
1992	4888	4884	4927	4946	4965	4973	4992	5032	5042	5052	5058	5059	4985	3.102%
1993	5071	5070	5106	5167	5262	5260	5252	5230	5255	5264	5278	5310	5210	4.514%
1994	5336	5371	5381	5405	5405	5408	5409	5424	5437	5437	5439	5439	5408	3.800%
1995	5443	5444	5435	5432	5433	5432	5484	5506	5491	5511	5519	5524	5471	1.165%
1996	5523	5532	5537	5550	5572	5597	5617	5652	5683	5719	5740	5744	5620	2.723%
1997	5765	5769	5759	5799	5837	5860	5863	5854	5851	5848	5838	5858	5826	3.665%
1998	5852	5874	5875	5883	5881	5895	5921	5929	5963	5986	5995	5991	5920	1.613%
1999	6000	5992	5986	6008	6006	6039	6076	6091	6128	6134	6127	6127	6059	2.348%
2000	6130	6160	6202	6201	6233	6238	6225	6233	6224	6259	6266	6283	6221	2.674%
2001	6281	6272	6279	6286	6288	6318	6404	6389	6391	6397	6410	6390	6343	1.961%
2002	6462	6462	6502	6480	6512	6532	6605	6592	6589	6579	6578	6563	6538	3.074%
2003	6581	6640	6627	6635	6642	6694	6695	6733	6741	6771	6794	6782	6694	2.386%
2004	6825	6862	6957	7017	7065	7109	7126	7188	7298	7314	7312	7308	7115	6.289%
2005	7297	7298	7309	7355	7398	7415	7422	7479	7540	7563	7630	7647	7446	4.652%
2006	7660	7689	7692	7695	7691	7700	7721	7722	7763	7883	7911	7888	7751	4.096%
2007	7880	7880	7856	7865	7942	7939	7959	8007	8050	8045	8092	8089	7966	2.774%
2008	8090	8094	8109	8112	8141	8185	8293	8362	8557	8623	8602	8551	8310	4.105%
2009	8549	8533	8534	8528	8574	8578	8566	8564	8586	8596	8592	8641	8570	3.081%
2010	8860	8672	8671	8677	8761	8805	8865	8858	8857	8921	8951	8952	8857	3.349%
2011	8938	8998	9011	9027	9035	9053	9080	9088	9116	9147	9173	9172	9070	2.405%
2012	9176	9198	9268	9273	9290	9291	9324	9351	9341	9376	9398	9412	9308	2.624%
2013	9437	9453	9456	9484	9516	9542	9552	9545	9552	9689	9666	9668	9547	2.564%
2014	9664	9681	9702	9750	9796	9800	9835	9846	9870	9886	9912	9936	9806	2.716%
2015	9972	9962	9972	9992	9975	10039	10037	10039	10065	10128	10092	10153	10035	2.335%
2016	10132	10181	10242	10279	10315	10337	10379	10385	10403	10434	10442	10530	10338	3.019%
2017	10542	10559	10667	10678	10692	10703	10789	10826	10823	10817	10870	10873	10737	3.856%
2018	10878	10889	10959										10909	5.520%

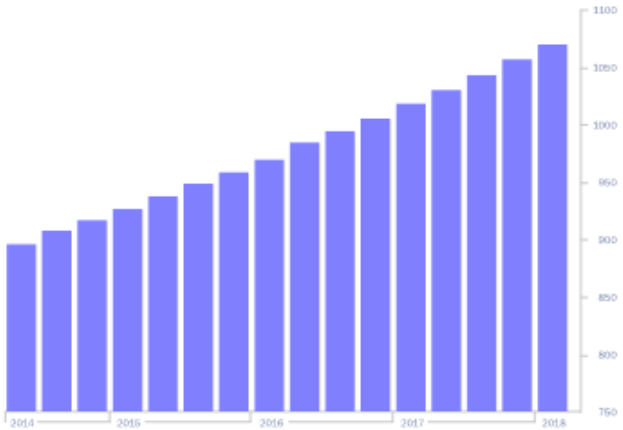
Base: 1913=100

Table 2-3 Turner Construction Building Cost Index

Turner Building Cost Index — 2018 First Quarter Forecast

"In a construction market that continues to show high levels of activity, the first quarter saw modest growth in raw material prices. Additionally, we are seeing a surge in steel driven by rising demand and limited offshore supply."

Attilio Rivetti
Vice President



Quarter	Index	△%
1st Quarter 2018	**1071**	**1.23**
4th Quarter 2017	1058	1.34
3rd Quarter 2017	1044	1.26
2nd Quarter 2017	1031	1.18

Year	Average Index	△%
2017	1038	5.0
2016	989	4.7
2015	943	4.5
2014	902	4.4
2013	864	4.1
2012	830	2.1
2011	812	1.6
2010	799	-4.0
2009	832	-8.4
2008	908	6.3
2007	854	7.7
2006	793	10.6
2005	717	9.5

The Turner Building Cost Index is determined by the following factors considered on a nationwide basis: labor rates and productivity, material prices and the competitive condition of the marketplace.

2.6 Design & Construction Contingency

Design contingencies are intended to account for three types of uncertainties which directly affect the estimated cost of a project as it advances from the planning stage through final design. These include: (1) unlisted items, (2) design and scope changes, and (3) cost estimating refinements. Based upon the apparent completeness of the listed items for the dam removal estimates, the design contingency was set at ±10 percent of the construction cost, which is a typical value for a the level of design presented in the Definite Plan, particularly given the fact that a large percentage of the demolition work is means and methods driven, as opposed to detailed design

This estimate of project costs includes a percentage allowance for construction contingencies to cover differences in actual and estimated quantities, unforeseeable difficulties at the site, changed site conditions, possible changes in plans, and other uncertainties during the construction period. The allowance is based on engineering judgment of the major pay items in the estimate, reliability of the data, adequacy of the estimated quantities, and general knowledge of the site conditions. KRRC used a value of ±20 percent of the construction cost for construction contingencies for the dam removal estimates, which is a typical value for this stage of project development.

KRRC applied the design and construction contingencies (total of 30%) discussed above as a percentage of the total construction cost, and added to the total estimate of project costs.

2.7 Monte Carlo Analysis

KRRC completed a Monte Carlo analysis to analyze uncertainties and risk, to be used as the basis for development of the MPL and MPH estimates.

The probabilistic range of costs for each estimate line item was determined with the use of '@Risk' Monte Carlo analysis software. The Monte Carlo analysis involves determining the impact and likelihood of occurrence of identified and quantified uncertainties and risks by running simulations to identify the range of possible outcomes for a number of scenarios - 10,000 scenarios in the case of this Project. A random sampling is performed in the simulation by using uncertain risk variable inputs to generate the range of outcomes with a confidence measure for each outcome.

Levels of probability are described from P1 to P100, where the number following the 'P' represents the percentage of most probable outcomes. For example, the P1 estimate amount will only cover the lowest 1% of the possible cost outcomes, whereas P100 will cover the maximum estimate amount determined from running the 10,000 scenarios. A P80 estimate covers the most likely final project cost in 80% of all scenarios, and is often used by the construction industry (Barreras 2011), including the USACE ("Per regulation and guidance, the P80 confidence level is the normal and accepted cost confidence level"), to calculate the amount of risk contingency to carry on a project.

Due to the unique nature of this Project and the KRRC, KRRC selected a conservative P90 to represent the MPH for the Project. The P90 estimate covers the most likely final project cost in 90% of all scenarios. KRRC selected a P10 to represent the MPL.

2.8 Ongoing Due Diligence

2.8.1 General

KRRC is undertaking additional due diligence on construction costs, measures to lower construction costs, and measures to manage construction risk. KRRC will complete additional engineering, select a design-build contractor, negotiate a construction agreement with the Contractor, establish a guaranteed maximum price for the work to be performed, implement its insurance programs, and establish the requirements for all bid bonds, payment bonds, and the performance bond. Many risks considered in the Monte Carlo analysis that deal with design and regulatory compliance will be mitigated or better understood when this process is completed, likely lowering the MPH significantly.

2.8.2 Independent Board of Consultants (BOC)

The FERC approved the BOC for the Lower Klamath Project on May 22, 2018. Among other things, FERC's letter of approval included a plan and schedule to obtain BOC review of the estimate of project costs and MPH estimates for the Full Removal alternative, adequacy of available funds for facilities removal, adequacy of the proposed contingency reserve, and adequacy of the proposed insurance and bonding arrangements. The five-member BOC includes Dan Hertel, PE (Engineering Solutions, LLC), James Borg, PE (D&H Concepts, LLC), Craig Findlay, PhD, PE, GE (Findlay Engineering, Inc.), Mary Louise Keefe, PhD (R2 Resource Consultants, Inc.), Ted Chant, PE (Chant Limited) and Robert Muncil, ARM (Cool Insurance Agency, Inc.). KRRC plans to convene the BOC on or before August 1, 2018.

The Definite Plan will be further informed by the review and recommendations of the BOC. KRRC will incorporate the recommendations of the BOC into a revised Definite Plan and this Appendix P will be updated accordingly.

Chapter 3: Cost Category Summaries

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3. COST CATEGORY SUMMARIES

The following sections provide detailed summaries of methods, assumptions and results of the estimate development for the various cost categories and subcategories.

3.1 Project Oversight

Project oversight and administration costs generally include costs associated with KRRC set-up and corporate insurance, management labor and travel, accounting and administrative support, project controls, contract management, BOC participation and facilitation, legal support, and outreach. Oversight costs exclude technical services, engineering, mitigation measures, construction contracting and land survey contracting. Table 3-1 summarizes estimated project costs for project oversight across the various project phases. Project oversight costs are the same for the Full and Partial Removal alternatives.

KRRC developed labor estimates for each activity using the latest understanding of management requirements in any given year, and applicable industry labor rates. KRRC developed ODCs using an understanding of actuals spent to date and requirements to continue management efforts into the future. ODCs include office space, travel, meals, postage, specialty reproduction, and vendor quotes for materials, supplies or services.

Table 3-1 Project Oversight Estimate Per Phase

Project Oversight	July 2016 - Jun 2017 (1 year)	July 2017 - Dec 2019 (2.5 years)	Jan 2020 - Jun 2022 (2.5 years)	Jul 2022 - Jun 2027 (5 years)	Total
Management Labor, ODCs & Insurance	$ 722,000	$ 3,653,000	$ 4,469,000	$ 832,000	$ 9,676,000
Accounting and Administation	$ 1,139,000	$ 2,777,000	$ 3,189,000	$ 811,000	$ 7,916,000
Contract Management and Controls	$ 1,110,000	$ 1,738,000	$ 373,000	$ 86,000	$ 3,307,000
Board of Consultants Process	$ -	$ 906,000	$ 494,000	$ -	$ 1,400,000
Legal Support	$ -	$ 3,052,000	$ 1,294,000	$ 241,000	$ 4,587,000
Outreach	$ 460,000	$ 1,102,000	$ 1,051,000	$ 75,000	$ 2,688,000
					$ 29,580,000

Note: Numbers based on 2018 dollars and exclude escalation

Table 3-2 summarizes average Full Time Equivalent (FTE) staffing for the various activities and line items. FTE numbers give a general understanding of how many full time staff may be working on each activity throughout each year or phase. KRRC calculated FTEs by dividing annual labor costs by the total working hours per year/phase and the average labor rate for each activity. FTE values for the BOC were calculated using working hours for a quarter of any given year, since BOC members are not full-time employees.

Project oversight FTEs are generally highest from 2019 through 2021, as the KRRC will be managing numerous contracts for engineering and construction of the various project components.

Table 3-2 Project Oversight Average FTEs Per Phase

Project Oversight	July 2016 - Jun 2017 (1 year)	July 2017 - Dec 2019 (2.5 years)	Jan 2020 - Jun 2022 (2.5 years)	Jul 2022 - Jun 2027 (5 years)
Management Labor, ODCs & Insurance	1.1	2.4	2.9	0.2
Accounting and Administation	3.4	3.3	3.8	0.5
Contract Management and Controls	4.4	2.8	0.6	0.0
Board of Consultants Process	-	2.3	1.2	-
Legal Support	-	1.7	0.7	0.1
Outreach	1.0	1.0	0.9	0.0

3.2 Environmental Compliance and Permitting

KRRC's plan for compliance with applicable laws and regulations is provided at Section 1.3 of the Definite Plan. Cost estimates reflected in this Appendix P are based upon implementation of that plan, and further assume that the license surrender order to be issued by the FERC will authorize implementation of the Definite Plan (as proposed) and will not impose any conditions that conflict with or are materially inconsistent with the Definite Plan. In additional to FERC 's surrender order (which will incorporate any conditions or requirements of the National Environmental Policy Act, California § 401 Clean Water Act Water Quality Certification, Oregon § 401 Clean Water Act Water Quality Certification, the Endangered Species Act, the Magnuson-Stevens Fishery Conservation and Management Act and the National Historic Preservation Act), the California § 401 Clean Water Act Water Quality Certification to be issued by the California State Water Resources Control Board will include and address any measures needed to comply with the CEQA. This report also assumes that implementation of the Definite Plan will require a Section 404 individual permit from the USACE, coverage under an National Pollutant Discharge Elimination System (NPDES) Construction Stormwater General Permits for construction-related stormwater discharges to surface waters in California and Oregon, and various other state and local permits required by applicable law. Table 3-3 summarizes estimated environmental compliance and permitting costs across the applicable project years. Environmental compliance and permitting costs are the same for the Full and Partial Removal alternatives.

KRRC developed labor estimates for each activity using the latest understanding of management requirements in any given year, and applicable industry labor rates. KRRC developed ODCs using an understanding of actuals spent to date and requirements to continue permitting and associated field efforts into the future. ODCs include travel, meals, and vendor quotes for materials, supplies or services.

Table 3-4 summarizes average FTE staffing for the various activities and line items. FTE numbers give a general understanding of how many full time staff may be working on each activity throughout each year or phase. KRRC calculated FTEs by dividing annual labor costs by the total working hours per year and the average labor rate for each activity.

Environmental compliance and permitting FTEs are generally highest in 2018 while numerous biological surveys are being completed along with development of materials to support FERC.

Table 3-3 Environmental Compliance Estimate Per Year

Permitting Activity	2017	2018	2019	2020	2021	2022	Subtotal
Permitting Approach	$ 90,000	$ 50,000	$ -	$ -	$ -	$ -	$ 140,000
Biological Surveys	$ 50,000	$ 960,000	$ 800,000	$ -	$ -	$ -	$ 1,810,000
Federal Permitting	$ 468,000	$ 1,335,000	$ 643,000	$ 427,000	$ 427,000	$ 214,000	$ 3,514,000
State Permitting	$ 115,000	$ 573,000	$ 28,000	$ -	$ -	$ -	$ 716,000
Local Permitting	$ 66,000	$ 445,000	$ 28,000	$ -	$ -	$ -	$ 539,000
TOTAL	**$ 789,000**	**$ 3,363,000**	**$ 1,499,000**	**$ 427,000**	**$ 427,000**	**$ 214,000**	**$ 6,719,000**

Note: Numbers based on 2018 dollars and exclude escalation

Table 3-4 Environmental Compliance Average FTEs Per Year

Permitting Activity	2017	2018	2019	2020	2021	2022
Permitting Approach	0.3	0.1	-	-	-	-
Biological Surveys	0.0	3.7	3.0	-	-	-
Federal Permitting	1.4	4.0	1.9	1.3	1.3	0.6
State Permitting	0.3	1.7	0.1	-	-	-
Local Permitting	0.2	1.3	0.1	-	-	-

3.3 Engineering and Procurement

Engineering and procurement includes all activities required to complete the final project engineering designs and procure construction contractors to complete the construction. Section 2.2 describes the construction procurement approach for the Project, and is a basis for the procurement estimates provided herein.

The first step in the design process is to complete the necessary field work to obtain design data to support the design analyses and drawings. The following activities fall into this category:

- Topographic/Bathymetric Surveys: Obtain updated data of topographic and reservoir bathymetric conditions at the Project
- Geotechnical Investigations: Obtain geologic information to evaluate reservoir rim stability and other geologic conditions to support design components
- Hazardous Material Investigation: Complete phase 1 hazardous material assessments for existing hydropower and other pertinent project features
- Biological Reconnaissance: Obtain initial understanding of existing biological conditions that may affect proposed design layout
- Engineering Reconnaissance: Obtain understanding of existing site facilities and infrastructure to inform design and demolition activities
- Groundwater Monitoring: Obtain groundwater well data adjacent to reservoirs to assess potential impacts associated with reservoir drawdown

The next step in the design process is to refine the preliminary designs based on the latest field data and input from regulatory and other stakeholders. This refined design will serve as the basis for environmental and regulatory reviews. Primary project components are listed below, and described in detail in the Definite Plan.

- Dam & hydropower demolition
- Reservoir restoration
- Road and bridge improvements
- Relocation of the City of Yreka's pipeline across Iron Gate Reservoir and associated diversion facility improvements
- Demolition [and replacement] of various recreation facilities adjacent to the reservoirs
- Recreation improvements
- Downstream flood control improvements
- Groundwater system improvements
- Fish hatchery modification and improvements (not included in estimate since funded separately by PacifiCorp)
- Cultural resource measures (to protect identified historic, cultural, and tribal resources)
- Groundwater improvements (well improvements adjacent to the reservoirs, if needed)

After preliminary design, the final engineering plans and specifications are developed. As described in Section 2.2, the PDB will complete final design of the large dam removal work package (access road improvements, dam modifications, access road improvements, dam and hydropower removal, and reservoir restoration), while final design of other components may be completed by a separate engineering entity.

The final activity for the engineering team(s) will be to provide engineering support during construction for quality control purposes.

Table 3-5 summarizes estimated engineering and procurement costs across the applicable project years. Engineering and procurement costs are the same for the Full and Partial Removal alternatives.

KRRC developed labor estimates for each activity using the latest understanding of engineering and procurement requirements in any given year, and applicable industry labor rates. KRRC developed ODCs using an understanding of actuals spent to date and requirements to continue engineering and procurement efforts into the future. ODCs include travel, meals, and vendor quotes for materials, supplies or services.

Table 3-5 Engineering & Procurement Estimate Per Year

Engineering & Procurement Activity	2017	2018	2019	2020	2021	2022	Subtotal
Design Data	$ 537,000	$ 1,455,000	$ -	$ -	$ -	$ -	$ 1,992,000
Preliminary Design	$ 1,909,000	$ 1,796,000	$ 125,000	$ 25,000	$ 25,000	$ -	$ 3,880,000
Final Design & Eng. Construction Support	$ -	$ 100,000	$ 6,120,000	$ 1,256,000	$ 1,094,000	$ 178,000	$ 8,748,000
Procurement	$ 37,000	$ 524,000	$ 348,000	$ 103,000	$ -	$ -	$ 1,012,000
TOTAL	**$ 2,483,000**	**$ 3,875,000**	**$ 6,593,000**	**$ 1,384,000**	**$ 1,119,000**	**$ 178,000**	**$ 15,632,000**

Note: Numbers based on 2018 dollars and exclude escalation

Table 3-6 summarizes average FTE staffing for the various activities and line items. FTE numbers give a general understanding of how many full time staff may be working on each activity throughout each year or phase. KRRC calculated FTEs by dividing annual labor costs by the total working hours per year and the average labor rate for each activity.

FTEs are highest for engineering design in 2019, when multiple engineering design teams will be developing final design packages for the various project components.

Table 3-6 Engineering & Procurement FTEs Per Year

Permitting Activity	2017	2018	2019	2020	2021	2022
Design Data	1.6	4.4	-	-	-	-
Preliminary Design	5.6	5.3	0.3	-	-	-
Final Design & Eng. Construction Support	0.0	0.3	18.3	3.8	3.3	0.5
Procurement	0.1	1.3	1.3	-	-	-

3.4 Construction Management

The estimate and proposed construction management (CM) approach for the Project is based on the information available at the time of the development of this analysis and on the assumption that the dam removal construction will be performed under a PDB contract and that other project components may be constructed through the implementation of conventional contracting methods (e.g. design-bid-build (DBB)).

KRRC estimated construction management to support all construction commencing mobilization in early 2020, dam modifications and commencement of work on construction of other components such as access road and bridge work, waterline relocation and downstream flood control improvements. Support continues through reservoir drawdowns into 2021 and ramps-up in the second year of construction for the parallel demolition of dams, and reservoir restoration.

The proposed CM approach is based on the assumption that two construction management offices located at the Iron Gate and Copco areas will be established for 2020, with a third office established in 2021 for the J.C. Boyle area. The estimate also reflects the traveling constraints between each of the sites under the prospective contracts.

The principal construction management office will be located near the existing Iron Gate dam, where the Senior Construction Manager is located. There will be one Project Control Manager, one Scheduler and one Field Contract Administrator to support the construction, who will likely be located in the Iron Gate dam offices. KRRC considers establishing the principal office at this location advantageous as the excavation work at Iron Gate is one of the more labor-intensive critical path aspects to the construction. Secondary construction management offices will each be headed up by a separate Construction Manager. Costs for these facilities are included in the construction Contractor's general conditions.

Third-party inspection oversight on the PDB is an important factor in construction management of a sensitive high-visibility project such as this. Inspectors will provide oversight of Contractors' safety, quality, environmental, cultural and scope compliance. They will also make timely observations of construction progress and conditions, to support identification of potential productivity issues, and support avoidance and evaluation of potential change work.

KRRC assumed that some construction work may occur outside normal working hours, and is likely required for excavation of Iron Gate dam and demolition of Copco No. 1 dam. A second shift Dam Removal Inspector has been included for 7 months to allow for this likelihood.

A Safety Manager and Quality Manager are included at 40 hours/month each to provide audits of contractor and construction management practices against established procedures and standards.

KRRC calculated labor costs based on applicable industry contract rates where available and escalated them at 3% annually. KRRC based all labor costs on a 40 hour work week, except for inspector labor costs which are based on a 50 hour work week. An allowance of 20% on labor has been included to cover ODCs including travel, lodging and other remuneration associated with the remote sites.

The estimated project cost assumes that cultural resources and environmental monitoring will be required. These costs are not captured in the CM section, but are included elsewhere in this estimate.

Table 3-7 summarizes estimated construction management costs on a per-year basis, per labor category and shows ODCs included in the estimate. Construction management costs are the same for the Full and Partial Removal alternatives.

Table 3-8 show staff included in this estimate, where 1.00 = one FTE for one month.

Table 3-7 Construction Management Estimate Per Year

Construction Management Staff	Hrs/ week	2020	2021	2022	Total
Sr. Construction Manager (1 person)	40	$ 441,852	$ 508,019	$ 43,605	$ 993,477
Construction Manager (2 people)	40	$ 410,262	$ 916,948	$ 80,378	$ 1,407,588
Administrative Assistant (3 people at peak)	40	$ 277,025	$ 482,882	$ 45,214	$ 805,121
Field Contract Administration (1 person)	40	$ 283,162	$ 327,748	$ 28,132	$ 639,042
Lead Dam Removal Inspector (3 people at peak)	50	$ -	$ 1,090,055	$ -	$ 1,090,055
Second Shift Dam Removal Inspector (1 person)	50	$ -	$ 305,215	$ -	$ 305,215
Yreka Water Supply Inspector (0.5 person)	50	$ 148,163	$ -	$ -	$ 148,163
Rec Improvements Inspector (0.5 person)	50	$ 148,163	$ 174,409	$ -	$ 322,572
Flood Improvements Inspector (0.5 person)	50	$ 148,163	$ 174,409	$ -	$ 322,572
Bridges and Roads Inspector (1 person)	50	$ 370,407	$ 436,022	$ 37,425	$ 843,854
Specialty Inspectors (1 person)	50	$ -	$ 339,128	$ -	$ 339,128
Scheduler (1 person)	40	$ 282,846	$ 327,748	$ 28,132	$ 638,726
Project Control Engineer (1 person)	40	$ 282,846	$ 327,748	$ 28,132	$ 638,726
Safety Manager (0.25 person)	40	$ 79,485	$ 89,312	$ 7,666	$ 176,463
Quality Manager (0.25 person)	40	$ 79,485	$ 89,312	$ 7,666	$ 176,463
ODCs at 20%	-	$ 590,372	$ 1,117,791	$ 61,270	$ 1,769,433
TOTAL		**$ 3,542,231**	**$ 6,706,749**	**$ 367,620**	**$ 10,616,599**

Note: Numbers based on 2018 dollars and exclude escalation

Table 3-8 Construction Management FTEs Per Month

	2020												2021												2022		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
CONSTRUCTION MANAGEMENT																											
Combined Construction Management																											
Sr. Construction Manager	0.25	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-	-
Administrative Assistant	-	0.50	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.50	2.50	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	-	-
Field Contract Administration	-	0.67	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-	-
Lead Dam Removal Inspector	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	-	-	-
Second Shift Dam Removal Inspector	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-	-	-	-	-
Yreka Water Supply Inspector	-	0.25	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rec Improvements Inspector	-	0.25	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	-	-	-
Flood Improvements Inspector	-	0.25	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	-	-	-
Specialty Inspectors	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-	-	-
Scheduler	-	0.67	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-	-
Project Control Engineer	-	0.67	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-	-
Safety Manager	-	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	-	-
Quality Manager	-	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	-	-
ODCs at 20%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	2020												2021												2022		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
CONSTRUCTION MANAGEMENT																											
Iron Gate																											
Sr. Construction Manager	0.25	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0		
Administrative Assistant	-	0.25	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0		
Field Contract Administration	-	0.17	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.3		
Lead Dam Removal Inspector	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-		
Second Shift Dam Removal Inspector	-	-	-	-	-	-	-	-	-	-	-	-	-	-		1.00	1.00	1.00	1.00	1.00	1.00	1.00			-		
Yreka Water Supply Inspector	-	0.25	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	-	-	-	-	-	-	-	-	-	-	-	-	-		
Rec Improvements Inspector	-	0.25	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	-		
Flood Improvements Inspector	-	0.25	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	-		
Specialty Inspectors	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	-		
Scheduler	-	0.17	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.3		
Project Control Engineer	-	0.17	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.3		
Safety Manager	-	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.1		
Quality Manager	-	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.1		

Table 3-8 Construction Management FTEs Per Month (continued)

	2020												2021												2022		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
CONSTRUCTION MANAGEMENT																											
Copco1 & 2																											
Construction Manager	0.33	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0		
Administrative Assistant	-	0.25	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0		
Field Contract Administration	-	0.17	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.3		
Lead Dam Removal Inspector	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-		
Bridges and Road Improvements	-	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0		
Specialty Inspectors	-	-	-	-	-	-	-	-	-	-	-	-			0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	-		
Scheduler	-	0.17	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.3		
Project Control Engineer	-	0.17	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.3		
Safety Manager	-	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.1		
Quality Manager	-	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.1		

	2020												2021												2022		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
CONSTRUCTION MANAGEMENT																											
JC Boyle																											
Construction Manager	-	-	-	-	-	-	-	-	-	-	-	-	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0		
Administrative Assistant	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.50	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0		
Field Contract Administration	-	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.3		
Lead Dam Removal Inspector	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-		
Specialty Inspectors	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	-		
Scheduler	-	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.3		
Project Control Engineer	-	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.3		
Safety Manager	-	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.1		
Quality Manager	-	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.1		

3.5 Construction

3.5.1 Dam Removal

The dam removal scope for Full and Partial Dam Removal alternatives is defined in Section 5 of the Definite Plan and was used as the basis for this estimate. Estimates were developed using the methods and schedule constraints summarized in Section 2.3 of this report. Escalation was applied per Section 2.5.

Pertinent assumptions from the Definite Plan are as follows:

- KRRC confirmed or updated quantities where new information was available, and as described in Section 5 of the Definite Plan.
- Estimate and schedule assumes that a second shift will be required for Copco No. 1 and Iron Gate demolition. KRRC assumed two 10-hour shifts, 5 days a week.
- Estimate and schedule assumes that work days are 8 hours per day, 6 days a week for Copco No. 2 and J.C. Boyle demolition.
- All concrete demolition debris will be hauled to onsite disposal area as described in more detail in Section 5 of the Definite Plan for Decommissioning (KRRC 2018).
- All earth work material from excavation activities will be hauled to onsite disposal area as described in more detail in Section 5 of the Definite Plan for Decommissioning (KRRC 2018).
- All concrete and earthwork demolition material will be processed during demolition activity and there is no process equipment (crusher, screener, and stacker) operated at disposal areas.
- One general PDB will be used to manage the entire design build process, but subcontractors will be used for certain specialized activities.

3.5.2 Reservoir Earthwork & Engineered Structures

This estimate assumes that a small percentage of sediment that remains in the reservoirs after drawdown will be mechanically excavated and placed elsewhere in the proposed floodplain area. Earthwork excavation volumes within the reservoir are based on surface models from historical site surveys compared to recently collected bathymetric data. KRRC developed labor rates, equipment rates, and materials costs from a combination of actual costs from past similar projects and RS Means Heavy Civil publication.

This estimate assumes the following:

- Earth excavation and subsequent fill (or disposal) will happen at the same time so that material is handled only once and placed on-site in the final location with minor grading and compaction. KRRC based volume estimates on neat line quantities using digital surface models.
- All excavated material is suitable for in-water disposal and will be disposed of on-site.

- Estimates include equipment and road access into site, assuming 3,000 linear feet (LF) on center (OC) or 0.56 miles per site (6 sites).

KRRC proposes elements for bank stability and channel fringe complexity, and will include a process-based restoration and velocity variations along bank line by adding large wood complexity for resting zone, feeding seams, cover and velocity refugia. KRRC based restoration areas and treatments on expected conditions after drawdown and may change based on actual conditions.

Areas identified for reservoir earthwork activities and engineered stability elements are described and shown in plan in Appendix H, Restoration Plan of the Definite Plan.

3.5.3 Restoration

Restoration activities can be broken into three primary categories: (1) Earthwork/engineered improvements (Section 3.5.2), (2) pre-drawdown activities, and (3) post drawdown activities. The following text summarizes key assumptions that are pertinent to the estimate development for the second two categories. A full description of these components can be found in Appendix H, Restoration Plan of the Definite Plan.

Pre-drawdown activities include seed collection, seed propagation and weed eradication, as further summarized below. In addition to the work described below, KRRC assumes completion of an RFP process to select a contractor or vendor for each activity.

1. **Seed Collection:** The main component of the revegetation process will be locally eco-typic seed of native plants for four different planting zones (bank wetland, bank riparian, floodplain riparian, and upland) based on hydrology. The seed will preserve the genetic integrity of the site and provide species and genetics best suited for this specific landscape. Collection of locally eco-typic seed subsequently grown by commercial growers to produce large amounts of seed or plant material will require advanced planning and will be implemented during the pre-dam removal period. To produce 50,000 lbs of pure live seed (PLS) in each of the four growing years before the 2022 fall season (totaling 200,000 lbs.), it is assumed that 3-7 lbs. of PLS/acre of wild collected seed will produce 2,000 LBS PLS/ acre. KRRC based this estimate upon propagation rate quotes obtained from BFI Native seed and Pacific Coast Seed. Conservatively, the higher seeding rate of 7 lbs PLS/acre is assumed to be planted on 25 acres at the seed propagation farm totaling the 175 lbs PLS of seed needed each year and resulting in the expected 50,000 lbs PLS if 2,000 lbs PLS is produced per acre on 25 acres. The cost of collecting 1 pound of wild seed ranges from low $1,000 to high $1,800. The seed must then be cleaned, stored in climate control warehouses and in some cases pre-treated. Seed pre-treatment may include scarification, stratification, imbibition, and others. Wild collected seed will be substantially more expensive than propagated seed due to additional cleaning costs.
2. **Seed Propagation:** In order reach the goal of 200,000 lbs. of PLS over 4 years, 25 acres of land will need to be rented to propagate collected seed (with an assumed minimal yield of 2,000 lbs PLS/acre) to produce 50,000 lbs per year. KRRC based the yield and other unit cost estimates on

information received from BFI, J Herbert Stone nursery, Pacific Coast Seed and the local forest service office.

3. **Weed Eradication:** The objective will be to implement a combination of weed control techniques that minimize the extent of environmental degradation and reduce the impact of chemical inputs on humans and non-target organisms. To identify the populations of existing invasive species, a field survey will be conducted at the site, geo-locating all invasive species. Assuming 100% of the project area outside of the existing reservoirs needs to be surveyed, it will take approximately 900 hours to survey the area. For a Scientist and Principal Scientist, the estimated cost is $135,000 plus approximately $2,247 for gas & mileage and $21,000 for per diems and accommodations. In the years before drawdown, KRRC assumed that 30% of the site above the water line of the reservoir (85- acres) will require invasive species eradication. KRRC based this percentage on estimates from surveys performed in the fall of 2017. Once drawdown occurs, the acreage of the site with vegetation will increase along with the need for invasive species control. For two years after drawdown, KRRC assumed 300 acres to potentially require weed eradication treatment.

Post-drawdown activities include pioneer seeding, pole cutting and salvaged plant collection, revegetation in each planting zone, followed by establishment period and long-term maintenance. Each activity is further summarized below:

1. **Pioneer Seeding:** Establishing a pioneer crop on the site, soon after drawdown of the reservoirs, is essential to preventing erosion, planting inhospitable moist substrate, preventing invasive species from establishing at the site and building up soil biota and structure. The pioneer seed mix is intended to take advantage of less expensive native seed. The seed generated in large amounts during propagation (overstock), and sterile non-native seed (sterile wheat and Regreen) that can readily establish in the sediment and will be less of a risk if it is washed out due to spring flooding or if it freezes in the early months of the year. Once river and soil conditions have stabilized, a fall broadcast seeding will be applied including locally ecotypic, native and diverse seed stock for each planting zone. Broadcast aerial seeding will be performed from helicopter(s), and is a very cost-efficient method of application. KRRC based pricing on an estimate from Ben Timberland (Timberland Helicopters, Inc, Ashland, OR) on the hourly rate of $950/hr. at the rate at which the operator can distribute the seed. KRRC assumed that the seed weighs on average 14 lbs/cubic foot, with a seed bucket that holds 27 cubic feet of seed, 12 minutes is assumed for each bucket. For distributing 100 lbs. PLS per acre, KRRC estimated to be 140 hours totaling 133,000 for a medium cost. The cost of seed per pound is based on cost for readily available seed from nurseries we anticipate working within the Project (i.e., California brome = $8-9 per PLS).
2. **Pole Cuttings and Salvaged Plants:** The establishment of habitat will greatly accelerate with the installation of pole cuttings, as well as transplantation of salvaged plants. These plants will also help prevent erosion and add species diversity to the site. KRRC's contractor will collect pole cuttings and potentially store them, short-term, prior to installation. 'Salvaged plants' will be transplanted on site; therefore their costs are not associated with contract growing and nursery care. KRRC assumed that the contractor will absorb the cost of an expected 30% mortality rate of the pole cuttings. KRRC's contractor will collect pole cuttings from areas surrounding the site. In order to increase the number of pole cuttings available, in the year prior to drawdown, contractors will selectively cut back pole

cutting species marked for plant salvage. This will promote an ample supply of young growth that can be harvested as needed the following year. It is assumed that the harvest and installation will be simultaneous, limiting the need for storage off-site. The number of pole cuttings allotted will vary by zone. Each 100 square foot area, for both the bank riparian and bank wetland zones, will include five pole cuttings. For the floodplain riparian zone, each 100 square foot area will contain one pole cutting.

3. Revegetation

a) Emergent Wetland Planting Zone: Revegetation for emergent wetlands will be installed instream along the river's edge. This vegetation will consist of 100% salvaged plants, taken from the rim of the reservoirs. During the first year, KRRC assumes salvaged plants at 20 LF OC along the edges of the river. The following spring, once the plants have established, KRRC's contractor will harvest propagules from installed salvaged plants and will then be planted at 10 LF OC between the plants from the prior year. KRRC based cost estimates for plant layout per acre on estimates from Caltrans and RS Means.

b) Bank Wetland Planting Zone: Bank wetland zones will be delineated as areas suitable for plant growth approximately between the base flow and 2-year flood event water surface elevations (Q2) of the Klamath River. These areas will consist of salvaged plants and pole cuttings. KRRC expects 50 percent of this area to be restored. KRRC's contractor will transplant salvaged plants to this zone from the existing reservoir edge. KRRC based cost estimates for this work on RS Means and Caltrans data for the operation of a backhoe with a bucket and the plantings for pole cuttings. KRRC's contractor will install pole cuttings in this initial stage of planting in the spring after drawdown. KRRC's contractor will perform plant layout for all plants by the Contractor's crews marking each planting spot with a pinflag for an overall review by a restoration ecologist. KRRC's contractor will aerial seed the pioneer crop in all zones early in the drawdown year creating fast-growing erosion control before the river stabilizes. Once the pioneer crop has grown, KRRC's contractor will either roll or mow it to help open the soil to sunlight and create a habitat for the fall broadcasting of ecotypic native seed. In the early spring of the following year, KRRC's contractor will layout and install one pole cutting per 100 square foot (SF).

c) Bank Riparian Planting Zone: The Bank Riparian Zone will extend approximately from the 2-year (Q2) to the 25-year (Q25) flood water surface elevations (Q-lines) of the Klamath River. KRRC expects 50 percent of this area to be available for restoration. It will be the most critical zone for rapid re-establishment of riparian habitat, short-term stability of the channel and banks, and for long-term establishment of an important transitional area between the riverine features and floodplain habitat areas. Planting densities within the riparian-bank areas will be variable, however, the substantial density of initial planting will be important to prevent invasion by reed canary grass (*Phalaris arundinacea*), a highly invasive non-native hybrid that is widespread around the reservoirs. The Bank Riparian zone will have a similar treatment to the Bank Wetland; with the same plant material and spacing. After drawdown, KRRC's contractor will transplant the plants from the rim of the reservoir to the river's edge. In the pioneer seeding process, KRRC's contractor will mainly apply mycorrhiza, with the seed in this area. In the fall, the area will be broadcast seeded with ecotypic zone selected seed. KRRC's contractor will install an additional pole cutting in the following spring. Selected areas will be fenced off to deter deer predation and

to serve as a seed bank to areas without fencing. Costs for fencing and installation and based on Caltrans data.

d) Floodplain Riparian Planting Zone: Floodplain riparian zones will be delineated as those areas suitable for revegetation that occur approximately between the 25-year (Q25) and 100-year (Q100) flood water surface elevations of the Klamath River. The Riparian Floodplain Planting Zone will be planted similarly to the Bank Riparian Planting Zone; however, the plant densities will decrease, producing a decrease in plant layout costs for this zone. For each 100 SF area, there will be one pole cutting and one seed plant installation in the second year. The cost of Construction/Installation maintenance decreases slightly from Bank Riparian area; it will have an18-month duration, until Plant Establishment. This section also includes emergency overhead irrigation in the high price estimate. KRRC based unit prices for this on a quote from Rain for Rent for the entire site. Costs include $60k for setup and design, $40k/month rent and $30k to disassemble the irrigation system, and a 5-month rental ($320K) and an uncertainty factor of 2 for 1,790 acres (costs pro-rated from the estimate for the Project). KRRC based costs for this on a quote from Rain for Rent that includes design and rental of all equipment.

e) Uplands below Rocky Wake Zone: The area between the upper edge of the Riparian Floodplain Planting Zone and the lower edge of the Rocky Wake Planting Zone constitutes the Uplands below the Rocky Wake Planting Zone. This area is the only formerly submerged area where upland vegetation will grow on sedimentary substrate. KRRC expects 50 percent of this area to be restored. The restoration process will be the same as for the planting zones below; mycorrhizal inoculant will be in the pioneer seed mix in the spring, broadcast seeding of the native ecotypic seed will be conducted in the fall 2021, and a spring 2022 with deer fence, emergency irrigation, and construction/installation maintenance. However, plantings in this zone will consist of four woody plants per 100 SF. Species will include acorns, juniper berries, pine nuts fir and various shrubs. KRRC's contractor will install these plants with cocoon irrigation planters that will irrigate the plants and slowly deteriorate as the plant becomes self-sustainable. KRRC's contractor will use an auger to create a planting pit approximately 2 feet in diameter and 1 foot deep. KRRC based installation costs upon Saylor's installation cost.

f) Rocky Wake Planting Zone: The Rocky Wake Planting Zone is the area of wake and wave action erosion around the edge of the existing reservoirs. Fluctuations of water level and wave action in the reservoir has eroded soil in a band or 'bathtub ring' leaving exposed rocky substrate, bedrock, areas that lack in vegetation. KRRC assumed that only 20% of this area is feasible to restore. Soil amendments consisting of mycorrhizal inoculant will be added at the time of seeding. After the pioneer crop is broadcast seeded in the spring, the grown vegetation will be mowed or rolled in preparation for the fall broadcast seeding of the ecotypic seed. The plant selection and densities will be the same as the uplands below rocky wake zone. KRRC's contractor will place deer fence in selected areas within the zone to create areas free of deer predation. These areas will serve as seed banks for the rest of the site if predation becomes severe. Additionally, overhead irrigation is included in the high estimation cost.

g) Disturbed Uplands Planting Zone: The Disturbed Uplands Planting Zone will consist of the existing developed areas proposed for demolition and recreational areas that will be removed after drawdown occurs. The revegetation schedule remains the same. However, the initial soil

preparation may vary. These areas will most likely have highly compacted areas due to the existence of concrete or vehicular traffic on gravel areas. In these areas, it is assumed that 75% of the recreation area will need de-compaction. KRRC's contractor will cross rip compacted areas (before fall seeding) to a depth of 24 inches to loosen the soil and prepare it for seeding and planting. After de-compaction, KRRC expects this area to have healthy viable soils, so it is assumed that 90% of the area will be restored.

h) Upland Stockpiles Planting Zone: Upland Stockpiles Planting Zones include areas where materials from the dam removal will be deposited. The topsoil in these areas will be heavily compacted. The revegetation process for these areas will be the same as for the Disturbed Uplands Planting Zone, however, 100% of this zone will have to be de-compacted, slightly increasing it's per acre cost. KRRC based estimates for this treatment on RS Means data for $110 to rip soil with a bulldozer.

i) Undisturbed Uplands Planting Zone: The Undisturbed Uplands Planting Zone will consist of areas above the Rocky Wake Zone that may be only minimally disturbed by the eradication of invasive exotic species. These areas will go through active weed removal for at least 3 years before drawdown. KRRC's contractor will reseed potential bare and disturbed patches resulting from invasive species eradication with a native upland seed mix via broadcasting. The majority of these areas will have existing native vegetation and only 30% is expected to need restoration.

4. Establishment Period Maintenance: KRRC assumes that the Project will be monitored and maintained for 5 consecutive years. Maintenance and monitoring, during the first plant establishment year is crucial to achieving revegetation performance criteria established in the revegetation plan and agreed to with regulatory agencies. The quality of establishment maintenance and monitoring will determine whether the project area will be taken over by invasive exotics or by heathy native plants. KRRC's contractor will perform monthly establishment maintenance and monitoring from November 1 through April 1 and bi-weekly the rest of the year, totaling approximately 20 visits during this critical first year. During each visit, botanists will be surveying the project area for a number of performance criteria related objectives. Plant species diversity and cover, the growth and health of woody vegetation, acres of wetlands, and noxious weed coverage may be monitored. The location of individual species or areas of species will be geo-located. Other monitoring items may include the minimum coverage of woody shrubs and trees in key restoration areas. KRRC based the labor rate for monitoring on the mean hourly rate of a Scientist and Principal Scientist, resulting in a probable cost of $139,884 for each visit, equaling about 932 hours of monitoring surveys at a rate of 2.5 acre/hour. Maintenance will follow monitoring, and may include re-seeding/re-planting of native vegetation (as necessary), invasive plant management, herbivore control, irrigation maintenance and other activities as situations arise (e.g., implementation of erosion repairs). KRRC based rates for these items roughly on quoted rates for invasive species removal in the area ($3,000/acre).

5. Long-term Maintenance: After Establishment Period Maintenance and Monitoring, long-term monitoring will continue for 4 years. For monitoring, the cost per visit and the rate of surveying is consistent throughout at 2.5 acres/hour (assuming the mean hourly rate of a Scientist and Principal Scientist). Tasks outlined in the Establishment Maintenance activity will also continue throughout this period. However, KRRC anticipates both the number of visits and maintenance needs (i.e. hourly

cost) to decrease. In Year Two (2024), there are bi-monthly surveys from November through April and monthly surveys the rest of the year, totaling 10 visits. In the second year, the number of acres in need of treatment is 80% of the total acreage, and cost of maintenance is 80% of the establishment monitoring. In Year Three (2025) there are 5 visits, one visit between November and April and bi-monthly the rest of the year. The number of acres and the cost of maintenance are 60% of the total acreage and cost of the establishment maintenance. In Year Four (2026) there are 4 visits and the acres and cost decrease to 40%. And in Year Five (2027), the final year, visits are down to twice a year and the percentage of land in need of maintenance and the rate cost is down to 20%. At this point the site should be close to natural conditions and meet the performance criteria for the upland, riparian floodplain, riparian bank, and wetland zones, as well as for invasive exotic plant presence.

3.5.4 Yreka Water Line Replacement

KRRC assumed for development of this estimate that an underground pipeline will be constructed to relocate the City of Yreka's water supply line currently crossing Iron Gate reservoir. This relocation option is discussed in detail in Section 7.5 of the Definite Plan.

The scope for replacing the Yreka Water Line will involve installation of two micro-tunneling pits on either side of the Klamath River. Once these pits are fully excavated and shored, micro tunneling equipment will install a 36" steel casing below the river bed. Once the casing is installed, a new 24-inch waterline will be installed to take the place of the river crossing section of the existing water line. On either side of the Klamath River, the new pipe will be installed using an open cut excavation method. Once the waterline is completely installed, tested and active, the micro tunneling pits and the open excavation are to be backfilled with existing material. Once the backfill operation is complete, the existing waterline will be removed and recycled.

The cost estimate for the Yreka Water Line Replacement was developed using the RS Means database with a city cost index adjustment of Redding, California. Crew output for each operation was adjusted to account for access, location, and construction operation. KRRC assumed that a pile and lagging wall will be used to shore micro tunneling pits and it will be installed simultaneously with the excavation operation.

3.5.5 Transportation Improvements

This section describes the proposed road improvements and maintenance activities that are the basis for the estimate of project costs. It is based on design information provided in Sections 5 and 7.4 of the Definite Plan. Several road, intersection, structure and culvert improvements are proposed as part of the Project to:

- Facilitate access for project-related vehicles and equipment associated with dam removal
- Provide safety measures for both public and project roads used during the dam removals
- Return roads used by project-related vehicles to the respective owners and users in an acceptable state, restoring any reduction in function attributed to the Project

The improvements will be implemented at various phases throughout the Project. Some will require completion prior to the dam removals (related to construction access), and others will be contingent on a future assessment of road elements once reservoir drawdown or hauling activities are complete (maintenance activities). There will also be some ongoing activities throughout the Project to maintain roads heavily trafficked by project construction vehicles.

Table 3-9 provides a summary of all pertinent road segments, bridges, and culverts and the associated improvements or maintenance. Table 3-10 summarizes maintenance and rehabilitation cost assumptions associated with roads being used for construction access. Section references within the table are to the sections within the Definite Plan.

Table 3-9 Transportation Improvements

Location	Improvements (Section References to Definite Plan (KRRC 2018))	Purpose		
		Construction Access	Drawdown Related	Maintenance/ Rehabilitation
J.C. Boyle				
The Dalles California Highway (US97)	• Pavement rehabilitation unlikely during or post-Project (Section 5.2.2)			X
Green Springs Highway (OR66)	• Pavement rehabilitation unlikely during or post-Project (Section 5.2.2)			X
Keno Worden Road	• Pavement rehabilitation unlikely during or post-Project (Section 5.2.2)			X
Topsy Grade Road	• Potential pavement rehabilitation during or post-Project (Section 5.2.2)			X
Culvert at Unnamed Creek	• Potential sediment removal and downstream erosion protection (Section 7.4.3)		X	
J.C. Boyle Dam Access Road from OR66	• Re-grading uneven or rutted areas (Section 5.2.2)	X		
Junction of OR66 and J.C. Boyle Dam Access Road	• Intersection widening (Section 5.2.2) • Tree removal (Section 5.2.2) • Signage (Section 5.2.2)	X		
Timber Bridge	• Remove (Section 5.2.2)	X		
Power Canal Access Road	• Periodic roadway maintenance grading during construction (Section 5.2.2)	X		
J.C. Boyle Disposal Access Road	• Re-grading (Section 5.2.2) • Minor widening (Section 5.2.2)	X		
Copco and Iron Gate				
Copco Road (I-5 to Ager Road)	• Potential pavement rehabilitation during or post-Project (Section 5.2.2)			X
Copco Road (Ager Road to Lakeview Road)	• Potential pavement rehabilitation during or post-Project (Section 5.2.2)			X
Dry Creek Bridge	• Temporary bridge for construction access during Project (Section 5.2.2)	X		

Location	Improvements (Section References to Definite Plan (KRRC 2018))	Purpose		
		Construction Access	Drawdown Related	Maintenance/ Rehabilitation
Copco Road (Lakeview Road to Daggett Road)	• Roadway maintenance during construction (Section 5.2.2) • Potential pavement rehabilitation during or post-Project (Section 5.2.2)	X		X
Unnamed Culverts between Brush Creek and Scotch Creek	• Potential rehabilitation or replacement post-construction (Section 7.4.3)			X
Scotch Creek Culvert	• Replace (Section 7.4.3)		X	
Camp Creek Culvert	• Replace with bridge (Section 7.4.3)		X	
Jenny Creek Bridge	• Replace (Section 7.4.3)		X	
Copco Road (Daggett Road to Copco Access Road)	• Potential road surface maintenance during or post-Project (Section 5.2.2)			X
Fall Creek Bridge	• Replace (Section 5.2.2)	X		
Copco Road (Copco Access Road to Copco Road Bridge)	• Potential road surface maintenance during or post-Project (Section 5.2.2)			X
Beaver Creek and E.F. Beaver Creek Culverts	• Potential erosion protection (Section 7.4.3)		X	
Raymond Gulch Culvert	• Potential erosion protection (Section 7.4.3)		X	
Copco Road Bridge	• Potential abutment erosion protection (Section 7.4.3)		X	
Copco Access Road	• Clear, grub and regrade (Section 5.2.2) • Minor widening into hillside if possible (Section 5.2.2) • Remove after construction is complete and restore area to native vegetation	X		
Copco Cove Access	• Minor works to enable barge mobilization (Section 5.2.2)	X		
Culverts at Unnamed Creeks (Copco Lake)	• Potential erosion protection (Section 7.4.3)		X	

Location	Improvements (Section References to Definite Plan (KRRC 2018))	Purpose		
		Construction Access	Drawdown Related	Maintenance/ Rehabilitation
Ager Beswick Road	• None (Section 5.2.2)			
Mallard Cove Boat Ramp Access	• Minor works to enable barge mobilization (Section 5.2.2)	X		
Daggett Road	• Minor grading improvements (Section 5.2.2) • Potential road surface maintenance during and post-Project (Section 5.2.2)	X		X
Daggett Road Bridge	• Replace (Section 5.2.2)	X		
Lakeview Road (Copco Road to Iron Gate disposal site)	• Potential road surface maintenance during and post-Project (Section 5.2.2)			X
Lakeview Road Bridge	• Replace (Section 5.2.2)	X		
Iron Gate Powerhouse Access Road	• Signage • Potential road surface maintenance during construction (Section 5.2.2) • Remove after construction is complete and restore area to native vegetation (Section 5.2.2)	X		X
Iron Gate Left Abutment Access Road	• Remove after construction is complete and restore area to native vegetation (Section 5.2.2)	X		
Iron Gate Upstream Left Abutment Access Road	• Remove after construction is complete and restore area to native vegetation (Section 5.2.2)	X		
Other Locations	•			
Pedestrian Bridge #1	• Will likely need to be removed by KRRC (Section 7.2). Cost estimate includes demolition only.			X
Pedestrian Bridge #2	• Evaluation will be performed by KRRC to determine whether removal or replacement will be required (Section 7.2). Cost estimate includes demolition only.			X

Table 3-10 Road Maintenance Assumptions

Location	Maintenance/Rehabilitation Assumptions
J.C. Boyle	
The Dalles California Highway (US97)	• None
Green Springs Highway (OR66)	• None
Keno Worden Road	• None
Topsy Grade Road	• Pre and post-construction 0.9 miles of 9-inch aggregate base section repair
J.C. Boyle Dam Access Road from OR66	• Pre-construction improvements include minor cut/fill, 0.25 miles of new 9-inch aggregate base section and 0.7 miles of 9-inch aggregate base section repair; Post-construction improvements include 0.6 miles of 9-inch aggregate base section repair
Power Canal Access Road	• Pre and post-construction 1.5 miles of 9-inch aggregate base section repair
Powerhouse Access Road	• None
J.C. Boyle Disposal Access Road	• Minor regrading & widening
Copco and Iron Gate	
Copco Road (I-5 to Ager Road)	• Post-construction 1 mile new asphalt overlay
Copco Road (Ager Road to Lakeview Road)	• Pre-construction improvements include 0.5 miles of crack sealer, and 0.75 miles of new asphalt section; Post-construction improvements include 1.0 miles of new asphalt overlay
Copco Road (Lakeview Road to Daggett Road)	• Pre-construction improvements include 1.0 mile of crack sealer, and 1.5 miles of new asphalt section; Post-construction improvements include 2.0 miles of new asphalt overlay
Copco Road (Daggett Road to Copco Access Road)	• Pre and post-construction 1.5 miles of 9-inch aggregate base section repair
Copco Road (Copco Access Road to Copco Road Bridge)	• Pre and post-construction 1.5 miles of 9-inch aggregate base section repair • Post-construction 0.25 mile overlay and minor riprap
Copco Access Road	• Pre-construction 2,500 CY cut/fill and 0.9 miles 9-inch aggregate base overlay • Remove after construction is complete and restore area to native vegetation
Ager Beswick Road	• None
Mallard Cove Boat Ramp Access	• Minor works to enable barge mobilization
Daggett Road	• None
Lakeview Road (Copco Road to Iron Gate disposal site)	• Post-construction improvements include 0.7 miles 6-inch aggregate base overlay
Iron Gate Powerhouse Access Road	• Remove after construction is complete and restore area to native vegetation

Location	Maintenance/Rehabilitation Assumptions
Iron Gate Left Abutment Access Road	• Remove after construction is complete and restore area to native vegetation
Iron Gate Upstream Left Abutment Access Road	• Remove after construction is complete and restore area to native vegetation

3.5.6 Recreation Plan

Costs associated with demolition of existing recreation facilities are included in the dam removal cost category. This section summarizes assumptions associated with construction of any new recreation facilities connected with the Project. Although the final recommendation for proposed recreation facilities has not been made, a list of possible improvements have been scoped for inclusion in this cost estimate.

Recreation costs were derived from itemized estimates for the various recreation facilities listed in Table 3-11. Rates and prices are derived from a combination of historical contracting information including Lake Berryessa Recreation Area Renovation project, and RS Means. Estimated project costs assume operation and maintenance support at each facility for up to 5 years.

Table 3-11 Assumptions For New or Improved Recreation Facilities

Dam (Sate)	Description
Campgrounds	
Jenny Creek Campground Expansion	Expand campground and upgrade facilities including new restroom, 5 picnic tables, 2 fire grates, 5 trash bins and minimal earthwork
Topsy Campground Upgrade	Replace or redesign boat ramp for river access
New Campground	New 20-site campground in TBD location (includes picnic tables, fire grates, trash bins and restroom)
Day-use Areas	
Fall Creek Day-use Area Upgrade	Upgrade facilities and reconstruct trail leading to Fall Creek waterfall
Iron Gate Hatchery Day-use Area Upgrade	Reconstruct day use site to provide additional facilities and a boat ramp
New Day-use Areas	Provide up to two day-use sites with river access at TBD defined locations. Includes new picnic table, fire grate, and trash bins. One of the sites may be located at the J.C. Boyle powerhouse and substation
River Access	
Fishing River Access Points	Up to two river access points at TBD locations. Sites include signage, portable toilets and trash receptacles
Boating River Access Ramps	Up to two river boating access points at TBD locations. Sites include access and boat ramps
Trails	
J.C. Boyle to Iron Gate walking trail	Up to 20 miles of non-motorized trail from J.C. Boyle to Iron Gate. Includes up to two viewing areas and/or interpretive signage

Dam (Sate)	Description
Walking Trails for River Access	Non-motorized side trails off main trail for access river

3.5.7 Downstream Flood Control Improvements

This section summarizes the assumptions used to develop costs associated with any required downstream flood control improvements. The analysis that led to the selection of improvements is discussed in Section 7.7 of the Definite Plan.

The cost estimate includes elevating 36 habitable homes and other structures. The rate used assumes that it will take five days to raise each house, with subcontractor costs based on the average cost of raising a building in California. Additional cost was included to add two sets of stairs per house, and supporting labor team for ancillary work associated with flood proofing.

3.5.8 Public Health and Safety Measures

The estimate includes costs for cattle exclusion fencing at reservoir sites where the former reservoirs will no longer be able to serve as a natural barrier to livestock, and for the protection of revegetation efforts against damage. Fencing will likely be four-wire fence with metal T-posts at 12 LF intervals.

Fencing quantities have been determined from a detailed analysis of fencing lengths in GIS, focused on fencing the reservoir restoration areas while avoiding fencing along portions of the perimeter with steep topography above the reservoir, forest and housing. As the scope is developed further, additional definition may be obtained by considering where fences might need to tie into property boundary fences (if they exist) or where steep topography just below the reservoir surface might act as a barrier.

3.6 Anticipated Mitigation Measures

The following sections summarize cost assumptions associated with anticipated regulatory mitigation measures for groundwater wells, downstream water intakes and cultural resources.

3.6.1 Groundwater Improvements

Groundwater well improvements adjacent to the reservoirs may be necessary if reservoir drawdown has a negative impact on existing well water levels. A groundwater well management plan is contained in Appendix N of the Definite Plan and is the basis for the estimate.

The current estimates assume public outreach will be completed with relevant property owners, and subsequent installation and monitoring of up to five (5) new 60-foot deep, 3-inch diameter monitoring wells will be completed. Well drilling costs assume PVC casing and hard rock geology. Wells will be monitored monthly for water level and water quality constituents over a 3-year period.

The estimate assumes up to 20 wells will ultimately require replacement. Costs include drilling of new wells and abandonment of existing wells. The estimate also assumes temporary water will be provided for up to 30 days during well installation.

3.6.2 Downstream Water Supply

Sediment buildup during reservoir drawdown may affect some downstream water supply intakes as needed, the KRRC will excavate affected intakes to clear them of aggraded sediment materials, and provide temporary settling basins or groundwater wells if potable water supply is impacted. Jetting and vacuum technologies such as those used for cleaning storm drains and sewers will be used to remove sediment at intakes. Temporary settling basins may also be used to remove silt and sediment prior to the primary treatment performed by the water right holder.

There are approximately 50 water diversions off the Klamath River that could be affected. The USBR believed between 7 and 18 intakes would require maintenance. As some intakes have been added after the 2012 EIS/R, this estimate is based on the higher end of the range as the most probable number of intakes that could require maintenance actions.

In some cases, where diversions are used primarily for irrigation, the KRRC may need to pay for lost or damaged crops. Water rights holders reported alfalfa and pasture as the majority crop types irrigated with the diverted water during the drawdown period. In 2012, the average return for alfalfa produced in Siskiyou County was approximately $1,200 per acre, where the average yield was approximately 6 tons per acre (UCCE 2012). Assuming all 129 acres will be affected, the cost will be approximately $154,800.

Supplying livestock with water requires providing a stock water tank and water. A 500 gallon stock water tank is estimated.

Table 3-12 Assumptions For Downstream Water Supply

Cost Level	Elements Included in Cost Estimate
MPE	Intake excavation for 18 intakes Water supply for domestic use for 8 water rights (claimed or registered rights with reported diversions) Temporary settling basins at 18 intakes Temporary groundwater wells at 18 intakes
Direct Crop Loss Mitigation	Payment for lost hay crops on 129 acres of irrigated lands.
Stock watering	Provide 500 gallon water tank and 1,500 gallons of water per month.

References:

• UCCE (University of California Cooperative Extension). 2012. Sample Costs to Establish and Produce Alfalfa Hay – Intermountain Siskiyou County, Scott Valley- Mixed Irrigation. Accessed February 27, 2018. Available at: https://coststudyfiles.ucdavis.edu/uploads/cs_public/a6/b3/a6b35d9d-bd82-495c-86b1-1987dd6154ae/alfalfa_im_scott2012.pdf

• County Road 67 Sediment Trap Maintenance Pilot Project 2013-2014, Douglas County CO. CH2M, Denver CO. Available at: http://www.vactor.com/Portals/0/PDF/hxx/HXX_Brochure_WEB_11.16.pdf
• League of Oregon Cities and the Community Planning Workshop at the University of Oregon. Water, Wastewater and Stormwater Rate Survey. March, 2015.
• Raftelis Financial Consultants, Inc. and California-Nevada Section of the American Water Works Association. 2015 California-Nevada Water and Wastewater Rate Survey.

3.6.3 Cultural Resources

Cultural resources mitigation and protective measures may be required during drawdown, throughout the dam removal and reservoir restoration durations, and post-construction. Activities will likely involve short- and long-term cultural site monitoring, inadvertent discovery of cultural resources, among others. Additional information about the potential scope of activities is available in Appendix L of the Definite Plan.

Site monitoring and resolution of inadvertent discoveries of cultural resources and human remains will follow protocols established during agency and tribal consultations, as documented in the Historic, Cultural, and Tribal Resources Management Plan discussed in Appendix L, as well as actions developed and approved during consultations under Section 106 and agreed to during consultations with California-recognized tribes.

The cultural resource mitigation and protective measures estimate is based on the following assumptions associated with agency and tribal outreach, drawdown and post-drawdown surveys/inspections, curation fees, discovery contingencies and associated protection and mitigation measures.

Agency and Tribal Outreach

During the two-year construction period starting with reservoir drawdown, management of cultural resources and associated mitigation will require ongoing agency and tribal outreach, consultation, and meeting attendance.

Post-construction, long-term cultural resources management and monitoring activities are estimated for a 3-year period, and based on the Historic, Cultural, and Tribal Resources Management Plan.

Drawdown Surveys

Archaeological and cultural inventories are planned for the J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate reservoir zones during (1) the course of drawdown activities, and (2) post-drawdown reservoir areas as soon as surface conditions permit. Cost assumptions associated with each are listed below:

- Drawdown Shoreline Survey: To the extent possible, and in consideration of safety factors, periodic pedestrian archaeological inventory will be conducted along the reservoir shorelines as drawdown occurs. The principal goal of this shoreline survey is to identify and reduce looting and disturbances of known and currently unknown cultural resources. Inventory methods for this shoreline survey are still under development, but may include low-elevation aerial surveys (e.g., drones, helicopter) or barge surveys, if feasible, that target areas subject to slumping or those that are not sufficiently

dried to allow safe access via foot-traffic and survey vehicles. A team of one archaeologist and one tribal monitor will conduct the shoreline inventory at each reservoir, for three teams (J.C. Boyle, Copco No.1 and 2, and Iron Gate). The estimate allows for weekly reconnaissance for six people for a 2-month period before the post-drawdown pedestrian inventory of the reservoir areas can begin.

- Post-drawdown Reservoir Survey: Archaeological inventory will be conducted of the post-drawdown reservoir areas after water has receded and soils have sufficiently dried to allow for pedestrian survey. Based on current estimates, the former reservoir footprints encompass a total of 2,275 acres. Archaeological pedestrian inventory will focus on reservoir areas covered by 0-4 feet of sediment, where water-induced erosion has the greatest potential to reveal buried archaeological deposits. The 0-4 foot sediment area is estimated as encompassing about 1,500 acres. Selected deep probing may be used in areas of high archaeological sensitivity that exceed sediment depth of 4 feet. Using a standard rate of 25 acres per person per day, 1,500-acre survey will require approximately 60 person/days to complete. Assuming an average of one site per every 50 acres inventoried, 30 archaeological sites would require recordation, which in turn will require an additional 60 person/days of effort.

Construction Surveys

Construction cultural resource monitoring is associated with implementation of the reservoir restoration plan during 2021 and 2022. The restoration plan involves removal of some portion of the remaining reservoir sediments to re-expose some high value pre-inundation river terraces. The Klamath River corridor and its associated terraces are areas of high archaeological and tribal resource sensitivity, and any subsurface disturbances associated with exposing the pre-inundation landscape (within approx. 5 vertical feet) will minimally require cultural resources monitoring.

Two teams comprised of archaeologists and tribal monitors, will participate during the course of any reservoir restoration actions. The estimate allows for monitoring for four people for a period of one year (FY 2021-2022). If cultural resources are inadvertently discovered during the restoration area monitoring activity, their recordation and evaluation will continue under Discovery Contingencies (see below).

Post-Construction Surveys

Post-construction cultural resources management and monitoring reflects compliance with mitigation of tribal cultural impacts, will be developed in the Historic, Cultural and Tribal Resources Management Plan, will require ongoing consultation with affected tribes, including meetings to identify site-specific mitigation as new sites are exposed or discovered; needs for additional survey; development and implementation of a Looting and Vandalism Protection Program (LVPP), including long-term monitoring and site documentation; tribal issue facilitation; and long-term assistance with implementation of the Programmatic Agreement. These requirements are expected to include efforts beyond those covered under more routine agency and tribal consultation.

The LVPP provisions for archaeological and tribal monitoring is estimated to occur for a maximum of 3 years following completion of ground disturbance activities. Monitoring frequency is currently estimated at

quarterly. The estimate for LVPP monitoring allows for two, 2-person crews, comprised of one archaeologist and one tribal monitor, for a 2-week period every quarter, for a total of 12 quarters. Additional non-field related costs are included for ongoing agency and tribal consultation and meetings.

Curation Fees

Curation fees have been included in the estimate for artifacts recovered during phase II and phase III fieldwork. As currently estimated, archaeological investigations involve excavation of 120m^3 for phase II efforts and 200m3 for phase III efforts, for a total of 320m^3. The estimate allows for permanent curation of archaeological materials recovered during the phase II and phase III programs as 1 archive box per 2m^3 of excavated sediment, for a 160 archive boxes. An additional 250 boxes may be required for discovery contingencies, for an estimated project total of 410 boxes. At an average of $500/ft^3 (2018 price quote from Oregon Museum of Natural and Cultural History), the curation of 410 archive boxes of cultural materials is estimated at $205,000 excluding escalation. Curation support labor for final artifact and paperwork preparation is estimated at an average of 4 hours per archive box.

Inadvertent Discovery Contingencies

Two types of inadvertent discovery contingencies are anticipated during project implementation, including unanticipated exposure of archaeological resources and human remains. For purposes of this cost estimate, it is assumed that up to 160 discoveries (60 archaeological materials and 100 human remains) may occur in both short-term and long-term contexts. Additional information is provided below:

- Archaeological Resources: It is anticipated that up to 30 new archaeological resources may be discovered during inventory of the former reservoir areas. Stabilization and/or recovery work (excavation) may be required at the anticipated sites to reduce project-related effects, particularly those related to erosion. In addition, ground disturbances associated with the reservoir restoration actions may expose archaeological components when reservoir sediments are removed and the pre-inundation landscape is exposed. The estimate allows for discovery, stabilization, and/or recovery work of up to an additional 30 new archaeological resources associated with restoration actions. The estimate allows a per unit rate of $30,000 per resource for stabilization and/or recovery work for each of the 60 newly identified archaeological resources, to include recordation, archaeological excavation, analysis, and reporting.
- Human Remains: Drawdown, dam removal, and post-dam removal activities have the potential to expose human burials within the former reservoir areas, as well as in downriver contexts where elevated water levels and subsequent bank erosion may occur. The estimate allows a per resource rate of $15,000 for recovery of 100 human remain locations. Discovery, removal, and/or relocation of human remains will require investigation and recovery by a 4-person team, comprised of one field supervisor (archaeologist or physical anthropologist), two archaeological technicians, and one tribal monitor for a period of two days in the field. Archaeological materials recovered from discovery situations will require reporting, analysis and curation.

TCP Reserve Fund

Current agency and tribal consultation efforts have not yet addressed issues related to mitigation of impacts to TCPs. Therefore, a conservative reserve fund of $1,000,000 has been estimated for this possibility.

3.7 Monitoring & Reporting

3.7.1 Aquatic Resource Measures

Measures to benefit aquatic resources (AR) have been developed through coordination with state and federal regulatory agencies, and have been incorporated into the Project. Aquatic resource activities will take place prior to, during, and after dam removal and are based on Appendix I of the Definite Plan. The following provides a summary of cost assumptions associated with AR measures:

- Monitoring of tributary confluence areas for connectivity will occur for 2 years post-dam removal and will include 9 key tributaries within the reservoir and downstream depositional reach (Iron Gate Dam to Cottonwood Creek).
- Tributary confluence connectivity maintenance will occur for 2 years and will require hand crews for 3 weeks per year for downstream tributaries, and 4 weeks of equipment removal per year for reservoir reach tributaries.
- Water quality monitoring and fish rescue/relocation will occur at 13 key tributaries and only during the year of drawdown.
- Juvenile fish rescue and relocation efforts will only take place if temperature and sediment thresholds are exceeded and will take no more than 3 weeks to complete during year of drawdown.
- Cost includes approximately $4 million in gravel augmentation for full mitigation of spawning habitat. The actual amount necessary is likely less and will be based on surveys completed after drawdown.
- Sucker rescue and relocation effort will occur on all three reservoirs and take no more than 2 weeks to complete.
- Freshwater mussels will be relocated to the hydroelectric reach between Keno Dam and the head of J.C. Boyle Reservoir. The relocation effort will take no more than 2 weeks.

3.7.2 Terrestrial Resource Measures

Measures to benefit terrestrial resources (TER) have been developed through coordination with state and federal regulatory agencies, and have been incorporated into the Project. Terrestrial resource activities will take place prior to, during, and after dam removal and are based on Appendix J of the Definite Plan. The following provides a summary of cost assumptions associated with TER measures:

- Habitat Restoration: Includes monitoring and reporting for 3 years following vegetation installation.
- Nesting Bird Surveys: Includes osprey and cliff swallow nest exclusion; monitoring; reporting; pre-clearing nest surveys; work zone monitoring and rescue. Likelihood of northern spotted owl nesting during construction period is low and is excluded from the estimate.

- Bald and Golden Eagles: Likelihood of existence and discovery of nesting bald or golden eagles during construction period is low and is excluded from the estimate.
- Special Status Plants: Likelihood of existence and discovery of special status plants during the construction period is low and is excluded from the estimate.
- Permanent Loss of Wetlands: Includes monitoring and reporting for 5 years, post-construction.
- Roosts for Special Status Bats: Estimate includes a combination of retained/modified structures and new artificial roost structures.

3.7.3 Water Quality Monitoring

Water quality monitoring was estimated to include monitoring at up to ten main stem stations along the Klamath River. Eight of these are existing USGS stations, while two will be new stations. Existing stations will be upgraded with equipment to meet the project objectives.

All sites will be equipped with a multi-parameter sonde to measure temperature, pH, dissolved oxygen, specific conductance and turbidity. In addition, all sites except Keno will be equipped with a high-range turbidity sensor and side-looking acoustic profiler (for acoustic attenuation and backscatter measurements). A TSS and NTU laboratory relationship study will be conducted using sediment samples collected from the reservoirs.

Analysis and reporting of data will be according to United States Geological Survey (USGS) guidelines. The primary final products of the monitoring network will be 15-minute time series of stage, discharge, temperature, pH, dissolved oxygen, specific conductance, turbidity, acoustic attenuation, acoustic backscatter, and suspended-sediment concentration (SSC, potentially discriminating between silt/clay and sand), and suspended-sediment flux.

Rates and prices are based on a USGS proposal submitted in March 2018, and account for monitoring for 3 years following dam removal.

Additional sediment, reservoir and estuary monitoring were assumed during the 5 year period after removal of the dams. The estimate assumes the following:

- High definition aerial photos and LiDAR will be flown together in a single aircraft mobilization each year in the spring of years 2-5. Year 1 includes only high definition aerial photos.
- Volitional fish passage monitoring includes 2 weeks of fieldwork to monitor fish passage through hydroelectric reach, and additional amounts for reporting.
- Monitoring work for all three reservoir areas will be performed at the same time.
- Corrective actions are not included in costs, if they are needed based on monitoring results.
- Estuary and river sampling for toxins before and after dam removal using four separate sampling events.

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Chapter 4: Results

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4. RESULTS

The following sections provide a summary of the results of the cost analyses described above. Detailed construction cost breakdowns for both Full Removal and Partial Removal alternatives are provided in Attachment A. Pay item cost detail worksheets, describing the calculation of individual cost estimate line items rates and prices are provided in Attachment B.

In addition to the estimated project cost results, a full range of results from the Monte Carlo analysis are provided in Section 4.2, and a comparison to the USBR 2012 estimate is provided in Section 4.3.

4.1 Total Cost Summary

Tables 4-1 and 4-2 provide a summary of the estimate of project costs for Full and Partial Removal alternatives, respectively. As described in Section 2.6, a combined design and construction contingency (30% of construction cost) has been included in the estimates. As the detailed design advances toward final construction drawings and specifications, the design contingency will decrease to near zero. While the construction contingency may decrease as more field data and information becomes available, some level of construction contingency will persist throughout the construction phase.

In addition to the estimate of project costs, the summary tables show probabilistic MPL and MPH costs based on the results of Monte Carlo simulations. The right-hand column indicates the estimated project costs, whereas the forecast range from MPL to MPH indicate the range of probabilistic outcomes.

As discussed in more detail in Section 2.7, while it is typical for large water infrastructure projects to select P80 to represent the upper range of project planning contingency (MPH), due to the unique nature of this Project and the KRRC, a more conservative P90 was selected to represent the MPH for the Project. The P90 estimate will cover the most likely final project cost in 90% of all risk scenarios. A P10 was selected to represent the MPL.

Table 4-1 Results Summary - Full Removal

Line Item/Cost Category		Forecast Range		Estimated Project Cost
		MPL (P10)	MPH (P90)	
Project Oversight		$29,466,000	$29,778,000	$29,581,000
10	Project Oversight	$29,466,000	$29,778,000	$29,581,000
Environmental Compliance & Permitting		$8,525,000	$8,829,000	$8,637,000
21	Permitting	$6,607,000	$6,911,000	$6,719,000
22	Environmental Compliance Support	$1,918,000	$1,918,000	$1,918,000
Engineering & Procurement		$15,023,000	$16,925,000	$15,632,000
31	Design Data	$1,938,000	$2,085,000	$1,992,000
32	Engineering - AECOM	$5,949,000	$6,400,000	$6,115,000
33	Engineering - PDB	$6,152,000	$7,381,000	$6,513,000
34	Procurement	$984,000	$1,059,000	$1,012,000
Construction Management		$10,328,000	$11,111,000	$10,617,000
35	Construction Management	$10,328,000	$11,111,000	$10,617,000
Construction		$202,108,000	$268,560,000	$227,980,000
41	Dam Removal	$99,282,000	$117,341,000	$106,827,000
42	Restoration Earthwork	$19,887,000	$24,270,000	$21,051,000
43	Restoration of Vegetation	$46,133,000	$71,103,000	$57,957,000
44	Yreka Water Line Replacement	$2,665,000	$3,305,000	$2,900,000
45	Transportation (Bridges, Culverts, Roads)	$26,980,000	$41,340,000	$30,799,000
46	Recreation Improvements	$3,295,000	$6,486,000	$4,584,000
47	Flood Proofing	$1,340,000	$1,715,000	$1,499,000
48	Public Health And Safety Measures	$2,526,000	$3,000,000	$2,363,000
Anticipated Mitigation Measures		$17,264,000	$19,510,000	$18,407,000
51	Groundwater Improvements	$1,627,000	$2,317,000	$1,982,000
52	Water Supply And Water Rights	$980,000	$1,185,000	$1,091,000
53	Cultural Resources	$14,657,000	$16,008,000	$15,334,000
Monitoring & Reporting		$15,332,000	$22,571,000	$18,405,000
61	Aquatic Resource Measures	$6,326,000	$8,101,000	$6,691,000
62	Terrestrial Resources Measures	$1,387,000	$3,164,000	$2,395,000
63	Water Quality Monitoring	$7,619,000	$11,306,000	$9,319,000
Design & Construction Contingency		-	-	$68,394,000
Risk Contingency		$48,410,000	$129,794,000	-
	TOTAL	**$346,500,000**	**$507,100,000**	**$397,700,000**

Table 4-2 Results Summary - Partial Removal

Line Item/Cost Category		Forecast Range		Estimated Project Cost
		MPL (P10)	MPH (P90)	
Project Oversight		$29,466,000	$29,778,000	$29,581,000
10	Project Oversight	$29,466,000	$29,778,000	$29,581,000
Environmental Compliance & Permitting		$8,525,000	$8,829,000	$8,637,000
21	Permitting	$6,607,000	$6,911,000	$6,719,000
22	Environmental Compliance Support	$1,918,000	$1,918,000	$1,918,000
Engineering & Procurement		$15,023,000	$16,925,000	$15,632,000
31	Design Data	$1,938,000	$2,085,000	$1,992,000
32	Engineering - AECOM	$5,949,000	$6,400,000	$6,115,000
33	Engineering - PDB	$6,152,000	$7,381,000	$6,513,000
34	Procurement	$984,000	$1,059,000	$1,012,000
Construction Management		$10,328,000	$11,111,000	$10,617,000
35	Construction Management	$10,328,000	$11,111,000	$10,617,000
Construction		$169,140,000	$229,250,000	$193,030,000
41	Dam Removal	$66,316,000	$78,042,000	$71,877,000
42	Restoration Earthwork	$19,887,000	$24,270,000	$21,051,000
43	Restoration of Vegetation	$46,131,000	$71,101,000	$57,957,000
44	Yreka Water Line Replacement	$2,665,000	$3,306,000	$2,900,000
45	Transportation (Bridges, Culverts, Roads)	$26,980,000	$41,329,000	$30,799,000
46	Recreation Improvements	$3,295,000	$6,487,000	$4,584,000
47	Flood Proofing	$1,340,000	$1,715,000	$1,499,000
48	Public Health And Safety Measures	$2,526,000	$3,000,000	$2,363,000
Anticipated Mitigation Measures		$17,270,000	$19,505,000	$18,407,000
51	Groundwater Improvements	$1,627,000	$2,317,000	$1,982,000
52	Water Supply And Water Rights	$985,000	$1,180,000	$1,091,000
53	Cultural Resources	$14,657,000	$16,008,000	$15,334,000
Monitoring & Reporting		$15,330,000	$22,576,000	$18,405,000
61	Aquatic Resource Measures	$6,326,000	$8,102,000	$6,691,000
62	Terrestrial Resources Measures	$1,386,000	$3,166,000	$2,395,000
63	Water Quality Monitoring	$7,618,000	$11,308,000	$9,319,000
Design & Construction Contingency		-	-	$57,909,000
Risk Contingency		$48,410,000	$129,794,000	-
	TOTAL	**$313,500,000**	**$467,800,000**	**$352,200,000**

4.2 Monte Carlo Results

The probabilistic range of costs for each estimate line item was determined with the use of '@Risk' Monte Carlo analysis software. The Monte Carlo analysis involves determining the impact and likelihood of occurrence of identified and quantified uncertainties and risks by running simulations to identify the range of possible outcomes for a number of scenarios - 10,000 scenarios in the case of this Project. A random sampling is performed in the simulation by using uncertain risk variable inputs to generate the range of outcomes with a confidence measure for each outcome. For each uncertain variable in a simulation, the possible values are defined using probability distributions. The type of distribution selected depends on the factors surrounding the variable. Selected distributions are included in Attachment C.

Tables 4-3 and 4-4 summarize the results of the Monte Carlo analysis for the Full Removal and Partial Removal alternatives, respectively. Levels of probability are described from P1 to P100, where the number following the 'P' represents the percentage of most probable outcomes. For example, the P1 estimate amount will only cover the lowest 1% of the possible cost outcomes, whereas P100 will cover the maximum estimate amount determined from running the 10,000 scenarios.

KLAMATH RIVER RENEWAL CORPORATION

Table 4-3 Results Summary – Full Removal Monte Carlo Results

FULL REMOVAL (Year of Construction Dollars)													
Estimate Element		Forecast Range											
		Mean	P01	P10 (MPL)	P20	P30	P40	P50 (Median)	P60	P70	P80	P90 (MPH)	P100
Project Oversight		29,616,000	29,402,000	29,466,000	29,508,000	29,543,000	29,575,000	29,608,000	29,641,000	29,678,000	29,721,000	29,778,000	29,951,000
10	Project Oversight	29,616,000	29,402,000	29,466,000	29,508,000	29,543,000	29,575,000	29,608,000	29,641,000	29,678,000	29,721,000	29,778,000	29,951,000
Environmental Compliance & Permitting		8,671,000	8,462,000	8,525,000	8,565,000	8,600,000	8,631,000	8,663,000	8,696,000	8,731,000	8,773,000	8,829,000	9,006,000
21	Permitting	6,753,000	6,544,000	6,607,000	6,647,000	6,682,000	6,713,000	6,745,000	6,778,000	6,813,000	6,855,000	6,911,000	7,088,000
22	Environmental Compliance Support	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000
Engineering & Procurement		15,925,000	14,675,000	15,023,000	15,261,000	15,465,000	15,659,000	15,855,000	16,059,000	16,288,000	16,557,000	16,925,000	18,099,000
31	Design Data	2,009,000	1,908,000	1,938,000	1,958,000	1,974,000	1,989,000	2,005,000	2,020,000	2,038,000	2,058,000	2,085,000	2,168,000
32	Engineering - AECOM	6,166,000	5,855,000	5,949,000	6,009,000	6,060,000	6,107,000	6,154,000	6,202,000	6,255,000	6,317,000	6,400,000	6,657,000
33	Engineering - PDB	6,730,000	5,943,000	6,152,000	6,300,000	6,429,000	6,553,000	6,678,000	6,811,000	6,960,000	7,137,000	7,381,000	8,173,000
34	Procurement	1,020,000	969,000	984,000	994,000	1,002,000	1,010,000	1,018,000	1,026,000	1,035,000	1,045,000	1,059,000	1,101,000
Construction Management		10,705,000	10,168,000	10,328,000	10,433,000	10,521,000	10,603,000	10,684,000	10,768,000	10,860,000	10,967,000	11,111,000	11,599,000
35	Construction Management	10,705,000	10,168,000	10,328,000	10,433,000	10,521,000	10,603,000	10,684,000	10,768,000	10,860,000	10,967,000	11,111,000	11,599,000
Construction		234,343,000	187,033,000	202,108,000	211,338,000	218,958,000	225,995,000	232,913,000	240,034,000	247,749,000	256,702,000	268,560,000	305,421,000
41	Dam Removal	108,104,000	95,066,000	99,282,000	101,858,000	103,967,000	105,905,000	107,795,000	109,727,000	111,811,000	114,207,000	117,341,000	126,917,000
42	Restoration Earthwork	21,928,000	19,197,000	19,887,000	20,391,000	20,839,000	21,275,000	21,721,000	22,198,000	22,732,000	23,377,000	24,270,000	27,408,000
43	Restoration	58,537,000	39,492,000	46,133,000	49,949,000	52,999,000	55,745,000	58,387,000	61,045,000	63,855,000	67,036,000	71,103,000	82,327,000
44	Yreka Water Line Replacement	2,973,000	2,532,000	2,665,000	2,750,000	2,822,000	2,889,000	2,955,000	3,024,000	3,100,000	3,188,000	3,305,000	3,663,000
45	Transportation	33,673,000	24,519,000	26,980,000	28,661,000	30,135,000	31,555,000	33,008,000	34,559,000	36,302,000	38,405,000	41,340,000	51,748,000
46	Recreation Improvements	4,848,000	2,555,000	3,295,000	3,743,000	4,112,000	4,452,000	4,784,000	5,126,000	5,496,000	5,923,000	6,486,000	8,198,000
47	Flood Proofing	1,524,000	1,251,000	1,340,000	1,394,000	1,438,000	1,478,000	1,517,000	1,558,000	1,601,000	1,651,000	1,715,000	1,898,000
48	Public Health And Safety	2,756,000	2,421,000	2,526,000	2,592,000	2,646,000	2,696,000	2,746,000	2,797,000	2,852,000	2,915,000	3,000,000	3,262,000
Anticipated Mitigation Measures		18,392,000	16,621,000	17,264,000	17,623,000	17,904,000	18,156,000	18,395,000	18,632,000	18,882,000	19,159,000	19,510,000	20,435,000
51	Groundwater Improvements	1,974,000	1,429,000	1,627,000	1,738,000	1,825,000	1,902,000	1,976,000	2,048,000	2,125,000	2,210,000	2,317,000	2,603,000
52	Water Supply And Water Rights	1,084,000	916,000	980,000	1,014,000	1,040,000	1,064,000	1,086,000	1,107,000	1,130,000	1,154,000	1,185,000	1,265,000
53	Cultural Resources	15,334,000	14,276,000	14,657,000	14,871,000	15,039,000	15,190,000	15,333,000	15,477,000	15,627,000	15,795,000	16,008,000	16,567,000
Monitoring & Reporting		18,876,000	13,513,000	15,332,000	16,384,000	17,232,000	18,009,000	18,761,000	19,531,000	20,360,000	21,316,000	22,571,000	26,570,000
61	Aquatic Resource Measures	7,137,000	6,092,000	6,326,000	6,512,000	6,683,000	6,855,000	7,032,000	7,226,000	7,447,000	7,719,000	8,101,000	9,581,000
62	Terrestrial Resources Measures	2,294,000	813,000	1,387,000	1,690,000	1,922,000	2,125,000	2,314,000	2,501,000	2,693,000	2,904,000	3,164,000	3,812,000
63	Water Quality Monitoring	9,445,000	6,608,000	7,619,000	8,182,000	8,627,000	9,029,000	9,415,000	9,804,000	10,220,000	10,693,000	11,306,000	13,177,000
Contingencies		87,387,000	27,366,000	48,410,000	59,454,000	67,928,000	76,144,000	84,215,000	92,833,000	102,114,000	113,550,000	129,794,000	233,371,000
Full Removal Total		423,900,000	307,200,000	346,500,000	368,600,000	386,200,000	402,800,000	419,100,000	436,200,000	454,700,000	476,700,000	507,100,000	654,500,000

Table 4-4 Results Summary – Partial Removal Monte Carlo Results

PARTIAL REMOVAL (Year of Construction Dollars)													
		Forecast Range											
Estimate Element		Mean	P01	P10 (MPL)	P20	P30	P40	P50 (Median)	P60	P70	P80	P90 (MPH)	P100
Project Oversight		29,616,000	29,402,000	29,466,000	29,508,000	29,543,000	29,575,000	29,608,000	29,641,000	29,678,000	29,721,000	29,778,000	29,959,000
10	Project Oversight	29,616,000	29,402,000	29,466,000	29,508,000	29,543,000	29,575,000	29,608,000	29,641,000	29,678,000	29,721,000	29,778,000	29,959,000
Environmental Compliance & Permitting		8,671,000	8,463,000	8,525,000	8,566,000	8,599,000	8,631,000	8,663,000	8,695,000	8,731,000	8,773,000	8,829,000	9,017,000
21	Permitting	6,753,000	6,545,000	6,607,000	6,648,000	6,681,000	6,713,000	6,745,000	6,777,000	6,813,000	6,855,000	6,911,000	7,099,000
22	Environmental Compliance Support	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000
Engineering & Procurement		15,925,000	14,680,000	15,025,000	15,261,000	15,466,000	15,659,000	15,855,000	16,059,000	16,289,000	16,558,000	16,927,000	18,123,000
31	Design Data	2,009,000	1,908,000	1,938,000	1,958,000	1,974,000	1,989,000	2,005,000	2,020,000	2,038,000	2,058,000	2,085,000	2,183,000
32	Engineering - AECOM	6,166,000	5,857,000	5,949,000	6,009,000	6,060,000	6,107,000	6,154,000	6,202,000	6,255,000	6,317,000	6,400,000	6,655,000
33	Engineering - PDB	6,730,000	5,946,000	6,154,000	6,300,000	6,430,000	6,553,000	6,678,000	6,811,000	6,961,000	7,138,000	7,383,000	8,182,000
34	Procurement	1,020,000	969,000	984,000	994,000	1,002,000	1,010,000	1,018,000	1,026,000	1,035,000	1,045,000	1,059,000	1,103,000
Construction Management		10,705,000	10,165,000	10,329,000	10,433,000	10,521,000	10,603,000	10,684,000	10,768,000	10,860,000	10,968,000	11,110,000	11,566,000
35	Construction Management	10,705,000	10,165,000	10,329,000	10,433,000	10,521,000	10,603,000	10,684,000	10,768,000	10,860,000	10,968,000	11,110,000	11,566,000
Construction		198,295,000	155,492,000	169,140,000	177,485,000	184,370,000	190,737,000	196,989,000	203,433,000	210,410,000	218,506,000	229,250,000	262,996,000
41	Dam Removal	72,056,000	63,530,000	66,316,000	68,004,000	69,379,000	70,641,000	71,871,000	73,126,000	74,471,000	76,018,000	78,042,000	84,008,000
42	Restoration Earthwork	21,928,000	19,198,000	19,887,000	20,391,000	20,839,000	21,275,000	21,721,000	22,198,000	22,733,000	23,377,000	24,270,000	27,427,000
43	Restoration of Vegetation	58,537,000	39,481,000	46,131,000	49,949,000	53,001,000	55,752,000	58,388,000	61,045,000	63,857,000	67,032,000	71,101,000	82,340,000
44	Yreka Water Line Replacement	2,973,000	2,532,000	2,665,000	2,750,000	2,822,000	2,889,000	2,955,000	3,024,000	3,100,000	3,188,000	3,306,000	3,683,000
45	Transportation	33,673,000	24,522,000	26,980,000	28,662,000	30,133,000	31,554,000	33,006,000	34,560,000	36,301,000	38,402,000	41,329,000	52,148,000
46	Recreation Improvements	4,848,000	2,556,000	3,295,000	3,743,000	4,112,000	4,452,000	4,784,000	5,126,000	5,496,000	5,923,000	6,487,000	8,226,000
47	Flood Proofing	1,524,000	1,251,000	1,340,000	1,394,000	1,438,000	1,478,000	1,518,000	1,558,000	1,601,000	1,651,000	1,715,000	1,918,000
48	Public Health And Safety	2,756,000	2,422,000	2,526,000	2,592,000	2,646,000	2,696,000	2,746,000	2,796,000	2,851,000	2,915,000	3,000,000	3,246,000
Anticipated Mitigation Measures		18,392,000	16,629,000	17,270,000	17,627,000	17,907,000	18,157,000	18,395,000	18,630,000	18,879,000	19,157,000	19,505,000	20,442,000
51	Groundwater Improvements	1,974,000	1,427,000	1,628,000	1,738,000	1,825,000	1,902,000	1,976,000	2,048,000	2,125,000	2,210,000	2,317,000	2,610,000
52	Water Supply And Water Rights	1,084,000	925,000	985,000	1,018,000	1,043,000	1,065,000	1,086,000	1,106,000	1,127,000	1,151,000	1,180,000	1,255,000
53	Cultural Resources	15,334,000	14,277,000	14,657,000	14,871,000	15,039,000	15,190,000	15,333,000	15,476,000	15,627,000	15,796,000	16,008,000	16,577,000
Monitoring & Reporting		18,876,000	13,507,000	15,330,000	16,383,000	17,233,000	18,008,000	18,762,000	19,532,000	20,360,000	21,314,000	22,576,000	26,522,000
61	Aquatic Resource Measures	7,137,000	6,091,000	6,326,000	6,512,000	6,683,000	6,854,000	7,033,000	7,226,000	7,447,000	7,717,000	8,102,000	9,569,000
62	Terrestrial Resources Measures	2,294,000	811,000	1,386,000	1,690,000	1,922,000	2,125,000	2,315,000	2,501,000	2,693,000	2,905,000	3,166,000	3,823,000
63	Water Quality Monitoring	9,445,000	6,605,000	7,618,000	8,181,000	8,628,000	9,029,000	9,414,000	9,805,000	10,220,000	10,692,000	11,308,000	13,130,000
Contingencies		87,387,000	27,366,000	48,410,000	59,454,000	67,928,000	76,144,000	84,215,000	92,833,000	102,114,000	113,550,000	129,794,000	233,371,000
Partial Removal Total		387,900,000	275,700,000	313,500,000	334,700,000	351,600,000	367,500,000	383,200,000	399,600,000	417,300,000	438,500,000	467,800,000	612,000,000

4.3 Comparison with Previous Estimates

A previous estimate was developed by the USBR in 2012 and is documented in the Detailed Plan for Dam Removal – Klamath River Dams (USBR 2012). Table 4-5 below compares the new estimate of project cost for Full Removal to the 2012 estimate amounts. It is important to note that previous USBR estimate were organized using different cost categories, in addition to separating escalation out as a stand-alone line item. For comparison purposes, the 2012 estimate has been reorganized into the new cost categories, and escalation has been incorporated into applicable line items.

Based on the analyses summarized herein, the projected project cost estimate for Full Removal increased from approximately $292M to $398K. The MPH estimate for Full Removal increased from $493M to $507M. The MPL estimate for Full Removal increased from $238M to $347M.

Based on the analyses summarized herein, the projected project cost estimate for Partial Removal increased from approximately $235M to $352K. The MPH estimate for Partial Removal increased from $404M to $468M. The MPL estimate for Full Removal increased from $185M to $314M.

There are several categories where the new estimate shows notable increases from the previous USBR estimate. A brief discussion of these increases is provided below:

- Escalation: The current project construction schedule includes construction beginning in 2020, which is one year later than what was assumed in the 2012 USBR estimate. This results in an increase in project funds that are reserved to account for escalation.
- Project Oversight: The previous USBR estimate did not account for costs attributable to KRRC project oversight and associated costs currently required for KRRC management, accounting, controls, etc. Accounting for these project oversight costs increases the overall project cost by approximately $30M.
- Transportation Costs: As new field data and associated engineering assessments have been completed, the costs associated with anticipated improvements and maintenance activities to accommodate construction access and traffic have increased significantly. It is anticipated that these costs may decrease through value engineering and future PDB input.
- Restoration Costs: Through close coordination with resource agency representatives and other stakeholders, the approach to reservoir restoration has evolved from the approach and assumptions that were utilized by USBR in 2012. The revised approach is detailed in Appendix H of the Definite Plan and represents both current resource agency expectations, as well as the latest science on restoration techniques to increase the probability of successful plant and habitat establishment. The revised approach includes accommodation of some level of floodplain earthwork, as well as more proactive revegetation efforts within the riparian zone, both of which have increased cost.

Table 4-5 Comparison to Previous Estimate

FULL REMOVAL (Year of Construction Dollars)			
Estimate Element		USBR 2012 Estimate	Estimated Project Cost
Project Oversight		2,361,957	29,581,000
10	Project Oversight	-	29,581,000
Environmental Compliance & Permitting		7,085,871	8,637,000
21	Permitting	7,085,871	6,719,000
22	Environmental Compliance Support	-	1,918,000
Engineering & Procurement		14,171,743	15,632,000
31	Design Data	2,361,957	1,992,000
32	Engineering - AECOM	4,723,914	6,115,000
33	Engineering - PDB	4,723,914	6,513,000
34	Procurement	2,361,957	1,012,000
Construction Management		23,619,571	10,617,000
35	Construction Management	23,619,571	10,617,000
Construction		143,627,356	227,980,000
41	Dam Removal	97,262,754	106,827,000
42	Restoration Earthwork	-	21,051,000
43	Restoration	27,298,194	57,957,000
44	Yreka Water Line Replacement	2,218,619	2,900,000
45	Transportation	2,035,303	30,799,000
46	Recreation Improvements	4,761,605	4,584,000
47	Flood Proofing	5,025,441	1,499,000
48	Public Health And Safety	5,025,441	2,363,000
Anticipated Mitigation Measures		35,540,544	18,407,000
51	Groundwater Improvements	1,158,992	1,982,000
52	Water Supply And Water Rights	459,828	1,091,000
53	Cultural Resources	32,665,364	15,334,000
54	Other Mitigations	1,256,360	-
Monitoring & Reporting		19,272,565	18,405,000
61	Aquatic Resource Measures	5,615,930	6,691,000
62	Terrestrial Resources Measures	590,489	2,395,000
63	Water Quality Monitoring	13,066,146	9,319,000
Contingencies		45,920,393	68,394,000
Design & Contingency		45,920,393	68,394,000
Full Removal Total		291,600,000	397,700,000

Chapter 5: References

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5. REFERENCES

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KRRC 2018. Definite Plan for the Lower Klamath Project, Klamath River Renewal Corporation, June 2018.

UCCE 2012. University of California Cooperative Extension – Sample Costs to Establish and Produce Alfalfa Hay, Intermountain – Siskiyou County.

USBR 2012. United States Bureau of Reclamation. Detailed Plan for Dam Removal – Klamath River Dams – Klamath Hydroelectric Project – FERC License No. 2082 – Oregon-California. July 2012.

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Attachment A Cost Estimate

A.1 Cost Estimate - Full Removal

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Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
10			**OVERSIGHT**												
10	Project		Compensation & Benefits	7/16-6/17 (year 1)	1	SUM	29,017.00	29,017	29,017	0%	29,017	0%	29,017	29,017	29,017
10	Project		Compensation & Benefits	7/17-12/19 (2.5 years)	1	SUM	1,557,347.00	1,557,347	1,557,347	0%	1,557,347	0%	1,557,347	1,557,347	1,557,347
10	Project		Compensation & Benefits	1/20-6/22 (2.5 years)	1	SUM	3,276,136.00	3,276,136	3,276,136	0%	3,276,136	0%	3,276,136	3,276,136	3,276,136
10	Project		Compensation & Benefits	7/22-6/27 (5 years)	1	SUM	193,967.00	193,967	193,967	0%	193,967	0%	193,967	193,967	193,967
10	Project		Travel and Meetings	7/16-6/17 (year 1)	1	SUM	45,223.00	45,223	45,223	0%	45,223	0%	45,223	45,223	45,223
10	Project		Travel and Meetings	7/17-12/19 (2.5 years)	1	SUM	272,538.00	272,538	272,538	0%	272,538	0%	272,538	272,538	272,538
10	Project		Travel and Meetings	1/20-6/22 (2.5 years)	1	SUM	450,000.00	450,000	450,000	0%	450,000	0%	450,000	450,000	450,000
10	Project		Travel and Meetings	7/22-6/27 (5 years)	1	SUM	45,000.00	45,000	45,000	0%	45,000	0%	45,000	45,000	45,000
10	Project		Dam Removal Contractors	Land Survey Contractor	1	SUM	1,020,000.00	1,020,000	1,020,000	0%	1,020,000	0%	1,020,000	1,020,000	1,020,000
10	Project		Professional Services; CEA Services & Expenses	7/16-6/17 (year 1)	1	SUM	1,054,732.00	1,054,732	1,054,732	0%	1,054,732	0%	1,054,732	1,054,732	1,054,732
10	Project		Professional Services; CEA Services & Expenses	7/17-12/19 (2.5 years)	1	SUM	2,386,949.16	2,386,949	2,386,949	0%	2,386,949	0%	2,386,949	2,386,949	2,386,949
10	Project		Professional Services; CEA Services & Expenses	1/20-6/22 (2.5 years)	1	SUM	2,375,442.96	2,375,443	2,375,443	0%	2,375,443	0%	2,375,443	2,375,443	2,375,443
10	Project		Professional Services; CEA Services & Expenses	7/22-6/27 (5 years)	1	SUM	563,853.35	563,853	563,853	0%	563,853	0%	563,853	563,853	563,853
10	Project		Legal Services; Power + Water, General Counsel	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Legal Services; Power + Water, General Counsel	7/17-12/19 (2.5 years)	1	SUM	500,863.00	500,863	500,863	0%	500,863	0%	500,863	500,863	500,863
10	Project		Legal Services; Power + Water, General Counsel	1/20-6/22 (2.5 years)	1	SUM	694,448.00	694,448	694,448	0%	694,448	0%	694,448	694,448	694,448
10	Project		Legal Services; Power + Water, General Counsel	7/22-6/27 (5 years)	1	SUM	240,843.00	240,843	240,843	0%	240,843	0%	240,843	240,843	240,843
10	Project		Legal Services; Hawkins, General Counsel	7/16-6/17 (year 1)	1	SUM	1,109,894.00	1,109,894	1,109,894	0%	1,109,894	0%	1,109,894	1,109,894	1,109,894
10	Project		Legal Services; Hawkins, General Counsel	7/17-12/19 (2.5 years)	1	SUM	718,211.00	718,211	718,211	0%	718,211	0%	718,211	718,211	718,211
10	Project		Legal Services; Hawkins, General Counsel	1/20-6/22 (2.5 years)	1	SUM	373,112.00	373,112	373,112	0%	373,112	0%	373,112	373,112	373,112
10	Project		Legal Services; Hawkins, General Counsel	7/22-6/27 (5 years)	1	SUM	86,063.00	86,063	86,063	0%	86,063	0%	86,063	86,063	86,063
10	Project		Legal Services; Hawkins, Construction Counsel	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Legal Services; Hawkins, Construction Counsel	7/17-12/19 (2.5 years)	1	SUM	2,551,000.00	2,551,000	2,551,000	0%	2,551,000	0%	2,551,000	2,551,000	2,551,000
10	Project		Legal Services; Hawkins, Construction Counsel	1/20-6/22 (2.5 years)	1	SUM	600,000.00	600,000	600,000	0%	600,000	0%	600,000	600,000	600,000
10	Project		Legal Services; Hawkins, Construction Counsel	7/22-6/27 (5 years)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Board of Consultants	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Board of Consultants	7/17-12/19 (2.5 years)	1	SUM	905,850.00	905,850	905,850	0%	905,850	0%	905,850	905,850	905,850
10	Project		Board of Consultants	1/20-6/22 (2.5 years)	1	SUM	494,100.00	494,100	494,100	0%	494,100	0%	494,100	494,100	494,100
10	Project		Board of Consultants	7/22-6/27 (5 years)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Accounting & Audit Fees	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Accounting & Audit Fees	7/17-12/19 (2.5 years)	1	SUM	246,728.00	246,728	246,728	0%	246,728	0%	246,728	246,728	246,728
10	Project		Accounting & Audit Fees	1/20-6/22 (2.5 years)	1	SUM	612,823.00	612,823	612,823	0%	612,823	0%	612,823	612,823	612,823
10	Project		Accounting & Audit Fees	7/22-6/27 (5 years)	1	SUM	206,252.00	206,252	206,252	0%	206,252	0%	206,252	206,252	206,252
10	Project		Risk Management Services	7/16-6/17 (year 1)	1	SUM	44,519.00	44,519	44,519	0%	44,519	0%	44,519	44,519	44,519
10	Project		Risk Management Services	7/17-12/19 (2.5 years)	1	SUM	91,250.00	91,250	91,250	0%	91,250	0%	91,250	91,250	91,250
10	Project		Risk Management Services	1/20-6/22 (2.5 years)	1	SUM	135,000.00	135,000	135,000	0%	135,000	0%	135,000	135,000	135,000
10	Project		Risk Management Services	7/22-6/27 (5 years)	1	SUM	10,000.00	10,000	10,000	0%	10,000	0%	10,000	10,000	10,000
10	Project		Communications External Services	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Communications External Services	7/17-12/19 (2.5 years)	1	SUM	485,400.00	485,400	485,400	0%	485,400	0%	485,400	485,400	485,400
10	Project		Communications External Services	1/20-6/22 (2.5 years)	1	SUM	950,790.00	950,790	950,790	0%	950,790	0%	950,790	950,790	950,790
10	Project		Communications External Services	7/22-6/27 (5 years)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Insurance & Risk Management	7/16-6/17 (year 1)	1	SUM	25,138.00	25,138	25,138	0%	25,138	0%	25,138	25,138	25,138
10	Project		Insurance & Risk Management	7/17-12/19 (2.5 years)	1	SUM	195,451.00	195,451	195,451	0%	195,451	0%	195,451	195,451	195,451
10	Project		Insurance & Risk Management	1/20-6/22 (2.5 years)	1	SUM	405,475.00	405,475	405,475	0%	405,475	0%	405,475	405,475	405,475
10	Project		Insurance & Risk Management	7/22-6/27 (5 years)	1	SUM	107,895.00	107,895	107,895	0%	107,895	0%	107,895	107,895	107,895
10	Project		Project Specific Insurance	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Project Specific Insurance	7/17-12/19 (2.5 years)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Project Specific Insurance	1/20-6/22 (2.5 years)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Project Specific Insurance	7/22-6/27 (5 years)	1	SUM	100,000.00	100,000	100,000	0%	100,000	0%	100,000	100,000	100,000
10	Project		Admin, IT, Fees	7/16-6/17 (year 1)	1	SUM	38,991.00	38,991	38,991	0%	38,991	0%	38,991	38,991	38,991
10	Project		Admin, IT, Fees	7/17-12/19 (2.5 years)	1	SUM	52,426.00	52,426	52,426	0%	52,426	0%	52,426	52,426	52,426
10	Project		Admin, IT, Fees	1/20-6/22 (2.5 years)	1	SUM	65,973.00	65,973	65,973	0%	65,973	0%	65,973	65,973	65,973
10	Project		Admin, IT, Fees	7/22-6/27 (5 years)	1	SUM	30,732.00	30,732	30,732	0%	30,732	0%	30,732	30,732	30,732

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
10	Project		Project Management, AECOM	Detailed separately	1	sum	2,977,635.66	2,977,636	2,828,754	-5%	3,275,399	10%	2,977,636	2,828,754	3,275,399
10	Project		Outreach, AECOM	Detailed separately	1	sum	1,253,904.32	1,253,904	1,191,209	-5%	1,379,295	10%	1,253,904	1,191,209	1,379,295
20			**ENVIRONMENTAL COMPLIANCE & PERMITTING**												
21			**PERMITTING**												
21	Project		Permitting, AECOM	Detailed separately	1	sum	4,113,000.00	4,113,000	3,907,350	-5%	4,524,300	10%	4,113,000	3,907,350	4,524,300
21	Project		Environmental Legal Serivces; Perkins Coie	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
21	Project		Environmental Legal Serivces; Perkins Coie	7/17-12/19 (2.5 years)	1	SUM	1,537,641.00	1,537,641	1,537,641	0%	1,537,641	0%	1,537,641	1,537,641	1,537,641
21	Project		Environmental Legal Serivces; Perkins Coie	1/20-6/22 (2.5 years)	1	SUM	1,068,125.00	1,068,125	1,068,125	0%	1,068,125	0%	1,068,125	1,068,125	1,068,125
21	Project		Environmental Legal Serivces; Perkins Coie	7/22-6/27 (5 years)	1	SUM	-	-	-	0%	-	0%	-	-	-
22			**CEQA & FERC SUPPORT**												
22	Project		Agency Fees and Reimbursements	Oregon Department of Environmental Quality	1	SUM	97,000.00	97,000	97,000	0%	97,000	0%	97,000	97,000	97,000
22	Project		Agency Fees and Reimbursements	CA State Water Resources Control Board	1	SUM	58,950.00	58,950	58,950	0%	58,950	0%	58,950	58,950	58,950
22	Project		Agency Fees and Reimbursements	Still Water Sciences (SWRCB)	1	SUM	1,281,945.00	1,281,945	1,281,945	0%	1,281,945	0%	1,281,945	1,281,945	1,281,945
22	Project		Agency Fees and Reimbursements	Other Environmental Studies	1	SUM	480,000.00	480,000	480,000	0%	480,000	0%	480,000	480,000	480,000
30			**ENGINEERING & CONSTRUCTION MANAGEMENT**												
31			**ENGINEERING - DESIGN DATA**												
31	Project		Engineering - Design Data	Detailed separately	1	sum	1,992,000.00	1,992,000	1,892,400	-5%	2,191,200	10%	1,992,000	1,892,400	2,191,200
32			**ENGINEERING - AECOM**												
32	Project		Construction Cost Estimate	Detailed separately	1	sum	295,000.00	295,000	280,250	-5%	324,500	10%	295,000	280,250	324,500
32	Project		AECOM Preliminary Design & Mitigation	Detailed separately	1	sum	3,585,000.00	3,585,000	3,405,750	-5%	3,943,500	10%	3,585,000	3,405,750	3,943,500
32	Project		AECOM Final Design & Construction Support	Detailed separately	1	sum	1,950,000.00	1,950,000	1,852,500	-5%	2,145,000	10%	1,950,000	1,852,500	2,145,000
32	Project		Review of PDB Final Design	Detailed separately	1	sum	285,000.00	285,000	270,750	-5%	313,500	10%	285,000	270,750	313,500
33			**ENGINEERING - PDB**												
33	Project		Engineering - PDB	Detailed separately	1	sum	6,513,000.00	6,513,000	5,861,700	-10%	8,466,900	30%	6,513,000	5,861,700	8,466,900
34			**PROCUREMENT**												
34	Project		Procurement	Detailed separately	1	sum	1,011,574.86	1,011,575	960,996	-5%	1,112,732	10%	1,011,575	960,996	1,112,732
35			**CONSTRUCTION MANAGEMENT**												
35	Project		Construction Management	Detailed separately	1	sum	10,616,599.33	10,616,599	10,085,769	-5%	11,678,259	10%	10,616,599	10,085,769	11,678,259
40			**CONSTRUCTION**												
41			**DAM REMOVAL**												
41	JC Boyle	1.001	JC Boyle Dam Removal	Removal of Diversion Conduit Bulkheads	14.00	CY	1,323.00	18,522	17,596	-5%	19,448	5%	20,835	19,793	21,876
41	JC Boyle	1.002	JC Boyle Dam Removal	Remove Water from behind Tailrace Cofferdam	500,000	GAL	0.01	5,309	4,778	-10%	6,105	15%	5,972	5,375	6,868
41	JC Boyle	1.003	JC Boyle Dam Removal	Provide Dewatering behind Tailrace Cofferdam	1.00	LS	61,036.38	61,036	54,933	-10%	70,192	15%	68,658	61,792	78,956
41	JC Boyle	1.004	JC Boyle Dam Removal	Construct Embankment Cofferdam in Tailrace around Powerho	2,000	CY	108.78	217,554	195,799	-10%	261,065	20%	244,719	220,247	293,662
41	JC Boyle	1.005	JC Boyle Dam Removal	Remove Spillway Concrete	2,100	CY	330.13	693,263	589,274	-15%	831,916	20%	779,827	662,853	935,793
41	JC Boyle	1.006	JC Boyle Dam Removal	Remove Monorail Structural Steel Components	15,000	LB	0.64	9,570	8,613	-10%	12,919	35%	10,765	9,688	14,533
41	JC Boyle	1.007	JC Boyle Dam Removal	Remove Fish Ladder Concrete	1,820	CY	333.49	606,952	546,257	-10%	667,647	10%	682,738	614,464	751,012
41	JC Boyle	1.008	JC Boyle Dam Removal	Remove Gravity Dam Section Concrete	600	CY	339.60	203,759	173,195	-15%	244,511	20%	229,201	194,821	275,041
41	JC Boyle	1.009	JC Boyle Dam Removal	Remove Timber Equipment Ramp on left side of Dam	10,500	LB	0.66	6,969	5,924	-15%	9,409	35%	7,840	6,664	10,584
41	JC Boyle	1.010	JC Boyle Dam Removal	Remove Pressure-Treated Lumber from Footbridge around Int	3,600	SF	7.19	25,886	23,298	-10%	29,769	15%	29,119	26,207	33,486
41	JC Boyle	1.011	JC Boyle Dam Removal	Remove Storage Shed located on access road	4,480	SF	27.79	124,519	118,293	-5%	136,970	10%	140,066	133,063	154,073
41	JC Boyle	1.012	JC Boyle Dam Removal	Remove Warehouse located on access road	2,580	SF	36.49	94,149	89,441	-5%	103,564	10%	105,905	100,609	116,495
41	JC Boyle	1.013	JC Boyle Dam Removal	Remove Fire System Control Bldg. on left abutment	520	SF	26.00	13,521	12,845	-5%	14,873	10%	15,209	14,448	16,730
41	JC Boyle	1.014	JC Boyle Dam Removal	Remove Dam Communication Bldg. on left abutment	490	SF	27.21	13,332	12,666	-5%	14,666	10%	14,997	14,247	16,497
41	JC Boyle	1.015	JC Boyle Dam Removal	Remove Concrete Slab on left abutment for former Control Ho	6.00	CY	1,778.57	10,671	9,604	-10%	12,272	15%	12,004	10,804	13,804
41	JC Boyle	1.016	JC Boyle Dam Removal	Remove 4'x5' Metal Hatch on top of Concrete Pull Box on left a	1.00	CY	1,769.46	1,769	1,593	-10%	1,946	10%	1,990	1,791	2,189
41	JC Boyle	1.017	JC Boyle Dam Removal	Remove Reservoir Level Gauge House on Dam Crest	24.00	SF	138.69	3,328	3,162	-5%	3,661	10%	3,744	3,557	4,118
41	JC Boyle	1.018	JC Boyle Dam Removal	Upstream Riprap	2,200	CY	93.45	205,581	185,023	-10%	226,139	10%	231,251	208,126	254,376
41	JC Boyle	1.019	JC Boyle Dam Removal	Downstream Riprap	1,300	CY	93.02	120,930	108,837	-10%	133,023	10%	136,030	122,427	149,633
41	JC Boyle	1.020	JC Boyle Dam Removal	Miscellaneous Excavation	132,500	CY	10.42	1,380,126	1,173,107	-15%	1,656,151	20%	1,552,454	1,319,586	1,862,945
41	JC Boyle	1.021	JC Boyle Dam Removal	Cutoff Wall Concrete Demolition	70.00	CY	655.64	45,895	43,600	-5%	52,779	15%	51,626	49,044	59,369
41	JC Boyle	1.022	JC Boyle Dam Removal	Cutoff Wall Anchors	285	EA	12.86	3,664	3,481	-5%	4,030	10%	4,121	3,915	4,533
41	JC Boyle	1.023	JC Boyle Dam Removal	Remove & Dispose Hand Rails and Light Poles	5,000	LB	0.85	4,227	4,016	-5%	4,861	15%	4,755	4,517	5,468
41	JC Boyle	1.024	JC Boyle Dam Removal	Remove & Dispose Spillway Radial Gates and Hoists	124,000	LB	2.14	264,891	238,402	-10%	357,603	35%	297,967	268,170	402,255
41	JC Boyle	1.025	JC Boyle Dam Removal	Remove & Dispose Stop Logs and Slots (steel)	92,000	LB	0.94	86,725	78,053	-10%	104,070	20%	97,554	87,799	117,065
41	JC Boyle	1.026	JC Boyle Dam Removal	Remove & Dispose of 24" Slide Gate at Entrance to Fish Ladd	4,200	LB	0.70	2,919	2,773	-5%	4,233	45%	3,284	3,120	4,761
41	JC Boyle	1.026a	JC Boyle Dam Removal	Remove petroleum products from Red Bam Area	1,600	GAL	13.34	21,338	18,137	-15%	27,739	30%	24,002	20,402	31,203
41	JC Boyle	1.027	JC Boyle Dam Removal	Remove & Dispose of Spillway gate motor & control panel	1.00	EA	1,282.33	1,282	1,154	-10%	1,539	20%	1,442	1,298	1,731
41	JC Boyle	1.028	JC Boyle Dam Removal	Remove & Dispose of Distribution equipment, panelboards	1.00	EA	5,877.55	5,878	5,290	-10%	7,053	20%	6,611	5,950	7,934

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	JC Boyle	1.029	JC Boyle Dam Removal	Remove Powerhouse Concrete down to Elevation 3324.0	1,500	CY	546.51	819,762	737,786	-10%	983,714	20%	922,121	829,909	1,106,545
41	JC Boyle	1.030	JC Boyle Dam Removal	Remove Structural Steel Item associated with Powerhouse	94,000	LB	0.63	59,073	53,166	-10%	67,935	15%	66,450	59,805	76,417
41	JC Boyle	1.031	JC Boyle Dam Removal	Remove Warehouse near Powerhouse	5,060	SF	32.95	166,704	158,369	-5%	183,375	10%	187,520	178,144	206,272
41	JC Boyle	1.032	JC Boyle Dam Removal	Remove & Dispose of 2 - Governor oil systems	52,500	LB	0.80	41,929	39,833	-5%	48,219	15%	47,165	44,807	54,240
41	JC Boyle	1.033	JC Boyle Dam Removal	Remove & Dispose of Cooling water and bearing oil systems	6,500	LB	1.06	6,905	6,215	-10%	7,941	15%	7,768	6,991	8,933
41	JC Boyle	1.034	JC Boyle Dam Removal	Remove & Dispose of 2 - Francis Turbines	560,000	LB	0.75	417,204	354,624	-15%	521,505	25%	469,298	398,903	586,623
41	JC Boyle	1.035	JC Boyle Dam Removal	Remove & Dispose of 150 Ton crane	240,000	LB	0.82	196,396	166,937	-15%	235,675	20%	220,919	187,781	265,103
41	JC Boyle	1.036	JC Boyle Dam Removal	Remove & Dispose of Compressed Air systems	1,100	LB	0.88	973	875	-10%	1,216	25%	1,094	985	1,368
41	JC Boyle	1.037	JC Boyle Dam Removal	Remove & Dispose of 2 - CO2 systems	6,600	LB	0.99	6,504	5,853	-10%	7,805	20%	7,316	6,584	8,779
41	JC Boyle	1.038	JC Boyle Dam Removal	Remove & Dispose of Plant Water and Fire Protection	3,100	LB	0.74	2,298	2,068	-10%	2,757	20%	2,585	2,326	3,101
41	JC Boyle	1.039	JC Boyle Dam Removal	Remove & Dispose of Transformer Oil Fire Protection	6,500	LB	0.80	5,207	4,426	-15%	6,248	20%	5,857	4,979	7,029
41	JC Boyle	1.04	JC Boyle Dam Removal	Remove & Dispose of Unwatering Piping	33,000	LB	0.74	24,351	19,481	-20%	30,439	25%	27,392	21,913	34,240
41	JC Boyle	1.041	JC Boyle Dam Removal	Remove & Dispose of Drainage Piping	10,000	LB	0.84	8,353	7,100	-15%	10,024	20%	9,396	7,987	11,275
41	JC Boyle	1.042	JC Boyle Dam Removal	Remove & Dispose of 2-Oil Sump pumps	2,000	LB	1.27	2,536	2,283	-10%	2,917	15%	2,853	2,568	3,281
41	JC Boyle	1.043	JC Boyle Dam Removal	Remove & Dispose of Draft Tube Bulk Head Gates and Hoists	65,000	LB	0.71	46,356	39,403	-15%	57,946	25%	52,145	44,323	65,181
41	JC Boyle	1.043a	JC Boyle Dam Removal	Remove petroleum products from Mechanical Equipment	2,700	GAL	10.27	27,735	23,575	-15%	36,056	30%	31,198	26,519	40,558
41	JC Boyle	1.044	JC Boyle Dam Removal	Remove & Dispose of Outdoor Vertical AC Generator, Unit 1:	2.00	EA	158,304.56	316,609	269,118	-15%	364,100	15%	356,142	302,721	409,564
41	JC Boyle	1.045	JC Boyle Dam Removal	Remove & Dispose of Excitation equipment for 53/50 MVA Ge	2.00	EA	13,425.63	26,851	24,166	-10%	29,536	10%	30,204	27,184	33,224
41	JC Boyle	1.046	JC Boyle Dam Removal	Remove & Dispose of Surge protection equip. for 53/50 MVA	2.00	EA	8,153.33	16,307	14,676	-10%	17,937	10%	18,343	16,508	20,177
41	JC Boyle	1.047	JC Boyle Dam Removal	Remove & Dispose of Neutral grounding equip. for 53/50 MVA	2.00	EA	3,980.33	7,961	7,165	-10%	8,757	10%	8,955	8,059	9,850
41	JC Boyle	1.048	JC Boyle Dam Removal	Remove & Dispose of Generator Switchgear, 15kV - (6 section	1.00	EA	19,730.68	19,731	16,771	-15%	24,663	25%	22,194	18,865	27,743
41	JC Boyle	1.049	JC Boyle Dam Removal	Remove & Dispose of Station Service Switchgear, 600 volt - (5	1.00	EA	10,780.56	10,781	9,703	-10%	11,859	10%	12,127	10,914	13,339
41	JC Boyle	1.050	JC Boyle Dam Removal	Remove & Dispose of Unit and plant control switchboard	1.00	EA	5,903.27	5,903	5,313	-10%	6,494	10%	6,640	5,976	7,304
41	JC Boyle	1.051	JC Boyle Dam Removal	Remove & Dispose of Battery system	1.00	EA	7,430.59	7,431	6,688	-10%	8,174	10%	8,358	7,523	9,194
41	JC Boyle	1.052	JC Boyle Dam Removal	Remove & Dispose of Raceways, Conduit and Cable	1.00	EA	13,891.88	13,892	12,503	-10%	15,281	10%	15,626	14,064	17,189
41	JC Boyle	1.053	JC Boyle Dam Removal	Remove & Dispose of Misc. power & control boards	1.00	EA	7,140.08	7,140	6,426	-10%	7,854	10%	8,032	7,228	8,835
41	JC Boyle	1.054	JC Boyle Dam Removal	Remove & Dispose of 5 Gantry Crane motors - hoist (50Hp*),	1.00	EA	1,729.51	1,730	1,557	-10%	2,075	20%	1,945	1,751	2,335
41	JC Boyle	1.055	JC Boyle Dam Removal	Remove & Dispose of Gantry Crane control equipment (3 cubi	1.00	EA	5,869.29	5,869	5,282	-10%	6,456	10%	6,602	5,942	7,262
41	JC Boyle	1.056	JC Boyle Dam Removal	Remove & Dispose of Conduit and Cable	1.00	EA	10,561.93	10,562	9,506	-10%	12,674	20%	11,881	10,693	14,257
41	JC Boyle	1.057	JC Boyle Dam Removal	Remove & Dispose of Exterior Lighting	1.00	EA	10,640.74	10,641	9,577	-10%	12,237	15%	11,969	10,772	13,765
41	JC Boyle	1.058	JC Boyle Dam Removal	Remove & Dispose of Transmission Line No. 59	1.66	MI	31,411.84	52,144	44,322	-15%	65,180	25%	58,655	49,856	73,318
41	JC Boyle	1.059	JC Boyle Dam Removal	Remove & Dispose of Transmission Line No. 98	0.24	MI	27,715.54	6,652	5,654	-15%	8,315	25%	7,482	6,360	9,353
41	JC Boyle	1.060	JC Boyle Dam Removal	Remove & Dispose of Transmission Line No. 58	1.66	MI	31,411.84	52,144	44,322	-15%	65,180	25%	58,655	49,856	73,318
41	JC Boyle	1.061	JC Boyle Dam Removal	Remove Intake Structure Concrete	1,600	CY	294.80	471,675	424,508	-10%	566,010	20%	530,570	477,513	636,685
41	JC Boyle	1.062	JC Boyle Dam Removal	Remove Fish Screen Building	2,010	SF	70.46	141,616	134,535	-5%	155,777	10%	159,298	151,333	175,228
41	JC Boyle	1.063	JC Boyle Dam Removal	Remove 24-inch-dia. Steel Fish Discharge Pipe	37,978	LB	0.31	11,804	10,033	-15%	14,755	25%	13,278	11,286	16,597
41	JC Boyle	1.064	JC Boyle Dam Removal	Remove Concrete Items associated with the 14-ft-diameter St	1,010	CY	313.62	316,752	269,239	-15%	364,265	15%	356,303	302,857	409,748
41	JC Boyle	1.065	JC Boyle Dam Removal	Remove Open Concrete Flume	26,000	CY	266.49	6,928,771	6,235,894	-10%	8,314,525	20%	7,793,925	7,014,533	9,352,710
41	JC Boyle	1.066	JC Boyle Dam Removal	Remove Structural Steel Items associated with the Forebay Tr	11,500	LB	0.49	5,628	4,784	-15%	7,035	25%	6,331	5,381	7,914
41	JC Boyle	1.067	JC Boyle Dam Removal	Remove Fore bay Concrete	2,500	CY	298.78	746,951	672,256	-10%	896,341	20%	840,218	756,197	1,008,262
41	JC Boyle	1.068	JC Boyle Dam Removal	Place Concrete Plugs at Tunnel Portals	30.00	CY	1,616.26	48,488	46,063	-5%	50,912	5%	54,542	51,815	57,269
41	JC Boyle	1.069	JC Boyle Dam Removal	Remove Concrete Items associated with Penstocks D/S from T	1,800	CY	495.44	891,799	802,619	-10%	1,070,158	20%	1,003,152	902,837	1,203,783
41	JC Boyle	1.070	JC Boyle Dam Removal	Remove Head gate Control Building at Flume Entrance	500	SF	99.08	49,542	44,588	-10%	56,973	15%	55,728	50,155	64,087
41	JC Boyle	1.071	JC Boyle Dam Removal	Remove Fore bay Spillway Gate House	610	SF	89.23	54,431	48,988	-10%	65,318	20%	61,228	55,105	73,473
41	JC Boyle	1.072	JC Boyle Dam Removal	Remove Fore bay Control Building	560	SF	96.68	54,141	48,727	-10%	64,969	20%	60,901	54,811	73,081
41	JC Boyle	1.074	JC Boyle Dam Removal	Remove Insulated Generator Building next to Fore bay Control	90.00	SF	166.30	14,967	13,470	-10%	17,960	20%	16,835	15,152	20,203
41	JC Boyle	1.075	JC Boyle Dam Removal	Remove Fixed Wheel Gate (gate, Frame, and Hoist)	55,000	LB	0.53	29,090	23,272	-20%	36,363	25%	32,722	26,178	40,903
41	JC Boyle	1.076	JC Boyle Dam Removal	Remove Trash rack and trash rake (steel)	75,000	LB	0.51	38,047	30,438	-20%	47,559	25%	42,798	34,238	53,497
41	JC Boyle	1.077	JC Boyle Dam Removal	Remove stop Logs and slots (steel)	136,000	LB	0.79	107,370	96,633	-10%	134,213	25%	120,777	108,699	150,971
41	JC Boyle	1.078	JC Boyle Dam Removal	Remove Traveling Water Screen	124,000	LB	0.50	62,509	56,258	-10%	78,136	25%	70,314	63,282	87,892
41	JC Boyle	1.079	JC Boyle Dam Removal	Remove Fish By-Pass and Supports (steel)	610,000	LB	0.77	468,978	422,080	-10%	539,325	15%	527,537	474,783	606,667
41	JC Boyle	1.080	JC Boyle Dam Removal	Remove Gates and Hoists	18,500	LB	0.48	8,848	7,521	-15%	11,503	30%	9,953	8,460	12,939
41	JC Boyle	1.081	JC Boyle Dam Removal	Remove Trash rack and trash rake (steel)	47,249	LB	0.60	28,236	24,001	-15%	36,707	30%	31,762	26,998	41,291
41	JC Boyle	1.082	JC Boyle Dam Removal	Remove stop Logs and slots (steel)	37,069	LB	0.62	23,167	19,692	-15%	30,117	30%	26,060	22,151	33,878
41	JC Boyle	1.083	JC Boyle Dam Removal	Remove & Dispose Penstocks and bifurcation (steel)	1,600,000	LB	0.70	1,112,218	945,385	-15%	1,334,661	20%	1,251,094	1,063,429	1,501,312
41	JC Boyle	1.084	JC Boyle Dam Removal	Remove & Dispose Surge Tank (steel)	79,000	LB	0.82	64,445	58,000	-10%	83,778	30%	72,492	65,242	94,239
41	JC Boyle	1.085	JC Boyle Dam Removal	Remove & Dispose 2 - 108" Butterfly valves	148,000	LB	0.74	109,839	98,855	-10%	142,790	30%	123,554	111,198	160,620
41	JC Boyle	1.086	JC Boyle Dam Removal	Remove & Dispose Gate, Stem and Frame	28,000	LB	0.71	19,883	17,895	-10%	23,860	20%	22,366	20,129	26,839
41	JC Boyle	1.087	JC Boyle Dam Removal	Remove & Dispose of Steel Transition Manifolds on Upstream	250,000	LB	0.64	160,863	136,734	-15%	209,122	30%	180,949	153,807	235,234
41	JC Boyle	1.087a	JC Boyle Dam Removal	Remove petroleum products from Mechanical Equipment	380	GAL	16.54	6,284	5,342	-15%	8,169	30%	7,069	6,008	9,189
41	JC Boyle	1.097	JC Boyle Dam Removal	Clear and Grub Disposal Area (Embankment)	10.00	AC	12,954.90	129,549	116,594	-10%	142,504	10%	145,725	131,152	160,297
41	JC Boyle	1.098	JC Boyle Dam Removal	Clear and Grub, 40' width	2.40	AC	12,954.90	31,092	27,983	-10%	34,201	10%	34,974	31,477	38,471
41	JC Boyle	1.099	JC Boyle Dam Removal	4" thick gravel surfacing	2,150	T	29.66	63,762	57,386	-10%	70,139	10%	71,724	64,552	78,896
41	JC Boyle	1.103	JC Boyle Dam Removal	Soil Cover over Concrete Rubble	13,000	CY	8.64	112,348	101,113	-10%	134,818	20%	126,376	113,739	151,651
41	JC Boyle	1.107	JC Boyle Dam Removal	Embankment Fill in Waste way (Fore bay) Scour Hole	55,900	CY	77.16	4,313,417	3,882,075	-10%	4,744,759	10%	4,852,008	4,366,807	5,337,209
41	JC Boyle	1.108	JC Boyle Dam Removal	Topsy Recreational Area - Concrete total	68.00	CY	454.68	30,918	29,372	-5%	34,010	10%	34,779	33,040	38,256
41	JC Boyle	1.109	JC Boyle Dam Removal	Topsy Recreational Area - 6'x80' Floating dock made of lumbe	1.00	EA	8,816.20	8,816	8,375	-5%	9,257	5%	9,917	9,421	10,413
41	JC Boyle	1.110	JC Boyle Dam Removal	Topsy Recreational Area - 5'x20' Walkway leading to hex fishir	200	SF	10.02	2,005	1,904	-5%	2,105	5%	2,255	2,142	2,368

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					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	JC Boyle	1.111	JC Boyle Dam Removal	Topsy Recreational Area - Regrade to natural contour	300	SF	14.63	4,390	4,171	-5%	4,829	10%	4,938	4,691	5,432
41	JC Boyle	1.112	JC Boyle Dam Removal	Pioneer Park - Picnic tables to be removed and hauled away	12.00	EA	156.62	1,879	1,785	-5%	1,973	5%	2,114	2,008	2,220
41	JC Boyle	1.113	JC Boyle Dam Removal	Pioneer Park - 12 Concrete fire rings	5.00	CY	353.89	1,769	1,681	-5%	1,858	5%	1,990	1,891	2,090
41	JC Boyle	1.114	JC Boyle Dam Removal	Pioneer Park - Portable toilets to be removed and hauled away	2.00	EA	1,002.35	2,005	1,904	-5%	2,105	5%	2,255	2,142	2,368
41	JC Boyle	1.115	JC Boyle Dam Removal	Pioneer Park - Signs to be removed and hauled away	6.00	EA	141.12	847	804	-5%	889	5%	952	905	1,000
41	JC Boyle	1.116	JC Boyle Dam Removal	Pioneer Park - Dumpster to be removed and hauled away	1.00	EA	2,971.02	2,971	2,674	-10%	3,417	15%	3,342	3,008	3,843
41	JC Boyle	1.118	JC Boyle Dam Removal	Pioneer Park - Regrade to natural contour	0.50	AC	17,560.36	8,780	7,902	-10%	9,658	10%	9,877	8,889	10,864
41	JC Boyle	5.000	JC Boyle Dam Removal	Remove Frame dead end structures 60-80 ft high	2.00	EA	7,101.59	14,203	12,783	-10%	17,044	20%	15,977	14,379	19,172
41	JC Boyle	5.001	JC Boyle Dam Removal	Remove (incl foundation) and Save Transformers 230KV	2.00	EA	2,688.70	5,377	4,840	-10%	6,184	15%	6,049	5,444	6,956
41	JC Boyle	5.002	JC Boyle Dam Removal	Remove (incl foundation) and Save Power Circuit Breakers 2	2.00	EA	3,640.83	7,282	6,918	-5%	8,010	10%	8,191	7,781	9,010
41	JC Boyle	5.003	JC Boyle Dam Removal	Substation Tie Structure 230KV	1.00	EA	41,482.05	41,482	37,334	-10%	47,704	15%	46,662	41,995	53,661
41	JC Boyle	5.004	JC Boyle Dam Removal	Remove Chain Link Fence	601	LF	17.70	10,639	9,575	-10%	11,703	10%	11,967	10,770	13,164
41	JC Boyle	5.005	JC Boyle Dam Removal	Demolish overhead distribution 2.5 miles (30-45 poles)	45.00	EA	1,160.01	52,200	46,980	-10%	62,640	20%	58,718	52,846	70,462
41	JC Boyle	5.032	JC Boyle Dam Removal	Install 230kV strain transmission structures outside JC Boyle S	2.00	EA	132,241.37	264,483	238,034	-10%	317,379	20%	297,507	267,756	357,009
41	Copco 1	2.001	Copco 1 Dam Removal	Furnish, Install, and Remove Barge-Mounted Crane in Reserv	1.00	LS	191,823.14	191,823	172,641	-10%	239,779	25%	215,775	194,197	269,719
41	Copco 1	2.002	Copco 1 Dam Removal	Remove Sediment from Diversion Tunnel Intake to provide acc	30.00	CY	3,434.68	103,040	92,736	-10%	123,649	20%	115,907	104,316	139,088
41	Copco 1	2.003	Copco 1 Dam Removal	Furnish, Install, and Remove Large Crane on Right Abutment	1.00	LS	566,865.71	566,866	481,836	-15%	651,896	15%	637,647	542,000	733,294
41	Copco 1	2.004	Copco 1 Dam Removal	Remove Water from behind Tailrace Cofferdam	200,000	GAL	0.01	2,091	1,882	-10%	2,405	15%	2,353	2,117	2,706
41	Copco 1	2.005	Copco 1 Dam Removal	Riprap Protection on Cofferdam	260	CY	148.31	38,561	32,777	-15%	46,273	20%	43,376	36,869	52,051
41	Copco 1	2.006	Copco 1 Dam Removal	Provide Dewatering behind Tailrace Cofferdam	1.00	LS	89,882.80	89,883	80,895	-10%	107,859	20%	101,106	90,995	121,327
41	Copco 1	2.007	Copco 1 Dam Removal	Remove Current Diversion Tunnel Plug	195	CY	1,390.41	271,129	244,016	-10%	325,355	20%	304,983	274,485	365,980
41	Copco 1	2.008	Copco 1 Dam Removal	Construct Embankment Cofferdam in Tailrace	1,700	CY	165.62	281,551	239,319	-15%	337,862	20%	316,707	269,201	380,049
41	Copco 1	2.009	Copco 1 Dam Removal	Installation of 3 each 72" Blind Flanges	38,000	LB	34.66	1,317,134	1,119,564	-15%	1,712,274	30%	1,481,597	1,259,357	1,926,076
41	Copco 1	2.009.2	Copco 1 Dam Removal	Installation of 16.5 X 18.5 Roller Gate and Gate Structure	1.00	LS	4,098,153.55	4,098,154	3,483,431	-15%	5,327,600	30%	4,609,865	3,918,386	5,992,825
41	Copco 1	2.009.3	Copco 1 Dam Removal	Removal of 16.5 X 18.5 Roller Gate and Gate Structure	1.00	LS	271,584.86	271,585	230,847	-15%	353,060	30%	305,496	259,672	397,145
41	Copco 1	2.010	Copco 1 Dam Removal	Remove Concrete Dam down to Elev. 2476	36,000	CY	227.38	8,185,528	7,366,975	-10%	9,822,633	20%	9,207,605	8,286,845	11,049,126
41	Copco 1	2.011	Copco 1 Dam Removal	Remove Concrete Intake Structure on Right Abutment	21,000	CY	346.51	7,276,705	6,185,199	-15%	8,732,046	20%	8,185,303	6,957,508	9,822,364
41	Copco 1	2.012	Copco 1 Dam Removal	Remove Structural Steel from Spillway	55,000	LB	1.27	69,659	59,210	-15%	87,074	25%	78,357	66,604	97,946
41	Copco 1	2.013	Copco 1 Dam Removal	Install Diversion Tunnel Plugs	30.00	CY	1,330.24	39,907	35,916	-10%	45,893	15%	44,890	40,401	51,624
41	Copco 1	2.014	Copco 1 Dam Removal	Remove Diversion Tunnel Control Structure Concrete	350	CY	231.13	80,895	72,805	-10%	97,074	20%	90,995	81,896	109,195
41	Copco 1	2.015	Copco 1 Dam Removal	Remove & Dispose of Hand Rails	11,000	LB	1.36	14,919	12,681	-15%	17,903	20%	16,782	14,265	20,139
41	Copco 1	2.016	Copco 1 Dam Removal	Remove & Dispose of Radial Gates	140,500	LB	1.11	156,117	140,505	-10%	195,146	25%	175,610	158,049	219,513
41	Copco 1	2.017	Copco 1 Dam Removal	Remove & Dispose Radial Gate Stop logs	18,000	LB	1.06	19,126	17,214	-10%	23,908	25%	21,515	19,363	26,893
41	Copco 1	2.018	Copco 1 Dam Removal	Remove & Dispose Stop log hoist, track and supports	26,000	LB	1.03	26,842	24,158	-10%	33,552	25%	30,193	27,174	37,742
41	Copco 1	2.019	Copco 1 Dam Removal	Remove & Dispose of 3 sections of 23' of 72" Dia. steel lining	54,000	LB	1.04	56,361	47,906	-15%	67,633	20%	63,398	53,888	76,078
41	Copco 1	2.020	Copco 1 Dam Removal	Remove & Dispose of 3 - 72" butterfly valves (embedded)	55,000	LB	1.10	60,293	54,264	-10%	69,337	15%	67,822	61,040	77,995
41	Copco 1	2.021	Copco 1 Dam Removal	Remove & Dispose of 3 - 72" flapper valves with remote mech	78,000	LB	5.54	432,104	388,894	-10%	496,920	15%	486,058	437,453	558,967
41	Copco 1	2.022	Copco 1 Dam Removal	Remove & Dispose of Spillway gate motor & control panel	1.00	EA	1,318.63	1,319	1,187	-10%	1,516	15%	1,483	1,335	1,706
41	Copco 1	2.023	Copco 1 Dam Removal	Remove & Dispose Distribution equipment, panelboards	1.00	EA	5,877.55	5,878	5,290	-10%	7,053	20%	6,611	5,950	7,934
41	Copco 1	2.024	Copco 1 Dam Removal	Remove Powerhouse Concrete down to top of rock under the	3,100	CY	387.53	1,201,333	1,021,133	-15%	1,501,667	25%	1,351,337	1,148,636	1,689,171
41	Copco 1	2.025	Copco 1 Dam Removal	Remove Powerhouse Structural Steel	110,000	LB	1.02	112,188	95,360	-15%	134,625	20%	126,196	107,267	151,435
41	Copco 1	2.026	Copco 1 Dam Removal	Remove & Dispose of 2 - Governor Oil Systems	38,000	LB	1.07	40,521	36,469	-10%	50,651	25%	45,580	41,022	56,975
41	Copco 1	2.027	Copco 1 Dam Removal	Remove & Dispose of Cooling water and bearing oil systems	11,000	LB	3.16	34,710	31,239	-10%	41,652	20%	39,044	35,140	46,853
41	Copco 1	2.028	Copco 1 Dam Removal	Remove & Dispose of 4 - Horizontal Tandem Francis Turbines	452,000	LB	0.80	362,135	325,922	-10%	434,562	20%	407,353	366,618	488,824
41	Copco 1	2.029	Copco 1 Dam Removal	Remove & Dispose of 2 - 40 Ton indoor cranes	140,000	LB	0.74	103,941	88,350	-15%	124,729	20%	116,920	99,382	140,304
41	Copco 1	2.030	Copco 1 Dam Removal	Remove & Dispose of Compressed Air System	1,000	LB	1.00	997	897	-10%	1,147	15%	1,122	1,009	1,290
41	Copco 1	2.031	Copco 1 Dam Removal	Remove & Dispose of 2 - CO2 Systems	3,100	LB	1.05	3,252	2,927	-10%	3,739	15%	3,658	3,292	4,206
41	Copco 1	2.032	Copco 1 Dam Removal	Remove & Dispose of Plant Water and Fire Protection	2,600	LB	1.35	3,511	3,160	-10%	4,214	20%	3,950	3,555	4,740
41	Copco 1	2.033	Copco 1 Dam Removal	Remove & Dispose of Transformer Oil Fire Protection	5,400	LB	1.22	6,586	5,927	-10%	7,903	20%	7,408	6,667	8,890
41	Copco 1	2.034	Copco 1 Dam Removal	Remove & Dispose of Unwatering Piping	27,000	LB	0.73	19,738	16,777	-15%	24,672	25%	22,202	18,872	27,753
41	Copco 1	2.035	Copco 1 Dam Removal	Remove & Dispose of Drainage Piping	5,000	LB	1.04	5,202	4,422	-15%	6,503	25%	5,852	4,974	7,314
41	Copco 1	2.035a	Copco 1 Dam Removal	Remove petroleum products from mechanical equipment	1,250	GAL	4.39	5,490	4,941	-10%	6,313	15%	6,175	5,558	7,101
41	Copco 1	2.036	Copco 1 Dam Removal	Remove & Dispose of Horizontal AC Generator, Indoor Open F	2.00	EA	38,691.77	77,384	65,776	-15%	92,860	20%	87,046	73,989	104,455
41	Copco 1	2.037	Copco 1 Dam Removal	Remove & Dispose of Excitation equipment for 12.5 MVA Gen	1.50	EA	8,472.47	12,709	10,802	-15%	15,886	25%	14,296	12,151	17,869
41	Copco 1	2.038	Copco 1 Dam Removal	Remove & Dispose of Surge protection equip. for 12.5 MVA G	2.00	EA	2,504.46	5,009	4,258	-15%	6,512	30%	5,634	4,789	7,325
41	Copco 1	2.039	Copco 1 Dam Removal	Remove & Dispose of Neutral grounding equip. for 12.5 MVA (	2.00	EA	2,332.24	4,664	4,198	-10%	5,364	15%	5,247	4,722	6,034
41	Copco 1	2.040	Copco 1 Dam Removal	Remove & Dispose of Generator Switchgear, 5kV-includes uni	1.00	EA	20,666.10	20,666	18,599	-10%	23,766	15%	23,247	20,922	26,734
41	Copco 1	2.041	Copco 1 Dam Removal	Remove & Dispose of Station Service Switchgear, 600 volt - (5	1.00	EA	11,311.14	11,311	10,180	-10%	13,008	15%	12,723	11,451	14,632
41	Copco 1	2.042	Copco 1 Dam Removal	Remove & Dispose of Unit and plant control switchboard	1.00	EA	6,110.32	6,110	5,499	-10%	7,027	15%	6,873	6,186	7,904
41	Copco 1	2.043	Copco 1 Dam Removal	Remove & Dispose of Battery System	1.00	EA	20,638.63	20,639	18,575	-10%	23,734	15%	23,216	20,894	26,698
41	Copco 1	2.044	Copco 1 Dam Removal	Remove & Dispose of Raceways, Conduit and Cable	1.00	EA	17,082.48	17,082	15,374	-10%	19,645	15%	19,215	17,294	22,098
41	Copco 1	2.045	Copco 1 Dam Removal	Remove & Dispose of Misc. power & control boards	1.00	EA	6,945.94	6,946	6,251	-10%	7,988	15%	7,813	7,032	8,985
41	Copco 1	2.046	Copco 1 Dam Removal	Remove & Dispose of Step-up Transformers, indoor, oil-filled,	3.00	EA	64,338.39	193,015	173,714	-10%	221,967	15%	217,116	195,404	249,683
41	Copco 1	2.047	Copco 1 Dam Removal	Remove & Dispose of Step-up Transformers, indoor, oil-filled.	3.00	EA	57,252.76	171,758	154,582	-10%	197,522	15%	193,205	173,884	222,185
41	Copco 1	2.048	Copco 1 Dam Removal	Remove & Dispose of Seven 40-Ton Travelling Crane motors	1.00	EA	3,306.69	3,307	2,976	-10%	3,803	15%	3,720	3,348	4,278
41	Copco 1	2.049	Copco 1 Dam Removal	Remove & Dispose of 40-Ton Travelling Crane control equipm	1.00	EA	4,364.61	4,365	3,928	-10%	5,019	15%	4,910	4,419	5,646
41	Copco 1	2.050	Copco 1 Dam Removal	Remove & Dispose of 40-Ton Travelling Crane Festoon Cable	1.00	EA	1,534.84	1,535	1,381	-10%	1,842	20%	1,726	1,554	2,072

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	Copco 1	2.051	Copco 1 Dam Removal	Remove & Dispose of Four 15-Ton Overhead Crane Motors - I	1.00	EA	959.54	960	864	-10%	1,151	20%	1,079	971	1,295
41	Copco 1	2.052	Copco 1 Dam Removal	Remove & Dispose of 15-Ton Overhead Crane control equipm	1.00	EA	434.20	434	391	-10%	499	15%	488	440	562
41	Copco 1	2.053	Copco 1 Dam Removal	Remove & Dispose of 15-Ton Overhead Crane Festoon Cable	1.00	EA	637.49	637	574	-10%	733	15%	717	645	825
41	Copco 1	2.053a	Copco 1 Dam Removal	Remove petroleum products from mechanical equipment	10,500	GAL	10.39	109,116	98,204	-10%	125,483	15%	122,740	110,466	141,151
41	Copco 1	2.054	Copco 1 Dam Removal	Remove & Dispose of 69kV circuit breakers, oil0 filled, PCB	2.00	EA	861.46	1,723	1,551	-10%	1,895	10%	1,938	1,744	2,132
41	Copco 1	2.055	Copco 1 Dam Removal	Remove & Dispose of 69kV disconnect switches, group-operat	2.00	EA	861.46	1,723	1,551	-10%	1,895	10%	1,938	1,744	2,132
41	Copco 1	2.056	Copco 1 Dam Removal	Remove & Dispose of 60-foot wood poles	12.00	EA	1,296.96	15,563	13,229	-15%	18,676	20%	17,507	14,881	21,008
41	Copco 1	2.057	Copco 1 Dam Removal	Remove & Dispose of 30-foot wood cross arms	24.00	EA	484.41	11,626	9,882	-15%	13,951	20%	13,078	11,116	15,693
41	Copco 1	2.058	Copco 1 Dam Removal	Remove & Dispose of 69-kV insulator strings	12.00	EA	372.92	4,475	3,804	-15%	5,370	20%	5,034	4,279	6,041
41	Copco 1	2.059	Copco 1 Dam Removal	Remove & Dispose of Transmission Line No. 3	1.66	MI	31,411.84	52,144	44,322	-15%	65,180	25%	58,655	49,856	73,318
41	Copco 1	2.060	Copco 1 Dam Removal	Remove & Dispose of Transmission Line No. 15	1.23	MI	33,971.31	41,785	35,517	-15%	52,231	25%	47,002	39,952	58,753
41	Copco 1	2.061	Copco 1 Dam Removal	Remove & Dispose of Transmission Line No. 26-1	0.07	MI	33,525.16	2,347	1,995	-15%	2,933	25%	2,640	2,244	3,300
41	Copco 1	2.062	Copco 1 Dam Removal	Remove & Dispose of Transmission Line No. 26-2	0.07	MI	33,525.16	2,347	1,995	-15%	2,933	25%	2,640	2,244	3,300
41	Copco 1	2.063	Copco 1 Dam Removal	Remove gate house #1 from top of dam	720	SF	72.06	51,880	44,098	-15%	64,850	25%	58,358	49,604	72,947
41	Copco 1	2.064	Copco 1 Dam Removal	Remove gate house #2 from top of dam	690	SF	74.35	51,302	43,607	-15%	64,128	25%	57,708	49,052	72,135
41	Copco 1	2.065	Copco 1 Dam Removal	Remove Concrete Items associated with 10 ft. diam. Penstock	1,050	CY	300.38	315,398	268,089	-15%	394,248	25%	354,780	301,563	443,476
41	Copco 1	2.066	Copco 1 Dam Removal	Plug 14-foot diameter penstock with concrete	23.00	CY	3,373.31	77,586	69,828	-10%	89,224	15%	87,274	78,547	100,365
41	Copco 1	2.067	Copco 1 Dam Removal	Remove & Dispose of 8 screens	18,000	LB	1.17	21,014	18,913	-10%	25,217	20%	23,638	21,275	28,366
41	Copco 1	2.068	Copco 1 Dam Removal	Remove & Dispose of 8 Water Gates	18,000	LB	1.10	19,802	17,822	-10%	23,762	20%	22,274	20,047	26,729
41	Copco 1	2.069	Copco 1 Dam Removal	Remove & Dispose of 3 - 30" Dia. x 25' stand pipes	6,000	LB	0.91	5,458	4,912	-10%	6,550	20%	6,140	5,526	7,368
41	Copco 1	2.070	Copco 1 Dam Removal	Remove & Dispose of 14' Dia. penstock pipe	256,000	LB	1.31	335,207	284,926	-15%	419,009	25%	377,063	320,503	471,328
41	Copco 1	2.071	Copco 1 Dam Removal	Remove & Dispose of 10' Dia. penstock pipe	270,000	LB	1.37	370,853	315,225	-15%	463,566	25%	417,159	354,585	521,449
41	Copco 1	2.081	Copco 1 Dam Removal	Site work - Clear and Grub Disposal Area	4.00	AC	13,732.22	54,929	46,690	-15%	65,915	20%	61,788	52,519	74,145
41	Copco 1	2.082	Copco 1 Dam Removal	Site work - Soil Cover for Disposal Area	12,000	CY	6.84	82,107	69,791	-15%	98,529	20%	92,359	78,505	110,831
41	Copco 1	2.089	Copco 1 Dam Removal	Mallard Cove - Concrete total	106	CY	338.09	35,838	30,462	-15%	41,214	15%	40,313	34,266	46,360
41	Copco 1	2.09	Copco 1 Dam Removal	Mallard Cove - 25'x5' Dock made of composite decking and po	1.00	EA	3,009.15	3,009	2,558	-15%	3,461	15%	3,385	2,877	3,893
41	Copco 1	2.091	Copco 1 Dam Removal	Mallard Cove - 20'x5' Gangway w/ aluminum grate and railings	1.00	EA	2,758.50	2,758	2,345	-15%	3,172	15%	3,103	2,637	3,568
41	Copco 1	2.092	Copco 1 Dam Removal	Mallard Cove - Signs to be removed and hauled away	6.00	EA	152.39	914	823	-10%	1,006	10%	1,029	926	1,131
41	Copco 1	2.093	Copco 1 Dam Removal	Mallard Cove - Wood plank tables to be removed and hauled a	8.00	EA	114.29	914	823	-10%	1,006	10%	1,029	926	1,131
41	Copco 1	2.094	Copco 1 Dam Removal	Mallard Cove - Parking area to be regraded	2.50	AC	7,451.08	18,628	16,765	-10%	21,422	15%	20,954	18,858	24,097
41	Copco 1	2.095	Copco 1 Dam Removal	Copco Cove - Concrete Total	84.00	CY	331.83	27,874	23,693	-15%	32,055	15%	31,354	26,651	36,058
41	Copco 1	2.096	Copco 1 Dam Removal	Copco Cove - Dock abutment railing made of 2.5" dia. steel pi	1.00	EA	1,446.70	1,447	1,302	-10%	1,591	10%	1,627	1,465	1,790
41	Copco 1	2.097	Copco 1 Dam Removal	Copco Cove - Signs to be removed and hauled away	6.00	EA	407.82	2,447	2,202	-10%	2,692	10%	2,752	2,477	3,028
41	Copco 1	2.098	Copco 1 Dam Removal	Copco Cove - Wood plank tables to be removed and hauled av	2.00	EA	152.39	305	274	-10%	335	10%	343	309	377
41	Copco 1	2.099	Copco 1 Dam Removal	Copco Cove - Regrade	2.30	AC	6,531.70	15,023	13,521	-10%	17,276	15%	16,899	15,209	19,434
41	Copco 1	2.100	Copco 1 Dam Removal	Diversion Tunnel Lining	1.00	LS	244,844.33	244,844	220,360	-10%	281,571	15%	275,417	247,875	316,729
41	Copco 1	5.006	Copco 1 Dam Removal	Remove Frame Dead End Structures 60-80ft High @ Switch Y	4.00	EA	6,436.15	25,745	21,883	-15%	33,468	30%	28,959	24,615	37,647
41	Copco 1	5.007	Copco 1 Dam Removal	Remove Power Circuit Breakers 69KV @ Switch Yard	2.00	EA	5,681.20	11,362	10,226	-10%	14,203	25%	12,781	11,503	15,976
41	Copco 1	5.008	Copco 1 Dam Removal	Remove Disconnect Switches @ Switch Yard	4.00	EA	9,731.40	38,926	35,033	-10%	48,657	25%	43,786	39,407	54,733
41	Copco 1	5.009	Copco 1 Dam Removal	Remove All Associated AUX Equipment @ Switch Yard (allow	1.00	LS	48,501.71	48,502	43,652	-10%	60,627	25%	54,558	49,102	68,197
41	Copco 1	5.010	Copco 1 Dam Removal	Remove Distribution Lines 69 KV Copco 1 Switch Yard and HE	6.00	EA	1,402.44	8,415	7,573	-10%	10,518	25%	9,465	8,519	11,832
41	Copco 1	5.011	Copco 1 Dam Removal	Remove Distribution Poles 2.4 KV Btw Copco 1/ HE Plant/ Co	8.00	EA	1,950.45	15,604	14,043	-10%	19,505	25%	17,552	15,797	21,940
41	Copco 1	5.012	Copco 1 Dam Removal	Remove Production Poles in General Area of Copco 1	7.00	EA	1,956.86	13,698	11,643	-15%	17,807	30%	15,408	13,097	20,031
41	Copco 1	5.013	Copco 1 Dam Removal	Remove Village House Distribution Poles Near Dam (Est 10 ea	10.00	EA	1,293.71	12,937	10,997	-15%	16,818	30%	14,552	12,370	18,918
41	Copco 1	5.014	Copco 1 Dam Removal	Remove 69 KV Distribution Line 1.6 Miles (30 Poles)	30.00	EA	2,096.19	62,886	53,453	-15%	81,751	30%	70,738	60,127	91,959
41	Copco 1	5.015	Copco 1 Dam Removal	Remove Transmission Conductors on Poles 1X/001 and 2X/00	2.00	EA	2,686.44	5,373	4,567	-15%	6,985	30%	6,044	5,137	7,857
41	Copco 1	5.016	Copco 1 Dam Removal	Remove Transmission Conductors 1.3 Miles Copco 1 to Copc	6,864	LF	7.16	49,138	41,767	-15%	63,880	30%	55,274	46,983	71,856
41	Copco 2	3.001	Copco 2 Dam Removal	Construct and Remove Embankment Cofferdam-Right Side of	3,100	CY	59.70	185,071	148,057	-20%	259,100	40%	208,180	166,544	291,452
41	Copco 2	3.002	Copco 2 Dam Removal	Furnish, Install, and Remove RipRap	465	CY	129.88	60,392	48,314	-20%	84,549	40%	67,933	54,347	95,106
41	Copco 2	3.003	Copco 2 Dam Removal	Provide Dewatering behind Cofferdams	1.00	LS	143,210.99	143,211	128,890	-10%	186,174	30%	161,093	144,984	209,421
41	Copco 2	3.004	Copco 2 Dam Removal	Remove Water from behind Cofferdams	241,000	GAL	0.02	5,834	5,251	-10%	7,584	30%	6,563	5,906	8,531
41	Copco 2	3.005	Copco 2 Dam Removal	Construct and Remove Embankment Cofferdam-Left Side of D	1,100	CY	172.54	189,793	147,837	-22%	258,715	36%	213,491	166,297	291,019
41	Copco 2	3.006	Copco 2 Dam Removal	Furnish, Install, and Remove RipRap	250	CY	185.94	46,486	37,189	-20%	65,080	40%	52,290	41,832	73,207
41	Copco 2	3.007	Copco 2 Dam Removal	Provide Dewatering behind left Side Cofferdam	1.00	LS	79,612.67	79,613	71,651	-10%	103,496	30%	89,553	80,598	116,419
41	Copco 2	3.008	Copco 2 Dam Removal	Remove Water from behind Cofferdams	36,000	GAL	0.15	5,352	4,817	-10%	6,958	30%	6,021	5,418	7,827
41	Copco 2	3.009	Copco 2 Dam Removal	Remove Water from behind Tailrace Cofferdam	400,000	GAL	0.03	10,287	9,258	-10%	13,373	30%	11,571	10,414	15,043
41	Copco 2	3.010	Copco 2 Dam Removal	Provide Dewatering behind Tailrace Cofferdam	1.00	LS	49,938.86	49,939	44,945	-10%	64,921	30%	56,174	50,557	73,027
41	Copco 2	3.011	Copco 2 Dam Removal	Construct Embankment Cofferdam across Tailrace	1,700	CY	115.34	196,077	156,862	-20%	274,508	40%	220,560	176,448	308,784
41	Copco 2	3.014	Copco 2 Dam Removal	Remove Concrete in Dam	4,430	CY	253.02	1,120,868	952,738	-15%	1,625,258	45%	1,260,824	1,071,700	1,828,195
41	Copco 2	3.015	Copco 2 Dam Removal	Remove concrete equipment slab from top of embankment wi	5.00	CY	353.89	1,769	1,504	-15%	2,300	30%	1,990	1,692	2,588
41	Copco 2	3.016	Copco 2 Dam Removal	Remove Concrete Wing wall	240	CY	217.45	52,187	44,359	-15%	67,843	30%	58,703	49,898	76,314
41	Copco 2	3.017	Copco 2 Dam Removal	Right Abutment Removal - Random Fill	1,510	CY	52.34	79,041	67,185	-15%	98,801	25%	88,910	75,574	111,138
41	Copco 2	3.018	Copco 2 Dam Removal	Right Abutment Removal - Remove Hand Placed Riprap	5,400	SF	2.26	12,211	10,379	-15%	15,264	25%	13,736	11,675	17,170
41	Copco 2	3.019	Copco 2 Dam Removal	Right Abutment Removal - Gunite Curtain Wall	180	CY	333.73	60,071	51,060	-15%	75,089	25%	67,572	57,436	84,465
41	Copco 2	3.020	Copco 2 Dam Removal	Remove & Dispose - Hand rails and Light Poles	5,000	LB	0.84	4,183	3,556	-15%	5,020	20%	4,706	4,000	5,647
41	Copco 2	3.021	Copco 2 Dam Removal	Remove & Dispose - Radial Gates and Hoists	66,000	LB	0.81	53,452	45,434	-15%	72,160	35%	60,126	51,107	81,170
41	Copco 2	3.022	Copco 2 Dam Removal	Remove & Dispose - 5-Radial Gate Stop logs & Slots (steel)	95,800	LB	0.93	89,381	75,974	-15%	120,665	35%	100,542	85,461	135,732

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	Copco 2	3.023	Copco 2 Dam Removal	Remove & Dispose - Spillway intake gate motor & control pane	1.00	EA	1,297.31	1,297	1,168	-10%	1,492	15%	1,459	1,313	1,678
41	Copco 2	3.024	Copco 2 Dam Removal	Remove & Dispose - Spillway radial gate motor & control pane	1.00	EA	1,297.31	1,297	1,168	-10%	1,492	15%	1,459	1,313	1,678
41	Copco 2	3.025	Copco 2 Dam Removal	Remove & Dispose - Spillway trash rake motor, festoon cable	1.00	EA	551.31	551	496	-10%	634	15%	620	558	713
41	Copco 2	3.026	Copco 2 Dam Removal	Remove & Dispose - Distribution equipment, panelboards	1.00	EA	5,877.55	5,878	5,290	-10%	6,759	15%	6,611	5,950	7,603
41	Copco 2	3.027	Copco 2 Dam Removal	Remove Copper Shingles from Roof of Powerhouse	7,000	SF	2.07	14,473	12,302	-15%	16,644	15%	16,280	13,838	18,722
41	Copco 2	3.028	Copco 2 Dam Removal	Remove Powerhouse Concrete down to spring-line of turbine	1,110	CY	514.15	570,702	485,097	-15%	827,518	45%	641,962	545,668	930,845
41	Copco 2	3.029	Copco 2 Dam Removal	Remove Structural Steel items associated with Powerhouse	220,000	LB	0.96	211,759	169,407	-20%	296,463	40%	238,200	190,560	333,480
41	Copco 2	3.030	Copco 2 Dam Removal	Remove Control House Concrete	30.00	CY	317.78	9,533	7,627	-20%	12,870	35%	10,724	8,579	14,477
41	Copco 2	3.031	Copco 2 Dam Removal	Remove Control House Structural Steel Items	3,500	LB	0.88	3,088	2,471	-20%	4,324	40%	3,474	2,779	4,864
41	Copco 2	3.032	Copco 2 Dam Removal	Remove Shop Building	4,300	SF	69.45	298,623	238,898	-20%	388,210	30%	335,910	268,728	436,683
41	Copco 2	3.033	Copco 2 Dam Removal	Remove & Dispose - 2 - Governor oil systems	38,000	LB	1.06	40,406	34,345	-15%	50,507	25%	45,451	38,633	56,814
41	Copco 2	3.034	Copco 2 Dam Removal	Remove & Dispose - Cooling water and bearing oil systems	13,300	LB	0.93	12,414	10,552	-15%	15,518	25%	13,965	11,870	17,456
41	Copco 2	3.035	Copco 2 Dam Removal	Remove & Dispose - Oil / Water separator tank and piping	2,700	LB	0.93	2,520	2,142	-15%	3,149	25%	2,834	2,409	3,543
41	Copco 2	3.036	Copco 2 Dam Removal	Remove & Dispose - 12 - Cast Iron Columns	54,000	LB	0.83	44,692	35,754	-20%	53,631	20%	50,273	40,218	60,327
41	Copco 2	3.037	Copco 2 Dam Removal	Remove & Dispose - 2 - Francis Turbines	660,000	LB	0.83	547,502	438,002	-20%	711,753	30%	615,866	492,692	800,625
41	Copco 2	3.038	Copco 2 Dam Removal	Remove & Dispose - 2 - 40 Ton indoor cranes	140,000	LB	1.17	163,271	130,617	-20%	212,253	30%	183,658	146,926	238,755
41	Copco 2	3.039	Copco 2 Dam Removal	Remove & Dispose - Compressed Air Systems	1,000	LB	1.13	1,129	960	-15%	1,411	25%	1,270	1,080	1,588
41	Copco 2	3.040	Copco 2 Dam Removal	Remove & Dispose - 2 - CO2 Systems	2,100	LB	1.23	2,573	2,187	-15%	3,216	25%	2,894	2,460	3,618
41	Copco 2	3.041	Copco 2 Dam Removal	Remove & Dispose - Plant Water and Fire Protection	3,100	LB	1.41	4,373	3,717	-15%	5,466	25%	4,919	4,181	6,149
41	Copco 2	3.042	Copco 2 Dam Removal	Remove & Dispose - Transformer Oil Fire Protection	6,500	LB	0.87	5,633	4,788	-15%	7,042	25%	6,337	5,386	7,921
41	Copco 2	3.043	Copco 2 Dam Removal	Remove & Dispose - Unwatering Piping	32,000	LB	0.75	24,116	20,499	-15%	30,145	25%	27,127	23,058	33,909
41	Copco 2	3.044	Copco 2 Dam Removal	Remove & Dispose - Drainage Piping	10,000	LB	1.39	13,877	11,795	-15%	17,346	25%	15,609	13,268	19,512
41	Copco 2	3.044a	Copco 2 Dam Removal	Remove & Dispose - Petroleum Products from Mechanical Equ	3,300	GAL	4.54	14,972	13,475	-10%	17,217	15%	16,841	15,157	19,367
41	Copco 2	3.044b	Copco 2 Dam Removal	Remove & Dispose - Remove Petroleum Products at or near th	3,300	GAL	4.54	14,972	13,475	-10%	17,217	15%	16,841	15,157	19,367
41	Copco 2	3.045	Copco 2 Dam Removal	Remove & Dispose - AC Generator, Indoor Vertical	2.00	EA	82,295.42	164,591	148,132	-10%	189,279	15%	185,142	166,628	212,914
41	Copco 2	3.046	Copco 2 Dam Removal	Remove & Dispose - Excitation equipment for 15 MVA Genera	2.00	EA	8,173.98	16,348	14,713	-10%	18,800	15%	18,389	16,550	21,148
41	Copco 2	3.047	Copco 2 Dam Removal	Remove & Dispose - Surge protection equip. for 15 MVA Gene	2.00	EA	2,582.65	5,165	4,649	-10%	5,940	15%	5,810	5,229	6,682
41	Copco 2	3.048	Copco 2 Dam Removal	Remove & Dispose - Neutral grounding equip. for 15 MVA Ger	2.00	EA	2,514.72	5,029	4,526	-10%	5,784	15%	5,657	5,092	6,506
41	Copco 2	3.049	Copco 2 Dam Removal	Remove & Dispose - Generator Switchgear, 7.2kV-includes un	1.00	EA	27,340.22	27,340	24,606	-10%	31,441	15%	30,754	27,679	35,367
41	Copco 2	3.050	Copco 2 Dam Removal	Remove & Dispose - Station Service Switchgear, 600-volt (5 s	1.00	EA	24,083.60	24,084	21,675	-10%	27,696	15%	27,091	24,382	31,154
41	Copco 2	3.051	Copco 2 Dam Removal	Remove & Dispose - Unit and plant control switchboard	1.00	EA	7,551.93	7,552	6,797	-10%	8,685	15%	8,495	7,645	9,769
41	Copco 2	3.052	Copco 2 Dam Removal	Remove & Dispose - Battery system	1.00	EA	10,473.21	10,473	9,426	-10%	12,044	15%	11,781	10,603	13,548
41	Copco 2	3.053	Copco 2 Dam Removal	Remove & Dispose - Raceways, Conduit and Cable	1.00	EA	15,384.27	15,384	13,846	-10%	17,692	15%	17,305	15,575	19,901
41	Copco 2	3.054	Copco 2 Dam Removal	Remove & Dispose - Misc. Power & Control Boards	1.00	EA	5,724.44	5,724	5,152	-10%	6,583	15%	6,439	5,795	7,405
41	Copco 2	3.055	Copco 2 Dam Removal	Remove & Dispose - 7 - 40-Ton Travelling Crane motors-hoist	1.00	EA	3,548.91	3,549	3,194	-10%	4,259	20%	3,992	3,593	4,790
41	Copco 2	3.056	Copco 2 Dam Removal	Remove & Dispose - 40-Ton Travelling Crane control equipme	1.00	EA	11,203.08	11,203	10,083	-10%	13,444	20%	12,602	11,342	15,122
41	Copco 2	3.057	Copco 2 Dam Removal	Remove & Dispose - 40-Ton Travelling Crane Festoon Cable	1.00	EA	2,557.66	2,558	2,302	-10%	3,069	20%	2,877	2,589	3,452
41	Copco 2	3.058a	Copco 2 Dam Removal	Remove Oil from Oil-Filled Step-up Transformers	23,000	GAL	10.59	243,653	207,105	-15%	280,201	15%	274,077	232,965	315,188
41	Copco 2	3.061	Copco 2 Dam Removal	Remove Intake Structure Concrete	1,650	CY	299.68	494,479	420,307	-15%	741,718	50%	556,221	472,788	834,332
41	Copco 2	3.062	Copco 2 Dam Removal	Remove Concrete Items associated with 16-foot I.D. Wood Sta	1,310	CY	299.39	392,197	333,367	-15%	568,685	45%	441,168	374,993	639,693
41	Copco 2	3.063	Copco 2 Dam Removal	Place Concrete Plugs for Tunnels	100	CY	1,827.07	182,707	155,301	-15%	237,519	30%	205,521	174,692	267,177
41	Copco 2	3.064	Copco 2 Dam Removal	Remove Concrete Items associated with Penstocks D/S from T	3,500	CY	298.85	1,045,973	836,779	-20%	1,359,765	30%	1,176,578	941,262	1,529,551
41	Copco 2	3.065	Copco 2 Dam Removal	Remove & Dispose of Caterpillar Gate (steel)	50,000	LB	0.92	45,874	38,993	-15%	52,755	15%	51,602	43,862	59,342
41	Copco 2	3.066	Copco 2 Dam Removal	Remove & Dispose of Trash rack and trash rake (steel)	86,000	LB	0.63	54,375	46,219	-15%	70,687	30%	61,164	51,990	79,513
41	Copco 2	3.067	Copco 2 Dam Removal	Remove & Dispose of Stop Logs and slots for intake (steel)	220,000	LB	0.78	170,795	145,176	-15%	222,034	30%	192,121	163,303	249,758
41	Copco 2	3.068	Copco 2 Dam Removal	Remove & Dispose of Wood Staves Soaked in Creosote	1,100,000	LB	0.93	1,021,716	715,201	-30%	1,328,231	30%	1,149,292	804,504	1,494,079
41	Copco 2	3.069	Copco 2 Dam Removal	Remove & Dispose of Cradles (steel)	290,000	LB	0.94	273,748	191,623	-30%	355,872	30%	307,929	215,550	400,308
41	Copco 2	3.070	Copco 2 Dam Removal	Remove & Dispose of Bands (steel)	463,000	LB	0.92	426,777	298,744	-30%	554,811	30%	480,067	336,047	624,086
41	Copco 2	3.071	Copco 2 Dam Removal	Remove & Dispose of Penstock after bifurcation to butterfly va	860,000	LB	1.08	925,612	647,928	-30%	1,203,295	30%	1,041,188	728,831	1,353,544
41	Copco 2	3.072	Copco 2 Dam Removal	Remove & Dispose of Bifurcated vent pipes and support struct	19,500	LB	1.13	22,033	15,423	-30%	28,643	30%	24,784	17,349	32,220
41	Copco 2	3.073	Copco 2 Dam Removal	Remove & Dispose of 2 - 138" Butterfly Valves	148,000	LB	0.88	129,906	90,934	-30%	168,878	30%	146,127	102,289	189,965
41	Copco 2	5.017	Copco 2 Dam Removal	Disconnect and Remove Medium Voltage Circuit Breakers 115	2.00	EA	678.35	1,357	1,153	-15%	1,899	40%	1,526	1,297	2,137
41	Copco 2	5.018	Copco 2 Dam Removal	Disconnect and Remove Medium Voltage Circuit Breakers 69K	5.00	LB	590.84	2,954	2,511	-15%	4,136	40%	3,323	2,825	4,652
41	Copco 2	5.019	Copco 2 Dam Removal	Disconnect and Remove Transformers 12KV @ substation	1.00	EA	816.83	817	694	-15%	1,144	40%	919	781	1,286
41	Copco 2	5.020	Copco 2 Dam Removal	Disconnect and Remove cable connection between Copco 2 a	0.10	MI	94,661.96	9,466	8,046	-15%	13,253	40%	10,648	9,051	14,907
41	Copco 2	5.021	Copco 2 Dam Removal	Remove All associated Aux Equipment @ substation (allowanc	1.00	LS	24,184.84	24,185	20,557	-15%	33,859	40%	27,205	23,124	38,087
41	Copco 2	5.022	Copco 2 Dam Removal	Demolish overhead transmission line and structure 69KV Copc	5.00	MI	118,983.58	594,918	505,680	-15%	832,885	40%	669,202	568,821	936,882
41	Copco 2	5.023	Copco 2 Dam Removal	Demolish transmission conductor from existing structure pole.	1.50	MI	7,073.23	10,610	9,018	-15%	14,854	40%	11,935	10,144	16,708
41	Copco 2	5.024	Copco 2 Dam Removal	Remove structures between pole 2/007 and Iron Gate	6.00	EA	3,754.31	22,526	20,273	-10%	31,536	40%	25,339	22,805	35,474
41	Iron Gate	4.001	Iron Gate Dam Removal	Furnish, Install, and Remove Barge-Mounted Crane in Reserv	1.00	LS	191,823.14	191,823	172,641	-10%	220,597	15%	215,775	194,197	248,141
41	Iron Gate	4.002	Iron Gate Dam Removal	Furnish, Install, and Remove Temporary Air Vent Hose from B	50.00	EA	315.45	15,773	13,407	-15%	18,927	20%	17,742	15,081	21,290
41	Iron Gate	4.003	Iron Gate Dam Removal	Remove Reinforced Concrete Ring Located D/S of Closure Ga	46.00	CY	1,012.49	46,575	39,589	-15%	58,218	25%	52,390	44,532	65,488
41	Iron Gate	4.004	Iron Gate Dam Removal	Remove Reinforced Concrete Stoplog Structure	6.00	CY	1,738.55	10,431	9,388	-10%	11,996	15%	11,734	10,560	13,494
41	Iron Gate	4.005	Iron Gate Dam Removal	Remove Water from behind Tailrace Cofferdam	300,000	GAL	0.01	3,132	2,662	-15%	3,602	15%	3,523	2,995	4,051
41	Iron Gate	4.006	Iron Gate Dam Removal	Provide Dewatering behind Tailrace Cofferdam for removal of	1.00	LS	29,462.94	29,463	25,044	-15%	33,882	15%	33,142	28,171	38,113
41	Iron Gate	4.007	Iron Gate Dam Removal	Construct Embankment Cofferdam across Tailrace to remove	1,650	CY	112.09	184,946	166,451	-10%	212,687	15%	208,039	187,235	239,244
41	Iron Gate	4.010	Iron Gate Dam Removal	Upstream Cofferdam to be Removed in the Wet	20,000	CY	14.70	294,012	249,910	-15%	338,114	15%	330,723	281,115	380,332

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	Iron Gate	4.011	Iron Gate Dam Removal	Remove 9' dia. hinged blind flange	19,000	LB	6.49	123,371	104,866	-15%	148,046	20%	138,776	117,960	166,531
41	Iron Gate	4.012	Iron Gate Dam Removal	Remove 18" plug valve and 7' of 18" drainage pipe	2,620	LB	2.70	7,061	6,002	-15%	8,473	20%	7,943	6,751	9,531
41	Iron Gate	4.013.1	Iron Gate Dam Removal	Furnish and Install 1-16.5'x18' roller gate, stem, and operator	110,000	LB	34.16	3,757,547	3,381,793	-10%	4,133,302	10%	4,226,730	3,804,057	4,649,403
41	Iron Gate	4.013.2	Iron Gate Dam Removal	Remove Existing sluice and diversion gates from shaft by dive	110,000	LB	4.38	482,328	434,095	-10%	530,561	10%	542,554	488,298	596,809
41	Iron Gate	4.013.3	Iron Gate Dam Removal	Remove 16.5'X 18' sluice and diversion gates from shaft in Di	110,000	LB	0.58	64,216	57,794	-10%	70,637	10%	72,234	65,011	79,457
41	Iron Gate	4.014	Iron Gate Dam Removal	Remove Concrete in Observation Platform, Crest Wall and Wa	780	CY	298.81	233,072	209,765	-10%	256,379	10%	262,174	235,957	288,392
41	Iron Gate	4.015	Iron Gate Dam Removal	Remove Concrete in Diversion Tunnel Intake Structure	715	CY	300.06	214,542	193,088	-10%	246,723	15%	241,330	217,197	277,530
41	Iron Gate	4.016	Iron Gate Dam Removal	Remove Concrete in Diversion Tunnel Gate Tower	650	CY	196.63	127,809	108,637	-15%	146,980	15%	143,767	122,202	165,333
41	Iron Gate	4.017	Iron Gate Dam Removal	Remove Steel Footbridge to Gate Tower	13,000	LB	1.10	14,259	12,120	-15%	16,398	15%	16,039	13,633	18,445
41	Iron Gate	4.018	Iron Gate Dam Removal	Remove Concrete in Diversion Tunnel Footbridge Abutment	39.00	CY	197.94	7,720	6,562	-15%	8,878	15%	8,684	7,381	9,986
41	Iron Gate	4.019	Iron Gate Dam Removal	Place Concrete Plugs for Diversion Tunnel	43.00	CY	1,672.11	71,901	64,711	-10%	79,091	10%	80,879	72,791	88,966
41	Iron Gate	4.020	Iron Gate Dam Removal	Remove Concrete Closure Gates in Gate Tower	85.00	CY	894.09	75,998	64,598	-15%	87,397	15%	85,487	72,664	98,310
41	Iron Gate	4.021	Iron Gate Dam Removal	Remove Upstream Riprap	92,400	CY	21.05	1,944,680	1,652,978	-15%	2,333,616	20%	2,187,500	1,859,375	2,625,000
41	Iron Gate	4.022	Iron Gate Dam Removal	Remove Downstream Riprap	23,400	CY	15.64	365,879	310,997	-15%	439,054	20%	411,564	349,829	493,876
41	Iron Gate	4.023	Iron Gate Dam Removal	Miscellaneous Excavation	270,000	CY	6.72	1,815,450	1,543,132	-15%	2,178,539	20%	2,042,134	1,735,814	2,450,561
41	Iron Gate	4.023.1	Iron Gate Dam Removal	Miscellaneous Excavation	761,159	CY	15.55	11,836,796	10,061,276	-15%	14,204,155	20%	13,314,785	11,317,568	15,977,742
41	Iron Gate	4.024	Iron Gate Dam Removal	Cutoff Wall Concrete Demolition	2,440	CY	112.84	275,336	247,803	-10%	316,637	15%	309,716	278,744	356,173
41	Iron Gate	4.025	Iron Gate Dam Removal	Earth Fill Crest Raise	13,000	CY	15.68	203,841	173,265	-15%	234,417	15%	229,293	194,899	263,687
41	Iron Gate	4.026	Iron Gate Dam Removal	Sheet pile Crest Raise	800	LF	281.18	224,946	191,204	-15%	258,688	15%	253,034	215,079	290,989
41	Iron Gate	4.027	Iron Gate Dam Removal	Remove 5 Monitoring Wells	5.00	EA	2,332.81	11,664	10,498	-10%	13,414	15%	13,120	11,808	15,089
41	Iron Gate	4.028	Iron Gate Dam Removal	Remove and Dispose of Trash Sluice Gate - 10 ft x 9 ft H	4,500	LB	1.01	4,544	3,408	-25%	5,680	25%	5,112	3,834	6,390
41	Iron Gate	4.029	Iron Gate Dam Removal	Remove and Dispose of Intake Structure	72,000	LB	0.90	64,663	54,964	-15%	77,596	20%	72,738	61,827	87,285
41	Iron Gate	4.030	Iron Gate Dam Removal	Remove and Dispose of Sluice and Diversion Tunnel Gate	28,000	LB	1.09	30,649	26,052	-15%	36,779	20%	34,476	29,304	41,371
41	Iron Gate	4.031	Iron Gate Dam Removal	Remove and Dispose of Hoist Stem - 6" Dia. Sch 160x150'	7,500	LB	1.01	7,578	6,441	-15%	9,093	20%	8,524	7,245	10,229
41	Iron Gate	4.032	Iron Gate Dam Removal	Remove and Dispose of Air Vent Pipe - 8" Dia. Sch 40 x160'	4,650	LB	2.12	9,855	8,377	-15%	11,826	20%	11,085	9,423	13,303
41	Iron Gate	4.034	Iron Gate Dam Removal	Remove and Dispose of Air Vent Pipe - 12" Dia. Sch 40 x560'	30,250	LB	2.26	68,353	58,100	-15%	82,024	20%	76,888	65,355	92,266
41	Iron Gate	4.035	Iron Gate Dam Removal	Remove and Dispose of Outlet Works Stop Logs	2,670	LB	1.01	2,696	2,022	-25%	3,370	25%	3,033	2,275	3,791
41	Iron Gate	4.036	Iron Gate Dam Removal	Remove and Dispose of Hydraulic Pump Motor (10 HP est) &	1.00	EA	415.82	416	312	-25%	520	25%	468	351	585
41	Iron Gate	4.037	Iron Gate Dam Removal	Remove and Dispose of Distribution Equipment, Junction Boxe	1.00	EA	2,019.67	2,020	1,515	-25%	2,525	25%	2,272	1,704	2,840
41	Iron Gate	4.038	Iron Gate Dam Removal	Remove and Dispose of Power Cable and 4" Conduit from Per	800	FT	49.86	39,887	33,904	-15%	45,870	15%	44,867	38,137	51,598
41	Iron Gate	4.039	Iron Gate Dam Removal	Remove Powerhouse Concrete	5,200	CY	402.36	2,092,267	1,883,040	-10%	2,406,107	15%	2,353,516	2,118,164	2,706,543
41	Iron Gate	4.040	Iron Gate Dam Removal	Remove and Dispose of Turbine Unit	344,058	LB	0.95	327,583	278,446	-15%	376,721	15%	368,487	313,214	423,760
41	Iron Gate	4.041	Iron Gate Dam Removal	Remove and Dispose of Draft Tube Bulkheads	16,500	LB	0.98	16,235	13,800	-15%	19,482	20%	18,263	15,523	21,915
41	Iron Gate	4.042	Iron Gate Dam Removal	Remove and Dispose of Crane	24,000	LB	1.07	25,619	21,776	-15%	32,023	25%	28,818	24,495	36,022
41	Iron Gate	4.043	Iron Gate Dam Removal	Remove and Dispose of Governor	20,310	LB	1.04	21,033	17,878	-15%	25,240	20%	23,660	20,111	28,392
41	Iron Gate	4.044	Iron Gate Dam Removal	Remove and Dispose of Bearing Oil System and Cooling Wate	9,182	LB	1.06	9,761	8,297	-15%	11,713	20%	10,980	9,333	13,176
41	Iron Gate	4.045	Iron Gate Dam Removal	Remove and Dispose of CO2 Systems	2,568	LB	1.01	2,604	2,343	-10%	3,124	20%	2,929	2,636	3,514
41	Iron Gate	4.046	Iron Gate Dam Removal	Remove and Dispose of Plant Water and Fire Protection Syste	9,182	LB	1.05	9,596	8,636	-10%	11,515	20%	10,794	9,714	12,953
41	Iron Gate	4.047	Iron Gate Dam Removal	Remove and Dispose of Sump Pumps	2,000	LB	1.05	2,092	1,883	-10%	2,510	20%	2,353	2,118	2,824
41	Iron Gate	4.048	Iron Gate Dam Removal	Remove and Dispose of Pumps	22,000	LB	1.09	24,084	21,676	-10%	28,901	20%	27,092	24,382	32,510
41	Iron Gate	4.049	Iron Gate Dam Removal	Remove and Dispose of Exposed Piping Around the Plant	19,291	LB	1.05	20,285	18,257	-10%	24,342	20%	22,818	20,536	27,382
41	Iron Gate	4.050	Iron Gate Dam Removal	Remove and Dispose of Unwatering Piping	19,291	LB	0.88	16,967	15,270	-10%	19,512	15%	19,085	17,177	21,948
41	Iron Gate	4.051	Iron Gate Dam Removal	Remove and Dispose of Drainage Piping	9,518	LB	1.12	10,657	9,591	-10%	12,256	15%	11,988	10,789	13,786
41	Iron Gate	4.052	Iron Gate Dam Removal	Remove and Dispose of Transformer Oil and Fire Protection	9,182	LB	1.00	9,199	8,739	-5%	10,119	10%	10,347	9,830	11,382
41	Iron Gate	4.053	Iron Gate Dam Removal	Remove and Dispose of Compressed Air System	1,450	LB	0.91	1,313	1,182	-10%	1,510	15%	1,477	1,329	1,698
41	Iron Gate	4.053a	Iron Gate Dam Removal	Remove & Dispose - Petroleum Products from Mechanical Equ	1,100	GAL	10.05	11,057	10,504	-5%	12,163	10%	12,438	11,816	13,681
41	Iron Gate	4.054	Iron Gate Dam Removal	Remove and Dispose of AC Generator, Outdoor Horizontal	1.00	EA	91,158.88	91,159	82,043	-10%	104,833	15%	102,541	92,287	117,923
41	Iron Gate	4.055	Iron Gate Dam Removal	Remove and Dispose of Excitation equipment for 18.975 MVA	1.00	EA	2,384.74	2,385	2,146	-10%	2,742	15%	2,683	2,414	3,085
41	Iron Gate	4.056	Iron Gate Dam Removal	Remove and Dispose of Surge protection equip. for 18.975 MV	1.00	EA	1,891.05	1,891	1,702	-10%	2,175	15%	2,127	1,914	2,446
41	Iron Gate	4.057	Iron Gate Dam Removal	Remove and Dispose of Neutral grounding equip. for 18.975 M	1.00	EA	3,980.33	3,980	3,582	-10%	4,577	15%	4,477	4,030	5,149
41	Iron Gate	4.058	Iron Gate Dam Removal	Remove and Dispose of Station Service Switchgear, 600 volt -	1.00	EA	7,378.96	7,379	6,641	-10%	8,486	15%	8,300	7,470	9,545
41	Iron Gate	4.059	Iron Gate Dam Removal	Remove and Dispose of Unit and plant control switchboard	1.00	EA	23,948.92	23,949	21,554	-10%	27,541	15%	26,939	24,245	30,980
41	Iron Gate	4.060	Iron Gate Dam Removal	Remove and Dispose of Battery System - assume 60 batteries	1.00	EA	15,350.22	15,350	13,815	-10%	17,653	15%	17,267	15,540	19,857
41	Iron Gate	4.061	Iron Gate Dam Removal	Remove and Dispose of Raceways, Bus, Conduit and Cable	1.00	EA	18,352.70	18,353	16,517	-10%	21,106	15%	20,644	18,580	23,741
41	Iron Gate	4.062	Iron Gate Dam Removal	Remove and Dispose of Misc. power & control boards	1.00	EA	5,642.84	5,643	5,079	-10%	6,489	15%	6,347	5,713	7,300
41	Iron Gate	4.063	Iron Gate Dam Removal	Remove and Dispose of Transformer (3 phase, 275 kVA, 6600	1.00	EA	9,142.79	9,143	8,229	-10%	10,514	15%	10,284	9,256	11,827
41	Iron Gate	4.064	Iron Gate Dam Removal	Remove and Dispose of Governor Oil Pump Motors (10 hp and	2.00	EA	244.50	489	440	-10%	562	15%	550	495	633
41	Iron Gate	4.065	Iron Gate Dam Removal	Remove and Dispose of Vertical Motors, outdoor, (480V, 100 h	4.00	EA	712.83	2,851	2,138	-25%	3,564	25%	3,207	2,405	4,009
41	Iron Gate	4.066	Iron Gate Dam Removal	Remove and Dispose of Transformer (3 phase, 300 kVA, 6600	1.00	EA	10,482.18	10,482	9,434	-10%	12,055	15%	11,791	10,612	13,560
41	Iron Gate	4.067	Iron Gate Dam Removal	Remove and Dispose of Step-up Transformer, outdoor, oil-fille	1.00	EA	85,541.22	85,541	76,987	-10%	98,372	15%	96,222	86,600	110,656
41	Iron Gate	4.068	Iron Gate Dam Removal	Remove and Dispose of Lattice steel structure, with 69-kV disc	1.00	EA	6,973.83	6,974	6,276	-10%	8,020	15%	7,845	7,060	9,021
41	Iron Gate	4.069	Iron Gate Dam Removal	Remove and Dispose of Generator Switchgear, outdoor, 7.2kV	1.00	EA	24,487.62	24,488	22,039	-10%	28,161	15%	27,545	24,791	31,677
41	Iron Gate	4.070	Iron Gate Dam Removal	Remove and Dispose of Single Phase Pole Transformers (25 k	3.00	EA	2,514.24	7,543	6,788	-10%	8,674	15%	8,485	7,636	9,757
41	Iron Gate	4.071	Iron Gate Dam Removal	Remove Concrete in Penstock Intake Structure	460	CY	302.54	139,169	118,294	-15%	160,044	15%	156,546	133,064	180,028
41	Iron Gate	4.072	Iron Gate Dam Removal	Remove Concrete in Penstock Encasement	710	CY	300.16	213,116	191,805	-10%	245,084	15%	239,727	215,754	275,686
41	Iron Gate	4.073	Iron Gate Dam Removal	Remove Concrete in 3 Penstock Anchors and 7 Penstock Sup	3,110	CY	298.85	929,437	790,022	-15%	1,068,853	15%	1,045,491	888,667	1,202,314
41	Iron Gate	4.074	Iron Gate Dam Removal	Remove Steel Footbridge to Intake Structure	11,000	LB	1.11	12,161	10,337	-15%	13,986	15%	13,680	11,628	15,732
41	Iron Gate	4.075	Iron Gate Dam Removal	Remove Concrete in Intake Structure Footbridge Abutment	5.00	CY	820.58	4,103	3,487	-15%	4,718	15%	4,615	3,923	5,307

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	Iron Gate	4.076	Iron Gate Dam Removal	Remove and Dispose of Intake Structure	131,630	LB	1.04	136,401	115,941	-15%	156,862	15%	153,433	130,418	176,448
41	Iron Gate	4.077	Iron Gate Dam Removal	Remove and Dispose of Gate Hoist Stem - 6" Sch160x40'	1,800	LB	1.01	1,818	1,363	-25%	2,272	25%	2,045	1,534	2,556
41	Iron Gate	4.078	Iron Gate Dam Removal	Remove and Dispose of Water Fill line- 12" Dia STD x 27'	1,350	LB	1.01	1,363	1,022	-25%	1,704	25%	1,534	1,150	1,917
41	Iron Gate	4.079	Iron Gate Dam Removal	Remove and Dispose of Air Vent - 12" Dia STD x 32'	1,600	LB	1.01	1,616	1,212	-25%	2,020	25%	1,817	1,363	2,272
41	Iron Gate	4.080	Iron Gate Dam Removal	Remove and Dispose of Gage Wells	2,612	LB	1.01	2,638	1,978	-25%	3,297	25%	2,967	2,225	3,709
41	Iron Gate	4.081	Iron Gate Dam Removal	Remove and Dispose of Penstock Vent - 46" Dia, 0.25" Thick x	7,440	LB	2.08	15,466	13,146	-15%	17,786	15%	17,398	14,788	20,007
41	Iron Gate	4.082	Iron Gate Dam Removal	Remove and Dispose of Penstock - 12" Dia, 0.25" Thick x 698'	294,428	LB	1.47	433,061	368,102	-15%	498,020	15%	487,135	414,065	560,205
41	Iron Gate	4.083	Iron Gate Dam Removal	Remove and Dispose of Bypass Outlet - 96" Dia, 0.25" Thick x	12,850	LB	0.90	11,547	9,815	-15%	13,279	15%	12,989	11,041	14,937
41	Iron Gate	4.084	Iron Gate Dam Removal	Remove and Dispose of Outlet Valve on bypass outlet - 66" Di	18,000	LB	1.62	29,193	24,814	-15%	33,572	15%	32,838	27,912	37,764
41	Iron Gate	4.085	Iron Gate Dam Removal	Remove and Dispose Overhead trolley Crane Motor (4hp est)	1.00	EA	1,188.04	1,188	891	-25%	1,485	25%	1,336	1,002	1,670
41	Iron Gate	4.086	Iron Gate Dam Removal	Remove and Dispose Distribution equipment, Junction Boxes	1.00	EA	2,970.11	2,970	2,228	-25%	3,713	25%	3,341	2,506	4,176
41	Iron Gate	4.087	Iron Gate Dam Removal	Remove and Dispose Power Cable and Conduit	1.00	EA	91,734.75	91,735	77,975	-15%	105,495	15%	103,189	87,711	118,667
41	Iron Gate	4.097	Iron Gate Dam Removal	Clear and Grub Disposal Area	29.00	AC	6,292.60	182,485	155,113	-15%	209,858	15%	205,271	174,481	236,062
41	Iron Gate	4.101	Iron Gate Dam Removal	Remove Building No. 2	800	SF	73.00	58,404	52,563	-10%	67,164	15%	65,696	59,127	75,551
41	Iron Gate	4.102	Iron Gate Dam Removal	Remove Building No. 3	1,088	SF	75.55	82,199	73,979	-10%	94,529	15%	92,463	83,217	106,332
41	Iron Gate	4.103	Iron Gate Dam Removal	Remove Concrete in Fish Ladder	1,240	CY	300.19	372,241	316,405	-15%	428,077	15%	418,721	355,913	481,529
41	Iron Gate	4.104	Iron Gate Dam Removal	Remove Concrete in Holding Ponds #1 thru #6	1,380	CY	196.04	270,529	243,476	-10%	311,109	15%	304,309	273,878	349,955
41	Iron Gate	4.105	Iron Gate Dam Removal	Remove Concrete in Fish Facility Items	1,200	CY	194.03	232,832	197,908	-15%	267,757	15%	261,905	222,619	301,191
41	Iron Gate	4.106	Iron Gate Dam Removal	Remove Miscellaneous Metalwork in Fish Facilities	12,000	LB	0.95	11,351	9,648	-15%	13,621	20%	12,768	10,853	15,322
41	Iron Gate	4.107	Iron Gate Dam Removal	Remove Concrete Associated with 30" Dia. water supply line	80.00	CY	194.03	15,522	13,194	-15%	17,850	15%	17,460	14,841	20,079
41	Iron Gate	4.108	Iron Gate Dam Removal	Remove Concrete in Aerator Structure	65.00	CY	191.23	12,430	10,565	-15%	14,294	15%	13,982	11,884	16,079
41	Iron Gate	4.109	Iron Gate Dam Removal	Remove Wood in Aerator Structure	6,000	LB	0.83	4,990	3,742	-25%	6,237	25%	5,613	4,210	7,016
41	Iron Gate	4.110	Iron Gate Dam Removal	Remove Structural Steel in Aerator Structure	2,500	LB	1.01	2,525	1,893	-25%	3,156	25%	2,840	2,130	3,550
41	Iron Gate	4.111	Iron Gate Dam Removal	Remove Asphalt Pavement	3,900	SF	6.54	25,489	21,665	-15%	29,312	15%	28,671	24,370	32,972
41	Iron Gate	4.112	Iron Gate Dam Removal	Remove Restroom Building near Aerator Structure	340	SF	60.38	20,528	18,475	-10%	23,607	15%	23,091	20,782	26,555
41	Iron Gate	4.113	Iron Gate Dam Removal	Remove Storage Shed near Aerator Structure	90.00	SF	70.22	6,320	5,688	-10%	7,268	15%	7,109	6,398	8,175
41	Iron Gate	4.114	Iron Gate Dam Removal	Remove Toe Drain Pipe	260	LF	27.00	7,021	5,968	-15%	8,074	15%	7,897	6,713	9,082
41	Iron Gate	4.115	Iron Gate Dam Removal	Remove Toe Drain Manhole	25.00	LF	59.40	1,485	1,114	-25%	1,856	25%	1,670	1,253	2,088
41	Iron Gate	4.116	Iron Gate Dam Removal	Berm Removal	53,000	CY	13.82	732,558	659,302	-10%	842,442	15%	824,028	741,625	947,633
41	Iron Gate	4.117	Iron Gate Dam Removal	Remove and Dispose of Intake Structures Trashracks	5,000	LB	0.89	4,455	3,341	-25%	5,569	25%	5,011	3,759	6,264
41	Iron Gate	4.118	Iron Gate Dam Removal	Remove and Dispose of Pipe Conduit, 30" Dia. x 0.25" Thick x	76,640	LB	1.03	78,948	67,106	-15%	94,738	20%	88,806	75,485	106,567
41	Iron Gate	4.119	Iron Gate Dam Removal	Remove and Dispose of Sluice Gate Valve, 30" Dia.	3,000	LB	1.01	3,030	2,272	-25%	3,787	25%	3,408	2,556	4,260
41	Iron Gate	4.120	Iron Gate Dam Removal	Remove and Dispose of Sluice Gate Stem, 2" Dia. Sch160x45	360	LB	1.01	364	273	-25%	454	25%	409	307	511
41	Iron Gate	4.121	Iron Gate Dam Removal	Remove and Dispose of Butterfly Valve, 30" Dia.	2,435	LB	1.01	2,459	1,844	-25%	3,074	25%	2,766	2,074	3,457
41	Iron Gate	4.122	Iron Gate Dam Removal	Remove and Dispose of Piping- 30-in. Dia. x 0.25 Thickness x	7,200	LB	0.60	4,332	3,682	-15%	5,198	20%	4,872	4,142	5,847
41	Iron Gate	4.123	Iron Gate Dam Removal	Remove and Dispose of Piping- 24-in. Dia. x 0.25 Thickness x	15,872	LB	0.50	8,005	6,804	-15%	9,606	20%	9,004	7,654	10,805
41	Iron Gate	4.124	Iron Gate Dam Removal	Remove and Dispose of Piping- 20-in. Dia. x 0.25 Thickness x	4,505	LB	0.58	2,599	2,209	-15%	3,119	20%	2,923	2,485	3,508
41	Iron Gate	4.125	Iron Gate Dam Removal	Remove and Dispose of Piping- 18-in. Dia. x 0.25 Thickness x	29,088	LB	0.38	11,115	9,448	-15%	13,338	20%	12,503	10,627	15,003
41	Iron Gate	4.126	Iron Gate Dam Removal	Remove and Dispose of Piping- 16-in. Dia. x 0.25 Thickness x	6,972	LB	0.56	3,898	3,314	-15%	4,678	20%	4,385	3,727	5,262
41	Iron Gate	4.127	Iron Gate Dam Removal	Remove and Dispose of Piping- 12-in. Dia. x 0.25 Thickness x	2,176	LB	0.46	992	843	-15%	1,190	20%	1,116	948	1,339
41	Iron Gate	4.128	Iron Gate Dam Removal	Remove and Dispose of Piping- 10-in. Dia. x 0.25 Thickness x	1,932	LB	0.45	864	734	-15%	1,036	20%	972	826	1,166
41	Iron Gate	4.129	Iron Gate Dam Removal	Remove and Dispose of Piping- 8-in. Dia. x 0.25 Thickness x	3,588	LB	0.23	818	695	-15%	982	20%	920	782	1,104
41	Iron Gate	4.130	Iron Gate Dam Removal	Remove and Dispose of Piping- 3-in. Dia. x STD x 30'	1,088	LB	0.38	412	350	-15%	494	20%	463	394	556
41	Iron Gate	4.131	Iron Gate Dam Removal	Remove and Dispose of Gate Valves	21,792	LB	0.98	21,312	18,116	-15%	25,575	20%	23,974	20,378	28,768
41	Iron Gate	4.132	Iron Gate Dam Removal	Remove and Dispose of Basin #1	2,880	LB	2.89	8,336	7,086	-15%	10,003	20%	9,377	7,970	11,252
41	Iron Gate	4.133	Iron Gate Dam Removal	Remove and Dispose of Basin #2	3,860	LB	2.16	8,336	7,086	-15%	10,003	20%	9,377	7,970	11,252
41	Iron Gate	4.134	Iron Gate Dam Removal	Remove and Dispose of Basin #3	2,880	LB	2.89	8,336	7,086	-15%	10,003	20%	9,377	7,970	11,252
41	Iron Gate	4.135	Iron Gate Dam Removal	Remove and Dispose of Basin #4	3,580	LB	2.33	8,336	7,086	-15%	10,003	20%	9,377	7,970	11,252
41	Iron Gate	4.136	Iron Gate Dam Removal	Remove and Dispose of Basin #5	1,440	LB	5.79	8,336	7,086	-15%	10,003	20%	9,377	7,970	11,252
41	Iron Gate	4.137	Iron Gate Dam Removal	Remove and Dispose of Basin #6	1,440	LB	5.79	8,336	7,086	-15%	10,003	20%	9,377	7,970	11,252
41	Iron Gate	4.138	Iron Gate Dam Removal	Remove and Dispose of Holding Tank	7,400	LB	1.53	11,355	9,652	-15%	13,627	20%	12,773	10,857	15,328
41	Iron Gate	4.139	Iron Gate Dam Removal	Remove and Dispose of Misc.: Motors, control panels, cables,	1.00	EA	1,782.06	1,782	1,337	-25%	2,228	25%	2,005	1,503	2,506
41	Iron Gate	4.140	Iron Gate Dam Removal	Wanaka Springs - Concrete Total	28.00	CY	306.28	8,576	7,290	-15%	9,862	15%	9,647	8,200	11,094
41	Iron Gate	4.141	Iron Gate Dam Removal	Wanaka Springs - Double Pipe Railings	60.00	LF	47.52	2,851	2,138	-25%	3,564	25%	3,207	2,405	4,009
41	Iron Gate	4.142	Iron Gate Dam Removal	Wanaka Springs - Wood picnic tables to be removed and haul	5.00	EA	118.80	594	446	-25%	743	25%	668	501	835
41	Iron Gate	4.143	Iron Gate Dam Removal	Wanaka Springs - 25'x5' Wooden floating dock	125	SF	23.76	2,970	2,228	-25%	3,713	25%	3,341	2,506	4,176
41	Iron Gate	4.144	Iron Gate Dam Removal	Wanaka Springs - Rip and reseed site and access road	2.50	AC	6,798.10	16,995	14,446	-15%	19,545	15%	19,117	16,250	21,985
41	Iron Gate	4.145	Iron Gate Dam Removal	Wanaka Springs - Signs to be removed and hauled away	3.00	EA	356.41	1,069	802	-25%	1,337	25%	1,203	902	1,503
41	Iron Gate	4.146	Iron Gate Dam Removal	Wanaka Springs - 15'x5' Gangplank with Railings	75.00	SF	23.76	1,782	1,337	-25%	2,228	25%	2,005	1,503	2,506
41	Iron Gate	4.147	Iron Gate Dam Removal	Juniper Point - Concrete Total	19.00	CY	359.74	6,835	5,810	-15%	7,860	15%	7,688	6,535	8,842
41	Iron Gate	4.148	Iron Gate Dam Removal	Juniper Point - 2, 4x4 Toilet Vaults	32.00	SF	118.80	3,802	2,851	-25%	4,752	25%	4,276	3,207	5,346
41	Iron Gate	4.149	Iron Gate Dam Removal	Juniper Point - Wood picnic tables to be removed and hauled	8.00	EA	118.80	950	713	-25%	1,188	25%	1,069	802	1,336
41	Iron Gate	4.150	Iron Gate Dam Removal	Juniper Point - Signs to be removed and hauled away	4.00	EA	356.41	1,426	1,069	-25%	1,782	25%	1,604	1,203	2,005
41	Iron Gate	4.151	Iron Gate Dam Removal	Juniper Point - Dock pile railing	50.00	LF	47.52	2,376	1,782	-25%	2,970	25%	2,673	2,005	3,341
41	Iron Gate	4.152	Iron Gate Dam Removal	Juniper Point - 50'x5' Composite dock with poly floats	250	SF	31.34	7,834	7,051	-10%	8,618	10%	8,812	7,931	9,694
41	Iron Gate	4.153	Iron Gate Dam Removal	Juniper Point - 20'x5' Composite gangplank with railings	100	SF	23.76	2,376	1,782	-25%	2,970	25%	2,673	2,005	3,341
41	Iron Gate	4.155	Iron Gate Dam Removal	Juniper Point - Regrade to Natural Contour, rip, and reseed	2.00	AC	10,546.17	21,092	17,928	-15%	24,256	15%	23,726	20,167	27,285
41	Iron Gate	4.156	Iron Gate Dam Removal	Camp Creek - Concrete Total	110	CY	306.56	33,722	28,664	-15%	38,780	15%	37,932	32,243	43,622

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	Iron Gate	4.157	Iron Gate Dam Removal	Camp Creek - 180'Lx16'Wx8'D Earth jetty to remove and/or re	855	CY	73.54	62,876	53,445	-15%	72,307	15%	70,727	60,118	81,336
41	Iron Gate	4.158	Iron Gate Dam Removal	Camp Creek - Well house 10'x16' concrete block building	160	SF	72.74	11,638	10,475	-10%	12,802	10%	13,092	11,783	14,401
41	Iron Gate	4.159	Iron Gate Dam Removal	Camp Creek - 2, 20'x5' Composite decking gangplanks	200	SF	23.76	4,752	3,564	-25%	5,940	25%	5,346	4,009	6,682
41	Iron Gate	4.160	Iron Gate Dam Removal	Camp Creek - 2, 20'x5' Floating composite w/ aluminum frame	200	SF	23.76	4,752	3,564	-25%	5,940	25%	5,346	4,009	6,682
41	Iron Gate	4.161	Iron Gate Dam Removal	Camp Creek - Concrete block double toilet bldg 10'x16'	160	SF	72.74	11,638	10,475	-10%	12,802	10%	13,092	11,783	14,401
41	Iron Gate	4.162	Iron Gate Dam Removal	Camp Creek - Dump stations and approx. 2000 gal buried	1.00	EA	6,596.62	6,597	5,607	-15%	7,916	20%	7,420	6,307	8,904
41	Iron Gate	4.163	Iron Gate Dam Removal	Camp Creek - Power poles and lines	3.00	EA	1,818.16	5,454	4,636	-15%	6,545	20%	6,136	5,215	7,363
41	Iron Gate	4.164	Iron Gate Dam Removal	Camp Creek - Remove waterlines and 3 faucets and regrade	600	LF	5.94	3,564	2,673	-25%	4,455	25%	4,009	3,007	5,011
41	Iron Gate	4.166	Iron Gate Dam Removal	Camp Creek - Steel pipe/plank picnic tables to be removed an	5.00	EA	118.80	594	446	-25%	743	25%	668	501	835
41	Iron Gate	4.167	Iron Gate Dam Removal	Camp Creek - Relocate concrete tables	12.00	EA	118.80	1,426	1,069	-25%	1,782	25%	1,604	1,203	2,005
41	Iron Gate	4.168	Iron Gate Dam Removal	Camp Creek - Regrade, rip, and reseed	4.00	AC	8,861.29	35,445	30,128	-15%	40,762	15%	39,871	33,890	45,852
41	Iron Gate	4.169	Iron Gate Dam Removal	Camp Creek - Signs to be removed and hauled away	7.00	EA	356.41	2,495	1,871	-25%	3,119	25%	2,806	2,105	3,508
41	Iron Gate	4.170	Iron Gate Dam Removal	Dutch Creek - 50'4'3' Dock Concrete Abutment	22.00	CY	333.37	7,334	6,601	-10%	8,068	10%	8,250	7,425	9,075
41	Iron Gate	4.171	Iron Gate Dam Removal	Dutch Creek - Double Pipe Railing	100	LF	47.52	4,752	3,564	-25%	5,940	25%	5,346	4,009	6,682
41	Iron Gate	4.172	Iron Gate Dam Removal	Mirror Cove - Concrete Total	89.00	CY	235.88	20,994	18,894	-10%	23,093	10%	23,615	21,254	25,977
41	Iron Gate	4.173	Iron Gate Dam Removal	Mirror Cove - 10'x16' Toilet Vault	160	SF	96.23	15,397	13,857	-10%	16,937	10%	17,320	15,588	19,052
41	Iron Gate	4.174	Iron Gate Dam Removal	Mirror Cove - 2, 30'x5' Composite Gangplanks w/ aluminum	300	SF	21.43	6,430	5,787	-10%	7,073	10%	7,233	6,510	7,957
41	Iron Gate	4.175	Iron Gate Dam Removal	Mirror Cove - Double pipe railings on dock	80.00	LF	47.52	3,802	2,851	-25%	4,752	25%	4,276	3,207	5,346
41	Iron Gate	4.177	Iron Gate Dam Removal	Mirror Cove - Regrade site	3.00	AC	12,512.61	37,538	31,907	-15%	43,169	15%	42,225	35,891	48,559
41	Iron Gate	4.178	Iron Gate Dam Removal	Mirror Cove - Signs to be removed and hauled away	7.00	EA	356.41	2,495	1,871	-25%	3,119	25%	2,806	2,105	3,508
41	Iron Gate	4.179	Iron Gate Dam Removal	Overlook Point - 1 concrete picnic table base	1.00	CY	356.41	356	267	-25%	446	25%	401	301	501
41	Iron Gate	4.180	Iron Gate Dam Removal	Overlook Point - Steel frame table to be removed and hauled a	1.00	EA	118.80	119	89	-25%	149	25%	134	100	167
41	Iron Gate	4.181	Iron Gate Dam Removal	Overlook Point - Regrade steep access road and site to natura	0.50	AC	30,630.71	15,315	13,018	-15%	17,613	15%	17,228	14,644	19,812
41	Iron Gate	4.182	Iron Gate Dam Removal	Long Gulch - 80'x25x4" Concrete boat ramp to be removed	25.00	CY	310.44	7,761	6,985	-10%	8,537	10%	8,730	7,857	9,603
41	Iron Gate	4.183	Iron Gate Dam Removal	Long Gulch - Remove picnic tables (steel frames with planks)	2.00	EA	118.80	238	178	-25%	297	25%	267	200	334
41	Iron Gate	4.184	Iron Gate Dam Removal	Long Gulch - Regrade ramp area to natural contours, rip, rese	0.05	AC	29,701.07	1,485	1,114	-25%	1,856	25%	1,670	1,253	2,088
41	Iron Gate	4.185	Iron Gate Dam Removal	Concrete Lining Installation for Diversion Tunnel	1.00	LS	1,196,251.74	1,196,252	1,076,627	-10%	1,315,877	10%	1,345,621	1,211,058	1,480,183
41	Iron Gate	5.025	Iron Gate Dam Removal	Remove Distribution Poles near Iron Gate Hydro Plant	5.00	EA	1,190.24	5,951	5,059	-15%	7,141	20%	6,694	5,690	8,033
41	Iron Gate	5.026	Iron Gate Dam Removal	Remove 69kV/6.6kV Transformer @Substation	1.00	EA	2,273.46	2,273	1,932	-15%	2,842	25%	2,557	2,174	3,197
41	Iron Gate	5.027	Iron Gate Dam Removal	Remove 6.6kV Power Circuit Breaker @Substation	1.00	EA	1,524.31	1,524	1,296	-15%	1,905	25%	1,715	1,457	2,143
41	Iron Gate	5.028	Iron Gate Dam Removal	Remove Generator @Substation	1.00	EA	4,767.78	4,768	4,053	-15%	5,960	25%	5,363	4,559	6,704
41	Iron Gate	5.029	Iron Gate Dam Removal	Remove all auxiliary equipment @Substation (Allowance)	1.00	LS	26,865.48	26,865	22,836	-15%	33,582	25%	30,220	25,687	37,775
41	Iron Gate	5.030	Iron Gate Dam Removal	New Connection @Iron Gate Hatchery from PacifiCorp's Horn	1.00	LS	298,809.00	298,809	268,928	-10%	328,690	10%	336,119	302,508	369,731
42			**RESTORATION EARTHWORKS & HABITAT**												
42	Copco 1 & 2		Tributary Connectivity	Removal of sediment and similar obstructions to ensure volitio	7.00	EA	119,000.00	833,000	749,700	-10%	1,124,550	35%	955,752	860,177	1,290,265
42	Copco 1 & 2		Wetlands, Floodplain and Off-channel Habitat Features Site 1	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Copco 1 & 2		Wetlands, Floodplain and Off-channel Habitat Features Site 1	Grading and shaping of floodplain sediments (no export)	81,367	CY	8.00	650,936	585,842	-10%	878,764	35%	732,214	658,993	988,490
42	Copco 1 & 2		Wetlands, Floodplain and Off-channel Habitat Features Site 1	Floodplain roughness for 50% of area	5.60	AC	30,000.00	168,000	151,200	-10%	226,800	35%	188,977	170,079	255,119
42	Copco 1 & 2		Site 2 (25.5 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Copco 1 & 2		Site 2 (25.5 acres)	Grading and shaping of floodplain sediments (no export)	164,252	CY	8.00	1,314,016	1,182,614	-10%	1,773,922	35%	1,478,089	1,330,280	1,995,421
42	Copco 1 & 2		Site 2 (25.5 acres)	Floodplain roughness for 50% of area	12.75	AC	30,000.00	382,500	344,250	-10%	516,375	35%	430,260	387,234	580,852
42	Copco 1 & 2		Site 3 (13.9 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Copco 1 & 2		Site 3 (13.9 acres)	Grading and shaping of floodplain sediments (no export)	78,556	CY	8.00	628,448	565,603	-10%	848,405	35%	706,919	636,227	954,340
42	Copco 1 & 2		Site 3 (13.9 acres)	Floodplain roughness for 50% of area	6.95	AC	30,000.00	208,500	187,650	-10%	281,475	35%	234,534	211,081	316,621
42	Copco 1 & 2		Site 4 (10.5 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Copco 1 & 2		Site 4 (10.5 acres)	Grading and shaping of floodplain sediments (no export)	50,600	CY	8.00	404,800	364,320	-10%	546,480	35%	455,345	409,810	614,716
42	Copco 1 & 2		Site 4 (10.5 acres)	Floodplain roughness for 50% of area	5.25	AC	30,000.00	157,500	141,750	-10%	212,625	35%	177,166	159,449	239,174
42	Copco 1 & 2		Site 5 (4.2 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Copco 1 & 2		Site 5 (4.2 acres)	Grading and shaping of floodplain sediments (no export)	20,267	CY	8.00	162,136	145,922	-10%	218,884	35%	182,381	164,143	246,214
42	Copco 1 & 2		Site 5 (4.2 acres)	Floodplain roughness for 50% of area	2.10	AC	30,000.00	63,000	56,700	-10%	85,050	35%	70,866	63,780	95,670
42	Copco 1 & 2		Site 6 (5.3 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Copco 1 & 2		Site 6 (5.3 acres)	Grading and shaping of floodplain sediments (no export)	17,148	CY	8.00	137,184	123,466	-10%	185,198	35%	154,313	138,882	208,323
42	Copco 1 & 2		Site 6 (5.3 acres)	Floodplain roughness for 50% of area	2.65	AC	30,000.00	79,500	71,550	-10%	107,325	35%	89,427	80,484	120,726
42	Copco 1 & 2		Site 6 (5.3 acres)	Bank Stability and Channel Fringe ComplexityDevelop process	2,500	LF	253.00	632,500	569,250	-10%	853,875	35%	725,706	653,135	979,703
42	Copco 1 & 2		Large Wood Habitat Features	Ground-Based Placement	20.00	EA	27,990.00	559,800	503,820	-10%	755,730	35%	642,293	578,064	867,095
42	Copco 1 & 2		Large Wood Habitat Features	Helicopter Placement (@ 50 members staged and placed per	8.00	EA	57,000.00	456,000	410,400	-10%	615,600	35%	523,197	470,877	706,316
42	Copco 1 & 2		General Conditions	Contractor overhead	15%	%	7,287,820.00	1,093,173	983,856	-10%	1,475,784	35%	1,234,142	1,110,728	1,666,092
42	Copco 1 & 2		General Conditions	Insurance	1%	%	8,380,993.00	83,810	75,429	-10%	113,143	35%	94,618	85,156	127,734
42	Copco 1 & 2		General Conditions	Bond	1%	%	8,380,993.00	83,810	75,429	-10%	113,143	35%	94,618	85,156	127,734
42	Iron Gate		Tributary Connectivity	Removal of sediment and similar obstructions to ensure volitio	5.00	EA	119,000.00	595,000	535,500	-10%	803,250	35%	682,680	614,412	921,618
42	Iron Gate		Site 1 (14.2 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Iron Gate		Site 1 (14.2 acres)	Grading and shaping of floodplain sediments (no export)	60,000	CY	8.00	480,000	432,000	-10%	648,000	35%	539,935	485,941	728,912
42	Iron Gate		Site 1 (14.2 acres)	Floodplain roughness for 50% of area	7.10	AC	30,000.00	213,000	191,700	-10%	287,550	35%	239,596	215,636	323,455
42	Iron Gate		Site 2 (5.8 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Iron Gate		Site 2 (5.8 acres)	Grading and shaping of floodplain sediments (no export)	19,000	CY	8.00	152,000	136,800	-10%	205,200	35%	170,979	153,881	230,822
42	Iron Gate		Site 2 (5.8 acres)	Floodplain roughness for 50% of area	2.90	AC	30,000.00	87,000	78,300	-10%	117,450	35%	97,863	88,077	132,115

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
42	Iron Gate		Site 3 (23.1 acres)	Equipment & road access into site	2,000	LF	25.00	50,000	45,000	-10%	67,500	35%	56,243	50,619	75,928
42	Iron Gate		Site 3 (23.1 acres)	Grading and shaping of floodplain sediments (no export)	95,000	CY	8.00	760,000	684,000	-10%	1,026,000	35%	854,897	769,407	1,154,110
42	Iron Gate		Site 3 (23.1 acres)	Floodplain roughness for 75% of area	17.30	AC	30,000.00	519,000	467,100	-10%	700,650	35%	583,804	525,424	788,136
42	Iron Gate		Bank Stability and Channel Fringe Complexity	Develop process-based restoration and velocity variations alor	1,000	LF	253.00	253,000	227,700	-10%	341,550	35%	290,282	261,254	391,881
42	Iron Gate		Large Wood Habitat Features	Ground-Based Placement	20.00	EA	27,990.00	559,800	503,820	-10%	755,730	35%	642,293	578,064	867,095
42	Iron Gate		Large Wood Habitat Features	Helicopter Placement (@ 50 members staged and placed per	4.00	EA	57,000.00	228,000	205,200	-10%	307,800	35%	261,598	235,439	353,158
42	Iron Gate		General Conditions	Contractor overhead	15%	%	4,046,800.00	607,020	546,318	-10%	819,477	35%	687,017	618,315	927,473
42	Iron Gate		General Conditions	Contractor profit (included in rates & prices)	0%	%	4,046,800.00	-	-	0%	-	0%	-	-	-
42	Iron Gate		General Conditions	Insurance	1%	%	4,653,820.00	46,538	41,884	-10%	62,827	35%	52,671	47,404	71,106
42	Iron Gate		General Conditions	Bond	1%	%	4,653,820.00	46,538	41,884	-10%	62,827	35%	52,671	47,404	71,106
42	JC Boyle		Tributary Connectivity	Removal of sediment and similar obstructions to ensure volitio	2.00	EA	119,000.00	238,000	214,200	-10%	321,300	35%	273,072	245,765	368,647
42	JC Boyle		Site 1 (3.3 acres)	Equipment & road access into site	500	LF	25.00	12,500	11,250	-10%	16,875	35%	14,061	12,655	18,982
42	JC Boyle		Site 1 (3.3 acres)	Grading and shaping of floodplain sediments (no export)	37,000	CY	8.00	296,000	266,400	-10%	399,600	35%	332,960	299,664	449,496
42	JC Boyle		Site 1 (3.3 acres)	Floodplain roughness for 50% of area	1.65	AC	30,000.00	49,500	44,550	-10%	66,825	35%	55,681	50,113	75,169
42	JC Boyle		Site 2 (43.8 acres)	Equipment & road access into site	500	LF	25.00	12,500	11,250	-10%	16,875	35%	14,061	12,655	18,982
42	JC Boyle		Site 2 (43.8 acres)	Grading and shaping of floodplain sediments (no export)	35,000	CY	8.00	280,000	252,000	-10%	378,000	35%	314,962	283,466	425,199
42	JC Boyle		Site 2 (43.8 acres)	Floodplain roughness for 50% of area	21.90	AC	30,000.00	657,000	591,300	-10%	886,950	35%	739,036	665,132	997,698
42	JC Boyle		Site 3 (65.8 acres)	Equipment & road access into site	500	LF	25.00	12,500	11,250	-10%	16,875	35%	14,061	12,655	18,982
42	JC Boyle		Site 3 (65.8 acres)	Grading and shaping of floodplain sediments (no export)	53,000	CY	8.00	424,000	381,600	-10%	572,400	35%	476,942	429,248	643,872
42	JC Boyle		Site 3 (65.8 acres)	Floodplain roughness for 30% of area	20.00	AC	30,000.00	600,000	540,000	-10%	810,000	35%	674,918	607,427	911,140
42	JC Boyle		Site 4 (21.3 acres)	Equipment & road access into site	500	LF	25.00	12,500	11,250	-10%	16,875	35%	14,061	12,655	18,982
42	JC Boyle		Site 4 (21.3 acres)	Grading and shaping of floodplain sediments (no export)	17,000	CY	8.00	136,000	122,400	-10%	183,600	35%	152,982	137,683	206,525
42	JC Boyle		Site 4 (21.3 acres)	Floodplain roughness for 50% of area	10.65	AC	30,000.00	319,500	287,550	-10%	431,325	35%	359,394	323,455	485,182
42	JC Boyle		Bank Stability and Channel Fringe Complexity	Develop process-based restoration and velocity variations alor	2,000	LF	253.00	506,000	455,400	-10%	683,100	35%	580,565	522,508	783,762
42	JC Boyle		Large Wood Habitat Features	Ground-Based Placement	30.00	EA	27,990.00	839,700	755,730	-10%	1,133,595	35%	963,439	867,095	1,300,643
42	JC Boyle		Large Wood Habitat Features	Helicopter Placement (50 members staged and placed per site	2.00	EA	57,000.00	114,000	102,600	-10%	153,900	35%	130,799	117,719	176,579
42	JC Boyle		General Conditions	Contractor overhead	15%	%	4,509,700.00	676,455	608,810	-10%	913,214	35%	764,724	688,252	1,032,378
42	JC Boyle		General Conditions	Contractor profit (included in rates & prices)	0%	%	4,509,700.00	-	-	0%	-	0%	-	-	-
42	JC Boyle		General Conditions	Insurance	1%	%	5,186,155.00	51,862	46,675	-10%	70,013	35%	58,629	52,766	79,149
42	JC Boyle		General Conditions	Bond	1%	%	5,186,155.00	51,862	46,675	-10%	70,013	35%	58,629	52,766	79,149
43			**RESTORATION OF VEGETATION**												
43	JC Boyle		Restoration of Vegetation	On-Site Pilot Growing Experiment	0.18	%	636,843.00	114,632	100,667	-12%	132,873	16%	115,847	101,734	134,282
43	JC Boyle		Restoration of Vegetation	Seed Collection	0.18	%	1,167,800.00	210,204	159,426	-24%	261,486	24%	221,213	167,775	275,181
43	JC Boyle		Restoration of Vegetation	Seed Propagation	0.18	%	2,803,989.00	504,718	189,718	-62%	648,718	29%	555,301	208,732	713,733
43	JC Boyle		Restoration of Vegetation	Weed Eradication	0.18	%	3,049,095.15	548,837	433,359	-21%	664,315	21%	606,617	478,982	734,252
43	JC Boyle		Restoration of Vegetation	Pioneer Seeding	0.18	%	2,150,000.00	387,000	252,000	-35%	594,000	53%	435,322	283,466	668,169
43	JC Boyle		Restoration of Vegetation	Container Plant Growing	0.18	%	1,057,742.00	190,394	69,627	-63%	311,160	63%	217,088	79,389	354,787
43	JC Boyle		Restoration of Vegetation	Establ. Prd. Maint. & Monitor'g	0.18	%	8,043,339.82	1,447,801	776,357	-46%	2,198,979	52%	1,761,471	944,557	2,675,394
43	JC Boyle		Restoration of Vegetation	Long-Term Maint. & Monitor'g	0.18	%	8,189,100.00	1,474,038	668,469	-55%	2,493,180	69%	1,923,473	872,286	3,253,352
43	JC Boyle		Restoration of Vegetation	Emergent Wetland	0.85	AC	35,203.00	29,775	20,555	-31%	41,297	39%	34,260	23,651	47,519
43	JC Boyle		Restoration of Vegetation	Bank Wetland	4.21	AC	21,453.20	90,220	54,232	-40%	116,796	29%	103,198	62,034	133,597
43	JC Boyle		Restoration of Vegetation	Bank Riparian	32.92	AC	30,175.20	993,384	643,821	-35%	1,362,911	37%	1,144,047	741,466	1,569,618
43	JC Boyle		Restoration of Vegetation	Floodplain Riparian	55.08	AC	13,817.40	761,037	507,182	-33%	1,043,992	37%	876,122	583,879	1,201,866
43	JC Boyle		Restoration of Vegetation	Uplands below RW	24.20	AC	9,714.00	235,062	175,776	-25%	318,207	35%	273,032	204,169	369,607
43	JC Boyle		Restoration of Vegetation	Rocky Wake Zone	16.37	AC	9,719.00	159,096	118,909	-25%	221,113	39%	184,792	138,114	256,825
43	JC Boyle		Restoration of Vegetation	Disturbed Uplands above RWZ	42.29	AC	9,502.00	401,819	302,294	-25%	559,998	39%	466,536	350,982	650,192
43	JC Boyle		Restoration of Vegetation	Uplands Stockpiles	6.73	AC	8,856.67	59,595	44,882	-25%	83,046	39%	64,832	48,826	90,344
43	JC Boyle		Restoration of Vegetation	Undisturbed Uplands	10.07	AC	4,850.00	48,829	37,251	-24%	59,904	23%	56,385	43,015	69,173
43	JC Boyle		Restoration of Vegetation	Contractor overhead	1.00	LS	1,391,623.54	1,391,624	879,961	-37%	2,005,720	44%	1,643,136	1,030,506	2,379,157
43	Iron Gate		Restoration of Vegetation	On-Site Pilot Growing Experiment	0.42	%	636,843.00	267,601	235,001	-12%	310,185	16%	270,438	237,492	313,474
43	Iron Gate		Restoration of Vegetation	Seed Collection	0.42	%	1,167,800.00	490,710	372,171	-24%	610,425	24%	516,409	391,662	642,394
43	Iron Gate		Restoration of Vegetation	Seed Propagation	0.42	%	2,803,989.00	1,178,236	442,886	-62%	1,514,396	29%	1,296,320	487,273	1,666,170
43	Iron Gate		Restoration of Vegetation	Weed Eradication	0.42	%	3,049,095.15	1,281,230	1,011,653	-21%	1,550,806	21%	1,416,113	1,118,156	1,714,070
43	Iron Gate		Restoration of Vegetation	Pioneer Seeding	0.42	%	2,150,000.00	903,430	588,280	-35%	1,386,660	53%	1,016,236	661,735	1,559,804
43	Iron Gate		Restoration of Vegetation	Container Plant Growing	0.42	%	1,057,742.00	444,463	162,540	-63%	726,386	63%	506,780	185,329	828,231
43	Iron Gate		Restoration of Vegetation	Establ. Prd. Maint. & Monitor'g	0.42	%	8,043,339.82	3,379,811	1,812,363	-46%	5,133,395	52%	4,112,057	2,205,016	6,245,560
43	Iron Gate		Restoration of Vegetation	Long-Term Maint. & Monitor'g	0.42	%	8,189,100.00	3,441,060	1,560,504	-55%	5,820,190	69%	4,490,241	2,036,303	7,594,770
43	Iron Gate		Restoration of Vegetation	Emergent Wetland	1.78	AC	35,203.00	62,658	43,255	-31%	86,907	39%	72,099	49,772	100,000
43	Iron Gate		Restoration of Vegetation	Bank Wetland	7.59	AC	21,453.20	162,728	97,818	-40%	210,662	29%	186,135	111,888	240,965
43	Iron Gate		Restoration of Vegetation	Bank Riparian	23.87	AC	30,175.20	720,169	466,748	-35%	988,064	37%	829,395	537,538	1,137,919
43	Iron Gate		Restoration of Vegetation	Floodplain Riparian	34.82	AC	13,817.40	481,147	320,653	-33%	660,039	37%	553,907	369,143	759,851
43	Iron Gate		Restoration of Vegetation	Uplands below RW	333	AC	9,714.00	3,230,647	2,415,835	-25%	4,373,379	35%	3,752,497	2,806,068	5,079,817
43	Iron Gate		Restoration of Vegetation	Rocky Wake Zone	11.20	AC	9,719.00	108,851	81,355	-25%	151,281	39%	126,431	94,495	175,715
43	Iron Gate		Restoration of Vegetation	Disturbed Uplands above RWZ	70.53	AC	9,502.00	670,217	504,215	-25%	934,054	39%	778,163	585,424	1,084,494
43	Iron Gate		Restoration of Vegetation	Uplands Stockpiles	38.76	AC	8,856.67	343,285	258,534	-25%	478,368	39%	373,450	281,252	520,404

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
43	Iron Gate		Restoration of Vegetation	Undisturbed Uplands	20.99	AC	4,850.00	101,810	77,669	-24%	124,901	23%	117,563	89,688	144,227
43	Iron Gate		Restoration of Vegetation	Contractor overhead	1.00	LS	3,094,512.21	3,094,512	2,008,187	-35%	4,458,145	44%	3,660,630	2,354,359	5,298,930
43	Copco 1		Restoration of Vegetation	On-Site Pilot Growing Experiment	0.40	%	636,843.00	253,909	222,977	-12%	294,314	16%	256,601	225,340	297,434
43	Copco 1		Restoration of Vegetation	Seed Collection	0.40	%	1,167,800.00	465,602	353,129	-24%	579,191	24%	489,986	371,623	609,525
43	Copco 1		Restoration of Vegetation	Seed Propagation	0.40	%	2,803,989.00	1,117,950	420,225	-62%	1,436,910	29%	1,229,992	462,341	1,580,919
43	Copco 1		Restoration of Vegetation	Weed Eradication	0.40	%	3,049,095.15	1,215,674	959,891	-21%	1,471,458	21%	1,343,656	1,060,945	1,626,368
43	Copco 1		Restoration of Vegetation	Pioneer Seeding	0.40	%	2,150,000.00	857,205	558,180	-35%	1,315,710	53%	964,239	627,877	1,479,995
43	Copco 1		Restoration of Vegetation	Container Plant Growing	0.40	%	1,057,742.00	421,722	154,224	-63%	689,220	63%	480,850	175,847	785,853
43	Copco 1		Restoration of Vegetation	Establ. Prd. Maint. & Monitor'g	0.40	%	8,043,339.82	3,206,880	1,719,631	-46%	4,870,739	52%	3,901,659	2,092,194	5,925,999
43	Copco 1		Restoration of Vegetation	Long-Term Maint. & Monitor'g	0.40	%	8,189,100.00	3,264,994	1,480,659	-55%	5,522,394	69%	4,260,493	1,932,113	7,206,175
43	Copco 1		Restoration of Vegetation	Emergent Wetland	1.79	AC	35,203.00	63,017	43,503	-31%	87,405	39%	72,512	50,058	100,574
43	Copco 1		Restoration of Vegetation	Bank Wetland	7.65	AC	21,453.20	164,188	98,696	-40%	212,553	29%	187,806	112,893	243,127
43	Copco 1		Restoration of Vegetation	Bank Riparian	48.01	AC	30,175.20	1,448,583	938,839	-35%	1,987,438	37%	1,668,284	1,081,229	2,288,865
43	Copco 1		Restoration of Vegetation	Floodplain Riparian	58.23	AC	13,817.40	804,552	536,182	-33%	1,103,686	37%	926,218	617,264	1,270,588
43	Copco 1		Restoration of Vegetation	Uplands below RW	306	AC	9,714.00	2,968,059	2,219,475	-25%	4,017,909	35%	3,447,493	2,577,989	4,666,927
43	Copco 1		Restoration of Vegetation	Rocky Wake Zone	15.06	AC	9,719.00	146,354	109,386	-25%	203,405	39%	169,993	127,053	236,257
43	Copco 1		Restoration of Vegetation	Disturbed Uplands above RWZ	8.02	AC	9,502.00	76,226	57,346	-25%	106,233	39%	88,503	66,582	123,343
43	Copco 1		Restoration of Vegetation	Uplands Stockpiles	3.37	AC	8,856.67	29,844	22,476	-25%	41,587	39%	32,466	24,451	45,242
43	Copco 1		Restoration of Vegetation	Undisturbed Uplands	13.39	AC	4,850.00	64,957	49,554	-24%	79,689	23%	75,008	57,222	92,020
43	Copco 1		Restoration of Vegetation	Contractor overhead	1.00	LS	2,983,330.50	2,983,330	1,912,476	-36%	4,291,645	44%	3,530,879	2,244,456	5,103,293
43	Copco 2		Restoration of Vegetation	On-Site Pilot Growing Experiment	0.00	%	636,843.00	701	615	-12%	812	16%	708	622	821
43	Copco 2		Restoration of Vegetation	Seed Collection	0.00	%	1,167,800.00	1,285	974	-24%	1,598	24%	1,352	1,025	1,682
43	Copco 2		Restoration of Vegetation	Seed Propagation	0.00	%	2,803,989.00	3,084	1,159	-62%	3,964	29%	3,394	1,276	4,362
43	Copco 2		Restoration of Vegetation	Weed Eradication	0.00	%	3,049,095.15	3,354	2,648	-21%	4,060	21%	3,707	2,927	4,487
43	Copco 2		Restoration of Vegetation	Pioneer Seeding	0.00	%	2,150,000.00	2,365	1,540	-35%	3,630	53%	2,660	1,732	4,083
43	Copco 2		Restoration of Vegetation	Container Plant Growing	0.00	%	1,057,742.00	1,164	426	-63%	1,902	63%	1,327	485	2,168
43	Copco 2		Restoration of Vegetation	Establ. Prd. Maint. & Monitor'g	0.00	%	8,043,339.82	8,848	4,744	-46%	13,438	52%	10,765	5,772	16,350
43	Copco 2		Restoration of Vegetation	Long-Term Maint. & Monitor'g	0.00	%	8,189,100.00	9,008	4,085	-55%	15,236	69%	11,755	5,331	19,882
43	Copco 2		Restoration of Vegetation	Floodplain Riparian	0.81	AC	13,817.40	11,157	7,435	-33%	15,305	37%	12,844	8,560	17,619
43	Copco 2		Restoration of Vegetation	Disturbed Uplands above RWZ	1.19	AC	9,502.00	11,280	8,486	-25%	15,721	39%	13,097	9,853	18,253
43	Copco 2		Restoration of Vegetation	Contractor overhead	1.00	LS	9,894.21	9,894	6,468	-35%	14,234	44%	11,663	7,569	16,845
44			**YREKA WATER LINE REPLACEMENT**												
44	Project	6.001	Yreka Water Line Replacement	Microtunneling	612	LH	1,558.34	953,701	810,646	-20%	1,239,812	40%	1,052,154	894,331	1,367,800
44	Project	6.002	Yreka Water Line Replacement	Pile and Lagging Pre Drilling	458	LF	150.68	69,010	58,658	-20%	89,712	40%	76,134	64,714	98,974
44	Project	6.003	Yreka Water Line Replacement	Pile and Lagging Wall InstallatioN	13,715	SF	73.01	1,001,297	851,102	-20%	1,301,686	40%	1,104,663	938,963	1,436,062
44	Project	6.004	Yreka Water Line Replacement	Pipe Installation	2,106	LF	133.76	281,698	239,443	-20%	366,207	40%	310,778	264,161	404,012
44	Project	6.005	Yreka Water Line Replacement	Excavation and Backfill	3,653	CY	88.45	323,097	274,632	-20%	420,026	40%	356,451	302,983	463,386
45			**TRANSPORTATION (BRIDGES, CULVERTS, ROADS)**												
45	Project		Lakeview Bridge	Sheet Pile Coffer Dam For Center Footer	2,400	SF	38.40	92,161	73,729	-20%	119,809	30%	100,878	80,702	131,141
45	Project		Lakeview Bridge	Backfill, structural, common earth, 105 H.P. dozer, 50' haul, fr	89.00	CY	39.77	3,540	2,832	-20%	4,602	30%	3,875	3,100	5,037
45	Project		Lakeview Bridge	Earth Work Coffer Dam Construction for side footers	1,186	CY	15.26	18,097	14,478	-20%	23,526	30%	19,809	15,847	25,752
45	Project		Lakeview Bridge	Structure Excavation (Rock) Drilling and blasting rock, boulder	107	CY	186.20	19,924	15,939	-20%	25,901	30%	21,808	17,447	28,351
45	Project		Lakeview Bridge	Structure Excavation (Type D)	1,122	CY	20.27	22,741	18,193	-20%	29,563	30%	24,892	19,913	32,359
45	Project		Lakeview Bridge	Structure Excavation (Bridge)	159	CY	58.08	9,234	7,387	-20%	12,004	30%	10,107	8,086	13,140
45	Project		Lakeview Bridge	Prestressed concrete piles, square, 40' long, 24" square, price	480	LF	165.17	79,283	63,426	-20%	103,068	30%	86,781	69,425	112,816
45	Project		Lakeview Bridge	18" Diameter 40' Long Tie Down Anchor Installation	480	LF	101.95	48,937	39,149	-20%	63,618	30%	53,565	42,852	69,634
45	Project		Lakeview Bridge	Piling special costs, pre-augering for Pile and Tie Down Ancho	960	LF	311.56	299,101	239,281	-20%	388,831	30%	327,390	261,912	425,606
45	Project		Lakeview Bridge	Mobilization, 150 ton, set up and remove crane, with pile leads	2.00	EA	22,228.11	44,456	35,565	-20%	57,793	30%	48,661	38,929	63,259
45	Project		Lakeview Bridge	A736 Barrier Wall	536	LF	388.00	207,966	166,373	-20%	270,356	30%	227,635	182,108	295,926
45	Project		Lakeview Bridge	Expansion joint, neoprene, liquid, 1" x 2", cold applied	46.00	LF	44.09	2,028	1,623	-20%	2,637	30%	2,220	1,776	2,886
45	Project		Lakeview Bridge	Columns Structural Concrete includes forms, Grade 60 rebar,	172	CY	1,953.07	335,929	268,743	-20%	436,707	30%	367,701	294,161	478,011
45	Project		Lakeview Bridge	Deck Structural concrete, in place, includes forms, Grade 60 re	168	CY	1,143.38	192,088	153,670	-20%	249,714	30%	210,255	168,204	273,332
45	Project		Lakeview Bridge	Footer Structural concrete,footing, reinforced, includes forms(4	448	CY	421.72	188,929	151,143	-20%	245,608	30%	206,798	165,438	268,837
45	Project		Lakeview Bridge	Approach Slab Structural concrete, in place, 6" thick, includes	17.00	CY	293.49	4,989	3,992	-20%	6,486	30%	5,461	4,369	7,100
45	Project		Lakeview Bridge	Precast 36" I-Girder 65'	8.00	EA	29,970.09	239,761	191,809	-20%	311,689	30%	262,437	209,950	341,168
45	Project		Lakeview Bridge	Precast 36" I-Girder 48'	8.00	EA	35,810.59	286,485	229,188	-20%	372,430	30%	313,580	250,864	407,654
45	Project		Lakeview Bridge	Bridge Demolition	3,917	SF	60.00	235,020	188,016	-20%	305,526	30%	257,248	205,798	334,422
45	Project		Lakeview Bridge - Paving	Roadway Excavation	510	CY	40.00	20,400	16,320	-20%	25,500	25%	22,329	17,864	27,912
45	Project		Lakeview Bridge - Paving	Imported Borrow	2,510	CY	45.00	112,950	90,360	-20%	141,188	25%	123,633	98,906	154,541
45	Project		Lakeview Bridge - Paving	Hot Mix Asphalt (Type A)	450	T	130.00	58,500	46,800	-20%	73,125	25%	64,033	51,226	80,041
45	Project		Lakeview Bridge - Paving	Class 2 Aggregate Base	330	CY	65.00	21,450	17,160	-20%	26,813	25%	23,479	18,783	29,348
45	Project		Lakeview Bridge - Paving	Midwest Guardrail System	200	LF	40.61	8,122	6,498	-20%	10,153	25%	8,890	7,112	11,113
45	Project		Lakeview Bridge - Paving	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
45	Project		Lakeview Bridge - Paving	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Lakeview Bridge - Paving	Temporary Reinforced Silt Fence	600	LF	7.58	4,548	3,638	-20%	5,685	25%	4,978	3,983	6,223
45	Project		Lakeview Bridge - Paving	Temporary Fence (Type ESA)	300	LF	5.03	1,509	1,207	-20%	1,886	25%	1,652	1,321	2,065
45	Project		Lakeview Bridge - Paving	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Lakeview Bridge - Paving	Water Pollution Control	0.10	%	213,300.00	21,330	17,064	-20%	26,663	25%	23,347	18,678	29,184
45	Project		Lakeview Bridge - Paving	Roadside Sign - One Post	2.00	EA	270.00	540	432	-20%	675	25%	591	473	739
45	Project		Lakeview Bridge - Paving	Reset Roadside Sign	4.00	EA	300.00	1,200	960	-20%	1,500	25%	1,313	1,051	1,642
45	Project		Lakeview Bridge - Paving	Relocate Roadside Sign	2.00	EA	100.00	200	160	-20%	250	25%	219	175	274
45	Project		Lakeview Bridge - Paving	Thermoplastic Traffic Stripe	660	LF	0.86	568	454	-20%	710	25%	621	497	777
45	Project		Lakeview Bridge - Paving	Type III Barricade	4.00	EA	274.29	1,097	878	-20%	1,371	25%	1,201	961	1,501
45	Project		Lakeview Bridge - Paving	Traffic Control System	20.00	DA	1,000.00	20,000	16,000	-20%	25,000	25%	21,892	17,513	27,364
45	Project		Lakeview Bridge - Paving	Temporary Railing (Type K)	300	LF	47.00	14,100	11,280	-20%	17,625	25%	15,434	12,347	19,292
45	Project		Fall Creek Bridge	Structure Excavation (Bridge)	499	CY	58.08	28,980	23,184	-20%	37,674	30%	31,721	25,377	41,237
45	Project		Fall Creek Bridge	A736 Barrier Wall	100	LF	388.00	38,800	31,040	-20%	50,440	30%	42,469	33,975	55,210
45	Project		Fall Creek Bridge	Columns/Walls Structural Concrete includes forms, Grade 60 r	111	CY	1,953.07	216,791	173,433	-20%	281,829	30%	237,295	189,836	308,484
45	Project		Fall Creek Bridge	Deck Structural concrete, in place, includes forms, Grade 60 r	31.00	CY	1,143.38	35,445	28,356	-20%	46,078	30%	38,797	31,038	50,436
45	Project		Fall Creek Bridge	Footer Structural concrete,footing, reinforced, includes forms(4	86.00	CY	421.72	36,268	29,014	-20%	47,148	30%	39,698	31,758	51,607
45	Project		Fall Creek Bridge	Approach Slab Structural concrete, in place, 6" thick, includes	22.00	CY	293.49	6,457	5,166	-20%	8,394	30%	7,068	5,654	9,188
45	Project		Fall Creek Bridge	Bridge Demolition	720	SF	60.00	43,200	34,560	-20%	56,160	30%	47,286	37,829	61,472
45	Project		Fall Creek Bridge - Paving	Roadway Excavation	720	CY	40.00	28,800	23,040	-20%	36,000	25%	31,524	25,219	39,405
45	Project		Fall Creek Bridge - Paving	Imported Borrow	2,380	CY	45.00	107,100	85,680	-20%	133,875	25%	117,229	93,784	146,537
45	Project		Fall Creek Bridge - Paving	Hot Mix Asphalt (Type A)	230	T	130.00	29,900	23,920	-20%	37,375	25%	32,728	26,182	40,910
45	Project		Fall Creek Bridge - Paving	Class 2 Aggregate Base	170	CY	65.00	11,050	8,840	-20%	13,813	25%	12,095	9,676	15,119
45	Project		Fall Creek Bridge - Paving	Midwest Guardrail System	100	LF	40.61	4,061	3,249	-20%	5,076	25%	4,445	3,556	5,556
45	Project		Fall Creek Bridge - Paving	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892
45	Project		Fall Creek Bridge - Paving	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Fall Creek Bridge - Paving	Relocate Gate	1.00	EA	100.00	100	80	-20%	125	25%	109	88	137
45	Project		Fall Creek Bridge - Paving	Temporary Reinforced Silt Fence	400	LF	7.58	3,032	2,426	-20%	3,790	25%	3,319	2,655	4,148
45	Project		Fall Creek Bridge - Paving	Temporary Fence (Type ESA)	400	LF	5.03	2,012	1,610	-20%	2,515	25%	2,202	1,762	2,753
45	Project		Fall Creek Bridge - Paving	Temporary Hydroseed	280	SY	9.22	2,582	2,065	-20%	3,227	25%	2,826	2,261	3,532
45	Project		Fall Creek Bridge - Paving	Rolled Erosion Control / Jute Mesh	280	SY	16.62	4,654	3,723	-20%	5,817	25%	5,094	4,075	6,367
45	Project		Fall Creek Bridge - Paving	Temporary Fiber Roll	375	LF	8.10	3,038	2,430	-20%	3,797	25%	3,325	2,660	4,156
45	Project		Fall Creek Bridge - Paving	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Fall Creek Bridge - Paving	Water Pollution Control	0.10	%	176,850.00	17,685	14,148	-20%	22,106	25%	19,358	15,486	24,197
45	Project		Fall Creek Bridge - Paving	Temporary Traffic Stripe	500	LF	1.20	600	480	-20%	750	25%	657	525	821
45	Project		Fall Creek Bridge - Paving	Thermoplastic Traffic Stripe	275	LF	0.86	237	189	-20%	296	25%	259	207	324
45	Project		Fall Creek Bridge - Paving	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Fall Creek Bridge - Paving	Traffic Control System	50.00	DA	1,000.00	50,000	40,000	-20%	62,500	25%	54,729	43,783	68,411
45	Project		Fall Creek Bridge - Paving	Temporary Railing (Type K)	200	LF	47.00	9,400	7,520	-20%	11,750	25%	10,289	8,231	12,861
45	Project		Daggett Road Bridge	Sheet Pile Coffer Dam For Footers	7,200	SF	38.40	276,483	221,186	-20%	359,428	30%	302,633	242,106	393,422
45	Project		Daggett Road Bridge	Backfill, structural, common earth, 105 H.P. dozer, 50' haul, fr	91.00	CY	39.77	3,619	2,896	-20%	4,705	30%	3,962	3,169	5,150
45	Project		Daggett Road Bridge	Structure Excavation (Rock) Drilling and blasting rock, boulder	107	CY	186.20	19,924	15,939	-20%	25,901	30%	21,808	17,447	28,351
45	Project		Daggett Road Bridge	Structure Excavation (Type D)	1,535	CY	20.27	31,112	24,889	-20%	40,445	30%	34,054	27,243	44,271
45	Project		Daggett Road Bridge	Structure Excavation (Bridge)	171	CY	58.08	9,931	7,945	-20%	12,910	30%	10,870	8,696	14,131
45	Project		Daggett Road Bridge	Prestressed concrete piles, square, 40' long, 24" square, price	480	LF	165.17	79,283	63,426	-20%	103,068	30%	86,781	69,425	112,816
45	Project		Daggett Road Bridge	18" Diameter 40' Long Tie Down Anchor Installation	480	LF	101.95	48,937	39,149	-20%	63,618	30%	53,565	42,852	69,634
45	Project		Daggett Road Bridge	Piling special costs, pre-augering for Pile and Tie Down Ancho	960	LF	311.56	299,101	239,281	-20%	388,831	30%	327,390	261,912	425,606
45	Project		Daggett Road Bridge	Mobilization, 150 ton, set up and remove crane, with pile leads	2.00	EA	22,228.11	44,456	35,565	-20%	57,793	30%	48,661	38,929	63,259
45	Project		Daggett Road Bridge	A736 Barrier Wall	530	LF	388.00	205,638	164,510	-20%	267,330	30%	225,087	180,070	292,613
45	Project		Daggett Road Bridge	Expansion joint, neoprene, liquid, 1" x 2", cold applied	46.00	LF	44.09	2,028	1,623	-20%	2,637	30%	2,220	1,776	2,886
45	Project		Daggett Road Bridge	Columns Structural Concrete includes forms, Grade 60 rebar,	157	CY	1,953.07	306,633	245,306	-20%	398,622	30%	335,634	268,507	436,324
45	Project		Daggett Road Bridge	Deck Structural concrete, in place, includes forms, Grade 60 r	167	CY	1,143.38	190,944	152,755	-20%	248,228	30%	209,004	167,203	271,705
45	Project		Daggett Road Bridge	Footer Structural concrete,footing, reinforced, includes forms(4	448	CY	421.72	188,929	151,143	-20%	245,608	30%	206,798	165,438	268,837
45	Project		Daggett Road Bridge	Approach Slab Structural concrete, in place, 6" thick, includes	17.00	CY	293.49	4,989	3,992	-20%	6,486	30%	5,461	4,369	7,100
45	Project		Daggett Road Bridge	Precast 36" I-Girder 65'	8.00	EA	29,970.09	239,761	191,809	-20%	311,689	30%	262,437	209,950	341,168
45	Project		Daggett Road Bridge	Precast 36" I-Girder 48'	8.00	EA	35,810.59	286,485	229,188	-20%	372,430	30%	313,580	250,864	407,654
45	Project		Daggett Road Bridge	Bridge Demolition	3,262	SF	60.00	195,720	156,576	-20%	254,436	30%	214,231	171,385	278,500
45	Project		Daggett Road Bridge - Paving	Roadway Excavation	1,500	CY	40.00	60,000	48,000	-20%	75,000	25%	65,675	52,540	82,093
45	Project		Daggett Road Bridge - Paving	Imported Borrow	5,500	CY	45.00	247,500	198,000	-20%	309,375	25%	270,908	216,727	338,635
45	Project		Daggett Road Bridge - Paving	Hot Mix Asphalt (Type A)	1,240	T	130.00	161,200	128,960	-20%	201,500	25%	176,446	141,157	220,558
45	Project		Daggett Road Bridge - Paving	Class 2 Aggregate Base	920	CY	65.00	59,800	47,840	-20%	74,750	25%	65,456	52,365	81,820
45	Project		Daggett Road Bridge - Paving	Remove Base and Surfacing	9,485	SF	6.00	56,910	45,528	-20%	71,138	25%	62,293	49,834	77,866
45	Project		Daggett Road Bridge - Paving	Midwest Guardrail System	200	LF	40.61	8,122	6,498	-20%	10,153	25%	8,890	7,112	11,113
45	Project		Daggett Road Bridge - Paving	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
45	Project		Daggett Road Bridge - Paving	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Daggett Road Bridge - Paving	Temporary Reinforced Silt Fence	1,000	LF	7.58	7,580	6,064	-20%	9,475	25%	8,297	6,638	10,371
45	Project		Daggett Road Bridge - Paving	Temporary Fence (Type ESA)	1,000	LF	5.03	5,030	4,024	-20%	6,288	25%	5,506	4,405	6,882
45	Project		Daggett Road Bridge - Paving	Temporary Hydroseed	1,200	SY	9.22	11,064	8,851	-20%	13,830	25%	12,110	9,688	15,138
45	Project		Daggett Road Bridge - Paving	Rolled Erosion Control / Jute Mesh	1,200	SY	16.62	19,944	15,955	-20%	24,930	25%	21,830	17,464	27,288
45	Project		Daggett Road Bridge - Paving	Temporary Fiber Roll	1,100	LF	8.10	8,910	7,128	-20%	11,138	25%	9,753	7,802	12,191
45	Project		Daggett Road Bridge - Paving	Temporary Construction Entrance	1.00	EA	4,303.25	4,303	3,443	-20%	5,379	25%	4,710	3,768	5,888
45	Project		Daggett Road Bridge - Paving	Water Pollution Control	0.10	%	585,410.00	58,541	46,833	-20%	73,176	25%	64,078	51,262	80,097
45	Project		Daggett Road Bridge - Paving	Roadside Sign - One Post	1.00	EA	270.00	270	216	-20%	338	25%	296	236	369
45	Project		Daggett Road Bridge - Paving	Remove Roadside Sign	2.00	EA	100.00	200	160	-20%	250	25%	219	175	274
45	Project		Daggett Road Bridge - Paving	Reset Roadside Sign	2.00	EA	300.00	600	480	-20%	750	25%	657	525	821
45	Project		Daggett Road Bridge - Paving	Thermoplastic Traffic Stripe	2,020	LF	0.86	1,737	1,390	-20%	2,172	25%	1,902	1,521	2,377
45	Project		Daggett Road Bridge - Paving	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Daggett Road Bridge - Paving	Traffic Control System	15.00	DA	1,000.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Daggett Road Bridge - Paving	Temporary Railing (Type K)	120	LF	47.00	5,640	4,512	-20%	7,050	25%	6,173	4,939	7,717
45	Project		Dry Creek Bridge	Temporary Bridge	1,015	SF	210.00	213,150	170,520	-20%	277,095	30%	233,310	186,648	303,302
45	Project		Dry Creek Bridge - Paving	Roadway Excavation	700	CY	40.00	28,000	22,400	-20%	35,000	25%	30,648	24,519	38,310
45	Project		Dry Creek Bridge - Paving	Imported Borrow	1,000	CY	45.00	45,000	36,000	-20%	56,250	25%	49,256	39,405	61,570
45	Project		Dry Creek Bridge - Paving	Hot Mix Asphalt (Type A)	600	T	130.00	78,000	62,400	-20%	97,500	25%	85,377	68,302	106,721
45	Project		Dry Creek Bridge - Paving	Class 2 Aggregate Base	380	CY	65.00	24,700	19,760	-20%	30,875	25%	27,036	21,629	33,795
45	Project		Dry Creek Bridge - Paving	Midwest Guardrail System	100	LF	40.61	4,061	3,249	-20%	5,076	25%	4,445	3,556	5,556
45	Project		Dry Creek Bridge - Paving	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892
45	Project		Dry Creek Bridge - Paving	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Dry Creek Bridge - Paving	Temporary Reinforced Silt Fence	400	LF	7.58	3,032	2,426	-20%	3,790	25%	3,319	2,655	4,148
45	Project		Dry Creek Bridge - Paving	Temporary Fence (Type ESA)	400	LF	5.03	2,012	1,610	-20%	2,515	25%	2,202	1,762	2,753
45	Project		Dry Creek Bridge - Paving	Temporary Hydroseed	550	SY	9.22	5,071	4,057	-20%	6,339	25%	5,551	4,440	6,938
45	Project		Dry Creek Bridge - Paving	Rolled Erosion Control / Jute Mesh	550	SY	16.62	9,141	7,313	-20%	11,426	25%	10,006	8,004	12,507
45	Project		Dry Creek Bridge - Paving	Temporary Fiber Roll	1,000	LF	8.10	8,100	6,480	-20%	10,125	25%	8,866	7,093	11,083
45	Project		Dry Creek Bridge - Paving	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Dry Creek Bridge - Paving	Water Pollution Control	0.10	%	175,700.00	17,570	14,056	-20%	21,963	25%	19,232	15,385	24,040
45	Project		Dry Creek Bridge - Paving	Thermoplastic Traffic Stripe	650	LF	0.86	559	447	-20%	699	25%	612	489	765
45	Project		Dry Creek Bridge - Paving	Portable Changeable Message Signs	2.00	EA	3,000.00	6,000	4,800	-20%	7,500	25%	6,567	5,254	8,209
45	Project		Dry Creek Bridge - Paving	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Dry Creek Bridge - Paving	Traffic Control System	20.00	DA	1,000.00	20,000	16,000	-20%	25,000	25%	21,892	17,513	27,364
45	Project		Dry Creek Bridge - Paving	Temporary Railing (Type K)	200	LF	47.00	9,400	7,520	-20%	11,750	25%	10,289	8,231	12,861
45	Project		Dry Creek Bridge - Temp Detour	Roadway Excavation	1,200	CY	40.00	48,000	38,400	-20%	60,000	25%	52,540	42,032	65,675
45	Project		Dry Creek Bridge - Temp Detour	Ditch Excavation	40.00	CY	35.00	1,400	1,120	-20%	1,750	25%	1,532	1,226	1,916
45	Project		Dry Creek Bridge - Temp Detour	Imported Borrow	1,620	CY	45.00	72,900	58,320	-20%	91,125	25%	79,795	63,836	99,744
45	Project		Dry Creek Bridge - Temp Detour	Hot Mix Asphalt (Type A)	530	T	130.00	68,900	55,120	-20%	86,125	25%	75,417	60,333	94,271
45	Project		Dry Creek Bridge - Temp Detour	Class 2 Aggregate Base	400	CY	65.00	26,000	20,800	-20%	32,500	25%	28,459	22,767	35,574
45	Project		Dry Creek Bridge - Temp Detour	Midwest Guardrail System	100	LF	40.61	4,061	3,249	-20%	5,076	25%	4,445	3,556	5,556
45	Project		Dry Creek Bridge - Temp Detour	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892
45	Project		Dry Creek Bridge - Temp Detour	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Dry Creek Bridge - Temp Detour	Temporary Reinforced Silt Fence	400	LF	7.58	3,032	2,426	-20%	3,790	25%	3,319	2,655	4,148
45	Project		Dry Creek Bridge - Temp Detour	Temporary Fence (Type ESA)	400	LF	5.03	2,012	1,610	-20%	2,515	25%	2,202	1,762	2,753
45	Project		Dry Creek Bridge - Temp Detour	Temporary Hydroseed	320	SY	9.22	2,950	2,360	-20%	3,688	25%	3,229	2,584	4,037
45	Project		Dry Creek Bridge - Temp Detour	Rolled Erosion Control / Jute Mesh	320	SY	16.62	5,318	4,255	-20%	6,648	25%	5,821	4,657	7,277
45	Project		Dry Creek Bridge - Temp Detour	Temporary Fiber Roll	400	LF	8.10	3,240	2,592	-20%	4,050	25%	3,546	2,837	4,433
45	Project		Dry Creek Bridge - Temp Detour	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Dry Creek Bridge - Temp Detour	Water Pollution Control	0.10	%	217,200.00	21,720	17,376	-20%	27,150	25%	23,774	19,019	29,718
45	Project		Dry Creek Bridge - Temp Detour	Construction Area Signs	1.00	LS	2,000.00	2,000	1,600	-20%	2,500	25%	2,189	1,751	2,736
45	Project		Dry Creek Bridge - Temp Detour	Temporary Traffic Stripe	620	LF	0.78	486	389	-20%	608	25%	532	426	665
45	Project		Dry Creek Bridge - Temp Detour	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Dry Creek Bridge - Temp Detour	Traffic Control System	5.00	DA	1,000.00	5,000	4,000	-20%	6,250	25%	5,473	4,378	6,841
45	Project		Dry Creek Bridge - Temp Detour	Temporary Railing (Type K)	160	LF	47.00	7,520	6,016	-20%	9,400	25%	8,231	6,585	10,289
45	Project		Camp Creek Bridge	Backfill, structural, common earth, 105 H.P. dozer, 50' haul, fr	420	CY	39.77	16,705	13,364	-20%	21,717	30%	18,285	14,628	23,771
45	Project		Camp Creek Bridge	Earth Work Coffer Dam Construction for side footers	1,186	CY	15.26	18,097	14,478	-20%	23,526	30%	19,809	15,847	25,752
45	Project		Camp Creek Bridge	Structure Excavation (Bridge)	585	CY	58.08	33,975	27,180	-20%	44,167	30%	37,188	29,750	48,344
45	Project		Camp Creek Bridge	Steel piles, "H" Sections, 50' long, HP14 X 89, excludes mobili	1,400	LF	86.12	120,571	96,457	-20%	156,742	30%	131,974	105,580	171,567
45	Project		Camp Creek Bridge	Piling special costs, pre-augering for Pile	1,400	LF	311.56	436,189	348,951	-20%	567,045	30%	477,443	381,955	620,676
45	Project		Camp Creek Bridge	Mobilization, 150 ton, set up and remove crane, with pile leads	2.00	EA	22,228.11	44,456	35,565	-20%	57,793	30%	48,661	38,929	63,259
45	Project		Camp Creek Bridge	A736 Barrier Wall	444	LF	388.00	172,270	137,816	-20%	223,952	30%	188,564	150,851	245,133
45	Project		Camp Creek Bridge	Expansion joint, neoprene, liquid, 1" x 2", cold applied	50.00	LF	44.09	2,205	1,764	-20%	2,866	30%	2,413	1,931	3,137
45	Project		Camp Creek Bridge	Columns Structural Concrete includes forms, Grade 60 rebar,	132	CY	1,953.07	257,806	206,245	-20%	335,148	30%	282,189	225,751	366,846

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
45	Project		Camp Creek Bridge	Deck Structural concrete, in place, includes forms, Grade 60 r	139	CY	1,143.38	158,930	127,144	-20%	206,609	30%	173,961	139,169	226,149
45	Project		Camp Creek Bridge	Footer Structural concrete,footing, reinforced, includes forms(	162	CY	421.72	68,318	54,655	-20%	88,814	30%	74,780	59,824	97,214
45	Project		Camp Creek Bridge	Approach Slab Structural concrete, in place, 6" thick, includes	19.00	CY	293.49	5,576	4,461	-20%	7,249	30%	6,104	4,883	7,935
45	Project		Camp Creek Bridge	Precast 36" I-Girder 67'	4.00	EA	29,970.09	119,880	95,904	-20%	155,844	30%	131,219	104,975	170,584
45	Project		Camp Creek Bridge	Precast 36" I-Girder 53'	8.00	EA	35,810.59	286,485	229,188	-20%	372,430	30%	313,580	250,864	407,654
45	Project		Camp Creek Bridge - Paving	Roadway Excavation	12,270	CY	40.00	490,800	392,640	-20%	613,500	25%	537,219	429,776	671,524
45	Project		Camp Creek Bridge - Paving	Ditch Excavation	200	CY	35.00	7,000	5,600	-20%	8,750	25%	7,662	6,130	9,578
45	Project		Camp Creek Bridge - Paving	Imported Borrow	12,550	CY	45.00	564,750	451,800	-20%	705,938	25%	618,164	494,531	772,705
45	Project		Camp Creek Bridge - Paving	Hot Mix Asphalt (Type A)	710	T	130.00	92,300	73,840	-20%	115,375	25%	101,030	80,824	126,287
45	Project		Camp Creek Bridge - Paving	Class 2 Aggregate Base	520	CY	65.00	33,800	27,040	-20%	42,250	25%	36,997	29,597	46,246
45	Project		Camp Creek Bridge - Paving	Midwest Guardrail System	400	LF	40.61	16,244	12,995	-20%	20,305	25%	17,780	14,224	22,225
45	Project		Camp Creek Bridge - Paving	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892
45	Project		Camp Creek Bridge - Paving	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Camp Creek Bridge - Paving	Temporary Reinforced Silt Fence	400	LF	7.58	3,032	2,426	-20%	3,790	25%	3,319	2,655	4,148
45	Project		Camp Creek Bridge - Paving	Temporary Fence (Type ESA)	400	LF	5.03	2,012	1,610	-20%	2,515	25%	2,202	1,762	2,753
45	Project		Camp Creek Bridge - Paving	Temporary Hydroseed	160	SY	9.22	1,475	1,180	-20%	1,844	25%	1,615	1,292	2,018
45	Project		Camp Creek Bridge - Paving	Rolled Erosion Control / Jute Mesh	160	SY	16.62	2,659	2,127	-20%	3,324	25%	2,911	2,329	3,638
45	Project		Camp Creek Bridge - Paving	Temporary Fiber Roll	225	LF	8.10	1,823	1,458	-20%	2,278	25%	1,995	1,596	2,494
45	Project		Camp Creek Bridge - Paving	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Camp Creek Bridge - Paving	Water Pollution Control	0.10	%	497,800.00	49,780	39,824	-20%	62,225	25%	54,488	43,591	68,110
45	Project		Camp Creek Bridge - Paving	Roadside Sign - One Post	8.00	EA	270.00	2,160	1,728	-20%	2,700	25%	2,364	1,891	2,955
45	Project		Camp Creek Bridge - Paving	Thermoplastic Traffic Stripe	810	LF	0.86	697	557	-20%	871	25%	762	610	953
45	Project		Camp Creek Bridge - Paving	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Camp Creek Bridge - Paving	Traffic Control System	20.00	DA	1,000.00	20,000	16,000	-20%	25,000	25%	21,892	17,513	27,364
45	Project		Camp Creek Bridge - Paving	Temporary Railing (Type K)	300	LF	47.00	14,100	11,280	-20%	17,625	25%	15,434	12,347	19,292
45	Project		Camp Creek Bridge - Temporary Culvert	Roadway Excavation	100	CY	40.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Camp Creek Bridge - Temporary Culvert	Ditch Excavation	150	CY	35.00	5,250	4,200	-20%	6,563	25%	5,747	4,597	7,183
45	Project		Camp Creek Bridge - Temporary Culvert	Imported Borrow	3,500	CY	45.00	157,500	126,000	-20%	196,875	25%	172,396	137,917	215,495
45	Project		Camp Creek Bridge - Temporary Culvert	Clearing & Grubbing	5,000	LS	1.00	5,000	4,000	-20%	6,250	25%	5,473	4,378	6,841
45	Project		Camp Creek Bridge - Temporary Culvert	Hot Mix Asphalt (Type A)	470	T	130.00	61,100	48,880	-20%	76,375	25%	66,879	53,503	83,598
45	Project		Camp Creek Bridge - Temporary Culvert	Class 2 Aggregate Base	235	CY	65.00	15,275	12,220	-20%	19,094	25%	16,720	13,376	20,900
45	Project		Camp Creek Bridge - Temporary Culvert	Rock Slope Protection (Class?) Method B	15.00	CY	100.00	1,500	1,200	-20%	1,875	25%	1,642	1,313	2,052
45	Project		Camp Creek Bridge - Temporary Culvert	Rock Slope Protection Fabric Class 8	45.00	SY	10.13	456	365	-20%	570	25%	499	399	624
45	Project		Camp Creek Bridge - Temporary Culvert	36" Alternative Pipe Culvert	300	LF	261.42	78,426	62,741	-20%	98,033	25%	85,843	68,675	107,304
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Reinforced Silt Fence	600	LF	7.58	4,548	3,638	-20%	5,685	25%	4,978	3,983	6,223
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Fence (Type ESA)	600	LF	5.03	3,018	2,414	-20%	3,773	25%	3,303	2,643	4,129
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Hydroseed	630	SY	9.22	5,809	4,647	-20%	7,261	25%	6,358	5,086	7,947
45	Project		Camp Creek Bridge - Temporary Culvert	Rolled Erosion Control / Jute Mesh	630	SY	16.62	10,471	8,376	-20%	13,088	25%	11,461	9,169	14,326
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Fiber Roll	1,190	LF	8.10	9,639	7,711	-20%	12,049	25%	10,551	8,441	13,188
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Concrete Washout	2,000	LS	1.50	2,999	2,399	-20%	3,749	25%	3,283	2,626	4,104
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Camp Creek Bridge - Temporary Culvert	Water Pollution Control	0.10	%	328,506.85	32,851	26,281	-20%	41,063	25%	35,958	28,766	44,947
45	Project		Camp Creek Bridge - Temporary Culvert	Construction Area Signs	1.00	LS	2,000.00	2,000	1,600	-20%	2,500	25%	2,189	1,751	2,736
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Traffic Stripe	650	LF	0.78	510	408	-20%	637	25%	558	446	698
45	Project		Camp Creek Bridge - Temporary Culvert	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Camp Creek Bridge - Temporary Culvert	Traffic Control System	10.00	DA	1,000.00	10,000	8,000	-20%	12,500	25%	10,946	8,757	13,682
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Railing (Type K)	600	LF	47.00	28,200	22,560	-20%	35,250	25%	30,867	24,694	38,584
45	Project		Jenny Creek Bridge	Sheet Pile Coffer Dam For Center Footer	2,400	SF	38.40	92,161	73,729	-20%	119,809	30%	100,878	80,702	131,141
45	Project		Jenny Creek Bridge	Earth Work Coffer Dam Construction for side footers	1,186	CY	15.26	18,097	14,478	-20%	23,526	30%	19,809	15,847	25,752
45	Project		Jenny Creek Bridge	Backfill, structural, common earth, 105 H.P. dozer, 50' haul, fr	142	CY	39.77	5,648	4,518	-20%	7,342	30%	6,182	4,946	8,037
45	Project		Jenny Creek Bridge	Structure Excavation (Type D)	320	CY	20.27	6,486	5,189	-20%	8,432	30%	7,099	5,679	9,229
45	Project		Jenny Creek Bridge	Structure Excavation (Bridge)	209	CY	58.08	12,138	9,710	-20%	15,779	30%	13,286	10,629	17,272
45	Project		Jenny Creek Bridge	Steel piles, "H" Sections, 50' long, HP14 X 89, excludes mobili	2,640	LF	86.12	227,362	181,890	-20%	295,571	30%	248,866	199,093	323,526
45	Project		Jenny Creek Bridge	Piling special costs, pre-augering for Pile and Tie Down Ancho	2,640	LF	311.56	822,527	658,022	-20%	1,069,286	30%	900,321	720,257	1,170,418
45	Project		Jenny Creek Bridge	Mobilization, 150 ton, set up and remove crane, with pile leads	2.00	EA	22,228.11	44,456	35,565	-20%	57,793	30%	48,661	38,929	63,259
45	Project		Jenny Creek Bridge	A736 Barrier Wall	776	LF	388.00	301,085	240,868	-20%	391,411	30%	329,562	263,649	428,430
45	Project		Jenny Creek Bridge	Expansion joint, neoprene, liquid, 1" x 2", cold applied	58.00	LF	44.09	2,557	2,046	-20%	3,325	30%	2,799	2,239	3,639
45	Project		Jenny Creek Bridge	Columns Structural Concrete includes forms, Grade 60 rebar,	174	CY	1,953.07	339,835	271,868	-20%	441,785	30%	371,976	297,581	483,569
45	Project		Jenny Creek Bridge	Deck Structural concrete, in place, includes forms, Grade 60 r	317	CY	1,143.38	362,451	289,961	-20%	471,186	30%	396,731	317,385	515,751
45	Project		Jenny Creek Bridge	Footer Structural concrete,footing, reinforced, includes forms(	281	CY	421.72	118,503	94,802	-20%	154,053	30%	129,710	103,768	168,624
45	Project		Jenny Creek Bridge	Approach Slab Structural concrete, in place, 6" thick, includes	22.00	CY	293.49	6,457	5,166	-20%	8,394	30%	7,068	5,654	9,188
45	Project		Jenny Creek Bridge	Precast 61" Bulb Tee 73'	8.00	EA	49,373.69	394,990	315,992	-20%	513,486	30%	432,347	345,878	562,052
45	Project		Jenny Creek Bridge	Precast 61" Bulb Tee 100'	8.00	EA	78,816.06	630,528	504,423	-20%	819,687	30%	690,163	552,131	897,212
45	Project		Jenny Creek Bridge	Bridge Demolition	3,102	SF	60.00	186,120	148,896	-20%	241,956	30%	203,723	162,978	264,840

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
45	Project		Jenny Creek Bridge - Paving	Roadway Excavation	30,000	CY	40.00	1,200,000	960,000	-20%	1,500,000	25%	1,313,495	1,050,796	1,641,869
45	Project		Jenny Creek Bridge - Paving	Ditch Excavation	210	CY	35.00	7,350	5,880	-20%	9,188	25%	8,045	6,436	10,056
45	Project		Jenny Creek Bridge - Paving	Imported Borrow	35,000	CY	45.00	1,575,000	1,260,000	-20%	1,968,750	25%	1,723,962	1,379,170	2,154,953
45	Project		Jenny Creek Bridge - Paving	Hot Mix Asphalt (Type A)	600	T	130.00	78,000	62,400	-20%	97,500	25%	85,377	68,302	106,721
45	Project		Jenny Creek Bridge - Paving	Class 2 Aggregate Base	370	CY	65.00	24,050	19,240	-20%	30,063	25%	26,325	21,060	32,906
45	Project		Jenny Creek Bridge - Paving	Midwest Guardrail System	200	LF	40.61	8,122	6,498	-20%	10,153	25%	8,890	7,112	11,113
45	Project		Jenny Creek Bridge - Paving	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892
45	Project		Jenny Creek Bridge - Paving	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Jenny Creek Bridge - Paving	Temporary Reinforced Silt Fence	400	LF	7.58	3,032	2,426	-20%	3,790	25%	3,319	2,655	4,148
45	Project		Jenny Creek Bridge - Paving	Temporary Fence (Type ESA)	400	LF	5.03	2,012	1,610	-20%	2,515	25%	2,202	1,762	2,753
45	Project		Jenny Creek Bridge - Paving	Temporary Hydroseed	1,770	SY	9.22	16,319	13,056	-20%	20,399	25%	17,863	14,290	22,329
45	Project		Jenny Creek Bridge - Paving	Rolled Erosion Control / Jute Mesh	1,770	SY	16.62	29,417	23,534	-20%	36,772	25%	32,200	25,760	40,250
45	Project		Jenny Creek Bridge - Paving	Temporary Fiber Roll	2,490	LF	8.10	20,169	16,135	-20%	25,211	25%	22,077	17,661	27,596
45	Project		Jenny Creek Bridge - Paving	Temporary Concrete Washout	2,000	LS	1.00	2,000	1,600	-20%	2,500	25%	2,189	1,751	2,736
45	Project		Jenny Creek Bridge - Paving	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Jenny Creek Bridge - Paving	Water Pollution Control	0.10	%	2,884,400.00	288,440	230,752	-20%	360,550	25%	315,720	252,576	394,651
45	Project		Jenny Creek Bridge - Paving	Roadside Sign - One Post	8.00	EA	270.00	2,160	1,728	-20%	2,700	25%	2,364	1,891	2,955
45	Project		Jenny Creek Bridge - Paving	Construction Area Signs	2,000	LS	1.00	2,000	1,600	-20%	2,500	25%	2,189	1,751	2,736
45	Project		Jenny Creek Bridge - Paving	Thermoplastic Traffic Stripe	1,000	LF	0.86	860	688	-20%	1,075	25%	941	753	1,177
45	Project		Jenny Creek Bridge - Paving	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Jenny Creek Bridge - Paving	Traffic Control System	20.00	DA	1,000.00	20,000	16,000	-20%	25,000	25%	21,892	17,513	27,364
45	Project		Jenny Creek Bridge - Paving	Temporary Railing (Type K)	300	LF	47.00	14,100	11,280	-20%	17,625	25%	15,434	12,347	19,292
45	Project		Other Structures	Pedestrian Bridge Total	800	SF	60.00	48,000	43,200	-10%	62,400	30%	52,540	47,286	68,302
45	Project		Other Structures	Bridge Demolition Ped Bridge Campground	800	SF	60.00	48,000	43,200	-10%	62,400	30%	52,540	47,286	68,302
45	Project		Other Structures	Bridge Demolition Timber JC Boyle	1,800	SF	60.00	108,000	97,200	-10%	140,400	30%	118,215	106,393	153,679
45	Project		Scotch Creek - Temporary Culvert	Roadway Excavation	550	CY	40.00	22,000	17,600	-20%	27,500	25%	24,081	19,265	30,101
45	Project		Scotch Creek - Temporary Culvert	Ditch Excavation	10.00	CY	35.00	350	280	-20%	438	25%	383	306	479
45	Project		Scotch Creek - Temporary Culvert	Imported Borrow	2,300	CY	45.00	103,500	82,800	-20%	129,375	25%	113,289	90,631	141,611
45	Project		Scotch Creek - Temporary Culvert	Hot Mix Asphalt (Type A)	510	T	130.00	66,300	53,040	-20%	82,875	25%	72,571	58,056	90,713
45	Project		Scotch Creek - Temporary Culvert	Class 2 Aggregate Base	380	CY	65.00	24,700	19,760	-20%	30,875	25%	27,036	21,629	33,795
45	Project		Scotch Creek - Temporary Culvert	Rock Slope Protection (Class?) Method B	10.00	CY	100.00	1,000	800	-20%	1,250	25%	1,095	876	1,368
45	Project		Scotch Creek - Temporary Culvert	Rock Slope Protection Fabric Class 8	30.00	SY	10.13	304	243	-20%	380	25%	333	266	416
45	Project		Scotch Creek - Temporary Culvert	36" Alternative Pipe Culvert	250	LF	261.42	65,355	52,284	-20%	81,694	25%	71,536	57,229	89,420
45	Project		Scotch Creek - Temporary Culvert	Temporary Reinforced Silt Fence	300	LF	7.58	2,274	1,819	-20%	2,843	25%	2,489	1,991	3,111
45	Project		Scotch Creek - Temporary Culvert	Temporary Fence (Type ESA)	300	LF	5.03	1,509	1,207	-20%	1,886	25%	1,652	1,321	2,065
45	Project		Scotch Creek - Temporary Culvert	Temporary Hydroseed	590	SY	9.22	5,440	4,352	-20%	6,800	25%	5,954	4,763	7,443
45	Project		Scotch Creek - Temporary Culvert	Rolled Erosion Control / Jute Mesh	590	SY	16.62	9,806	7,845	-20%	12,257	25%	10,733	8,587	13,417
45	Project		Scotch Creek - Temporary Culvert	Temporary Fiber Roll	450	LF	8.10	3,645	2,916	-20%	4,556	25%	3,990	3,192	4,987
45	Project		Scotch Creek - Temporary Culvert	Temporary Concrete Washout	2,000	LS	1.50	2,999	2,399	-20%	3,749	25%	3,283	2,626	4,104
45	Project		Scotch Creek - Temporary Culvert	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Scotch Creek - Temporary Culvert	Water Pollution Control	0.10	%	283,509.90	28,351	22,681	-20%	35,439	25%	31,032	24,826	38,791
45	Project		Scotch Creek - Temporary Culvert	Construction Area Signs	1.00	LS	2,000.00	2,000	1,600	-20%	2,500	25%	2,189	1,751	2,736
45	Project		Scotch Creek - Temporary Culvert	Temporary Traffic Stripe	520	LF	0.78	408	326	-20%	510	25%	446	357	558
45	Project		Scotch Creek - Temporary Culvert	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Scotch Creek - Temporary Culvert	Traffic Control System	10.00	DA	1,000.00	10,000	8,000	-20%	12,500	25%	10,946	8,757	13,682
45	Project		Scotch Creek - Temporary Culvert	Temporary Railing (Type K)	500	LF	47.00	23,500	18,800	-20%	29,375	25%	25,723	20,578	32,153
45	Project		Scotch Creek - Culvert	Roadway Excavation	3,000	CY	40.00	120,000	96,000	-20%	150,000	25%	131,350	105,080	164,187
45	Project		Scotch Creek - Culvert	Ditch Excavation	10.00	CY	35.00	350	280	-20%	438	25%	383	306	479
45	Project		Scotch Creek - Culvert	Imported Borrow	3,000	CY	45.00	135,000	108,000	-20%	168,750	25%	147,768	118,215	184,710
45	Project		Scotch Creek - Culvert	Hot Mix Asphalt (Type A)	170	T	130.00	22,100	17,680	-20%	27,625	25%	24,190	19,352	30,238
45	Project		Scotch Creek - Culvert	Class 2 Aggregate Base	120	CY	65.00	7,800	6,240	-20%	9,750	25%	8,538	6,830	10,672
45	Project		Scotch Creek - Culvert	Rock Slope Protection Class III, Method B	5.00	CY	100.00	500	400	-20%	625	25%	547	438	684
45	Project		Scotch Creek - Culvert	Rock Slope Protection Fabric Class 8	12.00	SY	10.13	122	97	-20%	152	25%	133	106	166
45	Project		Scotch Creek - Culvert	Structural Concrete, Box Culvert	10.00	CY	4,835.00	48,350	38,680	-20%	60,438	25%	52,923	42,338	66,154
45	Project		Scotch Creek - Culvert	Midwest Guardrail System	400	LF	34.19	13,676	10,941	-20%	17,095	25%	14,969	11,976	18,712
45	Project		Scotch Creek - Culvert	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Scotch Creek - Culvert	Temporary Reinforced Silt Fence	400	LF	7.58	3,032	2,426	-20%	3,790	25%	3,319	2,655	4,148
45	Project		Scotch Creek - Culvert	Temporary Fence (Type ESA)	400	LF	5.03	2,012	1,610	-20%	2,515	25%	2,202	1,762	2,753
45	Project		Scotch Creek - Culvert	Temporary Hydroseed	220	SY	9.22	2,028	1,623	-20%	2,536	25%	2,220	1,776	2,775
45	Project		Scotch Creek - Culvert	Rolled Erosion Control / Jute Mesh	220	SY	16.62	3,656	2,925	-20%	4,571	25%	4,002	3,202	5,003
45	Project		Scotch Creek - Culvert	Temporary Fiber Roll	450	LF	8.10	3,645	2,916	-20%	4,556	25%	3,990	3,192	4,987
45	Project		Scotch Creek - Culvert	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Scotch Creek - Culvert	Water Pollution Control	0.10	%	334,221.56	33,422	26,738	-20%	41,778	25%	36,583	29,267	45,729
45	Project		Scotch Creek - Culvert	Construction Area Signs	1.00	LS	2,500.00	2,500	2,000	-20%	3,125	25%	2,736	2,189	3,421
45	Project		Scotch Creek - Culvert	Thermoplastic Traffic Stripe	200	LF	0.86	172	138	-20%	215	25%	188	151	235

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
45	Project		Scotch Creek - Culvert	Traffic Control System	1.00	LS	10,000.00	10,000	8,000	-20%	12,500	25%	10,946	8,757	13,682
45	Project		Scotch Creek - Culvert	Temporary Railing (Type K)	200	LF	33.57	6,714	5,371	-20%	8,393	25%	7,349	5,879	9,187
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Roadway Excavation	3,000	CY	40.00	120,000	96,000	-20%	150,000	25%	131,350	105,080	164,187
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Imported Borrow	2,500	CY	45.00	112,500	90,000	-20%	140,625	25%	123,140	98,512	153,925
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Rock Slope Protection Class III, Method B	250	CY	100.00	25,000	20,000	-20%	31,250	25%	27,364	21,892	34,206
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Rock Slope Protection Fabric Class 8	700	SY	10.13	7,091	5,673	-20%	8,864	25%	7,762	6,209	9,702
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	60" CORRUGATED STEEL PIPE (.138" THICK)	80.00	LF	270.00	21,600	17,280	-20%	27,000	25%	23,643	18,914	29,554
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Temporary Reinforced Silt Fence	600	LF	7.58	4,548	3,638	-20%	5,685	25%	4,978	3,983	6,223
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Temporary Fence (Type ESA)	600	LF	5.03	3,018	2,414	-20%	3,773	25%	3,303	2,643	4,129
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Water Pollution Control	0.10	%	286,191.00	28,619	22,895	-20%	35,774	25%	31,326	25,061	39,157
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Construction Area Signs	1.00	LS	600.00	600	480	-20%	750	25%	657	525	821
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Traffic Control System	1.00	LS	10,000.00	10,000	8,000	-20%	12,500	25%	10,946	8,757	13,682
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Temporary Railing (Type K)	80.00	LF	33.57	2,686	2,149	-20%	3,357	25%	2,940	2,352	3,675
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Replace and Reconstruct 60-inch Culvert No.1 at Beaver Cree	1.00	LS	15,000.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Replace and Reconstruct 60-inch Culvert No.2 at Beaver Cree	1.00	LS	15,000.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Copco Rd at Raymond Gulch Culvert	Rock Slope Protection Class III, Method B	150	CY	100.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Copco Rd at Raymond Gulch Culvert	Rock Slope Protection Fabric Class 8	400	SY	10.13	4,052	3,242	-20%	5,065	25%	4,435	3,548	5,544
45	Project		Copco Rd at Raymond Gulch Culvert	Temporary Reinforced Silt Fence	600	LF	7.58	4,548	3,638	-20%	5,685	25%	4,978	3,983	6,223
45	Project		Copco Rd at Raymond Gulch Culvert	Temporary Fence (Type ESA)	600	LF	5.03	3,018	2,414	-20%	3,773	25%	3,303	2,643	4,129
45	Project		Copco Rd at Raymond Gulch Culvert	Water Pollution Control	1.00	LS	19,052.00	19,052	15,242	-20%	23,815	25%	20,854	16,683	26,067
45	Project		Copco Rd at Raymond Gulch Culvert	Traffic Control System	1.00	LS	1,000.00	1,000	800	-20%	1,250	25%	1,095	876	1,368
45	Project		Copco Rd at Raymond Gulch Culvert	60-inch Culvert at Raymond Gulch	1.00	LS	10,000.00	10,000	8,000	-20%	12,500	25%	10,946	8,757	13,682
45	Project		Patricia Avenue Culverts	Rock Slope Protection Class III, Method B	150	CY	100.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Patricia Avenue Culverts	Rock Slope Protection Fabric Class 8	400	SY	10.13	4,052	3,242	-20%	5,065	25%	4,435	3,548	5,544
45	Project		Patricia Avenue Culverts	Water Pollution Control	0.10	%	19,052.00	1,905	1,524	-20%	2,382	25%	2,085	1,668	2,607
45	Project		Patricia Avenue Culverts	Traffic Control System	1.00	LS	1,000.00	1,000	800	-20%	1,250	25%	1,095	876	1,368
45	Project		Topsy Grade Culverts	Trench Excavation	275	CY	40.00	11,000	8,800	-20%	13,750	25%	12,040	9,632	15,050
45	Project		Topsy Grade Culverts	Clearing & Grubbing	1.00	LS	2,000.00	2,000	1,600	-20%	2,500	25%	2,189	1,751	2,736
45	Project		Topsy Grade Culverts	Rock Slope Protection Class III, Method B	800	CY	100.00	80,000	64,000	-20%	100,000	25%	87,566	70,053	109,458
45	Project		Topsy Grade Culverts	Rock Slope Protection Fabric Class 8	2,350	SY	10.13	23,806	19,044	-20%	29,757	25%	26,057	20,846	32,571
45	Project		Topsy Grade Culverts	24" corrugated steel pipe (.138" thick)	200	LF	137.50	27,500	22,000	-20%	34,375	25%	30,101	24,081	37,626
45	Project		Topsy Grade Culverts	Temporary Reinforced Silt Fence	1,000	LF	7.58	7,580	6,064	-20%	9,475	25%	8,297	6,638	10,371
45	Project		Topsy Grade Culverts	Temporary Fence (Type ESA)	1,000	LF	5.03	5,030	4,024	-20%	6,288	25%	5,506	4,405	6,882
45	Project		Topsy Grade Culverts	Water Pollution Control	0.10	%	144,305.50	14,431	11,544	-20%	18,038	25%	15,795	12,636	19,744
45	Project		Topsy Grade Culverts	Traffic Control System	1.00	LS	5,000.00	5,000	4,000	-20%	6,250	25%	5,473	4,378	6,841
45	Project		JC Boyle Unnamed Culverts	Rock Slope Protection Class III, Method B	115	CY	100.00	11,500	9,200	-20%	14,375	25%	12,588	10,070	15,735
45	Project		JC Boyle Unnamed Culverts	Rock Slope Protection Fabric Class 8	350	SY	10.13	3,546	2,836	-20%	4,432	25%	3,881	3,105	4,851
45	Project		JC Boyle Unnamed Culverts	Water Pollution Control	0.10	%	15,045.50	1,505	1,204	-20%	1,881	25%	1,647	1,317	2,059
45	Project		JC Boyle Unnamed Culverts	Traffic Control System	1.00	LS	1,000.00	1,000	800	-20%	1,250	25%	1,095	876	1,368
45	Project		Copco Road at Unnamed Creek Culvert No. 1	Copco Road at Unnamed Creek Culvert No. 1	1.00	LS	15,000.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Copco Road at Unnamed Creek Culvert No. 2	Copco Road at Unnamed Creek Culvert No. 2	1.00	LS	15,000.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		6'x6'x34' Box Culvert installation	6'x6'x34' Box Culvert installation	1.00	LS	15,000.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Paving - Lakeview Disposal Access Road	Pre: none; Post: 0.7 miles 6" AB overlay (no drainage improve	1.00	EA	170,000.00	170,000	-	-20%	340,000	25%	191,227	-	382,454
45	Project		Paving - Copco 1 Dam Access	Pre: 2500CY roadway excavation, 0.9 miles 9" AB overlay (no	1.00	EA	250,000.00	250,000	190,000	-20%	370,000	25%	270,400	205,504	400,192
45	Project		Paving - Copco Rd from Copco 1 access to Copco Bridge	Pre: 1 mile 9" AB repair; Post: 1 mile 9" AB repair, 0.2 mile HM	1.00	EA	318,000.00	318,000	208,000	-20%	585,000	25%	352,204	230,372	647,922
45	Project		Paving - Copco 1 Ager Beswick Rd Barge Access	Pre: minor excavation and 9"' AB section; Post: none	1.00	EA	60,000.00	60,000	-	-20%	120,000	25%	64,896	-	129,792
45	Project		Paving - US 97 Dalles CA Hwy	Pre: none; Post: none (high only)	1.00	EA	-	-	-	-20%	966,000	25%	-	-	1,086,619
45	Project		Paving - OR 66 Green Springs hwy	Pre: none; Post: none (high only)	1.00	EA	-	-	-	-20%	988,000	25%	-	-	1,111,366
45	Project		Paving - JC Boyle Keno Worden	Pre: none; Post: none (high only)	1.00	EA	-	-	-	-20%	988,000	25%	-	-	1,111,366
45	Project		Paving - Topsy Grade Rd	Pre: 0.9 mile 9" AB repair; Post: 0.9 mile 9" AB repair	1.00	EA	880,000.00	880,000	440,000	-20%	1,320,000	25%	970,844	485,422	1,456,266
45	Project		Paving - JC Boyle Dam Access Rd (2,940 ft to dam toe)	Pre: minor excavation; 0.25 mile new 9" AB, 0.7 mile 9" AB rep	1.00	EA	335,000.00	335,000	212,000	-20%	374,000	25%	368,133	232,968	410,991
45	Project		Paving - JC Boyle Power Canal Access Rd	Pre: 1.5 mile 9" AB repair; post: 1.5 mile 9" AB repair; no guar	1.00	EA	432,000.00	432,000	216,000	-20%	744,000	25%	476,596	238,298	820,805
45	Project		Paving - JC Boyle Powerhouse Access Rd	Pre: none; Post: none (high only)	1.00	EA	-	-	-	-20%	216,000	25%	-	-	242,971
45	Project		Paving - Copco Rd I5 to Ager Rd	Pre: none; Post: 1 mile new asphalt overlay	1.00	EA	1,090,000.00	1,090,000	545,000	-20%	2,100,000	25%	1,226,102	613,051	2,362,214
45	Project		Paving - Copco Rd Ager Rd to Lakeview Rd	Pre: 0.5 miles crack sealer, 0.75 miles new asphalt; Post: 1 mi	1.00	EA	1,625,000.00	1,625,000	1,185,000	-20%	5,235,000	25%	1,799,782	1,312,457	5,798,068
45	Project		Paving - Copco Rd to Lakeview Rd to Dagget Rd	Pre: 1 mile crack sealer, 1.5 miles new asphalt; Post: 2 miles n	1.00	EA	2,980,000.00	2,980,000	2,370,000	-20%	10,470,000	25%	3,300,524	2,624,913	11,596,136
45	Project		Paving - Copco Rd Daggett Rd to Copco 1 Access Rd	Pre: 1.5 mile 9" AB repair; Post: 1.5 mile 9" AB repair, no guar	1.00	EA	432,000.00	432,000	216,000	-20%	744,000	25%	476,596	238,298	820,805
46			**RECREATION IMPROVEMENTS**												
46	Project		Campground - Jenny Creek expansion & upgrade	Picnic table	7.00	EA	2,363.80	16,547	10,500	-37%	21,000	27%	18,112	11,493	22,986
46	Project		Campground - Jenny Creek expansion & upgrade	Fire grate	7.00	EA	675.37	4,728	3,000	-37%	6,000	27%	5,175	3,284	6,567

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
46	Project		Campground - Jenny Creek expansion & upgrade	Trash bins	7.00	EA	1,000.00	7,000	5,000	-29%	10,000	43%	7,662	5,473	10,946
46	Project		Campground - Jenny Creek expansion & upgrade	Parking	7.00	EA	562.81	3,940	2,500	-37%	5,000	27%	4,312	2,736	5,473
46	Project		Campground - Jenny Creek expansion & upgrade	Shade structure	3.00	EA	14,633.07	43,899	26,000	-41%	65,000	48%	48,051	28,459	71,148
46	Project		Campground - Jenny Creek expansion & upgrade	Restroom (single vault toilet)	2.00	EA	57,406.66	114,813	114,813	0%	204,000	78%	125,672	125,672	223,294
46	Project		Campground - Jenny Creek expansion & upgrade	Assumed earthwork	450	CY	9.00	4,052	2,400	-41%	4,800	18%	4,435	2,627	5,254
46	Project		Campground - Jenny Creek expansion & upgrade	Signage	2.00	EA	5,000.00	10,000	5,000	-50%	15,000	50%	10,946	5,473	16,419
46	Project		Campground - Jenny Creek expansion & upgrade	Operations and maintenance	5.00	YR	33,768.63	168,843	-	0%	600,000	255%	184,812	-	656,748
46	Project		Campground - Topsy upgrade	boat ramp	1.00	EA	10,000.00	10,000	10,000	0%	10,000	0%	10,946	10,946	10,946
46	Project		Campground - Topsy upgrade	trash bins	1.00	EA	1,000.00	1,000	1,000	0%	1,000	0%	1,095	1,095	1,095
46	Project		Campground - Topsy upgrade	Operations and maintenance	5.00	YR	11,256.21	56,281	-	0%	200,000	255%	61,604	-	218,916
46	Project		Campground - New campgrounds	picnic table	20.00	EA	2,363.80	47,276	47,276	0%	47,276	0%	51,747	51,747	51,747
46	Project		Campground - New campgrounds	fire grate	20.00	EA	675.37	13,507	13,507	0%	13,507	0%	14,785	14,785	14,785
46	Project		Campground - New campgrounds	trash bins	20.00	EA	1,000.00	20,000	20,000	0%	20,000	0%	21,892	21,892	21,892
46	Project		Campground - New campgrounds	restroom (single vault toilet)	6.00	EA	57,406.66	344,440	344,440	0%	344,440	0%	377,017	377,017	377,017
46	Project		Campground - New campgrounds	parking	20.00	EA	562.81	11,256	11,256	0%	11,256	0%	12,321	12,321	12,321
46	Project		Campground - New campgrounds	boat ramp	2.00	EA	11,256.21	22,512	14,633	-35%	22,512	0%	24,642	16,017	24,642
46	Project		Campground - New campgrounds	trash bins	2.00	EA	1,000.00	2,000	1,300	-35%	2,000	0%	2,189	1,423	2,189
46	Project		Campground - New campgrounds	picnic table	2.00	EA	2,363.80	4,728	4,255	-10%	4,728	0%	5,175	4,657	5,175
46	Project		Campground - New campgrounds	fire grate	2.00	EA	675.37	1,351	1,216	-10%	1,351	0%	1,478	1,331	1,478
46	Project		Campground - New campgrounds	trash bins	2.00	EA	1,000.00	2,000	2,000	0%	2,000	0%	2,189	2,189	2,189
46	Project		Campground - New campgrounds	assumed earthwork	1,200	CY	9.00	10,806	9,725	-10%	10,806	0%	11,828	10,645	11,828
46	Project		Campground - New campgrounds	signage	4.00	EA	5,000.00	20,000	10,000	-50%	30,000	50%	21,892	10,946	32,837
46	Project		Campground - New campgrounds	Operations and maintenance	5.00	YR	67,537.25	337,686	-	0%	1,200,000	255%	369,624	-	1,313,495
46	Project		Recreation area - Fall Creek upgrade	restroom (single vault toilet)	1.00	EA	57,406.66	57,407	51,666	-10%	103,332	80%	62,836	56,553	113,105
46	Project		Recreation area - Fall Creek upgrade	picnic table	5.00	EA	2,363.80	11,819	8,400	-29%	12,600	7%	12,937	9,194	13,792
46	Project		Recreation area - Fall Creek upgrade	shade structure	2.00	EA	14,633.07	29,266	26,340	-10%	43,899	50%	32,034	28,831	48,051
46	Project		Recreation area - Fall Creek upgrade	fire grate	4.00	EA	675.37	2,701	1,800	-33%	3,000	11%	2,957	1,970	3,284
46	Project		Recreation area - Fall Creek upgrade	trash bins	5.00	EA	1,000.00	5,000	4,000	-20%	6,000	20%	5,473	4,378	6,567
46	Project		Recreation area - Fall Creek upgrade	parking	6.00	EA	562.81	3,377	2,000	-41%	4,000	18%	3,696	2,189	4,378
46	Project		Recreation area - Fall Creek upgrade	reconstructed trail	0.50	MI	35,659.67	17,830	7,920	-56%	31,680	78%	19,516	8,669	34,676
46	Project		Recreation area - Fall Creek upgrade	assumed earthwork	300	CY	9.00	2,701	1,600	-41%	3,200	18%	2,957	1,751	3,503
46	Project		Recreation area - Fall Creek upgrade	signage	2.00	EA	5,000.00	10,000	5,000	-50%	15,000	50%	10,946	5,473	16,419
46	Project		Recreation area - Fall Creek upgrade	Operations and maintenance	5.00	YR	16,884.31	84,422	-	0%	300,000	255%	92,406	-	328,374
46	Project		Recreation area - Iron Gate Hatchery day use site	shade structure	3.00	EA	14,633.07	43,899	26,000	-41%	52,000	18%	48,051	28,459	56,918
46	Project		Recreation area - Iron Gate Hatchery day use site	picnic table	6.00	EA	2,363.80	14,183	8,400	-41%	16,800	18%	15,524	9,194	18,389
46	Project		Recreation area - Iron Gate Hatchery day use site	trash bins	7.00	EA	1,000.00	7,000	5,000	-29%	9,000	29%	7,662	5,473	9,851
46	Project		Recreation area - Iron Gate Hatchery day use site	parking	6.00	EA	562.81	3,377	2,000	-41%	4,000	18%	3,696	2,189	4,378
46	Project		Recreation area - Iron Gate Hatchery day use site	fire grate	6.00	EA	675.37	4,052	2,400	-41%	4,800	18%	4,435	2,627	5,254
46	Project		Recreation area - Iron Gate Hatchery day use site	restroom (single vault toilet)	2.00	EA	57,406.66	114,813	114,813	0%	204,000	78%	125,672	125,672	223,294
46	Project		Recreation area - Iron Gate Hatchery day use site	boat ramp	1.00	EA	11,256.21	11,256	10,131	-10%	10,131	-10%	12,321	11,089	11,089
46	Project		Recreation area - Iron Gate Hatchery day use site	assumed earthwork	450	CY	9.00	4,052	2,400	-41%	4,800	18%	4,435	2,627	5,254
46	Project		Recreation area - Iron Gate Hatchery day use site	signage	2.00	EA	5,000.00	10,000	5,000	-50%	15,000	50%	10,946	5,473	16,419
46	Project		Recreation area - Iron Gate Hatchery day use site	Operations and maintenance	5.00	YR	16,884.31	84,422	-	0%	300,000	255%	92,406	-	328,374
46	Project		Recreation area - River fishing access sites	parking	18.00	EA	562.81	10,131	-	0%	12,000	18%	11,089	-	13,135
46	Project		Recreation area - River fishing access sites	portable toilet	6.00	EA	787.93	4,728	4,728	0%	5,600	18%	5,175	5,175	6,130
46	Project		Recreation area - River fishing access sites	trash bins	6.00	EA	1,000.00	6,000	6,000	0%	8,000	33%	6,567	6,567	8,757
46	Project		Recreation area - River fishing access sites	signage	6.00	EA	5,000.00	30,000	30,000	0%	40,000	33%	32,837	32,837	43,783
46	Project		Recreation area - River fishing access sites	trail refurbishment	7,920	LF	6.75	53,490	53,490	0%	63,360	18%	58,548	58,548	69,353
46	Project		Recreation area - River fishing access sites	Operations and maintenance	5.00	YR	11,256.21	56,281	-	0%	200,000	255%	61,604	-	218,916
46	Project		Recreation area - New day use sites	picnic table	4.00	EA	2,363.80	9,455	-	0%	12,600	33%	10,349	-	13,792
46	Project		Recreation area - New day use sites	fire grate	4.00	EA	675.37	2,701	-	0%	3,600	33%	2,957	-	3,940
46	Project		Recreation area - New day use sites	trash bins	4.00	EA	1,000.00	4,000	-	0%	6,000	50%	4,378	-	6,567
46	Project		Recreation area - New day use sites	shade structure	2.00	EA	14,633.07	29,266	-	0%	39,000	33%	32,034	-	42,689
46	Project		Recreation area - New day use sites	assumed earthwork	200	CY	9.00	1,801	-	0%	2,400	33%	1,971	-	2,627
46	Project		Recreation area - New day use sites	signage	2.00	EA	5,000.00	10,000	-	0%	15,000	50%	10,946	-	16,419
46	Project		Recreation area - New day use sites	Operations and maintenance	5.00	YR	22,512.42	112,562	-	0%	400,000	255%	123,208	-	437,832
46	Project		Recreation area - New boat ramps	New boat ramps	4.00	EA	11,256.21	45,025	20,000	-56%	80,000	78%	49,283	21,892	87,566
46	Project		Non-motorized rec trails - JC Boyle to Iron Gate	Trail	20.00	MI	35,659.67	713,193	-	0%	1,267,200	78%	780,647	-	1,387,051
46	Project		Non-motorized rec trails - JC Boyle to Iron Gate	Signage	2.00	EA	5,000.00	10,000	-	0%	15,000	50%	10,946	-	16,419

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					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
46	Project		Non-motorized rec trails	Walking trails for recreation access to river	7.00	MI	35,659.67	249,618	158,400	-37%	316,800	27%	273,226	173,381	346,763
46	Project		Non-motorized rec trails - Walking/wildlife viewing/interpretive	Trail Grading	5.00	MI	35,659.67	178,298	-	0%	316,800	78%	195,162	-	346,763
46	Project		Non-motorized rec trails - Walking/wildlife viewing/interpretive	trash bins	1.00	EA	1,000.00	1,000	-	0%	1,000	0%	1,095	-	1,095
46	Project		Non-motorized rec trails - Walking/wildlife viewing/interpretive	Signage	2.00	EA	5,000.00	10,000	-	0%	15,000	50%	10,946	-	16,419
46	Project		General Conditions	Contractor overhead	15%	%	3,337,792.01	500,669	450,602	-10%	650,869	30%	548,022	493,219	712,428
46	Project		General Conditions	Contractor profit	8%	%	3,337,792.01	267,023	240,321	-10%	347,130	30%	292,278	263,050	379,962
46	Project		General Conditions	Insurance	1%	%	4,105,484.17	41,055	36,949	-10%	53,371	30%	44,938	40,444	58,419
46	Project		General Conditions	Bond	1%	%	4,105,484.17	41,055	36,949	-10%	53,371	30%	44,938	40,444	58,419
47			**FLOOD PROOFING**												
47	Project	10.010	Raise homes	Cost to raise homes and add 2 stairs	45.00	EA	30,187.71	1,358,447	1,086,758	-20%	1,765,981	30%	1,498,682	1,198,946	1,948,287
48			**PUBLIC HEALTH AND SAFETY**												
48	Project		Public Health and Safety	Cattle exclusion fencing	182,160	LF	11.90	2,167,704	2,489,116	15%	3,042,253	40%	2,363,345	2,713,766	3,316,825
50			**MITIGATION MEASURES**												
51			**GROUNDWATER IMPROVEMENTS**												
51	Project		Groundwater improvements	Outreach to well owners	1.00	SUM	55,000.00	55,000	55,000	0%	55,000	0%	59,488	59,488	59,488
51	Project		Groundwater improvements	Drill and install new monitoring wells	5.00	EA	16,000.00	80,000	48,000	-40%	80,000	0%	88,259	52,955	88,259
51	Project		Groundwater improvements	Sentinel water level monitoring of new wells and landowner for	36.00	MO	2,800.00	100,800	86,400	-14%	115,200	14%	115,743	99,208	132,278
51	Project		Groundwater improvements	WQ laboratory analytical testing	1.00	SUM	37,500.00	37,500	15,000	-60%	60,000	60%	41,371	16,548	66,194
51	Project		Groundwater improvements	Well replacements	20.00	EA	63,375.00	1,267,500	810,000	-36%	1,725,000	36%	1,483,366	947,950	2,018,782
51	Project		Groundwater improvements	Well abandonment	20.00	EA	2,625.00	52,500	30,000	-43%	75,000	43%	58,488	33,421	83,554
51	Project		Groundwater improvements	Temporary water supply	16.00	EA	3,406.25	54,500	36,000	-34%	73,000	34%	60,716	40,106	81,326
51	Project		Groundwater improvements	Permitting and Reporting	1.00	SUM	66,500.00	66,500	37,000	-44%	96,000	44%	74,084	41,220	106,949
52			**WATER SUPPLY/RIGHTS**												
52	Project		Water supply rights	Hay production	3,379	T	175.00	591,357	506,877	-14%	675,836	14%	652,403	559,203	745,604
52	Project		Water supply rights	Water supply for domestic use for water rights	1.00	LS	28.01	8,666	8,436	-3%	9,053	4%	9,561	9,306	9,988
52	Project		Water supply rights	Sediment removal at intakes	254	CY	500.00	126,999	63,500	-50%	190,499	50%	140,110	70,055	210,164
52	Project		Water supply rights	Groundwater wells - domestic	9.00	EA	10,000.00	90,000	40,000	-56%	100,000	11%	99,291	44,129	110,323
52	Project		Water supply rights	Groundwater wells - municipal	1.00	EA	100,000.00	100,000	93,000	-7%	100,000	0%	110,323	102,601	110,323
52	Project		Water supply rights	Sediment basin	39.00	EA	1,851.85	72,222	72,222	0%	72,222	0%	79,678	79,678	79,678
53			**CULTURAL RESOURCES**												
53			**2017/18 Support**												
53	Project		Cultural Resources Tasks	Generally	12.00	MO	168,958.33	2,027,500	1,824,750	-10%	2,230,250	10%	2,027,500	1,824,750	2,230,250
53			**2018/19 Support**												
53	Project		Cultural Resources Tasks	Generally	12.00	MO	168,958.33	2,027,500	1,824,750	-10%	2,230,250	10%	2,068,050	1,861,245	2,274,855
			2019 H2 Support												
53	Project		Task management	Principal Scientist/Planner	208	HR	900.00	187,200	168,480	-10%	205,920	10%	194,688	175,219	214,157
53	Project		Task 1.2A Agency consultation	Principal Scientist/Planner	83.20	HR	180.00	14,976	13,478	-10%	16,474	10%	15,575	14,018	17,133
53	Project		Task 1.2A Agency consultation	Senior Scientist/Planner	41.60	HR	160.00	6,656	5,990	-10%	7,322	10%	6,922	6,230	7,614
53	Project		Task 1.2B Tribal consultation and work plans	Principal Scientist/Planner	256	HR	180.00	46,080	41,472	-10%	50,688	10%	47,923	43,131	52,716
53	Project		Task 1.2B Tribal consultation and work plans	Senior Scientist/Planner	128	HR	160.00	20,480	18,432	-10%	22,528	10%	21,299	19,169	23,429
53	Project		Task 1.2B Tribal consultation and work plans	Technical Editor	16.00	HR	105.00	1,680	1,512	-10%	1,848	10%	1,747	1,572	1,922
53	Project		Task 1.2B Tribal consultation and work plans	GIS/CADD/Graphics	24.00	HR	90.00	2,160	1,944	-10%	2,376	10%	2,246	2,022	2,471
			2020-2024 Support												
53	Project		Task management	Principal Scientist/Planner	1,040	HR	180.00	187,200	168,480	-10%	205,920	10%	210,795	189,715	231,874
53	Project		Task 1.2A Agency consultation	Principal Scientist/Planner	416	HR	180.00	74,880	67,392	-10%	82,368	10%	84,318	75,886	92,750
53	Project		Task 1.2A Agency consultation	Senior Scientist/Planner	208	HR	160.00	33,280	29,952	-10%	36,608	10%	37,475	33,727	41,222
53	Project		Task 1.2B Tribal consultation and work plans	Principal Scientist/Planner	1,280	HR	180.00	230,400	207,360	-10%	253,440	10%	259,440	233,496	285,384
53	Project		Task 1.2B Tribal consultation and work plans	Senior Scientist/Planner	640	HR	160.00	102,400	92,160	-10%	112,640	10%	115,307	103,776	126,837
53	Project		Task 1.2B Tribal consultation and work plans	Technical Editor	80.00	HR	105.00	8,400	7,560	-10%	9,240	10%	9,459	8,513	10,405
53	Project		Task 1.2B Tribal consultation and work plans	GIS/CADD/Graphics	120	HR	90.00	10,800	9,720	-10%	11,880	10%	12,161	10,945	13,377
53	Project		Task 2.6L Curation	Principal Scientist/Planner	80.00	HR	180.00	14,400	12,960	-10%	15,840	10%	16,110	14,499	17,721
53	Project		Task 2.6L Curation	Scientist/Planner	1,640	HR	120.00	196,800	177,120	-10%	216,480	10%	220,165	198,148	242,181
53	Project		Task 2.6L Curation	Curation	410	EA	500.00	205,000	184,500	-10%	225,500	10%	229,338	206,405	252,272
53	Project		Task 2.6L Curation	Other direct costs	1.00	SUM	5,000.00	5,000	4,500	-10%	5,500	10%	5,594	5,034	6,153

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Principal Scientist/Planner	200	HR	180.00	36,000	32,400	-10%	39,600	10%	38,938	35,044	42,831
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Senior Scientist/Planner	290	HR	160.00	46,400	41,760	-10%	51,040	10%	50,186	45,168	55,205
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Scientist/Planner	1,180	HR	120.00	141,600	127,440	-10%	155,760	10%	153,155	137,839	168,470
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Technical Editor	40.00	HR	105.00	4,200	3,780	-10%	4,620	10%	4,543	4,088	4,997
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Junior Scientist/Planner	10.00	HR	95.00	950	855	-10%	1,045	10%	1,028	925	1,130
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	GIS/CADD/Graphics	100	HR	90.00	9,000	8,100	-10%	9,900	10%	9,734	8,761	10,708
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Tribal monitor subcontract	149	DA	617.00	91,933	82,740	-10%	101,126	10%	99,435	89,491	109,378
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Travel and perdiem	1.00	SUM	35,858.00	35,858	32,272	-10%	39,444	10%	38,784	34,906	42,662
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Principal Scientist/Planner	200	HR	180.00	36,000	32,400	-10%	39,600	10%	40,495	36,446	44,545
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Senior Scientist/Planner	98.00	HR	160.00	15,680	14,112	-10%	17,248	10%	17,638	15,874	19,402
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Scientist/Planner	972	HR	120.00	116,640	104,976	-10%	128,304	10%	131,204	118,084	144,325
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Technical Editor	40.00	HR	105.00	4,200	3,780	-10%	4,620	10%	4,724	4,252	5,197
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Junior Scientist/Planner	20.00	HR	95.00	1,900	1,710	-10%	2,090	10%	2,137	1,924	2,351
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	GIS/CADD/Graphics	120	HR	90.00	10,800	9,720	-10%	11,880	10%	12,149	10,934	13,363
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Field Technician	768	HR	75.00	57,600	51,840	-10%	63,360	10%	64,792	58,313	71,271
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Tribal monitor subcontract	77.00	DA	647.85	49,884	44,896	-10%	54,873	10%	56,113	50,502	61,725
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Travel and perdiem	1.00	SUM	30,900.00	30,900	27,810	-10%	33,990	10%	34,758	31,282	38,234
53	Project		Task 2.6N Discoveries - Burial recovery	Human remains	100	EA	15,000.00	1,500,000	1,350,000	-10%	1,650,000	10%	1,689,061	1,520,155	1,857,968
53	Project		Task 2.6N Discoveries - Burial recovery	Other direct costs	1.00	SUM	500.00	500	450	-10%	550	10%	563	507	619
53	Project		Task 2.6N Discoveries - Arch resources	Archaelogical unit cost	60.00	EA	30,000.00	1,800,000	1,620,000	-10%	1,980,000	10%	2,026,874	1,824,186	2,229,561
53	Project		Task 2.6N Discoveries - Arch resources	Other direct costs	1.00	SUM	500.00	500	450	-10%	550	10%	563	507	619
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Principal Scientist/Planner	240	HR	180.00	43,200	38,880	-10%	47,520	10%	47,660	42,894	52,426
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Senior Scientist/Planner	1,808	HR	160.00	289,280	260,352	-10%	318,208	10%	319,143	287,229	351,057
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Scientist/Planner	1,928	HR	120.00	231,360	208,224	-10%	254,496	10%	255,244	229,719	280,768
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Technical Editor	40.00	HR	105.00	4,200	3,780	-10%	4,620	10%	4,634	4,170	5,097
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Junior Scientist/Planner	40.00	HR	95.00	3,800	3,420	-10%	4,180	10%	4,192	3,773	4,612
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	GIS/CADD/Graphics	120	HR	90.00	10,800	9,720	-10%	11,880	10%	11,915	10,723	13,106
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Field Technician	7,680	HR	75.00	576,000	518,400	-10%	633,600	10%	635,462	571,915	699,008
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Tribal monitor subcontract	452	EA	617.00	278,884	250,996	-10%	306,772	10%	307,674	276,906	338,441
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Other direct costs	1.00	SUM	127,984.00	127,984	115,186	-10%	140,782	10%	141,196	127,076	155,316
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Principal Scientist/Planner	240	HR	180.00	43,200	38,880	-10%	47,520	10%	52,586	47,328	57,845
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Senior Scientist/Planner	1,176	HR	160.00	188,160	169,344	-10%	206,976	10%	229,043	206,139	251,947
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Scientist/Planner	1,536	HR	120.00	184,320	165,888	-10%	202,752	10%	224,368	201,932	246,805
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Technical Editor	40.00	HR	105.00	4,200	3,780	-10%	4,620	10%	5,113	4,601	5,624
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Junior Scientist/Planner	40.00	HR	95.00	3,800	3,420	-10%	4,180	10%	4,626	4,163	5,088
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	GIS/CADD/Graphics	230	HR	90.00	20,700	18,630	-10%	22,770	10%	25,198	22,678	27,717
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Field Technician	7,680	HR	75.00	576,000	518,400	-10%	633,600	10%	701,151	631,036	771,267
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Tribal monitor subcontract	294	EA	647.85	190,468	171,421	-10%	209,515	10%	231,852	208,667	255,037
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Other direct costs	1.00	SUM	57,448.00	57,448	51,703	-10%	63,193	10%	69,930	62,937	76,923
53	Project		TCP Project allowance	TCP Project allowance	1.00	SUM	1,000,000.00	1,000,000	1,000,000	0%	1,000,000	0%	1,000,000	1,000,000	1,000,000
53	Project		Cultural resources allowance	Allowance for additional discoveries (reconciled with risk log)	1.00	SUM	1,000,000.00	1,000,000	1,000,000	0%	1,000,000	0%	1,000,000	1,000,000	1,000,000
60			**MONITORING AND OTHER COSTS**												
61			**AQUATIC RESOURCES**												
61	Project		Mainstem spawning (AR-1)	Tributory confluence monitoring (passage)	960	HR	46.13	44,280	39,852	-10%	66,420	50%	48,866	43,980	73,299
61	Project		Mainstem spawning (AR-1)	Confluence Area Maintenance (downstream tribs)	900	HR	46.13	41,513	37,361	-10%	62,269	50%	45,812	41,231	68,718
61	Project		Mainstem spawning (AR-1)	Confluence Area Maintenance (upstream tribs)	400	HR	102.50	41,000	36,900	-10%	61,500	50%	45,246	40,722	67,870
61	Project		Mainstem spawning (AR-1)	Mainstem Spawning Gravel Survey (45.3 miles)	100	HR	148.63	14,863	13,376	-10%	22,294	50%	16,402	14,762	24,603
61	Project		Mainstem spawning (AR-1)	Tributary Spawning Gravel Survey (13.9 miles)	200	HR	102.50	20,500	18,450	-10%	30,750	50%	22,623	20,361	33,935
61	Project		Mainstem spawning (AR-1)	Reporting and Coordination	1,280	HR	102.50	131,200	118,080	-10%	196,800	50%	144,789	130,310	217,183
61	Project		Mainstem spawning (AR-1)	Spawning Gravel Augmentation	16,132	CY	256.25	4,133,825	3,720,443	-10%	6,200,738	50%	4,561,971	4,105,774	6,842,957
61	Project		Mainstem spawning (AR-1)	Laborer (30 days)	240	HR	35.88	8,610	7,749	-10%	12,915	50%	9,502	8,552	14,253
61	Project		Mainstem spawning (AR-1)	200 Class Excavator (30 days)	240	HR	256.25	61,500	55,350	-10%	92,250	50%	67,870	61,083	101,804
61	Project		Juvenile outmigration (AR-2)	Tributary Confluence Monitoring (Passage)	960	HR	46.13	44,280	39,852	-10%	66,420	50%	48,866	43,980	73,299
61	Project		Juvenile outmigration (AR-2)	Tributary Confluence Monitoring (WQ)	960	HR	46.13	44,280	39,852	-10%	66,420	50%	48,866	43,980	73,299
61	Project		Juvenile outmigration (AR-2)	2018 Mainstem Winter Seining Recon	400	HR	107.63	43,050	38,745	-10%	64,575	50%	47,509	42,758	71,263
61	Project		Juvenile outmigration (AR-2)	2019 Mainstem Winter Seining	400	HR	153.75	61,500	55,350	-10%	92,250	50%	67,870	61,083	101,804
61	Project		Juvenile outmigration (AR-2)	Fish Transport (1 Truck)	400	HR	46.13	18,450	16,605	-10%	27,675	50%	20,361	18,325	30,541
61	Project		Juvenile outmigration (AR-2)	Fish Rescue and Relocation Crew	1,120	HR	153.75	172,200	154,980	-10%	258,300	50%	190,035	171,032	285,053
61	Project		Juvenile outmigration (AR-2)	Fish Transport (2 Trucks)	3,360	HR	46.13	154,980	139,482	-10%	232,470	50%	171,032	153,928	256,547
61	Project		Juvenile outmigration (AR-2)	Reporting and Coordination	1,280	HR	102.50	131,200	118,080	-10%	196,800	50%	144,789	130,310	217,183
61	Project		Juvenile outmigration (AR-2)	Miscellaneous Equipment	5.00	EA	6,150.00	30,750	27,675	-10%	46,125	50%	33,935	30,541	50,902
61	Project		Juvenile outmigration (AR-2)	H2O Monitoring Equipment	5.00	EA	30,750.00	153,750	138,375	-10%	230,625	50%	169,674	152,707	254,511

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					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
61	Project		Juvenile outmigration (AR-2)	H2O Monitoring Equipment	26.00	EA	307.50	7,995	7,196	-10%	11,993	50%	8,823	7,941	13,235
61	Project		Juvenile outmigration (AR-2)	Technician Equipment	14.00	EA	1,230.00	17,220	15,498	-10%	25,830	50%	19,004	17,103	28,505
61	Project		Juvenile outmigration (AR-2)	Transport Vehicle Rental ($300/day for 21 days)	672	HR	46.13	30,996	27,896	-10%	46,494	50%	34,206	30,786	51,309
61	Project		Juvenile outmigration (AR-2)	Transport Vehicle Operational Cost ($0.75/mi)	53,760	MI	0.92	49,594	44,634	-10%	74,390	50%	54,730	49,257	82,095
61	Project		Sucker rescue and relocation plan (AR-6)	Sucker Recapture Study (Spring and Fall)	280	HR	307.50	86,100	77,490	-10%	129,150	50%	95,018	85,516	142,526
61	Project		Sucker rescue and relocation plan (AR-6)	Sucker Salvage	280	HR	307.50	86,100	77,490	-10%	129,150	50%	95,018	85,516	142,526
61	Project		Sucker rescue and relocation plan (AR-6)	Sucker Transport (1 Truck)	140	HR	46.13	6,458	5,812	-10%	9,686	50%	7,126	6,414	10,689
61	Project		Sucker rescue and relocation plan (AR-6)	Reporting and Coordination	960	HR	102.50	98,400	88,560	-10%	147,600	50%	108,591	97,732	162,887
61	Project		Sucker rescue and relocation plan (AR-6)	Boat Electrofisher	300	HR	36.90	11,070	9,963	-10%	16,605	50%	12,217	10,995	18,325
61	Project		Sucker rescue and relocation plan (AR-6)	Boats (2 boats)	224	HR	92.25	20,664	18,598	-10%	30,996	50%	22,804	20,524	34,206
61	Project		Sucker rescue and relocation plan (AR-6)	Technician Equipment	12.00	EA	1,230.00	14,760	13,284	-10%	22,140	50%	16,289	14,660	24,433
61	Project		Sucker rescue and relocation plan (AR-6)	Tagging Equipment	1.00	EA	12,300.00	12,300	11,070	-10%	18,450	50%	13,574	12,217	20,361
61	Project		Sucker rescue and relocation plan (AR-6)	Transport Vehicle Rental ($300/day)	168	HR	46.13	7,749	6,974	-10%	11,624	50%	8,552	7,696	12,827
61	Project		Sucker rescue and relocation plan (AR-6)	Transport Vehicle Operational Cost ($0.75/mi)	7,200	MI	0.92	6,642	5,978	-10%	9,963	50%	7,330	6,597	10,995
61	Project		Freshwater mussel relocation (AR-7)	Freshwater Mussel Reconnaissance	280	HR	107.63	30,135	27,122	-10%	45,203	50%	33,256	29,931	49,884
61	Project		Freshwater mussel relocation (AR-7)	Mussel Salvage and Relocation	700	HR	107.63	75,338	67,804	-10%	113,006	50%	83,140	74,826	124,710
61	Project		Freshwater mussel relocation (AR-7)	Mussel Transport (1 Truck)	140	HR	46.13	6,458	5,812	-10%	9,686	50%	7,126	6,414	10,689
61	Project		Freshwater mussel relocation (AR-7)	Reporting and Coordination	960	HR	102.50	98,400	88,560	-10%	147,600	50%	108,591	97,732	162,887
61	Project		Freshwater mussel relocation (AR-7)	Miscellaneous Equipment	1.00	EA	6,150.00	6,150	5,535	-10%	9,225	50%	6,787	6,108	10,180
61	Project		Freshwater mussel relocation (AR-7)	Diving Gear	5.00	EA	1,230.00	6,150	5,535	-10%	9,225	50%	6,787	6,108	10,180
61	Project		Freshwater mussel relocation (AR-7)	Technician Equipment	10.00	EA	1,230.00	12,300	11,070	-10%	18,450	50%	13,574	12,217	20,361
61	Project		Freshwater mussel relocation (AR-7)	Transport Vehicle Rental ($300/day)	8.00	HR	922.50	7,380	6,642	-10%	11,070	50%	8,144	7,330	12,217
61	Project		Freshwater mussel relocation (AR-7)	Transport Vehicle Operational Cost ($0.75/mi)	14,000	MI	0.92	12,915	11,624	-10%	19,373	50%	14,253	12,827	21,379
62			**TERRESTRIAL RESOURCES MEASURES**												
62	Project		Habitat restoration plan (TER-1)	Annual maintenance and monitoring	3.00	EA	68,019.00	204,057	122,434	-40%	269,496	32%	248,394	149,036	328,051
62	Project		Habitat restoration plan (TER-1)	Annual reporting	3.00	EA	9,840.00	29,520	17,712	-40%	37,800	28%	35,934	21,560	46,013
62	Project		Habitat restoration plan (TER-1)	Post construction regulatory compliance and reporting	1.00	EA	14,760.00	14,760	8,856	-40%	18,900	28%	18,676	11,206	23,915
62	Project		Nesting Bird Surveys (TER-2); Osprey nests	Remove all nest platforms near construction, year 1	1.00	EA	53,640.30	53,640	-	0%	67,848	26%	58,017	-	73,384
62	Project		Nesting Bird Surveys (TER-2); Osprey nests	Nest exclusion monitoring, year 1	1.00	EA	110,896.80	110,897	-	0%	188,048	70%	119,946	-	203,393
62	Project		Nesting Bird Surveys (TER-2); Osprey nests	Remove all nest platforms near construction, year 2	1.00	EA	33,333.00	33,333	-	0%	46,632	40%	37,495	-	52,455
62	Project		Nesting Bird Surveys (TER-2); Osprey nests	Nest exclusion monitoring, year 2	1.00	EA	110,896.80	110,897	-	0%	188,048	70%	124,744	-	211,528
62	Project		Nesting Bird Surveys (TER-2); Osprey nests	Regulatory compliance and reporting, permitting	1.00	EA	9,840.00	9,840	-	0%	12,600	28%	11,069	-	14,173
62	Project		Nesting Bird Surveys (TER-2); Cliff swallow nests	Remove nests near construction, year 1	1.00	EA	28,019.40	28,019	-	0%	55,048	96%	30,306	-	59,540
62	Project		Nesting Bird Surveys (TER-2); Cliff swallow nests	Nest exclusion monitoring, year 1	1.00	EA	68,839.00	68,839	-	0%	146,600	113%	74,456	-	158,563
62	Project		Nesting Bird Surveys (TER-2); Cliff swallow nests	Remove nests near construction, year 2	1.00	EA	22,463.90	22,464	-	0%	27,320	22%	25,269	-	30,731
62	Project		Nesting Bird Surveys (TER-2); Cliff swallow nests	Nest exclusion monitoring, year 2	1.00	EA	68,839.00	68,839	-	0%	146,600	113%	77,435	-	164,905
62	Project		Nesting Bird Surveys (TER-2); Cliff swallow nests	Regulatory compliance and reporting, permitting	1.00	EA	7,380.00	7,380	-	0%	12,600	71%	8,301	-	14,173
62	Project		Nesting Bird Surveys (TER-2); Biological monitoring	Nesting bird surveys prior to vegetation clearing	1.00	EA	59,741.10	59,741	-	0%	212,568	256%	65,908	-	234,512
62	Project		Nesting Bird Surveys (TER-2); Biological monitoring	Daily biological monitoring throughout construction	3,114	HR	109.47	340,882	-	0%	540,568	59%	376,072	-	596,372
62	Project		Nesting Bird Surveys (TER-2); Biological monitoring	Regulatory compliance and reporting during construction	1.00	EA	63,960.00	63,960	23,665	-63%	63,960	0%	70,563	26,108	70,563
62	Project		Nesting Bird Surveys (TER-2); Biological monitoring	Special status wildlife and habitat monitoring	1.00	EA	61,008.00	61,008	-	0%	107,520	76%	71,371	-	125,783
62	Project		Wetlands at Reservoirs (TER-5)	Wetland Project	10.00	AC	35,875.00	358,750	-	0%	700,000	95%	454,632	-	887,086
62	Project		Wetlands at Reservoirs (TER-5)	Monitoring	960	HR	64.79	62,197	-	0%	73,920	19%	78,820	-	93,676
62	Project		Special Status Bats (TER-6)	Pre-Demolition Exclusion	1.00	SUM	74,536.36	74,536	40,828	-45%	72,718	-2%	79,068	43,311	77,140
62	Project		Special Status Bats (TER-6)	Bat Exclusion Plan (Draft/Final)	1.00	SUM	8,171.51	8,172	7,972	-2%	7,972	-2%	8,668	8,457	8,457
62	Project		Special Status Bats (TER-6)	Field Prep/Health and Safety	1.00	SUM	2,882.20	2,882	2,812	-2%	2,812	-2%	3,057	2,983	2,983
62	Project		Special Status Bats (TER-6)	Biological Monitoring During Demolition	1.00	SUM	96,129.83	96,130	96,130	0%	96,130	0%	106,469	106,469	106,469
62	Project		Special Status Bats (TER-6)	Agency Coordination/Meetings	1.00	SUM	11,233.18	11,233	11,233	0%	11,233	0%	12,109	12,109	12,109
62	Project		Special Status Bats (TER-6)	Design Replacement Roosts	1.00	SUM	11,697.71	11,698	11,698	0%	11,698	0%	12,411	12,411	12,411
62	Project		Special Status Bats (TER-6)	Construct/Install Replacement Roosts	1.00	SUM	14,481.82	14,482	-	0%	25,643	77%	15,611	-	27,642
62	Project		Special Status Bats (TER-6)	Monitor Replacement Roosts (3 years)	1.00	SUM	145,169.93	145,170	-	0%	239,027	65%	170,090	-	280,058
63			**WATER QUALITY MONITORING**												
63	Project		Field installation & equipment	Keno	1.00	SUM	60,900.00	60,900	38,000	-38%	79,170	30%	63,336	39,520	82,337
63	Project		Field installation & equipment	JC Boyle	1.00	SUM	158,550.00	158,550	120,000	-24%	206,115	30%	171,488	129,792	222,934
63	Project		Field installation & equipment	Copco	1.00	SUM	90,300.00	90,300	-	0%	117,390	30%	97,668	-	126,969
63	Project		Field installation & equipment	Iron Gate	1.00	SUM	77,700.00	77,700	74,000	-5%	101,010	30%	80,808	76,960	105,050
63	Project		Field installation & equipment	Walker Bridge	1.00	SUM	80,850.00	80,850	77,000	-5%	105,105	30%	87,447	83,283	113,682
63	Project		Field installation & equipment	Seiad Valley	1.00	SUM	65,100.00	65,100	42,000	-35%	84,630	30%	70,412	45,427	91,536
63	Project		Field installation & equipment	Orleans	1.00	SUM	67,200.00	67,200	44,000	-35%	87,360	30%	69,888	45,760	90,854
63	Project		Field installation & equipment	Klamath	1.00	SUM	61,950.00	61,950	59,000	-5%	80,535	30%	64,428	61,360	83,756
63	Project		Field installation & equipment	Shasta	1.00	SUM	68,250.00	68,250	45,000	-34%	88,725	30%	76,772	50,619	99,804

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
63	Project		Field installation & equipment	Scott	1.00	SUM	68,250.00	68,250	45,000	-34%	88,725	30%	76,772	50,619	99,804
63	Project		Field installation & equipment	Salmon	0.00	SUM	-	-	-	0%	-	0%	-	-	-
63	Project		Field installation & equipment	Trinity	0.00	SUM	-	-	-	0%	-	0%	-	-	-
63	Project		Field installation & equipment	Equipment replacement	1.00	SUM	315,000.00	315,000	200,000	-37%	500,000	59%	388,654	246,765	616,912
63	Project		Operation & Maintenance	Keno	17.00	QTR	16,800.00	285,600	130,000	-54%	464,000	62%	326,120	148,444	529,831
63	Project		Operation & Maintenance	JC Boyle	21.00	QTR	16,800.00	352,800	170,000	-52%	400,000	13%	427,595	206,041	484,802
63	Project		Operation & Maintenance	Copco	13.00	QTR	16,800.00	218,400	-	0%	400,000	83%	254,135	-	465,449
63	Project		Operation & Maintenance	Iron Gate	25.00	QTR	4,200.00	105,000	92,000	-12%	116,000	10%	124,895	109,432	137,979
63	Project		Operation & Maintenance	Walker Bridge	13.00	QTR	11,550.00	150,150	132,000	-12%	275,000	83%	174,718	153,598	319,996
63	Project		Operation & Maintenance	Seiad Valley	21.00	QTR	4,200.00	88,200	36,000	-59%	100,000	13%	106,899	43,632	121,201
63	Project		Operation & Maintenance	Orleans	25.00	QTR	4,200.00	105,000	42,000	-60%	116,000	10%	124,895	49,958	137,979
63	Project		Operation & Maintenance	Klamath	25.00	QTR	4,200.00	105,000	36,000	-66%	116,000	10%	124,895	42,821	137,979
63	Project		Operation & Maintenance	Shasta	9.00	QTR	5,250.00	47,250	27,000	-43%	105,000	122%	56,022	32,013	124,494
63	Project		Operation & Maintenance	Scott	9.00	QTR	5,250.00	47,250	27,000	-43%	105,000	122%	56,022	32,013	124,494
63	Project		Operation & Maintenance	Salmon	0.00	SUM	-	-	-	0%	45,000	0%	-	-	50,619
63	Project		Operation & Maintenance	Trinity	0.00	SUM	-	-	-	0%	45,000	0%	-	-	50,619
63	Project		Sediment, Sampling & Recording	Keno	17.00	QTR	12,600.00	214,200	1,040,000	386%	348,000	62%	244,590	1,187,552	397,373
63	Project		Sediment, Sampling & Recording	JC Boyle	21.00	QTR	15,750.00	330,750	170,000	-49%	375,000	13%	400,871	206,041	454,502
63	Project		Sediment, Sampling & Recording	Copco	13.00	QTR	15,750.00	204,750	-	0%	375,000	83%	238,252	-	436,359
63	Project		Sediment, Sampling & Recording	Iron Gate	25.00	QTR	25,200.00	630,000	552,000	-12%	696,000	10%	749,370	656,591	827,875
63	Project		Sediment, Sampling & Recording	Walker Bridge	13.00	QTR	25,200.00	327,600	288,000	-12%	600,000	83%	381,203	335,123	698,174
63	Project		Sediment, Sampling & Recording	Seiad Valley	21.00	QTR	25,200.00	529,200	216,000	-59%	600,000	13%	641,393	261,793	727,203
63	Project		Sediment, Sampling & Recording	Orleans	25.00	QTR	25,200.00	630,000	252,000	-60%	696,000	10%	749,370	299,748	827,875
63	Project		Sediment, Sampling & Recording	Klamath	25.00	QTR	16,800.00	420,000	288,000	-31%	464,000	10%	499,580	342,569	551,917
63	Project		Sediment, Sampling & Recording	Shasta	9.00	QTR	23,100.00	207,900	99,000	-52%	462,000	122%	246,498	117,380	547,773
63	Project		Sediment, Sampling & Recording	Scott	9.00	QTR	23,100.00	207,900	99,000	-52%	462,000	122%	246,498	117,380	547,773
63	Project		Sediment, Sampling & Recording	Salmon	0.00	SUM	-	-	-	0%	198,000	0%	-	-	222,723
63	Project		Sediment, Sampling & Recording	Trinity	0.00	SUM	-	-	-	0%	198,000	0%	-	-	222,723
63	Project		Sediment, Sampling & Recording	Data Management	1.00	SUM	462,000.00	462,000	293,000	-37%	600,600	30%	567,821	360,112	738,168
63	Project		Sediment, Sampling & Recording	ODCs	1.00	SUM	163,800.00	163,800	115,000	-30%	372,000	127%	190,635	133,840	432,943
63	Project		Sediment, Sampling & Recording	Esturary and river sampling for toxins	4.00	SUM	52,500.00	210,000	200,000	-5%	273,000	30%	234,041	222,896	304,253
63	Project		Sediment, Sampling & Recording	TSS and NTU laboratory relationship study by USGS	1.00	SUM	157,500.00	157,500	150,000	-5%	204,750	30%	175,531	167,172	228,190
63	Project		Aerial photos & LiDAR	Annual aircraft surveys + 1 after 5 year gap	5.00	EA	63,000.00	315,000	283,500	-10%	472,500	50%	379,026	341,123	568,539
63	Project		Volitional fish passage monitoring	Annual field survey; 2 wk field survey + study.	5.00	EA	26,250.00	131,250	118,125	-10%	196,875	50%	157,928	142,135	236,891
63	Project		Drone LiDAR in site specific locations, analysis & reporting	Drone LiDAR in site specific locations, analysis & reporting	4.00	EA	21,000.00	84,000	75,600	-10%	126,000	50%	96,452	86,807	144,679
63	Project		Surface comparison and analysis of sediment erosion	Surface comparison and analysis of sediment erosion	4.00	EA	21,000.00	84,000	75,600	-10%	126,000	50%	96,452	86,807	144,679

KLAMATH RIVER RENEWAL CORPORATION

A.2 Cost Estimate - Partial Removal

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Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
10			**OVERSIGHT**												
10	Project		Compensation & Benefits	7/16-6/17 (year 1)	1	SUM	29,017.00	29,017	29,017	0%	29,017	0%	29,017	29,017	29,017
10	Project		Compensation & Benefits	7/17-12/19 (2.5 years)	1	SUM	1,557,347.00	1,557,347	1,557,347	0%	1,557,347	0%	1,557,347	1,557,347	1,557,347
10	Project		Compensation & Benefits	1/20-6/22 (2.5 years)	1	SUM	3,276,136.00	3,276,136	3,276,136	0%	3,276,136	0%	3,276,136	3,276,136	3,276,136
10	Project		Compensation & Benefits	7/22-6/27 (5 years)	1	SUM	193,967.00	193,967	193,967	0%	193,967	0%	193,967	193,967	193,967
10	Project		Travel and Meetings	7/16-6/17 (year 1)	1	SUM	45,223.00	45,223	45,223	0%	45,223	0%	45,223	45,223	45,223
10	Project		Travel and Meetings	7/17-12/19 (2.5 years)	1	SUM	272,538.00	272,538	272,538	0%	272,538	0%	272,538	272,538	272,538
10	Project		Travel and Meetings	1/20-6/22 (2.5 years)	1	SUM	450,000.00	450,000	450,000	0%	450,000	0%	450,000	450,000	450,000
10	Project		Travel and Meetings	7/22-6/27 (5 years)	1	SUM	45,000.00	45,000	45,000	0%	45,000	0%	45,000	45,000	45,000
10	Project		Dam Removal Contractors	Land Survey Contractor	1	SUM	1,020,000.00	1,020,000	1,020,000	0%	1,020,000	0%	1,020,000	1,020,000	1,020,000
10	Project		Professional Services; CEA Services & Expenses	7/16-6/17 (year 1)	1	SUM	1,054,732.00	1,054,732	1,054,732	0%	1,054,732	0%	1,054,732	1,054,732	1,054,732
10	Project		Professional Services; CEA Services & Expenses	7/17-12/19 (2.5 years)	1	SUM	2,386,949.16	2,386,949	2,386,949	0%	2,386,949	0%	2,386,949	2,386,949	2,386,949
10	Project		Professional Services; CEA Services & Expenses	1/20-6/22 (2.5 years)	1	SUM	2,375,442.96	2,375,443	2,375,443	0%	2,375,443	0%	2,375,443	2,375,443	2,375,443
10	Project		Professional Services; CEA Services & Expenses	7/22-6/27 (5 years)	1	SUM	563,853.35	563,853	563,853	0%	563,853	0%	563,853	563,853	563,853
10	Project		Legal Services; Power + Water, General Counsel	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Legal Services; Power + Water, General Counsel	7/17-12/19 (2.5 years)	1	SUM	500,863.00	500,863	500,863	0%	500,863	0%	500,863	500,863	500,863
10	Project		Legal Services; Power + Water, General Counsel	1/20-6/22 (2.5 years)	1	SUM	694,448.00	694,448	694,448	0%	694,448	0%	694,448	694,448	694,448
10	Project		Legal Services; Power + Water, General Counsel	7/22-6/27 (5 years)	1	SUM	240,843.00	240,843	240,843	0%	240,843	0%	240,843	240,843	240,843
10	Project		Legal Services; Hawkins, General Counsel	7/16-6/17 (year 1)	1	SUM	1,109,894.00	1,109,894	1,109,894	0%	1,109,894	0%	1,109,894	1,109,894	1,109,894
10	Project		Legal Services; Hawkins, General Counsel	7/17-12/19 (2.5 years)	1	SUM	718,211.00	718,211	718,211	0%	718,211	0%	718,211	718,211	718,211
10	Project		Legal Services; Hawkins, General Counsel	1/20-6/22 (2.5 years)	1	SUM	373,112.00	373,112	373,112	0%	373,112	0%	373,112	373,112	373,112
10	Project		Legal Services; Hawkins, General Counsel	7/22-6/27 (5 years)	1	SUM	86,063.00	86,063	86,063	0%	86,063	0%	86,063	86,063	86,063
10	Project		Legal Services; Hawkins, Construction Counsel	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Legal Services; Hawkins, Construction Counsel	7/17-12/19 (2.5 years)	1	SUM	2,551,000.00	2,551,000	2,551,000	0%	2,551,000	0%	2,551,000	2,551,000	2,551,000
10	Project		Legal Services; Hawkins, Construction Counsel	1/20-6/22 (2.5 years)	1	SUM	600,000.00	600,000	600,000	0%	600,000	0%	600,000	600,000	600,000
10	Project		Legal Services; Hawkins, Construction Counsel	7/22-6/27 (5 years)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Board of Consultants	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Board of Consultants	7/17-12/19 (2.5 years)	1	SUM	905,850.00	905,850	905,850	0%	905,850	0%	905,850	905,850	905,850
10	Project		Board of Consultants	1/20-6/22 (2.5 years)	1	SUM	494,100.00	494,100	494,100	0%	494,100	0%	494,100	494,100	494,100
10	Project		Board of Consultants	7/22-6/27 (5 years)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Accounting & Audit Fees	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Accounting & Audit Fees	7/17-12/19 (2.5 years)	1	SUM	246,728.00	246,728	246,728	0%	246,728	0%	246,728	246,728	246,728
10	Project		Accounting & Audit Fees	1/20-6/22 (2.5 years)	1	SUM	612,823.00	612,823	612,823	0%	612,823	0%	612,823	612,823	612,823
10	Project		Accounting & Audit Fees	7/22-6/27 (5 years)	1	SUM	206,252.00	206,252	206,252	0%	206,252	0%	206,252	206,252	206,252
10	Project		Risk Management Services	7/16-6/17 (year 1)	1	SUM	44,519.00	44,519	44,519	0%	44,519	0%	44,519	44,519	44,519
10	Project		Risk Management Services	7/17-12/19 (2.5 years)	1	SUM	91,250.00	91,250	91,250	0%	91,250	0%	91,250	91,250	91,250
10	Project		Risk Management Services	1/20-6/22 (2.5 years)	1	SUM	135,000.00	135,000	135,000	0%	135,000	0%	135,000	135,000	135,000
10	Project		Risk Management Services	7/22-6/27 (5 years)	1	SUM	10,000.00	10,000	10,000	0%	10,000	0%	10,000	10,000	10,000
10	Project		Communications External Services	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Communications External Services	7/17-12/19 (2.5 years)	1	SUM	485,400.00	485,400	485,400	0%	485,400	0%	485,400	485,400	485,400
10	Project		Communications External Services	1/20-6/22 (2.5 years)	1	SUM	950,790.00	950,790	950,790	0%	950,790	0%	950,790	950,790	950,790
10	Project		Communications External Services	7/22-6/27 (5 years)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Insurance & Risk Management	7/16-6/17 (year 1)	1	SUM	25,138.00	25,138	25,138	0%	25,138	0%	25,138	25,138	25,138
10	Project		Insurance & Risk Management	7/17-12/19 (2.5 years)	1	SUM	195,451.00	195,451	195,451	0%	195,451	0%	195,451	195,451	195,451
10	Project		Insurance & Risk Management	1/20-6/22 (2.5 years)	1	SUM	405,475.00	405,475	405,475	0%	405,475	0%	405,475	405,475	405,475
10	Project		Insurance & Risk Management	7/22-6/27 (5 years)	1	SUM	107,895.00	107,895	107,895	0%	107,895	0%	107,895	107,895	107,895
10	Project		Project Specific Insurance	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Project Specific Insurance	7/17-12/19 (2.5 years)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Project Specific Insurance	1/20-6/22 (2.5 years)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Project Specific Insurance	7/22-6/27 (5 years)	1	SUM	100,000.00	100,000	100,000	0%	100,000	0%	100,000	100,000	100,000
10	Project		Admin, IT, Fees	7/16-6/17 (year 1)	1	SUM	38,991.00	38,991	38,991	0%	38,991	0%	38,991	38,991	38,991
10	Project		Admin, IT, Fees	7/17-12/19 (2.5 years)	1	SUM	52,426.00	52,426	52,426	0%	52,426	0%	52,426	52,426	52,426
10	Project		Admin, IT, Fees	1/20-6/22 (2.5 years)	1	SUM	65,973.00	65,973	65,973	0%	65,973	0%	65,973	65,973	65,973
10	Project		Admin, IT, Fees	7/22-6/27 (5 years)	1	SUM	30,732.00	30,732	30,732	0%	30,732	0%	30,732	30,732	30,732

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
10	Project		Project Management, AECOM	Detailed separately	1	sum	2,977,635.66	2,977,636	2,828,754	-5%	3,275,399	10%	2,977,636	2,828,754	3,275,399
10	Project		Outreach, AECOM	Detailed separately	1	sum	1,253,904.32	1,253,904	1,191,209	-5%	1,379,295	10%	1,253,904	1,191,209	1,379,295
20			**ENVIRONMENTAL COMPLIANCE & PERMITTING**												
21			**PERMITTING**												
21	Project		Permitting, AECOM	Detailed separately	1	sum	4,113,000.00	4,113,000	3,907,350	-5%	4,524,300	10%	4,113,000	3,907,350	4,524,300
21	Project		Environmental Legal Serivces; Perkins Coie	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
21	Project		Environmental Legal Serivces; Perkins Coie	7/17-12/19 (2.5 years)	1	SUM	1,537,641.00	1,537,641	1,537,641	0%	1,537,641	0%	1,537,641	1,537,641	1,537,641
21	Project		Environmental Legal Serivces; Perkins Coie	1/20-6/22 (2.5 years)	1	SUM	1,068,125.00	1,068,125	1,068,125	0%	1,068,125	0%	1,068,125	1,068,125	1,068,125
21	Project		Environmental Legal Serivces; Perkins Coie	7/22-6/27 (5 years)	1	SUM	-	-	-	0%	-	0%	-	-	-
22			**CEQA & FERC SUPPORT**												
22	Project		Agency Fees and Reimbursements	Oregon Department of Environmental Quality	1	SUM	97,000.00	97,000	97,000	0%	97,000	0%	97,000	97,000	97,000
22	Project		Agency Fees and Reimbursements	CA State Water Resources Control Board	1	SUM	58,950.00	58,950	58,950	0%	58,950	0%	58,950	58,950	58,950
22	Project		Agency Fees and Reimbursements	Still Water Sciences (SWRCB)	1	SUM	1,281,945.00	1,281,945	1,281,945	0%	1,281,945	0%	1,281,945	1,281,945	1,281,945
22	Project		Agency Fees and Reimbursements	Other Environmental Studies	1	SUM	480,000.00	480,000	480,000	0%	480,000	0%	480,000	480,000	480,000
30			**ENGINEERING & CONSTRUCTION MANAGEMENT**												
31			**ENGINEERING - DESIGN DATA**												
31	Project		Engineering - Design Data	Detailed separately	1	sum	1,992,000.00	1,992,000	1,892,400	-5%	2,191,200	10%	1,992,000	1,892,400	2,191,200
32			**ENGINEERING - AECOM**												
32	Project		Construction Cost Estimate	Detailed separately	1	sum	295,000.00	295,000	280,250	-5%	324,500	10%	295,000	280,250	324,500
32	Project		AECOM Preliminary Design & Mitigation	Detailed separately	1	sum	3,585,000.00	3,585,000	3,405,750	-5%	3,943,500	10%	3,585,000	3,405,750	3,943,500
32	Project		AECOM Final Design & Construction Support	Detailed separately	1	sum	1,950,000.00	1,950,000	1,852,500	-5%	2,145,000	10%	1,950,000	1,852,500	2,145,000
32	Project		Review of PDB Final Design	Detailed separately	1	sum	285,000.00	285,000	270,750	-5%	313,500	10%	285,000	270,750	313,500
33			**ENGINEERING - PDB**												
33	Project		Engineering - PDB	Detailed separately	1	sum	6,513,000.00	6,513,000	5,861,700	-10%	8,466,900	30%	6,513,000	5,861,700	8,466,900
34			**PROCUREMENT**												
34	Project		Procurement	Detailed separately	1	sum	1,011,574.86	1,011,575	960,996	-5%	1,112,732	10%	1,011,575	960,996	1,112,732
35			**CONSTRUCTION MANAGEMENT**												
35	Project		Construction Management	Detailed separately	1	sum	10,616,599.33	10,616,599	10,085,769	-5%	11,678,259	10%	10,616,599	10,085,769	11,678,259
40			**CONSTRUCTION**												
41			**DAM REMOVAL**												
41	JC Boyle	1.001	JC Boyle Dam Removal	Removal of Diversion Conduit Bulkheads	14.00	CY	1,323.00	18,522	17,596	-5%	19,448	5%	20,835	19,793	21,876
41	JC Boyle	1.002	JC Boyle Dam Removal	Remove Water from behind Tailrace Cofferdam	500,000	GAL	0.01	-	4,778	0%	6,105	0%	-	-	-
41	JC Boyle	1.003	JC Boyle Dam Removal	Provide Dewatering behind Tailrace Cofferdam	1.00	LS	61,036.38	-	54,933	0%	70,192	0%	-	-	-
41	JC Boyle	1.004	JC Boyle Dam Removal	Construct Embankment Cofferdam in Tailrace around	2,000	CY	108.78	-	195,799	0%	261,065	0%	-	-	-
41	JC Boyle	1.005	JC Boyle Dam Removal	Remove Spillway Concrete	2,100	CY	330.13	693,263	589,274	-15%	831,916	20%	779,827	662,853	935,793
41	JC Boyle	1.006	JC Boyle Dam Removal	Remove Monorail Structural Steel Components	15,000	LB	0.64	9,570	8,613	-10%	12,919	35%	10,765	9,688	14,533
41	JC Boyle	1.007	JC Boyle Dam Removal	Remove Fish Ladder Concrete	1,820	CY	333.49	606,952	546,257	-10%	667,647	10%	682,738	614,464	751,012
41	JC Boyle	1.008	JC Boyle Dam Removal	Remove Gravity Dam Section Concrete	600	CY	339.60	-	173,195	0%	244,511	0%	-	-	-
41	JC Boyle	1.009	JC Boyle Dam Removal	Remove Timber Equipment Ramp on left side of Dam	10,500	LB	0.66	6,969	5,924	-15%	9,409	35%	7,840	6,664	10,584
41	JC Boyle	1.010	JC Boyle Dam Removal	Remove Pressure-Treated Lumber from Footbridge around	3,600	SF	7.19	25,886	23,298	-10%	29,769	15%	29,119	26,207	33,486
41	JC Boyle	1.011	JC Boyle Dam Removal	Remove Storage Shed located on access road	4,480	SF	27.79	-	118,293	0%	136,970	0%	-	-	-
41	JC Boyle	1.012	JC Boyle Dam Removal	Remove Warehouse located on access road	2,580	SF	36.49	-	89,441	0%	103,564	0%	-	-	-
41	JC Boyle	1.013	JC Boyle Dam Removal	Remove Fire System Control Bldg. on left abutment	520	SF	26.00	13,521	12,845	-5%	14,873	10%	15,209	14,448	16,730
41	JC Boyle	1.014	JC Boyle Dam Removal	Remove Dam Communication Bldg. on left abutment	490	SF	27.21	13,332	12,666	-5%	14,666	10%	14,997	14,247	16,497
41	JC Boyle	1.015	JC Boyle Dam Removal	Remove Concrete Slab on left abutment for former Control	6.00	CY	1,778.57	10,671	9,604	-10%	12,272	15%	12,004	10,804	13,804
41	JC Boyle	1.016	JC Boyle Dam Removal	Remove 4'x5' Metal Hatch on top of Concrete Pull Box on left	1.00	CY	1,769.46	1,769	1,593	-10%	1,946	10%	1,990	1,791	2,189
41	JC Boyle	1.017	JC Boyle Dam Removal	Remove Reservoir Level Gauge House on Dam Crest	24.00	SF	138.69	3,328	3,162	-5%	3,661	10%	3,744	3,557	4,118
41	JC Boyle	1.018	JC Boyle Dam Removal	Upstream Riprap	2,200	CY	93.45	205,581	185,023	-10%	226,139	10%	231,251	208,126	254,376
41	JC Boyle	1.019	JC Boyle Dam Removal	Downstream Riprap	1,300	CY	93.02	120,930	108,837	-10%	133,023	10%	136,030	122,427	149,633
41	JC Boyle	1.020	JC Boyle Dam Removal	Miscellaneous Excavation	132,500	CY	10.42	1,380,126	1,173,107	-15%	1,656,151	20%	1,552,454	1,319,586	1,862,945
41	JC Boyle	1.021	JC Boyle Dam Removal	Cutoff Wall Concrete Demolition	70.00	CY	655.64	45,895	43,600	-5%	52,779	15%	51,626	49,044	59,369
41	JC Boyle	1.022	JC Boyle Dam Removal	Cutoff Wall Anchors	285	EA	12.86	3,664	3,481	-5%	4,030	10%	4,121	3,915	4,533
41	JC Boyle	1.023	JC Boyle Dam Removal	Remove & Dispose Hand Rails and Light Poles	5,000	LB	0.85	4,227	4,016	-5%	4,861	15%	4,755	4,517	5,468
41	JC Boyle	1.024	JC Boyle Dam Removal	Remove & Dispose Spillway Radial Gates and Hoists	124,000	LB	2.14	264,891	238,402	-10%	357,603	35%	297,967	268,170	402,255
41	JC Boyle	1.025	JC Boyle Dam Removal	Remove & Dispose Stop Logs and Slots (steel)	92,000	LB	0.94	86,725	78,053	-10%	104,070	20%	97,554	87,799	117,065
41	JC Boyle	1.026	JC Boyle Dam Removal	Remove & Dispose of 24" Slide Gate at Entrance to Fish	4,200	LB	0.70	2,919	2,773	-5%	4,233	45%	3,284	3,120	4,761
41	JC Boyle	1.026a	JC Boyle Dam Removal	Remove petroleum products from Red Bam Area	1,600	GAL	13.34	21,338	18,137	-15%	27,739	30%	24,002	20,402	31,203
41	JC Boyle	1.027	JC Boyle Dam Removal	Remove & Dispose of Spillway gate motor & control panel	1.00	EA	1,282.33	1,282	1,154	-10%	1,539	20%	1,442	1,298	1,731
41	JC Boyle	1.028	JC Boyle Dam Removal	Remove & Dispose of Distribution equipment, panelboards	1.00	EA	5,877.55	5,878	5,290	-10%	7,053	20%	6,611	5,950	7,934

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	JC Boyle	1.029	JC Boyle Dam Removal	Remove Powerhouse Concrete down to Elevation 3324.0	1,500	CY	546.51	-	737,786	0%	983,714	0%	-	-	-
41	JC Boyle	1.030	JC Boyle Dam Removal	Remove Structural Steel Item associated with Powerhouse	94,000	LB	0.63	-	53,166	0%	67,935	0%	-	-	-
41	JC Boyle	1.031	JC Boyle Dam Removal	Remove Warehouse near Powerhouse	5,060	SF	32.95	166,704	158,369	-5%	183,375	10%	187,520	178,144	206,272
41	JC Boyle	1.032	JC Boyle Dam Removal	Remove & Dispose of 2 - Governor oil systems	52,500	LB	0.80	-	39,833	0%	48,219	0%	-	-	-
41	JC Boyle	1.033	JC Boyle Dam Removal	Remove & Dispose of Cooling water and bearing oil systems	6,500	LB	1.06	-	6,215	0%	7,941	0%	-	-	-
41	JC Boyle	1.034	JC Boyle Dam Removal	Remove & Dispose of 2 - Francis Turbines	560,000	LB	0.75	-	354,624	0%	521,505	0%	-	-	-
41	JC Boyle	1.035	JC Boyle Dam Removal	Remove & Dispose of 150 Ton crane	240,000	LB	0.82	196,396	166,937	-15%	235,675	20%	220,919	187,781	265,103
41	JC Boyle	1.036	JC Boyle Dam Removal	Remove & Dispose of Compressed Air systems	1,100	LB	0.88	-	875	0%	1,216	0%	-	-	-
41	JC Boyle	1.037	JC Boyle Dam Removal	Remove & Dispose of 2 - CO2 systems	6,600	LB	0.99	-	5,853	0%	7,805	0%	-	-	-
41	JC Boyle	1.038	JC Boyle Dam Removal	Remove & Dispose of Plant Water and Fire Protection	3,100	LB	0.74	-	2,068	0%	2,757	0%	-	-	-
41	JC Boyle	1.039	JC Boyle Dam Removal	Remove & Dispose of Transformer Oil Fire Protection	6,500	LB	0.80	-	4,426	0%	6,248	0%	-	-	-
41	JC Boyle	1.04	JC Boyle Dam Removal	Remove & Dispose of Unwatering Piping	33,000	LB	0.74	-	19,481	0%	30,439	0%	-	-	-
41	JC Boyle	1.041	JC Boyle Dam Removal	Remove & Dispose of Drainage Piping	10,000	LB	0.84	-	7,100	0%	10,024	0%	-	-	-
41	JC Boyle	1.042	JC Boyle Dam Removal	Remove & Dispose of 2-Oil Sump pumps	2,000	LB	1.27	-	2,283	0%	2,917	0%	-	-	-
41	JC Boyle	1.043	JC Boyle Dam Removal	Remove & Dispose of Draft Tube Bulk Head Gates and	65,000	LB	0.71	-	39,403	0%	57,946	0%	-	-	-
41	JC Boyle	1.043a	JC Boyle Dam Removal	Remove petroleum products from Mechanical Equipment	2,700	GAL	10.27	27,735	23,575	-15%	36,056	30%	31,198	26,519	40,558
41	JC Boyle	1.044	JC Boyle Dam Removal	Remove & Dispose of Outdoor Vertical AC Generator, Unit 1:	2.00	EA	158,304.56	-	269,118	0%	364,100	0%	-	-	-
41	JC Boyle	1.045	JC Boyle Dam Removal	Remove & Dispose of Excitation equipment for 53/50 MVA	2.00	EA	13,425.63	-	24,166	0%	29,536	0%	-	-	-
41	JC Boyle	1.046	JC Boyle Dam Removal	Remove & Dispose of Surge protection equip. for 53/50 MVA	2.00	EA	8,153.33	-	14,676	0%	17,937	0%	-	-	-
41	JC Boyle	1.047	JC Boyle Dam Removal	Remove & Dispose of Neutral grounding equip. for 53/50	2.00	EA	3,980.33	-	7,165	0%	8,757	0%	-	-	-
41	JC Boyle	1.048	JC Boyle Dam Removal	Remove & Dispose of Generator Switchgear, 15kV - (6	1.00	EA	19,730.68	-	16,771	0%	24,663	0%	-	-	-
41	JC Boyle	1.049	JC Boyle Dam Removal	Remove & Dispose of Station Service Switchgear, 600 volt -	1.00	EA	10,780.56	-	9,703	0%	11,859	0%	-	-	-
41	JC Boyle	1.050	JC Boyle Dam Removal	Remove & Dispose of Unit and plant control switchboard	1.00	EA	5,903.27	-	5,313	0%	6,494	0%	-	-	-
41	JC Boyle	1.051	JC Boyle Dam Removal	Remove & Dispose of Battery system	1.00	EA	7,430.59	7,431	6,688	-10%	8,174	10%	8,358	7,523	9,194
41	JC Boyle	1.052	JC Boyle Dam Removal	Remove & Dispose of Raceways, Conduit and Cable	1.00	EA	13,891.88	-	12,503	0%	15,281	0%	-	-	-
41	JC Boyle	1.053	JC Boyle Dam Removal	Remove & Dispose of Misc. power & control boards	1.00	EA	7,140.08	-	6,426	0%	7,854	0%	-	-	-
41	JC Boyle	1.054	JC Boyle Dam Removal	Remove & Dispose of 5 Gantry Crane motors - hoist (50Hp*),	1.00	EA	1,729.51	1,730	1,557	-10%	2,075	20%	1,945	1,751	2,335
41	JC Boyle	1.055	JC Boyle Dam Removal	Remove & Dispose of Gantry Crane control equipment (3	1.00	EA	5,869.29	5,869	5,282	-10%	6,456	10%	6,602	5,942	7,262
41	JC Boyle	1.056	JC Boyle Dam Removal	Remove & Dispose of Conduit and Cable	1.00	EA	10,561.93	10,562	9,506	-10%	12,674	20%	11,881	10,693	14,257
41	JC Boyle	1.057	JC Boyle Dam Removal	Remove & Dispose of Exterior Lighting	1.00	EA	10,640.74	10,641	9,577	-10%	12,237	15%	11,969	10,772	13,765
41	JC Boyle	1.058	JC Boyle Dam Removal	Remove & Dispose of Transmission Line No. 59	1.66	MI	31,411.84	52,144	44,322	-15%	65,180	25%	58,655	49,856	73,318
41	JC Boyle	1.059	JC Boyle Dam Removal	Remove & Dispose of Transmission Line No. 98	0.24	MI	27,715.54	6,652	5,654	-15%	8,315	25%	7,482	6,360	9,353
41	JC Boyle	1.060	JC Boyle Dam Removal	Remove & Dispose of Transmission Line No. 58	1.66	MI	31,411.84	52,144	44,322	-15%	65,180	25%	58,655	49,856	73,318
41	JC Boyle	1.061	JC Boyle Dam Removal	Remove Intake Structure Concrete	1,600	CY	294.80	-	424,508	0%	566,010	0%	-	-	-
41	JC Boyle	1.062	JC Boyle Dam Removal	Remove Fish Screen Building	2,010	SF	70.46	-	134,535	0%	155,777	0%	-	-	-
41	JC Boyle	1.063	JC Boyle Dam Removal	Remove 24-inch-dia. Steel Fish Discharge Pipe	37,978	LB	0.31	11,804	10,033	-15%	14,755	25%	13,278	11,286	16,597
41	JC Boyle	1.064	JC Boyle Dam Removal	Remove Concrete Items associated with the 14-ft-diameter	1,010	CY	313.62	316,752	269,239	-15%	364,265	15%	356,303	302,857	409,748
41	JC Boyle	1.065	JC Boyle Dam Removal	Remove Open Concrete Flume	26,000	CY	266.49	-	2,926,073	-10%	3,901,430	20%	-	-	-
41	JC Boyle	1.066	JC Boyle Dam Removal	Remove Structural Steel Items associated with the Forebay	11,500	LB	0.49	5,628	4,784	-15%	7,035	25%	6,331	5,381	7,914
41	JC Boyle	1.067	JC Boyle Dam Removal	Remove Fore bay Concrete	2,500	CY	298.78	746,951	403,353	-10%	537,804	20%	840,218	453,718	604,957
41	JC Boyle	1.068	JC Boyle Dam Removal	Place Concrete Plugs at Tunnel Portals	30.00	CY	1,616.26	48,488	46,063	-5%	50,912	5%	54,542	51,815	57,269
41	JC Boyle	1.069	JC Boyle Dam Removal	Remove Concrete Items associated with Penstocks D/S from	1,800	CY	495.44	891,799	802,619	-10%	1,070,158	20%	1,003,152	902,837	1,203,783
41	JC Boyle	1.070	JC Boyle Dam Removal	Remove Head gate Control Building at Flume Entrance	500	SF	99.08	49,542	44,588	-10%	56,973	15%	55,728	50,155	64,087
41	JC Boyle	1.071	JC Boyle Dam Removal	Remove Fore bay Spillway Gate House	610	SF	89.23	54,431	48,988	-10%	65,318	20%	61,228	55,105	73,473
41	JC Boyle	1.072	JC Boyle Dam Removal	Remove Fore bay Control Building	560	SF	96.68	54,141	48,727	-10%	64,969	20%	60,901	54,811	73,081
41	JC Boyle	1.074	JC Boyle Dam Removal	Remove Insulated Generator Building next to Fore bay	90.00	SF	166.30	14,967	13,470	-10%	17,960	20%	16,835	15,152	20,203
41	JC Boyle	1.075	JC Boyle Dam Removal	Remove Fixed Wheel Gate (gate, Frame, and Hoist)	55,000	LB	0.53	-	23,272	0%	36,363	0%	-	-	-
41	JC Boyle	1.076	JC Boyle Dam Removal	Remove Trash rack and trash rake (steel)	75,000	LB	0.51	-	30,438	0%	47,559	0%	-	-	-
41	JC Boyle	1.077	JC Boyle Dam Removal	Remove stop Logs and slots (steel)	136,000	LB	0.79	-	96,633	0%	134,213	0%	-	-	-
41	JC Boyle	1.078	JC Boyle Dam Removal	Remove Traveling Water Screen	124,000	LB	0.50	-	56,258	0%	78,136	0%	-	-	-
41	JC Boyle	1.079	JC Boyle Dam Removal	Remove Fish By-Pass and Supports (steel)	610,000	LB	0.77	-	422,080	0%	539,325	0%	-	-	-
41	JC Boyle	1.080	JC Boyle Dam Removal	Remove Gates and Hoists	18,500	LB	0.48	8,848	7,521	-15%	11,503	30%	9,953	8,460	12,939
41	JC Boyle	1.081	JC Boyle Dam Removal	Remove Trash rack and trash rake (steel)	47,249	LB	0.60	-	24,001	0%	36,707	0%	-	-	-
41	JC Boyle	1.082	JC Boyle Dam Removal	Remove stop Logs and slots (steel)	37,069	LB	0.62	-	19,692	0%	30,117	0%	-	-	-
41	JC Boyle	1.083	JC Boyle Dam Removal	Remove & Dispose Penstocks and bifurcation (steel)	1,600,000	LB	0.70	1,112,218	945,385	-15%	1,334,661	20%	1,251,094	1,063,429	1,501,312
41	JC Boyle	1.084	JC Boyle Dam Removal	Remove & Dispose Surge Tank (steel)	79,000	LB	0.82	64,445	58,000	-10%	83,778	30%	72,492	65,242	94,239
41	JC Boyle	1.085	JC Boyle Dam Removal	Remove & Dispose 2 - 108" Butterfly valves	148,000	LB	0.74	-	98,855	0%	142,790	0%	-	-	-
41	JC Boyle	1.086	JC Boyle Dam Removal	Remove & Dispose Gate, Stem and Frame	28,000	LB	0.71	19,883	17,895	-10%	23,860	20%	22,366	20,129	26,839
41	JC Boyle	1.087	JC Boyle Dam Removal	Remove & Dispose of Steel Transition Manifolds on Upstream	250,000	LB	0.64	160,863	136,734	-15%	209,122	30%	180,949	153,807	235,234
41	JC Boyle	1.087a	JC Boyle Dam Removal	Remove petroleum products from Mechanical Equipment	380	GAL	16.54	6,284	5,342	-15%	8,169	30%	7,069	6,008	9,189
41	JC Boyle	1.097	JC Boyle Dam Removal	Clear and Grub Disposal Area (Embankment)	10.00	AC	12,954.90	129,549	116,594	-10%	142,504	10%	145,725	131,152	160,297
41	JC Boyle	1.098	JC Boyle Dam Removal	Clear and Grub, 40' width	2.40	AC	12,954.90	31,092	27,983	-10%	34,201	10%	34,974	31,477	38,471
41	JC Boyle	1.099	JC Boyle Dam Removal	4" thick gravel surfacing	2,150	T	29.66	63,762	57,386	-10%	70,139	10%	71,724	64,552	78,896
41	JC Boyle	1.103	JC Boyle Dam Removal	Soil Cover over Concrete Rubble	13,000	CY	8.64	112,348	101,113	-10%	134,818	20%	126,376	113,739	151,651
41	JC Boyle	1.107	JC Boyle Dam Removal	Embankment Fill in Waste way (Fore bay) Scour Hole	55,900	CY	77.16	4,313,417	3,882,075	-10%	4,744,759	10%	4,852,008	4,366,807	5,337,209
41	JC Boyle	1.108	JC Boyle Dam Removal	Topsy Recreational Area - Concrete total	68.00	CY	454.68	30,918	29,372	-5%	34,010	10%	34,779	33,040	38,256
41	JC Boyle	1.109	JC Boyle Dam Removal	Topsy Recreational Area - 6'x80' Floating dock made of	1.00	EA	8,816.20	8,816	8,375	-5%	9,257	5%	9,917	9,421	10,413
41	JC Boyle	1.110	JC Boyle Dam Removal	Topsy Recreational Area - 5'x20' Walkway leading to hex	200	SF	10.02	2,005	1,904	-5%	2,105	5%	2,255	2,142	2,368

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	JC Boyle	1.111	JC Boyle Dam Removal	Topsy Recreational Area - Regrade to natural contour	300	SF	14.63	4,390	4,171	-5%	4,829	10%	4,938	4,691	5,432
41	JC Boyle	1.112	JC Boyle Dam Removal	Pioneer Park - Picnic tables to be removed and hauled away	12.00	EA	156.62	1,879	1,785	-5%	1,973	5%	2,114	2,008	2,220
41	JC Boyle	1.113	JC Boyle Dam Removal	Pioneer Park - 12 Concrete fire rings	5.00	CY	353.89	1,769	1,681	-5%	1,858	5%	1,990	1,891	2,090
41	JC Boyle	1.114	JC Boyle Dam Removal	Pioneer Park - Portable toilets to be removed and hauled	2.00	EA	1,002.35	2,005	1,904	-5%	2,105	5%	2,255	2,142	2,368
41	JC Boyle	1.115	JC Boyle Dam Removal	Pioneer Park - Signs to be removed and hauled away	6.00	EA	141.12	847	804	-5%	889	5%	952	905	1,000
41	JC Boyle	1.116	JC Boyle Dam Removal	Pioneer Park - Dumpster to be removed and hauled away	1.00	EA	2,971.02	2,971	2,674	-10%	3,417	15%	3,342	3,008	3,843
41	JC Boyle	1.118	JC Boyle Dam Removal	Pioneer Park - Regrade to natural contour	0.50	AC	17,560.36	8,780	7,902	-10%	9,658	10%	9,877	8,889	10,864
41	JC Boyle	5.000	JC Boyle Dam Removal	Remove Frame dead end structures 60-80 ft high	2.00	EA	7,101.59	14,203	12,783	-10%	17,044	20%	15,977	14,379	19,172
41	JC Boyle	5.001	JC Boyle Dam Removal	Remove (incl foundation) and Save Transformers 230KV	2.00	EA	2,688.70	5,377	4,840	-10%	6,184	15%	6,049	5,444	6,956
41	JC Boyle	5.002	JC Boyle Dam Removal	Remove (incl foundation) and Save Power Circuit Breakers	2.00	EA	3,640.83	7,282	6,918	-5%	8,010	10%	8,191	7,781	9,010
41	JC Boyle	5.003	JC Boyle Dam Removal	Substation Tie Structure 230KV	1.00	EA	41,482.05	41,482	37,334	-10%	47,704	15%	46,662	41,995	53,661
41	JC Boyle	5.004	JC Boyle Dam Removal	Remove Chain Link Fence	601	LF	17.70	10,639	9,575	-10%	11,703	10%	11,967	10,770	13,164
41	JC Boyle	5.005	JC Boyle Dam Removal	Demolish overhead distribution 2.5 miles (30-45 poles)	45.00	EA	1,160.01	52,200	46,980	-10%	62,640	20%	58,718	52,846	70,462
41	JC Boyle	5.032	JC Boyle Dam Removal	Install 230kV strain transmission structures outside JC Boyle	2.00	EA	132,241.37	264,483	238,034	-10%	317,379	20%	297,507	267,756	357,009
41	Copco 1	2.001	Copco 1 Dam Removal	Furnish, Install, and Remove Barge-Mounted Crane in	1.00	LS	191,823.14	191,823	172,641	-10%	239,779	25%	215,775	194,197	269,719
41	Copco 1	2.002	Copco 1 Dam Removal	Remove Sediment from Diversion Tunnel Intake to provide	30.00	CY	3,434.68	103,040	92,736	-10%	123,649	20%	115,907	104,316	139,088
41	Copco 1	2.003	Copco 1 Dam Removal	Furnish, Install, and Remove Large Crane on Right Abutment	1.00	LS	566,865.71	566,866	481,836	-15%	651,896	15%	637,647	542,000	733,294
41	Copco 1	2.004	Copco 1 Dam Removal	Remove Water from behind Tailrace Cofferdam	200,000	GAL	0.01	2,091	1,882	-10%	2,405	15%	2,353	2,117	2,706
41	Copco 1	2.005	Copco 1 Dam Removal	Riprap Protection on Cofferdam	260	CY	148.31	38,561	32,777	-15%	46,273	20%	43,376	36,869	52,051
41	Copco 1	2.006	Copco 1 Dam Removal	Provide Dewatering behind Tailrace Cofferdam	1.00	LS	89,882.80	89,883	80,895	-10%	107,859	20%	101,106	90,995	121,327
41	Copco 1	2.007	Copco 1 Dam Removal	Remove Current Diversion Tunnel Plug	195	CY	1,390.41	271,129	244,016	-10%	325,355	20%	304,983	274,485	365,980
41	Copco 1	2.008	Copco 1 Dam Removal	Construct Embankment Cofferdam in Tailrace	1,700	CY	165.62	281,551	239,319	-15%	337,862	20%	316,707	269,201	380,049
41	Copco 1	2.009	Copco 1 Dam Removal	Installation of 3 each 72" Blind Flanges	38,000	LB	34.66	1,317,134	1,119,564	-15%	1,712,274	30%	1,481,597	1,259,357	1,926,076
41	Copco 1	2.009.2	Copco 1 Dam Removal	Installation of 16.5 X 18.5 Roller Gate and Gate Structure	1.00	LS	4,098,153.55	4,098,154	3,483,431	-15%	5,327,600	30%	4,609,865	3,918,386	5,992,825
41	Copco 1	2.009.3	Copco 1 Dam Removal	Removal of 16.5 X 18.5 Roller Gate and Gate Structure	1.00	LS	271,584.86	271,585	230,847	-15%	353,060	30%	305,496	259,672	397,145
41	Copco 1	2.010	Copco 1 Dam Removal	Remove Concrete Dam down to Elev. 2476	36,000	CY	227.38	8,185,528	7,366,975	-10%	9,822,633	20%	9,207,605	8,286,845	11,049,126
41	Copco 1	2.011	Copco 1 Dam Removal	Remove Concrete Intake Structure on Right Abutment	21,000	CY	346.51	-	6,185,199	0%	8,732,046	0%	-	-	-
41	Copco 1	2.012	Copco 1 Dam Removal	Remove Structural Steel from Spillway	55,000	LB	1.27	69,659	59,210	-15%	87,074	25%	78,357	66,604	97,946
41	Copco 1	2.013	Copco 1 Dam Removal	Install Diversion Tunnel Plugs	30.00	CY	1,330.24	39,907	28,733	-10%	36,714	15%	44,890	32,321	41,299
41	Copco 1	2.014	Copco 1 Dam Removal	Remove Diversion Tunnel Control Structure Concrete	350	CY	231.13	-	72,805	0%	97,074	0%	-	-	-
41	Copco 1	2.015	Copco 1 Dam Removal	Remove & Dispose of Hand Rails	11,000	LB	1.36	14,919	12,681	-15%	17,903	20%	16,782	14,265	20,139
41	Copco 1	2.016	Copco 1 Dam Removal	Remove & Dispose of Radial Gates	140,500	LB	1.11	156,117	140,505	-10%	195,146	25%	175,610	158,049	219,513
41	Copco 1	2.017	Copco 1 Dam Removal	Remove & Dispose Radial Gate Stop logs	18,000	LB	1.06	19,126	17,214	-10%	23,908	25%	21,515	19,363	26,893
41	Copco 1	2.018	Copco 1 Dam Removal	Remove & Dispose Stop log hoist, track and supports	26,000	LB	1.03	26,842	24,158	-10%	33,552	25%	30,193	27,174	37,742
41	Copco 1	2.019	Copco 1 Dam Removal	Remove & Dispose of 3 sections of 23' of 72" Dia. steel lining	54,000	LB	1.04	-	47,906	0%	67,633	0%	-	-	-
41	Copco 1	2.020	Copco 1 Dam Removal	Remove & Dispose of 3 - 72" butterfly valves (embedded)	55,000	LB	1.10	-	54,264	0%	69,337	0%	-	-	-
41	Copco 1	2.021	Copco 1 Dam Removal	Remove & Dispose of 3 - 72" flapper valves with remote	78,000	LB	5.54	432,104	388,894	-10%	496,920	15%	486,058	437,453	558,967
41	Copco 1	2.022	Copco 1 Dam Removal	Remove & Dispose of Spillway gate motor & control panel	1.00	EA	1,318.63	1,319	1,187	-10%	1,516	15%	1,483	1,335	1,706
41	Copco 1	2.023	Copco 1 Dam Removal	Remove & Dispose Distribution equipment, panelboards	1.00	EA	5,877.55	5,878	5,290	-10%	7,053	20%	6,611	5,950	7,934
41	Copco 1	2.024	Copco 1 Dam Removal	Remove Powerhouse Concrete down to top of rock under the	3,100	CY	387.53	-	1,021,133	0%	1,501,667	0%	-	-	-
41	Copco 1	2.025	Copco 1 Dam Removal	Remove Powerhouse Structural Steel	110,000	LB	1.02	-	95,360	0%	134,625	0%	-	-	-
41	Copco 1	2.026	Copco 1 Dam Removal	Remove & Dispose of 2 - Governor Oil Systems	38,000	LB	1.07	-	36,469	0%	50,651	0%	-	-	-
41	Copco 1	2.027	Copco 1 Dam Removal	Remove & Dispose of Cooling water and bearing oil systems	11,000	LB	3.16	-	31,239	0%	41,652	0%	-	-	-
41	Copco 1	2.028	Copco 1 Dam Removal	Remove & Dispose of 4 - Horizontal Tandem Francis	452,000	LB	0.80	-	325,922	0%	434,562	0%	-	-	-
41	Copco 1	2.029	Copco 1 Dam Removal	Remove & Dispose of 2 - 40 Ton indoor cranes	140,000	LB	0.74	-	88,350	0%	124,729	0%	-	-	-
41	Copco 1	2.030	Copco 1 Dam Removal	Remove & Dispose of Compressed Air System	1,000	LB	1.00	-	897	0%	1,147	0%	-	-	-
41	Copco 1	2.031	Copco 1 Dam Removal	Remove & Dispose of 2 - CO2 Systems	3,100	LB	1.05	-	2,927	0%	3,739	0%	-	-	-
41	Copco 1	2.032	Copco 1 Dam Removal	Remove & Dispose of Plant Water and Fire Protection	2,600	LB	1.35	-	3,160	0%	4,214	0%	-	-	-
41	Copco 1	2.033	Copco 1 Dam Removal	Remove & Dispose of Transformer Oil Fire Protection	5,400	LB	1.22	-	5,927	0%	7,903	0%	-	-	-
41	Copco 1	2.034	Copco 1 Dam Removal	Remove & Dispose of Unwatering Piping	27,000	LB	0.73	-	16,777	0%	24,672	0%	-	-	-
41	Copco 1	2.035	Copco 1 Dam Removal	Remove & Dispose of Drainage Piping	5,000	LB	1.04	-	4,422	0%	6,503	0%	-	-	-
41	Copco 1	2.035a	Copco 1 Dam Removal	Remove petroleum products from mechanical equipment	1,250	GAL	4.39	5,490	4,941	-10%	6,313	15%	6,175	5,558	7,101
41	Copco 1	2.036	Copco 1 Dam Removal	Remove & Dispose of Horizontal AC Generator, Indoor Open	2.00	EA	38,691.77	-	65,776	0%	92,860	0%	-	-	-
41	Copco 1	2.037	Copco 1 Dam Removal	Remove & Dispose of Excitation equipment for 12.5 MVA	1.50	EA	8,472.47	-	10,802	0%	15,886	0%	-	-	-
41	Copco 1	2.038	Copco 1 Dam Removal	Remove & Dispose of Surge protection equip. for 12.5 MVA	2.00	EA	2,504.46	-	4,258	0%	6,512	0%	-	-	-
41	Copco 1	2.039	Copco 1 Dam Removal	Remove & Dispose of Neutral grounding equip. for 12.5 MVA	2.00	EA	2,332.24	-	4,198	0%	5,364	0%	-	-	-
41	Copco 1	2.040	Copco 1 Dam Removal	Remove & Dispose of Generator Switchgear, 5kV-includes	1.00	EA	20,666.10	-	18,599	0%	23,766	0%	-	-	-
41	Copco 1	2.041	Copco 1 Dam Removal	Remove & Dispose of Station Service Switchgear, 600 volt -	1.00	EA	11,311.14	-	10,180	0%	13,008	0%	-	-	-
41	Copco 1	2.042	Copco 1 Dam Removal	Remove & Dispose of Unit and plant control switchboard	1.00	EA	6,110.32	-	5,499	0%	7,027	0%	-	-	-
41	Copco 1	2.043	Copco 1 Dam Removal	Remove & Dispose of Battery System	1.00	EA	20,638.63	20,639	18,575	-10%	23,734	15%	23,216	20,894	26,698
41	Copco 1	2.044	Copco 1 Dam Removal	Remove & Dispose of Raceways, Conduit and Cable	1.00	EA	17,082.48	-	15,374	0%	19,645	0%	-	-	-
41	Copco 1	2.045	Copco 1 Dam Removal	Remove & Dispose of Misc. power & control boards	1.00	EA	6,945.94	-	6,251	0%	7,988	0%	-	-	-
41	Copco 1	2.046	Copco 1 Dam Removal	Remove & Dispose of Step-up Transformers, indoor, oil-filled,	3.00	EA	64,338.39	-	173,714	0%	221,967	0%	-	-	-
41	Copco 1	2.047	Copco 1 Dam Removal	Remove & Dispose of Step-up Transformers, indoor, oil-filled,	3.00	EA	57,252.76	-	154,582	0%	197,522	0%	-	-	-
41	Copco 1	2.048	Copco 1 Dam Removal	Remove & Dispose of Seven 40-Ton Travelling Crane motors	1.00	EA	3,306.69	-	2,976	0%	3,803	0%	-	-	-
41	Copco 1	2.049	Copco 1 Dam Removal	Remove & Dispose of 40-Ton Travelling Crane control	1.00	EA	4,364.61	-	3,928	0%	5,019	0%	-	-	-
41	Copco 1	2.050	Copco 1 Dam Removal	Remove & Dispose of 40-Ton Travelling Crane Festoon Cable	1.00	EA	1,534.84	-	1,381	0%	1,842	0%	-	-	-

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	Copco 1	2.051	Copco 1 Dam Removal	Remove & Dispose of Four 15-Ton Overhead Crane Motors -	1.00	EA	959.54	-	864	0%	1,151	0%	-	-	-
41	Copco 1	2.052	Copco 1 Dam Removal	Remove & Dispose of 15-Ton Overhead Crane control	1.00	EA	434.20	-	391	0%	499	0%	-	-	-
41	Copco 1	2.053	Copco 1 Dam Removal	Remove & Dispose of 15-Ton Overhead Crane Festoon	1.00	EA	637.49	-	574	0%	733	0%	-	-	-
41	Copco 1	2.053a	Copco 1 Dam Removal	Remove petroleum products from mechanical equipment	10,500	GAL	10.39	109,116	98,204	-10%	125,483	15%	122,740	110,466	141,151
41	Copco 1	2.054	Copco 1 Dam Removal	Remove & Dispose of 69kV circuit breakers, oil0 filled, PCB	2.00	EA	861.46	1,723	1,551	-10%	1,895	10%	1,938	1,744	2,132
41	Copco 1	2.055	Copco 1 Dam Removal	Remove & Dispose of 69kV disconnect switches, group-	2.00	EA	861.46	1,723	1,551	-10%	1,895	10%	1,938	1,744	2,132
41	Copco 1	2.056	Copco 1 Dam Removal	Remove & Dispose of 60-foot wood poles	12.00	EA	1,296.96	15,563	13,229	-15%	18,676	20%	17,507	14,881	21,008
41	Copco 1	2.057	Copco 1 Dam Removal	Remove & Dispose of 30-foot wood cross arms	24.00	EA	484.41	11,626	9,882	-15%	13,951	20%	13,078	11,116	15,693
41	Copco 1	2.058	Copco 1 Dam Removal	Remove & Dispose of 69-kV insulator strings	12.00	EA	372.92	4,475	3,804	-15%	5,370	20%	5,034	4,279	6,041
41	Copco 1	2.059	Copco 1 Dam Removal	Remove & Dispose of Transmission Line No. 3	1.66	MI	31,411.84	52,144	44,322	-15%	65,180	25%	58,655	49,856	73,318
41	Copco 1	2.060	Copco 1 Dam Removal	Remove & Dispose of Transmission Line No. 15	1.23	MI	33,971.31	41,785	35,517	-15%	52,231	25%	47,002	39,952	58,753
41	Copco 1	2.061	Copco 1 Dam Removal	Remove & Dispose of Transmission Line No. 26-1	0.07	MI	33,525.16	2,347	1,995	-15%	2,933	25%	2,640	2,244	3,300
41	Copco 1	2.062	Copco 1 Dam Removal	Remove & Dispose of Transmission Line No. 26-2	0.07	MI	33,525.16	2,347	1,995	-15%	2,933	25%	2,640	2,244	3,300
41	Copco 1	2.063	Copco 1 Dam Removal	Remove gate house #1 from top of dam	720	SF	72.06	-	44,098	0%	64,850	0%	-	-	-
41	Copco 1	2.064	Copco 1 Dam Removal	Remove gate house #2 from top of dam	690	SF	74.35	-	43,607	0%	64,128	0%	-	-	-
41	Copco 1	2.065	Copco 1 Dam Removal	Remove Concrete Items associated with 10 ft. diam.	1,050	CY	300.38	-	268,089	0%	394,248	0%	-	-	-
41	Copco 1	2.066	Copco 1 Dam Removal	Plug 14-foot diameter penstock with concrete	23.00	CY	3,373.31	-	69,828	0%	89,224	0%	-	-	-
41	Copco 1	2.067	Copco 1 Dam Removal	Remove & Dispose of 8 screens	18,000	LB	1.17	-	18,913	0%	25,217	0%	-	-	-
41	Copco 1	2.068	Copco 1 Dam Removal	Remove & Dispose of 8 Water Gates	18,000	LB	1.10	-	17,822	0%	23,762	0%	-	-	-
41	Copco 1	2.069	Copco 1 Dam Removal	Remove & Dispose of 3 - 30" Dia. x 25' stand pipes	6,000	LB	0.91	-	4,912	0%	6,550	0%	-	-	-
41	Copco 1	2.070	Copco 1 Dam Removal	Remove & Dispose of 14' Dia. penstock pipe	256,000	LB	1.31	-	284,926	0%	419,009	0%	-	-	-
41	Copco 1	2.071	Copco 1 Dam Removal	Remove & Dispose of 10' Dia. penstock pipe	270,000	LB	1.37	-	315,225	0%	463,566	0%	-	-	-
41	Copco 1	2.081	Copco 1 Dam Removal	Site work - Clear and Grub Disposal Area	4.00	AC	13,732.22	54,929	36,685	-15%	51,790	20%	61,788	41,265	58,257
41	Copco 1	2.082	Copco 1 Dam Removal	Site work - Soil Cover for Disposal Area	12,000	CY	6.84	82,107	55	-15%	77	20%	92,359	61	87
41	Copco 1	2.089	Copco 1 Dam Removal	Mallard Cove - Concrete total	106	CY	338.09	35,838	30,462	-15%	41,214	15%	40,313	34,266	46,360
41	Copco 1	2.09	Copco 1 Dam Removal	Mallard Cove - 25'x5' Dock made of composite decking and	1.00	EA	3,009.15	3,009	2,558	-15%	3,461	15%	3,385	2,877	3,893
41	Copco 1	2.091	Copco 1 Dam Removal	Mallard Cove - 20'x5' Gangway w/ aluminum grate and	1.00	EA	2,758.50	2,758	2,345	-15%	3,172	15%	3,103	2,637	3,568
41	Copco 1	2.092	Copco 1 Dam Removal	Mallard Cove - Signs to be removed and hauled away	6.00	EA	152.39	914	823	-10%	1,006	10%	1,029	926	1,131
41	Copco 1	2.093	Copco 1 Dam Removal	Mallard Cove - Wood plank tables to be removed and hauled	8.00	EA	114.29	914	823	-10%	1,006	10%	1,029	926	1,131
41	Copco 1	2.094	Copco 1 Dam Removal	Mallard Cove - Parking area to be regraded	2.50	AC	7,451.08	18,628	16,765	-10%	21,422	15%	20,954	18,858	24,097
41	Copco 1	2.095	Copco 1 Dam Removal	Copco Cove - Concrete Total	84.00	CY	331.83	27,874	23,693	-15%	32,055	15%	31,354	26,651	36,058
41	Copco 1	2.096	Copco 1 Dam Removal	Copco Cove - Dock abutment railing made of 2.5" dia. steel	1.00	EA	1,446.70	1,447	1,302	-10%	1,591	10%	1,627	1,465	1,790
41	Copco 1	2.097	Copco 1 Dam Removal	Copco Cove - Signs to be removed and hauled away	6.00	EA	407.82	2,447	2,202	-10%	2,692	10%	2,752	2,477	3,028
41	Copco 1	2.098	Copco 1 Dam Removal	Copco Cove - Wood plank tables to be removed and hauled	2.00	EA	152.39	305	274	-10%	335	10%	343	309	377
41	Copco 1	2.099	Copco 1 Dam Removal	Copco Cove - Regrade	2.30	AC	6,531.70	15,023	13,521	-10%	17,276	15%	16,899	15,209	19,434
41	Copco 1	2.100	Copco 1 Dam Removal	Diversion Tunnel Lining	1.00	LS	244,844.33	244,844	220,360	-10%	281,571	15%	275,417	247,875	316,729
41	Copco 1	5.006	Copco 1 Dam Removal	Remove Frame Dead End Structures 60-80ft High @ Switch	4.00	EA	6,436.15	25,745	21,883	-15%	33,468	30%	28,959	24,615	37,647
41	Copco 1	5.007	Copco 1 Dam Removal	Remove Power Circuit Breakers 69KV @ Switch Yard	2.00	EA	5,681.20	11,362	10,226	-10%	14,203	25%	12,781	11,503	15,976
41	Copco 1	5.008	Copco 1 Dam Removal	Remove Disconnect Switches @ Switch Yard	4.00	EA	9,731.40	38,926	35,033	-10%	48,657	25%	43,786	39,407	54,733
41	Copco 1	5.009	Copco 1 Dam Removal	Remove All Associated AUX Equipment @ Switch Yard	1.00	LS	48,501.71	48,502	43,652	-10%	60,627	25%	54,558	49,102	68,197
41	Copco 1	5.010	Copco 1 Dam Removal	Remove Distribution Lines 69 KV Copco 1 Switch Yard and	6.00	EA	1,402.44	8,415	7,573	-10%	10,518	25%	9,465	8,519	11,832
41	Copco 1	5.011	Copco 1 Dam Removal	Remove Distribution Poles 2.4 KV Btw Copco 1/ HE Plant/	8.00	EA	1,950.45	15,604	14,043	-10%	19,505	25%	17,552	15,797	21,940
41	Copco 1	5.012	Copco 1 Dam Removal	Remove Production Poles in General Area of Copco 1	7.00	EA	1,956.86	13,698	11,643	-15%	17,807	30%	15,408	13,097	20,031
41	Copco 1	5.013	Copco 1 Dam Removal	Remove Village House Distribution Poles Near Dam (Est 10	10.00	EA	1,293.71	12,937	10,997	-15%	16,818	30%	14,552	12,370	18,918
41	Copco 1	5.014	Copco 1 Dam Removal	Remove 69 KV Distribution Line 1.6 Miles (30 Poles)	30.00	EA	2,096.19	62,886	53,453	-15%	81,751	30%	70,738	60,127	91,959
41	Copco 1	5.015	Copco 1 Dam Removal	Remove Transmission Conductors on Poles 1X/001 and	2.00	EA	2,686.44	5,373	4,567	-15%	6,985	30%	6,044	5,137	7,857
41	Copco 1	5.016	Copco 1 Dam Removal	Remove Transmission Conductors 1.3 Miles Copco 1 to	6,864	LF	7.16	49,138	41,767	-15%	63,880	30%	55,274	46,983	71,856
41	Copco 2	3.001	Copco 2 Dam Removal	Construct and Remove Embankment Cofferdam-Right Side of	3,100	CY	59.70	185,071	148,057	-20%	259,100	40%	208,180	166,544	291,452
41	Copco 2	3.002	Copco 2 Dam Removal	Furnish, Install, and Remove RipRap	465	CY	129.88	60,392	48,314	-20%	84,549	40%	67,933	54,347	95,106
41	Copco 2	3.003	Copco 2 Dam Removal	Provide Dewatering behind Cofferdams	1.00	LS	143,210.99	143,211	128,890	-10%	186,174	30%	161,093	144,984	209,421
41	Copco 2	3.004	Copco 2 Dam Removal	Remove Water from behind Cofferdams	241,000	GAL	0.02	5,834	5,251	-10%	7,584	30%	6,563	5,906	8,531
41	Copco 2	3.005	Copco 2 Dam Removal	Construct and Remove Embankment Cofferdam-Left Side of	1,100	CY	172.54	189,793	147,837	-22%	258,715	36%	213,491	166,297	291,019
41	Copco 2	3.006	Copco 2 Dam Removal	Furnish, Install, and Remove RipRap	250	CY	185.94	46,486	37,189	-20%	65,080	40%	52,290	41,832	73,207
41	Copco 2	3.007	Copco 2 Dam Removal	Provide Dewatering behind left Side Cofferdam	1.00	LS	79,612.67	79,613	71,651	-10%	103,496	30%	89,553	80,598	116,419
41	Copco 2	3.008	Copco 2 Dam Removal	Remove Water from behind Cofferdams	36,000	GAL	0.15	5,352	4,817	-10%	6,958	30%	6,021	5,418	7,827
41	Copco 2	3.009	Copco 2 Dam Removal	Remove Water from behind Tailrace Cofferdam	400,000	GAL	0.03	-	9,258	0%	13,373	0%	-	-	-
41	Copco 2	3.010	Copco 2 Dam Removal	Provide Dewatering behind Tailrace Cofferdam	1.00	LS	49,938.86	-	44,945	0%	64,921	0%	-	-	-
41	Copco 2	3.011	Copco 2 Dam Removal	Construct Embankment Cofferdam across Tailrace	1,700	CY	115.34	-	156,862	0%	274,508	0%	-	-	-
41	Copco 2	3.014	Copco 2 Dam Removal	Remove Concrete in Dam	4,430	CY	253.02	1,120,868	909,431	-15%	1,551,383	45%	1,260,824	1,022,987	1,745,095
41	Copco 2	3.015	Copco 2 Dam Removal	Remove concrete equipment slab from top of embankment	5.00	CY	353.89	1,769	1,504	-15%	2,300	30%	1,990	1,692	2,588
41	Copco 2	3.016	Copco 2 Dam Removal	Remove Concrete Wing wall	240	CY	217.45	52,187	44,359	-15%	67,843	30%	58,703	49,898	76,314
41	Copco 2	3.017	Copco 2 Dam Removal	Right Abutment Removal - Random Fill	1,510	CY	52.34	-	67,185	0%	98,801	0%	-	-	-
41	Copco 2	3.018	Copco 2 Dam Removal	Right Abutment Removal - Remove Hand Placed Riprap	5,400	SF	2.26	-	10,379	0%	15,264	0%	-	-	-
41	Copco 2	3.019	Copco 2 Dam Removal	Right Abutment Removal - Gunite Curtain Wall	180	CY	333.73	-	51,060	0%	75,089	0%	-	-	-
41	Copco 2	3.020	Copco 2 Dam Removal	Remove & Dispose - Hand rails and Light Poles	5,000	LB	0.84	4,183	3,556	-15%	5,020	20%	4,706	4,000	5,647
41	Copco 2	3.021	Copco 2 Dam Removal	Remove & Dispose - Radial Gates and Hoists	66,000	LB	0.81	53,452	45,434	-15%	72,160	35%	60,126	51,107	81,170
41	Copco 2	3.022	Copco 2 Dam Removal	Remove & Dispose - 5-Radial Gate Stop logs & Slots (steel)	95,800	LB	0.93	89,381	75,974	-15%	120,665	35%	100,542	85,461	135,732

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	Copco 2	3.023	Copco 2 Dam Removal	Remove & Dispose - Spillway intake gate motor & control	1.00	EA	1,297.31	1,297	1,168	-10%	1,492	15%	1,459	1,313	1,678
41	Copco 2	3.024	Copco 2 Dam Removal	Remove & Dispose - Spillway radial gate motor & control	1.00	EA	1,297.31	1,297	1,168	-10%	1,492	15%	1,459	1,313	1,678
41	Copco 2	3.025	Copco 2 Dam Removal	Remove & Dispose - Spillway trash rake motor, festoon cable	1.00	EA	551.31	551	496	-10%	634	15%	620	558	713
41	Copco 2	3.026	Copco 2 Dam Removal	Remove & Dispose - Distribution equipment, panelboards	1.00	EA	5,877.55	5,878	5,290	-10%	6,759	15%	6,611	5,950	7,603
41	Copco 2	3.027	Copco 2 Dam Removal	Remove Copper Shingles from Roof of Powerhouse	7,000	SF	2.07	-	12,302	0%	16,644	0%	-	-	-
41	Copco 2	3.028	Copco 2 Dam Removal	Remove Powerhouse Concrete down to spring-line of turbine	1,110	CY	514.15	-	485,097	0%	827,518	0%	-	-	-
41	Copco 2	3.029	Copco 2 Dam Removal	Remove Structural Steel items associated with Powerhouse	220,000	LB	0.96	-	169,407	0%	296,463	0%	-	-	-
41	Copco 2	3.030	Copco 2 Dam Removal	Remove Control House Concrete	30.00	CY	317.78	9,533	7,627	-20%	12,870	35%	10,724	8,579	14,477
41	Copco 2	3.031	Copco 2 Dam Removal	Remove Control House Structural Steel Items	3,500	LB	0.88	3,088	2,471	-20%	4,324	40%	3,474	2,779	4,864
41	Copco 2	3.032	Copco 2 Dam Removal	Remove Shop Building	4,300	SF	69.45	-	238,898	0%	388,210	0%	-	-	-
41	Copco 2	3.033	Copco 2 Dam Removal	Remove & Dispose - 2 - Governor oil systems	38,000	LB	1.06	-	34,345	0%	50,507	0%	-	-	-
41	Copco 2	3.034	Copco 2 Dam Removal	Remove & Dispose - Cooling water and bearing oil systems	13,300	LB	0.93	-	10,552	0%	15,518	0%	-	-	-
41	Copco 2	3.035	Copco 2 Dam Removal	Remove & Dispose - Oil / Water separator tank and piping	2,700	LB	0.93	-	2,142	0%	3,149	0%	-	-	-
41	Copco 2	3.036	Copco 2 Dam Removal	Remove & Dispose - 12 - Cast Iron Columns	54,000	LB	0.83	-	35,754	0%	53,631	0%	-	-	-
41	Copco 2	3.037	Copco 2 Dam Removal	Remove & Dispose - 2 - Francis Turbines	660,000	LB	0.83	-	438,002	0%	711,753	0%	-	-	-
41	Copco 2	3.038	Copco 2 Dam Removal	Remove & Dispose - 2 - 40 Ton indoor cranes	140,000	LB	1.17	-	130,617	0%	212,253	0%	-	-	-
41	Copco 2	3.039	Copco 2 Dam Removal	Remove & Dispose - Compressed Air Systems	1,000	LB	1.13	-	960	0%	1,411	0%	-	-	-
41	Copco 2	3.040	Copco 2 Dam Removal	Remove & Dispose - 2 - CO2 Systems	2,100	LB	1.23	-	2,187	0%	3,216	0%	-	-	-
41	Copco 2	3.041	Copco 2 Dam Removal	Remove & Dispose - Plant Water and Fire Protection	3,100	LB	1.41	-	3,717	0%	5,466	0%	-	-	-
41	Copco 2	3.042	Copco 2 Dam Removal	Remove & Dispose - Transformer Oil Fire Protection	6,500	LB	0.87	-	4,788	0%	7,042	0%	-	-	-
41	Copco 2	3.043	Copco 2 Dam Removal	Remove & Dispose - Unwatering Piping	32,000	LB	0.75	-	20,499	0%	30,145	0%	-	-	-
41	Copco 2	3.044	Copco 2 Dam Removal	Remove & Dispose - Drainage Piping	10,000	LB	1.39	-	11,795	0%	17,346	0%	-	-	-
41	Copco 2	3.044a	Copco 2 Dam Removal	Remove & Dispose - Petroleum Products from Mechanical	3,300	GAL	4.54	14,972	13,475	-10%	17,217	15%	16,841	15,157	19,367
41	Copco 2	3.044b	Copco 2 Dam Removal	Remove & Dispose - Remove Petroleum Products at or near	3,300	GAL	4.54	14,972	13,475	-10%	17,217	15%	16,841	15,157	19,367
41	Copco 2	3.045	Copco 2 Dam Removal	Remove & Dispose - AC Generator, Indoor Vertical	2.00	EA	82,295.42	-	148,132	0%	189,279	0%	-	-	-
41	Copco 2	3.046	Copco 2 Dam Removal	Remove & Dispose - Excitation equipment for 15 MVA	2.00	EA	8,173.98	-	14,713	0%	18,800	0%	-	-	-
41	Copco 2	3.047	Copco 2 Dam Removal	Remove & Dispose - Surge protection equip. for 15 MVA	2.00	EA	2,582.65	-	4,649	0%	5,940	0%	-	-	-
41	Copco 2	3.048	Copco 2 Dam Removal	Remove & Dispose - Neutral grounding equip. for 15 MVA	2.00	EA	2,514.72	-	4,526	0%	5,784	0%	-	-	-
41	Copco 2	3.049	Copco 2 Dam Removal	Remove & Dispose - Generator Switchgear, 7.2kV-includes	1.00	EA	27,340.22	-	24,606	0%	31,441	0%	-	-	-
41	Copco 2	3.050	Copco 2 Dam Removal	Remove & Dispose - Station Service Switchgear, 600-volt (5	1.00	EA	24,083.60	-	21,675	0%	27,696	0%	-	-	-
41	Copco 2	3.051	Copco 2 Dam Removal	Remove & Dispose - Unit and plant control switchboard	1.00	EA	7,551.93	-	6,797	0%	8,685	0%	-	-	-
41	Copco 2	3.052	Copco 2 Dam Removal	Remove & Dispose - Battery system	1.00	EA	10,473.21	-	9,426	0%	12,044	0%	-	-	-
41	Copco 2	3.053	Copco 2 Dam Removal	Remove & Dispose - Raceways, Conduit and Cable	1.00	EA	15,384.27	-	13,846	0%	17,692	0%	-	-	-
41	Copco 2	3.054	Copco 2 Dam Removal	Remove & Dispose - Misc. Power & Control Boards	1.00	EA	5,724.44	-	5,152	0%	6,583	0%	-	-	-
41	Copco 2	3.055	Copco 2 Dam Removal	Remove & Dispose - 7 - 40-Ton Travelling Crane motors-hoist	1.00	EA	3,548.91	-	3,194	0%	4,259	0%	-	-	-
41	Copco 2	3.056	Copco 2 Dam Removal	Remove & Dispose - 40-Ton Travelling Crane control	1.00	EA	11,203.08	-	10,083	0%	13,444	0%	-	-	-
41	Copco 2	3.057	Copco 2 Dam Removal	Remove & Dispose - 40-Ton Travelling Crane Festoon Cable	1.00	EA	2,557.66	-	2,302	0%	3,069	0%	-	-	-
41	Copco 2	3.058a	Copco 2 Dam Removal	Remove Oil from Oil-Filled Step-up Transformers	23,000	GAL	10.59	243,653	207,105	-15%	280,201	15%	274,077	232,965	315,188
41	Copco 2	3.061	Copco 2 Dam Removal	Remove Intake Structure Concrete	1,650	CY	299.68	-	420,307	0%	741,718	0%	-	-	-
41	Copco 2	3.062	Copco 2 Dam Removal	Remove Concrete Items associated with 16-foot I.D. Wood	1,310	CY	299.39	-	333,367	0%	568,685	0%	-	-	-
41	Copco 2	3.063	Copco 2 Dam Removal	Place Concrete Plugs for Tunnels	100	CY	1,827.07	182,707	99,392	-15%	152,012	30%	205,521	111,803	170,993
41	Copco 2	3.064	Copco 2 Dam Removal	Remove Concrete Items associated with Penstocks D/S from	3,500	CY	298.85	-	836,779	0%	1,359,765	0%	-	-	-
41	Copco 2	3.065	Copco 2 Dam Removal	Remove & Dispose of Caterpillar Gate (steel)	50,000	LB	0.92	-	38,993	0%	52,755	0%	-	-	-
41	Copco 2	3.066	Copco 2 Dam Removal	Remove & Dispose of Trash rack and trash rake (steel)	86,000	LB	0.63	-	46,219	0%	70,687	0%	-	-	-
41	Copco 2	3.067	Copco 2 Dam Removal	Remove & Dispose of Stop Logs and slots for intake (steel)	220,000	LB	0.78	-	145,176	0%	222,034	0%	-	-	-
41	Copco 2	3.068	Copco 2 Dam Removal	Remove & Dispose of Wood Staves Soaked in Creosote	1,100,000	LB	0.93	1,021,716	715,201	-30%	1,328,231	30%	1,149,292	804,504	1,494,079
41	Copco 2	3.069	Copco 2 Dam Removal	Remove & Dispose of Cradles (steel)	290,000	LB	0.94	273,748	191,623	-30%	355,872	30%	307,929	215,550	400,308
41	Copco 2	3.070	Copco 2 Dam Removal	Remove & Dispose of Bands (steel)	463,000	LB	0.92	426,777	298,744	-30%	554,811	30%	480,067	336,047	624,086
41	Copco 2	3.071	Copco 2 Dam Removal	Remove & Dispose of Penstock after bifurcation to butterfly	860,000	LB	1.08	-	647,928	0%	1,203,295	0%	-	-	-
41	Copco 2	3.072	Copco 2 Dam Removal	Remove & Dispose of Bifurcated vent pipes and support	19,500	LB	1.13	-	15,423	0%	28,643	0%	-	-	-
41	Copco 2	3.073	Copco 2 Dam Removal	Remove & Dispose of 2 - 138" Butterfly Valves	148,000	LB	0.88	-	90,934	0%	168,878	0%	-	-	-
41	Copco 2	5.017	Copco 2 Dam Removal	Disconnect and Remove Medium Voltage Circuit Breakers	2.00	EA	678.35	1,357	1,153	-15%	1,899	40%	1,526	1,297	2,137
41	Copco 2	5.018	Copco 2 Dam Removal	Disconnect and Remove Medium Voltage Circuit Breakers	5.00	LB	590.84	2,954	2,511	-15%	4,136	40%	3,323	2,825	4,652
41	Copco 2	5.019	Copco 2 Dam Removal	Disconnect and Remove Transformers 12KV @ substation	1.00	EA	816.83	817	694	-15%	1,144	40%	919	781	1,286
41	Copco 2	5.020	Copco 2 Dam Removal	Disconnect and Remove cable connection between Copco 2	0.10	MI	94,661.96	9,466	8,046	-15%	13,253	40%	10,648	9,051	14,907
41	Copco 2	5.021	Copco 2 Dam Removal	Remove All associated Aux Equipment @ substation	1.00	LS	24,184.84	24,185	20,557	-15%	33,859	40%	27,205	23,124	38,087
41	Copco 2	5.022	Copco 2 Dam Removal	Demolish overhead transmission line and structure 69KV	5.00	MI	118,983.58	594,918	505,680	-15%	832,885	40%	669,202	568,821	936,882
41	Copco 2	5.023	Copco 2 Dam Removal	Demolish transmission conductor from existing structure pole.	1.50	MI	7,073.23	10,610	9,018	-15%	14,854	40%	11,935	10,144	16,708
41	Copco 2	5.024	Copco 2 Dam Removal	Remove structures between pole 2/007 and Iron Gate	6.00	EA	3,754.31	22,526	20,273	-10%	31,536	40%	25,339	22,805	35,474
41	Iron Gate	4.001	Iron Gate Dam Removal	Furnish, Install, and Remove Barge-Mounted Crane in	1.00	LS	191,823.14	191,823	172,641	-10%	220,597	15%	215,775	194,197	248,141
41	Iron Gate	4.002	Iron Gate Dam Removal	Furnish, Install, and Remove Temporary Air Vent Hose from	50.00	EA	315.45	-	13,407	0%	18,927	0%	-	-	-
41	Iron Gate	4.003	Iron Gate Dam Removal	Remove Reinforced Concrete Ring Located D/S of Closure	46.00	CY	1,012.49	46,575	39,589	-15%	58,218	25%	52,390	44,532	65,488
41	Iron Gate	4.004	Iron Gate Dam Removal	Remove Reinforced Concrete Stoplog Structure	6.00	CY	1,738.55	10,431	9,388	-10%	11,996	15%	11,734	10,560	13,494
41	Iron Gate	4.005	Iron Gate Dam Removal	Remove Water from behind Tailrace Cofferdam	300,000	GAL	0.01	-	2,662	0%	3,602	0%	-	-	-
41	Iron Gate	4.006	Iron Gate Dam Removal	Provide Dewatering behind Tailrace Cofferdam for removal of	1.00	LS	29,462.94	-	25,044	0%	33,882	0%	-	-	-
41	Iron Gate	4.007	Iron Gate Dam Removal	Construct Embankment Cofferdam across Tailrace to remove	1,650	CY	112.09	-	166,451	0%	212,687	0%	-	-	-
41	Iron Gate	4.010	Iron Gate Dam Removal	Upstream Cofferdam to be Removed in the Wet	20,000	CY	14.70	294,012	249,910	-15%	338,114	15%	330,723	281,115	380,332

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	Iron Gate	4.011	Iron Gate Dam Removal	Remove 9' dia. hinged blind flange	19,000	LB	6.49	123,371	104,866	-15%	148,046	20%	138,776	117,960	166,531
41	Iron Gate	4.012	Iron Gate Dam Removal	Remove 18" plug valve and 7' of 18" drainage pipe	2,620	LB	2.70	7,061	6,002	-15%	8,473	20%	7,943	6,751	9,531
41	Iron Gate	4.013.1	Iron Gate Dam Removal	Furnish and Install 1-16.5'x18' roller gate, stem, and operator	110,000	LB	34.16	3,757,547	3,381,793	-10%	4,133,302	10%	4,226,730	3,804,057	4,649,403
41	Iron Gate	4.013.2	Iron Gate Dam Removal	Remove Existing sluice and diversion gates from shaft by	110,000	LB	4.38	482,328	434,095	-10%	530,561	10%	542,554	488,298	596,809
41	Iron Gate	4.013.3	Iron Gate Dam Removal	Remove 16.5'X 18' sluice and diversion gates from shaft in	110,000	LB	0.58	64,216	57,794	-10%	70,637	10%	72,234	65,011	79,457
41	Iron Gate	4.014	Iron Gate Dam Removal	Remove Concrete in Observation Platform, Crest Wall and	780	CY	298.81	233,072	209,765	-10%	256,379	10%	262,174	235,957	288,392
41	Iron Gate	4.015	Iron Gate Dam Removal	Remove Concrete in Diversion Tunnel Intake Structure	715	CY	300.06	214,542	193,088	-10%	246,723	15%	241,330	217,197	277,530
41	Iron Gate	4.016	Iron Gate Dam Removal	Remove Concrete in Diversion Tunnel Gate Tower	650	CY	196.63	127,809	108,637	-15%	146,980	15%	143,767	122,202	165,333
41	Iron Gate	4.017	Iron Gate Dam Removal	Remove Steel Footbridge to Gate Tower	13,000	LB	1.10	14,259	12,120	-15%	16,398	15%	16,039	13,633	18,445
41	Iron Gate	4.018	Iron Gate Dam Removal	Remove Concrete in Diversion Tunnel Footbridge Abutment	39.00	CY	197.94	7,720	6,562	-15%	8,878	15%	8,684	7,381	9,986
41	Iron Gate	4.019	Iron Gate Dam Removal	Place Concrete Plugs for Diversion Tunnel	43.00	CY	1,672.11	71,901	64,711	-10%	79,091	10%	80,879	72,791	88,966
41	Iron Gate	4.020	Iron Gate Dam Removal	Remove Concrete Closure Gates in Gate Tower	85.00	CY	894.09	75,998	64,598	-15%	87,397	15%	85,487	72,664	98,310
41	Iron Gate	4.021	Iron Gate Dam Removal	Remove Upstream Riprap	92,400	CY	21.05	1,944,680	1,652,978	-15%	2,333,616	20%	2,187,500	1,859,375	2,625,000
41	Iron Gate	4.022	Iron Gate Dam Removal	Remove Downstream Riprap	23,400	CY	15.64	365,879	310,997	-15%	439,054	20%	411,564	349,829	493,876
41	Iron Gate	4.023	Iron Gate Dam Removal	Miscellaneous Excavation	270,000	CY	6.72	1,815,450	1,543,132	-15%	2,178,539	20%	2,042,134	1,735,814	2,450,561
41	Iron Gate	4.023.1	Iron Gate Dam Removal	Miscellaneous Excavation	761,159	CY	15.55	11,836,796	10,061,276	-15%	14,204,155	20%	13,314,785	11,317,568	15,977,742
41	Iron Gate	4.024	Iron Gate Dam Removal	Cutoff Wall Concrete Demolition	2,440	CY	112.84	275,336	247,803	-10%	316,637	15%	309,716	278,744	356,173
41	Iron Gate	4.025	Iron Gate Dam Removal	Earth Fill Crest Raise	13,000	CY	15.68	203,841	173,265	-15%	234,417	15%	229,293	194,899	263,687
41	Iron Gate	4.026	Iron Gate Dam Removal	Sheet pile Crest Raise	800	LF	281.18	224,946	191,204	-15%	258,688	15%	253,034	215,079	290,989
41	Iron Gate	4.027	Iron Gate Dam Removal	Remove 5 Monitoring Wells	5.00	EA	2,332.81	11,664	10,498	-10%	13,414	15%	13,120	11,808	15,089
41	Iron Gate	4.028	Iron Gate Dam Removal	Remove and Dispose of Trash Sluice Gate - 10 ft x 9 ft H	4,500	LB	1.01	4,544	3,408	-25%	5,680	25%	5,112	3,834	6,390
41	Iron Gate	4.029	Iron Gate Dam Removal	Remove and Dispose of Intake Structure	72,000	LB	0.90	64,663	54,964	-15%	77,596	20%	72,738	61,827	87,285
41	Iron Gate	4.030	Iron Gate Dam Removal	Remove and Dispose of Sluice and Diversion Tunnel Gate	28,000	LB	1.09	30,649	26,052	-15%	36,779	20%	34,476	29,304	41,371
41	Iron Gate	4.031	Iron Gate Dam Removal	Remove and Dispose of Hoist Stem - 6" Dia. Sch 160x150'	7,500	LB	1.01	7,578	6,441	-15%	9,093	20%	8,524	7,245	10,229
41	Iron Gate	4.032	Iron Gate Dam Removal	Remove and Dispose of Air Vent Pipe - 8" Dia. Sch 40 x160'	4,650	LB	2.12	9,855	8,377	-15%	11,826	20%	11,085	9,423	13,303
41	Iron Gate	4.034	Iron Gate Dam Removal	Remove and Dispose of Air Vent Pipe - 12" Dia. Sch 40 x560'	30,250	LB	2.26	68,353	58,100	-15%	82,024	20%	76,888	65,355	92,266
41	Iron Gate	4.035	Iron Gate Dam Removal	Remove and Dispose of Outlet Works Stop Logs	2,670	LB	1.01	2,696	2,022	-25%	3,370	25%	3,033	2,275	3,791
41	Iron Gate	4.036	Iron Gate Dam Removal	Remove and Dispose of Hydraulic Pump Motor (10 HP est) &	1.00	EA	415.82	416	312	-25%	520	25%	468	351	585
41	Iron Gate	4.037	Iron Gate Dam Removal	Remove and Dispose of Distribution Equipment, Junction	1.00	EA	2,019.67	2,020	1,515	-25%	2,525	25%	2,272	1,704	2,840
41	Iron Gate	4.038	Iron Gate Dam Removal	Remove and Dispose of Power Cable and 4" Conduit from	800	FT	49.86	39,887	33,904	-15%	45,870	15%	44,867	38,137	51,598
41	Iron Gate	4.039	Iron Gate Dam Removal	Remove Powerhouse Concrete	5,200	CY	402.36	-	1,883,040	0%	2,406,107	0%	-	-	-
41	Iron Gate	4.040	Iron Gate Dam Removal	Remove and Dispose of Turbine Unit	344,058	LB	0.95	-	278,446	0%	376,721	0%	-	-	-
41	Iron Gate	4.041	Iron Gate Dam Removal	Remove and Dispose of Draft Tube Bulkheads	16,500	LB	0.98	-	13,800	0%	19,482	0%	-	-	-
41	Iron Gate	4.042	Iron Gate Dam Removal	Remove and Dispose of Crane	24,000	LB	1.07	-	21,776	0%	32,023	0%	-	-	-
41	Iron Gate	4.043	Iron Gate Dam Removal	Remove and Dispose of Governor	20,310	LB	1.04	-	17,878	0%	25,240	0%	-	-	-
41	Iron Gate	4.044	Iron Gate Dam Removal	Remove and Dispose of Bearing Oil System and Cooling	9,182	LB	1.06	-	8,297	0%	11,713	0%	-	-	-
41	Iron Gate	4.045	Iron Gate Dam Removal	Remove and Dispose of CO2 Systems	2,568	LB	1.01	-	2,343	0%	3,124	0%	-	-	-
41	Iron Gate	4.046	Iron Gate Dam Removal	Remove and Dispose of Plant Water and Fire Protection	9,182	LB	1.05	-	8,636	0%	11,515	0%	-	-	-
41	Iron Gate	4.047	Iron Gate Dam Removal	Remove and Dispose of Sump Pumps	2,000	LB	1.05	-	1,883	0%	2,510	0%	-	-	-
41	Iron Gate	4.048	Iron Gate Dam Removal	Remove and Dispose of Pumps	22,000	LB	1.09	-	21,676	0%	28,901	0%	-	-	-
41	Iron Gate	4.049	Iron Gate Dam Removal	Remove and Dispose of Exposed Piping Around the Plant	19,291	LB	1.05	-	18,257	0%	24,342	0%	-	-	-
41	Iron Gate	4.050	Iron Gate Dam Removal	Remove and Dispose of Unwatering Piping	19,291	LB	0.88	-	15,270	0%	19,512	0%	-	-	-
41	Iron Gate	4.051	Iron Gate Dam Removal	Remove and Dispose of Drainage Piping	9,518	LB	1.12	-	9,591	0%	12,256	0%	-	-	-
41	Iron Gate	4.052	Iron Gate Dam Removal	Remove and Dispose of Transformer Oil and Fire Protection	9,182	LB	1.00	-	8,739	0%	10,119	0%	-	-	-
41	Iron Gate	4.053	Iron Gate Dam Removal	Remove and Dispose of Compressed Air System	1,450	LB	0.91	-	1,182	0%	1,510	0%	-	-	-
41	Iron Gate	4.053a	Iron Gate Dam Removal	Remove & Dispose - Petroleum Products from Mechanical	1,100	GAL	10.05	11,057	10,504	-5%	12,163	10%	12,438	11,816	13,681
41	Iron Gate	4.054	Iron Gate Dam Removal	Remove and Dispose of AC Generator, Outdoor Horizontal	1.00	EA	91,158.88	-	82,043	0%	104,833	0%	-	-	-
41	Iron Gate	4.055	Iron Gate Dam Removal	Remove and Dispose of Excitation equipment for 18.975 MVA	1.00	EA	2,384.74	-	2,146	0%	2,742	0%	-	-	-
41	Iron Gate	4.056	Iron Gate Dam Removal	Remove and Dispose of Surge protection equip. for 18.975	1.00	EA	1,891.05	-	1,702	0%	2,175	0%	-	-	-
41	Iron Gate	4.057	Iron Gate Dam Removal	Remove and Dispose of Neutral grounding equip. for 18.975	1.00	EA	3,980.33	-	3,582	0%	4,577	0%	-	-	-
41	Iron Gate	4.058	Iron Gate Dam Removal	Remove and Dispose of Station Service Switchgear, 600 volt	1.00	EA	7,378.96	-	6,641	0%	8,486	0%	-	-	-
41	Iron Gate	4.059	Iron Gate Dam Removal	Remove and Dispose of Unit and plant control switchboard	1.00	EA	23,948.92	-	21,554	0%	27,541	0%	-	-	-
41	Iron Gate	4.060	Iron Gate Dam Removal	Remove and Dispose of Battery System - assume 60	1.00	EA	15,350.22	15,350	13,815	-10%	17,653	15%	17,267	15,540	19,857
41	Iron Gate	4.061	Iron Gate Dam Removal	Remove and Dispose of Raceways, Bus, Conduit and Cable	1.00	EA	18,352.70	-	16,517	0%	21,106	0%	-	-	-
41	Iron Gate	4.062	Iron Gate Dam Removal	Remove and Dispose of Misc. power & control boards	1.00	EA	5,642.84	-	5,079	0%	6,489	0%	-	-	-
41	Iron Gate	4.063	Iron Gate Dam Removal	Remove and Dispose of Transformer (3 phase, 275 kVA,	1.00	EA	9,142.79	-	8,229	0%	10,514	0%	-	-	-
41	Iron Gate	4.064	Iron Gate Dam Removal	Remove and Dispose of Governor Oil Pump Motors (10 hp	2.00	EA	244.50	-	440	0%	562	0%	-	-	-
41	Iron Gate	4.065	Iron Gate Dam Removal	Remove and Dispose of Vertical Motors, outdoor, (480V, 100	4.00	EA	712.83	2,851	2,138	-25%	3,564	25%	3,207	2,405	4,009
41	Iron Gate	4.066	Iron Gate Dam Removal	Remove and Dispose of Transformer (3 phase, 300 kVA,	1.00	EA	10,482.18	10,482	9,434	-10%	12,055	15%	11,791	10,612	13,560
41	Iron Gate	4.067	Iron Gate Dam Removal	Remove and Dispose of Step-up Transformer, outdoor, oil-	1.00	EA	85,541.22	85,541	76,987	-10%	98,372	15%	96,222	86,600	110,656
41	Iron Gate	4.068	Iron Gate Dam Removal	Remove and Dispose of Lattice steel structure, with 69-kV	1.00	EA	6,973.83	6,974	6,276	-10%	8,020	15%	7,845	7,060	9,021
41	Iron Gate	4.069	Iron Gate Dam Removal	Remove and Dispose of Generator Switchgear, outdoor,	1.00	EA	24,487.62	24,488	22,039	-10%	28,161	15%	27,545	24,791	31,677
41	Iron Gate	4.070	Iron Gate Dam Removal	Remove and Dispose of Single Phase Pole Transformers (25	3.00	EA	2,514.24	7,543	6,788	-10%	8,674	15%	8,485	7,636	9,757
41	Iron Gate	4.071	Iron Gate Dam Removal	Remove Concrete in Penstock Intake Structure	460	CY	302.54	139,169	118,294	-15%	160,044	15%	156,546	133,064	180,028
41	Iron Gate	4.072	Iron Gate Dam Removal	Remove Concrete in Penstock Encasement	710	CY	300.16	213,116	191,805	-10%	245,084	15%	239,727	215,754	275,686
41	Iron Gate	4.073	Iron Gate Dam Removal	Remove Concrete in 3 Penstock Anchors and 7 Penstock	3,110	CY	298.85	929,437	790,022	-15%	1,068,853	15%	1,045,491	888,667	1,202,314
41	Iron Gate	4.074	Iron Gate Dam Removal	Remove Steel Footbridge to Intake Structure	11,000	LB	1.11	12,161	10,337	-15%	13,986	15%	13,680	11,628	15,732
41	Iron Gate	4.075	Iron Gate Dam Removal	Remove Concrete in Intake Structure Footbridge Abutment	5.00	CY	820.58	4,103	3,487	-15%	4,718	15%	4,615	3,923	5,307

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	Iron Gate	4.076	Iron Gate Dam Removal	Remove and Dispose of Intake Structure	131,630	LB	1.04	136,401	115,941	-15%	156,862	15%	153,433	130,418	176,448
41	Iron Gate	4.077	Iron Gate Dam Removal	Remove and Dispose of Gate Hoist Stem - 6" Sch160x40'	1,800	LB	1.01	1,818	1,363	-25%	2,272	25%	2,045	1,534	2,556
41	Iron Gate	4.078	Iron Gate Dam Removal	Remove and Dispose of Water Fill line- 12" Dia STD x 27'	1,350	LB	1.01	1,363	1,022	-25%	1,704	25%	1,534	1,150	1,917
41	Iron Gate	4.079	Iron Gate Dam Removal	Remove and Dispose of Air Vent - 12" Dia STD x 32'	1,600	LB	1.01	1,616	1,212	-25%	2,020	25%	1,817	1,363	2,272
41	Iron Gate	4.080	Iron Gate Dam Removal	Remove and Dispose of Gage Wells	2,612	LB	1.01	2,638	1,978	-25%	3,297	25%	2,967	2,225	3,709
41	Iron Gate	4.081	Iron Gate Dam Removal	Remove and Dispose of Penstock Vent - 46" Dia, 0.25" Thick	7,440	LB	2.08	15,466	13,146	-15%	17,786	15%	17,398	14,788	20,007
41	Iron Gate	4.082	Iron Gate Dam Removal	Remove and Dispose of Penstock - 12" Dia, 0.25" Thick x	294,428	LB	1.47	433,061	368,102	-15%	498,020	15%	487,135	414,065	560,205
41	Iron Gate	4.083	Iron Gate Dam Removal	Remove and Dispose of Bypass Outlet - 96" Dia, 0.25" Thick	12,850	LB	0.90	11,547	9,815	-15%	13,279	15%	12,989	11,041	14,937
41	Iron Gate	4.084	Iron Gate Dam Removal	Remove and Dispose of Outlet Valve on bypass outlet - 66"	18,000	LB	1.62	29,193	24,814	-15%	33,572	15%	32,838	27,912	37,764
41	Iron Gate	4.085	Iron Gate Dam Removal	Remove and Dispose Overhead trolley Crane Motor (4hp est)	1.00	EA	1,188.04	1,188	891	-25%	1,485	25%	1,336	1,002	1,670
41	Iron Gate	4.086	Iron Gate Dam Removal	Remove and Dispose Distribution equipment, Junction Boxes	1.00	EA	2,970.11	2,970	2,228	-25%	3,713	25%	3,341	2,506	4,176
41	Iron Gate	4.087	Iron Gate Dam Removal	Remove and Dispose Power Cable and Conduit	1.00	EA	91,734.75	91,735	77,975	-15%	105,495	15%	103,189	87,711	118,667
41	Iron Gate	4.097	Iron Gate Dam Removal	Clear and Grub Disposal Area	29.00	AC	6,292.60	182,485	155,113	-15%	209,858	15%	205,271	174,481	236,062
41	Iron Gate	4.101	Iron Gate Dam Removal	Remove Building No. 2	800	SF	73.00	58,404	52,563	-10%	67,164	15%	65,696	59,127	75,551
41	Iron Gate	4.102	Iron Gate Dam Removal	Remove Building No. 3	1,088	SF	75.55	82,199	73,979	-10%	94,529	15%	92,463	83,217	106,332
41	Iron Gate	4.103	Iron Gate Dam Removal	Remove Concrete in Fish Ladder	1,240	CY	300.19	372,241	316,405	-15%	428,077	15%	418,721	355,913	481,529
41	Iron Gate	4.104	Iron Gate Dam Removal	Remove Concrete in Holding Ponds #1 thru #6	1,380	CY	196.04	270,529	243,476	-10%	311,109	15%	304,309	273,878	349,955
41	Iron Gate	4.105	Iron Gate Dam Removal	Remove Concrete in Fish Facility Items	1,200	CY	194.03	232,832	197,908	-15%	267,757	15%	261,905	222,619	301,191
41	Iron Gate	4.106	Iron Gate Dam Removal	Remove Miscellaneous Metalwork in Fish Facilities	12,000	LB	0.95	11,351	9,648	-15%	13,621	20%	12,768	10,853	15,322
41	Iron Gate	4.107	Iron Gate Dam Removal	Remove Concrete Associated with 30" Dia. water supply line	80.00	CY	194.03	15,522	13,194	-15%	17,850	15%	17,460	14,841	20,079
41	Iron Gate	4.108	Iron Gate Dam Removal	Remove Concrete in Aerator Structure	65.00	CY	191.23	12,430	10,565	-15%	14,294	15%	13,982	11,884	16,079
41	Iron Gate	4.109	Iron Gate Dam Removal	Remove Wood in Aerator Structure	6,000	LB	0.83	4,990	3,742	-25%	6,237	25%	5,613	4,210	7,016
41	Iron Gate	4.110	Iron Gate Dam Removal	Remove Structural Steel in Aerator Structure	2,500	LB	1.01	2,525	1,893	-25%	3,156	25%	2,840	2,130	3,550
41	Iron Gate	4.111	Iron Gate Dam Removal	Remove Asphalt Pavement	3,900	SF	6.54	25,489	21,665	-15%	29,312	15%	28,671	24,370	32,972
41	Iron Gate	4.112	Iron Gate Dam Removal	Remove Restroom Building near Aerator Structure	340	SF	60.38	20,528	18,475	-10%	23,607	15%	23,091	20,782	26,555
41	Iron Gate	4.113	Iron Gate Dam Removal	Remove Storage Shed near Aerator Structure	90.00	SF	70.22	6,320	5,688	-10%	7,268	15%	7,109	6,398	8,175
41	Iron Gate	4.114	Iron Gate Dam Removal	Remove Toe Drain Pipe	260	LF	27.00	7,021	5,968	-15%	8,074	15%	7,897	6,713	9,082
41	Iron Gate	4.115	Iron Gate Dam Removal	Remove Toe Drain Manhole	25.00	LF	59.40	1,485	1,114	-25%	1,856	25%	1,670	1,253	2,088
41	Iron Gate	4.116	Iron Gate Dam Removal	Berm Removal	53,000	CY	13.82	732,558	659,302	-10%	842,442	15%	824,028	741,625	947,633
41	Iron Gate	4.117	Iron Gate Dam Removal	Remove and Dispose of Intake Structures Trashracks	5,000	LB	0.89	4,455	3,341	-25%	5,569	25%	5,011	3,759	6,264
41	Iron Gate	4.118	Iron Gate Dam Removal	Remove and Dispose of Pipe Conduit, 30" Dia. x 0.25" Thick	76,640	LB	1.03	78,948	67,106	-15%	94,738	20%	88,806	75,485	106,567
41	Iron Gate	4.119	Iron Gate Dam Removal	Remove and Dispose of Sluice Gate Valve, 30" Dia.	3,000	LB	1.01	3,030	2,272	-25%	3,787	25%	3,408	2,556	4,260
41	Iron Gate	4.120	Iron Gate Dam Removal	Remove and Dispose of Sluice Gate Stem, 2" Dia.	360	LB	1.01	364	273	-25%	454	25%	409	307	511
41	Iron Gate	4.121	Iron Gate Dam Removal	Remove and Dispose of Butterfly Valve, 30" Dia.	2,435	LB	1.01	2,459	1,844	-25%	3,074	25%	2,766	2,074	3,457
41	Iron Gate	4.122	Iron Gate Dam Removal	Remove and Dispose of Piping- 30-in. Dia. x 0.25 Thickness	7,200	LB	0.60	4,332	3,682	-15%	5,198	20%	4,872	4,142	5,847
41	Iron Gate	4.123	Iron Gate Dam Removal	Remove and Dispose of Piping- 24-in. Dia. x 0.25 Thickness	15,872	LB	0.50	8,005	6,804	-15%	9,606	20%	9,004	7,654	10,805
41	Iron Gate	4.124	Iron Gate Dam Removal	Remove and Dispose of Piping- 20-in. Dia. x 0.25 Thickness	4,505	LB	0.58	2,599	2,209	-15%	3,119	20%	2,923	2,485	3,508
41	Iron Gate	4.125	Iron Gate Dam Removal	Remove and Dispose of Piping- 18-in. Dia. x 0.25 Thickness	29,088	LB	0.38	11,115	9,448	-15%	13,338	20%	12,503	10,627	15,003
41	Iron Gate	4.126	Iron Gate Dam Removal	Remove and Dispose of Piping- 16-in. Dia. x 0.25 Thickness	6,972	LB	0.56	3,898	3,314	-15%	4,678	20%	4,385	3,727	5,262
41	Iron Gate	4.127	Iron Gate Dam Removal	Remove and Dispose of Piping- 12-in. Dia. x 0.25 Thickness	2,176	LB	0.46	992	843	-15%	1,190	20%	1,116	948	1,339
41	Iron Gate	4.128	Iron Gate Dam Removal	Remove and Dispose of Piping- 10-in. Dia. x 0.25 Thickness	1,932	LB	0.45	864	734	-15%	1,036	20%	972	826	1,166
41	Iron Gate	4.129	Iron Gate Dam Removal	Remove and Dispose of Piping- 8-in. Dia. x 0.25 Thickness x	3,588	LB	0.23	818	695	-15%	982	20%	920	782	1,104
41	Iron Gate	4.130	Iron Gate Dam Removal	Remove and Dispose of Piping- 3-in. Dia. x STD x 30'	1,088	LB	0.38	412	350	-15%	494	20%	463	394	556
41	Iron Gate	4.131	Iron Gate Dam Removal	Remove and Dispose of Gate Valves	21,792	LB	0.98	21,312	18,116	-15%	25,575	20%	23,974	20,378	28,768
41	Iron Gate	4.132	Iron Gate Dam Removal	Remove and Dispose of Basin #1	2,880	LB	2.89	8,336	7,086	-15%	10,003	20%	9,377	7,970	11,252
41	Iron Gate	4.133	Iron Gate Dam Removal	Remove and Dispose of Basin #2	3,860	LB	2.16	8,336	7,086	-15%	10,003	20%	9,377	7,970	11,252
41	Iron Gate	4.134	Iron Gate Dam Removal	Remove and Dispose of Basin #3	2,880	LB	2.89	8,336	7,086	-15%	10,003	20%	9,377	7,970	11,252
41	Iron Gate	4.135	Iron Gate Dam Removal	Remove and Dispose of Basin #4	3,580	LB	2.33	8,336	7,086	-15%	10,003	20%	9,377	7,970	11,252
41	Iron Gate	4.136	Iron Gate Dam Removal	Remove and Dispose of Basin #5	1,440	LB	5.79	8,336	7,086	-15%	10,003	20%	9,377	7,970	11,252
41	Iron Gate	4.137	Iron Gate Dam Removal	Remove and Dispose of Basin #6	1,440	LB	5.79	8,336	7,086	-15%	10,003	20%	9,377	7,970	11,252
41	Iron Gate	4.138	Iron Gate Dam Removal	Remove and Dispose of Holding Tank	7,400	LB	1.53	11,355	9,652	-15%	13,627	20%	12,773	10,857	15,328
41	Iron Gate	4.139	Iron Gate Dam Removal	Remove and Dispose of Misc.: Motors, control panels, cables,	1.00	EA	1,782.06	1,782	1,337	-25%	2,228	25%	2,005	1,503	2,506
41	Iron Gate	4.140	Iron Gate Dam Removal	Wanaka Springs - Concrete Total	28.00	CY	306.28	8,576	7,290	-15%	9,862	15%	9,647	8,200	11,094
41	Iron Gate	4.141	Iron Gate Dam Removal	Wanaka Springs - Double Pipe Railings	60.00	LF	47.52	2,851	2,138	-25%	3,564	25%	3,207	2,405	4,009
41	Iron Gate	4.142	Iron Gate Dam Removal	Wanaka Springs - Wood picnic tables to be removed and	5.00	EA	118.80	594	446	-25%	743	25%	668	501	835
41	Iron Gate	4.143	Iron Gate Dam Removal	Wanaka Springs - 25'x5' Wooden floating dock	125	SF	23.76	2,970	2,228	-25%	3,713	25%	3,341	2,506	4,176
41	Iron Gate	4.144	Iron Gate Dam Removal	Wanaka Springs - Rip and reseed site and access road	2.50	AC	6,798.10	16,995	14,446	-15%	19,545	15%	19,117	16,250	21,985
41	Iron Gate	4.145	Iron Gate Dam Removal	Wanaka Springs - Signs to be removed and hauled away	3.00	EA	356.41	1,069	802	-25%	1,337	25%	1,203	902	1,503
41	Iron Gate	4.146	Iron Gate Dam Removal	Wanaka Springs - 15'x5' Gangplank with Railings	75.00	SF	23.76	1,782	1,337	-25%	2,228	25%	2,005	1,503	2,506
41	Iron Gate	4.147	Iron Gate Dam Removal	Juniper Point - Concrete Total	19.00	CY	359.74	6,835	5,810	-15%	7,860	15%	7,688	6,535	8,842
41	Iron Gate	4.148	Iron Gate Dam Removal	Juniper Point - 2, 4x4 Toilet Vaults	32.00	SF	118.80	3,802	2,851	-25%	4,752	25%	4,276	3,207	5,346
41	Iron Gate	4.149	Iron Gate Dam Removal	Juniper Point - Wood picnic tables to be removed and hauled	8.00	EA	118.80	950	713	-25%	1,188	25%	1,069	802	1,336
41	Iron Gate	4.150	Iron Gate Dam Removal	Juniper Point - Signs to be removed and hauled away	4.00	EA	356.41	1,426	1,069	-25%	1,782	25%	1,604	1,203	2,005
41	Iron Gate	4.151	Iron Gate Dam Removal	Juniper Point - Dock pile railing	50.00	LF	47.52	2,376	1,782	-25%	2,970	25%	2,673	2,005	3,341
41	Iron Gate	4.152	Iron Gate Dam Removal	Juniper Point - 50'x5' Composite dock with poly floats	250	SF	31.34	7,834	7,051	-10%	8,618	10%	8,812	7,931	9,694
41	Iron Gate	4.153	Iron Gate Dam Removal	Juniper Point - 20'x5' Composite gangplank with railings	100	SF	23.76	2,376	1,782	-25%	2,970	25%	2,673	2,005	3,341
41	Iron Gate	4.155	Iron Gate Dam Removal	Juniper Point - Regrade to Natural Contour, rip, and reseed	2.00	AC	10,546.17	21,092	17,928	-15%	24,256	15%	23,726	20,167	27,285
41	Iron Gate	4.156	Iron Gate Dam Removal	Camp Creek - Concrete Total	110	CY	306.56	33,722	28,664	-15%	38,780	15%	37,932	32,243	43,622

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	Iron Gate	4.157	Iron Gate Dam Removal	Camp Creek - 180'Lx16'Wx8'D Earth jetty to remove and/or	855	CY	73.54	62,876	53,445	-15%	72,307	15%	70,727	60,118	81,336
41	Iron Gate	4.158	Iron Gate Dam Removal	Camp Creek - Well house 10'x16' concrete block building	160	SF	72.74	11,638	10,475	-10%	12,802	10%	13,092	11,783	14,401
41	Iron Gate	4.159	Iron Gate Dam Removal	Camp Creek - 2, 20'x5' Composite decking gangplanks	200	SF	23.76	4,752	3,564	-25%	5,940	25%	5,346	4,009	6,682
41	Iron Gate	4.160	Iron Gate Dam Removal	Camp Creek - 2, 20'x5' Floating composite w/ aluminum	200	SF	23.76	4,752	3,564	-25%	5,940	25%	5,346	4,009	6,682
41	Iron Gate	4.161	Iron Gate Dam Removal	Camp Creek - Concrete block double toilet bldg 10'x16'	160	SF	72.74	11,638	10,475	-10%	12,802	10%	13,092	11,783	14,401
41	Iron Gate	4.162	Iron Gate Dam Removal	Camp Creek - Dump stations and approx. 2000 gal buried	1.00	EA	6,596.62	6,597	5,607	-15%	7,916	20%	7,420	6,307	8,904
41	Iron Gate	4.163	Iron Gate Dam Removal	Camp Creek - Power poles and lines	3.00	EA	1,818.16	5,454	4,636	-15%	6,545	20%	6,136	5,215	7,363
41	Iron Gate	4.164	Iron Gate Dam Removal	Camp Creek - Remove waterlines and 3 faucets and regrade	600	LF	5.94	3,564	2,673	-25%	4,455	25%	4,009	3,007	5,011
41	Iron Gate	4.166	Iron Gate Dam Removal	Camp Creek - Steel pipe/plank picnic tables to be removed	5.00	EA	118.80	594	446	-25%	743	25%	668	501	835
41	Iron Gate	4.167	Iron Gate Dam Removal	Camp Creek - Relocate concrete tables	12.00	EA	118.80	1,426	1,069	-25%	1,782	25%	1,604	1,203	2,005
41	Iron Gate	4.168	Iron Gate Dam Removal	Camp Creek - Regrade, rip, and reseed	4.00	AC	8,861.29	35,445	30,128	-15%	40,762	15%	39,871	33,890	45,852
41	Iron Gate	4.169	Iron Gate Dam Removal	Camp Creek - Signs to be removed and hauled away	7.00	EA	356.41	2,495	1,871	-25%	3,119	25%	2,806	2,105	3,508
41	Iron Gate	4.170	Iron Gate Dam Removal	Dutch Creek - 50'4'3' Dock Concrete Abutment	22.00	CY	333.37	7,334	6,601	-10%	8,068	10%	8,250	7,425	9,075
41	Iron Gate	4.171	Iron Gate Dam Removal	Dutch Creek - Double Pipe Railing	100	LF	47.52	4,752	3,564	-25%	5,940	25%	5,346	4,009	6,682
41	Iron Gate	4.172	Iron Gate Dam Removal	Mirror Cove - Concrete Total	89.00	CY	235.88	20,994	18,894	-10%	23,093	10%	23,615	21,254	25,977
41	Iron Gate	4.173	Iron Gate Dam Removal	Mirror Cove - 10'x16' Toilet Vault	160	SF	96.23	15,397	13,857	-10%	16,937	10%	17,320	15,588	19,052
41	Iron Gate	4.174	Iron Gate Dam Removal	Mirror Cove - 2, 30'x5' Composite Gangplanks w/ aluminum	300	SF	21.43	6,430	5,787	-10%	7,073	10%	7,233	6,510	7,957
41	Iron Gate	4.175	Iron Gate Dam Removal	Mirror Cove - Double pipe railings on dock	80.00	LF	47.52	3,802	2,851	-25%	4,752	25%	4,276	3,207	5,346
41	Iron Gate	4.177	Iron Gate Dam Removal	Mirror Cove - Regrade site	3.00	AC	12,512.61	37,538	31,907	-15%	43,169	15%	42,225	35,891	48,559
41	Iron Gate	4.178	Iron Gate Dam Removal	Mirror Cove - Signs to be removed and hauled away	7.00	EA	356.41	2,495	1,871	-25%	3,119	25%	2,806	2,105	3,508
41	Iron Gate	4.179	Iron Gate Dam Removal	Overlook Point - 1 concrete picnic table base	1.00	CY	356.41	356	267	-25%	446	25%	401	301	501
41	Iron Gate	4.180	Iron Gate Dam Removal	Overlook Point - Steel frame table to be removed and hauled	1.00	EA	118.80	119	89	-25%	149	25%	134	100	167
41	Iron Gate	4.181	Iron Gate Dam Removal	Overlook Point - Regrade steep access road and site to	0.50	AC	30,630.71	15,315	13,018	-15%	17,613	15%	17,228	14,644	19,812
41	Iron Gate	4.182	Iron Gate Dam Removal	Long Gulch - 80'x25x4" Concrete boat ramp to be removed	25.00	CY	310.44	7,761	6,985	-10%	8,537	10%	8,730	7,857	9,603
41	Iron Gate	4.183	Iron Gate Dam Removal	Long Gulch - Remove picnic tables (steel frames with planks)	2.00	EA	118.80	238	178	-25%	297	25%	267	200	334
41	Iron Gate	4.184	Iron Gate Dam Removal	Long Gulch - Regrade ramp area to natural contours, rip,	0.05	AC	29,701.07	1,485	1,114	-25%	1,856	25%	1,670	1,253	2,088
41	Iron Gate	4.185	Iron Gate Dam Removal	Concrete Lining Installation for Diversion Tunnel	1.00	LS	1,196,251.74	1,196,252	1,076,627	-10%	1,315,877	10%	1,345,621	1,211,058	1,480,183
41	Iron Gate	5.025	Iron Gate Dam Removal	Remove Distribution Poles near Iron Gate Hydro Plant	5.00	EA	1,190.24	5,951	5,059	-15%	7,141	20%	6,694	5,690	8,033
41	Iron Gate	5.026	Iron Gate Dam Removal	Remove 69kV/6.6kV Transformer @Substation	1.00	EA	2,273.46	2,273	1,932	-15%	2,842	25%	2,557	2,174	3,197
41	Iron Gate	5.027	Iron Gate Dam Removal	Remove 6.6kV Power Circuit Breaker @Substation	1.00	EA	1,524.31	1,524	1,296	-15%	1,905	25%	1,715	1,457	2,143
41	Iron Gate	5.028	Iron Gate Dam Removal	Remove Generator @Substation	1.00	EA	4,767.78	4,768	4,053	-15%	5,960	25%	5,363	4,559	6,704
41	Iron Gate	5.029	Iron Gate Dam Removal	Remove all auxiliary equipment @Substation (Allowance)	1.00	LS	26,865.48	26,865	22,836	-15%	33,582	25%	30,220	25,687	37,775
41	Iron Gate	5.030	Iron Gate Dam Removal	New Connection @Iron Gate Hatchery from PacifiCorp's	1.00	LS	298,809.00	298,809	268,928	-10%	328,690	10%	336,119	302,508	369,731
42			**RESTORATION EARTHWORKS & HABITAT**												
42	Copco 1 & 2		Tributary Connectivity	Removal of sediment and similar obstructions to ensure	7.00	EA	119,000.00	833,000	749,700	-10%	1,124,550	35%	955,752	860,177	1,290,265
42	Copco 1 & 2		Wetlands, Floodplain and Off-channel Habitat Features Site 1	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Copco 1 & 2		Wetlands, Floodplain and Off-channel Habitat Features Site 1	Grading and shaping of floodplain sediments (no export)	81,367	CY	8.00	650,936	585,842	-10%	878,764	35%	732,214	658,993	988,490
42	Copco 1 & 2		Wetlands, Floodplain and Off-channel Habitat Features Site 1	Floodplain roughness for 50% of area	5.60	AC	30,000.00	168,000	151,200	-10%	226,800	35%	188,977	170,079	255,119
42	Copco 1 & 2		Site 2 (25.5 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Copco 1 & 2		Site 2 (25.5 acres)	Grading and shaping of floodplain sediments (no export)	164,252	CY	8.00	1,314,016	1,182,614	-10%	1,773,922	35%	1,478,089	1,330,280	1,995,421
42	Copco 1 & 2		Site 2 (25.5 acres)	Floodplain roughness for 50% of area	12.75	AC	30,000.00	382,500	344,250	-10%	516,375	35%	430,260	387,234	580,852
42	Copco 1 & 2		Site 3 (13.9 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Copco 1 & 2		Site 3 (13.9 acres)	Grading and shaping of floodplain sediments (no export)	78,556	CY	8.00	628,448	565,603	-10%	848,405	35%	706,919	636,227	954,340
42	Copco 1 & 2		Site 3 (13.9 acres)	Floodplain roughness for 50% of area	6.95	AC	30,000.00	208,500	187,650	-10%	281,475	35%	234,534	211,081	316,621
42	Copco 1 & 2		Site 4 (10.5 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Copco 1 & 2		Site 4 (10.5 acres)	Grading and shaping of floodplain sediments (no export)	50,600	CY	8.00	404,800	364,320	-10%	546,480	35%	455,345	409,810	614,716
42	Copco 1 & 2		Site 4 (10.5 acres)	Floodplain roughness for 50% of area	5.25	AC	30,000.00	157,500	141,750	-10%	212,625	35%	177,166	159,449	239,174
42	Copco 1 & 2		Site 5 (4.2 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Copco 1 & 2		Site 5 (4.2 acres)	Grading and shaping of floodplain sediments (no export)	20,267	CY	8.00	162,136	145,922	-10%	218,884	35%	182,381	164,143	246,214
42	Copco 1 & 2		Site 5 (4.2 acres)	Floodplain roughness for 50% of area	2.10	AC	30,000.00	63,000	56,700	-10%	85,050	35%	70,866	63,780	95,670
42	Copco 1 & 2		Site 6 (5.3 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Copco 1 & 2		Site 6 (5.3 acres)	Grading and shaping of floodplain sediments (no export)	17,148	CY	8.00	137,184	123,466	-10%	185,198	35%	154,313	138,882	208,323
42	Copco 1 & 2		Site 6 (5.3 acres)	Floodplain roughness for 50% of area	2.65	AC	30,000.00	79,500	71,550	-10%	107,325	35%	89,427	80,484	120,726
42	Copco 1 & 2		Site 6 (5.3 acres)	Bank Stability and Channel Fringe Complexity	2,500	LF	253.00	632,500	569,250	-10%	853,875	35%	725,706	653,135	979,703
42	Copco 1 & 2		Large Wood Habitat Features	Ground-Based Placement	20.00	EA	27,990.00	559,800	503,820	-10%	755,730	35%	642,293	578,064	867,095
42	Copco 1 & 2		Large Wood Habitat Features	Helicopter Placement (@ 50 members staged and placed per	8.00	EA	57,000.00	456,000	410,400	-10%	615,600	35%	523,197	470,877	706,316
42	Copco 1 & 2		General Conditions	Contractor overhead	15%	%	7,287,820.00	1,093,173	983,856	-10%	1,475,784	35%	1,234,142	1,110,728	1,666,092
42	Copco 1 & 2		General Conditions	Insurance	1%	%	8,380,993.00	83,810	75,429	-10%	113,143	35%	94,618	85,156	127,734
42	Copco 1 & 2		General Conditions	Bond	1%	%	8,380,993.00	83,810	75,429	-10%	113,143	35%	94,618	85,156	127,734
42	Iron Gate		Tributary Connectivity	Removal of sediment and similar obstructions to ensure	5.00	EA	119,000.00	595,000	535,500	-10%	803,250	35%	682,680	614,412	921,618
42	Iron Gate		Site 1 (14.2 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Iron Gate		Site 1 (14.2 acres)	Grading and shaping of floodplain sediments (no export)	60,000	CY	8.00	480,000	432,000	-10%	648,000	35%	539,935	485,941	728,912
42	Iron Gate		Site 1 (14.2 acres)	Floodplain roughness for 50% of area	7.10	AC	30,000.00	213,000	191,700	-10%	287,550	35%	239,596	215,636	323,455
42	Iron Gate		Site 2 (5.8 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Iron Gate		Site 2 (5.8 acres)	Grading and shaping of floodplain sediments (no export)	19,000	CY	8.00	152,000	136,800	-10%	205,200	35%	170,979	153,881	230,822
42	Iron Gate		Site 2 (5.8 acres)	Floodplain roughness for 50% of area	2.90	AC	30,000.00	87,000	78,300	-10%	117,450	35%	97,863	88,077	132,115

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
42	Iron Gate		Site 3 (23.1 acres)	Equipment & road access into site	2,000	LF	25.00	50,000	45,000	-10%	67,500	35%	56,243	50,619	75,928
42	Iron Gate		Site 3 (23.1 acres)	Grading and shaping of floodplain sediments (no export)	95,000	CY	8.00	760,000	684,000	-10%	1,026,000	35%	854,897	769,407	1,154,110
42	Iron Gate		Site 3 (23.1 acres)	Floodplain roughness for 75% of area	17.30	AC	30,000.00	519,000	467,100	-10%	700,650	35%	583,804	525,424	788,136
42	Iron Gate		Bank Stability and Channel Fringe Complexity	Develop process-based restoration and velocity variations	1,000	LF	253.00	253,000	227,700	-10%	341,550	35%	290,282	261,254	391,881
42	Iron Gate		Large Wood Habitat Features	Ground-Based Placement	20.00	EA	27,990.00	559,800	503,820	-10%	755,730	35%	642,293	578,064	867,095
42	Iron Gate		Large Wood Habitat Features	Helicopter Placement (@ 50 members staged and placed per	4.00	EA	57,000.00	228,000	205,200	-10%	307,800	35%	261,598	235,439	353,158
42	Iron Gate		General Conditions	Contractor overhead	15%	%	4,046,800.00	607,020	546,318	-10%	819,477	35%	687,017	618,315	927,473
42	Iron Gate		General Conditions	Contractor profit (included in rates & prices)	0%	%	4,046,800.00	-	-	0%	-	0%	-	-	-
42	Iron Gate		General Conditions	Insurance	1%	%	4,653,820.00	46,538	41,884	-10%	62,827	35%	52,671	47,404	71,106
42	Iron Gate		General Conditions	Bond	1%	%	4,653,820.00	46,538	41,884	-10%	62,827	35%	52,671	47,404	71,106
42	JC Boyle		Tributary Connectivity	Removal of sediment and similar obstructions to ensure	2.00	EA	119,000.00	238,000	214,200	-10%	321,300	35%	273,072	245,765	368,647
42	JC Boyle		Site 1 (3.3 acres)	Equipment & road access into site	500	LF	25.00	12,500	11,250	-10%	16,875	35%	14,061	12,655	18,982
42	JC Boyle		Site 1 (3.3 acres)	Grading and shaping of floodplain sediments (no export)	37,000	CY	8.00	296,000	266,400	-10%	399,600	35%	332,960	299,664	449,496
42	JC Boyle		Site 1 (3.3 acres)	Floodplain roughness for 50% of area	1.65	AC	30,000.00	49,500	44,550	-10%	66,825	35%	55,681	50,113	75,169
42	JC Boyle		Site 2 (43.8 acres)	Equipment & road access into site	500	LF	25.00	12,500	11,250	-10%	16,875	35%	14,061	12,655	18,982
42	JC Boyle		Site 2 (43.8 acres)	Grading and shaping of floodplain sediments (no export)	35,000	CY	8.00	280,000	252,000	-10%	378,000	35%	314,962	283,466	425,199
42	JC Boyle		Site 2 (43.8 acres)	Floodplain roughness for 50% of area	21.90	AC	30,000.00	657,000	591,300	-10%	886,950	35%	739,036	665,132	997,698
42	JC Boyle		Site 3 (65.8 acres)	Equipment & road access into site	500	LF	25.00	12,500	11,250	-10%	16,875	35%	14,061	12,655	18,982
42	JC Boyle		Site 3 (65.8 acres)	Grading and shaping of floodplain sediments (no export)	53,000	CY	8.00	424,000	381,600	-10%	572,400	35%	476,942	429,248	643,872
42	JC Boyle		Site 3 (65.8 acres)	Floodplain roughness for 30% of area	20.00	AC	30,000.00	600,000	540,000	-10%	810,000	35%	674,918	607,427	911,140
42	JC Boyle		Site 4 (21.3 acres)	Equipment & road access into site	500	LF	25.00	12,500	11,250	-10%	16,875	35%	14,061	12,655	18,982
42	JC Boyle		Site 4 (21.3 acres)	Grading and shaping of floodplain sediments (no export)	17,000	CY	8.00	136,000	122,400	-10%	183,600	35%	152,982	137,683	206,525
42	JC Boyle		Site 4 (21.3 acres)	Floodplain roughness for 50% of area	10.65	AC	30,000.00	319,500	287,550	-10%	431,325	35%	359,394	323,455	485,182
42	JC Boyle		Bank Stability and Channel Fringe Complexity	Develop process-based restoration and velocity variations	2,000	LF	253.00	506,000	455,400	-10%	683,100	35%	580,565	522,508	783,762
42	JC Boyle		Large Wood Habitat Features	Ground-Based Placement	30.00	EA	27,990.00	839,700	755,730	-10%	1,133,595	35%	963,439	867,095	1,300,643
42	JC Boyle		Large Wood Habitat Features	Helicopter Placement (50 members staged and placed per	2.00	EA	57,000.00	114,000	102,600	-10%	153,900	35%	130,799	117,719	176,579
42	JC Boyle		General Conditions	Contractor overhead	15%	%	4,509,700.00	676,455	608,810	-10%	913,214	35%	764,724	688,252	1,032,378
42	JC Boyle		General Conditions	Contractor profit (included in rates & prices)	0%	%	4,509,700.00	-	-	0%	-	0%	-	-	-
42	JC Boyle		General Conditions	Insurance	1%	%	5,186,155.00	51,862	46,675	-10%	70,013	35%	58,629	52,766	79,149
42	JC Boyle		General Conditions	Bond	1%	%	5,186,155.00	51,862	46,675	-10%	70,013	35%	58,629	52,766	79,149
43			**RESTORATION OF VEGETATION**												
43	JC Boyle		Restoration of Vegetation	On-Site Pilot Growing Experiment	0.18	%	636,843.00	114,632	100,667	-12%	132,873	16%	115,847	101,734	134,282
43	JC Boyle		Restoration of Vegetation	Seed Collection	0.18	%	1,167,800.00	210,204	159,426	-24%	261,486	24%	221,213	167,775	275,181
43	JC Boyle		Restoration of Vegetation	Seed Propagation	0.18	%	2,803,989.00	504,718	189,718	-62%	648,718	29%	555,301	208,732	713,733
43	JC Boyle		Restoration of Vegetation	Weed Eradication	0.18	%	3,049,095.15	548,837	433,359	-21%	664,315	21%	606,617	478,982	734,252
43	JC Boyle		Restoration of Vegetation	Pioneer Seeding	0.18	%	2,150,000.00	387,000	252,000	-35%	594,000	53%	435,322	283,466	668,169
43	JC Boyle		Restoration of Vegetation	Container Plant Growing	0.18	%	1,057,742.00	190,394	69,627	-63%	311,160	63%	217,088	79,389	354,787
43	JC Boyle		Restoration of Vegetation	Establ. Prd. Maint. & Monitor'g	0.18	%	8,043,339.82	1,447,801	776,357	-46%	2,198,979	52%	1,761,471	944,557	2,675,394
43	JC Boyle		Restoration of Vegetation	Long-Term Maint. & Monitor'g	0.18	%	8,189,100.00	1,474,038	668,469	-55%	2,493,180	69%	1,923,473	872,286	3,253,352
43	JC Boyle		Restoration of Vegetation	Emergent Wetland	0.85	AC	35,203.00	29,775	20,555	-31%	41,297	39%	34,260	23,651	47,519
43	JC Boyle		Restoration of Vegetation	Bank Wetland	4.21	AC	21,453.20	90,220	54,232	-40%	116,796	29%	103,198	62,034	133,597
43	JC Boyle		Restoration of Vegetation	Bank Riparian	32.92	AC	30,175.20	993,384	643,821	-35%	1,362,911	37%	1,144,047	741,466	1,569,618
43	JC Boyle		Restoration of Vegetation	Floodplain Riparian	55.08	AC	13,817.40	761,037	507,182	-33%	1,043,992	37%	876,122	583,879	1,201,866
43	JC Boyle		Restoration of Vegetation	Uplands below RW	24.20	AC	9,714.00	235,062	175,776	-25%	318,207	35%	273,032	204,169	369,607
43	JC Boyle		Restoration of Vegetation	Rocky Wake Zone	16.37	AC	9,719.00	159,096	118,909	-25%	221,113	39%	184,792	138,114	256,825
43	JC Boyle		Restoration of Vegetation	Disturbed Uplands above RWZ	42.29	AC	9,502.00	401,819	302,294	-25%	559,998	39%	466,536	350,982	650,192
43	JC Boyle		Restoration of Vegetation	Uplands Stockpiles	6.73	AC	8,856.67	59,595	44,882	-25%	83,046	39%	64,832	48,826	90,344
43	JC Boyle		Restoration of Vegetation	Undisturbed Uplands	10.07	AC	4,850.00	48,829	37,251	-24%	59,904	23%	56,385	43,015	69,173
43	JC Boyle		Restoration of Vegetation	Contractor overhead	1.00	LS	1,391,623.54	1,391,624	879,961	-37%	2,005,720	44%	1,643,136	1,030,506	2,379,157
43	Iron Gate		Restoration of Vegetation	On-Site Pilot Growing Experiment	0.42	%	636,843.00	267,601	235,001	-12%	310,185	16%	270,438	237,492	313,474
43	Iron Gate		Restoration of Vegetation	Seed Collection	0.42	%	1,167,800.00	490,710	372,171	-24%	610,425	24%	516,409	391,662	642,394
43	Iron Gate		Restoration of Vegetation	Seed Propagation	0.42	%	2,803,989.00	1,178,236	442,886	-62%	1,514,396	29%	1,296,320	487,273	1,666,170
43	Iron Gate		Restoration of Vegetation	Weed Eradication	0.42	%	3,049,095.15	1,281,230	1,011,653	-21%	1,550,806	21%	1,416,113	1,118,156	1,714,070
43	Iron Gate		Restoration of Vegetation	Pioneer Seeding	0.42	%	2,150,000.00	903,430	588,280	-35%	1,386,660	53%	1,016,236	661,735	1,559,804
43	Iron Gate		Restoration of Vegetation	Container Plant Growing	0.42	%	1,057,742.00	444,463	162,540	-63%	726,386	63%	506,780	185,329	828,231
43	Iron Gate		Restoration of Vegetation	Establ. Prd. Maint. & Monitor'g	0.42	%	8,043,339.82	3,379,811	1,812,363	-46%	5,133,395	52%	4,112,057	2,205,016	6,245,560
43	Iron Gate		Restoration of Vegetation	Long-Term Maint. & Monitor'g	0.42	%	8,189,100.00	3,441,060	1,560,504	-55%	5,820,190	69%	4,490,241	2,036,303	7,594,770
43	Iron Gate		Restoration of Vegetation	Emergent Wetland	1.78	AC	35,203.00	62,658	43,255	-31%	86,907	39%	72,099	49,772	100,000
43	Iron Gate		Restoration of Vegetation	Bank Wetland	7.59	AC	21,453.20	162,728	97,818	-40%	210,662	29%	186,135	111,888	240,965
43	Iron Gate		Restoration of Vegetation	Bank Riparian	23.87	AC	30,175.20	720,169	466,748	-35%	988,064	37%	829,395	537,538	1,137,919
43	Iron Gate		Restoration of Vegetation	Floodplain Riparian	34.82	AC	13,817.40	481,147	320,653	-33%	660,039	37%	553,907	369,143	759,851
43	Iron Gate		Restoration of Vegetation	Uplands below RW	333	AC	9,714.00	3,230,647	2,415,835	-25%	4,373,379	35%	3,752,497	2,806,068	5,079,817
43	Iron Gate		Restoration of Vegetation	Rocky Wake Zone	11.20	AC	9,719.00	108,851	81,355	-25%	151,281	39%	126,431	94,495	175,715
43	Iron Gate		Restoration of Vegetation	Disturbed Uplands above RWZ	70.53	AC	9,502.00	670,217	504,215	-25%	934,054	39%	778,163	585,424	1,084,494
43	Iron Gate		Restoration of Vegetation	Uplands Stockpiles	38.76	AC	8,856.67	343,285	258,534	-25%	478,368	39%	373,450	281,252	520,404

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
43	Iron Gate		Restoration of Vegetation	Undisturbed Uplands	20.99	AC	4,850.00	101,810	77,669	-24%	124,901	23%	117,563	89,688	144,227
43	Iron Gate		Restoration of Vegetation	Contractor overhead	1.00	LS	3,094,512.21	3,094,512	2,008,187	-35%	4,458,145	44%	3,660,630	2,354,359	5,298,930
43	Copco 1		Restoration of Vegetation	On-Site Pilot Growing Experiment	0.40	%	636,843.00	253,909	222,977	-12%	294,314	16%	256,601	225,340	297,434
43	Copco 1		Restoration of Vegetation	Seed Collection	0.40	%	1,167,800.00	465,602	353,129	-24%	579,191	24%	489,986	371,623	609,525
43	Copco 1		Restoration of Vegetation	Seed Propagation	0.40	%	2,803,989.00	1,117,950	420,225	-62%	1,436,910	29%	1,229,992	462,341	1,580,919
43	Copco 1		Restoration of Vegetation	Weed Eradication	0.40	%	3,049,095.15	1,215,674	959,891	-21%	1,471,458	21%	1,343,656	1,060,945	1,626,368
43	Copco 1		Restoration of Vegetation	Pioneer Seeding	0.40	%	2,150,000.00	857,205	558,180	-35%	1,315,710	53%	964,239	627,877	1,479,995
43	Copco 1		Restoration of Vegetation	Container Plant Growing	0.40	%	1,057,742.00	421,722	154,224	-63%	689,220	63%	480,850	175,847	785,853
43	Copco 1		Restoration of Vegetation	Establ. Prd. Maint. & Monitor'g	0.40	%	8,043,339.82	3,206,880	1,719,631	-46%	4,870,739	52%	3,901,659	2,092,194	5,925,999
43	Copco 1		Restoration of Vegetation	Long-Term Maint. & Monitor'g	0.40	%	8,189,100.00	3,264,994	1,480,659	-55%	5,522,394	69%	4,260,493	1,932,113	7,206,175
43	Copco 1		Restoration of Vegetation	Emergent Wetland	1.79	AC	35,203.00	63,017	43,503	-31%	87,405	39%	72,512	50,058	100,574
43	Copco 1		Restoration of Vegetation	Bank Wetland	7.65	AC	21,453.20	164,188	98,696	-40%	212,553	29%	187,806	112,893	243,127
43	Copco 1		Restoration of Vegetation	Bank Riparian	48.01	AC	30,175.20	1,448,583	938,839	-35%	1,987,438	37%	1,668,284	1,081,229	2,288,865
43	Copco 1		Restoration of Vegetation	Floodplain Riparian	58.23	AC	13,817.40	804,552	536,182	-33%	1,103,686	37%	926,218	617,264	1,270,588
43	Copco 1		Restoration of Vegetation	Uplands below RW	306	AC	9,714.00	2,968,059	2,219,475	-25%	4,017,909	35%	3,447,493	2,577,989	4,666,927
43	Copco 1		Restoration of Vegetation	Rocky Wake Zone	15.06	AC	9,719.00	146,354	109,386	-25%	203,405	39%	169,993	127,053	236,257
43	Copco 1		Restoration of Vegetation	Disturbed Uplands above RWZ	8.02	AC	9,502.00	76,226	57,346	-25%	106,233	39%	88,503	66,582	123,343
43	Copco 1		Restoration of Vegetation	Uplands Stockpiles	3.37	AC	8,856.67	29,844	22,476	-25%	41,587	39%	32,466	24,451	45,242
43	Copco 1		Restoration of Vegetation	Undisturbed Uplands	13.39	AC	4,850.00	64,957	49,554	-24%	79,689	23%	75,008	57,222	92,020
43	Copco 1		Restoration of Vegetation	Contractor overhead	1.00	LS	2,983,330.50	2,983,330	1,912,476	-36%	4,291,645	44%	3,530,879	2,244,456	5,103,293
43	Copco 2		Restoration of Vegetation	On-Site Pilot Growing Experiment	0.00	%	636,843.00	701	615	-12%	812	16%	708	622	821
43	Copco 2		Restoration of Vegetation	Seed Collection	0.00	%	1,167,800.00	1,285	974	-24%	1,598	24%	1,352	1,025	1,682
43	Copco 2		Restoration of Vegetation	Seed Propagation	0.00	%	2,803,989.00	3,084	1,159	-62%	3,964	29%	3,394	1,276	4,362
43	Copco 2		Restoration of Vegetation	Weed Eradication	0.00	%	3,049,095.15	3,354	2,648	-21%	4,060	21%	3,707	2,927	4,487
43	Copco 2		Restoration of Vegetation	Pioneer Seeding	0.00	%	2,150,000.00	2,365	1,540	-35%	3,630	53%	2,660	1,732	4,083
43	Copco 2		Restoration of Vegetation	Container Plant Growing	0.00	%	1,057,742.00	1,164	426	-63%	1,902	63%	1,327	485	2,168
43	Copco 2		Restoration of Vegetation	Establ. Prd. Maint. & Monitor'g	0.00	%	8,043,339.82	8,848	4,744	-46%	13,438	52%	10,765	5,772	16,350
43	Copco 2		Restoration of Vegetation	Long-Term Maint. & Monitor'g	0.00	%	8,189,100.00	9,008	4,085	-55%	15,236	69%	11,755	5,331	19,882
43	Copco 2		Restoration of Vegetation	Floodplain Riparian	0.81	AC	13,817.40	11,157	7,435	-33%	15,305	37%	12,844	8,560	17,619
43	Copco 2		Restoration of Vegetation	Disturbed Uplands above RWZ	1.19	AC	9,502.00	11,280	8,486	-25%	15,721	39%	13,097	9,853	18,253
43	Copco 2		Restoration of Vegetation	Undisturbed Uplands	0.00	AC	4,850.00	4	3	-24%	5	23%	4	3	5
43	Copco 2		Restoration of Vegetation	Contractor overhead	1.00	LS	9,894.21	9,894	6,468	-35%	14,234	44%	11,663	7,569	16,845
44			**YREKA WATER LINE REPLACEMENT**												
44	Project	6.001	Yreka Water Line Replacement	Microtunneling	612	LH	1,558.34	953,701	810,646	-20%	1,239,812	40%	1,052,154	894,331	1,367,800
44	Project	6.002	Yreka Water Line Replacement	Pile and Lagging Pre Drilling	458	LF	150.68	69,010	58,658	-20%	89,712	40%	76,134	64,714	98,974
44	Project	6.003	Yreka Water Line Replacement	Pile and Lagging Wall InstallatioN	13,715	SF	73.01	1,001,297	851,102	-20%	1,301,686	40%	1,104,663	938,963	1,436,062
44	Project	6.004	Yreka Water Line Replacement	Pipe Installation	2,106	LF	133.76	281,698	239,443	-20%	366,207	40%	310,778	264,161	404,012
44	Project	6.005	Yreka Water Line Replacement	Excavation and Backfill	3,653	CY	88.45	323,097	274,632	-20%	420,026	40%	356,451	302,983	463,386
45			**TRANSPORTATION (BRIDGES, CULVERTS, ROADS)**												
45	Project		Lakeview Bridge	Sheet Pile Coffer Dam For Center Footer	2,400	SF	38.40	92,161	73,729	-20%	119,809	30%	100,878	80,702	131,141
45	Project		Lakeview Bridge	Backfill, structural, common earth, 105 H.P. dozer, 50' haul,	89.00	CY	39.77	3,540	2,832	-20%	4,602	30%	3,875	3,100	5,037
45	Project		Lakeview Bridge	Earth Work Coffer Dam Construction for side footers	1,186	CY	15.26	18,097	14,478	-20%	23,526	30%	19,809	15,847	25,752
45	Project		Lakeview Bridge	Structure Excavation (Rock) Drilling and blasting rock,	107	CY	186.20	19,924	15,939	-20%	25,901	30%	21,808	17,447	28,351
45	Project		Lakeview Bridge	Structure Excavation (Type D)	1,122	CY	20.27	22,741	18,193	-20%	29,563	30%	24,892	19,913	32,359
45	Project		Lakeview Bridge	Structure Excavation (Bridge)	159	CY	58.08	9,234	7,387	-20%	12,004	30%	10,107	8,086	13,140
45	Project		Lakeview Bridge	Prestressed concrete piles, square, 40' long, 24" square,	480	LF	165.17	79,283	63,426	-20%	103,068	30%	86,781	69,425	112,816
45	Project		Lakeview Bridge	18" Diameter 40' Long Tie Down Anchor Installation	480	LF	101.95	48,937	39,149	-20%	63,618	30%	53,565	42,852	69,634
45	Project		Lakeview Bridge	Piling special costs, pre-augering for Pile and Tie Down	960	LF	311.56	299,101	239,281	-20%	388,831	30%	327,390	261,912	425,606
45	Project		Lakeview Bridge	Mobilization, 150 ton, set up and remove crane, with pile	2.00	EA	22,228.11	44,456	35,565	-20%	57,793	30%	48,661	38,929	63,259
45	Project		Lakeview Bridge	A736 Barrier Wall	536	LF	388.00	207,966	166,373	-20%	270,356	30%	227,635	182,108	295,926
45	Project		Lakeview Bridge	Expansion joint, neoprene, liquid, 1" x 2", cold applied	46.00	LF	44.09	2,028	1,623	-20%	2,637	30%	2,220	1,776	2,886
45	Project		Lakeview Bridge	Columns Structural Concrete includes forms, Grade 60 rebar,	172	CY	1,953.07	335,929	268,743	-20%	436,707	30%	367,701	294,161	478,011
45	Project		Lakeview Bridge	Deck Structural concrete, in place, includes forms, Grade 60	168	CY	1,143.38	192,088	153,670	-20%	249,714	30%	210,255	168,204	273,332
45	Project		Lakeview Bridge	Footer Structural concrete,footing, reinforced, includes	448	CY	421.72	188,929	151,143	-20%	245,608	30%	206,798	165,438	268,837
45	Project		Lakeview Bridge	Approach Slab Structural concrete, in place, 6" thick, includes	17.00	CY	293.49	4,989	3,992	-20%	6,486	30%	5,461	4,369	7,100
45	Project		Lakeview Bridge	Precast 36" I-Girder 65'	8.00	EA	29,970.09	239,761	191,809	-20%	311,689	30%	262,437	209,950	341,168
45	Project		Lakeview Bridge	Precast 36" I-Girder 48'	8.00	EA	35,810.59	286,485	229,188	-20%	372,430	30%	313,580	250,864	407,654
45	Project		Lakeview Bridge	Bridge Demolition	3,917	SF	60.00	235,020	188,016	-20%	305,526	30%	257,248	205,798	334,422
45	Project		Lakeview Bridge - Paving	Roadway Excavation	510	CY	40.00	20,400	16,320	-20%	25,500	25%	22,329	17,864	27,912
45	Project		Lakeview Bridge - Paving	Imported Borrow	2,510	CY	45.00	112,950	90,360	-20%	141,188	25%	123,633	98,906	154,541
45	Project		Lakeview Bridge - Paving	Hot Mix Asphalt (Type A)	450	T	130.00	58,500	46,800	-20%	73,125	25%	64,033	51,226	80,041
45	Project		Lakeview Bridge - Paving	Class 2 Aggregate Base	330	CY	65.00	21,450	17,160	-20%	26,813	25%	23,479	18,783	29,348
45	Project		Lakeview Bridge - Paving	Midwest Guardrail System	200	LF	40.61	8,122	6,498	-20%	10,153	25%	8,890	7,112	11,113

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
45	Project		Lakeview Bridge - Paving	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892
45	Project		Lakeview Bridge - Paving	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Lakeview Bridge - Paving	Temporary Reinforced Silt Fence	600	LF	7.58	4,548	3,638	-20%	5,685	25%	4,978	3,983	6,223
45	Project		Lakeview Bridge - Paving	Temporary Fence (Type ESA)	300	LF	5.03	1,509	1,207	-20%	1,886	25%	1,652	1,321	2,065
45	Project		Lakeview Bridge - Paving	Temporary Concrete Washout	1.00	LS	1.00	-	1	-20%	1	25%	-	-	-
45	Project		Lakeview Bridge - Paving	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Lakeview Bridge - Paving	Water Pollution Control	0.10	%	213,300.00	21,330	17,064	-20%	26,663	25%	23,347	18,678	29,184
45	Project		Lakeview Bridge - Paving	Roadside Sign - One Post	2.00	EA	270.00	540	432	-20%	675	25%	591	473	739
45	Project		Lakeview Bridge - Paving	Reset Roadside Sign	4.00	EA	300.00	1,200	960	-20%	1,500	25%	1,313	1,051	1,642
45	Project		Lakeview Bridge - Paving	Relocate Roadside Sign	2.00	EA	100.00	200	160	-20%	250	25%	219	175	274
45	Project		Lakeview Bridge - Paving	Construction Area Signs	1.00	LS	1.00	-	1	-20%	1	25%	-	-	-
45	Project		Lakeview Bridge - Paving	Thermoplastic Traffic Stripe	660	LF	0.86	568	454	-20%	710	25%	621	497	777
45	Project		Lakeview Bridge - Paving	Type III Barricade	4.00	EA	274.29	1,097	878	-20%	1,371	25%	1,201	961	1,501
45	Project		Lakeview Bridge - Paving	Traffic Control System	20.00	DA	1,000.00	20,000	16,000	-20%	25,000	25%	21,892	17,513	27,364
45	Project		Lakeview Bridge - Paving	Temporary Railing (Type K)	300	LF	47.00	14,100	11,280	-20%	17,625	25%	15,434	12,347	19,292
45	Project		Fall Creek Bridge	Structure Excavation (Bridge)	499	CY	58.08	28,980	23,184	-20%	37,674	30%	31,721	25,377	41,237
45	Project		Fall Creek Bridge	A736 Barrier Wall	100	LF	388.00	38,800	31,040	-20%	50,440	30%	42,469	33,975	55,210
45	Project		Fall Creek Bridge	Columns/Walls Structural Concrete includes forms, Grade 60	111	CY	1,953.07	216,791	173,433	-20%	281,829	30%	237,295	189,836	308,484
45	Project		Fall Creek Bridge	Deck Structural concrete, in place, includes forms, Grade 60	31.00	CY	1,143.38	35,445	28,356	-20%	46,078	30%	38,797	31,038	50,436
45	Project		Fall Creek Bridge	Footer Structural concrete,footing, reinforced, includes	86.00	CY	421.72	36,268	29,014	-20%	47,148	30%	39,698	31,758	51,607
45	Project		Fall Creek Bridge	Approach Slab Structural concrete, in place, 6" thick, includes	22.00	CY	293.49	6,457	5,166	-20%	8,394	30%	7,068	5,654	9,188
45	Project		Fall Creek Bridge	Bridge Demolition	720	SF	60.00	43,200	34,560	-20%	56,160	30%	47,286	37,829	61,472
45	Project		Fall Creek Bridge - Paving	Roadway Excavation	720	CY	40.00	28,800	23,040	-20%	36,000	25%	31,524	25,219	39,405
45	Project		Fall Creek Bridge - Paving	Imported Borrow	2,380	CY	45.00	107,100	85,680	-20%	133,875	25%	117,229	93,784	146,537
45	Project		Fall Creek Bridge - Paving	Hot Mix Asphalt (Type A)	230	T	130.00	29,900	23,920	-20%	37,375	25%	32,728	26,182	40,910
45	Project		Fall Creek Bridge - Paving	Class 2 Aggregate Base	170	CY	65.00	11,050	8,840	-20%	13,813	25%	12,095	9,676	15,119
45	Project		Fall Creek Bridge - Paving	Midwest Guardrail System	100	LF	40.61	4,061	3,249	-20%	5,076	25%	4,445	3,556	5,556
45	Project		Fall Creek Bridge - Paving	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892
45	Project		Fall Creek Bridge - Paving	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Fall Creek Bridge - Paving	Relocate Gate	1.00	EA	100.00	100	80	-20%	125	25%	109	88	137
45	Project		Fall Creek Bridge - Paving	Temporary Reinforced Silt Fence	400	LF	7.58	3,032	2,426	-20%	3,790	25%	3,319	2,655	4,148
45	Project		Fall Creek Bridge - Paving	Temporary Fence (Type ESA)	400	LF	5.03	2,012	1,610	-20%	2,515	25%	2,202	1,762	2,753
45	Project		Fall Creek Bridge - Paving	Temporary Hydroseed	280	SY	9.22	2,582	2,065	-20%	3,227	25%	2,826	2,261	3,532
45	Project		Fall Creek Bridge - Paving	Rolled Erosion Control / Jute Mesh	280	SY	16.62	4,654	3,723	-20%	5,817	25%	5,094	4,075	6,367
45	Project		Fall Creek Bridge - Paving	Temporary Fiber Roll	375	LF	8.10	3,038	2,430	-20%	3,797	25%	3,325	2,660	4,156
45	Project		Fall Creek Bridge - Paving	Temporary Concrete Washout	1.00	LS	1.00	-	1	-20%	1	25%	-	-	-
45	Project		Fall Creek Bridge - Paving	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Fall Creek Bridge - Paving	Water Pollution Control	0.10	%	176,850.00	17,685	14,148	-20%	22,106	25%	19,358	15,486	24,197
45	Project		Fall Creek Bridge - Paving	Construction Area Signs	1.00	LS	1.00	-	1	-20%	1	25%	-	-	-
45	Project		Fall Creek Bridge - Paving	Temporary Traffic Stripe	500	LF	1.20	600	480	-20%	750	25%	657	525	821
45	Project		Fall Creek Bridge - Paving	Thermoplastic Traffic Stripe	275	LF	0.86	237	189	-20%	296	25%	259	207	324
45	Project		Fall Creek Bridge - Paving	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Fall Creek Bridge - Paving	Traffic Control System	50.00	DA	1,000.00	50,000	40,000	-20%	62,500	25%	54,729	43,783	68,411
45	Project		Fall Creek Bridge - Paving	Temporary Railing (Type K)	200	LF	47.00	9,400	7,520	-20%	11,750	25%	10,289	8,231	12,861
45	Project		Daggett Road Bridge	Sheet Pile Coffer Dam For Footers	7,200	SF	38.40	276,483	221,186	-20%	359,428	30%	302,633	242,106	393,422
45	Project		Daggett Road Bridge	Backfill, structural, common earth, 105 H.P. dozer, 50' haul,	91.00	CY	39.77	3,619	2,896	-20%	4,705	30%	3,962	3,169	5,150
45	Project		Daggett Road Bridge	Structure Excavation (Rock) Drilling and blasting rock,	107	CY	186.20	19,924	15,939	-20%	25,901	30%	21,808	17,447	28,351
45	Project		Daggett Road Bridge	Structure Excavation (Type D)	1,535	CY	20.27	31,112	24,889	-20%	40,445	30%	34,054	27,243	44,271
45	Project		Daggett Road Bridge	Structure Excavation (Bridge)	171	CY	58.08	9,931	7,945	-20%	12,910	30%	10,870	8,696	14,131
45	Project		Daggett Road Bridge	Prestressed concrete piles, square, 40' long, 24" square,	480	LF	165.17	79,283	63,426	-20%	103,068	30%	86,781	69,425	112,816
45	Project		Daggett Road Bridge	18" Diameter 40' Long Tie Down Anchor Installation	480	LF	101.95	48,937	39,149	-20%	63,618	30%	53,565	42,852	69,634
45	Project		Daggett Road Bridge	Piling special costs, pre-augering for Pile and Tie Down	960	LF	311.56	299,101	239,281	-20%	388,831	30%	327,390	261,912	425,606
45	Project		Daggett Road Bridge	Mobilization, 150 ton, set up and remove crane, with pile	2.00	EA	22,228.11	44,456	35,565	-20%	57,793	30%	48,661	38,929	63,259
45	Project		Daggett Road Bridge	A736 Barrier Wall	530	LF	388.00	205,638	164,510	-20%	267,330	30%	225,087	180,070	292,613
45	Project		Daggett Road Bridge	Expansion joint, neoprene, liquid, 1" x 2", cold applied	46.00	LF	44.09	2,028	1,623	-20%	2,637	30%	2,220	1,776	2,886
45	Project		Daggett Road Bridge	Columns Structural Concrete includes forms, Grade 60 rebar,	157	CY	1,953.07	306,633	245,306	-20%	398,622	30%	335,634	268,507	436,324
45	Project		Daggett Road Bridge	Deck Structural concrete, in place, includes forms, Grade 60	167	CY	1,143.38	190,944	152,755	-20%	248,228	30%	209,004	167,203	271,705
45	Project		Daggett Road Bridge	Footer Structural concrete,footing, reinforced, includes	448	CY	421.72	188,929	151,143	-20%	245,608	30%	206,798	165,438	268,837
45	Project		Daggett Road Bridge	Approach Slab Structural concrete, in place, 6" thick, includes	17.00	CY	293.49	4,989	3,992	-20%	6,486	30%	5,461	4,369	7,100
45	Project		Daggett Road Bridge	Precast 36" I-Girder 65'	8.00	EA	29,970.09	239,761	191,809	-20%	311,689	30%	262,437	209,950	341,168
45	Project		Daggett Road Bridge	Precast 36" I-Girder 48'	8.00	EA	35,810.59	286,485	229,188	-20%	372,430	30%	313,580	250,864	407,654
45	Project		Daggett Road Bridge	Bridge Demolition	3,262	SF	60.00	195,720	156,576	-20%	254,436	30%	214,231	171,385	278,500
45	Project		Daggett Road Bridge - Paving	Roadway Excavation	1,500	CY	40.00	60,000	48,000	-20%	75,000	25%	65,675	52,540	82,093
45	Project		Daggett Road Bridge - Paving	Imported Borrow	5,500	CY	45.00	247,500	198,000	-20%	309,375	25%	270,908	216,727	338,635

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
45	Project		Daggett Road Bridge - Paving	Hot Mix Asphalt (Type A)	1,240	T	130.00	161,200	128,960	-20%	201,500	25%	176,446	141,157	220,558
45	Project		Daggett Road Bridge - Paving	Class 2 Aggregate Base	920	CY	65.00	59,800	47,840	-20%	74,750	25%	65,456	52,365	81,820
45	Project		Daggett Road Bridge - Paving	Remove Base and Surfacing	9,485	SF	6.00	56,910	45,528	-20%	71,138	25%	62,293	49,834	77,866
45	Project		Daggett Road Bridge - Paving	Midwest Guardrail System	200	LF	40.61	8,122	6,498	-20%	10,153	25%	8,890	7,112	11,113
45	Project		Daggett Road Bridge - Paving	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892
45	Project		Daggett Road Bridge - Paving	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Daggett Road Bridge - Paving	Temporary Reinforced Silt Fence	1,000	LF	7.58	7,580	6,064	-20%	9,475	25%	8,297	6,638	10,371
45	Project		Daggett Road Bridge - Paving	Temporary Fence (Type ESA)	1,000	LF	5.03	5,030	4,024	-20%	6,288	25%	5,506	4,405	6,882
45	Project		Daggett Road Bridge - Paving	Temporary Hydroseed	1,200	SY	9.22	11,064	8,851	-20%	13,830	25%	12,110	9,688	15,138
45	Project		Daggett Road Bridge - Paving	Rolled Erosion Control / Jute Mesh	1,200	SY	16.62	19,944	15,955	-20%	24,930	25%	21,830	17,464	27,288
45	Project		Daggett Road Bridge - Paving	Temporary Fiber Roll	1,100	LF	8.10	8,910	7,128	-20%	11,138	25%	9,753	7,802	12,191
45	Project		Daggett Road Bridge - Paving	Temporary Construction Entrance	1.00	EA	4,303.25	4,303	3,443	-20%	5,379	25%	4,710	3,768	5,888
45	Project		Daggett Road Bridge - Paving	Water Pollution Control	0.10	%	585,410.00	58,541	46,833	-20%	73,176	25%	64,078	51,262	80,097
45	Project		Daggett Road Bridge - Paving	Roadside Sign - One Post	1.00	EA	270.00	270	216	-20%	338	25%	296	236	369
45	Project		Daggett Road Bridge - Paving	Remove Roadside Sign	2.00	EA	100.00	200	160	-20%	250	25%	219	175	274
45	Project		Daggett Road Bridge - Paving	Reset Roadside Sign	2.00	EA	300.00	600	480	-20%	750	25%	657	525	821
45	Project		Daggett Road Bridge - Paving	Construction Area Signs	1.00	LS	1.00	-	1	-20%	1	25%	-	-	-
45	Project		Daggett Road Bridge - Paving	Thermoplastic Traffic Stripe	2,020	LF	0.86	1,737	1,390	-20%	2,172	25%	1,902	1,521	2,377
45	Project		Daggett Road Bridge - Paving	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Daggett Road Bridge - Paving	Traffic Control System	15.00	DA	1,000.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Daggett Road Bridge - Paving	Temporary Railing (Type K)	120	LF	47.00	5,640	4,512	-20%	7,050	25%	6,173	4,939	7,717
45	Project		Dry Creek Bridge	Temporary Bridge	1,015	SF	210.00	213,150	170,520	-20%	277,095	30%	233,310	186,648	303,302
45	Project		Dry Creek Bridge - Paving	Roadway Excavation	700	CY	40.00	28,000	22,400	-20%	35,000	25%	30,648	24,519	38,310
45	Project		Dry Creek Bridge - Paving	Imported Borrow	1,000	CY	45.00	45,000	36,000	-20%	56,250	25%	49,256	39,405	61,570
45	Project		Dry Creek Bridge - Paving	Hot Mix Asphalt (Type A)	600	T	130.00	78,000	62,400	-20%	97,500	25%	85,377	68,302	106,721
45	Project		Dry Creek Bridge - Paving	Class 2 Aggregate Base	380	CY	65.00	24,700	19,760	-20%	30,875	25%	27,036	21,629	33,795
45	Project		Dry Creek Bridge - Paving	Midwest Guardrail System	100	LF	40.61	4,061	3,249	-20%	5,076	25%	4,445	3,556	5,556
45	Project		Dry Creek Bridge - Paving	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892
45	Project		Dry Creek Bridge - Paving	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Dry Creek Bridge - Paving	Temporary Reinforced Silt Fence	400	LF	7.58	3,032	2,426	-20%	3,790	25%	3,319	2,655	4,148
45	Project		Dry Creek Bridge - Paving	Temporary Fence (Type ESA)	400	LF	5.03	2,012	1,610	-20%	2,515	25%	2,202	1,762	2,753
45	Project		Dry Creek Bridge - Paving	Temporary Hydroseed	550	SY	9.22	5,071	4,057	-20%	6,339	25%	5,551	4,440	6,938
45	Project		Dry Creek Bridge - Paving	Rolled Erosion Control / Jute Mesh	550	SY	16.62	9,141	7,313	-20%	11,426	25%	10,006	8,004	12,507
45	Project		Dry Creek Bridge - Paving	Temporary Fiber Roll	1,000	LF	8.10	8,100	6,480	-20%	10,125	25%	8,866	7,093	11,083
45	Project		Dry Creek Bridge - Paving	Temporary Concrete Washout	1.00	LS	1.00	-	1	-20%	1	25%	-	-	-
45	Project		Dry Creek Bridge - Paving	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Dry Creek Bridge - Paving	Water Pollution Control	0.10	%	175,700.00	17,570	14,056	-20%	21,963	25%	19,232	15,385	24,040
45	Project		Dry Creek Bridge - Paving	Construction Area Signs	1.00	LS	1.00	-	1	-20%	1	25%	-	-	-
45	Project		Dry Creek Bridge - Paving	Thermoplastic Traffic Stripe	650	LF	0.86	559	447	-20%	699	25%	612	489	765
45	Project		Dry Creek Bridge - Paving	Portable Changeable Message Signs	2.00	EA	3,000.00	6,000	4,800	-20%	7,500	25%	6,567	5,254	8,209
45	Project		Dry Creek Bridge - Paving	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Dry Creek Bridge - Paving	Traffic Control System	20.00	DA	1,000.00	20,000	16,000	-20%	25,000	25%	21,892	17,513	27,364
45	Project		Dry Creek Bridge - Paving	Temporary Railing (Type K)	200	LF	47.00	9,400	7,520	-20%	11,750	25%	10,289	8,231	12,861
45	Project		Dry Creek Bridge - Temp Detour	Roadway Excavation	1,200	CY	40.00	48,000	38,400	-20%	60,000	25%	52,540	42,032	65,675
45	Project		Dry Creek Bridge - Temp Detour	Ditch Excavation	40.00	CY	35.00	1,400	1,120	-20%	1,750	25%	1,532	1,226	1,916
45	Project		Dry Creek Bridge - Temp Detour	Imported Borrow	1,620	CY	45.00	72,900	58,320	-20%	91,125	25%	79,795	63,836	99,744
45	Project		Dry Creek Bridge - Temp Detour	Hot Mix Asphalt (Type A)	530	T	130.00	68,900	55,120	-20%	86,125	25%	75,417	60,333	94,271
45	Project		Dry Creek Bridge - Temp Detour	Class 2 Aggregate Base	400	CY	65.00	26,000	20,800	-20%	32,500	25%	28,459	22,767	35,574
45	Project		Dry Creek Bridge - Temp Detour	Midwest Guardrail System	100	LF	40.61	4,061	3,249	-20%	5,076	25%	4,445	3,556	5,556
45	Project		Dry Creek Bridge - Temp Detour	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892
45	Project		Dry Creek Bridge - Temp Detour	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Dry Creek Bridge - Temp Detour	Temporary Reinforced Silt Fence	400	LF	7.58	3,032	2,426	-20%	3,790	25%	3,319	2,655	4,148
45	Project		Dry Creek Bridge - Temp Detour	Temporary Fence (Type ESA)	400	LF	5.03	2,012	1,610	-20%	2,515	25%	2,202	1,762	2,753
45	Project		Dry Creek Bridge - Temp Detour	Temporary Hydroseed	320	SY	9.22	2,950	2,360	-20%	3,688	25%	3,229	2,584	4,037
45	Project		Dry Creek Bridge - Temp Detour	Rolled Erosion Control / Jute Mesh	320	SY	16.62	5,318	4,255	-20%	6,648	25%	5,821	4,657	7,277
45	Project		Dry Creek Bridge - Temp Detour	Temporary Fiber Roll	400	LF	8.10	3,240	2,592	-20%	4,050	25%	3,546	2,837	4,433
45	Project		Dry Creek Bridge - Temp Detour	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Dry Creek Bridge - Temp Detour	Water Pollution Control	0.10	%	217,200.00	21,720	17,376	-20%	27,150	25%	23,774	19,019	29,718
45	Project		Dry Creek Bridge - Temp Detour	Construction Area Signs	1.00	LS	2,000.00	2,000	1,600	-20%	2,500	25%	2,189	1,751	2,736
45	Project		Dry Creek Bridge - Temp Detour	Temporary Traffic Stripe	620	LF	0.78	486	389	-20%	608	25%	532	426	665
45	Project		Dry Creek Bridge - Temp Detour	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Dry Creek Bridge - Temp Detour	Traffic Control System	5.00	DA	1,000.00	5,000	4,000	-20%	6,250	25%	5,473	4,378	6,841
45	Project		Dry Creek Bridge - Temp Detour	Temporary Railing (Type K)	160	LF	47.00	7,520	6,016	-20%	9,400	25%	8,231	6,585	10,289
45	Project		Camp Creek Bridge	Backfill, structural, common earth, 105 H.P. dozer, 50' haul,	420	CY	39.77	16,705	13,364	-20%	21,717	30%	18,285	14,628	23,771

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
45	Project		Camp Creek Bridge	Earth Work Coffer Dam Construction for side footers	1,186	CY	15.26	18,097	14,478	-20%	23,526	30%	19,809	15,847	25,752
45	Project		Camp Creek Bridge	Structure Excavation (Bridge)	585	CY	58.08	33,975	27,180	-20%	44,167	30%	37,188	29,750	48,344
45	Project		Camp Creek Bridge	Steel piles, "H" Sections, 50' long, HP14 X 89, excludes	1,400	LF	86.12	120,571	96,457	-20%	156,742	30%	131,974	105,580	171,567
45	Project		Camp Creek Bridge	Piling special costs, pre-augering for Pile	1,400	LF	311.56	436,189	348,951	-20%	567,045	30%	477,443	381,955	620,676
45	Project		Camp Creek Bridge	Mobilization, 150 ton, set up and remove crane, with pile	2.00	EA	22,228.11	44,456	35,565	-20%	57,793	30%	48,661	38,929	63,259
45	Project		Camp Creek Bridge	A736 Barrier Wall	444	LF	388.00	172,270	137,816	-20%	223,952	30%	188,564	150,851	245,133
45	Project		Camp Creek Bridge	Expansion joint, neoprene, liquid, 1" x 2", cold applied	50.00	LF	44.09	2,205	1,764	-20%	2,866	30%	2,413	1,931	3,137
45	Project		Camp Creek Bridge	Columns Structural Concrete includes forms, Grade 60 rebar,	132	CY	1,953.07	257,806	206,245	-20%	335,148	30%	282,189	225,751	366,846
45	Project		Camp Creek Bridge	Deck Structural concrete, in place, includes forms, Grade 60	139	CY	1,143.38	158,930	127,144	-20%	206,609	30%	173,961	139,169	226,149
45	Project		Camp Creek Bridge	Footer Structural concrete,footing, reinforced, includes	162	CY	421.72	68,318	54,655	-20%	88,814	30%	74,780	59,824	97,214
45	Project		Camp Creek Bridge	Approach Slab Structural concrete, in place, 6" thick, includes	19.00	CY	293.49	5,576	4,461	-20%	7,249	30%	6,104	4,883	7,935
45	Project		Camp Creek Bridge	Precast 36" I-Girder 67'	4.00	EA	29,970.09	119,880	95,904	-20%	155,844	30%	131,219	104,975	170,584
45	Project		Camp Creek Bridge	Precast 36" I-Girder 53'	8.00	EA	35,810.59	286,485	229,188	-20%	372,430	30%	313,580	250,864	407,654
45	Project		Camp Creek Bridge - Paving	Roadway Excavation	12,270	CY	40.00	490,800	392,640	-20%	613,500	25%	537,219	429,776	671,524
45	Project		Camp Creek Bridge - Paving	Ditch Excavation	200	CY	35.00	7,000	5,600	-20%	8,750	25%	7,662	6,130	9,578
45	Project		Camp Creek Bridge - Paving	Imported Borrow	12,550	CY	45.00	564,750	451,800	-20%	705,938	25%	618,164	494,531	772,705
45	Project		Camp Creek Bridge - Paving	Hot Mix Asphalt (Type A)	710	T	130.00	92,300	73,840	-20%	115,375	25%	101,030	80,824	126,287
45	Project		Camp Creek Bridge - Paving	Class 2 Aggregate Base	520	CY	65.00	33,800	27,040	-20%	42,250	25%	36,997	29,597	46,246
45	Project		Camp Creek Bridge - Paving	Midwest Guardrail System	400	LF	40.61	16,244	12,995	-20%	20,305	25%	17,780	14,224	22,225
45	Project		Camp Creek Bridge - Paving	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892
45	Project		Camp Creek Bridge - Paving	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Camp Creek Bridge - Paving	Temporary Reinforced Silt Fence	400	LF	7.58	3,032	2,426	-20%	3,790	25%	3,319	2,655	4,148
45	Project		Camp Creek Bridge - Paving	Temporary Fence (Type ESA)	400	LF	5.03	2,012	1,610	-20%	2,515	25%	2,202	1,762	2,753
45	Project		Camp Creek Bridge - Paving	Temporary Hydroseed	160	SY	9.22	1,475	1,180	-20%	1,844	25%	1,615	1,292	2,018
45	Project		Camp Creek Bridge - Paving	Rolled Erosion Control / Jute Mesh	160	SY	16.62	2,659	2,127	-20%	3,324	25%	2,911	2,329	3,638
45	Project		Camp Creek Bridge - Paving	Temporary Fiber Roll	225	LF	8.10	1,823	1,458	-20%	2,278	25%	1,995	1,596	2,494
45	Project		Camp Creek Bridge - Paving	Temporary Concrete Washout	1.00	LS	1.00	-	1	-20%	1	25%	-	-	-
45	Project		Camp Creek Bridge - Paving	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Camp Creek Bridge - Paving	Water Pollution Control	0.10	%	497,800.00	49,780	39,824	-20%	62,225	25%	54,488	43,591	68,110
45	Project		Camp Creek Bridge - Paving	Roadside Sign - One Post	8.00	EA	270.00	2,160	1,728	-20%	2,700	25%	2,364	1,891	2,955
45	Project		Camp Creek Bridge - Paving	Construction Area Signs	1.00	LS	1.00	-	1	-20%	1	25%	-	-	-
45	Project		Camp Creek Bridge - Paving	Thermoplastic Traffic Stripe	810	LF	0.86	697	557	-20%	871	25%	762	610	953
45	Project		Camp Creek Bridge - Paving	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Camp Creek Bridge - Paving	Traffic Control System	20.00	DA	1,000.00	20,000	16,000	-20%	25,000	25%	21,892	17,513	27,364
45	Project		Camp Creek Bridge - Paving	Temporary Railing (Type K)	300	LF	47.00	14,100	11,280	-20%	17,625	25%	15,434	12,347	19,292
45	Project		Camp Creek Bridge - Temporary Culvert	Roadway Excavation	100	CY	40.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Camp Creek Bridge - Temporary Culvert	Ditch Excavation	150	CY	35.00	5,250	4,200	-20%	6,563	25%	5,747	4,597	7,183
45	Project		Camp Creek Bridge - Temporary Culvert	Imported Borrow	3,500	CY	45.00	157,500	126,000	-20%	196,875	25%	172,396	137,917	215,495
45	Project		Camp Creek Bridge - Temporary Culvert	Clearing & Grubbing	5,000	LS	1.00	5,000	4,000	-20%	6,250	25%	5,473	4,378	6,841
45	Project		Camp Creek Bridge - Temporary Culvert	Hot Mix Asphalt (Type A)	470	T	130.00	61,100	48,880	-20%	76,375	25%	66,879	53,503	83,598
45	Project		Camp Creek Bridge - Temporary Culvert	Class 2 Aggregate Base	235	CY	65.00	15,275	12,220	-20%	19,094	25%	16,720	13,376	20,900
45	Project		Camp Creek Bridge - Temporary Culvert	Rock Slope Protection (Class?) Method B	15.00	CY	100.00	1,500	1,200	-20%	1,875	25%	1,642	1,313	2,052
45	Project		Camp Creek Bridge - Temporary Culvert	Rock Slope Protection Fabric Class 8	45.00	SY	10.13	456	365	-20%	570	25%	499	399	624
45	Project		Camp Creek Bridge - Temporary Culvert	36" Alternative Pipe Culvert	300	LF	261.42	78,426	62,741	-20%	98,033	25%	85,843	68,675	107,304
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Reinforced Silt Fence	600	LF	7.58	4,548	3,638	-20%	5,685	25%	4,978	3,983	6,223
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Fence (Type ESA)	600	LF	5.03	3,018	2,414	-20%	3,773	25%	3,303	2,643	4,129
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Hydroseed	630	SY	9.22	5,809	4,647	-20%	7,261	25%	6,358	5,086	7,947
45	Project		Camp Creek Bridge - Temporary Culvert	Rolled Erosion Control / Jute Mesh	630	SY	16.62	10,471	8,376	-20%	13,088	25%	11,461	9,169	14,326
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Fiber Roll	1,190	LF	8.10	9,639	7,711	-20%	12,049	25%	10,551	8,441	13,188
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Concrete Washout	2,000	LS	1.50	2,999	2,399	-20%	3,749	25%	3,283	2,626	4,104
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Camp Creek Bridge - Temporary Culvert	Water Pollution Control	0.10	%	328,506.85	32,851	26,281	-20%	41,063	25%	35,958	28,766	44,947
45	Project		Camp Creek Bridge - Temporary Culvert	Construction Area Signs	1.00	LS	2,000.00	2,000	1,600	-20%	2,500	25%	2,189	1,751	2,736
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Traffic Stripe	650	LF	0.78	510	408	-20%	637	25%	558	446	698
45	Project		Camp Creek Bridge - Temporary Culvert	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Camp Creek Bridge - Temporary Culvert	Traffic Control System	10.00	DA	1,000.00	10,000	8,000	-20%	12,500	25%	10,946	8,757	13,682
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Railing (Type K)	600	LF	47.00	28,200	22,560	-20%	35,250	25%	30,867	24,694	38,584
45	Project		Jenny Creek Bridge	Sheet Pile Coffer Dam For Center Footer	2,400	SF	38.40	92,161	73,729	-20%	119,809	30%	100,878	80,702	131,141
45	Project		Jenny Creek Bridge	Earth Work Coffer Dam Construction for side footers	1,186	CY	15.26	18,097	14,478	-20%	23,526	30%	19,809	15,847	25,752
45	Project		Jenny Creek Bridge	Backfill, structural, common earth, 105 H.P. dozer, 50' haul,	142	CY	39.77	5,648	4,518	-20%	7,342	30%	6,182	4,946	8,037
45	Project		Jenny Creek Bridge	Structure Excavation (Type D)	320	CY	20.27	6,486	5,189	-20%	8,432	30%	7,099	5,679	9,229
45	Project		Jenny Creek Bridge	Structure Excavation (Bridge)	209	CY	58.08	12,138	9,710	-20%	15,779	30%	13,286	10,629	17,272
45	Project		Jenny Creek Bridge	Steel piles, "H" Sections, 50' long, HP14 X 89, excludes	2,640	LF	86.12	227,362	181,890	-20%	295,571	30%	248,866	199,093	323,526
45	Project		Jenny Creek Bridge	Piling special costs, pre-augering for Pile and Tie Down	2,640	LF	311.56	822,527	658,022	-20%	1,069,286	30%	900,321	720,257	1,170,418
45	Project		Jenny Creek Bridge	Mobilization, 150 ton, set up and remove crane, with pile	2.00	EA	22,228.11	44,456	35,565	-20%	57,793	30%	48,661	38,929	63,259

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
45	Project		Jenny Creek Bridge	A736 Barrier Wall	776	LF	388.00	301,085	240,868	-20%	391,411	30%	329,562	263,649	428,430
45	Project		Jenny Creek Bridge	Expansion joint, neoprene, liquid, 1" x 2", cold applied	58.00	LF	44.09	2,557	2,046	-20%	3,325	30%	2,799	2,239	3,639
45	Project		Jenny Creek Bridge	Columns Structural Concrete includes forms, Grade 60 rebar,	174	CY	1,953.07	339,835	271,868	-20%	441,785	30%	371,976	297,581	483,569
45	Project		Jenny Creek Bridge	Deck Structural concrete, in place, includes forms, Grade 60	317	CY	1,143.38	362,451	289,961	-20%	471,186	30%	396,731	317,385	515,751
45	Project		Jenny Creek Bridge	Footer Structural concrete,footing, reinforced, includes	281	CY	421.72	118,503	94,802	-20%	154,053	30%	129,710	103,768	168,624
45	Project		Jenny Creek Bridge	Approach Slab Structural concrete, in place, 6" thick, includes	22.00	CY	293.49	6,457	5,166	-20%	8,394	30%	7,068	5,654	9,188
45	Project		Jenny Creek Bridge	Precast 61" Bulb Tee 73'	8.00	EA	49,373.69	394,990	315,992	-20%	513,486	30%	432,347	345,878	562,052
45	Project		Jenny Creek Bridge	Precast 61" Bulb Tee 100'	8.00	EA	78,816.06	630,528	504,423	-20%	819,687	30%	690,163	552,131	897,212
45	Project		Jenny Creek Bridge	Bridge Demolition	3,102	SF	60.00	186,120	148,896	-20%	241,956	30%	203,723	162,978	264,840
45	Project		Jenny Creek Bridge - Paving	Roadway Excavation	30,000	CY	40.00	1,200,000	960,000	-20%	1,500,000	25%	1,313,495	1,050,796	1,641,869
45	Project		Jenny Creek Bridge - Paving	Ditch Excavation	210	CY	35.00	7,350	5,880	-20%	9,188	25%	8,045	6,436	10,056
45	Project		Jenny Creek Bridge - Paving	Imported Borrow	35,000	CY	45.00	1,575,000	1,260,000	-20%	1,968,750	25%	1,723,962	1,379,170	2,154,953
45	Project		Jenny Creek Bridge - Paving	Hot Mix Asphalt (Type A)	600	T	130.00	78,000	62,400	-20%	97,500	25%	85,377	68,302	106,721
45	Project		Jenny Creek Bridge - Paving	Class 2 Aggregate Base	370	CY	65.00	24,050	19,240	-20%	30,063	25%	26,325	21,060	32,906
45	Project		Jenny Creek Bridge - Paving	Midwest Guardrail System	200	LF	40.61	8,122	6,498	-20%	10,153	25%	8,890	7,112	11,113
45	Project		Jenny Creek Bridge - Paving	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892
45	Project		Jenny Creek Bridge - Paving	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Jenny Creek Bridge - Paving	Temporary Reinforced Silt Fence	400	LF	7.58	3,032	2,426	-20%	3,790	25%	3,319	2,655	4,148
45	Project		Jenny Creek Bridge - Paving	Temporary Fence (Type ESA)	400	LF	5.03	2,012	1,610	-20%	2,515	25%	2,202	1,762	2,753
45	Project		Jenny Creek Bridge - Paving	Temporary Hydroseed	1,770	SY	9.22	16,319	13,056	-20%	20,399	25%	17,863	14,290	22,329
45	Project		Jenny Creek Bridge - Paving	Rolled Erosion Control / Jute Mesh	1,770	SY	16.62	29,417	23,534	-20%	36,772	25%	32,200	25,760	40,250
45	Project		Jenny Creek Bridge - Paving	Temporary Fiber Roll	2,490	LF	8.10	20,169	16,135	-20%	25,211	25%	22,077	17,661	27,596
45	Project		Jenny Creek Bridge - Paving	Temporary Concrete Washout	2,000	LS	1.00	2,000	1,600	-20%	2,500	25%	2,189	1,751	2,736
45	Project		Jenny Creek Bridge - Paving	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Jenny Creek Bridge - Paving	Water Pollution Control	0.10	%	2,884,400.00	288,440	230,752	-20%	360,550	25%	315,720	252,576	394,651
45	Project		Jenny Creek Bridge - Paving	Roadside Sign - One Post	8.00	EA	270.00	2,160	1,728	-20%	2,700	25%	2,364	1,891	2,955
45	Project		Jenny Creek Bridge - Paving	Construction Area Signs	2,000	LS	1.00	2,000	1,600	-20%	2,500	25%	2,189	1,751	2,736
45	Project		Jenny Creek Bridge - Paving	Thermoplastic Traffic Stripe	1,000	LF	0.86	860	688	-20%	1,075	25%	941	753	1,177
45	Project		Jenny Creek Bridge - Paving	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Jenny Creek Bridge - Paving	Traffic Control System	20.00	DA	1,000.00	20,000	16,000	-20%	25,000	25%	21,892	17,513	27,364
45	Project		Jenny Creek Bridge - Paving	Temporary Railing (Type K)	300	LF	47.00	14,100	11,280	-20%	17,625	25%	15,434	12,347	19,292
45	Project		Other Structures	Pedestrian Bridge Total	800	SF	60.00	48,000	43,200	-10%	62,400	30%	52,540	47,286	68,302
45	Project		Other Structures	Bridge Demolition Ped Bridge Campground	800	SF	60.00	48,000	43,200	-10%	62,400	30%	52,540	47,286	68,302
45	Project		Other Structures	Bridge Demolition Timber JC Boyle	1,800	SF	60.00	108,000	97,200	-10%	140,400	30%	118,215	106,393	153,679
45	Project		Scotch Creek - Temporary Culvert	Roadway Excavation	550	CY	40.00	22,000	17,600	-20%	27,500	25%	24,081	19,265	30,101
45	Project		Scotch Creek - Temporary Culvert	Ditch Excavation	10.00	CY	35.00	350	280	-20%	438	25%	383	306	479
45	Project		Scotch Creek - Temporary Culvert	Imported Borrow	2,300	CY	45.00	103,500	82,800	-20%	129,375	25%	113,289	90,631	141,611
45	Project		Scotch Creek - Temporary Culvert	Clearing & Grubbing	1.00	LS	1.00	-	1	-20%	1	25%	-	-	-
45	Project		Scotch Creek - Temporary Culvert	Hot Mix Asphalt (Type A)	510	T	130.00	66,300	53,040	-20%	82,875	25%	72,571	58,056	90,713
45	Project		Scotch Creek - Temporary Culvert	Class 2 Aggregate Base	380	CY	65.00	24,700	19,760	-20%	30,875	25%	27,036	21,629	33,795
45	Project		Scotch Creek - Temporary Culvert	Rock Slope Protection (Class?) Method B	10.00	CY	100.00	1,000	800	-20%	1,250	25%	1,095	876	1,368
45	Project		Scotch Creek - Temporary Culvert	Rock Slope Protection Fabric Class 8	30.00	SY	10.13	304	243	-20%	380	25%	333	266	416
45	Project		Scotch Creek - Temporary Culvert	36" Alternative Pipe Culvert	250	LF	261.42	65,355	52,284	-20%	81,694	25%	71,536	57,229	89,420
45	Project		Scotch Creek - Temporary Culvert	Temporary Reinforced Silt Fence	300	LF	7.58	2,274	1,819	-20%	2,843	25%	2,489	1,991	3,111
45	Project		Scotch Creek - Temporary Culvert	Temporary Fence (Type ESA)	300	LF	5.03	1,509	1,207	-20%	1,886	25%	1,652	1,321	2,065
45	Project		Scotch Creek - Temporary Culvert	Temporary Hydroseed	590	SY	9.22	5,440	4,352	-20%	6,800	25%	5,954	4,763	7,443
45	Project		Scotch Creek - Temporary Culvert	Rolled Erosion Control / Jute Mesh	590	SY	16.62	9,806	7,845	-20%	12,257	25%	10,733	8,587	13,417
45	Project		Scotch Creek - Temporary Culvert	Temporary Fiber Roll	450	LF	8.10	3,645	2,916	-20%	4,556	25%	3,990	3,192	4,987
45	Project		Scotch Creek - Temporary Culvert	Temporary Concrete Washout	2,000	LS	1.50	2,999	2,399	-20%	3,749	25%	3,283	2,626	4,104
45	Project		Scotch Creek - Temporary Culvert	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Scotch Creek - Temporary Culvert	Water Pollution Control	0.10	%	283,509.90	28,351	22,681	-20%	35,439	25%	31,032	24,826	38,791
45	Project		Scotch Creek - Temporary Culvert	Construction Area Signs	1.00	LS	2,000.00	2,000	1,600	-20%	2,500	25%	2,189	1,751	2,736
45	Project		Scotch Creek - Temporary Culvert	Temporary Traffic Stripe	520	LF	0.78	408	326	-20%	510	25%	446	357	558
45	Project		Scotch Creek - Temporary Culvert	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Scotch Creek - Temporary Culvert	Traffic Control System	10.00	DA	1,000.00	10,000	8,000	-20%	12,500	25%	10,946	8,757	13,682
45	Project		Scotch Creek - Temporary Culvert	Temporary Railing (Type K)	500	LF	47.00	23,500	18,800	-20%	29,375	25%	25,723	20,578	32,153
45	Project		Scotch Creek - Culvert	Roadway Excavation	3,000	CY	40.00	120,000	96,000	-20%	150,000	25%	131,350	105,080	164,187
45	Project		Scotch Creek - Culvert	Ditch Excavation	10.00	CY	35.00	350	280	-20%	438	25%	383	306	479
45	Project		Scotch Creek - Culvert	Imported Borrow	3,000	CY	45.00	135,000	108,000	-20%	168,750	25%	147,768	118,215	184,710
45	Project		Scotch Creek - Culvert	Hot Mix Asphalt (Type A)	170	T	130.00	22,100	17,680	-20%	27,625	25%	24,190	19,352	30,238
45	Project		Scotch Creek - Culvert	Class 2 Aggregate Base	120	CY	65.00	7,800	6,240	-20%	9,750	25%	8,538	6,830	10,672
45	Project		Scotch Creek - Culvert	Rock Slope Protection Class III, Method B	5.00	CY	100.00	500	400	-20%	625	25%	547	438	684
45	Project		Scotch Creek - Culvert	Rock Slope Protection Fabric Class 8	12.00	SY	10.13	122	97	-20%	152	25%	133	106	166
45	Project		Scotch Creek - Culvert	Structural Concrete, Box Culvert	10.00	CY	4,835.00	48,350	38,680	-20%	60,438	25%	52,923	42,338	66,154

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
45	Project		Scotch Creek - Culvert	Midwest Guardrail System	400	LF	34.19	13,676	10,941	-20%	17,095	25%	14,969	11,976	18,712
45	Project		Scotch Creek - Culvert	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Scotch Creek - Culvert	Temporary Reinforced Silt Fence	400	LF	7.58	3,032	2,426	-20%	3,790	25%	3,319	2,655	4,148
45	Project		Scotch Creek - Culvert	Temporary Fence (Type ESA)	400	LF	5.03	2,012	1,610	-20%	2,515	25%	2,202	1,762	2,753
45	Project		Scotch Creek - Culvert	Temporary Hydroseed	220	SY	9.22	2,028	1,623	-20%	2,536	25%	2,220	1,776	2,775
45	Project		Scotch Creek - Culvert	Rolled Erosion Control / Jute Mesh	220	SY	16.62	3,656	2,925	-20%	4,571	25%	4,002	3,202	5,003
45	Project		Scotch Creek - Culvert	Temporary Fiber Roll	450	LF	8.10	3,645	2,916	-20%	4,556	25%	3,990	3,192	4,987
45	Project		Scotch Creek - Culvert	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Scotch Creek - Culvert	Water Pollution Control	0.10	%	334,221.56	33,422	26,738	-20%	41,778	25%	36,583	29,267	45,729
45	Project		Scotch Creek - Culvert	Construction Area Signs	1.00	LS	2,500.00	2,500	2,000	-20%	3,125	25%	2,736	2,189	3,421
45	Project		Scotch Creek - Culvert	Thermoplastic Traffic Stripe	200	LF	0.86	172	138	-20%	215	25%	188	151	235
45	Project		Scotch Creek - Culvert	Traffic Control System	1.00	LS	10,000.00	10,000	8,000	-20%	12,500	25%	10,946	8,757	13,682
45	Project		Scotch Creek - Culvert	Temporary Railing (Type K)	200	LF	33.57	6,714	5,371	-20%	8,393	25%	7,349	5,879	9,187
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Roadway Excavation	3,000	CY	40.00	120,000	96,000	-20%	150,000	25%	131,350	105,080	164,187
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Imported Borrow	2,500	CY	45.00	112,500	90,000	-20%	140,625	25%	123,140	98,512	153,925
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Rock Slope Protection Class III, Method B	250	CY	100.00	25,000	20,000	-20%	31,250	25%	27,364	21,892	34,206
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Rock Slope Protection Fabric Class 8	700	SY	10.13	7,091	5,673	-20%	8,864	25%	7,762	6,209	9,702
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	60" CORRUGATED STEEL PIPE (.138" THICK)	80.00	LF	270.00	21,600	17,280	-20%	27,000	25%	23,643	18,914	29,554
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Temporary Reinforced Silt Fence	600	LF	7.58	4,548	3,638	-20%	5,685	25%	4,978	3,983	6,223
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Temporary Fence (Type ESA)	600	LF	5.03	3,018	2,414	-20%	3,773	25%	3,303	2,643	4,129
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Water Pollution Control	0.10	%	286,191.00	28,619	22,895	-20%	35,774	25%	31,326	25,061	39,157
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Construction Area Signs	1.00	LS	600.00	600	480	-20%	750	25%	657	525	821
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Traffic Control System	1.00	LS	10,000.00	10,000	8,000	-20%	12,500	25%	10,946	8,757	13,682
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Temporary Railing (Type K)	80.00	LF	33.57	2,686	2,149	-20%	3,357	25%	2,940	2,352	3,675
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Replace and Reconstruct 60-inch Culvert No.1 at Beaver	1.00	LS	15,000.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Replace and Reconstruct 60-inch Culvert No.2 at Beaver	1.00	LS	15,000.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Copco Rd at Raymond Gulch Culvert	Rock Slope Protection Class III, Method B	150	CY	100.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Copco Rd at Raymond Gulch Culvert	Rock Slope Protection Fabric Class 8	400	SY	10.13	4,052	3,242	-20%	5,065	25%	4,435	3,548	5,544
45	Project		Copco Rd at Raymond Gulch Culvert	Temporary Reinforced Silt Fence	600	LF	7.58	4,548	3,638	-20%	5,685	25%	4,978	3,983	6,223
45	Project		Copco Rd at Raymond Gulch Culvert	Temporary Fence (Type ESA)	600	LF	5.03	3,018	2,414	-20%	3,773	25%	3,303	2,643	4,129
45	Project		Copco Rd at Raymond Gulch Culvert	Water Pollution Control	1.00	LS	19,052.00	19,052	15,242	-20%	23,815	25%	20,854	16,683	26,067
45	Project		Copco Rd at Raymond Gulch Culvert	Traffic Control System	1.00	LS	1,000.00	1,000	800	-20%	1,250	25%	1,095	876	1,368
45	Project		Copco Rd at Raymond Gulch Culvert	60-inch Culvert at Raymond Gulch	1.00	LS	10,000.00	10,000	8,000	-20%	12,500	25%	10,946	8,757	13,682
45	Project		Patricia Avenue Culverts	Rock Slope Protection Class III, Method B	150	CY	100.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Patricia Avenue Culverts	Rock Slope Protection Fabric Class 8	400	SY	10.13	4,052	3,242	-20%	5,065	25%	4,435	3,548	5,544
45	Project		Patricia Avenue Culverts	Water Pollution Control	0.10	%	19,052.00	1,905	1,524	-20%	2,382	25%	2,085	1,668	2,607
45	Project		Patricia Avenue Culverts	Traffic Control System	1.00	LS	1,000.00	1,000	800	-20%	1,250	25%	1,095	876	1,368
45	Project		Topsy Grade Culverts	Trench Excavation	275	CY	40.00	11,000	8,800	-20%	13,750	25%	12,040	9,632	15,050
45	Project		Topsy Grade Culverts	Clearing & Grubbing	1.00	LS	2,000.00	2,000	1,600	-20%	2,500	25%	2,189	1,751	2,736
45	Project		Topsy Grade Culverts	Rock Slope Protection Class III, Method B	800	CY	100.00	80,000	64,000	-20%	100,000	25%	87,566	70,053	109,458
45	Project		Topsy Grade Culverts	Rock Slope Protection Fabric Class 8	2,350	SY	10.13	23,806	19,044	-20%	29,757	25%	26,057	20,846	32,571
45	Project		Topsy Grade Culverts	24" corrugated steel pipe (.138" thick)	200	LF	137.50	27,500	22,000	-20%	34,375	25%	30,101	24,081	37,626
45	Project		Topsy Grade Culverts	Temporary Reinforced Silt Fence	1,000	LF	7.58	7,580	6,064	-20%	9,475	25%	8,297	6,638	10,371
45	Project		Topsy Grade Culverts	Temporary Fence (Type ESA)	1,000	LF	5.03	5,030	4,024	-20%	6,288	25%	5,506	4,405	6,882
45	Project		Topsy Grade Culverts	Water Pollution Control	0.10	%	144,305.50	14,431	11,544	-20%	18,038	25%	15,795	12,636	19,744
45	Project		Topsy Grade Culverts	Traffic Control System	1.00	LS	5,000.00	5,000	4,000	-20%	6,250	25%	5,473	4,378	6,841
45	Project		JC Boyle Unnamed Culverts	Rock Slope Protection Class III, Method B	115	CY	100.00	11,500	9,200	-20%	14,375	25%	12,588	10,070	15,735
45	Project		JC Boyle Unnamed Culverts	Rock Slope Protection Fabric Class 8	350	SY	10.13	3,546	2,836	-20%	4,432	25%	3,881	3,105	4,851
45	Project		JC Boyle Unnamed Culverts	Water Pollution Control	0.10	%	15,045.50	1,505	1,204	-20%	1,881	25%	1,647	1,317	2,059
45	Project		JC Boyle Unnamed Culverts	Traffic Control System	1.00	LS	1,000.00	1,000	800	-20%	1,250	25%	1,095	876	1,368
45	Project		Copco Road at Unnamed Creek Culvert No. 1	Copco Road at Unnamed Creek Culvert No. 1	1.00	LS	15,000.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Copco Road at Unnamed Creek Culvert No. 2	Copco Road at Unnamed Creek Culvert No. 2	1.00	LS	15,000.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		6'x6'x34' Box Culvert installation	6'x6'x34' Box Culvert installation	1.00	LS	15,000.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Paving - Lakeview Disposal Access Road	Pre: none; Post: 0.7 miles 6" AB overlay (no drainage	1.00	EA	170,000.00	170,000	-	-20%	340,000	25%	191,227	-	382,454
45	Project		Paving - Copco 1 Dam Access	Pre: 2500CY roadway excavation, 0.9 miles 9" AB overlay (no	1.00	EA	250,000.00	250,000	190,000	-20%	370,000	25%	270,400	205,504	400,192
45	Project		Paving - Copco Rd from Copco 1 access to Copco Bridge	Pre: 1 mile 9" AB repair; Post: 1 mile 9" AB repair, 0.2 mile	1.00	EA	318,000.00	318,000	208,000	-20%	585,000	25%	352,204	230,372	647,922
45	Project		Paving - Copco 1 Ager Beswick Rd Barge Access	Pre: minor excavation and 9"" AB section; Post: none	1.00	EA	60,000.00	60,000	-	-20%	120,000	25%	64,896	-	129,792
45	Project		Paving - US 97 Dalles CA Hwy	Pre: none; Post: none (high only)	1.00	EA	966,000.00	-	-	-20%	966,000	25%	-	-	1,086,619
45	Project		Paving - OR 66 Green Springs hwy	Pre: none; Post: none (high only)	1.00	EA	-	-	-	-20%	988,000	25%	-	-	1,111,366
45	Project		Paving - JC Boyle Keno Worden	Pre: none; Post: none (high only)	1.00	EA	-	-	-	-20%	988,000	25%	-	-	1,111,366
45	Project		Paving - Topsy Grade Rd	Pre: 0.9 mile 9" AB repair; Post: 0.9 mile 9" AB repair	1.00	EA	880,000.00	880,000	440,000	-20%	1,320,000	25%	970,844	485,422	1,456,266

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
45	Project		Paving - JC Boyle Dam Access Rd (2,940 ft to dam toe)	Pre: minor excavation; 0.25 mile new 9" AB, 0.7 mile 9" AB	1.00	EA	335,000.00	335,000	212,000	-20%	374,000	25%	368,133	232,968	410,991
45	Project		Paving - JC Boyle Power Canal Access Rd	Pre: 1.5 mile 9" AB repair; post: 1.5 mile 9" AB repair; no	1.00	EA	432,000.00	432,000	216,000	-20%	744,000	25%	476,596	238,298	820,805
45	Project		Paving - JC Boyle Powerhouse Access Rd	Pre: none; Post: none (high only)	1.00	EA	-	-	-	-20%	216,000	25%	-	-	242,971
45	Project		Paving - Copco Rd I5 to Ager Rd	Pre: none; Post: 1 mile new asphalt overlay	1.00	EA	1,090,000.00	1,090,000	545,000	-20%	2,100,000	25%	1,226,102	613,051	2,362,214
45	Project		Paving - Copco Rd Ager Rd to Lakeview Rd	Pre: 0.5 miles crack sealer, 0.75 miles new asphalt; Post: 1	1.00	EA	1,625,000.00	1,625,000	1,185,000	-20%	5,235,000	25%	1,799,782	1,312,457	5,798,068
45	Project		Paving - Copco Rd to Lakeview Rd to Dagget Rd	Pre: 1 mile crack sealer, 1.5 miles new asphalt; Post: 2 miles	1.00	EA	2,980,000.00	2,980,000	2,370,000	-20%	10,470,000	25%	3,300,524	2,624,913	11,596,136
45	Project		Paving - Copco Rd Daggett Rd to Copco 1 Access Rd	Pre: 1.5 mile 9" AB repair; Post: 1.5 mile 9" AB repair, no	1.00	EA	432,000.00	432,000	216,000	-20%	744,000	25%	476,596	238,298	820,805
46			**RECREATION IMPROVEMENTS**												
46	Project		Campground - Jenny Creek expansion & upgrade	Picnic table	7.00	EA	2,363.80	16,547	10,500	-37%	21,000	27%	18,112	11,493	22,986
46	Project		Campground - Jenny Creek expansion & upgrade	Fire grate	7.00	EA	675.37	4,728	3,000	-37%	6,000	27%	5,175	3,284	6,567
46	Project		Campground - Jenny Creek expansion & upgrade	Trash bins	7.00	EA	1,000.00	7,000	5,000	-29%	10,000	43%	7,662	5,473	10,946
46	Project		Campground - Jenny Creek expansion & upgrade	Parking	7.00	EA	562.81	3,940	2,500	-37%	5,000	27%	4,312	2,736	5,473
46	Project		Campground - Jenny Creek expansion & upgrade	Shade structure	3.00	EA	14,633.07	43,899	26,000	-41%	65,000	48%	48,051	28,459	71,148
46	Project		Campground - Jenny Creek expansion & upgrade	Restroom (single vault toilet)	2.00	EA	57,406.66	114,813	102,000	-11%	204,000	78%	125,672	111,647	223,294
46	Project		Campground - Jenny Creek expansion & upgrade	Assumed earthwork	450	CY	9.00	4,052	2,400	-41%	4,800	18%	4,435	2,627	5,254
46	Project		Campground - Jenny Creek expansion & upgrade	Signage	2.00	EA	5,000.00	10,000	5,000	-50%	15,000	50%	10,946	5,473	16,419
46	Project		Campground - Jenny Creek expansion & upgrade	Operations and maintenance	5.00	YR	33,768.63	168,843	-	0%	600,000	255%	184,812	-	656,748
46	Project		Campground - Topsy upgrade	boat ramp	1.00	EA	10,000.00	10,000	10,000	0%	10,000	0%	10,946	10,946	10,946
46	Project		Campground - Topsy upgrade	trash bins	1.00	EA	1,000.00	1,000	1,000	0%	1,000	0%	1,095	1,095	1,095
46	Project		Campground - Topsy upgrade	Operations and maintenance	5.00	YR	11,256.21	56,281	-	0%	200,000	255%	61,604	-	218,916
46	Project		Campgrounds - New campgrounds	picnic table	20.00	EA	2,363.80	47,276	47,276	0%	47,276	0%	51,747	51,747	51,747
46	Project		Campgrounds - New campgrounds	fire grate	20.00	EA	675.37	13,507	13,507	0%	13,507	0%	14,785	14,785	14,785
46	Project		Campgrounds - New campgrounds	trash bins	20.00	EA	1,000.00	20,000	20,000	0%	20,000	0%	21,892	21,892	21,892
46	Project		Campgrounds - New campgrounds	restroom (single vault toilet)	6.00	EA	57,406.66	344,440	344,440	0%	344,440	0%	377,017	377,017	377,017
46	Project		Campgrounds - New campgrounds	parking	20.00	EA	562.81	11,256	11,256	0%	11,256	0%	12,321	12,321	12,321
46	Project		Campgrounds - New campgrounds	boat ramp	2.00	EA	11,256.21	22,512	14,633	-35%	22,512	0%	24,642	16,017	24,642
46	Project		Campgrounds - New campgrounds	trash bins	2.00	EA	1,000.00	2,000	1,300	-35%	2,000	0%	2,189	1,423	2,189
46	Project		Campgrounds - New campgrounds	picnic table	2.00	EA	2,363.80	4,728	4,255	-10%	4,728	0%	5,175	4,657	5,175
46	Project		Campgrounds - New campgrounds	fire grate	2.00	EA	675.37	1,351	1,216	-10%	1,351	0%	1,478	1,331	1,478
46	Project		Campgrounds - New campgrounds	trash bins	2.00	EA	1,000.00	2,000	2,000	0%	2,000	0%	2,189	2,189	2,189
46	Project		Campgrounds - New campgrounds	assumed earthwork	1,200	CY	9.00	10,806	9,725	-10%	10,806	0%	11,828	10,645	11,828
46	Project		Campgrounds - New campgrounds	signage	4.00	EA	5,000.00	20,000	10,000	-50%	30,000	50%	21,892	10,946	32,837
46	Project		Campgrounds - New campgrounds	Operations and maintenance	5.00	YR	67,537.25	337,686	-	0%	1,200,000	255%	369,624	-	1,313,495
46	Project		Recreation area - Fall Creek upgrade	restroom (single vault toilet)	1.00	EA	57,406.66	57,407	51,666	-10%	103,332	80%	62,836	56,553	113,105
46	Project		Recreation area - Fall Creek upgrade	picnic table	5.00	EA	2,363.80	11,819	8,400	-29%	12,600	7%	12,937	9,194	13,792
46	Project		Recreation area - Fall Creek upgrade	shade structure	2.00	EA	14,633.07	29,266	26,340	-10%	43,899	50%	32,034	28,831	48,051
46	Project		Recreation area - Fall Creek upgrade	fire grate	4.00	EA	675.37	2,701	1,800	-33%	3,000	11%	2,957	1,970	3,284
46	Project		Recreation area - Fall Creek upgrade	trash bins	5.00	EA	1,000.00	5,000	4,000	-20%	6,000	20%	5,473	4,378	6,567
46	Project		Recreation area - Fall Creek upgrade	parking	6.00	EA	562.81	3,377	2,000	-41%	4,000	18%	3,696	2,189	4,378
46	Project		Recreation area - Fall Creek upgrade	reconstructed trail	0.50	MI	35,659.67	17,830	7,920	-56%	31,680	78%	19,516	8,669	34,676
46	Project		Recreation area - Fall Creek upgrade	assumed earthwork	300	CY	9.00	2,701	1,600	-41%	3,200	18%	2,957	1,751	3,503
46	Project		Recreation area - Fall Creek upgrade	signage	2.00	EA	5,000.00	10,000	5,000	-50%	15,000	50%	10,946	5,473	16,419
46	Project		Recreation area - Fall Creek upgrade	Operations and maintenance	5.00	YR	16,884.31	84,422	-	0%	300,000	255%	92,406	-	328,374
46	Project		Recreation area - Iron Gate Hatchery day use site	shade structure	3.00	EA	14,633.07	43,899	26,000	-41%	52,000	18%	48,051	28,459	56,918
46	Project		Recreation area - Iron Gate Hatchery day use site	picnic table	6.00	EA	2,363.80	14,183	8,400	-41%	16,800	18%	15,524	9,194	18,389
46	Project		Recreation area - Iron Gate Hatchery day use site	trash bins	7.00	EA	1,000.00	7,000	5,000	-29%	9,000	29%	7,662	5,473	9,851
46	Project		Recreation area - Iron Gate Hatchery day use site	parking	6.00	EA	562.81	3,377	2,000	-41%	4,000	18%	3,696	2,189	4,378
46	Project		Recreation area - Iron Gate Hatchery day use site	fire grate	6.00	EA	675.37	4,052	2,400	-41%	4,800	18%	4,435	2,627	5,254
46	Project		Recreation area - Iron Gate Hatchery day use site	restroom (single vault toilet)	2.00	EA	57,406.66	114,813	102,000	-11%	204,000	78%	125,672	111,647	223,294
46	Project		Recreation area - Iron Gate Hatchery day use site	boat ramp	1.00	EA	11,256.21	11,256	11,256	0%	11,256	0%	12,321	12,321	12,321
46	Project		Recreation area - Iron Gate Hatchery day use site	assumed earthwork	450	CY	9.00	4,052	2,400	-41%	4,800	18%	4,435	2,627	5,254
46	Project		Recreation area - Iron Gate Hatchery day use site	signage	2.00	EA	5,000.00	10,000	5,000	-50%	15,000	50%	10,946	5,473	16,419
46	Project		Recreation area - Iron Gate Hatchery day use site	Operations and maintenance	5.00	YR	16,884.31	84,422	-	0%	300,000	255%	92,406	-	328,374
46	Project		Recreation area - River fishing access sites	parking	18.00	EA	562.81	10,131	-	0%	12,000	18%	11,089	-	13,135
46	Project		Recreation area - River fishing access sites	portable toilet	6.00	EA	787.93	4,728	4,200	-11%	5,600	18%	5,175	4,597	6,130
46	Project		Recreation area - River fishing access sites	trash bins	6.00	EA	1,000.00	6,000	6,000	0%	8,000	33%	6,567	6,567	8,757
46	Project		Recreation area - River fishing access sites	signage	6.00	EA	5,000.00	30,000	30,000	0%	40,000	33%	32,837	32,837	43,783
46	Project		Recreation area - River fishing access sites	trail refurbishment	7,920	LF	6.75	53,490	47,520	-11%	63,360	18%	58,548	52,014	69,353
46	Project		Recreation area - River fishing access sites	Operations and maintenance	5.00	YR	11,256.21	56,281	-	0%	200,000	255%	61,604	-	218,916
46	Project		Recreation area - New day use sites	picnic table	4.00	EA	2,363.80	9,455	-	0%	12,600	33%	10,349	-	13,792
46	Project		Recreation area - New day use sites	fire grate	4.00	EA	675.37	2,701	-	0%	3,600	33%	2,957	-	3,940

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
46	Project		Recreation area - New day use sites	trash bins	4.00	EA	1,000.00	4,000	-	0%	6,000	50%	4,378	-	6,567
46	Project		Recreation area - New day use sites	shade structure	2.00	EA	14,633.07	29,266	-	0%	39,000	33%	32,034	-	42,689
46	Project		Recreation area - New day use sites	assumed earthwork	200	CY	9.00	1,801	-	0%	2,400	33%	1,971	-	2,627
46	Project		Recreation area - New day use sites	signage	2.00	EA	5,000.00	10,000	-	0%	15,000	50%	10,946	-	16,419
46	Project		Recreation area - New day use sites	Operations and maintenance	5.00	YR	22,512.42	112,562	-	0%	400,000	255%	123,208	-	437,832
46	Project		Recreation area - New boat ramps	New boat ramps	4.00	EA	11,256.21	45,025	20,000	-56%	80,000	78%	49,283	21,892	87,566
46	Project		Non-motorized rec trails - JC Boyle to Iron Gate	Trail	20.00	MI	35,659.67	713,193	-	0%	1,267,200	78%	780,647	-	1,387,051
46	Project		Non-motorized rec trails - JC Boyle to Iron Gate	Signage	2.00	EA	5,000.00	10,000	-	0%	15,000	50%	10,946	-	16,419
46	Project		Non-motorized rec trails	Walking trails for recreation access to river	7.00	MI	35,659.67	249,618	158,400	-37%	316,800	27%	273,226	173,381	346,763
46	Project		Non-motorized rec trails - Walking/wildlife viewing/interpretive	Trail Grading	5.00	MI	35,659.67	178,298	-	0%	316,800	78%	195,162	-	346,763
46	Project		Non-motorized rec trails - Walking/wildlife viewing/interpretive	trash bins	1.00	EA	1,000.00	1,000	-	#####	1,000	0%	1,095	-	1,095
46	Project		Non-motorized rec trails - Walking/wildlife viewing/interpretive	Signage	2.00	EA	5,000.00	10,000	-	0%	15,000	0%	10,946	-	16,419
46	Project		General Conditions	Contractor overhead	15%	%	3,337,792.01	500,669	450,772	-10%	651,114	30%	548,022	493,405	712,696
46	Project		General Conditions	Contractor profit	8%	%	3,337,792.01	267,023	240,411	-10%	347,261	30%	292,278	263,149	380,105
46	Project		General Conditions	Insurance	1%	%	4,105,484.17	41,055	36,963	-10%	53,391	30%	44,938	40,459	58,441
46	Project		General Conditions	Bond	1%	%	4,105,484.17	41,055	36,963	-10%	53,391	30%	44,938	40,459	58,441
47			**FLOOD PROOFING**												
47	Project	10.010	Raise homes	Cost to raise homes and add 2 stairs	45.00	EA	30,187.71	1,358,447	1,086,758	-20%	1,765,981	30%	1,498,682	1,198,946	1,948,287
48			**PUBLIC HEALTH AND SAFETY**												
48	Project		Public Health and Safety	Cattle exclusion fencing	182,160	LF	11.90	2,167,704	2,489,116	15%	3,042,253	40%	2,363,345	2,713,766	3,316,825
50			**MITIGATION MEASURES**												
51			**GROUNDWATER IMPROVEMENTS**												
51	Project		Groundwater improvements	Outreach to well owners	1.00	SUM	55,000.00	55,000	55,000	0%	55,000	0%	59,488	59,488	59,488
51	Project		Groundwater improvements	Drill and install new monitoring wells	5.00	EA	16,000.00	80,000	48,000	-40%	80,000	0%	88,259	52,955	88,259
51	Project		Groundwater improvements	Sentinel water level monitoring of new wells and landowner	36.00	MO	2,800.00	100,800	86,400	-14%	115,200	14%	115,743	99,208	132,278
51	Project		Groundwater improvements	WQ laboratory analytical testing	1.00	SUM	37,500.00	37,500	15,000	-60%	60,000	60%	41,371	16,548	66,194
51	Project		Groundwater improvements	Well replacements	20.00	EA	63,375.00	1,267,500	810,000	-36%	1,725,000	36%	1,483,366	947,950	2,018,782
51	Project		Groundwater improvements	Well abandonment	20.00	EA	2,625.00	52,500	30,000	-43%	75,000	43%	58,488	33,421	83,554
51	Project		Groundwater improvements	Temporary water supply	16.00	EA	3,406.25	54,500	36,000	-34%	73,000	34%	60,716	40,106	81,326
51	Project		Groundwater improvements	Permitting and Reporting	1.00	SUM	66,500.00	66,500	37,000	-44%	96,000	44%	74,084	41,220	106,949
52			**WATER SUPPLY/RIGHTS**												
52	Project		Water supply rights	Hay production	3,379	T	175.00	591,357	506,877	-14%	675,836	14%	652,403	559,203	745,604
52	Project		Water supply rights	Water supply for domestic use for water rights	1.00	LS	28.01	8,666	8,436	-3%	9,053	4%	9,561	9,306	9,988
52	Project		Water supply rights	Sediment removal at intakes	254	CY	500.00	126,999	63,500	-50%	190,499	50%	140,110	70,055	210,164
52	Project		Water supply rights	Groundwater wells - domestic	9.00	EA	10,000.00	90,000	40,000	-56%	100,000	11%	99,291	44,129	110,323
52	Project		Water supply rights	Groundwater wells - municipal	1.00	EA	100,000.00	100,000	-	#####	100,000	0%	110,323	-	110,323
52	Project		Water supply rights	Sediment basin	39.00	EA	1,851.85	72,222	72,222	0%	72,222	0%	79,678	79,678	79,678
53			**CULTURAL RESOURCES**												
53			**2017/18 Support**												
53	Project		Cultural Resources Tasks	Generally	12.00	MO	168,958.33	2,027,500	1,824,750	-10%	2,230,250	10%	2,027,500	1,824,750	2,230,250
53			**2018/19 Support**												
53	Project		Cultural Resources Tasks	Generally	12.00	MO	168,958.33	2,027,500	1,824,750	-10%	2,230,250	10%	2,068,050	1,861,245	2,274,855
			2019 H2 Support												
53	Project		Task management	Principal Scientist/Planner	208	HR	900.00	187,200	168,480	-10%	205,920	10%	194,688	175,219	214,157
53	Project		Task 1.2A Agency consultation	Principal Scientist/Planner	83.20	HR	180.00	14,976	13,478	-10%	16,474	10%	15,575	14,018	17,133
53	Project		Task 1.2A Agency consultation	Senior Scientist/Planner	41.60	HR	160.00	6,656	5,990	-10%	7,322	10%	6,922	6,230	7,614
53	Project		Task 1.2B Tribal consultation and work plans	Principal Scientist/Planner	256	HR	180.00	46,080	41,472	-10%	50,688	10%	47,923	43,131	52,716
53	Project		Task 1.2B Tribal consultation and work plans	Senior Scientist/Planner	128	HR	160.00	20,480	18,432	-10%	22,528	10%	21,299	19,169	23,429
53	Project		Task 1.2B Tribal consultation and work plans	Technical Editor	16.00	HR	105.00	1,680	1,512	-10%	1,848	10%	1,747	1,572	1,922
53	Project		Task 1.2B Tribal consultation and work plans	GIS/CADD/Graphics	24.00	HR	90.00	2,160	1,944	-10%	2,376	10%	2,246	2,022	2,471
			2020-2024 Support												
53	Project		Task management	Principal Scientist/Planner	1,040	HR	180.00	187,200	168,480	-10%	205,920	10%	210,795	189,715	231,874
53	Project		Task 1.2A Agency consultation	Principal Scientist/Planner	416	HR	180.00	74,880	67,392	-10%	82,368	10%	84,318	75,886	92,750

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
53	Project		Task 1.2A Agency consultation	Senior Scientist/Planner	208	HR	160.00	33,280	29,952	-10%	36,608	10%	37,475	33,727	41,222
53	Project		Task 1.2B Tribal consultation and work plans	Principal Scientist/Planner	1,280	HR	180.00	230,400	207,360	-10%	253,440	10%	259,440	233,496	285,384
53	Project		Task 1.2B Tribal consultation and work plans	Senior Scientist/Planner	640	HR	160.00	102,400	92,160	-10%	112,640	10%	115,307	103,776	126,837
53	Project		Task 1.2B Tribal consultation and work plans	Technical Editor	80.00	HR	105.00	8,400	7,560	-10%	9,240	10%	9,459	8,513	10,405
53	Project		Task 1.2B Tribal consultation and work plans	GIS/CADD/Graphics	120	HR	90.00	10,800	9,720	-10%	11,880	10%	12,161	10,945	13,377
53	Project		Task 2.6L Curation	Principal Scientist/Planner	80.00	HR	180.00	14,400	12,960	-10%	15,840	10%	16,110	14,499	17,721
53	Project		Task 2.6L Curation	Scientist/Planner	1,640	HR	120.00	196,800	177,120	-10%	216,480	10%	220,165	198,148	242,181
53	Project		Task 2.6L Curation	Curation	410	EA	500.00	205,000	184,500	-10%	225,500	10%	229,338	206,405	252,272
53	Project		Task 2.6L Curation	Other direct costs	1.00	SUM	5,000.00	5,000	4,500	-10%	5,500	10%	5,594	5,034	6,153
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Principal Scientist/Planner	200	HR	180.00	36,000	32,400	-10%	39,600	10%	38,938	35,044	42,831
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Senior Scientist/Planner	290	HR	160.00	46,400	41,760	-10%	51,040	10%	50,186	45,168	55,205
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Scientist/Planner	1,180	HR	120.00	141,600	127,440	-10%	155,760	10%	153,155	137,839	168,470
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Technical Editor	40.00	HR	105.00	4,200	3,780	-10%	4,620	10%	4,543	4,088	4,997
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Junior Scientist/Planner	10.00	HR	95.00	950	855	-10%	1,045	10%	1,028	925	1,130
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	GIS/CADD/Graphics	100	HR	90.00	9,000	8,100	-10%	9,900	10%	9,734	8,761	10,708
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Tribal monitor subcontract	149	DA	617.00	91,933	82,740	-10%	101,126	10%	99,435	89,491	109,378
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Travel and perdiem	1.00	SUM	35,858.00	35,858	32,272	-10%	39,444	10%	38,784	34,906	42,662
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Principal Scientist/Planner	200	HR	180.00	36,000	32,400	-10%	39,600	10%	40,495	36,446	44,545
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Senior Scientist/Planner	98.00	HR	160.00	15,680	14,112	-10%	17,248	10%	17,638	15,874	19,402
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Scientist/Planner	972	HR	120.00	116,640	104,976	-10%	128,304	10%	131,204	118,084	144,325
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Technical Editor	40.00	HR	105.00	4,200	3,780	-10%	4,620	10%	4,724	4,252	5,197
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Junior Scientist/Planner	20.00	HR	95.00	1,900	1,710	-10%	2,090	10%	2,137	1,924	2,351
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	GIS/CADD/Graphics	120	HR	90.00	10,800	9,720	-10%	11,880	10%	12,149	10,934	13,363
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Field Technician	768	HR	75.00	57,600	51,840	-10%	63,360	10%	64,792	58,313	71,271
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Tribal monitor subcontract	77.00	DA	647.85	49,884	44,896	-10%	54,873	10%	56,113	50,502	61,725
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Travel and perdiem	1.00	SUM	30,900.00	30,900	27,810	-10%	33,990	10%	34,758	31,282	38,234
53	Project		Task 2.6N Discoveries - Burial recovery	Human remains	100	EA	15,000.00	1,500,000	1,350,000	-10%	1,650,000	10%	1,689,061	1,520,155	1,857,968
53	Project		Task 2.6N Discoveries - Burial recovery	Other direct costs	1.00	SUM	500.00	500	450	-10%	550	10%	563	507	619
53	Project		Task 2.6N Discoveries - Arch resources	Archaelogical unit cost	60.00	EA	30,000.00	1,800,000	1,620,000	-10%	1,980,000	10%	2,026,874	1,824,186	2,229,561
53	Project		Task 2.6N Discoveries - Arch resources	Other direct costs	1.00	SUM	500.00	500	450	-10%	550	10%	563	507	619
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Principal Scientist/Planner	240	HR	180.00	43,200	38,880	-10%	47,520	10%	47,660	42,894	52,426
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Senior Scientist/Planner	1,808	HR	160.00	289,280	260,352	-10%	318,208	10%	319,143	287,229	351,057
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Scientist/Planner	1,928	HR	120.00	231,360	208,224	-10%	254,496	10%	255,244	229,719	280,768
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Technical Editor	40.00	HR	105.00	4,200	3,780	-10%	4,620	10%	4,634	4,170	5,097
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Junior Scientist/Planner	40.00	HR	95.00	3,800	3,420	-10%	4,180	10%	4,192	3,773	4,612
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	GIS/CADD/Graphics	120	HR	90.00	10,800	9,720	-10%	11,880	10%	11,915	10,723	13,106
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Field Technician	7,680	HR	75.00	576,000	518,400	-10%	633,600	10%	635,462	571,915	699,008
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Tribal monitor subcontract	452	EA	617.00	278,884	250,996	-10%	306,772	10%	307,674	276,906	338,441
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Other direct costs	1.00	SUM	127,984.00	127,984	115,186	-10%	140,782	10%	141,196	127,076	155,316
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Principal Scientist/Planner	240	HR	180.00	43,200	38,880	-10%	47,520	10%	52,586	47,328	57,845
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Senior Scientist/Planner	1,176	HR	160.00	188,160	169,344	-10%	206,976	10%	229,043	206,139	251,947
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Scientist/Planner	1,536	HR	120.00	184,320	165,888	-10%	202,752	10%	224,368	201,932	246,805
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Technical Editor	40.00	HR	105.00	4,200	3,780	-10%	4,620	10%	5,113	4,601	5,624
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Junior Scientist/Planner	40.00	HR	95.00	3,800	3,420	-10%	4,180	10%	4,626	4,163	5,088
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	GIS/CADD/Graphics	230	HR	90.00	20,700	18,630	-10%	22,770	10%	25,198	22,678	27,717
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Field Technician	7,680	HR	75.00	576,000	518,400	-10%	633,600	10%	701,151	631,036	771,267
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Tribal monitor subcontract	294	EA	647.85	190,468	171,421	-10%	209,515	10%	231,852	208,667	255,037
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Other direct costs	1.00	SUM	57,448.00	57,448	51,703	-10%	63,193	10%	69,930	62,937	76,923
53	Project		TCP Project allowance	TCP Project allowance	1.00	SUM	1,000,000.00	1,000,000	1,000,000	0%	1,000,000	0%	1,000,000	1,000,000	1,000,000
53	Project		Cultural resources allowance	Allowance for additional discoveries (reconciled with risk log)	1.00	SUM	1,000,000.00	1,000,000	1,000,000	0%	1,000,000	0%	1,000,000	1,000,000	1,000,000
60			**MONITORING AND OTHER COSTS**												
61			**AQUATIC RESOURCES**												
61	Project		Mainstem spawning (AR-1)	Tributory confluence monitoring (passage)	960	HR	46.13	44,280	39,852	-10%	66,420	50%	48,866	43,980	73,299
61	Project		Mainstem spawning (AR-1)	Confluence Area Maintenance (downstream tribs)	900	HR	46.13	41,513	37,361	-10%	62,269	50%	45,812	41,231	68,718
61	Project		Mainstem spawning (AR-1)	Confluence Area Maintenance (upstream tribs)	400	HR	102.50	41,000	36,900	-10%	61,500	50%	45,246	40,722	67,870
61	Project		Mainstem spawning (AR-1)	Mainstem Spawning Gravel Survey (45.3 miles)	100	HR	148.63	14,863	13,376	-10%	22,294	50%	16,402	14,762	24,603
61	Project		Mainstem spawning (AR-1)	Tributary Spawning Gravel Survey (13.9 miles)	200	HR	102.50	20,500	18,450	-10%	30,750	50%	22,623	20,361	33,935
61	Project		Mainstem spawning (AR-1)	Reporting and Coordination	1,280	HR	102.50	131,200	118,080	-10%	196,800	50%	144,789	130,310	217,183
61	Project		Mainstem spawning (AR-1)	Spawning Gravel Augmentation	16,132	CY	256.25	4,133,825	3,720,443	-10%	6,200,738	50%	4,561,971	4,105,774	6,842,957
61	Project		Mainstem spawning (AR-1)	Laborer (30 days)	240	HR	35.88	8,610	7,749	-10%	12,915	50%	9,502	8,552	14,253
61	Project		Mainstem spawning (AR-1)	200 Class Excavator (30 days)	240	HR	256.25	61,500	55,350	-10%	92,250	50%	67,870	61,083	101,804

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
61	Project		Juvenile outmigration (AR-2)	Tributary Confluence Monitoring (Passage)	960	HR	46.13	44,280	39,852	-10%	66,420	50%	48,866	43,980	73,299
61	Project		Juvenile outmigration (AR-2)	Tributary Confluence Monitoring (WQ)	960	HR	46.13	44,280	39,852	-10%	66,420	50%	48,866	43,980	73,299
61	Project		Juvenile outmigration (AR-2)	2018 Mainstem Winter Seining Recon	400	HR	107.63	43,050	38,745	-10%	64,575	50%	47,509	42,758	71,263
61	Project		Juvenile outmigration (AR-2)	2019 Mainstem Winter Seining	400	HR	153.75	61,500	55,350	-10%	92,250	50%	67,870	61,083	101,804
61	Project		Juvenile outmigration (AR-2)	Fish Transport (1 Truck)	400	HR	46.13	18,450	16,605	-10%	27,675	50%	20,361	18,325	30,541
61	Project		Juvenile outmigration (AR-2)	Fish Rescue and Relocation Crew	1,120	HR	153.75	172,200	154,980	-10%	258,300	50%	190,035	171,032	285,053
61	Project		Juvenile outmigration (AR-2)	Fish Transport (2 Trucks)	3,360	HR	46.13	154,980	139,482	-10%	232,470	50%	171,032	153,928	256,547
61	Project		Juvenile outmigration (AR-2)	Reporting and Coordination	1,280	HR	102.50	131,200	118,080	-10%	196,800	50%	144,789	130,310	217,183
61	Project		Juvenile outmigration (AR-2)	Miscellaneous Equipment	5.00	EA	6,150.00	30,750	27,675	-10%	46,125	50%	33,935	30,541	50,902
61	Project		Juvenile outmigration (AR-2)	H2O Monitoring Equipment	5.00	EA	30,750.00	153,750	138,375	-10%	230,625	50%	169,674	152,707	254,511
61	Project		Juvenile outmigration (AR-2)	H2O Monitoring Equipment	26.00	EA	307.50	7,995	7,196	-10%	11,993	50%	8,823	7,941	13,235
61	Project		Juvenile outmigration (AR-2)	Technician Equipment	14.00	EA	1,230.00	17,220	15,498	-10%	25,830	50%	19,004	17,103	28,505
61	Project		Juvenile outmigration (AR-2)	Transport Vehicle Rental ($300/day for 21 days)	672	HR	46.13	30,996	27,896	-10%	46,494	50%	34,206	30,786	51,309
61	Project		Juvenile outmigration (AR-2)	Transport Vehicle Operational Cost ($0.75/mi)	53,760	MI	0.92	49,594	44,634	-10%	74,390	50%	54,730	49,257	82,095
61	Project		Sucker rescue and relocation plan (AR-6)	Sucker Recapture Study (Spring and Fall)	280	HR	307.50	86,100	77,490	-10%	129,150	50%	95,018	85,516	142,526
61	Project		Sucker rescue and relocation plan (AR-6)	Sucker Salvage	280	HR	307.50	86,100	77,490	-10%	129,150	50%	95,018	85,516	142,526
61	Project		Sucker rescue and relocation plan (AR-6)	Sucker Transport (1 Truck)	140	HR	46.13	6,458	5,812	-10%	9,686	50%	7,126	6,414	10,689
61	Project		Sucker rescue and relocation plan (AR-6)	Reporting and Coordination	960	HR	102.50	98,400	88,560	-10%	147,600	50%	108,591	97,732	162,887
61	Project		Sucker rescue and relocation plan (AR-6)	Boat Electrofisher	300	HR	36.90	11,070	9,963	-10%	16,605	50%	12,217	10,995	18,325
61	Project		Sucker rescue and relocation plan (AR-6)	Boats (2 boats)	224	HR	92.25	20,664	18,598	-10%	30,996	50%	22,804	20,524	34,206
61	Project		Sucker rescue and relocation plan (AR-6)	Technician Equipment	12.00	EA	1,230.00	14,760	13,284	-10%	22,140	50%	16,289	14,660	24,433
61	Project		Sucker rescue and relocation plan (AR-6)	Tagging Equipment	1.00	EA	12,300.00	12,300	11,070	-10%	18,450	50%	13,574	12,217	20,361
61	Project		Sucker rescue and relocation plan (AR-6)	Transport Vehicle Rental ($300/day)	168	HR	46.13	7,749	6,974	-10%	11,624	50%	8,552	7,696	12,827
61	Project		Sucker rescue and relocation plan (AR-6)	Transport Vehicle Operational Cost ($0.75/mi)	7,200	MI	0.92	6,642	5,978	-10%	9,963	50%	7,330	6,597	10,995
61	Project		Freshwater mussel relocation (AR-7)	Freshwater Mussel Reconnaissance	280	HR	107.63	30,135	27,122	-10%	45,203	50%	33,256	29,931	49,884
61	Project		Freshwater mussel relocation (AR-7)	Mussel Salvage and Relocation	700	HR	107.63	75,338	67,804	-10%	113,006	50%	83,140	74,826	124,710
61	Project		Freshwater mussel relocation (AR-7)	Mussel Transport (1 Truck)	140	HR	46.13	6,458	5,812	-10%	9,686	50%	7,126	6,414	10,689
61	Project		Freshwater mussel relocation (AR-7)	Reporting and Coordination	960	HR	102.50	98,400	88,560	-10%	147,600	50%	108,591	97,732	162,887
61	Project		Freshwater mussel relocation (AR-7)	Miscellaneous Equipment	1.00	EA	6,150.00	6,150	5,535	-10%	9,225	50%	6,787	6,108	10,180
61	Project		Freshwater mussel relocation (AR-7)	Diving Gear	5.00	EA	1,230.00	6,150	5,535	-10%	9,225	50%	6,787	6,108	10,180
61	Project		Freshwater mussel relocation (AR-7)	Technician Equipment	10.00	EA	1,230.00	12,300	11,070	-10%	18,450	50%	13,574	12,217	20,361
61	Project		Freshwater mussel relocation (AR-7)	Transport Vehicle Rental ($300/day)	8.00	HR	922.50	7,380	6,642	-10%	11,070	50%	8,144	7,330	12,217
61	Project		Freshwater mussel relocation (AR-7)	Transport Vehicle Operational Cost ($0.75/mi)	14,000	MI	0.92	12,915	11,624	-10%	19,373	50%	14,253	12,827	21,379
62			**TERRESTRIAL RESOURCES MEASURES**												
62	Project		Habitat restoration plan (TER-1)	Annual maintenance and monitoring	3.00	EA	68,019.00	204,057	122,434	-40%	269,496	32%	248,394	149,036	328,051
62	Project		Habitat restoration plan (TER-1)	Annual reporting	3.00	EA	9,840.00	29,520	17,712	-40%	37,800	28%	35,934	21,560	46,013
62	Project		Habitat restoration plan (TER-1)	Post construction regulatory compliance and reporting	1.00	EA	14,760.00	14,760	8,856	-40%	18,900	28%	18,676	11,206	23,915
62	Project		Nesting Bird Surveys (TER-2); Osprey nests	Remove all nest platforms near construction, year 1	1.00	EA	53,640.30	53,640	-	0%	67,848	26%	58,017	-	73,384
62	Project		Nesting Bird Surveys (TER-2); Osprey nests	Nest exclusion monitoring, year 1	1.00	EA	110,896.80	110,897	-	0%	188,048	70%	119,946	-	203,393
62	Project		Nesting Bird Surveys (TER-2); Osprey nests	Remove all nest platforms near construction, year 2	1.00	EA	33,333.00	33,333	-	0%	46,632	40%	37,495	-	52,455
62	Project		Nesting Bird Surveys (TER-2); Osprey nests	Nest exclusion monitoring, year 2	1.00	EA	110,896.80	110,897	-	0%	188,048	70%	124,744	-	211,528
62	Project		Nesting Bird Surveys (TER-2); Osprey nests	Regulatory compliance and reporting, permitting	1.00	EA	9,840.00	9,840	-	0%	12,600	28%	11,069	-	14,173
62	Project		Nesting Bird Surveys (TER-2); Cliff swallow nests	Remove nests near construction, year 1	1.00	EA	28,019.40	28,019	-	0%	55,048	96%	30,306	-	59,540
62	Project		Nesting Bird Surveys (TER-2); Cliff swallow nests	Nest exclusion monitoring, year 1	1.00	EA	68,839.00	68,839	-	0%	146,600	113%	74,456	-	158,563
62	Project		Nesting Bird Surveys (TER-2); Cliff swallow nests	Remove nests near construction, year 2	1.00	EA	22,463.90	22,464	-	0%	27,320	22%	25,269	-	30,731
62	Project		Nesting Bird Surveys (TER-2); Cliff swallow nests	Nest exclusion monitoring, year 2	1.00	EA	68,839.00	68,839	-	0%	146,600	113%	77,435	-	164,905
62	Project		Nesting Bird Surveys (TER-2); Cliff swallow nests	Regulatory compliance and reporting, permitting	1.00	EA	7,380.00	7,380	-	0%	12,600	71%	8,301	-	14,173
62	Project		Nesting Bird Surveys (TER-2); Biological monitoring	Nesting bird surveys prior to vegetation clearing	1.00	EA	59,741.10	59,741	-	0%	212,568	256%	65,908	-	234,512
62	Project		Nesting Bird Surveys (TER-2); Biological monitoring	Daily biological monitoring throughout construction	3,114	HR	109.47	340,882	-	0%	540,568	59%	376,072	-	596,372
62	Project		Nesting Bird Surveys (TER-2); Biological monitoring	Regulatory compliance and reporting during construction	1.00	EA	63,960.00	63,960	63,960	0%	63,960	0%	70,563	70,563	70,563
62	Project		Nesting Bird Surveys (TER-2); Biological monitoring	Special status wildlife and habitat monitoring	1.00	EA	61,008.00	61,008	-	0%	107,520	76%	71,371	-	125,783
62	Project		Wetlands at Reservoirs (TER-5)	Wetland Project	10.00	AC	35,875.00	358,750	-	0%	700,000	95%	454,632	-	887,086
62	Project		Wetlands at Reservoirs (TER-5)	Monitoring	960	HR	64.79	62,197	-	0%	73,920	19%	78,820	-	93,676
62	Project		Special Status Bats (TER-6)	Pre-Demolition Exclusion	1.00	SUM	74,536.36	74,536	74,536	0%	74,536	0%	79,068	79,068	79,068
62	Project		Special Status Bats (TER-6)	Bat Exclusion Plan (Draft/Final)	1.00	SUM	8,171.51	8,172	8,172	0%	8,172	0%	8,668	8,668	8,668
62	Project		Special Status Bats (TER-6)	Field Prep/Health and Safety	1.00	SUM	2,882.20	2,882	2,882	0%	2,882	0%	3,057	3,057	3,057
62	Project		Special Status Bats (TER-6)	Biological Monitoring During Demolition	1.00	SUM	96,129.83	96,130	96,130	0%	96,130	0%	106,469	106,469	106,469
62	Project		Special Status Bats (TER-6)	Agency Coordination/Meetings	1.00	SUM	11,233.18	11,233	11,233	0%	11,233	0%	12,109	12,109	12,109
62	Project		Special Status Bats (TER-6)	Design Replacement Roosts	1.00	SUM	11,697.71	11,698	11,698	0%	11,698	0%	12,411	12,411	12,411
62	Project		Special Status Bats (TER-6)	Construct/Install Replacement Roosts	1.00	SUM	14,481.82	14,482	-	0%	25,643	77%	15,611	-	27,642
62	Project		Special Status Bats (TER-6)	Monitor Replacement Roosts (3 years)	1.00	SUM	145,169.93	145,170	-	0%	239,027	65%	170,090	-	280,058

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
63			**WATER QUALITY MONITORING**												
63	Project		Field installation & equipment	Keno	1.00	SUM	60,900.00	60,900	38,000	-38%	79,170	30%	63,336	39,520	82,337
63	Project		Field installation & equipment	JC Boyle	1.00	SUM	158,550.00	158,550	120,000	-24%	206,115	30%	171,488	129,792	222,934
63	Project		Field installation & equipment	Copco	1.00	SUM	90,300.00	90,300	-	0%	117,390	30%	97,668	-	126,969
63	Project		Field installation & equipment	Iron Gate	1.00	SUM	77,700.00	77,700	74,000	-5%	101,010	30%	80,808	76,960	105,050
63	Project		Field installation & equipment	Walker Bridge	1.00	SUM	80,850.00	80,850	77,000	-5%	105,105	30%	87,447	83,283	113,682
63	Project		Field installation & equipment	Seiad Valley	1.00	SUM	65,100.00	65,100	42,000	-35%	84,630	30%	70,412	45,427	91,536
63	Project		Field installation & equipment	Orleans	1.00	SUM	67,200.00	67,200	44,000	-35%	87,360	30%	69,888	45,760	90,854
63	Project		Field installation & equipment	Klamath	1.00	SUM	61,950.00	61,950	59,000	-5%	80,535	30%	64,428	61,360	83,756
63	Project		Field installation & equipment	Shasta	1.00	SUM	68,250.00	68,250	45,000	-34%	88,725	30%	76,772	50,619	99,804
63	Project		Field installation & equipment	Scott	1.00	SUM	68,250.00	68,250	45,000	-34%	88,725	30%	76,772	50,619	99,804
63	Project		Field installation & equipment	Salmon	0.00	SUM	-	-	-	0%	-	0%	-	-	-
63	Project		Field installation & equipment	Trinity	0.00	SUM	-	-	-	0%	-	0%	-	-	-
63	Project		Field installation & equipment	Equipment replacement	1.00	SUM	315,000.00	315,000	200,000	-37%	500,000	59%	388,654	246,765	616,912
63	Project		Operation & Maintenance	Keno	17.00	QTR	16,800.00	285,600	130,000	-54%	464,000	62%	326,120	148,444	529,831
63	Project		Operation & Maintenance	JC Boyle	21.00	QTR	16,800.00	352,800	170,000	-52%	400,000	13%	427,595	206,041	484,802
63	Project		Operation & Maintenance	Copco	13.00	QTR	16,800.00	218,400	-	0%	400,000	83%	254,135	-	465,449
63	Project		Operation & Maintenance	Iron Gate	25.00	QTR	4,200.00	105,000	92,000	-12%	116,000	10%	124,895	109,432	137,979
63	Project		Operation & Maintenance	Walker Bridge	13.00	QTR	11,550.00	150,150	132,000	-12%	275,000	83%	174,718	153,598	319,996
63	Project		Operation & Maintenance	Seiad Valley	21.00	QTR	4,200.00	88,200	36,000	-59%	100,000	13%	106,899	43,632	121,201
63	Project		Operation & Maintenance	Orleans	25.00	QTR	4,200.00	105,000	42,000	-60%	116,000	10%	124,895	49,958	137,979
63	Project		Operation & Maintenance	Klamath	25.00	QTR	4,200.00	105,000	36,000	-66%	116,000	10%	124,895	42,821	137,979
63	Project		Operation & Maintenance	Shasta	9.00	QTR	5,250.00	47,250	27,000	-43%	105,000	122%	56,022	32,013	124,494
63	Project		Operation & Maintenance	Scott	9.00	QTR	5,250.00	47,250	27,000	-43%	105,000	122%	56,022	32,013	124,494
63	Project		Operation & Maintenance	Salmon	0.00	SUM	-	-	-	0%	45,000	0%	-	-	50,619
63	Project		Operation & Maintenance	Trinity	0.00	SUM	-	-	-	0%	45,000	0%	-	-	50,619
63	Project		Sediment, Sampling & Recording	Keno	17.00	QTR	12,600.00	214,200	1,040,000	386%	348,000	62%	244,590	1,187,552	397,373
63	Project		Sediment, Sampling & Recording	JC Boyle	21.00	QTR	15,750.00	330,750	170,000	-49%	375,000	13%	400,871	206,041	454,502
63	Project		Sediment, Sampling & Recording	Copco	13.00	QTR	15,750.00	204,750	-	0%	375,000	83%	238,252	-	436,359
63	Project		Sediment, Sampling & Recording	Iron Gate	25.00	QTR	25,200.00	630,000	552,000	-12%	696,000	10%	749,370	656,591	827,875
63	Project		Sediment, Sampling & Recording	Walker Bridge	13.00	QTR	25,200.00	327,600	288,000	-12%	600,000	83%	381,203	335,123	698,174
63	Project		Sediment, Sampling & Recording	Seiad Valley	21.00	QTR	25,200.00	529,200	216,000	-59%	600,000	13%	641,393	261,793	727,203
63	Project		Sediment, Sampling & Recording	Orleans	25.00	QTR	25,200.00	630,000	252,000	-60%	696,000	10%	749,370	299,748	827,875
63	Project		Sediment, Sampling & Recording	Klamath	25.00	QTR	16,800.00	420,000	288,000	-31%	464,000	10%	499,580	342,569	551,917
63	Project		Sediment, Sampling & Recording	Shasta	9.00	QTR	23,100.00	207,900	99,000	-52%	462,000	122%	246,498	117,380	547,773
63	Project		Sediment, Sampling & Recording	Scott	9.00	QTR	23,100.00	207,900	99,000	-52%	462,000	122%	246,498	117,380	547,773
63	Project		Sediment, Sampling & Recording	Salmon	0.00	SUM	-	-	-	0%	198,000	0%	-	-	222,723
63	Project		Sediment, Sampling & Recording	Trinity	0.00	SUM	-	-	-	0%	198,000	0%	-	-	222,723
63	Project		Sediment, Sampling & Recording	Data Management	1.00	SUM	462,000.00	462,000	293,000	-37%	600,600	30%	567,821	360,112	738,168
63	Project		Sediment, Sampling & Recording	ODCs	1.00	SUM	163,800.00	163,800	115,000	-30%	372,000	127%	190,635	133,840	432,943
63	Project		Sediment, Sampling & Recording	Esturary and river sampling for toxins	4.00	SUM	52,500.00	210,000	200,000	-5%	273,000	30%	234,041	222,896	304,253
63	Project		Sediment, Sampling & Recording	TSS and NTU laboratory relationship study by USGS	1.00	SUM	157,500.00	157,500	150,000	-5%	204,750	30%	175,531	167,172	228,190
63	Project		Aerial photos & LiDAR	Annual aircraft surveys + 1 after 5 year gap	5.00	EA	63,000.00	315,000	283,500	-10%	472,500	50%	379,026	341,123	568,539
63	Project		Volitional fish passage monitoring	Annual field survey; 2 wk field survey + study.	5.00	EA	26,250.00	131,250	118,125	-10%	196,875	50%	157,928	142,135	236,891
63	Project		Drone LiDAR in site specific locations, analysis & reporting	Drone LiDAR in site specific locations, analysis & reporting	4.00	EA	21,000.00	84,000	75,600	-10%	126,000	50%	96,452	86,807	144,679
63	Project		Surface comparison and analysis of sediment erosion	Surface comparison and analysis of sediment erosion	4.00	EA	21,000.00	84,000	75,600	-10%	126,000	50%	96,452	86,807	144,679

KLAMATH RIVER RENEWAL CORPORATION

Attachment B Pay Item Cost Detail Worksheets

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PAY ITEM COST DETAIL WORKSHEET

1.001 Removal of Diversion Conduit Bulkheads

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.001		**Project**	: JC Boyle			
Description	:	Removal of Diversion Conduit Bulkheads						
Quantity	:	14.00	CY					
Daily Production	:	7.00	CY per	8 hour shift	**Project #**	: 1		
Work Days	:	2.0	Days		**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$1,323.00	per CY		**Probable Low Cost Parameter**		**7.35**	**$17,596**	**$1,256.85**
Total Cost	:	$18,522			**Probable High Cost Parameter**		**6.65**	**$19,448**	**$1,389.15**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	incl. in rate	incl. in rate	$740.32
Diver, Wet	Active	1.00	2.0	8	16.00	L	$124.57	incl. in rate	incl. in rate	$1,993.12
Diver, Tender	Active	1.00	2.0	8	16.00	L	$79.22	incl. in rate	incl. in rate	$1,267.52
Equipment Operator (crane)	Active	1.00	2.0	8	16.00	L	$68.41	incl. in rate	incl. in rate	$1,094.56
Truck Driver (heavy)	Active	1.00	***1.0***	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Barge Operator	Active	1.00	2.0	8	16.00	L	$40.30	incl. in rate	incl. in rate	$644.80
Crawler Crane (130tn)	Active	1.00	2.0	8	16.00	E	$258.66	incl. in rate	incl. in rate	$4,138.56
Barge (400T)	Active	1.00	2.0	8	16.00	E	$99.50	incl. in rate	incl. in rate	$1,592.00
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	***1.0***	8	8.00	E	$70.35	incl. in rate	incl. in rate	$562.80
Air Compressor 600 cfm	Active	1.00	2.0	8	16.00	E	$21.74	incl. in rate	incl. in rate	$347.82
0	Active	1.00	2.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	2.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
Air Track Drill 4"	Active	1.00	***1.0***	8	8.00	E	$145.14	incl. in rate	incl. in rate	$1,161.12
Air Hose 100'	Active	1.00	***1.0***	8	8.00	E	$2.13	incl. in rate	incl. in rate	$17.04
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
				Labor Hours	**88**			**TOTAL LABOR**		**$6,201.04**
				Equipment Hours	**72**			**TOTAL EQUIPMENT**		**$7,819.34**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
Blasting Explosives and Caps	10.00	EA	1.000	10.00	$12.70	$127.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$127.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$6,201.04	Labor Burden @	0.0%			$6,201.04
Material Cost	$127.00	Material Tax @	7.75%	$9.84		$136.84
Equipment Cost	$7,819.34	Equipment Tax @	7.75%	$606.00		$8,425.34
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$14,147**			**$616**	**DIRECT COST SUBTOTALS**	**$14,763**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$14,763.22		$2,214.48
Installing Contractors Profit@	8.0%				$14,763.22		$1,181.06
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$3,395.54**
General Contractors Insurance @	1.0%			on	$18,158.77		$182
Bond @	1.0%			on	$18,158.77		$182
Contingency @	0.0%			on	$18,521.94		$0
						TOTAL COST for pay item	**$18,522**

Additional Pay Item Notes :

Crew make up is based on using a diver to drill and set explosive caps to demolish bulkhead. Crane on Barge will then be used to scoop material from water using the diver to guide bucket. Crane will then load material from water into dump truck. Figuring 2 days to set up and blast, remove, and dump debris in scour hole. Trucks will only be used one day.

PAY ITEM COST DETAIL WORKSHEET

1.002 Remove Water from behind Tailrace Cofferdam

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.002		**Project**	: JC Boyle			
Description	:	Remove Water from behind Tailrace Cofferdam						
Quantity	:	500,000.00	GAL					
Daily Production	:	153,120.00	GAL per 8 hour shift	**Project #**	: 1			
Work Days	:	3.3 Days		**Estimator**	: Eric Jones	**GAL per**	**Total Cost**	**Unit Price Per GAL**
Unit Price	:	$0.01 per GAL		**Probable Low Cost Parameter**		**168432**	**$4,778**	**$0.01**
Total Cost	:	$5,309		**Probable High Cost Parameter**		**130152**	**$6,105**	**$0.01**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	3.3	8	26.40	L	$46.27	incl. in rate	incl. in rate	$1,221.53
Laborer	Active	2.00	3.3	8	52.80	L	$45.80	incl. in rate	incl. in rate	$2,418.24
Pump, Submersible Trash Pump, 3" & 4"	Active	1.00	3.3	8	26.40	E	$3.87	incl. in rate	incl. in rate	$102.17
Truck, Pickup (4x4, 3/4tn)	Active	1.00	3.3	8	26.40	E	$16.94	incl. in rate	incl. in rate	$447.22
0		1.00	3.3	8	26.40	0	$0.00	$0.00		$0.00
0		1.00	3.3	8	26.40	0	$0.00	$0.00		$0.00
0		2.00	3.3	8	52.80	0	$0.00	$0.00		$0.00
0		1.00	3.3	8	26.40	0	$0.00	$0.00		$0.00
0		1.00	3.3	8	26.40	0	$0.00	$0.00		$0.00
		1.00	3.3	8	26.40	0	$0.00	$0.00		$0.00
		1.00	3.3	8	26.40	0	$0.00	$0.00		$0.00
		1.00	3.3	8	26.40	0	$0.00	$0.00		$0.00
			3.3	8	0.00					$0.00
			3.3	8	0.00					$0.00
			3.3	8	0.00					$0.00
			3.3	8	0.00					$0.00
			3.3	8	0.00					$0.00
				Labor Hours	**79.2**			**TOTAL LABOR**		**$3,639.77**
				Equipment Hours	**52.8**			**TOTAL EQUIPMENT**		**$549.38**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$3,639.77	Labor Burden @	0.0%			$3,639.77
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$549.38	Equipment Tax @	7.75%	$42.58		$591.96
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$4,189**			**$43**	**DIRECT COST SUBTOTALS**	**$4,232**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$4,231.73		$634.76
Installing Contractors Profit@	8.0%				$4,231.73		$338.54
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$973.30**
General Contractors Insurance @	1.0%		on		$5,205.03		$52
Bond @	1.0%		on		$5,205.03		$52
Contingency @	0.0%		on		$5,309.13		$0
						TOTAL COST for pay item	**$5,309**

Additional Pay Item Notes :

3" pump can pump 19,140 gallons per hour, 153,120 gallons per 8 hour shift, rough 1.5 days to remove water. 1 foreman to run operation, 2 laborer to tend to pump during the day, 1 laborer to tend pump at night.

PAY ITEM COST DETAIL WORKSHEET

1.003 Provide Dewatering behind Tailrace Cofferdam

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.003			**Project**	: JC Boyle			
Description	:	Provide Dewatering behind Tailrace Cofferdam							
Quantity	:	1.00	LS						
Daily Production	:	1.00	LS per	8 hour shift	**Project #**	: 1			
Work Days	:	1.0	Days		**Estimator**	: Eric Jones	**LS per**	**Total Cost**	**Unit Price Per LS**
Unit Price	:	$61,036.38	per LS		**Probable Low Cost Parameter**		**1.1**	**$54,933**	**$54,932.74**
Total Cost	:	$61,036			**Probable High Cost Parameter**		**0.85**	**$70,192**	**$70,191.83**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	***23.0***	8	184.00	L	$46.27	incl. in rate	incl. in rate	$8,513.68
Laborer	Active	2.00	***46.0***	8	736.00	L	$45.80	incl. in rate	incl. in rate	$33,708.80
Pump, Submersible Trash Pump, 3" & 4"	Active	1.00	***92.0***	8	736.00	E	$3.87	incl. in rate	incl. in rate	$2,848.32
Truck, Pickup (4x4, 3/4tn)	Active	1.00	***23.0***	8	184.00	E	$16.94	incl. in rate	incl. in rate	$3,116.96
0		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
0		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
0		2.00	1.0	8	16.00	0	$0.00	$0.00		$0.00
0		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
0		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	**920**			**TOTAL LABOR**		**$42,222.48**
				Equipment Hours	**920**			**TOTAL EQUIPMENT**		**$5,965.28**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$42,222.48	Labor Burden @	0.0%			$42,222.48
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$5,965.28	Equipment Tax @	7.75%	$462.31		$6,427.59
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$48,188**			**$462**	**DIRECT COST SUBTOTALS**	**$48,650**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$48,650.07		$7,297.51
Installing Contractors Profit@	8.0%				$48,650.07		$3,892.01
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$11,189.52**
General Contractors Insurance @	1.0%		on		$59,839.59		$598
Bond @	1.0%		on		$59,839.59		$598
Contingency @	0.0%		on		$61,036.38		$0
						TOTAL COST for pay item	**$61,036**

Additional Pay Item Notes :

Pump will be running for 3 months or 92 days (day and night), 1 laborer to maintain (refuel, adjust houses) during the day, 1 laborer to maintain (refuel, adjust houses) during the night, 1 foreman on activity .25 of the time to oversee operation.

PAY ITEM COST DETAIL WORKSHEET

1.004 Construct Embankment Cofferdam in Tailrace around Powerhouse

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.004			**Project**	: JC Boyle			
Description	:	Construct Embankment Cofferdam in Tailrace around Powerhouse							
Quantity	:	2,000.00	cy						
Daily Production	:	200.00	cy per	8 hour shift	**Project #**	: 1			
Work Days	:	10.0	Days		**Estimator**	: Michael Barba	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$108.78	per cy		**Probable Low Cost Parameter**		**220**	**$195,799**	**$97.90**
Total Cost	:	$217,554			**Probable High Cost Parameter**		**160**	**$261,065**	**$130.53**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (310hp)(CATD8)	Active	1.00	10.0	8	80.00	E	$197.60	$197.60		$15,808.00
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	10.0	8	160.00	E	$111.64	$111.64		$17,862.40
Equipment Operator (medium)	Active	1.00	10.0	8	80.00	L	$66.28	$0.00		$5,302.40
Truck Driver (heavy)	Active	2.00	10.0	8	160.00	L	$57.59	$0.00		$9,214.40
Laborer	Active	4.00	10.0	8	320.00	L	$45.80	$0.00		$14,656.00
Labor Foreman (out)	Active	1.00	10.0	8	80.00	L	$46.27	$0.00		$3,701.60
Truck, Pickup (4x4, 3/4tn)	Active	1.00	10.0	8	80.00	E	$16.94	$16.94		$1,355.20
	Active	1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
	Active	1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
		1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
		1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
		1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
				Labor Hours	**640**			**TOTAL LABOR**		**$32,874.40**
				Equipment Hours	**320**			**TOTAL EQUIPMENT**		**$35,025.60**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		SF	1.300	0.00	$0.00	$0.00
	0.00	ea	1.000	0.00	$0.00	$0.00
	0.00	ea	1.000	0.00	$0.00	$0.00
	0.00	ea	1.000	0.00	$0.00	$0.00
	0.00	ls	1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Cofferdam Sheet Piling Drive and Extract	4,830	SF	**RSMs Data**	$24.93	$120,411.90
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$120,411.90**

SUMMARY OF COSTS

Labor Cost	$32,874.40	Labor Burden @	49.7%	$0.00		$32,874.40
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$35,025.60	Equipment Tax @	7.75%	$2,714.48		$37,740.08
Subcontractors	$120,411.90					$120,411.90
DIRECT COST SUBTOTALS	**$188,312**			**$2,714**	**DIRECT COST SUBTOTALS**	**$191,026**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$70,614.48		$10,592.17
Installing Contractors Profit@	8.0%				$70,614.48		$5,649.16
GC Markup on Subs @	5.0%				$120,411.90		$6,020.60
						TOTAL MARKUP COSTS	**$22,261.93**
General Contractors Insurance @	1.0%			on	$213,288.31		$2,133
Bond @	1.0%			on	$213,288.31		$2,133
Contingency @	0.0%			on	$217,554.08		$0
						TOTAL COST for pay item	**$217,554**

Additional Pay Item Notes :

Sheetpile will be 35' and expected to be driven acrosss tailrace to demolishPowerhouse concrete

PAY ITEM COST DETAIL WORKSHEET — **1.006 Remove Monorail Structural Steel Components**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.006	**Project**	:	JCBOYLE			
Description	:	Remove Monorail Structural Steel Components						
Quantity	:	15,000.00 LBS						
Daily Production	:	18,500.00 LBS per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	0.8 Days	**Estimator**	:	Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.64 per LBS	**Probable Low Cost Parameter**			**20350**	**$8,613**	**$0.57**
Total Cost	:	$9,570	**Probable High Cost Parameter**			**12025**	**$12,919**	**$0.86**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	0.8	8	6.40	L	$47.23	incl. in rate	incl. in rate	$302.27
Electrician	Active	1.00	0.8	8	6.40	L	$45.23	incl. in rate	incl. in rate	$289.47
Steelworker	Active	4.00	0.8	8	25.60	L	$65.52	incl. in rate	incl. in rate	$1,677.31
Laborer	Active	4.00	0.8	8	25.60	L	$45.80	incl. in rate	incl. in rate	$1,172.48
Truck Driver (heavy)	Active	1.00	0.8	8	6.40	L	$57.59	incl. in rate	incl. in rate	$368.58
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.8	8	6.40	E	$111.64	incl. in rate	incl. in rate	$714.50
Hydraulic Crane (120tn)	Active	1.00	0.8	8	6.40	E	$239.06	incl. in rate	incl. in rate	$1,529.98
Welder	Active	1.00	0.8	8	6.40	L	$7.84	incl. in rate	incl. in rate	$50.16
Gas Welding Machine	Active	1.00	0.8	8	6.40	E	$2.88	incl. in rate	incl. in rate	$18.41
Equipment Operator (crane)	Active	1.00	0.8	8	6.40	L	$68.41	incl. in rate	incl. in rate	$437.82
Vibratory Hammer & Extractor	Active	1.00	0.8	8	6.40	E	$94.34	incl. in rate	incl. in rate	$603.78

Labor Hours	**83.2**	**TOTAL LABOR**	**$4,298.10**
Equipment Hours	**25.6**	**TOTAL EQUIPMENT**	**$2,866.67**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$429.81	$429.81

TOTAL MATERIAL	**$429.81**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$4,298.10	Labor Burden @	49.7%	$0.00	$4,298.10
Material Cost	$429.81	Material Tax @	7.8%	$33.31	$463.12
Equipment Cost	$2,866.67	Equipment Tax @	0.0%	$0.00	$2,866.67
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$7,595**			**$33**	**DIRECT COST SUBTOTALS** **$7,628**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$7,627.88	$1,144.18
Installing Contractors Profit@	8.0%				$7,627.88	$610.23
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,754.41**
General Contractors Insurance @	1.0%		on		$9,382.30	$94
Bond @	1.0%		on		$9,382.30	$94
Contingency @	0.0%		on		$9,569.94	$0
					TOTAL COST for pay item	**$9,570**

Additional Pay Item Notes :

Includes structure to install steel stop logs in spillway, radial gate opening. Crews: E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. by 13-men crew (4 steelworkers, 4 laborer, 1 electrician, 1 welder and 3 equipment operators). Based on the current production rate 15000lbs= 8.89 cy rmeans we will use 1 truck.

PAY ITEM COST DETAIL WORKSHEET

1.005 Remove Spillway Concrete

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.005			**Project**	: JC Boyle			
Description	:	Remove Spillway Concrete							
Quantity	:	2,100.00	cy						
Daily Production	:	45.00	cy per	8 hour shift	**Project #**	: 1			
Work Days	:	46.7	Days		**Estimator**	: Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$330.13	per cy		**Probable Low Cost Parameter**		**51.75**	**$589,274**	**$280.61**
Total Cost	:	$693,263			**Probable High Cost Parameter**		**36**	**$831,916**	**$396.15**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	46.7	8	747.20	L	$48.27	incl. in rate	incl. in rate	$36,067.34
Laborer	Active	8.00	46.7	8	2,988.80	L	$45.80	incl. in rate	incl. in rate	$136,887.04
Equipment Operator (medium)	Active	2.00	46.7	8	747.20	L	$66.28	incl. in rate	incl. in rate	$49,524.42
Truck Driver (heavy)	Active	1.00	46.7	8	373.60	L	$57.59	incl. in rate	incl. in rate	$21,515.62
Air Compressor 900 cfm	Active	1.00	46.7	8	373.60	E	$38.87	incl. in rate	incl. in rate	$14,521.43
Air Compressor 600 cfm	Active	1.00	46.7	8	373.60	E	$21.74	incl. in rate	incl. in rate	$8,121.66
Air Tool, Chipping Hammer	Active	5.00	46.7	8	1,868.00	E	$1.64	incl. in rate	incl. in rate	$3,061.72
Generator, Small Generator, 10 - 15 kW	Active	2.00	46.7	8	747.20	E	$7.04	incl. in rate	incl. in rate	$5,260.29
Hydraulic Excavator (2.5cy)	Active	2.00	46.7	8	747.20	E	$203.63	incl. in rate	incl. in rate	$152,152.34
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	46.7	8	373.60	E	$62.72	incl. in rate	incl. in rate	$23,432.19
Hydraulic Thumbs/Shear Attachment	Active	1.00	46.7	8	373.60	E	$16.39	incl. in rate	incl. in rate	$6,123.30
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	46.7	8	373.60	E	$111.64	incl. in rate	incl. in rate	$41,708.70
			46.7	8	0.00					$0.00
			46.7	8	0.00					$0.00
			46.7	8	0.00					$0.00
			46.7	8	0.00					$0.00
			46.7	8	0.00					$0.00
				Labor Hours	**4,857**				**TOTAL LABOR**	**$243,994.42**
				Equipment Hours	**5,230**				**TOTAL EQUIPMENT**	**$254,381.63**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$12,199.72	$12,199.72
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$12,199.72**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	10	EA	**Cost per Mob**	$2,500.00	$25,000.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$25,000.00**

SUMMARY OF COSTS

Labor Cost	$243,994.42	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$243,994.42
Material Cost	$12,199.72	Material Tax @	7.75%	$945.48		$13,145.20
Equipment Cost	$254,381.63	Equipment Tax @	7.75%	$19,714.58		$274,096.21
Subcontractors	$25,000.00					$25,000.00
DIRECT COST SUBTOTALS	**$535,576**			**$20,660**	**DIRECT COST SUBTOTALS**	**$556,236**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$531,235.83	$79,685.37
Installing Contractors Profit@	8.0%				$531,235.83	$42,498.87
GC Markup on Subs @	5.0%				$25,000.00	$1,250.00
					TOTAL MARKUP COSTS	**$123,434.24**
General Contractors Insurance @	1.0%		on		$679,670.07	$6,797
Bond @	1.0%		on		$679,670.07	$6,797
Contingency @	0.0%		on		$693,263.47	$0
					TOTAL COST for pay item	**$693,263**

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to scour hole is also included - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM COST DETAIL WORKSHEET

1.007 Remove Fish Ladder Concrete

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.007			**Project**	: JC Boyle			
Description	:	Remove Fish Ladder Concrete							
Quantity	:	1,820.00	cy						
Daily Production	:	28.00	cy per	8 hour shift	**Project #**	: 1			
Work Days	:	65.0	Days		**Estimator**	: Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$333.49	per cy		**Probable Low Cost Parameter**		**30.8**	**$546,257**	**$300.14**
Total Cost	:	$606,952			**Probable High Cost Parameter**		**25.2**	**$667,647**	**$366.84**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	65.0	8	520.00	L	$48.27	incl. in rate	incl. in rate	$25,100.40
Laborer	Active	4.00	65.0	8	2,080.00	L	$45.80	incl. in rate	incl. in rate	$95,264.00
Equipment Operator (medium)	Active	1.00	65.0	8	520.00	L	$66.28	incl. in rate	incl. in rate	$34,465.60
Truck Driver (heavy)	Active	1.00	65.0	8	520.00	L	$57.59	incl. in rate	incl. in rate	$29,946.80
Air Compressor 600 cfm	Active	1.00	65.0	8	520.00	E	$21.74	incl. in rate	incl. in rate	$11,304.24
Air Compressor 900 cfm	Active	1.00	65.0	8	520.00	E	$38.87	incl. in rate	incl. in rate	$20,211.84
Air Tool, Chipping Hammer	Active	3.00	65.0	8	1,560.00	E	$1.64	incl. in rate	incl. in rate	$2,556.89
Generator, Small Generator, 10 - 15 kW	Active	2.00	65.0	8	1,040.00	E	$7.04	incl. in rate	incl. in rate	$7,321.60
Hydraulic Excavator (2.5cy)	Active	1.00	65.0	8	520.00	E	$203.63	incl. in rate	incl. in rate	$105,887.60
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	65.0	8	520.00	E	$62.72	incl. in rate	incl. in rate	$32,614.40
Hydraulic Thumbs/Shear Attachment	Active	1.00	65.0	8	520.00	E	$16.39	incl. in rate	incl. in rate	$8,522.80
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	65.0	8	520.00	E	$111.64	incl. in rate	incl. in rate	$58,052.80
			65.0	8	0.00					$0.00
			65.0	8	0.00					$0.00
			65.0	8	0.00					$0.00
			65.0	8	0.00					$0.00
			65.0	8	0.00					$0.00
				Labor Hours	**3,640**			**TOTAL LABOR**		**$184,776.80**
				Equipment Hours	**5,720**			**TOTAL EQUIPMENT**		**$246,472.17**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$9,238.84	$9,238.84
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$9,238.84**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	11	EA	**Cost per Mob**	$2,500.00	$27,500.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$27,500.00**

SUMMARY OF COSTS

Labor Cost	$184,776.80	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$184,776.80
Material Cost	$9,238.84	Material Tax @	7.75%	$716.01		$9,954.85
Equipment Cost	$246,472.17	Equipment Tax @	7.75%	$19,101.59		$265,573.76
Subcontractors	$27,500.00					$27,500.00
DIRECT COST SUBTOTALS	**$467,988**			**$19,818**	**DIRECT COST SUBTOTALS**	**$487,805**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$460,305.41	$69,045.81
Installing Contractors Profit@	8.0%				$460,305.41	$36,824.43
GC Markup on Subs @	5.0%				$27,500.00	$1,375.00
					TOTAL MARKUP COSTS	**$107,245.25**
General Contractors Insurance @	1.0%		on		$595,050.66	$5,951
Bond @	1.0%		on		$595,050.66	$5,951
Contingency @	0.0%		on		$606,951.67	$0
					TOTAL COST for pay item	**$606,952**

Additional Pay Item Notes :

The work is done by one 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to scour hole is also included - based on the current production rate only 3 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. This productivity is considerably slower than flume demolition due to access. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM COST DETAIL WORKSHEET

1.008 Remove Gravity Dam Section Concrete

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.008			**Project**	: JC Boyle			
Description	:	Remove Gravity Dam Section Concrete							
Quantity	:	600.00	cy						
Daily Production	:	30.00	cy per	8 hour shift	**Project #**	: 1			
Work Days	:	20.0	Days		**Estimator**	: Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$339.60	per cy		**Probable Low Cost Parameter**		**34.5**	**$173,195**	**$288.66**
Total Cost	:	$203,759			**Probable High Cost Parameter**		**24**	**$244,511**	**$407.52**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	20.0	8	160.00	L	$48.27	incl. in rate	incl. in rate	$7,723.20
Laborer	Active	4.00	20.0	8	640.00	L	$45.80	incl. in rate	incl. in rate	$29,312.00
Equipment Operator (medium)	Active	1.00	20.0	8	160.00	L	$66.28	incl. in rate	incl. in rate	$10,604.80
Truck Driver (heavy)	Active	1.00	20.0	8	160.00	L	$57.59	incl. in rate	incl. in rate	$9,214.40
Air Compressor 600 cfm	Active	1.00	20.0	8	160.00	E	$21.74	incl. in rate	incl. in rate	$3,478.23
Air Compressor 900 cfm	Active	1.00	20.0	8	160.00	E	$38.87	incl. in rate	incl. in rate	$6,219.03
Air Tool, Chipping Hammer	Active	3.00	20.0	8	480.00	E	$1.64	incl. in rate	incl. in rate	$786.74
Generator, Small Generator, 10 - 15 kW	Active	2.00	20.0	8	320.00	E	$7.04	incl. in rate	incl. in rate	$2,252.80
Hydraulic Excavator (5.0cy)	Active	1.00	20.0	8	160.00	E	$274.63	incl. in rate	incl. in rate	$43,940.80
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	20.0	8	160.00	E	$62.72	incl. in rate	incl. in rate	$10,035.20
Hydraulic Thumbs/Shear Attachment	Active	1.00	20.0	8	160.00	E	$16.39	incl. in rate	incl. in rate	$2,622.40
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	20.0	8	160.00	E	$111.64	incl. in rate	incl. in rate	$17,862.40
			20.0	8	0.00					$0.00
			20.0	8	0.00					$0.00
			20.0	8	0.00					$0.00
			20.0	8	0.00					$0.00
			20.0	8	0.00					$0.00
				Labor Hours	**1,120**			**TOTAL LABOR**		**$56,854.40**
				Equipment Hours	**1,760**			**TOTAL EQUIPMENT**		**$87,197.59**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$2,842.72	$2,842.72
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$2,842.72**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	4	EA	**Cost per Mob**	$2,500.00	$10,000.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$10,000.00**

SUMMARY OF COSTS

Labor Cost	$56,854.40	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$56,854.40
Material Cost	$2,842.72	Material Tax @	7.75%	$220.31		$3,063.03
Equipment Cost	$87,197.59	Equipment Tax @	7.75%	$6,757.81		$93,955.40
Subcontractors	$10,000.00					$10,000.00
DIRECT COST SUBTOTALS	**$156,895**			**$6,978**	**DIRECT COST SUBTOTALS**	**$163,873**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$153,872.84	$23,080.93
Installing Contractors Profit@	8.0%				$153,872.84	$12,309.83
GC Markup on Subs @	5.0%				$10,000.00	$500.00
					TOTAL MARKUP COSTS	**$35,890.75**
General Contractors Insurance @	1.0%		on		$199,763.59	$1,998
Bond @	1.0%		on		$199,763.59	$1,998
Contingency @	0.0%		on		$203,758.86	$0
					TOTAL COST for pay item	**$203,759**

Additional Pay Item Notes :

The work is done by one 6-men crew (foreman, 4 laborers, and 2 equipment operators). Concrete hauling to scour hole is also included - based on the current production rate only 3 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. This productivity is considerably slower than flume demolition due to access. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM COST DETAIL WORKSHEET — **1.009 Remove Timber Equipment Ramp on left side of Dam**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.009	**Project**	:	JCBOYLE			
Description	:	Remove Timber Equipment Ramp on left side of Dam						
Quantity	:	10,500.00 LBS						
Daily Production	:	15,000.00 LBS per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	0.7 Days	**Estimator**	:	Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.66 per LBS	**Probable Low Cost Parameter**			**17250**	**$5,924**	**$0.56**
Total Cost	:	$6,969	**Probable High Cost Parameter**			**9750**	**$9,409**	**$0.90**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	0.7	8	5.60	L	$47.23	incl. in rate	incl. in rate	$264.49
Electrician	Active	1.00	0.7	8	5.60	L	$45.23	incl. in rate	incl. in rate	$253.29
Carpenters, Journeyman	Active	4.00	0.7	8	22.40	L	$65.37	incl. in rate	incl. in rate	$1,464.29
Laborer	Active	4.00	0.7	8	22.40	L	$45.80	incl. in rate	incl. in rate	$1,025.92
Truck Driver (heavy)	Active	1.00	0.7	8	5.60	L	$57.59	incl. in rate	incl. in rate	$322.50
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.7	8	5.60	E	$111.64	incl. in rate	incl. in rate	$625.18
Hydraulic Crane (17tn)	Active	1.00	0.7	8	5.60	E	$81.52	incl. in rate	incl. in rate	$456.51
Loader, FE Rubber Tire (3.5cy)	Active	1.00	0.7	8	5.60	E	$64.23	incl. in rate	incl. in rate	$359.69
Equipment Operator (crane)	Active	1.00	0.7	8	5.60	L	$68.41	incl. in rate	incl. in rate	$383.10

Labor Hours	**67.2**	**TOTAL LABOR**	**$3,713.58**
Equipment Hours	**16.8**	**TOTAL EQUIPMENT**	**$1,441.38**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$371.36	$371.36

TOTAL MATERIAL	**$371.36**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$3,713.58	Labor Burden @	49.7%	$0.00	$3,713.58
Material Cost	$371.36	Material Tax @	7.8%	$28.78	$400.14
Equipment Cost	$1,441.38	Equipment Tax @	0.0%	$0.00	$1,441.38
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$5,526**			**$29**	**DIRECT COST SUBTOTALS** **$5,555**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$5,555.11	$833.27
Installing Contractors Profit@	8.0%				$5,555.11	$444.41
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,277.67**
General Contractors Insurance @	1.0%		on		$6,832.78	$68
Bond @	1.0%		on		$6,832.78	$68
Contingency @	0.0%		on		$6,969.44	$0
					TOTAL COST for pay item	**$6,969**

Additional Pay Item Notes :

Includes structure to install steel stop logs in spillway, radial gate opening. Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. by one 13-men crew (4 steelworkers, 4 laborer, 1 electrician, 1 welder and 3 equipment operators). Based on the current production rate 15000lbs= 8.89 cy rmeans we will use 1 truck.

PAY ITEM COST DETAIL WORKSHEET

1.010 Remove Pressure-Treated Lumber from Footbridge around Intake Structure

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.010			**Project**	: JC Boyle			
Description	:	Remove Pressure-Treated Lumber from Footbridge around Intake Structure							
Quantity	:	3,600.00	SF						
Daily Production	:	900.00	SF per	8 hour shift	**Project #**	: 1			
Work Days	:	4.0	Days		**Estimator**	: Eric Jones	**SF per**	**Total Cost**	**Unit Price Per SF**
Unit Price	:	$7.19	per SF		**Probable Low Cost Parameter**		**990**	**$23,298**	**$6.47**
Total Cost	:	$25,886			**Probable High Cost Parameter**		**765**	**$29,769**	**$8.27**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (50tn)	Active	1.00	4.0	8	32.00	E	$134.32	incl. in rate	incl. in rate	$4,298.24
Truck, Pickup (4x4, 3/4tn)	Active	1.00	4.0	8	32.00	E	$16.94	incl. in rate	incl. in rate	$542.08
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	4.0	8	64.00	E	$31.90	incl. in rate	incl. in rate	$2,041.60
Labor Foreman (out)	Active	1.00	4.0	8	32.00	L	$46.27	incl. in rate	incl. in rate	$1,480.64
Equipment Operator (crane)	Active	1.00	4.0	8	32.00	L	$68.41	incl. in rate	incl. in rate	$2,189.12
Truck Driver (heavy)	Active	2.00	4.0	8	64.00	L	$57.59	incl. in rate	incl. in rate	$3,685.76
Laborer	Active	4.00	4.0	8	128.00	L	$45.80	incl. in rate	incl. in rate	$5,862.40
0		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
				Labor Hours	**256**			**TOTAL LABOR**		**$13,217.92**
				Equipment Hours	**128**			**TOTAL EQUIPMENT**		**$6,881.92**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$13,217.92	Labor Burden @	0.0%			$13,217.92
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$6,881.92	Equipment Tax @	7.75%	$533.35		$7,415.27
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$20,100**			**$533**	**DIRECT COST SUBTOTALS**	**$20,633**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$20,633.19		$3,094.98
Installing Contractors Profit@	8.0%				$20,633.19		$1,650.66
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$4,745.63**
General Contractors Insurance @	1.0%		on		$25,378.82		$254
Bond @	1.0%		on		$25,378.82		$254
Contingency @	0.0%		on		$25,886.40		$0
						TOTAL COST for pay item	**$25,886**

Additional Pay Item Notes :

Expecting complete operation will take 4 days, Crane used to fly material out of demolition area and load on to 2 trucks, 4 laborers will demo the foot bridge lumber and back up trucks, foreman to oversee operation, 2 trucks used to make sure there is always a place to load demolition materials.

PAY ITEM COST DETAIL WORKSHEET

1.011 Remove Storage Shed located on access road

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.011	**Project**	: JC Boyle				
Description	:	Remove Storage Shed located on access road						
Quantity	:	4,480.00 SF						
Daily Production	:	900.00 SF per 8 hour shift	**Project #**	: 1				
Work Days	:	5.0 Days	**Estimator**	: Eric Jones	**SF per**	**Total Cost**	**Unit Price Per SF**	
Unit Price	:	$27.79 per SF	**Probable Low Cost Parameter**		**945**	**$118,293**	**$26.40**	
Total Cost	:	$124,519	**Probable High Cost Parameter**		**810**	**$136,970**	**$30.57**	

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	5.0	8	40.00	L	$48.27	incl. in rate	incl. in rate	$1,930.80
Laborer	Active	4.00	5.0	8	160.00	L	$45.80	incl. in rate	incl. in rate	$7,328.00
Truck Driver (heavy)	Active	5.00	5.0	8	200.00	L	$57.59	incl. in rate	incl. in rate	$11,518.00
Equipment Operator (medium)	Active	4.00	5.0	8	160.00	L	$66.28	incl. in rate	incl. in rate	$10,604.80
Equipment Operator (crane)	Active	1.00	5.0	8	40.00	L	$68.41	incl. in rate	incl. in rate	$2,736.40
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	5.0	8	80.00	E	$31.90	incl. in rate	incl. in rate	$2,552.00
Truck, On-Highway Dump (6x4, 12cy)	Active	3.00	5.0	8	120.00	E	$70.35	incl. in rate	incl. in rate	$8,442.00
Forklift, Rough Terrain (9,000 lb capacity)	Active	1.00	5.0	8	40.00	E	$54.70	incl. in rate	incl. in rate	$2,188.00
Hydraulic Excavator (5.0cy)	Active	2.00	5.0	8	80.00	E	$274.63	incl. in rate	incl. in rate	$21,970.40
Loader, FE Rubber Tire (5.25cy)	Active	2.00	5.0	8	80.00	E	$75.42	incl. in rate	incl. in rate	$6,033.60
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
				Labor Hours	**600**			**TOTAL LABOR**		**$34,118.00**
				Equipment Hours	**400**			**TOTAL EQUIPMENT**		**$41,186.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Dump Fee Coversion (SFXH*.33/27)	657	CY			$0.00
Dump Fee Conversion (295 CY / 2 Tons)	328.53	tons	**Klamath County LandFill**	$74.00	$24,311.47
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$24,311.47**

SUMMARY OF COSTS

Labor Cost	$34,118.00	Labor Burden @	0.0%			$34,118.00
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$41,186.00	Equipment Tax @	7.75%	$3,191.92		$44,377.92
Subcontractors	$24,311.47					$24,311.47
DIRECT COST SUBTOTALS	**$99,615**			**$3,192**	**DIRECT COST SUBTOTALS**	**$102,807**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$78,495.92		$11,774.39
Installing Contractors Profit@	8.0%				$78,495.92		$6,279.67
GC Markup on Subs @	5.0%				$24,311.47		$1,215.57
						TOTAL MARKUP COSTS	**$19,269.63**
General Contractors Insurance @	1.0%			on	$122,077.02		$1,221
Bond @	1.0%			on	$122,077.02		$1,221
Contingency @	0.0%			on	$124,518.56		$0
						TOTAL COST for pay item	**$124,519**

Additional Pay Item Notes :

It will take 1 week to complete the demolition of the storage shed. This includes disassembly and material removal. Using 2 excavators to demolish building, using 1 FE loader to keep area clean and maintain haul path for trucks, 1 forklift to load trucks with demo material, Laborers will be used to guide trucks and assist equipment with demolition operation, Foreman will oversee operation.

PAY ITEM COST DETAIL WORKSHEET

1.012 Remove Warehouse located on access road

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.012		**Project**	: JC Boyle			
Description	:	Remove Warehouse located on access road						
Quantity	:	2,580.00	SF					
Daily Production	:	550.00	SF per 8 hour shift	**Project #**	: 1			
Work Days	:	4.7	Days	**Estimator**	: Eric Jones	**SF per**	**Total Cost**	**Unit Price Per SF**
Unit Price	:	$36.49	per SF	**Probable Low Cost Parameter**		**577.5**	**$89,441**	**$34.67**
Total Cost	:	$94,149		**Probable High Cost Parameter**		**495**	**$103,564**	**$40.14**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	4.7	8	37.60	L	$48.27	incl. in rate	incl. in rate	$1,814.95
Laborer	Active	4.00	4.7	8	150.40	L	$45.80	incl. in rate	incl. in rate	$6,888.32
Truck Driver (heavy)	Active	4.00	4.7	8	150.40	L	$57.59	incl. in rate	incl. in rate	$8,661.54
Equipment Operator (medium)	Active	3.00	4.7	8	112.80	L	$66.28	incl. in rate	incl. in rate	$7,476.38
Equipment Operator (light)	Active	1.00	4.7	8	37.60	L	$64.90	incl. in rate	incl. in rate	$2,440.24
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	4.7	8	75.20	E	$31.90	incl. in rate	incl. in rate	$2,398.88
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	4.7	8	75.20	E	$70.35	incl. in rate	incl. in rate	$5,290.32
Forklift, Rough Terrain (9,000 lb capacity)	Active	1.00	4.7	8	37.60	E	$54.70	incl. in rate	incl. in rate	$2,056.72
Hydraulic Excavator (5.0cy)	Active	2.00	4.7	8	75.20	E	$274.63	incl. in rate	incl. in rate	$20,652.18
Loader, FE Rubber Tire (5.25cy)	Active	1.00	4.7	8	37.60	E	$75.42	incl. in rate	incl. in rate	$2,835.79
		1.00	4.7	8	37.60	0	$0.00	$0.00		$0.00
		1.00	4.7	8	37.60	0	$0.00	$0.00		$0.00
			4.7	8	0.00					$0.00
			4.7	8	0.00					$0.00
			4.7	8	0.00					$0.00
			4.7	8	0.00					$0.00
			4.7	8	0.00					$0.00
				Labor Hours	**488.8**			**TOTAL LABOR**		**$27,281.43**
				Equipment Hours	**300.8**			**TOTAL EQUIPMENT**		**$33,233.89**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Dump Fee Coversion (SFXH*.33/27)	378	CY			$0.00
Dump Fee Conversion (295 CY / 2 Tons)	189.20	tons	**Klamath County LandFill**	$74.00	$14,000.80
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$14,000.80**

SUMMARY OF COSTS

Labor Cost	$27,281.43	Labor Burden @	0.0%		$27,281.43
Material Cost	$0.00	Material Tax @	7.75%	$0.00	$0.00
Equipment Cost	$33,233.89	Equipment Tax @	7.75%	$2,575.63	$35,809.51
Subcontractors	$14,000.80				$14,000.80
DIRECT COST SUBTOTALS	**$74,516**			**$2,576**	**DIRECT COST SUBTOTALS** **$77,092**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$63,090.95	$9,463.64
Installing Contractors Profit@	8.0%				$63,090.95	$5,047.28
GC Markup on Subs @	5.0%				$14,000.80	$700.04
					TOTAL MARKUP COSTS	**$15,210.96**
General Contractors Insurance @	1.0%			on	$92,302.70	$923
Bond @	1.0%			on	$92,302.70	$923
Contingency @	0.0%			on	$94,148.76	$0
					TOTAL COST for pay item	**$94,149**

Additional Pay Item Notes :

It will take 1 week to complete the demolition of the warehouse. This includes disassembly and material removal. Using 2 excavators to demolition building, using 1 FE loader to keep area clean and maintain haul path for trucks, 1 forklift to load trucks with demo material, Laborers will be used to guide trucks and assist equipment with demolition operation, Foreman will oversee operation.

PAY ITEM COST DETAIL WORKSHEET

1.013 Remove Fire System Control Bldg. on left abutment

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.013			**Project**	: JC Boyle			
Description	:	Remove Fire System Control Bldg. on left abutment							
Quantity	:	520.00	SF						
Daily Production	:	520.00	SF per	8 hour shift	**Project #**	: 1			
Work Days	:	1.0	Days		**Estimator**	: Eric Jones	**SF per**	**Total Cost**	**Unit Price Per SF**
Unit Price	:	$26.00	per SF		**Probable Low Cost Parameter**		**546**	**$12,845**	**$24.70**
Total Cost	:	$13,521			**Probable High Cost Parameter**		**468**	**$14,873**	**$28.60**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	incl. in rate	incl. in rate	$386.16
Laborer	Active	3.00	1.0	8	24.00	L	$45.80	incl. in rate	incl. in rate	$1,099.20
Truck Driver (heavy)	Active	2.00	1.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Equipment Operator (medium)	Active	2.00	1.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	incl. in rate	incl. in rate	$255.20
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	1.0	8	8.00	E	$70.35	incl. in rate	incl. in rate	$562.80
Forklift, Rough Terrain (9,000 lb capacity)	Active	1.00	1.0	8	8.00	E	$54.70	incl. in rate	incl. in rate	$437.60
Hydraulic Excavator (5.0cy)	Active	1.00	1.0	8	8.00	E	$274.63	incl. in rate	incl. in rate	$2,197.04
Loader, FE Rubber Tire (5.25cy)	Active	1.00	1.0	8	8.00	E	$75.42	incl. in rate	incl. in rate	$603.36
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	**72**			**TOTAL LABOR**		**$3,997.52**
				Equipment Hours	**40**			**TOTAL EQUIPMENT**		**$4,056.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Dump Fee Coversion (SFXH*.33/27)	76	CY			$0.00
Dump Fee Conversion (295 CY / 2 Tons)	38.13	tons	**Klamath County LandFill**	$74.00	$2,821.87
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$2,821.87**

SUMMARY OF COSTS

Labor Cost	$3,997.52	Labor Burden @	0.0%			$3,997.52
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$4,056.00	Equipment Tax @	7.75%	$314.34		$4,370.34
Subcontractors	$2,821.87					$2,821.87
DIRECT COST SUBTOTALS	**$10,875**			**$314**	**DIRECT COST SUBTOTALS**	**$11,190**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$8,367.86		$1,255.18
Installing Contractors Profit@	8.0%				$8,367.86		$669.43
GC Markup on Subs @	5.0%				$2,821.87		$141.09
						TOTAL MARKUP COSTS	**$2,065.70**
General Contractors Insurance @	1.0%		on		$13,255.43		$133
Bond @	1.0%		on		$13,255.43		$133
Contingency @	0.0%		on		$13,520.54		$0
						TOTAL COST for pay item	**$13,521**

Additional Pay Item Notes :

It will take 1 day to complete the demolition of the fire control building. This includes disassembly and material removal. Using 1 excavator to demolish building, 1 FE loader to keep area clean and maintain haul path for trucks, 1 forklift to load trucks with demo material, 1 flatbed truck and 1 dump truck to haul off materials, laborers will be used to direct trucks and assist operators with the demolition activity.

PAY ITEM COST DETAIL WORKSHEET

1.014 Remove Dam Communication Bldg. on left abutment

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.014		**Project**	: JC Boyle			
Description	:	Remove Dam Communication Bldg. on left abutment						
Quantity	:	490.00 SF						
Daily Production	:	490.00 SF per	8 hour shift	**Project #**	: 1			
Work Days	:	1.0 Days		**Estimator**	: Eric Jones	**SF per**	**Total Cost**	**Unit Price Per SF**
Unit Price	:	$27.21 per SF		**Probable Low Cost Parameter**		**514.5**	**$12,666**	**$25.85**
Total Cost	:	$13,332		**Probable High Cost Parameter**		**441**	**$14,666**	**$29.93**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	incl. in rate	incl. in rate	$386.16
Laborer	Active	3.00	1.0	8	24.00	L	$45.80	incl. in rate	incl. in rate	$1,099.20
Truck Driver (heavy)	Active	2.00	1.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Equipment Operator (medium)	Active	2.00	1.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Equipment Operator (light)	Active	1.00	1.0	8	8.00	L	$64.90	incl. in rate	incl. in rate	$519.20
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	incl. in rate	incl. in rate	$255.20
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	1.0	8	8.00	E	$70.35	incl. in rate	incl. in rate	$562.80
Forklift, Rough Terrain (9,000 lb capacity)	Active	1.00	1.0	8	8.00	E	$54.70	incl. in rate	incl. in rate	$437.60
Hydraulic Excavator (5.0cy)	Active	1.00	1.0	8	8.00	E	$274.63	incl. in rate	incl. in rate	$2,197.04
Loader, FE Rubber Tire (5.25cy)	Active	1.00	1.0	8	8.00	E	$75.42	incl. in rate	incl. in rate	$603.36
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	**72**				**TOTAL LABOR**	**$3,986.48**
				Equipment Hours	**40**				**TOTAL EQUIPMENT**	**$4,056.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Dump Fee Coversion (SFXH*.33/27)	72	CY			$0.00
Dump Fee Conversion (295 CY / 2 Tons)	35.93	tons	**Klamath County LandFill**	$74.00	$2,659.07
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$2,659.07**

SUMMARY OF COSTS

Labor Cost	$3,986.48	Labor Burden @	0.0%			$3,986.48
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$4,056.00	Equipment Tax @	7.75%	$314.34		$4,370.34
Subcontractors	$2,659.07					$2,659.07
DIRECT COST SUBTOTALS	**$10,702**			**$314**	**DIRECT COST SUBTOTALS**	**$11,016**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$8,356.82		$1,253.52
Installing Contractors Profit@	8.0%				$8,356.82		$668.55
GC Markup on Subs @	5.0%				$2,659.07		$132.95
						TOTAL MARKUP COSTS	**$2,055.02**
General Contractors Insurance @	1.0%			on	$13,070.91		$131
Bond @	1.0%			on	$13,070.91		$131
Contingency @	0.0%			on	$13,332.33		$0
						TOTAL COST for pay item	**$13,332**

Additional Pay Item Notes :

It will take 1 day to complete the demolition of the fire control building. This includes disassembly and material removal. Using 1 excavator to demolish building, 1 FE loader to keep area clean and maintain haul path for trucks, 1 forklift to load trucks with demo material, 1 flatbed truck and 1 dump truck to haul off materials, laborers will be used to direct trucks and assist operators with the demolition activity.

PAY ITEM COST DETAIL WORKSHEET

1.015 Remove Concrete Slab on left abutment for former Control House

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.015		**Project**	: JC Boyle			
Description	:	Remove Concrete Slab on left abutment for former Control House						
Quantity	:	6.00	CY					
Daily Production	:	6.00	CY per	8 hour shift	**Project #**	: 1		
Work Days	:	1.0	Days		**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$1,778.57	per CY		**Probable Low Cost Parameter**		**6.6**	**$9,604**	**$1,600.71**
Total Cost	:	$10,671			**Probable High Cost Parameter**		**5.1**	**$12,272**	**$2,045.36**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Equipment Operator (medium)	Active	2.00	1.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Hydraulic Excavator (5.0cy)	Active	2.00	1.0	8	16.00	E	$274.63	incl. in rate	incl. in rate	$4,394.08
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	1.0	8	8.00	E	$70.35	incl. in rate	incl. in rate	$562.80
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	1.0	8	8.00	E	$62.72	incl. in rate	incl. in rate	$501.76
	Active	1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
	Active	1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
	Active	1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	**48**			**TOTAL LABOR**		**$2,624.16**
				Equipment Hours	**32**			**TOTAL EQUIPMENT**		**$5,458.64**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,624.16	Labor Burden @	0.0%			$2,624.16
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$5,458.64	Equipment Tax @	7.75%	$423.04		$5,881.68
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$8,083**			**$423**	**DIRECT COST SUBTOTALS**	**$8,506**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$8,505.84		$1,275.88
Installing Contractors Profit@	8.0%				$8,505.84		$680.47
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$1,956.34**
General Contractors Insurance @	1.0%		on		$10,462.19		$105
Bond @	1.0%		on		$10,462.19		$105
Contingency @	0.0%		on		$10,671.43		$0
						TOTAL COST for pay item	**$10,671**

Additional Pay Item Notes :

1 day to demolish and removal all concrete material, 1 excavator with breaker, 1 excavator loading materials in to dump truck, 2 laborers to direct trucks and assist equipment with demolition operation, 1 foreman to oversee operation.

PAY ITEM COST DETAIL WORKSHEET

1.016 Remove 4'x5' Metal Hatch on top of Concrete Pull Box on left abutment

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.016			**Project**	: JC Boyle			
Description	:	Remove 4'x5' Metal Hatch on top of Concrete Pull Box on left abutment							
Quantity	:	1.00	CY						
Daily Production	:	3.00	CY per	8 hour shift	**Project #**	: 1			
Work Days	:	0.3	Days		**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$1,769.46	per CY		**Probable Low Cost Parameter**		**3.3**	**$1,593**	**$1,592.51**
Total Cost	:	$1,769			**Probable High Cost Parameter**		**2.7**	**$1,946**	**$1,946.40**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	0.3	8	2.40	L	$46.27	incl. in rate	incl. in rate	$111.05
Laborer	Active	1.00	0.3	8	2.40	L	$45.80	incl. in rate	incl. in rate	$109.92
Truck Driver (heavy)	Active	1.00	0.3	8	2.40	L	$57.59	incl. in rate	incl. in rate	$138.22
Equipment Operator (medium)	Active	1.00	0.3	8	2.40	L	$66.28	incl. in rate	incl. in rate	$159.07
Hydraulic Excavator (5.0cy)	Active	1.00	0.3	8	2.40	E	$274.63	incl. in rate	incl. in rate	$659.11
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	0.3	8	2.40	E	$70.35	incl. in rate	incl. in rate	$168.84
0		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
				Labor Hours	**9.6**			**TOTAL LABOR**		**$518.26**
				Equipment Hours	**4.8**			**TOTAL EQUIPMENT**		**$827.95**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$518.26	Labor Burden @	0.0%			$518.26
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$827.95	Equipment Tax @	7.75%	$64.17		$892.12
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,346**			**$64**	**DIRECT COST SUBTOTALS**	**$1,410**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,410.37		$211.56
Installing Contractors Profit@	8.0%				$1,410.37		$112.83
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$324.39**
General Contractors Insurance @	1.0%		on		$1,734.76		$17
Bond @	1.0%		on		$1,734.76		$17
Contingency @	0.0%		on		$1,769.46		$0
						TOTAL COST for pay item	**$1,769**

Additional Pay Item Notes :

2.5 hours to complete operation, using 1 excavator to demo and load material, laborer to support equipment, dump truck to haul material to scour haul, foreman to oversee operation.

PAY ITEM COST DETAIL WORKSHEET

1.017 Remove Reservoir Level Gauge House on Dam Crest

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.017			**Project**	: JC Boyle			
Description	:	Remove Reservoir Level Gauge House on Dam Crest							
Quantity	:	24.00	SF						
Daily Production	:	48.00	SF per	8 hour shift	**Project #**	: 1			
Work Days	:	0.5	Days		**Estimator**	: Eric Jones	**SF per**	**Total Cost**	**Unit Price Per SF**
Unit Price	:	$138.69	per SF		**Probable Low Cost Parameter**		**50.4**	**$3,162**	**$131.75**
Total Cost	:	$3,328			**Probable High Cost Parameter**		**43.2**	**$3,661**	**$152.55**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.5	8	4.00	L	$48.27	incl. in rate	incl. in rate	$193.08
Laborer	Active	2.00	0.5	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Truck Driver (heavy)	Active	1.00	0.5	8	4.00	L	$57.59	incl. in rate	incl. in rate	$230.36
Equipment Operator (medium)	Active	1.00	0.5	8	4.00	L	$66.28	incl. in rate	incl. in rate	$265.12
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	0.5	8	4.00	E	$70.35	incl. in rate	incl. in rate	$281.40
Hydraulic Excavator (5.0cy)	Active	1.00	0.5	8	4.00	E	$274.63	incl. in rate	incl. in rate	$1,098.52
0		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
0		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
				Labor Hours	**20**			**TOTAL LABOR**		**$1,054.96**
				Equipment Hours	**8**			**TOTAL EQUIPMENT**		**$1,379.92**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Dump Fee Coversion (SFXH*.33/27)	4	CY			$0.00
Dump Fee Conversion (295 CY / 2 Tons)	1.76	tons	**Klamath County LandFill**	$74.00	$130.24
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$130.24**

SUMMARY OF COSTS

Labor Cost	$1,054.96	Labor Burden @	0.0%		$1,054.96
Material Cost	$0.00	Material Tax @	7.75%	$0.00	$0.00
Equipment Cost	$1,379.92	Equipment Tax @	7.75%	$106.94	$1,486.86
Subcontractors	$130.24				$130.24
DIRECT COST SUBTOTALS	**$2,565**			**$107**	**DIRECT COST SUBTOTALS** **$2,672**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$2,541.82	$381.27
Installing Contractors Profit@	8.0%				$2,541.82	$203.35
GC Markup on Subs @	5.0%				$130.24	$6.51
					TOTAL MARKUP COSTS	**$591.13**
General Contractors Insurance @	1.0%		on		$3,263.20	$33
Bond @	1.0%		on		$3,263.20	$33
Contingency @	0.0%		on		$3,328.46	$0
					TOTAL COST for pay item	**$3,328**

Additional Pay Item Notes :

Operation will take 1/2 of a day to complete including mobilizing to area, excavator will be used to demolish and load material, truck will haul off material, to dump location, laborer to support equipment and truck coordination, foreman to oversee operation.

PAY ITEM COST DETAIL WORKSHEET

1.018 Downstream Riprap

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.018			**Project**	: JC Boyle			
Description	: Downstream Riprap							
Quantity	: 2,200.00	CY						
Daily Production	: 325.00	CY per	8 hour shift	**Project #**	: 1			
Work Days	: 6.8	Days		**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	: $93.45	per CY		**Probable Low Cost Parameter**		**357.5**	**$185,023**	**$84.10**
Total Cost	: $205,581			**Probable High Cost Parameter**		**292.5**	**$226,139**	**$102.79**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	4.00	6.8	8	217.60	E	$274.63	incl. in rate	incl. in rate	$59,759.49
Truck, On-Highway Dump (6x4, 12cy)	Active	10.00	6.8	8	544.00	E	$70.35	incl. in rate	incl. in rate	$38,270.40
Equipment Operator (medium)	Active	4.00	6.8	8	217.60	L	$66.28	incl. in rate	incl. in rate	$14,422.53
Truck Driver (heavy)	Active	10.00	6.8	8	544.00	L	$57.59	incl. in rate	incl. in rate	$31,328.96
Labor Foreman (out)	Active	1.00	6.8	8	54.40	L	$46.27	incl. in rate	incl. in rate	$2,517.09
Laborer	Active	4.00	6.8	8	217.60	L	$45.80	incl. in rate	incl. in rate	$9,966.08
0		1.00	6.8	8	54.40	0	$0.00	$0.00		$0.00
		1.00	6.8	8	54.40	0	$0.00	$0.00		$0.00
		1.00	6.8	8	54.40	0	$0.00	$0.00		$0.00
0		1.00	6.8	8	54.40	0	$0.00	$0.00		$0.00
		1.00	6.8	8	54.40	0	$0.00	$0.00		$0.00
		1.00	6.8	8	54.40	0	$0.00	$0.00		$0.00
			6.8	8	0.00					$0.00
			6.8	8	0.00					$0.00
			6.8	8	0.00					$0.00
			6.8	8	0.00					$0.00
			6.8	8	0.00					$0.00
				Labor Hours	**1033.6**			**TOTAL LABOR**		**$58,234.66**
				Equipment Hours	**761.6**			**TOTAL EQUIPMENT**		**$98,029.89**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$58,234.66	Labor Burden @	0.0%			$58,234.66
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$98,029.89	Equipment Tax @	7.75%	$7,597.32		$105,627.20
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$156,265**			**$7,597**	**DIRECT COST SUBTOTALS**	**$163,862**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$163,861.86		$24,579.28
Installing Contractors Profit@	8.0%				$163,861.86		$13,108.95
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$37,688.23**
General Contractors Insurance @	1.0%			on	$201,550.09		$2,016
Bond @	1.0%			on	$201,550.09		$2,016
Contingency @	0.0%			on	$205,581.09		$0
						TOTAL COST for pay item	**$205,581**

Additional Pay Item Notes :

Trucks will be hauling 10 CY of material at a time, 10 trucks will be 13 loads per truck, truck will be hauling roughly 4 loads per day due to time it takes to load material and potential void space from material. Trucks to haul material to disposal site, 2 excavators used to place material at loading stock pile, 2 excavators used to load trucks, laborers will be used to direct truck traffic, foreman to oversee operation.

PAY ITEM COST DETAIL WORKSHEET

1.019 Upstream Riprap

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.019			**Project**	: JC Boyle			
Description	:	Upstream Riprap							
Quantity	:	1,300.00	CY						
Daily Production	:	325.00	CY per	8 hour shift	**Project #**	: 1			
Work Days	:	4.0	Days		**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$93.02	per CY		**Probable Low Cost Parameter**		**357.5**	**$108,837**	**$83.72**
Total Cost	:	$120,930			**Probable High Cost Parameter**		**292.5**	**$133,023**	**$102.33**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	4.00	4.0	8	128.00	E	$274.63	incl. in rate	incl. in rate	$35,152.64
Truck, On-Highway Dump (6x4, 12cy)	Active	10.00	4.0	8	320.00	E	$70.35	incl. in rate	incl. in rate	$22,512.00
Equipment Operator (medium)	Active	4.00	4.0	8	128.00	L	$66.28	incl. in rate	incl. in rate	$8,483.84
Truck Driver (heavy)	Active	10.00	4.0	8	320.00	L	$57.59	incl. in rate	incl. in rate	$18,428.80
Labor Foreman (out)	Active	1.00	4.0	8	32.00	L	$46.27	incl. in rate	incl. in rate	$1,480.64
Laborer	Active	4.00	4.0	8	128.00	L	$45.80	incl. in rate	incl. in rate	$5,862.40
0		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
0		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
				Labor Hours	**608**			**TOTAL LABOR**		**$34,255.68**
				Equipment Hours	**448**			**TOTAL EQUIPMENT**		**$57,664.64**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$34,255.68	Labor Burden @	0.0%			$34,255.68
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$57,664.64	Equipment Tax @	7.75%	$4,469.01		$62,133.65
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$91,920**			**$4,469**	**DIRECT COST SUBTOTALS**	**$96,389**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$96,389.33		$14,458.40
Installing Contractors Profit@	8.0%				$96,389.33		$7,711.15
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$22,169.55**
General Contractors Insurance @	1.0%		on		$118,558.88		$1,186
Bond @	1.0%		on		$118,558.88		$1,186
Contingency @	0.0%		on		$120,930.05		$0
						TOTAL COST for pay item	**$120,930**

Additional Pay Item Notes :

Trucks will be hauling 10 CY of material at a time, 10 trucks will be 22 loads per truck, truck will be hauling roughly 4 loads per day due to time it takes to load material and potential void space from material. Trucks to haul material to scour site, 2 excavators used to place material at loading stock pile, 2 excavators used to load trucks, laborers will be used to direct truck traffic, foreman to oversee operation.

PAY ITEM COST DETAIL WORKSHEET

1.02 Miscellaneous Excavation (Dam Earth Section)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.02			**Project**	: JC Boyle			
Description	:	Miscellaneous Excavation (Dam Earth Section)							
Quantity	:	132,500.00	cy						
Daily Production	:	3,000.00	cy per	8 hour shift	**Project #**	: 1			
Work Days	:	44.2	Days		**Estimator**	: Michael Barba	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$10.42	per cy		**Probable Low Cost Parameter**		**3450**	**$1,173,107**	**$8.85**
Total Cost	:	$1,380,126			**Probable High Cost Parameter**		**2400**	**$1,656,151**	**$12.50**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (6.0cy)	Active	3.00	44.2	8	1,060.80	E	$322.48	$322.48		$342,086.78
Loader, FE Rubber Tire (8.6cy)	Active	3.00	44.2	8	1,060.80	E	$221.50	$221.50		$234,967.20
Truck, Off-Road, Articulated Rear, 20cy	Active	3.00	44.2	8	1,060.80	E	$111.64	$111.64		$118,427.71
Equipment Operator (medium)	Active	6.00	44.2	8	2,121.60	L	$66.28	$0.00		$140,619.65
Truck Driver (heavy)	Active	3.00	44.2	8	1,060.80	L	$57.59	$0.00		$61,091.47
Laborer		1.00	44.2	8	353.60	L	$45.80	$0.00		$16,194.88
		0.00	44.2	8	0.00	0	$0.00	$0.00		$0.00
			44.2	8	0.00					$0.00
			44.2	8	0.00					$0.00
			44.2	8	0.00					$0.00
			44.2	8	0.00					$0.00
			44.2	8	0.00					$0.00
				Labor Hours	**3536**			**TOTAL LABOR**		**$217,906.00**
				Equipment Hours	**3182.4**			**TOTAL EQUIPMENT**		**$695,481.70**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
	0.00	lf	1.000	0.00	$0.00	$0.00
	0.00	ea	1.000	0.00	$0.00	$0.00
	0.00	ea	1.000	0.00	$0.00	$0.00
	0.00	ea	1.000	0.00	$0.00	$0.00
	0.00	ls	1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$217,906.00	Labor Burden @	49.7%	$0.00		$217,906.00
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$695,481.70	Equipment Tax @	7.75%	$53,899.83		$749,381.53
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$913,388**			**$53,900**	**DIRECT COST SUBTOTALS**	**$967,288**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$967,287.53		$145,093.13
Installing Contractors Profit@	8.0%				$967,287.53		$77,383.00
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$222,476.13**
General Contractors Insurance @	15.0%			on	$1,189,763.66		$178,465
Bond @	1.0%			on	$1,189,763.66		$11,898
Contingency @	0.0%			on	$1,380,125.84		$0
						TOTAL COST for pay item	**$1,380,126**

Additional Pay Item Notes :

Used excavators for removal of material figuring 3000 CY per shift

PAY ITEM COST DETAIL WORKSHEET

1.021 Cutoff Wall Concrete Demolition

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.021	**Project**	: JC Boyle				
Description	:	Cutoff Wall Concrete Demolition						
Quantity	:	70.00 CY						
Daily Production	:	20.00 CY per 8 hour shift	**Project #**	: 1				
Work Days	:	3.5 Days	**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**	
Unit Price	:	$655.64 per CY	**Probable Low Cost Parameter**		**21**	**$43,600**	**$622.86**	
Total Cost	:	$45,895	**Probable High Cost Parameter**		**17**	**$52,779**	**$753.99**	

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	2.00	3.5	8	56.00	E	$274.63	incl. in rate	incl. in rate	$15,379.28
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	3.5	8	56.00	E	$70.35	incl. in rate	incl. in rate	$3,939.60
Truck, Pickup (4x4, 3/4tn)	Active	1.00	3.5	8	28.00	E	$16.94	incl. in rate	incl. in rate	$474.32
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	3.5	8	28.00	E	$62.72	incl. in rate	incl. in rate	$1,756.16
Labor Foreman (out)	Active	1.00	3.5	8	28.00	L	$46.27	incl. in rate	incl. in rate	$1,295.56
Laborer	Active	4.00	3.5	8	112.00	L	$45.80	incl. in rate	incl. in rate	$5,129.60
Equipment Operator (medium)	Active	2.00	3.5	8	56.00	L	$66.28	incl. in rate	incl. in rate	$3,711.68
Truck Driver (heavy)	Active	2.00	3.5	8	56.00	L	$57.59	incl. in rate	incl. in rate	$3,225.04
		1.00	3.5	8	28.00	0	$0.00	$0.00		$0.00
0		1.00	3.5	8	28.00	0	$0.00	$0.00		$0.00
		1.00	3.5	8	28.00	0	$0.00	$0.00		$0.00
		1.00	3.5	8	28.00	0	$0.00	$0.00		$0.00
			3.5	8	0.00					$0.00
			3.5	8	0.00					$0.00
			3.5	8	0.00					$0.00
			3.5	8	0.00					$0.00
			3.5	8	0.00					$0.00
				Labor Hours	**252**				**TOTAL LABOR**	**$13,361.88**
				Equipment Hours	**168**				**TOTAL EQUIPMENT**	**$21,549.36**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$13,361.88	Labor Burden @	0.0%			$13,361.88
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$21,549.36	Equipment Tax @	7.75%	$1,670.08		$23,219.44
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$34,911**			**$1,670**	**DIRECT COST SUBTOTALS**	**$36,581**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$36,581.32		$5,487.20
Installing Contractors Profit@	8.0%				$36,581.32		$2,926.51
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$8,413.70**
General Contractors Insurance @	1.0%		on		$44,995.02		$450
Bond @	1.0%		on		$44,995.02		$450
Contingency @	0.0%		on		$45,894.92		$0
						TOTAL COST for pay item	**$45,895**

Additional Pay Item Notes :

1 excavator with breaker will be used to demolish material, 1 excavator will be used to load trucks, 1 truck will haul 7 loads total roughly 2 load per day, overall duration accounts for setup and break down time, Laborers will be used to direct trucks and assist equipment operations, foreman will oversee the operation. Expect that the demolition operation is going to slow down the down the production of the dump trucks and the second excavator.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.022			Project	: JCBOYLE			
Description	:	Cuttoff Wall Anchors							
Quantity	:	285.00	EA						
Daily Production	:	285.00	EA per	8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	1.0	Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$12.86	per EA		Probable Low Cost Parameter		299.25	$3,481	$12.21
Total Cost	:	$3,664			Probable High Cost Parameter		256.5	$4,030	$14.14

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Steelworker	Active	2.00	1.0	8	16.00	L	$65.52	incl. in rate	incl. in rate	$1,048.32
Carpenters, Journeyman	Active	1.00	1.0	8	8.00	L	$65.37	incl. in rate	incl. in rate	$522.96
Equipment Operator (medium)	Active	1.00	0.5	8	4.00	L	$66.28	incl. in rate	incl. in rate	$265.12
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.5	8	4.00	E	$221.50	incl. in rate	incl. in rate	$886.00

Labor Hours	28	TOTAL LABOR	$1,836.40
Equipment Hours	4	TOTAL EQUIPMENT	$886.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$183.64	$183.64

TOTAL MATERIAL	$183.64

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$1,836.40	Labor Burden @	49.7%	$0.00	$1,836.40
Material Cost	$183.64	Material Tax @	7.8%	$14.23	$197.87
Equipment Cost	$886.00	Equipment Tax @	0.0%	$0.00	$886.00
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$2,906			$14	DIRECT COST SUBTOTALS $2,920

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$2,920.27	$438.04
Installing Contractors Profit@	8.0%				$2,920.27	$233.62
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$671.66
General Contractors Insurance @	1.0%		on		$3,591.93	$36
Bond @	1.0%		on		$3,591.93	$36
Contingency @	0.0%		on		$3,663.77	$0
					TOTAL COST for pay item	$3,664

Additional Pay Item Notes :

Assumed 1 day work and includes cutting anchors at top of bedrock.

PAY ITEM COST DETAIL WORKSHEET — **1.023 Remove & Dispose Hand Rails and Light Poles**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.023	**Project**	:	JCBOYLE			
Description	:	Remove & Dispose Hand Rails and Light Poles						
Quantity	:	5,000.00 LBS						
Daily Production	:	18,500.00 LBS per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	0.3 Days	**Estimator**	:	Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.85 per LBS	**Probable Low Cost Parameter**			**19425**	**$4,016**	**$0.80**
Total Cost	:	$4,227	**Probable High Cost Parameter**			**15725**	**$4,861**	**$0.97**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (80tn)	Active	1.00	0.3	8	2.40	E	$190.46	incl. in rate	incl. in rate	$457.10
Millwright	Active	6.00	0.3	8	14.40	L	$69.46	incl. in rate	incl. in rate	$1,000.22
Equipment Operator (crane)	Active	1.00	0.3	8	2.40	L	$68.41	incl. in rate	incl. in rate	$164.18
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.3	8	2.40	E	$221.50	incl. in rate	incl. in rate	$531.60
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.3	8	2.40	E	$111.64	incl. in rate	incl. in rate	$267.94
Truck Driver (heavy)	Active	1.00	0.3	8	2.40	L	$57.59	incl. in rate	incl. in rate	$138.22
Electrician	Active	1.00	0.3	8	2.40	L	$45.23	incl. in rate	incl. in rate	$108.55
Labor Foreman (out)	Active	2.00	0.3	8	4.80	L	$46.27	incl. in rate	incl. in rate	$222.10
Equipment Operator (medium)	Active	1.00	0.3	8	2.40	L	$66.28	incl. in rate	incl. in rate	$159.07

Labor Hours	**28.8**	**TOTAL LABOR**	**$1,792.34**
Equipment Hours	**7.2**	**TOTAL EQUIPMENT**	**$1,256.64**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$179.23	$179.23

TOTAL MATERIAL	**$179.23**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10%)	0.25	ton	1.000	0.25	$595.00	$148.75

TOTAL SUBCONTRACTS	**$148.75**

SUMMARY OF COSTS

Labor Cost	$1,792.34	Labor Burden @	49.7%	$0.00	$1,792.34
Material Cost	$179.23	Material Tax @	7.8%	$13.89	$193.13
Equipment Cost	$1,256.64	Equipment Tax @	0.0%	$0.00	$1,256.64
Subcontractors	$148.75				$148.75
DIRECT COST SUBTOTALS	**$3,377**			**$14**	**DIRECT COST SUBTOTALS** **$3,391**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,242.11	$486.32
Installing Contractors Profit@	8.0%				$3,242.11	$259.37
GC Markup on Subs @	5.0%				$148.75	$7.44
					TOTAL MARKUP COSTS	**$753.12**
General Contractors Insurance @	1.0%		on		$4,143.98	$41
Bond @	1.0%		on		$4,143.98	$41
Contingency @	0.0%		on		$4,226.86	$0
					TOTAL COST for pay item	**$4,227**

Additional Pay Item Notes :

Assumed 2.40 hours work for a crew formed of 1 Forman, 5 millwright for the handrails and 1 electrician to assure power for tools, etc. Assumed hazardous waste 10% of the total lbs, calculated 85.6 miles from JC Boyle to Yreka Transfer Recycling.

PAY ITEM COST DETAIL WORKSHEET — **1.024 Remove & Dispose Spillway Radial Gates and Hoists**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.024	**Project**	:	JCBOYLE			
Description	:	Remove & Dispose Spillway Radial Gates and Hoists						
Quantity	:	124,000.00 LBS						
Daily Production	:	8,000.00 LBS per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	15.5 Days	**Estimator**	:	Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$2.14 per LBS	**Probable Low Cost Parameter**			**8800**	**$238,402**	**$1.92**
Total Cost	:	$264,891	**Probable High Cost Parameter**			**5200**	**$357,603**	**$2.88**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	15.5	8	124.00	L	$47.23	$0.00		$5,856.52
Electrician	Active	1.00	15.5	8	124.00	L	$45.23	$0.00		$5,608.52
Steelworker	Active	5.00	15.5	8	620.00	L	$65.52	$0.00		$40,622.40
Loader, FE Rubber Tire (8.6cy)	Active	1.00	15.5	8	124.00	E	$221.50	$221.50		$27,466.00
Truck Driver (heavy)	Active	1.00	15.5	8	124.00	L	$57.59	$0.00		$7,141.16
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	15.5	8	124.00	E	$111.64	$111.64		$13,843.36
Hydraulic Crane (120tn)	Active	1.00	15.5	8	124.00	E	$239.06	$239.06		$29,643.44
Welder	Active	1.00	15.5	8	124.00	L	$7.84	$0.00		$971.85
Gas Welding Machine	Active	1.00	15.5	8	124.00	E	$2.88	$2.88		$356.75
Equipment Operator (medium)	Active	1.00	15.5	8	124.00	L	$66.28	$0.00		$8,218.72
Equipment Operator (crane)	Active	1.00	15.5	8	124.00	L	$68.41	$0.00		$8,482.84
Laborer	Active	4.00	15.5	8	496.00	L	$45.80	$0.00		$22,716.80

Labor Hours	**1860**	**TOTAL LABOR**	**$99,618.81**
Equipment Hours	**496**	**TOTAL EQUIPMENT**	**$71,309.55**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$4,980.94	$4,980.94
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	2,500.00	LF	1.000	2,500.00	$0.85	$2,125.00

TOTAL MATERIAL	**$7,105.94**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	62.00	ton	1.000	62.00	$595.00	$36,890.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	171.20	mile	1.000	171.20	$7.25	$1,241.20

TOTAL SUBCONTRACTS	**$38,131.20**

SUMMARY OF COSTS

Labor Cost	$99,618.81	Labor Burden @	49.7%	$0.00		$99,618.81
Material Cost	$7,105.94	Material Tax @	7.8%	$550.71		$7,656.65
Equipment Cost	$71,309.55	Equipment Tax @	0.0%	$0.00		$71,309.55
Subcontractors	$38,131.20					$38,131.20
DIRECT COST SUBTOTALS	**$216,165**			**$551**	**DIRECT COST SUBTOTALS**	**$216,716**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$178,585.01		$26,787.75
Installing Contractors Profit@	8.0%				$178,585.01		$14,286.80
GC Markup on Subs @	5.0%				$38,131.20		$1,906.56
						TOTAL MARKUP COSTS	**$42,981.11**
General Contractors Insurance @	1.0%		on		$259,697.32		$2,597
Bond @	1.0%		on		$259,697.32		$2,597
Contingency @	0.0%		on		$264,891.27		$0
						TOTAL COST for pay item	**$264,891**

Additional Pay Item Notes :

Production based on crew 1 Forman, 5 Steelworkers and 1 Welder to cut and attach hooks to the gate for disposal, 4 Laborers to rigging wire rope slings, 1 Electrician to provide power for tools, 1 Truck for disposal to Yreka facility. Production has been reduced due to activity occuring during the winter months.

PAY ITEM COST DETAIL WORKSHEET — **1.025 Remove & Dispose Stop Logs and Slots (steel)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.025	**Project**	:	JCBOYLE			
Description	:	Remove & Dispose Stop Logs and Slots (steel)						
Quantity	:	92,000.00 LBS						
Daily Production	:	30,000.00 LBS per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	3.1 Days	**Estimator**	:	Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.94 per LBS	**Probable Low Cost Parameter**			**33000**	**$78,053**	**$0.85**
Total Cost	:	$86,725	**Probable High Cost Parameter**			**24000**	**$104,070**	**$1.13**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	3.1	8	24.80	L	$47.23	$0.00		$1,171.30
Electrician	Active	1.00	3.1	8	24.80	L	$45.23	$0.00		$1,121.70
Ironworkers	Active	10.00	3.1	8	248.00	L	$63.95	$0.00		$15,859.60
Vibratory Hammer & Extractor	Active	1.00	3.1	8	24.80	E	$94.34	$94.34		$2,339.63
Truck Driver (heavy)	Active	2.00	3.1	8	49.60	L	$57.59	$0.00		$2,856.46
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	3.1	8	49.60	E	$111.64	$111.64		$5,537.34
Hydraulic Crane (120tn)	Active	2.00	3.1	8	49.60	E	$239.06	$239.06		$11,857.38
Welder	Active	2.00	3.1	8	49.60	L	$7.84	$0.00		$388.74
Gas Welding Machine	Active	2.00	3.1	8	49.60	E	$2.88	$2.88		$142.70
Equipment Operator (medium)	Active	2.00	3.1	8	49.60	L	$66.28	$0.00		$3,287.49
Equipment Operator (crane)	Active	1.00	3.1	8	24.80	L	$68.41	$0.00		$1,696.57
Laborer	Active	10.00	3.1	8	248.00	L	$45.80	$0.00		$11,358.40

Labor Hours	**719.2**	**TOTAL LABOR**	**$37,740.27**
Equipment Hours	**173.6**	**TOTAL EQUIPMENT**	**$19,877.05**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,887.01	$1,887.01
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	5,000.00	LF	1.000	5,000.00	$0.85	$4,250.00

TOTAL MATERIAL	**$6,137.01**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (20%)	9.20	ton	1.000	9.20	$595.00	$5,474.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	36.00	mile	1.000	36.00	$7.25	$261.00

TOTAL SUBCONTRACTS	**$5,735.00**

SUMMARY OF COSTS

Labor Cost	$37,740.27	Labor Burden @	49.7%	$0.00	$37,740.27
Material Cost	$6,137.01	Material Tax @	7.8%	$475.62	$6,612.63
Equipment Cost	$19,877.05	Equipment Tax @	0.0%	$0.00	$19,877.05
Subcontractors	$5,735.00				$5,735.00
DIRECT COST SUBTOTALS	**$69,489**			**$476**	**DIRECT COST SUBTOTALS** **$69,965**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$64,229.95	$9,634.49
Installing Contractors Profit@	8.0%				$64,229.95	$5,138.40
GC Markup on Subs @	5.0%				$5,735.00	$286.75
					TOTAL MARKUP COSTS	**$15,059.64**
General Contractors Insurance @	1.0%		on		$85,024.59	$850
Bond @	1.0%		on		$85,024.59	$850
Contingency @	0.0%		on		$86,725.08	$0
					TOTAL COST for pay item	**$86,725**

Additional Pay Item Notes :

Production based on crew 1 Forman, 5 Ironworkers and 1 Welder to cut and attach hooks to the gate for disposal, 4 Laborers to rigging wire rope slings. Electrical crew to provide power for tools, 1 Truck for disposal to Yreka facility. Assuming using a Vibratory Hammer & Extractor for attachments in concrete and 2 cranes for balance when the gates are discharged.

PAY ITEM COST DETAIL WORKSHEET — **1.026 Remove & Dispose of 24" Slide Gate at Entrance to Fish Ladder Structure**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.026	**Project**	:	JCBOYLE			
Description	:	Remove & Dispose of 24" Slide Gate at Entrance to Fish Ladder Structure						
Quantity	:	4,200.00 LBS						
Daily Production	:	30,000.00 LBS per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	0.1 Days	**Estimator**	:	Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.70 per LBS	**Probable Low Cost Parameter**			**31500**	**$2,773**	**$0.66**
Total Cost	:	$2,919	**Probable High Cost Parameter**			**16500**	**$4,233**	**$1.01**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	0.1	8	0.80	L	$47.23	$0.00		$37.78
Electrician	Active	1.00	0.1	8	0.80	L	$45.23	$0.00		$36.18
Steelworker	Active	5.00	0.1	8	4.00	L	$65.52	$0.00		$262.08
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.1	8	0.80	E	$221.50	$221.50		$177.20
Truck Driver (heavy)	Active	1.00	0.1	8	0.80	L	$57.59	$0.00		$46.07
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.1	8	0.80	E	$111.64	$111.64		$89.31
Hydraulic Crane (120tn)	Active	1.00	0.1	8	0.80	E	$239.06	$239.06		$191.25
Welder	Active	1.00	0.1	8	0.80	L	$7.84	$0.00		$6.27
Gas Welding Machine	Active	1.00	0.1	8	0.80	E	$2.88	$2.88		$2.30
Equipment Operator (medium)	Active	1.00	0.1	8	0.80	L	$66.28	$0.00		$53.02
Equipment Operator (crane)	Active	1.00	0.1	8	0.80	L	$68.41	$0.00		$54.73
Laborer	Active	4.00	0.1	8	3.20	L	$45.80	$0.00		$146.56

Labor Hours	**12**	**TOTAL LABOR**	**$642.70**
Equipment Hours	**3.2**	**TOTAL EQUIPMENT**	**$460.06**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$32.14	$32.14

TOTAL MATERIAL	**$32.14**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	2.10	ton	1.000	2.10	$595.00	$1,249.50
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	19.83	mile	1.000	19.83	$7.25	$143.79

TOTAL SUBCONTRACTS	**$1,393.29**

SUMMARY OF COSTS

Labor Cost	$642.70	Labor Burden @	49.7%	$0.00		$642.70
Material Cost	$32.14	Material Tax @	7.8%	$2.49		$34.63
Equipment Cost	$460.06	Equipment Tax @	0.0%	$0.00		$460.06
Subcontractors	$1,393.29					$1,393.29
DIRECT COST SUBTOTALS	**$2,528**			**$2**	**DIRECT COST SUBTOTALS**	**$2,531**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,137.39		$170.61
Installing Contractors Profit@	8.0%				$1,137.39		$90.99
GC Markup on Subs @	5.0%				$1,393.29		$69.66
						TOTAL MARKUP COSTS	**$331.26**
General Contractors Insurance @	1.0%		on		$2,861.94		$29
Bond @	1.0%		on		$2,861.94		$29
Contingency @	0.0%		on		$2,919.18		$0
						TOTAL COST for pay item	**$2,919**

Additional Pay Item Notes :

Production based on crew 1 Forman, 5 Steelworkers and 1 Welder to cut and attach hooks to the gate for disposal, 4 Laborers to rigging wire rope slings, 1 Electrician to provide power for tools, 1 Truck for disposal to Yreka facility. Assuming 1 hour of work.

PAY ITEM COST DETAIL WORKSHEET — **1.026a Remove petroleum products from Red Bam Area**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.026a	**Project**	: JCBOYLE				
Description	:	Remove petroleum products from Red Bam Area						
Quantity	:	1,600.00 GAL						
Daily Production	:	550.00 GAL per 8 hour shift	**Project #**	: Klamath Dams Removal				
Work Days	:	2.9 Days	**Estimator**	: Mihaela Tomulescu	**GAL per**	**Total Cost**	**Unit Price Per GAL**	
Unit Price	:	$13.34 per GAL	**Probable Low Cost Parameter**		**632.5**	**$18,137**	**$11.34**	
Total Cost	:	$21,338	**Probable High Cost Parameter**		**385**	**$27,739**	**$17.34**	

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.9	8	23.20	L	$46.27	incl. in rate	incl. in rate	$1,073.46
Electrician	Active	1.00	2.9	8	23.20	L	$45.23	incl. in rate	incl. in rate	$1,049.34
Laborer	Active	4.00	2.9	8	92.80	L	$45.80	incl. in rate	incl. in rate	$4,250.24
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.9	8	23.20	E	$221.50	incl. in rate	incl. in rate	$5,138.80
Truck Driver (heavy)	Active	1.00	2.9	8	23.20	L	$57.59	incl. in rate	incl. in rate	$1,336.09
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.9	8	23.20	E	$111.64	incl. in rate	incl. in rate	$2,590.05
Equipment Operator (light)	Active	1.00	2.9	8	23.20	L	$64.90	incl. in rate	incl. in rate	$1,505.68
Pump, Centrifugal, 3"	Active	1.00	2.9	8	23.20	E	$2.76	incl. in rate	incl. in rate	$63.93

Labor Hours	**185.6**	**TOTAL LABOR**	**$9,214.81**
Equipment Hours	**69.6**	**TOTAL EQUIPMENT**	**$7,792.78**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	0.00	LS	1.000	0.00	$0.00	$0.00
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	0.00	LF	1.000	0.00	$0.00	$0.00

TOTAL MATERIAL **$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS **$0.00**

SUMMARY OF COSTS

Labor Cost	$9,214.81	Labor Burden @	49.7%	$0.00		$9,214.81
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$7,792.78	Equipment Tax @	0.0%	$0.00		$7,792.78
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$17,008**			**$0**	**DIRECT COST SUBTOTALS**	**$17,008**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$17,007.59	$2,551.14
Installing Contractors Profit@	8.0%				$17,007.59	$1,360.61
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$3,911.75**
General Contractors Insurance @	1.0%		on		$20,919.33	$209
Bond @	1.0%		on		$20,919.33	$209
Contingency @	0.0%		on		$21,337.72	$0
					TOTAL COST for pay item	**$21,338**

Additional Pay Item Notes :

The petroleum waste is saved in drums and send it to recycling or disposal. Used a crew formed of 1 Forman, 4 Laborers to takeout the petroleum waste from the mech equipment, 1 Electrician to unplug the power and to assure the temporary power at the construction site.

PAY ITEM COST DETAIL WORKSHEET — **1.027 Remove & Dispose of Spillway gate motor & control panel**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.027	**Project**	: JCBOYLE		
Description	: Remove & Dispose of Spillway gate motor & control panel				
Quantity	: 1.00 EA				
Daily Production	: 1.00 EA per 8 hour shift	**Project #**	: Klamath Dams Removal		
Work Days	: 1.0 Days	**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost** / **Unit Price Per EA**
Unit Price	: $1,282.33 per EA	**Probable Low Cost Parameter**		**1.1**	**$1,154** / **$1,154.10**
Total Cost	: $1,282	**Probable High Cost Parameter**		**0.8**	**$1,539** / **$1,538.80**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	$0.00		$732.80

Labor Hours	**16**	**TOTAL LABOR**	**$732.80**
Equipment Hours	**0**	**TOTAL EQUIPMENT**	**$0.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 0.5% labor (Side Cutter, Sharp-Nose Pliers, Sharp Tip Tweezers PCB Clamp, etc)	3.66	LS	1.000	3.66	$73.28	$268.50

TOTAL MATERIAL **$268.50**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS **$0.00**

SUMMARY OF COSTS

Labor Cost	$732.80	Labor Burden @	49.7%	$0.00		$732.80
Material Cost	$268.50	Material Tax @	7.8%	$20.81		$289.31
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00		$0.00
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,001**			**$21**	**DIRECT COST SUBTOTALS**	**$1,022**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,022.11		$153.32
Installing Contractors Profit@	8.0%				$1,022.11		$81.77
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$235.08**
General Contractors Insurance @	1.0%	on			$1,257.19		$13
Bond @	1.0%	on			$1,257.19		$13
Contingency @	0.0%	on			$1,282.33		$0
						TOTAL COST for pay item	**$1,282**

Additional Pay Item Notes :

Assumed that two workers will work one day to unconnected and remove the control panel and the gate motor. They will discharge the control panel and the gate motor in an available truck used for the other scope of work on the construction site. Assumed weight:500 LBS

PAY ITEM COST DETAIL WORKSHEET — **1.028 Remove & Dispose of Distribution equipment, panelboards**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.028			**Project**	: JCBOYLE		
Description	:	Remove & Dispose of Distribution equipment, panelboards						
Quantity	:	1.00	EA					
Daily Production	:	0.50	EA per	8 hour shift	**Project #**	: Klamath Dams Removal		
Work Days	:	2.0	Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost** / **Unit Price Per EA**
Unit Price	:	$5,877.55	per EA		**Probable Low Cost Parameter**		**0.55**	**$5,290** / **$5,289.80**
Total Cost	:	$5,878			**Probable High Cost Parameter**		**0.4**	**$7,053** / **$7,053.06**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	2.0	8	16.00	L	$47.23	$0.00		$755.68
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	$0.00		$723.68
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	$0.00		$547.28
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	$111.64		$893.12
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72
Hydraulic Crane (17tn)	Active	1.00	2.0	8	16.00	E	$81.52	$81.52		$1,304.32

Labor Hours	**48**	**TOTAL LABOR**	**$2,487.36**
Equipment Hours	**24**	**TOTAL EQUIPMENT**	**$2,197.44**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 0.5% labor (Side Cutter, Sharp-Nose Pliers, Sharp Tip Tweezers PCB Clamp, etc)	0.00	LS	1.000	0.00	$124.37	$0.00

TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,487.36	Labor Burden @	49.7%	$0.00		$2,487.36
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$2,197.44	Equipment Tax @	0.0%	$0.00		$2,197.44
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$4,685**			**$0**	**DIRECT COST SUBTOTALS**	**$4,685**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,684.80	$702.72
Installing Contractors Profit@	8.0%				$4,684.80	$374.78
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,077.50**
General Contractors Insurance @	1.0%		on		$5,762.30	$58
Bond @	1.0%		on		$5,762.30	$58
Contingency @	0.0%		on		$5,877.55	$0
					TOTAL COST for pay item	**$5,878**

Additional Pay Item Notes :

Assumed that electrical crew formed of 1 Forman and 1 Electricians will work two days to unconnected and remove the distribution panels. They are going to use same crane and a truck for disposal of spillway intake, trash rake and radial motor & control panel. Assumed weight:500 LBS

PAY ITEM COST DETAIL WORKSHEET

1.029 Remove Powerhouse Concrete down to Elevation 3324.0

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.029			**Project**	: JC Boyle			
Description	:	Remove Powerhouse Concrete down to Elevation 3324.0							
Quantity	:	1,500.00	cy						
Daily Production	:	50.00	cy per	8 hour shift	**Project #**	: 1			
Work Days	:	30.0	Days		**Estimator**	: Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$546.51	per cy		**Probable Low Cost Parameter**		**55**	**$737,786**	**$491.86**
Total Cost	:	$819,762			**Probable High Cost Parameter**		**40**	**$983,714**	**$655.81**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	30.0	8	480.00	L	$48.27	incl. in rate	incl. in rate	$23,169.60
Laborer	Active	8.00	30.0	8	1,920.00	L	$45.80	incl. in rate	incl. in rate	$87,936.00
Equipment Operator (medium)	Active	4.00	30.0	8	960.00	L	$66.28	incl. in rate	incl. in rate	$63,628.80
Truck Driver (heavy)	Active	2.00	30.0	8	480.00	L	$57.59	incl. in rate	incl. in rate	$27,643.20
Air Compressor 600 cfm	Active	2.00	30.0	8	480.00	E	$21.74	incl. in rate	incl. in rate	$10,434.68
Air Compressor 900 cfm	Active	2.00	30.0	8	480.00	E	$38.87	incl. in rate	incl. in rate	$18,657.08
Air Tool, Chipping Hammer	Active	6.00	30.0	8	1,440.00	E	$1.64	incl. in rate	incl. in rate	$2,360.21
Generator, Small Generator, 10 - 15 kW	Active	4.00	30.0	8	960.00	E	$7.04	incl. in rate	incl. in rate	$6,758.40
Hydraulic Excavator (5.0cy)	Active	4.00	30.0	8	960.00	E	$274.63	incl. in rate	incl. in rate	$263,644.80
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	3.00	30.0	8	720.00	E	$62.72	incl. in rate	incl. in rate	$45,158.40
Hydraulic Thumbs/Shear Attachment	Active	2.00	30.0	8	480.00	E	$16.39	incl. in rate	incl. in rate	$7,867.20
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	30.0	8	480.00	E	$111.64	incl. in rate	incl. in rate	$53,587.20
			30.0	8	0.00					$0.00
			30.0	8	0.00					$0.00
			30.0	8	0.00					$0.00
			30.0	8	0.00					$0.00
			30.0	8	0.00					$0.00
				Labor Hours	**3,840**			**TOTAL LABOR**		**$202,377.60**
				Equipment Hours	**6,000**			**TOTAL EQUIPMENT**		**$408,467.97**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$10,118.88	$10,118.88
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$10,118.88**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$202,377.60	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$202,377.60
Material Cost	$10,118.88	Material Tax @	7.75%	$784.21		$10,903.09
Equipment Cost	$408,467.97	Equipment Tax @	7.75%	$31,656.27		$440,124.24
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$620,964**			**$32,440**	**DIRECT COST SUBTOTALS**	**$653,405**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$653,404.93	$98,010.74
Installing Contractors Profit@	8.0%				$653,404.93	$52,272.39
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$150,283.13**
General Contractors Insurance @	1.0%		on		$803,688.07	$8,037
Bond @	1.0%		on		$803,688.07	$8,037
Contingency @	0.0%		on		$819,761.83	$0
					TOTAL COST for pay item	**$819,762**

Additional Pay Item Notes :

There will be two 5 man demo crews using chipping hammers to support demolition, 3 excavators with breakers breaking material, 1 excavator loading 20 CY off road hauling trucks, expecting for each of the 2 trucks to get 1.5 load per day 50cys per shift.

PAY ITEM COST DETAIL WORKSHEET — **1.030 Remove Structural Steel items associated with Powerhouse**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.030	**Project**	:	JCBOYLE			
Description	:	Remove Structural Steel items associated with Powerhouse						
Quantity	:	94,000.00 lbs						
Daily Production	:	30,000.00 lbs per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	3.1 Days	**Estimator**	:	Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$0.63 per lbs	**Probable Low Cost Parameter**			**33000**	**$53,166**	**$0.57**
Total Cost	:	$59,073	**Probable High Cost Parameter**			**25500**	**$67,935**	**$0.72**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	3.1	8	24.80	L	$47.23	incl. in rate	incl. in rate	$1,171.30
Electrician	Active	1.00	3.1	8	24.80	L	$45.23	incl. in rate	incl. in rate	$1,121.70
Steelworker	Active	5.00	3.1	8	124.00	L	$65.52	incl. in rate	incl. in rate	$8,124.48
Loader, FE Rubber Tire (8.6cy)	Active	1.00	3.1	8	24.80	E	$221.50	incl. in rate	incl. in rate	$5,493.20
Truck Driver (heavy)	Active	1.00	3.1	8	24.80	L	$57.59	incl. in rate	incl. in rate	$1,428.23
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	3.1	8	24.80	E	$111.64	incl. in rate	incl. in rate	$2,768.67
Hydraulic Crane (120tn)	Active	1.00	3.1	8	24.80	E	$239.06	incl. in rate	incl. in rate	$5,928.69
Welder	Active	2.00	3.1	8	49.60	L	$7.84	incl. in rate	incl. in rate	$388.74
Gas Welding Machine	Active	2.00	3.1	8	49.60	E	$2.88	incl. in rate	incl. in rate	$142.70
Equipment Operator (medium)	Active	1.00	3.1	8	24.80	L	$66.28	incl. in rate	incl. in rate	$1,643.74
Equipment Operator (crane)	Active	1.00	3.1	8	24.80	L	$68.41	incl. in rate	incl. in rate	$1,696.57
Laborer	Active	10.00	3.1	8	248.00	L	$45.80	incl. in rate	incl. in rate	$11,358.40

Labor Hours	**545.6**	**TOTAL LABOR**	**$26,933.17**
Equipment Hours	**124**	**TOTAL EQUIPMENT**	**$14,333.26**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$2,693.32	$2,693.32

TOTAL MATERIAL	**$2,693.32**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10%)	4.70	ton	1.000	4.70	$595.00	$2,796.50
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	85.60	$7.25	$620.60

TOTAL SUBCONTRACTS	**$3,417.10**

SUMMARY OF COSTS

Labor Cost	$26,933.17	Labor Burden @	49.7%	$0.00		$26,933.17
Material Cost	$2,693.32	Material Tax @	7.8%	$208.73		$2,902.05
Equipment Cost	$14,333.26	Equipment Tax @	0.0%	$0.00		$14,333.26
Subcontractors	$3,417.10					$3,417.10
DIRECT COST SUBTOTALS	**$47,377**			**$209**	**DIRECT COST SUBTOTALS**	**$47,586**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$44,168.48		$6,625.27
Installing Contractors Profit@	8.0%				$44,168.48		$3,533.48
GC Markup on Subs @	5.0%				$3,417.10		$170.86
						TOTAL MARKUP COSTS	**$10,329.61**
General Contractors Insurance @	1.0%		on		$57,915.19		$579
Bond @	1.0%		on		$57,915.19		$579
Contingency @	0.0%		on		$59,073.49		$0
						TOTAL COST for pay item	**$59,073**

Additional Pay Item Notes :

Includes columns, beams, crane girders, bracing, misc. shapes, roof trusses, purlins, etc. Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Assumed hazardous waste 10% of the total lbs, calculated 85.6 miles from JC Boyle to Yreka Transfer Recycling.

PAY ITEM COST DETAIL WORKSHEET

1.031 Remove Warehouse near Powerhouse

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.031	**Project**	:	Copco 2			
Description	:	Remove Warehouse near Powerhouse						
Quantity	:	5,060.00 SF						
Daily Production	:	500.00 SF per 8 hour shift	**Project #**	:	1			
Work Days	:	10.1 Days	**Estimator**	:	Eric Jones	**SF per**	**Total Cost**	**Unit Price Per SF**
Unit Price	:	$32.95 per SF	**Probable Low Cost Parameter**			**525**	**$158,369**	**$31.30**
Total Cost	:	$166,704	**Probable High Cost Parameter**			**450**	**$183,375**	**$36.24**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	10.1	8	80.80	L	$46.27	incl. in rate	incl. in rate	$3,738.62
Laborer	Active	6.00	10.1	8	484.80	L	$45.80	incl. in rate	incl. in rate	$22,203.84
Equipment Operator (medium)	Active	2.00	10.1	8	161.60	L	$66.28	incl. in rate	incl. in rate	$10,710.85
Truck Driver (heavy)	Active	1.00	10.1	8	80.80	L	$57.59	incl. in rate	incl. in rate	$4,653.27
Steelworker	Active	2.00	10.1	8	161.60	L	$65.52	incl. in rate	incl. in rate	$10,588.03
Hydraulic Excavator (5.0cy)	Active	2.00	10.1	8	161.60	E	$274.63	incl. in rate	incl. in rate	$44,380.21
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	10.1	8	80.80	E	$111.64	incl. in rate	incl. in rate	$9,020.51
0		2.00	10.1	8	161.60	0	$0.00	$0.00		$0.00
0		1.00	10.1	8	80.80	0	$0.00	$0.00		$0.00
		1.00	10.1	8	80.80	0	$0.00	$0.00		$0.00
		1.00	10.1	8	80.80	0	$0.00	$0.00		$0.00
		1.00	10.1	8	80.80	0	$0.00	$0.00		$0.00
			10.1	8	0.00					$0.00
			10.1	8	0.00					$0.00
			10.1	8	0.00					$0.00
			10.1	8	0.00					$0.00
			10.1	8	0.00					$0.00
				Labor Hours	**969.6**				**TOTAL LABOR**	**$51,894.61**
				Equipment Hours	**242.4**				**TOTAL EQUIPMENT**	**$53,400.72**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Dump Fee Coversion (SFXH*.33/27)	742	CY			$0.00
Dump Fee Conversion (295 CY / 2 Tons)	371.07	tons	Klamath County LandFi	$74.00	$27,458.93
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$27,458.93**

SUMMARY OF COSTS

Labor Cost	$51,894.61	Labor Burden @	0.0%			$51,894.61
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$53,400.72	Equipment Tax @	7.75%	$4,138.56		$57,539.28
Subcontractors	$27,458.93					$27,458.93
DIRECT COST SUBTOTALS	**$132,754**			**$4,139**	**DIRECT COST SUBTOTALS**	**$136,893**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$109,433.88		$16,415.08
Installing Contractors Profit@	8.0%				$109,433.88		$8,754.71
GC Markup on Subs @	5.0%				$27,458.93		$1,372.95
						TOTAL MARKUP COSTS	**$26,542.74**
General Contractors Insurance @	1.0%		on		$163,435.56		$1,634
Bond @	1.0%		on		$163,435.56		$1,634
Contingency @	0.0%		on		$166,704.27		$0
						TOTAL COST for pay item	**$166,704**

Additional Pay Item Notes :

Crew should take 3 weeks to remove building. Assuming the building is a combination of structural steel and sheet metal, 1 labor foreman to run crews 6 laborer for running and cleaning up misc mats, and backing up trucks, 2 equipment operators 2 for the excavators (1 with breaker, 1 with bucket,) excavator will be performing the demolition and the excavator will load trucks, 1 truck driver to drive off road truck, 2 steel works to cut steel members as necessary.

PAY ITEM COST DETAIL WORKSHEET — **1.032 Remove & Dispose of 2 - Governor oil systems**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.032	**Project**	:	JCBOYLE			
Description	:	Remove & Dispose of 2 - Governor oil systems						
Quantity	:	52,500.00 lbs						
Daily Production	:	30,000.00 lbs per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	1.8 Days	**Estimator**	:	Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$0.80 per lbs	**Probable Low Cost Parameter**			**31500**	**$39,833**	**$0.76**
Total Cost	:	$41,929	**Probable High Cost Parameter**			**25500**	**$48,219**	**$0.92**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.8	8	14.40	L	$47.23	incl. in rate	incl. in rate	$680.11
Electrician	Active	1.00	1.8	8	14.40	L	$45.23	incl. in rate	incl. in rate	$651.31
Ironworkers	Active	4.00	1.8	8	57.60	L	$63.95	incl. in rate	incl. in rate	$3,683.52
Hydraulic Excavator (6.0cy)	Active	1.00	1.8	8	14.40	E	$322.48	incl. in rate	incl. in rate	$4,643.71
Truck Driver (heavy)	Active	1.00	1.8	8	14.40	L	$57.59	incl. in rate	incl. in rate	$829.30
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.8	8	14.40	E	$111.64	incl. in rate	incl. in rate	$1,607.62
Hydraulic Crane (120tn)	Active	1.00	1.8	8	14.40	E	$239.06	incl. in rate	incl. in rate	$3,442.46
Welder	Active	1.00	1.8	8	14.40	L	$7.84	incl. in rate	incl. in rate	$112.86
Gas Welding Machine	Active	1.00	1.8	8	14.40	E	$2.88	incl. in rate	incl. in rate	$41.43
Equipment Operator (medium)	Active	1.00	1.8	8	14.40	L	$66.28	incl. in rate	incl. in rate	$954.43
Equipment Operator (crane)	Active	1.00	1.8	8	14.40	L	$68.41	incl. in rate	incl. in rate	$985.10
Hydraulic Impact Breaker Attachment (2k-3k ft-lb)	Active	1.00	1.8	8	14.40	E	$30.85	incl. in rate	incl. in rate	$444.24

Labor Hours	**144**	**TOTAL LABOR**	**$7,896.64**
Equipment Hours	**72**	**TOTAL EQUIPMENT**	**$10,179.46**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$394.83	$394.83

TOTAL MATERIAL	**$394.83**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	26.25	ton	1.000	26.25 $595.00	$15,618.75
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	85.60 $7.25	$620.60

TOTAL SUBCONTRACTS	**$16,239.35**

SUMMARY OF COSTS

Labor Cost	$7,896.64	Labor Burden @	49.7%	$0.00	$7,896.64
Material Cost	$394.83	Material Tax @	7.8%	$30.60	$425.43
Equipment Cost	$10,179.46	Equipment Tax @	0.0%	$0.00	$10,179.46
Subcontractors	$16,239.35				$16,239.35
DIRECT COST SUBTOTALS	**$34,710**			**$31**	**DIRECT COST SUBTOTALS** **$34,741**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$18,501.53	$2,775.23
Installing Contractors Profit@	8.0%				$34,740.88	$2,779.27
GC Markup on Subs @	5.0%				$16,239.35	$811.97
					TOTAL MARKUP COSTS	**$6,366.47**
General Contractors Insurance @	1.0%		on		$41,107.34	$411
Bond @	1.0%		on		$41,107.34	$411
Contingency @	0.0%		on		$41,929.49	$0
					TOTAL COST for pay item	**$41,929**

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Using hydraulic impact breaker because of the systems that are encased in concrete. Assumed hazardous waste 100% of the total lbs, calculated 85.6 miles from JC Boyle to Yreka Transfer Recycling.

PAY ITEM COST DETAIL WORKSHEET — **1.033 Remove & Dispose of Cooling water and bearing oil systems**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.033	**Project**	:	JCBOYLE			
Description	:	Remove & Dispose of Cooling water and bearing oil systems						
Quantity	:	6,500.00 lbs						
Daily Production	:	6,000.00 lbs per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	1.1 Days	**Estimator**	:	Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$1.06 per lbs	**Probable Low Cost Parameter**			**6600**	**$6,215**	**$0.96**
Total Cost	:	$6,905	**Probable High Cost Parameter**			**5100**	**$7,941**	**$1.22**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.1	8	8.80	L	$48.27	incl. in rate	incl. in rate	$424.78
Laborer	Active	1.00	1.1	8	8.80	L	$45.80	incl. in rate	incl. in rate	$403.04
Steelworker	Active	1.00	1.1	8	8.80	L	$65.52	incl. in rate	incl. in rate	$576.58
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.5	8	4.00	E	$221.50	incl. in rate	incl. in rate	$886.00
Truck Driver (light)	Active	1.00	0.5	8	4.00	L	$56.29	incl. in rate	incl. in rate	$225.16
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.5	8	4.00	E	$111.64	incl. in rate	incl. in rate	$446.56
Equipment Operator (light)	Active	1.00	0.5	8	4.00	L	$64.90	incl. in rate	incl. in rate	$259.60
				Labor Hours	**34.4**			**TOTAL LABOR**		**$1,889.15**
				Equipment Hours	**8**			**TOTAL EQUIPMENT**		**$1,332.56**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, et	1.00	LS	1.000	1.00	$94.46	$94.46
					TOTAL MATERIAL	**$94.46**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	3.25	ton	1.000	3.25	$595.00	$1,933.75
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	85.60	$7.25	$620.60
					TOTAL SUBCONTRACTS	**$2,554.35**

SUMMARY OF COSTS

Labor Cost	$1,889.15	Labor Burden @	49.7%	$0.00	$1,889.15
Material Cost	$94.46	Material Tax @	7.8%	$7.32	$101.78
Equipment Cost	$1,332.56	Equipment Tax @	0.0%	$0.00	$1,332.56
Subcontractors	$2,554.35				$2,554.35
DIRECT COST SUBTOTALS	**$5,871**			**$7**	**DIRECT COST SUBTOTALS** **$5,878**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,323.49	$498.52
Installing Contractors Profit@	8.0%				$3,323.49	$265.88
GC Markup on Subs @	5.0%				$2,554.35	$127.72
					TOTAL MARKUP COSTS	**$892.12**
General Contractors Insurance @	1.0%		on		$6,769.96	$68
Bond @	1.0%		on		$6,769.96	$68
Contingency @	0.0%		on		$6,905.36	$0
					TOTAL COST for p	**$6,905**

Additional Pay Item Notes :

Used RS Means : Assumed " Pipe, metal pipe, to 1-1/2" diam., selective demolition", 2390 LF of 1 1/2" oil pipes at 2.72 Lbs/LF. Used 1 Forman, 1 Steelworkers to cut the pipes and 1 Laborers to load the pipes in the truck. The cooling and lubrication systems for the Hydroelectric Barge turbine, speed increaser and generator will be a combination of water and oil. These systems will be isolated from the water passages so that no contamination of passing water will occur. The following is a list of hazardous materials, substances, chemicals, and wastes normally found at a hydropower facility that may require disposal actions if not recycled or reused for their intended purpose:

1. Polychlorinated Biphenyls (PCBs)
2. Asbestos
3. Paint/abrasive blast grit (red lead paint)
4. **Oil**
5. Mercury
6. Antifreeze
7. Halogenated and non-halogenated solvents
8. Greases
9. Pesticides (includes herbicides, insecticides, and wood preservatives)
10. Petroleum contaminated
11. Chlorinated fluorocarbons (CFCs) Freon/Halon
12. Gasoline/diesel (includes product and sludge in tanks)
13. Batteries (includes acid)
14. Water treatment sludge (septic tanks/wastewater treatment). Assumed hazardous waste 100% of the total lbs

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.034	**Project**	: JC Boyle				
Description	:	Remove & Dispose of 2 - Francis Turbines						
Quantity	:	560,000.00 LBS						
Daily Production	:	30,000.00 LBS per 8 hour shift	**Project #**	: Klamath Dams Removal				
Work Days	:	18.7 Days	**Estimator**	: Mihaela Tomulescu		**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.75 per LBS	**Probable Low Cost Parameter**			**34500**	**$354,624**	**$0.63**
Total Cost	:	$417,204	**Probable High Cost Parameter**			**22500**	**$521,505**	**$0.93**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	18.7	8	149.60	L	$48.27	incl. in rate	incl. in rate	$7,221.19
Ironworkers	Active	10.00	18.7	8	1,496.00	L	$63.95	incl. in rate	incl. in rate	$95,669.20
Crawler Crane (270tn)	Active	1.00	18.7	8	149.60	E	$399.50	incl. in rate	incl. in rate	$59,765.20
Equipment Operator (crane)	Active	1.00	18.7	8	149.60	L	$68.41	incl. in rate	incl. in rate	$10,234.14
Welder	Active	4.00	18.7	8	598.40	L	$7.84	incl. in rate	incl. in rate	$4,689.96
Gas Welding Machine	Active	4.00	18.7	8	598.40	E	$2.88	incl. in rate	incl. in rate	$1,721.59
Electrician	Active	2.00	18.7	8	299.20	L	$45.23	incl. in rate	incl. in rate	$13,532.82
Electrician Foreman	Active	1.00	18.7	8	149.60	L	$47.23	incl. in rate	incl. in rate	$7,065.61
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	6.0	8	96.00	E	$31.90	incl. in rate	incl. in rate	$3,062.40
Loader, FE Rubber Tire (8.6cy)	Active	2.00	18.7	8	299.20	E	$221.50	incl. in rate	incl. in rate	$66,272.80
Truck Driver (heavy)	Active	5.00	18.7	8	748.00	L	$57.59	incl. in rate	incl. in rate	$43,077.32
Equipment Operator (medium)	Active	1.00	18.7	8	149.60	L	$66.28	incl. in rate	incl. in rate	$9,915.49

Labor Hours	**3740**	**TOTAL LABOR**	**$191,405.72**
Equipment Hours	**1143.2**	**TOTAL EQUIPMENT**	**$130,821.99**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$9,570.29	$9,570.29

TOTAL MATERIAL	**$9,570.29**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$191,405.72	Labor Burden @	49.7%	$0.00	$191,405.72
Material Cost	$9,570.29	Material Tax @	7.8%	$741.70	$10,311.98
Equipment Cost	$130,821.99	Equipment Tax @	0.0%	$0.00	$130,821.99
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$331,798**			**$742**	**DIRECT COST SUBTOTALS** **$332,540**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$332,539.69	$49,880.95
Installing Contractors Profit@	8.0%				$332,539.69	$26,603.18
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$76,484.13**
General Contractors Insurance @	1.0%		on		$409,023.82	$4,090
Bond @	1.0%		on		$409,023.82	$4,090
Contingency @	0.0%		on		$417,204.30	$0
					TOTAL COST for pay item	**$417,204**

Additional Pay Item Notes :

Working with a crew formed of 1 El. Foreman 2 Electrician starting to disconnect power and take care of the temporary electrical power they need at the site. The crew of 10 Ironworker / Millwright. open the engine side panels, and remove the nacelle access panels. Disconnect the engine thermocouple leads at the terminal board. Before disconnecting any lines all fuel, oil, and hydraulic fluid valves are closed. Plug all lines as they are disconnected to prevent entrance of foreign material. Remove the clamps securing the bleed-air ducts at the firewall. Then, disconnect the electrical connector plugs, engine breather and vent lines, and fuel, oil, and hydraulic lines. Disconnect the engine power lever and propeller control rods or cables. Remove the covers from the lift points, attach the sling, and remove slack from the cables using a suitable hoist. The sling must be adjusted to position. Remove the engine mount bolts. The engine ready to be removed. Move the engine forward, out of the nacelle structure, until it clears the aircraft. Lower the into position on the stand, and secure it prior to removing the engine sling. The crew of 4 Welder are going to cut in pieces the big parts of the turbine to be able to load them in the truck using a loader and dispose.

PAY ITEM COST DETAIL WORKSHEET

1.035 Remove & Dispose of 150 Ton crane

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.035	**Project**	:	JC Boyle			
Description	:	Remove & Dispose of 150 Ton crane						
Quantity	:	240,000.00 LBS						
Daily Production	:	24,000.00 LBS per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	10.0 Days	**Estimator**	:	Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.82 per LBS	**Probable Low Cost Parameter**			**27600**	**$166,937**	**$0.70**
Total Cost	:	$196,396	**Probable High Cost Parameter**			**19200**	**$235,675**	**$0.98**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (120tn)	Active	2.00	10.0	8	160.00	E	$239.06	incl. in rate	incl. in rate	$38,249.60
Equipment Operator (crane)	Active	2.00	10.0	8	160.00	L	$68.41	incl. in rate	incl. in rate	$10,945.60
Truck Driver (heavy)	Active	1.00	10.0	8	80.00	L	$57.59	incl. in rate	incl. in rate	$4,607.20
Equipment Operator (medium)	Active	1.00	10.0	8	80.00	L	$66.28	incl. in rate	incl. in rate	$5,302.40
Loader, FE Rubber Tire (8.6cy)	Active	1.00	10.0	8	80.00	E	$221.50	incl. in rate	incl. in rate	$17,720.00
Electrician Foreman	Active	1.00	10.0	8	80.00	L	$47.23	incl. in rate	incl. in rate	$3,778.40
Truck, Tractor (400hp)	Active	1.00	10.0	8	80.00	E	$69.30	incl. in rate	incl. in rate	$5,544.00
Labor Foreman	Active	1.00	10.0	8	80.00	L	$48.27	incl. in rate	incl. in rate	$3,861.60
Welder	Active	2.00	10.0	8	160.00	L	$7.84	incl. in rate	incl. in rate	$1,254.00
Gas Welding Machine	Active	2.00	10.0	8	160.00	E	$2.88	incl. in rate	incl. in rate	$460.32
Steelworker	Active	8.00	10.0	8	640.00	L	$65.52	incl. in rate	incl. in rate	$41,932.80
Laborer	Active	4.00	10.0	8	320.00	L	$45.80	incl. in rate	incl. in rate	$14,656.00

Labor Hours	**1600**	**TOTAL LABOR**	**$86,338.00**
Equipment Hours	**480**	**TOTAL EQUIPMENT**	**$61,973.92**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$4,316.90	$4,316.90
					TOTAL MATERIAL	**$4,316.90**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (5% of total weight)	6.00	ton	1.000	6.00 $595.00	$3,570.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	85.60 $7.25	$620.60
				TOTAL SUBCONTRACTS	**$4,190.60**

SUMMARY OF COSTS

Labor Cost	$86,338.00	Labor Burden @	49.7%	$0.00	$86,338.00
Material Cost	$4,316.90	Material Tax @	7.8%	$334.56	$4,651.46
Equipment Cost	$61,973.92	Equipment Tax @	0.0%	$0.00	$61,973.92
Subcontractors	$4,190.60				$4,190.60
DIRECT COST SUBTOTALS	**$156,819**			**$335**	**DIRECT COST SUBTOTALS** **$157,154**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$152,963.38	$22,944.51
Installing Contractors Profit@	8.0%				$152,963.38	$12,237.07
GC Markup on Subs @	5.0%				$4,190.60	$209.53
					TOTAL MARKUP COSTS	**$35,391.11**
General Contractors Insurance @	1.0%		on		$192,545.08	$1,925
Bond @	1.0%		on		$192,545.08	$1,925
Contingency @	0.0%		on		$196,395.99	$0
					TOTAL COST for pay item	**$196,396**

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Assumed hazardous waste 2% of the total lbs, calculated 85.6 miles from JC Boyle to Yreka Transfer Recycling.

PAY ITEM COST DETAIL WORKSHEET

1.036 Remove & Dispose of Compressed Air systems

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.036			**Project**	: JCBOYLE			
Description	:	Remove & Dispose of Compressed Air systems							
Quantity	:	1,100.00	lbs						
Daily Production	:	6,000.00	lbs per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	0.183	Days		**Estimator**	: Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$0.88	per lbs		**Probable Low Cost Parameter**		**6600**	**$875**	**$0.80**
Total Cost	:	$973			**Probable High Cost Parameter**		**4500**	**$1,216**	**$1.11**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Loader, FE Rubber Tire (5.25cy)	Active	1.00	0.183	8	1.47	E	$75.42	incl. in rate	incl. in rate	$110.62
Laborer	Active	3.00	0.183	8	4.40	L	$45.80	incl. in rate	incl. in rate	$201.52
Steelworker	Active	1.00	0.183	8	1.47	L	$65.52	incl. in rate	incl. in rate	$96.10
Equipment Operator (light)	Active	1.00	0.183	8	1.47	L	$64.90	incl. in rate	incl. in rate	$95.19
Truck Driver (light)	Active	1.00	0.183	8	1.47	L	$56.29	incl. in rate	incl. in rate	$82.56
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.183	8	1.47	E	$111.64	incl. in rate	incl. in rate	$163.74

Labor Hours	**8.8**	**TOTAL LABOR**	**$475.36**
Equipment Hours	**2.933333333**	**TOTAL EQUIPMENT**	**$274.35**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)						
	1.00	LS	1.000	1.00	$23.77	$23.77

TOTAL MATERIAL	**$23.77**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$475.36	Labor Burden @	49.7%	$0.00		$475.36
Material Cost	$23.77	Material Tax @	7.8%	$1.84		$25.61
Equipment Cost	$274.35	Equipment Tax @	0.0%	$0.00		$274.35
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$773**			**$2**	**DIRECT COST SUBTOTALS**	**$775**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$775.33	$116.30
Installing Contractors Profit@	8.0%				$775.33	$62.03
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$178.33**
General Contractors Insurance @	1.0%	on			$953.65	$10
Bond @	1.0%	on			$953.65	$10
Contingency @	0.0%	on			$972.72	$0
					TOTAL COST for pay item	**$973**

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 400 LF of 1 1/2" pipes at 2.72 Lbs/LF. Used 1 Steelworkers to cut the pipes and 3 Laborers for hauling.

PAY ITEM COST DETAIL WORKSHEET — **1.037 Remove & Dispose of 2 - CO2 systems**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.037	**Project**	:	JCBOYLE			
Description	:	Remove & Dispose of 2 - CO2 systems						
Quantity	:	6,600.00 lbs						
Daily Production	:	6,000.00 lbs per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	1.1 Days	**Estimator**	:	Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$0.99 per lbs	**Probable Low Cost Parameter**			**6600**	**$5,853**	**$0.89**
Total Cost	:	$6,504	**Probable High Cost Parameter**			**4800**	**$7,805**	**$1.18**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.1	8	8.80	L	$48.27	incl. in rate	incl. in rate	$424.78
Laborer	Active	2.00	1.1	8	17.60	L	$45.80	incl. in rate	incl. in rate	$806.08
Steelworker	Active	2.00	1.1	8	17.60	L	$65.52	incl. in rate	incl. in rate	$1,153.15
Equipment Operator (light)	Active	1.00	1.1	8	8.80	L	$64.90	incl. in rate	incl. in rate	$571.12
Loader, FE Rubber Tire (3.5cy)	Active	1.00	1.1	8	8.80	E	$64.23	incl. in rate	incl. in rate	$565.22
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.1	8	8.80	E	$111.64	incl. in rate	incl. in rate	$982.43
Truck Driver (light)	Active	1.00	1.1	8	8.80	L	$56.29	incl. in rate	incl. in rate	$495.35

Labor Hours	**61.6**	**TOTAL LABOR**	**$3,450.48**
Equipment Hours	**17.6**	**TOTAL EQUIPMENT**	**$1,547.66**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$172.52	$172.52

TOTAL MATERIAL	**$172.52**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$3,450.48	Labor Burden @	49.7%	$0.00		$3,450.48
Material Cost	$172.52	Material Tax @	7.8%	$13.37		$185.89
Equipment Cost	$1,547.66	Equipment Tax @	0.0%	$0.00		$1,547.66
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$5,171**			**$13**	**DIRECT COST SUBTOTALS**	**$5,184**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$5,184.03	$777.60
Installing Contractors Profit@	8.0%				$5,184.03	$414.72
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,192.33**
General Contractors Insurance @	1.0%		on		$6,376.36	$64
Bond @	1.0%		on		$6,376.36	$64
Contingency @	0.0%		on		$6,503.88	$0
					TOTAL COST for pay item	**$6,504**

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 2430 LF of 1 1/2" pipes at 2.72 Lbs. Used 1 Forman, 2 Steelworkers to cut the pipes and 2 Laborers to load the pipes in the truck.

PAY ITEM COST DETAIL WORKSHEET — **1.038 Remove & Dispose of Plant Water and Fire Protection**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.038	**Project**	:	JCBOYLE			
Description	:	Remove & Dispose of Plant Water and Fire Protection						
Quantity	:	3,100.00 lbs						
Daily Production	:	6,000.00 lbs per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	0.5 Days	**Estimator**	:	Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$0.74 per lbs	**Probable Low Cost Parameter**			**6600**	**$2,068**	**$0.67**
Total Cost	:	$2,298	**Probable High Cost Parameter**			**4800**	**$2,757**	**$0.89**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.5	8	4.00	L	$48.27	incl. in rate	incl. in rate	$193.08
Laborer	Active	2.00	0.5	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Steelworker	Active	2.00	0.5	8	8.00	L	$65.52	incl. in rate	incl. in rate	$524.16
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.5	8	4.00	E	$111.64	incl. in rate	incl. in rate	$446.56
Truck Driver (heavy)	Active	1.00	0.5	8	4.00	L	$57.59	incl. in rate	incl. in rate	$230.36

Labor Hours	**24**	**TOTAL LABOR**	**$1,314.00**
Equipment Hours	**4**	**TOTAL EQUIPMENT**	**$446.56**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$65.70	$65.70

TOTAL MATERIAL	**$65.70**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,314.00	Labor Burden @	49.7%	$0.00		$1,314.00
Material Cost	$65.70	Material Tax @	7.8%	$5.09		$70.79
Equipment Cost	$446.56	Equipment Tax @	0.0%	$0.00		$446.56
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,826**			**$5**	**DIRECT COST SUBTOTALS**	**$1,831**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,831.35		$274.70
Installing Contractors Profit@	8.0%				$1,831.35		$146.51
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$421.21**
General Contractors Insurance @	1.0%		on		$2,252.56		$23
Bond @	1.0%		on		$2,252.56		$23
Contingency @	0.0%		on		$2,297.61		$0
						TOTAL COST for pay item	**$2,298**

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 1140 LF of 1 1/2" pipes at 2.72 Lbs. Used 1 Forman, 2 Steelworkers to cut the pipes and 2 Laborers to load the pipes in the truck.

PAY ITEM COST DETAIL WORKSHEET — **1.039 Remove & Dispose of Transformer Oil Fire Protection**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.039	**Project**	:	JCBOYLE			
Description	:	Remove & Dispose of Transformer Oil Fire Protection						
Quantity	:	6,500.00 lbs						
Daily Production	:	6,000.00 lbs per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	1.1 Days	**Estimator**	:	Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$0.80 per lbs	**Probable Low Cost Parameter**			**6900**	**$4,426**	**$0.68**
Total Cost	:	$5,207	**Probable High Cost Parameter**			**4800**	**$6,248**	**$0.96**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.1	8	8.80	L	$48.27	incl. in rate	incl. in rate	$424.78
Laborer	Active	2.00	1.1	8	17.60	L	$45.80	incl. in rate	incl. in rate	$806.08
Steelworker	Active	2.00	1.1	8	17.60	L	$65.52	incl. in rate	incl. in rate	$1,153.15
Pump, Centrifugal, 3"	Active	1.00	1.1	8	8.80	E	$2.76	incl. in rate	incl. in rate	$24.25
Truck Driver (light)	Active	1.00	1.1	8	8.80	L	$56.29	incl. in rate	incl. in rate	$495.35
Truck, Pickup (4x4, 3/4tn)	Active	1.00	1.1	8	8.80	E	$16.94	incl. in rate	incl. in rate	$149.07

Labor Hours	**52.8**	**TOTAL LABOR**	**$2,879.36**
Equipment Hours	**17.6**	**TOTAL EQUIPMENT**	**$173.32**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$143.97	$143.97

TOTAL MATERIAL	**$143.97**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.81	ton	1.000	0.81	$595.00	$483.44
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	85.60	$7.25	$620.60

TOTAL SUBCONTRACTS	**$1,104.04**

SUMMARY OF COSTS

Labor Cost	$2,879.36	Labor Burden @	49.7%	$0.00		$2,879.36
Material Cost	$143.97	Material Tax @	7.8%	$11.16		$155.13
Equipment Cost	$173.32	Equipment Tax @	0.0%	$0.00		$173.32
Subcontractors	$1,104.04					$1,104.04
DIRECT COST SUBTOTALS	**$4,301**			**$11**	**DIRECT COST SUBTOTALS**	**$4,312**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,207.81	$481.17
Installing Contractors Profit@	8.0%				$3,207.81	$256.62
GC Markup on Subs @	5.0%				$1,104.04	$55.20
					TOTAL MARKUP COSTS	**$793.00**
General Contractors Insurance @	1.0%		on		$5,104.84	$51
Bond @	1.0%		on		$5,104.84	$51
Contingency @	0.0%		on		$5,206.94	$0
					TOTAL COST for pay item	**$5,207**

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 2390 LF of 1 1/2" fire protection pipes at 2.72 Lbs. Used 1 Forman, 2 Steelworkers to cut the pipes and 3 Laborers to load the pipes in the truck. Calculated 58.6 miles from JC Boyle to Yreka Transfer Recycling. Each hydropower facility has at least 150,000 gallons to 250,000 gallon of oil currently in use. This oil would have to be properly disposed of in the event of decommissioning. Oil removed from the turbines and other equipment, including transformer oil, would be either a waste oil or used oil, depending on prior use and contaminants found in the oil. Containerized oil containing contaminants such as solvents are commonly encountered at hydropower facilities. Oil sludge are common in tanks. Oil disposal would likely be costly due to the large volumes found at hydropower facilities and the ease of contamination with other regulated hazardous wastes.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.040	**Project**	: JCBOYLE				
Description	:	Remove & Dispose of Unwatering Piping						
Quantity	:	33,000.00 lbs						
Daily Production	:	18,000.00 lbs per 8 hour shift	**Project #**	: Klamath Dams Removal				
Work Days	:	1.8 Days	**Estimator**	: Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**	
Unit Price	:	$0.74 per lbs	**Probable Low Cost Parameter**		**21600**	**$19,481**	**$0.59**	
Total Cost	:	$24,351	**Probable High Cost Parameter**		**13500**	**$30,439**	**$0.92**	

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	1.8	8	28.80	L	$48.27	incl. in rate	incl. in rate	$1,390.18
Electrician	Active	1.00	1.8	8	14.40	L	$45.23	incl. in rate	incl. in rate	$651.31
Steelworker	Active	4.00	1.8	8	57.60	L	$65.52	incl. in rate	incl. in rate	$3,773.95
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.8	8	14.40	E	$221.50	incl. in rate	incl. in rate	$3,189.60
Truck Driver (heavy)	Active	1.00	1.8	8	14.40	L	$57.59	incl. in rate	incl. in rate	$829.30
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.8	8	14.40	E	$111.64	incl. in rate	incl. in rate	$1,607.62
Laborer	Active	4.00	1.8	8	57.60	L	$45.80	incl. in rate	incl. in rate	$2,638.08
Welder	Active	1.00	1.8	8	14.40	L	$7.84	incl. in rate	incl. in rate	$112.86
Gas Welding Machine	Active	1.00	1.8	8	14.40	E	$2.88	incl. in rate	incl. in rate	$41.43
Equipment Operator (medium)	Active	1.00	1.8	8	14.40	L	$66.28	incl. in rate	incl. in rate	$954.43
Equipment Operator (crane)	Active	1.00	1.8	8	14.40	L	$68.41	incl. in rate	incl. in rate	$985.10

Labor Hours	**216**	**TOTAL LABOR**	**$11,335.21**
Equipment Hours	**43.2**	**TOTAL EQUIPMENT**	**$4,838.64**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$566.76	$566.76

TOTAL MATERIAL	**$566.76**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (25% from total weight)	4.13	ton	1.000	4.13 $595.00	$2,454.38
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	85.60 $7.25	$620.60

TOTAL SUBCONTRACTS	**$3,074.98**

SUMMARY OF COSTS

Labor Cost	$11,335.21	Labor Burden @	49.7%	$0.00	$11,335.21
Material Cost	$566.76	Material Tax @	7.8%	$43.92	$610.68
Equipment Cost	$4,838.64	Equipment Tax @	0.0%	$0.00	$4,838.64
Subcontractors	$3,074.98				$3,074.98
DIRECT COST SUBTOTALS	**$19,816**			**$44**	**DIRECT COST SUBTOTALS** **$19,860**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$16,784.54	$2,517.68
Installing Contractors Profit@	8.0%				$16,784.54	$1,342.76
GC Markup on Subs @	5.0%				$3,074.98	$153.75
					TOTAL MARKUP COSTS	**$4,014.19**
General Contractors Insurance @	1.0%		on		$23,873.71	$239
Bond @	1.0%		on		$23,873.71	$239
Contingency @	0.0%		on		$24,351.18	$0
					TOTAL COST for pay item	**$24,351**

Additional Pay Item Notes :

Used RS Means : Assumed Pipe, metal pipe, to 1-1/2" diam., selective demolition, 12150 LF of 1 1/2" pipes at 2.72 Lbs. Used 2 Crew formed of 1 Forman, 2 Steelworkers to cut the pipes, 1 Welder to cut steel in inaccessible places , 2 Laborers to haul the pipes in the truck with the loader, 1 electrician to unplug the power and to assure the temporary power at the construction site. Calculated 85.6 miles from JC Boyle to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.041	**Project**	:	JCBOYLE			
Description	:	Remove & Dispose of Drainage Piping						
Quantity	:	10,000.00 lbs						
Daily Production	:	4,450.00 lbs per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	2.2 Days	**Estimator**	:	Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$0.84 per lbs	**Probable Low Cost Parameter**			**5117.5**	**$7,100**	**$0.71**
Total Cost	:	$8,353	**Probable High Cost Parameter**			**3560**	**$10,024**	**$1.00**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	2.2	8	17.60	L	$48.27	incl. in rate	incl. in rate	$849.55
Laborer	Active	1.00	2.2	8	17.60	L	$45.80	incl. in rate	incl. in rate	$806.08
Steelworker	Active	1.00	2.2	8	17.60	L	$65.52	incl. in rate	incl. in rate	$1,153.15
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Equipment Operator (light)	Active	1.00	1.0	8	8.00	L	$64.90	incl. in rate	incl. in rate	$519.20

Labor Hours	**68.8**	**TOTAL LABOR**	**$3,788.70**
Equipment Hours	**16**	**TOTAL EQUIPMENT**	**$2,665.12**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$189.44	$189.44

TOTAL MATERIAL	**$189.44**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$3,788.70	Labor Burden @	49.7%	$0.00	$3,788.70
Material Cost	$189.44	Material Tax @	7.8%	$14.68	$204.12
Equipment Cost	$2,665.12	Equipment Tax @	0.0%	$0.00	$2,665.12
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$6,643**			**$15**	**DIRECT COST SUBTOTALS** **$6,658**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$6,657.94	$998.69
Installing Contractors Profit@	8.0%				$6,657.94	$532.64
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,531.33**
General Contractors Insurance @	1.0%		on		$8,189.27	$82
Bond @	1.0%		on		$8,189.27	$82
Contingency @	0.0%		on		$8,353.05	$0
					TOTAL COST for pay item	**$8,353**

Additional Pay Item Notes :

2750 LF of 1 " drainage pipes at 3.66 Lbs. Used 1 Loader and 1 Forman, 1 Steelworkers to cut the pipes and 1 Laborers to load the pipes in the truck.

PAY ITEM COST DETAIL WORKSHEET — **1.042 Remove & Dispose of 2-Oil Sump pumps**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.042	**Project**	: JCBOYLE				
Description	:	Remove & Dispose of 2-Oil Sump pumps						
Quantity	:	2,000.00 lbs						
Daily Production	:	6,000.00 lbs per 8 hour shift	**Project #**	: Klamath Dams Removal				
Work Days	:	0.3 Days	**Estimator**	: Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**	
Unit Price	:	$1.27 per lbs	**Probable Low Cost Parameter**		**6600**	**$2,283**	**$1.14**	
Total Cost	:	$2,536	**Probable High Cost Parameter**		**5100**	**$2,917**	**$1.46**	

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.3	8	2.40	L	$48.27	incl. in rate	incl. in rate	$115.85
Electrician	Active	1.00	0.3	8	2.40	L	$45.23	incl. in rate	incl. in rate	$108.55
Laborer	Active	2.00	0.3	8	4.80	L	$45.80	incl. in rate	incl. in rate	$219.84
Hydraulic Crane (17tn)	Active	1.00	0.2	8	1.60	E	$81.52	incl. in rate	incl. in rate	$130.43
Truck Driver (heavy)	Active	1.00	0.2	8	1.60	L	$57.59	incl. in rate	incl. in rate	$92.14
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.2	8	1.60	E	$111.64	incl. in rate	incl. in rate	$178.62
Equipment Operator (light)	Active	1.00	0.2	8	1.60	L	$64.90	incl. in rate	incl. in rate	$103.84

Labor Hours	**12.8**	**TOTAL LABOR**	**$640.22**
Equipment Hours	**3.2**	**TOTAL EQUIPMENT**	**$309.06**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$32.01	$32.01

TOTAL MATERIAL	**$32.01**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (assumed weight)	1.00	ton	1.000	1.00	$595.00	$595.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	85.60	$7.25	$620.60

TOTAL SUBCONTRACTS	**$1,215.60**

SUMMARY OF COSTS

Labor Cost	$640.22	Labor Burden @	49.7%	$0.00	$640.22
Material Cost	$32.01	Material Tax @	7.8%	$2.48	$34.49
Equipment Cost	$309.06	Equipment Tax @	0.0%	$0.00	$309.06
Subcontractors	$1,215.60				$1,215.60
DIRECT COST SUBTOTALS	**$2,197**			**$2**	**DIRECT COST SUBTOTALS** **$2,199**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$983.77	$147.57
Installing Contractors Profit@	8.0%				$983.77	$78.70
GC Markup on Subs @	5.0%				$1,215.60	$60.78
					TOTAL MARKUP COSTS	**$287.05**
General Contractors Insurance @	1.0%		on		$2,486.42	$25
Bond @	1.0%		on		$2,486.42	$25
Contingency @	0.0%		on		$2,536.15	$0
					TOTAL COST for pay item	**$2,536**

Additional Pay Item Notes :

Used 1 crane to pick up the oil sump pumps, 1 Forman and 2 Laborers to remove the pumps. One electrician to unplug the power and assure the temporary power at the construction site. Assumed hazardous waste since we deal with the oil sump pump.

PAY ITEM COST DETAIL WORKSHEET — **1.043 Remove & Dispose of Draft Tube Bulk Head Gates and Hoists at the Powerhouse**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.043	**Project**	:	JCBOYLE			
Description	:	Remove & Dispose of Draft Tube Bulk Head Gates and Hoists at the Powerhouse						
Quantity	:	65,000.00 lbs						
Daily Production	:	25,000.00 lbs per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	2.6 Days	**Estimator**	:	Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$0.71 per lbs	**Probable Low Cost Parameter**			**28750**	**$39,403**	**$0.61**
Total Cost	:	$46,356	**Probable High Cost Parameter**			**18750**	**$57,946**	**$0.89**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	2.6	8	20.80	L	$48.27	incl. in rate	incl. in rate	$1,004.02
Electrician	Active	1.00	2.6	8	20.80	L	$45.23	incl. in rate	incl. in rate	$940.78
Ironworkers	Active	4.00	2.6	8	83.20	L	$63.95	incl. in rate	incl. in rate	$5,320.64
Millwright	Active	6.00	2.6	8	124.80	L	$69.46	incl. in rate	incl. in rate	$8,668.61
Truck Driver (heavy)	Active	4.00	2.6	8	83.20	L	$57.59	incl. in rate	incl. in rate	$4,791.49
Truck, Flatbed (4x4, 10,000 gvw)	Active	4.00	2.6	8	83.20	E	$31.90	incl. in rate	incl. in rate	$2,654.08
Crawler Crane (270tn)	Active	1.00	2.6	8	20.80	E	$399.50	incl. in rate	incl. in rate	$8,309.60
Welder	Active	2.00	2.6	8	41.60	L	$7.84	incl. in rate	incl. in rate	$326.04
Gas Welding Machine	Active	2.00	2.6	8	41.60	E	$2.88	incl. in rate	incl. in rate	$119.68
Equipment Operator (crane)	Active	1.00	2.6	8	20.80	L	$68.41	incl. in rate	incl. in rate	$1,422.93

Labor Hours	**395.2**	**TOTAL LABOR**	**$22,474.50**
Equipment Hours	**145.6**	**TOTAL EQUIPMENT**	**$11,083.36**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,123.73	$1,123.73

TOTAL MATERIAL	**$1,123.73**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	3.25	ton	1.000	3.25	$595.00	$1,933.75
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	85.60	$7.25	$620.60
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$2,554.35**

SUMMARY OF COSTS

Labor Cost	$22,474.50	Labor Burden @	49.7%	$0.00		$22,474.50
Material Cost	$1,123.73	Material Tax @	7.8%	$87.09		$1,210.81
Equipment Cost	$11,083.36	Equipment Tax @	0.0%	$0.00		$11,083.36
Subcontractors	$2,554.35					$2,554.35
DIRECT COST SUBTOTALS	**$37,236**			**$87**	**DIRECT COST SUBTOTALS**	**$37,323**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$34,768.68		$5,215.30
Installing Contractors Profit@	8.0%				$34,768.68		$2,781.49
GC Markup on Subs @	5.0%				$2,554.35		$127.72
						TOTAL MARKUP COSTS	**$8,124.51**
General Contractors Insurance @	1.0%		on		$45,447.54		$454
Bond @	1.0%		on		$45,447.54		$454
Contingency @	0.0%		on		$46,356.50		$0
						TOTAL COST for pay item	**$46,356**

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Assumed contains paint with heavy metals 10% of the total lbs., calculated 85.6 miles from JC Boyle to Yreka Transfer Recycling.

PAY ITEM COST DETAIL WORKSHEET — **1.043a Remove petroleum products from Mechanical Equipment**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.043a	**Project**	:	JCBOYLE			
Description	:	Remove petroleum products from Mechanical Equipment						
Quantity	:	2,700.00 GAL						
Daily Production	:	550.00 GAL per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	4.9 Days	**Estimator**	:	Mihaela Tomulescu	**GAL per**	**Total Cost**	**Unit Price Per GAL**
Unit Price	:	$10.27 per GAL	**Probable Low Cost Parameter**			**632.5**	**$23,575**	**$8.73**
Total Cost	:	$27,735	**Probable High Cost Parameter**			**385**	**$36,056**	**$13.35**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	4.9	8	39.20	L	$48.27	incl. in rate	incl. in rate	$1,892.18
Electrician	Active	1.00	4.9	8	39.20	L	$45.23	incl. in rate	incl. in rate	$1,773.02
Laborer	Active	4.00	4.9	8	156.80	L	$45.80	incl. in rate	incl. in rate	$7,181.44
Pump, Centrifugal, 3"	Active	3.00	4.9	8	117.60	E	$2.76	incl. in rate	incl. in rate	$324.07
Truck Driver (heavy)	Active	1.00	4.9	8	39.20	L	$57.59	incl. in rate	incl. in rate	$2,257.53
Truck, Tractor (400hp)	Active	1.00	4.9	8	39.20	E	$69.30	incl. in rate	incl. in rate	$2,716.56
Equipment Operator (medium)	Active	1.00	4.9	8	39.20	L	$66.28	incl. in rate	incl. in rate	$2,598.18
Loader, FE Rubber Tire (3.5cy)	Active	1.00	4.9	8	39.20	E	$64.23	incl. in rate	incl. in rate	$2,517.82

Labor Hours	**313.6**	**TOTAL LABOR**	**$15,702.34**
Equipment Hours	**196**	**TOTAL EQUIPMENT**	**$5,558.44**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (filters, pads, etc)	1.00	LS	1.000	1.00	$785.12	$785.12

TOTAL MATERIAL	**$785.12**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$15,702.34	Labor Burden @	49.7%	$0.00		$15,702.34
Material Cost	$785.12	Material Tax @	7.8%	$60.85		$845.96
Equipment Cost	$5,558.44	Equipment Tax @	0.0%	$0.00		$5,558.44
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$22,046**			**$61**	**DIRECT COST SUBTOTALS**	**$22,107**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$22,106.75		$3,316.01
Installing Contractors Profit@	8.0%				$22,106.75		$1,768.54
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$5,084.55**
General Contractors Insurance @	1.0%		on		$27,191.30		$272
Bond @	1.0%		on		$27,191.30		$272
Contingency @	0.0%		on		$27,735.13		$0
						TOTAL COST for pay item	**$27,735**

Additional Pay Item Notes :

The petroleum waste is saved in drums using the loader they are sent to recycling or disposal. Used a crew formed of 1 Forman, 4 Laborers to takeout the petroleum waste with a pump from the mech equipment, 1 Electrician to unplug the power and to assure the temporary power at the construction site.

PAY ITEM COST DETAIL WORKSHEET — **1.044 Remove & Dispose of Outdoor Vertical AC Generator, Unit 1: 53 MVA**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.044	**Project**	:	JC Boyle			
Description	:	Remove & Dispose of Outdoor Vertical AC Generator, Unit 1: 53 MVA						
Quantity	:	2.00 EA						
Daily Production	:	0.40 EA per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	5.0 Days	**Estimator**	:	Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$158,304.56 per EA	**Probable Low Cost Parameter**			**0.46**	**$269,118**	**$134,558.88**
Total Cost	:	$316,609	**Probable High Cost Parameter**			**0.34**	**$364,100**	**$182,050.25**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Crawler Crane (270tn)	Active	2.00	5.0	8	80.00	E	$399.50	incl. in rate	incl. in rate	$31,960.00
Electrician	Active	12.00	5.0	8	480.00	L	$45.23	incl. in rate	incl. in rate	$21,710.40
Equipment Operator (oiler)	Active	1.00	5.0	8	40.00	L	$62.94	incl. in rate	incl. in rate	$2,517.60
Equipment Operator (crane)	Active	2.00	5.0	8	80.00	L	$68.41	incl. in rate	incl. in rate	$5,472.80
Steelworker	Active	20.00	5.0	8	800.00	L	$65.52	incl. in rate	incl. in rate	$52,416.00
Loader, FE Rubber Tire (8.6cy)	Active	2.00	5.0	8	80.00	E	$221.50	incl. in rate	incl. in rate	$17,720.00
Labor Foreman	Active	4.00	5.0	8	160.00	L	$48.27	incl. in rate	incl. in rate	$7,723.20
Welder	Active	4.00	5.0	8	160.00	L	$7.84	incl. in rate	incl. in rate	$1,254.00
Gas Welding Machine	Active	4.00	5.0	8	160.00	E	$2.88	incl. in rate	incl. in rate	$460.32
Truck Driver (heavy)	Active	4.00	5.0	8	160.00	L	$57.59	incl. in rate	incl. in rate	$9,214.40
Truck, Flatbed (4x4, 10,000 gvw)	Active	4.00	5.0	8	160.00	E	$31.90	incl. in rate	incl. in rate	$5,104.00
Electrician Foreman	Active	4.00	5.0	8	160.00	L	$47.23	incl. in rate	incl. in rate	$7,556.80

Labor Hours	**2040**	**TOTAL LABOR**	**$107,865.20**
Equipment Hours	**480**	**TOTAL EQUIPMENT**	**$55,244.32**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$10,786.52	$10,786.52
					TOTAL MATERIAL	**$10,786.52**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Disposal fee	1	EA	1.000	1.00	$89,760.00	$89,760.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	85.60	$7.25	$620.60
					TOTAL SUBCONTRACTS	**$90,380.60**

SUMMARY OF COSTS

Labor Cost	$107,865.20	Labor Burden @	49.7%	$0.00		$107,865.20
Material Cost	$10,786.52	Material Tax @	7.8%	$835.96		$11,622.48
Equipment Cost	$55,244.32	Equipment Tax @	0.0%	$0.00		$55,244.32
Subcontractors	$90,380.60					$90,380.60
DIRECT COST SUBTOTALS	**$264,277**			**$836**	**DIRECT COST SUBTOTALS**	**$265,113**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$174,731.99	$26,209.80
Installing Contractors Profit@	8.0%				$174,731.99	$13,978.56
GC Markup on Subs @	5.0%				$102,003.08	$5,100.15
					TOTAL MARKUP COSTS	**$45,288.51**
General Contractors Insurance @	1.0%		on		$310,401.11	$3,104
Bond @	1.0%		on		$310,401.11	$3,104
Contingency @	0.0%		on		$316,609.13	$0
					TOTAL COST for pay item	**$316,609**

Additional Pay Item Notes :

Used RS Means, 4- R13 Crew formed of 1 Forman, 3 Electricians, 1 Oiler, 0 .25 Equipment Crane, 5 Steelworkers to cut adjacent appurtenances and 1 Welder to cut pipes. Calculated 85.6 miles from JC Boyle to Yreka Transfer Recycling (back and forth). Total Weight 650,000 LBS; Heaviest lift around: 300,000 LBS.

PAY ITEM COST DETAIL WORKSHEET — **1.045 Remove & Dispose of Excitation equipment for 53/50 MVA Generator**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.045	**Project**	:	JCBOYLE			
Description	:	Remove & Dispose of Excitation equipment for 53/50 MVA Generator						
Quantity	:	2.00 EA						
Daily Production	:	1.00 EA per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	2.0 Days	**Estimator**	:	Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$13,425.63 per EA	**Probable Low Cost Parameter**			**1.1**	**$24,166**	**$12,083.07**
Total Cost	:	$26,851	**Probable High Cost Parameter**			**0.9**	**$29,536**	**$14,768.20**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	2.00	2.0	8	32.00	L	$47.23	incl. in rate	incl. in rate	$1,511.36
Electrician	Active	4.00	2.0	8	64.00	L	$45.23	incl. in rate	incl. in rate	$2,894.72
Laborer	Active	4.00	2.0	8	64.00	L	$45.80	incl. in rate	incl. in rate	$2,931.20
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.0	8	16.00	E	$221.50	incl. in rate	incl. in rate	$3,544.00
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Hydraulic Crane (120tn)	Active	1.00	2.0	8	16.00	E	$239.06	incl. in rate	incl. in rate	$3,824.96
Welder	Active	2.00	2.0	8	32.00	L	$7.84	incl. in rate	incl. in rate	$250.80
Gas Welding Machine	Active	2.00	2.0	8	32.00	E	$2.88	incl. in rate	incl. in rate	$92.06
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Equipment Operator (crane)	Active	1.00	2.0	8	16.00	L	$68.41	incl. in rate	incl. in rate	$1,094.56

Labor Hours	**240**	**TOTAL LABOR**	**$10,664.56**
Equipment Hours	**80**	**TOTAL EQUIPMENT**	**$9,247.26**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$533.23	$533.23
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	1,000.00	LF	1.000	1,000.00	$0.85	$850.00

TOTAL MATERIAL	**$1,383.23**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$10,664.56	Labor Burden @	49.7%	$0.00		$10,664.56
Material Cost	$1,383.23	Material Tax @	7.8%	$107.20		$1,490.43
Equipment Cost	$9,247.26	Equipment Tax @	0.0%	$0.00		$9,247.26
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$21,295**			**$107**	**DIRECT COST SUBTOTALS**	**$21,402**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$21,402.25		$3,210.34
Installing Contractors Profit@	8.0%				$21,402.25		$1,712.18
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$4,922.52**
General Contractors Insurance @	1.0%		on		$26,324.77		$263
Bond @	1.0%		on		$26,324.77		$263
Contingency @	0.0%		on		$26,851.27		$0
						TOTAL COST for pay item	**$26,851**

Additional Pay Item Notes :

2 sections, weight 1000LBS - Used 2 Crew of 1 Forman, 1 Electrician, 1 Welder to cut to remove the electrical equipment and 1 laborer to haul. Equipment used 1 Loader and 1 Crane for disposal.

PAY ITEM COST DETAIL WORKSHEET — **1.046 Remove & Dispose of Surge protection equip. for 53/50 MVA Generator**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.046	**Project**	:	JCBOYLE			
Description	:	Remove & Dispose of Surge protection equip. for 53/50 MVA Generator						
Quantity	:	2.00 EA						
Daily Production	:	1.00 EA per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	2.0 Days	**Estimator**	:	Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$8,153.33 per EA	**Probable Low Cost Parameter**			**1.1**	**$14,676**	**$7,337.99**
Total Cost	:	$16,307	**Probable High Cost Parameter**			**0.9**	**$17,937**	**$8,968.66**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	2.00	2.0	8	32.00	L	$47.23	incl. in rate	incl. in rate	$1,511.36
Electrician	Active	2.00	2.0	8	32.00	L	$45.23	incl. in rate	incl. in rate	$1,447.36
Laborer	Active	2.00	2.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.0	8	16.00	E	$221.50	incl. in rate	incl. in rate	$3,544.00
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48

Labor Hours	**128**	**TOTAL LABOR**	**$6,406.24**
Equipment Hours	**32**	**TOTAL EQUIPMENT**	**$5,330.24**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$320.31	$320.31
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	1,000.00	LF	1.000	1,000.00	$0.85	$850.00

TOTAL MATERIAL **$1,170.31**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS **$0.00**

SUMMARY OF COSTS

Labor Cost	$6,406.24	Labor Burden @	49.7%	$0.00	$6,406.24
Material Cost	$1,170.31	Material Tax @	7.8%	$90.70	$1,261.01
Equipment Cost	$5,330.24	Equipment Tax @	0.0%	$0.00	$5,330.24
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$12,907**			**$91**	**DIRECT COST SUBTOTALS** **$12,997**

	Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@ 15.0%				$12,997.49	$1,949.62
Installing Contractors Profit@ 8.0%				$12,997.49	$1,039.80
GC Markup on Subs @ 5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS **$2,989.42**
General Contractors Insurance @ 1.0%		on		$15,986.91	$160
Bond @ 1.0%		on		$15,986.91	$160
Contingency @ 0.0%		on		$16,306.65	$0
					TOTAL COST for pay item **$16,307**

Additional Pay Item Notes :

Used 1 Forman, 1 Electrician to remove the electrical equipment and 1 laborer to haul.

PAY ITEM COST DETAIL WORKSHEET — **1.047 Remove & Dispose of Neutral grounding equip. for 53/50 MVA Generator**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.047	**Project**	:	JCBOYLE			
Description	:	Remove & Dispose of Neutral grounding equip. for 53/50 MVA Generator						
Quantity	:	2.00 EA						
Daily Production	:	1.00 EA per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	2.0 Days	**Estimator**	:	Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$3,980.33 per EA	**Probable Low Cost Parameter**			**1.1**	**$7,165**	**$3,582.30**
Total Cost	:	$7,961	**Probable High Cost Parameter**			**0.9**	**$8,757**	**$4,378.36**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	2.0	8	16.00	L	$47.23	incl. in rate	incl. in rate	$755.68
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Ironworkers	Active	1.00	2.0	8	16.00	L	$63.95	incl. in rate	incl. in rate	$1,023.20
Laborer	Active	1.00	2.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Gas Welding Machine	Active	1.00	2.0	8	16.00	E	$2.88	incl. in rate	incl. in rate	$46.03
Welder	Active	1.00	2.0	8	16.00	L	$7.84	incl. in rate	incl. in rate	$125.40

Labor Hours	**96**	**TOTAL LABOR**	**$4,282.20**
Equipment Hours	**32**	**TOTAL EQUIPMENT**	**$1,832.27**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$214.11	$214.11

TOTAL MATERIAL	**$214.11**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$4,282.20	Labor Burden @	49.7%	$0.00	$4,282.20
Material Cost	$214.11	Material Tax @	7.8%	$16.59	$230.70
Equipment Cost	$1,832.27	Equipment Tax @	0.0%	$0.00	$1,832.27
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$6,329**			**$17**	**DIRECT COST SUBTOTALS** **$6,345**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$6,345.18	$951.78
Installing Contractors Profit@	8.0%				$6,345.18	$507.61
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,459.39**
General Contractors Insurance @	1.0%		on		$7,804.57	$78
Bond @	1.0%		on		$7,804.57	$78
Contingency @	0.0%		on		$7,960.66	$0
					TOTAL COST for pay item	**$7,961**

Additional Pay Item Notes :

Used 1 Forman, 1 Electrician, 1 Ironworker and 1 welder to cut rods, to remove the electrical equipment and 1 laborer to haul in the truck.

PAY ITEM COST DETAIL WORKSHEET — **1.048 Remove & Dispose of Generator Switchgear, 15kV - (6 sections)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.048	**Project**	:	JCBOYLE			
Description	:	Remove & Dispose of Generator Switchgear, 15kV - (6 sections)						
Quantity	:	1.00 EA						
Daily Production	:	1.00 EA per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	1.0 Days	**Estimator**	:	Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$19,730.68 per EA	**Probable Low Cost Parameter**			**1.15**	**$16,771**	**$16,771.08**
Total Cost	:	$19,731	**Probable High Cost Parameter**			**0.75**	**$24,663**	**$24,663.35**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	3.00	1.0	8	24.00	L	$47.23	incl. in rate	incl. in rate	$1,133.52
Electrician	Active	9.00	1.0	8	72.00	L	$45.23	incl. in rate	incl. in rate	$3,256.56
Laborer	Active	6.00	1.0	8	48.00	L	$45.80	incl. in rate	incl. in rate	$2,198.40
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	2.00	1.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	1.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Hydraulic Crane (120tn)	Active	1.00	1.0	8	8.00	E	$239.06	incl. in rate	incl. in rate	$1,912.48
Welder	Active	1.00	1.0	8	8.00	L	$7.84	incl. in rate	incl. in rate	$62.70
Gas Welding Machine	Active	1.00	1.0	8	8.00	E	$2.88	incl. in rate	incl. in rate	$23.02
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
				Labor Hours	**184**			**TOTAL LABOR**		**$8,650.14**
				Equipment Hours	**40**			**TOTAL EQUIPMENT**		**$5,493.74**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$432.51	$432.51
				TOTAL MATERIAL		**$432.51**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (assumed qty)	1.00	ton	1.000	1.00 $595.00	$595.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum (assumed qty)	85.60	mile	1.000	85.60 $7.25	$620.60
				TOTAL SUBCONTRACTS	**$1,215.60**

SUMMARY OF COSTS

Labor Cost	$8,650.14	Labor Burden @	49.7%	$0.00		$8,650.14
Material Cost	$432.51	Material Tax @	7.8%	$33.52		$466.03
Equipment Cost	$5,493.74	Equipment Tax @	0.0%	$0.00		$5,493.74
Subcontractors	$1,215.60					$1,215.60
DIRECT COST SUBTOTALS	**$15,792**			**$34**	**DIRECT COST SUBTOTALS**	**$15,826**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$14,609.90		$2,191.49
Installing Contractors Profit@	8.0%				$15,825.50		$1,266.04
GC Markup on Subs @	5.0%				$1,215.60		$60.78
						TOTAL MARKUP COSTS	**$3,518.31**
General Contractors Insurance @	1.0%		on		$19,343.81		$193
Bond @	1.0%		on		$19,343.81		$193
Contingency @	0.0%		on		$19,730.68		$0
						TOTAL COST for pay item	**$19,731**

Additional Pay Item Notes :

Used 3 Crews (2 sections each) formed of 1 Forman, 3 Electrician, 2 laborer to haul with the crane in the truck. Assumed containing hazardous waste that will be disposed at 85.6 miles away from the construction site. In normal circumstances, decontaminated residual components could be accepted at landfill sites but Polychlorinated biphenyl, otherwise known as PCB, is a synthetic chemical that is widely used for industrial and commercial use as dielectric fluid in transformers and capacitors because of its high resistance to decomposition, low electrical conductivity, low flammability and high heat capacity. Transformer repair, reconditioning and retro-filling facilities are the major industry sectors that contributes to the spread of PCB contamination. Types of PCB Wastes:
PCB wastes are discarded materials that contain PCB or have been contaminated with PCBs and that are without any commercial, industrial, or economic use. For the purpose of this Code of Practice, PCBs wastes are classified as follows: Liquid PCB wastes
o PCB-based dielectric fluids removed from transformers and other equipment
o PCB-based heat transfer and hydraulic fluids Metallic solid wastes
o PCB equipment such as capacitors, transformers, switchgears, circuit breakers, heat transfer systems, etc.
o Contaminated components removed from electrical equipment such as windings; PCB-contaminated containers and equipment such as metal drums, tanks, pumps, metal filters, etc. Calculated 85.6 miles fromJC Boyle to Yreka Transfer Recycling

PAY ITEM COST DETAIL WORKSHEET

1.049 Remove & Dispose of Station Service Switchgear, 600 volt - (5 sections)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.049		**Project**	: JCBOYLE			
Description	:	Remove & Dispose of Station Service Switchgear, 600 volt - (5 sections)						
Quantity	:	1.00 EA						
Daily Production	:	1.00 EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	1.0 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$10,780.56 per EA		**Probable Low Cost Parameter**		**1.1**	**$9,703**	**$9,702.50**
Total Cost	:	$10,781		**Probable High Cost Parameter**		**0.9**	**$11,859**	**$11,858.62**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	3.00	1.0	8	24.00	L	$47.23	incl. in rate	incl. in rate	$1,133.52
Electrician	Active	4.00	1.0	8	32.00	L	$45.23	incl. in rate	incl. in rate	$1,447.36
Laborer	Active	4.00	1.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Welder	Active	1.00	1.0	8	8.00	L	$7.84	incl. in rate	incl. in rate	$62.70
Gas Welding Machine	Active	1.00	1.0	8	8.00	E	$2.88	incl. in rate	incl. in rate	$23.02

Labor Hours	**112**	**TOTAL LABOR**	**$5,100.14**
Equipment Hours	**24**	**TOTAL EQUIPMENT**	**$2,688.14**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$255.01	$255.01

TOTAL MATERIAL	**$255.01**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum (assumed qty)	85.60	mile	1.000	85.60 $7.25	$620.60

TOTAL SUBCONTRACTS	**$620.60**

SUMMARY OF COSTS

Labor Cost	$5,100.14	Labor Burden @	49.7%	$0.00	$5,100.14
Material Cost	$255.01	Material Tax @	7.8%	$19.76	$274.77
Equipment Cost	$2,688.14	Equipment Tax @	0.0%	$0.00	$2,688.14
Subcontractors	$620.60				$620.60
DIRECT COST SUBTOTALS	**$8,664**			**$20**	**DIRECT COST SUBTOTALS** **$8,684**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$8,063.05	$1,209.46
Installing Contractors Profit@	8.0%				$8,063.05	$645.04
GC Markup on Subs @	5.0%				$620.60	$31.03
					TOTAL MARKUP COSTS	**$1,885.53**
General Contractors Insurance @	1.0%		on		$10,569.18	$106
Bond @	1.0%		on		$10,569.18	$106
Contingency @	0.0%		on		$10,780.56	$0
					TOTAL COST for pay item	**$10,781**

Additional Pay Item Notes :

Used 3 Crews (2 sections each) formed of 1 Forman, 2 Electrician, 1welder to cut, 2 laborer to haul with the loader in the truck. Assumed containing hazardous waste that will be disposed . Calculated 85.6 miles fromJC Boyle to Yreka Transfer Recycling

PAY ITEM COST DETAIL WORKSHEET — **1.050 Remove & Dispose of Unit and plant control switchboard**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.050	**Project**	:	JCBOYLE			
Description	:	Remove & Dispose of Unit and plant control switchboard						
Quantity	:	1.00 EA						
Daily Production	:	1.00 EA per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	1.0 Days	**Estimator**	:	Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$5,903.27 per EA	**Probable Low Cost Parameter**			**1.1**	**$5,313**	**$5,312.94**
Total Cost	:	$5,903	**Probable High Cost Parameter**			**0.9**	**$6,494**	**$6,493.60**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.0	8	8.00	L	$47.23	incl. in rate	incl. in rate	$377.84
Electrician	Active	2.00	1.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (light)	Active	0.50	1.0	8	4.00	L	$56.29	incl. in rate	incl. in rate	$225.16
Truck, Off-Road, Articulated Rear, 20cy	Active	0.50	1.0	8	4.00	E	$111.64	incl. in rate	incl. in rate	$446.56

Labor Hours	**36**	**TOTAL LABOR**	**$1,856.92**
Equipment Hours	**12**	**TOTAL EQUIPMENT**	**$2,218.56**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$92.85	$92.85

TOTAL MATERIAL	**$92.85**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum (assumed qty)	85.60	mile	1.000	$7.25	$620.60

TOTAL SUBCONTRACTS	**$620.60**

SUMMARY OF COSTS

Labor Cost	$1,856.92	Labor Burden @	49.7%	$0.00	$1,856.92
Material Cost	$92.85	Material Tax @	7.8%	$7.20	$100.04
Equipment Cost	$2,218.56	Equipment Tax @	0.0%	$0.00	$2,218.56
Subcontractors	$620.60				$620.60
DIRECT COST SUBTOTALS	**$4,789**			**$7**	**DIRECT COST SUBTOTALS** **$4,796**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,175.52	$626.33
Installing Contractors Profit@	8.0%				$4,175.52	$334.04
GC Markup on Subs @	5.0%				$620.60	$31.03
					TOTAL MARKUP COSTS	**$991.40**
General Contractors Insurance @	1.0%		on		$5,787.52	$58
Bond @	1.0%		on		$5,787.52	$58
Contingency @	0.0%		on		$5,903.27	$0
					TOTAL COST for pay item	**$5,903**

Additional Pay Item Notes :

Used 1 crew formed of 1 Forman, 2 Electrician, 1 laborer to haul with the loader in the truck. Assumed containing hazardous waste that will be disposed . Calculated 85.6 miles from JC Boyle to Yreka Transfer Recycling

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.051			Project	:	JCBOYLE		
Description	:	Remove & Dispose - Battery system							
Quantity	:	1.00	EA						
Daily Production	:	0.50	EA per	8 hour shift	Project #	:	Klamath Dams Removal		
Work Days	:	2.0	Days		Estimator	:	Mihaela Tomulescu	EA per	Total Cost / Unit Price Per EA
Unit Price	:	$7,430.59	per EA		Probable Low Cost Parameter			0.55	$6,688 / $6,687.53
Total Cost	:	$7,431			Probable High Cost Parameter			0.45	$8,174 / $8,173.65

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	$0.00		$740.32
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	$0.00		$723.68
Laborer	Active	2.00	2.0	8	32.00	L	$45.80	$0.00		$1,465.60
Loader, FE Rubber Tire (3.5cy)	Active	1.00	1.0	8	8.00	E	$64.23	$64.23		$513.84
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	$111.64		$893.12
Equipment Operator (light)	Active	1.00	1.0	8	8.00	L	$64.90	$0.00		$519.20
Welder	Active	1.00	2.0	8	16.00	L	$7.84	$0.00		$125.40
Gas Welding Machine	Active	1.00	2.0	8	16.00	E	$2.88	$2.88		$46.03
				Labor Hours	96			TOTAL LABOR		$4,034.92
				Equipment Hours	32			TOTAL EQUIPMENT		$1,452.99

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$403.49	$403.49
					TOTAL MATERIAL	$403.49

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$4,034.92	Labor Burden @	49.7%	$0.00	$4,034.92
Material Cost	$403.49	Material Tax @	7.8%	$31.27	$434.76
Equipment Cost	$1,452.99	Equipment Tax @	0.0%	$0.00	$1,452.99
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$5,891			$31	DIRECT COST SUBTOTALS $5,923

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$5,922.67	$888.40
Installing Contractors Profit@	8.0%				$5,922.67	$473.81
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$1,362.22
General Contractors Insurance @	1.0%		on		$7,284.89	$73
Bond @	1.0%		on		$7,284.89	$73
Contingency @	0.0%		on		$7,430.59	$0
					TOTAL COST for pay item	$7,431

Additional Pay Item Notes :

Assuming 2 days of work disposing around 40 batteries, racks and supports. Using Crews E-19 for metals demolition, E-12 and E-25 for cutting steel and A-3H for equipment disposal, B-34A for hauling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.052	**Project**	:	JCBOYLE			
Description	:	Remove & Dispose of Raceways, Conduit and Cable						
Quantity	:	1.00 EA						
Daily Production	:	0.50 EA per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	2.0 Days	**Estimator**	:	Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$13,891.88 per EA	**Probable Low Cost Parameter**			**0.55**	**$12,503**	**$12,502.69**
Total Cost	:	$13,892	**Probable High Cost Parameter**			**0.45**	**$15,281**	**$15,281.07**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	2.0	8	16.00	L	$48.27	incl. in rate	incl. in rate	$772.32
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Laborer	Active	2.00	2.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.0	8	16.00	E	$221.50	incl. in rate	incl. in rate	$3,544.00
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48

Labor Hours	**96**	**TOTAL LABOR**	**$4,943.52**
Equipment Hours	**32**	**TOTAL EQUIPMENT**	**$5,330.24**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$741.53	$741.53

TOTAL MATERIAL	**$741.53**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$4,943.52	Labor Burden @	49.7%	$0.00	$4,943.52
Material Cost	$741.53	Material Tax @	7.8%	$57.47	$799.00
Equipment Cost	$5,330.24	Equipment Tax @	0.0%	$0.00	$5,330.24
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$11,015**			**$57**	**DIRECT COST SUBTOTALS** **$11,073**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$11,072.76	$1,660.91
Installing Contractors Profit@	8.0%				$11,072.76	$885.82
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$2,546.73**
General Contractors Insurance @	1.0%		on		$13,619.49	$136
Bond @	1.0%		on		$13,619.49	$136
Contingency @	0.0%		on		$13,891.88	$0
					TOTAL COST for pay item	**$13,892**

Additional Pay Item Notes :

Used 1 Forman, 2 Electrician, 1 Laborer hauling with the loader in the truck.

PAY ITEM COST DETAIL WORKSHEET — **1.053 Remove & Dispose of Misc. power & control boards**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.053		**Project**	: JCBOYLE			
Description	:	Remove & Dispose of Misc. power & control boards						
Quantity	:	1.00 EA						
Daily Production	:	0.50 EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	2.0 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$7,140.08 per EA		**Probable Low Cost Parameter**		**0.55**	**$6,426**	**$6,426.07**
Total Cost	:	$7,140		**Probable High Cost Parameter**		**0.45**	**$7,854**	**$7,854.09**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	2.0	8	16.00	L	$48.27	incl. in rate	incl. in rate	$772.32
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Laborer	Active	1.00	2.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	1.00	0.5	8	4.00	L	$57.59	incl. in rate	incl. in rate	$230.36
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.5	8	4.00	E	$111.64	incl. in rate	incl. in rate	$446.56
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24

Labor Hours	**60**	**TOTAL LABOR**	**$2,989.40**
Equipment Hours	**12**	**TOTAL EQUIPMENT**	**$2,218.56**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$448.41	$448.41

TOTAL MATERIAL	**$448.41**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,989.40	Labor Burden @	49.7%	$0.00		$2,989.40
Material Cost	$448.41	Material Tax @	7.8%	$34.75		$483.16
Equipment Cost	$2,218.56	Equipment Tax @	0.0%	$0.00		$2,218.56
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$5,656**			**$35**	**DIRECT COST SUBTOTALS**	**$5,691**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$5,691.12	$853.67
Installing Contractors Profit@	8.0%				$5,691.12	$455.29
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,308.96**
General Contractors Insurance @	1.0%		on		$7,000.08	$70
Bond @	1.0%		on		$7,000.08	$70
Contingency @	0.0%		on		$7,140.08	$0
					TOTAL COST for pay item	**$7,140**

Additional Pay Item Notes :

Used 1 Forman, 1 Electrician, 1 Laborer hauling with the loader in the truck.

PAY ITEM COST DETAIL WORKSHEET — **1.054 Remove & Dispose of 5 Gantry Crane motors - hoist (50Hp*), aux hoist**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.054		**Project**	: JCBOYLE				
Description	: Remove & Dispose of 5 Gantry Crane motors - hoist (50Hp*), aux hoist							
Quantity	: 1.00 EA							
Daily Production	: 5.00 EA per 8 hour shift		**Project #**	: Klamath Dams Removal				
Work Days	: 0.2 Days		**Estimator**	: Mihaela Tomulescu		**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	: $1,729.51 per EA		**Probable Low Cost Parameter**			**5.5**	**$1,557**	**$1,556.56**
Total Cost	: $1,730		**Probable High Cost Parameter**			**4**	**$2,075**	**$2,075.41**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	0.2	8	3.20	E	$111.64	$111.64		$357.25
Hydraulic Crane (17tn)	Active	1.00	0.2	8	1.60	E	$81.52	$81.52		$130.43
Laborer	Active	2.00	0.2	8	3.20	L	$45.80	$0.00		$146.56
Equipment Operator (crane)	Active	1.00	0.2	8	1.60	L	$68.41	$0.00		$109.46
Truck Driver (heavy)	Active	2.00	0.2	8	3.20	L	$57.59	$0.00		$184.29

Labor Hours	**8**	**TOTAL LABOR**	**$440.30**
Equipment Hours	**4.8**	**TOTAL EQUIPMENT**	**$487.68**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$22.02	$22.02

TOTAL MATERIAL	**$22.02**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Disposal fee	1	EA	1.000	1.00	$500.00	$500.00

TOTAL SUBCONTRACTS	**$500.00**

SUMMARY OF COSTS

Labor Cost	$440.30	Labor Burden @	49.7%	$0.00		$440.30
Material Cost	$22.02	Material Tax @	7.8%	$1.71		$23.72
Equipment Cost	$487.68	Equipment Tax @	0.0%	$0.00		$487.68
Subcontractors	$500.00					$500.00
DIRECT COST SUBTOTALS	**$1,450**			**$2**	**DIRECT COST SUBTOTALS**	**$1,452**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$951.71		$142.76
Installing Contractors Profit@	8.0%				$951.71		$76.14
GC Markup on Subs @	5.0%				$500.00		$25.00
						TOTAL MARKUP COSTS	**$243.89**
General Contractors Insurance @	1.0%	on			$1,695.60		$17
Bond @	1.0%	on			$1,695.60		$17
Contingency @	0.0%	on			$1,729.51		$0
						TOTAL COST for pay item	**$1,730**

Additional Pay Item Notes :

Assumed removal of hoist, hoist trolley, gantry: 2 Laborers to load the overhead crane motors in the truck using the crane.

PAY ITEM COST DETAIL WORKSHEET — **1.055 Remove & Dispose of Gantry Crane control equipment (3 cubicles)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.055	**Project**	: JCBOYLE		
Description	: Remove & Dispose of Gantry Crane control equipment (3 cubicles)				
Quantity	: 1.00 EA				
Daily Production	: 1.00 EA per 8 hour shift	**Project #**	: Klamath Dams Removal		
Work Days	: 1.0 Days	**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost** / **Unit Price Per EA**
Unit Price	: $5,869.29 per EA	**Probable Low Cost Parameter**		**1.1**	**$5,282** / **$5,282.36**
Total Cost	: $5,869	**Probable High Cost Parameter**		**0.9**	**$6,456** / **$6,456.22**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	$111.64		$893.12
Hydraulic Crane (80tn)	Active	1.00	1.0	8	8.00	E	$190.46	$190.46		$1,523.68
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	$0.00		$732.80
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	$0.00		$547.28
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72

Labor Hours	**32**	**TOTAL LABOR**	**$1,740.80**
Equipment Hours	**16**	**TOTAL EQUIPMENT**	**$2,416.80**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$87.04	$87.04

TOTAL MATERIAL	**$87.04**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Disposal fee	1	EA	1.000	1.00	$500.00	$500.00
						$0.00
						$0.00
				TOTAL SUBCONTRACTS		**$500.00**

SUMMARY OF COSTS

Labor Cost	$1,740.80	Labor Burden @	49.7%	$0.00	$1,740.80
Material Cost	$87.04	Material Tax @	7.8%	$6.75	$93.79
Equipment Cost	$2,416.80	Equipment Tax @	0.0%	$0.00	$2,416.80
Subcontractors	$500.00				$500.00
DIRECT COST SUBTOTALS	**$4,745**			**$7**	**DIRECT COST SUBTOTALS** **$4,751**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,251.39	$637.71
Installing Contractors Profit@	8.0%				$4,251.39	$340.11
GC Markup on Subs @	5.0%				$500.00	$25.00
					TOTAL MARKUP COSTS	**$1,002.82**
General Contractors Insurance @	1.0%		on		$5,754.20	$58
Bond @	1.0%		on		$5,754.20	$58
Contingency @	0.0%		on		$5,869.29	$0
					TOTAL COST for pay item	**$5,869**

Additional Pay Item Notes :

One day work for 3 cubicles: 2 Laborers and 1 Electrician will load in the truck with the crane the control equipment. Assumed weight: 900 LBS

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.056			Project	:	COPCO 2		
Description	:	Remove & Dispose of Conduit and Cable							
Quantity	:	1.00	EA						
Daily Production	:	0.50	EA per	8 hour shift	Project #	:	Klamath Dams Removal		
Work Days	:	2.0	Days		Estimator	:	Mihaela Tomulescu	EA per	Total Cost / Unit Price Per EA
Unit Price	:	$10,561.93	per EA		Probable Low Cost Parameter			0.55	$9,506 / $9,505.74
Total Cost	:	$10,562			Probable High Cost Parameter			0.4	$12,674 / $12,674.32

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Laborer	Active	4.00	2.0	8	64.00	L	$45.80	$0.00		$2,931.20
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	$0.00		$1,060.48
Loader, FE Rubber Tire (3.5cy)	Active	1.00	2.0	8	16.00	E	$64.23	$64.23		$1,027.68
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	$111.64		$1,786.24
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	$0.00		$921.44

Labor Hours	96	TOTAL LABOR	$4,913.12
Equipment Hours	32	TOTAL EQUIPMENT	$2,813.92

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$245.66	$245.66

TOTAL MATERIAL	$245.66

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Disposal fee (Allowance)	1.00	EA	1.000	1.00	$500.00	$500.00

TOTAL SUBCONTRACTS	$500.00

SUMMARY OF COSTS

Labor Cost	$4,913.12	Labor Burden @	49.7%	$0.00		$4,913.12
Material Cost	$245.66	Material Tax @	7.8%	$19.04		$264.69
Equipment Cost	$2,813.92	Equipment Tax @	0.0%	$0.00		$2,813.92
Subcontractors	$500.00					$500.00
DIRECT COST SUBTOTALS	$8,473			$19	DIRECT COST SUBTOTALS	$8,492

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$7,991.73	$1,198.76
Installing Contractors Profit@	8.0%				$7,991.73	$639.34
GC Markup on Subs @	5.0%				$500.00	$25.00
					TOTAL MARKUP COSTS	$1,863.10
General Contractors Insurance @	1.0%		on		$10,354.83	$104
Bond @	1.0%		on		$10,354.83	$104
Contingency @	0.0%		on		$10,561.93	$0
					TOTAL COST for pay item	$10,562

Additional Pay Item Notes :

Around 4000 LF of cable and conduit: 4 Laborers will load in the truck with the loader the overhead crane cable.

PAY ITEM COST DETAIL WORKSHEET — **1.057 Remove & Dispose of Exterior Lighting**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.057	**Project**	:	JC BOYLE			
Description	:	Remove & Dispose of Exterior Lighting						
Quantity	:	1.00 EA						
Daily Production	:	1.00 EA per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	1.0 Days	**Estimator**	:	Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$10,640.74 per EA	**Probable Low Cost Parameter**			**1.1**	**$9,577**	**$9,576.66**
Total Cost	:	$10,641	**Probable High Cost Parameter**			**0.85**	**$12,237**	**$12,236.85**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Hydraulic Crane (17tn)	Active	1.00	1.0	8	8.00	E	$81.52	incl. in rate	incl. in rate	$652.16
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Hydraulic Excavator (1.5cy)	Active	1.00	1.0	8	8.00	E	$141.92	incl. in rate	incl. in rate	$1,135.36
Truck, Utility, with Man-Basket	Active	1.00	1.0	8	8.00	E	$31.90	incl. in rate	incl. in rate	$255.20

Labor Hours	**48**	**TOTAL LABOR**	**$2,455.76**
Equipment Hours	**32**	**TOTAL EQUIPMENT**	**$2,935.84**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$122.79	$122.79
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	6.00	CY	1.000	6.00	$4.74	$28.44

TOTAL MATERIAL	**$151.23**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
line work - Rent per day	1.00	days		$3,000.00	$3,000.00

TOTAL SUBCONTRACTS	**$3,000.00**

SUMMARY OF COSTS

Labor Cost	$2,455.76	Labor Burden @	49.7%	$0.00	$2,455.76
Material Cost	$151.23	Material Tax @	7.8%	$11.72	$162.95
Equipment Cost	$2,935.84	Equipment Tax @	0.0%	$0.00	$2,935.84
Subcontractors	$3,000.00				$3,000.00
DIRECT COST SUBTOTALS	**$8,543**			**$12**	**DIRECT COST SUBTOTALS** **$8,555**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$8,554.55	$1,283.18
Installing Contractors Profit@	8.0%				$5,554.55	$444.36
GC Markup on Subs @	5.0%				$3,000.00	$150.00
					TOTAL MARKUP COSTS	**$1,877.55**
General Contractors Insurance @	1.0%		on		$10,432.09	$104
Bond @	1.0%		on		$10,432.09	$104
Contingency @	0.0%		on		$10,640.74	$0
					TOTAL COST for pay item	**$10,641**

Additional Pay Item Notes :

6 Poles with lights, weight 1500 LBS. Production is based of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane and 1 man-basket truck to help untie the line) for one day work. Considered 2 laborer and 1 Excavator for demolish the pole foundation, helping placing poles in a designated place and loading them in the truck for disposal. This process includes filling in pole locations with gravel, clean fill and topsoil.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.058	**Project**	:	JCBOYLE			
Description	:	Remove & Dispose of Transmission Line No. 59						
Quantity	:	1.66 Mile						
Daily Production	:	0.50 Mile per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	3.3 Days	**Estimator**	:	Mihaela Tomulescu	**Mile per**	**Total Cost**	**Unit Price Per Mile**
Unit Price	:	$31,411.84 per Mile	**Probable Low Cost Parameter**			**0.575**	**$44,322**	**$26,700.06**
Total Cost	:	$52,144	**Probable High Cost Parameter**			**0.375**	**$65,180**	**$39,264.80**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	3.3	8	26.56	L	$47.23	$0.00		$1,254.43
Electrician	Active	2.00	3.3	8	53.12	L	$45.23	$0.00		$2,402.62
Truck, Utility, with Man-Basket	Active	2.00	3.3	8	53.12	E	$31.90	$31.90		$1,694.53
Truck Driver (heavy)	Active	4.00	3.3	8	106.24	L	$57.59	$0.00		$6,118.36
Laborer	Active	2.00	3.3	8	53.12	L	$45.80	$0.00		$2,432.90
Hydraulic Excavator (2.5cy)	Active	1.00	3.3	8	26.56	E	$203.63	$203.63		$5,408.41
Hydraulic Crane (80tn)	Active	1.00	3.3	8	26.56	E	$190.46	$190.46		$5,058.62
Equipment Operator (crane)	Active	1.00	3.3	8	26.56	L	$68.41	$0.00		$1,816.97
Equipment Operator (light)	Active	1.00	3.3	8	26.56	L	$64.90	$0.00		$1,723.74
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	3.3	8	26.56	E	$62.72	$62.72		$1,665.84
Truck, Flatbed (4x4, 10,000 gvw)	Active	3.00	3.3	8	79.68	E	$31.90	$31.90		$2,541.79

Labor Hours	**292.16**	**TOTAL LABOR**	**$15,749.02**
Equipment Hours	**212.48**	**TOTAL EQUIPMENT**	**$16,369.19**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$787.45	$787.45
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	31.00	CY	1.000	31.00	$4.74	$146.94

TOTAL MATERIAL	**$934.39**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	3.32	days		$3,000.00	$9,960.00

TOTAL SUBCONTRACTS	**$9,960.00**

SUMMARY OF COSTS

Labor Cost	$15,749.02	Labor Burden @	49.7%	$0.00		$15,749.02
Material Cost	$934.39	Material Tax @	7.8%	$72.42		$1,006.81
Equipment Cost	$16,369.19	Equipment Tax @	0.0%	$0.00		$16,369.19
Subcontractors	$9,960.00					$9,960.00
DIRECT COST SUBTOTALS	**$43,013**			**$72**	**DIRECT COST SUBTOTALS**	**$43,085**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$33,125.02		$4,968.75
Installing Contractors Profit@	8.0%				$32,118.21		$2,569.46
GC Markup on Subs @	5.0%				$9,960.00		$498.00
						TOTAL MARKUP COSTS	**$8,036.21**
General Contractors Insurance @	1.0%		on		$51,121.23		$511
Bond @	1.0%		on		$51,121.23		$511
Contingency @	0.0%		on		$52,143.65		$0
						TOTAL COST for pay item	**$52,144**

Additional Pay Item Notes :

When a transmission line is decommissioned and is not converted to another use, the decommissioning typically includes the removal of all infrastructure if it is no longer required, or has reached end-of-life conditions. Removed parts will be re-used, recycled or disposed. Production is based off of RSMs using Crew B-1C and B-3 (1 Forman, 2 laborer, 1 Excavator & 1 crane for lift, position and load in the truck, 1 Hydraulic rock-splitting/rock-drilling equipment to break equipment foundations and concrete for demo :2 Electrician,, 1 utility truck to access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, hydro plant and switchyard. Transmission line poles or structures are commonly between 60 and 140 feet tall. There are several different kinds of transmission structures. Transmission structures can be constructed of metal or wood. They can be single-poled or multi-poled. They can be single-circuited, carrying one set of transmission lines or double-circuited with two sets of lines. Assumed based on RSMs we have "Communications transmission tower, radio towers self-supporting, wind load 70 mph basic wind speed, 120' high" (33811310). Pole height and load capacity limitations determine the distance between poles (span length) either on the basis of ground clearance or ability to support heavy wind and ice loads. Assumed average span between structures to be 275 feet so for 1.66 miles of overhead transmission we will have approximately 31 structures. In areas where single-pole structures are preferred, weak or wet soils may require concrete foundations for support. Where a transmission line must cross a street or slightly change direction, larger angle structures or guy wires may be required. Poles with guy wires impact a much larger area. Angle structures are usually more than double the diameter of other steel poles. They are made of steel, usually five to six feet in diameter, and have a large concrete base. The base may be buried ten or more feet below the ground surface. The diameter of the pole and the depth the base is buried depends on the condition of the soils and the voltage of the line. Assumed the structures are disposed to Yreka recycling, 85.6 miles away. This estimate is made as the best AECOM assumption, as actual pricing would occur during the detailed engineering and construction bid process.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.059			**Project**	: JCBOYLE			
Description	:	Remove & Dispose of Transmission Line No. 98							
Quantity	:	0.24	Mile						
Daily Production	:	0.50	Mile per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	0.5	Days		**Estimator**	: Mihaela Tomulescu	**Mile per**	**Total Cost**	**Unit Price Per Mile**
Unit Price	:	$27,715.54	per Mile		**Probable Low Cost Parameter**		**0.575**	**$5,654**	**$23,558.21**
Total Cost	:	$6,652			**Probable High Cost Parameter**		**0.375**	**$8,315**	**$34,644.42**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	0.5	8	3.84	L	$47.23	$0.00		$181.36
Electrician	Active	2.00	0.5	8	7.68	L	$45.23	$0.00		$347.37
Truck, Utility, with Man-Basket	Active	2.00	0.5	8	7.68	E	$31.90	$31.90		$244.99
Truck Driver (heavy)	Active	2.00	0.5	8	7.68	L	$57.59	$0.00		$442.29
Laborer	Active	2.00	0.5	8	7.68	L	$45.80	$0.00		$351.74
Hydraulic Excavator (2.5cy)	Active	1.00	0.5	8	3.84	E	$203.63	$203.63		$781.94
Hydraulic Crane (80tn)	Active	1.00	0.5	8	3.84	E	$190.46	$190.46		$731.37
Equipment Operator (crane)	Active	1.00	0.5	8	3.84	L	$68.41	$0.00		$262.69
Equipment Operator (light)	Active	1.00	0.5	8	3.84	L	$64.90	$0.00		$249.22
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	0.5	8	3.84	E	$62.72	$62.72		$240.84
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	0.5	8	3.84	E	$31.90	$31.90		$122.50

Labor Hours	**34.56**	**TOTAL LABOR**	**$1,834.68**
Equipment Hours	**23.04**	**TOTAL EQUIPMENT**	**$2,121.64**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$91.73	$91.73
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	5.00	CY	1.000	5.00	$4.74	$23.70

TOTAL MATERIAL	**$115.43**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	0.48	days		$3,000.00	$1,440.00

TOTAL SUBCONTRACTS	**$1,440.00**

SUMMARY OF COSTS

Labor Cost	$1,834.68	Labor Burden @	49.7%	$0.00	$1,834.68
Material Cost	$115.43	Material Tax @	7.8%	$8.95	$124.38
Equipment Cost	$2,121.64	Equipment Tax @	0.0%	$0.00	$2,121.64
Subcontractors	$1,440.00				$1,440.00
DIRECT COST SUBTOTALS	**$5,512**			**$9**	**DIRECT COST SUBTOTALS** **$5,521**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,080.69	$612.10
Installing Contractors Profit@	8.0%				$3,956.31	$316.51
GC Markup on Subs @	5.0%				$1,440.00	$72.00
					TOTAL MARKUP COSTS	**$1,000.61**
General Contractors Insurance @	1.0%		on		$6,521.30	$65
Bond @	1.0%		on		$6,521.30	$65
Contingency @	0.0%		on		$6,651.73	$0
					TOTAL COST for pay item	**$6,652**

Additional Pay Item Notes :

When a transmission line is decommissioned and is not converted to another use, the decommissioning typically includes the removal of all infrastructure if it is no longer required, or has reached end-of-life conditions. Removed parts will be re-used, recycled or disposed. Production is based off of RSMs using Crew B-1C and B-3 (1 Forman, 2 laborer, 1 Excavator & 1 crane for lift, position and load in the truck, 1 Hydraulic rock-splitting/rock-drilling equipment to break equipment foundations and concrete for demo :2 Electrician,, 1 utility truck to access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, hydro plant and switchyard. Transmission line poles or structures are commonly between 60 and 140 feet tall. There are several different kinds of transmission structures. Transmission structures can be constructed of metal or wood, assumed we have wood. They can be single-poled or multi-poled. They can be single-circuited, carrying one set of transmission lines or double-circuited with two sets of lines. Assumed based on RSMs we have "Communications transmission tower, radio towers self-supporting, wind load 70 mph basic wind speed, 120' high" (33811310). Pole height and load capacity limitations determine the distance between poles (span length) either on the basis of ground clearance or ability to support heavy wind and ice loads. Assumed average span between structures to be 275 feet so for 0.24 miles of overhead transmission we will have approximately 5 structures. In areas where single-pole structures are preferred, weak or wet soils may require concrete foundations for support. Where a transmission line must cross a street or slightly change direction, larger angle structures or guy wires may be required. Poles with guy wires impact a much larger area. Angle structures are usually more than double the diameter of other steel poles. They are made of steel, usually five to six feet in diameter, and have a large concrete base. The base may be buried ten or more feet below the ground surface. The diameter of the pole and the depth the base is buried depends on the condition of the soils and the voltage of the line. Assumed the structures are disposed to Yreka recycling, 85.6 miles away. This estimate is made as the best AECOM assumption, as actual pricing would occur during the detailed engineering and construction bid process.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.060		**Project**	:	JCBOYLE			
Description	:	Remove & Dispose of Transmission Line No. 58							
Quantity	:	1.66	Mile						
Daily Production	:	0.50	Mile per	8	hour shift	**Project #**	:	Klamath Dams Removal	
Work Days	:	3.3	Days			**Estimator**	:	Mihaela Tomulescu	
Unit Price	:	$31,411.84	per Mile			**Probable Low Cost Parameter**		**0.575**	**$44,322**	**$26,700.06**
Total Cost	:	$52,144				**Probable High Cost Parameter**		**0.375**	**$65,180**	**$39,264.80**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	3.3	8	26.56	L	$47.23	$0.00		$1,254.43
Electrician	Active	2.00	3.3	8	53.12	L	$45.23	$0.00		$2,402.62
Truck, Utility, with Man-Basket	Active	2.00	3.3	8	53.12	E	$31.90	$31.90		$1,694.53
Truck Driver (heavy)	Active	4.00	3.3	8	106.24	L	$57.59	$0.00		$6,118.36
Laborer	Active	2.00	3.3	8	53.12	L	$45.80	$0.00		$2,432.90
Hydraulic Excavator (2.5cy)	Active	1.00	3.3	8	26.56	E	$203.63	$203.63		$5,408.41
Hydraulic Crane (80tn)	Active	1.00	3.3	8	26.56	E	$190.46	$190.46		$5,058.62
Equipment Operator (crane)	Active	1.00	3.3	8	26.56	L	$68.41	$0.00		$1,816.97
Equipment Operator (light)	Active	1.00	3.3	8	26.56	L	$64.90	$0.00		$1,723.74
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	3.3	8	26.56	E	$62.72	$62.72		$1,665.84
Truck, Flatbed (4x4, 10,000 gvw)	Active	3.00	3.3	8	79.68	E	$31.90	$31.90		$2,541.79

Labor Hours	**292.16**	**TOTAL LABOR**	**$15,749.02**
Equipment Hours	**212.48**	**TOTAL EQUIPMENT**	**$16,369.19**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$787.45	$787.45
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	31.00	CY	1.000	31.00	$4.74	$146.94

TOTAL MATERIAL	**$934.39**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	3.32	days		$3,000.00	$9,960.00

TOTAL SUBCONTRACTS	**$9,960.00**

SUMMARY OF COSTS

Labor Cost	$15,749.02	Labor Burden @	49.7%	$0.00	$15,749.02
Material Cost	$934.39	Material Tax @	7.8%	$72.42	$1,006.81
Equipment Cost	$16,369.19	Equipment Tax @	0.0%	$0.00	$16,369.19
Subcontractors	$9,960.00				$9,960.00
DIRECT COST SUBTOTALS	**$43,013**			**$72**	**DIRECT COST SUBTOTALS** **$43,085**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$33,125.02	$4,968.75
Installing Contractors Profit@	8.0%				$32,118.21	$2,569.46
GC Markup on Subs @	5.0%				$9,960.00	$498.00
					TOTAL MARKUP COSTS	**$8,036.21**
General Contractors Insurance @	1.0%		on		$51,121.23	$511
Bond @	1.0%		on		$51,121.23	$511
Contingency @	0.0%		on		$52,143.65	$0
					TOTAL COST for pay item	**$52,144**

Additional Pay Item Notes :

When a transmission line is decommissioned and is not converted to another use, the decommissioning typically includes the removal of all infrastructure if it is no longer required, or has reached end-of-life conditions. Removed parts will be re-used, recycled or disposed. Production is based off of RSMs using Crew B-1C and B-3 (1 Forman, 2 laborer, 1 Excavator & 1 crane for lift, position and load in the truck, 1 Hydraulic rock-splitting/rock-drilling equipment to break equipment foundations and concrete for demo :2 Electrician,, 1 utility truck to access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, hydro plant and switchyard. Transmission line poles or structures are commonly between 60 and 140 feet tall. There are several different kinds of transmission structures. Transmission structures can be constructed of metal or wood. They can be single-poled or multi-poled. They can be single-circuited, carrying one set of transmission lines or double-circuited with two sets of lines. Assumed based on RSMs we have "Communications transmission tower, radio towers self-supporting, wind load 70 mph basic wind speed, 120' high" (33811310). Pole height and load capacity limitations determine the distance between poles (span length) either on the basis of ground clearance or ability to support heavy wind and ice loads. Assumed average span between structures to be 275 feet so for 1.66 miles of overhead transmission we will have approximately 31 structures. In areas where single-pole structures are preferred, weak or wet soils may require concrete foundations for support. Where a transmission line must cross a street or slightly change direction, larger angle structures or guy wires may be required. Poles with guy wires impact a much larger area. Angle structures are usually more than double the diameter of other steel poles. They are made of steel, usually five to six feet in diameter, and have a large concrete base. The base may be buried ten or more feet below the ground surface. The diameter of the pole and the depth the base is buried depends on the condition of the soils and the voltage of the line. Assumed the structures are disposed to Yreka recycling, 85.6 miles away. This estimate is made as the best AECOM assumption, as actual pricing would occur during the detailed engineering and construction bid process.

PAY ITEM COST DETAIL WORKSHEET

1.061 Remove Intake Structure Concrete

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.061			**Project**	: JC Boyle			
Description	:	Remove Intake Structure Concrete							
Quantity	:	1,600.00	cy						
Daily Production	:	60.00	cy per	8 hour shift	**Project #**	: 1			
Work Days	:	26.7	Days		**Estimator**	: Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$294.80	per cy		**Probable Low Cost Parameter**		**66**	**$424,508**	**$265.32**
Total Cost	:	$471,675			**Probable High Cost Parameter**		**48**	**$566,010**	**$353.76**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	26.7	8	427.20	L	$48.27	incl. in rate	incl. in rate	$20,620.94
Laborer	Active	8.00	26.7	8	1,708.80	L	$45.80	incl. in rate	incl. in rate	$78,263.04
Equipment Operator (medium)	Active	2.00	26.7	8	427.20	L	$66.28	incl. in rate	incl. in rate	$28,314.82
Truck Driver (heavy)	Active	1.00	26.7	8	213.60	L	$57.59	incl. in rate	incl. in rate	$12,301.22
Air Compressor 600 cfm	Active	1.00	26.7	8	213.60	E	$21.74	incl. in rate	incl. in rate	$4,643.43
Air Compressor 900 cfm	Active	1.00	26.7	8	213.60	E	$38.87	incl. in rate	incl. in rate	$8,302.40
Air Tool, Chipping Hammer	Active	5.00	26.7	8	1,068.00	E	$1.64	incl. in rate	incl. in rate	$1,750.49
Generator, Small Generator, 10 - 15 kW	Active	2.00	26.7	8	427.20	E	$7.04	incl. in rate	incl. in rate	$3,007.49
Hydraulic Excavator (5.0cy)	Active	2.00	26.7	8	427.20	E	$274.63	incl. in rate	incl. in rate	$117,321.94
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	2.00	26.7	8	427.20	E	$62.72	incl. in rate	incl. in rate	$26,793.98
Hydraulic Thumbs/Shear Attachment	Active	2.00	26.7	8	427.20	E	$16.39	incl. in rate	incl. in rate	$7,001.81
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	26.7	8	213.60	E	$111.64	incl. in rate	incl. in rate	$23,846.30
			26.7	8	0.00					$0.00
			26.7	8	0.00					$0.00
			26.7	8	0.00					$0.00
			26.7	8	0.00					$0.00
			26.7	8	0.00					$0.00
				Labor Hours	**2,777**			**TOTAL LABOR**		**$139,500.02**
				Equipment Hours	**3,418**			**TOTAL EQUIPMENT**		**$192,667.84**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$6,975.00	$6,975.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$6,975.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	10	EA	**Cost per Mob**	$2,500.00	$25,000.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$25,000.00**

SUMMARY OF COSTS

Labor Cost	$139,500.02	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$139,500.02
Material Cost	$6,975.00	Material Tax @	7.75%	$540.56		$7,515.56
Equipment Cost	$192,667.84	Equipment Tax @	7.75%	$14,931.76		$207,599.60
Subcontractors	$25,000.00					$25,000.00
DIRECT COST SUBTOTALS	**$364,143**			**$15,472**	**DIRECT COST SUBTOTALS**	**$379,615**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$354,615.19	$53,192.28
Installing Contractors Profit@	8.0%				$354,615.19	$28,369.22
GC Markup on Subs @	5.0%				$25,000.00	$1,250.00
					TOTAL MARKUP COSTS	**$82,811.49**
General Contractors Insurance @	1.0%			on	$462,426.68	$4,624
Bond @	1.0%			on	$462,426.68	$4,624
Contingency @	0.0%			on	$471,675.22	$0
					TOTAL COST for pay item	**$471,675**

Additional Pay Item Notes :

The work is done by one 6-men crew (foreman, 4 laborers, and 2 equipment operators). Concrete hauling to scour hole is also included - based on the current production rate only 3 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. This productivity is considerably slower than flume demolition due to access. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM COST DETAIL WORKSHEET

1.062 Remove Fish Screen Building

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.062		**Project**	: JC Boyle			
Description	:	Remove Fish Screen Building						
Quantity	:	2,010.00	SF					
Daily Production	:	260.00	SF per	8	hour shift	**Project #**	: 1	
Work Days	:	7.7	Days			**Estimator**	: Eric Jones	
Unit Price	:	$70.46	per SF			**Probable Low Cost Parameter**	**273**	**$134,535**	**$66.93**
Total Cost	:	$141,616				**Probable High Cost Parameter**	**234**	**$155,777**	**$77.50**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	7.7	8	61.60	L	$48.27	incl. in rate	incl. in rate	$2,973.43
Laborer	Active	2.00	7.7	8	123.20	L	$45.80	incl. in rate	incl. in rate	$5,642.56
Truck Driver (heavy)	Active	4.00	7.7	8	246.40	L	$57.59	incl. in rate	incl. in rate	$14,190.18
Equipment Operator (medium)	Active	3.00	7.7	8	184.80	L	$66.28	incl. in rate	incl. in rate	$12,248.54
Equipment Operator (crane)	Active	1.00	7.7	8	61.60	L	$68.41	incl. in rate	incl. in rate	$4,214.06
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	7.7	8	123.20	E	$31.90	incl. in rate	incl. in rate	$3,930.08
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	7.7	8	123.20	E	$70.35	incl. in rate	incl. in rate	$8,667.12
Hydraulic Crane (80tn)	Active	1.00	7.7	8	61.60	E	$190.46	incl. in rate	incl. in rate	$11,732.34
Hydraulic Excavator (5.0cy)	Active	2.00	7.7	8	123.20	E	$274.63	incl. in rate	incl. in rate	$33,834.42
Loader, FE Rubber Tire (5.25cy)	Active	1.00	***2.5***	8	20.00	E	$75.42	incl. in rate	incl. in rate	$1,508.40
		1.00	7.7	8	61.60	0	$0.00	$0.00		$0.00
		1.00	7.7	8	61.60	0	$0.00	$0.00		$0.00
			7.7	8	0.00					$0.00
			7.7	8	0.00					$0.00
			7.7	8	0.00					$0.00
			7.7	8	0.00					$0.00
			7.7	8	0.00					$0.00
				Labor Hours	**677.6**			**TOTAL LABOR**		**$39,268.77**
				Equipment Hours	**451.2**			**TOTAL EQUIPMENT**		**$59,672.35**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Dump Fee Coversion (SFXH*.33/27)	295	CY			$0.00
Dump Fee Conversion (295 CY / 2 Tons)	147.40	tons	**Klamath County LandFill**	$74.00	$10,907.60
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$10,907.60**

SUMMARY OF COSTS

Labor Cost	$39,268.77	Labor Burden @	0.0%		$39,268.77
Material Cost	$0.00	Material Tax @	7.75%	$0.00	$0.00
Equipment Cost	$59,672.35	Equipment Tax @	7.75%	$4,624.61	$64,296.96
Subcontractors	$10,907.60				$10,907.60
DIRECT COST SUBTOTALS	**$109,849**			**$4,625**	**DIRECT COST SUBTOTALS** **$114,473**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$103,565.73	$15,534.86
Installing Contractors Profit@	8.0%				$103,565.73	$8,285.26
GC Markup on Subs @	5.0%				$10,907.60	$545.38
					TOTAL MARKUP COSTS	**$24,365.50**
General Contractors Insurance @	1.0%			on	$138,838.82	$1,388
Bond @	1.0%			on	$138,838.82	$1,388
Contingency @	0.0%			on	$141,615.60	$0
					TOTAL COST for pay item	**$141,616**

Additional Pay Item Notes :

Duration accounts for mobilization and demobilization, crane is to be used for flying material out of the demolition area as the excavator tears building down building, some of the building will need to be taken down by hand with crane support due to excavator not be able to reach certain sections. 1 excavator will be used to load trucks, 1 FE loader will be used half of the time to maintain hauling area. due to the building being near water limiting access the production has been reduced when compared to other buildings being demolished.

PAY ITEM COST DETAIL WORKSHEET — **1.063 Remove 24" Steel Fish Discahrge Pipe**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.063	**Project**	:	JCBOYLE			
Description	:	Remove 24" Steel Fish Discahrge Pipe						
Quantity	:	37,978.00 LBS						
Daily Production	:	25,000.00 LBS per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	1.5 Days	**Estimator**	:	Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.31 per LBS	**Probable Low Cost Parameter**			**28750**	**$10,033**	**$0.26**
Total Cost	:	$11,804	**Probable High Cost Parameter**			**18750**	**$14,755**	**$0.39**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.5	8	12.00	L	$48.27	incl. in rate	incl. in rate	$579.24
Laborer	Active	1.00	1.5	8	12.00	L	$45.80	incl. in rate	incl. in rate	$549.60
Steelworker	Active	1.00	1.5	8	12.00	L	$65.52	incl. in rate	incl. in rate	$786.24
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.5	8	12.00	E	$221.50	incl. in rate	incl. in rate	$2,658.00
Truck Driver (heavy)	Active	1.00	1.5	8	12.00	L	$57.59	incl. in rate	incl. in rate	$691.08
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.5	8	12.00	E	$111.64	incl. in rate	incl. in rate	$1,339.68
Equipment Operator (light)	Active	1.00	1.5	8	12.00	L	$64.90	incl. in rate	incl. in rate	$778.80
Hydraulic Crane (17tn)	Active	1.00	1.5	8	12.00	E	$81.52	incl. in rate	incl. in rate	$978.24
Equipment Operator (crane)	Active	1.00	1.5	8	12.00	L	$68.41	incl. in rate	incl. in rate	$820.92

Labor Hours	**72**	**TOTAL LABOR**	**$4,205.88**
Equipment Hours	**36**	**TOTAL EQUIPMENT**	**$4,975.92**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$210.29	$210.29

TOTAL MATERIAL	**$210.29**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$4,205.88	Labor Burden @	49.7%	$0.00		$4,205.88
Material Cost	$210.29	Material Tax @	7.8%	$16.30		$226.59
Equipment Cost	$4,975.92	Equipment Tax @	0.0%	$0.00		$4,975.92
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$9,392**			**$16**	**DIRECT COST SUBTOTALS**	**$9,408**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$9,408.39		$1,411.26
Installing Contractors Profit@	8.0%				$9,408.39		$752.67
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$2,163.93**
General Contractors Insurance @	1.0%		on		$11,572.32		$116
Bond @	1.0%		on		$11,572.32		$116
Contingency @	0.0%		on		$11,803.77		$0
						TOTAL COST for pay item	**$11,804**

Additional Pay Item Notes :

340 LF of 24" iron drainage pipes at 111.7Lbs/LF. Used 1 Loader and 1 Forman, 1 Steelworkers to cut the pipes and 1 Laborers to load the pipes in the truck.

PAY ITEM COST DETAIL WORKSHEET — **1.064 Remove Concrete Items associated with the 14-ft-diameter Steel Pipe**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.064		**Project**	: JC Boyle			
Description	:	Remove Concrete Items associated with the 14-ft-diameter Steel Pipe						
Quantity	:	1,100.00 cy						
Daily Production	:	40.00 cy per 8 hour shift		**Project #**	: 1			
Work Days	:	27.5 Days		**Estimator**	: Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$287.96 per cy		**Probable Low Cost Parameter**		**46**	**$269,239**	**$244.76**
Total Cost	:	$316,752		**Probable High Cost Parameter**		**34**	**$364,265**	**$331.15**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	27.5	8	220.00	L	$48.27	incl. in rate	incl. in rate	$10,619.40
Laborer	Active	4.00	27.5	8	880.00	L	$45.80	incl. in rate	incl. in rate	$40,304.00
Equipment Operator (medium)	Active	2.00	27.5	8	440.00	L	$66.28	incl. in rate	incl. in rate	$29,163.20
Truck Driver (heavy)	Active	1.00	27.5	8	220.00	L	$57.59	incl. in rate	incl. in rate	$12,669.80
Air Compressor 900 cfm	Active	1.00	27.5	8	220.00	E	$38.87	incl. in rate	incl. in rate	$8,551.16
Air Tool, Chipping Hammer	Active	3.00	27.5	8	660.00	E	$1.64	incl. in rate	incl. in rate	$1,081.76
Generator, Small Generator, 10 - 15 kW	Active	2.00	27.5	8	440.00	E	$7.04	incl. in rate	incl. in rate	$3,097.60
Hydraulic Excavator (5.0cy)	Active	1.00	27.5	8	220.00	E	$274.63	incl. in rate	incl. in rate	$60,418.60
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	27.5	8	220.00	E	$62.72	incl. in rate	incl. in rate	$13,798.40
Hydraulic Thumbs/Shear Attachment	Active	1.00	27.5	8	220.00	E	$16.39	incl. in rate	incl. in rate	$3,605.80
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	27.5	8	220.00	E	$111.64	incl. in rate	incl. in rate	$24,560.80
Loader, FE Rubber Tire (5.25cy)	Active	1.00	27.5	8	220.00	E	$75.42	incl. in rate	incl. in rate	$16,592.40
			27.5	8	0.00					$0.00
			27.5	8	0.00					$0.00
			27.5	8	0.00					$0.00
			27.5	8	0.00					$0.00
			27.5	8	0.00					$0.00
				Labor Hours	**1,760**			**TOTAL LABOR**		**$92,756.40**
				Equipment Hours	**2,420**			**TOTAL EQUIPMENT**		**$131,706.53**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$4,637.82	$4,637.82
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$4,637.82**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	6	EA	**Cost per Mob**	$2,500.00	$15,000.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$15,000.00**

SUMMARY OF COSTS

Labor Cost	$92,756.40	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$92,756.40
Material Cost	$4,637.82	Material Tax @	7.75%	$359.43		$4,997.25
Equipment Cost	$131,706.53	Equipment Tax @	7.75%	$10,207.26		$141,913.78
Subcontractors	$15,000.00					$15,000.00
DIRECT COST SUBTOTALS	**$244,101**			**$10,567**	**DIRECT COST SUBTOTALS**	**$254,667**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$239,667.43	$35,950.11
Installing Contractors Profit@	8.0%				$239,667.43	$19,173.39
GC Markup on Subs @	5.0%				$15,000.00	$750.00
					TOTAL MARKUP COSTS	**$55,873.51**
General Contractors Insurance @	1.0%		on		$310,540.94	$3,105
Bond @	1.0%		on		$310,540.94	$3,105
Contingency @	0.0%		on		$316,751.76	$0
					TOTAL COST for pay item	**$316,752**

Additional Pay Item Notes :

The work is done by FOUR 7-men crew (foreman, 4 laborers, and 2 equipment operators). Concrete hauling to scour hole is also included - based on the current production rate only 3 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. This productivity is considerably slower than flume demolition due to access. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM COST DETAIL WORKSHEET

1.065 Remove Open Concrete Flume

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.065			**Project**	: JC Boyle			
Description	:	Remove Open Concrete Flume							
Quantity	:	26,000.00	cy						
Daily Production	:	180.00	cy per	8 hour shift	**Project #**	: 1			
Work Days	:	144.4	Days		**Estimator**	: Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$266.49	per cy		**Probable Low Cost Parameter**		**198**	**$6,235,894**	**$239.84**
Total Cost	:	$6,928,771			**Probable High Cost Parameter**		**144**	**$8,314,525**	**$319.79**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	4.00	144.4	8	4,620.80	L	$48.27	incl. in rate	incl. in rate	$223,046.02
Laborer	Active	16.00	144.4	8	18,483.20	L	$45.80	incl. in rate	incl. in rate	$846,530.56
Equipment Operator (medium)	Active	10.00	144.4	8	11,552.00	L	$66.28	incl. in rate	incl. in rate	$765,666.56
Truck Driver (heavy)	Active	2.00	144.4	8	2,310.40	L	$57.59	incl. in rate	incl. in rate	$133,055.94
Air Compressor 900 cfm	Active	4.00	144.4	8	4,620.80	E	$38.87	incl. in rate	incl. in rate	$179,605.51
Air Tool, Chipping Hammer	Active	12.00	144.4	8	13,862.40	E	$1.64	incl. in rate	incl. in rate	$22,720.95
Generator, Small Generator, 10 - 15 kW	Active	8.00	144.4	8	9,241.60	E	$7.04	incl. in rate	incl. in rate	$65,060.86
Hydraulic Excavator (5.0cy)	Active	6.00	144.4	8	6,931.20	E	$274.63	incl. in rate	incl. in rate	$1,903,515.46
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	4.00	144.4	8	4,620.80	E	$62.72	incl. in rate	incl. in rate	$289,816.58
Hydraulic Thumbs/Shear Attachment	Active	4.00	144.4	8	4,620.80	E	$16.39	incl. in rate	incl. in rate	$75,734.91
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	144.4	8	2,310.40	E	$111.64	incl. in rate	incl. in rate	$257,933.06
Loader, FE Rubber Tire (5.25cy)	Active	4.00	144.4	8	4,620.80	E	$75.42	incl. in rate	incl. in rate	$348,500.74
			144.4	8	0.00					$0.00
			144.4	8	0.00					$0.00
			144.4	8	0.00					$0.00
			144.4	8	0.00					$0.00
			144.4	8	0.00					$0.00
				Labor Hours	**36,966**			**TOTAL LABOR**		**$1,968,299.07**
				Equipment Hours	**50,829**			**TOTAL EQUIPMENT**		**$3,142,888.05**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$98,414.95	$98,414.95
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$98,414.95**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	29	EA	**Cost per Mob**	$2,500.00	$72,500.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$72,500.00**

SUMMARY OF COSTS

Labor Cost	$1,968,299.07	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$1,968,299.07
Material Cost	$98,414.95	Material Tax @	7.75%	$7,627.16		$106,042.11
Equipment Cost	$3,142,888.05	Equipment Tax @	7.75%	$243,573.82		$3,386,461.88
Subcontractors	$72,500.00					$72,500.00
DIRECT COST SUBTOTALS	**$5,282,102**			**$251,201**	**DIRECT COST SUBTOTALS**	**$5,533,303**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$5,460,803.06	$819,120.46
Installing Contractors Profit@	8.0%				$5,460,803.06	$436,864.24
GC Markup on Subs @	5.0%				$72,500.00	$3,625.00
					TOTAL MARKUP COSTS	**$1,259,609.70**
General Contractors Insurance @	1.0%			on	$6,792,912.77	$67,929
Bond @	1.0%			on	$6,792,912.77	$67,929
Contingency @	0.0%			on	$6,928,771.02	$0
					TOTAL COST for pay item	**$6,928,771**

Additional Pay Item Notes :

The work is done by FOUR 7-men crew (foreman, 4 laborers, and 2 equipment operators). Concrete hauling to scour hole is also included - based on the current production rate only 3 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM COST DETAIL WORKSHEET — **1.066 Remove Structural Steel items associated with Forebay Trash Rack Piers**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.066		**Project**	:	JCBOYLE			
Description	:	Remove Structural Steel items associated with Forebay Trash Rack Piers							
Quantity	:	11,500.00	LBS						
Daily Production	:	25,000.00	LBS per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	0.5	Days	**Estimator**	:	Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.49	per LBS	**Probable Low Cost Parameter**			**28750**	**$4,784**	**$0.42**
Total Cost	:	$5,628		**Probable High Cost Parameter**			**18750**	**$7,035**	**$0.61**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.5	8	4.00	L	$48.27	incl. in rate	incl. in rate	$193.08
Laborer	Active	2.00	0.5	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Steelworker	Active	1.00	0.5	8	4.00	L	$65.52	incl. in rate	incl. in rate	$262.08
Crawler Crane (90tn)	Active	1.00	1.0	8	8.00	E	$208.09	incl. in rate	incl. in rate	$1,664.72
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28

Labor Hours	**32**	**TOTAL LABOR**	**$1,829.56**
Equipment Hours	**16**	**TOTAL EQUIPMENT**	**$2,557.84**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$91.48	$91.48

TOTAL MATERIAL	**$91.48**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,829.56	Labor Burden @	49.7%	$0.00		$1,829.56
Material Cost	$91.48	Material Tax @	7.8%	$7.09		$98.57
Equipment Cost	$2,557.84	Equipment Tax @	0.0%	$0.00		$2,557.84
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$4,479**			**$7**	**DIRECT COST SUBTOTALS**	**$4,486**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,485.97	$672.90
Installing Contractors Profit@	8.0%				$4,485.97	$358.88
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,031.77**
General Contractors Insurance @	1.0%	on			$5,517.74	$55
Bond @	1.0%	on			$5,517.74	$55
Contingency @	0.0%	on			$5,628.09	$0
					TOTAL COST for pay item	**$5,628**

Additional Pay Item Notes :

Used 1 Crane and 1 Foreman, 1 Steelworkers to cut the beams that support the trash rack and 2 Laborers to load the pipes in the truck.

PAY ITEM COST DETAIL WORKSHEET

1.067 Remove Forebay Concrete

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.067			**Project**	: JC Boyle			
Description	:	Remove Forebay Concrete							
Quantity	:	2,500.00	cy						
Daily Production	:	75.00	cy per	8 hour shift	**Project #**	: 1			
Work Days	:	33.3	Days		**Estimator**	: Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$298.78	per cy		**Probable Low Cost Parameter**		**82.5**	**$672,256**	**$268.90**
Total Cost	:	$746,951			**Probable High Cost Parameter**		**60**	**$896,341**	**$358.54**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	33.3	8	532.80	L	$48.27	incl. in rate	incl. in rate	$25,718.26
Laborer	Active	8.00	33.3	8	2,131.20	L	$45.80	incl. in rate	incl. in rate	$97,608.96
Equipment Operator (medium)	Active	4.00	33.3	8	1,065.60	L	$66.28	incl. in rate	incl. in rate	$70,627.97
Truck Driver (heavy)	Active	2.00	33.3	8	532.80	L	$57.59	incl. in rate	incl. in rate	$30,683.95
Air Compressor 900 cfm	Active	2.00	33.3	8	532.80	E	$38.87	incl. in rate	incl. in rate	$20,709.36
Air Tool, Chipping Hammer	Active	6.00	33.3	8	1,598.40	E	$1.64	incl. in rate	incl. in rate	$2,619.83
Generator, Small Generator, 10 - 15 kW	Active	4.00	33.3	8	1,065.60	E	$7.04	incl. in rate	incl. in rate	$7,501.82
Hydraulic Excavator (5.0cy)	Active	2.00	33.3	8	532.80	E	$274.63	incl. in rate	incl. in rate	$146,322.86
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	2.00	33.3	8	532.80	E	$62.72	incl. in rate	incl. in rate	$33,417.22
Hydraulic Thumbs/Shear Attachment	Active	2.00	33.3	8	532.80	E	$16.39	incl. in rate	incl. in rate	$8,732.59
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	33.3	8	532.80	E	$111.64	incl. in rate	incl. in rate	$59,481.79
Loader, FE Rubber Tire (5.25cy)	Active	2.00	33.3	8	532.80	E	$75.42	incl. in rate	incl. in rate	$40,183.78
			33.3	8	0.00					$0.00
			33.3	8	0.00					$0.00
			33.3	8	0.00					$0.00
			33.3	8	0.00					$0.00
			33.3	8	0.00					$0.00
				Labor Hours	**4,262**			**TOTAL LABOR**		**$224,639.14**
				Equipment Hours	**5,861**			**TOTAL EQUIPMENT**		**$318,969.26**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$11,231.96	$11,231.96
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$11,231.96**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	7	EA	**Cost per Mob**	$2,500.00	$17,500.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$17,500.00**

SUMMARY OF COSTS

Labor Cost	$224,639.14	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$224,639.14
Material Cost	$11,231.96	Material Tax @	7.75%	$870.48		$12,102.43
Equipment Cost	$318,969.26	Equipment Tax @	7.75%	$24,720.12		$343,689.37
Subcontractors	$17,500.00					$17,500.00
DIRECT COST SUBTOTALS	**$572,340**			**$25,591**	**DIRECT COST SUBTOTALS**	**$597,931**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$580,430.94	$87,064.64
Installing Contractors Profit@	8.0%				$580,430.94	$46,434.48
GC Markup on Subs @	5.0%				$17,500.00	$875.00
					TOTAL MARKUP COSTS	**$134,374.12**
General Contractors Insurance @	1.0%		on		$732,305.06	$7,323
Bond @	1.0%		on		$732,305.06	$7,323
Contingency @	0.0%		on		$746,951.16	$0
					TOTAL COST for pay item	**$746,951**

Additional Pay Item Notes :

The work is done by FOUR 7-men crew (foreman, 4 laborers, and 2 equipment operators). Concrete hauling to scour hole is also included - based on the current production rate only 3 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. This productivity is considerably slower than flume demolition due to access. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM COST DETAIL WORKSHEET

1.068 Place Concrete Plugs at Tunnel Portals

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.068			**Project**	: JC Boyle			
Description	: Place Concrete Plugs at Tunnel Portals							
Quantity	: 30.00 CY							
Daily Production	: 6.00 CY per	8	hour shift	**Project #**	: 1			
Work Days	: 5.0 Days			**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	: $1,616.26 per CY			**Probable Low Cost Parameter**		**6.3**	**$46,063**	**$1,535.45**
Total Cost	: $48,488			**Probable High Cost Parameter**		**5.7**	**$50,912**	**$1,697.08**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Carpenter Foreman (out)	Active	1.00	5.0	8	40.00	L	$46.40	incl. in rate	incl. in rate	$1,856.00
Carpenters	Active	2.00	5.0	8	80.00	L	$72.60	incl. in rate	incl. in rate	$5,808.00
Carpenters, Journeyman	Active	4.00	5.0	8	160.00	L	$65.37	incl. in rate	incl. in rate	$10,459.20
Equipment Operator (crane)	Active	2.00	5.0	8	80.00	L	$68.41	incl. in rate	incl. in rate	$5,472.80
Equipment Operator (light)	Active	2.00	***1.0***	8	16.00	L	$64.90	incl. in rate	incl. in rate	$1,038.40
Hydraulic Crane (80tn)	Active	1.00	5.0	8	40.00	E	$190.46	incl. in rate	incl. in rate	$7,618.40
Conc Pump (small)	Active	1.00	***1.0***	8	8.00	E	$61.43	incl. in rate	incl. in rate	$491.44
0		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
0		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
				Labor Hours	**376**			**TOTAL LABOR**		**$24,634.40**
				Equipment Hours	**48**			**TOTAL EQUIPMENT**		**$8,109.84**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
Concrete	30.00	gal	1.000	30.00	$144.13	$4,323.90
Concrete blocks for backing	400.00	lbs PLS	1.000	400.00	$1.43	$572.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$4,895.90**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$24,634.40	Labor Burden @	0.0%		$24,634.40
Material Cost	$4,895.90	Material Tax @	7.75%	$379.43	$5,275.33
Equipment Cost	$8,109.84	Equipment Tax @	7.75%	$628.51	$8,738.35
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$37,640**			**$1,008**	**DIRECT COST SUBTOTALS** **$38,648**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$38,648.08	$5,797.21
Installing Contractors Profit@	8.0%				$38,648.08	$3,091.85
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$8,889.06**
General Contractors Insurance @	1.0%			on	$47,537.14	$475
Bond @	1.0%			on	$47,537.14	$475
Contingency @	0.0%			on	$48,487.89	$0
					TOTAL COST for pay item	**$48,488**

Additional Pay Item Notes :

Carpenter crew will be used to form and pour plugs in the dry after penstock is removed, Hydraulic Crane will be supporting crew for materials, Concrete pump is expected to used 1 day to pour concrete. Figuring a total of 5 days to mobilize and construct plug.

PAY ITEM COST DETAIL WORKSHEET

1.069 Remove Concrete Items associated with Penstocks D/S from Tunnel

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.069			**Project**	: JC Boyle			
Description	:	Remove Concrete Items associated with Penstocks D/S from Tunnel							
Quantity	:	1,800.00	cy						
Daily Production	:	40.00	cy per	8 hour shift	**Project #**	: 1			
Work Days	:	50.0	Days		**Estimator**	: Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$495.44	per cy		**Probable Low Cost Parameter**		**44**	**$802,619**	**$445.90**
Total Cost	:	$891,799			**Probable High Cost Parameter**		**32**	**$1,070,158**	**$594.53**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	50.0	8	800.00	L	$48.27	incl. in rate	incl. in rate	$38,616.00
Laborer	Active	8.00	50.0	8	3,200.00	L	$45.80	incl. in rate	incl. in rate	$146,560.00
Equipment Operator (medium)	Active	3.00	50.0	8	1,200.00	L	$66.28	incl. in rate	incl. in rate	$79,536.00
Truck Driver (heavy)	Active	1.00	50.0	8	400.00	L	$57.59	incl. in rate	incl. in rate	$23,036.00
Air Compressor 600 cfm	Active	1.00	50.0	8	400.00	E	$21.74	incl. in rate	incl. in rate	$8,695.57
Air Compressor 900 cfm	Active	1.00	50.0	8	400.00	E	$38.87	incl. in rate	incl. in rate	$15,547.57
Air Tool, Chipping Hammer	Active	5.00	50.0	8	2,000.00	E	$1.64	incl. in rate	incl. in rate	$3,278.07
Generator, Small Generator, 10 - 15 kW	Active	2.00	50.0	8	800.00	E	$7.04	incl. in rate	incl. in rate	$5,632.00
Hydraulic Excavator (5.0cy)	Active	2.00	50.0	8	800.00	E	$274.63	incl. in rate	incl. in rate	$219,704.00
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	50.0	8	800.00	E	$70.35	incl. in rate	incl. in rate	$56,280.00
Loader, FE Rubber Tire (5.25cy)	Active	1.00	50.0	8	400.00	E	$75.42	incl. in rate	incl. in rate	$30,168.00
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	50.0	***8***	400.00	E	$62.72	incl. in rate	incl. in rate	$25,088.00
			50.0	8	0.00					$0.00
			50.0	8	0.00					$0.00
			50.0	8	0.00					$0.00
			50.0	8	0.00					$0.00
			50.0	8	0.00					$0.00
				Labor Hours	**5,600**			**TOTAL LABOR**		**$287,748.00**
				Equipment Hours	**6,000**			**TOTAL EQUIPMENT**		**$364,393.20**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$14,387.40	$14,387.40
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$14,387.40**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	7	EA	Cost per Mob	$2,500.00	$17,500.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$17,500.00**

SUMMARY OF COSTS

Labor Cost	$287,748.00	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$287,748.00
Material Cost	$14,387.40	Material Tax @	7.75%	$1,115.02		$15,502.42
Equipment Cost	$364,393.20	Equipment Tax @	7.75%	$28,240.47		$392,633.68
Subcontractors	$17,500.00					$17,500.00
DIRECT COST SUBTOTALS	**$684,029**			**$29,355**	**DIRECT COST SUBTOTALS**	**$713,384**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$695,884.10	$104,382.62
Installing Contractors Profit@	8.0%				$695,884.10	$55,670.73
GC Markup on Subs @	5.0%				$17,500.00	$875.00
					TOTAL MARKUP COSTS	**$160,928.34**
General Contractors Insurance @	1.0%			on	$874,312.44	$8,743
Bond @	1.0%			on	$874,312.44	$8,743
Contingency @	0.0%			on	$891,798.69	$0
					TOTAL COST for pay item	**$891,799**

Additional Pay Item Notes :

Three locations on steep sloped area, production will be reduced due to access restrictions, 2 5 man ground crews to assist with demolition, 1 excavator with breaker to demolish concrete items, 1 excavator will load or oragnize material, 1 loader will assist with maintaining haul roads and loading material, concrete is to brought to scour location.

PAY ITEM COST DETAIL WORKSHEET

1.070 Remove Head gate Control Building at Flume Entrance

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.070	**Project**	: JC Boyle				
Description	:	Remove Head gate Control Building at Flume Entrance						
Quantity	:	500.00 SF						
Daily Production	:	165.00 SF per 8 hour shift	**Project #**	: 1				
Work Days	:	3.0 Days	**Estimator**	: Eric Jones		**SF per**	**Total Cost**	**Unit Price Per SF**
Unit Price	:	$99.08 per SF	**Probable Low Cost Parameter**			**181.5**	**$44,588**	**$89.18**
Total Cost	:	$49,542	**Probable High Cost Parameter**			**140.25**	**$56,973**	**$113.95**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	3.0	8	24.00	L	$48.27	incl. in rate	incl. in rate	$1,158.48
Laborer	Active	3.00	3.0	8	72.00	L	$45.80	incl. in rate	incl. in rate	$3,297.60
Truck Driver (heavy)	Active	3.00	3.0	8	72.00	L	$57.59	incl. in rate	incl. in rate	$4,146.48
Equipment Operator (medium)	Active	3.00	3.0	8	72.00	L	$66.28	incl. in rate	incl. in rate	$4,772.16
Equipment Operator (light)	Active	1.00	3.0	8	24.00	L	$64.90	incl. in rate	incl. in rate	$1,557.60
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	3.0	8	24.00	E	$31.90	incl. in rate	incl. in rate	$765.60
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	3.0	8	48.00	E	$70.35	incl. in rate	incl. in rate	$3,376.80
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	3.0	8	24.00	E	$62.72	incl. in rate	incl. in rate	$1,505.28
Hydraulic Excavator (5.0cy)	Active	2.00	3.0	8	48.00	E	$274.63	incl. in rate	incl. in rate	$13,182.24
Loader, FE Rubber Tire (5.25cy)	Active	1.00	3.0	8	24.00	E	$75.42	incl. in rate	incl. in rate	$1,810.08
		1.00	3.0	8	24.00	0	$0.00	$0.00		$0.00
		1.00	3.0	8	24.00	0	$0.00	$0.00		$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
				Labor Hours	**264**			**TOTAL LABOR**		**$14,932.32**
				Equipment Hours	**168**			**TOTAL EQUIPMENT**		**$20,640.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Dump Fee Coversion (SFXH*.33/27)	73	CY			$0.00
Dump Fee Conversion (295 CY / 2 Tons)	36.67	tons	**Klamath County LandFill**	$74.00	$2,713.33
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$2,713.33**

SUMMARY OF COSTS

Labor Cost	$14,932.32	Labor Burden @	0.0%			$14,932.32
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$20,640.00	Equipment Tax @	7.75%	$1,599.60		$22,239.60
Subcontractors	$2,713.33					$2,713.33
DIRECT COST SUBTOTALS	**$38,286**			**$1,600**	**DIRECT COST SUBTOTALS**	**$39,885**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$37,171.92		$5,575.79
Installing Contractors Profit@	8.0%				$37,171.92		$2,973.75
GC Markup on Subs @	5.0%				$2,713.33		$135.67
						TOTAL MARKUP COSTS	**$8,685.21**
General Contractors Insurance @	1.0%			on	$48,570.46		$486
Bond @	1.0%			on	$48,570.46		$486
Contingency @	0.0%			on	$49,541.87		$0
						TOTAL COST for pay item	**$49,542**

Additional Pay Item Notes :

3 days to demolish concrete block building and demo existing slab, 1 excavator with breaker to demolish structure, 1 excavator loading trucks. 1 FE load maintaining area and loading trucks, expecting rough 50 CY of debris 2 dump trucks will be used to haul concrete material to scour site, 1 flatbed will haul roofing material to disposal site.

PAY ITEM COST DETAIL WORKSHEET

1.071 Remove Fore bay Spillway Gate House

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.071		**Project**	: JC Boyle			
Description	:	Remove Fore bay Spillway Gate House						
Quantity	:	610.00	SF					
Daily Production	:	204.00	SF per 8 hour shift	**Project #**	: 1			
Work Days	:	3.0	Days	**Estimator**	: Eric Jones	**SF per**	**Total Cost**	**Unit Price Per SF**
Unit Price	:	$89.23	per SF	**Probable Low Cost Parameter**		**224.4**	**$48,988**	**$80.31**
Total Cost	:	$54,431		**Probable High Cost Parameter**		**163.2**	**$65,318**	**$107.08**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	3.0	8	24.00	L	$48.27	incl. in rate	incl. in rate	$1,158.48
Laborer	Active	3.00	3.0	8	72.00	L	$45.80	incl. in rate	incl. in rate	$3,297.60
Truck Driver (heavy)	Active	3.00	3.0	8	72.00	L	$57.59	incl. in rate	incl. in rate	$4,146.48
Equipment Operator (medium)	Active	3.00	3.0	8	72.00	L	$66.28	incl. in rate	incl. in rate	$4,772.16
Equipment Operator (crane)	Active	1.00	3.0	8	24.00	L	$68.41	incl. in rate	incl. in rate	$1,641.84
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	3.0	8	24.00	E	$31.90	incl. in rate	incl. in rate	$765.60
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	3.0	8	48.00	E	$70.35	incl. in rate	incl. in rate	$3,376.80
Hydraulic Crane (80tn)	Active	1.00	3.0	8	24.00	E	$190.46	incl. in rate	incl. in rate	$4,571.04
Hydraulic Excavator (5.0cy)	Active	2.00	3.0	8	48.00	E	$274.63	incl. in rate	incl. in rate	$13,182.24
Loader, FE Rubber Tire (5.25cy)	Active	1.00	3.0	8	24.00	E	$75.42	incl. in rate	incl. in rate	$1,810.08
		1.00	3.0	8	24.00	0	$0.00	$0.00		$0.00
		1.00	3.0	8	24.00	0	$0.00	$0.00		$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
				Labor Hours	**264**			**TOTAL LABOR**		**$15,016.56**
				Equipment Hours	**168**			**TOTAL EQUIPMENT**		**$23,705.76**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Dump Fee Coversion (SFXH*.33/27)	89	CY			$0.00
Dump Fee Conversion (295 CY / 2 Tons)	44.73	tons	**Klamath County LandFill**	$74.00	$3,310.27
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$3,310.27**

SUMMARY OF COSTS

Labor Cost	$15,016.56	Labor Burden @	0.0%			$15,016.56
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$23,705.76	Equipment Tax @	7.75%	$1,837.20		$25,542.96
Subcontractors	$3,310.27					$3,310.27
DIRECT COST SUBTOTALS	**$42,033**			**$1,837**	**DIRECT COST SUBTOTALS**	**$43,870**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$40,559.52		$6,083.93
Installing Contractors Profit@	8.0%				$40,559.52		$3,244.76
GC Markup on Subs @	5.0%				$3,310.27		$165.51
						TOTAL MARKUP COSTS	**$9,494.20**
General Contractors Insurance @	1.0%		on		$53,363.99		$534
Bond @	1.0%		on		$53,363.99		$534
Contingency @	0.0%		on		$54,431.26		$0
						TOTAL COST for pay item	**$54,431**

Additional Pay Item Notes :

3 days to demolish building which includes set up and break down, 1 excavator to demolish the building, 1 excavator to load dump trucks, 1crane to load flat bed truck, flat bed truck to haul roofing Material, dump trucks will haul demolish building material, FE load will be used to maintain area for trucks and equipment, laborers will assist with directing trucks and assisting equipment demolition, Foreman will oversee operation. Klamath Falls Dump is roughly 20 miles or 1 hour away from site

PAY ITEM COST DETAIL WORKSHEET

1.072 Remove Fore bay Control Building

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.072	**Project**	: JC Boyle				
Description	:	Remove Fore bay Control Building						
Quantity	:	560.00 SF						
Daily Production	:	187.00 SF per 8 hour shift	**Project #**	: 1				
Work Days	:	3.0 Days	**Estimator**	: Eric Jones	**SF per**	**Total Cost**	**Unit Price Per SF**	
Unit Price	:	$96.68 per SF	**Probable Low Cost Parameter**		**205.7**	**$48,727**	**$87.01**	
Total Cost	:	$54,141	**Probable High Cost Parameter**		**149.6**	**$64,969**	**$116.02**	

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	3.0	8	24.00	L	$48.27	incl. in rate	incl. in rate	$1,158.48
Laborer	Active	3.00	3.0	8	72.00	L	$45.80	incl. in rate	incl. in rate	$3,297.60
Truck Driver (heavy)	Active	3.00	3.0	8	72.00	L	$57.59	incl. in rate	incl. in rate	$4,146.48
Equipment Operator (medium)	Active	3.00	3.0	8	72.00	L	$66.28	incl. in rate	incl. in rate	$4,772.16
Equipment Operator (crane)	Active	1.00	3.0	8	24.00	L	$68.41	incl. in rate	incl. in rate	$1,641.84
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	3.0	8	24.00	E	$31.90	incl. in rate	incl. in rate	$765.60
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	3.0	8	48.00	E	$70.35	incl. in rate	incl. in rate	$3,376.80
Hydraulic Crane (80tn)	Active	1.00	3.0	8	24.00	E	$190.46	incl. in rate	incl. in rate	$4,571.04
Hydraulic Excavator (5.0cy)	Active	2.00	3.0	8	48.00	E	$274.63	incl. in rate	incl. in rate	$13,182.24
Loader, FE Rubber Tire (5.25cy)	Active	1.00	3.0	8	24.00	E	$75.42	incl. in rate	incl. in rate	$1,810.08
		1.00	3.0	8	24.00	0	$0.00	$0.00		$0.00
		1.00	3.0	8	24.00	0	$0.00	$0.00		$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
				Labor Hours	**264**				**TOTAL LABOR**	**$15,016.56**
				Equipment Hours	**168**				**TOTAL EQUIPMENT**	**$23,705.76**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Dump Fee Coversion (SFXH*.33/27)	82	CY			$0.00
Dump Fee Conversion (295 CY / 2 Tons)	41.07	tons	**Klamath County LandFill**	$74.00	$3,038.93
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$3,038.93**

SUMMARY OF COSTS

Labor Cost	$15,016.56	Labor Burden @	0.0%		$15,016.56
Material Cost	$0.00	Material Tax @	7.75%	$0.00	$0.00
Equipment Cost	$23,705.76	Equipment Tax @	7.75%	$1,837.20	$25,542.96
Subcontractors	$3,038.93				$3,038.93
DIRECT COST SUBTOTALS	**$41,761**			**$1,837**	**DIRECT COST SUBTOTALS** **$43,598**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$40,559.52	$6,083.93
Installing Contractors Profit@	8.0%				$40,559.52	$3,244.76
GC Markup on Subs @	5.0%				$3,038.93	$151.95
					TOTAL MARKUP COSTS	**$9,480.64**
General Contractors Insurance @	1.0%			on	$53,079.09	$531
Bond @	1.0%			on	$53,079.09	$531
Contingency @	0.0%			on	$54,140.67	$0
					TOTAL COST for pay item	**$54,141**

Additional Pay Item Notes :

3 days to demolish building which includes set up and break down, 1 excavator to demolish the building, 1 excavator to load dump trucks, 1 crane to load flat bed truck, flat bed truck to haul roofing Material, dump trucks will haul demolish building material, FE load will be used to maintain area for trucks and equipment, laborers will assist with directing trucks and assisting equipment demolition, Foreman will oversee operation. Klamath Falls Dump is roughly 20 miles or 1 Hour away from site.

PAY ITEM COST DETAIL WORKSHEET — **1.074 Remove Insulated Generator Building next to Fore bay Control Building**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.074			**Project**	: JC Boyle				
Description	:	Remove Insulated Generator Building next to Fore bay Control Building								
Quantity	:	90.00	SF							
Daily Production	:	60.00	SF per	8 hour shift	**Project #**	: 1				
Work Days	:	1.5	Days		**Estimator**	: Eric Jones		**SF per**	**Total Cost**	**Unit Price Per SF**
Unit Price	:	$166.30	per SF		**Probable Low Cost Parameter**			**66**	**$13,470**	**$149.67**
Total Cost	:	$14,967			**Probable High Cost Parameter**			**48**	**$17,960**	**$199.56**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.5	8	12.00	L	$48.27	incl. in rate	incl. in rate	$579.24
Laborer	Active	2.00	1.5	8	24.00	L	$45.80	incl. in rate	incl. in rate	$1,099.20
Truck Driver (heavy)	Active	1.00	1.5	8	12.00	L	$57.59	incl. in rate	incl. in rate	$691.08
Equipment Operator (medium)	Active	1.00	1.5	8	12.00	L	$66.28	incl. in rate	incl. in rate	$795.36
Equipment Operator (light)	Active	1.00	1.5	8	12.00	L	$64.90	incl. in rate	incl. in rate	$778.80
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.5	8	12.00	E	$31.90	incl. in rate	incl. in rate	$382.80
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	1.5	8	24.00	E	$70.35	incl. in rate	incl. in rate	$1,688.40
Hydraulic Excavator (5.0cy)	Active	1.00	1.5	8	12.00	E	$274.63	incl. in rate	incl. in rate	$3,295.56
Loader, FE Rubber Tire (5.25cy)	Active	1.00	1.5	8	12.00	E	$75.42	incl. in rate	incl. in rate	$905.04
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	1.5	8	12.00	E	$62.72	incl. in rate	incl. in rate	$752.64
		1.00	1.5	8	12.00	0	$0.00	$0.00		$0.00
		1.00	1.5	8	12.00	0	$0.00	$0.00		$0.00
			1.5	8	0.00					$0.00
			1.5	8	0.00					$0.00
			1.5	8	0.00					$0.00
			1.5	8	0.00					$0.00
			1.5	8	0.00					$0.00
				Labor Hours	**72**			**TOTAL LABOR**		**$3,943.68**
				Equipment Hours	**72**			**TOTAL EQUIPMENT**		**$7,024.44**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Dump Fee Coversion (SFXH*.33/27)	13	CY			$0.00
Dump Fee Conversion (295 CY / 2 Tons)	6.60	tons	**Klamath County LandFill**	$74.00	$488.40
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$488.40**

SUMMARY OF COSTS

Labor Cost	$3,943.68	Labor Burden @	0.0%		$3,943.68
Material Cost	$0.00	Material Tax @	7.75%	$0.00	$0.00
Equipment Cost	$7,024.44	Equipment Tax @	7.75%	$544.39	$7,568.83
Subcontractors	$488.40				$488.40
DIRECT COST SUBTOTALS	**$11,457**			**$544**	**DIRECT COST SUBTOTALS** **$12,001**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$11,512.51	$1,726.88
Installing Contractors Profit@	8.0%				$11,512.51	$921.00
GC Markup on Subs @	5.0%				$488.40	$24.42
					TOTAL MARKUP COSTS	**$2,672.30**
General Contractors Insurance @	1.0%		on		$14,673.21	$147
Bond @	1.0%		on		$14,673.21	$147
Contingency @	0.0%		on		$14,966.68	$0
					TOTAL COST for pay item	**$14,967**

Additional Pay Item Notes :

It will take 1.5 days to set up, demolish, and haul off material, 1 excavator will be demolishing the building, Loader will be loading trucks and maintaining area, dump trucks will haul demolished material to dump/ scour site, flat bed truck will hall material to dump, Laborers will direct truck traffic and assist equipment demolition, Foreman to oversee operation.

PAY ITEM COST DETAIL WORKSHEET — **1.075 Remove Fixed Wheel Gate (Gate, Frame, and Hoist)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.075	**Project**	:	JCBOYLE			
Description	:	Remove Fixed Wheel Gate (Gate, Frame, and Hoist)						
Quantity	:	55,000.00 lbs						
Daily Production	:	30,000.00 lbs per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	1.8 Days	**Estimator**	:	Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$0.53 per lbs	**Probable Low Cost Parameter**			**36000**	**$23,272**	**$0.42**
Total Cost	:	$29,090	**Probable High Cost Parameter**			**22500**	**$36,363**	**$0.66**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.8	8	14.40	L	$47.23	incl. in rate	incl. in rate	$680.11
Electrician	Active	1.00	1.8	8	14.40	L	$45.23	incl. in rate	incl. in rate	$651.31
Ironworkers	Active	5.00	1.8	8	72.00	L	$63.95	incl. in rate	incl. in rate	$4,604.40
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.8	8	14.40	E	$221.50	incl. in rate	incl. in rate	$3,189.60
Truck Driver (heavy)	Active	1.00	1.8	8	14.40	L	$57.59	incl. in rate	incl. in rate	$829.30
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.8	8	14.40	E	$111.64	incl. in rate	incl. in rate	$1,607.62
Hydraulic Crane (120tn)	Active	1.00	1.8	8	14.40	E	$239.06	incl. in rate	incl. in rate	$3,442.46
Welder	Active	1.00	1.8	8	14.40	L	$7.84	incl. in rate	incl. in rate	$112.86
Gas Welding Machine	Active	1.00	1.8	8	14.40	E	$2.88	incl. in rate	incl. in rate	$41.43
Equipment Operator (medium)	Active	1.00	1.8	8	14.40	L	$66.28	incl. in rate	incl. in rate	$954.43
Equipment Operator (crane)	Active	1.00	1.8	8	14.40	L	$68.41	incl. in rate	incl. in rate	$985.10

Labor Hours	**158.4**	**TOTAL LABOR**	**$8,817.52**
Equipment Hours	**57.6**	**TOTAL EQUIPMENT**	**$8,281.11**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$440.88	$440.88
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	2,500.00	LF	1.000	2,500.00	$0.85	$2,125.00
					TOTAL MATERIAL	**$2,565.88**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	5.50	ton	1.000	5.50	$595.00	$3,272.50
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	85.60	$7.25	$620.60
					TOTAL SUBCONTRACTS	**$3,893.10**

SUMMARY OF COSTS

Labor Cost	$8,817.52	Labor Burden @	49.7%	$0.00	$8,817.52
Material Cost	$2,565.88	Material Tax @	7.8%	$198.86	$2,764.73
Equipment Cost	$8,281.11	Equipment Tax @	0.0%	$0.00	$8,281.11
Subcontractors	$3,893.10				$3,893.10
DIRECT COST SUBTOTALS	**$23,558**			**$199**	**DIRECT COST SUBTOTALS** **$23,756**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$19,863.36	$2,979.50
Installing Contractors Profit@	8.0%				$19,863.36	$1,589.07
GC Markup on Subs @	5.0%				$3,893.10	$194.66
					TOTAL MARKUP COSTS	**$4,763.23**
General Contractors Insurance @	1.0%		on		$28,519.68	$285
Bond @	1.0%		on		$28,519.68	$285
Contingency @	0.0%		on		$29,090.08	$0
					TOTAL COST for pay item	**$29,090**

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Assumed hazardous waste 20% of the total lbs, calculated 85.6 miles from JC Boyle to Yreka Transfer Recycling.

PAY ITEM COST DETAIL WORKSHEET

1.076 Remove Trash rack and trash rake (steel)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.076	**Project**	:	JCBOYLE			
Description	:	Remove Trash rack and trash rake (steel)						
Quantity	:	75,000.00 lbs						
Daily Production	:	30,000.00 lbs per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	2.5 Days	**Estimator**	:	Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$0.51 per lbs	**Probable Low Cost Parameter**			**36000**	**$30,438**	**$0.41**
Total Cost	:	$38,047	**Probable High Cost Parameter**			**22500**	**$47,559**	**$0.63**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	2.5	8	20.00	L	$47.23	incl. in rate	incl. in rate	$944.60
Electrician	Active	1.00	2.5	8	20.00	L	$45.23	incl. in rate	incl. in rate	$904.60
Ironworkers	Active	3.00	2.5	8	60.00	L	$63.95	incl. in rate	incl. in rate	$3,837.00
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.5	8	20.00	E	$221.50	incl. in rate	incl. in rate	$4,430.00
Truck Driver (heavy)	Active	1.00	2.5	8	20.00	L	$57.59	incl. in rate	incl. in rate	$1,151.80
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.5	8	20.00	E	$111.64	incl. in rate	incl. in rate	$2,232.80
Hydraulic Crane (120tn)	Active	1.00	2.5	8	20.00	E	$239.06	incl. in rate	incl. in rate	$4,781.20
Welder	Active	2.00	2.5	8	40.00	L	$7.84	incl. in rate	incl. in rate	$313.50
Gas Welding Machine	Active	2.00	2.5	8	40.00	E	$2.88	incl. in rate	incl. in rate	$115.08
Equipment Operator (medium)	Active	1.00	2.5	8	20.00	L	$66.28	incl. in rate	incl. in rate	$1,325.60
Equipment Operator (crane)	Active	1.00	2.5	8	20.00	L	$68.41	incl. in rate	incl. in rate	$1,368.20
Laborer	Active	3.00	2.5	8	60.00	L	$45.80	incl. in rate	incl. in rate	$2,748.00

Labor Hours	**260**	**TOTAL LABOR**	**$12,593.30**
Equipment Hours	**100**	**TOTAL EQUIPMENT**	**$11,559.08**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$629.67	$629.67
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	6,000.00	LF	1.000	6,000.00	$0.85	$5,100.00

TOTAL MATERIAL **$5,729.67**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS **$0.00**

SUMMARY OF COSTS

Labor Cost	$12,593.30	Labor Burden @	49.7%	$0.00	$12,593.30
Material Cost	$5,729.67	Material Tax @	7.8%	$444.05	$6,173.71
Equipment Cost	$11,559.08	Equipment Tax @	0.0%	$0.00	$11,559.08
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$29,882**			**$444**	**DIRECT COST SUBTOTALS** **$30,326**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$30,326.09	$4,548.91
Installing Contractors Profit@	8.0%				$30,326.09	$2,426.09
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$6,975.00**
General Contractors Insurance @	1.0%		on		$37,301.10	$373
Bond @	1.0%		on		$37,301.10	$373
Contingency @	0.0%		on		$38,047.12	$0
					TOTAL COST for pay item	**$38,047**

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.077	**Project**	:	JCBOYLE			
Description	:	Remove Stop Logs and Slots (steel)						
Quantity	:	136,000.00 lbs						
Daily Production	:	30,000.00 lbs per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	4.5 Days	**Estimator**	:	Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$0.79 per lbs	**Probable Low Cost Parameter**			**33000**	**$96,633**	**$0.71**
Total Cost	:	$107,370	**Probable High Cost Parameter**			**22500**	**$134,213**	**$0.99**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	4.5	8	36.00	L	$46.27	incl. in rate	incl. in rate	$1,665.72
Electrician	Active	1.00	4.5	8	36.00	L	$45.23	incl. in rate	incl. in rate	$1,628.28
Steelworker	Active	5.00	4.5	8	180.00	L	$65.52	incl. in rate	incl. in rate	$11,793.60
Loader, FE Rubber Tire (8.6cy)	Active	1.00	4.5	8	36.00	E	$221.50	incl. in rate	incl. in rate	$7,974.00
Truck Driver (heavy)	Active	1.00	4.5	8	36.00	L	$57.59	incl. in rate	incl. in rate	$2,073.24
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	4.5	8	36.00	E	$111.64	incl. in rate	incl. in rate	$4,019.04
Hydraulic Crane (120tn)	Active	1.00	4.5	8	36.00	E	$239.06	incl. in rate	incl. in rate	$8,606.16
Welder	Active	1.00	4.5	8	36.00	L	$7.84	incl. in rate	incl. in rate	$282.15
Gas Welding Machine	Active	1.00	4.5	8	36.00	E	$2.88	incl. in rate	incl. in rate	$103.57
Equipment Operator (medium)	Active	1.00	4.5	8	36.00	L	$66.28	incl. in rate	incl. in rate	$2,386.08
Equipment Operator (crane)	Active	1.00	4.5	8	36.00	L	$68.41	incl. in rate	incl. in rate	$2,462.76
Laborer	Active	1.00	4.5	8	36.00	L	$45.80	incl. in rate	incl. in rate	$1,648.80

Labor Hours	**432**	**TOTAL LABOR**	**$23,940.63**
Equipment Hours	**144**	**TOTAL EQUIPMENT**	**$20,702.77**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,197.03	$1,197.03
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	5,000.00	LF	1.000	5,000.00	$0.85	$4,250.00
					TOTAL MATERIAL	**$5,447.03**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	68.00	ton	1.000	68.00	$595.00	$40,460.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	85.60	$7.25	$620.60
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$41,080.60**

SUMMARY OF COSTS

Labor Cost	$23,940.63	Labor Burden @	49.7%	$0.00		$23,940.63
Material Cost	$5,447.03	Material Tax @	7.8%	$422.14		$5,869.18
Equipment Cost	$20,702.77	Equipment Tax @	0.0%	$0.00		$20,702.77
Subcontractors	$41,080.60					$41,080.60
DIRECT COST SUBTOTALS	**$91,171**			**$422**	**DIRECT COST SUBTOTALS**	**$91,593**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$50,512.58		$7,576.89
Installing Contractors Profit@	8.0%				$50,512.58		$4,041.01
GC Markup on Subs @	5.0%				$41,080.60		$2,054.03
						TOTAL MARKUP COSTS	**$13,671.92**
General Contractors Insurance @	1.0%		on		$105,265.10		$1,053
Bond @	1.0%		on		$105,265.10		$1,053
Contingency @	0.0%		on		$107,370.40		$0
						TOTAL COST for pay item	**$107,370**

Additional Pay Item Notes :

The process of removing stop logs is not manual, but done with hydraulic stop log lifters and hoists done by one 12-men crew (5 steelworkers, 1 laborer, 1 electrician, 1 welder and 4 equipment operators). Based on the current production rate and 1 truck per day. The gate side guides and invert assumed having a minimum weight of 4 lbs./ft. for wall mounted and 3 lbs./ft. for embedded in concrete. The gate invert should contain a removable neoprene seal. Including stop log grooves, lifter, guide - weight around 136,000 lbs.

PAY ITEM COST DETAIL WORKSHEET

1.078 Remove Traveling Water Screen

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.078	**Project**	:	JCBOYLE			
Description	:	Remove Traveling Water Screen						
Quantity	:	124,000.00 lbs						
Daily Production	:	30,000.00 lbs per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	4.1 Days	**Estimator**	:	Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$0.50 per lbs	**Probable Low Cost Parameter**			**33000**	**$56,258**	**$0.45**
Total Cost	:	$62,509	**Probable High Cost Parameter**			**22500**	**$78,136**	**$0.63**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	4.1	8	65.60	L	$46.27	incl. in rate	incl. in rate	$3,035.31
Electrician	Active	1.00	4.1	8	32.80	L	$45.23	incl. in rate	incl. in rate	$1,483.54
Ironworkers	Active	6.00	4.1	8	196.80	L	$63.95	incl. in rate	incl. in rate	$12,585.36
Loader, FE Rubber Tire (8.6cy)	Active	1.00	4.1	8	32.80	E	$221.50	incl. in rate	incl. in rate	$7,265.20
Truck Driver (heavy)	Active	2.00	4.1	8	65.60	L	$57.59	incl. in rate	incl. in rate	$3,777.90
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	4.1	8	65.60	E	$111.64	incl. in rate	incl. in rate	$7,323.58
Hydraulic Crane (120tn)	Active	1.00	4.1	8	32.80	E	$239.06	incl. in rate	incl. in rate	$7,841.17
Welder	Active	2.00	4.1	8	65.60	L	$7.84	incl. in rate	incl. in rate	$514.14
Gas Welding Machine	Active	2.00	4.1	8	65.60	E	$2.88	incl. in rate	incl. in rate	$188.73
Equipment Operator (medium)	Active	1.00	4.1	8	32.80	L	$66.28	incl. in rate	incl. in rate	$2,173.98
Equipment Operator (crane)	Active	1.00	4.1	8	32.80	L	$68.41	incl. in rate	incl. in rate	$2,243.85

Labor Hours	**492**	**TOTAL LABOR**	**$25,814.09**
Equipment Hours	**196.8**	**TOTAL EQUIPMENT**	**$22,618.68**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,290.70	$1,290.70

TOTAL MATERIAL	**$1,290.70**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$25,814.09	Labor Burden @	49.7%	$0.00		$25,814.09
Material Cost	$1,290.70	Material Tax @	7.8%	$100.03		$1,390.73
Equipment Cost	$22,618.68	Equipment Tax @	0.0%	$0.00		$22,618.68
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$49,723**			**$100**	**DIRECT COST SUBTOTALS**	**$49,824**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$49,823.51		$7,473.53
Installing Contractors Profit@	8.0%				$49,823.51		$3,985.88
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$11,459.41**
General Contractors Insurance @	1.0%		on		$61,282.92		$613
Bond @	1.0%		on		$61,282.92		$613
Contingency @	0.0%		on		$62,508.57		$0
						TOTAL COST for pay item	**$62,509**

Additional Pay Item Notes :

Used RS Means Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal.

PAY ITEM COST DETAIL WORKSHEET

1.079 Remove Fish By-Pass and Supports (steel)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.079		**Project**	: JC Boyle				
Description	:	Remove Fish By-Pass and Supports (steel)							
Quantity	:	610,000.00	lb						
Daily Production	:	20,000.00	lb per	8	hour shift	**Project #**	: 1		
Work Days	:	30.5	Days			**Estimator**	: Felipe Poletto	**lb per**	**Total Cost**	**Unit Price Per lb**
Unit Price	:	$0.77	per lb			**Probable Low Cost Parameter**		**22000**	**$422,080**	**$0.69**
Total Cost	:	$468,978				**Probable High Cost Parameter**		**17000**	**$539,325**	**$0.88**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	30.5	8	244.00	L	$48.27	incl. in rate	incl. in rate	$11,777.88
Ironworkers	Active	3.00	30.5	8	732.00	L	$63.95	incl. in rate	incl. in rate	$46,811.40
Diver, Tender	Active	2.00	*10.0*	8	160.00	L	$79.22	incl. in rate	incl. in rate	$12,675.20
Diver, Wet	Active	2.00	*10.0*	8	160.00	L	$124.57	incl. in rate	incl. in rate	$19,931.20
Electrician Foreman	Active	1.00	30.5	8	244.00	L	$47.23	incl. in rate	incl. in rate	$11,524.12
Tugboat Captain	Active	1.00	30.5	8	244.00	L	$67.76	incl. in rate	incl. in rate	$16,533.44
Equipment Operator (crane)	Active	1.00	30.5	8	244.00	L	$68.41	incl. in rate	incl. in rate	$16,692.04
Barge Operator	Active	1.00	30.5	8	244.00	L	$68.11	incl. in rate	incl. in rate	$16,618.84
Barge (400T)	Active	3.00	30.5	8	732.00	E	$99.50	incl. in rate	incl. in rate	$72,834.00
Crawler Crane (270tn)	Active	1.00	30.5	8	244.00	E	$399.50	incl. in rate	incl. in rate	$97,478.00
Welder, Portable	Active	3.00	30.5	8	732.00	E	$7.84	incl. in rate	incl. in rate	$5,737.05
Tugboat (250hp)	Active	1.00	30.5	8	244.00	E	$88.74	incl. in rate	incl. in rate	$21,652.56
			30.5	8	0.00					$0.00
			30.5	8	0.00					$0.00
			30.5	8	0.00					$0.00
			30.5	8	0.00					$0.00
			30.5	8	0.00					$0.00
				Labor Hours	**2,272**			**TOTAL LABOR**		**$152,564.12**
				Equipment Hours	**1,952**			**TOTAL EQUIPMENT**		**$197,701.61**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$7,628.21	$7,628.21
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$7,628.21**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$152,564.12	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$152,564.12
Material Cost	$7,628.21	Material Tax @	7.75%	$591.19		$8,219.39
Equipment Cost	$197,701.61	Equipment Tax @	7.75%	$15,321.87		$213,023.48
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$357,894**			**$15,913**	**DIRECT COST SUBTOTALS**	**$373,807**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$373,807.00	$56,071.05
Installing Contractors Profit@	8.0%				$373,807.00	$29,904.56
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$85,975.61**
General Contractors Insurance @	1.0%			on	$459,782.61	$4,598
Bond @	1.0%			on	$459,782.61	$4,598
Contingency @	0.0%			on	$468,978.26	$0
					TOTAL COST for pay item	**$468,978**

Additional Pay Item Notes :

Barge is will be placed near fish bypass area, crane will attach to equipment, Iron workers will disassemble items and crane will load them on to truck for disposal. Production is affected due to the location of the recylcing plant.

PAY ITEM COST DETAIL WORKSHEET

1.080 Remove Gates and Hoists

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.080	**Project**	:	JCBOYLE			
Description	:	Remove Gates and Hoists						
Quantity	:	18,500.00 LBS						
Daily Production	:	25,000.00 LBS per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	0.7 Days	**Estimator**	:	Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.48 per LBS	**Probable Low Cost Parameter**			**28750**	**$7,521**	**$0.41**
Total Cost	:	$8,848	**Probable High Cost Parameter**			**17500**	**$11,503**	**$0.62**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	0.7	8	5.60	L	$47.23	$0.00		$264.49
Electrician	Active	1.00	0.7	8	5.60	L	$45.23	$0.00		$253.29
Steelworker	Active	2.00	0.7	8	11.20	L	$65.52	$0.00		$733.82
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.7	8	5.60	E	$221.50	$221.50		$1,240.40
Truck Driver (heavy)	Active	2.00	0.7	8	11.20	L	$57.59	$0.00		$645.01
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	0.7	8	11.20	E	$111.64	$111.64		$1,250.37
Crawler Crane (90tn)	Active	1.00	0.7	8	5.60	E	$208.09	$208.09		$1,165.30
Welder	Active	1.00	0.7	8	5.60	L	$7.84	$0.00		$43.89
Gas Welding Machine	Active	1.00	0.7	8	5.60	E	$2.88	$2.88		$16.11
Equipment Operator (medium)	Active	1.00	0.7	8	5.60	L	$66.28	$0.00		$371.17
Equipment Operator (crane)	Active	1.00	0.7	8	5.60	L	$68.41	$0.00		$383.10
Laborer	Active	2.00	0.7	8	11.20	L	$45.80	$0.00		$512.96

Labor Hours	**61.6**	**TOTAL LABOR**	**$3,207.72**
Equipment Hours	**28**	**TOTAL EQUIPMENT**	**$3,672.18**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$160.39	$160.39

TOTAL MATERIAL	**$160.39**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$3,207.72	Labor Burden @	49.7%	$0.00	$3,207.72
Material Cost	$160.39	Material Tax @	7.8%	$12.43	$172.82
Equipment Cost	$3,672.18	Equipment Tax @	0.0%	$0.00	$3,672.18
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$7,040**			**$12**	**DIRECT COST SUBTOTALS** **$7,053**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$7,052.72	$1,057.91
Installing Contractors Profit@	8.0%				$7,052.72	$564.22
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,622.13**
General Contractors Insurance @	1.0%		on		$8,674.85	$87
Bond @	1.0%		on		$8,674.85	$87
Contingency @	0.0%		on		$8,848.34	$0
					TOTAL COST for pay item	**$8,848**

Additional Pay Item Notes :

Production based on crew 1 Forman, 2 Steelworkers and 1 Welder to cut and attach hooks to 2 gates and 2 hoists for disposal, 2 Laborers to rigging wire rope slings, 1 Electrician to provide power for tools, 1 Truck for disposal to Yreka facility. Assuming 1/2 days of work;

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.081	**Project**	: JCBOYLE				
Description	:	Remove Trash rack and trash rake (steel)						
Quantity	:	47,249.00 LBS						
Daily Production	:	30,000.00 LBS per 8 hour shift	**Project #**	: Klamath Dams Removal				
Work Days	:	1.6 Days	**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**	
Unit Price	:	$0.60 per LBS	**Probable Low Cost Parameter**		**34500**	**$24,001**	**$0.51**	
Total Cost	:	$28,236	**Probable High Cost Parameter**		**21000**	**$36,707**	**$0.78**	

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.6	8	12.80	L	$46.27	$0.00		$592.26
Electrician	Active	1.00	1.6	8	12.80	L	$45.23	$0.00		$578.94
Steelworker	Active	6.00	1.6	8	76.80	L	$65.52	$0.00		$5,031.94
Hydraulic Excavator (6.0cy)	Active	1.00	1.6	8	12.80	E	$322.48	$322.48		$4,127.74
Truck Driver (heavy)	Active	1.00	1.6	8	12.80	L	$57.59	$0.00		$737.15
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.6	8	12.80	E	$111.64	$111.64		$1,428.99
Hydraulic Crane (120tn)	Active	1.00	1.6	8	12.80	E	$239.06	$239.06		$3,059.97
Welder	Active	2.00	1.6	8	25.60	L	$7.84	$0.00		$200.64
Gas Welding Machine	Active	2.00	1.6	8	25.60	E	$2.88	$2.88		$73.65
Equipment Operator (medium)	Active	2.00	1.6	8	25.60	L	$66.28	$0.00		$1,696.77
Equipment Operator (crane)	Active	1.00	1.6	8	12.80	L	$68.41	$0.00		$875.65
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	1.6	8	12.80	E	$62.72	$62.72		$802.82

Labor Hours	**179.2**	**TOTAL LABOR**	**$9,713.34**
Equipment Hours	**76.8**	**TOTAL EQUIPMENT**	**$9,493.17**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, electrodes, wrenches, hard hats etc)	1.00	LS	1.000	1.00	$1,457.00	$1,457.00

TOTAL MATERIAL	**$1,457.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (25%)	2.36	ton	1.000	$595.00	$1,405.66
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	$7.25	$620.60

TOTAL SUBCONTRACTS	**$2,026.26**

SUMMARY OF COSTS

Labor Cost	$9,713.34	Labor Burden @	49.7%	$0.00	$9,713.34
Material Cost	$1,457.00	Material Tax @	7.8%	$112.92	$1,569.92
Equipment Cost	$9,493.17	Equipment Tax @	0.0%	$0.00	$9,493.17
Subcontractors	$2,026.26				$2,026.26
DIRECT COST SUBTOTALS	**$22,690**			**$113**	**DIRECT COST SUBTOTALS** **$22,803**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$20,776.43	$3,116.47
Installing Contractors Profit@	8.0%				$20,776.43	$1,662.11
GC Markup on Subs @	5.0%				$2,026.26	$101.31
					TOTAL MARKUP COSTS	**$4,879.89**
General Contractors Insurance @	1.0%		on		$27,682.58	$277
Bond @	1.0%		on		$27,682.58	$277
Contingency @	0.0%		on		$28,236.24	$0
					TOTAL COST for pay item	**$28,236**

Additional Pay Item Notes :

The removal of gate, frame and hoist is done by one 9-men crew (1 foreman, 6 steelworkers, 1 welder, 1 electrician and 2 equipment operators). Based on the current production rate and the fact that we dispose big pieces of steel we use 1 trucks per day. Assumed hazardous waste cleanup 10% of total weight disposal.

PAY ITEM COST DETAIL WORKSHEET — **1.082 Remove stop Logs and slots (steel)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.082	**Project**	:	JCBOYLE			
Description	:	Remove stop Logs and slots (steel)						
Quantity	:	37,069.00 LBS						
Daily Production	:	30,000.00 LBS per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	1.2 Days	**Estimator**	:	Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.62 per LBS	**Probable Low Cost Parameter**			**34500**	**$19,692**	**$0.53**
Total Cost	:	$23,167	**Probable High Cost Parameter**			**21000**	**$30,117**	**$0.81**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.2	8	9.60	L	$46.27	$0.00		$444.19
Electrician	Active	1.00	1.2	8	9.60	L	$45.23	$0.00		$434.21
Steelworker	Active	6.00	1.2	8	57.60	L	$65.52	$0.00		$3,773.95
Hydraulic Excavator (6.0cy)	Active	1.00	1.2	8	9.60	E	$322.48	$322.48		$3,095.81
Truck Driver (heavy)	Active	1.00	1.2	8	9.60	L	$57.59	$0.00		$552.86
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.2	8	9.60	E	$111.64	$111.64		$1,071.74
Hydraulic Crane (120tn)	Active	1.00	1.2	8	9.60	E	$239.06	$239.06		$2,294.98
Welder	Active	2.00	1.2	8	19.20	L	$7.84	$0.00		$150.48
Gas Welding Machine	Active	2.00	1.2	8	19.20	E	$2.88	$2.88		$55.24
Equipment Operator (medium)	Active	2.00	1.2	8	19.20	L	$66.28	$0.00		$1,272.58
Equipment Operator (crane)	Active	1.00	1.2	8	9.60	L	$68.41	$0.00		$656.74
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	1.2	8	9.60	E	$62.72	$62.72		$602.11

Labor Hours	**134.4**	**TOTAL LABOR**	**$7,285.01**
Equipment Hours	**57.6**	**TOTAL EQUIPMENT**	**$7,119.88**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, electrodes, wrenches, hard hats etc)	1.00	LS	1.000	1.00	$1,092.75	$1,092.75

TOTAL MATERIAL	**$1,092.75**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10%)	4.63	ton	1.000	$595.00	$2,757.01
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	$7.25	$620.60

TOTAL SUBCONTRACTS	**$3,377.61**

SUMMARY OF COSTS

Labor Cost	$7,285.01	Labor Burden @	49.7%	$0.00		$7,285.01
Material Cost	$1,092.75	Material Tax @	7.8%	$84.69		$1,177.44
Equipment Cost	$7,119.88	Equipment Tax @	0.0%	$0.00		$7,119.88
Subcontractors	$3,377.61					$3,377.61
DIRECT COST SUBTOTALS	**$18,875**			**$85**	**DIRECT COST SUBTOTALS**	**$18,960**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$15,582.33	$2,337.35
Installing Contractors Profit@	8.0%				$15,582.33	$1,246.59
GC Markup on Subs @	5.0%				$3,377.61	$168.88
					TOTAL MARKUP COSTS	**$3,752.82**
General Contractors Insurance @	1.0%		on		$22,712.75	$227
Bond @	1.0%		on		$22,712.75	$227
Contingency @	0.0%		on		$23,167.00	$0
					TOTAL COST for pay item	**$23,167**

Additional Pay Item Notes :

The removal of gate, frame and hoist is done by one 9-men crew (1 foreman, 6 steelworkers, 1 welder, 1 electrician and 2 equipment operators). Based on the current production rate and the fact that we dispose big pieces of steel we use 1 trucks per day. Assumed hazardous waste cleanup 25% of total weight disposal.

PAY ITEM COST DETAIL WORKSHEET

1.083 Remove & Dispose Penstocks and bifurcation (steel)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.083			**Project**	: JC Boyle			
Description	:	Remove & Dispose Penstocks and bifurcation (steel)							
Quantity	:	1,600,000.00	LBS						
Daily Production	:	40,000.00	LBS per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	40.0	Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.70	per LBS		**Probable Low Cost Parameter**		**46000**	**$945,385**	**$0.59**
Total Cost	:	$1,112,218			**Probable High Cost Parameter**		**32000**	**$1,334,661**	**$0.83**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	3.00	40.0	8	960.00	L	$46.27	incl. in rate	incl. in rate	$44,419.20
Steelworker	Active	12.00	40.0	8	3,840.00	L	$65.52	incl. in rate	incl. in rate	$251,596.80
Equipment Operator (crane)	Active	1.00	40.0	8	320.00	L	$68.41	incl. in rate	incl. in rate	$21,891.20
Crawler Crane (130tn)	Active	1.00	40.0	8	320.00	E	$258.66	incl. in rate	incl. in rate	$82,771.20
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	40.0	8	640.00	E	$111.64	incl. in rate	incl. in rate	$71,449.60
Hydraulic Excavator (5.0cy)	Active	1.00	40.0	8	320.00	E	$274.63	incl. in rate	incl. in rate	$87,881.60
Welder	Active	3.00	40.0	8	960.00	L	$7.84	incl. in rate	incl. in rate	$7,524.00
Gas Welding Machine	Active	2.00	40.0	8	640.00	E	$2.88	incl. in rate	incl. in rate	$1,841.27
Carpenters, Journeyman	Active	6.00	40.0	8	1,920.00	L	$65.37	incl. in rate	incl. in rate	$125,510.40
Carpenter Foreman (out)	Active	4.00	40.0	8	1,280.00	L	$46.40	incl. in rate	incl. in rate	$59,392.00
Truck Driver (heavy)	Active	2.00	40.0	8	640.00	L	$57.59	incl. in rate	incl. in rate	$36,857.60
Loader, FE Rubber Tire (3.5cy)	Active	1.00	40.0	8	320.00	E	$64.23	incl. in rate	incl. in rate	$20,553.60
	Active	1.00	40.0	8	320.00	0	$0.00	incl. in rate	incl. in rate	$0.00

Labor Hours	**9920**	**TOTAL LABOR**	**$547,191.20**
Equipment Hours	**2240**	**TOTAL EQUIPMENT**	**$264,497.27**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$27,359.56	$27,359.56

TOTAL MATERIAL	**$27,359.56**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10% of total)	80.00	ton	1.000	$595.00	$47,600.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	760.89	mile	1.000	$7.25	$5,516.44

TOTAL SUBCONTRACTS	**$53,116.44**

SUMMARY OF COSTS

Labor Cost	$547,191.20	Labor Burden @	49.7%	$0.00	$547,191.20
Material Cost	$27,359.56	Material Tax @	7.8%	$2,120.37	$29,479.93
Equipment Cost	$264,497.27	Equipment Tax @	0.0%	$0.00	$264,497.27
Subcontractors	$53,116.44				$53,116.44
DIRECT COST SUBTOTALS	**$892,164**			**$2,120**	**DIRECT COST SUBTOTALS** **$894,285**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$841,168.40	$126,175.26
Installing Contractors Profit@	8.0%				$841,168.40	$67,293.47
GC Markup on Subs @	5.0%				$53,116.44	$2,655.82
					TOTAL MARKUP COSTS	**$196,124.55**
General Contractors Insurance @	1.0%		on		$1,090,409.40	$10,904
Bond @	1.0%		on		$1,090,409.40	$10,904
Contingency @	0.0%		on		$1,112,217.58	$0
					TOTAL COST for pa	**$1,112,218**

Additional Pay Item Notes :

Removal for pipe, expansion joints and support rings using E-19 crews for demolition. 3 Crews formed from 1 Forman, 4 steelworker, 1 welder, 2 carpenters. 3 equipment operators 1 for the crane, 1 excavator and 1 loader. 2 truck driver to drive off road truck Assumed that the steel includes exterior coatings containing heavy metals so the scrap metal painted with heavy metals will be sent to Yreka salvage yard for recycling 10% of totals Lbs, average miles 85.6. Fuel charges and consumable for field repair, lubrication, tire, etc are applied.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.084	**Project**	: JCBOYLE				
Description	:	Remove & Dispose Surge Tank (steel)						
Quantity	:	79,000.00 LBS						
Daily Production	:	19,750.00 LBS per 8 hour shift	**Project #**	: Klamath Dams Removal				
Work Days	:	4.0 Days	**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**	
Unit Price	:	$0.82 per LBS	**Probable Low Cost Parameter**		**21725**	**$58,000**	**$0.73**	
Total Cost	:	$64,445	**Probable High Cost Parameter**		**13825**	**$83,778**	**$1.06**	

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	4.0	8	32.00	L	$46.27	$0.00		$1,480.64
Electrician	Active	1.00	4.0	8	32.00	L	$45.23	$0.00		$1,447.36
Steelworker	Active	6.00	4.0	8	192.00	L	$65.52	$0.00		$12,579.84
Equipment Operator (crane)	Active	1.00	4.0	8	32.00	L	$68.41	$0.00		$2,189.12
Truck Driver (heavy)	Active	3.00	4.0	8	96.00	L	$57.59	$0.00		$5,528.64
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	4.0	8	32.00	E	$111.64	$111.64		$3,572.48
Hydraulic Crane (120tn)	Active	1.00	4.0	8	32.00	E	$239.06	$239.06		$7,649.92
Welder	Active	2.00	4.0	8	64.00	L	$7.84	$0.00		$501.60
Gas Welding Machine	Active	2.00	4.0	8	64.00	E	$2.88	$2.88		$184.13
Loader, FE Rubber Tire (5.25cy)	Active	2.00	4.0	8	64.00	E	$75.42	$75.42		$4,826.88
Truck, Utility, with Man-Basket	Active	2.00	4.0	8	64.00	E	$31.90	$31.90		$2,041.60
Equipment Operator (medium)	Active	1.00	4.0	8	32.00	L	$66.28	$0.00		$2,120.96

Labor Hours	**480**	**TOTAL LABOR**	**$25,848.16**
Equipment Hours	**256**	**TOTAL EQUIPMENT**	**$18,275.01**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, electrodes, wrenches, hard hats etc)	1.00	LS	1.000	1.00	$3,877.22	$3,877.22

TOTAL MATERIAL	**$3,877.22**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10%)	3.95	ton	1.000	$595.00	$2,350.25
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	171.20	mile	1.000	$7.25	$1,241.20

TOTAL SUBCONTRACTS	**$3,591.45**

SUMMARY OF COSTS

Labor Cost	$25,848.16	Labor Burden @	49.7%	$0.00	$25,848.16
Material Cost	$3,877.22	Material Tax @	7.8%	$300.48	$4,177.71
Equipment Cost	$18,275.01	Equipment Tax @	0.0%	$0.00	$18,275.01
Subcontractors	$3,591.45				$3,591.45
DIRECT COST SUBTOTALS	**$51,592**			**$300**	**DIRECT COST SUBTOTALS** **$51,892**

	Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%			$48,300.88	$7,245.13
Installing Contractors Profit@	8.0%			$48,300.88	$3,864.07
GC Markup on Subs @	5.0%			$3,591.45	$179.57
				TOTAL MARKUP COSTS	**$11,288.77**
General Contractors Insurance @	1.0%		on	$63,181.10	$632
Bond @	1.0%		on	$63,181.10	$632
Contingency @	0.0%		on	$64,444.72	$0
				TOTAL COST for pay item	**$64,445**

Additional Pay Item Notes :

The removal of surge tank, 79000 LBS is done by one 9-men crew (1 foreman, 6 steelworkers, 2 welders, 1 electrician and 4 equipment operators). Surge tank is high that's why we will use 2 trucks with basket to cut at the top. Assumed hazardous waste cleanup 10% of total weight disposal.

PAY ITEM COST DETAIL WORKSHEET

1.085 Remove & Dispose 2 - 108" Butterfly valves

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.085	**Project**	: JCBOYLE				
Description	:	Remove & Dispose 2 - 108" Butterfly valves						
Quantity	:	148,000.00 LBS						
Daily Production	:	25,000.00 LBS per 8 hour shift	**Project #**	: Klamath Dams Removal				
Work Days	:	5.9 Days	**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**	
Unit Price	:	$0.74 per LBS	**Probable Low Cost Parameter**		**27500**	**$98,855**	**$0.67**	
Total Cost	:	$109,839	**Probable High Cost Parameter**		**17500**	**$142,790**	**$0.96**	

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	5.9	8	94.40	L	$46.27	$0.00		$4,367.89
Steelworker	Active	4.00	5.9	8	188.80	L	$65.52	$0.00		$12,370.18
Laborer	Active	4.00	5.9	8	188.80	L	$45.80	$0.00		$8,647.04
Crawler Crane (90tn)	Active	1.00	5.9	8	47.20	E	$208.09	$208.09		$9,821.85
Carpenters, Journeyman	Active	4.00	5.9	8	188.80	L	$65.37	$0.00		$12,341.86
Welder	Active	2.00	5.9	8	94.40	L	$7.84	$0.00		$739.86
Gas Welding Machine	Active	2.00	5.9	8	94.40	E	$2.88	$2.88		$271.59
Loader, FE Rubber Tire (3.5cy)	Active	2.00	5.9	8	94.40	E	$64.23	$64.23		$6,063.31
Equipment Operator (crane)	Active	1.00	5.9	8	47.20	L	$68.41	$0.00		$3,228.95
Equipment Operator (medium)	Active	1.00	5.9	8	47.20	L	$66.28	$0.00		$3,128.42

Labor Hours	**849.6**	**TOTAL LABOR**	**$44,824.19**
Equipment Hours	**236**	**TOTAL EQUIPMENT**	**$16,156.75**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, electrodes, drill bits, etc)	1.00	LS	1.000	1.00	$6,723.63	$6,723.63

TOTAL MATERIAL	**$6,723.63**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (50%)	37.00	ton	1.000	37.00	$595.00	$22,015.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	85.60	$7.25	$620.60

TOTAL SUBCONTRACTS	**$22,635.60**

SUMMARY OF COSTS

Labor Cost	$44,824.19	Labor Burden @	49.7%	$0.00	$44,824.19
Material Cost	$6,723.63	Material Tax @	7.8%	$521.08	$7,244.71
Equipment Cost	$16,156.75	Equipment Tax @	0.0%	$0.00	$16,156.75
Subcontractors	$22,635.60				$22,635.60
DIRECT COST SUBTOTALS	**$90,340**			**$521**	**DIRECT COST SUBTOTALS** **$90,861**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$68,225.65	$10,233.85
Installing Contractors Profit@	8.0%				$68,225.65	$5,458.05
GC Markup on Subs @	5.0%				$22,635.60	$1,131.78
					TOTAL MARKUP COSTS	**$16,823.68**
General Contractors Insurance @	1.0%		on		$107,684.92	$1,077
Bond @	1.0%		on		$107,684.92	$1,077
Contingency @	0.0%		on		$109,838.62	$0
					TOTAL COST for pay item	**$109,839**

Additional Pay Item Notes :

Assumed the process of removing 108" butterfly valves is done in around 6 days by 2 crew formed of 1 foreman, 2 journeymen, 2 steelworkers ;We dispose cradles with 1 trucks per day for each crew. Assumed contains paint with heavy metals 50% of the total lbs, 85.6 miles from Copco lake to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary. Demolition is done using one crawler crane, excavator and welding machine.

PAY ITEM COST DETAIL WORKSHEET — **1.086 Remove & Dispose Gate, Stem and Frame**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.086	**Project**	:	JCBOYLE			
Description	:	Remove & Dispose Gate, Stem and Frame						
Quantity	:	28,000.00 LBS						
Daily Production	:	18,500.00 LBS per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	1.5 Days	**Estimator**	:	Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.71 per LBS	**Probable Low Cost Parameter**			**20350**	**$17,895**	**$0.64**
Total Cost	:	$19,883	**Probable High Cost Parameter**			**14800**	**$23,860**	**$0.85**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.5	8	12.00	L	$46.27	$0.00		$555.24
Electrician	Active	1.00	1.5	8	12.00	L	$45.23	$0.00		$542.76
Steelworker	Active	6.00	1.5	8	72.00	L	$65.52	$0.00		$4,717.44
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.5	8	12.00	E	$221.50	$221.50		$2,658.00
Truck Driver (heavy)	Active	2.00	1.5	8	24.00	L	$57.59	$0.00		$1,382.16
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	1.5	8	24.00	E	$31.90	$31.90		$765.60
Hydraulic Crane (120tn)	Active	1.00	1.5	8	12.00	E	$239.06	$239.06		$2,868.72
Welder	Active	2.00	1.5	8	24.00	L	$7.84	$0.00		$188.10
Gas Welding Machine	Active	2.00	1.5	8	24.00	E	$2.88	$2.88		$69.05
Equipment Operator (medium)	Active	1.00	1.5	8	12.00	L	$66.28	$0.00		$795.36
Equipment Operator (crane)	Active	1.00	1.5	8	12.00	L	$68.41	$0.00		$820.92

Labor Hours	**168**	**TOTAL LABOR**	**$9,001.98**
Equipment Hours	**72**	**TOTAL EQUIPMENT**	**$6,361.37**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$450.10	$450.10

TOTAL MATERIAL	**$450.10**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$9,001.98	Labor Burden @	49.7%	$0.00	$9,001.98
Material Cost	$450.10	Material Tax @	7.8%	$34.88	$484.98
Equipment Cost	$6,361.37	Equipment Tax @	0.0%	$0.00	$6,361.37
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$15,813**			**$35**	**DIRECT COST SUBTOTALS** **$15,848**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$15,848.33	$2,377.25
Installing Contractors Profit@	8.0%				$15,848.33	$1,267.87
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$3,645.12**
General Contractors Insurance @	1.0%		on		$19,493.45	$195
Bond @	1.0%		on		$19,493.45	$195
Contingency @	0.0%		on		$19,883.31	$0
					TOTAL COST for pay item	**$19,883**

Additional Pay Item Notes :

The removal of gate, frame and stem is done by one 9-men crew (1 foreman, 6 steelworkers, 1 welder, 1 electrician and 2 equipment operators). Based on the current production rate and the fact that we dispose big pieces of steel we use 2 trucks per day.

PAY ITEM COST DETAIL WORKSHEET — **1.087 Remove & Dispose of Steel Transition Manifolds on Upstream and Downstream**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.087			**Project**	: JC Boyle			
Description	: Remove & Dispose of Steel Transition Manifolds on Upstream and Downstream							
Quantity	: 250,000.00 LBS							
Daily Production	: 30,000.00 LBS per	8	hour shift	**Project #**	: Klamath Dams Removal			
Work Days	: 8.3 Days			**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	: $0.64 per LBS			**Probable Low Cost Parameter**		**34500**	**$136,734**	**$0.55**
Total Cost	: $160,863			**Probable High Cost Parameter**		**21000**	**$209,122**	**$0.84**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	8.3	8	132.80	L	$48.27	incl. in rate	incl. in rate	$6,410.26
Millwright	Active	6.00	8.3	8	398.40	L	$69.46	incl. in rate	incl. in rate	$27,672.86
Equipment Operator (crane)	Active	1.00	8.3	8	66.40	L	$68.41	incl. in rate	incl. in rate	$4,542.42
Crawler Crane (130tn)	Active	1.00	8.3	8	66.40	E	$258.66	incl. in rate	incl. in rate	$17,175.02
Electrician	Active	1.00	8.3	8	66.40	L	$45.23	incl. in rate	incl. in rate	$3,003.27
Equipment Operator (medium)	Active	1.00	8.3	8	66.40	L	$66.28	incl. in rate	incl. in rate	$4,400.99
Hydraulic Excavator (6.0cy)	Active	1.00	8.3	8	66.40	E	$322.48	incl. in rate	incl. in rate	$21,412.67
Truck Driver (heavy)	Active	2.00	8.3	8	132.80	L	$57.59	incl. in rate	incl. in rate	$7,647.95
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	8.3	8	132.80	E	$111.64	incl. in rate	incl. in rate	$14,825.79
Hydraulic Excavator (5.0cy)	Active	1.00	8.3	8	66.40	E	$274.63	incl. in rate	incl. in rate	$18,235.43

Labor Hours	**863.2**	**TOTAL LABOR**	**$53,677.76**
Equipment Hours	**332**	**TOTAL EQUIPMENT**	**$71,648.92**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$2,683.89	$2,683.89

TOTAL MATERIAL **$2,683.89**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				

TOTAL SUBCONTRACTS **$0.00**

SUMMARY OF COSTS

Labor Cost	$53,677.76	Labor Burden @	49.7%	$0.00	$53,677.76
Material Cost	$2,683.89	Material Tax @	7.8%	$208.00	$2,891.89
Equipment Cost	$71,648.92	Equipment Tax @	0.0%	$0.00	$71,648.92
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$128,011**			**$208**	**DIRECT COST SUBTOTALS** **$128,219**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$128,218.57	$19,232.79
Installing Contractors Profit@	8.0%				$128,218.57	$10,257.49
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$29,490.27**
General Contractors Insurance @	1.0%		on		$157,708.84	$1,577
Bond @	1.0%		on		$157,708.84	$1,577
Contingency @	0.0%		on		$160,863.02	$0
					TOTAL COST for pay item	**$160,863**

Additional Pay Item Notes :

Removal of steel transition manifolds using E-19 crews for demolition. 2 Crews formed from 1 Forman, 3 millwright.3 equipment operators 1 for the crane, 2 excavators. 2 truck driver to drive off road truck

PAY ITEM COST DETAIL WORKSHEET — **1.087a Remove petroleum products from Mechanical Equipment**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.087a	**Project**	: JCBOYLE				
Description	:	Remove petroleum products from Mechanical Equipment						
Quantity	:	380.00 GAL						
Daily Production	:	350.00 GAL per 8 hour shift	**Project #**	: Klamath Dams Removal				
Work Days	:	1.1 Days	**Estimator**	: Mihaela Tomulescu	**GAL per**	**Total Cost**	**Unit Price Per GAL**	
Unit Price	:	$16.54 per GAL	**Probable Low Cost Parameter**		**402.5**	**$5,342**	**$14.06**	
Total Cost	:	$6,284	**Probable High Cost Parameter**		**245**	**$8,169**	**$21.50**	

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.1	8	8.80	L	$46.27	incl. in rate	incl. in rate	$407.18
Electrician	Active	1.00	1.1	8	8.80	L	$45.23	incl. in rate	incl. in rate	$398.02
Laborer	Active	5.00	1.1	8	44.00	L	$45.80	incl. in rate	incl. in rate	$2,015.20
Truck Driver (heavy)	Active	1.00	1.1	8	8.80	L	$57.59	incl. in rate	incl. in rate	$506.79

Labor Hours	**70.4**	**TOTAL LABOR**	**$3,327.19**
Equipment Hours	**0**	**TOTAL EQUIPMENT**	**$0.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$166.36	$166.36

TOTAL MATERIAL	**$166.36**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
pickup, vacuum truck, stainless steel tank, 5000 gallons, minimum charge, 4 hours, 2 compartment	8.80	hour	1.000	$200.00	$1,760.00

TOTAL SUBCONTRACTS	**$1,760.00**

SUMMARY OF COSTS

Labor Cost	$3,327.19	Labor Burden @	49.7%	$0.00	$3,327.19
Material Cost	$166.36	Material Tax @	7.8%	$12.89	$179.25
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00	$0.00
Subcontractors	$1,760.00				$1,760.00
DIRECT COST SUBTOTALS	**$5,254**			**$13**	**DIRECT COST SUBTOTALS** **$5,266**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,506.44	$525.97
Installing Contractors Profit@	8.0%				$3,506.44	$280.52
GC Markup on Subs @	5.0%				$1,760.00	$88.00
					TOTAL MARKUP COSTS	**$894.48**
General Contractors Insurance @	1.0%		on		$6,160.93	$62
Bond @	1.0%		on		$6,160.93	$62
Contingency @	0.0%		on		$6,284.15	$0
					TOTAL COST for pay item	**$6,284**

Additional Pay Item Notes :

Petroleum-based products, ranging from fuel oil and hydraulic fluid to lubricating greases and oils, are found throughout every type of power generating plant or system. Lubrication supports bearings and moving parts in all sorts of equipment: pumps, conveyors, feeders, scrubbers, cranes, turbines, and more. A good oil/water separation system will result in a flow of concentrated waste oil to a collection area and a flow of oil-free water ready for secondary processing or discharge. Once an oil layer has been separated from free water, it must be removed for recycling or disposal. Many plants use one or more of these oil removal methods, but each has costly limitations:

1. Absorbent materials. Absorbent mats or materials are frequently used to dam up and absorb excess oils and greases resulting from accidents or the routine operation of machinery. These materials are very effective for preventing the spread of a source leak and very efficient in terms of oil pickup. Yet, their use on large volumes of waste oil results in multiple, recurring costs that can make them impractical as an everyday solution:
   - the costs of the materials themselves
   - the labor costs for ordering, stocking, application, and removal
   - the costs of used-media collection, disposal, or re-processing/recycling.
2. Manually operated "slotted pipes." Many separators feature a "slotted pipe," a pipe located near the top of the vessel that has a horizontal opening. Oil is removed by turning the horizontal opening downward until it meets the floating oil layer, which drains through the pipe to a collection receptacle. These pipes work well on thick layers of oil, but cannot drain off a sheen of oil without draining off a large amount of water as well.

AECOM assumed the best is Vacuum truck removal method .Used a crew formed of 1 Forman, 5 Laborers to takeout the petroleum waste, 1 Electrician to unplug the power and to assure the temporary power at the construction site. Vacuum-equipped tank trucks are used to remove waste oil from collection points at plants so that it can be transported to recycling or disposal locations. If the waste oil has been thoroughly separated, highly concentrated, and stored in an appropriate receptacle, this service can be used very efficiently. However, vacuum disposal units are often used to pump oil layers directly off of water. This results in the intake of a significant amount free water along with the waste oil – and a significantly higher cost.

PAY ITEM COST DETAIL WORKSHEET

1.097 Clear and Grub Disposal Area (Embankment)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.097		**Project**	: JC Boyle			
Description	:	Clear and Grub Disposal Area (Embankment)						
Quantity	:	10.00	AC					
Daily Production	:	1.00	AC per 8 hour shift	**Project #**	: 1			
Work Days	:	10.0	Days	**Estimator**	: Eric Jones	**AC per**	**Total Cost**	**Unit Price Per AC**
Unit Price	:	$12,954.90	per AC	**Probable Low Cost Parameter**		**1.1**	**$116,594**	**$11,659.41**
Total Cost	:	$129,549		**Probable High Cost Parameter**		**0.9**	**$142,504**	**$14,250.39**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	10.0	8	80.00	L	$46.27	incl. in rate	incl. in rate	$3,701.60
Laborer	Active	2.00	10.0	8	160.00	L	$45.80	incl. in rate	incl. in rate	$7,328.00
Equipment Operator (medium)	Active	4.00	10.0	8	320.00	L	$66.28	incl. in rate	incl. in rate	$21,209.60
Truck Driver (heavy)	Active	1.00	10.0	8	80.00	L	$57.59	incl. in rate	incl. in rate	$4,607.20
Loader, FE Rubber Tire (5.25cy)	Active	2.00	10.0	8	160.00	E	$75.42	incl. in rate	incl. in rate	$12,067.20
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	10.0	8	80.00	E	$70.35	incl. in rate	incl. in rate	$5,628.00
Hydraulic Excavator (5.0cy)	Active	2.00	10.0	8	160.00	E	$274.63	incl. in rate	incl. in rate	$43,940.80
0		1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
0		2.00	10.0	8	160.00	0	$0.00	$0.00		$0.00
		1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
		1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
		1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
				Labor Hours	**640**				**TOTAL LABOR**	**$36,846.40**
				Equipment Hours	**400**				**TOTAL EQUIPMENT**	**$61,636.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price		Material Cost
							$0.00
		gal	1.000	0.00	$18.87		$0.00
		lbs PLS	1.000	0.00	$8.17		$0.00
		lbs PLS	1.000	0.00	$14.40		$0.00
		lbs PLS	1.000	0.00	$8.96		$0.00
		lbs PLS	1.000	0.00	$5.85		$0.00
		lbs PLS	1.000	0.00	$30.24		$0.00
		lbs	1.000	0.00	$34.02		$0.00
		lbs	1.000	0.00	$10.80		$0.00
		ea	1.000	0.00	$18.00		$0.00
		ea	1.000	0.00	$0.09		$0.00
		ea	1.000	0.00	$6.30		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ls	1.000	0.00	$8,000.00		$0.00
						TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
	-					$0.00
						$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$36,846.40	Labor Burden @	0.0%			$36,846.40
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$61,636.00	Equipment Tax @	7.75%	$4,776.79		$66,412.79
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$98,482**			**$4,777**	**DIRECT COST SUBTOTALS**	**$103,259**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$103,259.19		$15,488.88
Installing Contractors Profit@	8.0%				$103,259.19		$8,260.74
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$23,749.61**
General Contractors Insurance @	1.0%		on		$127,008.80		$1,270
Bond @	1.0%		on		$127,008.80		$1,270
Contingency @	0.0%		on		$129,548.98		$0
						TOTAL COST for pay item	**$129,549**

Additional Pay Item Notes :

Hauling material to 1/2 mile onsite dump location, 2 excavators clearing trees and brush, 2 loaders loading dump trucks, laborers will be directing trucks, foreman will oversee operation.

PAY ITEM COST DETAIL WORKSHEET

1.098 Clear and Grub, 40' width

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.098		**Project**	: JC Boyle			
Description	:	Clear and Grub, 40' width						
Quantity	:	2.40	AC					
Daily Production	:	1.00	AC per	8	hour shift	**Project #**	: 1	
Work Days	:	2.4	Days			**Estimator**	: Eric Jones	
Unit Price	:	$12,954.90	per AC			**Probable Low Cost Parameter**	**1.1**	**$27,983**	**$11,659.41**
Total Cost	:	$31,092				**Probable High Cost Parameter**	**0.9**	**$34,201**	**$14,250.39**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.4	8	19.20	L	$46.27	incl. in rate	incl. in rate	$888.38
Laborer	Active	2.00	2.4	8	38.40	L	$45.80	incl. in rate	incl. in rate	$1,758.72
Equipment Operator (medium)	Active	4.00	2.4	8	76.80	L	$66.28	incl. in rate	incl. in rate	$5,090.30
Truck Driver (heavy)	Active	1.00	2.4	8	19.20	L	$57.59	incl. in rate	incl. in rate	$1,105.73
Loader, FE Rubber Tire (5.25cy)	Active	2.00	2.4	8	38.40	E	$75.42	incl. in rate	incl. in rate	$2,896.13
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	2.4	8	19.20	E	$70.35	incl. in rate	incl. in rate	$1,350.72
Hydraulic Excavator (5.0cy)	Active	2.00	2.4	8	38.40	E	$274.63	incl. in rate	incl. in rate	$10,545.79
0		1.00	2.4	8	19.20	0	$0.00	$0.00		$0.00
0		2.00	2.4	8	38.40	0	$0.00	$0.00		$0.00
		1.00	2.4	8	19.20	0	$0.00	$0.00		$0.00
		1.00	2.4	8	19.20	0	$0.00	$0.00		$0.00
		1.00	2.4	8	19.20	0	$0.00	$0.00		$0.00
			2.4	8	0.00					$0.00
			2.4	8	0.00					$0.00
			2.4	8	0.00					$0.00
			2.4	8	0.00					$0.00
			2.4	8	0.00					$0.00
				Labor Hours	**153.6**			**TOTAL LABOR**		**$8,843.14**
				Equipment Hours	**96**			**TOTAL EQUIPMENT**		**$14,792.64**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$8,843.14	Labor Burden @	0.0%			$8,843.14
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$14,792.64	Equipment Tax @	7.75%	$1,146.43		$15,939.07
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$23,636**			**$1,146**	**DIRECT COST SUBTOTALS**	**$24,782**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$24,782.21		$3,717.33
Installing Contractors Profit@	8.0%				$24,782.21		$1,982.58
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$5,699.91**
General Contractors Insurance @	1.0%		on		$30,482.11		$305
Bond @	1.0%		on		$30,482.11		$305
Contingency @	0.0%		on		$31,091.76		$0
						TOTAL COST for pay item	**$31,092**

Additional Pay Item Notes :

Hauling material to 1/2 mile onsite dump location, 2 excavators clearing trees and brush, 2 loaders loading dump trucks, laborers will be directing trucks, foreman will oversee operation.

PAY ITEM COST DETAIL WORKSHEET

1.099 4" thick gravel surfacing

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.099			**Project**	: JC Boyle			
Description	:	4" thick gravel surfacing							
Quantity	:	2,150.00	TN						
Daily Production	:	430.00	TN per	8 hour shift	**Project #**	: 1			
Work Days	:	5.0 Days			**Estimator**	: Eric Jones	**TN per**	**Total Cost**	**Unit Price Per TN**
Unit Price	:	$29.66 per TN			**Probable Low Cost Parameter**		**473**	**$57,386**	**$26.69**
Total Cost	:	$63,762			**Probable High Cost Parameter**		**387**	**$70,139**	**$32.62**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (125hp)(CATD6)	Active	2.00	5.0	8	80.00	E	$82.17	incl. in rate	incl. in rate	$6,573.60
Loader, FE Rubber Tire (5.25cy)	Active	1.00	5.0	8	40.00	E	$75.42	incl. in rate	incl. in rate	$3,016.80
Truck, On-Highway Dump (6x4, 12cy)	Active	4.00	5.0	8	160.00	E	$70.35	incl. in rate	incl. in rate	$11,256.00
Roller, Single Drum (steel wheel, 12.0 - 14.9 MTn)	Active	1.00	5.0	8	40.00	E	$72.79	incl. in rate	incl. in rate	$2,911.60
Equipment Operator (light)	Active	2.00	5.0	8	80.00	L	$64.90	incl. in rate	incl. in rate	$5,192.00
Equipment Operator (medium)	Active	2.00	5.0	8	80.00	L	$66.28	incl. in rate	incl. in rate	$5,302.40
Truck Driver (heavy)	Active	4.00	5.0	8	160.00	L	$57.59	incl. in rate	incl. in rate	$9,214.40
Labor Foreman (out)	Active	1.00	5.0	8	40.00	L	$46.27	incl. in rate	incl. in rate	$1,850.80
Laborer	Active	2.00	5.0	8	80.00	L	$45.80	incl. in rate	incl. in rate	$3,664.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
				Labor Hours	**440**			**TOTAL LABOR**		**$25,223.60**
				Equipment Hours	**320**			**TOTAL EQUIPMENT**		**$23,758.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$25,223.60	Labor Burden @	0.0%			$25,223.60
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$23,758.00	Equipment Tax @	7.75%	$1,841.25		$25,599.25
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$48,982**			**$1,841**	**DIRECT COST SUBTOTALS**	**$50,823**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$50,822.85		$7,623.43
Installing Contractors Profit@	8.0%				$50,822.85		$4,065.83
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$11,689.25**
General Contractors Insurance @	1.0%		on		$62,512.10		$625
Bond @	1.0%		on		$62,512.10		$625
Contingency @	0.0%		on		$63,762.34		$0
						TOTAL COST for pay item	**$63,762**

Additional Pay Item Notes :

Production is based off of a total of 2150 total tons of material, each truck can haul 18 tons per load. Roughly 119 loads of stone hauled with 4 trucks would be 30 loads per truck. Operation lasting 5 days would mean each of the 4 trucks would have to deliver 6 loads a day or 430 tons. 1 dozer will be used to place the initial material as it is dumped from the truck, 1 dozer will be used to fine grade in sequence with the compaction roller that is stabilizing the surface coarse. Loader will be assisting operation by scooping up loose material as needed and placing it back in to the surface foot print.

PAY ITEM COST DETAIL WORKSHEET

1.103 Soil Cover Over Concrete Rubble (Scour Hole)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.103			**Project**	: JC Boyle			
Description	:	Soil Cover Over Concrete Rubble (Scour Hole)							
Quantity	:	13,000.00	cy						
Daily Production	:	865.00	cy per	8 hour shift	**Project #**	: 1			
Work Days	:	15.0	Days		**Estimator**	: Michael Barba	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$8.64	per cy		**Probable Low Cost Parameter**		**951.5**	**$101,113**	**$7.78**
Total Cost	:	$112,348			**Probable High Cost Parameter**		**692**	**$134,818**	**$10.37**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (235hp)(CATD7)	Active	2.00	15.0	8	240.00	E	$165.11	$165.11		$39,626.40
Loader, FE Rubber Tire (5.25cy)	Active	1.00	15.0	8	120.00	E	$75.42	$75.42		$9,050.40
Equipment Operator (medium)	Active	3.00	15.0	8	360.00	L	$66.28	$0.00		$23,860.80
Laborer	Active	1.00	15.0	8	120.00	L	$45.80	$0.00		$5,496.00
Labor Foreman (out)	Active	1.00	15.0	8	120.00	L	$46.27	$0.00		$5,552.40
Truck, Pickup (4x4, 3/4tn)	Active	1.00	15.0	8	120.00	E	$16.94	$16.94		$2,032.80
	Active	1.00	15.0	8	120.00	0	$0.00	$0.00		$0.00
	Active	1.00	15.0	8	120.00	0	$0.00	$0.00		$0.00
	Active	1.00	15.0	8	120.00	0	$0.00	$0.00		$0.00
		1.00	15.0	8	120.00	0	$0.00	$0.00		$0.00
		1.00	15.0	8	120.00	0	$0.00	$0.00		$0.00
		1.00	15.0	8	120.00	0	$0.00	$0.00		$0.00
			15.0	8	0.00					$0.00
			15.0	8	0.00					$0.00
			15.0	8	0.00					$0.00
			15.0	8	0.00					$0.00
			15.0	8	0.00					$0.00
				Labor Hours	**600**			**TOTAL LABOR**		**$34,909.20**
				Equipment Hours	**480**			**TOTAL EQUIPMENT**		**$50,709.60**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
	0.00	cy	1.300	0.00	$30.00	$0.00
	0.00	ea	1.000	0.00	$0.00	$0.00
	0.00	ea	1.000	0.00	$0.00	$0.00
	0.00	ea	1.000	0.00	$0.00	$0.00
	0.00	ls	1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$34,909.20	Labor Burden @	49.7%	$0.00		$34,909.20
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$50,709.60	Equipment Tax @	7.75%	$3,929.99		$54,639.59
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$85,619**			**$3,930**	**DIRECT COST SUBTOTALS**	**$89,549**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$89,548.79	$13,432.32
Installing Contractors Profit@	8.0%				$89,548.79	$7,163.90
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$20,596.22**
General Contractors Insurance @	1.0%		on		$110,145.02	$1,101
Bond @	1.0%		on		$110,145.02	$1,101
Contingency @	0.0%		on		$112,347.92	$0
					TOTAL COST for pay item	**$112,348**

Additional Pay Item Notes :

This activity will be for excavating bolders and placing soil over concrete demo material at the scour hole location.

PAY ITEM COST DETAIL WORKSHEET

1.107 Embankment Fill in Waste way (Fore bay) Scour Hole

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.107			**Project**	: JC Boyle			
Description	:	Embankment Fill in Waste way (Fore bay) Scour Hole							
Quantity	:	55,900.00	CY						
Daily Production	:	400.00	CY per	8 hour shift	**Project #**	: 1			
Work Days	:	139.8	Days		**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$77.16	per CY		**Probable Low Cost Parameter**		**440**	**$3,882,075**	**$69.45**
Total Cost	:	$4,313,417			**Probable High Cost Parameter**		**360**	**$4,744,759**	**$84.88**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (125hp)(CATD6)	Active	1.00	139.8	8	1,118.40	E	$82.17	incl. in rate	incl. in rate	$91,898.93
Hydraulic Excavator (5.0cy)	Active	3.00	139.8	8	3,355.20	E	$274.63	incl. in rate	incl. in rate	$921,438.58
Truck, On-Highway Dump (6x4, 12cy)	Active	8.00	139.8	8	8,947.20	E	$70.35	incl. in rate	incl. in rate	$629,435.52
Loader, FE Rubber Tire (5.25cy)	Active	1.00	139.8	8	1,118.40	E	$75.42	incl. in rate	incl. in rate	$84,349.73
Crawler Crane (270tn)	Active	1.00	***69.9***	8	559.20	E	$399.50	incl. in rate	incl. in rate	$223,400.40
Equipment Operator (medium)	Active	3.00	139.8	8	3,355.20	L	$66.28	incl. in rate	incl. in rate	$222,382.66
Truck Driver (heavy)	Active	10.00	139.8	8	11,184.00	L	$57.59	incl. in rate	incl. in rate	$644,086.56
Labor Foreman (out)	Active	1.00	139.8	8	1,118.40	L	$46.27	incl. in rate	incl. in rate	$51,748.37
Laborer	Active	6.00	139.8	8	6,710.40	L	$45.80	incl. in rate	incl. in rate	$307,336.32
Equipment Operator (light)	Active	1.00	139.8	8	1,118.40	L	$64.90	incl. in rate	incl. in rate	$72,584.16
Equipment Operator (crane)	Active	1.00	***69.9***	8	559.20	L	$68.41	incl. in rate	incl. in rate	$38,254.87
		1.00	139.8	8	1,118.40	0	$0.00	$0.00		$0.00
			139.8	8	0.00					$0.00
			139.8	8	0.00					$0.00
			139.8	8	0.00					$0.00
			139.8	8	0.00					$0.00
			139.8	8	0.00					$0.00
				Labor Hours	**24045.6**			**TOTAL LABOR**		**$1,336,392.94**
				Equipment Hours	**15098.4**			**TOTAL EQUIPMENT**		**$1,950,523.15**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,336,392.94	Labor Burden @	0.0%			$1,336,392.94
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$1,950,523.15	Equipment Tax @	7.75%	$151,165.54		$2,101,688.70
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$3,286,916**			**$151,166**	**DIRECT COST SUBTOTALS**	**$3,438,082**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$3,438,081.63		$515,712.24
Installing Contractors Profit@	8.0%				$3,438,081.63		$275,046.53
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$790,758.78**
General Contractors Insurance @	1.0%		on		$4,228,840.41		$42,288
Bond @	1.0%		on		$4,228,840.41		$42,288
Contingency @	0.0%		on		$4,313,417.22		$0
						TOTAL COST for pay item	**$4,313,417**

Additional Pay Item Notes :

Each dump truck will be able to haul 10 CY per load which will be 5590 loads of material. 8 trucks will be hauling 5 loads a day or 500 CY per day. Production is lower than usual due to placing material in a critical area that will need extra safety observation. A crane will need to be mobilized to fly excavators to bottom of scour hole and to fly them out once filled. 1 excavators and 1 dozer will be placed up top to manage the delivery of the material and 2 excavators will be placed at the bottom managing material placement. Laborers will directing truck traffic and spotting in critical areas at the top and the bottom.

PAY ITEM COST DETAIL WORKSHEET

1.108 Topsy Recreational Area - Concrete total

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.108		**Project**	: JC Boyle			
Description	:	Topsy Recreational Area - Concrete total						
Quantity	:	68.00	CY					
Daily Production	:	34.00	CY per	8	hour shift	**Project #**	: 1	
Work Days	:	2.0	Days			**Estimator**	: Eric Jones	
Unit Price	:	$454.68	per CY			**Probable Low Cost Parameter**	**35.7**	**$29,372**	**$431.94**
Total Cost	:	$30,918				**Probable High Cost Parameter**	**30.6**	**$34,010**	**$500.14**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	2.00	2.0	8	32.00	E	$274.63	incl. in rate	incl. in rate	$8,788.16
Loader, FE Rubber Tire (5.25cy)	Active	1.00	2.0	8	16.00	E	$75.42	incl. in rate	incl. in rate	$1,206.72
Truck, On-Highway Dump (6x4, 12cy)	Active	3.00	2.0	8	48.00	E	$70.35	incl. in rate	incl. in rate	$3,376.80
Truck, Pickup (4x4, 3/4tn)	Active	1.00	2.0	8	16.00	E	$16.94	incl. in rate	incl. in rate	$271.04
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	2.0	8	16.00	E	$62.72	incl. in rate	incl. in rate	$1,003.52
Truck Driver (heavy)	Active	3.00	2.0	8	48.00	L	$57.59	incl. in rate	incl. in rate	$2,764.32
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	incl. in rate	incl. in rate	$740.32
Laborer	Active	3.00	2.0	8	48.00	L	$45.80	incl. in rate	incl. in rate	$2,198.40
Equipment Operator (light)	Active	1.00	2.0	8	16.00	L	$64.90	incl. in rate	incl. in rate	$1,038.40
Equipment Operator (medium)	Active	2.00	2.0	8	32.00	L	$66.28	incl. in rate	incl. in rate	$2,120.96
0		1.00	80.0	8	640.00	0	$0.00	$0.00		$0.00
		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
				Labor Hours	**160**			**TOTAL LABOR**		**$8,862.40**
				Equipment Hours	**128**			**TOTAL EQUIPMENT**		**$14,646.24**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$8,862.40	Labor Burden @	0.0%			$8,862.40
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$14,646.24	Equipment Tax @	7.75%	$1,135.08		$15,781.32
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$23,509**			**$1,135**	**DIRECT COST SUBTOTALS**	**$24,644**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$24,643.72		$3,696.56
Installing Contractors Profit@	8.0%				$24,643.72		$1,971.50
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$5,668.06**
General Contractors Insurance @	1.0%			on	$30,311.78		$303
Bond @	1.0%			on	$30,311.78		$303
Contingency @	0.0%			on	$30,918.02		$0
						TOTAL COST for pay item	**$30,918**

Additional Pay Item Notes :

1 excavator and breaker will be used to break up the concrete items, 1 excavator will stock pile the broken material, 1 FE loader will assist in loading trucks and maintain haul road, laborers will direct truck/ equipment traffic and assist the equipment for demolition, foreman will oversee operation. Material produced will be 7 loads of material, 3 trucks will be used to ensure the demolition team always has a truck to load in to.

PAY ITEM COST DETAIL WORKSHEET

1.109 Topsy Recreational Area - 6'x80' Floating dock made of lumber and composite decking

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.109			**Project**	: JC Boyle			
Description	:	Topsy Recreational Area - 6'x80' Floating dock made of lumber and composite decking							
Quantity	:	1.00	EA						
Daily Production	:	1.00	EA per	8 hour shift	**Project #**	: 1			
Work Days	:	1.0	Days		**Estimator**	: Eric Jones	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$8,816.20	per EA		**Probable Low Cost Parameter**		**1.05**	**$8,375**	**$8,375.39**
Total Cost	:	$8,816			**Probable High Cost Parameter**		**0.95**	**$9,257**	**$9,257.01**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (80tn)	Active	1.00	1.0	8	8.00	E	$190.46	incl. in rate	incl. in rate	$1,523.68
Truck, Flatbed (4x4, 10,000 gvw)	Active	3.00	1.0	8	24.00	E	$31.90	incl. in rate	incl. in rate	$765.60
Truck Driver (heavy)	Active	3.00	1.0	8	24.00	L	$57.59	incl. in rate	incl. in rate	$1,382.16
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Laborer	Active	3.00	1.0	8	24.00	L	$45.80	incl. in rate	incl. in rate	$1,099.20
Carpenters	Active	2.00	1.0	8	16.00	L	$72.60	incl. in rate	incl. in rate	$1,161.60
0		2.00	1.0	8	16.00	0	$0.00	$0.00		$0.00
0		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
0		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
0		1.00	80.0	8	640.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	**80**			**TOTAL LABOR**		**$4,560.40**
				Equipment Hours	**32**			**TOTAL EQUIPMENT**		**$2,289.28**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$4,560.40	Labor Burden @	0.0%			$4,560.40
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$2,289.28	Equipment Tax @	7.75%	$177.42		$2,466.70
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$6,850**			**$177**	**DIRECT COST SUBTOTALS**	**$7,027**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$7,027.10	$1,054.06
Installing Contractors Profit@	8.0%				$7,027.10	$562.17
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,616.23**
General Contractors Insurance @	1.0%		on		$8,643.33	$86
Bond @	1.0%		on		$8,643.33	$86
Contingency @	0.0%		on		$8,816.20	$0
					TOTAL COST for pay item	**$8,816**

Additional Pay Item Notes :

Carpenters and laborers will be on ground disassembling the dock and rigging dock pieces to crane. Crane will load floating dock on to truck to haul off. Figured 3 trucks 1 load per truck.

PAY ITEM COST DETAIL WORKSHEET

1.110 Topsy Recreational Area - 5'x20' Walkway leading to hex fishing platform

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.110		**Project**	:	JC Boyle			
Description	:	Topsy Recreational Area - 5'x20' Walkway leading to hex fishing platform							
Quantity	:	200.00	SF						
Daily Production	:	400.00	SF per 8 hour shift	**Project #**	:	1			
Work Days	:	0.5	Days	**Estimator**	:	Eric Jones	**SF per**	**Total Cost**	**Unit Price Per SF**
Unit Price	:	$10.02	per SF	**Probable Low Cost Parameter**			**420**	**$1,904**	**$9.52**
Total Cost	:	$2,005		**Probable High Cost Parameter**			**380**	**$2,105**	**$10.52**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Forklift, Rough Terrain (9,000 lb capacity)	Active	1.00	0.5	8	4.00	E	$54.70	incl. in rate	incl. in rate	$218.80
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	0.5	8	4.00	E	$31.90	incl. in rate	incl. in rate	$127.60
Truck Driver (heavy)	Active	1.00	0.5	8	4.00	L	$57.59	incl. in rate	incl. in rate	$230.36
Equipment Operator (light)	Active	1.00	0.5	8	4.00	L	$64.90	incl. in rate	incl. in rate	$259.60
Labor Foreman (out)	Active	1.00	0.5	8	4.00	L	$46.27	incl. in rate	incl. in rate	$185.08
Laborer	Active	3.00	0.5	8	12.00	L	$45.80	incl. in rate	incl. in rate	$549.60
0		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
0		2.00	0.5	8	8.00	0	$0.00	$0.00		$0.00
0		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
0		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
0		1.00	80.0	8	640.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
				Labor Hours	**24**			**TOTAL LABOR**		**$1,224.64**
				Equipment Hours	**8**			**TOTAL EQUIPMENT**		**$346.40**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,224.64	Labor Burden @	0.0%			$1,224.64
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$346.40	Equipment Tax @	7.75%	$26.85		$373.25
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,571**			**$27**	**DIRECT COST SUBTOTALS**	**$1,598**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,597.89		$239.68
Installing Contractors Profit@	8.0%				$1,597.89		$127.83
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$367.51**
General Contractors Insurance @	1.0%		on		$1,965.40		$20
Bond @	1.0%		on		$1,965.40		$20
Contingency @	0.0%		on		$2,004.71		$0
						TOTAL COST for pay item	**$2,005**

Additional Pay Item Notes :

Laborers will assist equipment operator with loading walkway on truck. Forklift will load truck and take walk way to disposal area.

PAY ITEM COST DETAIL WORKSHEET

1.111 Topsy Recreational Area - Regrade to natural contour

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.111			**Project**	: JC Boyle			
Description	:	Topsy Recreational Area - Regrade to natural contour							
Quantity	:	300.00	SF						
Daily Production	:	300.00	SF per	8 hour shift	**Project #**	: 1			
Work Days	:	1.0	Days		**Estimator**	: Eric Jones	**SF per**	**Total Cost**	**Unit Price Per SF**
Unit Price	:	$14.63	per SF		**Probable Low Cost Parameter**		**315**	**$4,171**	**$13.90**
Total Cost	:	$4,390			**Probable High Cost Parameter**		**270**	**$4,829**	**$16.10**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (125hp)(CATD6)	Active	1.00	1.0	8	8.00	E	$82.17	incl. in rate	incl. in rate	$657.36
Roller, Single Drum (steel wheel, 12.0 - 14.9 MTn)	Active	1.00	1.0	8	8.00	E	$72.79	incl. in rate	incl. in rate	$582.32
Equipment Operator (medium)	Active	2.00	1.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
	Active	0.00	1.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	0.00	1.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
0		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
0		1.00	80.0	8	640.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	**40**			**TOTAL LABOR**		**$2,163.44**
				Equipment Hours	**16**			**TOTAL EQUIPMENT**		**$1,239.68**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		lbs PLS	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,163.44	Labor Burden @	0.0%			$2,163.44
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$1,239.68	Equipment Tax @	7.75%	$96.08		$1,335.76
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$3,403**			**$96**	**DIRECT COST SUBTOTALS**	**$3,499**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$3,499.20		$524.88
Installing Contractors Profit@	8.0%				$3,499.20		$279.94
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$804.81**
General Contractors Insurance @	1.0%		on		$4,304.01		$43
Bond @	1.0%		on		$4,304.01		$43
Contingency @	0.0%		on		$4,390.09		$0
						TOTAL COST for pay item	**$4,390**

Additional Pay Item Notes :

It will take 1 day using 1 dozer and 1 roller to regrade area.

PAY ITEM COST DETAIL WORKSHEET

1.112 Pioneer Park - Picnic tables to be removed and hauled away

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.112			**Project**	: JC Boyle			
Description	:	Pioneer Park - Picnic tables to be removed and hauled away							
Quantity	:	12.00	EA						
Daily Production	:	24.00	EA per	8 hour shift	**Project #**	: 1			
Work Days	:	0.5	Days		**Estimator**	: Eric Jones	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$156.62	per EA		**Probable Low Cost Parameter**		**25.2**	**$1,785**	**$148.79**
Total Cost	:	$1,879			**Probable High Cost Parameter**		**22.8**	**$1,973**	**$164.45**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Forklift, Rough Terrain (9,000 lb capacity)	Active	1.00	0.5	8	4.00	E	$54.70	incl. in rate	incl. in rate	$218.80
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	0.5	8	4.00	E	$31.90	incl. in rate	incl. in rate	$127.60
Equipment Operator (light)	Active	1.00	0.5	8	4.00	L	$64.90	incl. in rate	incl. in rate	$259.60
Roller, Single Drum (steel wheel, 12.0 - 14.9 MTn)	Active	1.00	0.5	8	4.00	E	$72.79	incl. in rate	incl. in rate	$291.16
Labor Foreman (out)	Active	1.00	0.5	8	4.00	L	$46.27	incl. in rate	incl. in rate	$185.08
Laborer	Active	2.00	0.5	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
0		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
0		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
0		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
0		1.00	80.0	8	640.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
				Labor Hours	**16**			**TOTAL LABOR**		**$811.08**
				Equipment Hours	**12**			**TOTAL EQUIPMENT**		**$637.56**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		lbs PLS	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$811.08	Labor Burden @	0.0%			$811.08
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$637.56	Equipment Tax @	7.75%	$49.41		$686.97
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,449**			**$49**	**DIRECT COST SUBTOTALS**	**$1,498**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,498.05		$224.71
Installing Contractors Profit@	8.0%				$1,498.05		$119.84
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$344.55**
General Contractors Insurance @	1.0%		on		$1,842.60		$18
Bond @	1.0%		on		$1,842.60		$18
Contingency @	0.0%		on		$1,879.45		$0
						TOTAL COST for pay item	**$1,879**

Additional Pay Item Notes :

Fork lift to place table on truck, Laborers to rig tables to forklift and to guide during the lift, Foreman to run the crew.

PAY ITEM COST DETAIL WORKSHEET

1.113 Pioneer Park - 12 Concrete fire rings

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.113		**Project**	: JC Boyle			
Description	:	Pioneer Park - 12 Concrete fire rings						
Quantity	:	5.00	CY					
Daily Production	:	15.00	CY per	8	hour shift	**Project #**	: 1	
Work Days	:	0.3	Days			**Estimator**	: Eric Jones	
Unit Price	:	$353.89	per CY			**Probable Low Cost Parameter**	**15.75**	**$1,681**	**$336.20**
Total Cost	:	$1,769				**Probable High Cost Parameter**	**14.25**	**$1,858**	**$371.59**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	1.00	0.3	8	2.40	E	$274.63	incl. in rate	incl. in rate	$659.11
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	0.3	8	2.40	E	$70.35	incl. in rate	incl. in rate	$168.84
Equipment Operator (medium)	Active	1.00	0.3	8	2.40	L	$66.28	incl. in rate	incl. in rate	$159.07
Labor Foreman (out)	Active	1.00	0.3	8	2.40	L	$46.27	incl. in rate	incl. in rate	$111.05
Laborer	Active	1.00	0.3	8	2.40	L	$45.80	incl. in rate	incl. in rate	$109.92
Truck Driver (heavy)	Active	1.00	0.3	8	2.40	L	$57.59	incl. in rate	incl. in rate	$138.22
0		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
0		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
0		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
0		1.00	80.0	8	640.00	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
				Labor Hours	**9.6**			**TOTAL LABOR**		**$518.26**
				Equipment Hours	**4.8**			**TOTAL EQUIPMENT**		**$827.95**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		lbs PLS	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$518.26	Labor Burden @	0.0%			$518.26
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$827.95	Equipment Tax @	7.75%	$64.17		$892.12
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,346**			**$64**	**DIRECT COST SUBTOTALS**	**$1,410**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,410.37		$211.56
Installing Contractors Profit@	8.0%				$1,410.37		$112.83
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$324.39**
General Contractors Insurance @	1.0%		on		$1,734.76		$17
Bond @	1.0%		on		$1,734.76		$17
Contingency @	0.0%		on		$1,769.46		$0
						TOTAL COST for pay item	**$1,769**

Additional Pay Item Notes :

The concrete fire rings will be removed to during the regrading of the area. Figured it would have a few hours to coordinate equipment and load debris in truck.

PAY ITEM COST DETAIL WORKSHEET

1.114 Pioneer Park - Portable toilets to be removed and hauled away

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.114			**Project**	: JC Boyle			
Description	:	Pioneer Park - Portable toilets to be removed and hauled away							
Quantity	:	2.00	EA						
Daily Production	:	4.00	EA per	8 hour shift	**Project #**	: 1			
Work Days	:	0.5	Days		**Estimator**	: Eric Jones	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$1,002.35	per EA		**Probable Low Cost Parameter**		**4.2**	**$1,904**	**$952.24**
Total Cost	:	$2,005			**Probable High Cost Parameter**		**3.8**	**$2,105**	**$1,052.47**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Forklift, Rough Terrain (9,000 lb capacity)	Active	1.00	0.5	8	4.00	E	$54.70	incl. in rate	incl. in rate	$218.80
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	0.5	8	4.00	E	$31.90	incl. in rate	incl. in rate	$127.60
Labor Foreman (out)	Active	1.00	0.5	8	4.00	L	$46.27	incl. in rate	incl. in rate	$185.08
Laborer	Active	3.00	0.5	8	12.00	L	$45.80	incl. in rate	incl. in rate	$549.60
Truck Driver (heavy)	Active	1.00	0.5	8	4.00	L	$57.59	incl. in rate	incl. in rate	$230.36
Equipment Operator (light)	Active	1.00	0.5	8	4.00	L	$64.90	incl. in rate	incl. in rate	$259.60
		2.00	0.5	8	8.00	0	$0.00	$0.00		$0.00
0		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
0		1.00	80.0	8	640.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
				Labor Hours	**24**			**TOTAL LABOR**		**$1,224.64**
				Equipment Hours	**8**			**TOTAL EQUIPMENT**		**$346.40**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		lbs PLS	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,224.64	Labor Burden @	0.0%			$1,224.64
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$346.40	Equipment Tax @	7.75%	$26.85		$373.25
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,571**			**$27**	**DIRECT COST SUBTOTALS**	**$1,598**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,597.89		$239.68
Installing Contractors Profit@	8.0%				$1,597.89		$127.83
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$367.51**
General Contractors Insurance @	1.0%		on		$1,965.40		$20
Bond @	1.0%		on		$1,965.40		$20
Contingency @	0.0%		on		$2,004.71		$0
						TOTAL COST for pay item	**$2,005**

Additional Pay Item Notes :

Laborers will assist equipment operator with loading toilets on truck. Forklift will load truck and take walk way to disposal area.

PAY ITEM COST DETAIL WORKSHEET

1.115 Pioneer Park - Signs to be removed and hauled away

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.115			**Project**	: JC Boyle			
Description	: Pioneer Park - Signs to be removed and hauled away							
Quantity	: 6.00	EA						
Daily Production	: 32.00	EA per	8 hour shift	**Project #**	: 1			
Work Days	: 0.2	Days		**Estimator**	: Eric Jones	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	: $141.12	per EA		**Probable Low Cost Parameter**		**33.6**	**$804**	**$134.06**
Total Cost	: $847			**Probable High Cost Parameter**		**30.4**	**$889**	**$148.17**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Loader, FE Rubber Tire (5.25cy)	Active	1.00	0.2	8	1.60	E	$75.42	incl. in rate	incl. in rate	$120.67
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	0.2	8	1.60	E	$31.90	incl. in rate	incl. in rate	$51.04
Labor Foreman (out)	Active	1.00	0.2	8	1.60	L	$46.27	incl. in rate	incl. in rate	$74.03
Laborer	Active	3.00	0.2	8	4.80	L	$45.80	incl. in rate	incl. in rate	$219.84
Truck Driver (heavy)	Active	1.00	0.2	8	1.60	L	$57.59	incl. in rate	incl. in rate	$92.14
Equipment Operator (light)	Active	1.00	0.2	8	1.60	L	$64.90	incl. in rate	incl. in rate	$103.84
		2.00	0.2	8	3.20	0	$0.00	$0.00		$0.00
0		1.00	0.2	8	1.60	0	$0.00	$0.00		$0.00
		1.00	0.2	8	1.60	0	$0.00	$0.00		$0.00
		1.00	0.2	8	1.60	0	$0.00	$0.00		$0.00
0		1.00	80.0	8	640.00	0	$0.00	$0.00		$0.00
		1.00	0.2	8	1.60	0	$0.00	$0.00		$0.00
			0.2	8	0.00					$0.00
			0.2	8	0.00					$0.00
			0.2	8	0.00					$0.00
			0.2	8	0.00					$0.00
			0.2	8	0.00					$0.00
				Labor Hours	**9.6**			**TOTAL LABOR**		**$489.86**
				Equipment Hours	**3.2**			**TOTAL EQUIPMENT**		**$171.71**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		lbs PLS	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$489.86	Labor Burden @	0.0%			$489.86
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$171.71	Equipment Tax @	7.75%	$13.31		$185.02
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$662**			**$13**	**DIRECT COST SUBTOTALS**	**$675**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$674.88		$101.23
Installing Contractors Profit@	8.0%				$674.88		$53.99
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$155.22**
General Contractors Insurance @	1.0%		on		$830.10		$8
Bond @	1.0%		on		$830.10		$8
Contingency @	0.0%		on		$846.70		$0
						TOTAL COST for pay item	**$847**

Additional Pay Item Notes :

It will take the above crew just under 2 hours to remove, load, and dispose existing signs.

PAY ITEM COST DETAIL WORKSHEET

1.116 Pioneer Park - Dumpster to be removed and hauled away

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.116		**Project**	: JC Boyle			
Description	:	Pioneer Park - Dumpster to be removed and hauled away						
Quantity	:	1.00	EA					
Daily Production	:	2.00	EA per 8 hour shift	**Project #**	: 1			
Work Days	:	0.5	Days	**Estimator**	: Eric Jones	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$2,971.02	per EA	**Probable Low Cost Parameter**		**2.2**	**$2,674**	**$2,673.92**
Total Cost	:	$2,971		**Probable High Cost Parameter**		**1.7**	**$3,417**	**$3,416.68**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	1.00	0.5	8	4.00	E	$274.63	incl. in rate	incl. in rate	$1,098.52
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	0.5	8	4.00	E	$31.90	incl. in rate	incl. in rate	$127.60
Labor Foreman (out)	Active	1.00	0.5	8	4.00	L	$46.27	incl. in rate	incl. in rate	$185.08
Laborer	Active	2.00	0.5	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Equipment Operator (medium)	Active	1.00	0.5	8	4.00	L	$66.28	incl. in rate	incl. in rate	$265.12
Truck Driver (heavy)	Active	1.00	0.5	8	4.00	L	$57.59	incl. in rate	incl. in rate	$230.36
		2.00	0.5	8	8.00	0	$0.00	$0.00		$0.00
0		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
0		1.00	80.0	8	640.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
				Labor Hours	**20**			**TOTAL LABOR**		**$1,046.96**
				Equipment Hours	**8**			**TOTAL EQUIPMENT**		**$1,226.12**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		lbs PLS	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA	**RSM**	$1,035.95	$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,046.96	Labor Burden @	0.0%			$1,046.96
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$1,226.12	Equipment Tax @	7.75%	$95.02		$1,321.14
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$2,273**			**$95**	**DIRECT COST SUBTOTALS**	**$2,368**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$2,368.10		$355.22
Installing Contractors Profit@	8.0%				$2,368.10		$189.45
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$544.66**
General Contractors Insurance @	1.0%		on		$2,912.77		$29
Bond @	1.0%		on		$2,912.77		$29
Contingency @	0.0%		on		$2,971.02		$0
						TOTAL COST for pay item	**$2,971**

Additional Pay Item Notes :

Excavator will be used to place existing dumpster on flat bed truck, laborers will assist equipment operator in the loading operation.

PAY ITEM COST DETAIL WORKSHEET

1.118 Pioneer Park - Regrade to natural contour

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.118		**Project**	: JC Boyle				
Description	: Pioneer Park - Regrade to natural contour							
Quantity	: 0.50	AC						
Daily Production	: 0.25	AC per 8 hour shift	**Project #**	: 1				
Work Days	: 2.0	Days	**Estimator**	: Eric Jones		**AC per**	**Total Cost**	**Unit Price Per AC**
Unit Price	: $17,560.36	per AC	**Probable Low Cost Parameter**			**0.275**	**$7,902**	**$15,804.33**
Total Cost	: $8,780		**Probable High Cost Parameter**			**0.225**	**$9,658**	**$19,316.40**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (125hp)(CATD6)	Active	1.00	2.0	8	16.00	E	$82.17	incl. in rate	incl. in rate	$1,314.72
Roller, Single Drum (steel wheel, 12.0 - 14.9 MTn)	Active	1.00	2.0	8	16.00	E	$72.79	incl. in rate	incl. in rate	$1,164.64
Equipment Operator (medium)	Active	2.00	2.0	8	32.00	L	$66.28	incl. in rate	incl. in rate	$2,120.96
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	incl. in rate	incl. in rate	$740.32
Laborer	Active	2.00	2.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
0	Active	0.00	2.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	0.00	2.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
0		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
0		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
0		1.00	80.0	8	640.00	0	$0.00	$0.00		$0.00
		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
				Labor Hours	**80**			**TOTAL LABOR**		**$4,326.88**
				Equipment Hours	**32**			**TOTAL EQUIPMENT**		**$2,479.36**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price		Material Cost
							$0.00
		lbs PLS	1.000	0.00	$18.87		$0.00
		lbs PLS	1.000	0.00	$8.17		$0.00
		lbs PLS	1.000	0.00	$14.40		$0.00
		lbs PLS	1.000	0.00	$8.96		$0.00
		lbs PLS	1.000	0.00	$5.85		$0.00
		lbs PLS	1.000	0.00	$30.24		$0.00
		lbs	1.000	0.00	$34.02		$0.00
		lbs	1.000	0.00	$10.80		$0.00
		ea	1.000	0.00	$18.00		$0.00
		ea	1.000	0.00	$0.09		$0.00
		ea	1.000	0.00	$6.30		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ls	1.000	0.00	$8,000.00		$0.00
						TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
	-					$0.00
						$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$4,326.88	Labor Burden @	0.0%			$4,326.88
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$2,479.36	Equipment Tax @	7.75%	$192.15		$2,671.51
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$6,806**			**$192**	**DIRECT COST SUBTOTALS**	**$6,998**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$6,998.39		$1,049.76
Installing Contractors Profit@	8.0%				$6,998.39		$559.87
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$1,609.63**
General Contractors Insurance @	1.0%		on		$8,608.02		$86
Bond @	1.0%		on		$8,608.02		$86
Contingency @	0.0%		on		$8,780.18		$0
						TOTAL COST for pay item	**$8,780**

Additional Pay Item Notes :

Duration is based off of grading cut to fill with dozer the first day, using roller to stabilize area.

PAY ITEM COST DETAIL WORKSHEET

2.001 Furnish, Install, and Remove Barge-Mounted Crane in Reservoir for Dam Removal

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.001		**Project**	:	Copco 1			
Description	:	Furnish, Install, and Remove Barge-Mounted Crane in Reservoir for Dam Removal							
Quantity	:	1.00	ls						
Daily Production	:	0.10	ls per	8	hour shift	**Project #**	: 2		
Work Days	:	10.0	Days			**Estimator**	: Michael Barba	**ls per**	**Total Cost**	**Unit Price Per ls**
Unit Price	:	$191,823.14	per ls			**Probable Low Cost Parameter**		**0.11**	**$172,641**	**$172,640.83**
Total Cost	:	$191,823				**Probable High Cost Parameter**		**0.075**	**$239,779**	**$239,778.92**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Barge (400T)	Active	1.00	10.0	8	80.00	E	$99.50	incl. in rate	incl. in rate	$7,960.00
Crawler Crane (130tn)	Active	1.00	10.0	8	80.00	E	$258.66	incl. in rate	incl. in rate	$20,692.80
Crawler Crane (270tn)	Active	1.00	10.0	8	80.00	E	$399.50	incl. in rate	incl. in rate	$31,960.00
Tugboat (250hp)	Active	1.00	10.0	8	80.00	E	$88.74	incl. in rate	incl. in rate	$7,099.20
Equipment Operator (crane)	Active	2.00	10.0	8	160.00	L	$68.41	incl. in rate	incl. in rate	$10,945.60
Equipment Operator (oiler)	Active	2.00	10.0	8	160.00	L	$62.94	incl. in rate	incl. in rate	$10,070.40
Tugboat Captain	Active	1.00	10.0	8	80.00	L	$67.76	incl. in rate	incl. in rate	$5,420.80
Tugboat Hand	Active	1.00	10.0	8	80.00	L	$45.80	incl. in rate	incl. in rate	$3,664.00
Laborer	Active	2.00	10.0	8	160.00	L	$45.80	incl. in rate	incl. in rate	$7,328.00
		1.00	10.0	8	80.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	10.0	8	80.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	10.0	8	80.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
				Labor Hours	**640**				**TOTAL LABOR**	**$37,428.80**
				Equipment Hours	**320**				**TOTAL EQUIPMENT**	**$67,712.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
Barge Rental 3 Months	3.00	month	1.000	3.00	$9,600.00	$28,800.00
Tug Boat Rental 3 Months	3.00	month	1.000	3.00	$3,550.00	$10,650.00
	0.00	ea	1.000	0.00		$0.00
	0.00	ea	1.000	0.00		$0.00
	0.00	ls	1.000	0.00		$0.00
					TOTAL MATERIAL	**$39,450.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$37,428.80	Labor Burden @	49.7%	$0.00		$37,428.80
Material Cost	$39,450.00	Material Tax @	7.75%	$3,057.38		$42,507.38
Equipment Cost	$67,712.00	Equipment Tax @	7.75%	$5,247.68		$72,959.68
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$144,591**			**$8,305**	**DIRECT COST SUBTOTALS**	**$152,896**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$152,895.86	$22,934.38
Installing Contractors Profit@	8.0%				$152,895.86	$12,231.67
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$35,166.05**
General Contractors Insurance @	1.0%		on		$188,061.90	$1,881
Bond @	1.0%		on		$188,061.90	$1,881
Contingency @	0.0%		on		$191,823.14	$0
					TOTAL COST for pay item	**$191,823**

Additional Pay Item Notes :

270 TN Crane is to lift 130 TN crane onto and off of barge. 10 work days total.

PAY ITEM COST DETAIL WORKSHEET — **2.002 Remove Sediment from Diversion Tunnel Intake to provide access**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.002		**Project**	: Copco 1			
Description	:	Remove Sediment from Diversion Tunnel Intake to provide access						
Quantity	:	30.00 CY						
Daily Production	:	5.00 CY per	8 hour shift	**Project #**	: 2			
Work Days	:	6.0 Days		**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$3,434.68 per CY		**Probable Low Cost Parameter**		**5.5**	**$92,736**	**$3,091.21**
Total Cost	:	$103,040		**Probable High Cost Parameter**		**4**	**$123,649**	**$4,121.62**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	6.0	8	48.00	L	$46.27	incl. in rate	incl. in rate	$2,220.96
Barge Operator	Active	1.00	6.0	8	48.00	L	$40.30	incl. in rate	incl. in rate	$1,934.40
Diver, Wet	Active	4.00	6.0	8	192.00	L	$124.57	incl. in rate	incl. in rate	$23,917.44
Barge (400T)	Active	1.00	6.0	8	48.00	E	$99.50	incl. in rate	incl. in rate	$4,776.00
Laborer	Active	2.00	6.0	8	96.00	L	$45.80	incl. in rate	incl. in rate	$4,396.80
Barge, Deck Engineer, Winch Operator	Active	1.00	6.0	8	48.00	L	$64.26	incl. in rate	incl. in rate	$3,084.48
Barge (400T)	Active	4.00	6.0	8	192.00	E	$99.50	incl. in rate	incl. in rate	$19,104.00
Pump, Trash Pump, 6"+	Active	1.00	6.0	8	48.00	E	$16.11	incl. in rate	incl. in rate	$773.28
Loader, FE Rubber Tire (5.25cy)	Active	1.00	6.0	8	48.00	E	$75.42	incl. in rate	incl. in rate	$3,620.16
Equipment Operator (medium)	Active	1.00	6.0	8	48.00	L	$66.28	incl. in rate	incl. in rate	$3,181.44
		1.00	6.0	8	48.00	0	$0.00	$0.00		$0.00
		1.00	6.0	8	48.00	0	$0.00	$0.00		$0.00
6" Suction Hose	Active	1.00	6.0	8	48.00	E	$250.00	incl. in rate	incl. in rate	$12,000.00
			6.0	8	0.00					$0.00
			6.0	8	0.00					$0.00
			6.0	8	0.00					$0.00
			6.0	8	0.00					$0.00
				Labor Hours	**480**				**TOTAL LABOR**	**$38,735.52**
				Equipment Hours	**384**				**TOTAL EQUIPMENT**	**$40,273.44**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price		Material Cost
							$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ls	1.000	0.00	$8,000.00		$0.00
						TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
	-					$0.00
						$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$38,735.52	Labor Burden @	0.0%				$38,735.52
Material Cost	$0.00	Material Tax @	7.75%	$0.00			$0.00
Equipment Cost	$40,273.44	Equipment Tax @	7.75%	$3,121.19			$43,394.63
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	**$79,009**			**$3,121**		**DIRECT COST SUBTOTALS**	**$82,130**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$82,130.15		$12,319.52
Installing Contractors Profit@	8.0%				$82,130.15		$6,570.41
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$18,889.93**
General Contractors Insurance @	1.0%		on		$101,020.09		$1,010
Bond @	1.0%		on		$101,020.09		$1,010
Contingency @	0.0%		on		$103,040.49		$0
						TOTAL COST for pay item	**$103,040**

Additional Pay Item Notes :

Using suction dredge operation and divers. Figuring 6 days to mobilize, clean diversion tunnel 115' down and then demobilize. Barge for suction dredging equipment. Trash Pump for suction of sediment. Loader to manage 30 CY of fill material. Duration is for restriction of divers being under water actually working 15 mins on bottom at a time 4 divers total giving 45 mins of rest for each diver.

PAY ITEM COST DETAIL WORKSHEET

2.003 Furnish, Install, and Remove Large Crane on Right Abutment

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.003		**Project**	: Copco 1			
Description	:	Furnish, Install, and Remove Large Crane on Right Abutment						
Quantity	:	1.00 LS						
Daily Production	:	1.00 LS per	8 hour shift	**Project #**	: 2			
Work Days	:	1.0 Days		**Estimator**	: Eric Jones	**LS per**	**Total Cost**	**Unit Price Per LS**
Unit Price	:	$566,865.71 per LS		**Probable Low Cost Parameter**		**1.15**	**$481,836**	**$481,835.85**
Total Cost	:	$566,866		**Probable High Cost Parameter**		**0.85**	**$651,896**	**$651,895.57**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Crawler Crane (270tn)	Active	1.00	***122.0***	8	976.00	E	$399.50	incl. in rate	incl. in rate	$389,912.00
0		0.00	1.0	8	0.00	0	$0.00	$0.00		$0.00
0		0.00	1.0	8	0.00	0	$0.00	$0.00		$0.00
0		0.00	1.0	8	0.00	0	$0.00	$0.00		$0.00
		0.00	1.0	8	0.00	0	$0.00	$0.00		$0.00
0		0.00	1.0	8	0.00	0	$0.00	$0.00		$0.00
0		0.00	1.0	8	0.00	0	$0.00	$0.00		$0.00
0		0.00	1.0	8	0.00	0	$0.00	$0.00		$0.00
0		0.00	1.0	8	0.00	0	$0.00	$0.00		$0.00
		0.00	1.0	8	0.00	0	$0.00	$0.00		$0.00
		0.00	1.0	8	0.00	0	$0.00	$0.00		$0.00
		0.00	1.0	8	0.00	0	$0.00	$0.00		$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	**0**				**TOTAL LABOR**	**$0.00**
				Equipment Hours	**976**				**TOTAL EQUIPMENT**	**$389,912.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price		Material Cost
							$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ls	1.000	0.00	$8,000.00		$0.00
						TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Crane Mobilization	1	EA	**RSM Data Base**	$18,566.94		$18,566.94
Crane Demobilization	1	EA	**RSM Data Base**	$18,566.94		$18,566.94
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$37,133.88**

SUMMARY OF COSTS

Labor Cost	$0.00	Labor Burden @	0.0%			$0.00
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$389,912.00	Equipment Tax @	7.75%	$30,218.18		$420,130.18
Subcontractors	$37,133.88					$37,133.88
DIRECT COST SUBTOTALS	**$427,046**			**$30,218**	**DIRECT COST SUBTOTALS**	**$457,264**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$420,130.18		$63,019.53
Installing Contractors Profit@	8.0%				$420,130.18		$33,610.41
GC Markup on Subs @	5.0%				$37,133.88		$1,856.69
						TOTAL MARKUP COSTS	**$98,486.64**
General Contractors Insurance @	1.0%		on		$555,750.70		$5,558
Bond @	1.0%		on		$555,750.70		$5,558
Contingency @	0.0%		on		$566,865.71		$0
						TOTAL COST for pay item	**$566,866**

Additional Pay Item Notes :

Crane on site for 4 months, also includes the mobilization and demobilization

PAY ITEM COST DETAIL WORKSHEET

2.004 Remove Water from behind Tailrace Cofferdam

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.004		**Project**	: Copco 1			
Description	:	Remove Water from behind Tailrace Cofferdam						
Quantity	:	200,000.00	GAL					
Daily Production	:	153,120.00	GAL per 8 hour shift	**Project #**	: 2			
Work Days	:	1.3	Days	**Estimator**	: Eric Jones	**GAL per**	**Total Cost**	**Unit Price Per GAL**
Unit Price	:	$0.01	per GAL	**Probable Low Cost Parameter**		**168432**	**$1,882**	**$0.01**
Total Cost	:	$2,091		**Probable High Cost Parameter**		**130152**	**$2,405**	**$0.01**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.3	8	10.40	L	$46.27	incl. in rate	incl. in rate	$481.21
Laborer	Active	2.00	1.3	8	20.80	L	$45.80	incl. in rate	incl. in rate	$952.64
Pump, Submersible Trash Pump, 3" & 4"	Active	1.00	1.3	8	10.40	E	$3.87	incl. in rate	incl. in rate	$40.25
Truck, Pickup (4x4, 3/4tn)	Active	1.00	1.3	8	10.40	E	$16.94	incl. in rate	incl. in rate	$176.18
		1.00	1.3	8	10.40	0	$0.00	$0.00		$0.00
0		1.00	1.3	8	10.40	0	$0.00	$0.00		$0.00
0		1.00	1.3	8	10.40	0	$0.00	$0.00		$0.00
0		1.00	1.3	8	10.40	0	$0.00	$0.00		$0.00
0		1.00	1.3	8	10.40	0	$0.00	$0.00		$0.00
		1.00	1.3	8	10.40	0	$0.00	$0.00		$0.00
		1.00	1.3	8	10.40	0	$0.00	$0.00		$0.00
		1.00	1.3	8	10.40	0	$0.00	$0.00		$0.00
Intake and Discharge Hose, 3" 20' lengths	Active	5.00	1.3	8	52.00		$2.50	incl. in rate	incl. in rate	$130.00
			1.3	8	0.00					$0.00
			1.3	8	0.00					$0.00
			1.3	8	0.00					$0.00
			1.3	8	0.00					$0.00
				Labor Hours	**31.2**				**TOTAL LABOR**	**$1,433.85**
				Equipment Hours	**20.8**				**TOTAL EQUIPMENT**	**$216.42**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price		Material Cost
							$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ls	1.000	0.00	$8,000.00		$0.00
						TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
		EA				$0.00
		EA				$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,433.85	Labor Burden @	0.0%			$1,433.85
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$216.42	Equipment Tax @	7.75%	$16.77		$233.20
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,650**			**$17**	**DIRECT COST SUBTOTALS**	**$1,667**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,667.04		$250.06
Installing Contractors Profit@	8.0%				$1,667.04		$133.36
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$383.42**
General Contractors Insurance @	1.0%		on		$2,050.47		$21
Bond @	1.0%		on		$2,050.47		$21
Contingency @	0.0%		on		$2,091.47		$0
						TOTAL COST for pay item	**$2,091**

Additional Pay Item Notes :

Figured you would have 1 foreman with a truck and 2 laborers managing pump for gas and other maintenance. Figured 100' of discharge pipe. Based on a 3" pump being to pump 153,120 gallons per shift it will take 1.3 days to dewater area.

PAY ITEM COST DETAIL WORKSHEET

2.005 Riprap Protection on Cofferdam

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.005		**Project**	: Copco 1			
Description	:	Riprap Protection on Cofferdam						
Quantity	:	260.00	CY					
Daily Production	:	87.00	CY per	8	hour shift	**Project #**	: 2	
Work Days	:	3.0	Days			**Estimator**	: Eric Jones	
Unit Price	:	$148.31	per CY			**Probable Low Cost Parameter**		
Total Cost	:	$38,561				**Probable High Cost Parameter**		

	CY per	Total Cost	Unit Price Per CY
Probable Low Cost Parameter	**100.05**	**$32,777**	**$126.06**
Probable High Cost Parameter	**69.6**	**$46,273**	**$177.97**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	3.0	8	24.00	L	$46.27	incl. in rate	incl. in rate	$1,110.48
Laborer	Active	2.00	3.0	8	48.00	L	$45.80	incl. in rate	incl. in rate	$2,198.40
Equipment Operator (medium)	Active	2.00	3.0	8	48.00	L	$66.28	incl. in rate	incl. in rate	$3,181.44
Truck Driver (heavy)	Active	2.00	3.0	8	48.00	L	$57.59	incl. in rate	incl. in rate	$2,764.32
Hydraulic Excavator (5.0cy)	Active	2.00	3.0	8	48.00	E	$274.63	incl. in rate	incl. in rate	$13,182.24
Truck, On-Highway Dump (6x4, 12cy)	Active	4.00	3.0	8	96.00	E	$70.35	incl. in rate	incl. in rate	$6,753.60
0		1.00	3.0	8	24.00	0	$0.00	$0.00		$0.00
0		1.00	3.0	8	24.00	0	$0.00	$0.00		$0.00
0		1.00	3.0	8	24.00	0	$0.00	$0.00		$0.00
		1.00	3.0	8	24.00	0	$0.00	$0.00		$0.00
		1.00	3.0	8	24.00	0	$0.00	$0.00		$0.00
		1.00	3.0	8	24.00	0	$0.00	$0.00		$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
				Labor Hours	**168**				**TOTAL LABOR**	**$9,254.64**
				Equipment Hours	**144**				**TOTAL EQUIPMENT**	**$19,935.84**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$9,254.64	Labor Burden @	0.0%			$9,254.64
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$19,935.84	Equipment Tax @	7.75%	$1,545.03		$21,480.87
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$29,190**			**$1,545**	**DIRECT COST SUBTOTALS**	**$30,736**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$30,735.51		$4,610.33
Installing Contractors Profit@	8.0%				$30,735.51		$2,458.84
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$7,069.17**
General Contractors Insurance @	1.0%		on		$37,804.67		$378
Bond @	1.0%		on		$37,804.67		$378
Contingency @	0.0%		on		$38,560.77		$0
						TOTAL COST for pay item	**$38,561**

Additional Pay Item Notes :

Riprap is to protect temporary cofferdam during diversion tunnel releases. Riprap material is assumed to come from Iron Gate Dam removal. Two trucks will run material to stock pile, 1 excavator will supply 2nd excavator with material for placement, Each truck will be abled to haul roughly 10 CY a truck which will be 13 loads per truck, Each truck is expected to get roughly 3 loads per day for 4 days.

PAY ITEM COST DETAIL WORKSHEET — **2.006 Provide Dewatering behind Tailrace Cofferdam**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.006		**Project**	: Copco 1			
Description	:	Provide Dewatering behind Tailrace Cofferdam						
Quantity	:	1.00 LS						
Daily Production	:	1.00 LS per	8 hour shift	**Project #**	: 2			
Work Days	:	1.0 Days		**Estimator**	: Eric Jones	**LS per**	**Total Cost**	**Unit Price Per LS**
Unit Price	:	$89,882.80 per LS		**Probable Low Cost Parameter**		**1.1**	**$80,895**	**$80,894.52**
Total Cost	:	$89,883		**Probable High Cost Parameter**		**0.8**	**$107,859**	**$107,859.37**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	***23.0***	8	184.00	L	$46.27	incl. in rate	incl. in rate	$8,513.68
Laborer	Active	3.00	***46.0***	8	1,104.00	L	$45.80	incl. in rate	incl. in rate	$50,563.20
Pump, Submersible Trash Pump, 3" & 4"	Active	3.00	***92.0***	8	2,208.00	E	$3.87	incl. in rate	incl. in rate	$8,544.96
Truck, Pickup (4x4, 3/4tn)	Active	1.00	***23.0***	8	184.00	E	$16.94	incl. in rate	incl. in rate	$3,116.96
	Active	1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
0	Active	1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
0	Active	1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
0	Active	1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
0	Active	1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
	Active	1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
Intake and Discharge Hose, 3" (20' lengths)	Active	5.00	***92.0***	8	3,680.00		$2.50	incl. in rate	incl. in rate	$9,200.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	**1288**				**TOTAL LABOR**	**$59,076.88**
				Equipment Hours	**2392**				**TOTAL EQUIPMENT**	**$11,661.92**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$59,076.88	Labor Burden @	0.0%			$59,076.88
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$11,661.92	Equipment Tax @	7.75%	$903.80		$12,565.72
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$70,739**			**$904**	**DIRECT COST SUBTOTALS**	**$71,643**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$71,642.60		$10,746.39
Installing Contractors Profit@	8.0%				$71,642.60		$5,731.41
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$16,477.80**
General Contractors Insurance @	1.0%		on		$88,120.40		$881
Bond @	1.0%		on		$88,120.40		$881
Contingency @	0.0%		on		$89,882.80		$0
						TOTAL COST for pay item	**$89,883**

Additional Pay Item Notes :

3 pumps will be used 1 day, 1 night, and 1 back up on hand to ensure the dewatering continues during maintenance. 3 laborers to be used half of the pump time of 3 months to maintain pump (gas/maintenance). 1.5 laborers during the day and 1.5 laborers during the night shift. (1 laborer will be doing a split shift). 1 foreman 1/4 of the time to manage laborer and coordinate reposition of pumps. 100' of discharge pipe used for the entire duration of operation.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.013		**Project**	: Copco 1			
Description	:	Install Diversion Tunnel Plugs						
Quantity	:	30.00 CY						
Daily Production	:	6.00 CY per	8 hour shift	**Project #**	: 2			
Work Days	:	5.0 Days		**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$1,330.24 per CY		**Probable Low Cost Parameter**		**6.6**	**$35,916**	**$1,197.21**
Total Cost	:	$39,907		**Probable High Cost Parameter**		**5.1**	**$45,893**	**$1,529.77**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	5.0	8	40.00	L	$46.27	incl. in rate	incl. in rate	$1,850.80
Laborer	Active	2.00	5.0	8	80.00	L	$45.80	incl. in rate	incl. in rate	$3,664.00
Carpenters	Active	2.00	5.0	8	80.00	L	$72.60	incl. in rate	incl. in rate	$5,808.00
Diver, Tender	Active	2.00	5.0	8	80.00	L	$79.22	incl. in rate	incl. in rate	$6,337.60
Carpenters, Journeyman	Active	2.00	5.0	8	80.00	L	$65.37	incl. in rate	incl. in rate	$5,229.60
Equipment Operator (medium)	Active	1.00	***2.5***	8	20.00	L	$66.28	incl. in rate	incl. in rate	$1,325.60
Conc Pump (small)	Active	1.00	***2.5***	8	20.00	E	$61.43	incl. in rate	incl. in rate	$1,228.60
Truck, Pickup (4x4, 3/4tn)	Active	1.00	5.0	8	40.00	E	$16.94	incl. in rate	incl. in rate	$677.60
0		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
			5.0	8	0.00		$2.50			$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
					Labor Hours	**380**			**TOTAL LABOR**	**$24,215.60**
					Equipment Hours	**60**			**TOTAL EQUIPMENT**	**$1,906.20**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
Concrete	30.00	ea	1.050	31.50	$144.13	$4,540.10
Concrete blocks for backing	400.00	ea	1.050	420.00	$1.43	$600.60
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$5,140.70**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$24,215.60	Labor Burden @	0.0%			$24,215.60
Material Cost	$5,140.70	Material Tax @	7.75%	$398.40		$5,539.10
Equipment Cost	$1,906.20	Equipment Tax @	7.75%	$147.73		$2,053.93
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$31,262**			**$546**	**DIRECT COST SUBTOTALS**	**$31,809**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$31,808.63		$4,771.29
Installing Contractors Profit@	8.0%				$31,808.63		$2,544.69
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$7,315.98**
General Contractors Insurance @	1.0%		on		$39,124.61		$391
Bond @	1.0%		on		$39,124.61		$391
Contingency @	0.0%		on		$39,907.11		$0
						TOTAL COST for pay item	**$39,907**

Additional Pay Item Notes :

Diversion plug to be installed in the dry using CMU back and concrete. Carpenters to perform work.

PAY ITEM COST DETAIL WORKSHEET — **2.014 Remove Diversion Tunnel Control Structure Concrete**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.014		**Project**	: Copco 1			
Description	:	Remove Diversion Tunnel Control Structure Concrete						
Quantity	:	350.00 CY						
Daily Production	:	70.00 CY per	8 hour shift	**Project #**	: 2			
Work Days	:	5.0 Days		**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$231.13 per CY		**Probable Low Cost Parameter**		**77**	**$72,805**	**$208.01**
Total Cost	:	$80,895		**Probable High Cost Parameter**		**56**	**$97,074**	**$277.35**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	5.0	8	40.00	L	$46.27	incl. in rate	incl. in rate	$1,850.80
Laborer	Active	3.00	5.0	8	120.00	L	$45.80	incl. in rate	incl. in rate	$5,496.00
Equipment Operator (medium)	Active	3.00	5.0	8	120.00	L	$66.28	incl. in rate	incl. in rate	$7,953.60
Truck Driver (heavy)	Active	4.00	5.0	8	160.00	L	$57.59	incl. in rate	incl. in rate	$9,214.40
Truck, On-Highway Dump (6x4, 12cy)	Active	3.00	5.0	8	120.00	E	$70.35	incl. in rate	incl. in rate	$8,442.00
Hydraulic Excavator (5.0cy)	Active	2.00	5.0	8	80.00	E	$274.63	incl. in rate	incl. in rate	$21,970.40
Loader, FE Rubber Tire (5.25cy)	Active	1.00	5.0	8	40.00	E	$75.42	incl. in rate	incl. in rate	$3,016.80
Truck, Pickup (4x4, 3/4tn)	Active	1.00	5.0	8	40.00	E	$16.94	incl. in rate	incl. in rate	$677.60
Water Tanker (5,000gal)	Active	1.00	5.0	8	40.00	E	$74.56	incl. in rate	incl. in rate	$2,982.40
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
			5.0	8	0.00		$2.50			$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
					Labor Hours	**440**			**TOTAL LABOR**	**$24,514.80**
					Equipment Hours	**320**			**TOTAL EQUIPMENT**	**$37,089.20**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.050	0.00	$150.00	$0.00
		ea	1.050	0.00	$1.43	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$24,514.80	Labor Burden @	0.0%			$24,514.80
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$37,089.20	Equipment Tax @	7.75%	$2,874.41		$39,963.61
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$61,604**			**$2,874**	**DIRECT COST SUBTOTALS**	**$64,478**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$64,478.41		$9,671.76
Installing Contractors Profit@	8.0%				$64,478.41		$5,158.27
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$14,830.03**
General Contractors Insurance @	1.0%		on		$79,308.45		$793
Bond @	1.0%		on		$79,308.45		$793
Contingency @	0.0%		on		$80,894.62		$0
						TOTAL COST for pay item	**$80,895**

Additional Pay Item Notes :

1 excavator for demolition operation, 1 excavator for loading trucks/ piling material, 1 Loader at demo site to manage material stockpile, 3 trucks to haul material from demo site to dump site, 3 laborers 2 to flag and 1 to support operators, 1 foreman going back an forth between demo and dump site, 1 water truck to keep dust down during hauling operation. There will be 350 CY of material hauled with three trucks which will equal 12 load per truck. Each truck is expected to haul 3 loads per day for 5 days.

PAY ITEM COST DETAIL WORKSHEET

2.024 Remove Powerhouse Concrete down to top of rock under the Powerhouse

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.024		**Project**	: COPCO 1			
Description	:	Remove Powerhouse Concrete down to top of rock under the Powerhouse						
Quantity	:	3,100.00	cy					
Daily Production	:	60.00	cy per	8 hour shift	**Project #**	: 1		
Work Days	:	51.7	Days		**Estimator**	: Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$387.53	per cy		**Probable Low Cost Parameter**		**69**	**$1,021,133**	**$329.40**
Total Cost	:	$1,201,333			**Probable High Cost Parameter**		**45**	**$1,501,667**	**$484.41**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	51.7	8	827.20	L	$48.27	incl. in rate	incl. in rate	$39,928.94
Laborer	Active	8.00	51.7	8	3,308.80	L	$45.80	incl. in rate	incl. in rate	$151,543.04
Equipment Operator (medium)	Active	3.00	51.7	8	1,240.80	L	$66.28	incl. in rate	incl. in rate	$82,240.22
Truck Driver (heavy)	Active	2.00	51.7	8	827.20	L	$57.59	incl. in rate	incl. in rate	$47,638.45
Carpenters	Active	2.00	51.7	8	827.20	L	$72.60	incl. in rate	incl. in rate	$60,054.72
Equipment Operator (crane)	Active	1.00	***20.0***	8	160.00	L	$68.41	incl. in rate	incl. in rate	$10,945.60
Crawler Crane (90tn)	Active	1.00	***20.0***	8	160.00	E	$208.09	incl. in rate	incl. in rate	$33,294.40
Hydraulic Excavator (5.0cy)	Active	3.00	51.7	8	1,240.80	E	$274.63	incl. in rate	incl. in rate	$340,760.90
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	2.00	51.7	8	827.20	E	$62.72	incl. in rate	incl. in rate	$51,881.98
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	51.7	8	827.20	E	$70.35	incl. in rate	incl. in rate	$58,193.52
Truck, Pickup (4x4, 3/4tn)	Active	2.00	51.7	8	827.20	E	$16.94	incl. in rate	incl. in rate	$14,012.77
Hydraulic Thumbs/Shear Attachment	Active	1.00	51.7	8	413.60	E	$16.39	incl. in rate	incl. in rate	$6,778.90
			51.7	8	0.00					$0.00
			51.7	8	0.00					$0.00
			51.7	8	0.00					$0.00
			51.7	8	0.00					$0.00
			51.7	8	0.00					$0.00
				Labor Hours	**7,191**			**TOTAL LABOR**		**$392,350.98**
				Equipment Hours	**4,296**			**TOTAL EQUIPMENT**		**$504,922.48**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$19,617.55	$19,617.55
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$19,617.55**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$392,350.98	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$392,350.98
Material Cost	$19,617.55	Material Tax @	7.75%	$1,520.36		$21,137.91
Equipment Cost	$504,922.48	Equipment Tax @	7.75%	$39,131.49		$544,053.97
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$916,891**			**$40,652**	**DIRECT COST SUBTOTALS**	**$957,543**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$957,542.86	$143,631.43
Installing Contractors Profit@	8.0%				$957,542.86	$76,603.43
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$220,234.86**
General Contractors Insurance @	1.0%		on		$1,177,777.71	$11,778
Bond @	1.0%		on		$1,177,777.71	$11,778
Contingency @	0.0%		on		$1,201,333.27	$0
					TOTAL COST for pay item	**$1,201,333**

Additional Pay Item Notes :

Above production is based on having two crews working simultaneously. 1 excavator will be loading material in to dump trucks, two excavators with breakers/ shears will be demolishing concrete, Laborers and Carpenters will support truck and equipment operations, 2 foremans with trucks will oversee operation. Crane will be used half of the time to support demolition as needed, Figuring the use of 2 dump trucks due to the access restrictions from the haul road size, This would mean that each dump truck will have to get 3 loads a day and with the dump site being a short distance this should be achieveable.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.012		Project	: COPCO 1				
Description	:	Remove Structural Steel from Spillway							
Quantity	:	55,000.00	LBS						
Daily Production	:	11,000.00	LBS per	8	hour shift	Project #	: 2		
Work Days	:	5.0	Days			Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$1.27	per LBS			Probable Low Cost Parameter		12650	$59,210	$1.08
Total Cost	:	$69,659				Probable High Cost Parameter		8250	$87,074	$1.58

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	5.0	8	40.00	L	$46.27	incl. in rate	incl. in rate	$1,850.80
Electrician	Active	1.00	5.0	8	40.00	L	$45.23	incl. in rate	incl. in rate	$1,809.20
Steelworker	Active	4.00	5.0	8	160.00	L	$65.52	incl. in rate	incl. in rate	$10,483.20
Laborer	Active	4.00	5.0	8	160.00	L	$45.80	incl. in rate	incl. in rate	$7,328.00
Truck Driver (heavy)	Active	2.00	5.0	8	80.00	L	$57.59	incl. in rate	incl. in rate	$4,607.20
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	5.0	8	80.00	E	$111.64	incl. in rate	incl. in rate	$8,931.20
Crawler Crane (130tn)	Active	1.00	5.0	8	40.00	E	$258.66	incl. in rate	incl. in rate	$10,346.40
Welder	Active	1.00	5.0	8	40.00	L	$7.84	incl. in rate	incl. in rate	$313.50
Gas Welding Machine	Active	1.00	5.0	8	40.00	E	$2.88	incl. in rate	incl. in rate	$115.08
Equipment Operator (crane)	Active	1.00	5.0	8	40.00	L	$68.41	incl. in rate	incl. in rate	$2,736.40
Barge, Deck Engineer, Winch Operator	Active	1.00	5.0	8	40.00	L	$64.26	incl. in rate	incl. in rate	$2,570.40
Barge, Sectional, 40'x10', includes ramp	Active	1.00	5.0	8	40.00	E	$16.48	incl. in rate	incl. in rate	$659.20

Labor Hours	600	TOTAL LABOR	$31,698.70
Equipment Hours	200	TOTAL EQUIPMENT	$20,051.88

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,584.94	$1,584.94

TOTAL MATERIAL	$1,584.94

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Mobilization, barge by tug boat, small	30.00	Mile	1.000	$80.62	$2,418.60

TOTAL SUBCONTRACTS	$2,418.60

SUMMARY OF COSTS

Labor Cost	$31,698.70	Labor Burden @	49.7%	$0.00		$31,698.70
Material Cost	$1,584.94	Material Tax @	7.8%	$122.83		$1,707.77
Equipment Cost	$20,051.88	Equipment Tax @	0.0%	$0.00		$20,051.88
Subcontractors	$2,418.60					$2,418.60
DIRECT COST SUBTOTALS	$55,754			$123	DIRECT COST SUBTOTALS	$55,877

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%	☐	☐	☐	$53,458.35		$8,018.75
Installing Contractors Profit@	8.0%	☐	☐	☐	$53,458.35		$4,276.67
GC Markup on Subs @	5.0%	☐	☐	☐	$2,418.60		$120.93
						TOTAL MARKUP COSTS	$12,416.35
General Contractors Insurance @	1.0%		on		$68,293.30		$683
Bond @	1.0%		on		$68,293.30		$683
Contingency @	0.0%		on		$69,659.16		$0
						TOTAL COST for pay item	$69,659

Additional Pay Item Notes :

Includes rails. Crews: E-19 for metals demolition, E-12 and E-25 for cutting steel and A-3H for equipment disposal using a barge and a crane.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.015		Project	: COPCO 1				
Description	:	Remove & Dispose of Hand Rails at dam							
Quantity	:	11,000.00	LBS						
Daily Production	:	11,000.00	LBS per	8	hour shift	Project #	: 2		
Work Days	:	1.0	Days			Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$1.36	per LBS			Probable Low Cost Parameter		12650	$12,681	$1.15
Total Cost	:	$14,919				Probable High Cost Parameter		8800	$17,903	$1.63

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (80tn)	Active	1.00	1.0	8	8.00	E	$190.46	incl. in rate	incl. in rate	$1,523.68
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Truck Driver (light)	Active	1.00	1.0	8	8.00	L	$56.29	incl. in rate	incl. in rate	$450.32
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Millwright	Active	6.00	1.0	8	48.00	L	$69.46	incl. in rate	incl. in rate	$3,334.08
Labor Foreman	Active	2.00	1.0	8	16.00	L	$48.27	incl. in rate	incl. in rate	$772.32
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Barge Operator	Active	1.00	1.0	8	8.00	L	$40.30	incl. in rate	incl. in rate	$322.40
	Active	1.00	1.0	8	8.00	L	$64.26	incl. in rate	incl. in rate	$514.08

Labor Hours	112	TOTAL LABOR	$6,832.56
Equipment Hours	24	TOTAL EQUIPMENT	$4,188.80

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$341.63	$341.63
					TOTAL MATERIAL	$341.63

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10%)	0.55	ton	1.000	0.55 $595.00	$327.25
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	36.00	mile	1.000	36.00 $7.25	$261.00
				TOTAL SUBCONTRACTS	$588.25

SUMMARY OF COSTS

Labor Cost	$6,832.56	Labor Burden @	49.7%	$0.00		$6,832.56
Material Cost	$341.63	Material Tax @	7.8%	$26.48		$368.10
Equipment Cost	$4,188.80	Equipment Tax @	0.0%	$0.00		$4,188.80
Subcontractors	$588.25					$588.25
DIRECT COST SUBTOTALS	$11,951			$26	DIRECT COST SUBTOTALS	$11,978

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$11,389.46	$1,708.42
Installing Contractors Profit@	8.0%				$11,389.46	$911.16
GC Markup on Subs @	5.0%				$588.25	$29.41
					TOTAL MARKUP COSTS	$2,648.99
General Contractors Insurance @	1.0%		on		$14,626.70	$146
Bond @	1.0%		on		$14,626.70	$146
Contingency @	0.0%		on		$14,919.24	$0
					TOTAL COST for pay item	$14,919

Additional Pay Item Notes :

Using a barge and a crane work is done in 1 day by 2 crews (1 forman and 3 millwright). Assumed hazardous waste 10% of the total lbs, calculated 36 miles from Copco1 to Yreka Transfor Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.016		Project	: COPCO 1				
Description	:	Remove & Dispose of Radial Gates							
Quantity	:	140,500.00	LBS						
Daily Production	:	15,000.00	LBS per	8	hour shift	Project #	: 2		
Work Days	:	9.4	Days			Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$1.11	per LBS			Probable Low Cost Parameter		16500	$140,505	$1.00
Total Cost	:	$156,117				Probable High Cost Parameter		11250	$195,146	$1.39

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (120tn)	Active	2.00	9.4	8	150.40	E	$239.06	incl. in rate	incl. in rate	$35,954.62
Millwright	Active	2.00	9.4	8	150.40	L	$69.46	incl. in rate	incl. in rate	$10,446.78
Barge (400T)	Active	1.00	9.4	8	75.20	E	$99.50	incl. in rate	incl. in rate	$7,482.40
Barge Operator	Active	1.00	9.4	8	75.20	L	$40.30	incl. in rate	incl. in rate	$3,030.56
Loader, FE Rubber Tire (5.25cy)	Active	2.00	9.4	8	150.40	E	$75.42	incl. in rate	incl. in rate	$11,343.17
Diver, Wet	Active	2.00	9.4	8	150.40	L	$124.57	incl. in rate	incl. in rate	$18,735.33
Truck, Tractor (400hp)	Active	1.00	9.4	8	75.20	E	$69.30	incl. in rate	incl. in rate	$5,211.36
Truck Driver (heavy)	Active	1.00	9.4	8	75.20	L	$57.59	incl. in rate	incl. in rate	$4,330.77
Equipment Operator (medium)	Active	4.00	9.4	8	300.80	L	$66.28	incl. in rate	incl. in rate	$19,937.02

Labor Hours	752	TOTAL LABOR	$56,480.46
Equipment Hours	451.2	TOTAL EQUIPMENT	$59,991.55

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Anchor Systems	4.00	ea	1.000	4.00	$215.00	$860.00
Tow Bridles	4.00	ea	1.000	4.00	$50.00	$200.00
Consumables 5% labor (saw blades, drill bits, etc)	1.00	ls	1.000	1.00	$2,824.02	$2,824.02

TOTAL MATERIAL	$3,884.02

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10%)	7.03	ton	1.000	7.03 $595.00	$4,179.88
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	34.00	mile	1.000	34.00 $7.25	$246.50

TOTAL SUBCONTRACTS	$4,426.38

SUMMARY OF COSTS

Labor Cost	$56,480.46	Labor Burden @	49.7%	$0.00	$56,480.46
Material Cost	$3,884.02	Material Tax @	7.8%	$301.01	$4,185.03
Equipment Cost	$59,991.55	Equipment Tax @	0.0%	$0.00	$59,991.55
Subcontractors	$4,426.38				$4,426.38
DIRECT COST SUBTOTALS	$124,782			$301	DIRECT COST SUBTOTALS $125,083

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$120,657.05	$18,098.56
Installing Contractors Profit@	8.0%				$120,657.05	$9,652.56
GC Markup on Subs @	5.0%				$4,426.38	$221.32
					TOTAL MARKUP COSTS	$27,972.44
General Contractors Insurance @	1.0%		on		$153,055.87	$1,531
Bond @	1.0%		on		$153,055.87	$1,531
Contingency @	0.0%		on		$156,116.98	$0
					TOTAL COST for pay item	$156,117

Additional Pay Item Notes :

13 radial gates, wall and sillplates and 3-hoists, by barge and crane. Assumed contains paint with heavy metals 10% of the total lbs, 34 miles from Copco lake to Yreka transfer recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.017	Project	: COPCO 1				
Description	:	Remove & Dispose Radial Gate Stop logs						
Quantity	:	18,000.00 LBS						
Daily Production	:	20,000.00 LBS per 8 hour shift	Project #	: 2				
Work Days	:	0.9 Days	Estimator	: Mihaela Tomulescu		LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$1.06 per LBS	Probable Low Cost Parameter			22000	$17,214	$0.96
Total Cost	:	$19,126	Probable High Cost Parameter			15000	$23,908	$1.33

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Crawler Crane (90tn)	Active	1.00	0.9	8	7.20	E	$208.09	incl. in rate	incl. in rate	$1,498.25
Equipment Operator (medium)	Active	1.00	0.9	8	7.20	L	$66.28	incl. in rate	incl. in rate	$477.22
Equipment Operator (oiler)	Active	1.00	0.9	8	7.20	L	$62.94	incl. in rate	incl. in rate	$453.17
Carpenters, Journeyman	Active	5.00	0.9	8	36.00	L	$65.37	incl. in rate	incl. in rate	$2,353.32
Truck Driver (heavy)	Active	2.00	0.9	8	14.40	L	$57.59	incl. in rate	incl. in rate	$829.30
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	0.9	8	14.40	E	$31.90	incl. in rate	incl. in rate	$459.36
Hydraulic Impact Breaker Attachment (3k-4k ft-lb)	Active	1.00	0.9	8	7.20	E	$36.58	incl. in rate	incl. in rate	$263.38
Hydraulic Excavator (6.0cy)	Active	1.00	0.9	8	7.20	E	$322.48	incl. in rate	incl. in rate	$2,321.86
Steelworker	Active	6.00	0.9	8	43.20	L	$65.52	incl. in rate	incl. in rate	$2,830.46
Laborer	Active	5.00	0.9	8	36.00	L	$45.80	incl. in rate	incl. in rate	$1,648.80
Barge Operator	Active	1.00	0.9	8	7.20	L	$40.30	incl. in rate	incl. in rate	$290.16
Barge, Deck Engineer, Winch Operator	Active	1.00	0.9	8	7.20	L	$64.26	incl. in rate	incl. in rate	$462.67

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.018	Project	: COPCO 1				
Description	:	Remove & Dispose Stop log hoist, track and supports						
Quantity	:	26,000.00 LBS						
Daily Production	:	13,000.00 LBS per 8 hour shift	Project #	: 2				
Work Days	:	2.0 Days	Estimator	: Mihaela Tomulescu		LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$1.03 per LBS	Probable Low Cost Parameter			14300	$24,158	$0.93
Total Cost	:	$26,842	Probable High Cost Parameter			9750	$33,552	$1.29

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	incl. in rate	incl. in rate	$740.32
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Steelworker	Active	6.00	2.0	8	96.00	L	$65.52	incl. in rate	incl. in rate	$6,289.92
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.0	8	16.00	E	$221.50	incl. in rate	incl. in rate	$3,544.00
Truck Driver (heavy)	Active	2.00	2.0	8	32.00	L	$57.59	incl. in rate	incl. in rate	$1,842.88
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	2.0	8	32.00	E	$31.90	incl. in rate	incl. in rate	$1,020.80
Hydraulic Crane (120tn)	Active	1.00	2.0	8	16.00	E	$239.06	incl. in rate	incl. in rate	$3,824.96
Welder	Active	2.00	2.0	8	32.00	L	$7.84	incl. in rate	incl. in rate	$250.80
Gas Welding Machine	Active	2.00	2.0	8	32.00	E	$2.88	incl. in rate	incl. in rate	$92.06
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Equipment Operator (crane)	Active	1.00	2.0	8	16.00	L	$68.41	incl. in rate	incl. in rate	$1,094.56
Barge, Sectional, 40'x10', includes ramp	Active	1.00	2.0	8	16.00	E	$16.48	incl. in rate	incl. in rate	$263.68

Labor Hours	224	TOTAL LABOR	$12,002.64
Equipment Hours	112	TOTAL EQUIPMENT	$8,745.50

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$600.13	$600.13

TOTAL MATERIAL	$600.13

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$12,002.64	Labor Burden @	49.7%	$0.00		$12,002.64
Material Cost	$600.13	Material Tax @	7.8%	$46.51		$646.64
Equipment Cost	$8,745.50	Equipment Tax @	0.0%	$0.00		$8,745.50
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$21,348			$47	DIRECT COST SUBTOTALS	$21,395

		TRUE	TRUE	FALSE	Cost Basis	
Installing Contractors Overhead@	15.0%				$21,394.79	$3,209.22
Installing Contractors Profit@	8.0%				$21,394.79	$1,711.58
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$4,920.80
General Contractors Insurance @	1.0%		on		$26,315.59	$263
Bond @	1.0%		on		$26,315.59	$263
Contingency @	0.0%		on		$26,841.90	$0
					TOTAL COST for pay item	$26,842

Additional Pay Item Notes :

The removal of stoplog hoist, track and supports is done by barge and crane with one 9-men crew (1 foreman, 6 steelworkers, 1 welder, 1 electrician and 2 equipment operators). Based on the current production rate and the fact that we dispose big pieces of steel we use 2 trucks per day.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.019	Project	: COPCO1				
Description	:	Remove & Dispose of 3 sections of 23' of 72" Dia. steel lining (embedded)						
Quantity	:	54,000.00 lbs						
Daily Production	:	30,000.00 lbs per 8 hour shift	Project #	: 2				
Work Days	:	1.8 Days	Estimator	: Mihaela Tomulescu		lbs per	Total Cost	Unit Price Per lbs
Unit Price	:	$1.04 per lbs	Probable Low Cost Parameter			34500	$47,906	$0.89
Total Cost	:	$56,361	Probable High Cost Parameter			24000	$67,633	$1.25

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.8	8	14.40	L	$47.23	incl. in rate	incl. in rate	$680.11
Electrician	Active	7.00	1.8	8	100.80	L	$45.23	incl. in rate	incl. in rate	$4,559.18
Ironworkers	Active	6.00	1.8	8	86.40	L	$63.95	incl. in rate	incl. in rate	$5,525.28
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.8	8	14.40	E	$221.50	incl. in rate	incl. in rate	$3,189.60
Truck Driver (heavy)	Active	2.00	1.8	8	28.80	L	$57.59	incl. in rate	incl. in rate	$1,658.59
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	1.8	8	28.80	E	$111.64	incl. in rate	incl. in rate	$3,215.23
Hydraulic Crane (120tn)	Active	2.00	1.8	8	28.80	E	$239.06	incl. in rate	incl. in rate	$6,884.93
Welder	Active	1.00	1.8	8	14.40	L	$7.84	incl. in rate	incl. in rate	$112.86
Gas Welding Machine	Active	1.00	1.8	8	14.40	E	$2.88	incl. in rate	incl. in rate	$41.43
Equipment Operator (medium)	Active	1.00	1.8	8	14.40	L	$66.28	incl. in rate	incl. in rate	$954.43
Equipment Operator (crane)	Active	2.00	1.8	8	28.80	L	$68.41	incl. in rate	incl. in rate	$1,970.21

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.020	Project	: COPCO 1				
Description	:	Remove & Dispose of 3 - 72" butterfly valves (embedded)						
Quantity	:	55,000.00 lbs						
Daily Production	:	25,000.00 lbs per 8 hour shift	Project #	: 2				
Work Days	:	2.2 Days	Estimator	: Mihaela Tomulescu		lbs per	Total Cost	Unit Price Per lbs
Unit Price	:	$1.10 per lbs	Probable Low Cost Parameter			27500	$54,264	$0.99
Total Cost	:	$60,293	Probable High Cost Parameter			21250	$69,337	$1.26

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	4.00	2.2	8	70.40	L	$48.27	incl. in rate	incl. in rate	$3,398.21
Ironworkers	Active	8.00	2.2	8	140.80	L	$63.95	incl. in rate	incl. in rate	$9,004.16
Crawler Crane (270tn)	Active	2.00	2.2	8	35.20	E	$399.50	incl. in rate	incl. in rate	$14,062.40
Equipment Operator (medium)	Active	2.00	2.2	8	35.20	L	$66.28	incl. in rate	incl. in rate	$2,333.06
Welder	Active	4.00	2.2	8	70.40	L	$7.84	incl. in rate	incl. in rate	$551.76
Gas Welding Machine	Active	4.00	2.2	8	70.40	E	$2.88	incl. in rate	incl. in rate	$202.54
Electrician	Active	2.00	2.2	8	35.20	L	$45.23	incl. in rate	incl. in rate	$1,592.10
Millwright	Active	4.00	2.2	8	70.40	L	$69.46	incl. in rate	incl. in rate	$4,889.98
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.2	8	17.60	E	$111.64	incl. in rate	incl. in rate	$1,964.06
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.2	8	17.60	E	$221.50	incl. in rate	incl. in rate	$3,898.40
Truck Driver (heavy)	Active	1.00	2.2	8	17.60	L	$57.59	incl. in rate	incl. in rate	$1,013.58
Equipment Operator (oiler)	Active	1.00	2.2	8	17.60	L	$62.94	incl. in rate	incl. in rate	$1,107.74

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.021		Project	: COPCO 1				
Description	:	Remove & Dispose of 3 - 72" flapper valves with remote mechanical							
Quantity	:	78,000.00	LBS						
Daily Production	:	5,200.00	LBS per	8	hour shift	Project #	: 2		
Work Days	:	15.0	Days			Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$5.54	per LBS			Probable Low Cost Parameter		5720	$388,894	$4.99
Total Cost	:	$432,104				Probable High Cost Parameter		4420	$496,920	$6.37

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	15.0	8	240.00	L	$48.27	incl. in rate	incl. in rate	$11,584.80
Crawler Crane (270tn)	Active	2.00	15.0	8	240.00	E	$399.50	incl. in rate	incl. in rate	$95,880.00
Equipment Operator (crane)	Active	2.00	15.0	8	240.00	L	$68.41	incl. in rate	incl. in rate	$16,418.40
Diver, Wet	Active	6.00	15.0	8	720.00	L	$124.57	incl. in rate	incl. in rate	$89,690.40
Diver, Tender	Active	6.00	15.0	8	720.00	L	$79.22	incl. in rate	incl. in rate	$57,038.40
Barge, Sectional, 40'x10', includes ramp	Active	1.00	15.0	8	120.00	E	$16.48	incl. in rate	incl. in rate	$1,977.60
Barge Operator	Active	1.00	15.0	8	120.00	L	$40.30	incl. in rate	incl. in rate	$4,836.00
Truck, Flatbed (4x4, 10,000 gvw)	Active	3.00	15.0	8	360.00	E	$31.90	incl. in rate	incl. in rate	$11,484.00
Gas Welding Machine	Active	3.00	15.0	8	360.00	E	$2.88	incl. in rate	incl. in rate	$1,035.72
Barge, Deck Engineer, Winch Operator	Active	1.00	15.0	8	120.00	L	$64.26	incl. in rate	incl. in rate	$7,711.20
Equipment Operator (oiler)	Active	2.00	15.0	8	240.00	L	$62.94	incl. in rate	incl. in rate	$15,105.60
Truck Driver (heavy)	Active	1.00	15.0	8	120.00	L	$57.59	incl. in rate	incl. in rate	$6,910.80

Labor Hours	2520	TOTAL LABOR	$209,295.60
Equipment Hours	1080	TOTAL EQUIPMENT	$110,377.32

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$20,929.56	$20,929.56
					TOTAL MATERIAL	$20,929.56

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10%)	3.90	ton	1.000	3.90 $595.00	$2,320.50
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	34.00	mile	1.000	34.00 $7.25	$246.50
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$2,567.00

SUMMARY OF COSTS

Labor Cost	$209,295.60	Labor Burden @	49.7%	$0.00		$209,295.60
Material Cost	$20,929.56	Material Tax @	7.8%	$1,622.04		$22,551.60
Equipment Cost	$110,377.32	Equipment Tax @	0.0%	$0.00		$110,377.32
Subcontractors	$2,567.00					$2,567.00
DIRECT COST SUBTOTALS	$343,169			$1,622	DIRECT COST SUBTOTALS	$344,792

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$342,224.52	$51,333.68
Installing Contractors Profit@	8.0%				$342,224.52	$27,377.96
GC Markup on Subs @	5.0%				$2,567.00	$128.35
					TOTAL MARKUP COSTS	$78,839.99
General Contractors Insurance @	1.0%		on		$423,631.51	$4,236
Bond @	1.0%		on		$423,631.51	$4,236
Contingency @	0.0%		on		$432,104.14	$0
					TOTAL COST for pay item	$432,104

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal Assumed hazardous waste 10% of the total lbs, calculated 34 miles from Copco1 to Yreka Transfer Recycling. Figuring divers will disassemble existing Flap Gates 124' underwater.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.022	Project	: COPCO 1				
Description	:	Remove & Dispose of Spillway gate motor & control panel						
Quantity	:	1.00 EA						
Daily Production	:	1.00 EA per 8 hour shift	Project #	: 2				
Work Days	:	1.0 Days	Estimator	: Mihaela Tomulescu		EA per	Total Cost	Unit Price Per EA
Unit Price	:	$1,318.63 per EA	Probable Low Cost Parameter			1.1	$1,187	$1,186.77
Total Cost	:	$1,319	Probable High Cost Parameter			0.85	$1,516	$1,516.43

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80

Labor Hours	16	TOTAL LABOR	$732.80
Equipment Hours	0	TOTAL EQUIPMENT	$0.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 0.5% labor (Side Cutter, Sharp-Nose Pliers, Sharp Tip Tweezers PCB Clamp, etc)	4.03	LS	1.000	4.03	$73.28	$295.35

TOTAL MATERIAL	$295.35

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$732.80	Labor Burden @	49.7%	$0.00		$732.80
Material Cost	$295.35	Material Tax @	7.8%	$22.89		$318.24
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00		$0.00
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$1,028			$23	DIRECT COST SUBTOTALS	$1,051

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,051.04	$157.66
Installing Contractors Profit@	8.0%				$1,051.04	$84.08
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$241.74
General Contractors Insurance @	1.0%		on		$1,292.78	$13
Bond @	1.0%		on		$1,292.78	$13
Contingency @	0.0%		on		$1,318.63	$0
					TOTAL COST for pay item	$1,319

Additional Pay Item Notes :

Assumed that two workers will work one day to unconnect and remove the control panel and the gate motor. They will discharge the control panel and the gate motor in an available truck used for the other scope of work on the construction site.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.023		Project	: COPCO 1				
Description	: Remove & Dispose Distribution equipment, panelboards							
Quantity	: 1.00 EA							
Daily Production	: 0.50 EA per	8 hour shift	Project #	: 2				
Work Days	: 2.0 Days		Estimator	: Mihaela Tomulescu		EA per	Total Cost	Unit Price Per EA
Unit Price	: $5,877.55 per EA		Probable Low Cost Parameter			0.55	$5,290	$5,289.80
Total Cost	: $5,878		Probable High Cost Parameter			0.4	$7,053	$7,053.06

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	2.0	8	16.00	L	$47.23	incl. in rate	incl. in rate	$755.68
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Hydraulic Crane (17tn)	Active	1.00	2.0	8	16.00	E	$81.52	incl. in rate	incl. in rate	$1,304.32

Labor Hours	48	TOTAL LABOR	$2,487.36
Equipment Hours	24	TOTAL EQUIPMENT	$2,197.44

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 0.5% labor (Side Cutter, Sharp-Nose Pliers, Sharp Tip Tweezers PCB Clamp, etc)	0.00	LS	1.000	0.00	$124.37	$0.00

TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,487.36	Labor Burden @	49.7%	$0.00		$2,487.36
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$2,197.44	Equipment Tax @	0.0%	$0.00		$2,197.44
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$4,685			$0	DIRECT COST SUBTOTALS	$4,685

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%	☐	☑	☐	$4,684.80		$702.72
Installing Contractors Profit@	8.0%	☑	☐	☐	$4,684.80		$374.78
GC Markup on Subs @	5.0%	☐	☐	☑	$0.00		$0.00
						TOTAL MARKUP COSTS	$1,077.50
General Contractors Insurance @	1.0%		on		$5,762.30		$58
Bond @	1.0%		on		$5,762.30		$58
Contingency @	0.0%		on		$5,877.55		$0
						TOTAL COST for pay item	$5,878

Additional Pay Item Notes :

Assumed that electrical crew formed of 1 Forman and 1 Electricians will work two days to unconnect and remove the distribution panels. They are going to use same crane and a truck for disposal of spillway intake, trashrake and radial motor & control panel.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.025		Project	: COPCO 1			
Description	:	Remove Powerhouse Structural Steel						
Quantity	:	110,000.00 lbs						
Daily Production	:	25,000.00 lbs per	8 hour shift	Project #	: 2			
Work Days	:	4.4 Days		Estimator	: Mihaela Tomulescu	lbs per	Total Cost	Unit Price Per lbs
Unit Price	:	$1.02 per lbs		Probable Low Cost Parameter		28750	$95,360	$0.87
Total Cost	:	$112,188		Probable High Cost Parameter		20000	$134,625	$1.22

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	4.00	4.4	8	140.80	L	$48.27	incl. in rate	incl. in rate	$6,796.42
Ironworkers	Active	4.00	4.4	8	140.80	L	$63.95	incl. in rate	incl. in rate	$9,004.16
Crawler Crane (270tn)	Active	2.00	4.4	8	70.40	E	$399.50	incl. in rate	incl. in rate	$28,124.80
Equipment Operator (medium)	Active	2.00	4.4	8	70.40	L	$66.28	incl. in rate	incl. in rate	$4,666.11
Welder	Active	4.00	4.4	8	140.80	L	$7.84	incl. in rate	incl. in rate	$1,103.52
Gas Welding Machine	Active	4.00	4.4	8	140.80	E	$2.88	incl. in rate	incl. in rate	$405.08
Electrician	Active	2.00	4.4	8	70.40	L	$45.23	incl. in rate	incl. in rate	$3,184.19
Millwright	Active	4.00	4.4	8	140.80	L	$69.46	incl. in rate	incl. in rate	$9,779.97
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	4.4	8	35.20	E	$111.64	incl. in rate	incl. in rate	$3,929.73
Loader, FE Rubber Tire (8.6cy)	Active	1.00	4.4	8	35.20	E	$221.50	incl. in rate	incl. in rate	$7,796.80
Truck Driver (heavy)	Active	1.00	4.4	8	35.20	L	$57.59	incl. in rate	incl. in rate	$2,027.17
Equipment Operator (oiler)	Active	1.00	4.4	8	35.20	L	$62.94	incl. in rate	incl. in rate	$2,215.49

Labor Hours	774.4	TOTAL LABOR	$38,777.02
Equipment Hours	281.6	TOTAL EQUIPMENT	$40,256.41

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$3,877.70	$3,877.70
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	3,500.00	LF	1.000	3,500.00	$0.85	$2,975.00

TOTAL MATERIAL	$6,852.70

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10%)	5.50	ton	1.000	5.50	$595.00	$3,272.50
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	34.00	mile	1.000	34.00	$7.25	$246.50

TOTAL SUBCONTRACTS	$3,519.00

SUMMARY OF COSTS

Labor Cost	$38,777.02	Labor Burden @	49.7%	$0.00		$38,777.02
Material Cost	$6,852.70	Material Tax @	7.8%	$531.08		$7,383.79
Equipment Cost	$40,256.41	Equipment Tax @	0.0%	$0.00		$40,256.41
Subcontractors	$3,519.00					$3,519.00
DIRECT COST SUBTOTALS	$89,405			$531	DIRECT COST SUBTOTALS	$89,936

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$86,417.22	$12,962.58
Installing Contractors Profit@	8.0%				$86,417.22	$6,913.38
GC Markup on Subs @	5.0%				$3,519.00	$175.95
					TOTAL MARKUP COSTS	$20,051.91
General Contractors Insurance @	1.0%		on		$109,988.13	$1,100
Bond @	1.0%		on		$109,988.13	$1,100
Contingency @	0.0%		on		$112,187.89	$0
					TOTAL COST for pay item	$112,188

Additional Pay Item Notes :

Includes columns, beams, crane girders, bracing, misc. shapes, roof trusses, purlins, etc. Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal.Assumed hazardous waste 10% of the total lbs, calculated 34 miles from Copco1 to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.026			Project	: COPCO 1			
Description	:	Remove & Dispose of 2 - Governor Oil Systems							
Quantity	:	38,000.00	lbs						
Daily Production	:	25,000.00	lbs per	8 hour shift	Project #	: 2			
Work Days	:	1.5	Days		Estimator	: Mihaela Tomulescu	lbs per	Total Cost	Unit Price Per lbs
Unit Price	:	$1.07	per lbs		Probable Low Cost Parameter		27500	$36,469	$0.96
Total Cost	:	$40,521			Probable High Cost Parameter		18750	$50,651	$1.33

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	1.5	8	24.00	L	$48.27	incl. in rate	incl. in rate	$1,158.48
Ironworkers	Active	4.00	1.5	8	48.00	L	$63.95	incl. in rate	incl. in rate	$3,069.60
Crawler Crane (270tn)	Active	1.00	1.5	8	12.00	E	$399.50	incl. in rate	incl. in rate	$4,794.00
Equipment Operator (medium)	Active	1.00	1.5	8	12.00	L	$66.28	incl. in rate	incl. in rate	$795.36
Welder	Active	3.00	1.5	8	36.00	L	$7.84	incl. in rate	incl. in rate	$282.15
Gas Welding Machine	Active	3.00	1.5	8	36.00	E	$2.88	incl. in rate	incl. in rate	$103.57
Electrician	Active	2.00	1.5	8	24.00	L	$45.23	incl. in rate	incl. in rate	$1,085.52
Millwright	Active	4.00	1.5	8	48.00	L	$69.46	incl. in rate	incl. in rate	$3,334.08
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.5	8	12.00	E	$111.64	incl. in rate	incl. in rate	$1,339.68
Hydraulic Excavator (6.0cy)	Active	1.00	1.5	8	12.00	E	$322.48	incl. in rate	incl. in rate	$3,869.76
Truck Driver (heavy)	Active	1.00	1.5	8	12.00	L	$57.59	incl. in rate	incl. in rate	$691.08
Hydraulic Impact Breaker Attachment (2k-3k ft-lb)	Active	1.00	1.5	8	12.00	E	$30.85	incl. in rate	incl. in rate	$370.20
					Labor Hours	204		TOTAL LABOR		$10,416.27
					Equipment Hours	84		TOTAL EQUIPMENT		$10,477.21

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,041.63	$1,041.63
					TOTAL MATERIAL	$1,041.63

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	19.00	ton	1.000	19.00 $595.00	$11,305.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	34.00	mile	3.000	102.00 $7.25	$739.50
				TOTAL SUBCONTRACTS	$12,044.50

SUMMARY OF COSTS

Labor Cost	$10,416.27	Labor Burden @	49.7%	$0.00		$10,416.27
Material Cost	$1,041.63	Material Tax @	7.8%	$80.73		$1,122.35
Equipment Cost	$10,477.21	Equipment Tax @	0.0%	$0.00		$10,477.21
Subcontractors	$12,044.50					$12,044.50
DIRECT COST SUBTOTALS	$33,980			$81	DIRECT COST SUBTOTALS	$34,060

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$22,015.83	$3,302.38
Installing Contractors Profit@	8.0%				$22,015.83	$1,761.27
GC Markup on Subs @	5.0%				$12,044.50	$602.23
					TOTAL MARKUP COSTS	$5,665.87
General Contractors Insurance @	1.0%		on		$39,726.20	$397
Bond @	1.0%		on		$39,726.20	$397
Contingency @	0.0%		on		$40,520.73	$0
					TOTAL COST for pay item	$40,521

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Using hydraulic impact breaker because of the sytems that are encased in concrete.Assumed hazardous waste 100% of the total lbs, calculated 34 miles from Copco1 to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.027	Project	: COPCO 1				
Description	:	Remove & Dispose of Cooling water and bearing oil systems						
Quantity	:	11,000.00 lbs						
Daily Production	:	11,000.00 lbs per 8 hour shift	Project #	: 2				
Work Days	:	1.0 Days	Estimator	: Mihaela Tomulescu		lbs per	Total Cost	Unit Price Per lbs
Unit Price	:	$3.16 per lbs	Probable Low Cost Parameter			12100	$31,239	$2.84
Total Cost	:	$34,710	Probable High Cost Parameter			8800	$41,652	$3.79

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	4.00	1.0	8	32.00	L	$48.27	incl. in rate	incl. in rate	$1,544.64
Ironworkers	Active	8.00	1.0	8	64.00	L	$63.95	incl. in rate	incl. in rate	$4,092.80
Crawler Crane (270tn)	Active	2.00	1.0	8	16.00	E	$399.50	incl. in rate	incl. in rate	$6,392.00
Equipment Operator (medium)	Active	2.00	1.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Welder	Active	4.00	1.0	8	32.00	L	$7.84	incl. in rate	incl. in rate	$250.80
Gas Welding Machine	Active	4.00	1.0	8	32.00	E	$2.88	incl. in rate	incl. in rate	$92.06
Electrician	Active	2.00	1.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Millwright	Active	6.00	1.0	8	48.00	L	$69.46	incl. in rate	incl. in rate	$3,334.08
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Equipment Operator (oiler)	Active	1.00	1.0	8	8.00	L	$62.94	incl. in rate	incl. in rate	$503.52

Labor Hours	224	TOTAL LABOR	$11,970.72
Equipment Hours	64	TOTAL EQUIPMENT	$9,149.18

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,197.07	$1,197.07
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	2,000.00	LF	1.000	2,000.00	$0.85	$1,700.00

TOTAL MATERIAL	$2,897.07

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	5.50	ton	1.000	5.50 $595.00	$3,272.50
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	34.00	mile	3.000	102.00 $7.25	$739.50
					$0.00
					$0.00

TOTAL SUBCONTRACTS	$4,012.00

SUMMARY OF COSTS

Labor Cost	$11,970.72	Labor Burden @	49.7%	$0.00	$11,970.72
Material Cost	$2,897.07	Material Tax @	7.8%	$224.52	$3,121.60
Equipment Cost	$9,149.18	Equipment Tax @	0.0%	$0.00	$9,149.18
Subcontractors	$4,012.00				$4,012.00
DIRECT COST SUBTOTALS	$28,029			$225	DIRECT COST SUBTOTALS $28,253

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$24,241.50	$3,636.22
Installing Contractors Profit@	8.0%				$24,241.50	$1,939.32
GC Markup on Subs @	5.0%				$4,012.00	$200.60
					TOTAL MARKUP COSTS	$5,776.14
General Contractors Insurance @	1.0%		on		$34,029.64	$340
Bond @	1.0%		on		$34,029.64	$340
Contingency @	0.0%		on		$34,710.24	$0
					TOTAL COST for pay item	$34,710

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 4040 LF of 1 1/2" oil pipes at 2.72 Lbs. Used 1 Forman, 2 Steelworkers to cut the pipes and 3 Laborers to load the pipes in the truck.The cooling and lubrication systems for the Hydroelectric Barge turbine, speed increaser and generator will be a combination of water and oil. These systems will be isolated from the water passages so that no contamination of passing water will occur.The following is a list of hazardous materials, substances, chemicals, and wastes normally found at a hydropower facility that may require disposal actions if not recycled or reused for their intended purpose:

1. Polychlorinated Biphenyls (PCBs)
2. Asbestos
3. Paint/abrasive blast grit (red lead paint)
4. Oil
5. Mercury
6. Antifreeze
7. Halogenated and non-halogenated solvents
8. Greases
9. Pesticides (includes herbicides, insecticides, and wood preservatives)
10. Petroleum contaminated
11. Chlorinated fluorocarbons (CFCs) Freon/Halon
12. Gasoline/diesel (includes product and sludge in tanks)
13. Batteries (includes acid)
14. Water treatment sludge (septic tanks/wastewater treatment)

Based on the hazardous materials above assumed hazardous waste 100% of the total lbs

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.028		Project	: COPCO 1			
Description	:	Remove & Dispose of 4 - Horizontal Tandem Francis Turbines						
Quantity	:	452,000.00 lbs						
Daily Production	:	30,000.00 lbs per	8 hour shift	Project #	: 2			
Work Days	:	15.1 Days		Estimator	: Mihaela Tomulescu	lbs per	Total Cost	Unit Price Per lbs
Unit Price	:	$0.80 per lbs		Probable Low Cost Parameter		33000	$325,922	$0.72
Total Cost	:	$362,135		Probable High Cost Parameter		24000	$434,562	$0.96

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	15.1	8	120.80	L	$47.23	incl. in rate	incl. in rate	$5,705.38
Ironworkers	Active	5.00	15.1	8	604.00	L	$63.95	incl. in rate	incl. in rate	$38,625.80
Crawler Crane (270tn)	Active	2.00	15.1	8	241.60	E	$399.50	incl. in rate	incl. in rate	$96,519.20
Equipment Operator (crane)	Active	2.00	15.1	8	241.60	L	$68.41	incl. in rate	incl. in rate	$16,527.86
Welder	Active	4.00	15.1	8	483.20	L	$7.84	incl. in rate	incl. in rate	$3,787.08
Gas Welding Machine	Active	4.00	15.1	8	483.20	E	$2.88	incl. in rate	incl. in rate	$1,390.16
Electrician	Active	2.00	15.1	8	241.60	L	$45.23	incl. in rate	incl. in rate	$10,927.57
Millwright	Active	5.00	15.1	8	604.00	L	$69.46	incl. in rate	incl. in rate	$41,953.84
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	6.0	8	96.00	E	$31.90	incl. in rate	incl. in rate	$3,062.40
Loader, FE Rubber Tire (8.6cy)	Active	1.00	15.1	8	120.80	E	$221.50	incl. in rate	incl. in rate	$26,757.20
Truck Driver (heavy)	Active	1.00	15.1	8	120.80	L	$57.59	incl. in rate	incl. in rate	$6,956.87
Equipment Operator (medium)	Active	1.00	15.1	8	120.80	L	$66.28	incl. in rate	incl. in rate	$8,006.62

Labor Hours	2536.8	TOTAL LABOR	$132,491.02
Equipment Hours	941.6	TOTAL EQUIPMENT	$127,728.96

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$13,249.10	$13,249.10
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	2,000.00	LF	1.000	2,000.00	$0.85	$1,700.00

TOTAL MATERIAL	$14,949.10

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	22.60	ton	1.000	22.60	$595.00	$13,447.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	90.40	mile	1.500	135.60	$7.25	$983.10
						$0.00
						$0.00

TOTAL SUBCONTRACTS	$14,430.10

SUMMARY OF COSTS

Labor Cost	$132,491.02	Labor Burden @	49.7%	$0.00		$132,491.02
Material Cost	$14,949.10	Material Tax @	7.8%	$1,158.56		$16,107.66
Equipment Cost	$127,728.96	Equipment Tax @	0.0%	$0.00		$127,728.96
Subcontractors	$14,430.10					$14,430.10
DIRECT COST SUBTOTALS	$289,599			$1,159	DIRECT COST SUBTOTALS	$290,758

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$276,327.64	$41,449.15
Installing Contractors Profit@	8.0%				$276,327.64	$22,106.21
GC Markup on Subs @	5.0%				$14,430.10	$721.51
					TOTAL MARKUP COSTS	$64,276.86
General Contractors Insurance @	1.0%		on		$355,034.61	$3,550
Bond @	1.0%		on		$355,034.61	$3,550
Contingency @	0.0%		on		$362,135.30	$0
					TOTAL COST for pay item	$362,135

Additional Pay Item Notes :

Working with a crew formed of 1 El.Forman 2 Electrician starting to disconnect power and take care of the temporay electrical power they need at the site. The crew of 5 Ironworker and 5 Millwright: open the engine side panels, and remove the nacelle access panels. Disconnect the engine thermocouple leads at the terminal board. Before disconnecting any lines all fuel, oil, and hydraulic fluid valves are closed. Plug all lines as they are disconnected to prevent entrance of foreign material.Remove the clamps securing the bleed-air ducts at the firewall. Then, disconnect the electrical connector plugs, engine breather and vent lines, and fuel, oil, and hydraulic lines.Disconnect the engine power lever and propeller control rods or cables. Remove the covers from the lift points, attach the sling, and remove slack from the cables using a suitable hoist. The sling must be adjusted to position. Remove the engine mount bolts. The engine ready to be removed. Move the engine forward, out of the nacelle structure, until it clears the aircraft. Lower the into position on the stand, and secure it prior to removing the engine sling. The crew of 4 Welder are going to cut in pieces the big parts of the turbine to be able to load them in the truck using a loader and dispose.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.029	Project	: COPCO 1				
Description	:	Remove & Dispose of 2 - 40 Ton indoor cranes						
Quantity	:	140,000.00 LBS						
Daily Production	:	24,000.00 LBS per 8 hour shift	Project #	: 2				
Work Days	:	5.8 Days	Estimator	: Mihaela Tomulescu		LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$0.74 per LBS	Probable Low Cost Parameter			27600	$88,350	$0.63
Total Cost	:	$103,941	Probable High Cost Parameter			19200	$124,729	$0.89

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (80tn)	Active	2.00	5.8	8	92.80	E	$190.46	incl. in rate	incl. in rate	$17,674.69
Equipment Operator (crane)	Active	2.00	5.8	8	92.80	L	$68.41	incl. in rate	incl. in rate	$6,348.45
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	5.8	8	92.80	E	$31.90	incl. in rate	incl. in rate	$2,960.32
Equipment Operator (medium)	Active	1.00	5.8	8	46.40	L	$66.28	incl. in rate	incl. in rate	$3,075.39
Truck Driver (heavy)	Active	2.00	5.8	8	92.80	L	$57.59	incl. in rate	incl. in rate	$5,344.35
Electrician	Active	2.00	5.8	8	92.80	L	$45.23	incl. in rate	incl. in rate	$4,197.34
Millwright	Active	8.00	5.8	8	371.20	L	$69.46	incl. in rate	incl. in rate	$25,783.55
Labor Foreman	Active	2.00	5.8	8	92.80	L	$48.27	incl. in rate	incl. in rate	$4,479.46
Welder	Active	2.00	5.8	8	92.80	L	$7.84	incl. in rate	incl. in rate	$727.32
Gas Welding Machine	Active	2.00	5.8	8	92.80	E	$2.88	incl. in rate	incl. in rate	$266.98
Carpenters	Active	2.00	5.8	8	92.80	L	$72.60	incl. in rate	incl. in rate	$6,737.28

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.030	Project	: COPCO 1				
Description	:	Remove & Dispose of Compressed Air System						
Quantity	:	1,000.00 LBS						
Daily Production	:	6,000.00 LBS per 8 hour shift	Project #	: 2				
Work Days	:	0.2 Days	Estimator	: Mihaela Tomulescu		LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$1.00 per LBS	Probable Low Cost Parameter			6600	$897	$0.90
Total Cost	:	$997	Probable High Cost Parameter			5100	$1,147	$1.15

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Loader, FE Rubber Tire (3.5cy)	Active	1.00	0.2	8	1.60	E	$64.23	incl. in rate	incl. in rate	$102.77
Laborer	Active	3.00	0.2	8	4.80	L	$45.80	incl. in rate	incl. in rate	$219.84
Truck Driver (light)	Active	1.00	0.2	8	1.60	L	$56.29	incl. in rate	incl. in rate	$90.06
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.2	8	1.60	E	$111.64	incl. in rate	incl. in rate	$178.62
Steelworker	Active	1.00	0.2	8	1.60	L	$65.52	incl. in rate	incl. in rate	$104.83
Electrician	Active	1.00	0.2	8	1.60	L	$45.23	incl. in rate	incl. in rate	$72.37

Labor Hours	9.6	TOTAL LABOR	$487.10
Equipment Hours	3.2	TOTAL EQUIPMENT	$281.39

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$24.36	$24.36

TOTAL MATERIAL	$24.36

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$487.10	Labor Burden @	49.7%	$0.00			$487.10
Material Cost	$24.36	Material Tax @	7.8%	$1.89			$26.24
Equipment Cost	$281.39	Equipment Tax @	0.0%	$0.00			$281.39
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$793			$2		DIRECT COST SUBTOTALS	$795

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$794.74	$119.21
Installing Contractors Profit@	8.0%				$794.74	$63.58
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$182.79
General Contractors Insurance @	1.0%		on		$977.53	$10
Bond @	1.0%		on		$977.53	$10
Contingency @	0.0%		on		$997.08	$0
					TOTAL COST for pay item	$997

Additional Pay Item Notes :

Used RS Means , assumption for "Pipe, metal pipe, to 1-1/2" diam., selective demolition, 370 LF of 1 1/2" pipes at 2.72 Lbs. Used 1 Steelworkers to cut the pipes and 3 Laborers for hauling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.031	Project	: COPCO 1				
Description	:	Remove & Dispose of 2 - CO2 Systems						
Quantity	:	3,100.00 LBS						
Daily Production	:	6,000.00 LBS per 8 hour shift	Project #	: 2				
Work Days	:	0.5 Days	Estimator	: Mihaela Tomulescu		LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$1.05 per LBS	Probable Low Cost Parameter			6600	$2,927	$0.94
Total Cost	:	$3,252	Probable High Cost Parameter			5100	$3,739	$1.21

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.5	8	4.00	L	$48.27	incl. in rate	incl. in rate	$193.08
Steelworker	Active	2.00	0.5	8	8.00	L	$65.52	incl. in rate	incl. in rate	$524.16
Laborer	Active	2.00	0.5	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.5	8	4.00	E	$111.64	incl. in rate	incl. in rate	$446.56
Truck Driver (light)	Active	1.00	0.5	8	4.00	L	$56.29	incl. in rate	incl. in rate	$225.16
Electrician	Active	1.00	0.5	8	4.00	L	$45.23	incl. in rate	incl. in rate	$180.92
Loader, FE Rubber Tire (5.25cy)	Active	1.00	0.5	8	4.00	E	$75.42	incl. in rate	incl. in rate	$301.68
Equipment Operator (light)	Active	1.00	0.5	8	4.00	L	$64.90	incl. in rate	incl. in rate	$259.60

Labor Hours	32	TOTAL LABOR	$1,749.32
Equipment Hours	8	TOTAL EQUIPMENT	$748.24

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$87.47	$87.47
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$87.47

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$1,749.32	Labor Burden @	49.7%	$0.00	$1,749.32
Material Cost	$87.47	Material Tax @	7.8%	$6.78	$94.24
Equipment Cost	$748.24	Equipment Tax @	0.0%	$0.00	$748.24
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$2,585			$7	DIRECT COST SUBTOTALS $2,592

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☐	☑	☐	$2,591.80	$388.77
Installing Contractors Profit@	8.0%	☐	☑	☐	$2,591.80	$207.34
GC Markup on Subs @	5.0%	☐	☐	☑	$0.00	$0.00
					TOTAL MARKUP COSTS	$596.12
General Contractors Insurance @	1.0%		on		$3,187.92	$32
Bond @	1.0%		on		$3,187.92	$32
Contingency @	0.0%		on		$3,251.68	$0
					TOTAL COST for pay item	$3,252

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam , selective demolition, 1140 LF of 1 1/2" pipes at 2.72 Lbs. Used 1 Forman, 2 Steelworkers to cut the pipes and 2 Laborers to load the pipes in the truck. 1 electrician for tools.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.032		Project	: COPCO 1				
Description	: Remove & Dispose of Plant Water and Fire Protection							
Quantity	: 2,600.00 LBS							
Daily Production	: 6,000.00 LBS per	8 hour shift	Project #	: 2				
Work Days	: 0.4 Days		Estimator	: Mihaela Tomulescu		LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $1.35 per LBS		Probable Low Cost Parameter			6600	$3,160	$1.22
Total Cost	: $3,511		Probable High Cost Parameter			4800	$4,214	$1.62

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	0.4	8	6.40	L	$48.27	incl. in rate	incl. in rate	$308.93
Laborer	Active	4.00	0.4	8	12.80	L	$45.80	incl. in rate	incl. in rate	$586.24
Steelworker	Active	4.00	0.4	8	12.80	L	$65.52	incl. in rate	incl. in rate	$838.66
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.4	8	3.20	E	$111.64	incl. in rate	incl. in rate	$357.25
Truck Driver (light)	Active	1.00	0.4	8	3.20	L	$56.29	incl. in rate	incl. in rate	$180.13
Loader, FE Rubber Tire (3.5cy)	Active	1.00	0.4	8	3.20	E	$64.23	incl. in rate	incl. in rate	$205.54
Equipment Operator (light)	Active	1.00	0.4	8	3.20	L	$64.90	incl. in rate	incl. in rate	$207.68

Labor Hours	38.4	TOTAL LABOR	$2,121.63
Equipment Hours	6.4	TOTAL EQUIPMENT	$562.78

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$106.08	$106.08

TOTAL MATERIAL	$106.08

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,121.63	Labor Burden @	49.7%	$0.00		$2,121.63
Material Cost	$106.08	Material Tax @	7.8%	$8.22		$114.30
Equipment Cost	$562.78	Equipment Tax @	0.0%	$0.00		$562.78
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$2,790			$8	DIRECT COST SUBTOTALS	$2,799

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$2,798.72	$419.81
Installing Contractors Profit@	8.0%				$2,798.72	$223.90
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$643.71
General Contractors Insurance @	1.0%		on		$3,442.42	$34
Bond @	1.0%		on		$3,442.42	$34
Contingency @	0.0%		on		$3,511.27	$0
					TOTAL COST for pay item	$3,511

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 960 LF of 1 1/2" pipes at 2.72 Lbs. Used 2 Forman, 4 Steelworkers to cut the pipes and 4 Laborers to load the pipes in the truck.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.033	Project	: COPCO 1				
Description	:	Remove & Dispose of Transformer Oil Fire Protection						
Quantity	:	5,400.00 LBS						
Daily Production	:	6,000.00 LBS per 8 hour shift	Project #	: 2				
Work Days	:	0.9 Days	Estimator	: Mihaela Tomulescu		LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$1.22 per LBS	Probable Low Cost Parameter			6600	$5,927	$1.10
Total Cost	:	$6,586	Probable High Cost Parameter			4800	$7,903	$1.46

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Steelworker	Active	2.00	0.9	8	14.40	L	$65.52	incl. in rate	incl. in rate	$943.49
Labor Foreman	Active	1.00	0.9	8	7.20	L	$48.27	incl. in rate	incl. in rate	$347.54
Laborer	Active	2.00	0.9	8	14.40	L	$45.80	incl. in rate	incl. in rate	$659.52
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	0.9	8	7.20	E	$31.90	incl. in rate	incl. in rate	$229.68
Truck Driver (light)	Active	1.00	0.9	8	7.20	L	$56.29	incl. in rate	incl. in rate	$405.29
Loader, FE Rubber Tire (3.5cy)	Active	1.00	0.9	8	7.20	E	$64.23	incl. in rate	incl. in rate	$462.46
Equipment Operator (light)	Active	1.00	0.9	8	7.20	L	$64.90	incl. in rate	incl. in rate	$467.28

Labor Hours	50.4	TOTAL LABOR	$2,823.12
Equipment Hours	14.4	TOTAL EQUIPMENT	$692.14

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$141.16	$141.16
					TOTAL MATERIAL	$141.16

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	2.70	ton	1.000	2.70 $595.00	$1,606.50
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	34.00	mile	1.000	34.00 $7.25	$246.50
				TOTAL SUBCONTRACTS	$1,853.00

SUMMARY OF COSTS

Labor Cost	$2,823.12	Labor Burden @	49.7%	$0.00	$2,823.12
Material Cost	$141.16	Material Tax @	7.8%	$10.94	$152.10
Equipment Cost	$692.14	Equipment Tax @	0.0%	$0.00	$692.14
Subcontractors	$1,853.00				$1,853.00
DIRECT COST SUBTOTALS	$5,509			$11	DIRECT COST SUBTOTALS $5,520

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,667.35	$550.10
Installing Contractors Profit@	8.0%				$3,667.35	$293.39
GC Markup on Subs @	5.0%				$1,853.00	$92.65
					TOTAL MARKUP COSTS	$936.14
General Contractors Insurance @	1.0%		on		$6,456.49	$65
Bond @	1.0%		on		$6,456.49	$65
Contingency @	0.0%		on		$6,585.62	$0
					TOTAL COST for pay item	$6,586

Additional Pay Item Notes :

Based on RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 1985 LF of 1 1/2" fire protection pipes at 2.72 Lbs. Used 1 Forman and 1 Laborers to load in drums and put them in the truck.Calculated 34 miles from Copco 1 to Yreka Transfer Recycling. Each hydropower facility has at least 150,000 gallons to 250,000 gallon of oil currently in use. This oil would have to be properly disposed of in the event of decommissioning. Oil removed from the turbines and other equipment, including transformer oil, would be either a waste oil or used oil, depending on prior use and contaminants found in the oil. Containerized oil containing contaminants such as solvents are commonly encountered at hydropower facilities. Oil sludges are common in tanks. Oil disposal would likely be costly due to the large volumes found at hydropower facilities and the ease of contamination with other regulated hazardous wastes.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.034	Project	: COPCO 1				
Description	:	Remove & Dispose of Unwatering Piping						
Quantity	:	27,000.00 lbs						
Daily Production	:	18,000.00 lbs per 8 hour shift	Project #	: 2				
Work Days	:	1.5 Days	Estimator	: Mihaela Tomulescu		lbs per	Total Cost	Unit Price Per lbs
Unit Price	:	$0.73 per lbs	Probable Low Cost Parameter			20700	$16,777	$0.62
Total Cost	:	$19,738	Probable High Cost Parameter			13500	$24,672	$0.91

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.5	8	12.00	L	$48.27	incl. in rate	incl. in rate	$579.24
Laborer	Active	4.00	1.5	8	48.00	L	$45.80	incl. in rate	incl. in rate	$2,198.40
Steelworker	Active	4.00	1.5	8	48.00	L	$65.52	incl. in rate	incl. in rate	$3,144.96
Equipment Operator (medium)	Active	1.00	1.5	8	12.00	L	$66.28	incl. in rate	incl. in rate	$795.36
Welder	Active	1.00	1.5	8	12.00	L	$7.84	incl. in rate	incl. in rate	$94.05
Gas Welding Machine	Active	1.00	1.5	8	12.00	E	$2.88	incl. in rate	incl. in rate	$34.52
Electrician	Active	1.00	1.5	8	12.00	L	$45.23	incl. in rate	incl. in rate	$542.76
Equipment Operator (light)	Active	1.00	1.5	8	12.00	L	$64.90	incl. in rate	incl. in rate	$778.80
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.5	8	12.00	E	$111.64	incl. in rate	incl. in rate	$1,339.68
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.5	8	12.00	E	$221.50	incl. in rate	incl. in rate	$2,658.00
Truck Driver (heavy)	Active	1.00	1.5	8	12.00	L	$57.59	incl. in rate	incl. in rate	$691.08

Labor Hours	168	TOTAL LABOR	$8,824.65
Equipment Hours	36	TOTAL EQUIPMENT	$4,032.20

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$882.47	$882.47
					TOTAL MATERIAL	$882.47

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (25% from total weight)	3.38	ton	1.000	3.38 $595.00	$2,008.13
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	34.00	mile	1.000	34.00 $7.25	$246.50
				TOTAL SUBCONTRACTS	$2,254.63

SUMMARY OF COSTS

Labor Cost	$8,824.65	Labor Burden @	49.7%	$0.00	$8,824.65
Material Cost	$882.47	Material Tax @	7.8%	$68.39	$950.86
Equipment Cost	$4,032.20	Equipment Tax @	0.0%	$0.00	$4,032.20
Subcontractors	$2,254.63				$2,254.63
DIRECT COST SUBTOTALS	$15,994			$68	DIRECT COST SUBTOTALS $16,062

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☐	☐	☐	$13,807.71	$2,071.16
Installing Contractors Profit@	8.0%	☐	☐	☐	$13,807.71	$1,104.62
GC Markup on Subs @	5.0%	☐	☐	☐	$2,254.63	$112.73
					TOTAL MARKUP COSTS	$3,288.50
General Contractors Insurance @	1.0%		on		$19,350.84	$194
Bond @	1.0%		on		$19,350.84	$194
Contingency @	0.0%		on		$19,737.86	$0
					TOTAL COST for pay item	$19,738

Additional Pay Item Notes :

Used RS Means : Assumed Pipe, metal pipe, to 1-1/2" diam., selective demolition, around 9950 LF of 1 1/2" pipes at 2.72 Lbs. Used Crew formed of 1 Forman, 2 Steelworkers to cut the pipes, 1 Welder to cut steel in unaccesible places , 2 Laborers to haul the pipes in the truck with the loader, 1 electrician to unplug the power and to assure the temporaty power at the contruction site. Calculated 34 miles from JC Boyle to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.035		Project	: COPCO 1				
Description	: Remove & Dispose of Drainage Piping							
Quantity	: 5,000.00 LBS							
Daily Production	: 4,450.00 LBS per	8 hour shift	Project #	: 2				
Work Days	: 1.1 Days		Estimator	: Mihaela Tomulescu		LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $1.04 per LBS		Probable Low Cost Parameter			5117.5	$4,422	$0.88
Total Cost	: $5,202		Probable High Cost Parameter			3337.5	$6,503	$1.30

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Loader, FE Rubber Tire (3.5cy)	Active	1.00	1.1	8	8.80	E	$64.23	incl. in rate	incl. in rate	$565.22
Equipment Operator (light)	Active	1.00	1.1	8	8.80	L	$64.90	incl. in rate	incl. in rate	$571.12
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.1	8	8.80	E	$111.64	incl. in rate	incl. in rate	$982.43
Truck Driver (light)	Active	1.00	1.1	8	8.80	L	$56.29	incl. in rate	incl. in rate	$495.35
Labor Foreman	Active	1.00	1.1	8	8.80	L	$48.27	incl. in rate	incl. in rate	$424.78
Electrician	Active	1.00	1.1	8	8.80	L	$45.23	incl. in rate	incl. in rate	$398.02
Steelworker	Active	1.00	1.1	8	8.80	L	$65.52	incl. in rate	incl. in rate	$576.58

Labor Hours	44	TOTAL LABOR	$2,465.85
Equipment Hours	17.6	TOTAL EQUIPMENT	$1,547.66

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$123.29	$123.29

TOTAL MATERIAL	$123.29

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,465.85	Labor Burden @	49.7%	$0.00		$2,465.85
Material Cost	$123.29	Material Tax @	7.8%	$9.56		$132.85
Equipment Cost	$1,547.66	Equipment Tax @	0.0%	$0.00		$1,547.66
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$4,137			$10	DIRECT COST SUBTOTALS	$4,146

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,146.35	$621.95
Installing Contractors Profit@	8.0%				$4,146.35	$331.71
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$953.66
General Contractors Insurance @	1.0%		on		$5,100.01	$51
Bond @	1.0%		on		$5,100.01	$51
Contingency @	0.0%		on		$5,202.01	$0
					TOTAL COST for pay item	$5,202

Additional Pay Item Notes :

1370 LF of 1 " drainage pipes at 3.66 Lbs. Used 1 Loader and 1 Forman, 1 Steelworkers to cut the pipes and 1 Laborers to load the pipes in the truck.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.035a	Project	: COPCO 1				
Description	:	Remove petroleum products from mechanical equipment						
Quantity	:	1,250.00 GAL						
Daily Production	:	1,100.00 GAL per 8 hour shift	Project #	: 2				
Work Days	:	1.1 Days	Estimator	: Mihaela Tomulescu		GAL per	Total Cost	Unit Price Per GAL
Unit Price	:	$4.39 per GAL	Probable Low Cost Parameter			1210	$4,941	$3.95
Total Cost	:	$5,490	Probable High Cost Parameter			935	$6,313	$5.05

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.1	8	8.80	L	$46.27	incl. in rate	incl. in rate	$407.18
Carpenters, Journeyman	Active	2.00	1.1	8	17.60	L	$65.37	incl. in rate	incl. in rate	$1,150.51
Laborer	Active	2.00	1.1	8	17.60	L	$45.80	incl. in rate	incl. in rate	$806.08

Labor Hours	44	TOTAL LABOR	$2,363.77
Equipment Hours	0	TOTAL EQUIPMENT	$0.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 20% labor (absorbant materials, drums, etc)	1.00	LS	1.000	1.00	$472.75	$472.75
					TOTAL MATERIAL	$472.75

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, liquid pickup, vacuum truck, stainless steel tank, 5000 gallons, minimum charge, 4 hours, 2 compartment	8.80	hour	1.000	$200.00	$1,760.00
				TOTAL SUBCONTRACTS	$1,760.00

SUMMARY OF COSTS

Labor Cost	$2,363.77	Labor Burden @	49.7%	$0.00		$2,363.77
Material Cost	$472.75	Material Tax @	7.8%	$36.64		$509.39
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00		$0.00
Subcontractors	$1,760.00					$1,760.00
DIRECT COST SUBTOTALS	$4,597			$37	DIRECT COST SUBTOTALS	$4,633

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$2,873.16	$430.97
Installing Contractors Profit@	8.0%				$2,873.16	$229.85
GC Markup on Subs @	5.0%				$1,760.00	$88.00
					TOTAL MARKUP COSTS	$748.83
General Contractors Insurance @	1.0%	FALSE		FALSE	$5,381.99	$54
Bond @	1.0%	FALSE	on		$5,381.99	$54
Contingency @	0.0%		on		$5,489.63	$0
					TOTAL COST for pay item	$5,490

Additional Pay Item Notes :

Petroleum-based products, ranging from fuel oil and hydraulic fluid to lubricating greases and oils, are found throughout every type of power generating plant or system. Lubrication supports bearings and moving parts in all sorts of equipment: pumps, conveyors, feeders, scrubbers, cranes, turbines, and more A good oil/water separation system will result in a flow of concentrated waste oil to a collection area and a flow of oil free water ready for secondary processing or discharge. Once an oil layer has been separated from free water, it must be removed for recycling or disposal. Many plants use one or more of these oil removal methods, but each has costly limitations:

1. Absorbent materials. Absorbent mats or materials are frequently used to dam up and absorb excess oils and greases resulting from accidents or the routine operation of machinery. These materials are very effective for preventing the spread of a source leak and very efficient in terms of oil pickup. Yet, their use on large volumes of waste oil results in multiple, recurring costs that can make them impractical as an everyday solution:
   - the costs of the materials themselves
   - the labor costs for ordering, stocking, application, and removal
   - the costs of used-media collection, disposal, or re-processing/recycling.
2. Manually operated "slotted pipes." Many separators feature a "slotted pipe," a pipe located near the top of the vessel that has a horizontal opening. Oil is removed by turning the horizontal opening downward until it meets the floating oil layer, which drains through the pipe to a collection receptacle. These pipes work well on thick layers of oil, but cannot drain off a sheen of oil without draining off a large amount of water as well.

AECOM assumed the best is Vacuum truck removal method to remove petroleum fromturbines, generator, oil sumps, tanks, etc. Used a crew formed of 1 Forman, 2 Laborers and 2 journemen to takeout the petroleum waste, Vacuum-equipped tank trucks are used to remove waste oil from collection points (assumed existing drums or tanks) so that it can be transported to recycling or disposal locations. If the waste oil has been thoroughly separated, highly concentrated, and stored in an appropriate receptacle, this service can be used very efficiently. However, vacuum disposal units are often used to pump oil layers directly off of water. This results in the intake of a significant amount free water along with the waste oil – and a significantly higher cost.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.036		Project	: COPCO 1				
Description	: Remove & Dispose of Horizontal AC Generator, Indoor Open Frame							
Quantity	: 2.00 EA							
Daily Production	: 0.40 EA per 8 hour shift		Project #	: 2				
Work Days	: 5.0 Days		Estimator	: Mihaela Tomulescu		EA per	Total Cost	Unit Price Per EA
Unit Price	: $38,691.77 per EA		Probable Low Cost Parameter			0.46	$65,776	$32,888.00
Total Cost	: $77,384		Probable High Cost Parameter			0.32	$92,860	$46,430.12

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	5.0	8	40.00	L	$47.23	incl. in rate	incl. in rate	$1,889.20
Labor Foreman	Active	1.00	5.0	8	40.00	L	$48.27	incl. in rate	incl. in rate	$1,930.80
Electrician	Active	6.00	5.0	8	240.00	L	$45.23	incl. in rate	incl. in rate	$10,855.20
Steelworker	Active	6.00	5.0	8	240.00	L	$65.52	incl. in rate	incl. in rate	$15,724.80
Laborer	Active	2.00	5.0	8	80.00	L	$45.80	incl. in rate	incl. in rate	$3,664.00
Truck Driver (heavy)	Active	2.00	5.0	8	80.00	L	$57.59	incl. in rate	incl. in rate	$4,607.20
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	5.0	8	80.00	E	$31.90	incl. in rate	incl. in rate	$2,552.00
Gas Welding Machine	Active	2.00	5.0	8	80.00	E	$2.88	incl. in rate	incl. in rate	$230.16
Welder	Active	2.00	5.0	8	80.00	L	$7.84	incl. in rate	incl. in rate	$627.00
Equipment Operator (crane)	Active	1.00	5.0	8	40.00	L	$68.41	incl. in rate	incl. in rate	$2,736.40
Crawler Crane (130tn)	Active	1.00	5.0	8	40.00	E	$258.66	incl. in rate	incl. in rate	$10,346.40

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.037		Project	: COPCO1			
Description	:	Remove & Dispose of Excitation equipment for 12.5 MVA Generator						
Quantity	:	1.50 EA						
Daily Production	:	1.50 EA per	8 hour shift	Project #	: 2			
Work Days	:	1.0 Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$8,472.47 per EA		Probable Low Cost Parameter		1.725	$10,802	$7,201.60
Total Cost	:	$12,709		Probable High Cost Parameter		1.125	$15,886	$10,590.59

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.0	8	8.00	L	$47.23	incl. in rate	incl. in rate	$377.84
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Hydraulic Crane (120tn)	Active	1.00	1.0	8	8.00	E	$239.06	incl. in rate	incl. in rate	$1,912.48
Welder	Active	1.00	1.0	8	8.00	L	$7.84	incl. in rate	incl. in rate	$62.70
Gas Welding Machine	Active	1.00	1.0	8	8.00	E	$2.88	incl. in rate	incl. in rate	$23.02
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28

Labor Hours	64	TOTAL LABOR	$3,073.42
Equipment Hours	32	TOTAL EQUIPMENT	$4,600.62

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$153.67	$153.67
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	2,500.00	LF	1.000	2,500.00	$0.85	$2,125.00

TOTAL MATERIAL	$2,278.67

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.00	ton	1.000	0.00 $595.00	$0.45
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	0.00	mile	1.000	0.00 $7.25	$0.00
					$0.00
					$0.00

TOTAL SUBCONTRACTS	$0.45

SUMMARY OF COSTS

Labor Cost	$3,073.42	Labor Burden @	49.7%	$0.00	$3,073.42
Material Cost	$2,278.67	Material Tax @	7.8%	$176.60	$2,455.27
Equipment Cost	$4,600.62	Equipment Tax @	0.0%	$0.00	$4,600.62
Subcontractors	$0.45				$0.45
DIRECT COST SUBTOTALS	$9,963			$177	DIRECT COST SUBTOTALS $10,130

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$10,129.30	$1,519.40
Installing Contractors Profit@	8.0%				$10,129.30	$810.34
GC Markup on Subs @	5.0%				$0.45	$0.02
					TOTAL MARKUP COSTS	$2,329.76
General Contractors Insurance @	1.0%		on		$12,459.51	$125
Bond @	1.0%		on		$12,459.51	$125
Contingency @	0.0%		on		$12,708.70	$0
					TOTAL COST for pay item	$12,709

Additional Pay Item Notes :

Production based on 1 Forman, 1 Electrician, 1 Welder to cut to remove the electrical equipment and 1 laborer to haul. Equipment used 1 Loader and 1 Crane for disposal. Assumed 2 sections, weight 1000LBS.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.038		Project	: COPCO1			
Description	:	Remove & Dispose of Surge protection equip. for 12.5 MVA Generator						
Quantity	:	2.00 EA						
Daily Production	:	2.00 EA per	8 hour shift	Project #	: 2			
Work Days	:	1.0 Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$2,504.46 per EA		Probable Low Cost Parameter		2.3	$4,258	$2,128.79
Total Cost	:	$5,009		Probable High Cost Parameter		1.4	$6,512	$3,255.80

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Ironworkers	Active	2.00	1.0	8	16.00	L	$63.95	incl. in rate	incl. in rate	$1,023.20
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12

Labor Hours	56	TOTAL LABOR	$2,940.40
Equipment Hours	8	TOTAL EQUIPMENT	$893.12

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$147.02	$147.02
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	0.00	LF	1.000	0.00	$0.85	$0.00

TOTAL MATERIAL	$147.02

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.00	ton	1.000	0.00	$595.00	$0.60
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	0.00	mile	1.000	0.00	$7.25	$0.00

TOTAL SUBCONTRACTS	$0.60

SUMMARY OF COSTS

Labor Cost	$2,940.40	Labor Burden @	49.7%	$0.00		$2,940.40
Material Cost	$147.02	Material Tax @	7.8%	$11.39		$158.41
Equipment Cost	$893.12	Equipment Tax @	0.0%	$0.00		$893.12
Subcontractors	$0.60					$0.60
DIRECT COST SUBTOTALS	$3,981			$11	DIRECT COST SUBTOTALS	$3,993

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,991.93	$598.79
Installing Contractors Profit@	8.0%				$3,991.93	$319.35
GC Markup on Subs @	5.0%				$0.60	$0.03
					TOTAL MARKUP COSTS	$918.17
General Contractors Insurance @	1.0%		on		$4,910.70	$49
Bond @	1.0%		on		$4,910.70	$49
Contingency @	0.0%		on		$5,008.92	$0
					TOTAL COST for pay item	$5,009

Additional Pay Item Notes :

Assumption for Crew R3: 1 Forman, 1 Electrician, 1 Ironworker and 1 welder to cut rods, to remove the electrical equipment and 1 laborer to haul in the truck.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2039	Project	: COPCO1				
Description	:	Remove & Dispose of Neutral grounding equip. for 12.5 MVA Generator						
Quantity	:	2.00 EA						
Daily Production	:	2.00 EA per 8 hour shift	Project #	: 2				
Work Days	:	1.0 Days	Estimator	: Mihaela Tomulescu		EA per	Total Cost	Unit Price Per EA
Unit Price	:	$2,332.24 per EA	Probable Low Cost Parameter			2.2	$4,198	$2,099.01
Total Cost	:	$4,664	Probable High Cost Parameter			1.7	$5,364	$2,682.07

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.0	8	8.00	L	$47.23	incl. in rate	incl. in rate	$377.84
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Loader, FE Rubber Tire (3.5cy)	Active	2.00	0.5	8	8.00	E	$64.23	incl. in rate	incl. in rate	$513.84
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Equipment Operator (light)	Active	1.00	0.5	8	4.00	L	$64.90	incl. in rate	incl. in rate	$259.60

Labor Hours	44	TOTAL LABOR	$2,192.80
Equipment Hours	16	TOTAL EQUIPMENT	$1,406.96

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$109.64	$109.64

TOTAL MATERIAL	$109.64

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,192.80	Labor Burden @	49.7%	$0.00	$2,192.80
Material Cost	$109.64	Material Tax @	7.8%	$8.50	$118.14
Equipment Cost	$1,406.96	Equipment Tax @	0.0%	$0.00	$1,406.96
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$3,709			$8	DIRECT COST SUBTOTALS $3,718

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,717.90	$557.68
Installing Contractors Profit@	8.0%				$3,717.90	$297.43
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$855.12
General Contractors Insurance @	1.0%		on		$4,573.01	$46
Bond @	1.0%		on		$4,573.01	$46
Contingency @	0.0%		on		$4,664.47	$0
					TOTAL COST for pay item	$4,664

Additional Pay Item Notes :

Assumption for Crew R3: 1 Forman, 1 Electrician, 1 Ironworker and 1 welder to cut rods, to remove the electrical equipment and 1 laborer to haul in the truck.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.040			Project	: COPCO1			
Description	: Remove & Dispose of Generator Switchgear, 5kV-includes unit breakers							
Quantity	: 1.00 EA							
Daily Production	: 1.00 EA per	8	hour shift	Project #	: 2			
Work Days	: 1.0 Days			Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $20,666.10 per EA			Probable Low Cost Parameter		1.1	$18,599	$18,599.49
Total Cost	: $20,666			Probable High Cost Parameter		0.85	$23,766	$23,766.01

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	3.00	1.0	8	24.00	L	$47.23	incl. in rate	incl. in rate	$1,133.52
Electrician	Active	12.00	1.0	8	96.00	L	$45.23	incl. in rate	incl. in rate	$4,342.08
Laborer	Active	6.00	1.0	8	48.00	L	$45.80	incl. in rate	incl. in rate	$2,198.40
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	2.00	1.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	1.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Hydraulic Crane (120tn)	Active	1.00	1.0	8	8.00	E	$239.06	incl. in rate	incl. in rate	$1,912.48
Welder	Active	1.00	1.0	8	8.00	L	$7.84	incl. in rate	incl. in rate	$62.70
Gas Welding Machine	Active	1.00	1.0	8	8.00	E	$2.88	incl. in rate	incl. in rate	$23.02
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
				Labor Hours	208			TOTAL LABOR		$9,735.66
				Equipment Hours	40			TOTAL EQUIPMENT		$5,493.74

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$486.78	$486.78
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	0.00	LF	1.000	0.00	$0.85	$0.00
					TOTAL MATERIAL	$486.78

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	1.00	ton	1.000	1.00	$595.00	$595.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	34.00	mile	1.000	34.00	$7.25	$246.50
					TOTAL SUBCONTRACTS	$841.50

SUMMARY OF COSTS

Labor Cost	$9,735.66	Labor Burden @	49.7%	$0.00		$9,735.66
Material Cost	$486.78	Material Tax @	7.8%	$37.73		$524.51
Equipment Cost	$5,493.74	Equipment Tax @	0.0%	$0.00		$5,493.74
Subcontractors	$841.50					$841.50
DIRECT COST SUBTOTALS	$16,558			$38	DIRECT COST SUBTOTALS	$16,595

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$15,753.90	$2,363.09
Installing Contractors Profit@	8.0%				$15,753.90	$1,260.31
GC Markup on Subs @	5.0%				$841.50	$42.08
					TOTAL MARKUP COSTS	$3,665.47
General Contractors Insurance @	1.0%		on		$20,260.88	$203
Bond @	1.0%		on		$20,260.88	$203
Contingency @	0.0%		on		$20,666.10	$0
					TOTAL COST for pay item	$20,666

Additional Pay Item Notes :

Used 3 Crews (2 sections each weight around 800 LBS per crew) formed of 1 Forman, 3 Electrician, 2 laborer to haul with the crane in the truck. Assumed containing hazardous waste that will be disposed at 34 miles away from the construction site to Yreka Transfer Recycling . In normal circumstances, decontaminated residual components could be accepted at landfill sites but Polychlorinated biphenyl, otherwise known as PCB, is a synthetic chemical that is widely used for industrial and commercial use as dielectric fluid in transformers and capacitors because of its high resistance to decomposition, low electrical conductivity, low flammability and high heat capacity.Transformer repair, reconditioning and retro-filling facilities are the major industry sectors that contributes to the spread of PCB contamination.Types of PCB Wastes:
PCB wastes are discarded materials that contain PCB or have been contaminated with PCBs and that are without any commercial, industrial, or economic use. For the purpose of this Code of Practice, PCBs wastes are classified as follows:Liquid PCB wastes
o PCB-based dielectric fluids removed from transformers and other equipment
o PCB-based heat transfer and hydraulic fluidsMetallic solid wastes
o PCB equipment such as capacitors, transformers, **switchgears**, circuit breakers, heat transfer systems, etc.
o Contaminated components removed from electrical equipment such as windings;
contaminated containers and equipment such as metal drums, tanks, pumps, metal filters, etc.
o PCB

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.041		Project	: COPCO1				
Description	: Remove & Dispose of Station Service Switchgear, 600 volt - (5 sections)							
Quantity	: 1.00 EA							
Daily Production	: 1.00 EA per	8 hour shift	Project #	: 2				
Work Days	: 1.0 Days		Estimator	: Mihaela Tomulescu		EA per	Total Cost	Unit Price Per EA
Unit Price	: $11,311.14 per EA		Probable Low Cost Parameter			1.1	$10,180	$10,180.03
Total Cost	: $11,311		Probable High Cost Parameter			0.85	$13,008	$13,007.81

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	3.00	1.0	8	24.00	L	$47.23	incl. in rate	incl. in rate	$1,133.52
Electrician	Active	6.00	1.0	8	48.00	L	$45.23	incl. in rate	incl. in rate	$2,171.04
Laborer	Active	4.00	1.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Welder	Active	1.00	1.0	8	8.00	L	$7.84	incl. in rate	incl. in rate	$62.70
Gas Welding Machine	Active	1.00	1.0	8	8.00	E	$2.88	incl. in rate	incl. in rate	$23.02

Labor Hours	128	TOTAL LABOR	$5,823.82
Equipment Hours	24	TOTAL EQUIPMENT	$2,688.14

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$291.19	$291.19

TOTAL MATERIAL	$291.19

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	34.00	mile	1.000	$7.25	$246.50

TOTAL SUBCONTRACTS	$246.50

SUMMARY OF COSTS

Labor Cost	$5,823.82	Labor Burden @	49.7%	$0.00		$5,823.82
Material Cost	$291.19	Material Tax @	7.8%	$22.57		$313.76
Equipment Cost	$2,688.14	Equipment Tax @	0.0%	$0.00		$2,688.14
Subcontractors	$246.50					$246.50
DIRECT COST SUBTOTALS	$9,050			$23	DIRECT COST SUBTOTALS	$9,072

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☑	☐	☐	$8,825.71	$1,323.86
Installing Contractors Profit@	8.0%	☑	☐	☐	$8,511.96	$680.96
GC Markup on Subs @	5.0%	☐	☐	☑	$246.50	$12.33
					TOTAL MARKUP COSTS	$2,017.14
General Contractors Insurance @	1.0%		on		$11,089.35	$111
Bond @	1.0%		on		$11,089.35	$111
Contingency @	0.0%		on		$11,311.14	$0
					TOTAL COST for pay item	$11,311

Additional Pay Item Notes :

Used 3 Crews (2 sections each, weight around 800Lbs per crew) formed of 1 Forman, 2 Electrician, 1welder to cut, 2 laborer to haul with the loader in the truck. Assumed containing hazardous waste that will be disposed . Calculated 34 miles from Copco 1 to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.042	Project	: COPCO1				
Description	:	Remove & Dispose of Unit and plant control switchboard						
Quantity	:	1.00 EA						
Daily Production	:	1.00 EA per 8 hour shift	Project #	: 2				
Work Days	:	1.0 Days	Estimator	: Mihaela Tomulescu		EA per	Total Cost	Unit Price Per EA
Unit Price	:	$6,110.32 per EA	Probable Low Cost Parameter			1.1	$5,499	$5,499.29
Total Cost	:	$6,110	Probable High Cost Parameter			0.85	$7,027	$7,026.87

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.0	8	8.00	L	$47.23	incl. in rate	incl. in rate	$377.84
Electrician	Active	2.00	1.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12

Labor Hours	40	TOTAL LABOR	$2,092.48
Equipment Hours	16	TOTAL EQUIPMENT	$2,665.12

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$104.62	$104.62

TOTAL MATERIAL	$104.62

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,092.48	Labor Burden @	49.7%	$0.00		$2,092.48
Material Cost	$104.62	Material Tax @	7.8%	$8.11		$112.73
Equipment Cost	$2,665.12	Equipment Tax @	0.0%	$0.00		$2,665.12
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$4,862			$8	DIRECT COST SUBTOTALS	$4,870

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,870.33	$730.55
Installing Contractors Profit@	8.0%				$4,870.33	$389.63
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$1,120.18
General Contractors Insurance @	1.0%		on		$5,990.51	$60
Bond @	1.0%		on		$5,990.51	$60
Contingency @	0.0%		on		$6,110.32	$0
					TOTAL COST for pay item	$6,110

Additional Pay Item Notes :

Assumed 1 day of work to dispose unit and plant control switchboard with R3 electrical crew and laborers for hauling with the loader in the truck.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.043	Project	: COPCO 1				
Description	:	Remove & Dispose of Battery System						
Quantity	:	1.00 EA						
Daily Production	:	0.33 EA per 8 hour shift	Project #	: 2				
Work Days	:	3.0 Days	Estimator	: Mihaela Tomulescu		EA per	Total Cost	Unit Price Per EA
Unit Price	:	$20,638.63 per EA	Probable Low Cost Parameter			0.363	$18,575	$18,574.76
Total Cost	:	$20,639	Probable High Cost Parameter			0.2805	$23,734	$23,734.42

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	3.0	8	24.00	L	$48.27	incl. in rate	incl. in rate	$1,158.48
Electrician	Active	1.00	3.0	8	24.00	L	$45.23	incl. in rate	incl. in rate	$1,085.52
Equipment Operator (light)	Active	1.00	3.0	8	24.00	L	$64.90	incl. in rate	incl. in rate	$1,557.60
Loader, FE Rubber Tire (8.6cy)	Active	1.00	3.0	8	24.00	E	$221.50	incl. in rate	incl. in rate	$5,316.00
Truck Driver (heavy)	Active	1.00	3.0	8	24.00	L	$57.59	incl. in rate	incl. in rate	$1,382.16
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	3.0	8	24.00	E	$111.64	incl. in rate	incl. in rate	$2,679.36
Laborer	Active	2.00	3.0	8	48.00	L	$45.80	incl. in rate	incl. in rate	$2,198.40
Welder	Active	1.00	3.0	8	24.00	L	$7.84	incl. in rate	incl. in rate	$188.10
Gas Welding Machine	Active	1.00	3.0	8	24.00	E	$2.88	incl. in rate	incl. in rate	$69.05

Labor Hours	168	TOTAL LABOR	$7,570.26
Equipment Hours	72	TOTAL EQUIPMENT	$8,064.41

MATERIAL COSTS

Description	Item Quantity	Order Unit	onversion :tor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$757.03	$757.03

TOTAL MATERIAL	$757.03

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$7,570.26	Labor Burden @	49.7%	$0.00		$7,570.26
Material Cost	$757.03	Material Tax @	7.8%	$58.67		$815.70
Equipment Cost	$8,064.41	Equipment Tax @	0.0%	$0.00		$8,064.41
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$16,392			$59	DIRECT COST SUBTOTALS	$16,460

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$16,450.36	$2,467.55
Installing Contractors Profit@	8.0%				$16,450.36	$1,316.03
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$3,783.58
General Contractors Insurance @	1.0%		on		$20,233.95	$202
Bond @	1.0%		on		$20,233.95	$202
Contingency @	0.0%		on		$20,638.63	$0
					TOTAL COST for pay item	$20,639

Additional Pay Item Notes :

Assuming 3 days of work disposing around 60 batteries, racks and supports. Using Crews E-19 for metals demolition, E-12 and E-25 for cutting steel and A-3H for equipment disposal, B-34A for hauling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.044		Project	: COPCO1			
Description	:	Remove & Dispose of Raceways, Conduit and Cable						
Quantity	:	1.00 EA						
Daily Production	:	0.50 EA per	8 hour shift	Project #	: 2			
Work Days	:	2.0 Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$17,082.48 per EA		Probable Low Cost Parameter		0.55	$15,374	$15,374.23
Total Cost	:	$17,082		Probable High Cost Parameter		0.425	$19,645	$19,644.85

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	2.0	8	16.00	L	$48.27	incl. in rate	incl. in rate	$772.32
Electrician	Active	2.00	2.0	8	32.00	L	$45.23	incl. in rate	incl. in rate	$1,447.36
Laborer	Active	4.00	2.0	8	64.00	L	$45.80	incl. in rate	incl. in rate	$2,931.20
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.0	8	16.00	E	$221.50	incl. in rate	incl. in rate	$3,544.00
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48

Labor Hours	144	TOTAL LABOR	$7,132.80
Equipment Hours	32	TOTAL EQUIPMENT	$5,330.24

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,069.92	$1,069.92

TOTAL MATERIAL	$1,069.92

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$7,132.80	Labor Burden @	49.7%	$0.00		$7,132.80
Material Cost	$1,069.92	Material Tax @	7.8%	$82.92		$1,152.84
Equipment Cost	$5,330.24	Equipment Tax @	0.0%	$0.00		$5,330.24
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$13,533			$83	DIRECT COST SUBTOTALS	$13,616

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☐	☐	☐	$13,615.88	$2,042.38
Installing Contractors Profit@	8.0%	☐	☐	☐	$13,615.88	$1,089.27
GC Markup on Subs @	5.0%	☐	☐	☐	$0.00	$0.00
					TOTAL MARKUP COSTS	$3,131.65
General Contractors Insurance @	1.0%		on		$16,747.53	$167
Bond @	1.0%		on		$16,747.53	$167
Contingency @	0.0%		on		$17,082.48	$0
					TOTAL COST for pay item	$17,082

Additional Pay Item Notes :

Assumption for removal of control power cable, conduit (2000 LF) and cable tray (300 LF) - using R3 electrical crew and laborers for hauling with the loader.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.045	Project	: COPCO1				
Description	:	Remove & Dispose of Misc. power & control boards						
Quantity	:	1.00 EA						
Daily Production	:	1.00 EA per 8 hour shift	Project #	: 2				
Work Days	:	1.0 Days	Estimator	: Mihaela Tomulescu		EA per	Total Cost	Unit Price Per EA
Unit Price	:	$6,945.94 per EA	Probable Low Cost Parameter			1.1	$6,251	$6,251.35
Total Cost	:	$6,946	Probable High Cost Parameter			0.85	$7,988	$7,987.83

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	incl. in rate	incl. in rate	$386.16
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24

Labor Hours	48	TOTAL LABOR	$2,471.76
Equipment Hours	16	TOTAL EQUIPMENT	$2,665.12

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$370.76	$370.76

TOTAL MATERIAL	$370.76

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,471.76	Labor Burden @	49.7%	$0.00	$2,471.76
Material Cost	$370.76	Material Tax @	7.8%	$28.73	$399.50
Equipment Cost	$2,665.12	Equipment Tax @	0.0%	$0.00	$2,665.12
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$5,508			$29	DIRECT COST SUBTOTALS $5,536

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$5,536.38	$830.46
Installing Contractors Profit@	8.0%				$5,536.38	$442.91
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$1,273.37
General Contractors Insurance @	1.0%		on		$6,809.75	$68
Bond @	1.0%		on		$6,809.75	$68
Contingency @	0.0%		on		$6,945.94	$0
					TOTAL COST for pay item	$6,946

Additional Pay Item Notes :

Assumption for removal of 3' x 2' x 9" boards - 10 each using R3 electrical crew and laborers for hauling with the loader.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.046		Project	: COPCO 1			
Description	: Remove & Dispose of Step-up Transformers, indoor, oil-filled, 1-phase, 5000kVA						
Quantity	: 3.00 EA						
Daily Production	: 0.25 EA per	8 hour shift	Project #	: 2			
Work Days	: 12.0 Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $64,338.39 per EA		Probable Low Cost Parameter		0.275	$173,714	$57,904.55
Total Cost	: $193,015		Probable High Cost Parameter		0.2125	$221,967	$73,989.15

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	3.00	12.0	8	288.00	L	$47.23	incl. in rate	incl. in rate	$13,602.24
Electrician	Active	3.00	12.0	8	288.00	L	$45.23	incl. in rate	incl. in rate	$13,026.24
Laborer	Active	6.00	12.0	8	576.00	L	$45.80	incl. in rate	incl. in rate	$26,380.80
Hydraulic Excavator (6.0cy)	Active	1.00	12.0	8	96.00	E	$322.48	incl. in rate	incl. in rate	$30,958.08
Truck Driver (heavy)	Active	1.00	12.0	8	96.00	L	$57.59	incl. in rate	incl. in rate	$5,528.64
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	12.0	8	96.00	E	$31.90	incl. in rate	incl. in rate	$3,062.40
Crawler Crane (130tn)	Active	1.00	12.0	8	96.00	E	$258.66	incl. in rate	incl. in rate	$24,831.36
Truck, Utility, with Man-Basket	Active	1.00	12.0	8	96.00	E	$31.90	incl. in rate	incl. in rate	$3,062.40
Equipment Operator (medium)	Active	1.00	12.0	8	96.00	L	$66.28	incl. in rate	incl. in rate	$6,362.88
Equipment Operator (crane)	Active	1.00	12.0	8	96.00	L	$68.41	incl. in rate	incl. in rate	$6,567.36

Labor Hours	1440	TOTAL LABOR	$71,468.16
Equipment Hours	384	TOTAL EQUIPMENT	$61,914.24

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor	1.00	LS	1.000	1.00	$3,573.41	$3,573.41

TOTAL MATERIAL	$3,573.41

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Disposal fee	1	EA	1.000	1.00	$500.00	$500.00
Remove oil from oil-filled step-up transformer (allowance for oil containers, filters, etc)	1	EA	1.000	1.00	$13,000.00	$13,000.00
Forklift crew, all-terrain forklift, 45' lift, 35' reach, 9000 lb. capacity, weekly use	1	week	1.000	1.00	$5,961.23	$5,961.23

TOTAL SUBCONTRACTS	$19,461.23

SUMMARY OF COSTS

Labor Cost	$71,468.16	Labor Burden @	49.7%	$0.00		$71,468.16
Material Cost	$3,573.41	Material Tax @	7.8%	$276.94		$3,850.35
Equipment Cost	$61,914.24	Equipment Tax @	0.0%	$0.00		$61,914.24
Subcontractors	$19,461.23					$19,461.23
DIRECT COST SUBTOTALS	$156,417			$277	DIRECT COST SUBTOTALS	$156,694

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$137,232.75	$20,584.91
Installing Contractors Profit@	8.0%				$137,232.75	$10,978.62
GC Markup on Subs @	5.0%				$19,461.23	$973.06
					TOTAL MARKUP COSTS	$32,536.59
General Contractors Insurance @	1.0%		on		$189,230.57	$1,892
Bond @	1.0%		on		$189,230.57	$1,892
Contingency @	0.0%		on		$193,015.18	$0
					TOTAL COST for pay item	$193,015

Additional Pay Item Notes :

Weight and dimensions of the transformers have particular importance so transport vehicles must be adequate. A considerable proportion of the weight is due to the oil, so the direct consequence is that the big transformers have to be transported empty. During transport the transformers are filled either by dry air or nitrogen. Because of transportation, the auxiliaries have to be removed . For this reason the collaboration with all the people involved in the project is essential. AECOM best assumption for a 5000 kVA, 2300/72000 volt transformer removal- - 3 crew R3 formed of 1 Formen, 1 Electricians, 1 Utility man-backet truck, 1 crane for disposal of each transformer in the truck and 2 laboreres to remove the auxiliaries and the pad (1 excavator).

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.047		Project	: COPCO 1			
Description	:	Remove & Dispose of Step-up Transformers, indoor, oil-filled, 1-phase, 4165kVA						
Quantity	:	3.00	EA					
Daily Production	:	0.25	EA per 8 hour shift	Project #	: 2			
Work Days	:	12.0	Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$57,252.76	per EA	Probable Low Cost Parameter		0.275	$164,582	$51,527.49
Total Cost	:	$171,758		Probable High Cost Parameter		0.2125	$197,622	$66,840.68

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	3.00	12.0	8	288.00	L	$47.23	incl. in rate	incl. in rate	$13,602.24
Electrician	Active	3.00	12.0	8	288.00	L	$45.23	incl. in rate	incl. in rate	$13,026.24
Laborer	Active	6.00	12.0	8	576.00	L	$45.80	incl. in rate	incl. in rate	$26,380.80
Hydraulic Excavator (6.0cy)	Active	1.00	12.0	8	96.00	E	$322.48	incl. in rate	incl. in rate	$30,958.08
Truck Driver (heavy)	Active	3.00	2.0	8	48.00	L	$57.59	incl. in rate	incl. in rate	$2,764.32
Truck, Flatbed (4x4, 10,000 gvw)	Active	3.00	2.0	8	48.00	E	$31.90	incl. in rate	incl. in rate	$1,531.20
Crawler Crane (130tn)	Active	1.00	3.0	8	24.00	E	$258.66	incl. in rate	incl. in rate	$6,207.84
Equipment Operator (medium)	Active	1.00	12.0	8	96.00	L	$66.28	incl. in rate	incl. in rate	$6,362.88
Equipment Operator (crane)	Active	1.00	12.0	8	96.00	L	$68.41	incl. in rate	incl. in rate	$6,567.36
Truck, Utility, with Man-Basket	Active	3.00	12.0	8	288.00	E	$31.90	incl. in rate	incl. in rate	$9,187.20

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.048	Project	: COPCO 1				
Description	:	Remove & Dispose of Seven 40-Ton Travelling Crane motors - hoist						
Quantity	:	1.00 EA						
Daily Production	:	2.00 EA per 8 hour shift	Project #	: 2				
Work Days	:	0.5 Days	Estimator	: Mihaela Tomulescu		EA per	Total Cost	Unit Price Per EA
Unit Price	:	$3,306.69 per EA	Probable Low Cost Parameter			2.2	$2,976	$2,976.02
Total Cost	:	$3,307	Probable High Cost Parameter			1.7	$3,803	$3,802.69

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.5	8	4.00	E	$111.64	incl. in rate	incl. in rate	$446.56
Hydraulic Crane (80tn)	Active	1.00	0.5	8	4.00	E	$190.46	incl. in rate	incl. in rate	$761.84
Laborer	Active	1.00	0.5	8	4.00	L	$45.80	incl. in rate	incl. in rate	$183.20
Equipment Operator (crane)	Active	1.00	0.5	8	4.00	L	$68.41	incl. in rate	incl. in rate	$273.64
Truck Driver (heavy)	Active	1.00	0.5	8	4.00	L	$57.59	incl. in rate	incl. in rate	$230.36
Steelworker	Active	1.00	0.5	8	4.00	L	$65.52	incl. in rate	incl. in rate	$262.08

Labor Hours	16	TOTAL LABOR	$949.28
Equipment Hours	8	TOTAL EQUIPMENT	$1,208.40

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$47.46	$47.46
					TOTAL MATERIAL	$47.46

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Disposal fee	1	EA	1.000	1.00	$500.00	$500.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	$500.00

SUMMARY OF COSTS

Labor Cost	$949.28	Labor Burden @	49.7%	$0.00		$949.28
Material Cost	$47.46	Material Tax @	7.8%	$3.68		$51.14
Equipment Cost	$1,208.40	Equipment Tax @	0.0%	$0.00		$1,208.40
Subcontractors	$500.00					$500.00
DIRECT COST SUBTOTALS	$2,705			$4	DIRECT COST SUBTOTALS	$2,709

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$2,208.82	$331.32
Installing Contractors Profit@	8.0%				$2,208.82	$176.71
GC Markup on Subs @	5.0%				$500.00	$25.00
					TOTAL MARKUP COSTS	$533.03
General Contractors Insurance @	1.0%		on		$3,241.85	$32
Bond @	1.0%		on		$3,241.85	$32
Contingency @	0.0%		on		$3,306.69	$0
					TOTAL COST for pay item	$3,307

Additional Pay Item Notes :

Assumed removal of hoist, hoist trolley, gantry: 1 Steelworker and 1 Laborers to load the overhead crane motors in the truck using the crane.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.049	Project	: COPCO 1				
Description	:	Remove & Dispose of 40-Ton Travelling Crane control equipment						
Quantity	:	1.00 EA						
Daily Production	:	1.50 EA per 8 hour shift	Project #	: 2				
Work Days	:	0.7 Days	Estimator	: Mihaela Tomulescu		EA per	Total Cost	Unit Price Per EA
Unit Price	:	$4,364.61 per EA	Probable Low Cost Parameter			1.65	$3,928	$3,928.15
Total Cost	:	$4,365	Probable High Cost Parameter			1.275	$5,019	$5,019.30

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Laborer	Active	2.00	0.7	8	11.20	L	$45.80	incl. in rate	incl. in rate	$512.96
Electrician	Active	1.00	0.7	8	5.60	L	$45.23	incl. in rate	incl. in rate	$253.29
Hydraulic Crane (35tn)	Active	2.00	0.7	8	11.20	E	$116.30	incl. in rate	incl. in rate	$1,302.56
Equipment Operator (crane)	Active	1.00	0.7	8	5.60	L	$68.41	incl. in rate	incl. in rate	$383.10
Truck Driver (heavy)	Active	1.00	0.7	8	5.60	L	$57.59	incl. in rate	incl. in rate	$322.50
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.7	8	5.60	E	$111.64	incl. in rate	incl. in rate	$625.18

Labor Hours	28	TOTAL LABOR	$1,471.85
Equipment Hours	16.8	TOTAL EQUIPMENT	$1,927.74

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$73.59	$73.59

TOTAL MATERIAL	$73.59

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$1,471.85	Labor Burden @	49.7%	$0.00	$1,471.85
Material Cost	$73.59	Material Tax @	7.8%	$5.70	$79.30
Equipment Cost	$1,927.74	Equipment Tax @	0.0%	$0.00	$1,927.74
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$3,473			$6	DIRECT COST SUBTOTALS $3,479

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,478.89	$521.83
Installing Contractors Profit@	8.0%				$3,478.89	$278.31
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$800.14
General Contractors Insurance @	1.0%		on		$4,279.03	$43
Bond @	1.0%		on		$4,279.03	$43
Contingency @	0.0%		on		$4,364.61	$0
					TOTAL COST for pay item	$4,365

Additional Pay Item Notes :

Assumed 5 cubicles: 2 Laborers and 1 Electrician will load in the truck with the crane the control equipment.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.050	Project	: COPCO 1				
Description	:	Remove & Dispose of 40-Ton Travelling Crane Festoon Cable						
Quantity	:	1.00 EA						
Daily Production	:	2.00 EA per 8 hour shift	Project #	: 2				
Work Days	:	0.5 Days	Estimator	: Mihaela Tomulescu		EA per	Total Cost	Unit Price Per EA
Unit Price	:	$1,534.84 per EA	Probable Low Cost Parameter			2.2	$1,381	$1,381.36
Total Cost	:	$1,535	Probable High Cost Parameter			1.6	$1,842	$1,841.81

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.2	8	1.60	E	$111.64	incl. in rate	incl. in rate	$178.62
Laborer	Active	2.00	0.2	8	3.20	L	$45.80	incl. in rate	incl. in rate	$146.56
Loader, FE Rubber Tire (3.5cy)	Active	1.00	0.5	8	4.00	E	$64.23	incl. in rate	incl. in rate	$256.92
Equipment Operator (light)	Active	1.00	0.2	8	1.60	L	$64.90	incl. in rate	incl. in rate	$103.84
Truck Driver (heavy)	Active	1.00	0.2	8	1.60	L	$57.59	incl. in rate	incl. in rate	$92.14

Labor Hours	6.4	TOTAL LABOR	$342.54
Equipment Hours	5.6	TOTAL EQUIPMENT	$435.54

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$17.13	$17.13
					TOTAL MATERIAL	$17.13

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Disposal fee (Allowance)	1	EA	1.000	1.00 $500.00	$500.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$500.00

SUMMARY OF COSTS

Labor Cost	$342.54	Labor Burden @	49.7%	$0.00		$342.54
Material Cost	$17.13	Material Tax @	7.8%	$1.33		$18.45
Equipment Cost	$435.54	Equipment Tax @	0.0%	$0.00		$435.54
Subcontractors	$500.00					$500.00
DIRECT COST SUBTOTALS	$1,295			$1	DIRECT COST SUBTOTALS	$1,297

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☐	☐	☐	$796.54	$119.48
Installing Contractors Profit@	8.0%	☐	☐	☐	$796.54	$63.72
GC Markup on Subs @	5.0%	☐	☐	☐	$500.00	$25.00
					TOTAL MARKUP COSTS	$208.20
General Contractors Insurance @	1.0%		on		$1,504.75	$15
Bond @	1.0%		on		$1,504.75	$15
Contingency @	0.0%		on		$1,534.84	$0
					TOTAL COST for pay item	$1,535

Additional Pay Item Notes :

Assumed 200 LF of cable: 2 Laborers will load in the truck with the loader the overhead crane cable.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.051		Project	: COPCO 1			
Description	: Remove & Dispose of Four 15-Ton Overhead Crane Motors - hoist						
Quantity	: 1.00 EA						
Daily Production	: 8.00 EA per 8 hour shift		Project #	: 2			
Work Days	: 0.1 Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $959.54 per EA		Probable Low Cost Parameter		8.8	$864	$863.58
Total Cost	: $960		Probable High Cost Parameter		6.4	$1,151	$1,151.45

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.1	8	0.80	E	$111.64	incl. in rate	incl. in rate	$89.31
Hydraulic Crane (17tn)	Active	1.00	0.1	8	0.80	E	$81.52	incl. in rate	incl. in rate	$65.22
Laborer	Active	2.00	0.1	8	1.60	L	$45.80	incl. in rate	incl. in rate	$73.28
Equipment Operator (crane)	Active	1.00	0.1	8	0.80	L	$68.41	incl. in rate	incl. in rate	$54.73
Truck Driver (heavy)	Active	1.00	0.1	8	0.80	L	$57.59	incl. in rate	incl. in rate	$46.07

Labor Hours	3.2	TOTAL LABOR	$174.08
Equipment Hours	1.6	TOTAL EQUIPMENT	$154.53

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$8.70	$8.70

TOTAL MATERIAL	$8.70

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Disposal fee	1	EA	1.000	1.00 $500.00	$500.00

TOTAL SUBCONTRACTS	$500.00

SUMMARY OF COSTS

Labor Cost	$174.08	Labor Burden @	49.7%	$0.00	$174.08
Material Cost	$8.70	Material Tax @	7.8%	$0.67	$9.38
Equipment Cost	$154.53	Equipment Tax @	0.0%	$0.00	$154.53
Subcontractors	$500.00				$500.00
DIRECT COST SUBTOTALS	$837			$1	DIRECT COST SUBTOTALS $838

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$337.99	$50.70
Installing Contractors Profit@	8.0%				$337.99	$27.04
GC Markup on Subs @	5.0%				$500.00	$25.00
					TOTAL MARKUP COSTS	$102.74
General Contractors Insurance @	1.0%		on		$940.72	$9
Bond @	1.0%		on		$940.72	$9
Contingency @	0.0%		on		$959.54	$0
					TOTAL COST for pay item	$960

Additional Pay Item Notes :

Assumed removal of hoist, hoist trolley, gantry: 2 Laborers to load the overhead crane motors in the truck using the crane.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.052	Project	: COPCO 1				
Description	:	Remove & Dispose of 15-Ton Overhead Crane control equipment						
Quantity	:	1.00 EA						
Daily Production	:	3.00 EA per 8 hour shift	Project #	: 2				
Work Days	:	0.3 Days	Estimator	: Mihaela Tomulescu		EA per	Total Cost	Unit Price Per EA
Unit Price	:	$434.20 per EA	Probable Low Cost Parameter			3.3	$391	$390.78
Total Cost	:	$434	Probable High Cost Parameter			2.55	$499	$499.33

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Laborer	Active	2.00	0.3	8	4.80	L	$45.80	incl. in rate	incl. in rate	$219.84
Electrician	Active	1.00	0.3	8	2.40	L	$45.23	incl. in rate	incl. in rate	$108.55

Labor Hours	7.2	TOTAL LABOR	$328.39
Equipment Hours	0	TOTAL EQUIPMENT	$0.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$16.42	$16.42

TOTAL MATERIAL	$16.42

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$328.39	Labor Burden @	49.7%	$0.00		$328.39
Material Cost	$16.42	Material Tax @	7.8%	$1.27		$17.69
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00		$0.00
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$345			$1	DIRECT COST SUBTOTALS	$346

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$346.08	$51.91
Installing Contractors Profit@	8.0%				$346.08	$27.69
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$79.60
General Contractors Insurance @	1.0%		on		$425.68	$4
Bond @	1.0%		on		$425.68	$4
Contingency @	0.0%		on		$434.20	$0
					TOTAL COST for pay item	$434

Additional Pay Item Notes :

Assumed 1 cubicle: 1 Laborers and 1 Electrician. Using the same truck, loader, crane as the ones used to load at the end of the day the overhead crane cable and motors.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.053		Project	: COPCO 1				
Description	: Remove & Dispose of 15-Ton Overhead Crane Festoon Cable							
Quantity	: 1.00 EA							
Daily Production	: 2.00 EA per	8 hour shift	Project #	: 2				
Work Days	: 0.5 Days		Estimator	: Mihaela Tomulescu		EA per	Total Cost	Unit Price Per EA
Unit Price	: $637.49 per EA		Probable Low Cost Parameter			2.2	$574	$573.74
Total Cost	: $637		Probable High Cost Parameter			1.7	$733	$733.12

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.1	8	0.40	E	$111.64	incl. in rate	incl. in rate	$44.66
Truck Driver (heavy)	Active	1.00	0.1	8	0.40	L	$57.59	incl. in rate	incl. in rate	$23.04
Laborer	Active	2.00	0.5	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Loader, FE Rubber Tire (3.5cy)	Active	1.00	0.1	8	0.40	E	$64.23	incl. in rate	incl. in rate	$25.69
Equipment Operator (light)	Active	1.00	0.1	8	0.40	L	$64.90	incl. in rate	incl. in rate	$25.96

Labor Hours	8.8	TOTAL LABOR	$415.40
Equipment Hours	0.8	TOTAL EQUIPMENT	$70.35

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$20.77	$20.77

TOTAL MATERIAL	$20.77

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$415.40	Labor Burden @	49.7%	$0.00		$415.40
Material Cost	$20.77	Material Tax @	7.8%	$1.61		$22.38
Equipment Cost	$70.35	Equipment Tax @	0.0%	$0.00		$70.35
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$507			$2	DIRECT COST SUBTOTALS	$508

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$508.12	$76.22
Installing Contractors Profit@	8.0%				$508.12	$40.65
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$116.87
General Contractors Insurance @	1.0%		on		$624.99	$6
Bond @	1.0%		on		$624.99	$6
Contingency @	0.0%		on		$637.49	$0
					TOTAL COST for pay item	$637

Additional Pay Item Notes :

Assumed 100 LF of cable will be removed: 2 Laborers will load in the truck with the loader the overhead crane cable.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.053.a			Project	: COPCO1			
Description	:	Remove petroleum products from mechanical equipment							
Quantity	:	10,500.00	GAL						
Daily Production	:	550.00	GAL per	8 hour shift	Project #	: 2			
Work Days	:	19.1	Days		Estimator	: Mihaela Tomulescu	GAL per	Total Cost	Unit Price Per GAL
Unit Price	:	$10.39	per GAL		Probable Low Cost Parameter		605	$98,204	$9.35
Total Cost	:	$109,116			Probable High Cost Parameter		467.5	$125,483	$11.95

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	19.1	8	152.80	L	$46.27	incl. in rate	incl. in rate	$7,070.06
Electrician	Active	1.00	19.1	8	152.80	L	$45.23	incl. in rate	incl. in rate	$6,911.14
Laborer	Active	5.00	19.1	8	764.00	L	$45.80	incl. in rate	incl. in rate	$34,991.20
Truck Driver (heavy)	Active	1.00	19.1	8	152.80	L	$57.59	incl. in rate	incl. in rate	$8,799.75

Labor Hours	1222.4	TOTAL LABOR	$57,772.15
Equipment Hours	0	TOTAL EQUIPMENT	$0.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (filters, pads, etc)	1.00	LS	1.000	1.00	$2,888.61	$2,888.61
				TOTAL MATERIAL		$2,888.61

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, liquid pickup, vacuum truck, stainless steel tank, 5000 gallons, minimum charge, 4 hours, 2 compartment	152.80	hour	1.000	$200.00	$30,560.00
				TOTAL SUBCONTRACTS	$30,560.00

SUMMARY OF COSTS

Labor Cost	$57,772.15	Labor Burden @	49.7%	$0.00		$57,772.15
Material Cost	$2,888.61	Material Tax @	7.8%	$223.87		$3,112.47
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00		$0.00
Subcontractors	$30,560.00					$30,560.00
DIRECT COST SUBTOTALS	$91,221			$224	DIRECT COST SUBTOTALS	$91,445

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$60,884.63	$9,132.69
Installing Contractors Profit@	8.0%				$60,884.63	$4,870.77
GC Markup on Subs @	5.0%				$30,560.00	$1,528.00
					TOTAL MARKUP COSTS	$15,531.46
General Contractors Insurance @	1.0%		on		$106,976.09	$1,070
Bond @	1.0%		on		$106,976.09	$1,070
Contingency @	0.0%		on		$109,115.61	$0
					TOTAL COST for pay item	$109,116

Additional Pay Item Notes :

Petroleum-based products, ranging from fuel oil and hydraulic fluid to lubricating greases and oils, are found throughout every type of power generating plant or system. Lubrication supports bearings and moving parts in all sorts of equipment: pumps, conveyors, feeders, scrubbers, cranes, turbines, and more.A good oil/water separation system will result in a flow of concentrated waste oil to a collection area and a flow of oil free water ready for secondary processing or discharge. Once an oil layer has been separated from free water, it must be removed for recycling or disposal. Many plants use one or more of these oil removal methods, but each has costly limitations:

1. Absorbent materials. Absorbent mats or materials are frequently used to dam up and absorb excess oils and greases resulting from accidents or the routine operation of machinery. These materials are very effective for preventing the spread of a source leak and very efficient in terms of oil pickup. Yet, their use on large volumes of waste oil results in multiple, recurring costs that can make them impractical as an everyday solution:

- the costs of the materials themselves
- the labor costs for ordering, stocking, application, and removal
- the costs of used-media collection, disposal, or re-processing/recycling.

2. Manually operated “slotted pipes.” Many separators feature a “slotted pipe,” a pipe located near the top of the vessel that has a horizontal opening. Oil is removed by turning the horizontal opening downward until it meets the floating oil layer, which drains through the pipe to a collection receptacle. These pipes work well on thick layers of oil, but cannot drain off a sheen of oil without draining off a large amount of water as well.

AECOM assumed the best is Vacuum truck removal method .Used a crew formed of 1 Forman, 5 Laborers to takeout the petroleum waste, 1 Electrician to unplug the power and to assure the temporaty power at the contruction site. Vacuum-equipped tank trucks are used to remove waste oil from collection points at plants so that it can be transported to recycling or disposal locations. If the waste oil has been thoroughly separated, highly concentrated, and stored in an appropriate receptacle, this service can be used very efficiently. However, vacuum disposal units are often used to pump oil layers directly off of water. This results in the intake of a significant amount free water along with the waste oil – and a significantly higher cost.

PAY ITEM COST DETAIL WORKSHEET — **2.054 Remove & Dispose of 69kV circuit breakers, oil filled, PCB**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.054		**Project**	: COPCO 1			
Description	:	Remove & Dispose of 69kV circuit breakers, oil filled, PCB						
Quantity	:	2.00 EA						
Daily Production	:	2.00 EA per	8 hour shift	**Project #**	: 2			
Work Days	:	1.0 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$861.46 per EA		**Probable Low Cost Parameter**		**2.2**	**$1,551**	**$775.31**
Total Cost	:	$1,723		**Probable High Cost Parameter**		**1.8**	**$1,895**	**$947.61**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Hydraulic Crane (35tn)	Active	1.00	0.2	8	1.60	E	$116.30	incl. in rate	incl. in rate	$186.08
Equipment Operator (crane)	Active	1.00	0.2	8	1.60	L	$68.41	incl. in rate	incl. in rate	$109.46
Laborer	Active	2.00	0.2	8	3.20	L	$45.80	incl. in rate	incl. in rate	$146.56
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	0.2	8	1.60	E	$31.90	incl. in rate	incl. in rate	$51.04
Truck Driver (light)	Active	1.00	0.2	8	1.60	L	$56.29	incl. in rate	incl. in rate	$90.06
				Labor Hours	**22.4**			**TOTAL LABOR**		**$1,078.08**
				Equipment Hours	**3.2**			**TOTAL EQUIPMENT**		**$237.12**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$53.90	$53.90
					TOTAL MATERIAL	**$53.90**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,078.08	Labor Burden @	49.7%	$0.00		$1,078.08
Material Cost	$53.90	Material Tax @	7.8%	$4.18		$58.08
Equipment Cost	$237.12	Equipment Tax @	0.0%	$0.00		$237.12
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,369**			**$4**	**DIRECT COST SUBTOTALS**	**$1,373**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,373.28	$205.99
Installing Contractors Profit@	8.0%				$1,373.28	$109.86
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$315.85**
General Contractors Insurance @	1.0%		on		$1,689.14	$17
Bond @	1.0%		on		$1,689.14	$17
Contingency @	0.0%		on		$1,722.92	$0
					TOTAL COST for pay item	**$1,723**

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician,1Crane. Considered 1 laborer to help loading circuit breakers from the swichyard in the truck for saving it in the designated place.

PAY ITEM COST DETAIL WORKSHEET — **2.055 Remove & Dispose of 69kV disconnect switches, group-operated**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.055	**Project**	:	COPCO 1			
Description	:	Remove & Dispose of 69kV disconnect switches, group-operated						
Quantity	:	2.00 EA						
Daily Production	:	2.00 EA per 8 hour shift	**Project #**	:	2			
Work Days	:	1.0 Days	**Estimator**	:	Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$861.46 per EA	**Probable Low Cost Parameter**			**2.2**	**$1,551**	**$775.31**
Total Cost	:	$1,723	**Probable High Cost Parameter**			**1.8**	**$1,895**	**$947.61**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Hydraulic Crane (35tn)	Active	1.00	0.2	8	1.60	E	$116.30	incl. in rate	incl. in rate	$186.08
Equipment Operator (crane)	Active	1.00	0.2	8	1.60	L	$68.41	incl. in rate	incl. in rate	$109.46
Laborer	Active	2.00	0.2	8	3.20	L	$45.80	incl. in rate	incl. in rate	$146.56
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	0.2	8	1.60	E	$31.90	incl. in rate	incl. in rate	$51.04
Truck Driver (light)	Active	1.00	0.2	8	1.60	L	$56.29	incl. in rate	incl. in rate	$90.06

Labor Hours	**22.4**	**TOTAL LABOR**	**$1,078.08**
Equipment Hours	**3.2**	**TOTAL EQUIPMENT**	**$237.12**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$53.90	$53.90

TOTAL MATERIAL	**$53.90**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,078.08	Labor Burden @	49.7%	$0.00		$1,078.08
Material Cost	$53.90	Material Tax @	7.8%	$4.18		$58.08
Equipment Cost	$237.12	Equipment Tax @	0.0%	$0.00		$237.12
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,369**			**$4**	**DIRECT COST SUBTOTALS**	**$1,373**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,373.28		$205.99
Installing Contractors Profit@	8.0%				$1,373.28		$109.86
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$315.85**
General Contractors Insurance @	1.0%		on		$1,689.14		$17
Bond @	1.0%		on		$1,689.14		$17
Contingency @	0.0%		on		$1,722.92		$0
						TOTAL COST for pay item	**$1,723**

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician,1Crane. Considered 1 laborer to help loading circuit breakers from the swichyard in the truck for saving it in the designated place.

PAY ITEM COST DETAIL WORKSHEET

2.056 Remove & Dispose of 60-foot wood poles

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.056			**Project**	: COPCO 1			
Description	:	Remove & Dispose of 60-foot wood poles							
Quantity	:	12.00	EA						
Daily Production	:	5.00	EA per	8 hour shift	**Project #**	: 2			
Work Days	:	2.4	Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$1,296.96	per EA		**Probable Low Cost Parameter**		**5.75**	**$13,229**	**$1,102.41**
Total Cost	:	$15,563			**Probable High Cost Parameter**		**4**	**$18,676**	**$1,556.35**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.4	8	19.20	L	$46.27	incl. in rate	incl. in rate	$888.38
Electrician	Active	1.00	2.4	8	19.20	L	$45.23	incl. in rate	incl. in rate	$868.42
Hydraulic Crane (17tn)	Active	1.00	2.4	8	19.20	E	$81.52	incl. in rate	incl. in rate	$1,565.18
Equipment Operator (medium)	Active	1.00	2.4	8	19.20	L	$66.28	incl. in rate	incl. in rate	$1,272.58
Truck Driver (heavy)	Active	1.00	2.4	8	19.20	L	$57.59	incl. in rate	incl. in rate	$1,105.73
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.4	8	19.20	E	$111.64	incl. in rate	incl. in rate	$2,143.49
Laborer	Active	2.00	2.4	8	38.40	L	$45.80	incl. in rate	incl. in rate	$1,758.72
Vibratory Hammer & Extractor	Active	1.00	2.4	8	19.20	E	$94.34	incl. in rate	incl. in rate	$1,811.33
Truck, Utility, with Man-Basket	Active	1.00	2.4	8	19.20	E	$31.90	incl. in rate	incl. in rate	$612.48

Labor Hours	**115.2**	**TOTAL LABOR**	**$5,893.82**
Equipment Hours	**76.8**	**TOTAL EQUIPMENT**	**$6,132.48**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$294.69	$294.69
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	12.00	CY	1.000	12.00	$4.74	$56.88

TOTAL MATERIAL	**$351.57**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$5,893.82	Labor Burden @	49.7%	$0.00	$5,893.82
Material Cost	$351.57	Material Tax @	7.8%	$27.25	$378.82
Equipment Cost	$6,132.48	Equipment Tax @	0.0%	$0.00	$6,132.48
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$12,378**			**$27**	**DIRECT COST SUBTOTALS** **$12,405**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$12,405.12	$1,860.77
Installing Contractors Profit@	8.0%				$12,405.12	$992.41
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$2,853.18**
General Contractors Insurance @	1.0%		on		$15,258.30	$153
Bond @	1.0%		on		$15,258.30	$153
Contingency @	0.0%		on		$15,563.47	$0
					TOTAL COST for pay item	**$15,563**

Additional Pay Item Notes :

Production is based off of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane and 1 man-basket truck to help untie the line. Considered 2 laborer and 1 Vibratory Hammer for demolish the pole foundation, helping placing poles in a designated place and loading them in the truck for disposal. This process includes filling in pole locations with gravel, clean fill and topsoil.

PAY ITEM COST DETAIL WORKSHEET

2.057 Remove & Dispose of 30-foot wood cross arms

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.057		**Project**	: COPCO 1			
Description	:	Remove & Dispose of 30-foot wood cross arms						
Quantity	:	24.00 EA						
Daily Production	:	24.00 EA per	8 hour shift	**Project #**	: 2			
Work Days	:	1.0 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$484.41 per EA		**Probable Low Cost Parameter**		**27.6**	**$9,882**	**$411.75**
Total Cost	:	$11,626		**Probable High Cost Parameter**		**19.2**	**$13,951**	**$581.30**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Hydraulic Crane (17tn)	Active	1.00	1.0	8	8.00	E	$81.52	incl. in rate	incl. in rate	$652.16
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Truck Driver (heavy)	Active	1.00	5.0	8	40.00	L	$57.59	incl. in rate	incl. in rate	$2,303.60
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	5.0	8	40.00	E	$111.64	incl. in rate	incl. in rate	$4,465.60

Labor Hours	**72**	**TOTAL LABOR**	**$3,936.80**
Equipment Hours	**48**	**TOTAL EQUIPMENT**	**$5,117.76**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$196.84	$196.84

TOTAL MATERIAL	**$196.84**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$3,936.80	Labor Burden @	49.7%	$0.00	$3,936.80
Material Cost	$196.84	Material Tax @	7.8%	$15.26	$212.10
Equipment Cost	$5,117.76	Equipment Tax @	0.0%	$0.00	$5,117.76
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$9,251**			**$15**	**DIRECT COST SUBTOTALS** **$9,267**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$9,266.66	$1,390.00
Installing Contractors Profit@	8.0%				$9,266.66	$741.33
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$2,131.33**
General Contractors Insurance @	1.0%		on		$11,397.99	$114
Bond @	1.0%		on		$11,397.99	$114
Contingency @	0.0%		on		$11,625.95	$0
					TOTAL COST for pay item	**$11,626**

Additional Pay Item Notes :

Production is based off of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane and 1 truck to dispose the cross arms.

PAY ITEM COST DETAIL WORKSHEET

2.058 Remove & Dispose of 69-kV insulator strings

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.058	**Project**	:	COPCO 1			
Description	:	Remove & Dispose of 69-kV insulator strings						
Quantity	:	12.00 EA						
Daily Production	:	6.00 EA per 8 hour shift	**Project #**	:	2			
Work Days	:	2.0 Days	**Estimator**	:	Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$372.92 per EA	**Probable Low Cost Parameter**			**6.9**	**$3,804**	**$316.98**
Total Cost	:	$4,475	**Probable High Cost Parameter**			**4.8**	**$5,370**	**$447.50**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	incl. in rate	incl. in rate	$740.32
Laborer	Active	2.00	2.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Truck, Pickup (4x4, 3/4tn)	Active	1.00	2.0	8	16.00	E	$16.94	incl. in rate	incl. in rate	$271.04

Labor Hours	**64**	**TOTAL LABOR**	**$3,127.36**
Equipment Hours	**16**	**TOTAL EQUIPMENT**	**$271.04**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$156.37	$156.37

TOTAL MATERIAL	**$156.37**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$3,127.36	Labor Burden @	49.7%	$0.00		$3,127.36
Material Cost	$156.37	Material Tax @	7.8%	$12.12		$168.49
Equipment Cost	$271.04	Equipment Tax @	0.0%	$0.00		$271.04
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$3,555**			**$12**	**DIRECT COST SUBTOTALS**	**$3,567**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$3,566.89		$535.03
Installing Contractors Profit@	8.0%				$3,566.89		$285.35
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$820.38**
General Contractors Insurance @	1.0%		on		$4,387.27		$44
Bond @	1.0%		on		$4,387.27		$44
Contingency @	0.0%		on		$4,475.02		$0
						TOTAL COST for pay item	**$4,475**

Additional Pay Item Notes :

Production is based off of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane and 1 truck to dispose the insulator strings.

PAY ITEM COST DETAIL WORKSHEET

2.059 Remove & Dispose of Transmission Line No. 3

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.059	**Project**	:	COPCO 1			
Description	:	Remove & Dispose of Transmission Line No. 3						
Quantity	:	1.66 MILE						
Daily Production	:	0.50 MILE per 8 hour shift	**Project #**	:	2			
Work Days	:	3.3 Days	**Estimator**	:	Mihaela Tomulescu	**MILE per**	**Total Cost**	**Unit Price Per MILE**
Unit Price	:	$31,411.84 per MILE	**Probable Low Cost Parameter**			**0.575**	**$44,322**	**$26,700.06**
Total Cost	:	$52,144	**Probable High Cost Parameter**			**0.375**	**$65,180**	**$39,264.80**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	3.3	8	26.56	L	$47.23	incl. in rate	incl. in rate	$1,254.43
Electrician	Active	2.00	3.3	8	53.12	L	$45.23	incl. in rate	incl. in rate	$2,402.62
Truck, Utility, with Man-Basket	Active	2.00	3.3	8	53.12	E	$31.90	incl. in rate	incl. in rate	$1,694.53
Truck Driver (heavy)	Active	4.00	3.3	8	106.24	L	$57.59	incl. in rate	incl. in rate	$6,118.36
Laborer	Active	2.00	3.3	8	53.12	L	$45.80	incl. in rate	incl. in rate	$2,432.90
Hydraulic Excavator (2.5cy)	Active	1.00	3.3	8	26.56	E	$203.63	incl. in rate	incl. in rate	$5,408.41
Hydraulic Crane (80tn)	Active	1.00	3.3	8	26.56	E	$190.46	incl. in rate	incl. in rate	$5,058.62
Equipment Operator (crane)	Active	1.00	3.3	8	26.56	L	$68.41	incl. in rate	incl. in rate	$1,816.97
Equipment Operator (light)	Active	1.00	3.3	8	26.56	L	$64.90	incl. in rate	incl. in rate	$1,723.74
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	3.3	8	26.56	E	$62.72	incl. in rate	incl. in rate	$1,665.84
Truck, Flatbed (4x4, 10,000 gvw)	Active	3.00	3.3	8	79.68	E	$31.90	incl. in rate	incl. in rate	$2,541.79

Labor Hours	**292.16**	**TOTAL LABOR**	**$15,749.02**
Equipment Hours	**212.48**	**TOTAL EQUIPMENT**	**$16,369.19**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$787.45	$787.45
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	31.00	CY	1.000	31.00	$4.74	$146.94

TOTAL MATERIAL	**$934.39**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	3.32	days		$3,000.00	$9,960.00

TOTAL SUBCONTRACTS	**$9,960.00**

SUMMARY OF COSTS

Labor Cost	$15,749.02	Labor Burden @	49.7%	$0.00		$15,749.02
Material Cost	$934.39	Material Tax @	7.8%	$72.42		$1,006.81
Equipment Cost	$16,369.19	Equipment Tax @	0.0%	$0.00		$16,369.19
Subcontractors	$9,960.00					$9,960.00
DIRECT COST SUBTOTALS	**$43,013**			**$72**	**DIRECT COST SUBTOTALS**	**$43,085**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$33,125.02		$4,968.75
Installing Contractors Profit@	8.0%				$32,118.21		$2,569.46
GC Markup on Subs @	5.0%				$9,960.00		$498.00
						TOTAL MARKUP COSTS	**$8,036.21**
General Contractors Insurance @	1.0%		on		$51,121.23		$511
Bond @	1.0%		on		$51,121.23		$511
Contingency @	0.0%		on		$52,143.65		$0
						TOTAL COST for pay item	**$52,144**

Additional Pay Item Notes :

When a transmission line is decommissioned and is not converted to another use, the decommissioning typically includes the removal of all infrastructure if it is no longer required, or has reached end-of-life conditions. Removed parts will be re-used, recycled or disposed. Production is based off of RSMs using Crew B-1C and B-3 (1 Forman, 2 laborer, 1 Excavator & 1 crane for lift, position and load in the truck, 1 Hydraulic rock-splitting/rock-drilling equipment to break equipment foundations and concrete for demo :2 Electrician,, 1 utility truck to access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, hydro plant and switchyard. Transmission line poles or structures are 60 feet tall. There are several different kinds of transmission structures. Transmission structures are constructed of wood. They can be single-poled or multi-poled. They can be single-circuited, carrying one set of transmission lines or double-circuited with two sets of lines. Pole height and load capacity limitations determine the distance between poles (span length) either on the basis of ground clearance or ability to support heavy wind and ice loads. Assumed average span between structures to be 275 feet so for 1.66 miles of overhead transmission we will have approximately 31 structures. In areas where single-pole structures are preferred, weak or wet soils may require concrete foundations for support. Where a transmission line must cross a street or slightly change direction, larger angle structures or guy wires may be required. Poles with guy wires impact a much larger area. Angle structures are usually more than double the diameter of other steel poles. They are made of steel, usually five to six feet in diameter, and have a large concrete base. The base may be buried ten or more feet below the ground surface. The diameter of the pole and the depth the base is buried depends on the condition of the soils and the voltage of the line. Assumed the structures are disposed to Yreka recycling, 36 miles away.This estimate is made as the best AECOM assumption, as actual pricing would occur during the detailed engineering and construction bid process.

PAY ITEM COST DETAIL WORKSHEET

2.060 Remove & Dispose of Transmission Line No. 15

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.060			**Project**	: COPCO 1			
Description	:	Remove & Dispose of Transmission Line No. 15							
Quantity	:	1.33	MILE						
Daily Production	:	0.50	MILE per	8 hour shift	**Project #**	: 2			
Work Days	:	2.7	Days		**Estimator**	: Mihaela Tomulescu	**MILE per**	**Total Cost**	**Unit Price Per MILE**
Unit Price	:	$31,417.08	per MILE		**Probable Low Cost Parameter**		**0.575**	**$35,517**	**$26,704.51**
Total Cost	:	$41,785			**Probable High Cost Parameter**		**0.375**	**$52,231**	**$39,271.34**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	2.7	8	21.28	L	$47.23	incl. in rate	incl. in rate	$1,005.05
Electrician	Active	2.00	2.7	8	42.56	L	$45.23	incl. in rate	incl. in rate	$1,924.99
Truck, Utility, with Man-Basket	Active	2.00	2.7	8	42.56	E	$31.90	incl. in rate	incl. in rate	$1,357.66
Truck Driver (heavy)	Active	4.00	2.7	8	85.12	L	$57.59	incl. in rate	incl. in rate	$4,902.06
Laborer	Active	2.00	2.7	8	42.56	L	$45.80	incl. in rate	incl. in rate	$1,949.25
Hydraulic Excavator (2.5cy)	Active	1.00	2.7	8	21.28	E	$203.63	incl. in rate	incl. in rate	$4,333.25
Hydraulic Crane (80tn)	Active	1.00	2.7	8	21.28	E	$190.46	incl. in rate	incl. in rate	$4,052.99
Equipment Operator (crane)	Active	1.00	2.7	8	21.28	L	$68.41	incl. in rate	incl. in rate	$1,455.76
Equipment Operator (light)	Active	1.00	2.7	8	21.28	L	$64.90	incl. in rate	incl. in rate	$1,381.07
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	2.7	8	21.28	E	$62.72	incl. in rate	incl. in rate	$1,334.68
Truck, Flatbed (4x4, 10,000 gvw)	Active	3.00	2.7	8	63.84	E	$31.90	incl. in rate	incl. in rate	$2,036.50

Labor Hours	**234.08**	**TOTAL LABOR**	**$12,618.19**
Equipment Hours	**170.24**	**TOTAL EQUIPMENT**	**$13,115.08**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$630.91	$630.91
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	26.00	CY	1.000	26.00	$4.74	$123.24

TOTAL MATERIAL	**$754.15**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	2.66	days		$3,000.00	$7,980.00

TOTAL SUBCONTRACTS	**$7,980.00**

SUMMARY OF COSTS

Labor Cost	$12,618.19	Labor Burden @	49.7%	$0.00	$12,618.19
Material Cost	$754.15	Material Tax @	7.8%	$58.45	$812.60
Equipment Cost	$13,115.08	Equipment Tax @	0.0%	$0.00	$13,115.08
Subcontractors	$7,980.00				$7,980.00
DIRECT COST SUBTOTALS	**$34,467**			**$58**	**DIRECT COST SUBTOTALS** **$34,526**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$26,545.86	$3,981.88
Installing Contractors Profit@	8.0%				$25,733.27	$2,058.66
GC Markup on Subs @	5.0%				$7,980.00	$399.00
					TOTAL MARKUP COSTS	**$6,439.54**
General Contractors Insurance @	1.0%		on		$40,965.40	$410
Bond @	1.0%		on		$40,965.40	$410
Contingency @	0.0%		on		$41,784.71	$0
					TOTAL COST for pay item	**$41,785**

Additional Pay Item Notes :

When a transmission line is decommissioned and is not converted to another use, the decommissioning typically includes the removal of all infrastructure if it is no longer required, or has reached end-of-life conditions. Removed parts will be re-used, recycled or disposed. Production is based off of RSMs using Crew B-1C and B-3 (1 Forman, 2 laborer, 1 Excavator & 1 crane for lift, position and load in the truck, 1 Hydraulic rock-splitting/rock-drilling equipment to break equipment foundations and concrete for demo :2 Electrician,, 1 utility truck to access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, hydro plant and switchyard. Transmission line poles or structures are 60 feet tall. There are several different kinds of transmission structures. Transmission structures are constructed of wood. They can be single-poled or multi-poled. They can be single-circuited, carrying one set of transmission lines or double-circuited with two sets of lines. Pole height and load capacity limitations determine the distance between poles (span length) either on the basis of ground clearance or ability to support heavy wind and ice loads. Assumed average span between structures to be 275 feet so for 1.33 miles of overhead transmission we will have approximately 26 structures. In areas where single-pole structures are preferred, weak or wet soils may require concrete foundations for support. Where a transmission line must cross a street or slightly change direction, larger angle structures or guy wires may be required. Poles with guy wires impact a much larger area. Angle structures are usually more than double the diameter of other steel poles. They are made of steel, usually five to six feet in diameter, and have a large concrete base. The base may be buried ten or more feet below the ground surface. The diameter of the pole and the depth the base is buried depends on the condition of the soils and the voltage of the line. Assumed the structures are disposed to Yreka recycling, 36 miles away.This estimate is made as the best AECOM assumption, as actual pricing would occur during the detailed engineering and construction bid process.

PAY ITEM COST DETAIL WORKSHEET

2.061 Remove & Dispose of Transmission Line No. 26-1

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.061	**Project**	:	COPCO 1			
Description	:	Remove & Dispose of Transmission Line No. 26-1						
Quantity	:	0.07 MILE						
Daily Production	:	0.50 MILE per 8 hour shift	**Project #**	:	2			
Work Days	:	0.1 Days	**Estimator**	:	Mihaela Tomulescu	**MILE per**	**Total Cost**	**Unit Price Per MILE**
Unit Price	:	$33,525.16 per MILE	**Probable Low Cost Parameter**			**0.575**	**$1,995**	**$28,496.39**
Total Cost	:	$2,347	**Probable High Cost Parameter**			**0.375**	**$2,933**	**$41,906.45**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	0.1	8	1.12	L	$47.23	incl. in rate	incl. in rate	$52.90
Electrician	Active	2.00	0.1	8	2.24	L	$45.23	incl. in rate	incl. in rate	$101.32
Truck, Utility, with Man-Basket	Active	2.00	0.1	8	2.24	E	$31.90	incl. in rate	incl. in rate	$71.46
Truck Driver (heavy)	Active	4.00	0.1	8	4.48	L	$57.59	incl. in rate	incl. in rate	$258.00
Laborer	Active	2.00	0.1	8	2.24	L	$45.80	incl. in rate	incl. in rate	$102.59
Hydraulic Excavator (2.5cy)	Active	1.00	0.1	8	1.12	E	$203.63	incl. in rate	incl. in rate	$228.07
Hydraulic Crane (80tn)	Active	1.00	0.1	8	1.12	E	$190.46	incl. in rate	incl. in rate	$213.32
Equipment Operator (crane)	Active	1.00	0.1	8	1.12	L	$68.41	incl. in rate	incl. in rate	$76.62
Equipment Operator (light)	Active	1.00	0.1	8	1.12	L	$64.90	incl. in rate	incl. in rate	$72.69
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	0.1	8	1.12	E	$62.72	incl. in rate	incl. in rate	$70.25
Truck, Flatbed (4x4, 10,000 gvw)	Active	3.00	0.1	8	3.36	E	$31.90	incl. in rate	incl. in rate	$107.18

Labor Hours	**12.32**	**TOTAL LABOR**	**$664.12**
Equipment Hours	**8.96**	**TOTAL EQUIPMENT**	**$690.27**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$33.21	$33.21
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	26.00	CY	1.000	26.00	$4.74	$123.24

TOTAL MATERIAL	**$156.45**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	0.14	days		$3,000.00	$420.00

TOTAL SUBCONTRACTS	**$420.00**

SUMMARY OF COSTS

Labor Cost	$664.12	Labor Burden @	49.7%	$0.00		$664.12
Material Cost	$156.45	Material Tax @	7.8%	$12.12		$168.57
Equipment Cost	$690.27	Equipment Tax @	0.0%	$0.00		$690.27
Subcontractors	$420.00					$420.00
DIRECT COST SUBTOTALS	**$1,931**			**$12**	**DIRECT COST SUBTOTALS**	**$1,943**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,522.95	$228.44
Installing Contractors Profit@	8.0%				$1,354.38	$108.35
GC Markup on Subs @	5.0%				$420.00	$21.00
					TOTAL MARKUP COSTS	**$357.79**
General Contractors Insurance @	1.0%		on		$2,300.75	$23
Bond @	1.0%		on		$2,300.75	$23
Contingency @	0.0%		on		$2,346.76	$0
					TOTAL COST for pay item	**$2,347**

Additional Pay Item Notes :

When a transmission line is decommissioned and is not converted to another use, the decommissioning typically includes the removal of all infrastructure if it is no longer required, or has reached end-of-life conditions. Removed parts will be re-used, recycled or disposed. Production is based off of RSMs using Crew B-1C and B-3 (1 Forman, 2 laborer, 1 Excavator & 1 crane for lift, position and load in the truck, 1 Hydraulic rock-splitting/rock-drilling equipment to break equipment foundations and concrete for demo :2 Electrician,, 1 utility truck to access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, hydro plant and switchyard. Transmission line poles or structures are 60 feet tall. There are several different kinds of transmission structures. Transmission structures are constructed of wood. They can be single-poled or multi-poled. They can be single-circuited, carrying one set of transmission lines or double-circuited with two sets of lines. Pole height and load capacity limitations determine the distance between poles (span length) either on the basis of ground clearance or ability to support heavy wind and ice loads. Assumed average span between structures to be 275 feet so for 0.07 miles of overhead transmission we will have aproximately 2 structures. In areas where single-pole structures are preferred, weak or wet soils may require concrete foundations for support. Where a transmission line must cross a street or slightly change direction, larger angle structures or guy wires may be required. Poles with guy wires impact a much larger area. Angle structures are usually more than double the diameter of other steel poles. They are made of steel, usually five to six feet in diameter, and have a large concrete base. The base may be buried ten or more feet below the ground surface. The diameter of the pole and the depth the base is buried depends on the condition of the soils and the voltage of the line. Assumed the structures are disposed to Yreka recycling, 36 miles away.This estimate is made as the best AECOM assumption, as actual pricing would occur during the detailed engineering and construction bid process.

PAY ITEM COST DETAIL WORKSHEET — **2.062 Remove & Dispose of Transmission Line No. 26-2**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.062	**Project**	:	COPCO 1			
Description	:	Remove & Dispose of Transmission Line No. 26-2						
Quantity	:	0.07 MILE						
Daily Production	:	0.50 MILE per 8 hour shift	**Project #**	:	2			
Work Days	:	0.1 Days	**Estimator**	:	Mihaela Tomulescu	**MILE per**	**Total Cost**	**Unit Price Per MILE**
Unit Price	:	$33,525.16 per MILE	**Probable Low Cost Parameter**			**0.575**	**$1,995**	**$28,496.39**
Total Cost	:	$2,347	**Probable High Cost Parameter**			**0.375**	**$2,933**	**$41,906.45**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	0.1	8	1.12	L	$47.23	incl. in rate	incl. in rate	$52.90
Electrician	Active	2.00	0.1	8	2.24	L	$45.23	incl. in rate	incl. in rate	$101.32
Truck, Utility, with Man-Basket	Active	2.00	0.1	8	2.24	E	$31.90	incl. in rate	incl. in rate	$71.46
Truck Driver (heavy)	Active	4.00	0.1	8	4.48	L	$57.59	incl. in rate	incl. in rate	$258.00
Laborer	Active	2.00	0.1	8	2.24	L	$45.80	incl. in rate	incl. in rate	$102.59
Hydraulic Excavator (2.5cy)	Active	1.00	0.1	8	1.12	E	$203.63	incl. in rate	incl. in rate	$228.07
Hydraulic Crane (80tn)	Active	1.00	0.1	8	1.12	E	$190.46	incl. in rate	incl. in rate	$213.32
Equipment Operator (crane)	Active	1.00	0.1	8	1.12	L	$68.41	incl. in rate	incl. in rate	$76.62
Equipment Operator (light)	Active	1.00	0.1	8	1.12	L	$64.90	incl. in rate	incl. in rate	$72.69
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	0.1	8	1.12	E	$62.72	incl. in rate	incl. in rate	$70.25
Truck, Flatbed (4x4, 10,000 gvw)	Active	3.00	0.1	8	3.36	E	$31.90	incl. in rate	incl. in rate	$107.18

Labor Hours	**12.32**	**TOTAL LABOR**	**$664.12**
Equipment Hours	**8.96**	**TOTAL EQUIPMENT**	**$690.27**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$33.21	$33.21
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	26.00	CY	1.000	26.00	$4.74	$123.24

TOTAL MATERIAL	**$156.45**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	0.14	days		$3,000.00	$420.00

TOTAL SUBCONTRACTS	**$420.00**

SUMMARY OF COSTS

Labor Cost	$664.12	Labor Burden @	49.7%	$0.00		$664.12
Material Cost	$156.45	Material Tax @	7.8%	$12.12		$168.57
Equipment Cost	$690.27	Equipment Tax @	0.0%	$0.00		$690.27
Subcontractors	$420.00					$420.00
DIRECT COST SUBTOTALS	**$1,931**			**$12**	**DIRECT COST SUBTOTALS**	**$1,943**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,522.95	$228.44
Installing Contractors Profit@	8.0%				$1,354.38	$108.35
GC Markup on Subs @	5.0%				$420.00	$21.00
					TOTAL MARKUP COSTS	**$357.79**
General Contractors Insurance @	1.0%		on		$2,300.75	$23
Bond @	1.0%		on		$2,300.75	$23
Contingency @	0.0%		on		$2,346.76	$0
					TOTAL COST for pay item	**$2,347**

Additional Pay Item Notes :

When a transmission line is decommissioned and is not converted to another use, the decommissioning typically includes the removal of all infrastructure if it is no longer required, or has reached end-of-life conditions. Removed parts will be re-used, recycled or disposed. Production is based off of RSMs using Crew B-1C and B-3 (1 Forman, 2 laborer, 1 Excavator & 1 crane for lift, position and load in the truck, 1 Hydraulic rock-splitting/rock-drilling equipment to break equipment foundations and concrete for demo :2 Electrician,, 1 utility truck to access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, hydro plant and switchyard. Transmission line poles or structures are 60 feet tall. There are several different kinds of transmission structures. Transmission structures are constructed of wood. They can be single-poled or multi-poled. They can be single-circuited, carrying one set of transmission lines or double-circuited with two sets of lines. Pole height and load capacity limitations determine the distance between poles (span length) either on the basis of ground clearance or ability to support heavy wind and ice loads. Assumed average span between structures to be 275 feet so for 0.07 miles of overhead transmission we will have aproximately 2 structures. In areas where single-pole structures are preferred, weak or wet soils may require concrete foundations for support. Where a transmission line must cross a street or slightly change direction, larger angle structures or guy wires may be required. Poles with guy wires impact a much larger area. Angle structures are usually more than double the diameter of other steel poles. They are made of steel, usually five to six feet in diameter, and have a large concrete base. The base may be buried ten or more feet below the ground surface. The diameter of the pole and the depth the base is buried depends on the condition of the soils and the voltage of the line. Assumed the structures are disposed to Yreka recycling, 36 miles away.This estimate is made as the best AECOM assumption, as actual pricing would occur during the detailed engineering and construction bid process.

PAY ITEM COST DETAIL WORKSHEET — **2.063 Remove gate house #1 from top of dam**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.063		**Project**	: Copco 1			
Description	:	Remove gate house #1 from top of dam						
Quantity	:	720.00	SF					
Daily Production	:	250.00	SF per 8 hour shift	**Project #**	: 2			
Work Days	:	2.9	Days	**Estimator**	: Eric Jones	**SF per**	**Total Cost**	**Unit Price Per SF**
Unit Price	:	$72.06	per SF	**Probable Low Cost Parameter**		**287.5**	**$44,098**	**$61.25**
Total Cost	:	$51,880		**Probable High Cost Parameter**		**187.5**	**$64,850**	**$90.07**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Carpenter Foreman (out)	Active	1.00	2.9	8	23.20	L	$46.40	incl. in rate	incl. in rate	$1,076.48
Carpenters	Active	2.00	2.9	8	46.40	L	$72.60	incl. in rate	incl. in rate	$3,368.64
Laborer	Active	4.00	2.9	8	92.80	L	$45.80	incl. in rate	incl. in rate	$4,250.24
Truck Driver (heavy)	Active	2.00	2.9	8	46.40	L	$57.59	incl. in rate	incl. in rate	$2,672.18
Equipment Operator (medium)	Active	3.00	2.9	8	69.60	L	$66.28	incl. in rate	incl. in rate	$4,613.09
Equipment Operator (crane)	Active	2.00	***1.5***	8	24.00	L	$68.41	incl. in rate	incl. in rate	$1,641.84
Truck Driver (heavy)	Active	1.00	2.9	8	23.20	L	$57.59	incl. in rate	incl. in rate	$1,336.09
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	2.9	8	46.40	E	$70.35	incl. in rate	incl. in rate	$3,264.24
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	2.9	8	23.20	E	$31.90	incl. in rate	incl. in rate	$740.08
Hydraulic Crane (80tn)	Active	1.00	***1.5***	8	12.00	E	$190.46	incl. in rate	incl. in rate	$2,285.52
Hydraulic Excavator (5.0cy)	Active	2.00	2.9	8	46.40	E	$274.63	incl. in rate	incl. in rate	$12,742.83
Loader, FE Rubber Tire (5.25cy)	Active	1.00	2.9	8	23.20	E	$75.42	incl. in rate	incl. in rate	$1,749.74
			2.9	8	0.00		$2.50			$0.00
			2.9	8	0.00					$0.00
			2.9	8	0.00					$0.00
			2.9	8	0.00					$0.00
			2.9	8	0.00					$0.00
				Labor Hours	**325.6**				**TOTAL LABOR**	**$18,958.55**
				Equipment Hours	**151.2**				**TOTAL EQUIPMENT**	**$20,782.42**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.050	0.00	$150.00	$0.00
		ea	1.050	0.00	$1.43	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$18,958.55	Labor Burden @	0.0%				$18,958.55
Material Cost	$0.00	Material Tax @	7.75%	$0.00			$0.00
Equipment Cost	$20,782.42	Equipment Tax @	7.75%	$1,610.64			$22,393.05
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	**$39,741**			**$1,611**		**DIRECT COST SUBTOTALS**	**$41,352**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$41,351.61		$6,202.74
Installing Contractors Profit@	8.0%				$41,351.61		$3,308.13
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$9,510.87**
General Contractors Insurance @	1.0%		on		$50,862.47		$509
Bond @	1.0%		on		$50,862.47		$509
Contingency @	0.0%		on		$51,879.72		$0
						TOTAL COST for pay item	**$51,880**

Additional Pay Item Notes :

Remove Head Gate Building. Assumption the crew can remove 1/3 of the building per day. Crane is used to load items on flat bed figured using it half of the duration.

PAY ITEM COST DETAIL WORKSHEET

2.064 Remove gate house #2 from top of dam

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.064		**Project**	: Copco 1			
Description	:	Remove gate house #2 from top of dam						
Quantity	:	690.00	SF					
Daily Production	:	250.00	SF per	8	hour shift	**Project #**	: 2	
Work Days	:	2.8	Days			**Estimator**	: Eric Jones	
Unit Price	:	$74.35	per SF			**Probable Low Cost Parameter**	**287.5**	**$43,607**	**$63.20**
Total Cost	:	$51,302				**Probable High Cost Parameter**	**187.5**	**$64,128**	**$92.94**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Carpenter Foreman (out)	Active	1.00	2.8	8	22.40	L	$46.40	incl. in rate	incl. in rate	$1,039.36
Carpenters	Active	2.00	2.8	8	44.80	L	$72.60	incl. in rate	incl. in rate	$3,252.48
Laborer	Active	4.00	2.8	8	89.60	L	$45.80	incl. in rate	incl. in rate	$4,103.68
Truck Driver (heavy)	Active	2.00	2.8	8	44.80	L	$57.59	incl. in rate	incl. in rate	$2,580.03
Equipment Operator (medium)	Active	3.00	2.8	8	67.20	L	$66.28	incl. in rate	incl. in rate	$4,454.02
Equipment Operator (crane)	Active	2.00	2.8	8	44.80	L	$68.41	incl. in rate	incl. in rate	$3,064.77
Truck Driver (heavy)	Active	1.00	***1.5***	8	12.00	L	$57.59	incl. in rate	incl. in rate	$691.08
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	2.8	8	44.80	E	$70.35	incl. in rate	incl. in rate	$3,151.68
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	2.8	8	22.40	E	$31.90	incl. in rate	incl. in rate	$714.56
Hydraulic Crane (80tn)	Active	1.00	***1.5***	8	12.00	E	$190.46	incl. in rate	incl. in rate	$2,285.52
Hydraulic Excavator (5.0cy)	Active	2.00	2.8	8	44.80	E	$274.63	incl. in rate	incl. in rate	$12,303.42
Loader, FE Rubber Tire (5.25cy)	Active	1.00	2.8	8	22.40	E	$75.42	incl. in rate	incl. in rate	$1,689.41
			2.8	8	0.00		$2.50			$0.00
			2.8	8	0.00					$0.00
			2.8	8	0.00					$0.00
			2.8	8	0.00					$0.00
			2.8	8	0.00					$0.00
				Labor Hours	**325.6**				**TOTAL LABOR**	**$19,185.42**
				Equipment Hours	**146.4**				**TOTAL EQUIPMENT**	**$20,144.59**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.050	0.00	$150.00	$0.00
		ea	1.050	0.00	$1.43	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$19,185.42	Labor Burden @	0.0%				$19,185.42
Material Cost	$0.00	Material Tax @	7.75%	$0.00			$0.00
Equipment Cost	$20,144.59	Equipment Tax @	7.75%	$1,561.21			$21,705.80
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	**$39,330**			**$1,561**		**DIRECT COST SUBTOTALS**	**$40,891**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$40,891.21		$6,133.68
Installing Contractors Profit@	8.0%				$40,891.21		$3,271.30
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$9,404.98**
General Contractors Insurance @	1.0%		on		$50,296.19		$503
Bond @	1.0%		on		$50,296.19		$503
Contingency @	0.0%		on		$51,302.12		$0
						TOTAL COST for pay item	**$51,302**

Additional Pay Item Notes :

Remove Head Gate Building. Assumption the crew can remove 1/3 of the building per day. Crane is used to load items on flat bed figured using it half of the duration.

PAY ITEM COST DETAIL WORKSHEET

2.065 Remove Concrete Items associated with 10 ft. diam. Penstocks, reinf. Concrete

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.065			**Project**	: COPCO 1			
Description	:	Remove Concrete Items associated with 10 ft. diam. Penstocks, reinf. Concrete							
Quantity	:	1,050.00	cy						
Daily Production	:	50.00	cy per	8 hour shift	**Project #**	: 2			
Work Days	:	21.0	Days		**Estimator**	: Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$300.38	per cy		**Probable Low Cost Parameter**		**57.5**	**$268,089**	**$255.32**
Total Cost	:	$315,398			**Probable High Cost Parameter**		**37.5**	**$394,248**	**$375.47**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	21.0	8	336.00	L	$48.27	incl. in rate	incl. in rate	$16,218.72
Laborer	Active	8.00	21.0	8	1,344.00	L	$45.80	incl. in rate	incl. in rate	$61,555.20
Equipment Operator (medium)	Active	2.00	21.0	8	336.00	L	$66.28	incl. in rate	incl. in rate	$22,270.08
Truck Driver (heavy)	Active	1.00	21.0	8	168.00	L	$57.59	incl. in rate	incl. in rate	$9,675.12
Air Compressor 900 cfm	Active	1.00	21.0	8	168.00	E	$38.87	incl. in rate	incl. in rate	$6,529.98
Air Compressor 600 cfm	Active	1.00	21.0	8	168.00	E	$21.74	incl. in rate	incl. in rate	$3,652.14
Air Tool, Chipping Hammer	Active	4.00	21.0	8	672.00	E	$1.64	incl. in rate	incl. in rate	$1,101.43
Generator, Small Generator, 10 - 15 kW	Active	2.00	21.0	8	336.00	E	$7.04	incl. in rate	incl. in rate	$2,365.44
Hydraulic Excavator (2.5cy)	Active	2.00	21.0	8	336.00	E	$203.63	incl. in rate	incl. in rate	$68,419.68
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	21.0	8	168.00	E	$62.72	incl. in rate	incl. in rate	$10,536.96
Hydraulic Thumbs/Shear Attachment	Active	1.00	21.0	8	168.00	E	$16.39	incl. in rate	incl. in rate	$2,753.52
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	21.0	8	168.00	E	$111.64	incl. in rate	incl. in rate	$18,755.52
			21.0	8	0.00					$0.00
			21.0	8	0.00					$0.00
			21.0	8	0.00					$0.00
			21.0	8	0.00					$0.00
			21.0	8	0.00					$0.00
				Labor Hours	**2,184**			**TOTAL LABOR**		**$109,719.12**
				Equipment Hours	**2,184**			**TOTAL EQUIPMENT**		**$114,114.67**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$5,485.96	$5,485.96
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$5,485.96**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	6	EA	**Cost per Mob**	$2,500.00	$15,000.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$15,000.00**

SUMMARY OF COSTS

Labor Cost	$109,719.12	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$109,719.12
Material Cost	$5,485.96	Material Tax @	7.75%	$425.16		$5,911.12
Equipment Cost	$114,114.67	Equipment Tax @	7.75%	$8,843.89		$122,958.55
Subcontractors	$15,000.00					$15,000.00
DIRECT COST SUBTOTALS	**$244,320**			**$9,269**	**DIRECT COST SUBTOTALS**	**$253,589**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$238,588.79	$35,788.32
Installing Contractors Profit@	8.0%				$238,588.79	$19,087.10
GC Markup on Subs @	5.0%				$15,000.00	$750.00
					TOTAL MARKUP COSTS	**$55,625.42**
General Contractors Insurance @	1.0%		on		$309,214.21	$3,092
Bond @	1.0%		on		$309,214.21	$3,092
Contingency @	0.0%		on		$315,398.50	$0
					TOTAL COST for pay item	**$315,398**

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposable site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM COST DETAIL WORKSHEET — **2.066 Plug 14-foot diameter penstock with concrete**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.066		**Project**	: Copco 1			
Description	:	Plug 14-foot diameter penstock with concrete						
Quantity	:	23.00 CY						
Daily Production	:	2.30 CY per	8 hour shift	**Project #**	: 2			
Work Days	:	10.0 Days		**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$3,373.31 per CY		**Probable Low Cost Parameter**		**2.53**	**$69,828**	**$3,035.98**
Total Cost	:	$77,586		**Probable High Cost Parameter**		**1.955**	**$89,224**	**$3,879.31**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Carpenter Foreman (out)	Active	1.00	10.0	8	80.00	L	$46.40	incl. in rate	incl. in rate	$3,712.00
Carpenters	Active	2.00	10.0	8	160.00	L	$72.60	incl. in rate	incl. in rate	$11,616.00
Laborer	Active	2.00	10.0	8	160.00	L	$45.80	incl. in rate	incl. in rate	$7,328.00
Cement finisher	Active	2.00	10.0	8	160.00	L	$72.60	incl. in rate	incl. in rate	$11,616.00
Equipment Operator (light)	Active	2.00	10.0	8	160.00	L	$64.90	incl. in rate	incl. in rate	$10,384.00
Forklift, Rough Terrain (9,000 lb capacity)	Active	1.00	10.0	8	80.00	E	$54.70	incl. in rate	incl. in rate	$4,376.00
Conc Pump (small)	Active	1.00	10.0	8	80.00	E	$61.43	incl. in rate	incl. in rate	$4,914.40
Pump, Trash Pump, 6"+	Active	2.00	10.0	8	160.00	E	$16.11	incl. in rate	incl. in rate	$2,577.60
0		1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
		1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
		1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
		1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
			10.0	8	0.00		$2.50			$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
				Labor Hours	**720**				**TOTAL LABOR**	**$44,656.00**
				Equipment Hours	**320**				**TOTAL EQUIPMENT**	**$11,868.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
Concrete	23.00	ea	1.050	24.15	$144.13	$3,480.74
Concrete blocks for backing	400.00	ea	1.050	420.00	$1.43	$600.60
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$4,081.34**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$44,656.00	Labor Burden @	0.0%			$44,656.00
Material Cost	$4,081.34	Material Tax @	7.75%	$316.30		$4,397.64
Equipment Cost	$11,868.00	Equipment Tax @	7.75%	$919.77		$12,787.77
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$60,605**			**$1,236**	**DIRECT COST SUBTOTALS**	**$61,841**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$61,841.41		$9,276.21
Installing Contractors Profit@	8.0%				$61,841.41		$4,947.31
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$14,223.53**
General Contractors Insurance @	1.0%		on		$76,064.94		$761
Bond @	1.0%		on		$76,064.94		$761
Contingency @	0.0%		on		$77,586.24		$0
						TOTAL COST for pay item	**$77,586**

Additional Pay Item Notes :

8 man crew will construct plug in the dry rough 5 days of construction to plug each side for a total of 10 days. Expect 6" pump will be needed day and night entire duration to control water during construction of plugs.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.067	**Project**	:	COPCO 1			
Description	:	Remove & Dispose of 8 screens						
Quantity	:	18,000.00 lbs						
Daily Production	:	18,000.00 lbs per 8 hour shift	**Project #**	:	2			
Work Days	:	1.0 Days	**Estimator**	:	Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$1.17 per lbs	**Probable Low Cost Parameter**			**19800**	**$18,913**	**$1.05**
Total Cost	:	$21,014	**Probable High Cost Parameter**			**14400**	**$25,217**	**$1.40**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	incl. in rate	incl. in rate	$386.16
Laborer	Active	4.00	1.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
Crawler Crane (270tn)	Active	2.00	1.0	8	16.00	E	$399.50	incl. in rate	incl. in rate	$6,392.00
Equipment Operator (medium)	Active	2.00	1.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Welder	Active	2.00	1.0	8	16.00	L	$7.84	incl. in rate	incl. in rate	$125.40
Gas Welding Machine	Active	2.00	1.0	8	16.00	E	$2.88	incl. in rate	incl. in rate	$46.03
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Steelworker	Active	6.00	1.0	8	48.00	L	$65.52	incl. in rate	incl. in rate	$3,144.96
Truck, Flatbed (4x4, 10,000 gvw)	Active	4.00	1.0	8	32.00	E	$31.90	incl. in rate	incl. in rate	$1,020.80
Truck Driver (heavy)	Active	4.00	1.0	8	32.00	L	$57.59	incl. in rate	incl. in rate	$1,842.88

Labor Hours	**160**	**TOTAL LABOR**	**$8,387.32**
Equipment Hours	**64**	**TOTAL EQUIPMENT**	**$7,458.83**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$838.73	$838.73

TOTAL MATERIAL	**$838.73**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$8,387.32	Labor Burden @	49.7%	$0.00		$8,387.32
Material Cost	$838.73	Material Tax @	7.8%	$65.00		$903.73
Equipment Cost	$7,458.83	Equipment Tax @	0.0%	$0.00		$7,458.83
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$16,685**			**$65**	**DIRECT COST SUBTOTALS**	**$16,750**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$16,749.89		$2,512.48
Installing Contractors Profit@	8.0%				$16,749.89		$1,339.99
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$3,852.47**
General Contractors Insurance @	1.0%		on		$20,602.36		$206
Bond @	1.0%		on		$20,602.36		$206
Contingency @	0.0%		on		$21,014.41		$0
						TOTAL COST for pay item	**$21,014**

Additional Pay Item Notes :

Production based on crew 1 Forman, 2 Steelworkers and 1 Welder to cut and attach hooks to the gate for disposal, 4 Laborers to rigging wire rope slings, 1 Electrician to provide power for tools, 1 Truck for 2 screens. Assuming 1 day of work.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.068	**Project**	:	COPCO 1			
Description	:	Remove & Dispose of 8 Water Gates						
Quantity	:	18,000.00 lbs						
Daily Production	:	18,000.00 lbs per 8 hour shift	**Project #**	:	2			
Work Days	:	1.0 Days	**Estimator**	:	Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$1.10 per lbs	**Probable Low Cost Parameter**			**19800**	**$17,822**	**$0.99**
Total Cost	:	$19,802	**Probable High Cost Parameter**			**14400**	**$23,762**	**$1.32**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Laborer	Active	4.00	1.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
Crawler Crane (270tn)	Active	2.00	1.0	8	16.00	E	$399.50	incl. in rate	incl. in rate	$6,392.00
Equipment Operator (medium)	Active	2.00	1.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Welder	Active	2.00	1.0	8	16.00	L	$7.84	incl. in rate	incl. in rate	$125.40
Gas Welding Machine	Active	2.00	1.0	8	16.00	E	$2.88	incl. in rate	incl. in rate	$46.03
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Steelworker	Active	2.00	1.0	8	16.00	L	$65.52	incl. in rate	incl. in rate	$1,048.32
Truck, Flatbed (4x4, 10,000 gvw)	Active	4.00	1.0	8	32.00	E	$31.90	incl. in rate	incl. in rate	$1,020.80
Truck Driver (heavy)	Active	4.00	1.0	8	32.00	L	$57.59	incl. in rate	incl. in rate	$1,842.88

Labor Hours	**128**	**TOTAL LABOR**	**$6,274.68**
Equipment Hours	**64**	**TOTAL EQUIPMENT**	**$7,458.83**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$627.47	$627.47
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	1,500.00	LF	1.000	1,500.00	$0.85	$1,275.00

TOTAL MATERIAL	**$1,902.47**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$6,274.68	Labor Burden @	49.7%	$0.00		$6,274.68
Material Cost	$1,902.47	Material Tax @	7.8%	$147.44		$2,049.91
Equipment Cost	$7,458.83	Equipment Tax @	0.0%	$0.00		$7,458.83
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$15,636**			**$147**	**DIRECT COST SUBTOTALS**	**$15,783**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$15,783.42	$2,367.51
Installing Contractors Profit@	8.0%				$15,783.42	$1,262.67
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$3,630.19**
General Contractors Insurance @	1.0%		on		$19,413.61	$194
Bond @	1.0%		on		$19,413.61	$194
Contingency @	0.0%		on		$19,801.88	$0
					TOTAL COST for pay item	**$19,802**

Additional Pay Item Notes :

Production based on crew 1 Forman, 2 Steelworkers and 1 Welder to cut and attach hooks to the gate for disposal, 4 Laborers to rigging wire rope slings, 1 Electrician to provide power for tools, 1 Truck for 2 gates. Assuming 1 day of work.

PAY ITEM COST DETAIL WORKSHEET

2.069 Remove & Dispose of 3 - 30" Dia. x 25' stand pipes

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.069	**Project**	:	COPCO 1			
Description	:	Remove & Dispose of 3 - 30" Dia. x 25' stand pipes						
Quantity	:	6,000.00 LBS						
Daily Production	:	6,000.00 LBS per 8 hour shift	**Project #**	:	2			
Work Days	:	1.0 Days	**Estimator**	:	Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.91 per LBS	**Probable Low Cost Parameter**			**6600**	**$4,912**	**$0.82**
Total Cost	:	$5,458	**Probable High Cost Parameter**			**4800**	**$6,550**	**$1.09**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (35tn)	Active	1.00	1.0	8	8.00	E	$116.30	incl. in rate	incl. in rate	$930.40
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Truck Driver (light)	Active	1.00	1.0	8	8.00	L	$56.29	incl. in rate	incl. in rate	$450.32
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	incl. in rate	incl. in rate	$255.20
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	incl. in rate	incl. in rate	$386.16
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
Steelworker	Active	2.00	1.0	8	16.00	L	$65.52	incl. in rate	incl. in rate	$1,048.32

Labor Hours	**56**	**TOTAL LABOR**	**$3,164.88**
Equipment Hours	**16**	**TOTAL EQUIPMENT**	**$1,185.60**

MATERIAL COSTS

Description	Item	Order	Conversion	Order	Order	Material
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$3,164.88	Labor Burden @	49.7%	$0.00	$3,164.88
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$1,185.60	Equipment Tax @	0.0%	$0.00	$1,185.60
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$4,350**			**$0**	**DIRECT COST SUBTOTALS** **$4,350**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,350.48	$652.57
Installing Contractors Profit@	8.0%				$4,350.48	$348.04
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,000.61**
General Contractors Insurance @	1.0%		on		$5,351.09	$54
Bond @	1.0%		on		$5,351.09	$54
Contingency @	0.0%		on		$5,458.11	$0
					TOTAL COST for pay item	**$5,458**

Additional Pay Item Notes :

Crew formed of 2 Steelworker to cut the pipes and 2 Laborers that will use the crane to load the pipe in the truck.

PAY ITEM COST DETAIL WORKSHEET

2.070 Remove & Dispose of 14' Dia. penstock pipe

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.070		**Project**	:	COPCO 1			
Description	:	Remove & Dispose of 14' Dia. penstock pipe							
Quantity	:	256,000.00	LBS						
Daily Production	:	20,000.00	LBS per	8	hour shift	**Project #**	: 2		
Work Days	:	12.8	Days			**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$1.31	per LBS			**Probable Low Cost Parameter**		**23000**	**$284,926**	**$1.11**
Total Cost	:	$335,207				**Probable High Cost Parameter**		**15000**	**$419,009**	**$1.64**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	12.8	8	204.80	L	$46.27	incl. in rate	incl. in rate	$9,476.10
Steelworker	Active	8.00	12.8	8	819.20	L	$65.52	incl. in rate	incl. in rate	$53,673.98
Equipment Operator (crane)	Active	2.00	12.8	8	204.80	L	$68.41	incl. in rate	incl. in rate	$14,010.37
Crawler Crane (130tn)	Active	2.00	12.8	8	204.80	E	$258.66	incl. in rate	incl. in rate	$52,973.57
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	12.8	8	204.80	E	$111.64	incl. in rate	incl. in rate	$22,863.87
Hydraulic Excavator (2.5cy)	Active	2.00	12.8	8	204.80	E	$203.63	incl. in rate	incl. in rate	$41,703.42
Welder	Active	2.00	12.8	8	204.80	L	$7.84	incl. in rate	incl. in rate	$1,605.12
Gas Welding Machine	Active	2.00	12.8	8	204.80	E	$2.88	incl. in rate	incl. in rate	$589.21
Carpenters, Journeyman	Active	2.00	12.8	8	204.80	L	$65.37	incl. in rate	incl. in rate	$13,387.78
Truck Driver (heavy)	Active	2.00	12.8	8	204.80	L	$57.59	incl. in rate	incl. in rate	$11,794.43
Equipment Operator (oiler)	Active	2.00	12.8	8	204.80	L	$62.94	incl. in rate	incl. in rate	$12,890.11
Loader, FE Rubber Tire (8.6cy)	Active	1.00	12.8	8	102.40	E	$221.50	incl. in rate	incl. in rate	$22,681.60

Labor Hours	**2048**	**TOTAL LABOR**	**$116,837.89**
Equipment Hours	**921.6**	**TOTAL EQUIPMENT**	**$140,811.67**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$5,841.89	$5,841.89
Fuel charges and consumable for field repair, lubrication, tire, etc 1% labor	1.00	LS	1.000	1.00	$1,408.12	$1,408.12

TOTAL MATERIAL **$7,250.01**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (2% of total)	2.56	ton	1.000	$595.00	$1,523.20
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	68.00	mile	1.000	$7.25	$493.00

TOTAL SUBCONTRACTS **$2,016.20**

SUMMARY OF COSTS

Labor Cost	$116,837.89	Labor Burden @	49.7%	$0.00	$116,837.89
Material Cost	$7,250.01	Material Tax @	7.8%	$561.88	$7,811.89
Equipment Cost	$140,811.67	Equipment Tax @	0.0%	$0.00	$140,811.67
Subcontractors	$2,016.20				$2,016.20
DIRECT COST SUBTOTALS	**$266,916**			**$562**	**DIRECT COST SUBTOTALS** **$267,478**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$265,461.45	$39,819.22
Installing Contractors Profit@	8.0%				$265,461.45	$21,236.92
GC Markup on Subs @	5.0%				$2,016.20	$100.81
					TOTAL MARKUP COSTS	**$61,156.94**
General Contractors Insurance @	1.0%		on		$328,634.59	$3,286
Bond @	1.0%		on		$328,634.59	$3,286
Contingency @	0.0%		on		$335,207.28	$0
					TOTAL COST for pay item	**$335,207**

Additional Pay Item Notes :

Removal for pipe, expansion joints and support rings using E-19 crews for demolition. 2 Crews formed from 1 forman, 2 steelworker, 1 welder, 2 carpenters. 3 equipment operators 1 for the crane, 1 excavator and 1 loader. 2 truck driver to drive off road the rubbish. Assumed that the steel includes exterior coatings containing heavy metals so the scrap metal painted with heavy metals will be sent to Yreka salvage yard for recycling 2% of total lbs, average miles 34. Fuel charges and consumable for field repair, lubrication, tire, etc are applied.

PAY ITEM COST DETAIL WORKSHEET

2.071 Remove & Dispose of 10' Dia. penstock pipe

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.071		**Project**	:	COPCO1			
Description	:	Remove & Dispose of 10' Dia. penstock pipe							
Quantity	:	270,000.00	LBS						
Daily Production	:	20,000.00	LBS per	8	hour shift	**Project #**	:	2	
Work Days	:	13.5	Days			**Estimator**	:	Mihaela Tomulescu	
Unit Price	:	$1.37	per LBS			**Probable Low Cost Parameter**		**23000**	**$315,225**	**$1.17**
Total Cost	:	$370,853				**Probable High Cost Parameter**		**15000**	**$463,566**	**$1.72**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	13.5	8	216.00	L	$46.27	incl. in rate	incl. in rate	$9,994.32
Steelworker	Active	8.00	13.5	8	864.00	L	$65.52	incl. in rate	incl. in rate	$56,609.28
Equipment Operator (crane)	Active	2.00	13.5	8	216.00	L	$68.41	incl. in rate	incl. in rate	$14,776.56
Crawler Crane (130tn)	Active	2.00	13.5	8	216.00	E	$258.66	incl. in rate	incl. in rate	$55,870.56
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	13.5	8	216.00	E	$111.64	incl. in rate	incl. in rate	$24,114.24
Hydraulic Excavator (5.0cy)	Active	2.00	13.5	8	216.00	E	$274.63	incl. in rate	incl. in rate	$59,320.08
Welder	Active	2.00	13.5	8	216.00	L	$7.84	incl. in rate	incl. in rate	$1,692.90
Gas Welding Machine	Active	2.00	13.5	8	216.00	E	$2.88	incl. in rate	incl. in rate	$621.43
Carpenters, Journeyman	Active	2.00	13.5	8	216.00	L	$65.37	incl. in rate	incl. in rate	$14,119.92
Carpenter Foreman (out)	Active	2.00	13.5	8	216.00	L	$46.40	incl. in rate	incl. in rate	$10,022.40
Equipment Operator (oiler)	Active	2.00	13.5	8	216.00	L	$62.94	incl. in rate	incl. in rate	$13,595.04
Loader, FE Rubber Tire (8.6cy)	Active	1.00	13.5	8	108.00	E	$221.50	incl. in rate	incl. in rate	$23,922.00

Labor Hours	**2160**	**TOTAL LABOR**	**$120,810.42**
Equipment Hours	**972**	**TOTAL EQUIPMENT**	**$163,848.31**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$6,040.52	$6,040.52
Fuel charges and consumable for field repair, lubrication, tire, etc 2% labor	1.00	LS	1.000	1.00	$3,276.97	$3,276.97

TOTAL MATERIAL	**$9,317.49**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (1% of total)	1.35	ton	1.000	$595.00	$803.25
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	34.00	mile	1.000	$7.25	$246.50

TOTAL SUBCONTRACTS	**$1,049.75**

SUMMARY OF COSTS

Labor Cost	$120,810.42	Labor Burden @	49.7%	$0.00	$120,810.42
Material Cost	$9,317.49	Material Tax @	7.8%	$722.11	$10,039.59
Equipment Cost	$163,848.31	Equipment Tax @	0.0%	$0.00	$163,848.31
Subcontractors	$1,049.75				$1,049.75
DIRECT COST SUBTOTALS	**$295,026**			**$722**	**DIRECT COST SUBTOTALS** **$295,748**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$294,698.32	$44,204.75
Installing Contractors Profit@	8.0%				$294,698.32	$23,575.87
GC Markup on Subs @	5.0%				$1,049.75	$52.49
					TOTAL MARKUP COSTS	**$67,833.10**
General Contractors Insurance @	1.0%		on		$363,581.17	$3,636
Bond @	1.0%		on		$363,581.17	$3,636
Contingency @	0.0%		on		$370,852.80	$0
					TOTAL COST for pay item	**$370,853**

Additional Pay Item Notes :

Removal for pipe, expansion joints and support rings using E-19 crews for demolition. 2 Crews formed from 1 forman, 4 steelworker, 1 welder, 2 carpenters. 3 equipment operators 1 for the crane, 1 excavator and 1 loader. 2 truck drivers to drive off road the rubbish. Assumed that the steel includes exterior coatings containing heavy metals so the scrap metal painted with heavy metals will be sent to Yreka salvage yard for recycling 1% of total lbs, average miles 34. Fuel charges and consumable for field repair, lubrication, tire, etc are applied.

PAY ITEM COST DETAIL WORKSHEET

2.081 Site work - Clear and Grub Disposal Area

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.081		**Project**	: Copco 1			
Description	:	Site work - Clear and Grub Disposal Area						
Quantity	:	4.00 AC						
Daily Production	:	1.00 AC per 8 hour shift		**Project #**	: 2			
Work Days	:	4.0 Days		**Estimator**	: Eric Jones	**AC per**	**Total Cost**	**Unit Price Per AC**
Unit Price	:	$13,732.22 per AC		**Probable Low Cost Parameter**		**1.15**	**$46,690**	**$11,672.39**
Total Cost	:	$54,929		**Probable High Cost Parameter**		**0.8**	**$65,915**	**$16,478.66**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	4.0	8	32.00	L	$46.27	incl. in rate	incl. in rate	$1,480.64
Laborer	Active	4.00	4.0	8	128.00	L	$45.80	incl. in rate	incl. in rate	$5,862.40
Equipment Operator (medium)	Active	3.00	4.0	8	96.00	L	$66.28	incl. in rate	incl. in rate	$6,362.88
Truck Driver (heavy)	Active	2.00	4.0	8	64.00	L	$57.59	incl. in rate	incl. in rate	$3,685.76
Loader, FE Rubber Tire (5.25cy)	Active	1.00	4.0	8	32.00	E	$75.42	incl. in rate	incl. in rate	$2,413.44
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	4.0	8	64.00	E	$70.35	incl. in rate	incl. in rate	$4,502.40
Hydraulic Excavator (5.0cy)	Active	2.00	4.0	8	64.00	E	$274.63	incl. in rate	incl. in rate	$17,576.32
0		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
0		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
Chipper 600HP up to 22" diameter	Active	3.00	4.0	8	96.00		$57.91			$5,559.36
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
				Labor Hours	**320**				**TOTAL LABOR**	**$17,391.68**
				Equipment Hours	**160**				**TOTAL EQUIPMENT**	**$24,492.16**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.050	0.00	$144.13	$0.00
		ea	1.050	0.00	$1.43	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$17,391.68	Labor Burden @	0.0%				$17,391.68
Material Cost	$0.00	Material Tax @	7.75%	$0.00			$0.00
Equipment Cost	$24,492.16	Equipment Tax @	7.75%	$1,898.14			$26,390.30
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	**$41,884**			**$1,898**		**DIRECT COST SUBTOTALS**	**$43,782**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$43,781.98		$6,567.30
Installing Contractors Profit@	8.0%				$43,781.98		$3,502.56
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$10,069.86**
General Contractors Insurance @	1.0%		on		$53,851.84		$539
Bond @	1.0%		on		$53,851.84		$539
Contingency @	0.0%		on		$54,928.88		$0
						TOTAL COST for pay item	**$54,929**

Additional Pay Item Notes :

Production is based on a 7 man crew and 2 truck drivers processing 1 acre a day. Chipper will be used to process material on site and will be supplied by loader. 2 excavators will be clearing land , laborers will be assisting the excavators and chippers with chain saws.

PAY ITEM COST DETAIL WORKSHEET

2.082 Sitework - Soil Cover for Disposal Area

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.082			**Project**	: Copco 1			
Description	:	Sitework - Soil Cover for Disposal Area							
Quantity	:	12,000.00	cy						
Daily Production	:	1,000.00	cy per	8 hour shift	**Project #**	: 2			
Work Days	:	12.0	Days		**Estimator**	: Michael Barba	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$6.84	per cy		**Probable Low Cost Parameter**		**1150**	**$69,791**	**$5.82**
Total Cost	:	$82,107			**Probable High Cost Parameter**		**800**	**$98,529**	**$8.21**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (235hp)(CATD7)	Active	2.00	12.0	8	192.00	E	$165.11	incl. in rate	incl. in rate	$31,701.12
Loader, FE Rubber Tire (5.25cy)	Active	1.00	12.0	8	96.00	E	$75.42	incl. in rate	incl. in rate	$7,240.32
Equipment Operator (medium)	Active	3.00	12.0	8	288.00	L	$66.28	incl. in rate	incl. in rate	$19,088.64
Laborer	Active	1.00	12.0	8	96.00	L	$45.80	incl. in rate	incl. in rate	$4,396.80
		1.00	12.0	8	96.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	12.0	8	96.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	12.0	8	96.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	12.0	8	96.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	12.0	8	96.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	12.0	8	96.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	12.0	8	96.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			12.0	8	0.00					$0.00
			12.0	8	0.00					$0.00
			12.0	8	0.00					$0.00
			12.0	8	0.00					$0.00
			12.0	8	0.00					$0.00
				Labor Hours	**384**				**TOTAL LABOR**	**$23,485.44**
				Equipment Hours	**288**				**TOTAL EQUIPMENT**	**$38,941.44**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
			1.300	0.00	$30.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$23,485.44	Labor Burden @	49.7%	$0.00		$23,485.44
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$38,941.44	Equipment Tax @	7.75%	$3,017.96		$41,959.40
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$62,427**			**$3,018**	**DIRECT COST SUBTOTALS**	**$65,445**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$65,444.84	$9,816.73
Installing Contractors Profit@	8.0%				$65,444.84	$5,235.59
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$15,052.31**
General Contractors Insurance @	1.0%		on		$80,497.16	$805
Bond @	1.0%		on		$80,497.16	$805
Contingency @	0.0%		on		$82,107.10	$0
					TOTAL COST for pay item	**$82,107**

Additional Pay Item Notes :

Top soil will be provided from initially stripping disposal area.

PAY ITEM COST DETAIL WORKSHEET

2.085 Access/Haul Road Improvements - Soil Excavation

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.085		**Project**	: Copco 1			
Description	:	Access/Haul Road Improvements - Soil Excavation						
Quantity	:	1,600.00	cy					
Daily Production	:	1,000.00	cy per	8 hour shift	**Project #**	: 2		
Work Days	:	1.6	Days		**Estimator**	: Michael Barba	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$17.50	per cy		**Probable Low Cost Parameter**		**1150**	**$23,805**	**$14.88**
Total Cost	:	$28,006			**Probable High Cost Parameter**		**800**	**$33,607**	**$21.00**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (310hp)(CATD8)	Active	2.00	1.6	8	25.60	E	$197.60	incl. in rate	incl. in rate	$5,058.56
Hydraulic Excavator (5.0cy)	Active	1.00	1.6	8	12.80	E	$274.63	incl. in rate	incl. in rate	$3,515.26
Loader, FE Rubber Tire (5.25cy)	Active	2.00	1.6	8	25.60	E	$75.42	incl. in rate	incl. in rate	$1,930.75
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	1.6	8	25.60	E	$111.64	incl. in rate	incl. in rate	$2,857.98
Equipment Operator (medium)	Active	4.00	1.6	8	51.20	L	$66.28	incl. in rate	incl. in rate	$3,393.54
Equipment Operator (light)	Active	1.00	1.6	8	12.80	L	$64.90	incl. in rate	incl. in rate	$830.72
Truck Driver (heavy)	Active	1.00	1.6	8	12.80	L	$57.59	incl. in rate	incl. in rate	$737.15
Laborer	Active	4.00	1.6	8	51.20	L	$45.80	incl. in rate	incl. in rate	$2,344.96
Labor Foreman	Active	1.00	1.6	8	12.80	L	$48.27	incl. in rate	incl. in rate	$617.86
		1.00	1.6	8	12.80	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	1.6	8	12.80	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	1.6	8	12.80	0	$0.00	incl. in rate	incl. in rate	$0.00
		0.00	1.6	8	0.00					$0.00
			1.6	8	0.00					$0.00
			1.6	8	0.00					$0.00
			1.6	8	0.00					$0.00
			1.6	8	0.00					$0.00
				Labor Hours	**140.8**			**TOTAL LABOR**		**$7,924.22**
				Equipment Hours	**89.6**			**TOTAL EQUIPMENT**		**$13,362.56**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price		Material Cost
							$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
						TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
	-					$0.00
						$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$7,924.22	Labor Burden @	49.7%	$0.00		$7,924.22
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$13,362.56	Equipment Tax @	7.75%	$1,035.60		$14,398.16
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$21,287**			**$1,036**	**DIRECT COST SUBTOTALS**	**$22,322**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$22,322.38		$3,348.36
Installing Contractors Profit@	8.0%				$22,322.38		$1,785.79
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$5,134.15**
General Contractors Insurance @	1.0%		on		$27,456.53		$275
Bond @	1.0%		on		$27,456.53		$275
Contingency @	0.0%		on		$28,005.66		$0
						TOTAL COST for pay item	**$28,006**

Additional Pay Item Notes :

PAY ITEM COST DETAIL WORKSHEET — **2.087 County Road Improvements - Asphalt Overlay Repair - Juniper Road**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.087		**Project**	:	Copco 1			
Description	:	County Road Improvements - Asphalt Overlay Repair - Juniper Road							
Quantity	:	3.00	mile						
Daily Production	:	0.25	mile per 8 hour shift	**Project #**	:	2			
Work Days	:	12.0	Days	**Estimator**	:	Michael Barba	**mile per**	**Total Cost**	**Unit Price Per mile**
Unit Price	:	$383,087.98	per mile	**Probable Low Cost Parameter**			**0.2875**	**$976,874**	**$325,624.78**
Total Cost	:	$1,149,264		**Probable High Cost Parameter**			**0.2**	**$1,379,117**	**$459,705.57**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Asphalt Paver (80hp)	Active	1.00	12.0	8	96.00	E	$180.11	incl. in rate	incl. in rate	$17,290.56
Roller, Dbl Drum (steel wheel, 5.0 - 7.9 MTn)	Active	1.00	12.0	8	96.00	E	$64.77	incl. in rate	incl. in rate	$6,217.92
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	12.0	8	192.00	E	$70.35	incl. in rate	incl. in rate	$13,507.20
Equipment Operator (light)	Active	1.00	12.0	8	96.00	L	$64.90	incl. in rate	incl. in rate	$6,230.40
Equipment Operator (medium)	Active	2.00	12.0	8	192.00	L	$66.28	incl. in rate	incl. in rate	$12,725.76
Truck Driver (light)	Active	1.00	12.0	8	96.00	L	$56.29	incl. in rate	incl. in rate	$5,403.84
Laborer	Active	2.00	12.0	8	192.00	L	$45.80	incl. in rate	incl. in rate	$8,793.60
		1.00	12.0	8	96.00	0	$0.00	$0.00		$0.00
		1.00	12.0	8	96.00	0	$0.00	$0.00		$0.00
		1.00	12.0	8	96.00	0	$0.00	$0.00		$0.00
		1.00	12.0	8	96.00	0	$0.00	$0.00		$0.00
		1.00	12.0	8	96.00	0	$0.00	$0.00		$0.00
750 HP Pavement Profiler	Active	1.00	12.0	8	96.00	E	$729.37	incl. in rate	incl. in rate	$70,019.52
			12.0	8	0.00					$0.00
			12.0	8	0.00					$0.00
			12.0	8	0.00					$0.00
			12.0	8	0.00					$0.00
				Labor Hours	**576**				**TOTAL LABOR**	**$33,153.60**
				Equipment Hours	**480**				**TOTAL EQUIPMENT**	**$107,035.20**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
Asphalt for 3" Overlay	6,969.00		1.000	6,969.00	$100.00	$696,900.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	**$696,900.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
Pavement Markings	3	miles		$6,500.00	$19,500.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$19,500.00**

SUMMARY OF COSTS

Labor Cost	$33,153.60	Labor Burden @	49.7%	$0.00		$33,153.60
Material Cost	$696,900.00	Material Tax @	7.75%	$54,009.75		$750,909.75
Equipment Cost	$107,035.20	Equipment Tax @	7.75%	$8,295.23		$115,330.43
Subcontractors	$19,500.00					$19,500.00
DIRECT COST SUBTOTALS	**$856,589**			**$62,305**	**DIRECT COST SUBTOTALS**	**$918,894**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$899,393.78	$134,909.07
Installing Contractors Profit@	8.0%				$899,393.78	$71,951.50
GC Markup on Subs @	5.0%				$19,500.00	$975.00
					TOTAL MARKUP COSTS	**$207,835.57**
General Contractors Insurance @	1.0%		on		$1,126,729.35	$11,267
Bond @	1.0%		on		$1,126,729.35	$11,267
Contingency @	0.0%		on		$1,149,263.93	$0
					TOTAL COST for pay item	**$1,149,264**

Additional Pay Item Notes :

As per Page 142 of the Klamath Detailed Plan 3" is thickness of asphalt overlay.

PAY ITEM COST DETAIL WORKSHEET

2.088 County Road Improvements - Asphalt Overlay Repair - Copco Road

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.088		**Project**	: Copco 1			
Description	: County Road Improvements - Asphalt Overlay Repair - C						
Quantity	: 19.00	mile					
Daily Production	: 0.50	mile per 8 hour shift	**Project #**	: 2			
Work Days	: 38.0	Days	**Estimator**	: Michael Barba	**mile per**	**Total Cost**	**Unit Price Per mile**
Unit Price	: $352,027.38	per mile	**Probable Low Cost Parameter**		**0.575**	**$5,685,242**	**$299,223.27**
Total Cost	: $6,688,520		**Probable High Cost Parameter**		**0.4**	**$8,026,224**	**$422,432.85**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Asphalt Paver (80hp)	Active	2.00	38.0	8	608.00	E	$180.11	incl. in rate	incl. in rate	$109,506.88
Roller, Dbl Drum (steel wheel, 5.0 - 7.9 MTn)	Active	3.00	38.0	8	912.00	E	$64.77	incl. in rate	incl. in rate	$59,070.24
Truck, On-Highway Dump (6x4, 12cy)	Active	4.00	38.0	8	1,216.00	E	$70.35	incl. in rate	incl. in rate	$85,545.60
Equipment Operator (light)	Active	3.00	38.0	8	912.00	L	$64.90	incl. in rate	incl. in rate	$59,188.80
Equipment Operator (medium)	Active	2.00	38.0	8	608.00	L	$66.28	incl. in rate	incl. in rate	$40,298.24
Truck Driver (light)	Active	4.00	38.0	8	1,216.00	L	$56.29	incl. in rate	incl. in rate	$68,448.64
Laborer	Active	2.00	38.0	8	608.00	L	$45.80	incl. in rate	incl. in rate	$27,846.40
		1.00	38.0	8	304.00	0	$0.00	$0.00		$0.00
		1.00	38.0	8	304.00	0	$0.00	$0.00		$0.00
		1.00	38.0	8	304.00	0	$0.00	$0.00		$0.00
		1.00	38.0	8	304.00	0	$0.00	$0.00		$0.00
		1.00	38.0	8	304.00	0	$0.00	$0.00		$0.00
750 HP Pavement Profiler		2.00	38.0	8	608.00		$729.37	incl. in rate	incl. in rate	$443,456.96
			38.0	8	0.00					$0.00
			38.0	8	0.00					$0.00
			38.0	8	0.00					$0.00
			38.0	8	0.00					$0.00
				Labor Hours	**3344**				**TOTAL LABOR**	**$195,782.08**
				Equipment Hours	**2736**				**TOTAL EQUIPMENT**	**$254,122.72**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
Asphalt for 3" Overlay	44,140.80		1.000	44,140.80	$100.00	$4,414,080.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	**$4,414,080.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
Pavement Markings	19	miles		$6,500.00	$123,500.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$123,500.00**

SUMMARY OF COSTS

Labor Cost	$195,782.08	Labor Burden @	49.7%	$0.00	$195,782.08
Material Cost	$4,414,080.00	Material Tax @	7.75%	$342,091.20	$4,756,171.20
Equipment Cost	$254,122.72	Equipment Tax @	7.75%	$19,694.51	$273,817.23
Subcontractors	$123,500.00				$123,500.00
DIRECT COST SUBTOTALS	**$4,987,485**			**$361,786**	**DIRECT COST SUBTOTALS** **$5,349,271**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$5,225,770.51	$783,865.58
Installing Contractors Profit@	8.0%				$5,225,770.51	$418,061.64
GC Markup on Subs @	5.0%				$123,500.00	$6,175.00
						TOTAL MARKUP COSTS **$1,208,102.22**
General Contractors Insurance @	1.0%			on	$6,557,372.73	$65,574
Bond @	1.0%			on	$6,557,372.73	$65,574
Contingency @	0.0%			on	$6,688,520.18	$0
						TOTAL COST for pay item **$6,688,520**

Additional Pay Item Notes :

As per Page 142 of the Klamath Detailed Plan 3" is thickness of asphalt overlay.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.089		**Project**	: Copco 1			
Description	:	Mallard Cove - Concrete total						
Quantity	:	106.00	CY					
Daily Production	:	40.00	CY per 8 hour shift	**Project #**	: 2			
Work Days	:	2.7	Days	**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$338.09	per CY	**Probable Low Cost Parameter**		**46**	**$30,462**	**$287.38**
Total Cost	:	$35,838		**Probable High Cost Parameter**		**34**	**$41,214**	**$388.81**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	2.00	2.7	8	43.20	E	$274.63	incl. in rate	incl. in rate	$11,864.02
Loader, FE Rubber Tire (5.25cy)	Active	1.00	2.7	8	21.60	E	$75.42	incl. in rate	incl. in rate	$1,629.07
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	2.7	8	43.20	E	$70.35	incl. in rate	incl. in rate	$3,039.12
Truck, Pickup (4x4, 3/4tn)	Active	1.00	2.7	8	21.60	E	$16.94	incl. in rate	incl. in rate	$365.90
Hydraulic Impact Breaker Attachment (3k-4k ft-lb)	Active	1.00	2.7	8	21.60	E	$36.58	incl. in rate	incl. in rate	$790.13
Truck Driver (heavy)	Active	1.00	2.7	8	21.60	L	$57.59	incl. in rate	incl. in rate	$1,243.94
Labor Foreman (out)	Active	1.00	2.7	8	21.60	L	$46.27	incl. in rate	incl. in rate	$999.43
Laborer	Active	3.00	2.7	8	64.80	L	$45.80	incl. in rate	incl. in rate	$2,967.84
Equipment Operator (medium)	Active	3.00	2.7	8	64.80	L	$66.28	incl. in rate	incl. in rate	$4,294.94
0		0.00	2.7	8	0.00	0	$0.00	$0.00		$0.00
0		1.00	2.7	8	21.60	0	$0.00	$0.00		$0.00
		1.00	2.7	8	21.60	0	$0.00	$0.00		$0.00
			2.7	8	0.00					$0.00
			2.7	8	0.00					$0.00
			2.7	8	0.00					$0.00
			2.7	8	0.00					$0.00
			2.7	8	0.00					$0.00
				Labor Hours	**172.8**				**TOTAL LABOR**	**$9,506.16**
				Equipment Hours	**151.2**				**TOTAL EQUIPMENT**	**$17,688.24**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.050	0.00	$144.13	$0.00
		ea	1.050	0.00	$1.43	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$9,506.16	Labor Burden @	0.0%			$9,506.16
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$17,688.24	Equipment Tax @	7.75%	$1,370.84		$19,059.08
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$27,194**			**$1,371**	**DIRECT COST SUBTOTALS**	**$28,565**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$28,565.24		$4,284.79
Installing Contractors Profit@	8.0%				$28,565.24		$2,285.22
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$6,570.00**
General Contractors Insurance @	1.0%		on		$35,135.24		$351
Bond @	1.0%		on		$35,135.24		$351
Contingency @	0.0%		on		$35,837.95		$0
						TOTAL COST for pay item	**$35,838**

Additional Pay Item Notes :

1 excavator with breaker to perform demolition, 1 excavator to pile material, 1 loader to support loading operation, 1 foreman with truck to oversee operation, 3 laborers to direct trucks and support equipment demolition operations. Production currently shows 2 loads of concrete material per truck and duration of 3 days, the crew output is low due to the items being demolished are small and spaced out.

PAY ITEM COST DETAIL WORKSHEET — **2.090 Mallard Cove - 25'x5' Dock made of composite decking and poly floats**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.090		**Project**	: Copco 1			
Description	:	Mallard Cove - 25'x5' Dock made of composite decking and poly floats						
Quantity	:	1.00	EA					
Daily Production	:	2.00	EA per 8 hour shift	**Project #**	: 2			
Work Days	:	0.5	Days	**Estimator**	: Eric Jones	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$3,009.15	per EA	**Probable Low Cost Parameter**		**2.3**	**$2,558**	**$2,557.77**
Total Cost	:	$3,009		**Probable High Cost Parameter**		**1.7**	**$3,461**	**$3,460.52**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (50tn)	Active	1.00	0.5	8	4.00	E	$134.32	incl. in rate	incl. in rate	$537.28
Truck, Pickup (4x4, 3/4tn)	Active	1.00	0.5	8	4.00	E	$16.94	incl. in rate	incl. in rate	$67.76
Truck Driver (heavy)	Active	1.00	***1.0***	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Equipment Operator (crane)	Active	1.00	0.5	8	4.00	L	$68.41	incl. in rate	incl. in rate	$273.64
Labor Foreman (out)	Active	1.00	0.5	8	4.00	L	$46.27	incl. in rate	incl. in rate	$185.08
Laborer	Active	2.00	0.5	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Truck Driver (heavy)	Active	1.00	***1.0***	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
		3.00	0.5	8	12.00	0	$0.00	$0.00		$0.00
		2.00	0.5	8	8.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
					Labor Hours	**32**			**TOTAL LABOR**	**$1,746.56**
					Equipment Hours	**8**			**TOTAL EQUIPMENT**	**$605.04**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.050	0.00	$144.13	$0.00
		ea	1.050	0.00	$1.43	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,746.56	Labor Burden @	0.0%			$1,746.56
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$605.04	Equipment Tax @	7.75%	$46.89		$651.93
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$2,352**			**$47**	**DIRECT COST SUBTOTALS**	**$2,398**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$2,398.49		$359.77
Installing Contractors Profit@	8.0%				$2,398.49		$191.88
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$551.65**
General Contractors Insurance @	1.0%		on		$2,950.14		$30
Bond @	1.0%		on		$2,950.14		$30
Contingency @	0.0%		on		$3,009.15		$0
						TOTAL COST for pay item	**$3,009**

Additional Pay Item Notes :

This based on crane already being near location of the dock, 1 50ton crane to lift dock and place on truck, 1 flat bed truck hauling all day to dispose of material, 2 laborers will be used to disassemble the dock and rig dock to crane, Foreman with truck will oversee operation.

PAY ITEM COST DETAIL WORKSHEET — **2.091 Mallard Cove - 20'x5' Gangway w/ aluminum grate and railings**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.091		**Project**	: Copco 1			
Description	:	Mallard Cove - 20'x5' Gangway w/ aluminum grate and railings						
Quantity	:	1.00	EA					
Daily Production	:	2.00	EA per 8 hour shift	**Project #**	: 2			
Work Days	:	0.5	Days	**Estimator**	: Eric Jones	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$2,758.50	per EA	**Probable Low Cost Parameter**		**2.3**	**$2,345**	**$2,344.72**
Total Cost	:	$2,758		**Probable High Cost Parameter**		**1.7**	**$3,172**	**$3,172.27**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (50tn)	Active	1.00	0.5	8	4.00	E	$134.32	incl. in rate	incl. in rate	$537.28
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	***1.0***	8	8.00	E	$31.90	incl. in rate	incl. in rate	$255.20
Truck, Pickup (4x4, 3/4tn)	Active	1.00	0.5	8	4.00	E	$16.94	incl. in rate	incl. in rate	$67.76
Equipment Operator (light)	Active	1.00	0.5	8	4.00	L	$64.90	incl. in rate	incl. in rate	$259.60
Labor Foreman (out)	Active	1.00	0.5	8	4.00	L	$46.27	incl. in rate	incl. in rate	$185.08
Laborer	Active	2.00	0.5	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Truck Driver (heavy)	Active	1.00	***1.0***	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
		3.00	0.5	8	12.00	0	$0.00	$0.00		$0.00
		2.00	0.5	8	8.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
					Labor Hours	**24**			**TOTAL LABOR**	**$1,271.80**
					Equipment Hours	**16**			**TOTAL EQUIPMENT**	**$860.24**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.050	0.00	$144.13	$0.00
		ea	1.050	0.00	$1.43	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,271.80	Labor Burden @	0.0%			$1,271.80
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$860.24	Equipment Tax @	7.75%	$66.67		$926.91
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$2,132**			**$67**	**DIRECT COST SUBTOTALS**	**$2,199**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$2,198.71		$329.81
Installing Contractors Profit@	8.0%				$2,198.71		$175.90
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$505.70**
General Contractors Insurance @	1.0%		on		$2,704.41		$27
Bond @	1.0%		on		$2,704.41		$27
Contingency @	0.0%		on		$2,758.50		$0
						TOTAL COST for pay item	**$2,758**

Additional Pay Item Notes :

This based on crane already being near location of the dock, 1 50ton crane to lift gangway and place on truck, 1 flat bed truck hauling all day to dispose of material, 2 laborers will be used to disassemble the gangway and rig gangway to crane, Foreman with truck will oversee operation.

PAY ITEM COST DETAIL WORKSHEET

2.092 Mallard Cove - Signs to be removed and hauled away

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.092		**Project**	: Copco 1			
Description	:	Mallard Cove - Signs to be removed and hauled away						
Quantity	:	6.00 EA						
Daily Production	:	24.00 EA per 8 hour shift		**Project #**	: 2			
Work Days	:	0.3 Days		**Estimator**	: Eric Jones	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$152.39 per EA		**Probable Low Cost Parameter**		**26.4**	**$823**	**$137.15**
Total Cost	:	$914		**Probable High Cost Parameter**		**21.6**	**$1,006**	**$167.63**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Loader, FE Rubber Tire (5.25cy)	Active	1.00	0.3	8	2.40	E	$75.42	incl. in rate	incl. in rate	$181.01
Truck, Pickup (4x4, 3/4tn)	Active	1.00	0.3	8	2.40	E	$16.94	incl. in rate	incl. in rate	$40.66
Equipment Operator (medium)	Active	1.00	0.3	8	2.40	L	$66.28	incl. in rate	incl. in rate	$159.07
Labor Foreman (out)	Active	1.00	0.3	8	2.40	L	$46.27	incl. in rate	incl. in rate	$111.05
Laborer	Active	2.00	0.3	8	4.80	L	$45.80	incl. in rate	incl. in rate	$219.84
0	Active	1.00	0.3	8	2.40	0	$0.00	incl. in rate	incl. in rate	$0.00
0		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		3.00	0.3	8	7.20	0	$0.00	$0.00		$0.00
		2.00	0.3	8	4.80	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
				Labor Hours	**9.6**				**TOTAL LABOR**	**$489.96**
				Equipment Hours	**4.8**				**TOTAL EQUIPMENT**	**$221.66**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.050	0.00	$144.13	$0.00
		ea	1.050	0.00	$1.43	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$489.96	Labor Burden @	0.0%			$489.96
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$221.66	Equipment Tax @	7.75%	$17.18		$238.84
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$712**			**$17**	**DIRECT COST SUBTOTALS**	**$729**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$728.80		$109.32
Installing Contractors Profit@	8.0%				$728.80		$58.30
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$167.62**
General Contractors Insurance @	1.0%		on		$896.43		$9
Bond @	1.0%		on		$896.43		$9
Contingency @	0.0%		on		$914.36		$0
						TOTAL COST for pay item	**$914**

Additional Pay Item Notes :

Based on a 4 man crew removing signs with loader, material is expected to be loaded on either the gangway truck or the dock truck for disposal. This operation is expected to happen with the pay item 93.

PAY ITEM COST DETAIL WORKSHEET — **2.093 Mallard Cove - Wood plank tables to be removed and hauled away**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.093		**Project**	: Copco 1			
Description	:	Mallard Cove - Wood plank tables to be removed and hauled away						
Quantity	:	8.00 EA						
Daily Production	:	32.00 EA per	8 hour shift	**Project #**	: 2			
Work Days	:	0.3 Days		**Estimator**	: Eric Jones	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$114.29 per EA		**Probable Low Cost Parameter**		**35.2**	**$823**	**$102.87**
Total Cost	:	$914		**Probable High Cost Parameter**		**28.8**	**$1,006**	**$125.72**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Loader, FE Rubber Tire (5.25cy)	Active	1.00	0.3	8	2.40	E	$75.42	incl. in rate	incl. in rate	$181.01
Truck, Pickup (4x4, 3/4tn)	Active	1.00	0.3	8	2.40	E	$16.94	incl. in rate	incl. in rate	$40.66
Equipment Operator (medium)	Active	1.00	0.3	8	2.40	L	$66.28	incl. in rate	incl. in rate	$159.07
Labor Foreman (out)	Active	1.00	0.3	8	2.40	L	$46.27	incl. in rate	incl. in rate	$111.05
Laborer	Active	2.00	0.3	8	4.80	L	$45.80	incl. in rate	incl. in rate	$219.84
	Active	1.00	0.3	8	2.40	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		3.00	0.3	8	7.20	0	$0.00	$0.00		$0.00
		2.00	0.3	8	4.80	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
				Labor Hours	**9.6**				**TOTAL LABOR**	**$489.96**
				Equipment Hours	**4.8**				**TOTAL EQUIPMENT**	**$221.66**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.050	0.00	$144.13	$0.00
		ea	1.050	0.00	$1.43	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$489.96	Labor Burden @	0.0%			$489.96
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$221.66	Equipment Tax @	7.75%	$17.18		$238.84
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$712**			**$17**	**DIRECT COST SUBTOTALS**	**$729**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$728.80		$109.32
Installing Contractors Profit@	8.0%				$728.80		$58.30
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$167.62**
General Contractors Insurance @	1.0%		on		$896.43		$9
Bond @	1.0%		on		$896.43		$9
Contingency @	0.0%		on		$914.36		$0
						TOTAL COST for pay item	**$914**

Additional Pay Item Notes :

4 man crew will remove tables and load them on to either truck hauling dock or gangway. This activity will occur with pay item 92.

PAY ITEM COST DETAIL WORKSHEET

2.094 Mallard Cove - Parking area to be regraded

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.094		**Project**	: Copco 1			
Description	:	Mallard Cove - Parking area to be regraded						
Quantity	:	2.50 AC						
Daily Production	:	1.00 AC per	8 hour shift	**Project #**	: 2			
Work Days	:	2.5 Days		**Estimator**	: Eric Jones	**AC per**	**Total Cost**	**Unit Price Per AC**
Unit Price	:	$7,451.08 per AC		**Probable Low Cost Parameter**		**1.1**	**$16,765**	**$6,705.97**
Total Cost	:	$18,628		**Probable High Cost Parameter**		**0.85**	**$21,422**	**$8,568.74**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (125hp)(CATD6)	Active	1.00	2.5	8	20.00	E	$82.17	incl. in rate	incl. in rate	$1,643.40
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	2.5	8	20.00	E	$70.35	incl. in rate	incl. in rate	$1,407.00
Grader, 180hp, 13' blade	Active	1.00	2.5	8	20.00	E	$80.79	incl. in rate	incl. in rate	$1,615.80
Roller, Single Drum (steel wheel, 12.0 - 14.9 MTn)	Active	1.00	2.5	8	20.00	E	$72.79	incl. in rate	incl. in rate	$1,455.80
Truck, Pickup (4x4, 3/4tn)	Active	1.00	2.5	8	20.00	E	$16.94	incl. in rate	incl. in rate	$338.80
Truck Driver (heavy)	Active	1.00	2.5	8	20.00	L	$57.59	incl. in rate	incl. in rate	$1,151.80
Labor Foreman (out)	Active	1.00	2.5	8	20.00	L	$46.27	incl. in rate	incl. in rate	$925.40
Laborer	Active	2.00	2.5	8	40.00	L	$45.80	incl. in rate	incl. in rate	$1,832.00
Equipment Operator (medium)	Active	3.00	2.5	8	60.00	L	$66.28	incl. in rate	incl. in rate	$3,976.80
0	Active	2.00	2.5	8	40.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	3.00	2.5	8	60.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	2.5	8	20.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			2.5	8	0.00					$0.00
			2.5	8	0.00					$0.00
			2.5	8	0.00					$0.00
			2.5	8	0.00					$0.00
			2.5	8	0.00					$0.00
				Labor Hours	**140**				**TOTAL LABOR**	**$7,886.00**
				Equipment Hours	**100**				**TOTAL EQUIPMENT**	**$6,460.80**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		lbs PLS	1.050	0.00	$10.69	$0.00
		lbs PLS	1.050	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$7,886.00	Labor Burden @	0.0%			$7,886.00
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$6,460.80	Equipment Tax @	7.75%	$500.71		$6,961.51
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$14,347**			**$501**	**DIRECT COST SUBTOTALS**	**$14,848**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$14,847.51		$2,227.13
Installing Contractors Profit@	8.0%				$14,847.51		$1,187.80
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$3,414.93**
General Contractors Insurance @	1.0%		on		$18,262.44		$183
Bond @	1.0%		on		$18,262.44		$183
Contingency @	0.0%		on		$18,627.69		$0
						TOTAL COST for pay item	**$18,628**

Additional Pay Item Notes :

Production is based off of 12 man crew finishing .5 acres a shift, dozers will be regrading area, grader will be used to fine grade, tractors will be used to rip material for seeding, seed sprayers will use Idaho Fescue seed, water truck will continuously water area for 2 weeks.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.095		**Project**	: Copco 1			
Description	:	Copco Cove - Concrete Total						
Quantity	:	84.00 CY						
Daily Production	:	40.00 CY per	8 hour shift	**Project #**	: 2			
Work Days	:	2.1 Days		**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$331.83 per CY		**Probable Low Cost Parameter**		**46**	**$23,693**	**$282.06**
Total Cost	:	$27,874		**Probable High Cost Parameter**		**34**	**$32,055**	**$381.61**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	2.00	2.1	8	33.60	E	$274.63	incl. in rate	incl. in rate	$9,227.57
Loader, FE Rubber Tire (5.25cy)	Active	1.00	2.1	8	16.80	E	$75.42	incl. in rate	incl. in rate	$1,267.06
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	2.1	8	33.60	E	$70.35	incl. in rate	incl. in rate	$2,363.76
Truck, Pickup (4x4, 3/4tn)	Active	1.00	2.1	8	16.80	E	$16.94	incl. in rate	incl. in rate	$284.59
Hydraulic Impact Breaker Attachment (3k-4k ft-lb)	Active	1.00	2.1	8	16.80	E	$36.58	incl. in rate	incl. in rate	$614.54
Truck Driver (heavy)	Active	1.00	2.1	8	16.80	L	$57.59	incl. in rate	incl. in rate	$967.51
Labor Foreman (out)	Active	1.00	2.1	8	16.80	L	$46.27	incl. in rate	incl. in rate	$777.34
Laborer	Active	3.00	2.1	8	50.40	L	$45.80	incl. in rate	incl. in rate	$2,308.32
Equipment Operator (medium)	Active	3.00	2.1	8	50.40	L	$66.28	incl. in rate	incl. in rate	$3,340.51
		1.00	2.1	8	16.80	0	$0.00	$0.00		$0.00
		1.00	2.1	8	16.80	0	$0.00	$0.00		$0.00
		1.00	2.1	8	16.80	0	$0.00	$0.00		$0.00
			2.1	8	0.00					$0.00
			2.1	8	0.00					$0.00
			2.1	8	0.00					$0.00
			2.1	8	0.00					$0.00
			2.1	8	0.00					$0.00
					Labor Hours	**134.4**			**TOTAL LABOR**	**$7,393.68**
					Equipment Hours	**117.6**			**TOTAL EQUIPMENT**	**$13,757.52**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.050	0.00	$144.13	$0.00
		ea	1.050	0.00	$1.43	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$7,393.68	Labor Burden @	0.0%			$7,393.68
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$13,757.52	Equipment Tax @	7.75%	$1,066.21		$14,823.73
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$21,151**			**$1,066**	**DIRECT COST SUBTOTALS**	**$22,217**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$22,217.41		$3,332.61
Installing Contractors Profit@	8.0%				$22,217.41		$1,777.39
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$5,110.00**
General Contractors Insurance @	1.0%		on		$27,327.41		$273
Bond @	1.0%		on		$27,327.41		$273
Contingency @	0.0%		on		$27,873.96		$0
						TOTAL COST for pay item	**$27,874**

Additional Pay Item Notes :

1 excavator with breaker to perform demolition, 1 excavator to pile material, 1 loader to support loading operation, 1 foreman with truck to oversee operation, 3 laborers to direct trucks and support equipment demolition operations. Production currently shows 2 loads of concrete material per truck and duration of 3 days, the crew output is low due to the items being demolished are small and spaced out.

PAY ITEM COST DETAIL WORKSHEET

2.096 Copco Cove - Dock abutment railing made of 2.5" dia. steel pipe

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.096		**Project**	: COPCO 1			
Description	:	Copco Cove - Dock abutment railing made of 2.5" dia. steel pipe						
Quantity	:	1.00 EA						
Daily Production	:	2.00 EA per	8 hour shift	**Project #**	: 2			
Work Days	:	0.5 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$1,446.70 per EA		**Probable Low Cost Parameter**		**2.2**	**$1,302**	**$1,302.03**
Total Cost	:	$1,447		**Probable High Cost Parameter**		**1.8**	**$1,591**	**$1,591.37**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Laborer	Active	1.00	0.5	8	4.00	L	$45.80	incl. in rate	incl. in rate	$183.20
Steelworker	Active	1.00	0.5	8	4.00	L	$65.52	incl. in rate	incl. in rate	$262.08
Truck Driver (light)	Active	1.00	0.5	8	4.00	L	$56.29	incl. in rate	incl. in rate	$225.16
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.5	8	4.00	E	$111.64	incl. in rate	incl. in rate	$446.56

Labor Hours	**12**	**TOTAL LABOR**	**$670.44**
Equipment Hours	**4**	**TOTAL EQUIPMENT**	**$446.56**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$33.52	$33.52
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$33.52**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$670.44	Labor Burden @	49.7%	$0.00		$670.44
Material Cost	$33.52	Material Tax @	7.8%	$2.60		$36.12
Equipment Cost	$446.56	Equipment Tax @	0.0%	$0.00		$446.56
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,151**			**$3**	**DIRECT COST SUBTOTALS**	**$1,153**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,153.12	$172.97
Installing Contractors Profit@	8.0%				$1,153.12	$92.25
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$265.22**
General Contractors Insurance @	1.0%		on		$1,418.34	$14
Bond @	1.0%		on		$1,418.34	$14
Contingency @	0.0%		on		$1,446.70	$0
					TOTAL COST for pay item	**$1,447**

Additional Pay Item Notes :

Assumed 1/2 day of work done by 1 Steelman to cut and 1 Laborer to load in the truck.

PAY ITEM COST DETAIL WORKSHEET — **2.097 Copco Cove - Signs to be removed and hauled away**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.097		**Project**	: Copco 1			
Description	:	Copco Cove - Signs to be removed and hauled away						
Quantity	:	6.00 EA						
Daily Production	:	12.00 EA per	8 hour shift	**Project #**	: 2			
Work Days	:	0.5 Days		**Estimator**	: Eric Jones	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$407.82 per EA		**Probable Low Cost Parameter**		**13.2**	**$2,202**	**$367.04**
Total Cost	:	$2,447		**Probable High Cost Parameter**		**10.8**	**$2,692**	**$448.60**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Loader, FE Rubber Tire (5.25cy)	Active	1.00	0.5	8	4.00	E	$75.42	incl. in rate	incl. in rate	$301.68
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	***1.0***	8	8.00	E	$31.90	incl. in rate	incl. in rate	$255.20
Truck Driver (heavy)	Active	1.00	***1.0***	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Pickup (4x4, 3/4tn)	Active	1.00	0.5	8	4.00	E	$16.94	incl. in rate	incl. in rate	$67.76
Labor Foreman (out)	Active	1.00	0.5	8	4.00	L	$46.27	incl. in rate	incl. in rate	$185.08
Laborer	Active	2.00	0.5	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Equipment Operator (medium)	Active	1.00	0.5	8	4.00	L	$66.28	incl. in rate	incl. in rate	$265.12
		3.00	0.5	8	12.00	0	$0.00	$0.00		$0.00
		2.00	0.5	8	8.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
				Labor Hours	**24**				**TOTAL LABOR**	**$1,277.32**
				Equipment Hours	**16**				**TOTAL EQUIPMENT**	**$624.64**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.050	0.00	$144.13	$0.00
		ea	1.050	0.00	$1.43	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,277.32	Labor Burden @	0.0%			$1,277.32
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$624.64	Equipment Tax @	7.75%	$48.41		$673.05
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,902**			**$48**	**DIRECT COST SUBTOTALS**	**$1,950**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,950.37		$292.56
Installing Contractors Profit@	8.0%				$1,950.37		$156.03
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$448.59**
General Contractors Insurance @	1.0%		on		$2,398.95		$24
Bond @	1.0%		on		$2,398.95		$24
Contingency @	0.0%		on		$2,446.93		$0
						TOTAL COST for pay item	**$2,447**

Additional Pay Item Notes :

Based on a 4 man crew removing signs with loader, extra time accounts for getting equipment to area, flatbed truck is expected to be used whole day to dispose material.

PAY ITEM COST DETAIL WORKSHEET — **2.098 Copco Cove - Wood plank tables to be removed and hauled away**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.098		**Project**	: Copco 1			
Description	:	Copco Cove - Wood plank tables to be removed and hauled away						
Quantity	:	2.00	EA					
Daily Production	:	24.00	EA per 8 hour shift	**Project #**	: 2			
Work Days	:	0.1	Days	**Estimator**	: Eric Jones	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$152.39	per EA	**Probable Low Cost Parameter**		**26.4**	**$274**	**$137.15**
Total Cost	:	$305		**Probable High Cost Parameter**		**21.6**	**$335**	**$167.63**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Loader, FE Rubber Tire (5.25cy)	Active	1.00	0.1	8	0.80	E	$75.42	incl. in rate	incl. in rate	$60.34
Truck, Pickup (4x4, 3/4tn)	Active	1.00	0.1	8	0.80	E	$16.94	incl. in rate	incl. in rate	$13.55
Equipment Operator (medium)	Active	1.00	0.1	8	0.80	L	$66.28	incl. in rate	incl. in rate	$53.02
Labor Foreman (out)	Active	1.00	0.1	8	0.80	L	$46.27	incl. in rate	incl. in rate	$37.02
Laborer	Active	2.00	0.1	8	1.60	L	$45.80	incl. in rate	incl. in rate	$73.28
		0.00	0.1	8	0.00	0	$0.00	$0.00		$0.00
		0.00	0.1	8	0.00	0	$0.00	$0.00		$0.00
		0.00	0.1	8	0.00	0	$0.00	$0.00		$0.00
		0.00	0.1	8	0.00	0	$0.00	$0.00		$0.00
		0.00	0.1	8	0.00	0	$0.00	$0.00		$0.00
		0.00	0.1	8	0.00	0	$0.00	$0.00		$0.00
		0.00	0.1	8	0.00	0	$0.00	$0.00		$0.00
			0.1	8	0.00					$0.00
			0.1	8	0.00					$0.00
			0.1	8	0.00					$0.00
			0.1	8	0.00					$0.00
			0.1	8	0.00					$0.00
				Labor Hours	**3.2**				**TOTAL LABOR**	**$163.32**
				Equipment Hours	**1.6**				**TOTAL EQUIPMENT**	**$73.89**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.050	0.00	$144.13	$0.00
		ea	1.050	0.00	$1.43	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$163.32	Labor Burden @	0.0%			$163.32
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$73.89	Equipment Tax @	7.75%	$5.73		$79.61
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$237**			**$6**	**DIRECT COST SUBTOTALS**	**$243**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$242.93		$36.44
Installing Contractors Profit@	8.0%				$242.93		$19.43
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$55.87**
General Contractors Insurance @	1.0%		on		$298.81		$3
Bond @	1.0%		on		$298.81		$3
Contingency @	0.0%		on		$304.79		$0
						TOTAL COST for pay item	**$305**

Additional Pay Item Notes :

Base don four man crew taking 2 hours to remove and load tables. Tables to be loaded on same flatbed truck from pay item 97.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.099		Project	: Copco 1			
Description	:	Copco Cove - Regrade						
Quantity	:	2.30	AC					
Daily Production	:	1.00	AC per	8	hour shift	Project #	: 2	
Work Days	:	2.3	Days			Estimator	: Eric Jones	
Unit Price	:	$6,531.70	per AC			Probable Low Cost Parameter	1.1	$13,521	$5,878.53
Total Cost	:	$15,023				Probable High Cost Parameter	0.85	$17,276	$7,511.46

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (125hp)(CATD6)	Active	1.00	2.3	8	18.40	E	$82.17	incl. in rate	incl. in rate	$1,511.93
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	2.3	8	18.40	E	$70.35	incl. in rate	incl. in rate	$1,294.44
Grader, 180hp, 13' blade	Active	1.00	2.3	8	18.40	E	$80.79	incl. in rate	incl. in rate	$1,486.54
Roller, Single Drum (steel wheel, 12.0 - 14.9 MTn)	Active	1.00	2.3	8	18.40	E	$72.79	incl. in rate	incl. in rate	$1,339.34
Truck, Pickup (4x4, 3/4tn)	Active	1.00	2.3	8	18.40	E	$16.94	incl. in rate	incl. in rate	$311.70
Truck Driver (heavy)	Active	1.00	2.3	8	18.40	L	$57.59	incl. in rate	incl. in rate	$1,059.66
Labor Foreman (out)	Active	1.00	2.3	8	18.40	L	$46.27	incl. in rate	incl. in rate	$851.37
Equipment Operator (medium)	Active	3.00	2.3	8	55.20	L	$66.28	incl. in rate	incl. in rate	$3,658.66
0	Active	1.00	2.3	8	18.40	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	2.00	2.3	8	36.80	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	0.00	2.3	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	0.00	2.3	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			2.3	8	0.00					$0.00
			2.3	8	0.00					$0.00
			2.3	8	0.00					$0.00
			2.3	8	0.00					$0.00
			2.3	8	0.00					$0.00
				Labor Hours	92			TOTAL LABOR		$5,569.68
				Equipment Hours	92			TOTAL EQUIPMENT		$5,943.94

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		lbs PLS	1.050	0.00	$10.69	$0.00
		lbs PLS	1.050	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$5,569.68	Labor Burden @	0.0%		$5,569.68
Material Cost	$0.00	Material Tax @	7.75%	$0.00	$0.00
Equipment Cost	$5,943.94	Equipment Tax @	7.75%	$460.66	$6,404.59
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$11,514			$461	DIRECT COST SUBTOTALS $11,974

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$11,974.27	$1,796.14
Installing Contractors Profit@	8.0%				$11,974.27	$957.94
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$2,754.08
General Contractors Insurance @	1.0%		on		$14,728.35	$147
Bond @	1.0%		on		$14,728.35	$147
Contingency @	0.0%		on		$15,022.92	$0
					TOTAL COST for pay item	$15,023

Additional Pay Item Notes :

Production is based off of 12 man crew finishing .5 acres a shift, dozers will be regrading area, grader will be used to fine grade, tractors will be used to rip material for seeding, seed sprayers will use Idaho Fescue seed, water truck will continuously water area for 2 weeks.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.100		**Project**	: Copco 1			
Description	:	Diversion Tunnel Lining						
Quantity	:	1.00	LS					
Daily Production	:	0.33	LS per 8 hour shift	**Project #**	: 2			
Work Days	:	3.0	Days	**Estimator**	: Eric Jones	**LS per**	**Total Cost**	**Unit Price Per LS**
Unit Price	:	$244,844.33	per LS	**Probable Low Cost Parameter**		**0.363**	**$220,360**	**$220,359.90**
Total Cost	:	$244,844		**Probable High Cost Parameter**		**0.2805**	**$281,571**	**$281,570.98**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
0	Active	1.00	3.0	8	24.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	3.0	8	24.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	3.0	8	24.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	3.0	8	24.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	3.0	8	24.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	3.0	8	24.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	3.0	8	24.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	3.00	3.0	8	72.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	3.0	8	24.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	2.00	3.0	8	48.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	0.00	3.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	0.00	3.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
				Labor Hours	**0**			**TOTAL LABOR**		**$0.00**
				Equipment Hours	**0**			**TOTAL EQUIPMENT**		**$0.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		lbs PLS	1.050	0.00	$10.69	$0.00
		lbs PLS	1.050	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Tunnel Lining (Shotcrete with Reinforcement)	1	LS	**RSMs (569 CY @ $401.78/CY)**	$228,612.82	$228,612.82
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$228,612.82**

SUMMARY OF COSTS

Labor Cost	$0.00	Labor Burden @	0.0%		$0.00
Material Cost	$0.00	Material Tax @	7.75%	$0.00	$0.00
Equipment Cost	$0.00	Equipment Tax @	7.75%	$0.00	$0.00
Subcontractors	$228,612.82				$228,612.82
DIRECT COST SUBTOTALS	**$228,613**			**$0**	**DIRECT COST SUBTOTALS** **$228,613**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$0.00	$0.00
Installing Contractors Profit@	8.0%				$0.00	$0.00
GC Markup on Subs @	5.0%				$228,612.82	$11,430.64
						TOTAL MARKUP COSTS **$11,430.64**
General Contractors Insurance @	1.0%		on		$240,043.46	$2,400
Bond @	1.0%		on		$240,043.46	$2,400
Contingency @	0.0%		on		$244,844.33	$0
						TOTAL COST for pay item **$244,844**

Additional Pay Item Notes :

Subcontract will reinforce and shotcrete divervsion tunnels

PAY ITEM COST DETAIL WORKSHEET

3.001 Construct and Remove Embankment Cofferdam-Right Side of Dam

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.001			**Project**	:	Copco 2			
Description	:	Construct and Remove Embankment Cofferdam-Right Side of Dam								
Quantity	:	3,100.00	cy							
Daily Production	:	425.00	cy per	8 hour shift	**Project #**	:	3			
Work Days	:	7.3	Days		**Estimator**	:	Michael Barba	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$59.70	per cy		**Probable Low Cost Parameter**			**488.75**	**$157,311**	**$50.75**
Total Cost	:	$185,071			**Probable High Cost Parameter**			**361.25**	**$212,832**	**$68.66**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (310hp)(CATD8)	Active	1.00	7.3	8	58.40	E	$197.60	$197.60		$11,539.84
Hydraulic Excavator (5.0cy)	Active	1.00	7.3	8	58.40	E	$274.63	$274.63		$16,038.39
Truck, On-Highway Dump (6x4, 12cy)	Active	4.00	7.3	8	233.60	E	$70.35	$70.35		$16,433.76
Equipment Operator (medium)	Active	2.00	7.3	8	116.80	L	$66.28	$0.00		$7,741.50
Truck Driver (heavy)	Active	1.00	7.3	8	58.40	L	$57.59	$0.00		$3,363.26
Laborer	Active	2.00	7.3	8	116.80	L	$45.80	$0.00		$5,349.44
		1.00	7.3	8	58.40	0	$0.00	$0.00		$0.00
		1.00	7.3	8	58.40	0	$0.00	$0.00		$0.00
		1.00	7.3	8	58.40	0	$0.00	$0.00		$0.00
		1.00	7.3	8	58.40	0	$0.00	$0.00		$0.00
		1.00	7.3	8	58.40	0	$0.00	$0.00		$0.00
		1.00	7.3	8	58.40	0	$0.00	$0.00		$0.00
			7.3	8	0.00					$0.00
			7.3	8	0.00					$0.00
			7.3	8	0.00					$0.00
			7.3	8	0.00					$0.00
			7.3	8	0.00					$0.00
				Labor Hours	**292**				**TOTAL LABOR**	**$16,454.20**
				Equipment Hours	**350.4**				**TOTAL EQUIPMENT**	**$44,011.99**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
			1.300	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Cofferdam Sheet Piling Drive and Extract (131' X 3	3,930	SF	**RSMs Data**	$24.93	$97,974.90
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$97,974.90**

SUMMARY OF COSTS

Labor Cost	$16,454.20	Labor Burden @	49.7%	$0.00		$16,454.20
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$44,011.99	Equipment Tax @	7.75%	$3,410.93		$47,422.92
Subcontractors	$97,974.90					$97,974.90
DIRECT COST SUBTOTALS	**$158,441**			**$3,411**	**DIRECT COST SUBTOTALS**	**$161,852**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$63,877.12		$9,581.57
Installing Contractors Profit@	8.0%				$63,877.12		$5,110.17
GC Markup on Subs @	5.0%				$97,974.90		$4,898.75
						TOTAL MARKUP COSTS	**$19,590.48**
General Contractors Insurance @	1.0%		on		$181,442.50		$1,814
Bond @	1.0%		on		$181,442.50		$1,814
Contingency @	0.0%		on		$185,071.35		$0
						TOTAL COST for pay item	**$185,071**

Additional Pay Item Notes :

Figuring that there will need to be sheet pile drive to allow the cofferdam to with stand the flow from the river. Fill material will be provided from onsite demolition.

PAY ITEM COST DETAIL WORKSHEET

3.002 Furnish, Install, and Remove RipRap

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.002		**Project**	: Copco 2			
Description	:	Furnish, Install, and Remove RipRap						
Quantity	:	465.00	CY					
Daily Production	:	100.00	CY per 8 hour shift	**Project #**	: 3			
Work Days	:	4.7	Days	**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$129.88	per CY	**Probable Low Cost Parameter**		**115**	**$51,333**	**$110.39**
Total Cost	:	$60,392		**Probable High Cost Parameter**		**80**	**$72,471**	**$155.85**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	2.00	4.7	8	75.20	E	$274.63	incl. in rate	incl. in rate	$20,652.18
Equipment Operator (medium)	Active	2.00	4.7	8	75.20	L	$66.28	incl. in rate	incl. in rate	$4,984.26
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	4.7	8	75.20	E	$70.35	incl. in rate	incl. in rate	$5,290.32
Truck Driver (heavy)	Active	3.00	4.7	8	112.80	L	$57.59	incl. in rate	incl. in rate	$6,496.15
Labor Foreman	Active	1.00	4.7	8	37.60	L	$48.27	incl. in rate	incl. in rate	$1,814.95
Laborer	Active	4.00	4.7	8	150.40	L	$45.80	incl. in rate	incl. in rate	$6,888.32
		1.00	4.7	8	37.60	0	$0.00	$0.00		$0.00
		2.00	4.7	8	75.20	0	$0.00	$0.00		$0.00
		1.00	4.7	8	37.60	0	$0.00	$0.00		$0.00
		1.00	4.7	8	37.60	0	$0.00	$0.00		$0.00
		1.00	4.7	8	37.60	0	$0.00	$0.00		$0.00
		1.00	4.7	8	37.60	0	$0.00	$0.00		$0.00
			4.7	8	0.00					$0.00
			4.7	8	0.00					$0.00
			4.7	8	0.00					$0.00
			4.7	8	0.00					$0.00
			4.7	8	0.00					$0.00
				Labor Hours	**376**			**TOTAL LABOR**		**$20,183.68**
				Equipment Hours	**150.4**			**TOTAL EQUIPMENT**		**$25,942.50**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
			1.300	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$20,183.68	Labor Burden @	0.0%			$20,183.68
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$25,942.50	Equipment Tax @	7.75%	$2,010.54		$27,953.04
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$46,126**			**$2,011**	**DIRECT COST SUBTOTALS**	**$48,137**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$48,136.72		$7,220.51
Installing Contractors Profit@	8.0%				$48,136.72		$3,850.94
GC Markup on Subs @	10.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$11,071.45**
General Contractors Insurance @	1.0%			on	$59,208.16		$592
Bond @	1.0%			on	$59,208.16		$592
Contingency @	0.0%			on	$60,392.33		$0
						TOTAL COST for pay item	**$60,392**

Additional Pay Item Notes :

1 excavator will place the rip rap in its final position, two trucks will run from Iron gate and stock pile material due to tight area more trucks will cause too much congestion. Laborers will be directing truck traffic, foreman will oversee operation.

PAY ITEM COST DETAIL WORKSHEET

3.003 Provide Dewatering behind Cofferdams

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.003		**Project**	: Copco 2			
Description	:	Provide Dewatering behind Cofferdams						
Quantity	:	1.00 LS						
Daily Production	:	1.00 LS per	8 hour shift	**Project #**	: 3			
Work Days	:	1.0 Days		**Estimator**	: Eric Jones	**LS per**	**Total Cost**	**Unit Price Per LS**
Unit Price	:	$143,210.99 per LS		**Probable Low Cost Parameter**		**1.1**	**$128,890**	**$128,889.89**
Total Cost	:	$143,211		**Probable High Cost Parameter**		**0.9**	**$157,532**	**$157,532.09**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Pump, Submersible Trash Pump, 3" & 4"	Active	1.00	***120.0***	8	960.00	E	$3.87	incl. in rate	incl. in rate	$3,715.20
Laborer	Active	2.00	***120.0***	8	1,920.00	L	$45.80	incl. in rate	incl. in rate	$87,936.00
Labor Foreman (out)	Active	1.00	***60.0***	8	480.00	L	$46.27	incl. in rate	incl. in rate	$22,209.60
0		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
0		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		2.00	1.0	8	16.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		2.00	1.0	8	16.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	**2400**				**TOTAL LABOR**	**$110,145.60**
				Equipment Hours	**960**				**TOTAL EQUIPMENT**	**$3,715.20**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		cy	1.300	0.00	$65.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$110,145.60	Labor Burden @	0.0%			$110,145.60
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$3,715.20	Equipment Tax @	7.75%	$287.93		$4,003.13
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$113,861**			**$288**	**DIRECT COST SUBTOTALS**	**$114,149**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$114,148.73		$17,122.31
Installing Contractors Profit@	8.0%				$114,148.73		$9,131.90
GC Markup on Subs @	10.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$26,254.21**
General Contractors Insurance @	1.0%		on		$140,402.94		$1,404
Bond @	1.0%		on		$140,402.94		$1,404
Contingency @	0.0%		on		$143,210.99		$0
						TOTAL COST for pay item	**$143,211**

Additional Pay Item Notes :

3" pump will be used for 4 months, 1 laborer will be managing the pump during the day and 1 laborer will be managing the pump at night, foreman will be involved with managing the pump 1/2 of the 4 months.

PAY ITEM COST DETAIL WORKSHEET

3.004 Remove Water from behind Cofferdams

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.004		**Project**	: Copco 2			
Description	:	Remove Water from behind Cofferdams						
Quantity	:	241,000.00	GAL					
Daily Production	:	120,500.00	GAL per 8 hour shift	**Project #**	: 3			
Work Days	:	2.0	Days	**Estimator**	: Eric Jones	**GAL per**	**Total Cost**	**Unit Price Per GAL**
Unit Price	:	$0.02	per GAL	**Probable Low Cost Parameter**		**132550**	**$5,251**	**$0.02**
Total Cost	:	$5,834		**Probable High Cost Parameter**		**108450**	**$6,418**	**$0.03**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Pump, Submersible Trash Pump, 3" & 4"	Active	1.00	2.0	8	16.00	E	$3.87	incl. in rate	incl. in rate	$61.92
Loader, FE Rubber Tire (5.25cy)	Active	1.00	***1.0***	8	8.00	E	$75.42	incl. in rate	incl. in rate	$603.36
Truck, Pickup (4x4, 3/4tn)	Active	1.00	2.0	8	16.00	E	$16.94	incl. in rate	incl. in rate	$271.04
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	incl. in rate	incl. in rate	$740.32
Laborer	Active	3.00	2.0	8	48.00	L	$45.80	incl. in rate	incl. in rate	$2,198.40
Equipment Operator (medium)	Active	1.00	***1.0***	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
		2.00	2.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
Intake and Discharge Hose, 3" 20' lengths		4.00	2.0	8	64.00	E	$2.50			$160.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
				Labor Hours	**72**				**TOTAL LABOR**	**$3,468.96**
				Equipment Hours	**104**				**TOTAL EQUIPMENT**	**$1,096.32**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		cy	1.300	0.00	$65.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$3,468.96	Labor Burden @	0.0%			$3,468.96
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$1,096.32	Equipment Tax @	7.75%	$84.96		$1,181.28
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$4,565**			**$85**	**DIRECT COST SUBTOTALS**	**$4,650**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,650.24	$697.54
Installing Contractors Profit@	8.0%				$4,650.24	$372.02
GC Markup on Subs @	10.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,069.56**
General Contractors Insurance @	1.0%		on		$5,719.80	$57
Bond @	1.0%		on		$5,719.80	$57
Contingency @	0.0%		on		$5,834.20	$0
					TOTAL COST for pay item	**$5,834**

Additional Pay Item Notes :

It will take a 3" pump 2 days to dewater 241,000gallons of water, 1 laborer will manage pump at night and 1 laborer will manage the pump during the day, loader will be used half of the time to place pump. Foreman with truck will oversee operation.

PAY ITEM COST DETAIL WORKSHEET

3.005 Construct and Remove Embankment Cofferdam-Left Side of Dam

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.005	**Project**	: Copco 2				
Description	:	Construct and Remove Embankment Cofferdam-Left Side of Dam						
Quantity	:	1,100.00 CY						
Daily Production	:	200.00 CY per 8 hour shift	**Project #**	: 3				
Work Days	:	5.5 Days	**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**	
Unit Price	:	$172.54 per CY	**Probable Low Cost Parameter**		**230**	**$161,324**	**$146.66**	
Total Cost	:	$189,793	**Probable High Cost Parameter**		**160**	**$227,752**	**$207.05**	

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (310hp)(CATD8)	Active	1.00	5.5	8	44.00	E	$197.60	incl. in rate	incl. in rate	$8,694.40
Hydraulic Excavator (5.0cy)	Active	1.00	5.5	8	44.00	E	$274.63	incl. in rate	incl. in rate	$12,083.72
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	5.5	8	88.00	E	$70.35	incl. in rate	incl. in rate	$6,190.80
Loader, FE Rubber Tire (5.25cy)	Active	1.00	5.5	8	44.00	E	$75.42	incl. in rate	incl. in rate	$3,318.48
Roller, Single Drum (steel wheel, 12.0 - 14.9 MTn)	Active	1.00	5.5	8	44.00	E	$72.79	incl. in rate	incl. in rate	$3,202.76
Truck, Pickup (4x4, 3/4tn)	Active	1.00	5.5	8	44.00	E	$16.94	incl. in rate	incl. in rate	$745.36
Equipment Operator (medium)	Active	3.00	5.5	8	132.00	L	$66.28	incl. in rate	incl. in rate	$8,748.96
Equipment Operator (light)	Active	1.00	5.5	8	44.00	L	$64.90	incl. in rate	incl. in rate	$2,855.60
Truck Driver (heavy)	Active	2.00	5.5	8	88.00	L	$57.59	incl. in rate	incl. in rate	$5,067.92
Labor Foreman (out)	Active	1.00	5.5	8	44.00	L	$46.27	incl. in rate	incl. in rate	$2,035.88
Laborer	Active	4.00	5.5	8	176.00	L	$45.80	incl. in rate	incl. in rate	$8,060.80
		1.00	5.5	8	44.00	0	$0.00	$0.00		$0.00
		0.00	5.5	8	0.00	E	$0.00			$0.00
			5.5	8	0.00					$0.00
			5.5	8	0.00					$0.00
			5.5	8	0.00					$0.00
			5.5	8	0.00					$0.00
				Labor Hours	**484**				**TOTAL LABOR**	**$26,769.16**
				Equipment Hours	**308**				**TOTAL EQUIPMENT**	**$34,235.52**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		cy	1.300	0.00	$25.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Cofferdam Sheet Piling Drive and Extract (131' X	3,930	SF	**RSMs Data**	$24.93	$97,974.90
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$97,974.90**

SUMMARY OF COSTS

Labor Cost	$26,769.16	Labor Burden @	0.0%			$26,769.16
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$34,235.52	Equipment Tax @	7.75%	$2,653.25		$36,888.77
Subcontractors	$97,974.90					$97,974.90
DIRECT COST SUBTOTALS	**$158,980**			**$2,653**	**DIRECT COST SUBTOTALS**	**$161,633**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$63,657.93	$9,548.69
Installing Contractors Profit@	8.0%				$63,657.93	$5,092.63
GC Markup on Subs @	10.0%				$97,974.90	$9,797.49
					TOTAL MARKUP COSTS	**$24,438.81**
General Contractors Insurance @	1.0%		on		$186,071.65	$1,861
Bond @	1.0%		on		$186,071.65	$1,861
Contingency @	0.0%		on		$189,793.08	$0
					TOTAL COST for pay item	**$189,793**

Additional Pay Item Notes :

Figuring that there will need to be sheet pile drive to allow the cofferdam to with stand the flow from the river. Fill material will be provided from onsite demolition.

PAY ITEM COST DETAIL WORKSHEET

3.006 Furnish, Install, and Remove RipRap

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.006		**Project**	: Copco 2			
Description	:	Furnish, Install, and Remove RipRap						
Quantity	:	250.00 CY						
Daily Production	:	50.00 CY per	8 hour shift	**Project #**	: 3			
Work Days	:	5.0 Days		**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$185.94 per CY		**Probable Low Cost Parameter**		**57.5**	**$39,513**	**$158.05**
Total Cost	:	$46,486		**Probable High Cost Parameter**		**40**	**$55,783**	**$223.13**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	2.00	5.0	8	80.00	E	$274.63	incl. in rate	incl. in rate	$21,970.40
Truck, Pickup (4x4, 3/4tn)	Active	1.00	5.0	8	40.00	E	$16.94	incl. in rate	incl. in rate	$677.60
Labor Foreman (out)	Active	1.00	5.0	8	40.00	L	$46.27	incl. in rate	incl. in rate	$1,850.80
Laborer	Active	3.00	5.0	8	120.00	L	$45.80	incl. in rate	incl. in rate	$5,496.00
Equipment Operator (medium)	Active	2.00	5.0	8	80.00	L	$66.28	incl. in rate	incl. in rate	$5,302.40
0		2.00	5.0	8	80.00	0	$0.00	$0.00		$0.00
		2.00	5.0	8	80.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		0.00	5.0	8	0.00	E	$0.00			$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
				Labor Hours	**240**				**TOTAL LABOR**	**$12,649.20**
				Equipment Hours	**120**				**TOTAL EQUIPMENT**	**$22,648.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		cy	1.300	0.00	$65.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$12,649.20	Labor Burden @	0.0%			$12,649.20
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$22,648.00	Equipment Tax @	7.75%	$1,755.22		$24,403.22
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$35,297**			**$1,755**	**DIRECT COST SUBTOTALS**	**$37,052**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$37,052.42	$5,557.86
Installing Contractors Profit@	8.0%				$37,052.42	$2,964.19
GC Markup on Subs @	10.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$8,522.06**
General Contractors Insurance @	1.0%			on	$45,574.48	$456
Bond @	1.0%			on	$45,574.48	$456
Contingency @	0.0%			on	$46,485.97	$0
					TOTAL COST for pay item	**$46,486**

Additional Pay Item Notes :

Expect that existing riprap will be used from the right side of the coffer dam, material will be moved with 2 excavators, laborers will direct placement of lime stone and support the equipment, Foreman with truck will oversee operation. Production of this activity is low due to not be able to move big quantities using a dump truck.This material will be used as backfill behind sheet wall for coffer dam.

PAY ITEM COST DETAIL WORKSHEET

3.007 Provide Dewatering behind left Side Cofferdam

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.007		**Project**	: Copco 2			
Description	:	Provide Dewatering behind left Side Cofferdam						
Quantity	:	1.00 LS						
Daily Production	:	1.00 LS per 8 hour shift		**Project #**	: 3			
Work Days	:	1.0 Days		**Estimator**	: Eric Jones	**LS per**	**Total Cost**	**Unit Price Per LS**
Unit Price	:	$79,612.67 per LS		**Probable Low Cost Parameter**		**1.1**	**$71,651**	**$71,651.40**
Total Cost	:	$79,613		**Probable High Cost Parameter**		**0.9**	**$87,574**	**$87,573.93**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Pump, Submersible Trash Pump, 3" & 4"	Active	1.00	***120.0***	8	960.00	E	$3.87	incl. in rate	incl. in rate	$3,715.20
Truck, Pickup (4x4, 3/4tn)	Active	1.00	***30.0***	8	240.00	E	$16.94	incl. in rate	incl. in rate	$4,065.60
Labor Foreman (out)	Active	1.00	***30.0***	8	240.00	L	$46.27	incl. in rate	incl. in rate	$11,104.80
Laborer	Active	2.00	***60.0***	8	960.00	L	$45.80	incl. in rate	incl. in rate	$43,968.00
0		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		2.00	1.0	8	16.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		2.00	1.0	8	16.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	**1200**				**TOTAL LABOR**	**$55,072.80**
				Equipment Hours	**1200**				**TOTAL EQUIPMENT**	**$7,780.80**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		cy	1.300	0.00	$65.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$55,072.80	Labor Burden @	0.0%			$55,072.80
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$7,780.80	Equipment Tax @	7.75%	$603.01		$8,383.81
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$62,854**			**$603**	**DIRECT COST SUBTOTALS**	**$63,457**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$63,456.61		$9,518.49
Installing Contractors Profit@	8.0%				$63,456.61		$5,076.53
GC Markup on Subs @	10.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$14,595.02**
General Contractors Insurance @	1.0%			on	$78,051.63		$781
Bond @	1.0%			on	$78,051.63		$781
Contingency @	0.0%			on	$79,612.67		$0
						TOTAL COST for pay item	**$79,613**

Additional Pay Item Notes :

3" pump will be used for 4 months, 1 laborer during the day and 1 laborer during the night will maintain the pump half of the 4 month period, 1 foreman with truck will oversee the operation .25 of the duration.

PAY ITEM COST DETAIL WORKSHEET

3.008 Remove Water from behind Cofferdams

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.008		**Project**	: Copco 2			
Description	:	Remove Water from behind Cofferdams						
Quantity	:	36,000.00	GAL					
Daily Production	:	36,000.00	GAL per 8 hour shift	**Project #**	: 3			
Work Days	:	1.0	Days	**Estimator**	: Eric Jones	**GAL per**	**Total Cost**	**Unit Price Per GAL**
Unit Price	:	$0.15	per GAL	**Probable Low Cost Parameter**		**39600**	**$4,817**	**$0.13**
Total Cost	:	$5,352		**Probable High Cost Parameter**		**32400**	**$5,887**	**$0.16**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Pump, Submersible Trash Pump, 3" & 4"	Active	1.00	1.0	8	8.00	E	$3.87	incl. in rate	incl. in rate	$30.96
Hydraulic Excavator (5.0cy)	Active	1.00	1.0	8	8.00	E	$274.63	incl. in rate	incl. in rate	$2,197.04
Truck, Pickup (4x4, 3/4tn)	Active	1.00	1.0	8	8.00	E	$16.94	incl. in rate	incl. in rate	$135.52
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		2.00	1.0	8	16.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
Intake and Discharge Hose, 3"		4.00	1.0	8	32.00	E	$2.50			$80.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	**32**				**TOTAL LABOR**	**$1,633.20**
				Equipment Hours	**56**				**TOTAL EQUIPMENT**	**$2,443.52**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		cy	1.300	0.00	$65.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,633.20	Labor Burden @	0.0%			$1,633.20
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$2,443.52	Equipment Tax @	7.75%	$189.37		$2,632.89
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$4,077**			**$189**	**DIRECT COST SUBTOTALS**	**$4,266**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,266.09	$639.91
Installing Contractors Profit@	8.0%				$4,266.09	$341.29
GC Markup on Subs @	10.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$981.20**
General Contractors Insurance @	1.0%		on		$5,247.29	$52
Bond @	1.0%		on		$5,247.29	$52
Contingency @	0.0%		on		$5,352.24	$0
					TOTAL COST for pay item	**$5,352**

Additional Pay Item Notes :

3" pump will pump down 36,000 gals in .25 of a shift, It will take a full day to set pump up and to pump down area. Excavator will be used to set pump and hoses, laborers will assist equipment with setting up pump and maintaining the pump, 1 foreman with truck will oversee operation.

PAY ITEM COST DETAIL WORKSHEET

3.009 Remove Water from behind Tailrace Cofferdam

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.009		**Project**	: Copco 2			
Description	:	Remove Water from behind Tailrace Cofferdam						
Quantity	:	400,000.00	GAL					
Daily Production	:	100,000.00	GAL per 8 hour shift	**Project #**	: 3			
Work Days	:	4.0	Days	**Estimator**	: Eric Jones	**GAL per**	**Total Cost**	**Unit Price Per GAL**
Unit Price	:	$0.03	per GAL	**Probable Low Cost Parameter**		**110000**	**$9,258**	**$0.02**
Total Cost	:	$10,287		**Probable High Cost Parameter**		**90000**	**$11,316**	**$0.03**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Pump, Submersible Trash Pump, 3" & 4"	Active	1.00	4.0	8	32.00	E	$3.87	incl. in rate	incl. in rate	$123.84
Hydraulic Excavator (5.0cy)	Active	1.00	***1.0***	8	8.00	E	$274.63	incl. in rate	incl. in rate	$2,197.04
Truck, Pickup (4x4, 3/4tn)	Active	1.00	4.0	8	32.00	E	$16.94	incl. in rate	incl. in rate	$542.08
Labor Foreman (out)	Active	1.00	4.0	8	32.00	L	$46.27	incl. in rate	incl. in rate	$1,480.64
Laborer	Active	2.00	4.0	8	64.00	L	$45.80	incl. in rate	incl. in rate	$2,931.20
Equipment Operator (medium)	Active	1.00	***1.0***	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		2.00	4.0	8	64.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
Intake and Discharge Hose, 3"		2.00	4.0	8	64.00	E	$2.50			$160.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
				Labor Hours	**104**				**TOTAL LABOR**	**$4,942.08**
				Equipment Hours	**136**				**TOTAL EQUIPMENT**	**$3,022.96**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		cy	1.300	0.00	$65.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$4,942.08	Labor Burden @	0.0%			$4,942.08
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$3,022.96	Equipment Tax @	7.75%	$234.28		$3,257.24
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$7,965**			**$234**	**DIRECT COST SUBTOTALS**	**$8,199**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$8,199.32	$1,229.90
Installing Contractors Profit@	8.0%				$8,199.32	$655.95
GC Markup on Subs @	10.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,885.84**
General Contractors Insurance @	1.0%		on		$10,085.16	$101
Bond @	1.0%		on		$10,085.16	$101
Contingency @	0.0%		on		$10,286.87	$0
					TOTAL COST for pay item	**$10,287**

Additional Pay Item Notes :

It will take roughly 3 days to pump 300,000gallons with a 3" pump. 1 day will be need to set up pump and hoses, excavator will be used 1 day to set up pump, laborers will support equipment during set up and maintain the pump through the duration of the dewatering, 1 foreman with truck will oversee operation.

PAY ITEM COST DETAIL WORKSHEET

3.010 Provide Dewatering behind Tailrace Cofferdam

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.010		**Project**	: Copco 2			
Description	:	Provide Dewatering behind Tailrace Cofferdam						
Quantity	:	1.00	LS					
Daily Production	:	1.00	LS per 8 hour shift	**Project #**	: 3			
Work Days	:	1.0	Days	**Estimator**	: Eric Jones	**LS per**	**Total Cost**	**Unit Price Per LS**
Unit Price	:	$49,938.86	per LS	**Probable Low Cost Parameter**		**1.1**	**$44,945**	**$44,944.98**
Total Cost	:	$49,939		**Probable High Cost Parameter**		**0.9**	**$54,933**	**$54,932.75**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
0			1.0	8	0.00	0	$0.00	$0.00		$0.00
Pump, Submersible Trash Pump, 3" & 4"	Active	2.00	***92.0***	8	1,472.00	E	$3.87	incl. in rate	incl. in rate	$5,696.64
Laborer	Active	1.00	***46.0***	8	368.00	L	$45.80	incl. in rate	incl. in rate	$16,854.40
Labor Foreman	Active	1.00	***23.0***	8	184.00	L	$48.27	incl. in rate	incl. in rate	$8,881.68
0	Active	1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
	Active	2.00	1.0	8	16.00	0	$0.00	$0.00		$0.00
	Active	1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
	Active	2.00	1.0	8	16.00	0	$0.00	$0.00		$0.00
	Active	1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
Intake and Discharge Hose, 3"		4.00	***92.0***	8	2,944.00	E	$2.50			$7,360.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	**552**				**TOTAL LABOR**	**$25,736.08**
				Equipment Hours	**4416**				**TOTAL EQUIPMENT**	**$13,056.64**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price		Material Cost
							$0.00
			1.000	0.00	$65.00		$0.00
		lbs PLS	1.000	0.00	$8.17		$0.00
		lbs PLS	1.000	0.00	$14.40		$0.00
		lbs PLS	1.000	0.00	$8.96		$0.00
		lbs PLS	1.000	0.00	$5.85		$0.00
		lbs PLS	1.000	0.00	$30.24		$0.00
		lbs	1.000	0.00	$34.02		$0.00
		lbs	1.000	0.00	$10.80		$0.00
		ea	1.000	0.00	$18.00		$0.00
		ea	1.000	0.00	$0.09		$0.00
		ea	1.000	0.00	$6.30		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ls	1.000	0.00	$8,000.00		$0.00
						TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
	-					$0.00
						$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$25,736.08	Labor Burden @	0.0%			$25,736.08
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$13,056.64	Equipment Tax @	7.75%	$1,011.89		$14,068.53
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$38,793**			**$1,012**	**DIRECT COST SUBTOTALS**	**$39,805**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$39,804.61		$5,970.69
Installing Contractors Profit@	8.0%				$39,804.61		$3,184.37
GC Markup on Subs @	10.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$9,155.06**
General Contractors Insurance @	1.0%			on	$48,959.67		$490
Bond @	1.0%			on	$48,959.67		$490
Contingency @	0.0%			on	$49,938.86		$0
						TOTAL COST for pay item	**$49,939**

Additional Pay Item Notes :

1 Foreman Involved 1/4 of the time of the pump operation for adjustments and maintenance. 1 Laborer Involved 1/2 of the time of the pump operation for adjustments and maintenance (fueling). 1 Extra pump Added 1 extra pump to help manage water and when pump is down for maintenance.

PAY ITEM COST DETAIL WORKSHEET

3.011 Construct Embankment Cofferdam across Tailrace

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.011		**Project**	: Copco 2			
Description	:	Construct Embankment Cofferdam across Tailrace						
Quantity	:	1,700.00	cy					
Daily Production	:	100.00	cy per 8 hour shift	**Project #**	: 3			
Work Days	:	17.0	Days	**Estimator**	: Michael Barba	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$115.34	per cy	**Probable Low Cost Parameter**		**115**	**$166,666**	**$98.04**
Total Cost	:	$196,077		**Probable High Cost Parameter**		**85**	**$225,489**	**$132.64**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (310hp)(CATD8)	Active	1.00	17.0	8	136.00	E	$197.60	$197.60		$26,873.60
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	17.0	8	272.00	E	$70.35	$70.35		$19,135.20
Equipment Operator (medium)	Active	1.00	17.0	8	136.00	L	$66.28	$0.00		$9,014.08
Truck Driver (heavy)	Active	1.00	17.0	8	136.00	L	$57.59	$0.00		$7,832.24
Laborer	Active	1.00	17.0	8	136.00	L	$45.80	$0.00		$6,228.80
		1.00	17.0	8	136.00	0	$0.00	$0.00		$0.00
		1.00	17.0	8	136.00	0	$0.00	$0.00		$0.00
		1.00	17.0	8	136.00	0	$0.00	$0.00		$0.00
		1.00	17.0	8	136.00	0	$0.00	$0.00		$0.00
		1.00	17.0	8	136.00	0	$0.00	$0.00		$0.00
		1.00	17.0	8	136.00	0	$0.00	$0.00		$0.00
			17.0	8	0.00					$0.00
			17.0	8	0.00					$0.00
			17.0	8	0.00					$0.00
			17.0	8	0.00					$0.00
			17.0	8	0.00					$0.00
				Labor Hours	**408**				**TOTAL LABOR**	**$23,075.12**
				Equipment Hours	**408**				**TOTAL EQUIPMENT**	**$46,008.80**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price		Material Cost
							$0.00
			1.300	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
						TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Cofferdam Sheet Piling Drive and Extract (131' X	3,930	SF	**RSMs Data**	$24.93		$97,974.90
						$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$97,974.90**

SUMMARY OF COSTS

Labor Cost	$23,075.12	Labor Burden @	49.7%	$0.00		$23,075.12
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$46,008.80	Equipment Tax @	7.75%	$3,565.68		$49,574.48
Subcontractors	$97,974.90					$97,974.90
DIRECT COST SUBTOTALS	**$167,059**			**$3,566**	**DIRECT COST SUBTOTALS**	**$170,625**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$72,649.60	$10,897.44
Installing Contractors Profit@	8.0%				$72,649.60	$5,811.97
GC Markup on Subs @	5.0%				$97,974.90	$4,898.75
					TOTAL MARKUP COSTS	**$21,608.15**
General Contractors Insurance @	1.0%		on		$192,232.66	$1,922
Bond @	1.0%		on		$192,232.66	$1,922
Contingency @	0.0%		on		$196,077.31	$0
					TOTAL COST for pay item	**$196,077**

Additional Pay Item Notes :

PAY ITEM COST DETAIL WORKSHEET

3.014 Remove Concrete in Dam

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.014			**Project**	: COPCO 2			
Description	:	Remove Concrete in Dam							
Quantity	:	4,430.00	cy						
Daily Production	:	240.00	cy per	8 hour shift	**Project #**	: 3			
Work Days	:	18.5	Days		**Estimator**	: Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$253.02	per cy		**Probable Low Cost Parameter**		**276**	**$952,738**	**$215.06**
Total Cost	:	$1,120,868			**Probable High Cost Parameter**		**192**	**$1,345,041**	**$303.62**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	4.00	18.5	8	592.00	L	$48.27	incl. in rate	incl. in rate	$28,575.84
Laborer	Active	8.00	18.5	8	1,184.00	L	$45.80	incl. in rate	incl. in rate	$54,227.20
Equipment Operator (medium)	Active	8.00	18.5	8	1,184.00	L	$66.28	incl. in rate	incl. in rate	$78,475.52
Truck Driver (heavy)	Active	4.00	18.5	8	592.00	L	$57.59	incl. in rate	incl. in rate	$34,093.28
Barge (400T)	Active	4.00	18.5	8	592.00	E	$99.50	incl. in rate	incl. in rate	$58,904.00
Air Compressor 900 cfm	Active	2.00	18.5	8	296.00	E	$38.87	incl. in rate	incl. in rate	$11,505.20
Air Tool, Chipping Hammer	Active	8.00	18.5	8	1,184.00	E	$1.64	incl. in rate	incl. in rate	$1,940.62
Generator, Small Generator, 10 - 15 kW	Active	4.00	18.5	8	592.00	E	$7.04	incl. in rate	incl. in rate	$4,167.68
Hydraulic Excavator (5.0cy)	Active	8.00	18.5	8	1,184.00	E	$274.63	incl. in rate	incl. in rate	$325,161.92
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	8.00	18.5	8	1,184.00	E	$62.72	incl. in rate	incl. in rate	$74,260.48
Hydraulic Thumbs/Shear Attachment	Active	8.00	18.5	8	1,184.00	E	$16.39	incl. in rate	incl. in rate	$19,405.76
Truck, On-Highway Dump (6x4, 12cy)	Active	8.00	18.5	8	1,184.00	E	$70.35	incl. in rate	incl. in rate	$83,294.40
			18.5	8	0.00					$0.00
			18.5	8	0.00					$0.00
			18.5	8	0.00					$0.00
			18.5	8	0.00					$0.00
			18.5	8	0.0					$0.00
				Labor Hours	**3,552**			**TOTAL LABOR**		**$195,371.84**
				Equipment Hours	**7,400**			**TOTAL EQUIPMENT**		**$578,640.06**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$9,768.59	$9,768.59
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$9,768.59**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting and Drilling	30	EA	**Cost per Mob**	$2,500.00	$75,000.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$75,000.00**

SUMMARY OF COSTS

Labor Cost	$195,371.84	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$195,371.84
Material Cost	$9,768.59	Material Tax @	7.75%	$757.07		$10,525.66
Equipment Cost	$578,640.06	Equipment Tax @	7.75%	$44,844.60		$623,484.66
Subcontractors	$75,000.00					$75,000.00
DIRECT COST SUBTOTALS	**$858,780**			**$45,602**	**DIRECT COST SUBTOTALS**	**$904,382**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$829,382.16	$124,407.32
Installing Contractors Profit@	8.0%				$829,382.16	$66,350.57
GC Markup on Subs @	5.0%				$75,000.00	$3,750.00
					TOTAL MARKUP COSTS	**$194,507.90**
General Contractors Insurance @	1.0%		on		$1,098,890.06	$10,989
Bond @	1.0%		on		$1,098,890.06	$10,989
Contingency @	0.0%		on		$1,120,867.86	$0
					TOTAL COST for pay item	**$1,120,868**

Additional Pay Item Notes :

The work is done by one 6-men crew (foreman, 4 laborers, and 2 equipment operators). Concrete hauling to disposal site is also included - based on the current production rate only 3 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM COST DETAIL WORKSHEET

3.015 Remove concrete equipment slab from top of embankment wing dam on right abutment

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.015			**Project**	: Copco 2			
Description	:	Remove concrete equipment slab from top of embankment wing dam on right abutment							
Quantity	:	5.00	CY						
Daily Production	:	15.00	CY per	8 hour shift	**Project #**	: 3			
Work Days	:	0.3 Days			**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$353.89 per CY			**Probable Low Cost Parameter**		**16.5**	**$1,593**	**$318.50**
Total Cost	:	$1,769			**Probable High Cost Parameter**		**13.5**	**$1,946**	**$389.28**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	0.3	8	2.40	L	$46.27	incl. in rate	incl. in rate	$111.05
Laborer	Active	1.00	0.3	8	2.40	L	$45.80	incl. in rate	incl. in rate	$109.92
Equipment Operator (medium)	Active	1.00	0.3	8	2.40	L	$66.28	incl. in rate	incl. in rate	$159.07
Truck Driver (heavy)	Active	1.00	0.3	8	2.40	L	$57.59	incl. in rate	incl. in rate	$138.22
Hydraulic Excavator (5.0cy)	Active	1.00	0.3	8	2.40	E	$274.63	incl. in rate	incl. in rate	$659.11
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	0.3	8	2.40	E	$70.35	incl. in rate	incl. in rate	$168.84
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
			0.3	8	0.00	E	$0.00			$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
				Labor Hours	**9.6**				**TOTAL LABOR**	**$518.26**
				Equipment Hours	**4.8**				**TOTAL EQUIPMENT**	**$827.95**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		EA	1.000	0.00	$235.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$518.26	Labor Burden @	0.0%			$518.26
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$827.95	Equipment Tax @	7.75%	$64.17		$892.12
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,346**			**$64**	**DIRECT COST SUBTOTALS**	**$1,410**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,410.37		$211.56
Installing Contractors Profit@	8.0%				$1,410.37		$112.83
GC Markup on Subs @	10.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$324.39**
General Contractors Insurance @	1.0%		on		$1,734.76		$17
Bond @	1.0%		on		$1,734.76		$17
Contingency @	0.0%		on		$1,769.46		$0
						TOTAL COST for pay item	**$1,769**

Additional Pay Item Notes :

4 man crew roughly 3 hours to mobilize to area and haul off material

PAY ITEM COST DETAIL WORKSHEET

3.016 Remove Concrete Wing wall

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.016		**Project**	: Copco 2			
Description	:	Remove Concrete Wing wall						
Quantity	:	240.00	CY					
Daily Production	:	50.00	CY per	8 hour shift	**Project #**	: 3		
Work Days	:	4.8	Days		**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$217.45	per CY		**Probable Low Cost Parameter**		**55**	**$46,968**	**$195.70**
Total Cost	:	$52,187			**Probable High Cost Parameter**		**45**	**$57,406**	**$239.19**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	4.8	8	38.40	L	$46.27	incl. in rate	incl. in rate	$1,776.77
Laborer	Active	1.00	4.8	8	38.40	L	$45.80	incl. in rate	incl. in rate	$1,758.72
Equipment Operator (medium)	Active	2.00	4.8	8	76.80	L	$66.28	incl. in rate	incl. in rate	$5,090.30
Truck Driver (heavy)	Active	2.00	4.8	8	76.80	L	$57.59	incl. in rate	incl. in rate	$4,422.91
Hydraulic Excavator (5.0cy)	Active	2.00	4.8	8	76.80	E	$274.63	incl. in rate	incl. in rate	$21,091.58
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	4.8	8	76.80	E	$70.35	incl. in rate	incl. in rate	$5,402.88
		1.00	4.8	8	38.40	0	$0.00	$0.00		$0.00
		1.00	4.8	8	38.40	0	$0.00	$0.00		$0.00
		1.00	4.8	8	38.40	0	$0.00	$0.00		$0.00
		1.00	4.8	8	38.40	0	$0.00	$0.00		$0.00
		1.00	4.8	8	38.40	0	$0.00	$0.00		$0.00
		1.00	4.8	8	38.40	0	$0.00	$0.00		$0.00
			4.8	8	0.00	E	$0.00			$0.00
			4.8	8	0.00					$0.00
			4.8	8	0.00					$0.00
			4.8	8	0.00					$0.00
			4.8	8	0.00					$0.00
				Labor Hours	**230.4**				**TOTAL LABOR**	**$13,048.70**
				Equipment Hours	**153.6**				**TOTAL EQUIPMENT**	**$26,494.46**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		EA	1.000	0.00	$235.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$13,048.70	Labor Burden @	0.0%			$13,048.70
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$26,494.46	Equipment Tax @	7.75%	$2,053.32		$28,547.78
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$39,543**			**$2,053**	**DIRECT COST SUBTOTALS**	**$41,596**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$41,596.49		$6,239.47
Installing Contractors Profit@	8.0%				$41,596.49		$3,327.72
GC Markup on Subs @	10.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$9,567.19**
General Contractors Insurance @	1.0%		on		$51,163.68		$512
Bond @	1.0%		on		$51,163.68		$512
Contingency @	0.0%		on		$52,186.96		$0
						TOTAL COST for pay item	**$52,187**

Additional Pay Item Notes :

6 man crew 1 week to demolish wing wall. 1 excavator with breaker performing demolition, 1 excavator loading trucks, only two trucks due to the haul road being such a tight area.

PAY ITEM COST DETAIL WORKSHEET

3.017 Right Abutment Removal - Random Fill

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.017		**Project**	: Copco 2			
Description	:	Right Abutment Removal - Random Fill						
Quantity	:	1,510.00	CY					
Daily Production	:	300.00	CY per 8 hour shift	**Project #**	: 3			
Work Days	:	5.0 Days		**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$52.34 per CY		**Probable Low Cost Parameter**		**330**	**$71,137**	**$47.11**
Total Cost	:	$79,041		**Probable High Cost Parameter**		**270**	**$86,945**	**$57.58**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	5.0	8	40.00	L	$46.27	incl. in rate	incl. in rate	$1,850.80
Laborer	Active	3.00	5.0	8	120.00	L	$45.80	incl. in rate	incl. in rate	$5,496.00
Equipment Operator (medium)	Active	2.00	5.0	8	80.00	L	$66.28	incl. in rate	incl. in rate	$5,302.40
Truck Driver (heavy)	Active	5.00	5.0	8	200.00	L	$57.59	incl. in rate	incl. in rate	$11,518.00
Hydraulic Excavator (5.0cy)	Active	2.00	5.0	8	80.00	E	$274.63	incl. in rate	incl. in rate	$21,970.40
Truck, On-Highway Dump (6x4, 12cy)	Active	5.00	5.0	8	200.00	E	$70.35	incl. in rate	incl. in rate	$14,070.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
			5.0	8	0.00	E	$0.00			$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
				Labor Hours	**440**				**TOTAL LABOR**	**$24,167.20**
				Equipment Hours	**280**				**TOTAL EQUIPMENT**	**$36,040.40**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		EA	1.000	0.00	$235.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$24,167.20	Labor Burden @	0.0%			$24,167.20
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$36,040.40	Equipment Tax @	7.75%	$2,793.13		$38,833.53
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$60,208**			**$2,793**	**DIRECT COST SUBTOTALS**	**$63,001**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$63,000.73		$9,450.11
Installing Contractors Profit@	8.0%				$63,000.73		$5,040.06
GC Markup on Subs @	10.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$14,490.17**
General Contractors Insurance @	1.0%		on		$77,490.90		$775
Bond @	1.0%		on		$77,490.90		$775
Contingency @	0.0%		on		$79,040.72		$0
						TOTAL COST for pay item	**$79,041**

Additional Pay Item Notes :

Crew and production is based on moving 1510CY which is a total of 151 each 10 CY loads. 5 trucks will be used hauling 6 loads per day for 5 days. There will be 2 excavators loading trucks, 3 laborers directing truck traffic, 1 foreman will oversee operation. All material will be hauled to Copco disposal site.

PAY ITEM COST DETAIL WORKSHEET

3.018 Right Abutment Removal - Remove Hand Placed Riprap

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.018		**Project**	: Copco 2			
Description	:	Right Abutment Removal - Remove Hand Placed Riprap						
Quantity	:	5,400.00 SF						
Daily Production	:	5,400.00 SF per	8 hour shift	**Project #**	: 3			
Work Days	:	1.0 Days		**Estimator**	: Eric Jones	**SF per**	**Total Cost**	**Unit Price Per SF**
Unit Price	:	$2.26 per SF		**Probable Low Cost Parameter**		**5940**	**$10,990**	**$2.04**
Total Cost	:	$12,211		**Probable High Cost Parameter**		**4860**	**$13,432**	**$2.49**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Laborer	Active	1.00	1.0	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Equipment Operator (medium)	Active	2.00	1.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Truck Driver (heavy)	Active	3.00	1.0	8	24.00	L	$57.59	incl. in rate	incl. in rate	$1,382.16
Hydraulic Excavator (5.0cy)	Active	2.00	1.0	8	16.00	E	$274.63	incl. in rate	incl. in rate	$4,394.08
Truck, On-Highway Dump (6x4, 12cy)	Active	3.00	1.0	8	24.00	E	$70.35	incl. in rate	incl. in rate	$1,688.40
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
			1.0	8	0.00	E	$0.00			$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	**56**				**TOTAL LABOR**	**$3,179.20**
				Equipment Hours	**40**				**TOTAL EQUIPMENT**	**$6,082.48**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		EA	1.000	0.00	$235.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$3,179.20	Labor Burden @	0.0%			$3,179.20
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$6,082.48	Equipment Tax @	7.75%	$471.39		$6,553.87
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$9,262**			**$471**	**DIRECT COST SUBTOTALS**	**$9,733**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$9,733.07		$1,459.96
Installing Contractors Profit@	8.0%				$9,733.07		$778.65
GC Markup on Subs @	10.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$2,238.61**
General Contractors Insurance @	1.0%		on		$11,971.68		$120
Bond @	1.0%		on		$11,971.68		$120
Contingency @	0.0%		on		$12,211.11		$0
						TOTAL COST for pay item	**$12,211**

Additional Pay Item Notes :

Assuming Rip Rap is 12" thick which will equal 200 CY of material to move. 3 trucks total to be used each truck will haul 6 loads at 10 cy a load. Total of 200 Cys roughly 67 cy per truck, which is 7 loads a truck.

PAY ITEM COST DETAIL WORKSHEET

3.019 Right Abutment Removal - Gunite Curtain Wall

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.019		**Project**	: Copco 2			
Description	:	Right Abutment Removal - Gunite Curtain Wall						
Quantity	:	180.00 CY						
Daily Production	:	40.00 CY per	8 hour shift	**Project #**	: 3			
Work Days	:	4.5 Days		**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$333.73 per CY		**Probable Low Cost Parameter**		**44**	**$54,064**	**$300.35**
Total Cost	:	$60,071		**Probable High Cost Parameter**		**36**	**$66,078**	**$367.10**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	4.5	8	36.00	L	$46.27	incl. in rate	incl. in rate	$1,665.72
Laborer	Active	2.00	4.5	8	72.00	L	$45.80	incl. in rate	incl. in rate	$3,297.60
Equipment Operator (medium)	Active	2.00	4.5	8	72.00	L	$66.28	incl. in rate	incl. in rate	$4,772.16
Truck Driver (heavy)	Active	3.00	4.5	8	108.00	L	$57.59	incl. in rate	incl. in rate	$6,219.72
Hydraulic Excavator (5.0cy)	Active	2.00	4.5	8	72.00	E	$274.63	incl. in rate	incl. in rate	$19,773.36
Truck, On-Highway Dump (6x4, 12cy)	Active	3.00	4.5	8	108.00	E	$70.35	incl. in rate	incl. in rate	$7,597.80
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	4.5	8	36.00	E	$62.72	incl. in rate	incl. in rate	$2,257.92
0		1.00	4.5	8	36.00	0	$0.00	$0.00		$0.00
		1.00	4.5	8	36.00	0	$0.00	$0.00		$0.00
		1.00	4.5	8	36.00	0	$0.00	$0.00		$0.00
		1.00	4.5	8	36.00	0	$0.00	$0.00		$0.00
		1.00	4.5	8	36.00	0	$0.00	$0.00		$0.00
			4.5	8	0.00	E	$0.00			$0.00
			4.5	8	0.00					$0.00
			4.5	8	0.00					$0.00
			4.5	8	0.00					$0.00
			4.5	8	0.00					$0.00
				Labor Hours	**288**				**TOTAL LABOR**	**$15,955.20**
				Equipment Hours	**216**				**TOTAL EQUIPMENT**	**$29,629.08**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		EA	1.000	0.00	$235.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$15,955.20	Labor Burden @	0.0%			$15,955.20
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$29,629.08	Equipment Tax @	7.75%	$2,296.25		$31,925.33
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$45,584**			**$2,296**	**DIRECT COST SUBTOTALS**	**$47,881**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$47,880.53		$7,182.08
Installing Contractors Profit@	8.0%				$47,880.53		$3,830.44
GC Markup on Subs @	10.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$11,012.52**
General Contractors Insurance @	1.0%		on		$58,893.06		$589
Bond @	1.0%		on		$58,893.06		$589
Contingency @	0.0%		on		$60,070.92		$0
						TOTAL COST for pay item	**$60,071**

Additional Pay Item Notes :

3 trucks total to be used each truck will haul 6 loads at 10 cy a load, 2 laborers directing trucks,1 excavator loading trucks and 1 excavator breaking up curtain wall. Foreman will oversee operation.

PAY ITEM COST DETAIL WORKSHEET

3.020 Remove & Dispose - Hand rails and Light Poles

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.020			**Project**	: COPCO 2			
Description	:	Remove & Dispose - Hand rails and Light Poles							
Quantity	:	5,000.00	LBS						
Daily Production	:	18,500.00	LBS per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	0.3	Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.84	per LBS		**Probable Low Cost Parameter**		**20350**	**$3,765**	**$0.75**
Total Cost	:	$4,183			**Probable High Cost Parameter**		**16650**	**$4,602**	**$0.92**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (80tn)	Active	1.00	0.3	8	2.40	E	$190.46	$190.46		$457.10
Equipment Operator (crane)	Active	1.00	0.3	8	2.40	L	$68.41	$0.00		$164.18
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.3	8	2.40	E	$111.64	$111.64		$267.94
Truck Driver (light)	Active	1.00	0.3	8	2.40	L	$56.29	$0.00		$135.10
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.3	8	2.40	E	$221.50	$221.50		$531.60
Electrician	Active	1.00	0.3	8	2.40	L	$45.23	$0.00		$108.55
Millwright	Active	6.00	0.3	8	14.40	L	$69.46	$0.00		$1,000.22
Labor Foreman	Active	2.00	0.3	8	4.80	L	$48.27	$0.00		$231.70

Labor Hours	**26.4**	**TOTAL LABOR**	**$1,639.75**
Equipment Hours	**7.2**	**TOTAL EQUIPMENT**	**$1,256.64**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$81.99	$81.99

TOTAL MATERIAL	**$81.99**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10%)	0.25	ton	1.000	0.25 $595.00	$148.75
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	36.00	mile	1.000	36.00 $7.25	$261.00

TOTAL SUBCONTRACTS	**$409.75**

SUMMARY OF COSTS

Labor Cost	$1,639.75	Labor Burden @	49.7%	$0.00	$1,639.75
Material Cost	$81.99	Material Tax @	7.8%	$6.35	$88.34
Equipment Cost	$1,256.64	Equipment Tax @	0.0%	$0.00	$1,256.64
Subcontractors	$409.75				$409.75
DIRECT COST SUBTOTALS	**$3,388**			**$6**	**DIRECT COST SUBTOTALS** **$3,394**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$2,984.73	$447.71
Installing Contractors Profit@	8.0%				$2,984.73	$238.78
GC Markup on Subs @	5.0%				$409.75	$20.49
					TOTAL MARKUP COSTS	**$706.98**
General Contractors Insurance @	1.0%		on		$4,101.46	$41
Bond @	1.0%		on		$4,101.46	$41
Contingency @	0.0%		on		$4,183.49	$0
					TOTAL COST for pay item	**$4,183**

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Assumed hazardous waste 100% of the total lbs, calculated 36 miles from Copco2 to Yreka Transfer Recycling.

PAY ITEM COST DETAIL WORKSHEET

3.021 Remove & Dispose - Radial Gates and Hoists

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.021			**Project**	: COPCO2			
Description	:	Remove & Dispose - Radial Gates and Hoists							
Quantity	:	66,000.00	LBS						
Daily Production	:	30,000.00	LBS per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	2.2	Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.81	per LBS		**Probable Low Cost Parameter**		**34500**	**$45,434**	**$0.69**
Total Cost	:	$53,452			**Probable High Cost Parameter**		**24000**	**$64,142**	**$0.97**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	2.2	8	17.60	L	$47.23	$0.00		$831.25
Electrician	Active	1.00	2.2	8	17.60	L	$45.23	$0.00		$796.05
Steelworker	Active	5.00	2.2	8	88.00	L	$65.52	$0.00		$5,765.76
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.2	8	17.60	E	$221.50	$221.50		$3,898.40
Truck Driver (heavy)	Active	1.00	2.2	8	17.60	L	$57.59	$0.00		$1,013.58
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.2	8	17.60	E	$111.64	$111.64		$1,964.86
Hydraulic Crane (120tn)	Active	1.00	2.2	8	17.60	E	$239.06	$239.06		$4,207.46
Welder	Active	1.00	2.2	8	17.60	L	$7.84	$0.00		$137.94
Gas Welding Machine	Active	1.00	2.2	8	17.60	E	$2.88	$2.88		$50.64
Equipment Operator (medium)	Active	1.00	2.2	8	17.60	L	$66.28	$0.00		$1,166.53
Equipment Operator (crane)	Active	1.00	2.2	8	17.60	L	$68.41	$0.00		$1,204.02

Labor Hours	**193.6**	**TOTAL LABOR**	**$10,915.12**
Equipment Hours	**70.4**	**TOTAL EQUIPMENT**	**$10,121.36**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$545.76	$545.76
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	2,500.00	LF	1.000	2,500.00	$0.85	$2,125.00

TOTAL MATERIAL	**$2,670.76**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	33.00	ton	1.000	33.00	$595.00	$19,635.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	311.67	mile	1.000	311.67	$7.25	$2,259.58

TOTAL SUBCONTRACTS	**$21,894.58**

SUMMARY OF COSTS

Labor Cost	$10,915.12	Labor Burden @	49.7%	$0.00		$10,915.12
Material Cost	$2,670.76	Material Tax @	7.8%	$206.98		$2,877.74
Equipment Cost	$10,121.36	Equipment Tax @	0.0%	$0.00		$10,121.36
Subcontractors	$21,894.58					$21,894.58
DIRECT COST SUBTOTALS	**$45,602**			**$207**	**DIRECT COST SUBTOTALS**	**$45,809**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$23,914.22		$3,587.13
Installing Contractors Profit@	8.0%				$23,914.22		$1,913.14
GC Markup on Subs @	5.0%				$21,894.58		$1,094.73
						TOTAL MARKUP COSTS	**$6,595.00**
General Contractors Insurance @	1.0%	on			$52,403.80		$524
Bond @	1.0%	on			$52,403.80		$524
Contingency @	0.0%	on			$53,451.88		$0
						TOTAL COST for pay item	**$53,452**

Additional Pay Item Notes :

Production based on crew 1 Forman, 5 Steelworkers and 1 Welder to cut and attach hooks to the gate for disposal, 4 Laborers to rigging wire rope slings, 1 Electrician to provide power for tools, 1 Truck for disposal to Yreka facility. Assuming 2.2 day of work.

PAY ITEM COST DETAIL WORKSHEET

3.022 Remove & Dispose - 5-Radial Gate Stoplogs & Slots (steel)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.022		**Project**	: COPCO2			
Description	:	Remove & Dispose - 5-Radial Gate Stoplogs & Slots (steel)						
Quantity	:	95,800.00 LBS						
Daily Production	:	30,000.00 LBS per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	3.2 Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.93 per LBS		**Probable Low Cost Parameter**		**34500**	**$75,974**	**$0.79**
Total Cost	:	$89,381		**Probable High Cost Parameter**		**24000**	**$107,258**	**$1.12**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	3.2	8	25.60	L	$47.23	$0.00		$1,209.09
Electrician	Active	1.00	3.2	8	25.60	L	$45.23	$0.00		$1,157.89
Ironworkers	Active	10.00	3.2	8	256.00	L	$63.95	$0.00		$16,371.20
Vibratory Hammer & Extractor	Active	1.00	3.2	8	25.60	E	$94.34	$94.34		$2,415.10
Truck Driver (heavy)	Active	2.00	3.2	8	51.20	L	$57.59	$0.00		$2,948.61
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	3.2	8	51.20	E	$111.64	$111.64		$5,715.97
Hydraulic Crane (120tn)	Active	2.00	3.2	8	51.20	E	$239.06	$239.06		$12,239.87
Welder	Active	2.00	3.2	8	51.20	L	$7.84	$0.00		$401.28
Gas Welding Machine	Active	2.00	3.2	8	51.20	E	$2.88	$2.88		$147.30
Equipment Operator (medium)	Active	2.00	3.2	8	51.20	L	$66.28	$0.00		$3,393.54
Equipment Operator (crane)	Active	1.00	3.2	8	25.60	L	$68.41	$0.00		$1,751.30
Laborer	Active	10.00	3.2	8	256.00	L	$45.80	$0.00		$11,724.80

Labor Hours	**742.4**	**TOTAL LABOR**	**$38,957.70**
Equipment Hours	**179.2**	**TOTAL EQUIPMENT**	**$20,518.25**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,947.88	$1,947.88
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	5,000.00	LF	1.000	5,000.00	$0.85	$4,250.00

TOTAL MATERIAL	**$6,197.88**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (20%)	9.58	ton	1.000	9.58 $595.00	$5,700.10
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	36.00	mile	1.000	36.00 $7.25	$261.00

TOTAL SUBCONTRACTS	**$5,961.10**

SUMMARY OF COSTS

Labor Cost	$38,957.70	Labor Burden @	49.7%	$0.00	$38,957.70
Material Cost	$6,197.88	Material Tax @	7.8%	$480.34	$6,678.22
Equipment Cost	$20,518.25	Equipment Tax @	0.0%	$0.00	$20,518.25
Subcontractors	$5,961.10				$5,961.10
DIRECT COST SUBTOTALS	**$71,635**			**$480**	**DIRECT COST SUBTOTALS** **$72,115**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$66,154.16	$9,923.12
Installing Contractors Profit@	8.0%				$66,154.16	$5,292.33
GC Markup on Subs @	5.0%				$5,961.10	$298.06
					TOTAL MARKUP COSTS	**$15,513.51**
General Contractors Insurance @	1.0%		on		$87,628.78	$876
Bond @	1.0%		on		$87,628.78	$876
Contingency @	0.0%		on		$89,381.35	$0
					TOTAL COST for pay item	**$89,381**

Additional Pay Item Notes :

Production based on crew 1 Forman, 5 Ironworkers and 1 Welder to cut and attach hooks to the gate for disposal, 4 Laborers to rigging wire rope slings. Electrical crew to provide power for tools, 1 Truck for disposal to Yreka facility. Assuming using a Vibratory Hammer & Extractor for attachments in concrete and 2 cranes for balance when the gates are discharged.

PAY ITEM COST DETAIL WORKSHEET

3.023 Remove & Dispose - Spillway intake gate motor & control panel

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.023		**Project**	: COPCO 2			
Description	:	Remove & Dispose - Spillway intake gate motor & control panel						
Quantity	:	1.00 EA						
Daily Production	:	1.00 EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	1.0 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$1,297.31 per EA		**Probable Low Cost Parameter**		**1.1**	**$1,168**	**$1,167.58**
Total Cost	:	$1,297		**Probable High Cost Parameter**		**0.9**	**$1,427**	**$1,427.04**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician	Active	2.00	1.0	8	16.00	L	$45.23	$0.00		$723.68

Labor Hours	**16**	**TOTAL LABOR**	**$723.68**
Equipment Hours	**0**	**TOTAL EQUIPMENT**	**$0.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 0.5% labor (Side Cutter, Sharp-Nose Pliers, Sharp Tip Tweezers PCB Clamp, etc)	3.98	LS	1.000	3.98	$72.37	$288.04

TOTAL MATERIAL	**$288.04**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$723.68	Labor Burden @	49.7%	$0.00	$723.68
Material Cost	$288.04	Material Tax @	7.8%	$22.32	$310.37
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00	$0.00
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$1,012**			**$22**	**DIRECT COST SUBTOTALS** **$1,034**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,034.05	$155.11
Installing Contractors Profit@	8.0%				$1,034.05	$82.72
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$237.83**
General Contractors Insurance @	1.0%	on			$1,271.88	$13
Bond @	1.0%	on			$1,271.88	$13
Contingency @	0.0%	on			$1,297.31	$0
					TOTAL COST for pay item	**$1,297**

Additional Pay Item Notes :

Assumed that two electrician will work one day to unconnect and remove the control panel and the gate motor.

PAY ITEM COST DETAIL WORKSHEET

3.024 Remove & Dispose - Spillway radial gate motor & control panel

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.024		**Project**	: COPCO 2			
Description	:	Remove & Dispose - Spillway radial gate motor & control panel						
Quantity	:	1.00 EA						
Daily Production	:	1.00 EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	1.0 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$1,297.31 per EA		**Probable Low Cost Parameter**		**1.1**	**$1,168**	**$1,167.58**
Total Cost	:	$1,297		**Probable High Cost Parameter**		**0.9**	**$1,427**	**$1,427.04**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician	Active	2.00	1.0	8	16.00	L	$45.23	$0.00		$723.68

Labor Hours	**16**	**TOTAL LABOR**	**$723.68**
Equipment Hours	**0**	**TOTAL EQUIPMENT**	**$0.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 0.5% labor (Side Cutter, Sharp-Nose Pliers, Sharp Tip Tweezers PCB Clamp, etc)	3.98	LS	1.000	3.98	$72.37	$288.04

TOTAL MATERIAL	**$288.04**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$723.68	Labor Burden @	49.7%	$0.00		$723.68
Material Cost	$288.04	Material Tax @	7.8%	$22.32		$310.37
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00		$0.00
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,012**			**$22**	**DIRECT COST SUBTOTALS**	**$1,034**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,034.05	$155.11
Installing Contractors Profit@	8.0%				$1,034.05	$82.72
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$237.83**
General Contractors Insurance @	1.0%	on			$1,271.88	$13
Bond @	1.0%	on			$1,271.88	$13
Contingency @	0.0%	on			$1,297.31	$0
					TOTAL COST for pay item	**$1,297**

Additional Pay Item Notes :

Assumed that two electrician will work one day to unconnect and remove the control panel and the gate motor.

PAY ITEM COST DETAIL WORKSHEET — **3.025 Remove & Dispose - Spillway trashrake motor, festoon cable & control panel**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.025		**Project**	: COPCO 2			
Description	:	Remove & Dispose - Spillway trashrake motor, festoon cable & control panel						
Quantity	:	1.00 EA						
Daily Production	:	1.00 EA per 8 hour shift		**Project #**	: Klamath Dams Removal			
Work Days	:	1.0 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$551.31 per EA		**Probable Low Cost Parameter**		**1.1**	**$496**	**$496.18**
Total Cost	:	$551		**Probable High Cost Parameter**		**0.9**	**$606**	**$606.44**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	$0.00		$361.84

Labor Hours	**8**	**TOTAL LABOR**	**$361.84**
Equipment Hours	**0**	**TOTAL EQUIPMENT**	**$0.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 0.5% labor (Side Cutter, Sharp-Nose Pliers, Sharp Tip Tweezers PCB Clamp, etc)	1.99	LS	1.000	1.99	$36.18	$72.01

TOTAL MATERIAL	**$72.01**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$361.84	Labor Burden @	49.7%	$0.00		$361.84
Material Cost	$72.01	Material Tax @	7.8%	$5.58		$77.59
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00		$0.00
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$434**			**$6**	**DIRECT COST SUBTOTALS**	**$439**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$439.43		$65.91
Installing Contractors Profit@	8.0%				$439.43		$35.15
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$101.07**
General Contractors Insurance @	1.0%		on		$540.50		$5
Bond @	1.0%		on		$540.50		$5
Contingency @	0.0%		on		$551.31		$0
						TOTAL COST for pay item	**$551**

Additional Pay Item Notes :

Assumed that one electrician will work one day to unconnect and remove the festoon cable, control panel and the motor.

PAY ITEM COST DETAIL WORKSHEET

3.026 Remove & Dispose - Distribution equipment, panelboards

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.026		**Project**	: COPCO 2			
Description	:	Remove & Dispose - Distribution equipment, panelboards						
Quantity	:	1.00 EA						
Daily Production	:	0.50 EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	2.0 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$5,877.55 per EA		**Probable Low Cost Parameter**		**0.55**	**$5,290**	**$5,289.80**
Total Cost	:	$5,878		**Probable High Cost Parameter**		**0.45**	**$6,465**	**$6,465.31**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	2.0	8	16.00	L	$47.23	$0.00		$755.68
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	$0.00		$723.68
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	$0.00		$547.28
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	$111.64		$893.12
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72
Hydraulic Crane (17tn)	Active	1.00	2.0	8	16.00	E	$81.52	$81.52		$1,304.32

Labor Hours	**48**	**TOTAL LABOR**	**$2,487.36**
Equipment Hours	**24**	**TOTAL EQUIPMENT**	**$2,197.44**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 0.5% labor (Side Cutter, Sharp-Nose Pliers, Sharp Tip Tweezers PCB Clamp, etc)	0.00	LS	1.000	0.00	$124.37	$0.00

TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,487.36	Labor Burden @	49.7%	$0.00		$2,487.36
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$2,197.44	Equipment Tax @	0.0%	$0.00		$2,197.44
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$4,685**			**$0**	**DIRECT COST SUBTOTALS**	**$4,685**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,684.80	$702.72
Installing Contractors Profit@	8.0%				$4,684.80	$374.78
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,077.50**
General Contractors Insurance @	1.0%	on			$5,762.30	$58
Bond @	1.0%	on			$5,762.30	$58
Contingency @	0.0%	on			$5,877.55	$0
					TOTAL COST for pay item	**$5,878**

Additional Pay Item Notes :

Assumed that electrical crew formed of 1 Forman and 1 Electricians will work two days to unconnect and remove the distribution panels. They are going to use same crane and a truck for disposal of spillway intake, trash rake and radial motor & control panel.

PAY ITEM COST DETAIL WORKSHEET

3.027 Remove Copper Shingles from Roof of Powerhouse

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.027	**Project**	: Copco 2				
Description	:	Remove Copper Shingles from Roof of Powerhouse						
Quantity	:	7,000.00 SF						
Daily Production	:	3,500.00 SF per 8 hour shift	**Project #**	: 3				
Work Days	:	2.0 Days	**Estimator**	: Eric Jones	**SF per**	**Total Cost**	**Unit Price Per SF**	
Unit Price	:	$2.07 per SF	**Probable Low Cost Parameter**		**3850**	**$13,026**	**$1.86**	
Total Cost	:	$14,473	**Probable High Cost Parameter**		**3150**	**$15,920**	**$2.27**	

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Carpenter Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.40	incl. in rate	incl. in rate	$742.40
Carpenters	Active	2.00	2.0	8	32.00	L	$72.60	incl. in rate	incl. in rate	$2,323.20
Laborer	Active	3.00	2.0	8	48.00	L	$45.80	incl. in rate	incl. in rate	$2,198.40
Truck Driver (heavy)	Active	2.00	2.0	8	32.00	L	$57.59	incl. in rate	incl. in rate	$1,842.88
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	2.0	8	32.00	E	$70.35	incl. in rate	incl. in rate	$2,251.20
Forklift, Rough Terrain (9,000 lb capacity)	Active	1.00	2.0	8	16.00	E	$54.70	incl. in rate	incl. in rate	$875.20
		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
			2.0	8	0.00	E	$0.00			$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
				Labor Hours	**144**				**TOTAL LABOR**	**$8,167.36**
				Equipment Hours	**48**				**TOTAL EQUIPMENT**	**$3,126.40**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		EA	1.000	0.00	$235.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$8,167.36	Labor Burden @	0.0%			$8,167.36
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$3,126.40	Equipment Tax @	7.75%	$242.30		$3,368.70
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$11,294**			**$242**	**DIRECT COST SUBTOTALS**	**$11,536**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$11,536.06		$1,730.41
Installing Contractors Profit@	8.0%				$11,536.06		$922.88
GC Markup on Subs @	10.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$2,653.29**
General Contractors Insurance @	1.0%		on		$14,189.35		$142
Bond @	1.0%		on		$14,189.35		$142
Contingency @	0.0%		on		$14,473.14		$0
						TOTAL COST for pay item	**$14,473**

Additional Pay Item Notes :

2 working days to strip roof organize and haul off material. The carpenters and laborers will remove roof and stack and organized material, Forklift will be used to load material in two dump trucks.

PAY ITEM COST DETAIL WORKSHEET

3.028 Remove Powerhouse Concrete down to spring-line of turbine

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.028	**Project**	:	COPCO 2			
Description	:	Remove Powerhouse Concrete down to spring-line of turbine						
Quantity	:	1,110.00 cy						
Daily Production	:	50.00 cy per 8 hour shift	**Project #**	:	3			
Work Days	:	22.2 Days	**Estimator**	:	Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$514.15 per cy	**Probable Low Cost Parameter**			**57.5**	**$485,097**	**$437.02**
Total Cost	:	$570,702	**Probable High Cost Parameter**			**40**	**$684,843**	**$616.98**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	4.00	22.2	8	710.40	E	$274.63	incl. in rate	incl. in rate	$195,097.15
Hydraulic Thumbs/Shear Attachment	Active	1.00	22.2	8	177.60	E	$16.39	incl. in rate	incl. in rate	$2,910.86
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	22.2	8	177.60	E	$62.72	incl. in rate	incl. in rate	$11,139.07
Loader, FE Rubber Tire (5.25cy)	Active	2.00	22.2	8	355.20	E	$75.42	incl. in rate	incl. in rate	$26,789.18
Hydraulic Crane (80tn)	Active	1.00	22.2	8	177.60	E	$190.46	incl. in rate	incl. in rate	$33,825.70
Truck, On-Highway Dump (6x4, 12cy)	Active	4.00	22.2	8	710.40	E	$70.35	incl. in rate	incl. in rate	$49,976.64
Labor Foreman (out)	Active	1.00	22.2	8	177.60	L	$46.27	incl. in rate	incl. in rate	$8,217.55
Laborer	Active	1.00	22.2	8	177.60	L	$45.80	incl. in rate	incl. in rate	$8,134.08
Equipment Operator (medium)	Active	3.00	22.2	8	532.80	L	$66.28	incl. in rate	incl. in rate	$35,313.98
Equipment Operator (crane)	Active	1.00	22.2	8	177.60	L	$68.41	incl. in rate	incl. in rate	$12,149.62
Truck Driver (heavy)	Active	4.00	22.2	8	710.40	L	$57.59	incl. in rate	incl. in rate	$40,911.94
0		1.00	22.2	8	177.60	0	$0.00	incl. in rate	incl. in rate	$0.00
			22.2	8	0.00					$0.00
			22.2	8	0.00					$0.00
			22.2	8	0.00					$0.00
			22.2	8	0.00					$0.00
			22.2	8	0.00					$0.00
				Labor Hours	**1,776**			**TOTAL LABOR**		**$104,727.17**
				Equipment Hours	**2,309**			**TOTAL EQUIPMENT**		**$319,738.61**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$5,236.36	$5,236.36
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$5,236.36**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$104,727.17	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$104,727.17
Material Cost	$5,236.36	Material Tax @	7.75%	$405.82		$5,642.18
Equipment Cost	$319,738.61	Equipment Tax @	7.75%	$24,779.74		$344,518.35
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$429,702**			**$25,186**	**DIRECT COST SUBTOTALS**	**$454,888**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$454,887.69	$68,233.15
Installing Contractors Profit@	8.0%				$454,887.69	$36,391.02
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$104,624.17**
General Contractors Insurance @	1.0%		on		$559,511.86	$5,595
Bond @	1.0%		on		$559,511.86	$5,595
Contingency @	0.0%		on		$570,702.10	$0
					TOTAL COST for pay item	**$570,702**

Additional Pay Item Notes :

There will be 2 excavators managing material and loading trucks, 1 excavator with shear attachment to cut reinforcement, 1 excavator with breaker attachment breaking concrete, 4 trucks will be used to haul material to scour site, each truck will have to make roughly 2 loads per day for the duration of the operation, due to the distance to the dump site location 4 trucks will be the minimum used. Production of the concrete demolition will be reduced due to the amount of items that will need to be demolished.

PAY ITEM COST DETAIL WORKSHEET

3.029 Remove Structural Steel items associated with Powerhouse

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.029			**Project**	: COPCO 2			
Description	:	Remove Structural Steel items associated with Powerhouse							
Quantity	:	220,000.00	LBS						
Daily Production	:	30,000.00	LBS per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	7.3	Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.96	per LBS		**Probable Low Cost Parameter**		**34500**	**$179,995**	**$0.82**
Total Cost	:	$211,759			**Probable High Cost Parameter**		**25500**	**$243,523**	**$1.11**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	7.3	8	58.40	L	$47.23	$0.00		$2,758.23
Electrician	Active	1.00	7.3	8	58.40	L	$45.23	$0.00		$2,641.43
Ironworkers	Active	10.00	7.3	8	584.00	L	$63.95	$0.00		$37,346.80
Loader, FE Rubber Tire (8.6cy)	Active	1.00	7.3	8	58.40	E	$221.50	$221.50		$12,935.60
Truck Driver (heavy)	Active	2.00	7.3	8	116.80	L	$57.59	$0.00		$6,726.51
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	7.3	8	116.80	E	$111.64	$111.64		$13,039.55
Hydraulic Crane (120tn)	Active	2.00	7.3	8	116.80	E	$239.06	$239.06		$27,922.21
Welder	Active	4.00	7.3	8	233.60	L	$7.84	$0.00		$1,830.84
Gas Welding Machine	Active	4.00	7.3	8	233.60	E	$2.88	$2.88		$672.06
Equipment Operator (medium)	Active	1.00	7.3	8	58.40	L	$66.28	$0.00		$3,870.75
Equipment Operator (crane)	Active	1.00	7.3	8	58.40	L	$68.41	$0.00		$3,995.14
Laborer	Active	10.00	7.3	8	584.00	L	$45.80	$0.00		$26,747.20
				Labor Hours	**1752**			**TOTAL LABOR**		**$85,916.91**
				Equipment Hours	**525.6**			**TOTAL EQUIPMENT**		**$54,569.42**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, wrenches, electrodes, welding accessories, etc)	1.00	LS	1.000	1.00	$12,887.54	$12,887.54
					TOTAL MATERIAL	**$12,887.54**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (25% from total)	27.50	ton	1.000	27.50	$595.00	$16,362.50
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	72.00	mile	1.000	72.00	$7.25	$522.00
					TOTAL SUBCONTRACTS	**$16,884.50**

SUMMARY OF COSTS

Labor Cost	$85,916.91	Labor Burden @	49.7%	$0.00		$85,916.91
Material Cost	$12,887.54	Material Tax @	7.8%	$998.78		$13,886.32
Equipment Cost	$54,569.42	Equipment Tax @	0.0%	$0.00		$54,569.42
Subcontractors	$16,884.50					$16,884.50
DIRECT COST SUBTOTALS	**$170,258**			**$999**	**DIRECT COST SUBTOTALS**	**$171,257**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$154,372.66		$23,155.90
Installing Contractors Profit@	8.0%				$154,372.66		$12,349.81
GC Markup on Subs @	5.0%				$16,884.50		$844.23
						TOTAL MARKUP COSTS	**$36,349.94**
General Contractors Insurance @	1.0%		on		$207,607.09		$2,076
Bond @	1.0%		on		$207,607.09		$2,076
Contingency @	0.0%		on		$211,759.24		$0
						TOTAL COST for pay item	**$211,759**

Additional Pay Item Notes :

Includes columns, beams, crane girders, bracing, misc. shapes, roof trusses, purlins, etc. Assumed contains paint with heavy metals 25% of the total lbs, 36 miles from Copco lake to Yreka transfer recycling. Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Assuming using 2 cranes and 2 trucks for disposal in 7 days.

PAY ITEM COST DETAIL WORKSHEET

3.030 Remove Control House Concrete

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.030		**Project**	: Copco 2			
Description	:	Remove Control House Concrete						
Quantity	:	30.00 CY						
Daily Production	:	30.00 CY per	8 hour shift	**Project #**	: 3			
Work Days	:	1.0 Days		**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$317.78 per CY		**Probable Low Cost Parameter**		**34.5**	**$8,103**	**$270.11**
Total Cost	:	$9,533		**Probable High Cost Parameter**		**24**	**$11,440**	**$381.34**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Laborer	Active	1.00	1.0	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Equipment Operator (medium)	Active	2.00	1.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Hydraulic Excavator (5.0cy)	Active	2.00	1.0	8	16.00	E	$274.63	incl. in rate	incl. in rate	$4,394.08
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	1.0	8	8.00	E	$70.35	incl. in rate	incl. in rate	$562.80
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
			1.0	8	0.00	E	$0.00			$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	**40**				**TOTAL LABOR**	**$2,257.76**
				Equipment Hours	**24**				**TOTAL EQUIPMENT**	**$4,956.88**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		EA	1.000	0.00	$235.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,257.76	Labor Burden @	0.0%			$2,257.76
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$4,956.88	Equipment Tax @	7.75%	$384.16		$5,341.04
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$7,215**			**$384**	**DIRECT COST SUBTOTALS**	**$7,599**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$7,598.80		$1,139.82
Installing Contractors Profit@	8.0%				$7,598.80		$607.90
GC Markup on Subs @	10.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$1,747.72**
General Contractors Insurance @	1.0%		on		$9,346.52		$93
Bond @	1.0%		on		$9,346.52		$93
Contingency @	0.0%		on		$9,533.45		$0
						TOTAL COST for pay item	**$9,533**

Additional Pay Item Notes :

1 truck 3 loads and 2 excavators 1 breaking and 1 loading material, foreman managing operation and labor flagging trucks.

PAY ITEM COST DETAIL WORKSHEET

3.031 Remove Control House Structural Steel Items

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.031		**Project**	: COPCO2			
Description	:	Remove Control House Structural Steel Items						
Quantity	:	3,500.00 LBS						
Daily Production	:	18,000.00 LBS per	8 hour shift	**Project #**	: 0			
Work Days	:	0.2 Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.88 per LBS		**Probable Low Cost Parameter**		**20700**	**$2,625**	**$0.75**
Total Cost	:	$3,088		**Probable High Cost Parameter**		**15300**	**$3,552**	**$1.01**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.2	8	1.60	L	$48.27	$0.00		$77.23
Electrician	Active	1.00	0.2	8	1.60	L	$45.23	$0.00		$72.37
Steelworker	Active	2.00	0.2	8	3.20	L	$65.52	$0.00		$209.66
Welder	Active	1.00	0.2	8	1.60	L	$7.84	$0.00		$12.54
Truck Driver (heavy)	Active	1.00	0.2	8	1.60	L	$57.59	$0.00		$92.14
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.2	8	1.60	E	$111.64	$111.64		$178.62
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.2	8	1.60	E	$221.50	$221.50		$354.40
Hydraulic Crane (17tn)	Active	1.00	0.2	8	1.60	E	$81.52	$81.52		$130.43
Equipment Operator (medium)	Active	2.00	0.2	8	3.20	L	$66.28	$0.00		$212.10
Gas Welding Machine	Active	1.00	0.2	8	1.60	E	$2.88	$2.88		$4.60
Laborer	Active	4.00	0.2	8	6.40	L	$45.80	$0.00		$293.12

Labor Hours	**19.2**	**TOTAL LABOR**	**$969.16**
Equipment Hours	**6.4**	**TOTAL EQUIPMENT**	**$668.06**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, wrenches, electrodes, welding accessories, etc)	1.00	LS	1.000	1.00	$145.37	$145.37

TOTAL MATERIAL	**$145.37**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (25% from total)	0.44	ton	1.000	0.44 $595.00	$260.31
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	72.00	mile	1.000	72.00 $7.25	$522.00

TOTAL SUBCONTRACTS	**$782.31**

SUMMARY OF COSTS

Labor Cost	$969.16	Labor Burden @	49.7%	$0.00	$969.16
Material Cost	$145.37	Material Tax @	7.8%	$11.27	$156.64
Equipment Cost	$668.06	Equipment Tax @	0.0%	$0.00	$668.06
Subcontractors	$782.31				$782.31
DIRECT COST SUBTOTALS	**$2,565**			**$11**	**DIRECT COST SUBTOTALS** **$2,576**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,793.86	$269.08
Installing Contractors Profit@	8.0%				$1,793.86	$143.51
GC Markup on Subs @	5.0%				$782.31	$39.12
					TOTAL MARKUP COSTS	**$451.70**
General Contractors Insurance @	1.0%		on		$3,027.88	$30
Bond @	1.0%		on		$3,027.88	$30
Contingency @	0.0%		on		$3,088.44	$0
					TOTAL COST for pay item	**$3,088**

Additional Pay Item Notes :

Assumed structural frames contains paint with heavy metals 25% of the total lbs, 36 miles from Copco lake to Yreka transfer recycling. Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Assuming using 1 cranes, 1 loader and 1 trucks for disposal.

PAY ITEM COST DETAIL WORKSHEET

3.032 Remove Shop Building

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.032			**Project**	: Copco 2			
Description	:	Remove Shop Building							
Quantity	:	4,300.00	SF						
Daily Production	:	308.00	SF per	8 hour shift	**Project #**	: 3			
Work Days	:	14.0	Days		**Estimator**	: Eric Jones	**SF per**	**Total Cost**	**Unit Price Per SF**
Unit Price	:	$69.45	per SF		**Probable Low Cost Parameter**		**354.2**	**$253,829**	**$59.03**
Total Cost	:	$298,623			**Probable High Cost Parameter**		**231**	**$373,279**	**$86.81**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	14.0	8	112.00	L	$46.27	incl. in rate	incl. in rate	$5,182.24
Laborer	Active	6.00	14.0	8	672.00	L	$45.80	incl. in rate	incl. in rate	$30,777.60
Equipment Operator (medium)	Active	4.00	14.0	8	448.00	L	$66.28	incl. in rate	incl. in rate	$29,693.44
Truck Driver (heavy)	Active	1.00	14.0	8	112.00	L	$57.59	incl. in rate	incl. in rate	$6,450.08
Steelworker	Active	2.00	14.0	8	224.00	L	$65.52	incl. in rate	incl. in rate	$14,676.48
Hydraulic Excavator (5.0cy)	Active	3.00	14.0	8	336.00	E	$274.63	incl. in rate	incl. in rate	$92,275.68
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	2.00	14.0	8	224.00	E	$62.72	incl. in rate	incl. in rate	$14,049.28
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	14.0	8	224.00	E	$111.64	incl. in rate	incl. in rate	$25,007.36
Loader, FE Rubber Tire (5.25cy)	Active	1.00	14.0	8	112.00	E	$75.42	incl. in rate	incl. in rate	$8,447.04
		1.00	14.0	8	112.00	0	$0.00	$0.00		$0.00
		1.00	14.0	8	112.00	0	$0.00	$0.00		$0.00
		1.00	14.0	8	112.00	0	$0.00	$0.00		$0.00
			14.0	8	0.00					$0.00
			14.0	8	0.00					$0.00
			14.0	8	0.00					$0.00
			14.0	8	0.00					$0.00
			14.0	8	0.00					$0.00
				Labor Hours	**1568**			**TOTAL LABOR**		**$86,779.84**
				Equipment Hours	**896**			**TOTAL EQUIPMENT**		**$139,779.36**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
Glyphosate	31.00	gal	1.000	31.00	$18.87	$584.97
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$584.97**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$86,779.84	Labor Burden @	0.0%			$86,779.84
Material Cost	$584.97	Material Tax @	7.75%	$45.34		$630.31
Equipment Cost	$139,779.36	Equipment Tax @	7.75%	$10,832.90		$150,612.26
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$227,144**			**$10,878**	**DIRECT COST SUBTOTALS**	**$238,022**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$238,022.41		$35,703.36
Installing Contractors Profit@	8.0%				$238,022.41		$19,041.79
GC Markup on Subs @	10.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$54,745.15**
General Contractors Insurance @	1.0%		on		$292,767.56		$2,928
Bond @	1.0%		on		$292,767.56		$2,928
Contingency @	0.0%		on		$298,622.91		$0
						TOTAL COST for pay item	**$298,623**

Additional Pay Item Notes :

Crew should take 2 weeks to remove building. Assuming the building is a combination of structural steel and CMU. 1 labor foreman to run crews 6 laborer for running and cleaning up misc mats, and backing up trucks 3 equipment operators 2 for the excavators (1 with breaker, 1 with bucket,) and 1 for loader excavators will be performing the demolition and the loader/ excavator will load trucks, 1 truck driver to drive off road truck, 2 steel works to cut steel members as necessary, Work duration includes demo of Slab on grade

PAY ITEM COST DETAIL WORKSHEET

3.033 Remove & Dispose - 2 - Governor oil systems

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.033		**Project**	: COPCO 2			
Description	:	Remove & Dispose - 2 - Governor oil systems						
Quantity	:	38,000.00 LBS						
Daily Production	:	25,000.00 LBS per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	1.5 Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$1.06 per LBS		**Probable Low Cost Parameter**		**27500**	**$36,365**	**$0.96**
Total Cost	:	$40,406		**Probable High Cost Parameter**		**20000**	**$48,487**	**$1.28**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	1.5	8	24.00	L	$48.27	$0.00		$1,158.48
Laborer	Active	2.00	1.5	8	24.00	L	$45.80	$0.00		$1,099.20
Crawler Crane (270tn)	Active	2.00	1.5	8	24.00	E	$399.50	$446.84		$9,588.00
Equipment Operator (medium)	Active	2.00	1.5	8	24.00	L	$66.28	$0.00		$1,590.72
Welder	Active	3.00	1.5	8	36.00	L	$7.84	$0.00		$282.15
Gas Welding Machine	Active	3.00	1.5	8	36.00	E	$2.88	$2.88		$103.57
Electrician	Active	2.00	1.5	8	24.00	L	$45.23	$0.00		$1,085.52
Steelworker	Active	2.00	1.5	8	24.00	L	$65.52	$0.00		$1,572.48
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.5	8	12.00	E	$111.64	$111.64		$1,339.68
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.5	8	12.00	E	$221.50	$221.50		$2,658.00
Truck Driver (heavy)	Active	1.00	1.5	8	12.00	L	$57.59	$0.00		$691.08
Hydraulic Impact Breaker Attachment (2k-3k ft-lb)	Active	1.00	1.5	8	12.00	E	$30.85	$30.85		$370.20

Labor Hours	**168**	**TOTAL LABOR**	**$7,479.63**
Equipment Hours	**96**	**TOTAL EQUIPMENT**	**$14,059.45**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, wrenches, electrodes, welding accessories, etc)	1.00	LS	1.000	1.00	$747.96	$747.96

TOTAL MATERIAL	**$747.96**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	19.00	ton	1.000	19.00 $595.00	$11,305.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	34.00	mile	1.000	34.00 $7.25	$246.50

TOTAL SUBCONTRACTS	**$11,551.50**

SUMMARY OF COSTS

Labor Cost	$7,479.63	Labor Burden @	49.7%	$0.00		$7,479.63
Material Cost	$747.96	Material Tax @	7.8%	$57.97		$805.93
Equipment Cost	$14,059.45	Equipment Tax @	0.0%	$0.00		$14,059.45
Subcontractors	$11,551.50					$11,551.50
DIRECT COST SUBTOTALS	**$33,839**			**$58**	**DIRECT COST SUBTOTALS**	**$33,897**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$22,345.01		$3,351.75
Installing Contractors Profit@	8.0%				$22,345.01		$1,787.60
GC Markup on Subs @	5.0%				$11,551.50		$577.58
						TOTAL MARKUP COSTS	**$5,716.93**
General Contractors Insurance @	1.0%		on		$39,613.44		$396
Bond @	1.0%		on		$39,613.44		$396
Contingency @	0.0%		on		$40,405.71		$0
						TOTAL COST for pay item	**$40,406**

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Using hydraulic impact breaker because of the systems that are encased in concrete. Assumed hazardous waste 100% of the total lbs, calculated 34 miles from Copco1 to Yreka Transfer Recycling.

PAY ITEM COST DETAIL WORKSHEET — **3.034 Remove & Dispose - Cooling water and bearing oil systems**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.034			**Project**	: COPCO 2			
Description	:	Remove & Dispose - Cooling water and bearing oil systems							
Quantity	:	13,300.00	LBS						
Daily Production	:	25,000.00	LBS per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	0.5	Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.93	per LBS		**Probable Low Cost Parameter**		**27500**	**$11,173**	**$0.84**
Total Cost	:	$12,414			**Probable High Cost Parameter**		**20000**	**$14,897**	**$1.12**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.5	8	4.00	L	$48.27	$0.00		$193.08
Steelworker	Active	2.00	0.5	8	8.00	L	$65.52	$0.00		$524.16
Crawler Crane (270tn)	Active	2.00	0.5	8	8.00	E	$399.50	$446.84		$3,196.00
Equipment Operator (medium)	Active	2.00	0.5	8	8.00	L	$66.28	$0.00		$530.24
Welder	Active	3.00	0.5	8	12.00	L	$7.84	$0.00		$94.05
Gas Welding Machine	Active	3.00	0.5	8	12.00	E	$2.88	$2.88		$34.52
Electrician	Active	2.00	0.5	8	8.00	L	$45.23	$0.00		$361.84
Laborer	Active	3.00	0.5	8	12.00	L	$45.80	$0.00		$549.60
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	0.5	8	8.00	E	$70.35	$70.35		$562.80
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.5	8	4.00	E	$221.50	$221.50		$886.00
Truck Driver (heavy)	Active	1.00	0.5	8	4.00	L	$57.59	$0.00		$230.36
Equipment Operator (oiler)	Active	1.00	0.5	8	4.00	L	$62.94	$0.00		$251.76
				Labor Hours	**60**			**TOTAL LABOR**		**$2,735.09**
				Equipment Hours	**32**			**TOTAL EQUIPMENT**		**$4,679.32**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$273.51	$273.51
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	2,000.00	LF	1.000	2,000.00	$0.85	$1,700.00
					TOTAL MATERIAL	**$1,973.51**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.67	ton	1.000	0.67	$595.00	$395.68
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	2.66	mile	1.000	2.66	$7.25	$19.29
					TOTAL SUBCONTRACTS	**$414.96**

SUMMARY OF COSTS

Labor Cost	$2,735.09	Labor Burden @	49.7%	$0.00		$2,735.09
Material Cost	$1,973.51	Material Tax @	7.8%	$152.95		$2,126.46
Equipment Cost	$4,679.32	Equipment Tax @	0.0%	$0.00		$4,679.32
Subcontractors	$414.96					$414.96
DIRECT COST SUBTOTALS	**$9,803**			**$153**	**DIRECT COST SUBTOTALS**	**$9,956**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$9,540.87		$1,431.13
Installing Contractors Profit@	8.0%				$9,540.87		$763.27
GC Markup on Subs @	5.0%				$414.96		$20.75
						TOTAL MARKUP COSTS	**$2,215.15**
General Contractors Insurance @	1.0%		on		$12,170.98		$122
Bond @	1.0%		on		$12,170.98		$122
Contingency @	0.0%		on		$12,414.40		$0
						TOTAL COST for pay item	**$12,414**

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition,4890 LF of 1 1/2" oil pipes at 2.72 Lbs. Used 1 Forman, 2 Steelworkers to cut the pipes and 3 Laborers to load the pipes in the truck. The cooling and lubrication systems for the Hydroelectric Barge turbine, speed increaser and generator will be a combination of water and oil. These systems will be isolated from the water passages so that no contamination of passing water will occur. The following is a list of hazardous materials, substances, chemicals, and wastes normally found at a hydropower facility that may require disposal actions if not recycled or reused for their intended purpose:

1. Polychlorinated Biphenyls (PCBs)
2. Asbestos
3. Paint/abrasive blast grit (red lead paint)
4. Oil
5. Mercury
6. Antifreeze
7. Halogenated and non-halogenated solvents
8. Greases
9. Pesticides (includes herbicides, insecticides, and wood preservatives)
10. Petroleum contaminated
11. Chlorinated fluorocarbons (CFCs) Freon/Halon
12. Gasoline/diesel (includes product and sludge in tanks)
13. Batteries (includes acid)
14. Water treatment sludge (septic tanks/wastewater treatment).

Based on the hazardous materials above assumed hazardous waste 100% of the total lbs

PAY ITEM COST DETAIL WORKSHEET

3.035 Remove & Dispose - Oil / Water separator tank and piping

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.035			**Project**	: COPCO 2			
Description	:	Remove & Dispose - Oil / Water separator tank and piping							
Quantity	:	2,700.00	LBS						
Daily Production	:	15,000.00	LBS per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	0.2	Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.93	per LBS		**Probable Low Cost Parameter**		**16500**	**$2,268**	**$0.84**
Total Cost	:	$2,520			**Probable High Cost Parameter**		**12000**	**$3,024**	**$1.12**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.2	8	1.60	L	$48.27	$0.00		$77.23
Steelworker	Active	4.00	0.2	8	6.40	L	$65.52	$0.00		$419.33
Laborer	Active	4.00	0.2	8	6.40	L	$45.80	$0.00		$293.12
Equipment Operator (crane)	Active	1.00	0.2	8	1.60	L	$68.41	$0.00		$109.46
Truck Driver (heavy)	Active	1.00	0.2	8	1.60	L	$57.59	$0.00		$92.14
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.2	8	1.60	E	$111.64	$111.64		$178.62
Hydraulic Crane (80tn)	Active	1.00	0.2	8	1.60	E	$190.46	$190.46		$304.74

Labor Hours	**17.6**	**TOTAL LABOR**	**$991.28**
Equipment Hours	**3.2**	**TOTAL EQUIPMENT**	**$483.36**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$99.13	$99.13

TOTAL MATERIAL	**$99.13**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Disposal fee	1.00	EA	1.000	1.00 $500.00	$500.00

TOTAL SUBCONTRACTS	**$500.00**

SUMMARY OF COSTS

Labor Cost	$991.28	Labor Burden @	49.7%	$0.00		$991.28
Material Cost	$99.13	Material Tax @	7.8%	$7.68		$106.81
Equipment Cost	$483.36	Equipment Tax @	0.0%	$0.00		$483.36
Subcontractors	$500.00					$500.00
DIRECT COST SUBTOTALS	**$2,074**			**$8**	**DIRECT COST SUBTOTALS**	**$2,081**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,581.45		$237.22
Installing Contractors Profit@	8.0%				$1,581.45		$126.52
GC Markup on Subs @	5.0%				$500.00		$25.00
						TOTAL MARKUP COSTS	**$388.73**
General Contractors Insurance @	1.0%		on		$2,470.18		$25
Bond @	1.0%		on		$2,470.18		$25
Contingency @	0.0%		on		$2,519.59		$0
						TOTAL COST for pay item	**$2,520**

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-25 for cutting steel and A-3H for equipment disposal. .Assumed a disposal fee will be required.

PAY ITEM COST DETAIL WORKSHEET

3.036 Remove & Dispose - 12 - Cast Iron Columns

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.036			**Project**	: COPCO 2			
Description	:	Remove & Dispose - 12 - Cast Iron Columns							
Quantity	:	54,000.00	LBS						
Daily Production	:	25,000.00	LBS per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	2.2	Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.83	per LBS		**Probable Low Cost Parameter**		**28750**	**$37,988**	**$0.70**
Total Cost	:	$44,692			**Probable High Cost Parameter**		**21250**	**$51,396**	**$0.95**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	2.2	8	17.60	L	$48.27	$0.00		$849.55
Welder	Active	2.00	2.2	8	35.20	L	$7.84	$0.00		$275.88
Steelworker	Active	10.00	2.2	8	176.00	L	$65.52	$0.00		$11,531.52
Equipment Operator (crane)	Active	2.00	2.2	8	35.20	L	$68.41	$0.00		$2,408.03
Truck Driver (heavy)	Active	2.00	2.2	8	35.20	L	$57.59	$0.00		$2,027.17
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	2.2	8	35.20	E	$31.90	$31.90		$1,122.88
Crawler Crane (90tn)	Active	2.00	2.2	8	35.20	E	$208.09	$208.09		$7,324.77
Gas Welding Machine	Active	2.00	2.2	8	35.20	E	$2.88	$2.88		$101.27
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.2	8	17.60	E	$221.50	$221.50		$3,898.40
Vibratory Hammer & Extractor	Active	2.00	2.2	8	35.20	E	$94.34	$94.34		$3,320.77

Labor Hours	**299.2**	**TOTAL LABOR**	**$17,092.15**
Equipment Hours	**158.4**	**TOTAL EQUIPMENT**	**$15,768.09**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$2,563.82	$2,563.82

TOTAL MATERIAL	**$2,563.82**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$17,092.15	Labor Burden @	49.7%	$0.00		$17,092.15
Material Cost	$2,563.82	Material Tax @	7.8%	$198.70		$2,762.52
Equipment Cost	$15,768.09	Equipment Tax @	0.0%	$0.00		$15,768.09
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$35,424**			**$199**	**DIRECT COST SUBTOTALS**	**$35,623**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$35,622.76		$5,343.41
Installing Contractors Profit@	8.0%				$35,622.76		$2,849.82
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$8,193.23**
General Contractors Insurance @	1.0%		on		$43,815.99		$438
Bond @	1.0%		on		$43,815.99		$438
Contingency @	0.0%		on		$44,692.31		$0
						TOTAL COST for pay item	**$44,692**

Additional Pay Item Notes :

Assumed Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal., B-34A for hauling. Assuming using 2 cranes, 1 loader and 2 trucks for disposal. Using hydraulic impact breaker because columns that are encased in concrete.

PAY ITEM COST DETAIL WORKSHEET

3.037 Remove & Dispose - 2 - Francis Turbines

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.037			**Project**	: COPCO 2			
Description	:	Remove & Dispose - 2 - Francis Turbines							
Quantity	:	660,000.00	LBS						
Daily Production	:	30,000.00	LBS per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	22.0	Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.83	per LBS		**Probable Low Cost Parameter**		**34500**	**$465,377**	**$0.71**
Total Cost	:	$547,502			**Probable High Cost Parameter**		**24000**	**$657,003**	**$1.00**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	22.0	8	176.00	L	$47.23	$0.00		$8,312.48
Ironworkers	Active	5.00	22.0	8	880.00	L	$63.95	$0.00		$56,276.00
Crawler Crane (270tn)	Active	2.00	22.0	8	352.00	E	$399.50	$446.84		$140,624.00
Equipment Operator (medium)	Active	2.00	22.0	8	352.00	L	$66.28	$0.00		$23,330.56
Welder	Active	4.00	22.0	8	704.00	L	$7.84	$0.00		$5,517.60
Gas Welding Machine	Active	4.00	22.0	8	704.00	E	$2.88	$2.88		$2,025.40
Electrician	Active	2.00	22.0	8	352.00	L	$45.23	$0.00		$15,920.96
Millwright	Active	5.00	22.0	8	880.00	L	$69.46	$0.00		$61,124.80
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	22.0	8	352.00	E	$31.90	$31.90		$11,228.80
Loader, FE Rubber Tire (8.6cy)	Active	1.00	22.0	8	176.00	E	$221.50	$221.50		$38,984.00
Truck Driver (heavy)	Active	2.00	22.0	8	352.00	L	$57.59	$0.00		$20,271.68
Equipment Operator (oiler)	Active	1.00	22.0	8	176.00	L	$62.94	$0.00		$11,077.44

Labor Hours	**3872**	**TOTAL LABOR**	**$201,831.52**
Equipment Hours	**1584**	**TOTAL EQUIPMENT**	**$192,862.20**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$20,183.15	$20,183.15
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	3,000.00	LF	1.000	3,000.00	$0.85	$2,550.00

TOTAL MATERIAL	**$22,733.15**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10%)	33.00	ton	1.000	33.00	$595.00	$19,635.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	72.00	mile	1.000	72.00	$7.25	$522.00

TOTAL SUBCONTRACTS	**$20,157.00**

SUMMARY OF COSTS

Labor Cost	$201,831.52	Labor Burden @	49.7%	$0.00	$201,831.52
Material Cost	$22,733.15	Material Tax @	7.8%	$1,761.82	$24,494.97
Equipment Cost	$192,862.20	Equipment Tax @	0.0%	$0.00	$192,862.20
Subcontractors	$20,157.00				$20,157.00
DIRECT COST SUBTOTALS	**$437,584**			**$1,762**	**DIRECT COST SUBTOTALS** **$439,346**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$419,188.69	$62,878.30
Installing Contractors Profit@	8.0%				$419,188.69	$33,535.10
GC Markup on Subs @	5.0%				$20,157.00	$1,007.85
					TOTAL MARKUP COSTS	**$97,421.25**
General Contractors Insurance @	1.0%		on		$536,766.94	$5,368
Bond @	1.0%		on		$536,766.94	$5,368
Contingency @	0.0%		on		$547,502.28	$0
					TOTAL COST for pay item	**$547,502**

Additional Pay Item Notes :

Working with a crew formed of 1 El. Foreman 2 Electrician starting to disconnect power and take care of the temporary electrical power they need at the site. The crew of 5 Ironworker and 5 Millwright. open the engine side panels, and remove the nacelle access panels. Disconnect the engine thermocouple leads at the terminal board. Before disconnecting any lines all fuel, oil, and hydraulic fluid valves are closed. Plug all lines as they are disconnected to prevent entrance of foreign material. Remove the clamps securing the bleed-air ducts at the firewall. Then, disconnect the electrical connector plugs, engine breather and vent lines, and fuel, oil, and hydraulic lines. Disconnect the engine power lever and propeller control rods or cables. Remove the covers from the lift points, attach the sling, and remove slack from the cables using a suitable hoist. The sling must be adjusted to position. Remove the engine mount bolts. The engine ready to be removed. Move the engine forward, out of the nacelle structure, until it clears the aircraft. Lower the into position on the stand, and secure it prior to removing the engine sling. The crew of 4 Welder are going to cut in pieces the big parts of the turbine to be able to load them in the truck using a loader and dispose. .Assumed contains paint with heavy metals 10% of the total lbs, 36 miles from Copco2 to Yreka transfer recycling.

PAY ITEM COST DETAIL WORKSHEET

3.038 Remove & Dispose - 2 - 40 Ton indoor cranes

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.038		**Project**	: COPCO 2			
Description	:	Remove & Dispose - 2 - 40 Ton indoor cranes						
Quantity	:	140,000.00 LBS						
Daily Production	:	30,000.00 LBS per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	4.7 Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$1.17 per LBS		**Probable Low Cost Parameter**		**34500**	**$138,781**	**$0.99**
Total Cost	:	$163,271		**Probable High Cost Parameter**		**24000**	**$195,925**	**$1.40**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (80tn)	Active	2.00	4.7	8	75.20	E	$190.46	$190.46		$14,322.59
Equipment Operator (crane)	Active	2.00	4.7	8	75.20	L	$68.41	$0.00		$5,144.43
Hydraulic Excavator (6.0cy)	Active	2.00	4.7	8	75.20	E	$322.48	$322.48		$24,250.50
Equipment Operator (medium)	Active	3.00	4.7	8	112.80	L	$66.28	$0.00		$7,476.38
Loader, FE Rubber Tire (8.6cy)	Active	1.00	4.7	8	37.60	E	$221.50	$221.50		$8,328.40
Electrician	Active	6.00	4.7	8	225.60	L	$45.23	$0.00		$10,203.89
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	4.7	8	37.60	E	$111.64	$111.64		$4,197.66
Labor Foreman	Active	2.00	4.7	8	75.20	L	$48.27	$0.00		$3,629.90
Welder	Active	2.00	4.7	8	75.20	L	$7.84	$0.00		$589.38
Gas Welding Machine	Active	2.00	4.7	8	75.20	E	$2.88	$2.88		$216.35
Millwright	Active	16.00	4.7	8	601.60	L	$69.46	$0.00		$41,787.14
Truck Driver (heavy)	Active	1.00	4.7	8	37.60	L	$57.59	$0.00		$2,165.38

Labor Hours	**1203.2**	**TOTAL LABOR**	**$70,996.51**
Equipment Hours	**300.8**	**TOTAL EQUIPMENT**	**$51,315.50**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$3,549.83	$3,549.83

TOTAL MATERIAL	**$3,549.83**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	7.00	ton	1.000	7.00	$595.00	$4,165.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	72.00	mile	1.000	72.00	$7.25	$522.00

TOTAL SUBCONTRACTS	**$4,687.00**

SUMMARY OF COSTS

Labor Cost	$70,996.51	Labor Burden @	49.7%	$0.00		$70,996.51
Material Cost	$3,549.83	Material Tax @	7.8%	$275.11		$3,824.94
Equipment Cost	$51,315.50	Equipment Tax @	0.0%	$0.00		$51,315.50
Subcontractors	$4,687.00					$4,687.00
DIRECT COST SUBTOTALS	**$130,549**			**$275**	**DIRECT COST SUBTOTALS**	**$130,824**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$126,136.95		$18,920.54
Installing Contractors Profit@	8.0%				$126,136.95		$10,090.96
GC Markup on Subs @	5.0%				$4,687.00		$234.35
						TOTAL MARKUP COSTS	**$29,245.85**
General Contractors Insurance @	1.0%		on		$160,069.79		$1,601
Bond @	1.0%		on		$160,069.79		$1,601
Contingency @	0.0%		on		$163,271.19		$0
						TOTAL COST for pay item	**$163,271**

Additional Pay Item Notes :

Assumed the crane and the rail will take 5 days to dismantle and contains paint with heavy metals 10% of the total lbs, 36 miles from Copco lake to Yreka transfer recycling. Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal, B-34A for hauling.

PAY ITEM COST DETAIL WORKSHEET

3.039 Remove & Dispose - Compressed Air Systems

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.039		**Project**	: COPCO 2			
Description	:	Remove & Dispose - Compressed Air Systems						
Quantity	:	1,000.00 LBS						
Daily Production	:	6,000.00 LBS per	8 hour shift	**Project #**	: 0			
Work Days	:	0.167 Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$1.13 per LBS		**Probable Low Cost Parameter**		**6600**	**$1,016**	**$1.02**
Total Cost	:	$1,129		**Probable High Cost Parameter**		**4800**	**$1,355**	**$1.35**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	0.167	8	1.33	L	$47.23	$0.00		$62.97
Steelworker	Active	1.00	0.167	8	1.33	L	$65.52	$0.00		$87.36
Laborer	Active	3.00	0.167	8	4.00	L	$45.80	$0.00		$183.20
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.167	8	1.33	E	$221.50	$221.50		$295.33
Truck Driver (heavy)	Active	1.00	0.167	8	1.33	L	$57.59	$0.00		$76.79
Truck Driver (light)	Active	1.00	0.167	8	1.33	L	$56.29	$0.00		$75.05
Equipment Operator (medium)	Active	1.00	0.167	8	1.33	L	$66.28	$0.00		$88.37

Labor Hours	**10.66666667**	**TOTAL LABOR**	**$573.75**
Equipment Hours	**1.333333333**	**TOTAL EQUIPMENT**	**$295.33**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$28.69	$28.69

TOTAL MATERIAL	**$28.69**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$573.75	Labor Burden @	49.7%	$0.00	$573.75
Material Cost	$28.69	Material Tax @	7.8%	$2.22	$30.91
Equipment Cost	$295.33	Equipment Tax @	0.0%	$0.00	$295.33
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$898**			**$2**	**DIRECT COST SUBTOTALS** **$900**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$899.99	$135.00
Installing Contractors Profit@	8.0%				$899.99	$72.00
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$207.00**
General Contractors Insurance @	1.0%	on			$1,106.99	$11
Bond @	1.0%	on			$1,106.99	$11
Contingency @	0.0%	on			$1,129.13	$0
					TOTAL COST for pay item	**$1,129**

Additional Pay Item Notes :

Used RS Means : assumption for "Pipe, metal pipe, to 1-1/2" diam., selective demolition, 370 LF of 1 1/2" pipes at 2.72 Lbs. Used 1 Steelworkers to cut the pipes and 3 Laborers for hauling.

PAY ITEM COST DETAIL WORKSHEET

3.040 Remove & Dispose - 2 - CO2 Systems

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.040		**Project**	: COPCO 2			
Description	:	Remove & Dispose - 2 - CO2 Systems						
Quantity	:	2,100.00 LBS						
Daily Production	:	6,000.00 LBS per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	0.4 Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$1.23 per LBS		**Probable Low Cost Parameter**		**6600**	**$2,316**	**$1.10**
Total Cost	:	$2,573		**Probable High Cost Parameter**		**4800**	**$3,088**	**$1.47**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.4	8	3.20	L	$48.27	$0.00		$154.46
Steelworker	Active	2.00	0.4	8	6.40	L	$65.52	$0.00		$419.33
Laborer	Active	2.00	0.4	8	6.40	L	$45.80	$0.00		$293.12
Equipment Operator (medium)	Active	0.00	0.4	8	0.00	L	$66.28	$0.00		$0.00
Loader, FE Rubber Tire (8.6cy)	Active	0.00	0.4	8	0.00	E	$221.50	$221.50		$0.00
Electrician	Active	1.00	0.4	8	3.20	L	$45.23	$0.00		$144.74
Equipment Operator (light)	Active	2.00	0.4	8	6.40	L	$64.90	$0.00		$415.36
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.4	8	3.20	E	$111.64	$111.64		$357.25
Truck Driver (light)	Active	1.00	0.4	8	3.20	L	$56.29	$0.00		$180.13

Labor Hours	**28.8**	**TOTAL LABOR**	**$1,607.14**
Equipment Hours	**3.2**	**TOTAL EQUIPMENT**	**$357.25**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$80.36	$80.36

TOTAL MATERIAL	**$80.36**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,607.14	Labor Burden @	49.7%	$0.00	$1,607.14
Material Cost	$80.36	Material Tax @	7.8%	$6.23	$86.58
Equipment Cost	$357.25	Equipment Tax @	0.0%	$0.00	$357.25
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$2,045**			**$6**	**DIRECT COST SUBTOTALS** **$2,051**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$2,050.97	$307.65
Installing Contractors Profit@	8.0%				$2,050.97	$164.08
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$471.72**
General Contractors Insurance @	1.0%	on			$2,522.69	$25
Bond @	1.0%	on			$2,522.69	$25
Contingency @	0.0%	on			$2,573.15	$0
					TOTAL COST for pay item	**$2,573**

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 772 LF of 1 1/2" pipes at 2.72 Lbs. Used 1 Forman, 2 Steelworkers to cut the pipes and 2 Laborers to load the pipes in the truck. 1 electrician for tools.

PAY ITEM COST DETAIL WORKSHEET

3.041 Remove & Dispose - Plant Water and Fire Protection

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.041		**Project**	: COPCO2			
Description	:	Remove & Dispose - Plant Water and Fire Protection						
Quantity	:	3,100.00 LBS						
Daily Production	:	6,000.00 LBS per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	0.5 Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$1.41 per LBS		**Probable Low Cost Parameter**		**6600**	**$3,936**	**$1.27**
Total Cost	:	$4,373		**Probable High Cost Parameter**		**4800**	**$5,248**	**$1.69**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.5	8	4.00	L	$48.27	$0.00		$193.08
Steelworker	Active	4.00	0.5	8	16.00	L	$65.52	$0.00		$1,048.32
Truck Driver (light)	Active	1.00	0.5	8	4.00	L	$56.29	$0.00		$225.16
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.5	8	4.00	E	$111.64	$111.64		$446.56
Laborer	Active	4.00	0.5	8	16.00	L	$45.80	$0.00		$732.80
Electrician	Active	1.00	0.5	8	4.00	L	$45.23	$0.00		$180.92
Loader, FE Rubber Tire (3.5cy)	Active	1.00	0.5	8	4.00	E	$64.23	$64.23		$256.92
Equipment Operator (light)	Active	1.00	0.5	8	4.00	L	$64.90	$0.00		$259.60

Labor Hours	**48**	**TOTAL LABOR**	**$2,639.88**
Equipment Hours	**8**	**TOTAL EQUIPMENT**	**$703.48**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$131.99	$131.99

TOTAL MATERIAL	**$131.99**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,639.88	Labor Burden @	49.7%	$0.00	$2,639.88
Material Cost	$131.99	Material Tax @	7.8%	$10.23	$142.22
Equipment Cost	$703.48	Equipment Tax @	0.0%	$0.00	$703.48
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$3,475**			**$10**	**DIRECT COST SUBTOTALS** **$3,486**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,485.58	$522.84
Installing Contractors Profit@	8.0%				$3,485.58	$278.85
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$801.68**
General Contractors Insurance @	1.0%	on			$4,287.27	$43
Bond @	1.0%	on			$4,287.27	$43
Contingency @	0.0%	on			$4,373.01	$0
					TOTAL COST for pay item	**$4,373**

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 1140 LF of 1 1/2" pipes at 2.72 Lbs. Used 2 Forman, 4 Steelworkers to cut the pipes and 4 Laborers to load the pipes in the truck.

PAY ITEM COST DETAIL WORKSHEET

3.042 Remove & Dispose - Transformr Oil Fire Protection

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.042		**Project**	: COPCO2			
Description	:	Remove & Dispose - Transformr Oil Fire Protection						
Quantity	:	6,500.00 LBS						
Daily Production	:	18,500.00 LBS per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	0.4 Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.87 per LBS		**Probable Low Cost Parameter**		**20350**	**$5,070**	**$0.78**
Total Cost	:	$5,633		**Probable High Cost Parameter**		**14800**	**$6,760**	**$1.04**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.4	8	3.20	L	$48.27	$0.00		$154.46
Laborer	Active	2.00	0.4	8	6.40	L	$45.80	$0.00		$293.12
Steelworker	Active	2.00	0.4	8	6.40	L	$65.52	$0.00		$419.33
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.4	8	3.20	E	$111.64	$111.64		$357.25
Truck Driver (light)	Active	1.00	0.4	8	3.20	L	$56.29	$0.00		$180.13
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.4	8	3.20	E	$221.50	$221.50		$708.80
Equipment Operator (medium)	Active	2.00	0.4	8	6.40	L	$66.28	$0.00		$424.19

Labor Hours	**25.6**	**TOTAL LABOR**	**$1,471.23**
Equipment Hours	**6.4**	**TOTAL EQUIPMENT**	**$1,066.05**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$73.56	$73.56

TOTAL MATERIAL	**$73.56**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	3.25	ton	1.000	3.25 $595.00	$1,933.75
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	36.00	mile	1.000	36.00 $7.25	$261.00

TOTAL SUBCONTRACTS	**$2,194.75**

SUMMARY OF COSTS

Labor Cost	$1,471.23	Labor Burden @	49.7%	$0.00	$1,471.23
Material Cost	$73.56	Material Tax @	7.8%	$5.70	$79.26
Equipment Cost	$1,066.05	Equipment Tax @	0.0%	$0.00	$1,066.05
Subcontractors	$2,194.75				$2,194.75
DIRECT COST SUBTOTALS	**$4,806**			**$6**	**DIRECT COST SUBTOTALS** **$4,811**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$2,616.54	$392.48
Installing Contractors Profit@	8.0%				$2,616.54	$209.32
GC Markup on Subs @	5.0%				$2,194.75	$109.74
					TOTAL MARKUP COSTS	**$711.54**
General Contractors Insurance @	1.0%	on			$5,522.83	$55
Bond @	1.0%	on			$5,522.83	$55
Contingency @	0.0%	on			$5,633.29	$0
					TOTAL COST for pay item	**$5,633**

Additional Pay Item Notes :

Based on RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 2390 LF of 1 1/2" fire protection pipes at 2.72 Lbs. Used 1 Forman and 1 Laborers to load in drums and put them in the truck. Calculated 36 miles from Copco 1 to Yreka Transfer Recycling. Each hydropower facility has at least 150,000 gallons to 250,000 gallon of oil currently in use. This oil would have to be properly disposed of in the event of decommissioning. Oil removed from the turbines and other equipment, including transformer oil, would be either a waste oil or used oil, depending on prior use and contaminants found in the oil. Containerized oil containing contaminants such as solvents are commonly encountered at hydropower facilities. Oil sludges are common in tanks. Oil disposal would likely be costly due to the large volumes found at hydropower facilities and the ease of contamination with other regulated hazardous wastes.

PAY ITEM COST DETAIL WORKSHEET

3.043 Remove & Dispose - Unwatering Piping

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.043	**Project**	:	COPCO 2			
Description	:	Remove & Dispose - Unwatering Piping						
Quantity	:	32,000.00 LBS						
Daily Production	:	18,000.00 LBS per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	1.8 Days	**Estimator**	:	Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.75 per LBS	**Probable Low Cost Parameter**			**19800**	**$21,704**	**$0.68**
Total Cost	:	$24,116	**Probable High Cost Parameter**			**14400**	**$28,939**	**$0.90**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.8	8	14.40	L	$48.27	$0.00		$695.09
Laborer	Active	4.00	1.8	8	57.60	L	$45.80	$0.00		$2,638.08
Steelworker	Active	4.00	1.8	8	57.60	L	$65.52	$0.00		$3,773.95
Equipment Operator (medium)	Active	1.00	1.8	8	14.40	L	$66.28	$0.00		$954.43
Welder	Active	1.00	1.8	8	14.40	L	$7.84	$0.00		$112.86
Gas Welding Machine	Active	1.00	1.8	8	14.40	E	$2.88	$2.88		$41.43
Electrician	Active	1.00	1.8	8	14.40	L	$45.23	$0.00		$651.31
Equipment Operator (oiler)	Active	1.00	1.8	8	14.40	L	$62.94	$0.00		$906.34
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.8	8	14.40	E	$111.64	$111.64		$1,607.62
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.8	8	14.40	E	$221.50	$221.50		$3,189.60
Truck Driver (heavy)	Active	1.00	1.8	8	14.40	L	$57.59	$0.00		$829.30

Labor Hours	**201.6**	**TOTAL LABOR**	**$10,561.36**
Equipment Hours	**43.2**	**TOTAL EQUIPMENT**	**$4,838.64**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,056.14	$1,056.14
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	2,000.00	LF	1.000	2,000.00	$0.85	$1,700.00

TOTAL MATERIAL	**$2,756.14**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	1.60	ton	1.000	1.60 $595.00	$952.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	6.40	mile	1.000	6.40 $7.25	$46.40

TOTAL SUBCONTRACTS	**$998.40**

SUMMARY OF COSTS

Labor Cost	$10,561.36	Labor Burden @	49.7%	$0.00	$10,561.36
Material Cost	$2,756.14	Material Tax @	7.8%	$213.60	$2,969.74
Equipment Cost	$4,838.64	Equipment Tax @	0.0%	$0.00	$4,838.64
Subcontractors	$998.40				$998.40
DIRECT COST SUBTOTALS	**$19,155**			**$214**	**DIRECT COST SUBTOTALS** **$19,368**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$18,369.74	$2,755.46
Installing Contractors Profit@	8.0%				$18,369.74	$1,469.58
GC Markup on Subs @	5.0%				$998.40	$49.92
					TOTAL MARKUP COSTS	**$4,274.96**
General Contractors Insurance @	1.0%		on		$23,643.10	$236
Bond @	1.0%		on		$23,643.10	$236
Contingency @	0.0%		on		$24,115.96	$0
					TOTAL COST for pay item	**$24,116**

Additional Pay Item Notes :

Used RS Means : Assumed Pipe, metal pipe, to 1-1/2" diam., selective demolition, around 11765 LF of 1 1/2" pipes at 2.72 Lbs. Used Crew formed of 1 Forman, 2 Steelworkers to cut the pipes, 1 Welder to cut steel in inaccessible places , 2 Laborers to haul the pipes in the truck with the loader, 1 electrician to unplug the power and to assure the temporary power at the construction site. Calculated 36 miles from Copco to Yreka Transfer Recycling.

PAY ITEM COST DETAIL WORKSHEET

3.044 Remove & Dispose - Drainage Piping

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.044	**Project**	:	COPCO 2			
Description	:	Remove & Dispose - Drainage Piping						
Quantity	:	10,000.00 LBS						
Daily Production	:	4,450.00 LBS per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	2.2 Days	**Estimator**	:	Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$1.39 per LBS	**Probable Low Cost Parameter**			**4895**	**$12,489**	**$1.25**
Total Cost	:	$13,877	**Probable High Cost Parameter**			**3560**	**$16,652**	**$1.67**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	2.2	8	17.60	L	$48.27	$0.00		$849.55
Steelworker	Active	1.00	2.2	8	17.60	L	$65.52	$0.00		$1,153.15
Truck Driver (light)	Active	1.00	2.2	8	17.60	L	$56.29	$0.00		$990.70
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.2	8	17.60	E	$111.64	$111.64		$1,964.86
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.2	8	17.60	E	$221.50	$221.50		$3,898.40
Electrician	Active	1.00	2.2	8	17.60	L	$45.23	$0.00		$796.05
Equipment Operator (light)	Active	1.00	2.2	8	17.60	L	$64.90	$0.00		$1,142.24

Labor Hours	**88**	**TOTAL LABOR**	**$4,931.70**
Equipment Hours	**35.2**	**TOTAL EQUIPMENT**	**$5,863.26**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$246.58	$246.58

TOTAL MATERIAL	**$246.58**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$4,931.70	Labor Burden @	49.7%	$0.00		$4,931.70
Material Cost	$246.58	Material Tax @	7.8%	$19.11		$265.70
Equipment Cost	$5,863.26	Equipment Tax @	0.0%	$0.00		$5,863.26
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$11,042**			**$19**	**DIRECT COST SUBTOTALS**	**$11,061**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$11,060.66		$1,659.10
Installing Contractors Profit@	8.0%				$11,060.66		$884.85
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$2,543.95**
General Contractors Insurance @	1.0%		on		$13,604.61		$136
Bond @	1.0%		on		$13,604.61		$136
Contingency @	0.0%		on		$13,876.70		$0
						TOTAL COST for pay item	**$13,877**

Additional Pay Item Notes :

Assumed 2735 LF of 1 " drainage pipes at 3.66 Lbs. Used 1 Loader and 1 Forman, 1 Steelworkers to cut the pipes and 1 Laborers to load the pipes in the truck.

PAY ITEM COST DETAIL WORKSHEET

3.044a Remove & Dispose - Petroleum Products from Mechanical Equip.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.044a		**Project**	: #REF!			
Description	:	Remove & Dispose - Petroleum Products from Mechanical Equip.						
Quantity	:	3,300.00	GAL					
Daily Production	:	1,100.00	GAL per 8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	3.0	Days	**Estimator**	: Mihaela Tomulescu	**GAL per**	**Total Cost**	**Unit Price Per GAL**
Unit Price	:	$4.54	per GAL	**Probable Low Cost Parameter**		**1210**	**$13,475**	**$4.08**
Total Cost	:	$14,972		**Probable High Cost Parameter**		**935**	**$17,217**	**$5.22**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	3.0	8	24.00	L	$46.27	$0.00		$1,110.48
Carpenters, Journeyman	Active	2.00	3.0	8	48.00	L	$65.37	$0.00		$3,137.76
Laborer	Active	2.00	3.0	8	48.00	L	$45.80	$0.00		$2,198.40

Labor Hours	**120**	**TOTAL LABOR**	**$6,446.64**
Equipment Hours	**0**	**TOTAL EQUIPMENT**	**$0.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 20% labor (absorbant materials, drums, etc)	1.00	LS	1.000	1.00	$1,289.33	$1,289.33
					TOTAL MATERIAL	**$1,289.33**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, liquid pickup, vacuum truck, stainless steel tank, 5000 gallons, minimum charge, 4 hours, 2 compartment	24.00	hour	1.000	$200.00	$4,800.00
				TOTAL SUBCONTRACTS	**$4,800.00**

SUMMARY OF COSTS

Labor Cost	$6,446.64	Labor Burden @	49.7%	$0.00		$6,446.64
Material Cost	$1,289.33	Material Tax @	7.8%	$99.92		$1,389.25
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00		$0.00
Subcontractors	$4,800.00					$4,800.00
DIRECT COST SUBTOTALS	**$12,536**			**$100**	**DIRECT COST SUBTOTALS**	**$12,636**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$7,835.89	$1,175.38
Installing Contractors Profit@	8.0%				$7,835.89	$626.87
GC Markup on Subs @	5.0%				$4,800.00	$240.00
					TOTAL MARKUP COSTS	**$2,042.25**
General Contractors Insurance @	1.0%		on		$14,678.15	$147
Bond @	1.0%		on		$14,678.15	$147
Contingency @	0.0%		on		$14,971.71	$0
					TOTAL COST for pay item	**$14,972**

Additional Pay Item Notes :

Petroleum-based products, ranging from fuel oil and hydraulic fluid to lubricating greases and oils, are found throughout every type of power generating plant or system. Lubrication supports bearings and moving parts in all sorts of equipment: pumps, conveyors, feeders, scrubbers, cranes, turbines, and more.A good oil/water separation system will result in a flow of concentrated waste oil to a collection area and a flow of oil-free water ready for secondary processing or discharge. Once an oil layer has been separated from free water, it must be removed for recycling or disposal. Many plants use one or more of these oil removal methods, but each has costly limitations:

1. Absorbent materials. Absorbent mats or materials are frequently used to dam up and absorb excess oils and greases resulting from accidents or the routine operation of machinery. These materials are very effective for preventing the spread of a source leak and very efficient in terms of oil pickup. Yet, their use on large volumes of waste oil results in multiple, recurring costs that can make them impractical as an everyday solution:

- the costs of the materials themselves
- the labor costs for ordering, stocking, application, and removal
- the costs of used-media collection, disposal, or re-processing/recycling.

2. Manually operated “slotted pipes.” Many separators feature a “slotted pipe,” a pipe located near the top of the vessel that has a horizontal opening. Oil is removed by turning the horizontal opening downward until it meets the floating oil layer, which drains through the pipe to a collection receptacle. These pipes work well on thick layers of oil, but cannot drain off a sheen of oil without draining off a large amount of water as well.

AECOM assumed the best is Vacuum truck removal method .Used a crew formed of 1 Forman, 2 Laborers and 2 journemen to takeout the petroleum waste, Vacuum-equipped tank trucks are used to remove waste oil from collection points (assumed existing drums or tanks) so that it can be transported to recycling or disposal locations. If the waste oil has been thoroughly separated, highly concentrated, and stored in an appropriate receptacle, this service can be used very efficiently. However, vacuum disposal units are often used to pump oil layers directly off of water. This results in the intake of a significant amount free water along with the waste oil – and a significantly higher cost.

PAY ITEM COST DETAIL WORKSHEET

3.044b Remove & Dispose - Remove Petroleum Products at or near the Power House

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.044b			**Project**	: #REF!			
Description	:	Remove & Dispose - Remove Petroleum Products at or near the Power House							
Quantity	:	3,300.00	GAL						
Daily Production	:	1,100.00	GAL per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	3.0	Days		**Estimator**	: Mihaela Tomulescu	**GAL per**	**Total Cost**	**Unit Price Per GAL**
Unit Price	:	$4.54	per GAL		**Probable Low Cost Parameter**		**1210**	**$13,475**	**$4.08**
Total Cost	:	$14,972			**Probable High Cost Parameter**		**935**	**$17,217**	**$5.22**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	3.0	8	24.00	L	$46.27	$0.00		$1,110.48
Carpenters, Journeyman	Active	2.00	3.0	8	48.00	L	$65.37	$0.00		$3,137.76
Laborer	Active	2.00	3.0	8	48.00	L	$45.80	$0.00		$2,198.40

Labor Hours	**120**	**TOTAL LABOR**	**$6,446.64**
Equipment Hours	**0**	**TOTAL EQUIPMENT**	**$0.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 20% labor (absorbant materials, etc)	1.00	LS	1.000	1.00	$1,289.33	$1,289.33

TOTAL MATERIAL	**$1,289.33**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, liquid pickup, vacuum truck, stainless steel tank, 5000 gallons, minimum charge, 4 hours, 2 compartment	24.00	hour	1.000	$200.00	$4,800.00

TOTAL SUBCONTRACTS	**$4,800.00**

SUMMARY OF COSTS

Labor Cost	$6,446.64	Labor Burden @	49.7%	$0.00		$6,446.64
Material Cost	$1,289.33	Material Tax @	7.8%	$99.92		$1,389.25
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00		$0.00
Subcontractors	$4,800.00					$4,800.00
DIRECT COST SUBTOTALS	**$12,536**			**$100**	**DIRECT COST SUBTOTALS**	**$12,636**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$7,835.89		$1,175.38
Installing Contractors Profit@	8.0%				$7,835.89		$626.87
GC Markup on Subs @	5.0%				$4,800.00		$240.00
						TOTAL MARKUP COSTS	**$2,042.25**
General Contractors Insurance @	1.0%		on		$14,678.15		$147
Bond @	1.0%		on		$14,678.15		$147
Contingency @	0.0%		on		$14,971.71		$0
						TOTAL COST for pay item	**$14,972**

Additional Pay Item Notes :

Used a crew formed of 1 Forman, 2 journeymen, 2 Laborers to takeout the petroleum waste, Vacuum-equipped tank trucks are used to remove old and new oil and the fuel from collection points so that it can be transported to recycling or disposal locations.

PAY ITEM COST DETAIL WORKSHEET

3.045 Remove & Dispose - AC Generator, Indoor Vertical

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.045			**Project**	: COPCO 2			
Description	:	Remove & Dispose - AC Generator, Indoor Vertical							
Quantity	:	2.00	EA						
Daily Production	:	0.20	EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	10.0	Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$82,295.42	per EA		**Probable Low Cost Parameter**		**0.22**	**$148,132**	**$74,065.87**
Total Cost	:	$164,591			**Probable High Cost Parameter**		**0.18**	**$181,050**	**$90,524.96**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	10.0	8	80.00	L	$47.23	$0.00		$3,778.40
Electrician	Active	6.00	10.0	8	480.00	L	$45.23	$0.00		$21,710.40
Equipment Operator (oiler)	Active	2.00	10.0	8	160.00	L	$62.94	$0.00		$10,070.40
Equipment Operator (crane)	Active	1.00	10.0	8	80.00	L	$68.41	$0.00		$5,472.80
Crawler Crane (130tn)	Active	1.00	10.0	8	80.00	E	$258.66	$258.66		$20,692.80
Steelworker	Active	6.00	10.0	8	480.00	L	$65.52	$0.00		$31,449.60
Labor Foreman	Active	1.00	10.0	8	80.00	L	$48.27	$0.00		$3,861.60
Welder	Active	2.00	10.0	8	160.00	L	$7.84	$0.00		$1,254.00
Gas Welding Machine	Active	2.00	10.0	8	160.00	E	$2.88	$2.88		$460.32
Truck Driver (heavy)	Active	2.00	10.0	8	160.00	L	$57.59	$0.00		$9,214.40
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	10.0	8	160.00	E	$31.90	$31.90		$5,104.00
Hydraulic Impact Breaker Attachment (2k-3k ft-lb)	Active	2.00	10.0	8	160.00	E	$30.85	$30.85		$4,936.00

Labor Hours	**1680**	**TOTAL LABOR**	**$86,811.60**
Equipment Hours	**560**	**TOTAL EQUIPMENT**	**$31,193.12**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$8,681.16	$8,681.16

TOTAL MATERIAL	**$8,681.16**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Disposal fee (for 115 tons)	1	EA	1.000	1.00 $4,488.00	$4,488.00

TOTAL SUBCONTRACTS	**$4,488.00**

SUMMARY OF COSTS

Labor Cost	$86,811.60	Labor Burden @	49.7%	$0.00	$86,811.60
Material Cost	$8,681.16	Material Tax @	7.8%	$672.79	$9,353.95
Equipment Cost	$31,193.12	Equipment Tax @	0.0%	$0.00	$31,193.12
Subcontractors	$4,488.00				$4,488.00
DIRECT COST SUBTOTALS	**$131,174**			**$673**	**DIRECT COST SUBTOTALS** **$131,847**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$127,358.67	$19,103.80
Installing Contractors Profit@	8.0%				$127,358.67	$10,188.69
GC Markup on Subs @	5.0%				$4,488.00	$224.40
					TOTAL MARKUP COSTS	**$29,516.89**
General Contractors Insurance @	1.0%		on		$161,363.56	$1,614
Bond @	1.0%		on		$161,363.56	$1,614
Contingency @	0.0%		on		$164,590.83	$0
					TOTAL COST for pay item	**$164,591**

Additional Pay Item Notes :

Assumed removal of 2 units in 2 weeks, weight per unit around 230000 LBS (stator, rotor, base, exciter assembly). Used RS Means, 2 X R13 Crew formed of 1 Forman, 3 Electricians, 1 Oiler, 0 .25 Equipment Crane, 3 Steelworkers to cut adjacent appurtenances and 1 Welder to cut pipes. Calculated 34 miles from JC Copco1 to Yreka Transfer Recycling (back and forth).

PAY ITEM COST DETAIL WORKSHEET

3.046 Remove & Dispose - Excitation equipment for 15 MVA Generator

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.046		**Project**	: #REF!			
Description	:	Remove & Dispose - Excitation equipment for 15 MVA Generator						
Quantity	:	2.00 EA						
Daily Production	:	1.50 EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	1.3 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$8,173.98 per EA		**Probable Low Cost Parameter**		**1.65**	**$14,713**	**$7,356.58**
Total Cost	:	$16,348		**Probable High Cost Parameter**		**1.35**	**$17,983**	**$8,991.38**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.3	8	10.40	L	$47.23	$0.00		$491.19
Electrician	Active	2.00	1.3	8	20.80	L	$45.23	$0.00		$940.78
Ironworkers	Active	1.00	1.3	8	10.40	L	$63.95	$0.00		$665.08
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	$221.50		$1,772.00
Truck Driver (heavy)	Active	1.00	1.3	8	10.40	L	$57.59	$0.00		$598.94
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.3	8	10.40	E	$111.64	$111.64		$1,161.06
Hydraulic Crane (120tn)	Active	1.00	1.3	8	10.40	E	$239.06	$239.06		$2,486.22
Laborer	Active	2.00	1.3	8	20.80	L	$45.80	$0.00		$952.64
Equipment Operator (crane)	Active	1.00	1.3	8	10.40	L	$68.41	$0.00		$711.46
Equipment Operator (medium)	Active	1.00	1.3	8	10.40	L	$66.28	$0.00		$689.31

Labor Hours	**93.6**	**TOTAL LABOR**	**$5,049.41**
Equipment Hours	**28.8**	**TOTAL EQUIPMENT**	**$5,419.28**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$252.47	$252.47
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	2,500.00	LF	1.000	2,500.00	$0.85	$2,125.00

TOTAL MATERIAL	**$2,377.47**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$5,049.41	Labor Burden @	49.7%	$0.00		$5,049.41
Material Cost	$2,377.47	Material Tax @	7.8%	$184.25		$2,561.72
Equipment Cost	$5,419.28	Equipment Tax @	0.0%	$0.00		$5,419.28
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$12,846**			**$184**	**DIRECT COST SUBTOTALS**	**$13,030**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$13,030.41		$1,954.56
Installing Contractors Profit@	8.0%				$13,030.41		$1,042.43
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$2,996.99**
General Contractors Insurance @	1.0%		on		$16,027.41		$160
Bond @	1.0%		on		$16,027.41		$160
Contingency @	0.0%		on		$16,347.96		$0
						TOTAL COST for pay item	**$16,348**

Additional Pay Item Notes :

Production based on 1 Forman, 1 Electrician, 1 Welder to cut to remove the electrical equipment and 1 laborer to haul. Equipment used 1 Loader and 1 Crane for disposal. Assumed 2 sections, weight 1000LBS.

PAY ITEM COST DETAIL WORKSHEET

3.047 Remove & Dispose - Surge protection equip. for 15 MVA Generator

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.047		**Project**	: COPCO 2			
Description	:	Remove & Dispose - Surge protection equip. for 15 MVA Generator						
Quantity	:	2.00 EA						
Daily Production	:	1.50 EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	1.3 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$2,582.65 per EA		**Probable Low Cost Parameter**		**1.65**	**$4,649**	**$2,324.39**
Total Cost	:	$5,165		**Probable High Cost Parameter**		**1.35**	**$5,682**	**$2,840.92**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.3	8	10.40	L	$47.23	$0.00		$491.19
Electrician	Active	1.00	1.3	8	10.40	L	$45.23	$0.00		$470.39
Truck Driver (heavy)	Active	1.00	1.3	8	10.40	L	$57.59	$0.00		$598.94
Ironworkers	Active	1.00	1.0	8	8.00	L	$63.95	$0.00		$511.60
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	$0.00		$732.80
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.3	8	10.40	E	$111.64	$111.64		$1,161.06

Labor Hours	**55.2**	**TOTAL LABOR**	**$2,804.92**
Equipment Hours	**10.4**	**TOTAL EQUIPMENT**	**$1,161.06**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$140.25	$140.25

TOTAL MATERIAL	**$140.25**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,804.92	Labor Burden @	49.7%	$0.00		$2,804.92
Material Cost	$140.25	Material Tax @	7.8%	$10.87		$151.12
Equipment Cost	$1,161.06	Equipment Tax @	0.0%	$0.00		$1,161.06
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$4,106**			**$11**	**DIRECT COST SUBTOTALS**	**$4,117**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$4,117.09		$617.56
Installing Contractors Profit@	8.0%				$4,117.09		$329.37
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$946.93**
General Contractors Insurance @	1.0%		on		$5,064.02		$51
Bond @	1.0%		on		$5,064.02		$51
Contingency @	0.0%		on		$5,165.30		$0
						TOTAL COST for pay item	**$5,165**

Additional Pay Item Notes :

Assumption for Crew R3: 1 Forman, 1 Electrician, 2 Ironworker to cut rods and 1 laborer to haul in the truck.. Assumed 2 sections, weight 800LBS.

PAY ITEM COST DETAIL WORKSHEET

3.048 Remove & Dispose - Neutral grounding equip. for 15 MVA Generator

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.048	**Project**	:	COPCO 2			
Description	:	Remove & Dispose - Neutral grounding equip. for 15 MVA Generator						
Quantity	:	2.00 EA						
Daily Production	:	2.00 EA per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	1.0 Days	**Estimator**	:	Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$2,514.72 per EA	**Probable Low Cost Parameter**			**2.2**	**$4,526**	**$2,263.25**
Total Cost	:	$5,029	**Probable High Cost Parameter**			**1.7**	**$5,784**	**$2,891.93**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.0	8	8.00	L	$47.23	$0.00		$377.84
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	$0.00		$361.84
Ironworkers	Active	2.00	1.0	8	16.00	L	$63.95	$0.00		$1,023.20
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	$0.00		$732.80
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	$111.64		$893.12

Labor Hours	**56**	**TOTAL LABOR**	**$2,956.40**
Equipment Hours	**8**	**TOTAL EQUIPMENT**	**$893.12**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$147.82	$147.82

TOTAL MATERIAL	**$147.82**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,956.40	Labor Burden @	49.7%	$0.00		$2,956.40
Material Cost	$147.82	Material Tax @	7.8%	$11.46		$159.28
Equipment Cost	$893.12	Equipment Tax @	0.0%	$0.00		$893.12
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$3,997**			**$11**	**DIRECT COST SUBTOTALS**	**$4,009**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,008.80	$601.32
Installing Contractors Profit@	8.0%				$4,008.80	$320.70
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$922.02**
General Contractors Insurance @	1.0%	on			$4,930.82	$49
Bond @	1.0%	on			$4,930.82	$49
Contingency @	0.0%	on			$5,029.44	$0
					TOTAL COST for pay item	**$5,029**

Additional Pay Item Notes :

Assumption for Crew R3: 1 Forman, 1 Electrician, 2 Ironworker to cut rods and 2 laborer to haul in the truck. (500 lbs)

PAY ITEM COST DETAIL WORKSHEET — **3.049 Remove & Dispose - Generator Switchgear, 7.2kV-includes unit breakers**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.049		**Project**	: COPCO 2			
Description	:	Remove & Dispose - Generator Switchgear, 7.2kV-includes unit breakers						
Quantity	:	1.00 EA						
Daily Production	:	0.50 EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	2.0 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$27,340.22 per EA		**Probable Low Cost Parameter**		**0.55**	**$24,606**	**$24,606.19**
Total Cost	:	$27,340		**Probable High Cost Parameter**		**0.425**	**$31,441**	**$31,441.25**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	2.00	2.0	8	32.00	L	$47.23	$0.00		$1,511.36
Electrician	Active	6.00	2.0	8	96.00	L	$45.23	$0.00		$4,342.08
Laborer	Active	3.00	2.0	8	48.00	L	$45.80	$0.00		$2,198.40
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.0	8	16.00	E	$221.50	$221.50		$3,544.00
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	$0.00		$921.44
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	$111.64		$1,786.24
Hydraulic Crane (120tn)	Active	1.00	2.0	8	16.00	E	$239.06	$239.06		$3,824.96
Welder	Active	1.00	2.0	8	16.00	L	$7.84	$0.00		$125.40
Gas Welding Machine	Active	1.00	2.0	8	16.00	E	$2.88	$2.88		$46.03
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	$0.00		$1,060.48
Equipment Operator (crane)	Active	1.00	2.0	8	16.00	L	$68.41	$0.00		$1,094.56

Labor Hours	**240**	**TOTAL LABOR**	**$11,253.72**
Equipment Hours	**64**	**TOTAL EQUIPMENT**	**$9,201.23**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$562.69	$562.69

TOTAL MATERIAL	**$562.69**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	1.00	ton	1.000	1.00 $595.00	$595.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	36.00	mile	1.000	36.00 $7.25	$261.00

TOTAL SUBCONTRACTS	**$856.00**

SUMMARY OF COSTS

Labor Cost	$11,253.72	Labor Burden @	49.7%	$0.00		$11,253.72
Material Cost	$562.69	Material Tax @	7.8%	$43.61		$606.29
Equipment Cost	$9,201.23	Equipment Tax @	0.0%	$0.00		$9,201.23
Subcontractors	$856.00					$856.00
DIRECT COST SUBTOTALS	**$21,874**			**$44**	**DIRECT COST SUBTOTALS**	**$21,917**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$21,061.25	$3,159.19
Installing Contractors Profit@	8.0%				$21,061.25	$1,684.90
GC Markup on Subs @	5.0%				$856.00	$42.80
					TOTAL MARKUP COSTS	**$4,886.89**
General Contractors Insurance @	1.0%		on		$26,804.13	$268
Bond @	1.0%		on		$26,804.13	$268
Contingency @	0.0%		on		$27,340.22	$0
					TOTAL COST for pay item	**$27,340**

Additional Pay Item Notes :

Used 2 Crews (2 sections each weight around 2400 LBS per crew) formed of 1 Forman, 3 Electrician, 2 laborer to haul with the crane in the truck. Assumed containing hazardous waste that will be disposed at 36 miles away from the construction site to Yreka Transfer Recycling . In normal circumstances, decontaminated residual components could be accepted at landfill sites but Polychlorinated biphenyl, otherwise known as PCB, is a synthetic chemical that is widely used for industrial and commercial use as dielectric fluid in transformers and capacitors because of its high resistance to decomposition, low electrical conductivity, low flammability and high heat capacity. Transformer repair, reconditioning and retro-filling facilities are the major industry sectors that contributes to the spread of PCB contamination. Types of PCB Wastes:
PCB wastes are discarded materials that contain PCB or have been contaminated with PCBs and that are without any commercial, industrial, or economic use. For the purpose of this Code of Practice, PCBs wastes are classified as follows: Liquid PCB wastes
o PCB-based dielectric fluids removed from transformers and other equipment
o PCB-based heat transfer and hydraulic fluids Metallic solid wastes
o PCB equipment such as capacitors, transformers, **switchgears**, circuit breakers, heat transfer systems, etc.
o Contaminated components removed from electrical equipment such as windings;
o PCB-contaminated containers and equipment such as metal drums, tanks, pumps, metal filters, etc.

PAY ITEM COST DETAIL WORKSHEET

3.050 Remove & Dispose - Station Service Switchgear, 600-volt (5 sections)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.050			**Project**	: COPCO 2			
Description	:	Remove & Dispose - Station Service Switchgear, 600-volt (5 sections)							
Quantity	:	1.00	EA						
Daily Production	:	0.50	EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	2.0	Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$24,083.60	per EA		**Probable Low Cost Parameter**		**0.55**	**$21,675**	**$21,675.24**
Total Cost	:	$24,084			**Probable High Cost Parameter**		**0.425**	**$27,696**	**$27,696.15**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	3.00	2.0	8	48.00	L	$47.23	$0.00		$2,267.04
Electrician	Active	6.00	2.0	8	96.00	L	$45.23	$0.00		$4,342.08
Laborer	Active	6.00	2.0	8	96.00	L	$45.80	$0.00		$4,396.80
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.0	8	16.00	E	$221.50	$221.50		$3,544.00
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	$0.00		$921.44
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	$111.64		$1,786.24
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	$0.00		$1,060.48
Welder	Active	1.00	2.0	8	16.00	L	$7.84	$0.00		$125.40
Gas Welding Machine	Active	1.00	2.0	8	16.00	E	$2.88	$2.88		$46.03

Labor Hours	**288**	**TOTAL LABOR**	**$13,113.24**
Equipment Hours	**48**	**TOTAL EQUIPMENT**	**$5,376.27**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$655.66	$655.66
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	0.00	LF	1.000	0.00	$0.85	$0.00

TOTAL MATERIAL	**$655.66**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.00	ton	1.000	0.00	$595.00	$0.30
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	0.00	mile	1.000	0.00	$7.25	$0.00

TOTAL SUBCONTRACTS	**$0.30**

SUMMARY OF COSTS

Labor Cost	$13,113.24	Labor Burden @	49.7%	$0.00		$13,113.24
Material Cost	$655.66	Material Tax @	7.8%	$50.81		$706.48
Equipment Cost	$5,376.27	Equipment Tax @	0.0%	$0.00		$5,376.27
Subcontractors	$0.30					$0.30
DIRECT COST SUBTOTALS	**$19,145**			**$51**	**DIRECT COST SUBTOTALS**	**$19,196**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$19,195.99		$2,879.40
Installing Contractors Profit@	8.0%				$19,195.99		$1,535.68
GC Markup on Subs @	5.0%				$0.30		$0.01
						TOTAL MARKUP COSTS	**$4,415.09**
General Contractors Insurance @	1.0%		on		$23,611.38		$236
Bond @	1.0%		on		$23,611.38		$236
Contingency @	0.0%		on		$24,083.60		$0
						TOTAL COST for pay item	**$24,084**

Additional Pay Item Notes :

Used 3 Crews (2 sections each, weight around 800Lbs per crew) formed of 1 Forman, 2 Electrician, 1welder to cut, 2 laborer to haul with the loader in the truck. Assumed containing hazardous waste that will be disposed . Calculated 34 miles from Copco 1 to Yreka Transfer Recycling.

PAY ITEM COST DETAIL WORKSHEET

3.051 Remove & Dispose - Unit and plant control switchboard

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.051		**Project**	: COPCO 2			
Description	:	Remove & Dispose - Unit and plant control switchboard						
Quantity	:	1.00 EA						
Daily Production	:	1.00 EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	1.0 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$7,551.93 per EA		**Probable Low Cost Parameter**		**1.1**	**$6,797**	**$6,796.74**
Total Cost	:	$7,552		**Probable High Cost Parameter**		**0.85**	**$8,685**	**$8,684.72**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.0	8	8.00	L	$47.23	$0.00		$377.84
Electrician	Active	4.00	1.0	8	32.00	L	$45.23	$0.00		$1,447.36
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	$0.00		$530.24
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	$221.50		$1,772.00
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	$111.64		$893.12
Laborer	Active	1.00	1.0	8	8.00	L	$45.80	$0.00		$366.40

Labor Hours	**64**	**TOTAL LABOR**	**$3,182.56**
Equipment Hours	**16**	**TOTAL EQUIPMENT**	**$2,665.12**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$159.13	$159.13
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	0.00	LF	1.000	0.00	$0.85	$0.00

TOTAL MATERIAL	**$159.13**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.00	ton	1.000	0.00 $595.00	$0.30
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	0.00	mile	1.000	0.00 $7.25	$0.00

TOTAL SUBCONTRACTS	**$0.30**

SUMMARY OF COSTS

Labor Cost	$3,182.56	Labor Burden @	49.7%	$0.00	$3,182.56
Material Cost	$159.13	Material Tax @	7.8%	$12.33	$171.46
Equipment Cost	$2,665.12	Equipment Tax @	0.0%	$0.00	$2,665.12
Subcontractors	$0.30				$0.30
DIRECT COST SUBTOTALS	**$6,007**			**$12**	**DIRECT COST SUBTOTALS** **$6,019**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$6,019.14	$902.87
Installing Contractors Profit@	8.0%				$6,019.14	$481.53
GC Markup on Subs @	5.0%				$0.30	$0.01
					TOTAL MARKUP COSTS	**$1,384.42**
General Contractors Insurance @	1.0%		on		$7,403.86	$74
Bond @	1.0%		on		$7,403.86	$74
Contingency @	0.0%		on		$7,551.93	$0
					TOTAL COST for pay item	**$7,552**

Additional Pay Item Notes :

Assumed 2 day of work to dispose unit and plant control switchboard with R3 electrical crew and laborers for hauling with the loader in the truck.

PAY ITEM COST DETAIL WORKSHEET

3.052 Remove & Dispose - Battery system

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.052		**Project**	: COPCO 2			
Description	:	Remove & Dispose - Battery system						
Quantity	:	1.00 EA						
Daily Production	:	0.50 EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	2.0 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$10,473.21 per EA		**Probable Low Cost Parameter**		**0.55**	**$9,426**	**$9,425.89**
Total Cost	:	$10,473		**Probable High Cost Parameter**		**0.425**	**$12,044**	**$12,044.19**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	$0.00		$740.32
Electrician	Active	2.00	2.0	8	32.00	L	$45.23	$0.00		$1,447.36
Laborer	Active	4.00	2.0	8	64.00	L	$45.80	$0.00		$2,931.20
Loader, FE Rubber Tire (3.5cy)	Active	1.00	1.0	8	8.00	E	$64.23	$64.23		$513.84
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	$111.64		$893.12
Equipment Operator (light)	Active	1.00	1.0	8	8.00	L	$64.90	$0.00		$519.20
Welder	Active	1.00	2.0	8	16.00	L	$7.84	$0.00		$125.40
Gas Welding Machine	Active	1.00	2.0	8	16.00	E	$2.88	$2.88		$46.03

Labor Hours	**144**	**TOTAL LABOR**	**$6,224.20**
Equipment Hours	**32**	**TOTAL EQUIPMENT**	**$1,452.99**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$622.42	$622.42

TOTAL MATERIAL	**$622.42**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$6,224.20	Labor Burden @	49.7%	$0.00	$6,224.20
Material Cost	$622.42	Material Tax @	7.8%	$48.24	$670.66
Equipment Cost	$1,452.99	Equipment Tax @	0.0%	$0.00	$1,452.99
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$8,300**			**$48**	**DIRECT COST SUBTOTALS** **$8,348**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$8,347.85	$1,252.18
Installing Contractors Profit@	8.0%				$8,347.85	$667.83
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,920.01**
General Contractors Insurance @	1.0%	on			$10,267.85	$103
Bond @	1.0%	on			$10,267.85	$103
Contingency @	0.0%	on			$10,473.21	$0
					TOTAL COST for pay item	**$10,473**

Additional Pay Item Notes :

Assuming 2 days of work disposing around 100 batteries, racks and supports. Using Crews E-19 for metals demolition, E-12 and E-25 for cutting steel and A-3H for equipment disposal, B-34A for hauling.

PAY ITEM COST DETAIL WORKSHEET

3.053 Remove & Dispose - Raceways, Conduit and Cable

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.053		**Project**	: COPCO 2			
Description	:	Remove & Dispose - Raceways, Conduit and Cable						
Quantity	:	1.00 EA						
Daily Production	:	0.50 EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	2.0 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$15,384.27 per EA		**Probable Low Cost Parameter**		**0.55**	**$13,846**	**$13,845.84**
Total Cost	:	$15,384		**Probable High Cost Parameter**		**0.425**	**$17,692**	**$17,691.91**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	2.0	8	16.00	L	$48.27	$0.00		$772.32
Electrician	Active	4.00	2.0	8	64.00	L	$45.23	$0.00		$2,894.72
Laborer	Active	6.00	2.0	8	96.00	L	$45.80	$0.00		$4,396.80
Loader, FE Rubber Tire (3.5cy)	Active	1.00	1.0	8	8.00	E	$64.23	$64.23		$513.84
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	$111.64		$893.12
Equipment Operator (light)	Active	1.00	1.0	8	8.00	L	$64.90	$0.00		$519.20
Electrician Foreman	Active	1.00	2.0	8	16.00	L	$47.23	$0.00		$755.68

Labor Hours	**208**	**TOTAL LABOR**	**$9,799.44**
Equipment Hours	**16**	**TOTAL EQUIPMENT**	**$1,406.96**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$979.94	$979.94

TOTAL MATERIAL	**$979.94**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$9,799.44	Labor Burden @	49.7%	$0.00		$9,799.44
Material Cost	$979.94	Material Tax @	7.8%	$75.95		$1,055.89
Equipment Cost	$1,406.96	Equipment Tax @	0.0%	$0.00		$1,406.96
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$12,186**			**$76**	**DIRECT COST SUBTOTALS**	**$12,262**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$12,262.29		$1,839.34
Installing Contractors Profit@	8.0%				$12,262.29		$980.98
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$2,820.33**
General Contractors Insurance @	1.0%		on		$15,082.62		$151
Bond @	1.0%		on		$15,082.62		$151
Contingency @	0.0%		on		$15,384.27		$0
						TOTAL COST for pay item	**$15,384**

Additional Pay Item Notes :

Assumption for removal of control power cable, conduit (3000 LF) and cable tray (300 LF) - using R3 electrical crew and laborers for hauling with the loader.

PAY ITEM COST DETAIL WORKSHEET

3.054 Remove & Dispose - Misc. Power & Control Boards

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.054		**Project**	: COPCO 2			
Description	:	Remove & Dispose - Misc. Power & Control Boards						
Quantity	:	1.00 EA						
Daily Production	:	1.00 EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	1.0 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$5,724.44 per EA		**Probable Low Cost Parameter**		**1.1**	**$5,152**	**$5,152.00**
Total Cost	:	$5,724		**Probable High Cost Parameter**		**0.85**	**$6,583**	**$6,583.11**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	$0.00		$370.16
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	$0.00		$361.84
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	$0.00		$732.80
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	$0.00		$547.28
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	$111.64		$893.12
Hydraulic Crane (35tn)	Active	1.00	1.0	8	8.00	E	$116.30	$116.30		$930.40

Labor Hours	**48**	**TOTAL LABOR**	**$2,472.80**
Equipment Hours	**16**	**TOTAL EQUIPMENT**	**$1,823.52**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$247.28	$247.28

TOTAL MATERIAL	**$247.28**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,472.80	Labor Burden @	49.7%	$0.00	$2,472.80
Material Cost	$247.28	Material Tax @	7.8%	$19.16	$266.44
Equipment Cost	$1,823.52	Equipment Tax @	0.0%	$0.00	$1,823.52
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$4,544**			**$19**	**DIRECT COST SUBTOTALS** **$4,563**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,562.76	$684.41
Installing Contractors Profit@	8.0%				$4,562.76	$365.02
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,049.44**
General Contractors Insurance @	1.0%	on			$5,612.20	$56
Bond @	1.0%	on			$5,612.20	$56
Contingency @	0.0%	on			$5,724.44	$0
					TOTAL COST for pay item	**$5,724**

Additional Pay Item Notes :

Assumption for removal of 3' x 2' x 9" boards - 10 each using R3 electrical crew and laborers for hauling with the loader.

PAY ITEM COST DETAIL WORKSHEET

3.055 Remove & Dispose - 7 - 40-Ton Travelling Crane motors-hoist (2-30Hp)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.055			**Project**	: COPCO 2			
Description	:	Remove & Dispose - 7 - 40-Ton Travelling Crane motors-hoist (2-30Hp)							
Quantity	:	1.00 EA							
Daily Production	:	2.00 EA per	8 hour shift		**Project #**	: Klamath Dams Removal			
Work Days	:	0.5 Days			**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$3,548.91 per EA			**Probable Low Cost Parameter**		**2.2**	**$3,194**	**$3,194.02**
Total Cost	:	$3,549			**Probable High Cost Parameter**		**1.7**	**$4,081**	**$4,081.25**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (80tn)	Active	1.00	0.5	8	4.00	E	$190.46	$190.46		$761.84
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.5	8	4.00	E	$111.64	$111.64		$446.56
Laborer	Active	2.00	0.5	8	8.00	L	$45.80	$0.00		$366.40
Equipment Operator (crane)	Active	1.00	0.5	8	4.00	L	$68.41	$0.00		$273.64
Truck Driver (heavy)	Active	1.00	0.5	8	4.00	L	$57.59	$0.00		$230.36
Steelworker	Active	1.00	0.5	8	4.00	L	$65.52	$0.00		$262.08

Labor Hours	**20**	**TOTAL LABOR**	**$1,132.48**
Equipment Hours	**8**	**TOTAL EQUIPMENT**	**$1,208.40**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$56.62	$56.62

TOTAL MATERIAL	**$56.62**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Disposal fee	1	EA	**1**	$1.00	$500.00

TOTAL SUBCONTRACTS	**$500.00**

SUMMARY OF COSTS

Labor Cost	$1,132.48	Labor Burden @	49.7%	$0.00		$1,132.48
Material Cost	$56.62	Material Tax @	7.8%	$4.39		$61.01
Equipment Cost	$1,208.40	Equipment Tax @	0.0%	$0.00		$1,208.40
Subcontractors	$500.00					$500.00
DIRECT COST SUBTOTALS	**$2,898**			**$4**	**DIRECT COST SUBTOTALS**	**$2,902**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$2,401.89		$360.28
Installing Contractors Profit@	8.0%				$2,401.89		$192.15
GC Markup on Subs @	5.0%				$500.00		$25.00
						TOTAL MARKUP COSTS	**$577.44**
General Contractors Insurance @	1.0%		on		$3,479.33		$35
Bond @	1.0%		on		$3,479.33		$35
Contingency @	0.0%		on		$3,548.91		$0
						TOTAL COST for pay item	**$3,549**

Additional Pay Item Notes :

Assumed removal of hoist, hoist trolley, gantry: 1 Steelworker and 1 Laborers to load the overhead crane motors in the truck using the crane.

PAY ITEM COST DETAIL WORKSHEET

3.056 Remove & Dispose - 40-Ton Travelling Crane control equipment

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.056		**Project**	: COPCO 2			
Description	:	Remove & Dispose - 40-Ton Travelling Crane control equipment						
Quantity	:	1.00 EA						
Daily Production	:	0.50 EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	2.0 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$11,203.08 per EA		**Probable Low Cost Parameter**		**0.55**	**$10,083**	**$10,082.77**
Total Cost	:	$11,203		**Probable High Cost Parameter**		**0.425**	**$12,884**	**$12,883.54**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	$111.64		$1,786.24
Hydraulic Crane (80tn)	Active	1.00	2.0	8	16.00	E	$190.46	$190.46		$3,047.36
Laborer	Active	2.00	2.0	8	32.00	L	$45.80	$0.00		$1,465.60
Equipment Operator (crane)	Active	1.00	2.0	8	16.00	L	$68.41	$0.00		$1,094.56
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	$0.00		$921.44

Labor Hours	**64**	**TOTAL LABOR**	**$3,481.60**
Equipment Hours	**32**	**TOTAL EQUIPMENT**	**$4,833.60**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$174.08	$174.08

TOTAL MATERIAL	**$174.08**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Disposal fee	1	EA	1.000	1.00	$500.00	$500.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$500.00**

SUMMARY OF COSTS

Labor Cost	$3,481.60	Labor Burden @	49.7%	$0.00		$3,481.60
Material Cost	$174.08	Material Tax @	7.8%	$13.49		$187.57
Equipment Cost	$4,833.60	Equipment Tax @	0.0%	$0.00		$4,833.60
Subcontractors	$500.00					$500.00
DIRECT COST SUBTOTALS	**$8,989**			**$13**	**DIRECT COST SUBTOTALS**	**$9,003**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$8,502.77		$1,275.42
Installing Contractors Profit@	8.0%				$8,502.77		$680.22
GC Markup on Subs @	5.0%				$500.00		$25.00
						TOTAL MARKUP COSTS	**$1,980.64**
General Contractors Insurance @	1.0%		on		$10,983.41		$110
Bond @	1.0%		on		$10,983.41		$110
Contingency @	0.0%		on		$11,203.08		$0
						TOTAL COST for pay item	**$11,203**

Additional Pay Item Notes :

Assumed 5 cubicles: 2 Laborers and 1 Electrician will load in the truck with the crane the control equipment.

PAY ITEM COST DETAIL WORKSHEET

3.057 Remove & Dispose - 40-Ton Travelling Crane Festoon Cable

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.057		**Project**	: COPCO 2			
Description	:	Remove & Dispose - 40-Ton Travelling Crane Festoon Cable						
Quantity	:	1.00 EA						
Daily Production	:	2.00 EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	0.5 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$2,557.66 per EA		**Probable Low Cost Parameter**		**2.2**	**$2,302**	**$2,301.89**
Total Cost	:	$2,558		**Probable High Cost Parameter**		**1.7**	**$2,941**	**$2,941.30**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Laborer	Active	2.00	0.5	8	8.00	L	$45.80	$0.00		$366.40
Equipment Operator (medium)	Active	1.00	0.5	8	4.00	L	$66.28	$0.00		$265.12
Loader, FE Rubber Tire (3.5cy)	Active	1.00	0.5	8	4.00	E	$64.23	$64.23		$256.92
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.5	8	4.00	E	$111.64	$111.64		$446.56
Truck Driver (heavy)	Active	1.00	0.5	8	4.00	L	$57.59	$0.00		$230.36

Labor Hours	**16**	**TOTAL LABOR**	**$861.88**
Equipment Hours	**8**	**TOTAL EQUIPMENT**	**$703.48**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$43.09	$43.09

TOTAL MATERIAL	**$43.09**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Disposal fee (Allowance)	1.00	EA	1.000	1.00	$500.00	$500.00

TOTAL SUBCONTRACTS	**$500.00**

SUMMARY OF COSTS

Labor Cost	$861.88	Labor Burden @	49.7%	$0.00		$861.88
Material Cost	$43.09	Material Tax @	7.8%	$3.34		$46.43
Equipment Cost	$703.48	Equipment Tax @	0.0%	$0.00		$703.48
Subcontractors	$500.00					$500.00
DIRECT COST SUBTOTALS	**$2,108**			**$3**	**DIRECT COST SUBTOTALS**	**$2,112**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,611.79	$241.77
Installing Contractors Profit@	8.0%				$1,611.79	$128.94
GC Markup on Subs @	5.0%				$500.00	$25.00
					TOTAL MARKUP COSTS	**$395.71**
General Contractors Insurance @	1.0%	on			$2,507.51	$25
Bond @	1.0%	on			$2,507.51	$25
Contingency @	0.0%	on			$2,557.66	$0
					TOTAL COST for pay item	**$2,558**

Additional Pay Item Notes :

Assumed 200 LF of cable: 2 Laborers will load in the truck with the loader the overhead crane cable.

PAY ITEM COST DETAIL WORKSHEET

3.058a Remove Oil from Oil-Filled Step-up Transformers

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.058a		**Project**	: COPCO 2			
Description	:	Remove Oil from Oil-Filled Step-up Transformers						
Quantity	:	23,000.00 GAL						
Daily Production	:	10,000.00 GAL per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	2.3 Days		**Estimator**	: Mihaela Tomulescu	**GAL per**	**Total Cost**	**Unit Price Per GAL**
Unit Price	:	$10.59 per GAL		**Probable Low Cost Parameter**		**11000**	**$219,288**	**$9.53**
Total Cost	:	$243,653		**Probable High Cost Parameter**		**9000**	**$268,019**	**$11.65**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.3	8	18.40	L	$46.27	$0.00		$851.37
Electrician	Active	2.00	2.3	8	36.80	L	$45.23	$0.00		$1,664.46
Laborer	Active	2.00	2.3	8	36.80	L	$45.80	$0.00		$1,685.44

Labor Hours	**92**	**TOTAL LABOR**	**$4,201.27**
Equipment Hours	**0**	**TOTAL EQUIPMENT**	**$0.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 20% labor (absorbant materials, etc)	1.00	LS	1.000	1.00	$840.25	$840.25
Waste handling equipment, for handling hazardous waste materials, w/charcoal & HEPA filter, 55 gallon drum packer	5.00	EA	1.000	5.00	$35,100.00	$175,500.00
					TOTAL MATERIAL	**$176,340.25**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, liquid pickup, vacuum truck, stainless steel tank, 5000 gallons, minimum charge, 4 hours, 2 compartment	18.40	hour	1.000	$200.00	$3,680.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$4,201.27	Labor Burden @	49.7%	$0.00		$4,201.27
Material Cost	$176,340.25	Material Tax @	7.8%	$13,666.37		$190,006.62
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00		$0.00
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$180,542**			**$13,666**	**DIRECT COST SUBTOTALS**	**$194,208**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$194,207.90	$29,131.18
Installing Contractors Profit@	8.0%				$194,207.90	$15,536.63
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$44,667.82**
General Contractors Insurance @	1.0%		on		$238,875.71	$2,389
Bond @	1.0%		on		$238,875.71	$2,389
Contingency @	0.0%		on		$243,653.23	$0
					TOTAL COST for pay item	**$243,653**

Additional Pay Item Notes :

Used a crew formed of 1 Forman, 2 Electricians, 2 Laborers to takeout the petroleum waste, Vacuum-equipped tank trucks are used to remove waste oil from collection points at plants so that it can be transported to recycling or disposal locations. Assumed new waste handling equipment, for handling hazardous waste materials, w/charcoal & HEPA filter, 55 gallon drum packer is new to storage the oil from 8 transformers.

PAY ITEM COST DETAIL WORKSHEET

3.061 Remove Intake Structure Concrete

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.061			**Project**	: COPCO 2			
Description	:	Remove Intake Structure Concrete							
Quantity	:	1,650.00	cy						
Daily Production	:	50.00	cy per	8 hour shift	**Project #**	: 3			
Work Days	:	33.0	Days		**Estimator**	: Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$299.68	per cy		**Probable Low Cost Parameter**		**57.5**	**$420,307**	**$254.73**
Total Cost	:	$494,479			**Probable High Cost Parameter**		**40**	**$593,374**	**$359.62**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	33.0	8	528.00	L	$48.27	incl. in rate	incl. in rate	$25,486.56
Laborer	Active	8.00	33.0	8	2,112.00	L	$45.80	incl. in rate	incl. in rate	$96,729.60
Equipment Operator (medium)	Active	2.00	33.0	8	528.00	L	$66.28	incl. in rate	incl. in rate	$34,995.84
Truck Driver (heavy)	Active	1.00	33.0	8	264.00	L	$57.59	incl. in rate	incl. in rate	$15,203.76
Air Compressor 900 cfm	Active	1.00	33.0	8	264.00	E	$38.87	incl. in rate	incl. in rate	$10,261.40
Air Compressor 600 cfm	Active	1.00	33.0	8	264.00	E	$21.74	incl. in rate	incl. in rate	$5,739.08
Air Tool, Chipping Hammer	Active	4.00	33.0	8	1,056.00	E	$1.64	incl. in rate	incl. in rate	$1,730.82
Generator, Small Generator, 10 - 15 kW	Active	2.00	33.0	8	528.00	E	$7.04	incl. in rate	incl. in rate	$3,717.12
Hydraulic Excavator (2.5cy)	Active	2.00	33.0	8	528.00	E	$203.63	incl. in rate	incl. in rate	$107,516.64
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	33.0	8	264.00	E	$62.72	incl. in rate	incl. in rate	$16,558.08
Hydraulic Thumbs/Shear Attachment	Active	1.00	33.0	8	264.00	E	$16.39	incl. in rate	incl. in rate	$4,326.96
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	33.0	8	264.00	E	$111.64	incl. in rate	incl. in rate	$29,472.96
			33.0	8	0.00					$0.00
			33.0	8	0.00					$0.00
			33.0	8	0.00					$0.00
			33.0	8	0.00					$0.00
			33.0	8	0.00					$0.00
				Labor Hours	**3,432**			**TOTAL LABOR**		**$172,415.76**
				Equipment Hours	**3,432**			**TOTAL EQUIPMENT**		**$179,323.05**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$8,620.79	$8,620.79
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$8,620.79**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	9	EA	**Cost per Mob**	$2,500.00	$22,500.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$22,500.00**

SUMMARY OF COSTS

Labor Cost	$172,415.76	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$172,415.76
Material Cost	$8,620.79	Material Tax @	7.75%	$668.11		$9,288.90
Equipment Cost	$179,323.05	Equipment Tax @	7.75%	$13,897.54		$193,220.59
Subcontractors	$22,500.00					$22,500.00
DIRECT COST SUBTOTALS	**$382,860**			**$14,566**	**DIRECT COST SUBTOTALS**	**$397,425**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$374,925.25	$56,238.79
Installing Contractors Profit@	8.0%				$374,925.25	$29,994.02
GC Markup on Subs @	5.0%				$22,500.00	$1,125.00
					TOTAL MARKUP COSTS	**$87,357.81**
General Contractors Insurance @	1.0%			on	$484,783.05	$4,848
Bond @	1.0%			on	$484,783.05	$4,848
Contingency @	0.0%			on	$494,478.71	$0
					TOTAL COST for pay item	**$494,479**

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposable site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM COST DETAIL WORKSHEET

3.062 Remove Concrete Items associated with 16-foot I.D. Wood Stave Pipe

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.062	**Project**	: COPCO 2				
Description	:	Remove Concrete Items associated with 16-foot I.D. Wood Stave Pipe						
Quantity	:	1,310.00 cy						
Daily Production	:	50.00 cy per 8 hour shift	**Project #**	: 3				
Work Days	:	26.2 Days	**Estimator**	: Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**	
Unit Price	:	$299.39 per cy	**Probable Low Cost Parameter**		**57.5**	**$333,367**	**$254.48**	
Total Cost	:	$392,197	**Probable High Cost Parameter**		**40**	**$470,636**	**$359.26**	

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	26.2	8	419.20	L	$48.27	incl. in rate	incl. in rate	$20,234.78
Laborer	Active	8.00	26.2	8	1,676.80	L	$45.80	incl. in rate	incl. in rate	$76,797.44
Equipment Operator (medium)	Active	2.00	26.2	8	419.20	L	$66.28	incl. in rate	incl. in rate	$27,784.58
Truck Driver (heavy)	Active	1.00	26.2	8	209.60	L	$57.59	incl. in rate	incl. in rate	$12,070.86
Air Compressor 900 cfm	Active	1.00	26.2	8	209.60	E	$38.87	incl. in rate	incl. in rate	$8,146.93
Air Compressor 600 cfm	Active	1.00	26.2	8	209.60	E	$21.74	incl. in rate	incl. in rate	$4,556.48
Air Tool, Chipping Hammer	Active	4.00	26.2	8	838.40	E	$1.64	incl. in rate	incl. in rate	$1,374.17
Generator, Small Generator, 10 - 15 kW	Active	2.00	26.2	8	419.20	E	$7.04	incl. in rate	incl. in rate	$2,951.17
Hydraulic Excavator (2.5cy)	Active	2.00	26.2	8	419.20	E	$203.63	incl. in rate	incl. in rate	$85,361.70
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	26.2	8	209.60	E	$62.72	incl. in rate	incl. in rate	$13,146.11
Hydraulic Thumbs/Shear Attachment	Active	1.00	26.2	8	209.60	E	$16.39	incl. in rate	incl. in rate	$3,435.34
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	26.2	8	209.60	E	$111.64	incl. in rate	incl. in rate	$23,399.74
			26.2	8	0.00					$0.00
			26.2	8	0.00					$0.00
			26.2	8	0.00					$0.00
			26.2	8	0.00					$0.00
			26.2	8	0.00					$0.00
				Labor Hours	**2,725**				**TOTAL LABOR**	**$136,887.66**
				Equipment Hours	**2,725**				**TOTAL EQUIPMENT**	**$142,371.63**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$6,844.38	$6,844.38
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$6,844.38**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	7	EA	**Cost per Mob**	$2,500.00	$17,500.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$17,500.00**

SUMMARY OF COSTS

Labor Cost	$136,887.66	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$136,887.66
Material Cost	$6,844.38	Material Tax @	7.75%	$530.44		$7,374.82
Equipment Cost	$142,371.63	Equipment Tax @	7.75%	$11,033.80		$153,405.44
Subcontractors	$17,500.00					$17,500.00
DIRECT COST SUBTOTALS	**$303,604**			**$11,564**	**DIRECT COST SUBTOTALS**	**$315,168**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$297,667.92	$44,650.19
Installing Contractors Profit@	8.0%				$297,667.92	$23,813.43
GC Markup on Subs @	5.0%				$17,500.00	$875.00
					TOTAL MARKUP COSTS	**$69,338.62**
General Contractors Insurance @	1.0%		on		$384,506.54	$3,845
Bond @	1.0%		on		$384,506.54	$3,845
Contingency @	0.0%		on		$392,196.68	$0
					TOTAL COST for pay item	**$392,197**

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposable site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM COST DETAIL WORKSHEET

3.063 Place Concrete Plugs for Tunnels

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.063		**Project**	: COPCO 2			
Description	:	Place Concrete Plugs for Tunnels						
Quantity	:	100.00 cy						
Daily Production	:	11.00 cy per	8 hour shift	**Project #**	: 3			
Work Days	:	9.1 Days		**Estimator**	: Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$1,827.07 per cy		**Probable Low Cost Parameter**		**12.65**	**$155,301**	**$1,553.01**
Total Cost	:	$182,707		**Probable High Cost Parameter**		**9.35**	**$210,113**	**$2,101.13**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Carpenter Foreman (out)	Active	2.00	9.1	***8***	145.60	L	$74.60	incl. in rate	incl. in rate	$10,861.76
Carpenters	Active	6.00	9.1	***8***	436.80	L	$72.60	incl. in rate	incl. in rate	$31,711.68
Carpenters, Journeyman	Active	4.00	9.1	***8***	291.20	L	$65.37	incl. in rate	incl. in rate	$19,035.74
Equipment Operator (medium)	Active	1.00	9.1	***8***	72.80	L	$66.28	incl. in rate	incl. in rate	$4,825.18
Truck Driver (heavy)	Active	1.00	9.1	***8***	72.80	L	$57.59	incl. in rate	incl. in rate	$4,192.55
Loader, FE Rubber Tire (5.25cy)	Active	2.00	9.1	***8***	145.60	E	$75.42	incl. in rate	incl. in rate	$10,981.15
Hydraulic Excavator (5.0cy)	Active	1.00	9.1	***8***	72.80	E	$274.63	incl. in rate	incl. in rate	$19,993.06
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	9.1	***8***	72.80	E	$31.90	incl. in rate	incl. in rate	$2,322.32
Truck, Pickup (4x4, 3/4tn)	Active	2.00	9.1	***8***	145.60	E	$16.94	incl. in rate	incl. in rate	$2,466.46
0		0.00	9.1	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		3.00	9.1	8	218.40	0	$0.00	incl. in rate	incl. in rate	$0.00
0		1.00	9.1	8	72.80	0	$0.00	incl. in rate	incl. in rate	$0.00
			9.1	8.0	0.00					$0.00
			9.1	8.0	0.00					$0.00
			9.1	8.0	0.00					$0.00
			9.1	8.0	0.00					$0.00
			9.1	8.0	0.00					$0.00
				Labor Hours	**1,019**			**TOTAL LABOR**		**$70,626.92**
				Equipment Hours	**437**			**TOTAL EQUIPMENT**		**$35,763.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (25% labor)	1.00	LS	1.000	1.00	$17,656.73	$17,656.73
Concrete	100.00	CY	1.200	120.00	$150.00	$15,000.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$32,656.73**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Pump	1	LS	**1 Mobilization**	$1,500.00	$1,500.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$1,500.00**

SUMMARY OF COSTS

Labor Cost	$70,626.92	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$70,626.92
Material Cost	$32,656.73	Material Tax @	7.75%	$2,530.90		$35,187.63
Equipment Cost	$35,763.00	Equipment Tax @	7.75%	$2,771.63		$38,534.63
Subcontractors	$1,500.00					$1,500.00
DIRECT COST SUBTOTALS	**$140,547**			**$5,303**	**DIRECT COST SUBTOTALS**	**$145,849**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$144,349.18	$21,652.38
Installing Contractors Profit@	8.0%				$144,349.18	$11,547.93
GC Markup on Subs @	5.0%				$1,500.00	$75.00
					TOTAL MARKUP COSTS	**$33,275.31**
General Contractors Insurance @	1.0%		on		$179,124.49	$1,791
Bond @	1.0%		on		$179,124.49	$1,791
Contingency @	0.0%		on		$182,706.98	$0
					TOTAL COST for pay item	**$182,707**

Additional Pay Item Notes :

There will be 2 crews work in two locations at 1 time. The loaders will support crews for providing materials/ equipment that a pick up truck can not handle.There is a total of 9 plugs and figured roughly 1 day per plug.

PAY ITEM COST DETAIL WORKSHEET

3.064 Remove Concrete Items associated with Penstocks D/S from Tunnel No. 2

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.064		**Project**	: COPCO 2			
Description	:	Remove Concrete Items associated with Penstocks D/S from Tunnel No. 2						
Quantity	:	3,500.00	cy					
Daily Production	:	50.00	cy per	8 hour shift	**Project #**	: 3		
Work Days	:	70.0	Days		**Estimator**	: Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$298.85	per cy		**Probable Low Cost Parameter**		**57.5**	**$889,077**	**$254.02**
Total Cost	:	$1,045,973			**Probable High Cost Parameter**		**40**	**$1,255,168**	**$358.62**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	70.0	8	1,120.00	L	$48.27	incl. in rate	incl. in rate	$54,062.40
Laborer	Active	8.00	70.0	8	4,480.00	L	$45.80	incl. in rate	incl. in rate	$205,184.00
Equipment Operator (medium)	Active	2.00	70.0	8	1,120.00	L	$66.28	incl. in rate	incl. in rate	$74,233.60
Truck Driver (heavy)	Active	1.00	70.0	8	560.00	L	$57.59	incl. in rate	incl. in rate	$32,250.40
Air Compressor 900 cfm	Active	1.00	70.0	8	560.00	E	$38.87	incl. in rate	incl. in rate	$21,766.60
Air Compressor 600 cfm	Active	1.00	70.0	8	560.00	E	$21.74	incl. in rate	incl. in rate	$12,173.80
Air Tool, Chipping Hammer	Active	4.00	70.0	8	2,240.00	E	$1.64	incl. in rate	incl. in rate	$3,671.44
Generator, Small Generator, 10 - 15 kW	Active	2.00	70.0	8	1,120.00	E	$7.04	incl. in rate	incl. in rate	$7,884.80
Hydraulic Excavator (2.5cy)	Active	2.00	70.0	8	1,120.00	E	$203.63	incl. in rate	incl. in rate	$228,065.60
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	70.0	8	560.00	E	$62.72	incl. in rate	incl. in rate	$35,123.20
Hydraulic Thumbs/Shear Attachment	Active	1.00	70.0	8	560.00	E	$16.39	incl. in rate	incl. in rate	$9,178.40
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	70.0	8	560.00	E	$111.64	incl. in rate	incl. in rate	$62,518.40
			70.0	8	0.00					$0.00
			70.0	8	0.00					$0.00
			70.0	8	0.00					$0.00
			70.0	8	0.00					$0.00
			70.0	8	0.00					$0.00
				Labor Hours	**7,280**				**TOTAL LABOR**	**$365,730.40**
				Equipment Hours	**7,280**				**TOTAL EQUIPMENT**	**$380,382.23**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$18,286.52	$18,286.52
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$18,286.52**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	18	EA	**Cost per Mob**	$2,500.00	$45,000.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$45,000.00**

SUMMARY OF COSTS

Labor Cost	$365,730.40	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$365,730.40
Material Cost	$18,286.52	Material Tax @	7.75%	$1,417.21		$19,703.73
Equipment Cost	$380,382.23	Equipment Tax @	7.75%	$29,479.62		$409,861.85
Subcontractors	$45,000.00					$45,000.00

DIRECT COST SUBTOTALS	**$809,399**			**$30,897**	**DIRECT COST SUBTOTALS**	**$840,296**
		Crew	**Material**	**Subs**	**Cost Basis**	
Installing Contractors Overhead@	15.0%				$795,295.98	$119,294.40
Installing Contractors Profit@	8.0%				$795,295.98	$63,623.68
GC Markup on Subs @	5.0%				$45,000.00	$2,250.00
					TOTAL MARKUP COSTS	**$185,168.07**
General Contractors Insurance @	1.0%		on		$1,025,464.05	$10,255
Bond @	1.0%		on		$1,025,464.05	$10,255
Contingency @	0.0%		on		$1,045,973.33	$0
					TOTAL COST for pay item	**$1,045,973**

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposable site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM COST DETAIL WORKSHEET

3.065 Remove & Dispose of Caterpiller Gate (steel)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.065		**Project**	: COPCO2			
Description	:	Remove & Dispose of Caterpiller Gate (steel)						
Quantity	:	50,000.00 LBS						
Daily Production	:	25,000.00 LBS per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	2.0 Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.92 per LBS		**Probable Low Cost Parameter**		**27500**	**$41,287**	**$0.83**
Total Cost	:	$45,874		**Probable High Cost Parameter**		**22500**	**$50,461**	**$1.01**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	$0.00		$740.32
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	$0.00		$723.68
Steelworker	Active	6.00	2.0	8	96.00	L	$65.52	$0.00		$6,289.92
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.0	8	16.00	E	$221.50	$221.50		$3,544.00
Truck Driver (heavy)	Active	2.00	2.0	8	32.00	L	$57.59	$0.00		$1,842.88
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	2.0	8	32.00	E	$31.90	$31.90		$1,020.80
Hydraulic Crane (120tn)	Active	1.00	2.0	8	16.00	E	$239.06	$239.06		$3,824.96
Welder	Active	2.00	2.0	8	32.00	L	$7.84	$0.00		$250.80
Gas Welding Machine	Active	2.00	2.0	8	32.00	E	$2.88	$2.88		$92.06
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	$0.00		$1,060.48
Equipment Operator (crane)	Active	1.00	2.0	8	16.00	L	$68.41	$0.00		$1,094.56

Labor Hours	**224**	**TOTAL LABOR**	**$12,002.64**
Equipment Hours	**96**	**TOTAL EQUIPMENT**	**$8,481.82**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$600.13	$600.13
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	2,500.00	LF	1.000	2,500.00	$0.85	$2,125.00

TOTAL MATERIAL	**$2,725.13**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	25.00	ton	1.000	25.00	$595.00	$14,875.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	72.00	mile	1.000	72.00	$7.25	$522.00

TOTAL SUBCONTRACTS	**$15,397.00**

SUMMARY OF COSTS

Labor Cost	$12,002.64	Labor Burden @	49.7%	$0.00		$12,002.64
Material Cost	$2,725.13	Material Tax @	7.8%	$211.20		$2,936.33
Equipment Cost	$8,481.82	Equipment Tax @	0.0%	$0.00		$8,481.82
Subcontractors	$15,397.00					$15,397.00
DIRECT COST SUBTOTALS	**$38,607**			**$211**	**DIRECT COST SUBTOTALS**	**$38,818**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$23,420.79	$3,513.12
Installing Contractors Profit@	8.0%				$23,420.79	$1,873.66
GC Markup on Subs @	5.0%				$15,397.00	$769.85
					TOTAL MARKUP COSTS	**$6,156.63**
General Contractors Insurance @	1.0%		on		$44,974.43	$450
Bond @	1.0%		on		$44,974.43	$450
Contingency @	0.0%		on		$45,873.91	$0
					TOTAL COST for pay item	**$45,874**

Additional Pay Item Notes :

The removal of gate, frame and hoist is done by one 9-men crew (1 foreman, 6 steelworkers, 1 welder, 1 electrician and 2 equipment operators). Based on the current production rate and the fact that we dispose big pieces of steel we use 2 trucks per day. Assumed hazardous waste cleanup 100% disposal because of the engine Oil and Transmission Oil used for cranes .

PAY ITEM COST DETAIL WORKSHEET

3.066 Remove & Dispose of Trash rack and trash rake (steel)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.066		**Project**	: COPCO2			
Description	:	Remove & Dispose of Trash rack and trash rake (steel)						
Quantity	:	86,000.00 LBS						
Daily Production	:	30,000.00 LBS per	8 hour shift	**Project #**	: 0			
Work Days	:	2.9 Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.63 per LBS		**Probable Low Cost Parameter**		**33000**	**$48,937**	**$0.57**
Total Cost	:	$54,375		**Probable High Cost Parameter**		**24000**	**$65,250**	**$0.76**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.9	8	23.20	L	$46.27	$0.00		$1,073.46
Electrician	Active	1.00	2.9	8	23.20	L	$45.23	$0.00		$1,049.34
Steelworker	Active	6.00	2.9	8	139.20	L	$65.52	$0.00		$9,120.38
Hydraulic Excavator (6.0cy)	Active	1.00	2.9	8	23.20	E	$322.48	$322.48		$7,481.54
Truck Driver (heavy)	Active	1.00	2.9	8	23.20	L	$57.59	$0.00		$1,336.09
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.9	8	23.20	E	$111.64	$111.64		$2,590.05
Hydraulic Crane (120tn)	Active	1.00	2.9	8	23.20	E	$239.06	$239.06		$5,546.19
Welder	Active	2.00	2.9	8	46.40	L	$7.84	$0.00		$363.66
Gas Welding Machine	Active	2.00	2.9	8	46.40	E	$2.88	$2.88		$133.49
Equipment Operator (medium)	Active	2.00	2.9	8	46.40	L	$66.28	$0.00		$3,075.39
Equipment Operator (crane)	Active	1.00	2.9	8	23.20	L	$68.41	$0.00		$1,587.11
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	2.9	8	23.20	E	$62.72	$62.72		$1,455.10

Labor Hours	**324.8**	**TOTAL LABOR**	**$17,605.44**
Equipment Hours	**139.2**	**TOTAL EQUIPMENT**	**$17,206.37**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, electrodes, wrenches, hard hats etc)	1.00	LS	1.000	1.00	$2,640.82	$2,640.82

TOTAL MATERIAL	**$2,640.82**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (25%)	10.75	ton	1.000	10.75 $595.00	$6,396.25
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	36.00	mile	1.000	36.00 $7.25	$261.00

TOTAL SUBCONTRACTS	**$6,657.25**

SUMMARY OF COSTS

Labor Cost	$17,605.44	Labor Burden @	49.7%	$0.00	$17,605.44
Material Cost	$2,640.82	Material Tax @	7.8%	$204.66	$2,845.48
Equipment Cost	$17,206.37	Equipment Tax @	0.0%	$0.00	$17,206.37
Subcontractors	$6,657.25				$6,657.25
DIRECT COST SUBTOTALS	**$44,110**			**$205**	**DIRECT COST SUBTOTALS** **$44,315**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$37,657.29	$5,648.59
Installing Contractors Profit@	8.0%				$37,657.29	$3,012.58
GC Markup on Subs @	5.0%				$6,657.25	$332.86
						TOTAL MARKUP COSTS **$8,994.04**
General Contractors Insurance @	1.0%		on		$53,308.58	$533
Bond @	1.0%		on		$53,308.58	$533
Contingency @	0.0%		on		$54,374.75	$0
						TOTAL COST for pay item **$54,375**

Additional Pay Item Notes :

The removal of gate, frame and hoist is done by one 9-men crew (1 foreman, 6 steelworkers, 1 welder, 1 electrician and 2 equipment operators). Based on the current production rate and the fact that we dispose big pieces of steel we use 1 trucks per day. Assumed hazardous waste cleanup 25% of total weight disposal.

PAY ITEM COST DETAIL WORKSHEET

3.067 Remove & Dispose of Stop Logs and slots for intake (steel)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.067		**Project**	: COPCO 2			
Description	:	Remove & Dispose of Stop Logs and slots for intake (steel)						
Quantity	:	220,000.00	LBS					
Daily Production	:	20,000.00	LBS per 8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	11.0	Days	**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.78	per LBS	**Probable Low Cost Parameter**		**22000**	**$153,716**	**$0.70**
Total Cost	:	$170,795		**Probable High Cost Parameter**		**16000**	**$204,954**	**$0.93**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Crawler Crane (90tn)	Active	1.00	11.0	8	88.00	E	$208.09	$208.09		$18,311.92
Equipment Operator (medium)	Active	1.00	11.0	8	88.00	L	$66.28	$0.00		$5,832.64
Equipment Operator (oiler)	Active	1.00	11.0	8	88.00	L	$62.94	$0.00		$5,538.72
Carpenters, Journeyman	Active	4.00	11.0	8	352.00	L	$65.37	$0.00		$23,010.24
Truck Driver (heavy)	Active	2.00	11.0	8	176.00	L	$57.59	$0.00		$10,135.84
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	11.0	8	176.00	E	$31.90	$31.90		$5,614.40
Hydraulic Impact Breaker Attachment (3k-4k ft-lb)	Active	1.00	11.0	8	88.00	E	$36.58	$36.58		$3,219.04
Hydraulic Excavator (6.0cy)	Active	1.00	11.0	8	88.00	E	$322.48	$322.48		$28,378.24
Steelworker	Active	4.00	11.0	8	352.00	L	$65.52	$0.00		$23,063.04

Labor Hours	**1056**	**TOTAL LABOR**	**$67,580.48**
Equipment Hours	**440**	**TOTAL EQUIPMENT**	**$55,523.60**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$3,379.02	$3,379.02

TOTAL MATERIAL	**$3,379.02**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Stop log lifter - Rent per day	11.00	day	1.000	11.00	$1,000.00	$11,000.00

TOTAL SUBCONTRACTS	**$11,000.00**

SUMMARY OF COSTS

Labor Cost	$67,580.48	Labor Burden @	49.7%	$0.00		$67,580.48
Material Cost	$3,379.02	Material Tax @	7.8%	$261.87		$3,640.90
Equipment Cost	$55,523.60	Equipment Tax @	0.0%	$0.00		$55,523.60
Subcontractors	$11,000.00					$11,000.00
DIRECT COST SUBTOTALS	**$137,483**			**$262**	**DIRECT COST SUBTOTALS**	**$137,745**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$126,744.98		$19,011.75
Installing Contractors Profit@	8.0%				$126,744.98		$10,139.60
GC Markup on Subs @	5.0%				$11,000.00		$550.00
						TOTAL MARKUP COSTS	**$29,701.35**
General Contractors Insurance @	1.0%		on		$167,446.32		$1,674
Bond @	1.0%		on		$167,446.32		$1,674
Contingency @	0.0%		on		$170,795.25		$0
						TOTAL COST for pay item	**$170,795**

Additional Pay Item Notes :

The process of removing top logs is not manual, but done with hydraulic stop log lifters and hoists is done by one 11-men crew (6 steelworkers, 4 journeymen and 4 equipment operators). Based on the current production rate and the fact that we dispose big pieces of material we use 2 trucks per day. The gate side guides and invert shall have a minimum weight of 4 lbs./ft. for wall mounted and 3 lbs./ft. for embedded in concrete that we assume we have. The gate invert should contain a removable neoprene seal. Including stop log grooves, lifter, guide - weight around 220,000 lbs.

PAY ITEM COST DETAIL WORKSHEET

3.068 Remove & Dispose of Wood Staves Soaked in Creosote

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.068		**Project**	: COPCO 2			
Description	:	Remove & Dispose of Wood Staves Soaked in Creosote						
Quantity	:	1,100,000.00	LBS					
Daily Production	:	90,000.00	LBS per 8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	12.2 Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.93 per LBS		**Probable Low Cost Parameter**		**108000**	**$817,373**	**$0.74**
Total Cost	:	$1,021,716		**Probable High Cost Parameter**		**72000**	**$1,226,059**	**$1.11**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	7.00	12.2	8	683.20	L	$46.27	$0.00		$31,611.66
Loader, FE Rubber Tire (8.6cy)	Active	7.00	12.2	8	683.20	E	$221.50	$221.50		$151,328.80
Electrician	Active	7.00	12.2	8	683.20	L	$45.23	$0.00		$30,901.14
Carpenters	Active	21.00	12.2	8	2,049.60	L	$72.60	$0.00		$148,800.96
Truck, Off-Road, Articulated Rear, 20cy	Active	3.00	12.2	8	292.80	E	$111.64	$111.64		$32,688.19
Hydraulic Excavator (6.0cy)	Active	3.00	12.2	8	292.80	E	$322.48	$322.48		$94,422.14
Equipment Operator (crane)	Active	3.00	12.2	8	292.80	L	$68.41	$0.00		$20,030.45
Truck Driver (heavy)	Active	3.00	12.2	8	292.80	L	$57.59	$0.00		$16,862.35
Steelworker	Active	7.00	12.2	8	683.20	L	$65.52	$0.00		$44,763.26
Crawler Crane (270tn)	Active	3.00	12.2	8	292.80	E	$399.50	$446.84		$116,973.60
Equipment Operator (medium)	Active	10.00	12.2	8	976.00	L	$66.28	$0.00		$64,689.28

Labor Hours	**5660.8**	**TOTAL LABOR**	**$357,659.10**
Equipment Hours	**1561.6**	**TOTAL EQUIPMENT**	**$395,412.74**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$17,882.96	$17,882.96

TOTAL MATERIAL	**$17,882.96**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 30 min load/wait/unload, 18 C.Y. 8 wheel truck, cycle 50 miles, 50 MPH, excludes loading equipment	652	L.C.Y.	1.000	652.00	$13.10	$8,541.20
Disposal fees -RCRA hazardous waste treated to be a non-RCRA or nonhazardous waste	550	Ton	1.000	550.00	$74.00	$40,700.00

TOTAL SUBCONTRACTS	**$49,241.20**

SUMMARY OF COSTS

Labor Cost	$357,659.10	Labor Burden @	49.7%	$0.00		$357,659.10
Material Cost	$17,882.96	Material Tax @	7.8%	$1,385.93		$19,268.88
Equipment Cost	$395,412.74	Equipment Tax @	0.0%	$0.00		$395,412.74
Subcontractors	$49,241.20					$49,241.20
DIRECT COST SUBTOTALS	**$820,196**			**$1,386**	**DIRECT COST SUBTOTALS**	**$821,582**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$772,340.72		$115,851.11
Installing Contractors Profit@	8.0%				$772,340.72		$61,787.26
GC Markup on Subs @	5.0%				$49,241.20		$2,462.06
						TOTAL MARKUP COSTS	**$180,100.43**
General Contractors Insurance @	1.0%		on		$1,001,682.35		$10,017
Bond @	1.0%		on		$1,001,682.35		$10,017
Contingency @	0.0%		on		$1,021,716.00		$0
						TOTAL COST for pay item	**$1,021,716**

Additional Pay Item Notes :

Assumed the process of removing around 1,100000 lbs wood staves is done in 12 days by 7 crew formed of 1 foreman, 1 electrician, 3 carpenters, 1 steelworkers ; 12 equipment operators 3 for the crane, 3 for the excavator and 6 loader. Based on the current production rate and the fact that we dispose big pieces of material we use 3 trucks per day.

PAY ITEM COST DETAIL WORKSHEET

3.069 Remove & Dispose of Cradles (steel)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.069			**Project**	:	COPCO 2			
Description	:	Remove & Dispose of Cradles (steel)								
Quantity	:	290,000.00	LBS							
Daily Production	:	25,000.00	LBS per	8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	11.6	Days		**Estimator**	:	Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.94	per LBS		**Probable Low Cost Parameter**			**30000**	**$218,998**	**$0.76**
Total Cost	:	$273,748			**Probable High Cost Parameter**			**20000**	**$328,497**	**$1.13**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	11.6	8	185.60	L	$46.27	$0.00		$8,587.71
Steelworker	Active	2.00	11.6	8	185.60	L	$65.52	$0.00		$12,160.51
Equipment Operator (medium)	Active	2.00	11.6	8	185.60	L	$66.28	$0.00		$12,301.57
Carpenters, Journeyman	Active	10.00	11.6	8	928.00	L	$65.37	$0.00		$60,663.36
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	11.6	8	185.60	E	$111.64	$111.64		$20,720.38
Hydraulic Impact Breaker Attachment (2k-3k ft-lb)	Active	2.00	11.6	8	185.60	E	$30.85	$30.85		$5,725.76
Welder	Active	2.00	11.6	8	185.60	L	$7.84	$0.00		$1,454.64
Gas Welding Machine	Active	2.00	11.6	8	185.60	E	$2.88	$2.88		$533.97
Hydraulic Excavator (6.0cy)	Active	2.00	11.6	8	185.60	E	$322.48	$322.48		$59,852.29
Truck Driver (heavy)	Active	2.00	11.6	8	185.60	L	$57.59	$0.00		$10,688.70
Electrician	Active	2.00	11.6	8	185.60	L	$45.23	$0.00		$8,394.69

Labor Hours	**2041.6**	**TOTAL LABOR**	**$114,251.18**
Equipment Hours	**742.4**	**TOTAL EQUIPMENT**	**$86,832.40**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	1,500.00	LF	1.000	1,500.00	$0.85	$1,275.00

TOTAL MATERIAL	**$1,275.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	29.00	ton	1.000	29.00	$595.00	$17,255.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	115.20	mile	1.000	115.20	$10.25	$1,180.80

TOTAL SUBCONTRACTS	**$18,435.80**

SUMMARY OF COSTS

Labor Cost	$114,251.18	Labor Burden @	49.7%	$0.00	$114,251.18
Material Cost	$1,275.00	Material Tax @	7.8%	$98.81	$1,373.81
Equipment Cost	$86,832.40	Equipment Tax @	0.0%	$0.00	$86,832.40
Subcontractors	$18,435.80				$18,435.80
DIRECT COST SUBTOTALS	**$220,794**			**$99**	**DIRECT COST SUBTOTALS** **$220,893**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$202,457.40	$30,368.61
Installing Contractors Profit@	8.0%				$202,457.40	$16,196.59
GC Markup on Subs @	5.0%				$18,435.80	$921.79
					TOTAL MARKUP COSTS	**$47,486.99**
General Contractors Insurance @	1.0%		on		$268,380.19	$2,684
Bond @	1.0%		on		$268,380.19	$2,684
Contingency @	0.0%		on		$273,747.79	$0
					TOTAL COST for pay item	**$273,748**

Additional Pay Item Notes :

Assumed the process of removing steel cradles is done in around 12 days by 2 crew formed of 1 foreman, 1 electrician, 5 journeymen, 1 steelworkers ;2 equipment operators 1 for each excavator. We dispose cradles with 1 trucks per day for each crew.

PAY ITEM COST DETAIL WORKSHEET

3.070 Remove & Dispose of Bands (steel)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.070	**Project**	:	COPCO 2			
Description	:	Remove & Dispose of Bands (steel)						
Quantity	:	463,000.00 LBS						
Daily Production	:	65,000.00 LBS per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	6.0 Days	**Estimator**	:	Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.92 per LBS	**Probable Low Cost Parameter**			**78000**	**$341,422**	**$0.74**
Total Cost	:	$426,777	**Probable High Cost Parameter**			**52000**	**$512,133**	**$1.11**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	5.00	6.0	8	240.00	L	$48.27	$0.00		$11,584.80
Steelworker	Active	15.00	6.0	8	720.00	L	$65.52	$0.00		$47,174.40
Equipment Operator (crane)	Active	3.00	6.0	8	144.00	L	$68.41	$0.00		$9,851.04
Crawler Crane (130tn)	Active	5.00	6.0	8	240.00	E	$258.66	$258.66		$62,078.40
Welder	Active	5.00	6.0	8	240.00	L	$7.84	$0.00		$1,881.00
Gas Welding Machine	Active	5.00	6.0	8	240.00	E	$2.88	$2.88		$690.48
Hydraulic Excavator (6.0cy)	Active	5.00	6.0	8	240.00	E	$322.48	$322.48		$77,395.20
Truck Driver (heavy)	Active	4.00	6.0	8	192.00	L	$57.59	$0.00		$11,057.28
Truck, Off-Road, Articulated Rear, 20cy	Active	4.00	6.0	8	192.00	E	$111.64	$111.64		$21,434.88
Equipment Operator (medium)	Active	5.00	6.0	8	240.00	L	$66.28	$0.00		$15,907.20
Loader, FE Rubber Tire (8.6cy)	Active	5.00	6.0	8	240.00	E	$221.50	$221.50		$53,160.00

Labor Hours	**1776**	**TOTAL LABOR**	**$97,455.72**
Equipment Hours	**1152**	**TOTAL EQUIPMENT**	**$214,758.96**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$14,618.36	$14,618.36

TOTAL MATERIAL	**$14,618.36**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10%)	23.15	ton	1.000	23.15	$595.00	$13,774.25
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	72.00	mile	1.000	72.00	$7.25	$522.00

TOTAL SUBCONTRACTS	**$14,296.25**

SUMMARY OF COSTS

Labor Cost	$97,455.72	Labor Burden @	49.7%	$0.00		$97,455.72
Material Cost	$14,618.36	Material Tax @	7.8%	$1,132.92		$15,751.28
Equipment Cost	$214,758.96	Equipment Tax @	0.0%	$0.00		$214,758.96
Subcontractors	$14,296.25					$14,296.25
DIRECT COST SUBTOTALS	**$341,129**			**$1,133**	**DIRECT COST SUBTOTALS**	**$342,262**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$327,965.96		$49,194.89
Installing Contractors Profit@	8.0%				$327,965.96		$26,237.28
GC Markup on Subs @	5.0%				$14,296.25		$714.81
						TOTAL MARKUP COSTS	**$76,146.98**
General Contractors Insurance @	1.0%		on		$418,409.19		$4,184
Bond @	1.0%		on		$418,409.19		$4,184
Contingency @	0.0%		on		$426,777.37		$0
						TOTAL COST for pay item	**$426,777**

Additional Pay Item Notes :

Based on RSMeans we used Crew E-19 for metals demolition, banding the material into bundles and dispose to the staging area, E-12 for welding cut and E-25 for cutting steel. Assumed contains paint with heavy metals 10% of the total lbs, 36 miles from Copco lake to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary. Demolition is done using one crawler crane, excavator and welding machine.

PAY ITEM COST DETAIL WORKSHEET

3.071 Remove & Dispose of Penstock after bifurcation to butterfly valves

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.071			**Project**	: COPCO 2			
Description	:	Remove & Dispose of Penstock after bifurcation to butterfly valves							
Quantity	:	860,000.00	LBS						
Daily Production	:	43,000.00	LBS per	10 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	20.0	Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$1.08	per LBS		**Probable Low Cost Parameter**		**51600**	**$740,490**	**$0.86**
Total Cost	:	$925,612			**Probable High Cost Parameter**		**34400**	**$1,110,734**	**$1.29**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	3.00	20.0	10	600.00	L	$46.27	$0.00		$27,762.00
Steelworker	Active	12.00	20.0	10	2,400.00	L	$65.52	$0.00		$157,248.00
Equipment Operator (crane)	Active	2.00	20.0	10	400.00	L	$68.41	$0.00		$27,364.00
Crawler Crane (130tn)	Active	2.00	20.0	10	400.00	E	$258.66	$258.66		$103,464.00
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	20.0	10	400.00	E	$111.64	$111.64		$44,656.00
Hydraulic Excavator (5.0cy)	Active	2.00	20.0	10	400.00	E	$274.63	$274.63		$109,852.00
Welder	Active	3.00	20.0	10	600.00	L	$7.84	$0.00		$4,702.50
Gas Welding Machine	Active	3.00	20.0	10	600.00	E	$2.88	$2.88		$1,726.19
Carpenters, Journeyman	Active	12.00	20.0	10	2,400.00	L	$65.37	$0.00		$156,888.00
Loader, FE Rubber Tire (5.25cy)	Active	2.00	20.0	10	400.00	E	$75.42	$75.42		$30,168.00
Hydraulic Impact Breaker Attachment (2k-3k ft-lb)	Active	2.00	20.0	10	400.00	E	$30.85	$30.85		$12,340.00
Truck Driver (heavy)	Active	2.00	20.0	10	400.00	L	$57.59	$0.00		$23,036.00

Labor Hours	**6800**	**TOTAL LABOR**	**$397,000.50**
Equipment Hours	**2600**	**TOTAL EQUIPMENT**	**$302,206.19**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$15,110.31	$15,110.31

TOTAL MATERIAL	**$15,110.31**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	43.00	ton	1.000	43.00 $595.00	$25,585.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	72.00	mile	1.000	72.00 $7.25	$522.00

TOTAL SUBCONTRACTS	**$26,107.00**

SUMMARY OF COSTS

Labor Cost	$397,000.50	Labor Burden @	49.7%	$0.00		$397,000.50
Material Cost	$15,110.31	Material Tax @	7.8%	$1,171.05		$16,281.36
Equipment Cost	$302,206.19	Equipment Tax @	0.0%	$0.00		$302,206.19
Subcontractors	$26,107.00					$26,107.00
DIRECT COST SUBTOTALS	**$740,424**			**$1,171**	**DIRECT COST SUBTOTALS**	**$741,595**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$715,488.05		$107,323.21
Installing Contractors Profit@	8.0%				$715,488.05		$57,239.04
GC Markup on Subs @	5.0%				$26,107.00		$1,305.35
						TOTAL MARKUP COSTS	**$165,867.60**
General Contractors Insurance @	1.0%		on		$907,462.65		$9,075
Bond @	1.0%		on		$907,462.65		$9,075
Contingency @	0.0%		on		$925,611.91		$0
						TOTAL COST for pay item	**$925,612**

Additional Pay Item Notes :

Assumed the process of removing pipes, expansion joints and support rings encased in concrete is done in around 20 days by 3 crew formed of 1 foreman, 4 journeymen, 4 steelworkers ;6 equipment operators 1 for each excavator, crane and loader. We dispose pipes with 1 trucks per day for each crew. Assumed contains paint with heavy metals 10% of the total lbs, 36 miles from Copco lake to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary. Demolition is done using one crawler crane, excavator and welding machine.

PAY ITEM COST DETAIL WORKSHEET

3.072 Remove & Dispose of Bifurcated vent pipes and support structure

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.072		**Project**	: COPCO 2			
Description	:	Remove & Dispose of Bifurcated vent pipes and support structure						
Quantity	:	19,500.00 LBS						
Daily Production	:	43,000.00 LBS per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	0.5 Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$1.13 per LBS		**Probable Low Cost Parameter**		**51600**	**$17,627**	**$0.90**
Total Cost	:	$22,033		**Probable High Cost Parameter**		**34400**	**$26,440**	**$1.36**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	3.00	0.5	8	12.00	L	$48.27	$0.00		$579.24
Steelworker	Active	12.00	0.5	8	48.00	L	$65.52	$0.00		$3,144.96
Crawler Crane (270tn)	Active	2.00	0.5	8	8.00	E	$399.50	$446.84		$3,196.00
Equipment Operator (crane)	Active	2.00	0.5	8	8.00	L	$68.41	$0.00		$547.28
Welder	Active	3.00	0.5	8	12.00	L	$7.84	$0.00		$94.05
Gas Welding Machine	Active	3.00	0.5	8	12.00	E	$2.88	$2.88		$34.52
Electrician	Active	1.00	0.5	8	4.00	L	$45.23	$0.00		$180.92
Carpenters, Journeyman	Active	12.00	0.5	8	48.00	L	$65.37	$0.00		$3,137.76
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	0.5	8	8.00	E	$111.64	$111.64		$893.12
Loader, FE Rubber Tire (8.6cy)	Active	2.00	0.5	8	8.00	E	$221.50	$221.50		$1,772.00
Truck Driver (heavy)	Active	2.00	0.5	8	8.00	L	$57.59	$0.00		$460.72
	Active	2.00	0.5	8	8.00	E	$36.58	$36.58		$292.64

Labor Hours	**140**	**TOTAL LABOR**	**$8,144.93**
Equipment Hours	**44**	**TOTAL EQUIPMENT**	**$6,188.28**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$814.49	$814.49
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	2,000.00	LF	1.000	2,000.00	$0.85	$1,700.00
					TOTAL MATERIAL	**$2,514.49**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.98	ton	1.000	0.98 $595.00	$580.13
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	3.90	mile	1.000	3.90 $7.25	$28.28
				TOTAL SUBCONTRACTS	**$608.40**

SUMMARY OF COSTS

Labor Cost	$8,144.93	Labor Burden @	49.7%	$0.00		$8,144.93
Material Cost	$2,514.49	Material Tax @	7.8%	$194.87		$2,709.37
Equipment Cost	$6,188.28	Equipment Tax @	0.0%	$0.00		$6,188.28
Subcontractors	$608.40					$608.40
DIRECT COST SUBTOTALS	**$17,456**			**$195**	**DIRECT COST SUBTOTALS**	**$17,651**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$17,042.58		$2,556.39
Installing Contractors Profit@	8.0%				$17,042.58		$1,363.41
GC Markup on Subs @	5.0%				$608.40		$30.42
						TOTAL MARKUP COSTS	**$3,950.21**
General Contractors Insurance @	1.0%		on		$21,601.19		$216
Bond @	1.0%		on		$21,601.19		$216
Contingency @	0.0%		on		$22,033.22		$0
						TOTAL COST for pay item	**$22,033**

Additional Pay Item Notes :

Assumed the process of removing pipes, expansion joints and support rings encased in concrete is done in around 20 days by 3 crew formed of 1 foreman, 4 journeymen, 4 steelworkers ;6 equipment operators 1 for each excavator, crane and loader. We dispose pipes with 1 trucks per day for each crew. Assumed contains paint with heavy metals 10% of the total lbs, 36 miles from Copco lake to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary. Demolition is done using one crawler crane, excavator and welding machine.

PAY ITEM COST DETAIL WORKSHEET

3.073 Remove & Dispose of 2 - 138" Butterfly valves

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.073		**Project**	: COPCO 2			
Description	:	Remove & Dispose of 2 - 138" Butterfly valves						
Quantity	:	148,000.00 LBS						
Daily Production	:	25,000.00 LBS per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	5.9 Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.88 per LBS		**Probable Low Cost Parameter**		**30000**	**$103,925**	**$0.70**
Total Cost	:	$129,906		**Probable High Cost Parameter**		**20000**	**$155,888**	**$1.05**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	5.9	8	94.40	L	$46.27	$0.00		$4,367.89
Steelworker	Active	4.00	5.9	8	188.80	L	$65.52	$0.00		$12,370.18
Laborer	Active	4.00	5.9	8	188.80	L	$45.80	$0.00		$8,647.04
Crawler Crane (90tn)	Active	1.00	5.9	8	47.20	E	$208.09	$208.09		$9,821.85
Carpenters, Journeyman	Active	4.00	5.9	8	188.80	L	$65.37	$0.00		$12,341.86
Welder	Active	2.00	5.9	8	94.40	L	$7.84	$0.00		$739.86
Gas Welding Machine	Active	2.00	5.9	8	94.40	E	$2.88	$2.88		$271.59
Truck Driver (heavy)	Active	2.00	5.9	8	94.40	L	$57.59	$0.00		$5,436.50
Equipment Operator (crane)	Active	1.00	5.9	8	47.20	L	$68.41	$0.00		$3,228.95

Labor Hours	**896.8**	**TOTAL LABOR**	**$47,132.27**
Equipment Hours	**141.6**	**TOTAL EQUIPMENT**	**$10,093.44**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, electrodes, drill bits, etc)	1.00	LS	1.000	1.00	$7,069.84	$7,069.84

TOTAL MATERIAL	**$7,069.84**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	74.00	ton	1.000	74.00 $595.00	$44,030.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	180.00	mile	1.000	180.00 $7.25	$1,305.00

TOTAL SUBCONTRACTS	**$45,335.00**

SUMMARY OF COSTS

Labor Cost	$47,132.27	Labor Burden @	49.7%	$0.00		$47,132.27
Material Cost	$7,069.84	Material Tax @	7.8%	$547.91		$7,617.75
Equipment Cost	$10,093.44	Equipment Tax @	0.0%	$0.00		$10,093.44
Subcontractors	$45,335.00					$45,335.00
DIRECT COST SUBTOTALS	**$109,631**			**$548**	**DIRECT COST SUBTOTALS**	**$110,178**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$64,843.46		$9,726.52
Installing Contractors Profit@	8.0%				$64,843.46		$5,187.48
GC Markup on Subs @	5.0%				$45,335.00		$2,266.75
						TOTAL MARKUP COSTS	**$17,180.75**
General Contractors Insurance @	1.0%		on		$127,359.20		$1,274
Bond @	1.0%		on		$127,359.20		$1,274
Contingency @	0.0%		on		$129,906.39		$0
						TOTAL COST for pay item	**$129,906**

Additional Pay Item Notes :

Assumed the process of removing 138" butterfly valves is done in around 6 days by 2 crew formed of 1 foreman, 2 journeymen, 2 steelworkers ;We dispose cradles with 1 trucks per day for each crew. Assumed contains paint with heavy metals 100% of the total lbs, 36 miles from Copco lake to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary. Demolition is done using one crawler crane, excavator and welding machine.

PAY ITEM COST DETAIL WORKSHEET

4.001 Furnish, Install, and Remove Barge-Mounted Crane in Reservoir

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.001			**Project**	: Iron Gate			
Description	:	Furnish, Install, and Remove Barge-Mounted Crane in Reservoir							
Quantity	:	1.00	ls						
Daily Production	:	0.10	ls per	8 hour shift	**Project #**	: 4			
Work Days	:	10.0	Days		**Estimator**	: Michael Barba	**ls per**	**Total Cost**	**Unit Price Per ls**
Unit Price	:	$191,823.14	per ls		**Probable Low Cost Parameter**		**0.11**	**$172,641**	**$172,640.83**
Total Cost	:	$191,823			**Probable High Cost Parameter**		**0.085**	**$220,597**	**$220,596.61**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Barge (400T)	Active	1.00	10.0	8	80.00	E	$99.50	incl. in rate	incl. in rate	$7,960.00
Crawler Crane (130tn)	Active	1.00	10.0	8	80.00	E	$258.66	incl. in rate	incl. in rate	$20,692.80
Crawler Crane (270tn)	Active	1.00	10.0	8	80.00	E	$399.50	incl. in rate	incl. in rate	$31,960.00
Tugboat (250hp)	Active	1.00	10.0	8	80.00	E	$88.74	incl. in rate	incl. in rate	$7,099.20
Equipment Operator (crane)	Active	2.00	10.0	8	160.00	L	$68.41	incl. in rate	incl. in rate	$10,945.60
Equipment Operator (oiler)	Active	2.00	10.0	8	160.00	L	$62.94	incl. in rate	incl. in rate	$10,070.40
Tugboat Captain	Active	1.00	10.0	8	80.00	L	$67.76	incl. in rate	incl. in rate	$5,420.80
Tugboat Hand	Active	1.00	10.0	8	80.00	L	$45.80	incl. in rate	incl. in rate	$3,664.00
Laborer	Active	2.00	10.0	8	160.00	L	$45.80	incl. in rate	incl. in rate	$7,328.00
		1.00	10.0	8	80.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	10.0	8	80.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	10.0	8	80.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
				Labor Hours	**640**				**TOTAL LABOR**	**$37,428.80**
				Equipment Hours	**320**				**TOTAL EQUIPMENT**	**$67,712.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
Barge Rental 3 months	3.00	months	1.000	3.00	$9,600.00	$28,800.00
Tug Boat Rental 3 months	3.00	months	1.000	3.00	$3,550.00	$10,650.00
		ea	1.000	0.00	$0.00	$0.00
		ea	1.000	0.00	$0.00	$0.00
		ls	1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	**$39,450.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$37,428.80	Labor Burden @	49.7%	$0.00		$37,428.80
Material Cost	$39,450.00	Material Tax @	7.75%	$3,057.38		$42,507.38
Equipment Cost	$67,712.00	Equipment Tax @	7.75%	$5,247.68		$72,959.68
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$144,591**			**$8,305**	**DIRECT COST SUBTOTALS**	**$152,896**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$152,895.86	$22,934.38
Installing Contractors Profit@	8.0%				$152,895.86	$12,231.67
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$35,166.05**
General Contractors Insurance @	1.0%		on		$188,061.90	$1,881
Bond @	1.0%		on		$188,061.90	$1,881
Contingency @	0.0%		on		$191,823.14	$0
					TOTAL COST for pay item	**$191,823**

Additional Pay Item Notes :

270 tn Crane is to lift 130 tn crane onto and off of barge. 10 work days total.

PAY ITEM COST DETAIL WORKSHEET

4.002 Furnish, Install, and Remove Temporary Air Vent Hose from Barge to Diversion Tunnel Intake Structure

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.002	**Project**	: Iron Gate				
Description	:	Furnish, Install, and Remove Temporary Air Vent Hose from Barge to Diversion Tunnel Intake Structure						
Quantity	:	50.00 LS						
Daily Production	:	50.00 LS per 8 hour shift	**Project #**	: 4				
Work Days	:	1.0 Days	**Estimator**	: Eric Jones	**LS per**	**Total Cost**	**Unit Price Per LS**	
Unit Price	:	$315.45 per LS	**Probable Low Cost Parameter**		**57.5**	**$13,407**	**$268.13**	
Total Cost	:	$15,773	**Probable High Cost Parameter**		**40**	**$18,927**	**$378.54**	

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	1.0	8.00	16.00	L	$48.27	incl. in rate	incl. in rate	$772.32
Laborer	Active	8.00	1.0	8.00	64.00	L	$45.80	incl. in rate	incl. in rate	$2,931.20
Equipment Operator (medium)	Active	2.00	1.0	8.00	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Truck Driver (heavy)	Active	1.00	1.0	8.00	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Air Compressor 900 cfm	Active	1.00	1.0	8.00	8.00	E	$38.87	incl. in rate	incl. in rate	$310.95
Air Compressor 600 cfm	Active	1.00	1.0	8.00	8.00	E	$21.74	incl. in rate	incl. in rate	$173.91
Air Tool, Chipping Hammer	Active	4.00	1.0	8.00	32.00	E	$1.64	incl. in rate	incl. in rate	$52.45
Generator, Small Generator, 10 - 15 kW	Active	2.00	1.0	8.00	16.00	E	$7.04	incl. in rate	incl. in rate	$112.64
Hydraulic Excavator (2.5cy)	Active	2.00	1.0	8.00	16.00	E	$203.63	incl. in rate	incl. in rate	$3,258.08
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	1.0	8.00	8.00	E	$62.72	incl. in rate	incl. in rate	$501.76
Hydraulic Thumbs/Shear Attachment	Active	1.00	1.0	8.00	8.00	E	$16.39	incl. in rate	incl. in rate	$131.12
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8.00	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	**104**			**TOTAL LABOR**		**$5,224.72**
				Equipment Hours	**104**			**TOTAL EQUIPMENT**		**$5,434.03**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
	1.00	LS	1.000	1.00	$261.24	$261.24
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$261.24**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	1	EA	**Cost per Mob**	$2,500.00	$2,500.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$2,500.00**

SUMMARY OF COSTS

Labor Cost	$5,224.72	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$5,224.72
Material Cost	$261.24	Material Tax @	7.75%	$20.25		$281.48
Equipment Cost	$5,434.03	Equipment Tax @	7.75%	$421.14		$5,855.17
Subcontractors	$2,500.00					$2,500.00
DIRECT COST SUBTOTALS	**$13,420**			**$441**	**DIRECT COST SUBTOTALS**	**$13,861**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	5.0%				$11,361.37	$568.07
Installing Contractors Profit@	8.0%				$11,361.37	$908.91
GC Markup on Subs @	5.0%				$2,500.00	$125.00
					TOTAL MARKUP COSTS	**$1,601.98**
General Contractors Insurance @	1.0%		on		$15,463.35	$155
Bond @	1.0%		on		$15,463.35	$155
Contingency @	0.0%		on		$15,772.62	$0
					TOTAL COST for pay item	**$15,773**

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposable site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM COST DETAIL WORKSHEET

4.003 Remove Reinforced Concrete Ring Located D/S of Closure Gate and U/S for Flap Gate

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.003		**Project**	:	Iron Gate			
Description	:	Remove Reinforced Concrete Ring Located D/S of Closure Gate and U/S for Flap Gate							
Quantity	:	46.00	CY						
Daily Production	:	9.25	CY per 8 hour shift	**Project #**	:	4			
Work Days	:	5.0	Days	**Estimator**	:	Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$1,012.49	per CY	**Probable Low Cost Parameter**			**10.6375**	**$39,589**	**$860.62**
Total Cost	:	$46,575		**Probable High Cost Parameter**			**6.9375**	**$58,218**	**$1,265.62**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	5.0	8	40.00	L	$48.27	incl. in rate	incl. in rate	$1,930.80
Laborer	Active	4.00	5.0	8	160.00	L	$45.80	incl. in rate	incl. in rate	$7,328.00
Equipment Operator (medium)	Active	1.00	5.0	8	40.00	L	$66.28	incl. in rate	incl. in rate	$2,651.20
Truck Driver (heavy)	Active	1.00	5.0	8	40.00	L	$57.59	incl. in rate	incl. in rate	$2,303.60
Equipment Operator (crane)	Active	1.00	5.0	***8***	40.00	L	$68.41	incl. in rate	incl. in rate	$2,736.40
Air Tool, Chipping Hammer	Active	4.00	5.0	***8***	160.00	E	$1.64	incl. in rate	incl. in rate	$262.25
Crawler Crane (130tn)	Active	1.00	5.0	***8***	40.00	E	$258.66	incl. in rate	incl. in rate	$10,346.40
Air Compressor 600 cfm	Active	2.00	5.0	***8***	80.00	E	$21.74	incl. in rate	incl. in rate	$1,739.11
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	5.0	***8***	40.00	E	$111.64	incl. in rate	incl. in rate	$4,465.60
Loader, FE Rubber Tire (5.25cy)	Active	1.00	5.0	***8***	40.00	E	$75.42	incl. in rate	incl. in rate	$3,016.80
0	Active	4.00	5.0	8	160.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	2.00	5.0	8	80.00	0	$0.00	incl. in rate	incl. in rate	$0.00
Crane Bucket (Loading DEMO Material)	Active	1.00	5.0	***8***	40.00	E	$6.15	incl. in rate	incl. in rate	$246.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
				Labor Hours	**320**			**TOTAL LABOR**		**$16,950.00**
				Equipment Hours	**400**			**TOTAL EQUIPMENT**		**$20,076.16**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (10% labor)	1.00	LS	1.000	1.00	$1,695.00	$1,695.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$1,695.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA	**Cost per Mob**	$2,500.00	$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$16,950.00	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$16,950.00
Material Cost	$1,695.00	Material Tax @	7.75%	$131.36		$1,826.36
Equipment Cost	$20,076.16	Equipment Tax @	7.75%	$1,555.90		$21,632.06
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$38,721**			**$1,687**	**DIRECT COST SUBTOTALS**	**$40,408**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	5.0%				$40,408.42	$2,020.42
Installing Contractors Profit@	8.0%				$40,408.42	$3,232.67
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$5,253.10**
General Contractors Insurance @	1.0%		on		$45,661.52	$457
Bond @	1.0%		on		$45,661.52	$457
Contingency @	0.0%		on		$46,574.75	$0
					TOTAL COST for pay item	**$46,575**

Additional Pay Item Notes :

This work will conducted in dry using chipping hammers, Demolished material will be loaded in crane bucket and loaded into trucks. Material will have to be moved down diversion tunnel. This operation will take a week due to the location of the collar and tghe limited space to move materials

PAY ITEM COST DETAIL WORKSHEET

4.004 Remove Reinforced Concrete Stoplog Structure

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.004		**Project**	: Iron Gate				
Description	:	Remove Reinforced Concrete Stoplog Structure							
Quantity	:	6.00	CY						
Daily Production	:	6.00	CY per 8 hour shift	**Project #**	: 4				
Work Days	:	1.0	Days	**Estimator**	: Eric Jones		**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$1,738.55	per CY	**Probable Low Cost Parameter**			**6.6**	**$9,388**	**$1,564.69**
Total Cost	:	$10,431		**Probable High Cost Parameter**			**5.1**	**$11,996**	**$1,999.33**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	incl. in rate	incl. in rate	$386.16
Laborer	Active	3.00	1.0	8	24.00	L	$45.80	incl. in rate	incl. in rate	$1,099.20
Equipment Operator (medium)	Active	2.00	1.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Hydraulic Excavator (5.0cy)	Active	2.00	1.0	8	16.00	E	$274.63	incl. in rate	incl. in rate	$4,394.08
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	1.0	8	8.00	E	$62.72	incl. in rate	incl. in rate	$501.76
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	1.0	8	8.00	E	$70.35	incl. in rate	incl. in rate	$562.80
0	Active	1.00	1.0	8	8.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	1.0	8	8.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	4.00	1.0	8	32.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	4.00	1.0	8	32.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	2.00	1.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00

Labor Hours	**56**	**TOTAL LABOR**	**$3,006.56**
Equipment Hours	**32**	**TOTAL EQUIPMENT**	**$5,458.64**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$150.33	$150.33
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00

TOTAL MATERIAL	**$150.33**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA	**Cost per Mob**	$2,500.00	$0.00
					$0.00
					$0.00
					$0.00

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$3,006.56	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$3,006.56
Material Cost	$150.33	Material Tax @	7.75%	$11.65		$161.98
Equipment Cost	$5,458.64	Equipment Tax @	7.75%	$423.04		$5,881.68
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$8,616**			**$435**	**DIRECT COST SUBTOTALS**	**$9,050**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	5.0%				$9,050.22	$452.51
Installing Contractors Profit@	8.0%				$9,050.22	$724.02
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,176.53**
General Contractors Insurance @	1.0%		on		$10,226.75	$102
Bond @	1.0%		on		$10,226.75	$102
Contingency @	0.0%		on		$10,431.29	$0
					TOTAL COST for pay item	**$10,431**

Additional Pay Item Notes :

This work will be done using 2 excavators, 1 with a breaker and 1 with a bucket for loading the demolished material. The material will be loaded in 1 12CY dump truck and sent to dump site. Laborers will be used to flag and direct equipment and trucks. Foreman will be running the operation.

PAY ITEM COST DETAIL WORKSHEET

4.005 Remove Water from behind Tailrace Cofferdam

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.005			**Project**	:	Iron Gate			
Description	:	Remove Water from behind Tailrace Cofferdam								
Quantity	:	300,000.00	GAL							
Daily Production	:	153,120.00	GAL per	8 hour shift	**Project #**	:	4			
Work Days	:	2.0	Days		**Estimator**	:	Eric Jones	**GAL per**	**Total Cost**	**Unit Price Per GAL**
Unit Price	:	$0.01	per GAL		**Probable Low Cost Parameter**			**176088**	**$2,662**	**$0.01**
Total Cost	:	$3,132			**Probable High Cost Parameter**			**130152**	**$3,602**	**$0.01**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	2.0	8	16.00	L	$48.27	incl. in rate	incl. in rate	$772.32
Laborer	Active	2.00	2.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
Truck, Pickup (4x4, 3/4tn)	Active	1.00	2.0	8	16.00	E	$16.94	incl. in rate	incl. in rate	$271.04
Pump, Submersible Trash Pump, 3" & 4"	Active	1.00	2.0	8	16.00	E	$3.87	incl. in rate	incl. in rate	$61.92
0	Active	1.00	1.0	8	8.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	2.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	2.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	2.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	2.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	4.00	2.0	8	64.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	4.00	2.0	8	64.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	2.00	2.0	8	32.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
				Labor Hours	**48**			**TOTAL LABOR**		**$2,237.92**
				Equipment Hours	**32**			**TOTAL EQUIPMENT**		**$332.96**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$111.90	$111.90
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$111.90**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA	**Cost per Mob**	$2,500.00	$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,237.92	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$2,237.92
Material Cost	$111.90	Material Tax @	7.75%	$8.67		$120.57
Equipment Cost	$332.96	Equipment Tax @	7.75%	$25.80		$358.76
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$2,683**			**$34**	**DIRECT COST SUBTOTALS**	**$2,717**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	5.0%				$2,717.25	$135.86
Installing Contractors Profit@	8.0%				$2,717.25	$217.38
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$353.24**
General Contractors Insurance @	1.0%		on		$3,070.50	$31
Bond @	1.0%		on		$3,070.50	$31
Contingency @	0.0%		on		$3,131.91	$0
					TOTAL COST for pay item	**$3,132**

Additional Pay Item Notes :

Truck to drive pump to position laborers to place pump and run discharge hoses. The pump will take 2 shifts to dewater 300,000 gals of water and a crew will need to be there the whole time to adjust the pump as the water level changes.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.006			**Project**	: IRONGATE			
Description	:	Provide Dewatering behind Tailrace Cofferdam for removal of Powerhouse in the dry							
Quantity	:	3,000,000.00	GAL						
Daily Production	:	96,000.00	GAL per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	31.3	Days		**Estimator**	: Mihaela Tomulescu	**GAL per**	**Total Cost**	**Unit Price Per GAL**
Unit Price	:	$0.01	per GAL		**Probable Low Cost Parameter**		**110400**	**$25,044**	**$0**
Total Cost	:	$29,463			**Probable High Cost Parameter**		**81600**	**$33,882**	**$0**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Pump, Centrifugal, 3"	Active	1.00	31.3	8	250.40	E	$2.76	incl. in rate	incl. in rate	$690.02
Electrician	Active	1.00	31.3	8	250.40	L	$45.23	incl. in rate	incl. in rate	$11,325.59
Laborer	Active	1.00	31.3	8	250.40	L	$45.80	incl. in rate	incl. in rate	$11,468.32

Labor Hours	**500.8**	**TOTAL LABOR**	**$22,793.91**
Equipment Hours	**250.4**	**TOTAL EQUIPMENT**	**$690.02**

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost

TOTAL MATERIAL **$0.00**

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS **$0.00**

Labor Cost	$22,793.91	Labor Burden @	49.7%	$0.00		$22,793.91
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$690.02	Equipment Tax @	0.0%	$0.00		$690.02
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$23,484**			**$0**	**DIRECT COST SUBTOTALS**	**$23,484**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$23,483.93		$3,522.59
Installing Contractors Profit@	8.0%				$23,483.93		$1,878.71
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$5,401.30**
General Contractors Insurance @	1.0%		on		$28,885.24		$289
Bond @	1.0%		on		$28,885.24		$289
Contingency @	0.0%		on		$29,462.94		$0
						TOTAL COST for pay item	**$29,463**

Additional Pay Item Notes :

Assumed 3 Mil gal of water to be pumped out. Dewatering, pumping 8 hours, attended 2 hrs per day, 3" diaphragm pump, includes 20 LF of suction hose and 100 LF of discharge hose. Assumed Maximum Flow 200 GPM

PAY ITEM COST DETAIL WORKSHEET — **4.007 Construct Embankment Cofferdam across Tailrace to remove Powerhouse**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.007			**Project**	:	Iron Gate			
Description	:	Construct Embankment Cofferdam across Tailrace to remove Powerhouse								
Quantity	:	1,650.00	cy							
Daily Production	:	250.00	cy per	8 hour shift	**Project #**	:	4			
Work Days	:	6.6	Days		**Estimator**	:	Michael Barba	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$112.09	per cy		**Probable Low Cost Parameter**			**275**	**$166,451**	**$100.88**
Total Cost	:	$184,946			**Probable High Cost Parameter**			**212.5**	**$212,687**	**$128.90**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (235hp)(CATD7)	Active	1.00	6.6	8	52.80	E	$165.11	incl. in rate	incl. in rate	$8,717.81
Truck, On-Highway Dump (6x4, 12cy)	Active	4.00	6.6	8	211.20	E	$70.35	incl. in rate	incl. in rate	$14,857.92
Hydraulic Excavator (5.0cy)	Active	1.00	***4.6***	8	36.80	E	$274.63	incl. in rate	incl. in rate	$10,106.38
Truck, Pickup (4x4, 3/4tn)	Active	1.00	6.6	8	52.80	E	$16.94	incl. in rate	incl. in rate	$894.43
Crawler Crane (130tn)	Active	1.00	***2.0***	8	16.00	E	$258.66	incl. in rate	incl. in rate	$4,138.56
Equipment Operator (medium)	Active	2.00	6.6	8	105.60	L	$66.28	incl. in rate	incl. in rate	$6,999.17
Labor Foreman (out)	Active	1.00	6.6	8	52.80	L	$46.27	incl. in rate	incl. in rate	$2,443.06
Truck Driver (heavy)	Active	4.00	6.6	8	211.20	L	$57.59	incl. in rate	incl. in rate	$12,163.01
Equipment Operator (crane)	Active	1.00	***2.0***	8	16.00	L	$68.41	incl. in rate	incl. in rate	$1,094.56
		1.00	6.6	8	52.80	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	6.6	8	52.80	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	6.6	8	52.80	0	$0.00	incl. in rate	incl. in rate	$0.00
			6.6	8	0.00					$0.00
			6.6	8	0.00					$0.00
			6.6	8	0.00					$0.00
			6.6	8	0.00					$0.00
			6.6	8	0.00					$0.00
				Labor Hours	**385.6**				**TOTAL LABOR**	**$22,699.79**
				Equipment Hours	**369.6**				**TOTAL EQUIPMENT**	**$38,715.10**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price		Material Cost
							$0.00
		cy	1.300	0.00	$25.00		$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
						TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Cofferdam Sheet Piling Drive and Extract	3,900	SF	**RSMs Data**	$24.93		$97,227.00
						$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$97,227.00**

SUMMARY OF COSTS

Labor Cost	$22,699.79	Labor Burden @	49.7%	$0.00			$22,699.79
Material Cost	$0.00	Material Tax @	7.75%	$0.00			$0.00
Equipment Cost	$38,715.10	Equipment Tax @	7.75%	$3,000.42			$41,715.52
Subcontractors	$97,227.00						$97,227.00
DIRECT COST SUBTOTALS	**$158,642**			**$3,000**		**DIRECT COST SUBTOTALS**	**$161,642**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$64,415.32		$9,662.30
Installing Contractors Profit@	8.0%				$64,415.32		$5,153.23
GC Markup on Subs @	5.0%				$97,227.00		$4,861.35
						TOTAL MARKUP COSTS	**$19,676.87**
General Contractors Insurance @	1.0%			on	$181,319.19		$1,813
Bond @	1.0%			on	$181,319.19		$1,813
Contingency @	0.0%			on	$184,945.57		$0
						TOTAL COST for pay item	**$184,946**

Additional Pay Item Notes :

Figuring 4 trucks hauling material for 7 days, which would be 8 loads per truck each day, Laborers will direct trucks and support equipement, Foreman with truck will oversee operation. Dozer will push material is support from excavator. Sheet piling will be installed due to high flow of the river. Backfill material from dam excavation will be used behide sheet pile. Sheetpile will be 25' long 8' to 10' will be driven into river bed.

PAY ITEM COST DETAIL WORKSHEET

4.01 Upstream Cofferdam to be Removed in the Wet

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.01			**Project**	: Iron Gate			
Description	:	Upstream Cofferdam to be Removed in the Wet							
Quantity	:	20,000.00	cy						
Daily Production	:	2,000.00	cy per	8 hour shift	**Project #**	: 4			
Work Days	:	10.0	Days		**Estimator**	: Michael Barba	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$14.70	per cy		**Probable Low Cost Parameter**		**2300**	**$249,910**	**$12.50**
Total Cost	:	$294,012			**Probable High Cost Parameter**		**1700**	**$338,114**	**$16.91**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	2.00	10.0	8	160.00	E	$274.63	incl. in rate	incl. in rate	$43,940.80
Truck, Off-Road, Articulated Rear, 20cy	Active	8.00	10.0	8	640.00	E	$111.64	incl. in rate	incl. in rate	$71,449.60
Dozer (235hp)(CATD7)	Active	2.00	10.0	8	160.00	E	$165.11	incl. in rate	incl. in rate	$26,417.60
Truck, Pickup (4x4, 3/4tn)	Active	1.00	10.0	8	80.00	E	$16.94	incl. in rate	incl. in rate	$1,355.20
Truck Driver (heavy)	Active	8.00	10.0	8	640.00	L	$57.59	incl. in rate	incl. in rate	$36,857.60
Labor Foreman (out)	Active	1.00	10.0	8	80.00	L	$46.27	incl. in rate	incl. in rate	$3,701.60
Laborer	Active	5.00	10.0	8	400.00	L	$45.80	incl. in rate	incl. in rate	$18,320.00
Equipment Operator (medium)	Active	4.00	10.0	8	320.00	L	$66.28	incl. in rate	incl. in rate	$21,209.60
0	Active	1.00	10.0	8	80.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	10.0	8	80.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	10.0	8	80.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	10.0	8	80.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
				Labor Hours	**1440**			**TOTAL LABOR**		**$80,088.80**
				Equipment Hours	**1040**			**TOTAL EQUIPMENT**		**$143,163.20**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price		Material Cost
							$0.00
			1.300	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
						TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
	-					$0.00
						$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$80,088.80	Labor Burden @	49.7%	$0.00		$80,088.80
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$143,163.20	Equipment Tax @	7.75%	$11,095.15		$154,258.35
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$223,252**			**$11,095**	**DIRECT COST SUBTOTALS**	**$234,347**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$234,347.15		$35,152.07
Installing Contractors Profit@	8.0%				$234,347.15		$18,747.77
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$53,899.84**
General Contractors Insurance @	1.0%		on		$288,246.99		$2,882
Bond @	1.0%		on		$288,246.99		$2,882
Contingency @	0.0%		on		$294,011.93		$0
						TOTAL COST for pay item	**$294,012**

Additional Pay Item Notes :

Figuring this cofferdam will be removed once reservoir is drawn down, which will allow access for equipment to remove the coffer dam in the wet using excavators and dozer equipment.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.011	**Project**	:	IRON GATE			
Description	:	Remove 9' dia. hinged blind flange						
Quantity	:	19,000.00 lbs						
Daily Production	:	2,000.00 lbs per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	9.5 Days	**Estimator**	:	Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$6.49 per lbs	**Probable Low Cost Parameter**			**2300**	**$104,866**	**$5.52**
Total Cost	:	$123,371	**Probable High Cost Parameter**			**1600**	**$148,046**	**$7.79**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	9.5	8	76.00	L	$48.27	incl. in rate	incl. in rate	$3,668.52
Steelworker	Active	4.00	9.5	8	304.00	L	$65.52	incl. in rate	incl. in rate	$19,918.08
Loader, FE Rubber Tire (8.6cy)	Active	2.00	9.5	8	152.00	E	$221.50	incl. in rate	incl. in rate	$33,668.00
Equipment Operator (medium)	Active	2.00	9.5	8	152.00	L	$66.28	incl. in rate	incl. in rate	$10,074.56
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	9.5	8	152.00	E	$31.90	incl. in rate	incl. in rate	$4,848.80
Truck Driver (heavy)	Active	2.00	9.5	8	152.00	L	$57.59	incl. in rate	incl. in rate	$8,753.68
Hydraulic Crane (17tn)	Active	1.00	9.5	8	76.00	E	$81.52	incl. in rate	incl. in rate	$6,195.52
Welder	Active	1.00	9.5	8	76.00	L	$7.84	incl. in rate	incl. in rate	$595.65
Gas Welding Machine	Active	1.00	9.5	8	76.00	E	$2.88	incl. in rate	incl. in rate	$218.65
Equipment Operator (crane)	Active	1.00	9.5	8	76.00	L	$68.41	incl. in rate	incl. in rate	$5,199.16

Labor Hours	**836**	**TOTAL LABOR**	**$48,209.65**
Equipment Hours	**456**	**TOTAL EQUIPMENT**	**$44,930.97**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$4,820.97	$4,820.97

TOTAL MATERIAL	**$4,820.97**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$48,209.65	Labor Burden @	49.7%	$0.00	$48,209.65
Material Cost	$4,820.97	Material Tax @	7.8%	$373.62	$5,194.59
Equipment Cost	$44,930.97	Equipment Tax @	0.0%	$0.00	$44,930.97
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$97,962**			**$374**	**DIRECT COST SUBTOTALS** **$98,335**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$98,335.21	$14,750.28
Installing Contractors Profit@	8.0%				$98,335.21	$7,866.82
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$22,617.10**
General Contractors Insurance @	1.0%		on		$120,952.31	$1,210
Bond @	1.0%		on		$120,952.31	$1,210
Contingency @	0.0%		on		$123,371.36	$0
					TOTAL COST for pay item	**$123,371**

Additional Pay Item Notes :

Turning of the actuating bolts and nuts - accomplished by steelworker / weder crew using only standard hand tools - spreads the yoke halves until they are fully separated, allowing the head to be swung open on its hinge. Contact surfaces of the clamping yokes, head and hub are tapered and when the head is closed and the yoke bolts are tightened, the head and hub are wedged together, compressing the 0-ring and effecting a leakproof seal. Removing flanges is cumbersome and time consuming because of the tunnel work and the rusted fasteners. There is need to tug or hammer at bulky flanges or to struggle with bulky lugs and threads. Using loader, crane to load the flange and associated metal work in the truck. Included 5' of pipe spool.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.012	**Project**	: Iron Gate				
Description	:	Remove 18" plug valve and 7' of 18" drainage pipe						
Quantity	:	2,620.00 LBS						
Daily Production	:	2,620.00 LBS per 8 hour shift	**Project #**	: 4				
Work Days	:	1.0 Days	**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**	
Unit Price	:	$2.70 per LBS	**Probable Low Cost Parameter**		**3013**	**$6,002**	**$2.29**	
Total Cost	:	$7,061	**Probable High Cost Parameter**		**2096**	**$8,473**	**$3.23**	

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Trencher	Active	2.00	1.0	8	16.00	E	$4.07	incl. in rate	incl. in rate	$65.12
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
Hydraulic Crane (17tn)	Active	1.00	1.0	8	8.00	E	$81.52	incl. in rate	incl. in rate	$652.16
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Hydraulic Excavator (1.5cy)	Active	1.00	1.0	8	8.00	E	$141.92	incl. in rate	incl. in rate	$1,135.36
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Steelworker	Active	2.00	1.0	8	16.00	L	$65.52	incl. in rate	incl. in rate	$1,048.32

Labor Hours	**40**	**TOTAL LABOR**	**$2,586.56**
Equipment Hours	**40**	**TOTAL EQUIPMENT**	**$2,745.76**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$274.58	$274.58
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$274.58**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,586.56	Labor Burden @	49.7%	$0.00		$2,586.56
Material Cost	$274.58	Material Tax @	7.8%	$21.28		$295.86
Equipment Cost	$2,745.76	Equipment Tax @	0.0%	$0.00		$2,745.76
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$5,607**			**$21**	**DIRECT COST SUBTOTALS**	**$5,628**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$5,628.18		$844.23
Installing Contractors Profit@	8.0%				$5,628.18		$450.25
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$1,294.48**
General Contractors Insurance @	1.0%		on		$6,922.66		$69
Bond @	1.0%		on		$6,922.66		$69
Contingency @	0.0%		on		$7,061.11		$0
						TOTAL COST for pay item	**$7,061**

Additional Pay Item Notes :

This is tunnel work. Assumed 7' ductile iron 18" pipe at 78.5LBS /LF= 550 LBS, weight of the valve assumed API 600 gate valve for 18" is 2070 LBS.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.013 (1)		**Project**	: IRON GATE			
Description	:	Furnish and Install 1-16.5'x18' roller gate, stem, and operator in Wet						
Quantity	:	110,000.00	LBS					
Daily Production	:	4,400.00	LBS per 8 hour shift	**Project #**	: 4			
Work Days	:	25.0	Days	**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$34.16	per LBS	**Probable Low Cost Parameter**		**4840**	**$3,381,793**	**$31**
Total Cost	:	$3,757,547		**Probable High Cost Parameter**		**3960**	**$4,133,302**	**$38**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Equipment Operator (crane)	Active	1.00	25.0	8	200.00	L	$68.41	incl. in rate	incl. in rate	$13,682.00
Barge Operator	Active	1.00	25.0	8	200.00	L	$40.30	incl. in rate	incl. in rate	$8,060.00
Diver, Tender	Active	3.00	25.0	8	600.00	L	$79.22	incl. in rate	incl. in rate	$47,532.00
Diver, Wet	Active	3.00	25.0	8	600.00	L	$124.57	incl. in rate	incl. in rate	$74,742.00
Loader, FE Rubber Tire (8.6cy)	Active	1.00	25.0	8	200.00	E	$221.50	incl. in rate	incl. in rate	$44,300.00
Crawler Crane (270tn)	Active	1.00	25.0	8	200.00	E	$399.50	incl. in rate	incl. in rate	$79,900.00
Equipment Operator (medium)	Active	3.00	25.0	8	600.00	L	$66.28	incl. in rate	incl. in rate	$39,768.00
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	25.0	8	400.00	E	$70.35	incl. in rate	incl. in rate	$28,140.00
Barge (400T)	Active	1.00	25.0	8	200.00	E	$99.50	incl. in rate	incl. in rate	$19,900.00
Ironworkers	Active	4.00	25.0	8	800.00	L	$63.95	incl. in rate	incl. in rate	$51,160.00
Labor Foreman	Active	1.00	25.0	8	200.00	L	$48.27	incl. in rate	incl. in rate	$9,654.00

Labor Hours	**3200**	**TOTAL LABOR**	**$244,598.00**
Equipment Hours	**1000**	**TOTAL EQUIPMENT**	**$172,240.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Furnish one-16.5'x18' roller gate (based on quote from JM Works)	1.00	LS	1.000	1.00	$2,331,511.00	$2,331,511.00
Welding structural steel in field, cost per welder, 8# per ton, 1/8" dia, type 6011, incl 1 operating engineer	55.00	ton	1.000	55.00	$18.85	$1,036.75
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$24,459.80	$24,459.80
Misc Mats Allowance 1.5% of Gate Material	1.00	LS	1.000	1.00	$34,972.67	$34,972.67
						$0.00
						$0.00
					TOTAL MATERIAL	**$2,391,980.22**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
	2.00	EA	1.000	2.00	$480.00	$960.00
						$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$960.00**

SUMMARY OF COSTS

Labor Cost	$244,598.00	Labor Burden @	49.7%	$0.00		$244,598.00
Material Cost	$2,391,980.22	Material Tax @	7.8%	$185,378.47		$2,577,358.68
Equipment Cost	$172,240.00	Equipment Tax @	0.0%	$0.00		$172,240.00
Subcontractors	$960.00					$960.00
DIRECT COST SUBTOTALS	**$2,809,778**			**$185,378**	**DIRECT COST SUBTOTALS**	**$2,995,157**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$2,994,196.68		$449,129.50
Installing Contractors Profit@	8.0%				$2,994,196.68		$239,535.73
GC Markup on Subs @	5.0%				$960.00		$48.00
						TOTAL MARKUP COSTS	**$688,713.24**
General Contractors Insurance @	1.0%		on		$3,683,869.92		$36,839
Bond @	1.0%		on		$3,683,869.92		$36,839
Contingency @	0.0%		on		$3,757,547.32		$0
						TOTAL COST for pay item	**$3,757,547**

Additional Pay Item Notes :

Based on RSMeans we used Crew L-5A for installation of the roller gate in 8 days. Added welding inspection tehnician for the installation of the gate. Price of the gate based on quote by Johnson Machine Works Inc.Amounts based on similar projects from the past and an actual design was not done. JMW also assumes that existing frames will be reused.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.013 (2)		**Project**	: IRON GATE			
Description	:	Remove Existing sluice and diversion gates from shaft by divers						
Quantity	:	110,000.00 LBS						
Daily Production	:	6,000.00 LBS per	8 hour shift	**Project #**	: 4			
Work Days	:	18.3 Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$4.38 per LBS		**Probable Low Cost Parameter**		**6600**	**$434,095**	**$4**
Total Cost	:	$482,328		**Probable High Cost Parameter**		**5400**	**$530,561**	**$5**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (80tn)	Active	2.00	18.3	8	292.80	E	$190.46	incl. in rate	incl. in rate	$55,766.69
Barge Operator	Active	1.00	18.3	8	146.40	L	$40.30	incl. in rate	incl. in rate	$5,899.92
Diver, Tender	Active	2.00	18.3	8	292.80	L	$79.22	incl. in rate	incl. in rate	$23,195.62
Diver, Wet	Active	2.00	18.3	8	292.80	L	$124.57	incl. in rate	incl. in rate	$36,474.10
Loader, FE Rubber Tire (8.6cy)	Active	1.00	18.3	8	146.40	E	$221.50	incl. in rate	incl. in rate	$32,427.60
Crawler Crane (270tn)	Active	2.00	18.3	8	292.80	E	$399.50	incl. in rate	incl. in rate	$116,973.60
Equipment Operator (light)	Active	2.00	18.3	8	292.80	L	$64.90	incl. in rate	incl. in rate	$19,002.72
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	18.3	8	292.80	E	$70.35	incl. in rate	incl. in rate	$20,598.48
Barge (400T)	Active	1.00	18.3	8	146.40	E	$99.50	incl. in rate	incl. in rate	$14,566.80
Ironworkers	Active	4.00	18.3	8	585.60	L	$63.95	incl. in rate	incl. in rate	$37,449.12
Labor Foreman	Active	1.00	18.3	8	146.40	L	$48.27	incl. in rate	incl. in rate	$7,066.73

Labor Hours	**1756.8**	**TOTAL LABOR**	**$129,088.20**
Equipment Hours	**1171.2**	**TOTAL EQUIPMENT**	**$240,333.17**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Welding structural steel in field, cost per welder, 8# per ton, 1/8" dia, type 6011, incl 1 operating engineer	55.00	ton	1.000	55.00	$18.85	$1,036.75
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$12,908.82	$12,908.82
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$13,945.57**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$129,088.20	Labor Burden @	49.7%	$0.00		$129,088.20
Material Cost	$13,945.57	Material Tax @	7.8%	$1,080.78		$15,026.35
Equipment Cost	$240,333.17	Equipment Tax @	0.0%	$0.00		$240,333.17
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$383,367**			**$1,081**	**DIRECT COST SUBTOTALS**	**$384,448**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$384,447.72		$57,667.16
Installing Contractors Profit@	8.0%				$384,447.72		$30,755.82
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$88,422.98**
General Contractors Insurance @	1.0%		on		$472,870.70		$4,729
Bond @	1.0%		on		$472,870.70		$4,729
Contingency @	0.0%		on		$482,328.11		$0
						TOTAL COST for pay item	**$482,328**

Additional Pay Item Notes :

Remove sluice and diversion gates from shaft by divers, based on RSMeans we used a crew of 4 divers for demolition in 10 days. Hauling to disposable site - based on the current production rate, only 1 trips a day would be necessary. Demolition is done using one crawler crane, a welding machine and barge.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.013 (3)			**Project**	: IRON GATE			
Description	:	Remove 16.5'X 18' sluice and diversion gates from shaft in Dry							
Quantity	:	110,000.00	LBS						
Daily Production	:	12,000.00	LBS per	8 hour shift	**Project #**	: 4			
Work Days	:	9.2	Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.58	per LBS		**Probable Low Cost Parameter**		**13200**	**$57,794**	**$1**
Total Cost	:	$64,216			**Probable High Cost Parameter**		**10800**	**$70,637**	**$1**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Crawler Crane (130tn)	Active	1.00	9.2	8	73.60	E	$258.66	incl. in rate	incl. in rate	$19,037.38
Ironworkers	Active	4.00	9.2	8	294.40	L	$63.95	incl. in rate	incl. in rate	$18,826.88
Labor Foreman (out)	Active	1.00	9.2	8	73.60	L	$46.27	incl. in rate	incl. in rate	$3,405.47
Equipment Operator (crane)	Active	1.00	9.2	8	73.60	L	$68.41	incl. in rate	incl. in rate	$5,034.98
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	incl. in rate	incl. in rate	$255.20

Labor Hours	**449.6**	**TOTAL LABOR**	**$27,728.05**
Equipment Hours	**89.6**	**TOTAL EQUIPMENT**	**$21,064.58**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Welding structural steel in field, cost per welder, 8# per ton, 1/8" dia, type 6011, incl 1 operating engineer	6.00	ton	1.000	6.00	$18.85	$113.10
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$2,106.46	$2,106.46

TOTAL MATERIAL	**$2,219.56**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$27,728.05	Labor Burden @	49.7%	$0.00	$27,728.05
Material Cost	$2,219.56	Material Tax @	7.8%	$172.02	$2,391.57
Equipment Cost	$21,064.58	Equipment Tax @	0.0%	$0.00	$21,064.58
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$51,012**			**$172**	**DIRECT COST SUBTOTALS** **$51,184**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$51,184.20	$7,677.63
Installing Contractors Profit@	8.0%				$51,184.20	$4,094.74
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$11,772.37**
General Contractors Insurance @	1.0%		on		$62,956.56	$630
Bond @	1.0%		on		$62,956.56	$630
Contingency @	0.0%		on		$64,215.69	$0
					TOTAL COST for pay item	**$64,216**

Additional Pay Item Notes :

Based on RSMeans we used Crew L-5A for installation of the roller gate in 8 days. Added welding inspection tehnician for the installation of the gate. Price of the gate based on quote by Johnson Machine Works Inc.Amounts based on similar projects from the past and an actual design was not done. JMW also assumes that existing frames will be reused.

PAY ITEM COST DETAIL WORKSHEET — **4.014 Remove Concrete in Observation Platform, Crest Wall and Wall Extension**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.014	**Project**	:	Iron Gate			
Description	:	Remove Concrete in Observation Platform, Crest Wall and Wall Extension						
Quantity	:	780.00 cy						
Daily Production	:	50.00 cy per 8 hour shift	**Project #**	:	4			
Work Days	:	15.6 Days	**Estimator**	:	Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$298.81 per cy	**Probable Low Cost Parameter**			**55**	**$209,765**	**$268.93**
Total Cost	:	$233,072	**Probable High Cost Parameter**			**45**	**$256,379**	**$328.69**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	15.6	8	249.60	L	$48.27	incl. in rate	incl. in rate	$12,048.19
Laborer	Active	8.00	15.6	8	998.40	L	$45.80	incl. in rate	incl. in rate	$45,726.72
Equipment Operator (medium)	Active	2.00	15.6	8	249.60	L	$66.28	incl. in rate	incl. in rate	$16,543.49
Truck Driver (heavy)	Active	1.00	15.6	8	124.80	L	$57.59	incl. in rate	incl. in rate	$7,187.23
Air Compressor 900 cfm	Active	1.00	15.6	8	124.80	E	$38.87	incl. in rate	incl. in rate	$4,850.84
Air Compressor 600 cfm	Active	1.00	15.6	8	124.80	E	$21.74	incl. in rate	incl. in rate	$2,713.02
Air Tool, Chipping Hammer	Active	4.00	15.6	8	499.20	E	$1.64	incl. in rate	incl. in rate	$818.21
Generator, Small Generator, 10 - 15 kW	Active	2.00	15.6	8	249.60	E	$7.04	incl. in rate	incl. in rate	$1,757.18
Hydraulic Excavator (2.5cy)	Active	2.00	15.6	8	249.60	E	$203.63	incl. in rate	incl. in rate	$50,826.05
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	15.6	8	124.80	E	$62.72	incl. in rate	incl. in rate	$7,827.46
Hydraulic Thumbs/Shear Attachment	Active	1.00	15.6	8	124.80	E	$16.39	incl. in rate	incl. in rate	$2,045.47
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	15.6	8	124.80	E	$111.64	incl. in rate	incl. in rate	$13,932.67
			15.6	8	0.00					$0.00
			15.6	8	0.00					$0.00
			15.6	8	0.00					$0.00
			15.6	8	0.00					$0.00
			15.6	8	0.00					$0.00
				Labor Hours	**1,622**			**TOTAL LABOR**		**$81,505.63**
				Equipment Hours	**1,622**			**TOTAL EQUIPMENT**		**$84,770.90**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$4,075.28	$4,075.28
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$4,075.28**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	4	EA	**Cost per Mob**	$2,500.00	$10,000.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$10,000.00**

SUMMARY OF COSTS

Labor Cost	$81,505.63	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$81,505.63
Material Cost	$4,075.28	Material Tax @	7.75%	$315.83		$4,391.12
Equipment Cost	$84,770.90	Equipment Tax @	7.75%	$6,569.74		$91,340.64
Subcontractors	$10,000.00					$10,000.00
DIRECT COST SUBTOTALS	**$180,352**			**$6,886**	**DIRECT COST SUBTOTALS**	**$187,237**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$177,237.39	$26,585.61
Installing Contractors Profit@	8.0%				$177,237.39	$14,178.99
GC Markup on Subs @	5.0%				$10,000.00	$500.00
					TOTAL MARKUP COSTS	**$41,264.60**
General Contractors Insurance @	1.0%		on		$228,501.99	$2,285
Bond @	1.0%		on		$228,501.99	$2,285
Contingency @	0.0%		on		$233,072.03	$0
					TOTAL COST for pay item	**$233,072**

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposal site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM COST DETAIL WORKSHEET

4.015 Remove Concrete in Diversion Tunnel Intake Structure

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.015	**Project**	: Iron Gate				
Description	:	Remove Concrete in Diversion Tunnel Intake Structure						
Quantity	:	715.00 cy						
Daily Production	:	50.00 cy per 8 hour shift	**Project #**	: 4				
Work Days	:	14.3 Days	**Estimator**	: Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**	
Unit Price	:	$300.06 per cy	**Probable Low Cost Parameter**		**55**	**$193,088**	**$270.05**	
Total Cost	:	$214,542	**Probable High Cost Parameter**		**42.5**	**$246,723**	**$345.07**	

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	14.3	8	228.80	L	$48.27	incl. in rate	incl. in rate	$11,044.18
Laborer	Active	8.00	14.3	8	915.20	L	$45.80	incl. in rate	incl. in rate	$41,916.16
Equipment Operator (medium)	Active	2.00	14.3	8	228.80	L	$66.28	incl. in rate	incl. in rate	$15,164.86
Truck Driver (heavy)	Active	1.00	14.3	8	114.40	L	$57.59	incl. in rate	incl. in rate	$6,588.30
Air Compressor 900 cfm	Active	1.00	14.3	8	114.40	E	$38.87	incl. in rate	incl. in rate	$4,446.60
Air Compressor 600 cfm	Active	1.00	14.3	8	114.40	E	$21.74	incl. in rate	incl. in rate	$2,486.93
Air Tool, Chipping Hammer	Active	4.00	14.3	8	457.60	E	$1.64	incl. in rate	incl. in rate	$750.02
Generator, Small Generator, 10 - 15 kW	Active	2.00	14.3	8	228.80	E	$7.04	incl. in rate	incl. in rate	$1,610.75
Hydraulic Excavator (2.5cy)	Active	2.00	14.3	8	228.80	E	$203.63	incl. in rate	incl. in rate	$46,590.54
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	14.3	8	114.40	E	$62.72	incl. in rate	incl. in rate	$7,175.17
Hydraulic Thumbs/Shear Attachment	Active	1.00	14.3	8	114.40	E	$16.39	incl. in rate	incl. in rate	$1,875.02
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	14.3	8	114.40	E	$111.64	incl. in rate	incl. in rate	$12,771.62
			14.3	8	0.00					$0.00
			14.3	8	0.00					$0.00
			14.3	8	0.00					$0.00
			14.3	8	0.00					$0.00
			14.3	8	0.00					$0.00
				Labor Hours	**1,487**			**TOTAL LABOR**		**$74,713.50**
				Equipment Hours	**1,487**			**TOTAL EQUIPMENT**		**$77,706.66**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$3,735.67	$3,735.67
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$3,735.67**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	4	EA	**Cost per Mob**	$2,500.00	$10,000.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$10,000.00**

SUMMARY OF COSTS

Labor Cost	$74,713.50	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$74,713.50
Material Cost	$3,735.67	Material Tax @	7.75%	$289.51		$4,025.19
Equipment Cost	$77,706.66	Equipment Tax @	7.75%	$6,022.27		$83,728.92
Subcontractors	$10,000.00					$10,000.00
DIRECT COST SUBTOTALS	**$166,156**			**$6,312**	**DIRECT COST SUBTOTALS**	**$172,468**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$162,467.61	$24,370.14
Installing Contractors Profit@	8.0%				$162,467.61	$12,997.41
GC Markup on Subs @	5.0%				$10,000.00	$500.00
					TOTAL MARKUP COSTS	**$37,867.55**
General Contractors Insurance @	1.0%		on		$210,335.16	$2,103
Bond @	1.0%		on		$210,335.16	$2,103
Contingency @	0.0%		on		$214,541.86	$0
					TOTAL COST for pay item	**$214,542**

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposal site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.016			Project	: IRONGATE			
Description	:	Remove Concrete in Diversion Tunnel Gate Tower							
Quantity	:	650.00	CY						
Daily Production	:	75.00	CY per	8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	8.7	Days		Estimator	: Mihaela Tomulescu	CY per	Total Cost	Unit Price Per CY
Unit Price	:	$196.63	per CY		Probable Low Cost Parameter		86.25	$108,637	$167
Total Cost	:	$127,809			Probable High Cost Parameter		63.75	$146,980	$226

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	8.7	8	69.60	L	$46.27	incl. in rate	incl. in rate	$3,220.39
Equipment Operator (medium)	Active	3.00	8.7	8	208.80	L	$66.28	incl. in rate	incl. in rate	$13,839.26
Steelworker	Active	3.00	8.7	8	208.80	L	$65.52	incl. in rate	incl. in rate	$13,680.58
Electrician	Active	1.00	8.7	8	69.60	L	$45.23	incl. in rate	incl. in rate	$3,148.01
Truck Driver (heavy)	Active	2.00	8.7	8	139.20	L	$57.59	incl. in rate	incl. in rate	$8,016.53
Vibratory Hammer & Extractor	Active	1.00	8.7	8	69.60	E	$94.34	incl. in rate	incl. in rate	$6,566.06
Hydraulic Excavator (6.0cy)	Active	1.00	8.7	8	69.60	E	$322.48	incl. in rate	incl. in rate	$22,444.61
Loader, FE Rubber Tire (8.6cy)	Active	1.00	8.7	8	69.60	E	$221.50	incl. in rate	incl. in rate	$15,416.40
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	8.7	8	139.20	E	$111.64	incl. in rate	incl. in rate	$15,540.29

Labor Hours	696	TOTAL LABOR	$41,904.77
Equipment Hours	348	TOTAL EQUIPMENT	$59,967.36

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$41,904.77	Labor Burden @	49.7%	$0.00	$41,904.77
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$59,967.36	Equipment Tax @	0.0%	$0.00	$59,967.36
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$101,872			$0	DIRECT COST SUBTOTALS $101,872

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$101,872.13	$15,280.82
Installing Contractors Profit@	8.0%				$101,872.13	$8,149.77
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$23,430.59
General Contractors Insurance @	1.0%		on		$125,302.72	$1,253
Bond @	1.0%		on		$125,302.72	$1,253
Contingency @	0.0%		on		$127,808.77	$0
					TOTAL COST for pay item	$127,809

Additional Pay Item Notes :

Based on RS.Means - Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9 and B34B - Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.017			**Project**	: IRONGATE			
Description	: Remove Steel Footbridge to Gate Tower							
Quantity	: 13,000.00 LBS							
Daily Production	: 10,000.00 LBS per	8 hour shift		**Project #**	: Klamath Dams Removal			
Work Days	: 1.3 Days			**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	: $1.10 per LBS			**Probable Low Cost Parameter**		**11500**	**$12,120**	**$0.93**
Total Cost	: $14,259			**Probable High Cost Parameter**		**8500**	**$16,398**	**$1.26**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.3	8	10.40	L	$46.27	incl. in rate	incl. in rate	$481.21
Electrician	Active	1.00	1.3	8	10.40	L	$45.23	incl. in rate	incl. in rate	$470.39
Hydraulic Crane (50tn)	Active	1.00	1.3	8	10.40	E	$134.32	incl. in rate	incl. in rate	$1,396.93
Equipment Operator (crane)	Active	1.00	1.3	8	10.40	L	$68.41	incl. in rate	incl. in rate	$711.46
Vibratory Hammer & Extractor	Active	1.00	1.3	8	10.40	E	$94.34	incl. in rate	incl. in rate	$981.14
Laborer	Active	2.00	1.3	8	20.80	L	$45.80	incl. in rate	incl. in rate	$952.64
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	1.3	8	20.80	E	$111.64	incl. in rate	incl. in rate	$2,322.11
Truck Driver (heavy)	Active	2.00	1.3	8	20.80	L	$57.59	incl. in rate	incl. in rate	$1,197.87
Equipment Operator (light)	Active	1.00	1.3	8	10.40	L	$64.90	incl. in rate	incl. in rate	$674.96
Steelworker	Active	2.00	1.3	8	20.80	L	$65.52	incl. in rate	incl. in rate	$1,362.82

Labor Hours	**104**	**TOTAL LABOR**	**$5,851.35**
Equipment Hours	**41.6**	**TOTAL EQUIPMENT**	**$4,700.18**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$292.57	$292.57
					TOTAL MATERIAL	**$292.57**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent aerial lift, articulating boom, to 80' high, 500 lb. capacity, diesel - Rent per day (RS Means 01543340)	1.00	days	1.000	1.00 $584.00	$584.00
				TOTAL SUBCONTRACTS	**$584.00**

SUMMARY OF COSTS

Labor Cost	$5,851.35	Labor Burden @	49.7%	$0.00		$5,851.35
Material Cost	$292.57	Material Tax @	7.8%	$22.67		$315.24
Equipment Cost	$4,700.18	Equipment Tax @	0.0%	$0.00		$4,700.18
Subcontractors	$584.00					$584.00
DIRECT COST SUBTOTALS	**$11,428**			**$23**	**DIRECT COST SUBTOTALS**	**$11,451**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$10,866.77		$1,630.02
Installing Contractors Profit@	8.0%				$10,866.77		$869.34
GC Markup on Subs @	5.0%				$584.00		$29.20
						TOTAL MARKUP COSTS	**$2,528.56**
General Contractors Insurance @	1.0%		on		$13,979.33		$140
Bond @	1.0%		on		$13,979.33		$140
Contingency @	0.0%		on		$14,258.91		$0
						TOTAL COST for pay item	**$14,259**

Additional Pay Item Notes :

The bridge steel grid, excess steel members and similar materials shall be removed from each span prior to removing the main supporting beams, girders or trusses over land. Assumed crew is formed of 1 Forman, 1 Electrician (tempoary power for tools), 2 steelworkers to cut steel in the articulated boom and 2 Laborers (Load, Haul, help with the crane rops, etc).

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.018		**Project**	:	IRONGATE			
Description	:	Remove Concrete in Diversion Tunnel Footbridge Abutment							
Quantity	:	39.00	CY						
Daily Production	:	50.00	CY per	8	hour shift	**Project #**	: Klamath Dams Removal		
Work Days	:	0.8	Days			**Estimator**	: Mihaela Tomulescu	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$197.94	per CY			**Probable Low Cost Parameter**		**57.5**	**$6,562**	**$168**
Total Cost	:	$7,720				**Probable High Cost Parameter**		**42.5**	**$8,878**	**$228**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	0.8	8	6.40	L	$46.27	incl. in rate	incl. in rate	$296.13
Equipment Operator (medium)	Active	2.00	0.8	8	12.80	L	$66.28	incl. in rate	incl. in rate	$848.38
Steelworker	Active	3.00	0.8	8	19.20	L	$65.52	incl. in rate	incl. in rate	$1,257.98
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.8	8	6.40	E	$111.64	incl. in rate	incl. in rate	$714.50
Truck Driver (heavy)	Active	1.00	0.8	8	6.40	L	$57.59	incl. in rate	incl. in rate	$368.58
Vibratory Hammer & Extractor	Active	1.00	0.8	8	6.40	E	$94.34	incl. in rate	incl. in rate	$603.78
Hydraulic Excavator (6.0cy)	Active	1.00	0.8	8	6.40	E	$322.48	incl. in rate	incl. in rate	$2,063.87

Labor Hours	**44.8**	**TOTAL LABOR**	**$2,771.07**
Equipment Hours	**19.2**	**TOTAL EQUIPMENT**	**$3,382.14**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,771.07	Labor Burden @	49.7%	$0.00		$2,771.07
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$3,382.14	Equipment Tax @	0.0%	$0.00		$3,382.14
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$6,153**			**$0**	**DIRECT COST SUBTOTALS**	**$6,153**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$6,153.22	$922.98
Installing Contractors Profit@	8.0%				$6,153.22	$492.26
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,415.24**
General Contractors Insurance @	1.0%		on		$7,568.46	$76
Bond @	1.0%		on		$7,568.46	$76
Contingency @	0.0%		on		$7,719.82	$0
					TOTAL COST for pay item	**$7,720**

Additional Pay Item Notes :

Based on RS.Means - Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9 and B34B - Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.019	**Project**	: IRONGATE				
Description	:	Place Concrete Plugs for Diversion Tunnel						
Quantity	:	43.00 CY						
Daily Production	:	15.00 CY per 8 hour shift	**Project #**	: Klamath Dams Removal				
Work Days	:	2.9 Days	**Estimator**	: Mihaela Tomulescu		**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$1,672.11 per CY	**Probable Low Cost Parameter**			**16.5**	**$64,711**	**$1,505**
Total Cost	:	$71,901	**Probable High Cost Parameter**			**13.5**	**$79,091**	**$1,839**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Carpenter Foreman (out)	Active	1.00	2.9	8	23.20	L	$46.40	incl. in rate	incl. in rate	$1,076.48
Equipment Operator (medium)	Active	1.00	2.9	8	23.20	L	$66.28	incl. in rate	incl. in rate	$1,537.70
Carpenters	Active	18.00	2.9	8	417.60	L	$72.60	incl. in rate	incl. in rate	$30,317.76
Electrician	Active	1.00	2.9	8	23.20	L	$45.23	incl. in rate	incl. in rate	$1,049.34
Laborer	Active	2.00	2.9	8	46.40	L	$45.80	incl. in rate	incl. in rate	$2,125.12
Ironworkers	Active	2.00	2.9	8	46.40	L	$63.95	incl. in rate	incl. in rate	$2,967.28
Equipment Operator (crane)	Active	1.00	2.9	8	23.20	L	$68.41	incl. in rate	incl. in rate	$1,587.11
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.9	8	23.20	E	$221.50	incl. in rate	incl. in rate	$5,138.80
Hydraulic Crane (17tn)	Active	1.00	2.9	8	23.20	E	$81.52	incl. in rate	incl. in rate	$1,891.26

Labor Hours	**603.2**	**TOTAL LABOR**	**$40,660.78**
Equipment Hours	**46.4**	**TOTAL EQUIPMENT**	**$7,030.06**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Structural concrete, ready mix, heavyweight, 4500 psi, includes local aggregate, sand, Portland cement (Type I) and water, delivered, excludes all additives and treatments	43.00	CY	1.000	43.00	$128.00	$5,504.00
C.I.P. concrete forms, wall, job built, plywood, over 16' high, 1 use, includes erecting, bracing, stripping and cleaning	232.50	sfca	1.000	232.50	$2.69	$625.43
C.I.P. concrete forms, wall, radial, curved, below grade, job built plywood, over 8' to 16' high, 2 ' chords, 1 use, includes erecting, bracing, stripping and cleaning	1,024.00	sfca	1.000	1,024.00	$0.94	$962.56
Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	1.00	ton	1.000	1.00	$940.00	$1,835.00
					TOTAL MATERIAL	**$8,926.99**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$40,660.78	Labor Burden @	49.7%	$0.00		$40,660.78
Material Cost	$8,926.99	Material Tax @	7.8%	$691.84		$9,618.83
Equipment Cost	$7,030.06	Equipment Tax @	0.0%	$0.00		$7,030.06
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$56,618**			**$692**	**DIRECT COST SUBTOTALS**	**$57,310**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$57,309.67		$8,596.45
Installing Contractors Profit@	8.0%				$57,309.67		$4,584.77
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$13,181.23**
General Contractors Insurance @	1.0%		on		$70,490.90		$705
Bond @	1.0%		on		$70,490.90		$705
Contingency @	0.0%		on		$71,900.72		$0
						TOTAL COST for pay item	**$71,901**

Additional Pay Item Notes :

Plugs for openings 15.5' x 16.5' curved formes and 15.5' x 7.5' rectangulare formes is based on RS.Means - Crew C2, Crew RODM4, Crew C7.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.020		Project	: IRONGATE			
Description	:	Remove Concrete Closure Gates in Gate Tower						
Quantity	:	85.00 CY						
Daily Production	:	6.00 CY per	8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	14.2 Days		Estimator	: Mihaela Tomulescu	CY per	Total Cost	Unit Price Per CY
Unit Price	:	$894.09 per CY		Probable Low Cost Parameter		6.9	$64,598	$760
Total Cost	:	$75,998		Probable High Cost Parameter		5.1	$87,397	$1,028

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	14.2	8	113.60	L	$46.27	incl. in rate	incl. in rate	$5,256.27
Equipment Operator (medium)	Active	4.00	14.2	8	454.40	L	$66.28	incl. in rate	incl. in rate	$30,117.63
Steelworker	Active	8.00	0.2	8	12.80	L	$65.52	incl. in rate	incl. in rate	$838.66
Electrician	Active	1.00	0.2	8	1.60	L	$45.23	incl. in rate	incl. in rate	$72.37
Truck Driver (heavy)	Active	1.00	0.2	8	1.60	L	$57.59	incl. in rate	incl. in rate	$92.14
Vibratory Hammer & Extractor	Active	2.00	0.2	8	3.20	E	$94.34	incl. in rate	incl. in rate	$301.89
Hydraulic Excavator (6.0cy)	Active	1.00	4.0	8	32.00	E	$322.48	incl. in rate	incl. in rate	$10,319.36
Loader, FE Rubber Tire (8.6cy)	Active	1.00	4.0	8	32.00	E	$221.50	incl. in rate	incl. in rate	$7,088.00
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Diver, Wet	Active	2.00	2.0	8	32.00	L	$124.57	incl. in rate	incl. in rate	$3,986.24
Barge, Sectional, 20'x10'	Active	1.00	2.0	8	16.00	E	$4.48	incl. in rate	incl. in rate	$71.68
Barge Operator	Active	1.00	2.0	8	16.00	L	$40.30	incl. in rate	incl. in rate	$644.80

Labor Hours	632	TOTAL LABOR	$41,008.11
Equipment Hours	99.2	TOTAL EQUIPMENT	$19,567.17

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$41,008.11	Labor Burden @	49.7%	$0.00	$41,008.11
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$19,567.17	Equipment Tax @	0.0%	$0.00	$19,567.17
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$60,575**			**$0**	**DIRECT COST SUBTOTALS** $60,575

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$60,575.28	$9,086.29
Installing Contractors Profit@	8.0%				$60,575.28	$4,846.02
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$13,932.31
General Contractors Insurance @	1.0%		on		$74,507.59	$745
Bond @	1.0%		on		$74,507.59	$745
Contingency @	0.0%		on		$75,997.75	$0
					TOTAL COST for pay item	**$75,998**

Additional Pay Item Notes :

Requires dive depth 150 feet. Based on RS.Means - Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9 and B34B - Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment

PAY ITEM COST DETAIL WORKSHEET

4.021 Remove Upstream Riprap (10' thick upstream side of Dam)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.021		**Project**	:	Iron Gate			
Description	:	Remove Upstream Riprap (10' thick upstream side of Dam)							
Quantity	:	92,400.00	cy						
Daily Production	:	2,000.00	cy per	8	hour shift	**Project #**	: 4		
Work Days	:	46.2	Days			**Estimator**	: Michael Barba	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$21.05	per cy			**Probable Low Cost Parameter**		**2300**	**$1,652,978**	**$17.89**
Total Cost	:	$1,944,680				**Probable High Cost Parameter**		**1600**	**$2,333,616**	**$25.26**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	4.00	46.2	8	1,478.40	E	$274.63	incl. in rate	incl. in rate	$406,012.99
Dozer (310hp)(CATD8)	Active	2.00	46.2	8	739.20	E	$197.60	incl. in rate	incl. in rate	$146,065.92
Truck, Off-Road, Articulated Rear, 20cy	Active	10.00	46.2	8	3,696.00	E	$111.64	incl. in rate	incl. in rate	$412,621.44
Truck, Pickup (4x4, 3/4tn)	Active	2.00	46.2	8	739.20	E	$16.94	incl. in rate	incl. in rate	$12,522.05
Truck Driver (heavy)	Active	10.00	46.2	8	3,696.00	L	$57.59	incl. in rate	incl. in rate	$212,852.64
Laborer	Active	6.00	46.2	8	2,217.60	L	$45.80	incl. in rate	incl. in rate	$101,566.08
Labor Foreman	Active	2.00	46.2	8	739.20	L	$48.27	incl. in rate	incl. in rate	$35,681.18
Equipment Operator (medium)	Active	6.00	46.2	8	2,217.60	L	$66.28	incl. in rate	incl. in rate	$146,982.53
		1.00	46.2	8	369.60	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	46.2	8	369.60	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	46.2	8	369.60	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	46.2	8	369.60	0	$0.00	incl. in rate	incl. in rate	$0.00
			46.2	8	0.00					$0.00
			46.2	8	0.00					$0.00
			46.2	8	0.00					$0.00
			46.2	8	0.00					$0.00
			46.2	8	0.00					$0.00
				Labor Hours	**8870.4**				**TOTAL LABOR**	**$497,082.43**
				Equipment Hours	**6652.8**				**TOTAL EQUIPMENT**	**$977,222.40**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price		Material Cost
							$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
						TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
	-					$0.00
						$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$497,082.43	Labor Burden @	49.7%	$0.00		$497,082.43
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$977,222.40	Equipment Tax @	7.75%	$75,734.74		$1,052,957.14
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,474,305**			**$75,735**	**DIRECT COST SUBTOTALS**	**$1,550,040**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,550,039.57	$232,505.94
Installing Contractors Profit@	8.0%				$1,550,039.57	$124,003.17
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$356,509.10**
General Contractors Insurance @	1.0%		on		$1,906,548.67	$19,065
Bond @	1.0%		on		$1,906,548.67	$19,065
Contingency @	0.0%		on		$1,944,679.64	$0
					TOTAL COST for pay item	**$1,944,680**

Additional Pay Item Notes :

Production is based on using 20CY trucks, Material will be used for temporary coffer dams and hauled to disposal area. Excavators will load material into 20CY trucks that we aniticipate will be able to haul 18CY per load. This will be roughly 14 loads per truck per day.Dozers will be used to push material in to piles for load out. Laborers will direct truck traffic and laborer foreman will oversee operation. During Dam construction the rip rap was placed on the upstream slope at a thickness of 10'.

PAY ITEM COST DETAIL WORKSHEET

4.022 Remove Downstream Riprap

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.022		**Project**	:	Iron Gate			
Description	:	Remove Downstream Riprap							
Quantity	:	23,400.00	cy						
Daily Production	:	2,500.00	cy per	8	hour shift	**Project #**	: 4		
Work Days	:	9.4	Days			**Estimator**	: Michael Barba	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$15.64	per cy			**Probable Low Cost Parameter**		**2875**	**$310,997**	**$13.29**
Total Cost	:	$365,879				**Probable High Cost Parameter**		**2000**	**$439,054**	**$18.76**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	4.00	9.4	8	300.80	E	$274.63	incl. in rate	incl. in rate	$82,608.70
Dozer (310hp)(CATD8)	Active	2.00	9.4	8	150.40	E	$197.60	incl. in rate	incl. in rate	$29,719.04
Truck, Off-Road, Articulated Rear, 20cy	Active	10.00	9.4	8	752.00	E	$111.64	incl. in rate	incl. in rate	$83,953.28
Equipment Operator (medium)	Active	6.00	9.4	8	451.20	L	$66.28	incl. in rate	incl. in rate	$29,905.54
Truck Driver (heavy)	Active	10.00	9.4	8	752.00	L	$57.59	incl. in rate	incl. in rate	$43,307.68
Labor Foreman (out)	Active	1.00	9.4	8	75.20	L	$46.27	incl. in rate	incl. in rate	$3,479.50
Laborer	Active	1.00	9.4	8	75.20	L	$45.80	incl. in rate	incl. in rate	$3,444.16
		1.00	9.4	8	75.20	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	9.4	8	75.20	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	9.4	8	75.20	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	9.4	8	75.20	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	9.4	8	75.20	0	$0.00	incl. in rate	incl. in rate	$0.00
			9.4	8	0.00					$0.00
			9.4	8	0.00					$0.00
			9.4	8	0.00					$0.00
			9.4	8	0.00					$0.00
			9.4	8	0.00					$0.00
				Labor Hours	**1353.6**				**TOTAL LABOR**	**$80,136.88**
				Equipment Hours	**1203.2**				**TOTAL EQUIPMENT**	**$196,281.02**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$80,136.88	Labor Burden @	49.7%	$0.00		$80,136.88
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$196,281.02	Equipment Tax @	7.75%	$15,211.78		$211,492.80
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$276,418**			**$15,212**	**DIRECT COST SUBTOTALS**	**$291,630**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$291,629.68	$43,744.45
Installing Contractors Profit@	8.0%				$291,629.68	$23,330.37
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$67,074.83**
General Contractors Insurance @	1.0%		on		$358,704.51	$3,587
Bond @	1.0%		on		$358,704.51	$3,587
Contingency @	0.0%		on		$365,878.60	$0
					TOTAL COST for pay item	**$365,879**

Additional Pay Item Notes :

Production is based on using 20CY trucks, Material will be used for temporary coffer dams and hauled to disposal area. Excavators will load material into 20CY trucks that we aniticipate will be able to haul 18CY per load. This will be roughly 11 loads per truck per day.Dozers will be used to push material in to piles for load out. Laborers will direct truck traffic and laborer foreman will oversee operation. During Dam construction the rip rap was placed on the udown stream slope at a thickness of 5'.

PAY ITEM COST DETAIL WORKSHEET

4.023 Miscellaneous Excavation (Dam Fill to Spillway)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.023			**Project**	: Iron Gate			
Description	:	Miscellaneous Excavation (Dam Fill to Spillway)							
Quantity	:	270,000.00	cy						
Daily Production	:	10,000.00	cy per	10 hour shift	**Project #**	: 4			
Work Days	:	27.0 Days			**Estimator**	: Michael Barba	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$6.72	per cy		**Probable Low Cost Parameter**		**11500**	**$1,543,132**	**$5.72**
Total Cost	:	$1,815,450			**Probable High Cost Parameter**		**8000**	**$2,178,539**	**$8.07**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (310hp)(CATD8)	Active	3.00	27.0	10	810.00	E	$197.60	incl. in rate	incl. in rate	$160,056.00
Hydraulic Excavator (6.0cy)	Active	4.00	27.0	10	1,080.00	E	$322.48	incl. in rate	incl. in rate	$348,278.40
Loader, FE Rubber Tire (8.6cy)	Active	2.00	27.0	10	540.00	E	$221.50	incl. in rate	incl. in rate	$119,610.00
Truck, Off-Road, Articulated Rear, 20cy	Active	10.00	27.0	10	2,700.00	E	$111.64	incl. in rate	incl. in rate	$301,428.00
Truck, Pickup (4x4, 3/4tn)	Active	1.00	27.0	10	270.00	E	$16.94	incl. in rate	incl. in rate	$4,573.80
Truck Driver (heavy)	Active	14.00	27.0	10	3,780.00	L	$57.59	incl. in rate	incl. in rate	$217,690.20
Labor Foreman (out)	Active	1.00	27.0	10	270.00	L	$46.27	incl. in rate	incl. in rate	$12,492.90
Laborer	Active	4.00	27.0	10	1,080.00	L	$45.80	incl. in rate	incl. in rate	$49,464.00
Equipment Operator (medium)	Active	9.00	27.0	10	2,430.00	L	$66.28	incl. in rate	incl. in rate	$161,060.40
		1.00	27.0	10	270.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	27.0	10	270.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	27.0	10	270.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			27.0	10	0.00					$0.00
			27.0	10	0.00					$0.00
			27.0	10	0.00					$0.00
			27.0	10	0.00					$0.00
			27.0	10	0.00					$0.00
				Labor Hours	**7560**			**TOTAL LABOR**		**$440,707.50**
				Equipment Hours	**5400**			**TOTAL EQUIPMENT**		**$933,946.20**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price		Material Cost
							$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
						TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
	-					$0.00
						$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$440,707.50	Labor Burden @	49.7%	$0.00		$440,707.50
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$933,946.20	Equipment Tax @	7.75%	$72,380.83		$1,006,327.03
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,374,654**			**$72,381**	**DIRECT COST SUBTOTALS**	**$1,447,035**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,447,034.53		$217,055.18
Installing Contractors Profit@	8.0%				$1,447,034.53		$115,762.76
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$332,817.94**
General Contractors Insurance @	1.0%			on	$1,779,852.47		$17,799
Bond @	1.0%			on	$1,779,852.47		$17,799
Contingency @	0.0%			on	$1,815,449.52		$0
						TOTAL COST for pay item	**$1,815,450**

Additional Pay Item Notes :

Price is based on hauling material to spillway using both dozers and haul trucks. Figured 1/4 of the material will be placed using Dozer and excavators only and the other half of the material will need haul trucks to move material to spillway from opposite side of dam. Figuring 10 trucks moving 14 loads a day.

PAY ITEM COST DETAIL WORKSHEET

4.023 Miscellaneous Excavation (Dam Fill to Disposal Site)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.023			**Project**	: Iron Gate			
Description	:	Miscellaneous Excavation (Dam Fill to Disposal Site)							
Quantity	:	761,159.00	cy						
Daily Production	:	6,000.00	cy per	10 hour shift	**Project #**	: 4			
Work Days	:	126.9	Days		**Estimator**	: Michael Barba	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$15.55	per cy		**Probable Low Cost Parameter**		**6900**	**$10,061,276**	**$13.22**
Total Cost	:	$11,836,796			**Probable High Cost Parameter**		**4800**	**$14,204,155**	**$18.66**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (310hp)(CATD8)	Active	4.00	126.9	10	5,076.00	E	$197.60	incl. in rate	incl. in rate	$1,003,017.60
Hydraulic Excavator (6.0cy)	Active	4.00	126.9	10	5,076.00	E	$322.48	incl. in rate	incl. in rate	$1,636,908.48
Loader, FE Rubber Tire (8.6cy)	Active	2.00	126.9	10	2,538.00	E	$221.50	incl. in rate	incl. in rate	$562,167.00
Truck, Off-Road, Articulated Rear, 20cy	Active	20.00	126.9	10	25,380.00	E	$111.64	incl. in rate	incl. in rate	$2,833,423.20
Truck, Pickup (4x4, 3/4tn)	Active	2.00	126.9	10	2,538.00	E	$16.94	incl. in rate	incl. in rate	$42,993.72
Truck Driver (heavy)	Active	20.00	126.9	10	25,380.00	L	$57.59	incl. in rate	incl. in rate	$1,461,634.20
Labor Foreman (out)	Active	2.00	126.9	10	2,538.00	L	$46.27	incl. in rate	incl. in rate	$117,433.26
Laborer	Active	8.00	126.9	10	10,152.00	L	$45.80	incl. in rate	incl. in rate	$464,961.60
Equipment Operator (medium)	Active	10.00	126.9	10	12,690.00	L	$66.28	incl. in rate	incl. in rate	$841,093.20
		1.00	126.9	10	1,269.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	126.9	10	1,269.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	126.9	10	1,269.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			126.9	10	0.00					$0.00
			126.9	10	0.00					$0.00
			126.9	10	0.00					$0.00
			126.9	10	0.00					$0.00
			126.9	10	0.00					$0.00
				Labor Hours	**50760**				**TOTAL LABOR**	**$2,885,122.26**
				Equipment Hours	**40608**				**TOTAL EQUIPMENT**	**$6,078,510.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price		Material Cost
							$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
			1.000	0.00	$0.00		$0.00
						TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
	-					$0.00
						$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,885,122.26	Labor Burden @	49.7%	$0.00		$2,885,122.26
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$6,078,510.00	Equipment Tax @	7.75%	$471,084.53		$6,549,594.53
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$8,963,632**			**$471,085**	**DIRECT COST SUBTOTALS**	**$9,434,717**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$9,434,716.79	$1,415,207.52
Installing Contractors Profit@	8.0%				$9,434,716.79	$754,777.34
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$2,169,984.86**
General Contractors Insurance @	1.0%			on	$11,604,701.65	$116,047
Bond @	1.0%			on	$11,604,701.65	$116,047
Contingency @	0.0%			on	$11,836,795.68	$0
					TOTAL COST for pay item	**$11,836,796**

Additional Pay Item Notes :

Price is based on using 2 crews working 10 hours per day, a total of 20 trucks (10 trucks per crew) will haul material from dam location to disposal site. Each truck is expected to haul 15 loads per day for a total of 139 days. Excavators will load trucks with dozers assisting. Loaders will maintain hauling roads for trucks.

PAY ITEM COST DETAIL WORKSHEET

4.024 Cutoff Wall Concrete Demolition

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.024	**Project**	:	Iron Gate			
Description	:	Cutoff Wall Concrete Demolition						
Quantity	:	2,440.00 cy						
Daily Production	:	150.00 cy per 8 hour shift	**Project #**	:	4			
Work Days	:	16.3 Days	**Estimator**	:	Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$112.84 per cy	**Probable Low Cost Parameter**			**165**	**$247,803**	**$101.56**
Total Cost	:	$275,336	**Probable High Cost Parameter**			**127.5**	**$316,637**	**$129.77**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	16.3	8	260.80	L	$48.27	incl. in rate	incl. in rate	$12,588.82
Laborer	Active	8.00	16.3	8	1,043.20	L	$45.80	incl. in rate	incl. in rate	$47,778.56
Equipment Operator (medium)	Active	2.00	16.3	8	260.80	L	$66.28	incl. in rate	incl. in rate	$17,285.82
Truck Driver (heavy)	Active	2.00	16.3	8	260.80	L	$57.59	incl. in rate	incl. in rate	$15,019.47
Air Compressor 900 cfm	Active	1.00	16.3	8	130.40	E	$38.87	incl. in rate	incl. in rate	$5,068.51
Air Compressor 600 cfm	Active	1.00	16.3	8	130.40	E	$21.74	incl. in rate	incl. in rate	$2,834.76
Air Tool, Chipping Hammer	Active	4.00	16.3	8	521.60	E	$1.64	incl. in rate	incl. in rate	$854.92
Generator, Small Generator, 10 - 15 kW	Active	2.00	16.3	8	260.80	E	$7.04	incl. in rate	incl. in rate	$1,836.03
Hydraulic Excavator (2.5cy)	Active	2.00	16.3	8	260.80	E	$203.63	incl. in rate	incl. in rate	$53,106.70
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	16.3	8	130.40	E	$62.72	incl. in rate	incl. in rate	$8,178.69
Hydraulic Thumbs/Shear Attachment	Active	1.00	16.3	8	130.40	E	$16.39	incl. in rate	incl. in rate	$2,137.26
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	16.3	8	260.80	E	$111.64	incl. in rate	incl. in rate	$29,115.71
			16.3	8	0.00					$0.00
			16.3	8	0.00					$0.00
			16.3	8	0.00					$0.00
			16.3	8	0.00					$0.00
			16.3	8	0.00					$0.00
				Labor Hours	**1,826**			**TOTAL LABOR**		**$92,672.67**
				Equipment Hours	**1,826**			**TOTAL EQUIPMENT**		**$103,132.57**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$4,633.63	$4,633.63
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$4,633.63**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	5	EA	**Cost per Mob**	$2,500.00	$12,500.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$12,500.00**

SUMMARY OF COSTS

Labor Cost	$92,672.67	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$92,672.67
Material Cost	$4,633.63	Material Tax @	7.75%	$359.11		$4,992.74
Equipment Cost	$103,132.57	Equipment Tax @	7.75%	$7,992.77		$111,125.35
Subcontractors	$12,500.00					$12,500.00
DIRECT COST SUBTOTALS	**$212,939**			**$8,352**	**DIRECT COST SUBTOTALS**	**$221,291**

	Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@ 15.0%				$208,790.76	$31,318.61
Installing Contractors Profit@ 8.0%				$208,790.76	$16,703.26
GC Markup on Subs @ 5.0%				$12,500.00	$625.00
				TOTAL MARKUP COSTS	**$48,646.88**
General Contractors Insurance @ 1.0%		on		$269,937.64	$2,699
Bond @ 1.0%		on		$269,937.64	$2,699
Contingency @ 0.0%		on		$275,336.39	$0
				TOTAL COST for pay item	**$275,336**

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposal site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.025		**Project**	:	Iron Gate			
Description	:	Earth Fill Crest Raise Demolition							
Quantity	:	13,000.00	cy						
Daily Production	:	1,100.00	cy per	8	hour shift	**Project #**	: 4		
Work Days	:	11.8	Days			**Estimator**	: Michael Barba	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$15.68	per cy			**Probable Low Cost Parameter**		**1265**	**$173,265**	**$13.33**
Total Cost	:	$203,841				**Probable High Cost Parameter**		**935**	**$234,417**	**$18.03**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (310hp)(CATD8)	Active	2.00	11.8	8	188.80	E	$197.60	incl. in rate	incl. in rate	$37,306.88
Loader, FE Rubber Tire (5.25cy)	Active	2.00	11.8	8	188.80	E	$75.42	incl. in rate	incl. in rate	$14,239.30
Truck, Off-Road, Articulated Rear, 20cy	Active	4.00	11.8	8	377.60	E	$111.64	incl. in rate	incl. in rate	$42,155.26
Truck, Pickup (4x4, 3/4tn)	Active	1.00	11.8	8	94.40	E	$16.94	incl. in rate	incl. in rate	$1,599.14
Truck Driver (heavy)	Active	4.00	11.8	8	377.60	L	$57.59	incl. in rate	incl. in rate	$21,745.98
Equipment Operator (medium)	Active	4.00	11.8	8	377.60	L	$66.28	incl. in rate	incl. in rate	$25,027.33
Labor Foreman (out)	Active	1.00	11.8	8	94.40	L	$46.27	incl. in rate	incl. in rate	$4,367.89
Laborer	Active	2.00	11.8	8	188.80	L	$45.80	incl. in rate	incl. in rate	$8,647.04
		1.00	11.8	8	94.40	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	11.8	8	94.40	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	11.8	8	94.40	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	11.8	8	94.40	0	$0.00	incl. in rate	incl. in rate	$0.00
			11.8	8	0.00					$0.00
			11.8	8	0.00					$0.00
			11.8	8	0.00					$0.00
			11.8	8	0.00					$0.00
			11.8	8	0.00					$0.00
				Labor Hours	**1038.4**				**TOTAL LABOR**	**$59,788.24**
				Equipment Hours	**849.6**				**TOTAL EQUIPMENT**	**$95,300.58**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$59,788.24	Labor Burden @	49.7%	$0.00		$59,788.24
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$95,300.58	Equipment Tax @	7.75%	$7,385.79		$102,686.37
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$155,089**			**$7,386**	**DIRECT COST SUBTOTALS**	**$162,475**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$162,474.61	$24,371.19
Installing Contractors Profit@	8.0%				$162,474.61	$12,997.97
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$37,369.16**
General Contractors Insurance @	1.0%		on		$199,843.77	$1,998
Bond @	1.0%		on		$199,843.77	$1,998
Contingency @	0.0%		on		$203,840.65	$0
					TOTAL COST for pay item	**$203,841**

Additional Pay Item Notes :

Production is based on 4 trucks hauling 15 loads a day. Dozers will stock pile material and loaders will load trucks.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.026		**Project**	:	Iron Gate			
Description	:	Sheetpile Crest Raise Demolition							
Quantity	:	800.00	lf						
Daily Production	:	160.00	lf per	8	hour shift	**Project #**	:	4	
Work Days	:	5.0	Days			**Estimator**	:	Michael Barba	
Unit Price	:	$281.18	per lf			**Probable Low Cost Parameter**		**184**	**$191,204**	**$239.01**
Total Cost	:	$224,946				**Probable High Cost Parameter**		**136**	**$258,688**	**$323.36**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	2.00	5.0	8	80.00	E	$274.63	incl. in rate	incl. in rate	$21,970.40
Equipment Operator (medium)	Active	2.00	5.0	8	80.00	L	$66.28	incl. in rate	incl. in rate	$5,302.40
Laborer	Active	4.00	5.0	8	160.00	L	$45.80	incl. in rate	incl. in rate	$7,328.00
Labor Foreman (out)	Active	1.00	5.0	8	40.00	L	$46.27	incl. in rate	incl. in rate	$1,850.80
Steelworker	Active	4.00	5.0	8	160.00	L	$65.52	incl. in rate	incl. in rate	$10,483.20
Equipment Operator (medium)	Active	2.00	5.0	8	80.00	L	$66.28	incl. in rate	incl. in rate	$5,302.40
Welder	Active	2.00	5.0	8	80.00	E	$7.84	incl. in rate	incl. in rate	$627.00
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	5.0	8	80.00	E	$31.90	incl. in rate	incl. in rate	$2,552.00
Truck Driver (heavy)	Active	2.00	5.0	8	80.00	L	$57.59	incl. in rate	incl. in rate	$4,607.20
Equipment Operator (crane)	Active	1.00	5.0	8	40.00	L	$68.41	incl. in rate	incl. in rate	$2,736.40
Crawler Crane (130tn)	Active	1.00	5.0	8	40.00	E	$258.66	incl. in rate	incl. in rate	$10,346.40
		1.00	5.0	8	40.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
				Labor Hours	**640**				**TOTAL LABOR**	**$37,610.40**
				Equipment Hours	**280**				**TOTAL EQUIPMENT**	**$35,495.80**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
Sheetpiling 800' x 20'	4,800.00	sf	1.000	4,800.00	$20.00	$96,000.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	**$96,000.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$37,610.40	Labor Burden @	49.7%	$0.00		$37,610.40
Material Cost	$96,000.00	Material Tax @	7.75%	$7,440.00		$103,440.00
Equipment Cost	$35,495.80	Equipment Tax @	7.75%	$2,750.92		$38,246.72
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$169,106**			**$10,191**	**DIRECT COST SUBTOTALS**	**$179,297**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$179,297.12	$26,894.57
Installing Contractors Profit@	8.0%				$179,297.12	$14,343.77
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$41,238.34**
General Contractors Insurance @	1.0%		on		$220,535.46	$2,205
Bond @	1.0%		on		$220,535.46	$2,205
Contingency @	0.0%		on		$224,946.17	$0
					TOTAL COST for pay item	**$224,946**

Additional Pay Item Notes :

Production is based on having two operations at 1 time pulling sheets with an excavator, crane will be on site for support for half of the duration to load sheets and support pulling operaton.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.027	**Project**	: IRONGATE				
Description	:	Remove 5 Reservoir Monitoring Wells						
Quantity	:	5.00 EA						
Daily Production	:	2.00 EA per 8 hour shift	**Project #**	: Klamath Dams Removal				
Work Days	:	2.5 Days	**Estimator**	: Mihaela Tomulescu		**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$2,332.81 per EA	**Probable Low Cost Parameter**			**2.2**	**$10,498**	**$2,099.53**
Total Cost	:	$11,664	**Probable High Cost Parameter**			**1.7**	**$13,414**	**$2,682.73**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.5	8	20.00	L	$46.27	incl. in rate	incl. in rate	$925.40
Laborer	Active	1.00	2.5	8	20.00	L	$45.80	incl. in rate	incl. in rate	$916.00
Hydraulic Excavator (2.5cy)	Active	1.00	2.5	8	20.00	E	$203.63	incl. in rate	incl. in rate	$4,072.60
Equipment Operator (medium)	Active	1.00	2.5	8	20.00	L	$66.28	incl. in rate	incl. in rate	$1,325.60
Vibratory Hammer & Extractor	Active	1.00	2.5	8	20.00	E	$94.34	incl. in rate	incl. in rate	$1,886.80

Labor Hours	**60**	**TOTAL LABOR**	**$3,167.00**
Equipment Hours	**40**	**TOTAL EQUIPMENT**	**$5,959.40**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$158.35	$158.35

TOTAL MATERIAL	**$158.35**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$3,167.00	Labor Burden @	49.7%	$0.00		$3,167.00
Material Cost	$158.35	Material Tax @	7.8%	$12.27		$170.62
Equipment Cost	$5,959.40	Equipment Tax @	0.0%	$0.00		$5,959.40
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$9,285**			**$12**	**DIRECT COST SUBTOTALS**	**$9,297**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$9,297.02		$1,394.55
Installing Contractors Profit@	8.0%				$9,297.02		$743.76
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$2,138.32**
General Contractors Insurance @	1.0%		on		$11,435.34		$114
Bond @	1.0%		on		$11,435.34		$114
Contingency @	0.0%		on		$11,664.04		$0
						TOTAL COST for pay item	**$11,664**

Additional Pay Item Notes :

Assumed 150 lenght of public water supply wells, wells domestic water, drilled, 4" to 6" diameter, removed in the same time with the regular excavation.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.029			**Project**	: IRONGATE			
Description	:	Remove and Dispose of Intake Structure							
Quantity	:	72,000.00	LBS						
Daily Production	:	20,000.00	LBS per	8 hour shift	**Project #**	: 0			
Work Days	:	3.6	Days		**Estimator**	: Mihaela Tomules	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.90	per LBS		**Probable Low Cost Parameter**		**23000**	**$54,964**	**$0.76**
Total Cost	:	$64,663			**Probable High Cost Parameter**		**16000**	**$77,596**	**$1.08**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	3.6	8	28.80	L	$46.27	$0.00		$1,332.58
Electrician	Active	1.00	3.6	8	28.80	L	$45.23	$0.00		$1,302.62
Steelworker	Active	6.00	3.6	8	172.80	L	$65.52	$0.00		$11,321.86
Hydraulic Excavator (6.0cy)	Active	1.00	3.6	8	28.80	E	$322.48	$322.48		$9,287.42
Truck Driver (heavy)	Active	1.00	3.6	8	28.80	L	$57.59	$0.00		$1,658.59
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	3.6	8	28.80	E	$111.64	$111.64		$3,215.23
Hydraulic Crane (120tn)	Active	1.00	3.6	8	28.80	E	$239.06	$239.06		$6,884.93
Welder	Active	2.00	3.6	8	57.60	L	$7.84	$0.00		$451.44
Gas Welding Machine	Active	2.00	3.6	8	57.60	E	$2.88	$2.88		$165.71
Equipment Operator (medium)	Active	2.00	3.6	8	57.60	L	$66.28	$0.00		$3,817.73
Equipment Operator (crane)	Active	1.00	3.6	8	28.80	L	$68.41	$0.00		$1,970.21
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	3.6	8	28.80	E	$62.72	$62.72		$1,806.34

Labor Hours	**403.2**	**TOTAL LABOR**	**$21,855.02**
Equipment Hours	**172.8**	**TOTAL EQUIPMENT**	**$21,359.63**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, electrodes, wrenches, hard hats etc)	1.00	LS	1.000	1.00	$3,278.25	$3,278.25

TOTAL MATERIAL	**$3,278.25**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (25%)	9.00	ton	1.000	9.00	$595.00	$5,355.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	36.00	mile	1.000	36.00	$7.25	$261.00

TOTAL SUBCONTRACTS	**$5,616.00**

SUMMARY OF COSTS

Labor Cost	$21,855.02	Labor Burden @	49.7%	$0.00		$21,855.02
Material Cost	$3,278.25	Material Tax @	7.8%	$254.06		$3,532.32
Equipment Cost	$21,359.63	Equipment Tax @	0.0%	$0.00		$21,359.63
Subcontractors	$5,616.00					$5,616.00
DIRECT COST SUBTOTALS	**$52,109**			**$254**	**DIRECT COST SUBTOTALS**	**$52,363**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$46,746.98		$7,012.05
Installing Contractors Profit@	8.0%				$46,746.98		$3,739.76
GC Markup on Subs @	5.0%				$5,616.00		$280.80
						TOTAL MARKUP COSTS	**$11,032.60**
General Contractors Insurance @	1.0%		on		$63,395.58		$634
Bond @	1.0%		on		$63,395.58		$634
Contingency @	0.0%		on		$64,663.49		$0
						TOTAL COST for pay item	**$64,663**

Additional Pay Item Notes :

The removal trash rack and trash rake is done by one 9-men crew (1 foreman, 6 steelworkers, 1 welder, 1 electrician and 2 equipment operators). Based on the current production rate and the fact that we dispose big pieces of steel we use 1 trucks per day. Assumed hazardous waste cleanup 25% of total weight disposal.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.030		**Project**	: IRONGATE			
Description	:	Remove and Dispose of Sluice and Diversion Tunnel Gate						
Quantity	:	28,000.00 LBS						
Daily Production	:	18,000.00 LBS per	8 hour shift	**Project #**	: 2			
Work Days	:	1.6 Days		**Estimator**	: Mihaela Tomulesc	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$1.09 per LBS		**Probable Low Cost Parameter**		**20700**	**$26,052**	**$0.93**
Total Cost	:	$30,649		**Probable High Cost Parameter**		**14400**	**$36,779**	**$1.31**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.6	8	12.80	L	$46.27	$0.00		$592.26
Laborer	Active	4.00	1.6	8	51.20	L	$45.80	$0.00		$2,344.96
Crawler Crane (270tn)	Active	2.00	1.6	8	25.60	E	$399.50	$446.84		$10,227.20
Equipment Operator (medium)	Active	2.00	1.6	8	25.60	L	$66.28	$0.00		$1,696.77
Welder	Active	2.00	1.6	8	25.60	L	$7.84	$0.00		$200.64
Gas Welding Machine	Active	2.00	1.6	8	25.60	E	$2.88	$2.88		$73.65
Electrician	Active	1.00	1.6	8	12.80	L	$45.23	$0.00		$578.94
Steelworker	Active	2.00	1.6	8	25.60	L	$65.52	$0.00		$1,677.31
Truck, Flatbed (4x4, 10,000 gvw)	Active	4.00	1.6	8	51.20	E	$31.90	$31.90		$1,633.28
Truck Driver (heavy)	Active	4.00	1.6	8	51.20	L	$57.59	$0.00		$2,948.61

Labor Hours	**204.8**	**TOTAL LABOR**	**$10,039.49**
Equipment Hours	**102.4**	**TOTAL EQUIPMENT**	**$11,934.13**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,003.95	$1,003.95
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	1,500.00	LF	1.000	1,500.00	$0.85	$1,275.00

TOTAL MATERIAL	**$2,278.95**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$10,039.49	Labor Burden @	49.7%	$0.00		$10,039.49
Material Cost	$2,278.95	Material Tax @	7.8%	$176.62		$2,455.57
Equipment Cost	$11,934.13	Equipment Tax @	0.0%	$0.00		$11,934.13
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$24,253**			**$177**	**DIRECT COST SUBTOTALS**	**$24,429**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$24,429.19		$3,664.38
Installing Contractors Profit@	8.0%				$24,429.19		$1,954.33
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$5,618.71**
General Contractors Insurance @	1.0%		on		$30,047.90		$300
Bond @	1.0%		on		$30,047.90		$300
Contingency @	0.0%		on		$30,648.86		$0
						TOTAL COST for pay item	**$30,649**

Additional Pay Item Notes :

Production based on crew 1 Forman, 2 Steelworkers and 1 Welder to cut and attach hooks to the gate for disposal, 4 Laborers to rigging wire rope slings, 1 Electrician to provide power for tools, 1 Truck for 2 gates. Assuming 1 day of work.

PAY ITEM COST DETAIL WORKSHEET

4.031 Remove and Dispose of Hoist Stem - 6" Dia. Sch 160' x150'

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.031		**Project**	:	IRONGATE
Description	:	Remove and Dispose of Hoist Stem - 6" Dia. Sch 160' x150'				
Quantity	:	7,500.00 LBS				
Daily Production	:	12,500.00 LBS per	8 hour shift	**Project #**	:	Klamath Dams Removal
Work Days	:	0.6 Days		**Estimator**	:	Mihaela Tomules
Unit Price	:	$1.01 per LBS		**Probable Low Cost Parameter**		**LBS per 14375** **Total Cost $6,441** **Unit Price Per LBS $0.86**
Total Cost	:	$7,578		**Probable High Cost Parameter**		**LBS per 10000** **Total Cost $9,093** **Unit Price Per LBS $1.21**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	0.6	8	4.80	L	$46.27	$0.00		$222.10
Electrician	Active	1.00	0.6	8	4.80	L	$45.23	$0.00		$217.10
Steelworker	Active	3.00	0.6	8	14.40	L	$65.52	$0.00		$943.49
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.6	8	4.80	E	$221.50	$221.50		$1,063.20
Truck Driver (heavy)	Active	2.00	0.6	8	9.60	L	$57.59	$0.00		$552.86
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	0.6	8	9.60	E	$31.90	$31.90		$306.24
Hydraulic Crane (120tn)	Active	1.00	0.6	8	4.80	E	$239.06	$239.06		$1,147.49
Welder	Active	2.00	0.6	8	9.60	L	$7.84	$0.00		$75.24
Gas Welding Machine	Active	2.00	0.6	8	9.60	E	$2.88	$2.88		$27.62
Equipment Operator (medium)	Active	1.00	0.6	8	4.80	L	$66.28	$0.00		$318.14
Equipment Operator (crane)	Active	1.00	0.6	8	4.80	L	$68.41	$0.00		$328.37
Laborer	Active	3.00	0.6	8	14.40	L	$45.80	$0.00		$659.52

Labor Hours	**67.2**	**TOTAL LABOR**	**$3,316.82**
Equipment Hours	**28.8**	**TOTAL EQUIPMENT**	**$2,544.55**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$165.84	$165.84

TOTAL MATERIAL	**$165.84**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$3,316.82	Labor Burden @	49.7%	$0.00	$3,316.82
Material Cost	$165.84	Material Tax @	7.8%	$12.85	$178.69
Equipment Cost	$2,544.55	Equipment Tax @	0.0%	$0.00	$2,544.55
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$6,027**			**$13**	**DIRECT COST SUBTOTALS $6,040**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$6,040.06	$906.01
Installing Contractors Profit@	8.0%				$6,040.06	$483.21
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,389.21**
General Contractors Insurance @	1.0%		on		$7,429.28	$74
Bond @	1.0%		on		$7,429.28	$74
Contingency @	0.0%		on		$7,577.87	$0
					TOTAL COST for pay item	**$7,578**

Additional Pay Item Notes :

The removal hoist stem 150 LF is done by one 9-men crew (1 foreman, 3 steelworkers, 1 welder, 3 laborer,1 electrician and 2 equipment operators). Based on the fact that we dispose big pieces of steel we use 2 trucks per day. Assumed is not taking around 1/2 day of work.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.032			**Project**	: Iron Gate			
Description	:	Remove and Dispose of Air Vent Pipe - 8" Dia. Sch 40 x160'							
Quantity	:	4,650.00	LBS						
Daily Production	:	2,325.00	LBS per	8 hour shift	**Project #**	: 4			
Work Days	:	2.0	Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$2.12	per LBS		**Probable Low Cost Parameter**		**2673.75**	**$8,377**	**$1.80**
Total Cost	:	$9,855			**Probable High Cost Parameter**		**1860**	**$11,826**	**$2.54**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (light)	Active	1.00	2.0	8	16.00	L	$56.29	incl. in rate	incl. in rate	$900.64
Laborer	Active	1.00	2.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Equipment Operator (light)	Active	1.00	2.0	8	16.00	L	$64.90	incl. in rate	incl. in rate	$1,038.40
Loader, FE Rubber Tire (3.5cy)	Active	1.00	2.0	8	16.00	E	$64.23	incl. in rate	incl. in rate	$1,027.68
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Steelworker	Active	1.00	2.0	8	16.00	L	$65.52	incl. in rate	incl. in rate	$1,048.32

Labor Hours	**64**	**TOTAL LABOR**	**$3,720.16**
Equipment Hours	**32**	**TOTAL EQUIPMENT**	**$2,813.92**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$281.39	$281.39
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$281.39**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Forklift crew, all-terrain forklift, 45' lift, 35' reach, 9000 lb. capacity, weekly use	0.20	week	1.000	0.20	$5,961.23	$1,192.25
						$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$1,192.25**

SUMMARY OF COSTS

Labor Cost	$3,720.16	Labor Burden @	49.7%	$0.00		$3,720.16
Material Cost	$281.39	Material Tax @	7.8%	$21.81		$303.20
Equipment Cost	$2,813.92	Equipment Tax @	0.0%	$0.00		$2,813.92
Subcontractors	$1,192.25					$1,192.25
DIRECT COST SUBTOTALS	**$8,008**			**$22**	**DIRECT COST SUBTOTALS**	**$8,030**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$6,837.28		$1,025.59
Installing Contractors Profit@	8.0%				$6,837.28		$546.98
GC Markup on Subs @	5.0%				$1,192.25		$59.61
						TOTAL MARKUP COSTS	**$1,632.19**
General Contractors Insurance @	1.0%		on		$9,661.71		$97
Bond @	1.0%		on		$9,661.71		$97
Contingency @	0.0%		on		$9,854.95		$0
						TOTAL COST for pay item	**$9,855**

Additional Pay Item Notes :

Assumed we need forklift because of work in the tunnel near sluice gate, based on RS Means, Utility removal, pipe, sewer/water, 8" diameter, remove, excludes excavation, B12Z Crew is formed of 2 laborers loading 1 truck with the crane for disposal based on daily production.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.034			**Project**	: Iron Gate			
Description	:	Remove and Dispose of Air Vent Pipe - 12" Dia. Sch 40 x560'							
Quantity	:	30,250.00	LBS						
Daily Production	:	2,500.00	LBS per	8 hour shift	**Project #**	: 4			
Work Days	:	12.1	Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$2.26	per LBS		**Probable Low Cost Parameter**		**2875**	**$58,100**	**$1.92**
Total Cost	:	$68,353			**Probable High Cost Parameter**		**2000**	**$82,024**	**$2.71**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (light)	Active	1.00	1.0	8	8.00	L	$56.29	incl. in rate	incl. in rate	$450.32
Laborer	Active	2.00	12.1	8	193.60	L	$45.80	incl. in rate	incl. in rate	$8,866.88
Equipment Operator (medium)	Active	1.00	12.1	8	96.80	L	$66.28	incl. in rate	incl. in rate	$6,415.90
Loader, FE Rubber Tire (5.25cy)	Active	1.00	12.1	8	96.80	E	$75.42	incl. in rate	incl. in rate	$7,300.66
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Steelworker	Active	2.00	12.1	8	193.60	L	$65.52	incl. in rate	incl. in rate	$12,684.67
Labor Foreman	Active	1.00	12.1	8	96.80	L	$48.27	incl. in rate	incl. in rate	$4,672.54

Labor Hours	**588.8**	**TOTAL LABOR**	**$33,090.31**
Equipment Hours	**104.8**	**TOTAL EQUIPMENT**	**$8,193.78**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$819.38	$819.38
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$819.38**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Forklift crew, all-terrain forklift, 45' lift, 35' reach, 9000 lb. capacity, weekly use	2.42	week	1.000	2.42	$5,961.23	$14,426.18
						$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$14,426.18**

SUMMARY OF COSTS

Labor Cost	$33,090.31	Labor Burden @	49.7%	$0.00		$33,090.31
Material Cost	$819.38	Material Tax @	7.8%	$63.50		$882.88
Equipment Cost	$8,193.78	Equipment Tax @	0.0%	$0.00		$8,193.78
Subcontractors	$14,426.18					$14,426.18
DIRECT COST SUBTOTALS	**$56,530**			**$64**	**DIRECT COST SUBTOTALS**	**$56,593**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$42,166.97		$6,325.05
Installing Contractors Profit@	8.0%				$42,166.97		$3,373.36
GC Markup on Subs @	5.0%				$14,426.18		$721.31
						TOTAL MARKUP COSTS	**$10,419.71**
General Contractors Insurance @	1.0%		on		$67,012.86		$670
Bond @	1.0%		on		$67,012.86		$670
Contingency @	0.0%		on		$68,353.11		$0
						TOTAL COST for pay item	**$68,353**

Additional Pay Item Notes :

Assumed we need forklift because of work in the tunnel from gate to outlet works, based on RS Means, Utility removal, pipe, sewer/water, 12" diameter, remove, excludes excavation & Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH. Using CREW B6 .

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.038			**Project**	: IRON GATE			
Description	:	Remove and Dispose of Power Cable and 4" Conduit from Penstock Structure							
Quantity	:	800.00	LF						
Daily Production	:	125.00	LF per	8 hour shift	**Project #**	: 4			
Work Days	:	6.4	Days		**Estimator**	: Mihaela Tomulescu	**LF per**	**Total Cost**	**Unit Price Per LF**
Unit Price	:	$49.86	per LF		**Probable Low Cost Parameter**		**143.75**	**$33,904**	**$42**
Total Cost	:	$39,887			**Probable High Cost Parameter**		**106.25**	**$45,870**	**$57**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	6.4	8	51.20	L	$47.23	incl. in rate	incl. in rate	$2,418.18
Electrician	Active	4.00	6.4	8	204.80	L	$45.23	incl. in rate	incl. in rate	$9,263.10
Laborer	Active	2.00	6.4	8	102.40	L	$45.80	incl. in rate	incl. in rate	$4,689.92
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	6.4	8	102.40	E	$111.64	incl. in rate	incl. in rate	$11,431.94
Truck Driver (heavy)	Active	1.00	6.4	8	51.20	L	$57.59	incl. in rate	incl. in rate	$2,948.61

Labor Hours	**409.6**	**TOTAL LABOR**	**$19,319.81**
Equipment Hours	**102.4**	**TOTAL EQUIPMENT**	**$11,431.94**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$965.99	$965.99
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$965.99**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$19,319.81	Labor Burden @	49.7%	$0.00		$19,319.81
Material Cost	$965.99	Material Tax @	7.8%	$74.86		$1,040.85
Equipment Cost	$11,431.94	Equipment Tax @	0.0%	$0.00		$11,431.94
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$31,718**			**$75**	**DIRECT COST SUBTOTALS**	**$31,793**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$31,792.60		$4,768.89
Installing Contractors Profit@	8.0%				$31,792.60		$2,543.41
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$7,312.30**
General Contractors Insurance @	1.0%		on		$39,104.90		$391
Bond @	1.0%		on		$39,104.90		$391
Contingency @	0.0%		on		$39,886.99		$0
						TOTAL COST for pay item	**$39,887**

Additional Pay Item Notes :

Based on RS Means:26050510- Armored cable, (BX), #8, 3 wire, average 50' runs, electrical demolition, remove we use crew Elec2 and 26050510 -Conduit, rigid galvanized steel, 4" to 6" diameter, electrical demolition, remove conduit to 10' high, including fittings & hangers

PAY ITEM COST DETAIL WORKSHEET

4.039 Remove Powerhouse Concrete down to spring-line of turbine

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.039	**Project**	:	COPCO 2			
Description	:	Remove Powerhouse Concrete down to spring-line of turbine						
Quantity	:	5,200.00 cy						
Daily Production	:	50.00 cy per 8 hour shift	**Project #**	:	3			
Work Days	:	104.0 Days	**Estimator**	:	Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$402.36 per cy	**Probable Low Cost Parameter**			**55**	**$1,883,040**	**$362.12**
Total Cost	:	$2,092,267	**Probable High Cost Parameter**			**42.5**	**$2,406,107**	**$462.71**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	104.0	8	832.00	L	$48.27	incl. in rate	incl. in rate	$40,160.64
Laborer	Active	3.00	104.0	8	2,496.00	L	$45.80	incl. in rate	incl. in rate	$114,316.80
Carpenters	Active	2.00	104.0	8	1,664.00	L	$72.60	incl. in rate	incl. in rate	$120,806.40
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	104.0	8	1,664.00	E	$70.35	incl. in rate	incl. in rate	$117,062.40
Equipment Operator (medium)	Active	1.00	104.0	8	832.00	L	$66.28	incl. in rate	incl. in rate	$55,144.96
Truck Driver (heavy)	Active	1.00	104.0	8	832.00	L	$57.59	incl. in rate	incl. in rate	$47,914.88
Hydraulic Excavator (5.0cy)	Active	4.00	104.0	8	3,328.00	E	$274.63	incl. in rate	incl. in rate	$913,968.64
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	2.00	104.0	8	1,664.00	E	$62.72	incl. in rate	incl. in rate	$104,366.08
Truck, Pickup (4x4, 3/4tn)	Active	3.00	104.0	8	2,496.00	E	$16.94	incl. in rate	incl. in rate	$42,282.24
0	Active	1.00	104.0	8	832.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	3.00	104.0	8	2,496.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	104.0	8	832.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			104.0	8	0.00					$0.00
			104.0	8	0.00					$0.00
			104.0	8	0.00					$0.00
			104.0	8	0.00					$0.00
			104.0	8	0.00					$0.00
				Labor Hours	**6,656**			**TOTAL LABOR**		**$378,343.68**
				Equipment Hours	**9,152**			**TOTAL EQUIPMENT**		**$1,177,679.36**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$18,917.18	$18,917.18
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$18,917.18**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$378,343.68	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$378,343.68
Material Cost	$18,917.18	Material Tax @	7.75%	$1,466.08		$20,383.27
Equipment Cost	$1,177,679.36	Equipment Tax @	7.75%	$91,270.15		$1,268,949.51
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,574,940**			**$92,736**	**DIRECT COST SUBTOTALS**	**$1,667,676**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,667,676.46	$250,151.47
Installing Contractors Profit@	8.0%				$1,667,676.46	$133,414.12
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$383,565.58**
General Contractors Insurance @	1.0%		on		$2,051,242.04	$20,512
Bond @	1.0%		on		$2,051,242.04	$20,512
Contingency @	0.0%		on		$2,092,266.88	$0
					TOTAL COST for pay item	**$2,092,267**

Additional Pay Item Notes :

Production is based on 2 trucks hauling 3 loads per day on average, 2 excavators with breakers will demolish concrete and 2 excavators will load trucks with demolished material, Carpenters and laborers will support equipment on the ground level, Foreman with truck will oversee operation.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.040		**Project**	: Iron Gate			
Description	:	Remove and Dispose of Turbine Unit						
Quantity	:	344,058.00 LBS						
Daily Production	:	30,000.00 LBS per	8 hour shift	**Project #**	: 4			
Work Days	:	11.5 Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.95 per LBS		**Probable Low Cost Parameter**		**34500**	**$278,446**	**$1**
Total Cost	:	$327,583		**Probable High Cost Parameter**		**25500**	**$376,721**	**$1**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	11.5	8	92.00	L	$48.27	incl. in rate	incl. in rate	$4,440.84
Ironworkers	Active	5.00	11.5	8	460.00	L	$63.95	incl. in rate	incl. in rate	$29,417.00
Crawler Crane (270tn)	Active	2.00	11.5	8	184.00	E	$399.50	incl. in rate	incl. in rate	$73,508.00
Equipment Operator (medium)	Active	2.00	11.5	8	184.00	L	$66.28	incl. in rate	incl. in rate	$12,195.52
Welder	Active	4.00	11.5	8	368.00	L	$7.84	incl. in rate	incl. in rate	$2,884.20
Gas Welding Machine	Active	4.00	11.5	8	368.00	E	$2.88	incl. in rate	incl. in rate	$1,058.73
Electrician	Active	2.00	11.5	8	184.00	L	$45.23	incl. in rate	incl. in rate	$8,322.32
Electrician Foreman	Active	1.00	11.5	8	92.00	L	$47.23	incl. in rate	incl. in rate	$4,345.16
Truck, Off-Road, Articulated Rear, 20cy	Active	4.00	11.5	8	368.00	E	$111.64	incl. in rate	incl. in rate	$41,083.52
Loader, FE Rubber Tire (8.6cy)	Active	2.00	11.5	8	184.00	E	$221.50	incl. in rate	incl. in rate	$40,756.00
Millwright	Active	5.00	11.5	8	460.00	L	$69.46	incl. in rate	incl. in rate	$31,951.60
Equipment Operator (oiler)	Active	1.00	11.5	8	92.00	L	$62.94	incl. in rate	incl. in rate	$5,790.48

Labor Hours	**1932**	**TOTAL LABOR**	**$99,347.12**
Equipment Hours	**1104**	**TOTAL EQUIPMENT**	**$156,406.25**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$4,967.36	$4,967.36
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$4,967.36**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$99,347.12	Labor Burden @	49.7%	$0.00		$99,347.12
Material Cost	$4,967.36	Material Tax @	7.8%	$384.97		$5,352.33
Equipment Cost	$156,406.25	Equipment Tax @	0.0%	$0.00		$156,406.25
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$260,721**			**$385**	**DIRECT COST SUBTOTALS**	**$261,106**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$261,105.70		$39,165.85
Installing Contractors Profit@	8.0%				$261,105.70		$20,888.46
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$60,054.31**
General Contractors Insurance @	1.0%		on		$321,160.01		$3,212
Bond @	1.0%		on		$321,160.01		$3,212
Contingency @	0.0%		on		$327,583.21		$0
						TOTAL COST for pay item	**$327,583**

Additional Pay Item Notes :

Working with a crew formed of 1 El. Forman 2 Electrician starting to disconnect power and take care of the temporary electrical power they need at the site. The crew of 5 Ironworker and 5 Millwright. open the engine side panels, and remove the nacelle access panels. Disconnect the engine thermocouple leads at the terminal board. Before disconnecting any lines all fuel, oil, and hydraulic fluid valves are closed. Plug all lines as they are disconnected to prevent entrance of foreign material. Remove the clamps securing the bleed-air ducts at the firewall. Then, disconnect the electrical connector plugs, engine breather and vent lines, and fuel, oil, and hydraulic lines. Disconnect the engine power lever and propeller control rods or cables. Remove the covers from the lift points, attach the sling, and remove slack from the cables using a suitable hoist. The sling must be adjusted to position. Remove the engine mount bolts. The engine ready to be removed. Move the engine forward, out of the nacelle structure, until it clears the aircraft. Lower the into position on the stand, and secure it prior to removing the engine sling. The crew of 4 Welder are going to cut in pieces the big parts of the runner, turbine, scroll case to be able to load them in the truck using a loader and dispose.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.041		**Project**	:	IRON GATE			
Description	:	Remove and Dispose of Draft Tube Bulkheads							
Quantity	:	16,500.00 lbs							
Daily Production	:	25,000.00 lbs per	8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	0.7 Days		**Estimator**	:	Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$0.98 per lbs		**Probable Low Cost Parameter**			**28750**	**$13,800**	**$0.84**
Total Cost	:	$16,235		**Probable High Cost Parameter**			**20000**	**$19,482**	**$1.18**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.7	8	5.60	L	$48.27	incl. in rate	incl. in rate	$270.31
Ironworkers	Active	4.00	0.7	8	22.40	L	$63.95	incl. in rate	incl. in rate	$1,432.48
Crawler Crane (270tn)	Active	2.00	0.7	8	11.20	E	$399.50	incl. in rate	incl. in rate	$4,474.40
Equipment Operator (crane)	Active	2.00	0.7	8	11.20	L	$68.41	incl. in rate	incl. in rate	$766.19
Welder	Active	2.00	0.7	8	11.20	L	$7.84	incl. in rate	incl. in rate	$87.78
Gas Welding Machine	Active	2.00	0.7	8	11.20	E	$2.88	incl. in rate	incl. in rate	$32.22
Electrician	Active	1.00	0.7	8	5.60	L	$45.23	incl. in rate	incl. in rate	$253.29
Millwright	Active	6.00	0.7	8	33.60	L	$69.46	incl. in rate	incl. in rate	$2,333.86
Truck, Flatbed (4x4, 10,000 gvw)	Active	4.00	0.7	8	22.40	E	$31.90	incl. in rate	incl. in rate	$714.56
Truck Driver (heavy)	Active	4.00	0.7	8	22.40	L	$57.59	incl. in rate	incl. in rate	$1,290.02

Labor Hours	**112**	**TOTAL LABOR**	**$6,433.92**
Equipment Hours	**44.8**	**TOTAL EQUIPMENT**	**$5,221.18**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$643.39	$643.39
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$643.39**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.83	ton	1.000	0.83	$595.00	$490.88
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
					TOTAL SUBCONTRACTS	**$693.88**

SUMMARY OF COSTS

Labor Cost	$6,433.92	Labor Burden @	49.7%	$0.00		$6,433.92
Material Cost	$643.39	Material Tax @	7.8%	$49.86		$693.26
Equipment Cost	$5,221.18	Equipment Tax @	0.0%	$0.00		$5,221.18
Subcontractors	$693.88					$693.88
DIRECT COST SUBTOTALS	**$12,992**			**$50**	**DIRECT COST SUBTOTALS**	**$13,042**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$12,348.36		$1,852.25
Installing Contractors Profit@	8.0%				$12,348.36		$987.87
GC Markup on Subs @	5.0%				$693.88		$34.69
						TOTAL MARKUP COSTS	**$2,874.82**
General Contractors Insurance @	1.0%		on		$15,917.05		$159
Bond @	1.0%		on		$15,917.05		$159
Contingency @	0.0%		on		$16,235.39		$0
						TOTAL COST for pay item	**$16,235**

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Assumed contains paint with heavy metals 10% of the total lbs., calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.042	**Project**	:	IRON GATE			
Description	:	Remove and Dispose of Crane						
Quantity	:	24,000.00 lbs						
Daily Production	:	25,000.00 lbs per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	1.0 Days	**Estimator**	:	Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$1.07 per lbs	**Probable Low Cost Parameter**			**28750**	**$21,776**	**$0.91**
Total Cost	:	$25,619	**Probable High Cost Parameter**			**18750**	**$32,023**	**$1.33**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	1.0	8	16.00	L	$48.27	incl. in rate	incl. in rate	$772.32
Laborer	Active	8.00	1.0	8	64.00	L	$45.80	incl. in rate	incl. in rate	$2,931.20
Crawler Crane (270tn)	Active	2.00	1.0	8	16.00	E	$399.50	incl. in rate	incl. in rate	$6,392.00
Equipment Operator (medium)	Active	2.00	1.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Welder	Active	4.00	1.0	8	32.00	L	$7.84	incl. in rate	incl. in rate	$250.80
Gas Welding Machine	Active	4.00	1.0	8	32.00	E	$2.88	incl. in rate	incl. in rate	$92.06
Electrician	Active	2.00	1.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Millwright	Active	2.00	1.0	8	16.00	L	$69.46	incl. in rate	incl. in rate	$1,111.36
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Equipment Operator (oiler)	Active	1.00	1.0	8	8.00	L	$62.94	incl. in rate	incl. in rate	$503.52

Labor Hours	**176**	**TOTAL LABOR**	**$7,814.08**
Equipment Hours	**64**	**TOTAL EQUIPMENT**	**$9,149.18**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$781.41	$781.41
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	2,000.00	LF	1.000	2,000.00	$0.85	$1,700.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$2,481.41**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	1.20	ton	1.000	1.20	$595.00	$714.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
					TOTAL SUBCONTRACTS	**$917.00**

SUMMARY OF COSTS

Labor Cost	$7,814.08	Labor Burden @	49.7%	$0.00	$7,814.08
Material Cost	$2,481.41	Material Tax @	7.8%	$192.31	$2,673.72
Equipment Cost	$9,149.18	Equipment Tax @	0.0%	$0.00	$9,149.18
Subcontractors	$917.00				$917.00
DIRECT COST SUBTOTALS	**$20,362**			**$192**	**DIRECT COST SUBTOTALS** **$20,554**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$19,636.98	$2,945.55
Installing Contractors Profit@	8.0%				$19,636.98	$1,570.96
GC Markup on Subs @	5.0%				$917.00	$45.85
					TOTAL MARKUP COSTS	**$4,562.36**
General Contractors Insurance @	1.0%		on		$25,116.34	$251
Bond @	1.0%		on		$25,116.34	$251
Contingency @	0.0%		on		$25,618.66	$0
					TOTAL COST for pay item	**$25,619**

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Assumed contains paint with heavy metals 10% of the total lbs., calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.043		**Project**	:	IRON GATE			
Description	:	Remove and Dispose of Gorvernor							
Quantity	:	20,310.00 lbs							
Daily Production	:	25,000.00 lbs per	8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	0.8 Days		**Estimator**	:	Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$1.04 per lbs		**Probable Low Cost Parameter**			**28750**	**$17,878**	**$0.88**
Total Cost	:	$21,033		**Probable High Cost Parameter**			**20000**	**$25,240**	**$1.24**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	0.8	8	12.80	L	$48.27	incl. in rate	incl. in rate	$617.86
Laborer	Active	8.00	0.8	8	51.20	L	$45.80	incl. in rate	incl. in rate	$2,344.96
Crawler Crane (270tn)	Active	2.00	0.8	8	12.80	E	$399.50	incl. in rate	incl. in rate	$5,113.60
Equipment Operator (medium)	Active	2.00	0.8	8	12.80	L	$66.28	incl. in rate	incl. in rate	$848.38
Welder	Active	4.00	0.8	8	25.60	L	$7.84	incl. in rate	incl. in rate	$200.64
Gas Welding Machine	Active	4.00	0.8	8	25.60	E	$2.88	incl. in rate	incl. in rate	$73.65
Electrician	Active	2.00	0.8	8	12.80	L	$45.23	incl. in rate	incl. in rate	$578.94
Millwright	Active	2.00	0.8	8	12.80	L	$69.46	incl. in rate	incl. in rate	$889.09
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.8	8	6.40	E	$111.64	incl. in rate	incl. in rate	$714.50
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.8	8	6.40	E	$221.50	incl. in rate	incl. in rate	$1,417.60
Truck Driver (heavy)	Active	1.00	0.8	8	6.40	L	$57.59	incl. in rate	incl. in rate	$368.58
Equipment Operator (oiler)	Active	1.00	0.8	8	6.40	L	$62.94	incl. in rate	incl. in rate	$402.82

Labor Hours	**140.8**	**TOTAL LABOR**	**$6,251.26**
Equipment Hours	**51.2**	**TOTAL EQUIPMENT**	**$7,319.35**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$625.13	$625.13
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	2,000.00	LF	1.000	2,000.00	$0.85	$1,700.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$2,325.13**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	1.02	ton	1.000	1.02	$595.00	$604.22
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$807.22**

SUMMARY OF COSTS

Labor Cost	$6,251.26	Labor Burden @	49.7%	$0.00		$6,251.26
Material Cost	$2,325.13	Material Tax @	7.8%	$180.20		$2,505.32
Equipment Cost	$7,319.35	Equipment Tax @	0.0%	$0.00		$7,319.35
Subcontractors	$807.22					$807.22
DIRECT COST SUBTOTALS	**$16,703**			**$180**	**DIRECT COST SUBTOTALS**	**$16,883**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$16,075.93		$2,411.39
Installing Contractors Profit@	8.0%				$16,075.93		$1,286.07
GC Markup on Subs @	5.0%				$807.22		$40.36
						TOTAL MARKUP COSTS	**$3,737.83**
General Contractors Insurance @	1.0%		on		$20,620.98		$206
Bond @	1.0%		on		$20,620.98		$206
Contingency @	0.0%		on		$21,033.40		$0
						TOTAL COST for pay item	**$21,033**

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Assumed contains paint with heavy metals 10% of the total lbs., calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.044		**Project**	: IRON GATE			
Description	:	Remove and Dispose of Bearing Oil System and Cooling Water System						
Quantity	:	9,182.00 lbs						
Daily Production	:	6,000.00 lbs per	8 hour shift	**Project #**	: 4			
Work Days	:	1.5 Days		**Estimator**	: Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$1.06 per lbs		**Probable Low Cost Parameter**		**6900**	**$8,297**	**$0.90**
Total Cost	:	$9,761		**Probable High Cost Parameter**		**4800**	**$11,713**	**$1.28**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.5	8	12.00	L	$48.27	incl. in rate	incl. in rate	$579.24
Laborer	Active	2.00	1.5	8	24.00	L	$45.80	incl. in rate	incl. in rate	$1,099.20
Steelworker	Active	2.00	1.5	8	24.00	L	$65.52	incl. in rate	incl. in rate	$1,572.48
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.5	8	4.00	E	$221.50	incl. in rate	incl. in rate	$886.00
Truck Driver (heavy)	Active	1.00	0.5	8	4.00	L	$57.59	incl. in rate	incl. in rate	$230.36
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.5	8	4.00	E	$111.64	incl. in rate	incl. in rate	$446.56
Equipment Operator (light)	Active	1.00	0.5	8	4.00	L	$64.90	incl. in rate	incl. in rate	$259.60

Labor Hours	**68**	**TOTAL LABOR**	**$3,740.88**
Equipment Hours	**8**	**TOTAL EQUIPMENT**	**$1,332.56**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$187.04	$187.04
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$187.04**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	4.59	ton	1.000	4.59	$595.00	$2,731.65
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
						$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$2,934.65**

SUMMARY OF COSTS

Labor Cost	$3,740.88	Labor Burden @	49.7%	$0.00		$3,740.88
Material Cost	$187.04	Material Tax @	7.8%	$14.50		$201.54
Equipment Cost	$1,332.56	Equipment Tax @	0.0%	$0.00		$1,332.56
Subcontractors	$2,934.65					$2,934.65
DIRECT COST SUBTOTALS	**$8,195**			**$14**	**DIRECT COST SUBTOTALS**	**$8,210**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$5,274.98		$791.25
Installing Contractors Profit@	8.0%				$5,274.98		$422.00
GC Markup on Subs @	5.0%				$2,934.65		$146.73
						TOTAL MARKUP COSTS	**$1,359.98**
General Contractors Insurance @	1.0%		on		$9,569.60		$96
Bond @	1.0%		on		$9,569.60		$96
Contingency @	0.0%		on		$9,760.99		$0
						TOTAL COST for pay item	**$9,761**

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 3375 LF of 1 1/2" oil pipes at 2.72 Lbs. Used 1 Forman, 2 Steelworkers to cut the pipes and 3 Laborers to load the pipes in the truck.
The cooling and lubrication systems for the Hydroelectric Barge turbine, speed increaser and generator will be a combination of water and oil. These systems will be isolated from the water passages so that no contamination of passing water will occur. The following is a list of hazardous materials, substances, chemicals, and wastes normally found at a hydropower facility that may require disposal actions if not recycled or reused for their intended purpose:

1. Polychlorinated Biphenyls (PCBs)
2. Asbestos
3. Paint/abrasive blast grit (red lead paint)
4. Oil
5. Mercury
6. Antifreeze
7. Halogenated and non-halogenated solvents
8. Greases
9. Pesticides (includes herbicides, insecticides, and wood preservatives)
10. Petroleum contaminated
11. Chlorinated fluorocarbons (CFCs) Freon/Halon
12. Gasoline/diesel (includes product and sludge in tanks)
13. Batteries (includes acid)
14. Water treatment sludge (septic tanks/wastewater treatment)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.045	**Project**	: IRON GATE				
Description	:	Remove and Dispose of CO2 Systems						
Quantity	:	2,568.00 lbs						
Daily Production	:	6,000.00 lbs per 8 hour shift	**Project #**	: Klamath Dams Removal				
Work Days	:	0.4 Days	**Estimator**	: Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**	
Unit Price	:	$1.01 per lbs	**Probable Low Cost Parameter**		**6600**	**$2,343**	**$0.91**	
Total Cost	:	$2,604	**Probable High Cost Parameter**		**4800**	**$3,124**	**$1.22**	

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Loader, FE Rubber Tire (3.5cy)	Active	1.00	0.4	8	3.20	E	$64.23	incl. in rate	incl. in rate	$205.54
Equipment Operator (light)	Active	1.00	0.4	8	3.20	L	$64.90	incl. in rate	incl. in rate	$207.68
Truck Driver (light)	Active	1.00	0.4	8	3.20	L	$56.29	incl. in rate	incl. in rate	$180.13
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.4	8	3.20	E	$111.64	incl. in rate	incl. in rate	$357.25
Gas Welding Machine	Active	1.00	0.4	8	3.20	E	$2.88	incl. in rate	incl. in rate	$9.21
Laborer	Active	3.00	0.4	8	9.60	L	$45.80	incl. in rate	incl. in rate	$439.68
Steelworker	Active	2.00	0.4	8	6.40	L	$65.52	incl. in rate	incl. in rate	$419.33
Labor Foreman	Active	1.00	0.4	8	3.20	L	$48.27	incl. in rate	incl. in rate	$154.46
Welder	Active	1.00	0.4	8	3.20	L	$7.84	incl. in rate	incl. in rate	$25.08

Labor Hours	**28.8**	**TOTAL LABOR**	**$1,426.36**
Equipment Hours	**9.6**	**TOTAL EQUIPMENT**	**$571.99**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$71.32	$71.32
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$71.32**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,426.36	Labor Burden @	49.7%	$0.00		$1,426.36
Material Cost	$71.32	Material Tax @	7.8%	$5.53		$76.85
Equipment Cost	$571.99	Equipment Tax @	0.0%	$0.00		$571.99
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$2,070**			**$6**	**DIRECT COST SUBTOTALS**	**$2,075**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$2,075.20		$311.28
Installing Contractors Profit@	8.0%				$2,075.20		$166.02
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$477.29**
General Contractors Insurance @	1.0%		on		$2,552.49		$26
Bond @	1.0%		on		$2,552.49		$26
Contingency @	0.0%		on		$2,603.54		$0
						TOTAL COST for pay item	**$2,604**

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 945 LF of 1 1/2" pipes at 2.72 Lbs. Used 1 Forman, 2 Steelworkers/ 1 Welder to cut the pipes and 3 Laborers to haul the pipes in the truck with the loader.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.046	**Project**	:	IRON GATE			
Description	:	Remove and Dispose of Plant Water and Fire Protection System						
Quantity	:	9,182.00 lbs						
Daily Production	:	6,000.00 lbs per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	1.5 Days	**Estimator**	:	Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$1.05 per lbs	**Probable Low Cost Parameter**			**6600**	**$8,636**	**$0.94**
Total Cost	:	$9,596	**Probable High Cost Parameter**			**4800**	**$11,515**	**$1.25**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.5	8	12.00	L	$48.27	incl. in rate	incl. in rate	$579.24
Laborer	Active	3.00	1.5	8	36.00	L	$45.80	incl. in rate	incl. in rate	$1,648.80
Truck Driver (light)	Active	1.00	1.5	8	12.00	L	$56.29	incl. in rate	incl. in rate	$675.48
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.5	8	12.00	E	$111.64	incl. in rate	incl. in rate	$1,339.68
Steelworker	Active	2.00	1.5	8	24.00	L	$65.52	incl. in rate	incl. in rate	$1,572.48
Loader, FE Rubber Tire (3.5cy)	Active	1.00	1.5	8	12.00	E	$64.23	incl. in rate	incl. in rate	$770.76
Equipment Operator (light)	Active	1.00	1.5	8	12.00	L	$64.90	incl. in rate	incl. in rate	$778.80

Labor Hours	**96**	**TOTAL LABOR**	**$5,254.80**
Equipment Hours	**24**	**TOTAL EQUIPMENT**	**$2,110.44**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$262.74	$262.74
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$262.74**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$5,254.80	Labor Burden @	49.7%	$0.00		$5,254.80
Material Cost	$262.74	Material Tax @	7.8%	$20.36		$283.10
Equipment Cost	$2,110.44	Equipment Tax @	0.0%	$0.00		$2,110.44
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$7,628**			**$20**	**DIRECT COST SUBTOTALS**	**$7,648**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$7,648.34	$1,147.25
Installing Contractors Profit@	8.0%				$7,648.34	$611.87
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,759.12**
General Contractors Insurance @	1.0%		on		$9,407.46	$94
Bond @	1.0%		on		$9,407.46	$94
Contingency @	0.0%		on		$9,595.61	$0
					TOTAL COST for pay item	**$9,596**

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 3375 LF of 1 1/2" pipes at 2.72 Lbs. Used 1 Forman, 2 Steelworkers to cut the pipes and 3 Laborers to load the pipes in the truck.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.047			Project	: IRON GATE			
Description	:	Remove and Dispose of Oil Sump Pumps							
Quantity	:	2,000.00	lbs						
Daily Production	:	6,000.00	lbs per	8 hour shift	Project #	: 4			
Work Days	:	0.3	Days		Estimator	: Mihaela Tomulescu	lbs per	Total Cost	Unit Price Per lbs
Unit Price	:	$1.05	per lbs		Probable Low Cost Parameter		6600	$1,883	$0.94
Total Cost	:	$2,092			Probable High Cost Parameter		4800	$2,510	$1.26

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.3	8	2.40	L	$48.27	incl. in rate	incl. in rate	$115.85
Electrician	Active	1.00	0.3	8	2.40	L	$45.23	incl. in rate	incl. in rate	$108.55
Laborer	Active	2.00	0.3	8	4.80	L	$45.80	incl. in rate	incl. in rate	$219.84
Hydraulic Crane (17tn)	Active	1.00	0.2	8	1.60	E	$81.52	incl. in rate	incl. in rate	$130.43
Truck Driver (heavy)	Active	1.00	0.2	8	1.60	L	$57.59	incl. in rate	incl. in rate	$92.14
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.2	8	1.60	E	$111.64	incl. in rate	incl. in rate	$178.62
Equipment Operator (medium)	Active	1.00	0.2	8	1.60	L	$66.28	incl. in rate	incl. in rate	$106.05

Labor Hours	12.8	TOTAL LABOR	$642.43
Equipment Hours	3.2	TOTAL EQUIPMENT	$309.06

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$32.12	$32.12
						$0.00
					TOTAL MATERIAL	$32.12

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (assumed weight)	1.00	ton	1.000	1.00	$595.00	$595.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
					TOTAL SUBCONTRACTS	$798.00

SUMMARY OF COSTS

Labor Cost	$642.43	Labor Burden @	49.7%	$0.00	$642.43
Material Cost	$32.12	Material Tax @	7.8%	$2.49	$34.61
Equipment Cost	$309.06	Equipment Tax @	0.0%	$0.00	$309.06
Subcontractors	$798.00				$798.00
DIRECT COST SUBTOTALS	**$1,782**			**$2**	**DIRECT COST SUBTOTALS** **$1,784**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$986.10	$147.91
Installing Contractors Profit@	8.0%				$986.10	$78.89
GC Markup on Subs @	5.0%				$798.00	$39.90
					TOTAL MARKUP COSTS	$266.70
General Contractors Insurance @	1.0%		on		$2,050.80	$21
Bond @	1.0%		on		$2,050.80	$21
Contingency @	0.0%		on		$2,091.82	$0
					TOTAL COST for pay item	**$2,092**

Additional Pay Item Notes :

Used 1 crane to pick up the oil sump pumps, 1 Forman and 2 Laborers to remove the pumps. One electrician to unplug the power and assure the temporary power at the construction site. Assumed hazardous waste since we deal with the oil sump pump.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.048		**Project**	:	IRON GATE			
Description	:	Remove and Dispose of Pumps							
Quantity	:	22,000.00	lbs						
Daily Production	:	18,000.00	lbs per	8	hour shift	**Project #**	:	Klamath Dams Removal	
Work Days	:	1.2	Days			**Estimator**	:	Mihaela Tomulescu	
Unit Price	:	$1.09	per lbs			**Probable Low Cost Parameter**		**19800**	**$21,676**	**$0.99**
Total Cost	:	$24,084				**Probable High Cost Parameter**		**14400**	**$28,901**	**$1.31**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	1.2	8	19.20	L	$48.27	incl. in rate	incl. in rate	$926.78
Laborer	Active	4.00	1.2	8	38.40	L	$45.80	incl. in rate	incl. in rate	$1,758.72
Crawler Crane (270tn)	Active	2.00	1.2	8	19.20	E	$399.50	incl. in rate	incl. in rate	$7,670.40
Equipment Operator (medium)	Active	2.00	1.2	8	19.20	L	$66.28	incl. in rate	incl. in rate	$1,272.58
Welder	Active	2.00	1.2	8	19.20	L	$7.84	incl. in rate	incl. in rate	$150.48
Gas Welding Machine	Active	2.00	1.2	8	19.20	E	$2.88	incl. in rate	incl. in rate	$55.24
Electrician	Active	1.00	1.2	8	9.60	L	$45.23	incl. in rate	incl. in rate	$434.21
Millwright	Active	2.00	1.2	8	19.20	L	$69.46	incl. in rate	incl. in rate	$1,333.63
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.2	8	9.60	E	$111.64	incl. in rate	incl. in rate	$1,071.74
Equipment Operator (crane)	Active	1.00	1.2	8	9.60	L	$68.41	incl. in rate	incl. in rate	$656.74
Truck Driver (light)	Active	1.00	1.2	8	9.60	L	$56.29	incl. in rate	incl. in rate	$540.38

Labor Hours	**144**	**TOTAL LABOR**	**$7,073.52**
Equipment Hours	**48**	**TOTAL EQUIPMENT**	**$8,797.38**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$707.35	$707.35
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	2,000.00	LF	1.000	2,000.00	$0.85	$1,700.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$2,407.35**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	1.10	ton	1.000	1.10	$595.00	$654.50
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$857.50**

SUMMARY OF COSTS

Labor Cost	$7,073.52	Labor Burden @	49.7%	$0.00		$7,073.52
Material Cost	$2,407.35	Material Tax @	7.8%	$186.57		$2,593.92
Equipment Cost	$8,797.38	Equipment Tax @	0.0%	$0.00		$8,797.38
Subcontractors	$857.50					$857.50
DIRECT COST SUBTOTALS	**$19,136**			**$187**	**DIRECT COST SUBTOTALS**	**$19,322**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$18,464.82	$2,769.72
Installing Contractors Profit@	8.0%				$18,464.82	$1,477.19
GC Markup on Subs @	5.0%				$857.50	$42.88
					TOTAL MARKUP COSTS	**$4,289.78**
General Contractors Insurance @	1.0%		on		$23,612.11	$236
Bond @	1.0%		on		$23,612.11	$236
Contingency @	0.0%		on		$24,084.35	$0
					TOTAL COST for pay item	**$24,084**

Additional Pay Item Notes :

Used 2 Crew formed of 1 crane to pick up the pumps, 1 Forman, 1 Millwright to cut steel , 1 Welder to cut steel in inaccessible places and 2 Laborers to remove the pumps. 1 electrician to unplug the power and assure the temporary power at the construction site. Calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.049			**Project**	: IRON GATE			
Description	:	Remove and Dispose of Exposed Piping Around the Plant							
Quantity	:	19,291.00	lbs						
Daily Production	:	14,500.00	lbs per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	1.3	Days		**Estimator**	: Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$1.05	per lbs		**Probable Low Cost Parameter**		**15950**	**$18,257**	**$0.95**
Total Cost	:	$20,285			**Probable High Cost Parameter**		**11600**	**$24,342**	**$1.26**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	1.3	8	20.80	L	$48.27	incl. in rate	incl. in rate	$1,004.02
Laborer	Active	6.00	1.3	8	62.40	L	$45.80	incl. in rate	incl. in rate	$2,857.92
Truck Driver (heavy)	Active	1.00	1.3	8	10.40	L	$57.59	incl. in rate	incl. in rate	$598.94
Equipment Operator (oiler)	Active	1.00	1.3	8	10.40	L	$62.94	incl. in rate	incl. in rate	$654.58
Welder	Active	4.00	1.3	8	41.60	L	$7.84	incl. in rate	incl. in rate	$326.04
Gas Welding Machine	Active	4.00	1.3	8	41.60	E	$2.88	incl. in rate	incl. in rate	$119.68
Electrician	Active	2.00	1.3	8	20.80	L	$45.23	incl. in rate	incl. in rate	$940.78
Steelworker	Active	4.00	1.3	8	41.60	L	$65.52	incl. in rate	incl. in rate	$2,725.63
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.3	8	10.40	E	$111.64	incl. in rate	incl. in rate	$1,161.06
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.3	8	10.40	E	$221.50	incl. in rate	incl. in rate	$2,303.60

Labor Hours	**208**	**TOTAL LABOR**	**$9,107.90**
Equipment Hours	**62.4**	**TOTAL EQUIPMENT**	**$3,584.34**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$910.79	$910.79
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	2,000.00	LF	1.000	2,000.00	$0.85	$1,700.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$2,610.79**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.96	ton	1.000	0.96 $595.00	$573.91
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00 $7.25	$203.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$776.91**

SUMMARY OF COSTS

Labor Cost	$9,107.90	Labor Burden @	49.7%	$0.00	$9,107.90
Material Cost	$2,610.79	Material Tax @	7.8%	$202.34	$2,813.13
Equipment Cost	$3,584.34	Equipment Tax @	0.0%	$0.00	$3,584.34
Subcontractors	$776.91				$776.91
DIRECT COST SUBTOTALS	**$16,080**			**$202**	**DIRECT COST SUBTOTALS** **$16,282**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$15,505.37	$2,325.81
Installing Contractors Profit@	8.0%				$15,505.37	$1,240.43
GC Markup on Subs @	5.0%				$776.91	$38.85
						TOTAL MARKUP COSTS **$3,605.08**
General Contractors Insurance @	1.0%		on		$19,887.36	$199
Bond @	1.0%		on		$19,887.36	$199
Contingency @	0.0%		on		$20,285.10	$0
						TOTAL COST for pay item **$20,285**

Additional Pay Item Notes :

Used RS Means : Assumed Pipe, metal pipe, to 1-1/2" diam., selective demolition, 9200 LF of 1 1/2" pipes at 2.72 Lbs. Used 2 Crew formed of 1 Forman, 2 Steelworkers to cut the pipes, 1 Welder to cut steel in inaccessible places , 3 Laborers to haul the pipes in the truck with the loader, 1 electrician to unplug the power and assure the temporary power at the construction site.. Assumed contains paint with heavy metals 10% of the total lbs. calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.050		**Project**	: IRON GATE			
Description	: Remove and Dispose of Unwatering Piping						
Quantity	: 19,291.00 lbs						
Daily Production	: 18,000.00 lbs per	8 hour shift	**Project #**	: 4			
Work Days	: 1.1 Days		**Estimator**	: Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	: $0.88 per lbs		**Probable Low Cost Parameter**		**19800**	**$15,270**	**$0.79**
Total Cost	: $16,967		**Probable High Cost Parameter**		**15300**	**$19,512**	**$1.01**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.1	8	8.80	L	$48.27	incl. in rate	incl. in rate	$424.78
Electrician	Active	1.00	1.1	8	8.80	L	$45.23	incl. in rate	incl. in rate	$398.02
Steelworker	Active	2.00	1.1	8	17.60	L	$65.52	incl. in rate	incl. in rate	$1,153.15
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.1	8	8.80	E	$221.50	incl. in rate	incl. in rate	$1,949.20
Truck Driver (heavy)	Active	1.00	1.1	8	8.80	L	$57.59	incl. in rate	incl. in rate	$506.79
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.1	8	8.80	E	$111.64	incl. in rate	incl. in rate	$982.43
Laborer	Active	3.00	1.1	8	26.40	L	$45.80	incl. in rate	incl. in rate	$1,209.12
Welder	Active	1.00	1.1	8	8.80	L	$7.84	incl. in rate	incl. in rate	$68.97
Gas Welding Machine	Active	1.00	1.1	8	8.80	E	$2.88	incl. in rate	incl. in rate	$25.32
Equipment Operator (medium)	Active	1.00	1.1	8	8.80	L	$66.28	incl. in rate	incl. in rate	$583.26

Labor Hours	**88**	**TOTAL LABOR**	**$4,344.10**
Equipment Hours	**26.4**	**TOTAL EQUIPMENT**	**$2,956.95**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$217.20	$217.20
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	1,000.00	LF	1.000	1,000.00	$0.85	$850.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$1,067.20**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	9.65	ton	1.000	9.65	$595.00	$5,739.07
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$5,942.07**

SUMMARY OF COSTS

Labor Cost	$4,344.10	Labor Burden @	49.7%	$0.00	$4,344.10
Material Cost	$1,067.20	Material Tax @	7.8%	$82.71	$1,149.91
Equipment Cost	$2,956.95	Equipment Tax @	0.0%	$0.00	$2,956.95
Subcontractors	$5,942.07				$5,942.07
DIRECT COST SUBTOTALS	**$14,310**			**$83**	**DIRECT COST SUBTOTALS** **$14,393**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$8,450.96	$1,267.64
Installing Contractors Profit@	8.0%				$8,450.96	$676.08
GC Markup on Subs @	5.0%				$5,942.07	$297.10
					TOTAL MARKUP COSTS	**$2,240.82**
General Contractors Insurance @	1.0%		on		$16,633.86	$166
Bond @	1.0%		on		$16,633.86	$166
Contingency @	0.0%		on		$16,966.54	$0
					TOTAL COST for pay item	**$16,967**

Additional Pay Item Notes :

Used RS Means : Assumed Pipe, metal pipe, to 1-1/2" diam., selective demolition, 7100 LF of 1 1/2" pipes at 2.72 Lbs. Used 1 Crew formed of 1 Forman, 2 Steelworkers to cut the pipes, 1 Welder to cut steel in inaccessible places , 3 Laborers to haul the pipes in the truck with the loader, 1 electrician to unplug the power and to assure the temporary power at the construction site. Calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.051		**Project**	: IRON GATE				
Description	:	Remove and Dispose of Drainage Piping							
Quantity	:	9,518.00 lbs							
Daily Production	:	4,450.00 lbs per	8 hour shift	**Project #**	: 4				
Work Days	:	2.1 Days		**Estimator**	: Mihaela Tomulescu		**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$1.12 per lbs		**Probable Low Cost Parameter**			**4895**	**$9,591**	**$1.01**
Total Cost	:	$10,657		**Probable High Cost Parameter**			**3782.5**	**$12,256**	**$1.29**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	2.1	8	16.80	L	$48.27	incl. in rate	incl. in rate	$810.94
Laborer	Active	2.00	2.1	8	33.60	L	$45.80	incl. in rate	incl. in rate	$1,538.88
Steelworker	Active	2.00	2.1	8	33.60	L	$65.52	incl. in rate	incl. in rate	$2,201.47
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Equipment Operator (light)	Active	1.00	1.0	8	8.00	L	$64.90	incl. in rate	incl. in rate	$519.20

Labor Hours	**100**	**TOTAL LABOR**	**$5,531.21**
Equipment Hours	**16**	**TOTAL EQUIPMENT**	**$2,665.12**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$276.56	$276.56
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$276.56**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$5,531.21	Labor Burden @	49.7%	$0.00		$5,531.21
Material Cost	$276.56	Material Tax @	7.8%	$21.43		$297.99
Equipment Cost	$2,665.12	Equipment Tax @	0.0%	$0.00		$2,665.12
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$8,473**			**$21**	**DIRECT COST SUBTOTALS**	**$8,494**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$8,494.32		$1,274.15
Installing Contractors Profit@	8.0%				$8,494.32		$679.55
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$1,953.69**
General Contractors Insurance @	1.0%		on		$10,448.02		$104
Bond @	1.0%		on		$10,448.02		$104
Contingency @	0.0%		on		$10,656.98		$0
						TOTAL COST for pay item	**$10,657**

Additional Pay Item Notes :

2600 LF of 1 " drainage pipes at 3.66 Lbs. Used 1 Loader and 1 Forman, 2 Steelworkers to cut the pipes and 2 Laborers to load the pipes in the truck.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.052			**Project**	: IRON GATE			
Description	:	Remove and Dispose of Transformer Oil and Fire Protection Pipes							
Quantity	:	9,182.00 lbs							
Daily Production	:	6,000.00 lbs per	8	hour shift	**Project #**	: 4			
Work Days	:	1.5 Days			**Estimator**	: Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$1.00 per lbs			**Probable Low Cost Parameter**		**6300**	**$8,739**	**$0.95**
Total Cost	:	$9,199			**Probable High Cost Parameter**		**5400**	**$10,119**	**$1.10**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Laborer	Active	2.00	1.5	8	24.00	L	$45.80	incl. in rate	incl. in rate	$1,099.20
Truck Driver (light)	Active	1.00	1.0	8	8.00	L	$56.29	incl. in rate	incl. in rate	$450.32
Steelworker	Active	2.00	1.5	8	24.00	L	$65.52	incl. in rate	incl. in rate	$1,572.48
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Pump, Centrifugal, 3"	Active	1.00	1.5	8	12.00	E	$2.76	incl. in rate	incl. in rate	$33.07
Labor Foreman	Active	1.00	1.5	8	12.00	L	$48.27	incl. in rate	incl. in rate	$579.24

Labor Hours	**68**	**TOTAL LABOR**	**$3,701.24**
Equipment Hours	**20**	**TOTAL EQUIPMENT**	**$926.19**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$185.06	$185.06
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$185.06**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	4.59	ton	1.000	4.59	$595.00	$2,731.65
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
						$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$2,934.65**

SUMMARY OF COSTS

Labor Cost	$3,701.24	Labor Burden @	49.7%	$0.00		$3,701.24
Material Cost	$185.06	Material Tax @	7.8%	$14.34		$199.40
Equipment Cost	$926.19	Equipment Tax @	0.0%	$0.00		$926.19
Subcontractors	$2,934.65					$2,934.65
DIRECT COST SUBTOTALS	**$7,747**			**$14**	**DIRECT COST SUBTOTALS**	**$7,761**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$4,826.83		$724.02
Installing Contractors Profit@	8.0%				$4,826.83		$386.15
GC Markup on Subs @	5.0%				$2,934.65		$146.73
						TOTAL MARKUP COSTS	**$1,256.90**
General Contractors Insurance @	1.0%		on		$9,018.38		$90
Bond @	1.0%		on		$9,018.38		$90
Contingency @	0.0%		on		$9,198.75		$0
						TOTAL COST for pay item	**$9,199**

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 3375 LF of 1 1/2" fire protection pipes at 2.72 Lbs. Used 1 Forman, 2 Steelworkers to cut the pipes and 3 Laborers to load the pipes in the truck. Used a pump for the oil disposal. Each hydropower facility has at least 150,000 gallons to 250,000 gallon of oil currently in use. This oil would have to be properly disposed of in the event of decommissioning. Oil removed from the turbines and other equipment, including transformer oil, would be either a waste oil or used oil, depending on prior use and contaminants found in the oil. Containerized oil containing contaminants such as solvents are commonly encountered at hydropower facilities. Oil sludges are common in tanks. Oil disposal would likely be costly due to the large volumes found at hydropower facilities and the ease of contamination with other regulated hazardous wastes. Calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.053			**Project**	: IRONGATE			
Description	:	Remove and Dispose of Compressed Air System							
Quantity	:	1,450.00 lbs							
Daily Production	:	6,000.00 lbs per	8	hour shift	**Project #**	: 4			
Work Days	:	0.242 Days			**Estimator**	: Mihaela Tomulescu	**lbs per**	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$0.91 per lbs			**Probable Low Cost Parameter**		**6600**	**$1,182**	**$0.81**
Total Cost	:	$1,313			**Probable High Cost Parameter**		**5100**	**$1,510**	**$1.04**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Loader, FE Rubber Tire (5.25cy)	Active	1.00	0.242	8	1.93	E	$75.42	incl. in rate	incl. in rate	$145.81
Laborer	Active	1.00	0.242	8	1.93	L	$45.80	incl. in rate	incl. in rate	$88.55
Steelworker	Active	1.00	0.242	8	1.93	L	$65.52	incl. in rate	incl. in rate	$126.67
Equipment Operator (light)	Active	1.00	0.242	8	1.93	L	$64.90	incl. in rate	incl. in rate	$125.47

Labor Hours	**5.8**	**TOTAL LABOR**	**$340.69**
Equipment Hours	**1.933333333**	**TOTAL EQUIPMENT**	**$145.81**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price			Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$17.03			$17.03
								$0.00
								$0.00
								$0.00
								$0.00
								$0.00
						TOTAL MATERIAL		**$17.03**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price				Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.73	ton	1.000	0.73	$595.00			$431.38
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25			$203.00
								$0.00
								$0.00
						TOTAL SUBCONTRACTS		**$634.38**

SUMMARY OF COSTS

Labor Cost	$340.69	Labor Burden @	49.7%	$0.00		$340.69
Material Cost	$17.03	Material Tax @	7.8%	$1.32		$18.35
Equipment Cost	$145.81	Equipment Tax @	0.0%	$0.00		$145.81
Subcontractors	$634.38					$634.38
DIRECT COST SUBTOTALS	**$1,138**			**$1**	**DIRECT COST SUBTOTALS**	**$1,139**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$504.86		$75.73
Installing Contractors Profit@	8.0%				$504.86		$40.39
GC Markup on Subs @	5.0%				$634.38		$31.72
						TOTAL MARKUP COSTS	**$147.84**
General Contractors Insurance @	1.0%		on		$1,287.07		$13
Bond @	1.0%		on		$1,287.07		$13
Contingency @	0.0%		on		$1,312.81		$0
						TOTAL COST for pay item	**$1,313**

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 535 LF of 1 1/2" pipes at 2.72 Lbs. Used 1 Steelworkers to cut the pipes and 1 Laborers for hauling. Assumed hazardous waste 100% of the total lbs, calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.053a			Project	: IRON GATE			
Description	:	Remove & Dispose - Petroleum Products from Mechanical Equip.							
Quantity	:	1,100.00	GAL						
Daily Production	:	550.00	GAL per	8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	2.0	Days		Estimator	: Mihaela Tomulescu	GAL per	Total Cost	Unit Price Per GAL
Unit Price	:	$10.05	per GAL		Probable Low Cost Parameter		577.5	$10,504	$10
Total Cost	:	$11,057			Probable High Cost Parameter		495	$12,163	$11

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	2.0	8	16.00	L	$48.27	incl. in rate	incl. in rate	$772.32
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Laborer	Active	5.00	2.0	8	80.00	L	$45.80	incl. in rate	incl. in rate	$3,664.00
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44

Labor Hours	128	TOTAL LABOR	$6,081.44
Equipment Hours	0	TOTAL EQUIPMENT	$0.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	0.00	LS	1.000	0.00	$0.00	$0.00
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, liquid pickup, vacuum truck, stainless steel tank, 5000 gallons, minimum charge, 4 hours, 2 compartment	16.00	hour	1.000	$200.00	$3,200.00
				TOTAL SUBCONTRACTS	$3,200.00

SUMMARY OF COSTS

Labor Cost	$6,081.44	Labor Burden @	49.7%	$0.00		$6,081.44
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00		$0.00
Subcontractors	$3,200.00					$3,200.00
DIRECT COST SUBTOTALS	$9,281			$0	DIRECT COST SUBTOTALS	$9,281

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$6,081.44	$912.22
Installing Contractors Profit@	8.0%				$6,081.44	$486.52
GC Markup on Subs @	5.0%				$3,200.00	$160.00
					TOTAL MARKUP COSTS	$1,558.73
General Contractors Insurance @	1.0%		on		$10,840.17	$108
Bond @	1.0%		on		$10,840.17	$108
Contingency @	0.0%		on		$11,056.97	$0
					TOTAL COST for pay item	$11,057

Additional Pay Item Notes :

Petroleum-based products, ranging from fuel oil and hydraulic fluid to lubricating greases and oils, are found throughout every type of power generating plant or system. Lubrication supports bearings and moving parts in all sorts of equipment: pumps, conveyors, feeders, scrubbers, cranes, turbines, and more. A good oil/water separation system will result in a flow of concentrated waste oil to a collection area and a flow of oil-free water ready for secondary processing or discharge. Once an oil layer has been separated from free water, it must be removed for recycling or disposal. Many plants use one or more of these oil removal methods, but each has costly limitations:

1. Absorbent materials. Absorbent mats or materials are frequently used to dam up and absorb excess oils and greases resulting from accidents or the routine operation of machinery. These materials are very effective for preventing the spread of a source leak and very efficient in terms of oil pickup. Yet, their use on large volumes of waste oil results in multiple, recurring costs that can make them impractical as an everyday solution:
   - the costs of the materials themselves
   - the labor costs for ordering, stocking, application, and removal
   - the costs of used-media collection, disposal, or re-processing/recycling.
2. Manually operated “slotted pipes.” Many separators feature a “slotted pipe,” a pipe located near the top of the vessel that has a horizontal opening. Oil is removed by turning the horizontal opening downward until it meets the floating oil layer, which drains through the pipe to a collection receptacle. These pipes work well on thick layers of oil, but cannot drain off a sheen of oil without draining off a large amount of water as well.

AECOM assumed the best is Vacuum truck removal method .Used a crew formed of 1 Forman, 5 Laborers to takeout the petroleum waste, 1 Electrician to unplug the power and to assure the temporary power at the construction site. Vacuum-equipped tank trucks are used to remove waste oil from collection points at plants so that it can be transported to recycling or disposal locations. If the waste oil has been thoroughly separated, highly concentrated, and stored in an appropriate receptacle, this service can be used very efficiently. However, vacuum disposal units are often used to pump oil layers directly off of water. This results in the intake of a significant amount free water along with the waste oil – and a significantly higher cost.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.054			**Project**	: Iron Gate			
Description	:	Remove and Dispose of AC Generator, Outdoor Horizontal							
Quantity	:	1.00	EA						
Daily Production	:	0.10	EA per	8 hour shift	**Project #**	: 4			
Work Days	:	10.0	Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$91,158.88	per EA		**Probable Low Cost Parameter**		**0.11**	**$82,043**	**$82,043**
Total Cost	:	$91,159			**Probable High Cost Parameter**		**0.085**	**$104,833**	**$104,833**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (120tn)	Active	2.00	2.5	8	40.00	E	$239.06	incl. in rate	incl. in rate	$9,562.40
Electrician	Active	3.00	10.0	8	240.00	L	$45.23	incl. in rate	incl. in rate	$10,855.20
Equipment Operator (oiler)	Active	2.00	10.0	8	160.00	L	$62.94	incl. in rate	incl. in rate	$10,070.40
Equipment Operator (crane)	Active	2.00	2.5	8	40.00	L	$68.41	incl. in rate	incl. in rate	$2,736.40
Laborer	Active	5.00	10.0	8	400.00	L	$45.80	incl. in rate	incl. in rate	$18,320.00
Loader, FE Rubber Tire (5.25cy)	Active	2.00	10.0	8	160.00	E	$75.42	incl. in rate	incl. in rate	$12,067.20
Electrician Foreman	Active	1.00	10.0	8	80.00	L	$47.23	incl. in rate	incl. in rate	$3,778.40
Welder	Active	1.00	10.0	8	80.00	L	$7.84	incl. in rate	incl. in rate	$627.00
Gas Welding Machine	Active	1.00	10.0	8	80.00	E	$2.88	incl. in rate	incl. in rate	$230.16
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	2.0	8	16.00	E	$31.90	incl. in rate	incl. in rate	$510.40

Labor Hours	**1016**	**TOTAL LABOR**	**$47,308.84**
Equipment Hours	**296**	**TOTAL EQUIPMENT**	**$22,370.16**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$2,365.44	$2,365.44
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$2,365.44**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price				Contract or Quote Amount
Disposal fee	1	EA	1.000	1.00	$100.00			$100.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum (assumed qty)	56.00	mile	1.000	56.00	$7.25			$406.00
								$0.00
							TOTAL SUBCONTRACTS	**$506.00**

SUMMARY OF COSTS

Labor Cost	$47,308.84	Labor Burden @	49.7%	$0.00		$47,308.84
Material Cost	$2,365.44	Material Tax @	7.8%	$183.32		$2,548.76
Equipment Cost	$22,370.16	Equipment Tax @	0.0%	$0.00		$22,370.16
Subcontractors	$506.00					$506.00
DIRECT COST SUBTOTALS	**$72,550**			**$183**	**DIRECT COST SUBTOTALS**	**$72,734**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$72,227.76		$10,834.16
Installing Contractors Profit@	8.0%				$72,227.76		$5,778.22
GC Markup on Subs @	5.0%				$506.00		$25.30
						TOTAL MARKUP COSTS	**$16,637.69**
General Contractors Insurance @	1.0%		on		$89,371.45		$894
Bond @	1.0%		on		$89,371.45		$894
Contingency @	0.0%		on		$91,158.88		$0
						TOTAL COST for pay item	**$91,159**

Additional Pay Item Notes :

The cooling and lubrication systems for the generator will be a combination of water and oil. These systems will be isolated from the water passages so that no contamination of passing water will occur. Used RS Means, a R13 Crew formed of 1 Forman, 3 Electricians, 1 Oiler, 0 .25 Equipment Crane. 5 Steelworkers to cut adjacent appurtenances and 1 Welder to cut pipes. Calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling (back and forth).

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.055	**Project**	: IRON GATE				
Description	:	Remove and Dispose of Excitation equipment for 18.975 MVA Generator						
Quantity	:	1.00 EA						
Daily Production	:	1.00 EA per 8 hour shift	**Project #**	: 4				
Work Days	:	1.0 Days	**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**	
Unit Price	:	$2,384.74 per EA	**Probable Low Cost Parameter**		**1.1**	**$2,146**	**$2,146**	
Total Cost	:	$2,385	**Probable High Cost Parameter**		**0.85**	**$2,742**	**$2,742**	

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.0	8	8.00	L	$47.23	incl. in rate	incl. in rate	$377.84
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Laborer	Active	1.00	1.0	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.5	8	4.00	E	$111.64	incl. in rate	incl. in rate	$446.56
Truck Driver (heavy)	Active	1.00	0.5	8	4.00	L	$57.59	incl. in rate	incl. in rate	$230.36

Labor Hours	**28**	**TOTAL LABOR**	**$1,336.44**
Equipment Hours	**4**	**TOTAL EQUIPMENT**	**$446.56**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$66.82	$66.82
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	50.00	LF	1.000	50.00	$0.85	$42.50
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$109.32**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,336.44	Labor Burden @	49.7%	$0.00		$1,336.44
Material Cost	$109.32	Material Tax @	7.8%	$8.47		$117.79
Equipment Cost	$446.56	Equipment Tax @	0.0%	$0.00		$446.56
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,892**			**$8**	**DIRECT COST SUBTOTALS**	**$1,901**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,900.79		$285.12
Installing Contractors Profit@	8.0%				$1,900.79		$152.06
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$437.18**
General Contractors Insurance @	1.0%		on		$2,337.98		$23
Bond @	1.0%		on		$2,337.98		$23
Contingency @	0.0%		on		$2,384.74		$0
						TOTAL COST for pay item	**$2,385**

Additional Pay Item Notes :

Used 1 Forman, 1 Electrician to remove the electrical equipment and 1 laborer to haul.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.056	Project	:	IRON GATE			
Description	:	Remove and Dispose of Surge protection equip. for 18.975 MVA Generator						
Quantity	:	1.00 EA						
Daily Production	:	1.00 EA per 4 hour shift	Project #	:	4			
Work Days	:	1.0 Days	Estimator	:	Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$1,891.05 per EA	Probable Low Cost Parameter			1.1	$1,702	$1,702
Total Cost	:	$1,891	Probable High Cost Parameter			0.85	$2,175	$2,175

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.0	4	4.00	L	$47.23	incl. in rate	incl. in rate	$188.92
Electrician	Active	1.00	1.0	4	4.00	L	$45.23	incl. in rate	incl. in rate	$180.92
Laborer	Active	1.00	1.0	4	4.00	L	$45.80	incl. in rate	incl. in rate	$183.20
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.5	4	2.00	E	$221.50	incl. in rate	incl. in rate	$443.00
Truck Driver (heavy)	Active	1.00	0.5	4	2.00	L	$57.59	incl. in rate	incl. in rate	$115.18
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.5	4	2.00	E	$111.64	incl. in rate	incl. in rate	$223.28
Equipment Operator (light)	Active	1.00	0.5	4	2.00	L	$64.90	incl. in rate	incl. in rate	$129.80

Labor Hours	16	TOTAL LABOR	$798.02
Equipment Hours	4	TOTAL EQUIPMENT	$666.28

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$39.90	$39.90
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$39.90

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$798.02	Labor Burden @	49.7%	$0.00		$798.02
Material Cost	$39.90	Material Tax @	7.8%	$3.09		$42.99
Equipment Cost	$666.28	Equipment Tax @	0.0%	$0.00		$666.28
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,504**			**$3**	**DIRECT COST SUBTOTALS**	**$1,507**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,507.29	$226.09
Installing Contractors Profit@	8.0%				$1,507.29	$120.58
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$346.68
General Contractors Insurance @	1.0%		on		$1,853.97	$19
Bond @	1.0%		on		$1,853.97	$19
Contingency @	0.0%		on		$1,891.05	$0
					TOTAL COST for pay item	**$1,891**

Additional Pay Item Notes :

Used 1 Forman, 1 Electrician to remove the electrical equipment and 1 laborer to haul.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.057		**Project**	: IRON GATE			
Description	: Remove and Dispose of Neutral grounding equip. for 18.975 MVA Generator						
Quantity	: 1.00 EA						
Daily Production	: 1.00 EA per 8 hour shift		**Project #**	: 4			
Work Days	: 1.0 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	: $3,980.33 per EA		**Probable Low Cost Parameter**		**1.1**	**$3,582**	**$3,582**
Total Cost	: $3,980		**Probable High Cost Parameter**		**0.85**	**$4,577**	**$4,577**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.0	8	8.00	L	$47.23	incl. in rate	incl. in rate	$377.84
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Ironworkers	Active	1.00	1.0	8	8.00	L	$63.95	incl. in rate	incl. in rate	$511.60
Laborer	Active	1.00	1.0	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Gas Welding Machine	Active	1.00	1.0	8	8.00	E	$2.88	incl. in rate	incl. in rate	$23.02
Welder	Active	1.00	1.0	8	8.00	L	$7.84	incl. in rate	incl. in rate	$62.70

Labor Hours	**48**	**TOTAL LABOR**	**$2,141.10**
Equipment Hours	**16**	**TOTAL EQUIPMENT**	**$916.14**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$107.06	$107.06
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$107.06**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,141.10	Labor Burden @	49.7%	$0.00		$2,141.10
Material Cost	$107.06	Material Tax @	7.8%	$8.30		$115.35
Equipment Cost	$916.14	Equipment Tax @	0.0%	$0.00		$916.14
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$3,164**			**$8**	**DIRECT COST SUBTOTALS**	**$3,173**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,172.59	$475.89
Installing Contractors Profit@	8.0%				$3,172.59	$253.81
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$729.70**
General Contractors Insurance @	1.0%		on		$3,902.28	$39
Bond @	1.0%		on		$3,902.28	$39
Contingency @	0.0%		on		$3,980.33	$0
					TOTAL COST for pay item	**$3,980**

Additional Pay Item Notes :

Used 1 Forman, 1 Electrician, 1 Ironworker and 1 welder to cut rods, to remove the electrical equipment and 1 laborer to haul in the truck.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.058	**Project**	: IRON GATE				
Description	:	Remove and Dispose of Station Service Switchgear, 600 volt - (5 sections)						
Quantity	:	1.00 EA						
Daily Production	:	1.00 EA per 8 hour shift	**Project #**	: 4				
Work Days	:	1.0 Days	**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**	
Unit Price	:	$7,378.96 per EA	**Probable Low Cost Parameter**		**1.1**	**$6,641**	**$6,641**	
Total Cost	:	$7,379	**Probable High Cost Parameter**		**0.85**	**$8,486**	**$8,486**	

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.0	8	8.00	L	$47.23	incl. in rate	incl. in rate	$377.84
Electrician	Active	3.00	1.0	8	24.00	L	$45.23	incl. in rate	incl. in rate	$1,085.52
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Hydraulic Crane (35tn)	Active	1.00	1.0	8	8.00	E	$116.30	incl. in rate	incl. in rate	$930.40
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28

Labor Hours	**64**	**TOTAL LABOR**	**$3,204.16**
Equipment Hours	**16**	**TOTAL EQUIPMENT**	**$1,823.52**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$160.21	$160.21
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$160.21**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price		Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (assumed qty)	1.00	ton		1.000	1.00	$595.00	$595.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum (assumed qty)	28.00	mile		1.000	28.00	$7.25	$203.00
						TOTAL SUBCONTRACTS	**$798.00**

SUMMARY OF COSTS

Labor Cost	$3,204.16	Labor Burden @	49.7%	$0.00		$3,204.16
Material Cost	$160.21	Material Tax @	7.8%	$12.42		$172.62
Equipment Cost	$1,823.52	Equipment Tax @	0.0%	$0.00		$1,823.52
Subcontractors	$798.00					$798.00
DIRECT COST SUBTOTALS	**$5,986**			**$12**	**DIRECT COST SUBTOTALS**	**$5,998**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$5,200.30	$780.05
Installing Contractors Profit@	8.0%				$5,200.30	$416.02
GC Markup on Subs @	5.0%				$798.00	$39.90
					TOTAL MARKUP COSTS	**$1,235.97**
General Contractors Insurance @	1.0%		on		$7,234.27	$72
Bond @	1.0%		on		$7,234.27	$72
Contingency @	0.0%		on		$7,378.96	$0
					TOTAL COST for pay item	**$7,379**

Additional Pay Item Notes :

Used 1 Forman, 3 Electrician, 2 laborer to haul with the crane in the truck. Assumed containing hazardous waste that will be disposed at 28 miles away from the construction site. In normal circumstances, decontaminated residual components could be accepted at landfill sites but Polychlorinated biphenyl, otherwise known as PCB, is a synthetic chemical that is widely used for industrial and commercial use as dielectric fluid in transformers and capacitors because of its high resistance to decomposition, low electrical conductivity, low flammability and high heat capacity. Transformer repair, reconditioning and retro-filling facilities are the major industry sectors that contributes to the spread of PCB contamination. Types of PCB Wastes:
PCB wastes are discarded materials that contain PCB or have been contaminated with PCBs and that are without any commercial, industrial, or economic use. For the purpose of this Code of Practice, PCBs wastes are classified as follows: Liquid PCB wastes
o PCB-based dielectric fluids removed from transformers and other equipment
o PCB-based heat transfer and hydraulic fluids Metallic solid wastes
o PCB equipment such as capacitors, transformers, switchgears, circuit breakers, heat transfer systems, etc.
o Contaminated components removed from electrical equipment such as windings; PCB-contaminated containers and equipment such as metal drums, tanks, pumps, metal filters, etc. Calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling

PAY ITEM COST DETAIL WORKSHEET

4.059 Remove and Dispose of Unit and plant control switchboard

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.059	**Project**	: IRON GATE				
Description	:	Remove and Dispose of Unit and plant control switchboard						
Quantity	:	1.00 EA						
Daily Production	:	0.20 EA per 8 hour shift	**Project #**	: 4				
Work Days	:	5.0 Days	**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**	
Unit Price	:	$23,948.92 per EA	**Probable Low Cost Parameter**		**0.22**	**$21,554**	**$21,554**	
Total Cost	:	$23,949	**Probable High Cost Parameter**		**0.17**	**$27,541**	**$27,541**	

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	5.0	8	40.00	L	$47.23	incl. in rate	incl. in rate	$1,889.20
Electrician	Active	6.00	5.0	8	240.00	L	$45.23	incl. in rate	incl. in rate	$10,855.20
Loader, FE Rubber Tire (3.5cy)	Active	1.00	2.0	8	16.00	E	$64.23	incl. in rate	incl. in rate	$1,027.68
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Equipment Operator (light)	Active	1.00	2.0	8	16.00	L	$64.90	incl. in rate	incl. in rate	$1,038.40

Labor Hours	**312**	**TOTAL LABOR**	**$14,704.24**
Equipment Hours	**32**	**TOTAL EQUIPMENT**	**$2,813.92**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$735.21	$735.21
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$735.21**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	1.00	ton	1.000	1.00	$595.00	$595.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$798.00**

SUMMARY OF COSTS

Labor Cost	$14,704.24	Labor Burden @	49.7%	$0.00		$14,704.24
Material Cost	$735.21	Material Tax @	7.8%	$56.98		$792.19
Equipment Cost	$2,813.92	Equipment Tax @	0.0%	$0.00		$2,813.92
Subcontractors	$798.00					$798.00
DIRECT COST SUBTOTALS	**$19,051**			**$57**	**DIRECT COST SUBTOTALS**	**$19,108**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$19,108.35		$2,866.25
Installing Contractors Profit@	8.0%				$18,310.35		$1,464.83
GC Markup on Subs @	5.0%				$798.00		$39.90
						TOTAL MARKUP COSTS	**$4,370.98**
General Contractors Insurance @	1.0%		on		$23,479.33		$235
Bond @	1.0%		on		$23,479.33		$235
Contingency @	0.0%		on		$23,948.92		$0
						TOTAL COST for pay item	**$23,949**

Additional Pay Item Notes :

Used 1 Forman, 6 Electrician including hauling with the loader in the truck. Assumed containing hazardous waste that will be disposed at 200 miles away from the construction site. Calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.060			**Project**	: IRONGATE			
Description	:	Remove and Dispose of Battery System - assume 60 batteries, charger							
Quantity	:	1.00	EA						
Daily Production	:	0.33	EA per	8 hour shift	**Project #**	: 2			
Work Days	:	3.0	Days		**Estimator**	: Mihaela Tomules	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$15,350.22	per EA		**Probable Low Cost Parameter**		**0.363**	**$13,815**	**$13,815.20**
Total Cost	:	$15,350			**Probable High Cost Parameter**		**0.2805**	**$17,653**	**$17,652.76**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	3.0	8	24.00	L	$48.27	$0.00		$1,158.48
Electrician	Active	1.00	3.0	8	24.00	L	$45.23	$0.00		$1,085.52
Equipment Operator (light)	Active	1.00	3.0	8	24.00	L	$64.90	$0.00		$1,557.60
Loader, FE Rubber Tire (3.5cy)	Active	1.00	3.0	8	24.00	E	$64.23	$64.23		$1,541.52
Truck Driver (light)	Active	1.00	3.0	8	24.00	L	$56.29	$0.00		$1,350.96
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	3.0	8	24.00	E	$111.64	$111.64		$2,679.36
Laborer	Active	2.00	3.0	8	48.00	L	$45.80	$0.00		$2,198.40
Welder	Active	1.00	3.0	8	24.00	L	$7.84	$0.00		$188.10
Gas Welding Machine	Active	1.00	3.0	8	24.00	E	$2.88	$2.88		$69.05

Labor Hours	**168**	**TOTAL LABOR**	**$7,539.06**
Equipment Hours	**72**	**TOTAL EQUIPMENT**	**$4,289.93**

MATERIAL COSTS

Description	Item Quantity	Order Unit	onversion ctor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$376.95	$376.95

TOTAL MATERIAL	**$376.95**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$7,539.06	Labor Burden @	49.7%	$0.00			$7,539.06
Material Cost	$376.95	Material Tax @	7.8%	$29.21			$406.17
Equipment Cost	$4,289.93	Equipment Tax @	0.0%	$0.00			$4,289.93
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	**$12,206**			**$29**		**DIRECT COST SUBTOTALS**	**$12,235**

					Cost Basis		
Installing Contractors Overhead@	15.0%				$12,235.15		$1,835.27
Installing Contractors Profit@	8.0%				$12,235.15		$978.81
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$2,814.09**
General Contractors Insurance @	1.0%		on		$15,049.24		$150
Bond @	1.0%		on		$15,049.24		$150
Contingency @	0.0%		on		$15,350.22		$0
						TOTAL COST for pay item	**$15,350**

Additional Pay Item Notes :

Assuming 3 days of work disposing around 60 batteries, racks and supports. Using Crews E-19 for metals demolition, E-12 and E-25 for cutting steel and A-3H for equipment disposal, B-34A for hauling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.061			Project	: IRON GATE			
Description	:	Remove and Dispose of Raceways, Bus, Conduit and Cable							
Quantity	:	1.00	EA						
Daily Production	:	0.20	EA per	8 hour shift	Project #	: 4			
Work Days	:	5.0	Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$18,352.70	per EA		Probable Low Cost Parameter		0.22	$16,517	$16,517
Total Cost	:	$18,353			Probable High Cost Parameter		0.17	$21,106	$21,106

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	5.0	8	40.00	L	$47.23	incl. in rate	incl. in rate	$1,889.20
Electrician	Active	2.00	5.0	8	80.00	L	$45.23	incl. in rate	incl. in rate	$3,618.40
Laborer	Active	1.00	5.0	8	40.00	L	$45.80	incl. in rate	incl. in rate	$1,832.00
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	5.0	8	40.00	E	$111.64	incl. in rate	incl. in rate	$4,465.60
Truck Driver (heavy)	Active	1.00	5.0	8	40.00	L	$57.59	incl. in rate	incl. in rate	$2,303.60

Labor Hours	200	TOTAL LABOR	$9,643.20
Equipment Hours	40	TOTAL EQUIPMENT	$4,465.60

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$482.16	$482.16
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$482.16

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$9,643.20	Labor Burden @	49.7%	$0.00		$9,643.20
Material Cost	$482.16	Material Tax @	7.8%	$37.37		$519.53
Equipment Cost	$4,465.60	Equipment Tax @	0.0%	$0.00		$4,465.60
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$14,591**			**$37**	**DIRECT COST SUBTOTALS**	**$14,628**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$14,628.33		$2,194.25
Installing Contractors Profit@	8.0%				$14,628.33		$1,170.27
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$3,364.52
General Contractors Insurance @	1.0%		on		$17,992.84		$180
Bond @	1.0%		on		$17,992.84		$180
Contingency @	0.0%		on		$18,352.70		$0
						TOTAL COST for pay item	$18,353

Additional Pay Item Notes :

Used 1 Forman, 2 Electrician, 1 Laborer hauling with the loader in the truck.

PAY ITEM COST DETAIL WORKSHEET

4.062 Remove and Dispose of Unit and plant control switchboard

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.062			**Project**	: IRON GATE			
Description	:	Remove and Dispose of Unit and plant control switchboard							
Quantity	:	1.00	EA						
Daily Production	:	0.65	EA per	8 hour shift	**Project #**	: 4			
Work Days	:	1.5	Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$5,642.84	per EA		**Probable Low Cost Parameter**		**0.715**	**$5,079**	**$5,079**
Total Cost	:	$5,643			**Probable High Cost Parameter**		**0.5525**	**$6,489**	**$6,489**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.5	8	12.00	L	$47.23	incl. in rate	incl. in rate	$566.76
Electrician	Active	1.00	1.5	8	12.00	L	$45.23	incl. in rate	incl. in rate	$542.76
Laborer	Active	1.00	1.5	8	12.00	L	$45.80	incl. in rate	incl. in rate	$549.60
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.5	8	12.00	E	$111.64	incl. in rate	incl. in rate	$1,339.68
Truck Driver (heavy)	Active	1.00	1.5	8	12.00	L	$57.59	incl. in rate	incl. in rate	$691.08

Labor Hours	**48**	**TOTAL LABOR**	**$2,350.20**
Equipment Hours	**12**	**TOTAL EQUIPMENT**	**$1,339.68**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$117.51	$117.51
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
				TOTAL MATERIAL		**$117.51**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	1.00	ton	1.000	1.00	$595.00	$595.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
					TOTAL SUBCONTRACTS	**$798.00**

SUMMARY OF COSTS

Labor Cost	$2,350.20	Labor Burden @	49.7%	$0.00		$2,350.20
Material Cost	$117.51	Material Tax @	7.8%	$9.11		$126.62
Equipment Cost	$1,339.68	Equipment Tax @	0.0%	$0.00		$1,339.68
Subcontractors	$798.00					$798.00
DIRECT COST SUBTOTALS	**$4,605**			**$9**	**DIRECT COST SUBTOTALS**	**$4,614**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,816.50	$572.47
Installing Contractors Profit@	8.0%				$3,816.50	$305.32
GC Markup on Subs @	5.0%				$798.00	$39.90
					TOTAL MARKUP COSTS	**$917.69**
General Contractors Insurance @	1.0%	on			$5,532.19	$55
Bond @	1.0%	on			$5,532.19	$55
Contingency @	0.0%	on			$5,642.84	$0
					TOTAL COST for pay item	**$5,643**

Additional Pay Item Notes :

Used 1 Forman, 6 Electrician including hauling with the loader in the truck. Assumed containing hazardous waste that will be disposed at 200 miles away from the construction site. Calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.063		Project	: IRON GATE			
Description	:	Remove and Dispose of Unit and plant control switchboard						
Quantity	:	1.00 EA						
Daily Production	:	0.65 EA per	8 hour shift	Project #	: 4			
Work Days	:	1.5 Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$9,142.79 per EA		Probable Low Cost Parameter		0.715	$8,229	$8,229
Total Cost	:	$9,143		Probable High Cost Parameter		0.5525	$10,514	$10,514

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.5	8	12.00	L	$47.23	incl. in rate	incl. in rate	$566.76
Electrician	Active	3.00	1.5	8	36.00	L	$45.23	incl. in rate	incl. in rate	$1,628.28
Laborer	Active	2.00	1.5	8	24.00	L	$45.80	incl. in rate	incl. in rate	$1,099.20
Truck, Pickup (4x4, 3/4tn)	Active	1.00	1.5	8	12.00	E	$16.94	incl. in rate	incl. in rate	$203.28
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.5	8	12.00	E	$111.64	incl. in rate	incl. in rate	$1,339.68
Loader, FE Rubber Tire (3.5cy)	Active	1.00	1.5	8	12.00	E	$64.23	incl. in rate	incl. in rate	$770.76
Equipment Operator (light)	Active	1.00	1.5	8	12.00	L	$64.90	incl. in rate	incl. in rate	$778.80

Labor Hours	84	TOTAL LABOR	$4,073.04
Equipment Hours	36	TOTAL EQUIPMENT	$2,313.72

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$203.65	$203.65
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$203.65

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	1.00	ton	1.000	1.00	$595.00	$595.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
					TOTAL SUBCONTRACTS	$798.00

SUMMARY OF COSTS

Labor Cost	$4,073.04	Labor Burden @	49.7%	$0.00		$4,073.04
Material Cost	$203.65	Material Tax @	7.8%	$15.78		$219.44
Equipment Cost	$2,313.72	Equipment Tax @	0.0%	$0.00		$2,313.72
Subcontractors	$798.00					$798.00
DIRECT COST SUBTOTALS	$7,388			$16	DIRECT COST SUBTOTALS	$7,404

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$6,606.20		$990.93
Installing Contractors Profit@	8.0%				$6,606.20		$528.50
GC Markup on Subs @	5.0%				$798.00		$39.90
						TOTAL MARKUP COSTS	$1,559.32
General Contractors Insurance @	1.0%		on		$8,963.52		$90
Bond @	1.0%		on		$8,963.52		$90
Contingency @	0.0%		on		$9,142.79		$0
						TOTAL COST for pay item	$9,143

Additional Pay Item Notes :

Used 1 Forman, 3 Electrician, 2 laborer to haul with the loader in the truck. Assumed containing hazardous waste that will be disposed at 200 miles away from the construction site. In normal circumstances, decontaminated residual components could be accepted at landfill sites but Polychlorinated biphenyl, otherwise known as PCB, is a synthetic chemical that is widely used for industrial and commercial use as dielectric fluid in transformers and capacitors because of its high resistance to decomposition, low electrical conductivity, low flammability and high heat capacity. Transformer repair, reconditioning and retro-filling facilities are the major industry sectors that contributes to the spread of PCB contamination. Types of PCB Wastes:
PCB wastes are discarded materials that contain PCB or have been contaminated with PCBs and that are without any commercial, industrial, or economic use. For the purpose of this Code of Practice, PCBs wastes are classified as follows: Liquid PCB wastes
o PCB-based dielectric fluids removed from transformers and other equipment
o PCB-based heat transfer and hydraulic fluids Metallic solid wastes
o PCB equipment such as capacitors, transformers, switchgears, circuit breakers, heat transfer systems, etc.
o Contaminated components removed from electrical equipment such as windings; PCB-contaminated containers and equipment such as metal drums, tanks, pumps, metal filters, etc. Calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.064			**Project**	: IRON GATE			
Description	:	Remove and Dispose of Unit and plant control switchboard							
Quantity	:	1.00	EA						
Daily Production	:	1.00	EA per	8 hour shift	**Project #**	: 4			
Work Days	:	0.5	Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$489.00	per EA		**Probable Low Cost Parameter**		**1.1**	**$440**	**$440**
Total Cost	:	$489			**Probable High Cost Parameter**		**0.85**	**$562**	**$562**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	0.5	8	4.00	L	$47.23	incl. in rate	incl. in rate	$188.92
Electrician	Active	1.00	0.5	8	4.00	L	$45.23	incl. in rate	incl. in rate	$180.92

Labor Hours	**8**	**TOTAL LABOR**	**$369.84**
Equipment Hours	**0**	**TOTAL EQUIPMENT**	**$0.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$18.49	$18.49
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	0.00	LF	1.000	0.00	$0.85	$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$18.49**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$369.84	Labor Burden @	49.7%	$0.00		$369.84
Material Cost	$18.49	Material Tax @	7.8%	$1.43		$19.93
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00		$0.00
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$388**			**$1**	**DIRECT COST SUBTOTALS**	**$390**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$389.77		$58.46
Installing Contractors Profit@	8.0%				$389.77		$31.18
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$89.65**
General Contractors Insurance @	1.0%		on		$479.41		$5
Bond @	1.0%		on		$479.41		$5
Contingency @	0.0%		on		$489.00		$0
						TOTAL COST for pay item	**$489**

Additional Pay Item Notes :

Crew formed of 1 Forman and 1 Electrician.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.066		**Project**	: IRONGATE			
Description	:	Remove and Dispose of Transformer (3 phase, 300 kVA, 6600/480V est.)						
Quantity	:	1.00 EA						
Daily Production	:	1.00 EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	1.0 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$10,482.18 per EA		**Probable Low Cost Parameter**		**1.1**	**$9,434**	**$9,434**
Total Cost	:	$10,482		**Probable High Cost Parameter**		**0.85**	**$12,055**	**$12,055**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.0	8	8.00	L	$47.23	incl. in rate	incl. in rate	$377.84
Electrician	Active	2.00	1.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Hydraulic Crane (50tn)	Active	1.00	1.0	8	8.00	E	$134.32	incl. in rate	incl. in rate	$1,074.56
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
Vibratory Hammer & Extractor	Active	1.00	1.0	8	8.00	E	$94.34	incl. in rate	incl. in rate	$754.72
Truck, Utility, with Man-Basket	Active	1.00	1.0	8	8.00	E	$31.90	incl. in rate	incl. in rate	$255.20
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	1.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Truck Driver (heavy)	Active	2.00	1.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Equipment Operator (light)	Active	2.00	1.0	8	16.00	L	$64.90	incl. in rate	incl. in rate	$1,038.40

Labor Hours	**64**	**TOTAL LABOR**	**$3,608.64**
Equipment Hours	**40**	**TOTAL EQUIPMENT**	**$3,870.72**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$180.43	$180.43

TOTAL MATERIAL	**$180.43**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	1.00	ton	1.000	1.00 $595.00	$595.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00 $7.25	$203.00

TOTAL SUBCONTRACTS	**$798.00**

SUMMARY OF COSTS

Labor Cost	$3,608.64	Labor Burden @	49.7%	$0.00		$3,608.64
Material Cost	$180.43	Material Tax @	7.8%	$13.98		$194.42
Equipment Cost	$3,870.72	Equipment Tax @	0.0%	$0.00		$3,870.72
Subcontractors	$798.00					$798.00
DIRECT COST SUBTOTALS	**$8,458**			**$14**	**DIRECT COST SUBTOTALS**	**$8,472**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$7,673.78		$1,151.07
Installing Contractors Profit@	8.0%				$7,673.78		$613.90
GC Markup on Subs @	5.0%				$798.00		$39.90
						TOTAL MARKUP COSTS	**$1,804.87**
General Contractors Insurance @	1.0%			on	$10,276.64		$103
Bond @	1.0%			on	$10,276.64		$103
Contingency @	0.0%			on	$10,482.18		$0
						TOTAL COST for pay item	**$10,482**

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician,1 Crane to load the transformer in the truck for disposal. In normal circumstances, decontaminated residual components could be accepted at landfill sites. Transformers of known PCB content over 50 ppm must be handled and disposed of in a manner that adheres to a strict code of Federal regulations (4O CFR Part 761).Transformers and other oil filled equipment that are known to be less than 50 ppm PCB are not regulated. Calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.067		**Project**	: Iron Gate			
Description	:	Remove and Dispose of Step-up Transformer, outdoor, oil-filled, 3-phase, 18.947 kVA, 6.600/69.000 volt						
Quantity	:	1.00 EA						
Daily Production	:	0.25 EA per	8 hour shift	**Project #**	: 4			
Work Days	:	4.0 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$85,541.22 per EA		**Probable Low Cost Parameter**		**0.275**	**$76,987**	**$76,987**
Total Cost	:	$85,541		**Probable High Cost Parameter**		**0.2125**	**$98,372**	**$98,372**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	2.00	4.0	8	64.00	L	$47.23	incl. in rate	incl. in rate	$3,022.72
Electrician	Active	2.00	4.0	8	64.00	L	$45.23	incl. in rate	incl. in rate	$2,894.72
Laborer	Active	4.00	4.0	8	128.00	L	$45.80	incl. in rate	incl. in rate	$5,862.40
Hydraulic Excavator (6.0cy)	Active	1.00	4.0	8	32.00	E	$322.48	incl. in rate	incl. in rate	$10,319.36
Truck Driver (heavy)	Active	1.00	4.0	8	32.00	L	$57.59	incl. in rate	incl. in rate	$1,842.88
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	4.0	8	32.00	E	$31.90	incl. in rate	incl. in rate	$1,020.80
Crawler Crane (130tn)	Active	2.00	4.0	8	64.00	E	$258.66	incl. in rate	incl. in rate	$16,554.24
Truck, Utility, with Man-Basket	Active	2.00	4.0	8	64.00	E	$31.90	incl. in rate	incl. in rate	$2,041.60
Equipment Operator (crane)	Active	2.00	4.0	8	64.00	L	$68.41	incl. in rate	incl. in rate	$4,378.24
Equipment Operator (medium)	Active	1.00	4.0	8	32.00	L	$66.28	incl. in rate	incl. in rate	$2,120.96

Labor Hours	**384**	**TOTAL LABOR**	**$20,121.92**
Equipment Hours	**192**	**TOTAL EQUIPMENT**	**$29,936.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,006.10	$1,006.10
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$1,006.10**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Disposal fee	1	EA	1.000	1.00	$1,000.00	$1,000.00
Remove oil from oil-filled step-up transformer (allowance for oil containers, filters, etc)	1	EA	1.000	1.00	$13,000.00	$13,000.00
Forklift crew, all-terrain forklift, 45' lift, 35' reach, 9000 lb. capacity, weekly use	1	week	1.000	1.00	$5,961.23	$5,961.23
					TOTAL SUBCONTRACTS	**$19,961.23**

SUMMARY OF COSTS

Labor Cost	$20,121.92	Labor Burden @	49.7%	$0.00		$20,121.92
Material Cost	$1,006.10	Material Tax @	7.8%	$77.97		$1,084.07
Equipment Cost	$29,936.00	Equipment Tax @	0.0%	$0.00		$29,936.00
Subcontractors	$19,961.23					$19,961.23
DIRECT COST SUBTOTALS	**$71,025**			**$78**	**DIRECT COST SUBTOTALS**	**$71,103**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$51,141.99		$7,671.30
Installing Contractors Profit@	8.0%				$51,141.99		$4,091.36
GC Markup on Subs @	5.0%				$19,961.23		$998.06
						TOTAL MARKUP COSTS	**$12,760.72**
General Contractors Insurance @	1.0%		on		$83,863.94		$839
Bond @	1.0%		on		$83,863.94		$839
Contingency @	0.0%		on		$85,541.22		$0
						TOTAL COST for pay item	**$85,541**

Additional Pay Item Notes :

Weight and dimensions of the transformers have particular importance so transport vehicles must be adequate. A considerable proportion of the weight is due to the oil, so the direct consequence is that the big transformers have to be transported empty. During transport the transformers are filled either by dry air or nitrogen. Because of transportation, the auxiliaries have to be removed . For this reason the collaboration with all the people involved in the project is essential. AECOM best assumption - 2 crew R3 formed of 1 Forman, 1 Electricians, 1 utility man-bucket truck to work on the electrical line, 1 crane for disposal of each transformer in the truck and 2 laborers to remove the auxiliaries and the pad (1 excavator).

PAY ITEM COST DETAIL WORKSHEET

4.068 Remove and Dispose of Lattice steel structure, with 69-kV disconnect switches and insulators

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.068			**Project**	: IRONGATE			
Description	:	Remove and Dispose of Lattice steel structure, with 69-kV disconnect switches and insulators							
Quantity	:	1.00 EA							
Daily Production	:	1.00 EA per	8	hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	1.0 Days			**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$6,973.83 per EA			**Probable Low Cost Parameter**		**1.1**	**$6,276**	**$6,276.45**
Total Cost	:	$6,974			**Probable High Cost Parameter**		**0.85**	**$8,020**	**$8,019.91**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	$0.00		$370.16
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	$0.00		$361.84
Hydraulic Crane (35tn)	Active	1.00	1.0	8	8.00	E	$116.30	$116.30		$930.40
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	$0.00		$547.28
Steelworker	Active	1.00	1.0	8	8.00	L	$65.52	$0.00		$524.16
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	$111.64		$893.12
Truck Driver (light)	Active	1.00	1.0	8	8.00	L	$56.29	$0.00		$450.32
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	$0.00		$732.80
Gas Welding Machine	Active	1.00	1.0	8	8.00	E	$2.88	$2.88		$23.02
Welder	Active	1.00	1.0	8	8.00	L	$7.84	$0.00		$62.70

Labor Hours	**64**	**TOTAL LABOR**	**$3,049.26**
Equipment Hours	**24**	**TOTAL EQUIPMENT**	**$1,846.54**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$152.46	$152.46
				TOTAL MATERIAL		**$152.46**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent aerial lift, articulating boom, to 80' high, 500 lb. capacity, diesel - Rent per day (RS Means 01543340)	1.00	days	1.000	1.00 $584.00	$584.00
				TOTAL SUBCONTRACTS	**$584.00**

SUMMARY OF COSTS

Labor Cost	$3,049.26	Labor Burden @	49.7%	$0.00		$3,049.26
Material Cost	$152.46	Material Tax @	7.8%	$11.82		$164.28
Equipment Cost	$1,846.54	Equipment Tax @	0.0%	$0.00		$1,846.54
Subcontractors	$584.00					$584.00
DIRECT COST SUBTOTALS	**$5,632**			**$12**	**DIRECT COST SUBTOTALS**	**$5,644**

			TRUE	FALSE	Cost Basis		
Installing Contractors Overhead@	15.0%				$5,060.07		$759.01
Installing Contractors Profit@	8.0%				$5,060.07		$404.81
GC Markup on Subs @	5.0%				$584.00		$29.20
						TOTAL MARKUP COSTS	**$1,193.02**
General Contractors Insurance @	1.0%		on		$6,837.09		$68
Bond @	1.0%		on		$6,837.09		$68
Contingency @	0.0%		on		$6,973.83		$0
						TOTAL COST for pay item	**$6,974**

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician disconnect switches and insulators, 2 steelworkers to cut in pieces the structure, 2 laborer to help loading and hauling lattice steel members. It will require the use of steel haul trucks; carry alls, boom cranes. the structure will be dismantle on a basis of top to bottom, thus avoiding any form of collapse or toppling over.

PAY ITEM COST DETAIL WORKSHEET

4.069 Remove and Dispose of Generator Switchgear, outdoor, 7.2kV includes unit breaker (5 sections)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.069			**Project**	: IRONGATE		
Description	:	Remove and Dispose of Generator Switchgear, outdoor, 7.2kV includes unit breaker (5 sections)						
Quantity	:	1.00 EA						
Daily Production	:	0.50 EA per	8 hour shift		**Project #**	: Klamath Dams Removal		
Work Days	:	2.0 Days			**Estimator**	: Mihaela Tomulesc	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$24,487.62 per EA			**Probable Low Cost Parameter**		**0.55**	**$22,039**	**$22,038.86**
Total Cost	:	$24,488			**Probable High Cost Parameter**		**0.425**	**$28,161**	**$28,160.77**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	2.0	8	32.00	L	$46.27	$0.00		$1,480.64
Electrician	Active	6.00	2.0	8	96.00	L	$45.23	$0.00		$4,342.08
Hydraulic Crane (50tn)	Active	1.00	2.0	8	16.00	E	$134.32	$134.32		$2,149.12
Equipment Operator (crane)	Active	1.00	2.0	8	16.00	L	$68.41	$0.00		$1,094.56
Laborer	Active	4.00	2.0	8	64.00	L	$45.80	$0.00		$2,931.20
Steelworker	Active	2.00	2.0	8	32.00	L	$65.52	$0.00		$2,096.64

Labor Hours	**240**	**TOTAL LABOR**	**$11,945.12**
Equipment Hours	**16**	**TOTAL EQUIPMENT**	**$2,149.12**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$597.26	$597.26

TOTAL MATERIAL	**$597.26**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	6.00	ton	1.000	6.00 $595.00	$3,570.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	280.00	mile	1.000	280.00 $7.25	$2,030.00

TOTAL SUBCONTRACTS	**$5,600.00**

SUMMARY OF COSTS

Labor Cost	$11,945.12	Labor Burden @	49.7%	$0.00		$11,945.12
Material Cost	$597.26	Material Tax @	7.8%	$46.29		$643.54
Equipment Cost	$2,149.12	Equipment Tax @	0.0%	$0.00		$2,149.12
Subcontractors	$5,600.00					$5,600.00
DIRECT COST SUBTOTALS	**$20,291**			**$46**	**DIRECT COST SUBTOTALS**	**$20,338**

			TRUE	FALSE	Cost Basis		
Installing Contractors Overhead@	15.0%				$14,737.78		$2,210.67
Installing Contractors Profit@	8.0%				$14,737.78		$1,179.02
GC Markup on Subs @	5.0%				$5,600.00		$280.00
						TOTAL MARKUP COSTS	**$3,669.69**
General Contractors Insurance @	1.0%	on			$24,007.47		$240
Bond @	1.0%	on			$24,007.47		$240
Contingency @	0.0%	on			$24,487.62		$0
						TOTAL COST for pay item	**$24,488**

Additional Pay Item Notes :

Used 2 Crews (2 sections each weight around 2400 LBS per crew) formed of 1 Forman, 3 Electrician, 2 laborer to haul with the crane in the truck considering one way for each section. Assumed containing hazardous waste that will be disposed (12000 LBS) at 28 miles away from the construction site to Yreka Transfer Recycling .

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.070		**Project**	: IRONGATE			
Description	:	Remove and Dispose of Single Phase Pole Transformers (25 kVA est.)						
Quantity	:	3.00 EA						
Daily Production	:	3.00 EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	1.0 Days		**Estimator**	: Mihaela Tomules	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$2,514.24 per EA		**Probable Low Cost Parameter**		**3.3**	**$6,788**	**$2,262.82**
Total Cost	:	$7,543		**Probable High Cost Parameter**		**2.55**	**$8,674**	**$2,891.38**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	3.00	1.0	8	24.00	L	$47.23	incl. in rate	incl. in rate	$1,133.52
Electrician	Active	3.00	1.0	8	24.00	L	$45.23	incl. in rate	incl. in rate	$1,085.52
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Hydraulic Crane (17tn)	Active	1.00	1.0	8	8.00	E	$81.52	incl. in rate	incl. in rate	$652.16
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
Truck, Utility, with Man-Basket	Active	3.00	1.0	8	24.00	E	$31.90	incl. in rate	incl. in rate	$765.60

Labor Hours	**64**	**TOTAL LABOR**	**$3,227.04**
Equipment Hours	**40**	**TOTAL EQUIPMENT**	**$2,310.88**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$161.35	$161.35
					TOTAL MATERIAL	**$161.35**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.25	ton	1.000	0.25 $595.00	$148.75
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00 $7.25	$203.00
				TOTAL SUBCONTRACTS	**$351.75**

SUMMARY OF COSTS

Labor Cost	$3,227.04	Labor Burden @	49.7%	$0.00		$3,227.04
Material Cost	$161.35	Material Tax @	7.8%	$12.50		$173.86
Equipment Cost	$2,310.88	Equipment Tax @	0.0%	$0.00		$2,310.88
Subcontractors	$351.75					$351.75
DIRECT COST SUBTOTALS	**$6,051**			**$13**	**DIRECT COST SUBTOTALS**	**$6,064**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$5,711.78		$856.77
Installing Contractors Profit@	8.0%				$5,711.78		$456.94
GC Markup on Subs @	5.0%				$351.75		$17.59
						TOTAL MARKUP COSTS	**$1,331.30**
General Contractors Insurance @	1.0%		on		$7,394.82		$74
Bond @	1.0%		on		$7,394.82		$74
Contingency @	0.0%		on		$7,542.72		$0
						TOTAL COST for pay item	**$7,543**

Additional Pay Item Notes :

Production is based off of RSMs using 3 Crew formed of 1 Forman, 1 Electrician,1 Articulated boom for each transformers. In normal circumstances, decontaminated residual components could be accepted at landfill sites. Transformers of known PCB content over 50 ppm must be handled and disposed of in a manner that adheres to a strict code of Federal regulations.Transformers and other oil filled equipment that are known to be less than 50 ppm PCB are not regulated. Calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling.

PAY ITEM COST DETAIL WORKSHEET

4.071 Remove Concrete in Penstock Intake Structure

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.071		**Project**	: Iron Gate			
Description	:	Remove Concrete in Penstock Intake Structure						
Quantity	:	460.00	cy					
Daily Production	:	50.00	cy per	8 hour shift	**Project #**	: 4		
Work Days	:	9.2	Days		**Estimator**	: Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$302.54	per cy		**Probable Low Cost Parameter**		**57.5**	**$118,294**	**$257.16**
Total Cost	:	$139,169			**Probable High Cost Parameter**		**42.5**	**$160,044**	**$347.92**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	9.2	8	147.20	L	$48.27	incl. in rate	incl. in rate	$7,105.34
Laborer	Active	8.00	9.2	8	588.80	L	$45.80	incl. in rate	incl. in rate	$26,967.04
Equipment Operator (medium)	Active	2.00	9.2	8	147.20	L	$66.28	incl. in rate	incl. in rate	$9,756.42
Truck Driver (heavy)	Active	1.00	9.2	8	73.60	L	$57.59	incl. in rate	incl. in rate	$4,238.62
Air Compressor 900 cfm	Active	1.00	9.2	8	73.60	E	$38.87	incl. in rate	incl. in rate	$2,860.75
Air Compressor 600 cfm	Active	1.00	9.2	8	73.60	E	$21.74	incl. in rate	incl. in rate	$1,599.98
Air Tool, Chipping Hammer	Active	4.00	9.2	8	294.40	E	$1.64	incl. in rate	incl. in rate	$482.53
Generator, Small Generator, 10 - 15 kW	Active	2.00	9.2	8	147.20	E	$7.04	incl. in rate	incl. in rate	$1,036.29
Hydraulic Excavator (2.5cy)	Active	2.00	9.2	8	147.20	E	$203.63	incl. in rate	incl. in rate	$29,974.34
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	9.2	8	73.60	E	$62.72	incl. in rate	incl. in rate	$4,616.19
Hydraulic Thumbs/Shear Attachment	Active	1.00	9.2	8	73.60	E	$16.39	incl. in rate	incl. in rate	$1,206.30
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	9.2	8	73.60	E	$111.64	incl. in rate	incl. in rate	$8,216.70
			9.2	8	0.00					$0.00
			9.2	8	0.00					$0.00
			9.2	8	0.00					$0.00
			9.2	8	0.00					$0.00
			9.2	8	0.00					$0.00
				Labor Hours	**957**			**TOTAL LABOR**		**$48,067.42**
				Equipment Hours	**957**			**TOTAL EQUIPMENT**		**$49,993.09**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$2,403.37	$2,403.37
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$2,403.37**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	3	EA	**Cost per Mob**	$2,500.00	$7,500.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$7,500.00**

SUMMARY OF COSTS

Labor Cost	$48,067.42	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$48,067.42
Material Cost	$2,403.37	Material Tax @	7.75%	$186.26		$2,589.63
Equipment Cost	$49,993.09	Equipment Tax @	7.75%	$3,874.46		$53,867.56
Subcontractors	$7,500.00					$7,500.00
DIRECT COST SUBTOTALS	**$107,964**			**$4,061**	**DIRECT COST SUBTOTALS**	**$112,025**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$104,524.61	$15,678.69
Installing Contractors Profit@	8.0%				$104,524.61	$8,361.97
GC Markup on Subs @	5.0%				$7,500.00	$375.00
					TOTAL MARKUP COSTS	**$24,415.66**
General Contractors Insurance @	1.0%		on		$136,440.28	$1,364
Bond @	1.0%		on		$136,440.28	$1,364
Contingency @	0.0%		on		$139,169.08	$0
					TOTAL COST for pay item	**$139,169**

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposal site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM COST DETAIL WORKSHEET

4.072 Remove Concrete in Penstock Encasement

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.072	**Project**	:	Iron Gate			
Description	:	Remove Concrete in Penstock Encasement						
Quantity	:	710.00 cy						
Daily Production	:	50.00 cy per 8 hour shift	**Project #**	:	4			
Work Days	:	14.2 Days	**Estimator**	:	Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$300.16 per cy	**Probable Low Cost Parameter**			**55**	**$191,805**	**$270.15**
Total Cost	:	$213,116	**Probable High Cost Parameter**			**42.5**	**$245,084**	**$345.19**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	14.2	8	227.20	L	$48.27	incl. in rate	incl. in rate	$10,966.94
Laborer	Active	8.00	14.2	8	908.80	L	$45.80	incl. in rate	incl. in rate	$41,623.04
Equipment Operator (medium)	Active	2.00	14.2	8	227.20	L	$66.28	incl. in rate	incl. in rate	$15,058.82
Truck Driver (heavy)	Active	1.00	14.2	8	113.60	L	$57.59	incl. in rate	incl. in rate	$6,542.22
Air Compressor 900 cfm	Active	1.00	14.2	8	113.60	E	$38.87	incl. in rate	incl. in rate	$4,415.51
Air Compressor 600 cfm	Active	1.00	14.2	8	113.60	E	$21.74	incl. in rate	incl. in rate	$2,469.54
Air Tool, Chipping Hammer	Active	4.00	14.2	8	454.40	E	$1.64	incl. in rate	incl. in rate	$744.78
Generator, Small Generator, 10 - 15 kW	Active	2.00	14.2	8	227.20	E	$7.04	incl. in rate	incl. in rate	$1,599.49
Hydraulic Excavator (2.5cy)	Active	2.00	14.2	8	227.20	E	$203.63	incl. in rate	incl. in rate	$46,264.74
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	14.2	8	113.60	E	$62.72	incl. in rate	incl. in rate	$7,124.99
Hydraulic Thumbs/Shear Attachment	Active	1.00	14.2	8	113.60	E	$16.39	incl. in rate	incl. in rate	$1,861.90
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	14.2	8	113.60	E	$111.64	incl. in rate	incl. in rate	$12,682.30
			14.2	8	0.00					$0.00
			14.2	8	0.00					$0.00
			14.2	8	0.00					$0.00
			14.2	8	0.00					$0.00
			14.2	8	0.00					$0.00
				Labor Hours	**1,477**			**TOTAL LABOR**		**$74,191.02**
				Equipment Hours	**1,477**			**TOTAL EQUIPMENT**		**$77,163.25**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$3,709.55	$3,709.55
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$3,709.55**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	4	EA	**Cost per Mob**	$2,500.00	$10,000.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$10,000.00**

SUMMARY OF COSTS

Labor Cost	$74,191.02	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$74,191.02
Material Cost	$3,709.55	Material Tax @	7.75%	$287.49		$3,997.04
Equipment Cost	$77,163.25	Equipment Tax @	7.75%	$5,980.15		$83,143.40
Subcontractors	$10,000.00					$10,000.00
DIRECT COST SUBTOTALS	**$165,064**			**$6,268**	**DIRECT COST SUBTOTALS**	**$171,331**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$161,331.47	$24,199.72
Installing Contractors Profit@	8.0%				$161,331.47	$12,906.52
GC Markup on Subs @	5.0%				$10,000.00	$500.00
					TOTAL MARKUP COSTS	**$37,606.24**
General Contractors Insurance @	1.0%		on		$208,937.71	$2,089
Bond @	1.0%		on		$208,937.71	$2,089
Contingency @	0.0%		on		$213,116.46	$0
					TOTAL COST for pay item	**$213,116**

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposal site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM COST DETAIL WORKSHEET

4.073 Remove Concrete in 3 Penstock Anchors and 7 Penstock Supports

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.073	**Project**	: Iron Gate				
Description	:	Remove Concrete in 3 Penstock Anchors and 7 Penstock Supports						
Quantity	:	3,110.00 cy						
Daily Production	:	50.00 cy per 8 hour shift	**Project #**	: 4				
Work Days	:	62.2 Days	**Estimator**	: Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**	
Unit Price	:	$298.85 per cy	**Probable Low Cost Parameter**		**57.5**	**$790,022**	**$254.03**	
Total Cost	:	$929,437	**Probable High Cost Parameter**		**42.5**	**$1,068,853**	**$343.68**	

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	62.2	8	995.20	L	$48.27	incl. in rate	incl. in rate	$48,038.30
Laborer	Active	8.00	62.2	8	3,980.80	L	$45.80	incl. in rate	incl. in rate	$182,320.64
Equipment Operator (medium)	Active	2.00	62.2	8	995.20	L	$66.28	incl. in rate	incl. in rate	$65,961.86
Truck Driver (heavy)	Active	1.00	62.2	8	497.60	L	$57.59	incl. in rate	incl. in rate	$28,656.78
Air Compressor 900 cfm	Active	1.00	62.2	8	497.60	E	$38.87	incl. in rate	incl. in rate	$19,341.17
Air Compressor 600 cfm	Active	1.00	62.2	8	497.60	E	$21.74	incl. in rate	incl. in rate	$10,817.29
Air Tool, Chipping Hammer	Active	4.00	62.2	8	1,990.40	E	$1.64	incl. in rate	incl. in rate	$3,262.33
Generator, Small Generator, 10 - 15 kW	Active	2.00	62.2	8	995.20	E	$7.04	incl. in rate	incl. in rate	$7,006.21
Hydraulic Excavator (2.5cy)	Active	2.00	62.2	8	995.20	E	$203.63	incl. in rate	incl. in rate	$202,652.58
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	62.2	8	497.60	E	$62.72	incl. in rate	incl. in rate	$31,209.47
Hydraulic Thumbs/Shear Attachment	Active	1.00	62.2	8	497.60	E	$16.39	incl. in rate	incl. in rate	$8,155.66
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	62.2	8	497.60	E	$111.64	incl. in rate	incl. in rate	$55,552.06
			62.2	8	0.00					$0.00
			62.2	8	0.00					$0.00
			62.2	8	0.00					$0.00
			62.2	8	0.00					$0.00
			62.2	8	0.00					$0.00
				Labor Hours	**6,469**			**TOTAL LABOR**		**$324,977.58**
				Equipment Hours	**6,469**			**TOTAL EQUIPMENT**		**$337,996.78**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$16,248.88	$16,248.88
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$16,248.88**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	16	EA	**Cost per Mob**	$2,500.00	$40,000.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$40,000.00**

SUMMARY OF COSTS

Labor Cost	$324,977.58	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$324,977.58
Material Cost	$16,248.88	Material Tax @	7.75%	$1,259.29		$17,508.17
Equipment Cost	$337,996.78	Equipment Tax @	7.75%	$26,194.75		$364,191.53
Subcontractors	$40,000.00					$40,000.00
DIRECT COST SUBTOTALS	**$719,223**			**$27,454**	**DIRECT COST SUBTOTALS**	**$746,677**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$706,677.28	$106,001.59
Installing Contractors Profit@	8.0%				$706,677.28	$56,534.18
GC Markup on Subs @	5.0%				$40,000.00	$2,000.00
					TOTAL MARKUP COSTS	**$164,535.77**
General Contractors Insurance @	1.0%		on		$911,213.06	$9,112
Bond @	1.0%		on		$911,213.06	$9,112
Contingency @	0.0%		on		$929,437.32	$0
					TOTAL COST for pay item	**$929,437**

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposal site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM COST DETAIL WORKSHEET

4.075 Remove Concrete in Intake Structure Footbridge Abutment

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.075	**Project**	:	Iron Gate			
Description	:	Remove Concrete in Intake Structure Footbridge Abutment						
Quantity	:	5.00 cy						
Daily Production	:	50.00 cy per 8 hour shift	**Project #**	:	4			
Work Days	:	0.1 Days	**Estimator**	:	Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$820.58 per cy	**Probable Low Cost Parameter**			**57.5**	**$3,487**	**$697.49**
Total Cost	:	$4,103	**Probable High Cost Parameter**			**42.5**	**$4,718**	**$943.67**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	0.1	8	1.60	L	$48.27	incl. in rate	incl. in rate	$77.23
Laborer	Active	8.00	0.1	8	6.40	L	$45.80	incl. in rate	incl. in rate	$293.12
Equipment Operator (medium)	Active	2.00	0.1	8	1.60	L	$66.28	incl. in rate	incl. in rate	$106.05
Truck Driver (heavy)	Active	1.00	0.1	8	0.80	L	$57.59	incl. in rate	incl. in rate	$46.07
Air Compressor 900 cfm	Active	1.00	0.1	8	0.80	E	$38.87	incl. in rate	incl. in rate	$31.10
Air Compressor 600 cfm	Active	1.00	0.1	8	0.80	E	$21.74	incl. in rate	incl. in rate	$17.39
Air Tool, Chipping Hammer	Active	4.00	0.1	8	3.20	E	$1.64	incl. in rate	incl. in rate	$5.24
Generator, Small Generator, 10 - 15 kW	Active	2.00	0.1	8	1.60	E	$7.04	incl. in rate	incl. in rate	$11.26
Hydraulic Excavator (2.5cy)	Active	2.00	0.1	8	1.60	E	$203.63	incl. in rate	incl. in rate	$325.81
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	0.1	8	0.80	E	$62.72	incl. in rate	incl. in rate	$50.18
Hydraulic Thumbs/Shear Attachment	Active	1.00	0.1	8	0.80	E	$16.39	incl. in rate	incl. in rate	$13.11
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.1	8	0.80	E	$111.64	incl. in rate	incl. in rate	$89.31
			0.1	8	0.00					$0.00
			0.1	8	0.00					$0.00
			0.1	8	0.00					$0.00
			0.1	8	0.00					$0.00
			0.1	8	0.00					$0.00
				Labor Hours	**10**			**TOTAL LABOR**		**$522.47**
				Equipment Hours	**10**			**TOTAL EQUIPMENT**		**$543.40**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$26.12	$26.12
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$26.12**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	1	EA	**Cost per Mob**	$2,500.00	$2,500.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$2,500.00**

SUMMARY OF COSTS

Labor Cost	$522.47	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$522.47
Material Cost	$26.12	Material Tax @	7.75%	$2.02		$28.15
Equipment Cost	$543.40	Equipment Tax @	7.75%	$42.11		$585.52
Subcontractors	$2,500.00					$2,500.00
DIRECT COST SUBTOTALS	**$3,592**			**$44**	**DIRECT COST SUBTOTALS**	**$3,636**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,136.14	$170.42
Installing Contractors Profit@	8.0%				$1,136.14	$90.89
GC Markup on Subs @	5.0%				$2,500.00	$125.00
					TOTAL MARKUP COSTS	**$386.31**
General Contractors Insurance @	1.0%		on		$4,022.45	$40
Bond @	1.0%		on		$4,022.45	$40
Contingency @	0.0%		on		$4,102.90	$0
					TOTAL COST for pay item	**$4,103**

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposal site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.074		**Project**	: IRONGATE			
Description	:	Remove Steel Footbridge to Intake Structure						
Quantity	:	11,000.00 LBS						
Daily Production	:	10,000.00 LBS per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	1.1 Days		**Estimator**	: Mihaela Tomules	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$1.11 per LBS		**Probable Low Cost Parameter**		**11500**	**$10,337**	**$0.94**
Total Cost	:	$12,161		**Probable High Cost Parameter**		**8500**	**$13,986**	**$1.27**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.1	8	8.80	L	$46.27	incl. in rate	incl. in rate	$407.18
Electrician	Active	1.00	1.1	8	8.80	L	$45.23	incl. in rate	incl. in rate	$398.02
Hydraulic Crane (50tn)	Active	1.00	1.1	8	8.80	E	$134.32	incl. in rate	incl. in rate	$1,182.02
Equipment Operator (crane)	Active	1.00	1.1	8	8.80	L	$68.41	incl. in rate	incl. in rate	$602.01
Vibratory Hammer & Extractor	Active	1.00	1.1	8	8.80	E	$94.34	incl. in rate	incl. in rate	$830.19
Laborer	Active	2.00	1.1	8	17.60	L	$45.80	incl. in rate	incl. in rate	$806.08
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	1.1	8	17.60	E	$111.64	incl. in rate	incl. in rate	$1,964.86
Truck Driver (heavy)	Active	2.00	1.1	8	17.60	L	$57.59	incl. in rate	incl. in rate	$1,013.58
Equipment Operator (light)	Active	1.00	1.1	8	8.80	L	$64.90	incl. in rate	incl. in rate	$571.12
Steelworker	Active	2.00	1.1	8	17.60	L	$65.52	incl. in rate	incl. in rate	$1,153.15

Labor Hours	**88**	**TOTAL LABOR**	**$4,951.14**
Equipment Hours	**35.2**	**TOTAL EQUIPMENT**	**$3,977.07**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$247.56	$247.56

TOTAL MATERIAL	**$247.56**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent aerial lift, articulating boom, to 80' high, 500 lb. capacity, diesel - Rent per day (RS Means 01543340)	1.00	days	1.000	1.00 $584.00	$584.00

TOTAL SUBCONTRACTS	**$584.00**

SUMMARY OF COSTS

Labor Cost	$4,951.14	Labor Burden @	49.7%	$0.00		$4,951.14
Material Cost	$247.56	Material Tax @	7.8%	$19.19		$266.74
Equipment Cost	$3,977.07	Equipment Tax @	0.0%	$0.00		$3,977.07
Subcontractors	$584.00					$584.00
DIRECT COST SUBTOTALS	**$9,760**			**$19**	**DIRECT COST SUBTOTALS**	**$9,779**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$9,194.96		$1,379.24
Installing Contractors Profit@	8.0%				$9,194.96		$735.60
GC Markup on Subs @	5.0%				$584.00		$29.20
						TOTAL MARKUP COSTS	**$2,144.04**
General Contractors Insurance @	1.0%		on		$11,923.00		$119
Bond @	1.0%		on		$11,923.00		$119
Contingency @	0.0%		on		$12,161.46		$0
						TOTAL COST for pay item	**$12,161**

Additional Pay Item Notes :

The bridge steel grid, excess steel members and similar materials shall be removed from each span prior to removing the main supporting beams, girders or trusses over land. Assumed crew is formed of 1 Forman, 1 Electrician (tempoary power for tools), 2 steelworkers to cut steel and 2 Laborers (Load, Haul, help with the crane rops, etc).

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.076			**Project**	: Iron Gate			
Description	:	Remove and Dispose of Intake Structure							
Quantity	:	131,630.00	LBS						
Daily Production	:	25,000.00	LBS per	8 hour shift	**Project #**	: 4			
Work Days	:	5.3	Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$1.04	per LBS		**Probable Low Cost Parameter**		**28750**	**$115,941**	**$0.88**
Total Cost	:	$136,401			**Probable High Cost Parameter**		**21250**	**$156,862**	**$1.19**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Barge, Bargeman, Deckhand, Fireman, Oiler	Active	1.00	5.3	8	42.40	L	$60.96	incl. in rate	incl. in rate	$2,584.70
Carpenter Foreman (out)	Active	1.00	5.3	8	42.40	L	$46.40	incl. in rate	incl. in rate	$1,967.36
Carpenters, Journeyman	Active	6.00	5.3	8	254.40	L	$65.37	incl. in rate	incl. in rate	$16,630.13
Hydraulic Excavator (6.0cy)	Active	2.00	5.3	8	84.80	E	$322.48	incl. in rate	incl. in rate	$27,346.30
Hydraulic Crane (120tn)	Active	1.00	5.3	8	42.40	E	$239.06	incl. in rate	incl. in rate	$10,136.14
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	5.3	8	42.40	E	$62.72	incl. in rate	incl. in rate	$2,659.33
Truck Driver (heavy)	Active	2.00	5.3	8	84.80	L	$57.59	incl. in rate	incl. in rate	$4,883.63
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	5.3	8	84.80	E	$70.35	incl. in rate	incl. in rate	$5,965.68

Labor Hours	**424**	**TOTAL LABOR**	**$26,065.82**
Equipment Hours	**254.4**	**TOTAL EQUIPMENT**	**$46,107.46**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Permeable Floating Turbidity Barrier	600.00	lf	1.000	600.00	$38.00	$22,800.00
Floating Marker Buoy	7.00	ea	1.000	7.00	$32.00	$224.00
Anchor Systems	13.00	ea	1.000	13.00	$215.00	$2,795.00
Tow Bridles	2.00	ea	1.000	2.00	$50.00	$100.00
Pile Template	1.00	ls	1.000	1.00	$8,000.00	$8,000.00
					TOTAL MATERIAL	**$33,919.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$26,065.82	Labor Burden @	49.7%	$0.00	$26,065.82
Material Cost	$33,919.00	Material Tax @	7.8%	$2,628.72	$36,547.72
Equipment Cost	$46,107.46	Equipment Tax @	0.0%	$0.00	$46,107.46
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$106,092**			**$2,629**	**DIRECT COST SUBTOTALS** **$108,721**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$108,721.00	$16,308.15
Installing Contractors Profit@	8.0%				$108,721.00	$8,697.68
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$25,005.83**
General Contractors Insurance @	1.0%		on		$133,726.83	$1,337
Bond @	1.0%		on		$133,726.83	$1,337
Contingency @	0.0%		on		$136,401.37	$0
					TOTAL COST for pay item	**$136,401**

Additional Pay Item Notes :

AECOM best estimate - the crew is formed of 1 Forman, 6 journeyman working with 2 excavators, 1 hydraulic breaker and 1 crane. Using 2 trucks per day for disposal based on daily production.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.081			**Project**	: Iron Gate			
Description	:	Remove and Dispose of Penstock Vent - 46" Dia, 0.25" Thick x 60'							
Quantity	:	7,440.00	LBS						
Daily Production	:	7,440.00	LBS per	8 hour shift	**Project #**	: 4			
Work Days	:	1.0	Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$2.08	per LBS		**Probable Low Cost Parameter**		**8556**	**$13,146**	**$1.77**
Total Cost	:	$15,466			**Probable High Cost Parameter**		**6324**	**$17,786**	**$2.39**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Steelworker	Active	5.00	1.0	8	40.00	L	$65.52	incl. in rate	incl. in rate	$2,620.80
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
Crawler Crane (130tn)	Active	1.00	1.0	8	8.00	E	$258.66	incl. in rate	incl. in rate	$2,069.28
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Hydraulic Excavator (5.0cy)	Active	1.00	1.0	8	8.00	E	$274.63	incl. in rate	incl. in rate	$2,197.04
Welder	Active	1.00	1.0	8	8.00	L	$7.84	incl. in rate	incl. in rate	$62.70
Gas Welding Machine	Active	1.00	1.0	8	8.00	E	$2.88	incl. in rate	incl. in rate	$23.02
Carpenters, Journeyman	Active	5.00	1.0	8	40.00	L	$65.37	incl. in rate	incl. in rate	$2,614.80
Carpenter Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.40	incl. in rate	incl. in rate	$371.20

Labor Hours	**112**	**TOTAL LABOR**	**$6,586.94**
Equipment Hours	**32**	**TOTAL EQUIPMENT**	**$5,182.46**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$518.25	$518.25
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$518.25**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$6,586.94	Labor Burden @	49.7%	$0.00		$6,586.94
Material Cost	$518.25	Material Tax @	7.8%	$40.16		$558.41
Equipment Cost	$5,182.46	Equipment Tax @	0.0%	$0.00		$5,182.46
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$12,288**			**$40**	**DIRECT COST SUBTOTALS**	**$12,328**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$12,327.81		$1,849.17
Installing Contractors Profit@	8.0%				$12,327.81		$986.22
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$2,835.40**
General Contractors Insurance @	1.0%		on		$15,163.20		$152
Bond @	1.0%		on		$15,163.20		$152
Contingency @	0.0%		on		$15,466.46		$0
						TOTAL COST for pay item	**$15,466**

Additional Pay Item Notes :

AECOM best estimate - the crew is formed of 1 Forman,5 steelworkers and 1 Welder cutting the steel bends, 1 hydraulic breaker and 1 crane. 5 journeymen loading 1 trucks per day for disposal based on daily production.

PAY ITEM COST DETAIL WORKSHEET

4.082 Remove and Dispose of Penstock - 12" Dia, 0.25" Thick x 698'

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.082			**Project**	: Iron Gate			
Description	:	Remove and Dispose of Penstock - 12" Dia, 0.25" Thick x 698'							
Quantity	:	294,428.00	LBS						
Daily Production	:	10,500.00	LBS per	8 hour shift	**Project #**	: 4			
Work Days	:	28.0	Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$1.47	per LBS		**Probable Low Cost Parameter**		**12075**	**$368,102**	**$1.25**
Total Cost	:	$433,061			**Probable High Cost Parameter**		**8925**	**$498,020**	**$1.69**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	28.0	8	224.00	L	$46.27	incl. in rate	incl. in rate	$10,364.48
Steelworker	Active	5.00	28.0	8	1,120.00	L	$65.52	incl. in rate	incl. in rate	$73,382.40
Equipment Operator (crane)	Active	1.00	28.0	8	224.00	L	$68.41	incl. in rate	incl. in rate	$15,323.84
Crawler Crane (130tn)	Active	1.00	28.0	8	224.00	E	$258.66	incl. in rate	incl. in rate	$57,939.84
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	28.0	8	224.00	E	$111.64	incl. in rate	incl. in rate	$25,007.36
Hydraulic Excavator (5.0cy)	Active	1.00	28.0	8	224.00	E	$274.63	incl. in rate	incl. in rate	$61,517.12
Welder	Active	1.00	28.0	8	224.00	L	$7.84	incl. in rate	incl. in rate	$1,755.60
Gas Welding Machine	Active	1.00	28.0	8	224.00	E	$2.88	incl. in rate	incl. in rate	$644.45
Carpenters, Journeyman	Active	5.00	28.0	8	1,120.00	L	$65.37	incl. in rate	incl. in rate	$73,214.40
Carpenter Foreman (out)	Active	1.00	28.0	8	224.00	L	$46.40	incl. in rate	incl. in rate	$10,393.60

Labor Hours	**3136**	**TOTAL LABOR**	**$184,434.32**
Equipment Hours	**896**	**TOTAL EQUIPMENT**	**$145,108.77**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$14,510.88	$14,510.88
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$14,510.88**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$184,434.32	Labor Burden @	49.7%	$0.00		$184,434.32
Material Cost	$14,510.88	Material Tax @	7.8%	$1,124.59		$15,635.47
Equipment Cost	$145,108.77	Equipment Tax @	0.0%	$0.00		$145,108.77
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$344,054**			**$1,125**	**DIRECT COST SUBTOTALS**	**$345,179**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$345,178.55		$51,776.78
Installing Contractors Profit@	8.0%				$345,178.55		$27,614.28
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$79,391.07**
General Contractors Insurance @	1.0%		on		$424,569.62		$4,246
Bond @	1.0%		on		$424,569.62		$4,246
Contingency @	0.0%		on		$433,061.02		$0
						TOTAL COST for pay item	**$433,061**

Additional Pay Item Notes :

AECOM best estimate - the crew is formed of 1 Forman,5 steelworkers and 1 Welder cutting the steel bends, 1 hydraulic breaker and 1 crane. 5 journeymen loading 1 trucks per day for disposal based on daily production.

PAY ITEM COST DETAIL WORKSHEET

4.083 Remove and Dispose of Bypass Outlet - 96" Dia, 0.25" Thick x 50'

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.083		**Project**	: IRONGATE			
Description	:	Remove and Dispose of Bypass Outlet - 96" Dia, 0.25" Thick x 50'						
Quantity	:	12,800.00 LBS						
Daily Production	:	43,000.00 LBS per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	0.3 Days		**Estimator**	: Mihaela Tomulesc	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.90 per LBS		**Probable Low Cost Parameter**		**49450**	**$9,815**	**$0.77**
Total Cost	:	$11,547		**Probable High Cost Parameter**		**36550**	**$13,279**	**$1.04**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	3.00	0.3	8	7.20	L	$48.27	$0.00		$347.54
Steelworker	Active	12.00	0.3	8	28.80	L	$65.52	$0.00		$1,886.98
Crawler Crane (270tn)	Active	2.00	0.3	8	4.80	E	$399.50	$446.84		$1,917.60
Equipment Operator (crane)	Active	2.00	0.3	8	4.80	L	$68.41	$0.00		$328.37
Welder	Active	3.00	0.3	8	7.20	L	$7.84	$0.00		$56.43
Gas Welding Machine	Active	3.00	0.3	8	7.20	E	$2.88	$2.88		$20.71
Electrician	Active	1.00	0.3	8	2.40	L	$45.23	$0.00		$108.55
Carpenters, Journeyman	Active	12.00	0.3	8	28.80	L	$65.37	$0.00		$1,882.66
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.3	8	2.40	E	$111.64	$111.64		$267.94
Loader, FE Rubber Tire (8.6cy)	Active	2.00	0.3	8	4.80	E	$221.50	$221.50		$1,063.20
Truck Driver (heavy)	Active	1.00	0.3	8	2.40	L	$57.59	$0.00		$138.22
	Active	2.00	0.3	8	4.80	E	$36.58	$36.58		$175.58

Labor Hours	**81.6**	**TOTAL LABOR**	**$4,748.74**
Equipment Hours	**24**	**TOTAL EQUIPMENT**	**$3,445.03**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$474.87	$474.87

TOTAL MATERIAL	**$474.87**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.64	ton	1.000	0.64	$595.00	$380.80
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00

TOTAL SUBCONTRACTS	**$583.80**

SUMMARY OF COSTS

Labor Cost	$4,748.74	Labor Burden @	49.7%	$0.00		$4,748.74
Material Cost	$474.87	Material Tax @	7.8%	$36.80		$511.68
Equipment Cost	$3,445.03	Equipment Tax @	0.0%	$0.00		$3,445.03
Subcontractors	$583.80					$583.80
DIRECT COST SUBTOTALS	**$9,252**			**$37**	**DIRECT COST SUBTOTALS**	**$9,289**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$8,705.45		$1,305.82
Installing Contractors Profit@	8.0%				$8,705.45		$696.44
GC Markup on Subs @	5.0%				$583.80		$29.19
						TOTAL MARKUP COSTS	**$2,031.44**
General Contractors Insurance @	1.0%		on		$11,320.70		$113
Bond @	1.0%		on		$11,320.70		$113
Contingency @	0.0%		on		$11,547.11		$0
						TOTAL COST for pay item	**$11,547**

Additional Pay Item Notes :

Assumed the process of removing and disposing of Bypass Outlet - 96" Dia, 0.25" Thick x 50' (weight: 256 LBS/LF)is done in around 1/2 day by 3 crew formed of 1 forman, 4 jouneymen, 4 steelworkers ;6 equipment operators 1 for each excavator, crane and loader. We dispose pipes with 1 trucks per day for each crew. Assumed contains paint with heavy metals 10% of the total lbs, 28 miles from Iron Gate to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary. Demolition is done using one crawler crane, excavator and welding machine.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.084		**Project**	: IRONGATE			
Description	:	Remove and Dispose of Outlet Valve on bypass outlet - 66" Dia.						
Quantity	:	18,000.00 LBS						
Daily Production	:	9,000.00 LBS per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	2.0 Days		**Estimator**	: Mihaela Tomulesc	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$1.62 per LBS		**Probable Low Cost Parameter**		**10350**	**$24,814**	**$1.38**
Total Cost	:	$29,193		**Probable High Cost Parameter**		**7650**	**$33,572**	**$1.87**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	2.0	8	16.00	L	$48.27	$0.00		$772.32
Steelworker	Active	2.00	2.0	8	32.00	L	$65.52	$0.00		$2,096.64
Crawler Crane (270tn)	Active	1.00	2.0	8	16.00	E	$399.50	$446.84		$6,392.00
Equipment Operator (crane)	Active	1.00	2.0	8	16.00	L	$68.41	$0.00		$1,094.56
Welder	Active	1.00	2.0	8	16.00	L	$7.84	$0.00		$125.40
Gas Welding Machine	Active	1.00	2.0	8	16.00	E	$2.88	$2.88		$46.03
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	$0.00		$723.68
Carpenters, Journeyman	Active	2.00	2.0	8	32.00	L	$65.37	$0.00		$2,091.84
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	$111.64		$1,786.24
Hydraulic Excavator (6.0cy)	Active	1.00	2.0	8	16.00	E	$322.48	$322.48		$5,159.68
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	$0.00		$921.44
	Active	1.00	2.0	8	16.00	E	$36.58	$36.58		$585.28

Labor Hours	**144**	**TOTAL LABOR**	**$7,825.88**
Equipment Hours	**80**	**TOTAL EQUIPMENT**	**$13,969.23**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$782.59	$782.59

TOTAL MATERIAL	**$782.59**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.90	ton	1.000	0.90	$595.00	$535.50
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00

TOTAL SUBCONTRACTS	**$738.50**

SUMMARY OF COSTS

Labor Cost	$7,825.88	Labor Burden @	49.7%	$0.00		$7,825.88
Material Cost	$782.59	Material Tax @	7.8%	$60.65		$843.24
Equipment Cost	$13,969.23	Equipment Tax @	0.0%	$0.00		$13,969.23
Subcontractors	$738.50					$738.50
DIRECT COST SUBTOTALS	**$23,316**			**$61**	**DIRECT COST SUBTOTALS**	**$23,377**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$22,638.35		$3,395.75
Installing Contractors Profit@	8.0%				$22,638.35		$1,811.07
GC Markup on Subs @	5.0%				$738.50		$36.93
						TOTAL MARKUP COSTS	**$5,243.75**
General Contractors Insurance @	1.0%		on		$28,620.60		$286
Bond @	1.0%		on		$28,620.60		$286
Contingency @	0.0%		on		$29,193.01		$0
						TOTAL COST for pay item	**$29,193**

Additional Pay Item Notes :

Assumed the process of removing and disposing of Outlet Valve on bypass outlet - 66" Dia. is done in around 1/2 day by crew formed of 1 forman, 2 jouneymen, 2 steelworkers ; 2 equipment operators for excavator, crane. We dispose Outlet Valve with 1 truck. Assumed contains paint with heavy metals 10% of the total lbs, 28 miles from Iron Gate to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary. Demolition is done using one crawler crane, excavator and welding machine.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.087		**Project**	: IRON GATE			
Description	:	Remove and Dispose Power Cable and Conduit						
Quantity	:	1.00 EA						
Daily Production	:	0.14 EA per	8 hour shift	**Project #**	: 4			
Work Days	:	7.1 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$91,734.75 per EA		**Probable Low Cost Parameter**		**0.161**	**$77,975**	**$77,975**
Total Cost	:	$91,735		**Probable High Cost Parameter**		**0.119**	**$105,495**	**$105,495**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	2.00	7.1	8	113.60	L	$47.23	incl. in rate	incl. in rate	$5,365.33
Electrician	Active	8.00	7.1	8	454.40	L	$45.23	incl. in rate	incl. in rate	$20,552.51
Laborer	Active	6.00	7.1	8	340.80	L	$45.80	incl. in rate	incl. in rate	$15,608.64
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	7.1	8	56.80	E	$111.64	incl. in rate	incl. in rate	$6,341.15
Truck Driver (heavy)	Active	1.00	7.1	8	56.80	L	$57.59	incl. in rate	incl. in rate	$3,271.11
Equipment Operator (medium)	Active	1.00	7.1	8	56.80	L	$66.28	incl. in rate	incl. in rate	$3,764.70
Hydraulic Excavator (5.0cy)	Active	1.00	7.1	8	56.80	E	$274.63	incl. in rate	incl. in rate	$15,598.98

Labor Hours	**1022.4**	**TOTAL LABOR**	**$48,562.30**
Equipment Hours	**113.6**	**TOTAL EQUIPMENT**	**$21,940.14**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$2,428.11	$2,428.11
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$2,428.11**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$48,562.30	Labor Burden @	49.7%	$0.00		$48,562.30
Material Cost	$2,428.11	Material Tax @	7.8%	$188.18		$2,616.29
Equipment Cost	$21,940.14	Equipment Tax @	0.0%	$0.00		$21,940.14
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$72,931**			**$188**	**DIRECT COST SUBTOTALS**	**$73,119**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$73,118.73		$10,967.81
Installing Contractors Profit@	8.0%				$73,118.73		$5,849.50
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$16,817.31**
General Contractors Insurance @	1.0%		on		$89,936.03		$899
Bond @	1.0%		on		$89,936.03		$899
Contingency @	0.0%		on		$91,734.75		$0
						TOTAL COST for pay item	**$91,735**

Additional Pay Item Notes :

Based on RS Means:26050510- 1. Armored cable, (BX), #8, 3 wire, average 50' runs, electrical demolition, remove we use crew Elec2 (9000 LF); 2. Conduit, rigid galvanized steel, 4" to 6" diameter, electrical demolition, remove conduit to 10' high, including fittings & hangers (1800 LF); 3. Conduit, rigid galvanized steel, 2-1/2" to 3-1/2" diameter, electrical demolition, remove conduit to 10 high, including fittings & hangers (1200 LF)

PAY ITEM COST DETAIL WORKSHEET

4.097 Clear and Grub Disposal Area

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.097		**Project**	: Iron Gate			
Description	:	Clear and Grub Disposal Area						
Quantity	:	29.00 AC						
Daily Production	:	1.25 AC per	10 hour shift	**Project #**	: 4			
Work Days	:	23.2 Days		**Estimator**	: Eric Jones	**AC per**	**Total Cost**	**Unit Price Per AC**
Unit Price	:	$6,292.60 per AC		**Probable Low Cost Parameter**		**1.4375**	**$155,113**	**$5,348.71**
Total Cost	:	$182,485		**Probable High Cost Parameter**		**1.0625**	**$209,858**	**$7,236.49**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	23.2	10	232.00	L	$46.27	incl. in rate	incl. in rate	$10,734.64
Equipment Operator (medium)	Active	2.00	23.2	10	464.00	L	$66.28	incl. in rate	incl. in rate	$30,753.92
Laborer	Active	4.00	23.2	10	928.00	L	$45.80	incl. in rate	incl. in rate	$42,502.40
Loader, FE Rubber Tire (5.25cy)	Active	1.00	23.2	10	232.00	E	$75.42	incl. in rate	incl. in rate	$17,497.44
0		2.00	23.2	10	464.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		2.00	23.2	10	464.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		2.00	23.2	10	464.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		2.00	23.2	10	464.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		4.00	23.2	10	928.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	23.2	10	232.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	23.2	10	232.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	23.2	10	232.00	0	$0.00	incl. in rate	incl. in rate	$0.00
Brush Chipper	Active	1.00	23.2	10	232.00	E	$50.55	incl. in rate	incl. in rate	$11,727.60
Crawler Loader 3CY Bucket	Active	1.00	23.2	10	232.00	E	$160.13	incl. in rate	incl. in rate	$37,150.16
Chain Saw, Gas, 36" Long	Active	2.00	23.2	10	464.00	E	$5.63	incl. in rate	incl. in rate	$2,612.32
			23.2	10	0.00					$0.00
			23.2	10	0.00					$0.00
				Labor Hours	**1624**				**TOTAL LABOR**	**$83,990.96**
				Equipment Hours	**1160**				**TOTAL EQUIPMENT**	**$68,987.52**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$83,990.96	Labor Burden @	0.0%			$83,990.96
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$68,987.52	Equipment Tax @	7.75%	$5,346.53		$74,334.05
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$152,978**			**$5,347**	**DIRECT COST SUBTOTALS**	**$158,325**

		Crew	Material	Subs	Cost Basis	
Installi	5.0%				$158,325.01	$7,916.25
Installi	8.0%				$158,325.01	$12,666.00
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$20,582.25**
General Contractors Insurance @	1.0%		on		$178,907.26	$1,789
Bond @	1.0%		on		$178,907.26	$1,789
Contingency @	0.0%		on		$182,485.41	$0
					TOTAL COST for pay item	**$182,485**

Additional Pay Item Notes :

Crew is based off clear and grub crew B7 off of RSM means. Production for the crew in 1.25 ac per day to clear and process the trees/ shrubs on site. Production was adjust to .75 acres per day, Equipment is B7 off of RSMs no adjustment was made.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.099			**Project**	: IRONGATE			
Description	:	Clear and Grub, 40' width for 1 mile - Prepare Haul Road - 1.25 mi							
Quantity	:	5.00	AC						
Daily Production	:	0.69	AC per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	7.3	Days		**Estimator**	: Mihaela Tomulescu	**AC per**	**Total Cost**	**Unit Price Per AC**
Unit Price	:	$5,479.92	per AC		**Probable Low Cost Parameter**		**0.7935**	**$23,290**	**$4,658**
Total Cost	:	$27,400			**Probable High Cost Parameter**		**0.5865**	**$31,510**	**$6,302**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	7.3	8	58.00	L	$46.27	incl. in rate	incl. in rate	$2,683.66
Equipment Operator (medium)	Active	1.00	7.3	8	58.00	L	$66.28	incl. in rate	incl. in rate	$3,844.24
Laborer	Active	4.00	7.3	8	232.00	L	$45.80	incl. in rate	incl. in rate	$10,625.60
Grader. 180hp, 13' blade	Active	1.00	7.3	8	58.00	E	$80.79	incl. in rate	incl. in rate	$4,685.82

Labor Hours	**348**	**TOTAL LABOR**	**$17,153.50**
Equipment Hours	**58**	**TOTAL EQUIPMENT**	**$4,685.82**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$17,153.50	Labor Burden @	49.7%	$0.00		$17,153.50
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$4,685.82	Equipment Tax @	0.0%	$0.00		$4,685.82
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$21,839**			**$0**	**DIRECT COST SUBTOTALS**	**$21,839**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$21,839.32		$3,275.90
Installing Contractors Profit@	8.0%				$21,839.32		$1,747.15
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$5,023.04**
General Contractors Insurance @	1.0%		on		$26,862.36		$269
Bond @	1.0%		on		$26,862.36		$269
Contingency @	0.0%		on		$27,399.61		$0
						TOTAL COST for pay item	**$27,400**

Additional Pay Item Notes :

Crew is based off clear and grub crew B7 off of RSM means. Production for the crew in .69 ac per day to clear and process the trees/ strubs on site.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.101			Project	: IRONGATE			
Description	:	Remove Building No. 2							
Quantity	:	800.00	SF						
Daily Production	:	150.00	SF per	8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	5.3	Days		Estimator	: Mihaela Tomulescu	SF per	Total Cost	Unit Price Per SF
Unit Price	:	$73.00	per SF		Probable Low Cost Parameter		165	$52,563	$66
Total Cost	:	$58,404			Probable High Cost Parameter		127.5	$67,164	$84

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	5.3	8	42.64	L	$46.27	incl. in rate	incl. in rate	$1,972.95
Equipment Operator (medium)	Active	2.00	5.3	8	85.28	L	$66.28	incl. in rate	incl. in rate	$5,652.36
Laborer	Active	3.00	5.3	8	127.92	L	$45.80	incl. in rate	incl. in rate	$5,858.74
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	5.3	8	42.64	E	$111.64	incl. in rate	incl. in rate	$4,760.33
Truck Driver (heavy)	Active	1.00	5.3	8	42.64	L	$57.59	incl. in rate	incl. in rate	$2,455.64
Hydraulic Impact Breaker Attachment (2k-3k ft-lb)	Active	1.00	5.3	8	42.64	E	$30.85	incl. in rate	incl. in rate	$1,315.44
Hydraulic Excavator (2.5cy)	Active	2.00	5.3	8	85.28	E	$203.63	incl. in rate	incl. in rate	$17,365.57

Labor Hours	298.48	TOTAL LABOR	$15,939.68
Equipment Hours	170.56	TOTAL EQUIPMENT	$23,441.34

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Harzardous waste disposal	1	LS		$8,400.00	$8,400.00
				TOTAL SUBCONTRACTS	$8,400.00

SUMMARY OF COSTS

Labor Cost	$15,939.68	Labor Burden @	49.7%	$0.00	$15,939.68
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$23,441.34	Equipment Tax @	0.0%	$0.00	$23,441.34
Subcontractors	$8,400.00				$8,400.00
DIRECT COST SUBTOTALS	$47,781			$0	DIRECT COST SUBTOTALS $47,781

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$39,381.02	$5,907.15
Installing Contractors Profit@	8.0%				$39,381.02	$3,150.48
GC Markup on Subs @	5.0%				$8,400.00	$420.00
					TOTAL MARKUP COSTS	$9,477.64
General Contractors Insurance @	1.0%		on		$57,258.66	$573
Bond @	1.0%		on		$57,258.66	$573
Contingency @	0.0%		on		$58,403.83	$0
					TOTAL COST for pay item	$58,404

Additional Pay Item Notes :

The price of removing a building is based on several factors including the size of the space, structural additions on the property, required permits and waste material clearing. A complete demo of a house and its foundation or basement can cost much as $25,000.
The cost of removal can vary based on the area lived in and the typical wages in the region. Some estimates put a price tag of $18,000 on bulldozing a 1,500 square-foot house, while others show that the average estimate is around $4-$15 per square foot.
Hazardous waste can greatly impact the cost of clearing debris. Many older homes contain asbestos, and there are special fees and considerations associated with its removal and disposal. The national average cost to eliminate asbestos is about $200-$700 per hour. We take in consideration this aspect in our estimate assuming 3 Laborers working 3 days, 8 hours per day @$350

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.102			Project	: IRONGATE			
Description	:	Remove Building No. 3							
Quantity	:	1,088.00	SF						
Daily Production	:	150.00	SF per	8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	7.3	Days		Estimator	: Mihaela Tomulescu	SF per	Total Cost	Unit Price Per SF
Unit Price	:	$75.55	per SF		Probable Low Cost Parameter		165	$73,979	$68
Total Cost	:	$82,199			Probable High Cost Parameter		127.5	$94,529	$87

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	7.3	8	58.00	L	$46.27	incl. in rate	incl. in rate	$2,683.66
Equipment Operator (medium)	Active	2.00	7.3	8	116.00	L	$66.28	incl. in rate	incl. in rate	$7,688.48
Laborer	Active	3.00	7.3	8	174.00	L	$45.80	incl. in rate	incl. in rate	$7,969.20
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	7.3	8	58.00	E	$111.64	incl. in rate	incl. in rate	$6,475.12
Truck Driver (heavy)	Active	1.00	7.3	8	58.00	L	$57.59	incl. in rate	incl. in rate	$3,340.22
Hydraulic Excavator (2.5cy)	Active	2.00	7.3	8	116.00	E	$203.63	incl. in rate	incl. in rate	$23,621.08
Hydraulic Impact Breaker Attachment (2k-3k ft-lb)	Active	1.00	7.3	8	58.00	E	$30.85	incl. in rate	incl. in rate	$1,789.30

Labor Hours	406	TOTAL LABOR	$21,681.56
Equipment Hours	232	TOTAL EQUIPMENT	$31,885.50

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Harzardous waste disposal	1	LS		$14,000.00	$14,000.00
				TOTAL SUBCONTRACTS	$14,000.00

SUMMARY OF COSTS

Labor Cost	$21,681.56	Labor Burden @	49.7%	$0.00		$21,681.56
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$31,885.50	Equipment Tax @	0.0%	$0.00		$31,885.50
Subcontractors	$14,000.00					$14,000.00
DIRECT COST SUBTOTALS	**$67,567**			**$0**	**DIRECT COST SUBTOTALS**	**$67,567**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$53,567.06	$8,035.06
Installing Contractors Profit@	8.0%				$53,567.06	$4,285.36
GC Markup on Subs @	5.0%				$14,000.00	$700.00
					TOTAL MARKUP COSTS	$13,020.42
General Contractors Insurance @	1.0%		on		$80,587.48	$806
Bond @	1.0%		on		$80,587.48	$806
Contingency @	0.0%		on		$82,199.23	$0
					TOTAL COST for pay item	**$82,199**

Additional Pay Item Notes :

The price of removing a building is based on several factors including the size of the space, structural additions on the property, required permits and waste material clearing. A complete demo of a house and its foundation or basement can cost much as $25,000.
The cost of removal can vary based on the area lived in and the typical wages in the region. Some estimates put a price tag of $18,000 on bulldozing a 1,500 square-foot house, while others show that the average estimate is around $4-$15 per square foot.
Hazardous waste can greatly impact the cost of clearing debris. Many older homes contain asbestos, and there are special fees and considerations associated with its removal and disposal. The national average cost to eliminate asbestos is about $200-$700 per hour. We take in consideration this aspect in our estimate assuming 3 Laborers working 5 days, 8 hours per day @$350

PAY ITEM COST DETAIL WORKSHEET

4.103 Remove Concrete in Fish Ladder

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.103	**Project**	:	Iron Gate			
Description	:	Remove Concrete in Fish Ladder						
Quantity	:	1,240.00 cy						
Daily Production	:	50.00 cy per 8 hour shift	**Project #**	:	4			
Work Days	:	24.8 Days	**Estimator**	:	Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$300.19 per cy	**Probable Low Cost Parameter**			**57.5**	**$316,405**	**$255.17**
Total Cost	:	$372,241	**Probable High Cost Parameter**			**42.5**	**$428,077**	**$345.22**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	24.8	8	396.80	L	$48.27	incl. in rate	incl. in rate	$19,153.54
Laborer	Active	8.00	24.8	8	1,587.20	L	$45.80	incl. in rate	incl. in rate	$72,693.76
Equipment Operator (medium)	Active	2.00	24.8	8	396.80	L	$66.28	incl. in rate	incl. in rate	$26,299.90
Truck Driver (heavy)	Active	1.00	24.8	8	198.40	L	$57.59	incl. in rate	incl. in rate	$11,425.86
Air Compressor 900 cfm	Active	1.00	24.8	8	198.40	E	$38.87	incl. in rate	incl. in rate	$7,711.59
Air Compressor 600 cfm	Active	1.00	24.8	8	198.40	E	$21.74	incl. in rate	incl. in rate	$4,313.00
Air Tool, Chipping Hammer	Active	4.00	24.8	8	793.60	E	$1.64	incl. in rate	incl. in rate	$1,300.74
Generator, Small Generator, 10 - 15 kW	Active	2.00	24.8	8	396.80	E	$7.04	incl. in rate	incl. in rate	$2,793.47
Hydraulic Excavator (2.5cy)	Active	2.00	24.8	8	396.80	E	$203.63	incl. in rate	incl. in rate	$80,800.38
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	24.8	8	198.40	E	$62.72	incl. in rate	incl. in rate	$12,443.65
Hydraulic Thumbs/Shear Attachment	Active	1.00	24.8	8	198.40	E	$16.39	incl. in rate	incl. in rate	$3,251.78
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	24.8	8	198.40	E	$111.64	incl. in rate	incl. in rate	$22,149.38
			24.8	8	0.00					$0.00
			24.8	8	0.00					$0.00
			24.8	8	0.00					$0.00
			24.8	8	0.00					$0.00
			24.8	8	0.00					$0.00
				Labor Hours	**2,579**			**TOTAL LABOR**		**$129,573.06**
				Equipment Hours	**2,579**			**TOTAL EQUIPMENT**		**$134,763.99**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$6,478.65	$6,478.65
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$6,478.65**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	7	EA	**Cost per Mob**	$2,500.00	$17,500.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$17,500.00**

SUMMARY OF COSTS

Labor Cost	$129,573.06	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$129,573.06
Material Cost	$6,478.65	Material Tax @	7.75%	$502.10		$6,980.75
Equipment Cost	$134,763.99	Equipment Tax @	7.75%	$10,444.21		$145,208.20
Subcontractors	$17,500.00					$17,500.00
DIRECT COST SUBTOTALS	**$288,316**			**$10,946**	**DIRECT COST SUBTOTALS**	**$299,262**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$281,762.00	$42,264.30
Installing Contractors Profit@	8.0%				$281,762.00	$22,540.96
GC Markup on Subs @	5.0%				$17,500.00	$875.00
					TOTAL MARKUP COSTS	**$65,680.26**
General Contractors Insurance @	1.0%		on		$364,942.26	$3,649
Bond @	1.0%		on		$364,942.26	$3,649
Contingency @	0.0%		on		$372,241.11	$0
					TOTAL COST for pay item	**$372,241**

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposal site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.104		Project	:	IRONGATE			
Description	:	Remove Concrete in Holding Ponds #1 thru #6							
Quantity	:	1,380.00	CY						
Daily Production	:	80.00	CY per	8	hour shift	Project #	: Klamath Dams Removal		
Work Days	:	17.3	Days			Estimator	: Mihaela Tomulescu	CY per	Total Cost / Unit Price Per CY
Unit Price	:	$196.04	per CY			Probable Low Cost Parameter		88	$243,476 / $176
Total Cost	:	$270,529				Probable High Cost Parameter		68	$311,109 / $225

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	17.3	8	138.40	L	$46.27	incl. in rate	incl. in rate	$6,403.77
Equipment Operator (medium)	Active	3.00	17.3	8	415.20	L	$66.28	incl. in rate	incl. in rate	$27,519.46
Steelworker	Active	3.00	17.3	8	415.20	L	$65.52	incl. in rate	incl. in rate	$27,203.90
Electrician	Active	1.00	17.3	8	138.40	L	$45.23	incl. in rate	incl. in rate	$6,259.83
Truck Driver (heavy)	Active	2.00	17.3	8	276.80	L	$57.59	incl. in rate	incl. in rate	$15,940.91
Vibratory Hammer & Extractor	Active	2.00	17.3	8	276.80	E	$94.34	incl. in rate	incl. in rate	$26,113.31
Hydraulic Excavator (6.0cy)	Active	1.00	17.3	8	138.40	E	$322.48	incl. in rate	incl. in rate	$44,631.23
Loader, FE Rubber Tire (8.6cy)	Active	1.00	17.3	8	138.40	E	$221.50	incl. in rate	incl. in rate	$30,655.60
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	17.3	8	276.80	E	$111.64	incl. in rate	incl. in rate	$30,901.95

Labor Hours	1384	TOTAL LABOR	$83,327.87
Equipment Hours	830.4	TOTAL EQUIPMENT	$132,302.10

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$83,327.87	Labor Burden @	49.7%	$0.00	$83,327.87
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$132,302.10	Equipment Tax @	0.0%	$0.00	$132,302.10
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$215,630**			**$0**	**DIRECT COST SUBTOTALS $215,630**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$215,629.97	$32,344.50
Installing Contractors Profit@	8.0%				$215,629.97	$17,250.40
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$49,594.89
General Contractors Insurance @	1.0%		on		$265,224.86	$2,652
Bond @	1.0%		on		$265,224.86	$2,652
Contingency @	0.0%		on		$270,529.36	$0
					TOTAL COST for pay item	**$270,529**

Additional Pay Item Notes :

Based on RS.Means - Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9 and B34B - Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.105		Project	:	IRONGATE			
Description	:	Remove Concrete in Fish Facility Items							
Quantity	:	1,200.00	CY						
Daily Production	:	160.00	CY per	8	hour shift	Project #	: Klamath Dams Removal		
Work Days	:	7.5	Days			Estimator	: Mihaela Tomulescu	CY per	Total Cost / Unit Price Per CY
Unit Price	:	$194.03	per CY			Probable Low Cost Parameter		184	$197,908 / $165
Total Cost	:	$232,832				Probable High Cost Parameter		136	$267,757 / $223

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	7.5	8	120.00	L	$46.27	incl. in rate	incl. in rate	$5,552.40
Equipment Operator (medium)	Active	8.00	7.5	8	480.00	L	$66.28	incl. in rate	incl. in rate	$31,814.40
Steelworker	Active	6.00	7.5	8	360.00	L	$65.52	incl. in rate	incl. in rate	$23,587.20
Electrician	Active	1.00	7.5	8	60.00	L	$45.23	incl. in rate	incl. in rate	$2,713.80
Truck Driver (heavy)	Active	2.00	7.5	8	120.00	L	$57.59	incl. in rate	incl. in rate	$6,910.80
Vibratory Hammer & Extractor	Active	3.00	7.5	8	180.00	E	$94.34	incl. in rate	incl. in rate	$16,981.20
Hydraulic Excavator (6.0cy)	Active	3.00	7.5	8	180.00	E	$322.48	incl. in rate	incl. in rate	$58,046.40
Loader, FE Rubber Tire (8.6cy)	Active	2.00	7.5	8	120.00	E	$221.50	incl. in rate	incl. in rate	$26,580.00
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	7.5	8	120.00	E	$111.64	incl. in rate	incl. in rate	$13,396.80

Labor Hours	1140	TOTAL LABOR	$70,578.60
Equipment Hours	600	TOTAL EQUIPMENT	$115,004.40

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost

TOTAL MATERIAL $0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS $0.00

SUMMARY OF COSTS

Labor Cost	$70,578.60	Labor Burden @	49.7%	$0.00	$70,578.60
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$115,004.40	Equipment Tax @	0.0%	$0.00	$115,004.40
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$185,583			$0	DIRECT COST SUBTOTALS $185,583

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$185,583.00	$27,837.45
Installing Contractors Profit@	8.0%				$185,583.00	$14,846.64
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$42,684.09
General Contractors Insurance @	1.0%		on		$228,267.09	$2,283
Bond @	1.0%		on		$228,267.09	$2,283
Contingency @	0.0%		on		$232,832.43	$0
					TOTAL COST for pay item	$232,832

Additional Pay Item Notes :

Based on RS.Means - "Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9" and "Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment Crew B34B"

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.106		**Project**	:	IRONGATE		
Description	:	Remove Miscellaneous Metalwork in Fish Facilities						
Quantity	:	12,000.00 LBS						
Daily Production	:	43,000.00 LBS per	8 hour shift	**Project #**	:	Klamath Dams Removal		
Work Days	:	0.3 Days		**Estimator**	:	Mihaela Tomulesc	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.95 per LBS		**Probable Low Cost Parameter**			**49450**	**$9,648**	**$0.80**
Total Cost	:	$11,351		**Probable High Cost Parameter**			**34400**	**$13,621**	**$1.14**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	3.00	0.3	8	7.20	L	$48.27	$0.00		$347.54
Steelworker	Active	12.00	0.3	8	28.80	L	$65.52	$0.00		$1,886.98
Crawler Crane (270tn)	Active	2.00	0.3	8	4.80	E	$399.50	$446.84		$1,917.60
Equipment Operator (crane)	Active	2.00	0.3	8	4.80	L	$68.41	$0.00		$328.37
Welder	Active	3.00	0.3	8	7.20	L	$7.84	$0.00		$56.43
Gas Welding Machine	Active	3.00	0.3	8	7.20	E	$2.88	$2.88		$20.71
Electrician	Active	1.00	0.3	8	2.40	L	$45.23	$0.00		$108.55
Carpenters, Journeyman	Active	12.00	0.3	8	28.80	L	$65.37	$0.00		$1,882.66
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.3	8	2.40	E	$111.64	$111.64		$267.94
Hydraulic Excavator (6.0cy)	Active	1.00	0.3	8	2.40	E	$322.48	$322.48		$773.95
Truck Driver (heavy)	Active	2.00	0.3	8	4.80	L	$57.59	$0.00		$276.43
	Active	2.00	0.3	8	4.80	E	$36.58	$36.58		$175.58

Labor Hours	**84**	**TOTAL LABOR**	**$4,886.96**
Equipment Hours	**21.6**	**TOTAL EQUIPMENT**	**$3,155.79**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$488.70	$488.70

TOTAL MATERIAL	**$488.70**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.60	ton	1.000	0.60	$595.00	$357.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00

TOTAL SUBCONTRACTS	**$560.00**

SUMMARY OF COSTS

Labor Cost	$4,886.96	Labor Burden @	49.7%	$0.00		$4,886.96
Material Cost	$488.70	Material Tax @	7.8%	$37.87		$526.57
Equipment Cost	$3,155.79	Equipment Tax @	0.0%	$0.00		$3,155.79
Subcontractors	$560.00					$560.00
DIRECT COST SUBTOTALS	**$9,091**			**$38**	**DIRECT COST SUBTOTALS**	**$9,129**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$8,569.31		$1,285.40
Installing Contractors Profit@	8.0%				$8,569.31		$685.55
GC Markup on Subs @	5.0%				$560.00		$28.00
						TOTAL MARKUP COSTS	**$1,998.94**
General Contractors Insurance @	1.0%		on		$11,128.26		$111
Bond @	1.0%		on		$11,128.26		$111
Contingency @	0.0%		on		$11,350.82		$0
						TOTAL COST for pay item	**$11,351**

Additional Pay Item Notes :

Assumed the process of removing and disposing of Miscellaneous Metalwork in Fish Facilities (frames, grating, handrails, laddrs, mechanical sweeps) is done in around 1/2 day by 3 crew formed of 1 forman, 4 jouneymen, 4 steelworkers. We dispose metal with 1 trucks per day for each crew. Assumed contains paint with heavy metals 10% of the total lbs, 28 miles from Iron Gate to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary. Demolition is done using one crawler crane, excavator and welding machine.

PAY ITEM COST DETAIL WORKSHEET

4.107 Remoce Concrete Associated with 30" Dia. water supply line

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.107			**Project**	: IRONGATE				
Description	:	Remoce Concrete Associated with 30" Dia. water supply line								
Quantity	:	80.00	CY							
Daily Production	:	150.00	CY per	8 hour shift	**Project #**	: Klamath Dams Removal				
Work Days	:	0.5	Days		**Estimator**	: Mihaela Tomulescu		**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$194.03	per CY		**Probable Low Cost Parameter**			**172.5**	**$13,194**	**$165**
Total Cost	:	$15,522			**Probable High Cost Parameter**			**127.5**	**$17,850**	**$223**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	0.5	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Equipment Operator (medium)	Active	8.00	0.5	8	32.00	L	$66.28	incl. in rate	incl. in rate	$2,120.96
Steelworker	Active	6.00	0.5	8	24.00	L	$65.52	incl. in rate	incl. in rate	$1,572.48
Electrician	Active	1.00	0.5	8	4.00	L	$45.23	incl. in rate	incl. in rate	$180.92
Truck Driver (heavy)	Active	2.00	0.5	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Vibratory Hammer & Extractor	Active	3.00	0.5	8	12.00	E	$94.34	incl. in rate	incl. in rate	$1,132.08
Hydraulic Excavator (6.0cy)	Active	3.00	0.5	8	12.00	E	$322.48	incl. in rate	incl. in rate	$3,869.76
Loader, FE Rubber Tire (8.6cy)	Active	2.00	0.5	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	0.5	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12

Labor Hours	**76**	**TOTAL LABOR**	**$4,705.24**
Equipment Hours	**40**	**TOTAL EQUIPMENT**	**$7,666.96**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$4,705.24	Labor Burden @	49.7%	$0.00		$4,705.24
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$7,666.96	Equipment Tax @	0.0%	$0.00		$7,666.96
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$12,372**			**$0**	**DIRECT COST SUBTOTALS**	**$12,372**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$12,372.20	$1,855.83
Installing Contractors Profit@	8.0%				$12,372.20	$989.78
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$2,845.61**
General Contractors Insurance @	1.0%		on		$15,217.81	$152
Bond @	1.0%		on		$15,217.81	$152
Contingency @	0.0%		on		$15,522.16	$0
					TOTAL COST for pay item	**$15,522**

Additional Pay Item Notes :

Based on RS.Means - "Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9" and "Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment Crew B34B"

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.108			Project	: IRONGATE			
Description	:	Remove Concrete in Aerator Structure							
Quantity	:	65.00	CY						
Daily Production	:	50.00	CY per	8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	1.3	Days		Estimator	: Mihaela Tomulescu	CY per	Total Cost	Unit Price Per CY
Unit Price	:	$191.23	per CY		Probable Low Cost Parameter		57.5	$10,565	$163
Total Cost	:	$12,430			Probable High Cost Parameter		42.5	$14,294	$220

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.3	8	10.40	L	$46.27	incl. in rate	incl. in rate	$481.21
Equipment Operator (medium)	Active	2.00	1.3	8	20.80	L	$66.28	incl. in rate	incl. in rate	$1,378.62
Steelworker	Active	3.00	1.3	8	31.20	L	$65.52	incl. in rate	incl. in rate	$2,044.22
Electrician	Active	1.00	1.3	8	10.40	L	$45.23	incl. in rate	incl. in rate	$470.39
Truck Driver (heavy)	Active	1.00	1.3	8	10.40	L	$57.59	incl. in rate	incl. in rate	$598.94
Vibratory Hammer & Extractor	Active	1.00	1.3	8	10.40	E	$94.34	incl. in rate	incl. in rate	$981.14
Hydraulic Excavator (6.0cy)	Active	1.00	1.3	8	10.40	E	$322.48	incl. in rate	incl. in rate	$3,353.79
Truck Driver (heavy)	Active	1.00	1.3	8	10.40	L	$57.59	incl. in rate	incl. in rate	$598.94

Labor Hours	93.6	TOTAL LABOR	$5,572.32
Equipment Hours	20.8	TOTAL EQUIPMENT	$4,334.93

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$5,572.32	Labor Burden @	49.7%	$0.00		$5,572.32
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$4,334.93	Equipment Tax @	0.0%	$0.00		$4,334.93
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$9,907			$0	DIRECT COST SUBTOTALS	$9,907

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$9,907.25	$1,486.09
Installing Contractors Profit@	8.0%				$9,907.25	$792.58
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$2,278.67
General Contractors Insurance @	1.0%		on		$12,185.92	$122
Bond @	1.0%		on		$12,185.92	$122
Contingency @	0.0%		on		$12,429.63	$0
					TOTAL COST for pay item	$12,430

Additional Pay Item Notes :

Based on RS.Means - "Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9" and "Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment Crew B34B"

PAY ITEM COST DETAIL WORKSHEET

4.111 Remove Asphalt Pavement

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.111			**Project**	: Iron Gate			
Description	:	Remove Asphalt Pavement							
Quantity	:	3,900.00	SF						
Daily Production	:	1,270.00	SF per	8 hour shift	**Project #**	: 4			
Work Days	:	3.1	Days		**Estimator**	: Eric Jones	**SF per**	**Total Cost**	**Unit Price Per SF**
Unit Price	:	$6.54	per SF		**Probable Low Cost Parameter**		**1460.5**	**$21,665**	**$5.56**
Total Cost	:	$25,489			**Probable High Cost Parameter**		**1079.5**	**$29,312**	**$7.52**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	3.1	8	24.80	L	$46.27	incl. in rate	incl. in rate	$1,147.50
Laborer	Active	2.00	3.1	8	49.60	L	$45.80	incl. in rate	incl. in rate	$2,271.68
Equipment Operator (light)	Active	1.00	3.1	8	24.80	L	$64.90	incl. in rate	incl. in rate	$1,609.52
Equipment Operator (medium)	Active	1.00	3.1	8	24.80	L	$66.28	incl. in rate	incl. in rate	$1,643.74
Hydraulic Excavator (5.0cy)	Active	1.00	3.1	8	24.80	E	$274.63	incl. in rate	incl. in rate	$6,810.82
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	3.1	8	24.80	E	$62.72	incl. in rate	incl. in rate	$1,555.46
Loader, FE Rubber Tire (5.25cy)	Active	1.00	3.1	8	24.80	E	$75.42	incl. in rate	incl. in rate	$1,870.42
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	3.1	8	24.80	E	$111.64	incl. in rate	incl. in rate	$2,768.67
Truck Driver (heavy)	Active	1.00	3.1	8	24.80	L	$57.59	incl. in rate	incl. in rate	$1,428.23
		1.00	3.1	8	24.80	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	3.1	8	24.80	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	3.1	8	24.80	0	$0.00	incl. in rate	incl. in rate	$0.00
			3.1	8	0.00					$0.00
			3.1	8	0.00					$0.00
			3.1	8	0.00					$0.00
			3.1	8	0.00					$0.00
			3.1	8	0.00					$0.00
				Labor Hours	**148.8**			**TOTAL LABOR**		**$8,100.67**
				Equipment Hours	**99.2**			**TOTAL EQUIPMENT**		**$13,005.37**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
			1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$8,100.67	Labor Burden @	0.0%			$8,100.67
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$13,005.37	Equipment Tax @	7.75%	$1,007.92		$14,013.28
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$21,106**			**$1,008**	**DIRECT COST SUBTOTALS**	**$22,114**

		Crew	Material	Subs	Cost Basis	
Installi	5.0%				$22,113.96	$1,105.70
Installi	8.0%				$22,113.96	$1,769.12
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$2,874.81**

General Contractors Insurance @	1.0%	on	$24,988.77	$250
Bond @	1.0%	on	$24,988.77	$250
Contingency @	0.0%	on	$25,488.55	$0
			TOTAL COST for pay item	**$25,489**

Additional Pay Item Notes :

Crew is built from B38 RSM which has a production of 53 SY an hour or 424 sy/ 3816 SF a day. Production was adjusted to show reaching 1/3 of the production from RSM's due to working in tight area, working around existing structures, and the haul route location/ turnaround time (which will not be fast). Also added an off-road dump truck and truck driver to haul asphalt waste to disposal area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.112		Project	:	IRONGATE			
Description	:	Remove Restroom Building near Aerator Structure							
Quantity	:	340.00	SF						
Daily Production	:	205.00	SF per	8	hour shift	Project #	:	Klamath Dams Removal	
Work Days	:	1.7	Days			Estimator	:	Mihaela Tomulescu	
Unit Price	:	$60.38	per SF			Probable Low Cost Parameter			
Total Cost	:	$20,528				Probable High Cost Parameter			

SF per	Total Cost	Unit Price Per SF
225.5	$18,475	$54
174.25	$23,607	$69

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.7	8	13.28	L	$46.27	incl. in rate	incl. in rate	$614.47
Equipment Operator (medium)	Active	1.00	1.7	8	13.28	L	$66.28	incl. in rate	incl. in rate	$880.20
Laborer	Active	2.00	1.7	8	26.56	L	$45.80	incl. in rate	incl. in rate	$1,216.45
Electrician	Active	1.00	1.7	8	13.28	L	$45.23	incl. in rate	incl. in rate	$600.65
Truck Driver (heavy)	Active	1.00	1.7	8	13.28	L	$57.59	incl. in rate	incl. in rate	$764.80
Steelworker	Active	2.00	1.7	8	26.56	L	$65.52	incl. in rate	incl. in rate	$1,740.21
Hydraulic Excavator (6.0cy)	Active	1.00	1.7	8	13.28	E	$322.48	incl. in rate	incl. in rate	$4,282.53
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.7	8	13.28	E	$111.64	incl. in rate	incl. in rate	$1,482.58

Labor Hours	106.24	TOTAL LABOR	$5,816.77
Equipment Hours	26.56	TOTAL EQUIPMENT	$5,765.11

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost

TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Harzardous waste disposal	1	LS		$5,600.00	$5,600.00

TOTAL SUBCONTRACTS	$5,600.00

SUMMARY OF COSTS

Labor Cost	$5,816.77	Labor Burden @	49.7%	$0.00		$5,816.77
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$5,765.11	Equipment Tax @	0.0%	$0.00		$5,765.11
Subcontractors	$5,600.00					$5,600.00
DIRECT COST SUBTOTALS	$17,182			$0	DIRECT COST SUBTOTALS	$17,182

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$11,581.89	$1,737.28
Installing Contractors Profit@	8.0%				$11,581.89	$926.55
GC Markup on Subs @	5.0%				$5,600.00	$280.00
					TOTAL MARKUP COSTS	$2,943.83
General Contractors Insurance @	1.0%		on		$20,125.72	$201
Bond @	1.0%		on		$20,125.72	$201
Contingency @	0.0%		on		$20,528.23	$0
					TOTAL COST for pay item	$20,528

Additional Pay Item Notes :

The price of removing a building is based on several factors including the size of the space, structural additions on the property, required permits and waste material clearing. A complete demo of a house and its foundation or basement can cost much as $25,000.
The cost of removal can vary based on the area lived in and the typical wages in the region. Some estimates put a price tag of $18,000 on bulldozing a 1,500 square-foot house, while others show that the average estimate is around $4-$15 per square foot.
Hazardous waste can greatly impact the cost of clearing debris. Many older homes contain asbestos, and there are special fees and considerations associated with its removal and disposal. The national average cost to eliminate asbestos is about $200-$700 per hour. We take in consideration this aspect in our estimate assuming 3 Laborers working 2 days, 8 hours per day @$350

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.113			Project	: IRONGATE			
Description	:	Remove Storage Shed near Aerator Structure							
Quantity	:	90.00	SF						
Daily Production	:	160.00	SF per	8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	0.6	Days		Estimator	: Mihaela Tomulescu	SF per	Total Cost	Unit Price Per SF
Unit Price	:	$70.22	per SF		Probable Low Cost Parameter		176	$5,688	$63
Total Cost	:	$6,320			Probable High Cost Parameter		136	$7,268	$81

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	0.6	8	4.48	L	$46.27	incl. in rate	incl. in rate	$207.29
Equipment Operator (medium)	Active	1.00	0.6	8	4.48	L	$66.28	incl. in rate	incl. in rate	$296.93
Laborer	Active	2.00	0.6	8	8.96	L	$45.80	incl. in rate	incl. in rate	$410.37
Hydraulic Excavator (5.0cy)	Active	1.00	0.6	8	4.48	E	$274.63	incl. in rate	incl. in rate	$1,230.34
Truck Driver (heavy)	Active	1.00	0.6	8	4.48	L	$57.59	incl. in rate	incl. in rate	$258.00
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.6	8	4.48	E	$111.64	incl. in rate	incl. in rate	$500.15

Labor Hours	22.4	TOTAL LABOR	$1,172.60
Equipment Hours	8.96	TOTAL EQUIPMENT	$1,730.49

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	1	EA	**Cost per Mob**	$2,500.00	$2,500.00
				TOTAL SUBCONTRACTS	$2,500.00

SUMMARY OF COSTS

Labor Cost	$1,172.60	Labor Burden @	49.7%	$0.00		$1,172.60
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$1,730.49	Equipment Tax @	0.0%	$0.00		$1,730.49
Subcontractors	$2,500.00					$2,500.00
DIRECT COST SUBTOTALS	**$5,403**			**$0**	**DIRECT COST SUBTOTALS**	**$5,403**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$2,903.08		$435.46
Installing Contractors Profit@	8.0%				$2,903.08		$232.25
GC Markup on Subs @	5.0%				$2,500.00		$125.00
						TOTAL MARKUP COSTS	$792.71
General Contractors Insurance @	1.0%		on		$6,195.79		$62
Bond @	1.0%		on		$6,195.79		$62
Contingency @	0.0%		on		$6,319.71		$0
						TOTAL COST for pay item	**$6,320**

Additional Pay Item Notes :

The cost of removal can vary based on the area lived in and the typical wages in the region. We assumed that we need 1 Forman, 2 Laboreres and 1 Excavator to load the rubbish in the truck in 1/2 day.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.114			**Project**	: IRONGATE				
Description	:	Remove Toe Drain Pipe								
Quantity	:	260.00	LF							
Daily Production	:	225.00	LF per	8 hour shift	**Project #**	: Klamath Dams Removal				
Work Days	:	1.2	Days		**Estimator**	: Mihaela Tomulescu		**LF per**	**Total Cost**	**Unit Price Per LF**
Unit Price	:	$27.00	per LF		**Probable Low Cost Parameter**			**258.75**	**$5,968**	**$23**
Total Cost	:	$7,021			**Probable High Cost Parameter**			**191.25**	**$8,074**	**$31**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.2	8	9.28	L	$46.27	incl. in rate	incl. in rate	$429.39
Equipment Operator (medium)	Active	1.00	1.2	8	9.28	L	$66.28	incl. in rate	incl. in rate	$615.08
Trencher	Active	2.00	1.2	8	18.56	E	$4.07	incl. in rate	incl. in rate	$75.54
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.2	8	9.28	E	$111.64	incl. in rate	incl. in rate	$1,036.02
Truck Driver (heavy)	Active	1.00	1.2	8	9.28	L	$57.59	incl. in rate	incl. in rate	$534.44
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.2	8	9.28	E	$221.50	incl. in rate	incl. in rate	$2,055.52
Laborer	Active	2.00	1.2	8	18.56	L	$45.80	incl. in rate	incl. in rate	$850.05

Labor Hours	**46.4**	**TOTAL LABOR**	**$2,428.95**
Equipment Hours	**37.12**	**TOTAL EQUIPMENT**	**$3,167.08**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,428.95	Labor Burden @	49.7%	$0.00	$2,428.95
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$3,167.08	Equipment Tax @	0.0%	$0.00	$3,167.08
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$5,596**			**$0**	**DIRECT COST SUBTOTALS** **$5,596**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$5,596.03	$839.40
Installing Contractors Profit@	8.0%				$5,596.03	$447.68
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,287.09**
General Contractors Insurance @	1.0%		on		$6,883.11	$69
Bond @	1.0%		on		$6,883.11	$69
Contingency @	0.0%		on		$7,020.77	$0
					TOTAL COST for pay item	**$7,021**

Additional Pay Item Notes :

Based on RS>Means (22050510) crew PLUM2 -"Pipe, metal pipe, 8" to 14" diam., selective demolition".

PAY ITEM COST DETAIL WORKSHEET

4.116 Berm Removal

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.116			**Project**	:	Iron Gate			
Description	:	Berm Removal								
Quantity	:	53,000.00	cy							
Daily Production	:	2,500.00	cy per	8 hour shift	**Project #**	:	4			
Work Days	:	21.2	Days		**Estimator**	:	Michael Barba	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$13.82	per cy		**Probable Low Cost Parameter**			**2750**	**$659,302**	**$12.44**
Total Cost	:	$732,558			**Probable High Cost Parameter**			**2125**	**$842,442**	**$15.90**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (235hp)(CATD7)	Active	2.00	21.2	8	339.20	E	$165.11	incl. in rate	incl. in rate	$56,005.31
Loader, FE Rubber Tire (5.25cy)	Active	2.00	21.2	8	339.20	E	$75.42	incl. in rate	incl. in rate	$25,582.46
Truck, Off-Road, Articulated Rear, 20cy	Active	10.00	21.2	8	1,696.00	E	$111.64	incl. in rate	incl. in rate	$189,341.44
Hydraulic Excavator (5.0cy)	Active	2.00	21.2	8	339.20	E	$274.63	incl. in rate	incl. in rate	$93,154.50
Equipment Operator (medium)	Active	6.00	21.2	8	1,017.60	L	$66.28	incl. in rate	incl. in rate	$67,446.53
Truck Driver (heavy)	Active	10.00	21.2	8	1,696.00	L	$57.59	incl. in rate	incl. in rate	$97,672.64
Laborer	Active	2.00	21.2	8	339.20	L	$45.80	incl. in rate	incl. in rate	$15,535.36
Labor Foreman (out)	Active	1.00	21.2	8	169.60	L	$46.27	incl. in rate	incl. in rate	$7,847.39
Truck, Pickup (4x4, 3/4tn)	Active	1.00	21.2	8	169.60	E	$16.94	incl. in rate	incl. in rate	$2,873.02
		0.00	21.2	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		0.00	21.2	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		0.00	21.2	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			21.2	8	0.00					$0.00
			21.2	8	0.00					$0.00
			21.2	8	0.00					$0.00
			21.2	8	0.00					$0.00
			21.2	8	0.00					$0.00
				Labor Hours	**3222.4**				**TOTAL LABOR**	**$188,501.92**
				Equipment Hours	**2883.2**				**TOTAL EQUIPMENT**	**$366,956.74**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price		Material Cost
							$0.00
	0.00	TN	1.300	0.00	$0.00		$0.00
	0.00	ea	1.000	0.00	$0.00		$0.00
	0.00	ea	1.000	0.00	$0.00		$0.00
	0.00	ea	1.000	0.00	$0.00		$0.00
	0.00	ls	1.000	0.00	$0.00		$0.00
						TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$188,501.92	Labor Burden @	49.7%	$0.00		$188,501.92
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$366,956.74	Equipment Tax @	7.75%	$28,439.15		$395,395.88
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$555,459**			**$28,439**	**DIRECT COST SUBTOTALS**	**$583,898**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$583,897.80	$87,584.67
Installing Contractors Profit@	8.0%				$583,897.80	$46,711.82
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$134,296.49**
General Contractors Insurance @	1.0%		on		$718,194.30	$7,182
Bond @	1.0%		on		$718,194.30	$7,182
Contingency @	0.0%		on		$732,558.18	$0
					TOTAL COST for pay item	**$732,558**

Additional Pay Item Notes :

Production is based on using 10 each 20 CY dump trucks hauling 14 load per day on average. Excavators will be used to excavate material and load trucks, loader will be used to load trucks and maintain haul roads, dozers will be used to scrape and stock pile material.

PAY ITEM COST DETAIL WORKSHEET

4.118 Remove and Dispose of Pipe Conduit, 30" Dia. x 0.25" Thick x 960'

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.118			**Project**	: Iron Gate			
Description	:	Remove and Dispose of Pipe Conduit, 30" Dia. x 0.25" Thick x 960'							
Quantity	:	76,640.00	LBS						
Daily Production	:	2,500.00	LBS per	8 hour shift	**Project #**	: 4			
Work Days	:	30.7	Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$1.03	per LBS		**Probable Low Cost Parameter**		**2875**	**$67,106**	**$0.88**
Total Cost	:	$78,948			**Probable High Cost Parameter**		**2000**	**$94,738**	**$1.24**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Laborer	Active	2.00	30.7	8	491.20	L	$45.80	incl. in rate	incl. in rate	$22,496.96
Equipment Operator (crane)	Active	1.00	30.7	8	245.60	L	$68.41	incl. in rate	incl. in rate	$16,801.50
Hydraulic Crane (17tn)	Active	1.00	30.7	8	245.60	E	$81.52	incl. in rate	incl. in rate	$20,021.31
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12

Labor Hours	**744.8**	**TOTAL LABOR**	**$39,759.18**
Equipment Hours	**253.6**	**TOTAL EQUIPMENT**	**$20,914.43**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$2,091.44	$2,091.44
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$2,091.44**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$39,759.18	Labor Burden @	49.7%	$0.00		$39,759.18
Material Cost	$2,091.44	Material Tax @	7.8%	$162.09		$2,253.53
Equipment Cost	$20,914.43	Equipment Tax @	0.0%	$0.00		$20,914.43
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$62,765**			**$162**	**DIRECT COST SUBTOTALS**	**$62,927**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$62,927.14		$9,439.07
Installing Contractors Profit@	8.0%				$62,927.14		$5,034.17
GC Markup on Subs @	5.0%				$0.00		$0.00
				.		**TOTAL MARKUP COSTS**	**$14,473.24**
General Contractors Insurance @	1.0%		on		$77,400.38		$774
Bond @	1.0%		on		$77,400.38		$774
Contingency @	0.0%		on		$78,948.39		$0
						TOTAL COST for pay item	**$78,948**

Additional Pay Item Notes :

Based on RS Means, Utility removal, pipe, sewer/water, 27" to 36" diameter, remove, excludes excavation & Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH. Using CREW B12Z .

PAY ITEM COST DETAIL WORKSHEET

4.122 Remove and Dispose of Piping- 30-in. Dia. x 0.25 Thikness x 90'

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.122			**Project**	: Iron Gate			
Description	:	Remove and Dispose of Piping- 30-in. Dia. x 0.25 Thikness x 90'							
Quantity	:	7,200.00	LBS						
Daily Production	:	7,200.00	LBS per	8 hour shift	**Project #**	: 4			
Work Days	:	1.0	Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.60	per LBS		**Probable Low Cost Parameter**		**8280**	**$3,682**	**$0.51**
Total Cost	:	$4,332			**Probable High Cost Parameter**		**5760**	**$5,198**	**$0.72**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
Hydraulic Crane (17tn)	Active	1.00	1.0	8	8.00	E	$81.52	incl. in rate	incl. in rate	$652.16
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12

Labor Hours	**32**	**TOTAL LABOR**	**$1,740.80**
Equipment Hours	**16**	**TOTAL EQUIPMENT**	**$1,545.28**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$154.53	$154.53
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$154.53**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,740.80	Labor Burden @	49.7%	$0.00		$1,740.80
Material Cost	$154.53	Material Tax @	7.8%	$11.98		$166.50
Equipment Cost	$1,545.28	Equipment Tax @	0.0%	$0.00		$1,545.28
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$3,441**			**$12**	**DIRECT COST SUBTOTALS**	**$3,453**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$3,452.58		$517.89
Installing Contractors Profit@	8.0%				$3,452.58		$276.21
GC Markup on Subs @	5.0%				$0.00		$0.00
				.		**TOTAL MARKUP COSTS**	**$794.09**
General Contractors Insurance @	1.0%		on		$4,246.68		$42
Bond @	1.0%		on		$4,246.68		$42
Contingency @	0.0%		on		$4,331.61		$0
						TOTAL COST for pay item	**$4,332**

Additional Pay Item Notes :

Based on RS Means, Utility removal, pipe, sewer/water, 27" to 36" diameter, remove, excludes excavation & Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH. Using CREW B12Z .

PAY ITEM COST DETAIL WORKSHEET

4.123 Remove and Dispose of Piping- 24-in. Dia. x 0.25 Thikness x 248'

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.123			**Project**	: Iron Gate			
Description	:	Remove and Dispose of Piping- 24-in. Dia. x 0.25 Thikness x 248'							
Quantity	:	15,872.00	LBS						
Daily Production	:	7,600.00	LBS per	8 hour shift	**Project #**	: 4			
Work Days	:	2.1	Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.50	per LBS		**Probable Low Cost Parameter**		**8740**	**$6,804**	**$0.43**
Total Cost	:	$8,005			**Probable High Cost Parameter**		**6080**	**$9,606**	**$0.61**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (heavy)	Active	1.00	1.5	8	12.00	L	$57.59	incl. in rate	incl. in rate	$691.08
Laborer	Active	2.00	2.1	8	33.60	L	$45.80	incl. in rate	incl. in rate	$1,538.88
Equipment Operator (crane)	Active	1.00	2.1	8	16.80	L	$68.41	incl. in rate	incl. in rate	$1,149.29
Hydraulic Crane (17tn)	Active	1.00	2.1	8	16.80	E	$81.52	incl. in rate	incl. in rate	$1,369.54
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.5	8	12.00	E	$111.64	incl. in rate	incl. in rate	$1,339.68

Labor Hours	**62.4**	**TOTAL LABOR**	**$3,379.25**
Equipment Hours	**28.8**	**TOTAL EQUIPMENT**	**$2,709.22**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$270.92	$270.92
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$270.92**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$3,379.25	Labor Burden @	49.7%	$0.00		$3,379.25
Material Cost	$270.92	Material Tax @	7.8%	$21.00		$291.92
Equipment Cost	$2,709.22	Equipment Tax @	0.0%	$0.00		$2,709.22
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$6,359**			**$21**	**DIRECT COST SUBTOTALS**	**$6,380**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$6,380.38		$957.06
Installing Contractors Profit@	8.0%				$6,380.38		$510.43
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$1,467.49**
General Contractors Insurance @	1.0%		on		$7,847.87		$78
Bond @	1.0%		on		$7,847.87		$78
Contingency @	0.0%		on		$8,004.83		$0
						TOTAL COST for pay item	**$8,005**

Additional Pay Item Notes :

Based on RS Means, Utility removal, pipe, sewer/water, 21" to 24" diameter, remove, excludes excavation & Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH. Using CREW B12Z .

PAY ITEM COST DETAIL WORKSHEET

4.124 Remove and Dispose of Piping- 20-in. Dia. x 0.25 Thikness x 85'

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.124		**Project**	: Iron Gate			
Description	:	Remove and Dispose of Piping- 20-in. Dia. x 0.25 Thikness x 85'						
Quantity	:	4,505.00 LBS						
Daily Production	:	7,600.00 LBS per	8 hour shift	**Project #**	: 4			
Work Days	:	0.6 Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.58 per LBS		**Probable Low Cost Parameter**		**8740**	**$2,209**	**$0.49**
Total Cost	:	$2,599		**Probable High Cost Parameter**		**6080**	**$3,119**	**$0.69**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (heavy)	Active	1.00	0.6	8	4.80	L	$57.59	incl. in rate	incl. in rate	$276.43
Laborer	Active	2.00	0.6	8	9.60	L	$45.80	incl. in rate	incl. in rate	$439.68
Equipment Operator (crane)	Active	1.00	0.6	8	4.80	L	$68.41	incl. in rate	incl. in rate	$328.37
Hydraulic Crane (17tn)	Active	1.00	0.6	8	4.80	E	$81.52	incl. in rate	incl. in rate	$391.30
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.6	8	4.80	E	$111.64	incl. in rate	incl. in rate	$535.87

Labor Hours	**19.2**	**TOTAL LABOR**	**$1,044.48**
Equipment Hours	**9.6**	**TOTAL EQUIPMENT**	**$927.17**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$92.72	$92.72
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$92.72**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,044.48	Labor Burden @	49.7%	$0.00		$1,044.48
Material Cost	$92.72	Material Tax @	7.8%	$7.19		$99.90
Equipment Cost	$927.17	Equipment Tax @	0.0%	$0.00		$927.17
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$2,064**			**$7**	**DIRECT COST SUBTOTALS**	**$2,072**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$2,071.55		$310.73
Installing Contractors Profit@	8.0%				$2,071.55		$165.72
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$476.46**
General Contractors Insurance @	1.0%		on		$2,548.01		$25
Bond @	1.0%		on		$2,548.01		$25
Contingency @	0.0%		on		$2,598.97		$0
						TOTAL COST for pay item	**$2,599**

Additional Pay Item Notes :

Based on RS Means, Utility removal, pipe, sewer/water, 21" to 24" diameter, remove, excludes excavation & Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH. Using CREW B12Z .

PAY ITEM COST DETAIL WORKSHEET

4.125 Remove and Dispose of Piping- 18-in. Dia. x 0.25 Thikness x 432'

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.125			**Project**	: Iron Gate			
Description	:	Remove and Dispose of Piping- 18-in. Dia. x 0.25 Thikness x 432'							
Quantity	:	29,088.00	LBS						
Daily Production	:	7,900.00	LBS per	8 hour shift	**Project #**	: 4			
Work Days	:	3.7	Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.38	per LBS		**Probable Low Cost Parameter**		**9085**	**$9,448**	**$0.32**
Total Cost	:	$11,115			**Probable High Cost Parameter**		**6320**	**$13,338**	**$0.46**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Laborer	Active	2.00	3.7	8	59.20	L	$45.80	incl. in rate	incl. in rate	$2,711.36
Equipment Operator (crane)	Active	1.00	3.7	8	29.60	L	$68.41	incl. in rate	incl. in rate	$2,024.94
Hydraulic Crane (17tn)	Active	1.00	3.7	8	29.60	E	$81.52	incl. in rate	incl. in rate	$2,412.99
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12

Labor Hours	**96.8**	**TOTAL LABOR**	**$5,197.02**
Equipment Hours	**37.6**	**TOTAL EQUIPMENT**	**$3,306.11**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$330.61	$330.61
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$330.61**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$5,197.02	Labor Burden @	49.7%	$0.00		$5,197.02
Material Cost	$330.61	Material Tax @	7.8%	$25.62		$356.23
Equipment Cost	$3,306.11	Equipment Tax @	0.0%	$0.00		$3,306.11
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$8,834**			**$26**	**DIRECT COST SUBTOTALS**	**$8,859**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$8,859.36		$1,328.90
Installing Contractors Profit@	8.0%				$8,859.36		$708.75
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$2,037.65**
General Contractors Insurance @	1.0%		on		$10,897.01		$109
Bond @	1.0%		on		$10,897.01		$109
Contingency @	0.0%		on		$11,114.96		$0
						TOTAL COST for pay item	**$11,115**

Additional Pay Item Notes :

Based on RS Means, Utility removal, pipe, sewer/water, 15" to 18" diameter, remove, excludes excavation & Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH. Using CREW B12Z .

PAY ITEM COST DETAIL WORKSHEET

4.126 Remove and Dispose of Piping- 16-in. Dia. x 0.25 Thikness x 166'

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.126			**Project**	: Iron Gate			
Description	:	Remove and Dispose of Piping- 16-in. Dia. x 0.25 Thikness x 166'							
Quantity	:	6,972.00	LBS						
Daily Production	:	7,900.00	LBS per	8 hour shift	**Project #**	: 4			
Work Days	:	0.9	Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.56	per LBS		**Probable Low Cost Parameter**		**9085**	**$3,314**	**$0.48**
Total Cost	:	$3,898			**Probable High Cost Parameter**		**6320**	**$4,678**	**$0.67**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (heavy)	Active	1.00	0.9	8	7.20	L	$57.59	incl. in rate	incl. in rate	$414.65
Laborer	Active	2.00	0.9	8	14.40	L	$45.80	incl. in rate	incl. in rate	$659.52
Equipment Operator (crane)	Active	1.00	0.9	8	7.20	L	$68.41	incl. in rate	incl. in rate	$492.55
Hydraulic Crane (17tn)	Active	1.00	0.9	8	7.20	E	$81.52	incl. in rate	incl. in rate	$586.94
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.9	8	7.20	E	$111.64	incl. in rate	incl. in rate	$803.81

Labor Hours	**28.8**	**TOTAL LABOR**	**$1,566.72**
Equipment Hours	**14.4**	**TOTAL EQUIPMENT**	**$1,390.75**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$139.08	$139.08
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$139.08**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,566.72	Labor Burden @	49.7%	$0.00		$1,566.72
Material Cost	$139.08	Material Tax @	7.8%	$10.78		$149.85
Equipment Cost	$1,390.75	Equipment Tax @	0.0%	$0.00		$1,390.75
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$3,097**			**$11**	**DIRECT COST SUBTOTALS**	**$3,107**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$3,107.33		$466.10
Installing Contractors Profit@	8.0%				$3,107.33		$248.59
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$714.68**
General Contractors Insurance @	1.0%		on		$3,822.01		$38
Bond @	1.0%		on		$3,822.01		$38
Contingency @	0.0%		on		$3,898.45		$0
						TOTAL COST for pay item	**$3,898**

Additional Pay Item Notes :

Based on RS Means, Utility removal, pipe, sewer/water, 15" to 18" diameter, remove, excludes excavation & Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH. Using CREW B12Z .

PAY ITEM COST DETAIL WORKSHEET

4.127 Remove and Dispose of Piping- 12-in. Dia. x 0.25 Thikness x 64'

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.127			**Project**	: Iron Gate			
Description	:	Remove and Dispose of Piping- 12-in. Dia. x 0.25 Thikness x 64'							
Quantity	:	2,176.00	LBS						
Daily Production	:	9,500.00	LBS per	8 hour shift	**Project #**	: 4			
Work Days	:	0.2	Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.46	per LBS		**Probable Low Cost Parameter**		**10925**	**$843**	**$0.39**
Total Cost	:	$992			**Probable High Cost Parameter**		**7600**	**$1,190**	**$0.55**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (heavy)	Active	1.00	0.2	8	1.83	L	$57.59	incl. in rate	incl. in rate	$105.50
Laborer	Active	2.00	0.2	8	3.66	L	$45.80	incl. in rate	incl. in rate	$167.81
Equipment Operator (crane)	Active	1.00	0.2	8	1.83	L	$68.41	incl. in rate	incl. in rate	$125.33
Hydraulic Crane (17tn)	Active	1.00	0.2	8	1.83	E	$81.52	incl. in rate	incl. in rate	$149.34
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.2	8	1.83	E	$111.64	incl. in rate	incl. in rate	$204.52

Labor Hours	**7.328**	**TOTAL LABOR**	**$398.64**
Equipment Hours	**3.664**	**TOTAL EQUIPMENT**	**$353.87**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$35.39	$35.39
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$35.39**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$398.64	Labor Burden @	49.7%	$0.00		$398.64
Material Cost	$35.39	Material Tax @	7.8%	$2.74		$38.13
Equipment Cost	$353.87	Equipment Tax @	0.0%	$0.00		$353.87
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$788**			**$3**	**DIRECT COST SUBTOTALS**	**$791**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$790.64		$118.60
Installing Contractors Profit@	8.0%				$790.64		$63.25
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$181.85**
General Contractors Insurance @	1.0%		on		$972.49		$10
Bond @	1.0%		on		$972.49		$10
Contingency @	0.0%		on		$991.94		$0
						TOTAL COST for pay item	**$992**

Additional Pay Item Notes :

Based on RS Means, Utility removal, pipe, sewer/water, 12" diameter, remove, excludes excavation & Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH. Using CREW B6 .

PAY ITEM COST DETAIL WORKSHEET

4.128 Remove and Dispose of Piping- 10-in. Dia. x 0.25 Thikness x 69'

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.128			**Project**	: Iron Gate			
Description	:	Remove and Dispose of Piping- 10-in. Dia. x 0.25 Thikness x 69'							
Quantity	:	1,932.00	LBS						
Daily Production	:	10,000.00	LBS per	8 hour shift	**Project #**	: 4			
Work Days	:	0.2	Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.45	per LBS		**Probable Low Cost Parameter**		**11500**	**$734**	**$0.38**
Total Cost	:	$864			**Probable High Cost Parameter**		**8000**	**$1,036**	**$0.54**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (light)	Active	1.00	0.2	8	1.60	L	$56.29	incl. in rate	incl. in rate	$90.06
Laborer	Active	2.00	0.2	8	3.20	L	$45.80	incl. in rate	incl. in rate	$146.56
Equipment Operator (crane)	Active	1.00	0.2	8	1.60	L	$68.41	incl. in rate	incl. in rate	$109.46
Hydraulic Crane (17tn)	Active	1.00	0.2	8	1.60	E	$81.52	incl. in rate	incl. in rate	$130.43
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.2	8	1.60	E	$111.64	incl. in rate	incl. in rate	$178.62

Labor Hours	**6.4**	**TOTAL LABOR**	**$346.08**
Equipment Hours	**3.2**	**TOTAL EQUIPMENT**	**$309.06**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$30.91	$30.91
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$30.91**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$346.08	Labor Burden @	49.7%	$0.00		$346.08
Material Cost	$30.91	Material Tax @	7.8%	$2.40		$33.30
Equipment Cost	$309.06	Equipment Tax @	0.0%	$0.00		$309.06
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$686**			**$2**	**DIRECT COST SUBTOTALS**	**$688**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$688.44		$103.27
Installing Contractors Profit@	8.0%				$688.44		$55.07
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$158.34**
General Contractors Insurance @	1.0%		on		$846.78		$8
Bond @	1.0%		on		$846.78		$8
Contingency @	0.0%		on		$863.71		$0
						TOTAL COST for pay item	**$864**

Additional Pay Item Notes :

Based on RS Means, Utility removal, pipe, sewer/water, 10" diameter, remove, excludes excavation & Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH. Using CREW B6 .

PAY ITEM COST DETAIL WORKSHEET

4.129 Remove and Dispose of Piping- 8-in. Dia. x 0.25 Thikness x 30'

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.129			**Project**	: Iron Gate			
Description	:	Remove and Dispose of Piping- 8-in. Dia. x 0.25 Thikness x 30'							
Quantity	:	3,588.00	LBS						
Daily Production	:	18,000.00	LBS per	8 hour shift	**Project #**	: 4			
Work Days	:	0.2	Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.23	per LBS		**Probable Low Cost Parameter**		**20700**	**$695**	**$0.19**
Total Cost	:	$818			**Probable High Cost Parameter**		**14400**	**$982**	**$0.27**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (light)	Active	1.00	0.2	8	1.60	L	$56.29	incl. in rate	incl. in rate	$90.06
Laborer	Active	2.00	0.2	8	3.20	L	$45.80	incl. in rate	incl. in rate	$146.56
Equipment Operator (light)	Active	1.00	0.2	8	1.60	L	$64.90	incl. in rate	incl. in rate	$103.84
Loader, FE Rubber Tire (3.5cy)	Active	1.00	0.2	8	1.60	E	$64.23	incl. in rate	incl. in rate	$102.77
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.2	8	1.60	E	$111.64	incl. in rate	incl. in rate	$178.62

Labor Hours	**6.4**	**TOTAL LABOR**	**$340.46**
Equipment Hours	**3.2**	**TOTAL EQUIPMENT**	**$281.39**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$28.14	$28.14
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$28.14**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$340.46	Labor Burden @	49.7%	$0.00		$340.46
Material Cost	$28.14	Material Tax @	7.8%	$2.18		$30.32
Equipment Cost	$281.39	Equipment Tax @	0.0%	$0.00		$281.39
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$650**			**$2**	**DIRECT COST SUBTOTALS**	**$652**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$652.18		$97.83
Installing Contractors Profit@	8.0%				$652.18		$52.17
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$150.00**
General Contractors Insurance @	1.0%		on		$802.18		$8
Bond @	1.0%		on		$802.18		$8
Contingency @	0.0%		on		$818.22		$0
						TOTAL COST for pay item	**$818**

Additional Pay Item Notes :

Based on RS Means, Utility removal, pipe, sewer/water, 8" diameter, remove, excludes excavation, B12Z Crew is formed of 2 laborers loading 1 truck with the crane for disposal based on daily production.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.130		**Project**	: Iron Gate			
Description	:	Remove and Dispose of Piping- 3-in. Dia. x STD x 30'						
Quantity	:	1,088.00 LBS						
Daily Production	:	18,000.00 LBS per	8 hour shift	**Project #**	: 4			
Work Days	:	0.1 Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.38 per LBS		**Probable Low Cost Parameter**		**20700**	**$350**	**$0.32**
Total Cost	:	$412		**Probable High Cost Parameter**		**14400**	**$494**	**$0.45**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (light)	Active	1.00	0.1	8	0.48	L	$56.29	incl. in rate	incl. in rate	$27.02
Laborer	Active	2.00	0.1	8	0.96	L	$45.80	incl. in rate	incl. in rate	$43.97
Equipment Operator (crane)	Active	1.00	0.1	8	0.48	L	$68.41	incl. in rate	incl. in rate	$32.84
Crawler Crane (130tn)	Active	1.00	0.1	8	0.48	E	$258.66	incl. in rate	incl. in rate	$124.16
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.1	8	0.48	E	$111.64	incl. in rate	incl. in rate	$53.59
Truck Driver (heavy)	Active	1.00	0.1	8	0.48	L	$57.59	incl. in rate	incl. in rate	$27.64

Labor Hours	**2.4**	**TOTAL LABOR**	**$131.47**
Equipment Hours	**0.96**	**TOTAL EQUIPMENT**	**$177.74**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$17.77	$17.77
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$17.77**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$131.47	Labor Burden @	49.7%	$0.00		$131.47
Material Cost	$17.77	Material Tax @	7.8%	$1.38		$19.15
Equipment Cost	$177.74	Equipment Tax @	0.0%	$0.00		$177.74
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$327**			**$1**	**DIRECT COST SUBTOTALS**	**$328**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$328.36		$49.25
Installing Contractors Profit@	8.0%				$328.36		$26.27
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$75.52**
General Contractors Insurance @	1.0%		on		$403.89		$4
Bond @	1.0%		on		$403.89		$4
Contingency @	0.0%		on		$411.96		$0
						TOTAL COST for pay item	**$412**

Additional Pay Item Notes :

Based on RS Means, Utility removal, pipe, sewer/water, 3" diameter, remove, excludes excavation, B12Z Crew is formed of 2 laborers loading 1 truck with the crane for disposal based on daily production.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.131			**Project**	: IRONGATE			
Description	:	Remove and Dispose of Gate Valves							
Quantity	:	21,792.00	LBS						
Daily Production	:	10,500.00	LBS per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	2.1	Days		**Estimator**	: Mihaela Tomules	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$0.98	per LBS		**Probable Low Cost Parameter**		**12075**	**$18,116**	**$0.83**
Total Cost	:	$21,312			**Probable High Cost Parameter**		**8400**	**$25,575**	**$1.17**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	2.1	8	33.20	L	$48.27	$0.00		$1,602.56
Steelworker	Active	2.00	2.1	8	33.20	L	$65.52	$0.00		$2,175.26
Crawler Crane (90tn)	Active	1.00	2.1	8	16.60	E	$208.09	$208.09		$3,454.29
Equipment Operator (crane)	Active	1.00	2.1	8	16.60	L	$68.41	$0.00		$1,135.61
Welder	Active	2.00	2.1	8	33.20	L	$7.84	$0.00		$260.21
Gas Welding Machine	Active	2.00	2.1	8	33.20	E	$2.88	$2.88		$95.52
Electrician	Active	2.00	2.1	8	33.20	L	$45.23	$0.00		$1,501.64
Carpenters, Journeyman	Active	2.00	2.1	8	33.20	L	$65.37	$0.00		$2,170.28
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.1	8	16.60	E	$111.64	$111.64		$1,853.22
Truck Driver (heavy)	Active	1.00	2.1	8	16.60	L	$57.59	$0.00		$955.99

Labor Hours	**199.2**	**TOTAL LABOR**	**$9,801.55**
Equipment Hours	**66.4**	**TOTAL EQUIPMENT**	**$5,403.03**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$980.16	$980.16

TOTAL MATERIAL	**$980.16**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	1.09	ton	1.000	1.09	$595.00	$648.31
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00

TOTAL SUBCONTRACTS	**$851.31**

SUMMARY OF COSTS

Labor Cost	$9,801.55	Labor Burden @	49.7%	$0.00		$9,801.55
Material Cost	$980.16	Material Tax @	7.8%	$75.96		$1,056.12
Equipment Cost	$5,403.03	Equipment Tax @	0.0%	$0.00		$5,403.03
Subcontractors	$851.31					$851.31
DIRECT COST SUBTOTALS	**$17,036**			**$76**	**DIRECT COST SUBTOTALS**	**$17,112**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$16,260.70		$2,439.11
Installing Contractors Profit@	8.0%				$16,260.70		$1,300.86
GC Markup on Subs @	5.0%				$851.31		$42.57
						TOTAL MARKUP COSTS	**$3,782.53**
General Contractors Insurance @	1.0%		on		$20,894.54		$209
Bond @	1.0%		on		$20,894.54		$209
Contingency @	0.0%		on		$21,312.43		$0
						TOTAL COST for pay item	**$21,312**

Additional Pay Item Notes :

Assumed the process of removing and disposing of 18 Gate Valves between 3" to 24"is done in around 1 day by crews formed of forman, jouneymen, steelworkers. We dispose metal with 1 trucks per day for each crew. Assumed contains paint with heavy metals 10% of the total lbs, 28 miles from Iron Gate to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary.

PAY ITEM COST DETAIL WORKSHEET

4.132 Remove and Dispose of Basin #1

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.132		**Project**	:	IRONGATE		
Description	:	Remove and Dispose of Basin #1						
Quantity	:	2,880.00 LBS						
Daily Production	:	2,880.00 LBS per	8 hour shift	**Project #**	:	Klamath Dams Removal		
Work Days	:	1.0 Days		**Estimator**	:	Mihaela Tomulesc	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$2.89 per LBS		**Probable Low Cost Parameter**			**3312**	**$7,086**	**$2.46**
Total Cost	:	$8,336		**Probable High Cost Parameter**			**2304**	**$10,003**	**$3.47**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	$0.00		$386.16
Steelworker	Active	2.00	1.0	8	16.00	L	$65.52	$0.00		$1,048.32
Crawler Crane (90tn)	Active	1.00	1.0	8	8.00	E	$208.09	$208.09		$1,664.72
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	$0.00		$547.28
Welder	Active	2.00	1.0	8	16.00	L	$7.84	$0.00		$125.40
Gas Welding Machine	Active	2.00	1.0	8	16.00	E	$2.88	$2.88		$46.03
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	$0.00		$361.84
Carpenters, Journeyman	Active	1.00	1.0	8	8.00	L	$65.37	$0.00		$522.96
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	$31.90		$255.20
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72

Labor Hours	**72**	**TOTAL LABOR**	**$3,452.68**
Equipment Hours	**32**	**TOTAL EQUIPMENT**	**$1,965.95**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$345.27	$345.27

TOTAL MATERIAL	**$345.27**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Stop log lifter - Rent per day	1.00	day	1.000	1.00 $1,000.00	$1,000.00

TOTAL SUBCONTRACTS	**$1,000.00**

SUMMARY OF COSTS

Labor Cost	$3,452.68	Labor Burden @	49.7%	$0.00		$3,452.68
Material Cost	$345.27	Material Tax @	7.8%	$26.76		$372.03
Equipment Cost	$1,965.95	Equipment Tax @	0.0%	$0.00		$1,965.95
Subcontractors	$1,000.00					$1,000.00
DIRECT COST SUBTOTALS	**$6,764**			**$27**	**DIRECT COST SUBTOTALS**	**$6,791**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$5,790.66		$868.60
Installing Contractors Profit@	8.0%				$5,790.66		$463.25
GC Markup on Subs @	5.0%				$1,000.00		$50.00
						TOTAL MARKUP COSTS	**$1,381.85**
General Contractors Insurance @	1.0%		on		$8,172.51		$82
Bond @	1.0%		on		$8,172.51		$82
Contingency @	0.0%		on		$8,335.96		$0
						TOTAL COST for pay item	**$8,336**

Additional Pay Item Notes :

Assumed the process of removing and disposing of basin#6 (manually operated 18" slide gate and stop logs) is done in around 1 day by crew formed of forman, jouneymen, steelworkers. We dispose metal with 1 trucks per day for each crew. Assumed contains petroleum products 10% of the total lbs, 28 miles from Iron Gate to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary.

PAY ITEM COST DETAIL WORKSHEET

4.133 Remove and Dispose of Basin #2

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.133		**Project**	:	IRONGATE		
Description	:	Remove and Dispose of Basin #2						
Quantity	:	3,660.00 LBS						
Daily Production	:	3,660.00 LBS per	8 hour shift	**Project #**	:	Klamath Dams Removal		
Work Days	:	1.0 Days		**Estimator**	:	Mihaela Tomulesc	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$2.28 per LBS		**Probable Low Cost Parameter**			**4209**	**$7,086**	**$1.94**
Total Cost	:	$8,336		**Probable High Cost Parameter**			**2928**	**$10,003**	**$2.73**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	$0.00		$386.16
Steelworker	Active	2.00	1.0	8	16.00	L	$65.52	$0.00		$1,048.32
Crawler Crane (90tn)	Active	1.00	1.0	8	8.00	E	$208.09	$208.09		$1,664.72
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	$0.00		$547.28
Welder	Active	2.00	1.0	8	16.00	L	$7.84	$0.00		$125.40
Gas Welding Machine	Active	2.00	1.0	8	16.00	E	$2.88	$2.88		$46.03
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	$0.00		$361.84
Carpenters, Journeyman	Active	1.00	1.0	8	8.00	L	$65.37	$0.00		$522.96
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	$31.90		$255.20
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72

Labor Hours	**72**	**TOTAL LABOR**	**$3,452.68**
Equipment Hours	**32**	**TOTAL EQUIPMENT**	**$1,965.95**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$345.27	$345.27

TOTAL MATERIAL	**$345.27**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Stop log lifter - Rent per day	1.00	day	1.000	1.00 $1,000.00	$1,000.00

TOTAL SUBCONTRACTS	**$1,000.00**

SUMMARY OF COSTS

Labor Cost	$3,452.68	Labor Burden @	49.7%	$0.00		$3,452.68
Material Cost	$345.27	Material Tax @	7.8%	$26.76		$372.03
Equipment Cost	$1,965.95	Equipment Tax @	0.0%	$0.00		$1,965.95
Subcontractors	$1,000.00					$1,000.00
DIRECT COST SUBTOTALS	**$6,764**			**$27**	**DIRECT COST SUBTOTALS**	**$6,791**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$5,790.66		$868.60
Installing Contractors Profit@	8.0%				$5,790.66		$463.25
GC Markup on Subs @	5.0%				$1,000.00		$50.00
						TOTAL MARKUP COSTS	**$1,381.85**
General Contractors Insurance @	1.0%		on		$8,172.51		$82
Bond @	1.0%		on		$8,172.51		$82
Contingency @	0.0%		on		$8,335.96		$0
						TOTAL COST for pay item	**$8,336**

Additional Pay Item Notes :

Assumed the process of removing and disposing of basin#6 (manually operated 18" slide gate and stop logs) is done in around 1 day by crew formed of forman, jouneymen, steelworkers. We dispose metal with 1 trucks per day for each crew. Assumed contains petroleum products 10% of the total lbs, 28 miles from Iron Gate to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary.

PAY ITEM COST DETAIL WORKSHEET

4.134 Remove and Dispose of Basin #3

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.134		**Project**	:	IRONGATE		
Description	:	Remove and Dispose of Basin #3						
Quantity	:	2,880.00 LBS						
Daily Production	:	2,880.00 LBS per	8 hour shift	**Project #**	:	Klamath Dams Removal		
Work Days	:	1.0 Days		**Estimator**	:	Mihaela Tomulesc	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$2.89 per LBS		**Probable Low Cost Parameter**			**3312**	**$7,086**	**$2.46**
Total Cost	:	$8,336		**Probable High Cost Parameter**			**2304**	**$10,003**	**$3.47**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	$0.00		$386.16
Steelworker	Active	2.00	1.0	8	16.00	L	$65.52	$0.00		$1,048.32
Crawler Crane (90tn)	Active	1.00	1.0	8	8.00	E	$208.09	$208.09		$1,664.72
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	$0.00		$547.28
Welder	Active	2.00	1.0	8	16.00	L	$7.84	$0.00		$125.40
Gas Welding Machine	Active	2.00	1.0	8	16.00	E	$2.88	$2.88		$46.03
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	$0.00		$361.84
Carpenters, Journeyman	Active	1.00	1.0	8	8.00	L	$65.37	$0.00		$522.96
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	$31.90		$255.20
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72

Labor Hours	**72**	**TOTAL LABOR**	**$3,452.68**
Equipment Hours	**32**	**TOTAL EQUIPMENT**	**$1,965.95**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$345.27	$345.27

TOTAL MATERIAL	**$345.27**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Stop log lifter - Rent per day	1.00	day	1.000	1.00 $1,000.00	$1,000.00

TOTAL SUBCONTRACTS	**$1,000.00**

SUMMARY OF COSTS

Labor Cost	$3,452.68	Labor Burden @	49.7%	$0.00		$3,452.68
Material Cost	$345.27	Material Tax @	7.8%	$26.76		$372.03
Equipment Cost	$1,965.95	Equipment Tax @	0.0%	$0.00		$1,965.95
Subcontractors	$1,000.00					$1,000.00
DIRECT COST SUBTOTALS	**$6,764**			**$27**	**DIRECT COST SUBTOTALS**	**$6,791**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$5,790.66		$868.60
Installing Contractors Profit@	8.0%				$5,790.66		$463.25
GC Markup on Subs @	5.0%				$1,000.00		$50.00
						TOTAL MARKUP COSTS	**$1,381.85**
General Contractors Insurance @	1.0%		on		$8,172.51		$82
Bond @	1.0%		on		$8,172.51		$82
Contingency @	0.0%		on		$8,335.96		$0
						TOTAL COST for pay item	**$8,336**

Additional Pay Item Notes :

Assumed the process of removing and disposing of basin#6 (manually operated 18" slide gate and stop logs) is done in around 1 day by crew formed of forman, jouneymen, steelworkers. We dispose metal with 1 trucks per day for each crew. Assumed contains petroleum products 10% of the total lbs, 28 miles from Iron Gate to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary.

PAY ITEM COST DETAIL WORKSHEET

4.135 Remove and Dispose of Basin #4

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.135		**Project**	:	IRONGATE		
Description	:	Remove and Dispose of Basin #4						
Quantity	:	3,580.00 LBS						
Daily Production	:	3,580.00 LBS per	8 hour shift	**Project #**	:	Klamath Dams Removal		
Work Days	:	1.0 Days		**Estimator**	:	Mihaela Tomulesc	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$2.33 per LBS		**Probable Low Cost Parameter**			**4117**	**$7,086**	**$1.98**
Total Cost	:	$8,336		**Probable High Cost Parameter**			**2864**	**$10,003**	**$2.79**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	$0.00		$386.16
Steelworker	Active	2.00	1.0	8	16.00	L	$65.52	$0.00		$1,048.32
Crawler Crane (90tn)	Active	1.00	1.0	8	8.00	E	$208.09	$208.09		$1,664.72
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	$0.00		$547.28
Welder	Active	2.00	1.0	8	16.00	L	$7.84	$0.00		$125.40
Gas Welding Machine	Active	2.00	1.0	8	16.00	E	$2.88	$2.88		$46.03
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	$0.00		$361.84
Carpenters, Journeyman	Active	1.00	1.0	8	8.00	L	$65.37	$0.00		$522.96
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	$31.90		$255.20
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72

Labor Hours	**72**	**TOTAL LABOR**	**$3,452.68**
Equipment Hours	**32**	**TOTAL EQUIPMENT**	**$1,965.95**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$345.27	$345.27

TOTAL MATERIAL	**$345.27**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Stop log lifter - Rent per day	1.00	day	1.000	1.00 $1,000.00	$1,000.00

TOTAL SUBCONTRACTS	**$1,000.00**

SUMMARY OF COSTS

Labor Cost	$3,452.68	Labor Burden @	49.7%	$0.00		$3,452.68
Material Cost	$345.27	Material Tax @	7.8%	$26.76		$372.03
Equipment Cost	$1,965.95	Equipment Tax @	0.0%	$0.00		$1,965.95
Subcontractors	$1,000.00					$1,000.00
DIRECT COST SUBTOTALS	**$6,764**			**$27**	**DIRECT COST SUBTOTALS**	**$6,791**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$5,790.66		$868.60
Installing Contractors Profit@	8.0%				$5,790.66		$463.25
GC Markup on Subs @	5.0%				$1,000.00		$50.00
						TOTAL MARKUP COSTS	**$1,381.85**
General Contractors Insurance @	1.0%		on		$8,172.51		$82
Bond @	1.0%		on		$8,172.51		$82
Contingency @	0.0%		on		$8,335.96		$0
						TOTAL COST for pay item	**$8,336**

Additional Pay Item Notes :

Assumed the process of removing and disposing of basin#6 (manually operated 18" slide gate and stop logs) is done in around 1 day by crew formed of forman, jouneymen, steelworkers. We dispose metal with 1 trucks per day for each crew. Assumed contains petroleum products 10% of the total lbs, 28 miles from Iron Gate to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary.

PAY ITEM COST DETAIL WORKSHEET

4.136 Remove and Dispose of Basin #5

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.136		**Project**	:	IRONGATE		
Description	:	Remove and Dispose of Basin #5						
Quantity	:	1,440.00 LBS						
Daily Production	:	1,440.00 LBS per	8 hour shift	**Project #**	:	Klamath Dams Removal		
Work Days	:	1.0 Days		**Estimator**	:	Mihaela Tomulesc	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$5.79 per LBS		**Probable Low Cost Parameter**			**1656**	**$7,086**	**$4.92**
Total Cost	:	$8,336		**Probable High Cost Parameter**			**1152**	**$10,003**	**$6.95**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	$0.00		$386.16
Steelworker	Active	2.00	1.0	8	16.00	L	$65.52	$0.00		$1,048.32
Crawler Crane (90tn)	Active	1.00	1.0	8	8.00	E	$208.09	$208.09		$1,664.72
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	$0.00		$547.28
Welder	Active	2.00	1.0	8	16.00	L	$7.84	$0.00		$125.40
Gas Welding Machine	Active	2.00	1.0	8	16.00	E	$2.88	$2.88		$46.03
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	$0.00		$361.84
Carpenters, Journeyman	Active	1.00	1.0	8	8.00	L	$65.37	$0.00		$522.96
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	$31.90		$255.20
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72

Labor Hours	**72**	**TOTAL LABOR**	**$3,452.68**
Equipment Hours	**32**	**TOTAL EQUIPMENT**	**$1,965.95**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$345.27	$345.27

TOTAL MATERIAL	**$345.27**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Stop log lifter - Rent per day	1.00	day	1.000	1.00	$1,000.00	$1,000.00

TOTAL SUBCONTRACTS	**$1,000.00**

SUMMARY OF COSTS

Labor Cost	$3,452.68	Labor Burden @	49.7%	$0.00		$3,452.68
Material Cost	$345.27	Material Tax @	7.8%	$26.76		$372.03
Equipment Cost	$1,965.95	Equipment Tax @	0.0%	$0.00		$1,965.95
Subcontractors	$1,000.00					$1,000.00
DIRECT COST SUBTOTALS	**$6,764**			**$27**	**DIRECT COST SUBTOTALS**	**$6,791**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$5,790.66		$868.60
Installing Contractors Profit@	8.0%				$5,790.66		$463.25
GC Markup on Subs @	5.0%				$1,000.00		$50.00
						TOTAL MARKUP COSTS	**$1,381.85**
General Contractors Insurance @	1.0%		on		$8,172.51		$82
Bond @	1.0%		on		$8,172.51		$82
Contingency @	0.0%		on		$8,335.96		$0
						TOTAL COST for pay item	**$8,336**

Additional Pay Item Notes :

Assumed the process of removing and disposing of basin#6 (manually operated 18" slide gate and stop logs) is done in around 1 day by crew formed of forman, jouneymen, steelworkers. We dispose metal with 1 trucks per day for each crew. Assumed contains petroleum products 10% of the total lbs, 28 miles from Iron Gate to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary.

PAY ITEM COST DETAIL WORKSHEET

4.137 Remove and Dispose of Basin #6

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.137			**Project**	:	IRONGATE		
Description	:	Remove and Dispose of Basin #6							
Quantity	:	1,440.00	LBS						
Daily Production	:	1,440.00	LBS per	8 hour shift	**Project #**	:	Klamath Dams Removal		
Work Days	:	1.0	Days		**Estimator**	:	Mihaela Tomulesc	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$5.79	per LBS		**Probable Low Cost Parameter**			**1656**	**$7,086**	**$4.92**
Total Cost	:	$8,336			**Probable High Cost Parameter**			**1152**	**$10,003**	**$6.95**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	$0.00		$386.16
Steelworker	Active	2.00	1.0	8	16.00	L	$65.52	$0.00		$1,048.32
Crawler Crane (90tn)	Active	1.00	1.0	8	8.00	E	$208.09	$208.09		$1,664.72
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	$0.00		$547.28
Welder	Active	2.00	1.0	8	16.00	L	$7.84	$0.00		$125.40
Gas Welding Machine	Active	2.00	1.0	8	16.00	E	$2.88	$2.88		$46.03
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	$0.00		$361.84
Carpenters, Journeyman	Active	1.00	1.0	8	8.00	L	$65.37	$0.00		$522.96
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	$31.90		$255.20
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72

Labor Hours	**72**	**TOTAL LABOR**	**$3,452.68**
Equipment Hours	**32**	**TOTAL EQUIPMENT**	**$1,965.95**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$345.27	$345.27

TOTAL MATERIAL	**$345.27**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Stop log lifter - Rent per day	1.00	day	1.000	1.00	$1,000.00	$1,000.00

TOTAL SUBCONTRACTS	**$1,000.00**

SUMMARY OF COSTS

Labor Cost	$3,452.68	Labor Burden @	49.7%	$0.00		$3,452.68
Material Cost	$345.27	Material Tax @	7.8%	$26.76		$372.03
Equipment Cost	$1,965.95	Equipment Tax @	0.0%	$0.00		$1,965.95
Subcontractors	$1,000.00					$1,000.00
DIRECT COST SUBTOTALS	**$6,764**			**$27**	**DIRECT COST SUBTOTALS**	**$6,791**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$5,790.66		$868.60
Installing Contractors Profit@	8.0%				$5,790.66		$463.25
GC Markup on Subs @	5.0%				$1,000.00		$50.00
						TOTAL MARKUP COSTS	**$1,381.85**
General Contractors Insurance @	1.0%		on		$8,172.51		$82
Bond @	1.0%		on		$8,172.51		$82
Contingency @	0.0%		on		$8,335.96		$0
						TOTAL COST for pay item	**$8,336**

Additional Pay Item Notes :

Assumed the process of removing and disposing of basin#6 (manually operated 18" slide gate and stop logs) is done in around 1 day by crew formed of forman, jouneymen, steelworkers. We dispose metal with 1 trucks per day for each crew. Assumed contains petroleum products 10% of the total lbs, 28 miles from Iron Gate to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.138		**Project**	:	IRONGATE		
Description	:	Remove and Dispose of Holding Tank						
Quantity	:	7,400.00 LBS						
Daily Production	:	7,400.00 LBS per	8 hour shift	**Project #**	:	Klamath Dams Removal		
Work Days	:	1.0 Days		**Estimator**	:	Mihaela Tomulesc	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$1.53 per LBS		**Probable Low Cost Parameter**			**8510**	**$9,652**	**$1.30**
Total Cost	:	$11,355		**Probable High Cost Parameter**			**5920**	**$13,627**	**$1.84**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	$0.00		$386.16
Steelworker	Active	4.00	1.0	8	32.00	L	$65.52	$0.00		$2,096.64
Crawler Crane (90tn)	Active	1.00	1.0	8	8.00	E	$208.09	$208.09		$1,664.72
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	$0.00		$547.28
Welder	Active	2.00	1.0	8	16.00	L	$7.84	$0.00		$125.40
Gas Welding Machine	Active	2.00	1.0	8	16.00	E	$2.88	$2.88		$46.03
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	$0.00		$361.84
Carpenters, Journeyman	Active	4.00	1.0	8	32.00	L	$65.37	$0.00		$2,091.84
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	$31.90		$255.20
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72

Labor Hours	**112**	**TOTAL LABOR**	**$6,069.88**
Equipment Hours	**32**	**TOTAL EQUIPMENT**	**$1,965.95**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$606.99	$606.99

TOTAL MATERIAL	**$606.99**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.37	ton	1.000	0.37	$595.00	$220.15
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00

TOTAL SUBCONTRACTS	**$423.15**

SUMMARY OF COSTS

Labor Cost	$6,069.88	Labor Burden @	49.7%	$0.00		$6,069.88
Material Cost	$606.99	Material Tax @	7.8%	$47.04		$654.03
Equipment Cost	$1,965.95	Equipment Tax @	0.0%	$0.00		$1,965.95
Subcontractors	$423.15					$423.15
DIRECT COST SUBTOTALS	**$9,066**			**$47**	**DIRECT COST SUBTOTALS**	**$9,113**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$8,689.86		$1,303.48
Installing Contractors Profit@	8.0%				$8,689.86		$695.19
GC Markup on Subs @	5.0%				$423.15		$21.16
						TOTAL MARKUP COSTS	**$2,019.83**
General Contractors Insurance @	1.0%		on		$11,132.84		$111
Bond @	1.0%		on		$11,132.84		$111
Contingency @	0.0%		on		$11,355.49		$0
						TOTAL COST for pay item	**$11,355**

Additional Pay Item Notes :

Assumed the process of removing and disposing of holding tank (2 slide gates 42" x 72" with motor and recirculation pumps) is done in around 1 day by crew formed of forman, jouneymen, steelworkers. Assumed contains petroleum products 10% of the total lbs, 28 miles from Iron Gate to Yreka transfer recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.140			Project	: IRONGATE			
Description	:	Wanaka Springs - Concrete Total							
Quantity	:	28.00	CY						
Daily Production	:	150.00	CY per	8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	0.2	Days		Estimator	: Mihaela Tomulescu	CY per	Total Cost	Unit Price Per CY
Unit Price	:	$306.28	per CY		Probable Low Cost Parameter		172.5	$7,290	$260
Total Cost	:	$8,576			Probable High Cost Parameter		127.5	$9,862	$352

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	0.2	8	3.04	L	$46.27	incl. in rate	incl. in rate	$140.66
Equipment Operator (medium)	Active	8.00	0.2	8	12.16	L	$66.28	incl. in rate	incl. in rate	$805.96
Steelworker	Active	6.00	0.2	8	9.12	L	$65.52	incl. in rate	incl. in rate	$597.54
Electrician	Active	1.00	0.2	8	1.52	L	$45.23	incl. in rate	incl. in rate	$68.75
Truck Driver (heavy)	Active	2.00	0.2	8	3.04	L	$57.59	incl. in rate	incl. in rate	$175.07
Vibratory Hammer & Extractor	Active	3.00	0.2	8	4.56	E	$94.34	incl. in rate	incl. in rate	$430.19
Hydraulic Excavator (6.0cy)	Active	3.00	0.2	8	4.56	E	$322.48	incl. in rate	incl. in rate	$1,470.51
Loader, FE Rubber Tire (8.6cy)	Active	2.00	0.2	8	3.04	E	$221.50	incl. in rate	incl. in rate	$673.36
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	0.2	8	3.04	E	$111.64	incl. in rate	incl. in rate	$339.39

Labor Hours	28.88	TOTAL LABOR	$1,787.99
Equipment Hours	15.2	TOTAL EQUIPMENT	$2,913.44

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	1	EA	**Cost per Mob**	$2,500.00	$2,500.00
				TOTAL SUBCONTRACTS	$2,500.00

SUMMARY OF COSTS

Labor Cost	$1,787.99	Labor Burden @	49.7%	$0.00	$1,787.99
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$2,913.44	Equipment Tax @	0.0%	$0.00	$2,913.44
Subcontractors	$2,500.00				$2,500.00
DIRECT COST SUBTOTALS	**$7,201**			**$0**	**DIRECT COST SUBTOTALS** **$7,201**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,701.44	$705.22
Installing Contractors Profit@	8.0%				$4,701.44	$376.11
GC Markup on Subs @	5.0%				$2,500.00	$125.00
					TOTAL MARKUP COSTS	$1,206.33
General Contractors Insurance @	1.0%		on		$8,407.77	$84
Bond @	1.0%		on		$8,407.77	$84
Contingency @	0.0%		on		$8,575.92	$0
					TOTAL COST for pay item	**$8,576**

Additional Pay Item Notes :

Based on RS.Means - "Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9" and "Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment Crew B34B".

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.144		Project	:	IRONGATE			
Description	:	Wanaka Springs - Regrade							
Quantity	:	2.50 AC							
Daily Production	:	0.69 AC per	8 hour shift	Project #	:	Klamath Dams Removal			
Work Days	:	3.6 Days		Estimator	:	Mihaela Tomulescu	AC per	Total Cost	Unit Price Per AC
Unit Price	:	$6,798.10 per AC		Probable Low Cost Parameter			0.7935	$14,446	$5,778
Total Cost	:	$16,995		Probable High Cost Parameter			0.5865	$19,545	$7,818

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	3.6	8	28.96	L	$46.27	incl. in rate	incl. in rate	$1,339.98
Equipment Operator (medium)	Active	1.00	3.6	8	28.96	L	$66.28	incl. in rate	incl. in rate	$1,919.47
Laborer	Active	4.00	3.6	8	115.84	L	$45.80	incl. in rate	incl. in rate	$5,305.47
Grader. 180hp, 13' blade	Active	1.00	3.6	8	28.96	E	$80.79	incl. in rate	incl. in rate	$2,339.68
Dozer (235hp)(CATD7)	Active	1.00	2.0	8	16.00	E	$165.11	incl. in rate	incl. in rate	$2,641.76
	Active	1.00	2.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	2.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active		0.0	8		E				$0.00
	Active		0.0	8		E				$0.00
	Active		0.0	8		E				$0.00

Labor Hours	173.76	TOTAL LABOR	$8,564.92
Equipment Hours	44.96	TOTAL EQUIPMENT	$4,981.44

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs	1.000	0.00		$0.00
		lbs	1.000	0.00		$0.00
		ea	1.000	0.00		$0.00
		ea	1.000	0.00		$0.00
		ea	1.000	0.00		$0.00

TOTAL MATERIAL $0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS $0.00

SUMMARY OF COSTS

Labor Cost	$8,564.92	Labor Burden @	49.7%	$0.00		$8,564.92
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$4,981.44	Equipment Tax @	0.0%	$0.00		$4,981.44
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$13,546**			**$0**	**DIRECT COST SUBTOTALS**	**$13,546**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$13,546.36	$2,031.95
Installing Contractors Profit@	8.0%				$13,546.36	$1,083.71
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$3,115.66
General Contractors Insurance @	1.0%		on		$16,662.02	$167
Bond @	1.0%		on		$16,662.02	$167
Contingency @	0.0%		on		$16,995.26	$0
					TOTAL COST for pay item	**$16,995**

Additional Pay Item Notes :

Crew is based off clear and grub crew B7 off of RSM means. Production for the crew in .69 ac per day to clear and process the trees/ strubs on site. Assumed Seeding, mechanical seeding, 215 lb./acre with crew B66. The amount and type of seed are calculated as 215 lbs per acre in total.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.147			Project	: IRONGATE			
Description	:	Juniper Point - Concrete Total							
Quantity	:	19.00	CY						
Daily Production	:	60.00	CY per	8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	0.3	Days		Estimator	: Mihaela Tomulescu	CY per	Total Cost	Unit Price Per CY
Unit Price	:	$359.74	per CY		Probable Low Cost Parameter		69	$5,810	$306
Total Cost	:	$6,835			Probable High Cost Parameter		51	$7,860	$414

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	0.3	8	2.56	L	$46.27	incl. in rate	incl. in rate	$118.45
Equipment Operator (medium)	Active	3.00	0.3	8	7.68	L	$66.28	incl. in rate	incl. in rate	$509.03
Steelworker	Active	3.00	0.3	8	7.68	L	$65.52	incl. in rate	incl. in rate	$503.19
Electrician	Active	1.00	0.3	8	2.56	L	$45.23	incl. in rate	incl. in rate	$115.79
Truck Driver (heavy)	Active	1.00	0.3	8	2.56	L	$57.59	incl. in rate	incl. in rate	$147.43
Vibratory Hammer & Extractor	Active	1.00	0.3	8	2.56	E	$94.34	incl. in rate	incl. in rate	$241.51
Hydraulic Excavator (6.0cy)	Active	1.00	0.3	8	2.56	E	$322.48	incl. in rate	incl. in rate	$825.55
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.3	8	2.56	E	$221.50	incl. in rate	incl. in rate	$567.04
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.3	8	2.56	E	$111.64	incl. in rate	incl. in rate	$285.80

Labor Hours	23.04	TOTAL LABOR	$1,393.89
Equipment Hours	10.24	TOTAL EQUIPMENT	$1,919.90

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost

TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	1	EA	**Cost per Mob**	$2,500.00	$2,500.00

TOTAL SUBCONTRACTS	$2,500.00

SUMMARY OF COSTS

Labor Cost	$1,393.89	Labor Burden @	49.7%	$0.00	$1,393.89
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$1,919.90	Equipment Tax @	0.0%	$0.00	$1,919.90
Subcontractors	$2,500.00				$2,500.00
DIRECT COST SUBTOTALS	**$5,814**			**$0**	**DIRECT COST SUBTOTALS** $5,814

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,313.79	$497.07
Installing Contractors Profit@	8.0%				$3,313.79	$265.10
GC Markup on Subs @	5.0%				$2,500.00	$125.00
					TOTAL MARKUP COSTS	**$887.17**
General Contractors Insurance @	1.0%		on		$6,700.96	$67
Bond @	1.0%		on		$6,700.96	$67
Contingency @	0.0%		on		$6,834.98	$0
					TOTAL COST for pay item	**$6,835**

Additional Pay Item Notes :

Based on RS.Means - "Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9" and "Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment Crew B34B"

PAY ITEM COST DETAIL WORKSHEET

4.152 Juniper Point - 50'x5' Composite dock with poly floats

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.152			**Project**	: IRONGATE			
Description	:	Juniper Point - 50'x5' Composite dock with poly floats							
Quantity	:	250.00	SF						
Daily Production	:	180.00	SF per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	1.4	Days		**Estimator**	: Mihaela Tomulescu	**SF per**	**Total Cost**	**Unit Price Per SF**
Unit Price	:	$31.34	per SF		**Probable Low Cost Parameter**		**198**	**$7,051**	**$28**
Total Cost	:	$7,834			**Probable High Cost Parameter**		**162**	**$8,618**	**$34**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.4	8	11.12	L	$46.27	incl. in rate	incl. in rate	$514.52
Carpenters, Journeyman	Active	3.00	1.4	8	33.36	L	$65.37	incl. in rate	incl. in rate	$2,180.74
Hydraulic Crane (17tn)	Active	1.00	1.4	8	11.12	E	$81.52	incl. in rate	incl. in rate	$906.50
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.4	8	11.12	E	$111.64	incl. in rate	incl. in rate	$1,241.44
Truck Driver (heavy)	Active	1.00	1.4	8	11.12	L	$57.59	incl. in rate	incl. in rate	$640.40
Equipment Operator (crane)	Active	1.00	1.4	8	11.12	L	$68.41	incl. in rate	incl. in rate	$760.72

Labor Hours	**66.72**	**TOTAL LABOR**	**$4,096.39**
Equipment Hours	**22.24**	**TOTAL EQUIPMENT**	**$2,147.94**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$4,096.39	Labor Burden @	49.7%	$0.00	$4,096.39
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$2,147.94	Equipment Tax @	0.0%	$0.00	$2,147.94
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$6,244**			**$0**	**DIRECT COST SUBTOTALS** **$6,244**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$6,244.32	$936.65
Installing Contractors Profit@	8.0%				$6,244.32	$499.55
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,436.19**
General Contractors Insurance @	1.0%		on		$7,680.52	$77
Bond @	1.0%		on		$7,680.52	$77
Contingency @	0.0%		on		$7,834.13	$0
					TOTAL COST for pay item	**$7,834**

Additional Pay Item Notes :

Based on RS.Means Crew F3 the Labor and equipment for "Docks, floating, small boat, prefabricated, no shore facilities, excludes pilings, maximum"

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.155		Project	:	IRONGATE			
Description	:	Juniper Point - Regrade to Natural Contour							
Quantity	:	2.00	AC						
Daily Production	:	0.50	AC per 8 hour shift	Project #	:	Klamath Dams Removal			
Work Days	:	4.0	Days	Estimator	:	Mihaela Tomulescu	AC per	Total Cost	Unit Price Per AC
Unit Price	:	$10,546.17	per AC	Probable Low Cost Parameter			0.575	$17,928	$8,964
Total Cost	:	$21,092		Probable High Cost Parameter			0.425	$24,256	$12,128

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	4.0	8	32.00	L	$46.27	incl. in rate	incl. in rate	$1,480.64
Equipment Operator (medium)	Active	2.00	4.0	8	64.00	L	$66.28	incl. in rate	incl. in rate	$4,241.92
Laborer	Active	4.00	4.0	8	128.00	L	$45.80	incl. in rate	incl. in rate	$5,862.40
Grader. 180hp, 13' blade	Active	1.00	4.0	8	32.00	E	$80.79	incl. in rate	incl. in rate	$2,585.28
Dozer (235hp)(CATD7)	Active	1.00	2.0	8	16.00	E	$165.11	incl. in rate	incl. in rate	$2,641.76
	Active	1.00	2.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	2.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active		0.0		16.00	E				$0.00
	Active		0.0		32.00	E				$0.00
	Active		0.0		16.00	E				$0.00

Labor Hours	224	TOTAL LABOR	$11,584.96
Equipment Hours	112	TOTAL EQUIPMENT	$5,227.04

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs	1.000	0.00		$0.00
		lbs	1.000	0.00		$0.00
		ea	1.000	0.00		$0.00
		ea	1.000	0.00		$0.00
		ea	1.000	0.00		$0.00

TOTAL MATERIAL $0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS $0.00

SUMMARY OF COSTS

Labor Cost	$11,584.96	Labor Burden @	49.7%	$0.00		$11,584.96
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$5,227.04	Equipment Tax @	0.0%	$0.00		$5,227.04
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$16,812**			**$0**	**DIRECT COST SUBTOTALS**	**$16,812**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$16,812.00	$2,521.80
Installing Contractors Profit@	8.0%				$16,812.00	$1,344.96
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$3,866.76
General Contractors Insurance @	1.0%		on		$20,678.76	$207
Bond @	1.0%		on		$20,678.76	$207
Contingency @	0.0%		on		$21,092.34	$0
					TOTAL COST for pay item	**$21,092**

Additional Pay Item Notes :

Crew is based off clear and grub crew B7 off of RSM means. Production for the crew in .69 ac per day to clear and process the trees/ strubs on site. Assumed Seeding, mechanical seeding, 215 lb./acre with crew B66.The amount and type of seed are calculated as 215 lbs per acre in total.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.156			Project	: IRONGATE			
Description	:	Camp Creek - Concrete Total							
Quantity	:	110.00	CY						
Daily Production	:	110.00	CY per	8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	1.0	Days		Estimator	: Mihaela Tomulescu	CY per	Total Cost	Unit Price Per CY
Unit Price	:	$306.56	per CY		Probable Low Cost Parameter		126.5	$28,664	$261
Total Cost	:	$33,722			Probable High Cost Parameter		93.5	$38,780	$353

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	1.0	8	16.00	L	$46.27	incl. in rate	incl. in rate	$740.32
Equipment Operator (medium)	Active	8.00	1.0	8	64.00	L	$66.28	incl. in rate	incl. in rate	$4,241.92
Steelworker	Active	6.00	1.0	8	48.00	L	$65.52	incl. in rate	incl. in rate	$3,144.96
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Truck Driver (heavy)	Active	2.00	1.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Vibratory Hammer & Extractor	Active	3.00	1.0	8	24.00	E	$94.34	incl. in rate	incl. in rate	$2,264.16
Hydraulic Excavator (6.0cy)	Active	3.00	1.0	8	24.00	E	$322.48	incl. in rate	incl. in rate	$7,739.52
Loader, FE Rubber Tire (8.6cy)	Active	2.00	1.0	8	16.00	E	$221.50	incl. in rate	incl. in rate	$3,544.00
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	1.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24

Labor Hours	152	TOTAL LABOR	$9,410.48
Equipment Hours	80	TOTAL EQUIPMENT	$15,333.92

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	1	EA	**Cost per Mob**	$2,500.00	$2,500.00
				TOTAL SUBCONTRACTS	$2,500.00

SUMMARY OF COSTS

Labor Cost	$9,410.48	Labor Burden @	49.7%	$0.00		$9,410.48
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$15,333.92	Equipment Tax @	0.0%	$0.00		$15,333.92
Subcontractors	$2,500.00					$2,500.00
DIRECT COST SUBTOTALS	**$27,244**			**$0**	**DIRECT COST SUBTOTALS**	**$27,244**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$24,744.40	$3,711.66
Installing Contractors Profit@	8.0%				$24,744.40	$1,979.55
GC Markup on Subs @	5.0%				$2,500.00	$125.00
					TOTAL MARKUP COSTS	$5,816.21
General Contractors Insurance @	1.0%		on		$33,060.61	$331
Bond @	1.0%		on		$33,060.61	$331
Contingency @	0.0%		on		$33,721.82	$0
					TOTAL COST for pay item	**$33,722**

Additional Pay Item Notes :

Based on RS.Means - "Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9" and "Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment Crew B34B"

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.157			Project	: IRONGATE			
Description	:	Camp Creek - 180'Lx16'Wx8'D Earth jetty to remove and/or regrade							
Quantity	:	855.00	CY						
Daily Production	:	200.00	CY per	8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	4.3	Days		Estimator	: Mihaela Tomulescu	CY per	Total Cost	Unit Price Per CY
Unit Price	:	$73.54	per CY		Probable Low Cost Parameter		230	$53,445	$63
Total Cost	:	$62,876			Probable High Cost Parameter		170	$72,307	$85

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	4.3	8	34.24	L	$46.27	incl. in rate	incl. in rate	$1,584.28
Equipment Operator (medium)	Active	3.00	4.3	8	102.72	L	$66.28	incl. in rate	incl. in rate	$6,808.28
Steelworker	Active	3.00	4.3	8	102.72	L	$65.52	incl. in rate	incl. in rate	$6,730.21
Electrician	Active	1.00	4.3	8	34.24	L	$45.23	incl. in rate	incl. in rate	$1,548.68
Truck Driver (heavy)	Active	2.00	4.3	8	68.48	L	$57.59	incl. in rate	incl. in rate	$3,943.76
Vibratory Hammer & Extractor	Active	1.00	4.3	8	34.24	E	$94.34	incl. in rate	incl. in rate	$3,230.20
Hydraulic Excavator (6.0cy)	Active	1.00	4.3	8	34.24	E	$322.48	incl. in rate	incl. in rate	$11,041.72
Loader, FE Rubber Tire (8.6cy)	Active	1.00	4.3	8	34.24	E	$221.50	incl. in rate	incl. in rate	$7,584.16
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	4.3	8	68.48	E	$111.64	incl. in rate	incl. in rate	$7,645.11

Labor Hours	342.4	TOTAL LABOR	$20,615.22
Equipment Hours	171.2	TOTAL EQUIPMENT	$29,501.18

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$20,615.22	Labor Burden @	49.7%	$0.00	$20,615.22
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$29,501.18	Equipment Tax @	0.0%	$0.00	$29,501.18
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$50,116			$0	DIRECT COST SUBTOTALS $50,116

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$50,116.40	$7,517.46
Installing Contractors Profit@	8.0%				$50,116.40	$4,009.31
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$11,526.77
General Contractors Insurance @	1.0%		on		$61,643.18	$616
Bond @	1.0%		on		$61,643.18	$616
Contingency @	0.0%		on		$62,876.04	$0
					TOTAL COST for pay item	$62,876

Additional Pay Item Notes :

Based on RS.Means - Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9 and B34B - Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.158			**Project**	:	IRONGATE			
Description	:	Camp Creek - Well house 10'x16' concrete block building								
Quantity	:	160.00	SF							
Daily Production	:	160.00	SF per	8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	1.0	Days		**Estimator**	:	Mihaela Tomulescu	**SF per**	**Total Cost**	**Unit Price Per SF**
Unit Price	:	$72.74	per SF		**Probable Low Cost Parameter**			**176**	**$10,475**	**$65**
Total Cost	:	$11,638			**Probable High Cost Parameter**			**144**	**$12,802**	**$80**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Truck Driver (heavy)	Active	2.00	1.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	1.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Hydraulic Excavator (1.5cy)	Active	1.00	1.0	8	8.00	E	$141.92	incl. in rate	incl. in rate	$1,135.36
Steelworker	Active	2.00	1.0	8	16.00	L	$65.52	incl. in rate	incl. in rate	$1,048.32

Labor Hours	**72**	**TOTAL LABOR**	**$3,964.80**
Equipment Hours	**24**	**TOTAL EQUIPMENT**	**$2,921.60**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost

TOTAL MATERIAL **$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Harzardous waste disposal	1	LS		$2,800.00	$2,800.00

TOTAL SUBCONTRACTS **$2,800.00**

SUMMARY OF COSTS

Labor Cost	$3,964.80	Labor Burden @	49.7%	$0.00	$3,964.80
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$2,921.60	Equipment Tax @	0.0%	$0.00	$2,921.60
Subcontractors	$2,800.00				$2,800.00
DIRECT COST SUBTOTALS	**$9,686**			**$0**	**DIRECT COST SUBTOTALS** **$9,686**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$6,886.40	$1,032.96
Installing Contractors Profit@	8.0%				$6,886.40	$550.91
GC Markup on Subs @	5.0%				$2,800.00	$140.00
					TOTAL MARKUP COSTS	**$1,723.87**
General Contractors Insurance @	1.0%		on		$11,410.27	$114
Bond @	1.0%		on		$11,410.27	$114
Contingency @	0.0%		on		$11,638.48	$0
					TOTAL COST for pay item	**$11,638**

Additional Pay Item Notes :

The price of removing a building is based on several factors including the size of the space, structural additions on the property, required permits and waste material clearing. A complete demo of a house and its foundation or basement can cost much as $25,000.
The cost of removal can vary based on the area lived in and the typical wages in the region. Some estimates put a price tag of $18,000 on bulldozing a 1,500 square-foot house, while others show that the average estimate is around $4-$15 per square foot.
Hazardous waste can greatly impact the cost of clearing debris. Many older homes contain asbestos, and there are special fees and considerations associated with its removal and disposal. The national average cost to eliminate asbestos is about $200-$700 per hour. We take in consideration this aspect in our estimate assuming 3 Laborers working 1 days, 8 hours per day @$350

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.161			Project	: IRONGATE			
Description	:	Camp Creek - Concrete block double toilet bldg 10'x16'							
Quantity	:	160.00	SF						
Daily Production	:	160.00	SF per	8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	1.0	Days		Estimator	: Mihaela Tomulescu	SF per	Total Cost	Unit Price Per SF
Unit Price	:	$72.74	per SF		Probable Low Cost Parameter		176	$10,475	$65
Total Cost	:	$11,638			Probable High Cost Parameter		144	$12,802	$80

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Truck Driver (heavy)	Active	2.00	1.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	1.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Hydraulic Excavator (1.5cy)	Active	1.00	1.0	8	8.00	E	$141.92	incl. in rate	incl. in rate	$1,135.36
Steelworker	Active	2.00	1.0	8	16.00	L	$65.52	incl. in rate	incl. in rate	$1,048.32

Labor Hours	72	TOTAL LABOR	$3,964.80
Equipment Hours	24	TOTAL EQUIPMENT	$2,921.60

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Harzardous waste disposal	1	LS		$2,800.00	$2,800.00
				TOTAL SUBCONTRACTS	$2,800.00

SUMMARY OF COSTS

Labor Cost	$3,964.80	Labor Burden @	49.7%	$0.00	$3,964.80
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$2,921.60	Equipment Tax @	0.0%	$0.00	$2,921.60
Subcontractors	$2,800.00				$2,800.00
DIRECT COST SUBTOTALS	**$9,686**			**$0**	**DIRECT COST SUBTOTALS** **$9,686**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$6,886.40	$1,032.96
Installing Contractors Profit@	8.0%				$6,886.40	$550.91
GC Markup on Subs @	5.0%				$2,800.00	$140.00
					TOTAL MARKUP COSTS	$1,723.87
General Contractors Insurance @	1.0%		on		$11,410.27	$114
Bond @	1.0%		on		$11,410.27	$114
Contingency @	0.0%		on		$11,638.48	$0
					TOTAL COST for pay item	**$11,638**

Additional Pay Item Notes :

The price of removing a building is based on several factors including the size of the space, structural additions on the property, required permits and waste material clearing. A complete demo of a house and its foundation or basement can cost much as $25,000.
The cost of removal can vary based on the area lived in and the typical wages in the region. Some estimates put a price tag of $18,000 on bulldozing a 1,500 square-foot house, while others show that the average estimate is around $4-$15 per square foot.
Hazardous waste can greatly impact the cost of clearing debris. Many older homes contain asbestos, and there are special fees and considerations associated with its removal and disposal. The national average cost to eliminate asbestos is about $200-$700 per hour. We take in consideration this aspect in our estimate assuming 3 Laborers working 2 days, 8 hours per day @$350

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.162			**Project**	: IRONGATE		
Description	:	Camp Creek - Dump stations and approx. 2000 gal buried						
Quantity	:	1.00	EA					
Daily Production	:	1.50	EA per	8 hour shift	**Project #**	: Klamath Dams Removal		
Work Days	:	0.7	Days		**Estimator**	: Mihaela Tomulesc	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$6,596.62	per EA		**Probable Low Cost Parameter**		**1.725**	**$5,607**	**$5,607.12**
Total Cost	:	$6,597			**Probable High Cost Parameter**		**1.2**	**$7,916**	**$7,915.94**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.7	8	5.60	L	$48.27	$0.00		$270.31
Vibratory Hammer & Extractor	Active	1.00	0.7	8	5.60	E	$94.34	$94.34		$528.30
Backhoe Loader (91hp)	Active	1.00	0.7	8	5.60	E	$40.35	$40.35		$225.96
Equipment Operator (medium)	Active	2.00	0.7	8	11.20	L	$66.28	$0.00		$742.34
Truck Driver (heavy)	Active	2.00	0.7	8	11.20	L	$57.59	$0.00		$645.01
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	0.7	8	11.20	E	$111.64	$111.64		$1,250.37
Electrician	Active	1.00	0.7	8	5.60	L	$45.23	$0.00		$253.29
Laborer	Active	4.00	0.7	8	22.40	L	$45.80	$0.00		$1,025.92

Labor Hours	**56**	**TOTAL LABOR**	**$2,936.86**
Equipment Hours	**22.4**	**TOTAL EQUIPMENT**	**$2,004.63**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$293.69	$293.69

TOTAL MATERIAL	**$293.69**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,936.86	Labor Burden @	49.7%	$0.00		$2,936.86
Material Cost	$293.69	Material Tax @	7.8%	$22.76		$316.45
Equipment Cost	$2,004.63	Equipment Tax @	0.0%	$0.00		$2,004.63
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$5,235**			**$23**	**DIRECT COST SUBTOTALS**	**$5,258**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$5,257.94		$788.69
Installing Contractors Profit@	8.0%				$5,257.94		$420.64
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$1,209.33**
General Contractors Insurance @	1.0%		on		$6,467.27		$65
Bond @	1.0%		on		$6,467.27		$65
Contingency @	0.0%		on		$6,596.62		$0
						TOTAL COST for pay item	**$6,597**

Additional Pay Item Notes :

Assumed the process dumping stations and removing 2000 gal buried concrete tank is done in around 1/2 day by crew formed of 1 forman, 4 laborers and 2 equipment operators (Backhoe loader and Vibratory hammer). We 2 trucks for haulingand disposal.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.163			**Project**	: IRONGATE			
Description	:	Camp Creek - Power poles and lines							
Quantity	:	3.00 EA							
Daily Production	:	2.00 EA per	8	hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	1.5 Days			**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$1,818.16 per EA			**Probable Low Cost Parameter**		**2.3**	**$4,636**	**$1,545**
Total Cost	:	$5,454			**Probable High Cost Parameter**		**1.6**	**$6,545**	**$2,182**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.5	8	12.00	L	$46.27	incl. in rate	incl. in rate	$555.24
Electrician	Active	1.00	1.5	8	12.00	L	$45.23	incl. in rate	incl. in rate	$542.76
Hydraulic Crane (17tn)	Active	1.00	1.0	8	8.00	E	$81.52	incl. in rate	incl. in rate	$652.16
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	incl. in rate	incl. in rate	$255.20
Vibratory Hammer & Extractor	Active	1.00	1.0	8	8.00	E	$94.34	incl. in rate	incl. in rate	$754.72
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Utility, with Man-Basket	Active	1.00	1.0	8	8.00	E	$31.90	incl. in rate	incl. in rate	$255.20

Labor Hours	**48**	**TOTAL LABOR**	**$2,291.52**
Equipment Hours	**32**	**TOTAL EQUIPMENT**	**$1,917.28**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$114.58	$114.58
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	3.00	CY	1.000	3.00	$4.74	$14.22
					TOTAL MATERIAL	**$128.80**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,291.52	Labor Burden @	49.7%	$0.00		$2,291.52
Material Cost	$128.80	Material Tax @	7.8%	$9.98		$138.78
Equipment Cost	$1,917.28	Equipment Tax @	0.0%	$0.00		$1,917.28
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$4,338**			**$10**	**DIRECT COST SUBTOTALS**	**$4,348**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$4,347.58		$652.14
Installing Contractors Profit@	8.0%				$4,347.58		$347.81
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$999.94**
General Contractors Insurance @	1.0%		on		$5,347.52		$53
Bond @	1.0%		on		$5,347.52		$53
Contingency @	0.0%		on		$5,454.47		$0
						TOTAL COST for pay item	**$5,454**

Additional Pay Item Notes :

Production is based off of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane). Considered 2 laborer and 1 Vibratory Hammer for demolish the pole foundation and helping placing poles in a designated place and loading them in the truck for disposal. This process includes filling in pole locations with gravel, clean fill and topsoil.

PAY ITEM COST DETAIL WORKSHEET

4.168 Camp Creek-Regrade

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.168			**Project**	: Iron Gate			
Description	:	Camp Creek-Regrade							
Quantity	:	4.00	AC						
Daily Production	:	1.00	AC per	8 hour shift	**Project #**	: 4			
Work Days	:	4.0	Days		**Estimator**	: Eric Jones	**AC per**	**Total Cost**	**Unit Price Per AC**
Unit Price	:	$8,861.29	per AC		**Probable Low Cost Parameter**		**1.15**	**$30,128**	**$7,532.09**
Total Cost	:	$35,445			**Probable High Cost Parameter**		**0.85**	**$40,762**	**$10,190.48**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	4.0	8	32.00	L	$46.27	incl. in rate	incl. in rate	$1,480.64
Equipment Operator (medium)	Active	2.00	4.0	8	64.00	L	$66.28	incl. in rate	incl. in rate	$4,241.92
Laborer	Active	2.00	4.0	8	64.00	L	$45.80	incl. in rate	incl. in rate	$2,931.20
Dozer (235hp)(CATD7)	Active	3.00	4.0	8	96.00	E	$165.11	incl. in rate	incl. in rate	$15,850.56
Roller, Single Drum (steel wheel, 12.0 - 14.9 MTn)	Active	2.00	4.0	8	64.00	E	$72.79	incl. in rate	incl. in rate	$4,658.56
0	Active	1.00	4.0	8	32.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	4.0	8	32.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	4.0	8	32.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	4.0	8	32.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	4.0	8	32.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	4.0	8	32.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	4.0	8	32.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
				Labor Hours	**160**			**TOTAL LABOR**		**$8,653.76**
				Equipment Hours	**160**			**TOTAL EQUIPMENT**		**$20,509.12**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		lbs PLS	1.000	0.00	$10.69	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$8,653.76	Labor Burden @	0.0%			$8,653.76
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$20,509.12	Equipment Tax @	7.75%	$1,589.46		$22,098.58
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$29,163**			**$1,589**	**DIRECT COST SUBTOTALS**	**$30,752**

		Crew	Material	Subs	Cost Basis	
Installi	5.0%				$30,752.34	$1,537.62
Installi	8.0%				$30,752.34	$2,460.19
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$3,997.80**
General Contractors Insurance @	1.0%		on		$34,750.14	$348
Bond @	1.0%		on		$34,750.14	$348
Contingency @	0.0%		on		$35,445.14	$0
					TOTAL COST for pay item	**$35,445**

Additional Pay Item Notes :

Crew will grade, rip, and reseed 1/3 of anchor per day, All equipment will be staged at area during operation due to the location of the operation. Seeding was assumed to be the same seeding used on other parts of the job using the same ratio.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.170	Project	:	IRONGATE			
Description	:	Dutch Creek - 50'4'3' Dock Concrete Abutment						
Quantity	:	22.00 CY						
Daily Production	:	148.00 CY per 8 hour shift	Project #	:	Klamath Dams Removal			
Work Days	:	0.2 Days	Estimator	:	Mihaela Tomulescu	CY per	Total Cost	Unit Price Per CY
Unit Price	:	$333.37 per CY	Probable Low Cost Parameter			162.8	$6,601	$300
Total Cost	:	$7,334	Probable High Cost Parameter			133.2	$8,068	$367

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	0.2	8	2.40	L	$46.27	incl. in rate	incl. in rate	$111.05
Equipment Operator (medium)	Active	8.00	0.2	8	9.60	L	$66.28	incl. in rate	incl. in rate	$636.29
Steelworker	Active	6.00	0.2	8	7.20	L	$65.52	incl. in rate	incl. in rate	$471.74
Electrician	Active	1.00	0.2	8	1.20	L	$45.23	incl. in rate	incl. in rate	$54.28
Truck Driver (heavy)	Active	2.00	0.2	8	2.40	L	$57.59	incl. in rate	incl. in rate	$138.22
Vibratory Hammer & Extractor	Active	3.00	0.2	8	3.60	E	$94.34	incl. in rate	incl. in rate	$339.62
Hydraulic Excavator (6.0cy)	Active	3.00	0.2	8	3.60	E	$322.48	incl. in rate	incl. in rate	$1,160.93
Loader, FE Rubber Tire (8.6cy)	Active	2.00	0.2	8	2.40	E	$221.50	incl. in rate	incl. in rate	$531.60
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	0.2	8	2.40	E	$111.64	incl. in rate	incl. in rate	$267.94

Labor Hours	22.8	TOTAL LABOR	$1,411.57
Equipment Hours	12	TOTAL EQUIPMENT	$2,300.09

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	1	EA	**Cost per Mob**	$2,500.00	$2,500.00
				TOTAL SUBCONTRACTS	$2,500.00

SUMMARY OF COSTS

Labor Cost	$1,411.57	Labor Burden @	49.7%	$0.00		$1,411.57
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$2,300.09	Equipment Tax @	0.0%	$0.00		$2,300.09
Subcontractors	$2,500.00					$2,500.00
DIRECT COST SUBTOTALS	**$6,212**			**$0**	**DIRECT COST SUBTOTALS**	**$6,212**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,711.66	$556.75
Installing Contractors Profit@	8.0%				$3,711.66	$296.93
GC Markup on Subs @	5.0%				$2,500.00	$125.00
					TOTAL MARKUP COSTS	**$978.68**
General Contractors Insurance @	1.0%		on		$7,190.34	$72
Bond @	1.0%		on		$7,190.34	$72
Contingency @	0.0%		on		$7,334.15	$0
					TOTAL COST for pay item	**$7,334**

Additional Pay Item Notes :

Based on RS.Means - "Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9" and "Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment Crew B34B"

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.172		**Project**	:	IRONGATE			
Description	:	Mirror Cove - Concrete Total							
Quantity	:	89.00	CY						
Daily Production	:	150.00	CY per	8	hour shift	**Project #**	: Klamath Dams Removal		
Work Days	:	0.6	Days			**Estimator**	: Mihaela Tomulescu	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$235.88	per CY			**Probable Low Cost Parameter**		**165**	**$18,894**	**$212**
Total Cost	:	$20,994				**Probable High Cost Parameter**		**135**	**$23,093**	**$259**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	0.6	8	9.44	L	$46.27	incl. in rate	incl. in rate	$436.79
Equipment Operator (medium)	Active	8.00	0.6	8	37.76	L	$66.28	incl. in rate	incl. in rate	$2,502.73
Steelworker	Active	6.00	0.6	8	28.32	L	$65.52	incl. in rate	incl. in rate	$1,855.53
Electrician	Active	1.00	0.6	8	4.72	L	$45.23	incl. in rate	incl. in rate	$213.49
Truck Driver (heavy)	Active	2.00	0.6	8	9.44	L	$57.59	incl. in rate	incl. in rate	$543.65
Vibratory Hammer & Extractor	Active	3.00	0.6	8	14.16	E	$94.34	incl. in rate	incl. in rate	$1,335.85
Hydraulic Excavator (6.0cy)	Active	3.00	0.6	8	14.16	E	$322.48	incl. in rate	incl. in rate	$4,566.32
Loader, FE Rubber Tire (8.6cy)	Active	2.00	0.6	8	9.44	E	$221.50	incl. in rate	incl. in rate	$2,090.96
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	0.6	8	9.44	E	$111.64	incl. in rate	incl. in rate	$1,053.88

Labor Hours	**89.68**	**TOTAL LABOR**	**$5,552.18**
Equipment Hours	**47.2**	**TOTAL EQUIPMENT**	**$9,047.01**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	1	EA	**Cost per Mob**	$2,500.00	$2,500.00
				TOTAL SUBCONTRACTS	**$2,500.00**

SUMMARY OF COSTS

Labor Cost	$5,552.18	Labor Burden @	49.7%	$0.00		$5,552.18
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$9,047.01	Equipment Tax @	0.0%	$0.00		$9,047.01
Subcontractors	$2,500.00					$2,500.00
DIRECT COST SUBTOTALS	**$17,099**			**$0**	**DIRECT COST SUBTOTALS**	**$17,099**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$14,599.20		$2,189.88
Installing Contractors Profit@	8.0%				$14,599.20		$1,167.94
GC Markup on Subs @	5.0%				$2,500.00		$125.00
						TOTAL MARKUP COSTS	**$3,482.82**
General Contractors Insurance @	1.0%		on		$20,582.01		$206
Bond @	1.0%		on		$20,582.01		$206
Contingency @	0.0%		on		$20,993.65		$0
						TOTAL COST for pay item	**$20,994**

Additional Pay Item Notes :

Based on RS.Means - "Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9" and "Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment Crew B34B"

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.173			Project	: IRONGATE			
Description	:	Mirror Cove - 10'x16' Toilet Vault							
Quantity	:	160.00	SF						
Daily Production	:	160.00	SF per	8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	1.0	Days		Estimator	: Mihaela Tomulescu	SF per	Total Cost	Unit Price Per SF
Unit Price	:	$96.23	per SF		Probable Low Cost Parameter		176	$13,857	$87
Total Cost	:	$15,397			Probable High Cost Parameter		144	$16,937	$106

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Equipment Operator (medium)	Active	3.00	1.0	8	24.00	L	$66.28	incl. in rate	incl. in rate	$1,590.72
Laborer	Active	3.00	1.0	8	24.00	L	$45.80	incl. in rate	incl. in rate	$1,099.20
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Vibratory Hammer & Extractor	Active	1.00	1.0	8	8.00	E	$94.34	incl. in rate	incl. in rate	$754.72
Hydraulic Excavator (6.0cy)	Active	1.00	1.0	8	8.00	E	$322.48	incl. in rate	incl. in rate	$2,579.84
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12

Labor Hours	72	TOTAL LABOR	$3,882.64
Equipment Hours	32	TOTAL EQUIPMENT	$5,999.68

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost

TOTAL MATERIAL $0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Harzardous waste disposal	1	LS		$2,800.00	$2,800.00

TOTAL SUBCONTRACTS $2,800.00

SUMMARY OF COSTS

Labor Cost	$3,882.64	Labor Burden @	49.7%	$0.00	$3,882.64
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$5,999.68	Equipment Tax @	0.0%	$0.00	$5,999.68
Subcontractors	$2,800.00				$2,800.00
DIRECT COST SUBTOTALS	$12,682			$0	DIRECT COST SUBTOTALS $12,682

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$9,882.32	$1,482.35
Installing Contractors Profit@	8.0%				$9,882.32	$790.59
GC Markup on Subs @	5.0%				$2,800.00	$140.00
					TOTAL MARKUP COSTS	$2,412.93
General Contractors Insurance @	1.0%		on		$15,095.25	$151
Bond @	1.0%		on		$15,095.25	$151
Contingency @	0.0%		on		$15,397.16	$0
					TOTAL COST for pay item	$15,397

Additional Pay Item Notes :

The price of removing a building is based on several factors including the size of the space, structural additions on the property, required permits and waste material clearing. A complete demo of a house and its foundation or basement can cost much as $25,000.
The cost of removal can vary based on the area lived in and the typical wages in the region. Some estimates put a price tag of $18,000 on bulldozing a 1,500 square-foot house, while others show that the average estimate is around $4-$15 per square foot.
Hazardous waste can greatly impact the cost of clearing debris. Many older homes contain asbestos, and there are special fees and considerations associated with its removal and disposal. The national average cost to eliminate asbestos is about $200-$700 per hour. We take in consideration this aspect in our estimate assuming 3 Laborers working 1 days, 8 hours per day @$350

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.174			**Project**	: IRONGATE			
Description	:	Mirror Cove - 2, 30'x5' Composite Gangplanks w/ aluminum							
Quantity	:	300.00	SF						
Daily Production	:	300.00	SF per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	1.0	Days		**Estimator**	: Mihaela Tomulescu	**SF per**	**Total Cost**	**Unit Price Per SF**
Unit Price	:	$21.43	per SF		**Probable Low Cost Parameter**		**330**	**$5,787**	**$19**
Total Cost	:	$6,430			**Probable High Cost Parameter**		**270**	**$7,073**	**$24**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Laborer	Active	3.00	1.0	8	24.00	L	$45.80	incl. in rate	incl. in rate	$1,099.20
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00

Labor Hours	**48**	**TOTAL LABOR**	**$2,460.32**
Equipment Hours	**16**	**TOTAL EQUIPMENT**	**$2,665.12**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,460.32	Labor Burden @	49.7%	$0.00	$2,460.32
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$2,665.12	Equipment Tax @	0.0%	$0.00	$2,665.12
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$5,125**			**$0**	**DIRECT COST SUBTOTALS** **$5,125**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$5,125.44	$768.82
Installing Contractors Profit@	8.0%				$5,125.44	$410.04
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,178.85**
General Contractors Insurance @	1.0%		on		$6,304.29	$63
Bond @	1.0%		on		$6,304.29	$63
Contingency @	0.0%		on		$6,430.38	$0
					TOTAL COST for pay item	**$6,430**

Additional Pay Item Notes :

The cost of removal can vary based on the area lived in and the typical wages in the region. We assumed that we need 1 Forman, 3 Laboreres and 1 Loader to load the rubbish in the truck in 1/2 day.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.177			Project	:	IRONGATE		
Description	:	Mirror Cove - Regrade site							
Quantity	:	3.00	AC						
Daily Production	:	0.50	AC per	8 hour shift	Project #	:	Klamath Dams Removal		
Work Days	:	6.0	Days		Estimator	:	Mihaela Tomulescu	AC per	Total Cost / Unit Price Per AC
Unit Price	:	$12,512.61	per AC		Probable Low Cost Parameter			0.575	$31,907 / $10,636
Total Cost	:	$37,538			Probable High Cost Parameter			0.425	$43,169 / $14,390

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	6.0	8	48.00	L	$46.27	incl. in rate	incl. in rate	$2,220.96
Equipment Operator (medium)	Active	2.00	6.0	8	96.00	L	$66.28	incl. in rate	incl. in rate	$6,362.88
Laborer	Active	4.00	6.0	8	192.00	L	$45.80	incl. in rate	incl. in rate	$8,793.60
Grader. 180hp, 13' blade	Active	1.00	6.0	8	48.00	E	$80.79	incl. in rate	incl. in rate	$3,877.92
Dozer (235hp)(CATD7)	Active	1.00	2.0	8	16.00	E	$165.11	incl. in rate	incl. in rate	$2,641.76
	Active		2.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active		2.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
Brush Chipper	Active	1.00	0.0	8	16.00	E	$50.55			$808.80
Crawler Loader 3CY Bucket	Active	1.00	0.0	8	32.00	E	$160.13			$5,124.16
Chain Saw, Gas, 36" Long	Active	2.00	0.0	8	16.00	E	$5.63			$90.08
				Labor Hours	336			TOTAL LABOR		$17,377.44
				Equipment Hours	128			TOTAL EQUIPMENT		$12,542.72

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs	1.000	0.00		$0.00
		lbs	1.000	0.00		$0.00
		ea	1.000	0.00		$0.00
		ea	1.000	0.00		$0.00
		ea	1.000	0.00		$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$17,377.44	Labor Burden @	49.7%	$0.00		$17,377.44
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$12,542.72	Equipment Tax @	0.0%	$0.00		$12,542.72
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$29,920			$0	DIRECT COST SUBTOTALS	$29,920

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$29,920.16		$4,488.02
Installing Contractors Profit@	8.0%				$29,920.16		$2,393.61
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$6,881.64
General Contractors Insurance @	1.0%		on		$36,801.80		$368
Bond @	1.0%		on		$36,801.80		$368
Contingency @	0.0%		on		$37,537.83		$0
						TOTAL COST for pay item	$37,538

Additional Pay Item Notes :

Crew is based off clear and grub crew B7 off of RSM means. Production for the crew in .69 ac per day to clear and process the trees/ strubs on site. Assumed Seeding, mechanical seeding, 215 lb./acre with crew B66.The amount and type of seed are assumed and calculated as 215 lbs per acre in total.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.181			**Project**	: IRONGATE			
Description	:	Overlook Point - Regrade steep access road and site to natural contours							
Quantity	:	0.50	AC						
Daily Production	:	0.50	AC per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	1.0	Days		**Estimator**	: Mihaela Tomulescu	**AC per**	**Total Cost**	**Unit Price Per AC**
Unit Price	:	$30,630.71	per AC		**Probable Low Cost Parameter**		**0.575**	**$13,018**	**$26,036**
Total Cost	:	$15,315			**Probable High Cost Parameter**		**0.425**	**$17,613**	**$35,225**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Equipment Operator (medium)	Active	2.00	1.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Laborer	Active	4.00	1.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
Grader. 180hp, 13' blade	Active	1.00	1.0	8	8.00	E	$80.79	incl. in rate	incl. in rate	$646.32
Dozer (235hp)(CATD7)	Active	1.00	2.0	8	16.00	E	$165.11	incl. in rate	incl. in rate	$2,641.76
	Active	1.00	2.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	2.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
Brush Chipper	Active	1.00	0.0	8	16.00	E	$50.55			$808.80
Crawler Loader 3CY Bucket	Active	1.00	0.0	8	32.00	E	$160.13			$5,124.16
Chain Saw, Gas, 36" Long	Active	2.00	0.0	8	16.00	E	$5.63			$90.08

Labor Hours	**56**	**TOTAL LABOR**	**$2,896.24**
Equipment Hours	**88**	**TOTAL EQUIPMENT**	**$9,311.12**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Idaho fescue (Festuca idahoensis)		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs	1.000	0.00		$0.00
		lbs	1.000	0.00		$0.00
		ea	1.000	0.00		$0.00
		ea	1.000	0.00		$0.00
		ea	1.000	0.00		$0.00

TOTAL MATERIAL **$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS **$0.00**

SUMMARY OF COSTS

Labor Cost	$2,896.24	Labor Burden @	49.7%	$0.00	$2,896.24
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$9,311.12	Equipment Tax @	0.0%	$0.00	$9,311.12
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$12,207**			**$0**	**DIRECT COST SUBTOTALS** **$12,207**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$12,207.36	$1,831.10
Installing Contractors Profit@	8.0%				$12,207.36	$976.59
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$2,807.69**
General Contractors Insurance @	1.0%		on		$15,015.05	$150
Bond @	1.0%		on		$15,015.05	$150
Contingency @	0.0%		on		$15,315.35	$0
					TOTAL COST for pay item	**$15,315**

Additional Pay Item Notes :

Crew is based off clear and grub crew B7 off of RSM means. Production for the crew in .69 ac per day to clear and process the trees/ strubs on site. Assumed Seeding, mechanical seeding, 215 lb./acre with crew B66.The amount and type of seed are calculated as 215 lbs per acre in total.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.182		**Project**	:	IRONGATE			
Description	:	Long Gulch - 80'x25x4" Concrete boat ramp to be removed							
Quantity	:	25.00 CY							
Daily Production	:	100.00 CY per	8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	0.3 Days		**Estimator**	:	Mihaela Tomulescu	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$310.44 per CY		**Probable Low Cost Parameter**			**110**	**$6,985**	**$279**
Total Cost	:	$7,761		**Probable High Cost Parameter**			**90**	**$8,537**	**$341**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	0.3	8	4.00	L	$46.27	incl. in rate	incl. in rate	$185.08
Equipment Operator (medium)	Active	8.00	0.3	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Steelworker	Active	6.00	0.3	8	12.00	L	$65.52	incl. in rate	incl. in rate	$786.24
Electrician	Active	1.00	0.3	8	2.00	L	$45.23	incl. in rate	incl. in rate	$90.46
Truck Driver (heavy)	Active	2.00	0.3	8	4.00	L	$57.59	incl. in rate	incl. in rate	$230.36
Vibratory Hammer & Extractor	Active	3.00	0.3	8	6.00	E	$94.34	incl. in rate	incl. in rate	$566.04
Hydraulic Excavator (6.0cy)	Active	3.00	0.3	8	6.00	E	$322.48	incl. in rate	incl. in rate	$1,934.88
Loader, FE Rubber Tire (8.6cy)	Active	2.00	0.3	8	4.00	E	$221.50	incl. in rate	incl. in rate	$886.00
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	0.3	8	4.00	E	$111.64	incl. in rate	incl. in rate	$446.56

Labor Hours	**38**	**TOTAL LABOR**	**$2,352.62**
Equipment Hours	**20**	**TOTAL EQUIPMENT**	**$3,833.48**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,352.62	Labor Burden @	49.7%	$0.00		$2,352.62
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$3,833.48	Equipment Tax @	0.0%	$0.00		$3,833.48
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$6,186**			**$0**	**DIRECT COST SUBTOTALS**	**$6,186**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$6,186.10		$927.92
Installing Contractors Profit@	8.0%				$6,186.10		$494.89
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$1,422.80**
General Contractors Insurance @	1.0%		on		$7,608.90		$76
Bond @	1.0%		on		$7,608.90		$76
Contingency @	0.0%		on		$7,761.08		$0
						TOTAL COST for pay item	**$7,761**

Additional Pay Item Notes :

Based on RS.Means - "Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9" and "Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment Crew B34B"

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.185	**Project**	:	IRONGATE			
Description	:	Concrete Lining Installation for Diversion Tunnel						
Quantity	:	1.00 LS						
Daily Production	:	0.04 LS per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	25.0 Days	**Estimator**	:	Mihaela Tomulescu	**LS per**	**Total Cost**	**Unit Price Per LS**
Unit Price	:	$1,196,251.74 per LS	**Probable Low Cost Parameter**			**0.044**	**$1,076,627**	**$1,076,627**
Total Cost	:	$1,196,252	**Probable High Cost Parameter**			**0.036**	**$1,315,877**	**$1,315,877**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
	Active	1.00	25.0	8	200.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	25.0	8	200.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	25.0	8	200.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	25.0	8	200.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	25.0	8	200.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	25.0	8	200.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	25.0	8	200.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	25.0	8	200.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	25.0	8	200.00	0	$0.00	incl. in rate	incl. in rate	$0.00

Labor Hours	**0**	**TOTAL LABOR**	**$0.00**
Equipment Hours	**0**	**TOTAL EQUIPMENT**	**$0.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Tunnel Lining (Shotcrete with Reinforcement)	1.00	LS	RSMs (2780 CY @ $401.78/CY)	$1,116,948.40	$1,116,948.40
				TOTAL SUBCONTRACTS	**$1,116,948.40**

SUMMARY OF COSTS

Labor Cost	$0.00	Labor Burden @	49.7%	$0.00	$0.00
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00	$0.00
Subcontractors	$1,116,948.40				$1,116,948.40
DIRECT COST SUBTOTALS	**$1,116,948**			**$0**	**DIRECT COST SUBTOTALS** **$1,116,948**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$0.00	$0.00
Installing Contractors Profit@	8.0%				$0.00	$0.00
GC Markup on Subs @	5.0%				$1,116,948.40	$55,847.42
						TOTAL MARKUP COSTS **$55,847.42**
General Contractors Insurance @	1.0%		on		$1,172,795.82	$11,728
Bond @	1.0%		on		$1,172,795.82	$11,728
Contingency @	0.0%		on		$1,196,251.74	$0
						TOTAL COST for pay item **$1,196,252**

Additional Pay Item Notes :

Subcontractor will install reinforcement and shotcrete concrete lining in diversion tunnel.

PAY ITEM COST DETAIL WORKSHEET

5.000 Remove Frame dead end structures 60-80 ft high

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.000		**Project**	: JC BOYLE			
Description	:	Remove Frame dead end structures 60-80 ft high						
Quantity	:	2.00 EA						
Daily Production	:	1.00 EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	2.0 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$7,101.59 per EA		**Probable Low Cost Parameter**		**1.1**	**$12,783**	**$6,391.43**
Total Cost	:	$14,203		**Probable High Cost Parameter**		**0.8**	**$17,044**	**$8,521.91**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	incl. in rate	incl. in rate	$740.32
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Hydraulic Excavator (1.5cy)	Active	1.00	2.0	8	16.00	E	$141.92	incl. in rate	incl. in rate	$2,270.72
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Water Tanker (5,000gal)	Active	1.00	2.0	8	16.00	E	$74.56	incl. in rate	incl. in rate	$1,192.96
Gas Welding Machine	Active	1.00	2.0	8	16.00	E	$2.88	incl. in rate	incl. in rate	$46.03
Laborer	Active	2.00	2.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	2.0	8	16.00	E	$70.35	incl. in rate	incl. in rate	$1,125.60
Vibratory Hammer & Extractor	Active	1.00	2.0	8	16.00	E	$94.34	incl. in rate	incl. in rate	$1,509.44

Labor Hours	**96**	**TOTAL LABOR**	**$4,911.52**
Equipment Hours	**80**	**TOTAL EQUIPMENT**	**$6,144.75**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$245.58	$245.58
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$245.58**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$4,911.52	Labor Burden @	49.7%	$0.00		$4,911.52
Material Cost	$245.58	Material Tax @	7.8%	$19.03		$264.61
Equipment Cost	$6,144.75	Equipment Tax @	0.0%	$0.00		$6,144.75
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$11,302**			**$19**	**DIRECT COST SUBTOTALS**	**$11,321**

	Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%			$11,320.88		$1,698.13
Installing Contractors Profit@	8.0%			$11,320.88		$905.67
GC Markup on Subs @	5.0%			$0.00		$0.00
					TOTAL MARKUP COSTS	**$2,603.80**
General Contractors Insurance @	1.0%	on		$13,924.68		$139
Bond @	1.0%	on		$13,924.68		$139
Contingency @	0.0%	on		$14,203.18		$0
					TOTAL COST for pay item	**$14,203**

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician,1 Excavator, 1 Hammer. Considered one welder for cutting frame/ support of equipment, 2 laborer to load demolished equipment /materials in the truck for disposal.

PAY ITEM COST DETAIL WORKSHEET — **5.001 Remove (incl foundation) and Save Transformers 230KV**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.001			**Project**	: JC BOYLE			
Description	:	Remove (incl foundation) and Save Transformers 230KV							
Quantity	:	2.00	EA						
Daily Production	:	1.79	EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	1.1	Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$2,688.70	per EA		**Probable Low Cost Parameter**		**1.969**	**$4,840**	**$2,419.83**
Total Cost	:	$5,377			**Probable High Cost Parameter**		**1.5215**	**$6,184**	**$3,092.00**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.1	8	8.96	L	$47.23	incl. in rate	incl. in rate	$423.18
Electrician	Active	1.00	1.1	8	8.96	L	$45.23	incl. in rate	incl. in rate	$405.26
Hydraulic Crane (50tn)	Active	1.00	1.1	8	8.96	E	$134.32	incl. in rate	incl. in rate	$1,203.51
Equipment Operator (crane)	Active	1.00	1.1	8	8.96	L	$68.41	incl. in rate	incl. in rate	$612.95
Vibratory Hammer & Extractor	Active	1.00	1.1	8	8.96	E	$94.34	incl. in rate	incl. in rate	$845.29
Truck, Utility, with Man-Basket	Active	1.00	1.1	8	8.96	E	$31.90	incl. in rate	incl. in rate	$285.82
Laborer	Active	1.00	1.1	8	8.96	L	$45.80	incl. in rate	incl. in rate	$410.37

Labor Hours	**35.84**	**TOTAL LABOR**	**$1,851.76**
Equipment Hours	**26.88**	**TOTAL EQUIPMENT**	**$2,334.62**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$92.59	$92.59

TOTAL MATERIAL	**$92.59**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,851.76	Labor Burden @	49.7%	$0.00		$1,851.76
Material Cost	$92.59	Material Tax @	7.8%	$7.18		$99.76
Equipment Cost	$2,334.62	Equipment Tax @	0.0%	$0.00		$2,334.62
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$4,279**			**$7**	**DIRECT COST SUBTOTALS**	**$4,286**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$4,286.14		$642.92
Installing Contractors Profit@	8.0%				$4,286.14		$342.89
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$985.81**
General Contractors Insurance @	1.0%		on		$5,271.96		$53
Bond @	1.0%		on		$5,271.96		$53
Contingency @	0.0%		on		$5,377.40		$0
						TOTAL COST for pay item	**$5,377**

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician,1 Crane to load the transformer in the truck for disposal. In normal circumstances, decontaminated residual components could be accepted at landfill sites.

PAY ITEM COST DETAIL WORKSHEET — **5.002 Remove (incl foundation) and Save Power Circuit Breakers 230KV**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.002		**Project**	: JC BOYLE			
Description	:	Remove (incl foundation) and Save Power Circuit Breakers 230KV						
Quantity	:	2.00 EA						
Daily Production	:	1.00 EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	2.0 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$3,640.83 per EA		**Probable Low Cost Parameter**		**1.05**	**$6,918**	**$3,458.79**
Total Cost	:	$7,282		**Probable High Cost Parameter**		**0.9**	**$8,010**	**$4,004.91**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	incl. in rate	incl. in rate	$740.32
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Hydraulic Crane (35tn)	Active	1.00	2.0	8	16.00	E	$116.30	incl. in rate	incl. in rate	$1,860.80
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Laborer	Active	1.00	2.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	2.0	8	16.00	E	$31.90	incl. in rate	incl. in rate	$510.40

Labor Hours	**64**	**TOTAL LABOR**	**$3,257.28**
Equipment Hours	**32**	**TOTAL EQUIPMENT**	**$2,371.20**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$162.86	$162.86
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$162.86**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$3,257.28	Labor Burden @	49.7%	$0.00		$3,257.28
Material Cost	$162.86	Material Tax @	7.8%	$12.62		$175.49
Equipment Cost	$2,371.20	Equipment Tax @	0.0%	$0.00		$2,371.20
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$5,791**			**$13**	**DIRECT COST SUBTOTALS**	**$5,804**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$5,803.97		$870.59
Installing Contractors Profit@	8.0%				$5,803.97		$464.32
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$1,334.91**
General Contractors Insurance @	1.0%		on		$7,138.88		$71
Bond @	1.0%		on		$7,138.88		$71
Contingency @	0.0%		on		$7,281.66		$0
						TOTAL COST for pay item	**$7,282**

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician,1Crane. Considered 1 laborer to help loading circuit breakers in the truck for saving it in the designated place.

PAY ITEM COST DETAIL WORKSHEET

5.003 Substation Tie Structure 230KV

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.003			**Project**	: JC BOYLE			
Description	:	Substation Tie Structure 230KV							
Quantity	:	1.00 EA							
Daily Production	:	0.25 EA per	8 hour shift		**Project #**	: Klamath Dams Removal			
Work Days	:	4.0 Days			**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$41,482.05 per EA			**Probable Low Cost Parameter**		**0.275**	**$37,334**	**$37,333.84**
Total Cost	:	$41,482			**Probable High Cost Parameter**		**0.2125**	**$47,704**	**$47,704.36**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	4.0	8	64.00	L	$46.27	incl. in rate	incl. in rate	$2,961.28
Electrician	Active	4.00	4.0	8	128.00	L	$45.23	incl. in rate	incl. in rate	$5,789.44
Hydraulic Crane (35tn)	Active	2.00	4.0	8	64.00	E	$116.30	incl. in rate	incl. in rate	$7,443.20
Equipment Operator (medium)	Active	2.00	4.0	8	64.00	L	$66.28	incl. in rate	incl. in rate	$4,241.92
Truck, Utility, with Man-Basket	Active	2.00	4.0	8	64.00	E	$31.90	incl. in rate	incl. in rate	$2,041.60
Truck, Pickup (4x4, 3/4tn)	Active	2.00	4.0	8	64.00	E	$16.94	incl. in rate	incl. in rate	$1,084.16

Labor Hours	**256**	**TOTAL LABOR**	**$12,992.64**
Equipment Hours	**192**	**TOTAL EQUIPMENT**	**$10,568.96**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$649.63	$649.63
Ceramis Insulators	96.00	Bells	1.000	96.00	$18.00	$1,728.00
V-String Hardware	3.00	EA	1.000	3.00	$230.00	$690.00
Grounding	1.00	EA	1.000	1.00	$150.00	$150.00

TOTAL MATERIAL	**$3,217.63**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable tensioning rig, for high voltage line work - Rent per day	2.00	days		$535.00	$1,070.00
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	2.00	days		$3,000.00	$6,000.00

TOTAL SUBCONTRACTS	**$7,070.00**

SUMMARY OF COSTS

Labor Cost	$12,992.64	Labor Burden @	49.7%	$0.00	$12,992.64
Material Cost	$3,217.63	Material Tax @	7.8%	$249.37	$3,467.00
Equipment Cost	$10,568.96	Equipment Tax @	0.0%	$0.00	$10,568.96
Subcontractors	$7,070.00				$7,070.00
DIRECT COST SUBTOTALS	**$33,849**			**$249**	**DIRECT COST SUBTOTALS** **$34,099**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$27,028.60	$4,054.29
Installing Contractors Profit@	8.0%				$27,028.60	$2,162.29
GC Markup on Subs @	5.0%				$7,070.00	$353.50
					TOTAL MARKUP COSTS	**$6,570.08**
General Contractors Insurance @	1.0%		on		$40,668.68	$407
Bond @	1.0%		on		$40,668.68	$407
Contingency @	0.0%		on		$41,482.05	$0
					TOTAL COST for pay item	**$41,482**

Additional Pay Item Notes :

Production is based off of RSMs using 2 Crew formed of 1 Forman, 1 Electrician,1Crane.

PAY ITEM COST DETAIL WORKSHEET

5.004 Remove Chain Link Fence

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.004	**Project**	:	JC BOYLE			
Description	:	Remove Chain Link Fence						
Quantity	:	601.00 LF						
Daily Production	:	300.00 LF per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	2.0 Days	**Estimator**	:	Mihaela Tomulescu	**LF per**	**Total Cost**	**Unit Price Per LF**
Unit Price	:	$17.70 per LF	**Probable Low Cost Parameter**			**330**	**$9,575**	**$15.93**
Total Cost	:	$10,639	**Probable High Cost Parameter**			**270**	**$11,703**	**$19.47**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Laborer	Active	2.00	2.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
Truck Driver (light)	Active	1.00	2.0	8	16.00	L	$56.29	incl. in rate	incl. in rate	$900.64
Hydraulic Excavator (2.5cy)	Active	1.00	2.0	8	16.00	E	$203.63	incl. in rate	incl. in rate	$3,258.08
Equipment Operator (light)	Active	1.00	2.0	8	16.00	L	$64.90	incl. in rate	incl. in rate	$1,038.40
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	2.0	8	32.00	E	$31.90	incl. in rate	incl. in rate	$1,020.80

Labor Hours	**64**	**TOTAL LABOR**	**$3,404.64**
Equipment Hours	**48**	**TOTAL EQUIPMENT**	**$4,278.88**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$170.23	$170.23
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	120.00	CY	1.000	120.00	$4.74	$568.80

TOTAL MATERIAL	**$739.03**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$3,404.64	Labor Burden @	49.7%	$0.00		$3,404.64
Material Cost	$739.03	Material Tax @	7.8%	$57.27		$796.31
Equipment Cost	$4,278.88	Equipment Tax @	0.0%	$0.00		$4,278.88
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$8,423**			**$57**	**DIRECT COST SUBTOTALS**	**$8,480**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$8,479.83		$1,271.97
Installing Contractors Profit@	8.0%				$8,479.83		$678.39
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$1,950.36**
General Contractors Insurance @	1.0%		on		$10,430.19		$104
Bond @	1.0%		on		$10,430.19		$104
Contingency @	0.0%		on		$10,638.79		$0
						TOTAL COST for pay item	**$10,639**

Additional Pay Item Notes :

Production is based off of RSMs using Crew B80c, 2 laborers and 1 truck driver light. Considered using an excavator for the CLF foundation removal.

PAY ITEM COST DETAIL WORKSHEET — **5.005 Demolish overhead distribution 2.5 miles (30-45 poles)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.005	**Project**	:	JC BOYLE			
Description	:	Demolish overhead distribution 2.5 miles (30-45 poles)						
Quantity	:	45.00 EA						
Daily Production	:	3.50 EA per 8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	12.9 Days	**Estimator**	:	Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$1,160.01 per EA	**Probable Low Cost Parameter**			**3.85**	**$46,980**	**$1,044.01**
Total Cost	:	$52,200	**Probable High Cost Parameter**			**2.8**	**$62,640**	**$1,392.01**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	12.9	8	103.20	L	$46.27	incl. in rate	incl. in rate	$4,775.06
Electrician	Active	1.00	12.9	8	103.20	L	$45.23	incl. in rate	incl. in rate	$4,667.74
Hydraulic Crane (17tn)	Active	1.00	12.9	8	103.20	E	$81.52	incl. in rate	incl. in rate	$8,412.86
Equipment Operator (medium)	Active	1.00	12.9	8	103.20	L	$66.28	incl. in rate	incl. in rate	$6,840.10
Truck Driver (heavy)	Active	1.00	5.0	8	40.00	L	$57.59	incl. in rate	incl. in rate	$2,303.60
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	5.0	8	40.00	E	$111.64	incl. in rate	incl. in rate	$4,465.60
Laborer	Active	2.00	5.0	8	80.00	L	$45.80	incl. in rate	incl. in rate	$3,664.00
Vibratory Hammer & Extractor	Active	1.00	5.0	8	40.00	E	$94.34	incl. in rate	incl. in rate	$3,773.60
Truck, Utility, with Man-Basket	Active	1.00	5.0	8	40.00	E	$31.90	incl. in rate	incl. in rate	$1,276.00

Labor Hours	**429.6**	**TOTAL LABOR**	**$22,250.50**
Equipment Hours	**223.2**	**TOTAL EQUIPMENT**	**$17,928.06**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,112.52	$1,112.52
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	45.00	CY	1.000	45.00	$4.74	$213.30

TOTAL MATERIAL	**$1,325.82**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$22,250.50	Labor Burden @	49.7%	$0.00	$22,250.50
Material Cost	$1,325.82	Material Tax @	7.8%	$102.75	$1,428.58
Equipment Cost	$17,928.06	Equipment Tax @	0.0%	$0.00	$17,928.06
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$41,504**			**$103**	**DIRECT COST SUBTOTALS** **$41,607**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$41,607.14	$6,241.07
Installing Contractors Profit@	8.0%				$41,607.14	$3,328.57
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$9,569.64**
General Contractors Insurance @	1.0%		on		$51,176.78	$512
Bond @	1.0%		on		$51,176.78	$512
Contingency @	0.0%		on		$52,200.31	$0
					TOTAL COST for pay item	**$52,200**

Additional Pay Item Notes :

Production is based off of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane and 1 man-basket truck to help untie the line). Considered 2 laborer and 1 Vibratory Hammer for demolish the pole foundation, helping placing poles in a designated place and loading them in the truck for disposal. This process includes filling in pole locations with gravel, clean fill and topsoil.

PAY ITEM COST DETAIL WORKSHEET — **5.006 Remove Frame dead end structures 60-80 ft high @Switchyard**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.006	**Project**	: COPCO 1				
Description	:	Remove Frame dead end structures 60-80 ft high @Switchyard						
Quantity	:	4.00 EA						
Daily Production	:	1.00 EA per 8 hour shift	**Project #**	: 2				
Work Days	:	4.0 Days	**Estimator**	: Mihaela Tomulescu		**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$6,436.15 per EA	**Probable Low Cost Parameter**			**1.15**	**$21,883**	**$5,470.72**
Total Cost	:	$25,745	**Probable High Cost Parameter**			**0.7**	**$33,468**	**$8,366.99**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	4.0	8	32.00	L	$46.27	incl. in rate	incl. in rate	$1,480.64
Electrician	Active	1.00	4.0	8	32.00	L	$45.23	incl. in rate	incl. in rate	$1,447.36
Hydraulic Excavator (1.5cy)	Active	1.00	4.0	8	32.00	E	$141.92	incl. in rate	incl. in rate	$4,541.44
Equipment Operator (medium)	Active	1.00	4.0	8	32.00	L	$66.28	incl. in rate	incl. in rate	$2,120.96
Welder	Active	1.00	4.0	8	32.00	L	$7.84	incl. in rate	incl. in rate	$250.80
Gas Welding Machine	Active	1.00	4.0	8	32.00	E	$2.88	incl. in rate	incl. in rate	$92.06
Laborer	Active	2.00	4.0	8	64.00	L	$45.80	incl. in rate	incl. in rate	$2,931.20
Truck Driver (heavy)	Active	1.00	4.0	8	32.00	L	$57.59	incl. in rate	incl. in rate	$1,842.88
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	4.0	8	32.00	E	$70.35	incl. in rate	incl. in rate	$2,251.20
Vibratory Hammer & Extractor	Active	1.00	4.0	8	32.00	E	$94.34	incl. in rate	incl. in rate	$3,018.88

Labor Hours	**224**	**TOTAL LABOR**	**$10,073.84**
Equipment Hours	**128**	**TOTAL EQUIPMENT**	**$9,903.58**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$503.69	$503.69
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$503.69**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$10,073.84	Labor Burden @	49.7%	$0.00		$10,073.84
Material Cost	$503.69	Material Tax @	7.8%	$39.04		$542.73
Equipment Cost	$9,903.58	Equipment Tax @	0.0%	$0.00		$9,903.58
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$20,481**			**$39**	**DIRECT COST SUBTOTALS**	**$20,520**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☑	☑	☐	$20,520.15	$3,078.02
Installing Contractors Profit@	8.0%	☑	☑	☐	$20,520.15	$1,641.61
GC Markup on Subs @	5.0%	☐	☐	☑	$0.00	$0.00
					TOTAL MARKUP COSTS	**$4,719.63**
General Contractors Insurance @	1.0%		on		$25,239.79	$252
Bond @	1.0%		on		$25,239.79	$252
Contingency @	0.0%		on		$25,744.58	$0
					TOTAL COST for pay item	**$25,745**

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician,1 Excavator, 1 Hammer. Considered one welder for cutting frame/ support of equipment, 2 laborer to load demolished equipment /materials in the truck for disposal. Crews may be working simultaneously along the project alignment and substations, power plant and switchyard.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.007	Project	: COPCO 1				
Description	:	Remove Power Circuit Breakers 69KV @Switchyard						
Quantity	:	2.00 EA						
Daily Production	:	1.00 EA per 8 hour shift	Project #	: 2				
Work Days	:	2.0 Days	Estimator	: Mihaela Tomulescu		EA per	Total Cost	Unit Price Per EA
Unit Price	:	$5,681.20 per EA	Probable Low Cost Parameter			1.1	$10,226	$5,113.08
Total Cost	:	$11,362	Probable High Cost Parameter			0.75	$14,203	$7,101.50

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	2.0	8	32.00	L	$46.27	incl. in rate	incl. in rate	$1,480.64
Electrician	Active	2.00	2.0	8	32.00	L	$45.23	incl. in rate	incl. in rate	$1,447.36
Hydraulic Crane (35tn)	Active	1.00	1.0	8	8.00	E	$116.30	incl. in rate	incl. in rate	$930.40
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
Laborer	Active	2.00	2.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	2.0	8	16.00	E	$31.90	incl. in rate	incl. in rate	$510.40
Truck, Utility, with Man-Basket	Active	1.00	2.0	8	16.00	E	$31.90	incl. in rate	incl. in rate	$510.40
Truck Driver (light)	Active	2.00	2.0	8	32.00	L	$56.29	incl. in rate	incl. in rate	$1,801.28

Labor Hours	136	TOTAL LABOR	$6,742.16
Equipment Hours	40	TOTAL EQUIPMENT	$1,951.20

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$337.11	$337.11

TOTAL MATERIAL	$337.11

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$6,742.16	Labor Burden @	49.7%	$0.00		$6,742.16
Material Cost	$337.11	Material Tax @	7.8%	$26.13		$363.23
Equipment Cost	$1,951.20	Equipment Tax @	0.0%	$0.00		$1,951.20
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$9,030			$26	DIRECT COST SUBTOTALS	$9,057

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☑	☑	☐	$9,056.59	$1,358.49
Installing Contractors Profit@	8.0%	☑	☑	☐	$9,056.59	$724.53
GC Markup on Subs @	5.0%	☐	☐	☑	$0.00	$0.00
					TOTAL MARKUP COSTS	$2,083.02
General Contractors Insurance @	1.0%		on		$11,139.61	$111
Bond @	1.0%		on		$11,139.61	$111
Contingency @	0.0%		on		$11,362.40	$0
					TOTAL COST for pay item	$11,362

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician,1Crane. Considered 1 laborer to help loading circuit breakers in the truck for saving it in the designated place. 1 utility truck access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, power plant and switchyard.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.008	Project	: COPCO 1				
Description	:	Remove Disconnect Switches @Switchyard						
Quantity	:	4.00 EA						
Daily Production	:	1.00 EA per 8 hour shift	Project #	: 2				
Work Days	:	4.0 Days	Estimator	: Mihaela Tomulescu		EA per	Total Cost	Unit Price Per EA
Unit Price	:	$9,731.40 per EA	Probable Low Cost Parameter			1.1	$35,033	$8,758.26
Total Cost	:	$38,926	Probable High Cost Parameter			0.75	$48,657	$12,164.25

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	4.0	8	32.00	L	$46.27	incl. in rate	incl. in rate	$1,480.64
Electrician	Active	2.00	4.0	8	64.00	L	$45.23	incl. in rate	incl. in rate	$2,894.72
Hydraulic Excavator (6.0cy)	Active	1.00	4.0	8	32.00	E	$322.48	incl. in rate	incl. in rate	$10,319.36
Equipment Operator (medium)	Active	1.00	4.0	8	32.00	L	$66.28	incl. in rate	incl. in rate	$2,120.96
Laborer	Active	2.00	4.0	8	64.00	L	$45.80	incl. in rate	incl. in rate	$2,931.20
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	2.0	8	16.00	E	$31.90	incl. in rate	incl. in rate	$510.40
Truck, Utility, with Man-Basket	Active	2.00	4.0	8	64.00	E	$31.90	incl. in rate	incl. in rate	$2,041.60
Truck Driver (light)	Active	2.00	4.0	8	64.00	L	$56.29	incl. in rate	incl. in rate	$3,602.56
Vibratory Hammer & Extractor	Active	1.00	4.0	8	32.00	E	$94.34	incl. in rate	incl. in rate	$3,018.88

Labor Hours	256	TOTAL LABOR	$13,030.08
Equipment Hours	144	TOTAL EQUIPMENT	$15,890.24

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,954.51	$1,954.51

TOTAL MATERIAL	$1,954.51

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$13,030.08	Labor Burden @	49.7%	$0.00		$13,030.08
Material Cost	$1,954.51	Material Tax @	7.8%	$151.47		$2,105.99
Equipment Cost	$15,890.24	Equipment Tax @	0.0%	$0.00		$15,890.24
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$30,875			$151	DIRECT COST SUBTOTALS	$31,026

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☑	☑	☐	$31,026.31	$4,653.95
Installing Contractors Profit@	8.0%	☑	☑	☐	$31,026.31	$2,482.10
GC Markup on Subs @	5.0%	☐	☐	☑	$0.00	$0.00
					TOTAL MARKUP COSTS	$7,136.05
General Contractors Insurance @	1.0%		on		$38,162.36	$382
Bond @	1.0%		on		$38,162.36	$382
Contingency @	0.0%		on		$38,925.60	$0
					TOTAL COST for pay item	$38,926

Additional Pay Item Notes :

Production is based off of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane). Considered two laborer for loding it in the truck for disposal and for hauling the demolished foundation (same structure as circuit breakers).Crews may be working simultaneously along the project alignment and substations, power plant and switchyard.

PAY ITEM COST DETAIL WORKSHEET — **5.009 Remove all associated auxiliary equipment @Switchyard (Allowance)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.009		**Project**	: COPCO 1			
Description	:	Remove all associated auxiliary equipment @Switchyard (Allowance)						
Quantity	:	1.00 LS						
Daily Production	:	1.00 LS per	8 hour shift	**Project #**	: 2			
Work Days	:	3.0 Days		**Estimator**	: Mihaela Tomulescu	**LS per**	**Total Cost**	**Unit Price Per LS**
Unit Price	:	$48,501.71 per LS		**Probable Low Cost Parameter**		**1.1**	**$43,652**	**$43,651.54**
Total Cost	:	$48,502		**Probable High Cost Parameter**		**0.75**	**$60,627**	**$60,627.14**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	3.0	8	24.00	L	$46.27	incl. in rate	incl. in rate	$1,110.48
Electrician	Active	4.00	3.0	8	96.00	L	$45.23	incl. in rate	incl. in rate	$4,342.08
Hydraulic Excavator (1.5cy)	Active	1.00	3.0	8	24.00	E	$141.92	incl. in rate	incl. in rate	$3,406.08
Equipment Operator (medium)	Active	2.00	3.0	8	48.00	L	$66.28	incl. in rate	incl. in rate	$3,181.44
Truck, Utility, with Man-Basket	Active	1.00	3.0	8	24.00	E	$31.90	incl. in rate	incl. in rate	$765.60
Hydraulic Crane (17tn)	Active	1.00	3.0	8	24.00	E	$81.52	incl. in rate	incl. in rate	$1,956.48
Laborer	Active	4.00	3.0	8	96.00	L	$45.80	incl. in rate	incl. in rate	$4,396.80
Truck Driver (heavy)	Active	2.00	3.0	8	48.00	L	$57.59	incl. in rate	incl. in rate	$2,764.32
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	3.0	8	48.00	E	$70.35	incl. in rate	incl. in rate	$3,376.80
Vibratory Hammer & Extractor	Active	1.00	3.0	8	24.00	E	$94.34	incl. in rate	incl. in rate	$2,264.16

Labor Hours	**312**	**TOTAL LABOR**	**$15,795.12**
Equipment Hours	**144**	**TOTAL EQUIPMENT**	**$11,769.12**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$789.76	$789.76

TOTAL MATERIAL	**$789.76**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	1.00	days	4.00	$3,000.00	$12,000.00

TOTAL SUBCONTRACTS	**$12,000.00**

SUMMARY OF COSTS

Labor Cost	$15,795.12	Labor Burden @	49.7%	$0.00		$15,795.12
Material Cost	$789.76	Material Tax @	7.8%	$61.21		$850.96
Equipment Cost	$11,769.12	Equipment Tax @	0.0%	$0.00		$11,769.12
Subcontractors	$12,000.00					$12,000.00
DIRECT COST SUBTOTALS	**$40,354**			**$61**	**DIRECT COST SUBTOTALS**	**$40,415**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%	☑	☑	☐	$28,415.20		$4,262.28
Installing Contractors Profit@	8.0%	☑	☑	☐	$28,415.20		$2,273.22
GC Markup on Subs @	5.0%	☐	☐	☑	$12,000.00		$600.00
						TOTAL MARKUP COSTS	**$7,135.50**
General Contractors Insurance @	1.0%	on			$47,550.70		$476
Bond @	1.0%	on			$47,550.70		$476
Contingency @	0.0%	on			$48,501.71		$0
						TOTAL COST for pay item	**$48,502**

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 4 Electrician, 2 laborer, 1 Excavator & 1 crane for lift, position and load in the truck,, 1 Hydraulic rock-splitting/rock-drilling equipment to break equipment foundations, 1 utility truck access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, hydro plant and switchyard.

PAY ITEM COST DETAIL WORKSHEET — **5.010 Remove Distribution lines 69 Kv between Copco 1 Switchyard and HE Plant (6 Poles)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.010		Project	: COPCO 1			
Description	:	Poles)						
Quantity	:	6.00	EA					
Daily Production	:	3.00	EA per 8 hour shift	Project #	: 2			
Work Days	:	2.0	Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$1,402.44	per EA	Probable Low Cost Parameter		3.3	$7,573	$1,262.20
Total Cost	:	$8,415		Probable High Cost Parameter		2.25	$10,518	$1,753.05

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	incl. in rate	incl. in rate	$740.32
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Hydraulic Crane (17tn)	Active	1.00	2.0	8	16.00	E	$81.52	incl. in rate	incl. in rate	$1,304.32
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Laborer	Active	1.00	2.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Truck Driver (light)	Active	1.00	2.0	8	16.00	L	$56.29	incl. in rate	incl. in rate	$900.64
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	2.0	8	16.00	E	$31.90	incl. in rate	incl. in rate	$510.40
Truck, Utility, with Man-Basket	Active	1.00	2.0	8	16.00	E	$31.90	incl. in rate	incl. in rate	$510.40

Labor Hours	80	TOTAL LABOR	$4,157.92
Equipment Hours	48	TOTAL EQUIPMENT	$2,325.12

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$207.90	$207.90

TOTAL MATERIAL	$207.90

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$4,157.92	Labor Burden @	49.7%	$0.00		$4,157.92
Material Cost	$207.90	Material Tax @	7.8%	$16.11		$224.01
Equipment Cost	$2,325.12	Equipment Tax @	0.0%	$0.00		$2,325.12
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$6,691**			**$16**	**DIRECT COST SUBTOTALS**	**$6,707**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☑	☑	☐	$6,707.05	$1,006.06
Installing Contractors Profit@	8.0%	☑	☑	☐	$6,707.05	$536.56
GC Markup on Subs @	5.0%	☐	☐	☑	$0.00	$0.00
					TOTAL MARKUP COSTS	$1,542.62
General Contractors Insurance @	1.0%		on		$8,249.67	$82
Bond @	1.0%		on		$8,249.67	$82
Contingency @	0.0%		on		$8,414.66	$0
					TOTAL COST for pay item	**$8,415**

Additional Pay Item Notes :

Production is based off of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane). Considered one laborer for demolish the pole and helping placing poles in a designated place and loding it in the truck for disposal. Crews may be working simultaneously along the project alignment and substations, power plant and switchyard.

PAY ITEM COST DETAIL WORKSHEET — **5.011 Remove Distribution poles 2.4 Kv between Copco#1 HE Plant and Copco#2 Diversion Dam**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.011		Project	: COPCO 1			
Description	:	Diversion Dam						
Quantity	:	8.00	EA					
Daily Production	:	2.00	EA per	8 hour shift	Project #	: 2		
Work Days	:	4.0	Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$1,950.45	per EA		Probable Low Cost Parameter		2.2	$14,043	$1,755.41
Total Cost	:	$15,604			Probable High Cost Parameter		1.5	$19,505	$2,438.07

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	4.0	8	32.00	L	$46.27	incl. in rate	incl. in rate	$1,480.64
Electrician	Active	1.00	4.0	8	32.00	L	$45.23	incl. in rate	incl. in rate	$1,447.36
Hydraulic Crane (17tn)	Active	1.00	4.0	8	32.00	E	$81.52	incl. in rate	incl. in rate	$2,608.64
Equipment Operator (medium)	Active	1.00	4.0	8	32.00	L	$66.28	incl. in rate	incl. in rate	$2,120.96
Truck Driver (heavy)	Active	1.00	4.0	8	32.00	L	$57.59	incl. in rate	incl. in rate	$1,842.88
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	4.0	8	32.00	E	$31.90	incl. in rate	incl. in rate	$1,020.80
Laborer	Active	1.00	4.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60

Labor Hours	160	TOTAL LABOR	$8,357.44
Equipment Hours	64	TOTAL EQUIPMENT	$3,629.44

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$417.87	$417.87

TOTAL MATERIAL	$417.87

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$8,357.44	Labor Burden @	49.7%	$0.00	$8,357.44
Material Cost	$417.87	Material Tax @	7.8%	$32.39	$450.26
Equipment Cost	$3,629.44	Equipment Tax @	0.0%	$0.00	$3,629.44
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$12,405**			**$32**	**DIRECT COST SUBTOTALS** $12,437

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☑	☑	☐	$12,437.14	$1,865.57
Installing Contractors Profit@	8.0%	☑	☑	☐	$12,437.14	$994.97
GC Markup on Subs @	5.0%	☐	☐	☑	$0.00	$0.00
					TOTAL MARKUP COSTS	$2,860.54
General Contractors Insurance @	1.0%		on		$15,297.68	$153
Bond @	1.0%		on		$15,297.68	$153
Contingency @	0.0%		on		$15,603.63	$0
					TOTAL COST for pay item	$15,604

Additional Pay Item Notes :

Production is based off of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane). Considered one laborer for demolish the pole and helping placing poles in a designated place and loding it in the truck for disposal. Crews may be working simultaneously along the project alignment and substations, power plant and switchyard.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.012	Project	: COPCO 1				
Description	:	Remove "Production Poles" in general area Copco#1						
Quantity	:	7.00 EA						
Daily Production	:	2.00 EA per 8 hour shift	Project #	: 2				
Work Days	:	3.5 Days	Estimator	: Mihaela Tomulescu		EA per	Total Cost	Unit Price Per EA
Unit Price	:	$1,956.86 per EA	Probable Low Cost Parameter			2.3	$11,643	$1,663.33
Total Cost	:	$13,698	Probable High Cost Parameter			1.4	$17,807	$2,543.92

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	3.5	8	28.00	L	$46.27	incl. in rate	incl. in rate	$1,295.56
Electrician	Active	1.00	3.5	8	28.00	L	$45.23	incl. in rate	incl. in rate	$1,266.44
Hydraulic Crane (17tn)	Active	1.00	3.5	8	28.00	E	$81.52	incl. in rate	incl. in rate	$2,282.56
Equipment Operator (medium)	Active	1.00	3.5	8	28.00	L	$66.28	incl. in rate	incl. in rate	$1,855.84
Laborer	Active	1.00	3.5	8	28.00	L	$45.80	incl. in rate	incl. in rate	$1,282.40
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	3.5	8	28.00	E	$31.90	incl. in rate	incl. in rate	$893.20
Truck Driver (heavy)	Active	1.00	3.5	8	28.00	L	$57.59	incl. in rate	incl. in rate	$1,612.52

Labor Hours	140	TOTAL LABOR	$7,312.76
Equipment Hours	56	TOTAL EQUIPMENT	$3,175.76

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$365.64	$365.64
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	7.00	CY	1.000	7.00	$4.74	$33.18

TOTAL MATERIAL $398.82

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS $0.00

SUMMARY OF COSTS

Labor Cost	$7,312.76	Labor Burden @	49.7%	$0.00		$7,312.76
Material Cost	$398.82	Material Tax @	7.8%	$30.91		$429.73
Equipment Cost	$3,175.76	Equipment Tax @	0.0%	$0.00		$3,175.76
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$10,887			$31	DIRECT COST SUBTOTALS	$10,918

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☑	☑	☐	$10,918.25	$1,637.74
Installing Contractors Profit@	8.0%	☑	☑	☐	$10,918.25	$873.46
GC Markup on Subs @	5.0%	☐	☐	☑	$0.00	$0.00
					TOTAL MARKUP COSTS	$2,511.20
General Contractors Insurance @	1.0%		on		$13,429.44	$134
Bond @	1.0%		on		$13,429.44	$134
Contingency @	0.0%		on		$13,698.03	$0
					TOTAL COST for pay item	$13,698

Additional Pay Item Notes :

Production is based off of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane). Considered one laborer for demolish the pole and helping placing poles in a designated place and loding them in the truck for disposal. This process includes filling in pole locations with gravel, clean fill and topsoil. Crews may be working simultaneously along the project alignment and substations, power plant and switchyard.

PAY ITEM COST DETAIL WORKSHEET — **5.013 Remove "Village Houses Distribution Poles" near dam (assumed 10)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.013		**Project**	: COPCO 1				
Description	: Remove "Village Houses Distribution Poles" near dam (assumed 10)							
Quantity	: 10.00 EA							
Daily Production	: 3.00 EA per	8 hour shift	**Project #**	: 2				
Work Days	: 3.3 Days		**Estimator**	: Mihaela Tomulescu		**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	: $1,293.71 per EA		**Probable Low Cost Parameter**			**3.45**	**$10,997**	**$1,099.65**
Total Cost	: $12,937		**Probable High Cost Parameter**			**2.1**	**$16,818**	**$1,681.82**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	3.3	8	26.40	L	$46.27	incl. in rate	incl. in rate	$1,221.53
Electrician	Active	1.00	3.3	8	26.40	L	$45.23	incl. in rate	incl. in rate	$1,194.07
Hydraulic Crane (17tn)	Active	1.00	3.3	8	26.40	E	$81.52	incl. in rate	incl. in rate	$2,152.13
Equipment Operator (medium)	Active	1.00	3.3	8	26.40	L	$66.28	incl. in rate	incl. in rate	$1,749.79
Truck Driver (heavy)	Active	1.00	3.3	8	26.40	L	$57.59	incl. in rate	incl. in rate	$1,520.38
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	3.3	8	26.40	E	$31.90	incl. in rate	incl. in rate	$842.16
Laborer	Active	1.00	3.3	8	26.40	L	$45.80	incl. in rate	incl. in rate	$1,209.12

Labor Hours	**132**	**TOTAL LABOR**	**$6,894.89**
Equipment Hours	**52.8**	**TOTAL EQUIPMENT**	**$2,994.29**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$344.74	$344.74
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	10.00	CY	1.000	10.00	$4.74	$47.40

TOTAL MATERIAL	**$392.14**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$6,894.89	Labor Burden @	49.7%	$0.00	$6,894.89
Material Cost	$392.14	Material Tax @	7.8%	$30.39	$422.54
Equipment Cost	$2,994.29	Equipment Tax @	0.0%	$0.00	$2,994.29
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$10,281**			**$30**	**DIRECT COST SUBTOTALS** **$10,312**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☑	☑	☐	$10,311.71	$1,546.76
Installing Contractors Profit@	8.0%	☑	☑	☐	$10,311.71	$824.94
GC Markup on Subs @	5.0%	☐	☐	☑	$0.00	$0.00
					TOTAL MARKUP COSTS	**$2,371.69**
General Contractors Insurance @	1.0%		on		$12,683.41	$127
Bond @	1.0%		on		$12,683.41	$127
Contingency @	0.0%		on		$12,937.07	$0
					TOTAL COST for pay item	**$12,937**

Additional Pay Item Notes :

Production is based off of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane). Considered one laborer for demolish the pole and helping placing poles in a designated place and loding them in the truck for disposal. This process includes filling in pole locations with gravel, clean fill and topsoil. Crews may be working simultaneously along the project alignment and substations, power plant and switchyard.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.014	Project	: Fall Creak				
Description	:	Remove 69 KV Distribution line 1.6 miles (30 poles)						
Quantity	:	30.00 EA						
Daily Production	:	4.00 EA per 8 hour shift	Project #	: 2				
Work Days	:	7.5 Days	Estimator	: Mihaela Tomulescu		EA per	Total Cost	Unit Price Per EA
Unit Price	:	$2,096.19 per EA	Probable Low Cost Parameter			4.6	$53,453	$1,781.76
Total Cost	:	$62,886	Probable High Cost Parameter			2.8	$81,751	$2,725.04

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	7.5	8	60.00	L	$46.27	incl. in rate	incl. in rate	$2,776.20
Electrician	Active	4.00	7.5	8	240.00	L	$45.23	incl. in rate	incl. in rate	$10,855.20
Hydraulic Crane (17tn)	Active	1.00	7.5	8	60.00	E	$81.52	incl. in rate	incl. in rate	$4,891.20
Equipment Operator (medium)	Active	1.00	7.5	8	60.00	L	$66.28	incl. in rate	incl. in rate	$3,976.80
Truck Driver (heavy)	Active	1.00	7.5	8	60.00	L	$57.59	incl. in rate	incl. in rate	$3,455.40
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	7.5	8	60.00	E	$31.90	incl. in rate	incl. in rate	$1,914.00
Laborer	Active	4.00	7.5	8	240.00	L	$45.80	incl. in rate	incl. in rate	$10,992.00
Truck, Utility, with Man-Basket	Active	4.00	7.5	8	240.00	E	$31.90	incl. in rate	incl. in rate	$7,656.00

Labor Hours	660	TOTAL LABOR	$32,055.60
Equipment Hours	360	TOTAL EQUIPMENT	$14,461.20

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits,etc)	1.00	LS	1.000	1.00	$3,205.56	$3,205.56
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	30.00	CY	1.000	30.00	$4.74	$142.20

TOTAL MATERIAL $3,347.76

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS $0.00

SUMMARY OF COSTS

Labor Cost	$32,055.60	Labor Burden @	49.7%	$0.00		$32,055.60
Material Cost	$3,347.76	Material Tax @	7.8%	$259.45		$3,607.21
Equipment Cost	$14,461.20	Equipment Tax @	0.0%	$0.00		$14,461.20
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$49,865			$259	DIRECT COST SUBTOTALS	$50,124

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☑	☑	☐	$50,124.01	$7,518.60
Installing Contractors Profit@	8.0%	☑	☑	☐	$50,124.01	$4,009.92
GC Markup on Subs @	5.0%	☐	☐	☑	$0.00	$0.00
					TOTAL MARKUP COSTS	$11,528.52
General Contractors Insurance @	1.0%		on		$61,652.53	$617
Bond @	1.0%		on		$61,652.53	$617
Contingency @	0.0%		on		$62,885.58	$0
					TOTAL COST for pay item	$62,886

Additional Pay Item Notes :

Production is based off of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane). Considered one laborer for demolish the pole foundation and helping placing poles in a designated place and loding them in the truck for disposal.This process includes filling in pole locations with gravel, clean fill and topsoil. Crews may be working simultaneously along the project alignment and substations, power plant and switchyard.

PAY ITEM COST DETAIL WORKSHEET — **5.015 Remove Transmission conductors on poles 1X/001 and 2X/001 but keep distribution intact**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.015			Project	: Fall Creak			
Description	:	intact							
Quantity	:	2.00	EA						
Daily Production	:	2.00	EA per	8 hour shift	Project #	: 2			
Work Days	:	1.0	Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$2,686.44	per EA		Probable Low Cost Parameter		2.3	$4,567	$2,283.48
Total Cost	:	$5,373			Probable High Cost Parameter		1.4	$6,985	$3,492.37

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	1.0	8	16.00	L	$46.27	incl. in rate	incl. in rate	$740.32
Electrician	Active	4.00	1.0	8	32.00	L	$45.23	incl. in rate	incl. in rate	$1,447.36
Truck, Pickup (4x4, 3/4tn)	Active	1.00	1.0	8	8.00	E	$16.94	incl. in rate	incl. in rate	$135.52
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Truck, Utility, with Man-Basket	Active	2.00	1.0	8	16.00	E	$31.90	incl. in rate	incl. in rate	$510.40
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80

Labor Hours	72	TOTAL LABOR	$3,450.72
Equipment Hours	24	TOTAL EQUIPMENT	$645.92

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$172.54	$172.54

TOTAL MATERIAL	$172.54

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$3,450.72	Labor Burden @	49.7%	$0.00		$3,450.72
Material Cost	$172.54	Material Tax @	7.8%	$13.37		$185.91
Equipment Cost	$645.92	Equipment Tax @	0.0%	$0.00		$645.92
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$4,269**			**$13**	**DIRECT COST SUBTOTALS**	**$4,283**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☑	☑	☐	$4,282.55	$642.38
Installing Contractors Profit@	8.0%	☑	☑	☐	$4,282.55	$342.60
GC Markup on Subs @	5.0%	☐	☐	☑	$0.00	$0.00
					TOTAL MARKUP COSTS	$984.99
General Contractors Insurance @	1.0%		on		$5,267.53	$53
Bond @	1.0%		on		$5,267.53	$53
Contingency @	0.0%		on		$5,372.88	$0
					TOTAL COST for pay item	**$5,373**

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed from 2 Forman and 4 Electrician,2 Laborer, 2 utility truck access poles, string conductor, modify structure arms, provide guard structures., 2 Laborer to help ground side.Crews may be working simultaneously along the project alignment and substations, power plant and switchyard.

PAY ITEM COST DETAIL WORKSHEET — **5.016 Remove Transmission conductors 1.3 miles Copco#1 to Copco#2**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.016		**Project**	: COPCO 1			
Description	:	Remove Transmission conductors 1.3 miles Copco#1 to Copco#2						
Quantity	:	6,864.00 LF						
Daily Production	:	600.00 LF per	8 hour shift	**Project #**	: 2			
Work Days	:	11.4 Days		**Estimator**	: Mihaela Tomulescu	**LF per**	**Total Cost**	**Unit Price Per LF**
Unit Price	:	$7.16 per LF		**Probable Low Cost Parameter**		**690**	**$41,767**	**$6.09**
Total Cost	:	$49,138		**Probable High Cost Parameter**		**420**	**$63,880**	**$9.31**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	11.4	8	182.40	L	$46.27	incl. in rate	incl. in rate	$8,439.65
Electrician	Active	2.00	11.4	8	182.40	L	$45.23	incl. in rate	incl. in rate	$8,249.95
Truck, Pickup (4x4, 3/4tn)	Active	1.00	11.4	8	91.20	E	$16.94	incl. in rate	incl. in rate	$1,544.93
Truck Driver (light)	Active	1.00	11.4	8	91.20	L	$56.29	incl. in rate	incl. in rate	$5,133.65
Truck, Utility, with Man-Basket	Active	2.00	11.4	8	182.40	E	$31.90	incl. in rate	incl. in rate	$5,818.56
Laborer	Active	2.00	11.4	8	182.40	L	$45.80	incl. in rate	incl. in rate	$8,353.92

Labor Hours	**638.4**	**TOTAL LABOR**	**$30,177.17**
Equipment Hours	**273.6**	**TOTAL EQUIPMENT**	**$7,363.49**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,508.86	$1,508.86

TOTAL MATERIAL	**$1,508.86**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$30,177.17	Labor Burden @	49.7%	$0.00		$30,177.17
Material Cost	$1,508.86	Material Tax @	7.8%	$116.94		$1,625.79
Equipment Cost	$7,363.49	Equipment Tax @	0.0%	$0.00		$7,363.49
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$39,050**			**$117**	**DIRECT COST SUBTOTALS**	**$39,166**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☑	☑	☐	$39,166.45	$5,874.97
Installing Contractors Profit@	8.0%	☑	☑	☐	$39,166.45	$3,133.32
GC Markup on Subs @	5.0%	☐	☐	☑	$0.00	$0.00
					TOTAL MARKUP COSTS	**$9,008.28**
General Contractors Insurance @	1.0%		on		$48,174.73	$482
Bond @	1.0%		on		$48,174.73	$482
Contingency @	0.0%		on		$49,138.23	$0
					TOTAL COST for pay item	**$49,138**

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed from 2 Forman and 4 Electrician, 4 utility truck access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, power plant and switchyard.

PAY ITEM COST DETAIL WORKSHEET

5.017 Disconnect and remove MV Transformers 115 KV @ Substation

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.017			**Project**	: COPCO2			
Description	:	Disconnect and remove MV Transformers 115 KV @ Substation							
Quantity	:	2.00	EA						
Daily Production	:	1.79	EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	1.1	Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$678.35	per EA		**Probable Low Cost Parameter**		**1.969**	**$1,221**	**$610.51**
Total Cost	:	$1,357			**Probable High Cost Parameter**		**1.432**	**$1,628**	**$814.02**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.1	8	8.96	L	$47.23	$0.00		$423.18
Electrician	Active	1.00	1.1	8	8.96	L	$45.23	$0.00		$405.26
Hydraulic Excavator (1.5cy)	Active	1.00	0.2	8	1.20	E	$141.92	$141.92		$170.30
Equipment Operator (light)	Active	0.50	0.2	8	0.60	L	$64.90	$0.00		$38.94

Labor Hours	**18.52**	**TOTAL LABOR**	**$867.38**
Equipment Hours	**1.2**	**TOTAL EQUIPMENT**	**$170.30**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$43.37	$43.37

TOTAL MATERIAL	**$43.37**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$867.38	Labor Burden @	49.7%	$0.00		$867.38
Material Cost	$43.37	Material Tax @	7.8%	$3.36		$46.73
Equipment Cost	$170.30	Equipment Tax @	0.0%	$0.00		$170.30
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,081**			**$3**	**DIRECT COST SUBTOTALS**	**$1,084**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,084.42		$162.66
Installing Contractors Profit@	8.0%				$1,037.69		$83.01
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$245.68**
General Contractors Insurance @	1.0%		on		$1,330.09		$13
Bond @	1.0%		on		$1,330.09		$13
Contingency @	0.0%		on		$1,356.69		$0
						TOTAL COST for pay item	**$1,357**

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician,1 Excavator to load the transformer in the truck for disposal.

PAY ITEM COST DETAIL WORKSHEET

5.018 Disconnect and remove Medium Voltage Circuit Breakers 69KV @ Substation

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.018			**Project**	: COPCO2			
Description	:	Disconnect and remove Medium Voltage Circuit Breakers 69KV @ Substation							
Quantity	:	5.00 EA							
Daily Production	:	2.00 EA per	8	hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	2.5 Days			**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$590.84 per EA			**Probable Low Cost Parameter**		**2.2**	**$2,659**	**$531.76**
Total Cost	:	$2,954			**Probable High Cost Parameter**		**1.6**	**$3,545**	**$709.01**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.5	8	20.00	L	$46.27	$0.00		$925.40
Electrician	Active	1.00	2.5	8	20.00	L	$45.23	$0.00		$904.60
Hydraulic Crane (35tn)	Active	1.00	0.2	8	1.60	E	$116.30	$116.30		$186.08
Equipment Operator (medium)	Active	1.00	0.2	8	1.60	L	$66.28	$0.00		$106.05
Laborer	Active	1.00	0.2	8	1.60	L	$45.80	$0.00		$73.28
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	0.2	8	1.60	E	$31.90	$31.90		$51.04

Labor Hours	**43.2**	**TOTAL LABOR**	**$2,009.33**
Equipment Hours	**3.2**	**TOTAL EQUIPMENT**	**$237.12**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$100.47	$100.47

TOTAL MATERIAL	**$100.47**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,009.33	Labor Burden @	49.7%	$0.00		$2,009.33
Material Cost	$100.47	Material Tax @	7.8%	$7.79		$108.25
Equipment Cost	$237.12	Equipment Tax @	0.0%	$0.00		$237.12
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$2,347**			**$8**	**DIRECT COST SUBTOTALS**	**$2,355**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$2,354.70		$353.21
Installing Contractors Profit@	8.0%				$2,354.70		$188.38
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$541.58**
General Contractors Insurance @	1.0%		on		$2,896.28		$29
Bond @	1.0%		on		$2,896.28		$29
Contingency @	0.0%		on		$2,954.21		$0
						TOTAL COST for pay item	**$2,954**

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician,1Crane. Considered 1 laborer to help loading circuit breakers in the truck for saving it in the designated place.

PAY ITEM COST DETAIL WORKSHEET

5.019 Disconnect and remove MV Transformers 12 KV @ Substation

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.019		**Project**	: COPCO2			
Description	:	Disconnect and remove MV Transformers 12 KV @ Substation						
Quantity	:	1.00 EA						
Daily Production	:	4.00 EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	0.3 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$816.83 per EA		**Probable Low Cost Parameter**		**4.4**	**$735**	**$735.15**
Total Cost	:	$817		**Probable High Cost Parameter**		**3.2**	**$980**	**$980.20**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	0.3	8	2.00	L	$47.23	$0.00		$94.46
Electrician	Active	1.00	0.3	8	2.00	L	$45.23	$0.00		$90.46
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.2	8	1.20	E	$221.50	$221.50		$265.80
Equipment Operator (light)	Active	1.00	0.2	8	1.20	L	$64.90	$0.00		$77.88
Truck Driver (light)	Active	1.00	0.2	8	1.20	L	$56.29	$0.00		$67.55
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	0.2	8	1.20	E	$31.90	$31.90		$38.28

Labor Hours	**6.4**	**TOTAL LABOR**	**$330.35**
Equipment Hours	**2.4**	**TOTAL EQUIPMENT**	**$304.08**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$16.52	$16.52

TOTAL MATERIAL	**$16.52**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$330.35	Labor Burden @	49.7%	$0.00	$330.35
Material Cost	$16.52	Material Tax @	7.8%	$1.28	$17.80
Equipment Cost	$304.08	Equipment Tax @	0.0%	$0.00	$304.08
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$651**			**$1**	**DIRECT COST SUBTOTALS** **$652**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$652.23	$97.83
Installing Contractors Profit@	8.0%				$634.43	$50.75
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$148.59**
General Contractors Insurance @	1.0%	on			$800.81	$8
Bond @	1.0%	on			$800.81	$8
Contingency @	0.0%	on			$816.83	$0
					TOTAL COST for pay item	**$817**

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician,1 Loader to discharge the transformer in the truck for disposal.

PAY ITEM COST DETAIL WORKSHEET

5.020 Disconnect and remove cable connection between Copco#2 sub and HE plant @ Substation

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.020			**Project**	: COPCO2			
Description	:	Disconnect and remove cable connection between Copco#2 sub and HE plant @ Substation							
Quantity	:	0.10	Mile						
Daily Production	:	0.05	Mile per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	2.0	Days		**Estimator**	: Mihaela Tomulescu	**Mile per**	**Total Cost**	**Unit Price Per Mile**
Unit Price	:	$94,661.96	per Mile		**Probable Low Cost Parameter**		**0.055**	**$8,520**	**$85,195.77**
Total Cost	:	$9,466			**Probable High Cost Parameter**		**0.04**	**$11,359**	**$113,594.36**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	2.0	8	16.00	L	$47.23	$0.00		$755.68
Electrician	Active	2.00	2.0	8	32.00	L	$45.23	$0.00		$1,447.36
Truck, Utility, with Man-Basket	Active	1.00	0.2	8	1.20	E	$31.90	$31.90		$38.28
Truck Driver (light)	Active	1.00	0.2	8	1.20	L	$56.29	$0.00		$67.55

Labor Hours	**49.2**	**TOTAL LABOR**	**$2,270.59**
Equipment Hours	**1.2**	**TOTAL EQUIPMENT**	**$38.28**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$113.53	$113.53

TOTAL MATERIAL	**$113.53**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	2.00	days		$3,000.00	$6,000.00

TOTAL SUBCONTRACTS	**$6,000.00**

SUMMARY OF COSTS

Labor Cost	$2,270.59	Labor Burden @	49.7%	$0.00		$2,270.59
Material Cost	$113.53	Material Tax @	7.8%	$8.80		$122.33
Equipment Cost	$38.28	Equipment Tax @	0.0%	$0.00		$38.28
Subcontractors	$6,000.00					$6,000.00
DIRECT COST SUBTOTALS	**$8,422**			**$9**	**DIRECT COST SUBTOTALS**	**$8,431**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$2,431.20		$364.68
Installing Contractors Profit@	8.0%				$2,308.87		$184.71
GC Markup on Subs @	5.0%				$6,000.00		$300.00
						TOTAL MARKUP COSTS	**$849.39**
General Contractors Insurance @	1.0%		on		$9,280.58		$93
Bond @	1.0%		on		$9,280.58		$93
Contingency @	0.0%		on		$9,466.20		$0
						TOTAL COST for pay item	**$9,466**

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician. Equipment": 1 Utility Man-Basket Truck, Trailer with cable pulling rig, for high voltage line work.

PAY ITEM COST DETAIL WORKSHEET

5.021 Remove all associated auxiliary equipment @ Substation (Allowance)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.021		**Project**	: COPCO2			
Description	:	Remove all associated auxiliary equipment @ Substation (Allowance)						
Quantity	:	1.00 LS						
Daily Production	:	1.00 LS per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	2.0 Days		**Estimator**	: Mihaela Tomulescu	**LS per**	**Total Cost**	**Unit Price Per LS**
Unit Price	:	$24,184.84 per LS		**Probable Low Cost Parameter**		**1.1**	**$21,766**	**$21,766.36**
Total Cost	:	$24,185		**Probable High Cost Parameter**		**0.8**	**$29,022**	**$29,021.81**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	2.0	8	16.00	L	$47.23	$0.00		$755.68
Electrician	Active	4.00	2.0	8	64.00	L	$45.23	$0.00		$2,894.72
Truck, Utility, with Man-Basket	Active	1.00	2.0	8	16.00	E	$31.90	$31.90		$510.40
Truck Driver (light)	Active	1.00	2.0	8	16.00	L	$56.29	$0.00		$900.64
Laborer	Active	2.00	2.0	8	32.00	L	$45.80	$0.00		$1,465.60
Hydraulic Excavator (1.5cy)	Active	1.00	2.0	8	16.00	E	$141.92	$141.92		$2,270.72
Hydraulic Crane (17tn)	Active	1.00	2.0	8	16.00	E	$81.52	$81.52		$1,304.32
Equipment Operator (crane)	Active	1.00	2.0	8	16.00	L	$68.41	$0.00		$1,094.56
Equipment Operator (light)	Active	1.00	2.0	8	16.00	L	$64.90	$0.00		$1,038.40
Vibratory Hammer & Extractor	Active	1.00	2.0	8	16.00	E	$94.34	$94.34		$1,509.44

Labor Hours	**160**	**TOTAL LABOR**	**$8,149.60**
Equipment Hours	**64**	**TOTAL EQUIPMENT**	**$5,594.88**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$407.48	$407.48

TOTAL MATERIAL	**$407.48**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	2.00	days		$3,000.00	$6,000.00

TOTAL SUBCONTRACTS	**$6,000.00**

SUMMARY OF COSTS

Labor Cost	$8,149.60	Labor Burden @	49.7%	$0.00		$8,149.60
Material Cost	$407.48	Material Tax @	7.8%	$31.58		$439.06
Equipment Cost	$5,594.88	Equipment Tax @	0.0%	$0.00		$5,594.88
Subcontractors	$6,000.00					$6,000.00
DIRECT COST SUBTOTALS	**$20,152**			**$32**	**DIRECT COST SUBTOTALS**	**$20,184**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$14,183.54		$2,127.53
Installing Contractors Profit@	8.0%				$13,744.48		$1,099.56
GC Markup on Subs @	5.0%				$6,000.00		$300.00
						TOTAL MARKUP COSTS	**$3,527.09**
General Contractors Insurance @	1.0%		on		$23,710.63		$237
Bond @	1.0%		on		$23,710.63		$237
Contingency @	0.0%		on		$24,184.84		$0
						TOTAL COST for pay item	**$24,185**

Additional Pay Item Notes :

When a transmission line is decommissioned and is not converted to another use, the decommissioning typically includes the removal of all infrastructure if it is no longer required, or has reached end-of-life conditions. Removed parts will be re-used, recycled or disposed. Production is based off of RSMs using Crew B-1C and B-3 (1 Forman, 2 laborer, 1 Excavator& 1 crane for lift, position and load in the truck, 1 Hydraulic rock-splitting/rock-drilling equipment to break equipment foundations and concrete) for demo :4 Electrician,, 1 utility truck access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, hydro plant and switchyard. .

PAY ITEM COST DETAIL WORKSHEET — **5.022 Demolish overhead transmission line and structure 69 KV Copco#1 to Iron Gate**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.022		**Project**	: COPCO2			
Description	:	Demolish overhead transmission line and structure 69 KV Copco#1 to Iron Gate						
Quantity	:	5.00 Miles						
Daily Production	:	0.10 Miles per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	50.0 Days		**Estimator**	: Mihaela Tomulescu	**Miles per**	**Total Cost**	**Unit Price Per Miles**
Unit Price	:	$118,983.58 per Miles		**Probable Low Cost Parameter**		**0.11**	**$535,426**	**$107,085.22**
Total Cost	:	$594,918		**Probable High Cost Parameter**		**0.08**	**$713,901**	**$142,780.29**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	50.0	8	400.00	L	$47.23	$0.00		$18,892.00
Electrician	Active	2.00	50.0	8	800.00	L	$45.23	$0.00		$36,184.00
Truck, Utility, with Man-Basket	Active	2.00	50.0	8	800.00	E	$31.90	$31.90		$25,520.00
Truck Driver (heavy)	Active	2.00	50.0	8	800.00	L	$57.59	$0.00		$46,072.00
Laborer	Active	2.00	50.0	8	800.00	L	$45.80	$0.00		$36,640.00
Hydraulic Excavator (1.5cy)	Active	1.00	50.0	8	400.00	E	$141.92	$141.92		$56,768.00
Hydraulic Crane (80tn)	Active	1.00	50.0	8	400.00	E	$190.46	$190.46		$76,184.00
Equipment Operator (crane)	Active	1.00	50.0	8	400.00	L	$68.41	$0.00		$27,364.00
Equipment Operator (light)	Active	1.00	50.0	8	400.00	L	$64.90	$0.00		$25,960.00
Vibratory Hammer & Extractor	Active	1.00	50.0	8	400.00	E	$94.34	$94.34		$37,736.00
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	50.0	8	400.00	E	$31.90	$31.90		$12,760.00

Labor Hours	**3600**	**TOTAL LABOR**	**$191,112.00**
Equipment Hours	**2400**	**TOTAL EQUIPMENT**	**$208,968.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$9,555.60	$9,555.60
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	96.00	CY	1.000	96.00	$4.74	$455.04

TOTAL MATERIAL	**$10,010.64**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	25.00	days		$3,000.00	$75,000.00

TOTAL SUBCONTRACTS	**$75,000.00**

SUMMARY OF COSTS

Labor Cost	$191,112.00	Labor Burden @	49.7%	$0.00		$191,112.00
Material Cost	$10,010.64	Material Tax @	7.8%	$775.82		$10,786.46
Equipment Cost	$208,968.00	Equipment Tax @	0.0%	$0.00		$208,968.00
Subcontractors	$75,000.00					$75,000.00
DIRECT COST SUBTOTALS	**$485,091**			**$776**	**DIRECT COST SUBTOTALS**	**$485,866**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$410,866.46		$61,629.97
Installing Contractors Profit@	8.0%				$400,080.00		$32,006.40
GC Markup on Subs @	5.0%				$75,000.00		$3,750.00
						TOTAL MARKUP COSTS	**$97,386.37**
General Contractors Insurance @	1.0%		on		$583,252.83		$5,833
Bond @	1.0%		on		$583,252.83		$5,833
Contingency @	0.0%		on		$594,917.89		$0
						TOTAL COST for pay item	**$594,918**

Additional Pay Item Notes :

When a transmission line is decommissioned and is not converted to another use, the decommissioning typically includes the removal of all infrastructure if it is no longer required, or has reached end-of-life conditions. Removed parts will be re-used, recycled or disposed. Production is based off of RSMs using Crew B-1C and B-3 (1 Forman, 2 laborer, 1 Excavator & 1 crane for lift, position and load in the truck, 1 Hydraulic rock-splitting/rock-drilling equipment to break equipment foundations and concrete for demo :2 Electrician,, 1 utility truck to access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, hydro plant and switchyard. Transmission line poles or structures are commonly between 60 and 140 feet tall. There are several different kinds of transmission structures. Transmission structures can be constructed of metal or wood. They can be single-poled or multi-poled. They can be single-circuited, carrying one set of transmission lines or double-circuited with two sets of lines. Assumed based on RSMs we have "Communications transmission tower, radio towers self-supporting, wind load 70 mph basic wind speed, 120' high" (33811310). Pole height and load capacity limitations determine the distance between poles (span length) either on the basis of ground clearance or ability to support heavy wind and ice loads. Assumed average span between structures to be 275 feet so for 5 miles of overhead transmission we will have approximately 96 structures. In areas where single-pole structures are preferred, weak or wet soils may require concrete foundations for support. Where a transmission line must cross a street or slightly change direction, larger angle structures or guy wires may be required. Poles with guy wires impact a much larger area. Angle structures are usually more than double the diameter of other steel poles. They are made of steel, usually five to six feet in diameter, and have a large concrete base. The base may be buried ten or more feet below the ground surface. The diameter of the pole and the depth the base is buried depends on the condition of the soils and the voltage of the line. Assumed the structures are disposed to Yreka recycling, 34 miles away. This estimate is made as the best AECOM assumption, as actual pricing would occur during the detailed engineering and construction bid process.

PAY ITEM COST DETAIL WORKSHEET

5.023 Demolish transmission conductor from existing structure pole. Structures remain.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.023			**Project**	: COPCO2			
Description	:	Demolish transmission conductor from existing structure pole. Structures remain.							
Quantity	:	1.50	Miles						
Daily Production	:	0.75	Miles per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	2.0	Days		**Estimator**	: Mihaela Tomulescu	**Miles per**	**Total Cost**	**Unit Price Per Miles**
Unit Price	:	$7,073.23	per Miles		**Probable Low Cost Parameter**		**0.825**	**$9,549**	**$6,365.91**
Total Cost	:	$10,610			**Probable High Cost Parameter**		**0.6**	**$12,732**	**$8,487.88**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	2.0	8	16.00	L	$47.23	$0.00		$755.68
Electrician	Active	2.00	2.0	8	32.00	L	$45.23	$0.00		$1,447.36
Truck, Utility, with Man-Basket	Active	2.00	2.0	8	32.00	E	$31.90	$31.90		$1,020.80

Labor Hours	**48**	**TOTAL LABOR**	**$2,203.04**
Equipment Hours	**32**	**TOTAL EQUIPMENT**	**$1,020.80**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$110.15	$110.15

TOTAL MATERIAL	**$110.15**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	2.00	days		$3,000.00	$6,000.00

TOTAL SUBCONTRACTS	**$6,000.00**

SUMMARY OF COSTS

Labor Cost	$2,203.04	Labor Burden @	49.7%	$0.00		$2,203.04
Material Cost	$110.15	Material Tax @	7.8%	$8.54		$118.69
Equipment Cost	$1,020.80	Equipment Tax @	0.0%	$0.00		$1,020.80
Subcontractors	$6,000.00					$6,000.00
DIRECT COST SUBTOTALS	**$9,334**			**$9**	**DIRECT COST SUBTOTALS**	**$9,343**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$3,342.53		$501.38
Installing Contractors Profit@	8.0%				$3,223.84		$257.91
GC Markup on Subs @	5.0%				$6,000.00		$300.00
						TOTAL MARKUP COSTS	**$1,059.29**
General Contractors Insurance @	1.0%		on		$10,401.82		$104
Bond @	1.0%		on		$10,401.82		$104
Contingency @	0.0%		on		$10,609.85		$0
						TOTAL COST for pay item	**$10,610**

Additional Pay Item Notes :

Production is based off of RSMs using Crew Elec2: 2 Electrician,, 2 utility truck to access poles, string conductor, etc. assumed they need to rent trailer with cable pulling rig, for high voltage line work. Crews may be working simultaneously along the project alignment and substations, hydro plant and switchyard. This estimate is made as the best AECOM assumption, as actual pricing would occur during the detailed engineering and construction bid process.

PAY ITEM COST DETAIL WORKSHEET

5.024 Remove structures between pole 2/007 and Iron Gate

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.024		**Project**	: COPCO2			
Description	:	Remove structures between pole 2/007 and Iron Gate						
Quantity	:	6.00 EA						
Daily Production	:	2.00 EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	3.0 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$3,754.31 per EA		**Probable Low Cost Parameter**		**2.2**	**$20,273**	**$3,378.88**
Total Cost	:	$22,526		**Probable High Cost Parameter**		**1.6**	**$27,031**	**$4,505.17**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	3.0	8	24.00	L	$47.23	$0.00		$1,133.52
Electrician	Active	1.00	3.0	8	24.00	L	$45.23	$0.00		$1,085.52
Truck, Utility, with Man-Basket	Active	1.00	3.0	8	24.00	E	$31.90	$31.90		$765.60
Truck Driver (light)	Active	1.00	3.0	8	24.00	L	$56.29	$0.00		$1,350.96
Laborer	Active	2.00	3.0	8	48.00	L	$45.80	$0.00		$2,198.40
Hydraulic Excavator (1.5cy)	Active	1.00	2.0	8	16.00	E	$141.92	$141.92		$2,270.72
Hydraulic Crane (50tn)	Active	1.00	3.0	8	24.00	E	$134.32	$134.32		$3,223.68
Equipment Operator (crane)	Active	1.00	3.0	8	24.00	L	$68.41	$0.00		$1,641.84
Equipment Operator (light)	Active	1.00	3.0	8	24.00	L	$64.90	$0.00		$1,557.60
Vibratory Hammer & Extractor	Active	1.00	2.0	8	16.00	E	$94.34	$94.34		$1,509.44
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	3.0	8	24.00	E	$31.90	$31.90		$765.60

Labor Hours	**168**	**TOTAL LABOR**	**$8,967.84**
Equipment Hours	**104**	**TOTAL EQUIPMENT**	**$8,535.04**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$448.39	$448.39

TOTAL MATERIAL	**$448.39**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$8,967.84	Labor Burden @	49.7%	$0.00		$8,967.84
Material Cost	$448.39	Material Tax @	7.8%	$34.75		$483.14
Equipment Cost	$8,535.04	Equipment Tax @	0.0%	$0.00		$8,535.04
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$17,951**			**$35**	**DIRECT COST SUBTOTALS**	**$17,986**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$17,986.02	$2,697.90
Installing Contractors Profit@	8.0%				$17,502.88	$1,400.23
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$4,098.13**
General Contractors Insurance @	1.0%	on			$22,084.16	$221
Bond @	1.0%	on			$22,084.16	$221
Contingency @	0.0%	on			$22,525.84	$0
					TOTAL COST for pay item	**$22,526**

Additional Pay Item Notes :

The switchyard site and transmission line rights-of-way will be restored to the natural conditions. Production is based off of RSMs using Crew B-1C and B-3 (1 Forman, 2 laborer, 1 Excavator& 1 crane for lift, position and load in the truck, 1 Hydraulic rock-splitting/rock-drilling equipment to break equipment foundations and concrete for demo :4 Electrician,, 1 utility truck access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment. Assumed the structures are disposed to Yreka recycling, 34 miles away. These are only estimates as actual pricing would occur during the detailed engineering and construction bid process.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.025		**Project**	: IRONGATE			
Description	:	Remove Distribution Poles near Iron Gate Hydro Plant						
Quantity	:	5.00 EA						
Daily Production	:	2.50 EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	2.0 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$1,190.24 per EA		**Probable Low Cost Parameter**		**2.875**	**$5,059**	**$1,012**
Total Cost	:	$5,951		**Probable High Cost Parameter**		**2**	**$7,141**	**$1,428**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	incl. in rate	incl. in rate	$740.32
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Hydraulic Crane (17tn)	Active	1.00	1.0	8	8.00	E	$81.52	incl. in rate	incl. in rate	$652.16
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	incl. in rate	incl. in rate	$255.20
Vibratory Hammer & Extractor	Active	1.00	1.0	8	8.00	E	$94.34	incl. in rate	incl. in rate	$754.72
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Utility, with Man-Basket	Active	1.00	1.0	8	8.00	E	$31.90	incl. in rate	incl. in rate	$255.20

Labor Hours	**56**	**TOTAL LABOR**	**$2,657.52**
Equipment Hours	**32**	**TOTAL EQUIPMENT**	**$1,917.28**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$132.88	$132.88
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	5.00	CY	1.000	5.00	$4.74	$23.70
					TOTAL MATERIAL	**$156.58**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,657.52	Labor Burden @	49.7%	$0.00		$2,657.52
Material Cost	$156.58	Material Tax @	7.8%	$12.13		$168.71
Equipment Cost	$1,917.28	Equipment Tax @	0.0%	$0.00		$1,917.28
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$4,731**			**$12**	**DIRECT COST SUBTOTALS**	**$4,744**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,743.51	$711.53
Installing Contractors Profit@	8.0%				$4,743.51	$379.48
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,091.01**
General Contractors Insurance @	1.0%		on		$5,834.52	$58
Bond @	1.0%		on		$5,834.52	$58
Contingency @	0.0%		on		$5,951.21	$0
					TOTAL COST for pay item	**$5,951**

Additional Pay Item Notes :

Production is based off of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane). Considered 2 laborer and 1 Vibratory Hammer for demolish the pole foundation and helping placing poles in a designated place and loading them in the truck for disposal. This process includes filling in pole locations with gravel, clean fill and topsoil.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.026		**Project**	: IRONGATE			
Description	:	Remove 69kV/6.6kV Transformer @Substation						
Quantity	:	1.00 EA						
Daily Production	:	2.50 EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	0.4 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$2,273.46 per EA		**Probable Low Cost Parameter**		**2.875**	**$1,932**	**$1,932**
Total Cost	:	$2,273		**Probable High Cost Parameter**		**1.875**	**$2,842**	**$2,842**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	0.4	8	3.20	L	$47.23	incl. in rate	incl. in rate	$151.14
Electrician	Active	1.00	0.4	8	3.20	L	$45.23	incl. in rate	incl. in rate	$144.74
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.4	8	3.20	E	$221.50	incl. in rate	incl. in rate	$708.80
Truck Driver (light)	Active	1.00	0.4	8	3.20	L	$56.29	incl. in rate	incl. in rate	$180.13
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.4	8	3.20	E	$111.64	incl. in rate	incl. in rate	$357.25
Equipment Operator (light)	Active	1.00	0.4	8	3.20	L	$64.90	incl. in rate	incl. in rate	$207.68

Labor Hours	**12.8**	**TOTAL LABOR**	**$683.68**
Equipment Hours	**6.4**	**TOTAL EQUIPMENT**	**$1,066.05**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$34.18	$34.18
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	5.00	CY	1.000	5.00	$4.74	$23.70

TOTAL MATERIAL **$57.88**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00

TOTAL SUBCONTRACTS **$0.00**

SUMMARY OF COSTS

Labor Cost	$683.68	Labor Burden @	49.7%	$0.00		$683.68
Material Cost	$57.88	Material Tax @	7.8%	$4.49		$62.37
Equipment Cost	$1,066.05	Equipment Tax @	0.0%	$0.00		$1,066.05
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,808**			**$4**	**DIRECT COST SUBTOTALS**	**$1,812**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,812.10	$271.81
Installing Contractors Profit@	8.0%				$1,812.10	$144.97
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$416.78**
General Contractors Insurance @	1.0%		on		$2,228.88	$22
Bond @	1.0%		on		$2,228.88	$22
Contingency @	0.0%		on		$2,273.46	$0
					TOTAL COST for pay item	**$2,273**

Additional Pay Item Notes :

Production is based off of RSMs using Crew Elec2 : 1 El. Forman and 1 Electrician,1 Loader and 1 truck for disposal.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.027			**Project**	: IRONGATE			
Description	:	Remove 6.6kV Power Circuit Breaker @Substation							
Quantity	:	1.00	EA						
Daily Production	:	1.00	EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	1.0	Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$1,524.31	per EA		**Probable Low Cost Parameter**		**1.15**	**$1,296**	**$1,296**
Total Cost	:	$1,524			**Probable High Cost Parameter**		**0.75**	**$1,905**	**$1,905**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.0	8	8.00	L	$47.23	incl. in rate	incl. in rate	$377.84
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Loader, FE Rubber Tire (3.5cy)	Active	1.00	0.2	8	1.60	E	$64.23	incl. in rate	incl. in rate	$102.77
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.2	8	1.60	E	$111.64	incl. in rate	incl. in rate	$178.62
Truck Driver (light)	Active	1.00	0.2	8	1.60	L	$56.29	incl. in rate	incl. in rate	$90.06
Equipment Operator (light)	Active	1.00	0.2	8	1.60	L	$64.90	incl. in rate	incl. in rate	$103.84

Labor Hours	**19.2**	**TOTAL LABOR**	**$933.58**
Equipment Hours	**3.2**	**TOTAL EQUIPMENT**	**$281.39**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$933.58	Labor Burden @	49.7%	$0.00		$933.58
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$281.39	Equipment Tax @	0.0%	$0.00		$281.39
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,215**			**$0**	**DIRECT COST SUBTOTALS**	**$1,215**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,214.98		$182.25
Installing Contractors Profit@	8.0%				$1,214.98		$97.20
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$279.44**
General Contractors Insurance @	1.0%		on		$1,494.42		$15
Bond @	1.0%		on		$1,494.42		$15
Contingency @	0.0%		on		$1,524.31		$0
						TOTAL COST for pay item	**$1,524**

Additional Pay Item Notes :

Production is based off of RSMs using Crew Elec2 : 1 El. Forman and 1 Electrician,1 Loader and 1 truck for disposal.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.028			**Project**	: IRONGATE			
Description	:	Remove Generator @Substation							
Quantity	:	1.00	EA						
Daily Production	:	0.25	EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	4.0	Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$4,767.78	per EA		**Probable Low Cost Parameter**		**0.2875**	**$4,053**	**$4,053**
Total Cost	:	$4,768			**Probable High Cost Parameter**		**0.1875**	**$5,960**	**$5,960**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	4.0	8	32.00	L	$47.23	incl. in rate	incl. in rate	$1,511.36
Electrician	Active	1.00	4.0	8	32.00	L	$45.23	incl. in rate	incl. in rate	$1,447.36
Hydraulic Crane (17tn)	Active	1.00	0.2	8	1.60	E	$81.52	incl. in rate	incl. in rate	$130.43
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.2	8	1.60	E	$111.64	incl. in rate	incl. in rate	$178.62
Truck Driver (light)	Active	1.00	0.2	8	1.60	L	$56.29	incl. in rate	incl. in rate	$90.06
Equipment Operator (crane)	Active	1.00	0.2	8	1.60	L	$68.41	incl. in rate	incl. in rate	$109.46
	Active	1.00	0.2	8	1.60	E	$208.09	incl. in rate	incl. in rate	$332.94

Labor Hours	**67.2**	**TOTAL LABOR**	**$3,158.24**
Equipment Hours	**4.8**	**TOTAL EQUIPMENT**	**$642.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$3,158.24	Labor Burden @	49.7%	$0.00		$3,158.24
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$642.00	Equipment Tax @	0.0%	$0.00		$642.00
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$3,800**			**$0**	**DIRECT COST SUBTOTALS**	**$3,800**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$3,800.24		$570.04
Installing Contractors Profit@	8.0%				$3,800.24		$304.02
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$874.06**
General Contractors Insurance @	1.0%		on		$4,674.30		$47
Bond @	1.0%		on		$4,674.30		$47
Contingency @	0.0%		on		$4,767.78		$0
						TOTAL COST for pay item	**$4,768**

Additional Pay Item Notes :

Production is based off of RSMs using Crew Elec2 : 1 El. Forman and 1 Electrician,1 Crane , 1 Laborer and 1 truck for disposal.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.029			Project	: IRONGATE			
Description	:	Remove all auxiliary equipment @Substation (Allowance)							
Quantity	:	1.00	LS						
Daily Production	:	0.25	LS per	8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	3.0	Days		Estimator	: Mihaela Tomulescu	LS per	Total Cost	Unit Price Per LS
Unit Price	:	$26,865.48	per LS		Probable Low Cost Parameter		0.2875	$22,836	$22,836
Total Cost	:	$26,865			Probable High Cost Parameter		0.1875	$33,582	$33,582

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	3.0	8	24.00	L	$47.23	incl. in rate	incl. in rate	$1,133.52
Electrician	Active	2.00	3.0	8	48.00	L	$45.23	incl. in rate	incl. in rate	$2,171.04
Hydraulic Crane (17tn)	Active	1.00	0.2	8	1.60	E	$81.52	incl. in rate	incl. in rate	$130.43
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	0.2	8	3.20	E	$111.64	incl. in rate	incl. in rate	$357.25
Truck Driver (light)	Active	2.00	0.2	8	3.20	L	$56.29	incl. in rate	incl. in rate	$180.13
Equipment Operator (crane)	Active	1.00	0.2	8	1.60	L	$68.41	incl. in rate	incl. in rate	$109.46
Laborer	Active	2.00	4.0	8	64.00	L	$45.80	incl. in rate	incl. in rate	$2,931.20
Hydraulic Excavator (2.5cy)	Active	1.00	4.0	8	32.00	E	$203.63	incl. in rate	incl. in rate	$6,516.16
Truck, Utility, with Man-Basket	Active	1.00	2.0	8	16.00	E	$31.90	incl. in rate	incl. in rate	$510.40
Vibratory Hammer & Extractor	Active	1.00	0.2	8	1.60	E	$94.34	incl. in rate	incl. in rate	$150.94
Equipment Operator (light)	Active	1.00	4.0	8	32.00	L	$64.90	incl. in rate	incl. in rate	$2,076.80
Grader. 180hp, 13' blade	Active	1.00	4.0	8	32.00	E	$80.79	incl. in rate	incl. in rate	$2,585.28

Labor Hours	172.8	TOTAL LABOR	$8,602.14
Equipment Hours	86.4	TOTAL EQUIPMENT	$10,250.46

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Soils for earthwork, common borrow, spread with 200 H.P. dozer, includes load at pit and haul, 2 miles round trip, excludes compaction		CY	1.000	0.00	$21.00	$0.00

TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	1.00	days		$3,000.00	$3,000.00

TOTAL SUBCONTRACTS	$3,000.00

SUMMARY OF COSTS

Labor Cost	$8,602.14	Labor Burden @	49.7%	$0.00	$8,602.14
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$10,250.46	Equipment Tax @	0.0%	$0.00	$10,250.46
Subcontractors	$3,000.00				$3,000.00
DIRECT COST SUBTOTALS	$21,853			$0	DIRECT COST SUBTOTALS $21,853

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$18,852.61	$2,827.89
Installing Contractors Profit@	8.0%				$18,852.61	$1,508.21
GC Markup on Subs @	5.0%				$3,000.00	$150.00
					TOTAL MARKUP COSTS	$4,486.10
General Contractors Insurance @	1.0%		on		$26,338.71	$263
Bond @	1.0%		on		$26,338.71	$263
Contingency @	0.0%		on		$26,865.48	$0
					TOTAL COST for pay item	$26,865

Additional Pay Item Notes :

Assumed 3 days of work to clean and the substation rights-of-way to be restored to the natural conditions. Production is based off of RSMs using Crew formed of 1 Forman, 4 Electrician, 2 laborer, 1 Excavator & 1 crane for lift, position and load in the truck,, 1 Hydraulic rock-splitting/rock-drilling equipment to break equipment foundations, 1 utility truck access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, hydro plant and switchyard.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.030		**Project**	:	IRONGATE			
Description	:	New Connection @Iron Gate Hatchery from PacifiCorp's Hornbrook Substation (Allowance)							
Quantity	:	1.00 LS							
Daily Production	:	1.00 LS per	8 hour shift	**Project #**	:	Klamath Dams Removal			
Work Days	:	10.0 Days		**Estimator**	:	Mihaela Tomulescu	**LS per**	**Total Cost**	**Unit Price Per LS**
Unit Price	:	$298,809.00 per LS		**Probable Low Cost Parameter**			**1.1**	**$268,928**	**$268,928**
Total Cost	:	$298,809		**Probable High Cost Parameter**			**0.9**	**$328,690**	**$328,690**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost

PAY ITEM COST DETAIL WORKSHEET — **5.032 Install 230kV strain transmission structures outside JC Boyle Substation**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.032		**Project**	: JC BOYLE			
Description	:	Install 230kV strain transmission structures outside JC Boyle Substation						
Quantity	:	2.00 EA						
Daily Production	:	0.10 EA per	8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	20.0 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$132,241.37 per EA		**Probable Low Cost Parameter**		**0.11**	**$238,034**	**$119,017.23**
Total Cost	:	$264,483		**Probable High Cost Parameter**		**0.08**	**$317,379**	**$158,689.64**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	20.0	8	160.00	L	$46.27	incl. in rate	incl. in rate	$7,403.20
Electrician	Active	2.00	20.0	8	320.00	L	$45.23	incl. in rate	incl. in rate	$14,473.60
Hydraulic Crane (35tn)	Active	2.00	20.0	8	320.00	E	$116.30	incl. in rate	incl. in rate	$37,216.00
Equipment Operator (crane)	Active	2.00	20.0	8	320.00	L	$68.41	incl. in rate	incl. in rate	$21,891.20
Truck Driver (heavy)	Active	1.00	20.0	8	160.00	L	$57.59	incl. in rate	incl. in rate	$9,214.40
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	20.0	8	160.00	E	$31.90	incl. in rate	incl. in rate	$5,104.00
Steelworker	Active	2.00	20.0	8	320.00	L	$65.52	incl. in rate	incl. in rate	$20,966.40
Truck, Utility, with Man-Basket	Active	1.00	20.0	8	160.00	E	$31.90	incl. in rate	incl. in rate	$5,104.00
Truck, Pickup (4x4, 3/4tn)	Active	1.00	20.0	8	160.00	E	$16.94	incl. in rate	incl. in rate	$2,710.40
Grader. 180hp, 13' blade	Active	1.00	1.0	8	8.00	E	$80.79	incl. in rate	incl. in rate	$646.32
Leverman	Active	1.00	1.0	8	8.00	L	$70.34	incl. in rate	incl. in rate	$562.72
Hydraulic Excavator (2.5cy)	Active	1.00	1.0	8	8.00	E	$203.63	incl. in rate	incl. in rate	$1,629.04
Loader, FE Rubber Tire (3.5cy)	Active	1.00	2.0	8	16.00	E	$64.23	incl. in rate	incl. in rate	$1,027.68

Labor Hours	**1288**	**TOTAL LABOR**	**$74,511.52**
Equipment Hours	**832**	**TOTAL EQUIPMENT**	**$53,437.44**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$3,725.58	$3,725.58
Steel Tower - Large Angle	2.00	EA	1.000	2.00	$25,500.00	$51,000.00
Foundation	48.00	CY	1.000	48.00	$155.00	$7,440.00
Piles	8.00	EA	1.000	8.00	$1,200.00	$9,600.00
Ceramic Insulators	192.00	Bells	1.000	192.00	$18.00	$3,456.00
V-String Hardware	6.00	EA	1.000	6.00	$230.00	$1,380.00
Grounding	2.00	EA	1.000	2.00	$150.00	$300.00
					TOTAL MATERIAL	**$76,901.58**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$74,511.52	Labor Burden @	49.7%	$0.00		$74,511.52
Material Cost	$76,901.58	Material Tax @	7.8%	$5,959.87		$82,861.45
Equipment Cost	$53,437.44	Equipment Tax @	0.0%	$0.00		$53,437.44
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$204,851**			**$5,960**	**DIRECT COST SUBTOTALS**	**$210,810**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$210,810.41	$31,621.56
Installing Contractors Profit@	8.0%				$210,810.41	$16,864.83
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$48,486.39**
General Contractors Insurance @	1.0%		on		$259,296.80	$2,593
Bond @	1.0%		on		$259,296.80	$2,593
Contin	0.0%		on		$264,482.74	$0
					TOTAL COST for pa	**$264,483**

Additional Pay Item Notes :

Engineering and construction costs only. Environmental, Permitting, and Right of way Acquisition costs are not included. The following is a summary of anticipated equipment to be used for each construction activity. Survey work only requires the use of pickup trucks or ATVs. To dig holes and install the directly embedded structures or install 230-kV foundations it is anticipated that pickup trucks, 2-ton trucks, hole diggers, bulldozers, concrete trucks, carry alls, cranes, hydro crane, wagon drill, dump trucks, and front-end loaders will be used. Hauling lattice steel members, tubular poles, braces and hardware to the structure sites will require the use of steel haul trucks; carry all's, cranes, and forklifts. For assembly and erection of structures it is anticipated that pickup trucks, 2-ton trucks, carry all's, cranes, and a heavy lift helicopter may be used, not included here. Final cleanup, reclamation, and restoration will utilize pickups, 2-ton trucks, bulldozers, motor graders, dump trucks, front-end loaders.. The contractor will mobilize equipment and personnel to the construction site at various stages in the Project schedule depending on operational requirements. Assumed 230KV Single Circuit Tower. Estimate includes just towers and not included the transmission line to tie existing 230kV transmission line north and south of JC Boyle Substation together. The estimated costs can vary due to fluctuations in steel pricing, subsurface conditions, contractor availability and the time of year. Taking into account these fluctuations, the estimates are subject to a contingency of 20%. These are only estimates as actual pricing would occur during the detailed engineering and construction bid process.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	6.001		**Project**	: Yreka Waterline			
Description	:	Yreka Waterline Replacement (Microtunneling)						
Quantity	:	612.00	LF					
Daily Production	:	20.00	LF per 8 hour shift	**Project #**	: 6			
Work Days	:	30.6	Days	**Estimator**	: Eric Jones	**LF per**	**Total Cost**	**Unit Price Per LF**
Unit Price	:	$1,558.34	per LF	**Probable Low Cost Parameter**		**24**	**$762,961**	**$1,324.59**
Total Cost	:	$953,701		**Probable High Cost Parameter**		**12**	**$1,335,182**	**$2,025.84**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	30.6	8	244.80	L	$46.27	incl. in rate	incl. in rate	$11,326.90
Laborer	Active	2.00	30.6	8	489.60	L	$45.80	incl. in rate	incl. in rate	$22,423.68
Truck, Pickup (4x4, 3/4tn)	Active	1.00	30.6	8	244.80	E	$16.94	incl. in rate	incl. in rate	$4,146.91
		0.00	30.6	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.6	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.6	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.6	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.6	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.6	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		0.00	30.6	8	0.00	0	$0.00	$0.00		$0.00
		0.00	30.6	8	0.00	0	$0.00	$0.00		$0.00
			30.6	8	0.00	E	$250.00	incl. in rate	incl. in rate	$0.00
			30.6	8	0.00					$0.00
			30.6	8	0.00					$0.00
			30.6	8	0.00					$0.00
			30.6	8	0.00					$0.00
				Labor Hours	**734.4**			**TOTAL LABOR**		**$33,750.58**
				Equipment Hours	**244.8**			**TOTAL EQUIPMENT**		**$4,146.91**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price		Material Cost
							$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ls	1.000	0.00	$8,000.00		$0.00
						TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Microtunneling 36" ID Casing	1	LS	**RSM Data Base**	$730,454.00	$730,454.00
Mobilization/ Demobilization	1	LS	**RSM Data Base**	$115,252.72	$115,252.72
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$845,706.72**

SUMMARY OF COSTS

Labor Cost	$33,750.58	Labor Burden @	0.0%			$33,750.58
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$4,146.91	Equipment Tax @	7.75%	$321.39		$4,468.30
Subcontractors	$845,706.72					$845,706.72
DIRECT COST SUBTOTALS	**$883,604**			**$321**	**DIRECT COST SUBTOTALS**	**$883,926**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$38,218.87		$5,732.83
Installing Contractors Profit@	8.0%				$38,218.87		$3,057.51
GC Markup on Subs @	5.0%				$845,706.72		$42,285.34
						TOTAL MARKUP COSTS	**$51,075.68**
General Contractors Insurance @	1.0%		on		$935,001.27		$9,350
Bond @	1.0%		on		$935,001.27		$9,350
Contingency @	0.0%		on		$953,701.30		$0
						TOTAL COST for pay item	**$953,701**

Additional Pay Item Notes :

Mircrotunneling will be completed by subcontractor, Operation cost will be $535,500.00 Operating technician will be onsite for 30days to support operation $18,900.00, and Material cost for 36" permanenet casing will be $176,054.00. This does not includded pit construction. Crew listed above is to support subbcontractor needs.

PAY ITEM COST DETAIL WORKSHEET — **6.002 Yreka Waterline Replacement (Pile and Lagging Pre Drilling)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	6.002	**Project**	:	Yreka Waterline			
Description	:	Yreka Waterline Replacement (Pile and Lagging Pre Drilling)						
Quantity	:	458.00 LF						
Daily Production	:	45.80 LF per 8 hour shift	**Project #**	:	6			
Work Days	:	10.0 Days	**Estimator**	:	Eric Jones	**LF per**	**Total Cost**	**Unit Price Per LF**
Unit Price	:	$150.68 per LF	**Probable Low Cost Parameter**			**54.96**	**$55,208**	**$128.07**
Total Cost	:	$69,010	**Probable High Cost Parameter**			**27.48**	**$96,613**	**$195.88**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	10.0	8	80.00	L	$46.27	incl. in rate	incl. in rate	$3,701.60
Laborer	Active	3.00	10.0	8	240.00	L	$45.80	incl. in rate	incl. in rate	$10,992.00
Equipment Operator (crane)	Active	1.00	10.0	8	80.00	L	$68.41	incl. in rate	incl. in rate	$5,472.80
Equipment Operator (oiler)	Active	1.00	10.0	8	80.00	L	$62.94	incl. in rate	incl. in rate	$5,035.20
0			10.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	10.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	10.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	10.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	10.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	10.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		0.00	10.0	8	0.00	0	$0.00	$0.00		$0.00
		0.00	10.0	8	0.00	0	$0.00	$0.00		$0.00
Drillrig Truck mounted	Active	1.00	10.0	8	80.00	E	$345.75	incl. in rate	incl. in rate	$27,660.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
				Labor Hours	**480**			**TOTAL LABOR**		**$25,201.60**
				Equipment Hours	**80**			**TOTAL EQUIPMENT**		**$27,660.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		SF	1.000	0.00	$38.80	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$25,201.60	Labor Burden @	0.0%			$25,201.60
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$27,660.00	Equipment Tax @	7.75%	$2,143.65		$29,803.65
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$52,862**			**$2,144**	**DIRECT COST SUBTOTALS**	**$55,005**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$55,005.25	$8,250.79
Installing Contractors Profit@	8.0%				$55,005.25	$4,400.42
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$12,651.21**
General Contractors Insurance @	1.0%		on		$67,656.46	$677
Bond @	1.0%		on		$67,656.46	$677
Contingency @	0.0%		on		$69,009.59	$0
					TOTAL COST for pay item	**$69,010**

Additional Pay Item Notes :

Crew is based off of B43 for the predrilling of the H pile for the pile and lagging wall. Prodcution is expecting crew to take a week per side to predrill holes due to the material hardness.

PAY ITEM COST DETAIL WORKSHEET — **6.003 Yreka Waterline Replacement (Pile and Lagging Wall Installation)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	6.003	**Project**	:	Yreka Waterline			
Description	:	Yreka Waterline Replacement (Pile and Lagging Wall Installation)						
Quantity	:	13,715.00 SF						
Daily Production	:	457.17 SF per 8 hour shift	**Project #**	:	6			
Work Days	:	30.0 Days	**Estimator**	:	Eric Jones	**SF per**	**Total Cost**	**Unit Price Per SF**
Unit Price	:	$73.01 per SF	**Probable Low Cost Parameter**			**548.604**	**$801,038**	**$62.06**
Total Cost	:	$1,001,297	**Probable High Cost Parameter**			**274.302**	**$1,401,816**	**$94.91**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Equipment Operator (crane)	Active	2.00	30.0	8	480.00	L	$68.41	incl. in rate	incl. in rate	$32,836.80
Equipment Operator (oiler)	Active	1.00	30.0	8	240.00	L	$62.94	incl. in rate	incl. in rate	$15,105.60
Laborer	Active	3.00	30.0	8	720.00	L	$45.80	incl. in rate	incl. in rate	$32,976.00
Crawler Crane (90tn)	Active	1.00	30.0	8	240.00	E	$208.09	incl. in rate	incl. in rate	$49,941.60
Air Compressor 600 cfm	Active	1.00	30.0	8	240.00	E	$21.74	incl. in rate	incl. in rate	$5,217.34
0		0.00	30.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		0.00	30.0	8	0.00	0	$0.00	$0.00		$0.00
		0.00	30.0	8	0.00	0	$0.00	$0.00		$0.00
Pile Driver	Active	4.00	30.0	8	960.00	L	$49.50	incl. in rate	incl. in rate	$47,520.00
Pile Driver Foreman	Active	1.00	30.0	8	240.00	L	$51.50	incl. in rate	incl. in rate	$12,360.00
Lead 60' High	Active	1.00	30.0	8	240.00	E	$9.50	incl. in rate	incl. in rate	$2,280.00
Hammer Diesel 15K ft-lbs	Active	1.00	30.0	8	240.00	E	$75.72	incl. in rate	incl. in rate	$18,172.80
50' Air Hoses 3"	Active	2.00	30.0	8	480.00	E	$1.86	incl. in rate	incl. in rate	$892.80
Chainsaw Gas, 36"	Active	1.00	30.0	8	240.00	E	$5.63			$1,351.20
					Labor Hours	**2640**			**TOTAL LABOR**	**$140,798.40**
					Equipment Hours	**1680**			**TOTAL EQUIPMENT**	**$77,855.74**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
Pile and Lagging	13,715.00	SF	1.000	13,715.00	$38.80	$532,169.43
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$532,169.43**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$140,798.40	Labor Burden @	0.0%			$140,798.40
Material Cost	$532,169.43	Material Tax @	7.75%	$41,243.13		$573,412.56
Equipment Cost	$77,855.74	Equipment Tax @	7.75%	$6,033.82		$83,889.56
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$750,824**			**$47,277**	**DIRECT COST SUBTOTALS**	**$798,101**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$798,100.52		$119,715.08
Installing Contractors Profit@	8.0%				$798,100.52		$63,848.04
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$183,563.12**
General Contractors Insurance @	1.0%	on			$981,663.64		$9,817
Bond @	1.0%	on			$981,663.64		$9,817
Contingency @	0.0%	on			$1,001,296.91		$0
						TOTAL COST for pay item	**$1,001,297**

Additional Pay Item Notes :

Adjusted RSM Crew B50 to account for tight work area. Equipment matches Crew B50 from RSM. Figure it will take 3 weeks per side to install wall there will be some equipment downtime due to having to do the pile and lagging wall being built from top down.

PAY ITEM COST DETAIL WORKSHEET — **6.004 Yreka Waterline Replacement (Pipe Installation)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	6.004	**Project**	:	Yreka Waterline			
Description	:	Yreka Waterline Replacement (Pipe Installation)						
Quantity	:	2,106.00 LF						
Daily Production	:	70.00 LF per 8 hour shift	**Project #**	:	6			
Work Days	:	30.1 Days	**Estimator**	:	Eric Jones	**LF per**	**Total Cost**	**Unit Price Per LF**
Unit Price	:	$133.76 per LF	**Probable Low Cost Parameter**			**84**	**$225,358**	**$113.70**
Total Cost	:	$281,698	**Probable High Cost Parameter**			**42**	**$394,377**	**$173.89**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	30.1	8	240.80	L	$46.27	incl. in rate	incl. in rate	$11,141.82
Laborer	Active	1.00	30.1	8	240.80	L	$45.80	incl. in rate	incl. in rate	$11,028.64
Equipment Operator (crane)	Active	1.00	30.1	8	240.80	L	$68.41	incl. in rate	incl. in rate	$16,473.13
Hydraulic Crane (17tn)	Active	1.00	30.1	8	240.80	E	$81.52	incl. in rate	incl. in rate	$19,630.02
Welder, Portable	Active	1.00	30.1	8	240.80	E	$7.84	incl. in rate	incl. in rate	$1,887.27
Steelworker		0.00	30.1	8	0.00	L	$65.52	incl. in rate	incl. in rate	$0.00
0		0.00	30.1	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.1	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.1	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.1	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		0.00	30.1	8	0.00	0	$0.00	$0.00		$0.00
		0.00	30.1	8	0.00	0	$0.00	$0.00		$0.00
Plumber	Active	1.00	30.1	8	240.80	L	$61.80	incl. in rate	incl. in rate	$14,881.44
Plumber Apprentice	Active	1.00	30.1	8	240.80	L	$49.45	incl. in rate	incl. in rate	$11,907.56
	Active	0.00	30.1	8	0.00	E	$9.50	incl. in rate	incl. in rate	$0.00
	Active	0.00	30.1	8	0.00	E	$75.72	incl. in rate	incl. in rate	$0.00
	Active	0.00	30.1	8	0.00	E	$1.86	incl. in rate	incl. in rate	$0.00
	Active	0.00	30.1	8	0.00	E	$5.63			$0.00
				Labor Hours	**1204**			**TOTAL LABOR**		**$65,432.58**
				Equipment Hours	**481.6**			**TOTAL EQUIPMENT**		**$21,517.29**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
Pipe Material	1,053.00	LF	1.000	1,053.00	$119.79	$126,138.87
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$50.00	$0.00
					TOTAL MATERIAL	**$126,138.87**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$65,432.58	Labor Burden @	0.0%			$65,432.58
Material Cost	$126,138.87	Material Tax @	7.75%	$9,775.76		$135,914.63
Equipment Cost	$21,517.29	Equipment Tax @	7.75%	$1,667.59		$23,184.88
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$213,089**			**$11,443**	**DIRECT COST SUBTOTALS**	**$224,532**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$224,532.09	$33,679.81
Installing Contractors Profit@	8.0%				$224,532.09	$17,962.57
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$51,642.38**
General Contractors Insurance @	1.0%	on			$276,174.47	$2,762
Bond @	1.0%	on			$276,174.47	$2,762
Contingency @	0.0%	on			$281,697.96	$0
					TOTAL COST for pay item	**$281,698**

Additional Pay Item Notes :

Figuring it will take 1 month to install pipe complete including welding joints.

PAY ITEM COST DETAIL WORKSHEET — **6.005 Yreka Waterline Replacement (Excavation and Backfill)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	6.005	**Project**	: Yreka Waterline			
Description	:	Yreka Waterline Replacement (Excavation and Backfill)					
Quantity	:	3,653.00 CY					
Daily Production	:	91.00 CY per 8 hour shift	**Project #**	: 6			
Work Days	:	40.1 Days	**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$88.45 per CY	**Probable Low Cost Parameter**		**109.2**	**$258,477**	**$75.18**
Total Cost	:	$323,097	**Probable High Cost Parameter**		**54.6**	**$452,335**	**$114.98**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Equipment Operator (crane)	Active	1.00	***30.1***	8	240.60	L	$68.41	incl. in rate	incl. in rate	$16,459.45
Equipment Operator (oiler)	Active	1.00	***30.1***	8	240.60	L	$62.94	incl. in rate	incl. in rate	$15,143.36
Laborer	Active	5.00	40.1	8	1,604.00	L	$45.80	incl. in rate	incl. in rate	$73,463.20
Equipment Operator (medium)	Active	2.00	40.1	8	641.60	L	$66.28	incl. in rate	incl. in rate	$42,525.25
Labor Foreman (out)	Active	1.00	40.1	8	320.80	L	$46.27	incl. in rate	incl. in rate	$14,843.42
Crawler Crane (90tn)	Active	1.00	***30.1***	8	240.60	E	$208.09	incl. in rate	incl. in rate	$50,066.45
Dozer (235hp)(CATD7)	Active	1.00	***20.1***	8	160.40	E	$165.11	incl. in rate	incl. in rate	$26,483.64
Roller, Dbl Drum (steel wheel, 5.0 - 7.9 MTn)	Active	1.00	***20.1***	8	160.40	E	$64.77	incl. in rate	incl. in rate	$10,389.11
Gas Engine Tamp	Active	1.00	40.1	8	320.80	E	$4.10	incl. in rate	incl. in rate	$1,316.01
0		0.00	40.1	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		0.00	40.1	8	0.00	0	$0.00	$0.00		$0.00
		0.00	40.1	8	0.00	0	$0.00	$0.00		$0.00
	Active	0.00	40.1	8	0.00	L	$49.50	incl. in rate	incl. in rate	$0.00
	Active	0.00	40.1	8	0.00	L	$51.50	incl. in rate	incl. in rate	$0.00
	Active	0.00	40.1	8	0.00	E	$9.50	incl. in rate	incl. in rate	$0.00
	Active	0.00	40.1	8	0.00	E	$75.72	incl. in rate	incl. in rate	$0.00
	Active	0.00	40.1	8	0.00	E	$1.86	incl. in rate	incl. in rate	$0.00
	Active	0.00	40.1	8	0.00	E	$5.63			$0.00
				Labor Hours	**3047.6**				**TOTAL LABOR**	**$162,434.67**
				Equipment Hours	**882.2**				**TOTAL EQUIPMENT**	**$88,255.22**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price		Material Cost
							$0.00
		SF	1.000	0.00	$38.80		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ls	1.000	0.00	$8,000.00		$0.00
						TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$162,434.67	Labor Burden @	0.0%			$162,434.67
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$88,255.22	Equipment Tax @	7.75%	$6,839.78		$95,094.99
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$250,690**			**$6,840**	**DIRECT COST SUBTOTALS**	**$257,530**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$257,529.67		$38,629.45
Installing Contractors Profit@	8.0%				$257,529.67		$20,602.37
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$59,231.82**
General Contractors Insurance @	1.0%		on		$316,761.49		$3,168
Bond @	1.0%		on		$316,761.49		$3,168
Contingency @	0.0%		on		$323,096.72		$0
						TOTAL COST for pay item	**$323,097**

Additional Pay Item Notes :

Figuring material will be piled near excavation due to material needing me reused for backfilling pits and new watermain. Figuring crane will be used 3/4 of the time to backfill pits. Figured dozer and roller will be used 1/2 of the time to backfill open excavation area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	10.01		Project	: Flood Mitigation			
Description	:	Raising of Existing Residential/ Commericial Structures						
Quantity	:	45.00 EA						
Daily Production	:	0.20 EA per	8 hour shift	Project #	: 6			
Work Days	:	225.0 Days		Estimator	: Eric Jones	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$30,187.71 per EA		Probable Low Cost Parameter		0.24	$1,086,758	$24,150.17
Total Cost	:	$1,358,447		Probable High Cost Parameter		0.14	$1,765,981	$36,225.25

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	225.0	8	1,800.00	L	$46.27	incl. in rate	incl. in rate	$83,286.00
Laborer	Active	2.00	225.0	8	3,600.00	L	$45.80	incl. in rate	incl. in rate	$164,880.00
Truck, Pickup (4x4, 3/4tn)	Active	1.00	225.0	8	1,800.00	E	$16.94	incl. in rate	incl. in rate	$30,492.00
		0.00	225.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	225.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	225.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	225.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	225.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	225.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	225.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		0.00	225.0	8	0.00	0	$0.00	$0.00		$0.00
		0.00	225.0	8	0.00	0	$0.00	$0.00		$0.00
			225.0	8	0.00	E	$250.00	incl. in rate	incl. in rate	$0.00
			225.0	8	0.00					$0.00
			225.0	8	0.00					$0.00
			225.0	8	0.00					$0.00
			225.0	8	0.00					$0.00
				Labor Hours	5400			TOTAL LABOR		$248,166.00
				Equipment Hours	1800			TOTAL EQUIPMENT		$30,492.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price		Material Cost
							$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ea	1.000	0.00	$50.00		$0.00
		ls	1.000	0.00	$8,000.00		$0.00
						TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Cost to Raise Homes	45	EA	California Highend to Raise Home	$18,473.00	$831,285.00
Set of stairs per house	90	EA	RSM Data Base	$1,199.00	$107,910.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$939,195.00

SUMMARY OF COSTS

Labor Cost	$248,166.00	Labor Burden @	0.0%				$248,166.00
Material Cost	$0.00	Material Tax @	7.75%	$0.00			$0.00
Equipment Cost	$30,492.00	Equipment Tax @	7.75%	$2,363.13			$32,855.13
Subcontractors	$939,195.00						$939,195.00
DIRECT COST SUBTOTALS	$1,217,853			$2,363		DIRECT COST SUBTOTALS	$1,220,216

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$281,021.13		$42,153.17
Installing Contractors Profit@	8.0%				$281,021.13		$22,481.69
GC Markup on Subs @	5.0%				$939,195.00		$46,959.75
						TOTAL MARKUP COSTS	$111,594.61
General Contractors Insurance @	1.0%		on		$1,331,810.74		$13,318
Bond @	1.0%		on		$1,331,810.74		$13,318
Contingency @	0.0%		on		$1,358,446.95		$0
						TOTAL COST for pay item	$1,358,447

Additional Pay Item Notes :

Figuring that it will take 5 days to raise each house. The cost listed is the average cost for raising a building in California. Foreman and laborer are supporting subcontractor. Stair cost is total cost from RSM Data base.

KLAMATH RIVER RENEWAL CORPORATION

Attachment C Risk Distribution Model Inputs

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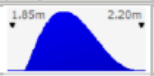
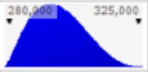
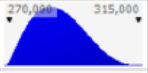
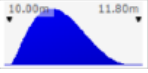
Risk Distribution Model Inputs

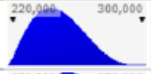
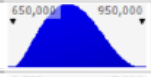
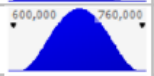
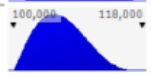
ENGINEERING & CONSTRUCTION MANAGEMENT

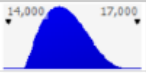
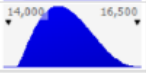
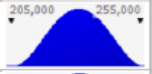
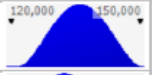
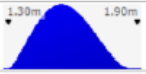
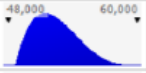
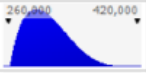
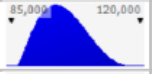
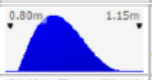
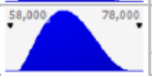
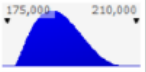
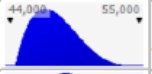
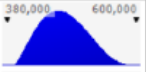
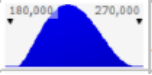
Name	Cell	Graph	Function	Min	Mean	Max
31ProjectDetail attached	U95		RiskPert(S95,R95,T95,RiskName(B95&C95&H95))	1892400	2008600	$2,191,200.00
32ProjectDetail attached	U98		RiskPert(S98,R98,T98,RiskName(B98&C98&H98))	280250	297458.3	$324,500.00
32Project	U99		RiskPert(S99,R99,T99,RiskName(B99&C99&H99))	3405750	3614875	$3,943,500.00
32Project	U100		RiskPert(S100,R100,T100,RiskName(B100&C100&H100))	1852500	1966250	$2,145,000.00
32Project	U101		RiskPert(S101,R101,T101,RiskName(B101&C101&H101))	270750	287375	$313,500.00
33ProjectDetail attached	U104		RiskPert(S104,R104,T104,RiskName(B104&C104&H104))	5861700	6730100	$8,466,900.00
34ProjectDetail attached	U107		RiskPert(S107,R107,T107,RiskName(B107&C107&H107))	960996.1	1020005	$1,112,732.00
35ProjectDetail attached	U110		RiskPert(S110,R110,T110,RiskName(B110&C110&H110))	10085770	10705070	$11,678,260.00

CONSTRUCTION

DAM REMOVAL

JC Boyle

Name	Cell	Graph	Function	Min	Mean	Max
41JC BoyleRemoval of Diversion Conduit Bulkheads	U114		RiskPert(S114,R114,T114,RiskName(B114&C114&H114))	19792.93	20834.66	$21,876.40
41JC BoyleRemove Water from behind Tailrace Cofferdam	U115		RiskPert(S115,R115,T115,RiskName(B115&C115&H115))	5374.84	6021.81	$6,867.85
41JC BoyleProvide Dewatering behind Tailrace Cofferdam	U116		RiskPert(S116,R116,T116,RiskName(B116&C116&H116))	61791.86	69229.77	$78,956.27
41JC BoyleConstruct Embankment Cofferdam in Tailrace around Powerhouse	U117		RiskPert(S117,R117,T117,RiskName(B117&C117&H117))	220246.9	248797.4	$293,662.50
41JC BoyleRemove Spillway Concrete	U118		RiskPert(S118,R118,T118,RiskName(B118&C118&H118))	662853.1	786325.7	$935,792.60
41JC BoyleRemove Monorail Structural Steel Components	U119		RiskPert(S119,R119,T119,RiskName(B119&C119&H119))	9688.4	11213.42	$14,532.60
41JC BoyleRemove Fish Ladder Concrete	U120		RiskPert(S120,R120,T120,RiskName(B120&C120&H120))	614464.3	682738.1	$751,011.90
41JC BoyleRemove Gravity Dam Section Concrete	U121		RiskPert(S121,R121,T121,RiskName(B121&C121&H121))	194820.9	231111	$275,041.20
41JC BoyleRemove Timber Equipment Ramp on left side of Dam	U122		RiskPert(S122,R122,T122,RiskName(B122&C122&H122))	6663.72	8100.99	$10,583.55
41JC BoyleRemove Pressure-Treated Lumber from Footbridge around Intake Structure	U123		RiskPert(S123,R123,T123,RiskName(B123&C123&H123))	26206.81	29361.33	$33,486.48
41JC BoyleRemove Storage Shed located on access road	U124		RiskPert(S124,R124,T124,RiskName(B124&C124&H124))	133063.1	141233.7	$154,073.10
41JC BoyleRemove Warehouse located on access road	U125		RiskPert(S125,R125,T125,RiskName(B125&C125&H125))	100609.3	106787.1	$116,495.00

Name	Cell	Graph	Function	Min	Mean	Max
41JC BoyleRemove Warehouse located on access road	U125		RiskPert(S125,R125,T125,RiskName(B125&C125&H125))	100609.3	106787.1	$116,495.00
41JC BoyleRemove Fire System Control Bldg. on left abutment	U126		RiskPert(S126,R126,T126,RiskName(B126&C126&H126))	14448.33	15335.5	$16,729.64
41JC BoyleRemove Dam Communication Bldg. on left abutment	U127		RiskPert(S127,R127,T127,RiskName(B127&C127&H127))	14247.2	15122.03	$16,496.76
41JC BoyleRemove Concrete Slab on left abutment for former Control House	U128		RiskPert(S128,R128,T128,RiskName(B128&C128&H128))	10803.52	12103.94	$13,804.50
41JC BoyleRemove 4'x5' Metal Hatch on top of Concrete Pull Box on left abutment	U129		RiskPert(S129,R129,T129,RiskName(B129&C129&H129))	1791.36	1990.4	$2,189.44
41JC BoyleRemove Reservoir Level Gauge House on Dam Crest	U130		RiskPert(S130,R130,T130,RiskName(B130&C130&H130))	3556.86	3775.26	$4,118.47
41JC BoyleUpstream Riprap	U131		RiskPert(S131,R131,T131,RiskName(B131&C131&H131))	208125.7	231250.8	$254,375.80
41JC BoyleDownstream Riprap	U132		RiskPert(S132,R132,T132,RiskName(B132&C132&H132))	122426.9	136029.9	$149,632.80
41JC BoyleMiscellaneous Excavation	U133		RiskPert(S133,R133,T133,RiskName(B133&C133&H133))	1319586	1565391	$1,862,945.00
41JC BoyleCutoff Wall Concrete Demolition	U134		RiskPert(S134,R134,T134,RiskName(B134&C134&H134))	49044.27	52485.97	$59,369.37
41JC BoyleCutoff Wall Anchors	U135		RiskPert(S135,R135,T135,RiskName(B135&C135&H135))	3915.18	4155.59	$4,533.37
41JC BoyleRemove & Dispose Hand Rails and Light Poles	U136		RiskPert(S136,R136,T136,RiskName(B136&C136&H136))	4516.91	4833.89	$5,467.84
41JC BoyleRemove & Dispose Spillway Radial Gates and Hoists	U137		RiskPert(S137,R137,T137,RiskName(B137&C137&H137))	268170	310381.9	$402,255.00
41JC BoyleRemove & Dispose Stop Logs and Slots (steel)	U138		RiskPert(S138,R138,T138,RiskName(B138&C138&H138))	87798.53	99179.82	$117,064.70
41JC BoyleRemove & Dispose of 24" Slide Gate at Entrance to Fish Ladder Structure	U139		RiskPert(S139,R139,T139,RiskName(B139&C139&H139))	3119.5	3502.6	$4,761.34
41JC BoyleRemove petroleum products from Red Barn Area	U140		RiskPert(S140,R140,T140,RiskName(B140&C140&H140))	20401.73	24602.08	$31,202.64
41JC BoyleRemove & Dispose of Spillway gate motor & control panel	U141		RiskPert(S141,R141,T141,RiskName(B141&C141&H141))	1298.21	1466.49	$1,730.94
41JC BoyleRemove & Dispose of Distribution equipment, panelboards	U142		RiskPert(S142,R142,T142,RiskName(B142&C142&H142))	5950.3	6721.64	$7,933.73
41JC BoyleRemove Powerhouse Concrete down to Elevation 3324.0	U143		RiskPert(S143,R143,T143,RiskName(B143&C143&H143))	829908.5	937489.3	$1,106,545.00
41JC BoyleRemove Structural Steel Item associated with Powerhouse	U144		RiskPert(S144,R144,T144,RiskName(B144&C144&H144))	59804.68	67003.39	$76,417.09
41JC BoyleRemove Warehouse near Powerhouse	U145		RiskPert(S145,R145,T145,RiskName(B145&C145&H145))	178143.7	189082.3	$206,271.60
41JC BoyleRemove & Dispose of 2 - Governor oil systems	U146		RiskPert(S146,R146,T146,RiskName(B146&C146&H146))	44806.73	47951.06	$54,239.72
41JC BoyleRemove & Dispose of Cooling water and bearing oil systems	U147		RiskPert(S147,R147,T147,RiskName(B147&C147&H147))	6990.83	7832.32	$8,932.73
41JC BoyleRemove & Dispose of 2 - Francis Turbines	U148		RiskPert(S148,R148,T148,RiskName(B148&C148&H148))	398903.4	477119.7	$586,622.60
41JC BoyleRemove & Dispose of 150 Ton crane	U149		RiskPert(S149,R149,T149,RiskName(B149&C149&H149))	187781	222759.8	$265,102.50

Name	Cell	Graph	Function	Min	Mean	Max
41JC BoyleRemove & Dispose of Compressed Air systems	U150	950 1,400	RiskPert(S150,R150,T150,RiskName(B150&C150&H150))	984.76	1121.54	$1,367.73
41JC BoyleRemove & Dispose of 2 - CO2 systems	U151	6,500 9,000	RiskPert(S151,R151,T151,RiskName(B151&C151&H151))	6584.39	7437.92	$8,779.18
41JC BoyleRemove & Dispose of Plant Water and Fire Protection	U152	2,300 3,200	RiskPert(S152,R152,T152,RiskName(B152&C152&H152))	2326.05	2627.58	$3,101.40
41JC BoyleRemove & Dispose of Transformer Oil Fire Protection	U153	4,500 7,500	RiskPert(S153,R153,T153,RiskName(B153&C153&H153))	4978.53	5905.91	$7,028.52
41JC BoyleRemove & Dispose of Unwatering Piping	U154	20,000 36,000	RiskPert(S154,R154,T154,RiskName(B154&C154&H154))	21913.42	27620.04	$34,239.71
41JC BoyleRemove & Dispose of Drainage Piping	U155	7,500 11,500	RiskPert(S155,R155,T155,RiskName(B155&C155&H155))	7986.64	9474.35	$11,275.26
41JC BoyleRemove & Dispose of 2-Oil Sump pumps	U156	2,500 3,300	RiskPert(S156,R156,T156,RiskName(B156&C156&H156))	2567.54	2876.6	$3,280.75
41JC BoyleRemove & Dispose of Draft Tube Bulk Head Gates and Hoists at the Powerhouse	U157	40,000 70,000	RiskPert(S157,R157,T157,RiskName(B157&C157&H157))	44323.04	53013.83	$65,180.94
41JC BoyleRemove petroleum products from Mechanical Equipment	U158	26,000 42,000	RiskPert(S158,R158,T158,RiskName(B158&C158&H158))	26518.51	31978.21	$40,557.73
41JC BoyleRemove & Dispose of Outdoor Vertical AC Generator, Unit 1: 53 MVA	U159	300,000 420,000	RiskPert(S159,R159,T159,RiskName(B159&C159&H159))	302720.9	356142.2	$409,563.50
41JC BoyleRemove & Dispose of Generator Switchgear, 15kV - (6 sections)	U163	18,000 28,000	RiskPert(S163,R163,T163,RiskName(B163&C163&H163))	18865.19	22564.24	$27,742.92
41JC BoyleRemove & Dispose of Station Service Switchgear, 600 volt - (5 sections)	U164	10,500 13,500	RiskPert(S164,R164,T164,RiskName(B164&C164&H164))	10914	12126.66	$13,339.33
41JC BoyleRemove & Dispose of Unit and plant control switchboard	U165	5,800 7,400	RiskPert(S165,R165,T165,RiskName(B165&C165&H165))	5976.34	6640.38	$7,304.42
41JC BoyleRemove & Dispose of Battery system	U166	7,400 9,200	RiskPert(S166,R166,T166,RiskName(B166&C166&H166))	7522.56	8358.4	$9,194.24
41JC BoyleRemove & Dispose of Raceways, Conduit and Cable	U167	14,000 17,500	RiskPert(S167,R167,T167,RiskName(B167&C167&H167))	14063.83	15626.48	$17,189.12
41JC BoyleRemove & Dispose of Misc. power & control boards	U168	7,200 9,000	RiskPert(S168,R168,T168,RiskName(B168&C168&H168))	7228.46	8031.62	$8,834.78
41JC BoyleRemove & Dispose of 5 Gantry Crane motors - hoist (50Hp), aux hoist*	U169	1,700 2,400	RiskPert(S169,R169,T169,RiskName(B169&C169&H169))	1750.92	1977.89	$2,334.56
41JC BoyleRemove & Dispose of Gantry Crane control equipment (3 cubicles)	U170	5,800 7,400	RiskPert(S170,R170,T170,RiskName(B170&C170&H170))	5941.94	6602.15	$7,262.37
41JC BoyleRemove & Dispose of Conduit and Cable	U171	10,500 14,500	RiskPert(S171,R171,T171,RiskName(B171&C171&H171))	10692.66	12078.75	$14,256.88
41JC BoyleRemove & Dispose of Exterior Lighting	U172	10,500 14,000	RiskPert(S172,R172,T172,RiskName(B172&C172&H172))	10772.44	12069.13	$13,764.79
41JC BoyleRemove & Dispose of Transmission Line No. 59	U173	45,000 75,000	RiskPert(S173,R173,T173,RiskName(B173&C173&H173))	49856.34	59632.09	$73,318.15
41JC BoyleRemove & Dispose of Transmission Line No. 98	U174	6,000 9,500	RiskPert(S174,R174,T174,RiskName(B174&C174&H174))	6359.95	7607	$9,352.86
41JC BoyleRemove & Dispose of Transmission Line No. 58	U175	45,000 75,000	RiskPert(S175,R175,T175,RiskName(B175&C175&H175))	49856.34	59632.09	$73,318.15
41JC BoyleRemove Intake Structure Concrete	U176	460,000 640,000	RiskPert(S176,R176,T176,RiskName(B176&C176&H176))	477513.4	539413.3	$636,684.60
41JC BoyleRemove Fish Screen Building	U177	150,000 180,000	RiskPert(S177,R177,T177,RiskName(B177&C177&H177))	151333.4	160625.8	$175,228.10

Name	Cell	Graph	Function	Min	Mean	Max
41JC BoyleRemove 24-inch-dia. Steel Fish Discharge Pipe	U178	11,000 17,000	RiskPert(S178,R178,T178,RiskName(B178&C178&H178))	11285.99	13498.93	$16,597.04
41JC BoyleRemove Concrete Items associated with the 14-ft-diameter Steel Pipe	U179	300,000 420,000	RiskPert(S179,R179,T179,RiskName(B179&C179&H179))	302857.3	356302.7	$409,748.10
41JC BoyleRemove Open Concrete Flume	U180	7.00m 9.50m	RiskPert(S180,R180,T180,RiskName(B180&C180&H180))	7014533	7923824	$9,352,710.00
41JC BoyleRemove Structural Steel Items associated with the Forebay Trash rack Piers	U181	5,000 8,000	RiskPert(S181,R181,T181,RiskName(B181&C181&H181))	5381.22	6436.36	$7,913.55
41JC BoyleRemove Fore bay Concrete	U182	0.75m 1.05m	RiskPert(S182,R182,T182,RiskName(B182&C182&H182))	756196.6	854222.1	$1,008,262.00
41JC BoylePlace Concrete Plugs at Tunnel Portals	U183	51,000 58,000	RiskPert(S183,R183,T183,RiskName(B183&C183&H183))	51815.16	54542.28	$57,269.39
41JC BoyleRemove Head gate Control Building at Flume Entrance	U185	50,000 66,000	RiskPert(S185,R185,T185,RiskName(B185&C185&H185))	50155.08	56192.27	$64,087.05
41JC BoyleRemove Fore bay Spillway Gate House	U186	54,000 74,000	RiskPert(S186,R186,T186,RiskName(B186&C186&H186))	55104.99	62248.23	$73,473.33
41JC BoyleRemove Fore bay Control Building	U187	54,000 74,000	RiskPert(S187,R187,T187,RiskName(B187&C187&H187))	54810.8	61915.9	$73,081.06
41JC BoyleRemove Insulated Generator Building next to Fore bay Control Building	U188	15,000 21,000	RiskPert(S188,R188,T188,RiskName(B188&C188&H188))	15151.93	17116.07	$20,202.57
41JC BoyleRemove Fixed Wheel Gate (gate, Frame, and Hoist)	U189	26,000 42,000	RiskPert(S189,R189,T189,RiskName(B189&C189&H189))	26177.9	32995.07	$40,902.97
41JC BoyleRemove Trash rack and trash rake (steel)	U190	34,000 54,000	RiskPert(S190,R190,T190,RiskName(B190&C190&H190))	34238.27	43154.48	$53,497.29
41JC BoyleRemove stop Logs and slots (steel)	U191	105,000 155,000	RiskPert(S191,R191,T191,RiskName(B191&C191&H191))	108699.4	123796.5	$150,971.40
41JC BoyleRemove Traveling Water Screen	U192	60,000 90,000	RiskPert(S192,R192,T192,RiskName(B192&C192&H192))	63282.28	72071.48	$87,892.05
41JC BoyleRemove Fish By-Pass and Supports (steel)	U193	460,000 620,000	RiskPert(S193,R193,T193,RiskName(B193&C193&H193))	474783.1	531932.9	$606,667.30
41JC BoyleRemove Gates and Hoists	U194	8,000 13,000	RiskPert(S194,R194,T194,RiskName(B194&C194&H194))	8460.21	10202.01	$12,939.14

41JC BoyleRemove Trash rack and trash rake (steel)	U195	26,000 42,000	RiskPert(S195,R195,T195,RiskName(B195&C195&H195))	26997.64	32555.97	$41,290.50
41JC BoyleRemove stop Logs and slots (steel)	U196	22,000 34,000	RiskPert(S196,R196,T196,RiskName(B196&C196&H196))	22150.77	26711.22	$33,877.64
41JC BoyleRemove & Dispose Penstocks and bifurcation (steel)	U197	1.05m 1.55m	RiskPert(S197,R197,T197,RiskName(B197&C197&H197))	1063430	1261519	$1,501,312.00
41JC BoyleRemove & Dispose Surge Tank (steel)	U198	65,000 95,000	RiskPert(S198,R198,T198,RiskName(B198&C198&H198))	65242.39	74907.93	$94,239.02
41JC BoyleRemove & Dispose 2 - 108" Butterfly valves	U199	110,000 165,000	RiskPert(S199,R199,T199,RiskName(B199&C199&H199))	111198.2	127672	$160,619.60
41JC BoyleRemove & Dispose Gate, Stem and Frame	U200	20,000 27,000	RiskPert(S200,R200,T200,RiskName(B200&C200&H200))	20129.42	22738.79	$26,839.23
41JC BoyleRemove & Dispose of Steel Transition Manifolds on Upstream and Downstream	U201	150,000 240,000	RiskPert(S201,R201,T201,RiskName(B201&C201&H201))	153806.7	185472.8	$235,233.70
41JC BoyleRemove petroleum products from Mechanical Equipment	U202	6,000 9,500	RiskPert(S202,R202,T202,RiskName(B202&C202&H202))	6008.49	7245.53	$9,189.45

Name	Cell	Graph	Function	Min	Mean	Max
41JC BoyleRemove petroleum products from Mechanical Equipment	U202	6,000 9,500	RiskPert(S202,R202,T202,RiskName(B202&C202&H202))	6008.49	7245.53	$9,189.45
41JC BoyleClear and Grub Disposal Area (Embankment)	U203	130,000 165,000	RiskPert(S203,R203,T203,RiskName(B203&C203&H203))	131152.5	145725	$160,297.50
41JC BoyleClear and Grub, 40' width	U204	31,000 39,000	RiskPert(S204,R204,T204,RiskName(B204&C204&H204))	31476.6	34974	$38,471.39
41JC Boyle4" thick gravel surfacing	U205	64,000 80,000	RiskPert(S205,R205,T205,RiskName(B205&C205&H205))	64551.57	71723.96	$78,896.36
41JC BoyleSoil Cover over Concrete Rubble	U206	110,000 155,000	RiskPert(S206,R206,T206,RiskName(B206&C206&H206))	113738.5	128482.4	$151,651.40
41JC BoyleEmbankment Fill in Waste way (Fore bay) Scour Hole	U207	4.30m 5.40m	RiskPert(S207,R207,T207,RiskName(B207&C207&H207))	4366807	4852008	$5,337,209.00
41JC BoyleTopsy Recreational Area - Concrete total	U208	33,000 39,000	RiskPert(S208,R208,T208,RiskName(B208&C208&H208))	33039.63	35068.38	$38,256.42
41JC BoyleTopsy Recreational Area - 6'x80' Floating dock made of lumber and composite decking	U209	9,400 10,500	RiskPert(S209,R209,T209,RiskName(B209&C209&H209))	9421.17	9917.02	$10,412.88
41JC BoyleTopsy Recreational Area - 5'x20' Walkway leading to hex fishing platform	U210	2,100 2,400	RiskPert(S210,R210,T210,RiskName(B210&C210&H210))	2142.27	2255.02	$2,367.78
41JC BoyleTopsy Recreational Area - Regrade to natural contour	U211	4,600 5,500	RiskPert(S211,R211,T211,RiskName(B211&C211&H211))	4691.34	4979.41	$5,432.08
41JC BoylePioneer Park - Picnic tables to be removed and hauled away	U212	2,000 2,250	RiskPert(S212,R212,T212,RiskName(B212&C212&H212))	2008.42	2114.13	$2,219.84
41JC BoylePioneer Park - 12 Concrete fire rings	U213	1,880 2,100	RiskPert(S213,R213,T213,RiskName(B213&C213&H213))	1890.88	1990.4	$2,089.92
41JC BoylePioneer Park - Portable toilets to be removed and hauled away	U214	2,100 2,400	RiskPert(S214,R214,T214,RiskName(B214&C214&H214))	2142.27	2255.02	$2,367.78
41JC BoylePioneer Park - Signs to be removed and hauled away	U215	900 1,010	RiskPert(S215,R215,T215,RiskName(B215&C215&H215))	904.8	952.42	$1,000.04
41JC BoylePioneer Park - Dumpster to be removed and hauled away	U216	3,000 3,900	RiskPert(S216,R216,T216,RiskName(B216&C216&H216))	3007.8	3369.85	$3,843.30
41JC BoylePioneer Park - Regrade to natural contour	U217	8,800 11,000	RiskPert(S217,R217,T217,RiskName(B217&C217&H217))	8888.86	9876.51	$10,864.16
41JC BoyleRemove Frame dead end structures 60-80 ft high	U218	14,000 19,500	RiskPert(S218,R218,T218,RiskName(B218&C218&H218))	14378.98	16242.92	$19,171.97
41JC BoyleRemove (incl foundation) and Save Transformers 230KV	U219	5,400 7,000	RiskPert(S219,R219,T219,RiskName(B219&C219&H219))	5443.96	6099.25	$6,956.17
41JC BoyleRemove (incl foundation) and Save Power Circuit Breakers 230KV	U220	7,600 9,200	RiskPert(S220,R220,T220,RiskName(B220&C220&H220))	7781.33	8259.13	$9,009.96
41JC BoyleSubstation Tie Structure 230KV	U221	40,000 54,000	RiskPert(S221,R221,T221,RiskName(B221&C221&H221))	41995.5	47050.51	$53,660.91
41JC BoyleRemove Chain Link Fence	U222	10,500 13,500	RiskPert(S222,R222,T222,RiskName(B222&C222&H222))	10770.47	11967.19	$13,163.91
41JC BoyleDemolish overhead distribution 2.5 miles (30-45 poles)	U223	52,000 72,000	RiskPert(S223,R223,T223,RiskName(B223&C223&H223))	52846.43	59696.89	$70,461.91
41JC BoyleInstall 230kV strain transmission structures outside JC Boyle Substation	U224	260,000 360,000	RiskPert(S224,R224,T224,RiskName(B224&C224&H224))	267756.4	302465.6	$357,008.50

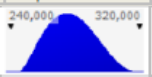
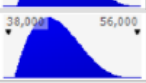
Copco 1

Name	Cell	Graph	Function	Min	Mean	Max
41Copco 1Furnish, Install, and Remove Barge-Mounted Crane in Reservoir for Dam Removal	U226	190,000 270,000	RiskPert(S226,R226,T226,RiskName(B226&C226&H226))	194197.5	221169.3	$269,718.70
41Copco 1Remove Sediment from Diversion Tunnel Intake to provide access	U227	100,000 140,000	RiskPert(S227,R227,T227,RiskName(B227&C227&H227))	104315.9	117838.3	$139,087.80
41Copco 1Furnish, Install, and Remove Large Crane on Right Abutment	U228	540,000 740,000	RiskPert(S228,R228,T228,RiskName(B228&C228&H228))	541999.8	637646.8	$733,293.90
41Copco 1Remove Water from behind Tailrace Cofferdam	U229	2,100 2,800	RiskPert(S229,R229,T229,RiskName(B229&C229&H229))	2117.36	2372.23	$2,705.52
41Copco 1Riprap Protection on Cofferdam	U230	36,000 54,000	RiskPert(S230,R230,T230,RiskName(B230&C230&H230))	36869.28	43737.08	$52,050.74
41Copco 1Provide Dewatering behind Tailrace Cofferdam	U231	90,000 125,000	RiskPert(S231,R231,T231,RiskName(B231&C231&H231))	90995.34	102791	$121,327.10
41Copco 1Remove Current Diversion Tunnel Plug	U232	270,000 370,000	RiskPert(S232,R232,T232,RiskName(B232&C232&H232))	274485	310066.4	$365,980.00
41Copco 1Construct Embankment Cofferdam in Tailrace	U233	260,000 400,000	RiskPert(S233,R233,T233,RiskName(B233&C233&H233))	269201	319346.3	$380,048.50
41Copco 1Installation of 3 each 72" Blind Flanges	U234	1.20m 2.00m	RiskPert(S234,R234,T234,RiskName(B234&C234&H234))	1259357	1518637	$1,926,076.00
41Copco 1Installation of 16.5 X 18.5 Roller Gate and Gate Structure	U235	3.50m 6.00m	RiskPert(S235,R235,T235,RiskName(B235&C235&H235))	3918386	4725112	$5,992,825.00
41Copco 1Removal of 16.5 X 18.5 Roller Gate and Gate Structure	U236	240,000 400,000	RiskPert(S236,R236,T236,RiskName(B236&C236&H236))	259671.6	313133.4	$397,144.80
41Copco 1Remove Concrete Dam down to Elev. 2476	U237	8.00m 11.50m	RiskPert(S237,R237,T237,RiskName(B237&C237&H237))	8286845	9361065	$11,049,130.00
41Copco 1Remove Concrete Intake Structure on Right Abutment	U238	6.50m 10.00m	RiskPert(S238,R238,T238,RiskName(B238&C238&H238))	6957508	8253515	$9,822,364.00
41Copco 1Remove Structural Steel from Spillway	U239	65,000 100,000	RiskPert(S239,R239,T239,RiskName(B239&C239&H239))	66603.52	79663.04	$97,946.36
41Copco 1Install Diversion Tunnel Plugs	U240	40,000 52,000	RiskPert(S240,R240,T240,RiskName(B240&C240&H240))	40401.06	45264.15	$51,623.58
41Copco 1Remove Diversion Tunnel Control Structure Concrete	U241	80,000 110,000	RiskPert(S241,R241,T241,RiskName(B241&C241&H241))	81895.9	92512.03	$109,194.50
41Copco 1Remove & Dispose of Hand Rails	U242	14,000 21,000	RiskPert(S242,R242,T242,RiskName(B242&C242&H242))	14264.8	16921.96	$20,138.54
41Copco 1Remove & Dispose of Radial Gates	U243	150,000 220,000	RiskPert(S243,R243,T243,RiskName(B243&C243&H243))	158049.3	180000.6	$219,513.00
41Copco 1Remove & Dispose Radial Gate Stop logs	U244	19,000 27,000	RiskPert(S244,R244,T244,RiskName(B244&C244&H244))	19363.19	22052.53	$26,893.32
41Copco 1Remove & Dispose Stop log hoist, track and supports	U245	26,000 38,000	RiskPert(S245,R245,T245,RiskName(B245&C245&H245))	27174.14	30948.32	$37,741.86
41Copco 1Remove & Dispose of 3 sections of 23' of 72" Dia. steel lining (embedded)	U246	50,000 80,000	RiskPert(S246,R246,T246,RiskName(B246&C246&H246))	53888.25	63926.26	$76,077.53
41Copco 1Remove & Dispose of 3 - 72" butterfly valves (embedded)	U247	60,000 80,000	RiskPert(S247,R247,T247,RiskName(B247&C247&H247))	61039.71	68387.09	$77,995.19
41Copco 1Remove & Dispose of 3 - 72" flapper valves with remote mechanical	U248	420,000 560,000	RiskPert(S248,R248,T248,RiskName(B248&C248&H248))	437452.6	490108.9	$558,967.10
41Copco 1Remove & Dispose of Spillway gate motor & control panel	U249	1,300 1,750	RiskPert(S249,R249,T249,RiskName(B249&C249&H249))	1334.95	1495.64	$1,705.77

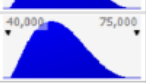
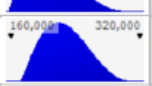
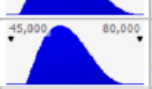
Name	Cell	Graph	Function	Min	Mean	Max
41Copco 1Remove & Dispose Distribution equipment, panelboards	U250	5,800 8,000	RiskPert(S250,R250,T250,RiskName(B250&C250&H250))	5950.3	6721.64	$7,933.73
41Copco 1Remove Powerhouse Concrete down to top of rock under the Powerhouse	U251	1.10m 1.70m	RiskPert(S251,R251,T251,RiskName(B251&C251&H251))	1148636	1373859	$1,689,171.00
41Copco 1Remove Powerhouse Structural Steel	U252	105,000 155,000	RiskPert(S252,R252,T252,RiskName(B252&C252&H252))	107266.7	127247.8	$151,435.30
41Copco 1Remove & Dispose of 2 - Governor Oil Systems	U253	40,000 58,000	RiskPert(S253,R253,T253,RiskName(B253&C253&H253))	41022.27	46719.81	$56,975.38
41Copco 1Remove & Dispose of Cooling water and bearing oil systems	U254	34,000 48,000	RiskPert(S254,R254,T254,RiskName(B254&C254&H254))	35139.87	39695.04	$46,853.15
41Copco 1Remove & Dispose of 4 - Horizontal Tandem Francis Turbines	U255	360,000 500,000	RiskPert(S255,R255,T255,RiskName(B255&C255&H255))	366617.7	414142.2	$488,823.60
41Copco 1Remove & Dispose of 2 - 40 Ton indoor cranes	U256	95,000 145,000	RiskPert(S256,R256,T256,RiskName(B256&C256&H256))	99381.76	117894	$140,303.70
41Copco 1Remove & Dispose of Compressed Air System	U257	1,000 1,300	RiskPert(S257,R257,T257,RiskName(B257&C257&H257))	1009.42	1130.93	$1,289.82
41Copco 1Remove & Dispose of 2 - CO2 Systems	U258	3,200 4,300	RiskPert(S258,R258,T258,RiskName(B258&C258&H258))	3291.93	3688.18	$4,206.35
41Copco 1Remove & Dispose of Plant Water and Fire Protection	U259	3,400 4,800	RiskPert(S259,R259,T259,RiskName(B259&C259&H259))	3554.73	4015.53	$4,739.65
41Copco 1Remove & Dispose of Transformer Oil Fire Protection	U260	6,500 9,000	RiskPert(S260,R260,T260,RiskName(B260&C260&H260))	6667.14	7531.4	$8,889.52
41Copco 1Remove & Dispose of Unwatering Piping	U261	18,000 28,000	RiskPert(S261,R261,T261,RiskName(B261&C261&H261))	18872.04	22572.44	$27,753.00
41Copco 1Remove & Dispose of Drainage Piping	U262	4,500 7,500	RiskPert(S262,R262,T262,RiskName(B262&C262&H262))	4973.82	5949.08	$7,314.45
41Copco 1Remove petroleum products from mechanical equipment	U263	5,400 7,200	RiskPert(S263,R263,T263,RiskName(B263&C263&H263))	5557.58	6226.54	$7,101.35
41Copco 1Remove & Dispose of Horizontal AC Generator, Indoor Open Frame	U264	70,000 105,000	RiskPert(S264,R264,T264,RiskName(B264&C264&H264))	73989.06	87771.34	$104,455.10
41Copco 1Remove & Dispose of Excitation equipment for 12.5 MVA Generator	U265	12,000 18,000	RiskPert(S265,R265,T265,RiskName(B265&C265&H265))	12151.23	14533.82	$17,869.45
41Copco 1Remove & Dispose of Surge protection equip. for 12.5 MVA Generator	U266	4,500 7,500	RiskPert(S266,R266,T266,RiskName(B266&C266&H266))	4789.2	5775.21	$7,324.66
41Copco 1Remove & Dispose of Neutral grounding equip. for 12.5 MVA Generator	U267	4,600 6,200	RiskPert(S267,R267,T267,RiskName(B267&C267&H267))	4722.21	5290.62	$6,033.93
41Copco 1Remove & Dispose of Generator Switchgear, 5kV-includes unit breakers	U268	20,000 27,000	RiskPert(S268,R268,T268,RiskName(B268&C268&H268))	20921.89	23440.27	$26,733.53
41Copco 1Remove & Dispose of Station Service Switchgear, 600 volt - (5 sections)	U269	11,000 15,000	RiskPert(S269,R269,T269,RiskName(B269&C269&H269))	11451.14	12829.52	$14,632.02
41Copco 1Remove & Dispose of Unit and plant control switchboard	U270	6,000 8,000	RiskPert(S270,R270,T270,RiskName(B270&C270&H270))	6185.95	6930.56	$7,904.27
41Copco 1Remove & Dispose of Battery System	U271	20,000 27,000	RiskPert(S271,R271,T271,RiskName(B271&C271&H271))	20894.08	23409.11	$26,697.99
41Copco 1Remove & Dispose of Raceways, Conduit and Cable	U272	17,000 22,500	RiskPert(S272,R272,T272,RiskName(B272&C272&H272))	17293.92	19375.6	$22,097.79
41Copco 1Remove & Dispose of Misc. power & control boards	U273	7,000 9,000	RiskPert(S273,R273,T273,RiskName(B273&C273&H273))	7031.91	7878.35	$8,985.22

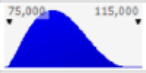
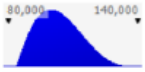
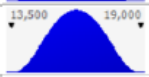
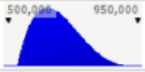
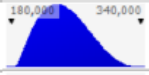
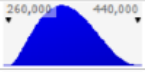
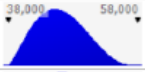
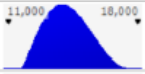
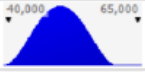
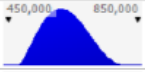
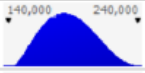
Name	Cell	Graph	Function	Min	Mean	Max
41Copco 1Remove & Dispose of Misc. power & control boards	U273	7,000 9,000	RiskPert(S273,R273,T273,RiskName(B273&C273&H273))	7031.91	7878.35	$8,985.22
41Copco 1Remove & Dispose of Step-up Transformers, indoor, oil-filled, 1-phase, 5000kVA	U274	190,000 250,000	RiskPert(S274,R274,T274,RiskName(B274&C274&H274))	195404.3	218925.1	$249,683.20
41Copco 1Remove & Dispose of Step-up Transformers, indoor, oil-filled, 1-phase, 4165kVA	U275	170,000 225,000	RiskPert(S275,R275,T275,RiskName(B275&C275&H275))	173884.2	194814.8	$222,185.40
41Copco 1Remove & Dispose of Seven 40-Ton Travelling Crane motors - hoist	U276	3,300 4,300	RiskPert(S276,R276,T276,RiskName(B276&C276&H276))	3347.62	3750.57	$4,277.51
41Copco 1Remove & Dispose of 40-Ton Travelling Crane control equipment	U277	4,400 5,800	RiskPert(S277,R277,T277,RiskName(B277&C277&H277))	4418.64	4950.51	$5,646.04
41Copco 1Remove & Dispose of 40-Ton Travelling Crane Festoon Cable	U278	1,500 2,100	RiskPert(S278,R278,T278,RiskName(B278&C278&H278))	1553.84	1755.26	$2,071.79
41Copco 1Remove & Dispose of Four 15-Ton Overhead Crane Motors - hoist	U279	950 1,300	RiskPert(S279,R279,T279,RiskName(B279&C279&H279))	971.41	1097.34	$1,295.22
41Copco 1Remove & Dispose of 15-Ton Overhead Crane control equipment	U280	420 580	RiskPert(S280,R280,T280,RiskName(B280&C280&H280))	439.57	492.48	$561.67
41Copco 1Remove & Dispose of 15-Ton Overhead Crane Festoon Cable	U281	640 840	RiskPert(S281,R281,T281,RiskName(B281&C281&H281))	645.38	723.07	$824.66
41Copco 1Remove petroleum products from mechanical equipment	U282	110,000 145,000	RiskPert(S282,R282,T282,RiskName(B282&C282&H282))	110466.2	123763.1	$141,151.30
41Copco 1Remove & Dispose of 69kV circuit breakers, oil0 filled, PCB	U283	1,700 2,150	RiskPert(S283,R283,T283,RiskName(B283&C283&H283))	1744.25	1938.05	$2,131.85
41Copco 1Remove & Dispose of 69kV disconnect switches, group-operated	U284	1,700 2,150	RiskPert(S284,R284,T284,RiskName(B284&C284&H284))	1744.25	1938.05	$2,131.85
41Copco 1Remove & Dispose of 60-foot wood poles	U285	14,000 22,000	RiskPert(S285,R285,T285,RiskName(B285&C285&H285))	14880.77	17652.67	$21,008.14
41Copco 1Remove & Dispose of 30-foot wood cross arms	U286	11,000 16,000	RiskPert(S286,R286,T286,RiskName(B286&C286&H286))	11115.97	13186.59	$15,693.13
41Copco 1Remove & Dispose of 69-kV insulator strings	U287	4,200 6,200	RiskPert(S287,R287,T287,RiskName(B287&C287&H287))	4278.72	5075.73	$6,040.54
41Copco 1Remove & Dispose of Transmission Line No. 3	U288	45,000 75,000	RiskPert(S288,R288,T288,RiskName(B288&C288&H288))	49856.34	59632.09	$73,318.15
41Copco 1Remove & Dispose of Transmission Line No. 15	U289	38,000 60,000	RiskPert(S289,R289,T289,RiskName(B289&C289&H289))	39951.8	47785.48	$58,752.64
41Copco 1Remove & Dispose of Transmission Line No. 26-1	U290	2,200 3,400	RiskPert(S290,R290,T290,RiskName(B290&C290&H290))	2243.82	2683.78	$3,299.73
41Copco 1Remove & Dispose of Transmission Line No. 26-2	U291	2,200 3,400	RiskPert(S291,R291,T291,RiskName(B291&C291&H291))	2243.82	2683.78	$3,299.73

Name	Cell	Graph	Function	Min	Mean	Max
41Copco 1Remove gate house #1 from top of dam	U292	45,000 75,000	RiskPert(S292,R292,T292,RiskName(B292&C292&H292))	49603.99	59330.26	$72,947.04
41Copco 1Remove gate house #2 from top of dam	U293	45,000 75,000	RiskPert(S293,R293,T293,RiskName(B293&C293&H293))	49051.72	58669.7	$72,134.88
41Copco 1Remove Concrete Items associated with 10 ft. diam. Penstocks, reinf. Concrete	U294	300,000 460,000	RiskPert(S294,R294,T294,RiskName(B294&C294&H294))	301563.3	360693.4	$443,475.50
41Copco 1Plug 14-foot diameter penstock with concrete	U295	75,000 105,000	RiskPert(S295,R295,T295,RiskName(B295&C295&H295))	78546.57	88001.25	$100,365.10
41Copco 1Remove & Dispose of 8 screens	U296	21,000 29,000	RiskPert(S296,R296,T296,RiskName(B296&C296&H296))	21274.51	24032.32	$28,366.02
41Copco 1Remove & Dispose of 8 Water Gates	U297	20,000 27,000	RiskPert(S297,R297,T297,RiskName(B297&C297&H297))	20046.98	22645.66	$26,729.31
41Copco 1Remove & Dispose of 3 - 30" Dia. x 25' stand pipes	U298	5,400 7,400	RiskPert(S298,R298,T298,RiskName(B298&C298&H298))	5525.67	6241.96	$7,367.56
41Copco 1Remove & Dispose of 14' Dia. penstock pipe	U299	320,000 480,000	RiskPert(S299,R299,T299,RiskName(B299&C299&H299))	320503.2	383347	$471,328.30
41Copco 1Remove & Dispose of 10' Dia. penstock pipe	U300	340,000 540,000	RiskPert(S300,R300,T300,RiskName(B300&C300&H300))	354585.1	424111.6	$521,448.70
41Copco 1Site work - Clear and Grub Disposal Area	U301	50,000 75,000	RiskPert(S301,R301,T301,RiskName(B301&C301&H301))	52519.39	62302.41	$74,145.02
41Copco 1Site work - Soil Cover for Disposal Area	U302	75,000 115,000	RiskPert(S302,R302,T302,RiskName(B302&C302&H302))	78505.42	93128.98	$110,831.20
41Copco 1Mallard Cove - Concrete total	U303	34,000 48,000	RiskPert(S303,R303,T303,RiskName(B303&C303&H303))	34265.89	40312.82	$46,359.74
41Copco 1Mallard Cove - 25'x5' Dock made of composite decking and poly floats	U304	2,800 4,000	RiskPert(S304,R304,T304,RiskName(B304&C304&H304))	2877.15	3384.88	$3,892.61
41Copco 1Mallard Cove - Signs to be removed and hauled away	U306	900 1,150	RiskPert(S306,R306,T306,RiskName(B306&C306&H306))	925.67	1028.53	$1,131.38
41Copco 1Mallard Cove - Wood plank tables to be removed and hauled away	U307	900 1,150	RiskPert(S307,R307,T307,RiskName(B307&C307&H307))	925.67	1028.53	$1,131.38
41Copco 1Mallard Cove - Parking area to be regraded	U308	18,000 25,000	RiskPert(S308,R308,T308,RiskName(B308&C308&H308))	18858.25	21128.23	$24,096.66
41Copco 1Copco Cove - Concrete Total	U309	26,000 37,000	RiskPert(S309,R309,T309,RiskName(B309&C309&H309))	26651.25	31354.41	$36,057.57
41Copco 1Copco Cove - Dock abutment railing made of 2.5" dia. steel pipe	U310	1,450 1,800	RiskPert(S310,R310,T310,RiskName(B310&C310&H310))	1464.61	1627.35	$1,790.08
41Copco 1Copco Cove - Signs to be removed and hauled away	U311	2,400 3,100	RiskPert(S311,R311,T311,RiskName(B311&C311&H311))	2477.22	2752.47	$3,027.71
41Copco 1Copco Cove - Wood plank tables to be removed and hauled away	U312	300 380	RiskPert(S312,R312,T312,RiskName(B312&C312&H312))	308.56	342.84	$377.13
41Copco 1Copco Cove - Regrade	U313	15,000 19,500	RiskPert(S313,R313,T313,RiskName(B313&C313&H313))	15208.87	17039.56	$19,433.55

Name	Cell	Graph	Function	Min	Mean	Max
41Copco 1Diversion Tunnel Lining	U314		RiskPert(S314,R314,T314,RiskName(B314&C314&H314))	247874.9	277711.7	$316,729.10
41Copco 1Remove Frame Dead End Structures 60-80ft High @ Switch Yard	U315		RiskPert(S315,R315,T315,RiskName(B315&C315&H315))	24615.28	29683.13	$37,646.90
41Copco 1Remove Power Circuit Breakers 69KV @ Switch Yard	U316		RiskPert(S316,R316,T316,RiskName(B316&C316&H316))	11503.04	13100.69	$15,976.45
41Copco 1Remove Disconnect Switches @ Switch Yard	U317		RiskPert(S317,R317,T317,RiskName(B317&C317&H317))	39407.41	44880.66	$54,732.52
41Copco 1Remove All Associated AUX Equipment @ Switch Yard (allowance)	U318		RiskPert(S318,R318,T318,RiskName(B318&C318&H318))	49102.05	55921.78	$68,197.29
41Copco 1Remove Distribution Lines 69 KV Copco 1 Switch Yard and HE Plant (6 poles)	U319		RiskPert(S319,R319,T319,RiskName(B319&C319&H319))	8518.82	9701.98	$11,831.69
41Copco 1Remove Production Poles in General Area of Copco 1	U321		RiskPert(S321,R321,T321,RiskName(B321&C321&H321))	13097.16	15793.63	$20,030.95
41Copco 1Remove Village House Distribution Poles Near Dam (Est 10 each)	U322		RiskPert(S322,R322,T322,RiskName(B322&C322&H322))	12369.58	14916.26	$18,918.18
41Copco 1Remove 69 KV Distribution Line 1.6 Miles (30 Poles)	U323		RiskPert(S323,R323,T323,RiskName(B323&C323&H323))	60127.07	72506.17	$91,959.05
41Copco 1Remove Transmission Conductors 1.3 Miles Copco 1 to Copco 2	U325		RiskPert(S325,R325,T325,RiskName(B325&C325&H325))	46982.75	56655.67	$71,855.98

Copco 2

Name	Cell	Graph	Function	Min	Mean	Max
41Copco 2Construct and Remove Embankment Cofferdam-Right Side of Dam	U327		RiskPert(S327,R327,T327,RiskName(B327&C327&H327))	166544.1	215119.4	$291,452.20
41Copco 2Furnish, Install, and Remove RipRap	U328		RiskPert(S328,R328,T328,RiskName(B328&C328&H328))	54346.52	70197.59	$95,106.42
41Copco 2Provide Dewatering behind Cofferdams	U329		RiskPert(S329,R329,T329,RiskName(B329&C329&H329))	144983.6	166462.7	$209,420.80
41Copco 2Remove Water from behind Cofferdams	U330		RiskPert(S330,R330,T330,RiskName(B330&C330&H330))	5906.41	6781.43	$8,531.48
41Copco 2Construct and Remove Embankment Cofferdam-Left Side of Dam	U331		RiskPert(S331,R331,T331,RiskName(B331&C331&H331))	166296.6	218546.9	$291,019.10
41Copco 2Furnish, Install, and Remove RipRap	U332		RiskPert(S332,R332,T332,RiskName(B332&C332&H332))	41832.31	54033.4	$73,206.55
41Copco 2Provide Dewatering behind left Side Cofferdam	U333		RiskPert(S333,R333,T333,RiskName(B333&C333&H333))	80598.08	92538.54	$116,419.40
41Copco 2Remove Water from behind Cofferdams	U334		RiskPert(S334,R334,T334,RiskName(B334&C334&H334))	5418.49	6221.23	$7,826.71
41Copco 2Remove Water from behind Tailrace Cofferdam	U335		RiskPert(S335,R335,T335,RiskName(B335&C335&H335))	10414.19	11957.04	$15,042.72
41Copco 2Provide Dewatering behind Tailrace Cofferdam	U336		RiskPert(S336,R336,T336,RiskName(B336&C336&H336))	50556.99	58046.91	$73,026.76
41Copco 2Construct Embankment Cofferdam across Tailrace	U337		RiskPert(S337,R337,T337,RiskName(B337&C337&H337))	176448.3	227912.3	$308,784.40
41Copco 2Remove Concrete in Dam	U338		RiskPert(S338,R338,T338,RiskName(B338&C338&H338))	1071700	1323865	$1,828,195.00
41Copco 2Remove concrete equipment slab from top of embankment wing dam on right abutment	U339		RiskPert(S339,R339,T339,RiskName(B339&C339&H339))	1691.84	2040.16	$2,587.52
41Copco 2Remove Concrete Wing wall	U340		RiskPert(S340,R340,T340,RiskName(B340&C340&H340))	49897.74	60170.81	$76,314.20

Name	Cell	Graph	Function	Min	Mean	Max
41Copco 2Right Abutment Removal - Random Fill	U341		RiskPert(S341,R341,T341,RiskName(B341&C341&H341))	75573.55	90391.89	$111,137.60
41Copco 2Right Abutment Removal - Remove Hand Placed Riprap	U342		RiskPert(S342,R342,T342,RiskName(B342&C342&H342))	11675.46	13964.77	$17,169.80
41Copco 2Right Abutment Removal - Gunite Curtain Wall	U343		RiskPert(S343,R343,T343,RiskName(B343&C343&H343))	57435.87	68697.8	$84,464.52
41Copco 2Remove & Dispose - Hand rails and Light Poles	U344		RiskPert(S344,R344,T344,RiskName(B344&C344&H344))	3999.98	4745.07	$5,647.03
41Copco 2Remove & Dispose - Radial Gates and Hoists	U345		RiskPert(S345,R345,T345,RiskName(B345&C345&H345))	51107.18	62130.3	$81,170.23
41Copco 2Remove & Dispose - 5-Radial Gate Stop logs & Slots (steel)	U346		RiskPert(S346,R346,T346,RiskName(B346&C346&H346))	85460.59	103893.3	$135,731.50
41Copco 2Remove & Dispose - Spillway intake gate motor & control panel	U347		RiskPert(S347,R347,T347,RiskName(B347&C347&H347))	1313.37	1471.46	$1,678.20
41Copco 2Remove & Dispose - Spillway radial gate motor & control panel	U348		RiskPert(S348,R348,T348,RiskName(B348&C348&H348))	1313.37	1471.46	$1,678.20
41Copco 2Remove & Dispose - Spillway trash rake motor, festoon cable & control panel	U349		RiskPert(S349,R349,T349,RiskName(B349&C349&H349))	558.13	625.32	$713.17
41Copco 2Remove & Dispose - Distribution equipment, panelboards	U350		RiskPert(S350,R350,T350,RiskName(B350&C350&H350))	5950.3	6666.54	$7,603.16
41Copco 2Remove Copper Shingles from Roof of Powerhouse	U351		RiskPert(S351,R351,T351,RiskName(B351&C351&H351))	13838.26	16280.31	$18,722.36
41Copco 2Remove Powerhouse Concrete down to spring-line of turbine	U352		RiskPert(S352,R352,T352,RiskName(B352&C352&H352))	545667.9	674060.4	$930,845.30
41Copco 2Remove Structural Steel items associated with Powerhouse	U353		RiskPert(S353,R353,T353,RiskName(B353&C353&H353))	190560.3	246140.4	$333,480.50
41Copco 2Remove Control House Concrete	U354		RiskPert(S354,R354,T354,RiskName(B354&C354&H354))	8579.07	10991.93	$14,477.18
41Copco 2Remove Control House Structural Steel Items	U355		RiskPert(S355,R355,T355,RiskName(B355&C355&H355))	2779.26	3589.88	$4,863.70
41Copco 2Remove Shop Building	U356		RiskPert(S356,R356,T356,RiskName(B356&C356&H356))	268728.1	341508.7	$436,683.20
41Copco 2Remove & Dispose - 2 - Governor oil systems	U357		RiskPert(S357,R357,T357,RiskName(B357&C357&H357))	38633.29	46208.44	$56,813.66
41Copco 2Remove & Dispose - Cooling water and bearing oil systems	U358		RiskPert(S358,R358,T358,RiskName(B358&C358&H358))	11869.83	14197.25	$17,455.64
41Copco 2Remove & Dispose - 12 - Cast Iron Columns	U360		RiskPert(S360,R360,T360,RiskName(B360&C360&H360))	40218.22	50272.77	$60,327.32
41Copco 2Remove & Dispose - 2 - Francis Turbines	U361		RiskPert(S361,R361,T361,RiskName(B361&C361&H361))	492692.5	626130	$800,625.30
41Copco 2Remove & Dispose - 2 - 40 Ton indoor cranes	U362		RiskPert(S362,R362,T362,RiskName(B362&C362&H362))	146926.3	186718.8	$238,755.30
41Copco 2Remove & Dispose - Compressed Air Systems	U363		RiskPert(S363,R363,T363,RiskName(B363&C363&H363))	1079.6	1291.28	$1,587.65
41Copco 2Remove & Dispose - 2 - CO2 Systems	U364		RiskPert(S364,R364,T364,RiskName(B364&C364&H364))	2460.27	2942.68	$3,618.05
41Copco 2Remove & Dispose - Plant Water and Fire Protection	U365		RiskPert(S365,R365,T365,RiskName(B365&C365&H365))	4181.19	5001.03	$6,148.81
41Copco 2Remove & Dispose - Transformer Oil Fire Protection	U366		RiskPert(S366,R366,T366,RiskName(B366&C366&H366))	5386.18	6442.3	$7,920.86

Name	Cell	Graph	Function	Min	Mean	Max
41Copco 2Remove & Dispose - Unwatering Piping	U367	22,000 34,000	RiskPert(S367,R367,T367,RiskName(B367&C367&H367))	23058.1	27579.29	$33,908.96
41Copco 2Remove & Dispose - Drainage Piping	U368	13,000 20,000	RiskPert(S368,R368,T368,RiskName(B368&C368&H368))	13267.99	15869.55	$19,511.75
41Copco 2Remove & Dispose - Petroleum Products from Mechanical Equip.	U369	15,000 19,500	RiskPert(S369,R369,T369,RiskName(B369&C369&H369))	15157.02	16981.48	$19,367.31
41Copco 2Remove & Dispose - Remove Petroleum Products at or near the Power House	U370	15,000 19,500	RiskPert(S370,R370,T370,RiskName(B370&C370&H370))	15157.02	16981.48	$19,367.31
41Copco 2Remove & Dispose - AC Generator, Indoor Vertical	U371	165,000 215,000	RiskPert(S371,R371,T371,RiskName(B371&C371&H371))	166628.1	186685.2	$212,913.60
41Copco 2Remove & Dispose - Excitation equipment for 15 MVA Generator	U372	16,500 21,500	RiskPert(S372,R372,T372,RiskName(B372&C372&H372))	16550.3	18542.47	$21,147.61
41Copco 2Remove & Dispose - Surge protection equip. for 15 MVA Generator	U373	5,200 6,800	RiskPert(S373,R373,T373,RiskName(B373&C373&H373))	5229.24	5858.68	$6,681.80
41Copco 2Remove & Dispose - Neutral grounding equip. for 15 MVA Generator	U374	5,000 6,600	RiskPert(S374,R374,T374,RiskName(B374&C374&H374))	5091.69	5704.58	$6,506.05
41Copco 2Remove & Dispose - Generator Switchgear, 7.2kV-includes unit breakers	U375	27,000 36,000	RiskPert(S375,R375,T375,RiskName(B375&C375&H375))	27678.62	31010.31	$35,367.13
41Copco 2Remove & Dispose - Station Service Switchgear, 600-volt (5 sections)	U376	24,000 32,000	RiskPert(S376,R376,T376,RiskName(B376&C376&H376))	24381.7	27316.54	$31,154.40
41Copco 2Remove & Dispose - Unit and plant control switchboard	U377	7,500 10,000	RiskPert(S377,R377,T377,RiskName(B377&C377&H377))	7645.41	8565.69	$9,769.13
41Copco 2Remove & Dispose - Battery system	U378	10,500 14,000	RiskPert(S378,R378,T378,RiskName(B378&C378&H378))	10602.84	11879.11	$13,548.08
41Copco 2Remove & Dispose - Raceways, Conduit and Cable	U379	15,500 20,000	RiskPert(S379,R379,T379,RiskName(B379&C379&H379))	15574.69	17449.42	$19,900.99
41Copco 2Remove & Dispose - Misc. Power & Control Boards	U380	5,600 7,600	RiskPert(S380,R380,T380,RiskName(B380&C380&H380))	5795.3	6492.88	$7,405.10
41Copco 2Remove & Dispose - 7 - 40-Ton Travelling Crane motors-hoist (2-30Hp)	U381	3,400 4,800	RiskPert(S381,R381,T381,RiskName(B381&C381&H381))	3592.84	4058.58	$4,790.46
41Copco 2Remove & Dispose - 40-Ton Travelling Crane control equipment	U382	11,000 15,500	RiskPert(S382,R382,T382,RiskName(B382&C382&H382))	11341.74	12811.97	$15,122.33
41Copco 2Remove & Dispose - 40-Ton Travelling Crane Festoon Cable	U383	2,500 3,500	RiskPert(S383,R383,T383,RiskName(B383&C383&H383))	2589.31	2924.97	$3,452.42
41Copco 2Remove Oil from Oil-Filled Step-up Transformers	U384	230,000 320,000	RiskPert(S384,R384,T384,RiskName(B384&C384&H384))	232965.2	274076.8	$315,188.30
41Copco 2Remove Intake Structure Concrete	U385	450,000 850,000	RiskPert(S385,R385,T385,RiskName(B385&C385&H385))	472788.1	588667.6	$834,331.90
41Copco 2Remove Concrete Items associated with 16-foot I.D. Wood Stave Pipe	U386	350,000 650,000	RiskPert(S386,R386,T386,RiskName(B386&C386&H386))	374992.7	463226.3	$639,693.50
41Copco 2Place Concrete Plugs for Tunnels	U387	170,000 270,000	RiskPert(S387,R387,T387,RiskName(B387&C387&H387))	174692.4	210658.5	$267,176.70
41Copco 2Remove & Dispose of Caterpillar Gate (steel)	U389	42,000 60,000	RiskPert(S389,R389,T389,RiskName(B389&C389&H389))	43861.63	51601.91	$59,342.20
41Copco 2Remove & Dispose of Trash rack and trash rake (steel)	U390	50,000 80,000	RiskPert(S390,R390,T390,RiskName(B390&C390&H390))	51989.57	62693.3	$79,513.45
41Copco 2Remove & Dispose of Stop Logs and slots for intake (steel)	U391	160,000 250,000	RiskPert(S391,R391,T391,RiskName(B391&C391&H391))	163303.2	196924.5	$249,757.90

Name	Cell	Graph	Function	Min	Mean	Max
41Copco 2Remove & Dispose of Bands (steel)	U394	300,000 650,000	RiskPert(S394,R394,T394,RiskName(B394&C394&H394))	336046.6	480066.5	$624,086.40
41Copco 2Remove & Dispose of Penstock after bifurcation to butterfly valves	U395	0.70m 1.40m	RiskPert(S395,R395,T395,RiskName(B395&C395&H395))	728831.3	1041188	$1,353,544.00
41Copco 2Remove & Dispose of Bifurcated vent pipes and support structure	U396	16,000 34,000	RiskPert(S396,R396,T396,RiskName(B396&C396&H396))	17349.06	24784.37	$32,219.69
41Copco 2Remove & Dispose of 2 - 138" Butterfly Valves	U397	100,000 200,000	RiskPert(S397,R397,T397,RiskName(B397&C397&H397))	102288.9	146127	$189,965.10
41Copco 2Disconnect and Remove Medium Voltage Circuit Breakers 115KV @ Substation	U398	1,200 2,200	RiskPert(S398,R398,T398,RiskName(B398&C398&H398))	1297.18	1589.69	$2,136.54
41Copco 2Disconnect and Remove Medium Voltage Circuit Breakers 69KV @ Substation	U399	2,800 4,800	RiskPert(S399,R399,T399,RiskName(B399&C399&H399))	2824.62	3461.54	$4,652.31
41Copco 2Disconnect and Remove Transformers 12KV @ substation	U400	700 1,300	RiskPert(S400,R400,T400,RiskName(B400&C400&H400))	781	957.11	$1,286.35
41Copco 2Disconnect and Remove cable connection between Copco 2 and HE plant At substation	U401	9,000 15,000	RiskPert(S401,R401,T401,RiskName(B401&C401&H401))	9050.96	11091.86	$14,907.46
41Copco 2Remove All associated Aux Equipment @ substation (allowance)	U402	22,000 40,000	RiskPert(S402,R402,T402,RiskName(B402&C402&H402))	23123.96	28338.19	$38,086.52
41Copco 2Demolish overhead transmission line and structure 69KV Copco #1 to Iron Gate	U403	550,000 950,000	RiskPert(S403,R403,T403,RiskName(B403&C403&H403))	568821.4	697085.1	$936,882.40
41Copco 2Demolish transmission conductor from existing structure pole. Structures to Remain	U404	10,000 17,000	RiskPert(S404,R404,T404,RiskName(B404&C404&H404))	10144.44	12431.92	$16,708.50

Iron Gate

Name	Cell	Graph	Function	Min	Mean	Max
41Iron GateFurnish, Install, and Remove Barge-Mounted Crane in Reservoir	U407	190,000 250,000	RiskPert(S407,R407,T407,RiskName(B407&C407&H407))	194197.5	217573.1	$248,141.20
41Iron GateFurnish, Install, and Remove Temporary Air Vent Hose from Barge to Diversion Tunnel Intake Structure	U408	15,000 22,000	RiskPert(S408,R408,T408,RiskName(B408&C408&H408))	15080.74	17889.9	$21,290.46
41Iron GateRemove Reinforced Concrete Stoplog Structure	U410	10,500 13,500	RiskPert(S410,R410,T410,RiskName(B410&C410&H410))	10560.4	11831.56	$13,493.85
41Iron GateRemove Water from behind Tailrace Cofferdam	U411	2,800 4,200	RiskPert(S411,R411,T411,RiskName(B411&C411&H411))	2994.52	3522.97	$4,051.41
41Iron GateProvide Dewatering behind Tailrace Cofferdam for removal of Powerhouse in the dry	U412	28,000 39,000	RiskPert(S412,R412,T412,RiskName(B412&C412&H412))	28170.54	33141.8	$38,113.08
41Iron GateConstruct Embankment Cofferdam across Tailrace to remove Powerhouse in dry	U413	180,000 240,000	RiskPert(S413,R413,T413,RiskName(B413&C413&H413))	187234.8	209772.3	$239,244.40
41Iron GateUpstream Cofferdam to be Removed in the Wet	U414	280,000 390,000	RiskPert(S414,R414,T414,RiskName(B414&C414&H414))	281114.9	330723.4	$380,332.00
41Iron GateRemove 9' dia. hinged blind flange	U415	115,000 170,000	RiskPert(S415,R415,T415,RiskName(B415&C415&H415))	117959.6	139932.5	$166,531.20
41Iron GateRemove 18" plug valve and 7' of 18" drainage pipe	U416	6,500 10,000	RiskPert(S416,R416,T416,RiskName(B416&C416&H416))	6751.37	8008.98	$9,531.35
41Iron GateFurnish and Install 1-16.5'x18' roller gate, stem, and operator in Wet	U417	3.80m 4.70m	RiskPert(S417,R417,T417,RiskName(B417&C417&H417))	3804057	4226730	$4,649,403.00
41Iron GateRemove Existing sluice and diversion gates from shaft by divers	U418	480,000 600,000	RiskPert(S418,R418,T418,RiskName(B418&C418&H418))	488298.2	542553.5	$596,808.90
41Iron GateRemove 16.5'X 18' sluice and diversion gates from shaft in Dry	U419	64,000 80,000	RiskPert(S419,R419,T419,RiskName(B419&C419&H419))	65010.53	72233.92	$79,457.31
41Iron GateRemove Concrete in Observation Platform, Crest Wall and Wall Extension	U420	230,000 290,000	RiskPert(S420,R420,T420,RiskName(B420&C420&H420))	235956.9	262174.3	$288,391.80

Name	Cell	Graph	Function	Min	Mean	Max
41Iron GateRemove Concrete in Diversion Tunnel Intake Structure	U421	210,000 280,000	RiskPert(S421,R421,T421,RiskName(B421&C421&H421))	217197.4	243341.5	$277,530.00
41Iron GateRemove Concrete in Diversion Tunnel Gate Tower	U422	120,000 170,000	RiskPert(S422,R422,T422,RiskName(B422&C422&H422))	122202.4	143767.5	$165,332.60
41Iron GateRemove Steel Footbridge to Gate Tower	U423	13,500 18,500	RiskPert(S423,R423,T423,RiskName(B423&C423&H423))	13633.44	16039.34	$18,445.24
41Iron GateRemove Concrete in Diversion Tunnel Footbridge Abutment	U424	7,000 10,000	RiskPert(S424,R424,T424,RiskName(B424&C424&H424))	7381.19	8683.75	$9,986.32
41Iron GatePlace Concrete Plugs for Diversion Tunnel	U425	72,000 90,000	RiskPert(S425,R425,T425,RiskName(B425&C425&H425))	72790.67	80878.53	$88,966.38
41Iron GateRemove Concrete Closure Gates in Gate Tower	U426	70,000 100,000	RiskPert(S426,R426,T426,RiskName(B426&C426&H426))	72664.06	85487.13	$98,310.20
41Iron GateRemove Upstream Riprap	U427	1.80m 2.70m	RiskPert(S427,R427,T427,RiskName(B427&C427&H427))	1859375	2205729	$2,625,000.00
41Iron GateRemove Downstream Riprap	U428	340,000 500,000	RiskPert(S428,R428,T428,RiskName(B428&C428&H428))	349829.1	414993.4	$493,876.40
41Iron GateMiscellaneous Excavation	U429	1.70m 2.50m	RiskPert(S429,R429,T429,RiskName(B429&C429&H429))	1735814	2059152	$2,450,561.00
41Iron GateMiscellaneous Excavation	U430	11.00m 16.00m	RiskPert(S430,R430,T430,RiskName(B430&C430&H430))	11317570	13425740	$15,977,740.00
41Iron GateCutoff Wall Concrete Demolition	U431	270,000 360,000	RiskPert(S431,R431,T431,RiskName(B431&C431&H431))	278744.4	312297	$356,173.40
41Iron GateEarth Fill Crest Raise	U432	190,000 270,000	RiskPert(S432,R432,T432,RiskName(B432&C432&H432))	194899	229293	$263,687.00
41Iron GateSheet pile Crest Raise	U433	210,000 300,000	RiskPert(S433,R433,T433,RiskName(B433&C433&H433))	215078.8	253033.8	$290,988.90
41Iron GateRemove 5 Monitoring Wells	U434	11,500 15,500	RiskPert(S434,R434,T434,RiskName(B434&C434&H434))	11808.42	13229.8	$15,088.53
41Iron GateRemove and Dispose of Trash Sluice Gate - 10 ft x 9 ft H	U435	3,500 6,500	RiskPert(S435,R435,T435,RiskName(B435&C435&H435))	3833.76	5111.68	$6,389.60
41Iron GateRemove and Dispose of Intake Structure	U436	60,000 90,000	RiskPert(S436,R436,T436,RiskName(B436&C436&H436))	61826.99	73343.78	$87,285.16
41Iron GateRemove and Dispose of Sluice and Diversion Tunnel Gate	U437	28,000 42,000	RiskPert(S437,R437,T437,RiskName(B437&C437&H437))	29304.43	34763.09	$41,370.96
41Iron GateRemove and Dispose of Hoist Stem - 6" Dia. Sch 160x150'	U438	7,000 10,500	RiskPert(S438,R438,T438,RiskName(B438&C438&H438))	7245.46	8595.1	$10,228.88
41Iron GateRemove and Dispose of Air Vent Pipe - 8" Dia. Sch 40 x160'	U439	9,000 13,500	RiskPert(S439,R439,T439,RiskName(B439&C439&H439))	9422.65	11177.85	$13,302.57
41Iron GateRemove and Dispose of Air Vent Pipe - 12" Dia. Sch 40 x560'	U440	65,000 95,000	RiskPert(S440,R440,T440,RiskName(B440&C440&H440))	65354.76	77528.69	$92,265.55
41Iron GateRemove and Dispose of Outlet Works Stop Logs	U441	2,200 3,800	RiskPert(S441,R441,T441,RiskName(B441&C441&H441))	2274.7	3032.93	$3,791.16
41Iron GateRemove and Dispose of Hydraulic Pump Motor (10 HP est) & control panel	U442	350 600	RiskPert(S442,R442,T442,RiskName(B442&C442&H442))	350.8	467.74	$584.67
41Iron GateRemove and Dispose of Distribution Equipment, Junction Boxes	U443	1,600 3,000	RiskPert(S443,R443,T443,RiskName(B443&C443&H443))	1703.89	2271.86	$2,839.82
41Iron GateRemove and Dispose of Power Cable and 4" Conduit from Penstock Structure	U444	38,000 52,000	RiskPert(S444,R444,T444,RiskName(B444&C444&H444))	38137.33	44867.45	$51,597.56

Name	Cell	Graph	Function	Min	Mean	Max
41Iron GateRemove Powerhouse Concrete	U445	2.10m 2.80m	RiskPert(S445,R445,T445,RiskName(B445&C445&H445))	2118164	2373128	$2,706,543.00
41Iron GateRemove and Dispose of Turbine Unit	U446	300,000 440,000	RiskPert(S446,R446,T446,RiskName(B446&C446&H446))	313213.6	368486.6	$423,759.50
41Iron GateRemove and Dispose of Draft Tube Bulkheads	U447	15,000 22,000	RiskPert(S447,R447,T447,RiskName(B447&C447&H447))	15523.22	18414.8	$21,915.13
41Iron GateRemove and Dispose of Crane	U448	24,000 38,000	RiskPert(S448,R448,T448,RiskName(B448&C448&H448))	24494.88	29297.8	$36,021.89
41Iron GateRemove and Dispose of Governor	U449	20,000 29,000	RiskPert(S449,R449,T449,RiskName(B449&C449&H449))	20110.76	23856.88	$28,391.66
41Iron GateRemove and Dispose of Bearing Oil System and Cooling Water System	U450	9,000 13,500	RiskPert(S450,R450,T450,RiskName(B450&C450&H450))	9332.82	11071.29	$13,175.75
41Iron GateRemove and Dispose of CO2 Systems	U451	2,600 3,600	RiskPert(S451,R451,T451,RiskName(B451&C451&H451))	2635.77	2977.44	$3,514.35
41Iron GateRemove and Dispose of Plant Water and Fire Protection System	U452	9,500 13,000	RiskPert(S452,R452,T452,RiskName(B452&C452&H452))	9714.38	10973.65	$12,952.51
41Iron GateRemove and Dispose of Sump Pumps	U453	2,100 2,900	RiskPert(S453,R453,T453,RiskName(B453&C453&H453))	2117.71	2392.23	$2,823.61
41Iron GateRemove and Dispose of Pumps	U454	24,000 33,000	RiskPert(S454,R454,T454,RiskName(B454&C454&H454))	24382.46	27543.15	$32,509.94
41Iron GateRemove and Dispose of Exposed Piping Around the Plant	U455	20,000 28,000	RiskPert(S455,R455,T455,RiskName(B455&C455&H455))	20536.19	23198.28	$27,381.58
41Iron GateRemove and Dispose of Unwatering Piping	U456	17,000 22,000	RiskPert(S456,R456,T456,RiskName(B456&C456&H456))	17176.54	19244.09	$21,947.80
41Iron GateRemove and Dispose of Drainage Piping	U457	10,500 14,000	RiskPert(S457,R457,T457,RiskName(B457&C457&H457))	10788.88	12087.55	$13,785.80
41Iron GateRemove and Dispose of Transformer Oil and Fire Protection	U458	9,800 11,400	RiskPert(S458,R458,T458,RiskName(B458&C458&H458))	9829.98	10433.57	$11,382.08
41Iron GateRemove and Dispose of Compressed Air System	U459	1,300 1,700	RiskPert(S459,R459,T459,RiskName(B459&C459&H459))	1329.06	1489.04	$1,698.25
41Iron GateRemove & Dispose - Petroleum Products from Mechanical Equip.	U460	11,800 13,800	RiskPert(S460,R460,T460,RiskName(B460&C460&H460))	11815.71	12541.24	$13,681.35
41Iron GateRemove and Dispose of AC Generator, Outdoor Horizontal	U461	90,000 120,000	RiskPert(S461,R461,T461,RiskName(B461&C461&H461))	92287.2	103395.9	$117,922.50
41Iron GateRemove and Dispose of Excitation equipment for 18.975 MVA Generator	U462	2,400 3,100	RiskPert(S462,R462,T462,RiskName(B462&C462&H462))	2414.25	2704.86	$3,084.88
41Iron GateRemove and Dispose of Surge protection equip. for 18.975 MVA Generator	U463	1,900 2,500	RiskPert(S463,R463,T463,RiskName(B463&C463&H463))	1914.46	2144.9	$2,446.25
41Iron GateRemove and Dispose of Neutral grounding equip. for 18.975 MVA Generator	U464	4,000 5,200	RiskPert(S464,R464,T464,RiskName(B464&C464&H464))	4029.6	4514.64	$5,148.93
41Iron GateRemove and Dispose of Station Service Switchgear, 600 volt - (5 sections)	U465	7,000 10,000	RiskPert(S465,R465,T465,RiskName(B465&C465&H465))	7470.29	8369.5	$9,545.38
41Iron GateRemove and Dispose of Unit and plant control switchboard	U466	24,000 31,000	RiskPert(S466,R466,T466,RiskName(B466&C466&H466))	24245.35	27163.77	$30,980.17
41Iron GateRemove and Dispose of Battery System - assume 60 batteries, charger	U467	15,500 20,000	RiskPert(S467,R467,T467,RiskName(B467&C467&H467))	15540.22	17410.81	$19,856.95
41Iron GateRemove and Dispose of Raceways, Bus, Conduit and Cable	U468	18,000 24,000	RiskPert(S468,R468,T468,RiskName(B468&C468&H468))	18579.86	20816.33	$23,740.94

Name	Cell	Graph	Function	Min	Mean	Max
41Iron GateRemove and Dispose of Misc. power & control boards	U469	5,600 7,400	RiskPert(S469,R469,T469,RiskName(B469&C469&H469))	5712.68	6400.32	$7,299.54
41Iron GateRemove and Dispose of Governor Oil Pump Motors (10 hp and 20 hp est.)	U471	480 640	RiskPert(S471,R471,T471,RiskName(B471&C471&H471))	495.05	554.64	$632.57
41Iron GateRemove and Dispose of Vertical Motors, outdoor, (480V, 100 HP est.)	U472	2,400 4,200	RiskPert(S472,R472,T472,RiskName(B472&C472&H472))	2405.5	3207.33	$4,009.16
41Iron GateRemove and Dispose of Step-up Transformer, outdoor, oil-filled, 3-phase	U474	85,000 115,000	RiskPert(S474,R474,T474,RiskName(B474&C474&H474))	86600.01	97024.09	$110,655.60
41Iron GateRemove and Dispose of Lattice steel structure, with 69-kV disconnect	U475	7,000 9,200	RiskPert(S475,R475,T475,RiskName(B475&C475&H475))	7060.15	7909.99	$9,021.31
41Iron GateRemove and Dispose of Generator Switchgear, outdoor, 7.2kV	U476	24,000 32,000	RiskPert(S476,R476,T476,RiskName(B476&C476&H476))	24790.72	27774.79	$31,677.03
41Iron GateRemove and Dispose of Single Phase Pole Transformers (25 kVA est.)	U477	7,500 10,000	RiskPert(S477,R477,T477,RiskName(B477&C477&H477))	7636.08	8555.24	$9,757.21
41Iron GateRemove Concrete in Penstock Intake Structure	U478	130,000 185,000	RiskPert(S478,R478,T478,RiskName(B478&C478&H478))	133064.3	156546.3	$180,028.20
41Iron GateRemove Concrete in Penstock Encasement	U479	210,000 280,000	RiskPert(S479,R479,T479,RiskName(B479&C479&H479))	215754.3	241724.8	$275,686.10
41Iron GateRemove Concrete in 3 Penstock Anchors and 7 Penstock Supports	U480	0.85m 1.25m	RiskPert(S480,R480,T480,RiskName(B480&C480&H480))	888667	1045491	$1,202,314.00
41Iron GateRemove Steel Footbridge to Intake Structure	U481	11,500 16,000	RiskPert(S481,R481,T481,RiskName(B481&C481&H481))	11627.99	13679.99	$15,731.99
41Iron GateRemove Concrete in Intake Structure Footbridge Abutment	U482	3,800 5,400	RiskPert(S482,R482,T482,RiskName(B482&C482&H482))	3922.92	4615.2	$5,307.48
41Iron GateRemove and Dispose of Intake Structure	U483	130,000 180,000	RiskPert(S483,R483,T483,RiskName(B483&C483&H483))	130418	153433	$176,447.90
41Iron GateRemove and Dispose of Gate Hoist Stem - 6" Sch160x40'	U484	1,400 2,600	RiskPert(S484,R484,T484,RiskName(B484&C484&H484))	1533.5	2044.67	$2,555.84
41Iron GateRemove and Dispose of Water Fill line- 12" Dia STD x 27'	U485	1,100 2,000	RiskPert(S485,R485,T485,RiskName(B485&C485&H485))	1150.13	1533.5	$1,916.88
41Iron GateRemove and Dispose of Air Vent - 12" Dia STD x 32'	U486	1,300 2,300	RiskPert(S486,R486,T486,RiskName(B486&C486&H486))	1363.11	1817.49	$2,271.86
41Iron GateRemove and Dispose of Gage Wells	U487	2,200 3,800	RiskPert(S487,R487,T487,RiskName(B487&C487&H487))	2225.28	2967.05	$3,708.81
41Iron GateRemove and Dispose of Penstock Vent - 46" Dia, 0.25" Thick x 60'	U488	14,000 21,000	RiskPert(S488,R488,T488,RiskName(B488&C488&H488))	14788.02	17397.67	$20,007.32
41Iron GateRemove and Dispose of Penstock - 12" Dia, 0.25" Thick x 698'	U489	400,000 580,000	RiskPert(S489,R489,T489,RiskName(B489&C489&H489))	414064.5	487134.8	$560,204.90
41Iron GateRemove and Dispose of Bypass Outlet - 96" Dia, 0.25" Thick x 50'	U490	11,000 15,000	RiskPert(S490,R490,T490,RiskName(B490&C490&H490))	11040.59	12988.93	$14,937.27
41Iron GateRemove and Dispose of Outlet Valve on bypass outlet - 66" Dia.	U491	27,000 38,000	RiskPert(S491,R491,T491,RiskName(B491&C491&H491))	27912.44	32838.16	$37,763.89
41Iron GateRemove and Dispose Overhead trolley Crane Motor (4hp est) & Controls	U492	1,000 1,700	RiskPert(S492,R492,T492,RiskName(B492&C492&H492))	1002.29	1336.39	$1,670.48
41Iron GateRemove and Dispose Distribution equipment, Junction Boxes	U493	2,400 4,200	RiskPert(S493,R493,T493,RiskName(B493&C493&H493))	2505.73	3340.97	$4,176.21
41Iron GateRemove and Dispose Power Cable and Conduit	U494	85,000 120,000	RiskPert(S494,R494,T494,RiskName(B494&C494&H494))	87710.75	103189.1	$118,667.50

Name	Cell	Graph	Function	Min	Mean	Max
41Iron GateClear and Grub Disposal Area	U495	170,000 240,000	RiskPert(S495,R495,T495,RiskName(B495&C495&H495))	174480.6	205271.3	$236,062.00
41Iron GateRemove Building No. 2	U496	58,000 76,000	RiskPert(S496,R496,T496,RiskName(B496&C496&H496))	59126.73	66243.84	$75,550.83
41Iron GateRemove Building No. 3	U497	80,000 110,000	RiskPert(S497,R497,T497,RiskName(B497&C497&H497))	83216.66	93233.48	$106,332.40
41Iron GateRemove Concrete in Fish Ladder	U498	340,000 500,000	RiskPert(S498,R498,T498,RiskName(B498&C498&H498))	355912.5	418720.6	$481,528.70
41Iron GateRemove Concrete in Holding Ponds #1 thru #6	U499	270,000 360,000	RiskPert(S499,R499,T499,RiskName(B499&C499&H499))	273877.9	306844.7	$349,955.00
41Iron GateRemove Concrete in Fish Facility Items	U500	220,000 310,000	RiskPert(S500,R500,T500,RiskName(B500&C500&H500))	222619.1	261904.8	$301,190.50
41Iron GateRemove Miscellaneous Metalwork in Fish Facilities	U501	10,500 15,500	RiskPert(S501,R501,T501,RiskName(B501&C501&H501))	10852.91	12874.53	$15,321.76
41Iron GateRemove Concrete Associated with 30" Dia. water supply line	U502	14,000 21,000	RiskPert(S502,R502,T502,RiskName(B502&C502&H502))	14841.27	17460.32	$20,079.37
41Iron GateRemove Concrete in Aerator Structure	U503	11,500 16,500	RiskPert(S503,R503,T503,RiskName(B503&C503&H503))	11884.4	13981.65	$16,078.89
41Iron GateRemove Wood in Aerator Structure	U504	4,000 7,500	RiskPert(S504,R504,T504,RiskName(B504&C504&H504))	4209.62	5612.82	$7,016.03
41Iron GateRemove Structural Steel in Aerator Structure	U505	2,000 3,600	RiskPert(S505,R505,T505,RiskName(B505&C505&H505))	2129.87	2839.82	$3,549.78
41Iron GateRemove Asphalt Pavement	U506	24,000 33,000	RiskPert(S506,R506,T506,RiskName(B506&C506&H506))	24370.47	28671.15	$32,971.82
41Iron GateRemove Restroom Building near Aerator Structure	U507	20,000 27,000	RiskPert(S507,R507,T507,RiskName(B507&C507&H507))	20782.32	23283.9	$26,555.19
41Iron GateRemove Storage Shed near Aerator Structure	U508	6,200 8,200	RiskPert(S508,R508,T508,RiskName(B508&C508&H508))	6397.93	7168.06	$8,175.14
41Iron GateRemove Toe Drain Pipe	U509	6,500 9,500	RiskPert(S509,R509,T509,RiskName(B509&C509&H509))	6712.8	7897.42	$9,082.03
41Iron GateRemove Toe Drain Manhole	U510	1,200 2,100	RiskPert(S510,R510,T510,RiskName(B510&C510&H510))	1252.86	1670.48	$2,088.10
41Iron GateBerm Removal	U511	700,000 950,000	RiskPert(S511,R511,T511,RiskName(B511&C511&H511))	741625.5	830895.3	$947,632.60
41Iron GateRemove and Dispose of Intake Structures Trashracks	U512	3,500 6,500	RiskPert(S512,R512,T512,RiskName(B512&C512&H512))	3758.59	5011.45	$6,264.31
41Iron GateRemove and Dispose of Pipe Conduit, 30" Dia. x 0.25" Thick x 960'	U513	75,000 110,000	RiskPert(S513,R513,T513,RiskName(B513&C513&H513))	75485.27	89546.25	$106,567.40
41Iron GateRemove and Dispose of Sluice Gate Valve, 30" Dia.	U514	2,400 4,400	RiskPert(S514,R514,T514,RiskName(B514&C514&H514))	2555.84	3407.79	$4,259.73
41Iron GateRemove and Dispose of Sluice Gate Stem, 2" Dia. Sch160x45'	U515	300 550	RiskPert(S515,R515,T515,RiskName(B515&C515&H515))	306.7	408.93	$511.17
41Iron GateRemove and Dispose of Butterfly Valve, 30" Dia.	U516	2,000 3,600	RiskPert(S516,R516,T516,RiskName(B516&C516&H516))	2074.49	2765.99	$3,457.48
41Iron GateRemove and Dispose of Piping- 30-in. Dia. x 0.25 Thickness x 90'	U517	4,000 6,000	RiskPert(S517,R517,T517,RiskName(B517&C517&H517))	4141.6	4913.08	$5,846.97
41Iron GateRemove and Dispose of Piping- 24-in. Dia. x 0.25 Thickness x 248'	U518	7,500 11,000	RiskPert(S518,R518,T518,RiskName(B518&C518&H518))	7653.69	9079.38	$10,805.21

Name	Cell	Graph	Function	Min	Mean	Max
41Iron GateRemove and Dispose of Piping- 20-in. Dia. x 0.25 Thickness x 85'	U519	2,400 3,600	RiskPert(S519,R519,T519,RiskName(B519&C519&H519))	2484.96	2947.85	$3,508.18
41Iron GateRemove and Dispose of Piping- 18-in. Dia. x 0.25 Thickness x 432'	U520	10,500 15,500	RiskPert(S520,R520,T520,RiskName(B520&C520&H520))	10627.39	12607	$15,003.38
41Iron GateRemove and Dispose of Piping- 16-in. Dia. x 0.25 Thickness x 166'	U521	3,600 5,400	RiskPert(S521,R521,T521,RiskName(B521&C521&H521))	3727.44	4421.77	$5,262.27
41Iron GateRemove and Dispose of Piping- 12-in. Dia. x 0.25 Thickness x 64'	U522	900 1,350	RiskPert(S522,R522,T522,RiskName(B522&C522&H522))	948.43	1125.1	$1,338.96
41Iron GateRemove and Dispose of Piping- 10-in. Dia. x 0.25 Thickness x 69'	U523	800 1,200	RiskPert(S523,R523,T523,RiskName(B523&C523&H523))	825.83	979.66	$1,165.87
41Iron GateRemove and Dispose of Piping- 8-in. Dia. x 0.25 Thickness x 30'	U524	750 1,150	RiskPert(S524,R524,T524,RiskName(B524&C524&H524))	782.33	928.06	$1,104.46
41Iron GateRemove and Dispose of Piping- 3-in. Dia. x STD x 30'	U525	380 560	RiskPert(S525,R525,T525,RiskName(B525&C525&H525))	393.89	467.27	$556.08
41Iron GateRemove and Dispose of Gate Valves	U526	20,000 29,000	RiskPert(S526,R526,T526,RiskName(B526&C526&H526))	20377.55	24173.37	$28,768.31
41Iron GateRemove and Dispose of Basin #1	U527	7,500 11,500	RiskPert(S527,R527,T527,RiskName(B527&C527&H527))	7970.3	9454.96	$11,252.19
41Iron GateRemove and Dispose of Basin #2	U528	7,500 11,500	RiskPert(S528,R528,T528,RiskName(B528&C528&H528))	7970.3	9454.96	$11,252.19
41Iron GateRemove and Dispose of Basin #3	U529	7,500 11,500	RiskPert(S529,R529,T529,RiskName(B529&C529&H529))	7970.3	9454.96	$11,252.19
41Iron GateRemove and Dispose of Basin #4	U530	7,500 11,500	RiskPert(S530,R530,T530,RiskName(B530&C530&H530))	7970.3	9454.96	$11,252.19
41Iron GateRemove and Dispose of Basin #5	U531	7,500 11,500	RiskPert(S531,R531,T531,RiskName(B531&C531&H531))	7970.3	9454.96	$11,252.19
41Iron GateRemove and Dispose of Basin #6	U532	7,500 11,500	RiskPert(S532,R532,T532,RiskName(B532&C532&H532))	7970.3	9454.96	$11,252.19
41Iron GateRemove and Dispose of Holding Tank	U533	10,500 15,500	RiskPert(S533,R533,T533,RiskName(B533&C533&H533))	10857.38	12879.83	$15,328.06
41Iron GateRemove and Dispose of Misc.: Motors, control panels, cables, conduit	U534	1,400 2,600	RiskPert(S534,R534,T534,RiskName(B534&C534&H534))	1503.44	2004.58	$2,505.73
41Iron GateWanaka Springs - Concrete Total	U535	8,000 11,500	RiskPert(S535,R535,T535,RiskName(B535&C535&H535))	8199.73	9646.75	$11,093.76
41Iron GateWanaka Springs - Double Pipe Railings	U536	2,400 4,200	RiskPert(S536,R536,T536,RiskName(B536&C536&H536))	2405.5	3207.33	$4,009.16
41Iron GateWanaka Springs - Wood picnic tables to be removed and hauled	U537	500 850	RiskPert(S537,R537,T537,RiskName(B537&C537&H537))	501.15	668.19	$835.24
41Iron GateWanaka Springs - 25'x5' Wooden floating dock	U538	2,400 4,200	RiskPert(S538,R538,T538,RiskName(B538&C538&H538))	2505.73	3340.97	$4,176.21
41Iron GateWanaka Springs - Rip and reseed site and access road	U539	16,000 22,000	RiskPert(S539,R539,T539,RiskName(B539&C539&H539))	16249.75	19117.36	$21,984.96
41Iron GateWanaka Springs - Signs to be removed and hauled away	U540	900 1,600	RiskPert(S540,R540,T540,RiskName(B540&C540&H540))	902.06	1202.75	$1,503.44
41Iron GateWanaka Springs - 15'x5' Gangplank with Railings	U541	1,400 2,600	RiskPert(S541,R541,T541,RiskName(B541&C541&H541))	1503.44	2004.58	$2,505.73
41Iron GateJuniper Point - Concrete Total	U542	6,500 9,000	RiskPert(S542,R542,T542,RiskName(B542&C542&H542))	6535.16	7688.43	$8,841.69

Name	Cell	Graph	Function	Min	Mean	Max
41Iron GateJuniper Point - 2, 4x4 Toilet Vaults	U543	3,000 5,500	RiskPert(S543,R543,T543,RiskName(B543&C543&H543))	3207.33	4276.44	$5,345.55
41Iron GateJuniper Point - Wood picnic tables to be removed and hauled	U544	800 1,400	RiskPert(S544,R544,T544,RiskName(B544&C544&H544))	801.83	1069.11	$1,336.39
41Iron GateJuniper Point - Signs to be removed and hauled away	U545	1,200 2,100	RiskPert(S545,R545,T545,RiskName(B545&C545&H545))	1202.75	1603.66	$2,004.58
41Iron GateJuniper Point - Dock pile railing	U546	2,000 3,400	RiskPert(S546,R546,T546,RiskName(B546&C546&H546))	2004.58	2672.77	$3,340.97
41Iron GateJuniper Point - 50'x5' Composite dock with poly floats	U547	7,800 9,800	RiskPert(S547,R547,T547,RiskName(B547&C547&H547))	7931.1	8812.33	$9,693.56
41Iron GateJuniper Point - 20'x5' Composite gangplank with railings	U548	2,000 3,400	RiskPert(S548,R548,T548,RiskName(B548&C548&H548))	2004.58	2672.77	$3,340.97
41Iron GateJuniper Point - Regrade to Natural Contour, rip, and reseed	U549	20,000 28,000	RiskPert(S549,R549,T549,RiskName(B549&C549&H549))	20167.11	23726.01	$27,284.91
41Iron GateCamp Creek - Concrete Total	U550	32,000 44,000	RiskPert(S550,R550,T550,RiskName(B550&C550&H550))	32242.6	37932.46	$43,622.34
41Iron GateCamp Creek - Well house 10'x16' concrete block building	U552	11,500 14,500	RiskPert(S552,R552,T552,RiskName(B552&C552&H552))	11782.53	13091.7	$14,400.88
41Iron GateCamp Creek - 2, 20'x5' Composite decking gangplanks	U553	4,000 7,000	RiskPert(S553,R553,T553,RiskName(B553&C553&H553))	4009.16	5345.55	$6,681.93
41Iron GateCamp Creek - Concrete block double toilet bldg 10'x16'	U555	11,500 14,500	RiskPert(S555,R555,T555,RiskName(B555&C555&H555))	11782.53	13091.7	$14,400.88
41Iron GateCamp Creek - Dump stations and approx. 2000 gal buried	U556	6,000 9,000	RiskPert(S556,R556,T556,RiskName(B556&C556&H556))	6307.25	7482.13	$8,904.35
41Iron GateCamp Creek - Power poles and lines	U557	5,000 7,500	RiskPert(S557,R557,T557,RiskName(B557&C557&H557))	5215.21	6186.67	$7,362.65
41Iron GateCamp Creek - Remove waterlines and 3 faucets and regrade	U558	3,000 5,500	RiskPert(S558,R558,T558,RiskName(B558&C558&H558))	3006.87	4009.16	$5,011.45
41Iron GateCamp Creek - Relocate concrete tables	U560	1,200 2,100	RiskPert(S560,R560,T560,RiskName(B560&C560&H560))	1202.75	1603.66	$2,004.58
41Iron GateCamp Creek - Regrade, rip, and reseed	U561	32,000 46,000	RiskPert(S561,R561,T561,RiskName(B561&C561&H561))	33890.32	39870.96	$45,851.61
41Iron GateCamp Creek - Signs to be removed and hauled away	U562	2,000 3,600	RiskPert(S562,R562,T562,RiskName(B562&C562&H562))	2104.81	2806.41	$3,508.02
41Iron GateDutch Creek - 50'4'3' Dock Concrete Abutment	U563	7,400 9,200	RiskPert(S563,R563,T563,RiskName(B563&C563&H563))	7424.93	8249.92	$9,074.91
41Iron GateDutch Creek - Double Pipe Railing	U564	4,000 7,000	RiskPert(S564,R564,T564,RiskName(B564&C564&H564))	4009.16	5345.55	$6,681.93
41Iron GateMirror Cove - Concrete Total	U565	21,000 26,000	RiskPert(S565,R565,T565,RiskName(B565&C565&H565))	21253.5	23615	$25,976.50
41Iron GateMirror Cove - 10'x16' Toilet Vault	U566	15,500 19,500	RiskPert(S566,R566,T566,RiskName(B566&C566&H566))	15587.74	17319.71	$19,051.68
41Iron GateMirror Cove - Double pipe railings on dock	U568	3,000 5,500	RiskPert(S568,R568,T568,RiskName(B568&C568&H568))	3207.33	4276.44	$5,345.55
41Iron GateMirror Cove - Regrade site	U569	34,000 50,000	RiskPert(S569,R569,T569,RiskName(B569&C569&H569))	35891.21	42224.96	$48,558.70
41Iron GateMirror Cove - Signs to be removed and hauled away	U570	2,000 3,600	RiskPert(S570,R570,T570,RiskName(B570&C570&H570))	2104.81	2806.41	$3,508.02

Name	Cell	Graph	Function	Min	Mean	Max
41Iron GateOverlook Point - 1 concrete picnic table base	U571	300 550	RiskPert(S571,R571,T571,RiskName(B571&C571&H571))	300.69	400.92	$501.15
41Iron GateOverlook Point - Steel frame table to be removed and hauled away	U572	100 170	RiskPert(S572,R572,T572,RiskName(B572&C572&H572))	100.23	133.64	$167.05
41Iron GateOverlook Point - Regrade steep access road and site to natural contours	U573	14,000 20,000	RiskPert(S573,R573,T573,RiskName(B573&C573&H573))	14643.54	17227.69	$19,811.84
41Iron GateLong Gulch - 80'x25x4" Concrete boat ramp to be removed	U574	7,800 9,800	RiskPert(S574,R574,T574,RiskName(B574&C574&H574))	7857.15	8730.16	$9,603.18
41Iron GateLong Gulch - Remove picnic tables (steel frames with planks) and haul away	U575	200 340	RiskPert(S575,R575,T575,RiskName(B575&C575&H575))	200.46	267.28	$334.10
41Iron GateLong Gulch - Regrade ramp area to natural contours, rip, reseed	U576	1,200 2,100	RiskPert(S576,R576,T576,RiskName(B576&C576&H576))	1252.86	1670.48	$2,088.10
41Iron GateConcrete Lining Installation for Diversion Tunnel	U577	1.20m 1.50m	RiskPert(S577,R577,T577,RiskName(B577&C577&H577))	1211059	1345621	$1,480,183.00
41Iron GateRemove Distribution Poles near Iron Gate Hydro Plant	U578	5,500 8,500	RiskPert(S578,R578,T578,RiskName(B578&C578&H578))	5690.16	6750.09	$8,033.16
41Iron GateRemove 6.6kV Power Circuit Breaker @Substation	U580	1,400 2,200	RiskPert(S580,R580,T580,RiskName(B580&C580&H580))	1457.44	1743.22	$2,143.30
41Iron GateRemove Generator @Substation	U581	4,500 7,000	RiskPert(S581,R581,T581,RiskName(B581&C581&H581))	4558.64	5452.49	$6,703.88
41Iron GateRemove all auxiliary equipment @Substation (Allowance)	U582	24,000 38,000	RiskPert(S582,R582,T582,RiskName(B582&C582&H582))	25687.01	30723.68	$37,775.02
41Iron GateNew Connection @Iron Gate Hatchery from PacifiCorp's Hornbrook Substation (Allowance)	U583	300,000 370,000	RiskPert(S583,R583,T583,RiskName(B583&C583&H583))	302507.5	336119.5	$369,731.40

RESTORATION EARTHWORKS & HABITAT

Copco 1 & 2

Name	Cell	Graph	Function	Min	Mean	Max
42Copco 1 & 2Removal of sediment and similar obstructions to ensure volitional fish passage + wood habitat structures	U586	0.85m 1.30m	RiskPert(S586,R586,T586,RiskName(B586&C586&H586))	860176.8	995574.9	$1,290,265.00
42Copco 1 & 2Equipment & road access into site	U587	75,000 115,000	RiskPert(S587,R587,T587,RiskName(B587&C587&H587))	75928.32	87880	$113,892.50
42Copco 1 & 2Grading and shaping of floodplain sediments (no export)	U588	0.68m 1.00m	RiskPert(S588,R588,T588,RiskName(B588&C588&H588))	658993	762723.4	$988,489.60
42Copco 1 & 2Floodplain roughness for 50% of area	U589	160,000 260,000	RiskPert(S589,R589,T589,RiskName(B589&C589&H589))	170079.4	196851.2	$255,119.20
42Copco 1 & 2Equipment & road access into site	U590	75,000 115,000	RiskPert(S590,R590,T590,RiskName(B590&C590&H590))	75928.32	87880	$113,892.50
42Copco 1 & 2Grading and shaping of floodplain sediments (no export)	U591	1.30m 2.00m	RiskPert(S591,R591,T591,RiskName(B591&C591&H591))	1330280	1539676	$1,995,421.00
42Copco 1 & 2Floodplain roughness for 50% of area	U592	380,000 600,000	RiskPert(S592,R592,T592,RiskName(B592&C592&H592))	387234.4	448188	$580,851.60
42Copco 1 & 2Equipment & road access into site	U593	75,000 115,000	RiskPert(S593,R593,T593,RiskName(B593&C593&H593))	75928.32	87880	$113,892.50
42Copco 1 & 2Grading and shaping of floodplain sediments (no export)	U594	0.60m 1.00m	RiskPert(S594,R594,T594,RiskName(B594&C594&H594))	636226.7	736373.5	$954,340.00
42Copco 1 & 2Floodplain roughness for 50% of area	U595	200,000 320,000	RiskPert(S595,R595,T595,RiskName(B595&C595&H595))	211080.7	244306.4	$316,621.10

Name	Cell	Graph	Function	Min	Mean	Max
42Copco 1 & 2Equipment & road access into site	U596	75,000 115,000	RiskPert(S596,R596,T596,RiskName(B596&C596&H596))	75928.32	87880	$113,892.50
42Copco 1 & 2Grading and shaping of floodplain sediments (no export)	U597	400,000 650,000	RiskPert(S597,R597,T597,RiskName(B597&C597&H597))	409810.4	474317.7	$614,715.70
42Copco 1 & 2Floodplain roughness for 50% of area	U598	150,000 240,000	RiskPert(S598,R598,T598,RiskName(B598&C598&H598))	159449.5	184548	$239,174.20
42Copco 1 & 2Equipment & road access into site	U599	75,000 115,000	RiskPert(S599,R599,T599,RiskName(B599&C599&H599))	75928.32	87880	$113,892.50
42Copco 1 & 2Grading and shaping of floodplain sediments (no export)	U600	160,000 250,000	RiskPert(S600,R600,T600,RiskName(B600&C600&H600))	164142.9	189980.2	$246,214.30
42Copco 1 & 2Floodplain roughness for 50% of area	U601	60,000 100,000	RiskPert(S601,R601,T601,RiskName(B601&C601&H601))	63779.79	73819.2	$95,669.68
42Copco 1 & 2Equipment & road access into site	U602	75,000 115,000	RiskPert(S602,R602,T602,RiskName(B602&C602&H602))	75928.32	87880	$113,892.50
42Copco 1 & 2Grading and shaping of floodplain sediments (no export)	U603	130,000 210,000	RiskPert(S603,R603,T603,RiskName(B603&C603&H603))	138882	160743.1	$208,323.00
42Copco 1 & 2Floodplain roughness for 50% of area	U604	80,000 125,000	RiskPert(S604,R604,T604,RiskName(B604&C604&H604))	80484.02	93152.8	$120,726.00
42Copco 1 & 2Bank Stability and Channel Fringe Complexity *Develop process-based restoration and velocity variations along banklines by adding large wood*	U605	0.68m 1.00m	RiskPert(S605,R605,T605,RiskName(B605&C605&H605))	653135.4	755943.8	$979,703.10
42Copco 1 & 2Ground-Based Placement	U606	550,000 900,000	RiskPert(S606,R606,T606,RiskName(B606&C606&H606))	578063.6	669055.1	$867,095.30
42Copco 1 & 2Helicopter Placement (@ 50 members staged and placed per site)	U607	450,000 750,000	RiskPert(S607,R607,T607,RiskName(B607&C607&H607))	470877.1	544996.6	$706,315.60
42Copco 1 & 2Contractor overhead	U608	1.10m 1.70m	RiskPert(S608,R608,T608,RiskName(B608&C608&H608))	1110728	1285565	$1,666,092.00
42Copco 1 & 2Contractor profit (included in rates & prices)	U609	-0.60 0.60	RiskPert(S609,R609,T609,RiskName(B609&C609&H609))	0	0	$0.00
42Copco 1 & 2Insurance	U610	85,000 130,000	RiskPert(S610,R610,T610,RiskName(B610&C610&H610))	85155.83	98559.99	$127,733.80
42Copco 1 & 2Bond	U611	85,000 130,000	RiskPert(S611,R611,T611,RiskName(B611&C611&H611))	85155.83	98559.99	$127,733.80

Iron Gate

Name	Cell	Graph	Function	Min	Mean	Max
42Iron GateRemoval of sediment and similar obstructions to ensure volitional fish passage + wood habitat structures	U613	600,000 950,000	RiskPert(S613,R613,T613,RiskName(B613&C613&H613))	614411.9	711124.9	$921,617.90
42Iron GateEquipment & road access into site	U614	75,000 115,000	RiskPert(S614,R614,T614,RiskName(B614&C614&H614))	75928.32	87880	$113,892.50
42Iron GateGrading and shaping of floodplain sediments (no export)	U615	450,000 750,000	RiskPert(S615,R615,T615,RiskName(B615&C615&H615))	485941.3	562432	$728,911.90
42Iron GateFloodplain roughness for 50% of area	U616	200,000 340,000	RiskPert(S616,R616,T616,RiskName(B616&C616&H616))	215636.4	249579.2	$323,454.70
42Iron GateEquipment & road access into site	U617	75,000 115,000	RiskPert(S617,R617,T617,RiskName(B617&C617&H617))	75928.32	87880	$113,892.50
42Iron GateGrading and shaping of floodplain sediments (no export)	U618	150,000 240,000	RiskPert(S618,R618,T618,RiskName(B618&C618&H618))	153881.4	178103.5	$230,822.10
42Iron GateFloodplain roughness for 50% of area	U619	85,000 135,000	RiskPert(S619,R619,T619,RiskName(B619&C619&H619))	88076.85	101940.8	$132,115.30
42Iron GateEquipment & road access into site	U620	50,000 80,000	RiskPert(S620,R620,T620,RiskName(B620&C620&H620))	50618.88	58586.67	$75,928.32

Name	Cell	Graph	Function	Min	Mean	Max
42Iron GateGrading and shaping of floodplain sediments (no export)	U621	0.75m 1.20m	RiskPert(S621,R621,T621,RiskName(B621&C621&H621))	769407	890517.3	$1,154,111.00
42Iron GateFloodplain roughness for 75% of area	U622	500,000 800,000	RiskPert(S622,R622,T622,RiskName(B622&C622&H622))	525424	608129.6	$788,135.90
42Iron GateDevelop process-based restoration and velocity variations along bankline by adding large wood complexity for resting zone, feeding seams,	U623	260,000 400,000	RiskPert(S623,R623,T623,RiskName(B623&C623&H623))	261254.2	302377.5	$391,881.30
42Iron GateGround-Based Placement	U624	550,000 900,000	RiskPert(S624,R624,T624,RiskName(B624&C624&H624))	578063.6	669055.1	$867,095.30
42Iron GateHelicopter Placement (@ 50 members staged and placed per site)	U625	220,000 360,000	RiskPert(S625,R625,T625,RiskName(B625&C625&H625))	235438.5	272498.3	$353,157.80
42Iron GateContractor overhead	U626	600,000 950,000	RiskPert(S626,R626,T626,RiskName(B626&C626&H626))	618315.2	715642.6	$927,472.80
42Iron GateContractor profit (included in rates & prices)	U627	-0.60 0.60	RiskPert(S627,R627,T627,RiskName(B627&C627&H627))	0	0	$0.00
42Iron GateInsurance	U628	45,000 75,000	RiskPert(S628,R628,T628,RiskName(B628&C628&H628))	47404.16	54865.93	$71,106.25
42Iron GateBond	U629	45,000 75,000	RiskPert(S629,R629,T629,RiskName(B629&C629&H629))	47404.16	54865.93	$71,106.25

JC Boyle

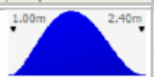
Name	Cell	Graph	Function	Min	Mean	Max
42JC BoyleRemoval of sediment and similar obstructions to ensure volitional fish passage + wood habitat structures	U631	240,000 380,000	RiskPert(S631,R631,T631,RiskName(B631&C631&H631))	245764.8	284450	$368,647.20
42JC BoyleEquipment & road access into site	U632	12,000 19,000	RiskPert(S632,R632,T632,RiskName(B632&C632&H632))	12654.72	14646.67	$18,982.08
42JC BoyleGrading and shaping of floodplain sediments (no export)	U633	280,000 460,000	RiskPert(S633,R633,T633,RiskName(B633&C633&H633))	299663.8	346833.1	$449,495.70
42JC BoyleFloodplain roughness for 50% of area	U634	50,000 80,000	RiskPert(S634,R634,T634,RiskName(B634&C634&H634))	50112.69	58000.8	$75,169.04
42JC BoyleEquipment & road access into site	U635	12,000 19,000	RiskPert(S635,R635,T635,RiskName(B635&C635&H635))	12654.72	14646.67	$18,982.08
42JC BoyleGrading and shaping of floodplain sediments (no export)	U636	280,000 440,000	RiskPert(S636,R636,T636,RiskName(B636&C636&H636))	283465.7	328085.3	$425,198.60
42JC BoyleFloodplain roughness for 50% of area	U637	0.65m 1.00m	RiskPert(S637,R637,T637,RiskName(B637&C637&H637))	665132.1	769828.8	$997,698.10
42JC BoyleEquipment & road access into site	U638	12,000 19,000	RiskPert(S638,R638,T638,RiskName(B638&C638&H638))	12654.72	14646.67	$18,982.08
42JC BoyleGrading and shaping of floodplain sediments (no export)	U639	400,000 650,000	RiskPert(S639,R639,T639,RiskName(B639&C639&H639))	429248.1	496814.9	$643,872.10
42JC BoyleFloodplain roughness for 30% of area	U640	600,000 950,000	RiskPert(S640,R640,T640,RiskName(B640&C640&H640))	607426.6	703040	$911,139.80
42JC BoyleEquipment & road access into site	U641	12,000 19,000	RiskPert(S641,R641,T641,RiskName(B641&C641&H641))	12654.72	14646.67	$18,982.08
42JC BoyleGrading and shaping of floodplain sediments (no export)	U642	130,000 210,000	RiskPert(S642,R642,T642,RiskName(B642&C642&H642))	137683.4	159355.7	$206,525.00
42JC BoyleFloodplain roughness for 50% of area	U643	320,000 500,000	RiskPert(S643,R643,T643,RiskName(B643&C643&H643))	323454.7	374368.8	$485,182.00
42JC BoyleDevelop process-based restoration and velocity variations along bankline by adding large wood complexity for resting zone, feeding seams,	U644	500,000 800,000	RiskPert(S644,R644,T644,RiskName(B644&C644&H644))	522508.3	604755	$783,762.50
42JC BoyleGround-Based Placement	U645	0.85m 1.35m	RiskPert(S645,R645,T645,RiskName(B645&C645&H645))	867095.3	1003583	$1,300,643.00

Name	Cell	Graph	Function	Min	Mean	Max
42JC BoyleContractor profit (included in rates & prices)	U648	-0.60 0.60	RiskPert(S648,R648,T648,RiskName(B648&C648&H648))	0	0	$0.00
42JC BoyleInsurance	U649	50,000 80,000	RiskPert(S649,R649,T649,RiskName(B649&C649&H649))	52765.99	61071.75	$79,148.98
42JC BoyleBond	U650	50,000 80,000	RiskPert(S650,R650,T650,RiskName(B650&C650&H650))	52765.99	61071.75	$79,148.98

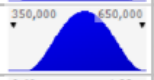
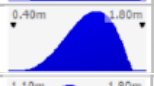
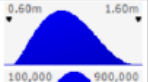
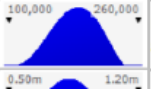
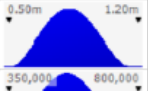
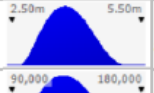
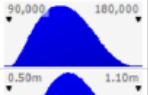
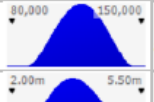
RESTORATION OF VEGETATION

JC Boyle

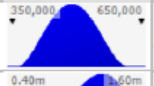
Name	Cell	Graph	Function	Min	Mean	Max
42JC BoyleContractor profit (included in rates & prices)	U648	-0.60 0.60	RiskPert(S648,R648,T648,RiskName(B648&C648&H648))	0	0	$0.00
42JC BoyleInsurance	U649	50,000 80,000	RiskPert(S649,R649,T649,RiskName(B649&C649&H649))	52765.99	61071.75	$79,148.98
42JC BoyleBond	U650	50,000 80,000	RiskPert(S650,R650,T650,RiskName(B650&C650&H650))	52765.99	61071.75	$79,148.98
43JC BoyleOn-Site Pilot Growing Experiment	U653	100,000 135,000	RiskPert(S653,R653,T653,RiskName(B653&C653&H653))	101733.8	116567.2	$134,281.90
43JC BoyleSeed Collection	U654	160,000 280,000	RiskPert(S654,R654,T654,RiskName(B654&C654&H654))	167775.5	221301.2	$275,180.60
43JC BoyleSeed Propagation	U655	200,000 600,000	RiskPert(S655,R655,T655,RiskName(B655&C655&H655))	208731.7	523944.9	$713,733.00
43JC BoyleWeed Eradication	U656	450,000 750,000	RiskPert(S656,R656,T656,RiskName(B656&C656&H656))	478981.8	606616.8	$734,251.80
43JC BoylePioneer Seeding	U657	250,000 700,000	RiskPert(S657,R657,T657,RiskName(B657&C657&H657))	283465.7	448820.8	$668,169.20
43JC BoyleContainer Plant Growing	U658	50,000 400,000	RiskPert(S658,R658,T658,RiskName(B658&C658&H658))	79389.05	217088.1	$354,787.10
43JC BoyleEstabl. Prd. Maint. & Monitor'g	U659	0.80m 2.80m	RiskPert(S659,R659,T659,RiskName(B659&C659&H659))	944557.2	1777640	$2,675,395.00
43JC BoyleLong-Term Maint. & Monitor'g	U660	0.50m 3.50m	RiskPert(S660,R660,T660,RiskName(B660&C660&H660))	872285.8	1969922	$3,253,352.00
43JC BoyleEmergent Wetland	U661	20,000 50,000	RiskPert(S661,R661,T661,RiskName(B661&C661&H661))	23651.35	34702.09	$47,519.24
43JC BoyleBank Wetland	U662	60,000 140,000	RiskPert(S662,R662,T662,RiskName(B662&C662&H662))	62033.59	101403.6	$133,596.50
43JC BoyleBank Riparian	U663	0.70m 1.60m	RiskPert(S663,R663,T663,RiskName(B663&C663&H663))	741466.4	1147879	$1,569,618.00
43JC BoyleFloodplain Riparian	U664	0.50m 1.30m	RiskPert(S664,R664,T664,RiskName(B664&C664&H664))	583878.6	881705.6	$1,201,866.00
43JC BoyleUplands below RW	U665	200,000 380,000	RiskPert(S665,R665,T665,RiskName(B665&C665&H665))	204169.5	277650.6	$369,607.50
43JC BoyleRocky Wake Zone	U666	120,000 260,000	RiskPert(S666,R666,T666,RiskName(B666&C666&H666))	138113.8	189017.7	$256,825.10
43JC BoyleDisturbed Uplands above RWZ	U667	350,000 700,000	RiskPert(S667,R667,T667,RiskName(B667&C667&H667))	350982.4	477886.6	$650,192.10
43JC BoyleUplands Stockpiles	U668	45,000 95,000	RiskPert(S668,R668,T668,RiskName(B668&C668&H668))	48826.25	66416.49	$90,343.84
43JC BoyleUndisturbed Uplands	U669	40,000 70,000	RiskPert(S669,R669,T669,RiskName(B669&C669&H669))	43015.37	56288.13	$69,173.37

Name	Cell	Graph	Function	Min	Mean	Max
43JC BoyleContractor overhead	U670		RiskPert(S670,R670,T670,RiskName(B670&C670&H670))	1030506	1663701	$2,379,157.00

Iron Gate

Name	Cell	Graph	Function	Min	Mean	Max
43Iron GateOn-Site Pilot Growing Experiment	U672		RiskPert(S672,R672,T672,RiskName(B672&C672&H672))	237491.8	272119.7	$313,473.50
43Iron GateSeed Collection	U673		RiskPert(S673,R673,T673,RiskName(B673&C673&H673))	391662.5	516615.4	$642,393.70
43Iron GateSeed Propagation	U674		RiskPert(S674,R674,T674,RiskName(B674&C674&H674))	487272.5	1223120	$1,666,170.00
43Iron GateWeed Eradication	U675		RiskPert(S675,R675,T675,RiskName(B675&C675&H675))	1118156	1416113	$1,714,070.00
43Iron GatePioneer Seeding	U676		RiskPert(S676,R676,T676,RiskName(B676&C676&H676))	661735	1047747	$1,559,804.00
43Iron GateContainer Plant Growing	U677		RiskPert(S677,R677,T677,RiskName(B677&C677&H677))	185329.3	506780	$828,230.70
43Iron GateEstabl. Prd. Maint. & Monitor'g	U678		RiskPert(S678,R678,T678,RiskName(B678&C678&H678))	2205016	4149801	$6,245,560.00
43Iron GateLong-Term Maint. & Monitor'g	U679		RiskPert(S679,R679,T679,RiskName(B679&C679&H679))	2036303	4598673	$7,594,770.00
43Iron GateEmergent Wetland	U680		RiskPert(S680,R680,T680,RiskName(B680&C680&H680))	49772.4	73027.82	$100,000.50
43Iron GateBank Wetland	U681		RiskPert(S681,R681,T681,RiskName(B681&C681&H681))	111888.4	182899	$240,964.50
43Iron GateBank Riparian	U682		RiskPert(S682,R682,T682,RiskName(B682&C682&H682))	537537.8	832172.8	$1,137,920.00
43Iron GateFloodplain Riparian	U683		RiskPert(S683,R683,T683,RiskName(B683&C683&H683))	369143.2	557437.2	$759,851.10
43Iron GateUplands below RW	U684		RiskPert(S684,R684,T684,RiskName(B684&C684&H684))	2806068	3815979	$5,079,817.00
43Iron GateRocky Wake Zone	U685		RiskPert(S685,R685,T685,RiskName(B685&C685&H685))	94494.99	129322.5	$175,715.20
43Iron GateDisturbed Uplands above RWZ	U686		RiskPert(S686,R686,T686,RiskName(B686&C686&H686))	585424.3	797095.4	$1,084,494.00
43Iron GateUplands Stockpiles	U687		RiskPert(S687,R687,T687,RiskName(B687&C687&H687))	281252	382576.3	$520,404.10
43Iron GateUndisturbed Uplands	U688		RiskPert(S688,R688,T688,RiskName(B688&C688&H688))	89687.52	117361.4	$144,227.20
43Iron GateContractor overhead	U689		RiskPert(S689,R689,T689,RiskName(B689&C689&H689))	2354359	3715968	$5,298,931.00

Copco 1

Name	Cell	Graph	Function	Min	Mean	Max
43Copco 1On-Site Pilot Growing Experiment	U691		RiskPert(S691,R691,T691,RiskName(B691&C691&H691))	225340.3	258196.4	$297,434.30
43Copco 1Seed Collection	U692		RiskPert(S692,R692,T692,RiskName(B692&C692&H692))	371622.7	490182.2	$609,524.90
43Copco 1Seed Propagation	U693		RiskPert(S693,R693,T693,RiskName(B693&C693&H693))	462340.7	1160538	$1,580,919.00

Name	Cell	Graph	Function	Min	Mean	Max
43Copco 1Weed Eradication	U694	1.00m 1.70m	RiskPert(S694,R694,T694,RiskName(B694&C694&H694))	1060945	1343656	$1,626,368.00
43Copco 1Pioneer Seeding	U695	0.60m 1.50m	RiskPert(S695,R695,T695,RiskName(B695&C695&H695))	627876.6	994137.9	$1,479,995.00
43Copco 1Container Plant Growing	U696	100,000 800,000	RiskPert(S696,R696,T696,RiskName(B696&C696&H696))	175846.8	480850.1	$785,853.40
43Copco 1Establ. Prd. Maint. & Monitor'g	U697	2.00m 6.00m	RiskPert(S697,R697,T697,RiskName(B697&C697&H697))	2092194	3937472	$5,925,999.00
43Copco 1Long-Term Maint. & Monitor'g	U698	1m 8m	RiskPert(S698,R698,T698,RiskName(B698&C698&H698))	1932113	4363377	$7,206,175.00
43Copco 1Emergent Wetland	U699	50,000 110,000	RiskPert(S699,R699,T699,RiskName(B699&C699&H699))	50057.63	73446.31	$100,573.60
43Copco 1Bank Wetland	U700	100,000 260,000	RiskPert(S700,R700,T700,RiskName(B700&C700&H700))	112892.6	184540.6	$243,127.30
43Copco 1Bank Riparian	U701	1.00m 2.40m	RiskPert(S701,R701,T701,RiskName(B701&C701&H701))	1081229	1673872	$2,288,865.00
43Copco 1Floodplain Riparian	U702	0.60m 1.30m	RiskPert(S702,R702,T702,RiskName(B702&C702&H702))	617264	932120.4	$1,270,588.00
43Copco 1Uplands below RW	U703	2.50m 5.00m	RiskPert(S703,R703,T703,RiskName(B703&C703&H703))	2577989	3505815	$4,666,927.00
43Copco 1Rocky Wake Zone	U704	120,000 240,000	RiskPert(S704,R704,T704,RiskName(B704&C704&H704))	127052.8	173880	$236,256.90
43Copco 1Disturbed Uplands above RWZ	U705	60,000 130,000	RiskPert(S705,R705,T705,RiskName(B705&C705&H705))	66582.32	90656.4	$123,343.20
43Copco 1Uplands Stockpiles	U706	20,000 50,000	RiskPert(S706,R706,T706,RiskName(B706&C706&H706))	24450.96	33259.71	$45,241.93
43Copco 1Undisturbed Uplands	U707	55,000 95,000	RiskPert(S707,R707,T707,RiskName(B707&C707&H707))	57222.34	74878.79	$92,019.71
43Copco 1Contractor overhead	U708	2.00m 5.50m	RiskPert(S708,R708,T708,RiskName(B708&C708&H708))	2244456	3578544	$5,103,293.00

Copco 2

Name	Cell	Graph	Function	Min	Mean	Max
43Copco 2On-Site Pilot Growing Experiment	U710	620 840	RiskPert(S710,R710,T710,RiskName(B710&C710&H710))	621.71	712.36	$820.61
43Copco 2Seed Collection	U711	1,000 1,700	RiskPert(S711,R711,T711,RiskName(B711&C711&H711))	1025.29	1352.4	$1,681.66
43Copco 2Seed Propagation	U712	1,000 4,500	RiskPert(S712,R712,T712,RiskName(B712&C712&H712))	1275.58	3201.89	$4,361.70
43Copco 2Weed Eradication	U713	2,800 4,600	RiskPert(S713,R713,T713,RiskName(B713&C713&H713))	2927.11	3707.1	$4,487.09
43Copco 2Pioneer Seeding	U714	1,500 4,500	RiskPert(S714,R714,T714,RiskName(B714&C714&H714))	1732.29	2742.79	$4,083.26
43Copco 2Container Plant Growing	U715	400 2,200	RiskPert(S715,R715,T715,RiskName(B715&C715&H715))	485.16	1326.65	$2,168.14
43Copco 2Establ. Prd. Maint. & Monitor'g	U716	4,000 18,000	RiskPert(S716,R716,T716,RiskName(B716&C716&H716))	5772.29	10863.35	$16,349.63
43Copco 2Long-Term Maint. & Monitor'g	U717	4,000 20,000	RiskPert(S717,R717,T717,RiskName(B717&C717&H717))	5330.64	12038.41	$19,881.60
43Copco 2Emergent Wetland	U718	-0.60 0.60	RiskPert(S718,R718,T718,RiskName(B718&C718&H718))	0	0	$0.00

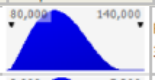
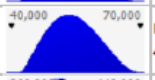
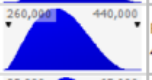
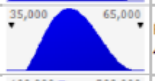
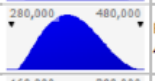
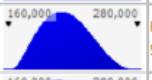
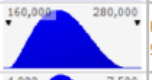
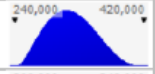
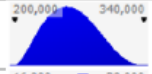
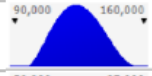
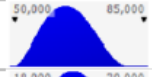
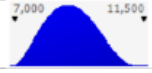
Name	Cell	Graph	Function	Min	Mean	Max
43Copco 2On-Site Pilot Growing Experiment	U710	620 840	RiskPert(S710,R710,T710,RiskName(B710&C710&H710))	621.71	712.36	$820.61
43Copco 2Seed Collection	U711	1,000 1,700	RiskPert(S711,R711,T711,RiskName(B711&C711&H711))	1025.29	1352.4	$1,681.66
43Copco 2Seed Propagation	U712	1,000 4,500	RiskPert(S712,R712,T712,RiskName(B712&C712&H712))	1275.58	3201.89	$4,361.70
43Copco 2Weed Eradication	U713	2,800 4,600	RiskPert(S713,R713,T713,RiskName(B713&C713&H713))	2927.11	3707.1	$4,487.09
43Copco 2Pioneer Seeding	U714	1,500 4,500	RiskPert(S714,R714,T714,RiskName(B714&C714&H714))	1732.29	2742.79	$4,083.26
43Copco 2Container Plant Growing	U715	400 2,200	RiskPert(S715,R715,T715,RiskName(B715&C715&H715))	485.16	1326.65	$2,168.14
43Copco 2Establ. Prd. Maint. & Monitor'g	U716	4,000 18,000	RiskPert(S716,R716,T716,RiskName(B716&C716&H716))	5772.29	10863.35	$16,349.63
43Copco 2Long-Term Maint. & Monitor'g	U717	4,000 20,000	RiskPert(S717,R717,T717,RiskName(B717&C717&H717))	5330.64	12038.41	$19,881.60
43Copco 2Emergent Wetland	U718	-0.60 0.60	RiskPert(S718,R718,T718,RiskName(B718&C718&H718))	0	0	$0.00
43Copco 2Bank Wetland	U719	-0.60 0.60	RiskPert(S719,R719,T719,RiskName(B719&C719&H719))	0	0	$0.00
43Copco 2Bank Riparian	U720	-0.60 0.60	RiskPert(S720,R720,T720,RiskName(B720&C720&H720))	0	0	$0.00
43Copco 2Floodplain Riparian	U721	8,000 18,000	RiskPert(S721,R721,T721,RiskName(B721&C721&H721))	8559.58	12925.68	$17,619.19
43Copco 2Uplands below RW	U722	-0.60 0.60	RiskPert(S722,R722,T722,RiskName(B722&C722&H722))	0	0	$0.00
43Copco 2Rocky Wake Zone	U723	-0.60 0.60	RiskPert(S723,R723,T723,RiskName(B723&C723&H723))	0	0	$0.00
43Copco 2Disturbed Uplands above RWZ	U724	9,000 19,000	RiskPert(S724,R724,T724,RiskName(B724&C724&H724))	9853.08	13415.64	$18,252.75
43Copco 2Uplands Stockpiles	U725	-0.60 0.60	RiskPert(S725,R725,T725,RiskName(B725&C725&H725))	0	0	$0.00
43Copco 2Undisturbed Uplands	U726	3.20 5.40	RiskPert(S726,R726,T726,RiskName(B726&C726&H726))	3.25	4.25	$5.23
43Copco 2Contractor overhead	U727	7,000 17,000	RiskPert(S727,R727,T727,RiskName(B727&C727&H727))	7569.28	11844.54	$16,845.22

YREKA WATER LINE REPLACEMENT

Name	Cell	Graph	Function	Min	Mean	Max
44ProjectMicrotunneling	U730	0.85m 1.40m	RiskPert(S730,R730,T730,RiskName(B730&C730&H730))	894330.8	1078458	$1,367,800.00
44ProjectPile and Lagging Pre Drilling	U731	60,000 100,000	RiskPert(S731,R731,T731,RiskName(B731&C731&H731))	64713.55	78036.92	$98,973.66
44ProjectPile and Lagging Wall InstallatioN	U732	0.90m 1.45m	RiskPert(S732,R732,T732,RiskName(B732&C732&H732))	938963.4	1132279	$1,436,062.00
44ProjectPipe Installation	U733	260,000 420,000	RiskPert(S733,R733,T733,RiskName(B733&C733&H733))	264161.5	318547.7	$404,011.70
44ProjectExcavation and Backfill	U734	300,000 480,000	RiskPert(S734,R734,T734,RiskName(B734&C734&H734))	302983	365361.9	$463,385.80

TRANSPORTATION (BRIDGES, CULVERTS, ROADS)

Lakeview Bridge

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectSheet Pile Coffer Dam For Center Footer	U737		RiskPert(S737,R737,T737,RiskName(B737&C737&H737))	80702.01	102558.8	$131,140.80
45ProjectBackfill, structural, common earth, 105 H.P. dozer, 50' haul, from existing stockpile, excludes compaction	U738		RiskPert(S738,R738,T738,RiskName(B738&C738&H738))	3099.77	3939.29	$5,037.13
45ProjectEarth Work Coffer Dam Construction for side footers	U739		RiskPert(S739,R739,T739,RiskName(B739&C739&H739))	15847.14	20139.08	$25,751.61
45ProjectStructure Excavation (Type D)	U741		RiskPert(S741,R741,T741,RiskName(B741&C741&H741))	19913.47	25306.7	$32,359.39
45ProjectStructure Excavation (Bridge)	U742		RiskPert(S742,R742,T742,RiskName(B742&C742&H742))	8085.96	10275.91	$13,139.69
45ProjectPrestressed concrete piles, square, 40' long, 24" square, priced using 200 piles, excludes pile caps or mobilization	U743		RiskPert(S743,R743,T743,RiskName(B743&C743&H743))	69425.02	88227.63	$112,815.60
45Project18" Diameter 40' Long Tie Down Anchor Installation	U744		RiskPert(S744,R744,T744,RiskName(B744&C744&H744))	42851.99	54457.73	$69,634.48
45ProjectPiling special costs, pre-augering for Pile and Tie Down Anchor	U745		RiskPert(S745,R745,T745,RiskName(B745&C745&H745))	261911.7	332846.1	$425,606.40
45ProjectMobilization, 150 ton, set up and remove crane, with pile leads and pile hammer	U746		RiskPert(S746,R746,T746,RiskName(B746&C746&H746))	38928.68	49471.87	$63,259.11
45ProjectA736 Barrier Wall	U747		RiskPert(S747,R747,T747,RiskName(B747&C747&H747))	182108.3	231429.3	$295,925.90
45ProjectExpansion joint, neoprene, liquid, 1" x 2", cold applied	U748		RiskPert(S748,R748,T748,RiskName(B748&C748&H748))	1776.1	2257.13	$2,886.16
45ProjectColumns Structural Concrete includes forms, Grade 60 rebar, concrete, placing and finishing	U749		RiskPert(S749,R749,T749,RiskName(B749&C749&H749))	294160.5	373829	$478,010.80
45ProjectDeck Structural concrete, in place, includes forms, Grade 60 rebar, concrete, placing and finishing	U750		RiskPert(S750,R750,T750,RiskName(B750&C750&H750))	168204.1	213759.4	$273,331.70
45ProjectFooter Structural concrete,footing, reinforced, includes forms(4 uses), Grade 60 rebar, concrete, placing and finishing	U751		RiskPert(S751,R751,T751,RiskName(B751&C751&H751))	165438.5	210244.7	$268,837.50
45ProjectApproach Slab Structural concrete, in place, 6" thick, includes forms, Grade 60 rebar, concrete, and placing, excludes finishing	U752		RiskPert(S752,R752,T752,RiskName(B752&C752&H752))	4369.04	5552.32	$7,099.68
45ProjectPrecast 36" I-Girder 65'	U753		RiskPert(S753,R753,T753,RiskName(B753&C753&H753))	209949.7	266811	$341,168.20
45ProjectPrecast 36" I-Girder 48'	U754		RiskPert(S754,R754,T754,RiskName(B754&C754&H754))	250864.2	318806.5	$407,654.30
45ProjectBridge Demolition	U755		RiskPert(S755,R755,T755,RiskName(B755&C755&H755))	205798.4	261535.5	$334,422.40
45ProjectRoadway Excavation	U757		RiskPert(S757,R757,T757,RiskName(B757&C757&H757))	17863.53	22515.49	$27,911.77
45ProjectImported Borrow	U758		RiskPert(S758,R758,T758,RiskName(B758&C758&H758))	98906.18	124663	$154,540.90
45ProjectHot Mix Asphalt (Type A)	U759		RiskPert(S759,R759,T759,RiskName(B759&C759&H759))	51226.3	64566.49	$80,041.10
45ProjectClass 2 Aggregate Base	U760		RiskPert(S760,R760,T760,RiskName(B760&C760&H760))	18782.98	23674.38	$29,348.40
45ProjectRemove Base and Surfacing	U761		RiskPert(S761,R761,T761,RiskName(B761&C761&H761))	0	0	$0.00
45ProjectMidwest Guardrail System	U762		RiskPert(S762,R762,T762,RiskName(B762&C762&H762))	7112.14	8964.26	$11,112.71

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectTransition Railing (Type WB-31)	U763	14,000 22,000	RiskPert(S763,R763,T763,RiskName(B763&C763&H763))	14010.61	17659.21	$21,891.58
45ProjectAlternative Flared Terminal System	U764	3,400 5,600	RiskPert(S764,R764,T764,RiskName(B764&C764&H764))	3502.65	4414.8	$5,472.90
45ProjectTemporary Reinforced Silt Fence	U765	3,500 6,500	RiskPert(S765,R765,T765,RiskName(B765&C765&H765))	3982.52	5019.63	$6,222.68
45ProjectTemporary Fence (Type ESA)	U766	1,300 2,100	RiskPert(S766,R766,T766,RiskName(B766&C766&H766))	1321.38	1665.48	$2,064.65
45ProjectTemporary Concrete Washout	U767	0.85 1.40	RiskPert(S767,R767,T767,RiskName(B767&C767&H767))	0.88	1.1	$1.37
45ProjectTemporary Construction Entrance	U768	7,500 12,000	RiskPert(S768,R768,T768,RiskName(B768&C768&H768))	7536.4	9499	$11,775.62
45ProjectWater Pollution Control	U769	18,000 30,000	RiskPert(S769,R769,T769,RiskName(B769&C769&H769))	18677.9	23541.94	$29,184.22
45ProjectRoadside Sign - One Post	U770	450 750	RiskPert(S770,R770,T770,RiskName(B770&C770&H770))	472.86	596	$738.84
45ProjectReset Roadside Sign	U771	1,000 1,700	RiskPert(S771,R771,T771,RiskName(B771&C771&H771))	1050.8	1324.44	$1,641.87
45ProjectRelocate Roadside Sign	U772	170 280	RiskPert(S772,R772,T772,RiskName(B772&C772&H772))	175.13	220.74	$273.64
45ProjectConstruction Area Signs	U773	0.85 1.40	RiskPert(S773,R773,T773,RiskName(B773&C773&H773))	0.88	1.1	$1.37
45ProjectThermoplastic Traffic Stripe	U774	450 800	RiskPert(S774,R774,T774,RiskName(B774&C774&H774))	497.03	626.46	$776.60
45ProjectType III Barricade	U775	900 1,600	RiskPert(S775,R775,T775,RiskName(B775&C775&H775))	960.74	1210.94	$1,501.16
45ProjectTraffic Control System	U776	17,000 28,000	RiskPert(S776,R776,T776,RiskName(B776&C776&H776))	17513.27	22074.01	$27,364.48
45ProjectTemporary Railing (Type K)	U777	12,000 20,000	RiskPert(S777,R777,T777,RiskName(B777&C777&H777))	12346.85	15562.18	$19,291.96

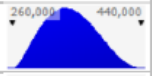
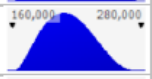
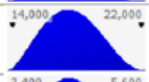
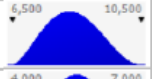
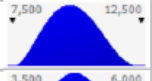
Fall Creek Bridge

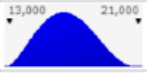
Name	Cell	Graph	Function	Min	Mean	Max
45ProjectStructure Excavation (Bridge)	U779	24,000 42,000	RiskPert(S779,R779,T779,RiskName(B779&C779&H779))	25376.7	32249.55	$41,237.13
45ProjectA736 Barrier Wall	U780	30,000 60,000	RiskPert(S780,R780,T780,RiskName(B780&C780&H780))	33975.42	43177.1	$55,210.06
45ProjectDeck Structural concrete, in place, includes forms, Grade 60 rebar, concrete, placing and finishing	U782	30,000 52,000	RiskPert(S782,R782,T782,RiskName(B782&C782&H782))	31037.66	39443.69	$50,436.20
45ProjectFooter Structural concrete,footing, reinforced, includes forms(4 uses), Grade 60 rebar, concrete, placing and finishing	U783	30,000 52,000	RiskPert(S783,R783,T783,RiskName(B783&C783&H783))	31758.28	40359.48	$51,607.20
45ProjectApproach Slab Structural concrete, in place, 6" thick, includes forms, Grade 60 rebar, concrete, and placing, excludes finishing	U784	5,500 9,500	RiskPert(S784,R784,T784,RiskName(B784&C784&H784))	5654.05	7185.36	$9,187.84
45ProjectBridge Demolition	U785	35,000 65,000	RiskPert(S785,R785,T785,RiskName(B785&C785&H785))	37828.66	48073.92	$61,471.57
45ProjectRoadway Excavation	U787	24,000 40,000	RiskPert(S787,R787,T787,RiskName(B787&C787&H787))	25219.11	31786.58	$39,404.85
45ProjectImported Borrow	U788	90,000 150,000	RiskPert(S788,R788,T788,RiskName(B788&C788&H788))	93783.55	118206.3	$146,536.80
45ProjectHot Mix Asphalt (Type A)	U789	26,000 42,000	RiskPert(S789,R789,T789,RiskName(B789&C789&H789))	26182.33	33000.65	$40,909.90

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectClass 2 Aggregate Base	U790	9,000 16,000	RiskPert(S790,R790,T790,RiskName(B790&C790&H790))	9676.08	12195.89	$15,118.88
45ProjectMidwest Guardrail System	U791	3,500 6,000	RiskPert(S791,R791,T791,RiskName(B791&C791&H791))	3556.07	4482.13	$5,556.36
45ProjectTransition Railing (Type WB-31)	U792	14,000 22,000	RiskPert(S792,R792,T792,RiskName(B792&C792&H792))	14010.61	17659.21	$21,891.58
45ProjectAlternative Flared Terminal System	U793	3,400 5,600	RiskPert(S793,R793,T793,RiskName(B793&C793&H793))	3502.65	4414.8	$5,472.90
45ProjectRelocate Gate	U794	85 140	RiskPert(S794,R794,T794,RiskName(B794&C794&H794))	87.57	110.37	$136.82
45ProjectTemporary Reinforced Silt Fence	U795	2,600 4,200	RiskPert(S795,R795,T795,RiskName(B795&C795&H795))	2655.01	3346.42	$4,148.46
45ProjectTemporary Fence (Type ESA)	U796	1,700 2,800	RiskPert(S796,R796,T796,RiskName(B796&C796&H796))	1761.84	2220.65	$2,752.87
45ProjectTemporary Hydroseed	U797	2,200 3,600	RiskPert(S797,R797,T797,RiskName(B797&C797&H797))	2260.61	2849.31	$3,532.21
45ProjectTemporary Fiber Roll	U799	2,600 4,200	RiskPert(S799,R799,T799,RiskName(B799&C799&H799))	2659.83	3352.49	$4,155.98
45ProjectTemporary Concrete Washout	U800	0.85 1.40	RiskPert(S800,R800,T800,RiskName(B800&C800&H800))	0.88	1.1	$1.37
45ProjectTemporary Construction Entrance	U801	7,500 12,000	RiskPert(S801,R801,T801,RiskName(B801&C801&H801))	7536.4	9499	$11,775.62
45ProjectWater Pollution Control	U802	15,000 25,000	RiskPert(S802,R802,T802,RiskName(B802&C802&H802))	15486.11	19518.95	$24,197.04
45ProjectConstruction Area Signs	U803	0.85 1.40	RiskPert(S803,R803,T803,RiskName(B803&C803&H803))	0.88	1.1	$1.37
45ProjectTemporary Traffic Stripe	U804	500 850	RiskPert(S804,R804,T804,RiskName(B804&C804&H804))	525.4	662.22	$820.93
45ProjectThermoplastic Traffic Stripe	U805	200 340	RiskPert(S805,R805,T805,RiskName(B805&C805&H805))	207.09	261.03	$323.59
45ProjectType III Barricade	U806	450 800	RiskPert(S806,R806,T806,RiskName(B806&C806&H806))	480.37	605.47	$750.58
45ProjectTraffic Control System	U807	40,000 70,000	RiskPert(S807,R807,T807,RiskName(B807&C807&H807))	43783.17	55185.04	$68,411.20
45ProjectTemporary Railing (Type K)	U808	8,000 13,000	RiskPert(S808,R808,T808,RiskName(B808&C808&H808))	8231.24	10374.79	$12,861.31

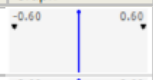
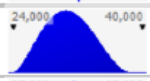
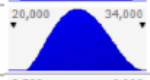
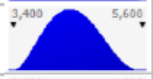
Daggett Road Bridge

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectSheet Pile Coffer Dam For Footers	U810	240,000 400,000	RiskPert(S810,R810,T810,RiskName(B810&C810&H810))	242106	307676.4	$393,422.30
45ProjectBackfill, structural, common earth, 105 H.P. dozer, 50' haul, from existing stockpile, excludes compaction	U811	3,000 5,200	RiskPert(S811,R811,T811,RiskName(B811&C811&H811))	3169.43	4027.82	$5,150.32
45ProjectStructure Excavation (Type D)	U813	26,000 46,000	RiskPert(S813,R813,T813,RiskName(B813&C813&H813))	27243.47	34621.91	$44,270.64
45ProjectStructure Excavation (Bridge)	U814	8,000 15,000	RiskPert(S814,R814,T814,RiskName(B814&C814&H814))	8696.22	11051.45	$14,131.36
45ProjectPrestressed concrete piles, square, 40' long, 24" square, priced using 200 piles, excludes pile caps or mobilization	U815	65,000 115,000	RiskPert(S815,R815,T815,RiskName(B815&C815&H815))	69425.02	88227.63	$112,815.60
45Project18" Diameter 40' Long Tie Down Anchor Installation	U816	40,000 70,000	RiskPert(S816,R816,T816,RiskName(B816&C816&H816))	42851.99	54457.73	$69,634.48

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectPiling special costs, pre-augering for Pile and Tie Down Anchor	U817		RiskPert(S817,R817,T817,RiskName(B817&C817&H817))	261911.7	332846.1	$425,606.40
45ProjectMobilization, 150 ton, set up and remove crane, with pile leads and pile hammer	U818		RiskPert(S818,R818,T818,RiskName(B818&C818&H818))	38928.68	49471.87	$63,259.11
45ProjectA736 Barrier Wall	U819		RiskPert(S819,R819,T819,RiskName(B819&C819&H819))	180069.8	228838.6	$292,613.30
45ProjectExpansion joint, neoprene, liquid, 1" x 2", cold applied	U820		RiskPert(S820,R820,T820,RiskName(B820&C820&H820))	1776.1	2257.13	$2,886.16
45ProjectColumns Structural Concrete includes forms, Grade 60 rebar, concrete, placing and finishing	U821		RiskPert(S821,R821,T821,RiskName(B821&C821&H821))	268507	341227.6	$436,323.80
45ProjectDeck Structural concrete, in place, includes forms, Grade 60 rebar, concrete, placing and finishing	U822		RiskPert(S822,R822,T822,RiskName(B822&C822&H822))	167202.9	212487	$271,704.70
45ProjectFooter Structural concrete,footing, reinforced, includes forms(4 uses), Grade 60 rebar, concrete, placing and finishing	U823		RiskPert(S823,R823,T823,RiskName(B823&C823&H823))	165438.5	210244.7	$268,837.50
45ProjectApproach Slab Structural concrete, in place, 6" thick, includes forms, Grade 60 rebar, concrete, and placing, excludes finishing	U824		RiskPert(S824,R824,T824,RiskName(B824&C824&H824))	4369.04	5552.32	$7,099.68
45ProjectPrecast 36" I-Girder 65'	U825		RiskPert(S825,R825,T825,RiskName(B825&C825&H825))	209949.7	266811	$341,168.20
45ProjectPrecast 36" I-Girder 48'	U826		RiskPert(S826,R826,T826,RiskName(B826&C826&H826))	250864.2	318806.5	$407,654.30
45ProjectBridge Demolition	U827		RiskPert(S827,R827,T827,RiskName(B827&C827&H827))	171384.8	217801.6	$278,500.30
45ProjectRoadway Excavation	U829		RiskPert(S829,R829,T829,RiskName(B829&C829&H829))	52539.8	66222.04	$82,093.44
45ProjectImported Borrow	U830		RiskPert(S830,R830,T830,RiskName(B830&C830&H830))	216726.7	273165.9	$338,635.40
45ProjectHot Mix Asphalt (Type A)	U831		RiskPert(S831,R831,T831,RiskName(B831&C831&H831))	141156.9	177916.5	$220,557.70
45ProjectClass 2 Aggregate Base	U832		RiskPert(S832,R832,T832,RiskName(B832&C832&H832))	52364.67	66001.3	$81,819.80
45ProjectRemove Base and Surfacing	U833		RiskPert(S833,R833,T833,RiskName(B833&C833&H833))	49834	62811.61	$77,865.63
45ProjectMidwest Guardrail System	U834		RiskPert(S834,R834,T834,RiskName(B834&C834&H834))	7112.14	8964.26	$11,112.71
45ProjectTransition Railing (Type WB-31)	U835		RiskPert(S835,R835,T835,RiskName(B835&C835&H835))	14010.61	17659.21	$21,891.58
45ProjectAlternative Flared Terminal System	U836		RiskPert(S836,R836,T836,RiskName(B836&C836&H836))	3502.65	4414.8	$5,472.90
45ProjectTemporary Reinforced Silt Fence	U837		RiskPert(S837,R837,T837,RiskName(B837&C837&H837))	6637.53	8366.05	$10,371.14
45ProjectTemporary Fence (Type ESA)	U838		RiskPert(S838,R838,T838,RiskName(B838&C838&H838))	4404.59	5551.61	$6,882.17
45ProjectTemporary Hydroseed	U839		RiskPert(S839,R839,T839,RiskName(B839&C839&H839))	9688.34	12211.34	$15,138.03
45ProjectTemporary Fiber Roll	U841		RiskPert(S841,R841,T841,RiskName(B841&C841&H841))	7802.16	9833.97	$12,190.88
45ProjectTemporary Construction Entrance	U842		RiskPert(S842,R842,T842,RiskName(B842&C842&H842))	3768.2	4749.5	$5,887.81
45ProjectWater Pollution Control	U843		RiskPert(S843,R843,T843,RiskName(B843&C843&H843))	51262.21	64611.74	$80,097.20

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectRoadside Sign - One Post	U844		RiskPert(S844,R844,T844,RiskName(B844&C844&H844))	236.43	298	$369.42
45ProjectRemove Roadside Sign	U845		RiskPert(S845,R845,T845,RiskName(B845&C845&H845))	175.13	220.74	$273.64
45ProjectReset Roadside Sign	U846		RiskPert(S846,R846,T846,RiskName(B846&C846&H846))	525.4	662.22	$820.93
45ProjectConstruction Area Signs	U847		RiskPert(S847,R847,T847,RiskName(B847&C847&H847))	0.88	1.1	$1.37
45ProjectThermoplastic Traffic Stripe	U848		RiskPert(S848,R848,T848,RiskName(B848&C848&H848))	1521.2	1917.35	$2,376.88
45ProjectType III Barricade	U849		RiskPert(S849,R849,T849,RiskName(B849&C849&H849))	480.37	605.47	$750.58
45ProjectTraffic Control System	U850		RiskPert(S850,R850,T850,RiskName(B850&C850&H850))	13134.95	16555.51	$20,523.36
45ProjectTemporary Railing (Type K)	U851		RiskPert(S851,R851,T851,RiskName(B851&C851&H851))	4938.74	6224.87	$7,716.78

Dry Creek Bridge

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectStructure Excavation (Bridge)	U853		RiskPert(S853,R853,T853,RiskName(B853&C853&H853))	0	0	$0.00
45ProjectA736 Barrier Wall	U854		RiskPert(S854,R854,T854,RiskName(B854&C854&H854))	0	0	$0.00
45ProjectDeck Structural concrete, in place, includes forms, Grade 60 rebar, concrete, placing and finishing	U856		RiskPert(S856,R856,T856,RiskName(B856&C856&H856))	0	0	$0.00
45ProjectFooter Structural concrete,footing, reinforced, includes forms(4 uses), Grade 60 rebar, concrete, placing and finishing	U857		RiskPert(S857,R857,T857,RiskName(B857&C857&H857))	0	0	$0.00
45ProjectApproach Slab Structural concrete, in place, 6" thick, includes forms, Grade 60 rebar, concrete, and placing, excludes finishing	U858		RiskPert(S858,R858,T858,RiskName(B858&C858&H858))	0	0	$0.00
45ProjectTemporary Bridge	U859		RiskPert(S859,R859,T859,RiskName(B859&C859&H859))	186647.6	237198	$303,302.40
45ProjectBridge Demolition	U860		RiskPert(S860,R860,T860,RiskName(B860&C860&H860))	0	0	$0.00
45ProjectRoadway Excavation	U862		RiskPert(S862,R862,T862,RiskName(B862&C862&H862))	24518.57	30903.62	$38,310.27
45ProjectImported Borrow	U863		RiskPert(S863,R863,T863,RiskName(B863&C863&H863))	39404.85	49666.53	$61,570.08
45ProjectHot Mix Asphalt (Type A)	U864		RiskPert(S864,R864,T864,RiskName(B864&C864&H864))	68301.74	86088.66	$106,721.50
45ProjectClass 2 Aggregate Base	U865		RiskPert(S865,R865,T865,RiskName(B865&C865&H865))	21628.88	27261.41	$33,795.13
45ProjectMidwest Guardrail System	U866		RiskPert(S866,R866,T866,RiskName(B866&C866&H866))	3556.07	4482.13	$5,556.36
45ProjectTransition Railing (Type WB-31)	U867		RiskPert(S867,R867,T867,RiskName(B867&C867&H867))	14010.61	17659.21	$21,891.58
45ProjectAlternative Flared Terminal System	U868		RiskPert(S868,R868,T868,RiskName(B868&C868&H868))	3502.65	4414.8	$5,472.90
45ProjectTemporary Reinforced Silt Fence	U869		RiskPert(S869,R869,T869,RiskName(B869&C869&H869))	2655.01	3346.42	$4,148.46
45ProjectTemporary Fence (Type ESA)	U870		RiskPert(S870,R870,T870,RiskName(B870&C870&H870))	1761.84	2220.65	$2,752.87

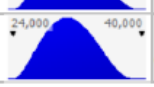
Name	Cell	Graph	Function	Min	Mean	Max
45ProjectTemporary Hydroseed	U871	4,000 7,000	RiskPert(S871,R871,T871,RiskName(B871&C871&H871))	4440.49	5596.87	$6,938.26
45ProjectTemporary Fiber Roll	U873	7,000 11,500	RiskPert(S873,R873,T873,RiskName(B873&C873&H873))	7092.87	8939.98	$11,082.61
45ProjectTemporary Concrete Washout	U874	0.85 1.40	RiskPert(S874,R874,T874,RiskName(B874&C874&H874))	0.88	1.1	$1.37
45ProjectTemporary Construction Entrance	U875	7,500 12,000	RiskPert(S875,R875,T875,RiskName(B875&C875&H875))	7536.4	9499	$11,775.62
45ProjectWater Pollution Control	U876	15,000 25,000	RiskPert(S876,R876,T876,RiskName(B876&C876&H876))	15385.41	19392.02	$24,039.70
45ProjectConstruction Area Signs	U877	0.85 1.40	RiskPert(S877,R877,T877,RiskName(B877&C877&H877))	0.88	1.1	$1.37
45ProjectThermoplastic Traffic Stripe	U878	450 800	RiskPert(S878,R878,T878,RiskName(B878&C878&H878))	489.5	616.97	$764.84
45ProjectPortable Changeable Message Signs	U879	5,000 8,500	RiskPert(S879,R879,T879,RiskName(B879&C879&H879))	5253.98	6622.2	$8,209.34
45ProjectType III Barricade	U880	450 800	RiskPert(S880,R880,T880,RiskName(B880&C880&H880))	480.37	605.47	$750.58
45ProjectTraffic Control System	U881	17,000 28,000	RiskPert(S881,R881,T881,RiskName(B881&C881&H881))	17513.27	22074.01	$27,364.48
45ProjectTemporary Railing (Type K)	U882	8,000 13,000	RiskPert(S882,R882,T882,RiskName(B882&C882&H882))	8231.24	10374.79	$12,861.31
45ProjectRoadway Excavation	U884	40,000 70,000	RiskPert(S884,R884,T884,RiskName(B884&C884&H884))	42031.84	52977.63	$65,674.75
45ProjectDitch Excavation	U885	1,200 2,000	RiskPert(S885,R885,T885,RiskName(B885&C885&H885))	1225.93	1545.18	$1,915.51
45ProjectImported Borrow	U886	60,000 100,000	RiskPert(S886,R886,T886,RiskName(B886&C886&H886))	63835.86	80459.78	$99,743.53
45ProjectHot Mix Asphalt (Type A)	U887	60,000 95,000	RiskPert(S887,R887,T887,RiskName(B887&C887&H887))	60333.21	76044.98	$94,270.63
45ProjectClass 2 Aggregate Base	U888	22,000 36,000	RiskPert(S888,R888,T888,RiskName(B888&C888&H888))	22767.25	28696.22	$35,573.82
45ProjectMidwest Guardrail System	U889	3,500 6,000	RiskPert(S889,R889,T889,RiskName(B889&C889&H889))	3556.07	4482.13	$5,556.36
45ProjectTransition Railing (Type WB-31)	U890	14,000 22,000	RiskPert(S890,R890,T890,RiskName(B890&C890&H890))	14010.61	17659.21	$21,891.58
45ProjectAlternative Flared Terminal System	U891	3,400 5,600	RiskPert(S891,R891,T891,RiskName(B891&C891&H891))	3502.65	4414.8	$5,472.90
45ProjectTemporary Reinforced Silt Fence	U892	2,600 4,200	RiskPert(S892,R892,T892,RiskName(B892&C892&H892))	2655.01	3346.42	$4,148.46
45ProjectTemporary Fence (Type ESA)	U893	1,700 2,800	RiskPert(S893,R893,T893,RiskName(B893&C893&H893))	1761.84	2220.65	$2,752.87
45ProjectTemporary Hydroseed	U894	2,400 4,200	RiskPert(S894,R894,T894,RiskName(B894&C894&H894))	2583.56	3256.36	$4,036.81
45ProjectTemporary Fiber Roll	U896	2,800 4,600	RiskPert(S896,R896,T896,RiskName(B896&C896&H896))	2837.15	3575.99	$4,433.05
45ProjectTemporary Concrete Washout	U897	1.30 2.10	RiskPert(S897,R897,T897,RiskName(B897&C897&H897))	1.31	1.66	$2.05
45ProjectTemporary Construction Entrance	U898	7,500 12,000	RiskPert(S898,R898,T898,RiskName(B898&C898&H898))	7536.4	9499	$11,775.62

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectWater Pollution Control	U899	18,000 30,000	RiskPert(S899,R899,T899,RiskName(B899&C899&H899))	19019.41	23972.38	$29,717.83
45ProjectConstruction Area Signs	U900	1,700 2,800	RiskPert(S900,R900,T900,RiskName(B900&C900&H900))	1751.33	2207.4	$2,736.45
45ProjectTemporary Traffic Stripe	U901	400 700	RiskPert(S901,R901,T901,RiskName(B901&C901&H901))	425.84	536.73	$665.37
45ProjectType III Barricade	U902	450 800	RiskPert(S902,R902,T902,RiskName(B902&C902&H902))	480.37	605.47	$750.58
45ProjectTraffic Control System	U903	4,000 7,000	RiskPert(S903,R903,T903,RiskName(B903&C903&H903))	4378.32	5518.5	$6,841.12
45ProjectTemporary Railing (Type K)	U904	6,500 10,500	RiskPert(S904,R904,T904,RiskName(B904&C904&H904))	6584.99	8299.83	$10,289.04

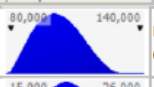
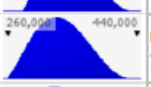
Camp Creek Bridge

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectBackfill, structural, common earth, 105 H.P. dozer, 50' haul, from existing stockpile, excludes compaction	U906	14,000 24,000	RiskPert(S906,R906,T906,RiskName(B906&C906&H906))	14628.13	18589.92	$23,770.71
45ProjectEarth Work Coffer Dam Construction for side footers	U907	15,000 26,000	RiskPert(S907,R907,T907,RiskName(B907&C907&H907))	15847.14	20139.08	$25,751.61
45ProjectStructure Excavation (Bridge)	U908	28,000 50,000	RiskPert(S908,R908,T908,RiskName(B908&C908&H908))	29750.24	37807.6	$48,344.14
45ProjectSteel piles, "H" Sections, 50' long, HP14 X 89, excludes mobilization or demobilization	U909	100,000 180,000	RiskPert(S909,R909,T909,RiskName(B909&C909&H909))	105579.5	134174	$171,566.80
45ProjectPiling special costs, pre-augering for Pile	U910	350,000 650,000	RiskPert(S910,R910,T910,RiskName(B910&C910&H910))	381954.5	485400.5	$620,676.10
45ProjectMobilization, 150 ton, set up and remove crane, with pile leads and pile hammer	U911	35,000 65,000	RiskPert(S911,R911,T911,RiskName(B911&C911&H911))	38928.68	49471.87	$63,259.11
45ProjectA736 Barrier Wall	U912	150,000 250,000	RiskPert(S912,R912,T912,RiskName(B912&C912&H912))	150850.9	191706.3	$245,132.70
45ProjectExpansion joint, neoprene, liquid, 1" x 2", cold applied	U913	1,800 3,200	RiskPert(S913,R913,T913,RiskName(B913&C913&H913))	1930.55	2453.41	$3,137.14
45ProjectColumns Structural Concrete includes forms, Grade 60 rebar, concrete, placing and finishing	U914	220,000 380,000	RiskPert(S914,R914,T914,RiskName(B914&C914&H914))	225751.1	286892	$366,845.50
45ProjectDeck Structural concrete, in place, includes forms, Grade 60 rebar, concrete, placing and finishing	U915	130,000 230,000	RiskPert(S915,R915,T915,RiskName(B915&C915&H915))	139168.9	176860.4	$226,149.40
45ProjectFooter Structural concrete,footing, reinforced, includes forms(4 uses), Grade 60 rebar, concrete, placing and finishing	U916	55,000 100,000	RiskPert(S916,R916,T916,RiskName(B916&C916&H916))	59823.73	76025.98	$97,213.55
45ProjectApproach Slab Structural concrete, in place, 6" thick, includes forms, Grade 60 rebar, concrete, and placing, excludes finishing	U917	4,500 8,000	RiskPert(S917,R917,T917,RiskName(B917&C917&H917))	4883.04	6205.53	$7,934.94
45ProjectPrecast 36" I-Girder 67'	U918	100,000 180,000	RiskPert(S918,R918,T918,RiskName(B918&C918&H918))	104974.8	133405.5	$170,584.10
45ProjectPrecast 36" I-Girder 53'	U919	240,000 420,000	RiskPert(S919,R919,T919,RiskName(B919&C919&H919))	250864.2	318806.5	$407,654.30
45ProjectRoadway Excavation	U921	400,000 700,000	RiskPert(S921,R921,T921,RiskName(B921&C921&H921))	429775.6	541696.3	$671,524.30
45ProjectDitch Excavation	U922	6,000 10,000	RiskPert(S922,R922,T922,RiskName(B922&C922&H922))	6129.64	7725.91	$9,577.57
45ProjectImported Borrow	U923	450,000 800,000	RiskPert(S923,R923,T923,RiskName(B923&C923&H923))	494530.9	623314.9	$772,704.50
45ProjectHot Mix Asphalt (Type A)	U924	80,000 130,000	RiskPert(S924,R924,T924,RiskName(B924&C924&H924))	80823.73	101871.6	$126,287.10

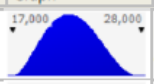
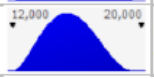
Name	Cell	Graph	Function	Min	Mean	Max
45ProjectClass 2 Aggregate Base	U925	28,000 48,000	RiskPert(S925,R925,T925,RiskName(B925&C925&H925))	29597.42	37305.08	$46,245.97
45ProjectMidwest Guardrail System	U926	14,000 23,000	RiskPert(S926,R926,T926,RiskName(B926&C926&H926))	14224.28	17928.51	$22,225.43
45ProjectTransition Railing (Type WB-31)	U927	14,000 22,000	RiskPert(S927,R927,T927,RiskName(B927&C927&H927))	14010.61	17659.21	$21,891.58
45ProjectAlternative Flared Terminal System	U928	3,400 5,600	RiskPert(S928,R928,T928,RiskName(B928&C928&H928))	3502.65	4414.8	$5,472.90
45ProjectTemporary Reinforced Silt Fence	U929	2,600 4,200	RiskPert(S929,R929,T929,RiskName(B929&C929&H929))	2655.01	3346.42	$4,148.46
45ProjectTemporary Fence (Type ESA)	U930	1,700 2,800	RiskPert(S930,R930,T930,RiskName(B930&C930&H930))	1761.84	2220.65	$2,752.87
45ProjectTemporary Hydroseed	U931	1,200 2,100	RiskPert(S931,R931,T931,RiskName(B931&C931&H931))	1291.78	1628.18	$2,018.40
45ProjectTemporary Fiber Roll	U933	1,500 2,500	RiskPert(S933,R933,T933,RiskName(B933&C933&H933))	1595.9	2011.5	$2,493.59
45ProjectTemporary Concrete Washout	U934	0.85 1.40	RiskPert(S934,R934,T934,RiskName(B934&C934&H934))	0.88	1.1	$1.37
45ProjectTemporary Construction Entrance	U935	7,500 12,000	RiskPert(S935,R935,T935,RiskName(B935&C935&H935))	7536.4	9499	$11,775.62
45ProjectWater Pollution Control	U936	40,000 70,000	RiskPert(S936,R936,T936,RiskName(B936&C936&H936))	43590.52	54942.22	$68,110.19
45ProjectRoadside Sign - One Post	U937	1,800 3,000	RiskPert(S937,R937,T937,RiskName(B937&C937&H937))	1891.43	2383.99	$2,955.36
45ProjectConstruction Area Signs	U938	0.85 1.40	RiskPert(S938,R938,T938,RiskName(B938&C938&H938))	0.88	1.1	$1.37
45ProjectThermoplastic Traffic Stripe	U939	600 1,000	RiskPert(S939,R939,T939,RiskName(B939&C939&H939))	609.99	768.84	$953.10
45ProjectType III Barricade	U940	450 800	RiskPert(S940,R940,T940,RiskName(B940&C940&H940))	480.37	605.47	$750.58
45ProjectTraffic Control System	U941	17,000 28,000	RiskPert(S941,R941,T941,RiskName(B941&C941&H941))	17513.27	22074.01	$27,364.48
45ProjectTemporary Railing (Type K)	U942	12,000 20,000	RiskPert(S942,R942,T942,RiskName(B942&C942&H942))	12346.85	15562.18	$19,291.96
45ProjectRoadway Excavation	U944	3,400 5,600	RiskPert(S944,R944,T944,RiskName(B944&C944&H944))	3502.65	4414.8	$5,472.90
45ProjectDitch Excavation	U945	4,500 7,500	RiskPert(S945,R945,T945,RiskName(B945&C945&H945))	4597.23	5794.43	$7,183.18
45ProjectImported Borrow	U946	130,000 220,000	RiskPert(S946,R946,T946,RiskName(B946&C946&H946))	137917	173832.9	$215,495.30
45ProjectClearing & Grubbing	U947	4,000 7,000	RiskPert(S947,R947,T947,RiskName(B947&C947&H947))	4378.32	5518.5	$6,841.12
45ProjectHot Mix Asphalt (Type A)	U948	50,000 85,000	RiskPert(S948,R948,T948,RiskName(B948&C948&H948))	53503.03	67436.11	$83,598.48
45ProjectClass 2 Aggregate Base	U949	13,000 21,000	RiskPert(S949,R949,T949,RiskName(B949&C949&H949))	13375.76	16859.03	$20,899.62
45ProjectRock Slope Protection (Class?) Method B	U950	1,300 2,100	RiskPert(S950,R950,T950,RiskName(B950&C950&H950))	1313.5	1655.55	$2,052.34
45ProjectRock Slope Protection Fabric Class 8	U951	350 650	RiskPert(S951,R951,T951,RiskName(B951&C951&H951))	399.17	503.12	$623.70

Name	Cell	Graph	Function	Min	Mean	Max
45Project36" Alternative Pipe Culvert	U952		RiskPert(S952,R952,T952,RiskName(B952&C952&H952))	68674.77	86558.83	$107,304.30
45ProjectTemporary Reinforced Silt Fence	U953		RiskPert(S953,R953,T953,RiskName(B953&C953&H953))	3982.52	5019.63	$6,222.68
45ProjectTemporary Fence (Type ESA)	U954		RiskPert(S954,R954,T954,RiskName(B954&C954&H954))	2642.75	3330.97	$4,129.30
45ProjectTemporary Hydroseed	U955		RiskPert(S955,R955,T955,RiskName(B955&C955&H955))	5086.38	6410.96	$7,947.47
45ProjectTemporary Fiber Roll	U957		RiskPert(S957,R957,T957,RiskName(B957&C957&H957))	8440.52	10638.57	$13,188.31
45ProjectTemporary Concrete Washout	U958		RiskPert(S958,R958,T958,RiskName(B958&C958&H958))	2626.33	3310.27	$4,103.65
45ProjectTemporary Construction Entrance	U959		RiskPert(S959,R959,T959,RiskName(B959&C959&H959))	7536.4	9499	$11,775.62
45ProjectWater Pollution Control	U960		RiskPert(S960,R960,T960,RiskName(B960&C960&H960))	28766.14	36257.32	$44,947.09
45ProjectConstruction Area Signs	U961		RiskPert(S961,R961,T961,RiskName(B961&C961&H961))	1751.33	2207.4	$2,736.45
45ProjectTemporary Traffic Stripe	U962		RiskPert(S962,R962,T962,RiskName(B962&C962&H962))	446.44	562.7	$697.56
45ProjectType III Barricade	U963		RiskPert(S963,R963,T963,RiskName(B963&C963&H963))	480.37	605.47	$750.58
45ProjectTraffic Control System	U964		RiskPert(S964,R964,T964,RiskName(B964&C964&H964))	8756.63	11037.01	$13,682.24
45ProjectTemporary Railing (Type K)	U965		RiskPert(S965,R965,T965,RiskName(B965&C965&H965))	24693.71	31124.36	$38,583.92

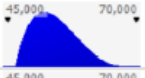
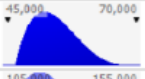
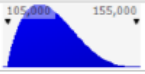
Jenny Creek Bridge

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectSheet Pile Coffer Dam For Center Footer	U967		RiskPert(S967,R967,T967,RiskName(B967&C967&H967))	80702.01	102558.8	$131,140.80
45ProjectEarth Work Coffer Dam Construction for side footers	U968		RiskPert(S968,R968,T968,RiskName(B968&C968&H968))	15847.14	20139.08	$25,751.61
45ProjectBackfill, structural, common earth, 105 H.P. dozer, 50' haul, from existing stockpile, excludes compaction	U969		RiskPert(S969,R969,T969,RiskName(B969&C969&H969))	4945.7	6285.16	$8,036.77
45ProjectStructure Excavation (Type D)	U970		RiskPert(S970,R970,T970,RiskName(B970&C970&H970))	5679.42	7217.6	$9,229.06
45ProjectStructure Excavation (Bridge)	U971		RiskPert(S971,R971,T971,RiskName(B971&C971&H971))	10628.72	13507.34	$17,271.68
45ProjectSteel piles, "H" Sections, 50' long, HP14 X 89, excludes mobilization or demobilization	U972		RiskPert(S972,R972,T972,RiskName(B972&C972&H972))	199092.8	253013.8	$323,525.80
45ProjectPiling special costs, pre-augering for Pile and Tie Down Anchor	U973		RiskPert(S973,R973,T973,RiskName(B973&C973&H973))	720257.1	915326.7	$1,170,418.00
45ProjectMobilization, 150 ton, set up and remove crane, with pile leads and pile hammer	U974		RiskPert(S974,R974,T974,RiskName(B974&C974&H974))	38928.68	49471.87	$63,259.11
45ProjectA736 Barrier Wall	U975		RiskPert(S975,R975,T975,RiskName(B975&C975&H975))	263649.3	335054.3	$428,430.10
45ProjectExpansion joint, neoprene, liquid, 1" x 2", cold applied	U976		RiskPert(S976,R976,T976,RiskName(B976&C976&H976))	2239.43	2845.94	$3,639.07
45ProjectColumns Structural Concrete includes forms, Grade 60 rebar, concrete, placing and finishing	U977		RiskPert(S977,R977,T977,RiskName(B977&C977&H977))	297581	378175.8	$483,569.10

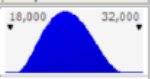
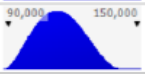
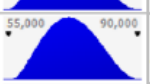
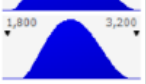
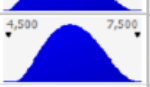
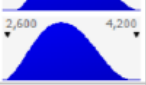
Name	Cell	Graph	Function	Min	Mean	Max
45ProjectDeck Structural concrete, in place, includes forms, Grade 60 rebar, concrete, placing and finishing	U978	300,000 520,000	RiskPert(S978,R978,T978,RiskName(B978&C978&H978))	317385.1	403343.6	$515,750.80
45ProjectFooter Structural concrete,footing, reinforced, includes forms(4 uses), Grade 60 rebar, concrete, placing and finishing	U979	100,000 170,000	RiskPert(S979,R979,T979,RiskName(B979&C979&H979))	103768.3	131872.2	$168,623.50
45ProjectApproach Slab Structural concrete, in place, 6" thick, includes forms, Grade 60 rebar, concrete, and placing, excludes finishing	U980	5,500 9,500	RiskPert(S980,R980,T980,RiskName(B980&C980&H980))	5654.05	7185.36	$9,187.84
45ProjectPrecast 61" Bulb Tee 73'	U981	300,000 600,000	RiskPert(S981,R981,T981,RiskName(B981&C981&H981))	345877.8	439553.1	$562,051.50
45ProjectPrecast 61" Bulb Tee 100'	U982	550,000 900,000	RiskPert(S982,R982,T982,RiskName(B982&C982&H982))	552130.7	701666.1	$897,212.40
45ProjectBridge Demolition	U983	160,000 280,000	RiskPert(S983,R983,T983,RiskName(B983&C983&H983))	162978.5	207118.5	$264,840.00
45ProjectRoadway Excavation	U985	1.00m 1.70m	RiskPert(S985,R985,T985,RiskName(B985&C985&H985))	1050796	1324441	$1,641,869.00
45ProjectDitch Excavation	U986	6,000 10,500	RiskPert(S986,R986,T986,RiskName(B986&C986&H986))	6436.13	8112.2	$10,056.45
45ProjectImported Borrow	U987	1.30m 2.20m	RiskPert(S987,R987,T987,RiskName(B987&C987&H987))	1379170	1738329	$2,154,953.00
45ProjectHot Mix Asphalt (Type A)	U988	65,000 110,000	RiskPert(S988,R988,T988,RiskName(B988&C988&H988))	68301.74	86088.66	$106,721.50
45ProjectClass 2 Aggregate Base	U989	20,000 34,000	RiskPert(S989,R989,T989,RiskName(B989&C989&H989))	21059.7	26544	$32,905.79
45ProjectMidwest Guardrail System	U990	7,000 11,500	RiskPert(S990,R990,T990,RiskName(B990&C990&H990))	7112.14	8964.26	$11,112.71
45ProjectTransition Railing (Type WB-31)	U991	14,000 22,000	RiskPert(S991,R991,T991,RiskName(B991&C991&H991))	14010.61	17659.21	$21,891.58
45ProjectAlternative Flared Terminal System	U992	3,400 5,600	RiskPert(S992,R992,T992,RiskName(B992&C992&H992))	3502.65	4414.8	$5,472.90
45ProjectTemporary Reinforced Silt Fence	U993	2,600 4,200	RiskPert(S993,R993,T993,RiskName(B993&C993&H993))	2655.01	3346.42	$4,148.46
45ProjectTemporary Fence (Type ESA)	U994	1,700 2,800	RiskPert(S994,R994,T994,RiskName(B994&C994&H994))	1761.84	2220.65	$2,752.87
45ProjectTemporary Hydroseed	U995	14,000 23,000	RiskPert(S995,R995,T995,RiskName(B995&C995&H995))	14290.3	18011.73	$22,328.60
45ProjectTemporary Fiber Roll	U997	17,000 28,000	RiskPert(S997,R997,T997,RiskName(B997&C997&H997))	17661.25	22260.54	$27,595.71
45ProjectTemporary Concrete Washout	U998	1,700 2,800	RiskPert(S998,R998,T998,RiskName(B998&C998&H998))	1751.33	2207.4	$2,736.45
45ProjectTemporary Construction Entrance	U999	7,500 12,000	RiskPert(S999,R999,T999,RiskName(B999&C999&H999))	7536.4	9499	$11,775.62
45ProjectWater Pollution Control	U1000	240,000 400,000	RiskPert(S1000,R1000,T1000,RiskName(B1000&C1000&H1000))	252576.3	318351.4	$394,650.50
45ProjectRoadside Sign - One Post	U1001	1,800 3,000	RiskPert(S1001,R1001,T1001,RiskName(B1001&C1001&H1001))	1891.43	2383.99	$2,955.36
45ProjectConstruction Area Signs	U1002	1,700 2,800	RiskPert(S1002,R1002,T1002,RiskName(B1002&C1002&H1002))	1751.33	2207.4	$2,736.45
45ProjectThermoplastic Traffic Stripe	U1003	750 1,200	RiskPert(S1003,R1003,T1003,RiskName(B1003&C1003&H1003))	753.07	949.18	$1,176.67
45ProjectType III Barricade	U1004	450 800	RiskPert(S1004,R1004,T1004,RiskName(B1004&C1004&H1004))	480.37	605.47	$750.58

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectTraffic Control System	U1005		RiskPert(S1005,R1005,T1005,RiskName(B1005 &C1005&H1005))	17513.27	22074.01	$27,364.48
45ProjectTemporary Railing (Type K)	U1006		RiskPert(S1006,R1006,T1006,RiskName(B1006 &C1006&H1006))	12346.85	15562.18	$19,291.96

Other Structures

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectPedestrian Bridge Total	U1008		RiskPert(S1008,R1008,T1008,RiskName(B1008 &C1008&H1008))	47285.82	54291.13	$68,301.74
45ProjectBridge Demolition Ped Bridge Campground	U1009		RiskPert(S1009,R1009,T1009,RiskName(B1009 &C1009&H1009))	47285.82	54291.13	$68,301.74
45ProjectBridge Demolition Timber JC Boyle	U1010		RiskPert(S1010,R1010,T1010,RiskName(B1010 &C1010&H1010))	106393.1	122155	$153,678.90

Scotch Creek

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectRoadway Excavation	U1012		RiskPert(S1012,R1012,T1012,RiskName(B1012 &C1012&H1012))	19264.59	24281.42	$30,100.93
45ProjectDitch Excavation	U1013		RiskPert(S1013,R1013,T1013,RiskName(B1013 &C1013&H1013))	306.48	386.3	$478.88
45ProjectImported Borrow	U1014		RiskPert(S1014,R1014,T1014,RiskName(B1014 &C1014&H1014))	90631.16	114233	$141,611.20
45ProjectClearing & Grubbing	U1015		RiskPert(S1015,R1015,T1015,RiskName(B1015 &C1015&H1015))	0.88	1.1	$1.37
45ProjectHot Mix Asphalt (Type A)	U1016		RiskPert(S1016,R1016,T1016,RiskName(B1016 &C1016&H1016))	58056.48	73175.36	$90,713.25
45ProjectClass 2 Aggregate Base	U1017		RiskPert(S1017,R1017,T1017,RiskName(B1017 &C1017&H1017))	21628.88	27261.41	$33,795.13
45ProjectRock Slope Protection (Class?) Method B	U1018		RiskPert(S1018,R1018,T1018,RiskName(B1018 &C1018&H1018))	875.66	1103.7	$1,368.22
45ProjectRock Slope Protection Fabric Class 8	U1019		RiskPert(S1019,R1019,T1019,RiskName(B1019 &C1019&H1019))	266.11	335.41	$415.80
45Project36" Alternative Pipe Culvert	U1020		RiskPert(S1020,R1020,T1020,RiskName(B1020 &C1020&H1020))	57228.98	72132.36	$89,420.28
45ProjectTemporary Reinforced Silt Fence	U1021		RiskPert(S1021,R1021,T1021,RiskName(B1021 &C1021&H1021))	1991.26	2509.82	$3,111.34
45ProjectTemporary Fence (Type ESA)	U1022		RiskPert(S1022,R1022,T1022,RiskName(B1022 &C1022&H1022))	1321.38	1665.48	$2,064.65
45ProjectTemporary Hydroseed	U1023		RiskPert(S1023,R1023,T1023,RiskName(B1023 &C1023&H1023))	4763.43	6003.91	$7,442.87
45ProjectTemporary Fiber Roll	U1025		RiskPert(S1025,R1025,T1025,RiskName(B1025 &C1025&H1025))	3191.79	4022.99	$4,987.18
45ProjectTemporary Concrete Washout	U1026		RiskPert(S1026,R1026,T1026,RiskName(B1026 &C1026&H1026))	2626.33	3310.27	$4,103.65
45ProjectTemporary Construction Entrance	U1027		RiskPert(S1027,R1027,T1027,RiskName(B1027 &C1027&H1027))	7536.4	9499	$11,775.62
45ProjectWater Pollution Control	U1028		RiskPert(S1028,R1028,T1028,RiskName(B1028 &C1028&H1028))	24825.92	31291.01	$38,790.50
45ProjectConstruction Area Signs	U1029		RiskPert(S1029,R1029,T1029,RiskName(B1029 &C1029&H1029))	1751.33	2207.4	$2,736.45

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectTemporary Traffic Stripe	U1030	350 600	RiskPert(S1030,R1030,T1030,RiskName(B1030 &C1030&H1030))	357.15	450.16	$558.05
45ProjectType III Barricade	U1031	450 800	RiskPert(S1031,R1031,T1031,RiskName(B1031 &C1031&H1031))	480.37	605.47	$750.58
45ProjectTraffic Control System	U1032	8,500 14,000	RiskPert(S1032,R1032,T1032,RiskName(B1032 &C1032&H1032))	8756.63	11037.01	$13,682.24
45ProjectTemporary Railing (Type K)	U1033	20,000 34,000	RiskPert(S1033,R1033,T1033,RiskName(B1033 &C1033&H1033))	20578.09	25936.97	$32,153.26
45ProjectRoadway Excavation	U1035	100,000 170,000	RiskPert(S1035,R1035,T1035,RiskName(B1035 &C1035&H1035))	105079.6	132444.1	$164,186.90
45ProjectDitch Excavation	U1036	300 480	RiskPert(S1036,R1036,T1036,RiskName(B1036 &C1036&H1036))	306.48	386.3	$478.88
45ProjectImported Borrow	U1037	110,000 190,000	RiskPert(S1037,R1037,T1037,RiskName(B1037 &C1037&H1037))	118214.6	148999.6	$184,710.20
45ProjectHot Mix Asphalt (Type A)	U1038	18,000 32,000	RiskPert(S1038,R1038,T1038,RiskName(B1038 &C1038&H1038))	19352.16	24391.79	$30,237.75
45ProjectClass 2 Aggregate Base	U1039	6,500 11,000	RiskPert(S1039,R1039,T1039,RiskName(B1039 &C1039&H1039))	6830.17	8608.87	$10,672.15
45ProjectRock Slope Protection Class III, Method B	U1040	400 700	RiskPert(S1040,R1040,T1040,RiskName(B1040 &C1040&H1040))	437.83	551.85	$684.11
45ProjectRock Slope Protection Fabric Class 8	U1041	100 170	RiskPert(S1041,R1041,T1041,RiskName(B1041 &C1041&H1041))	106.45	134.17	$166.32
45ProjectStructural Concrete, Box Culvert	U1042	40,000 70,000	RiskPert(S1042,R1042,T1042,RiskName(B1042 &C1042&H1042))	42338.32	53363.93	$66,153.63
45ProjectMidwest Guardrail System	U1043	11,000 19,000	RiskPert(S1043,R1043,T1043,RiskName(B1043 &C1043&H1043))	11975.57	15094.21	$18,711.83
45ProjectAlternative Flared Terminal System	U1044	3,400 5,600	RiskPert(S1044,R1044,T1044,RiskName(B1044 &C1044&H1044))	3502.65	4414.8	$5,472.90
45ProjectTemporary Reinforced Silt Fence	U1045	2,600 4,200	RiskPert(S1045,R1045,T1045,RiskName(B1045 &C1045&H1045))	2655.01	3346.42	$4,148.46
45ProjectTemporary Fence (Type ESA)	U1046	1,700 2,800	RiskPert(S1046,R1046,T1046,RiskName(B1046 &C1046&H1046))	1761.84	2220.65	$2,752.87
45ProjectTemporary Hydroseed	U1047	1,600 2,800	RiskPert(S1047,R1047,T1047,RiskName(B1047 &C1047&H1047))	1776.2	2238.75	$2,775.31
45ProjectTemporary Fiber Roll	U1049	3,000 5,000	RiskPert(S1049,R1049,T1049,RiskName(B1049 &C1049&H1049))	3191.79	4022.99	$4,987.18
45ProjectTemporary Construction Entrance	U1050	7,500 12,000	RiskPert(S1050,R1050,T1050,RiskName(B1050 &C1050&H1050))	7536.4	9499	$11,775.62
45ProjectWater Pollution Control	U1051	28,000 46,000	RiskPert(S1051,R1051,T1051,RiskName(B1051 &C1051&H1051))	29266.56	36888.06	$45,729.00
45ProjectConstruction Area Signs	U1052	2,000 3,600	RiskPert(S1052,R1052,T1052,RiskName(B1052 &C1052&H1052))	2189.16	2759.25	$3,420.56
45ProjectThermoplastic Traffic Stripe	U1053	150 240	RiskPert(S1053,R1053,T1053,RiskName(B1053 &C1053&H1053))	150.61	189.84	$235.33
45ProjectTraffic Control System	U1054	8,500 14,000	RiskPert(S1054,R1054,T1054,RiskName(B1054 &C1054&H1054))	8756.63	11037.01	$13,682.24
45ProjectTemporary Railing (Type K)	U1055	5,500 9,500	RiskPert(S1055,R1055,T1055,RiskName(B1055 &C1055&H1055))	5879.45	7410.56	$9,186.65

Copco Rd at Beaver Creek

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectRoadway Excavation	U1057	100,000 170,000	RiskPert(S1057,R1057,T1057,RiskName(B1057 &C1057&H1057))	105079.6	132444.1	$164,186.90
45ProjectImported Borrow	U1058	90,000 160,000	RiskPert(S1058,R1058,T1058,RiskName(B1058 &C1058&H1058))	98512.13	124166.3	$153,925.20
45ProjectRock Slope Protection Class III, Method B	U1059	20,000 36,000	RiskPert(S1059,R1059,T1059,RiskName(B1059 &C1059&H1059))	21891.58	27592.52	$34,205.60
45ProjectRock Slope Protection Fabric Class 8	U1060	6,000 10,000	RiskPert(S1060,R1060,T1060,RiskName(B1060 &C1060&H1060))	6209.33	7826.34	$9,702.08
45Project60" CORRUGATED STEEL PIPE (.138" THICK)	U1061	18,000 30,000	RiskPert(S1061,R1061,T1061,RiskName(B1061 &C1061&H1061))	18914.33	23839.94	$29,553.64
45ProjectTemporary Reinforced Silt Fence	U1062	3,500 6,500	RiskPert(S1062,R1062,T1062,RiskName(B1062 &C1062&H1062))	3982.52	5019.63	$6,222.68
45ProjectTemporary Fence (Type ESA)	U1063	2,600 4,200	RiskPert(S1063,R1063,T1063,RiskName(B1063 &C1063&H1063))	2642.75	3330.97	$4,129.30
45ProjectWater Pollution Control	U1064	24,000 40,000	RiskPert(S1064,R1064,T1064,RiskName(B1064 &C1064&H1064))	25060.7	31586.92	$39,157.34
45ProjectConstruction Area Signs	U1065	500 850	RiskPert(S1065,R1065,T1065,RiskName(B1065 &C1065&H1065))	525.4	662.22	$820.93
45ProjectTraffic Control System	U1066	8,500 14,000	RiskPert(S1066,R1066,T1066,RiskName(B1066 &C1066&H1066))	8756.63	11037.01	$13,682.24
45ProjectTemporary Railing (Type K)	U1067	2,200 3,800	RiskPert(S1067,R1067,T1067,RiskName(B1067 &C1067&H1067))	2351.78	2964.23	$3,674.66
45ProjectReplace and Reconstruct 60-inch Culvert No.1 at Beaver Creek	U1068	13,000 21,000	RiskPert(S1068,R1068,T1068,RiskName(B1068 &C1068&H1068))	13134.95	16555.51	$20,523.36
45ProjectReplace and Reconstruct 60-inch Culvert No.2 at Beaver Creek	U1069	13,000 21,000	RiskPert(S1069,R1069,T1069,RiskName(B1069 &C1069&H1069))	13134.95	16555.51	$20,523.36

Copco Rd at Raymond Gulch

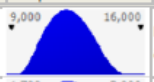
Name	Cell	Graph	Function	Min	Mean	Max
45ProjectRock Slope Protection Class III, Method B	U1071	13,000 21,000	RiskPert(S1071,R1071,T1071,RiskName(B1071 &C1071&H1071))	13134.95	16555.51	$20,523.36
45ProjectRock Slope Protection Fabric Class 8	U1072	3,400 5,600	RiskPert(S1072,R1072,T1072,RiskName(B1072 &C1072&H1072))	3548.19	4472.2	$5,544.04
45ProjectTemporary Reinforced Silt Fence	U1073	3,500 6,500	RiskPert(S1073,R1073,T1073,RiskName(B1073 &C1073&H1073))	3982.52	5019.63	$6,222.68
45ProjectTemporary Fence (Type ESA)	U1074	2,600 4,200	RiskPert(S1074,R1074,T1074,RiskName(B1074 &C1074&H1074))	2642.75	3330.97	$4,129.30
45ProjectWater Pollution Control	U1075	16,000 27,000	RiskPert(S1075,R1075,T1075,RiskName(B1075 &C1075&H1075))	16683.14	21027.71	$26,067.40
45ProjectTraffic Control System	U1076	850 1,400	RiskPert(S1076,R1076,T1076,RiskName(B1076 &C1076&H1076))	875.66	1103.7	$1,368.22
45Project60-inch Culvert at Raymond Gulch	U1077	8,500 14,000	RiskPert(S1077,R1077,T1077,RiskName(B1077 &C1077&H1077))	8756.63	11037.01	$13,682.24

Patricia Avenue Culverts

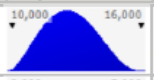
Name	Cell	Graph	Function	Min	Mean	Max
45ProjectRock Slope Protection Class III, Method B	U1079	13,000 21,000	RiskPert(S1079,R1079,T1079,RiskName(B1079 &C1079&H1079))	13134.95	16555.51	$20,523.36
45ProjectRock Slope Protection Fabric Class 8	U1080	3,400 5,600	RiskPert(S1080,R1080,T1080,RiskName(B1080 &C1080&H1080))	3548.19	4472.2	$5,544.04

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectWater Pollution Control	U1081		RiskPert(S1081,R1081,T1081,RiskName(B1081&C1081&H1081))	1668.31	2102.77	$2,606.74
45ProjectTraffic Control System	U1082		RiskPert(S1082,R1082,T1082,RiskName(B1082&C1082&H1082))	875.66	1103.7	$1,368.22

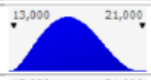
Topsy Grade Culverts

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectTrench Excavation	U1084		RiskPert(S1084,R1084,T1084,RiskName(B1084&C1084&H1084))	9632.3	12140.71	$15,050.46
45ProjectClearing & Grubbing	U1085		RiskPert(S1085,R1085,T1085,RiskName(B1085&C1085&H1085))	1751.33	2207.4	$2,736.45
45ProjectRock Slope Protection Class III, Method B	U1086		RiskPert(S1086,R1086,T1086,RiskName(B1086&C1086&H1086))	70053.07	88296.05	$109,457.90
45ProjectRock Slope Protection Fabric Class 8	U1087		RiskPert(S1087,R1087,T1087,RiskName(B1087&C1087&H1087))	20845.6	26274.15	$32,571.26
45Project24" corrugated steel pipe (.138" thick)	U1088		RiskPert(S1088,R1088,T1088,RiskName(B1088&C1088&H1088))	24080.74	30351.77	$37,626.16
45ProjectTemporary Reinforced Silt Fence	U1089		RiskPert(S1089,R1089,T1089,RiskName(B1089&C1089&H1089))	6637.53	8366.05	$10,371.14
45ProjectTemporary Fence (Type ESA)	U1090		RiskPert(S1090,R1090,T1090,RiskName(B1090&C1090&H1090))	4404.59	5551.61	$6,882.17
45ProjectWater Pollution Control	U1091		RiskPert(S1091,R1091,T1091,RiskName(B1091&C1091&H1091))	12636.3	15927.01	$19,744.22
45ProjectTraffic Control System	U1092		RiskPert(S1092,R1092,T1092,RiskName(B1092&C1092&H1092))	4378.32	5518.5	$6,841.12

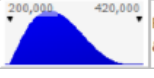
JC Boyle Unnamed Culverts

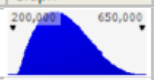
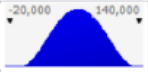
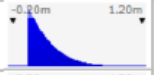
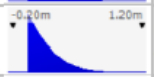
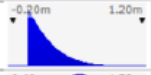
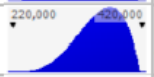
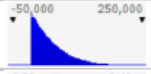
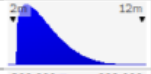
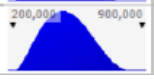
Name	Cell	Graph	Function	Min	Mean	Max
45ProjectRock Slope Protection Class III, Method B	U1094		RiskPert(S1094,R1094,T1094,RiskName(B1094&C1094&H1094))	10070.13	12692.56	$15,734.58
45ProjectRock Slope Protection Fabric Class 8	U1095		RiskPert(S1095,R1095,T1095,RiskName(B1095&C1095&H1095))	3104.67	3913.17	$4,851.04
45ProjectWater Pollution Control %	U1096		RiskPert(S1096,R1096,T1096,RiskName(B1096&C1096&H1096))	1317.48	1660.57	$2,058.56
45ProjectTraffic Control System	U1097		RiskPert(S1097,R1097,T1097,RiskName(B1097&C1097&H1097))	875.66	1103.7	$1,368.22

Other Structures

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectCopco Road at Unnamed Creek Culvert No. 1	U1099		RiskPert(S1099,R1099,T1099,RiskName(B1099&C1099&H1099))	13134.95	16555.51	$20,523.36
45ProjectCopco Road at Unnamed Creek Culvert No. 2	U1100		RiskPert(S1100,R1100,T1100,RiskName(B1100&C1100&H1100))	13134.95	16555.51	$20,523.36
45Project6'x6'x34' Box Culvert installation	U1101		RiskPert(S1101,R1101,T1101,RiskName(B1101&C1101&H1101))	13134.95	16555.51	$20,523.36

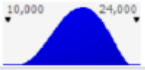
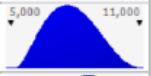
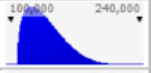
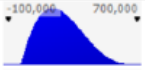
Paving

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectPre: none; Post: 0.7 miles 6" AB overlay (no drainage improvements, but some BMPs)	U1103		RiskPert(S1103,R1103,T1103,RiskName(B1103&C1103&H1103))	0	191226.9	$382,453.80
45ProjectPre: 2500CY roadway excavation, 0.9 miles 9" AB overlay (no drainage improvements, but some BMPs); Post: none	U1104		RiskPert(S1104,R1104,T1104,RiskName(B1104&C1104&H1104))	205504	281216	$400,192.00

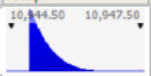
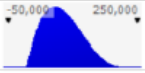
Name	Cell	Graph	Function	Min	Mean	Max
45ProjectPre: 1 mile 9" AB repair; Post: 1 mile 9" AB repair, 0.2 mile HMA overlay, RSP	U1105		RiskPert(S1105,R1105,T1105,RiskName(B1105 &C1105&H1105))	230372.1	381184.7	$647,921.70
45ProjectPre: minor excavation and 9"' AB section; Post: none	U1106		RiskPert(S1106,R1106,T1106,RiskName(B1106 &C1106&H1106))	0	64896	$129,792.00
45ProjectPre: none; Post: none	U1107		RiskPert(S1107,R1107,T1107,RiskName(B1107 &C1107&H1107))	0	181103.1	$1,086,619.00
45ProjectPre: none; Post: none	U1108		RiskPert(S1108,R1108,T1108,RiskName(B1108 &C1108&H1108))	0	185227.6	$1,111,366.00
45ProjectPre: none; Post: none	U1109		RiskPert(S1109,R1109,T1109,RiskName(B1109 &C1109&H1109))	0	185227.6	$1,111,366.00
45ProjectPre: 0.9 mile 9" AB repair; Post: 0.9 mile 9" AB repair	U1110		RiskPert(S1110,R1110,T1110,RiskName(B1110 &C1110&H1110))	485422.1	970844.2	$1,456,266.00
45ProjectPre: minor excavation; 0.25 mile new 9" AB, 0.7 mile 9" AB repair; post: no excavation; 0.6 mile 9" AB repair	U1111		RiskPert(S1111,R1111,T1111,RiskName(B1111 &C1111&H1111))	232968	352748.7	$410,990.70
45ProjectPre: 1.5 mile 9" AB repair; post: 1.5 mile 9" AB repair; no guardrail	U1112		RiskPert(S1112,R1112,T1112,RiskName(B1112 &C1112&H1112))	238298.1	494247.9	$820,804.60
45ProjectPre: none; Post: none	U1113		RiskPert(S1113,R1113,T1113,RiskName(B1113 &C1113&H1113))	0	40495.11	$242,970.60
45ProjectPre: none; Post: 1 mile new asphalt overlay	U1114		RiskPert(S1114,R1114,T1114,RiskName(B1114 &C1114&H1114))	613050.9	1313279	$2,362,215.00
45ProjectPre: 0.5 miles crack sealer, 0.75 miles new asphalt; Post: 1 miles new asphalt overlay	U1115		RiskPert(S1115,R1115,T1115,RiskName(B1115 &C1115&H1115))	1312457	2384943	$5,798,068.00
45ProjectPre: 1 mile crack sealer, 1.5 miles new asphalt; Post: 2 miles new asphalt overlay	U1116		RiskPert(S1116,R1116,T1116,RiskName(B1116 &C1116&H1116))	2624914	4570525	$11,596,140.00
45ProjectPre: 1.5 mile 9" AB repair; Post: 1.5 mile 9" AB repair, no guardrail	U1117		RiskPert(S1117,R1117,T1117,RiskName(B1117 &C1117&H1117))	238298.1	494247.9	$820,804.60

RECREATION

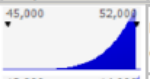
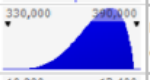
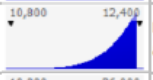
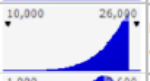
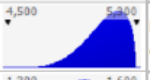
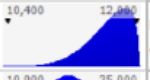
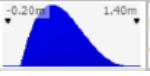
Campground - Jenny Creek

Name	Cell	Graph	Function	Min	Mean	Max
46ProjectPicnic table	U1120		RiskPert(S1120,R1120,T1120,RiskName(B1120 &C1120&H1120))	11493.08	17820.94	$22,986.16
46ProjectFire grate	U1121		RiskPert(S1121,R1121,T1121,RiskName(B1121 &C1121&H1121))	3283.74	5091.7	$6,567.48
46ProjectTrash bins	U1122		RiskPert(S1122,R1122,T1122,RiskName(B1122 &C1122&H1122))	5472.9	7844.48	$10,945.79
46ProjectParking	U1123		RiskPert(S1123,R1123,T1123,RiskName(B1123 &C1123&H1123))	2736.45	4243.08	$5,472.90
46ProjectShade structure	U1124		RiskPert(S1124,R1124,T1124,RiskName(B1124 &C1124&H1124))	28459.06	48635.23	$71,147.65
46ProjectRestroom (single vault toilet)	U1125		RiskPert(S1125,R1125,T1125,RiskName(B1125 &C1125&H1125))	111647.1	139605.1	$223,294.20
46ProjectAssumed earthwork	U1126		RiskPert(S1126,R1126,T1126,RiskName(B1126 &C1126&H1126))	2626.99	4270.49	$5,253.98
46ProjectSignage	U1127		RiskPert(S1127,R1127,T1127,RiskName(B1127 &C1127&H1127))	5472.9	10945.79	$16,418.69
46ProjectOperations and maintenance	U1128		RiskPert(S1128,R1128,T1128,RiskName(B1128 &C1128&H1128))	0	232666	$656,747.50

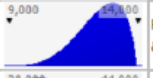
Campground - Topsy Upgrade

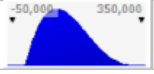
Name	Cell	Graph	Function	Min	Mean	Max
46Projectboat ramp	U1130		RiskPert(S1130,R1130,T1130,RiskName(B1130 &C1130&H1130))	10945	10945.33	$10,947.00
46Projecttrash bins	U1131		RiskPert(S1131,R1131,T1131,RiskName(B1131 &C1131&H1131))	1094.58	1094.58	$1,094.58
46ProjectOperations and maintenance	U1132		RiskPert(S1132,R1132,T1132,RiskName(B1132 &C1132&H1132))	0	77555.34	$218,915.80

Campground - New Campground

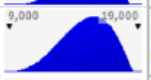
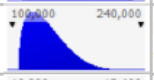
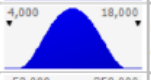
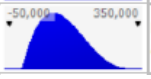
Name	Cell	Graph	Function	Min	Mean	Max
46Projectpicnic table	U1134		RiskPert(S1134,R1134,T1134,RiskName(B1134 &C1134&H1134))	45972.33	50785	$51,748.00
46Projectfire grate	U1135		RiskPert(S1135,R1135,T1135,RiskName(B1135 &C1135&H1135))	13134.95	14510.14	$14,786.00
46Projecttrash bins	U1136		RiskPert(S1136,R1136,T1136,RiskName(B1136 &C1136&H1136))	21891.58	21891.58	$21,891.58
46Projectrestroom (single vault toilet)	U1137		RiskPert(S1137,R1137,T1137,RiskName(B1137 &C1137&H1137))	334941.3	371670.9	$387,017.00
46Projectparking	U1138		RiskPert(S1138,R1138,T1138,RiskName(B1138 &C1138&H1138))	10945.79	12091.84	$12,322.00
46Projectboat ramp	U1139		RiskPert(S1139,R1139,T1139,RiskName(B1139 &C1139&H1139))	10945.79	22359.21	$24,643.00
46Projecttrash bins	U1140		RiskPert(S1140,R1140,T1140,RiskName(B1140 &C1140&H1140))	1094.58	2056.7	$2,489.00
46Projectpicnic table	U1141		RiskPert(S1141,R1141,T1141,RiskName(B1141 &C1141&H1141))	4597.23	5095.2	$5,275.00
46Projectfire grate	U1142		RiskPert(S1142,R1142,T1142,RiskName(B1142 &C1142&H1142))	1313.5	1467.58	$1,578.00
46Projecttrash bins	U1143		RiskPert(S1143,R1143,T1143,RiskName(B1143 &C1143&H1143))	2189.16	2189.16	$2,189.16
46Projectassumed earthwork	U1144		RiskPert(S1144,R1144,T1144,RiskName(B1144 &C1144&H1144))	10507.96	11633.65	$11,982.00
46Projectsignage	U1145		RiskPert(S1145,R1145,T1145,RiskName(B1145 &C1145&H1145))	10945.79	21891.58	$32,837.38
46ProjectOperations and maintenance	U1146		RiskPert(S1146,R1146,T1146,RiskName(B1146 &C1146&H1146))	0	465332.1	$1,313,495.00

Recreation Area - Fall Creek

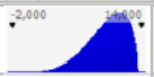
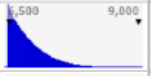
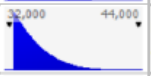
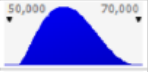
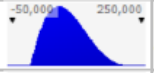
Name	Cell	Graph	Function	Min	Mean	Max
46Projectrestroom (single vault toilet)	U1148		RiskPert(S1148,R1148,T1148,RiskName(B1148 &C1148&H1148))	55823.54	69802.53	$111,647.10
46Projectpicnic table	U1149		RiskPert(S1149,R1149,T1149,RiskName(B1149 &C1149&H1149))	9194.47	12455.6	$13,791.70
46Projectshade structure	U1150		RiskPert(S1150,R1150,T1150,RiskName(B1150 &C1150&H1150))	28459.06	33214.02	$42,688.59
46Projectfire grate	U1151		RiskPert(S1151,R1151,T1151,RiskName(B1151 &C1151&H1151))	1970.24	2846.99	$3,283.74
46Projecttrash bins	U1152		RiskPert(S1152,R1152,T1152,RiskName(B1152 &C1152&H1152))	4378.32	5472.9	$6,567.48
46Projectparking	U1153		RiskPert(S1153,R1153,T1153,RiskName(B1153 &C1153&H1153))	2189.16	3558.74	$4,378.32

Name	Cell	Graph	Function	Min	Mean	Max
46Projectreconstructed trail	U1154		RiskPert(S1154,R1154,T1154,RiskName(B1154 &C1154&H1154))	8669.07	20235	$34,676.27
46Projectassumed earthwork	U1155		RiskPert(S1155,R1155,T1155,RiskName(B1155 &C1155&H1155))	1751.33	2846.99	$3,502.65
46Projectsignage	U1156		RiskPert(S1156,R1156,T1156,RiskName(B1156 &C1156&H1156))	5472.9	10945.79	$16,418.69
46ProjectOperations and maintenance	U1157		RiskPert(S1157,R1157,T1157,RiskName(B1157 &C1157&H1157))	0	116333	$328,373.80

Recreation Area - Iron Gate

Name	Cell	Graph	Function	Min	Mean	Max
46Projectshade structure	U1159		RiskPert(S1159,R1159,T1159,RiskName(B1159 &C1159&H1159))	28459.06	46263.64	$56,918.12
46Projectpicnic table	U1160		RiskPert(S1160,R1160,T1160,RiskName(B1160 &C1160&H1160))	9194.47	14946.71	$18,388.93
46Projecttrash bins	U1161		RiskPert(S1161,R1161,T1161,RiskName(B1161 &C1161&H1161))	5472.9	7662.05	$9,851.21
46Projectparking	U1162		RiskPert(S1162,R1162,T1162,RiskName(B1162 &C1162&H1162))	2189.16	3558.74	$4,378.32
46Projectfire grate	U1163		RiskPert(S1163,R1163,T1163,RiskName(B1163 &C1163&H1163))	2626.99	4270.49	$5,253.98
46Projectrestroom (single vault toilet)	U1164		RiskPert(S1164,R1164,T1164,RiskName(B1164 &C1164&H1164))	111647.1	139605.1	$223,294.20
46Projectboat ramp	U1165		RiskPert(S1165,R1165,T1165,RiskName(B1165 &C1165&H1165))	10945.79	12093.67	$12,333.00
46Projectassumed earthwork	U1166		RiskPert(S1166,R1166,T1166,RiskName(B1166 &C1166&H1166))	2626.99	4270.49	$5,253.98
46Projectsignage	U1167		RiskPert(S1167,R1167,T1167,RiskName(B1167 &C1167&H1167))	5472.9	10945.79	$16,418.69
46ProjectOperations and maintenance	U1168		RiskPert(S1168,R1168,T1168,RiskName(B1168 &C1168&H1168))	0	116333	$328,373.80

Recreation Area - River Fishing Access Sites

Name	Cell	Graph	Function	Min	Mean	Max
46Projectparking	U1170		RiskPert(S1170,R1170,T1170,RiskName(B1170 &C1170&H1170))	0	9581.65	$13,134.95
46Projectportable toilet	U1171		RiskPert(S1171,R1171,T1171,RiskName(B1171 &C1171&H1171))	4597.23	5237.64	$6,129.64
46Projecttrash bins	U1172		RiskPert(S1172,R1172,T1172,RiskName(B1172 &C1172&H1172))	6567.48	6932.34	$8,756.63
46Projectsignage	U1173		RiskPert(S1173,R1173,T1173,RiskName(B1173 &C1173&H1173))	32837.38	34661.68	$43,783.17
46Projecttrail refurbishment	U1174		RiskPert(S1174,R1174,T1174,RiskName(B1174 &C1174&H1174))	52014.4	59260.16	$69,352.54
46ProjectOperations and maintenance	U1175		RiskPert(S1175,R1175,T1175,RiskName(B1175 &C1175&H1175))	0	77555.34	$218,915.80

Recreation Area - New Day Use Sites

Name	Cell	Graph	Function	Min	Mean	Max
46Projectpicnic table	U1177	-2,000 14,000	RiskPert(S1177,R1177,T1177,RiskName(B1177 &C1177&H1177))	0	9198.27	$13,791.70
46Projectfire grate	U1178	-500 4,000	RiskPert(S1178,R1178,T1178,RiskName(B1178 &C1178&H1178))	0	2628.08	$3,940.49
46Projecttrash bins	U1179	-1,000 7,000	RiskPert(S1179,R1179,T1179,RiskName(B1179 &C1179&H1179))	0	4013.46	$6,567.48
46Projectshade structure	U1180	-5,000 45,000	RiskPert(S1180,R1180,T1180,RiskName(B1180 &C1180&H1180))	0	28470.84	$42,688.59
46Projectassumed earthwork	U1181	-500 3,000	RiskPert(S1181,R1181,T1181,RiskName(B1181 &C1181&H1181))	0	1752.05	$2,626.99
46Projectsignage	U1182	-2,000 18,000	RiskPert(S1182,R1182,T1182,RiskName(B1182 &C1182&H1182))	0	10033.64	$16,418.69
46ProjectOperations and maintenance	U1183	-50,000 450,000	RiskPert(S1183,R1183,T1183,RiskName(B1183 &C1183&H1183))	0	155110.7	$437,831.70

Recreation Area - New Boat Ramps

Name	Cell	Graph	Function	Min	Mean	Max
46ProjectNew boat ramps	U1185	20,000 90,000	RiskPert(S1185,R1185,T1185,RiskName(B1185 &C1185&H1185))	21891.58	51098.48	$87,566.34

Non-motorized Recreation Trails

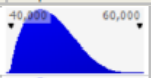
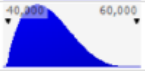
Name	Cell	Graph	Function	Min	Mean	Max
46ProjectTrail	U1207	-0.20m 1.40m	RiskPert(S1207,R1207,T1207,RiskName(B1207 &C1207&H1207))	0	751606.2	$1,387,051.00
46ProjectSignage	U1208	-2,000 18,000	RiskPert(S1208,R1208,T1208,RiskName(B1208 &C1208&H1208))	0	10033.64	$16,418.69
46ProjectWalking trails for recreation access to river	U1210	160,000 360,000	RiskPert(S1210,R1210,T1210,RiskName(B1210 &C1210&H1210))	173381.3	268841.6	$346,762.70
46ProjectTrail Grading	U1212	-50,000 350,000	RiskPert(S1212,R1212,T1212,RiskName(B1212 &C1212&H1212))	0	187901.5	$346,762.70
46Projecttrash bins	U1213	-200 1,200	RiskPert(S1213,R1213,T1213,RiskName(B1213 &C1213&H1213))	0	912.15	$1,094.58
46ProjectSignage	U1214	-2,000 18,000	RiskPert(S1214,R1214,T1214,RiskName(B1214 &C1214&H1214))	0	10033.64	$16,418.69

Motorized Recreation Trails

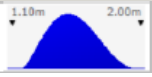
Name	Cell	Graph	Function	Min	Mean	Max
46ProjectDirt Road Improvements	U1216	-0.60 0.60	RiskPert(S1216,R1216,T1216,RiskName(B1216 &C1216&H1216))	0	0	$0.00
46ProjectUpgrade Topsy Grade Road	U1217	-0.60 0.60	RiskPert(S1217,R1217,T1217,RiskName(B1217 &C1217&H1217))	0	0	$0.00
46ProjectNew Bridge over Klamath River at Frain Ranch	U1218	-0.60 0.60	RiskPert(S1218,R1218,T1218,RiskName(B1218 &C1218&H1218))	0	0	$0.00

Recreation, General Conditions

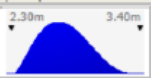
Name	Cell	Graph	Function	Min	Mean	Max
46ProjectContractor overhead	U1220	450,000 750,000	RiskPert(S1220,R1220,T1220,RiskName(B1220 &C1220&H1220))	493405.1	566502.2	$712,696.30
46ProjectContractor profit	U1221	260,000 400,000	RiskPert(S1221,R1221,T1221,RiskName(B1221 &C1221&H1221))	263149.4	302134.5	$380,104.70

Name	Cell	Graph	Function	Min	Mean	Max
46ProjectInsurance	U1222		RiskPert(S1222,R1222,T1222,RiskName(B1222&C1222&H1222))	40459.22	46453.18	$58,441.09
46ProjectBond	U1223		RiskPert(S1223,R1223,T1223,RiskName(B1223&C1223&H1223))	40459.22	46453.18	$58,441.09

FLOOD PROOFING

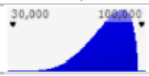
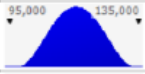
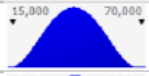
Name	Cell	Graph	Function	Min	Mean	Max
47ProjectCost to raise homes and add 2 stairs	U1226		RiskPert(S1226,R1226,T1226,RiskName(B1226&C1226&H1226))	1198946	1523660	$1,948,287.00

PUBLIC HEALTH AND SAFETY

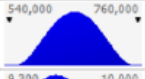
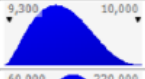
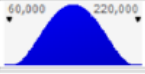
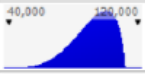
Name	Cell	Graph	Function	Min	Mean	Max
48ProjectCattle exclusion fencing	U1231		RiskPert(S1231,R1231,T1231,RiskName(B1231&C1231&H1231))	2363345	2755872	$3,316,825.00

MITIGATION MEASURES

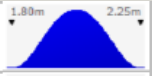
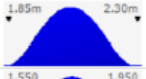
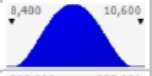
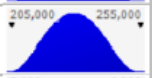
Groundwater Improvements

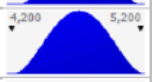
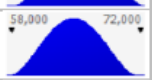
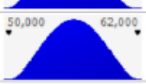
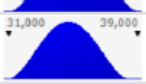
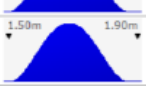
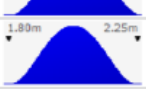
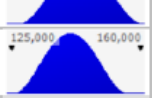
Name	Cell	Graph	Function	Min	Mean	Max
51ProjectOutreach to well owners	U1235		RiskPert(S1235,R1235,T1235,RiskName(B1235&C1235&H1235))	59488	59488	$59,488.00
51ProjectDrill and install new monitoring wells	U1236		RiskPert(S1236,R1236,T1236,RiskName(B1236&C1236&H1236))	35855	80790.7	$95,855.00
51ProjectSentinel water level monitoring of new wells and landowner for 3 years	U1237		RiskPert(S1237,R1237,T1237,RiskName(B1237&C1237&H1237))	99208.27	115743	$132,277.70
51ProjectWQ laboratory analytical testing	U1238		RiskPert(S1238,R1238,T1238,RiskName(B1238&C1238&H1238))	16548.48	41371.2	$66,193.92
51ProjectWell replacements	U1239		RiskPert(S1239,R1239,T1239,RiskName(B1239&C1239&H1239))	947949.9	1483366	$2,018,782.00
51ProjectWell abandonment	U1240		RiskPert(S1240,R1240,T1240,RiskName(B1240&C1240&H1240))	33421.44	58487.52	$83,553.60
51ProjectTemporary water supply	U1241		RiskPert(S1241,R1241,T1241,RiskName(B1241&C1241&H1241))	40105.73	60715.62	$81,325.51
51ProjectPermitting and Reporting	U1242		RiskPert(S1242,R1242,T1242,RiskName(B1242&C1242&H1242))	41219.78	74084.2	$106,948.60

Water Supply/Rights

Name	Cell	Graph	Function	Min	Mean	Max
52ProjectHay production	U1245		RiskPert(S1245,R1245,T1245,RiskName(B1245&C1245&H1245))	559202.9	652403.4	$745,603.90
52ProjectWater supply for domestic use for water rights	U1246		RiskPert(S1246,R1246,T1246,RiskName(B1246&C1246&H1246))	9306.48	9589.69	$9,988.07
52ProjectSediment removal at intakes	U1247		RiskPert(S1247,R1247,T1247,RiskName(B1247&C1247&H1247))	70054.8	140109.6	$210,164.40
52ProjectGroundwater wells - domestic	U1248		RiskPert(S1248,R1248,T1248,RiskName(B1248&C1248&H1248))	44129.28	91936	$110,323.20
52ProjectGroundwater wells - municipal	U1249		RiskPert(S1249,R1249,T1249,RiskName(B1249&C1249&H1249))	100323	110323.1	$120,323.00
52ProjectSediment basin	U1250		RiskPert(S1250,R1250,T1250,RiskName(B1250&C1250&H1250))	79677.87	79677.87	$79,677.87

CULTURAL RESOURCES

Name	Cell	Graph	Function	Min	Mean	Max
53ProjectGenerally	U1255		RiskPert(S1255,R1255,T1255,RiskName(B1255 &C1255&H1255))	1824750	2027500	$2,230,250.00
53ProjectGenerally	U1258		RiskPert(S1258,R1258,T1258,RiskName(B1258 &C1258&H1258))	1861245	2068050	$2,274,855.00
53ProjectTechnical Editor	U1266		RiskPert(S1266,R1266,T1266,RiskName(B1266 &C1266&H1266))	1572.48	1747.2	$1,921.92
53ProjectTechnical Editor	U1277		RiskPert(S1277,R1277,T1277,RiskName(B1277 &C1277&H1277))	8512.87	9458.74	$10,404.62
53ProjectCuration	U1282		RiskPert(S1282,R1282,T1282,RiskName(B1282 &C1282&H1282))	206404.6	229338.4	$252,272.30
53ProjectOther direct costs	U1283		RiskPert(S1283,R1283,T1283,RiskName(B1283 &C1283&H1283))	5034.26	5593.62	$6,152.98
53ProjectTechnical Editor	U1288		RiskPert(S1288,R1288,T1288,RiskName(B1288 &C1288&H1288))	4088.45	4542.72	$4,996.99

Name	Cell	Graph	Function	Min	Mean	Max
53ProjectTribal monitor subcontract	U1291		RiskPert(S1291,R1291,T1291,RiskName(B1291 &C1291&H1291))	89491.26	99434.73	$109,378.20
53ProjectTravel and perdiem	U1292		RiskPert(S1292,R1292,T1292,RiskName(B1292 &C1292&H1292))	34905.61	38784.01	$42,662.41
53ProjectTechnical Editor	U1296		RiskPert(S1296,R1296,T1296,RiskName(B1296 &C1296&H1296))	4251.99	4724.43	$5,196.87
53ProjectField Technician	U1299		RiskPert(S1299,R1299,T1299,RiskName(B1299 &C1299&H1299))	58312.95	64792.17	$71,271.38
53ProjectTribal monitor subcontract	U1300		RiskPert(S1300,R1300,T1300,RiskName(B1300 &C1300&H1300))	50501.9	56113.22	$61,724.54
53ProjectTravel and perdiem	U1301		RiskPert(S1301,R1301,T1301,RiskName(B1301 &C1301&H1301))	31282.47	34758.3	$38,234.13
53ProjectHuman remains	U1303		RiskPert(S1303,R1303,T1303,RiskName(B1303 &C1303&H1303))	1520155	1689062	$1,857,968.00
53ProjectOther direct costs	U1304		RiskPert(S1304,R1304,T1304,RiskName(B1304 &C1304&H1304))	506.72	563.02	$619.32
53ProjectArchaelogical unit cost	U1305		RiskPert(S1305,R1305,T1305,RiskName(B1305 &C1305&H1305))	1824186	2026874	$2,229,561.00
53ProjectOther direct costs	U1306		RiskPert(S1306,R1306,T1306,RiskName(B1306 &C1306&H1306))	506.72	563.02	$619.32
53ProjectTechnical Editor	U1311		RiskPert(S1311,R1311,T1311,RiskName(B1311 &C1311&H1311))	4170.22	4633.57	$5,096.93
53ProjectField Technician	U1314		RiskPert(S1314,R1314,T1314,RiskName(B1314 &C1314&H1314))	571915.5	635461.6	$699,007.80
53ProjectTribal monitor subcontract	U1315		RiskPert(S1315,R1315,T1315,RiskName(B1315 &C1315&H1315))	276906.4	307673.8	$338,441.10
53ProjectOther direct costs	U1316		RiskPert(S1316,R1316,T1316,RiskName(B1316 &C1316&H1316))	127076.4	141196	$155,315.70

Name	Cell	Graph	Function	Min	Mean	Max
53ProjectTechnical Editor	U1320	4,600 5,800	RiskPert(S1320,R1320,T1320,RiskName(B1320 &C1320&H1320))	4601.31	5112.56	$5,623.82
53ProjectField Technician	U1323	620,000 780,000	RiskPert(S1323,R1323,T1323,RiskName(B1323 &C1323&H1323))	631036.3	701151.4	$771,266.60
53ProjectTribal monitor subcontract	U1324	205,000 260,000	RiskPert(S1324,R1324,T1324,RiskName(B1324 &C1324&H1324))	208666.9	231852.2	$255,037.40
53ProjectOther direct costs	U1325	62,000 78,000	RiskPert(S1325,R1325,T1325,RiskName(B1325 &C1325&H1325))	62937.11	69930.12	$76,923.13
53ProjectTCP Project allowance	U1327	0.88m 1.10m	RiskPert(S1327,R1327,T1327,RiskName(B1327 &C1327&H1327))	1000000	1000000	$1,000,000.00
53ProjectAllowance for additional discoveries (reconciled with risk log)	U1328	0.88m 1.10m	RiskPert(S1328,R1328,T1328,RiskName(B1328 &C1328&H1328))	1000000	1000000	$1,000,000.00

GHG/Climate Change

Name	Cell	Graph	Function	Min	Mean	Max
54ProjectGenerated by construction work	U1331	110,000 200,000	RiskPert(S1331,R1331,T1331,RiskName(B1331 &C1331&H1331))	110622.7	148726.1	$191,746.00

MONITORING AND OTHER COSTS

AQUATIC RESOURCES

Mainstem spawning (AR-1)

Name	Cell	Graph	Function	Min	Mean	Max
61ProjectTributory confluence monitoring (passage)	U1338	40,000 75,000	RiskPert(S1338,R1338,T1338,RiskName(B1338 &C1338&H1338))	43979.53	52123.89	$73,299.22
61ProjectConfluence Area Maintenance (downstream tribs)	U1339	40,000 70,000	RiskPert(S1339,R1339,T1339,RiskName(B1339 &C1339&H1339))	41230.81	48866.14	$68,718.02
61ProjectConfluence Area Maintenance (upstream tribs)	U1340	40,000 70,000	RiskPert(S1340,R1340,T1340,RiskName(B1340 &C1340&H1340))	40721.79	48262.86	$67,869.65
61ProjectMainstem Spawning Gravel Survey (45.3 miles)	U1341	14,000 25,000	RiskPert(S1341,R1341,T1341,RiskName(B1341 &C1341&H1341))	14761.65	17495.29	$24,602.75
61ProjectTributary Spawning Gravel Survey (13.9 miles)	U1342	20,000 34,000	RiskPert(S1342,R1342,T1342,RiskName(B1342 &C1342&H1342))	20360.89	24131.43	$33,934.82
61ProjectReporting and Coordination	U1343	130,000 220,000	RiskPert(S1343,R1343,T1343,RiskName(B1343 &C1343&H1343))	130309.7	154441.1	$217,182.90
61ProjectSpawning Gravel Augmentation	U1344	4.00m 7.00m	RiskPert(S1344,R1344,T1344,RiskName(B1344 &C1344&H1344))	4105774	4866103	$6,842,957.00
61ProjectLaborer (30 days)	U1345	8,000 15,000	RiskPert(S1345,R1345,T1345,RiskName(B1345 &C1345&H1345))	8551.58	10135.2	$14,252.63
61Project200 Class Excavator (30 days)	U1346	60,000 105,000	RiskPert(S1346,R1346,T1346,RiskName(B1346 &C1346&H1346))	61082.68	72394.29	$101,804.50

Juvenile outmigration (AR-2)

Name	Cell	Graph	Function	Min	Mean	Max
61ProjectTributary Confluence Monitoring (Passage)	U1348	40,000 75,000	RiskPert(S1348,R1348,T1348,RiskName(B1348 &C1348&H1348))	43979.53	52123.89	$73,299.22
61ProjectTributary Confluence Monitoring (WQ)	U1349	40,000 75,000	RiskPert(S1349,R1349,T1349,RiskName(B1349 &C1349&H1349))	43979.53	52123.89	$73,299.22
61Project2018 Mainstem Winter Seining Recon	U1350	40,000 75,000	RiskPert(S1350,R1350,T1350,RiskName(B1350 &C1350&H1350))	42757.88	50676	$71,263.13

Name	Cell	Graph	Function	Min	Mean	Max
61Project2019 Mainstem Winter Seining	U1351	60,000 105,000	RiskPert(S1351,R1351,T1351,RiskName(B1351 &C1351&H1351))	61082.68	72394.29	$101,804.50
61ProjectFish Transport (1 Truck)	U1352	18,000 32,000	RiskPert(S1352,R1352,T1352,RiskName(B1352 &C1352&H1352))	18324.8	21718.29	$30,541.34
61ProjectFish Rescue and Relocation Crew	U1353	160,000 300,000	RiskPert(S1353,R1353,T1353,RiskName(B1353 &C1353&H1353))	171031.5	202704	$285,052.50
61ProjectFish Transport (2 Trucks)	U1354	140,000 260,000	RiskPert(S1354,R1354,T1354,RiskName(B1354 &C1354&H1354))	153928.4	182433.6	$256,547.30
61ProjectReporting and Coordination	U1355	130,000 220,000	RiskPert(S1355,R1355,T1355,RiskName(B1355 &C1355&H1355))	130309.7	154441.1	$217,182.90
61ProjectMiscellaneous Equipment	U1356	30,000 55,000	RiskPert(S1356,R1356,T1356,RiskName(B1356 &C1356&H1356))	30541.34	36197.14	$50,902.23
61ProjectH2O Monitoring Equipment	U1357	140,000 260,000	RiskPert(S1357,R1357,T1357,RiskName(B1357 &C1357&H1357))	152706.7	180985.7	$254,511.20
61ProjectH2O Monitoring Equipment	U1358	7,000 14,000	RiskPert(S1358,R1358,T1358,RiskName(B1358 &C1358&H1358))	7940.75	9411.26	$13,234.58
61ProjectTechnician Equipment	U1359	16,000 30,000	RiskPert(S1359,R1359,T1359,RiskName(B1359 &C1359&H1359))	17103.15	20270.4	$28,505.25

Sucker rescue and relocation plan (AR-6)

Name	Cell	Graph	Function	Min	Mean	Max
61ProjectSucker Recapture Study (Spring and Fall)	U1363	80,000 150,000	RiskPert(S1363,R1363,T1363,RiskName(B1363 &C1363&H1363))	85515.75	101352	$142,526.30
61ProjectSucker Salvage	U1364	80,000 150,000	RiskPert(S1364,R1364,T1364,RiskName(B1364 &C1364&H1364))	85515.75	101352	$142,526.30
61ProjectSucker Transport (1 Truck)	U1365	6,000 11,000	RiskPert(S1365,R1365,T1365,RiskName(B1365 &C1365&H1365))	6413.68	7601.4	$10,689.47
61ProjectReporting and Coordination	U1366	90,000 170,000	RiskPert(S1366,R1366,T1366,RiskName(B1366 &C1366&H1366))	97732.29	115830.9	$162,887.10
61ProjectBoat Electrofisher	U1367	10,000 19,000	RiskPert(S1367,R1367,T1367,RiskName(B1367 &C1367&H1367))	10994.88	13030.97	$18,324.80
61ProjectBoats (2 boats)	U1368	20,000 36,000	RiskPert(S1368,R1368,T1368,RiskName(B1368 &C1368&H1368))	20523.78	24324.48	$34,206.30
61ProjectTechnician Equipment	U1369	14,000 25,000	RiskPert(S1369,R1369,T1369,RiskName(B1369 &C1369&H1369))	14659.84	17374.63	$24,433.07
61ProjectTagging Equipment	U1370	12,000 21,000	RiskPert(S1370,R1370,T1370,RiskName(B1370 &C1370&H1370))	12216.54	14478.86	$20,360.89

Freshwater mussel relocation (AR-7)

Name	Cell	Graph	Function	Min	Mean	Max
61ProjectFreshwater Mussel Reconnaissance	U1374	28,000 50,000	RiskPert(S1374,R1374,T1374,RiskName(B1374 &C1374&H1374))	29930.51	35473.2	$49,884.19
61ProjectMussel Salvage and Relocation	U1375	70,000 125,000	RiskPert(S1375,R1375,T1375,RiskName(B1375 &C1375&H1375))	74826.28	88683	$124,710.50
61ProjectMussel Transport (1 Truck)	U1376	6,000 11,000	RiskPert(S1376,R1376,T1376,RiskName(B1376 &C1376&H1376))	6413.68	7601.4	$10,689.47
61ProjectReporting and Coordination	U1377	90,000 170,000	RiskPert(S1377,R1377,T1377,RiskName(B1377 &C1377&H1377))	97732.29	115830.9	$162,887.10
61ProjectMiscellaneous Equipment	U1378	6,000 10,500	RiskPert(S1378,R1378,T1378,RiskName(B1378 &C1378&H1378))	6108.27	7239.43	$10,180.45
61ProjectDiving Gear	U1379	6,000 10,500	RiskPert(S1379,R1379,T1379,RiskName(B1379 &C1379&H1379))	6108.27	7239.43	$10,180.45

Name	Cell	Graph	Function	Min	Mean	Max
61ProjectTechnician Equipment	U1380	12,000 21,000	RiskPert(S1380,R1380,T1380,RiskName(B1380 &C1380&H1380))	12216.54	14478.86	$20,360.89

TERRESTRIAL RESOURCES MEASURES

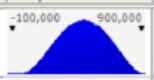
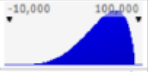
Habitat restoration plan (TER-1)

Name	Cell	Graph	Function	Min	Mean	Max
62ProjectAnnual maintenance and monitoring	U1385	140,000 340,000	RiskPert(S1385,R1385,T1385,RiskName(B1385 &C1385&H1385))	149036.3	245110.5	$328,051.30
62ProjectAnnual reporting	U1386	20,000 50,000	RiskPert(S1386,R1386,T1386,RiskName(B1386 &C1386&H1386))	21560.41	35218.25	$46,013.06
62ProjectPost construction regulatory compliance and reporting	U1387	10,000 24,000	RiskPert(S1387,R1387,T1387,RiskName(B1387 &C1387&H1387))	11205.67	18304.11	$23,914.53

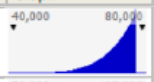
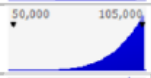
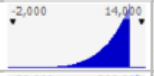
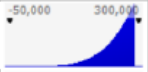
Nesting Bird Surveys (TER-2); Osprey nests

Name	Cell	Graph	Function	Min	Mean	Max
62ProjectRemove all nest platforms near construction, year 1	U1389	-10,000 80,000	RiskPert(S1389,R1389,T1389,RiskName(B1389 &C1389&H1389))	0	50908.96	$73,384.40
62ProjectNest exclusion monitoring, year 1	U1390	-50,000 250,000	RiskPert(S1390,R1390,T1390,RiskName(B1390 &C1390&H1390))	0	113862.8	$203,392.70
62ProjectRemove all nest platforms near construction, year 2	U1391	-10,000 60,000	RiskPert(S1391,R1391,T1391,RiskName(B1391 &C1391&H1391))	0	33739.17	$52,454.66
62ProjectNest exclusion monitoring, year 2	U1392	-50,000 250,000	RiskPert(S1392,R1392,T1392,RiskName(B1392 &C1392&H1392))	0	118417.3	$211,528.40
62ProjectRegulatory compliance and reporting, permitting	U1393	-2,000 16,000	RiskPert(S1393,R1393,T1393,RiskName(B1393 &C1393&H1393))	0	9741.32	$14,173.29
62ProjectRemove nests near construction, year 1	U1394	-10,000 60,000	RiskPert(S1394,R1394,T1394,RiskName(B1394 &C1394&H1394))	0	30127.18	$59,539.92
62ProjectNest exclusion monitoring, year 1	U1395	-20,000 160,000	RiskPert(S1395,R1395,T1395,RiskName(B1395 &C1395&H1395))	0	76064.6	$158,562.60
62ProjectRemove nests near construction, year 2	U1396	-5,000 35,000	RiskPert(S1396,R1396,T1396,RiskName(B1396 &C1396&H1396))	0	21967.77	$30,731.29
62ProjectNest exclusion monitoring, year 2	U1397	-20,000 180,000	RiskPert(S1397,R1397,T1397,RiskName(B1397 &C1397&H1397))	0	79107.19	$164,905.10
62ProjectRegulatory compliance and reporting, permitting	U1398	-2,000 16,000	RiskPert(S1398,R1398,T1398,RiskName(B1398 &C1398&H1398))	0	7896.55	$14,173.29
62ProjectNesting bird surveys prior to vegetation clearing	U1399	-50,000 250,000	RiskPert(S1399,R1399,T1399,RiskName(B1399 &C1399&H1399))	0	83024.16	$234,511.80
62ProjectDaily biological monitoring throughout construction	U1400	-100,000 660,000	RiskPert(S1400,R1400,T1400,RiskName(B1400 &C1400&H1400))	0	350110.1	$596,371.90
62ProjectRegulatory compliance and reporting during construction	U1401	-10,000 80,000	RiskPert(S1401,R1401,T1401,RiskName(B1401 &C1401&H1401))	0	57633.33	$70,432.00
62ProjectSpecial status wildlife and habitat monitoring	U1402	-20,000 140,000	RiskPert(S1402,R1402,T1402,RiskName(B1402 &C1402&H1402))	0	68544.35	$125,783.20
62ProjectConstruction timing and activity restrictions (if nest present)	U1403	-0.60 0.60	RiskPert(S1403,R1403,T1403,RiskName(B1403 &C1403&H1403))	0	0	$0.00
62ProjectSecond year of protocol studies (if nest present)	U1404	-0.60 0.60	RiskPert(S1404,R1404,T1404,RiskName(B1404 &C1404&H1404))	0	0	$0.00
62ProjectMonitoring nest during breeding season (if nest present)	U1405	-0.60 0.60	RiskPert(S1405,R1405,T1405,RiskName(B1405 &C1405&H1405))	0	0	$0.00

Wetlands at Reservoirs (TER-5)

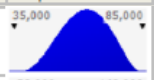
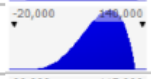
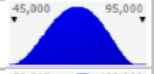
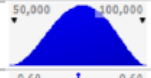
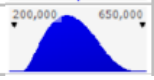
Name	Cell	Graph	Function	Min	Mean	Max
62ProjectWetland Project	U1414		RiskPert(S1414,R1414,T1414,RiskName(B1414 &C1414&H1414))	0	450935.6	$887,086.40
62ProjectMonitoring	U1415		RiskPert(S1415,R1415,T1415,RiskName(B1415 &C1415&H1415))	0	68159.49	$93,676.32

Special Status Bats (TER-6)

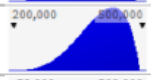
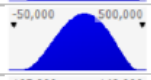
Name	Cell	Graph	Function	Min	Mean	Max
62ProjectPre-Demolition Exclusion	U1417		RiskPert(S1417,R1417,T1417,RiskName(B1417 &C1417&H1417))	43310.77	71501.52	$77,139.68
62ProjectBiological Monitoring During Demolition	U1420		RiskPert(S1420,R1420,T1420,RiskName(B1420 &C1420&H1420))	54925.15	95714.68	$103,872.60
62ProjectDesign Replacement Roosts	U1422		RiskPert(S1422,R1422,T1422,RiskName(B1422 &C1422&H1422))	0	10090.14	$12,108.17
62ProjectMonitor Replacement Roosts (3 years)	U1424		RiskPert(S1424,R1424,T1424,RiskName(B1424 &C1424&H1424))	0	233382	$280,058.30

WATER QUALITY MONITORING

Field installation & equipment

Name	Cell	Graph	Function	Min	Mean	Max
63ProjectKeno	U1427		RiskPert(S1427,R1427,T1427,RiskName(B1427 &C1427&H1427))	39520	62533.46	$82,336.80
63ProjectCopco	U1429		RiskPert(S1429,R1429,T1429,RiskName(B1429 &C1429&H1429))	0	86273.82	$126,969.00
63ProjectWalker Bridge	U1431		RiskPert(S1431,R1431,T1431,RiskName(B1431 &C1431&H1431))	83283.2	91125.7	$113,681.60
63ProjectSeiad Valley	U1432		RiskPert(S1432,R1432,T1432,RiskName(B1432 &C1432&H1432))	45427.2	69768.61	$91,535.80
63ProjectOrleans	U1433		RiskPert(S1433,R1433,T1433,RiskName(B1433 &C1433&H1433))	45760	69361.07	$90,854.40
63ProjectShasta	U1435		RiskPert(S1435,R1435,T1435,RiskName(B1435 &C1435&H1435))	50618.88	76251.72	$99,803.55
63ProjectScott	U1436		RiskPert(S1436,R1436,T1436,RiskName(B1436 &C1436&H1436))	50618.88	76251.72	$99,803.55
Trinity	U1438		RiskPert(S1438,R1438,T1438,RiskName(H1438))	0	0	$0.00
63ProjectEquipment replacement	U1439		RiskPert(S1439,R1439,T1439,RiskName(B1439 &C1439&H1439))	246764.7	403048.9	$616,911.60

Operation & Maintenance

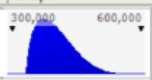
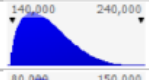
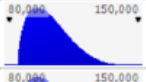
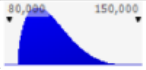
Name	Cell	Graph	Function	Min	Mean	Max
63ProjectKeno	U1441		RiskPert(S1441,R1441,T1441,RiskName(B1441 &C1441&H1441))	148444	330459.1	$529,830.80
63ProjectJC Boyle	U1442		RiskPert(S1442,R1442,T1442,RiskName(B1442 &C1442&H1442))	206040.8	400204.1	$484,802.00
63ProjectCopco	U1443		RiskPert(S1443,R1443,T1443,RiskName(B1443 &C1443&H1443))	0	246998.4	$465,449.30
63ProjectIron Gate	U1444		RiskPert(S1444,R1444,T1444,RiskName(B1444 &C1444&H1444))	109431.8	124498.5	$137,979.20

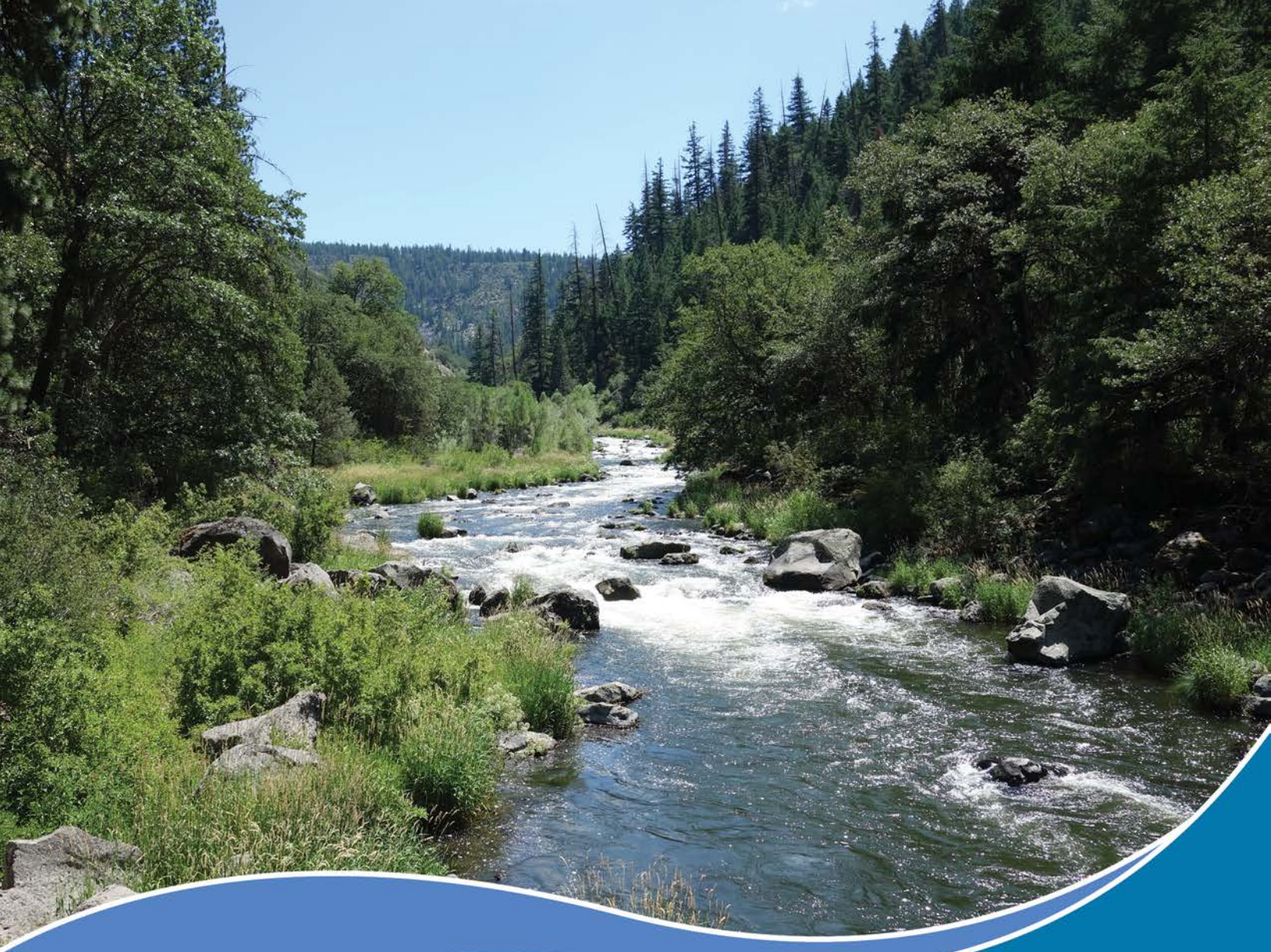
Name	Cell	Graph	Function	Min	Mean	Max
63ProjectWalker Bridge	U1445	140,000 340,000	RiskPert(S1445,R1445,T1445,RiskName(B1445&C1445&H1445))	153598.3	195411.1	$319,996.40
63ProjectSeiad Valley	U1446	40,000 130,000	RiskPert(S1446,R1446,T1446,RiskName(B1446&C1446&H1446))	43632.18	98738.01	$121,200.50
63ProjectOrleans	U1447	40,000 140,000	RiskPert(S1447,R1447,T1447,RiskName(B1447&C1447&H1447))	49958	114586.2	$137,979.20
63ProjectKlamath	U1448	40,000 140,000	RiskPert(S1448,R1448,T1448,RiskName(B1448&C1448&H1448))	42821.14	113396.7	$137,979.20
63ProjectShasta	U1449	30,000 130,000	RiskPert(S1449,R1449,T1449,RiskName(B1449&C1449&H1449))	32012.73	63432.63	$124,493.90
63ProjectScott	U1450	30,000 130,000	RiskPert(S1450,R1450,T1450,RiskName(B1450&C1450&H1450))	32012.73	63432.63	$124,493.90
63ProjectSalmon	U1451	-10,000 60,000	RiskPert(S1451,R1451,T1451,RiskName(B1451&C1451&H1451))	0	8436.5	$50,619.00
63ProjectTrinity	U1452	-10,000 60,000	RiskPert(S1452,R1452,T1452,RiskName(B1452&C1452&H1452))	0	8436.5	$50,619.00

Sediment, Sampling & Recording

Name	Cell	Graph	Function	Min	Mean	Max
63ProjectKeno	U1454	150,000 400,000	RiskPert(S1454,R1454,T1454,RiskName(B1454&C1454&H1454))	187552	260547.5	$397,373.10
63ProjectJC Boyle	U1455	200,000 500,000	RiskPert(S1455,R1455,T1455,RiskName(B1455&C1455&H1455))	206040.8	377337.6	$454,501.90
63ProjectCopco	U1456	-50,000 450,000	RiskPert(S1456,R1456,T1456,RiskName(B1456&C1456&H1456))	0	231561	$436,358.70
63ProjectIron Gate	U1457	640,000 840,000	RiskPert(S1457,R1457,T1457,RiskName(B1457&C1457&H1457))	656590.9	746991.1	$827,875.40
63ProjectWalker Bridge	U1458	300,000 700,000	RiskPert(S1458,R1458,T1458,RiskName(B1458&C1458&H1458))	335123.5	426351.6	$698,173.90
63ProjectSeiad Valley	U1459	250,000 750,000	RiskPert(S1459,R1459,T1459,RiskName(B1459&C1459&H1459))	261793.1	592428.1	$727,203.00
63ProjectOrleans	U1460	200,000 900,000	RiskPert(S1460,R1460,T1460,RiskName(B1460&C1460&H1460))	299748	687517.3	$827,875.40
63ProjectKlamath	U1461	300,000 600,000	RiskPert(S1461,R1461,T1461,RiskName(B1461&C1461&H1461))	342569.2	482134.3	$551,916.90
63ProjectShasta	U1462	100,000 550,000	RiskPert(S1462,R1462,T1462,RiskName(B1462&C1462&H1462))	117380	275190.9	$547,773.40
63ProjectScott	U1463	100,000 550,000	RiskPert(S1463,R1463,T1463,RiskName(B1463&C1463&H1463))	117380	275190.9	$547,773.40
63ProjectSalmon	U1464	-50,000 250,000	RiskPert(S1464,R1464,T1464,RiskName(B1464&C1464&H1464))	0	37120.5	$222,723.00
63ProjectTrinity	U1465	-50,000 250,000	RiskPert(S1465,R1465,T1465,RiskName(B1465&C1465&H1465))	0	37120.5	$222,723.00
63ProjectData Management	U1466	350,000 750,000	RiskPert(S1466,R1466,T1466,RiskName(B1466&C1466&H1466))	360111.8	561594.1	$738,167.60
63ProjectODCs	U1467	100,000 450,000	RiskPert(S1467,R1467,T1467,RiskName(B1467&C1467&H1467))	133840	221553.7	$432,943.30
63ProjectEsturary and river sampling for toxins	U1468	220,000 310,000	RiskPert(S1468,R1468,T1468,RiskName(B1468&C1468&H1468))	222896.1	243885.5	$304,253.20
63ProjectTSS and NTU laboratory relationship study by USGS	U1469	160,000 230,000	RiskPert(S1469,R1469,T1469,RiskName(B1469&C1469&H1469))	167172.1	182914.1	$228,189.90

Other

Name	Cell	Graph	Function	Min	Mean	Max
63ProjectAnnual aircraft surveys + 1 after 5 year gap	U1471		RiskPert(S1471,R1471,T1471,RiskName(B1471 &C1471&H1471))	341123.5	404294.5	$568,539.10
63ProjectAnnual field survey; 2 wk field survey + study.	U1472		RiskPert(S1472,R1472,T1472,RiskName(B1472 &C1472&H1472))	142134.8	168456	$236,891.30
63ProjectDrone LiDAR in site specific locations, analysis & reporting	U1473		RiskPert(S1473,R1473,T1473,RiskName(B1473 &C1473&H1473))	86807.23	102882.6	$144,678.70
63ProjectSurface comparison and analysis of sediment erosion	U1474		RiskPert(S1474,R1474,T1474,RiskName(B1474 &C1474&H1474))	86807.23	102882.6	$144,678.70



Definite Plan for the Lower Klamath Project

Appendix Q – Draft Recreation Plan

KLAMATH
RIVER RENEWAL
CORPORATION

June 2018

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Acronyms

BLM Bureau of Land Management
CDFW California Fish and Wildlife

Chapter 1: Introduction

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1. INTRODUCTION

KRRC developed this Draft Recreation Plan to provide information on the changes to existing recreation sites that will occur as part of the decommissioning and removal of the Lower Klamath Project consistent with the terms of the KHSA (the Project) and to provide a programmatic level of detail on proposed recreation opportunities and facilities that are consistent with pre-hydropower development conditions. KRRC developed this Draft Recreation Plan with input from a variety of stakeholders including tribes, state and federal agencies, county agencies and chambers of commerce, local residents, and public interest groups.

1.1 Existing Recreation Sites

Recreation sites are located throughout the project area from J.C. Boyle Reservoir to the Iron Gate fish hatchery. The existing recreation facilities and their planned disposition as part of the Project is presented in Tables 1-1 and 1-2.

Table 1-1 Existing PacifiCorp Recreation Facilities in the Project Area and Proposed Actions

Site	Property Type[1]	Facilities	Proposed Action	Estimated Annual Use[2]
J.C. Boyle Reservoir Recreation				**40 – 65%**
Pioneer Park (East and West)	Parcel A	Picnic areas, boat launches, shoreline fishing, interpretive signs, restrooms	Remove	
Stateline Take-out	Parcel A	Boat put-in/take-out, shoreline fishing access, restrooms. Upstream of Copco Lake	Unknown	
Fishing Access Sites 1-6	Parcel A	Shoreline fishing access, parking. Upstream of Copco Lake	Unknown	
Copco Lake Recreation				**5 – 15%**
Mallard Cove	Parcel B	Day use/picnic area, restrooms, boat launch with boarding dock, interpretive signs	Remove	
Copco Cove	Parcel B	Picnic area, restrooms, boat launch with boarding dock, interpretive signs	Remove	
Iron Gate Reservoir Recreation				**5 – 25%**

Site	Property Type[1]	Facilities	Proposed Action	Estimated Annual Use[2]
Fall Creek Day Use Area and Fall Creek Trail	Parcel B	Picnic areas, boat launch, restroom, hiking trail	Retain / modify	
Overlook Point	Parcel B	Picnic area, restrooms	Remove	
Wanaka Springs Day Use Area	Parcel B	Day use/ camping areas, fishing dock, restrooms, interpretive signs	Remove	
Jenny Creek Day Use Area and Campground	Parcel B	Campsites/day use areas (6), hiking trails, shoreline fishing, restrooms	Retain / modify	
Camp Creek Day Use Area and Campground (including Dutch or Scotch Creek)	Parcel B	Campsites (22), boat launch, boarding and fishing docks (3), swimming area, a RV dump station, interpretive display, restrooms	Remove	
Juniper Point Day Use Area and Campground	Parcel B	Campsites (9), a fishing dock, interpretive signs, restroom	Remove	
Mirror Cove Day Use Area and Campground	Parcel B	Campsites (10), a boat launch, fishing dock, interpretive signs, restroom	Remove	
Long Gulch Day Use Area and Campground	Parcel B	Picnic sites, boat launch, restrooms	Remove	
Iron Gate Fish Hatchery Day Use Area	Parcel B	Picnic areas, picnic shelter, visitor center, interpretive kiosks, restrooms, trail to river, fishing dock, boat launch (3)	Retain / Modify	

Notes

1. Parcel A lands will remain with PacifiCorp because these parcels are not directly related to the hydroelectric facilities to be transferred to KRRC (J.C. Boyle, Copco 1&2, and Iron Gate). Parcel B lands are directly related to these four hydroelectric facilities. According to the 2016 Amended KHSA, Parcel B lands are to be transferred to through KRRC to the states or other entities they designate and are intended for the public interest. There are over 8,000 acres of Parcel B land.
2. Data from 2015 PacifiCorp Licensed Hydropower Development Recreation Reports for J.C. Boyle, Copco 1, Copco 2, and Iron Gate.

Table 1-2 Other Existing Recreation Facilities in the Project Area and Proposed Actions

Site	Ownership	Facilities	Reservoir	Proposed Action
Topsy Campground	BLM	Campsites (15), an RV dump, day use areas (2), a boat launch with boarding dock, an accessible fishing pier, restrooms	J.C. Boyle	Modify / Retain
Sportsman's Park	Klamath County	Shooting ranges, dirt racetracks, archery courses, a model aircraft flying field, OHV area, restrooms	J.C. Boyle	Unchanged
Spring Island Boater Access	BLM	Boat launch, shoreline fishing access, interpretive signs, restrooms. Located downstream of J.C. Boyle	J.C. Boyle	Unknown
Klamath River Campground	BLM	Campsites (3), shoreline fishing and boating access, restrooms. Located downstream of J.C. Boyle	J.C. Boyle	Unknown
Turtle Camp	BLM	Primitive camping site downstream of J.C. Boyle	J.C. Boyle	Unknown
Dispersed Site	BLM	Primitive camping site downstream of J.C. Boyle	J.C. Boyle	Unknown

As shown in Tables 1-1 and 1-2, the Project will result in the removal of up to 9 recreation sites that are FERC license requirements along the Klamath River between J.C. Boyle Reservoir and Iron Gate Dam. This will include three separate recreation sites with campgrounds that provide a total of 41 campsites, 5 boat launches, 9 fishing docs, 9 recreation sites with restrooms, and 9 sites that support fishing access.

1.2 Existing Recreation Activities

The existing recreation sites described above primarily provide fishing, boating, and day use access to the three reservoirs. Some sites provide camping facilities for overnight use. In addition, whitewater rafting and associated put-ins, take-outs, and camping occurs in the Hell's Corner Reach between J.C. Boyle powerhouse and Copco Lake. Release flows from J.C. Boyle powerhouse supports whitewater rafting, which operates on a regular schedule and provides consistent flows during daylight hours.

The Project includes permanent removal of recreation sites associated with the reservoirs and the reduction in the number of days with acceptable flows associated with the FERC licensed hydropower facilities for whitewater boating in the Hell's Corner Reach, due to the removal of the J.C. Boyle development. Specifically, at the four developments, KRRC will completely remove a number of recreational facilities and the former recreation areas, parking areas, and access trails will be regraded and revegetated. In the Hell's Corner

Reach of the Klamath River, there will be a loss of flows acceptable for whitewater boating in the only Class IV+ rapids in the region that occur during the late summer.

1.3 Recreation Objectives

This Draft Recreation Plan seeks to identify recreation opportunities that will offset the removal of reservoir recreation sites and the reduction in whitewater boating days associated with the Project. The goal of the plan is to provide new riverine opportunities and facilities that are consistent with pre-hydropower development conditions. The recreation opportunities identified in this plan will need to be implementable by KRRC, offset the removal of reservoir recreation facilities and river access, and represent durable solutions – with parties responsible for maintenance and upkeep identified.

Chapter 2: Recreation Option Identification

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2. RECREATION OPPORTUNITY IDENTIFICATION

2.1 Recreation Opportunity Identification Process

KRRC has implemented a comprehensive recreation opportunity survey to support development of a Recreation Plan that will be included in the Project. KRRC has considered opportunities identified in the 2011 *Detailed Plan for Dam Removal – Klamath River Dams* (Detailed Plan) by Reclamation. In addition, KRRC has started an on-going stakeholder outreach process seeking input from potentially impacted recreation users, operators, managers and administrators, including Tribes, state and federal agencies, county agencies and chambers of commerce, local residents, recreation businesses, and public interest groups. This stakeholder outreach process will continue through the development of the Final Recreation Plan scheduled for completion in June of 2019.

The recreation opportunities identified in this plan are all presented at a programmatic or planning level of detail with some opportunities including more detail than others depending on their level development as a part of earlier studies or review by stakeholders. The descriptions presented in Sections 2.2 and 2.3 provide at a minimum, sufficient detail to give reviewers an indication of the specific type of recreation condition they will offset or improve, their general location, the source that identified the opportunity, and in the case of new facilities, their future potential owner/operator if known and in the cases of existing facilities their current owner/operator.

2.1.1 Detailed Plan

The 2011 Detailed Plan was developed by staff from the Bureau of Reclamation's Technical Services Center consistent with the requirements outlined in the 2010 KHSA to inform the Secretarial Determination process with details on the proposed physical methods for removal of the four lower PacifiCorp dams, including plans for waste disposal, reservoir drawdown, reservoir restoration, existing recreation facility modification or removal, and recreation impact mitigation.

The Detailed Plan identified multiple new recreation facilities and river access points for camping and hiking, and river access for boating and fishing along the river channel between J.C. Boyle Reservoir and Iron Gate Dam to replace the function of the existing facilities to be removed or modified due to reservoir drawdown; these new facilities are detailed in Section 2.2.

2.1.2 Stakeholder Outreach

KRRC initiated a stakeholder outreach process to seek input on the recreation opportunities previously identified during development of the 2011 Detailed Plan as well as support with the identification of new opportunities that had not previously been identified. This ongoing outreach effort has included coordination with California and Oregon state officials, Siskiyou County, Klamath County, the Bureau of Land Management (BLM), PacifiCorp, economic development organizations including chambers of commerce, tourism organizations, recreation businesses, local communities (e.g., Copco, Hornbrook), and the general public. Section 2.3 presents recreation opportunities identified during this outreach effort. Table 2-1 identifies the stakeholders that participated in this outreach effort.

KRRC will continue the stakeholder outreach process through the development of the Final Recreation Plan. KRRC will also work with regulators to determine any requirements for the final plan.

Table 2-1 Stakeholder Outreach Participants

Name	Name	Name
All-Outdoors	Hornbrook Residents[1]	Oregon Parks and Recreation Department
American Whitewater	Indigo Creek Outfitters[2]	PacifiCorp
Bruce Kinseth (R-Ranch)	Jack Trout[3]	Quartz Valley Indian Tribe
Bureau of Land Management	Jeff Stone	River Dancers
California Department of Fish and Wildlife	John Jacques (Klamathon Lodge)	Rogue Riverkeeper
California Natural Resources Agency	K. Bermel	Shasta Indian Nation
California Trout	Karuk Tribe	Shasta Nation
Carl and Linda Ebert (Copco Village Residents)	Klamath County Chamber of Commerce	Siskiyou Economic Development Council
Copco Village Residents[1]	Klamath County Economic Development	SWCA[4]
Discover Klamath	Momentum River Expeditions[2]	Trout Unlimited
Discover Siskiyou	Noah's Rafting Adventures[2]	
Fly Fishers International - Oregon Council	Oregon Fish and Wildlife	

Notes

1. Participants at public meetings held by KRRC in Copco Village and Hornbrook in June 2018 to seek input on recreation opportunities to be considered in the Recreation Plan
2. Member of the Upper Klamath Outfitters Association
3. Unaffiliated representatives from local (Klamath River Basin) recreational fishing industry
4. Consultant for Siskiyou County

The outreach effort also focused on the identification of evaluation criteria for these recreation opportunities to refine the list of opportunities identified for potential implementation by KRRC. The results of this feedback are described in greater detail in Section 3 of this plan.

2.2 Recreation Opportunities Identified in the Detailed Plan

This section presents descriptions of recreation features identified in the 2011 Detailed Plan. The Detailed Plan identified a list of potential recreation facilities and access areas that could be implemented under Mitigation Measure REC-1. These features were assumed to support cost estimates developed for the Detailed Plan. The Detailed Plan indicated that these opportunities were not assumed to be the only opportunities that would be considered. KRRC is presenting these opportunities from the Detailed Plan, along with stakeholder-suggested opportunities (see Section 2.3), as opportunities to consider in the development of the Final Recreation Plan. Like all opportunities presented in this draft, those described below will be subject to screening through the process described in Section 3.

Topsy Campground

Topsy Campground is an existing facility located on the southeastern shoreline of J.C. Boyle reservoir (shown on Figure 2-1 as Site 1). It is owned and operated by BLM. The Detailed Plan proposed modifications to accommodate river-based recreation as opposed to its current reservoir-based recreation use. This would include removal and replacement of the current boat ramp to support river access. In addition, the Detailed Plan proposed revegetation of the area around the existing campground. These modifications were identified to provide continued recreational access to the area for camping, hiking, boating, and fishing. BLM would continue to be the owner and operator of this modified facility. In addition to the proposed changes identified in the Detailed Plan, BLM suggested during initial stakeholder outreach completed during the development of this draft Recreation Plan that new camping areas and restrooms be developed next to the new water's edge. Development of additional campsites and parking would provide additional opportunities for camping, fishing, and hiking in this reach. The Detailed Plan proposed completion of these modifications for the year following dam removal and reservoir/river restoration.

Fall Creek Day Use Area

Fall Creek Day Use Area is an existing facility located on the far northeast shore of Iron Gate Reservoir (shown on Figure 2-1 as Site 14). The facility is currently owned and operated by PacifiCorp on Parcel B land. The Detailed Plan proposed that the site be retained and modified to support day use activities and hiking at Fall Creek. Upgrades identified in the plan included the reconstruction of the trail leading to the waterfall and other upgrades to support continued and improved recreational access in the area. The future owner and operator of the Fall Creek Facility is unknown. The Detailed Plan proposed completion of these modifications for the year following dam removal and reservoir/river restoration.

In addition to PacifiCorp's continued operations at Fall Creek, the Project includes development in close proximity to Fall Creek Day Use Area, including the Fall Creek Hatchery and changes to the Yreka water supply line. The area may become unsupportive of additional recreation opportunities.

Jenny Creek Day Use Area and Campground

The existing recreation site at Jenny Creek is located on the northern shoreline of Iron Gate Reservoir, between Copco Road and Jenny Creek (shown on Figure 2-1 as Site 15). This facility includes six campsite/day use sites and several user-defined trails. The Jenny Creek facilities are currently owned and operated by PacifiCorp on Parcel B land. The Detailed Plan proposed the site be expanded and upgraded to accommodate additional campsites and improved amenities. These modifications and upgrades to the Jenny Creek Day Use Area and Campground were proposed to increase recreation activities such as camping, hiking, and fishing at this location. The future owner and operator of the Jenny Creek Facility is unknown. The Detailed Plan proposed completion of these modifications for the year following dam removal and reservoir/river restoration.

Iron Gate Hatchery Day Use Area

The Iron Gate Hatchery Day Use Area is located just downstream of Iron Gate Dam, adjacent to Iron Gate Fish Hatchery (shown on Figure 2-1 as Site 16). The day use site is owned by PacifiCorp on Parcel B land and operated by California Fish and Wildlife (CDFW). The facility currently includes a covered picnic area, a visitor center/interpretive kiosk, and an ADA-accessible to the river shoreline. There is also a boat launch on the river shoreline across from the hatchery. The Detail Plan proposed that the site be retained and modified to provide additional facilities and a reconstructed boat ramp to support continued and improved recreational access in the area. The KHSA includes funding by PacifiCorp for the continued operation of the Iron Gate Fish Hatchery by CDFW for up to 8 years following facility removal, this included the transfer of ownership of the facility to CDFW. Future ownership and plans for operation of the recreation facilities at the Iron Gate Hatchery Day Use Area following facilities removal are however unknown. The Detailed Plan proposed completion of these modifications for the year following dam removal and reservoir/river restoration.

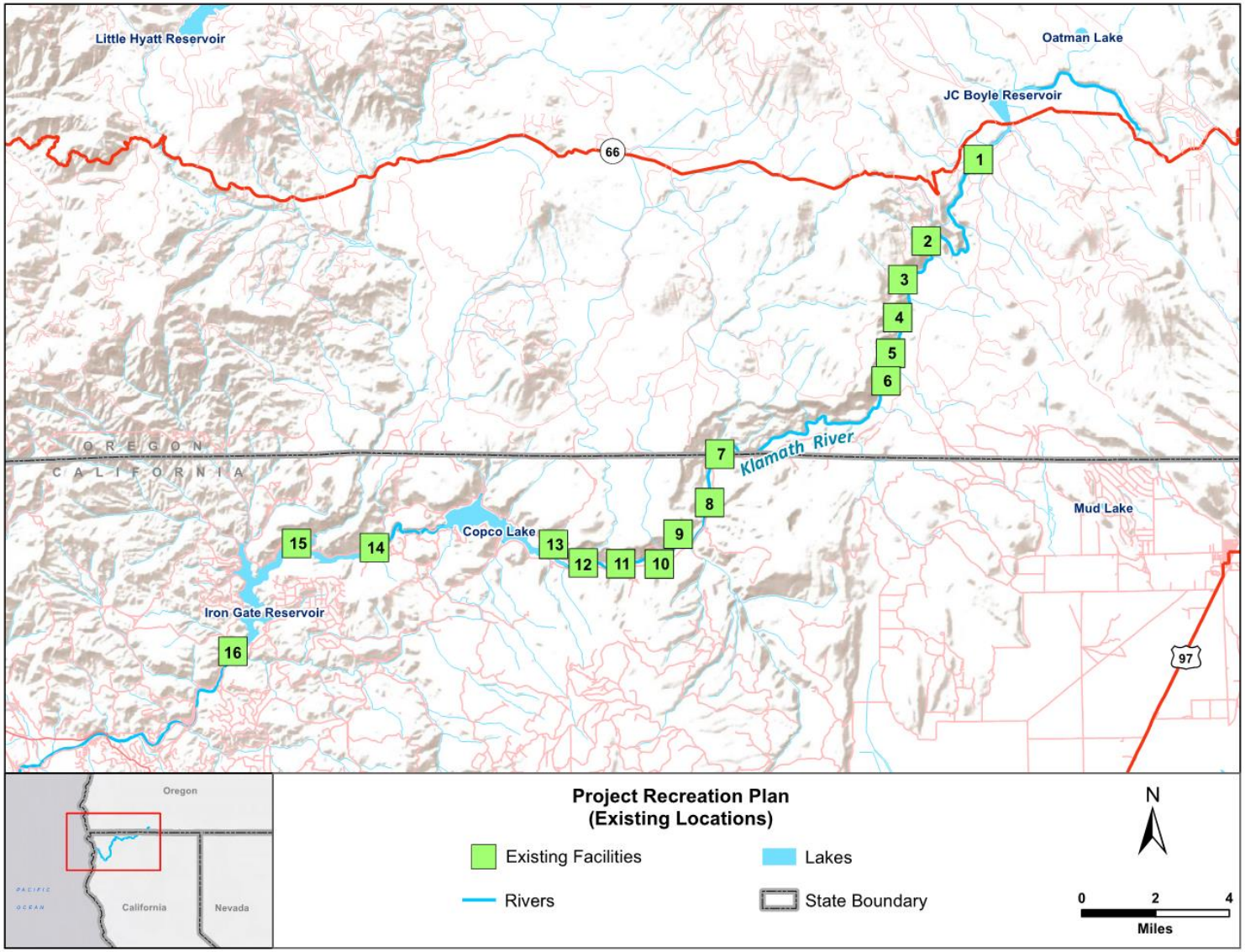

Figure 2-1 Existing Recreation Facility Locations That Could Be Retained or Modified

New Campgrounds

Two small to medium campgrounds were identified for development in the Detailed Plan. These campgrounds would accommodate a total of 20 campsites and include parking, day use facilities and a boat launch. If implemented, these newly developed campgrounds would provide river access, parking, day use amenities, essentially offsetting the loss of campgrounds at other locations post-dam removal. The specific location of these facilities was not identified in the Detailed Plan. The future owner and operator of these facilities is also unknown. The Detailed Plan proposed completion of these developments for the year following dam removal and reservoir/river restoration.

New Routes and Roads

The Detailed Plan identified as a potential recreation opportunity, the development of two potential routes/roads, with one route on each side of the river to provide public recreation access to existing and newly developed facilities on the river. These routes would be developed in coordination with the appropriate federal, state, and local agencies along with any private landowners because of their need to cross land held by multiple owners. These new roadways were identified in the Detailed Plan as permanent features. These roads were proposed in the Detailed Plan given their potential to improve access for recreational uses as well as improve law enforcement's ability to police the area. The specific configuration/layout of these proposed roadways was not provided in the Detailed Plan and no proposed owner/operator for the roadways was identified. The Detailed Plan proposed development of these new roadways would be incorporated into the overall reservoir/river restoration design as appropriate to complement its success.

Non-motorized Trail

The Detailed Plan also identified as a potential recreation opportunity, the development of a new non-motorized trail to provide fishing, biking, and hiking access along the river bank from the current J.C. Boyle dam site to Iron Gate Fish Hatchery. This new trail would be developed in coordination with the appropriate federal, state, and local agencies along with any private landowners because of its need to cross land held by multiple owners. This new trail was identified in the Detailed Plan as a permanent feature. The specific configuration/layout of this new trail was not provided in the Detailed Plan and no proposed owner/operator for the trail was identified. This trail would be developed in a way to be connected to any existing and developed recreation facilities developed as part of the Final Recreation Plan or in coordination with other regional efforts. The Detailed Plan proposed completion of this new trail for the year following dam removal and reservoir/river restoration.

2.3 Recreation Opportunities Identified through Stakeholder Outreach

This section presents descriptions of the recreation features identified during the initial stakeholder outreach effort described above in Section 2.1.2. The recreation opportunities identified during this process varied in levels of detail depending on what was provided by the stakeholders at the outreach meetings they participated in and in some cases in follow up submittals provided to KRRC in writing. In some cases, stakeholders identified opportunities that had already been evaluated as a part of the Detailed Plan effort described above in Section 2.2, those opportunities are not described again in this section. The opportunities identified ranged from the establishment of additional river access points, the funding of tourism campaigns, promoting regional recreation, and the development of commercial recreation establishments on the river. Suggestions were made the retention and/or improvement of existing facilities as well as the development of new facilities. KRRC is presenting these opportunities, along with those included in the Detailed Plan (see Section 2.2), as opportunities to consider in the development of the Final Recreation Plan. Like all opportunities presented in this draft, those described below would be subject to screening through the evaluation process described in Section 3.

2.3.1 Existing Facilities

Stakeholders suggested several potential recreation opportunities and features that could be developed at existing recreation sites in the project area that were not proposed for modification in the Detailed Plan.

Spring Island Boater Access

Spring Island Boater Access is located downstream of J.C. Boyle (shown on Figure 2-1 as Site 2). This site is owned and operated by BLM. The facility currently provides river access for boating. Stakeholders requested that the site be retained and enhanced to improve the site's conditions, if possible. Suggested enhancements could include an improved boat launch, access road, day use area, and/or restrooms and additional parking. Stakeholders indicated that Spring Island Boater Access is important to boaters as a location that would break up the whitewater rafting run upstream and downstream of the point where a clear shift in difficulty would occur. Retention of this site would allow the continued use of an established boater access site. BLM would continue to be the owner and operator of the access. If included in the Final Recreation Plan, completion of any enhancements to the site would be scheduled for the year following facility removal and reservoir/river restoration.

Campground South of J.C. Boyle Powerhouse

Stakeholders requested a campground be developed south of J.C. Boyle Powerhouse or enhancements be made to the campgrounds at one of the three existing river-side campgrounds operated by BLM (BLM Dispersed Site 1, Klamath River Campground, and Turtle Camp shown on Figure 2-1 as Sites 3, 4, 5). Klamath River Campground and Turtle Camp currently allow campfires and access for kayaks and small rafts. These existing sites could be enhanced to include defined campsites and improved boat launches,

access roads, day use facilities, and/or restrooms. Enhancements to these sites or the development of a new site that would provide improved river access and river-side camping would provide additional opportunities for camping, boating, and hiking in this reach. BLM would continue to be the owner and operator of this modified facility. If included in the Final Recreation Plan, completion of these modifications would be scheduled for the year following facility removal and reservoir/river restoration.

Klamath River Campground and Turtle Camp

Klamath River Campground and Turtle Camp, shown on Figure 2-1 as Sites 4 and 5, are located south of J.C. Boyle Powerhouse. Klamath River Campground and Turtle Camp currently allow campfires and access for kayaks and small rafts. The sites are owned and operated by BLM. BLM suggested KRRC increase the number of camping sites and provide additional day use parking to accommodate additional users. Improvements to Copco Big Bend Road would be necessary. Development of additional campsites and parking would provide additional opportunities for camping, fishing, and hiking in this reach. BLM would continue to be the owner and operator of this modified facility. If included in the Final Recreation Plan, completion of these modifications would be scheduled for the year following facility removal and reservoir/river restoration.

Frain Ranch Campground

Frain Ranch is an existing dispersed recreation area and undeveloped campground in Oregon located between J.C. Boyle Reservoir and Copco (shown on Figure 2-1 as Site 6). Ownership of the land is divided between PacifiCorp (Parcel A) and BLM and is operated by the BLM. This site is mainly used by boaters, campers, and ATV users. Stakeholders requested that the site be enhanced to provide a developed campground on lands owned by the BLM with defined campsites, restrooms, picnic tables, and fire rings. Development at this site would require improvements to Topsy Grade Road, the main access road for the site. These enhancements were identified to provide additional opportunities for camping, boating, and hiking. BLM would continue to be the owner and operator of this modified facility. The entity responsible for long-term maintenance of the improved road has not yet been identified. If included in the Final Recreation Plan, completion of these modifications would be scheduled for the year following facility removal and reservoir/river restoration.

Stateline Boater Takeout

Stateline Boater Takeout is located between J.C. Boyle Reservoir and Copco Lake (shown on Figure 2-1 as Site 7), just below the state line. Ownership of the lands at this site is divided between BLM and PacifiCorp (Parcel A) and the site is currently operated by the BLM. Stakeholders requested that the site be retained and modified to allow future boating access and shoreline fishing. The portion of this access point owned by PacifiCorp is on Parcel A property, which would generally be retained by PacifiCorp after license surrender; however, the future ownership of this property is unknown. To improve river access following facility removal, stakeholders suggested the portion of the access point on BLM property could be upgraded to support additional use. Retention of and enhancements at this facility would allow the continued use of a recreation facility that offers river access for boating, fishing, and day use. BLM would continue to be the owner and

operator of the modified facility. Completion of these modifications would be scheduled for the year following facility removal and reservoir/river restoration.

PacifiCorp Fishing Access Sites 1 through 6

PacifiCorp Fishing Access Sites 1-6 are located just upstream of Copco Lake (shown on Figure 2-1 as Sites 8 through 13). These sites are owned and operated by PacifiCorp (Parcel A), but they are not part of the FERC license for the hydroelectric developments. The facilities currently provide river access for fishing (and rafting at sites #1 and #6) along with some amenities for users. Stakeholders requested that access to these sites be maintained and if possible improved. PacifiCorp will retain ownership of these sites following license surrender for the hydroelectric developments and public access will no longer be available. It is unknown whether these sites would be sold to another entity or whether public access agreements could be granted in the future by PacifiCorp. If it is possible to maintain or enhance these sites, they could continue to provide river access for recreational fishing and boating uses. If included in the Final Recreation Plan, completion of any modifications at these sites would be scheduled for the year following facility removal and reservoir/river restoration.

R-Ranch

R-Ranch is located downstream of Iron Gate Reservoir in Hornbrook, California. The ranch currently supports camping, dirt bike and ATV riding, fishing, hiking, hunting, swimming, and horseback riding. Stakeholders suggested the ranch be expanded or enhanced to provide additional recreation opportunities. This expansion could include the development of a waterpark or similar attraction. R-Ranch is privately owned and operated. Future ownership and operations would remain unchanged. An expansion of R-Ranch would provide additional recreation, potentially reducing the impact from the loss of reservoir recreation. If included in the Final Recreation Plan, completion of any enhancements at R-Ranch would be scheduled for the year following facility removal and reservoir/river restoration.

2.3.2 New Facilities and Plans

This section presents descriptions of recreation opportunities stakeholders identified during outreach that were not directly linked to the retention of an existing facility.

Fishing Access Upstream of J.C. Boyle Powerhouse

Fishing access could be provided along the river approximately one mile upstream of the J.C. Boyle Powerhouse. The specific location of this access site was not however identified by the stakeholders that suggested it as a recreation opportunity for consideration. Currently, there is no trail next to river in this area, but there is the power canal access road that runs parallel to the river that could be connected to this new site. If the power canal access road would be closed to vehicles after dam removal, it could be converted to a trail and used for river access in this area. This new feature would provide river access for recreation uses such as fishing and walking. The future owner and operator of this facility is unknown. If included in the Final

Recreation Plan, completion of the development of these facilities would be scheduled for the year following facility removal/ river restoration.

Day Use and River Access at J.C. Boyle Powerhouse

Stakeholders recommended consideration of day use site to provide river access at the J.C. Boyle Powerhouse. The land directly surrounding J.C. Boyle Powerhouse and substation has been identified by stakeholders as a large and flat area that could serve as an effective location for a day use facility and/or campground. This land is currently owned by BLM, and BLM would continue to own the land following facilities removal and could potentially operate any new recreational facilities developed on this land. Development of a recreation facility at this site could increase recreational use and provide additional river access for hiking, fishing, and boating. If included in the Final Recreation Plan, completion of the development of these facilities would be scheduled for the year following facility removal/ river restoration.

New River Access Locations

Multiple whitewater rafting access locations were suggested by stakeholders between Keno Dam and the Iron Gate Hatchery. These locations were chosen based on known or expected changes in river conditions (rafting difficulty levels) and are shown in Figure 2-2. The site numbers identified for each access point in Figure 2-2 correspond to the site numbers listed for the descriptions of each access point presented in Table 2-2. Some of the locations identified were recommended for development prior to dam deconstruction to allow the continued use of existing river runs and to reduce the loss of boating access during dam decommissioning. No boating access will be allowed in the reservoirs themselves during drawdown and dam removal because conditions will constantly be changing, and it will be too risky to allow boating in the former reservoir areas due to the operation of the diversion facilities (e.g., large gates and tunnels at the dams) as well as the potential for mass movements of reservoir sediment into the river. Non-reservoir portions of the Klamath River system will remain accessible to boating during drawdown and dam removal. If included in the Final Recreation Plan, development of these pre-construction access sites needed during drawdown and dam decommissioning would need to be located outside of the existing reservoir footprints and scheduled for completion prior to the initiation of reservoir drawdown. The future owner and operator of these facilities is unknown. If included in the Final Recreation Plan, the remaining access sites would be completed the year following facility removal and reservoir/river restoration.

Table 2-2 Stakeholder Suggested Whitewater Rafting Access Points

Site ID	Location	Proposed Recreation Development
17	Keno Dam	Proposed access on river left. There is no existing facility for the run from Keno to J.C. Boyle. This would provide an additional river access point.
18	Highway 66 Bridge Crossing	Proposed access on river left. The current reservoir boat ramp could become a good location for rafting access point. This point could serve as a take-out for the Keno run and a put-in for the reach currently under J.C. Boyle Reservoir that would become available after dam removal.

Site ID	Location	Proposed Recreation Development
1*	Below J.C. Boyle Dam	Proposed on river left. Would serve as a put-in for the Boyle Bypass run during dam removal and future take-out for the extended Keno run post dam removal. Depending on river conditions post drawdown, this site might be exchangeable with access at Topsy Campground (if Topsy Campground is retained).
2	Spring Island Boater Access	Existing boater access site suggested for retention. This site is important to boaters as a location that breaks up the runs at a point where the difficulty changes. If this point is retained there would not be a need for a point at the J.C. Boyle Powerhouse.
19	Above Caldera	Proposed on river right, opposite to Frain Ranch. This would serve as an important location for rafters as the run changes from a class 3 to a class 4. The location opposite to the existing access site at Frain Ranch would provide boaters the opportunity to run the J.C. Boyle run and have shuttle access on the south side of the river. Currently boaters can only be shuttled on the north side, which restricts accessibility and reduces potential recreation use. This location would serve as a take-out for the J.C. Boyle Bypass run or put-in for Hell's Corner gorge. There is an existing road on the west side of the river that goes down to Caldera that could serve as an access road for this point.
7	Stateline Boater Takeout	Existing boater access site suggested for retention.
8	PacifiCorp Fishing Access Site 6	Existing boater access site suggested for retention. As noted above, this site is located on PacifiCorp Parcel A lands. Ability to obtain for future public access is uncertain.
13	PacifiCorp Fishing Access Site 1	Existing boater access site suggested for retention. As noted above, this site is located on PacifiCorp Parcel A lands. Ability to obtain for future public access is uncertain.
20	Above Copco 1 Dam	Proposed on river right. This point would serve as a take-out for the run currently under Copco Lake and a future put-in for the Copco 2 Bypass (Ward's Canyon) and Iron Gate runs. This area is anticipated to break up a Class 2 run (run under Copco Lake) and a Class 4 run (Ward's Canyon).
21	Copco 2 Dam (Ward's Canyon)	Proposed on river right, approximately 1,500 feet downstream of Copco 1 Dam. During drawdown and dam decommissioning activities, stakeholders indicated that this point could serve as an important access site for boaters, providing a put-in for the Ward's Canyon run. Given this facility's close proximity to Copco 1 Dam it would be located in an active construction area during dam removal. Stakeholders requested limited access to this site on a schedule coordinated with KRRC and contractors on-site. After dam removal has been completed, the site would serve as a put-in for the Iron Gate run. There is an existing dirt road that could provide access to this site.
22	Copco 2 Powerhouse	Proposed on river left. This site would serve as a take-out for the Ward's Canyon run or a put-in for the future Iron Gate run. It would represent a break in runs where there is a shift in difficulty.
14	Fall Creek	Proposed on river right. This point could serve as a take-out for upstream runs and a put-in for the run currently under Iron Gate Dam.
15	Jenny Creek Confluence	Proposed on river right. Stakeholders indicated that this site could allow boating during drawdown and serve as a take-out for the upper portion of the run currently under Iron Gate Reservoir and a future put-in for runs to Iron Gate and beyond. This site is interchangeable with the Camp Creek Confluence location.

Site ID	Location	Proposed Recreation Development
23	Camp Creek Confluence	Proposed on river right. Stakeholders indicated that this site could allow boating during drawdown and serve as a take-out for the upper portion of the run currently under Iron Gate Reservoir and a future put-in for runs to Iron Gate and beyond. This site is interchangeable with the Jenny Creek Confluence location, but may be a better location, based on bathymetry and pre-dam topographic maps.
16	Iron Gate Hatchery	Existing boater access site suggested for retention. Improvements to the existing facilities offered at Iron Gate Hatchery could provide needed access for boaters and serve as a take-out for the future Iron Gate run following dam removal.

*This site was proposed to be placed in close proximity to the existing Topsy Campground and is therefore represented in Figure 2-2 as site 1, Topsy Campground.

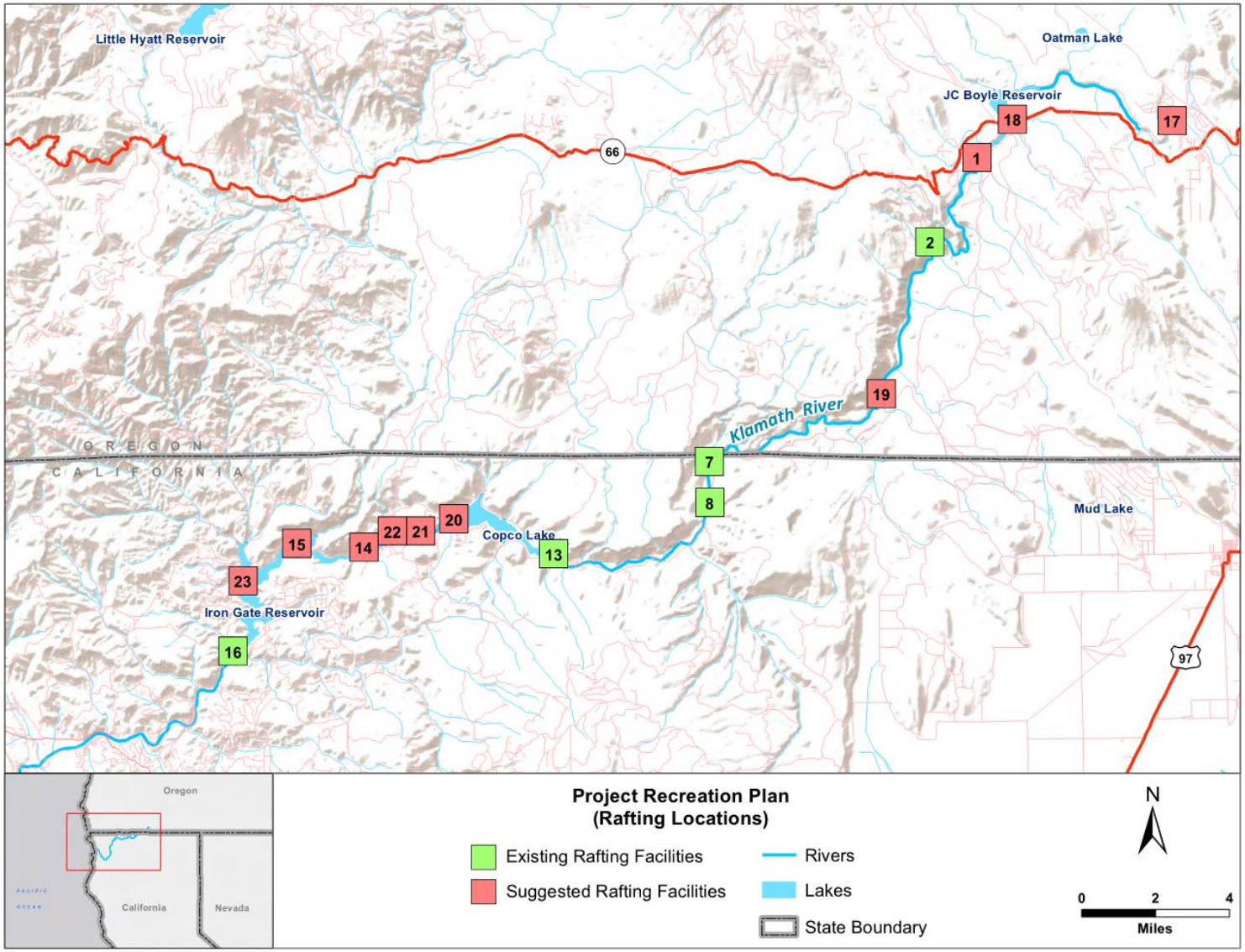

Figure 2-2 Potential Proposed River Access Sites

Copco 2 Bypass Reach

Stakeholders identified riparian vegetation that has grown into the historic river channel in the Copco 2 bypass reach due to low flows as a substantial safety hazard for future water-based recreation in that stretch of the river. The stakeholders indicated that the complete removal of this woody vegetation in the historic river channel prior to facilities removal would be most efficient to avoid complications generated by with vegetation removal attempted after the reach is inundated. Vegetation removal would make the reach navigable for boaters, providing an additional whitewater rafting run that would increase recreational boating use in the restored river. If included in the Final Recreation Plan, completion of vegetation removal would be scheduled for the year prior to reservoir drawdown.

Road Improvement

Stakeholders suggested that improvements could be made to some of the existing roadways that provide access to the Klamath River. The stakeholders indicated that many of the existing access roads in the area between Keno Dam and Iron Gate Dam are in need of improvement and long-term maintenance. Some of the roads have become unnavigable and inadequate for use to access recreation facilities. These poor road conditions also contribute to difficulties experienced by law enforcement personnel that need to access these areas. Stakeholders proposed that improvements be made to existing roads, such as Topsy Grade Road and Copco Big Bend Road, to improve accessibility and policing which could result in increased recreational use in the area. Specific stretches of roadways that need improvements have not been determined. It is assumed that roadways would continue to be owned and maintained by their current owners following any improvements. If included in the Final Recreation Plan, completion of roadway construction would be scheduled for the year following facility removal and reservoir/river restoration.

Access During Deconstruction

Stakeholders suggested that, where possible, access to roads currently used for river access be retained during the drawdown and deconstruction periods. These roads include but are not limited to the access road leading to J.C. Boyle Powerhouse and the dirt road near Copco 2 Dam, on river right. Road access could involve placing a flagger in established areas to direct traffic or establishing time intervals during which roads could be made open to the public. Providing road access that allows continued use for boaters and whitewater rafters during construction periods would reduce the impact made to boating in the Hell's Corner Reach during this time. Access requests would be coordinated with the contractor responsible for dam deconstruction activities. The terms of the access agreement would be determined and shared prior to facility removal and reservoir/river restoration.

Frain Ranch Bridge

Stakeholders suggested that a new bridge could be constructed to replace an old bridge that crossed the Klamath River at Frain Ranch. Reconstruction of this bridge would provide a point of access to either side of the river, increasing accessibility and recreational use in the area. The future owner and operator responsible for maintenance at the new bridge is unknown. If included in the Final Recreation Plan,

completion of bridge reconstruction would be scheduled for the year following facility removal and reservoir/river restoration.

RV Park in Seiad Valley or Happy Camp

A RV park with full hookups and amenities to be developed in Seiad Valley or Happy Camp was identified as a potential recreation opportunity by stakeholders. The RV park could generate revenue and tourism within the county, potentially offsetting lost tax revenue due to dam removal. The location of this park and its proposed owner and operator were not identified. If included in the Final Recreation Plan, completion of the development of the RV park would be scheduled for the year following facility removal.

Walking Trails/Wildlife Viewing/ Interpretive Trails

The development of educational recreational use sites and interpretative exhibits in the area was identified by stakeholders as a potential recreation opportunity. It was suggested that instead of full removal of dam infrastructure, some infrastructure (e.g., fish ladders, powerhouses, etc.) could be retained and signage added to promote educational tourism. Trails could be developed and routed to take recreational users through or by some of these remaining structures (preferably those with historic backgrounds). Signage promoting wildlife viewing could also be provided along these trails.

Locations for these trails have not yet been determined but could include areas around Copco residential areas or in the reservoir footprints of JC Boyle, Copco, and Iron Gate reservoirs. Development of recreational activities close to residential areas at Copco could provide residents with beneficial uses to offset the loss of reservoir-based recreation opportunities. Interpretative trails could provide additional recreational uses and opportunities for walking and tourism and as well as utilize local services. Future owners and operators of the remaining infrastructure were not identified. If included in the Final Recreation Plan, completion of the proposed trails and educational sites would be scheduled for the year following facility removal and reservoir/river restoration.

Flatwater Recreation in Siskiyou County

New or enhanced day use and/or camping sites could be developed in Siskiyou County to replace lost flatwater recreation opportunities. Locations have not yet been determined but could include the enhancement of existing recreation facilities and/or the development of new facilities at Lake Shastina or Medicine Lake. Specific amenities that would be available at these sites were not specified. The future owner and operator of these facilities is unknown. The development of additional day use and/or camping sites could promote recreational use and potentially offset lost flatwater recreation opportunities due to facility removal. If included in the Final Recreation Plan, completion of the development of these facilities would be scheduled for the year following facility removal.

Fishing Access Upstream or Downstream of J.C. Boyle Powerhouse

Fishing access sites could be developed upstream or downstream of J.C. Boyle Powerhouse in the J.C. Boyle Powerhouse footprint and in the bypass reach. Stakeholders did not identify specific locations for these new access sites. With the removal of dam facilities an increase in steelhead fish is expected in this reach of the river. Development of fishing access sites in this area would promote increased fishing activity and recreational use in the hydroelectric reach. The future owner and operator of these facilities is unknown. If included in the Final Recreation Plan, completion of development of these access sites would be scheduled for the year following facility removal/ river restoration.

Whitewater Park

Stakeholders identified the development of an in-river or off-river whitewater park along the river as a potential facility that could help offset whitewater rafting impacts in the Hell's Corner Reach by facilities removal. The proposed facility could be established by diverting from the river to provide whitewater conditions for recreational users to practice whitewater boating. The site could include day use areas and various amenities. A whitewater park would provide additional recreational opportunities for boating and could be a newly established tourist attraction, which could provide economic benefits for the county. The location of this park has not yet been determined. The future owner and operator is also unknown. Initiation of construction of the whitewater park would be scheduled for the year following facility removal alongside ongoing river restoration activities.

Recreational Gold Mining

Recreational gold panning opportunities could be established in areas on the river in Siskiyou County where users could participate in the county's history and culture. Specific locations where gold panning might be supported have not yet been determined. These locations could provide interpretative signage for the activity, including information on the history of gold mining in the county. Stakeholders indicated that the establishment of gold panning opportunities along the river could attract tourists and contribute to recreational use and available activities in the area. The future owner and operator of these facilities is unknown. If included in the Final Recreation Plan, development of these access points would be scheduled for the year following facility removal/river restoration.

New ADA Facilities

The Detailed Plan identified Camp Creek as an existing facility that would be removed after dam removal. Camp Creek is one of the few ADA recreation facilities in Siskiyou County. The Detailed Plan proposed that at least one of the recreation facilities retained along the Klamath River between J.C. Boyle Dam and Iron Gate Dam be upgraded to an ADA facility to offset this lost facility. Stakeholders noted during outreach meetings that shifting demographics for recreational users in the area could warrant the development additional ADA-accessible facilities. These facilities could include, but are not limited to, fishing access sites, boat ramps, and restrooms. The specific location of this replacement facility was not determined in the Detailed Plan. The future owner and operator of this facility is unknown. If included in the Final Recreation Plan, development of

the proposed facility would be scheduled for the year following facility removal and reservoir/river restoration.

Fishing Lodges

Stakeholders identified the development of two to five public fishing lodges to support fly fishing tourism along the hydroelectric reach as a recreation opportunity that should be considered. The fish lodges could provide year-round guided drift boat fishing, both fly and conventional fishing, for salmon, steelhead, and trout. Locations have not yet been determined but could be developed on Parcel B lands. Stakeholders suggested that these fishing lodges could be owned and operated under public/private partnerships, but the specific future owners and operators of these developments were not identified. Fees for facility use may be collected, but exclusive membership would not be permitted, and open access would be required. Fishing lodges could provide additional fishing access, increase recreational use in the area, additional jobs, and serve as a revenue generator to help offset lost tax revenue resulting from facilities removal. If included in the Final Recreation Plan, completion of development of these facilities would be scheduled for the year following facility removal and reservoir/river restoration.

River-side Commercial Recreational Development

Stakeholders suggested that commercial recreation facilities that could support recreational tourism could be developed on the river in the hydroelectric reach. The types of recreational uses for these developments were not specified. Potential locations were also not identified but facilities could be developed on Parcel B lands adjacent to the river. Similar to the fishing lodges described above, stakeholders suggested that these commercial developments could be owned and operated under public/private partnerships, but the specific future owners and operators of these developments were not identified. Fees for facility use may be collected, but exclusive membership would not be permitted, and open access would be required. River-side commercial recreation development could provide additional recreation opportunities such as fishing, hiking, boating, among other opportunities, as well as serve as a revenue generator to help offset lost tax revenue due to facilities removal. If included in the Final Recreation Plan, completion of development of these facilities would be scheduled for the year following facility removal and reservoir/river restoration.

Siskiyou Tourism Plan

The Siskiyou County County-wide Tourism Marketing Plan (Siskiyou Tourism Plan) includes a variety of ideas intended to promote tourism within the county by reaching a broader audience. Stakeholders proposed that some elements in the Siskiyou Tourism Plan be implemented as part of the Final Recreation Plan. The Siskiyou Tourism Plan highlights a lack of available tourism promotion funding, which poses a significant challenge for the county. Through either direct funding or partnering to develop destination awareness for attractions and outdoor recreation opportunities within the county, this recreation opportunity could promote continued recreational uses such as hiking, fishing, hunting, biking, and boating which could help reduce the loss of recreation use due to reservoir removal. If included in the Final Recreation Plan, implementation of this plan could be scheduled to coincide with facility removal and continue for an undetermined period following completion of river and reservoir restoration.

Upgrade Private Campgrounds

Numerous private campgrounds were identified in the region by stakeholders as being important recreational resources. These facilities are owned and operated by a variety of private owners and operators. Modifications and/or upgrades to these facilities were suggested by stakeholders as a way to provide continued and improved recreational use in the area. The future owner and operator of these sites would be the current owners and operators. If included in the Final Recreation Plan, completion of the upgrades proposed to these sites would be scheduled for the year following facility removal/ river restoration.

Transportation Plan

Development of a Transportation Plan that identifies appropriate roads and trails that could provide access to existing and newly developed recreation facilities was identified by stakeholders as important for planning potential recreation facilities and road improvements. Stakeholders suggested that the plan also identify which lands the roads cross and the entity or entities with current and future responsibility for road maintenance. The Transportation Plan would help inform the identification of new access routes for development in the future along with potential existing roadways that could be repurposed for trail use. The timeline for the plan was not specified. If included in the Final Recreation Plan, efforts developing the plan could begin prior to reservoir drawdown.

Enhance Private Docks

Several homeowners use private docks to access the Klamath River for fishing. Stakeholders from the Copco Village community suggested these private docks be extended to the newly formed river. The extension of private docks post dam removal would provide continued access for residents. If included in the Final Recreation Plan, completion of these modifications would be scheduled for the year following facility removal and reservoir/river restoration.

Klamath Hot Springs

Stakeholders suggested that a recreation facility near the historic Klamath Hot Springs Resort could be developed as commercial recreation facility. Development of a structure with restrooms and shelter for visitors could increase access to the existing hot springs near Shovel Creek. The potential future owner and operator of this facility was not identified. If included in the Final Recreation Plan, completion of the development of this facility would be scheduled for the year following facility removal and reservoir/river restoration.

2.4 Summary of Identified Recreation Opportunities

Table 2-3 presents a summary of the recreation opportunities identified including details on the location, current and future ownership if known, and where the opportunity was identified.

Table 2-3 Identified Recreation Opportunities

Site ID	Feature	Proposed Recreation Development	Current Owner/Operator	Origin
1	Topsy Campground	Replace or redesign boat ramp for river access and revegetate the reservoir rim in the vicinity of the campground	Owned and operated by BLM on J.C. Boyle Reservoir	Detailed Plan
14	Fall Creek Day Use Area	Upgrade facilities and reconstruct trail leading to Fall Creek waterfall	Owned/operated by PacifiCorp (Parcel B); located on Copco Road which is maintained by PacifiCorp	Detailed Plan
15	Jenny Creek Campground	Expand campground and upgrade facilities to provide Jenny Creek and Klamath River recreation	Owned/operated by PacifiCorp (Parcel B) on the edge of Iron Gate Reservoir	Detailed Plan
16	Iron Gate Hatchery Day Use Area	Reconstruct day use site to provide additional facilities and a boat ramp	Owned by PacifiCorp (Parcel B) and operated by CDFW	Detailed Plan
--	New Campgrounds	Two small to medium campgrounds in TBD location	N/A	Detailed Plan
--	New Routes/Roads	Provide routes on each side of the river that could be retained permanently to provide public recreation access to the river at defined locations	N/A	Detailed Plan
--	Non-motorized Trail	Construct trail to provide fisherman, biking, and hiking access from JC Boyle dam site to Iron Gate fish hatchery	New trail would need to cross PacifiCorp (Parcel A and B), BLM, private lands and potentially USFS land	Detailed Plan
2	Spring Island Boater Access	Retain/Enhance existing Spring Island boater put in below JC Boyle Powerhouse on the Klamath River and provide additional parking	BLM owns land	American Whitewater and BLM
3, 4, 5	Campground South of JC Boyle Powerhouse	Enhance and develop a new campground near JC Boyle Powerhouse; Klamath River Campground (primitive), Dispersed Site 1 and Turtle Camp could be modified or improved	BLM operates Klamath River campground (primitive), Dispersed Site 1 and Turtle Camp	American Whitewater

Site ID	Feature	Proposed Recreation Development	Current Owner/Operator	Origin
6	Frain Ranch Campground	Enhance and develop campground and improve Topsy Grade Road to Frain Ranch; Frain Ranch is a dispersed recreation site used by boaters and campers	Operated by BLM on PacifiCorp (Parcel A) land between Copco and JC Boyle Powerhouse	American Whitewater
8 through 13	PacifiCorp Fishing Access Sites 1 through 6	Maintain or enhance fishing access sites on Parcel A land between Copco Lake and Stateline. Sites include signage, porta-johns, and trash receptacles	Owned/operated by PacifiCorp (Parcel A); these sites are part of the FERC Lower Klamath Project definition	American Whitewater & Fishing Interests
7	Stateline Boater Takeout	Retain/enhance existing boater takeout on the river at Stateline to accommodate multiple parties in the take-out area and provide additional camp sites	Operated by BLM on PacifiCorp (Parcel A) land	American Whitewater and BLM
--	Fishing Access Upstream of J.C. Boyle Powerhouse	Provide fishing access along the river near the powerhouse approximately 1 mile up stream	BLM owns land	BLM
--	Day Use and River Access at J.C. Boyle	Provide recreational use/access in the large flat area on the river by the powerhouse and substation	BLM owns land	BLM
1, 2, 7, 8, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23	New River Access Locations	Develop river boating access with amenities (restrooms, road access, parking) in areas where the difficulty of river navigation changes	BLM and PacifiCorp-owned land (Parcel A and B)	American Whitewater
--	Copco 2 Bypass Reach	Remove riverine vegetation to provide safe boating thoroughfare in the Copco bypass reach	Owned and operated by PacifiCorp (Parcel B)	American Whitewater
--	Road Improvement	Improvements to the existing roads, including but not limited to Topsy Grade Road and Copco Big Bend Road	Various	Multiple stakeholders

Site ID	Feature	Proposed Recreation Development	Current Owner/Operator	Origin
--	Access During Construction	Provide access to roads that lead to river access for boaters to use during drawdown and deconstruction periods. Access could be granted by flagger or established time intervals for public use.	N/A	Upper Klamath Outfitters Association and American Whitewater
--	Frain Ranch Bridge	Construct a replacement bridge that crosses the Klamath River at Frain Ranch to provide continuous access to both side of the river	N/A	BLM
--	RV Park in Seiad Valley or Happy Camp	Develop an RV park with full hookups that would be generate revenue and tourism	N/A	SWCA[1]
--	Walking Trails / Wildlife Viewing / Interpretive Trails	Retain portions of the dam structures, provide interpretive signage, and develop a walking trail around it. Trails could also incorporate wildlife viewing. Construct trails around Copco Village residential areas to provide recreation opportunities for residents.	PacifiCorp-owned land (Parcel B)	SWCA[1]
--	Flatwater Recreation in Siskiyou County	Develop day use and/or camping sites in TBD locations for public recreational use to replace lost flatwater recreation opportunities. Locations could include Lake Shastina and Medicine Lake.	N/A	SWCA[1]
--	Fishing Access Upstream or Downstream of J.C. Boyle Powerhouse	Develop fishing access sites in the J.C. Boyle Powerhouse footprint and in the bypass reach	BLM and PacifiCorp-owned land (Parcel A and B)	BLM and ODFW
--	Whitewater Park	Develop an in-river or off-river whitewater park	N/A	SWCA[1]

Site ID	Feature	Proposed Recreation Development	Current Owner/Operator	Origin
--	Recreational Gold Mining	Establish gold panning recreation opportunities in Siskiyou County	N/A	SWCA[1]
--	New ADA Facility	Provide at least one ADA facility to retain the current ratio of ADA opportunities in the area.	N/A	Detailed Plan, SWCA[1], Oregon Council, Copco Village Residents
--	Fishing Lodges	Provide up to five public fishing lodges that could support fly fishing tourism along the current hydroelectric reach. These could be developed on Parcel B land under public/private ownership	N/A	John Jacques
--	River-side Commercial Recreation Development	Develop commercial recreation uses at points along the river.	N/A	John Jacques
--	Siskiyou Tourism Plan	Provide funding to establish a tourism campaign that would point people to other recreation facilities within Siskiyou County. This could include strategically placed signage.	N/A	SWCA[1], Siskiyou Economic Development Council / Discover Siskiyou
--	Upgrade Private Campgrounds	Improve existing private campgrounds in the area	Unidentified private owners	Siskiyou Economic Development Council / Discover Siskiyou
--	Transportation Plan	Develop a transportation plan that identifies appropriate roads and trails that could provide access to recreation facilities	N/A	BLM
--	Expand R-Ranch	Expand the recreation opportunities provided at R-Ranch. This could include the development of a water park.	Bruce Kinseth	Bruce Kinseth
--	Enhance Private Docks	Enhance private docks that are currently on the reservoir to provide river access	Various private owners	Copco Village Resident

Site ID	Feature	Proposed Recreation Development	Current Owner/Operator	Origin
3,5	BLM Klamath River Campground and [Turtle] Camp	Increase the number of camping sites and increase the day use area parking and related infrastructure. Existing road will need to be enhanced.	BLM	BLM
1	Topsy Campground	Develop new camping areas and bathrooms next to the new water's edge. Remove and replace existing boat ramp and dock.	BLM	BLM
--	Klamath Hot Springs	Develop structure with restrooms and shelter at the Klamath Hot Springs near the Klamath River's confluence with Shovel Creek	N/A	K. Bermel

Notes

1. Consultant for Siskiyou County
2. Frain Ranch Bridge does not currently exist. Current ownership of the lands where the bridge could be developed is divided between PacifiCorp (Parcel A) and BLM.

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Chapter 3: Recreation Opportunity Evaluation and Screening

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3. RECREATION OPPORTUNITY EVALUATION AND SCREENING

KRRC is developing evaluation and screening criteria that will be used to measure each recreation opportunity's consistency with the Recreation Objectives developed for this plan (Section 1.3). In addition, KRRC sought and continues to seek input on appropriate screening criteria as part of the stakeholder outreach effort that is underway in support of developing this plan. The preliminary criteria that have been identified, will be utilized during development of the Final Recreation Plan to measure whether each recreation opportunity will:

A. Directly address the recreation impacts generated by implementation of the KHSA.
B. Directly address or offset changes in the localized reservoir recreation or Hells Corner boating near where the impacts are occuring.
C. Improve access to or usability of an existing recreation resource on lands with a land manager/owner that will accept and agree to maintain the new or upgraded facility.
D. new or substantially increased O&M demands.
E. Not result in impacts to sensitive river and riparian habitats including important river spawning areas in and adjacent to any river channel.
F. Minimize and mitigate for any impacts to culturally sensitive areas.
G. Integrate into the existing communities and infrastructure.
H. Contribute to the regional recreation vision of Klamath River restoration
I. Be acceptible to law enforcement
J. Avoid impacts to local economics
K. Be implementable through available funding

Each opportunity that will be proposed for implementation by KRRC will need to support the criteria presented in the Final Recreation Plan. The preliminary criteria presented above are not final and may change in response to feedback received during the refinement and finalization of the plan. It is anticipated that the evaluation completed for the Final Recreation Plan will measure the degree to which each opportunity supports these criteria. Some of the recreation opportunities identified in this Draft Recreation Plan and others identified through continued stakeholder outreach may fully support some criteria and only partially support others. KRRC will use the screening process to identify in the Final Recreation Plan the proposed recreation facilities that are best able to support these criteria. The preliminary plans for how each screening criteria will be used to evaluate the recreation opportunities is presented below.

Criterion A will verify that each opportunity provides new or supports existing recreation activities or river access. Similarly, Criterion B tests whether a recreation opportunity will address, or offset, recreation impacts in the areas near where the impacts are occurring is measuring how well that the recreation facility

or access point will improve conditions along the newly formed river channel between J.C. Boyle Reservoir and Iron Gate Dam. These criteria will evaluate recreation opportunities both qualitatively to verify the proposed location and type of facility and quantitatively to measure the amount of recreation access and use these facilities will provide to offset the removed facilities described in Section 1.2.1.

Criterion C was developed to ensure the durability of opportunities implemented as a result of this plan. Following the completion of facility removal and river restoration activities, KRRC will surrender its license for these facilities and will be unable to operate and maintain any new recreation features developed by this plan, jeopardizing their continued success in mitigating the impacts they were developed to address. For an opportunity to perform well under Criterion C, an entity responsible for its ownership, operation, and ongoing maintenance will need to be identified. Criterion D then evaluates whether each opportunity will generate new or substantially increased O&M demands given the need for this Recreation Plan to ensure the selection and implementation of durable solutions.

Criteria E and F utilized in this evaluation effort were identifed through stakeholder input. Participants in the outreach efforts detailed concerns that potential recreation facilities or river access points created by this Recreation Plan could potentially impact locations important for spawning and rearing along the newly formed river channel and could potentially be developed in areas at or nearby culturally significant resources. The evaluations under both of these criteria will rely on existing resource mapping, river restoration plans and input from the stakeholder groups that raised these concerns.

Criteria G and H were developed to ensure the seamless integration of recreation opportunities into the local communities as well as the entire region. These criteria evaluate each opportunity's potential to integrate into the communities and existing infrastructure and its consistency with the overall vision for a restored Klamath River. The evaluations under both criteria will rely heavily on stakeholder feedback received during outreach and the plans and objectives of local agencies.

Criterion I was developed to evaluate each opportunities acceptability to local law enforcement. During outreach, stakeholders indicated that recreation opportunities developed in the area will need to be accessible by law enforcement to minimize risk and vandalism. The existing access roads in several areas near the river need improvement and their current condition results in slower response times for law enforcement. This criterion will evaluate whether the option will be sufficiently accessible to law enforcement.

Criterion J was developed to assess each opportunity's impact to the local economies in Siskiyou and Klamath counties. This criterion will evaluate recreation opportunities both qualitatively and quantitatively to determine how the opportunity benefits the local economy and/or provides a means to offset lost tax revenue resulting from dam removal.

Criterion K was developed to determine whether available funding will be sufficient to support the development of each opportunity.

Chapter 4: Recreation Plan Implementation

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4. RECREATION PLAN FINALIZATION

This Draft Recreation Plan identifies the types of recreation opportunities and facilities consistent with pre-hydropower development conditions that will be developed to achieve the goals of the plan. This draft plan also describes the process envisioned by KRRC to evaluate these opportunities and identify the proposed facilities that will ultimately be recommended for implementation in the Final Recreation Plan.

Based on the anticipated removal of reservoir recreation sites and reduced whitewater rafting use under the Project, KRRC has identified the need to implement, in the Klamath River Basin, recreation facility upgrades and/or new facility developments to provide, at minimum, the types of facilities that are proposed in this Draft Recreation Plan. KRRC configured these proposed opportunities to offset the anticipated effects on recreation access associated with dam and associated reservoir removal. The proposed location of specific opportunity types identified below was driven by KRRC's desire to support continued recreation use and access throughout the project area. Under the Amended KHSA, the existing license for the four dams will be transferred to KRRC to implement their removal. Following their removal, KRRC will surrender this license. Ultimately, the ownership, operation, and ongoing maintenance of the recreation opportunities developed by this plan will be the responsibility of the parties that the lands are transferred to.

KRRC initiated a stakeholder outreach process to seek input on the recreation opportunities previously identified during development of the 2011 *Detailed Plan for Dam Removal – Klamath River Dams* (Detailed Plan) as well as support with the identification of new opportunities that had not previously been considered. This ongoing outreach effort has included coordination with California and Oregon state officials, Siskiyou County, Klamath County, the BLM, PacifiCorp, economic development organizations including chambers of commerce, tourism organizations, recreation businesses, local communities, and the broader public. The outreach effort will continue throughout the refinement of this draft plan into a Final Recreation Plan scheduled for completion in June of 2019.

4.1 Proposed Recreation Facilities

KRRC, through its review of the potential recreation facilities removed under the Project and through preliminary stakeholder outreach, has identified two types of recreation access facilities that if developed will offset recreation access that will be eliminated by implementation of the Project – whitewater boat put-in/take-out sites and fishing access sites. In addition, KRRC intends to continue to collect input from stakeholders on both the refinement of these options with the identification of specific locations for implementation and additional detail on the types of amenities developed at each site. KRRC also intends to collect input from these stakeholders on new recreation opportunities beyond the new and upgraded access sites identified in this draft plan.

4.1.1 River Access Sites – Whitewater Put-in/Take-out

To offset reductions in boating access on the Klamath River generated by both the removal of reservoir boating access locations and reductions in river flow conditions capable of supporting whitewater rafting and

kayaking, KRRC has identified the development of river access sites that will support whitewater activities. This draft plan assumes the development of new or improved existing river access sites to allow for new whitewater boat access at or near the upstream and downstream ends of J.C. Boyle Reservoir, Copco Lake, and Iron Gate Reservoir. Developing put-in/take-out facilities at these locations will provide access to new sections of the river not currently accessible with the reservoirs in place.

These general locations will be refined during development of the Final Recreation Plan to incorporate input from stakeholders on site preferences, including input from future users on the specific locations anticipated to provide the best recreation experience. KRRC will also seek stakeholder input on any important in-river and river-adjacent habitat areas as well as sections of the river with specific cultural sensitivities to avoid and/or protect from future use. Preliminary feedback that has been provided by stakeholders on whitewater access preferences focused on identifying locations along the river with known or anticipated changes in future rafting/kayaking difficulty levels to better facilitate use of these sections by whitewater rafters and kayakers of varying skill levels.

KRRC will develop these river access sites to include at a minimum:

- An area near or along the adjacent roadway for the parking of trucks with trailers used to transport whitewater rafts, large passenger vans and buses for transporting commercial whitewater rafters,
- If necessary, an access road between any new parking areas and the adjacent existing roadway, and
- If necessary, developed paths from the area designated for parking to the river edge wide enough to support the portage of rafts.

Development of these whitewater access sites are assumed to require slope stabilization, drainage improvement, grading activities, and vegetation removal where necessary to develop parking areas, access roads and paths down to the river, if necessary, for raft portage.

4.1.2 River Access Sites – Fishing Access

To offset the loss of reservoir recreation sites that support flatwater recreation, KRRC has identified the development or improvement of access sites that will support fishing access on the river. This draft plan assumes the development of new or improved existing access sites to allow for access to the river for fishing and other active and passive recreation activities, including swimming. These sites could potentially be shared in some cases with the whitewater access sites identified above. KRRC will develop the sites to allow for new fishing access sites at locations along the river near or in the existing footprints of J.C. Boyle Reservoir, Copco Lake, Iron Gate Reservoir, and Copco No. 2.

Similar to the whitewater access sites described above, these general locations will be refined during development of the Final Recreation Plan to incorporate input from stakeholders on future user site preferences along with stakeholder concerns for biological and/or cultural resources. KRRC assumes that this will include input from stakeholders on preferred amenities at some or all of the sites. These amenities could potentially include fishing docks and Americans with Disabilities Act compliant features to support site accessibility.

KRRC will develop these river access sites to include at a minimum:

- An area near or on a road shoulder for the parking of personal vehicles,
- If necessary, an access road between any new parking areas and the adjacent existing roadway, and
- If necessary, developed trails from the area designated for parking to the river edge.

Similar to the whitewater access sites, development of these fishing access sites are assumed to require slope stabilization, drainage improvement, grading activities and vegetation removal where necessary to develop parking areas and access trails leading down to the river.

4.1.3 Other Recreation Facilities

KRRC intends to continue stakeholder outreach efforts during development of the Final Recreation Plan to refine the proposed recreation facilities identified above. KRRC intends this outreach effort to identify specific locations for recreation facility development and refine the site-specific details on the configuration of the preliminary amenities described above.

In addition to this refinement, KRRC intends to continue to collect input on other recreation facilities in the Klamath River Basin from stakeholders that could be developed in addition to or potentially in place of the facilities identified for implementation in this draft plan to offset impacts on reservoir recreation and whitewater recreation access in the Hell's Corner Reach associated with implementation of the Project.

4.2 Final Recreation Plan

As the Final Recreation Plan is developed, an evaluation and screening process will be implemented with input from stakeholders to identify the specific locations of, features developed for, and plans for operation and maintenance of the ultimate recreation opportunities. In addition, as was noted above, KRRC anticipates that additional recreation opportunities that have been identified during development of the final plan will perform well in this evaluation and screening process and could potentially be proposed by KRRC for implementation in the Final Recreation Plan alongside or in place of the facility types identified in this draft plan.

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KLAMATH
RIVER RENEWAL
CORPORATION

VIA U.S. MAIL AND EMAIL

October 10, 2018

State Water Resources Control Board
Division of Water Rights - Water Quality Certification Program
Attn: Parker Thaler
P.O. Box 2000
Sacramento, CA 95812-2000

Subject: Proposed Update to Definite Plan – Appendix I - AR-7 Freshwater Mussels

Dear Mr. Thaler:

This correspondence follows recent discussions between the Klamath River Renewal Corporation (KRRC) and the State Water Resources Control Board (SWRCB) and California Department of Fish and Wildlife (CDFW) concerning KRRC's proposed revision to Aquatic Resource (AR-7), the measure to reduce project effects to freshwater mussels located between Iron Gate Dam and Cottonwood Creek. On a short-term basis, mussels located in this reach are expected to experience moderate to high mortality due to bedload burial associated with the sediment release during the removal of the Klamath River dams. The management objective of this measure during this period is to reduce this mortality by relocation of individual animals.

The three mussel taxa in the Klamath River include *Gonidea angulata* (Western ridged mussel), *Margaritifera falcata* (Western pearlshell mussel), and *Anodonta sp.* (floater mussel) (Davis et al. 2013). Mussels are abundant and widely distributed throughout the mainstem Klamath River and tributaries. *G. angulata* is more widely distributed and more abundant than the other species (Davis et al. 2013). *Anodonta sp.* are located immediately below Iron Gate Dam, but are uncommon elsewhere. *M. falcata* is most abundant between the Salmon River and Trinity River confluences, and are nearly equally common as *G. angulata* in the vicinity of the Trinity River (Davis et al. 2013). Mussel abundance also generally declines with increasing distance downstream from Iron Gate Dam, suggesting the effects of the increasing hydrologic variability of the Klamath River with distance from Iron Gate. Davis et al. (2013) concluded that habitats

located further downstream had lower probabilities of supporting mussels due to more variable conditions.

During meetings in 2017, the Aquatic Technical Working Group (ATWG) reviewed relocation opportunities including moving mussels to the Keno to J.C. Boyle Reservoir reach. In June 2018, KRRC reviewed habitat conditions in the Keno to J.C. Boyle Reservoir reach and determined there is insufficient suitable freshwater mussel habitat in the reach. As there is insufficient habitat in the Keno to J.C. Boyle Reservoir reach, KRRC is now proposing to relocate mussels to the Klamath River downstream from the Trinity River confluence, or upstream of Copco Reservoir in the J.C. Boyle Dam to Copco Reservoir reach. In 2019, KRRC will be completing a more comprehensive freshwater mussel habitat reconnaissance to document existing freshwater mussel locations in the Iron Gate Dam to Cottonwood Creek reach, and to determine appropriate relocation sites in the two aforementioned reaches. *G. angulata* and *M. falcata* will mainly be targeted for relocation as there is appropriate habitat downstream from the Trinity River for both taxa (Davis et al. 2013). *G. angulata* have also been found upstream from Copco Reservoir (Byron and Tupen 2017). There are no recent published records of *M. falcata* upstream of Copco Reservoir.

The attached document summarizes the proposed updated language for the Detailed Plan – Appendix I. Narrative updates include the AR summary section, and Chapter 9 - Freshwater Mussels.

We appreciate your consideration of this proposed revision to measure AR-7. Please acknowledge receipt of this correspondence. If you have any questions on the application, please feel free to contact me at 510-679-6929 or mark@klamathrenewal.org.

Mark Bransom
Chief Executive Officer
Klamath River Renewal Corporation

cc: Erin Ragazzi, State Water Resources Control Board

encl: Appendix I – Freshwater Mussel Updated Language dated September 21, 2018.

Update for 20170929_krrc-tech_report.pdg

PDF p.262, report p. 7-8

First paragraph: “beds that will be salvaged and translocated is predicated on the available habitat in the Klamath River downstream from the Trinity River confluence (RM 43.4), and between J.C. Boyle Dam (RM 230.6) and Copco Reservoir (RM 209.0), and the abundance of mussels between Iron Gate Dam…”

9. FRESHWATER MUSSELS

The objective of the freshwater mussels measure is to address reservoir drawdown and project effects on freshwater mussels located in the Klamath River in the Hydroelectric Reach and downstream from Iron Gate Dam (RM 193.1). The 2012 EIS/R AR-7 focused conducting a freshwater mussel relocation pilot study followed by the salvage and relocation of freshwater mussels prior to reservoir drawdown. Salvaged mussels were to be held in a temporary location for later placement following reservoir drawdown, and placed in locations that will not be affected by the reservoir drawdown. Based on a review of the information discussed in greater detail below, KRRC and the ATWG concluded that a moderate scale freshwater mussel relocation effort is warranted. The proposed measure includes a freshwater mussel reconnaissance in 2019 followed by a limited freshwater mussel salvage prior to reservoir drawdown. Specifically, KRRC will salvage freshwater mussels from the 8-mile long Iron Gate Dam (RM 193.1) to Cottonwood Creek (RM 185.1) reach and translocate these mussels to one or more appropriate locations in the Klamath River downstream from the Trinity River confluence (RM 43.4), and between J.C. Boyle Dam (RM 230.6) and Copco Reservoir (RM 209.0). The translocation sites will be determined following the 2019 reconnaissance and discussion with the ATWG.

9.1 Proposed Measure

Based on a review of the 2012 EIS/R AR-7 presented in Section 9.2 below, input from the ATWG, and current freshwater mussels literature, the KRRC concluded that revisions to AR-7 are necessary to offset the anticipated short-term effects of the Project on freshwater mussels. The proposed measure includes a reconnaissance, salvage, and relocation of freshwater mussels from the 8-mile reach between Iron Gate Dam and the Cottonwood Creek confluence with the Klamath River. The monitoring and adaptive management plan has two specific actions.

- Action 1: KRRC will complete a reconnaissance in 2019 to assess the distribution and density of freshwater mussels in the 8-mile long bedload deposition reach from Iron Gate Dam (RM 193.1) downstream to the Cottonwood Creek confluence (RM 185.1). The reconnaissance effort will determine if the mussel beds identified in the 2007-2010 surveys are still present, and estimate abundance of a subset of the mussel beds in the reach.

- Action 2: Based on the reconnaissance and discussions with ATWG, KRRC will salvage and relocate a portion of the freshwater mussels located between Iron Gate Dam and Cottonwood Creek prior to drawdown to reduce project effects to the mussel community. Up to 20,000 mussels are planned for translocation to appropriate habitats in the Klamath River downstream from the Trinity River confluence (RM 43.4), and between J.C. Boyle Dam (RM 230.6) and Copco Reservoir (RM 209.0). Translocation sites will be located in areas that are anticipated by KRRC to experience minimal changes in channel bed elevation due to sediment deposition associated with the Project.

The proposed measure is intended to reduce project effects on freshwater mussels located downstream from Iron Gate Dam. The following sections provide additional detail on the proposed measure actions.

9.1.1 Action 1: Freshwater Mussel Reconnaissance

The KRRC will prepare a reconnaissance plan to assess freshwater mussels in the Iron Gate Dam to Cottonwood Creek reach in 2018. Habitat conditions will also be evaluated downstream from the Trinity River confluence, and between J.C. Boyle Dam and Copco Reservoir to determine the habitat capacity for translocated mussels. An existing freshwater mussel data set (base data for Davis et al. 2013), compiled by the Karuk Tribe, USFWS, and other collaborators from 2007 to 2010 for the Klamath River downstream from Iron Gate Dam, will be reviewed and used to plan the reconnaissance. The reconnaissance will confirm mussel beds identified in the 2007-2010 surveys and estimate abundance at a subset of the mussel beds locations. Habitat metrics in the potential translocation reach will be evaluated to maximize translocation success. The freshwater mussel reconnaissance and translocation reach habitat assessment are anticipated to take 5 days.

9.1.2 Action 2: Freshwater Mussel Salvage and Relocation

The KRRC will coordinate and implement a freshwater mussel salvage plan with freshwater mussel specialists. Based on the reconnaissance, a portion of the freshwater mussels located between Iron Gate Dam and Cottonwood Creek will be salvaged and relocated to reduce project effects to the freshwater mussel community. The freshwater mussel salvage and translocation effort is anticipated to require 10 days. The percentage of the existing mussel beds that will be salvaged and translocated is predicated on the available habitat in the Klamath River downstream from the Trinity River confluence, and between J.C. Boyle Dam and Copco Reservoir, and the abundance of mussels between Iron Gate Dam and Cottonwood Creek. Approximately 15,000 to 20,000 mussels are planned for translocation. During the course of these actions, it is not anticipated that the entire population of mussels residing below Iron Gate Dam will be recovered.

9.2 Summary of the Affected Species, Anticipated Project Benefits and Effects, Recent Literature, 2012 EIS/R AR-7, and Proposed Measure

The following sections review the components of the 2012 EIS/R AR-7, anticipated project effects and long-term benefits on freshwater mussels, and current freshwater mussel literature.

9.2.1 Affected Species

Species intended to be addressed in the 2012 EIS/R AR-7 include:

- Oregon floater *(Anodonta oregonensis)*
- California floater *(A. californiensis)*
- Western ridged mussel *(Gonidea angulata)*
- Western pearlshell mussel *(Margaritifera falcata)*

9.2.2 Anticipated Project Effects on Measure Species

Short-term effects of the Project (prolonged exposure to high suspended sediment levels and bedload movement) are predicted to be deleterious to freshwater mussels in the Hydroelectric Reach and in the lower Klamath River downstream from Iron Gate Dam (Reclamation and CDFG 2012). Substantial freshwater mussel population reductions are expected due to sediment effects and possibly low dissolved oxygen levels. The change in hydrological properties following project implementation may also disrupt the current distribution of freshwater mussels downstream from Iron Gate Dam (Davis et al. 2013). Table 9-1 includes the likely and worst-case effects on freshwater mussel species in the Klamath River.

Table 9-1 2012 EIS/R anticipated effects summary for freshwater mussels

Species	Life Stage	Likely Effects	Worst Effects
California Floater Oregon Floater Western Ridged Western Pearlshell	All	Substantial reduction in populations	Substantial reduction in populations

Source: USBR and CDFG 2012

The following sections include descriptions of anticipated effects to freshwater mussels based on information 2012 EIS/R (Reclamation and CDFG 2012; Vol. 1, pp. 3.3-173 to 3.3-175) as well as additional information from additional freshwater mussel studies, some of which were completed after the publication of the 2012 EIS/EIR.

Freshwater Mussels

Available studies have evaluated Klamath River Basin freshwater mussel age structure, growth rates, and size distribution (*G. angulata*; Tennant 2010); population distribution and habitat use (Krall 2010; Davis et al. 2013; May and Pryor 2015); and habitat associations (Westover 2010; Davis et al. 2013). Klamath River mussels are long lived (from 10 to more than 100 years, depending on species) and may not reach sexual maturity until 4 years of age or more. *Anodonta* species are found primarily downstream from Iron Gate Dam, and likely benefit from the stable hydrology and fine sediment deposits attributed to hydroregulation below the dam (Davis et al. 2013). *G. angulata* is the most abundant freshwater mussel in the Klamath River and the species is widely distributed between Iron Gate Dam and the Trinity River (Westover 2010;

Davis et al. 2013). *M. falcata* is the least abundant freshwater mussel found in the Klamath River and seems to be mostly found downstream from the confluence of the Salmon River (Westover 2010; Davis et al. 2013).

Freshwater mussel tolerance of high suspended sediment, low dissolved oxygen, and bedload deposition are not well understood. Vannote and Minshall (1982) evaluated freshwater mussels in an aggrading river system in Idaho and concluded that *G. angulata* appear to be better adapted for aggrading rivers based on siphon positions, shell morphology, and foot placement in the underlying substrate. *M. falcata* seemed to be less adapted for aggrading rivers due to a less developed siphon for filtering water. *M. falcata* also rarely burrow into substrate more than 25-40 percent of the valve length which may increase the mussel's susceptibility to scour (Vannote and Minshall 1982). *G. angulata* migrate vertically in the channel bed and are capable of maintaining position near the channel bed surface (Vannote and Minshall 1982). *M. falcata* are not known to migrate and are therefore more susceptible to sediment burial. *Anodonta* species are likewise susceptible to sediment scour and burial due to their thinner shells. Mussels that are dislodged from their normal vertical position and fall onto their sides may not regain the normal position and may perish (Vannote and Minshall 1982).

Mussels play important roles in aquatic ecosystems. Mussels influence water quality, nutrient cycling, and habitat and are also known as "ecosystem engineers" that actively modify their environment (Xerces Society 2009; Lopes-Lima et al. 2016; Lummer et al. 2016). They filter fine sediment and organic particles, create byproducts that are food items for macroinvertebrates, and comprise the greatest proportion of animal biomass in some waterbodies (Xerces Society 2009). In the Klamath River Basin, freshwater mussels filter and sequester toxins including toxigenic algae microsystins (Kann et al. 2010) and mercury (Bettaso and Goodman 2010). Filtration of waterborne toxins may result in bioaccumulation in freshwater mussels leading to human consumption risks (Bettaso and Goodman 2010; Kann et al. 2010).

The Project is anticipated to result in high suspended sediment levels and bedload deposition in the 8 miles of the Klamath River between Iron Gate Dam and Cottonwood Creek. Extremely poor water quality due to high suspended sediment concentrations is expected in the first 2 miles of the Klamath River downstream from Iron Gate Dam (Reclamation and CDFG 2012). Fine sediment effects on freshwater mussels include gill clogging, possible growth reduction, and impairment to mussel larval stages (Lummer et al. 2016). Due to both the anticipated deleterious high suspended sediment concentrations and low dissolved oxygen levels, freshwater mussels downstream from Iron Gate Dam may experience substantial mortality with the most significant impacts anticipated to mussels located immediately downstream from Iron Gate Dam.

Over the long-term, freshwater mussels are expected to benefit from the Project through the conversion of Hydroelectric Reach reservoirs to gravel bed rivers which will restore freshwater mussel habitat, reduce water quality and water temperature impairments related to the reservoirs, and restore access for anadromous and resident host fish species that will distribute freshwater mussel larvae throughout the Klamath River upstream from Iron Gate Dam. However, due to the long time freshwater mussels take to reach sexual maturity, the recolonization and/or growth of existing freshwater mussel populations upstream of Iron Gate Dam may be slow and may not be readily noticeable for some time.

9.2.3 2012 EIS/R AR-7

The 2012 EIS/R AR-1 (Vol. I, pp. 3.3-248 to 3.3-249) directed the salvage of freshwater mussels from the Hydroelectric Reach and downstream from Iron Gate Dam. Salvaged mussels were to be relocated to suitable instream habitat unaffected by high suspended sediment concentrations, or could be placed in temporary facilities and returned to the Klamath River following the Project. A salvage and relocation pilot study was also suggested to assess salvage feasibility and relocated mussel survival. Based on the pilot study results, a detailed salvage and relocation plan was to be developed.

9.2.4 KRRC's and the ATWG's Review of AR-7 for Feasibility and Appropriateness

The KRRC assessed the feasibility and appropriateness of AR-7 through multiple planning meetings held with the ATWG between May and August 2017. During these meetings, current information on Klamath River fisheries was presented and information on other dam removal projects conducted in the western United States was reviewed to understand how the aquatic ecosystem might respond, as discussed above. The ATWG's concerns regarding the 2012 AR-7 included:

- Unfamiliarity with successful freshwater mussel relocation efforts.
- Disease transmission concerns.

The following sections provide additional information regarding AR-7 feasibility and appropriateness, based on fisheries literature and ATWG input.

Unfamiliarity with Successful Freshwater Mussel Relocation Efforts

The ATWG was unfamiliar with successful freshwater mussel translocation efforts. Anecdotal information discussed during the ATWG planning meeting (Yreka, CA, May 23, 2017) alluded to low translocation success for the Elwha Dam Removal Project and highway construction projects. Additional information was acquired by the KRRC on the Elwha Dam Removal Project freshwater mussel (*M. falcata*) translocation. For that project, freshwater mussels were translocated to two sites and remained in one site prior to the dam removal project (P. Crain, U.S. Park Service, personal communication, 2017). The relocated freshwater mussels had high survival following the translocation and prior to the dam removals. Subsequent events that impacted the translocated mussels resulted in high mussel mortality. The events included raccoon predation due to shallow habitat at the first translocation site, and excessive sediment deposition at a side channel translocation site. The third monitored site was an artificial outfall channel from the water treatment facility that went dry due to inadvertent project operations. Mussels that remained in the Elwha River downstream from Elwha Dam are suspected to have experienced high mortality due to excessive sediment deposition following dam removal, followed by channel scour during the post-dam sediment sorting process.

Freshwater mussel translocation project monitoring results are not well represented in the fisheries literature. Unpublished freshwater mussel translocation monitoring manuscripts were reviewed to better

understand the range of potential translocation success. Fernandez (2013) described the translocation success of 265 individual *M. falcata* in coastal southwest Washington. Between 55 percent and 95 percent of the transplanted *M. falcata* were accounted for in the translocation sites between one and three years following the translocation.

A review of translocation projects found mean mortality of relocated mussels was 49 percent based on an average recovery rate of 43 percent (Cope and Waller 1995). Cope and Waller (1995) found that survival of relocated mussels was generally poor and the factors influencing the survival of relocated mussels were poorly understood. For mussel relocation to be successful, more consideration must be given to habitat characterization at both the source and translocation sites. Olden et al. (2010) and Germano et al. (2015) offer considerations for successful freshwater organism and wildlife translocation efforts, respectively Luzier and Miller (2009) offer suggestions and considerations for freshwater mussel translocations.

Disease Transmission Concerns

The role of freshwater mussels in freshwater disease transmission is not well understood. Freshwater mussels are known to provide habitat for polychaete worms, one of the hosts in the life *C. shasta*. Polychaetes have been infrequently collected from freshwater mussel shells in the Hydroelectric Reach of the Klamath River (PacifiCorp 2004). Mussels may serve as a vector for other fish pathogens like *Flavobacterium columnare* and *Ichthyophthirius multifiliis* that are endemic to the Klamath River Basin (K. Kwak, CDFW, personal communication 2017).

Freshwater mussels inhabit the Klamath River upstream from Iron Gate Dam (Byron and Tupen 2017) and in tributaries upstream (Byron and Tupen 2017) and downstream from Iron Gate Dam (Davis et al. 2013; Howard et al. 2015; May and Pryor 2015), disease transmission may be less of a concern.

9.3 Summary

The Project is anticipated to have significant short-term effects, but long-term benefits for freshwater mussels. The 2012 EIS/R AR-7 included a freshwater mussel salvage and relocation pilot study followed by an informed salvage and relocation plan prior to the Project. The proposed measure includes completing a reconnaissance of existing freshwater mussels from Iron Gate Dam to Cottonwood Creek and potential translocation habitat on the Klamath River downstream from the Trinity River confluence, and between J.C. Boyle Dam and Copco Reservoir. KRRC will salvage and relocate freshwater mussels prior to the reservoir drawdown. It is not anticipated that the entire population of mussels residing below Iron Gate Dam will be recovered.

Appendix C

Water Quality Supporting Technical Information

C.1 Water Temperature

C.1.1 Upper Klamath Basin

C.1.1.1 Keno Impoundment/Lake Ewauna

Water temperatures in much of the Upper Klamath River, including the reach from Link River Dam through the Keno Impoundment/Lake Ewauna, exceed 20°C (68°F) in June through August. The Keno Impoundment/Lake Ewauna experiences periods of intermittent, weak summertime stratification, however water temperatures are generally similar throughout the water column and are among the warmest in the Klamath Basin with peak values greater than 25°C (77°F). Weekly measurements in 2007 in the Link River and upper portion of the Keno Impoundment indicate maximum temperatures of 25ºC (77ºF) in mid-to-late summer (Deas and Vaughn 2006, Sullivan et al. 2008). Recorded average monthly temperatures for the period 2001 to 2004 in Keno Impoundment were 22.4ºC (72.3ºF) in July, 20.8ºC (69.4ºF) in August and 18.0ºC (64.4ºF) in September (FERC 2007). Average monthly temperatures reported by PacifiCorp downstream from Keno Dam for the same period were 23.2ºC (73.8ºF), 21.1ºC (70.0ºF), and 16.9ºC (62.4ºF) during July, August, and September, respectively (FERC 2007). Similarly, during 2009, summer water temperatures downstream from Keno Dam were generally greater than 16 °C (60.8 °F) from June through September, with peak temperatures exceeding 26 °C (78.8 °F) in late-July (Watercourse Engineering, Inc. 2011a).

C.1.1.2 Hydroelectric Reach

The Hydroelectric Reach spans the Oregon–California state line from J.C. Boyle to Iron Gate Dam. During summer months, maximum weekly maximum temperatures (MWMTs) in the Hydroelectric Reach regularly exceed the range of chronic effects temperature thresholds (13 to 20ºC [55.4 to 68ºF]) for full salmonid support (North Coast Regional Board 2010, Kirk et al. 2010, Asarian and Kann 2011).

In general, water temperatures in this reach follow a seasonal pattern, with average monthly water temperatures from March through November ranging from just over 5°C (41ºF) in November to more than 22°C (71.6°F) during June through August (FERC 2007). Winter water temperatures throughout the reach are largely driven by the temperature of river inflows (Deas and Orlob 1999). In the summer, the relatively shallow J.C. Boyle Reservoir does not exhibit long-term thermal stratification, with a typical vertical temperature difference of less than 2ºC (3.6ºF) in the water column (FERC 2007; Raymond 2008, 2009, 2010). In the Bypass Reach downstream from J.C. Boyle Dam, at approximately RM 225.8, water from cold groundwater springs enters the river at a relatively constant 11 to 12ºC (51.8 to 53.6ºF). During daily peaking operations at J.C. Boyle Powerhouse (RM 225.2), warmer reservoir discharges are diverted around this reach (see also Section 2.3.1 *J.C. Boyle Dam Development*), leaving the cold groundwater springs to dominate the river flow. Water temperatures in the Bypass Reach can decrease by 9–27°F when bypass operations are underway due to the influence of the springs (Kirk et al. 2010). Downstream in the Peaking Reach, the cooler, spring-influenced river mixes rapidly with the warmer water discharged from the J.C. Boyle Powerhouse that can exceed 25ºC (77ºF) in July and August (Kirk et al. 2010). In the Peaking Reach, downstream of the Bypass Reach, the flow diverted around the Bypass Reach rejoins the Klamath River (see Figure 2.3-1). At the upstream

end of the Peaking Reach, the natural, cold groundwater input into the Bypass Reach, combined with fluctuations in river flow due to hydroelectric power operations in the Peaking Reach also produces an observed increase in daily water temperature range above the natural diel water temperature fluctuations (Kirk et al. 2010).

Further downstream in the Peaking Reach, near the confluence of the Klamath River and Shovel Creek (Figure 2.2-3), there are natural hot springs that contribute flows to the mainstem river. The natural hot springs were not found to result in warming of the Klamath River based on two measurements made in November and December 2017. Water temperature data collected upstream and downstream of the confluence of the Klamath River and Shovel Creek showed a 1.4°F increase in the downstream direction during the November 2017 measurement, but a 0.2°F decrease during the December 2017 measurement (KRRC 2018).

Within and downstream from Copco No. 1 Reservoir, spring, summer and fall temperatures in the Hydroelectric Reach are heavily influenced by the large thermal mass of the two deepest reservoirs, Copco No. 1 and Iron Gate reservoirs, and their seasonal stratification patterns. Spring temperatures are generally cooler than would be expected under natural conditions, and summer and fall temperatures are generally warmer (PacifiCorp 2004a, North Coast Regional Board 2010). Both Iron Gate and Copco No. 1 reservoirs thermally stratify beginning in April/May and do not mix again until October to December (Figure C-1, Table C-1) (Raymond 2008, 2009, 2010; Asarian and Kann 2011). Water temperature data indicate thermal stratification in Copco No. 1 Reservoir begins about a month later and ends about a month earlier than stratification in Iron Gate Reservoir (Asarian and Kann 2011). The onset of spring/summer stratification and the timing of fall turnover in Iron Gate and Copco No. 1 Reservoirs are driven by meteorological conditions (Deas and Orlob 1999, Asarian and Kann 2011).

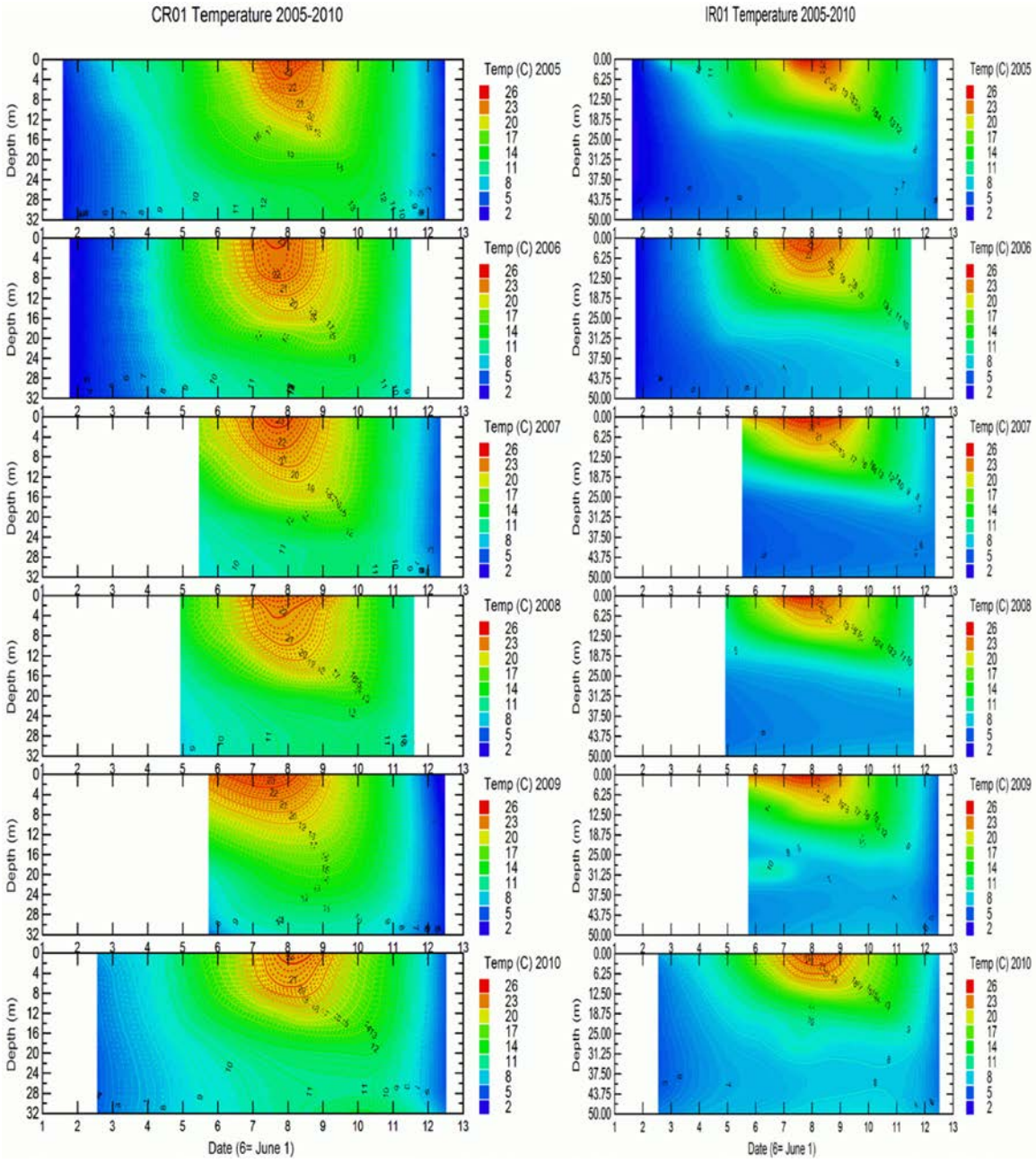

Figure C-1. Depth-time Distribution of Isopleths of Water Temperature at Station CR01 in Copco No. 1 Reservoir and IR01 in Iron Gate Reservoir from January 2005 to December 2010. Source: Asarian and Kann 2011.

Table C-1. General Reservoir Turnover Dates for Copco No. 1 and Iron Gate Reservoirs (2007 to 2009).

Year	Thermally Stable Hypolimnion Establishment Date		Approximate Reservoir Turnover Date		Source
	Copco	Iron Gate	Copco	Iron Gate	
2007	By June 6	By June 6	Before October 23	Before November 28	Raymond 2008
2008	By April 30	By April 30	Before October 22	Before November 19	Raymond 2009
2009	By May 24	By May 24	Before October 13	Before November 17	Raymond 2010

Powerhouse withdrawals for Copco No. 1 and Iron Gate dams are primarily from the epilimnion (surface water). The depth of the epilimnion changes over time based on the season and characteristics of each reservoir. The depth of the thermocline (metalimnion) separating the epilimnion (surface waters) from the hypolimnion (bottom waters) is approximately 50 feet below the water surface in both Copco No. 1 and Iron Gate reservoirs by mid-summer when thermal stratification is present in the reservoirs (FERC 2007). In Copco No. 1 Reservoir, powerhouse withdrawal is from approximately 9.8 m (32 ft) below the water surface when the reservoir is full (full pool) and in Iron Gate Reservoir powerhouse withdrawal is from approximately 10.7 m (35 ft) below the water surface when the reservoir is full (FERC 2007). Occasionally, withdrawals extend into the hypolimnion; for example, in Iron Gate Reservoir, the withdrawal envelope has been estimated to extend down to approximately 18 m (60 ft) in depth (Deas and Orlob 1999). Additionally, a small withdrawal (about 50 cfs) for the Iron Gate Hatchery occurs from the hypolimnion at Iron Gate Reservoir. In general, however, temperature in waters discharged from Copco No. 1 and Iron Gate reservoirs reflect the warmer temperatures of surface water (NRC 2003). Seasonal stratification of these two reservoirs also prevents mixing of waters within the water column and adversely affects dissolved oxygen concentrations, nutrient concentration (and speciation), and pH in bottom waters, limiting the potential for hypolimnetic cool water releases to the Mid- and Lower Klamath River (FERC 2007). The small relative volumes of the hypolimnions in Copco No. 1 and Iron Gate reservoirs also limit the potential for seasonal releases to decrease water temperatures in downstream river reaches. Since J.C. Boyle Reservoir does not exhibit long-term thermal stratification (i.e., it lacks a seasonal hypolimnion), there are no controllable actions that can be taken to cool water released from this waterbody (FERC 2007).

C.1.2 Mid- and Lower Klamath Basin

C.1.2.1 Iron Gate Dam to Salmon River

Water temperature in the Lower Klamath Basin varies seasonally, with mean monthly temperatures in the river downstream from Iron Gate Dam ranging from 3 to 6°C (37 to 43°F) in January to 20 to 22.5°C (68 to 72.5°F) in July and August (Bartholow 2005; Karuk Tribe of California 2009, 2010a, 2010b, 2011, 2012, 2013; Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015, 2016; Asarian and Kann 2013). Water temperature increases with distance downstream from Iron Gate Dam due

to meteorological controls (Basdekas and Deas 2007, Asarian and Kann 2013). Based upon annual water temperature monitoring conducted by the Karuk Tribe, water temperatures peak during the summer when air temperatures increase and flows decrease in the Klamath Basin (Figure C-2; Karuk Tribe of California 2002, 2003, 2007, 2009, 2010a, 2010b, 2011, 2012, 2013). Figures C-2, C-3, C-4, C-5, and C-6 show the range of annual variability in daily average water temperature at several Klamath River locations downstream of Iron Gate Dam from 2006 to 2013. Daily average summer water temperatures regularly exceed 20°C during summer months near Seiad Valley, while daily average values documented immediately downstream from Iron Gate Dam are generally cooler and less variable. Daily average temperatures between June and September are between 1 to 6°C (1.8 to 10.8°F) higher near Seiad Valley than those just downstream from Iron Gate Dam (Figure C-2 to C-6; Karuk Tribe of California 2009, 2010a, 2010b, 2011, 2012, 2013). Water temperature modeling in the Klamath River indicates releases from Iron Gate Dam do not affect mainstem water temperature by the Salmon River (RM 66.3) (PacifiCorp 2005, Dunsmoor and Huntington 2006, North Coast Regional Board 2010, Perry et al. 2011, Risley et al. 2012).

Water temperature trends under the 2013 BiOp flows are consistent with measured water temperature between 2001 and 2012 (Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015 2016; Asarian and Kann 2013). An average of water temperature data from 2001 to 2011 at locations along the Klamath River shows that daily mean and daily maximum water temperature peaked between July and August with a maximum temperature of approximately 24°C (Figure C-7; Asarian and Kann 2013). A comparison of water temperature and flow measured in 2009 (Figure C-8) and 2015 (Figure C-9) demonstrates that water temperature downstream of Iron Gate Dam in 2015 peaked in July under 2013 BiOp minimum flows of 900 cfs (NMFS and USFWS 2013, Watercourse Engineering, Inc. 2016), similar to the water temperature downstream of Iron Gate Dam in 2009 which peaked between July and August under 2002 Biological Opinion minimum flows of 1,000 cfs (NMFS 2002, Watercourse Engineering, Inc. 2010). Similar water temperature trends are also observed in the Klamath River at Seiad Valley (Figures C-8 and C-9).

With respect to the longer term water temperature record (i.e., prior to 2000), Bartholow (2005) presents evidence that water temperatures in the lower Klamath River have been increasing since before 1950. Bartholow (2005) indicates that the observed multi-decade trend of increasing water temperatures in the lower river is related to the cyclic Pacific Decadal Oscillation and is consistent with a measured average basin wide air temperature increase of 0.33°C/decade (0.59°F/decade). Bartholow (2005) estimates that the season of high temperatures that are potentially stressful to salmonids has lengthened by about 1 month in the Klamath River since the early 1960s, and the average length of the lower river exhibiting summer water temperatures less than 15°C (59°F) has declined by about 8.2 km/decade (5.1 mi/decade). Potential climate change effects on water temperature are discussed in more detail as part of the effects determination for the No Project Alternative (see Section 3.2.4.3).

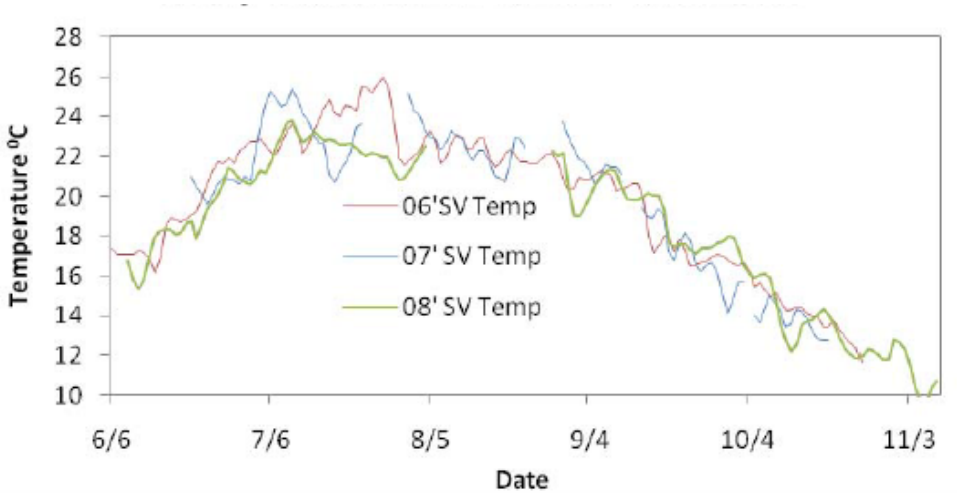

Figure C-2. Daily Average Water Temperature in the Klamath River near Seiad Valley (RM 132.7) June through November 2006, 2007, and 2008. Source: Karuk Tribe of California 2009.

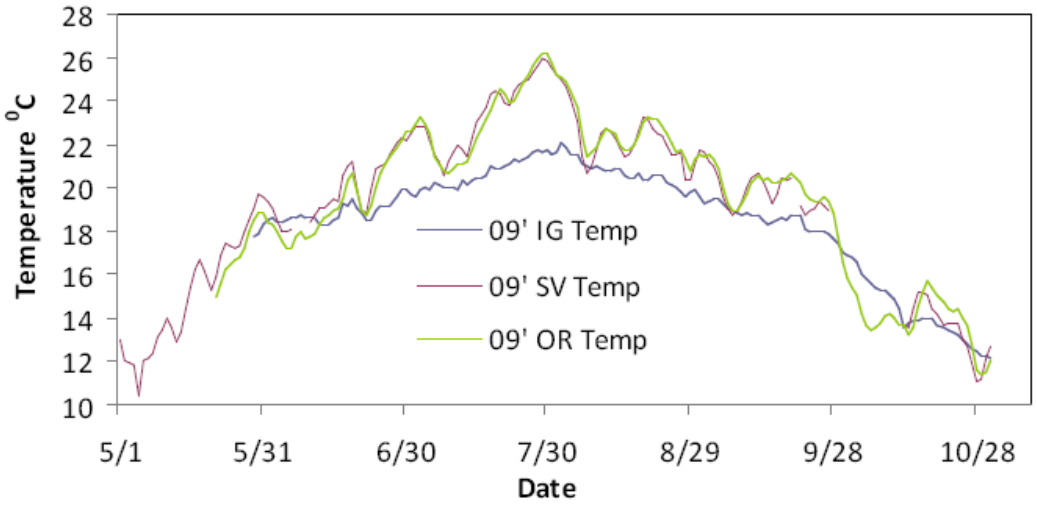

Figure C-3. Daily Average Water Temperature in the Klamath River Downstream from Iron Gate Dam (≈RM 193.1), near Seiad Valley (RM 132.7) and at Orleans (RM 58.9) During May through October 2009. Source: Karuk Tribe of California 2010a.

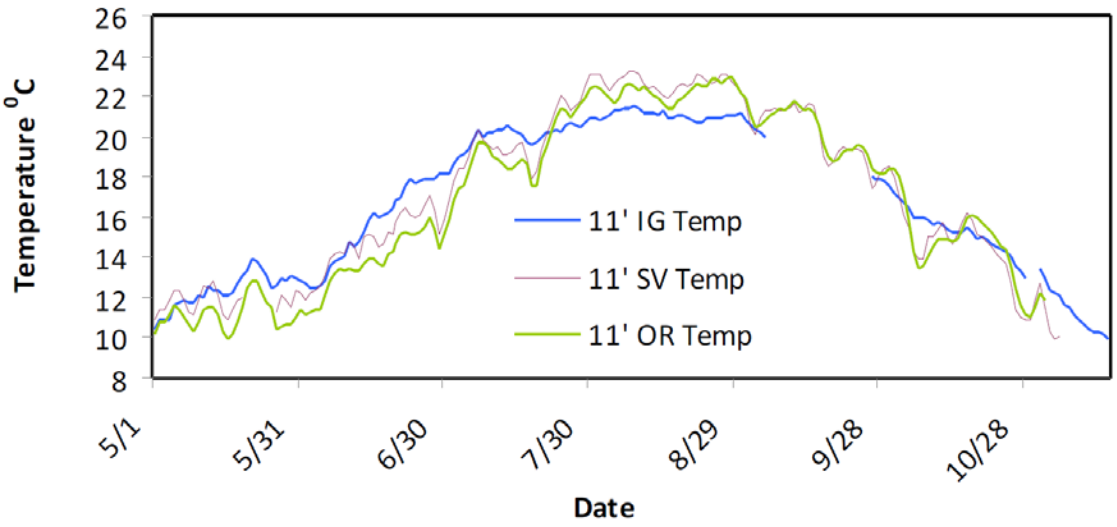

Figure C-4. Daily Average Water Temperature in the Klamath River Downstream from Iron Gate Dam (≈RM 193.1), near Seiad Valley (RM 132.7) and at Orleans (RM 58.9) During May through November 2011. Source: Karuk Tribe of California 2011.

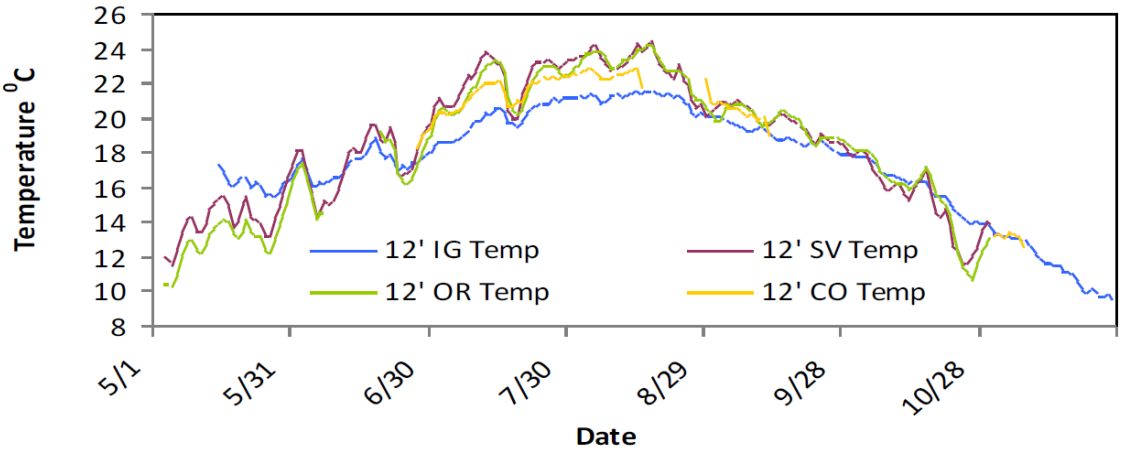

Figure C-5. Daily Average Water Temperature in the Klamath River Downstream from Iron Gate Dam (≈RM 193.1), near Colliers Rest Area/I-5 Bridge upstream of the Shasta River confluence (≈RM 179.5), near Seiad Valley (RM 132.7) and at Orleans (RM 58.9) During May through November 2012. Source: Karuk Tribe of California 2012.

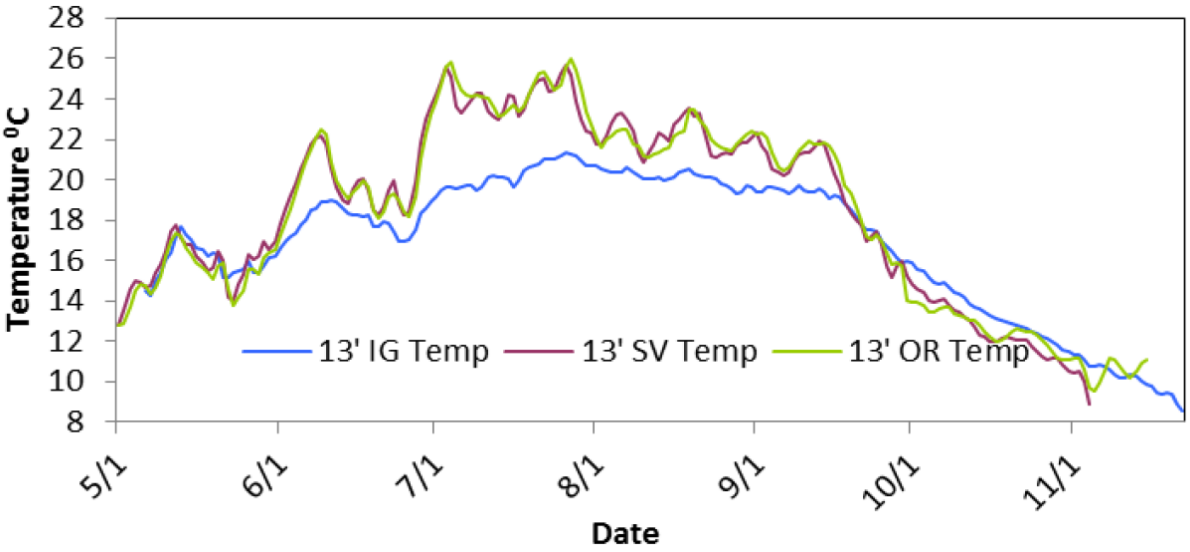

Figure C-6. Daily Average Water Temperature in the Klamath River Downstream from Iron Gate Dam (≈RM 193.1), near Seiad Valley (RM 132.7) and at Orleans (RM 58.9) During May through November 2013. Source: Karuk Tribe of California 2013.

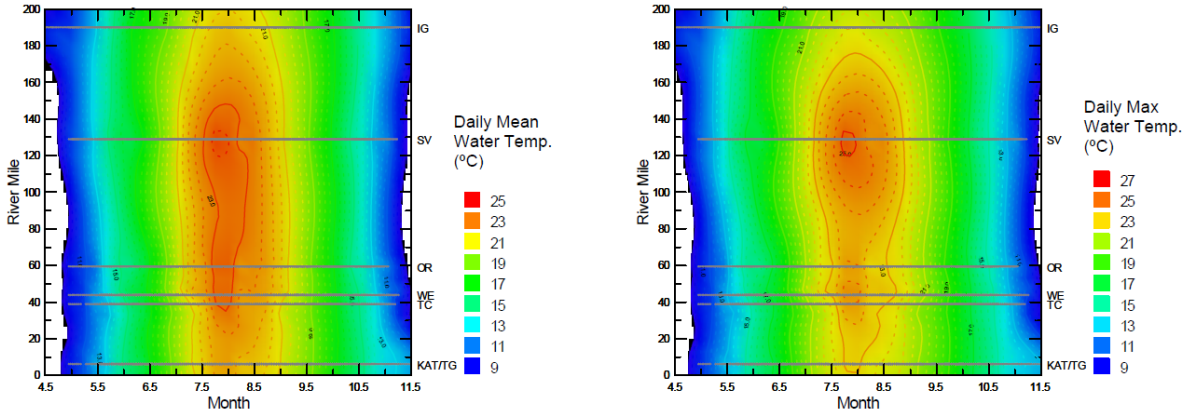

Figure C-7. Daily Mean and Daily Maximum Water Temperature in the Klamath River Downstream from Iron Gate Dam (≈RM 193.1) to the Klamath River at Turwar (≈RM 5.6) Averaged from 2001 to 2011 Data. Horizontal Grey Lines Indicate the Location and Time Period of Measurement in the Klamath River at Iron Gate (IG), Seiad Valley (SV), Orleans (OR), Weitchpec Upstream of the Trinity River (WE), Upstream of Tully Creek (TC), and Turwar (KAT/TG). Source: Asarian and Kann 2013.

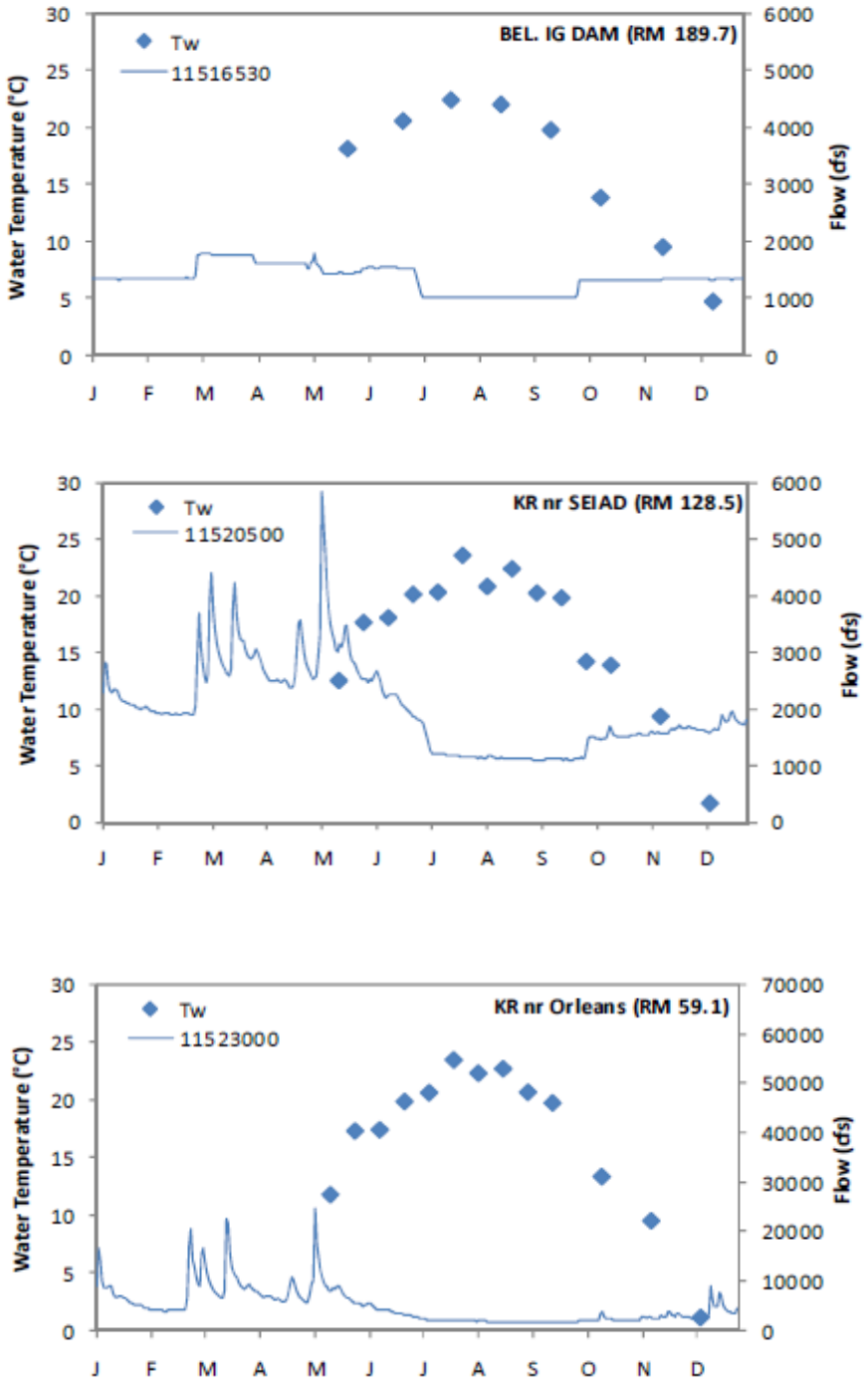

Figure C-8. Klamath River Water Temperature in 2009 During Monthly Water Quality Grab Samples and Flow at USGS Gage Stations (Station Number Listed in the Legend). Source: Watercourse Engineering, Inc. 2011a.

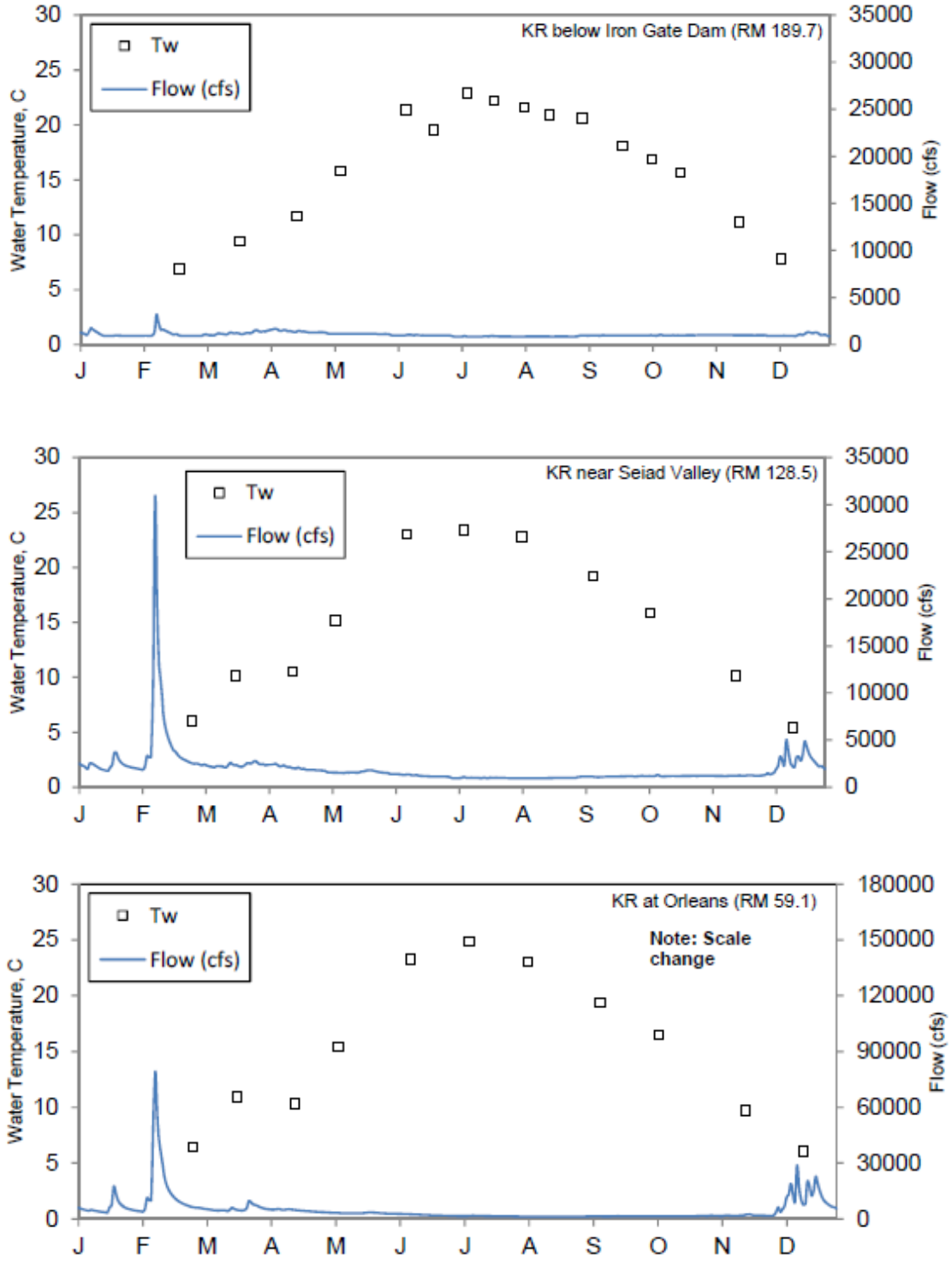

Figure C-9. Klamath River Water Temperature in 2015 During Monthly Water Quality Grab Samples and Flow at USGS Gage Stations. Source: Watercourse Engineering, Inc. 2016.

C.1.2.2 Salmon River to Estuary

Water temperature monitoring by the Karuk Tribe includes data from Orleans (RM 58.9), which is just downstream from the Salmon River confluence with the mainstem Klamath River. Daily average water temperature at Orleans was 10.5 to 26°C (50.9 to 78.8ºF) from June through November 2006 to 2008, with the warmest temperatures generally occurring during July (Figure C-10; Karuk Tribe of California 2009). More contemporary data from 2009 to 2015 (Figures C-3 to C-9) further support these water temperature trends at Orleans (Karuk Tribe of California 2009, 2010a, 2010b, 2011, 2012, 2013; Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015, 2016; Asarian and Kann 2013). Asarian and Kann (2013) reports that average daily maximum water temperature between 2001 and 2011 is approximately 23°C to 24°C between July and August from the Salmon River (RM 66.3) to Turwar Creek (RM 5.6) (Figure C-7).

In the mainstem river between the Klamath River's confluence with the Trinity River and the Klamath River Estuary, the Yurok Tribe, through the Yurok Tribe Environmental Program (YTEP), has conducted annual water temperature monitoring since 2002 (YTEP 2004; Sinnott 2010a, 2011a, 2012a; Hanington 2013; Hanington and Ellien 2013). Between 2009 and 2013, peak temperatures generally occur in mid-July to mid-August with the highest daily maximum temperatures recorded at the most upstream locations (Sinnott 2010a, 2011a, 2012a; Hanington 2013; Hanington and Ellien 2013). The effect of the Trinity River on the mainstem Klamath River water temperature varied within individual years and between years. A small (0.5°C [0.9°F] or less) cooling effect was usually observed from the contribution of the Trinity River to the mainstem Klamath River between 2009 and 2011, but inflows from the Trinity River caused a 0.5°C (0.9°F) or less warming effect between mid-May and late June during 2010 and 2011 (Sinnott 2010a, 2011a, 2012a). During 2012 and 2013, inflows from the Trinity River usually altered water temperature in the Klamath River by 0.5°C (0.9°F) or less, but from mid-August to late September inflow from the Trinity River cooled Klamath River water temperature on average by approximately 1°C (Hanington 2013, Hanington and Ellien 2013). During May through November 2009, water temperatures ranged from approximately 11.1°C (52.0°F) in October to 26.8°C (80.2°F) in July (Sinnott 2010a). Similar trends were measured during 2013 with the lowest water temperature of 12.4°C (54.2°F) occurring in October while the highest water temperature of 26.4°C (79.4°F) occurred in July (Hanington and Ellien 2013). Between 2009 and 2013, the daily maximum summer water temperatures ranged from approximately 23.8 to 26.9°C (74.8 to 80.4°F) just upstream of the confluence with the Trinity River (Weitchpec [RM 43.3]), decreasing to approximately 23.4 to 24.9°C (74.1 to 76.8°F) near Turwar Creek (RM 5.6) (YTEP 2005; Sinnott 2010a, 2011a, 2012a; Hanington 2013; Hanington and Ellien 2013). Figure C-11 shows the upper range of the daily maximum water temperature which occurred in 2009, while Figure C-12 shows the lower range of the daily maximum water temperature which occurred in 2011 (Sinnott 2010a, 2012a). These summer temperatures exceed optimal growth thresholds as well as critical thermal maxima for coho, Chinook salmon, and steelhead (Brett 1952, Armour 1991, Stein et al. 1972, McGeer et al. 1991). Historically, summer water temperature maxima in the lower Klamath River have been greater than in other coastal rivers to the north and south. For example, Blakey (1966, as cited in Bartholow 2005), reports water temperatures in the Klamath River downstream from the Trinity River confluence (RM 43.3) reaching 26.6°C (79.9°F) for up to 10 days per year, in contrast to proximal coastal rivers that never reach this temperature.

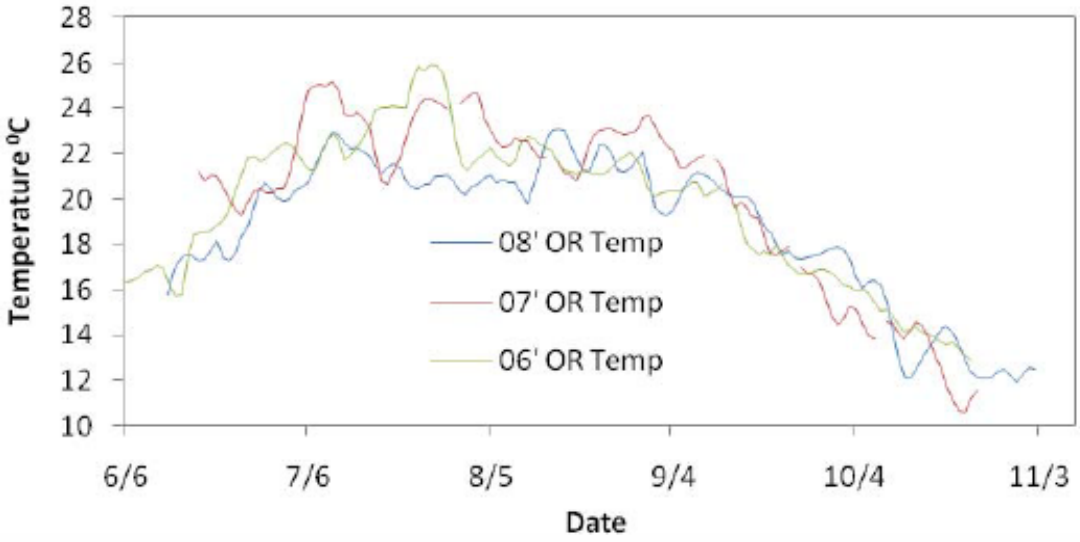

Figure C-10. Daily Average Water Temperature in the Klamath River at Orleans (RM 58.9) June through November 2006, 2007, and 2008. Source: Karuk Tribe of California 2009.

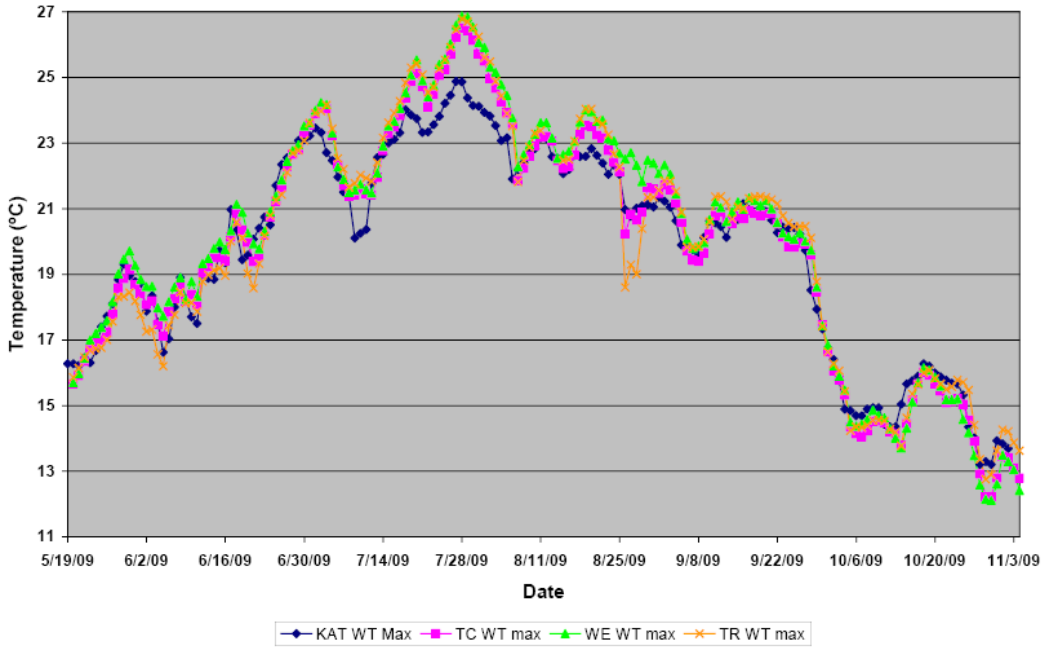

Figure C-11. Daily Maximum Water Temperatures in the Klamath River at Weitchpec (RM 43.6 [WE]), Upstream of Tully Creek (RM 40.1 [TC]), and Upstream of Turwar Boat Ramp (RM 6 [KAT]), as well as in the Trinity River (RM 43.3) near the Confluence with the Klamath River (RM 0.5 [TR]) May through November 2009. Source: Sinnott 2010a.

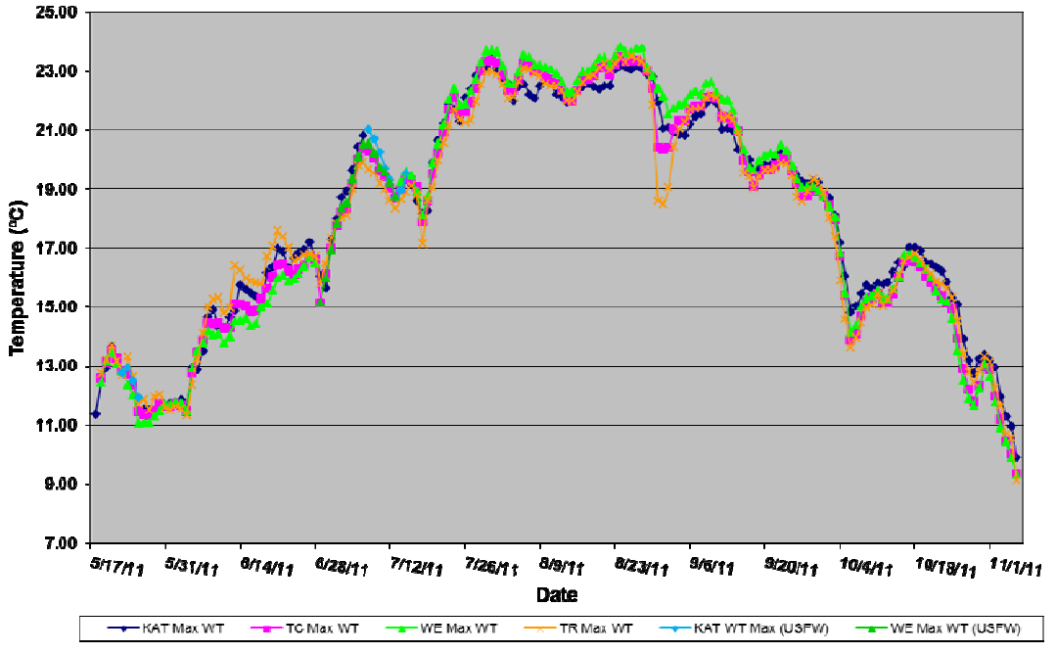

Figure C-12. Daily Maximum Water Temperatures in the Klamath River at Weitchpec (RM 43.6 [WE]), Upstream of Tully Creek (RM 40.1 [TC]), and Upstream of Turwar Boat Ramp (RM 6 [KAT]), well as in the Trinity River (RM 43.3) near the Confluence with the Klamath River (RM 0.5 [TR]), at Upstream of Turwar Boat Ramp from the U. S. Fish and Wildlife (RM 6 [KAT (USFW)]), and at Weitchpec from U. S. Fish and Wildlife (RM 43.6 [WE (USFW)]) May through November 2011. Source: Sinnott 2012a.

C.1.2.3 Klamath River Estuary

Hydrodynamics and water quality within the Klamath River Estuary are highly variable spatially and temporally and are greatly influenced by season, river flow, vertical water column stratification (thermal and/or chemical), and location of the estuary mouth, the latter changing due to periodic sand bar movement. Input of cool ocean water and fog along the coast minimizes extreme water temperatures much of the time (Scheiff and Zedonis 2011). Water temperature has been monitored in the Klamath River Estuary by California Department of Fish and Game (Wallace 1998) and most recently by the Yurok Tribe Fisheries Program (Hiner 2006) and the YTEP (2005), with support from the North Coast Regional Board. Water temperatures in the Klamath River Estuary from December through April are roughly 5 to 12°C (41 to 54°F) (Hiner 2006). In summer and fall months, warmer air temperatures and lower flows result in increased water temperatures. Under low-flow summertime conditions, water temperatures in the Klamath River Estuary have been observed at 20 to 24°C (68 to 75.2°F) (Wallace 1998) or greater than 24°C (75.2°F) (Hiner 2006). During June to September from 2009 to 2015, water temperatures during water quality grab samples ranged from approximately 13.1 to 21.9°C (55.6 to 71.4°F) (Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015, 2016). These levels exceed optimal growth thresholds for salmonids, as cited in the previous section.

Estuarine water temperature is linked to upstream hydrology and periods of mouth closure because when the estuary mouth is open, denser salt water from the ocean sinks below the less dense fresh river water, resulting in chemical stratification and a "salt wedge" that moves up and down the estuary with the daily tides (Horne and Goldman 1994, Wallace 1998, Hiner 2006). The salt wedge is also thermally stratified with cooler, higher salinity ocean waters remaining near the estuary bottom, and warmer, lower salinity river water near the surface. Upstream hydrology can affect the location of the salt water wedge and thus, affect thermal structure in the Klamath River Estuary. For example, during pulse flows released from the Lewiston Dam on the Trinity River in August 2004, the upstream extent of the salt wedge moved downstream approximately one mile (YTEP 2005). In the Klamath River Estuary, mouth closure has been reported to reduce the size of the salt water wedge, decrease overall salinity, and subsequently increase water temperatures in the Klamath River Estuary (Hiner 2006). Mouth closure, caused by formation of a sand berm across the mouth of the Klamath River Estuary, is a function of off-shore and alongshore wave power and sediment supply, freshwater inflows, the tidal prism, and morphological characteristics of the inlet (Escoffier 1940, Brunn 1966, O'Brien 1971, Barnes 1980). The historical frequency and duration of mouth closure in the Klamath River Estuary has not been documented, although it is expected to occur during low-flow periods (June to October).

C.2 Suspended Sediments

For the purposes of the Lower Klamath Project EIR, "suspended sediments" refer to settleable suspended material in the water column. Bed materials, such as gravels and larger substrates, are discussed in Section 3.11.2.4 *Sediment Load*. Two types of suspended sediments are considered for the analysis in the Lower Klamath Project EIR: algal-derived (organic) suspended material and mineral (inorganic) suspended material. Sources of each type of suspended material differ, as do spatial and temporal trends for each within the Upper, Mid-, and Lower Klamath Basins.

Suspended sediments in the water column are quantified using different methods, depending on the study. Two standard methods widely used for determining the amount of suspended sediments in water are Method D 3977-97, which reports suspended sediments as suspended sediment concentrations (SSCs), and Method 2450 D, which reports the suspended sediments as total suspended solids (TSS) (Gray et al. 2000). While data produced by the SSC method are more representative of natural suspended sediments, SCC is considered equivalent to TSS for this report. As needed, data from multiple sources, reported as either TSS or SSC, are used interchangeably for the Lower Klamath Project EIR, despite potential differences in the numeric values reported by each method (Gray et al. 2000).

Turbidity, an optical property referring to the amount of light scattered or absorbed by a fluid, is another common way to quantify suspended sediments and is measured in nephelometric turbidity units (NTUs). The exact relationship between turbidity and suspended sediment is dependent on the parent geology and must be determined for each watershed (Montgomery 1985; MacDonald et al. 1991). High suspended sediments in the water column affect organisms directly (e.g., interfering with vision) or indirectly by changing water temperature (e.g., suspended sediment particles absorb heat from sunlight) and reducing dissolved oxygen (DO) concentrations by scattering light and reducing photosynthetic activity. Suspended sediments are also a water quality

concern because they are often associated with storing contaminants from the water column (e.g., polar organics and cationic metal forms). Municipal and domestic water supply beneficial uses can also be adversely affected by changes in suspended sediment concentrations and turbidity in streams.

For the Klamath River, coincident turbidity data is occasionally presented along with TSS data. However, as the dataset is not consistent in space or time, turbidity levels are not used to support significance determinations (see Section 3.2.4 *Impact Analysis Approach*) and are not analyzed in detail in the Lower Klamath Project EIR.

C.2.1 Upper Klamath Basin

C.2.1.1 Hydroelectric Reach

Suspended sediment generally decreases through the Hydroelectric Reach as suspended sediment from upstream is intercepted, decomposed, retained, or diluted between the J.C. Boyle and Copco No. 1 reservoirs. Organic suspended sediment originating from Upper Klamath Lake is the predominant form of suspended sediment entering the Hydroelectric Reach from upstream and affecting water quality (PacifiCorp 2004a, Deas and Vaughn 2006, Watercourse Engineering, Inc. 2011). During the winter and spring (November through April), the reservoirs at the Lower Klamath Project intercept and retain inorganic suspended sediment delivered from tributaries (e.g., Shovel Creek, Fall Creek, Jenny Creek) to the reservoirs, where peak concentrations occur in association with high-flow events. While this may be somewhat beneficial for downstream reaches by decreasing suspended sediment concentrations and turbidity, the interception of inorganic sediments by the reservoirs does not appear to be an important mechanism related to sediment delivery in the mainstem Klamath River. This is because a relatively small (3.4 percent) fraction of total inorganic sediment supplied to the Klamath River on an annual basis originates from the upper and middle Klamath River (i.e., from Keno Dam to the Shasta River) (Stillwater Sciences 2010) and beneficial uses in the upper Klamath River are currently not impaired due to inorganic suspended material (see Section 3.2, Table 3.2-8).

During the phytoplankton[1] growth season (May through October), organic suspended sediments exhibit a general decreasing trend from upstream to downstream in the Hydroelectric Reach, although the relative decrease through this reach is less than that occurring further upstream where phytoplankton blooms (also called algal blooms) originating in Upper Klamath Lake largely settle out of the water column (Figure C-13; PacifiCorp 2004a; Raymond 2008, 2009, 2010). The most significant decrease (approximately 50 percent) in organic suspended sediments (as TSS) typically occurs between the mouth of Link River and Keno Dam. Further decreases in concentrations of organic suspended sediments can occur in the upstream end of the Hydroelectric Reach, which may be due to the mechanical breakdown of phytoplankton remains and sorting of progressively smaller sizes of natural organic matter (NOM) in the turbulent river reaches between J.C. Boyle Dam and Copco No. 1 Reservoir, as well as by dilution from the springs immediately downstream from J.C. Boyle Dam. By the upstream end of Copco No. 1 Reservoir, average TSS concentrations are approximately 70 percent lower

[1] Microscopic organisms, including algae, bacteria, protists, and other single-celled plants, that float in the water column of fresh and salt waters and obtain energy from photosynthesis.

than those measured at the mouth of Link River (Figure C-13; PacifiCorp 2004a; Raymond 2008, 2009, 2010).

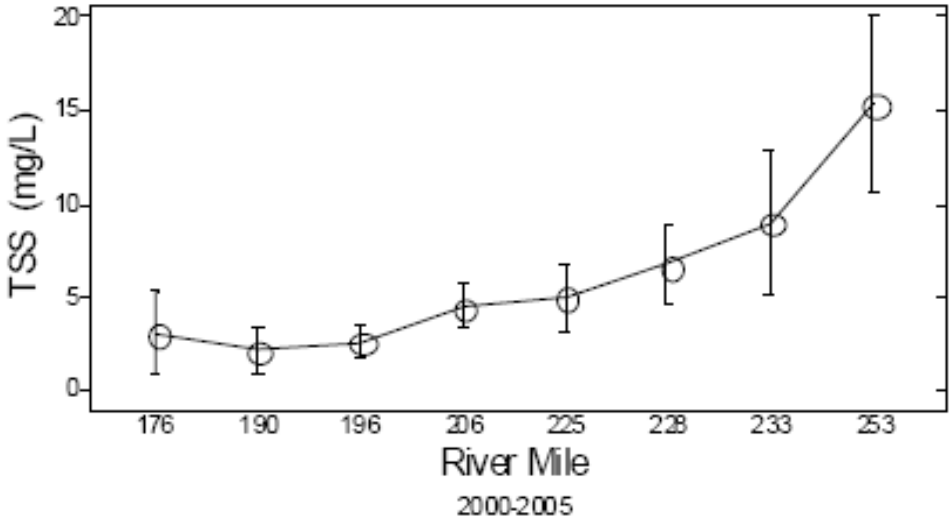

Figure C-13. Mean May to October Total Suspended Solids (TSS) Values for Data Collected from Various Sites in the Klamath River Between 2000 and 2005. Error bars depict 90 percent confidence interval of the mean. The location of features in the graph are specified using 2008 river mile designations, which are slightly different from updated 2018 river miles (see Table 3.2-1). The location of key landmarks in 2008 river mile designations: RM 176 = Klamath River at I-5 crossing; RM 190 = Klamath River downstream of Iron Gate Dam; RM 196 = Klamath River downstream of Copco No. 2 Powerhouse; RM 206 = Klamath River upstream of Copco No. 1 Reservoir; RM 220 = Klamath River downstream of J.C. Boyle Powerhouse; RM 225 = Klamath River downstream of J.C. Boyle Dam; RM 228 = Klamath River upstream of J.C. Boyle Reservoir; RM 233 = Klamath River downstream of Keno Dam; RM 253 = mouth of Link River. Source: Raymond 2008.

Despite the mechanisms supporting decreased longitudinal concentrations of organic suspended sediments in the riverine portions of the Hydroelectric Reach, concentrations in this reach can also increase due to large seasonal phytoplankton blooms occurring in Copco No. 1 and Iron Gate reservoirs. TSS values in Copco No. 1 Reservoir during the phytoplankton growth season (May through October) typically range less than 2 to 20 mg/L and those in Iron Gate Reservoir range less than 2 to 14 mg/L, although intense phytoplankton blooms can result in TSS levels greater than 20 mg/L (Raymond 2008, 2009, 2010). During 2003 sampling by PacifiCorp, a particularly high TSS measurement of 280 mg/L was recorded in the epilimnion of Copco No. 1 Reservoir during May. Simultaneous measurements of suspended sediments measured in the outflow to the reservoir indicated only 4.8 mg/L TSS (FERC 2007), suggesting that the suspended sediment source (phytoplankton cells) had largely settled out of the water column within the reservoir. Since powerhouse withdrawals for Copco No. 1 and Iron Gate dams are from depths of approximately 9.8 m (32 ft) to 10.7 m (35 ft) below the water surface when the reservoirs are full (Section C.1.1.1), only portions of the extensive phytoplankton blooms positioned closer to the water surface may be transported to the downstream Klamath River. During 2009 water quality monitoring, TSS measured in

J.C. Boyle Reservoir ranged less than 2 to 6.8 mg/L from May through November. Levels in Copco No. 1 and Iron Gate reservoirs levels were somewhat greater, with TSS ranging less than 2 to 9.6 mg/L in Copco No. 1 Reservoir (peak in August) and less than 2 to 7.2 mg/L in Iron Gate Reservoir (peak in May) (Watercourse Engineering, Inc. 2011a). Additional water quality monitoring has been conducted from 2010 to 2015 with TSS data from May through October that generally supports previous findings that TSS in Copco No. 1 Reservoir was higher than TSS in Iron Gate Reservoir. TSS in Copco No. 1 Reservoir from 2010 to 2015 usually ranged from the lower reporting limit (0.5 to 5 mg/L) to 17.6 mg/L, with peak TSS measured at 140 mg/L in 2013 and 72.4 mg/L in 2015. TSS in Iron Gate Reservoir from 2010 to 2015 usually ranged from the lower reporting limit (0.5 to 5 mg/L) to 9.2 mg/L, with a peak TSS of 37.6 mg/L measured in 2014 (Watercourse Engineering, Inc. 2011b, 2012, 2013, 2014, 2015, 2016).

There are currently 13.1 million cubic yards of sediment deposits stored within J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate reservoirs (USBR 2012) (see also Table 2.8). Prior estimates of the sediment deposits were 14.5 million cubic yards (Eilers and Gubala 2003) and 20.4 million cubic yards (GEC 2006). Sediment texture analysis results of the current reservoir deposits indicate that the deposits are composed of predominantly fine material (i.e., silt and clay less than 0.0625 mm [GEC 2006]; see also Section 3.11) with 3 to 5 percent of the accumulated material as organic carbon, corroborating interpretation of longitudinal suspended sediment patterns and indicating that in-reservoir and upstream phytoplankton growth is largely intercepted and retained in reservoir sediments in the Hydroelectric Reach.

C.2.2 Mid- and Lower Klamath Basin

C.2.2.1 Iron Gate Dam to Salmon River

Immediately downstream from Iron Gate Dam (RM 193.1), inorganic suspended sediment tend to increase with distance downstream from the dam during winter months. Two of the three tributaries that contribute the largest amount of sediment to the Klamath River on an annual basis are in this reach. The Scott River, which enters the mainstem Klamath River at RM 145.1, contributes 607,300 tons per year of suspended sediment or 10 percent of the cumulative average annual delivery from the basin. The Salmon River (RM 66.3) contributes 320,600 tons per year or 5.5 percent of the cumulative average annual delivery from the basin (Stillwater Sciences 2010).

During the phytoplankton growth season (May to October), suspended sediments immediately downstream from Iron Gate Dam are relatively lower than upstream locations, with generally low (less than 5 to 8 mg/L) concentrations for 2000 to 2005 (PacifiCorp 2004a; Raymond 2008, 2009, 2010) (Figure C-13). Between Iron Gate Dam and Seiad Valley (RM 132.7), suspended sediments can increase; for example TSS concentrations near the Shasta River confluence (RM 179.5) for the period 2000 to 2005 were roughly 1 mg/L greater than those measured further upstream at Iron Gate Dam (Figure C-13), and during 2009 monitoring, TSS ranged 0.87 to 4.4 mg/L downstream from Iron Gate Dam (RM 193.1), increasing to 2.5 to 11.5 mg/L downstream from Seiad Valley (RM 132.7) (Watercourse Engineering, Inc. 2011a)[2]. Additional TSS monitoring in the Klamath River was conducted from 2010 to 2015 with TSS in 2015 ranging from 0.8 to 3.8 mg/L downstream of Iron Gate Dam to 4.2 to 155.0 mg/L downstream of Seiad

[2] This data set includes measurements in November and December 2009 as well.

Valley (Watercourse Engineering, Inc. 2011b, 2012, 2013, 2014, 2015, 2016). In 2015, TSS in the Klamath River downstream of Seiad Valley peaked at 155.0 mg/L in July, but otherwise did not exceed 13.0 mg/L between May and October (Watercourse Engineering, Inc. 2016). The pattern of suspended sediments increasing in the Klamath River downstream from Seiad Valley compared to downstream of Iron Gate Dam may be related to the transport of some portion of the in-reservoir phytoplankton blooms to downstream reaches of Klamath River. River bed scour may also cause resuspension of previously settled materials and increases in summer and fall TSS from 0 to 20 miles downstream from Iron Gate Dam (Figure C-14). Farther downstream, near the confluence with the Scott River (RM 145.1 or approximately 47 miles downstream from Iron Gate Dam) concentration of suspended sediments tend to decrease with distance as suspended sediment gradually settle out of the water column or are diluted by tributary inputs (Armstrong and Ward 2008). Chlorophyll-*a* data show a similar trend (see Section C.6.2.1).

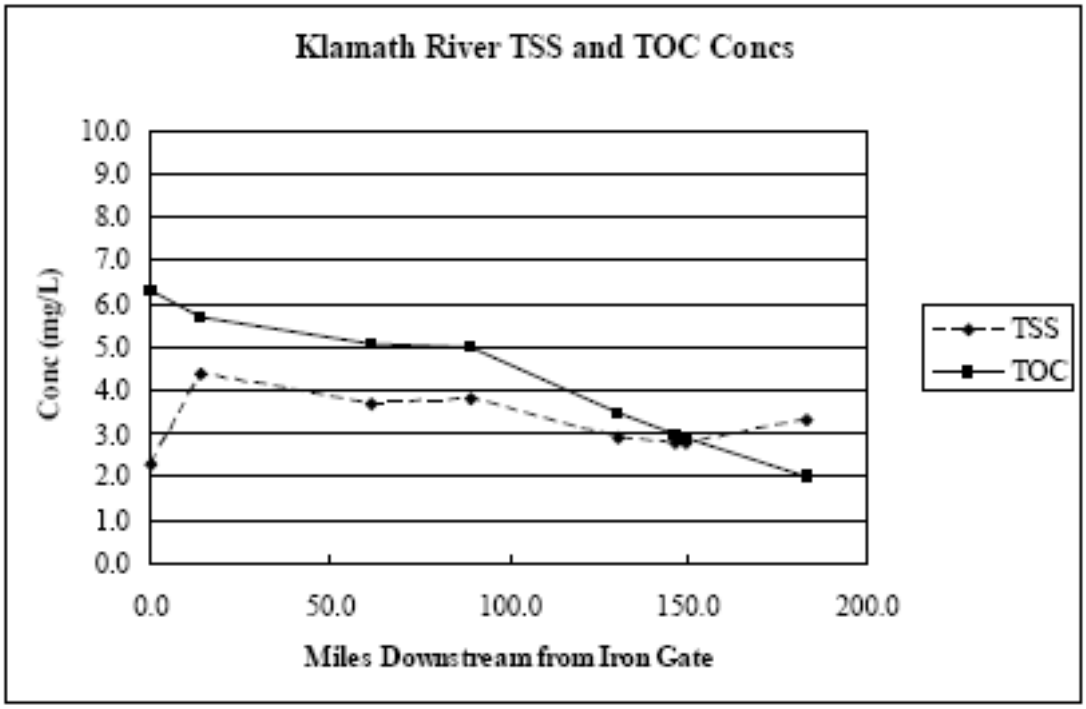

Figure C-14. Average TSS and Total Organic Carbon in the Klamath River Downstream from Iron Gate Dam during June to October 2001 to 2005. River Miles Specified Are Based on the River Miles Designations Used in 2008 and Differ Slightly from 2018 River Mile Designations. Source: Armstrong and Ward 2008.

C.2.2.2 Salmon River to Klamath River Estuary

As in other reaches of the Klamath River, seasonal variation in turbidity and suspended sediments is evident in the Klamath River from the Salmon River (RM 66.3) to the Klamath River Estuary (RM 0 to 3.9), with peak summer turbidity values associated with organic matter (i.e., algal blooms) and peak spring and winter turbidity values associated with inorganic sediments that are mobilized during high flow events (Stillwater Sciences 2009).

Historical (1950 to 1979) suspended sediment data (in SCC) for the Klamath River at Orleans (RM 58.9) (USGS gage no.11523000) range from less than 5 mg/L during summer (low-flow) periods to greater than 5,000 mg/L during winter (high-flow) periods, although some high (>1,000 mg/L) suspended sediment events have occurred during summer months (e.g., 1974, see Figure C-15). During the winter periods, elevated suspended sediment levels are typically associated with storm events and high flows, lasting on the order of days to weeks. More recent data indicate that suspended material levels in the lower Klamath River from the Salmon River confluence (RM 66.3) to the Estuary (RM 0 to 3.9) can be similar to those measured in the upstream reach from Iron Gate Dam to the Salmon River (RM 66.3). During 2009 monitoring, TSS values measured at Orleans were generally 1.1 to 13.3 mg/L between May and December, with peak values (approximately 56 mg/L) occurring during October (Watercourse Engineering, Inc. 2011a). TSS measured at Orleans from 2010 to 2015 had similar trends with TSS usually between 1.2 to 17 mg/L, but TSS occasionally peaking anywhere from 71 mg/L in August 2014 up to 437 mg/L in June 2010 (Watercourse Engineering, Inc. 2011b, 2012, 2013, 2014, 2015, 2016).

Results from grab samples collected by the Yurok Tribe Environmental Program during the period 2003 to 2004 indicate that TSS ranged less than 1.0 to 3.2 mg/L upstream of the Trinity River (RM 43.3) and less than 1.0 to 14.0 farther downstream at Turwar (RM 5.6), with the peak value (14.0 mg/L) occurring in December 2003 (YTEP 2005). However, the majority of the grab samples were collected from June to September and only two grab samples were collected in December and January. The data exhibit similar values for 2007, with the highest TSS (up to 16.0 mg/L) observed at Turwar in September of that year (Fetcho 2008). Additional water quality monitoring has been conducted by the Hoopa Valley Tribal Environmental Protection Agency (HVTEPA) from 2008 to 2012 and the Yurok Tribe Environmental Program from 2006 to 2014 with TSS at sites from upstream of the confluence with the Trinity River to the Klamath River Estuary (Sinnott 2008, 2009a, 2009b, 2010b, 2011b, 2012b; Hanington and Torso 2013; HVTEPA 2013; Hanington and Stawasz 2014; Hanington and Cooper-Carouseli 2014). Between 2008 and 2012, TSS in the Klamath River at Saints Rest Bar (RM 44.9) ranged from 1.0 to 15 mg/L, with TSS reaching a peak of 33.0 mg/L in October 2009. In 2014, TSS in the Klamath River at Weitchpec, upstream from the Trinity River (RM 43.6), ranged from 1 to 12 mg/L while TSS in the Klamath River at the Turwar Boat Ramp (RM 6) ranged 1 to 20 mg/L with the peak values occurring in February at Weitchpec and December at the Turwar Boat Ramp (Figure C-16; Hanington and Cooper-Carouseli 2014).

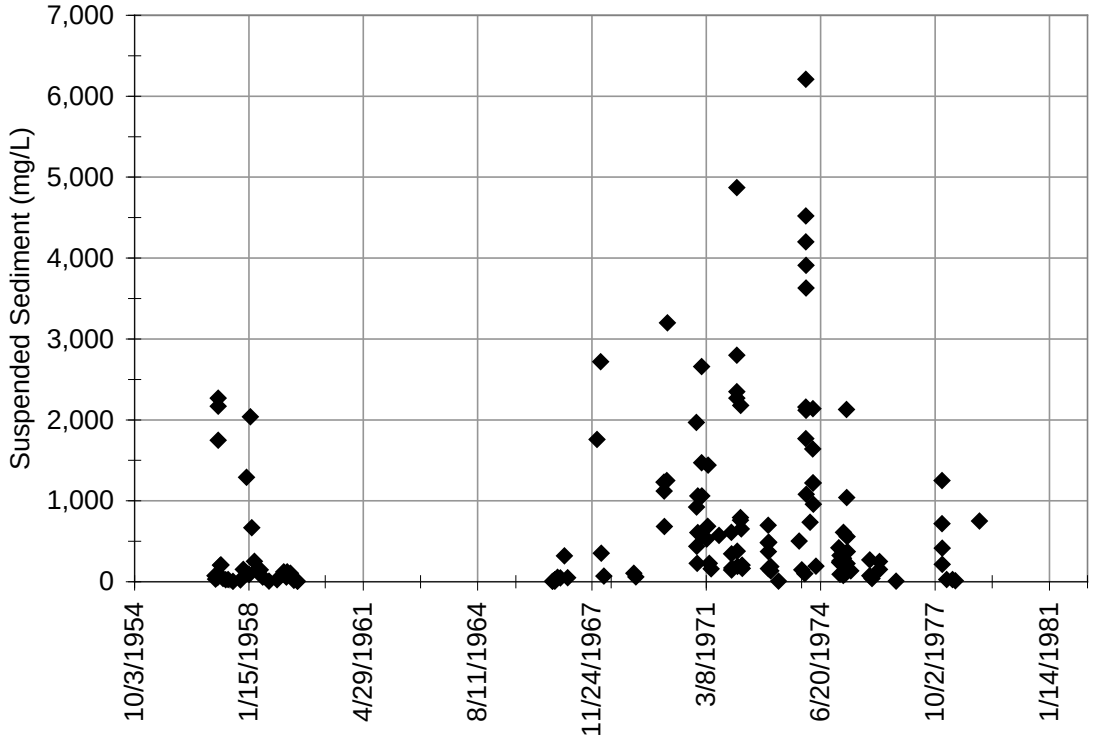

Figure C-15. Suspended Sediment (mg/L in SCC) Grab Samples for USGS Klamath River at Orleans (USGS Gage No. 11523000) (RM 58.9) 1950 to 1979. Source: USGS 2011 (**http://waterdata.usgs.gov/nwis**)

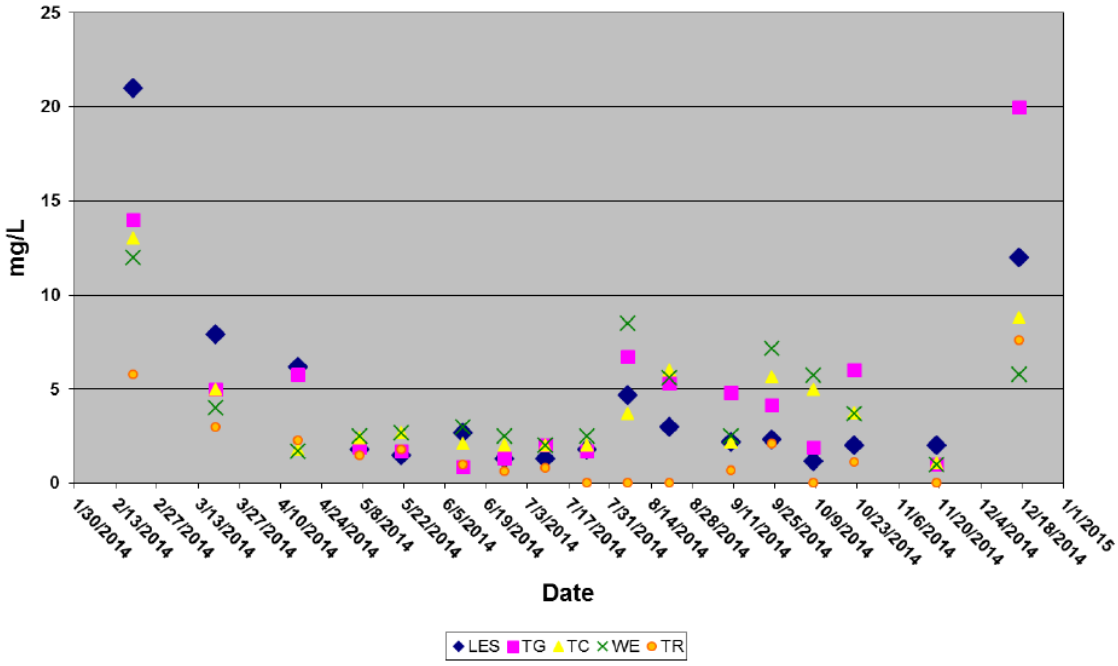

Figure C-16. Suspended Sediment (mg/L TSS) Grab Samples at the Lower Estuary Surface (LES [RM 0]), the Klamath River at Turwar Boat Ramp (TG [RM 6]), the Klamath River Upstream of Tully Creek (TC [RM 40.1]), the Klamath River at Weitchpec (Upstream of the Trinity River) (WE [RM 43.6]), and the Trinity River Upstream of the Confluence with the Klamath River (TR). Source: Hanington and Cooper-Carouseli 2014.

The Trinity River contributes 3,317,300 tons of sediment per year to the lower Klamath River or 57 percent of the cumulative average annual delivery from the basin (Stillwater Sciences 2010). Mass wasting, bank erosion, and other natural erosion processes contribute a large but currently unknown portion of the total fine sediment supply to the lower Klamath River, along with management activities such as timber harvest and road construction along tributaries (USDA Forest Service 2004; Stillwater Sciences 2010). When combined with the steep terrain, granular soil matrix, and high precipitation, these sources may be a primary contributor to fine sediment deposits found in deep pools near cultural sites in the lower Klamath River (FERC 2007).

Available historical (1958 to 1996) suspended sediment data for the Klamath River at Klamath Glen (RM 5.9) (USGS gage no. 11530500) indicates values of less than 5 mg/L (in SCC) during summer (low-flow) periods to greater than 500 mg/L during winter (high-flow) periods, although one high (>750 mg/L) suspended sediment event appears to have occurred during the early fall (i.e., October 1977, see Figure C-17).

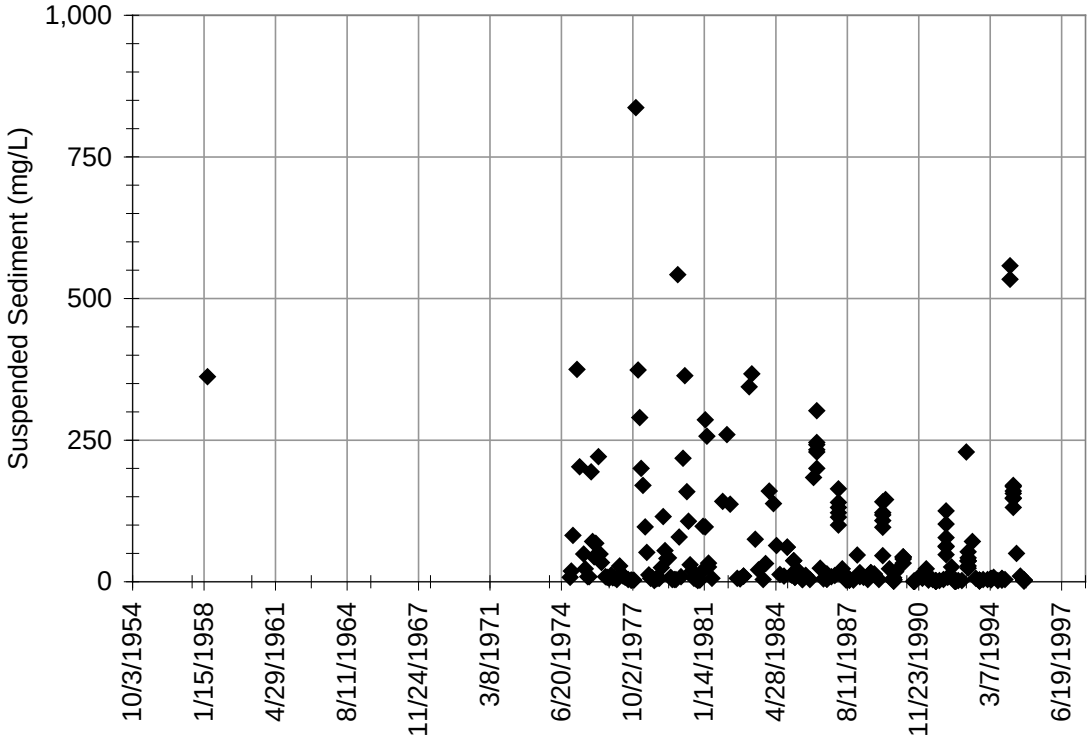

Figure C-17. Suspended Sediment (mg/L) Grab Samples for USGS Klamath River near Klamath (USGS Gage No. 11530500) (RM 7) 1958 to 1995. Source: USGS 2011 (http://waterdata.usgs.gov/nwis).

C.2.2.3 Klamath River Estuary

An analysis of collected TSS data in the Klamath River Estuary indicates that TSS are variable but generally similar to those measured at upstream sites in the lower Klamath River (YTEP 2004, 2005; Sinnott 2008). For 2003 to 2004, TSS levels were less than 1.0 to 3.2 mg/L for surface waters in the mid- and lower-estuary, and slightly greater (1.8 to 10.0 mg/L) at depth (YTEP 2004, 2005). During May to December 2009, measured TSS levels were generally 2.1 to 12.7 mg/L, with the peak value (17.9 mg/L) occurring in May (Watercourse Engineering, Inc. 2011a). More contemporary data measured between 2006 to 2014 show a larger range in the TSS in the lower Klamath River Estuary, with TSS ranging from 1.3 to 21 mg/L in 2014[3] (Figure C-16; Sinnott 2008, 2009a, 2009b, 2010b, 2011b, 2012b; Hanington and Torso 2013; Hanington and Stawasz 2014; Hanington and Cooper-Carouseli 2014). Turbidity measurements in small tributaries (e.g., McGarvey, Den, Blue, and Turwar creeks) immediately upstream or within a few river miles upstream of the Klamath River Estuary exhibit peak values during winter high flow periods (i.e., storm events), with measured values exceeding 500 NTU during December through February 2004 (YTEP 2005). Additional turbidity measurements at sites from upstream of the confluence with the Trinity River to the

[3] The various reports cited for available TSS information provide data for each individual year. There is currently no synthesis report for TSS monitoring data for the Klamath River. The most recent data range that highlights the intent of the discussion is presented, along with multiple citations to available reports.

Klamath River Estuary have been collected by the Yurok Tribe Environmental Program from 2010 to 2014 with peak turbidity typically occurring between December and April and a secondary smaller peak in turbidity occurring in the summer or fall (Sinnott 2008, 2009a, 2009b, 2010b, 2011b, 2012b; Hanington and Torso 2013; Hanington and Stawasz 2014; Hanington and Cooper-Carouseli 2014). In 2014, turbidity in the Klamath River Estuary ranged from 0.49 to 9.4 NTU with the peak occurring in February (Figure C-18; Hanington and Cooper-Carouseli 2014). During late spring through early fall, when average rates of precipitation in the Klamath Basin are relatively lower, inorganic suspended sediments and turbidity in the Klamath River Estuary are generally lower as well.

Blooms of phytoplankton within and upstream of the Klamath River Estuary have the potential to cause large spikes in turbidity and organic suspended sediments in the estuary. This occurred during the extensive phytoplankton bloom detected throughout at least 40 river miles of the lower Klamath River in September 2007 (Kann 2007a, b, c, d). In the lower estuary, increases in nutrient levels and phytoplankton concentrations were correlated with an increase in TSS from 2.2 mg/L on August 21, 2007 to 9.0 mg/L on September 18, 2007, and increases in nutrients, phytoplankton levels, and TSS during that period were measured as far upstream as Iron Gate and Copco No. 1 reservoirs (Asarian et al. 2009). Thus, the observed 2007 increase in estuarine TSS may have been influenced by phytoplankton growth originating in Iron Gate and Copco No. 1 reservoirs. The downstream transport of phytoplankton from Iron Gate and Copco No. 1 reservoirs into the Middle and Lower Klamath River and the Klamath River Estuary is discussed more in Section C.6 and Section 3.4 *Phytoplankton and Periphyton*.

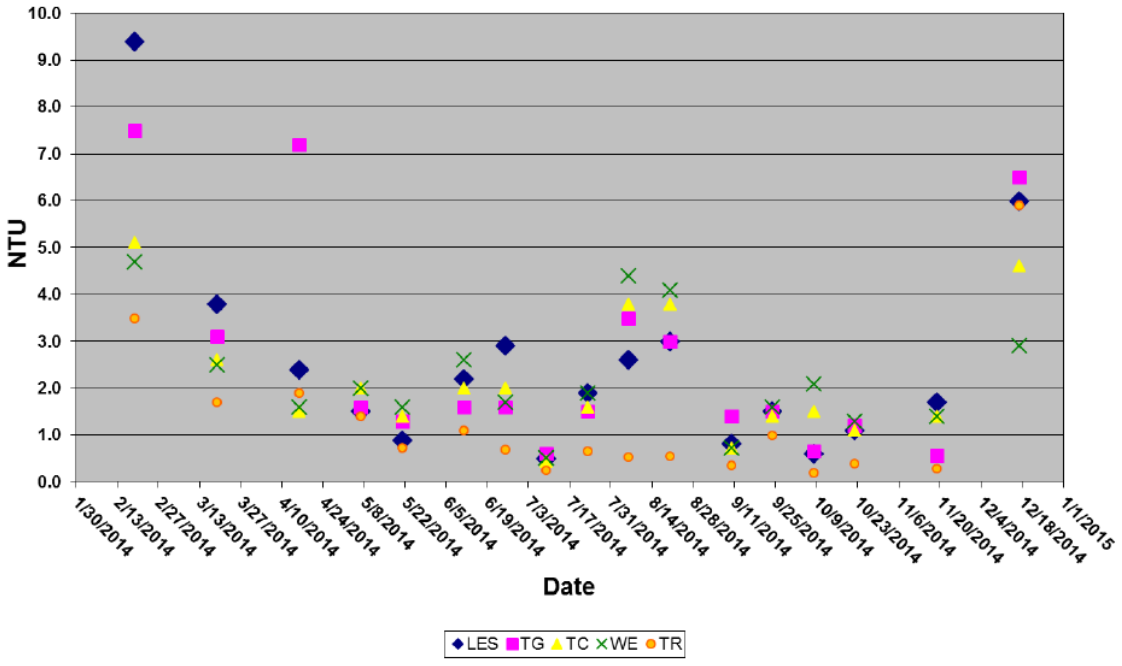

Figure C-18. Turbidity (NTU) Grab Samples at the Lower Estuary Surface (LES [RM 0]), the Klamath River at Turwar Boat Ramp (TG [RM 6]), the Klamath River Upstream of Tully Creek (TC [RM 40.1]), the Klamath River at Weitchpec (Upstream of Trinity River)(WE [RM 43.6]), and the Trinity River Upstream the Confluence with the Klamath River (TR). Source: Hanington and Cooper-Carouseli 2014.

C.3 Nutrients

Nutrients are critical for the support of primary productivity (i.e., plant growth) in both terrestrial and aquatic ecosystems. High levels of nutrients (nitrogen and phosphorus) in lakes and rivers have the potential to impact overall water quality by increasing rates of phytoplankton growth and decay, which can lead to increased levels of turbidity, large fluctuations in dissolved oxygen concentrations and pH levels, as well as potential increases of toxic substances such as ammonia (NH_4^+/NH_3), hydrogen sulfide (H_2S), and release of heavy metals from low oxidation-reduction potential at the sediment water interface (see Section 3.2.3.1 for additional background information on water quality processes in the Klamath Basin). Dissolved nutrients (e.g., ortho-phosphorus, nitrate, and ammonium) can be used directly by phytoplankton, whereas particulate nutrients (e.g., organic phosphorus, organic nitrogen) are not readily bioavailable for most phytoplankton species.

C.3.1 Upper Klamath Basin

C.3.1.1 Hydroelectric Reach

Nutrients are introduced into the mainstem Klamath River Area of Analysis primarily by the Upper Klamath Lake which inputs nitrogen and phosphorus (Kann and Walker 1999, ODEQ 2002, PacifiCorp 2004b, Deas and Vaughn 2006, FERC 2007, Sullivan et al. 2008, Asarian et al. 2010) and the Lost River Basin via the Klamath Straits Drain and the Lost River Diversion channel which inputs nutrients and organic matter (Lytle 2000, Mayer 2005, Sullivan et al. 2009, Sullivan et al. 2011, Kirk et al. 2010). Historical and contemporary nutrient data indicate that, on an annual basis, nutrients in the Hydroelectric Reach tend to be lower than upstream due in part to dilution from springs downstream of J.C. Boyle Reservoir. According to Asarian et al. (2010), who cited analysis by IFR and PCFFA (2009), Gard (2006), and TetraTech (2009), the long-term average nutrient concentrations of the springs downstream of J.C. Boyle Dam was estimated to be on the order of 0.2 mg/L for total nitrogen (TN) and on the order of 0.07 mg/L for total phosphorus (TP) using mixing equations and PacifiCorp's 2001-2007 nutrient sampling data. The Klamath TMDL model TN and TP concentrations, derived from model calibration through 2000, are consistent with these values.

Total Nitrogen and Total Phosphorus Patterns

The settling of particulate matter and associated nutrients in the larger Lower Klamath Project reservoirs contributes significantly to decreases in nutrient concentrations in the Klamath River from the Oregon-California state line to Iron Gate Dam (PacifiCorp 2004a, FERC 2007, Butcher 2008, Asarian et al. 2009, Asarian and Kann 2011, Oliver et al. 2014). In J.C. Boyle Reservoir (RM 229.8), the furthest upstream reservoir in the Hydroelectric Reach, concentrations of TN and TP measured between the inflow and outflow are typically similar, likely due to the shallow depth and short residence time characteristic of this impoundment (PacifiCorp 2006), indicating that relatively little nutrient retention occurs in this reservoir. A decreasing longitudinal trend in TN and TP from downstream of J.C. Boyle to Iron Gate Dam is generally consistent in analyses of datasets from 2005 to 2015, but the annual range and seasonal variations of TN and TP concentrations occasionally results in TN and TP plateauing or slightly increasing in the Copco No. 1 to Iron Gate portion. Analysis of nutrient data from 2005 to 2008 found the flow-weighted longitudinal TN and TP concentrations generally decrease with distance downstream from J.C. Boyle Dam with a strongly downward trend through Copco No. 1 and Iron Gate reservoirs, particularly for TN, due to nutrient retention in Copco No. 1 and

Iron Gate reservoirs (see Figure C-19 and C-20; Asarian et al. 2009; Asarian et al. 2010). Nutrient data from 2007 to 2015 supports the overall annual longitudinal trend of TN and TP, but also reveals the longitudinal variability in both the range and median TN and TP concentrations through the Hydroelectric Reach (Raymond 2008, 2009, 2010; Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015, 2016). Data from 2012 to 2015 highlight the range of TN and TP variations downstream from J.C. Boyle Dam (Figures C-21 and C-22; Watercourse Engineering, Inc. 2013, 2014, 2015, 2016). Asarian and Kann (2011) observe an overall longitudinal decrease in TN through the Hydroelectric Reach of the Upper Klamath River with concentrations usually highest upstream of Copco No. 1, intermediate upstream of Iron Gate, and lowest downstream of Iron Gate Dam. Longitudinal trends in TP show a seasonal variation though with TP generally decreasing through the Hydroelectric Reach from January to May and from July to August/September (varies by year), but TP exhibiting an increasing trend from August/September until approximately December (Asarian and Kann 2011). Oliver et al. (2014) also note TN and TP usually decrease with distance downstream from J.C. Boyle, but TP is found to occasionally slightly increase from J.C. Boyle to Iron Gate primarily between July and November.

Annual data from 2000 through 2004 and early modeling studies by PacifiCorp conducted for the FERC relicensing process indicates that Copco No. 1 and Iron Gate reservoirs act primarily as TN and TP sinks due to trapping of phytoplankton detritus (PacifiCorp 2004a; FERC 2007), but subsequent analyses found that while overall annual retention is likely occurring, the Lower Klamath Project reservoirs can also serve as seasonal sources of TN and TP (though far less for TN than for TP) through the release of nutrients from reservoir sediments into the water column during periods of phytoplankton decomposition and seasonal hypolimnetic anoxia, and possibly through direct nitrogen fixation from the atmosphere by cyanobacteria [blue-green algae] (Kann and Asarian 2005, 2006; Asarian and Kann 2006a, 2006b; Butcher 2008; Asarian et al. 2009; Asarian et al. 2010; Asarian and Kann 2011; Oliver et al. 2014). Seasonal variations of TN and TP occurred from 2005 to 2008 due to release of nutrients to the water column during periods of seasonal hypolimnetic anoxia (Figures C-23 and C-24; Asarian et al. 2010). Asarian and Kann (2011) detail the 2005-2010 average monthly TN and TP variations at various depths in Copco No. 1 and Iron Gate reservoirs. TN concentrations generally are highest at the deepest depths in both reservoirs except in July to September when organic N was very high during phytoplankton blooms (also called algal blooms). Asarian and Kann (2011) report TP concentrations are approximately uniform with depth when the reservoirs are not stratified, but the TP increases significantly with depth, especially in the bottom layer, during the period the reservoirs stratify (June to October in Copco No. 1 and June through November in Iron Gate). Data presented in Asarian et al. (2009), Asarian et al. (2010), and Asarian and Kann (2011) suggest that much of the TP released from sediments in Copco No. 1 and Iron Gate reservoirs during summertime anoxia remains in the hypolimnion until the reservoirs begin to turn over in the fall, rather than being released to downstream river reaches during the summer period of peak periphyton growth. A frequent and notable exception occurs during August to November, when TP concentrations are often higher in Iron Gate Reservoir than they are upstream of Copco No. 1 Reservoir. This is likely due to the combination of internally-driven nutrient dynamics related to algal bloom crashes in Copco No. 1 and Iron Gate reservoirs and an approximately 1- to 2-month temporal lag due to the longer hydraulic retention time of the reservoirs as compared to free-flowing river reaches (Kann and Asarian 2007; Asarian et al. 2009; Asarian et al. 2010; Asarian and Kann 2011; Watercourse Engineering, Inc. 2011a). Oliver et al.

(2014) further explore the seasonality of TP dynamics with algal bloom variations highlighting measurements that show TP concentrations are lowest during May to July ("bloom period"), highest during August to October ("post-bloom period"), and then decrease during the winter periods. These results indicate that some release of TP may occur at times which could stimulate downstream periphyton growth.

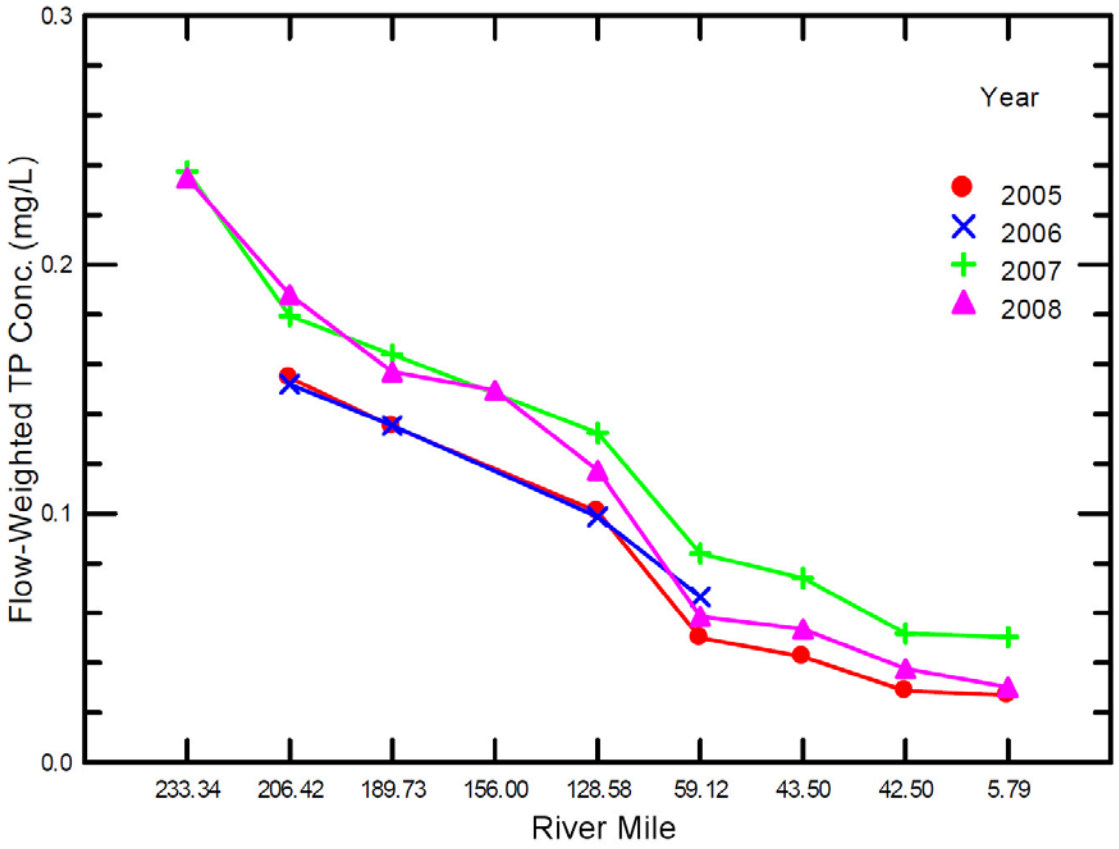

Figure C-19. Summary of Flow-Weighted Mean Concentration (mg/L) for TP at Mainstem Klamath River Sites for the Months of June to October (2005 to 2008). River Miles Specified Are Based on the River Miles Designations Used in 2010 and Differ Slightly from 2018 River Mile Designations (Table 3.2-1). Location of Mainstem Klamath River Measurements in 2010 River Mile Designations: Downstream Keno Dam (RM 233.34), Upstream Copco No. 1 Reservoir (RM 206.42), Downstream Iron Gate Dam (RM 189.73), Walker Bridge (RM 156.00), Seiad Valley (RM 128.58), Orleans (RM 59.12), Upstream Trinity River Confluence (RM 43.50), Downstream Trinity River Confluence (RM 42.50), Turwar (RM 5.79). Source: Asarian et al. 2010.

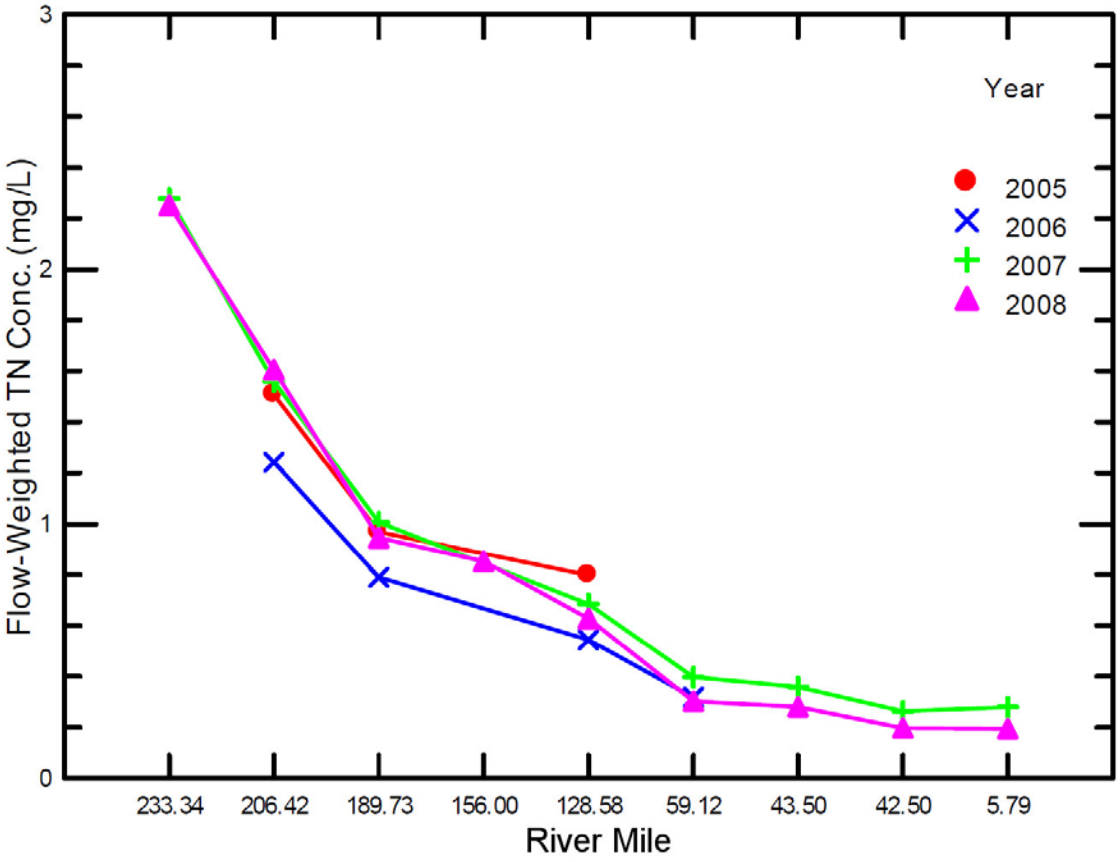

Figure C-20. Summary of Flow-Weighted Mean Concentration (mg/L) for TN at Mainstem Klamath River Sites for the Months of June to October (2005 to 2008). River Miles Specified Are Based on the River Miles Designations Used in 2010 and Differ Slightly from 2018 River Mile Designations (Table 3.2-1). Location of Mainstem Klamath River Measurements in 2010 River Mile Designations: Downstream Keno Dam (RM 233.34), Upstream Copco No. 1 Reservoir (RM 206.42), Downstream Iron Gate Dam (RM 189.73), Walker Bridge (RM 156.00), Seiad Valley (RM 128.58), Orleans (RM 59.12), Upstream Trinity River Confluence (RM 43.50), Downstream Trinity River Confluence (RM 42.50), Turwar (RM 5.79). Source: Asarian et al. 2010.

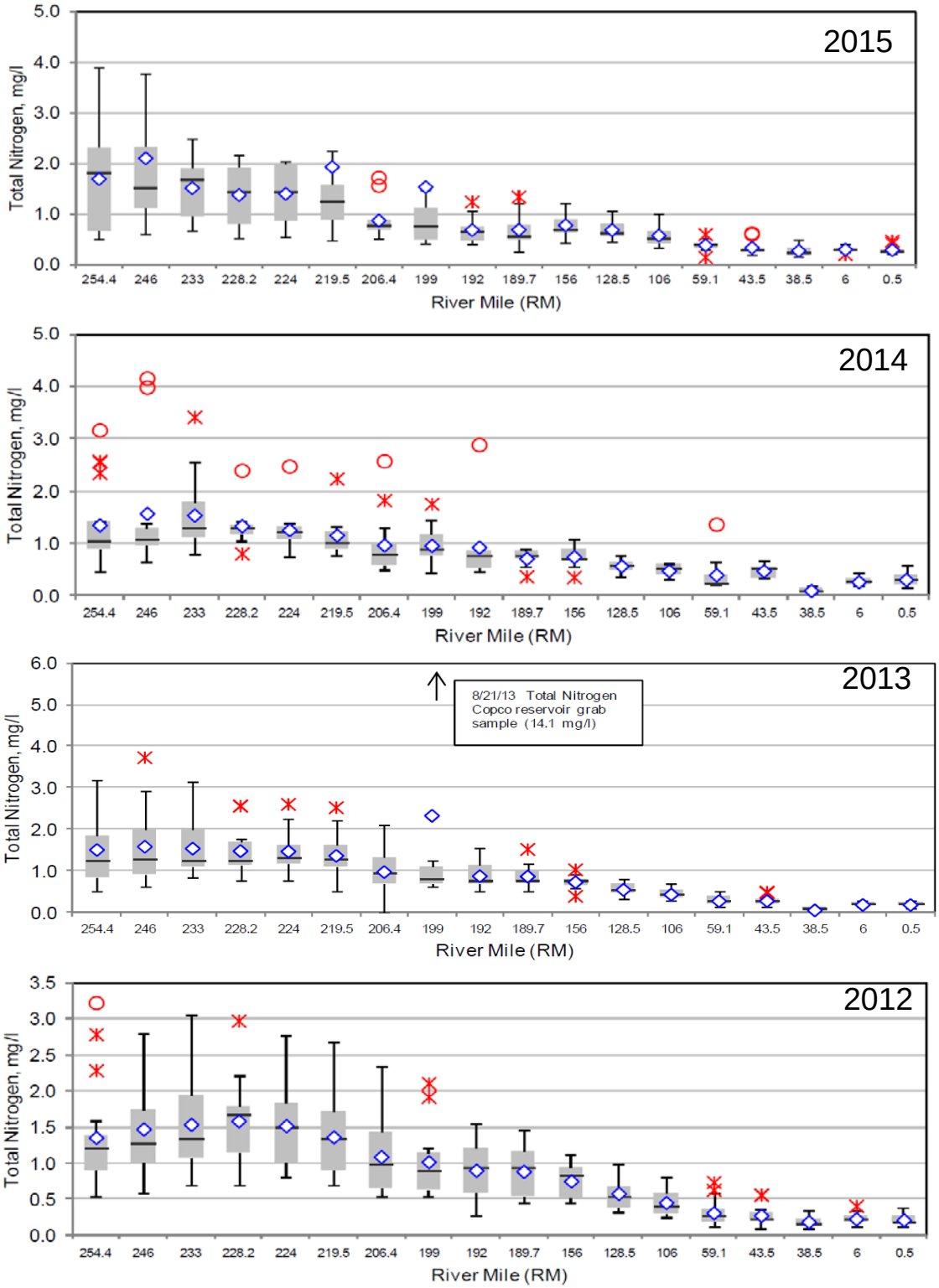

Figure C-21. Klamath River total nitrogen trends including Copco Reservoir (RM 198.7) and Iron Gate Reservoir (RM 189.7) with median (-), mean (◊), outlier (*), and extreme outliers (○) identified (Watercourse Engineering, Inc. 2013, 2014, 2015, 2016). River miles specified are based on those accurate at time of reports and differ slightly from 2018 river mile designations (Table 3.2-1).

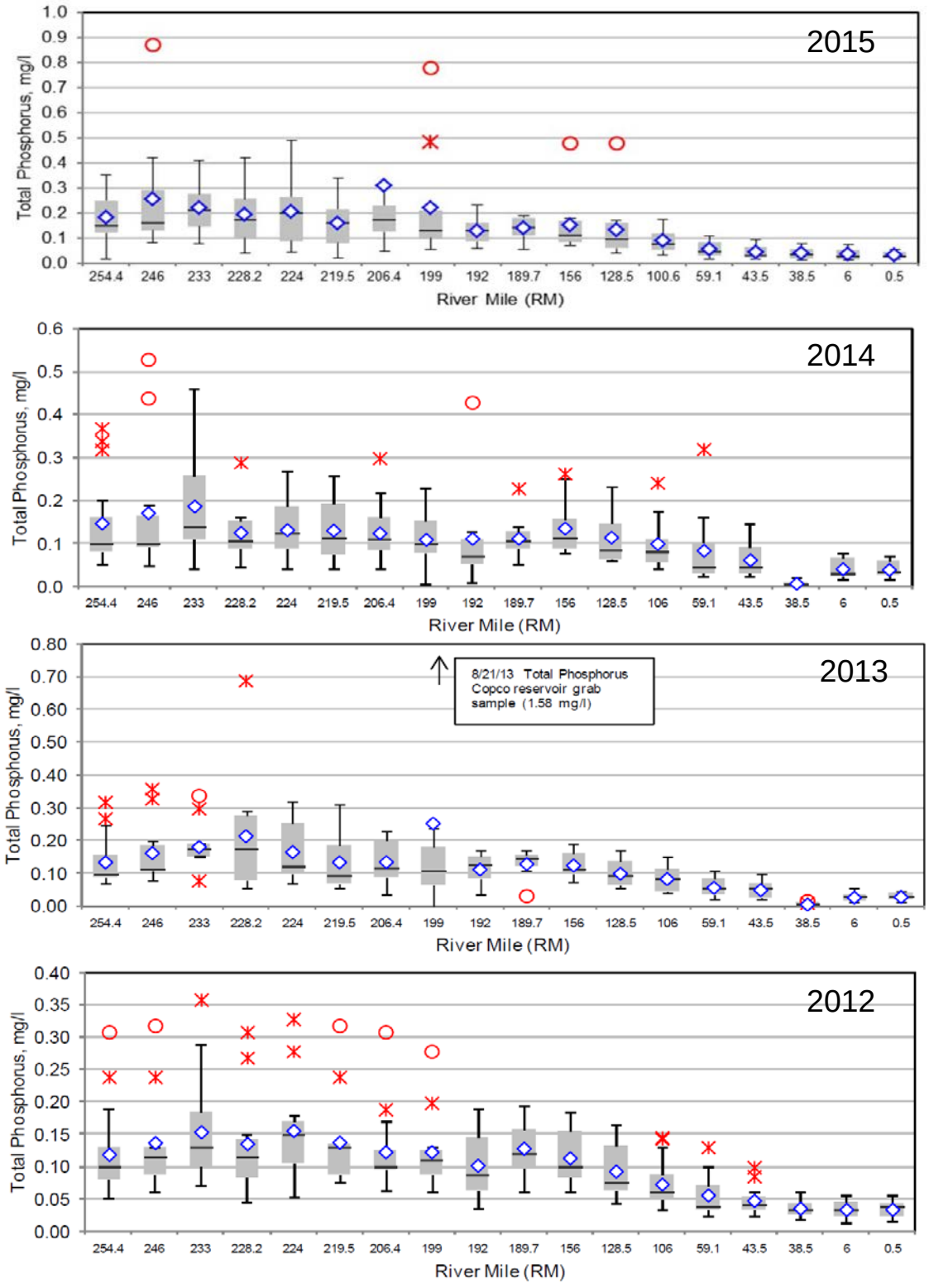

Figure C-22. Klamath River total phosphorus trends including Copco Reservoir (RM 198.7) and Iron Gate Reservoir (RM 189.7) with median (-), mean (◊), outlier (*), and extreme outliers (○) identified (Watercourse Engineering, Inc. 2013, 2014, 2015, 2016). River miles specified are based on those accurate at the time of the reports and differ slightly from 2018 river mile designations (Table 3.2-1).

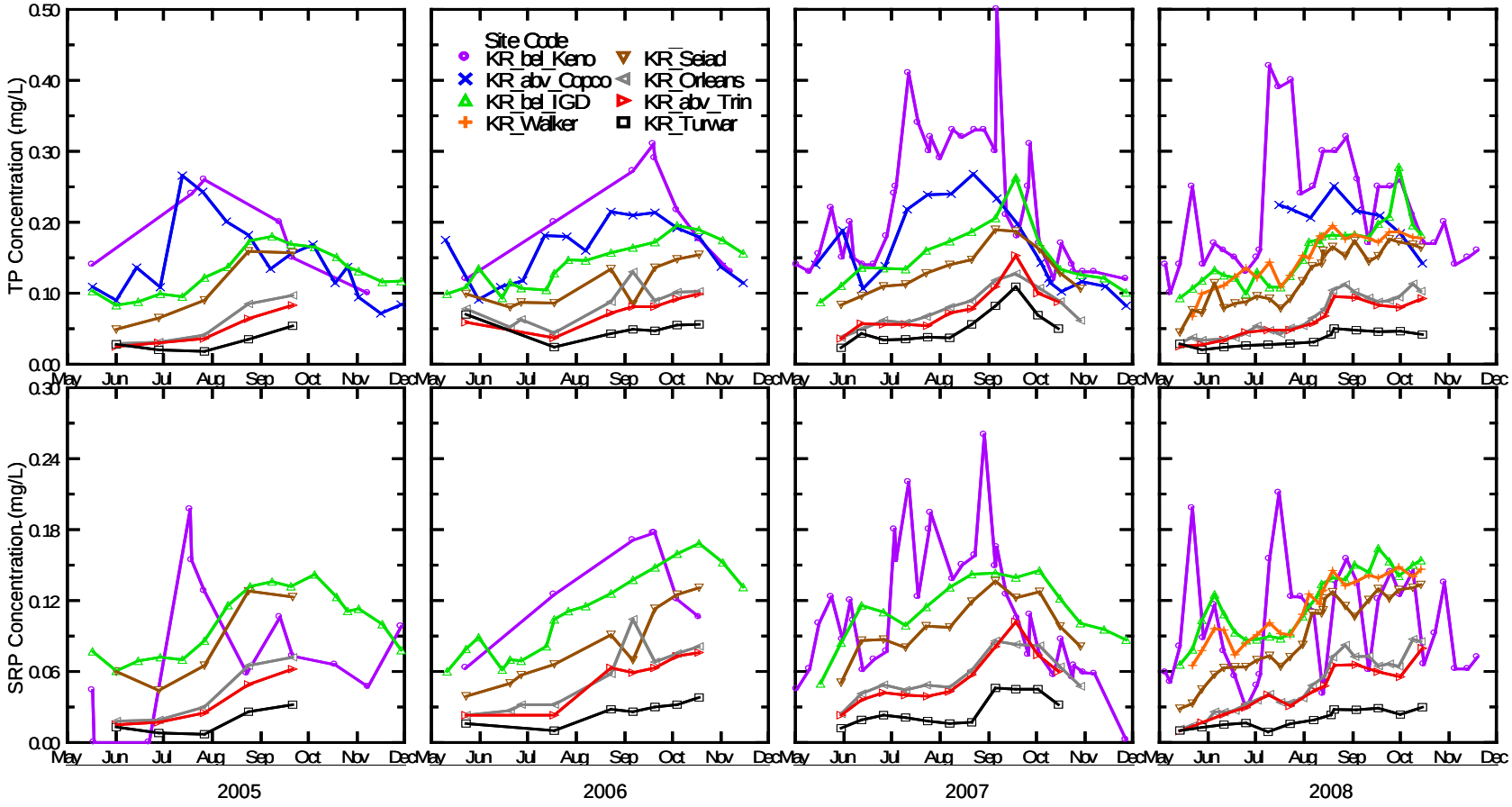

Figure C-23. Time Series of Total Phosphorus (TP) and Soluble Reactive Phosphorus (SRP) Concentrations for Selected Mainstem Klamath River Sites from Downstream Including the J.C. Boyle Dam (RM 229.8) to Turwar (RM 5.6) Reach, May 2005 to November 2008. Source: Asarian et al. 2010.

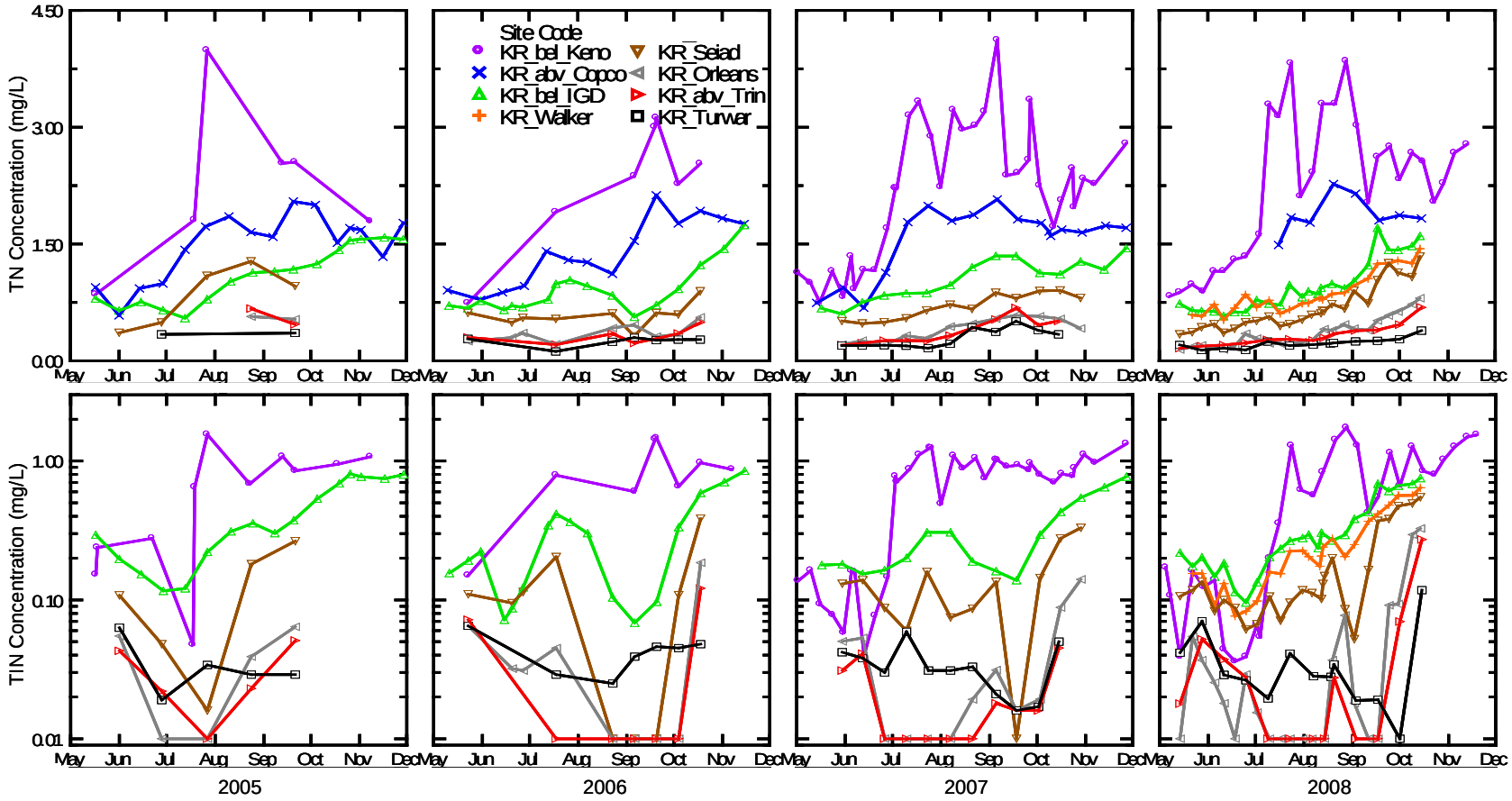

Figure C-24. Time Series of Total Nitrogen (TN) and Total Inorganic Nitrogen (TIN) Concentrations for Selected Mainstem Klamath Sites from Downstream Including the J.C. Boyle Dam (RM 229.8) to Turwar (RM 5.6) Reach, May 2005 to November 2008. Source: Asarian et al. 2010.

With respect to nutrient speciation, internally-driven reservoir nutrient dynamics due to stratification patterns and hydraulic residence time in Iron Gate and Copco No. 1 reservoirs appear to influence ortho-phosphorus and, to a lesser degree, ammonium concentrations within the Hydroelectric Reach.

Orthophosphate

Orthophosphate is a bioavailable and dissolved form of phosphorus that is frequently measured in addition to total phosphorus to assess the nutrients available for uptake by aquatic organisms. Orthophosphate is the most commonly measured form of dissolved phosphorus, but soluble reactive phosphorus (SRP) is also measured and can be used as a surrogate for orthophosphate. SRP concentrations in the riverine portions of the Hydroelectric Reach generally follow a decreasing longitudinal trend through this reach for summer and fall months (i.e., May through November; see Figure C-23). However, concentrations in Iron Gate Reservoir can exceed those of upstream sites (i.e., Klamath River downstream from J.C. Boyle and Copco No. 1 reservoirs) particularly between September and December (Asarian et al. 2009; Asarian et al. 2010; Raymond 2009, 2010; Asarian and Kann 2011; Oliver et al. 2014). Although there are limited data during winter months when the reservoirs are mixed, a synthesis of SRP data from 2005 to 2010 shows concentrations of orthophosphate appear to be more constant throughout the water column, while in stratified periods (i.e., May to October/November) concentrations near the bottom of the reservoirs can reach relatively high levels (Asarian and Kann 2011). For example, orthophosphate concentrations in the bottom waters of Copco No. 1 Reservoir reached 1.4 mg/L in September and October of 2008 and 2009, while surface water concentrations were approximately 0.2 to 0.3 mg/L (see Figure 26 in Raymond [2009] and Figure 22 in Raymond [2010]). Orthophosphorus concentrations in Iron Gate Reservoir during this same period ranged from approximately 0.1 mg/L to 0.3 mg/L (Raymond 2009, 2010). Vertical differences in orthophosphorus concentrations in Iron Gate Reservoir were less than 0.1 mg/L, but the highest concentrations often occurred near the bottom sediments (see Figure 26 in Raymond [2009] and Figure 25 in Raymond [2010]).

Nitrate

Data from 2001 to 2008 indicate that nitrate concentrations often peak in the vicinity of J.C. Boyle Reservoir and decrease through the remainder of the Hydroelectric Reach (Raymond 2009). More recent analyses of nitrate concentrations from 2005 to 2011 in the Hydroelectric Reach support this conclusion and detail seasonal nitrate variations with nitrate substantially higher upstream of Copco No. 1 Reservoir than downstream of Copco No. 1 Reservoir or Iron Gate Reservoir (Asarian and Kann 2011, Oliver et al. 2014). On a seasonal basis, coupled nutrient and phytoplankton data indicate that nitrate levels decrease during algal blooms in the Hydroelectric Reach. Cyanobacteria [blue-green algae] blooms were recorded in Iron Gate and Copco No. 1 reservoirs in summer and fall 2005 coincident with a nitrate decrease of up to 0.8 mg/L between the inflow to Copco No. 1 and the outflow of Iron Gate reservoirs (Kann and Asarian 2007). In 2010 to 2011, Oliver et al. (2014) also observed low nitrate concentrations corresponding to algal blooms measuring nitrate concentrations from 0.01 to 0.08 mg/L NO_3^--N in May-July during the onset and initial peak of the algal bloom, 0.08 to 0.94 mg/L NO_3^--N in August to October following the bloom peak and during the initial bloom decline , 0.39 to 1.01 mg/L NO_3^--N in November to January, and 0.21 to 0.73 mg/L NO_3^--N in February to April. Dilution from the springs downstream from J.C. Boyle Dam also reduces nitrate concentrations in this reach even though the springs are also a relatively constant source of nitrate (Oliver et al. 2014).

Ammonium/Ammonia (NH_4^+/NH_3)

Ammonium (NH_4^+) and ammonia (NH_3) are two related forms of nitrogen that influence water quality, with the ratio of ammonium and ammonia dependent on the water temperature and pH (North Coast Regional Board 2010). Ammonium is converted to ammonia at higher water temperatures and higher pH. Ammonium and ammonia are naturally formed in the environment by microbes and some forms of blue-green algae that combine nitrogen from the air with hydrogen (nitrogen fixation), microbes that convert nitrogen in decaying organic matter into ammonia and ammonium, and fish excreting ammonia (USEPA 2013). Ammonium is a nutrient that is directly usable by phytoplankton and as such it can promote phytoplankton growth. At high concentrations, ammonium and ammonia are toxic to aquatic species, with toxicity levels varying by species. Ammonia is more toxic than ammonium (North Coast Regional Board 2010), so it is the form typically measured and reported.

Nutrient data from 2005 to 2010 show ammonia concentrations from May to September are often lowest upstream of Copco No. 1 Reservoir or downstream of Iron Gate Dam with the highest concentrations in Copco No. 1 Reservoir, but ammonia concentrations from October to December are higher upstream of Iron Gate Reservoir and downstream of Iron Gate Dam (Asarian and Kann 2011). Low ammonia concentrations between May and September are attributed to nitrification in the turbulent oxygen-rich Klamath River upstream of Copco Reservoir (Deas 2008). Asarian and Kann (2011) identify deterioration and decay of algal blooms along with reservoir turnover as the likely causes of higher ammonia concentrations from October to December. Seasonal longitudinal trends in the ammonium concentrations in the Hydroelectric Reach show minimums occur during May to July algal bloom periods and maximums occur during November to January (Oliver et al. 2014).

Relatively high levels of ammonium have been recorded in reservoirs in the Hydroelectric Reach especially in the lower reservoir depths. While available data collected to date suggests no actual ammonia toxicity events associated with the operation of the Lower Klamath Project (North Coast Regional Board 2010), elevated ammonia levels in the deeper portions of the hypolimnion of both Copco No. 1 and Iron Gate reservoirs in summer of 2005 exceeded 0.6 mg/L (Figures 12 and 14 in Kann and Asarian 2007), indicating that anoxic conditions are likely causing conversion of organic nitrogen in reservoir deposits to ammonia. From 2001 to 2004, June and November mean ammonia concentrations in Iron Gate Reservoir were 0.1 to 0.3 mg/L to a depth of 45 meters, whereas Copco No. 1 Reservoir concentrations were consistently higher for the 20- to 32-meter depth and were 0.9 to 1.0 mg/L in September and October (FERC 2007). Only minor increases in ammonia (0.05 to 0.1 mg/L) have been observed to occur in the Hydroelectric Reach between upstream of Copco No. 1 Reservoir and downstream from Iron Gate Reservoir, most often during October and November (Kann and Asarian 2005, 2007). The 2005 to 2010 average monthly ammonia concentrations support previous findings showing ammonia concentrations increase substantially (often over an order of magnitude) with depth in Copco No. 1 Reservoir between May and October peaking at over 1.0 mg/L in September/October, while ammonia concentrations in Iron Gate Reservoir increase with depth between May and November usually peaking around 0.4 to 0.8 mg/L in October/November (Asarian and Kann 2011).

C.3.2 Mid- and Lower Klamath Basin

C.3.2.1 Iron Gate Dam to Salmon River

Historical (1950 to 2001) TP data indicate median values of 0.11 to 0.19 mg/L in the Lower Klamath Basin between Iron Gate Dam and Seiad Valley, with the highest values occurring just downstream from the dam (Figure C-25). Variability over the long-term record in this reach is lower than upstream reaches, with concentrations varying from near zero to over 0.3 mg/L for the period of record (Figure C-25). The historical record indicates relatively low variability in orthophosphate concentrations in the reach (as compared with variability in the Upper Klamath Basin), with median values of 0.03 to 0.1 mg/L (PacifiCorp 2004b).

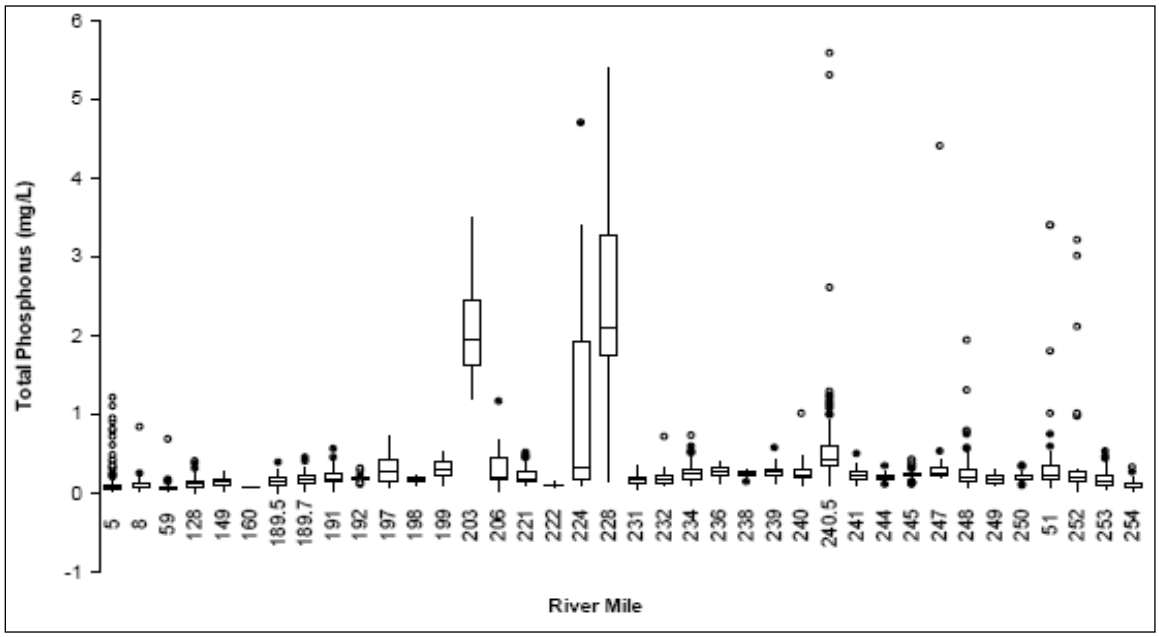

Figure C-25. Box and Whisker Plot of Historical TP Data Collected from Various Sites in the Klamath River from Klamath River at Klamath Glen (RM 5.9) to Klamath River at Link River Dam (RM 259.7) Between 1950 and 2001. Source: PacifiCorp 2004b.

More recent data from 2001 to 2015 also show TP concentrations generally decreasing with distance downstream from Iron Gate Dam and indicate that phosphorus dynamics in the Klamath River immediately downstream from Iron Gate Dam are affected by conditions within the Lower Klamath Project reservoirs (Section C.3.1.1) (Figures C-22 and C-26; Asarian et al. 2010; Asarian and Kann 2013; Oliver et al. 2014; Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015, 2016). Analysis of data from 2001 to 2011 shows the highest TP concentrations occurring during the low flow years of 2001 to 2004 when TP exceeded 0.4 mg/L downstream from Iron Gate Dam and the lowest TP concentrations occurring during the high flow years of 2006, 2010, and 2011 and the moderate flow year of 2005 (Asarian and Kann 2013). TP concentrations vary seasonally with TP peaking after the algal bloom peak and then decreasing during late fall and early winter (Oliver et al. 2014). During May 2005 to November 2008, peak TP concentrations at locations downstream from Iron Gate Dam occurred between mid-August and early October, which is roughly one to two months later than peak timing in upstream reaches and may be due to the hydraulic residence time in Iron Gate and

Copco No. 1 reservoirs, or release of TP from anoxic sediments during summer stratification or following algal bloom and death (Figure C-23). After peaking, the TP concentrations declined steeply in late-fall in some years, but they exhibited a more gradual decline in others (Figure C-23). Orthophosphate or SRP tends to decrease in the mainstem Klamath River with distance downstream from Iron Gate Dam (FERC 2007; Asarian et al. 2010; Asarian and Kann 2013). Seasonal trends in orthophosphate closely follow observed TP concentrations and for the period 2005 to 2008 this phosphorus species regularly accounts for 60 to 90 percent of TP sampled (Asarian et al. 2010; Asarian and Kann 2013; Oliver et al. 2014).

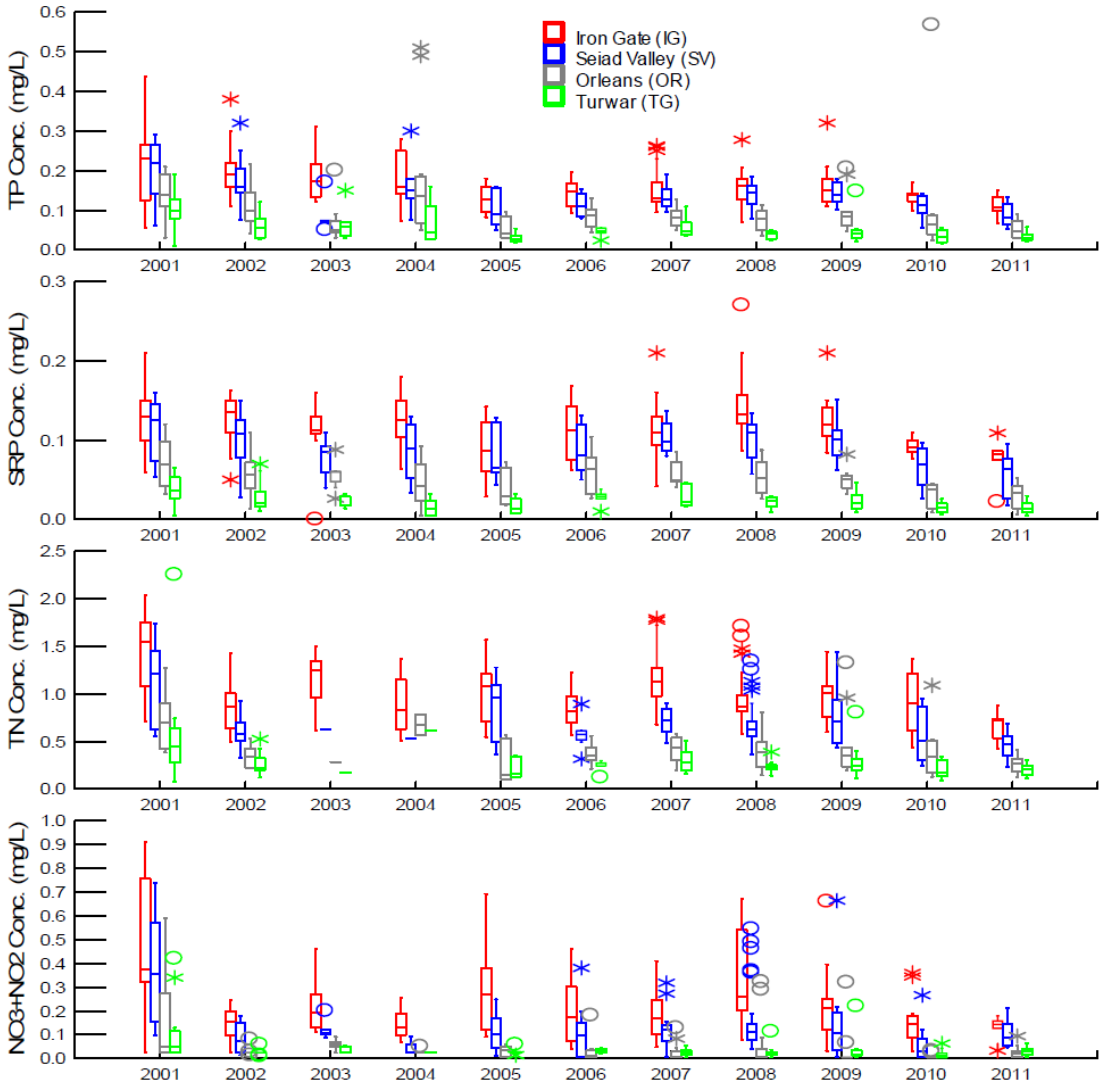

Figure C-26. Box and Whisker Plot of Total Phosphorus (TP), Soluble Reactive Phosphorus (SRP), Total Nitrogen (TN), and Nitrate plus Nitrite Nitrogen (NO3+NO2) for the June-October Period from 2001-2011 at Four Mainstem Klamath River Sites. Source: Asarian and Kann 2013.

For the period 1996 to 2007, average TN concentrations downstream from Iron Gate Dam (RM 193.1), vary by year, with mean concentrations of 1.2 mg/L (FERC 2007) and

a range of measured concentrations from less than 0.1 to over 2.0 mg/L (North Coast Regional Board 2010). Additional historical (1951 to 2001) nitrogen data is available as Total Kjeldahl Nitrogen or TKN, a measure of organic nitrogen plus ammonia. TKN median values for this period were 0.6 to 0.9 mg/L in the Lower Klamath Basin between Iron Gate Dam and Seiad Valley, with the highest median values occurring just downstream from the dam (PacifiCorp 2004b). Variability over the long-term record in this reach is relatively low compared with that of upstream reaches. For 1951 to 2001, high variability in nitrate concentrations is apparent in the reach between Iron Gate Dam and the Salmon River confluence, with some relatively high concentrations (greater than 5 mg/L) occurring at the Seiad Valley location (RM 132.7) (PacifiCorp 2004b).

More recent data from 2001 to 2015 show TN concentrations tend to decrease with distance downstream from Iron Gate Dam (Figures C-21, C-24, and C-26) and the nitrogen dynamics immediately downstream of Iron Gate Dam are affected by conditions within the Lower Klamath Project reservoirs (Asarian et al. 2010; Asarian and Kann 2013; Oliver et al. 2014; Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015, 2016). Based on data collected from 2001-2011, TN concentrations in the river downstream from Iron Gate Dam are generally lower than those in upstream reaches (Figures C-24 and C-26) due to dilution from the springs downstream from J.C. Boyle Dam and reservoir retention in the Hydroelectric Reach (Asarian et al. 2009; Asarian and Kann 2013). Further decreases in TN occur in the mainstem river downstream from Iron Gate Dam due to a combination of tributary dilution and in-river nitrogen removal processes such as denitrification and/or storage related to biomass uptake (Asarian et al. 2010). TN concentrations between 2001 and 2011 are highest in the low flow year 2001 and lowest in the high flow year 2011 (Asarian and Kann 2013). On a seasonal basis, TN increases from May through November, with peak concentrations (1−1.5 mg/L) typically observed during September and October (Figure C-24). Analysis of the 2001−2004 dataset also indicates that median TN concentrations in the Klamath River from Iron Gate Dam to (RM 193.1) to Seiad Valley (RM 132.7) exceed 0.2 mg/L (Asarian and Kann 2006b). A review of median TN concentrations from 2012 to 2015 (Figure C-21) also shows TN consistently exceeding 0.2 mg/L downstream of Iron Gate Dam (RM 193.1), Seiad Valley (RM 132.7), and Happy Camp (RM 108.4) (Watercourse Engineering, Inc. 2013, 2014, 2015, 2016).

Ratios of TN to TP (TN:TP) measured in the Klamath River suggest the potential for the system to be nitrogen-limited with some periods of co-limitation by N and P; however, concentrations of both nutrients are high enough in the river from Iron Gate Dam (RM 193.1) to approximately Seiad Valley (RM 132.7) (and potentially farther downstream) that nutrients are not likely to be limiting primary productivity (e.g., periphyton growth) in this portion of the Klamath River (FERC 2007, HVTEPA 2008, Asarian et al. 2010). In addition, nitrogen-fixing species dominate the periphyton communities in the lower reaches of the Klamath River where inorganic nitrogen concentrations are low (Asarian et al. 2010, Asarian et al. 2015). Since these species can fix their own nitrogen from the atmosphere, nitrogen would not limit their growth (Asarian et al. 2015).

Data collected during 2001 to 2015 indicate nitrate concentrations also tend to decrease longitudinally in the Klamath River downstream from Iron Gate Dam (Asarian et al. 2010; Asarian and Kann 2013; Oliver et al. 2014; Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015, 2016). Although patterns in nutrient concentrations vary between years, nitrate typically increases between July and September, with measured

concentrations downstream from Iron Gate Dam frequently greater than 0.25 mg/L (Asarian et al. 2010; Asarian and Kann 2013). In the fall, nitrate concentrations tend to increase again, occasionally reaching values of over 0.6 mg/L (Asarian et al. 2010, Asarian and Kann 2013). Mean 2000 to 2004 nitrate concentrations downstream from Iron Gate Dam were 0.15 to 0.44 mg/L between March and November, with the highest concentrations observed in early September (FERC 2007). Over the same time period, mean nitrate concentrations farther downstream near the confluence of the Shasta River (RM 179.5) had decreased to 0.02 to 0.36 mg/L, with peaks observed in early November (FERC 2007). Nitrate generally comprises less than 40 percent of the TN concentration throughout the lower Klamath River (Asarian et al. 2010). Nitrate concentrations at Seiad Valley (RM 132.7) from 2001 to 2011 consistently increase in the fall between August and November frequently exceeding 0.2 mg/L (Asarian and Kann 2013, Oliver et al. 2014).

As a result of the seasonal production of ammonia in anoxic hypolimnetic waters of the Lower Klamath Project reservoirs (Section C.3.1.1) and the high pH levels (greater than 7.5 pH units) measured seasonally downstream from Iron Gate Dam (YTEP 2005, North Coast Regional Board 2011), the North Coast Regional Board evaluated all available sampling data records as part of Klamath River TMDL development. The North Coast Regional Board analysis showed that for sampling events in which all three parameters (pH, ammonia, and water temperature) were collected simultaneously, no acute or chronic toxicity exceedances of the *Water Quality Control Plan for the North Coast Region* (Basin Plan) criteria for ammonia were indicated (North Coast Regional Board 2010). For the May to November sampling period in 2005 to 2008, ammonia concentrations in the Klamath River downstream from Iron Gate Dam were generally less than 0.3 mg/L and constituted less than 10 percent of the TN concentration (Asarian et al. 2010). Highest concentrations were measured during fall months downstream from Iron Gate Dam (RM 193.1), with late-fall ammonia concentrations generally increasing at this location and values increasing to above 0.2 mg/L during November 2006. For the period 2000 to 2004, mean ammonia levels of 0.13 mg/L were reported in Iron Gate Dam outflow (FERC 2007).

Although tributary dilution generally has a proportionally greater effect on nutrient concentration reductions in the Klamath River downstream from Iron Gate Dam, nutrient retention is an important component of overall nutrient dynamics in this reach (Asarian et al. 2010, Oliver et al. 2014). In a study of the June to October and July to September periods during 2005 to 2008, nutrient retention in the reach from Iron Gate Dam to the Klamath River Estuary was calculated after accounting for tributary dilution (Asarian et al. 2010). For the study, positive retention values represented seasonal removal of nutrients from the water column through storage in phytoplankton/plant biomass or denitrification, and negative retention represented an internal source of nutrients from sediment release or phytoplankton regeneration and nitrogen fixation. Retention rates downstream from Iron Gate Dam were variable but generally positive for TP, although negative retention was observed during some years in the reach between Seiad Valley (RM 132.7) and the Salmon River (RM 66.3), as well as further downstream to Turwar (RM 5.6) (Asarian et al. 2010). In general, TP and orthophosphate retention increased with distance downstream from Iron Gate Dam while particulate phosphorus retention decreased (i.e., negative retention). Nutrient retention for TN was similarly positive, with instances of negative retention observed during 2005 between Iron Gate Dam (RM 193.1) and Seiad Valley (RM 132.7) (see Section C.3.2.2 for discussion of retention in lower reaches). Additionally, during 2005 to 2008, total inorganic nitrogen (TIN = nitrite

+ nitrate + ammonia) retention was consistently positive between Iron Gate Dam and as far downstream as the Trinity River confluence (RM 43.3). The Asarian et al. (2010) analysis indicates that large quantities of nitrogen and phosphorus were retained in the river across the roughly 130 miles from Iron Gate Dam to just downstream from the Salmon River at Orleans (RM 58.9). During July to September of 2007 to 2008, the incoming nutrient load at Iron Gate Dam was reduced by 24 percent for TP, 25 percent for orthophosphate, 21 percent for particulate phosphorus, 41 percent for TN, 93 percent for TIN, and 21 percent for organic nitrogen (Asarian et al. 2010). Oliver et al. (2014) report a pattern of decreasing TN loads downstream of Iron Gate Dam due to algal sedimentation or denitrification during August to November, increasing TN loading during December through April once discharge increased in the winter/spring period, and relatively similar TN loads across sites from downstream of Iron Gate Dam to Seiad Valley between May and July. Trends in TP loads indicate TP is less influenced by algal blooms than seasonal changes in discharge with TP loads generally increasing with distance downstream of Iron Gate Dam at higher winter/spring discharge rates (Oliver et al. 2014).

C.3.2.2 Salmon River to Estuary

Downstream from the confluence with the Salmon River (RM 66.3), nutrient concentrations continue to decrease in the Klamath River as compared with those measured farther upstream. Historical (1950 to 2001) TP data indicate median values of 0.06 to 0.07 mg/L in river between the Salmon River confluence and near the Klamath River Estuary, with generally low variability (Figure C-25). Orthophosphate levels and variability over the long-term record in the reach downstream from the Salmon River are similar to those in the reach downstream from Iron Gate Dam (see previous section). Data from 2001 to 2015 indicate that TP concentrations in this reach are generally 0.05 to 0.1 mg/L with TP concentrations approaching 0.2 mg/L or greater in some years at the furthest upstream site Orleans (RM 58.9) (Figures C-22, C-23, and C-14; Asarian et al. 2010; Asarian and Kann 2013; Oliver et al. 2014; Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015, 2016). Data from 2005-2008 shows peak values occurring in September and October (Figure C-23). Water quality monitoring by the HVTEPA from 2008 to 2012 at Saints Rest Bar (RM 44.9) in the Klamath River shows TP ranging from 0.026-0.127 mg/L while SRP ranges from approximately 0.005 to 0.07 mg/L. Both TP and SRP (i.e., orthophosphate) at Saints Rest Bar generally increase from June through October reaching the annual peak between August and October (HVTEPA 2013). Data from 2007 to 2014 collected by the Yurok Tribe Environmental Program provide more recent seasonal patterns in the TP and SRP concentrations from Weitchpec (RM 43.6) upstream of the confluence with the Trinity River to the Klamath River Estuary (Sinnott 2008, 2009a, 2009b, 2010b, 2011b, 2012b, Hanington and Torso 2013; Hanington and Stawasz 2014; Hanington and Cooper-Carouseli 2014). In 2014, both TP and SRP at sites downstream of the Trinity River are at a minimum around mid-May, increase until peaking in September/October, and decrease until December (Hanington and Cooper-Carouseli 2014). Downstream from the Trinity River, orthophosphate often accounts for less than 50 percent of TP, possibly due to dilution from the Trinity River (Asarian et al. 2010).

As with upstream reaches, historical (1951 to 2001) nitrogen data is available as TKN, nitrate, and ammonia. TKN median values downstream from the Salmon River for this period were 0.25 to 0.3 mg/L (PacifiCorp 2004b). Variability over the 1951 to 2001 record in this reach is dependent on sampling location, with the greatest variability for

the most downstream site at Klamath Glen (RM 5.9). In the 1951 to 2001 dataset, high variability in nitrate concentrations is apparent throughout this reach, with some relatively high concentrations (greater than 3 mg/L) occurring at Orleans (RM 58.9) and Klamath Glen (RM 5.9) (PacifiCorp 2004b). Data from 2001 to 2015 indicate that TN concentrations in this reach are generally between 0.1 to 0.5 mg/L with TN concentrations frequently peaking above 0.5 mg/L between August and October at sites upstream of the Trinity River (Sinnott 2008, 2009a, 2009b, 2010b, 2011b, 2012b; Asarian and Kann 2013; Hanington and Torso 2013; Hanington and Stawasz 2014; Hanington and Cooper-Carouseli 2014; Watercourse Engineering, Inc 2012, 2013, 2014, 2015, 2016). However, TN concentrations substantially exceeded the typical range in some years like 2001. Data from 2005 to 2008 show the seasonal variations with TN increasing from May through November and peak concentrations (approximately 0.5 mg/L) typically observed during September and October (Figure C-24), which are at or above the Hoopa Valley Tribe numeric criterion of 0.2 mg/L TN. TN concentrations from 2008 to 2012 at Saints Rest Bar (RM 44.9) range from less than 0.1 mg/L to approximately 1.0 mg/L while nitrate plus nitrite ranges from less than 0.05 mg/L to approximately 0.28 mg/L. TN at Saints Rest Bar generally increases from June through October reaching the annual peak between September and October, but nitrate plus nitrite varies less until September when it increases and peaks between September and October (HVTEPA 2013). Downstream from the Trinity River confluence (RM 43.3), TN concentrations are typically less than 0.5 mg/L (YTEP 2005; Sinnott 2008, 2009a, 2009b, 2010b, 2011b, 2012b; Asarian and Kann 2013; Hanington and Torso 2013; Hanington and Stawasz 2014; Hanington and Cooper-Carouseli 2014), with general increases from spring to fall months. For the 2005 to 2008 dataset, TN increases were observed between September and October at Orleans (RM 58.9), upstream of the confluence with the Trinity River (approximately RM 43.3), and at Turwar (RM 5.6) (Figure C-24; Asarian et al. 2010). Similar patterns in TN concentrations were measured between 2009 and 2014 at sites between Orleans and Turwar (Sinnott 2008, 2009a, 2009b, 2010b, 2011b, 2012b; Asarian and Kann 2013; Hanington and Torso 2013; Hanington and Stawasz 2014; Hanington and Cooper-Carouseli 2014).

Nutrient retention rates in the Klamath River, from approximately the Salmon River confluence to the Trinity River, are variable for the period 2005 to 2008, but generally positive for TN and TP. However, from the Trinity River to the Klamath River Estuary, TN and TP nutrient retention rates are generally negative (Asarian et al. 2010). For example, during 2005 to 2008, total inorganic nitrogen (TIN = nitrite + nitrate + ammonia) retention was consistently negative between the Trinity River confluence and Turwar (RM 5.6) (Asarian et al. 2010). The Asarian et al. (2010) analysis suggests that while nitrogen and phosphorus are largely being removed from the river upstream of the Trinity River confluence (RM 43.3) during the June to October and July to September study periods, downstream from the confluence, nutrients are being added. Since retention is a load-based estimate and is inherently tied to flows, it is possible for nutrient loads to increase even while nutrient concentrations in the water decrease (in this case, only slightly).

C.3.2.3 Klamath River Estuary

Nutrient concentrations in the Klamath River Estuary are highly variable spatially and temporally and are greatly influenced by season, river flow, tidal prism, and location of the estuary mouth. In general, nutrient concentrations in the Klamath River Estuary are lower than in the Klamath River just upstream of the Trinity River confluence (RM 43.6)

and comparable to the nearest river sampling station (RM 5.6) near Turwar (YTEP 2004, 2005; Sinnott 2008, 2009a, 2009b, 2010b, 2011b, 2012b; Hanington and Torso 2013; Hanington and Stawasz 2014; Hanington and Cooper-Carouseli 2014). One exception to that trend is ammonia which is consistently higher in the Klamath River Estuary than upstream locations with peaks occurring between August and December (YTEP 2004, 2005; Sinnott 2009a, 2009b, 2010b, 2011b, 2012b; Hanington and Torso 2013; Hanington and Stawasz 2014; Hanington and Cooper-Carouseli 2014). Inter-annual and seasonal variability are apparent in the contemporary data collected by the Yurok Tribe during 2006 to 2014 (Sinnott 2008, 2009a, 2009b, 2010b, 2011b, 2012b; Hanington and Torso 2013; Hanington and Stawasz 2014; Hanington and Cooper-Carouseli 2014). For example, measured concentrations of TP in the Klamath River Estuary are below 0.12 mg/L during the period June to October 2006 to 2014. Contemporary data (2006 to 2014) indicate that TP concentrations in the Klamath River Estuary generally range from approximately 0.02 to 0.08 mg/L with peak values generally occurring in September and October, although 2009 and 2010 data indicated that concentrations of TP can continue to increase into November and December, especially during elevated river flows (Sinnott 2008, 2009a, 2009b, 2010b, 2011b, 2012b; Hanington and Torso 2013; Hanington and Stawasz 2014; Hanington and Cooper-Carouseli 2014). During peak concentrations, values often exceed the Hoopa Valley Tribe's standard of 0.035 mg/L TP (HVTEPA 2008). During the same period, orthophosphate is consistently reported at less than 0.06 mg/L. Orthophosphate often accounts for more than 50 percent of TP from June through October.

Contemporary data (2006 to 2014) indicate that TN concentrations in the Klamath River Estuary were consistently below 0.7 mg/L, generally ranging from approximately 0.1 to 0.6 mg/L (Sinnott 2008, 2009a, 2009b, 2010b, 2011b, 2012b; Hanington and Torso 2013; Hanington and Stawasz 2014; Hanington and Cooper-Carouseli 2014). Concentrations increase from June to October with peak values occurring in September and October, although 2009, 2010, and 2011 data indicate that concentrations can continue to increase into November and December, especially during high river flows (Sinnott 2008, 2009a, 2009b, 2010b, 2011b, 2012b; Hanington and Torso 2013; Hanington and Stawasz 2014; Hanington and Cooper-Carouseli 2014). During peak concentrations, values often exceed the Hoopa Valley Tribe's standard of 0.2 mg/L TN (HVTEPA 2008). During June to October 2006 to 2014, measured values of nitrate plus nitrite in the Klamath River Estuary are near or below the reporting limit (0.01 mg/L) with concentrations ranging from 0.01 mg/L to 0.2 mg/L though nitrate plus nitrite concentrations are typically between 0.01 mg/L and 0.04 mg/L. Concentrations of nitrate plus nitrite in the Klamath River Estuary increase from June to October, with peak values during this period occurring in September and October. As with TN, recent data indicates that nitrate plus nitrite concentrations can continue to increase into November and December, especially during elevated river flows (Sinnott 2010b, 2011b). Measured values of ammonia in the Klamath River Estuary were low, with measurements consistently below 0.1 mg/L during the period June to October 2006 to 2014, generally ranging from 0.01 mg/L to approximately 0.04 mg/L, with peak values generally occurring in September. Many ammonia samples from the Klamath River Estuary return values near or below the reporting limit of 0.01 mg/L (YTEP 2004, 2005; Sinnott 2008, 2009a, 2009b, 2010b, 2011b, 2012b; Hanington and Torso 2013; Hanington and Stawasz 2014; Hanington and Cooper-Carouseli 2014). However, the Klamath River Estuary sampling site has more detectable concentrations of ammonia than any other sampling site within the Yurok Reservation. Nutrient retention has not been explicitly measured in the Klamath River Estuary, although measurements have been made just

upstream of the Klamath River Estuary in the reach from the Trinity River confluence (RM 43.3) to Turwar (RM 5.6).

C.4 Dissolved Oxygen

C.4.1 Upper Klamath Basin

C.4.1.1 Keno Impoundment/Lake Ewauna

In the downstream Keno Impoundment/Lake Ewauna, dissolved oxygen reaches very low levels (less than 1 to 2 mg/L) during July through October as algae transported from Upper Klamath Lake settle out of the water and decay (see Figure 3.4-9). Decomposition of algae transported from Upper Klamath Lake appears to be the primary driver of low oxygen in the Keno Impoundment/Lake Ewauna. Dissolved oxygen concentrations measured in 2005 from the downstream end of Lake Ewauna to Keno Dam ranged from 7 to 8 mg/L in the early spring, and by late July concentrations were less than 2 mg/L throughout the water column (Deas and Vaughn 2006). During this same period, dissolved oxygen concentrations in Link River inflow were 7 to 8 mg/L, but apparently had little effect on the dissolved oxygen concentrations in the Keno Impoundment. Continuous dissolved oxygen data collected by Reclamation at Klamath River upstream of Keno Dam (USGS gage no. 11509370) for the period January 2006 through December 2018 exhibit seasonally low dissolved oxygen concentrations (less than 1 mg/L to 5 mg/L) from July through October.

C.4.1.2 Hydroelectric Reach

Dissolved oxygen concentrations in the Hydroelectric Reach vary on a seasonal and daily basis (e.g., FISHPRO 2000; PacifiCorp 2004b, 2008a; FERC 2007; Raymond 2008, 2009, 2010; USFWS 2008; Kirk et al. 2010; Zedonis and Turner 2010; Asarian and Kann 2011; Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015). Historical (1950 to 2001) data collected during daytime at various times in the year show median dissolved oxygen concentrations of approximately 5 to 8 mg/L in the Upper Klamath River between J.C. Boyle Reservoir and Iron Gate Dam, with the lowest median values occurring at RM 201.8 and RM 193.1 corresponding to Copco No. 1 Reservoir and Iron Gate Reservoir, respectively (Figure C-27). The highest historical median dissolved oxygen concentrations in the Hydroelectric Reach occur from RM 229.8 to RM 201.8 downstream of J.C. Boyle and upstream of Copco No. 1 Reservoir. Historical water column oxygen demand data is also available for the Hydroelectric Reach from J.C. Boyle to Iron Gate reservoirs. The historical record indicates relatively low biological oxygen demand (BOD) in the Lower Klamath Project reservoirs (Figure C-28).

During summer months, the Lower Klamath Project reservoirs exhibit varying degrees of dissolved oxygen supersaturation in surface waters due to high rates of phytoplankton photosynthesis and hypolimnetic anoxia as dissolved oxygen is depleted in bottom waters during seasonal thermal stratification and microbial decomposition of dead phytoplankton. While reaeration in the reach between Keno Dam and J.C. Boyle Reservoir can increase dissolved oxygen concentrations in the river to near saturation levels, the high oxygen demand in water entering J.C. Boyle Reservoir and a vertical water temperature gradient driven by diurnal fluctuations in river water temperature that limit vertical mixing from July to mid-September can still reduce dissolved oxygen concentrations in the reservoir itself (Figure C-29; Raymond 2008, 2009, 2010).

Peaking operations from J.C. Boyle Dam seem to have a negligible effect on dissolved oxygen concentrations between J.C. Boyle and Copco No. 1 because the free-flowing river upstream of J.C. Boyle and the high velocity of peaking flows provides sufficient aeration (PacifiCorp 2004b). Dissolved oxygen concentrations in Copco No. 1 and Iron Gate reservoirs vary seasonally with thermal stratification that limits mixing of surface and bottom waters and results in decreasing dissolved oxygen concentrations with depth. Copco No. 1 and Iron Gate reservoirs thermally stratify beginning in April or May and do not mix again until October to December with Iron Gate achieving complete mixing approximately a month later than Copco No. 1 (FERC 2007; Asarian and Kann 2011). During the stratification time period, dissolved oxygen concentrations in Iron Gate and Copco No. 1 surface waters generally are at or above saturation likely due to photosynthesis by aquatic plants and phytoplankton growth concentrating near the reservoirs' surface (Asarian and Kann 2011). Dissolved oxygen concentrations in the hypolimnetic waters near the bottom of the reservoirs are much lower reaching minimum values near 0 mg/L by July (for example, see 2008 data shown in Figures C-30 and C-31). Low dissolved oxygen concentrations (less than 3 mg/L) extend further up in the water column and longer in the season in Iron Gate Reservoir than in Copco No. 1 Reservoir (Figure C-32; Asarian and Kann 2011).

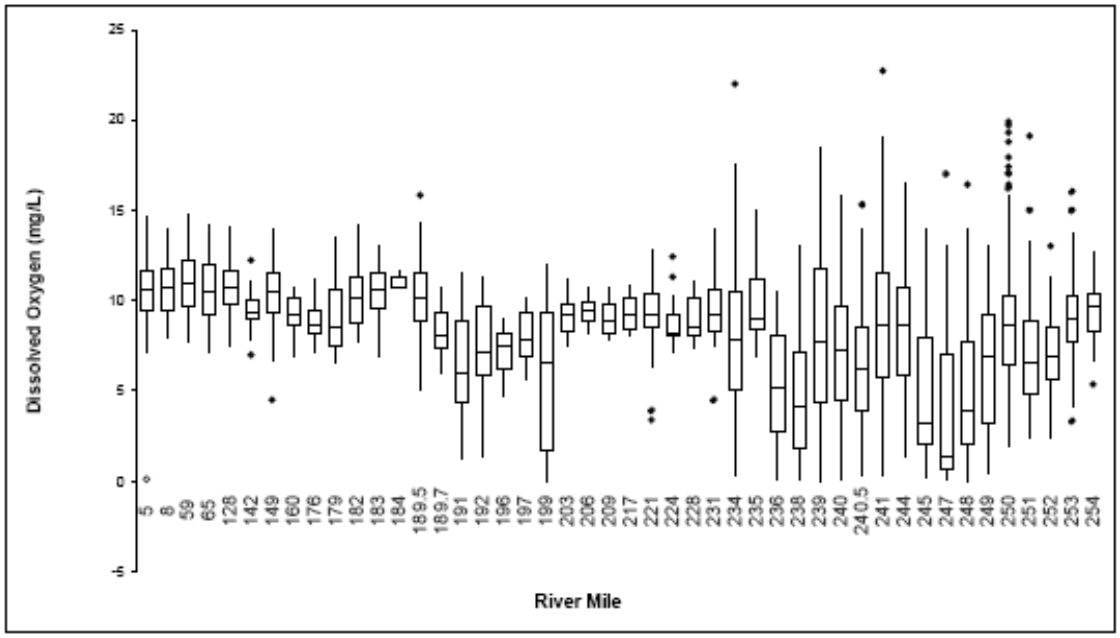

Figure C-27. Box and Whisker Plot of Historical Dissolved Oxygen Concentration Data Collected as Daytime Grab Samples from Various Sites in the Klamath River from Klamath River at Klamath Glen (RM 5.9) to Klamath River at Link River Dam (RM 259.7) between 1950 and 2001. Source: PacifiCorp 2004b.

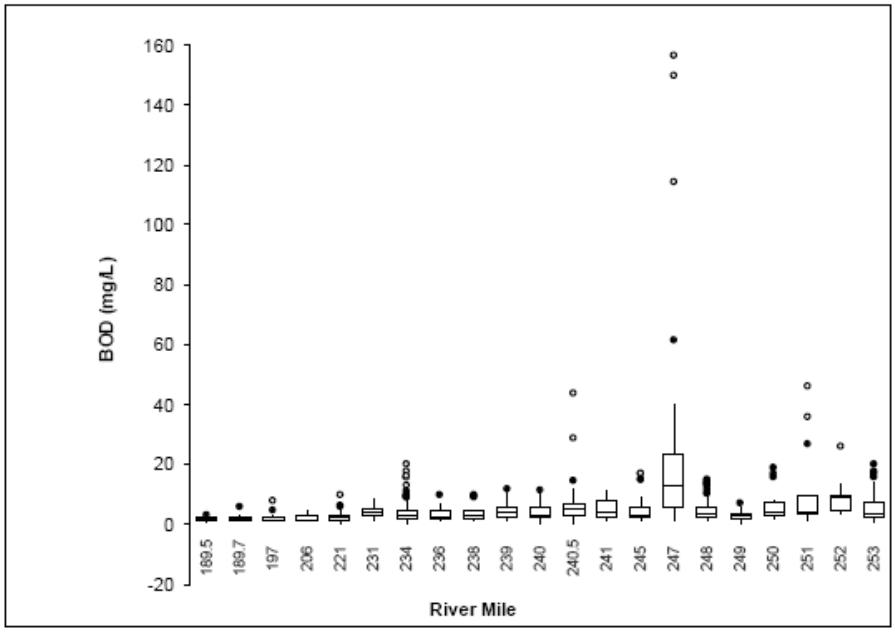

Figure C-28. Box and Whisker Plot of Historical BOD Data Collected from Riverine Sites in the Klamath River Between 1950 and 2001. J.C. Boyle Reservoir (RM 229.8 to RM 233.3), Copco No. 1 Reservoir (RM 201.8 to RM 208.3), Copco No. 2 Reservoir (RM 201.5 to RM 201.8), Iron Gate Reservoir (RM 193.1 to RM 200.0). Source: PacifiCorp 2004b.

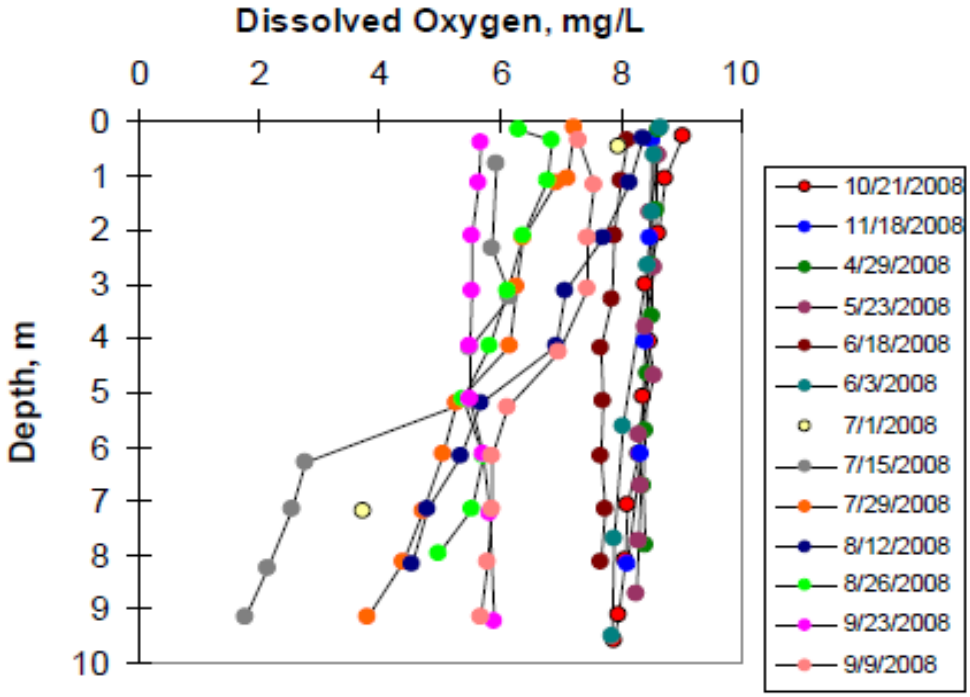

Figure C-29. Vertical Profiles of Dissolved Oxygen Concentration Measured in J.C. Boyle Reservoir Near the Dam in 2008. Source: Raymond 2009.

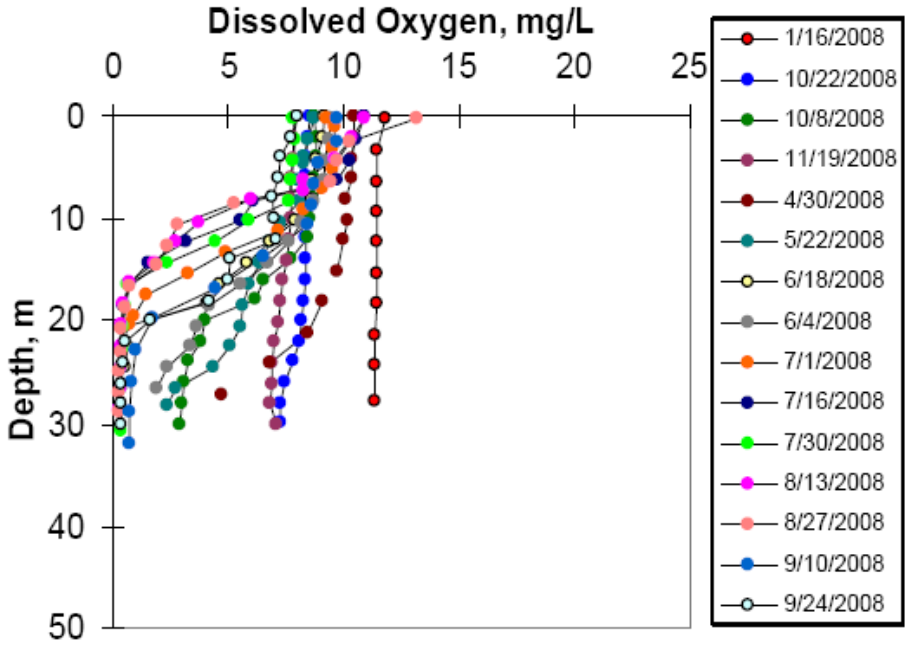

Figure C-30. Vertical Profiles of Dissolved Oxygen Concentration Measured in Copco No. 1 Reservoir Near the Dam in 2008. Source: Raymond 2009.

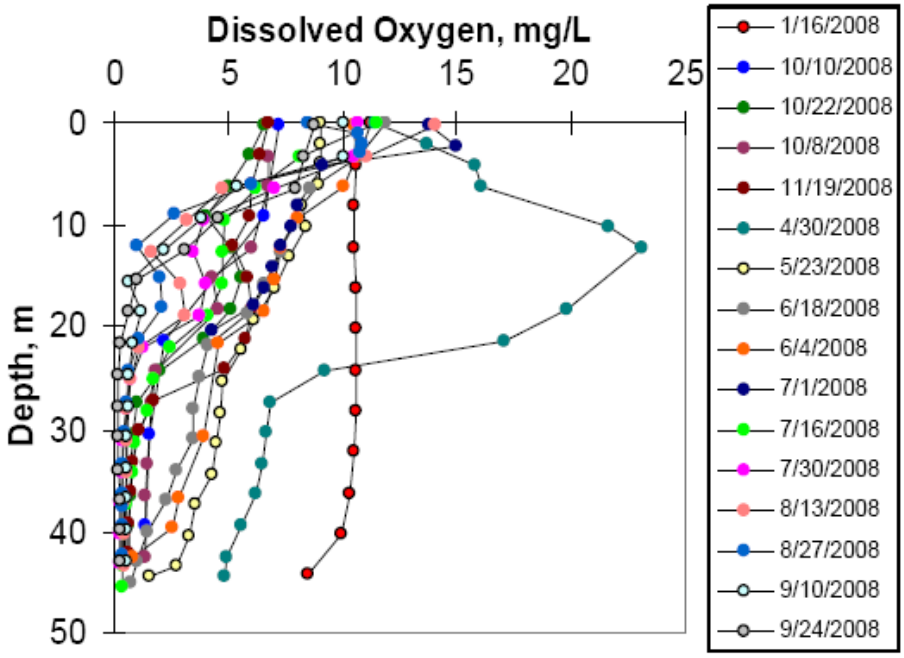

Figure C-31. Vertical Profiles of Dissolved Oxygen Concentration Measured in Iron Gate Reservoir Near the Dam (Bottom Plot) in 2008. Source: Raymond 2009.

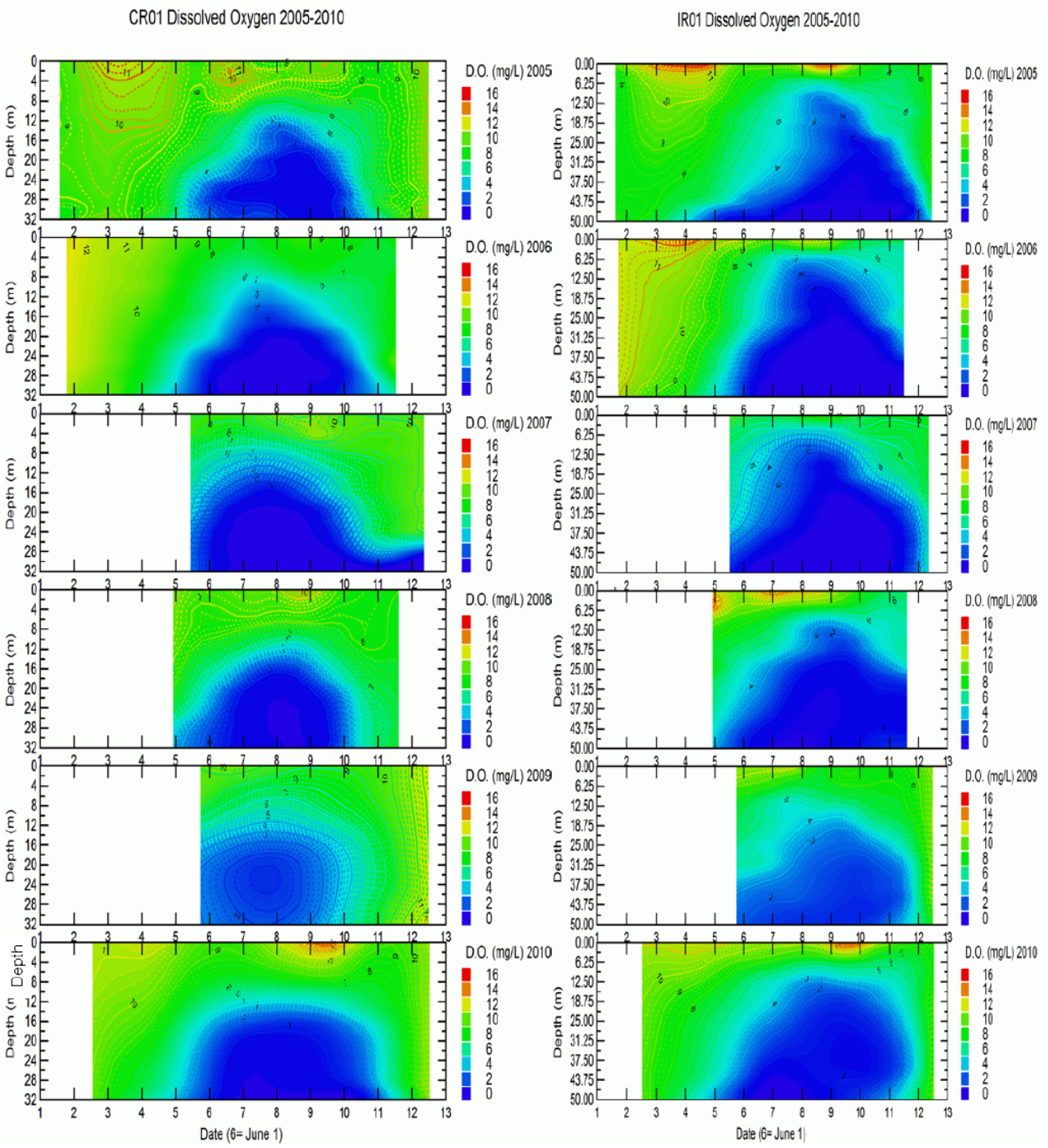

Figure C-32. Depth-time Distribution of Isopleths of Dissolved Oxygen Concentrations in Copco No. 1 Reservoir (CR01) and in Iron Gate Reservoir (IR01) from January 2005-December 2010. Source: Asarian and Kann 2011.

Substantial depression of dissolved oxygen concentrations with depth are reported in Iron Gate Reservoir as early as 1975 as part of the United States Environmental Protection Agency (USEPA) National Eutrophication Study (USEPA 1978). While

minimum dissolved oxygen concentrations generally occur coincident with maximum water temperatures in July and August, low dissolved oxygen concentrations (62 percent less than 8.0 mg/L and 11 percent less than 6.0 mg/L) and dissolved oxygen percent saturation (74 percent less than 90 percent saturation, 61 percent less than 85 percent saturation) occur in October at Iron Gate Reservoir. The lower dissolved oxygen concentrations and their occurrence later in the season at Iron Gate Reservoir is likely associated with the decomposition of cyanobacteria [blue-green algae] biomass as seasonal blooms decline and the breakdown of thermal stratification in the reservoir (Asarian and Kann 2013).

Daily patterns in dissolved oxygen concentrations follow a 24-hour cycle with photosynthesis by aquatic plants and phytoplankton elevating dissolved oxygen concentrations during the day and respiration by those same organisms decreasing dissolved oxygen concentrations at night. The daily dissolved oxygen concentration range has a seasonal trend typically peaking between late July and early September. The magnitude of the 24-hour variations in dissolved oxygen concentration is muted in Iron Gate Reservoir compared to other sections of the river due to the reservoir thermal mass and the depth water is withdrawn from the reservoir (Asarian and Kann 2013).

In addition to the biological oxygen demand from aerobic organisms in the water column itself, there is also a sediment oxygen demand that also that influences dissolved oxygen concentrations in the water column. Sediment oxygen demand is the rate at which dissolved oxygen is removed from the water column by the decomposition of organic matter in streambed or lakebed sediments. In lakes, reservoirs, and rivers, sediment oxygen demand can affect the level of dissolved oxygen concentrations in the water column (Doyle and Lynch 2005). Sediment oxygen demand ranges from approximately 1.75 to 3.25 grams of oxygen per square meter per day (g O_2/m^2/day) in sediment cores from three locations in J.C. Boyle sampled in 2002. The sediment oxygen demand from Copco No. 1 and Iron Gate reservoirs ranges from approximately 1.0 to 2.0 g O_2/m^2/day (FERC 2007). A comparison of the total oxygen required to meet the sediment oxygen demand and the water column biological oxygen demand in the reservoirs indicates that the sediment oxygen demand in J.C. Boyle was much less than water column biological oxygen demand and thus the sediments are not the largest influence on dissolved oxygen concentrations in J.C. Boyle Reservoir. Conversely, the sediment oxygen demand was greater than the water column biological oxygen demand in Copco No. 1 and Iron Gate reservoirs, indicating that sediment oxygen demand has a greater influence on water column dissolved oxygen concentrations in the two larger reservoirs (PacifiCorp 2004b).

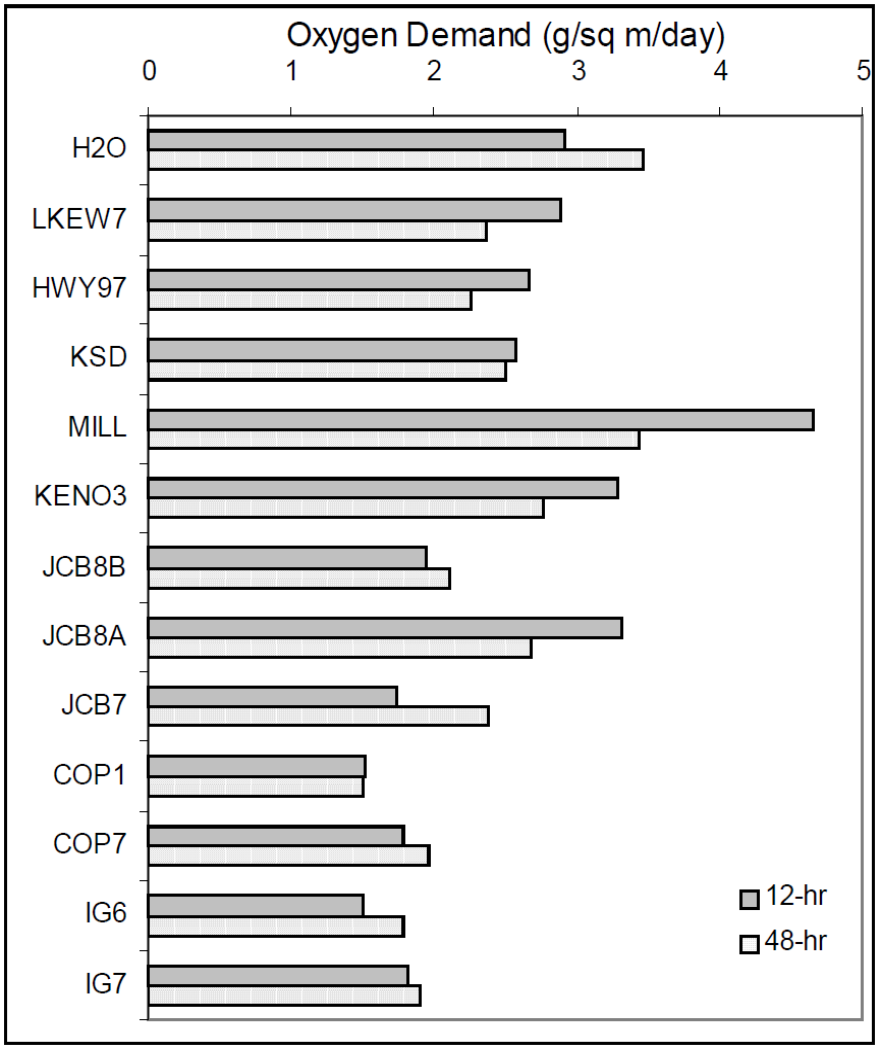

Figure C-33. Sediment Oxygen Demand from Sediment Cores at Multiple Locations within J.C. Boyle (JCB8B, JCB8A, JCB7), Copco No. 1 (COP1 and COP7), and Iron Gate (IG6 and IG7) Reservoirs. Source: PacifiCorp 2004b.

C.4.2 Mid- and Lower Klamath Basin

C.4.2.1 Iron Gate Dam to Salmon River

Historical (1950 to 2001) dissolved oxygen concentrations (reflecting day time grab sampling) in the Klamath River downstream of Iron Gate Dam are variable with dissolved oxygen concentrations approaching saturation values in Klamath River reaches that are free-flowing (PacifiCorp 2004b). Discharges occur from depths of approximately 12 meters in Iron Gate Reservoir, so downstream dissolved oxygen concentrations tend to reflect oxygen conditions of the reservoir's lower epilimnion (Section C.4.1.1) when the reservoir is stratified, with some increases in dissolved oxygen concentrations as the water is re-aerated upon discharge. In the fall, before and after reservoir turnover, low dissolved oxygen concentrations from the hypolimnion can

be translated downstream. Dissolved oxygen concentration median values between 1950 and 2001 were 8.1 to 10.8 mg/L in the Klamath River between Iron Gate Dam and the confluence with the Salmon River, with the lowest median values and the greatest general variability in the first mile downstream from the dam (Figure C-27, PacifiCorp 2004b).

More recent data indicates dissolved oxygen concentrations immediately downstream from Iron Gate Dam regularly fall below 8.0 mg/L and the current Basin Plan minimum dissolved oxygen criteria based on percent saturation (Figure C-34) (Karuk Tribe of California 2001, 2002, 2003, 2007, 2009, 2010a, 2010b, 2011, 2012, 2013; North Coast Regional Board 2010; Asarian and Kann 2011, 2013; Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015, 2016). Based on continuous sonde data collected at multiple locations in the lower Klamath River during summer 2004 to 2006, roughly 45 to 65 percent of measurements immediately downstream from Iron Gate Dam did not achieve the (previous) Basin Plan water quality objective of 8.0 mg/L (instantaneous minimum concentration). The Basin Plan water quality objective is now based on percent saturation. The percent of dissolved oxygen concentration measurements below 8.0 mg/L decreases with distance downstream, particularly in 2005 and 2006. Table C-2 summarizes the percent of dissolved oxygen concentrations in the Lower Klamath River below 8.0 mg/L during Summer 2004 to 2006.

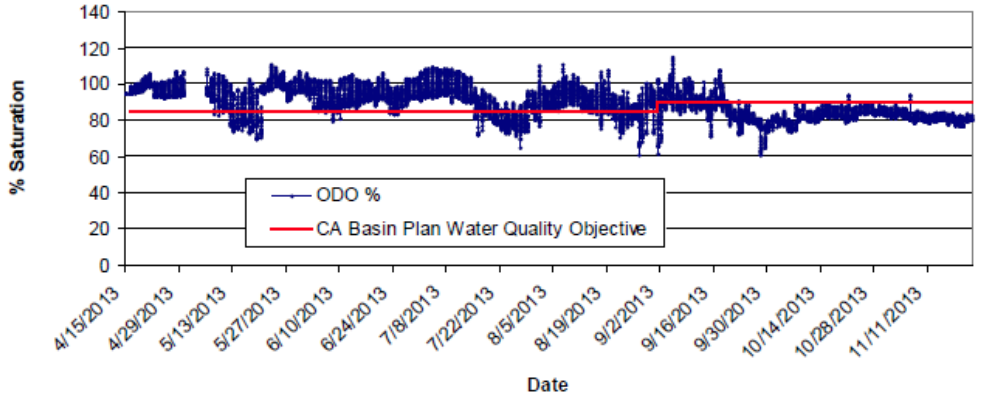

Figure C-34. Percent saturation dissolved oxygen readings recorded every 30-minutes for Klamath River below Iron Gate Dam (IG) in 2013. The red line indicates the Basin Plan Klamath River site-specific dissolved oxygen water quality objective from the Oregon-California state line to the mouth of the Scott River (greater than 90 percent saturation from October 1 to March 30 and greater than 85 percent saturation from April 1 to September 30. Source: Karuk Tribe of California (2013).

Continuous Sonde data collected between 2001 and 2017 show the range of daily average dissolved oxygen concentrations downstream from Iron Gate Dam (RM 193.1) between September through October and in November (Table C-3). Analysis of the longer dataset from 2001 to 2017 agrees with the 2004 to 2006 analysis results showing dissolved oxygen concentrations are less than 8.0 mg/L for June to October immediately downstream of Iron Gate Dam approximately 48 percent of the time. Asarian and Kann (2013) note that dissolved oxygen concentrations immediately downstream of Iron Gate Dam exceed water quality thresholds later in the year than other sites downstream of

Iron Gate Dam. *In situ* continuous data collected during 2008 to 2017 by PacifiCorp in the Klamath River downstream from Iron Gate Dam also demonstrate the seasonal decreases in dissolved oxygen (measured as percent saturation and concentration) originating from the reservoirs, with the lowest average monthly values occurring in August (warmer water temperatures) through November (cooler water temperatures), depending on the year (Table C-4).

In 2008, PacifiCorp began implementation of turbine venting at Iron Gate Dam as KHSA Interim Measure 3, with the goal of improving dissolved oxygen concentrations immediately downstream from the dam during periods of reservoir stratification. Early testing results in 2008 indicated that dissolved oxygen concentrations immediately downstream from Iron Gate Dam could be increased by approximately 0.5 to 2 mg/L (approximately 7 to 20 percent dissolved oxygen saturation) through the mechanical introduction of oxygen as water passed through the turbines (Carlson and Foster 2008, PacifiCorp 2008a). In 2009, PacifiCorp installed a forced air blower to enhance aeration, which became fully operational in 2010. The combination of turbine venting and the blower during the 2010 testing period increased dissolved oxygen immediately downstream of the dam from approximately 50 percent saturation to approximately 70 percent saturation. Further downstream, 2.5 river miles from the dam, the combination of turbine venting and the blower increased dissolved oxygen from approximately 65 percent saturation to approximately 80 percent saturation. By approximately six river miles downstream from the dam, natural river aeration increased dissolved oxygen concentrations sufficiently that there was no difference between periods with turbine venting plus blower operation and periods without (PacifiCorp 2011). Currently, and on a year-round basis, PacifiCorp automatically operates the blower when dissolved oxygen levels drop below 87 percent saturation and the blower is automatically turned off when dissolved oxygen levels exceed 87 percent saturation.

Despite the improvements reported during 2008 and 2011, and as discussed in the previous paragraphs, dissolved oxygen immediately downstream of Iron Gate Dam has continued to exhibit percent saturation values below the Basin Plan Basin Plan minimum dissolved oxygen criteria of 85 percent saturation for the period April 1 through September 30, and below the minimum criterion of 90 percent saturation for the period October 1 to March 31, with the majority of measured low dissolved oxygen saturation values occurring from August through November (PacifiCorp 2013, 2014, 2014, 2015, 2016, 2017, Karuk Tribe of California 2012, 2013).

Table C-2. Percent of Dissolved Oxygen Concentrations below 8.0 mg/L in the Lower Klamath River during Summer 2004 to 2006.

Location	2004		2005		2006	
	n [(1)]	%	n [(1)]	%	n [(1)]	%
At Iron Gate Dam (RM 193.1)	2,706	64	4,498	45	5,391	61
Upstream of Shasta River (RM 179.5)	5,478	50	5,533	49	-	-
Upstream of Scott River (RM 145.1)	2,966	58	4,457	47	-	-
Seiad Valley (RM 132.7)	3,381	57	4,713	45	5,526	40
Orleans (RM 58.9)	57	37	4,533	23	5,349	15
Weitchpec (RM 43.6)	4,142	48	5,400	7	5,332	6
Downstream from Weitchpec (≈ RM 43.4)	5,500	16	3,529	11	5,293	4
Upstream of Trinity (RM 43.3)	-	-	5,535	5	5,739	3
Turwar (RM 5.6)	5,066	30	5,543	6	-	-

Source: Ward and Armstrong 2006, North Coast Regional Board 2010.

[1] Dissolved oxygen measurements were collected at 30-minute increments for a total of forty-eight daily measurements.

Key:

n=number of measurements

%=percent of measurements not achieving the Basin Plan previous water quality objective of 8.0 mg/L

Table C-3. Range of Observed Dissolved Oxygen Concentrations Downstream from Iron Gate Reservoir.

Year	General Range of Daily Average Dissolved Oxygen (mg/L) downstream from Iron Gate Dam (RM 193.1, near USGS Gage No. 11516530)		
	September–October	November	Source
2001	4–6[(1)]	7–8	Karuk Tribe of California 2003
2002	4–9[(2)]	-	Karuk Tribe of California 2003
2004	6–9.5	8–9	Zedonis and Turner 2010
2006	6.5–8	7–8	Karuk Tribe of California 2009
2007	7–9[(2)]	-	Karuk Tribe of California 2009
2008	6.5–8.5	-	Karuk Tribe of California 2009
2009	7.5–10	-	Karuk Tribe of California 2010a
2010	7–9.5	-	Karuk Tribe of California 2010b
2011	7–9.5	8–9.5	Karuk Tribe of California 2011
2012	6–9.5	7.5–8.5	Karuk Tribe of California 2012
2013	7–9	8.5–9.5	Karuk Tribe of California 2013
2014	6–13	8.5–11	PacifiCorp 2014
2015	7–9	7–9	PacifiCorp 2015
2016	6–9.5	8–9	PacifiCorp 2016
2017	5–10	8–9.5	PacifiCorp 2017

[1] No September data reported

[2] No October data reported

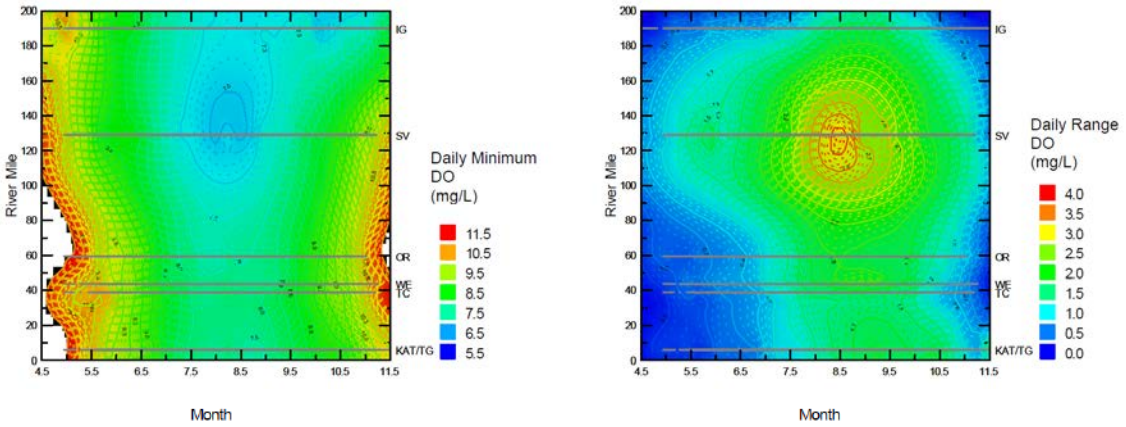

Figure C-35. Distribution of Isopleths Showing the 2001-2011 Average Daily Minimum Dissolved Oxygen (DO) Concentrations and Daily Range of Dissolved Oxygen (DO) Concentrations at Klamath River Sites Downstream of Iron Gate Dam from Around Mid-April (4.5) to Mid-November (11.5). Grey Lines Represent the Times Dissolved Oxygen Was Measured in the Klamath River Downstream of Iron Gate Dam (IG at RM 193.1), at Seiad Valley (SV at RM 132.7), at Orleans (OR at RM 58.9), at Weitchpec Upstream of the Trinity River (WE at RM 43.6), Upstream of Tully Creek (TC at RM 40.1), and at Turwar (KAT/TG at RM 5.6). Source: Asarian and Kann 2013.

It has been suggested that daily fluctuations of up to 3 mg/L measured in the Klamath River downstream from Iron Gate Dam (RM 193.1) (Karuk Tribe of California 2002, 2003; YTEP 2005; North Coast Regional Board 2010; Asarian and Kann 2011, 2013) are caused by daytime phytoplankton photosynthesis and nighttime respiration. Low dissolved oxygen concentrations can also be often caused by bacterial aerobic decomposition of phytoplankton in the reservoir (Ward and Armstrong 2010).

Table C-4. Average Monthly Water Temperature, Dissolved Oxygen Percent Saturation, and Dissolved Oxygen Concentration in the Klamath River Downstream from Iron Gate Dam (RM 193.1).

Month	Average Monthly Water Temperature (°C)	Average Monthly Dissolved Oxygen (% Saturation)	Average Monthly Dissolved Oxygen (mg/L)
2008			
June	18.4	92.2	8.7
July	22.3	90.0	7.8
August	21.8	91.8	8.0
September	18.6	84.5	7.9
October	14.8	66.2	6.7
November	10.3	67.4	7.5
December	7.0	70.0	8.5
2009			
January	3.7	79.4	10.5
February	4.4	83.0	10.8
March	6.7	83.2	10.2
April	8.4	82.2	9.6
May	17.4	94.4	9.0
June	19.3	87.9	8.1

Month	Average Monthly Water Temperature (°C)	Average Monthly Dissolved Oxygen (% Saturation)	Average Monthly Dissolved Oxygen (mg/L)
July	21.2	86.8	7.7
August	21.7	99.9	8.8
September	19.4	95.7	8.8
October	14.6	77.7	7.9
November	9.9	71.2	8.1
December	5.0	81.2	10.4
2010			
January	3.9	94.2	11.4
February	5.4	100.2	11.1
March	7.2	96.6	10.5
April	9.5	108.9	11.4
May	12.7	104.8	10.2
June	16.8	94.9	8.5
July	21.3	98.8	8.1
August	21.9	95.9	7.7
September	18.4	105.2	9.1
October	15.5	92.5	8.5
November	11.8	62.5	6.2
2011			
January	4.0	90.2	10.9
February	4.6	95.0	11.3
March	5.8	96.3	11.1
April	9.2	101.4	10.7
May	12.9	107.1	10.4
June	16.1	100.9	9.2
July	20.6	94.0	7.8
August	22.2	97.9	7.8
September	20.2	93.4	7.8
October	16.0	92.1	8.4
November	10.1	74.6	7.8
December	5.6	90.2	10.5
2012			
January	3.8	12.0	90.8
February	4.3	12.6	96.2
March	5.8	12.0	95.7
April	9.4	10.6	92.2
May	15.5	9.5	94.9
June	17.8	8.8	92.2
July	20.9	8.2	91.7
August	21.9	7.5	85.0
September	19.5	7.7	83.1
October	16.1	7.2	72.9
November	11.3	8.0	72.3
December	7.2	9.7	79.8
2013			
January	15.2	97.8	9.1
February	8.5	96.6	10.4
March	11.4	102.4	10.3
April	16.0	107.8	9.8
May	18.9	105.6	9.0
June	21.7	101.6	8.2

Month	Average Monthly Water Temperature (°C)	Average Monthly Dissolved Oxygen (% Saturation)	Average Monthly Dissolved Oxygen (mg/L)
July	21.4	100.3	8.2
August	19.9	92.5	7.8
September	14.2	89.5	8.5
October	10.0	89.6	9.4
November	5.3	91.2	10.7
December	15.2	97.8	9.1
2014			
January	3.8	94.0	11.5
February	4.7	99.3	11.9
March	8.4	98.6	10.9
April	12.0	97.1	9.9
May	16.7	101.4	9.3
June	19.3	101.0	8.7
July	22.3	103.6	8.6
August	22.0	111.1	9.8
September	19.3	104.7	9.7
October	15.8	80.3	8.0
November	11.0	87.1	9.7
December	7.6	91.0	10.9
2015			
January	5.7	93.5	11.7
February	-	-	-
March	10.3	103.5	11.6
April	12.0	93.4	10.1
May	15.9	96.9	9.6
June	20.0	94.4	8.6
July	22.4	91.9	8.0
August	20.9	83.3	7.4
September	18.7	80.0	7.5
October	15.8	79.5	7.9
November	11.6	78.2	8.5
December	6.8	85.3	10.4
2016			
January	4.3	103.8	12.5
February	5.2	101.3	11.9
March	7.7	103.6	11.4
April	12.4	101.7	10.1
May	15.7	105.9	9.7
June	19.0	103.3	8.9
July	20.2	93.7	7.9
August	21.4	81.9	6.7
September	18.7	77.8	7.2
October	15.0	84.1	8.1
November	11.3	87.1	8.9
December	7.0	91.3	10.3
2017			
January	2.9	90.3	12.2
February	4.3	97.8	12.7
March	7.2	102.7	12.4
April	10.2	106.1	11.2
May	14.7	94.2	9.6

Month	Average Monthly Water Temperature (°C)	Average Monthly Dissolved Oxygen (% Saturation)	Average Monthly Dissolved Oxygen (mg/L)
June	19.4	97.5	8.5
July	21.9	89.3	7.8
August	22.3	79.2	6.9
September	19.9	74.0	6.7
October	14.3	73.4	7.5
November	10.5	78.8	8.8
December	6.6	84.6	10.4

Raw daily data from http://www.pacificorp.com/es/hydro/hl/kr.html# (PacifiCorp 2008b, 2009, 2010b, 2011, 2012, 2013, 2014, 2015 2016, 2017). Data obtained with YSI 6600 V2 or 6900 Multiprobe DataSondes (30-minute intervals).

Farther downstream in the mainstem Klamath River, near Seiad Valley (RM 132.7), dissolved oxygen concentrations tend to increase; however, values below 8.0 mg/L do still occur (i.e., 2001, 2002, 2006, 2007, 2010, 2011, 2012, 2013, 2014, and 2015 as reported in Karuk Tribe of California [2001, 2002, 2009, 2010b, 2011, 2012, 2013] and Watercourse Engineering, Inc. [2011a, 2011b, 2012, 2013, 2014, 2015, 2016]). Dissolved oxygen concentrations near Seiad Valley continue to exhibit variability, with mean daily values ranging from approximately 6.5 mg/L to supersaturated concentrations of approximately 11.5 mg/L from June through November 2001 to 2002 and 2006 to 2013 (Karuk Tribe of California 2001, 2002, 2003, 2007, 2009, 2010a, 2010b, 2011, 2012, 2013). Longitudinal variations in dissolved oxygen concentrations from Iron Gate Dam (RM 193.1) to Seiad Valley (RM 132.7) are most pronounced between mid-September and November when dissolved oxygen concentrations decrease immediately downstream of Iron Gate but increase at Seiad Valley (Karuk Tribe of California 2013). Dissolved oxygen concentrations at Seiad Valley between 2001 and 2011 are less than the 8.0 mg/L, 90 percent saturation, and 85 percent saturation water quality thresholds less frequently than immediately downstream of Iron Gate Dam, but still are less than these water quality thresholds more frequently than further downstream sites (Asarian and Kann 2013). Between July and September, dissolved oxygen concentrations at Seiad Valley are less than 8.0 mg/L for 29 to 51 percent of measurements, less than 90 percent saturation for 28 to 34 percent of measurements, and less than 85 percent saturation for 10 to 18 percent of measurements (Asarian and Kann 2013). More contemporary data from 2012 to 2016 have dissolved oxygen concentration patterns similar to previous measurements with concentrations ranging from approximately 6.0 mg/L to (supersaturated concentrations of) approximately 12 mg/L from June through November and dissolved oxygen concentrations regularly less than 8.0 mg/L during that time period (Watercourse Engineering, Inc. 2013, 2014, 2015, 2016).

C.4.2.2 Salmon River to Estuary

Measured dissolved oxygen concentrations in the mainstem Klamath River downstream from the confluence with the Salmon River (RM 66.3) continue to increase relative to concentrations at upstream sites (Figure C-36). Despite this, values sometimes fall below 8.0 mg/L in this reach (e.g., at the Orleans gage [RM 58.9] during 2001, 2002, 2006, 2012, 2013 as reported in Karuk Tribe of California [2001, 2002, 2007, 2009, 2010a, 2010b, 2011, 2012, 2013], Ward and Armstrong 2006, North Coast Regional Board 2010). Dissolved oxygen concentrations near Orleans also exhibit variability, with

mean daily values ranging from approximately 6.5 mg/L to supersaturated concentrations of 11.5 mg/L from June through November in 2001, 2002, and 2006 to 2013. Asarian and Kann (2013) report dissolved oxygen concentrations at Orleans are less than 8.0 mg/L for 16 percent of measurements, less than 90 percent saturation for 10 percent of measurements, and less than 85 percent saturation for only 1 percent of measurements between June and October from 2001 to 2011. Dissolved oxygen concentrations were most frequently less than the 8.0 mg/L, 90 percent saturation, and 85 percent saturation water quality thresholds during July and August when water temperature peaked (Asarian and Kann 2013). Extremely high mean daily dissolved oxygen concentrations (11 to 15.5 mg/L) (Sonde data) were reported for October 2006 at the Orleans gage (Karuk Tribe of California 2007, 2009). More contemporary grab sample data from 2012 to 2015 agree with previous measurements showing dissolved oxygen concentrations generally increase from Seiad Valley (RM 132.7) to Orleans (RM 58.9) with dissolved oxygen concentrations ranging from approximately 7.5 mg/L to supersaturated concentrations of approximately 11.5 mg/L between June and November with the minimum concentrations occurring in July or August (Figure C-36; Watercourse Engineering, Inc. 2013, 2014, 2015, 2016).

Dissolved oxygen concentrations in the mainstem Klamath River upstream of the confluence with the Trinity River (RM 43.3) ranged from approximately 5.5 to 10.3 mg/L in 2004, with the lowest concentration of dissolved oxygen occurring in September and the highest dissolved oxygen concentration occurring in October. Dissolved oxygen concentrations below 8.0 mg/L (the Basin Plan minimum dissolved oxygen criterion prior to 2010) occurred for extended periods of time in mid-August (8/13 to 8/22) and early September (8/30 to 9/8) (YTEP 2005). In 2009 at this location, dissolved oxygen concentrations ranged from approximately 7.1 to 11.8 mg/L, with minimum dissolved oxygen concentrations dropping below 8.0 mg/L (the Basin Plan minimum dissolved oxygen criterion prior to 2010) for an extended period of time from mid-July to early August, and again from late August to early September (Sinnott 2010a). In 2010, dissolved oxygen concentrations ranged from 7.9 to 12.1 mg/L (Sinnott 2011a), with minimum dissolved oxygen concentrations remaining above the 2010 amended Basin Plan minimum dissolved oxygen concentration criteria based on percent saturation (e.g., 7.0, 6.9, and 7.8 mg/L for July, August, and September, respectively, see Section 3.2, Table 3.2-5). A synthesis of dissolved oxygen concentration data from 2001 to 2011 at Weitchpec (RM 43.6) on the mainstem Klamath River upstream of the confluence with the Trinity River indicates dissolved oxygen concentrations are below 8.0 mg/L most frequently between July and August, but the dissolved oxygen percent saturation is most frequently below 90 percent or 85 percent in August and September (Asarian and Kann 2013). On average, between June and October from 2001 to 2011, dissolved oxygen concentrations at Weitchpec (RM 43.6) are less than 8.0 mg/L for 16 percent of measurements, less than 90 percent saturation for 12 percent of measurements, and less than 85 percent saturation for only 5 percent of measurements. While only based on discrete dissolved oxygen concentration measurements during water quality grab samples, dissolved oxygen concentrations at Weitchpec (RM 43.6) from 2011 to 2015 are similar to previous measurements with concentrations ranging from approximately 8.0 mg/L to supersaturated concentrations of approximately 11.5 mg/L between June and November (Figure C-36; Sinnott 2010a, 2011a, 2012a; Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015; Hanington 2013; Hanington and Ellien 2013).

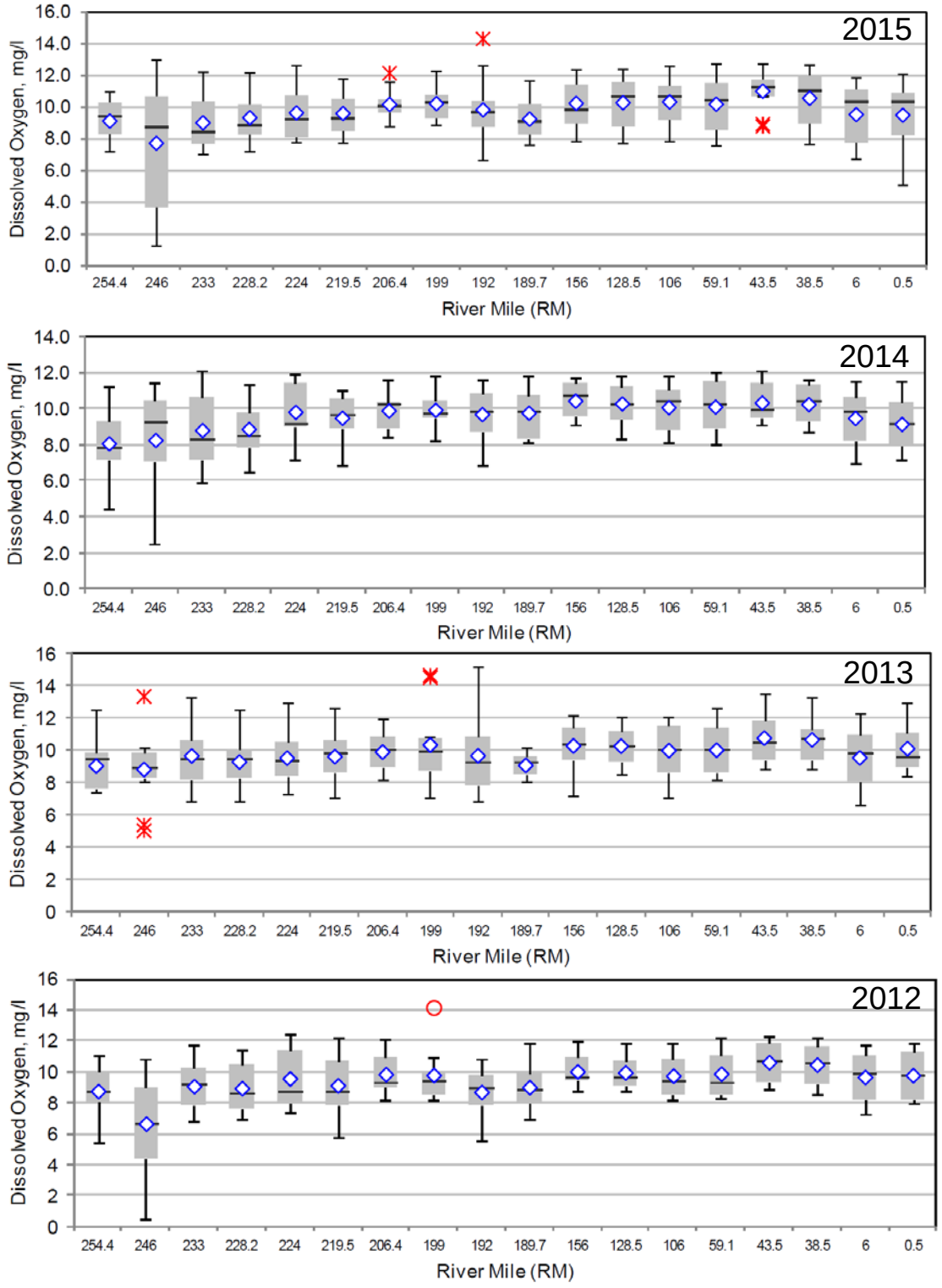

Figure C-36. Klamath River dissolved oxygen concentration trends from measurements made between February and December with median (-), mean (◊), outlier (*), and extreme outliers (○) identified. River miles specified are based on those accurate at the time of the reports and differ slightly from 2018 river mile designations (Table 3.2-1). Source: Watercourse Engineering, Inc. 2013, 2014, 2015, 2016.

Dissolved oxygen concentrations tend to decrease downstream from the confluence of the Trinity River with the Klamath River (Sinnott 2010a, 2011a, 2012a; Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015; Asarian and Kann 2013; Hanington 2013; Hanington and Ellien 2013). At the confluence with the Trinity River (RM 43.3) and at the Turwar gage (RM 5.6), daily minimum dissolved oxygen concentrations at the Trinity River and Turwar sites during May through November are consistently observed to occur late-night or early in the morning, likely due to respiration by aquatic vegetation (YTEP 2004, 2005; Sinnott 2010a, 2011a). At Turwar (RM 5.6) in 2004, minimum dissolved oxygen concentrations dropped below 8.0 mg/L (the Basin Plan minimum dissolved oxygen criterion prior to 2010) between late July and late August (YTEP 2005); dissolved oxygen concentrations ranging 5.9 to 10.1 mg/L were observed in August and September. In 2009, dissolved oxygen concentrations at Turwar ranged from 7.3 to 11.7 mg/L, with minimum dissolved oxygen concentrations dropping below 8.0 mg/L for an extended period of time from mid-July to early August (Sinnott 2010a). In 2010, dissolved oxygen concentrations ranged from 7.8 to 11.8 mg/L, with minimum values remaining above 2010 amended Basin Plan minimum dissolved oxygen concentration criteria based on percent saturation (e.g., 7.0, 6.9, and 7.8 mg/L for July, August, and September, respectively, see Section 3.2, Table 3.2-5). Dissolved oxygen concentration data from 2001 to 2011 downstream of the Trinity River (RM 43.3) and at Turwar (RM 5.6) show dissolved oxygen concentrations are the lowest and most frequently below the 8.0 mg/L, 90 percent saturation, and 85 percent saturation water quality thresholds during July and August (Asarian and Kann 2013). Turwar (RM 5.6) consistently has lower dissolved oxygen concentrations and is more frequently below the 90 percent or the 85 percent saturation levels than the site immediately downstream of the confluence with the Trinity River (RM 43.3) (Asarian and Kann 2013). Dissolved oxygen concentrations downstream of the confluence with the Trinity River (RM 43.3) to Turwar (RM 5.6) from 2011 to 2015 are similar to previous measurements in that reach. During that period, dissolved oxygen concentrations range from approximately 6.5 mg/L to supersaturated concentrations of approximately 11.5 mg/L between June and November with lower dissolved oxygen concentrations occurring more frequently at Turwar and higher dissolved oxygen concentrations occurring more frequently immediately downstream of the confluence with the Trinity River (Figure C-36; Sinnott 2010a, 2011a, 2012a; Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015; Hanington 2013; Hanington and Ellien 2013; Hanington and Cooper Carouseli 2014).

C.4.2.3 Klamath River Estuary

Dissolved oxygen concentrations within the Klamath River Estuary are highly variable spatially and temporally and are greatly influenced by season, river flow, vertical water column stratification (thermal and/or chemical), and location of the estuary mouth, the latter changing due to periodic sand bar movement. Dissolved oxygen concentrations have been monitored in the Klamath River Estuary by CDFG (Wallace 1998) and most recently by the Yurok Tribe Fisheries (Hiner 2006) and Environmental Programs (YTEP 2005) with support from the North Coast Regional Water Quality Control Board. Concentrations in the deeper, main channel of the estuary are generally greater than approximately 6.0 to 7.0 mg/L throughout the year (Hiner 2006; YTEP 2004, 2005).

Lower dissolved oxygen concentrations (ranging 2.5 to 5.5 mg/L) have been measured near the bottom of deep pools or in heavily vegetated side channels (Wallace 1998).

Low dissolved oxygen concentrations (less than 1.0 mg/L to approximately 5.0 mg/L) have been observed during summer months in the relatively shallow, heavily vegetated south slough (Wallace 1998, Hiner 2006). The low levels of dissolved oxygen observed in the slough are likely due to high rates of growth and subsequent decomposition of phytoplankton and aquatic plants, which are not abundant elsewhere in the Klamath River Estuary.

Dissolved oxygen concentrations become progressively more variable and generally lower nearer the estuary bottom and the estuary mouth, with concentrations frequently below 6.0 mg/L during summer months (YTEP 2004, 2005; Hiner 2006). Low dissolved oxygen has also been observed during late summer months when a sand berm forms across the river mouth, forcing the river to flow south diagonally between two sand spits. This berm prevents ocean water from entering the Klamath River Estuary, creating 'lagoon-like' conditions until higher flows breech the berm (Wallace 1998, Hiner 2006). These conditions were documented in 1994 and 2001; in 2001, a decrease in dissolved oxygen concentrations was measured related to sand berm formation, with especially marked decreases in dissolved oxygen concentrations in the south slough (Hiner 2006).

Additional monitoring by the Yurok Tribe Environmental Program from 2009 to 2015 detail more recent dissolved oxygen concentration trends near the surface in the lower Klamath River Estuary (RM 0.5). During that time period, dissolved oxygen concentrations usually range from approximately 7 mg/L to (supersaturated concentrations of) approximately 11 mg/L between June and November, with a particularly low value of 5.08 mg/L recorded on June 10, 2015 (Sinnott 2010a, 2011a, 2012a; Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015, 2016; Hanington 2013; Hanington and Ellien 2013; Hanington and Cooper Carouseli 2014). The dissolved oxygen percent saturation between 2009 and 2014 ranges from approximately 83 percent to 106 percent, with the percent saturation in 2014 exhibiting almost that entire range and broad seasonal variability (Figure C-37; Sinnott 2010a, 2011a, 2012a; Hanington 2013; Hanington and Ellien 2013; Hanington and Cooper Carouseli 2014).

Eilers and Raymond (2005) report sediment oxygen demand from a sediment core taken in the Klamath River Estuary in 2004. The raw sediment oxygen demand in the first 24-hours is 3.21 g O_2/m^2/day while the corrected sediment oxygen demand is 2.06 g O_2/m^2/day. The long-term rate of sediment oxygen demand is approximately 0.5 g O_2/m^2/day after 600 hours of incubation which is attributed to the high proportion of sand in the estuary sediment core (Eilers and Raymond 2005).

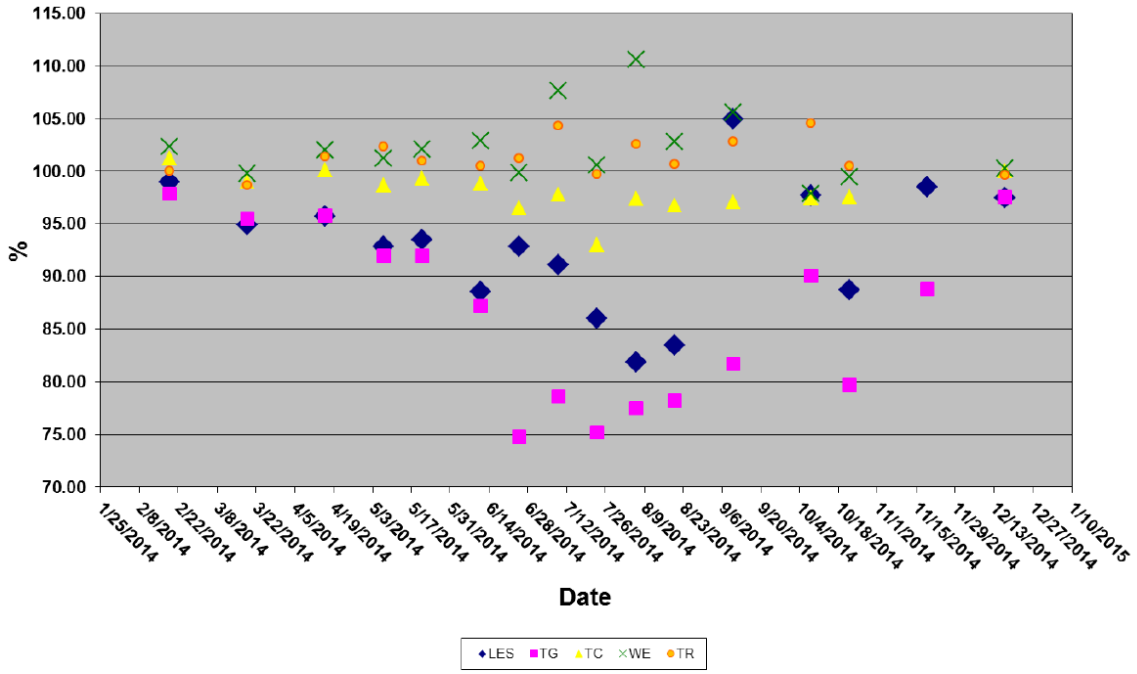

Figure C-37. Percent Saturation of Dissolved Oxygen During Grab Samples at the Lower Estuary Surface (LES [RM 0]), the Klamath River at Turwar Boat Ramp (TG [RM 6]), the Klamath River Upstream of Tully Creek (TC [RM 40.1]), the Klamath River at Weitchpec (Upstream of Trinity River) (WE [RM 43.6]), and the Trinity River Upstream the Confluence with the Klamath River (TR). Source: Hanington and Cooper-Carouseli 2014.

C.5 pH

C.5.1 Upper Klamath Basin

C.5.1.1 Hydroelectric Reach

Based upon monitoring conducted by PacifiCorp, pH in the Hydroelectric Reach is seasonally variable, with levels near neutral (7.5 to 8.0 standard units [s.u.]) during the winter and increasing in the spring and summer (7.7 to 8.1 s.u.). Peak values (8.0 to 9.2 s.u.) are recorded during May and September (Raymond 2010). Longitudinally, pH ranges from 7.3 to 9.2 s.u. in this reach, with the lowest values recorded downstream from J.C. Boyle Reservoir and the highest values in Copco and Iron Gate reservoirs (Raymond 2008, 2009, 2010). In 2009, springtime pH levels at J.C. Boyle Reservoir were typically 8.5 s.u., decreasing during the summer and fall to 7.6 to 7.9 s.u. (Watercourse Engineering, Inc. 2011). As part of monthly sampling events between March and November from 2000 to 2005 and June through November 2007, pH was measured at Klamath River sites along within Iron Gate and Copco reservoirs (Figure C-38; PacifiCorp 2008c). Summer pH values tend to fluctuate the most at all sites with the largest variations and highest pH values occurring primarily between September and November upstream of Copco No. 1 Reservoir and between August and October downstream of Copco No. 1 Reservoir (PacifiCorp 2008c).

Depth profiles of pH in the Copco and Iron Gate reservoirs show pH generally decreasing with depth in both reservoirs (Table C-5; PacifiCorp 2008c). At depths less than 8 meters (the epilimnion), pH is greater than 8.5 s.u. in approximately 30 percent of samples (144 of 494) collected in Copco Reservoir and 20 percent of samples (25 of 485[4]) collected in Iron Gate Reservoir, while pH less than 7.0 s.u. occurred in less than 2 percent (6 of 494) of the samples. At depth greater than 20 meters (the hypolimnion), pH is greater than 8.5 s.u. in less than 1 percent of samples (1 of 391 in Copco No. 1 and 0 of 613 in Iron Gate) collected in both reservoirs, but approximately 17 percent of samples (68 of 391) collected in Copco Reservoir and 22 percent of samples (135 of 613) collected in Iron Gate Reservoir record pH values less than 7.0 s.u. (PacifiCorp 2008c). The distribution of pH values in both reservoirs is attributed to a phytoplankton response to nutrient inputs from upstream sources with photosynthesis in the upper reservoir waters (the epilimnion) resulting in higher pH levels (PacifiCorp 2008c; Raymond 2008). Subsequent analysis of pH data from 2005 to 2010 concurs with previous results that high pH near the surface during summer stratification is likely due to higher phytoplankton biomass and productivity from buoyant cyanobacteria [blue-green algae] near reservoir surfaces (Asarian and Kann 2011). Monthly water quality grab samples collected in Copco and Iron Gate reservoirs at three depths (near the surface [epilimnion], thermocline [metalimnion], and near the bottom [hypolimnion]) show similar pH trends in both reservoirs between 2011 and 2015 with pH usually between approximately 7.0 and 9.0 s.u., but ranging from 5.3 to 9.9 s.u. in Copco No. 1 Reservoir and 5.4 to 10.0 s.u. in Iron Gate Reservoir during 2013 (Watercourse Engineering, Inc. 2012, 2013, 2014, 2015, 2016).

Table C-5. Frequency of pH values in the Klamath River above or below threshold values from 2000 to 2007.

Location	Summary of pH values				
	N	N > 8.5	% > 8.5	N < 7.0	% < 7.0
Klamath River above Shovel Creek	72	7	9.7	1	1.4
Copco Reservoir	1202	148	12.3	84	7.0
Copco Reservoir < 8 m	494	144	29.1	6	1.2
Copco Reservoir > 18 m	391	1	0.3	68	17.4
Iron Gate Reservoir	1470	116	7.9	189	41.9
Iron Gate Reservoir < 8 m	485	25	19.6	8	1.6
Iron Gate Reservoir > 20 m	613	0	0.0	135	22.0
Below Iron Gate Dam	71	3	4.2	4	5.6
Klamath River at I-5	30	7	23.3	2	6.7
Klamath River near Shasta River	7	6	85.7	0	0.0

Source: PacifiCorp 2008c.

[4] In PacifiCorp (2008c) Table 5.2-11, reproduced here as Table C-5, the number of samples with pH greater than 8.5 is listed as 25 of 485 total samples, but the percent of samples with pH greater than 8.5 is listed as 19.6 percent. The inconsistency between the number of samples with pH greater than 8.5 and the percent of samples with pH greater than 8.5 cannot be resolved with the available information in PacifiCorp (2008), so both are presented here for completeness and transparency

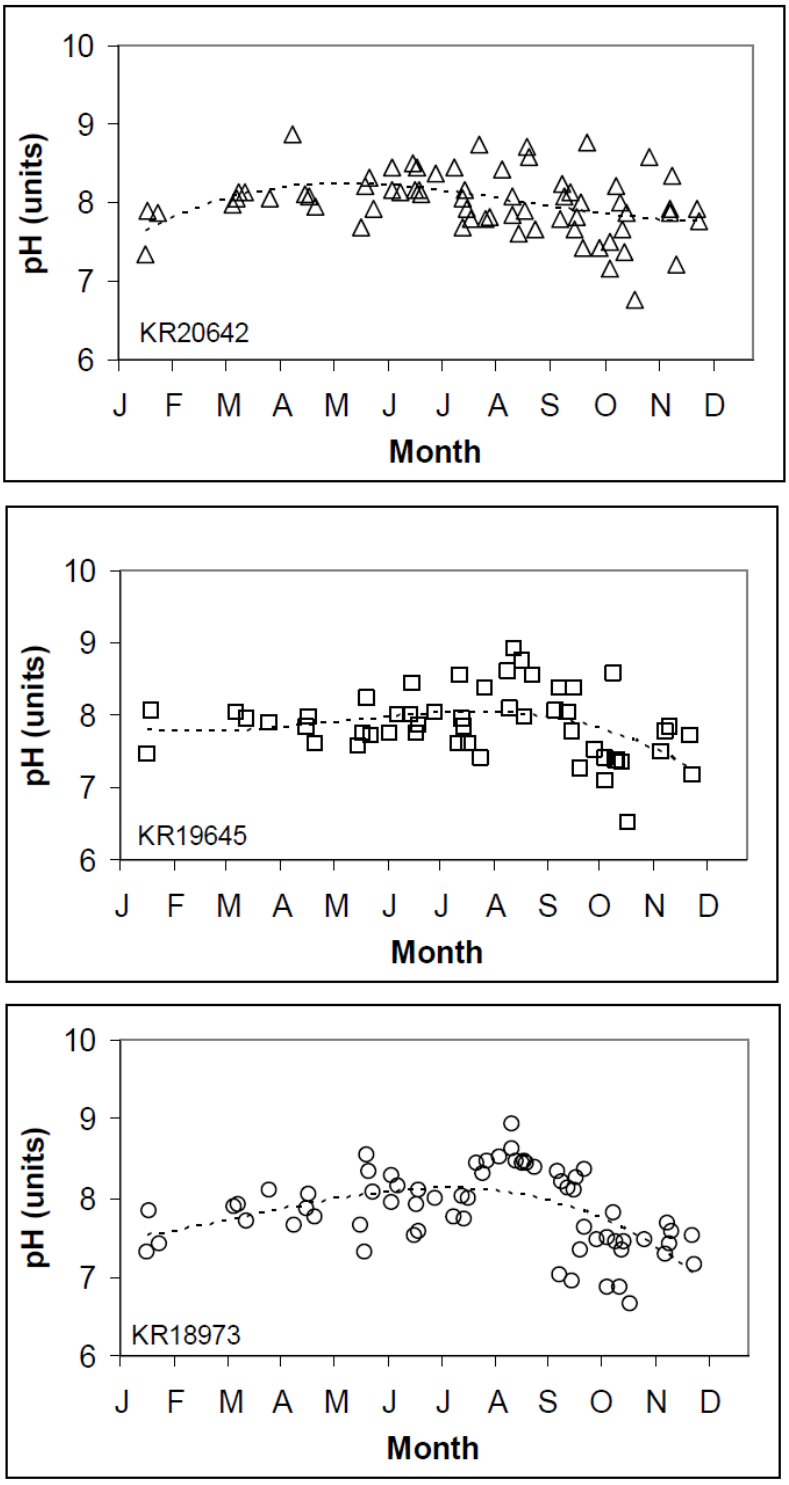

Figure C-38. Seasonal variations in pH values measured in the Klamath River upstream of Copco Reservoir near Shovel Creek (KR20642), downstream of Copco No. 2 powerhouse (KR19645), and downstream of Iron Gate Dam (KR18973). Source: PacifiCorp 2008c.

C.5.2 Mid- and Lower Klamath Basin

C.5.2.1 Iron Gate Dam to Salmon River

Downstream of Iron Gate Dam (RM 193.1) to Salmon River (RM 66.3) pH varies both longitudinally and temporally with the highest seasonal values generally occurring during late-summer and early fall months (August to September) depending on the location in the Klamath River (Figure C-39; Asarian and Kann 2013). The Basin Plan pH maximum of 8.5 s.u. is regularly exceeded in the Klamath River downstream from Iron Gate Dam (FISHPRO 2000; Karuk Tribe of California 2002, 2003, 2007, 2009, 2010a, 2010b, 2011, 2012, 2013; YTEP 2004, 2005; FERC 2007; USFWS 2008; North Coast Regional Board 2010, 2011; Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015, 2016; Asarian and Kann 2013). During April through October 2000 to 2009, incidences of pH *below* the minimum Basin Plan limit of 7.0 s.u. were also observed immediately downstream from Iron Gate Dam (RM 193.1), but pH below 7.0 s.u. was not recorded after 2009 (Karuk Tribe of California 2002, 2003, 2009, 2010a, 2010b, 2011, 2012, 2013; PacifiCorp 2004b; Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015, 2016). The Klamath River is a weakly buffered system (i.e., has typically low alkalinity below 100 mg/L as calcium carbonate [$CaCO_3$]), so it is susceptible to photosynthesis-driven daily swings in pH. Observed exceedances of pH water quality objectives usually occur during later afternoon or early evening, following the period of maximum photosynthesis (North Coast Regional Board 2010, Asarian and Kann 2013). A synthesis of pH measurements from 2001 to 2011 shows the daily range (i.e., daily maximum minus daily minimum) of pH generally peaks between late July and early September corresponding to daily cycles of photosynthesis and respiration (Figure C-38; Asarian and Kann 2013).

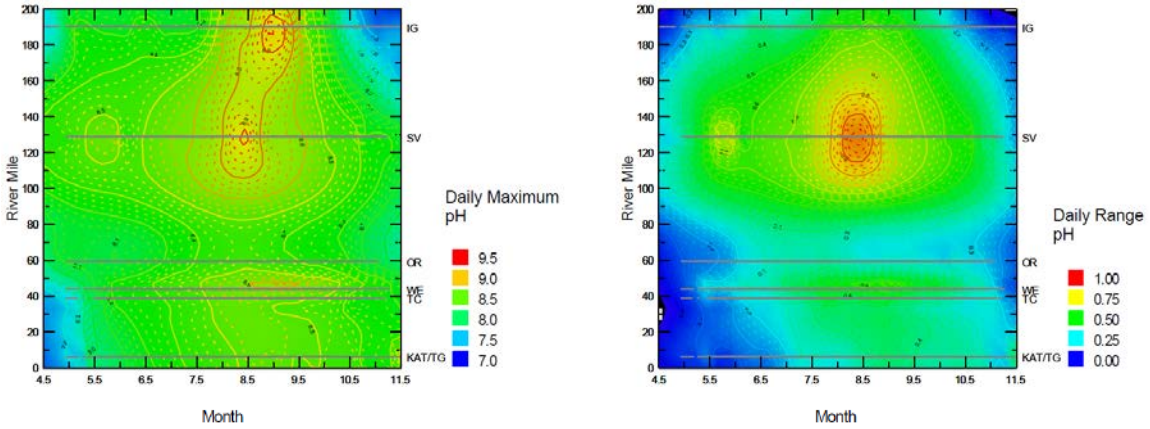

Figure C-39. Distribution of Isopleths Showing the 2001-2011 Average Daily Maximum pH and Daily Range of pH at Klamath River Sites Downstream of Iron Gate Dam from Around Mid-April (4.5) to Mid-November (11.5). Grey Lines Represent the Times the Dissolved Oxygen Concentration Was Measured in the Klamath River Downstream of Iron Gate Dam (IG at RM 193.1), at Seiad Valley (SV at RM 132.7), at Orleans (OR at RM 58.9), at Weitchpec Upstream of the Trinity River (WE at RM 43.6), Upstream of Tully Creek (TC at RM 40.1), and at Turwar (KAT/TG at RM 5.6). Source: Asarian and Kann 2013.

The most extreme pH exceedances typically occur from Iron Gate Dam (RM 193.1) to approximately Seiad Valley (RM 132.7) with pH values generally increasing from Iron

Gate Dam to the Klamath River upstream of Shasta River (RM 179.5) then decreasing with distance downstream (Figure C-40; FERC 2007; Karuk Tribe of California 2007, 2009, 2010a, 2010b, 2011, 2012, 2013; Asarian and Kann 2013). During May to October 2005, the greatest number of pH exceedances in this reach occur just upstream of the mainstem confluence with the Shasta River (RM 179.5) (Figure C-41). In 2007, daily maximum pH values downstream from Iron Gate Dam (RM 193.1) were 8.2 to 9.6 s.u. with the highest documented pH occurring in September (Figure C-42); near Seiad Valley (RM 132.7), maximum pH values were slightly lower, at 8.1 to 9.4 s.u. with the highest documented pH occurring in mid-August (Figure C-43; Karuk Tribe of California 2007). A synthesis of all the data from June through October 2001 to 2011 shows these trends are consistent over time with pH greater than 8.5 s.u. in 23 percent of measurements downstream of Iron Gate Dam, 35 percent of measurements upstream from the Shasta River, and 26 percent of measurements at Seiad Valley. Measurements of pH greater than 8.5 s.u. are most frequent in August and September for most mainstem locations, but they are most frequent in July and August in the Klamath River upstream of Shasta River. Measurements of pH greater than 9.0 s.u. are most frequent at Iron Gate Dam (9 percent for September), upstream from Shasta River (8 percent for August), and Seiad Valley (6 percent for August), but measurements of pH greater than 9.0 s.u. are rare (less than 0.1 percent) at mainstem locations downstream of Seiad Valley. High daily maximum pH values at Iron Gate Dam are correlated with high chlorophyll-*a* concentrations from upstream algal blooms rather than large 24-hour cycles (Asarian and Kann 2013).

Trends in pH from 2011 to 2015 are generally similar to previous findings with pH initially increasing with distance downstream of Iron Gate Dam before then decreasing with distance downstream to Salmon River, but there is substantial variability in the pH both seasonally and during individual days (Watercourse Engineering, Inc. 2012, 2013, 2014, 2015, 2016). Measurements of pH in 2015 demonstrate typical patterns with the seasonal range in pH being greater immediately downstream of Iron Gate Dam, but the daily range in pH being greater at Seiad Valley (Figure C-44; Watercourse Engineering, Inc. 2016). Downstream of Iron Gate Dam, pH ranges from approximately 7.5 to 9.5 s.u., while pH ranges from approximately 7.5 to 9.0 s.u. at Seiad Valley.

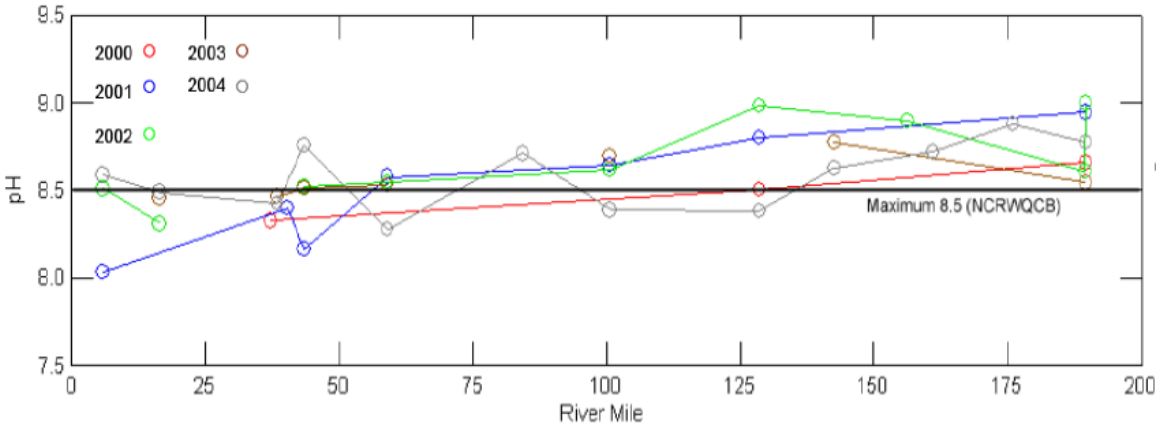

Figure C-40. Average August Daily Maximum pH Values for Locations along the Mainstem Klamath River Downstream from Iron Gate Dam for the Years 2000 to 2004 using Data Collected by USFWS, USGS, and the Karuk Tribe of California and Yurok Tribe. Source: Kier Associates 2006 as cited in FERC 2007.

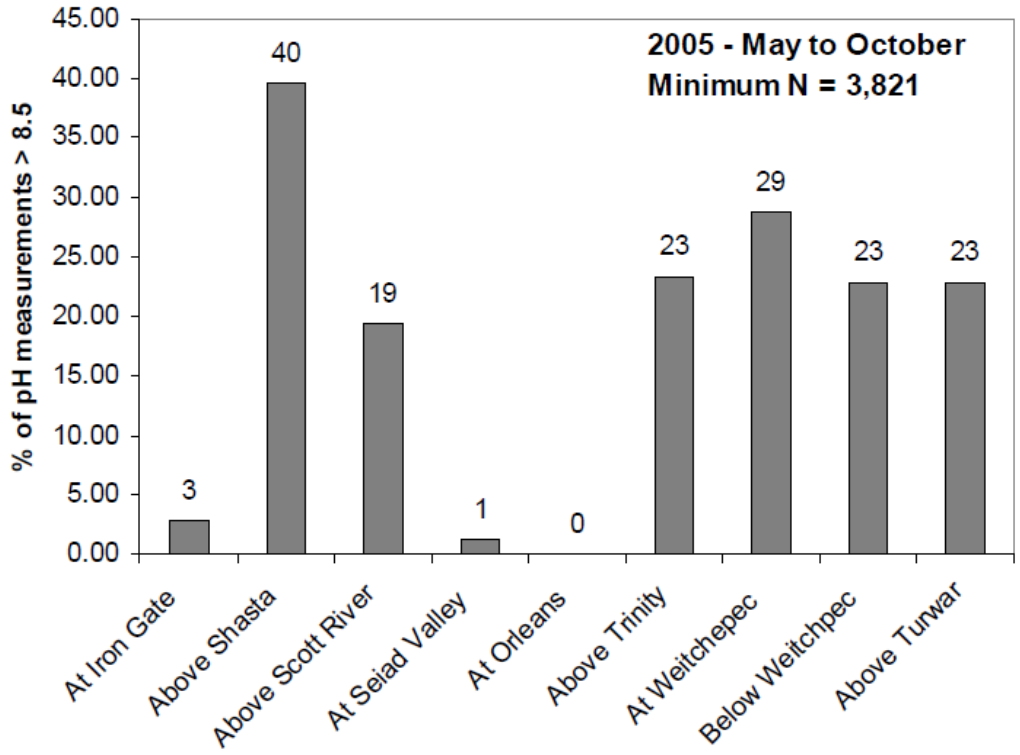

Figure C-41. Percent of pH Measurements in the Lower Klamath River Exceeding the Basin Plan Water Quality Objective of 8.5 s.u. during 2005. Source: North Coast Regional Board 2010.

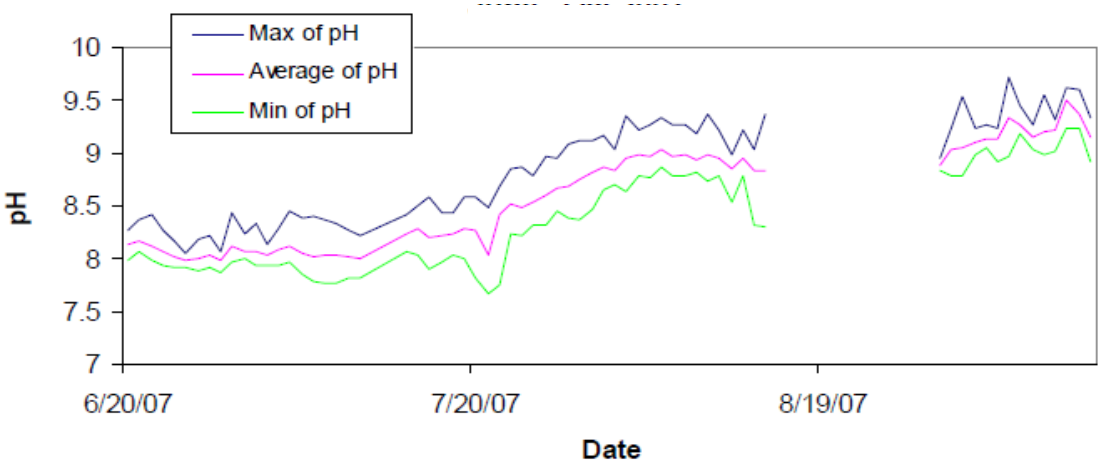

Figure C-42. Daily Maximum, Mean, and Minimum pH in the Klamath River Downstream from Iron Gate Dam (RM 193.1) from June to October 2007. Source: Karuk Tribe of California 2007.

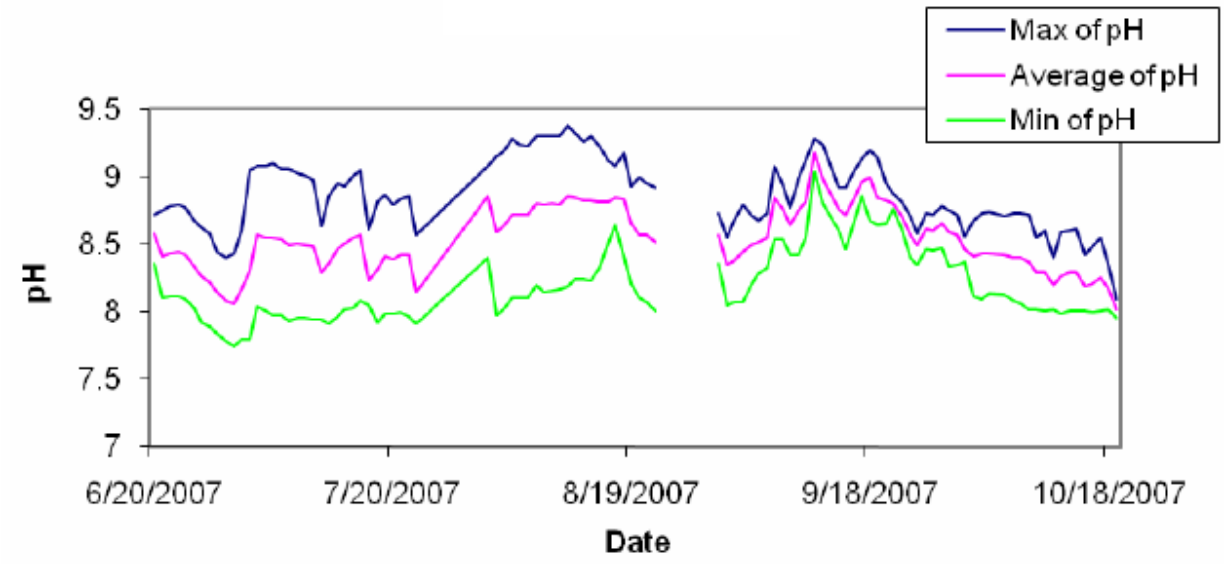

Figure C-43. Daily Maximum, Mean, and Minimum pH in the Klamath River near Seiad (≈RM 132.7) from June to October 2007. Source: Karuk Tribe of California 2007.

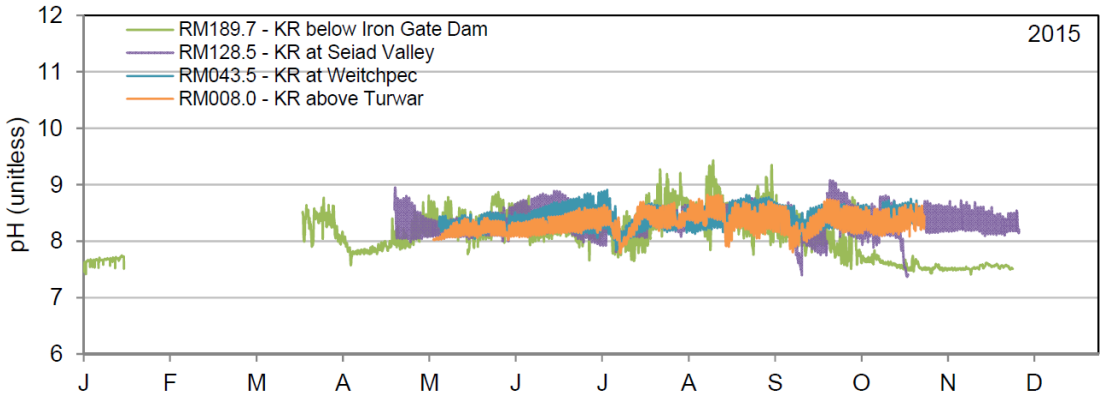

Figure C-44. Continuous pH Data from 2015 in the Klamath River Downstream of Iron Gate Dam (RM 193.1), at of Seiad Valley (RM 132.7), at Weitchpec (RM 43.6), and Upstream of Turwar (RM 5.6). Source: Watercourse Engineering, Inc. 2016.

C.5.2.2 Salmon River to Estuary

The Basin Plan pH maximum of 8.5 s.u. is also regularly exceeded in the lower Klamath River between the Salmon River (RM 66.3) and Turwar Creek (RM 5.6) during summer months with most of the exceedances occurring downstream of the Trinity River (Figures C-39 and C-41; FISHPRO 2000; Karuk Tribe of California 2002, 2003, 2009, 2010a, 2010b, 2011, 2012, 2013; YTEP 2004, 2005; USFWS 2008; North Coast Regional Board 2010, 2011; Sinnott 2010a, 2011a, 2012a; Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015, 2016; Asarian and Kann 2013 Hanington 2013; Hanington and Ellien 2013; Hanington and Cooper Carouseli 2014). Water quality monitoring by the Karuk Tribe includes pH data from Orleans (RM 58.9), which is just downstream from the mainstem confluence with the Salmon River (see also Section

C.5.2.1). Daily maximum pH values at Orleans were 7.9 to 8.9 s.u. from June through October 2007, with the highest pH occurring in mid-September (Figure C-45; Karuk Tribe of California 2007). Analysis of data from 2001 to 2011 by Asarian and Kann (2013) shows similar trends, yet pH at Orleans most frequently exceeds 8.5 s.u. during August (19 percent) rather than September (12 percent). More contemporary data from 2012 and 2013 further indicate that the maximum pH and frequency of exceeding 8.5 s.u. varies between August and September, depending on the year, with pH peaking in August in 2012 and peaking in September in 2013 (Karuk Tribe of California 2012, 2013).

In the mainstem river between the confluence with the Trinity River and the Klamath River Estuary, annual water pH monitoring has been conducted by the YTEP since 2002 (YTEP 2004, 2005; Sinnott 2010a, 2011a, 2012a; Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015, 2016; Asarian and Kann 2013; Hanington 2013; Hanington and Ellien 2013; Hanington and Cooper Carouseli 2014). The pH trends downstream of Weitchpec (RM 43.6) to Turwar (RM 5.6) vary seasonally with a general decreasing trend during the earlier part of the year then during September through October the pH decreases from the Klamath River at Weitchpec (RM 43.6) to the Klamath River upstream of Tully Creek (RM 40.1) then increases from upstream of Tully Creek downstream to Turwar (Figure C-39; Asarian and Kann 2013). The timing of peak pH and highest frequency of exceeding 8.5 s.u. varies between July and September depending on the year. Between 2001 and 2011, the pH most frequently exceeds 8.5 s.u. in September at Weitchpec (36 percent) and at Turwar (24 percent), while it most frequently exceeds 8.5 s.u. in the Klamath River upstream of Tully Creek (RM 40.1) in August (23 percent) (Asarian and Kann 2013). However, during 2009 monitoring, peak pH values were documented from July through September with the highest daily maximums recorded in early July. The highest pH values were documented at the most upstream location (i.e., just over 9.0 s.u. at Klamath River at Weitchpec [RM 43.6]), while both sample locations farther downstream were approximately 8.8 s.u. (Klamath River upstream of Tully Creek [RM 40.1] and upstream of Turwar Boat Ramp [RM 6]) (Figure C-46; Sinnott 2010a). More recent pH monitoring from 2012 and 2013 also show the variability in timing of pH peaks with pH at Weitchpec (RM 43.6) peaking at 8.7 s.u. in October in 2012 and 8.8 s.u. in July in 2013. The pH recorded upstream of the Turwar Boat Ramp (RM 6) is more consistent with pH peaking at approximately 8.7 s.u. during August in both 2012 and 2013 (Hanington 2013; Hanington and Ellien 2013).

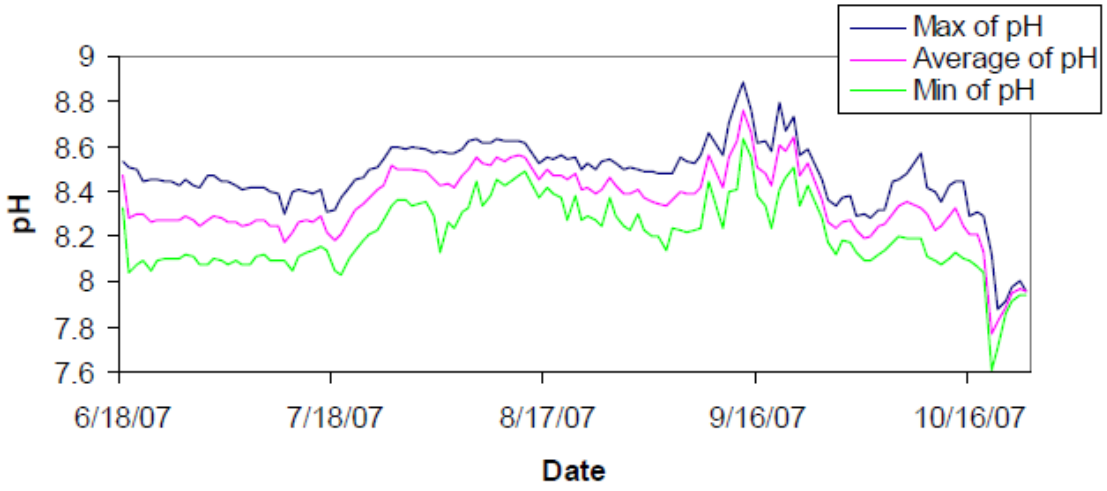

Figure C-45. Daily Maximum, Mean, and Minimum pH on the Klamath River near Orleans (RM 58.9) from June to October 2007. Source: Karuk Tribe of California 2007.

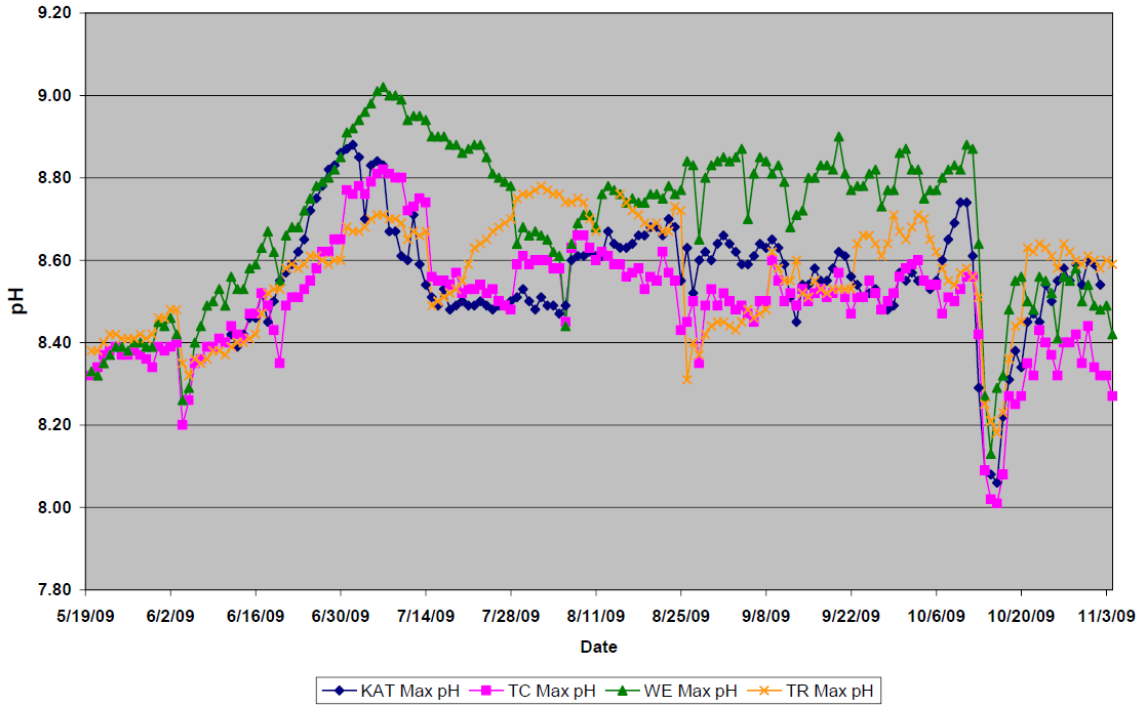

Figure C-46. Daily Maximum pH in the Klamath River at Weitchpec (RM 43.6 [WE]), Upstream of Tully Creek (RM 40.1 [TC]), and Upstream of Turwar Boat Ramp (RM 6 [KAT]), as well as in the Trinity River (RM 43.3 [TR]) near the Confluence with the Klamath River (RM 0.5 [TR]). Source**:** Sinnott 2010a.

C.5.2.3 Klamath River Estuary

pH within the Klamath River Estuary is variable spatially and temporally and is influenced by season, river flow, vertical stratification (thermal and/or salinity), and location of the estuary mouth, the latter changing due to periodic sand bar movement. The Basin Plan pH maximum of 8.5 s.u. is regularly exceeded in the Klamath River Estuary though pH measured during monthly grab samples near the surface of the lower estuary from 2009 to 2015 only show pH exceeding 8.5 s.u. in February 2011 and August 2013 (YTEP 2005; Sinnott 2010a, 2011a, 2012a; Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015, 2016; Hanington and Torso 2013; Hanington and Stawasz 2014; Hanington and Cooper Carouseli 2014). Based on Yurok Tribe water quality data, pH in the Klamath Estuary ranges between approximately 6.9 to 9.0 s.u. though values below 7.0 s.u. are occasionally measured, with peak values generally occurring during the summer months (YTEP 2005; Sinnott 2010a, 2011a, 2012a; Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015, 2016; Hanington and Torso 2013; Hanington and Stawasz 2014; Hanington and Cooper Carouseli 2014). Daily variations in pH are typically on the order of 0.5 s.u., and fluctuations tend to be somewhat larger in the late summer and early fall. The Environmental Fluid Dynamics Code estuary model component used in the California Klamath River TMDL development as well as observed data show very low phytoplankton and chlorophyll-*a* concentrations in the Klamath River Estuary (YTEP 2005), suggesting that local photosynthesis and biological respiration are not significant enough to cause large daily fluctuations of pH, as seen in upstream reaches. When large daily fluctuations are observed, they are likely caused by an upstream daily signal that is subsequently transported into the Klamath River Estuary.

C.6 Algal Toxins and Chlorophyll-*a*

C.6.1 Upper Klamath Basin

C.6.1.1 Hydroelectric Reach

Seasonal phytoplankton blooms (also called algal blooms) in the Hydroelectric Reach have been recorded historically, with chlorophyll-*a* concentrations in Iron Gate Reservoir ranging from 0.3 micrograms per liter (ug/L) to 21.6 ug/L during March, July, and October 1975 (USEPA 1978). Over the past decade, algal toxins and chlorophyll-*a* have become routinely monitored water quality parameters in the Hydroelectric Reach. PacifiCorp's chlorophyll-*a* monitoring data for the river upstream of J.C. Boyle Reservoir to immediately downstream from Iron Gate Dam from 2002 through 2009 (May to October) indicates that annual mean values above 10.0 ug/L are typical of the dataset and there is generally greater apparent variability upstream of J.C. Boyle Reservoir as compared with just downstream from Iron Gate Reservoir (PacifiCorp 2004a; Raymond 2008, 2009, 2010). Chlorophyll-*a* concentrations have a wider range with higher peak values in reservoirs compared to the free-flowing portion of the Klamath River (Raymond 2008; Asarian and Kann 2011).

A broader longitudinal analysis of measured chlorophyll-*a* concentrations was conducted using monitoring data compiled during 2005 to 2007 (May to September) from the Yurok Tribe, Karuk Tribe of California, North Coast Regional Board, and PacifiCorp (North Coast Regional Board 2010). Results at numerous locations from the lower Klamath River Estuary (RM 0 to 3.9) to J.C. Boyle Dam (RM 229.8) demonstrate that median chlorophyll-*a* concentrations within Copco No. 1 and Iron Gate reservoirs are 2 to 10

times greater (note the logarithmic scale in Figure C-47) than those documented in free-flowing locations in the mainstem river, with median concentrations greater than 10.0 ug/L exhibited in the reservoirs and median concentrations less than 10.0 ug/L exhibited at river locations (North Coast Regional Board 2010). Analysis of chlorophyll-*a* measurements from June to October 2005 to 2010 show similar trends with chlorophyll-*a* higher in Copco No. 1 and Iron Gate reservoirs than in river locations upstream, between, and downstream of the reservoirs (Figure C-48; Asarian and Kann 2011). Chlorophyll-*a* concentrations upstream of Copco No. 1 Reservoir ("Abv Shovel" location in Figure C-47; "KRACorig" location in Figure C-48) are lower than those measured downstream within the reservoir suggesting chlorophyll-*a* concentrations in the reservoirs are due to algal blooms originating in the reservoirs. Chlorophyll-*a* concentrations are generally higher in Copco No. 1 Reservoir than Iron Gate Reservoir though annual variability does result in Iron Gate Reservoir having higher median chlorophyll-*a* concentrations during some years (Asarian and Kann 2011). In the Copco No. 1 and Iron Gate reservoirs, median chlorophyll-*a* concentrations are highest near the surface than decrease with depth (Figure C-48). Chlorophyll-*a* data indicates concentrations at a 5 m depth are elevated compared to inflow values from upstream with chlorophyll-*a* in Copco No. 1 (and Iron Gate to a lesser extent) exceeding 10.0 ug/L for much of August to September in 2005 to 2007 (Asarian and Kann 2011). Peak chlorophyll-*a* concentrations indicating periods of algal blooms are generally larger in Copco No. 1 than Iron Gate with some exceptions (Asarian and Kann 2011).

Seasonal chlorophyll-*a* patterns in the Hydroelectric Reach indicate that relatively high concentrations can occur during spring diatom blooms (e.g., approximately 30.0 to 40.0 ug/L for Copco No. 1 and Iron Gate reservoirs in March 2000 to 2003), followed by a period of relatively low concentrations after the blooms die (e.g., less than 10 mg/L for Copco No. 1 and Iron Gate reservoirs in April to July 2000 to 2003). In some years (e.g., 2009 and 2010), the intense spring blooms have included the blue-green algae *Anabaena* spp. with sufficient density to require health advisory posting of the reservoirs. A second increase occurs during August and September when dense blooms dominated by both *Aphanizomenon flos-aquae* and *Microcystis aeruginosa* are typical (e.g., approximately 30.0 to 58.0 ug/L for Copco No. 1 and Iron Gate reservoirs 2000 to 2003) (FERC 2007). Asarian and Kann (2011) found similar seasonal chlorophyll-*a* trends in 2005 to 2010 data with peak values occurring from March to April and August to September. Chlorophyll-*a* concentrations from November to April were lower downstream of Iron Gate Dam than upstream of Copco due to settling of diatoms from upstream (Asarian and Kann 2011).

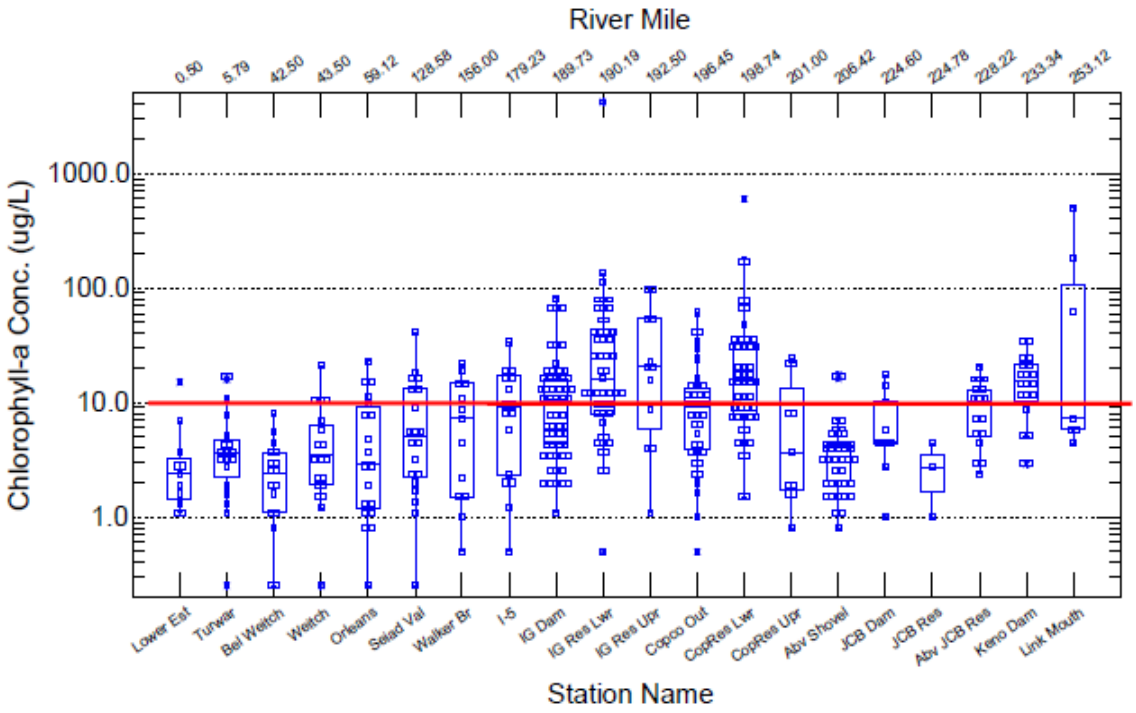

Figure C-47. Longitudinal Analysis of Summer (May through September) Chlorophyll-*a* Concentrations from 2005 to 2007 Along the Klamath River. Note the Logarithmic Scale. River miles specified for Klamath River features are based on those accurate at the time of the report and differ slightly from 2018 river mile designations (Table 3.2-1). Data from the Yurok Tribe, Karuk Tribe of California, North Coast Regional Water Quality Control Board, and PacifiCorp. Source: North Coast Regional Board 2010.

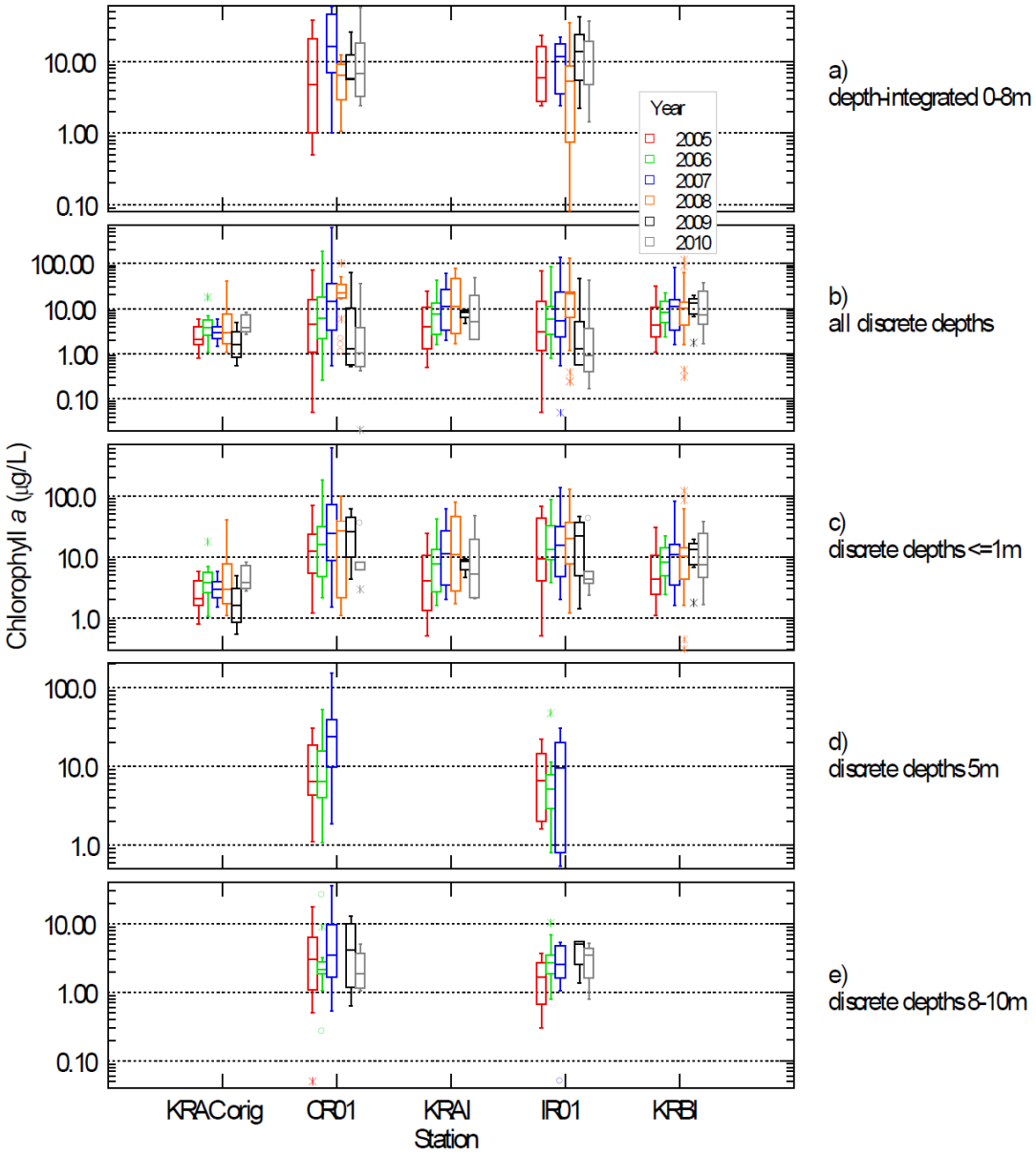

Figure C-48. Longitudinal and Vertical Chlorophyll-*a* Concentrations June to October 2005 to 2010 at the Klamath River Upstream of Copco (KRACorig), Copco Reservoir Before the Dam (CR01), Klamath River Upstream of Iron Gate (KRAI), Iron Gate Reservoir Before the Dam (IR01), and Klamath River Downstream of Iron Gate Dam (KRBI). Source: Asarian and Kann 2011.

Algal toxins, also referred to as cyanotoxins, can be produced by some species of blue-green algae, which are also called cyanobacteria, especially during large seasonal blooms in reservoir or lake environments. Cyanotoxins (e.g., cyclic peptide toxins such as microcystin that act on the liver, alkaloid toxins such as anatoxin-a and saxitoxin that act on the nervous system) can cause irritation, sickness, or in extreme cases, death to exposed organisms, including humans (WHO 1999). Species capable of producing microcystin include *Microcystis aeruginosa*, while species in the genus *Anabaena* can produce anatoxin-a and saxitoxin. More complete listings of specific toxins produced by

genera of blue-green algae worldwide are provided in Lopez et al. (2008) and ODEQ (2011). The California Cyanobacteria and Harmful Algal Bloom (CCHAB) Network, a multi-agency workgroup formerly called the Statewide Blue-Green Algae Working Group, has developed guidance for responding to harmful algal blooms (HABs), cyanotoxin [algal toxin] threshold levels for protection of human health, and posting and de-posting cyanotoxin [algal toxin] triggers in recreational waters (State Water Board et al. 2010, updated 2016). The State Water Resources Control Board (State Water Board), the California Department of Public Health (CDPH), and the California Environmental Protection Agency (CalEPA) Office of Environmental Health and Hazard Assessment (OEHHA) Caution Action trigger threshold for the protection of human health in recreational waters was previously 8 ug/L of microcystin, but it is 0.8 ug/L of microcystin in the 2016 update (State Water Board et al. 2010, updated 2016).

Microcystin concentrations are generally low from J.C. Boyle to Copco No. 1 reservoirs, higher between Copco No. 1 and Iron Gate reservoirs, then decrease with distance downstream from Iron Gate Dam (Kann 2006; Jacoby and Kann 2007; Kann 2007a, b, c, d; Kann and Corum 2007, 2009; CH2M Hill 2008; Kann et al. 2010a; Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015, 2016; Otten et al. 2015). High chlorophyll-*a* concentrations have been shown to correlate with the toxigenic blue-green algae blooms dominated by *Anabaena* spp. and *Microcystis aeruginosa* and sharp increases in microcystin levels above WHO numeric targets (Kann and Corum 2009) and the State Water Board, the CDPH, and CalEPA OEHHA public health thresholds (State Water Board et al. 2010, updated 2016). Data collected from 2005 through 2009 indicate high levels of microcystin in Copco No. 1 and Iron Gate reservoirs, with measured concentrations exceeding the current State Water Board, CDPH, and CalEPA OEHHA public health threshold of 0.8 ug/L for microcystin by over 10,000 times in Copco No. 1 Reservoir in 2006, 2007, 2008, and 2009 and by over 1,000 times in Iron Gate Reservoir in 2006 and 2009 (Figure C-49; Jacoby and Kann 2007; Kann 2007a, b, c, d; Kann and Corum 2007, 2009; Kann et al. 2010a).

Microcystin measured during May to December 2009 exhibited extremely high concentrations (1,000 to 73,000 ug/L) during algal blooms occurring in July, August, and September in Copco No. 1 Reservoir in Mallard Cove and Copco Cove, and in Iron Gate Reservoir at Jay Williams. The highest microcystin concentration (73,000 ug/L) was measured on September 28, 2009 at Mallard Cove in Copco No. 1 Reservoir. Microcystin concentrations in Iron Gate Reservoir at Jay Williams peaked in October at 3,200 ug/L (Watercourse Engineering, Inc. 2011a). More contemporary measurements of microcystin in the Copco No. 1 and Iron Gate reservoirs during May to December 2015 exhibit very high concentrations consistent with previous findings (Watercourse Engineering, Inc. 2016). In Copco No. 1 Reservoir at Mallard Cove and Copco Cove, microcystin increases in June to July 2015 until peaking at 12,000 to 16,000 ug/L during algal blooms while microcystin concentrations also increase to between 200 to 370 ug/L in August, September, and October. In Iron Gate Reservoir at Jay Williams, microcystin concentrations in 2015 peaked at 770 ug/L in September, while microcystin in Iron Gate Reservoir at Camp Creek reached a maximum of 64 ug/L (Watercourse Engineering, Inc. 2016).

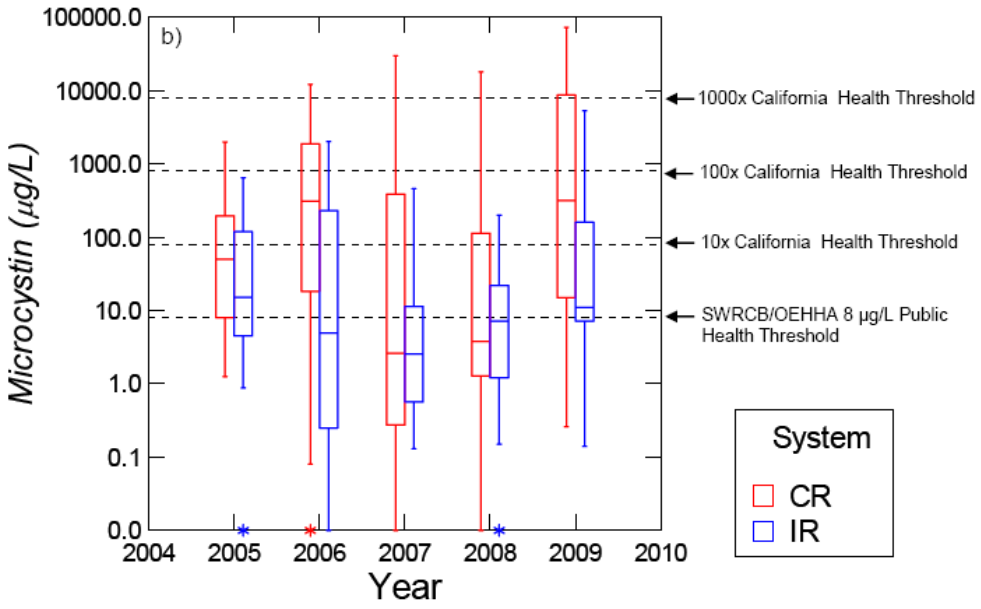

Figure C-49. Inter-annual Comparison of Microcystin Concentration for Copco No. 1 Reservoir (Red Square) and Iron Gate Reservoir (Blue Square) during July through October 2005 to 2009. Note: the SWRCB [State Water Board]/[CalEPA] OEHHA Public Health Threshold for microcystin was 8 ug/L in 2010, but it was revised to 0.8 ug/L in 2016. Source: Kann et al. 2010a.

Otten et al. (2015) report the longitudinal and temporal variations in microcystin levels from upstream of Copco No. 1 to Turwar indicate Iron Gate Reservoir is the principal source of *Microcystis* cells contributing to microcystin concentrations downstream of Iron Gate Dam. The consistently low microcystin levels above Copco No. 1 along with phycological (conditions associated with algae), genetic, and toxin analyses that identify different population dynamics in Copco No. 1 and Iron Gate reservoirs indicate microcystin in the Copco No. 1 and Iron Gate reservoirs is due to local *Microcystis aeruginosa* populations (Otten et al. 2015). In 2012, Copco No. 1 microcystin concentrations peak in August then decline while Iron Gate Reservoir microcystin concentrations peak in September with the temporal differences in peak microcystin occurring because depth differences between the reservoirs cause thermal stratification in Iron Gate approximately two weeks later than Copco No. 1. The timing of peak microcystin levels in Iron Gate corresponds to the highest microcystin concentrations in the Klamath River downstream of Iron Gate Dam consistent with Iron Gate Reservoir being the source of downstream *Microcystis aeruginosa* cells. Genetic analysis of the *Microcystis aeruginosa* populations showed Copco No. 1 Reservoir populations were dominated by one genetic type the entire year, but the populations in Iron Gate Reservoir and immediately downstream of Iron Gate Dam had a simultaneous switch in the dominant genetic type in late August that was also detected in the further downstream populations. The simultaneous timing of the genetic change in Iron Gate Reservoir and downstream *Microcystis aeruginosa* populations, but no corresponding genetic change in Copco No. 1 Reservoir provides direct evidence that downstream populations are originating in Iron Gate Reservoir rather than Copco No. 1 (Otten et al. 2015).

In 2007, a *Microcystis aeruginosa* bloom prompted a Yurok Tribe health advisory along multiple affected reaches in the Klamath River (Kann 2007a, b, c, d); data from July through September 2007 also indicate microcystin bioaccumulation in fish and mussel tissue samples collected in the Klamath River and Iron Gate and Copco No. 1 reservoirs (Kann 2008a; see Section 3.3.3.3 for more information on algal toxins in fish and mussel tissue). Additional public health advisories were issued in 2009 and 2010 in Copco No. 1 and Iron Gate reservoirs, as well as downstream locations in the Klamath River (including locations on the Yurok Reservation), for microcystin levels in ambient and/or freshwater mussel tissue (Fetcho 2010, Kann et al. 2010a, Kann et al. 2010b). Data from 2008 and 2009 did not show microcystin bioaccumulation in the tissue and liver samples from fish collected from Copco No. 1 and Iron Gate reservoirs (CH2M Hill 2009, PacifiCorp 2010a). In 2010, the Lower Klamath Project reservoirs were posted to protect public health due to elevated blue-green algae cell counts and algal toxin (i.e., microcystin) concentrations. In 2013, 2014, and 2016, public health advisories were posted for both Copco No. 1 and Iron Gate reservoirs when algal toxin levels or blue-green algae cell concentrations exceeded one or more public health advisory threshold (North Coast Regional Board 2013, 2014, 2016). Copco No. 1 Reservoir also had a public health advisory posted in July 2017 when microcystin concentrations exceeded both the "caution action trigger" threshold (0.8 ug/L) and the "warning, Tier 1" threshold (6 ug/L) (North Coast Regional Board 2017) with microcystin concentrations reaching 380,000 ug/L in Copco No. 1 Reservoir in August 2017 (E&S Environmental Chemistry, Inc. 2017).

As part of an evaluation of the relationship between *Microcystis aeruginosa* cell density and microcystin concentration, Kann et al. (2010a) compared the 2009 measured values to the 2010 WHO guidelines for a low probability of adverse health effect (20,000 cells/mL *Microcystis aeruginosa*, or 4 ug/L microcystin) and the 2010 State Water Board/ [CalEPA] OEHHA guidelines for protection against a moderate probability of adverse effects (40,000 cells/mL *Microcystis aeruginosa*, or 8 ug/L microcystin). These results showed that the more conservative guideline of 20,000 cells/mL *Microcystis aeruginosa* decreases the frequency of exceeding the 8 ug/L 2010 State Water Board/ [CalEPA] OEHHA guideline value for microcystin, and it is more protective of public health (Kann and Corum 2009, Kann 2014). Overall, the 2005 to 2012 results clearly illustrate that the majority of exceedances to all guidelines and thresholds occurred in the reservoirs in the Hydroelectric Reach (as compared with downstream riverine sites), with the highest overall levels measured in Copco No. 1 Reservoir (Figure C-50; Kann and Corum 2009, Kann and Bowman 2012, Kann 2014, Watercourse Engineering, Inc. 2016). Concentrations of microcystin toxin in Iron Gate and Copco No. 1 reservoirs are typically 1 to 3 orders of magnitude greater relative to the Klamath River downstream of Iron Gate Dam (Raymond 2008, Kann et al. 2010a, Kann and Bowman 2012, Kann 2014, Watercourse Engineering, Inc. 2016). Overall, the available data indicate that while river exceedances to the 2010 microcystin water quality guidelines do occur, they are far less in number than exceedances in Copco No. 1 and Iron Gate reservoirs (Figure C-50; see also Raymond 2008, Kann et al. 2010a, Kann and Bowman 2012, Kann 2014, Watercourse Engineering, Inc. 2016).

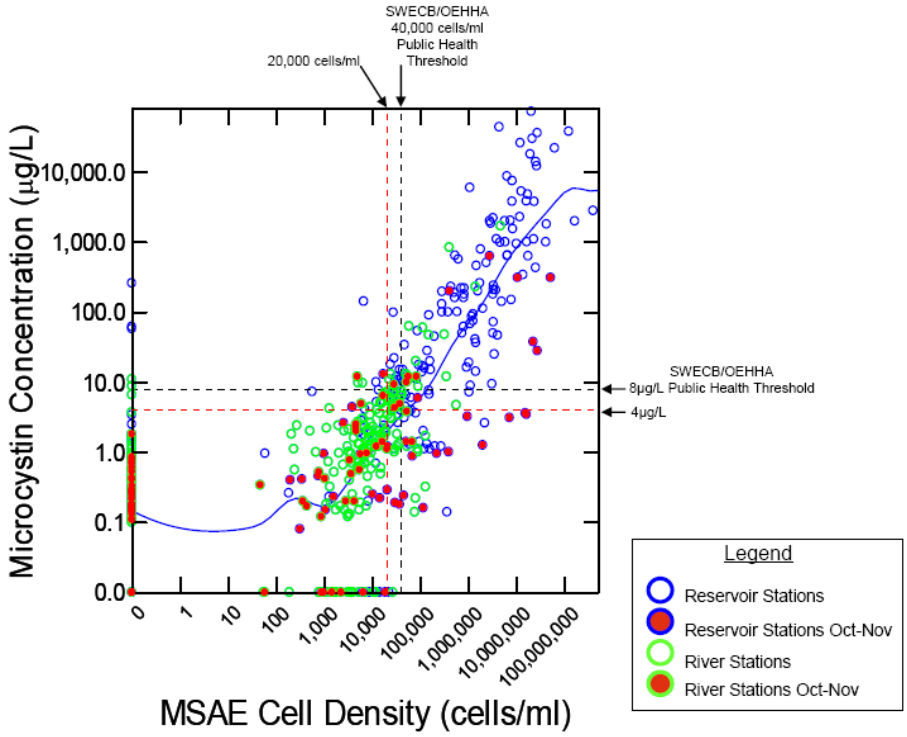

Figure C-50. Relationship between Microcystis aeruginosa Cell Density and Microcystin Toxin Concentration for Copco No. 1 and Iron Gate Reservoirs and Klamath River Stations 2005 to 2009. Note: the SWRCB [State Water Board]/[CalEPA] OEHHA Public Health Threshold for microcystin was 8 ug/L in 2010, but it was revised to 0.8 ug/L in 2016. Similarly, the SWRCB [State Water Board]/[CalEPA] OEHHA Public Health Threshold for Microcystis aeruginosa Cell Density was 40,000 cells/mL in 2010, but it was revised to 4,000 cells/mL of any toxin producing blue-green algae in 2016. Source: Kann et al. 2010a.

Anatoxin-a produced by blue-green algae species in the genus *Anabaena* was detected in Iron Gate Reservoir on September 3, 2005 in testing by the California Department of Health Services (Kann 2007b; Kann 2008b). In additional monitoring conducted for the Karuk Tribe, no anatoxin-a was detected during 2005, 2006, 2007, 2008 in Copco No. 1 or Iron Gate reservoirs (Kann and Corum 2006, 2007, 2009; Kann 2007d). While concentrations of *Anabaena flos-aquae* cells have continued to be monitored, anatoxin-a concentrations are not available for Lower Klamath Project reservoir sites in recent years.

C.6.2 Mid- and Lower Klamath Basin

C.6.2.1 Iron Gate Dam to Salmon River

As noted above (Section C.6.1.1), 2005 to 2007 data indicate that during May through September median chlorophyll-*a* concentrations decrease longitudinally with distance downstream from Iron Gate Dam (Figure C-47) to the Klamath River confluence with the Salmon River (RM 66.3), but concentrations remain greater than those measured just upstream of Copco No. 1 Reservoir. This suggests that algal blooms occurring in the reservoirs were being transported to the downstream river reaches. Ward and Armstrong (2010) report the 2001 to 2005 mean chlorophyll-*a* concentrations ranged

from approximately 0.5 to 3.5 ug/L, with concentrations generally decreasing with distance downstream from Iron Gate Dam though variability is observed (Figure C-41). During 2001 to 2005, the highest annual mean value (approximately 5.0 ug/L) occurs in 2005 at the confluence with the Shasta River (RM 179.5). In 2009, the Karuk Tribe collected chlorophyll-*a* and pheophytin-*a* (an additional photosynthetic pigment) data from the Klamath River downstream from Iron Gate Dam; chlorophyll-*a* values were approximately 1.0 to 35.0 ug/L and were variable depending on location. Generally speaking, relatively greater values were observed at upstream locations near Iron Gate Dam (RM 193.1) and Walker Bridge sites, but the peak value was observed farther downstream of the confluence with the Salmon River (RM 66.3) at Orleans (RM 58.9) (Karuk Tribe of California 2010a). Analysis of the chlorophyll-*a* data from 2001 to 2011 by Asarian and Kann (2013) summarizes the June to October annual variability and range of chlorophyll-*a* concentrations downstream of Iron Gate Dam (Figure C-52). The highest values occur in 2007 and 2008 with chlorophyll-*a* concentrations greater than 100 ug/L downstream of Iron Gate Dam, yet most measurements were less than 50 ug/L. Chlorophyll-*a* concentrations have a seasonal variation with concentrations in Seiad Valley (RM 132.7) decreasing in May/June, then increasing from July until peaking in late August/early September, and finally declining from September to October (Asarian and Kann 2013). Monthly/bi-weekly monitoring data from 2012 to 2015 show similar trends with chlorophyll-*a* concentrations generally decreasing from downstream of Iron Gate Dam (RM 193.1) to the Klamath River downstream of Seiad Valley (RM 132.7), but chlorophyll-*a* concentrations occasionally remained approximately the same or increased between Iron Gate Dam and Seiad Valley (Watercourse Engineering, Inc. 2013, 2014, 2015, 2016). In June to October 2015, chlorophyll-*a* concentrations range from approximately 1.3 to 9.5 ug/L downstream of Iron Gate Dam (RM 193.1), while chlorophyll-*a* concentrations range from approximately 1.3 to 9.6 ug/L downstream of Seiad Valley (RM 132.7) (Watercourse Engineering, Inc. 2016).

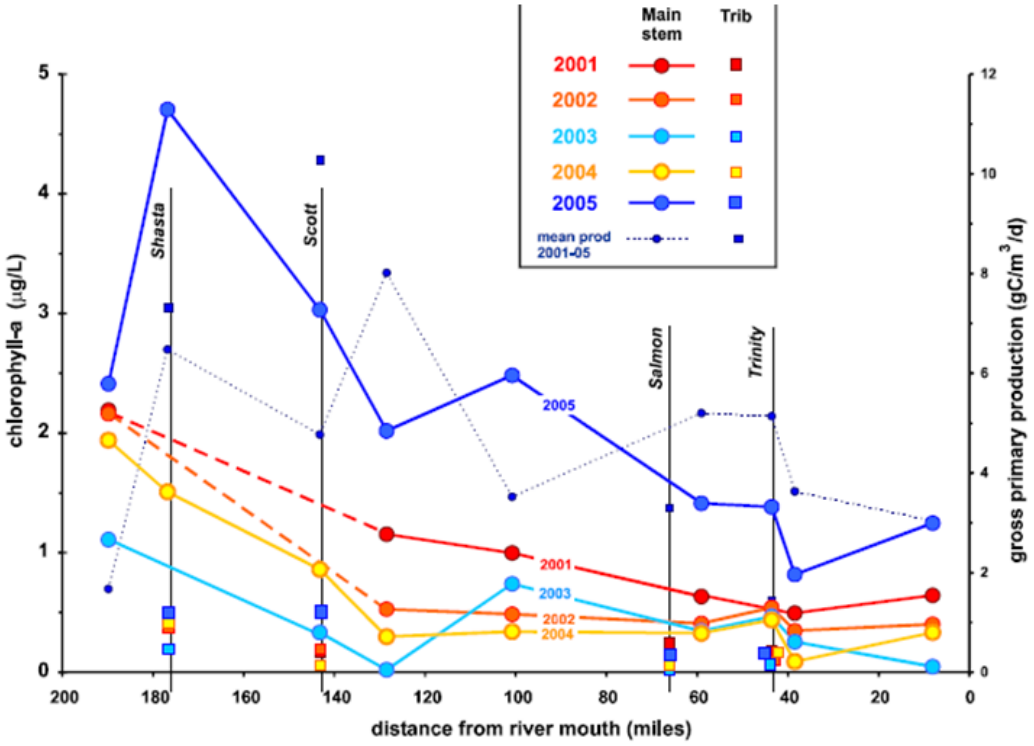

Figure C-51. Annual mean values of chlorophyll-*a* in the Klamath River downstream from Iron Gate Dam during June to September 2001 to 2005. River miles specified for Klamath River features are based on those accurate in 2010 and differ slightly from 2018 river mile designations (Table 3.2-1). Source: Ward and Armstrong 2010.

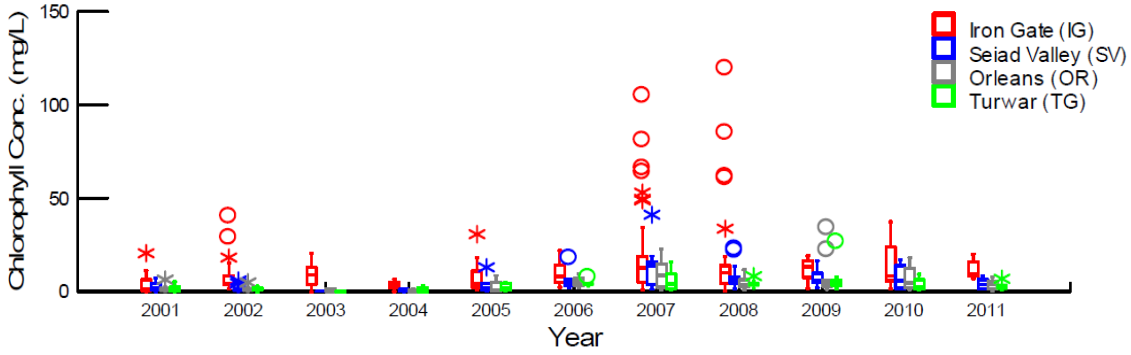

Figure C-52. Chlorophyll-*a* in the Klamath River downstream from Iron Gate Dam during June to October 2001 to 2011. Source: Asarian and Kann 2013.

In 2008, the Karuk Tribe collected blue-green algae concentrations (cells/mL) using optical phycocyanin probes to allow more timely assessment of public health threats from toxigenic blue-green algae species. Data from downstream from Iron Gate Dam collected during June to October indicated peak values (greater than 25,000 cells/mL) in July and early-to-mid September (Karuk Tribe of California 2009). Blue-green algae

concentrations (cells/mL) were also collected by the Karuk Tribe in 2016 at sites downstream of Iron Gate Dam to the confluence with the Salmon River with peak values (greater than 30,000 cells/mL) occurring in July (Watercourse Engineering, Inc. 2016).

Although concentrations of both *Microcystis aeruginosa* and microcystin in the Klamath River downstream from the Hydroelectric Reach are lower relative to the reservoirs (Figures C-53 and C-54), WHO guidelines for exposure to microcystin (i.e., less than 4.0 ug/L) have been exceeded downstream from Iron Gate Dam on numerous occasions (Kann 2004; Kann and Corum 2009; Kann et al. 2010a; Fetcho 2010; Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015, 2016; KTWQC 2016), including late-summer/early-fall *Microcystis aeruginosa* blooms in September 2007, 2009, 2010, 2011, 2012, 2013, and 2016 from Iron Gate Dam (RM 193.1) to the mouth of the Klamath River (RM 0.0). Health Advisories were posted along the Iron Gate Dam to Shasta River reach of the Klamath River in 2009 and 2010, due to elevated *Microcystis aeruginosa* cell counts and/or microcystin concentrations in river water. During 2009, mean microcystin concentrations immediately downstream from Iron Gate Dam (RM 193.1) were approximately 2.0 ug/L, with mean values decreasing to less than 1.0 ug/L at sites further downstream to approximately Orleans (RM 58.9) (Watercourse Engineering, Inc. 2011a). However, two measurements exceeded 7.0 ug/L at stations located at RM 156 and 128.5 (Watercourse Engineering, Inc. 2011a). Baseline grab sample water quality monitoring between 2012 and 2015 demonstrate the range of annual variability in longitudinal microcystin concentration trends (Figure C-54). Additional public health sampling, separate from the baseline monitoring, in 2015 show microcystin concentrations peaking in late July to early August between 2.9 and 5.6 ug/L (Watercourse Engineering, Inc. 2016). Microcystin concentrations collected in 2012 and 2013 document how microcystin concentrations vary over a 24-hour period and the potential influence of grab sampling time on microcystin measurements. On September 17 to 18, 2013, microcystin downstream of Iron Gate Dam ranges from approximately 8.0 to 16.0 ug/L with minimum values occurring around noon and the peak occurring at midnight (Kann 2014).

Available data indicate that algal blooms in Iron Gate and Copco No. 1 reservoirs have been responsible for the public health exceedances in the lower river (Kann 2006, Kann and Corum 2009). The highest microcystin concentrations in the Klamath River downstream of Iron Gate Dam coincide with peak microcystin levels in Iron Gate Reservoir. This is consistent with the reservoir being the source of downstream *Microcystis* cells causing elevated microcystin concentrations. A simultaneous genetic change in Iron Gate Reservoir and downstream *Microcystis aeruginosa* populations, but no corresponding genetic change in Copco No. 1 Reservoir provides further evidence that downstream populations are originating in Iron Gate Reservoir rather than Copco No. 1 (Otten et al. 2015).

Additionally, data from 2007 indicate microcystin bioaccumulation in juvenile salmonids reared in Iron Gate hatchery (Kann 2008a) and, in 2010, algal toxins were found in salmonid tissues collected near Happy Camp (Kann et al. 2011, Kann et al. 2013) (see also Section 3.3.3.3).

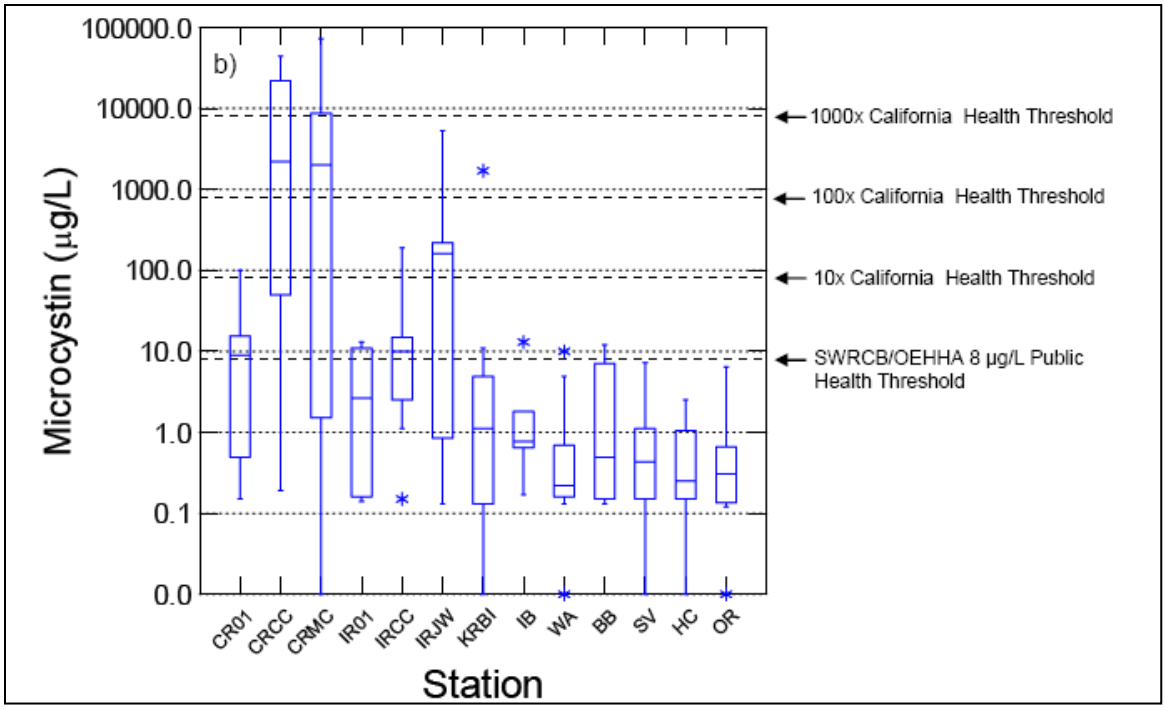

Figure C-53. Microcystin Concentration in Klamath River from Copco No. 1 (CR01) to Orleans (RM 58.9) during June to November 2009. WA=Walker Bridge, SV=Seiad Valley (RM 132.7), OR=Orleans (RM 58.9). Note: the SWRCB [State Water Board]/[CalEPA] OEHHA Public Health Threshold for microcystin was 8 ug/L in 2010, but it was revised to 0.8 ug/L in 2016. Source: Kann et al. 2010a.

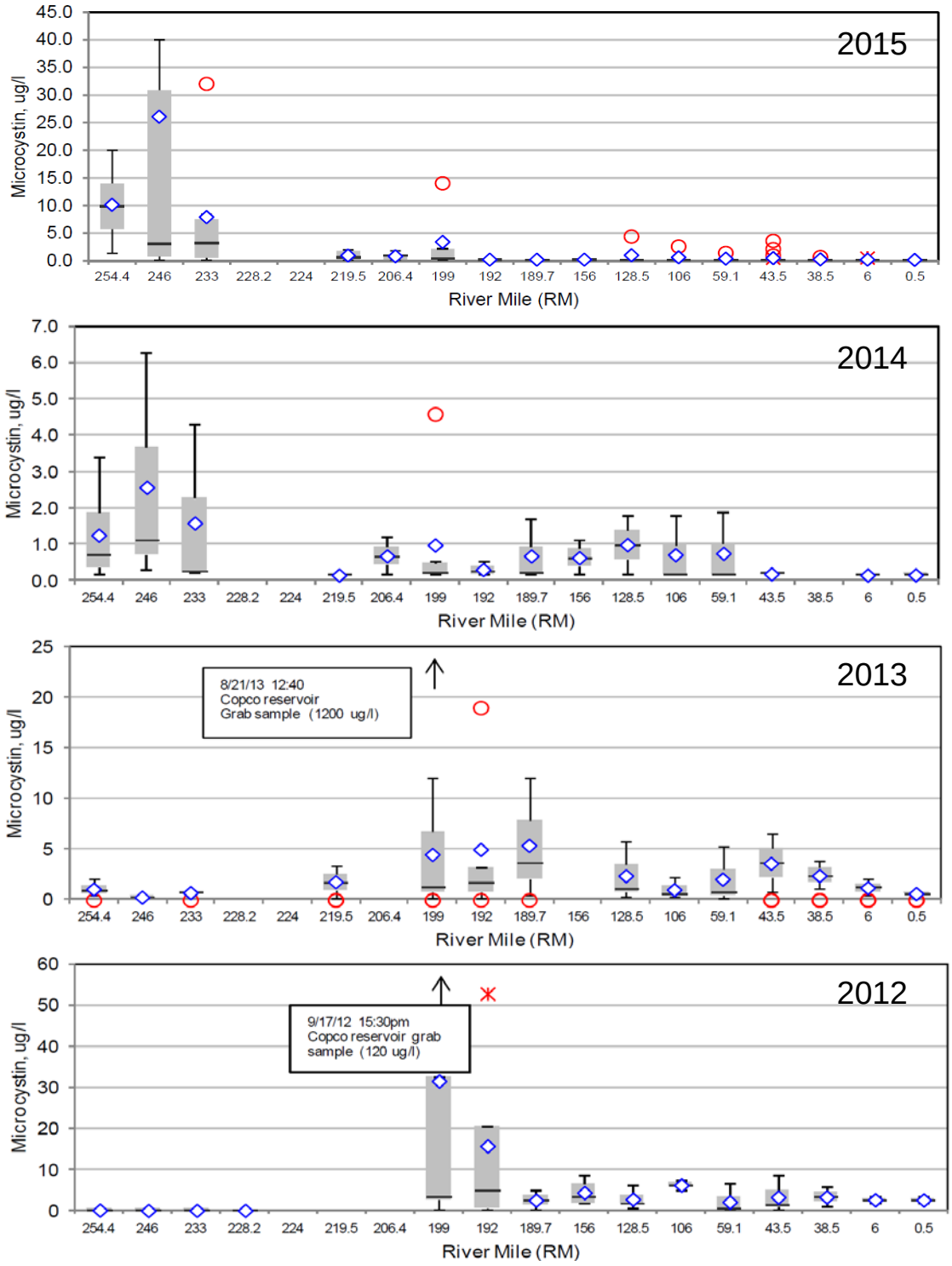

Figure C-54. Klamath River Microcystin Concentration trends from measurements made between February and December with median (-), mean (◊), outlier (*), and extreme outliers (○) identified. River miles specified are based on those accurate at the time of the reports and differ slightly from 2018 river mile designations (Table 3.2-1). Source: Watercourse Engineering, Inc. 2013, 2014, 2015, 2016.

C.6.2.2 Salmon River to Estuary

Downstream from the confluence with the Salmon River (RM 66.3), chlorophyll-*a* and algal toxin concentrations exhibit variability and are generally lower than those measured farther upstream. Water quality monitoring from 2008 to 2012 at Saints Rest Bar (RM 44.9) in the Klamath River shows chlorophyll-*a* usually ranging from approximately 1.0 to 15.0 ug/L, but occasional higher peaks with one peak reaching 44.9 ug/L in August 2011 (HVTEPA 2013). The Yurok Tribe monitors chlorophyll-*a*, pheophytin-*a*, and blue-green algae concentrations (cells/mL) annually, and use optical phycocyanin probes to allow more timely assessment of public health threats from toxigenic blue-green algae species on the Yurok Reservation (YTEP 2005; Fetcho 2006, 2007, 2008, 2009, 2011; Sinnott 2008, 2009a, 2009b, 2010b, 2011b, 2012b; Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015, 2016; Hanington and Torso 2013; Hanington and Stawasz 2014; Hanington and Cooper Carouseli 2014; Gibson 2016). Chlorophyll-*a* 2001 to 2005 data from Ward and Armstrong (2010) show small relative increases in chlorophyll-*a* with distance downstream, from near the Trinity River confluence (RM 43.3) to Turwar (RM 5.6), (Figure C-51), suggesting that phytoplankton productivity may increase slightly as water moves toward the Klamath River Estuary. Chlorophyll-*a* data measured from Weitchpec (RM 43.6) to the Klamath River Estuary during 2003 to 2004 did not show that trend though with concentrations, where detectable, generally decreasing in the downstream direction and below 5.0 ug/L (YTEP 2004, 2005). During 2006 to 2010 from May to October, chlorophyll-*a* concentrations frequently show an increase in chlorophyll-*a* with distance downstream from the confluence with the Trinity River (RM 43.3) to the Turwar Boat Ramp (RM 6) consistent with the findings of Ward and Armstrong (2010) (Sinnott 2008, 2009a, 2009b, 2010b, 2011b). Between May and July chlorophyll-*a* is typically less than 5.0 ug/L, but it increases during August to October with peak concentrations of 24.0 to 27.0 ug/L in 2009 (Sinnott 2008, 2009a, 2009b, 2010b, 2011b). Longitudinal chlorophyll-*a* concentrations from 2011 to 2014 are variable from the confluence with the Trinity River (RM 43.3) to the Turwar Boat Ramp (RM 6) with concentrations seasonally increasing or decreasing with distance downstream (Sinnott 2012b; Hanington and Torso 2013; Hanington and Stawasz 2014; Hanington and Cooper Carouseli 2014). In 2011 to 2014, chlorophyll-*a* is less than 6.0 ug/L from May to July then increases to approximately 10.0 to 15.0 ug/L during August to October before decreasing to below 3.0 ug/L in December (Sinnott 2012b; Hanington and Torso 2013; Hanington and Stawasz 2014; Hanington and Cooper Carouseli 2014). The peak values between 2006 and 2014 usually occur at Weitchpec (RM 43.6) from late August to mid-October and varying by year (6.7 ug/L in 2008 and 26.0 ug/L in 2009), but there is one exception in November 2013 when chlorophyll-*a* at Weitchpec reaches 27.0 ug/L.

During 2009, mean microcystin concentrations from Orleans (RM 58.9) to Klamath River at Klamath (RM 5.9) were less than 1.0 ug/L, well below the 2010 State Water Board/ [CalEPA] OEHHA guideline value for microcystin (8 ug/L), but greater than the 2016 State Water Board/ [CalEPA] OEHHA guideline for microcystin (0.8 ug/L) (Watercourse Engineering, Inc. 2011a). Individual microcystin measurements generally remained less than 1.0 ug/L as well, with the exception of a sample collected in late-September at Orleans (RM 58.9) for which the microcystin concentration was 6.4 ug/L (Watercourse Engineering, Inc. 2011a). Microcystin at Saints Rest Bar (RM 44.9) in 2010 to 2012 usually ranges from below 0.15 ug/L (the detection limit) to 5.6 ug/L, but microcystin in September 2012 reaches a peak of 19.0 ug/L (HVTEPA 2013). Microcystin concentrations from 2010 to 2015 range from less than 1.0 ug/L to approximately

12.0 ug/L with concentrations usually highest at Weitchpec (RM 43.6) then decreasing with distance downstream (Gibson 2016) though microcystin was occasionally higher at Orleans (RM 58.9) than Weitchpec (RM 43.6) in some years (Figure C-54). Microcystin concentrations peak between July and September around the same time the maximum concentration of *Microcystis aeruginosa* are measured, but Gibson (2016) notes microcystin is present at high levels in some samples even when *Microcystis aeruginosa* are not. While peak microcystin in the Klamath River at Weitchpec exceeds 8.0 ug/L in 2010, 2012, and 2013, microcystin concentrations downstream of Weitchpec, are less than 8.0 ug/L for all years between 2010 and 2015 (Gibson 2016). Microcystin exceeded 0.8 ug/L at Weitchpec at least once every year between 2010 to 2015, but microcystin exceeded 0.8 ug/L only once every year in 2010 through 2013 in the Klamath River at the Turwar Boat Ramp (RM 6). While microcystin levels in fish tissue samples are usually below detection level or trace (0.17 micrograms per gram [ug/g]), 0.54 ug/g microcystin was measured in a half pounder steelhead liver collected in the Klamath River at Weitchpec in 2005 (Kann 2006).

As described for the Klamath River from Iron Gate Dam to the Salmon River (Section C.6.2.1), there have been numerous exceedances of public health guidelines in the Klamath River from the Salmon River confluence to the Klamath River Estuary, particularly in 2010. Public health advisories were issued in 2009 and 2010 in this reach (including locations on the Yurok Reservation) for elevated microcystin levels in ambient and/or freshwater mussel tissue samples (Fetcho 2010; Kann et al. 2010a; Kann et al. 2010b). In addition, substantial bioaccumulation (exceeding public health guidelines) of microcystin in freshwater mussels has been shown in this reach (Kann 2008a, Kann et al. 2010b). In 2014 and 2015, public health advisories were posted when microcystin concentrations exceeded the 0.8 ug/L Recommended Threshold for Recreational Waters and blue-green algae cell concentrations were elevated (YTEP 2014, 2015).

Anatoxin-a was not detected above the reporting limit in water samples collected during 2008 and 2009 at Lower Klamath River monitoring sites (Fetcho 2009, 2011). In recent years, anatoxin-a has been measured in the Klamath River downstream of Iron Gate Reservoir on several occasions, typically in the lower reaches including at monitoring sites near Weitchpec and Orleans (Otten 2017). Concentrations of *Anabaena flos-aquae* cells have continued to be monitored in recent years, but anatoxin-a concentrations are not available for Klamath River monitoring sites.

C.6.2.3 Klamath River Estuary

Chlorophyll-*a* and algal toxin levels in the Klamath River Estuary are generally similar to those measured at stations just upstream. During 2006 to 2014, chlorophyll-*a* concentrations in the Klamath River Estuary were less than 5.0 ug/L from May to July (except for one measurement of 9.9 ug/L in July 2012), then ranged from 0.5 to 15.0 ug/L from August to October (Sinnott 2008, 2009a, 2009b, 2010b, 2011b, 2012b; Hanington and Torso 2013; Hanington and Stawasz 2014; Hanington and Cooper Carouseli 2014). Peak concentrations of chlorophyll-*a* during 2006 to 2014 occurred during late-July to mid-October and varied by year (2.4 ug/L in 2006, 15.0 ug/L in 2007).

Algal toxin concentrations in the Klamath River Estuary are generally below 4.0 ug/L, corresponding to relatively low concentrations of *Microcystis aeruginosa* with several exceptions (Fetcho 2006, 2007, 2008, 2009, 2011; Watercourse Engineering, Inc. 2011a, 2011b, 2012, 2013, 2014, 2015, 2016; Gibson 2016). In September 2007 and

2010 the Yurok Tribe issued advisories because *Microcystis aeruginosa* concentrations exceeded 40,000 cells/mL. In 2010 and 2011 measured microcystin concentrations exceeded 4.0 ug/L between September and October (Gibson 2016). Microcystin in the Klamath River Estuary (RM 0.5) exceeded 0.8 ug/L at least once every year in 2010 through 2012, but it did not exceed 0.8 ug/L in 2013 through 2015 (Gibson 2016). In one additional instance, in September 2005, concentrations exceeded the WHO guideline for low risk recreational use (20,000 cells/mL). These elevated levels of *Microcystis aeruginosa* corresponded with elevated levels measured farther upstream in Copco No. 1 and Iron Gate reservoirs (Kann and Corum 2006). Lastly, there is emerging evidence that algal toxins flushing from coastal rivers into Monterey Bay, California were responsible for numerous sea otter deaths in 2007 (Miller et al. 2010). While it is not known if conditions in Monterey Bay are similar to those in the Klamath River marine nearshore environment, there may be potential for microcystin to adversely impact marine organisms when large blooms are transported through the Klamath River Estuary and into the Pacific Ocean.

C.7 Inorganic and Organic Contaminants

C.7.1 Upper Klamath Basin

C.7.1.1 Hydroelectric Reach

Water Column Contaminants

Existing water quality data are available from the California Surface Water Ambient Monitoring Program (SWAMP), which collected water quality data, including inorganic and organic contaminant data, from 2001 through 2005 at eight monitoring sites from the Oregon-California state line (RM 214.1) to Klamath River at Klamath Glen (RM 5.9) (North Coast Regional Board 2008). Results from the state line site indicated that for the majority of inorganic constituents, excluding nutrients (i.e., arsenic, cadmium, chloride, chromium, copper, lead, mercury, nickel, selenium, silver, sulfate, and zinc), concentrations were in compliance with water quality objectives at the time of sampling. Nutrients are discussed above in Section C.3.1. Aluminum concentrations (50.7 to 99.2 ug/L) exceeded the USEPA continuous concentration for freshwater aquatic life protection (87 ug/L) on two of four site visits (50 percent exceedance rate), and exceeded the USEPA secondary Maximum Contaminant Level (MCL) for drinking water (50 ug/L) on all four site visits (100 percent exceedance rate) (North Coast Regional Board 2008). Grab samples were analyzed for 100 pesticides, pesticide constituents, isomers, or metabolites; 50 polychlorinated biphenyls (PCBs) congeners; and 6 phenolic compounds. Results indicated no PCBs detections, but one detection of dichlorodiphenyldichloroethylene (1,1-bis-(4-chlorophenyl)-2,2-dichloroethene or DDE) (25 percent of samples) and one detection of trans-nonachlor (25 percent of samples) were found (North Coast Regional Board 2008).

Sediment Contaminants

To investigate the potential for toxicity of the sediments trapped behind the Lower Klamath Project reservoirs, Shannon & Wilson, Inc. (2006) collected 25 cores from J.C. Boyle, Copco No. 1, and Iron Gate reservoirs during 2006 and analyzed them for contaminants including acid volatile sulfides, metals, pesticides, chlorinated acid herbicides, PCBs, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), cyanide, and dioxins. The locations of the sediment cores were distributed throughout each reservoir, including locations on the historical Klamath River channel

(on-thalweg) and the surrounding submerged terraces or near tributary mouths (off-thalweg) along the edge of the historical Klamath River. Four locations on-thalweg were sampled in J.C. Boyle Reservoir, with maximum core depths ranging from 0.3 feet at the upstream end of the reservoir to 13.2 feet near the dam. Twelve locations (7 on-thalweg, 5 off-thalweg) were sampled in Copco No. 1 Reservoir, with maximum core depths ranging from 1.5 feet at the upstream end of the reservoir to 12.1 feet near the middle of the reservoir. Nine locations (5 on-thalweg, 4 off-thalweg) were sampled in Iron Gate Reservoir, with maximum core depths ranging from 0.7 feet at the upstream end of the reservoir to 7.8 feet within the Slide Creek/Camp Creek arm of the reservoir. During sediment core drilling, the sediments were evaluated to distinguish recent reservoir-deposited sediment from pre-reservoir sediment with drilling logs noting the depth of different sediment horizons. Interval composite/depth interval sediment samples were generated from the sediment cores, including both the reservoir-deposited and pre-reservoir sediments, with the number of interval samples depending on the total depth of the sediment core. No herbicides or PCBs were found above U.S. Army Corps of Engineers (USACE) Puget Sound Dredged Disposal Analysis Program (PSDDA) screening levels and only one sample exceeded applicable PSDDA screening levels for VOCs ethyl benzenes and total xylenes (Shannon & Wilson, Inc. 2006). While cyanide was detected in two of three sediment cores, it was not found in toxic free cyanide form (HCN or CN^-), and it is not likely to be bioavailable or result in adverse effects on fish and other aquatic biota.

Dioxin, a known carcinogen, was measured in three samples from J.C. Boyle, Copco No. 1, and Iron Gate reservoirs. Long-term exposure to dioxin in humans is linked to impairment of the immune system, the developing nervous system, the endocrine system and reproductive functions. In the 2006 reservoir samples, measured levels were 2.48 to 4.83 pg/g (picograms per gram or parts per trillion [ppt] expressed as Toxic Equivalent Concentrations)) and did not exceed USACE (1,000 pg/g), proposed freshwater sediment Apparent Effects Threshold for benthic fauna (8.8 pg/g), International Joint Commission for Great Lakes Science Advisory Board (10 pg/g), PSDDA bioaccumulation (15 pg/g), or U.S. Environmental Protection Agency fish and wildlife guidelines (2.5 to 210 pg/g) screening levels (Shannon & Wilson, Inc. 2006). More comprehensive reviews of dioxin guidelines and sediment studies from watersheds outside of the Klamath basin were conducted by Dillon (2008) and USEPA (2010), the latter presenting an estimate of background dioxin concentrations (2 to 5 ppt) for non-source-impacted sediments throughout the U.S. and specifically in the western U.S. (USEPA 2010). Based on the information presented in (USEPA 2010), in addition to being within the range of natural background, Klamath dioxin sediment levels reported by Shannon & Wilson, Inc. (2006) are one to three orders of magnitude below risk-based USEPA (1,000 pg/g dry weight [DW], toxicity equivalent quotient [TEQ]) preliminary remediation goals in residential soils, and Washington Department of Ecology (11 pg/g DW TEQ) for residential soil clean-up levels (USEPA 2010). They are also generally an order of magnitude below USEPA effects-based ecological receptors thresholds (60 to 100 pg/g DW TEQ for fish; 2.5 to 25 pg/g DW TEQ for mammals; 21 to 210 pg/g DW TEQ for birds).

While the existing sediment data (Shannon & Wilson, Inc. 2006) did not indicate a high risk of sediment toxicity, it was not sufficient to evaluate all analytes of interest. Thus, as part of the Secretarial Determination studies, a sediment evaluation was undertaken during 2009 to 2011 to provide a more comprehensive data set to further guide decisionmakers in an evaluation of potential impacts from dam removal. The United

States Bureau of Reclamation (USBR) and USFWS plan expanded the number of sediment cores and the analyte suite examined, including chemicals likely to bioaccumulate, and included biological and elutriate tests (USBR 2010). In 2009 to 2011 evaluation, establishment of toxicity and/or bioaccumulative potential for sediment contaminants relied upon thresholds developed through regional and state efforts such as the 2009 Sediment Evaluation Framework (SEF) for the Pacific Northwest Oregon and ODEQ bioaccumulation screening level values (SLVs). Sediment cores were collected during 2009 to 2010 at 37 sites on the historical Klamath River channel (on-thalweg) and the surrounding submerged terraces or near tributary mouths along the edge of the historical Klamath River (off-thalweg), distributed throughout J.C. Boyle Reservoir (Figure 2.6-4), Copco No. 1 Reservoir (Figure 2.6-5), Iron Gate Reservoir (Figure 2.6-6), and the Klamath River Estuary (Figure 3.2-5) (USBR 2010, 2011). Twelve sites (7 on-thalweg, 5 off-thalweg) were sampled in J.C. Boyle Reservoir, with maximum core depths ranging from 0.3 feet near the middle of the reservoir to 18.7 feet near the dam. Twelve sites (7 on-thalweg, 5 off-thalweg) were sampled in Copco No. 1 Reservoir, with maximum core depths ranging from 1.2 feet on an off-thalweg site downstream of the Beaver Creek arm of the reservoir to 9.7 feet on an off-thalweg location upstream of the Beaver Creek arm of the reservoir. Thirteen sites (8 on-thalweg, 5 off-thalweg) were sampled in Iron Gate Reservoir, with maximum core depths ranging from 0.5 feet at the upstream end of the reservoir to 7.7 feet within the Jenny Creek arm of the reservoir. At each site, cores were inspected by on-site geologists to verify that the reservoir-deposited/pre-reservoir sediment contact had been reached for each core. Sediment cores were used to either create whole core composite sediment samples or interval composite/depth interval composite sediment samples for laboratory analysis of potential contaminants with samples representing both the reservoir-deposited and pre-reservoir sediments. Area composite samples were also generated from sediment cores for the Klamath River Estuary. A total of 77 sediment samples were created to analyze sediment conditions in J.C. Boyle Reservoir (26 sediment samples), Copco No. 1 Reservoir (25 sediment samples), Iron Gate Reservoir (24 sediment samples), and the Klamath River Estuary (2 sediment samples) from the 37 sediment cores (USBR 2011).

A total of 501 analytes were quantified across the samples, including metals, poly-aromatic hydrocarbons (PAHs), PCBs, pesticides/herbicides, phthalates, VOCs, SVOCs, dioxins, furans, and polybrominated diphenyl ethers (PBDEs) (i.e., flame retardants). The chemical composition of sediment and elutriate[5] sediment samples were analyzed, and bioassays were conducted on the sediment and elutriate sediment samples using fish and invertebrate national benchmark toxicity species. Using results of these analyses, the following five exposure pathways were evaluated under Level 2A and 2B of the SEF using multiple lines of evidence: (CDM 2011):

- Pathway 1 – Proposed Project - Short-term water column exposure for aquatic biota from sediments flushed downstream (suspended sediments, not a bioaccumulation issue).

[5] Elutriate sediment samples are created from reservoir composite sediment samples mixed with reservoir water (e.g., one part sediment to four parts water). In general, elutriate tests are a standard approach that analyze the chemical composition of the overlying water of the elutriate sediment samples to estimate potential chemical concentrations in the water between the grains of sediment (pore water). Standard elutriate tests do not reflect the full dilution of re-suspended sediments that would occur during dam removal.

- Pathway 2 – Proposed Project - Long-term sediment exposure for riparian biota and humans from reservoir terrace deposits and river bank deposits (terrestrial exposures).
- Pathway 3 – Proposed Project - Long-term sediment exposure for aquatic biota and humans from river bed deposits (aquatic exposures).
- Pathway 4 – Proposed Project - Long-term sediment exposure for aquatic biota from estuary and marine near shore deposits.
- Pathway 5 – No Project Alternative - Long-term sediment exposure for aquatic biota and humans (via fish consumption) to reservoir sediments.

Results indicate that sediment in all three reservoirs exceeded freshwater ecological screening levels (SLs) for nickel, iron, and 2,3,4,7,8-Pentachlorodibenzofuran (PECDF) (Table C-6). Sediment in J.C. Boyle Reservoir also exceeded freshwater ecological SLs for 4,4'-Dichlorodiphenyltrichloroethane (DDT), 4,4'-Dichlorodiphenyldichloroethane (DDD), 4,4'-dichlorodiphenyldichloroethylene (DDE), dieldrin, and 2,3,7,8-Tetrachlorodibenzodioxin (TCDD) (Table C-6). Several pesticides and semi-volatile organic compounds (SVOCs) were not detected in the reservoir sediments, but the reporting limits were above the freshwater SLs. Human health SLs were only exceeded for arsenic and nickel, pentachlorophenol (in the case of J.C. Boyle Reservoir), and some legacy pesticides (e.g., 4,4'-DDT, 4,4'-DDD, 4,4'-DDE, dieldrin, see Table C-7). Several dioxin-like compounds were detected and exceeded the ODEQ Bioaccumulation SLVs (Table C-7). Several pesticides and SVOCs were not detected, but the reporting limits were above the human health SLs (Table C-7). Marine ecological SLs were only exceeded for dieldrin and 2,3,4,7,8-PECDF in J.C. Boyle Reservoir (see Table C-8). Several organic compounds were not detected, but the reporting limits were above the available marine SLs (Table C-8). Analytes that were not detected but had reporting limits above freshwater or marine SLs were listed as chemicals of potential concern (COPCs) and analyzed in macroinvertebrate and/or fish tissue bioaccumulation tests to evaluate any effects from those chemicals potentially being in the sediment. No consistent pattern of elevated chemical composition was observed across discrete sampling locations within a reservoir, but sediment in J.C. Boyle Reservoir does have marginally higher iron concentrations and more detected COPCs as compared to Copco No. 1 and Iron Gate Reservoir and Klamath River Estuary sediments (CDM 2011). Also, J.C. Boyle reservoir has more COPCs based on comparison to CalEPA, National Oceanic and Atmospheric Administration (NOAA), U.S. Fish and Wildlife Service (USFWS), USEPA, and ODEQ freshwater ecological and human health SLs.

Several chemicals identified as COPCs may occur in reservoir sediments at concentrations similar to background levels, however, background concentrations of most chemicals associated with Lower Klamath Project reservoir sediments are generally unavailable for the Klamath Basin. Arsenic concentrations in measured reservoir sediments (4.3 to 15 mg/kg) were within the range of arsenic concentrations measured in soil samples from the Mid- and Lower Klamath Basin (0.8 to 23 mg/kg with typical arsenic concentrations between approximately 2.0 and 7.0 mg/kg) (USGS NGS 2008) and arsenic may be naturally elevated in the Upper Klamath Basin, with average regional background arsenic concentrations of 3.99 mg/kg ± 5.03 mg/kg in the vicinity of the Upper Klamath Lake (Sturdevant 2010; ODEQ 2013; Sullivan and Round 2016). Suitable background sites characterized by similar sediment compositions as the Lower Klamath Project reservoirs, but without the same potential chemical sources (e.g., urban

areas, irrigated agriculture, industry, and hydroelectric development), could not be identified (CDM 2011).

Overall, there were relatively few chemicals in sediment from the three reservoirs (and the Klamath River Estuary) identified as COPCs, with several COPCs being listed for the reservoirs only because the reporting limits were greater than freshwater or marine SLs. Analytical testing methods for chemicals were selected to achieve a reporting limit 3 to 5 times lower than the lowest applicable sediment screening level or water quality criteria. Despite this, due to limitations of the standard methods, several reporting limits were greater than the associated SLs and other reporting limits were not achieved due to background effects of the sample matrix or required sample dilutions (USBR 2011). However, as part of multiple lines of evidence (see *Contaminants in Aquatic Biota* below), CDM (2011) concluded that the sediment quality of reservoirs does not appear to be notably contaminated based on the detected COPCs in reservoir sediments and comparisons to ecological freshwater and marine SEF, USACE Dredge Material Management Program (DMMP), NOAA Screening Quick Reference Tables (SQuiRT), and ODEQ bioaccumulative SLs along with comparisons to human health SLs, including USEPA residential (total carcinogenic and total non-carcinogenic) regional screening levels (RSLs), CalEPA OEHHA California Human Health Screening Levels (CHHSLs), or ODEQ bioaccumulation (human subsistence and human general) SLs.

Updates to SEF Screening Levels

In 2015, new SEF SLs were implemented by the RSET to replace the 2009 SEF SLs. RSET undertook a range of updates to the various SEF SLs, including increasing SLs, decreasing SLs, adding SLs for new chemicals, and removing SLs for chemicals listed in the 2009 SEF SLs (RSET 2009, 2018). The majority of the changes to the SLs were updates to the freshwater SEF SLs with only a few updates to the marine SEF SLs (e.g., the marine SL for DDT was revised from 34 ug/kg in 2009 to 12 ug/kg in 2018). The 2009 Pacific Northwest SEF freshwater SLs and the updated freshwater SLs detailed in the 2018 Pacific Northwest SEF are presented in Table C-9. While the value of SLs for some analytes changed between the 2009 and 2018 SEF, the changes in SLs did not alter the detected COPC list determined by CDM (2011) or the resulting analysis, since the detected COPCs were not listed only in reference to the SEF SLs. More specifically, a decrease in the lower SEF SL (SL1) for nickel between the 2009 and 2018 SEF did not change its classification in the COPC list, because nickel had already been identified as a COPC in the CDM (2011) analysis for exceedances of the FWS TEL, FWS LEL, and FWS TEC screening values. Nickel concentrations measured in reservoir sediments (18 to 33 mg/kg) were occasionally above the nickel 2018 SEF lower SL (26 mg/kg), so exceedances of the 2018 SEF lower SL would be added to the list of reasons why nickel is listed as a COPC for the reservoir sediment. While the chromium SEF SLs decreased, chromium concentrations in reservoir sediments were still below chromium 2018 SEF SLs, so it is still not a COPC for reservoir sediments. Selenium was added to the list of 2018 SEF SLs, but selenium concentrations measured in reservoir sediments were less than the 2018 SEF SLs and it would not be a COPC.

As some SEF SLs are less than the laboratory reporting limit, the COPCs listed in CDM (2011) would change with application of the 2018 SEF SLs for the following reasons:

1. a SL no longer applied for a chemical in the 2018 SEF SL;
2. a SL was added for a new chemical and the USBR (2011) reporting limit for that chemical was less than the 2018 SEF SL; or

3. a SL was added for a new chemical and the chemical had not been tested in the USBR (2011) analysis of reservoir sediments.

Analyte-specific details are provided below.
The 2009 SEF SLs for PAHs no longer appear in the 2018 SEF SLs, so they would be removed from the COPC list. Total PAHs would be added to the COPC list, because it is a new analyte in the 2018 SEF SLs and the total PAHs were not measured as part of the USBR (2011) tests. While individual PAHs were measured in reservoir sediment testing and the range of the reporting limits for individual PAHs (6.7 to 1,200 ug/kg) were below the total PAHs 2018 SEF lower SL (17,000 ug/kg), total PAHs were not measured and would need added to the COPC list. Similarly, individual aroclors (e.g., aroclor 1221) would be removed from the COPC list and total aroclors would be added to the COPC list since it was not measured as part of the USBR (2011) testing.

The 2018 SEF added SLs for several organochlorine pesticides (i.e., 4-4'-DDD, 4-4'-DDE, 4-4'-DDT, dieldrin, beta-hexachlorocyclohexane, and endrin ketone). UBSR (2011) testing did not detect any of these chemicals in reservoir sediments and the reporting limits for these chemicals were above the 2018 SEF SL, so 4-4'-DDD, 4-4'-DDE, 4-4'-DDT, dieldrin, beta-hexachlorocyclohexane, and endrin ketone would not need to be added to the COPC list based on 2018 SEF SLs.

The 2018 SEF revised the SLs for phthalates (Bis(2-ethylhexyl) phthalate and Di-N-octyl phthalate), removed SLs for phthalates (Butyl benzyl phthalate and Dimethyl phthalate), and added SLs for phthalates (Di-n-butyl-phthalate). None of the phthalates were detected in reservoir sediments above the reporting limit, but all the phthalates with 2018 SEF SLs would be retained or added to the COPC list since their reporting limit was below the 2018 SEF SLs. The phthalates without 2018 SEF SLs (Butyl benzyl phthalate and Dimethyl phthalate) would be removed from the COPC list.

The 2018 SEF added SLs for several SVOC phenols (Phenol, 4-Methylphenol, and Pentachlorophenol). Pentachlorophenol was not detected in USBR (2011) reservoir sediments and the reporting limit was below the 2018 SEF SLs, so it would not need to be added to the COPC list. Phenol and 4-Methylphenol were not detected in reservoir sediments, but the reporting limit was greater than the 2018 SEF SLs, so it would be added to the COPC list.

SLs were also added in the 2018 SEF for the extractable compounds benzoic acid, carbazole, and dibenzofuran. These three chemicals were not detected in USBR (2011) sediment tests, but the range of reporting limits was greater than the 2018 SEF SLs. As such, they would be added to the COPCs list.

Several new chemicals were added to the list of chemicals with 2018 SEF SLs that had not been previously considered or measured in USBR (2011) reservoir sediments tests. Butyltins are a group of organotin compounds used as stabilizers for polyvinyl chloride (PVC), biocides, fungicides, and anti-biofouling agents, especially used in coatings and paints applied to the bottom hull of ships to minimize biofouling (USEPA 2003; RSET 2018). Tributyltin is the primarily form of butyltin of concern in the environment due to its use as an anti-biofouling agent in paints for large ships with other forms (mono-, di-, and tetra-butyltin) occurring as byproducts as tributyltin breaks down. Elevated concentrations of butyltins in fresh and salt waters, sediments, and biota are primarily associated with harbors, marinas, boat yards, and dry docks with frequent ship traffic,

but use of butyltin as an anti-biofouling agent on nets, crab pots, docks, and water cooling towers also contributes to its presence in aquatic environments (WHO 1999; USEPA 2003). According to RSET (2018), the need for analysis of butyltins (and other organotins) is limited to areas and sites affected by vessel maintenance and construction activities, marine shipping, and frequent vessel traffic (e.g., shipyards, boatyards, marinas, and marine terminals). Conditions in the Hydroelectric Reach of the Klamath River and upstream reaches did not support these activities historically and currently the reservoirs do not experience frequent large vessel traffic, therefore the site-specific SEF butyltin SLs would not apply to the Lower Klamath Project.

Total Petroleum Hydrocarbons (TPHs) represent gasoline, diesel, and other petroleum hydrocarbon compounds (e.g., motor oil or grease). While many other individual hydrocarbons that are present in gasoline, diesel, and petroleum products (e.g., PAHs, VOCs, SVOCs) were measured by USBR (2011), the overarching TPH test was not performed, thus TPHs would need to be added to the COPC list.

While the COPCs list would change due to the changes in SLs between the 2009 SEF and 2018 SEF, the previous CDM (2011) analysis of the five exposure pathways still sufficiently analyzes the potential effects of chemicals in Lower Klamath Project reservoir sediments through sediment toxicity and bioaccumulation tests for macroinvertebrates and/or fish. Since the sediment toxicity and bioaccumulation tests were performed using sediment samples from the Lower Klamath Project reservoirs, the results quantify the integrative (cumulative) effects of all COPCs in the reservoir sediments, even if the full updated list of COPCs was not included in the CDM (2011) analysis. Additionally, SEF SLs were only one of three ecological freshwater sediment SLs used in the original analysis, so the other SLs (USACE DMMP, NOAA SQuiRT, and ODEQ bioaccumulation) ensure that the CDM (2011) analysis sufficiently assessed the inorganic and organic contaminants in reservoir sediment that may impact freshwater aquatic species. Finally, SEF SLs were not used as human health screening levels, so the changes in the SEF SLs would not alter the CDM (2011) analysis with respect to reservoir sediments on human health.

Sediment Toxicity and Bioaccumulation Tests

Toxicity equivalent quotients (TEQs) were calculated for dioxin, furan, and dioxin-like PCBs in reservoir sediment samples to evaluate potential adverse effects from exposure to dioxin, furan, and dioxin-like PCBs. TEQs ranged from approximately 4 to 9 pg/g for J.C. Boyle Reservoir, 5 to 10 pg/g for Copco No. 1 Reservoir, and 2 to 4 pg/g for Iron Gate Reservoir. In some cases, these values are slightly higher than background values reported by USEPA for Region 9 (i.e., 2 to 5 pg/g), Region 10 (i.e., 4 pg/g), and for non-impacted lakes of the United States (i.e., 5.3 pg/g) (USEPA 2010, CDM 2011). The calculated TEQs may also be within the range of local background values. Since the TEQs are only slightly above regional background concentrations and the nationwide background for non-impacted lakes, they have limited potential for adverse effects for fish exposed to reservoir sediments (CDM 2011).

Toxicity tests generally indicated low potential for sediment toxicity to benchmark benthic indicator species with the exception of a single sample from J.C. Boyle Reservoir, where survival of the benthic amphipod *Hyalella azteca* indicated a moderate potential for sediment toxicity (CDM 2011). Results of elutriate chemistry and elutriate toxicity tests on rainbow trout (*Oncorhynchus mykiss*) are discussed as part of the Proposed Project potential impact analysis (Section 3.2.5.7 *Inorganic and Organic Contaminants*).

Collectively, the elutriate chemistry and elutriate toxicity test results do not identify a consistent pattern of toxicity by location, representative organism, or conditions.

Overall, twenty lines of evidence were used with various lines of evidence integrated to evaluate the five exposure pathways and to draw conclusions regarding potential adverse effects from the chemicals present in the reservoir sediments (Table C-10). Lines of evidence related to contaminants in aquatic biota are detailed and discussed together below. Based on these twenty lines of evidence from the 2009 to 2010 Secretarial Determination study, reservoir sediments do not appear to be highly contaminated (CDM 2011). No consistent pattern of elevated chemical composition is observed across discrete sampling locations within a reservoir. No single reservoir was observed to be consistently more or less contaminated based on these 20 lines of evidence. Where elevated concentrations of chemicals in sediment are found, the degree of exceedance based on comparisons of measured (i.e., detected) chemical concentrations to SLs is small, and in several cases, may reflect regional background conditions (CDM 2011).

Table C-6. Chemicals in Sediment that Exceed One or More Freshwater Sediment Screening Levels. Source: CDM (2011).

Chemical	COC Based on Detect (D) or Elevated Reporting Limit (RL)	Units	Range of Detections for Detected Analytes that Exceed One or More Screening Levels	Range of Reporting Limits (RL) for Non-Detects	Ratio of Maximum Chemical Concentration to SL for Detected Analytes[a]	Screening Values Exceeded	Highest of Screening Value Hierarchy Level[b]
J.C. Boyle Reservoir							
Nickel	D	mg/kg	19–32	---	2 [c]	FWS TEL, **FWS LEL** [c], FWS TEC	2d [c]
4,4-DDD	D	ug/kg	3.7	---	9.5	ODEQ Bioacc SLV	2c
4,4-DDE	D	ug/kg	3.4	---	8.7	ODEQ Bioacc SLV	2c
4,4-DDT	D	ug/kg	4.1	---	11	ODEQ Bioacc SLV	2c
Dieldrin	D	ug/kg	3.4	---	1.5–9.2	FWS TEL, FWS LEL, FWS TEC, **ODEQ F-FW, ODEQ B-I**, ODEQ B-P, ODEQ M-I, ODEQ M-P	2c
2,3,4,7,8-PECDF	D	pg/g	1.5–1.5	---	1.4–8.8	**ODEQ F-FW**, ODEQ B-I, **ODEQ M-I**	2c
2,3,7,8-TCDD	D	pg/g	0.19	---	3.7	ODEQ M-I	2c
Iron	D	mg/kg	21,000–37,000	---	1.85	FWS LEL	2d
Cadmium	RL	mg/kg	---	0.16–0.84	---	SEF-SL1	2a
Aroclor 1221	RL	ug/kg	---	0.24–0.49	---	SEF-SL1 (total PCBs)	2a
Aroclor 1232	RL	ug/kg	---	0.16–0.24	---	SEF-SL1 (total PCBs)	2a
Aroclor 1242	RL	ug/kg	---	0.045–0.24	---	SEF-SL1 (total PCBs)	2a
Aroclor 1248	RL	ug/kg	---	0.045–0.24	---	SEF-SL1 (total PCBs)	2a
Aroclor 1254	RL	ug/kg	---	0.045–0.24	---	SEF-SL1 (total PCBs)	2a
Aroclor 1260	RL	ug/kg	---	0.045–0.24	---	SEF-SL1 (total PCBs)	2a
Bis(2-ethylhexyl)phthalate	RL	ug/kg	---	230–1200	---	SEF-SL1	2a
Butyl benzyl phthalate	RL	ug/kg	---	230–1200	---	SEF-SL1	2a
Dimethyl phthalate	RL	ug/kg	---	230–1200	---	SEF-SL1	2a
Di-n-octyl phthalate	RL	ug/kg	---	230–1200	---	SEF-SL1	2a

Chemical	COC Based on Detect (D) or Elevated Reporting Limit (RL)	Units	Range of Detections for Detected Analytes that Exceed One or More Screening Levels	Range of Reporting Limits (RL) for Non-Detects	Ratio of Maximum Chemical Concentration to SL for Detected Analytes[a]	Screening Values Exceeded	Highest of Screening Value Hierarchy Level[b]
2-METHYLNAPHTHALENE	RL	ug/kg	---	230–1200	---	SEF-SL1	2a
ACENAPHTHENE	RL	ug/kg	---	230–1200	---	SEF-SL1	2a
ACENAPHTHYLENE	RL	ug/kg	---	230–1200	---	SEF-SL1	2a
BENZO(K)FLUORANTHENE	RL	ug/kg	---	230–1200	---	SEF-SL1	2a
DIBENZ(A,H)ANTHRACENE	RL	ug/kg	---	230–1200	---	SEF-SL1	2a
DIBENZOFURAN	RL	ug/kg	---	230–1200	---	SEF-SL1	2a
FLUORENE	RL	ug/kg	---	230–1200	---	SEF-SL1	2a
Chlordane (Technical)	RL	ug/kg	---	4.5–24	---	ODEQ Bioacc SLV	2c
Chlordane-Alpha	RL	ug/kg	---	0.9–4.9	---	ODEQ Bioacc SLV	2c
Chlordane-Gamma	RL	ug/kg	---	0.9–4.9	---	ODEQ Bioacc SLV	2c
Dieldrin	RL	ug/kg	---	0.9–4.9	---	ODEQ Bioacc SLV	2c
BHC-Gamma (HCH-gamma, Lindane)	RL	ug/kg	---	0.9–4.9	---	SQuiRTs (TEL, LEL, PEL, TEC)	2d
Endrin	RL	ug/kg	---	0.9–4.9	---	SQuiRTs (TEL, LEL, TEC)	2d
Heptachlor	RL	ug/kg	---	0.9–4.9	---	SQuiRTs (TEL, LEL, TEC)	2d
Heptachlor Epoxide	RL	ug/kg	---	0.9–4.9	---	SQuiRTs (TEL, PEL, TEC)	2d
Toxaphene	RL	ug/kg	---	45–240	---	SQuiRTs (TEL)	2d
Copco No. 1 Reservoir							
Nickel	D	mg/kg	22–32	---	2 [c]	FWS TEL, **FWS LEL** [c], FWS TEC	2d [c]
2,3,4,7,8-PECDF	D	pg/g	1.8–1.9	---	1.7–11.2	**ODEQ F-FW, ODEQ B-I, ODEQ M-I**	2c
Iron	D	mg/kg	21,000–24,000	---	1.2	FWS LEL	2d
SILVER	RL	mg/kg	---	1.8–2.4	---	SEF-SL1	2a
AROCLOR 1221	RL	ug/kg	---	0.24–0.3	---	SEF-SL1 (total PCBs)	2a
AROCLOR 1232	RL	ug/kg	---	0.12–0.15	---	SEF-SL1 (total PCBs)	2a

Chemical	COC Based on Detect (D) or Elevated Reporting Limit (RL)	Units	Range of Detections for Detected Analytes that Exceed One or More Screening Levels	Range of Reporting Limits (RL) for Non-Detects	Ratio of Maximum Chemical Concentration to SL for Detected Analytes[a]	Screening Values Exceeded	Highest of Screening Value Hierarchy Level[b]
BIS(2-ETHYLHEXYL) PHTHALATE	RL	ug/kg	---	580–730	---	SEF-SL1	2a
BUTYL BENZYL PHTHALATE	RL	ug/kg	---	580–730	---	SEF-SL1	2a
DIMETHYL PHTHALATE	RL	ug/kg	---	580–730	---	SEF-SL1	2a
DI-N-OCTYL PHTHALATE	RL	ug/kg	---	580–730	---	SEF-SL1	2a
2-METHYLNAPHTHALENE	RL	ug/kg	---	580–730	---	SEF-SL1	2a
ACENAPHTHYLENE	RL	ug/kg	---	580–730	---	SEF-SL1	2a
BENZO(K)FLUORANTHENE	RL	ug/kg	---	580–730	---	SEF-SL1	2a
DIBENZOFURAN	RL	ug/kg	---	580–730	---	SEF-SL1	2a
4,4'-DDE	RL	ug/kg	---	2.4–3	---	SQuiRTs (TEL)	2d
4,4'-DDT	RL	ug/kg	---	2.4–3	---	SQuiRTs (TEL)	2d
BHC-gamma (HCH-gamma, Lindane)	RL	ug/kg	---	2.4–3	---	SQuiRTs (TEL, PEL, TEC)	2d
CHLORDANE (TECHNICAL)	RL	ug/kg	---	12–15	---	SQuiRTs (TEL, LEL, PEL, TEC)	2d
DIELDRIN	RL	ug/kg	---	2.4–3	---	SQuiRTs (TEL, LEL, TEC)	2d
ENDRIN	RL	ug/kg	---	2.4–3	---	SQuiRTs (TEC)	2d
HEPTACHLOR	RL	ug/kg	---	2.4–3	---	SQuiRTs (TEL, TEC)	2d
HEPTACHLOR EPOXIDE	RL	ug/kg	---	2.4–3	---	SQuiRTs (TEL, PEL, TEC)	2d
TOXAPHENE	RL	ug/kg	---	120–150	---	SQuiRTs (TEL)	2d

Chemical	COC Based on Detect (D) or Elevated Reporting Limit (RL)	Units	Range of Detections for Detected Analytes that Exceed One or More Screening Levels	Range of Reporting Limits (RL) for Non-Detects	Ratio of Maximum Chemical Concentration to SL for Detected Analytes[a]	Screening Values Exceeded	Highest of Screening Value Hierarchy Level[b]
Iron Gate Reservoir							
Nickel	D	mg/kg	18–33	---	2.1 [c]	FWS TEL, **FWS LEL** [c], FWS TEC	2d [c]
2,3,4,7,8-PECDF	D	pg/g	0.74	---	1.1–4.4	ODEQ B-I, ODEQ M-I	2c
Iron	D	mg/kg	26,000–32,000	---	1.6	FWS LEL	2d
SILVER	RL	mg/kg	---	0.94–2.2	---	SEF-SL1	2a
AROCLOR 1221	RL	ug/kg	---	0.067–0.3	---	SEF-SL1 (total PCBs)	2a
AROCLOR 1232	RL	ug/kg	---	0.033–0.15	---	SEF-SL1 (total PCBs)	2a
BIS(2-ETHYLHEXYL) PHTHALATE	RL	ug/kg	---	170–730	---	SEF-SL1	2a
BUTYL BENZYL PHTHALATE	RL	ug/kg	---	170–730	---	SEF-SL1	2a
DI-N-OCTYL PHTHALATE	RL	ug/kg	---	170–730	---	SEF-SL1	2a
2-METHYLNAPHTHALENE	RL	ug/kg	---	170–730	---	SEF-SL1	2a
ACENAPHTHYLENE	RL	ug/kg	---	170–730	---	SEF-SL1	2a
BENZO(K)FLUORANTHENE	RL	ug/kg	---	170–730	---	SEF-SL1	2a
DIBENZOFURAN	RL	ug/kg	---	170–730	---	SEF-SL1	2a
NAPHTHALENE	RL	ug/kg	---	5–520	---	SEF-SL1	2a
4,4'-DDE	RL	ug/kg	---	0.67–3	---	SQuiRTs (TEL, TEC)	2d
4,4'-DDT	RL	ug/kg	---	0.67–3	---	SQuiRTs (TEL)	2d
BHC-gamma (HCH-gamma, Lindane)	RL	ug/kg	---	0.67–3	---	SQuiRTs (TEL, PEL, TEC)	2d
CHLORDANE (TECHNICAL)	RL	ug/kg	---	3.3–15	---	SQuiRTs (TEL, PEL, LEL, TEC)	2d
DIELDRIN	RL	ug/kg	---	0.67–3	---	SQuiRTs (TEL, LEL, TEC)	2d
ENDRIN	RL	ug/kg	---	0.67–3	---	SQuiRTs (TEL, TEC)	2d
HEPTACHLOR	RL	ug/kg	---	0.67–3	---	SQuiRTs (TEL, TEC)	2d
HEPTACHLOR EPOXIDE	RL	ug/kg	---	0.67–3	---	SQuiRTs (TEL, PEL, TEC)	2d
TOXAPHENE	RL	ug/kg	---	33–150	---	SQuiRTs (TEL)	2d

Chemical	COC Based on Detect (D) or Elevated Reporting Limit (RL)	Units	Range of Detections for Detected Analytes that Exceed One or More Screening Levels	Range of Reporting Limits (RL) for Non-Detects	Ratio of Maximum Chemical Concentration to SL for Detected Analytes[a]	Screening Values Exceeded	Highest of Screening Value Hierarchy Level[b]
Klamath River Estuary							
Lower Klamath							
Chromium	D	mg/kg	96	--	1.0	**SL1-FWS**, SL2-FWS, FWS TEL, FWS LEL, FWS PEL, FWS TEC	2b
Nickel	D	mg/kg	110	--	1.8 [c]	**SL1-FWS,** SL2-FWS, FWS TEL, FWS LEL, FWS PEL, FWS TEC	2b
Iron	D	mg/kg	24,000–24,000	--	1.2	**FWS LEL**	2d
BIS(2-ETHYLHEXYL) PHTHALATE	RL	ug/kg	---	230	---	**SEF-SL1**	2a
DIMETHYL PHTHALATE	RL	ug/kg	---	230	---	**SEF-SL1**	2a
DI-N-OCTYL PHTHALATE	RL	ug/kg	---	230	---	**SEF-SL1**	2a
CHLORDANE (TECHNICAL)	RL	ug/kg	---	4.6	---	**SQuiRTs (TEL, TEC)**	2d
HEPTACHLOR EPOXIDE	RL	ug/kg	---	0.91	---	**SQuiRTs (TEL)**	2d
TOXAPHENE	RL	ug/kg	---	46	---	**SQuiRTs (TEL)**	2d
Upper Klamath							
Chromium	D	mg/kg	96–97	---	1.0	**SL1-FWS,** FWS TEL, FWS LEL, FWS PEL, FWS TEC	2a
Bis(2-ethylhexyl)phthalate	D	ug/kg	250	---	1.1	**SL1-FWS**	2a
DIMETHYL PHTHALATE	RL	ug/kg	---	230	---	**SEF-SL1**	2a
DI-N-OCTYL PHTHALATE	RL	ug/kg	---	230	---	**SEF-SL1**	2a
CHLORDANE (TECHNICAL)	RL	ug/kg	---	4.6	---	**SQuiRTs (TEL, TEC)**	2d

Chemical	COC Based on Detect (D) or Elevated Reporting Limit (RL)	Units	Range of Detections for Detected Analytes that Exceed One or More Screening Levels	Range of Reporting Limits (RL) for Non-Detects	Ratio of Maximum Chemical Concentration to SL for Detected Analytes[a]	Screening Values Exceeded	Highest of Screening Value Hierarchy Level[b]
HEPTACHLOR EPOXIDE	RL	ug/kg	---	0.93	---	**SQuiRTs (TEL)**	2d
TOXAPHENE	RL	ug/kg	---	46	---	**SQuiRTs (TEL)**	2d

Notes:
Screening Level Hierarchy --
Retain if above:

1) DMMP-MLs

2a) SEF-SL1
2b) SEF-SL1 AND SEF-SL2
2c) Chemicals with no SEF and one or more ODEQ bioaccumulative SLVs exceeded
2d) Chemicals with no SEF or ODEQ but one or more SQuiRT exceeded

Units:

Metals:	mg/kg
Pesticides:	ug/kg
dioxins and furans:	pg/g
SVOCs:	ug/kg
phthalates:	ug/kg

Key:

FWS =	U.S. Fish and Wildlife Service	DMMP =	Dredged Material Management Program	TEL =	threshold effect level
TEL =	Threshold Effect Level	LEL =	Lowest Effect level	LEL =	lowest effect level
SL1 =	Sediment Screening Level 1	TEC =	Threshold Effect Concentration	PEL =	probable effect level
SEF =	Sediment Evaluation Framework	PEL =	Probable Effect Level	TEC =	threshold effect concentration
SLV =	Screening Level Value	ODEQ:	Oregon Department of Environmental Quality		B-P: Bird population
	B-I: Bird individual F-FW: Fish-freshwater		M-I: Mammal individual		M-P: Mammal population

[a] Ratio of maximum detected concentration to the SL is typically expressed as a Hazard Quotient (HQ). This ratio is presented above for each detected chemical and is calculated using the maximum detected concentration; the highest and lowest of screening values when multiple screening values are exceeded of same level in screening hierarchy. When more than two screening values are exceeded, the screening level used for calculation of the ratio (HQ) are in **bold**.

[b] Screening level hierarchy depicted in CDM (2011) Figure 2.

[c] Updated from CDM (2011) Table 2 based on review of screening values listed in CDM (2011) Table A-2 and range of detections for detected analytes in CDM (2011) and USBR (2011).

Based on the information provided in Table A-6 in CDM (2011) and database query for ambiguous and positive exceedances.

Table C-7. Chemicals in Sediment that Exceed One or More Human Health Sediment Screening Levels. Source: CDM (2011).

Chemical	COC Based on Detect (D) or Elevated Reporting Limit (RL)	Units	Range of Detections for Detected Analytes that Exceed One or More Screening Levels	Range of Reporting Limits (RL) for Non-Detects	Ratio of Maximum Chemical Concentration to SL for Detected Analytes[1]	Screening Values Exceeded	Notes
J.C. Boyle Reservoir							
Arsenic	D	mg/kg	4.3–15	---	38–214	**EPA RSL TOT CAR**, **CHHSL Res**, CHHSL Comm	a
Nickel	D	mg/kg	19–32	---	84	**EPA RSL TOT CAR**	a
4,4-DDD	D	ug/kg	3.7	---	11–93	ODEQ BSLV H-S, ODEQ BSLV H-G	---
4,4-DDE	D	ug/kg	3.4	---	10–85	ODEQ BSLV H-S, ODEQ BSLV H-G	---
4,4-DDT	D	ug/kg	4.1	---	12–103	ODEQ BSLV H-S, ODEQ BSLV H-G	---
Dieldrin	D	ug/kg	3.4	---	420–3,400	ODEQ BSLV H-S, ODEQ BSLV H-G	---
1,2,3,4,6,7,8-HPCDD	D	pg/g	170–180	---	2.1	ODEQ BSLV H-S	---
1,2,3,4,7,8-HXCDD	D	pg/g	1.5–1.6	---	4.4	ODEQ BSLV H-S	---
1,2,3,6,7,8-HXCDD	D	pg/g	6.6–7.3	---	2.7–21	ODEQ BSLV H-S, ODEQ BSLV H-G	---
1,2,3,7,8,9-HXCDD	D	pg/g	3.7	---	1.4–11	ODEQ BSLV H-S, ODEQ BSLV H-G	---
1,2,3,4,7,8-HXCDF	D	pg/g	1.7–2.1	---	6.2	ODEQ BSLV H-S	
1,2,3,6,7,8-HXCDF	D	pg/g	4.4–5.3	---	2.0–16	ODEQ BSLV H-S, ODEQ BSLV H-G	---
1,2,3,7,8,9-HXCDF	D	pg/g	0.66–0.67	---	0.5–1.9	ODEQ BSLV H-S	---
1,2,3,7,8-PECDD	D	pg/g	1.1	---	4.1–37	ODEQ BSLV H-S, ODEQ BSLV H-G	---
1,2,3,7,8-PECDF	D	pg/g	0.88–1.1	---	3.5	ODEQ BSLV H-S	---
2,3,4,6,7,8-HXCDF	D	pg/g	3–3.2	---	1.2–9.4	ODEQ BSLV H-S, ODEQ BSLV H-G	---
2,3,4,7,8-PECDF	D	pg/g	1.5	---	50–405	ODEQ BSLV H-S, ODEQ BSLV H-G	---
2,3,7,8-TCDD	D	pg/g	0.19	---	19–173	ODEQ BSLV H-S, ODEQ BSLV H-G	b
2,3,7,8-TCDF	D	pg/g	0.88–0.9	---	1.2–9.6	ODEQ BSLV H-S, ODEQ BSLV H-G	---
Pentachlorophenol	D	ug/kg	34	---	1.1	ODEQ BSLV H-S	b
4,4,'-DDD	RL	ug/kg	---	0.9–4.9	---	ODEQ	---
4,4,'-DDE	RL	ug/kg	---	0.9–4.9	---	ODEQ	---
4,4,'-DDT	RL	ug/kg	---	0.9–4.9	---	ODEQ	---

Chemical	COC Based on Detect (D) or Elevated Reporting Limit (RL)	Units	Range of Detections for Detected Analytes that Exceed One or More Screening Levels	Range of Reporting Limits (RL) for Non-Detects	Ratio of Maximum Chemical Concentration to SL for Detected Analytes[(1)]	Screening Values Exceeded	Notes
Aroclor 1221	RL	ug/kg	---	0.24–0.49	---	EPA RSL	---
Aroclor 1232	RL	ug/kg	---	0.16–0.24	---	EPA RSL	---
Aroclor 1242	RL	ug/kg	---	0.045–0.24	---	EPA RSL	---
Aroclor 1248	RL	ug/kg	---	0.045–0.24	---	EPA RSL	---
Aroclor 1254	RL	ug/kg	---	0.045–0.24	---	EPA RSL	---
Aroclor 1260	RL	ug/kg	---	0.045–0.24	---	EPA RSL	---
BHC-Gamma (HCH-gamma, Lindane)	RL	ug/kg	---	0.9–4.9	---	CHHSLs	---
Chlordane (Technical)	RL	ug/kg	---	4.5–24	---	ODEQ	---
Chlordane-Alpha	RL	ug/kg	---	0.9–4.9	---	ODEQ	---
Chlordane-Gamma	RL	ug/kg	---	0.9–4.9	---	ODEQ	---
1,2,3-TRICHLOROPROPANE	RL	ug/kg	---	6.7–36	---	EPA RSL	---
1,2-DIBROMO-3-CHLOROPROPANE	RL	ug/kg	---	6.7–36	---	EPA RSL	---
3,3'-DICHLOROBENZIDINE	RL	ug/kg	---	230–1200	---	EPA RSL	---
BENZ(A)ANTHRACENE	RL	ug/kg	---	230–1200	---	EPA RSL	---
BENZO(A)PYRENE	RL	ug/kg	---	230–1200	---	EPA RSL, CHHSLs	---
BENZO(B)FLUORANTHENE	RL	ug/kg	---	230–1200	---	EPA RSL	---
BIS(2-CHLOROETHYL) ETHER	RL	ug/kg	---	230–1200	---	EPA RSL	---
DIBENZ(A,H)ANTHRACENE	RL	ug/kg	---	230–1200	---	EPA RSL	---
FLUORENE	RL	ug/kg	---	230–1200	---	EPA RSL	---
HEXACHLOROBENZENE	RL	ug/kg	---	230–1200	---	ODEQ, USEPA RSL	---
INDENO(1,2,3-CD)PYRENE	RL	ug/kg	---	230–1200	---	EPA RSL	---
N-NITROSODI-N-PROPYLAMINE	RL	ug/kg	---	230–1200	---	EPA RSL	---

Chemical	COC Based on Detect (D) or Elevated Reporting Limit (RL)	Units	Range of Detections for Detected Analytes that Exceed One or More Screening Levels	Range of Reporting Limits (RL) for Non-Detects	Ratio of Maximum Chemical Concentration to SL for Detected Analytes[(1)]	Screening Values Exceeded	Notes
TRANS-1,4-DICHLORO-2-BUTENE	RL	ug/kg	---	6.7–36	---	EPA RSL	---
1,2-DIBROMOETHANE	RL	ug/kg	---	6.7–36	---	EPA RSL	---
Copco No. 1 Reservoir							
Arsenic	D	mg/kg	6.3–13	---	33–186	**EPA RSL TOT CAR, CHHSL Res,** CHHSL Comm	---
Nickel	D	mg/kg	22–32	---	84	EPA RSL TOT CAR	---
1,2,3,4,6,7,8-HPCDD	D	pg/g	180–190	---	---	----	c
1,2,3,4,6,7,8-HPCDF	D	pg/g	89–96	---	---	----	c
1,2,3,4,7,8-HXCDD	D	pg/g	1.7–1.9	---	---	----	c
1,2,3,6,7,8-HXCDD	D	pg/g	8.8–9.8	---	---	----	c
1,2,3,7,8,9-HXCDD	D	pg/g	4.2–4.3	---	---	----	c
1,2,3,4,7,8-HXCDF	D	pg/g	2.3–2.8	---	---	----	c
1,2,3,6,7,8-HXCDF	D	pg/g	3.5–5.5	---	---	----	c
1,2,3,7,8,9-HXCDF	D	pg/g	1.0	---	---	----	c
2,3,4,6,7,8-HXCDF	D	pg/g	3.2–3.7	---	---	----	c
1,2,3,7,8-PECDD	D	pg/g	1.2–1.4	---	---	----	c
1,2,3,7,8-PECDF	D	pg/g	0.84	---	---	----	c
2,3,4,7,8-PECDF	D	pg/g	1.8–1.9	---	---	----	c
2,3,7,8-TCDF	D	pg/g	0.99–1.2	---	---	---	c
AROCLOR 1221	RL	ug/kg	---	0.24–0.3	---	EPA RSL	---
AROCLOR 1232	RL	ug/kg	---	0.12–0.15	---	EPA RSL	---
BHC-gamma (HCH-gamma, Lindane)	RL	ug/kg	---	2.4–3	---	CHHSLs	---
1,2,3-TRICHLOROPROPANE	RL	ug/kg	---	18–22	---	EPA RSL	---

Chemical	COC Based on Detect (D) or Elevated Reporting Limit (RL)	Units	Range of Detections for Detected Analytes that Exceed One or More Screening Levels	Range of Reporting Limits (RL) for Non-Detects	Ratio of Maximum Chemical Concentration to SL for Detected Analytes[(1)]	Screening Values Exceeded	Notes
1,2-DIBROMO-3-CHLOROPROPANE	RL	ug/kg	---	18–22	---	EPA RSL	---
BENZ(A)ANTHRACENE	RL	ug/kg	---	580–730	---	EPA RSL	---
BENZO(A)PYRENE	RL	ug/kg	---	580–730	---	EPA RSL, CHHSLs	---
BENZO(B)FLUORANTHENE	RL	ug/kg	---	580–730	---	EPA RSL	---
BIS(2-CHLOROETHYL) ETHER	RL	ug/kg	---	580–730	---	EPA RSL	---
DIBENZ(A,H)ANTHRACENE	RL	ug/kg	---	580–730	---	EPA RSL	---
HEXACHLOROBENZENE	RL	ug/kg	---	580–730	---	EPA RSL	---
INDENO(1,2,3-CD)PYRENE	RL	ug/kg	---	580–730	---	EPA RSL	---
N-NITROSODI-N-PROPYLAMINE	RL	ug/kg	---	580–730	---	EPA RSL	---
TRANS-1,4-DICHLORO-2-BUTENE	RL	ug/kg	---	18–22	---	EPA RSL	---
Iron Gate Reservoir							
Arsenic	D	mg/kg	7.4–10	---	26–143	**EPA RSL TOT CAR, CHHSL Res,** CHHSL Comm	---
Nickel	D	mg/kg	18–33	---	87	EPA RSL TOT CAR	---
1,2,3,4,7,8-HXCDD	D	pg/g	1.1	---	---	----	c
1,2,3,6,7,8-HXCDD	D	pg/g	3.4–3.5	---	---	----	c
1,2,3,7,8,9-HXCDD	D	pg/g	2–2.5	---	---	----	c
1,2,3,4,7,8-HXCDF	D	pg/g	1.2	---	---	----	c
1,2,3,6,7,8-HXCDF	D	pg/g	1.2–1.4	---	---	----	c
2,3,4,6,7,8-HXCDF	D	pg/g	1.2–1.4	---	---	----	c
1,2,3,7,8-PECDD	D	pg/g	0.62–0.82	---	---	----	c
1,2,3,7,8-PECDF	D	pg/g	0.44–0.52	---	---	----	c

Chemical	COC Based on Detect (D) or Elevated Reporting Limit (RL)	Units	Range of Detections for Detected Analytes that Exceed One or More Screening Levels	Range of Reporting Limits (RL) for Non-Detects	Ratio of Maximum Chemical Concentration to SL for Detected Analytes[(1)]	Screening Values Exceeded	Notes
2,3,4,7,8-PECDF	D	pg/g	0.74	---	---	----	c
2,3,7,8-TCDF	D	pg/g	0.68	---	---	---	c
AROCLOR 1221	RL	ug/kg	---	0.067–0.3	---	EPA RSL	---
AROCLOR 1232	RL	ug/kg	---	0.033–0.15	---	EPA RSL	---
1,2,3-TRICHLOROPROPANE	RL	ug/kg	---	5–22	---	EPA RSL	---
1,2-DIBROMO-3-CHLOROPROPANE	RL	ug/kg	---	5–22	---	EPA RSL	---
BENZ(A)ANTHRACENE	RL	ug/kg	---	170–730	---	EPA RSL	---
BENZO(A)PYRENE	RL	ug/kg	---	170–730	---	EPA RSL, CHHSLs	---
BENZO(B)FLUORANTHENE	RL	ug/kg	---	170–730	---	EPA RSL	---
BIS(2-CHLOROETHYL) ETHER	RL	ug/kg	---	170–730	---	EPA RSL	---
DIBENZ(A,H)ANTHRACENE	RL	ug/kg	---	170–730	---	EPA RSL	---
HEXACHLOROBENZENE	RL	ug/kg	---	170–730	---	EPA RSL	---
INDENO(1,2,3-CD)PYRENE	RL	ug/kg	---	170–730	---	EPA RSL	---
N-NITROSODI-N-PROPYLAMINE	RL	ug/kg	---	170–730	---	EPA RSL	---
TRANS-1,4-DICHLORO-2-BUTENE	RL	ug/kg	---	5–22	---	EPA RSL	---
Klamath River Estuary							
Lower Klamath River Estuary							
Arsenic	D	mg/kg	3.2	---	8.2–46	**EPA RSL TOT CAR, CHHSL Res,** CHHSL Comm	---
Nickel	D	mg/kg	110	---	289	EPA RSL TOT CAR	---
BHC-gamma (HCH-gamma, Lindane)	RL	ug/kg	---	0.91	---	CHHSLs	---

Chemical	COC Based on Detect (D) or Elevated Reporting Limit (RL)	Units	Range of Detections for Detected Analytes that Exceed One or More Screening Levels	Range of Reporting Limits (RL) for Non-Detects	Ratio of Maximum Chemical Concentration to SL for Detected Analytes[(1)]	Screening Values Exceeded	Notes
1,2,3-TRICHLOROPROPANE	RL	ug/kg	---	6.8	---	EPA RSL	---
1,2-DIBROMO-3-CHLOROPROPANE	RL	ug/kg	---	6.8	---	EPA RSL	---
BENZ(A)ANTHRACENE	RL	ug/kg	---	230	---	EPA RSL	---
BENZO(A)PYRENE	RL	ug/kg	---	230	---	EPA RSL, CHHSLs	---
BENZO(B)FLUORANTHENE	RL	ug/kg	---	230	---	EPA RSL	---
BIS(2-CHLOROETHYL) ETHER	RL	ug/kg	---	230	---	EPA RSL	---
DIBENZ(A,H)ANTHRACENE	RL	ug/kg	---	230	---	EPA RSL	---
INDENO(1,2,3-CD)PYRENE	RL	ug/kg	---	230	---	EPA RSL	---
N-NITROSODI-N-PROPYLAMINE	RL	ug/kg	---	230	---	EPA RSL	---
Upper Klamath River Estuary							
Arsenic	D	mg/kg	2.2	---	5.6–31	**EPA RSL TOT CAR, CHHSL Res,** CHHSL Comm	---
Nickel	D	mg/kg	110	---	289	EPA RSL TOT CAR	---
BHC-gamma (HCH-gamma, Lindane)	RL	ug/kg	---	0.93	---	CHHSLs	---
1,2,3-TRICHLOROPROPANE	RL	ug/kg	---	7	---	EPA RSL	---
1,2-DIBROMO-3-CHLOROPROPANE	RL	ug/kg	---	7	---	EPA RSL	---
BENZ(A)ANTHRACENE	RL	ug/kg	---	230	---	EPA RSL	---
BENZO(A)PYRENE	RL	ug/kg	---	230	---	EPA RSL, CHHSLs	---
BENZO(B)FLUORANTHENE	RL	ug/kg	---	230	---	EPA RSL	---
BIS(2-CHLOROETHYL) ETHER	RL	ug/kg	---	230	---	EPA RSL	---

Chemical	COC Based on Detect (D) or Elevated Reporting Limit (RL)	Units	Range of Detections for Detected Analytes that Exceed One or More Screening Levels	Range of Reporting Limits (RL) for Non-Detects	Ratio of Maximum Chemical Concentration to SL for Detected Analytes[(1)]	Screening Values Exceeded	Notes
DIBENZ(A,H)ANTHRACENE	RL	ug/kg	---	230	---	EPA RSL	---
INDENO(1,2,3-CD)PYRENE	RL	ug/kg	---	230	---	EPA RSL	---
N-NITROSODI-N-PROPYLAMINE	RL	ug/kg	---	230	---	EPA RSL	---
TRANS-1,4-DICHLORO-2-BUTENE	RL	ug/kg	---	7	---	EPA RSL	---

Notes:

[1] Ratio of maximum detected concentration to the SL is typically expressed as a Hazard Quotient (HQ). This ratio is presented above for each detected chemical and is calculated using the maximum detected concentration; the highest and lowest of screening values when multiple screening values are exceeded of same level in screening hierarchy. When more than two screening values are exceeded, the screening level used for calculation of the ratio (HQ) are in **bold**.

Screening Level Hierarchy for Human Health:

USEPA Residential RSLs (total carcinogenic and total non-carcinogenic), CHHSLs, and ODEQ bioaccumulation SLVs (Human Subsistence and Human General)

a no ODEQ values

b below USEPA RSLs, CHHSLs

c ODEQ values not applicable per text of Appendix A (only applicable for J.C. Boyle Reservoir); USEPA RSL and CHHSLs not available

Key:

EPA =	U.S. Environmental Protection Agency
RSL =	Residential Screening Level
TOT CAR =	Total carcinogen
TOT NON CAR =	Total non-carcinogen
CHHSL =	California Human Health Screening Levels
BSLV =	Land Quality Division Sediment Bioaccumulation Screening Level Values
Comm =	commercial/industrial
Res =	residential

Units:

metals:	mg/kg
pesticides:	ug/kg
dioxins and furans:	pg/g
SVOCs:	ug/kg

Table C-8. Chemicals in Sediment that Exceed One or More Marine Sediment Screening Levels. Source: CDM (2011).

Chemical	COC Based on Detect (D) or Elevated Reporting Limit (RL)	Units	Range of Detections for Detected Analytes that Exceed One or More Screening Levels	Range of Reporting Limits (RL) for Non-Detects	Ratio of Maximum Chemical Concentration to SL for Detected Analytes[a]	Screening Values Exceeded	Highest of Screening Value Hierarchy Level[b]
J.C. Boyle Reservoir							
Dieldrin	D	ug/kg	3.4	---	1.8	**SEF-SL1**, SEF-SL2, MS ERL, MS T20, MS TEL, MS T50, F-M	2a
2,3,4,7,8-PECDF	D	pg/g	1.5–1.5	---	1.4	ODEQ BSLV	2c
Butyl benzyl phthalate	RL	ug/kg	---	230–1,200	---	DMMP-ML	1
2,4-DIMETHYLPHENOL	RL	ug/kg	---	230–1,200	---	DMMP-ML	1
2-METHYLPHENOL	RL	ug/kg	---	230–1,200	---	DMMP-ML	1
4-METHYLPHENOL	RL	ug/kg	---	230–1,200	---	DMMP-ML	1
BENZOIC ACID	RL	ug/kg	---	930–4,800	---	DMMP-ML	1
BENZYL ALCOHOL	RL	ug/kg	---	230–1,200	---	DMMP-ML	1
HEXACHLOROBENZENE	RL	ug/kg	---	230–1,200	---	DMMP-ML	1
N-NITROSODIPHENYLAMINE	RL	ug/kg	---	230–1,200	---	DMMP-ML	1
Aroclor 1232	RL	ug/kg	---	0.16–0.24	---	DMMP-SL, SEF-SL1 (total PCBs)	2a
Aroclor 1242	RL	ug/kg	---	0.045–0.24	---	DMMP-SL, SEF-SL1 (total PCBs)	2a
Aroclor 1248	RL	ug/kg	---	0.045–0.24	---	DMMP-SL, SEF-SL1 (total PCBs)	2a
Aroclor 1254	RL	ug/kg	---	0.045–0.24	---	DMMP-SL, SEF-SL1 (total PCBs)	2a
Aroclor 1260	RL	ug/kg	---	0.045–0.24	---	DMMP-SL, SEF-SL1 (total PCBs)	2a
Chlordane (Technical)	RL	ug/kg	---	4.5–24	---	DMMP-SL, SEF-SL1	2a
Chlordane-Alpha	RL	ug/kg	---	0.9–4.9	---	DMMP-SL, SEF-SL1	2a
Chlordane-Gamma	RL	ug/kg	---	0.9–4.9	---	DMMP-SL, SEF-SL1	2a
Heptachlor	RL	ug/kg	---	0.9–4.9	---	SEF-SL1	2a
Endrin	RL	ug/kg	---	0.9–4.9	---	no value	2c
Heptachlor Epoxide	RL	ug/kg	---	0.9–4.9	---	SQuiRTs (T20, PEL)	2c
Toxaphene	RL	ug/kg	---	45–240	---	SQuiRTs (TEL)	2c
BENZO(B)FLUORANTHENE	RL	ug/kg	---	230–1200	---	SQuiRTs (T20, T50)	2c

Chemical	COC Based on Detect (D) or Elevated Reporting Limit (RL)	Units	Range of Detections for Detected Analytes that Exceed One or More Screening Levels	Range of Reporting Limits (RL) for Non-Detects	Ratio of Maximum Chemical Concentration to SL for Detected Analytes[a]	Screening Values Exceeded	Highest of Screening Value Hierarchy Level[b]
Butyl benzyl phthalate	RL	ug/kg		230–1,200		DMMP-ML	
Copco No. 1 Reservoir							
2,4-DIMETHYLPHENOL	RL	ug/kg	---	580–730	---	DMMP-ML	1
2-METHYLPHENOL	RL	ug/kg	---	580–730	---	DMMP-ML	1
BENZOIC ACID	RL	ug/kg	---	2,300–2,900	---	DMMP-ML	1
HEXACHLOROBENZENE	RL	ug/kg	---	580–730	---	DMMP-ML	1
N-NITROSODIPHENYLAMINE	RL	ug/kg	---	580–730	---	DMMP-ML	1
AROCLOR 1221	RL	ug/kg	---	0.24–0.3	---	DMMP-SL, SEF-SL1 (total PCBs)	2a
AROCLOR 1232	RL	ug/kg	---	0.12–0.15	---	DMMP-SL, SEF-SL1 (total PCBs)	2a
CHLORDANE (TECHNICAL)	RL	ug/kg	---	12–15	---	DMMP-SL, SEF-SL1	2a
CHLORDANE-ALPHA	RL	ug/kg	---	2.4–3	---	SEF-SL1	2a
CHLORDANE-GAMMA	RL	ug/kg	---	2.4–3	---	SEF-SL1	2a
DIELDRIN	RL	ug/kg	---	2.4–3	---	SEF-SL1	2a
HEPTACHLOR	RL	ug/kg	---	2.4–3	---	SEF-SL1	2a
HEPTACHLOR EPOXIDE	RL	ug/kg	---	2.4–3	---	SQuiRTs (T20, PEL)	2c
BENZO(B)FLUORANTHENE	RL	ug/kg	---	580–730	---	SQuiRTs (T20)	2c
BENZO(G,H,I)PERYLENE	RL	ug/kg	---	580–730	---	no value	2c
Iron Gate Reservoir							
1,4-DICHLOROBENZENE	RL	ug/kg	---	5–520	**---**	DMMP-ML	1
2,4-DIMETHYLPHENOL	RL	ug/kg	---	170–730	**---**	DMMP-ML	1
2-METHYLPHENOL	RL	ug/kg	---	170–730	**---**	DMMP-ML	1
BENZOIC ACID	RL	ug/kg	---	670–2900	**---**	DMMP-ML	1
HEXACHLOROBENZENE	RL	ug/kg	---	170–730	**---**	DMMP-ML	1
HEXACHLOROBUTADIENE	RL	ug/kg	---	5–520	**---**	DMMP-ML	1
N-NITROSODIPHENYLAMINE	RL	ug/kg	---	170–730	**---**	DMMP-ML	1
AROCLOR 1221	RL	ug/kg	---	0.067–0.3	**---**	DMMP-SL, SEF-SL1 (total PCBs)	2a

Chemical	COC Based on Detect (D) or Elevated Reporting Limit (RL)	Units	Range of Detections for Detected Analytes that Exceed One or More Screening Levels	Range of Reporting Limits (RL) for Non-Detects	Ratio of Maximum Chemical Concentration to SL for Detected Analytes[a]	Screening Values Exceeded	Highest of Screening Value Hierarchy Level[b]
AROCLOR 1232	RL	ug/kg	---	0.033–0.15	**---**	DMMP-SL, SEF-SL1 (total PCBs)	2a
CHLORDANE (TECHNICAL)	RL	ug/kg	---	3.3–15	**---**	DMMP-SL, SEF-SL1	2a
CHLORDANE-ALPHA	RL	ug/kg	---	0.67–3	**---**	SEF-SL1	2a
CHLORDANE-GAMMA	RL	ug/kg	---	0.67–3	**---**	SEF-SL1	2a
DIELDRIN	RL	ug/kg	---	0.67–3	**---**	SEF-SL1	2a
HEPTACHLOR	RL	ug/kg	---	0.67–3	**---**	SEF-SL1	2a
HEPTACHLOR EPOXIDE	RL	ug/kg	---	0.67–3	**---**	SEF-SL1	2a
1,2,4-TRICHLOROBENZENE	RL	ug/kg	---	5–520	**---**	DMMP-SL, SEF-SL1	2a
1,3-DICHLOROBENZENE	RL	ug/kg	---	5–520	**---**	DMMP-SL	2a
BENZO(B)FLUORANTHENE	RL	ug/kg	---	170–730	**---**	SQuiRTs (T20)	2c
Klamath River Estuary							
Lower Klamath							
2,4-DIMETHYLPHENOL	RL	ug/kg	---	230	---	DMMP-ML	1
2-METHYLPHENOL	RL	ug/kg	---	230	---	DMMP-ML	1
BENZOIC ACID	RL	ug/kg	---	910	---	DMMP-ML	1
N-NITROSODIPHENYLAMINE	RL	ug/kg	---	230	---	DMMP-ML	1
CHLORDANE (TECHNICAL)	RL	ug/kg	---	4.6	---	SEF-SL1	2a
HEPTACHLOR EPOXIDE	RL	ug/kg	---	0.91	---	SQuiRTs (T20)	2c
TOXAPHENE	RL	ug/kg	---	46	---	SQuiRTs (TEL)	2c
BENZO(B)FLUORANTHENE	RL	ug/kg	---	230	---	SQuiRTs (T20)	2c
Upper Klamath							
2,4-DIMETHYLPHENOL	RL	ug/kg	---	230	---	DMMP-ML	1
2-METHYLPHENOL	RL	ug/kg	---	230	---	DMMP-ML	1
BENZOIC ACID	RL	ug/kg	---	930	---	DMMP-ML	1
N-NITROSODIPHENYLAMINE	RL	ug/kg	---	230	---	DMMP-ML	1
CHLORDANE (TECHNICAL)	RL	ug/kg	---	4.6	---	SEF-SL1	2a

Chemical	COC Based on Detect (D) or Elevated Reporting Limit (RL)	Units	Range of Detections for Detected Analytes that Exceed One or More Screening Levels	Range of Reporting Limits (RL) for Non-Detects	Ratio of Maximum Chemical Concentration to SL for Detected Analytes[a]	Screening Values Exceeded	Highest of Screening Value Hierarchy Level[b]
HEPTACHLOR EPOXIDE	RL	ug/kg	---	0.93	---	SQuiRTs (T20)	2c
TOXAPHENE	RL	ug/kg	---	46	---	SQuiRTs (TEL)	2c
BENZO(B)FLUORANTHENE	RL	ug/kg	---	230	---	SQuiRTs (T20)	2c

Notes:
Screening Level Hierarchies for Marine Waters--
Retain if above:
1) DMMP-MLs
2a) SEF-SL1 or DMMP-SL
2b) SEF-SL1 or DMMP-SL AND SEF-SL2 or DMMP-BT
2c) Chemicals with no SEF or DMMP and one or more SQuiRTs exceeded

Units:
metals: mg/kg
pesticides: ug/kg
dioxins and furans: pg/g
SVOCs: ug/kg
phthalates: ug/kg

Key:
MS = marine sediment
ERL = Effects Range Low
TEL = Threshold Effect Level
SL1 = Sediment Screening Level 1
SEF = Sediment Evaluation Framework
T20 = concentration representing 20 percent probability of observing effect
T50 = concentration representing 50 percent probability of observing effect
BSLV = Land Quality Division Sediment Bioaccumulation Screening Level Values
DMMP = Dredged Material Management Program
ERM = Effects Range Median
F-M = Fish-marine
PEL = Probable Effect Level
ODEQ = Oregon Department of Environmental Quality
RL = Reporting Limit
D = Detect
ML = Maximum Level

[a] Ratio of maximum detected concentration to the SL is typically expressed as a Hazard Quotient (HQ). This ratio is presented above for each detected chemical and is calculated using the maximum detected concentration; the highest and lowest of screening values when multiple screening values are exceeded of same level in screening hierarchy. When more than two screening values are exceeded, the screening level used for calculation of the ratio (HQ) are in **bold**.

[b] Screening level hierarchy depicted on Figure 2 in CDM (2011).

Based on the information provided in Table A-5 in CDM (2011) and database query for ambiguous and positive exceedances.

Table C-9. 2009 and 2018 Pacific Northwest Sediment Evaluation Framework Freshwater Screening Levels. Adapted from RSET (2009) and RSET (2018).

Analyte	Units	Pacific Northwest SEF [a]				Add (+), Remove (-), or No Change (o) to COPC[d] list
		SL1[b] 2009	SL1[b] 2018	SL2[c] 2009	SL2[c] 2018	
Metals						
Arsenic	mg/kg	20	14	51	120	o
Cadmium	mg/kg	1.1	2.1	1.5	5.4	-
Chromium	mg/kg	95	72	100	88	o
Copper	mg/kg	80	400	830	1,200	o
Lead	mg/kg	340	360	430	>1,300	o
Mercury	mg/kg	0.28	0.66	0.75	0.8	o
Nickel	mg/kg	60	26	70	110	+
Selenium	mg/kg	n/a[e]	11	n/a	>20	o
Silver	mg/kg	2	0.57	2.5	1.7	o
Zinc	mg/kg	130	3,200	400	>4,200	o
Organics Polycyclic Aromatic Hydrocarbons (PAHs)						
Total PAHs	ug/kg	n/a	17,000	n/a	30,000	+
2-Methylnaphthalene	ug/kg	470	n/a	560	n/a	-
Acenaphthene	ug/kg	1,100	n/a	1,300	n/a	-
Acenaphthylene	ug/kg	470	n/a	640	n/a	-
Anthracene	ug/kg	1,200	n/a	1,600	n/a	-
Benz(a)anthracene	ug/kg	4,300	n/a	5,800	n/a	-
Benzo(a)pyrene	ug/kg	3,300	n/a	4,800	n/a	-
Benzo(g,h,i)perylene	ug/kg	4,000	n/a	5,200	n/a	-
Benzo(k)fluoranthene	ug/kg	600	n/a	4,000	n/a	-
Chrysene	ug/kg	5,900	n/a	6,400	n/a	-
Dibenz(a,h)anthracene	ug/kg	800	n/a	840	n/a	-
Dibenzofuran	ug/kg	400	n/a	440	n/a	-
Fluoranthene	ug/kg	11,000	n/a	15,000	n/a	-
Fluorene	ug/kg	1,000	n/a	3,000	n/a	-
Indeno(1,2,3-cd)pyrene	ug/kg	4,100	n/a	5,300	n/a	-
Naphthalene	ug/kg	500	n/a	1,300	n/a	-
Phenanthrene	ug/kg	6,100	n/a	7,600	n/a	-
Pyrene	ug/kg	8,800	n/a	16,000	n/a	-
Organics Polychlorinated biphenyl (PCBs)						
Total PCBs	pg/g	60,000	n/a	120,000	n/a	+
Total Aroclors	ug/kg	n/a	110	n/a	2,500	-

Analyte	Units	Pacific Northwest SEF [a]				Add (+), Remove (-), or No Change (o) to COPC[d] list
		SL1[b] 2009	SL1[b] 2018	SL2[c] 2009	SL2[c] 2018	
Organics Pesticides/Herbicides/Insecticides: Organochlorine Pesticides						
4,4'-DDD	ug/kg	n/a	310	n/a	860	o
4,4'-DDE	ug/kg	n/a	21	n/a	33	o
4,4'-DDT	ug/kg	n/a	100	n/a	8,100	o
BHC-alpha (HCH-alpha)	ug/kg	n/a	n/a	n/a	n/a	o
BHC-beta(HCH-beta)	ug/kg	n/a	n/a	n/a	n/a	o
BHC-gamma (HCH-gamma, Lindane)	ug/kg	n/a	n/a	n/a	n/a	o
Chlordane	ug/kg	n/a	n/a	n/a	n/a	o
Chlordane (technical)	ug/kg	n/a	n/a	n/a	n/a	o
Chlordane-alpha	ug/kg	n/a	n/a	n/a	n/a	o
Chlordane-gamma	ug/kg	n/a	n/a	n/a	n/a	o
Dieldrin	ug/kg	n/a	4.9	n/a	9.3	o
Heptachlor	ug/kg	n/a	n/a	n/a	n/a	o
Heptachlor epoxide	ug/kg	n/a	n/a	n/a	n/a	o
beta-Hexachlorocyclohexane	ug/kg	n/a	7.2	n/a	11	o
Endrin ketone	ug/kg	n/a	8.5	n/a	n/a	o
Organics Phthalates						
Bis(2-ethylhexyl) phthalate	ug/kg	220	500	320	22,000	o
Butyl benzyl phthalate	ug/kg	260	n/a	370	n/a	-
Dimethyl phthalate	ug/kg	46	n/a	440	n/a	-
Di-n-butyl-phthalate	ug/kg	n/a	380	n/a	1,000	+
Di-N-octyl phthalate	ug/kg	26	39	45	1,100	o
Organics Semi-Volatile Organic Compounds (SVOCs): Phenols						
Phenol	ug/kg	n/a	120	n/a	210	+
4-Methylphenol	ug/kg	n/a	260	n/a	2,000	+
Pentachlorophenol	ug/kg	n/a	1,200	n/a	<1,200	o
Organics SVOCs: Chlorinated hydrocarbons						
Hexachlorobenzene	ug/kg	n/a	n/a	n/a	n/a	o
Organics Polychlorinated Dioxins and Furans						
1,2,3,4,6,7,8-HPCDD	pg/g	n/a	n/a	n/a	n/a	o
1,2,3,4,6,7,8-HPCDF	pg/g	n/a	n/a	n/a	n/a	o
1,2,3,4,7,8,9-HPCDF	pg/g	n/a	n/a	n/a	n/a	o
1,2,3,4,7,8-HXCDD	pg/g	n/a	n/a	n/a	n/a	o
1,2,3,4,7,8-HXCDF	pg/g	n/a	n/a	n/a	n/a	o

Analyte	Units	Pacific Northwest SEF [a]				Add (+), Remove (-), or No Change (o) to COPC[d] list
		SL1[b] 2009	SL1[b] 2018	SL2[c] 2009	SL2[c] 2018	
1,2,3,6,7,8-HXCDD	pg/g	n/a	n/a	n/a	n/a	o
1,2,3,6,7,8-HXCDF	pg/g	n/a	n/a	n/a	n/a	o
1,2,3,7,8,9-HXCDD	pg/g	n/a	n/a	n/a	n/a	o
1,2,3,7,8,9-HXCDF	pg/g	n/a	n/a	n/a	n/a	o
1,2,3,7,8-PECDD	pg/g	n/a	n/a	n/a	n/a	o
1,2,3,7,8-PECDF	pg/g	n/a	n/a	n/a	n/a	o
2,3,4,6,7,8-HXCDF	pg/g	n/a	n/a	n/a	n/a	o
2,3,4,7,8-PECDF	pg/g	n/a	n/a	n/a	n/a	o
2,3,7,8-TCDD	pg/g	n/a	n/a	n/a	n/a	o
2,3,7,8-TCDF	pg/g	n/a	n/a	n/a	n/a	o
OCDD	pg/g	n/a	n/a	n/a	n/a	o
OCDF	pg/g	n/a	n/a	n/a	n/a	o
Site Specific Chemicals of Concern						
Butyltins						
Monobutyltin (µg/kg)	ug/kg	n/a	540	n/a	>4,800	o
Dibutyltin (µg/kg)	ug/kg	n/a	910	n/a	130,000	o
Tributyltin (µg/kg)	ug/kg	n/a	47	n/a	320	o
Tetrabutyltin (µg/kg)	ug/kg	n/a	97	n/a	>97	o
Total [Bulk] Petroleum Hydrocarbons (TPHs)						
TPH-diesel	mg/kg	n/a	340	n/a	510	+
TPH-residual	mg/kg	n/a	3,600	n/a	4,400	+
Miscellaneous Extractables Compounds						
Benzoic acid	ug/kg	n/a	2,900	n/a	3,800	+
Carbazole	ug/kg	n/a	900	n/a	1,100	+
Dibenzofuran	ug/kg	n/a	200	n/a	680	+

[a] Sediment Evaluation Framework
[b] Screening Level 1
[c] Screening Level 2
[d] Chemicals of Potential Concern
[e] not applicable

Units Key:

g	gram
kg	kilogram (1,000 grams)
mg	milligram (10^{-3} grams)
ug	microgram (10^{-6} grams)
pg	picogram (10^{-12} grams)

Table C-10. Summary of the Lines of Evidence Used to Evaluate Each Exposure Pathway. Source: CDM (2011).

Line of Evidence	Exposure Pathways				
	1	2	3	4	5
Sediment Evaluation Framework Level 2A Step 1 – Sediment Screening Levels					
1. DMMP Marine MLs				+	
Sediment Evaluation Framework Level 2A Steps 2a, 2b, 2c, 2d – Sediment Screening Levels					
2. Ecological SLs (freshwater and marine)			+	+	+
3. Ecological TEQ SLVs (sediment)			+	+	+
Sediment Evaluation Framework Level 2B – Results of Water Quality Criteria Evaluations and Bioassays					
4. Elutriate WQC (ecological)	+			+	
5. Benthic midge *(Chironomus dilutens)* Bioassay			+	+	+
6. Benthic amphipod *(Hyalella azteca)* Bioassay			+	+	+
7. Rainbow trout *(Oncorhynchus mykiss)* Bioassay	+			+	
8. Asian clam *(Corbicula fluminea)*[1] Bioaccumulation Study/BSAF			+		+
9. Blackworm *(Lumbriculus variegatus)*[2] Bioaccumulation Study/BSAF			+		+
10. Asian clam *(Corbicula fluminea)*[1] Tissue TRV			+	+	+
11. Blackworm *(Lumbriculus variegatus)*[2] Tissue TRV			+	+	+
Special Evaluations – Human Health in Sediment and Fish Tissue					
12. Yellow perch (*Perca flavescens*) Tissue TRV (ecological)			+	+	+
13. Bullhead (*Ameirus sp.*) Tissue TRV (ecological)			+	+	+
14. Fish Tissue TEQ (ecological)			+	+	+
15. HHSLs		+	+		+
16. HH TEQ SLVs (sediment)		+	+		+
17. Elutriate WQC (human health)					
18. Perch Tissue TRV (human health)			+		+
19. Bullhead Tissue TRV (human health)			+		+
20. Fish Tissue TEQ (human health)			+		+

+: Applicable line of evidence for exposure pathway

[1] Representative bivalve

[2] Representative oligochaete

Key:

DMMP = Dredged Material Management Program
ML = Maximum Level
SL = Screening Level
TEQ = Toxic Equivalency
SLV = Screening Level Value
WQC = Water Quality Criteria
TRV = Toxicity Reference Value
BSAF = Biota-Sediment Accumulation Factor
HHSL = Human Health Screening Level
HH = Human Health

Contaminants in Aquatic Biota

Separate assessments of contaminants in fish tissue for the Hydroelectric Reach have been undertaken by SWAMP and PacifiCorp. SWAMP data include sport fish tissue samples collected during 2007 and 2008 to evaluate accumulated contaminants in

nearly 300 lakes statewide. Sport fish were sampled to provide information on potential human exposure to selected contaminants and to represent the higher aquatic trophic levels (i.e., the top of the aquatic food web).

In the Hydroelectric Reach, fish tissue samples were collected in Copco No. 1 and Iron Gate reservoirs and analyzed for total mercury, selenium, and PCBs (Iron Gate Reservoir only) (Davis et al. 2010). SWAMP data for Iron Gate and Copco No. 1 reservoirs (Table C-11) indicate mercury tissue concentrations above the USEPA criterion of 300 nanograms per gram (ng/g) methylmercury in fish tissue to protect the health of consumers of noncommercial freshwater fish; and greater than the OEHHA public health guideline levels advisory tissue level (Klasing and Brodberg 2008) for consumption for 3 and 2 servings per week (70 and 150 ng/g wet weight, respectively) and the fish contaminant goal (220 ng/g wet weight). Measured selenium concentrations were 3 to 4 orders of magnitude lower than OEHHA thresholds of concern (2,500 to 15,000 ng/g wet weight) and PCB concentrations were below the lowest OEHHA threshold (i.e., fish contaminant goal of 3.6 ng/g wet weight) (Davis et al. 2010).

Table C-11. Total Mercury, Selenium, and PCBs in (ng/g wet weight) in Largemouth Bass taken from Iron Gate and Copco No. 1 Reservoirs During 2007 to 2008 (Davis et al. 2010).

Contaminant	Species	Iron Gate Reservoir	Copco No. 1 Reservoir
Methylmercury	Largemouth Bass (LMB)	330	310
Selenium	LMB	80	80
PCBs	LMB	1.31	*Not reported*

In a screening-level study of potential chemical contaminants in fish tissue in J.C. Boyle, Copco No. 1, and Iron Gate reservoirs, PacifiCorp analyzed metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc), organochlorine (pesticide) compounds, and PCBs in largemouth bass (*Micropterus salmoides*) (PacifiCorp 2004c). PacifiCorp reported that, in general, contaminant levels in fish tissue are below both screening level values for protection of human health (USEPA 2000) and recommended guidance values for the protection of wildlife (MacDonald 1994). Exceptions to this include measured fish tissue levels of total mercury in samples from Copco No. 1 and Iron Gate reservoirs as compared to the wildlife screening level of 0.00227 ug/g and measured fish tissue levels of arsenic (less than 0.3 ug/g) that PacifiCorp indicated may equal or exceed the toxicity screening level for subsistence fishers (0.147 ug/g) in samples of largemouth bass from J.C. Boyle, Copco No. 1, and Iron Gate reservoirs. Subsequent reanalysis of the PacifiCorp mercury tissue data indicates that all tissue samples exceed the most protective wildlife screening level of 0.00227 ug/g, samples from J.C. Boyle, Copco No. 1, and Iron Gate reservoirs exceed the screening level for subsistence fishers (0.049 ug/g), and samples from Copco No. 1 and Iron Gate reservoirs exceed the screening level for recreational fishers (0.4 ug/g) (Table C-12).

Table C-12. Total Mercury Concentrations (ug/g wet weight) in Largemouth Bass (LMB) Composite Tissue Samples taken from Lower Klamath Project Reservoirs in 2003 (PacifiCorp 2004c).

Sample	Composite	Site	Species	Total Mercury (ug/g wet weight)[1]
L-262-03	2F	J.C. Boyle Reservoir	LMB	0.153
L-262-03	3F	J.C. Boyle Reservoir	LMB	0.190
L-273-03	1F	Iron Gate Reservoir	LMB	0.564
L-273-03	2F	Iron Gate Reservoir	LMB	0.508
L-273-03	3F	Copco No. 1 Reservoir	LMB	0.563
L-273-03	4F	Copco No. 1 Reservoir	LMB	0.389
		Method Detection Limit		0.003[2]
		Method Reporting Limit		0.007[2]
		Screening Levels[3]:		
		Recreational fishers		0.4
		Subsistence fishers		0.049
		Wildlife		0.00227

[1] PacifiCorp (2004c) total mercury data was provided in ng/g dry weight. Data was converted to ug/g wet weight using percent moisture data provided for each sample by Moss Landing Marine Laboratory (A. Bonnema, pers. comm., 17 February 2011).

[2] The Method Detection Limit and Reporting Limit were converted from dry weight to wet weight using an average of the percent moisture data for all samples.

[3] Screening Levels (SLs) are numeric chemical guidelines that are used to assess and characterize the potential toxicity or bioaccumulative nature of environmental samples (i.e., sediments, water, organism tissue).

Additionally, PacifiCorp indicated that some of the fish tissue samples from J. C. Boyle and Copco No. 1 reservoirs exceeded the suggested wildlife screening value for total DDTs (Table C-13) (DDE,p,p' was detected; however DDT and DDD were not detected in the study), and total PCB values exceeded the screening level for subsistence fishers in largemouth bass from J.C. Boyle, Copco No. 1, and Iron Gate Reservoirs (Table C-14). Dioxins were not tested.

Table C-13. Total DDE Concentration (ng/g) in Large Mouth Bass (LMB) Composite Tissue Samples taken from Lower Klamath Project Reservoirs in 2003 (PacifiCorp 2004c).

Sample	Composite	Site	Species	DDE,p,p' (ng/g wet weight)
L-262-03	2F	J.C. Boyle Reservoir	LMB	<2.00
L-262-03	2F Duplicate	J.C. Boyle Reservoir	LMB	<2.00
L-262-03	3F	J.C. Boyle Reservoir	LMB	2.91
L-273-03	1F	Iron Gate Reservoir	LMB	<2.00
L-273-03	2F	Iron Gate Reservoir	LMB	<2.00
L-273-03	3F	Copco Reservoir	LMB	2.16
L-273-03	4F	Copco Reservoir	LMB	<2.00
		Method Detection Limit		0.56
		Method Reporting Limit		2
		Screening Levels[1] (for Total DDTs):		
		Recreational fishers		117
		Subsistence fishers		14.4
		Wildlife		0.2–1.07

[1] Screening Levels (SLs) are numeric chemical guidelines that are used to assess and characterize the potential toxicity or bioaccumulative nature of environmental samples (i.e., sediments, water, organism tissue).

Table C-14. Total PCB Concentrations (ng/g) in Large Mouth Bass (LMB) Composite Tissue Samples taken from Lower Klamath Project Reservoirs in 2003 (PacifiCorp 2004c).

Sample	Composite	Site	Species	Total PCB (ng/g wet weight)
L-262-03	2F	J.C. Boyle Reservoir	LMB	0.885
L-262-03	2F Duplicate	J.C. Boyle Reservoir	LMB	1.397
L-262-03	3F	J.C. Boyle Reservoir	LMB	3.521
L-273-03	1F	Iron Gate Reservoir	LMB	6.574
L-273-03	2F	Iron Gate Reservoir	LMB	4.909
L-273-03	3F	Copco Reservoir	LMB	2.822
L-273-03	4F	Copco Reservoir	LMB	2.158
		Method Detection Limit		Varies
		Method Reporting Limit		0.2
		Screening Levels[1]:		
		Recreational fishers		20
		Subsistence fishers		2.45
		Wildlife		100

[1] Screening Levels (SLs) are numeric chemical guidelines that are used to assess and characterize the potential toxicity or bioaccumulative nature of environmental samples (i.e., sediments, water, organism tissue).

To provide additional lines of evidence in the Klamath Dam Removal Secretarial Determination sediment evaluation, the potential for chemicals in sediment samples to bioaccumulate in aquatic species was investigated using laboratory invertebrates (Asian clams, *Corbicula fluminea*; and Black worms, *Lumbriculus variegates*) exposed to reservoir-derived sediments. Results indicated that multiple chemicals were found in

invertebrate tissue (acenaphthene, arsenic, benzo(a)pyrene, DDD/DDE, endosulfan I, endosulfan II, endosulfan sulfate, fluoranthene, hexachlorobenzene, lead, mercury, phenanthrene, pyrene, total PBDEs, total PCBs). Of these detected chemicals, only fluoranthene possessed a toxicity reference value (TRV) for the species tested; exceedances of the fluoranthene TRV were only identified above the No Effect TRV and were below the Low Effect TRV. Tissue-based TRVs were unavailable for the remaining invertebrate chemicals detected, and hexachlorobenzene has no tissue-based TRVs (for any species) (CDM 2011).

Lastly, two species of field-caught fish (yellow perch and bullhead) were collected during late September 2010 from J.C. Boyle, Copco No. 1, and Iron Gate reservoirs and analyzed for contaminant concentrations (CDM 2011). Table C-15 lists all the chemicals detected in the fish tissue along with a list of chemicals tested for, but not detected in any sample of fish tissue. Chemicals found in the fish tissue samples included 2,3,7,8-TCDD, arsenic, DDE/DDT, dieldrin, endrin, mercury, mirex, selenium, and total PCBs (CDM 2011). Mercury exceeded tissue-based TRVs for perch in Iron Gate Reservoir and bullhead samples in all three reservoirs (CDM 2011). TRVs were not available the remaining several chemicals detected in yellow perch and bullhead samples (CDM 2011). Results of chemical analyses of field collected fish revealed that no consistent pattern of contaminant distribution was identified among chemicals, media type, or location. Data revealed that fish can accumulate a fairly large number of sediment-associated chemicals; however, regional background conditions may be elevated for more than one of the measured chemicals (e.g., arsenic, mercury) (CDM 2011).

Table C-15. Chemicals Detected and Not Detected in Fish Tissue Field Caught in 2010 from J.C. Boyle, Copco No. 1, and Iron Gate reservoirs (CDM 2011).

Bullhead (*Ameiurus sp.*)		**Yellow Perch (*Perca flavescens*)**	
Detected[1]	**Not Detected[2]**	**Detected[1]**	**Not Detected[2]**
2,4'-DDD	2,4'-DDT	2,4'-DDD	Acenaphthene
2,4'-DDE	Acenaphthene	2,4'-DDE	Acenaphthylene
2-Fluorobiphenyl	Acenaphthylene	2,4'-DDT	Aldrin
4,4'-DDD	Aldrin	2-Fluorobiphenyl	Anthracene
4,4'-DDE	Anthracene	4,4'-DDD	BDE (4)
4,4'-DDT	BDE (3)	4,4'-DDE	Benzo(a)anthracene
alpha-BHC	Benzo(a)anthracene	4,4'-DDT	Benzo(a)pyrene
Arsenic	Benzo(a)pyrene	alpha-BHC	Benzo(b)fluoranthene
BDE (8)	Benzo(b)fluoranthene	Arsenic	Benzo(ghi)perylene
beta-BHC	Benzo(ghi)perylene	BDE (7)	Benzo(k)fluoranthene
cis-Chlordane	Benzo(k)fluoranthene	beta-BHC	Chrysene
cis-Nonachlor	Chrysene	cis-Chlordane	D/F (14)
D/F (1)	D/F (14)	cis-Nonachlor	Dibenz(a,h)anthracene
delta-BHC	Dibenz(a,h)anthracene	D/F (1)	Endosulfan I
Dieldrin	Endosulfan I	delta-BHC	Endosulfan II
Endosulfan sulfate	Endosulfan II	Dieldrin	Endrin aldehyde
Fluorene	Endrin	Endosulfan sulfate	Endrin ketone

Bullhead (*Ameiurus sp.*)		Yellow Perch (*Perca flavescens*)	
gamma-BHC (Lindane)	Endrin aldehyde	Endrin	Fluoranthene
Heptachlor epoxide	Endrin ketone	gamma-BHC (Lindane)	Fluorene
Hexachlorobenzene	Fluoranthene	Heptachlor	Indeno(1,2,3-cd)pyrene
Lead	Heptachlor	Heptachlor epoxide	Lead
Mercury	Indeno(1,2,3-cd)pyrene	Hexachlorobenzene	OCDF
Methoxychlor	OCDF	Mercury	PCB congeners (24)
Mirex	PCB congeners (28)	Methoxychlor	Phenanthrene
Naphthalene	Phenanthrene	Mirex	Pyrene
Nitrobenzene-d5	Pyrene	Naphthalene	Total HpCDF
OCDD	Total HpCDF	Nitrobenzene-d5	Total HxCDD
oxy-Chlordane	Total HxCDD	OCDD	Total HxCDF
PCB congeners (181)	Total HxCDF	oxy-Chlordane	Total PeCDD
Selenium	Total PeCDD	PCB congeners (185)	Total PeCDF
Total HpCDD	Total PeCDF	Selenium	Total TCDD
trans-Chlordane	Total TCDD	Total HpCDD	Total TCDF
trans-Nonachlor	Total TCDF	trans-Chlordane	
		trans-Nonachlor	

[1] Detected in one or more samples
[2] Not detected in any sample

In 2017, the State Water Board established water quality objectives for mercury to protect people and wildlife from consuming fish that contain high levels of mercury (State Water Board 2017). Five mercury fish tissue water quality objectives were developed depending on consumption patterns by individuals and wildlife. The Copco No. 1 and Iron Gate reservoirs were 303(d) listed as impaired for mercury by the State Water Board based on four or more lines of evidence showing mercury concentrations in fish fillets exceeding USEPA 304(a) concentrations of methylmercury in fish tissue of trophic level 4 fish (USEPA 2000, PacifiCorp 2004a, Davis et al. 2010, CDM 2011). No TMDL has been determined for Copco No. 1 or Iron Gate reservoirs, with an expected TMDL completion date of 2025.

C.7.2 Mid- to Lower Klamath Basin

C.7.2.1 Iron Gate Dam to Salmon River

Water Column Contaminants

SWAMP collected water quality data for inorganic and organic contaminants from 2000 through 2005 at eight monitoring sites from the Oregon-California state line (RM 214.1) to Klamath River at Klamath Glen (RM 5.9) (North Coast Regional Board 2008). As was the case for the SWAMP state line site (Section C.7.1.1), results for the four sites in the reach from Iron Gate Dam to the Salmon River indicated that with the exception of aluminum, all other measured concentrations of inorganic constituents (i.e., arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver and zinc) were in compliance with all water quality objectives at the time of sampling. Aluminum

concentrations (26.3 to 280.0 ug/L) exceeded the USEPA continuous concentration for freshwater aquatic life protection (87 ug/L) on 23 of 59 site visits (39 percent exceedance rate), exceeded the USEPA secondary MCL for drinking water (50 ug/L) on 37 site visits (63 percent exceedance rate), and exceeded the California Department of Health Services secondary MCL for drinking water (200 ug/L) on five site visits (8 percent exceedances rate) (North Coast Regional Board 2008). The Klamath River from Iron Gate Dam to its confluence with the Scott River is 303(d) listed for aluminum. Water quality measurements in 2002 and 2003 at two USGS gage stations downstream of Iron Gate Dam to the Salmon River indicate that, with the exception of barium, nickel, magnesium, and calcium, the concentration of trace elements either remained the same or decreased as water flowed downstream, most likely because of binding to other particles and settling out of the water column (Tables C-16 and C-17; Flint et al. 2005). Additional data from two more USGS gage stations downstream of the confluence of the Klamath River and the Salmon River further support these trends, except for magnesium which does not continue to increase downstream of the Salmon River. Asarian and Kann (2014) note that the mean dissolved copper concentrations at three Klamath River sites between 2001 to 2013 are approximately 0.75 ug/L or less and the maximum is always less than 1.5 ug/L.

Sediment Contaminants

Sediment data for inorganic and organic contaminants in the Klamath River from Iron Gate Dam to the Salmon River are not readily available, nor are fish tissue analyses for contaminants in the lower Klamath River.

Table C-16. Water Quality Data Collected at 4 Sites in the Klamath River in 2002 (Flint et al. 2005).

Trace Element	Walker[1]	Seiad[2]	Orleans[3]	Klamath[4]
Aluminum	2	2	1	<1
Antimony	E0.04	E0.04	E0.05	<0.05
Arsenic	5	4	3	3
Barium	8.0	10.0	14.0	14.0
Beryllium	<0.06	<0.06	<0.06	<0.06
Cadmium	<0.04	<0.04	<0.04	<0.04
Chromium	<0.8	2.4	<0.8	<0.8
Cobalt	0.13	0.13	0.1	0.08
Copper	0.6	1.2	0.8	0.7
Manganese	6.1	7.2	2.5	3
Mercury	E0.01	0.01	<0.01	E0.01
Mercury (total recoverable)	E0.01	0.02	<0.01	<0.01
Molybdenum	1.0	1.0	0.8	0.6
Nickel	1.00	1.36	2.28	2.43
Selenium	<2	<2	<2	E1
Silver	<1	<1	<1	<1

Trace Element	Walker[1]	Seiad[2]	Orleans[3]	Klamath[4]
Zinc	ND	ND	ND	1
Uranium	0.13	0.12	0.11	0.07

Notes:
[1] Klamath River at Walker Bridge (USGS 11517818)
[2] Klamath River at Seiad Valley (USGS 11520500)
[3] Klamath River at Orleans (USGS 11523000)
[4] Klamath River near Klamath (USGS 11530500)
All data shown in micrograms per liter.

Table C-17. Water Quality Data Collected at 4 Sites in the Klamath River in 2003 (Flint et al. 2005).

Trace Element	Walker[1]		Seiad[2]		Orleans[3]		Klamath[4]	
	July	Sept	July	Sept	July	Sept	July	Sept
Calcium	15.3	12.7	16.9	14.4	16.0	15.6	15.5	15.9
Magnesium	9.63	8.21	10.6	9.22	8.19	8.69	7.59	8.77
Potassium	2.85	2.55	2.25	2.47	1.47	1.99	0.91	1.34
Sodium	16.6	14.1	13.4	13.9	8.18	11.3	5.25	7.59
Chloride	5.37	5.21	5.48	5.65	3.78	5.23	2.87	3.87
Fluoride	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Silica	27.2	36.1	23.9	34.4	19.8	29.2	16.2	21.4
Sulfate	11.9	6.4	10.5	6.5	7.0	5.9	5.7	5.4

Notes:
[1] Klamath River at Walker Bridge (USGS 11517818)
[2] Klamath River at Seiad Valley (USGS 11520500)
[3] Klamath River at Orleans (USGS 11523000)
[4] Klamath River near Klamath (USGS 11530500)
All data shown in micrograms per liter.

C.7.2.2 Salmon River to Klamath River Estuary

Water Column Contaminants

SWAMP collected water quality data for inorganic and organic contaminants from 2001 through 2005 at three monitoring sites in this reach of the Klamath River to Klamath Glen (RM 5.9) (North Coast Regional Board 2008). With the exception of aluminum, all other measured concentrations of inorganic constituents (i.e., arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc) were in compliance with all water quality objectives at the time of sampling. Aluminum concentrations (8.8 to 565.0 ug/L) exceeded the USEPA continuous concentration for freshwater aquatic life protection (87 ug/L) on 12 of 28 site visits (43 percent exceedance rate), exceeded the USEPA secondary MCL for drinking water (50 ug/L) on 15 site visits (54 percent exceedance rate), and exceeded the California Department of Health Services secondary MCL for drinking water (200 ug/L) on four site visits (14 percent exceedances rate). At one station (Klamath River at Klamath Glen [RM 5.9]), grab samples were analyzed for 100 pesticides, pesticide constituents, or pesticide metabolites; 50 PCB congeners; and 6 phenolic compounds. There were no PCB detections, but the pesticide disulfoton was detected in one sample. Disulfoton is a systemic

organophosphate insecticide for which there is no numeric water quality objective. Similar to the Klamath River from downstream of Iron Gate to the confluence with the Salmon River, the water quality measurements in 2002 and 2003 at two USGS gage stations in the Lower Klamath River from the confluence with the Salmon River to the Klamath River Estuary indicate that, with the exception of barium, nickel, and calcium, the concentration of trace elements either remained the same or decreased as water flowed downstream, most likely because of binding to other particles and settling out of the water column (Tables C-16 and C-17; Flint et al. 2005). While barium concentrations remain the same at the two USGS gage stations between the Salmon River and the Klamath River Estuary (Orleans and Klamath), a comparison of barium concentrations at those gages with the two upstream gages (Walker Bridge and Seiad Valley) shows an increasing trend in barium with distance downstream from Iron Gate Dam. Nickel concentrations consistently increase with distance downstream.

Sediment Contaminants

Sediment data characterizing inorganic and organic contaminants in the Lower Klamath River from the Salmon River to the Klamath River Estuary are not readily available, nor are fish tissue analyses for contaminants in this reach of the Klamath River. Sediment data from the Klamath River Estuary are described below.

C.7.2.3 Klamath River Estuary

Sediment and water column data for inorganic and organic contaminants in the Klamath River Estuary are not readily available. However, contaminant conditions in the Klamath River Estuary (RM 0 to 3.9) are likely to be similar to those a few miles upstream at the site for which SWAMP data have been recently collected (see previous section).

As part of the Secretarial Determination studies, a sediment evaluation evaluated the potential environmental and human health impacts of the downstream release of sediment deposits currently stored behind the dams under the Proposed Project. Sediment cores were collected during 2009 to 2010 at multiple sites and at various sediment depths per site, including two locations in the Klamath River Estuary (see Section C.7.1.1). Overall, using thirteen lines of evidence from the 2009 to 2010 Secretarial Determination study (Lines of Evidence 1 to 11, 15, and 16 in Table C-10), sediment quality in the Klamath River Estuary does not appear to be highly contaminated (CDM 2011). The other lines of evidence were not used in the evaluation of conditions in the Klamath River Estuary, because no fish tissue was collected from the Klamath River Estuary. Where elevated concentrations of chemicals in sediment were found (i.e., arsenic, chromium, iron, nickel, bis[2-ethylhexyl]phthalate), the degree of exceedance based on comparisons of measured (i.e., detected) chemical concentrations to SLs was small and in several cases (i.e., arsenic, nickel) may reflect regional background conditions (CDM 2011). The results of the acute toxicity bioassays for midge and amphipod identified no statistically significant difference in survival of either test organism exposed to estuary sediments compared to control sediments. As with the reservoir sediments (Section C.7.1.1), the lone chemical identified in tissue from invertebrates exposed to estuary sediments above TRVs was fluoranthene. Further, it was only identified above the No Effect TRV, and was below the Low Effect TRV. TEQs for dioxin, furan, and dioxin-like PCBs were all below 0.2 pg/g for the Klamath River Estuary, thus adverse effects from exposure to TEQs are not expected following exposure to sediment in the Klamath River Estuary (CDM 2011).

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Appendix D

Water Quality Environmental Effects Determination Methodology Supplemental Information

D.1 Available Numeric Models for Analysis of the Proposed Project and Alternatives

D.1.1 Klamath River Water Quality Model (KRWQM)

Numeric models[6] used to assess potential water quality impacts for the Proposed Project and Alternatives are presented in Table D-1. For the FERC relicensing process, PacifiCorp developed the Klamath River Water Quality Model (KRWQM) (Watercourse Engineering, Inc. 2003, PacifiCorp 2004), consisting of linked Resource Management Associates (RMA) RMA-2 and RMA-11 dimensional models for riverine segments, where RMA-2 simulates riverine hydrodynamics and RMA-11 simulates water quality processes, and a 2-dimensional CE-QUAL-W2 model used for water quality in reservoir segments. The KRWQM does not include an analysis for the Klamath River Estuary. The KRWQM possesses the following attributes (Tetra Tech 2009a):

- Uses proven and generally accepted hydrodynamic and water quality models, including historical application to the Klamath River;
- Has been reviewed by a number of stakeholders in the watershed;
- Can be directly compared to many Oregon Department of Environmental Quality (DEQ), North Coast Regional Water Quality Control Board (North Coast Regional Board) and tribal water quality criteria;
- Has been calibrated for the Klamath River; and,
- Uses the public domain model CE-QUAL-W2 and a version of RMA that can be distributed to the public.

KRWQM results for water temperature and dissolved oxygen compare the existing condition (all Project dams in place) to four without-dams scenarios (i.e., without Iron Gate Dam ["WIG"]; without Copco No. 1, Copco No. 2, and Iron Gate dams ["WIGC"]; without J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate dams ["WIGCJCB"]; and without Keno, J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate dams ["WOP" and "WOP2"]). Model runs were calibrated using data from calendar years 2001–2004 (PacifiCorp 2004). General modeling assumptions in comparison to conditions considered for this EIR water quality effects analyses are presented in Table D-2. Limitations and sources of uncertainty for the KRWQM are presented in Watercourse Engineering, Inc. (2003).

D.1.2 Klamath River TMDL Model

For development of Klamath River Total Maximum Daily Loads (TMDLs) in Oregon and California, Oregon DEQ, North Coast Regional Board, and the United States Environmental Protection Agency (USEPA) Regions 9 and 10 collaborated to enhance the existing KRWQM by revisiting assumptions for several model algorithms, including the three-dimensional Environmental Fluid Dynamics Code model, to represent water quality in the Klamath River Estuary. Algorithm enhancements are described in Tetra Tech (2009a). The Klamath River TMDL model was calibrated for water temperature, dissolved oxygen, nutrients (TP, TN, ortho-phosphorus, nitrate, ammonia), and pH using year 2000 data, with the exception of the Klamath River Estuary which was calibrated

[6] Here numeric models refers to mathematical models that are developed to represent the physical, chemical, and biological conditions in waterbodies such as rivers, lakes, reservoirs, wetlands, estuaries, and the ocean.

using year 2004 data. Additional model corroboration was conducted for Klamath River reaches in Oregon using data from year 2002, indicating that the Klamath River TMDL model scenarios reproduce general temporal and spatial trends in the observed data (Tetra Tech 2009a). Four simulated scenarios were run for the Klamath River TMDL model including the following (Tetra Tech 2009b):

- Natural conditions baseline scenario (T1BSR)—applies to the Upper, Middle, and Lower Klamath River;
- Oregon TMDLs allocation scenario (TOD2RN)—applies to the Hydroelectric Reach to the Oregon-California state line (RM 214.1);
- California TMDLs allocation scenario (TCD2RN)—applies to the Hydroelectric Reach downstream from the Oregon-California state line (RM 214.1) and the Middle and Lower Klamath River; and,
- With-dams Oregon and California TMDLs scenario (T4BSRN)—applies to the Upper, Middle, and Lower Klamath River.

General modeling assumptions in comparison to conditions considered for this EIR's water quality effects analyses are presented in Table D-2. As shown in Table D-2, the historically natural Keno Reef was included in place of Keno Dam, such that the Keno Reach is not characterized as a free-flowing river for the T1BSR, TOD2RN, and TCD2RN Klamath River TMDL model runs. All dams were retained in the analysis for T4BSRN including Link River, Keno, J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate dams. In the analysis for this EIR, only the dams within the area of analysis were considered. Other modeling assumptions, limitations, and sources of uncertainty for the Klamath River TMDL model are presented in Tetra Tech (2009a).

Table D-1. Numeric Models Used to Assess Potential Water Quality Impacts for the Proposed Project and Alternatives.

Reach	Water Quality Parameter					
	Water Temperature	Sediment and Turbidity	Dissolved Oxygen		Nutrients	pH
	Long-term[1]	Short-term[2]	Short-term[2]	Long-term[1]	Long-term[1]	Long-term[1]
No Project Alternative, Continued Operations with Fish Passage Alternative						
Downstream from J.C. Boyle Reservoir (RM 229.8)	Klamath TMDL T4BSRN Klamath TMDL T1BSR RBM10			Klamath TMDL T4BSRN Klamath TMDL T1BSR	Klamath TMDL T4BSRN	Klamath TMDL T4BSRN
Oregon-California State line (RM 214.1)						
Downstream from Iron Gate Dam (RM 193.1)						
Shasta River (RM 179.5)						
Scott River (RM 145.1)						
Seiad Valley (RM 132.7)						
Salmon River (RM 66.3)						
Trinity River (RM 43.3)						
Turwar (RM 5.6)						
Klamath River Estuary (RM 0-3.9)						
Proposed Project, Partial Removal Alternative, No Hatchery Alternative						
Downstream from J.C. Boyle Reservoir (RM 229.8)	Klamath TMDL TOD2RN			Klamath TMDL TOD2RN	Klamath TMDL TOD2RN	Klamath TMDL TOD2RN
Oregon-California State line (RM 214.1)						
Downstream from Iron Gate Dam (RM 193.1)	Klamath TMDL TCD2RN KRWQM WIGCJCB[3] RBM10	Reclamation SRH-1	Reclamation, USFWS, USGS, Stillwater Sciences BOD/IOD	Klamath TMDL TCD2RN KRWQM WIGCJCB[3]	Klamath TMDL TCD2RN	Klamath TMDL TCD2RN
Shasta River (RM 179.5)						
Scott River (RM 145.1)						
Seiad Valley (RM 132.7)						
Salmon River (RM 66.3)						
Trinity River (RM 43.3)						
Turwar (RM 5.6)						
Klamath River Estuary (RM 0-3.9)						

<table>
<tr><th rowspan="3">Reach</th><th colspan="6">Water Quality Parameter</th></tr>
<tr><th>Water Temperature</th><th>Sediment and Turbidity</th><th colspan="2">Dissolved Oxygen</th><th>Nutrients</th><th>pH</th></tr>
<tr><th>Long-term[1]</th><th>Short-term[2]</th><th>Short-term[2]</th><th>Long-term[1]</th><th>Long-term[1]</th><th>Long-term[1]</th></tr>
<tr><td colspan="7">Three Dam Removal Alternative, Two Dam Removal Alternative</td></tr>
<tr><td>Downstream from J.C. Boyle Reservoir (RM 229.8)</td><td rowspan="2"></td><td rowspan="10"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="10"></td></tr>
<tr><td>Oregon-California State line (RM 214.1)</td></tr>
<tr><td>Downstream from Iron Gate Dam (RM 193.1)</td><td rowspan="5">KRWQM WIGC[3]

RBM10</td><td rowspan="5">KRWQM WIGC[3]</td></tr>
<tr><td>Shasta River (RM 179.5)</td></tr>
<tr><td>Scott River (RM 145.1)</td></tr>
<tr><td>Seiad Valley (RM 132.7)</td></tr>
<tr><td>Salmon River (RM 66.3)</td></tr>
<tr><td>Trinity River (RM 43.3)</td><td rowspan="3"></td><td rowspan="3"></td></tr>
<tr><td>Turwar (RM 5.6)</td></tr>
<tr><td>Klamath River Estuary (RM 0-3.9)</td></tr>
</table>

[1] Long-term—greater than 2 years following dam removal/construction of fish passage facilities or greater than 5 years for the No Project Alternative

[2] Short-term—less than 2 years following dam removal/construction of fish passage facilities or 1–5 years for the No Project Alternative.

[3] KRWQM results available for the mainstem immediately downstream from Iron Gate Dam, Scott River confluence, and Salmon River confluence (PacifiCorp 2004).

Key:

Klamath TMDL T4BSRN—with-dams Oregon and California TMDLs allocation scenario (Tetra Tech 2009b).

Klamath TMDL T1BSR—natural conditions baseline scenario for California TMDLs (Tetra Tech 2009b). The T1BSR natural conditions scenario is useful for analyzing those water quality parameters that rely on a comparison to background or natural levels for regulatory water quality standards, such as water temperature and dissolved oxygen.

Klamath TMDL TOD2RN—Oregon TMDLs allocation scenario (Tetra Tech 2009b).

Klamath TMDL TCD2RN—California TMDLs allocation scenario (Tetra Tech 2009b).

KRWQM WIGCJCB—Klamath River Water Quality Model Without Iron Gate, Copco No. 1, Copco No. 2, and J.C. Boyle dams scenario (Watercourse Engineering, Inc. 2003, PacifiCorp 2004).

KRWQM WIGC – Klamath River Water Quality Model Without Iron Gate, Copco No. 1, and Copco No. 2 dams scenario (Watercourse Engineering, Inc. 2003, PacifiCorp 2004).

RBM10—water temperature model including climate change and BO and KBRA flows (Perry et al. 2011).

Reclamation SRH-1—1-dimensional sedimentation and river hydraulics model (Huang and Greimann 2010, USBR 2012).

BOD/IOD—biological oxygen demand (BOD)/immediate oxygen demand (IOD) spreadsheet model developed in collaboration with Reclamation, USGS, and USFWS (Stillwater Sciences 2011).

Table D-2. Comparison of Assumptions and Parameters for Available Numeric Models to Conditions Used for the Assessment of Potential Water Quality Impacts.

Assumptions/Model Parameters	Available Numeric Models for Long-term Conditions			Conditions Considered for Lower Klamath Project EIR			
	KRWQM	Klamath TMDL	RBM10	Proposed Project, Partial Removal Alternative, No Hatchery Alternative	No Project and Continued Operations with Fish Passage Alternative	Three Dam Removal	Two Dam Removal
Water quality constituents considered	• Water temperature [1] • Dissolved oxygen[1] • Nutrients • Chlorophyll-a	• Water temperature • Dissolved oxygen • Nutrients • pH • Chlorophyll-a	• Water temperature	• Water temperature • Suspended material • Dissolved oxygen • Nutrients • pH • Chlorophyll-a			
Dams remaining in-place (different modeling scenario names are shown in quotations for KRWQM and the Klamath TMDL model)	• "WOP" and "WOP2" = Link River • "WIGCJCB" = Link River and Keno • "WIGC" = Link River, Keno, J.C. Boyle • "WIG" = Link River, Keno, J.C. Boyle, Copco No. 1 and 2 • "EC" = Link River, Keno, J.C. Boyle, Copco No. 1 and 2, Iron Gate	• "T4BSRN" = Link River, Keno, J.C. Boyle, Copco No. 1 and 2, Iron Gate • "TOD2RN" and "TCD2RN" = Link River and Keno Reef [2] • "T1BSR" = Link River and Keno Reef [2]	"No Action Alternative" = J.C. Boyle, Copco No. 1, Copco No. 2, Iron Gate	None	J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate	J.C. Boyle	J.C. Boyle and Copco No. 2

Assumptions/Model Parameters		Available Numeric Models for Long-term Conditions			Conditions Considered for Lower Klamath Project EIR			
		KRWQM	**Klamath TMDL**	**RBM10**	**Proposed Project, Partial Removal Alternative, No Hatchery Alternative**	**No Project and Continued Operations with Fish Passage Alternative**	**Three Dam Removal**	**Two Dam Removal**
Flows		• Existing conditions for 2000–2004 [3] • NMFS 2002 Biological Opinion Mandatory Flows for the Klamath Project	Existing conditions for 2000 [4]	2010 Biological Opinion Mandatory (NMFS) and KBRA Flows[5]	See Section 3.1.6	See Sections 4.2.1.2 and 4.4.1.1	See Section 4.6.1.1	See Section 4.5.1.1
Reaches		Link River Dam (RM 259.7) to Turwar (RM 5.6)	Link River Dam (RM 259.7) to the Klamath River Estuary (RM 0–3.9)	Link River Dam (RM 259.7) to the Pacific Ocean	J.C. Boyle Reservoir (RM 233.3) to the Klamath River Estuary (RM 0–3.9)			
Analysis year(s)		2000–2004	2000	2012–2061	As detailed in EIR Sections 3 and 4			
Climate change		Not included	Not included	Included				
Nutrients	Upper Klamath Lake and inputs to Keno Impoundment[6]	Current conditions at the time of the model development[7]	OR and CA full TMDL compliance [8]	Not applicable	• Eventual OR and CA full TMDL compliance[8] • Timescale assumed to be decades			
	Small tributaries to the lower Klamath River (i.e., Iron Gate Dam to Klamath River Estuary)	• TN: 0.275 mg/L • TP: 0.075 mg/L	• TN: 0.077 mg/L [10] • TP: 0.014 mg/L [10]	Not applicable	See assumptions for Klamath TMDL			

Assumptions/Model Parameters		Available Numeric Models for Long-term Conditions			Conditions Considered for Lower Klamath Project EIR			
		KRWQM	**Klamath TMDL**	**RBM10**	**Proposed Project, Partial Removal Alternative, No Hatchery Alternative**	**No Project and Continued Operations with Fish Passage Alternative**	**Three Dam Removal**	**Two Dam Removal**
Algae and particulate organic matter (POM)	Upper Klamath Lake and inputs to Keno Impoundment[6]	Current conditions at the time of the model development[7]	OR and CA full TMDL compliance[8]	Not applicable	• OR and CA full TMDL compliance[8] • Timescale unknown			
	Settling rates in all reservoirs	• Algal settling rate = 1.0 m/day • POM = 0.5 m/day [9]	• Algal settling rate = 0.3 m/day [11] • POM = 0.8 m/day [11]	Not applicable	See assumptions for Klamath TMDL			

[1] Published results available for water temperature and dissolved oxygen in PacifiCorp (2005). Additional results available in the FERC record and as an electronic appendix to http://www.riverbendsci.com/reports-and-publications-1/klam_wq_model_eval.pdf

[2] The historically natural Keno Reef was included in place of Keno Dam, such that the Keno Reach is not characterized as a free-flowing river.

[3] The WOP2 scenario has "smoothed flows" from Klamath Irrigation Project, to account for the fact that if Keno Dam were removed, Link releases would have to be smoothed due to instream flow requirements downstream.

[4] Exceptions to current conditions include the TIBSR model (natural conditions) where dramatically increased summer flows (i.e., no diversions) were assumed for tributaries to the mainstem Klamath River. USBR 2005 "un-depleted natural flows" were used for flows at Link River Dam and Keno Impoundment. For T4BSRN, TOD2RN, and TCD2RN, Shasta River flows are increased by 45 cfs. Hydropower peaking in the J.C. Boyle Peaking Reach was not included in the no-dam scenarios (TOD2RN, TCD2RN, T1BSR) (Tetra Tech 2009a).

[5] While analysis for the Lower Klamath Project EIR considered the 2013 Joint Biological Opinion and the court-ordered flushing and emergency dilution flows, the KBRA and 2013 Joint Biological Opinion flows were determined to be sufficiently similar (see Section 3.1.6) that modeling using KBRA flows was used if modeling using 2013 Joint Biological Opinion flows was not available.

[6] Upper Klamath Lake and inputs to Keno impoundment are model boundary inputs for the available numeric models only. The area of analysis for water quality constituents in the Lower Klamath Project License Surrender only considers the Klamath River in Oregon from J.C. Boyle Reservoir to the Oregon-California State line to the extent that conditions in that reach influence water quality in California. See Section 3.2.1 for further details.

[7] Current conditions at the time of the model development based on combination of individual samples and long-term monthly averages (used when individual samples not available) from Freemont Bridge (near outlet of Upper Klamath Lake, Link Dam, and Eastside/Westside powerhouses. Current conditions at the time of the model development for other inputs to Keno Impoundment are based on combination of individual samples and averages.

[8] Full implementation assumes the decrease in nutrient loads at the Oregon-California State line is 87% for TP and 62% for TN and BOD (calculated from information in Table 2-8, Kirk et al. [2010]). Analysis for the Lower Klamath Project EIR only considered OR TMDL compliance with regard to what crosses the Oregon-California State line into California and how it may influence water quality in the Upper, Mid-, and Lower Klamath Basin in California.

[9] PacifiCorp (2005).

[10] North Coast Regional Board (2010).

[11] Tetra Tech (2009a).

D.1.3 RBM10 Model

The one-dimensional RBM10 water temperature model was developed as part of the Secretarial Determination studies in 2010 and 2011. The RBM10 model is well suited to the temporal, spatial, and structural requirements for simulating water temperatures in the Klamath Basin because it can (1) predict mean daily water temperature along a longitudinal gradient of a river, (2) accommodate both reservoir and river sections, and (3) simulate long time series (50 years) quickly (Perry et al. 2011). RBM10 was used to simulate water temperatures for 2012–2061 under two management alternatives ("BO" [Biological Opinion], which represents the No Project Alternative, and "KBRA", which represents the Proposed Project). RBM10 includes six future climate scenarios (i.e., 12 fifty-year simulations). The six future climate scenarios represent hydrology and meteorology using the Index Sequential Method and five alternative Global Circulation Models (GCMs; USBR 2012). The Index Sequential Method generates flows based on historical hydrology and meteorology under future operational conditions (USBR 2012)

D.1.4 Considerations for the Lower Klamath Project

As presented in Table D-2, major differences between the existing numeric models and the conditions considered for water quality analyses in this EIR include the following:

- The Klamath River TMDL TOD2RN and TCD2RN ("dams out") model runs remove PacifiCorp dams and represent Keno Dam as the historical natural Keno Reef, such that the Keno Reach is not characterized as a free-flowing river. The KRWQM includes a model run retaining Keno. The analysis in this EIR retains Keno Dam for the Proposed Project and all alternatives.
- River flows for the Lower Klamath Project EIR analysis are based on the NMFS and USFWS 2013 Joint Biological Opinion flows (NMFS and USFWS 2013) and the court-ordered flushing and emergency dilutions flows (U.S. District Court 2017), but modeling using KBRA flows are used if modeling using the 2013 Joint Biological Opinion flows are not available. The KBRA and 2013 Joint Biological Opinion flows are sufficiently similar (see Section 3.1.6) that modeling using KBRA flows still captures the range of conditions under 2013 Joint Biological Opinion flows. The river flows used in the Lower Klamath Project EIR analysis tend to be greater than those modeled in either the Klamath River TMDL model (with the exception of T1BSR) or the KRWQM.
- Climate change was not considered in either the KRWQM or the Klamath River TMDL model.
- The RBM10 water temperature model includes climate change projections, but uses NMFS 2010 Biological Opinion (NMFS 2010) flows "BO" alternative for the "No Action Alternative" analyzed in the Secretarial Determination studies and KBRA flows for the "Action Alternative" analyzed in the Secretarial Determination studies.

To place the Proposed Project analysis in the proper context, the above differences are generally considered as part of the water quality effects determinations whenever numeric model results are utilized.

Additionally, two models have been developed for the Secretarial Determination process to determine potential short-term impacts under the Proposed Project on suspended sediment and dissolved oxygen downstream from the Lower Klamath Project dams. The

first, a one-dimensional sedimentation and river hydraulics model (SRH-1D), was developed to simulate existing conditions for hydraulics and sediment transport downstream from Iron Gate Dam as well as predict suspended sediment concentrations under multiple drawdown scenarios of the Proposed Project. The SRH-1D model uses three "water year types" defined by the probability that in a given year the river could experience flows exceeding the low-level outlet capacities of the reservoirs (i.e., ability of the low-level outlet to evacuate the major portion of the reservoir storage volume by gravity flow) between March and June; a typical "dry year" is defined as having a 10 percent probability of exceedance (i.e., Water Year[7] [WY] 2001), a median year has a 50 percent probability of exceedance (i.e., WY 1976), and a typical wet year has a 90 percent probability of exceedance (i.e., WY 1984) (USBR 2012). The SRH-1D modeling uses KBRA and NMFS 2010 Biological Opinion (NMFS 2010) flows, but the flow requirements in the Klamath River have changed since the modeling was performed. NMFS and USFWS 2013 Joint Biological Opinion flows are the main flow requirements in the Klamath River. KBRA and NMFS 2010 Biological Opinion flows and 2013 Joint Biological Opinion flows are sufficiently similar (see Section 3.1.6) that modeling results using KBRA flows represent the range of conditions under 2013 Joint Biological Opinion flows (USBR 2016). Modeling assumptions, limitations and sources of uncertainty are presented in Huang and Greimann (2010) and USBR (2012).

The second model developed for the Secretarial Determination process is a simplified spreadsheet model used to investigate the potential influences that re-suspension of reservoir sediments may have on short-term dissolved oxygen levels downstream from Iron Gate Dam. Developed in collaboration with USBR, USGS, and USFWS, the model uses results from a combination of *in situ* sampling of reservoir sediments and water quality, and laboratory analysis of oxygen demand from the resuspended reservoir sediments, combined with numerical modeling of biochemical oxygen demand, immediate oxygen demand, sediment oxygen demand and oxygen demand as a function of suspended sediment concentrations and other variables. The short-term dissolved oxygen modeling uses outputs from USBR modeling that utilizes KBRA flows, but as previously discussed the modeling results using KBRA flows capture the range of conditions under 2013 Joint Biological Opinion flows (USBR 2016). Modeling assumptions, limitations and sources of uncertainty are presented in Stillwater Sciences (2011).

D.2 Environmental Effects Determination Methodology for Short-term Suspended Sediments

The North Coast Regional Board developed the Desired Conditions Report (2006) as a guidance document describing sediment-related indices of importance to salmonid habitat conditions, including the application of the Newcombe and Jensen (1996) Severity Index and the Suspended Sediment Dose Index. The Suspended Sediment Dose Index relates exposure time to suspended sediment using a natural logarithm relationship, while the Severity Index provides a ranking of the effects of suspended sediment on salmonids, as shown below for coho salmon.

Suspended Sediment Dose Index (SSDI) = ln x (suspended sediment [mg/L] x exposure time [hrs])

[7] Water year is defined as October 1 to September 30.

Severity Index (coho salmon) = 0.7523 x SSDI + 0.5735

The North Coast Regional Board guidance document suggests that a Severity Index Rank of 4.0 or greater represents significant harm to salmonids so as to be detrimental to the beneficial use associated with cold freshwater habitat (North Coast Regional Board 2006). This ranking would equate to a suspended sediment concentration of 0.15 mg/L and a Suspended Sediment Dose Index of 3.9 (Table D-3 below), assuming 2 weeks exposure for salmonids as a chronic condition that is likely to occur under a dam removal scenario. However, the general significance criteria adopted for this analysis state that an impact must result in *substantial* adverse effects on beneficial uses of water to be considered significant. For the Lower Klamath Project EIR water quality analysis, a continuous suspended sediment concentration of 100 mg/L for a 2-week chronic exposure condition is considered to be a substantial impact, because this exposure corresponds to a Severity Index Rank of 8.4 (Table D-3), which generally spans the transition from sublethal effects (8 = long-term reduction in feeding rate and feeding success, poor condition) to lethal effects (9 = delayed hatching, reduced fish density) for exposed salmonids (Newcombe and Jensen 1996).

Table D-3. Calculated Suspended Sediment Dose Index (SSDI) and Severity Index Rank for a Range of Suspended Sediment Concentrations (SSCs). Based on Newcombe and Jensen (1996).

SSC (mg/L)	SSDI[1]	Severity Index Rank
0.15	3.9	3.5
0.5	5.1	4.4
1	5.8	4.9
4	7.2	6.0
10	8.1	6.7
30	9.2	7.5
60	9.9	8.0
100	10.4	8.4
200	11.1	8.9
800	12.5	10.0
3,000	13.8	11.0
7,000	14.7	11.6

[1] Based on 2-week exposure period as a chronic condition.

A more detailed analysis of suspended sediment effects on key fish species, including consideration of specific life history stages, suspended sediment concentrations, and exposure period, is required for a comprehensive assessment of the impacts of the Proposed Project alternatives on the cold water designated beneficial use. This level of analysis is presented in Section 3.3 Aquatic Resources and appendices to that section, including additional background regarding the applicability of the Newcombe and Jensen (1996) Severity Index Ranks and the Suspended Sediment Dose Index for key fish species in the Klamath River. Further discussion of particular effects of suspended sediment on shellfish and estuarine and marine organisms is also presented in Section 3.3.5.1 Aquatic Resources.

D.3 Environmental Effects Determination Methodology for Inorganic and Organic Contaminants

The Secretarial Determination sediment evaluation process followed screening protocols of the Sediment Evaluation Framework (SEF) for the Pacific Northwest, issued by the interagency Regional Sediment Evaluation Team (RSET) 2009 and updated in 2016. The SEF is a regional guidance document that provides a framework for the assessment and characterization of freshwater and marine sediments in Idaho, Oregon, and Washington (RSET 2009, 2016). Level 2A of the SEF involves a data screening assessment to compare reservoir sediment data to available and appropriate sediment maximum levels (MLs), screening levels (SLs), and bioaccumulation triggers (BTs); and, Level 2B, including bioassays, bioaccumulation tests and special evaluations such as elutriate chemistry and risk assessments (CDM 2011).

The set of sediment MLs, SLs, and BTs included in the Secretarial Determination process for Level 2A of the SEF represented an array of screening tools for different potential effects scenarios and are (briefly) the following:

- **Pacific Northwest SEF** sediment screening levels for standard chemicals of concern and chemicals of special occurrence in marine and freshwater bulk sediments for Idaho, Oregon, and Washington (RSET 2009, 2016)[8];
- **Dredged Material Management Program (DMMP)** screening levels (SL), bioaccumulation thresholds (BT), and maximum levels (MT) for marine sediments[9] in Puget Sound, Washington;
- **Screening Quick Reference Tables (SQuiRTs)** guideline values compiled by NMFS, covering organic and inorganic contaminants in a variety of environmental media, including marine and freshwater sediments;
- **Oregon DEQ bioaccumulation screening level values (BSLVs)** for humans and relevant classes of wildlife (e.g., freshwater fish, birds, mammals);
- **California Human Health Screening Levels** are concentrations of hazardous chemicals in soil or soil gas that the California Environmental Protection Agency considers to be below thresholds of concern for risks to human health**;** and,
- **USEPA Regional Screening Levels** (formerly Preliminary Remediation Goals) for assessing human health long-term (i.e., 24-yr) exposure risk for contaminated soils and sediments in various settings (USEPA 1991, 1996, 2002).

Additional information regarding the screening levels is presented in CDM (2011), along with the compilation of SL values. For the Secretarial Determination process, the sediment screening values have been used in a step-wise manner to systematically consider potential impact pathways under each of the Project alternatives (or later, during subsequent permitting actions). The applicability of each of the screening levels

[8] Similar numeric chemical guidelines for the assessment and characterization of freshwater and marine sediments do not exist for California. The State Water Board is in the process of developing and adopting sediment quality objectives (SQOs) for enclosed bays and estuaries. However, the California SQOs are designed to assess in-place, surficial sediments as opposed to deeper sediment deposits or sediment discharges. As such, the California SQOs are not considered particularly relevant to the Secretarial Determination process or the Lower Klamath Project EIR effects assessment.

[9] The DMMP guidelines do not include numeric values for freshwater sediments.

to the Lower Klamath Project EIR effects determination analysis varies depending on the Project alternative (Table D-2).

Level 2B testing under the SEF consists of biological testing (bioassays or tissue analyses) or other special evaluations that are completed to provide more empirical evidence regarding the potential for sediment contamination to have adverse effects on receptors (RSET 2009). While tests involving undiluted sediments identify potential contamination that could affect bottom-dwelling (benthic) organisms, tests using suspension/elutriates of dredged material assess potential water column toxicity. For freshwater ecosystems that contain salmonid species, rainbow trout (*Oncorhynchus mykiss*) is recommended as one of the elutriate test species. A bioaccumulation evaluation is undertaken under SEF Level 2B when bioaccumulative chemicals of concern compared to screening levels either exceed or are inconclusive, and thus need further evaluation to determine if they pose a potential risk to human health or ecological health in the aquatic environment (RSET 2009, 2016).

Results from elutriate chemistry, sediment bioassays, and elutriate bioassays carried out for the Secretarial Determination studies were used to provide additional information beyond simple comparisons of sediment contaminant levels to regional or national screening levels (CDM 2011). Elutriate data was evaluated through comparison with a suite of regional, state, and federal standards for water quality (Tables D-4 and D-5); the comparison was first carried out without consideration of dilution as a conservative approach. The results of sediment and elutriate bioassays were analyzed for acute toxicity potential for two benthic organisms (*Chironomus dilutus, Hyalella azteca*) and one freshwater fish (*Onchorhynchus mykiss*). *Chironomus dilutus* and *Hyalella azteca* are national "benchmark" toxicity indicator species, as identified in the joint USEPA–United States Army Corps of Engineering (USACE) Inland Testing Manual for the evaluation of dredged material proposed for discharge into waters of the United States, as follows:

> *Benchmark species comprise a substantial data base, represent the sensitive range of a variety of ecosystems, and provide comparable data on the relative sensitivity of local test species. Other species may be designated in future as benchmark species by USEPA and the US Army Corps of Engineers when data on their response to contaminants are adequate. Only benthic species should be tested. Although sediment dwellers are preferable, intimate contact with sediment is acceptable. Note that testing with all recommended taxa is not required; however, at least one [benchmark] amphipod taxon should be tested* (USEPA and USACE 1998).

Table D-4. Applicable Screening Levels for Determination of Potential Toxicity and Bioaccumulation Effects from Sediment-Associated Contaminants Under the Proposed Project and Alternatives.

Screening Level	No Project	Full Removal (Proposed Project)	Partial Removal	Continued Operations of the Lower Klamath Project With Fish Passage	Three Dam Removal
Pacific Northwest Sediment Evaluation Framework (SEF)					
Marine (SL1, SL2*)		X	X		X
Freshwater (SL2, SL2*)	X	X	X	X	X
Puget Sound Dredged Materials Management Program (DMMP)					
Marine (SL, BT, ML)		X	X		X
SQuiRT Values					
Marine (ERL, ERM, T20, TEL, T50, PEL)		X	X		X
Freshwater (TEL, LEL, PEL, SEL, TEC, PEC)	X	X	X	X	X
Oregon DEQ Bioaccumulation Screening Level Values (BSLVs)					
Freshwater (Fish, Bird-Individual, Bird-Population, Mammal-Individual, Human-General, Human-Subsistence)	X	X	X	X	X
USEPA Regional Screening Levels (RSLs)					
Residential Soil Supporting (Total Carcinogenic, Total Non-carcinogenic)	X	X	X	X	X

Screening Level	No Project	Full Removal (Proposed Project)	Partial Removal	Continued Operations of the Lower Klamath Project With Fish Passage	Three Dam Removal
California Human Health Screening Levels (CHHSLs)					
Residential Soil Supporting (Total Carcinogenic, Total Non-carcinogenic)	X	X	X	X	X

* SL2's have been removed from the Pacific Northwest SEF; however, they are shown here because they were part of the SEF at the time that the intensive sediment investigation on the Lower Klamath Project reservoirs was ongoing.

Screening Level Key:

SL1= Sediment Screening Level 1—SEF lower (more protective) sediment screening level value.
SL2= Sediment Screening Level 2—SEF higher (less protective) sediment screening level value.
SL= Screening Level - a guideline value defined for each DMMP chemical of concern that identifies concentrations at or below which there is no reason to believe that dredged material disposal would result in unacceptable adverse effects.
BT= Bioaccumulation Trigger represents the sediment concentration that constitutes a "reason to believe" level that the chemical would accumulate in the tissues of target organisms for bioaccumulative chemicals of concern. Sediments with chemical concentrations above the calculated BT require bioaccumulation testing before suitability for open-water disposal can be determined.
ML= Maximum Level represents a guideline value derived for each chemical of concern which represents the highest Apparent Effects Threshold (AET)—a chemical concentration at which biological indicators show significant effects.
SQuiRTs= Screening Quick Reference Tables developed by NMFS to screen natural resources of concern.
ERL= Effects Range Low represents the chemical concentration below which adverse effects would be rarely observed.
ERM= Effects Range Median represents the chemical concentration above which adverse effects would frequently occur.
T20= Chemical concentration representing a 20% probability of observing an effect, calculated using individual chemical logistic regression models based on 10-day survival results from marine amphipod tests (Ampelisca a. and Rhepoxynius a.).
TEL= Threshold Effect Level represents the concentration below which adverse effects are expected to occur only rarely.
T50= Chemical concentration representing a 50% probability of observing an effect, calculated using individual chemical logistic regression models based on 10-day survival results from marine amphipod tests (Ampelisca a. and Rhepoxynius a.).
PEL= Probable Effect Level represents the concentration above which adverse effects are expected to occur frequently.
LEL= Lowest Effect Level represents the concentration at which sediments are considered to be clean to marginally polluted. No effects on the majority of sediment-dwelling organisms are expected below this concentration.
SEL= Severe Effect Level represents the concentration at which sediments are considered to be heavily polluted. Adverse effects on the majority of sediment-dwelling organisms are expected when this concentration is exceeded.
TEC= Threshold Effect Concentration represents the concentration at which adverse effects are not expected to occur.
PEC= Probable Effect Concentration represents the concentration at which above which adverse effects are expected to occur more often than not.

Table D-5. Applicable Water Quality Criteria for Determination of Potential Toxicity and Bioaccumulation Effects from Sediment-Associated Contaminants Under the Proposed Project and Alternatives.

Water Quality Criteria	No Project	Full Removal (Proposed Project)	Partial Removal	Continued Operations of the Lower Klamath Project With Fish Passage	Three Dam Removal
North Coast Regional Board Basin Plan					
Freshwater (Aquatic Life CTR, Aquatic Life NTR)	X	X	X	X	X
Human Health (Primary MCL, Secondary MCL, Agriculture, Human Health CTR, Human Health NTR)	X	X	X	X	X
California Ocean Plan					
Marine (Aquatic Life Chronic, Aquatic Life Acute, Aquatic Life Instant)		X	X		X
Human Health (CAR, NCAR, Water and Organism)		X	X	X	X
CCR-California Department of Public Health					
Human Health (DLR, MCL)	X	X	X	X	X
National Regional Water Quality Criteria Priority Pollutants					
Freshwater (CMC, CCC)	X	X	X	X	X
Marine (CMC, CCC)		X	X		X
Human Health (Water and Organism, Organism Only)	X	X	X	X	X
National Regional Water Quality Criteria Non-priority Pollutants					
Freshwater (CMC, CCC)	X	X	X	X	X
Marine (CMC, CCC)		X	X		X
Human Health (Water and Organism, Organism Only)	X	X	X	X	X

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Appendix E

An Analysis of Potential Suspended Sediment Effects on Anadromous Fish in the Klamath Basin

E.1 Introduction

Under the Proposed Project removing the four Lower Klamath Project dams could release up to 5.3 to 8.6 million yd^3 of sediment (sand, silt, and finer) downstream (USBR 2012), resulting in high suspended sediment loads and local, short-term sediment deposition. Over 80 percent of the reservoir sediments are fine sediment (organics, silts, and clays), which are expected to remain suspended in the Klamath River flow as it moves downstream and out into the Pacific Ocean. Coarse sediment (i.e., sand and larger) transport would occur more slowly depending on the hydrologic conditions with deposition of coarser sediment from dam removal expected to primarily occur between the reservoirs and the confluence of the Klamath River and the Shasta River. The downstream transport of this sediment, currently stored in reservoir deposits, can affect downstream habitats as both suspended sediment and bedload deposition. Elevated suspended sediment concentrations (SSC) may clog or abrade the gills of fish or prevent fish from foraging efficiently. As the transported sand and fine sediment settles on the streambed, it can reduce the survival of incubating eggs and developing alevins in salmonid redds by impeding intergravel flow as well as the emergence of fry.

Sediment release associated with the Proposed Project are also anticipated to cause short-term increases in oxygen demand and corresponding reductions in dissolved oxygen. As described in Section 3.2.5.4 *Dissolved Oxygen*, predicted short-term increases in oxygen demand under the Proposed Project generally result in dissolved oxygen concentrations remaining greater than 5 mg/L. Exceptions to this would occur four to eight weeks following reservoir drawdown (approximately in February of dam removal year 2) for median and dry year hydrologic conditions, when dissolved oxygen would drop to levels below 5 mg/L from Iron Gate Dam to near the confluence with the Shasta River (RM 179.5). The impacts on aquatic resources from reduced dissolved oxygen are considered synergistic with the impacts of SSC within this reach of primary impact. As such, the impacts of SSC are anticipated to dominate and mask any impacts that would occur otherwise as a result of reduced dissolved oxygen.

This appendix to the Lower Klamath Project EIR describes a modeling analysis of the potential effects of suspended sediment on anadromous fish populations in the Klamath Basin under: 1) existing conditions; 2) the No Project Alternative; and 3) the Proposed Project (described in Section 2 *Proposed Project*). Available data on SSCs under existing conditions in the Klamath River upstream and downstream from Iron Gate Dam (summarized in Section 3.2.3, Water Quality – Existing Conditions/Affected Environment) were determined to be insufficient for conducting this type of analysis. To compensate for this shortfall, the USBR used suspended sediment data collected by United States Geological Survey (USGS) stream gages at (1) Shasta River near the City of Yreka, (2) Klamath River near Orleans, and (3) Klamath River at Klamath, CA to estimate daily SSCs (milligrams per liter [mg/l]) as a function of flow (cubic feet per second [cfs]) using the SRH-1D 2.4 sediment transport model (Sedimentation and River Hydraulics–One Dimension Version 2.4) (Huang and Greimann 2010, USBR 2012), hereafter referred to as “the model.” Daily SSCs were modeled for water years 1961 through 2008 to represent existing conditions and the No Project Alternative, as well as for the year following removal of the dams under multiple drawdown scenarios (USBR 2012).

E.2 Methods

Daily durations of SSC concentrations were modeled assuming the Proposed Project occurred within each of the 48 years in the available hydrology from 1961 through 2009. As described in Chapter 6 of USBR (2012), the 2010 NMFS BiOp (NMFS 2010) flows were used for modeling suspended sediment, but flow requirements in the Klamath River have changed since the modeling was performed. The NMFS and USFWS 2013 Joint BiOp (NMFS and USFWS 2013) along with court-ordered flushing and emergency dilution flows are the current key flow requirements to which the Lower Klamath Project must operate. The 2013 Joint BiOp altered flow conditions by shifting the monthly timing and water year type distribution of flows but retained the overall magnitude of 2010 BiOp flows. As described in Section 3.1.6 *Summary of Available Hydrology Information for the Proposed Project*, the 2013 Joint BiOp (NMFS and USFWS 2013) flows, that replaced the 2010 BiOp flows, are sufficiently similar to the 2010 BiOp flow releases used in the modeling that the model results are still representative of the key hydrological factors including timing, frequency, and magnitude of flows released during winter and spring.

Flows under the Proposed Project were modeled assuming Klamath River hydrology defined by Klamath Basin Restoration Agreement (KBRA) operations of the Klamath Irrigation Project (USBR 2012). As described in Section 3.1.6 *Summary of Available Hydrology Information for the Proposed Project*, the KBRA has expired, and hydrology under the Proposed Project will be pursuant to the 2013 BiOp (NMFS and USFWS 2013). As detailed in Section 3.1.6, the 2013 Joint BiOp flows are sufficiently similar to KBRA flows used in the modeling that the model results are still representative of the key hydrological factors including timing, frequency, and magnitude of flows released during winter and spring.

The rate of reservoir drawdown would also affect the amount of erosion of the sediment deposit. A faster drawdown rate would reduce the time of interaction between the flow and reservoir sediment deposits, thus reducing the overall amount of sediment erosion, whereas a slower drawdown rate would increase the time of interaction between the flow and reservoir sediment deposits, thus increasing the overall amount of sediment erosion. The analysis presented here is based on USBR (2012) modeled maximum drawdown rate of 2.25 to 3 feet per day. However, under Proposed Project, a maximum drawdown rate of 5 feet per day would occur (Appendix B: *Definite Plan – Appendix P*). As described in detail in Section 2.7.3 *Reservoir Sediment Deposits and Erosion During Drawdown*, this increased drawdown rate would slightly decrease the total amount of sediment erosion that occurs during drawdown. The modeled maximum drawdown rate would result in 36 to 57 percent of erosion of the sediment deposit from the reservoirs and increasing the drawdown rate to 5 feet per day would most likely result in an amount of erosion toward the lower end of the estimated range or slightly lower. The implication for this analysis is that predictions of impacts discussed here based on a lower drawdown rate may be slightly higher than would occur with the faster drawdown rate under the Proposed Project.

In addition, under the Proposed Project, as describe in Section 2.7.3 *Reservoir Sediment Deposits and Erosion During Drawdown,* during drawdown, erosion and transport of sediments deposited within the Copco No. 1 and Iron Gate reservoir footprints would be supported by using barge-mounted pressure sprayers to jet water onto newly exposed reservoir-deposited sediments as the water level decreases, a process called sediment jetting. Sediment jetting was not considered with the USBR (2012) model used for this

analysis. Sediment jetting would maximize the erosion of reservoir-deposited sediments on the historical floodplain areas during drawdown and minimize the potential for reservoir sediment erosion outside of the reservoir drawdown period. The majority of the sediment erosion would occur during the reservoir drawdown process and would be a combination of direct erosion of the sediment by moving water, slumping of the fine sediment along the reservoir sides toward the river, and sediment jetting of some areas of reservoir-deposited sediments during drawdown. Considering the relatively small amount of water coming from the hose(s) (estimated to be approximately 18 cfs) used for jetting compared to the river flow anticipated during drawdown, the additional sediment erosion from the jetting practice will only marginally (500 to 1,000 mg/l) increase the predicted sediment concentration and may decrease the duration of increased suspended sediment in comparison with the model results of USBR (2012) used in this analysis. However, the range in estimated erosion volume in each reservoir will be primarily dependent upon whether the prevailing hydrology during reservoir drawdown corresponds to a dry hydrologic year or a wet hydrologic year, and the relative influence of the sediment jetting would have an unsubstantial effect on SSC magnitude and duration. The peak increase in SSCs due to sediment jetting using conservative assumptions would be within the general uncertainty of the modeled SSCs (factor of 2). The increase in SSCs due to sediment jetting likely would be less than the peak increase in SSCs due to the relatively low magnitude of flow from the hose(s), and relatively high magnitude of SSC predicted from upstream sources. As a result, the SSCs associated with drawdown and sediment jetting would usually be within the range of modeled SSCs with only occasional potential increases above the modeled peak SSCs (still within the factor of 2 uncertainty). Therefore, the model results of USBR (2012) are assumed to be sufficient for the prediction of impacts to aquatic resources, without quantitative consideration of sediment jetting.

The analysis of the potential effects of SSC on aquatic species in the Klamath River followed a four-step process similar to that used in prior modeling of these effects conducted by Stillwater Sciences (2008, 2009a, 2009b):

1. Select appropriate focal species for the analysis;
2. Use the model to predict SSC regimes for a) existing conditions/No Project Alternative, and b) the Proposed Project;
3. Describe the potential effects of predicted SSCs on the various life stages of each focal species using available information; and
4. Evaluate the potential consequences of SSC for focal species' populations under existing conditions and the Proposed Project.

E.2.1 Focal Species Selection

Focal species selected for the analysis were expected to meet the following criteria:

1. Species historically native to, and still found within the Klamath Basin downstream from Iron Gate Dam, and within the area of primary effect (i.e., upstream of the confluence with Trinity River);
2. Species that are listed or proposed for listing under the federal or state Endangered Species Acts;
3. Species without special regulatory status that meet other criteria, such as: species having high economic or public interest value, species believed to be important interactors within the affected ecosystem ("key species"), species believed to be

strong indicators of the overall health of aquatic communities ("indicator species"), or those whose presence is believed to reflect habitat conditions for a large suite of species ("umbrella species"); and

4. Species for which sufficient information is available to allow at least a qualitative assessment of their response to increases in SSCs.

Based on this vetting process, the following focal species were selected for the suspended sediment analysis:

- Chinook salmon (fall- and spring-runs)
- coho salmon
- steelhead (summer and fall/winter runs)
- Pacific lamprey
- green sturgeon

E.2.2 Using the Model to Predict Suspended Sediment Concentrations

Predictions of SSCs used in this analysis were based on the sediment transport model, which:

1. Predicts daily SSC as a continuous time series following facility removal; and
2. Predicts the downstream dilution of SSC at important locations within the distributions of the focal species where gauging data are available, including Iron Gate Dam, Seiad Valley, Orleans, and Klamath Station.

The model was used to predict the magnitude and duration of SSCs for discrete calendar-year periods corresponding to each species' life history stages. These periods could not overlap in order to avoid erroneously accounting for an event's impact on two separate life stages of a cohort at the same time, which is impossible (e.g., a pulse of suspended sediment in March cannot simultaneously affect rearing juveniles and outmigrating smolts of the same cohort, but can simultaneously affect different life history stages of different species such as adult migrants of one species and smolts of another. For predicting potential SSC impacts to species identified above, the model evaluated each species and its life history stages separately.

E.2.2.1 Range of Conditions Assessed

Modeling results are very sensitive to hydrology. Effects on individual species (discussed below) during winter are predicted to be more severe during a dry year when sediment releases will be less diluted by surface flows. Effects during spring are more severe during a wet year, when it is predicted that under the Proposed Project the reservoirs could re-fill during winter, delaying the release of SSC until they drop during spring (USBR 2012). Daily durations of SSC concentrations were modeled assuming the Proposed Project occurred within each of the 49 years in the available hydrology record (1961 through 2009). During this 49 years of record all hydrological conditions are represented, including extremely wet years, and multiple extreme drought years of equal magnitude to that which occurred more recently (e.g., 2014). The results of modeling all potential years were summarized for each life-stage of each species assessed.

Because the SSC varies with hydrology, and in order to account for (and compare) the range of results and impacts that might occur under each alternative, three scenarios were analyzed for existing conditions/No Project Alternative, and for the Proposed Project, with the goal of predicting the potential impacts to fish that has either a 90 percent (least impacts on fish), 50 percent (likely to occur) or 10 percent (worst impacts on fish) probability of occurring, defined as follows:

For Existing Conditions/No Project Alternative:

- **Median conditions for fish:** This scenario represents the conditions that most often occur for each species and life stage—that is to say, SSCs and durations with a 50 percent exceedance probability for the mainstem Klamath River downstream from Iron Gate Dam. This means that under existing conditions there is an equal chance that the SSCs will be higher or lower than described. Exceedance probabilities were based on modeling SSCs for all water years from 1961 to 2009 with facilities in place.
- **Mild conditions for fish:** This scenario represents mild conditions of the potential sediment-related impacts to a species and life stage. It uses suspended sediment concentrations and durations with a 90 percent exceedance probability. This means that under this rare mild conditions for fish scenario the probability of these concentrations and durations being equal to or less than this level for each assessed species and life-stage in any one year is 10 percent, and the probability of them being exceeded is 90 percent.
- **Extreme conditions for fish:** This scenario represents extreme conditions for fish from potential sediment-related impacts. It uses SSCs and durations with a 10 percent exceedance probability. This means that under this rare extreme conditions for fish scenario the probability of these concentrations and durations being equal to or greater than this level for each assessed species and life-stage in any one year is 10 percent, and the probability of them being less than this level is 90 percent.

For the Proposed Project:

- **Most-likely impacts on fish:** This scenario represents the conditions that are most likely to occur for each species and life stage—that is to say, SSCs and durations with a 50 percent exceedance probability for the mainstem Klamath River downstream from Iron Gate Dam. This means that there is an equal chance that the SSCs will be higher or lower than described. Exceedance probabilities were based on modeling SSCs for all water years from 1961 to 2009 under the Proposed Project.
- **Least impacts on fish:** This scenario represents the least impacts on fish from potential sediment-related impacts to a species and life stage. It uses suspended sediment concentrations and durations with a 90 percent exceedance probability. This means that under this rare least impacts on fish scenario the probability of these concentrations and durations being equal to or less than this level for each assessed species and life-stage in any one year is 10 percent, and the probability of them being exceeded is 90 percent.
- **Worst impacts on fish:** This scenario represents the worst impacts on fish of potential sediment-related impacts to the species. It uses SSCs and durations with a 10 percent exceedance probability. This means that under this rare worst impacts on fish scenario the probability of these concentrations and durations

being equal to or greater than this level for each assessed species and life-stage in any one year is 10 percent, and the probability of them being less than this level is 90 percent.

By definition, the "median conditions for fish" and "most-likely impacts on fish" scenarios described above use a median (50 percent) threshold of analysis, which means that for any given fish species and life-stage there are numerous (approximately half) corresponding water years in the modeled hydrologic record during which the predicted median SSCs and associated exposure durations would occur. However, there may be few instances in the modeled 49-year hydrologic record in which the median condition would occur in the same water year for multiple life-stages of a given species (e.g., three years [6 percent] for spring-run Chinook salmon smolts and adults), and even fewer instances in which the median condition would occur in the same water year for multiple species and life-stages (e.g., one year [2 percent] for fall-run Chinook salmon smolts and coho salmon smolts).

The "mild conditions for fish" and "least impacts on fish" scenarios described above use a 90 percent threshold of analysis, which means that for any given species and life-stage the predicted low SSC and duration is infrequent, and SSCs would be higher would be higher nearly all (90 percent) of the water years in the modeled hydrologic record. There are even fewer instances in which the low SSCs condition would occur in the same water year for multiple life-stages of a given species (e.g., four years [8 percent] for spring-run Chinook salmon smolts and adults), and few instances (< 0.5 percent) in which the low SSCs condition would occur in the same water year for multiple species and life-stages.

Similarly, by definition, the "extreme conditions for fish" and "worst impacts on fish" described above use a 10 percent threshold of analysis, which means that for any given species and life-stage there are only a few corresponding water years in the modeled hydrologic record during which the predicted high SSCs and associated exposure durations would occur. There are few instances in which the high SSCs condition would occur in the same water year for multiple life-stages of a given species (e.g., two years [4 percent] for coho salmon smolts and adults), and few instances (< 0.5 percent) in which the high SSCs condition would occur in the same water year for multiple species and life-stages.

Overall, this analysis framework was chosen to allow for a more meaningful assessment of the potential impacts of predicted SSCs and exposure durations specific to the species and life-history stage that would experience them, rather than applying a set of predicted SSCs and exposure durations associated with a particular water year and potentially exaggerating or understating the range of possible conditions experienced by any one species and/or life-stage under the Proposed Project and the alternatives.

E.2.3 Effects Analysis

Based on a review of the scientific literature, the most commonly observed effects of suspended sediment on salmonids include: (1) avoidance of turbid waters in homing adult anadromous salmonids, (2) avoidance or alarm reactions by juvenile salmonids, (3) displacement of juvenile salmonids, (4) reduced feeding and growth, (5) physiological stress and respiratory impairment, (6) damage to gills, (7) reduced tolerance to disease and toxicants, (8) reduced survival, and (9) direct mortality (Newcombe and Jensen

1996). Information on both concentration and duration of suspended sediment is necessary for understanding the potential severity of its effects on salmonids (Newcombe and MacDonald 1991). Herbert and Merkens (1961) stated that "there is no doubt that many species of fresh-water fish can withstand extremely high concentrations of suspended solids for short periods, but this does not mean that much lower concentrations are harmless to fish which remain in contact with them for a very long time." Effects of suspended sediment on fish may be exacerbated if pollutants or other stressors (e.g., water temperature, disease) are present as well. Turbidity can function as cover to reduce predation at some life stages, not only in riverine, but also in estuary and nearshore marine environments (Gregory and Levings 1998, Wilber and Clarke 2001, Gadomski and Parsley 2005). Some species have been shown to be attracted to turbid water over clear, which may reflect its use as cover (Gradall and Swenson 1982, Cyrus and Blaber 1992, both as cited in Wilber and Clarke 2001). This analysis will consider these other factors qualitatively, but not quantitatively, in assessing the effects of a sediment pulse to the population.

Determining the concentrations that cause direct lethal effects in salmonids has generally been based on laboratory studies experimenting with exposures to concentrations of suspended sediment over 1,000 mg/l and usually much higher. According to Sigler et al. (1984), "yearling and older salmonids can survive high concentrations of suspended sediment for considerable periods, and acute lethal effects generally occur only if concentrations exceed 20,000 ppm [i.e., 20,000 mg/L] (see e.g., review by Cordone and Kelly 1961)." At very high concentrations (e.g., 20,000 to 30,000 mg/l), juvenile salmon may survive short-term exposures (48 hours one study), but their survival may be subsequently affected by slower response times for seeking cover and avoiding predators (Korstrom and Birtwell 2006). Based on the results of laboratory studies, it appears that relatively short-term (days rather than weeks) exposures to increases in suspended sediment concentrations under 500–600 mg/l would not likely result in substantial direct mortality to either juvenile or adult anadromous salmonids in the Klamath River. If the duration of exposure is extended for weeks or months, however, direct mortality (10–20 percent of individuals exposed) is expected (Newcombe and Jensen 1996).

Potential population-level effects of suspended sediment released from dam removal activities for a given species not only depend on their abundance, distribution, and life stages present, but also on the timing, duration, and concentration of suspended sediment released. In this analysis, the results of Newcombe and Jensen (1996) were used to assess impacts of SSC on aquatic species. Newcombe and Jensen (1996) reviewed and synthesized 80 published reports of fish responses to suspended sediment in streams and estuaries and established a set of equations to calculate "severity of ill effect" indices (Table E-1) for various species and life stages based on the duration of exposure and concentration of suspended sediment present. The severity of ill effects provides a ranking of the effects of SSC on salmonid species, as calculated by any of six equations that address various taxonomic groups of fishes, life stages of species within those groups, and particle sizes of suspended sediments.

Assessing the potential effects of suspended sediment on anadromous fish species required identifying the spatial and temporal distribution of each life stage in the Klamath Basin relative to the expected areas of elevated suspended sediment. For each focal species and life stage, potential effects were determined by evaluating the magnitude and duration of SSC predicted by the model for the mainstem Klamath River at times

and locations where the life stage of any focal species is likely to be present. For salmonids, Newcombe and Jensen's (1996) Severity of Ill Effects (SEV) table (Table E-1) was used to rate the severity of exposure to suspended sediment. Newcombe and Jensen (1996) collected data on fish effects (on the SEV scale), suspended-sediment concentration (C in mg/L), and suspended-sediment exposure time (D in hr), from a large number of papers dealing with many salmonid fishes at various life stages. Newcombe and Jensen (1996) fit models of the form $SEV = b_0 + b_1 \log C + b_2 \log D$ to these data for adults, juveniles, and eggs/alevins life stages, where "*b*" are terms for regression coefficients based on selection of the best performing model. These data all appear to consider constant concentration values. However, for this application the effects of concentration levels, which change over the exposure period, are evaluated. Following Newcombe and MacDonald (1991), models of the form $SEV = b_0 + b_1 \log(CD)$ are applied to varying concentrations by replacing the term CD with the integral of concentration over time to accurately predict SEV when concentrations fluctuate over the period being assessed.

Table E-1. Scale of the Severity of Ill Effects Associated with Elevated Suspended Sediment (based on Newcombe and Jensen 1996).

Severity	Category of Effect	Description of Effect
0	Nil effect	No behavioral effects
1	Behavioral effects	Alarm reaction
2		Abandonment of cover
3		Avoidance response
4	Sublethal effects	Short-term reduction in feeding rates Short-term reduction in feeding success
5		Minor physiological stress: Increase in rate of coughing Increased respiration rate
6		Moderate physiological stress
7		Moderate habitat degradation Impaired homing
8		Indications of major physiological stress: Long-term reduction in feeding rate Long-term reduction in feeding success Poor condition
9	Lethal effects	Reduced growth rate: Delayed hatching Reduced fish density
10		0–20 percent mortality Increased predation of effected fish
11		>20–40 percent mortality
12		>40–60 percent mortality
13		>60–80 percent mortality
14		>80–100 percent mortality

The result of this approach is a location, species, and life-stage specific prediction of the SEV for each year in the hydrologic record using the SSC predictions of USBR (2012). For example, Figure E-1 shows the SEV results for all years for dam removal years 1 and 2 for adult salmon with a rolling 30-day exposure (typical migration duration) at Iron Gate Dam.

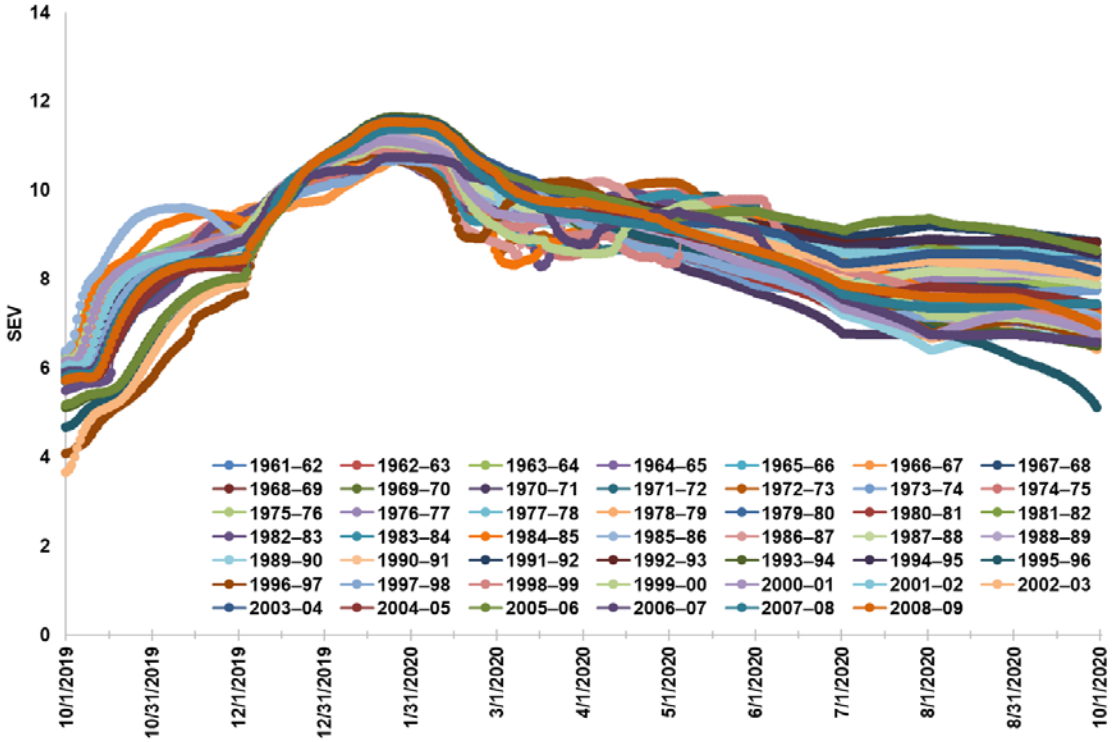

Figure E-1. Example SEV Values Assuming a 30-day Exposure at Iron Gate Dam, based on the SSC Predictions using the SRH-1D Model.

To assess the least impacts on fish, most-likely impacts on fish, or worst impacts on fish scenario, SSCs and durations were predicted for all years in the record. In addition, for the time-period each life stage was assessed, it was assumed that species would encounter either the lowest, highest, or median SSC concentration during that period. For example (and as described in detail for each species), smolts of some species outmigrating from tributaries have been observed to alter behavior (e.g., delay and avoidance) in response to poor water quality conditions are assumed to delay migration in response to high SSC concentration until SSC decrease, and thus will be exposed to the lowest SSCs during the period of their typical peak in outmigration, whereas fish spawning in the mainstem will be unable to avoid the highest concentrations during the period. As an example, Figure E-2 shows the median results for adult coho salmon migrating to tributaries downstream of Iron Gate Dam (SSC predications at Seiad Valley), based on their life history timing and assuming that based on behavioral response adults would be able to avoid the highest peaks in SSC. The best (90

percent), most-likely (50 percent), and worst impacts on fish scenarios (10 percent) can be interpreted based on the exceedance values.

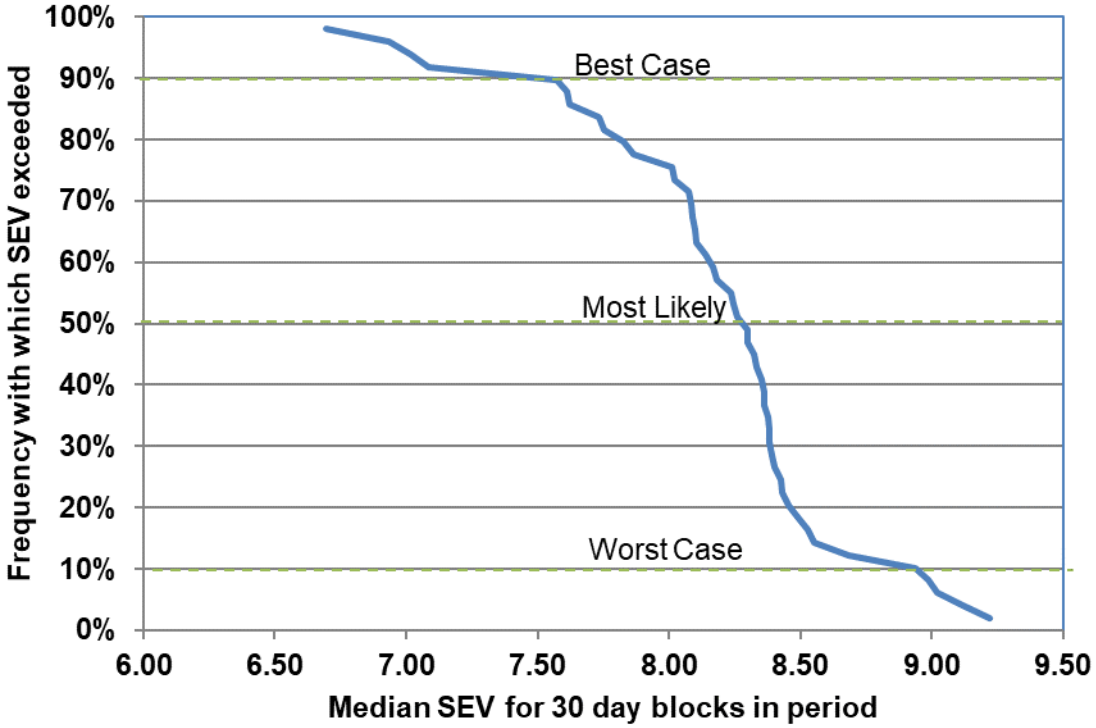

Figure E-2. Example SEV exceedance for a 30-day Coho Salmon Adult Migration.

Wherever possible, effects were quantified based on the percentage of the cohort predicted be in the mainstem during suspended sediment events, considering both spatial distribution (proportion of the life stage expected to be in the mainstem compared to tributaries and proximity to Iron Gate Dam) and life-history timing (proportion of the population expected to be present during period of effect).

The indices used by Newcombe and Jensen (1996) have become a standard for selecting management-related turbidity and suspended sediment criteria (e.g., Walters et al. 2001), and their report remains the best available source for determining effects of SSC on salmonids (Berry et al. 2003). However, there are inherent sources of uncertainty in this application of the model. Newcombe and Jensen (1996) base much of their analysis on laboratory studies that were conducted in controlled environments over short-durations, mostly examining acute lethal impacts of non-fluctuating concentrations of suspended sediment. This analysis is a relatively complex application of the Newcombe and Jensen (1996) model, in that temporal variation in SSC within periods is captured by summing continuous days of exposure to suspended sediment. This means that three occurrences of exposure to extreme sediment each lasting for two days can be, for example, equivalent to a SEV predicted for 6 continuous days. How the actual outcome will vary from predictions is uncertain. In addition, Newcombe and Jensen (1996) do not explicitly address the translation of sublethal severity levels into population-level effects. As Gregory et al. (1993) note in their criticism of the SEV stress model (first presented by Newcombe and MacDonald 1991), the approach simplifies the

effects of suspended sediment and in doing so assumes all effects of suspended sediment are negative, despite literature to the contrary. Assuming only negative effects of elevated SSCs exaggerates the effects of suspended sediment, particularly for lower concentrations and durations of exposure. Although the predictions of mortality at high concentrations and durations of exposure are considered more certain than the predictions of sublethal effects, in this application sublethal effects resulting from exposure to lower concentrations are included because of the concern that sublethal impacts of suspended sediment could be lethal when occurring in conjunction with the already stressed condition of some species and life-stages from water temperature (Bozek and Young 1994) and disease.

Because of their relative importance within the watershed, potential impacts of SSC on Pacific lamprey (*Lampetra tridentata*) and green sturgeon (*Acipenser medirostris*) were assessed. However, little scientific literature exists regarding the effects of SSC on these species. The models developed by Newcombe and Jensen (1996) for assessing impacts to non-salmonids were used in this analysis to assess effects on Pacific lamprey and green sturgeon, in conjunction with discussions with experts (documented in Section E.3.1.6) regarding the potential effects.

E.3 Results

E.3.1 Existing Conditions

Information on sediment transport within the Klamath Basin is available from Stillwater Sciences (2010) and USBR (2012). The current supply of coarse and fine sediment can be summarized, as follows:

- Upstream of Keno Dam, sediment supply to the Klamath River is minimal due to deposition in Upper Klamath Lake, which captures nearly all sediment entering from its tributaries.
- Between Keno Dam and Iron Gate Dam, total average annual sediment delivery is an estimated 200,000 tons/year.
- Downstream from Iron Gate Dam, the Scott, Salmon, and Trinity rivers supply approximately 607,000 tons/year; 320,000 tons/year; and 3.3 million tons/year, respectively.

Appendix C.2 *Suspended Sediments* summarizes suspended sediment concentrations under existing conditions in the Klamath River upstream and downstream from Iron Gate Dam. Historical (1950 to 1979) SSC for the Klamath River at Orleans (RM 58.9) (USGS gage no.11523000) range from less than 5 mg/L during summer (low-flow) periods to greater than 5,000 mg/L during winter (high-flow) periods, although some high (>1,000 mg/L) suspended sediment events have occurred during summer months (e.g., 1974, see Figure C-15 in Appendix C). To assess existing conditions daily SSC were modeled for water years 1961–2009 (USBR 2012).

E.3.1.1 Fall-run Chinook Salmon

Fall-run Chinook salmon range throughout the Klamath River and its tributaries downstream from Iron Gate Dam. The Upper Klamath and Trinity Rivers ESU is listed as a CDFW Species of Special Concern and a USDA Forest Service Sensitive Species. The largest number of spawners are found in the Trinity River (36 percent), Bogus Creek

(11 percent), Shasta River (7 percent), Scott River (7 percent), and the Salmon River (3 percent), based on escapement data collected from 1978 to 2002 (FERC 2007). They also spawn in the mainstem Klamath River (approximately 8 percent on average), with the highest densities of redds found between Iron Gate Dam (River Mile [RM] 193.1) and the confluence with the Shasta River (RM 179.5) (Magneson 2006). Incubation for Chinook salmon, with typical water temperature in the mainstem Klamath River, requires approximately 90 days (Velsen 1987).

Fall-run Chinook salmon in the Klamath Basin exhibit three juvenile life-history types: Type I (ocean entry at age 0[10] in early spring within a few months of emergence), Type II (ocean entry at age 0 in fall or early winter), and Type III (ocean entry at age 1 in spring) (Sullivan 1989). Based on outmigrant trapping at Big Bar on the Klamath River from 1997 to 2000, 63 percent of natural Chinook salmon outmigrants are Type I, 37 percent are Type II, and less than 1 percent are Type III (Scheiff et al. 2001). Although, trapping efforts are not equal among seasons, the results are consistent with scale analysis of adult returns by Sullivan (1989). Large numbers of fry from the Shasta River, Scott River, and Hunter and Blue creeks move into the mainstem Klamath River in spring (Jetter and Chesney 2016), where they may continue to rear before outmigrating to the ocean (Chesney 2000, Chesney and Yokel 2003). Few age-0 juveniles are observed in the mainstem Klamath River or Trinity River in the fall; most have probably already outmigrated in early fall as Type II smolts.

Fall-run Chinook salmon typically migrate upstream in late summer and early fall when SSCs are usually very low in the Klamath River, resulting in minor behavioral effects to avoidance under most conditions. Spawning typically peaks in late October and substantially declines by the end of November (Shaw et al. 1997). Based on the propensity of fall-run Chinook salmon to spawn upstream of the Shasta River confluence and downstream of Iron Gate Dam, the analysis is based on modeling results from Iron Gate Dam Station. The SRH-1D SSC modeling analysis does not account for stress or mortality that might result from infiltration of fine sediment into the channel bed because no suitable measurements or models were available with which to calculate this component. However, it is well documented that fine sediment can infiltrate spawning gravel and reduce survival of salmonid eggs (Newcomb and MacDonald 1991). Under mild and median conditions for fish, exposure to suspended sediment in the mainstem is predicted to result in delayed growth and possibly low levels of mortality for eggs, alevins, and fry (Table E-2), but may cause 20 to 40 percent mortality under extreme conditions for fish (Table E-2) as well as downstream from the Shasta River confluence, where SSCs would be expected to be higher due to accretion from tributary streams.

Most fry produced by fall-run Chinook salmon in the Klamath River exhibit the Type I life history, in which they enter the ocean within a few months of emergence in early spring. Juveniles that are progeny of mainstem spawning rear in the mainstem during late winter prior to outmigration and are anticipated to have behavioral effects to minor physiological stress depending on conditions (Table E-2). Jetter and Chesney (2016) report that between 2001 and 2016 Type I outmigration from the Shasta and Scott rivers occurred primarily between February and June. Numerous field and laboratory studies have shown that juvenile salmonids actively avoid exposure to high (greater than 150 mg/l) SSC, including altering migratory patterns to seek lower turbidity (Bisson and Bilby 1982,

[10] A fish emerging in spring is designated as age 0 until January 1st of the following year, when it is designated as age 1 until January 1st of the next year, when it is designated age 2.

Berg and Northcote 1985, Redding et al. 1987, Servizi and Martens 1992, Bash et al. 2001, Carlson et al. 2001, Kemp et al. 2011, Kjelland et al. 2015). Therefore, it was assumed that Chinook salmon outmigration during dam removal year 2 will occur within the period of typical outmigration with the lowest predicted SSC. Based on the location of the majority of outmigration from Shasta River and tributaries downstream, the analysis is based on modeling results from Seiad Valley station. Using radio-tag data, Foott et al. (2009) reported that it took hatchery Chinook smolts a median of 10.2 days to travel the 184 miles from Iron Gate Dam to Blake's Riffle (RM 8). Wallace (2004) reported that it took radio-tagged hatchery Chinook smolts a median of 30–34 days (range 13–109 days) to travel from the hatchery to the estuary. Based on these studies, the analysis assumed a maximum duration of exposure to suspended sediment during migration of 30 days at Seiad Valley. Under existing conditions, suspended sediment in the mainstem is predicted to be at concentrations resulting in minor to major physiological stress for Type I fry during their 30-day migration depending on conditions. In either scenario, this exposure, although not predicted to result in direct mortality, could indirectly affect survival by reducing growth and thus the size at which the smolts enter the ocean (Bilton 1984). Exposure to disease or elevated temperatures in the mainstem Klamath River would likely result in the mortality of some portion of these fish. The parr-smolt transformation can also be compromised in stressed juveniles (Bash et al. 2001), which could increase mortality.

Table E-2. Predicted Newcombe and Jensen Severity Index and Anticipated Effects on Fall-run Chinook Salmon in the Klamath River at Iron Gate Dam[1] and Seiad Valley[2].

Life-history Stage (period)	SEV at Conditions			Effects on Production
	Mild[1]	Median[2]	Extreme[3]	
Adult upstream migrants (July 15–Oct 31) Exposure to median SSC for the period	2.5	3.3	3.8	Behavioral effects such as alarm reaction or avoidance under most conditions
Spawning, incubation, and fry emergence (Oct 15–Feb 28) 90 days of exposure to highest SSC for the period	9.8	10.6	11.5	Effects of suspended sediment on egg survival were not modeled; however, long duration of exposure could result in delayed growth to greater than 20 to 40 percent mortality depending on conditions. ~8 percent of adults spawn in the mainstem downstream from Iron Gate Dam.
Juvenile rearing (Jan 1–Mar 28) 30 days of exposure to highest SSC for the period	5.9	6.9	7.6	Minor to major stress depending on conditions
Type I outmigration (Feb 1–August 1) 30 days of exposure to lowest SSC for the period	5.2	6.2	7.3	Minor to moderate physiological stress and reduced growth depending on conditions. Applies to ~60 percent of total production.

Life-history Stage (period)	SEV at Conditions			Effects on Production
	Mild[1]	Median[2]	Extreme[3]	
Type II outmigration (Sept 1–Nov 30) 30 days of exposure to lowest SSC for the period	3.8	5.0	5.7	Behavioral effects such as avoidance to minor physiological stress depending on conditions. Applies to ~40 percent of total production.
Type III outmigration (Feb 1–April 15) 30 days of exposure to lowest SSC for the period	7.2	7.9	8.6	Moderate stress to reduced growth depending on conditions for Type III (yearling) outmigrants (<1 percent of production)

[1] Adult migration, spawning, incubation, and fry emergence life stages
[2] Juvenile rearing and outmigration life stages
[3] Mild conditions for fish = 90 percent exceedance probability
[4] Median conditions for fish = 50 percent exceedance probability
[5] Extreme conditions for fish = 10 percent exceedance probability

The Type II life-history is also common among Klamath River fall-run Chinook. These juveniles remain to rear in the tributaries in which they were spawned (Section 3.3.3.1) and are only exposed to suspended sediment in the mainstem Klamath River on their outmigration to the ocean in the fall, when SSCs are lowest. Under existing conditions, avoidance behavior (under mild or median conditions for fish) to minor physiological stress (under extreme conditions for fish) are predicted for Type II life-history fish. Additional factors such as disease or elevated temperatures in the lower Klamath River are less likely to increase the impacts of suspended sediment on Type II life-history fish than for other life-history types, because neither disease or water temperature are problems in the Klamath River mainstem during the fall when Type II smolts outmigrate.

Type III life-history fish are relatively rare less than one percent of all production) in the Klamath River fall-run Chinook population (USFWS 2001), although based on Sullivan (1989) these larger smolts can contribute approximately 4 percent of the escapement. These fish typically remain to rear in the spawning tributaries until outmigrating in late winter and early spring as yearlings. The model predicts that suspended sediment would cause moderate (under mild conditions for fish) to major physiological stress (under median conditions for fish), and growth could be affected in extreme conditions for fish.

Overall, fall-run Chinook salmon use the mainstem Klamath River for spawning, rearing, and as a migratory corridor. SSCs under existing conditions can be high (>500 mg/L) in the mainstem Klamath River, resulting in reduced growth of alevins, and low levels of mortality in some years with poor water quality conditions. SSCs and durations during upstream and downstream migration, even under extreme conditions for fish, are low enough that effects are limited to physiological stress and possibly reduced growth rates. In general, fall-run Chinook salmon appear relatively resilient to current suspended sediment conditions because of their limited use of the mainstem Klamath River for spawning and rearing, and the fact that smolt outmigration primarily occurs when SSCs are naturally low (< 200 mg/l).

E.3.1.2 Spring-run Chinook Salmon

Spring-run Chinook salmon spawn primarily in the Salmon and Trinity rivers, with the vast majority (approximately 95 percent) spawning in the Trinity River; therefore, the review of existing conditions focuses on potential exposure to suspended sediment in the mainstem Klamath River downstream from the Salmon River. The Upper Klamath and Trinity Rivers ESU is listed as a CDFW Species of Special Concern and a USDA Forest Service Sensitive Species.

Sediment-transport model predictions for suspended sediment and associated effects on spring-run Chinook salmon under varying conditions are summarized in Table E-3. Adult spring-run migrants returning to the Salmon River may be exposed to SSCs that cause impaired homing (under mild to median conditions for fish) to major stress (under extreme conditions for fish). Adult spring-run Chinook migrating to the Trinity River may only be exposed to suspended sediment in the mainstem Klamath River for about a week, and about two weeks for those migrating to the Salmon River (Strange 2007a, 2007b, 2008).

Table E-3. Predicted Newcombe and Jensen Severity Index and Anticipated Effects on Spring-run Chinook Salmon under for Klamath River at Orleans (RM 60).

Life-history Stage (period)	SEV at Conditions			Effects on Production
	Mild[1]	Median[2]	Extreme[3]	
Adult spring migration (Apr 1–June 30) 14 days of exposure to median SSC for the period	7.2	7.8	8.3	Impaired homing to major physiological stress for adults returning to Salmon River. Majority (~95 percent on average) of adults enter Trinity River and would be exposed to higher concentrations for shorter durations. However, up to 35 percent of "natural" escapement returns to Salmon River.
Adult summer migration (Jul 1–Aug 31) 2 days of exposure to median SSC for the period	4.3	4.8	5.4	Behavioral to minor physiological stress to the ~50 percent of the summer migration returning exclusively to the Trinity River.
Spawning, incubation, and fry emergence (Sept 1–Feb 28)	No effect	No effect	No effect	Spring-run do not generally spawn in the mainstem; no effect to this life stage is anticipated.
Juvenile rearing (variable)	No effect	No effect	No effect	Juveniles primarily rear in tributaries; no effect is anticipated.
Type I outmigration (Apr 1–May 31) 30 days of exposure to lowest SSC for the period	7.3	7.9	8.4	Moderate to major stress for Type I fry (~80 percent of production) in smolt outmigration from Salmon River. Majority (~95 percent) of juveniles outmigrate from Trinity River and are exposed to higher concentrations.

Life-history Stage (period)	SEV at Conditions			Effects on Production
	Mild[1]	Median[2]	Extreme[3]	
Type II outmigration (Oct 1–Nov 15) 30 days of exposure to lowest SSC for the period	5.2	6.0	6.5	Minor to moderate stress for Type II smolts from the Salmon River (~20 percent) during downstream migration. Majority (~95 percent) of juveniles outmigrate from Trinity River and are exposed to higher concentrations.
Type III outmigration (Jan 15–May 31) 30 days of exposure to lowest SSC for the period	7.1	7.6	8.3	Moderate to major stress for Type III fry from Salmon River (<1 percent) during downstream migration. Majority (~95 percent) of juveniles outmigrate from Trinity River and are exposed to higher concentrations for shorter durations. Outmigrate from Trinity River and are exposed to higher concentrations for shorter durations.

[1] Mild conditions for fish = 90 percent exceedance probability
[2] Median conditions for fish= 50 percent exceedance probability
[3] Extreme conditions for fish = 10 percent exceedance probability

In some years, later-arriving adults have been observed to delay migration upon encountering high water temperatures in the mainstem Klamath River (greater than 22°C) and hold in the river for up to 30 days before continuing on to their spawning streams (Strange 2007a, 2007b, 2008). These fish could be exposed to elevated SSCs for longer durations, particularly in years with extreme conditions for fish. Stressed adults are assumed to be more susceptible to disease, possibly increasing pre-spawn mortality, unless exposure causes avoidance behavior and early entrance into tributary habitat as was observed for upstream-migrating fall-run Chinook and coho salmon (*Oncorhynchus kisutch*) adults during the September 2002 fish kill in the lower Klamath River (M. Belchik, Senior Biologist, Yurok Tribe, pers. comm., 2008). Among radio-tagged adult spring-run Chinook, these later-returning migrants have been observed to have the highest mortality rates (Strange 2007a, 2007b, 2008). In contrast, approximately half of the observed spring-run Chinook salmon adults make a relatively rapid summer migration (approximately 2 days in the Klamath River) to the Trinity River, at a time of year in which suspended sediment is naturally low.

Since no spring-run Chinook salmon spawning occurs in the mainstem Klamath River under existing conditions, incubating eggs, developing alevins, and emergent fry are not anticipated to be affected by suspended sediment in the mainstem Klamath River.

There appear to be three juvenile life-history types for spring-run Chinook salmon in the Klamath Basin: Type I (ocean entry at age 0 in early spring within a few months of emergence), Type II (ocean entry at age 0 in fall or early winter [Olson 1996]), and Type III (ocean entry at age 1 in spring) (Sullivan 1989). Based on outmigrant trapping in the Salmon River from 2001 to 2006 (Karuk Tribe, unpubl. data), approximately 80 percent of outmigrants are Type I, 20 percent are Type II, and less than 1 percent are Type III. Rearing of age-0 juveniles likely occurs to some extent in the mainstem Klamath River, although it appears that the majority remain to rear in their natal streams (i.e., Salmon

and tributaries to the Trinity rivers). It is unclear to what extent juvenile spring-run Chinook rear in the mainstem Trinity and Klamath rivers as trapping studies do not differentiate between the spring- and fall-runs.

Numerous field and laboratory studies have shown that juvenile salmonids actively avoid exposure to high (> 150 mg/l) SSC, including altering migratory patterns to seek lower turbidity (Bisson and Bilby 1982, Berg and Northcote 1985, Redding et al. 1987, Servizi and Martens 1992, Bash et al. 2001, Carlson et al. 2001, Kemp et al. 2011, Kjelland et al. 2015). Therefore, it was assumed that Chinook salmon outmigration during dam removal year 2 will occur within the period of typical outmigration with the lowest predicted SSC. Most late-winter rearing of Type I and II juveniles is thought to occur in tributaries (West 1991, Dean 1994, 1995), reducing the likelihood of exposure to suspended sediment in the mainstem Klamath River. Type I juveniles migrate downstream to the mainstem and ocean in April and May. Based on radio-tagging studies of Chinook salmon smolt travel times (Wallace 2004), a maximum of 30 days is assumed for exposure of outmigrating smolts. Exposure to suspended sediment during Type I smolt outmigration is anticipated to result in moderate (under mild or median conditions for fish) to major physiological stress (under extreme conditions for fish). This exposure, in association with other environmental factors in the basin (e.g., water temperatures, exposure to disease), could lead to sublethal or lethal effects, although data is not available to estimate potential mortality. The Type II outmigration pattern is common (~20 percent), with juveniles departing from the Salmon River in the fall when suspended sediment downstream from the Salmon River is predicted to cause minor (under mild conditions for fish) to major physiological stress (under median or extreme conditions for fish). Age-1 juveniles of the Type III life history outmigrating during winter and early spring may be exposed to SSCs causing moderate (under mild or median conditions for fish) to major physiological stress (under extreme conditions for fish).

E.3.1.3 Coho Salmon

In order to evaluate the effects of suspended sediment on coho salmon in the Klamath River, the historical population structure of Southern Oregon Northern California Coast coho salmon presented in Williams et al. (2006) was used, as described in Section 3.3.2.1 *Aquatic Species [Coho Salmon]*. Williams et al. (2006) identifies nine populations within the Klamath River, including the Upper Klamath River, Shasta River, Scott River, Salmon River, Mid-Klamath River, Lower Klamath River, and three population units within the Trinity River watershed (Upper Trinity River, Lower Trinity River, and South Fork Trinity River population units). Southern Oregon Northern California Coast coho are listed as threatened under the ESA. Effects of SSC on distinct population units are differentiated where appropriate.

Coho salmon are distributed throughout the Klamath River downstream from Iron Gate Dam, and spawn primarily in tributaries (Trihey and Associates 1996, NRC 2004). Rearing has also been observed in tributary confluence pools in the mainstem Klamath River (NRC 2004). During their upstream migration, adult coho salmon from the Upper Klamath River Population Unit may travel upstream as far as Iron Gate Dam (RM 193.1) and were formerly known to occupy mainstem Klamath River and tributary habitat at least as far upstream as Spencer Creek at RM 232.6 (NRC 2004, as cited in NMFS 2007). Thus, the mainstem Klamath River functions primarily as a migration corridor for coho salmon, but also likely provides rearing habitat and allows for movement of juvenile fish between tributaries. Based on radio telemetry data for five coho salmon adults

tagged in the Klamath River Estuary and tracked to upstream tributaries (Strange 2004), upstream migration is highly variable and averages approximately 33 days. Exposure to SSC in the mainstem Klamath River during migration was assumed to occur for 30 days.

The vast majority of coho salmon that spawn in the Klamath Basin are believed to be of hatchery origin. Indirect estimates indicate 90 percent of adult coho salmon in the system return directly to hatcheries or spawning grounds in the immediate vicinity of hatcheries (Brown et al. 1994). This analysis of SSC effects pertains to the adults and progeny of both hatchery-returning adults and those that spawn in the river, differentiating between the two where possible.

Upstream migration of adult coho salmon in the Klamath River spans the period from September to January, with peak movement occurring between late-October and mid-November. As this is the only period when adults are present in the mainstem Klamath River, it is also the only period when they would be exposed to elevated suspended sediment in the mainstem. Exposure is predicted to result in moderate stress (under mild conditions for fish), to impaired homing (under median conditions for fish), or major physiological stress (under extreme conditions for fish) (Table E-4). Adults from the Trinity River population units and the Lower Klamath River Population Unit likely receive less exposure to suspended sediment due to shorter migration times than for populations farther upstream.

Table E-4. Predicted Newcombe and Jensen Severity Index and Anticipated Effects on Coho Salmon for Klamath River at Seiad Valley (RM 132.7).

Life-history Stage (period)	SEV at Conditions			Effects on Production
	Mild[1]	Median[2]	Extreme[3]	
Adult upstream migrants (Sept 1–Jan 1) 30 days of exposure to median SSC for the period	6.6	7.2	8.5	Moderate to major stress and impaired homing for adults migrating upstream (~4 percent of all populations exposed).
Spawning, incubation, and fry emergence (Nov 1–Mar 14) 60 days of exposure to highest SSC for the period	11.6	12.2	12.9	No modeling of suspended sediment infiltration into gravel was conducted. Available information suggests 20 to 60 percent mortality of spawning adults, incubating eggs, and emergent fry in the mainstem; typically, a small percentage of the percent of the Upper Klamath River Population spawns in the mainstem as opposed to tributaries.
Age-1 juveniles during winter (Nov 15–Feb 14) Exposure to highest SSC for the period	7.4	8.7	9.9	Moderate to major stress and reduced growth rates depending on conditions for age 1 juveniles rearing the mainstem. An unknown but assumed small number of all juveniles (<1 percent) rear in mainstem during winter.

Life-history Stage (period)	SEV at Conditions			Effects on Production
	Mild[1]	Median[2]	Extreme[3]	
Age-0 juveniles during summer (Mar 15–Nov 14) Exposure to highest SSC for the period	8.8	9.5	10.2	Major stress to some mortality depending on conditions for age 0 juveniles rearing in mainstem.
Age 1 juvenile outmigration (Feb 15–May 31) 20 days of exposure to median SSC for the period	8.3	8.7	8.9	Moderate to major stress and reduced growth rates depending on conditions for smolts.

1 Mild conditions for fish = 90 percent exceedance probability
2 Median conditions for fish = 50 percent exceedance probability
3 Extreme conditions for Fish (10 percent exceedance probability

Spawning begins within a few weeks of fish arriving at their spawning grounds. Potential effects on the Upper Klamath River Population Unit spawning coho salmon in the mainstem Klamath River were evaluated based on SSC predictions for the period of November 1 to March 15 in the vicinity of Seiad Valley. Based on typical water temperatures in the mainstem Klamath River, incubation likely occurs within 60 days or less (Velsen 1987). The modeling analysis does not account for effects that might result from infiltration of fine sediment into the channel bed because no suitable measurements or models were available with which to calculate this component. However, cumulative effects of suspended sediment on spawning adults, incubating eggs, developing alevins, and emergent fry would result in low survival for any coho salmon spawning in the mainstem Klamath River under both normal and extreme conditions, with possibly up to 100 percent mortality under extreme conditions in the vicinity of Seiad Valley (Table E-4) and farther downstream. However, coho salmon are typically tributary spawners (NMFS 2010) and based on Magneson and Gough (2006) spawning surveys from 2001 to 2005, only from 6 to 13 redds are typically observed in the mainstem. In 2015 no redds were observed in the mainstem Klamath River between Portuguese Creek (RM 128) and Bogus Creek (RM 192.6) (Hentz and Wickman 2016), and seven were observed in 2017 in the same reach (Dennis et al. 2017). Due to the low number of redds observed in the mainstem Klamath River, it can be assumed that elevated suspended sediment during winter flows have only minimal effects on the Upper Klamath River Population Unit. In addition, it is believed by experts in the watershed that progeny of mainstem spawning coho salmon experience reduced survival compared to fish produced from tributary spawners (Simondet 2006), since rearing and growth conditions within tributaries are more favorable than in the mainstem Klamath River.

There may be wide variation in terms of how long juvenile coho salmon rear in natal tributaries versus the mainstem Klamath River, making it difficult to determine their exposure to elevated SSC in the mainstem. Numerous field and laboratory studies have shown that juvenile salmonids actively avoid exposure to high (> 150 mg/l) SSC, including altering migratory patterns to seek lower turbidity (Bisson and Bilby 1982, Berg and Northcote 1985, Redding et al. 1987, Servizi and Martens 1992, Bash et al. 2001, Carlson et al. 2001, Kemp et al. 2011, Kjelland et al. 2015). Therefore, it was assumed that coho salmon outmigration during dam removal year 2 will occur within the period of typical outmigration with the lowest predicted SSC. Some fry and age 0 juveniles enter the mainstem Klamath River in the spring and summer following emergence. These fish

may spend their remaining rearing period in the mainstem Klamath River, but by early fall, only low densities of juvenile coho salmon are found in the mainstem. The latter indicates that over-summer survival may be low due to high temperatures and exposure to disease in the mainstem Klamath River (NRC 2004). Even those that survive may experience reduced growth due to high summer temperatures, resulting in ocean entry at a smaller size and lower marine survival (Bilton et al. 1982, Hemmingsen et al. 1986). SSC modeling predicts that age 0 fish rearing in the mainstem Klamath River during winter would also be exposed to SSCs high enough to cause major physiological stress even under mild or median conditions for fish (Table E-4). Although some juveniles may rear in the mainstem Klamath River, most production from all population units probably results from fish that rear in tributaries.

Additional age 0 juveniles depart from tributaries in the Mid-Klamath and Salmon River population units (and possibly others) during fall (Soto et al. 2008, Hillemeier et al. 2009). Some of these have been observed to overwinter in tributaries and off-channel habitats in the lower mainstem Klamath River near or within the estuary (Soto et al. 2008, Hillemeier et al. 2009), which may reduce the amount of time they are exposed to suspended sediment in the mainstem.

Most juveniles from all population units appear to rear in tributaries or off-channel habitats during winter and are not affected by mainstem Klamath River pulses of suspended sediment until they migrate to the ocean as smolts, with the exception of potential migrations among tributaries (e.g., Ebersole et al. 2006). This seems to be the case for most naturally produced coho salmon, which depart tributaries from February through mid-June as age-1 smolts (Wallace 2004). During outmigrant trapping efforts from 1997 to 2006 in tributaries in the Upper-Klamath River, Shasta River, and Scott River populations, 44 percent of coho salmon smolts were captured from February 1 to March 31, and 56 percent from April 1 through the end of June (Courter et al. 2008). Once in the mainstem Klamath River, smolts move downstream fairly quickly. Stutzer et al. (2006) report a median migration rate for wild coho smolts of 13.5 miles/day (range -0.09–114 miles/day) and a median migration rate for hatchery smolts of 14.6 miles/day (range -2.3–27.8 miles/day). This equates to 14.3 days for wild smolts to travel the 193 miles from Iron Gate Dam to the estuary, and 13.2 days for hatchery smolts. Beeman et al. (2007) report even higher rates of travel: a median migration rate for wild smolts of 22.5 miles/day (range 2.9–113.9 miles/day) and 15.7 miles/day (range 1.9–122.0 miles/day) for hatchery smolts. At these rates, it would take an average of 7.6 days (range 1.5–59.8 days) for wild smolts to travel from Iron Gate Dam to the estuary and 10.9 days (range 1.4–91.8 days) for hatchery smolts. Based on these data, and the observed outmigration rates for Chinook salmon of approximately 30 days, a maximum of 20 days exposure to mainstem suspended sediment at Seiad Valley during migration was assumed for the analysis. Under normal or extreme conditions, SSC in the mainstem Klamath River during outmigration for all populations would remain in the sublethal range but could result in moderate or major physiological stress and inhibit feeding.

During experimental releases of wild and hatchery radio-tagged coho salmon smolts in the Klamath River near Iron Gate Dam, the fish sustained mortality rates of approximately 35 to 70 percent (Beeman et al. 2007, 2008). Variability in survival rates may be associated with: (1) the length of residency in tributaries prior to migrating (i.e., fish that enter the mainstem Klamath River later have higher survival), (2) mainstem discharge (migrants sometimes showed higher survival when flows in the mainstem

Klamath River were higher), or (3) spawning location (i.e., survival is much lower for smolts originating upstream of the Scott River). The relative contribution from SSC under existing conditions to these mortality rates is not known.

Overall, under existing conditions, SSC in the mainstem Klamath River are sufficiently high and of long enough duration that major physiological stress and reduced growth of coho salmon are anticipated in most years. Consistent with these findings, the Lower Klamath River downstream from the Trinity River confluence (RM 43.3) to the estuary mouth (RM 0.0) is listed as sediment impaired under Section 303(d) of the Clean Water Act (State Water Board 2006, North Coast Regional Board 2010). Relatively high SSC, in association with elevated water temperatures and disease may be contributing to the high smolt mortality that has been observed in the mainstem Klamath River (Beeman et al. 2007, 2008).

E.3.1.4 Steelhead

The following analysis and discussion apply to summer-, fall-, and winter-run steelhead (*Oncorhynchus mykiss*) (steelhead returning in the fall are sometimes lumped with the winter run) except where indicated. Because juvenile steelhead from various runs are indistinguishable from each other, the model assumes that steelhead from both the summer and winter runs share similar juvenile life-history patterns. The vast majority of existing information addresses steelhead rather than resident rainbow trout. This section primarily addresses steelhead, but it is reasonable to assume that effects of suspended sediment on resident steelhead would be similar to those found for juvenile steelhead.

Both summer and winter steelhead are distributed throughout the Klamath River and its tributaries downstream from Iron Gate Dam. Based on available escapement data, approximately 55 percent of summer steelhead spawn in the Trinity River and other lower-elevation tributaries. Most remaining summer steelhead are believed to spawn in tributaries between the Trinity River (RM 43.3) and Seiad Creek (RM 132), with high water temperatures limiting their use of tributaries farther upstream (NRC 2004). Winter steelhead spawn primarily in the Trinity, Scott, Shasta, and Salmon rivers.

Adult summer steelhead typically enter and migrate up the Klamath River from March through June (Hopelain 1998) and then hold in cooler tributary habitat until spawning begins in December (USFWS 1998). Summer steelhead in the Klamath River were reported by Hopelain (1998) to have a greater incidence of repeat spawning (40–64 percent) than the fall and winter runs, and a large proportion of adults are observed to migrate downstream to the ocean after spawning (also known as “runbacks”). Under mild and median conditions for fish, SSC would remain in the sublethal range during adult migration; however, concentrations may be high enough to cause avoidance, physiological stress, and possibly impaired homing during extreme conditions.

In contrast to summer-run steelhead, winter-run are sexually mature upon freshwater entry (Papa et al. 2007). Upstream migration for adult fall-run steelhead in the Klamath River typically lasts from July to October and for adult winter-run steelhead from November through March (Hopelain 1998, USFWS 1998). Fall steelhead may be migrating as early as July, but elevated SSCs are uncommon during summer. Under median conditions for fish, SSC are high enough to cause major stress and possibly impaired homing. The 80 percent of steelhead spawning upstream of the Trinity River

would be exposed to elevated SSCs for a longer period due to the additional time spent migrating in the mainstem Klamath River. Under extreme conditions, SSC would cause major stress and impaired homing. Concentrations remain in the sublethal range; however, adult steelhead stressed by elevated suspended sediment could be more vulnerable to disease-related mortality. The amount of time that adult steelhead could be exposed would vary, depending on run timing relative to precipitation events that cause high SSC and how quickly an adult moves upstream and enters a spawning tributary.

Post-spawning adult steelhead, or "runbacks," migrate downstream in the spring to return to the sea, typically from April through May 30. Under most conditions, SSCs are high enough to cause major stress. There are little data on downstream-migrating steelhead in the Klamath River with which to understand potential consequences of exposure to suspended sediment during this life history phase.

Half-pounders (i.e., sexually immature fish that return after one year in the ocean) migrate upstream in the late summer and remain in the Klamath River through March. On average, 32 percent of summer steelhead adults returning to the North Fork Trinity River are half-pounders (Hopelain 1998); the proportion of the summer run that employs this life-history pattern in the area upstream of the Trinity River is unknown. A large portion (~94 percent) of the fall steelhead run that spawns in tributaries upstream of Weitchpec return as half-pounders, as well as a large portion of adults returning to the Trinity River (~80 percent) (Hopelain 1998). The winter run has a much lower incidence of the adult half-pounder life history, approximately 18 percent. Half-pounders tend to be found in the lower mainstem Klamath River, but they can be found all the way upstream to Beaver Creek from December through February. In a normal year under existing conditions, SSCs in the mainstem Klamath River during the period when half-pounders are present would be in a range that may cause major physiological stress, and possibly mortality (0–20 percent), depending on conditions (i.e., moderate, normal, and extreme) (Table E-5).

No steelhead spawning occurs in the mainstem Klamath River; therefore, spawning adults, incubating eggs and developing alevins, and emergent fry should be unaffected by suspended sediment in the mainstem Klamath River.

Juvenile summer-run steelhead in the Klamath Basin may rear in fresh water for up to three years before outmigrating. Although the majority of steelhead outmigrate at age-1 (Scheiff et al. 2001), those that outmigrate at age-2 appear to have the highest survival. (Hopelain 1998). Juveniles outmigrating from tributaries at age-0 and age-1 may rear in the mainstem Klamath River for one or more years before reaching an appropriate size for smolting. Because juvenile steelhead may spend varying amounts of time between tributaries and the mainstem Klamath River, it is difficult to track how much exposure each cohort might receive to suspended sediment in the mainstem. Numerous field and laboratory studies have shown that juvenile salmonids actively avoid exposure to high (> 150 mg/l) SSC, including altering migratory patterns to seek lower turbidity (Bisson and Bilby 1982, Berg and Northcote 1985, Redding et al. 1987, Servizi and Martens 1992, Bash et al. 2001, Carlson et al. 2001, Kemp et al. 2011, Kjelland et al. 2015). Therefore, the analysis assumes that steelhead outmigration during dam removal year 2 will occur within the period of typical outmigration, with the lowest predicted SSC. Juveniles found in the mainstem Klamath River cannot generally be identified to a specific run, so for this analysis the model assumes summer-, fall-, and winter-run fish share a similar life

history with those that have been observed. There is evidence in the literature that juvenile salmonids actively avoid turbid waters by moving into tributaries, so behavior in years of relatively clear conditions may be different from that in years with elevated suspended sediment.

Table E-5. Predicted Newcombe and Jensen Severity Index and Anticipated Effects on Steelhead for Klamath River at Seiad Valley (RM 132.7).

Life-history Stage (period)	SEV at Conditions			Effects on Production
	Mild[1]	Median[2]	Extreme[3]	
Adult summer upstream migrants and runbacks (Mar 1–June 30) 30 days of exposure to median SSC for the period	7.8	8.5	9.1	Major stress, avoidance of turbidity, and possibly impaired homing.
Adult winter upstream migrants (Aug 1–Mar 31) 30 days of exposure to median SSC for the period	7.2	8.0	9.0	Major stress and potential for impaired homing.
Adult runbacks (Apr 1–May 30) 30 days of exposure to median SSC for the period	7.9	8.5	9.0	Major stress to downstream-migrating adults; effect dependent on time it takes runbacks to return downstream to the sea.
Half-pounder residence (Aug 15–Mar 31) 90 days of exposure to median SSC for the period	7.8	8.9	10.0	Major stress, and possibly reduce growth or some mortality (0–20 percent) depending on conditions. Proportion of run that returns as half-pounders is unknown. Fish may escape exposure to high suspended sediment in the mainstem by entering tributaries.
Spawning though emergence (Dec 1–June 1) Exposure to highest SSC for the period	No effect	No effect	No effect	No mainstem spawning.
Age 0 juvenile rearing (Mar 15–Nov 14) Exposure to highest SSC for the period	8.3	9.0	9.8	Major stress to reduced growth rates for portion of age 0 juveniles rearing in mainstem (~60 percent of run upstream of Trinity River)
Age 1 juvenile rearing (year-round) Exposure to highest SSC for the period	8.8	9.5	10.0	Major stress, reduced growth rates, to mortality (0–20 percent) depending on conditions for portion of age 1 juveniles rearing in mainstem (~60 percent of run upstream of Trinity River)

Life-history Stage (period)	SEV at Conditions			Effects on Production
	Mild[1]	Median[2]	Extreme[3]	
Age 2 juvenile rearing (Nov 15–Mar 31) Exposure to highest SSC for the period	8.3	9.0	9.8	Age 2 in the mainstem (~40 percent of run upstream of Trinity River) expected to experience major stress to reduced growth rates depending on conditions.
Juvenile/smolt outmigrants (Mar 1–May 1) 20 days of exposure to lowest SSC for the period	8.8	9.5	10.0	Major stress, reduced growth rates, to mortality (0–20 percent) depending on conditions.

[1] Mild conditions for fish = 90 percent exceedance probability
[2] Median conditions for fish = 50 percent exceedance probability
[3] Extreme conditions for Fish = 10 percent exceedance probability

Under normal existing conditions, age-0 steelhead may experience major physiological stress (mild conditions for fish) and or reduced growth (median conditions or extreme conditions for fish) (Table E-5). If steelhead remain to rear in the mainstem Klamath River for another year, SSCs would result in major physiological stress and reduced growth rates for this cohort. However, it appears that many of these juveniles are avoiding conditions in the mainstem Klamath River by using tributary and other off-channel habitat during winter (Soto et al. 2008, Hillemeier et al. 2009), lowering their exposure to SSCs. The approximately 55 percent of the total summer-run steelhead population that spawn and rear in the Trinity River and downstream the mainstem Klamath River may be exposed to higher concentrations due to tributary accretion, but for shorter durations because of the shorter distance (and shorter travel time) from the sea to the mouths of their spawning tributaries.

Based on captures in tributaries and the mainstem Klamath River, it appears that approximately 40 percent of the steelhead population rears in tributaries until age-2. Approximately 60 percent of juvenile steelhead in the mainstem Klamath River upstream of the Trinity River confluence are age 1, approximately 37 percent are age 2, and approximately 3 percent are age 3 (Scheiff et al. 2001). Age 1 steelhead rearing year-round in the mainstem Klamath River could experience major physiological stress (under mild conditions for fish), reduced growth rates (under median conditions for fish), or mortality rates up to 20 percent (under extreme conditions for fish). For juvenile steelhead age 2- or 3- rearing in the mainstem during fall, suspended sediment may cause major stress (under mild conditions for fish) or reduced growth rates (under median or extreme conditions for fish).

Smolts are captured in the mainstem Klamath River and estuary throughout the fall and winter (Wallace 2004), but peak smolt outmigration normally occurs from April through June, based on estuary captures (Wallace 2004). Jetter and Chesney (2016) report that between 2001 and 2016 steelhead age-2 outmigration from the Shasta and Scott rivers occurred primarily between March and May. Temperatures in the mainstem Klamath River are generally suitable for juvenile steelhead, except for reaches upstream of Seiad Valley where summer water temperatures are considered stressful. Exposure of

outmigrating juvenile and smolt steelhead to suspended sediment in the mainstem Klamath River would depend on the timing of their outmigration relative to conditions contributing to elevated suspended sediment, as well as the length of time it takes them to outmigrate to the ocean. Approximately half of the juvenile steelhead population outmigrates from the Trinity River and tributaries downstream; the shorter distance to the ocean should also shorten the time they are exposed to suspended sediment in the mainstem Klamath River during outmigration. Under mild or median conditions for fish, SSCs can cause major physiological stress during the outmigration period. Under extreme conditions for fish, SSCs and durations could be high enough to cause up to 20 percent mortality. Smolts originating from tributaries farther inland (i.e., not produced from the Trinity River or lower-elevation streams) would likely be exposed to high SSCs because there is a greater chance that their outmigration may coincide with a sediment pulse. The duration of their exposure to high SSCs would depend both on timing and rates of travel downstream (i.e., the amount of time spent in the mainstem Klamath River; assumed to be 20 days for this analysis, based migration monitoring data [Goldsmith 1994]). For smolts that are outmigrating in an active fashion, feeding may be less important, thus the effect of suspended sediment on growth may be relatively minimal in terms of overall survival.

E.3.1.5 Pacific Lamprey

At least four, and possibly five or six species of lamprey occur in the Klamath River system (Kostow 2002, FERC 2007, PacifiCorp 2006), of which only resident Klamath River lamprey and anadromous Pacific lamprey are present downstream from Iron Gate Dam (PacifiCorp 2004, FERC 2007). Pacific lamprey was chosen as the focal species, since most information on life-history, distribution, and habitat requirements is from this species. Pacific lamprey have no Federal or State special status. If basic patterns in distribution differ between the species (e.g., if Klamath River lamprey are found in more abundance directly downstream from Iron Gate Dam), then effects could vary from those discussed here.

Pacific lamprey are present in the mainstem Klamath River and tributaries below Iron Gate Dam and in the Trinity, Salmon, Shasta, and Scott river basins (Hardy and Addley 2001, NRC 2004). Based on observations and available habitat, most ammocoete (lamprey larva) rearing likely occurs in the Salmon, Scott, and Trinity rivers, as well as in the mainstem Klamath River. The Klamath River upstream of the Shasta River appears to have less spawning and rearing habitat, and Pacific lamprey are not regularly observed there (Goodman and Hetrick 2017). Therefore, the review of existing conditions focuses on exposure of Pacific lamprey life stages to suspended sediment in the mainstem Klamath River downstream from Seiad Valley.

There is not extensive literature on the effects of suspended sediment on lamprey. This analysis was based on the effects of SSC on salmonids, with the assumption that impacts on lamprey are likely less than or equal to those on salmonids. It is generally observed that most life stages of Pacific lamprey are more resilient to poor water quality than salmonids (Zaroban et al. 1999), so these assumptions are likely conservative.

Anadromous Pacific lamprey enter the Klamath Basin throughout the year. Radio telemetry studies of adult migrating Pacific lamprey observe adults often hold in suitable habitat in lower river areas, and then migrate relatively rapidly to spawning areas during early winter when temperatures decrease and flows increase (Clemens et al. 2011,

McCovey 2011, Starcevich et al. 2014). Based on typical migration rates of approximately five miles/day or slightly faster (Starcevich et al. 2014), this analysis assumed 30 days of exposure to SSC during adult Pacific lamprey winter migration to reach spawning habitat between Seiad Valley (RM 132.2) or farther upstream (adults migrating to downstream locations would have a shorter exposure). Under existing conditions, SSC during adult Pacific lamprey migration could cause major physiological stress and impaired homing (Table E-6). Pacific lamprey are observed to spawn in the mainstem Klamath River, exposing ammocoetes to suspended sediment within the mainstem year-round. Under mild conditions for fish there could be major stress, and under extreme conditions for fish mortality of 0 to 20 percent is anticipated (Table E-6). Most ammocoete rearing occurs within tributaries.

Juvenile Pacific lamprey (ages 2 to 10) outmigrate to the ocean from the mainstem Klamath River and tributaries year-round, with peaks in migration during late spring and fall. Based on effects on salmonids, juvenile Pacific lamprey migrating during spring are anticipated to be exposed to SSCs high enough to cause moderate (under mild or median conditions for fish), to major physiological stress (under extreme conditions for fish) (Table E-6). Juvenile Pacific lamprey migrating during fall are exposed to relatively low concentrations of suspended sediment. Based on data collected on salmonids, concentrations would cause minor (under mild conditions for fish) to moderate physiological stress (under median or extreme conditions for fish) (Table E-6).

As there are multiple year-classes of Pacific lamprey in the mainstem Klamath River at any given time, and since adults may migrate upstream throughout the year, Pacific lamprey populations may be well-adapted to persisting through years when SSCs are high.

Table E-6. Predicted Newcombe and Jensen Severity Index and Anticipated Effects on Pacific lamprey for Klamath River at Seiad Valley (RM 132.7).

Life-history Stage (period)	SEV at Conditions			Effects on Production
	Mild[1]	Median[2]	Extreme[3]	
Adult upstream migration and spawning (year-round) 30 days of exposure to median SSC for the period	7.8	8.5	9.0	Major stress and impaired homing for adult migrants. Adults migrating during late spring and summer are exposed to lower concentrations of SSC.
Ammocoete rearing (year-round) Exposure to highest SSC for the period	8.7	9.5	10.3	Major stress of ammocoetes rearing in the mainstem, reduced growth, and potentially 0–20 percent mortality depending on conditions. A majority of ammocoetes rear in tributaries.
Spring outmigration (May 1–June 30) 30 days of exposure to lowest SSC for the period	6.7	7.8	8.7	Moderate to major stress for juveniles during spring outmigration.

Life-history Stage (period)	SEV at Conditions			Effects on Production
	Mild[1]	Median[2]	Extreme[3]	
Fall/winter outmigration (Sept 1–Dec 31) 30 days of exposure to lowest SSC for the period	5.0	5.9	6.4	Minor to moderate stress for juveniles during fall outmigration.

[1] Mild conditions for fish = 90 percent exceedance probability
[2] Median conditions for fish = 50 percent exceedance probability
[3] Extreme conditions for fish = 10 percent exceedance probability

E.3.1.6 Green Sturgeon

The Klamath Basin is the principal spawning watershed for green sturgeon in California (Moyle 2002). Green sturgeon in the Klamath River are part of the Northern DPS and are not a special status species. Green sturgeon spawn primarily in the lower 67 miles of the mainstem Klamath River (downstream from Ishi Pishi Falls), in the Trinity River upstream to Greys Falls, and potentially in the lower Salmon River upstream to Wooley Creek (KRBFTF 1991, Adams et al. 2002, Benson et al. 2007). Based on this distribution, this analysis focuses on exposure of green sturgeon life stages to suspended sediment in the mainstem Klamath River downstream from Orleans.

There is not extensive literature on the effects of suspended sediment on green sturgeon. This analysis is based on available information of the effects of SSC on salmonids, with the assumption that effects of suspended sediment on sturgeon are likely less than or equal to those on salmonids. It is generally believed that most life stages of green sturgeon are more resilient to turbidity than salmonids, so these assumptions are likely conservative. For example, juvenile green sturgeon exposed to high suspended sediment in the Connecticut River showed no apparent physiological stress, even though several other sturgeon species suffered gill infections (B. Kynard, Fisheries Biologist, BK-Riverfish, pers. comm., 2008). During extensive radio telemetry studies of green sturgeon, McCovey (2010) found that adults did not respond to periods of poor water quality, including high water temperature, algal blooms, disease outbreaks, and pulses of suspended sediment. In addition, adult green sturgeon have been observed to remain alive for days out of water, and no adult or juvenile green sturgeon mortalities were observed during the September 2002 fish kill in the Lower Klamath River.

Adult green sturgeon enter the Klamath River beginning in mid-March when SSCs reach levels expected to cause moderate (under mild conditions for fish) to major physiological stress (under median or extreme conditions for fish). However, adult green sturgeon are likely to be relatively tolerant compared to salmonids. Feeding is not likely to be a problem even when SSCs are high, because green sturgeon do not generally rely on eyesight to feed, but instead feed primarily on invertebrates in mud and silt using sensitive barbels to detect prey, and they may suspend feeding for long periods during their spawning migration (EPIC et al. 2001, as cited in DWR 2003).

Green sturgeon females are broadcast spawners that lay thousands of adhesive eggs that settle into the spaces between cobble substrates (Moyle 2002; Emmett et al. 1991, as cited in CALFED 2007). It is generally believed that silt can cause mortality by preventing eggs from adhering to one another and attaching to the substrate (EPIC et al.

2001, as cited in DWR 2003). Under median conditions for fish, eggs and larvae are expected to be exposed to SSCs over 50 mg/l for a period of about three weeks which, based on the Newcombe and Jensen (1996) approach, would be expected to cause high rates of mortality of salmonid eggs and emergent fry (Table E-7). However, green sturgeon do successfully spawn in the mainstem Klamath River under existing conditions (Benson et al. 2007), and while some mortality is likely occurring, it is likely that effects are not as severe as suggested for salmonids.

After spawning, approximately 25 percent of green sturgeon migrate directly back to the ocean (Benson et al. 2007), and the remainder hold in mainstem Klamath River pools from RM 13 to RM 67 through November. During this holding period, SSCs are relatively low, and only minor to moderate effects are anticipated.

Juvenile green sturgeon may rear for one to three years in the Klamath River system before they migrate to the estuary and the ocean (NRC 2004, FERC 2007, CALFED 2007), usually during summer and fall (Emmett et al. 1991, as cited in CALFED 2007). Juvenile green sturgeon are reported to grow rapidly and are capable of entering the ocean at young ages (Allen and Cech 2007, as cited in Klimley et al. 2007). Rearing for more than one year is rarely observed in the mid-Klamath River (M. Belchik, pers. comm., 2008), but juvenile green sturgeon may be rearing for additional months or years in the lower Klamath River or estuary before migrating to the ocean. During the rearing period, juvenile green sturgeon are anticipated to be exposed to SSCs that cause moderate to major stress and reduced growth in salmonids (Table E-7). However, juvenile green sturgeon exposed to high suspended sediment in the Connecticut River showed no apparent physiological stress, even though several other sturgeon species suffered gill infections (B. Kynard, pers. comm., 2008). Green sturgeon eggs sampled in the Klamath River by Van Eenennaam et al. (2006) were the largest recorded for a North American sturgeon, and likely produce large, fast-growing juveniles. These traits may allow green sturgeon to migrate to the estuary or the ocean after only one year of residence (Van Eenennaam et al. 2006). This is consistent with observations of high growth rates in the mid-Klamath River (M. Belchik, pers. comm., 2008), and may be related to the fact that the lower Klamath River and estuary offer very little foraging habitat compared with large systems such as the Sacramento-San Joaquin Bay-Delta, or Columbia River estuaries (J. Van Eenennaam, Research Associate, University of California Department of Animal Science, pers. comm., 2008).

Overall, under existing conditions, green sturgeon in the Klamath River mainstem are regularly exposed to SSCs documented to cause major physiological stress, reduced growth, and mortality in salmonids, especially during their egg and larval stages, and the year-round juvenile rearing period. However, this approach likely overestimates effects on green sturgeon.

Table E-7. Predicted Newcombe and Jensen Severity Index and Anticipated Effects on Green Sturgeon for Klamath River at Orleans (RM 59).

Life-history Stage (period)	SEV at Conditions			Effects on Production
	Mild[1]	Median[2]	Extreme[3]	
Adult migration and spawning (Mar 15–July 15) Exposure to median SSC for the period	7.7	8.3	8.8	Moderate to major stress for adult migrants and spawners.
Eggs and larvae (Apr 1–Aug 15) Exposure to highest SSC for the period	11.5	11.8	12.2	20 to 60 percent mortality for eggs and larvae depending on conditions (based on salmonid literature, effects likely overestimated).
Adult post-spawning holding (July 15–Nov 15) Exposure to median SSC for the period	5.6	6.1	6.6	Minor to moderate physiological stress (based on salmonid literature, effects likely overestimated).
Juvenile rearing (year-round) and outmigration (May 15–Oct 15) Exposure to median SSC for the period	7.1	7.7	8.4	Moderate to major stress (based on salmonid literature, effects likely overestimated).

[1] Mild conditions for fish = 90 percent exceedance probability
[2] Median conditions for fish = 50 percent exceedance probability
[3] Extreme conditions for fish = 10 percent exceedance probability

E.3.2 Proposed Project

Under the Proposed Project, full facility removal would result in the release of 5.3 and 8.6 million yd^3 of fine sediment stored in the reservoirs into the Klamath River downstream from Iron Gate Dam over a two-year period (USBR 2012), resulting in higher SSCs than would normally occur under existing conditions, and local, short-term sediment deposition. SSCs would begin to increase during reservoir drawdown, prior to the deconstruction of the dams and continue to rise through the spring runoff period as material behind the dams is mobilized downstream the Klamath River. Reservoir drawdown is expected to commence in January dam removal year 2. Based on the suspended sediment modeling conducted to analyze each alternative (including facility removal) (USBR 2012), SSCs are expected to exceed 1,000 mg/l for weeks, with the potential for peak concentrations exceeding 5,000 mg/l for hours or days, depending on hydrologic conditions during facility removal. The transport of this suspended sediment load is expected to affect anadromous fish species in various ways. In the following sections, the predicted effects of SSC on each focal fish species and cohort (referenced by the year of birth) are analyzed to evaluate the likely effects of the Proposed Project on anadromous fish populations in the Klamath River.

Model results (USBR 2012) indicate that the impact of increased SSC is limited to one year following the initiation of dam removal. As a result, the hydrologic conditions beyond the first year following dam removal will have minimal effect toward the impact of

increased SSC. After the first year following dam removal, the flow will be confined within the historical main channel and no longer be able to access the remaining fine sediment left on the floodplain, unless an extremely high flood event is to occur. As a result, the suspended sediment condition in the Klamath River after the first year will be similar to existing conditions with minimal impact from dam removal under most hydrological conditions. The riverine flows will have the potential to access the reservoir deposits left on the floodplain only during high flood events, during which the additional suspended sediment from erosion of the reservoir deposits is expected to be minor (high flow events carry high concentrations of suspended solids and any increase in SSCs from reservoir sediments would be insignificant). In the following sections, SSCs predicted for the most-likely and worst impacts on fish scenarios are used to evaluate the potential effects of the Proposed Project on anadromous fish species.

E.3.2.1 Fall-run Chinook Salmon

Although fall-run Chinook salmon migrate as far upstream as Iron Gate Dam to spawn, they are primarily distributed downstream from Seiad Valley. Therefore, the assessment of effects focuses on exposure of fall-run Chinook salmon adult migrants and spawning to suspended sediment in the mainstem downstream from downstream from Iron Gate Dam, and downstream from Seiad Valley for all other life stages.

Adult fall-run Chinook salmon in the Klamath River migrate upstream from August through October, when suspended sediment levels are generally low, and typically take two to four weeks to reach their spawning grounds. Under the Proposed Project, SSCs during fall migration could be high enough to cause moderate physiological stress and impaired homing (under least or most-likely impacts on fish), to major physiological stress (under worst impacts on fish) in the fall following removal of the dams (dam removal year 2).

Fall-run Chinook salmon spawning typically peaks in late October and substantially declines by the end of November (Shaw et al. 1997). The SSC modeling analysis does not account for potential effects that might result from infiltration of fine sediment into the channel bed because no suitable measurements or models were available to calculate this component; however, suspended sediment resulting from the Proposed Project is predicted to result in up to 100 percent mortality of eggs and fry from all mainstem Klamath River spawning in dam removal year 1 (Table E-8). The sediments released during dam removal would likely be primarily conveyed as wash load and would not fall out of suspension; however, the fraction deposited on spawning gravels would carry high concentrations of very fine sediment. These sediments may smother the eggs by adhering to the chorion (Greig et al. 2005, Levasseur et al. 2006). The degree to which sediments will adhere to the egg is affected by the properties (e.g., angularity) of the sediment. Sediment transport analysis conducted by Stillwater Sciences (2008) concluded that fine sediment deposition is expected to be limited to the upper portion of the bed surface after dam removal, which can be readily flushed during a high-flow event after the fine sediment supply in the former reservoir area is exhausted, or to be removed by redd construction activities of spawning fish in subsequent years. Therefore, since the majority of sediment is predicted to be released within the first year following reservoir drawdown, the effect of fine sediment from the Proposed Project on spawning success is unlikely to persist beyond the summer of dam removal year 2.

Much of the overall effect of the Proposed Project on fall-run Chinook salmon would depend on the relative proportion of mainstem Klamath River spawners during the fall of dam removal year 1, prior to the January dam removal year 2 initiation of facility removal. Based on redd surveys using a mark and re-sight methodology from 1999 through 2009 (Magneson and Wright 2010), an average of approximately 2,100 redds from hatchery and naturally returning adults are constructed in the mainstem Klamath River, which based on escapement estimates in the Klamath River Basin from 2001 through 2009 (CDFG 2010, unpublished data) is consistently approximately eight percent (range from 5.3 to 13.5 percent) of the total escapement in the Klamath Basin (not including grilses). Spawner surveys conducted by USFWS (Magneson and Wright 2010) indicate that approximately half of the fall-run Chinook that spawn within the 82-mile survey reach construct their redds in the 13.5-mile section between Iron Gate Dam and the Shasta River (FERC 2007) and thus would be most vulnerable to sediment released in association with the Proposed Project. With a predicted 100 percent mortality, approximately 2,100 redds on average could be lost under the Proposed Project assuming either the mostly-likely or worst impacts on fish scenario. Assuming constructed redds are related to escapement, this equates to approximately 8 percent of all anticipated redds in the basin in dam removal year 1. Based on the proximity to the Iron Gate Hatchery, it is expected that much of the redds affected would be of hatchery origin.

Approximately 60 percent of the fry produced by fall-run Chinook salmon in the Klamath River exhibit the Type I life history, in which they enter the ocean within a few months of emergence in early spring. Jetter and Chesney (2016) report that, between 2001 and 2016, Type I outmigration from the Shasta and Scott rivers occurred primarily between February and June. Numerous field and laboratory studies have shown that juvenile salmonids actively avoid exposure to high (> 150 mg/l) SSCs, including altering migratory patterns to seek lower turbidity (Bisson and Bilby 1982, Berg and Northcote 1985, Redding et al. 1987, Servizi and Martens 1992, Bash et al. 2001, Carlson et al. 2001, Kemp et al. 2011, Kjelland et al. 2015). Therefore, it was assumed that Chinook salmon outmigration during dam removal year 2 will occur within the period of typical outmigration with the lowest predicted SSC. As discussed in Section E.3.1.1, a maximum duration of exposure to SSCs at Seiad Valley during migration of 30 days was assumed for the analysis (Wallace 2004). Under the Proposed Project, SSC in the mainstem would likely result in moderate (under least impacts on fish) to major physiological stress (under most-likely or worst impacts on fish), which is a slightly higher impact than predicted under existing conditions (Table E-8). Prolonged exposure to higher SSCs could affect early marine survival by reducing growth and thus the size at which the smolts enter the ocean (Bilton 1984). This would also be expected to be the case under existing conditions even in normal years, but to a lesser degree. Exposure to disease or elevated temperatures during this phase would likely result in the mortality of some portion of fall-run Chinook. Parr-smolt transformation can also be compromised in stressed juveniles (Bash et al. 2001) and be a potential source of mortality.

The Type II life history is also common for fall-run Chinook salmon (~40 percent of cohort) (Sullivan 1989). These juveniles remain to rear in the tributaries in which they were spawned and would only be exposed to suspended sediment in the mainstem Klamath River during their outmigration to the ocean in the fall. Under the Proposed Project, SSCs would be slightly higher than existing conditions, unless there are worst impacts on fish conditions in the fall after dam removal (dam removal year 2), in which case SSCs would be high enough to cause major physiological stress.

Type III life-history fish are relatively rare (<1 percent of production) in the Klamath River fall-run Chinook population (USFWS 2001). These fish typically remain to rear in the spawning tributaries and outmigrate in late winter and early spring as yearlings. Under the Proposed Project, SSC could cause major stress or reduced growth in a worst impacts on fish scenario (Table E-8); slightly more of an impact than predicted under existing conditions (Table E-8). Based on outmigrant trapping in the mainstem Klamath River at Big Bar, approximately 942,829 Chinook salmon smolts outmigrate each spring, including both hatchery and naturally produced fish (USFWS 2001). Type III age 1 spring outmigrants are very rare, and only 31 were observed at Big Bar in four years of trapping, or approximately 0.1 percent of trap captures. Based on abundance estimates, annual average Type III life-history Chinook outmigration is approximately 943 smolts each year. Based on Sullivan (1989) the typically larger Type III fall-run Chinook smolts can contribute up to 4 percent of the escapement despite their low proportion of smolt production, perhaps due to their larger size at ocean entry (Bilton 1984).

Table E-8. Predicted Newcombe and Jensen Severity Index and Anticipated Effects on fall-run Chinook Salmon for Proposed Project for the Klamath River at Iron Gate Dam[1] and Seiad Valley[2].

Life-history Stage (period)	SEV at Impacts			Effects on Production
	Least[3]	Most Likely[4]	Worst[5]	
Adult upstream migrants (July 15–Oct 31) Exposure to median SSC for the period	6.9	7.6	8.8	Moderate to major physiological stress and impaired homing depending on scenario.
Spawning, incubation, and fry emergence (Oct 15–Feb 28) 90 days of exposure to highest SSC for the period	13.6	13.8	14.0	Effects of suspended sediment on spawning gravel quality were not modeled; however, suspended sediment may result in nearly 100 percent mortality of all progeny from mainstem spawning under all scenarios (approximately 2,100 redds, or approximately 8 percent of production).
Juvenile rearing (Jan 1–Mar 28) 30 days of exposure to the highest SSC for the period	10.5	10.8	11.1	No juvenile progeny anticipated from mainstem due to impacts during incubation. All other juveniles rear in tributaries.
Type I outmigration (Feb 1–August 1) 30 days of exposure to lowest SSC for the period	6.9	7.2	7.8	Moderate to major physiological stress and reduced growth depending on scenario. Applies to ~60 percent of total production.
Type II outmigration (Sept 1–Nov 30) 30 days of exposure to lowest SSC for the period	6.2	6.5	7.4	Moderate to major physiological stress depending on scenario. Applies to ~40 percent of total production.

Life-history Stage (period)	SEV at Impacts			Effects on Production
	Least[3]	Most Likely[4]	Worst[5]	
Type III outmigration (Feb 1–April 15) 30 days of exposure to lowest SSC for the period	8.5	9.0	9.4	Major stress to reduced growth depending on scenario. (0 to 189 smolts, or less than 1 percent of production).

[1] Adult migration, spawning, incubation, and fry emergence life stages
[2] Juvenile rearing and outmigration life stages
[3] Least impacts on fish= 90 percent exceedance probability
[4] Most likely impacts on fish = 50 percent exceedance probability
[5] Worst impacts on fish = 10 percent exceedance probability

E.3.2.2 Spring-run Chinook Salmon

Based on spring-run Chinook salmon distribution, the Proposed Project would have the largest effect on spring-run Chinook salmon returning to or emigrating from the Salmon River. Therefore, this assessment focuses on life stages most likely to be found in the mainstem Klamath River downstream from the Salmon River, including those that migrate to and from the Trinity River.

Under existing conditions and the Proposed Project, SSC during upstream migration would cause impaired homing to major stress to spring-run Chinook salmon. Adult Chinook migrating later in the season (July through August) would experience minor (under least or most-likely impacts on fish) to moderate physiological stress (under worst impacts on fish) under the Proposed Project.

Spring-run Chinook upstream migration is separated into two time periods—spring and summer. Under the Proposed Project, adult spring migrants are expected to be exposed to higher SSCs than under existing conditions, leading to increased stress and impaired homing (Table E-9). However, the duration of exposure is relatively short (<14 days), and effects are expected to be sub-lethal. Behavioral responses of adult Chinook salmon to high suspended sediment can include straying into nearby tributaries with lower levels of suspended sediment and ceasing or delaying upstream movements when there are no clearer waters to take refuge in (Cordone and Kelley 1961). Whitman et al. (1982) found that adult male Chinook showed an avoidance response to their home water when exposed to an ash suspension of 650 mg/l, but no indication that homing was affected. The increased energy expenditure that may result from a delay in migration can potentially reduce spawning success (Berman and Quinn 1991), particularly if factors such as elevated temperatures or disease are a problem.

Approximately half of the observed spring-run Chinook salmon adults migrate relatively rapidly to the Trinity River in the summer (approximately two days within the mainstem Klamath River). Even under a worst impacts on fish scenario, effects would only be slightly higher than under existing conditions—only 1–2 days of exposure to SSCs causing moderate stress (Table E-9).

Since no spring-run Chinook salmon spawning occurs in the mainstem Klamath River under existing conditions, the egg through fry life stages are not anticipated to be affected by suspended sediment resulting from the Proposed Project (Table E-9).

Table E-9. Predicted Newcombe and Jensen Severity Index and Anticipated Effects on Spring-run Chinook Salmon for Proposed Project for Klamath River at Orleans (RM 59).

Life-history Stage (period)	SEV at Impacts			Effects on Production
	Least[1]	Most Likely[2]	Worst[3]	
Adult spring migration (Apr 1–June 30) 14 days of exposure to median SSC for the period	7.8	8.0	8.5	Impaired homing to major stress for adults returning to Salmon River for all scenarios. Majority (~95 percent on average) of adults enter Trinity River, and would be exposed to lower concentrations. Up to 35 percent of "natural" escapement returns to Salmon River.
Adult summer migration (Jul 1–Aug 31) 2 days of exposure to median SSC for the period	5.3	5.7	6.4	Minor to moderate physiological stress depending on scenario to the ~50 percent of the summer migrants returning to Trinity River.
Spawning, incubation, and fry emergence (Sept 1–Feb 28)	No effect	No effect	No effect	Spring-run do not generally spawn in the mainstem; no effect to this life stage is anticipated.
Juvenile rearing (variable)	No effect	No effect	No effect	Juveniles rear in tributaries; no effect to this life stage is anticipated.
Type I outmigration (Apr 1–May 31) 30 days of exposure to lowest SSC for the period	7.9	8.2	8.6	Major stress and possibly reduced growth rates under a worst impacts on fish scenario for Type I fry (~80 percent) in smolt outmigration from Salmon River. Majority (~95 percent) of juveniles outmigrate from the Trinity River, and would be exposed to lower concentrations.
Type II outmigration (Oct 1–Nov 15) 30 days of exposure to lowest SSC for the period	6.2	6.6	7.2	Moderate physiological stress for Type II smolts from the Salmon River (~20 percent) during downstream migration. Majority (~95 percent) of juveniles outmigrate from Trinity River and are also exposed to no SSC from Proposed Project.
Type III outmigration (Jan 15–May 31) 30 days of exposure to lowest SSC for the period	7.9	8.2	8.6	Major stress to reduced growth rates for Type III smolts from Salmon River. (approximately 16 smolts less than 1 percent of the total smolt population from the Salmon River).

[1] Least impacts on fish = 90 percent exceedance probability
[2] Most likely impacts on fish = 50 percent exceedance probability
[3] Worst impacts on fish = 10 percent exceedance probability

Based on outmigrant trapping in the Salmon River from 2001 to 2006 (Karuk Tribe, unpubl. data), approximately 80 percent of spring-run Chinook salmon outmigrants are Type I, 20 percent are Type II, and less than 1 percent are Type III. Based on otolith

analysis conducted by Olson (1996), most adult Chinook returning to the Salmon River (~70 percent) exhibited the Type II life history and outmigrate during fall, and approximately 7 percent exhibited the Type III life history despite being infrequently observed outmigrating. Juvenile spring-run Chinook of both Types I and II are believed to mainly rear in tributaries (West 1991, Dean 1994, 1995), reducing likelihood of exposure to suspended sediment in the mainstem Klamath River. Type I juveniles move from tributaries into the mainstem Klamath River and continue downstream to the ocean in April and May. Numerous field and laboratory studies have shown that juvenile salmonids actively avoid exposure to high (> 150 mg/l) SSCs, including altering migratory patterns to seek lower turbidity (Bisson and Bilby 1982, Berg and Northcote 1985, Redding et al. 1987, Servizi and Martens 1992, Bash et al. 2001, Carlson et al. 2001, Kemp et al. 2011, Kjelland et al. 2015). Therefore, it was assumed that Type I spring-run Chinook salmon outmigration during dam removal year 2 will occur within the period of typical outmigration with the lowest predicted SSC. SSCs would cause major stress (under least impacts on fish) to reduced growth rates (under most-likely or worst impacts on fish), slightly higher than under existing conditions.

Under the Proposed Project, SSCs during the Type II outmigration would cause moderate stress, slightly higher than under existing conditions.

Type III Chinook outmigrants that overwinter in the mainstem Klamath River when SSCs are highest, or those migrating from the Salmon River (<1 percent of outmigrants within Klamath River watershed), would have the greatest exposure to suspended sediment. Suspended sediment conditions would cause major physiological stress to reduced growth rates during the Type III Chinook outmigration under all scenarios of the Proposed Project, but would remain in the sub-lethal range. Type III age 1 spring-run Chinook outmigrants are very rare (only 30 were observed in the Salmon River in five years of trapping). Based on Olson (1996) the typically larger Type III Chinook smolts can contribute up to 7 percent of the escapement despite their low proportion of smolt production, perhaps due to their larger size at ocean entry (Bilton 1984). Most spring-run Chinook outmigrants (95 percent) originate from the Trinity River; they have a shorter distance to travel to the ocean and SSCs resulting from the Proposed Project should be lower due to dilution (USBR 2012), so they may experience major stress, but suffer little or no mortality.

E.3.2.3 Coho Salmon

The effects of suspended sediment on coho salmon in the Klamath River described here follow the Williams et al. (2006) designation of nine population units (see Section E.3.1.3). Although coho salmon within the Upper Klamath River Population Unit do migrate as far upstream as Iron Gate Dam, in general coho salmon are primarily distributed within tributaries downstream from the Shasta River. Therefore, the analysis focuses on exposure to suspended sediment within, and downstream from, Seiad Valley. Coho salmon within the Upper Klamath River Population Unit upstream of Seiad Valley are expected to be exposed to slightly higher SSCs, and fish rearing in all other population units further downstream to lower SSCs.

Adult coho salmon enter the Klamath River between late September and mid-December, with peak upstream migration occurring between late October and mid-November. Based on adult coho salmon migration observations in the Scott River (2007–2009), Shasta River (2007–2009), and Bogus Creek (2003–2009), on average only

approximately 4 percent of adults remain in the mainstem Klamath River after December 15 (initiation of reservoir drawdown under the Proposed Project) (California Department of Fish and Game, unpubl. data). In most years, all adult coho salmon have entered tributaries prior to December 15, although in some years (e.g., Scott River in 2009) most fish were delayed until between December 15 and January 1. Therefore, most adult coho should already be in tributaries when reservoir drawdown begins in January of dam removal year 2 (Table E-10). In addition, adult migrant coho salmon are anticipated to avoid high SSCs by seeking refuge in tributaries, as was observed for Chinook salmon during removal of the Elwha Dam (McHenry et al. 2017). Therefore, it is assumed that all adult coho salmon will be within tributary habitat by December 15 of dam removal year 1, and the impacts analysis is based on the assumption that adult coho salmon are exposed to the median SSC conditions for 30 days of migration (Strange 2004). Under the most-likely impacts on fish and worst impacts on fish scenarios, effects of the Proposed Project on migrating adult coho salmon from all population units are anticipated to be slightly higher than those experienced under existing conditions but would remain in the sub-lethal range (Table E-10).

Coho salmon from the Upper Klamath River Population Unit that spawn in the mainstem Klamath River, as well as their progeny, would suffer 60 to 80 percent mortality depending on scenarios of the Proposed Project (Table E-10); however, even under existing conditions, very high mortality (20 to 60 percent) is expected due to the effects of suspended sediment on these life stages (in addition to other sources of mortality). Based on spawning surveys conducted from 2001 through 2017 (Magneson and Gough 2006, Hentz and Wickman 2016, Dennis et al. 2017), 0 to 13 redds could be affected in dam removal year 1 during the Proposed Project. Many of these redds are thought to be from returning hatchery fish (NMFS 2010a), and thus may be only selecting this habitat after failing to locate the hatchery collection site. Based on the range of escapement estimates of Ackerman et al. (2006), 13 redds (the highest number observed) would be much less than one percent of the natural and hatchery returns combined.

Table E-10. Predicted Newcombe and Jensen Severity Index and Anticipated Effects on Coho Salmon for Proposed Project for Klamath River at Seiad Valley (RM 132.7).

Life-history Stage (period)	SEV at Impacts			Effects on Production
	Least[1]	Most Likely[2]	Worst[3]	
Adult upstream migrants (Sept 1–Dec 15) 30 days of exposure to median SSC for the period	6.8	8.0	8.6	Moderate to major stress and impaired homing for adults migrating upstream (~4 percent of all populations exposed).
Spawning, incubation, and fry emergence (Nov 1–Mar 14) 60 days of exposure to highest SSC for the period	13.5	13.7	13.9	60 to 80 percent mortality of progeny from mainstem spawning. (<13 redds, or 0.7–26 percent of Upper Klamath River Population unit natural escapement).

Life-history Stage (period)	SEV at Impacts			Effects on Production
	Least[1]	Most Likely[2]	Worst[3]	
Age-1 juveniles during winter (Nov 15–Feb 14) Exposure to highest SSC for the period	10.8	11.0	11.3	20 to 40 percent mortality for age 1 juveniles from the dam removal year 1 cohort rearing in the mainstem depending on scenario. An unknown but assumed small number (<1 percent) of juveniles rear in mainstem during winter.
Age-0 juveniles during summer (Mar 15–Nov 14) Exposure to highest SSC for the period	10.8	11.0	11.4	20 to 40 percent mortality for age 1 juveniles from dam removal year 1 cohort rearing in mainstem during late spring and early summer. Avoidance behavior anticipated to result in small number (<1 percent) of juveniles rearing in mainstem during dam removal year 2.
Age 1 juvenile outmigration (Feb 15–May 31) 20 days of exposure to lowest SSC for the period	7.2	7.7	8.3	Moderate to major stress and possibly reduced feeding depending on scenario for smolts outmigrating from Upper Klamath, Mid-Klamath, Shasta River, and Scott River populations during early spring. (impacts vary by population)

[1] Least impacts on fish = 90 percent exceedance probability
[2] Most likely impacts on fish = 50 percent exceedance probability
[3] Worst impacts on fish = 10 percent exceedance probability

Although most (assumed >50 percent) coho salmon fry rearing is believed to occur in tributaries, age-0 fry are observed outmigrating from tributaries in late spring and early summer. Juvenile coho in the mainstem Klamath River during the spring and summer following dam removal (dam removal year 2) would be exposed to concentrations of suspended sediment that would result in 20 to 40 percent mortality under the Proposed Project (Table E-10), slightly higher than predictions for existing conditions under the worst impacts on fish scenario. These effects, in addition to possible exposure to diseases and the elevated temperatures often recorded in the mainstem Klamath River during summer, could result in high mortality of this cohort for all populations that have some rearing in the mainstem Klamath River. There could also be indirect effects on marine survival for coho salmon that survive the summer, but smolt at a smaller size (Bilton et al. 1982, Hemmingsen et al. 1986).

Under existing conditions, SSCs are typically high during the winter in the mainstem Klamath River and predicted to cause major stress under all scenarios (least impacts on fish, most-likely impacts on fish, or worst impacts on fish). Under the Proposed Project, age-1 juveniles (progeny of the dam removal year 1 cohort) that have either successfully over-summered or moved from tributaries into the mainstem Klamath River during the fall, could be exposed to much higher SSCs in the mainstem during the winter of dam removal than under existing conditions, and may suffer mortality rates of up to 40 percent under a worst impacts on fish scenario (Table E-10). However, many juvenile coho salmon in the mainstem Klamath River appear to migrate downstream to rear and may avoid adverse conditions in the mainstem by using tributary or off-channel habitats during winter, thus reducing high SSC exposure and potential mortality (Soto et al. 2008, Hillemeier et al. 2009). This assumption is consistent with the observation that juvenile

salmonids avoid turbid conditions (Sigler et al. 1984, Servizi and Martens 1992). This strategy may be even more pronounced under the higher SSCs expected under the Proposed Project. Overall, it is not known how many juvenile coho salmon rear in the mainstem Klamath River during winter, but it is assumed to be a small (<1 percent) proportion of any of the coho salmon populations.

Coho salmon smolts from the dam removal year 1 cohort are expected to outmigrate to the ocean beginning in late February, although most natural origin smolts outmigrate to the mainstem Klamath River during April and May (Wallace 2004). During migrant trapping studies from 1997–2006, in tributaries upstream of and including Seiad Creek (Horse Creek, Seiad Creek, Shasta River, and Scott River), 44 percent of coho smolts were captured from February 15 to March 31, and 56 percent from April 1 through the end of June (Courter et al. 2008). Numerous field and laboratory studies have shown that juvenile salmonids actively avoid exposure to high (> 150 mg/l) SSCs, including altering migratory patterns to seek lower turbidity (Bisson and Bilby 1982, Berg and Northcote 1985, Redding et al. 1987, Servizi and Martens 1992, Bash et al. 2001, Carlson et al. 2001, Kemp et al. 2011, Kjelland et al. 2015). Therefore, it was assumed that coho salmon outmigration during dam removal year 2 will occur within the period of typical outmigration with the lowest predicted SSC. Once in the mainstem Klamath River, coho salmon smolts move downstream fairly quickly (Stutzer et al. 2006). As discussed in detail in Section E.3.1.3, this analysis assumes a maximum exposure of 20 days of exposure at Seiad Valley for downstream migration. Under the Proposed Project, SSCs would be slightly higher during spring than under existing conditions, and coho salmon smolts are likely to suffer moderate to major stress and reduced feeding depending on scenario (Table E-10); assuming delayed outmigration to avoid high SSCs as discussed above.

Based on the results of coho salmon outmigrant trapping by the USFWS (2001) on the mainstem Klamath River compared with trapping in the Trinity River from 1997 to 2000 (USFWS 2011), most (>80 percent) coho smolts originate from the Trinity River and Lower Klamath River populations. For the majority of coho salmon smolts, produced from tributaries downstream from Orleans, effects of the Proposed Project would be similar to existing conditions by late April.

Under existing conditions, coho salmon smolts outmigrating from the Upper Klamath River, Scott River, and Shasta River populations currently have high mortality rates (35 to 70 percent) presumably as a result of poor water quality and disease (Beeman et al. 2007, 2008), which, in conjunction with physiological stress and reduced growth resulting from the Proposed Project, could result in even higher mortality in the spring of dam removal year 2.

E.3.2.4 Steelhead

Although steelhead do migrate as far upstream as Iron Gate Dam, nearly all spawning occurs in tributaries downstream from Seiad Valley (NRC 2004); therefore, this analysis focuses on exposure to suspended sediment in the mainstem Klamath River downstream from Seiad Valley.

Adult summer-run steelhead typically enter and migrate up the Klamath River from March through June (Hopelain 1998). Under the Proposed Project, SSCs would be higher than under existing conditions, most likely resulting in major physiological stress

and impaired homing. Based on summer-run steelhead surveys conducted in the Salmon River and other tributaries to the Klamath River by the USDA Forest Service and others from 1985 to 2009, on average approximately 657 adult summer-run steelhead migrate up the Klamath River to tributaries upstream of the Trinity River (USDA Forest Service, unpubl. data; Salmon River Restoration Council, unpubl. data), with an additional 800 on average migrating up the Trinity River (Busby et al. 1994). The summer-run steelhead that spawn in the Trinity River (~55 percent of the run based on escapement data) and other downstream tributaries would likely be exposed to only slightly higher impacts from suspended sediment than under existing conditions.

The Proposed Project is anticipated to have a direct effect on returning adult winter-run steelhead. Adult winter-run steelhead enter the Klamath River in late summer and fall and migrate and hold in the mainstem Klamath River through fall and winter. These adult steelhead would likely be exposed to higher SSCs than under existing conditions (Table E-11). Information on the abundance of winter-run steelhead, which is considered to be the most abundant form, is very limited due to logistical difficulties in sampling adults during the winter season. The only decent long-term data on adult winter-run returns is from hatchery returns to the Iron Gate Hatchery and Trinity River Hatchery (Busby et al. 1994). In a good year, around 7,000 adults return to both hatcheries, including approximately 3,500 to the Klamath River upstream of the Trinity River (Busby et al. 1994). However, in more recent years (2000 through 2016), the highest return was 631 adult steelhead to the Iron Gate Hatchery (Pomeroy 2016). Based on USFWS (1998), on average approximately 80 percent of winter-run steelhead migrate upstream after December 15 and could be exposed to high SSCs from the Proposed Project, although in some years many more steelhead migrate in the fall before that time. Stressed adult steelhead are also assumed to be more susceptible to disease, possibly increasing pre-spawn mortality, unless they respond to the high turbidity by entering tributaries earlier than usual, as was observed for upstream-migrating Chinook and coho salmon during the September 2002 fish kill event in the lower Klamath River (M. Belchik, pers. comm., 2008).

Since no winter-run steelhead spawning occurs in the mainstem Klamath River under existing conditions, the egg, alevin, and fry life stages are not anticipated to be affected by suspended sediment resulting from the Proposed Project (Table E-11).

Post-spawning adult steelhead (“runbacks”) migrate downstream in the spring to return to the sea, typically from April through May. Under the Proposed Project, SSCs would be higher than under existing conditions, and sub-lethal but major stress is likely under all scenarios (Table E-11). There are little data on downstream-migrating steelhead in the Klamath River to understand the potential consequences of exposure to suspended sediment during this life-history phase.

Table E-11. Predicted Newcombe and Jensen Severity Index and Anticipated Effects on Steelhead for Proposed Project Seiad Valley (RM 132.7).

Life-history Stage (period)	SEV at Impacts			Effects on Production
	Least[1]	Most Likely[2]	Worst[3]	
Adult summer upstream migrants (Mar 1–June 30) 30 days of exposure to median SSC for the period	8.7	9.0	9.3	Major stress and impaired homing for adult migrants. The ~55 percent that migrate to the Trinity River or tributaries further downstream would not be as affected.
Adult winter upstream migrants (Aug 1–Mar 31) 30 days of exposure to median SSC for the period	9.3	9.4	9.9	Major stress, impaired homing, and possibly some mortality (0–20 percent for adult migrants.
Adult run-backs (Apr 1–May 30) 30 days of exposure to median SSC for the period	8.7	9.0	9.5	Moderate to major stress to downstream-migrating adults; effect would depend on timing of outmigration in relation to suspended sediment pulse.
Half-pounder adults (Aug 15–Mar 31) 90 days of exposure to median SSC for the period	10.7	10.7	11.1	Mortality ranging from 0 to 40 percent depending on scenario. Majority remain in tributaries and would not be affected.
Spawning through emergence (Dec 1–June 1)	No effect	No effect	No effect	Spawning occurs in tributaries; no effect.
Age 0 juvenile rearing (Mar 15–Nov 14) Exposure to highest SSC for the period	9.3	9.7	10.0	Major stress, reduced growth to 20 percent mortality depending on scenario (up to 843 juveniles or approximately 3 percent of population basin-wide age 0 production in a worst impact on fish scenario). Approximately 40 percent rear in tributaries and would not be affected.
Age 1 juvenile rearing (year-round) Exposure to highest SSC for the period	10.9	11.1	11.5	0 to 40 percent mortality depending on scenario (up to 6,314 juveniles or approximately 11 percent of population basin-wide age 1 production in a most-likely or worst impact on fish scenario).
Age 2 juvenile rearing (Nov 15–Mar 31) Exposure to highest SSC for the period	10.9	11.1	11.4	0 to 40 percent mortality depending on scenario (up to 5,303 juveniles or approximately 10 percent of population basin-wide age 2 production in a most-likely or worst impact on fish scenario).
Juvenile/smolt outmigrants (Mar 1–May 1) 20 days of exposure to lowest SSC for the period	8.0	8.4	8.7	Major stress and reduced growth. Approximately 57 percent outmigrate from Trinity River and would have less exposure.

[1] Least impacts on fish = 90 percent exceedance probability
[2] Most likely scenario = 50 percent exceedance probability
[3] Worst-case impacts on fish scenario = 10 percent exceedance probability

Adult summer-run steelhead half-pounders typically enter the mainstem Klamath River and hold from mid-August through March, and thus would be affected by the Proposed Project during the winter of dam removal year 2. Steelhead half-pounders in the mainstem Klamath River upstream of the Trinity River could be exposed to higher SSC than under existing conditions, with potential mortality ranging from 0 to 40 percent depending on scenario (Table E-11). However, an unknown proportion of steelhead half-pounders are observed to hold in the Trinity River or other tributaries, and these fish would not be affected.

Juvenile steelhead rear in the mainstem Klamath River, tributaries to the Klamath, and the estuary. Since most (>90 percent) juvenile steelhead smolt at age-2, those juveniles leaving tributaries to rear in the mainstem Klamath River would be exposed to elevated SSCs resulting from the Proposed Project through both winter and spring. Based on captures in tributaries and the mainstem Klamath River, it appears that approximately 40 percent of the juvenile steelhead population rears in tributaries until age-2 (Scheiff et al. 2001) and would only be susceptible while outmigrating. The approximately 60 percent of the rearing population that outmigrates from tributaries as age-0 or age-1 and rears for extended periods in the mainstem Klamath River upstream of Trinity River would likely be exposed to much higher SSCs than under existing conditions, with mortality rates up to 40 percent in a worst impacts on fish scenario (Table E-11). Table E-12 summarizes the total number of rearing juvenile steelhead of each class within the Klamath River, estimated based on migrant trapping data from the Trinity River at Willow Creek and the Klamath River at Big Bar from 1997 to 2000 (Scheiff et al. 2001). Mortality estimates in Table E-12 were based on extrapolated estimates of abundance for each class within the Klamath River, as compared to the average total production estimated in both the Klamath and Trinity river trap locations, and assuming approximately 40 percent of steelhead juveniles rear in tributaries and would not be exposed. These mortality estimates do not consider juvenile steelhead produced from tributaries downstream from the Trinity River, and thus the actual rate of mortality could be lower. Numerous field and laboratory studies have shown that juvenile salmonids actively avoid exposure to high (> 150 mg/l) SSCs, including altering migratory patterns to seek lower turbidity (Bisson and Bilby 1982, Berg and Northcote 1985, Redding et al. 1987, Servizi and Martens 1992, Bash et al. 2001, Carlson et al. 2001, Kemp et al. 2011, Kjelland et al. 2015). Therefore, it was assumed that steelhead outmigration during dam removal year 2 will occur within the period of typical outmigration with the lowest predicted SSC. It does appear that many of these juveniles avoid conditions in the mainstem Klamath River by using tributary and off-channel habitats during winter, which would reduce their exposure to high SSCs (Soto et al. 2008, Hillemeier et al. 2009). This assumption is consistent with the observation that juvenile salmonids avoid turbid conditions. Most steelhead smolts outmigrate in the fall, so many juveniles should already be in the estuary or ocean when initial pulses in sediment occur, or they may migrate out of the mainstem Klamath River later in the winter after concentrations decrease.

Table E-12. Summary of Steelhead Juvenile Rearing Abundance and Estimated Mortality Resulting from the Proposed Project.

	Klamath River			Trinity River		
	Age 0	**Age 1**	**Age 2+**	**Age 0**	**Age 1**	**Age 2+**
Average juvenile abundance	4,217	15,784	13,256	13,384	20,445	17,401
Least Impacts on Fish						
Estimated mortality rate	0%	20%	20%	0%	0%	0%
Mortality estimate	0	3,157	2,651	0	0	0
Percentage of total production	0%	5.2%	5.2%	0%	0%	0%
Most-Likely Impacts on Fish						
Estimated mortality rate	0%	40%	40%	0%	0%	0%
Mortality estimate	0	6,314	5,303	0	0	0
Percentage of total production	0%	10.5%	10.4%	0%	0%	0%
Worst Impacts on Fish						
Estimated mortality rate	20%	40%	40%	0%	0%	0%
Mortality estimate	843	6,314	5,303	0	0	0
Percentage of total production	2.9%	10.5%	10.4%	0%	0%	0%

Under the Proposed Project, steelhead outmigrating in spring as age-2 smolts from tributaries higher in the basin would likely be exposed to suspended sediment for longer than under existing conditions, with major physiological stress predicted for all scenarios (Table E-11). Based on migrant trapping data from the Trinity River at Willow Creek and the Klamath River at Big Bar from 1997 to 2000 (Scheiff et al. 2001) approximately 57 percent of smolts outmigrate from the Trinity River, and would be exposed to SSCs similar to those under existing conditions.

E.3.2.5 Pacific Lamprey

Based on Pacific lamprey distribution, the impacts of the Proposed Project would be highest on those lamprey returning to or emigrating from mid-Klamath River tributaries such as the Scott River; therefore, this analysis focuses on exposure to suspended sediment in the reach downstream from Seiad Valley.

There is little to no literature on the effects of suspended sediment on lamprey. This analysis used the effects of suspended sediment on salmonids to predict effects on lamprey, with the assumption that effects on lamprey are equivalent or less severe than on salmonids. In general, most life stages of Pacific lamprey appear more resilient to poor water quality conditions than salmonids (Zaroban et al. 1999), so this analysis is likely a conservative assessment of potential effects.

Anadromous Pacific lamprey enter the Klamath Basin throughout the year, although their numbers peak in early winter (December through February), and thus a large proportion of adults could be directly affected by suspended sediment resulting from the Proposed

Project in winter and early spring, with major stress and likely impaired homing (Table E-13). Goodman and Hetrick (2017) report that in a 2008 ammocoete survey within the Klamath River Basin no Pacific lamprey were detected in the reach from Iron Gate Dam downstream to the confluence with the Shasta River (RM 179.5), and the densities did not approach levels observed elsewhere in the watershed until the confluence with the Scott River (RM 145.1). Therefore, the proportion of the Pacific lamprey population potentially exposed to high SSCs during dam removal is low. Approximately 44 percent of Pacific lamprey are believed to spawn in the Trinity River basin (Scheiff et al. 2001). These individuals would be exposed to lower SSCs, while those adults returning in fall, summer, or late spring would avoid exposure to the highest SSCs likely to result from the Proposed Project.

Pacific lamprey ammocoetes rear for a variable number of years before outmigrating to the ocean; therefore, suspended sediment resulting from the Proposed Project has the potential to affect multiple year-classes of the population (Table E-13). Lamprey are reported to have an intermediate level of tolerance to increased sedimentation and turbidity (Zaroban et al. 1999), but it is not known how changes in suspended sediment affect ammocoete survival. Juvenile salmonids would have mortality rates of 20–40 percent depending on scenario (Table E-13), but because Pacific lamprey ammocoetes rear in burrows in fine sediment, they may tolerate spikes in suspended sediment resulting from the Proposed Project, although excessive sedimentation from the settling out of suspended fines could possibly smother ammocoetes in some areas. Ammocoetes are filter-feeders, so reduced growth rates might be expected from elevated suspended sediment, and it is assumed that mortality would be higher than under existing conditions. However, the broad spatial distribution of Pacific lamprey in the Klamath Basin, including mid-Klamath River tributaries such as the Scott River, and the fact that ~44 percent of adults return to the Trinity River, should mean that a large portion of the rearing ammocoete population would not be impacted by the Proposed Project.

Juvenile Pacific lamprey (ages 2 to 10) outmigrate to the ocean from the mainstem Klamath River and tributaries rear-round, with peaks in late spring (late May to mid-June) and fall (October and November). Exposure to suspended sediment from the Proposed Project is only slightly higher during the spring and fall migration than under existing conditions (Table E-13).

Table E-13. Predicted Newcombe and Jensen Severity Index and Anticipated Effects on Pacific lamprey for Proposed Project for Klamath River at Seiad Valley (RM 132.7).

Life-history Stage (period)	SEV at Impacts			Effects on Production
	Least[1]	Most Likely[2]	Worst[3]	
Adult upstream migration and spawning (all of dam removal year 2) 30 days of exposure to median SSC for the period	8.8	9.1	9.4	Major stress and impaired homing. Adults migrating in late spring and summer exposed to lower SSC, as are lamprey returning to lower river tributaries such as the Trinity River.

Life-history Stage (period)	SEV at Impacts			Effects on Production
	Least[1]	Most Likely[2]	Worst[3]	
Ammocoete rearing (all of dam removal year 2) Exposure to highest SSC for the period	11.0	11.1	11.5	20–40 percent mortality depending on scenario for multiple year classes. Majority rear in tributaries and would not suffer mortality.
Spring outmigration (May 1–June 30) 30 days of exposure to lowest SSC for the period	7.7	8.1	8.9	Moderate to major stress and reduced growth rate depending on scenario for all juveniles during spring outmigration.
Fall/winter outmigration (Sept 1–Dec 31) 30 days of exposure to lowest SSC for the period	5.6	6.1	6.5	Minor to moderate stress for all juveniles during spring outmigration.

[1] Least impacts on fish = 90 percent exceedance probability
[2] Most likely scenario = 50 percent exceedance probability
[3] Worst-case impacts on fish scenario = 10 percent exceedance probability

E.3.2.6 Green Sturgeon

Based on green sturgeon distribution, the Proposed Project would have the highest potential effect on green sturgeon within the Klamath River downstream from Ishi Pishi Falls; therefore, this analysis focuses on exposure of green sturgeon to suspended sediment downstream from Ishi Pishi Falls (at the confluence with the Salmon River).

Very little information is available on the effects of suspended sediment on green sturgeon. This assessment is based on available information of the effects of suspended sediment on salmonids, with the assumption that effects on green sturgeon are equivalent or less severe than on salmonids. Most life stages of green sturgeon are more resilient to poor water quality conditions than salmonids, so this is likely a conservative assessment.

Adult green sturgeon enter the Klamath River beginning in mid-March, and under the Proposed Project, are likely to be to exposed to long durations of high SSCs that would result in major physiological stress in salmonids under all scenarios (Table E-14). Green sturgeon typically go for long periods without feeding during their spawning migration, and generally feed on benthic organisms detected in fine sediments by their sensitive barbels, both of which traits would likely reduce the impacts of suspended sediments on the species in terms of feeding ability (EPIC et al. 2001, as cited in DWR 2003). Green sturgeon in the Klamath River spawn approximately every four years (occasionally males spawn every two years) (McCovey 2010), which is consistent with spawning return intervals observed in the Rogue River (Erickson and Webb 2007; D. Erickson, Fisheries Biologist, PEW Institute for Ocean Science, pers. comm., August 2008). The result of this life history pattern is that up to 75 percent of the mature adult green sturgeon population (as well as 100 percent of sub-adults) can be assumed to be in the

ocean during dam removal year 2 and avoid effects associated with the Proposed Project.

Another behavior that may influence the effects of the Proposed Project is that green sturgeon appear to forego spawning migrations if environmental conditions are less than optimal (CALFED 2007). Webb and Erickson (2007) observed that some of the mature adult green sturgeon that entered the Rogue River returned downstream without spawning. Similar behavior has also been observed in white sturegon (J. Van Eenennaam, pers. comm., 2008). Some adults may turn back upon encountering high SSCs resulting from the Proposed Project and not complete their spawning migration or may enter later in the spring when concentrations are expected to be lower. However, this behavior has not been documented in the Klamath River (J. Israel, Research Associate, University of California Department of Animal Science, pers. comm., 2008).

Green sturgeon are broadcast spawners that lay thousands of adhesive eggs that settle into the spaces between cobbles (Moyle 2002). The Proposed Project may affect the spawning, egg, and larval stages in a variety of ways. Based on the limited information available, it is generally believed that silt can prevent eggs from adhering to one another, reducing egg viability (EPIC et al. 2001, as cited in DWR 2003). Fine sediment deposition on the channel bed may reduce availability of exposed cobble surfaces for eggs to adhere to, and incubating eggs could be exposed to higher SSCs for longer periods than under existing conditions. Although 40–60 percent mortality is predicted based on effects on salmonids under the Proposed Project (Table E-14), this is only slightly higher existing conditions and does not occur every year. Fine sediment deposition resulting from the Proposed Project could reduce production from the mainstem Klamath River to an unknown degree (J. Van Eenennaam, pers. comm., 2008). Spawning of green sturgeon is common downstream from the confluence with the Trinity River, where SSCs resulting from the Proposed Project should be similar to existing conditions. Green sturgeon production from the Trinity River, which is estimated to be approximately 30 percent of total production from the Klamath Basin (Scheiff et al. 2001), would be unaffected by the Proposed Project in dam removal year 2. In addition, production from the Salmon River in dam removal year 2, which is occasionally high, would be unaffected by the Proposed Project.

Table E-14. Predicted Newcombe and Jensen Severity Index and Anticipated Effects on Green Sturgeon for Proposed Project for Klamath River at Orleans (RM 59).

Life-history Stage (period)	SEV at Impacts			Effects on Production
	Least[1]	Most Likely[2]	Worst[3]	
Adult migrants (Mar 15–July 15) Exposure to median SSC for the period	8.3	8.6	9.0	Major stress for adult migrants and spawners. Approximately 75 percent of mature adult population not expected to migrate in dam removal year 2.
Incubation and emergence (April 1–Aug 15) Exposure to highest SSC for the period	12.2	12.4	12.6	40 to 60 percent mortality depending on scenario for all mainstem production. Approximately 30 percent of production is from Trinity River and would be unaffected. Assessment based on salmonid literature, effects likely exaggerated.

Life-history Stage (period)	SEV at Impacts			Effects on Production
	Least[1]	Most Likely[2]	Worst[3]	
Adult post-spawning holding (Jul 15–Nov 15) Exposure to median SSC for the period	6.7	7.0	7.9	Moderate to major physiological stress.
Juvenile rearing (year-round) and outmigration (May 15–Oct 15) Exposure to median SSC for the period	7.6	8.0	8.6	Moderate to major stress. Approximately 30 percent of juveniles rear in the Trinity River and would not be affected.

[1] Least likely impacts on fish = 90 percent exceedance probability),
[2] Most likely scenario = 50 percent exceedance probability)
[3] Worst-case impacts on fish scenario = 10 percent exceedance probability

After spawning, approximately 25 percent of green sturgeon return directly back to the ocean (Moyle 2002), and the remainder hold in mainstem pools in the Klamath River from RM 13 to RM 66.3 through November. Benson et al. (2007) found that after spawning, most green sturgeon held in deep pools (15–30 feet) in the mainstem Klamath and Trinity rivers from June through November for 116 to 199 days. Benson et al. (2007) reported that during three years of study (2002–2004) the majority of post-spawning adult green sturgeon outmigrated in the fall and winter after summer holding and appeared to be triggered by increasing flows. SSCs related to the Proposed Project prior to adult green sturgeon downstream migration is predicted to be similar to existing conditions, with major stress anticipated under a worst impacts on fish scenario.

Juvenile green sturgeon may rear for one to three years in the Klamath River system before they outmigrate to the estuary and ocean (NRC 2004, FERC 2007, CALFED 2007), usually during summer and fall (Emmett et al. 1991, as cited in CALFED 2007). Green sturgeon juveniles are reported to have rapid growth, and are capable of entering the ocean at young ages (Allen and Cech 2007, as cited in Klimley et al. 2007). Rearing for more than one year is rarely observed in the mid-Klamath River (M. Belchik, pers. comm., 2008), but some juvenile green sturgeon may rear for additional months or years in the lower Klamath River and the estuary before migrating to the ocean. Under the Proposed Project, juvenile green sturgeon, of the dam removal year 1 cohort rearing downstream from Orleans in dam removal year 2, are anticipated to be exposed to higher SSCs for longer periods than under existing conditions. These exposures are expected to result in moderate to major stress to juvenile green sturgeon depending on scenario (Table 14). However, juvenile green sturgeon exposed to high suspended sediment in the Connecticut River showed no apparent physiological stress, despite the fact that several other sturgeon species suffered gill infections during these same events (B. Kynard, pers. comm., 2008). Juvenile green sturgeon rearing is common downstream from the Trinity River, where SSCs would be similar to existing conditions. Juvenile green sturgeon rearing in the Trinity River, which may represent ~30 percent of the total production in the Klamath Basin (Scheiff et al. 2001), would not be impacted by the Proposed Project in dam removal year 2. In addition, any juvenile green sturgeon rearing in the Salmon River in dam removal year 2, which occasionally has abundant production, would not be impacted by the Proposed Project.

E.4 Klamath River Estuary

Estuary fish species regularly documented to occur in the Klamath River Estuary (Moyle 2002) include:

- Pacific herring (*Clupea pallasii*); no special status
- Longfin smelt (*Spirinchus thaleichthys*); Federal candidate species
- Eulachon (*Thaleichthys pacificus*); Federally listed as Threatened
- Topsmelt (*Atherinops affinis*); no special status
- Shiner perch (*Cymatogaster aggregata*); no special status
- Arrow goby (*Clevelandia ios*); no special status
- Starry flounder (*Platichthys stellatus*); no special status

Under existing conditions, SSCs within the Klamath River Estuary is relatively high (often 100 to 800 mg/l for several days) , the lower Klamath River downstream from the Trinity River confluence (RM 43.3) to the estuary mouth (RM 0.0) is currently listed as sediment impaired under Section 303(d) of the Clean Water Act, as related to protection of the cold freshwater habitat (COLD) beneficial use associated with salmonids (State Water Board 2006, North Coast Regional Board 2010) (EIR Section 3.2.3.3). Under the Proposed Project, sediment would be released from Iron Gate Dam and would decline in concentration in the downstream direction as a result of accretion from downstream tributaries. As a result, the magnitude of SSC from the Proposed Project relative to existing conditions is at its lowest level in the Klamath River Estuary (Figure E-3). SSCs in the estuary would be less than 40 percent of the peak concentrations that are anticipated to occur immediately downstream from Iron Gate Dam. These peaks would still be substantial and would be higher than the extreme conditions for fish values estimated by the sediment transport model for existing conditions. However, aquatic species that occur in the Klamath River Estuary are highly adapted to estuary conditions, including periods of elevated suspended sediment. The habitat conditions that currently exist within the Klamath River Estuary also provide some refuge from poor water quality conditions. In addition, many of these species are known to migrate out of the estuary environment to avoid poor water quality conditions (NMFS 2010b). Overall, predicted increases in SSCs under the most-likely impacts on fish scenario are within the range of existing extreme conditions for fish that estuarine species have adapted to survive, and only sublethal physiological stress is anticipated under the Proposed Project. Under a worst impacts on fish scenario SSCs could be higher than typically occur within the estuary (>1,000 mg/l) for a period of weeks, which could result in mortality of some individuals.

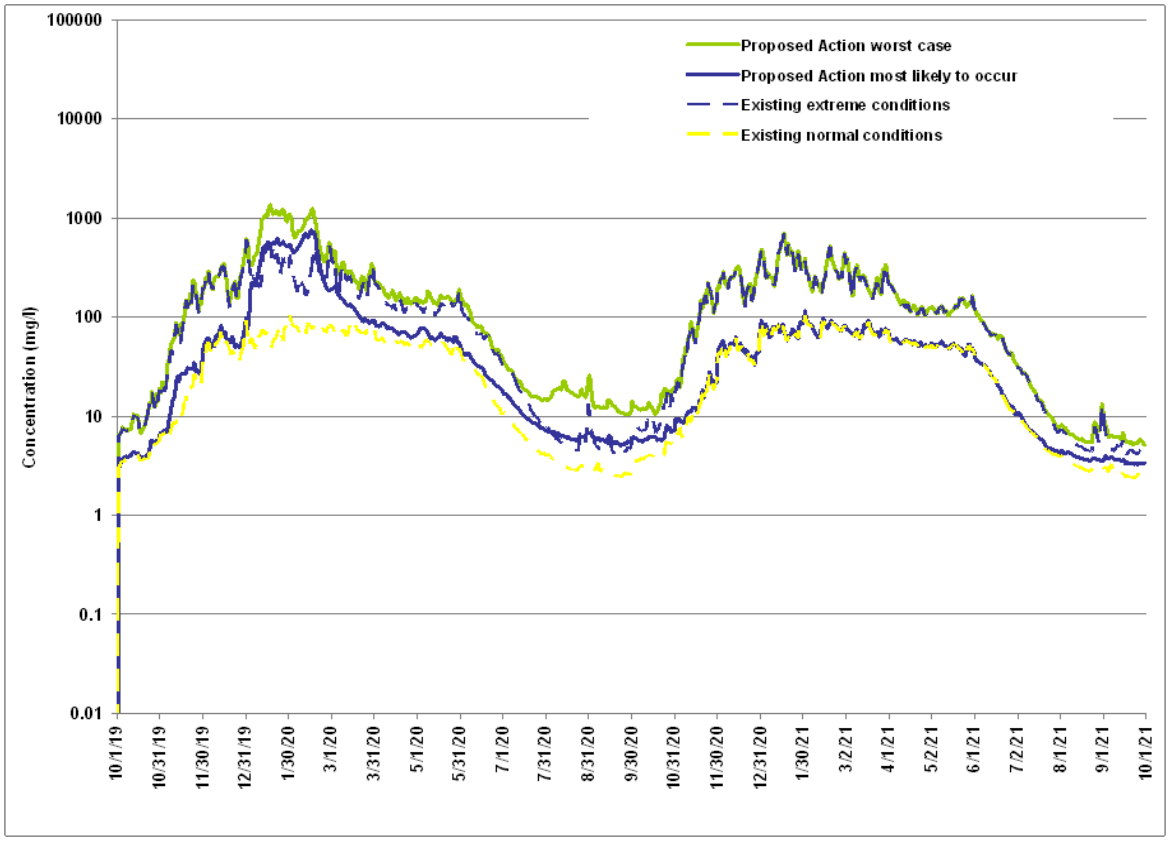

Figure E-3. Comparison of SSC at Klamath Station (RM 5) under Existing Conditions and the Proposed Project, as Predicted Using SRH-1D Model.

E.5 Pacific Ocean Nearshore Environment

Many aquatic species occur within the nearshore environment in the vicinity of the Klamath River. Under existing conditions there exists a "plume" within the nearshore environment in the vicinity of the Klamath River that is subject to strong land runoff effects following winter rainfall events. This includes low-salinity, high levels of suspended particles, high sedimentation, and low light (and potential exposure to land-derived contaminants). The extent and shape of plume is variable, and influenced by wind patterns, upwelling effects, shoreline topography (especially Point Saint George), and alongshore currents. High SSC events contribute to the plume, especially during floods (Figure E-4). In a study of the Eel River nearshore sediment plume, located approximately 80 miles to the south of the Klamath River, *in situ* measurements of plume characteristics indicated a relationship between effective settling velocity (bulk mean settling velocity) of plume sediments and wind speed/direction, as well as with tides (Curran et al. 2002). In contrast to the lower Klamath River, modeled short-term SSCs following dam removal are not available for the nearshore marine environment adjacent to the Klamath River. Substantial dilution of the high (>1,000 mg/L) mainstem Klamath River suspended sediment concentrations is expected to occur in the nearshore under the Proposed Project; based on data from 110 coastal watersheds in California, where nearshore SSCs were measured at >100 mg/L during the El Niño winter of 1998 (Mertes and Warrick 2001), peak SSCs leaving the Klamath River Estuary may be diluted by 1–2

orders of magnitude from >1,000 mg/L to >10–100 mg/L. However, considering that dilution of high wintertime SSC loads occurs under existing conditions as well, the magnitude and extent of the sediment plume under the Proposed Project is likely to be greater than under existing conditions. This would potentially increase the rate of sediment deposition to nearshore benthic sediments. Overall, any spikes in SSCs associated with the Proposed Project are not anticipated to have effects on species distinguishable from existing conditions.



Figure E-4. River Plumes for Rivers in the Vicinity of the Klamath River during Typical Winter Conditions.

E.6 References

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Appendix F

An Analysis of Potential Bedload Sediment Effects on Andadromous Fish in the Klamath Basin

F.1 Introduction

This appendix describes channel conditions and assesses changes to channel bed elevations, substrate, and related anadromous fish habitat under the Proposed Project and alternatives described in Section 2 Project Description.

F.2 Methods

The effects analysis relied on model simulations using the one-dimensional Sediment and River Hydraulics (SRH-1D) model (Huang and Greimann 2010) to estimate changes in bed elevation and substrate in the mainstem Klamath River in response to reservoir sediment release and renewed sediment supply from upstream sources. One-dimensional modeling is transect based, depth averaged, and assumes steady or unsteady flow in primarily one direction. The model simulated changes in bed grain size in the following four size classes: fine sediment (median substrate size [D_{50}] less than 0.063 mm), sand (0.063 to 2 mm), gravel (2 to 64 mm), and cobble (64 to 256 mm). The modeling approach examined short-term (2-year) changes by month under various scenarios involving two consecutive wet water years (i.e., wet simulation), two consecutive median water years (median simulation), and two consecutive dry years (dry simulation). The modeling approach also evaluated longer-term changes (5, 10, 25, and 50 years) using a range of flows taken from historical hydrology. Long-term simulations were not conducted for the Klamath River upstream of Iron Gate Dam, since bed gradations at the end of short-term simulations likely represent conditions that will persist through time and vary as a function of hydrology (USBR 2012; D. Varyu, pers. comm., January 4, 2011). The effects determination used conclusions from the modeling simulations and knowledge of habitat requirements of affected fish species to determine how changes in bed elevation and substrate would potentially impact aquatic habitat (e.g., pools and spawning gravel).

Reservoir sediment release combined with renewed sediment supply from upstream sources will affect spawning habitat over the short and long term. In the short term, fine sediment deposition in the interstitial spaces within spawning gravel could reduce survival of salmonids from egg deposition to emergence by impeding intragravel flow, preventing exchange of nutrients and dissolved oxygen from the water column to embryos, and impede emergence of alevins (Chapman 1988, Bjornn and Reiser 1991). Studies indicate sediment up to 10 mm in grain size can impede intragravel flow and block emergence (Kondolf 2000). A review by Kondolf (2000) found that 10 to 40 percent sediment ranging in grain size from 2 to 10 mm within spawning gravels corresponded to 50% survival-to-emergence of various salmonid species. Bjornn and Reiser (1991) summarized the effects of increasing levels of sediment with grain size less than 6.35 mm in the bed on salmonid incubation and found embryo survival-to-emergence largely unaffected at levels less than 20%. Levels more than 30% showed minor effects on embryo survival (90%) but greater effects on survival-to-emergence (10 to 60%).

The median bed grain size and percent sand predicted by SRH-1D was used to estimate the potential effects of the Proposed Project and alternatives on salmonid spawning success in specific reaches under short-term and long-term scenarios. For the purposes of the effects analysis, a channel bed comprised of a D_{50} grain size suitable for spawning (e.g., 16 to 70 mm for Chinook salmon and 10 to 46 mm for steelhead) with less than

20% sand was considered suitable habitat for salmonid spawning (Kondolf and Wolman 1993). A channel bed with D_{50} outside the observed spawning gravel size ranges and comprised of more than 20% sand was considered unsuitable habitat. Changes in substrate composition occurring as a result of dam removal that changed habitat from suitable to unsuitable was considered an adverse impact on salmonids.

F.3 Area of Analysis

The Area of Analysis includes the bed and banks of the Klamath River downstream of the California-Oregon state line, including Iron Gate, Copco No. 1, and Copco No. 2 reservoirs. Areas of the Upper Klamath Basin in Oregon are discussed in this section as they pertain to potential impacts to bedload, channel conditions, and aquatic habitat in California.

No detailed bathymetry or sediment sampling results were available for the small (approximately 73 acre-feet) Copco No. 2 Reservoir due to the absence of accumulated sediment deposits (USBR 2011). This condition likely results from the presence of the larger, upstream Copco No. 1 Dam that was completed seven years prior to Copco No. 2 Dam, cutting off upstream sediment supply to the Copco No. 2 Reservoir. Estimates of the particle trapping efficiency of Copco No. 2 Reservoir over a range of grain sizes suggest that no particle trapping would occur in this reservoir for particles smaller than 0.2 millimeters (silt) and 1.0 millimeters (clay). Regular scour along the thalweg would limit any potential coarse sand and larger substrates that may be trapped in Copco No. 2 Reservoir to quiescent areas along the channel margins and areas nearest the dam face.

The assessment includes the following reaches of the Klamath River defined by changes in physiography, presence of the facilities included in the Lower Klamath Project, and tidal influence:

1. Hydroelectric Reach from the upstream extent of J.C. Boyle Reservoir to Iron Gate Dam, including the following:
    a. J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate reservoirs
    b. J.C. Boyle Bypass and Peaking reaches
    c. Copco No. 2 Bypass Channel;
2. Klamath River downstream of Iron Gate Dam;
3. Klamath River Estuary; and
4. Pacific Ocean nearshore environment.

F.3.2 Hydroelectric Reach

The Hydroelectric Reach includes the 21-mile riverine section between J.C. Boyle Dam (RM 229.8) and the upstream end of Copco No. 1 Reservoir (RM 208.3) and the 1.4-mile riverine reach between Copco No. 2 Dam (RM 201.5) and the upstream end of Iron Gate Reservoir (RM 200.0).

Little to no sediment is supplied to the Klamath River from the basin upstream of Keno Dam (USBR 2012). Upper Klamath Lake, with its large surface area, traps nearly all sediment delivered from upstream tributaries. Tributary and streamside sources within the reaches from Keno Dam to Iron Gate Dam supply approximately 24,200 tons of

coarse sediment per year (1.2% of the cumulative average annual basin-wide coarse sediment delivery) (Stillwater Sciences 2010a).

The four Lower Klamath Project developments, in combination with upstream lakes (e.g., Klamath Lake) and reservoirs, trap all coarse sediment produced from upstream source areas, which encompasses predominantly young volcanic terrain with very low erosion rates. The four Lower Klamath Project reservoirs currently store 13,150,000 cubic yards of sediment (3,605,000 tons) (USBR 2012), with Copco No. 1 Reservoir storing the largest amount and J.C. Boyle Reservoir storing the least (Table F-1). Most of the stored sediment is fine, with 85% silt and clay size particles (less than 0.063 mm) and 15% sand or coarser particles (greater than 0.063 mm) (GEC 2006, Stillwater Sciences 2008, USBR 2012).

Table F-1. Estimated Volume (yd^3) and Weight (tons) of Sediment Currently Stored within Hydroelectric Reach Reservoirs.

Reservoir	Sediment Volume (yd^3)	Sediment Dry Weight (tons)
J.C. Boyle	1,000,000	287,000
Copco No. 1	7,440,000	1,884,000
Copco No. 2	0	0
Iron Gate	4,710,000	1,434,000
Total	**13,150,000**	**3,600,000**

Source: USBR 2012

Sediment trapping in Lower Klamath Project reservoirs results in coarsening of the channel bed downstream from the dams (PacifiCorp 2004, USBR 2012). Tributary sediment supply helps reduce the bed coarsening process by delivering gravel, sand, and fine sediment to the Klamath River channel (PacifiCorp 2004).

F.3.3 Klamath River Downstream of Iron Gate Dam

F.3.3.1 Lower Klamath Project

The reach from Iron Gate Dam to Cottonwood Creek (RM 193.1 to RM 185.1) is characterized by coarse cobble-boulder bars immediately downstream from the dam transitioning to a cobble bed with pool-riffle morphology farther downstream near Cottonwood Creek (PacifiCorp 2004, Stillwater Sciences 2010a). The reach from Cottonwood Creek to the Scott River (RM 185.1 to RM 145.1) is a confined channel with a cobble-gravel bed and pool-riffle morphology (PacifiCorp 2004). The median bed grain size ranges from 45 to 50 mm. Bar substrates fine in the downstream direction, with median sizes of 49 mm and 25 mm at the upstream and downstream ends, respectively. Downstream from the Scott River, the Klamath River is typically cobble-gravel bedded with pool-riffle morphology (PacifiCorp 2004). PacifiCorp (2004) also noted increasing quantities of sand and fine gravel on the bed surface with distance downstream of the Scott river confluence, likely reflecting the supply of finer sediment from tributaries.

Because approximately 98 percent of the sediment supplied to the mainstem Klamath River is delivered from tributaries downstream of the Cottonwood Creek confluence (Stillwater Sciences 2010a), the effects of sediment trapping by the Lower Klamath Project reservoirs on downstream channel conditions is limited to a relatively short

longitudinal distance. Analysis of the area and number of gravel bars downstream from Iron Gate Dam suggests that the influence of the Lower Klamath Project developments on these alluvial features, which are sources of salmonid spawning gravel, is limited to the reach from Iron Gate Dam to Cottonwood Creek (PacifiCorp 2004).

F.4 No Project Alternative

F.4.1 Hydroelectric Reach

Under the No Project Alternative, the four Lower Klamath Project developments would continue to trap fine and coarse sediment. Approximately 100,600 yd^3/yr (151,000 tons/yr, assuming a sediment density of 1.5 tons/yd) of sediment is delivered to the Klamath River between Keno and Iron Gate dams (Stillwater Sciences 2010a), all of which would deposit within the Lower Klamath Project reservoirs. USBR (2012) estimates these reservoirs would store 23,500,000 yd^3 of sediment (coarse and fine) by 2061.

Under the No Project Alternative, anadromous fish would not have access to this reach, as is currently the case. Effects of sediment deposition would be limited to riverine (redband trout and Lost River and Shortnose suckers) and non-native reservoir fish.

F.4.1.1 Redband Trout

Redband trout are found within the Hydroelectric Reach, migrating between tributaries and reservoirs to complete their life cycle (Hamilton et al. 2011). The No Project Alternative would not change bedload sediment dynamics and would not result in significant effects to redband trout.

F.4.1.2 Lost River and Shortnose Suckers

Federally endangered Lost River and shortnose suckers are found within the Hydroelectric Reach. However, there is little or no successful reproduction of either species downstream from Keno Dam, and habitat in these reaches does not substantially contribute to conservation goals or recovery (Hamilton et al. 2011). The No Project Alternative would not change bedload sediment dynamics, and would not result in significant effects to Lost River or Shortnose suckers.

F.4.1.3 Non-native Reservoir Fish

The No Project Alternative would not change bedload sediment dynamics and would not result in significant effects to non-native fish within the reservoirs.

F.4.2 Klamath River Downstream of Iron Gate Dam

Under the No Project Alternative, the four Lower Klamath Project developments would continue to interrupt bedload supply and transport necessary for long-term maintenance of aquatic habitats. Trapping of sand, gravel, and coarser sediment supplied from sources upstream of Iron Gate Dam would not result in any change to the existing channel bed downstream from Iron Gate Dam (USBR 2012). As occurs under existing conditions, the coarse bed material is relatively immobile, resulting in channel features that are unnaturally static and provide lower value aquatic habitat (Buer 1981).

Spawning habitat would continue to be sparsely distributed and of low quality. The coarsened channel bed gradually fines downstream as mobile coarse sediment (including spawning gravel) is supplied by tributaries (Hetrick et al. 2009). These effects of the Lower Klamath Project developments on channel bed coarsening are substantially reduced downstream of the Cottonwood Creek confluence due to the proportional increase in mobile coarse sediment from Cottonwood Creek and other downstream tributaries. (PacifiCorp 2004).

F.4.2.1 Fall-Run Chinook Salmon

The distribution of fall-run Chinook salmon would continue to be limited by Iron Gate Dam. Under the No Project Alternative, the substrate immediately downstream from Iron Gate Dam would remain coarsened. There would be no change in stream bed elevation or in habitat composition.

F.4.2.2 Spring-Run Chinook Salmon

Habitat relating to bedload movement within the current distribution of spring-run Chinook salmon under the No Project Alternative would remain the same as under current conditions, and thus the effects on this species under the No Project Alternative would be the same as under current conditions.

F.4.2.3 Coho Salmon

Coho salmon use the Klamath River as far upstream as Iron Gate Dam, but most spawning occurs in tributaries. The No Project Alternative would maintain the coarsened, relatively immobile substrate in the mainstem channel, limiting coho salmon spawning habitat as described above for fall-run Chinook salmon.

F.4.2.4 Summer Steelhead

The habitat changes relating to bedload movement under the No Project Alternative would not overlap with the distribution of summer steelhead (NRC 2004). Therefore, the effects on this species under the No Project Alternative would be the same as under current conditions.

F.4.2.5 Winter Steelhead

Winter steelhead are currently distributed throughout the Klamath River upstream to Iron Gate Dam, but spawn and rear in tributaries (FERC 2007). There is no record of winter steelhead spawning in the mainstem Klamath River, which is used mainly as a migration corridor for adults and juveniles (NRC 2004). Therefore, the effects on this species under the No Project Alternative would be the same as under current conditions.

F.4.2.6 Green Sturgeon

The habitat changes relating to bedload movement under the No Project Alternative would not overlap with the habitat of green sturgeon. Therefore, the effects on this species under the No Project Alternative would be the same as under current conditions.

F.4.3 Klamath River Estuary

As discussed above, the effects of dams on channel conditions in and downstream of the Hydroelectric Reach would be substantially reduced downstream from the Cottonwood Creek confluence, and largely absent downstream from the Shasta River confluence (RM 179.5). There would be no effects to aquatic species in the Klamath River Estuary under the No Project Alternative.

F.4.4 Pacific Ocean Near Shore Environment

As discussed above, the effects of dams on channel conditions in and downstream of the Hydroelectric Reach would be substantially reduced at the Cottonwood Creek confluence, and largely absent downstream from the Shasta River confluence (PacifiCorp 2004). There would be no effects to aquatic species in the Pacific Ocean nearshore environment under the No Project Alternative.

F.5 Proposed Project

F.5.1 Hydroelectric Reach

Reservoirs in the Hydroelectric Reach currently store 13,150,000 yd^3 (3,605,000 tons) of sediment (Table F-1) (USBR 2012). No detailed measurements (bathymetry or sediment sampling results) are available for the smaller (approximately 73 acre-feet) Copco No. 2 Reservoir. Sediment sampling was attempted in Copco No. 2, but no samples were collected due to the absence of accumulated sediment deposits (USBR 2011). This condition likely results from the presence of the larger, upstream Copco No. 1 Dam that was completed seven years prior to Copco No. 2 Dam, cutting off upstream sediment supply to the Copco No. 2 Reservoir. Model simulations indicate that 36 to 57 percent (5.3 to 8.6 million yd^3) of sediment stored in J.C. Boyle, Copco No. 1, and Copco No. 2 reservoirs would erode during the first year following dam removal, depending on the water year type (dry, median, or wet) (Figure F-1). Sediment retained on floodplains and terraces within the Lower Klamath Project reservoirs after the first year would be eroded more slowly through hillslope and fluvial processes (Stillwater Sciences 2008). With successful revegetation in accordance with the Reservoir Area Management Plan (Appendix B: *Definite Plan − Appendix H*), reservoir sediments that remain in long term storage above the high water mark of the Klamath River channel would experience limited erosion.

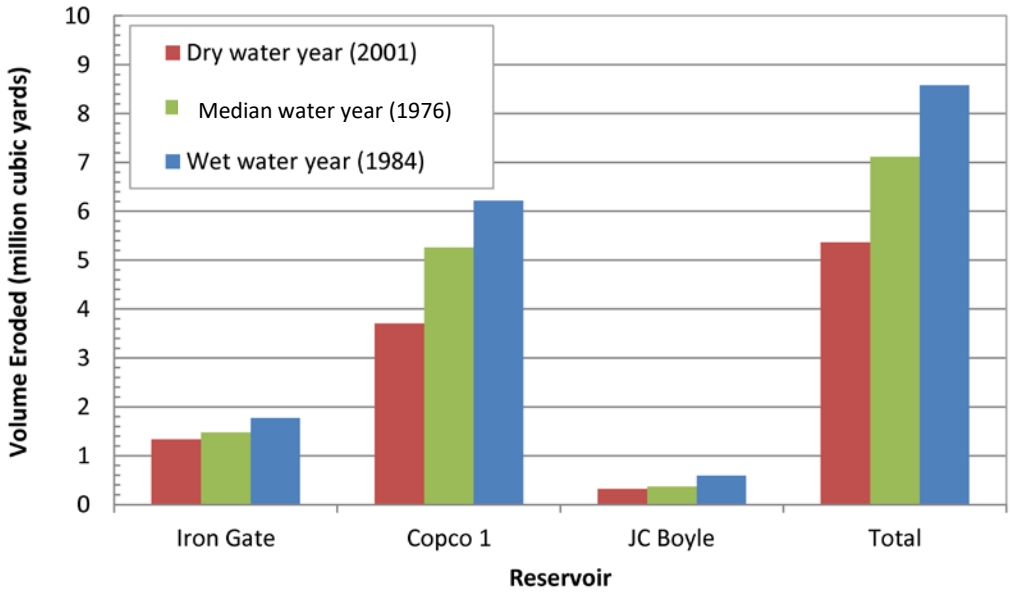

Figure F-1. Cumulative Sediment Volume Eroded from Reservoirs in the Hydroelectric Reach during Drawdown (USBR 2012).

F.5.1.1 Changes in Bed Elevation

SRH-1D model simulations indicate substantial decreases in bed elevation within the reservoirs during drawdown, which stabilize as the river channel within the former reservoir reaches returns to historical (i.e., pre-dam) bed elevations (USBR 2012; B. Greimann, pers. comm., December 23, 2010). In all simulations, the greatest decrease in bed elevations occurs through the Copco No. 1 Reservoir (10 feet of erosion), followed by J.C. Boyle Reservoir (three to four feet), and Iron Gate Reservoir (three feet) (Figure F-2 and Figure F-3). Little or no bed elevation change is anticipated to occur in Copco No. 2 reservoir due to the lack of sediment storage. Drawdown of J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate reservoirs and erosion of the accumulated sediment is expected to result in the river channels within reservoirs reaching their historical elevations within six months. Fluvial geomorphic processes would restore these sections of river channel to a pool-riffle morphology, like that existing in the reach downstream from Iron Gate Dam (PacifiCorp 2004).

The river reaches from the upstream end of Copco No. 1 Reservoir to J.C. Boyle Dam and from the upstream end of Iron Gate Reservoir to Copco No. 2 Dam show little change in bed elevations during the wet and dry simulations (Figure F-2 and Figure F-3). Both simulations indicate minimal deposition between Iron Gate Reservoir and Copco No. 2 Dam, and little change in the other riverine reaches (Figure F-2 and Figure F-3). Model simulations also indicate little to no change in channel conditions upstream of J.C. Boyle Reservoir (Figure F-2 and Figure F-3).

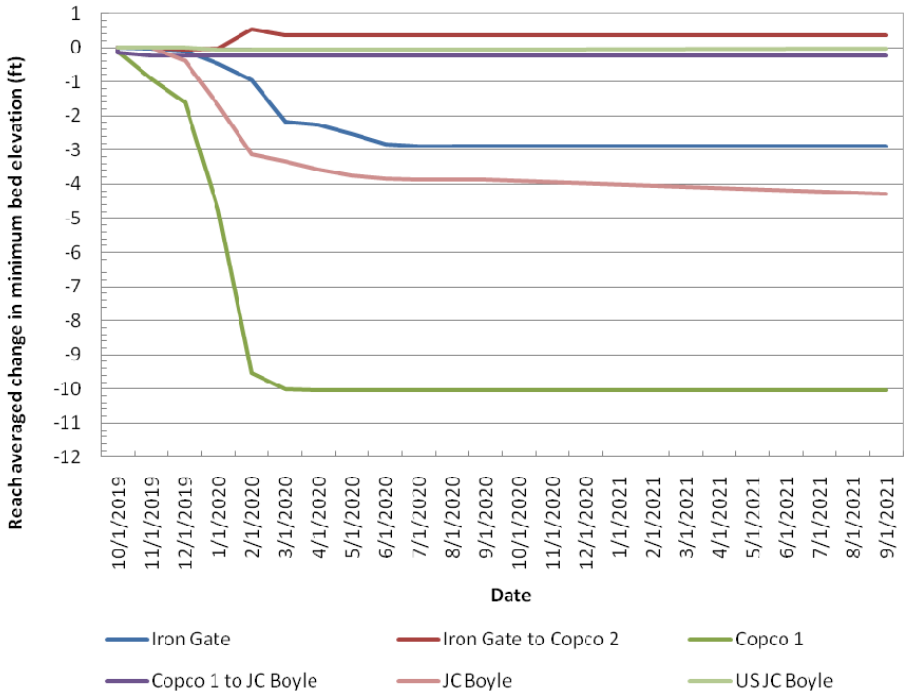

Figure F-2. Reach-Averaged Change in Bed Elevation in the Hydroelectric Reach during a Wet Year (USBR 2012).

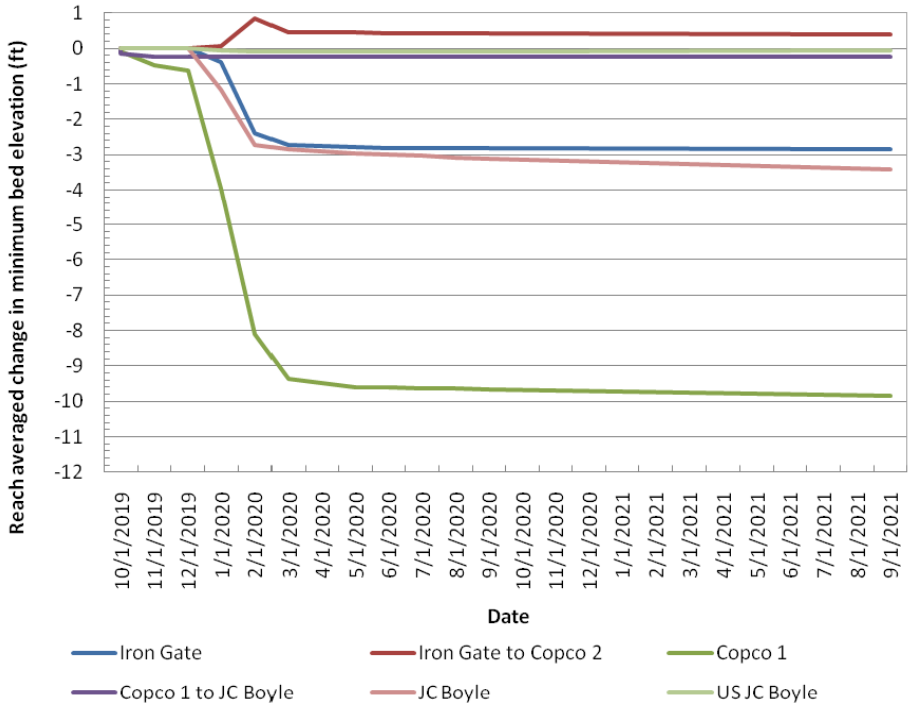

Figure F-3. Reach-Averaged Change in Bed Elevation in the Hydroelectric Reach during a Dry Year (USBR 2012).

F.5.1.2 Changes in Bed Substrate

SRH-1D model simulations for the first two years following dam removal indicate decreases in fine sediment composition and increases in median grain size within the reservoirs. These changes stabilize as the channel bed returns to historical (pre-dam) elevations. The proportion of fine sediment decreases from 50 to 80% to near zero within two months after drawdown. The sand proportion initially increases to 30 to 50% then decreases to 10 to 25%. The proportion of gravel mostly increases to 20 to 35%, and the proportion of cobble increases to 50 to 70%. These estimated changes in sediment composition vary depending on the reservoir and water year type (i.e., wet, median, or dry) (Attachment F-1, Figures F1-1 to F1-9). Median grain sizes increase from less than 1 mm to small cobble (64 to 128 mm) (Figure F-4, Figure F-5, and Figure F-6) (USBR 2012). The dry year scenario results in finer median grain sizes, but substrate is expected to eventually reach median grain sizes similar to those occurring under the wet and normal scenario (USBR 2012).

The simulations indicate similar changes in the D_{16} (16% of all particles are less than 0.063 mm) during drawdown. The model simulations analyze D_{16} as a measure of the finer fraction of the grain size distribution that could affect the quality of salmonid spawning gravel and survival-to-emergence. The D_{16} typically remains sand size or finer (less than 2 mm) sediments under the dry and median water year type simulations in the J.C. Boyle and Iron Gate reservoir reaches (Figure F-4 and Figure F-6) (USBR 2012).

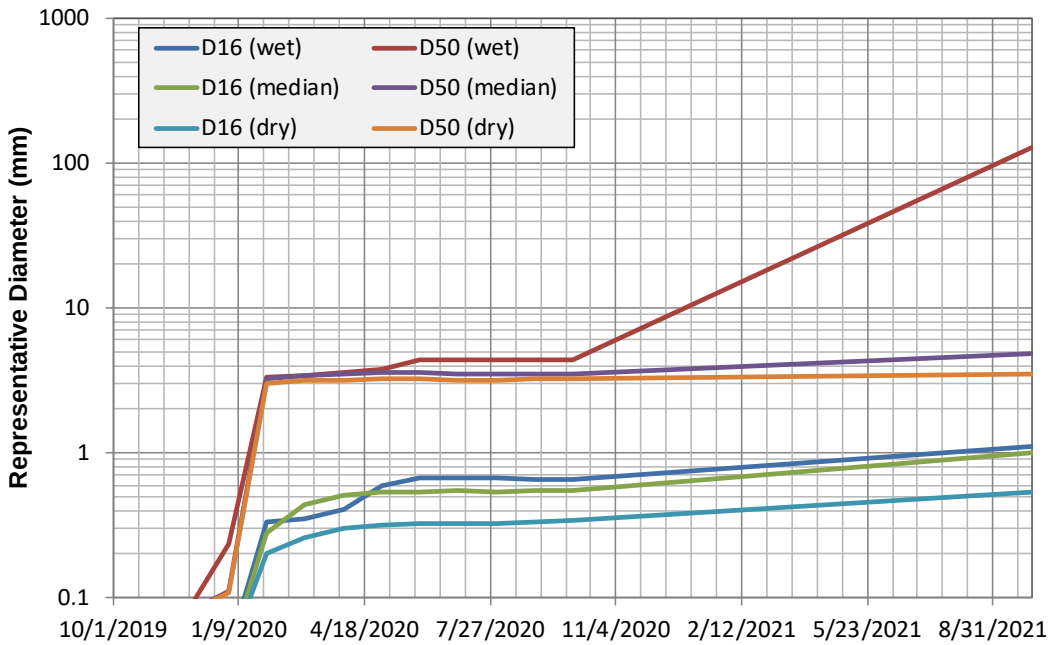

Figure F-4. Reach-Averaged D_{16} and D_{50} in the J.C. Boyle Reservoir Reach Following Dam Removal (based on simulation results provided by USBR, March 2012).

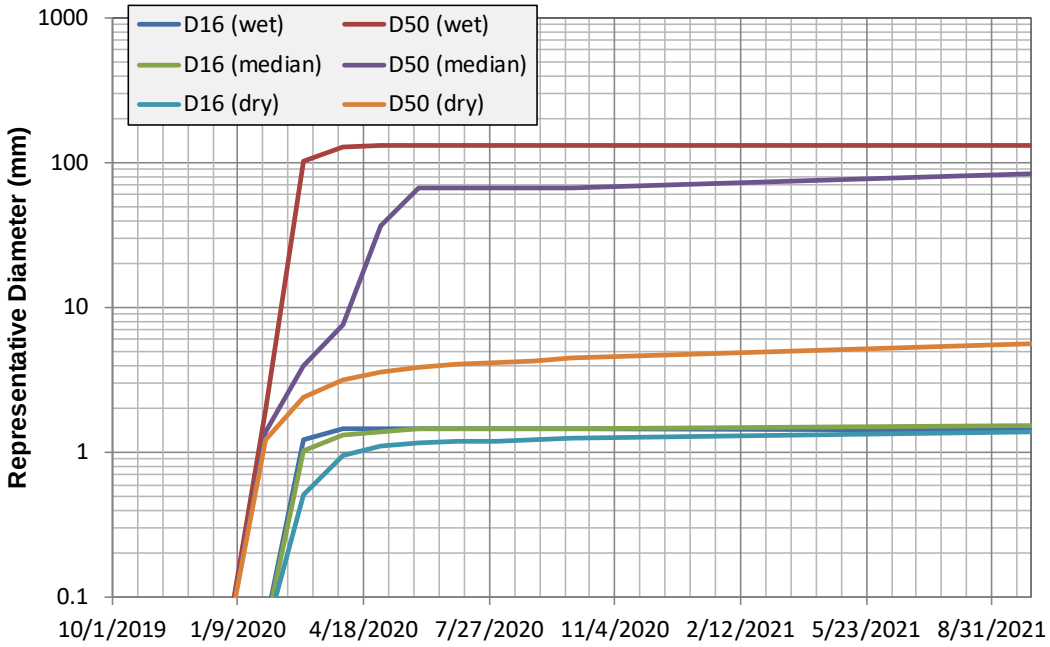

Figure F-5. Reach-Averaged D_{16} and D_{50} in the Copco No. 1 Reservoir Reach Following Dam Removal (based on simulation results provided by USBR, March 2012).

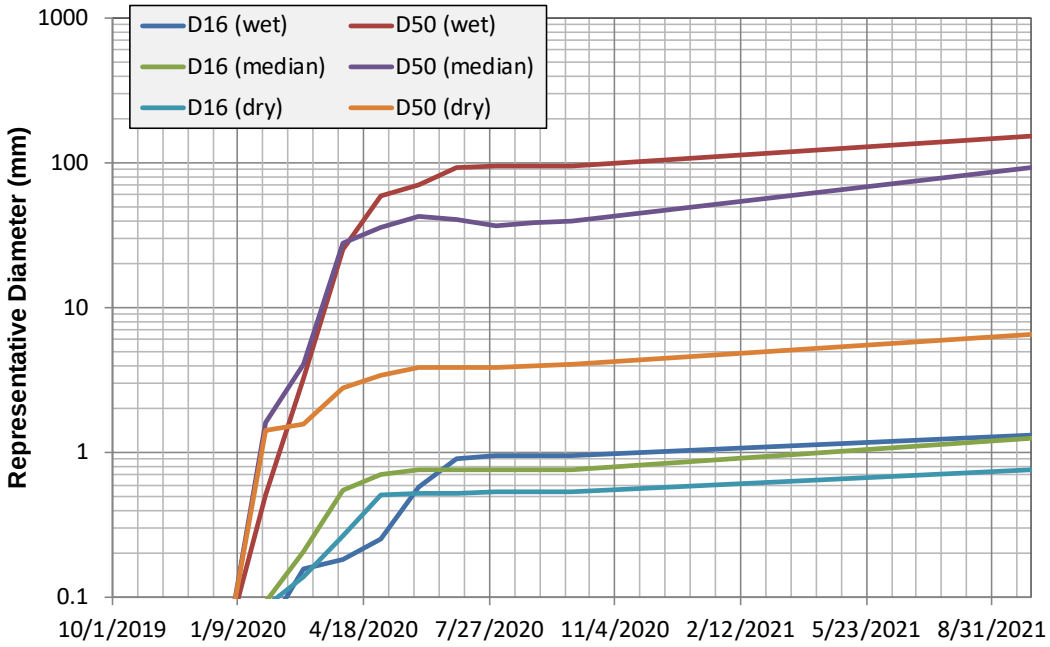

Figure F-6. Reach-Averaged D_{16} and D_{50} in the Iron Gate Reservoir Reach Following Dam Removal (based on simulation results provided by USBR, March 2012).

The river reaches upstream of J.C. Boyle Reservoir and from Copco No. 1 Reservoir to J.C. Boyle Dam show little change in bed composition during drawdown. There is little or no change in bed material in response to drawdown upstream of J.C. Boyle Reservoir

and from J.C. Boyle Dam to Copco No. 1 Reservoir, regardless of water year type (Attachment F-1, Figures F1-10 to F1-15). These reaches are currently predominantly (90%) cobble, with small fractions of gravel and sand. This composition is maintained throughout the short-term (2-year) model simulation.

The short-term model simulations indicate decreases in the combined proportion of sand and finer sediment in the river reach from Copco No. 2 Dam to Iron Gate Reservoir. The wet, median, and dry simulations indicate decreases in the proportion of sand and finer sediment to approximately 20, 30, and 35%, respectively, (Figure F-7 and Figure F-8).

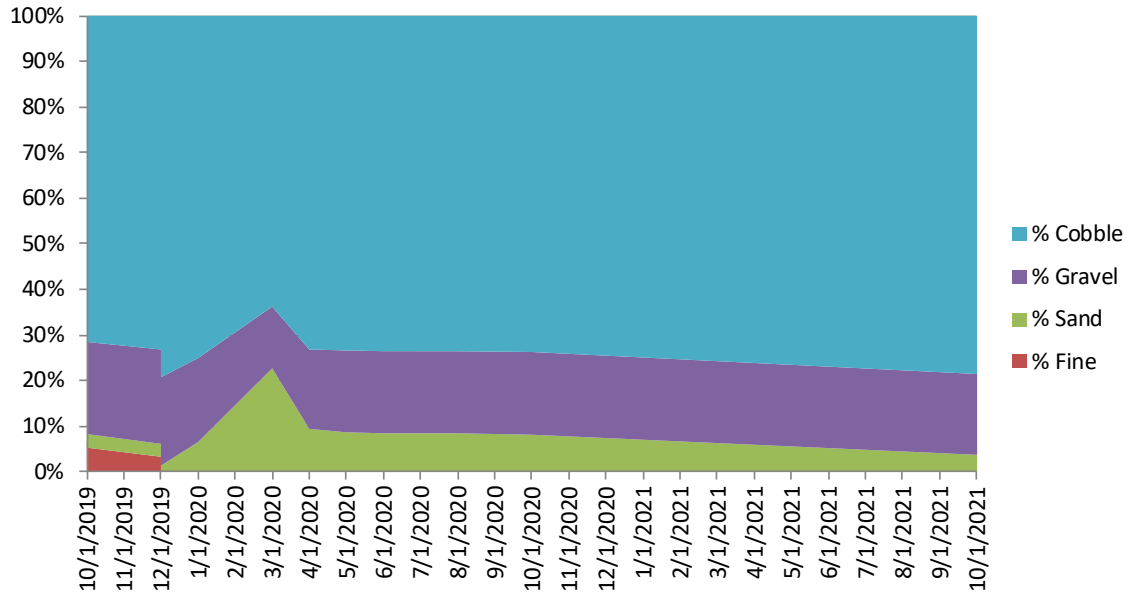

Figure F-7. Simulated Bed Composition from Copco No. 2 Dam to Iron Gate Reservoir for Two Successive Wet Water Years during and after Drawdown (based on simulation results provided by USBR, March 2012).

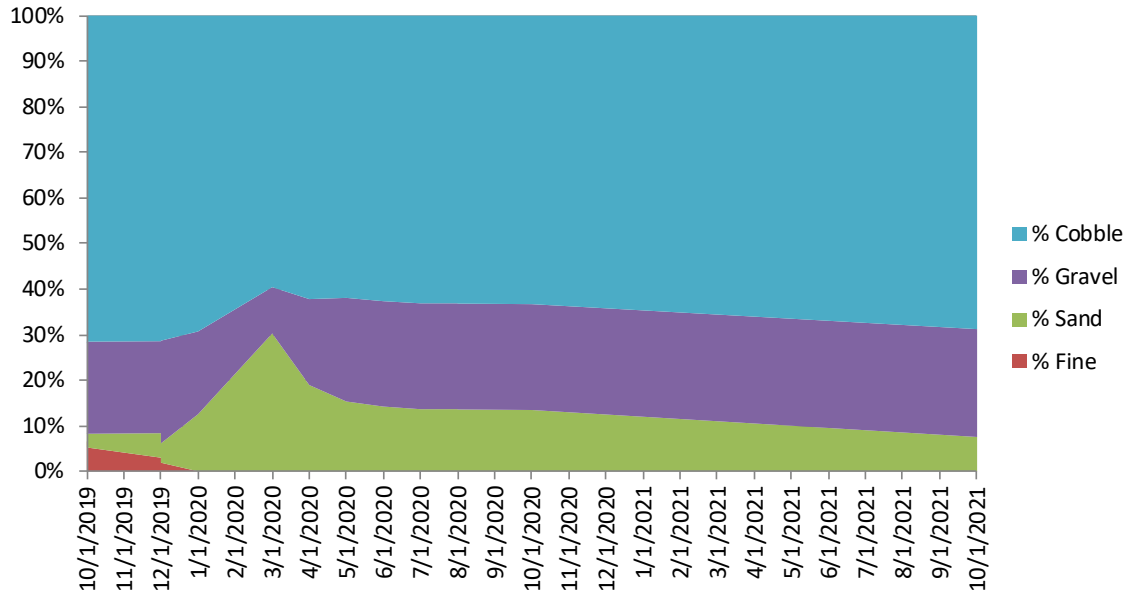

Figure F-8. Simulated Bed Composition from Copco No. 2 Dam to Iron Gate Reservoir for Two Successive Median Water Years during and after Drawdown (based on simulation results provided by USBR, March 2012).

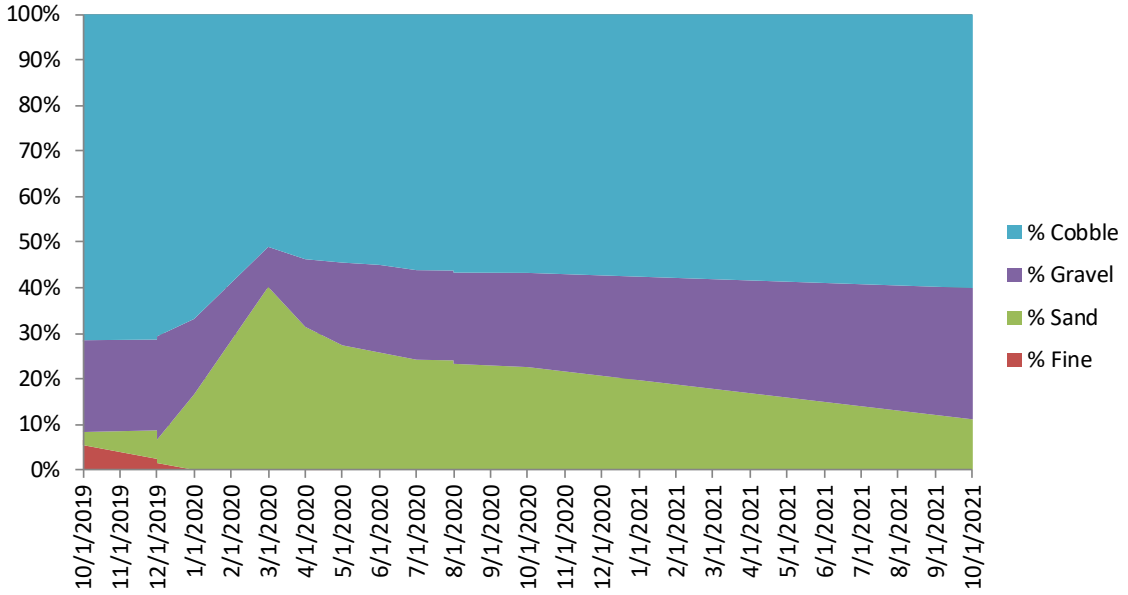

Figure F-9. Simulated Bed Composition from Copco No. 2 Dam to Iron Gate Reservoir for Two Successive Dry Water Years during and after Drawdown (based on simulation results provided by USBR, March 2012).

Fall-Run Chinook Salmon

The Proposed Project Could Have Effects on Pool-Riffle Habitat

The Proposed Project would erode sediment from reservoirs within the Hydroelectric Reach and result in a small amount (less than 0.5 feet) of deposition in river reaches

between reservoirs (Figure F-2 and Figure F-3). The return of riverine processes in reservoir reaches would likely establish a channel with historical (pre-dam) bed elevations and composition within six months, likely resulting in and maintaining pool-riffle morphology similar to the reach downstream from Iron Gate Dam (PacifiCorp 2004). This would likely create holding and rearing habitat for anadromous salmonids within the Hydroelectric Reach. Removal of the dams would provide Chinook salmon access to these habitats in upstream reaches.

The Proposed Project Could Have Effects on Spawning Habitat

The Proposed Project would likely increase median substrate sizes in the Hydroelectric Reach. SRH-1D model simulations indicate that the median grain size would range from coarse gravel (16–32 mm) to small cobble (64–128 mm) during the first fall-run Chinook salmon spawning season following dam removal (Figure F-4, Figure F-5, and Figure F-6). These grain sizes are suitable for Chinook salmon spawning (Kondolf and Wolman 1993). River reaches between reservoirs would provide suitable spawning gravel for fall-run Chinook salmon (Attachment F-1, Figures F1-10 to F1-15). The proportion of sand in the bed may remain high in former reservoir reaches (Figure F-9, Attachment F-1, Figures F1-1 to F1-9), which could impact spawning (Chapman 1988).

Spring-Run Chinook Salmon

Spring-run Chinook salmon distribution extends from the mouth of the Klamath River upstream to its confluence with the Salmon River (Stillwater Sciences 2010b). Most spawning and rearing take place within the Salmon and South Fork Trinity rivers. The current distribution of spring-run Chinook salmon does not extend as far as the Hydroelectric Reach. Spring-run Chinook salmon would likely expand their range in response to dam removal and benefit from this action in the same manner as fall-run Chinook salmon. Because spring-run Chinook salmon generally do not spawn in the mainstem, the benefits of increased coarse sediment supply and finer channel substrate in the mainstem Klamath River downstream of Iron Gate Dam would be less than that for fall-run Chinook salmon.

Coho Salmon

The Proposed Project would restore access for coho salmon to the mainstem Klamath River and its tributaries upstream of Iron Gate Dam, increasing available rearing and spawning habitat. The changes to pool and spawning habitat described above for fall-run Chinook salmon may also provide suitable conditions for coho salmon holding, spawning, and rearing. Coho generally do not spawn in the mainstem Klamath River, but would benefit from having access to tributaries upstream of Iron Gate Dam.

Summer Steelhead

Summer steelhead distribution extends from the mouth of the Klamath River upstream to Empire Creek (RM 168.4) and may be rare above Seiad Creek (RM 131.9) due to seasonally high water temperatures (NRC 2004). With the removal of the dams, summer steelhead would be able to re-establish throughout much of their historical range, including the mainstem and tributaries within the Hydroelectric Reach and the upper basin (Hamilton et al. 2005). Under the Proposed Project, increased coarse sediment supply and finer channel substrate in the mainstem Klamath River downstream of Iron Gate Dam would improve spawning habitat, and improved pool habitat would benefit rearing summer steelhead.

Winter Steelhead

Winter steelhead generally spawn and rear in tributaries (FERC 2007). There is no record of winter steelhead spawning in the mainstem Klamath River, which is used mainly as a migration corridor for adults and juveniles (NRC 2004). With the removal of the dams, winter steelhead would be able to re-establish throughout much of their historical range, including the mainstem and tributaries within the hydroelectric reach and the upper basin (Hamilton et al. 2005). Under the Proposed Project, improved pool habitat would benefit rearing winter steelhead.

Green Sturgeon

Green sturgeon are distributed from the mouth of the Klamath River upstream to the Salmon River (RM 66.3). Green sturgeon have been observed occasionally migrating into the Salmon River. Most spawning and rearing takes place within the lower mainstem Klamath and Trinity rivers. Changes in bedload sediment under the Proposed Project are not anticipated to affect green sturgeon.

Redband Trout

Within the Hydroelectric Reach, redband trout migrate between tributaries, free flowing Lower Klamath Project reaches, and reservoirs to complete their lifecycle (Hamilton et al. 2011). The Proposed Project would eliminate reservoir habitat, returning sections of the Hydroelectric Reach currently inundated by reservoirs and riverine sections between reservoirs to a pool-riffle morphology. Although most redband trout are anticipated to continue to spawn in tributaries, after dam removal, spawning gravel in all sections of the Hydroelectric Reach would be within the range usable for redband trout, but the amount of sand within the bed within former reservoir sections might inhibit spawning success in the short term. Riverine sections between reservoirs would be expected to contain gravel with very little sand, suggesting high-quality spawning habitat would become available within a few years following dam removal. The initial movement of coarse and fine sediment after drawdown would likely create unfavorable conditions for redband trout within the mainstem Klamath River, but these conditions would be short term. Buchanan et al. (2011a) estimate that 43 miles of additional riverine habitat would be available to resident redband trout as a result of the Proposed Project.

Lost River and Shortnose Suckers

Federally endangered Lost River and shortnose suckers occur within the Hydroelectric Reach. The Proposed Project would eliminate reservoir habitat. All individual suckers occurring within these reservoirs would likely be lost within dam removal year 2; however, these individuals are not considered to substantially contribute to the achievement of conservation goals or recovery, since little or no reproduction occurs downstream from Keno Dam (Buettner et al. 2006), and there is no potential for interaction with upstream populations (Hamilton et al. 2011). Although both species are fully protected species under California Fish and Game Code, Section 2081.11 was added to the Fish and Game Code under Assembly Bill Number 2640 (Wood 2018) to allow CDFW to authorize the take of both sucker species resulting from impacts attributable to the decommissioning and removal of the Lower Klamath Project facilities, consistent with the Proposed Project. Changes in bedload sediment under the Proposed Project are not anticipated to affect Lost River and shortnose suckers.

Non-native Reservoir Fish

As discussed above, the Proposed Project would eliminate reservoir habitat as dams are removed. Changes in bedload sediment under the Proposed Project are not anticipated to affect non-native reservoir fish.

F.5.2 Lower Klamath River: Downstream from Iron Gate Dam

The Klamath River channel downstream of Iron Gate Dam would be affected by sediment eroded from reservoirs and by restoring sediment delivery from upstream areas. Eighty-five percent of the sediment stored within Lower Klamath Project reservoirs is silt and clay size (less than 0.063 mm), with 15% sand or coarser (greater than 0.063 mm) (GEC 2006, Stillwater Sciences 2008, USBR 2012). Most sediment eroded from the reservoirs would therefore be silt and clay, with smaller fractions of sand (0.063 to 2 mm), gravel (2 to 64 mm), and cobble (64 to 256 mm) (GEC 2006, Stillwater Sciences 2010c, USBR 2012) (Table F-2). Silt and finer sediment, which comprise a large proportion of the stored sediment volume, would likely be transported in suspension and would travel to the ocean shortly after being eroded from the reservoir deposits (GEC 2006). Coarser (greater than 0.063 mm) sediment would travel downstream more slowly, attenuated by channel storage and the frequency and magnitude of mobilizing flows. The amount of sand transported in suspension would vary with flow, with greater proportions of sand in suspension at higher flows. Table F-2 reports the total amount of sediment that would be eroded from Lower Klamath Project reservoirs and delivered to the Klamath River downstream of Iron Gate Dam. The amount of sediment released to the reaches downstream of Iron Gate Dam will generally be lower than the amount of sediment eroded from each reservoir due to sediment deposition in the reaches between the existing dams and within the former reservoir areas.

Table F-2. Estimated Mass (tons)[1] of Reservoir Sediment Released Below Iron Gate by Size for Wet, Median, and Dry Water Year Types During the First Year After Dam Removal.

Sediment Size	Wet	Median	Dry
Silt (<0.063 mm)	2,352,233	1,808,719	1,238,525
Sand (0.063 to 2.0 mm)	185,797	276,558	124,371
Gravel (2 to 64 mm)	37,942	18,213	1,116
Cobble (64 to 256 mm)	5,889	1,513	76
Total	**2,581,862**	**2,105,002**	**1,364,089**

Source: USBR 2012

[1] Dry weight

F.5.2.1 Downstream Extent of Effects

The effects of sediment delivery from reservoirs and upstream areas will likely extend to the Cottonwood Creek confluence (USBR 2012). Reach-averaged stream power (based on channel width, depth, and slope) decreases from Iron Gate Dam to Cottonwood Creek and then increases downstream of Cottonwood Creek (Figure F-10). The increase suggests that short-term and long-term coarse sediment deposition is unlikely downstream of Cottonwood Creek. Using Cottonwood Creek as the downstream extent of effects related to increased coarse sediment supply, eight miles of channel could potentially be affected by sediment delivery from reservoirs and upstream areas. The affected channel length is four percent of the total 190-mile Klamath River channel

length downstream of Iron Gate Dam. The channel bed downstream of Cottonwood Creek is expected to be more mobile due to the additional supply and transport of sand.

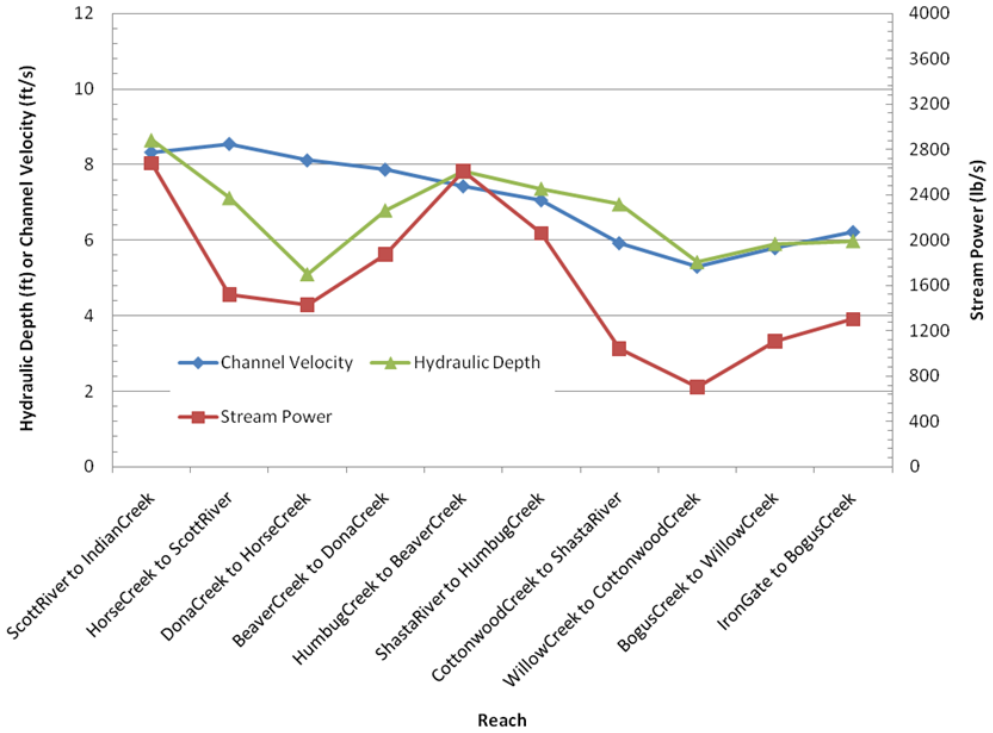

Figure F-10. Reach-Averaged Channel Velocity, Hydraulic Depth, and Stream Power Downstream from Iron Gate Dam during a 2-Year Peak Flow (USBR 2012).

F.5.2.2 Changes in Bed Elevation

Short-term (2-year) model simulations indicate no significant deposition between Iron Gate Dam and Bogus Creek (RM 192.6), up to about 0.9 feet of reach-averaged deposition between Bogus Creek and Willow Creek (RM 188.0), and up to about 0.4 feet of deposition from Willow Creek to Cottonwood Creek (USBR 2012) (Figure F-11, Figure F-12, Figure F-13). Model simulations indicate that reaches located farther downstream will change little (< 0.5 ft). Eight miles of the Klamath River mainstem channel could potentially be affected by sediment release and resupply, representing 4 percent of the total mainstem channel length downstream of Iron Gate Dam (190 miles). Bed elevations over the long-term (from 5 to 50 years) would adjust to a new equilibrium in response to the restored sediment supply from upstream areas. Model simulations predict 2 to 3 feet of aggradation between Iron Gate Dam and Cottonwood Creek over the next 50 years (USBR 2012).

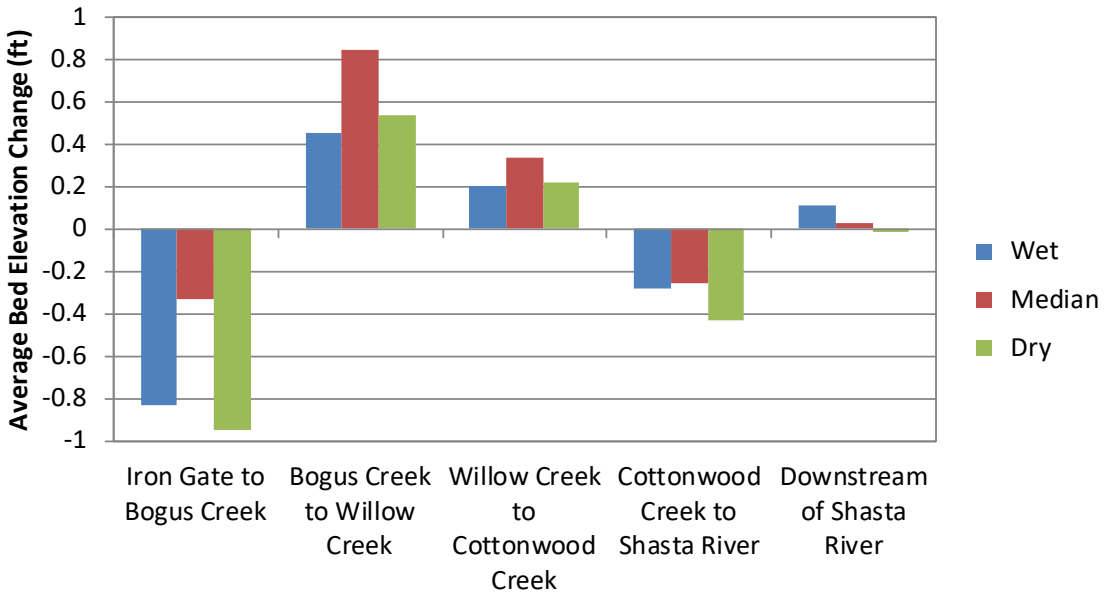

Figure F-11. Reach-Averaged Bed Elevation Change for Two Successive Wet, Median, or Dry Water Years Following Dam Removal (based on simulation results provided by USBR, March 2012).

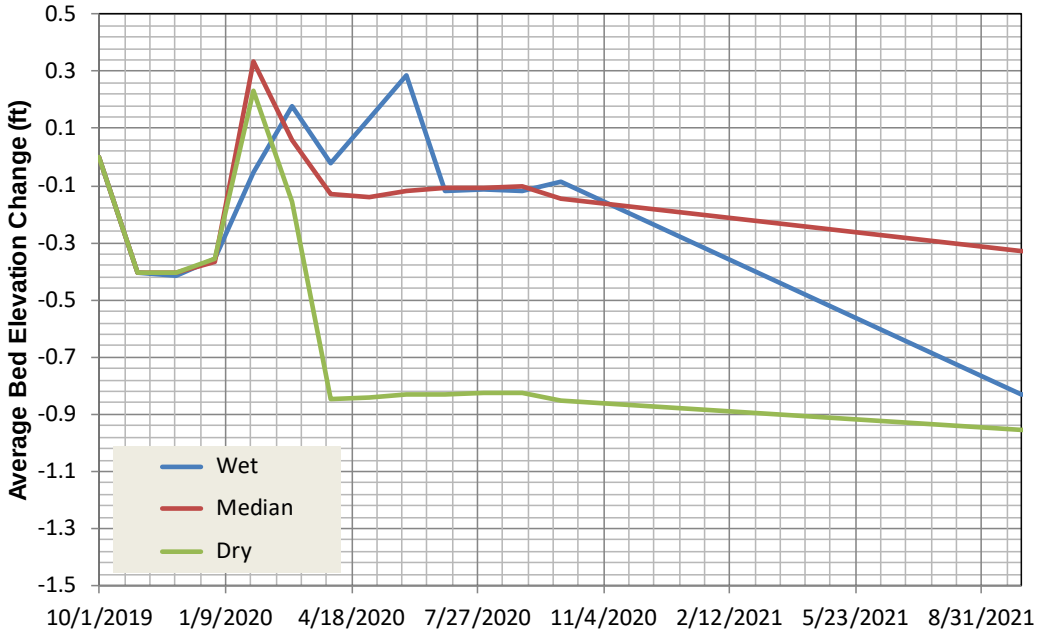

Figure F-12. Reach-Averaged Bed Elevation Change for Two Successive Wet, Median, or Dry Water Years following Dam Removal from Iron Gate Dam to Bogus Creek (based on simulation results provided by USBR, March 2012).

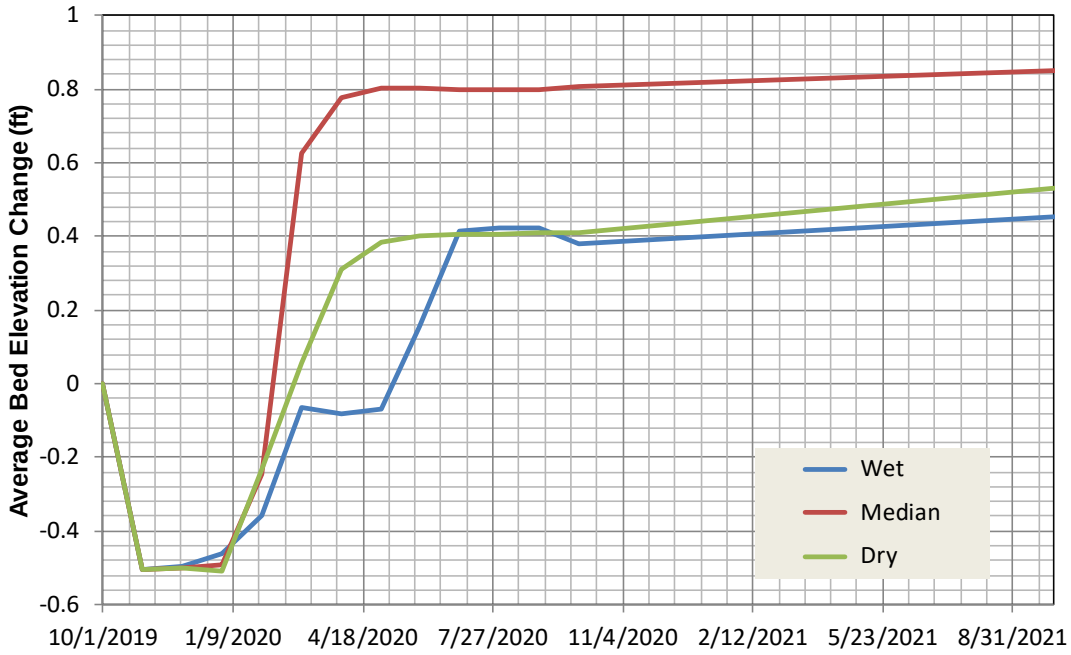

Figure F-13. Reach-Averaged Bed Elevation Changes for Two Successive Wet, Median, or Dry Water Years following Dams Removal from Bogus Creek to Willow Creek (based on simulation results provided by USBR, March 2012).

F.5.2.3 Changes in Bed Substrate

In the short-term (2 years following drawdown), model simulations indicate sediment delivery from reservoirs and upstream areas would increase the proportion of sand in the channel bed and decrease median grain size (USBR 2012). Under wet, median and dry simulations, sand within the bed in the reach from Iron Gate to Bogus Creek would increase to 30 to 35 percent by March to June of the drawdown year, gradually decreasing to 10 to 20 percent by September two years later. Median grain size would fluctuate slightly before stabilizing to approximately the initial condition of 100 mm (Figure F-14, Figure F-15, Figure 16, and Figure F-17). Model simulations indicate a decrease in median grain size (from an initial value of approximately 80 mm down to 40 to 65 mm) and an increase in the proportion of sand (up to 40 percent) in the reach from Bogus Creek to Willow Creek (Attachment F-1 Figures F1-16 to F1-19). Model simulations indicated an increase in the proportion of sand (up to 35 percent) and a decrease in median grain size (from an initial value of approximately 65 mm down to 38 to 45 mm) in the reach from Willow Creek to Cottonwood Creek (Attachment F-1, Figures F1-20 to F1-23).

The probability of transporting fine sediment out of the reach from Iron Gate Dam to Bogus Creek depends on flow magnitude and duration. USBR (2012) estimated that a flow of 6,000 cfs would be necessary to flush sands and fine material from the bed following dam removal. This flow is approximately equal to the 2-year flood (50 percent probability of occurring in a given year) at Iron Gate. If the dams are removed during a median or dry year, the probability that sand and finer sediment would be flushed from the bed is 50 percent by the end of the first year following removal, 75 percent by the

end of second year following removal, and over 95 percent by end of the fifth year following removal.

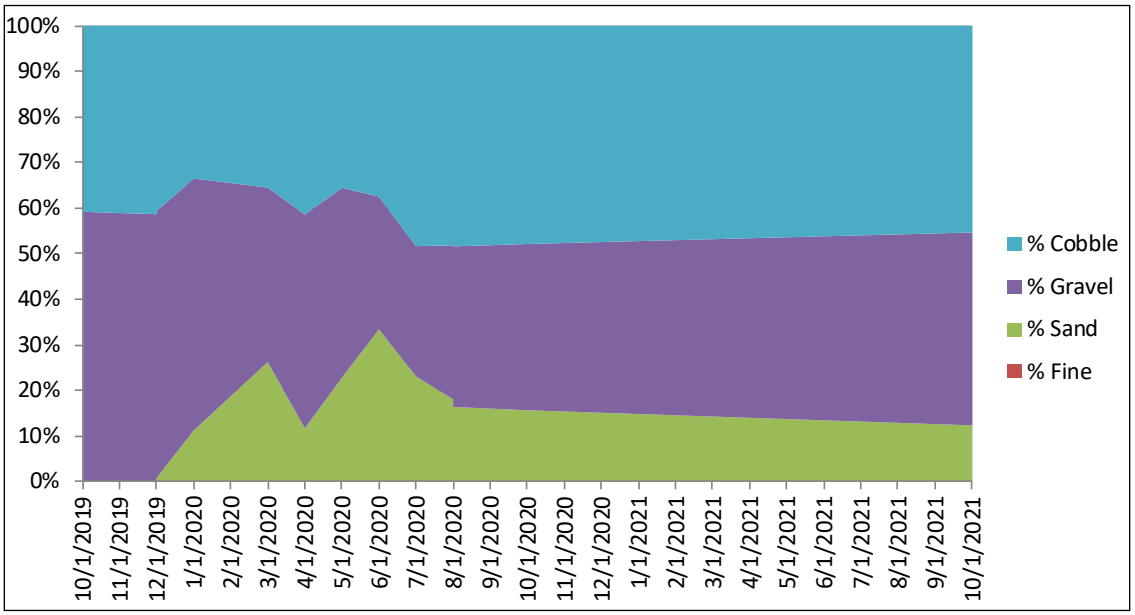

Figure F-14. Simulated Bed Composition from Iron Gate Dam to Bogus Creek for Two Successive Wet Water Years Following Dam Removal (based on simulation results provided by USBR, March 2012).

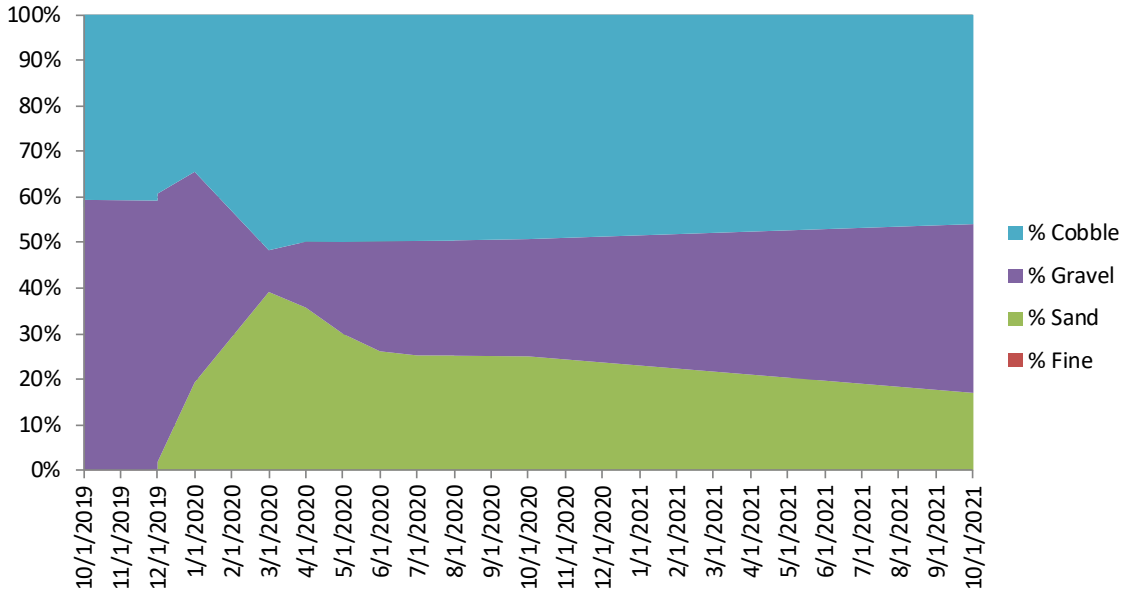

Figure F-15. Simulated Bed Composition from Iron Gate Dam to Bogus Creek for Two Successive Median Water Years Following Dam Removal (based on simulation results provided by USBR, March 2012).



Figure F-16. Simulated D_{50} (mm) From Iron Gate Dam to Bogus Creek for Successive Wet, Median, and Dry Water Years Following Dam Removal (based on simulation results provided by USBR, March 2012).

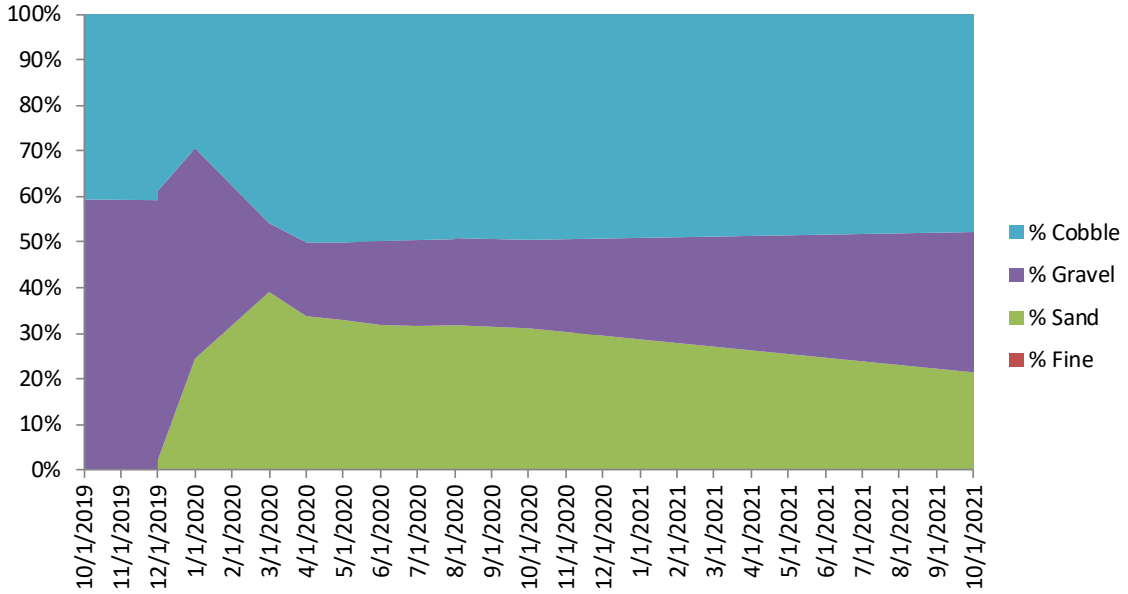

Figure F-17. Simulated Bed Composition from Iron Gate Dam to Bogus Creek for Two Successive Dry Water Years Following Dam Removal (based on simulation results provided by USBR, March 2012).

Longer-term (5, 10, 25, and 50 years) model simulations indicate increases in the proportion of sand to 5 to 22 percent and decreases in D_{50} to approximately 50 to 55 mm

(Attachment F-1, Figures F1-24 to F1-30) after five years. These changes stabilize and continue through year 50. Model simulations indicate no long-term changes in bed composition or substrate size in the mainstem Klamath River downstream from Cottonwood Creek (USBR 2012).

Under the Proposed Project, the channel bed elevations would increase in response to increased sediment supply. Flows required to mobilize the channel bed would decrease. USBR (2012) estimated the magnitude and return period of flows required to mobilize sediment downstream from Iron Gate Dam, 10 years after dam removal, using reach-averaged predicted grain sizes from long-term SRH-1D simulations. The estimates indicate that under the Proposed Project, the threshold for bed mobilization from Bogus Creek to Willow Creek and from Willow Creek to Cottonwood Creek would range from 3,000 to 7,000 cfs (1.5- to 2.5-year return period) and 5,000 to 9,000 cfs (1.5- to 3.2-year return period), respectively. These mobility thresholds are lower than under current conditions and the No Project Alternative. Downstream from the Shasta River, there would be no difference in flow magnitudes required for bed mobilization between the Proposed Project and current conditions or the No Project Alternative.

Bedload sediment effects on aquatic species

Fall-run Chinook Salmon

The Proposed Project Could Have Short-term Effects on Spawning Habitat

The proportion of sand in the channel bed will likely be higher during the first four months following dam removal than under existing conditions. More interstitial sand in the Klamath River channel upstream of the Cottonwood Creek confluence could reduce embryo survival-to-emergence in these reaches (Chapman 1988). The approximately 8-mile affected channel length encompasses only four percent of the current total Klamath River channel length. These effects would be most apparent in successive median or dry years following dam removal, but less apparent in successive wet years.

USBR (2012) estimated that a flow of 6,000 cfs would be necessary to flush sands and fine material from the bed following dam removal. This flow is approximately equal to the 2-year flood (50 percent probability of occurring in a given year) at Iron Gate. If the dams are removed during a median or dry year, the probability that sand and finer sediment would be flushed from the bed is 50 percent by the end of the first year following removal, 75 percent by the end of second year following removal, and over 95 percent by end of the fifth year following removal. Flume experiments (Wooster et al. 2008) found that the amount of fine sediment infiltrating into a static channel bed during sediment pulses decreased with depth below the surface, with significant deposition observed to a shallow depth (i.e., a thickness less than the diameter of the D_{90} grain size). The results suggest that fine sediment infiltration into the gravel bed (and potential spawning gravel) following dam removal would likely be short-lived due to bed mobility and sediment transport during subsequent high flows (Stillwater Sciences 2008).

Short-term (two-year) sediment aggradation following dam removal may be substantial between Iron Gate Dam and Willow Creek (Figure F-12 and Figure F-13). Deposition in these reaches is expected to temporarily bury redds and associated eggs to depths that would adversely affect alevin emergence. The depth of sediment deposition in reaches downstream of Willow Creek likely would not affect survival-to-emergence.

The proportion of sand in the channel bed would be higher during the first and potentially the second years following dam removal than under current conditions (Figure F-14,

Figure F-15, Figure F-17). Salmonids select spawning habitat that maximizes egg survival and are adapted to natural geomorphic processes that alter these habitats from year to year. Adults returning during the first and second years following dam removal would spawn in the reach from Iron Gate Dam to Cottonwood Creek if suitable habitat is present. If no suitable habitat exists, adults may spawn in downstream reaches or newly accessible upstream reaches with suitable habitat. Because of these behavioral adaptations, eggs from fall-run Chinook salmon returning during the first and second years following dam removal would likely be unaffected by the geomorphic changes described above.

Any fall-run Chinook salmon eggs deposited in the reach from Iron Gate Dam to Willow Creek during the Fall prior to dam removal would likely experience high mortality. More successful survival-to-emergence would occur downstream of Cottonwood Creek. These potential negative impacts affect a small proportion of the total habitat available in the mainstem Klamath River downstream of Iron Gate Dam and do not affect habitat in tributaries. Finally, these effects will likely occur only during the first and possibly the second years following dam removal.

The Proposed Project Could Have Long-term Effects on Spawning Habitat

Model simulations indicate that five years after dam removal, the proportion of sand in the bed would be less than 15 percent and the median grain sizes will decrease from existing conditions to near 55 mm in all reaches from Iron Gate Dam to Cottonwood Creek (Attachment F-1, Figures F1-24 to F1-30) (USBR 2012). Less than 15 percent sand in spawning gravel is not expected to substantially reduce survival-to-emergence, and 55 mm gravel is suitable for Chinook salmon spawning (Kondolf and Wolman 1993). Long-term changes in bed elevation and substrate size are expected to improve spawning habitat and benefit fall-run Chinook salmon.

The Proposed Project Could Have Short-term Effects on Pool Habitat

The Proposed Project may result in sediment deposition in pools and other slack water habitat features used for adult holding or juvenile rearing in the 8-mile reach downstream from Iron Gate Dam. These effects on the depth and area of available pool habitat are likely to be most apparent in the 5.1-mile reach from Iron Gate Dam to Willow Creek (Figure F-11 and Figure F-12). The SRH-1D model estimates reach-average changes in bed elevation and substrate size but cannot simulate these changes at the scale of individual geomorphic features (e.g., pools) or the spatial distribution of these changes within a reach (USBR 2012). Flume experiments conducted by Stillwater Sciences (2008) found that a coarse-bedded channel with pool-riffle morphology, similar to that found in the Klamath River below Iron Gate Dam, would maintain pool topography during transient sediment deposition in response to a pulse of increased sediment delivery. Pools are erosional features that typically evacuate sediment before other morphologic units (e.g., riffles). Pool depths would likely return to depths observed prior to dam removal after the initial sediment wave resulting from dam removal passes (Stillwater Sciences 2008). These effects would be most apparent in the 5.1-mile length of channel between Iron Gate Dam and the Willow Creek confluence (Figure F-11). The affected channel length encompasses less than three percent of the current total Klamath River channel length. The fall-run Chinook salmon life stages that use pools (e.g., adults, juveniles, and fry) will utilize other suitable habitats. These results suggest that the effects of the Proposed Project on pool habitat would likely be short term.

The Proposed Project Could Have Long-term Effects on Pool Habitat
In the long-term (from 5 to 50 years) after the initial wave of sediment from the Proposed Project passes downstream, bed elevations would adjust to a new equilibrium in response to sediment supply from upstream areas (sediment that was formerly trapped by dams within the Hydroelectric Reach). The river would likely revert to and maintain a natural pool-riffle morphology, with pool frequency, size, and depth similar to current conditions.

Spring-Run Chinook Salmon
Spring-run Chinook salmon would likely distribute upstream of Iron Gate Dam under the Proposed Project. Chinook salmon may be affected by short- and long-term effects on pool habitat, as described above for fall-run Chinook salmon. Spring-run Chinook salmon are not expected to spawn in the mainstem channel.

Coho Salmon
The Proposed Project Could Have Short-term Effects on Spawning Habitat
Most coho salmon spawn in tributaries to the Klamath River. Most rearing occurs on these tributaries as well, although some coho juveniles may rear in the mainstem when conditions in the tributaries become unsuitable. The effects of the Proposed Project on bed elevations and grain size would likely eradicate any coho salmon eggs that were spawned on the mainstem above Willow Creek in the year preceeding dam removal (as described above for fall-run Chinook salmon). The effect is expected to be small because most coho salmon spawning occurs in the tributaries. In the years following dam removal, no effect is expected because coho salmon would be able to behaviorally adapt (e.g., disperse to other suitable spawning habitat) in response to changes in bed elevation and grain size.

The Proposed Project Could Have Long-term Effects on Spawning Habitat
Model simulations indicate that the proportion of sand in the bed would be less than 15 percent and median grain sizes would decrease in all reaches from Iron Gate Dam to Cottonwood Creek five years after dam removal (Attachment F-1, Figures F1-24 to F1-30) (USBR 2012). The decrease in median substrate size may increase the availability and quality of mainstem spawning habitat for coho salmon, although most coho spawning is still anticipated to occur in tributaries. The increase in sand composition within spawning gravel is not expected to substantially reduce survival-to-emergence (Chapman 1988).

The Proposed Project Could Have Short-term Effects on Pool Habitat
The effects on coho salmon resulting from short-term pools filling in the mainstem channel would be minor and short term for the same reasons described above for fall-run Chinook salmon.

The Proposed Project Could Have Long-term Effects on Pool Habitat
The effects on coho salmon resulting from long-term pool filling in the mainstem would be negligible because the river would likely revert to and maintain a natural pool-riffle morphology, with pool frequency, size, and depth similar to current conditions.

Summer Steelhead
Summer steelhead currently occupy the Klamath River downstream of Empire Creek (RM 168.4). This run of steelhead spawns in tributaries, although some fish may rear in the mainstem. Based on the current distribution, short-term changes in bed elevation

and grain size are not expected to affect summer steelhead, and long-term benefits are similar to those described above for coho salmon.

Winter Steelhead
Winter steelhead adults and juveniles occupy the Klamath River upstream to Iron Gate Dam, using the mainstem primarily as a migration corridor (NRC 2004). Like summer steelhead, spawning occurs in tributaries (NRC 2004). Changes in bed elevation and grain size would not impact spawning habitat or incubation, and would have minimal effect on rearing habitat as described above for fall-run Chinook salmon and summer steelhead.

Northern Green Sturgeon
Northern Green Sturgeon currently occupy the Klamath River from the mouth upstream to Ishi Pishi Falls (Moyle 2002, FERC 2007), with some observed migration into the Salmon River. As discussed above, effects of the Proposed Project on bed elevations and grain size in response to increased sediment supply and transport likely extend down to the Cottonwood Creek confluence. The Proposed Project would likely not affect Northern Green Sturgeon.

F.5.3 Klamath River Estuary

Effects of the Proposed Project on bed elevations and grain size related to increased sediment supply will likely extend only to the Cottonwood Creek confluence (RM 185.1). Therefore, the Proposed Project is unlikely to have an effect on bed elevations, grain size, and associated aquatic habitats in the Klamath River Estuary.

F.5.4 Pacific Ocean Near Shore Environment

Effects of the Proposed Project on bed elevations and grain size related to increased sediment supply will likely extend only to the Cottonwood Creek confluence (RM 185.1). Therefore, the Proposed Project is unlikely to have an effect on bed elevations, grain size, and associated aquatic habitats in the Pacific Ocean nearshore environment.

F.6 Partial Removal Alternative

The Partial Removal Alternative would remove enough of each dam to allow free-flowing river conditions and volitional fish passage at all times. Under the Partial Removal Alternative, portions of each dam would remain in place along with ancillary buildings and structures such as powerhouses, foundations, tunnels, and pipes. Under this alternative, embankment/earth-filled dam and concrete dam structures would be removed similar to the Proposed Project, allowing release of sediment stored in the reservoirs. Effects to channel bed elevation, grain size, and associated impacts to aquatic habitat under the Partial Removal Alternative are expected to be the same as those for the Proposed Project.

F.7 Continued Operations with Fish Passage

Under the Continued Operations with Fish Passage Alternative, fish passage structures would be installed at each dam to allow for upstream fish passage. No portion of the dams would be removed under this alternative and sediment would continue to be stored

behind Lower Klamath Project dams, similar to the No Project Alternative. Effects to channel bed elevation, grain size, and associated impacts to aquatic habitat under the Continued Operations with Fish Passage Alternative are expected to be the same as those for the No Project Alternative.

F.8 Two Dam Removal Alternative

This scenario has not been modeled, but the effects to channel bed elevation, grain size, and associated impacts to aquatic habitat are expected to be similar but of lesser magnitude than those occurring under the Proposed Project.

F.9 Three Dam Removal Alternative

This scenario has not been modeled, but the effects to channel bed elevation, grain size, and associated impacts to aquatic habitat are expected to be similar but of lesser magnitude than those occurring under the Proposed Project.

F.10 No Hatchery Alternative

This scenario has not been modeled, but the effects to channel bed elevation, grain size, and associated impacts to aquatic habitat are expected to be the same as those occurring under the Proposed Project.

F.11 References

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Attachment F-1

Potential Effects of Dam Removal on Channel Bed Elevations, Grain Size, and Related Anadromous Fish Habitat Impacts in the Hydroelectric Reach of the Lower Klamath River from Iron Gate Dam to the Cottonwood Creek Confluence

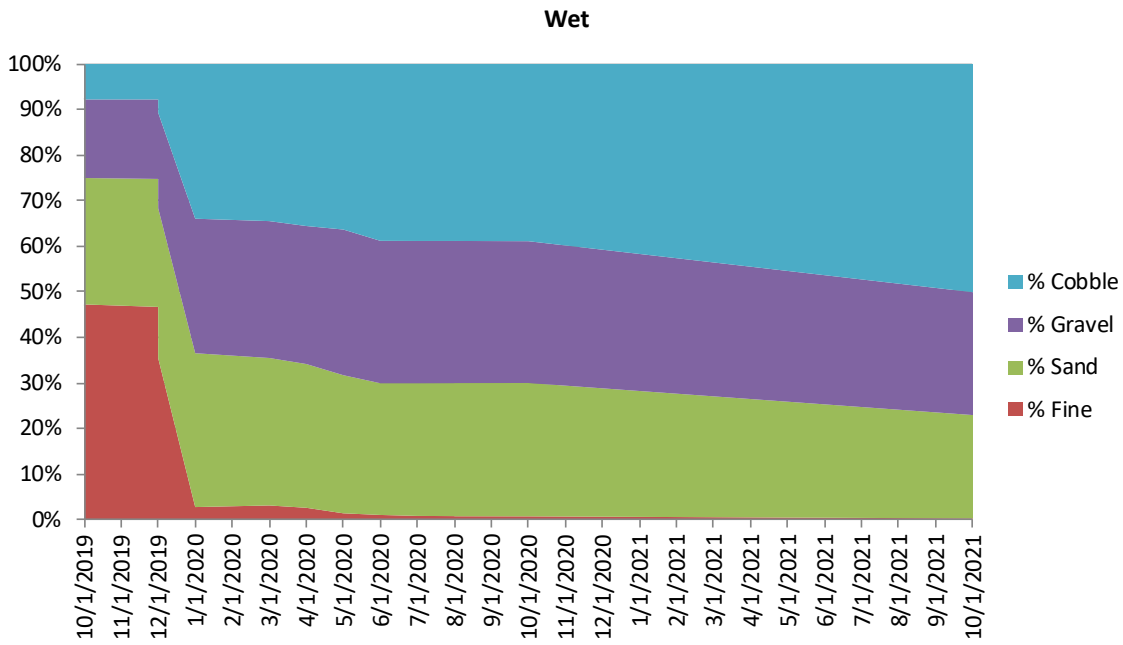


Figure F1-1. Simulated Bed Composition for J.C. Boyle Reservoir for Two Successive Wet Water Years Following Dam Removal. Based on simulation results provided by USBR, March 2012.

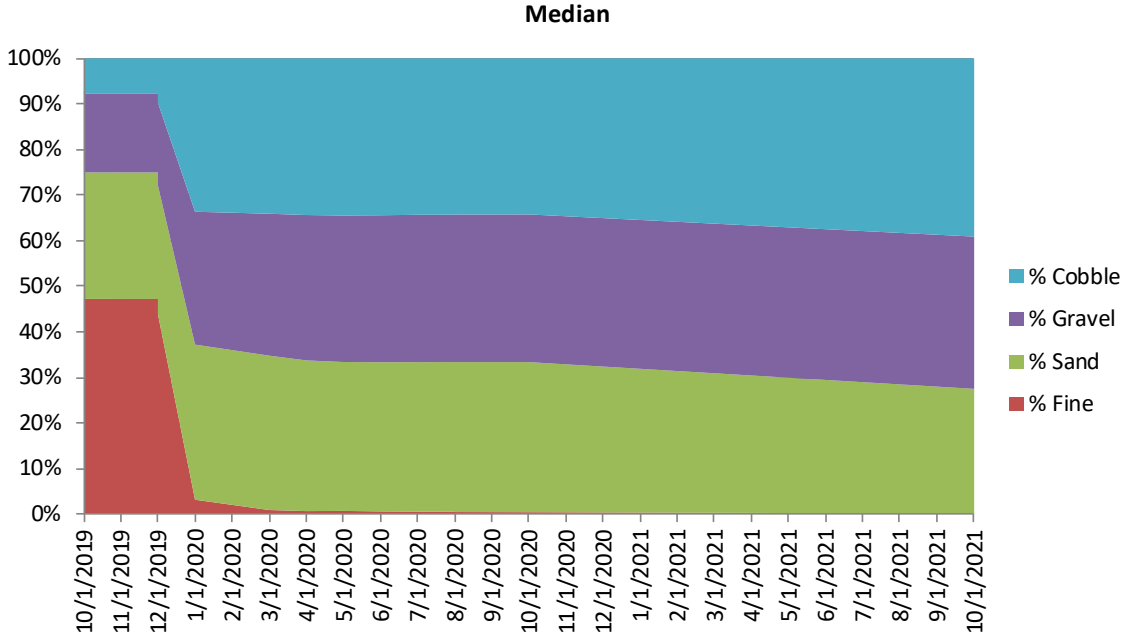


Figure F1-2. Simulated Bed Composition for J.C. Boyle Reservoir for Two Successive Median Water Years Following Dam Removal. Based on simulation results provided by USBR, March 2012.

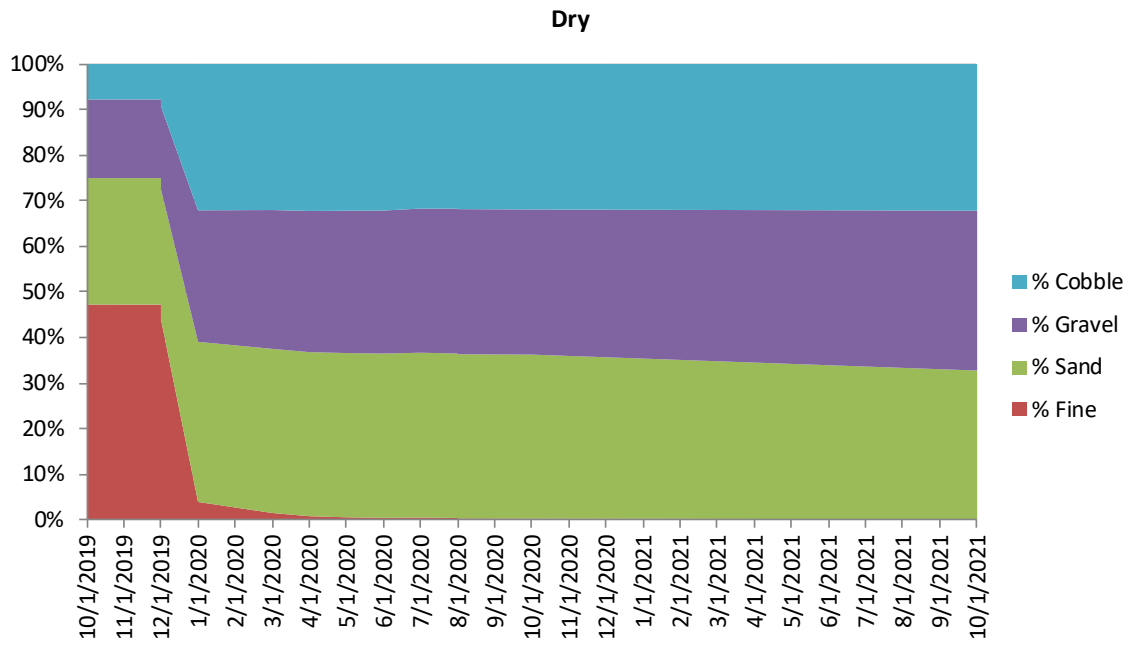


Figure F1-3. Simulated Bed Composition for J.C. Boyle Reservoir for Two Successive Dry Water Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

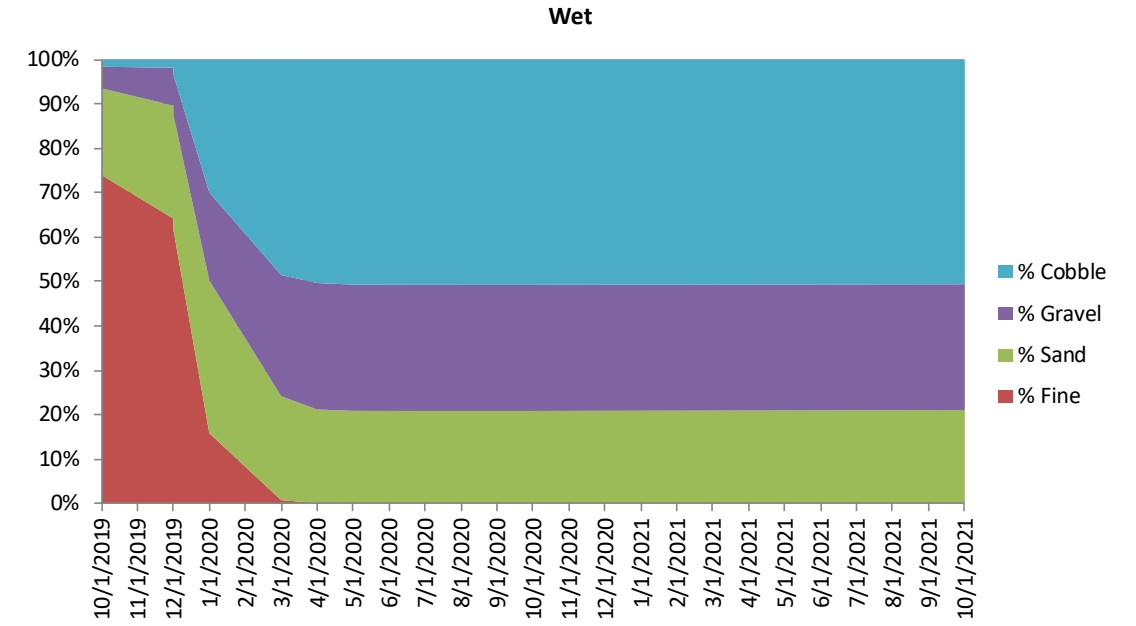


Figure F1-4. Simulated Bed Composition for Copco No. 1 Reservoir for Two Successive Wet Water Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

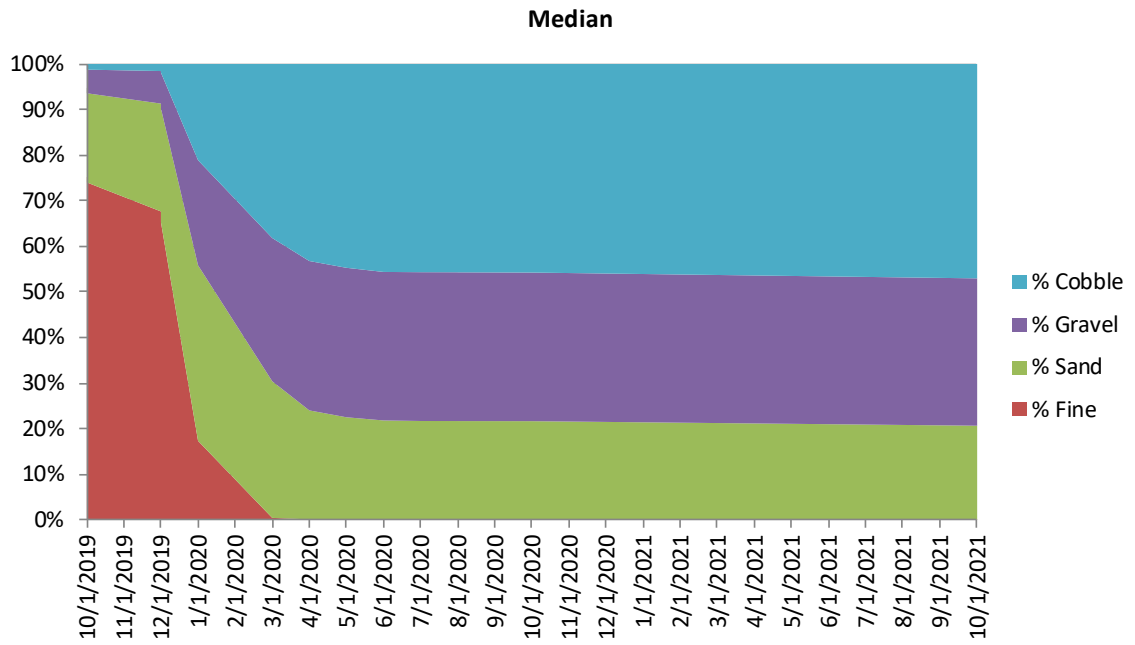


Figure F1-5. Simulated Bed Composition for Copco No. 1 Reservoir for Two Successive Median Water Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

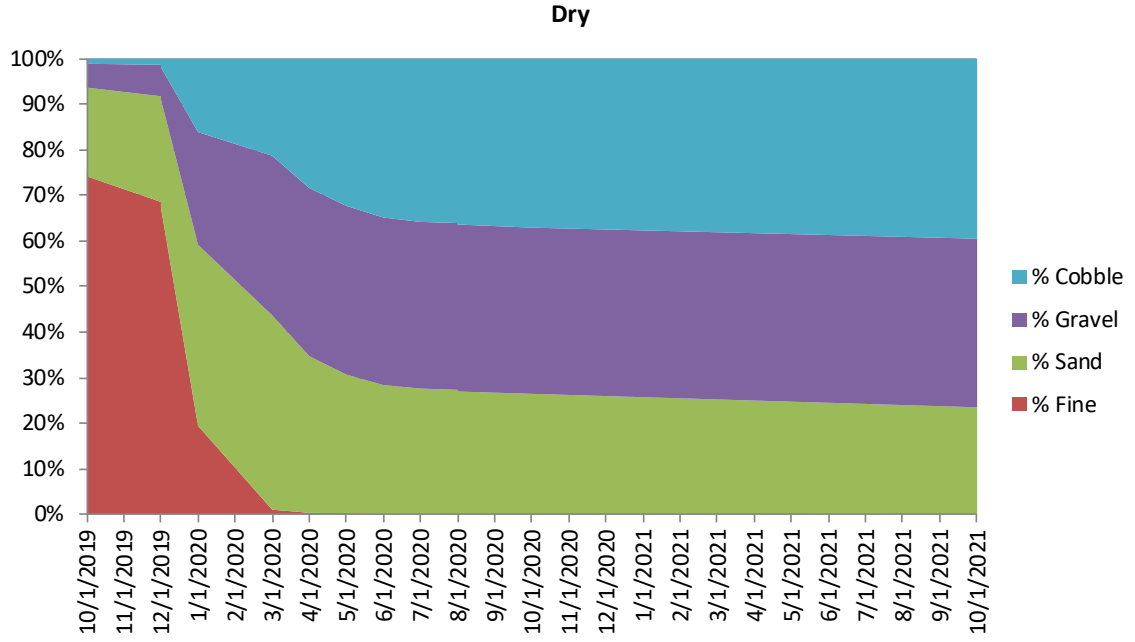


Figure F1-6. Simulated Bed Composition for Copco No. 1 Reservoir for Two Successive Dry Water Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

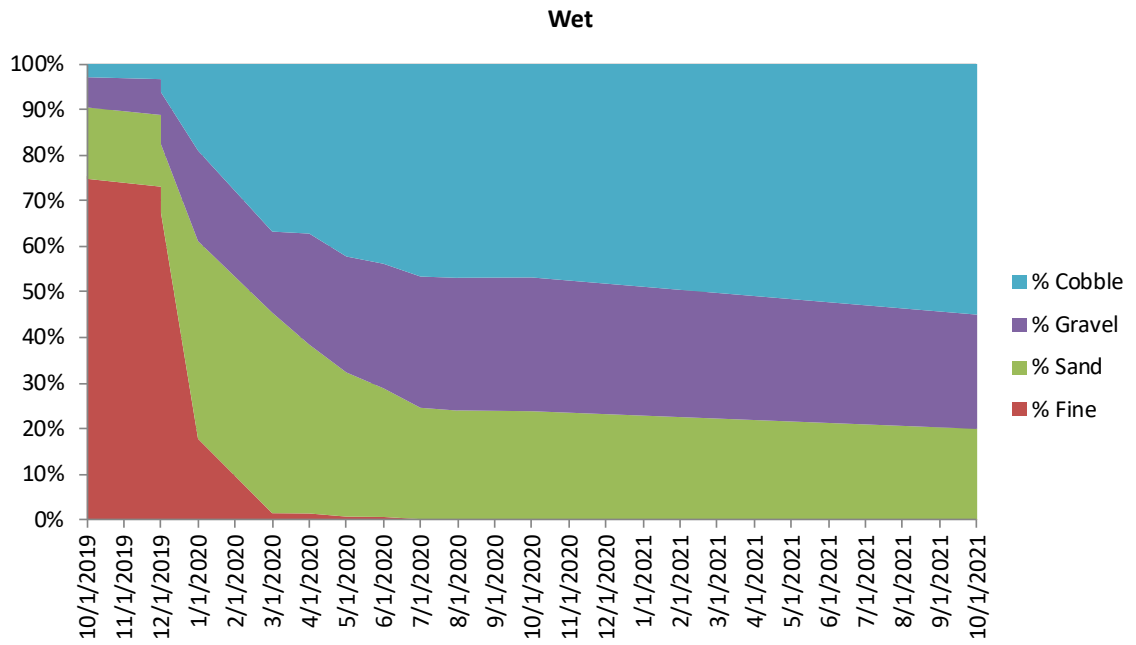


Figure F1-7. Simulated Bed Composition for Iron Gate Reservoir for Two Successive Wet Water Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

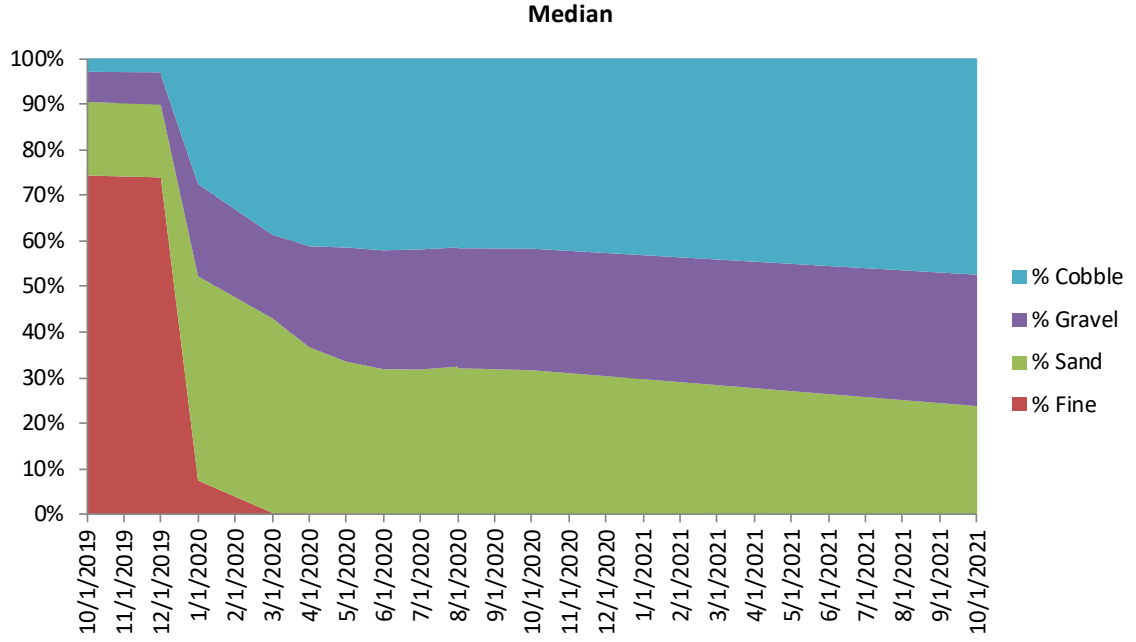


Figure F1-8. Simulated Bed Composition for Iron Gate Reservoir for Two Successive Median Water Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

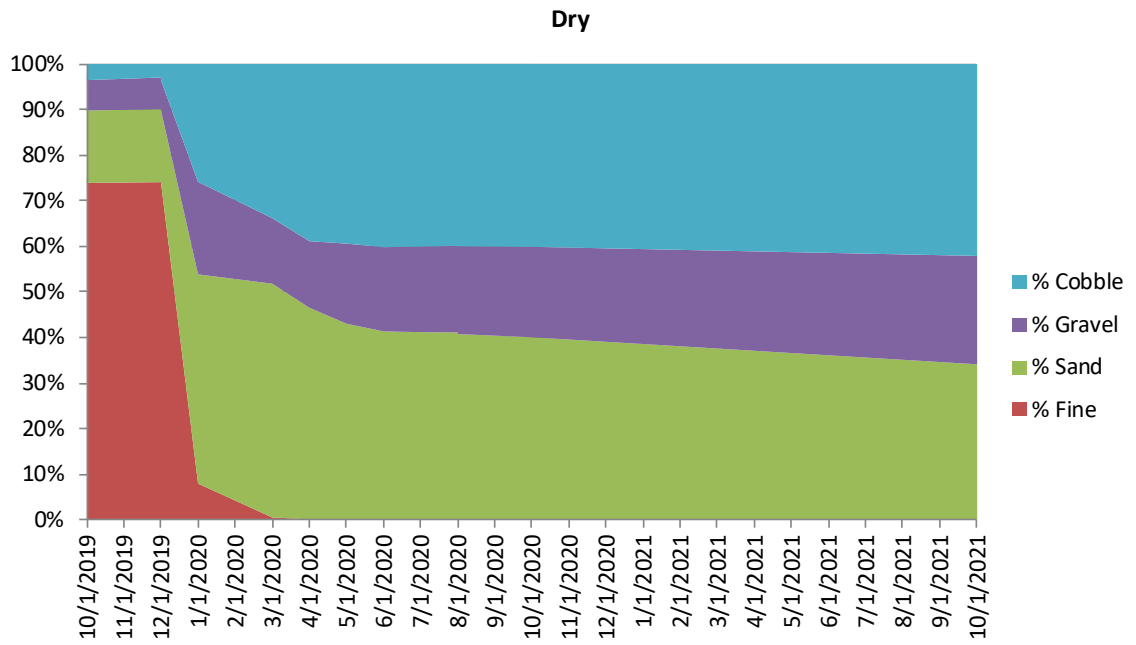


Figure F1-9. Simulated Bed Composition for Iron Gate Reservoir for Two Successive Dry Water Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

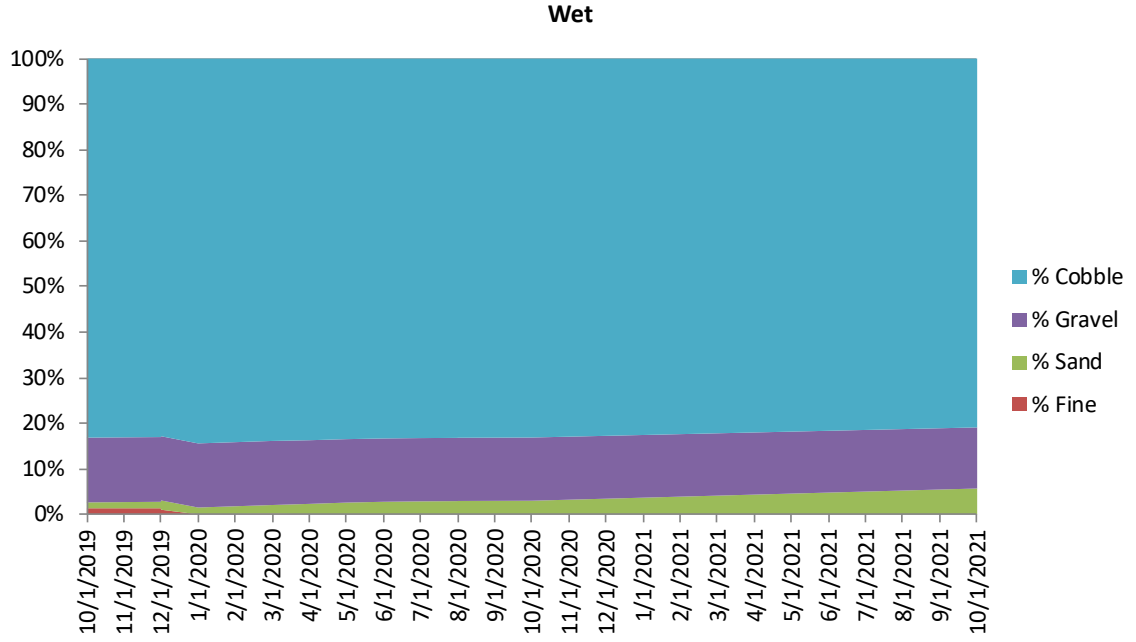


Figure F1-10. Simulated Bed Composition Upstream of J.C. Boyle Reservoir for Two Successive Wet Water Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

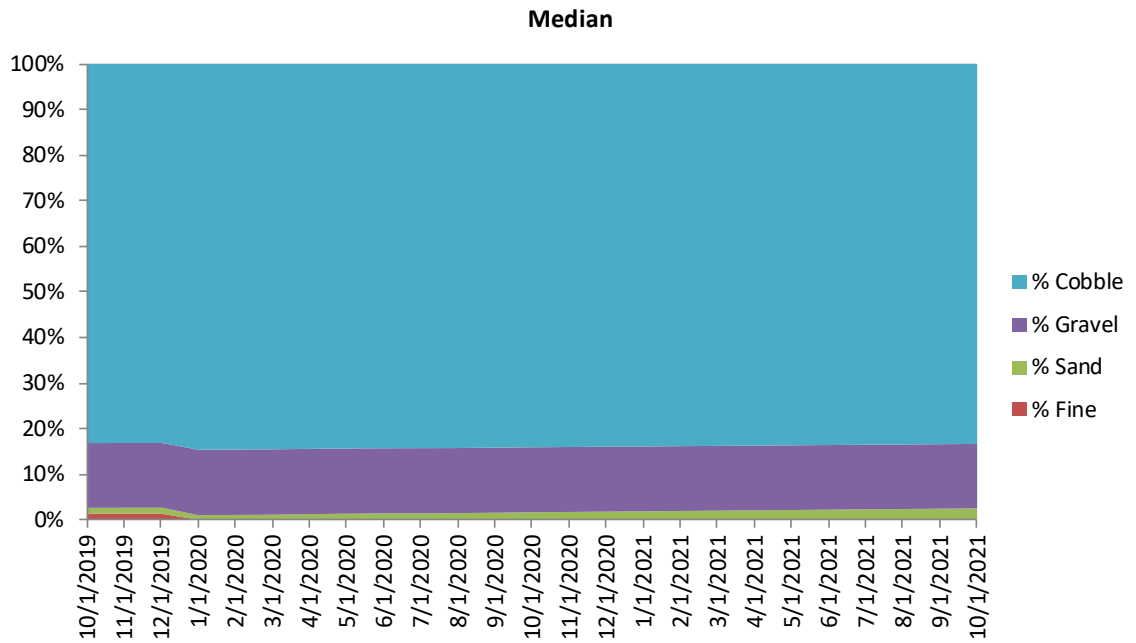


Figure F1-11. Simulated Bed Composition Upstream of J.C. Boyle Reservoir for Two Successive Median Water Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

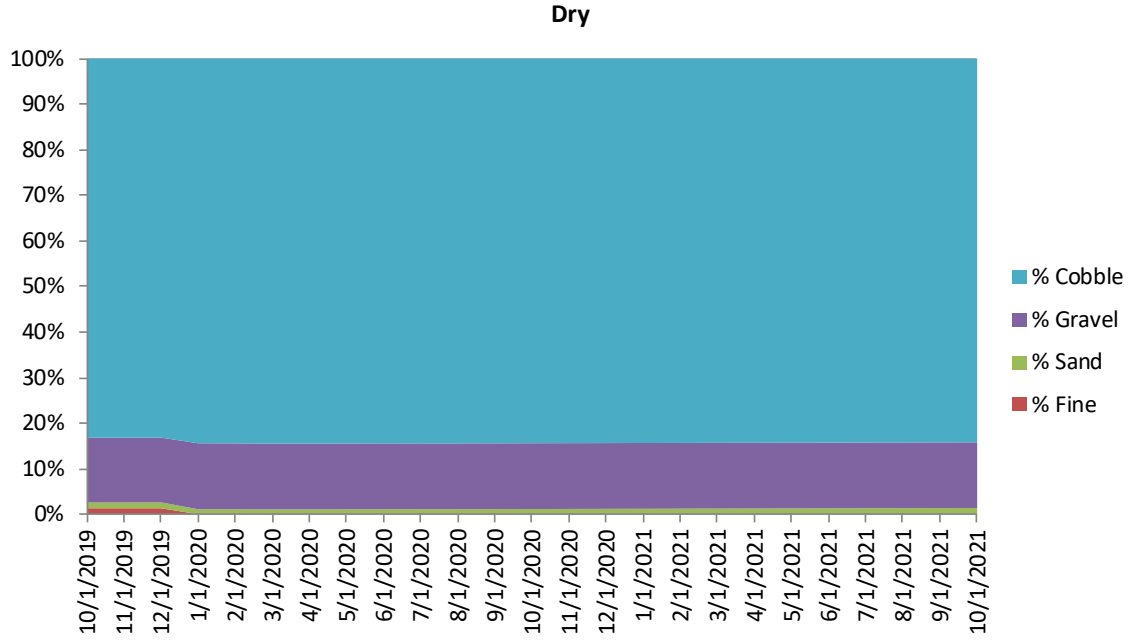


Figure F1-12. Simulated Bed Composition Upstream of J.C. Boyle Reservoir for Two Successive Dry Water Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

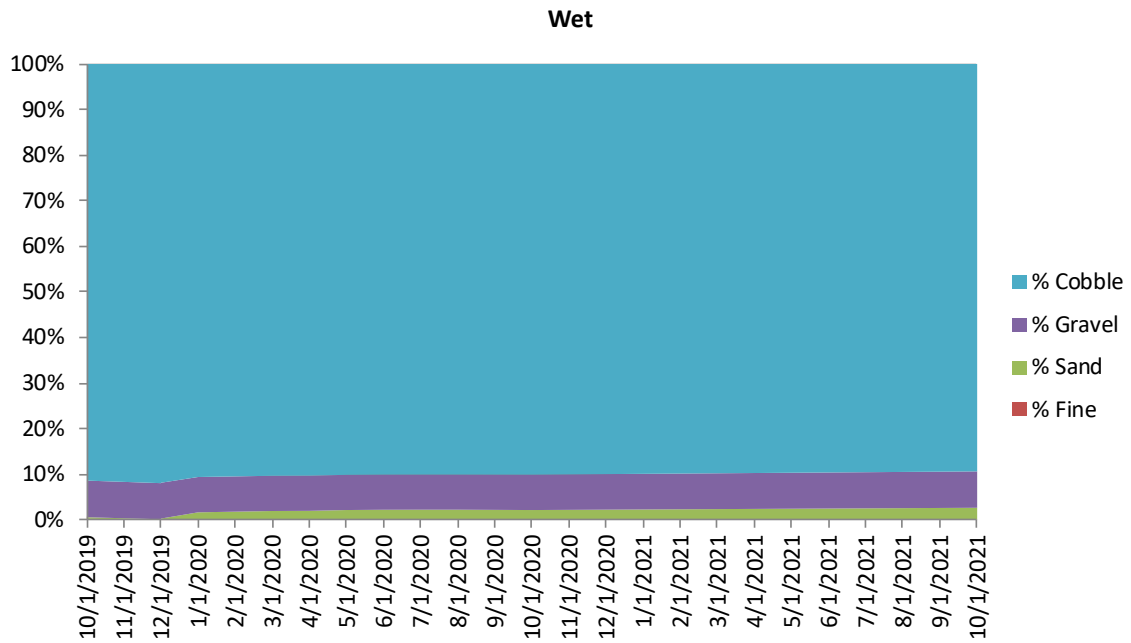


Figure F1-13. Simulated Bed Composition from J.C. Boyle to Copco No. 1 Reservoirs for Two Successive Wet Water Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

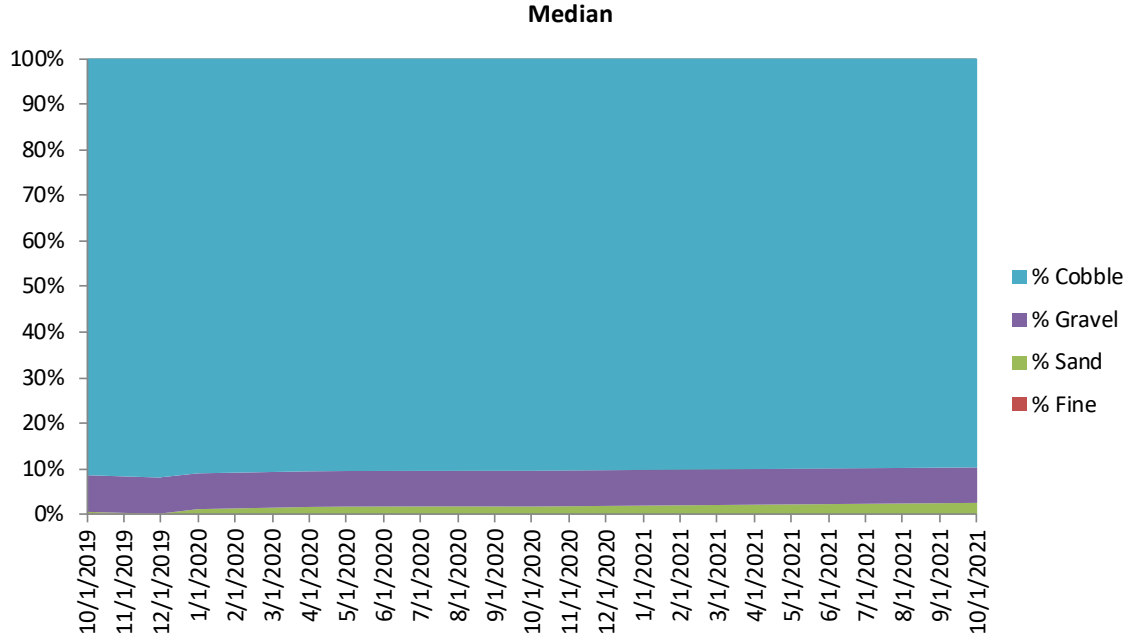


Figure F1-14. Simulated Bed Composition from J.C. Boyle to Copco No. 1 Reservoirs for Two Successive Median Water Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

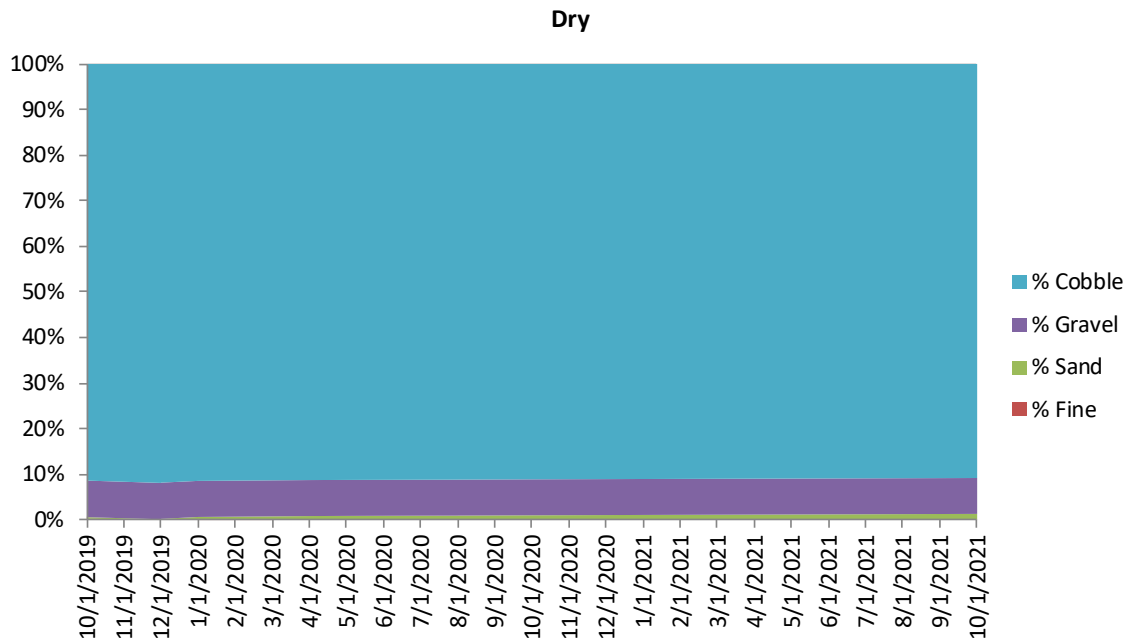


Figure F1-15. Simulated Bed Composition from J.C. Boyle to Copco No. 1 Reservoirs for Two Successive Dry Water Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

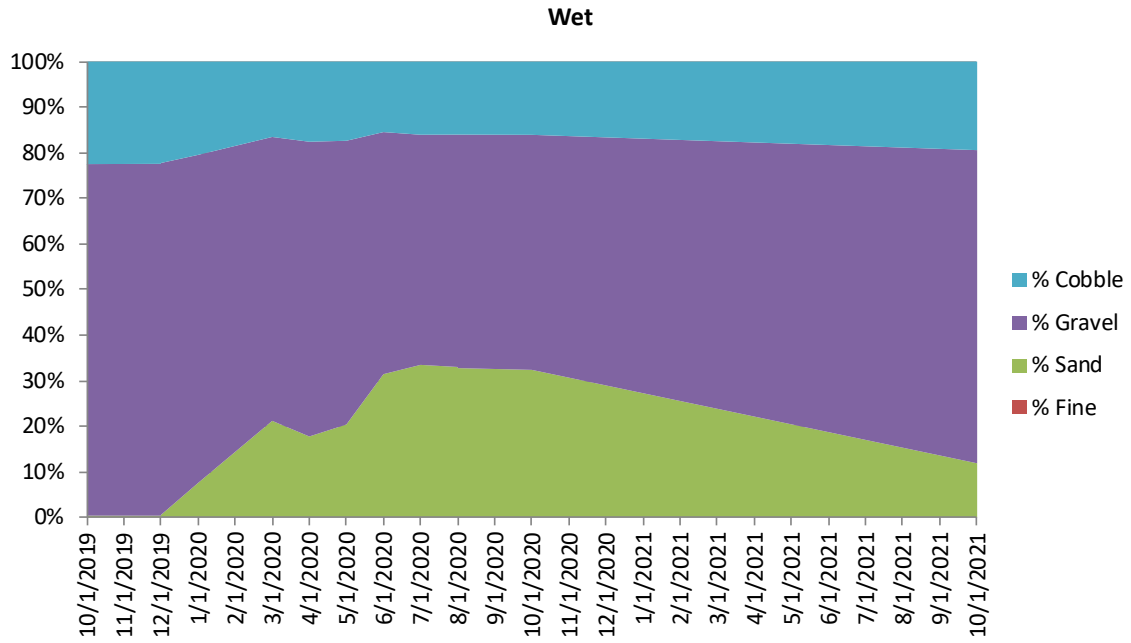


Figure F1-16. Simulated Bed Composition from Bogus Creek to Willow Creek for Two Successive Wet Water Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

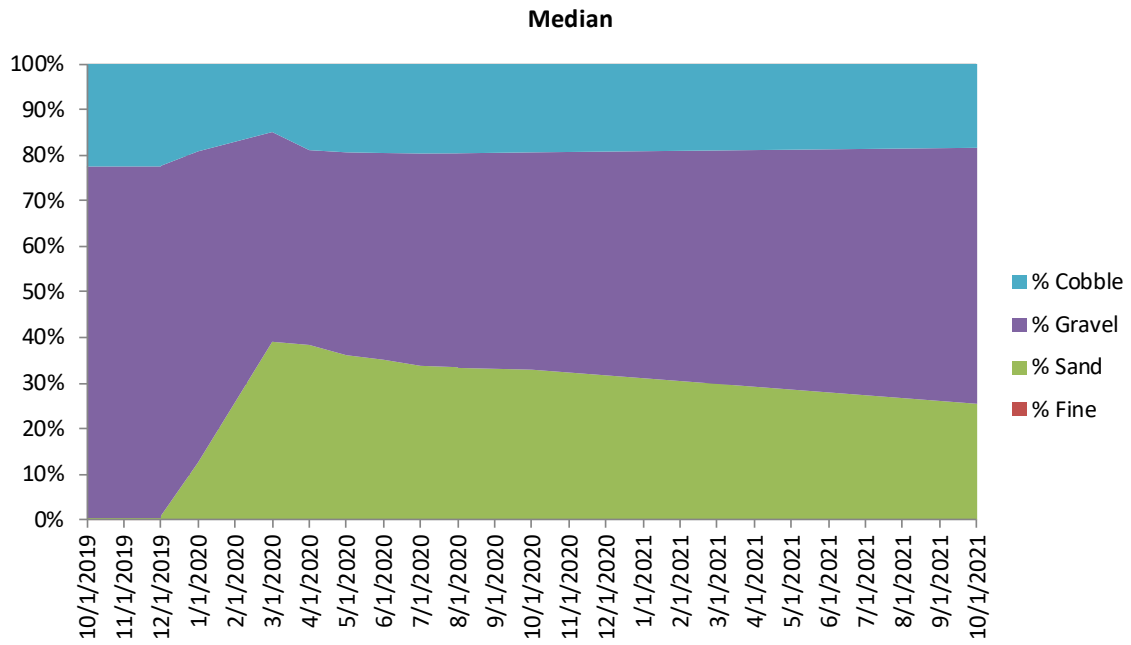


Figure F1-17. Simulated Bed Composition from Bogus Creek to Willow Creek for Two Successive Median Water Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

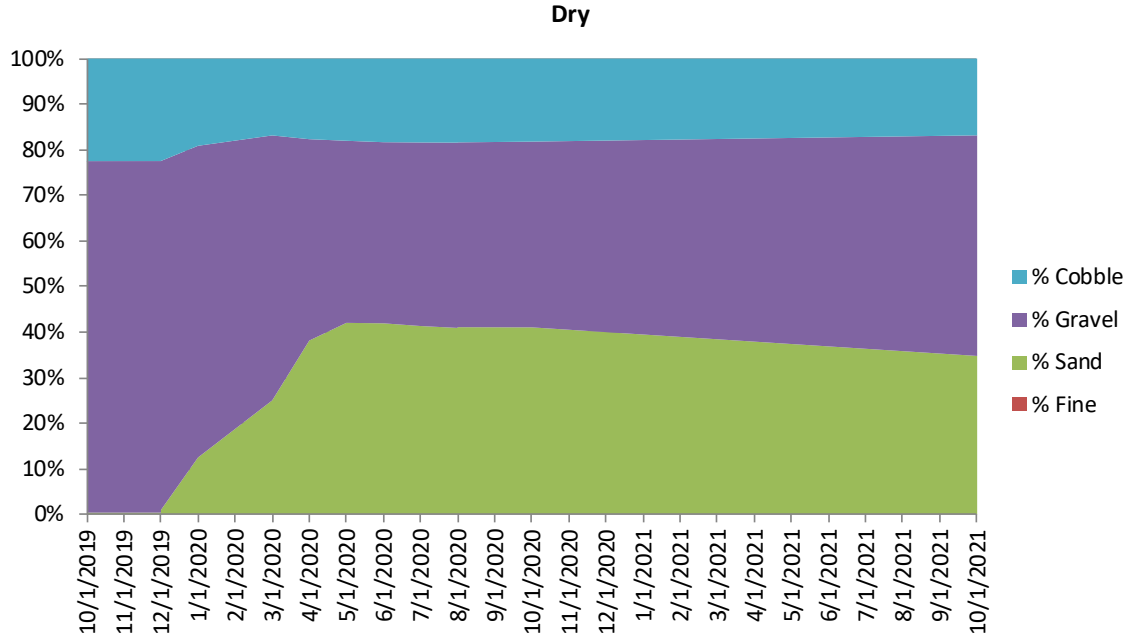


Figure F1-18. Simulated Bed Composition from Bogus Creek to Willow Creek for Two Successive Dry Water Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

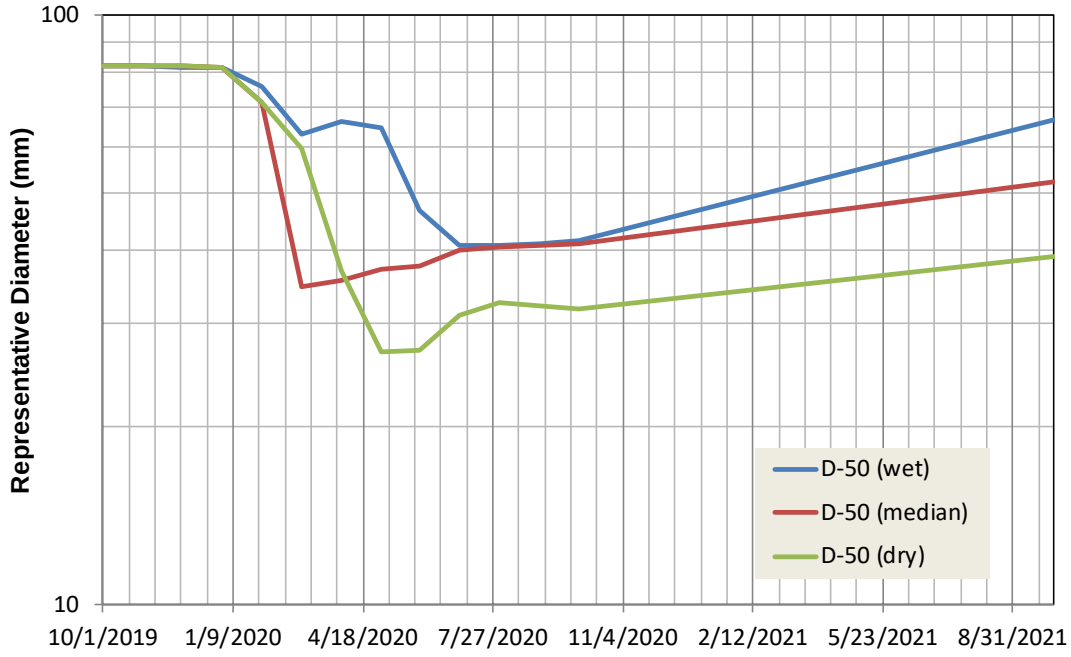


Figure F1-19. Simulated Bed Substrate Size from Bogus Creek to Willow Creek for Successive Wet, Median, and Dry Water Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

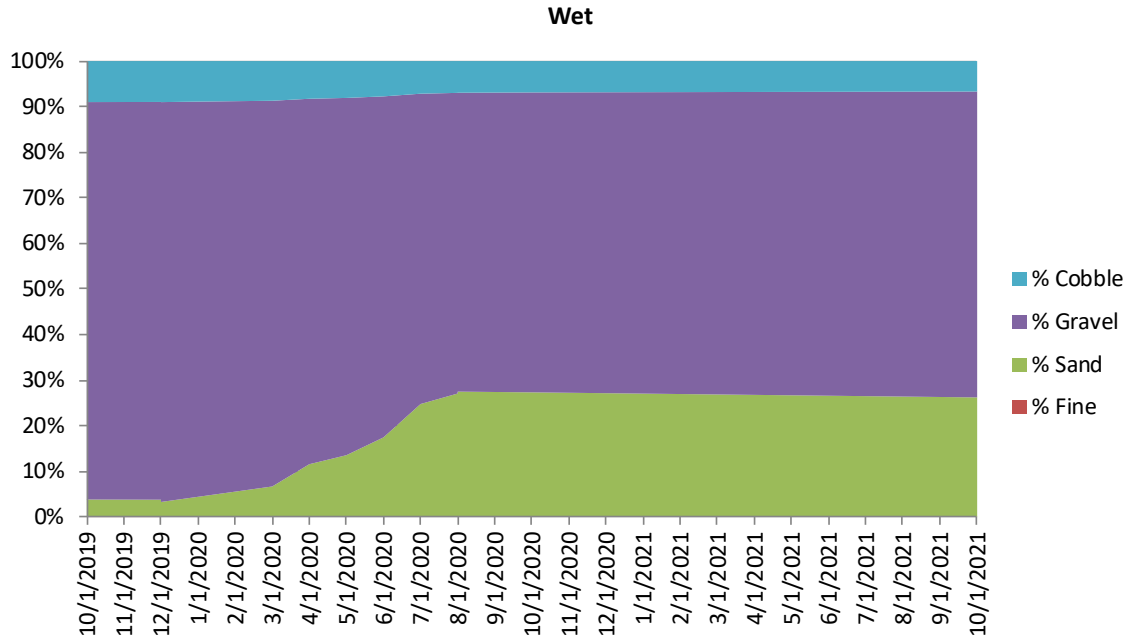


Figure F1-20. Simulated Bed Composition from Willow Creek to Cottonwood Creek for Two Successive Wet Water Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

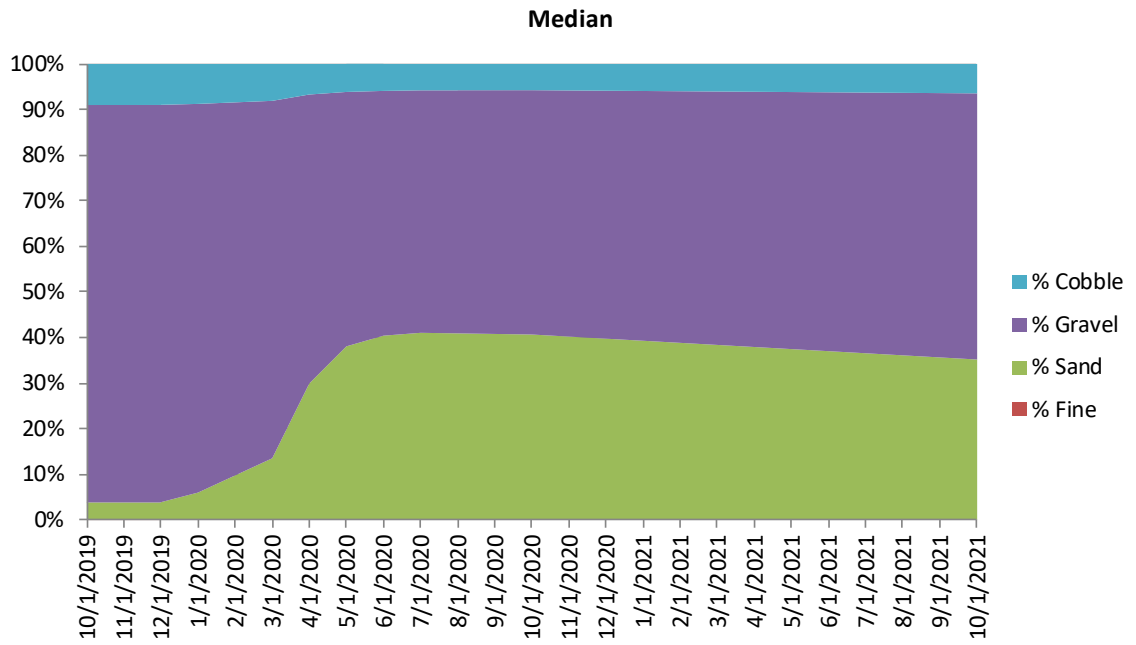


Figure F1-21. Simulated Bed Composition from Willow Creek to Cottonwood Creek for Two Median Water Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

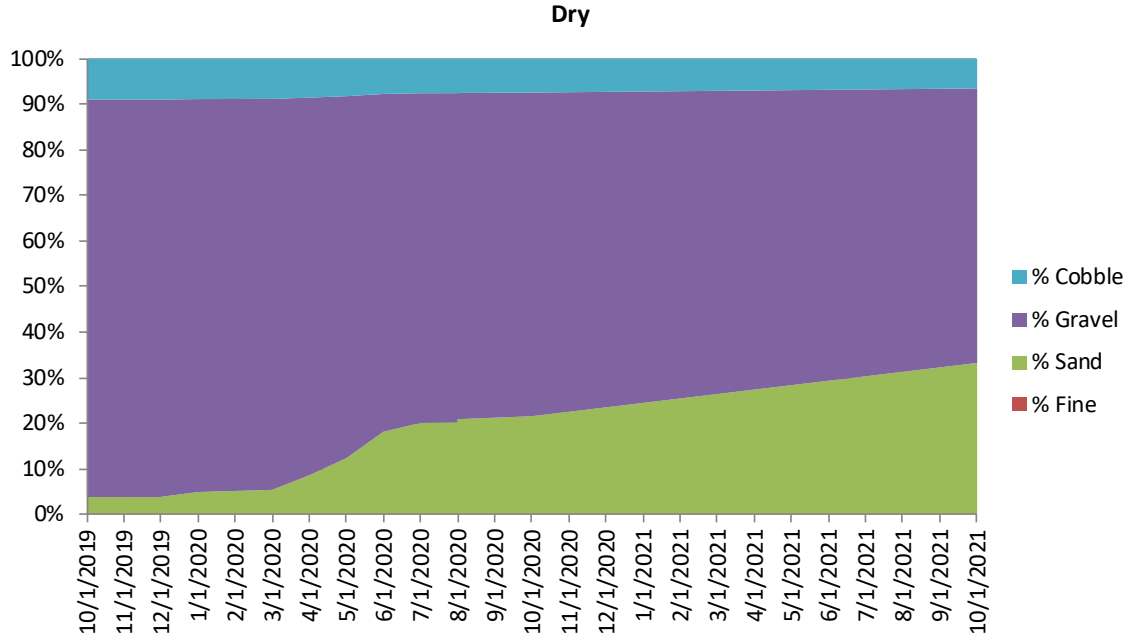


Figure F1-22. Simulated Bed Composition from Willow Creek to Cottonwood Creek for Two Dry Water Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

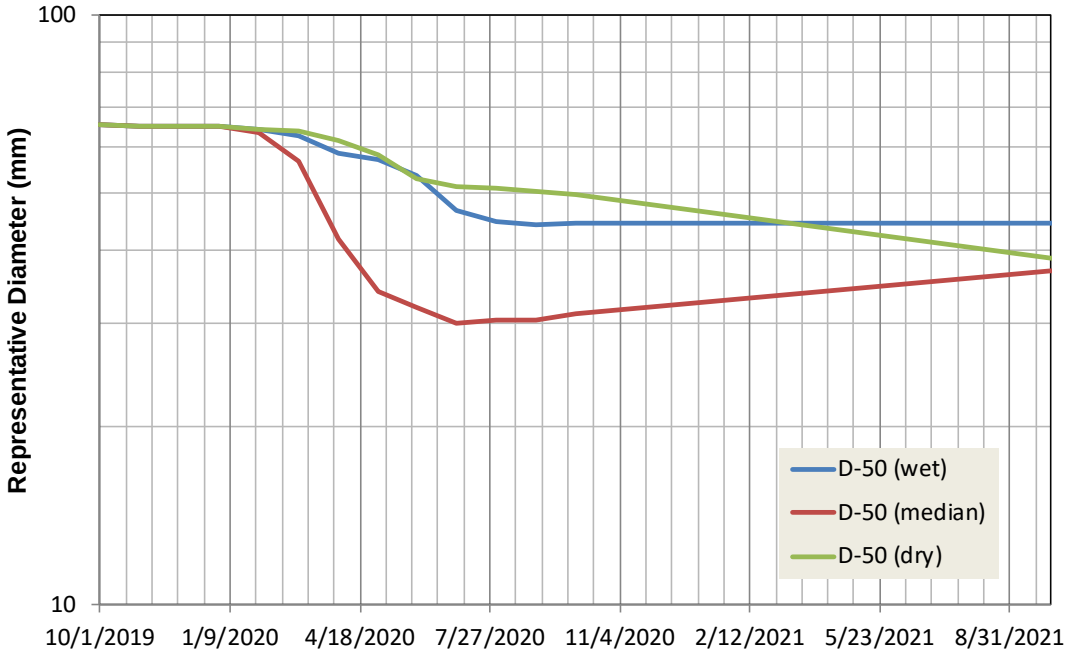


Figure F1-23. Simulated Bed Substrate Size from Willow Creek to Cottonwood Creek for Successive Wet, Median, and Dry Water Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

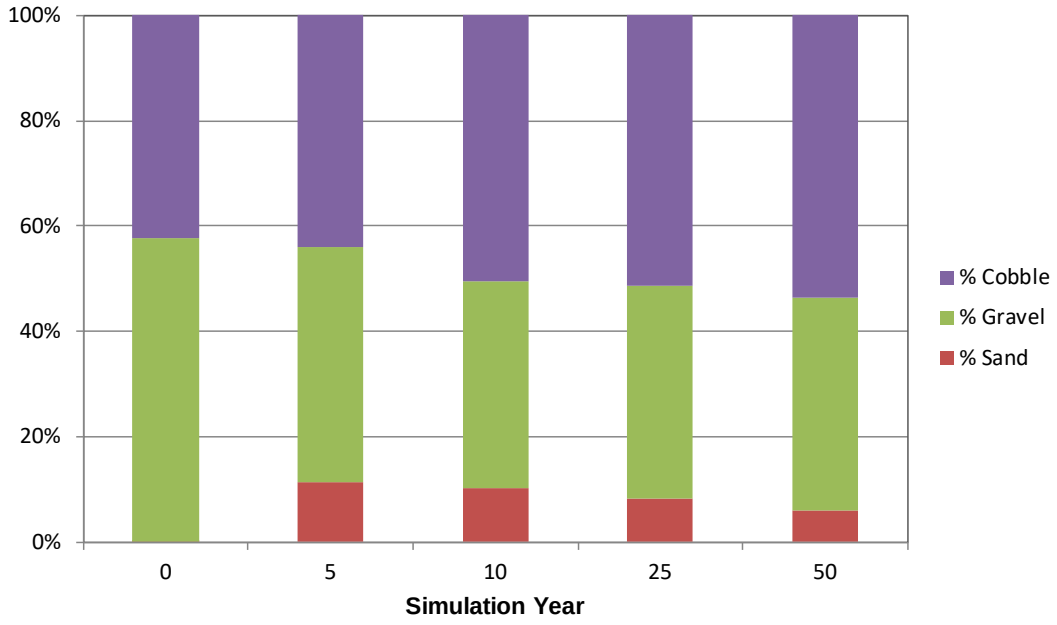


Figure F1-24. Simulated Bed Composition of Iron Gate Dam to Bogus Creek Reach 5, 10, 25, and 50 Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

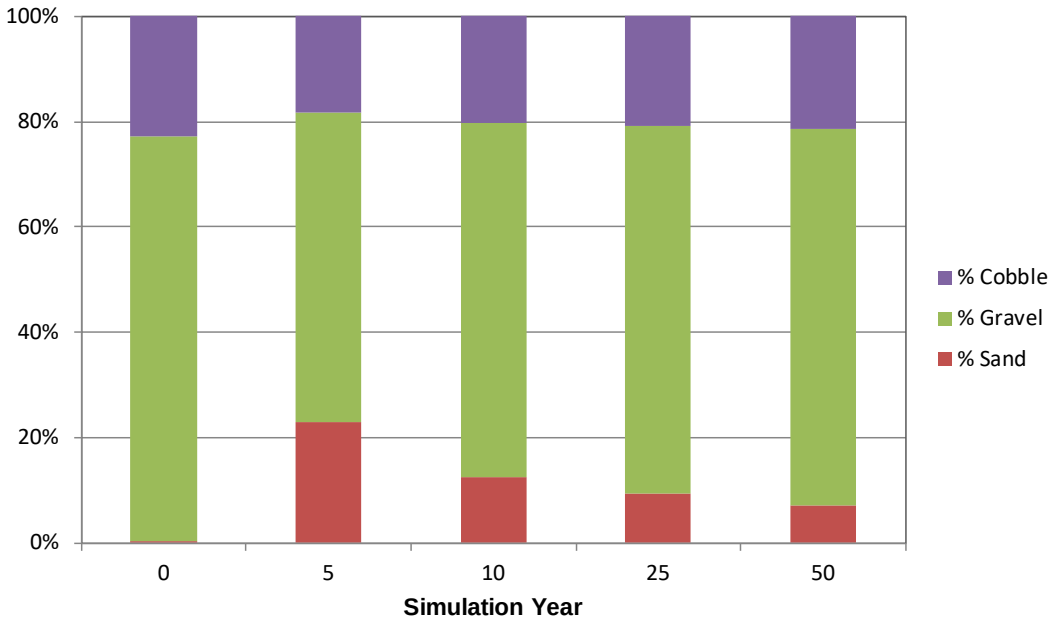


Figure F1-25. Simulated Bed Composition of Bogus Creek to Willow Creek Reach 5, 10, 25, and 50 Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

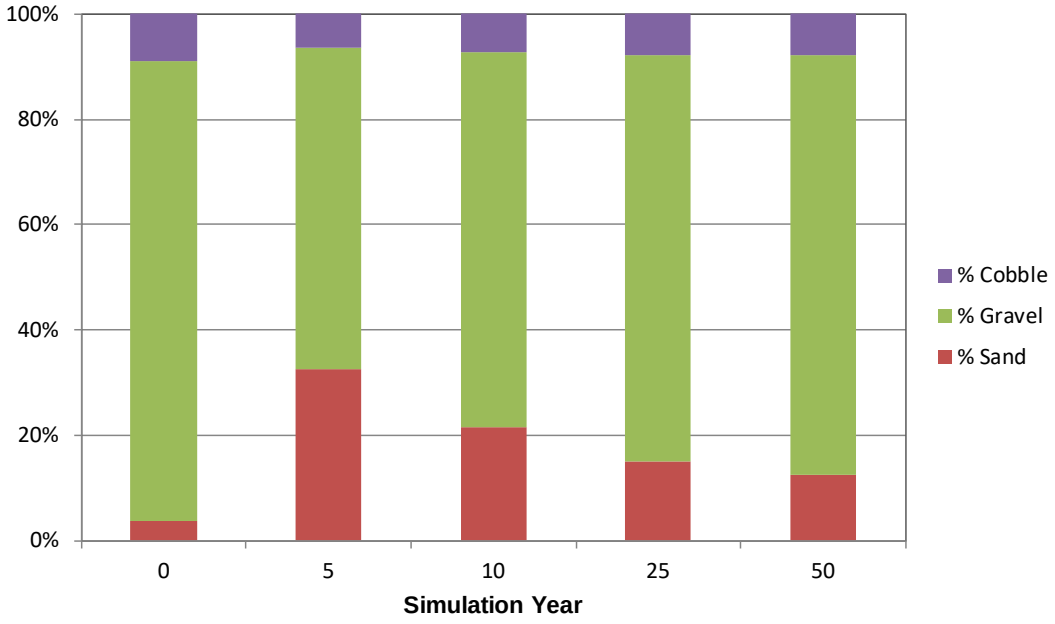


Figure F1-26. Simulated Bed Composition of Willow Creek to Cottonwood Creek Reach 5, 10, 25, and 50 Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

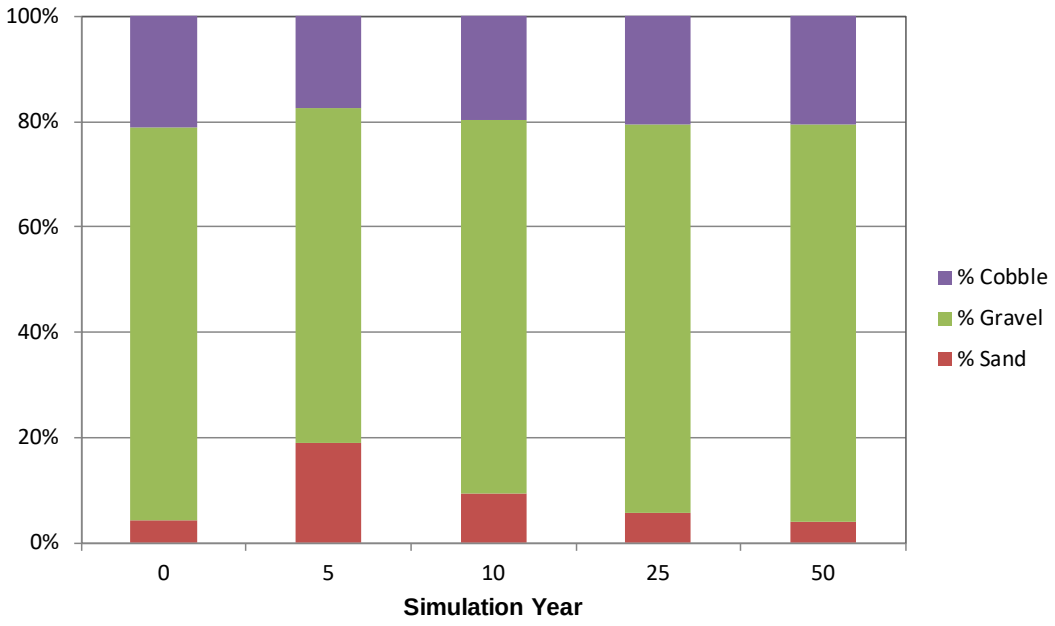


Figure F1-27. Simulated Bed Composition of Cottonwood Creek to Shasta River Reach 5, 10, 25, and 50 Years Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

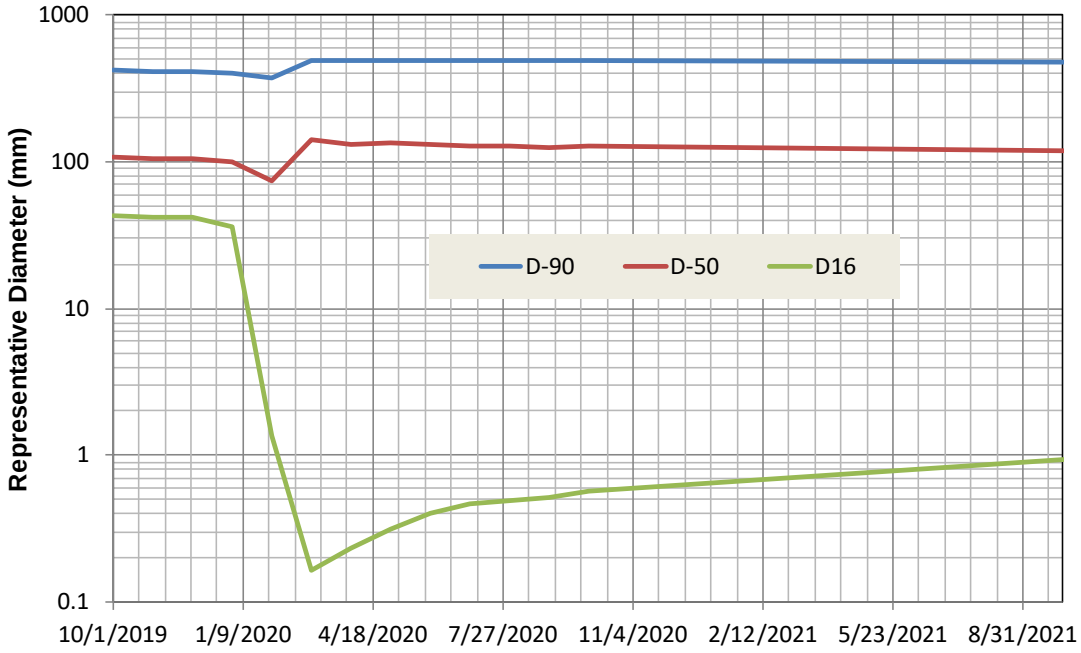


Figure F1-28. Simulated Bed Substrate Size from Iron Gate Dam to Bogus Creek Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.



Figure F1-29. Simulated Bed Substrate Size from Bogus Creek to Willow Creek Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

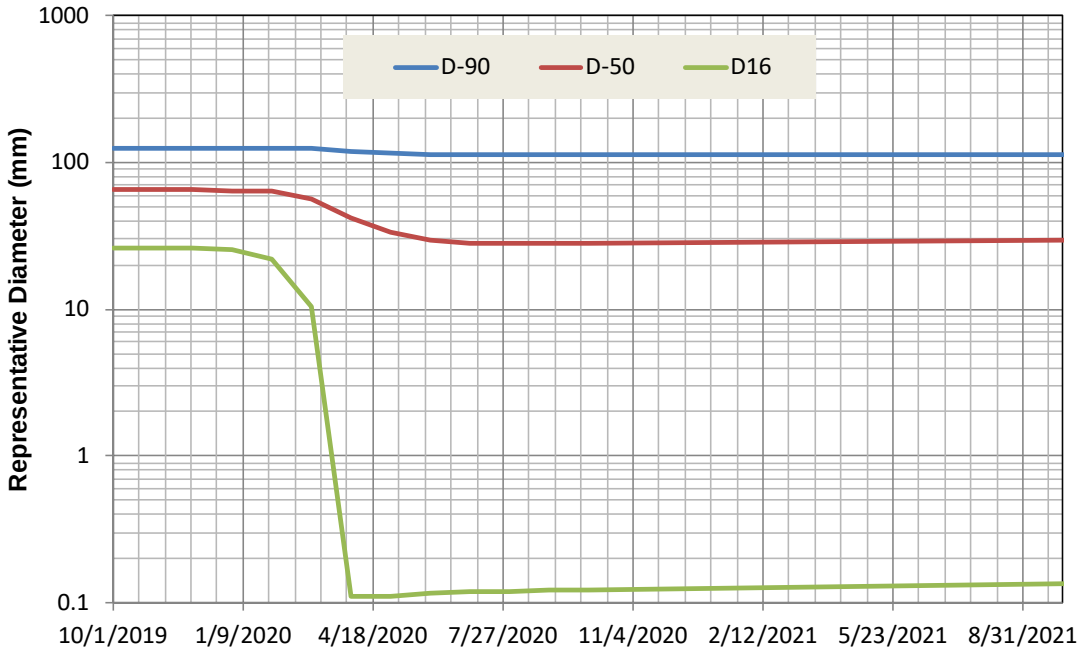


Figure F1-30. Simulated Bed Substrate Size from Willow Creek to Cottonwood Following Dam Removal. Based on simulation results provided by Reclamation, March 2012.

Appendix G

Vegetation Communities in the Area of Analysis

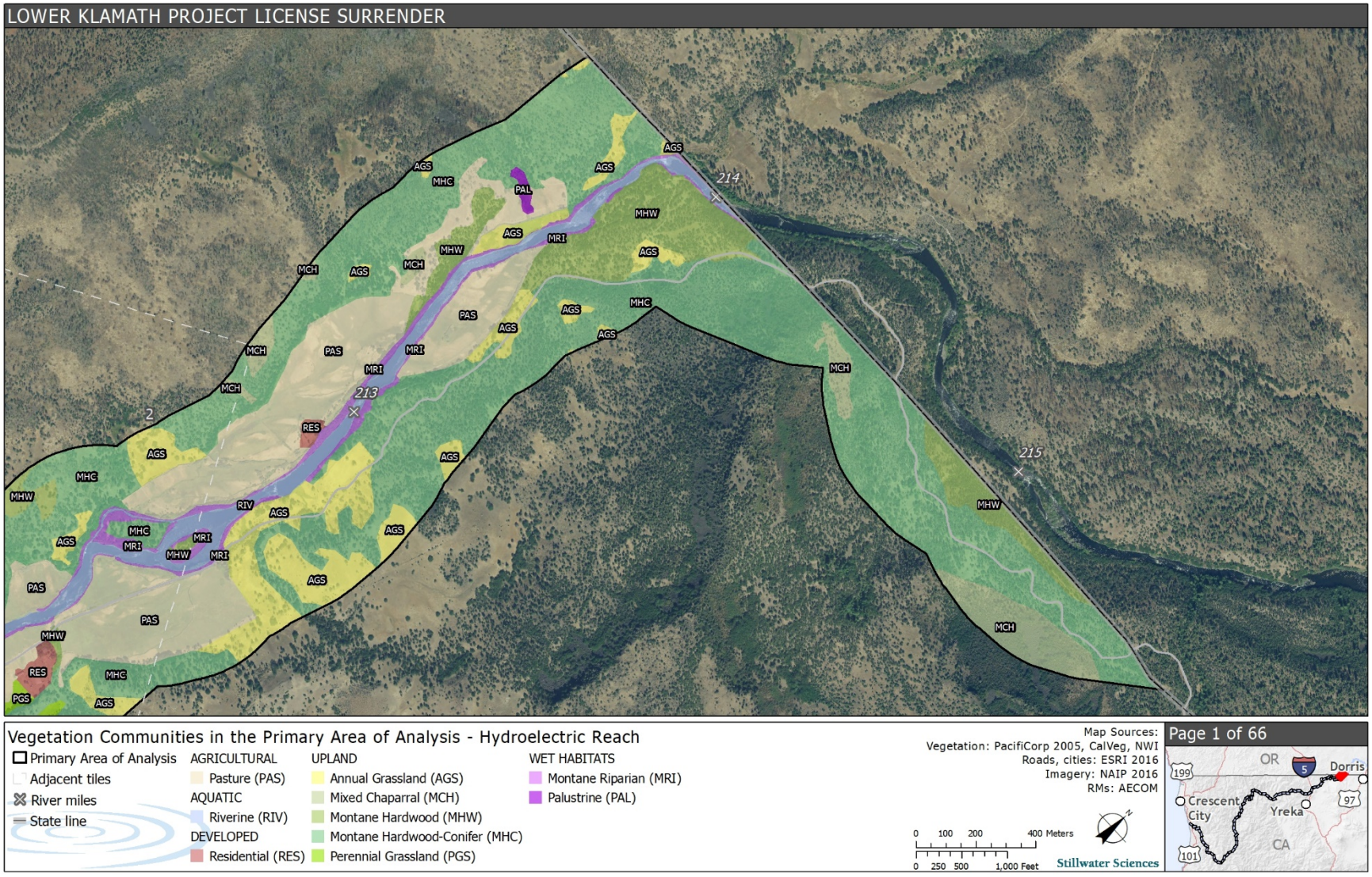


Figure G-1. Vegetation Communities and Habitat Types in the Primary Area of Analysis.

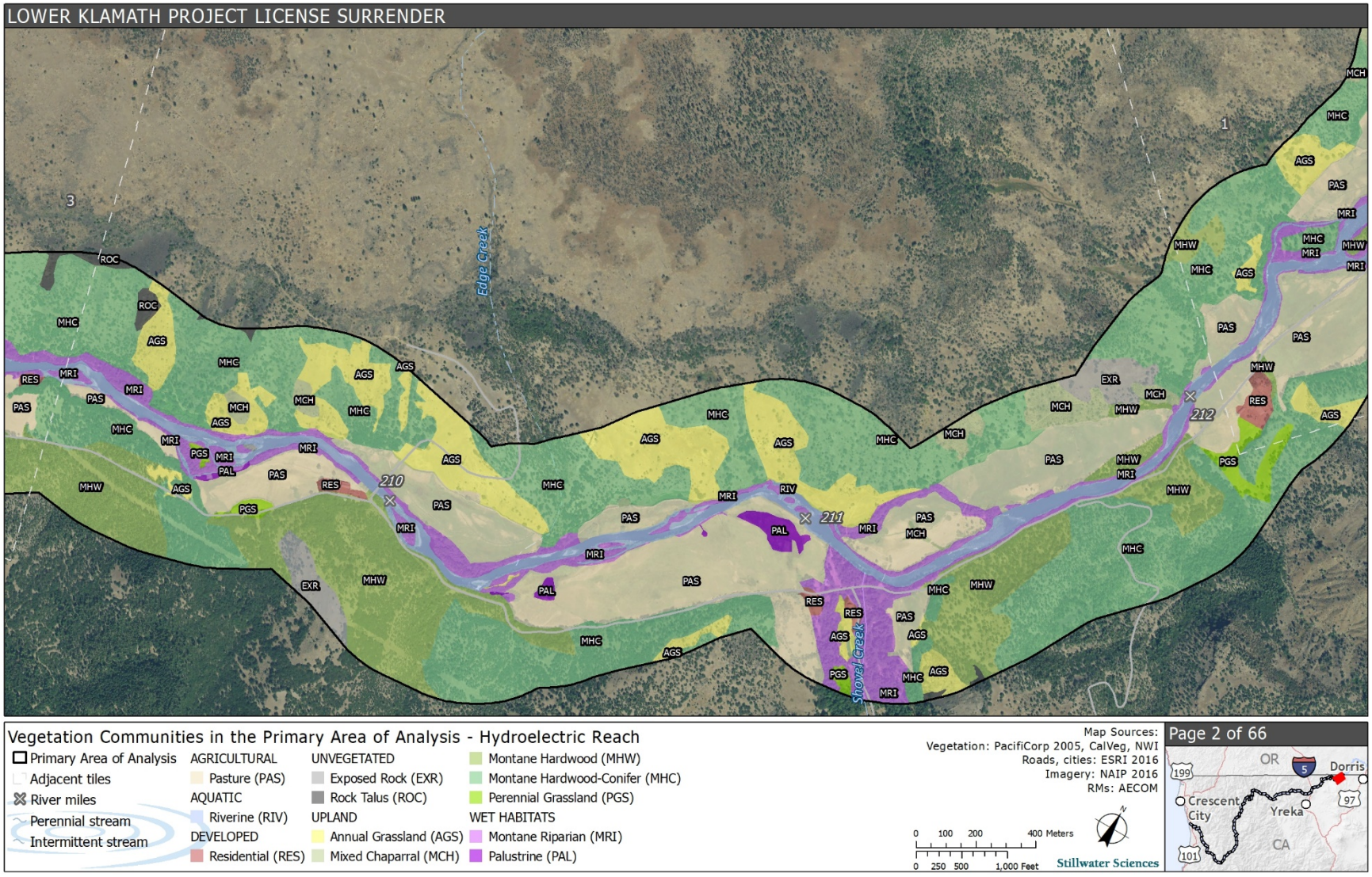


Figure G-2. Vegetation Communities and Habitat Types in the Primary Area of Analysis.

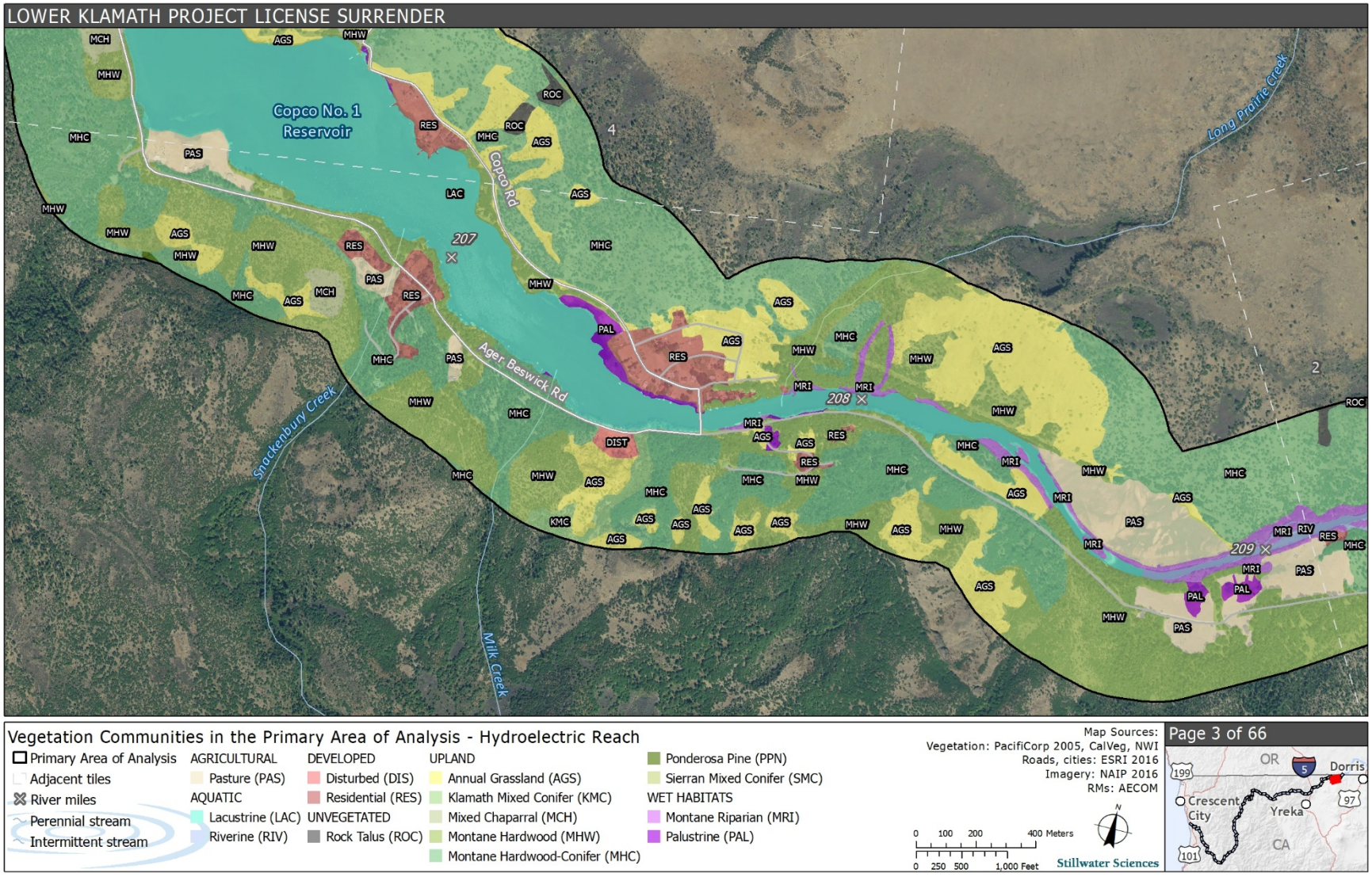


Figure G-3. Vegetation Communities and Habitat Types in the Primary Area of Analysis.

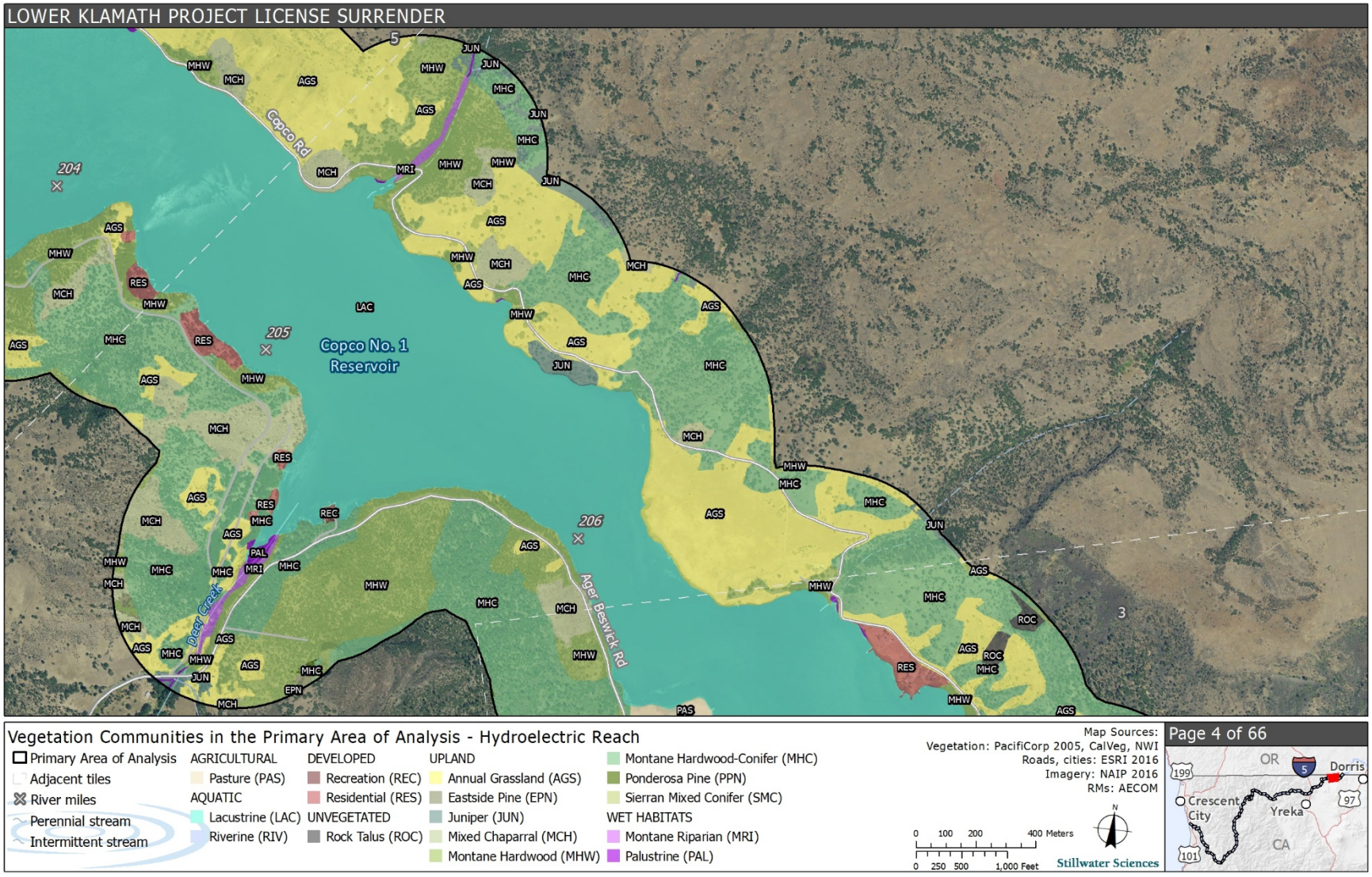


Figure G-4. Vegetation Communities and Habitat Types in the Primary Area of Analysis.

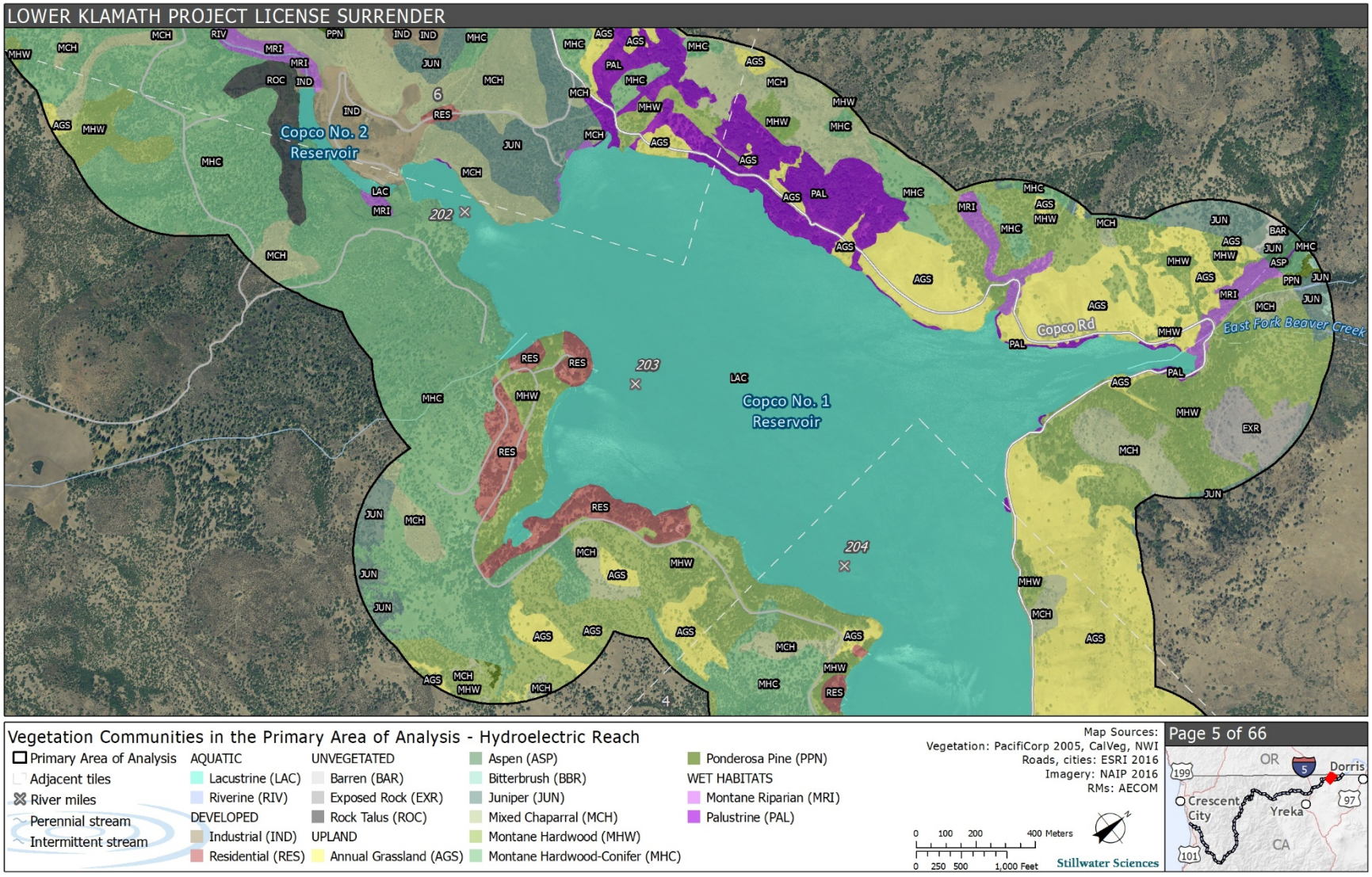


Figure G-5. Vegetation Communities and Habitat Types in the Primary Area of Analysis.

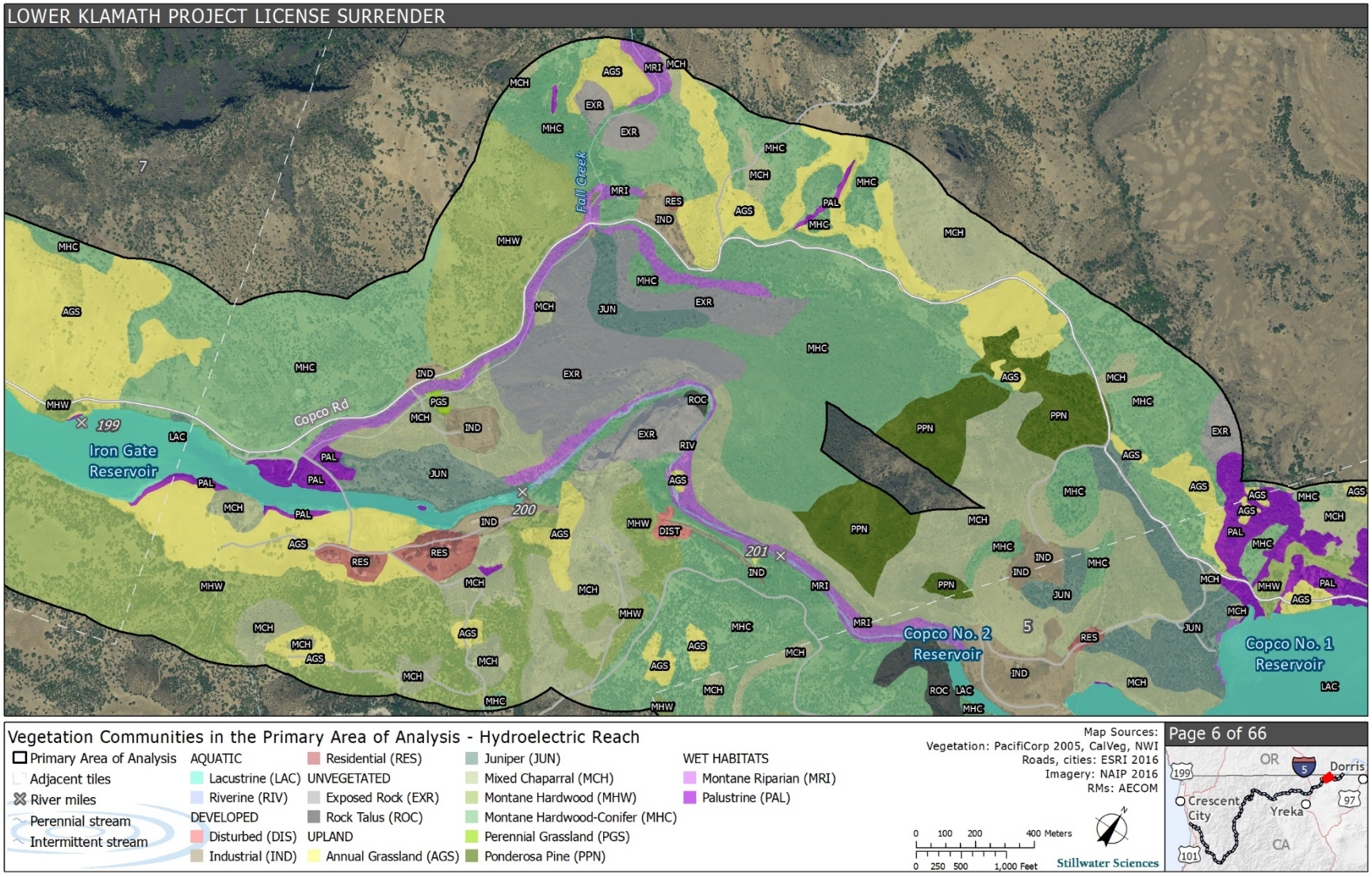


Figure G-6. Vegetation Communities and Habitat Types in the Primary Area of Analysis.

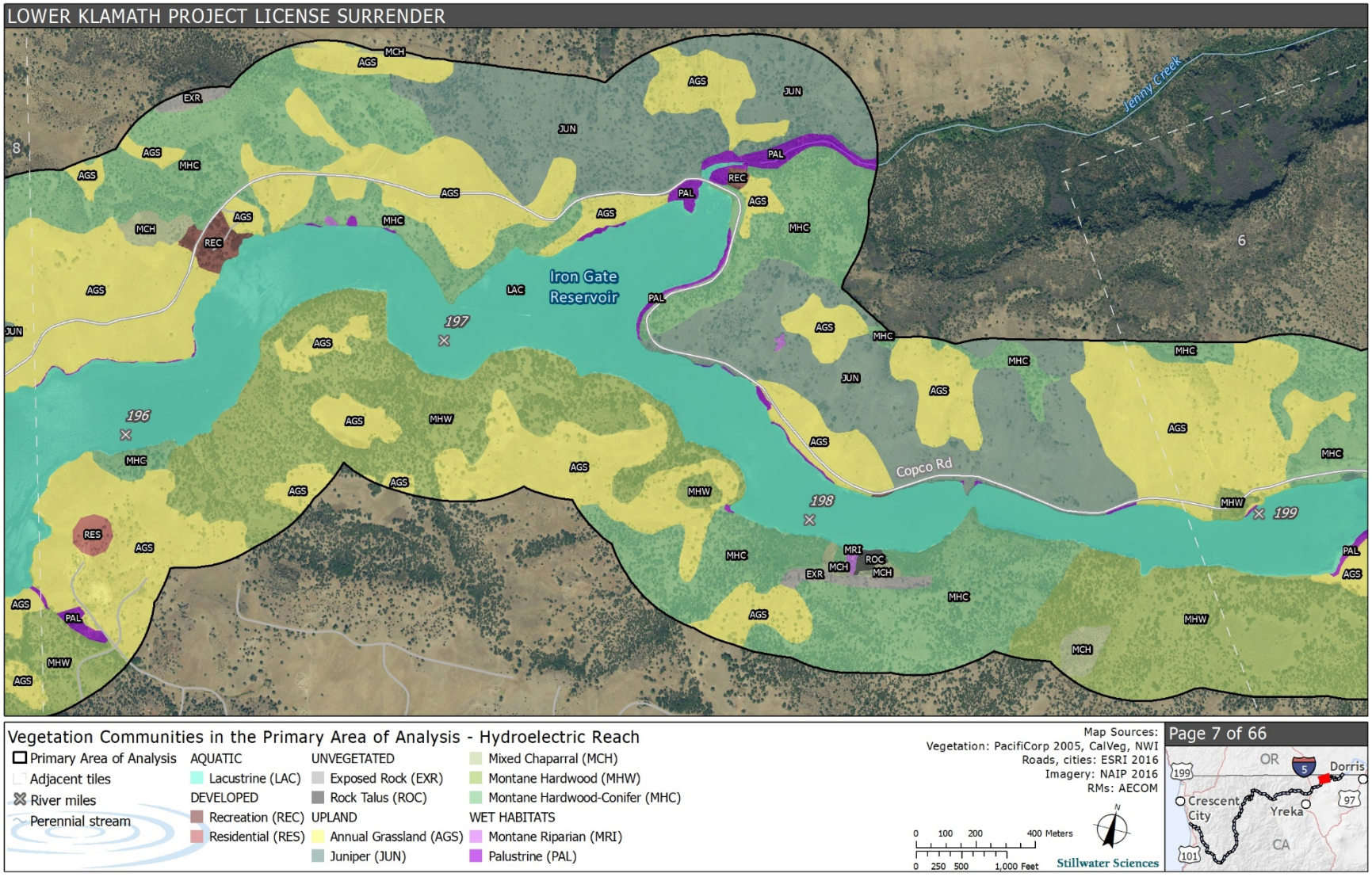


Figure G-7. Vegetation Communities and Habitat Types in the Primary Area of Analysis.

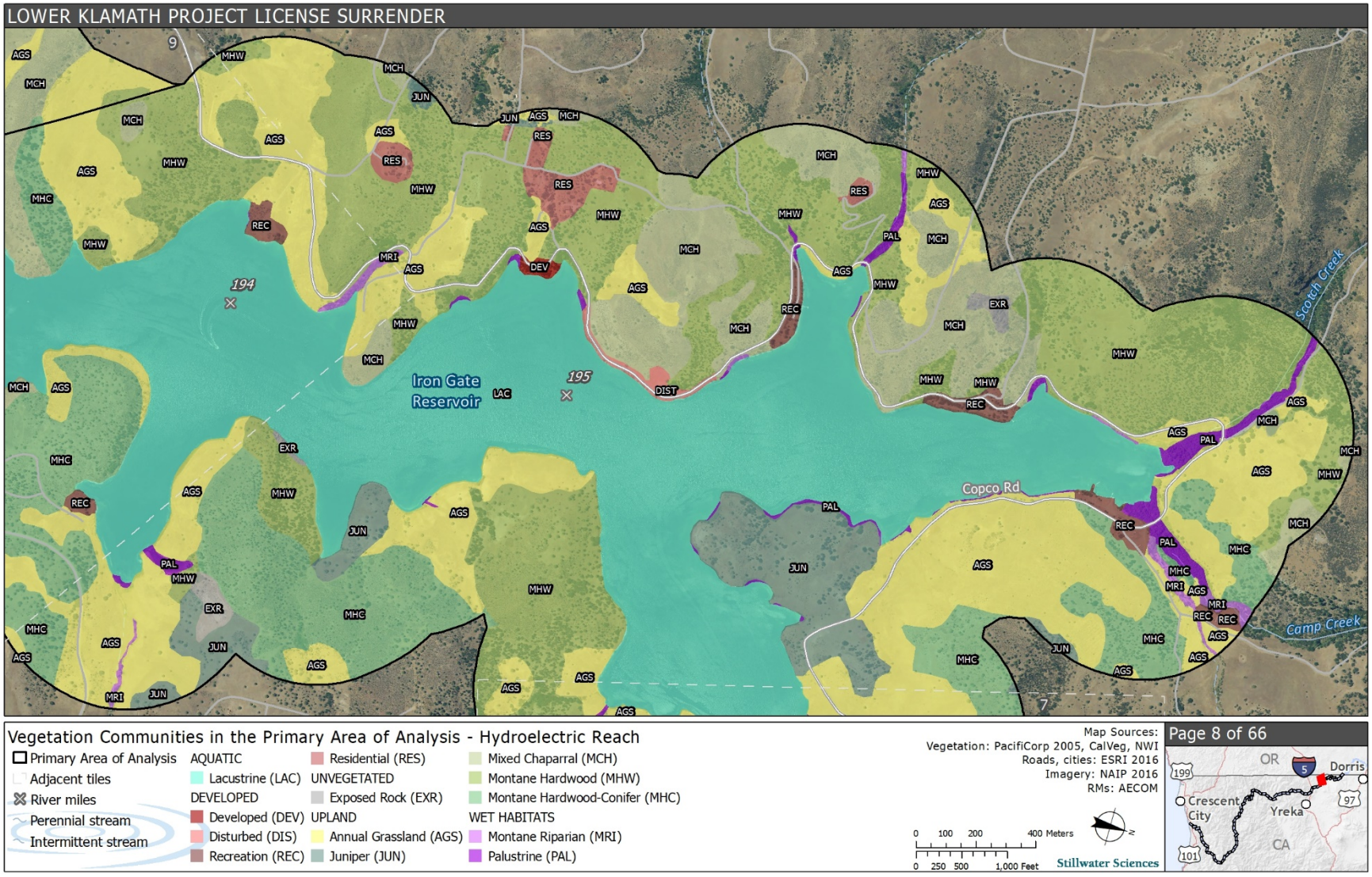


Figure G-8. Vegetation Communities and Habitat Types in the Primary Area of Analysis.

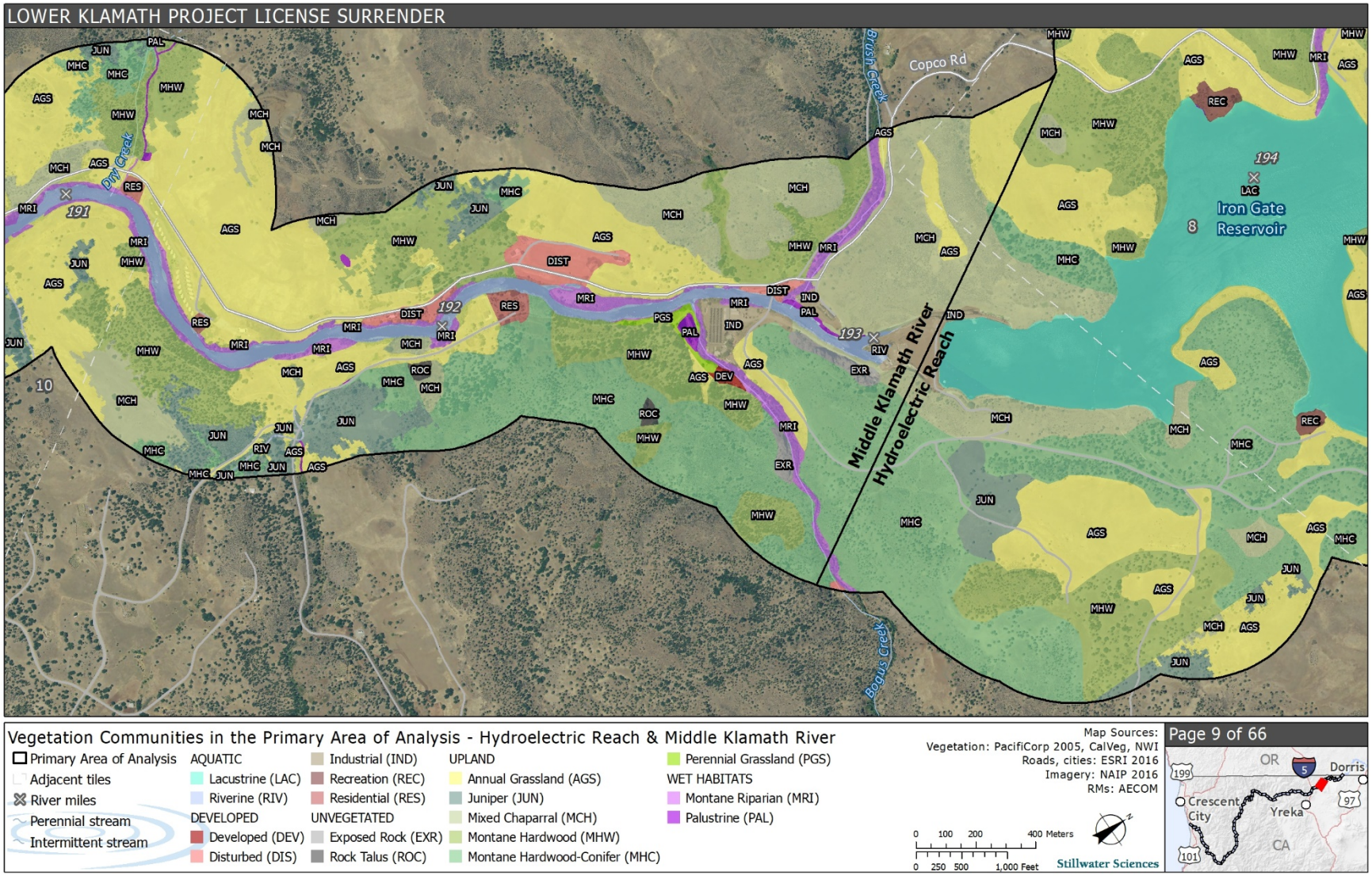


Figure G-9. Vegetation Communities and Habitat Types in the Primary Area of Analysis.

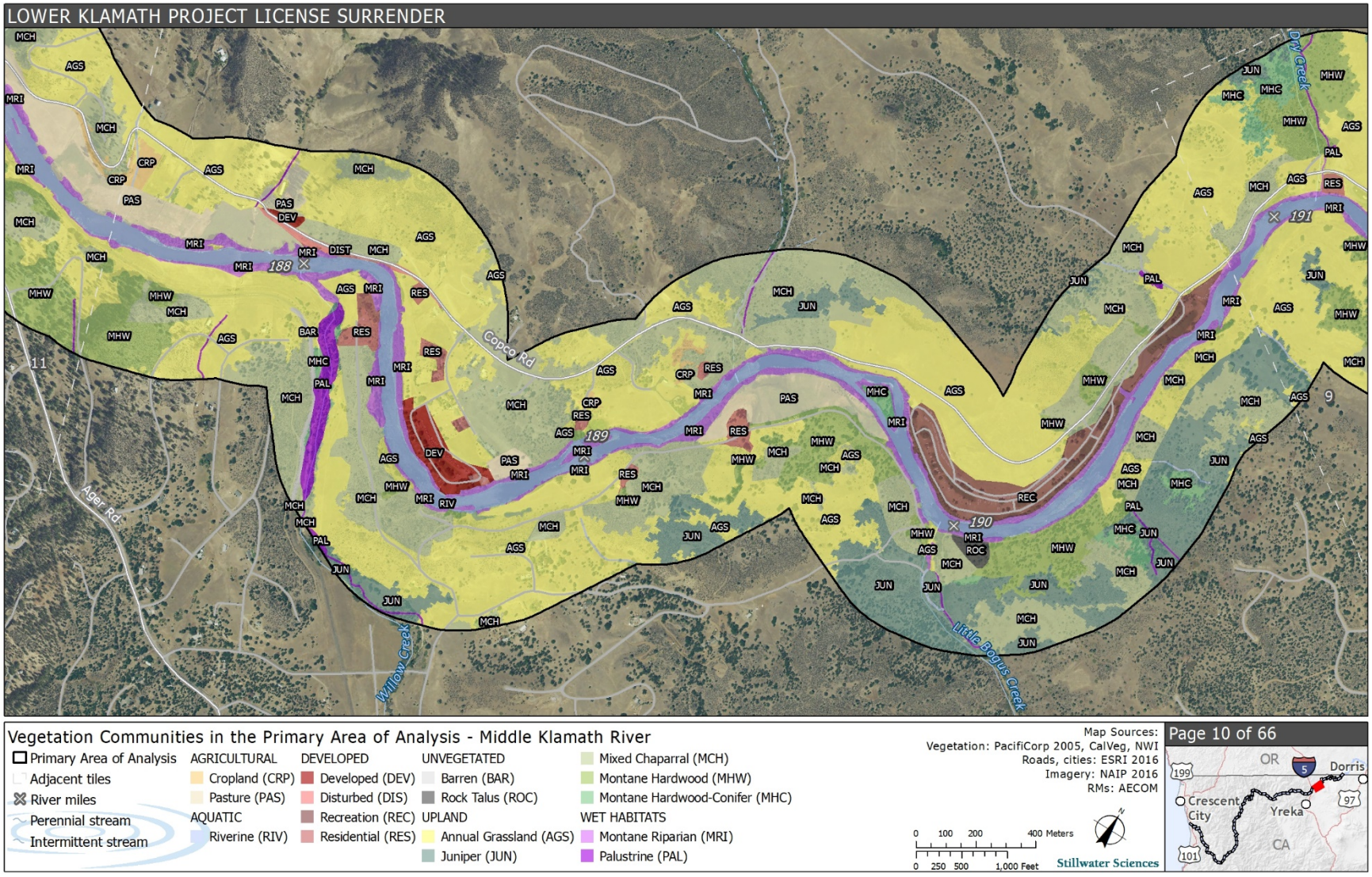


Figure G-10. Vegetation Communities and Habitat Types in the Primary Area of Analysis.

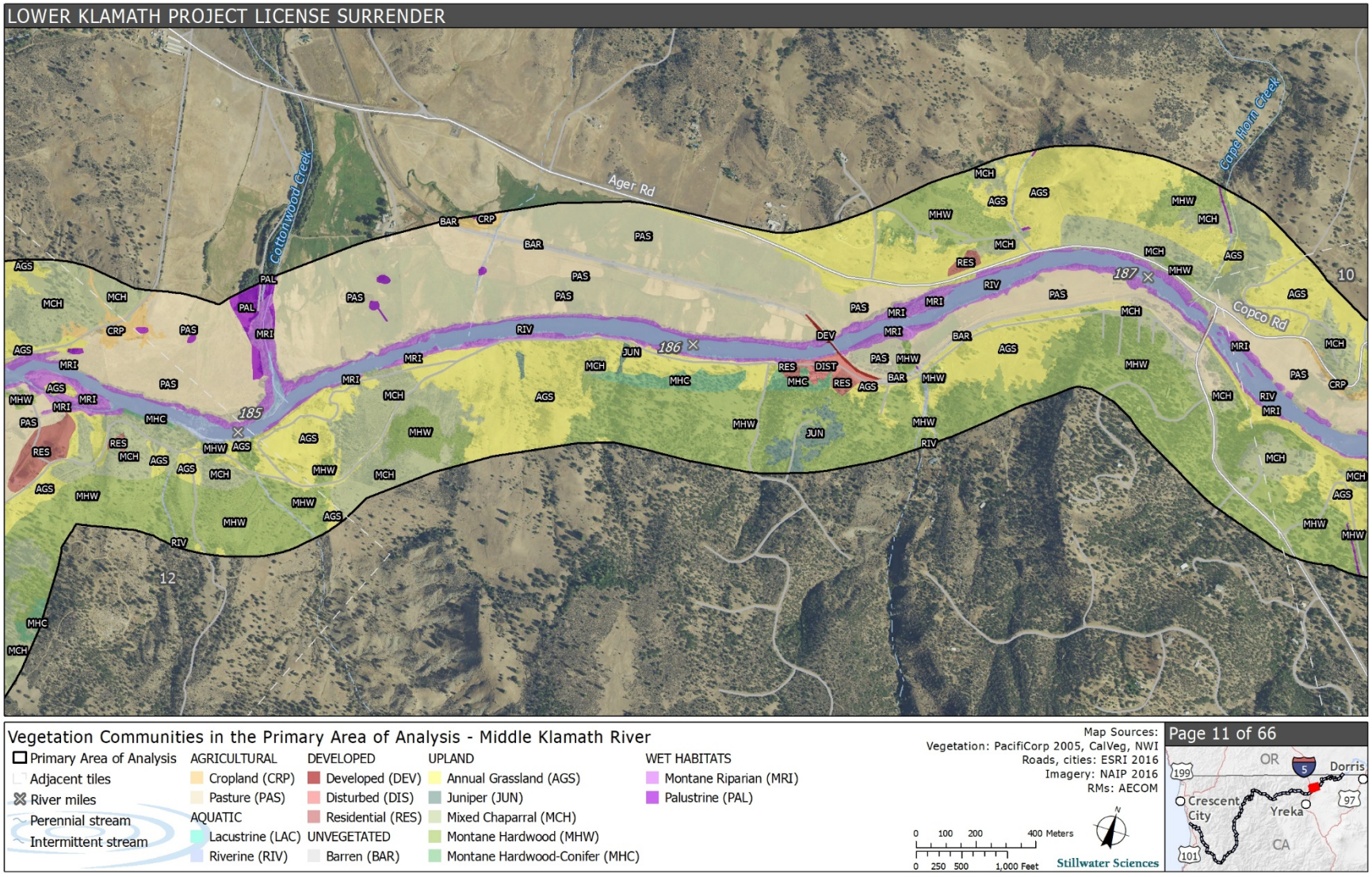


Figure G-11. Vegetation Communities and Habitat Types in the Primary Area of Analysis.

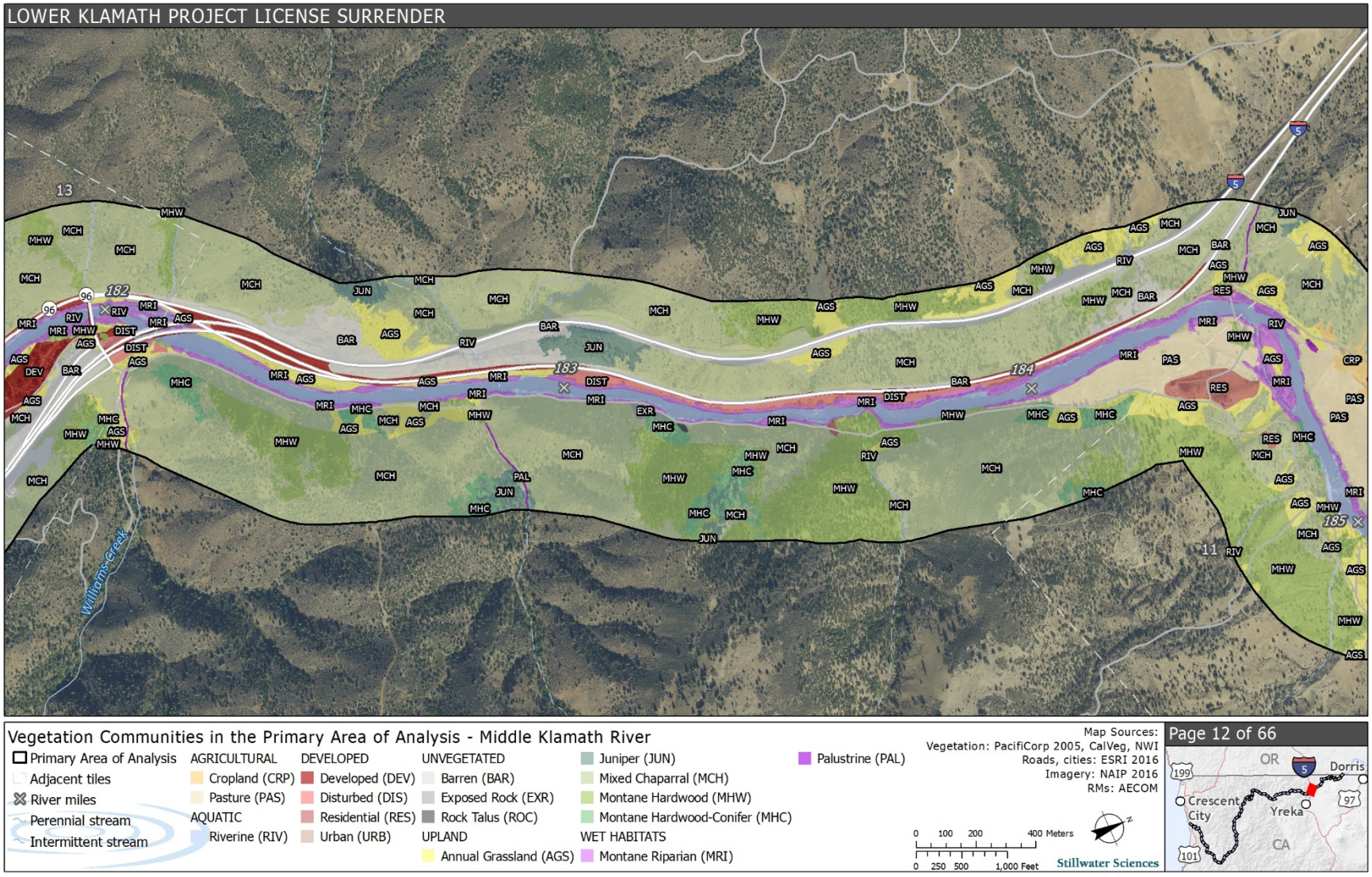


Figure G-12. Vegetation Communities and Habitat Types in the Primary Area of Analysis.

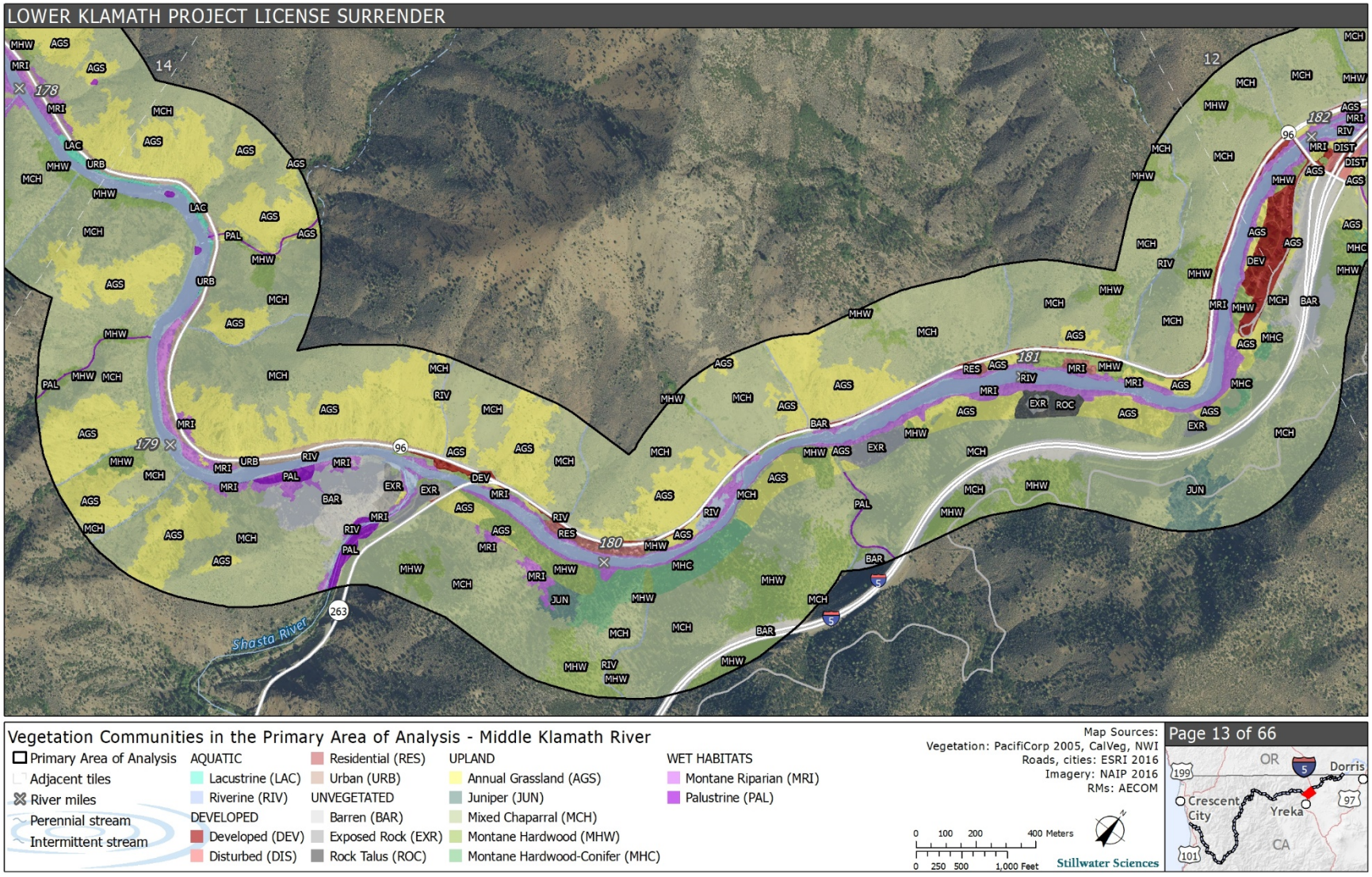


Figure G-13. Vegetation Communities and Habitat Types in the Primary Area of Analysis.

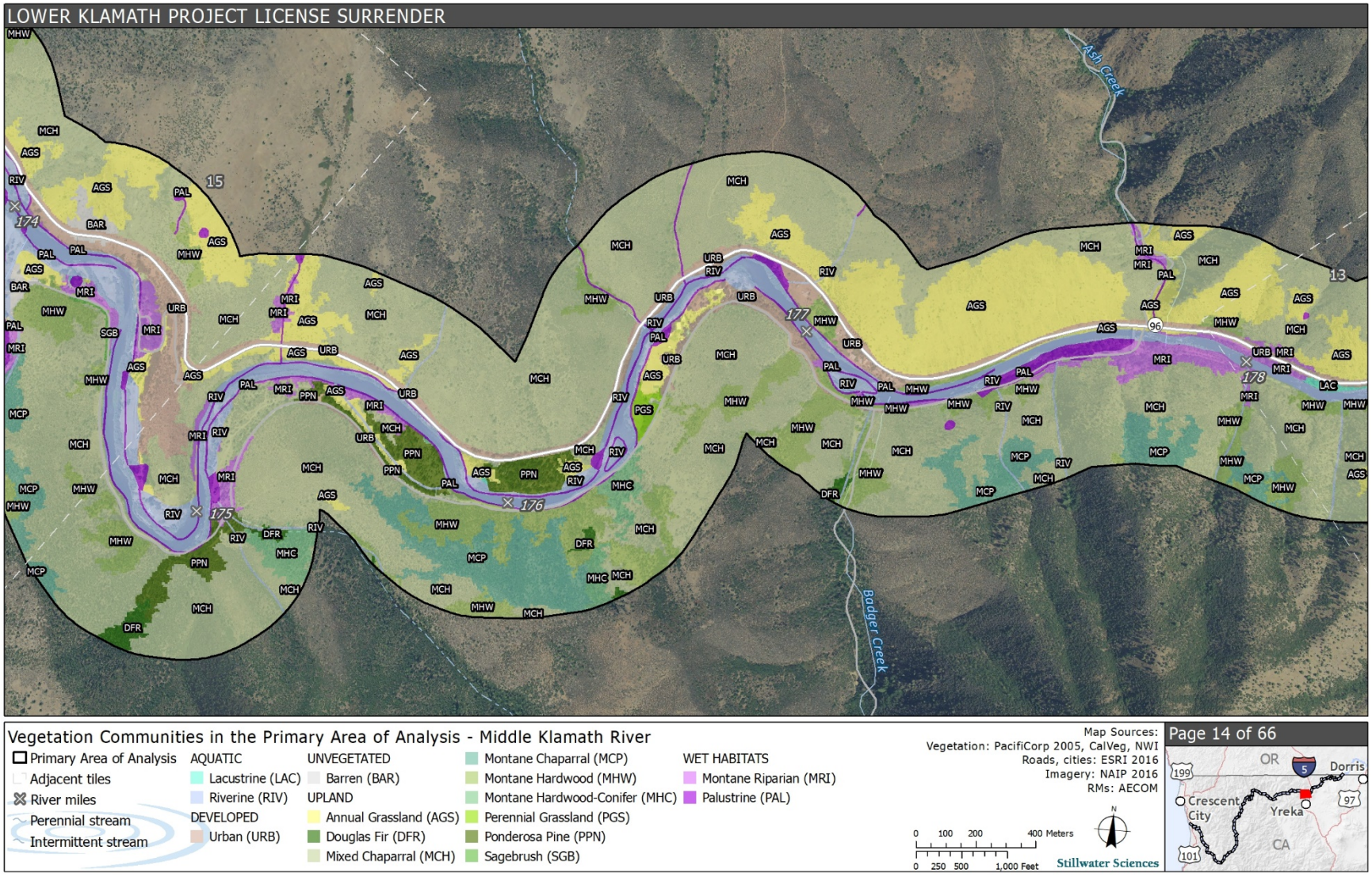


Figure G-14. Vegetation Communities and Habitat Types in the Primary Area of Analysis.

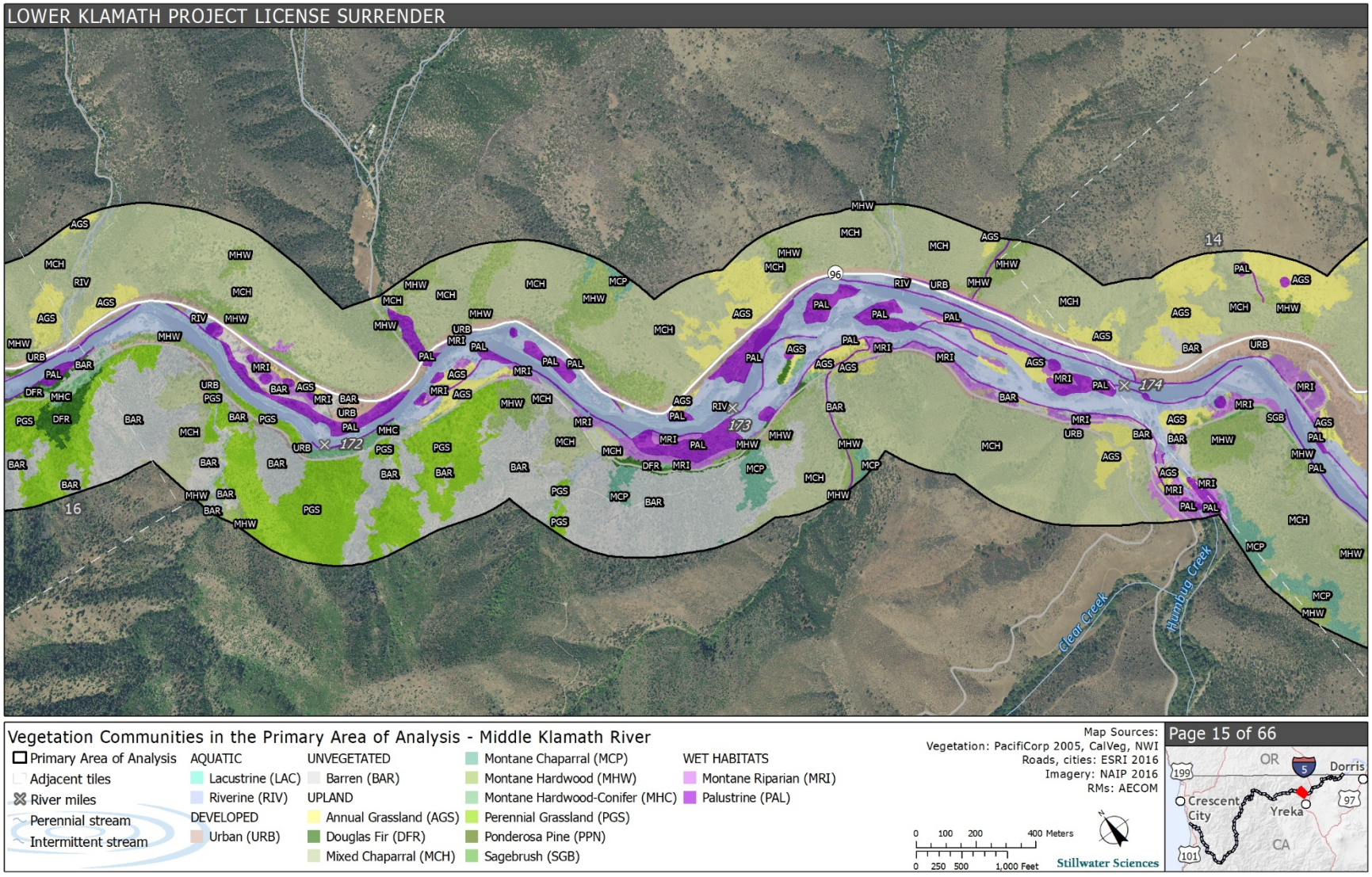


Figure G-15. Vegetation Communities and Habitat Types in the Primary Area of Analysis.

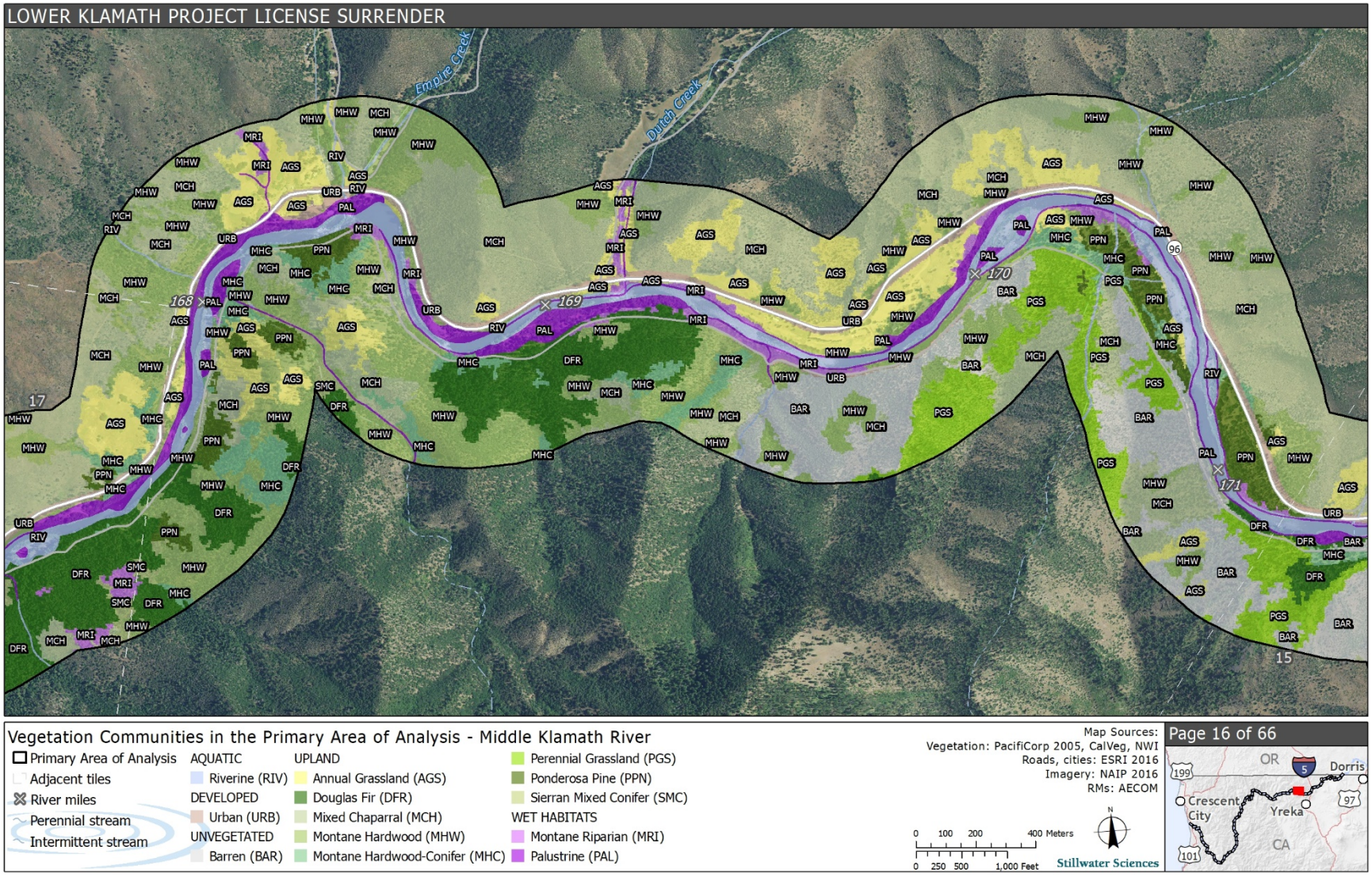


Figure G-16. Vegetation Communities and Habitat Types in the Primary Area of Analysis.

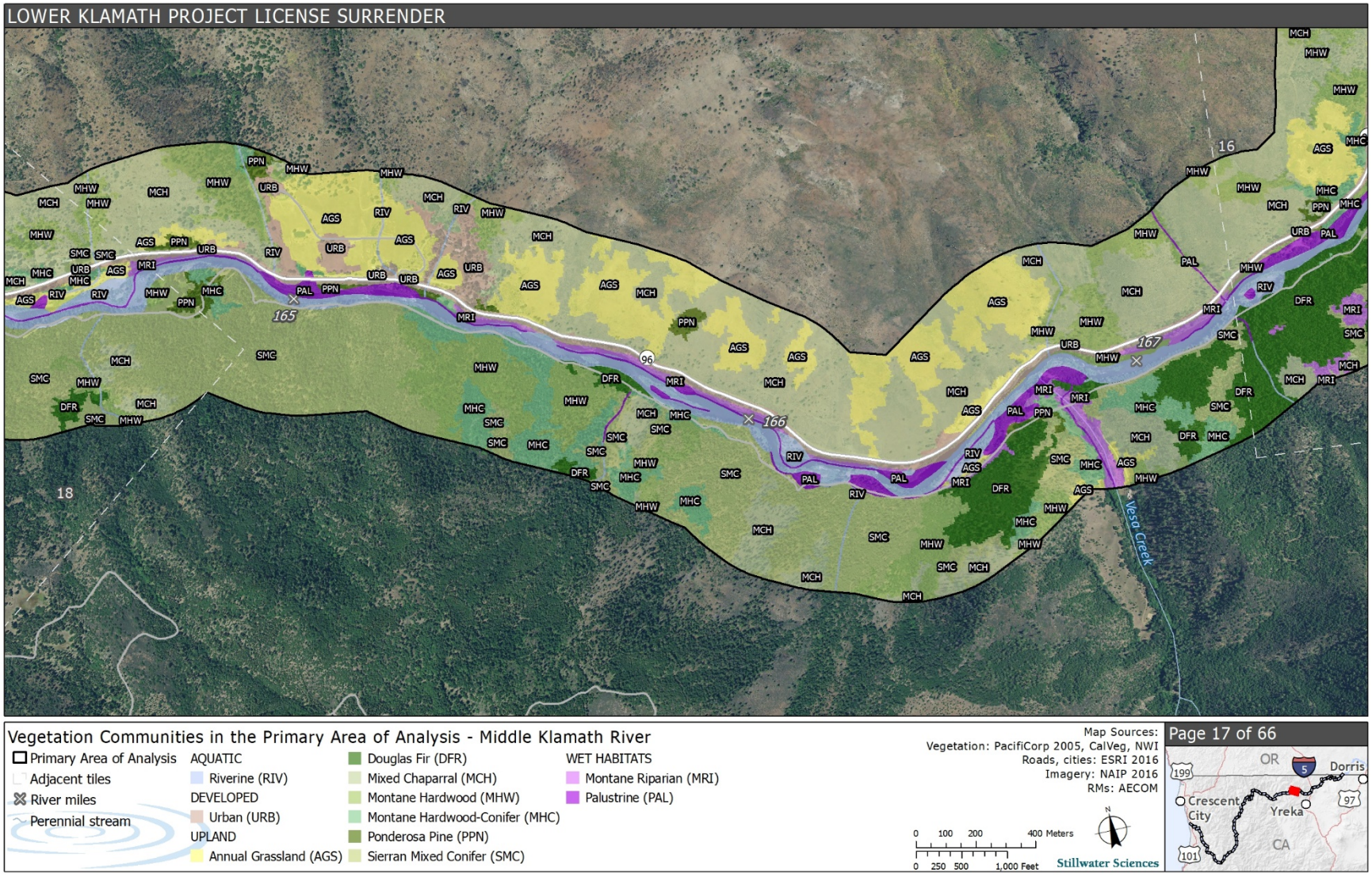


Figure G-17. Vegetation Communities and Habitat Types in the Primary Area of Analysis.

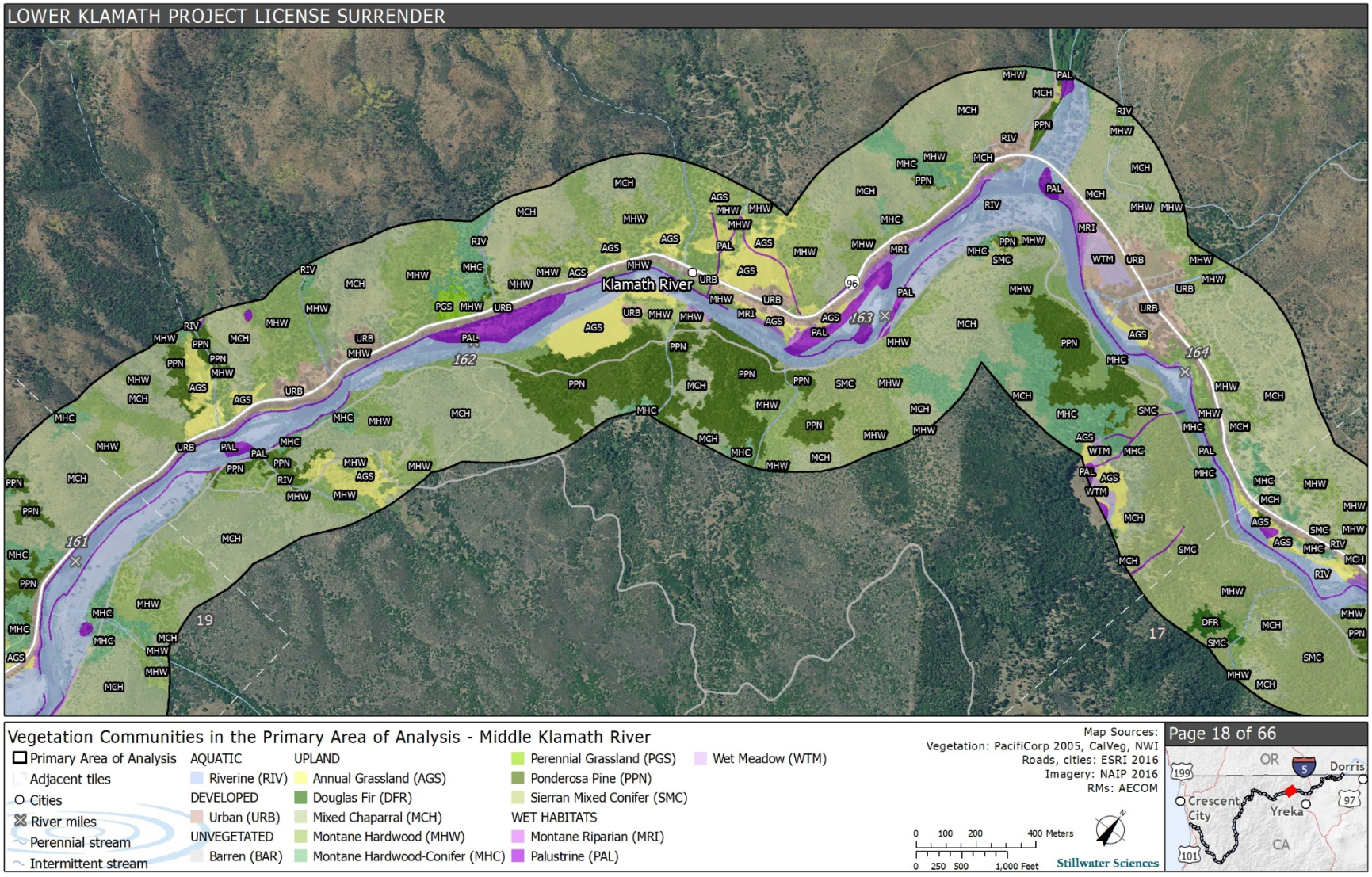


Figure G-18. Vegetation Communities and Habitat Types in the Primary Area of Analysis.

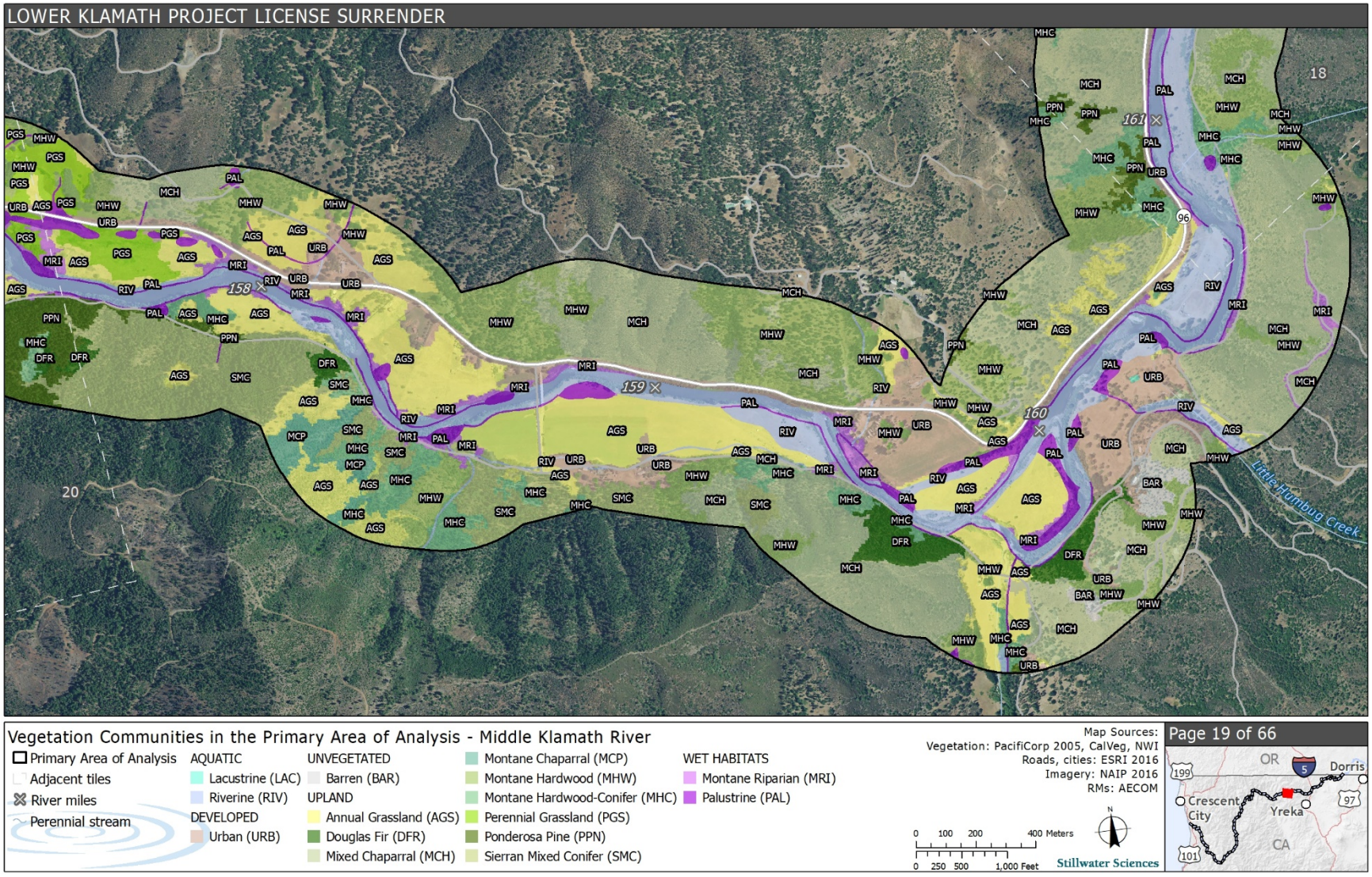


Figure G-19. Vegetation Communities and Habitat Types in the Primary Area of Analysis.

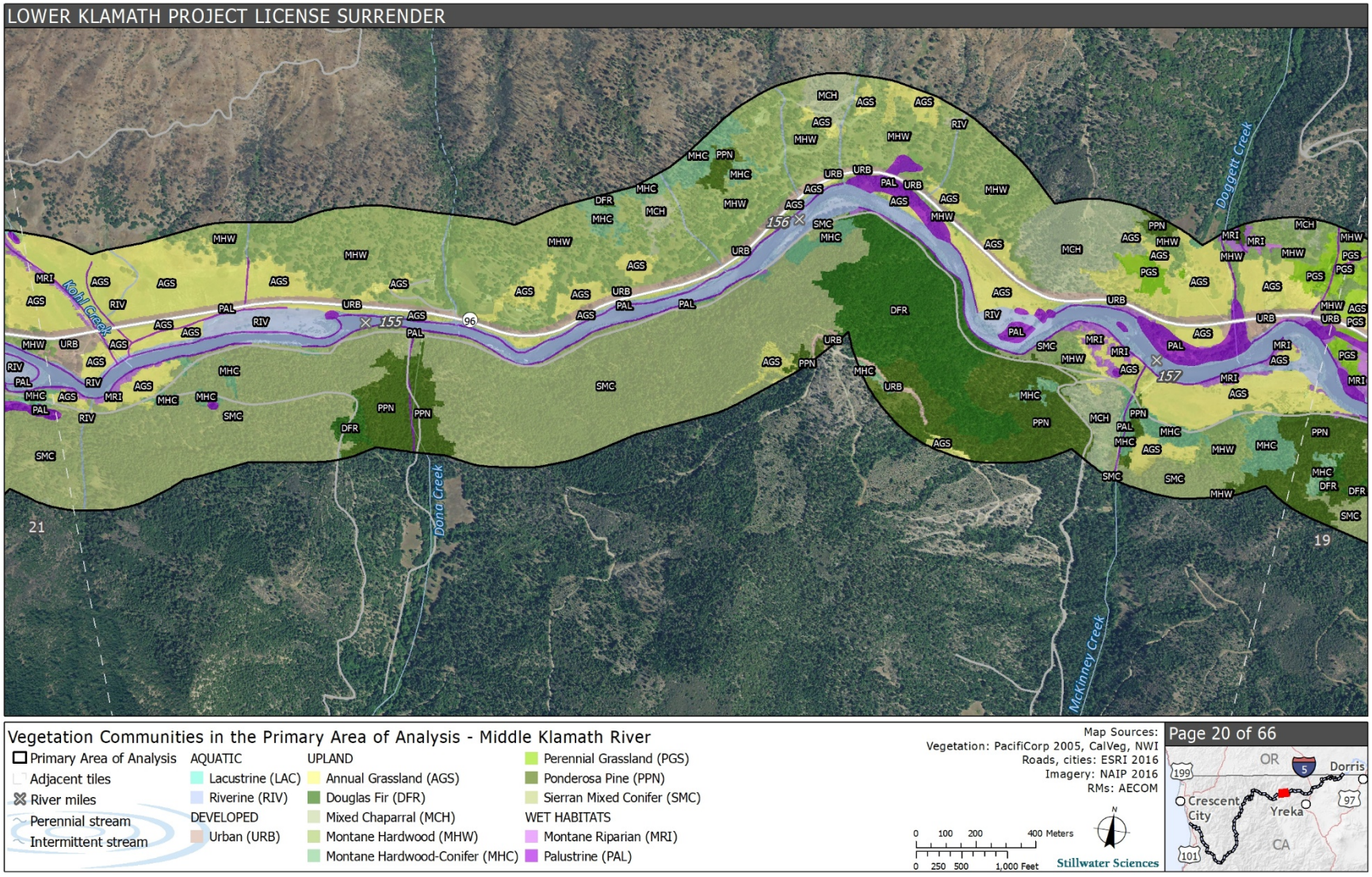


Figure G-20. Vegetation Communities and Habitat Types in the Primary Area of Analysis.

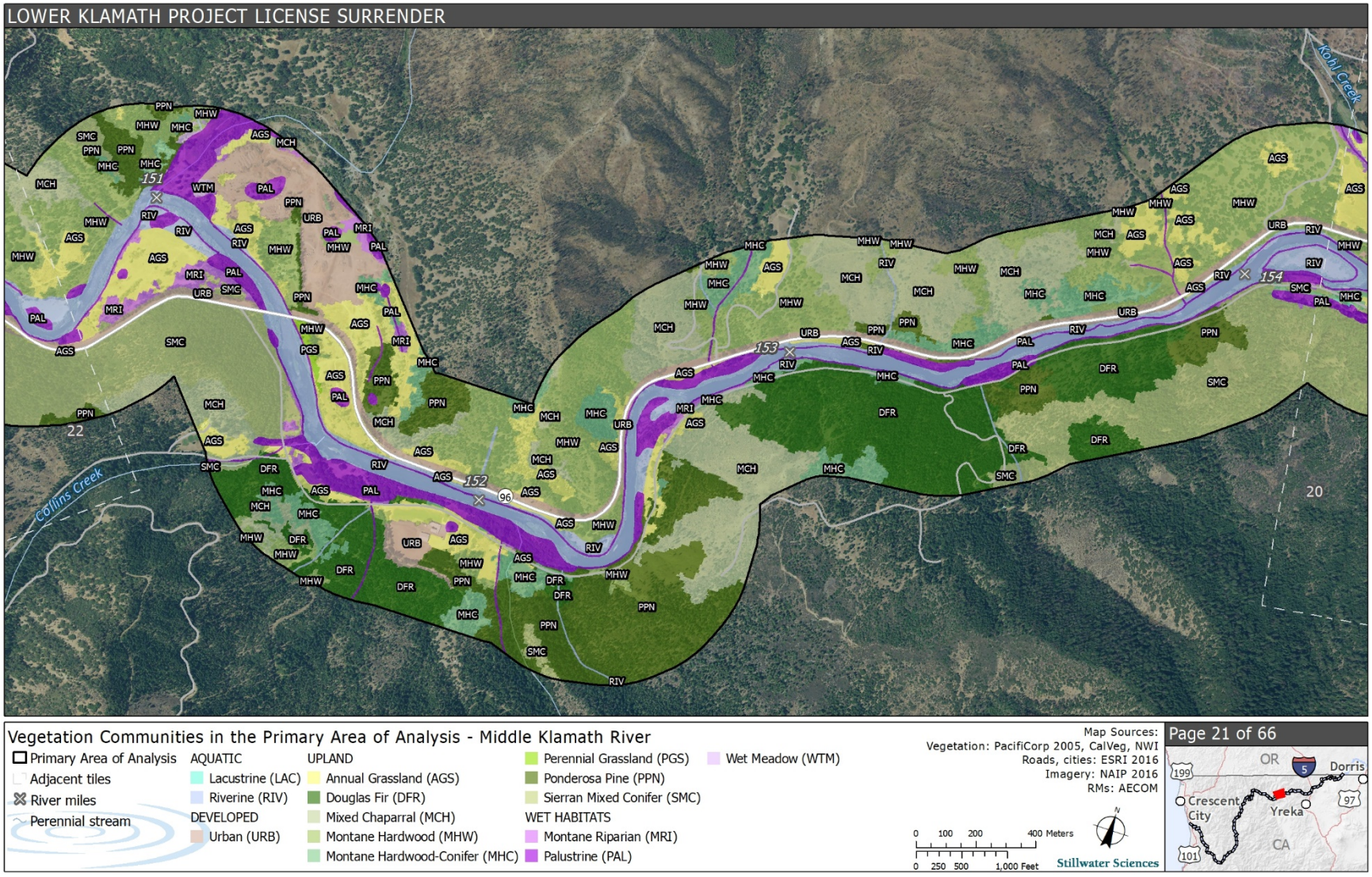
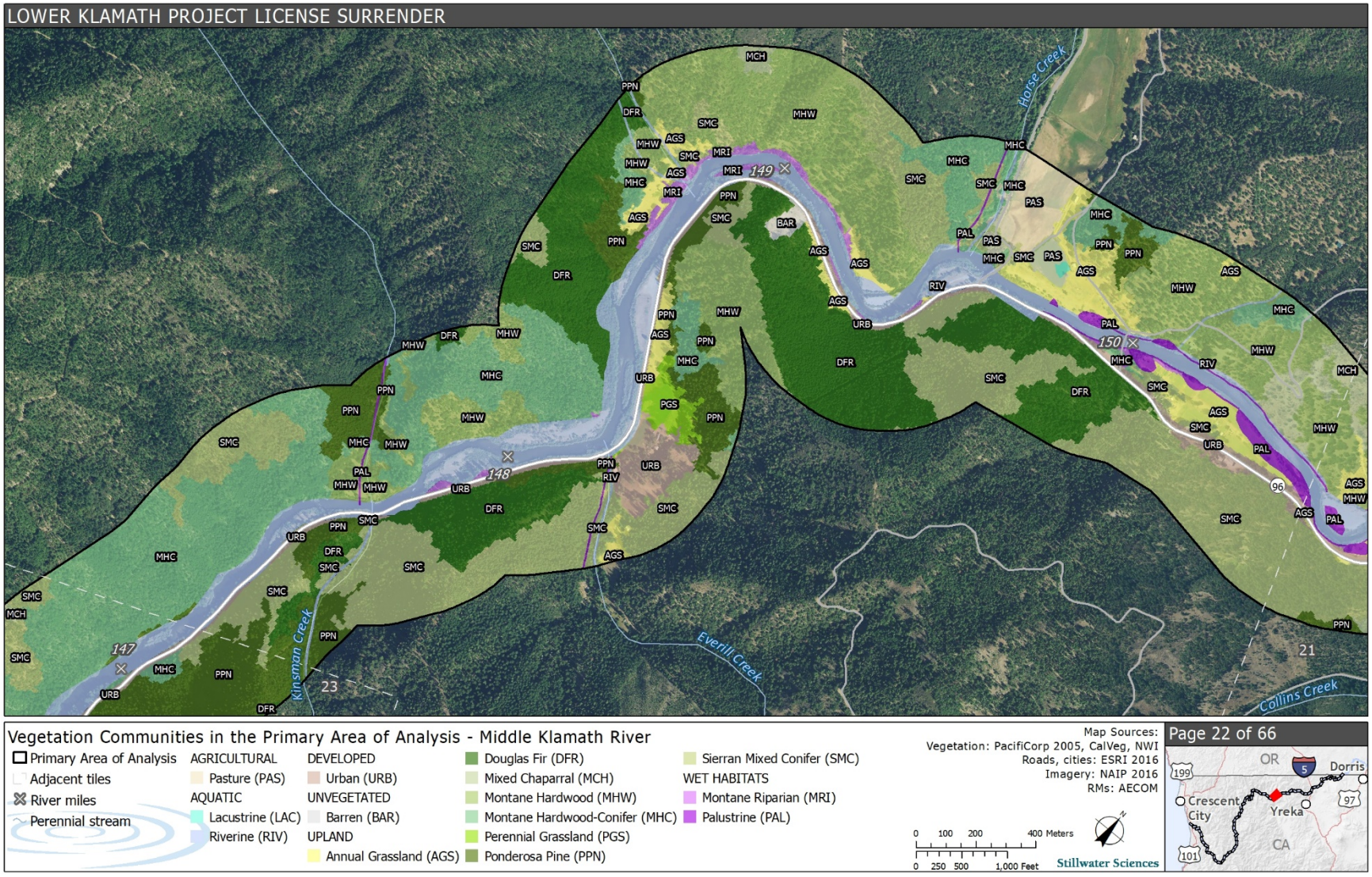


Figure G-21. Vegetation Communities and Habitat Types in the Primary Area of Analysis.



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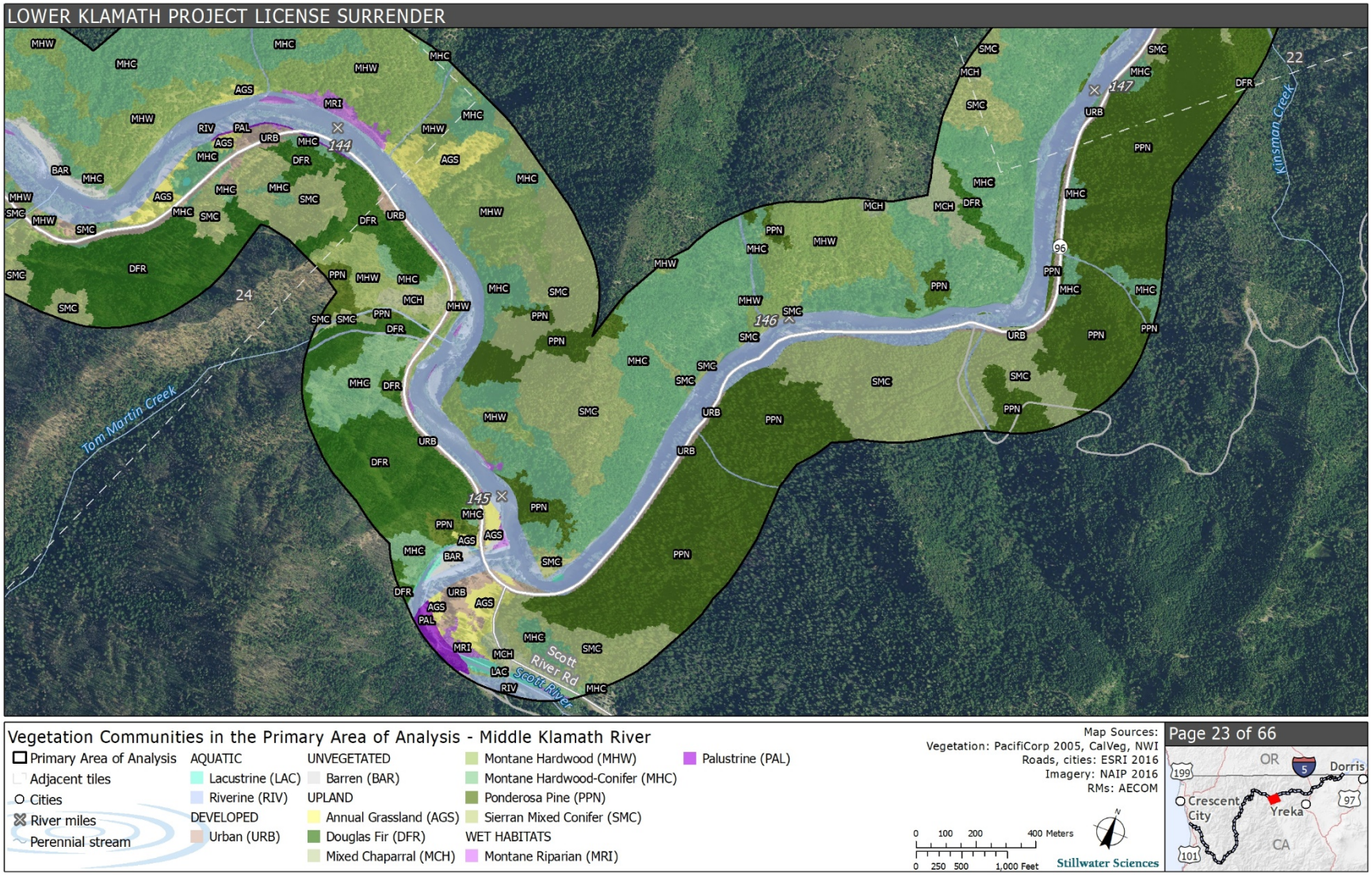

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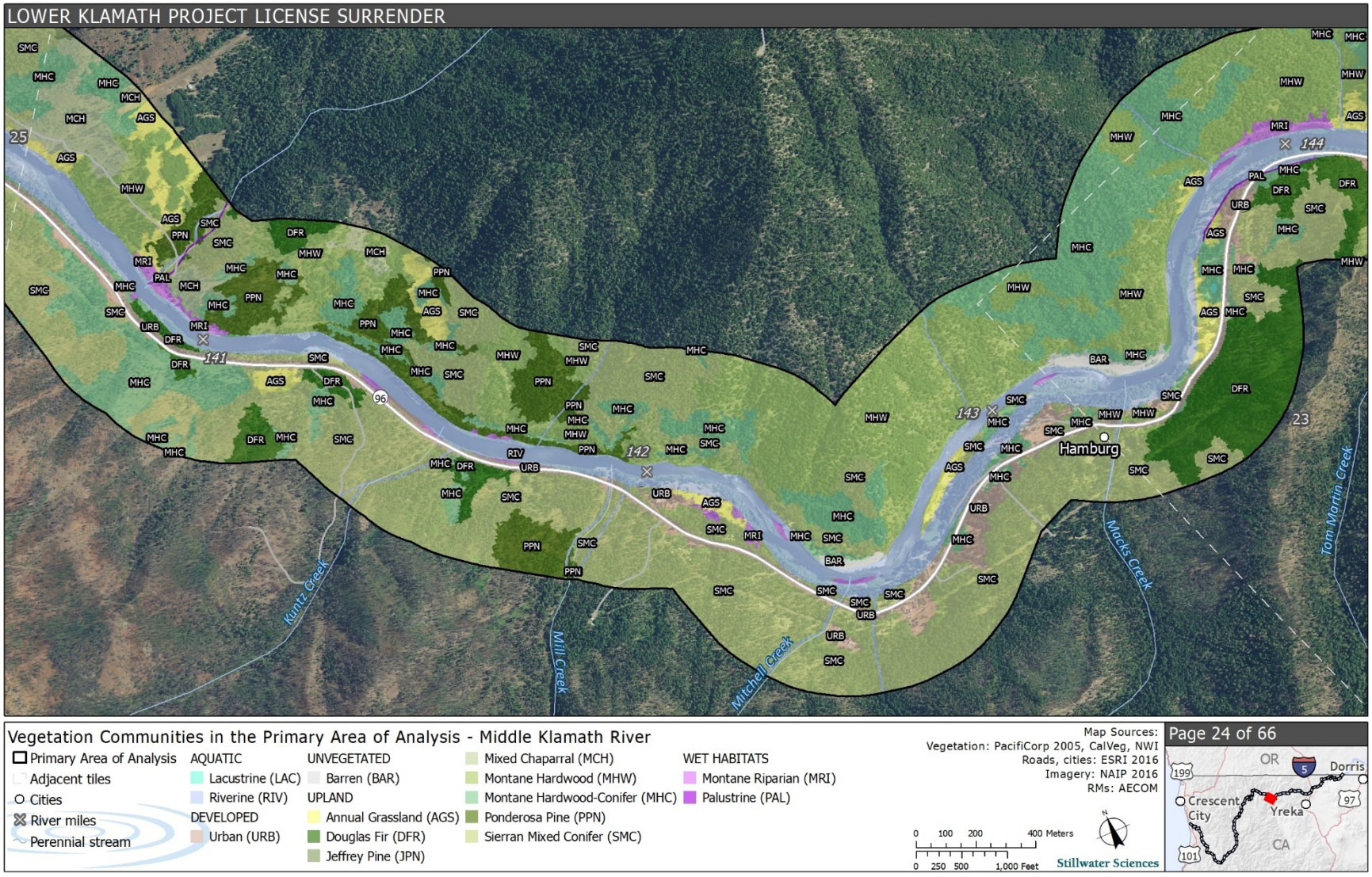

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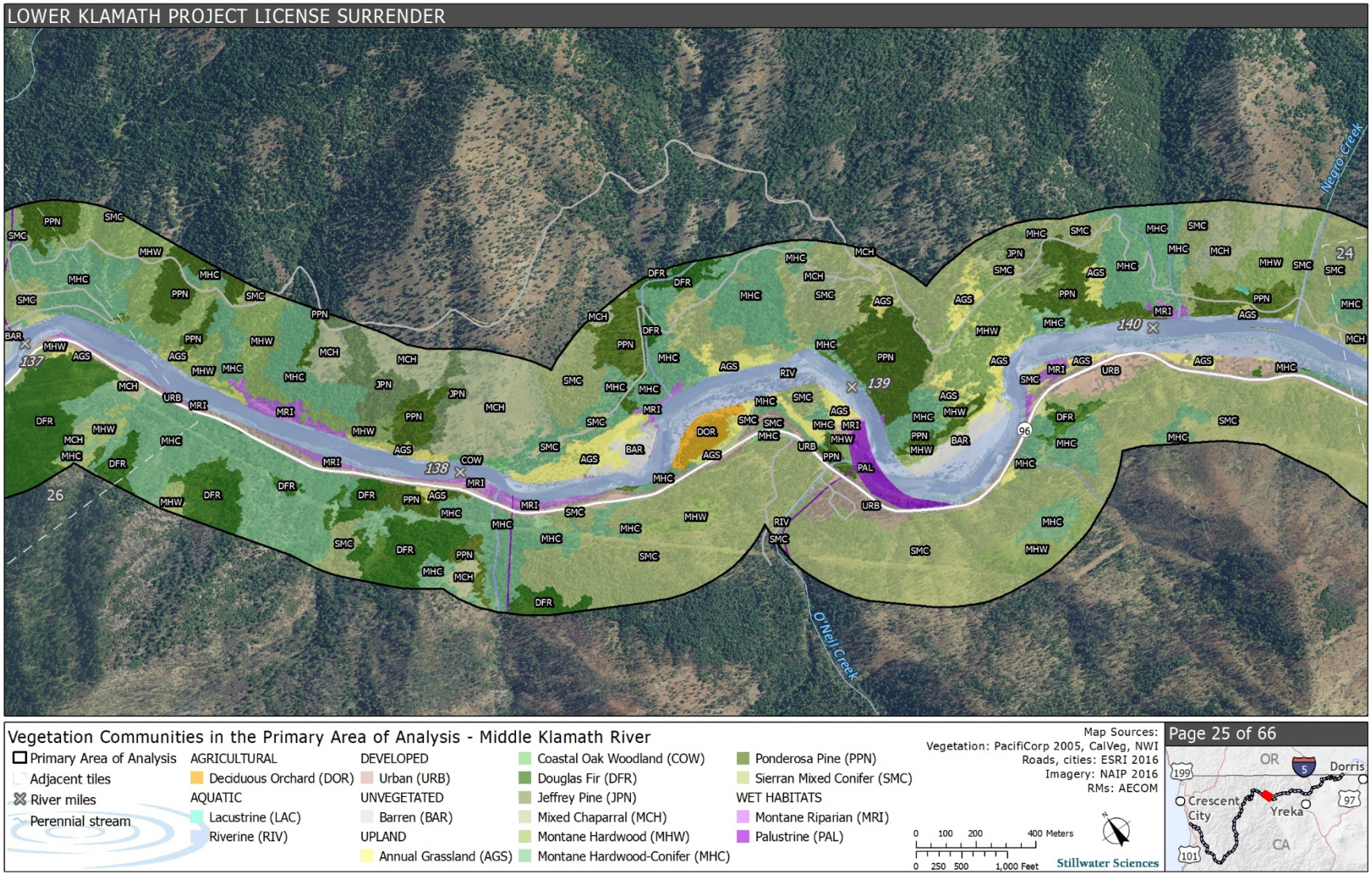

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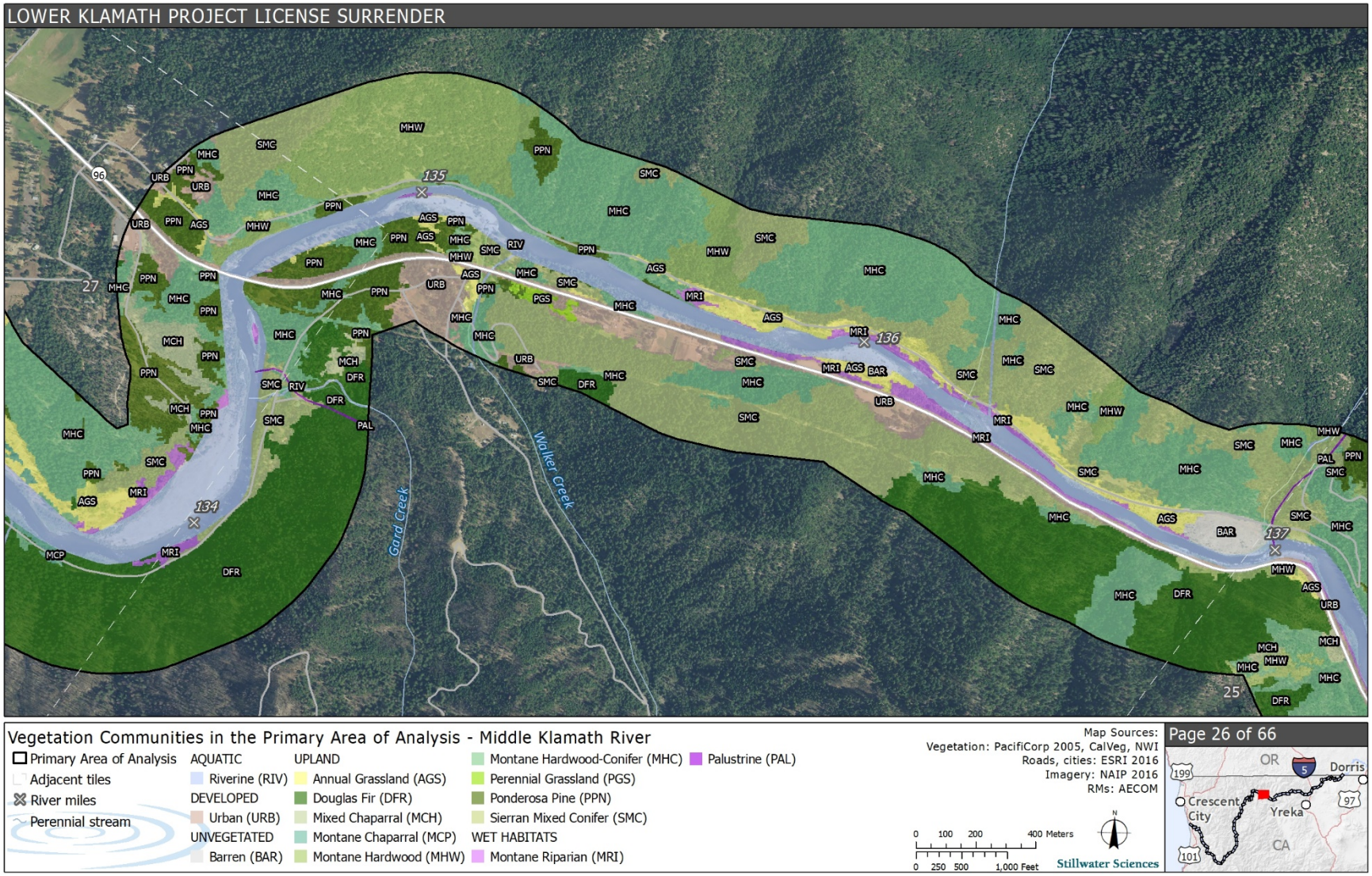

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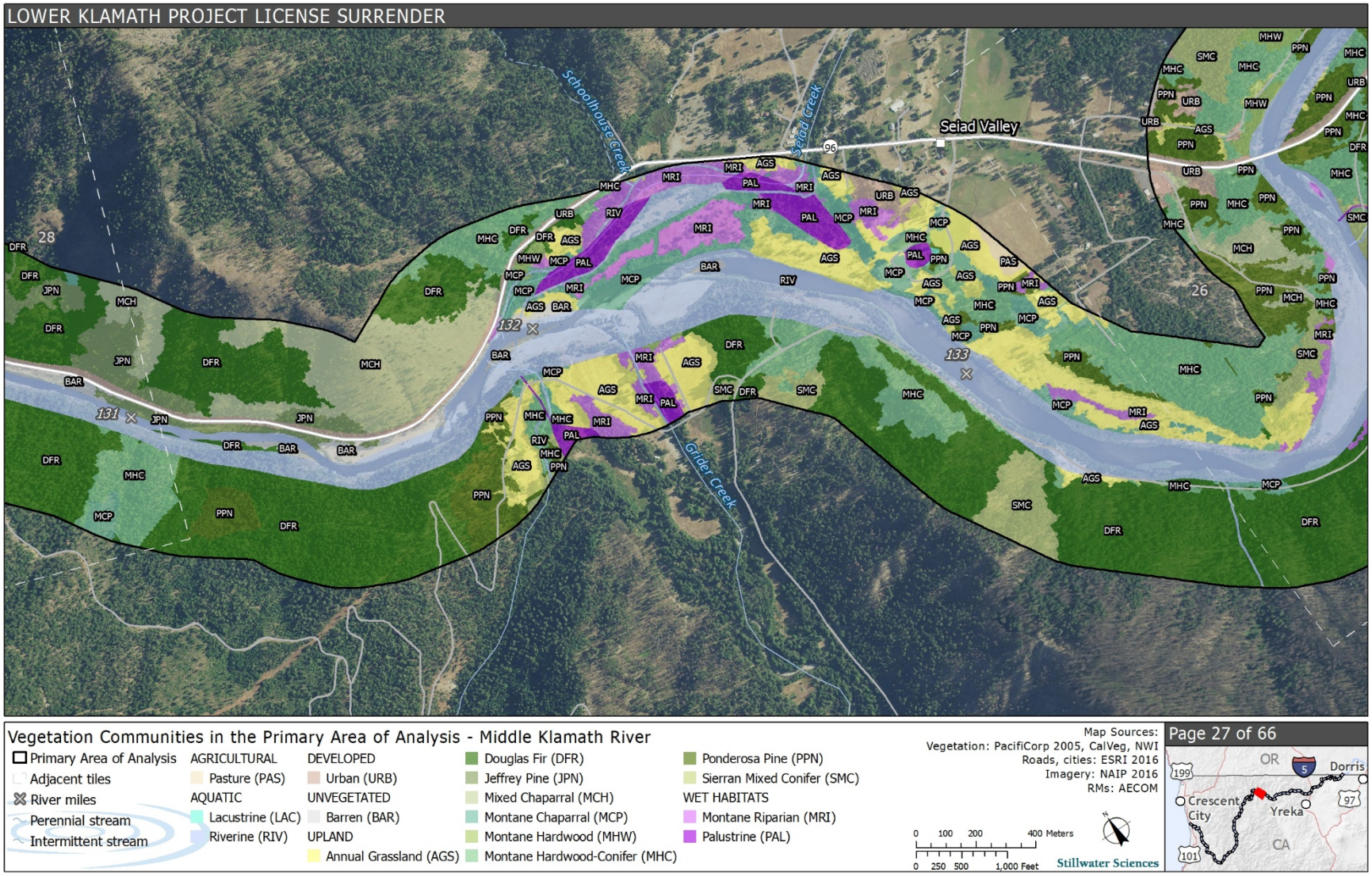

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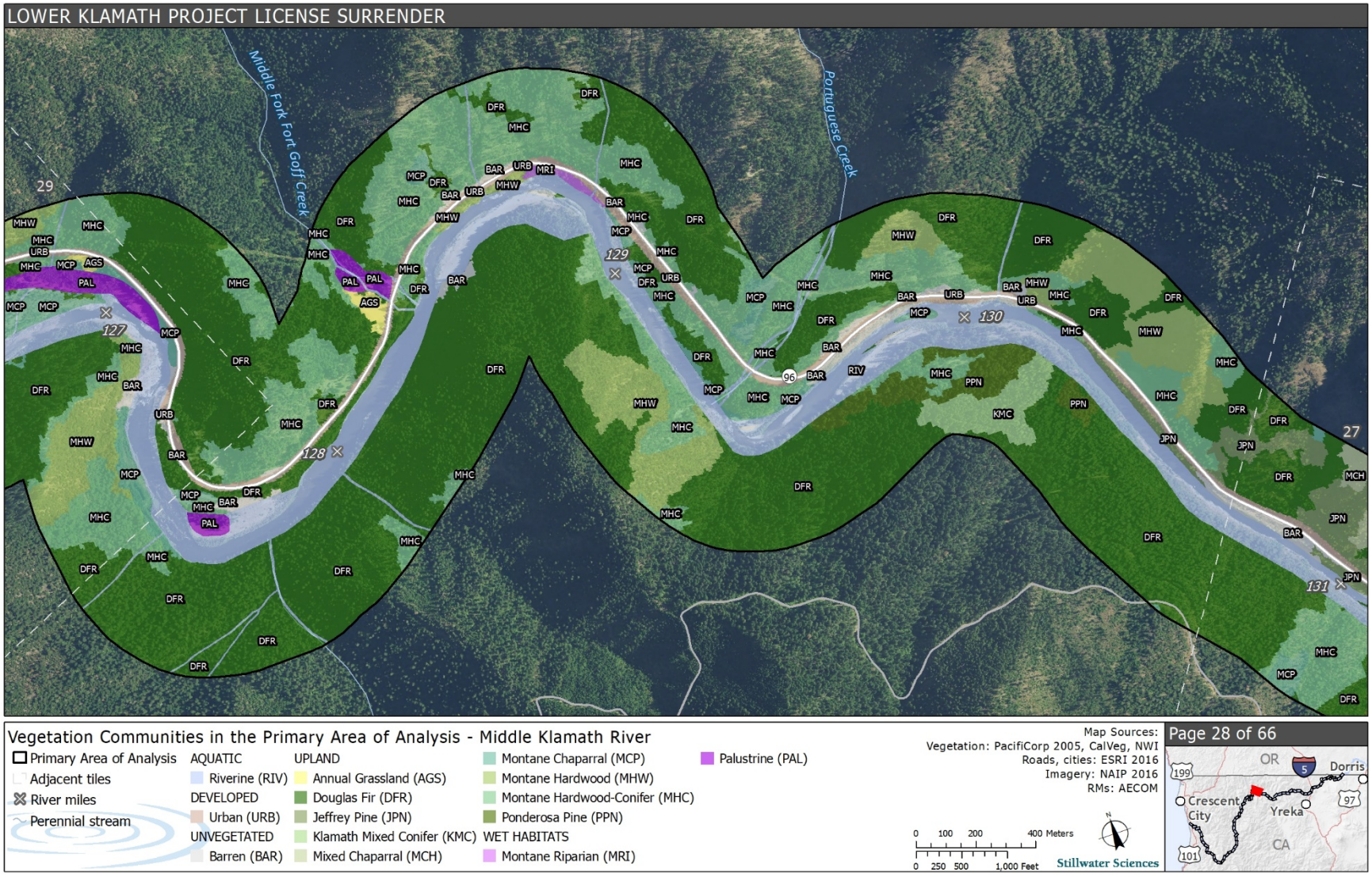

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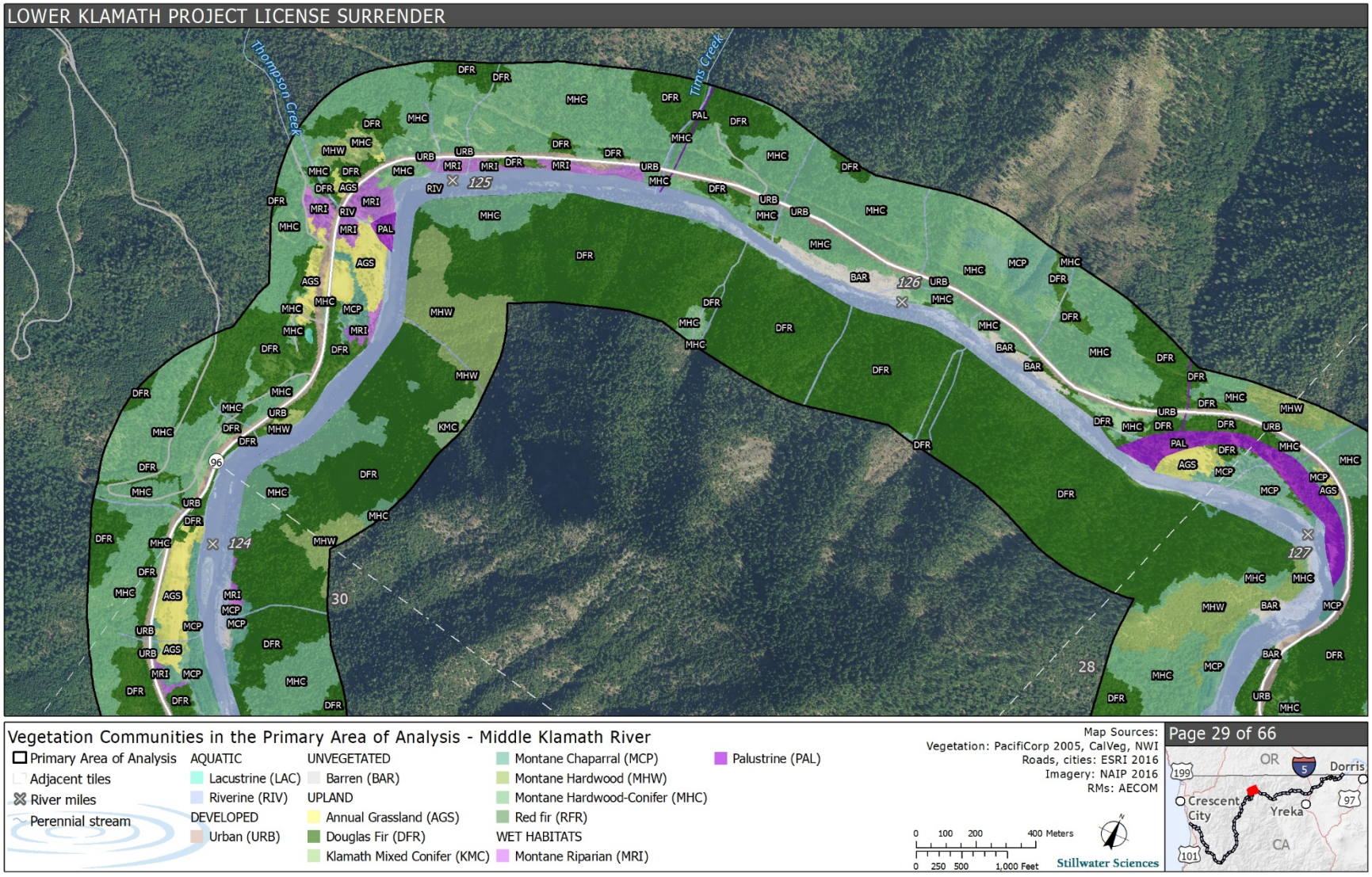

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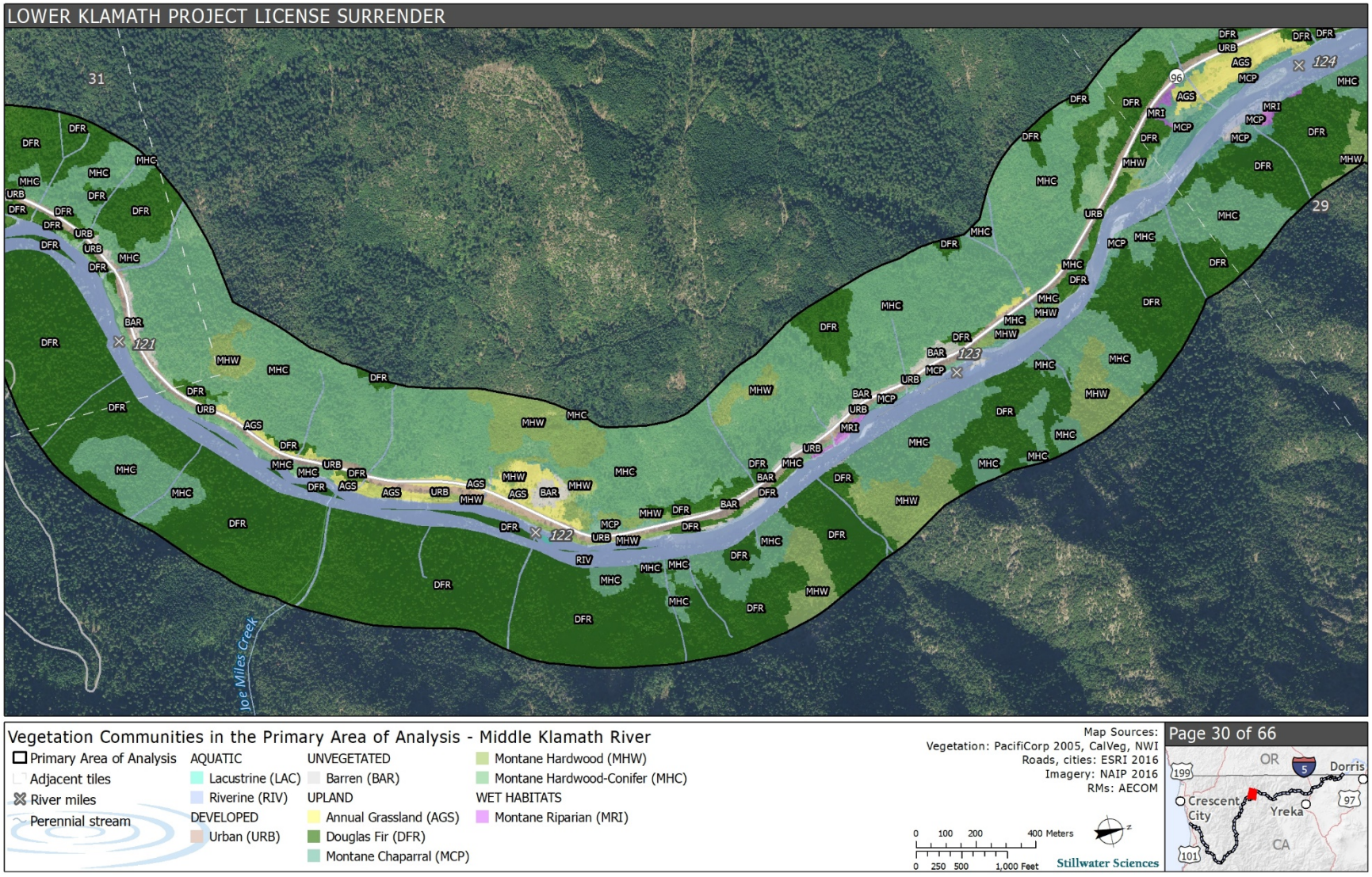

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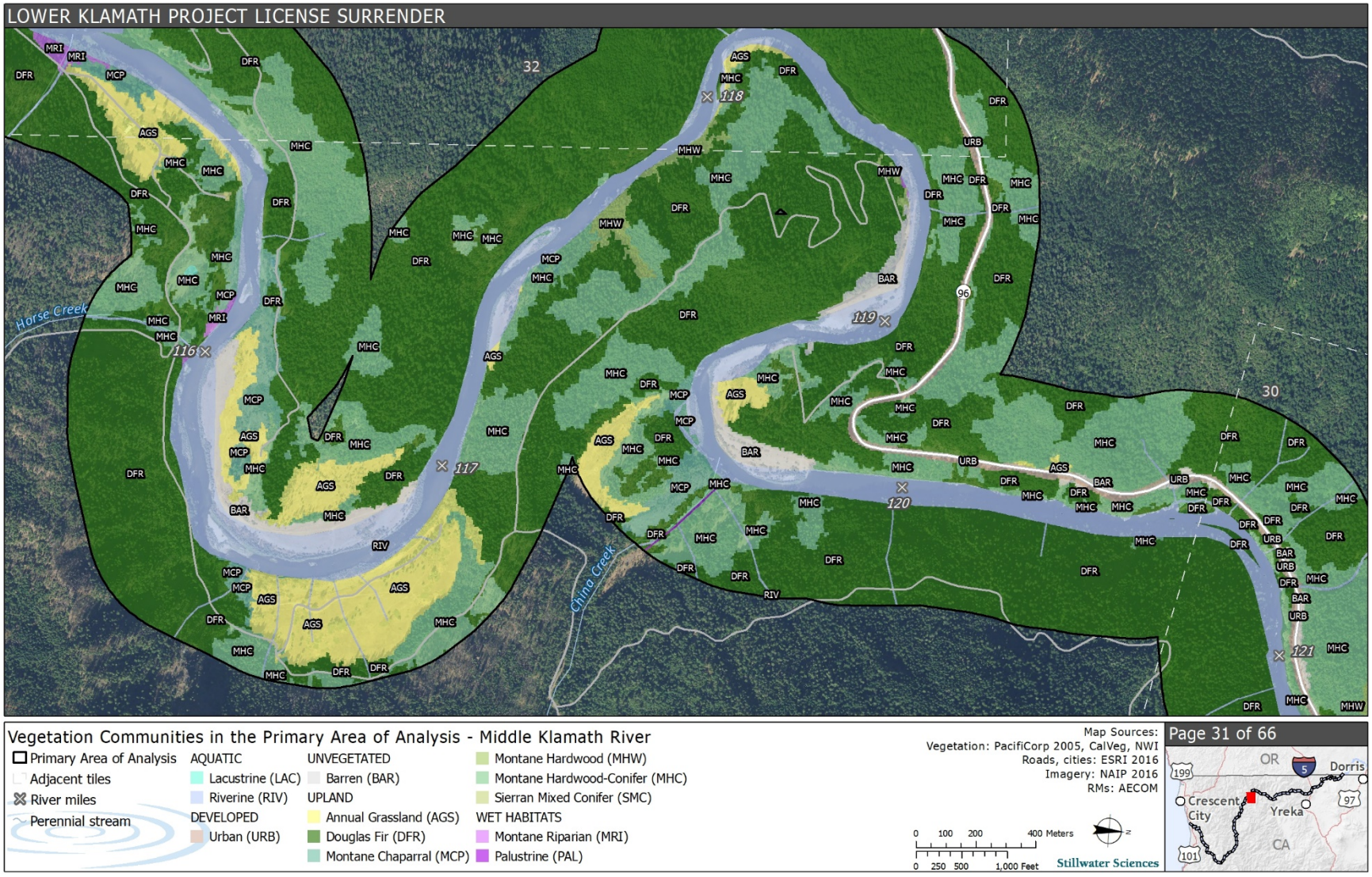

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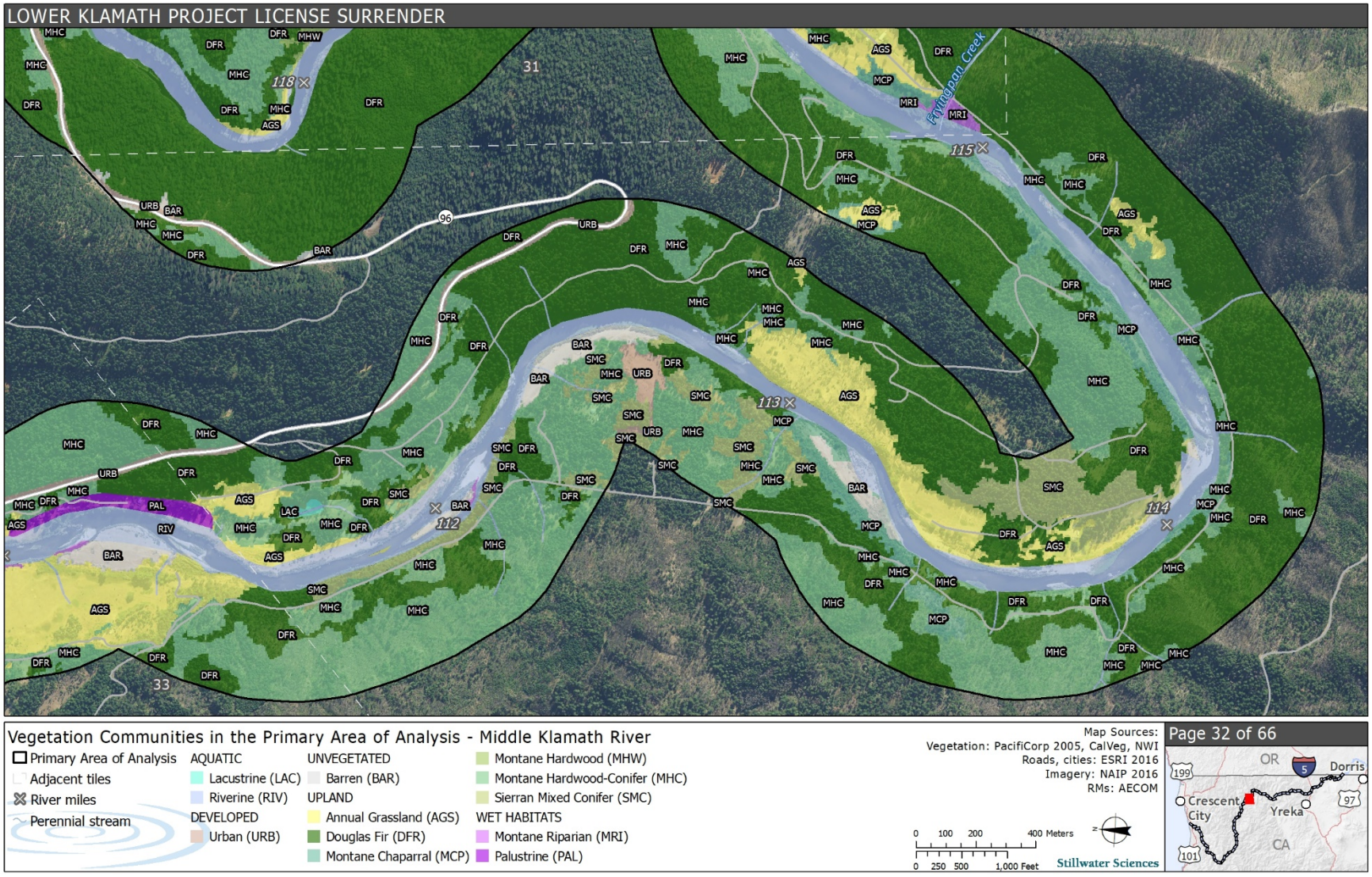

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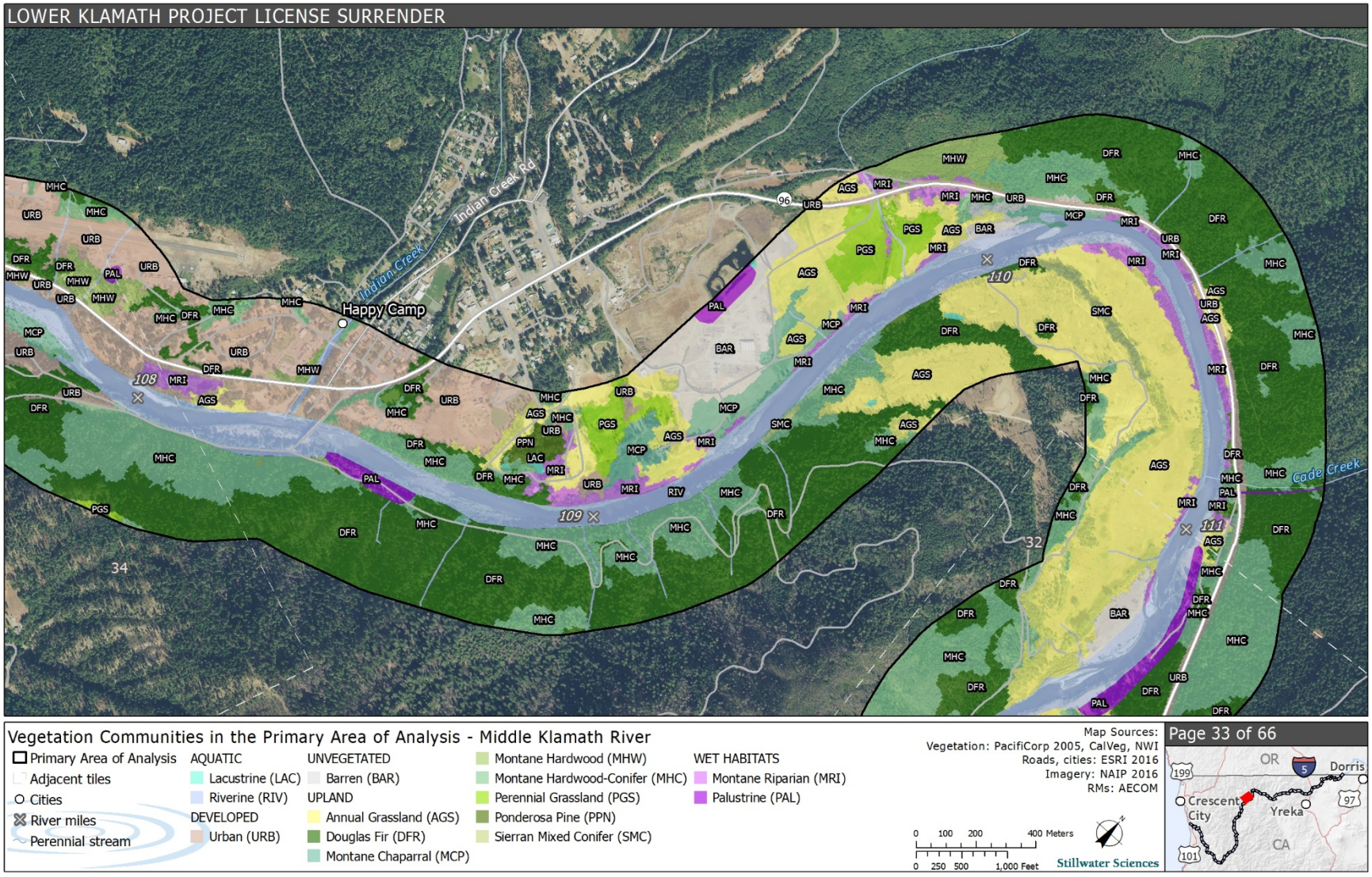

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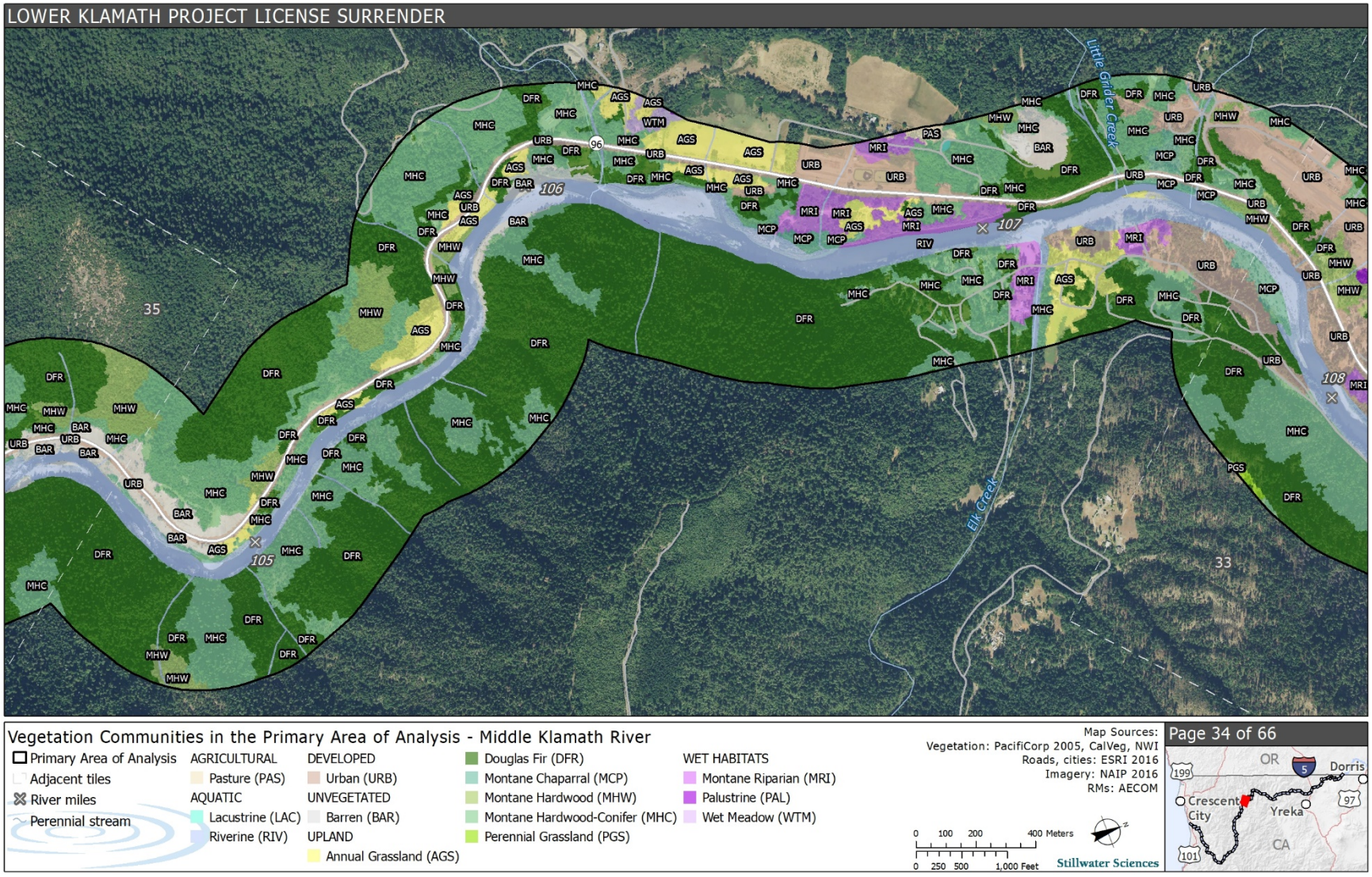

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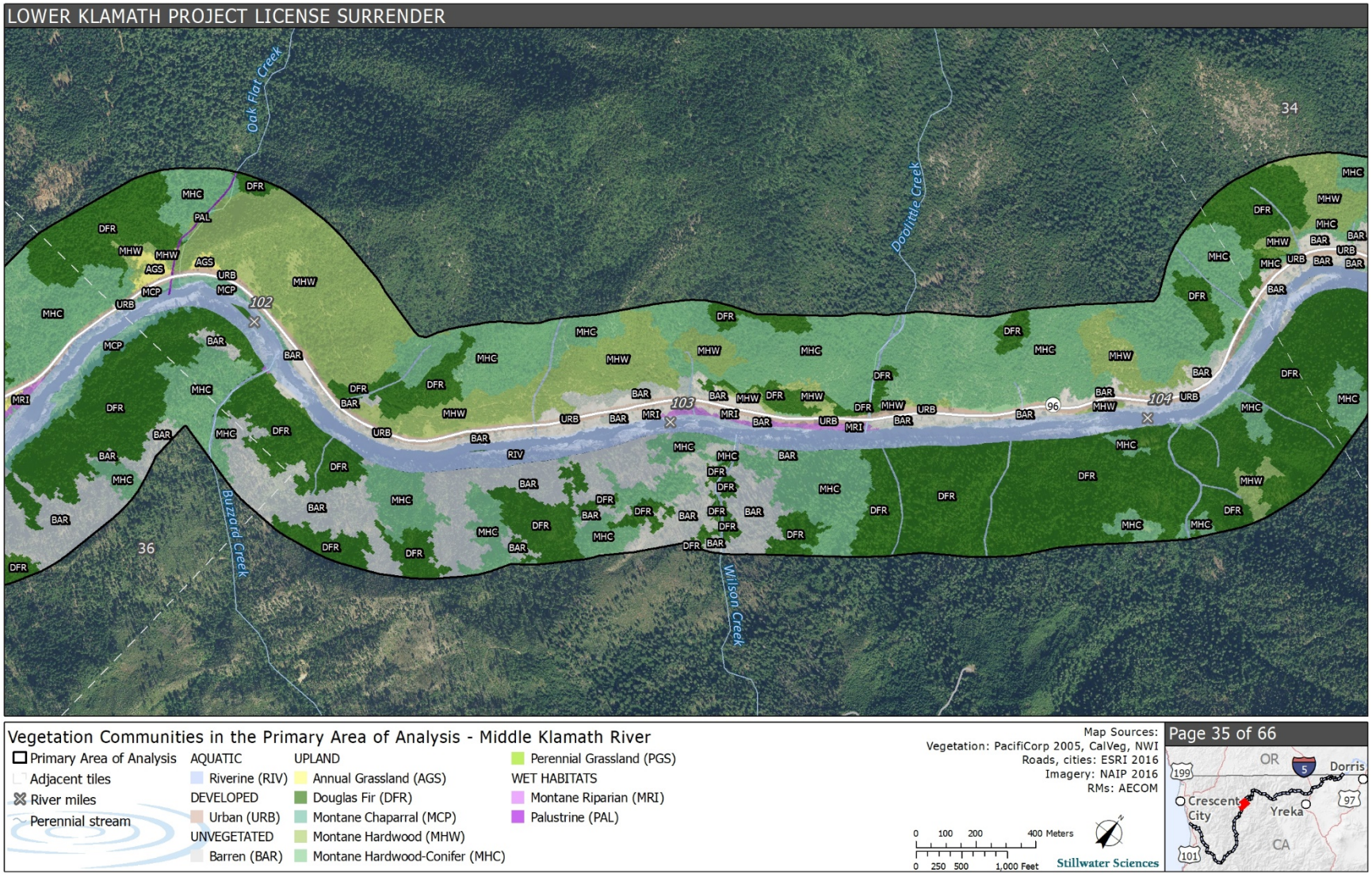

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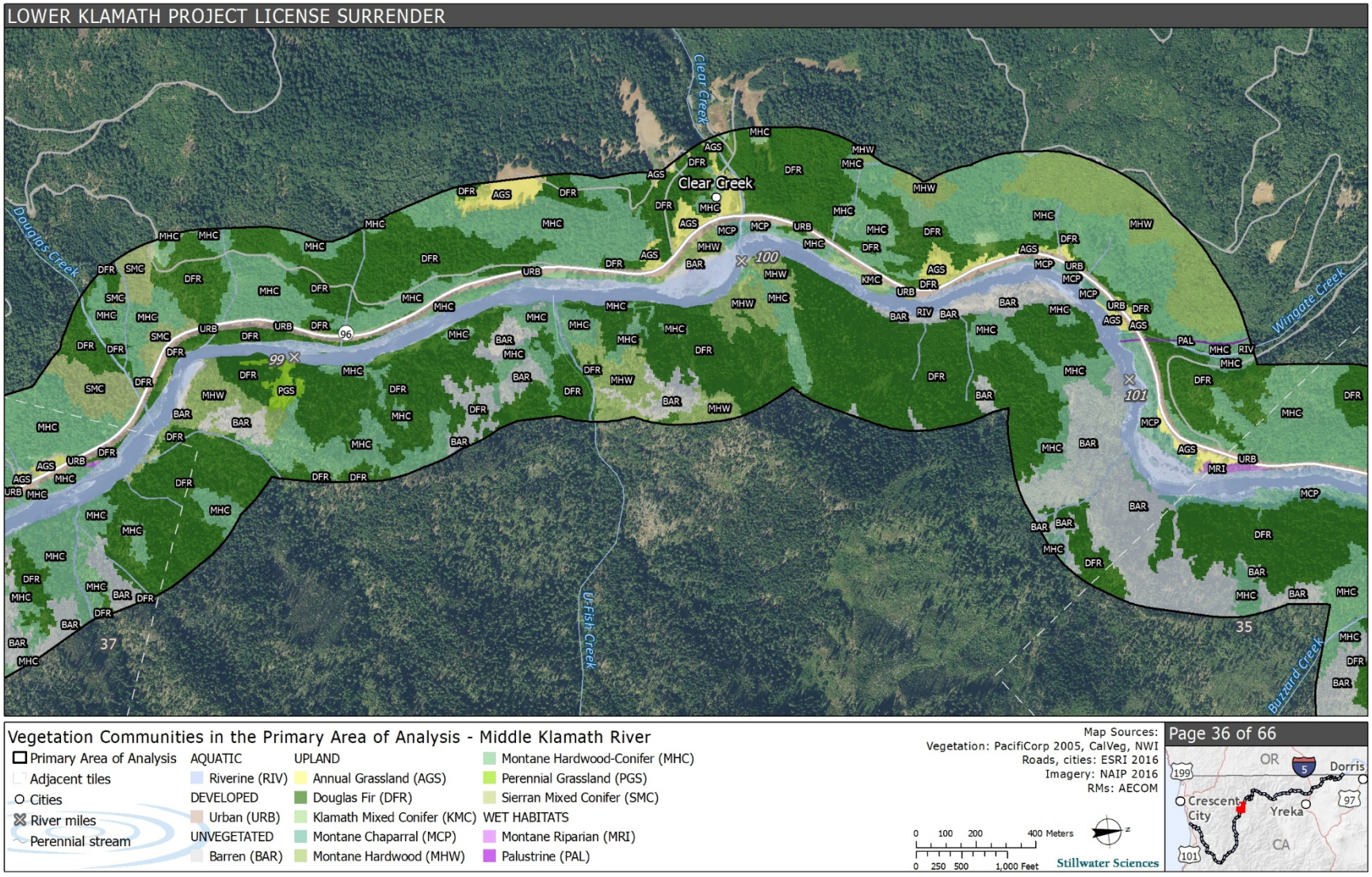

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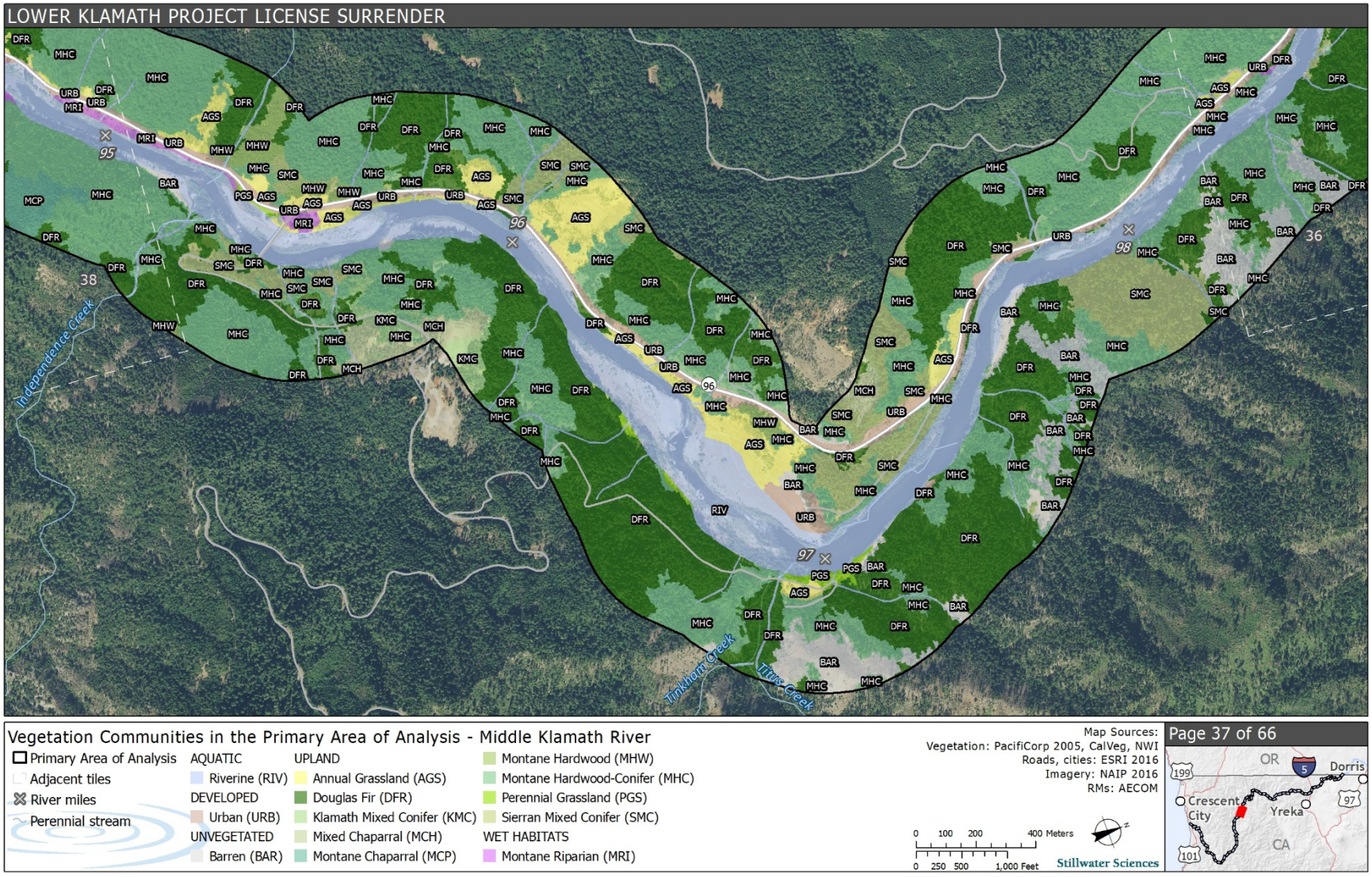

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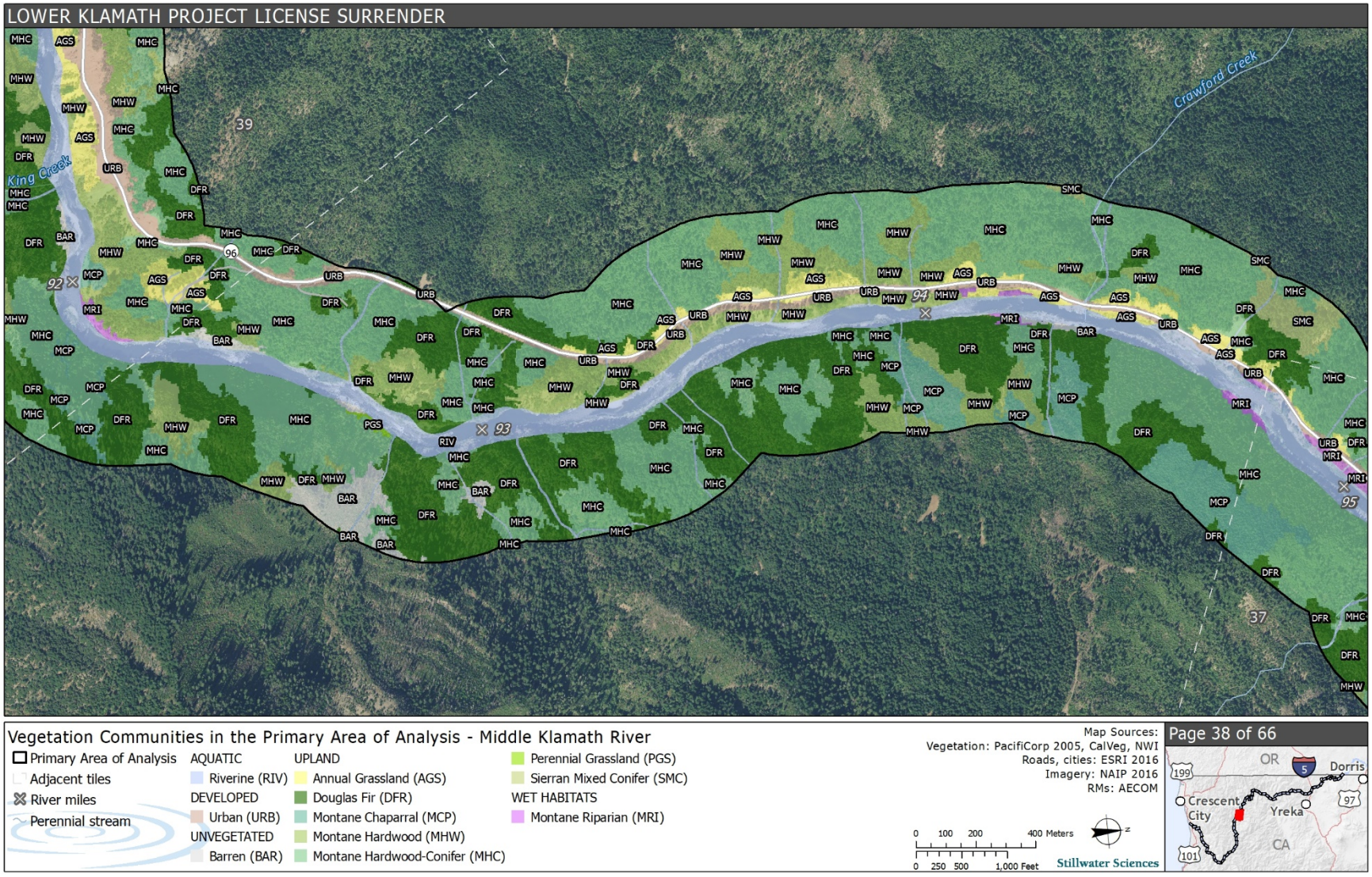

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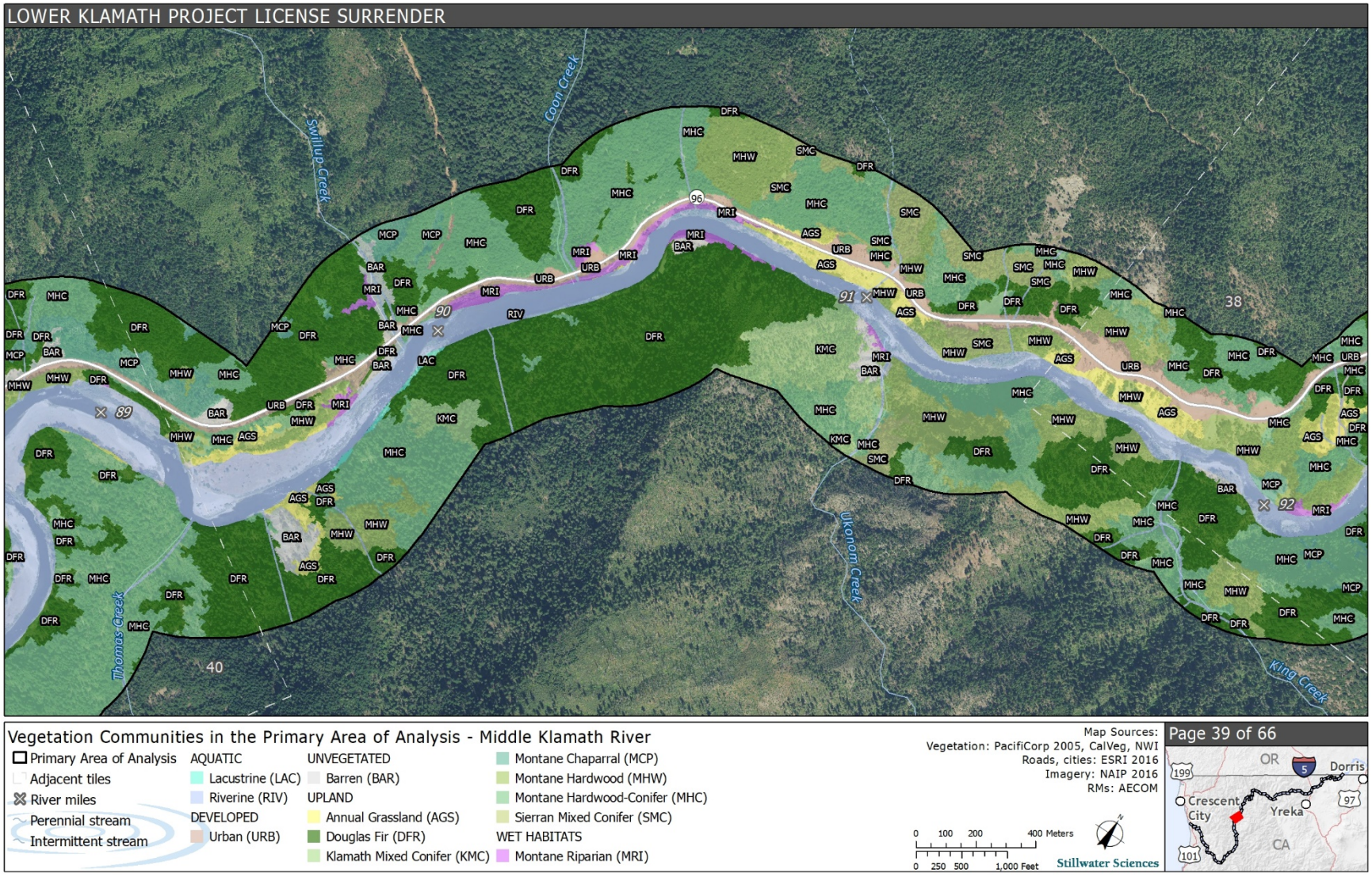

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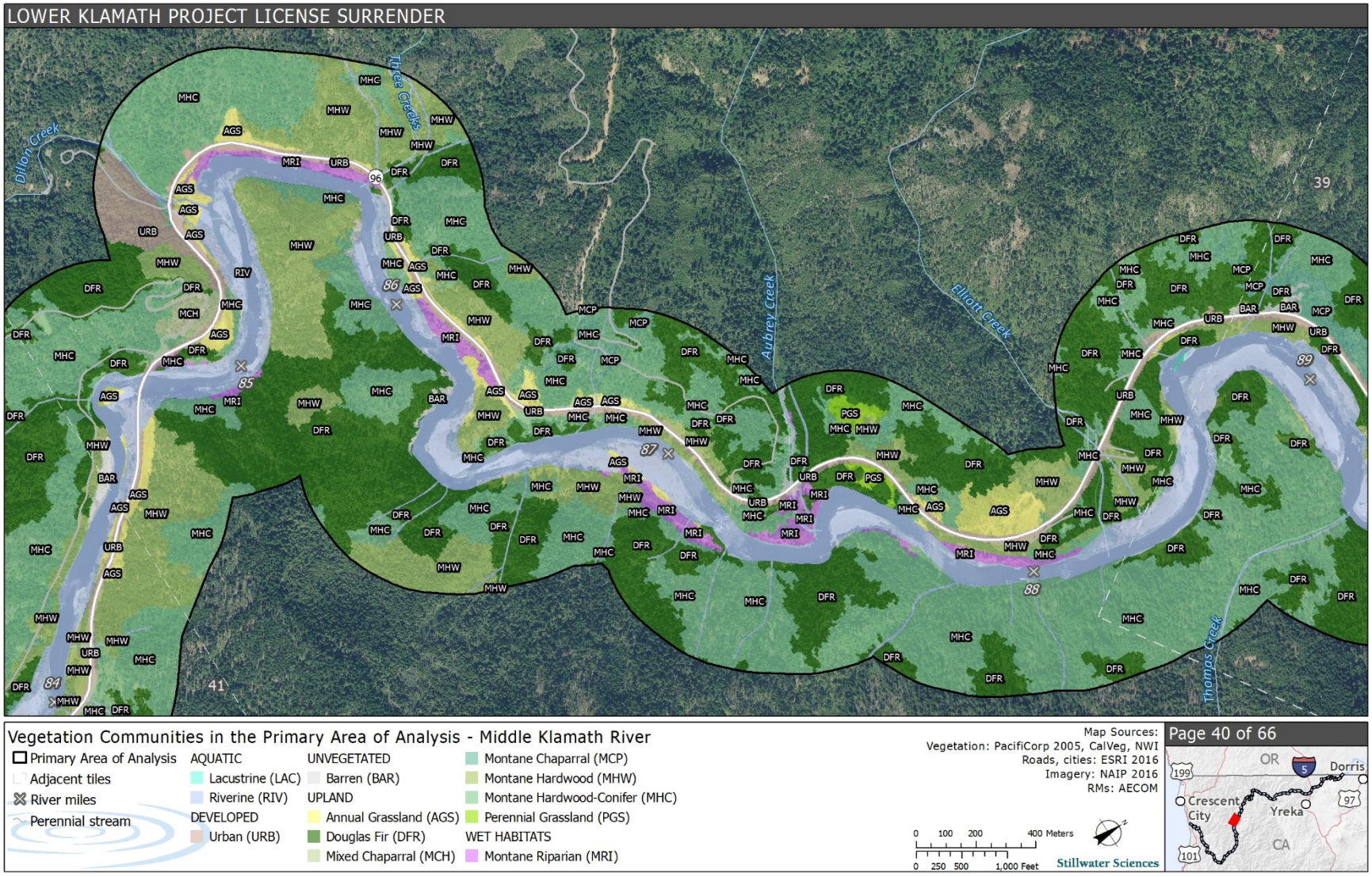

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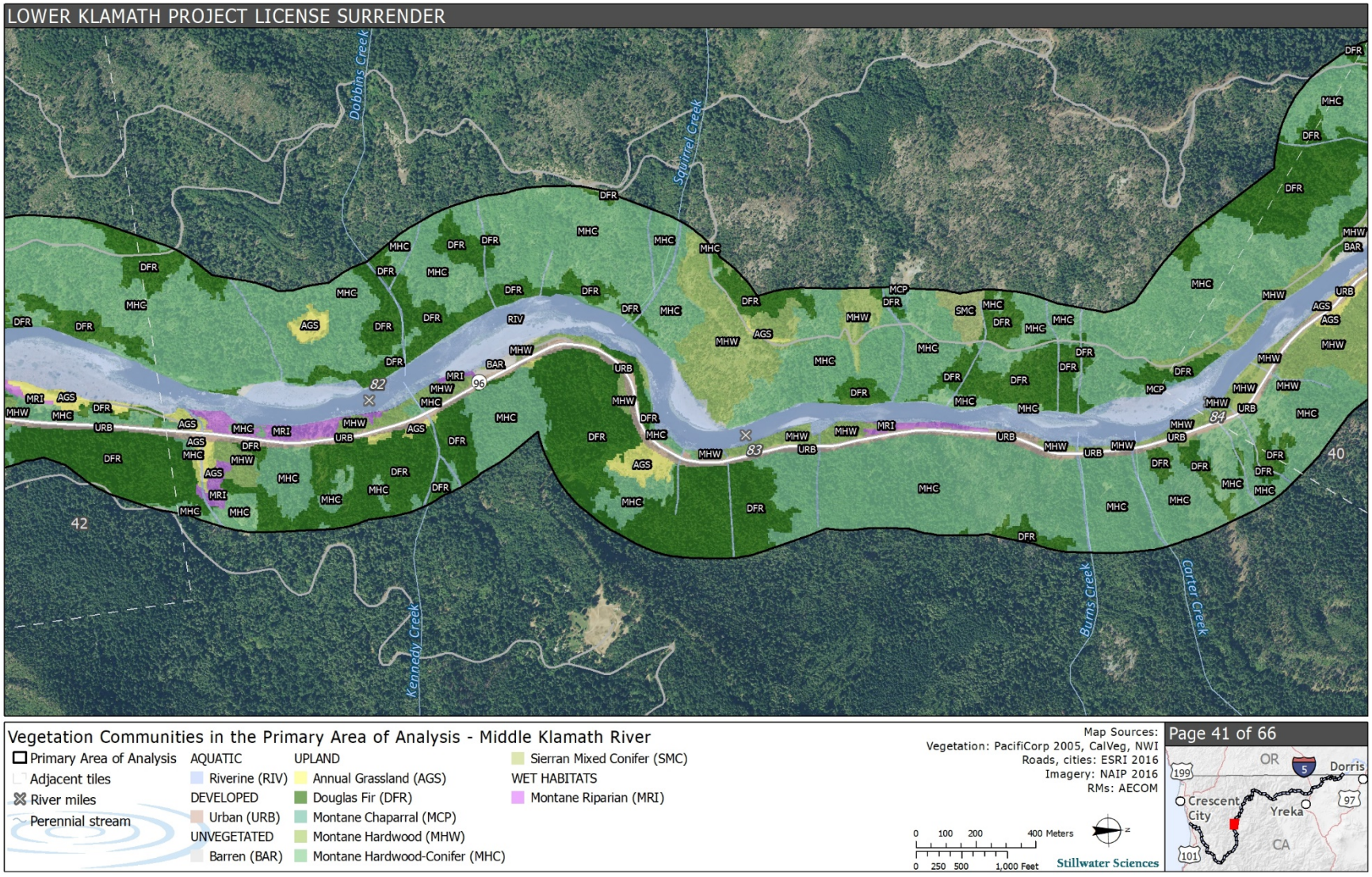

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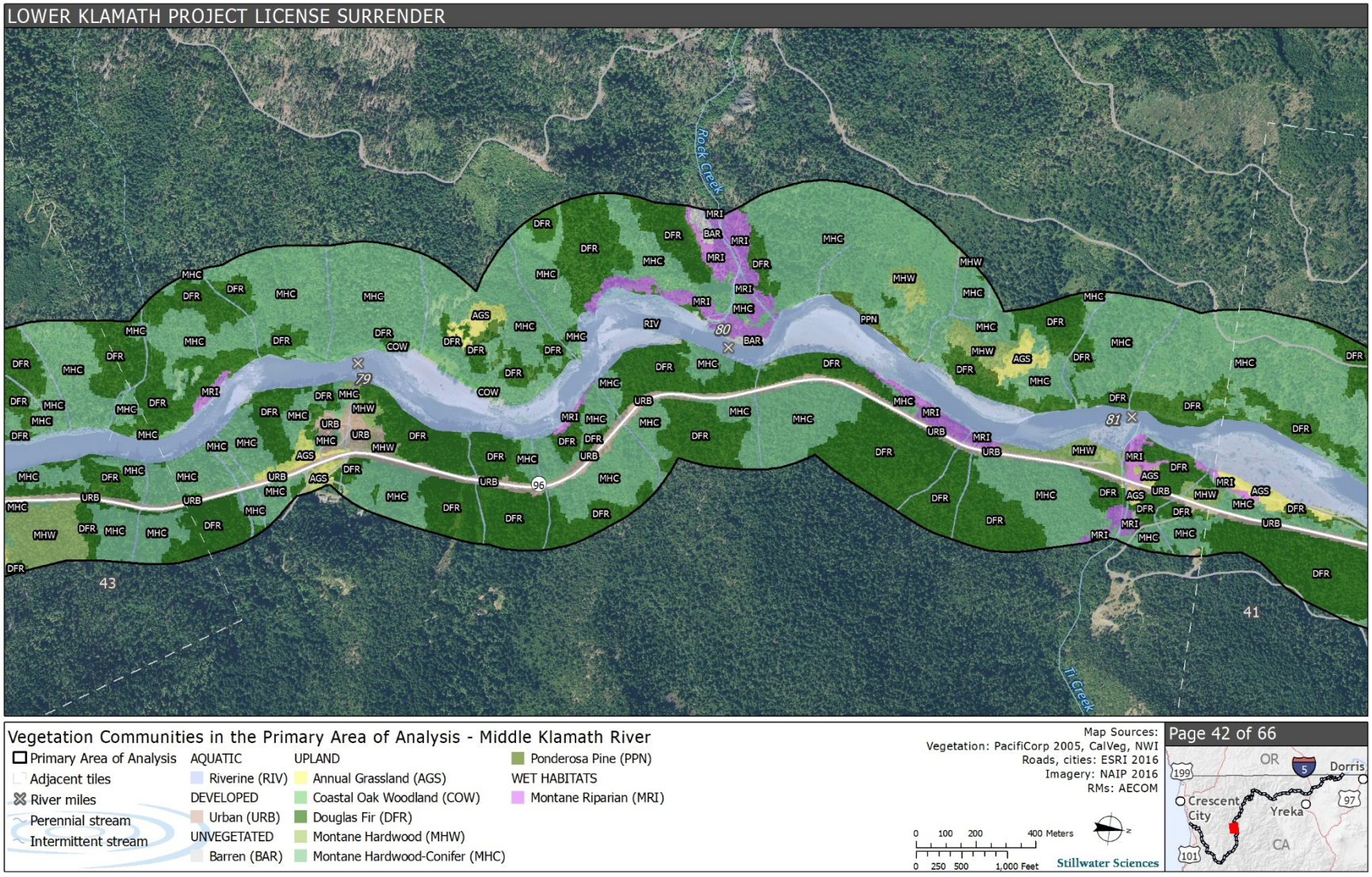

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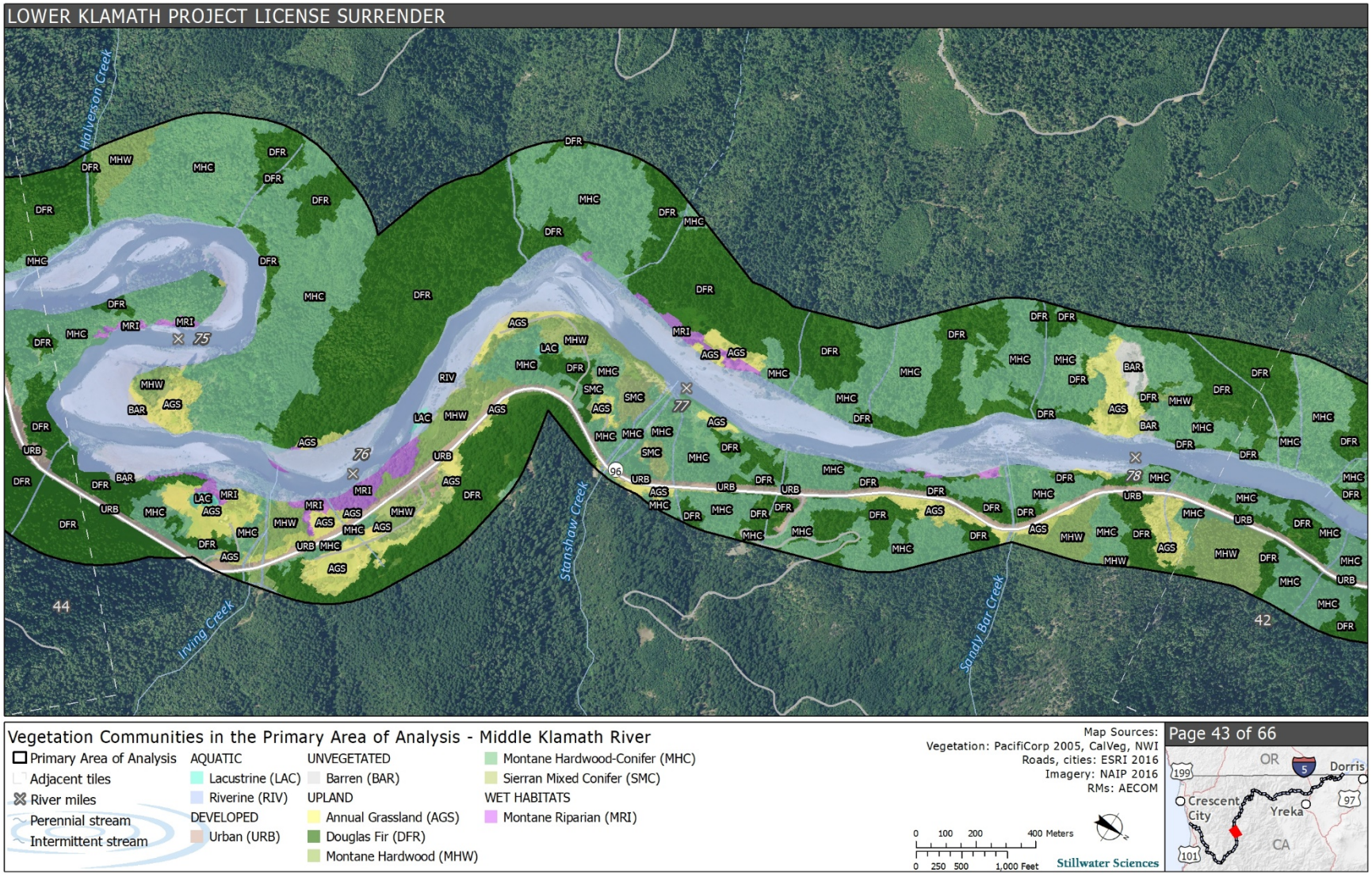

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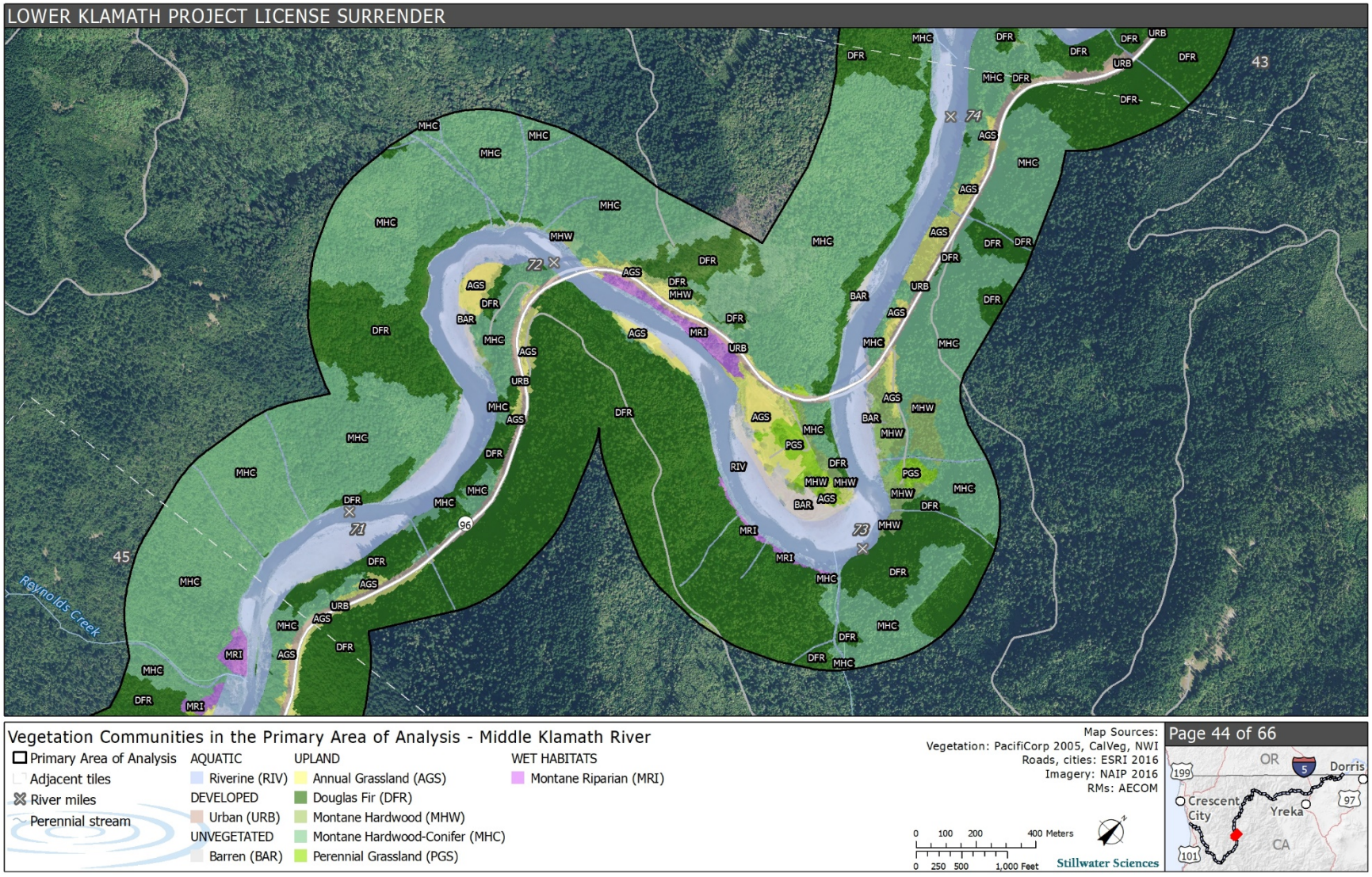

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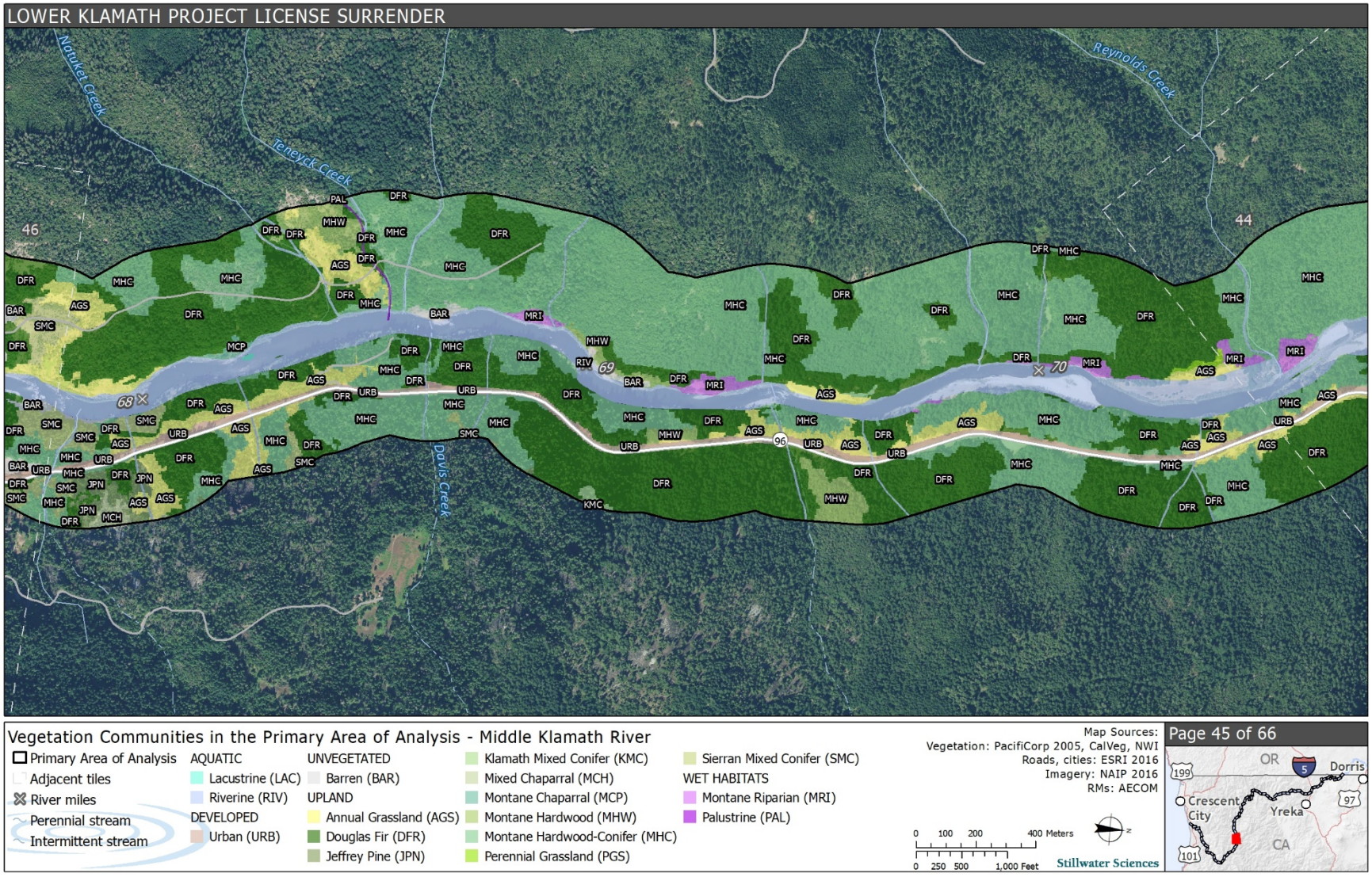

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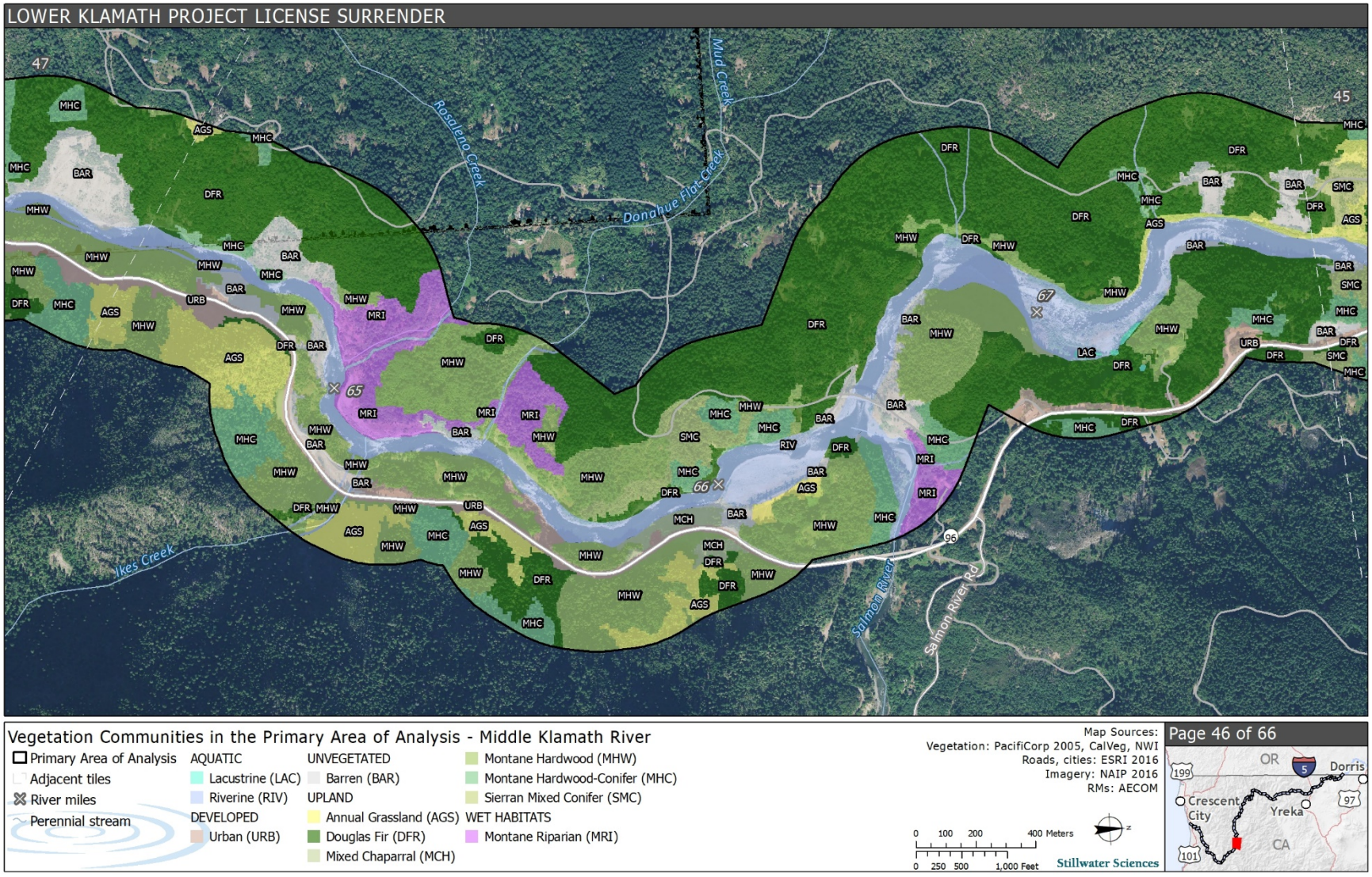

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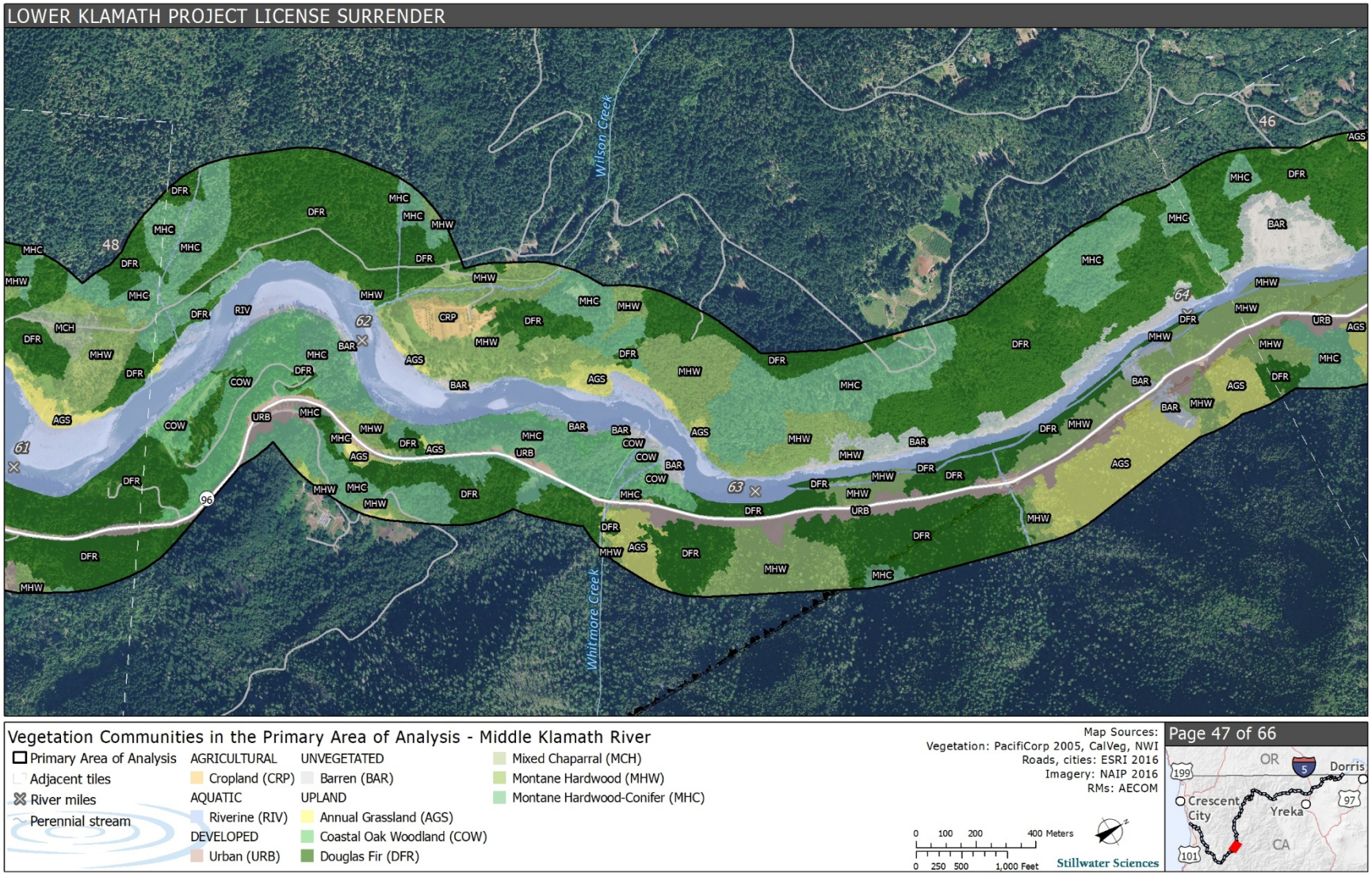

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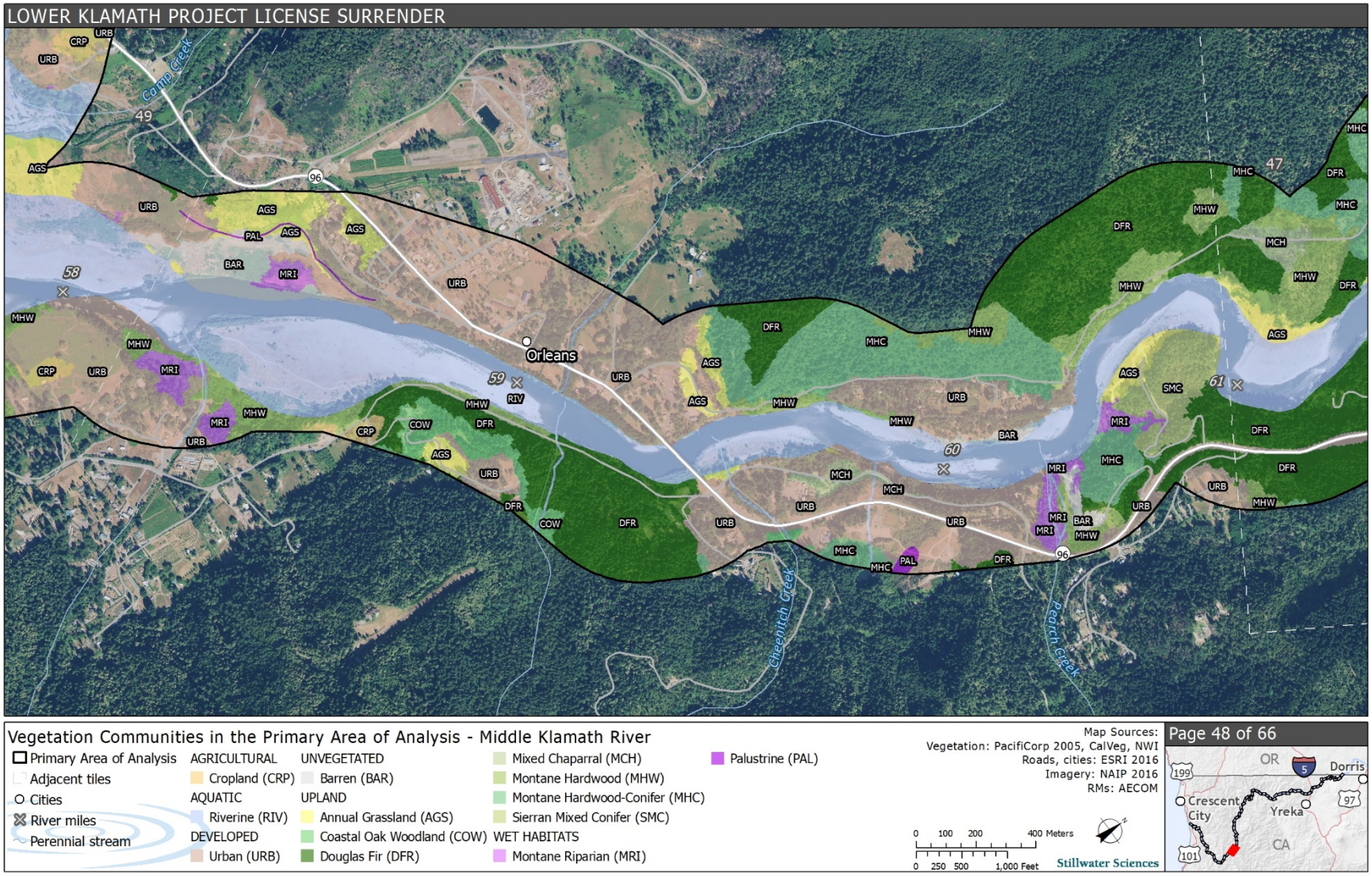

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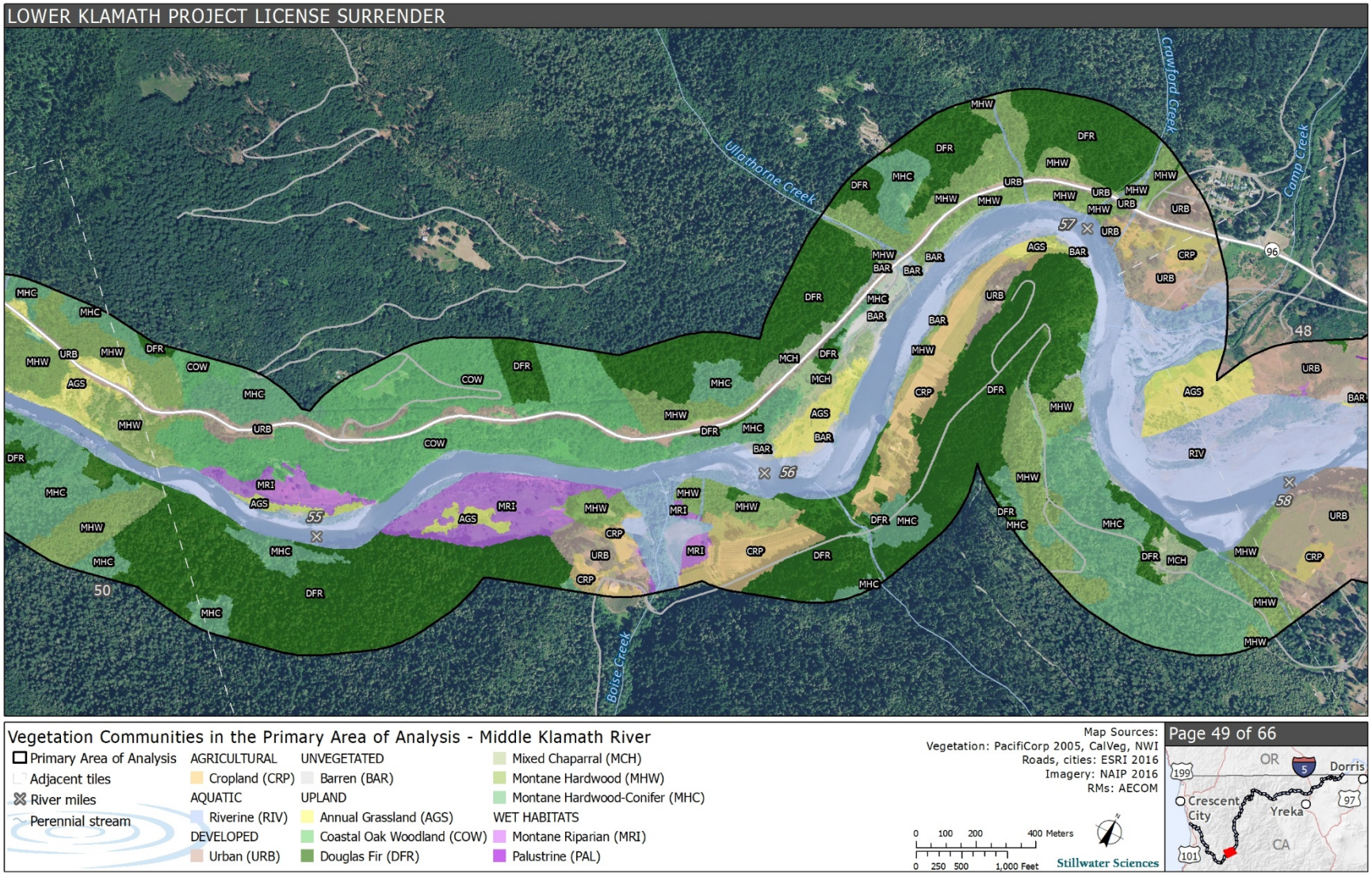

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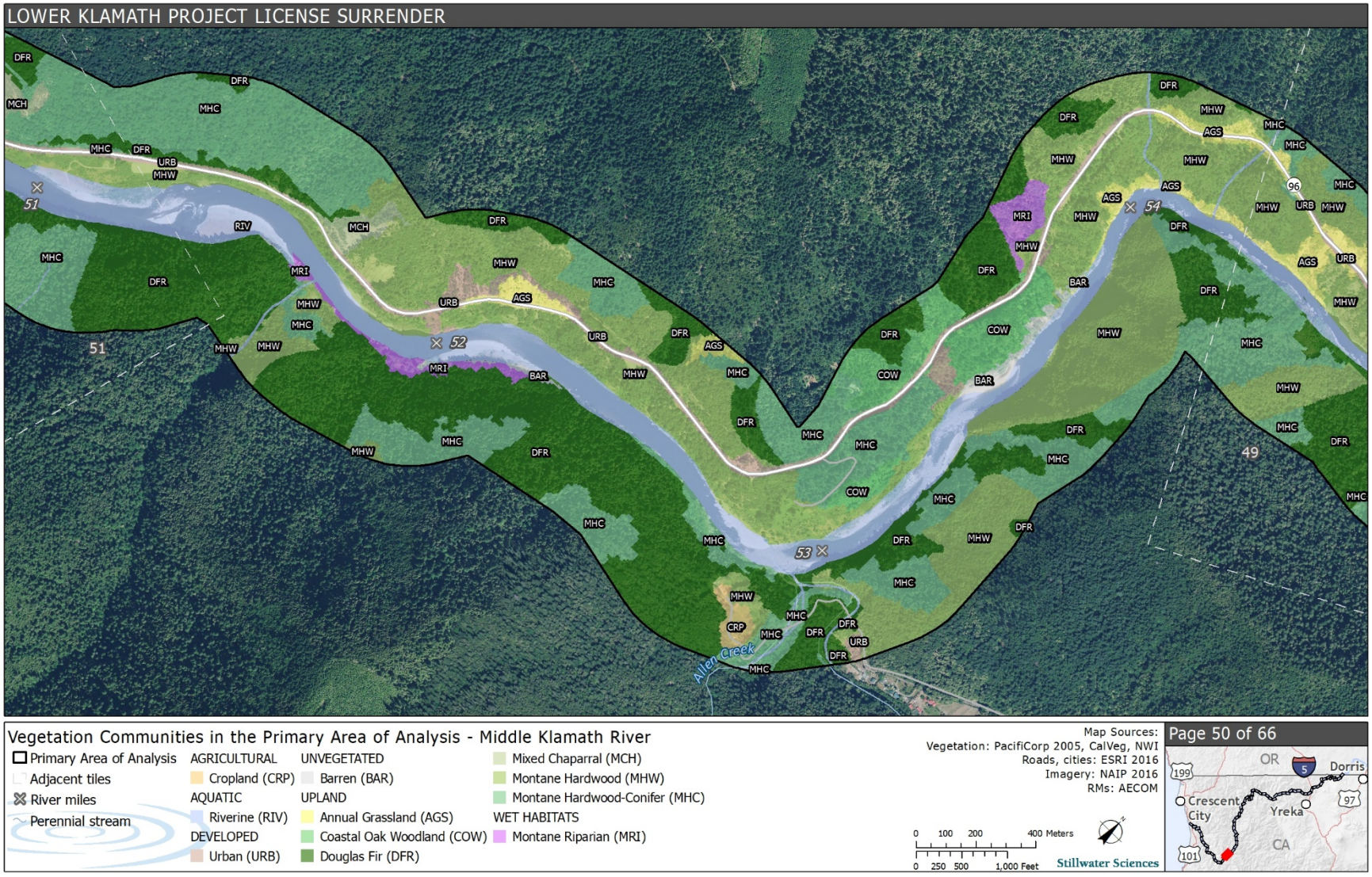

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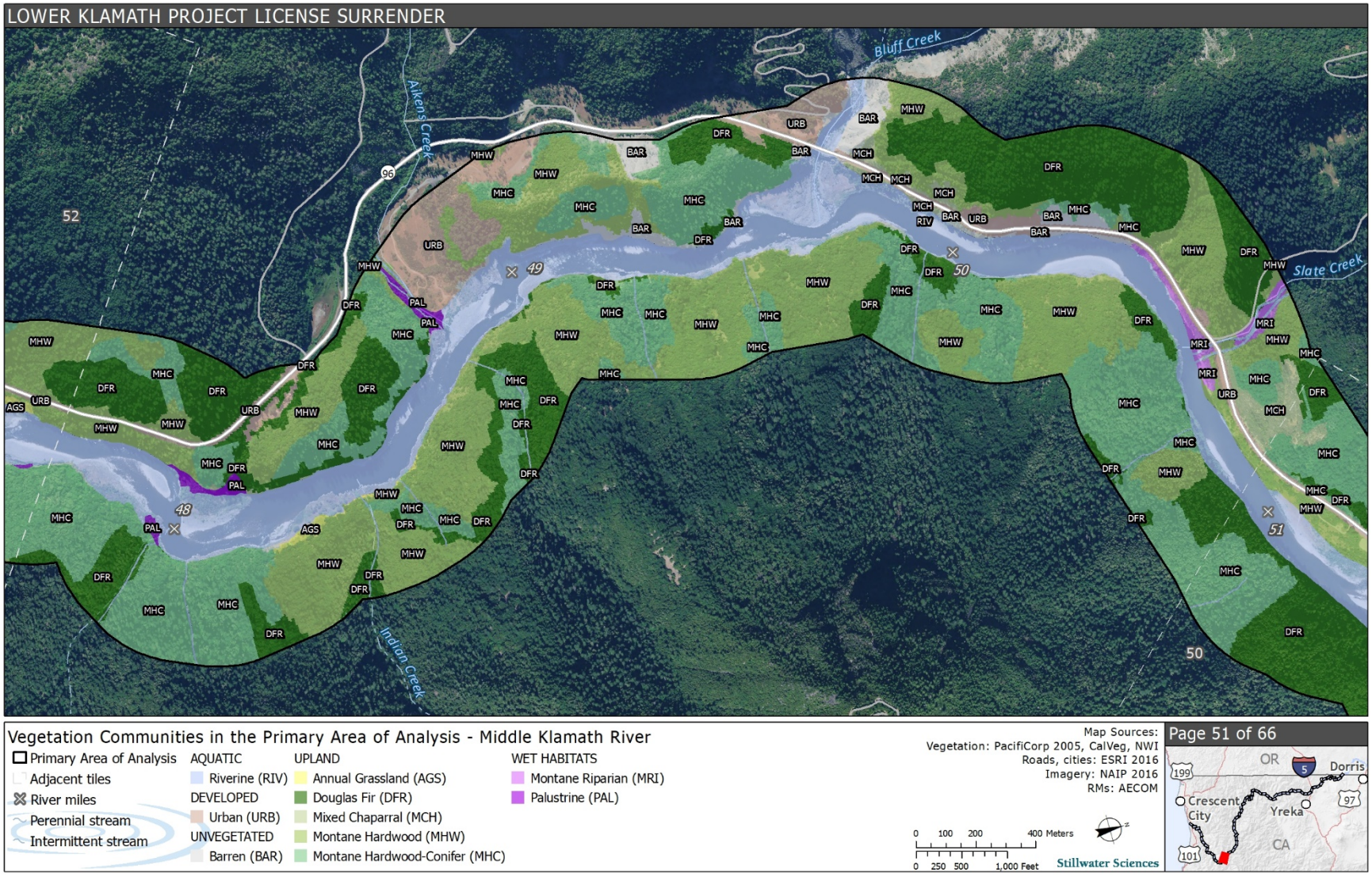

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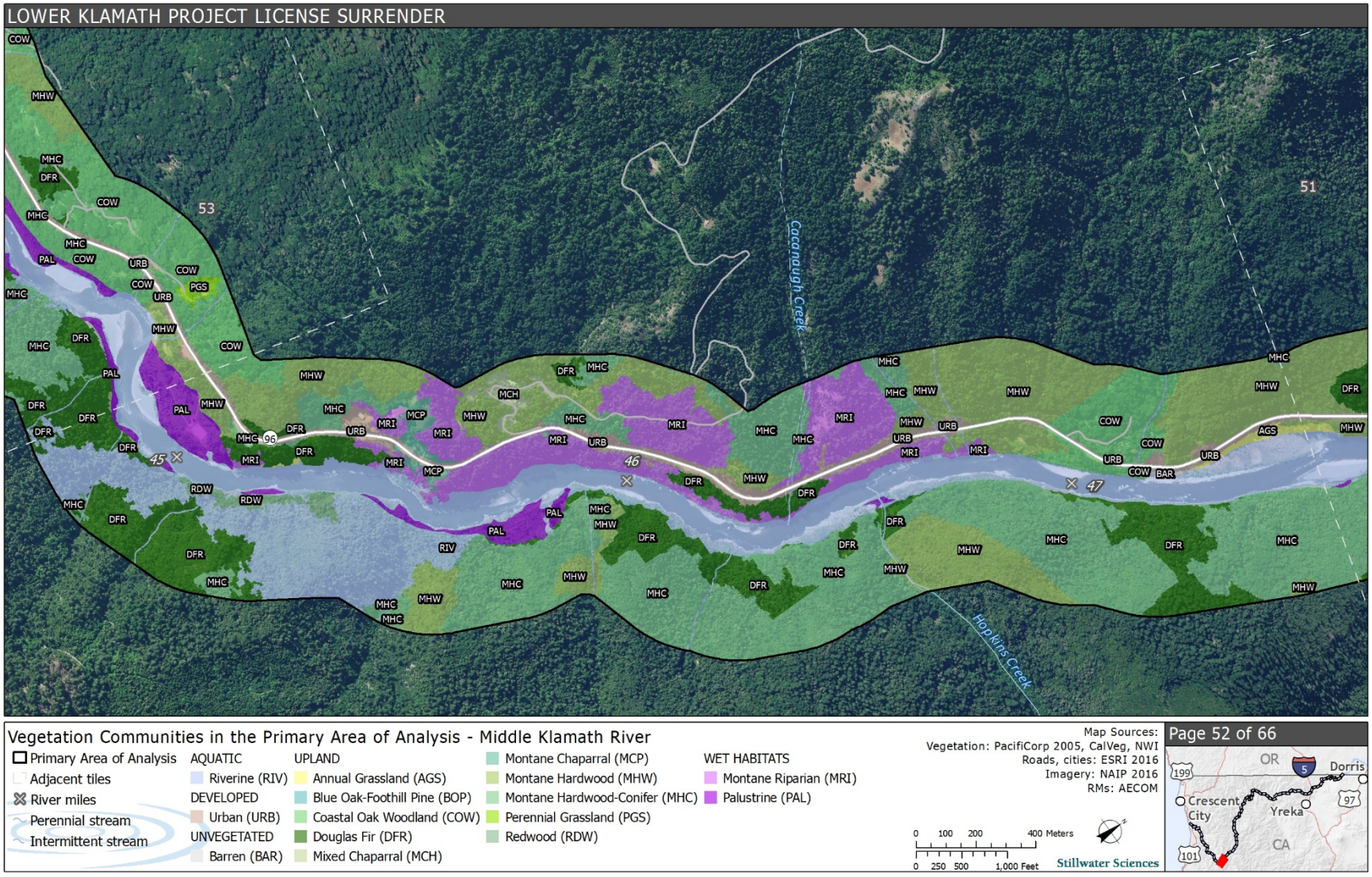

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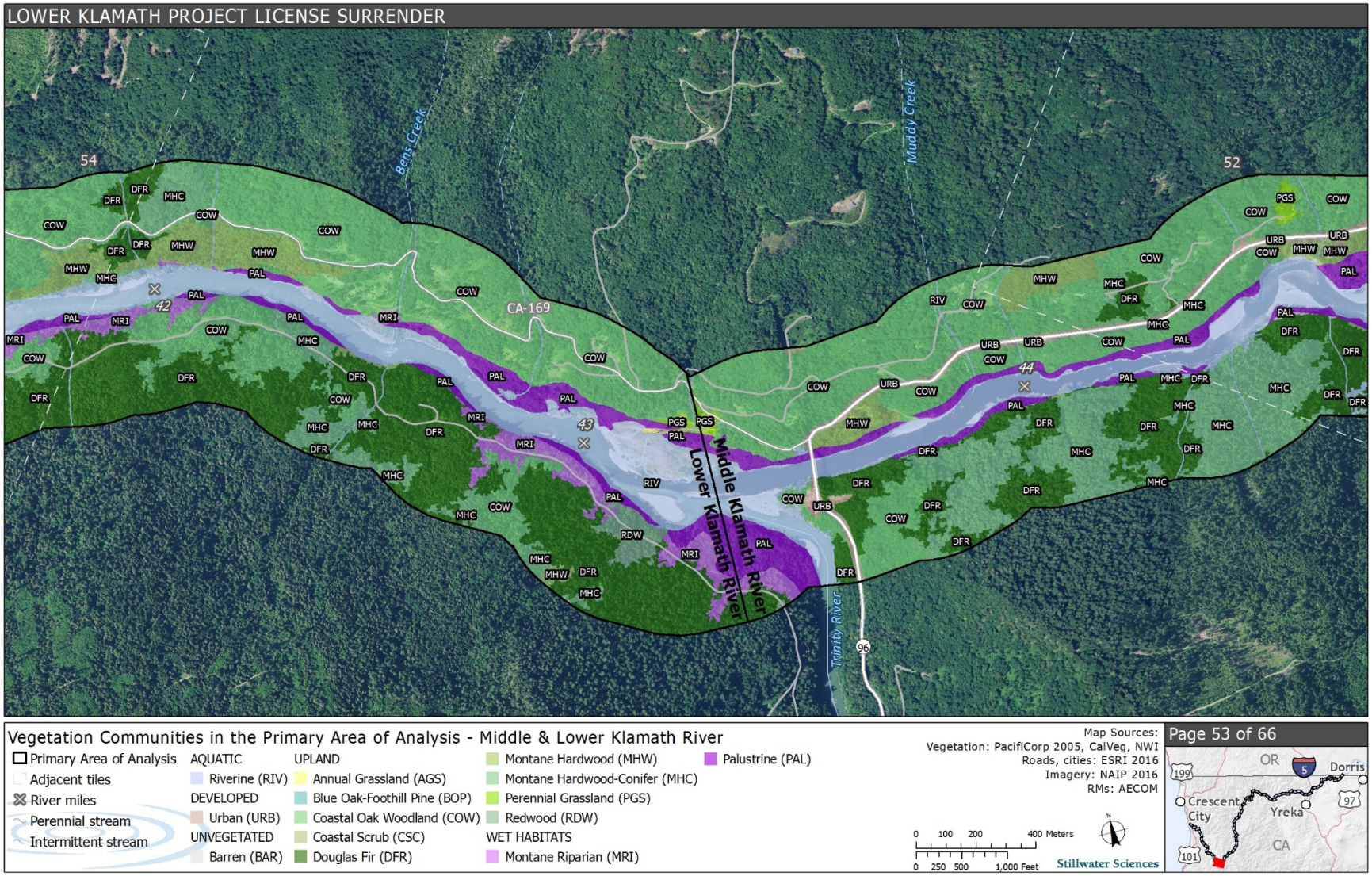

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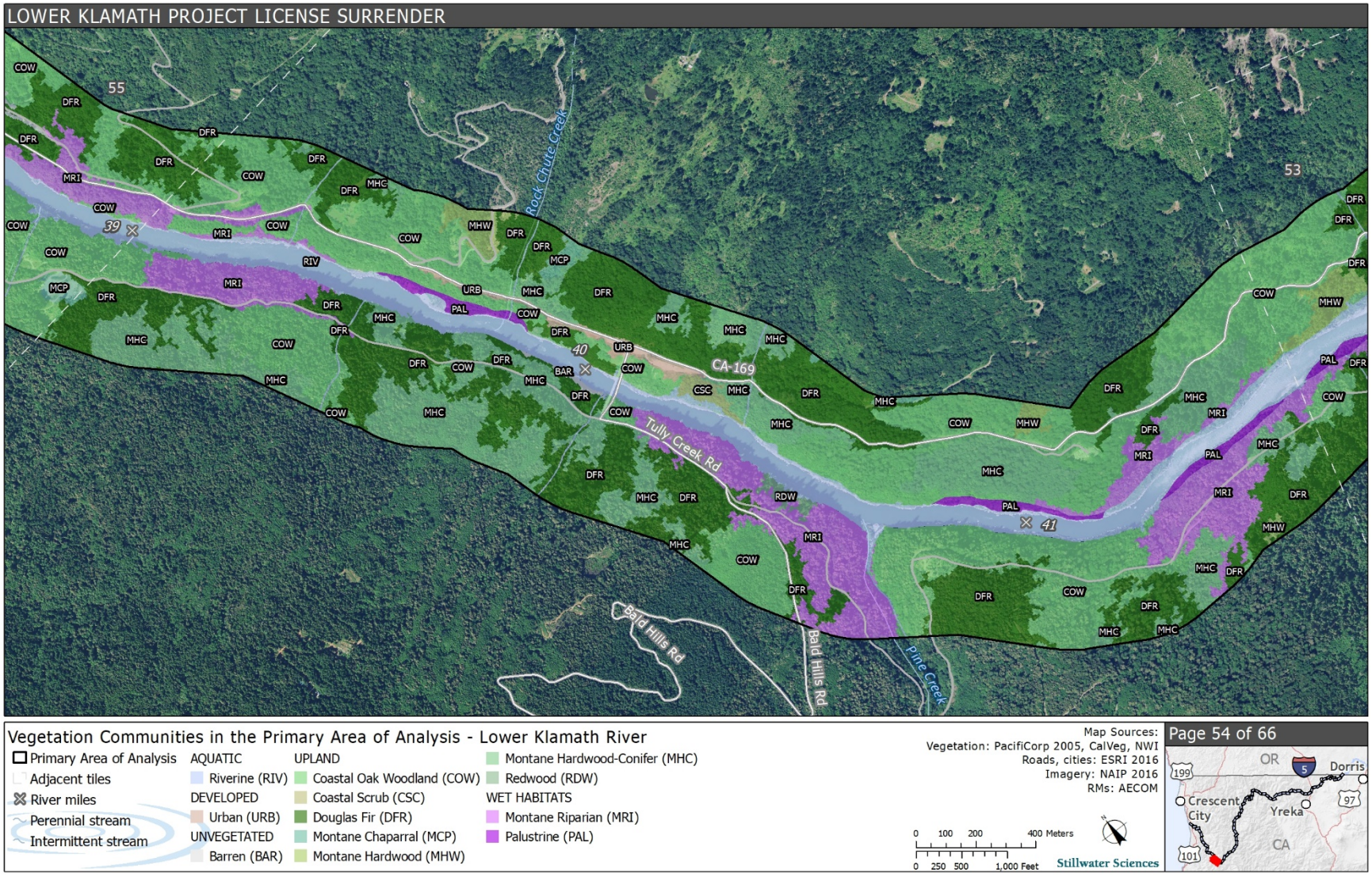

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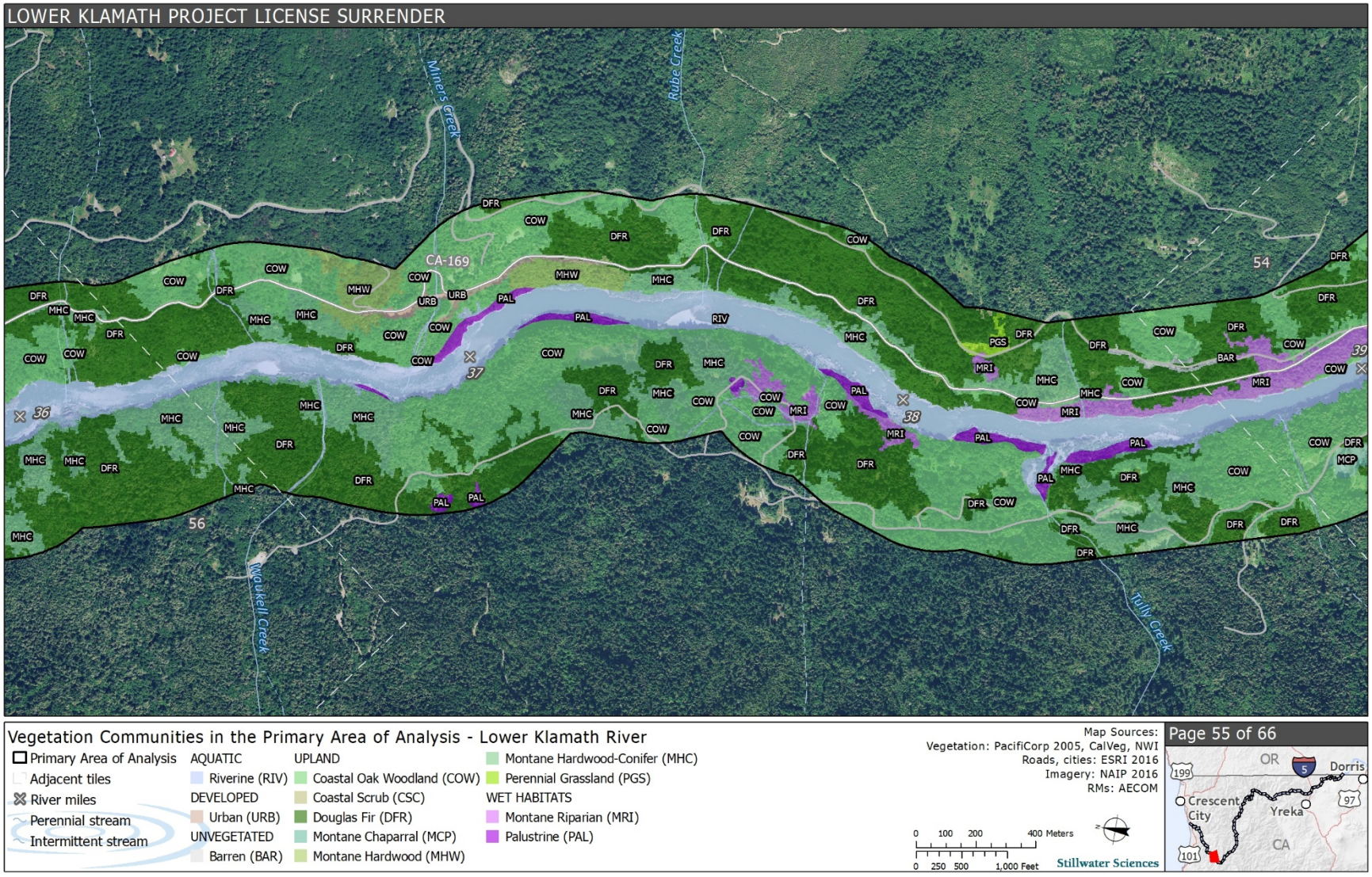

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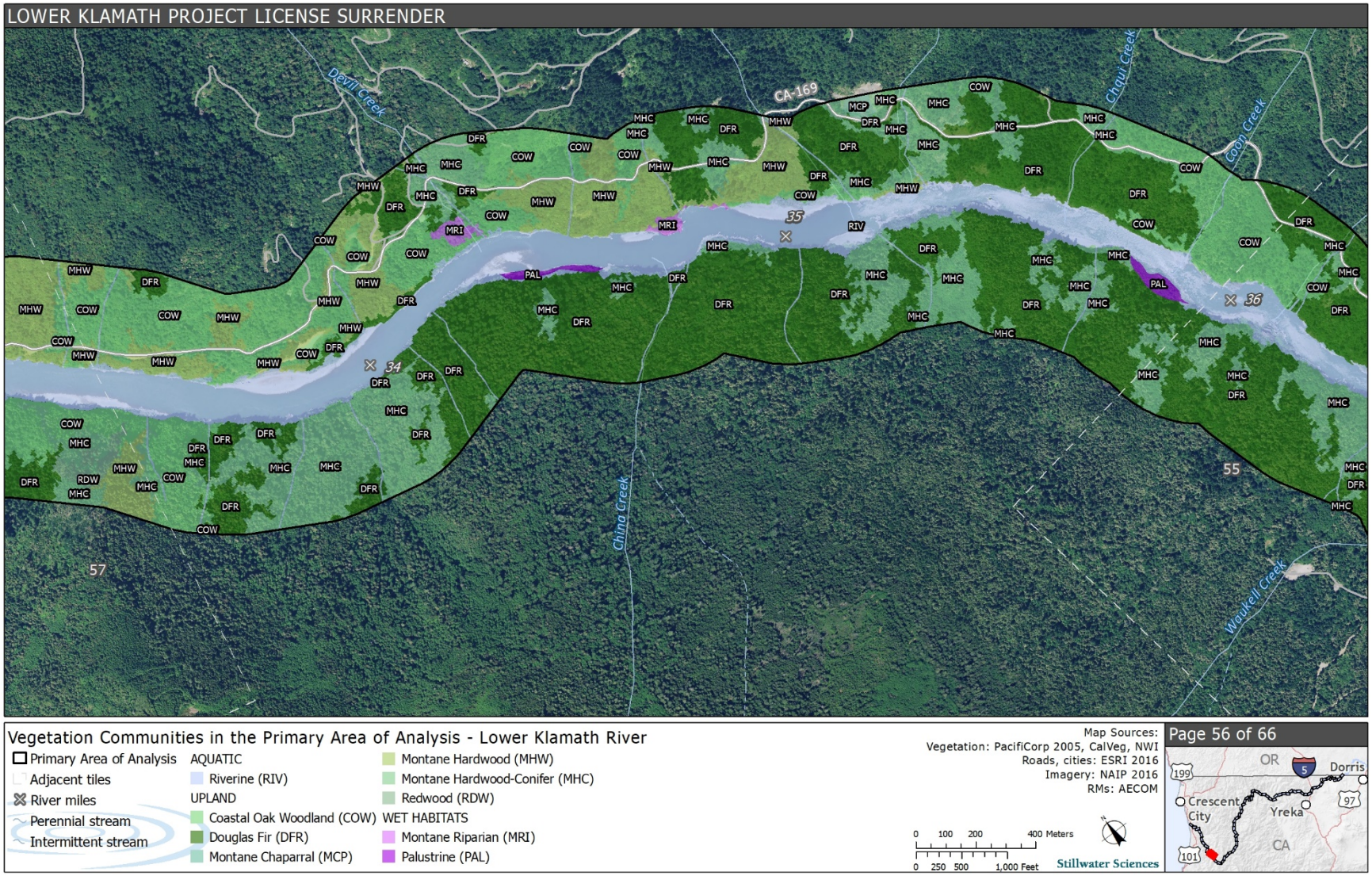

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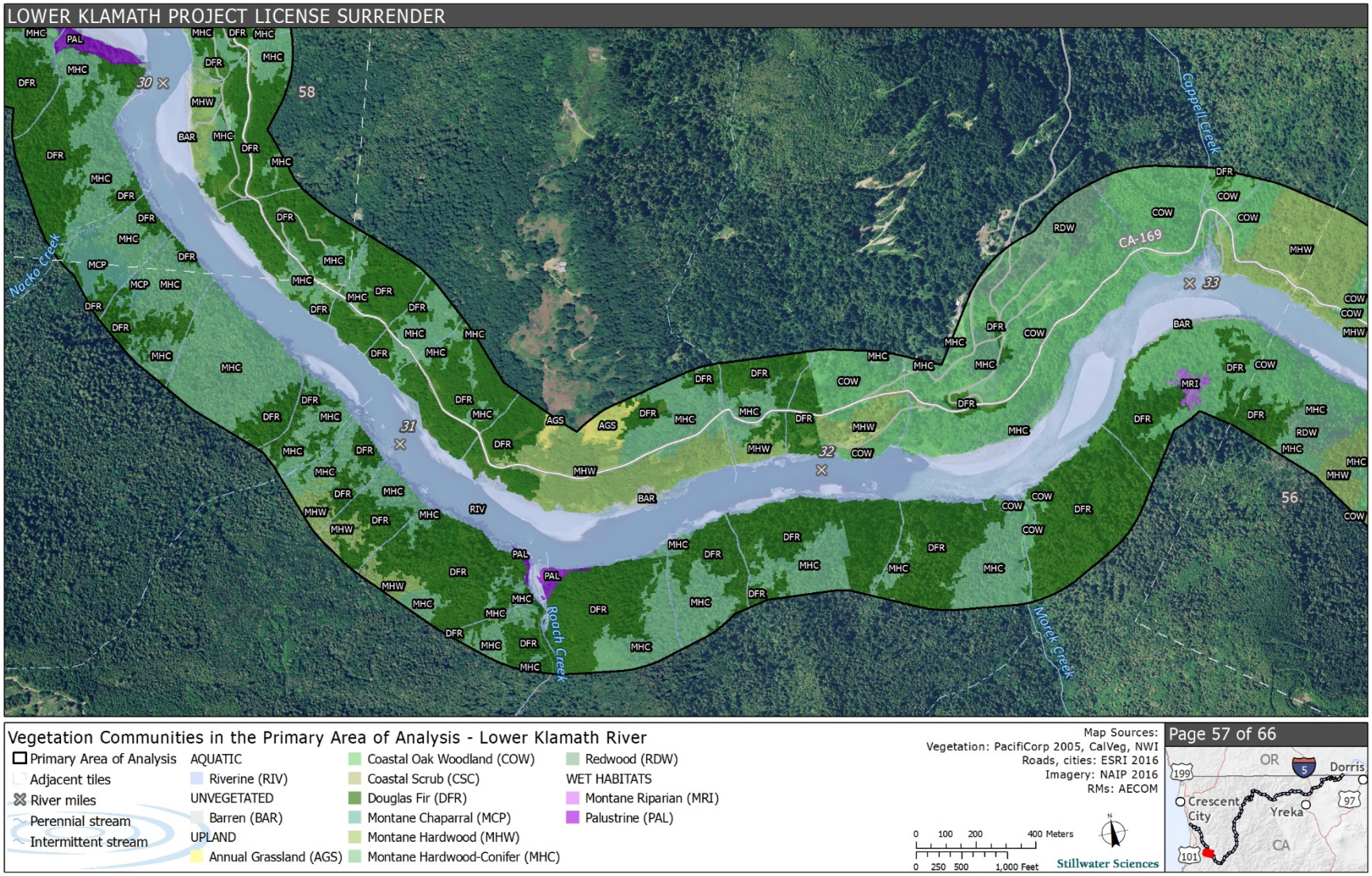

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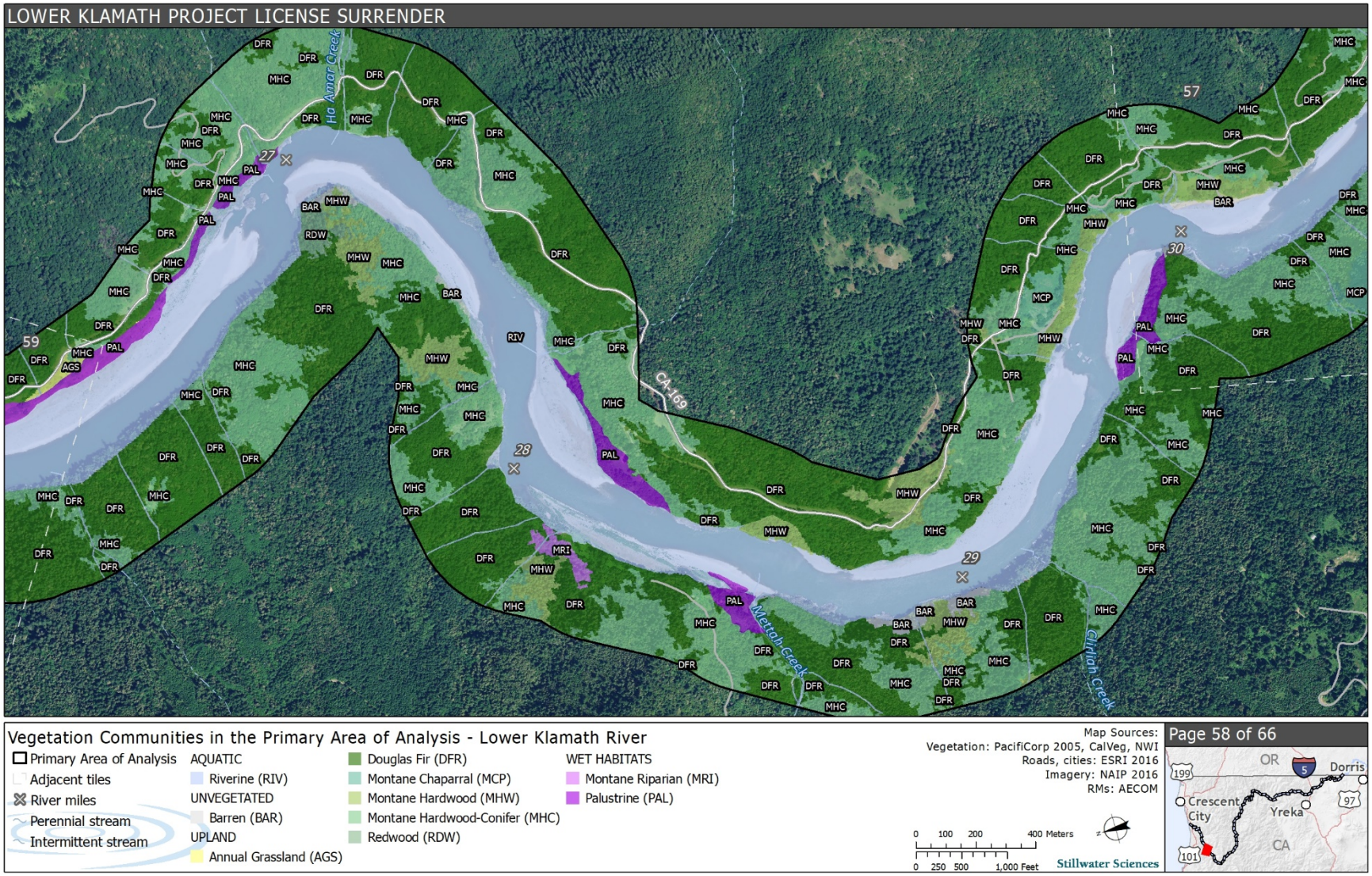

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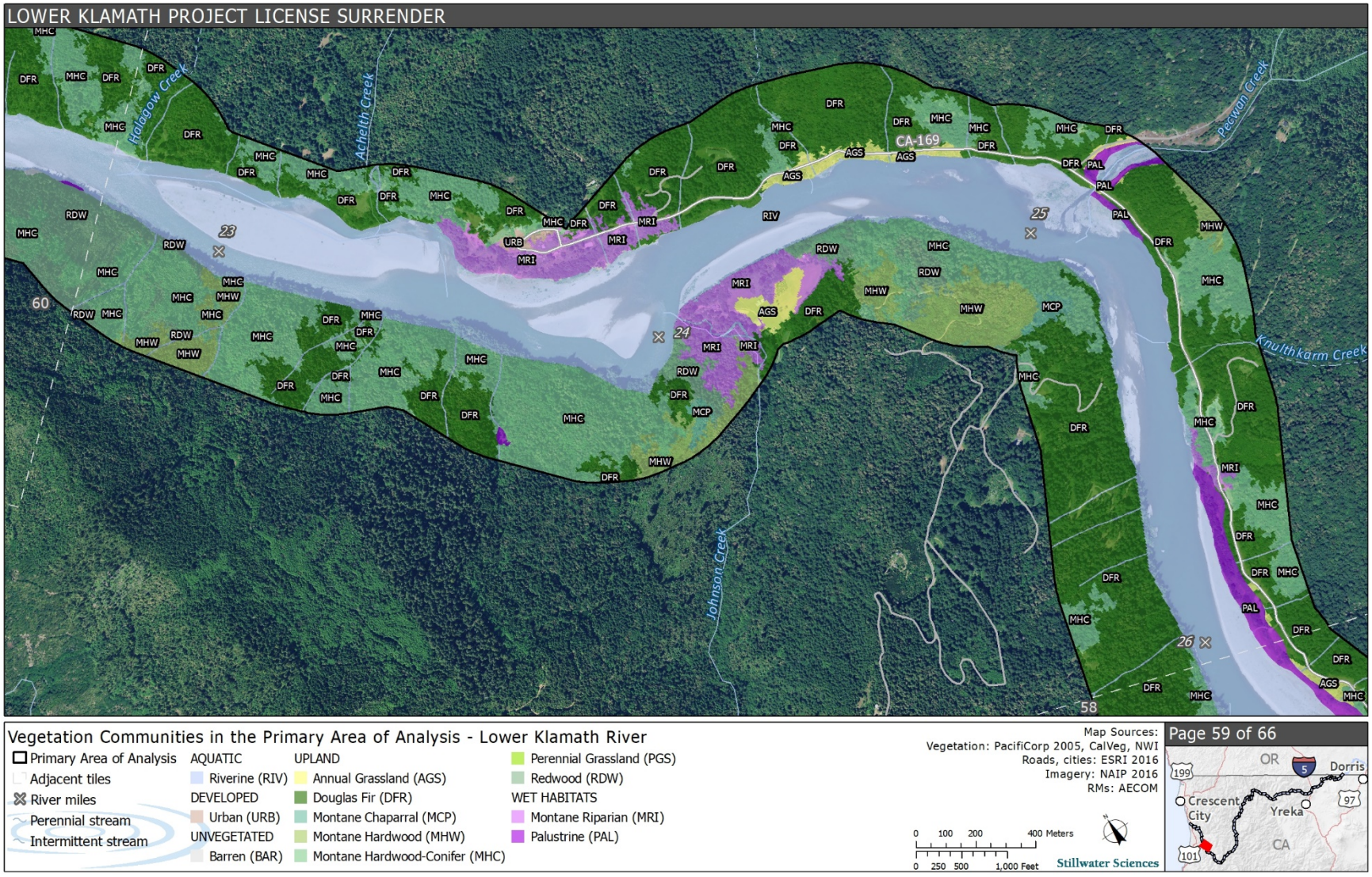

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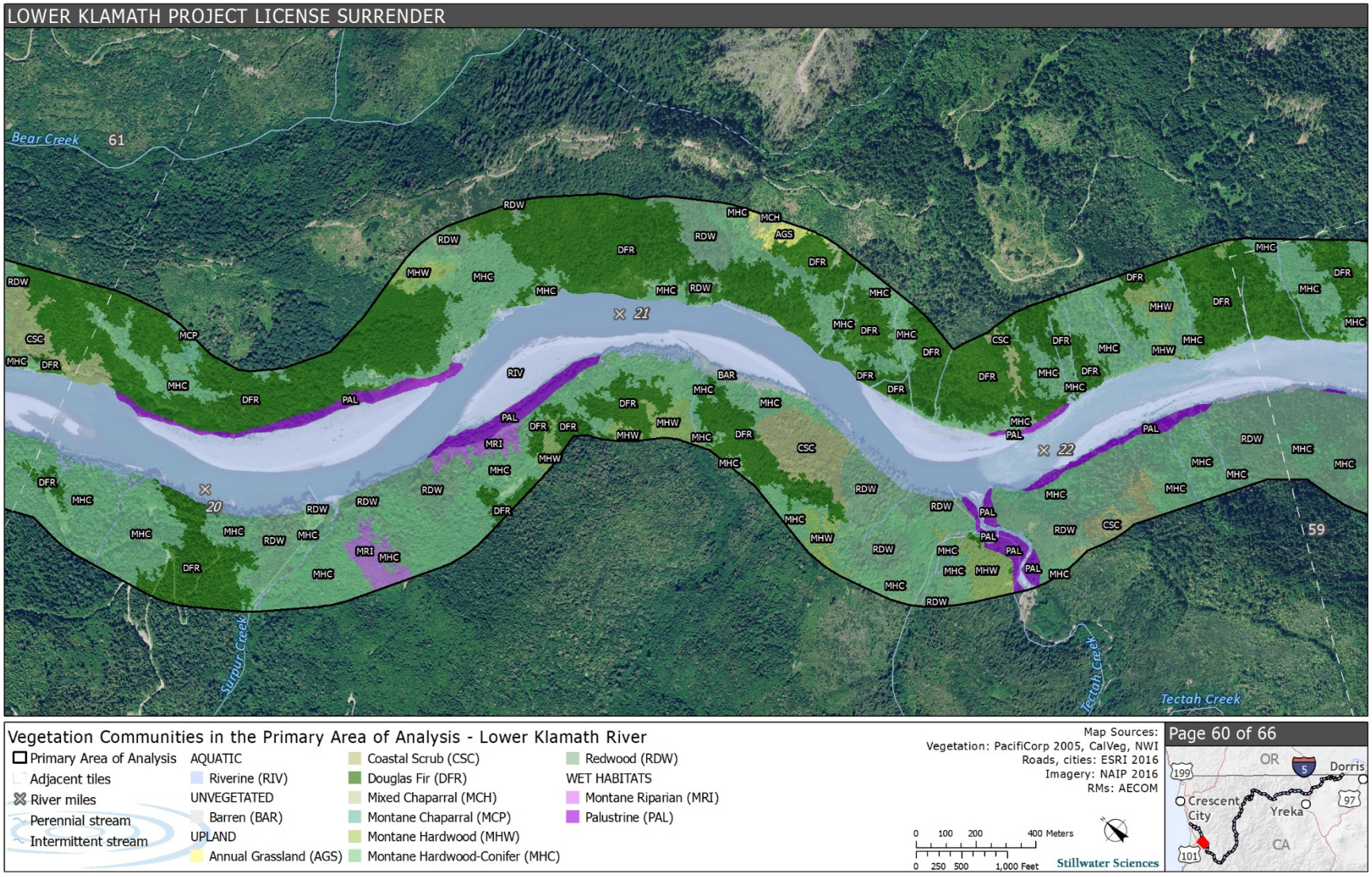

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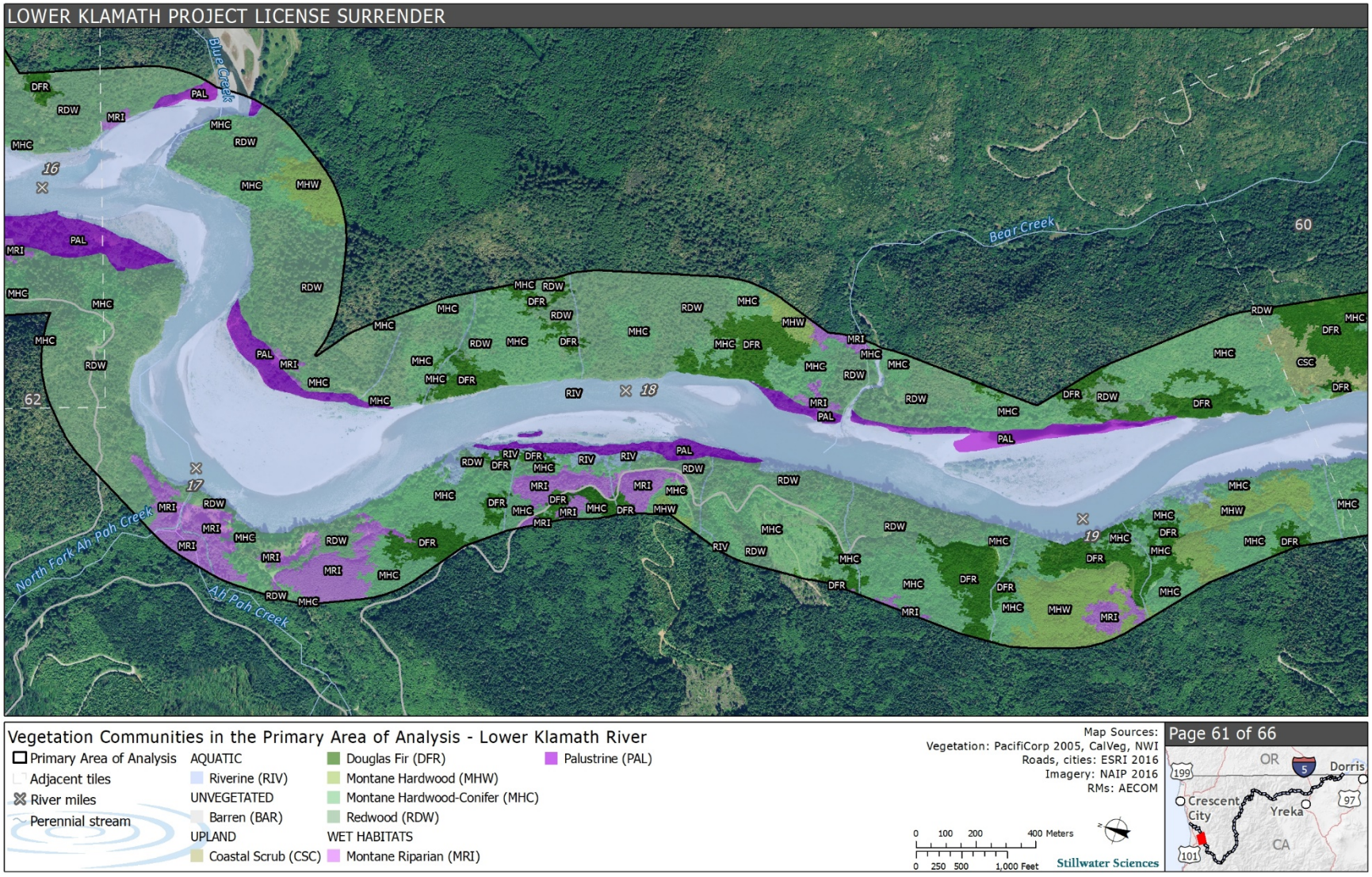

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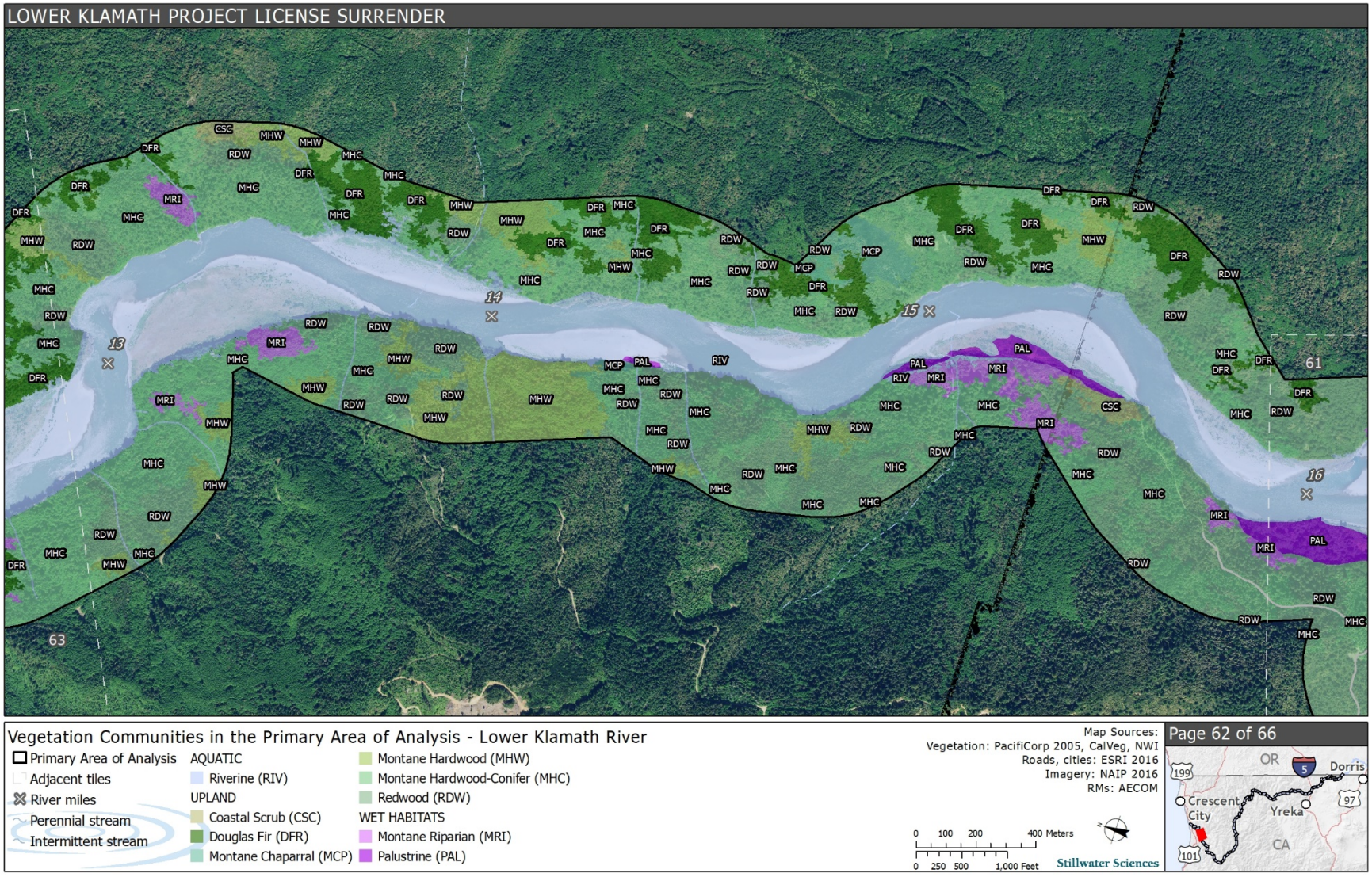

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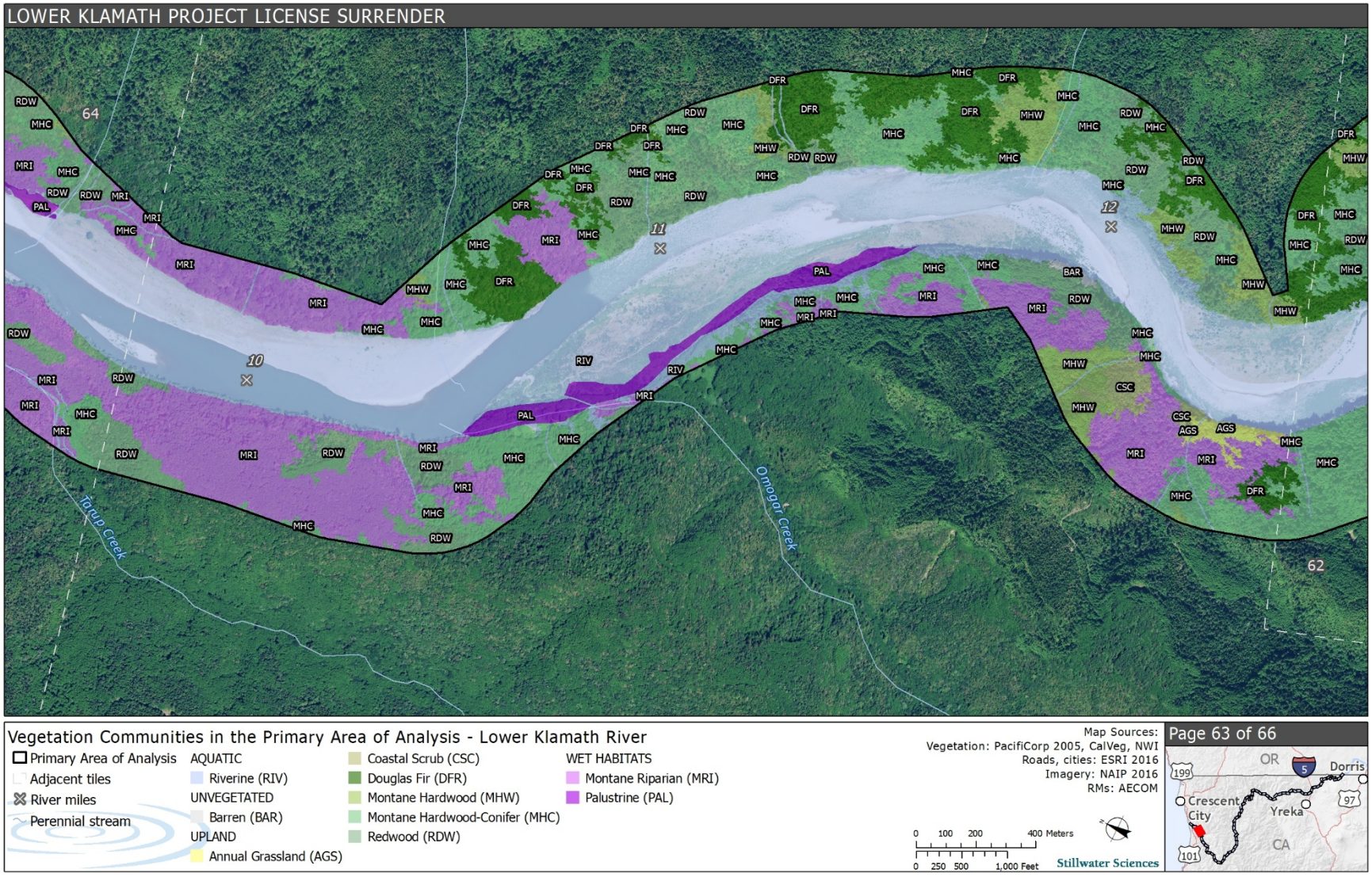

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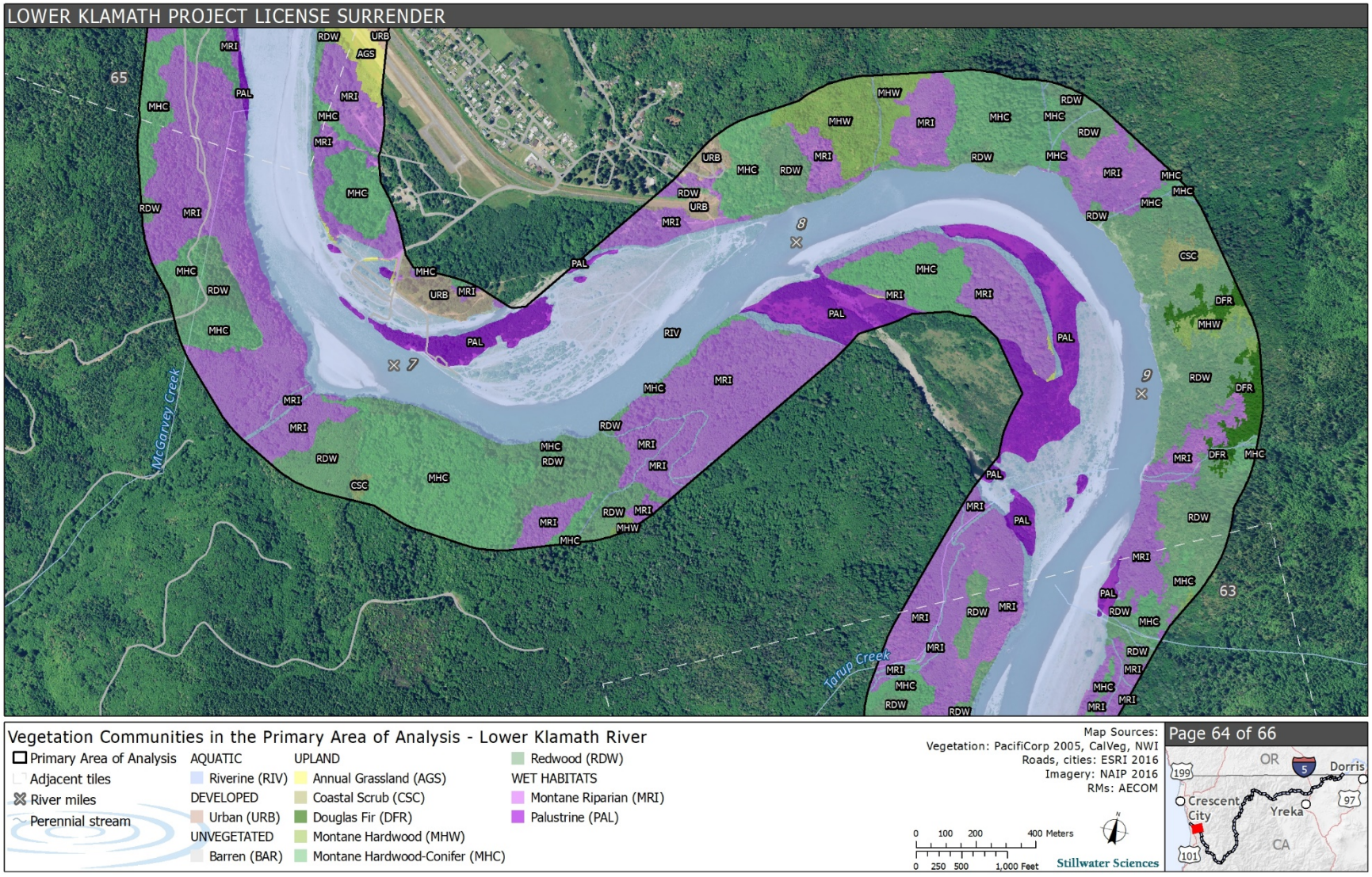

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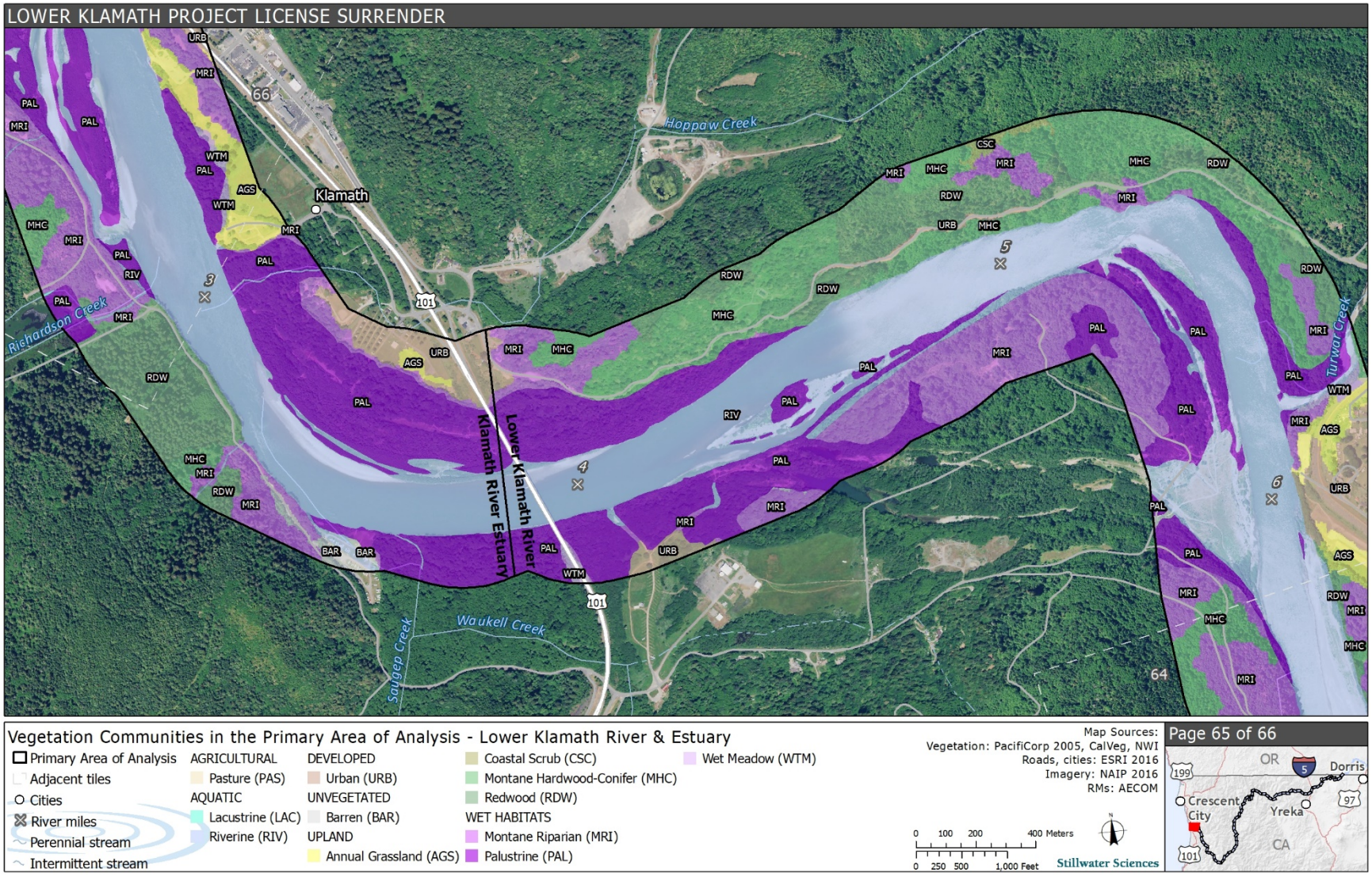

Figure G-65. Vegetation Communities and Habitat Types in the Primary Area of Analysis.

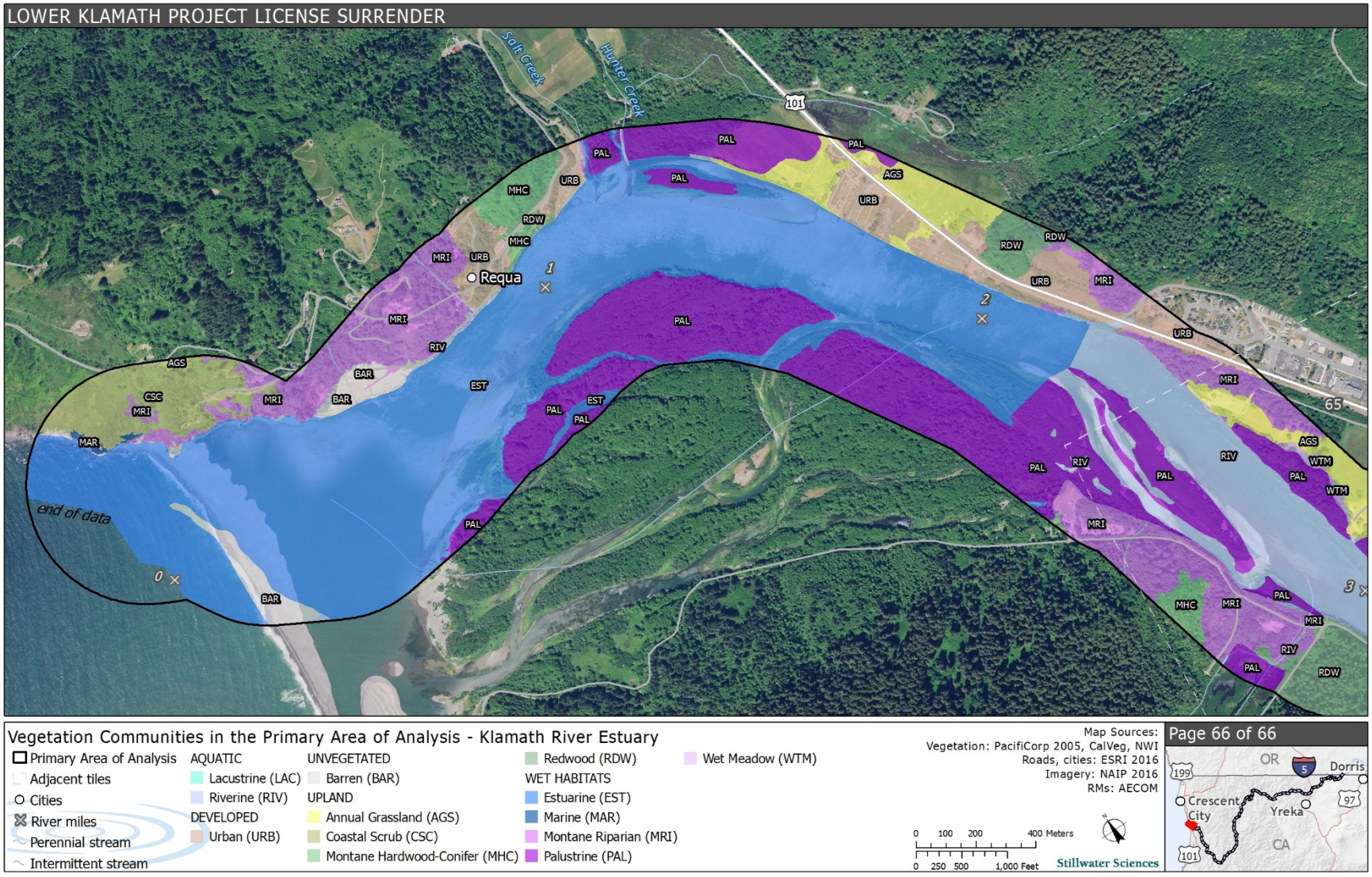

Figure G-66. Vegetation Communities and Habitat Types in the Primary Area of Analysis.

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Appendix H

Rare Natural Communities in the Area of Analysis

Table H-1. Rare Natural Communities Documented in the Project Vicinity[1].

Natural Community (Holland 1986)	Rank[2] (Global /State)	Habitat Description[3]	Included in or Excluded from the EIR, and Rationale
Coastal and Valley Freshwater Marsh	G3/S2.1	Dominated by perennial, emergent monocots including tules (*Schoenoplectus* spp.) and cattails (*Typha* spp.). Often forms completely closed canopies.	Included; likely occurs in areas typed as Palustrine within the Primary Area of Analysis.
Darlingtonia Seep	G4/S3.2	Typically on peridotite but also on other parent materials in wet boggy meadows and other habitats saturated with running water that may or may not have peat.[5]	Included; may be habitat in the Primary Area of Analysis.
Northern Interior Cypress Forest	G2/S2.2	An open forest dominated by cypress (*Cupressus* spp.) that is low in stature, usually less than 49.5 feet. On dry, rocky, sterile, often ultramafic soils.	Included; may be inclusions in forested areas within the Primary Area of Analysis.
Northern Basalt Flow Vernal Pool[6]	G2/S2.1	A low, amphibious, herbaceous community dominated by annual herbs and grasses. Germination and growth begin with fall rains, often continuing even when inundated. Pools are typically less than 540 square feet. Rising spring temperatures evaporate the pools.	Included; may be habitat in the Primary Area of Analysis.
Sitka Spruce Forest	G1/S1.1	Dense forest dominated by Sitka spruce with a dense understory of broadleaved trees, shrubs and perennial herbs, including several species of ferns.	Included; may be inclusions in forested areas immediately adjacent to the coast within the Primary Area of Analysis.
Upland Douglas-fir Forest	G4/S3.1	A mixed-age climax forest dominated by Douglas-fir (*Pseudotsuga menziesii)*. Stands are typically even-aged and dense with canopy closure greater than 70 percent. Sites typically occur on moderately deep, well-drained soils.	Included; may be inclusions in areas typed as Douglas Fir within the Primary Area of Analysis.

[1] Source: CDFW. 2017. California Natural Diversity Database. RareFind5. Electronic database. Natural Heritage Division, California Department of Fish and Game, Sacramento, California. https://map.dfg.ca.gov/rarefind/view/RareFind.aspx [Accessed May 2017].

[2] Status:

Global Rank
- G1 Critically Imperiled—At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
- G2 Imperiled: At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
- G3 Vulnerable: At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.
- G4 Apparently Secure: Uncommon but not rare; some cause for long-term concern due to declines or other factors.

State Rank
- S1 Critically Imperiled—Critically imperiled in the state because of extreme rarity (often five or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.
- S2 Imperiled: Imperiled in the nation or state/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.
- S3 Vulnerable: Vulnerable in the nation or state/province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.

Additional Threat Ranks
- 0.1 Very Threatened
- 0.2 Threatened

[3] Holland, R. F. 1986. Preliminary descriptions of the terrestrial natural communities of California. California Department of Fish and Game, Nongame-Heritage Program, Sacramento, California. unless otherwise noted.

[4] Details regarding what rare natural communities are documented and may have potential habitat in the Secondary Area of Analysis are not included since this area was analyzed at a programmatic level.

[5] Sawyer, J. O., T. Keeler-Wolf, and J. M. Evens. 2009. A manual of California vegetation. Second edition. California Native Plant Society Press, in collaboration with California Department of Fish and Game. Sacramento.

[6] Listed as "Northern Vernal Pool" in CNDDB; assumed based on distribution to be Northern Basalt Flow Vernal pool Holland Type.

Appendix I

Terrestrial Scoping Quadrangles

Table I-1. USGS 7.5-minute Quadrangles for the Terrestrial Primary Area of Analysis[1] (AOA) and the Adjacent Quadrangles.

Quadrangle Name	Quadrangle Code	Includes AOA or Adjacent?
Ah Pah Ridge	41123-D8	Includes AOA
Badger Mountain	41122-G6	Includes AOA
Bark Shanty Gulch	41123-D5	Includes AOA
Clear Creek	41123-F4	Includes AOA
Copco	41122-H3	Includes AOA
Dillon Mountain	41123-E5	Includes AOA
Fish Lake	41123-C6	Includes AOA
French Camp Ridge	41123-B7	Includes AOA
Hamburg	41123-G1	Includes AOA
Happy Camp	41123-G4	Includes AOA
Hawkinsville	41122-G5	Includes AOA
Holter Ridge	41123-C8	Includes AOA
Hornbrook	41122-H5	Includes AOA
Horse Creek	41122-G8	Includes AOA
Iron Gate Reservoir	41122-H4	Includes AOA
Johnsons	41123-C7	Includes AOA
Klamath Glen	41123-E8	Includes AOA
McKinley Mountain	41122-G7	Includes AOA
Orleans	41123-C5	Includes AOA
Orleans Mountain	41123-C4	Includes AOA
Requa	41124-E1	Includes AOA
Secret Spring Mountain	41122-H2	Includes AOA
Seiad Valley	41123-G2	Includes AOA
Slater Butte	41123-G3	Includes AOA
Somes Bar	41123-D4	Includes AOA
Spencer Creek	42122-B1	Includes AOA
Ukonom Mountain	41123-E4	Includes AOA
Weitchpec	41123-B6	Includes AOA
Parker Mountain	42122-A3	Adjacent to AOA (Includes AOA for Northern Spotted Owl query only)
Bald Hills	41123-B8	Adjacent to AOA
Bear Peak	41123-F5	Adjacent to AOA
Blue Creek Mountain	41123-D7	Adjacent to AOA
Bogus Mountain	41122-G4	Adjacent to AOA
Buckhorn Bally	41122-H7	Adjacent to AOA
Cant Hook Mountain	41123-F8	Adjacent to AOA
Chicken Hills	42122-A1	Adjacent to AOA
Childs Hill	41124-F1	Adjacent to AOA

Quadrangle Name	Quadrangle Code	Includes AOA or Adjacent?
Chimney Rock	41123-E6	Adjacent to AOA
Condrey Mountain	41122-H8	Adjacent to AOA
Cottonwood Peak	41122-H6	Adjacent to AOA
Deadman Point	41123-H4	Adjacent to AOA
Dewey Gulch	41122-G3	Adjacent to AOA
Dorris	41121-H8	Adjacent to AOA
Dutch Creek	41123-H1	Adjacent to AOA
Fern Canyon	41124-D1	Adjacent to AOA
Figurehead Mountain	41123-H3	Adjacent to AOA
Forks of Salmon	41123-C3	Adjacent to AOA
Grider Valley	41123-F2	Adjacent to AOA
Hamaker Mountain	42121-A8	Adjacent to AOA
Hoopa	41123-A6	Adjacent to AOA
Hopkins Butte	41123-B5	Adjacent to AOA
Huckleberry Mountain	41123-F3	Adjacent to AOA
Hupa Mountain	41123-A7	Adjacent to AOA
Indian Creek Baldy	41122-F7	Adjacent to AOA
Kangaroo Mountain	41123-H2	Adjacent to AOA
Little Shasta	41122-F4	Adjacent to AOA
Lonesome Ridge	41123-D6	Adjacent to AOA
MacDoel	41122-G1	Adjacent to AOA
Medicine Mountain	41123-D3	Adjacent to AOA
Montague	41122-F5	Adjacent to AOA
Mount Ashland	42122-A6	Adjacent to AOA
Mule Hill	42122-A2	Adjacent to AOA
Orick	41124-C1	Adjacent to AOA
Panther Creek	41123-A8	Adjacent to AOA
Panther Rock	41122-G2	Adjacent to AOA
Polar Bear Mountain	41123-H5	Adjacent to AOA
Prescott Mountain	41123-F6	Adjacent to AOA
Preston Peak	41123-G5	Adjacent to AOA
Rodgers Peak	41124-B1	Adjacent to AOA
Russell Peak	41122-F8	Adjacent to AOA
Salmon Mountain	41123-B4	Adjacent to AOA
Sams Neck	41122-H1	Adjacent to AOA
Scott Bar	41123-F1	Adjacent to AOA
Ship Mountain	41123-F7	Adjacent to AOA
Siskiyou Pass	42122-A5	Adjacent to AOA
Sister Rocks	41124-F2	Adjacent to AOA
Soda Mountain	42122-A4	Adjacent to AOA

Quadrangle Name	Quadrangle Code	Includes AOA or Adjacent?
Summit Valley	41123-E7	Adjacent to AOA
Tish Tang Point	41123-A5	Adjacent to AOA
Ukonom Lake	41123-E3	Adjacent to AOA
Youngs Peak	41123-B3	Adjacent to AOA
Yreka	41122-F6	Adjacent to AOA

[1] USGS 7.5-minute Quadrangles were identified based on the Primary Area of Analysis to support the analysis of this EIR, as the Secondary Area of Analysis was analyzed at a programmatic level.

Appendix J

Terrestrial Special-status Plant and Wildlife Scoping List

Table J-1. Special-status aquatic wildlife and fish documented in the Project vicinity.

Common Name ***Scientific Name***	**Status[a] Federal/ State/Forest Service, Bureau of Land Management**	**Query Sources**	**Distribution**	**Habitat Association**	**Rational for Inclusion/Exclusion In EIR**
Fish					
Klamath largescale sucker *Catostomus snyderi*	--/SSC/--	CNDDB	Resident fish observed in the Upper Klamath Basin. In California, they are found in Clear Lake Reservoir, Tule Lake, and the portion of the Lost River between them.	Although known to inhabit both lentic and lotic habitats, it seems to be primarily adapted to a riverine existence.	Not included in EIR. Not common within California portion of Area of Analysis
shortnose sucker *Chasmistes brevirostris*	FE/SE, SFP/-- Designated critical habitat	CNDDB USFWS	Resident fish observed in the Upper Klamath Basin. In California, they are found in the Klamath River downstream to Copco Reservoir and Iron Gate Reservoir.	Warm slow-moving waters or lakes. Spawning occurs along shorelines of lakes or tributaries.	Included in EIR. Critical habitat designated within California portion of Area of Analysis
Lost River sucker *Deltistes luxatus*	FE/SE, SFP Designated critical habitat within Area of Analysis	CNDDB USFWS	Resident fish observed in the Upper Klamath Basin. In California, they are found in the Klamath River downstream to Copco Reservoir and Iron Gate Reservoir.	Warm slow-moving waters or lakes. Spawning occurs along shorelines of lakes or tributaries.	Included in EIR. Critical habitat designated within California portion of Area of Analysis
coho salmon, southern Oregon/northern California coasts ESU *Oncorhynchus kisutch*	FT/ST/-- Designated critical habitat within Area of Analysis	USFWS	Within the Area of Analysis anadromous fish occurring downstream in the mainstem Klamath River and tributaries downstream of Iron Gate Dam	Streams; spawns in gravel riffles	Included in EIR. Critical habitat designated within California portion of Area of Analysis
Chinook salmon - upper Klamath and Trinity Rivers ESU *Oncorhynchus tshawytscha*	--/SSC/FSS	CNDDB	Within the Area of Analysis anadromous fish occurring downstream in the mainstem Klamath River and tributaries downstream of Iron Gate Dam	Streams; spawns in gravel riffles	Included in EIR. Occurs within California portion of Area of Analysis

Common Name ***Scientific Name***	**Status[a] Federal/ State/Forest Service, Bureau of Land Management**	**Query Sources**	**Distribution**	**Habitat Association**	**Rational for Inclusion/Exclusion In EIR**
coastal cutthroat trout *Oncorhynchus clarki clarki*	--/SSC/FSS	CNDDB	Within the Area of Analysis coastal cutthroat trout are distributed primarily within smaller tributaries to the lower 22 miles of the Klamath River mainstem above the estuary, but also within tributaries to the Trinity River.	Shaded streams with water temperatures below 18˚C and small gravel for spawning	Included in EIR. Occurs within California portion of Area of Analysis
summer-run steelhead trout *Oncorhynchus mykiss irideus*	--/SSC/--	CNDDB	Within the Area of Analysis anadromous fish distributed throughout the Klamath River and in its tributaries, downstream from Iron Gate Dam	Streams; spawns in gravel riffles	Included in EIR. Occurs within California portion of Area of Analysis
longfin smelt *Spirinchus thaleichthys*	FC/ST, SSC/--	CNDDB	Within the Area of Analysis anadromous fish found in Klamath River Estuary	Adults in large bays, estuaries, and nearshore coastal areas; migrate into freshwater rivers to spawn; salinities of 15–30 ppt	Included in EIR. Occurs within California portion of Area of Analysis
eulachon *Thaleichthys pacificus*	FT/--/-- Designated critical habitat within Area of Analysis	CNDDB	Within the Area of Analysis anadromous fish found in Klamath River Estuary	Adults in large bays, estuaries, and nearshore coastal areas; migrate into freshwater rivers to spawn.	Included in EIR. Occurs within California portion of Area of Analysis
tidewater goby *Eucyclogobius newberryi*	FE/SSC/-- No critical habitat designated in Area of Analysis	CNDDB USFWS	Not currently found in Area of Analysis, critical habitat does not include Klamath River estuary	Coastal lagoons and the uppermost zone of brackish large estuaries; prefer sandy substrate for spawning, but can be found on silt, mud, or rocky substrates; can occur in water up to 15 feet in lagoons and within a wide range of salinity (0–42 ppt)	Not included in EIR. Does not occur within of Area of Analysis

Common Name *Scientific Name*	Status[a] Federal/ State/Forest Service, Bureau of Land Management	Query Sources	Distribution	Habitat Association	Rational for Inclusion/Exclusion In EIR
Aquatic Mollusks					
Chace juga snail *Juga chacei*	–/–/FSS	USDA Forest Service	Not currently found in Area of Analysis	Mollusk found in small spring-fed creeks and springs	Not included in EIR. Does not occur within of Area of Analysis
Pristine spring snail *Pristinicola hemphilli*	–/–/FSS	USDA Forest Service	Not currently found in Area of Analysis	Mollusk found in small cold springs or seeps which are in a pristine condition and contain coarse gravel/cobble substrate	Not included in EIR. Does not occur within of Area of Analysis
montane peaclam *Pisidium ultramontanum*	–/–/FSS	CNDDB	Within the Area of Analysis, they have been found in Upper and Lower Klamath Basin	Mollusk found in spring-influenced streams, lakes, and pools and strongly associated with sands or small clean gravels	Included in EIR. Occurs within California portion of Area of Analysis
topaz juga *Juga acutifilosa*	–/–/FSS	CNDDB	Not found within Area of Analysis	Aquatic mollusk found in cold, well-oxygenated, unpolluted water, generally with stable gravel substrate	Not included in EIR. Does not occur within of Area of Analysis
Shasta crayfish *Pacifastacus fortis*	FE/SE/--	USFWS	Not found within Area of Analysis	cool, clear, spring-fed headwaters that are characterized by clean volcanic cobbles and boulders on top of gravel or sand	Not included in EIR. Does not occur within of Area of Analysis
Aquatic Invertebrates					
conservancy fairy shrimp *Branchinecta conservatio*	FE/–/-- No critical habitat designated in Area of Analysis	USFWS	Not found within Area of Analysis	Large, deep vernal pools in annual grasslands	Not included in EIR. Vernal pools not expected to occur within of Area of Analysis
vernal pool fairy shrimp *Branchinecta lynchi*	FT/–/– No critical habitat designated in Area of Analysis	USFWS	Not found within Area of Analysis	Vernal pools; also found in sandstone rock outcrop pools	Not included in EIR. Vernal pools not expected to occur within of Area of Analysis
vernal pool tadpole shrimp *Lepidurus packardi*	FE/–/– No critical habitat designated in Project Area	USFWS	Not found within Area of Analysis	Vernal pools and ephemeral stock ponds	Not included in EIR. Vernal pools not expected to occur within of Area of Analysis

Common Name *Scientific Name*	Status[a] Federal/ State/Forest Service, Bureau of Land Management	Query Sources	Distribution	Habitat Association	Rational for Inclusion/Exclusion In EIR
Reptiles					
olive (=Pacific) ridley sea turtle *Lepidochelys olivacea*	FT/– No critical habitat designated in Project Area	NMFS	Not found within Area of Analysis	Within pelagic zone as well as coastal areas, including bays and estuaries; nests on sandy ocean beaches	Not included in EIR. Does not occur within of Area of Analysis
green sea turtle *Chelonia mydas*	FT/–	NMFS	Not found within Area of Analysis	Uses convergence zones in the open ocean and benthic feeding grounds in coastal areas; nests on sandy ocean beaches	Not included in EIR. Does not occur within of Area of Analysis
leatherback sea turtle *Dermochelys coriacea*	FE/– No critical habitat designated in Area of Analysis	NMFS	Not found within Area of Analysis	Pelagic, though also forages near coastal waters	Not included in EIR. Does not occur within of Area of Analysis
Mammals					
right whale *Eubalaena (=Balaena) glacialis*	FE/SFP Critical habitat (Designated)	NMFS	Pacific Ocean	Deep ocean waters	Not included in EIR. Does not occur within of Area of Analysis
sei whale *Balaenoptera borealis*	FE/–	NMFS	Pacific Ocean	Deep ocean waters far from the coastline	Not included in EIR. Does not occur within of Area of Analysis
blue whale *Balaenoptera musculus*	FE/–	NMFS	Pacific Ocean	Deep ocean waters; also can be found in coastal waters	Not included in EIR. Rare within of Area of Analysis
fin whale *Balaenoptera physalus*	FE/–	NMFS	Pacific Ocean	Deep ocean waters	Not included in EIR. Not common within of Area of Analysis
humpback whale *Megaptera novaengliae*	FE/–	NMFS	Pacific Ocean	Deep ocean waters	Not included in EIR. Not common within of Area of Analysis

Common Name ***Scientific Name***	**Status[a] Federal/ State/Forest Service, Bureau of Land Management**	**Query Sources**	**Distribution**	**Habitat Association**	**Rational for Inclusion/Exclusion In EIR**
killer whale *Orcinus orca* Southern Resident DPS	FE/– Critical habitat (Designated)	NMFS	Pacific Ocean	Coastal habitats of temperate waters, including bays	Included in EIR. Occur within Area of Analysis, and partially dependent on Chinook salmon from Area of Analysis
sperm whale *Physeter macrocephalus*	FE/–	NMFS	Pacific Ocean	Deep ocean waters	Not included in EIR. Does not occur within of Area of Analysis

[a] Status codes:

Federal
- FE = Listed as endangered under the federal Endangered Species Act
- FT = Listed as threatened under the federal Endangered Species Act
- FPE = Federally proposed as endangered
- FPT = Federally proposed as threatened
- FC = Federal candidate species
- FD = Federally delisted
- PD = Federally proposed for delisting
- BGEPA = Federally protected under the Bald and Golden Eagle Protection Act
- FSS = Forest Service Sensitive species
- BLMS = Bureau of Land Management Sensitive Species

State
- SE = Listed as Endangered under the California Endangered Species Act
- ST = Listed as Threatened under the California Endangered Species Act
- SCE = State Candidate Endangered
- SD = State Delisted
- SSC = CDFW Species of Special Concern
- SFP = CDFW Fully Protected species
- BOFS = Considered a sensitive species by the California Board of Forestry under the California Forest Practice Rules (14 CCR §895.1)

Table J-2. Special-status Plants Documented in the Project Vicinity.

Common Name *Scientific Name*	Status[1] Federal/ State/USFS/ BLM/CRPR	Query Source	Family	Life-form	Blooming Period[2,3]	Elevation Range[2] (m)	Habitat Associations[2]	Included in or Excluded from the EIR, and Rationale
Vascular Plants								
Pacific silver fir *Abies amabilis*	–/–/–/–/2B.3	CNPS, CNDDB	Pinaceae	perennial evergreen tree	N/A	1,700–2,195	Upper montane coniferous forest	Excluded; outside of the Primary Area of Analysis[4] elevation range
pink sand-verbena *Abronia umbellata* var. *breviflora*	–/–/–/BLMS/1B.1	CNPS, CNDDB	Nyctaginaceae	perennial herb	June–October	0–10	Coastal dunes	Included; potential habitat within the Primary Area of Analysis
Great Basin onion *Allium atrorubens* var. *atrorubens*	–/–/–/–/2B.3	CNPS, CNDDB	Alliaceae	perennial bulbiferous herb	May–June	1,200–2,315	Rocky or sandy soils in Great Basin scrub and pinyon and juniper woodland	Excluded; outside of the Primary Area of Analysis elevation range
Siskiyou onion *Allium siskiyouense*	–/–/–/–/4.3	CNPS	Alliaceae	perennial bulbiferous herb	(April) May–July	855–2,500	Rocky and sometimes serpentine soils in lower montane coniferous forest and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
California androsace *Androsace elongata* subsp. *acuta*	–/–/–/–/4.2	CNPS	Primulaceae	annual herb	March–June	150–1,305	Chaparral, cismontane woodland, coastal scrub, meadows and seeps, pinyon and juniper woodland, and valley and foothill grassland	Included; potential habitat within the Primary Area of Analysis
slender-stemmed androsace *Androsace filiformis*	–/–/–/–/2B.3	CNPS, CNDDB	Primulaceae	annual herb	June–October	1,800–1,830	Meadows and seeps and upper montane coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range

Common Name ***Scientific Name***	**Status[1] Federal/ State/USFS/ BLM/CRPR**	**Query Source**	**Family**	**Life-form**	**Blooming Period[2,3]**	**Elevation Range[2] (m)**	**Habitat Associations[2]**	**Included in or Excluded from the EIR, and Rationale**
sea-watch *Angelica lucida*	–/–/–/–/4.2	CNPS	Apiaceae	perennial herb	May–September	0–150	Coastal bluff scrub, coastal dunes, coastal scrub, and coastal salt marshes and swamps	Included; potential habitat within the Primary Area of Analysis
evergreen everlasting *Antennaria suffrutescens*	–/–/–/–/4.3	CNPS	Asteraceae	perennial stoloniferous herb	January–July	500–1,600	Serpentine soils in lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
vanilla-grass *Anthoxanthum nitens* subsp. *nitens*	–/–/–/–/2B.3	CNPS, CNDDB	Poaceae	perennial rhizomatous herb	April–July	1,500–1,895	Mesic soils in meadows and seeps	Excluded; outside of the Primary Area of Analysis elevation range
Waldo rockcress *Arabis aculeolata*	–/–/–/–/2B.2	CNPS, CNDDB	Brassicaceae	perennial herb	April–June	410–1,800	Serpentine soils in broadleafed upland forest, lower montane coniferous forest, and upper montane coniferous forest	Included; documented within the Primary Area of Analysis (CDFW 2017b[5])
McDonald's rockcress *Arabis mcdonaldiana*	FE/CE/FSS/–/1B.1	CNPS, CNDDB, USFWS	Brassicaceae	perennial herb	May–July	135–1,800	Serpentine soils in lower montane coniferous forest and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
modest rockcress *Arabis modesta*	–/–/–/–/4.3	CNPS	Brassicaceae	perennial herb	March–July	120–800	Chaparral and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Oregon rockcress *Arabis oregana*	–/–/–/–/4.3	CNPS	Brassicaceae	perennial herb	May	600–1,830	Serpentine soils in chaparral and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis

Common Name ***Scientific Name***	**Status[1] Federal/ State/USFS/ BLM/CRPR**	**Query Source**	**Family**	**Life-form**	**Blooming Period[2,3]**	**Elevation Range[2] (m)**	**Habitat Associations[2]**	**Included in or Excluded from the EIR, and Rationale**
Howell's manzanita *Arctostaphylos hispidula*	–/–/–/–/4.2	CNPS	Ericaceae	perennial evergreen shrub	March–April	120–1,250	Serpentine or sandstone soils in chaparral	Included; potential habitat within the Primary Area of Analysis
Del Norte manzanita *Arctostaphylos nortensis*	–/–/–/–/4.3	CNPS	Ericaceae	perennial evergreen shrub	February	500–800	Often serpentine soils in chaparral and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
serpentine arnica *Arnica cernua*	–/–/–/–/4.3	CNPS	Asteraceae	perennial rhizomatous herb	April–July	500–1,920	Serpentine soils in lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Klamath arnica *Arnica spathulata*	–/–/–/–/4.3	CNPS	Asteraceae	perennial rhizomatous herb	May–August	640–1,800	Serpentine soils in lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Mt. Shasta arnica *Arnica viscosa*	–/–/–/–/4.3	CNPS	Asteraceae	perennial rhizomatous herb	August–September	1,705–2,745	Rocky soils in subalpine coniferous forest and upper montane coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range
marbled wild-ginger *Asarum marmoratum*	–/–/–/–/2B.3	CNPS, CNDDB	Aristolochiaceae	perennial rhizomatous herb	April–August	200–1,800	Lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Applegate's Milk-vetch *Astragalus applegatei*	FE/OE/–/–/–	USFWS, PacifiCorp	Fabaceae	perennial herb	June-August[4]	~1,250[5]	Flat-lying, seasonally moist, strongly alkaline soils dominated by greasewood (Sarcobatus vermiculatus) with sparse, native bunch grasses and patches of bare soil[6]	Excluded; range restricted to Oregon

Common Name ***Scientific Name***	**Status[1] Federal/ State/USFS/ BLM/CRPR**	**Query Source**	**Family**	**Life-form**	**Blooming Period[2,3]**	**Elevation Range[2] (m)**	**Habitat Associations[2]**	**Included in or Excluded from the EIR, and Rationale**
Bald Mountain milk-vetch *Astragalus umbraticus*	–/–/–/–/2B.3	CNPS, CNDDB	Fabaceae	perennial herb	May–August	150–1,250	Sometimes on roadsides in cismontane woodland and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
woolly balsamroot *Balsamorhiza lanata*	–/–/–/BLMS/1B.2	CNPS, CNDDB	Asteraceae	perennial herb	April–June	800–1,895	Rocky, volcanic soils in cismontane woodland	Included; potential habitat within the Primary Area of Analysis
bensoniella *Bensoniella oregana*	–/CR/FSS/–/1B.1	USFS	Saxifragaceae	perennial herb	May-July	915–1,400	Bogs and fens, lower montane coniferous forest, meadows and seeps	Included; potential habitat within the Primary Area of Analysis
dwarf resin birch *Betula glandulosa*	–/–/–/–/2B.2	CNPS, CNDDB	Betulaceae	perennial deciduous shrub	May–July	1,300–2,300	Mesic soils in bogs and fens, lower montane coniferous forest, meadows and seeps, marshes and swamps, and subalpine coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range
Koehler's stipitate rockcress *Boechera koehleri*	–/–/FSS/–/1B.3	CNPS, CNDDB	Brassicaceae	perennial herb	(March) April–July	155–1,660	Serpentine, rocky soils in chaparral and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Rolle's rockcress *Boechera rollei*	–/–/–/–/1B.1	CNPS, CNDDB	Brassicaceae	perennial herb	August	1,600–1,800	Peridotite rocks on sparsely forested slopes in upper montane coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range

Common Name ***Scientific Name***	**Status[1] Federal/ State/USFS/ BLM/CRPR**	**Query Source**	**Family**	**Life-form**	**Blooming Period[2,3]**	**Elevation Range[2] (m)**	**Habitat Associations[2]**	**Included in or Excluded from the EIR, and Rationale**
Bolander's reed grass *Calamagrostis bolanderi*	–/–/–/–/4.2	CNPS	Poaceae	perennial rhizomatous herb	May–August	0–455	Mesic soils in bogs and fens, broadleafed upland forest, closed-cone coniferous forest, coastal scrub, meadows and seeps, freshwater marshes and swamps, and North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
Thurber's reed grass *Calamagrostis crassiglumis*	–/–/–/–/2B.1	CNPS, CNDDB	Poaceae	perennial rhizomatous herb	May–August	10–60	Mesic soils in coastal scrub and freshwater marshes and swamps	Included; potential habitat within the Primary Area of Analysis
leafy reed grass *Calamagrostis foliosa*	–/CR/–/BLMS/4.2	CNPS, CNDDB	Poaceae	perennial herb	May–September	0–1,220	Rocky soils in coastal bluff scrub and North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
Alaska cedar *Callitropsis nootkatensis*	Petition to list/–/–/–/4.3	CNPS	Cupressaceae	perennial evergreen tree		650–2,500	Upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis

Common Name *Scientific Name*	Status[1] Federal/ State/USFS/ BLM/CRPR	Query Source	Family	Life-form	Blooming Period[2,3]	Elevation Range[2] (m)	Habitat Associations[2]	Included in or Excluded from the EIR, and Rationale
Greene's mariposa lily *Calochortus greenei*	–/– /FSS/BLMS/1B.2	CNPS, CNDDB, PacifiCorp	Liliaceae	perennial bulbiferous herb	June–August	1,035–1,890	Volcanic soils in cismontane woodland, meadows and seeps, pinyon and juniper woodland, and upper montane coniferous forest	Included; documented during PacifiCorp surveys at Iron Gate Reservoir and also known to occur at Copco Reservoir and along J.C. Boyle peaking reach (PacifiCorp 2004a[7]). Several occurrences on CNDDB along Klamath River (2017b).
single-flowered mariposa lily *Calochortus monanthus*	–/–/–/BLMS/1A	CNPS, CNDDB	Liliaceae	perennial bulbiferous herb	June	745–800	Meadows and seeps	Included; potential habitat within the Primary Area of Analysis
Siskiyou mariposa lily *Calochortus persistens*	– /CR/FSS/BLMS/1 B.2	CNPS, CNDDB	Liliaceae	perennial bulbiferous herb	June–July	1,000–1,860	Rocky, acidic soils in lower montane coniferous forest and North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
small-flowered calycadenia *Calycadenia micrantha*	–/–/FSS/–/1B.2	USFS	Asteraceae	annual herb	June-September	5–1,500	Roadsides, rocky, talus, scree, sometimes serpentine soils and sparsely vegetated areas in chaparral, volcanic meadows and seeps, and valley and foothill grassland	Included; potential habitat within the Primary Area of Analysis

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seaside bittercress *Cardamine angulata*	–/–/–/–/2B.1	CNPS, CNDDB	Brassicaceae	perennial herb	(January) March–July	25–915	Wet areas and streambanks in lower montane coniferous forest and North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
fleshy toothwort *Cardamine bellidifolia* var. *pachyphylla*	–/–/–/–/4.3	CNPS	Brassicaceae	perennial herb	June–August	1,900–2,835	Rocky soils, talus and scree in alpine boulder and rock field, subalpine coniferous forest, and upper montane coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range
Buxbaum's sedge *Carex buxbaumii*	–/–/–/–/4.2	CNPS	Cyperaceae	perennial rhizomatous herb	March–August	3–3,300	Bogs and fens, mesic soils in meadows and seeps, and marshes and swamps	Included; potential habitat within the Primary Area of Analysis
Geyer's sedge *Carex geyeri*	–/–/–/–/4.2	CNPS	Cyperaceae	perennial rhizomatous herb	May–August	1,155–2,195	Great Basin scrub and lower montane coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range
Oregon sedge *Carex halliana*	–/–/–/–/2B.3	CNPS, CNDDB	Cyperaceae	perennial rhizomatous herb	(May) July–September	1,370–2,105	Often pumice soils in meadows and seeps, subalpine coniferous forest,and upper montane coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range
porcupine sedge *Carex hystericina*	–/–/–/–/2B.1	CNPS	Cyperaceae	perennial rhizomatous herb	May–June	610–915	Streambanks in marshes and swamps	Included; potential habitat within the Primary Area of Analysis

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lagoon sedge *Carex lenticularis* var. *limnophila*	–/–/–/–/2B.2	CNPS, CNDDB	Cyperaceae	perennial herb	June–August	0–6	Often gravelly soils along shores, beaches in bogs and fens, marshes and swamps, and North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
bristle-stalked sedge *Carex leptalea*	–/–/–/–/2B.2	CNPS, CNDDB	Cyperaceae	perennial rhizomatous herb	March–July	0–700	Bogs and fens, mesic areas of meadows and seeps, marshes and swamps	Included; potential habitat within the Primary Area of Analysis
Lyngbye's sedge *Carex lyngbyei*	–/–/–/–/2B.2	CNPS, CNDDB	Cyperaceae	perennial rhizomatous herb	April–August	0–10	Brackish or freshwater marshes and swamps	Included; potential habitat within the Primary Area of Analysis
northern meadow sedge *Carex praticola*	–/–/–/–/2B.2	CNPS, CNDDB	Cyperaceae	perennial herb	May–July	0–3,200	Mesic areas of meadows and seeps	Included; potential habitat within the Primary Area of Analysis
deceiving sedge *Carex saliniformis*	–/–/–/–/1B.2	CNPS, CNDDB	Cyperaceae	perennial rhizomatous herb	June (July)	3–230	Mesic soils in coastal prairie, coastal scrub, meadows and seeps, and coastal salt marshes and swamps	Included; potential habitat within the Primary Area of Analysis
Siskiyou sedge *Carex scabriuscula*	–/–/–/–/4.3	CNPS	Cyperaceae	perennial rhizomatous herb	May–July	710–2,345	Mesic, sometimes serpentine soils in lower montane coniferous forest, meadows and seeps, and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis

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serpentine sedge *Carex serpenticola*	–/–/–/–/2B.3	CNPS, CNDDB	Cyperaceae	perennial rhizomatous herb	March–May	60–1,200	Mesic, serpentine soils in meadows and seeps	Included; potential habitat within the Primary Area of Analysis
green yellow sedge *Carex viridula* subsp. *viridula*	–/–/–/–/2B.3	CNPS, CNDDB	Cyperaceae	perennial herb	(June) July–September (November)	0–1,600	Bogs and fens, freshwater marshes and swamps, and mesic North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
Humboldt Bay owl's-clover *Castilleja ambigua* var. *humboldtiensis*	–/–/–/BLMS/1B.2	CNPS, CNDDB	Orobanchaceae	annual herb (hemiparasitic)	April–August	0–3	Coatal salt marshes and swamps	Included; potential habitat within the Primary Area of Analysis
short-lobed paintbrush *Castilleja brevilobata*	–/–/–/–/4.2	CNPS	Orobanchaceae	perennial herb (hemiparasitic)	April–July	120–1,700	Serpentine soils and edges and openings in lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Siskiyou paintbrush *Castilleja elata*	–/–/–/–/2B.2	CNPS, CNDDB	Orobanchaceae	perennial herb (hemiparasitic)	May–August	0–1,750	Often serpentine soils in bogs and fens, and seeps in lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Oregon coast paintbrush *Castilleja litoralis*	–/–/–/–/2B.2	CNPS, CNDDB	Orobanchaceae	perennial herb (hemiparasitic)	June	15–100	Sandy soils in coastal bluff scrub, coastal dunes, and coastal scrub	Included; potential habitat within the Primary Area of Analysis
split-hair paintbrush *Castilleja schizotricha*	–/–/–/–/4.3	CNPS	Orobanchaceae	perennial herb (hemiparasitic)	July–August	1,500–2,300	Decomposed granitic or marble soils in upper montane coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range

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Shasta chaenactis *Chaenactis suffrutescens*	–/–/–/–/1B.3	CNPS	Asteraceae	perennial herb	May–September	750–2,800	Sandy, serpentine soils in lower montane coniferous forest and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Wheeler's dune-broom *Chaetadelpha wheeleri*	–/–/–/–/2B.2	CNPS	Asteraceae	perennial rhizomatous herb	April–September	795–1,900	Sandy soils in desert dunes, Great Basin scrub, and Mojavean desert scrub	Excluded; no habitat in the Primary Area of Analysis
Hoover's Spurge *Chamaesyce hooveri*	FT/–/–/–/1B.2	USFWS	Euphorbiaceae	annual herb	July–September (October)	25–250	Vernal pools	Included; potential habitat within the Primary Area of Analysis
Pacific golden saxifrage *Chrysosplenium glechomifolium*	–/–/–/–/4.3	CNPS	Saxifragaceae	perennial herb	February–June	10–220	Streambanks, sometimes seeps, sometimes roadsides in North Coast coniferous forest, and riparian forest	Included; potential habitat within the Primary Area of Analysis
Ashland thistle *Cirsium ciliolatum*	–/CE/– /BLMS/2B.1	CNPS, CNDDB	Asteraceae	perennial herb	June–August	800–1,400	Cismontane woodland and valley and foothill grassland	Included; potential habitat within the Primary Area of Analysis
Hillman's cleomella *Cleomella hillmanii* var. *hillmanii*	–/–/–/–/2B.2	CNPS, CNDDB	Cleomaceae	annual herb	April–June	1,220–1,220	Clay soils in chenopod scrub and Great Basin scrub	Excluded; outside of the Primary Area of Analysis elevation range
Tracy's collomia *Collomia tracyi*	–/–/–/–/4.3	CNPS	Polemoniaceae	annual herb	June–July	300–2,100	Rocky, sometimes serpentine soils in broadleafed upland forest and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis

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Oregon goldthread *Coptis laciniata*	–/–/–/–/4.2	CNPS, CNDDB	Ranunculaceae	perennial rhizomatous herb	(February) March–May (September–November)	0–1,000	Mesic soils in meadows and seeps and streambanks in North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
bunchberry *Cornus canadensis*	–/–/–/–/2B.2	CNPS, CNDDB	Cornaceae	perennial rhizomatous herb	May–July	60–1,920	Bogs and fens, meadows and seeps, and North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
California lady's-slipper *Cypripedium californicum*	–/–/–/–/4.2	CNPS	Orchidaceae	perennial rhizomatous herb	April–August (September)	30–2,750	Usually serpentine soils in bogs and fens, seeps and streambanks and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
clustered lady's-slipper *Cypripedium fasciculatum*	–/–/FSS/–/4.2	CNPS	Orchidaceae	perennial rhizomatous herb	March–August	100–2,435	Usually serpentine soils in seeps and streambanks, lower montane coniferous forest and North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
mountain lady's-slipper *Cypripedium montanum*	–/–/FSS/–/4.2	CNPS	Orchidaceae	perennial rhizomatous herb	March–August	185–2,225	Broadleafed upland forest, cismontane woodland, lower montane coniferous forest, and North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
California pitcherplant *Darlingtonia californica*	–/–/–/–/4.2	CNPS	Sarraceniaceae	perennial rhizomatous herb (carnivorous)	April–August	0–2,585	Serpentine soils in bogs and fens, and meadows and seeps	Included; potential habitat within the Primary Area of Analysis

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Oregon bleeding heart *Dicentra formosa* subsp. *oregana*	–/–/–/–/4.2	CNPS	Papaveraceae	perennial herb	April–May	425–1,485	Serrpentinite soils in lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Mt. Eddy draba *Draba carnosula*	–/–/FSS/–/1B.3	CNPS, CNDDB	Brassicaceae	perennial herb	July–August	1,935–3,000	Serpentine, rocky soils in subalpine coniferous forest and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
black crowberry *Empetrum nigrum*	–/–/–/–/2B.2	CNPS, CNDDB	Empetraceae	perennial evergreen shrub	April–June	10–200	Coastal bluff scrub and coastal prairie	Included; potential habitat within the Primary Area of Analysis
yellow willowherb *Epilobium luteum*	–/–/–/–/2B.3	CNPS, CNDDB	Onagraceae	perennial stoloniferous herb	July–September	1,500–2,195	Along streams and seeps in lower montane coniferous forest and in meadows and seeps	Excluded; outside of the Primary Area of Analysis elevation range
Oregon fireweed *Epilobium oreganum*	–/– /FSS/BLMS/1B.2	CNPS, CNDDB	Onagraceae	perennial herb	June–September	500–2,240	Mesic soils in bogs and fens, lower montane coniferous forest, meadows and seeps, and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Siskiyou Mountains willowherb *Epilobium rigidum*	–/–/–/–/4.3	CNPS	Onagraceae	perennial herb	July–August	150–1,200	Serpentine soils in lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Humboldt County fuchsia *Epilobium septentrionale*	–/–/–/–/4.3	CNPS	Onagraceae	perennial herb	July–September	45–1,800	Sandy or rocky soils in broadleafed upland forest and North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis

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Siskiyou fireweed *Epilobium siskiyouense*	–/–/–/BLMS/1B.3	CNPS, CNDDB	Onagraceae	perennial herb	July–September	1,700–2,500	Rocky, serpentine soils in alpine boulder and rock field, subalpine coniferous forest, and upper montane coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range
Pine Creek evening-primrose *Eremothera boothii* subsp. *alyssoides*	–/–/–/–/4.3	CNPS	Onagraceae	annual herb	April–August	600–1,700	Sandy or gravelly soils in Great Basin scrub	Excluded; no habitat in the Primary Area of Analysis
Nelson's evening-primrose *Eremothera minor*	–/–/–/–/2B.3	CNPS, CNDDB	Onagraceae	annual herb	April–July	1,200–1,380	Chenopod scrub, sandy soils in Great Basin scrub	Excluded; outside of the Primary Area of Analysis elevation range
Waldo daisy *Erigeron bloomeri* var. *nudatus*	–/–/–/–/2B.3	CNPS, CNDDB	Asteraceae	perennial herb	June–July	600–2,300	Serpentine soils in lower montane coniferous forest and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Mad River fleabane daisy *Erigeron maniopotamicus*	–/–/FSS/–/1B.2	USFS	Asteraceae	perennial herb	May-August	1,275–1,500	Open, disturbed areas including road cuts, rocky soils in lower montane coniferous forest and meadows and seeps	Excluded; outside of the Primary Area of Analysis elevation range
Congdon's buckwheat *Eriogonum congdonii*	–/–/–/–/4.3	CNPS	Polygonaceae	perennial deciduous shrub	(May) June–August (September)	800–2,345	Serpentine soils in rocky openings in lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Jaynes Canyon buckwheat *Eriogonum diclinum*	–/–/–/–/2B.3	CNPS, CNDDB	Polygonaceae	perennial herb	June–September	1,700–2,400	Often serpentine soils in upper montane coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range

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Klamath Mountain buckwheat *Eriogonum hirtellum*	–/–/FSS/–/1B.3	CNPS, CNDDB	Polygonaceae	perennial rhizomatous herb	July–September	610–1,900	Serpentine soils in chaparral, lower montane coniferous forest, and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Del Norte buckwheat *Eriogonum nudum* var. *paralinum*	–/–/–/–/2B.2	CNPS, CNDDB	Polygonaceae	perennial herb	June–September	5–80	Coastal bluff scrub and coastal prairie	Included; documented within the Primary Area of Analysis (CDFW 2017b)
Dugway wild buckwheat *Eriogonum nutans* var. *nutans*	–/–/–/–/2B.3	CNPS, CNDDB	Polygonaceae	annual herb	May–September (October)	1,220–3,000	Sandy or gravelly soils in chenopod scrub and Great Basin scrub	Excluded; outside of the Primary Area of Analysis elevation range
Siskiyou buckwheat *Eriogonum siskiyouense*	–/–/–/–/4.3	CNPS	Polygonaceae	perennial herb	(June) July–September	970–2,740	Rocky, often serpentine soils in lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
ternate buckwheat *Eriogonum ternatum*	–/–/–/–/4.3	CNPS	Polygonaceae	perennial herb	June–August	305–2,225	Serpentine soils in lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
blushing wild buckwheat *Eriogonum ursinum* var. *erubescens*	–/–/–/BLMS/1B.3	CNPS, CNDDB	Polygonaceae	perennial herb	June–September	750–1,900	Rocky soils, scree, and talus in montane chaparral and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
bluff wallflower *Erysimum concinnum*	–/–/–/–/1B.2	CNPS, CNDDB	Brassicaceae	annual / perennial herb	February–July	0–185	Coastal bluff scrub, coastal dunes, and coastal prairie	Included; potential habitat within the Primary Area of Analysis

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Menzies' Wallflower *Erysimum menziesii*	FT/CE/–/–/1B.1	USFWS	Brassicaceae	perennial herb	March–September	0–35	Coastal dunes	Included; potential habitat within the Primary Area of Analysis
Henderson's fawn lily *Erythronium hendersonii*	–/–/FSS/–/2B.3	CNPS, CNDDB	Liliaceae	perennial bulbiferous herb	April–July	300–1,600	Lower montane coniferous forest	Included; documented within the Primary Area of Analysis (CDFW 2017b)
Howell's fawn lily *Erythronium howellii*	–/–/–/–/1B.3	CNPS, CNDDB	Liliaceae	perennial bulbiferous herb	April–May	200–1,145	Sometimes serpentine soils in lower montane coniferous forest and North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
giant fawn lily *Erythronium oregonum*	–/–/–/–/2B.2	CNPS, CNDDB	Liliaceae	perennial herb	March–June (July)	100–1,150	Sometimes serpentine soils and in rocky openings in cismontane woodland and meadows and seeps	Included; documented within the Primary Area of Analysis (CDFW 2017b)
coast fawn lily *Erythronium revolutum*	–/–/–/–/2B.2	CNPS, CNDDB	Liliaceae	perennial bulbiferous herb	March–July (August)	0–1,600	Bogs and fens, streambanks, broadleafed upland forest, and North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
wayside aster *Eucephalus vialis*	–/–/FSS/–/1B.2	CNPS, CNDDB	Asteraceae	perennial herb	June–September	910–1,545	Gravelly soils in lower montane coniferous forest and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis

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Umpqua green-gentian *Frasera umquaensis*	–/–/FSS/–/2B.2	USFS	Gentianaceae	perennial herb	June-July	1,555–1,900	Chaparral, lower montane coniferous forest, meadows and seeps, and North Coast coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range
Gentner's fritillary *Fritillaria gentneri*	FE/–/–/–/1B.1	CNPS, CNDDB, USFWS	Liliaceae	perennial bulbiferous herb	April–May	1,005–2,970	Sometimes serpentine soils in chaparral, cismontane woodland, and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Oregon bedstraw *Galium oreganum*	–/–/–/–/3	CNPS	Rubiaceae	perennial rhizomatous herb	May–September	1,500–1,500	Lower montane coniferous forest and North Coast coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range
Scott Mountain bedstraw *Galium serpenticum* subsp. *scotticum*	–/–/–/BLMS/1B.2	CNPS, CNDDB	Rubiaceae	perennial herb	May–August	1,000–2,075	Serpentine soils in lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Klamath gentian *Gentiana plurisetosa*	–/–/–/–/1B.3	CNPS, CNDDB	Gentianaceae	perennial herb	July–September	1,200–1,900	Mesic soils in lower montane coniferous forest, meadows and seeps, and upper montane coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range
Mendocino gentian *Gentiana setigera*	–/–/FSS/–/1B.2	CNPS	Gentianaceae	perennial herb	(April–July) August–September	335–1,065	Mesic soils in lower montane coniferous forest, and meadows and seeps	Included; potential habitat within the Primary Area of Analysis

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Pacific gilia *Gilia capitata* subsp. *pacifica*	–/–/–/–/1B.2	CNPS, CNDDB	Polemoniaceae	annual herb	April–August	5–1,665	Coastal bluff scrub, openings in chaparral, coastal prairie, and valley and foothill grassland	Included; potential habitat within the Primary Area of Analysis
dark-eyed gilia *Gilia millefoliata*	–/–/–/BLMS/1B.2	CNPS, CNDDB	Polemoniaceae	annual herb	April–July	2–30	Coastal dunes	Included; potential habitat within the Primary Area of Analysis
American glehnia *Glehnia littoralis* subsp. *leiocarpa*	–/–/–/–/4.2	CNPS	Apiaceae	perennial herb	May–August	0–20	Coastal dunes	Included; potential habitat within the Primary Area of Analysis
serpentine sunflower *Helianthus bolanderi*	–/–/–/–/4.2	PacifiCorp	Asteraceae	annual herb	June-November	150–1,525	Serpentine seeps in chaparral and cismontane woodland	Included; documented during PacifiCorp surveys south of Iron Gate Reservoir (PacifiCorp 2004a)
buttercup-leaf suksdorfia *Hemieva ranunculifolia*	–/–/–/–/2B.2	CNPS, CNDDB	Saxifragaceae	perennial herb	June–August	1,500–2,500	Mesic, rocky, granitic soils in meadows and seeps and upper montane coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range
Baker cypress *Hesperocyparis bakeri*	–/–/–/–/4.2	CNPS	Cupressaceae	perennial evergreen tree		820–1,995	Serpentine or volcanic soils in chaparral and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Henderson's horkelia *Horkelia hendersonii*	–/–/–/BLMS/1B.1	CNPS, CNDDB	Rosaceae	perennial herb	June–August	2,000–2,300	Granitic soils in upper montane coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range

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Howell's horkelia *Horkelia sericata*	–/–/–/–/4.3	CNPS	Rosaceae	perennial herb	May–July	60–1,280	Serpentine or clay soils in chaparral and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Yolla Bolly Mtns. bird's-foot trefoil *Hosackia yollabolliensis*	–/–/FSS/–/1B.2	USFS	Fabaceae	perennial herb	Jun-August	1,645–2,135	Gravelly, dry barren exposed slopes, meadows and seeps, and openings in upper montane coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range
alkali hymenoxys *Hymenoxys lemmonii*	–/–/–/–/2B.2	CNPS, CNDDB	Asteraceae	perennial herb	June–August (September)	240–3,390	Great Basin scrub, lower montane coniferous forest, and subalkaline meadows and seeps	Included; potential habitat within the Primary Area of Analysis
California globe mallow *Iliamna latibracteata*	–/–/FSS/–/1B.2	CNPS, CNDDB	Malvaceae	perennial herb	June–August	60–2,000	Montane chaparral, lower montane coniferous forest, mesic soils in North Coast coniferous forest, and streambanks in riparian scrub Often in burned areas	Included; potential habitat within the Primary Area of Analysis
Siskiyou iris *Iris bracteata*	–/–/–/–/3.3	CNPS	Iridaceae	perennial rhizomatous herb	May–June	180–1,070	Serpentine soils in broadleafed upland forest and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Del Norte County iris *Iris innominata*	–/–/–/–/4.3	CNPS	Iridaceae	perennial rhizomatous herb	May–June	300–2,000	Serpentine soils in lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis

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Orleans iris *Iris tenax* subsp. *klamathensis*	–/–/–/–/4.3	CNPS	Iridaceae	perennial rhizomatous herb	April–May	100–1,400	Lower montane coniferous forest, often in disturbed areas	Included; potential habitat within the Primary Area of Analysis
Dudley's rush *Juncus dudleyi*	–/–/–/–/2B.3	CNPS, CNDDB	Juncaceae	perennial herb	July–August	455–2,000	Mesic soils in lower montane coniferous forest	Included; documented within the Primary Area of Analysis (CDFW 2017a)
Regel's rush *Juncus regelii*	–/–/–/–/2B.3	CNPS, CNDDB	Juncaceae	perennial rhizomatous herb	August	760–1,900	Mesic soils in meadows and seeps and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
small groundcone *Kopsiopsis hookeri*	–/–/–/–/2B.3	CNPS, CNDDB	Orobanchaceae	perennial rhizomatous herb (parasitic)	April–August	90–885	North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
Del Norte pea *Lathyrus delnorticus*	–/–/–/–/4.3	CNPS	Fabaceae	perennial herb	June–July	30–1,450	Often serpentine soils in lower montane coniferous forest and North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
seaside pea *Lathyrus japonicus*	–/–/–/–/2B.1	CNPS, CNDDB	Fabaceae	perennial rhizomatous herb	May–August	1–30	Coastal dunes	Included; potential habitat within the Primary Area of Analysis
marsh pea *Lathyrus palustris*	–/–/–/–/2B.2	CNPS, CNDDB	Fabaceae	perennial herb	March–August	1–100	Mesic soils in bogs and fens, coastal prairie, coastal scrub, lower montane coniferous forest, marshes and swamps, and North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis

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beach layia *Layia carnosa*	FE/CE/–/–/1B.1	CNPS, CNDDB, USFWS	Asteraceae	annual herb	March–July	0–60	Coastal dunes, and sandy soils in coastal scrub	Included; potential habitat within the Primary Area of Analysis
Heckner's lewisia *Lewisia cotyledon* var. *heckneri*	–/–/–/BLMS/1B.2	CNPS, CNDDB	Montiaceae	perennial herb	May–July	225–2,100	Rocky soils in lower montane coniferous forest	Included; documented within the Primary Area of Analysis (CDFW 2017b)
Howell's lewisia *Lewisia cotyledon* var. *howellii*	–/–/–/–/3.2	CNPS	Montiaceae	perennial herb	April–July	150–2,010	Rocky soils in broadleafed upland forest, chaparral, cismontane woodland, and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Hutchison's lewisia *Lewisia kelloggii* subsp. *hutchisonii*	–/–/–/–/3.2	CNPS	Montiaceae	perennial herb	(April) May–August	765–2,365	Openings, ridgetops, often slate, sometimes rhyolite tuff in upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Kellogg's lewisia *Lewisia kelloggii* subsp. *kelloggii*	–/–/FSS/–/3.2	CNPS	Montiaceae	perennial herb	(April) May–August	1,465–2,365	Openings, ridgetops, often slate, sometimes rhyolite tuff in upper montane coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range
opposite-leaved lewisia *Lewisia oppositifolia*	–/–/FSS/–/2B.2	USFS	Montiaceae	perennial herb	April-May (June)	300–1,220	Mesic soils in lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Bolander's lily *Lilium bolanderi*	–/–/–/–/4.2	CNPS	Liliaceae	perennial bulbiferous herb	June–July	30–1,600	Serpentine soils in chaparral lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis

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western lily *Lilium occidentale*	FE/CE/–/–/1B.1	CNPS, CNDDB, USFWS	Liliaceae	perennial bulbiferous herb	June–July	2–185	Bogs and fens, coastal bluff scrub, coastal prairie, coastal scrub, freshwater marshes and swamps, and openings in North Coast coniferous forest)	Included; potential habitat within the Primary Area of Analysis
Vollmer's lily *Lilium pardalinum* subsp. *vollmeri*	–/–/–/–/4.3	CNPS	Liliaceae	perennial bulbiferous herb	(June) July–August	30–1,680	Bogs and fens, and mesic soils in meadows and seeps	Included; potential habitat within the Primary Area of Analysis
Wiggins' lily *Lilium pardalinum* subsp. *wigginsii*	–/–/–/–/4.3	CNPS	Liliaceae	perennial bulbiferous herb	June–August	485–2,000	Mesic soils in bogs and fens, broadleafed upland forest, lower montane coniferous forest, meadows and seeps, and riparian scrub	Included; potential habitat within the Primary Area of Analysis
redwood lily *Lilium rubescens*	–/–/–/–/4.2	CNPS	Liliaceae	perennial bulbiferous herb	April–August (September)	30–1,910	Sometimes serpentine soils in broadleafed upland forest, chaparral, lower montane coniferous forest, North Coast coniferous forest, and upper montane coniferous forest Sometimes roadsides	Included; potential habitat within the Primary Area of Analysis

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woolly meadowfoam *Limnanthes floccosa* subsp. *floccosa*	–/–/–/–/4.2	CNPS, CNDDB	Limnanthaceae	annual herb	March–May (June)	60–1,335	Vernally mesic soils in chaparral, cismontane woodland, and valley and foothill grassland, and vernal pools	Included; potential habitat within the Primary Area of Analysis
heart-leaved twayblade *Listera cordata*	–/–/–/–/4.2	CNPS	Orchidaceae	perennial herb	February–July	5–1,370	Bogs and fens, lower montane coniferous forest, and North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
depressed standing-cypress *Loeseliastrum depressum*	–/–/–/–/4.3	CNPS	Polemoniaceae	annual herb	April–July	1,220–2,100	Sandy or gravelly soils in Great Basin scrub, Mojavean desert scrub, and pinyon and juniper woodland	Excluded; outside of the Primary Area of Analysis elevation range
MacDougal's lomatium *Lomatium foeniculaceum* subsp. *macdougalii*	–/–/–/–/2B.2	CNPS, CNDDB	Apiaceae	perennial herb	April–July	1,200–2,065	Volcanic soils in chenopod scrub, Great Basin scrub, lower montane coniferous forest, and pinyon and juniper woodland	Excluded; outside of the Primary Area of Analysis elevation range
Howell's lomatium *Lomatium howellii*	–/–/–/–/4.3	CNPS	Apiaceae	perennial herb	April–July	110–1,705	Serpentine soils in chaparral and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Coast Range lomatium *Lomatium martindalei*	–/–/–/–/2B.3	CNPS, CNDDB	Apiaceae	perennial herb	May–June (August)	240–3,000	Coastal bluff scrub, lower montane coniferous forest, and meadows and seeps	Included; potential habitat within the Primary Area of Analysis

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Peck's lomatium *Lomatium peckianum*	–/–/–/–/2B.2	CNPS, CNDDB	Apiaceae	perennial herb	April–May (June)	700–1,800	Volcanic soils in chaparral, cismontane woodland, lower montane coniferous forest, and pinyon and juniper woodland	Included; documented within the Primary Area of Analysis (CDFW 2017b)
Raven's lomatium *Lomatium ravenii*	–/–/–/–/2B.3	CNPS, CNDDB	Apiaceae	perennial herb	April–June	1,000–3,000	Adobe, alkaline soils in Great Basin scrub	Excluded; no habitat in the Primary Area of Analysis
Tracy's lomatium *Lomatium tracyi*	–/–/–/–/4.3	CNPS	Apiaceae	perennial herb	May–June	455–1,950	Serpentine soils in lower montane coniferous forest and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Tracy's lupine *Lupinus tracyi*	–/–/–/–/4.3	CNPS	Fabaceae	perennial herb	(May) June–July	895–2,000	Upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
inundated bog club-moss *Lycopodiella inundata*	–/–/–/–/2B.2	CNPS	Lycopodiaceae	perennial rhizomatous herb	June–September	5–1,000	Coastal bogs and fens, mesic soils in lower montane coniferous forest, marshes and swamps and lake margins	Included; potential habitat within the Primary Area of Analysis

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running-pine *Lycopodium clavatum*	–/–/–/–/4.1	CNPS, CNDDB	Lycopodiaceae	perennial rhizomatous herb	June–August (September)	45–1,225	Often edges, openings, and roadsides in mesic soils in lower montane coniferous forest and North Coast coniferous forest, and marshes and swamps	Included; potential habitat within the Primary Area of Analysis
arctic starflower *Lysimachia europaea*	–/–/–/–/2B.2	CNPS, CNDDB	Myrsinaceae	perennial herb	June–July	0–15	Coastal bogs and fens and meadows and seeps	Included; potential habitat within the Primary Area of Analysis
Oregon lungwort *Mertensia bella*	–/–/–/–/2B.2	CNPS, CNDDB	Boraginaceae	perennial herb	May–July	1,500–2,000	Mesic soils in meadows and seeps and upper montane coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range
Marshall's saxifrage *Micranthes marshallii*	–/–/–/–/4.3	CNPS	Saxifragaceae	perennial rhizomatous herb	March–August	90–2,130	Riparian forest, rocky streambanks	Included; potential habitat within the Primary Area of Analysis
dwarf monolepis *Micromonolepis pusilla*	–/–/–/–/2B.3	CNPS	Chenopodiaceae	annual herb	May–August	1,500–2,400	Alkaline soils in openings in Great Basin scrub	Excluded; outside of the Primary Area of Analysis elevation range
Detling's silverpuffs *Microseris laciniata* subsp. *detlingii*	–/–/–/–/2B.2	CNPS, CNDDB	Asteraceae	perennial herb	May–June	600–1,500	Clay soils in openings in cismontane woodland	Included; documented within the Primary Area of Analysis (CDFW 2017b)

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leafy-stemmed mitrewort *Mitellastra caulescens*	–/–/–/–/4.2	CNPS, CNDDB	Saxifragaceae	perennial rhizomatous herb	(March) April–October	5–1,700	Mesic soils in broadleafed upland forest, lower montane coniferous forest, meadows and seeps, and North Coast coniferous forest Sometimes roadsides	Included; potential habitat within the Primary Area of Analysis
woodnymph *Moneses uniflora*	–/–/–/–/2B.2	CNPS, CNDDB	Ericaceae	perennial rhizomatous herb	May–August	100–1,100	Broadleafed upland forest and North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
ghost-pipe *Monotropa uniflora*	–/–/–/–/2B.2	CNPS, CNDDB	Ericaceae	perennial herb (achlorophyllous)	June–August (September)	10–550	Broadleafed upland forest and North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
Howell's montia *Montia howellii*	–/–/–/–/2B.2	CNPS, CNDDB	Montiaceae	annual herb	(February) March–May	0–835	Meadows and seeps, North Coast coniferous forest, and vernal pools Sometimes roadsides	Included; potential habitat within the Primary Area of Analysis
Wolf's evening-primrose *Oenothera wolfii*	–/–/–/BLMS/1B.1	CNPS, CNDDB	Onagraceae	perennial herb	May–October	3–800	Sandy, usually mesic soils in coastal bluff scrub, coastal dunes, coastal prairie, and lower montane coniferous forest	Included; documented within the Primary Area of Analysis (CDFW 2017b)
brittle prickly-pear *Opuntia fragilis*	–/–/–/–/2B.1	CNPS, CNDDB	Cactaceae	perennial stem succulent	April–July	820–880	Volcanic soils in pinyon and juniper woodland	Included; potential habitat within the Primary Area of Analysis

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Slender Orcutt Grass *Orcuttia tenuis*	FT/CE/–/–/1B.1	USFWS	Poaceae	annual herb	May–September (October)	35–1,760	Often gravelly vernal pools	Included; potential habitat within the Primary Area of Analysis
Shasta orthocarpus *Orthocarpus pachystachyus*	–/–/–/BLMS/1B.1	CNPS, CNDDB	Orobanchaceae	annual herb	May	840–850	Great Basin scrub, meadows and seeps, and valley and foothill grassland	Included; potential habitat within the Primary Area of Analysis
Suksdorf's wood-sorrel *Oxalis suksdorfii*	–/–/–/–/4.3	CNPS	Oxalidaceae	perennial rhizomatous herb	May–August	15–700	Broadleafed upland forest and North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
seacoast ragwort *Packera bolanderi* var. *bolanderi*	–/–/–/–/2B.2	CNPS, CNDDB	Asteraceae	perennial rhizomatous herb	(January–April) May–July (August)	30–650	Coastal scrub and North Coast coniferous forest Sometimes roadsides	Included; potential habitat within the Primary Area of Analysis
western ragwort *Packera hesperia*	–/–/FSS/–/2B.2	USFS	Asteraceae	perennial herb	April-June	500–2,500	Serpentine soils in meadows and seeps and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Siskiyou Mountains ragwort *Packera macounii*	–/–/–/–/4.3	CNPS	Asteraceae	perennial herb	June–July	400–915	Sometimes serpentine soils, often in disturbed areas in chaparral and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Howell's lousewort *Pedicularis howellii*	–/–/FSS/–/4.3	CNPS	Orobanchaceae	perennial herb	June–August	1,500–1,900	Often serpentine soils in upper montane coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range

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ash beardtongue *Penstemon cinicola*	–/–/–/–/4.3	CNPS	Plantaginaceae	perennial herb	June–August (September)	730–2,685	Volcanic, sandy or rocky soils in lower montane coniferous forest, meadows and seeps, and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
thread-leaved beardtongue *Penstemon filiformis*	–/–/–/BLMS/1B.3	CNPS, CNDDB	Plantaginaceae	perennial herb	May–August (September)	450–1,875	Rocky, often serpentine soils in cismontane woodland and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Scott Valley phacelia *Phacelia greenei*	–/–/–/BLMS/1B.2	CNPS, CNDDB	Hydrophyllaceae	annual herb	April–June	800–2,440	Serpentine soils in closed-cone coniferous forest, lower montane coniferous forest, subalpine coniferous forest, and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
naked-stemmed phacelia *Phacelia gymnoclada*	–/–/–/–/2B.3	CNPS	Hydrophyllaceae	annual herb	April–June (August)	1,220–2,500	Gravelly or clay soils in chenopod scrub, Great Basin scrub, and pinyon and juniper woodland	Excluded; outside of the Primary Area of Analysis elevation range
Siskiyou phacelia *Phacelia leonis*	–/–/–/BLMS/1B.3	CNPS, CNDDB	Hydrophyllaceae	annual herb	June–August	1,200–2,000	Often serpentine soils in meadows and seeps and openings in upper montane coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range

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Yreka phlox *Phlox hirsuta*	FE/CE/–/–/1B.2	CNPS, CNDDB, USFWS	Polemoniaceae	perennial herb	March–April	760–1,500	Serpentine soils, talus in lower montane coniferous forest and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
horned butterwort *Pinguicula macroceras*	–/–/–/–/2B.2	CNPS, CNDDB	Lentibulariaceae	perennial herb (carnivorous)	April–June	40–1,920	Serpentine soils in bogs and fens	Included; potential habitat within the Primary Area of Analysis
Whitebark Pine *Pinus albicaulis*	–/–/–/–/–	USFWS	Pinaceae	tree	N/A	2,000–3,700	Upper red-fir forest to timberline, especially subalpine forest	Excluded; outside of the Primary Area of Analysis elevation range
white-flowered rein orchid *Piperia candida*	–/–/–/BLMS/1B.2	CNPS, CNDDB	Orchidaceae	perennial herb	(March) May–September	30–1,310	Sometimes serpentine in broadleafed upland forest, lower montane coniferous forest, and North Coast coniferous forest	Included; documented within the Primary Area of Analysis (CDFW 2017b)
California pinefoot *Pityopus californicus*	–/–/–/–/4.2	CNPS	Ericaceae	perennial herb (achlorophyllous)	(March–April) May–August	15–2,225	Mesic soils in broadleafed upland forest, lower montane coniferous forest, North Coast coniferous forest, and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
nodding semaphore grass *Pleuropogon refractus*	–/–/–/–/4.2	CNPS	Poaceae	perennial rhizomatous herb	(March) April–August	0–1,600	Mesic soils in lower montane coniferous forest, meadows and seeps, North Coast coniferous forest, and riparian forest	Included; potential habitat within the Primary Area of Analysis

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Piper's blue grass *Poa piperi*	–/–/–/–/4.3	CNPS	Poaceae	perennial rhizomatous herb	April–May	100–1,460	Serpentine, rocky soils in chaparral and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Oregon polemonium *Polemonium carneum*	–/–/–/–/2B.2	CNPS, CNDDB	Polemoniaceae	perennial herb	April–September	0–1,830	Coastal prairie, coastal scrub, and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
spiny milkwort *Polygala subspinosa*	–/–/–/–/2B.2	CNPS, CNDDB	Polygalaceae	perennial herb	May–August	1,330–1,705	Gravelly, rocky soils in Great Basin scrub, and pinyon and juniper woodland	Excluded; outside of the Primary Area of Analysis elevation range
northern holly fern *Polystichum lonchitis*	–/–/–/–/3	CNPS	Dryopteridaceae	perennial rhizomatous herb	June–September	1,800–2,600	Granitic or carbonate soils in subalpine coniferous forest and upper montane coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range
fibrous pondweed *Potamogeton foliosus* subsp. *fibrillosus*	–/–/–/–/2B.3	CNPS, CNDDB	Potamogetonaceae	perennial rhizomatous herb (aquatic)	July–October	5–1,300	Shallow freshwater marshes and swamps	Included; potential habitat within the Primary Area of Analysis
Robbins' pondweed *Potamogeton robbinsii*	–/–/–/–/2B.3	CNPS, CNDDB	Potamogetonaceae	perennial rhizomatous herb (aquatic)	July–August	1,530–3,300	Marshes and swamps and edges of deep water, lakes	Excluded; outside of the Primary Area of Analysis elevation range
crested potentilla *Potentilla cristae*	–/–/–/–/1B.3	CNPS	Rosaceae	perennial herb	August–September	1,800–2,800	Seasonally mesic, often serpentine seeps, gravelly or rocky soils in alpine boulder and rock field and subalpine coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range

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Newberry's cinquefoil *Potentilla newberryi*	–/–/–/–/2B.3	CNPS, CNDDB	Rosaceae	perennial herb	May–August	1,300–2,200	Drying margins of marshes and swamps and vernal pools	Excluded; outside of the Primary Area of Analysis elevation range
Siskiyou bells *Prosartes parvifolia*	–/–/FSS/–/1B.2	CNPS, CNDDB	Liliaceae	perennial bulbiferous herb	May–September	700–1,525	Often roadsides, disturbed areas, and burned areas in lower montane coniferous forest and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Del Norte pyrrocoma *Pyrrocoma racemosa* var. *congesta*	–/–/–/–/2B.3	CNPS, CNDDB	Asteraceae	perennial herb	August–September	200–1,000	Serpentine soils in chaparral and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
western black currant *Ribes hudsonianum* var. *petiolare*	–/–/–/–/2B.3	CNPS, CNDDB	Grossulariaceae	perennial deciduous shrub	May–July	1,500–2,230	Riparian scrub	Excluded; outside of the Primary Area of Analysis elevation range
trailing black currant *Ribes laxiflorum*	–/–/–/–/4.3	CNPS	Grossulariaceae	perennial deciduous shrub	March–July (August)	5–1,395	North Coast coniferous forest, sometimes roadsides	Included; potential habitat within the Primary Area of Analysis
Tracy's romanzoffia *Romanzoffia tracyi*	–/–/–/–/2B.3	CNPS, CNDDB	Hydrophyllaceae	perennial herb	March–May	15–30	Rocky soils in coastal bluff scrub and coastal scrub	Included; potential habitat within the Primary Area of Analysis
Columbia yellow cress *Rorippa columbiae*	–/–/–/BLMS/1B.2	CNPS, CNDDB, PacifiCorp	Brassicaceae	perennial rhizomatous herb	May–September	1,200–1,800	Mesic soils in lower montane coniferous forest, meadows and seeps, playas, and vernal pools	Excluded; outside of the Primary Area of Analysis elevation range

Common Name ***Scientific Name***	**Status[1] Federal/ State/USFS/ BLM/CRPR**	**Query Source**	**Family**	**Life-form**	**Blooming Period[2,3]**	**Elevation Range[2] (m)**	**Habitat Associations[2]**	**Included in or Excluded from the EIR, and Rationale**
Gasquet rose *Rosa gymnocarpa* var. *serpentina*	–/–/–/–/1B.3	CNPS, CNDDB	Rosaceae	perennial rhizomatous shrub	April–June (August)	400–1,725	Serpentine soils, often roadsides, sometimes ridges, streambanks, and openings in chaparral and cismontane woodland	Included; potential habitat within the Primary Area of Analysis
snow dwarf bramble *Rubus nivalis*	–/–/–/–/2B.3	CNPS, CNDDB	Rosaceae	perennial evergreen vine	June–August	1,085–1,350	North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
Howell's sandwort *Sabulina howellii*	–/–/–/BLMS/1B.3	CNPS, CNDDB	Caryophyllaceae	perennial herb	April–July	550–1,000	Serpentine and xeric soisl in chaparral and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
fleshy sage *Salvia dorrii* var. *incana*	–/–/–/–/3	CNPS, PacifiCorp	Lamiaceae	perennial evergreen shrub	May–July	300–1,295	Great Basin scrub and pinyon and juniper woodland	Included; documented during PacifiCorp surveys at Iron Gate Reservoir and along Klamath River from Iron Gate Dam to Shasta River (PacifiCorp 2004a)

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great burnet *Sanguisorba officinalis*	–/–/–/–/2B.2	CNPS, CNDDB	Rosaceae	perennial rhizomatous herb	July–October	60–1,400	Often serpentine soils in bogs and fens, broadleafed upland forest, meadows and seeps, marshes and swamps, North Coast coniferous forest, and riparian forest	Included; potential habitat within the Primary Area of Analysis
Peck's sanicle *Sanicula peckiana*	–/–/–/–/4.3	CNPS	Apiaceae	perennial herb	(March) May, June	150–800	Often serpentine soils in chaparral and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Tracy's sanicle *Sanicula tracyi*	–/–/FSS/–/4.2	CNPS, CNDDB	Apiaceae	perennial herb	April–July	100–1,585	Openings in cismontane woodland, lower montane coniferous forest, and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Bailey's greasewood *Sarcobatus baileyi*	–/–/–/–/2B.3	CNPS	Sarcobataceae	perennial deciduous shrub	April–July	1,500–1,600	Alkaline soils in dry lakes, washes, roadsides, and chenopod scrub	Excluded; outside of the Primary Area of Analysis elevation range
American saw-wort *Saussurea americana*	–/–/–/–/2B.2	CNPS, CNDDB	Asteraceae	perennial herb	July–August	1,735–1,950	Mesic soils in lower montane coniferous forest and meadows and seeps	Excluded; outside of the Primary Area of Analysis elevation range
water bulrush *Schoenoplectus subterminalis*	–/–/–/–/2B.3	CNPS, CNDDB	Cyperaceae	perennial rhizomatous herb (aquatic)	June–August (September)	750–2,250	Bogs and fens, marshes and swamps and montane lake margins	Included; potential habitat within the Primary Area of Analysis

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pendulous bulrush *Scirpus pendulus*	–/–/–/–/2B.2	CNPS, CNDDB, PacifiCorp	Cyperaceae	perennial rhizomatous herb	June– August	800–1,000	Mesic meadows and seeps, and assorted freshwater marshes and swamps	Included; potential habitat within the Primary Area of Analysis
Blue Creek stonecrop *Sedum citrinum*	–/–/–/–/1B.2	CNPS, CNDDB	Crassulaceae	perennial herb	June	1,050–1,280	Serpentine and rocky soils in North Coast coniferous forest, talus, scree, or boulder crevices; sometimes roadsides	Included; potential habitat within the Primary Area of Analysis
Cascade stonecrop *Sedum divergens*	–/–/–/–/2B.3	CNPS, CNDDB	Crassulaceae	perennial herb	July–September	1,600–2,330	Alpine boulder and rock field	Excluded; outside of the Primary Area of Analysis elevation range
pale yellow stonecrop *Sedum laxum* subsp. *flavidum*	–/–/–/–/4.3	CNPS, CNDDB	Crassulaceae	perennial herb	May–July	455–2,000	Serpentine or volcanic soils in broadleafed upland forest, chaparral, cismontane woodland, lower montane coniferous forest, and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Heckner's stonecrop *Sedum laxum* subsp. *heckneri*	–/–/–/–/4.3	CNPS	Crassulaceae	perennial herb	June–July	100–2,100	Serpentine or gabbroic soils in lower montane coniferous forest and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Applegate stonecrop *Sedum oblanceolatum*	–/–/–/–/1B.1	CNPS, CNDDB	Crassulaceae	perennial herb	June–July	400–2,000	Rocky soils and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis

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Canyon Creek stonecrop *Sedum obtusatum spp. paradisum*	–/–/FSS/–/1B.3	USFS	Crassulaceae	perennial herb	May-June	300–1,900	Granitic, rocky soils in broadleafed upland forest, chaparral, lower montane coniferous forest, and subalpine coniferous forest	Included; potential habitat within the Primary Area of Analysis
Rocky Mountain spike-moss *Selaginella scopulorum*	–/–/–/–/3	CNPS	Selaginellaceae	perennial rhizomatous herb	August	1,500–2,200	Decomposed granitic, rocky soils in North Coast coniferous forest, subalpine coniferous forest, and upper montane coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range
Redding checkerbloom *Sidalcea celata*	–/–/–/–/3	CNPS	Malvaceae	perennial herb	April–August	135–1,525	Sometimes serpentine soils in cismontane woodland	Included; potential habitat within the Primary Area of Analysis
Del Norte checkerbloom *Sidalcea elegans*	–/–/–/–/3.3	CNPS	Malvaceae	perennial rhizomatous herb	May–July	215–1,365	Serpentine soils in chaparral and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
maple-leaved checkerbloom *Sidalcea malachroides*	–/–/–/–/4.2	CNPS, CNDDB	Malvaceae	perennial herb	(March) April–August	0–730	Often in disturbed areas in broadleafed upland forest, coastal prairie, coastal scrub, North Coast coniferous forest, and riparian woodland	Included; potential habitat within the Primary Area of Analysis
Siskiyou checkerbloom *Sidalcea malviflora* subsp. *patula*	–/–/–/BLMS/1B.2	CNPS, CNDDB	Malvaceae	perennial rhizomatous herb	May–August	15–880	Often roadcuts in coastal bluff scrub, coastal prairie, and North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis

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coast checkerbloom *Sidalcea oregana* subsp. *eximia*	–/–/–/BLMS/1B.2	CNPS, CNDDB	Malvaceae	perennial herb	June–August	5–1,340	Lower montane coniferous forest, meadows and seeps, and North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
Marble Mountain campion *Silene marmorensis*	–/–/–/–/1B.2	CNPS, CNDDB	Caryophyllaceae	perennial herb	June–August	170–1,250	Broadleafed upland forest, chaparral, cismontane woodland, and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
serpentine catchfly *Silene serpentinicola*	–/–/FSS/–/1B.2	CNPS, CNDDB	Caryophyllaceae	perennial rhizomatous herb	May–July	145–1,650	Serpentine openings, gravelly or rocky soils in chaparral and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
English Peak greenbrier *Smilax jamesii*	–/–/–/BLMS/4.2	CNPS, CNDDB	Smilacaceae	perennial rhizomatous herb	May–July (August–October)	505–1,975	Streambanks and lake margins, mesic depressions, broadleafed upland forest, lower montane coniferous forest, marshes and swamps, North Coast coniferous forest, and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
currant-leaved desert mallow *Sphaeralcea grossulariifolia*	–/–/–/–/2B.3	CNPS, CNDDB	Malvaceae	perennial herb	May–October	1,200–2,100	Volcanic soils in chenopod scrub and Great Basin scrub	Excluded; outside of the Primary Area of Analysis elevation range

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hairy marsh hedge-nettle *Stachys pilosa*	–/–/–/–/2B.3	CNPS, CNDDB	Lamiaceae	perennial rhizomatous herb	June–August	1,200–1,770	Mesic Great Basin scrub, meadows and seeps	Excluded; outside of the Primary Area of Analysis elevation range
green-flowered prince's plume *Stanleya viridiflora*	–/–/–/–/2B.3	CNPS, CNDDB	Brassicaceae	perennial herb	May–August	1,300–1,600	White ash deposits in Great Basin scrub	Excluded; outside of the Primary Area of Analysis elevation range
Howell's jewelflower *Strepthanthus howellii*	–/–/FSS/–/1B.2	USFS	Brassicaceae	perennial herb	July-August	305–1,500	Serpentine, rocky soils in lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Trinity River jewelflower *Strepthanthus oblanceolatus*	–/–/FSS/–/1B.2	USFS	Brassicaceae	perennial herb	April-June	20–420	Cismontane woodland	Included; potential habitat within the Primary Area of Analysis
glaucous tauschia *Tauschia glauca*	–/–/–/–/4.3	CNPS	Apiaceae	perennial herb	April–June	80–1,700	Gravelly, serpentine soils in lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Howell's tauschia *Tauschia howellii*	–/–/FSS/–/1B.3	CNPS, CNDDB	Apiaceae	perennial herb	June–August	1,705–2,500	Granitic, gravelly soils in subalpine coniferous forest and upper montane coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range
slender false lupine *Thermopsis gracilis*	–/–/–/–/4.3	CNPS	Fabaceae	perennial rhizomatous herb	March–July	100–1,720	Chaparral, cismontane woodland, lower montane coniferous forest, meadows and seeps, and North Coast coniferous forest Sometimes roadsides	Included; potential habitat within the Primary Area of Analysis

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robust false lupine *Thermopsis robusta*	–/–/FSS/–/1B.2	CNPS, CNDDB	Fabaceae	perennial rhizomatous herb	May–July	150–1,500	Broadleafed upland forest and North Coast coniferous forest	Included; documented within the Primary Area of Analysis (CDFW 2017b)
trifoliate laceflower *Tiarella trifoliata* var. *trifoliata*	–/–/–/–/3.2	CNPS	Saxifragaceae	perennial rhizomatous herb	(May) June–August	170–1,500	Edges, moist shady streambanks in lower montane coniferous forest and North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
beaked tracyina *Tracyina rostrata*	–/–/FSS/–/1B.2	USFS	Asteraceae	annual herb	May-June	90–750	Chaparral, cismontane woodland, and valley and foothill grassland	Included; potential habitat within the Primary Area of Analysis
Siskiyou clover *Trifolium siskiyouense*	–/–/–/–/1B.1	CNPS, CNDDB	Fabaceae	perennial herb	June–July	880–1,500	Mesic meadows and seeps, sometimes streambanks	Included; potential habitat within the Primary Area of Analysis
Salmon Mountains wakerobin *Trillium ovatum* subsp. *oettingeri*	–/–/–/–/4.2	CNPS	Melanthiaceae	perennial herb	February–July	855–2,024	Mesic soils in lower montane coniferous forest, riparian scrub, and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Kellogg's sand-verbena *Tripterocalyx crux-maltae*	–/–/–/–/2B.2	CNPS	Nyctaginaceae	perennial herb	May–July	1,200–1,500	Partially or fully stabilized sand dunes in Great Basin scrub	Excluded; outside of the Primary Area of Analysis elevation range

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yellow triteleia *Triteleia crocea* var. *crocea*	–/–/–/–/4.3	CNPS	Themidaceae	perennial bulbiferous herb	May–June	1,200–2,000	Granitic or serpentine soils in lower montane coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range
large-flowered triteleia *Triteleia grandiflora*	–/–/–/–/2B.1	CNPS, CNDDB	Themidaceae	perennial bulbiferous herb	April–June	700–1,500	Great Basin scrub and Pinyon and juniper woodland	Included; potential habitat within the Primary Area of Analysis
Henderson's triteleia *Triteleia hendersonii*	–/–/–/–/2B.2	CNPS, CNDDB	Themidaceae	perennial bulbiferous herb	May–July	760–1,200	Cismontane woodland	Included; potential habitat within the Primary Area of Analysis
Siskiyou Mountains huckleberry *Vaccinium coccineum*	–/–/–/–/3.3	CNPS	Ericaceae	perennial deciduous shrub	June–August	1,095–2,135	Often serpentine soils in lower montane coniferous forest and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
little-leaved huckleberry *Vaccinium scoparium*	–/–/–/–/2B.2	CNPS, CNDDB	Ericaceae	perennial deciduous shrub	June–August	1,036–2,200	Rocky soils in subalpine coniferous forest	Included; potential habitat within the Primary Area of Analysis
Siskiyou false-hellebore *Veratrum insolitum*	–/–/–/–/4.3	CNPS	Melanthiaceae	perennial herb	June–August	45–1,635	Clay soils in chaparral and lower montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
Copeland's speedwell *Veronica copelandii*	–/–/–/–/4.3	CNPS	Plantaginaceae	perennial herb	August	2,225–2,590	Serpentine soils in meadows and seeps and subalpine coniferous forest	Excluded; outside of the Primary Area of Analysis elevation range

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Howell's violet *Viola howellii*	–/–/–/–/2B.2	CNPS, CNDDB	Violaceae	perennial herb	May–June	655	North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
western white bog violet *Viola lanceolata ssp. occidentalis*	–/–/FSS/–/1B.2	USFS	Violaceae	perennial rhizomatous herb	April-September	100–990	Serpentine soils in bogs and fens, marshes and swamps	Included; potential habitat within the Primary Area of Analysis
alpine marsh violet *Viola palustris*	–/–/–/–/2B.2	CNPS, CNDDB	Violaceae	perennial rhizomatous herb	March–August	0–150	Coastal bogs and fens and mesic coastal scrub	Included; potential habitat within the Primary Area of Analysis
western white bog violet *V iola primulifolia* subsp. *occidentalis*	–/–/–/–/1B.2	CNPS	Violaceae	perennial rhizomatous herb	April–September	100–990	Serpentine bogs and fens and marshes and swamps	Included; potential habitat within the Primary Area of Analysis
Bryophytes								
slender silver moss *Anomobryum julaceum*	–/–/–/–/4.2	CNPS, CNDDB	Bryaceae	moss	N/A	100–1,000	Damp rock and soil on outcrops, usually on roadcuts in broadleafed upland forest, lower montane coniferous forest, and North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis

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buxbaumia moss *Buxbaumia viridis*	–/– /FSS/BLMS/2B.2	CNPS, CNDDB	Buxbaumiaceae	moss	N/A	975–2,200	Fallen, decorticated wood or humus in lower montane coniferous forest, subalpine coniferous forest, and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
naked flag moss *Discelium nudum*	–/–/–/–/2B.2	CNPS, CNDDB	Disceliaceae	ephemeral moss	N/A	10–50	Clay banks in coastal bluff scrub	Included; documented within the Primary Area of Analysis (CDFW 2017b)
minute pocket moss *Fissidens pauperculus*	–/–/FSS/–/1B.2	CNPS, CNDDB	Fissidentaceae	moss	N/A	10–1,024	Damp soil in coastal North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
Blandow's bog moss *Helodium blandowii*	–/–/–/–/2B.3	CNPS, CNDDB	Helodiaceae	moss	N/A	1,862–2,700	Damp soil in meadows and seeps and subalpine coniferous forest	Excluded; outside of Primary Area of Analysis elevation range
three-ranked hump moss *Meesia triquetra*	–/–/–/–/4.2	CNPS, CNDDB	Meesiaceae	moss	July	1,300–2,953	Soil in bogs and fens, meadows and seeps, subalpine coniferous forest, and mesic upper montane coniferous forest	Excluded; outside of Primary Area of Analysis elevation range

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broad-nerved hump moss *Meesia uliginosa*	–/–/–/–/2B.2	CNPS, CNDDB	Meesiaceae	moss	July, October	1,210–2,804	Damp soils in bogs and fens, meadows and seeps, subalpine coniferous forest, and upper montane coniferous forest	Excluded; outside of Primary Area of Analysis elevation range
elongate copper moss *Mielichhoferia elongata*	–/–/FSS/–/4.3	CNPS, CNDDB	Mielichhoferiaceae	moss	N/A	0–1,960	Metamorphic rock, usually acidic, usually vernally mesic, and sometimes carbonate soils in broadleafed upland forest, chaparral, cismontane woodland, coastal scrub, lower montane coniferous forest, meadows and seeps, and subalpine coniferous forest	Included; potential habitat within the Primary Area of Analysis
Holzinger's orthotrichum moss *Orthotrichum holzingeri*	–/–/–/–/1B.3	CNPS, CNDDB	Orthotrichaceae	moss	N/A	715–1,800	Usually on rock in and along streams, and rarely on tree limbs in cismontane woodland, lower montane coniferous forest, pinyon and juniper woodland, and upper montane coniferous forest	Included; documented within the Primary Area of Analysis (CDFW 2017b)

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Pacific fuzz wort *Ptilidium californicum*	–/–/–/BLMS/4.3	CNPS, CNDDB	Ptilidiaceae	liverwort	May–August	1,140–1,800	Usually epiphytic on trees, fallen and decaying logs, and stumps and rarely on humus over boulders in lower montane coniferous forest and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
cylindrical trichodon *Trichodon cylindricus*	–/–/–/–/2B.2	CNPS, CNDDB	Ditrichaceae	moss	N/A	50–2,002	Sandy, exposed soil, roadbanks in broadleafed upland forest, meadows and seeps, and upper montane coniferous forest	Included; potential habitat within the Primary Area of Analysis
coastal triquetrella *Triquetrella californica*	–/–/–/–/1B.2	CNPS, CNDDB	Pottiaceae	moss	N/A	10–100	On soils in coastal bluff scrub and coastal scrub	Included; documented within the Primary Area of Analysis (CDFW 2017b)
Lichen								
false gray horsehair lichen *Bryoria pseudocapillaris*	–/–/–/–/3.2	CNPS	Parmeliaceae	fruticose lichen (epiphytic)	N/A	0–90	Usually on conifers in North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
spiral-spored guilded-head pin lichen *Calicium adspersum*	–/–/FSS/–/2B.2	CNPS, CNDDB	Caliciaceae	crustose lichen (epiphytic)	N/A	200	Often restricted to bark of conifers that are over 200 years old in lower montane coniferous forest and North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis

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western waterfan lichen *Peltigera gowardii*	–/–/FSS/–/4.2	USFS	Peltigeraceae	foliose lichen (aquatic)	N/A	1,065–2,620	On rocks in cold water creeks with little or no sediment or disturbance in riparian forest	Included; potential habitat within the Primary Area of Analysis
angel's hair lichen *Ramalina thrausta*	–/–/FSS/–/2B.1	USFS	Ramalinaceae	fruticose lichen (epiphytic)	N/A	75–430	On dead twigs and other lichens in North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis
groovy beard lichen *Sulcaria badia*	–/–/FSS/–/–	USFS	Alectoriaceae	fruticose lichen (epiphytic)	N/A	0–670	Mesic mixed hardwood/mid-mature Pseudotsuga menziesii forest, with additional hardwoods (Quercus kelloggii) occasional in the vicinity.[8]	Included; potential habitat within the Primary Area of Analysis
Methuselah's beard lichen *Usnea longissima*	–/–/–/BLMS/4.2	CNPS, CNDDB	Parmeliaceae	fruticose lichen (epiphytic)	N/A	50–1,460	On tree branches, usually on old-growth hardwoods and conifers in broadleafed upland forest and North Coast coniferous forest	Included; potential habitat within the Primary Area of Analysis

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Fungi[8]								
Cudonia monticola	–/–/FSS/–/–	USFS	Cudoniaceae	fungi	fruits primarily in spring	160–1,827	Common under conifers in mature moist coniferous forests in northern CA and the Pacific Northwest. Typically associated with very rotten wood.	Included; potential habitat within the Primary Area of Analysis
branched Collybia *Dendrocollybia racemosa*	–/–/FSS/–/–	USFS	Tricholomataceae	fungi	fruits in autumn	Unknown	Grows on the remains of decayed mushrooms, or in duff of mixed hardwood-conifer woods in Pacific Northwest	Included; potential habitat within the Primary Area of Analysis
Otidea smithii	–/–/FSS/–/–	USFS	Pyronemataceae	fungi	fruits August-December	381–1,144	Usually under conifer forests in Pacific Northwest and Norther California	Included; potential habitat within the Primary Area of Analysis
Olive Phaeocollybia *Phaeocollybia olivacea*	–/–/FSS/–/–	USFS	Cortinariaceae	fungi	fruits September-December	6–962	Grows on ground in mixed woods and under conifers in southern Oregon and northern California	Included; potential habitat within the Primary Area of Analysis
red-pored Bolete *Rubroboletus pulcherrimus [Boletus pulcherrimus]*	–/–/FSS/–/–	USFS	Boletaceae	fungi	fruits July-December	13–1,713	In mixed hardwood-conifer forests. Often found growing under conifers	Included; potential habitat within the Primary Area of Analysis

Common Name ***Scientific Name***	**Status[1] Federal/ State/USFS/ BLM/CRPR**	**Query Source**	**Family**	**Life-form**	**Blooming Period[2,3]**	**Elevation Range[2] (m)**	**Habitat Associations[2]**	**Included in or Excluded from the EIR, and Rationale**
Tricholomopsis fulvescens	–/–/FSS/–/–	USFS	Tricholomataceae	fungi	Unknown	1,000–unknown	Grows on rotting conifer logs in the Pacific Northwest and northern California	Included; potential habitat within the Primary Area of Analysis

N/A = Not applicable

[1] Status:

Federal
- FE Federally Endangered
- FT Federally Threatened
- – No federal status

USDA Forest Service
- FSS USDA Forest Service Sensitive
- – No USFS status

BLM
- BLMS BLM Sensitive
- – No BLM status

State
- CE California State Endangered
- CR California State Rare
- OE Oregon State Endangered
- – No state status

California Rare Plant Rank (formerly known as CNPS Lists)
- List 1B Plants rare, threatened, or endangered in California and elsewhere
- List 2B Plants rare, threatened, or endangered in California, but more common elsewhere
- List 3 More information needed about this plant, a review list
- List 4 Plants of limited distribution, a watch list
- – No CRPR status

CNPS Threat Ranks:
- 0.1 Seriously threatened in California (high degree/immediacy of threat)
- 0.2 Fairly threatened in California (moderate degree/immediacy of threat)
- 0.3 Not very threatened in California (low degree/immediacy of threats or no current threats known)

[2] CDFW. 2017a. Natural Diversity Database. April 2017. Special vascular plants, bryophytes, and lichens list. Quarterly publication. CNPS. 2017. Inventory of rare and endangered plants (online edition, v8-03 0.39). California Native Plant Society, Sacramento, California. http://www.rareplants.cnps.org/ [Accessed May 2017]. Baldwin, B. G., D. H. Goldman, D. J. Keil, R. Patterson, T. J. Rosatti, and D. H. Wilken, editors. 2012. The Jepson manual: vascular plants of California, second edition. University of California Press, Berkeley. Unless otherwise cited.

[3] Species may bloom in months listed in parentheses but there are outside of the most common blooming range

[4] Details regarding what special-status plants are documented and may have potential habitat in the Secondary Area of Analysis are not included since this area was analyzed at a programmatic level.

[5] CDFW. 2017b. California Natural Diversity Database. RareFind5. Electronic database. Natural Heritage Division, California Department of Fish and Game, Sacramento, California. https://map.dfg.ca.gov/rarefind/view/RareFind.aspx [Accessed May 2017].

[6] Oregon Department of Agriculture. 2017. Applegate's milkvetch *(Astragalus applegatei*). Prepared by Oregon Department of Agriculture, Salem.

[7] PacifiCorp. 2004a. Terrestrial resources. Klamath Hydroelectric Project (FERC Project No. 2082). Final Technical Report. Prepared by PacifiCorp, Portland, Oregon.

[8] USDA Forest Service. 2012. Region 5 U.S. Forest Service sensitive vascular plant, bryophyte & lichen species. Evaluation & Documentation Form for *Sulcaria badia*.

[8] Information sources include Arora, D. 1986. Mushrooms demystified a comprehensive guide to the fleshy fungi. Second edition. Ten Speed Press, Berkeley, California; and USDA Forest Service and BLM (Bureau of Land Management). 2017. Interagency Special Status/Sensitive Species Program (ISSSSP). Website. https://www.fs.fed.us/r6/sfpnw/issssp/species-index/flora-fungi.shtml [Accessed September 20, 2017].

Table J-3. Special-status Terrestrial Wildlife Documented in the Project Vicinity.

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
Invertebrates					
Hooded lancetooth *Ancotrema voyanum*	--/--/BLMS	CNDDB	Occurs mostly in the Shasta-Trinity National forests in the northern half of Trinity County	Limestone substrates, mostly in an elevation range of 550–3,100 feet	Included for further analysis as documented in Primary Area of Analysis [b] as the species was documented in 1992 approximately 4 miles southwest of Orleans and approximately 0.2 miles from the Klamath River (greater than 100 river miles (RM) downstream of Iron Gate Dam) (CDFW 2017[c]).
Oregon shoulderband *Helminthoglypta hertleini*	--/--/BLMS	CNDDB	Siskiyou, Shasta, and Tehama counties	Found on basaltic talus slopes where ground cover/moisture is present; adapted to dry conditions during a portion of the year	Included for further analysis as a single occurrence has been documented within the Primary Area of Analysis approximately 100 RM downstream of Iron Gate Dam (no documentation date) (CDFW 2017[c]).
Trinity shoulderband *Helminthoglypta talmadgei*	--/--/BLMS	CNDDB	Streams in the Klamath mountains	Limestone rockslides, litter in coniferous forests, old mine tailings, and along shaded streams	Included for further analysis as a single occurrence within the Primary Area of Analysis was documented at mine tailings in 1954 more than 100 RM downstream of Iron Gate Dam (CDFW 2017[c]).
Siskiyou shoulderband *Monadenia chaceana*	--/--/BLMS	CNDDB	Siskiyou County	Lower reaches of major drainages. Talus and rock slides, under rocks and woody debris in moist conifer forests, caves, and riparian corridors in shrubby areas	Included for further analysis as a single occurrence has been documented within the Primary Area of Analysis approximately 0.25 RM downstream of Copco No. 2 Dam in a lava rockslide (no documentation date) (CDFW 2017[c]).

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
Tehama chaparral *Trilobopsis tehamana*	--/--/FSS, BLMS	USDA-FS, CNDDB	Butte, Tehama, and Siskiyou counties.	Rocky talus and under leaf litter or woody debris within 330 feet of limestone outcrops	Included for further analysis as documented in the Primary Area of Analysis in 1990 and 1994—one sighting near the Klamath River and another along the hill slope, both more 20 RM downstream of Iron Gate Dam (CDFW 2017[c]).
Western bumblebee *Bombus occidentalis*	–/–/FSS	USDA-FS, CNDDB	Limited information about current distribution; historically throughout central and northern California.	Shrub, chaparral, and open grassy areas (urban parks, mountain meadows)	Included for further analysis as species was documented in Primary Area of Analysis; however, all six sightings are from 1969 and earlier more than 70 RM downstream of Iron Gate Dam (CDFW 2017[c]).
Franklin's bumblebee Bombus franklini	Petition to list/–/–	Under review as noted by USFWS (https://ecos.fws.gov)	In northern California the range is known or believed to occur in Del Norte, Trinity, and Humboldt counties, and portions of Siskiyou county	Pollen and nectar sources from wild flowers	Excluded from further analysis. The species range includes the Lower Klamath river and estuary and a portion of the Middle Klamath River approximately 80 RM downstream of Iron Gate Dam, and no suitable habitat would be affected.
Oregon silverspot butterfly *Speyeria zerene hippolyta*	FT/–/– No critical habitat designated within the Primary Area of Analysis	USFWS	Limited sites	Young dependent on the early blue violet (*Viola adunca*), which grows best in undisturbed coastal prairies and montane grasslands	Excluded from further analysis as there are no documented occurrences by CNDDB in the Primary Area of Analysis, no critical habitat designated within the Primary Area of Analysis and not within the known range of the species.
Mardon skipper *Polites mardon*	–/–/FSS	USDA-FS	Del Norte County	Grassy openings in subalpine coniferous forests where the caterpillars feed primarily on fescue grasses	Excluded from further analysis as the known range does not occur within the Primary Area of Analysis

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
Amphibians					
Southern torrent (=southern seep) salamander *Rhyacotriton variegatus*	–/SSC/FSS	USDA-FS, CNDDB	Coastal drainages from near Point Arena in Mendocino County to the Oregon border	In and adjacent to cold, permanent, well shaded mountain springs, waterfalls, and seeps with rock substrate	Included for further analysis as the species has been documented in Primary Area of Analysis. Although not observed in California during PacifiCorp amphibian surveys (PacifiCorp 2004a[c]), approximately 10 sightings have been recorded, 50 RM or more downstream from Iron Gate Dam typically along tributaries or at the confluence to the Klamath River. The most recent sighting was from 2007.
Southern long-toed salamander *Ambystoma macrodactylum sigillatum*	–/SSC/–	CNDDB	Northeast California and along the northern Sierra Nevada south to Garner Meadows and Spicer Reservoir, and in Trinity and Siskiyou Counties near the Trinity Alps	Alpine meadows and high mountain ponds and lakes	Excluded from further analysis as there are no CNDDB occurrences within the Primary Area of Analysis and only one occurrence within the Project Vicinity (CDFW 2017[c]). The species was not documented in California during PacifiCorp amphibian surveys (PacifiCorp 2004a[d], 2004b[e]).
Scott Bar salamander *Plethodon asupak*	--/ST/--	CNDDB	Found in a very small area of the Siskiyou Mountains near the confluence of the Klamath and Scott Rivers	Rocky forested areas, especially thick moss-covered talus; elevation range approximately 1,500–2,000 feet	Included for further analysis as documented in Primary Area of Analysis Although not documented in California during PacifiCorp amphibian surveys (PacifiCorp 2004a[d], 2004b[e], between 1996 and 2005, the species was documented at four locations approximately 30 RM downstream of Iron Gate Dam (CDFW 2017[c]).

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
Siskiyou Mountains salamander *Plethodon stormi*	--/ST/FSS	USDA-FS, CNDDB	Found within a small location of the Siskiyou Mountains, in northern Siskiyou county	Loose rock talus on north-facing slopes or in dense wooded areas; also under bark near talus	Included for further analysis as documented in Primary Area of Analysis Although not documented in California during PacifiCorp amphibian surveys (PacifiCorp 2004a[d]), the species was documented between 1972 and 2003 at five locations approximately 30 RM downstream of Iron Gate Dam (CDFW 2017[c]).
Pacific tailed frog *Ascaphus truei*	–/SSC/–	CNDDB	Coastal Mendocino County north to the Oregon border, with an isolated population in Shasta region	In and adjacent to cold, clear, moderate- to fast-flowing, perennial mountain streams in conifer forest	Included for further analysis as documented in the Primary Area of Analysis Although not documented in California during PacifiCorp amphibian surveys (PacifiCorp 2004a[d]), the species was observed in 1989 at the confluence of a tributary to the Klamath River approximately 60 RM downstream from Iron Gate Dam. Farther downstream, five additional occurrences are documented along tributaries to the Klamath River or at the confluence (CDFW 2017[c]).

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
Foothill yellow-legged frog *Rana boylii*	Petition to list/ SCT, SSC/FSS, BLMS	USDA-FS, CNDDB	From the Oregon border along the coast to the Transverse Ranges, and south along the western side of the Sierra Nevada Mountains to Kern County; a possible isolated population in Baja California	Shallow tributaries and mainstems of perennial streams and rivers, typically associated with cobble or boulder substrate	Included for further analysis as the species was documented in the Primary Area of Analysis. Although not documented in during PacifiCorp amphibian surveys (PacifiCorp 2004a[d], 2004b[e]), a few sightings have been recorded—in 2017 on the Lower Klamath River, approximately 13 RM upstream of the estuary (M. Wikaira Yurok Tribe to Parker Thaler, pers. comm., January 2018), approximately 20 RM upstream of the estuary by landowner Green Diamond in 1994 (CDFW 2017[c]), and approximately 50 RM downstream from Iron Gate Dam in 1970 and farther downstream in 1976 (CDFW 2017[c]).
Cascades frog *Rana cascadae*	–/SCE, SSC/FSS	USDA-FS, CNDDB	Range extends as isolated, noncontiguous patches along the Cascade mountain corridor to the Sierra Nevada Mountains in California.	Wet meadows, bogs, moist forests, pond and stream edges; breeds in bogs or ponds with cold alpine springs or snow melt and lays eggs in water depths < 20 cm	Excluded from further analysis as the species range is within isolated patches sub-alpine meadows, which are not present within the Primary Area of Analysis, no individuals were documented in California during PacifiCorp amphibian surveys (PacifiCorp 2004a[d]), and no CNDDB occurrences are within the Area of Analysis; only one occurrence within the Project Vicinity (CDFW 2017[c]).

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
Northern red-legged frog *Rana aurora*	–/SSC/FSS	USDA-FS, CNDDB	Ranges from Mill Creek in Mendocino County to Oregon border	Breeds in still or slow-moving water with emergent and overhanging vegetation, including wetlands, wet meadows, ponds, lakes, and low-gradient, slow-moving stream reaches with permanent pools; uses adjacent uplands for dispersal and summer retreat	Included for further analysis as although the species was not documented in California during PacifiCorp amphibian surveys (PacifiCorp 2004a[d]), a 1995 sighting was documented in the Primary Area of Analysis approximately 20 RM upstream of the Klamath estuary along Klamath River in mats of vegetation (CDFW 2017[c]).
Oregon spotted frog *Rana pretiosa*	FT/SSC/BLMS No critical habitat designated within the Primary Area of Analysis	USFWS	Found in the extreme northeastern area of California, and known in only few localities including Pine Creek, South Fork Pitt River near Alturas, Warner Mountains, and the southwest side of Lower Klamath Lake	Slow-moving and still water in wetlands, ponds, and lake/river edges	Excluded from further analysis as no critical habitat is designated within the Primary Area of Analysis, the species was not documented in California during PacifiCorp amphibian surveys (PacifiCorp 2004a[d]), no critical habitat is designated within the Primary Area of Analysis, and there are no record in CNDDB within the Area of Analysis (CDFW 2017[c]).

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
Reptiles					
Western pond turtle *Actinemys marmorata*	Petition to list/SSC/FSS, BLMS	USDA-FS, CNDDB, PacifiCorp	From the Oregon border along the coast ranges to the Mexican border, and west of the crest of the Cascades and Sierras	Permanent, slow-moving fresh or brackish water with available basking sites and adjacent open habitats or forest for nesting	Included for further analysis as the species was documented during PacifiCorp surveys in the Primary Area of Analysis at Copco No. 1 and Iron Gate Reservoirs, along J.C. Boyle peaking reach in California, and along Klamath River from Iron Gate Dam to Shasta River (PacifiCorp 2004a[d]). Approximately 10 RM downstream of Iron Gate Dam, an individual was observed basking approximately 0.5 miles upstream of Williams Creek in November 2005 (CDFW 2017[c]). (CDFW 2017[c]). KRRC Pre-Proposed Project surveys documented pond turtles on the northern and southern shoreline of the northeastern extent of Iron Gate Reservoir, Jenny Creek, and western and southern shores and western cove of Copco No. 1 Reservoir (CDM Smith 2018[f]).

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
Northern sagebrush lizard *Sceloporus graciosus graciosus*	–/–/BLMS	PacifiCorp	Sierra Nevada and the northeast corner of the state	Inhabits sagebrush, chaparral, juniper woodlands, and dry conifer forests	Included for further analysis as the species was documented in the Primary Area of Analysis during PacifiCorp surveys near the edge of a forested wetland along Iron Gate Reservoir (PacifiCorp 2004a[d]). KRRC Pre-Proposed Project surveys documented in several areas surrounding Copco No. 1 Reservoir and Iron Gate Reservoir, including Bogus Creek fish hatchery and recreational areas (CDM Smith 2018[f]).
Birds					
American white pelican *Pelecanus erythrorhynchos*	–/SSC/–	PacifiCorp	Throughout California, from wintering in the Central Valley to breeding within a restricted range along the California/Oregon border	Nests at lakes and marshes and uses almost any lake outside of the breeding season	Included for further analysis as the species was documented in the Primary Area of Analysis at the Copco Dam and Iron Gate Dam areas in 2017 (AECOM 2017[g]), PacifiCorp surveys (PacifiCorp 2004a[d]), and Ebird (2018[g]). Numerous observations east of the Proposed Project near the Lower Klamath National Wildlife Refuge and Tule Lake National Wildlife Refuge (eBird 2018[g]). Documented during KRRC Pre-Proposed Project surveys throughout Copco No. 1 Reservoir and Iron Gate Reservoir, specifically Mirror Cove Recreation Area and near boom in front of Iron Gate Dam (CDM Smith 2018[f]).

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
Barrow's goldeneye *Bucephala islandica*	–/SSC/–	PacifiCorp	Northern California during the winter (non-breeding) season	May be found in open water and riverine habitat. Typically breeds around isolated mountain lakes; nesting habitat includes mixed conifer forest and ponderosa pine forests with sparse to moderate tree canopy closure close to lakes and ponds. Nests in cavities, including artificial nest boxes.	Included for further analysis as the species was documented in the Primary Area of Analysis during PacifiCorp surveys at Copco and Iron Gate reservoirs, primarily between January and April (PacifiCorp 2004a[d]) prior to northward migration. Also documented on the Klamath River downstream of Iron Gate Dam (eBird 2018). Species documented east of the Proposed Project at the Lower Klamath National Wildlife Refuge and Tule Lake National Wildlife Refuge (Ebird 2018[g]).
Common loon *Gavia immer*	–/SSC/–	PacifiCorp	Found throughout the state	Freshwater lakes, rivers, estuaries, and coastlines	Included for further analysis as species was documented in the Primary Area of Analysis during PacifiCorp surveys at Iron Gate Reservoir (PacifiCorp 2004a[d]). Species also documented at Iron Gate Reservoir and near Copco No. 1 Reservoir (eBird 2018[g]). Documented during KRRC pre-Proposed Project surveys at Copco No. 1 Reservoir (CDM Smith 2018[f]).
Short-tailed albatross *Phoebastris albatrus*	FE/SSC/– No critical habitat designated	USFWS	During the non-breeding season, range along the continental shelf margins of the Pacific Rim from southern Japan to northern California (USFWS 2008[f]) (species does not nest in California)	North Pacific marine ocean; forages in regions of upwelling and high productivity (e.g., Gulf of Alaska, along the Aleutian Chain, and along the Bering Sea shelfbreak from the Alaska Peninsula out towards St. Matthew Island) (USFWS 2008[f]).	Excluded from further analysis, as the Primary Area of Analysis is outside of the distribution for breeding and preferred distribution for foraging, and no critical habitat is designated in the Primary Area of Analysis.

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
Fork-tailed storm-petrel *Oceanodroma furcata*	–/SSC/BLMS	CNDDB	Along and off the coast of central and northern California	Forages and winters on nearshore waters and cold waters in the open ocean and continental shelf	Excluded from further analysis as there are no CNDDB occurrences within the Primary Area of Analysis; only one occurrence within the Project Vicinity (CDFW 2017[c]).
Bald eagle *Haliaeetus leucocephalus*	–, BGEPA, SFP/SE, BLMS, FSS	CNDDB, USDA-FS, BLM PacifiCorp	Permanent resident and uncommon winter migrant, found nesting primarily in Butte, Lake, Lassen, Modoc, Plumas, Shasta, Siskiyou, and Trinity counties	Large bodies of water or rivers with abundant fish; uses adjacent snags or other perches; nests and winter communal roosts in advanced-successional conifer forest within 1.6 km (1 mi) of open water	Included for further analysis as the species was documented in the Primary Area of Analysis during PacifiCorp surveys at J.C. Boyle and Copco No. 1 reservoirs, including nesting (PacifiCorp 2004a,b[d,e]), and has been documented along the Klamath River and approximately 2 miles from Copco No. 1 and Copco No. 2 dams (CDFW 2017a[d]). Numerous sightings in areas surrounding the Proposed Project, including but not limited to the Lower Klamath National Wildlife Refuge and Tule Lake National Wildlife Refuge (EBird 2018[g]).
Northern harrier *Circus cyaneus*	–/SSC/–	PacifiCorp	Year-round resident; scattered throughout California; in the northwest, nests largely within coastal lowlands from Del Norte County south to Bodega Head in Sonoma County, inland to Napa County	Nests, forages, and roosts in wetlands or along rivers or lakes, but also in grasslands, meadows, or grain fields	Included for further analysis as the species was documented in the Primary Area of Analysis during PacifiCorp surveys along the Klamath River from Iron Gate Dam to Shasta River (PacifiCorp 2004a[d]). Species also documented along Copco No. 1 Reservoir, along Iron Gate Reservoir and tributaries, and Klamath River downstream of Iron Gate Reservoir (eBird 2018[g]).

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
Northern goshawk *Accipter gentilis*	–/SSC/FSS, BLMS	CNDDB, USDA-FS, PacifiCorp	Nests in North Coast Ranges through Sierra Nevada, Klamath, Cascade, and Warner mountains, in Mount Pinos and San Jacinto, San Bernardino, and White mountains; winters along North Coast, throughout foothills, and in northern deserts	Mature and old-growth stands of coniferous forest, middle and higher elevations; nests in dense part of stands near an opening	Included for further analysis as the species was documented in the Primary Area of Analysis during PacifiCorp surveys flying over J.C. Boyle peaking reach (PacifiCorp 2004a[d]). Documented within the Area of Analysis in 1981 more than 80 RM downstream of Iron Gate Dam (CDFW 2017[c]).
Swainson's hawk *Buteo swainsoni*	–/ST/BLMS	CNDDB, BLM	Summer resident; breeds in lower Sacramento and San Joaquin valleys, the Klamath Basin, and Butte Valley; highest nesting densities occur near Davis and Woodland, Yolo County	Nests in oaks or cottonwoods in or near riparian habitats; forages in grasslands, irrigated pastures, and grain fields	Included for further analysis. Although there are no CNDDB occurrences within the Primary Area of Analysis (CDFW 2017[c]) and not observed during PacifiCorp surveys (PacifiCorp 2004a[d]), documented occurrences within the Project Vicinity occur near agricultural fields approximately 10 miles east of Copco No. 1 Reservoir (CDFW 2017[c]) including but not limited to the Lower Klamath National Wildlife Refuge and Tule Lake National Wildlife Refuge (eBird 2018[g]).
Golden eagle *Aquila chrysaetos*	–/SFP/–	PacifiCorp, BLM	Uncommon permanent resident and migrant throughout California, except center of Central Valley	Open woodlands and oak savannahs, grasslands, chaparral, sagebrush flats; nests on steep cliffs or large trees	Included for further analysis as the species was documented in the Primary Area of Analysis during PacifiCorp surveys along the lower reaches of the J.C. Boyle peaking reach and along Iron Gate and Copco No. 1 reservoirs (PacifiCorp 2004a[d]). Also documented along the Klamath River, downstream of Iron Gate Dam (eBird 2018[g]).

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
American peregrine falcon *Falco peregrinus*	–/SFP/–	BLM	Most of California during migrations and in winter; nests primarily in the Coast Ranges, northern Sierra Nevada Mountains, and other mountainous areas of northern California	Wetlands, woodlands, cities, agricultural lands, and coastal area with cliffs (and rarely broken-top, predominant trees) for nesting; often forages near water	Included for further analysis as CNDDB occurrences within the Primary Area of Analysis, including around Iron Gate Reservoir (CDFW 2017[c]) and downstream along the Klamath River (eBird 2018).
Greater sandhill crane *Grus canadensis tabida*	–/ST, SFP/FSS, BLMS	USDA-FS, CNDDB	Winter visitor and migrant; scattered locations in the Central Valley; breeds in extreme northeastern California	Forages in freshwater marshes and grasslands as well as harvested rice fields, corn stubble, barley, and newly planted grain fields	Included for further analysis as the species was documented in the Primary Area of Analysis during PacifiCorp surveys at J C. Boyle Reservoir (PacifiCorp 2004a[d]). Other sightings in ponds and near agricultural fields east of Yreka (CDFW 2017[c]).
Western snowy plover *Charadrius alexandrinus nivosus*	FT (Pacific coastal population)/SSC (interior population) No critical habitat designated within the Primary Area of Analysis	CNDDB USFWS	Nests in locations along the California coast, including the Eel River in Humboldt County and in Del Norte, Humboldt, and Mendocino counties; nests in the interior of the state in the Central Valley, Klamath Basin, Modoc Plateau, and Great Basin, Mojave, and Colorado deserts; winters primarily along coast	Barren to sparsely vegetated beaches, barrier beaches, salt-evaporation pond levees, and shores of alkali lakes; also nests on gravel bars in rivers with wide flood plains; needs sandy, gravelly, or friable soils for nesting	Excluded from further analysis as there is no designated critical habitat or documented occurrences of species within the Primary Area of Analysis (CDFW 2017[c]).
Black tern *Chlidonias niger*	–/SSC/–	PacifiCorp	Migrant and summer resident; breeds in northeastern California and in scattered locations throughout the Central Valley	Nests semi-colonially in protected areas of marshes	Included for further analysis as the species was documented in the Primary Area of Analysis during PacifiCorp surveys at J.C. Boyle Reservoir (PacifiCorp 2004a[d]). Species documented east of the Proposed Project at the Lower Klamath National Wildlife Refuge and Tule Lake National Wildlife Refuge (Ebird 2018[g]).

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
Marbled murrelet *Brachyramphus marmoratus*	FT/SE/-- Critical habitat designated in Primary Area of Analysis	CNDDB USFWS	Nesting murrelets in California are mostly concentrated on coastal waters near Del Norte and Humboldt counties, and in lesser numbers near San Mateo and Santa Cruz counties; winter throughout nesting range, and in small numbers in southern California	Most time spent on the ocean; nests inland in old-growth conifers with suitable platforms, especially redwood or Douglas-fir forests near coastal areas	Excluded from further analysis. Designated critical habitat does overlap with the Primary Area of Analysis (CDFW 2017[c]); however, this area is located approximately 100 RM downstream of Iron Gate Dam and there is no habitat within 100-year floodplain that, if modified, would have the potential to affect the species.
Western yellow-billed cuckoo *Coccyzus americanus*	FT/SE/FSS, BLMS No critical habitat proposed within the Primary Area of Analysis	USFWS, USDA-FS	Breeds in limited portions of the Sacramento River and the South Fork Kern River; small populations may nest in Butte, Yuba, Sutter, San Bernardino, Riverside, Inyo, Los Angeles, and Imperial counties	Summer resident of valley foothill and desert riparian habitats; nests in open woodland with clearings and low, dense, scrubby vegetation	Included for further analysis as it has been noted that although not documented in the Primary Area of Analysis (PacifiCorp 2004a[d], CDFW 2017[c]), the species has the potential to be in the vicinity (PacifiCorp 2004a [d]). There is no designated critical habitat in the Primary Area of Analysis.
Northern spotted owl *Strix occidentalis caurina*	FT/ST, SSC/– Critical habitat designated approximately 0.5 miles south east of Copco No. 1 Reservoir	USFWS, PacifiCorp	Northwestern California south to Marin County, and southeast to the Pit River area of Shasta County	Typically, in older forested habitats; nests in complex stands dominated by conifers, especially coastal redwood, with hardwood understories; some open areas are important for foraging	Included for further analysis an activity center is located approximately 1.7 miles southeast of Copco No. 1 Reservoir (CDFW 2017[c]). Designated critical habitat approximately 0.5 miles southeast of Copco No. 1 Reservoir and along the Klamath River approximately 40 RM downstream of Iron Gate Dam.

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
Great gray owl *Strix nebulosa*	–/SE/FSS	USDA-FS, CNDDB, PacifiCorp	In the Sierra Nevada from the vicinity of Quincy, Plumas County south to around Yosemite	Dense, coniferous forest, usually near a meadow for foraging; nests in large, broken-topped snags	Included for further analysis as the species was documented during PacifiCorp surveys east of Fall Creek near Jenny Creek (PacifiCorp 2004[d]). Although no other sightings are documented with the Primary Area of Analysis (CDFW 2017[c]), there are documented occurrences within the Project Vicinity approximately 30 RM downstream of Iron Gate Dam and 10 miles north of the Klamath River.
Black swift *Cypseloides niger*	–/SSC/–	CNDDB	Breeds locally in Sierra Nevada and Cascade ranges, the San Gabriel, San Bernardino, and San Jacinto mountains., and from San Mateo County south likely to San Luis Obispo County	Nests in moist crevices behind or beside permanent or semi-permanent waterfalls in deep canyons, on perpendicular sea cliffs above surf, and in sea caves; forages widely over many habitats	Included for further analysis. Although the species was not documented in California during PacifiCorp surveys (PacifiCorp 2004a[d]), a single occurrence is known within the Primary Area of Analysis from summer 1982 along the banks of the Klamath River, over 100 RM downstream of Iron Gate Dam (CDFW 2017[c]).
Vaux's swift *Chaetura vauxi*	–/SSC/–	PacifiCorp	Summer resident of northern California; nests in the Coast Ranges from Sonoma County north and very locally south to Santa Cruz County; also found in the Sierra Nevada and possibly in the Cascade Range	Redwood and Douglas-fir habitats with large snags, especially forest with larger basal hollows and chimney trees	Included for further analysis as the species was documented in the Primary Area of Analysis during PacifiCorp surveys at Copco No. 1 and Iron Gate reservoirs, along the J.C. Boyle peaking reach, along Fall Creek, and along Klamath River from Iron Gate Dam to Shasta River (PacifiCorp 2004[d]).

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
Black-backed woodpecker *Picoides arcticus*	Petitioned for listing filed in 2012 and in October 2017 USFWS released a finding indicating listing of the species is not warrented (USFWS 2017[g])/ Petitioned for listing filed in 2012 and in May 2013, the Fish and Game Commission released a finding indicating listing of the species is not warranted (CDFW 2013[h])/–	Not identified in query, but included due to petition for listing	Sierra Nevada range including Siskiyou and Shasta counties	Affinity to boreal and montane coniferous forests post-burn or following outbreaks of wood-burning beetles	Included for further analysis due to the potential for the species to occur and presence of suitable habitat (coniferous forest) in the Primary Area of Analysis.
Olive-sided flycatcher *Contopus cooperi*	–/SSC/–	PacifiCorp	Summer resident throughout California except in deserts, the Central Valley, and other lowland areas	Primarily advanced-successional conifer forests with open canopies	Included for further analysis as the species was documented in the Primary Area of Analysis during PacifiCorp surveys at Iron Gate Reservoir and along J.C. Boyle peaking reach (PacifiCorp 2004[d]). Documented during pre-Proposed Project surveys in northern coves and riparian woodlands of Copco No. 1 Reservoir (CDM Smith 2018[f]).

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
Willow flycatcher *Empidonax traillii*	–/SE/FSS	USDA-FS, CNDDB	In the Sierra Nevada and Cascade ranges; nests as far south as San Diego County; confirmed breeding along the Eel River and in northern Humboldt County	Dense brushy thickets within riparian woodland often dominated by willows and/or alder, near permanent standing water; uses brushy, early-succession forests (e.g., clearcuts) in the Pacific Northwest	Included for further analysis as the species was documented in the Primary Area of Analysis during PacifiCorp surveys in riparian or wetland habitat located the shoreline of Copco No. 1 and Iron Gate reservoirs, along the J.C. Boyle peaking reach, and along Klamath River from Iron Gate Dam to Shasta River (PacifiCorp 2004[d]). Also, a documented occurrence from 2008 occurred at Iron Gate Reservoir at Jenny Creek (CDFW 2017[c]). Observed during pre-Proposed Project surveys at Jenny Creek on the Iron Gate Reservoir and along Copco No. 1 Reservoir in the northern cove at the confluence of West Fork Beaver Creek, Beaver Creek, and East Fork Beaver Creek in fringe willow (CDM Smith 2018[f]).
Purple martin *Progne subis*	–/SSC/–	PacifiCorp	Summer resident and migrant; most densely populated in central and northern coastal conifer forests and smaller and more localized areas in the Sierra Nevada, interior foothills, and southern California	Conifer, valley-foothill, montane-hardwood forests with large snags in open areas; most nest sites located in upper slopes of hilly terrain; also, may nest in human-made structures with cavities	Included for further analysis as the species was documented upstream of the upper falls at Fall Creek (PacifiCorp 2004[d]), and at a few locations in the Primary Area of Analysis along the Klamath River, downstream of Iron Gate Dam (eBird 2018[g]). Observed nesting during pre-Proposed Project survey on a utility pole near the intersection of Copco Road and the dam access spur road (CDM Smith 2018[f]).

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
Bank swallow *Riparia riparia*	–/ST/BLMS	CNDDB	Summer resident; occurs along the Sacramento River from Tehama County to Sacramento County, along the Feather and lower American rivers; and in the plains east of the Cascade Range in Modoc, Lassen, and northern Siskiyou counties; small populations near the coast from San Francisco County to Monterey County	Nests in vertical bluffs or banks, usually adjacent to water, where the soil consists of sand or sandy loam	Excluded from further analysis as the species is not known on the Klamath and there are no CNDDB occurrences within the Primary Area of Analysis (CDFW 2017[c]). Documented occurrences within the Project Vicinity occur at a lake approximately 20 miles east of Copco No. 1 Reservoir.
tricolored blackbird *Agelaius tricolor*	Petition to list/SCE, SSC/–	Not identified in query, but added due to the candidate listing status	Permanent resident, but makes extensive migrations both in breeding season and winter	Feeds in grasslands and agriculture fields; nesting habitat components include open accessible water, a protected nesting substrate (including flooded or thorny vegetation), and a suitable nearby foraging space with adequate insect prey	Included for further analysis due to the potential for the species to occur and potential presence of suitable habitat (open foraging area adjacent to aquatic habitat) in the Primary Area of Analysis. A single sighting in 2011 (eBird 2018[g]) at Copco No. 1 Reservoir. Numerous accounts documented east of the Proposed Project at the Lower Klamath National Wildlife Refuge and Tule Lake National Wildlife Refuge (Ebird 2018[g]).

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
Yellow warbler *Setophaga petechia*	–/SSC/–	PacifiCorp	Summer resident; nests in most of California, except most of the Central Valley, high Sierras, and Mojave and Colorado deserts	Open-canopy, deciduous riparian woodland close to water, along streams or wet meadows	Included for further analysis as the species was documented in the Primary Area of Analysis during PacifiCorp surveys at all Lower Klamath Project reservoirs and reaches (PacifiCorp 2004[d]). Species also documented along the Klamath River downstream of Iron Gate Dam (eBird 2018[g]). Observed in riparian woodlands and hillside seep areas surrounding Copco No. 1 Reservoir and also Iron Gate Reservoir, including Bogus Creek fish hatchery and Jenny Creek (CDM Smith 2018[f]).
Yellow-breasted chat *Icteria virens*	–/SSC/–	PacifiCorp	Summer resident and migrant in coastal California and in foothills of the Sierra Nevada	Early-successional riparian habitats with a dense shrub layer and an open canopy	Included for further analysis as the species was documented in the Primary Area of Analysis during PacifiCorp surveys primarily in wetland and riparian habitats along J.C. Boyle peaking reach, at Copco No. 1 Reservoir, along Fall Creek, and along Klamath River from Iron Gate Dam to Shasta River (PacifiCorp 2004[d]). Observed during pre-project surveys in areas surrounding Copco No. 1 Reservoir and at the northern cove of Iron Gate Reservoir (CDM Smith 2018[f]).

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
Mammals					
Sonoma tree vole *Arborimus pomo*	–/SSC/–	CNDDB	North Coast fog belt from the Oregon border south to Sonoma County	Associated with Douglas-fir trees and occasionally grand fir, hemlock, or spruce trees	Excluded from further analysis. There is a single occurrence (1991) documented within the Primary Area of Analysis approximately 15 miles upstream of the Klamath Estuary within a large Douglas-fir tree (CDFW 2017[c]). This area is located over 100 RM downstream of Iron Gate Dam and no suitable habitat would be affected.
Townsend's western big-eared bat *Corynorhinus townsendii*	–/SSC/FSS, BLMS	USDA-FS, BLM CNDDB	Throughout California, found in all but subalpine and alpine habitats; details of distribution not well known	Roosts in cavities, usually in tunnels, caves, buildings, and mines, but also rock shelters, preferentially close to water. Caves near water's edge are favored Forages in riparian zone and follows creeks and river drainages on foraging bouts. Feeds primarily on moths. Drinks at stream pools	Included for further analysis, as although the species was not documented in California during PacifiCorp bat structure evaluation surveys (PacifiCorp 2004[d]), two occurrences were documented in 1997 within the Primary Area of Analysis at bridges approximately 40 RM downstream of Iron Gate Dam (CDFW 2017[c]) and suitable habitat is present in the Project Area.

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
Pallid bat *Antrozous pallidus*	–/SSC/FSS, BLMS	USDA-FS, CNDDB	Throughout California at elevations below 9,800 ft	Roosts in rock crevices, live or dead tree hollows, mines, caves, and a variety of vacant and occupied structures or buildings. Feeds low to or on the ground in a variety of open habitats, primarily on ground-dwelling arthropods. Forages most frequently in riparian zone, in open oak savannah, and open mixed deciduous forest, drinks at stream pools	Included for further analysis, as although the species was not documented in California during PacifiCorp bat structure evaluation surveys (PacifiCorp 2004[d]) and no CNDDB occurrences are documented within the Primary Area of Analysis, suitable habitat (e.g., man-made structures) are present in the Project Area. PacifiCorp (2004[d]) noted that species presence of a roost site was documented by one dead individual (Yuma myotis), and that it is possible that sites with confirmed evidence of bat use support aggregations of more than one species.
Fringed myotis *Myotis thysanodes*	–/–/BLMS, FSS	USDA-FS, BLM CNDDB	Throughout California	Roosts in crevices, cavities, and foliage, in a wide variety of habitats including rock crevices, caves, mines, buildings and bridges, and large-diameter snags. Forages in open air and by gleaning prey from vegetation. Feeds primarily on beetles and moths in meadows and thick riparian vegetation	Included for further analysis, as although the species was not documented in California during PacifiCorp bat structure evaluation surveys (PacifiCorp 2004[d]) and no CNDDB occurrences are documented within the Primary Area of Analysis, suitable habitat (e.g., man-made structures) are present in the Limits of Work. PacifiCorp (2004[d]) noted that species presence of a roost site was documented by one dead individual (Yuma myotis), and that it is possible that sites with confirmed evidence of bat use support aggregations of more than one species.

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
Long-eared myotis *Myotis evotis*	–/–/BLMS	BLM	Throughout California	Roosts in bridges, buildings, under exfoliating tree bark, and in hollow trees, caves, mines, cliff crevices, sinkholes, rocky outcrops on the ground. Forages by eating prey off of foliage, tree trunks, rocks, and from the ground.	Included for further analysis, as although the species was not documented in California during PacifiCorp bat structure evaluation surveys (PacifiCorp 2004[d]) and no CNDDB occurrences are documented within the Primary Area of Analysis, suitable habitat (e.g., man-made structures) are present in the Limits of Work. PacifiCorp (2004[d]) noted that species presence of a roost site was documented by one dead individual (Yuma myotis), and that it is possible that sites with confirmed evidence of bat use support aggregations of more than one species.
Spotted bat *Euderma maculatum*	–/SSC/BLMS	BLM	Small number of localities identified in California; mostly found in the foothills, mountains and desert regions of southern California	Roosts in cracks, crevices, and caves, usually high in fractured rock cliffs Solitary or roost in small groups. Forages over open areas and along forest edges, particularly in association with wet meadows. Drinks at stream pools	Included for further analysis, as although the species was not documented in California during PacifiCorp bat structure evaluation surveys (PacifiCorp 2004[d]) and no CNDDB occurrences are documented within the Primary Area of Analysis, suitable habitat for this species (e.g., large dam faces) may be present in the Limits of Work.

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
Yuma myotis *Myotis yumanensis*	–/–/BLMS	BLM	Distributed throughout California	Roosts in bridges, buildings, cliff crevices, caves, mines, and trees. Foraging primarily on aquatic emerging insects and drinking occurs over rivers and streams	Included for further analysis, as structures providing habitat for Yuma myotis were documented during PacifiCorp bat structure evaluation surveys at the Copco No. 1 powerhouse and the Iron Gate south gatehouse (PacifiCorp 2004a[d]). No CNDDB occurrences are documented within the Primary Area of Analysis. Pre-Proposed Project surveys documented species at the Bogus Creek fish hatchery (CDM Smith 2018[f]).
Western mastiff bat Eumops perotis californicus	–/SSC/–	Documented in the area (K. Hubbard, CDFW, pers comm., October 2017)	Distributed throughout central and southern California and in northern California found Siskiyou, Shasta, and Trinity counties	Roosting in large rock features in a variety of habitats including desert scrub, chaparral, oak woodland, ponderosa pine, mid-elevation conifer (e.g., giant sequoia) Forages seasonally at high elevations	Included for further analysis as documented at Medicine Lake, Siskiyou County (Pierson and Rainey 1998[j]), and existing range includes the Primary Analysis Area (CDFW 1997[k]).
North American wolverine *Gulo gulo luscus*	FPT/ST, SFP/FSS No critical habitat designated	USFWS, USDA-FS, CNDDB	North Coast mountains and Sierra Nevada	Dense mixed-conifer forest in high elevations (4,300–10,800 feet); uses caves, hollows, logs, rock outcrops, and burrows for cover	Excluded from further analysis as no designated critical habitat is present within the Primary Area of Analysis, no CNDDB sightings are in the Primary Area of Analysis, the species was not documented in California during PacifiCorp mammal surveys (PacifiCorp 2004[d]), and the only documented occurrences within the Project Vicinity are located over 5 miles from the Klamath River and dated over 25 years ago (CDFW 2017[c]).

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
Pacific marten *Martes caurina*	–/–/FSS	CNDDB, USDA-FS	Coastal redwood zone from the Oregon border south to Fort Ross, Sonoma County	Forest with conifer overstory, dense shrubs, large-diameter standing and downed wood	Excluded from further analysis as the species was not documented in California during PacifiCorp mammal surveys (PacifiCorp 2004[d]), no CNDDB occurrences have been recorded within the Primary Area of Analysis (CDFW 2017[c]), the most recent occurrences within the Project Vicinity are from 1972 approximately 10 miles south of Copco No. 1 Reservoir (CDFW 2017[c]), and there is no habitat within 100-year floodplain that, if modified, would have the potential to affect the species.
Humboldt marten *Martes caurina humboldtensis*	–/CE,SCE/FSS	CNDDB	Humboldt, Del Norte, and Siskiyou counties	Mid- to advanced-successional stands of conifers with complex structure near the ground and dense canopy closure	Excluded from further analysis as the species was not documented in California during PacifiCorp mammal surveys (PacifiCorp 2004[d]), no CNDDB occurrences have been recorded within the Primary Area of Analysis (CDFW 2017[c]), the closest documented occurrences within the Project Vicinity are in the lower Klamath River watershed (CDFW 2017[c]), and there is no habitat within 100-year floodplain that, if modified, would have the potential to affect the species.

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
Pacific fisher *Martes pennanti (pacifica)* West Coast DPS	FPT/ST, SSC/FSS, BLMS No critical habitat designated	USDA-FS, CNDDB	Two widely separated regions: the northern Coast Range and Klamath Province, and the southern Sierra Nevada	Advanced-successional conifer forests with complex forest structure; den in hollow trees and snags	Excluded from further analysis as the species was not documented in California during PacifiCorp mammal surveys (PacifiCorp 2004[d]), the closest CNDDB occurrence within the Primary Area of Analysis is approximately 80 RM downstream of Iron Gate Dam (with approximately one dozen occurrences further downstream) (CDFW 2017[c]), and there is no habitat within 100-year flood plain that, if modified, would have the potential to affect the species.
American badger *Taxidea taxus*	–/SSC/–	CNDDB	Throughout the state except in the humid coastal forests of Del Norte County and the northwest portion of Humboldt County	Shrubland, open grasslands, fields, and alpine meadows with friable soils	Included for further analysis, as although the species was not documented in California during PacifiCorp mammal surveys (PacifiCorp 2004[d]), a single occurrence within the Primary Area of Analysis and Project Vicinity (unknown date) was documented approximately 2 RM upstream of Copco No. 1 Reservoir (CDFW 2017[c]).

Common Name Scientific Name	Status[a] Federal/ State/USDA Forest Service, US Bureau of Land Management	Query Sources	Distribution in California	Habitat Association	Included in or Excluded from EIR, and Rationale
Gray wolf *Canis lupus*	FE/SE/– No critical habitat designated	USFWS, BLM	Northern portion of California	Range of habitats including temperate forests, mountains, tundra, taiga, and grasslands	Included for further analysis, as the range has the potential to overlap with the Primary Area of Analysis.

[a] Status codes:

Federal		State	
FE	= Listed as endangered under the federal Endangered Species Act	SE	= Listed as Endangered under the California Endangered Species Act
FT	= Listed as threatened under the federal Endangered Species Act	ST	= Listed as Threatened under the California Endangered Species Act
FPT	= Federally proposed as threatened	SCE	= State Candidate Endangered
BGEPA	= Federally protected under the Bald and Golden Eagle Protection Act	SCT	= State Candidate Threatened
FSS	= Forest Service Sensitive species	SSC	= CDFW Species of Special Concern
BLMS	= Bureau of Land Management Sensitive Species	SFP	= CDFW Fully Protected species

[b] Details regarding what special-status wildlife are documented and may have potential habitat in the Secondary Area of Analysis are not included since this area was analyzed at a programmatic level.

[c] CDFW. 2017. California Natural Diversity Database. RareFind5. Electronic database. Natural Heritage Division, California Department of Fish and Game, Sacramento, California. https://map.dfg.ca.gov/rarefind/view/RareFind.aspx [Accessed May 2017].

[d] PacifiCorp. 2004a. Terrestrial resources. Klamath Hydroelectric Project (FERC Project No. 2082). Final Technical Report. Prepared by PacifiCorp, Portland, Oregon.

[e] PacifiCorp. 2004b. Botanical and wildlife resources. Klamath Hydroelectric Project (FERC Project No. 2082). 2004 Terrestrial Resources Technical Report. Prepared by PacifiCorp, Portland, Oregon.

[f] CDM Smith. 2018. June 2018 vegetation communities summary report. Prepared by CDM Smith, Sacramento, California.

[g] eBird. 2018. eBird home page. Website. https://ebird.org/home. Prepared by The Cornell Lab of Ornithology, Ithaca, New York. [Accessed 8 June 2018].

[h] USFWS. 2017. Endangered and threatened wildlife and plants; 12-month findings on petitions to list 25 species as endangered or threatened species. Federal Register 82: 46,618–46,645.

[i] CDFW. 2013. Black-backed woodpecker status evaluation. Prepared by CDFW, Sacramento, California.

[j] Pierson, E. D., and W. E. Rainey. 1998. Distribution, habitat associations, status, and survey methodologies for three molossid bat species (*Eumops perotis, Nyctinomops femorosaccus, Nyctinomops macrotis*) and the vespertilionid (*Euderma maculatum*). Final Report. Prepared for California Department of Fish and Game, Wildlife Management Division, Sacramento, California.

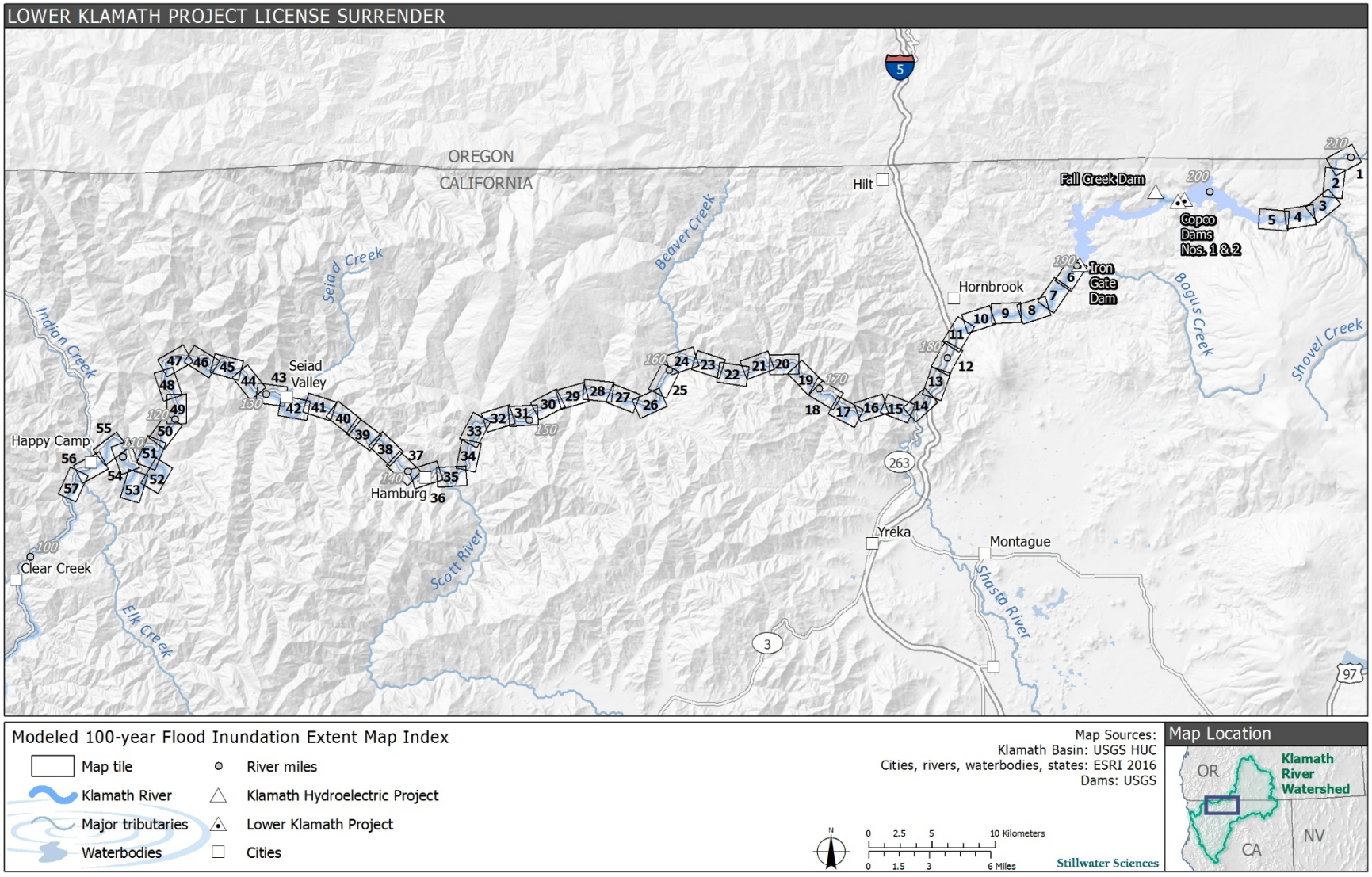
[k] CDFW (California Department of Fish and Wildlife). 1997. California wildlife habitat relationships system: western mastiff bat (*Eumops perotis*). CDFW, California Interagency Wildlife Task Group.

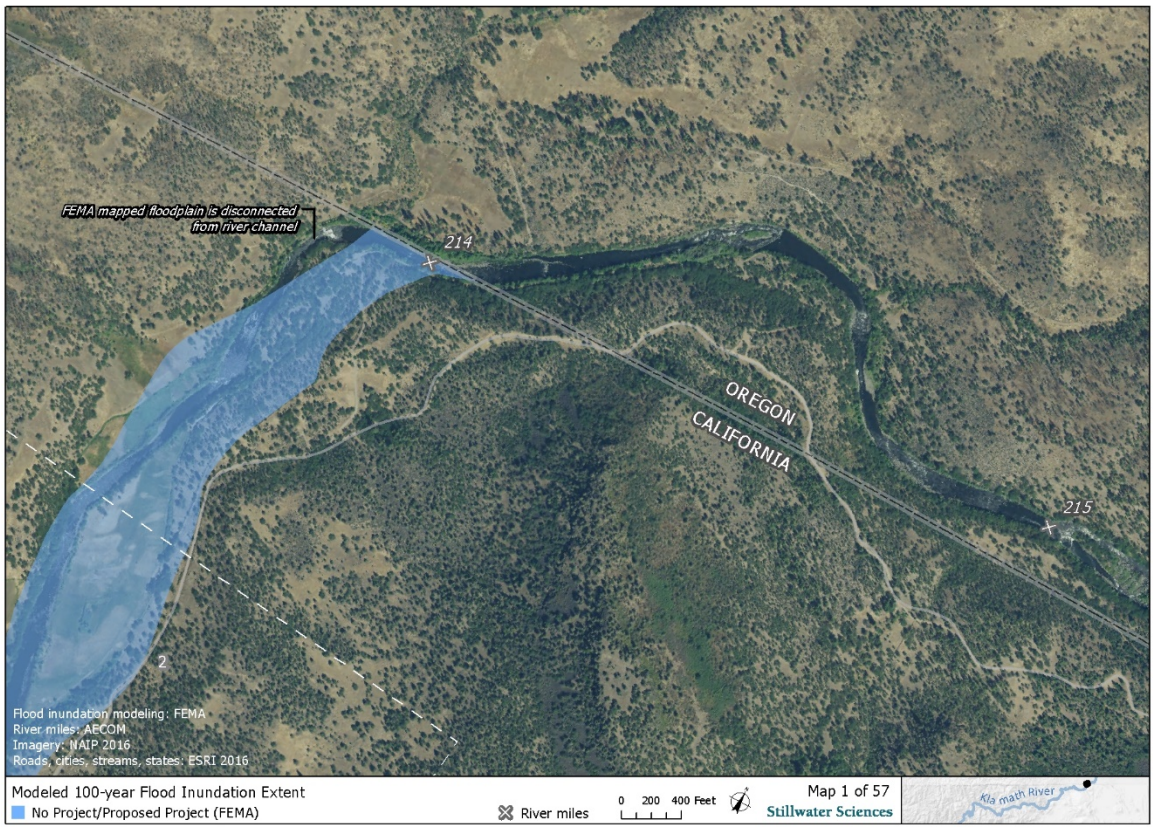
Appendix K

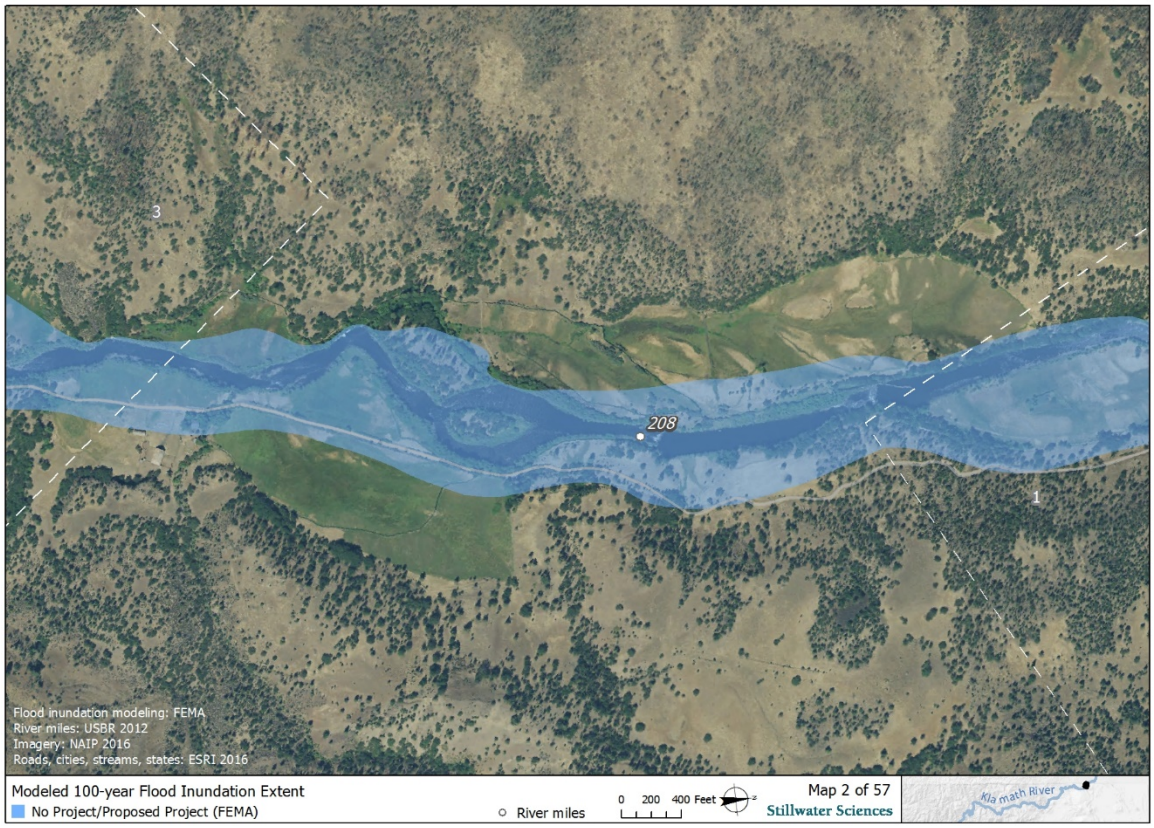
Flood Hydrology

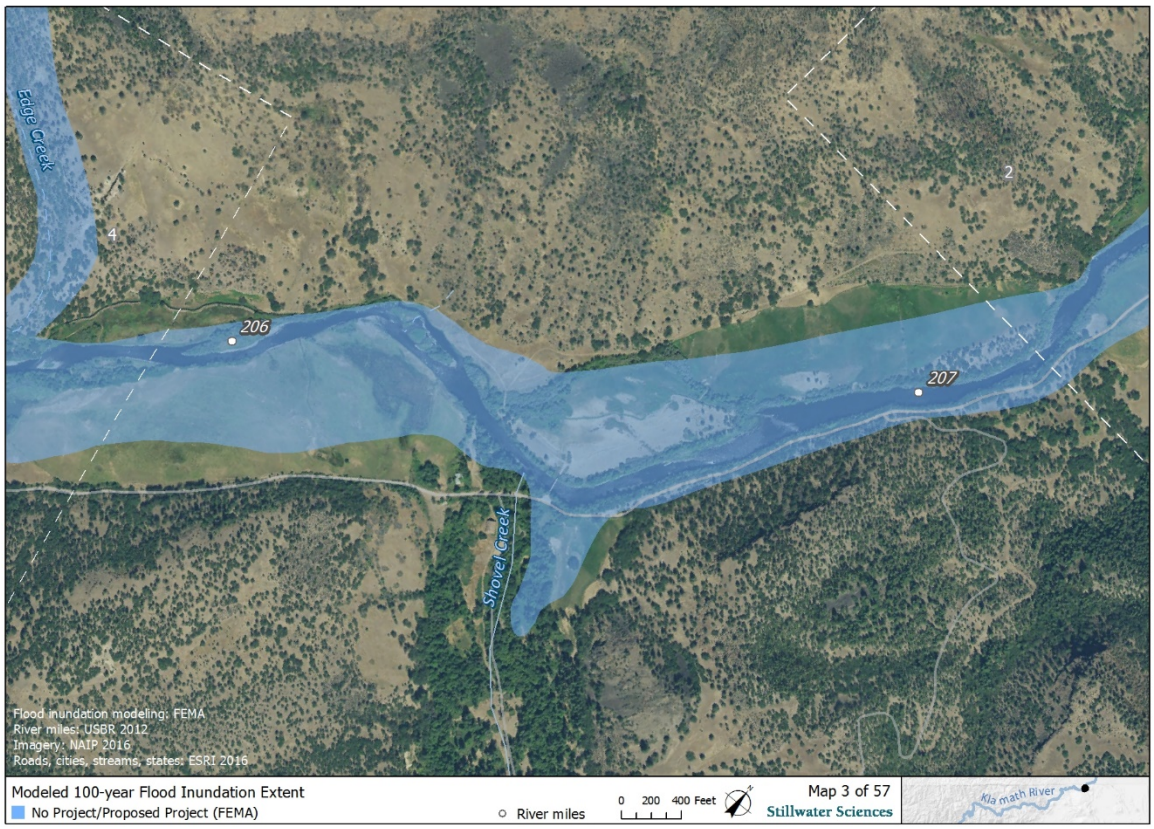
The following maps illustrate modeled 100-year flood inundation mapping conducted by FEMA (map tiles 1−5) and USBR (map tiles 6−57). USBR flood inundation mapping uses daily average flows under the two scenarios modeled in USBR (2012[11]), including the Proposed Project (dams removal) and No Project (dams remain in place). The USBR modeling extends from Iron Gate Dam downstream to Happy Camp at approximately river mile 107. FEMA will make the final determination of the future 100-year floodplain after dam removal and the KRRC is coordinating with FEMA to initiate the map revision process.

[11] USBR. 2012. Hydrology, Hydraulics, and Sediment Transport Studies for the Secretary's Determination on Klamath River Dam Removal and Basin Restoration. Technical Report No. SRH-2011-02. Prepared for Mid-Pacific Region, Bureau of Reclamation, Technical Service Center, Denver, Colorado.

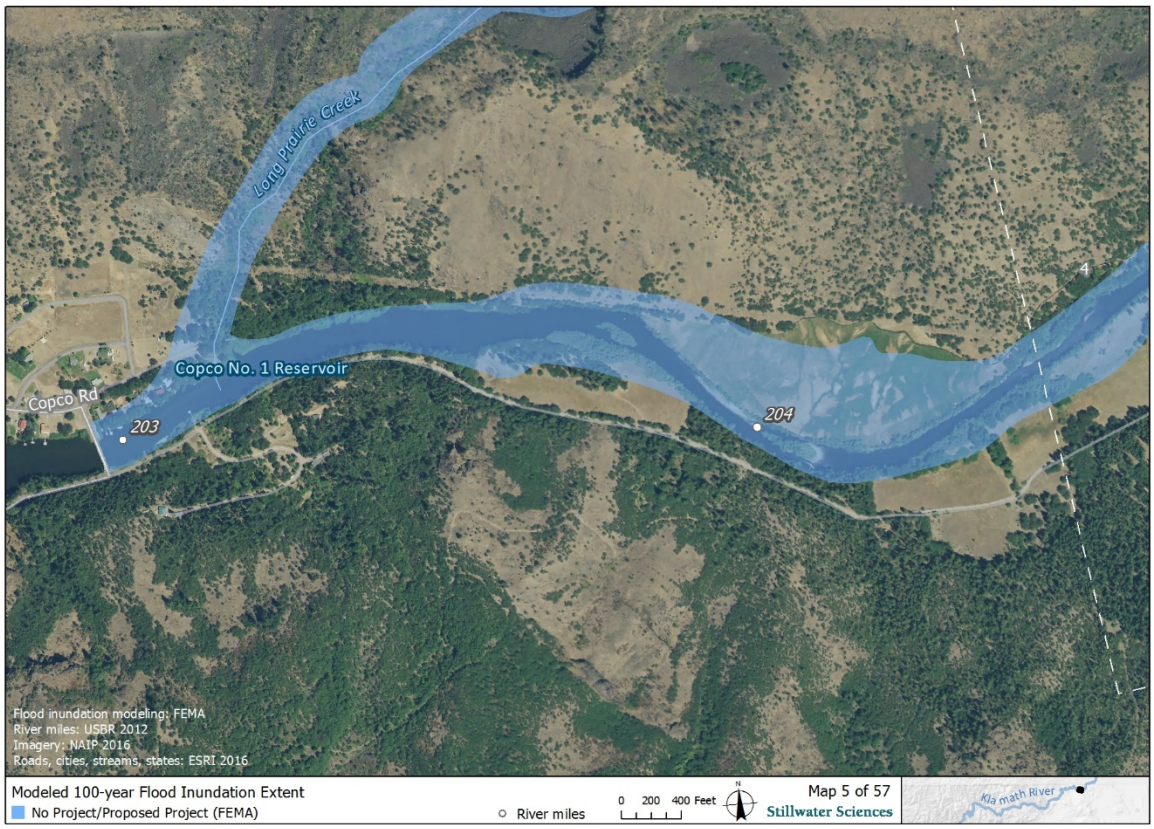

LOWER KLAMATH PROJECT LICENSE SURRENDER
OREGON
CALIFORNIA
Hilt
Fall Creek Dam
Copco Dams Nos. 1 & 2
Iron Gate Dam
Hornbrook
Seiad Valley
Happy Camp
Clear Creek
Hamburg
Yreka
Montague
Beaver Creek
Seiad Creek
Indian Creek
Bogus Creek
Shovel Creek
Scott River
Elk Creek
Shasta River
Modeled 100-year Flood Inundation Extent Map Index
Map tile
Klamath River
Major tributaries
Waterbodies
River miles
Klamath Hydroelectric Project
Lower Klamath Project
Cities
Map Sources:
Klamath Basin: USGS HUC
Cities, rivers, waterbodies, states: ESRI 2016
Dams: USGS
0 2.5 5 10 Kilometers
0 1.5 3 6 Miles
Stillwater Sciences
Map Location
OR
CA
NV
Klamath River Watershed

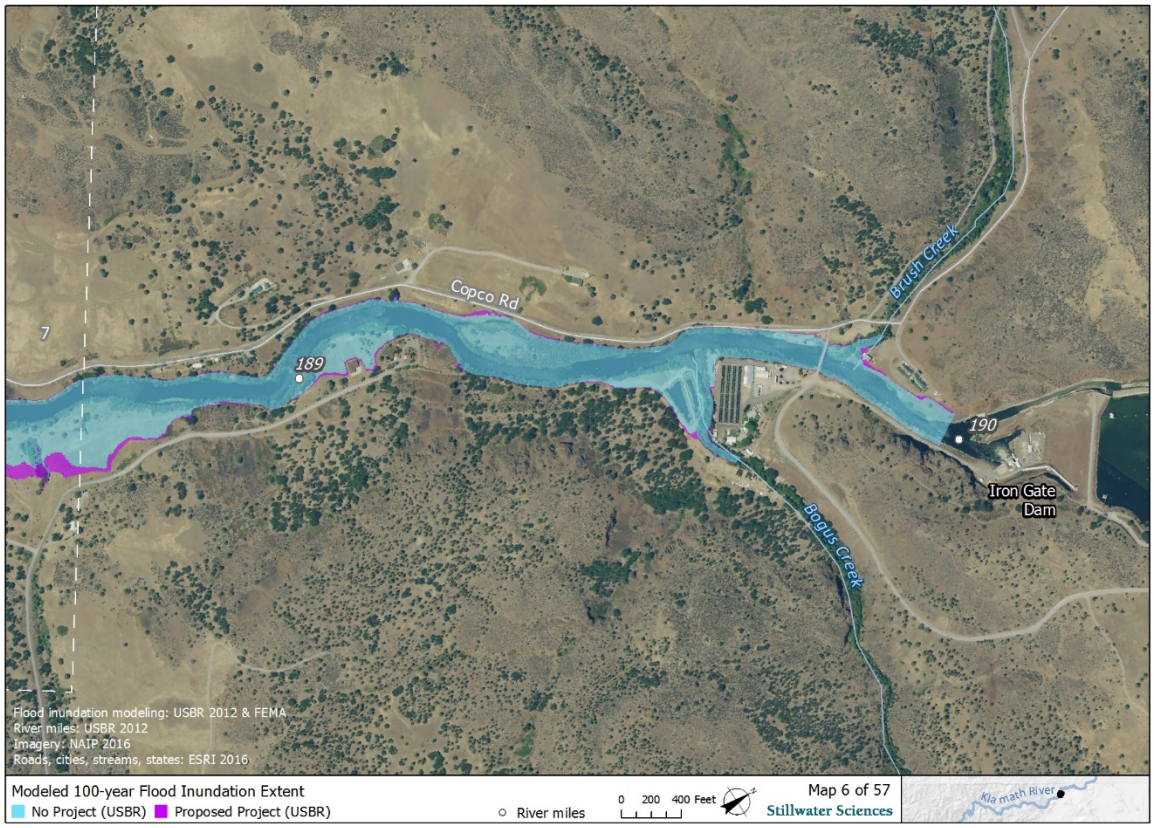

FEMA mapped floodplain is disconnected from river channel
214
OREGON
CALIFORNIA
215
2
Flood inundation modeling: FEMA
River miles: AECOM
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project/Proposed Project (FEMA)
River miles
0 200 400 Feet
Map 1 of 57
Stillwater Sciences
Klamath River

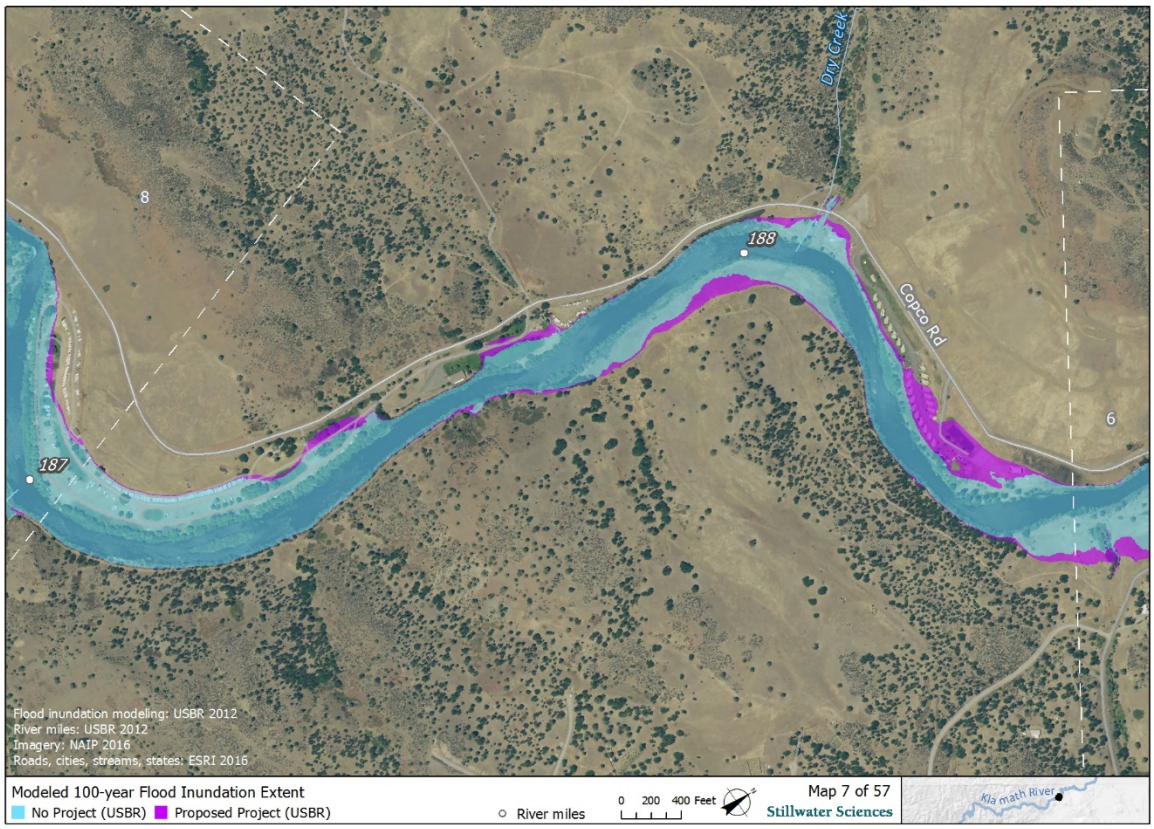

3
208
1
Flood inundation modeling: FEMA
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project/Proposed Project (FEMA)
River miles
0 200 400 Feet
Map 2 of 57
Stillwater Sciences
Klamath River

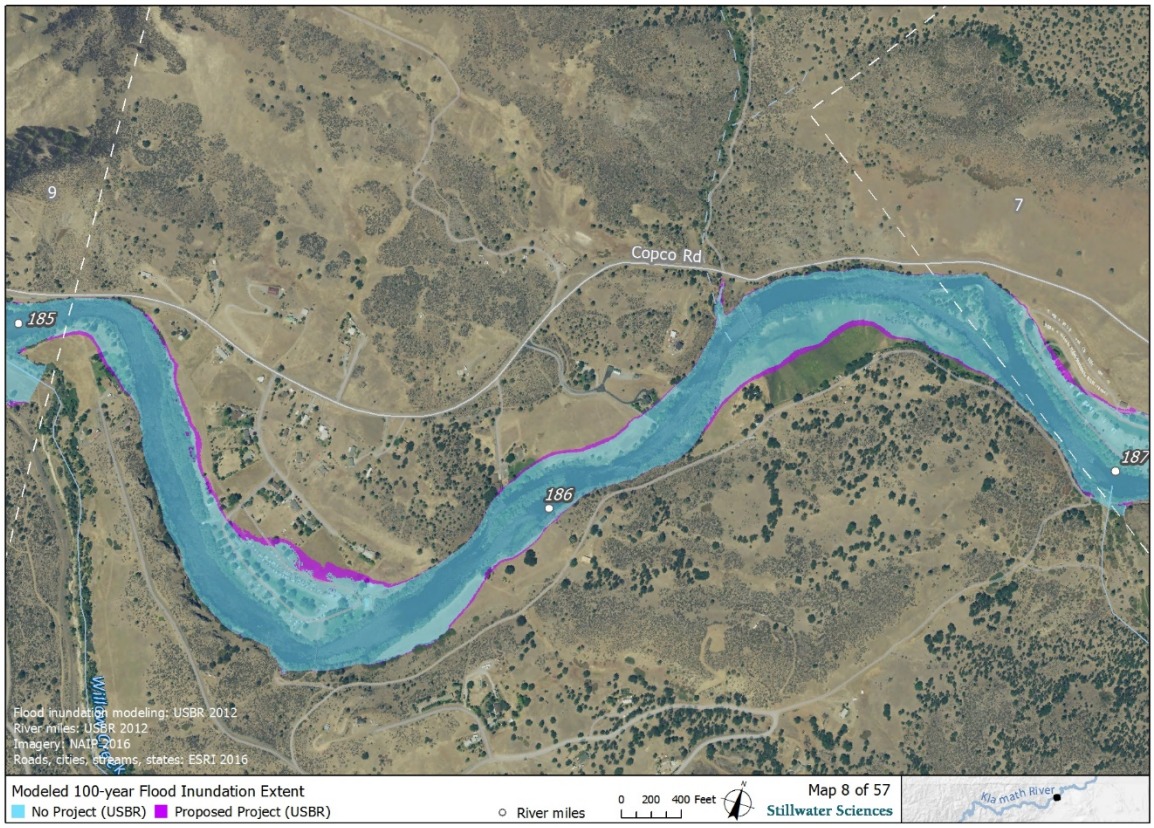

Edge Creek
4
2
206
207
Shovel Creek
Flood inundation modeling: FEMA
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project/Proposed Project (FEMA)
River miles
0 200 400 Feet
Map 3 of 57
Stillwater Sciences
Klamath River

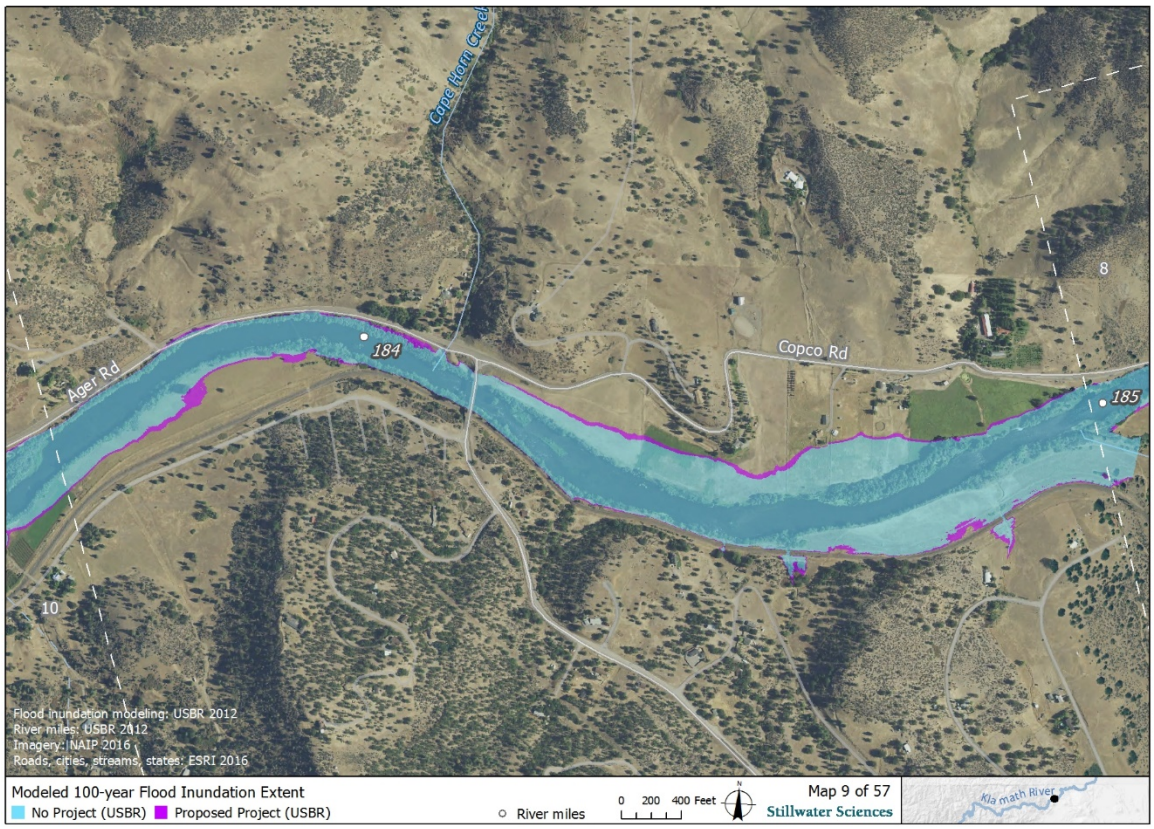

Edge Creek
3
205
5
Flood inundation modeling: FEMA
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project/Proposed Project (FEMA)
River miles
0 200 400 Feet
Map 4 of 57
Stillwater Sciences
Klamath River

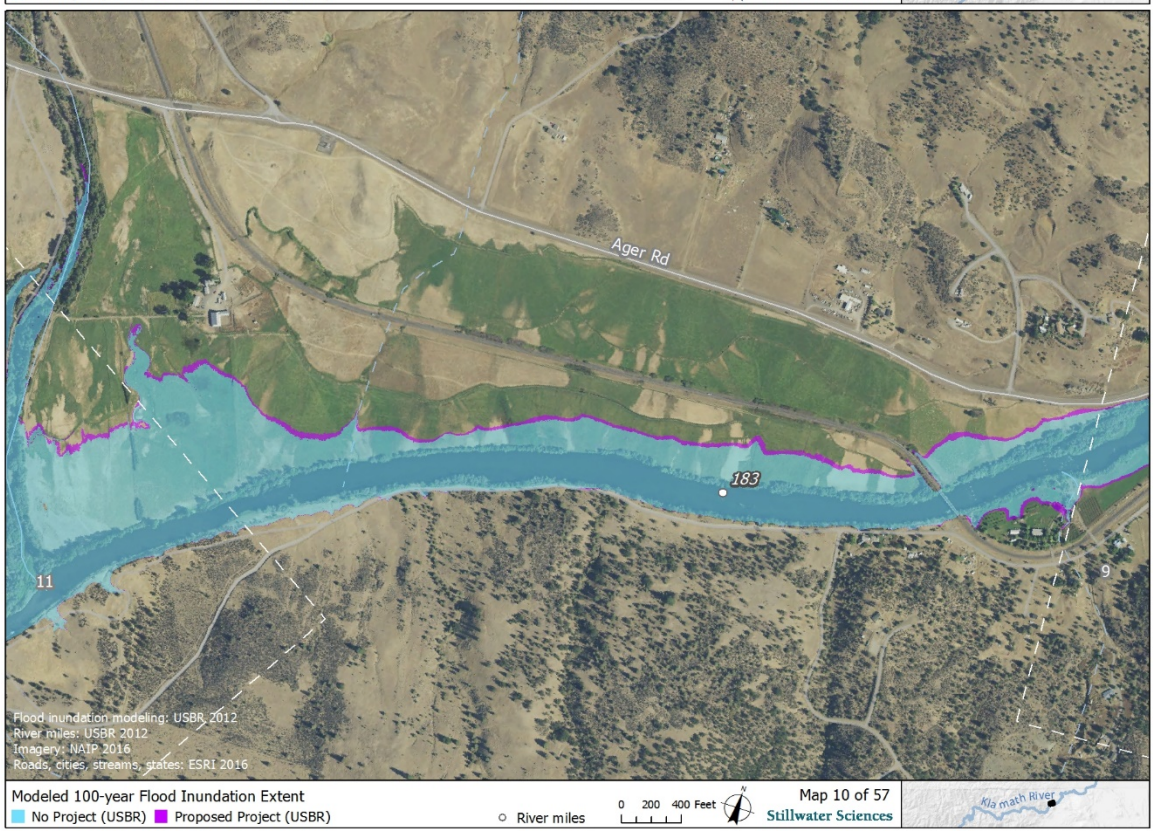

Long Prairie Creek
Copco No. 1 Reservoir
Copco Rd
203
204
4
Flood inundation modeling: FEMA
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project/Proposed Project (FEMA)
River miles
0 200 400 Feet
Map 5 of 57
Stillwater Sciences
Klamath River

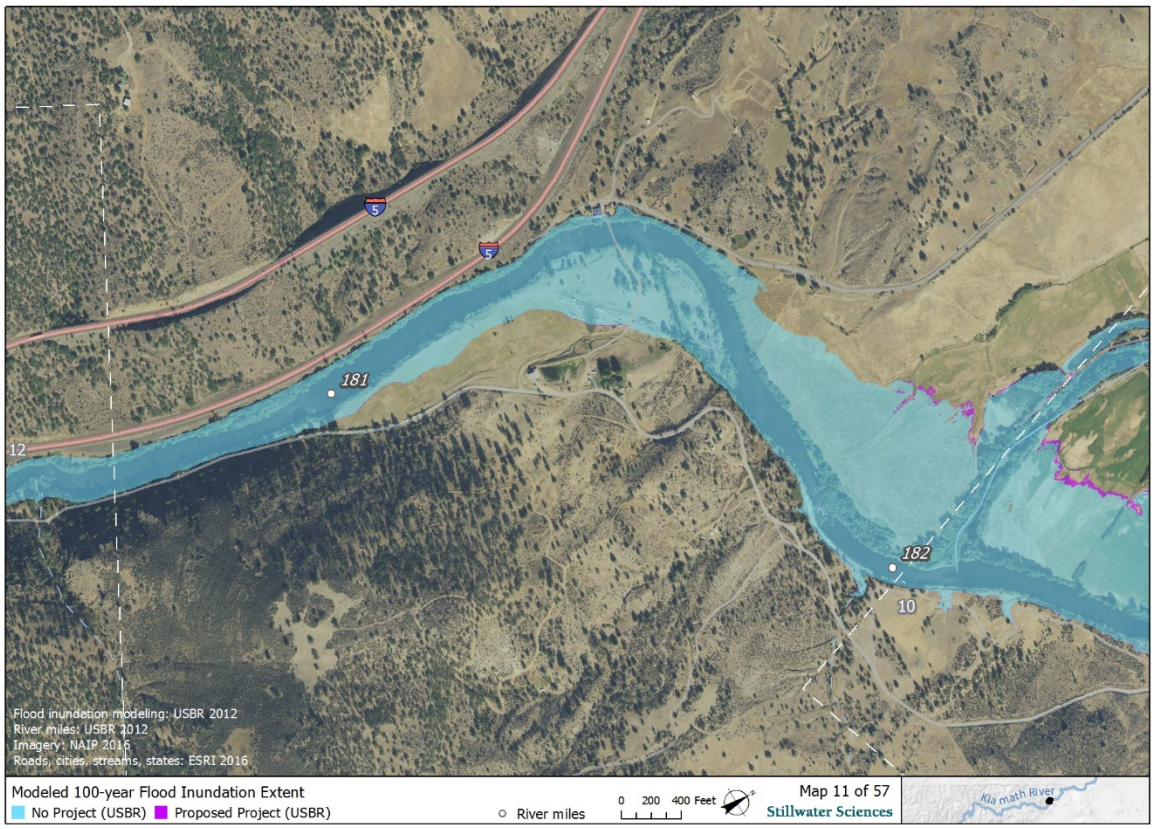

Copco Rd
Brush Creek
7
189
190
Iron Gate Dam
Bogus Creek
Flood inundation modeling: USBR 2012 & FEMA
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 6 of 57
Stillwater Sciences
Klamath River

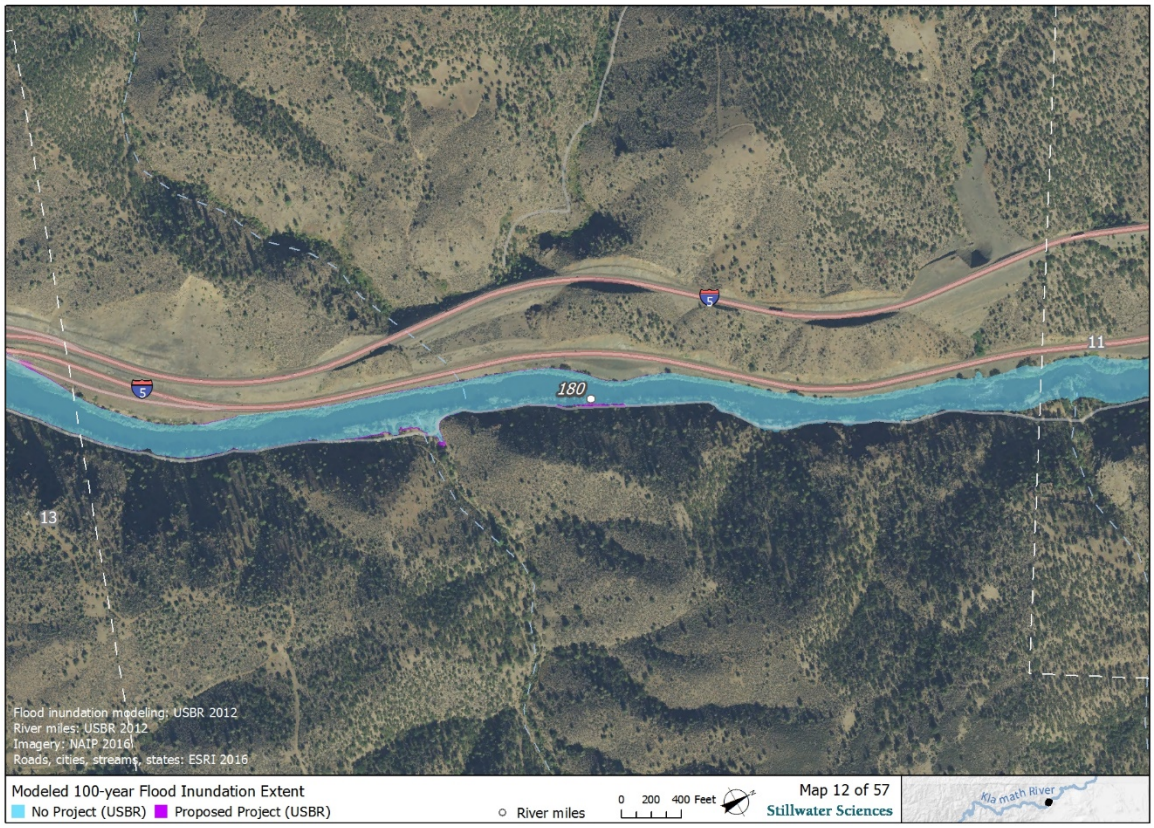

Dry Creek
8
188
Copco Rd
6
187
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 7 of 57
Stillwater Sciences
Klamath River

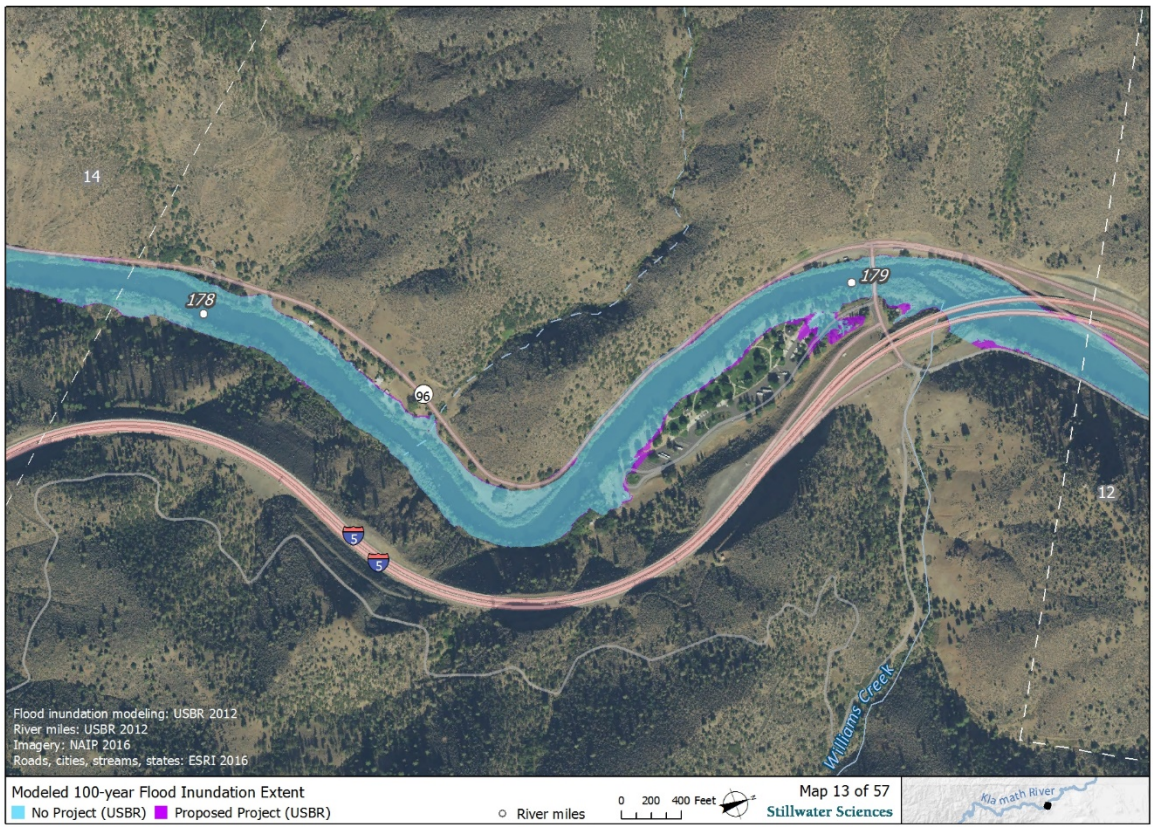

9
Copco Rd
7
185
187
186
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 8 of 57
Stillwater Sciences
Klamath River

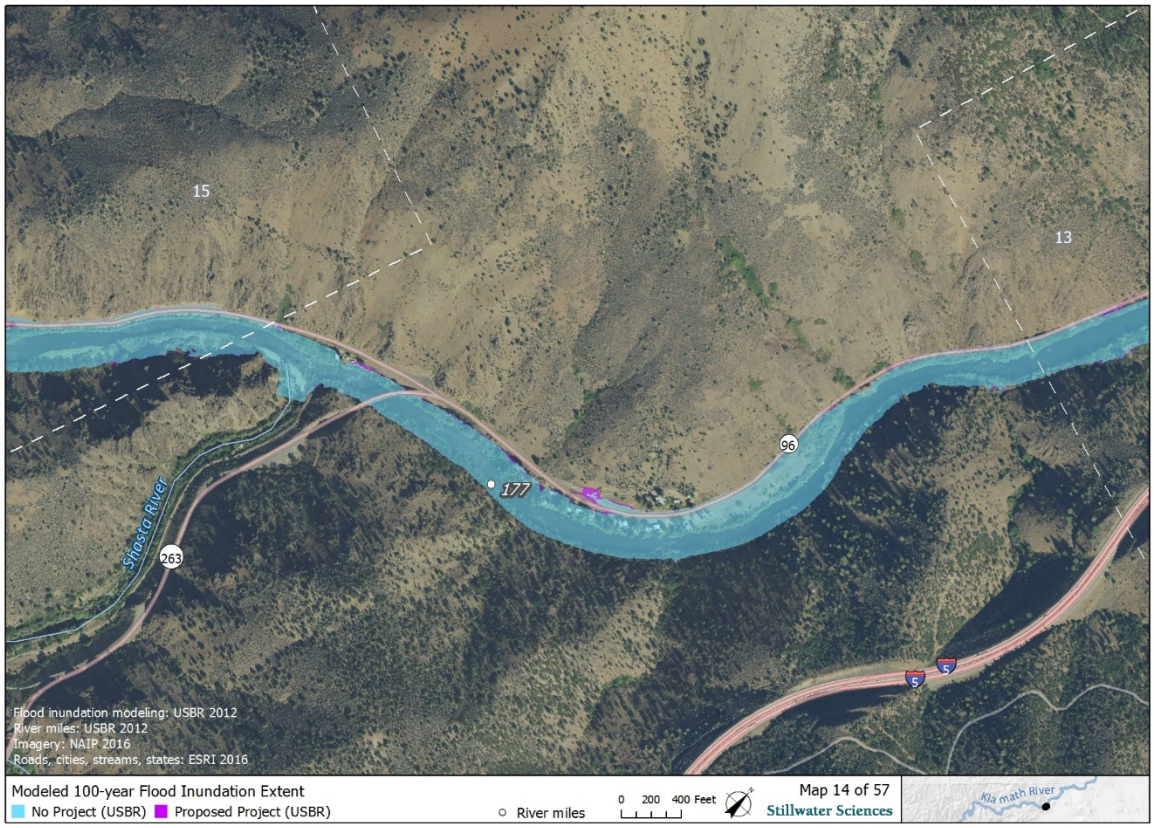

Cape Horn Creek
Ager Rd
Copco Rd
184
185
8
10
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 9 of 57
Stillwater Sciences
Klamath River


Ager Rd
183
11
9
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 10 of 57
Stillwater Sciences
Klamath River

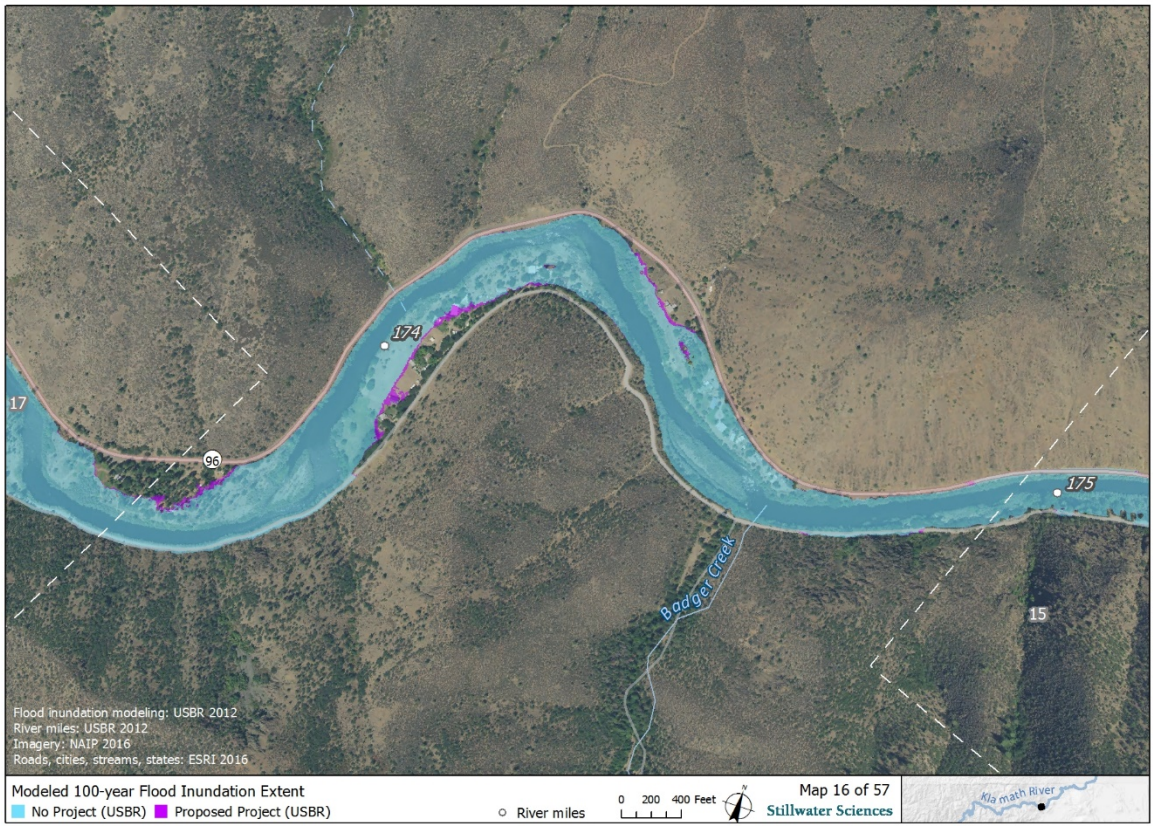

181
182
12
10
5
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 11 of 57
Stillwater Sciences
Klamath River

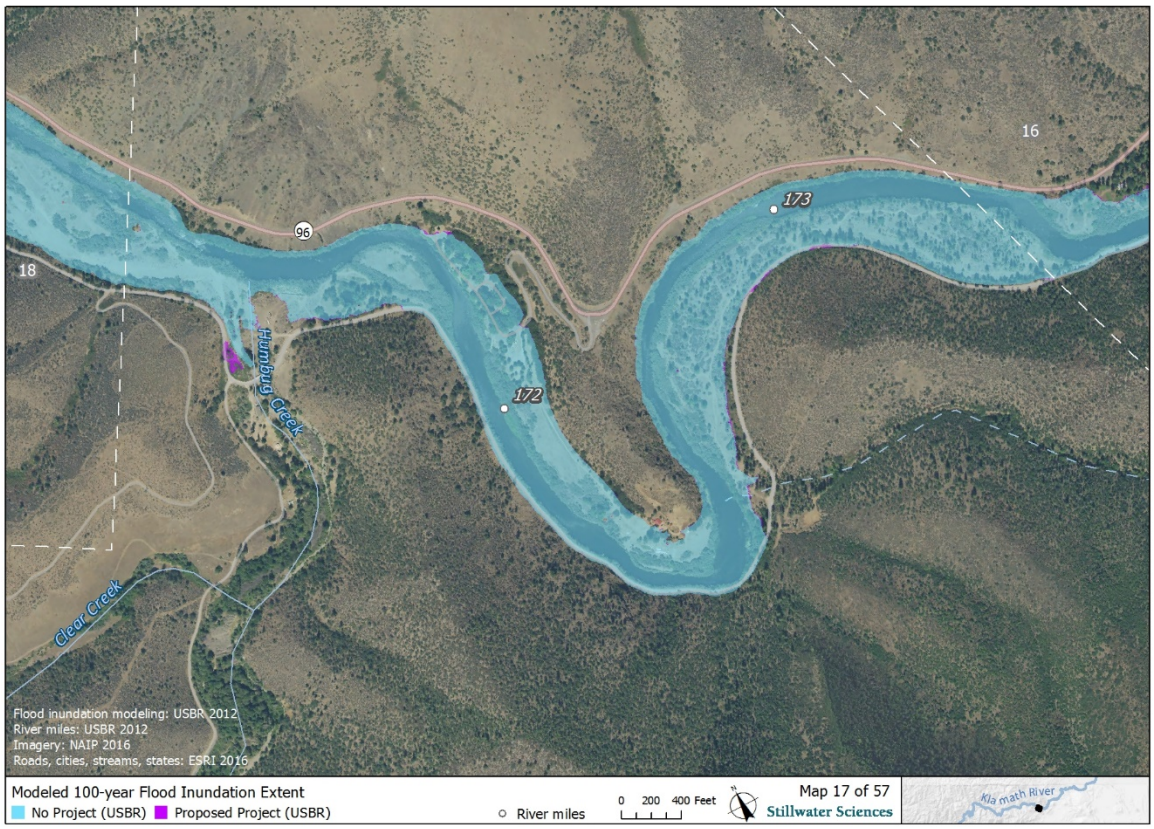

180
11
13
5
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 12 of 57
Stillwater Sciences
Klamath River

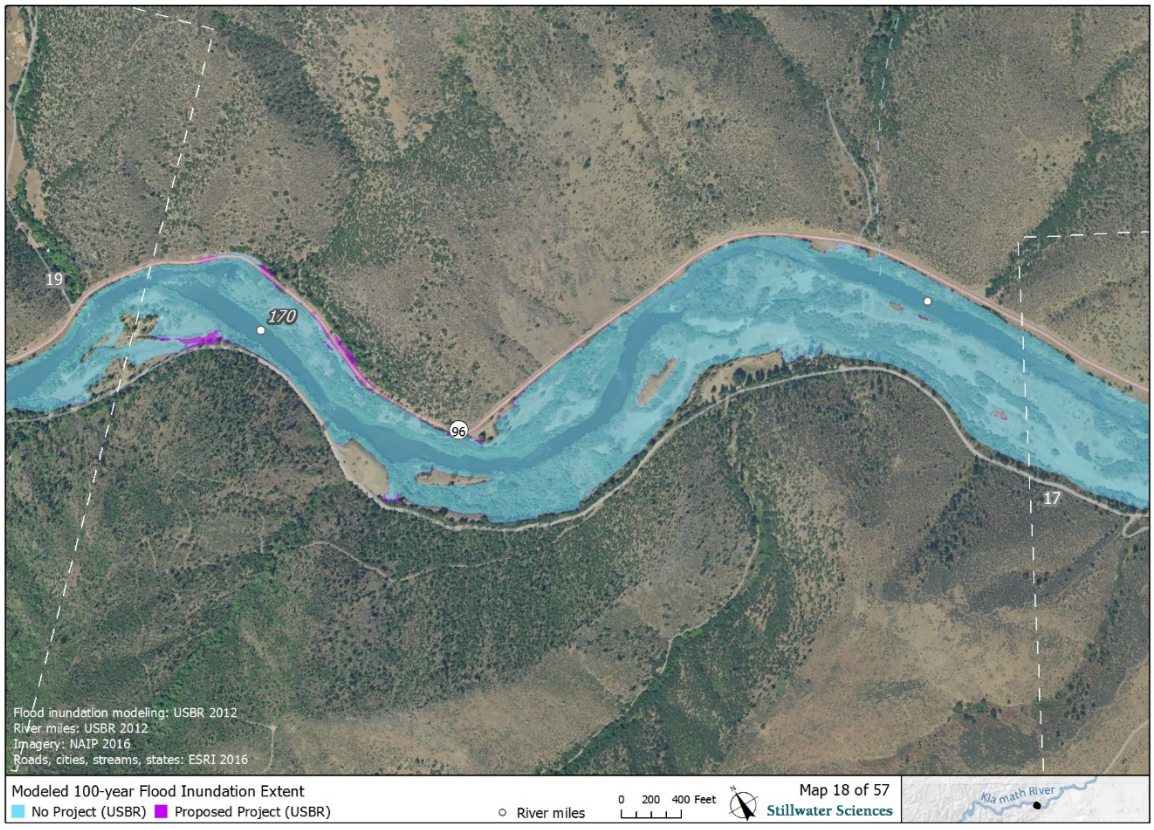

14
178
179
96
12
5
5
Williams Creek
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 13 of 57
Stillwater Sciences
Klamath River

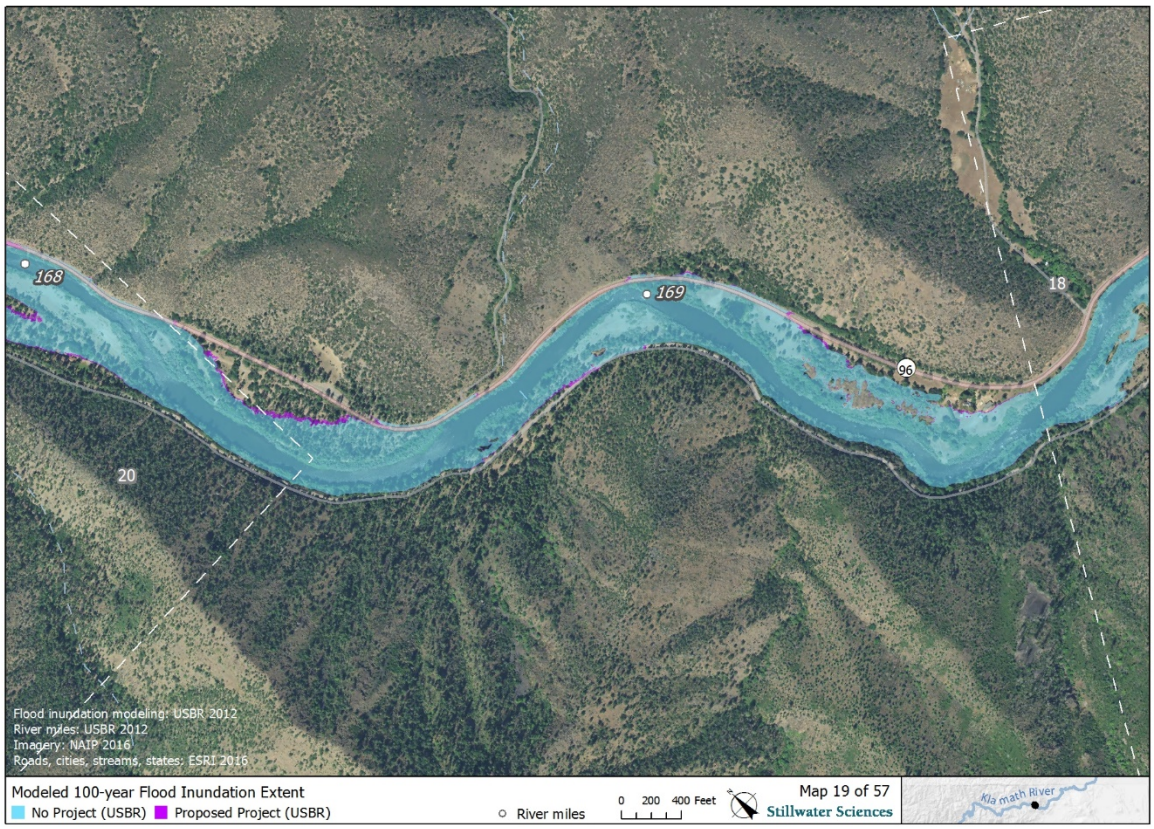

15
13
96
177
Shasta River
263
5
5
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 14 of 57
Stillwater Sciences
Klamath River

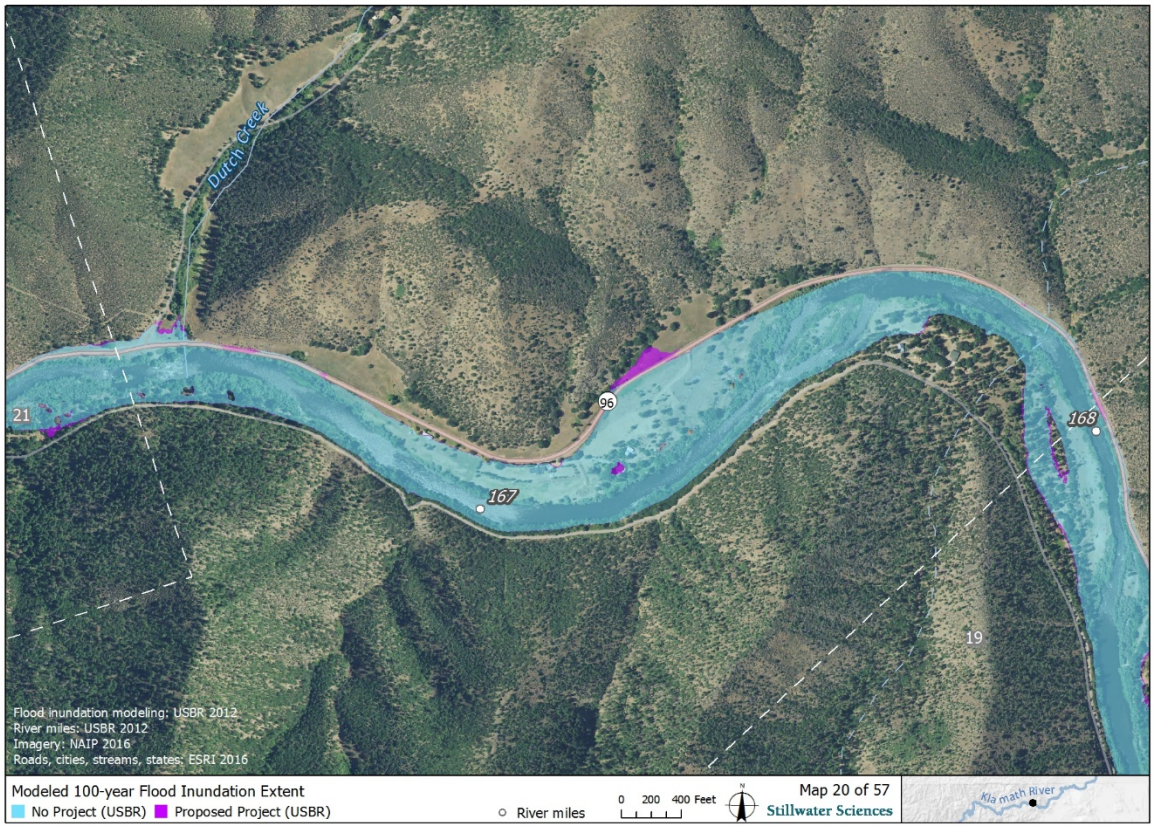

Ash Creek
14
176
175
16
96
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 15 of 57
Stillwater Sciences
Klamath River


174
17
96
175
Badger Creek
15
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 16 of 57
Stillwater Sciences
Klamath River

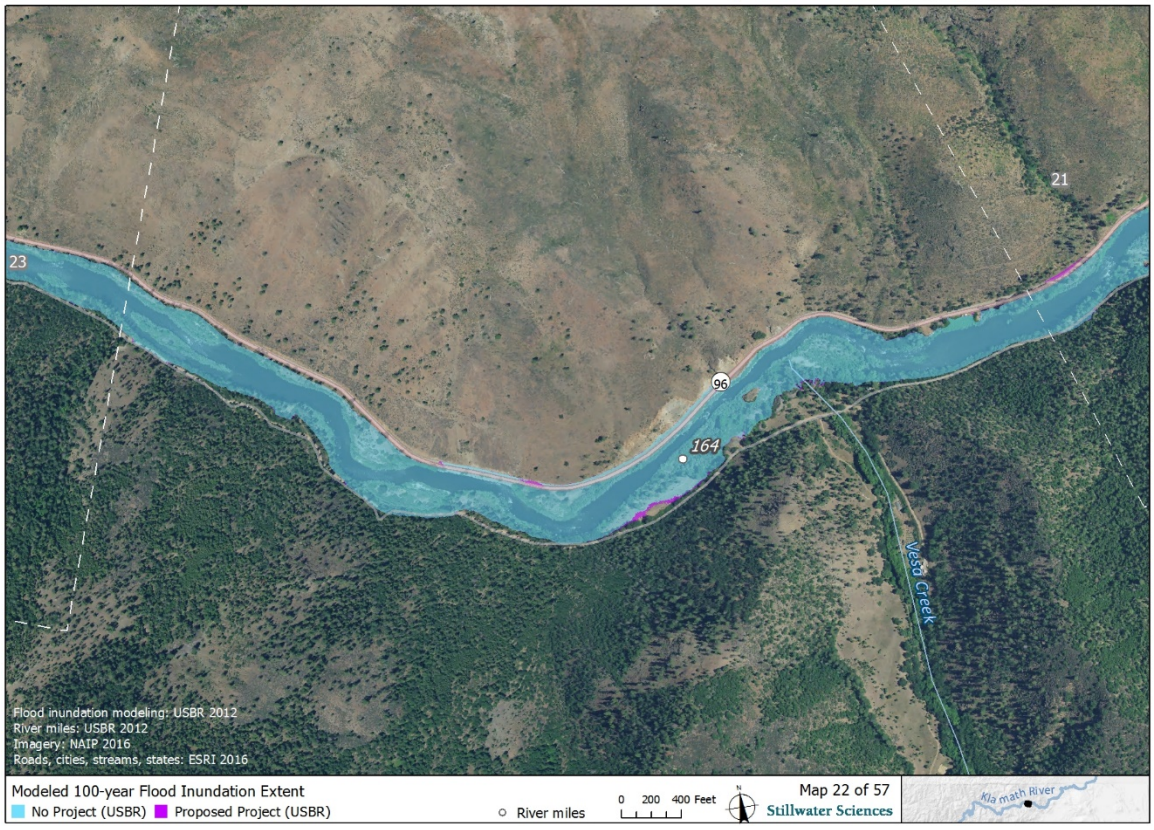

16
173
96
18
Humbug Creek
172
Clear Creek
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 17 of 57
Stillwater Sciences
Klamath River

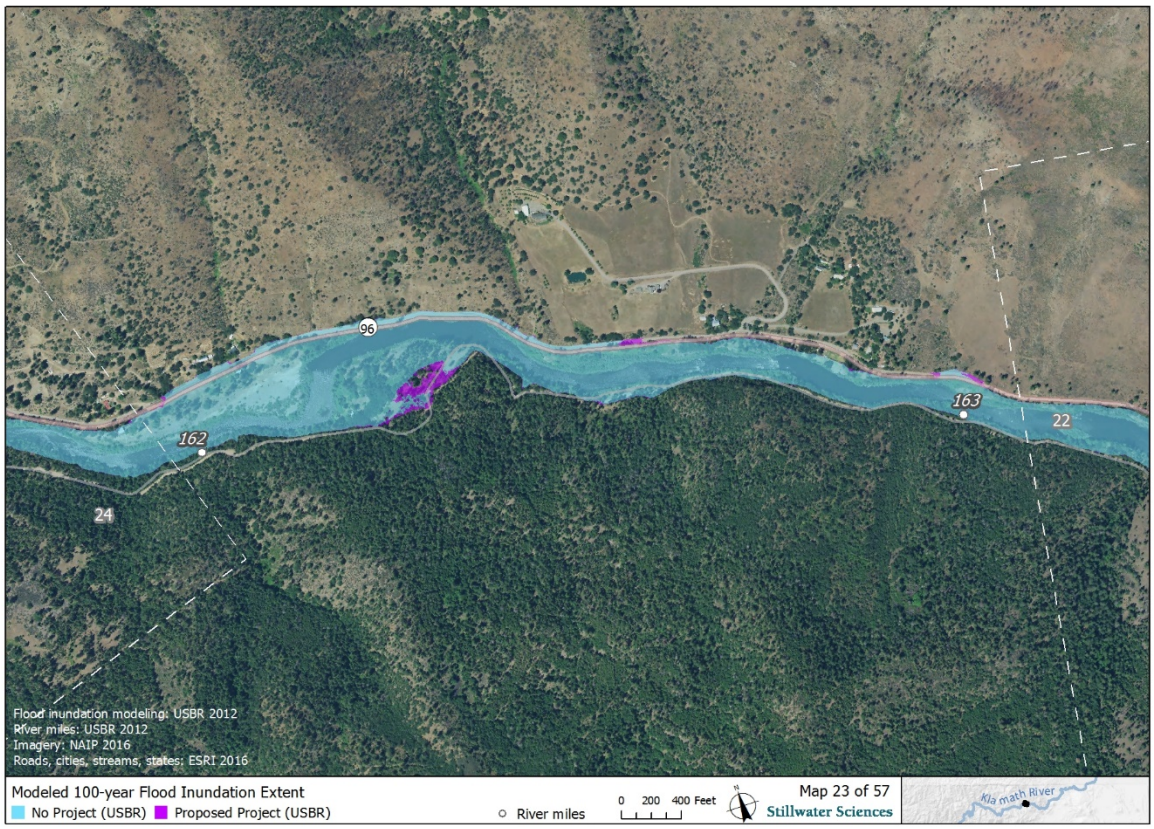

19
170
96
17
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 18 of 57
Stillwater Sciences
Klamath River

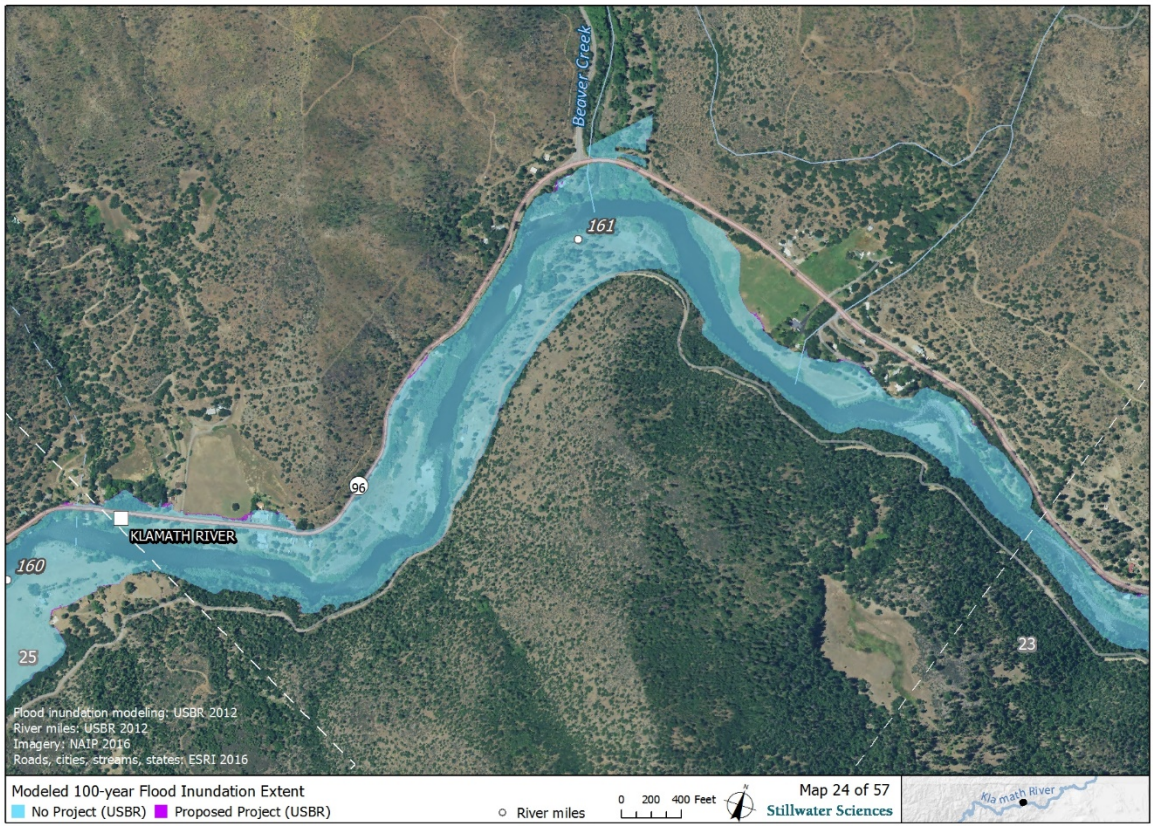

168
169
18
96
20
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 19 of 57
Stillwater Sciences
Klamath River

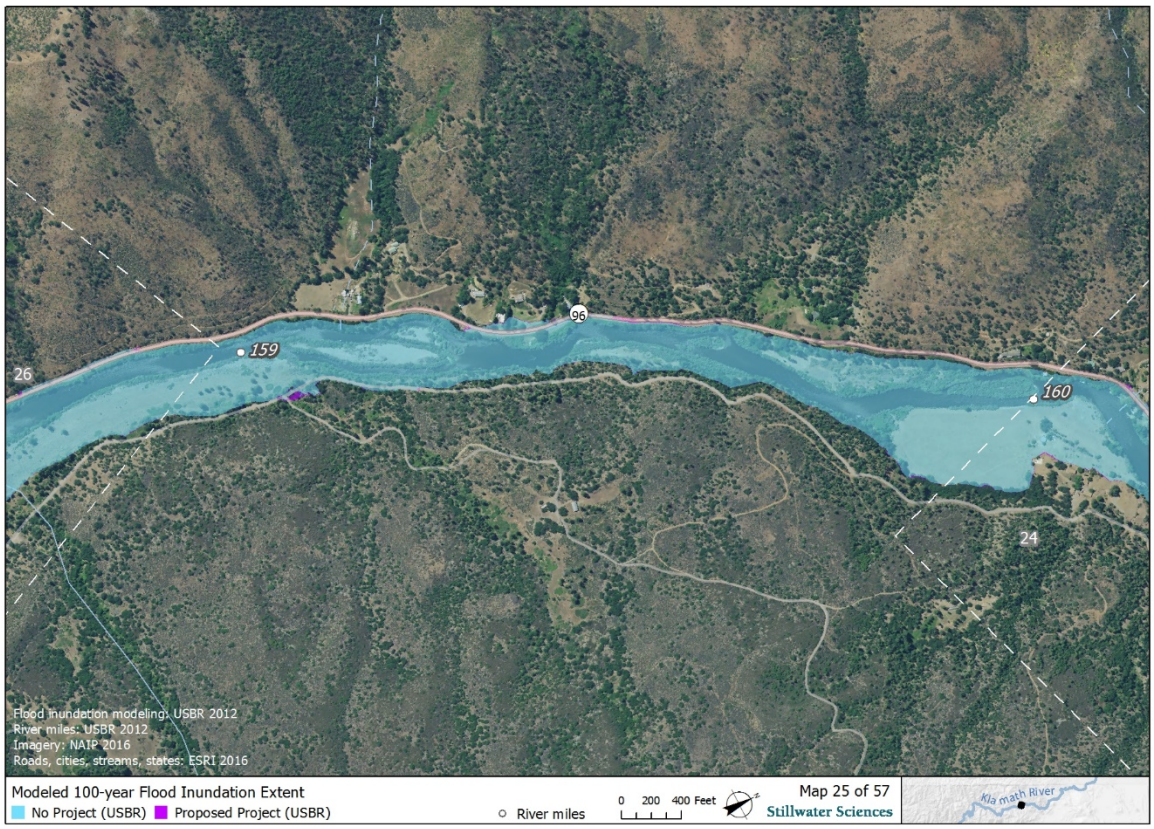

Dutch Creek
21
96
168
167
19
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 20 of 57
Stillwater Sciences
Klamath River

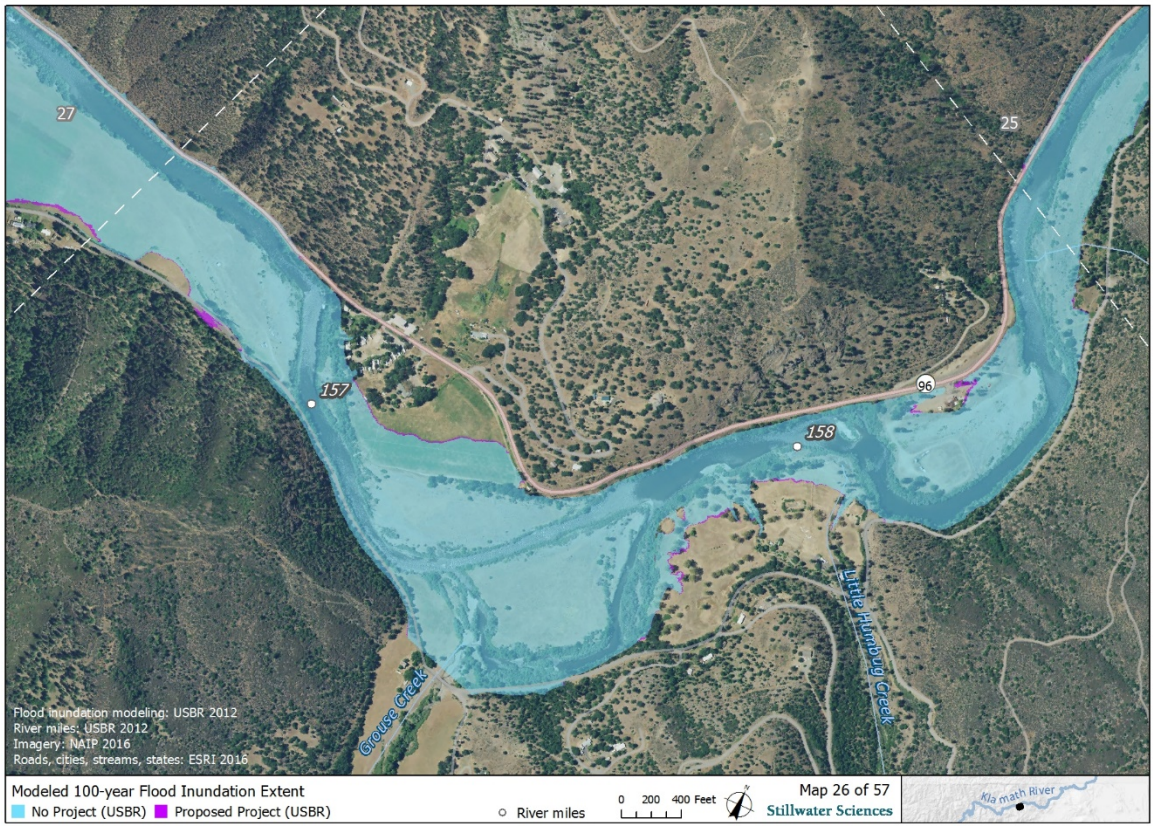

Lumgrey Creek
Empire Creek
96
166
22
165
20
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 21 of 57
Stillwater Sciences
Klamath River

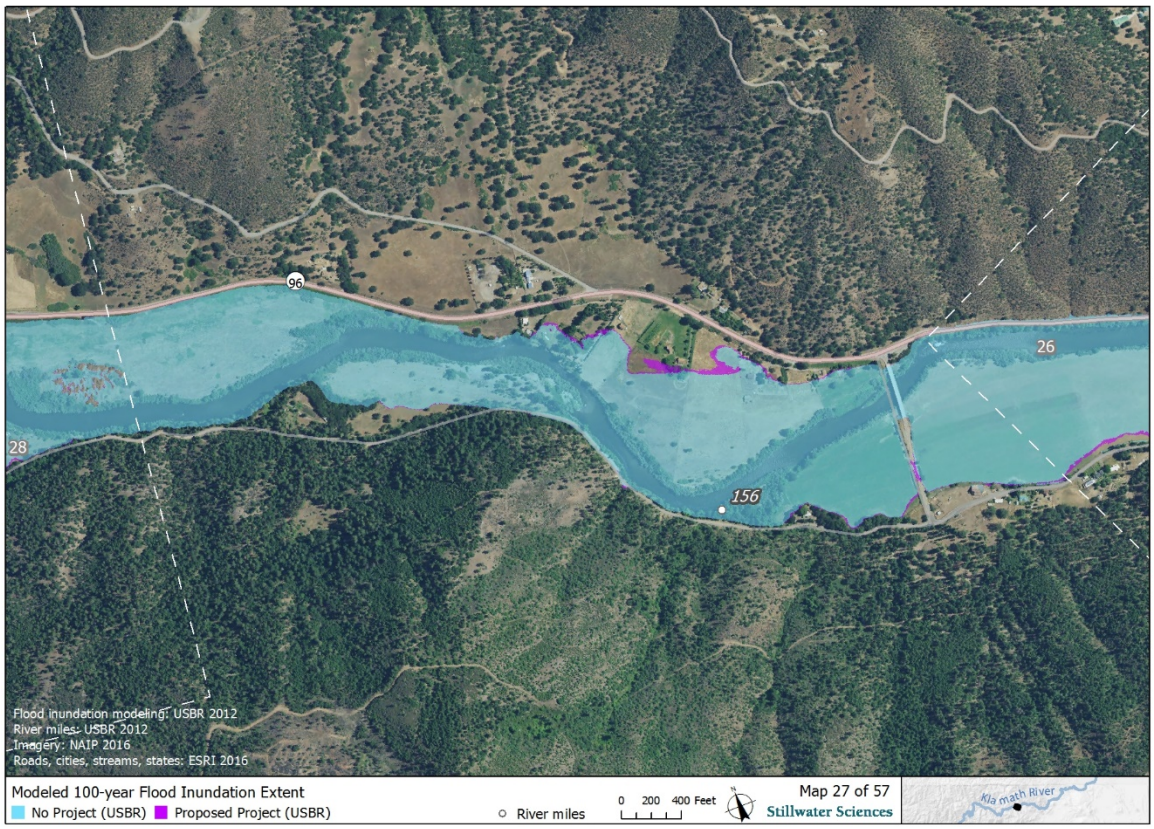

21
23
96
164
Vesa Creek
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 22 of 57
Stillwater Sciences
Klamath River

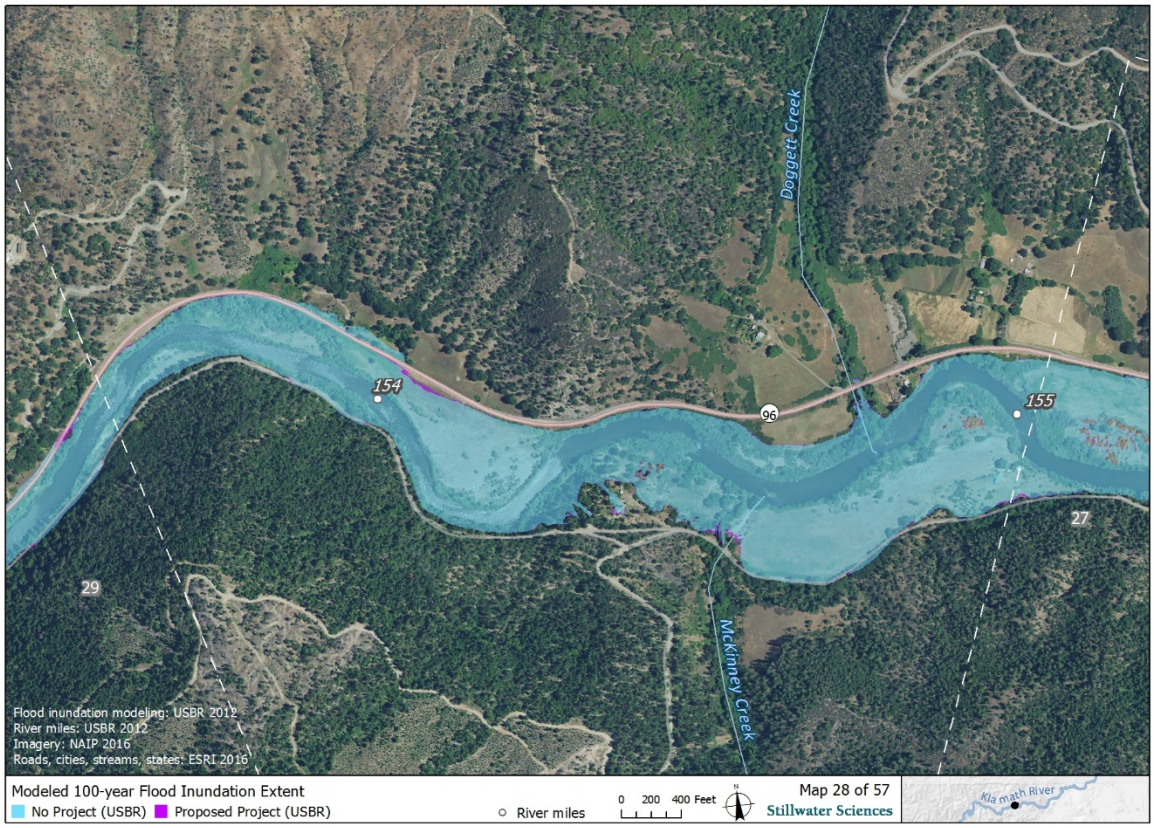

96
162
163
22
24
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 23 of 57
Stillwater Sciences
Klamath River

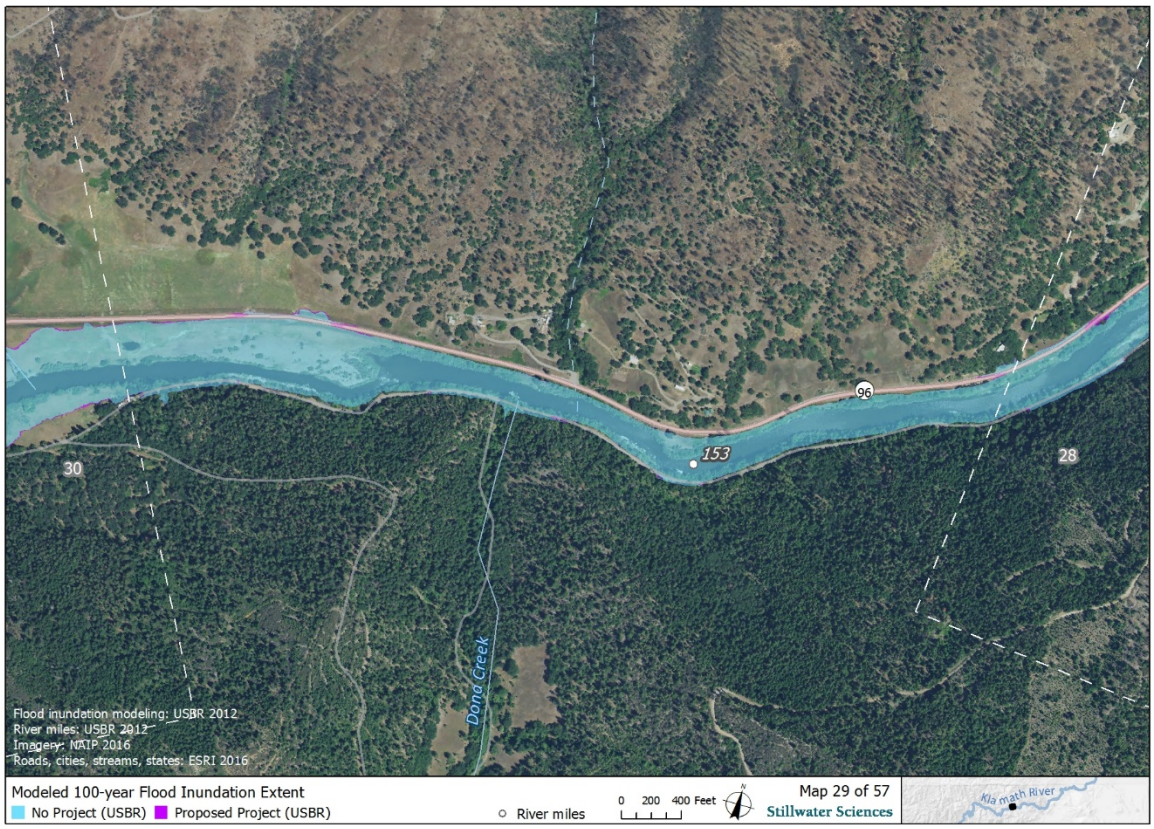

Beaver Creek
161
96
KLAMATH RIVER
160
25
23
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 24 of 57
Stillwater Sciences
Klamath River

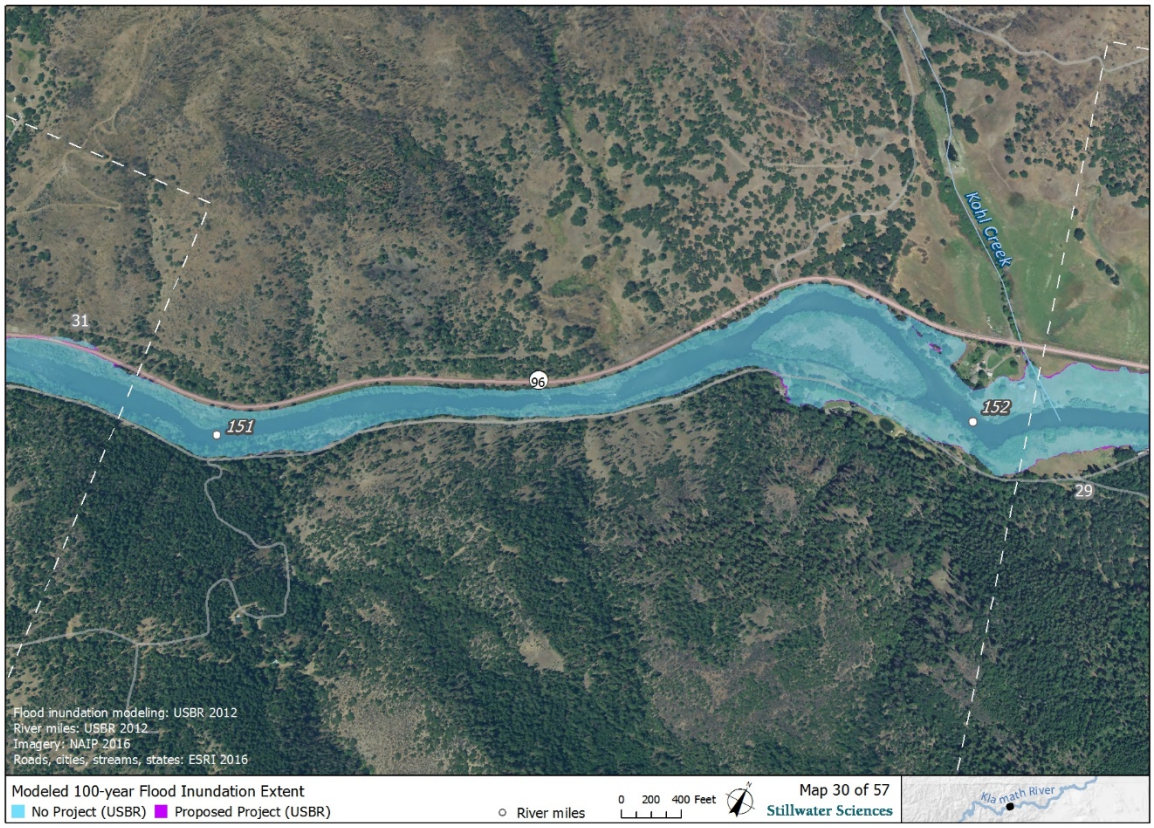

96
159
26
160
24
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 25 of 57
Stillwater Sciences
Klamath River

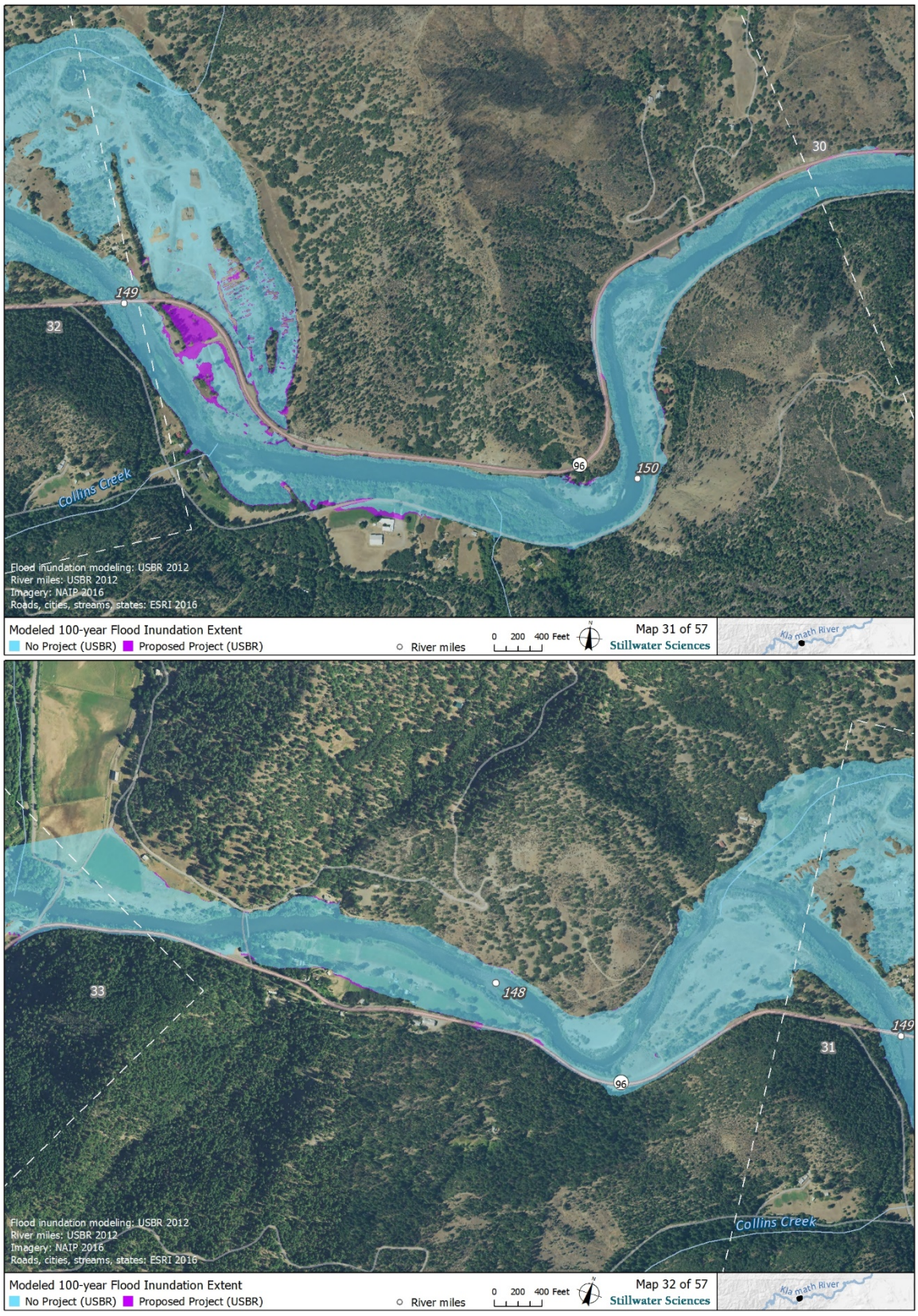

27
25
157
96
158
Little Humbug Creek
Grouse Creek
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 26 of 57
Stillwater Sciences
Klamath River

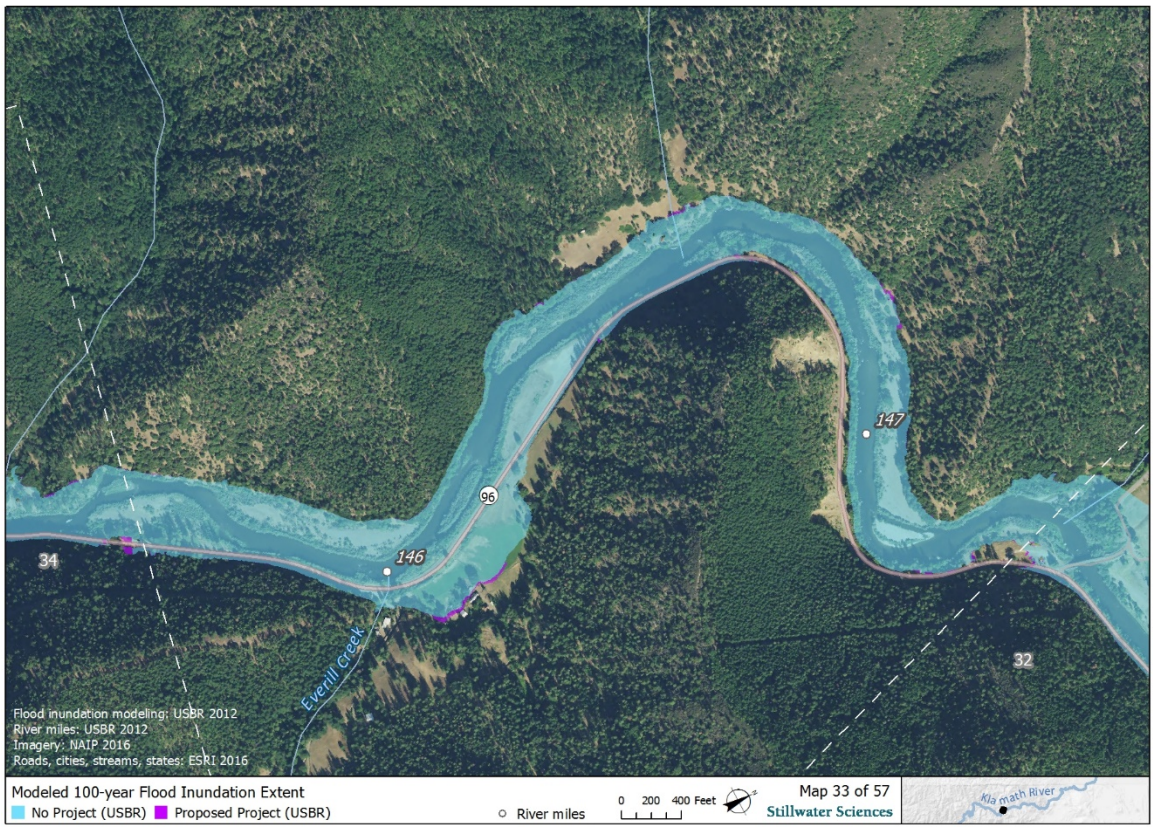

96
26
28
156
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 27 of 57
Stillwater Sciences
Klamath River

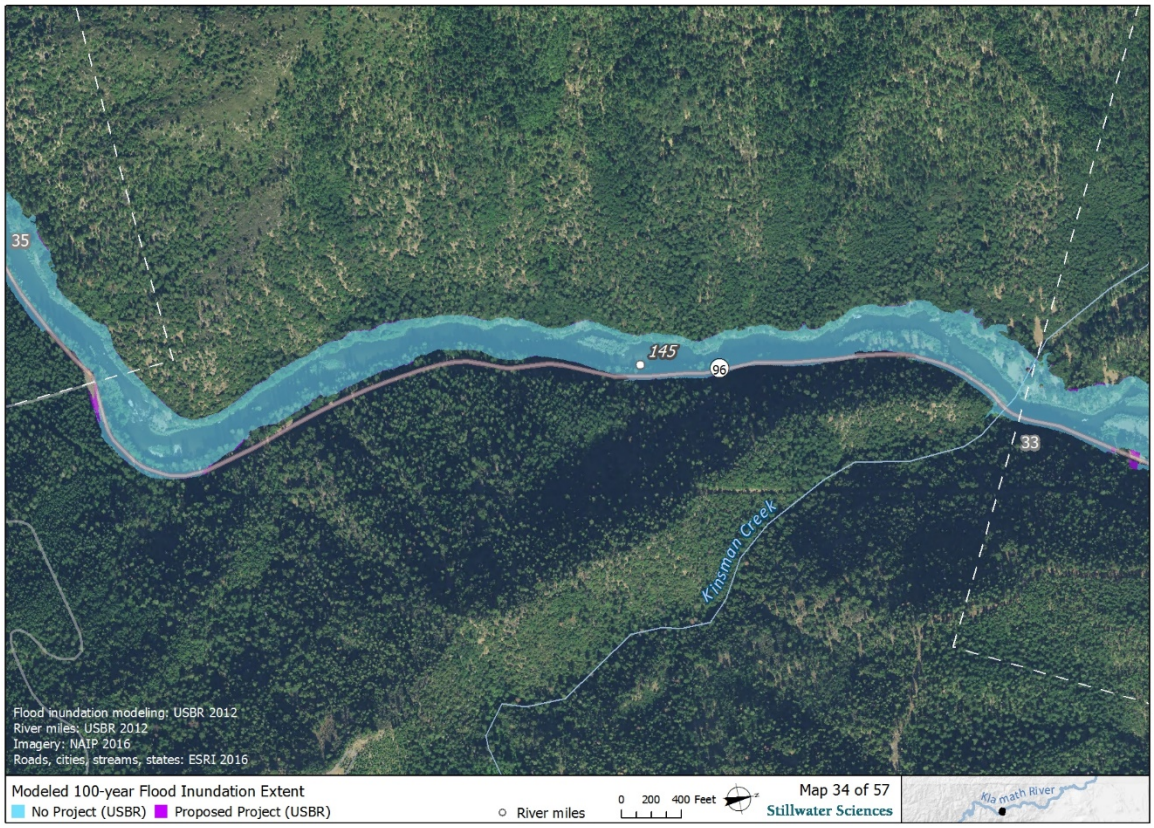

Doggett Creek
154
96
155
27
29
McKinney Creek
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 28 of 57
Stillwater Sciences
Klamath River


96
153
30
28
Dona Creek
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 29 of 57
Stillwater Sciences
Klamath River


Kohl Creek
31
96
151
152
29
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 30 of 57
Stillwater Sciences
Klamath River


30
149
32
96
150
Collins Creek
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 31 of 57
Stillwater Sciences
Klamath River
33
148
149
31
96
Collins Creek
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 32 of 57
Stillwater Sciences
Klamath River


147
95
146
34
Everill Creek
32
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 33 of 57
Stillwater Sciences
Klamath River


35
145
96
33
Kinsman Creek
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 34 of 57
Stillwater Sciences
Klamath River


142
34
144
36
96
Tom Martin Creek
143
Scott River
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 35 of 57
Stillwater Sciences
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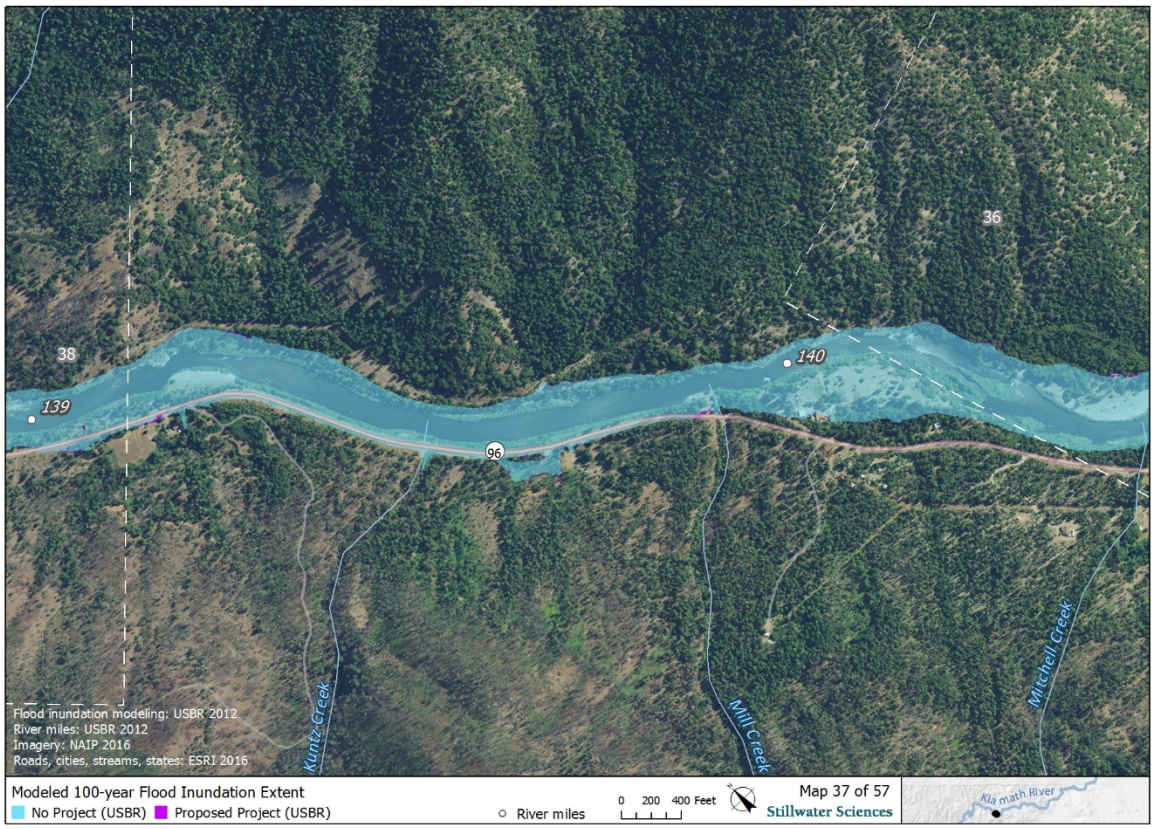
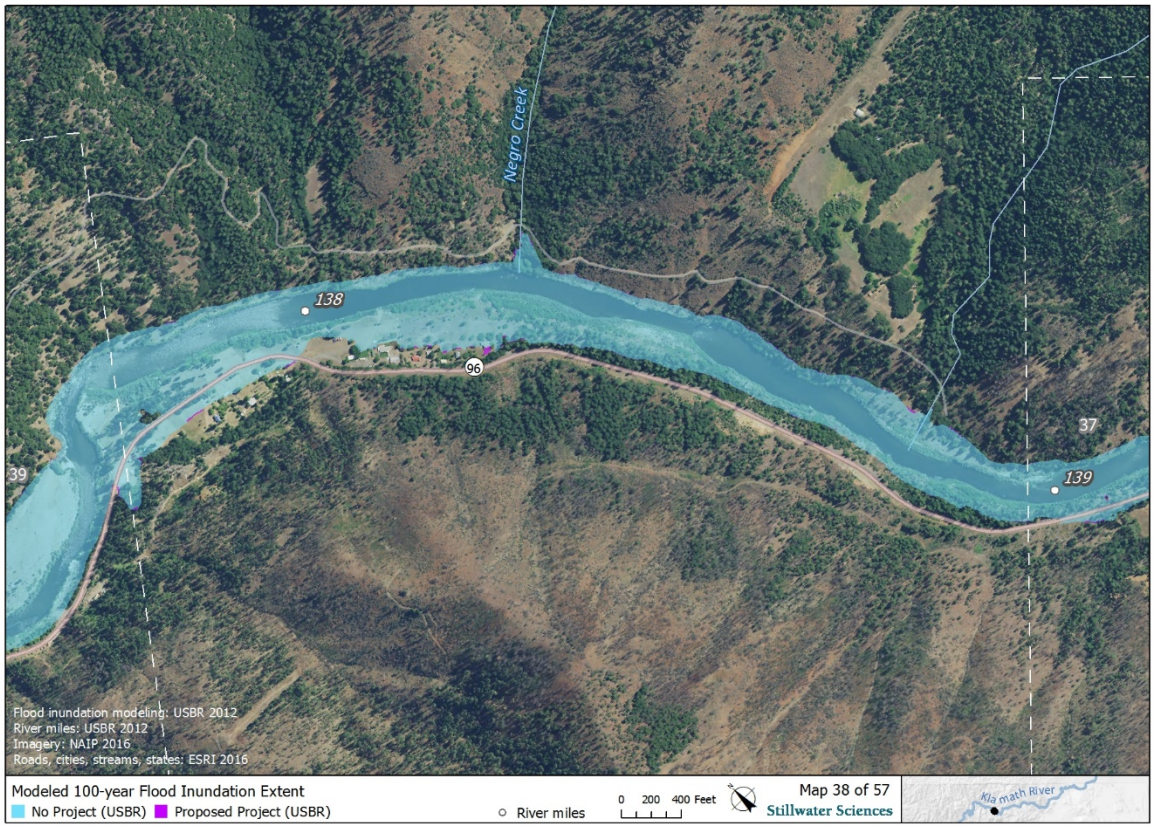
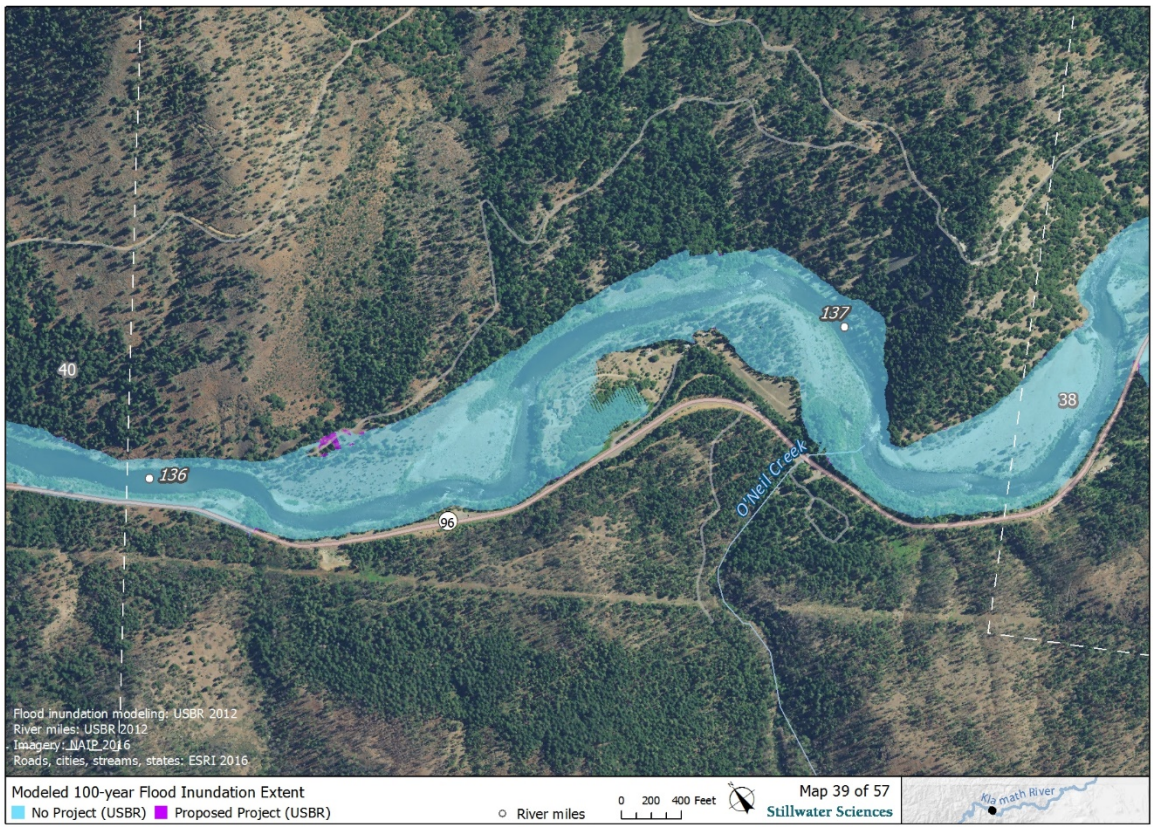
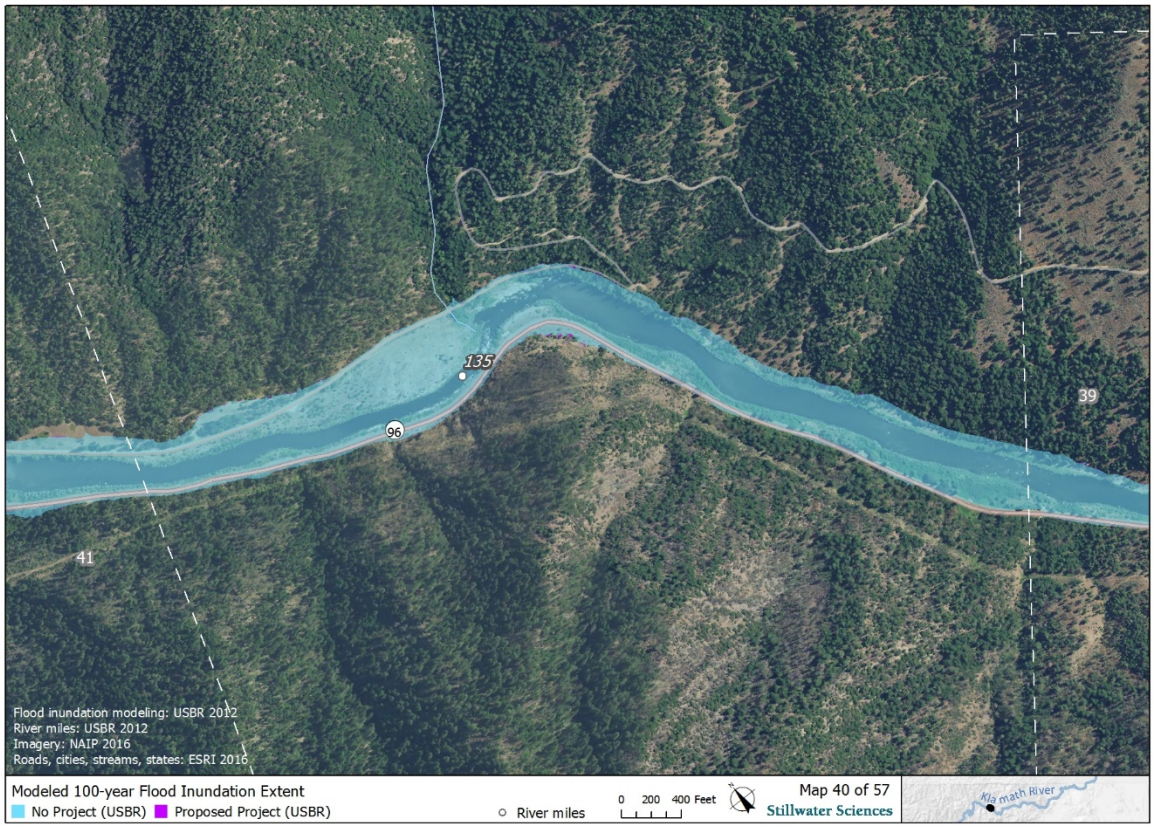
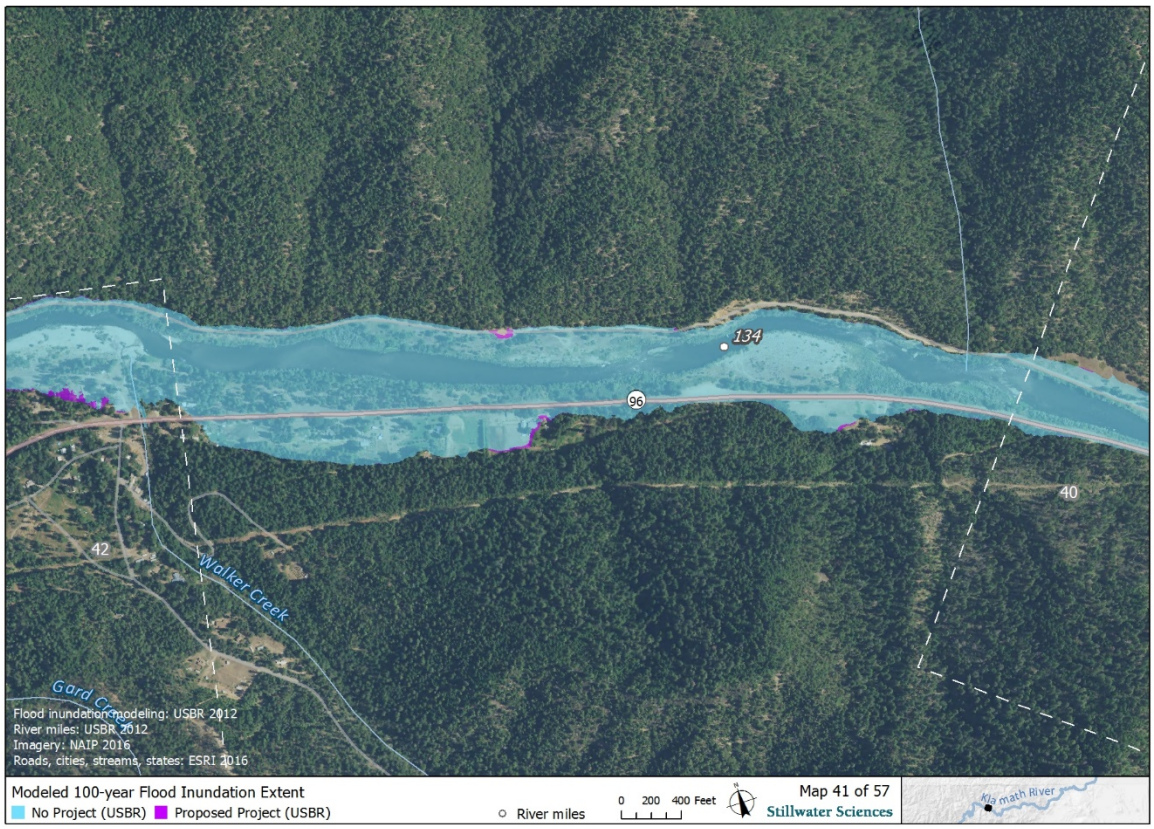
37
141
142
HAMBURG
96
Macks Creek
35
Tom Martin Creek
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 36 of 57
Stillwater Sciences
Klamath River

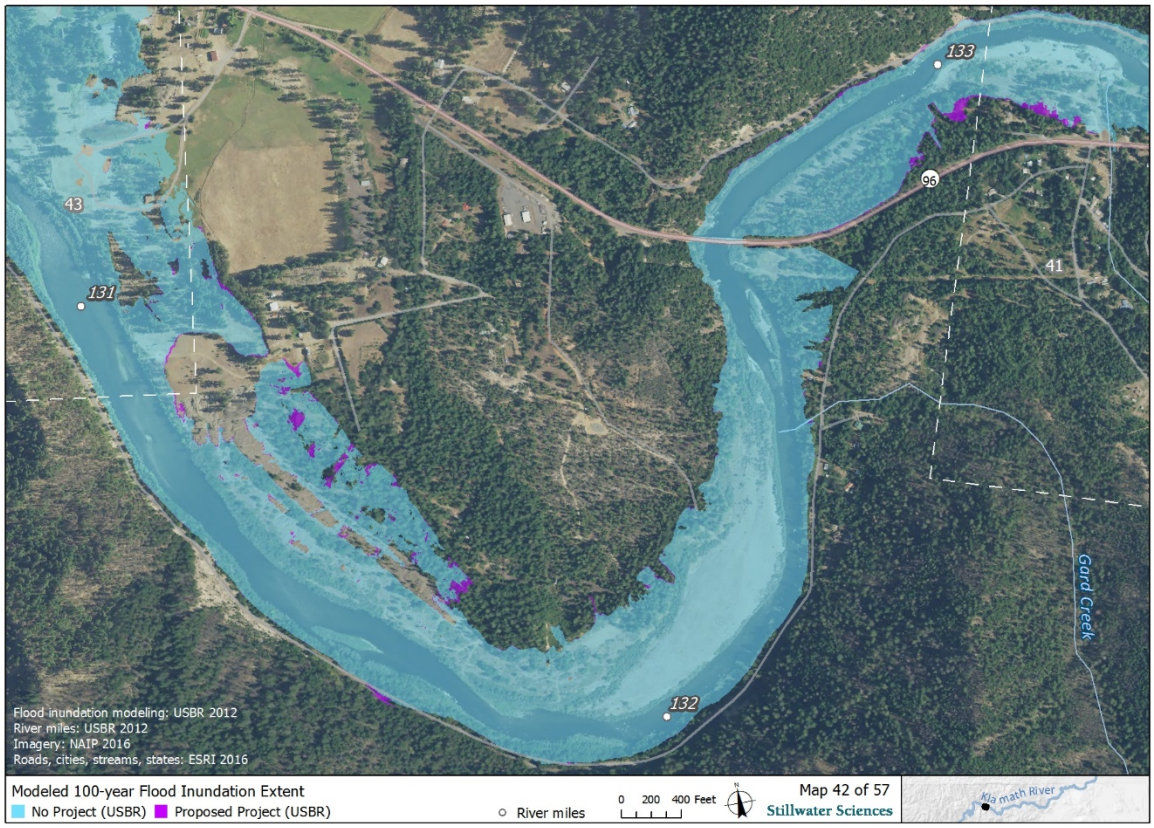

36
38
140
139
96
Kuntz Creek
Mill Creek
Mitchell Creek
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 37 of 57
Stillwater Sciences
Klamath River

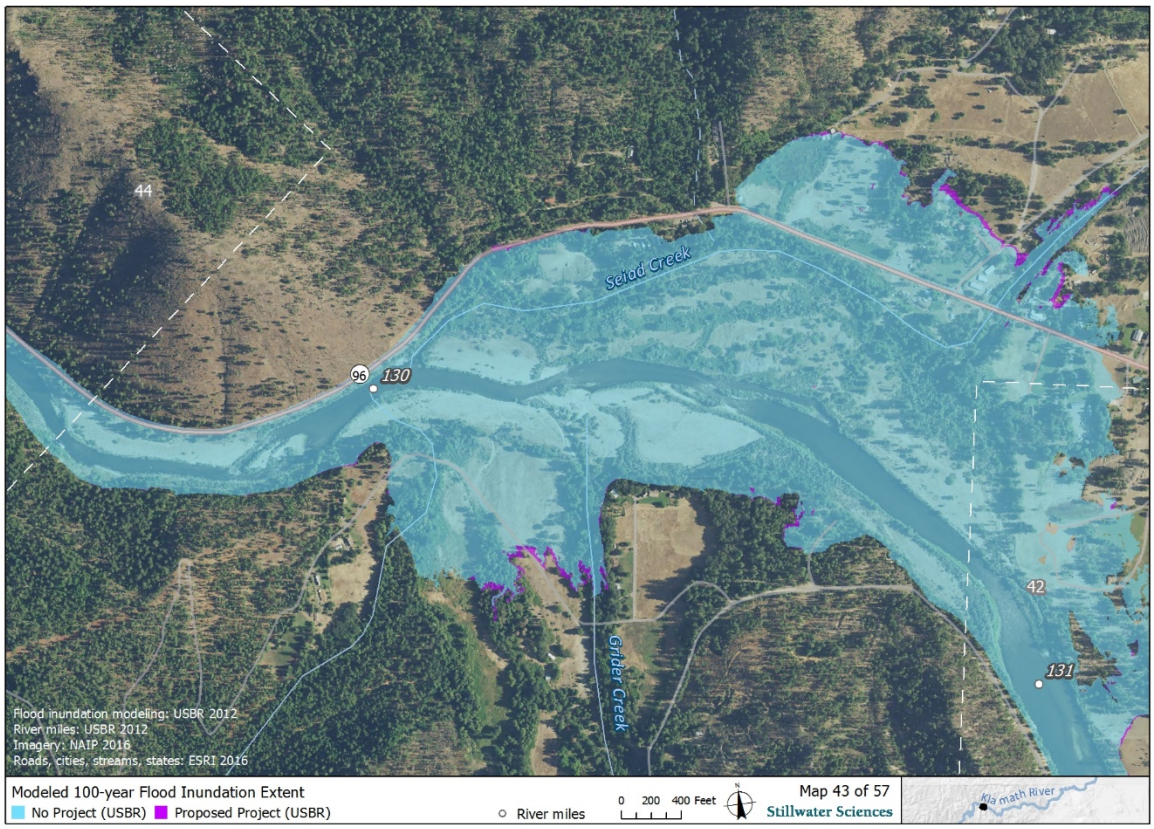

Negro Creek
138
96
37
39
139
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 38 of 57
Stillwater Sciences
Klamath River


137
40
38
136
96
O'Neil Creek
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 39 of 57
Stillwater Sciences
Klamath River


135
96
39
41
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 40 of 57
Stillwater Sciences
Klamath River

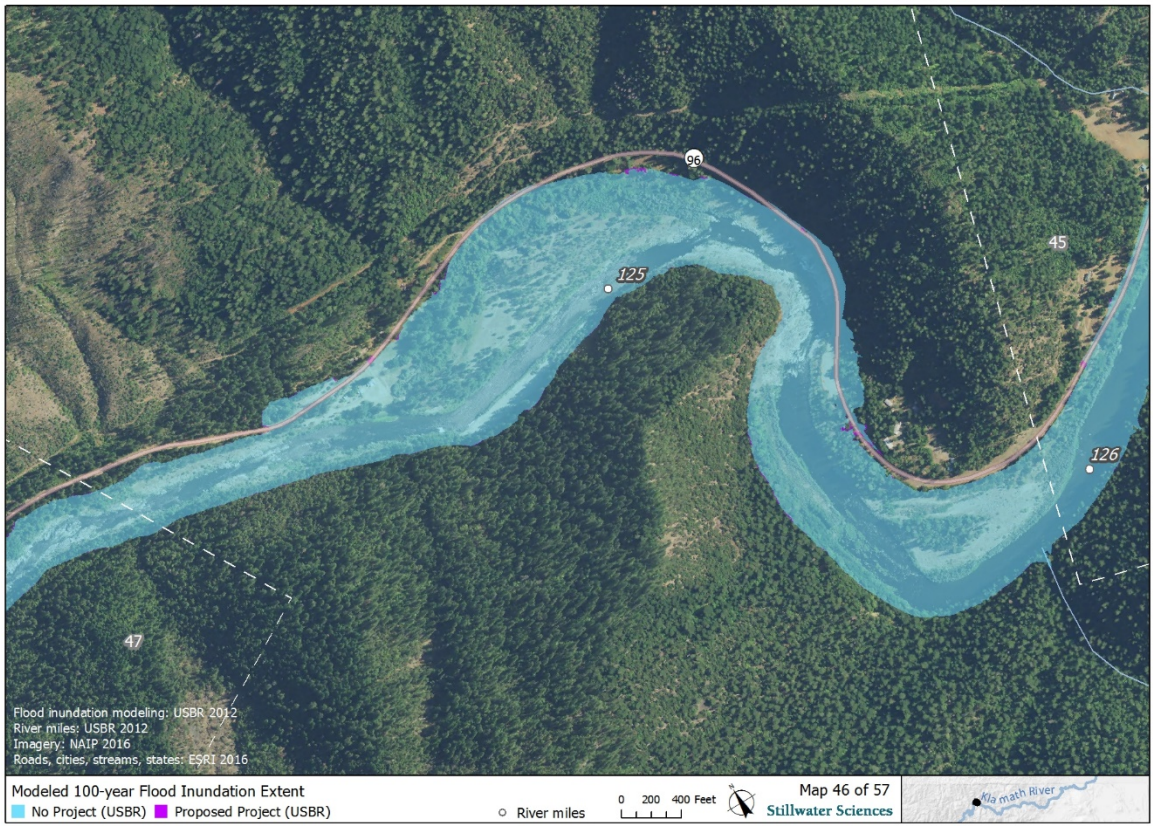

134
96
40
42
Walker Creek
Gard Creek
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 41 of 57
Stillwater Sciences
Klamath River

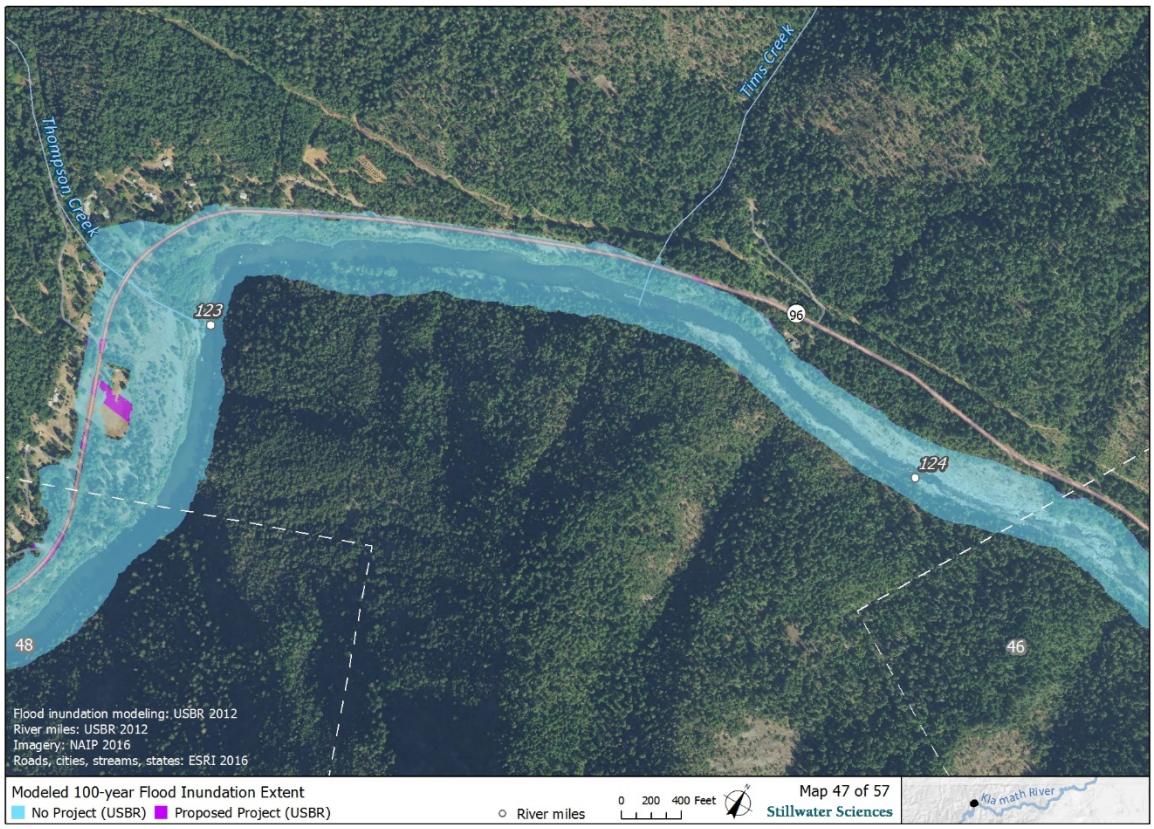

133
96
43
41
131
Gard Creek
132
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 42 of 57
Stillwater Sciences
Klamath River

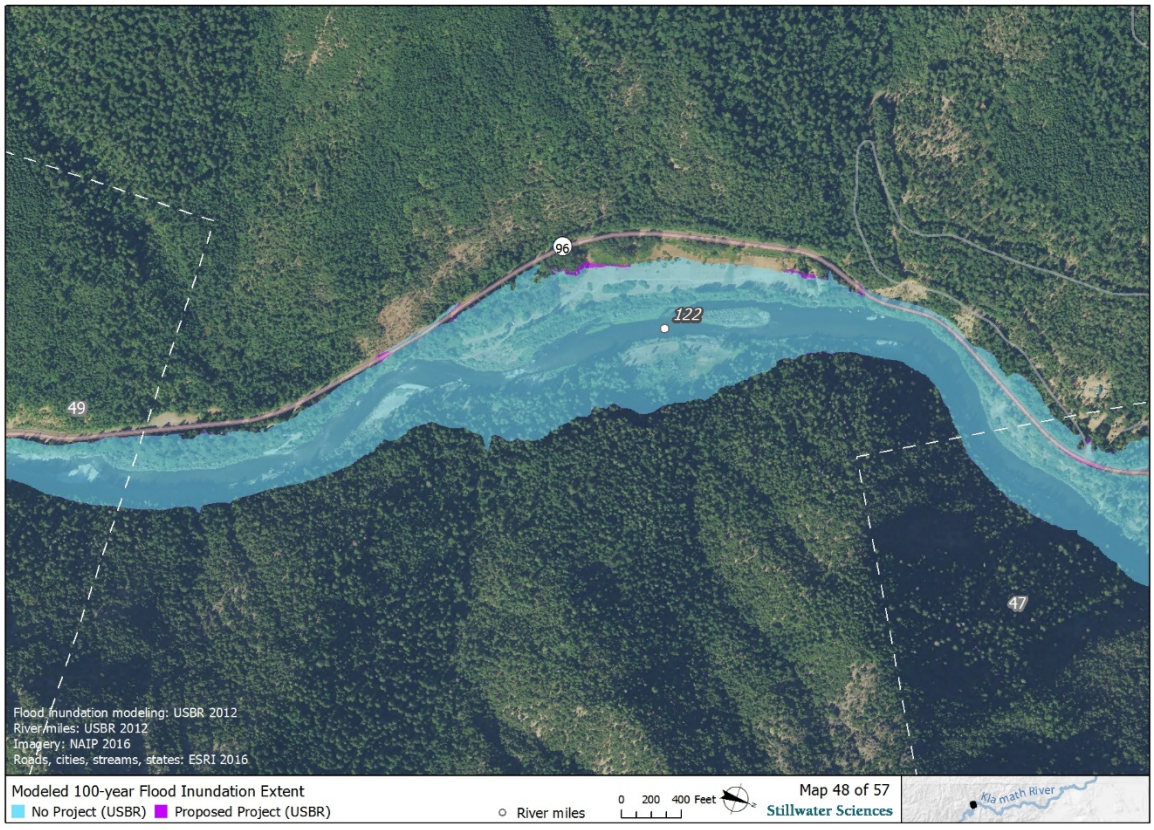

44
Seiad Creek
96
130
42
Grider Creek
131
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 43 of 57
Stillwater Sciences
Klamath River

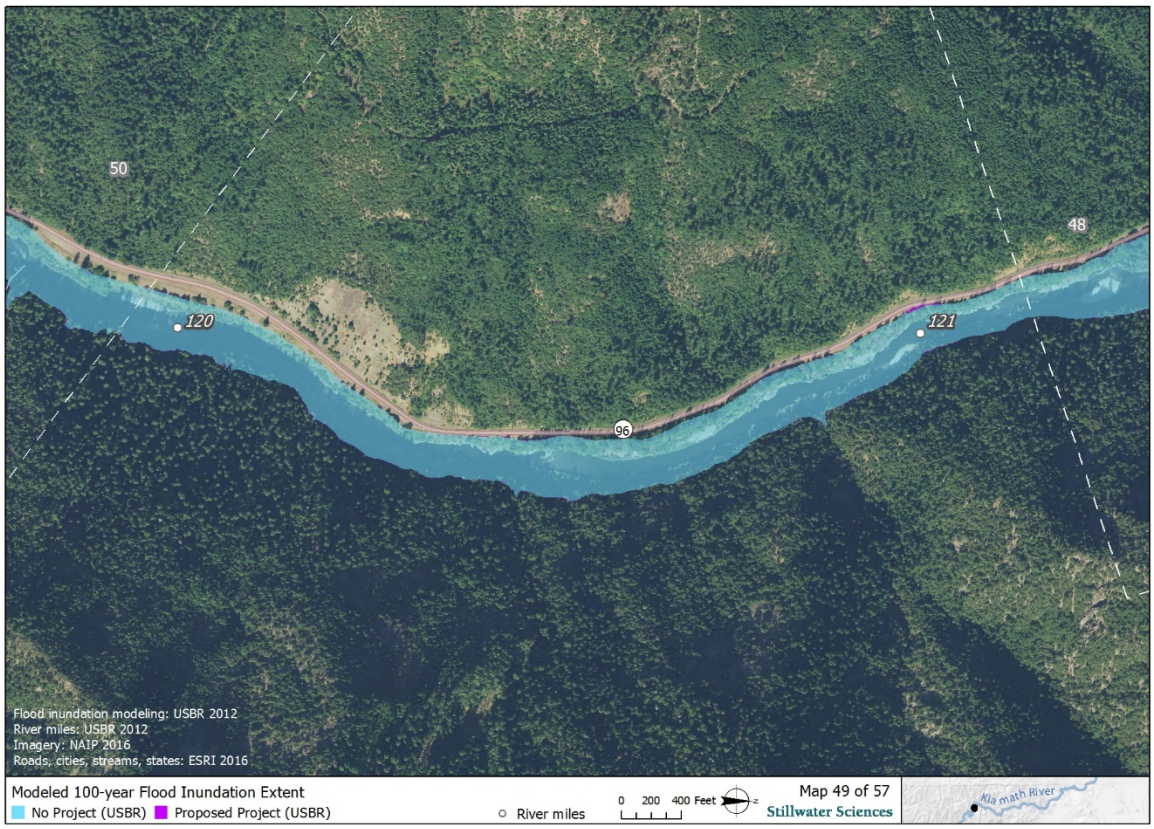

43
96
129
45
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 44 of 57
Stillwater Sciences
Klamath River


Middle Fork Fort Goff Creek
Portuguese Creek
96
127
128
126
46
44
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 45 of 57
Stillwater Sciences
Klamath River


96
125
126
45
47
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 46 of 57
Stillwater Sciences
Klamath River

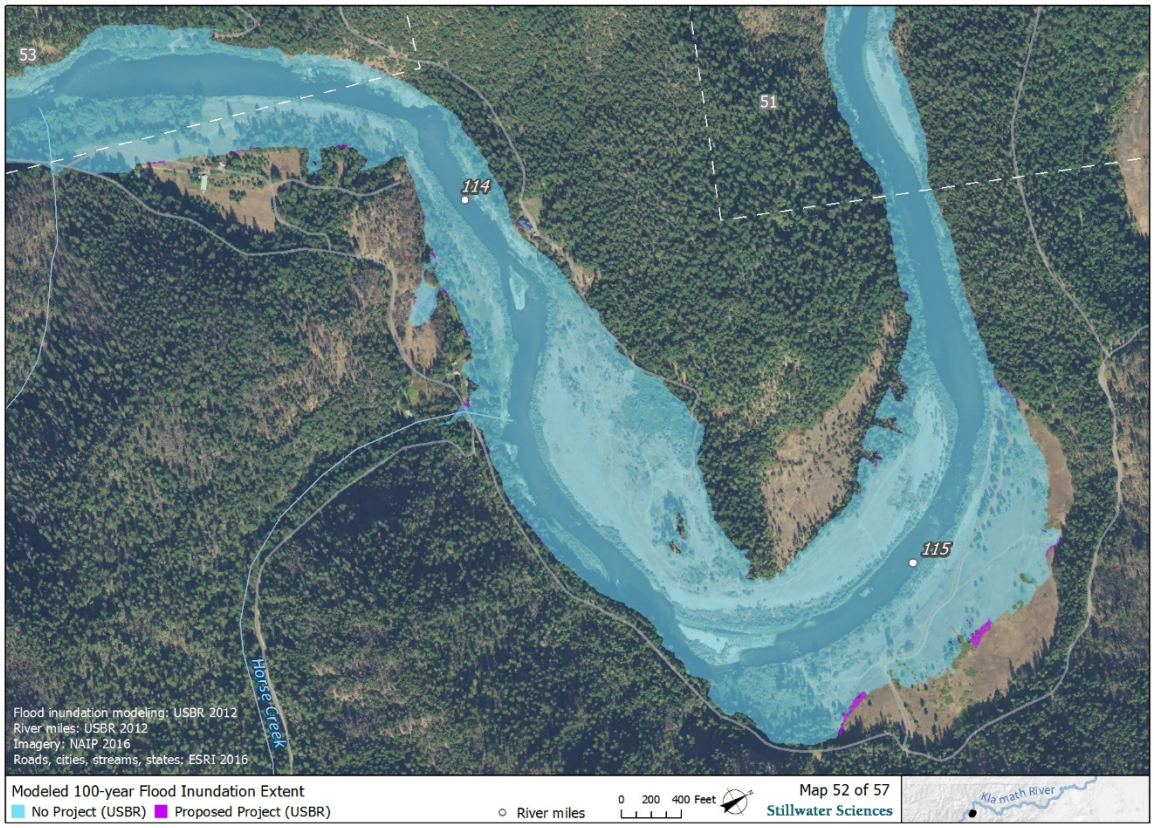

Thompson Creek
Tims Creek
123
124
96
48
46
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 47 of 57
Stillwater Sciences
Klamath River

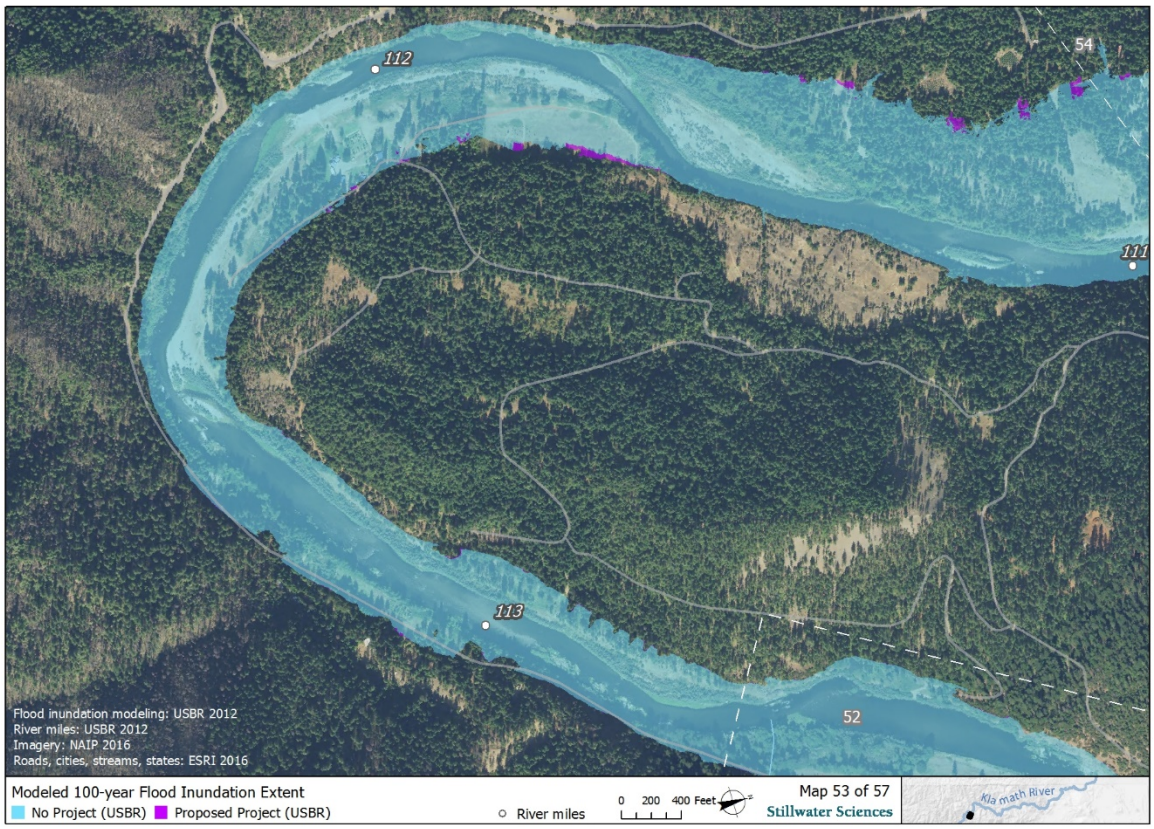

96
122
49
47
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 48 of 57
Stillwater Sciences
Klamath River

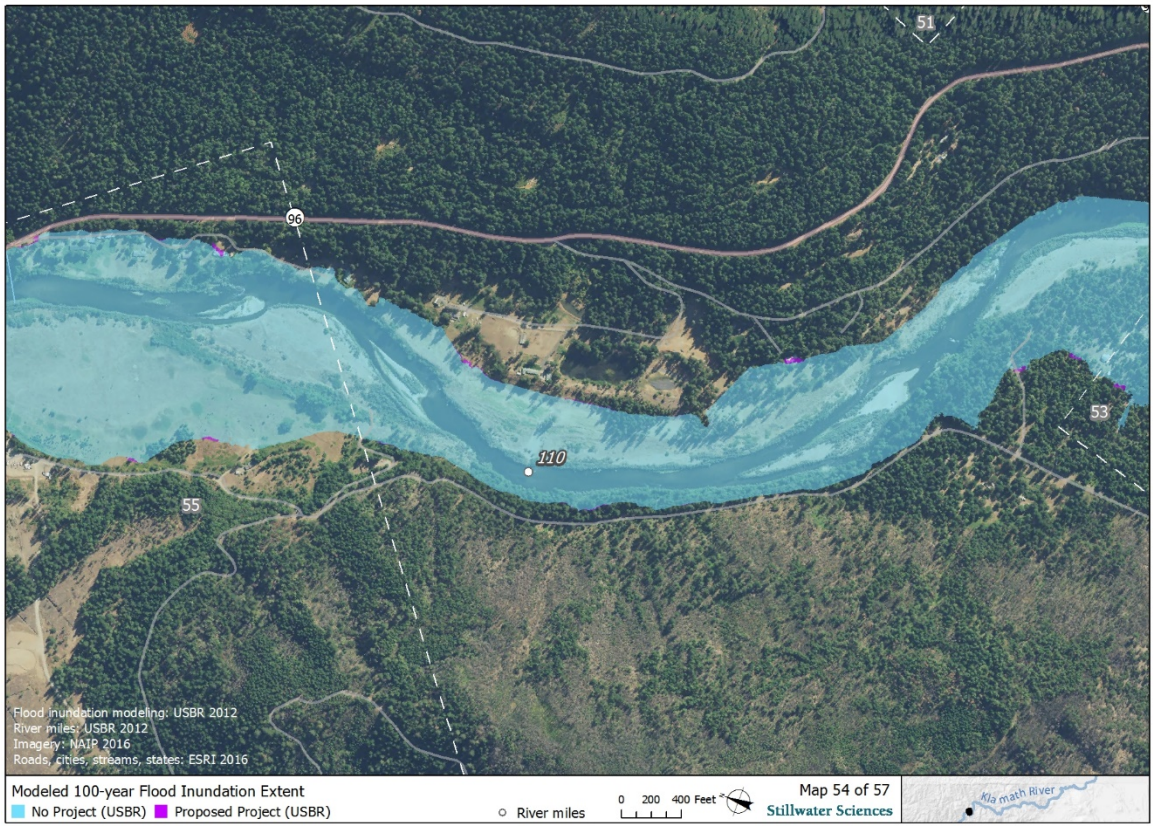

50
48
120
121
96
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 49 of 57
Stillwater Sciences
Klamath River

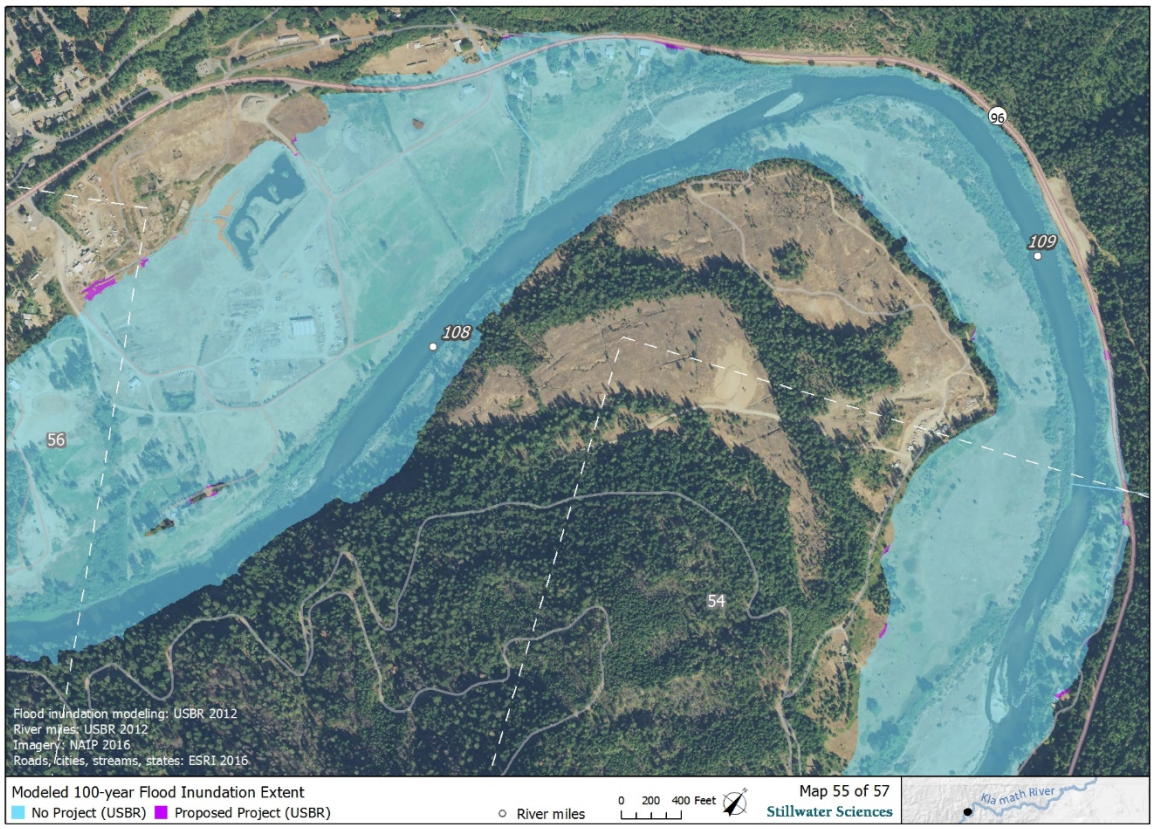

119
96
49
51
Joe Miles Creek
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 50 of 57
Stillwater Sciences
Klamath River

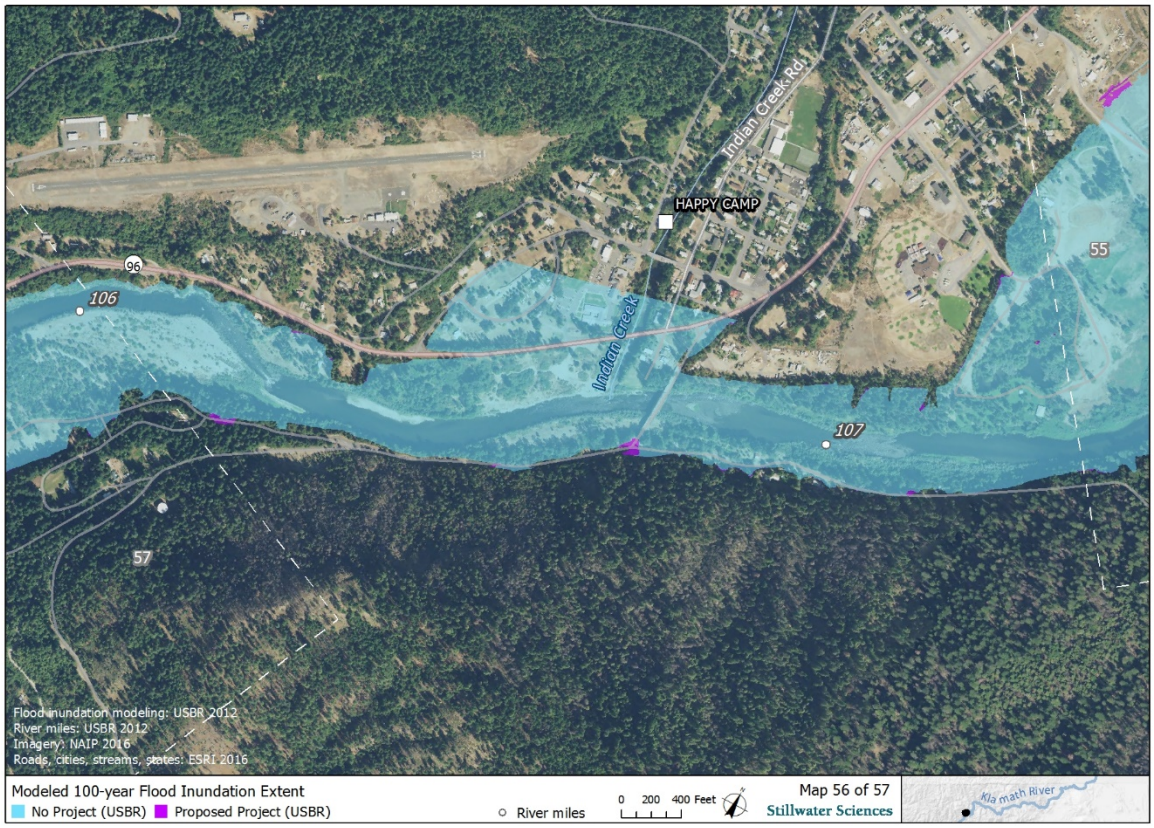

54
96
117
96
116
50
52
118
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 51 of 57
Stillwater Sciences
Klamath River

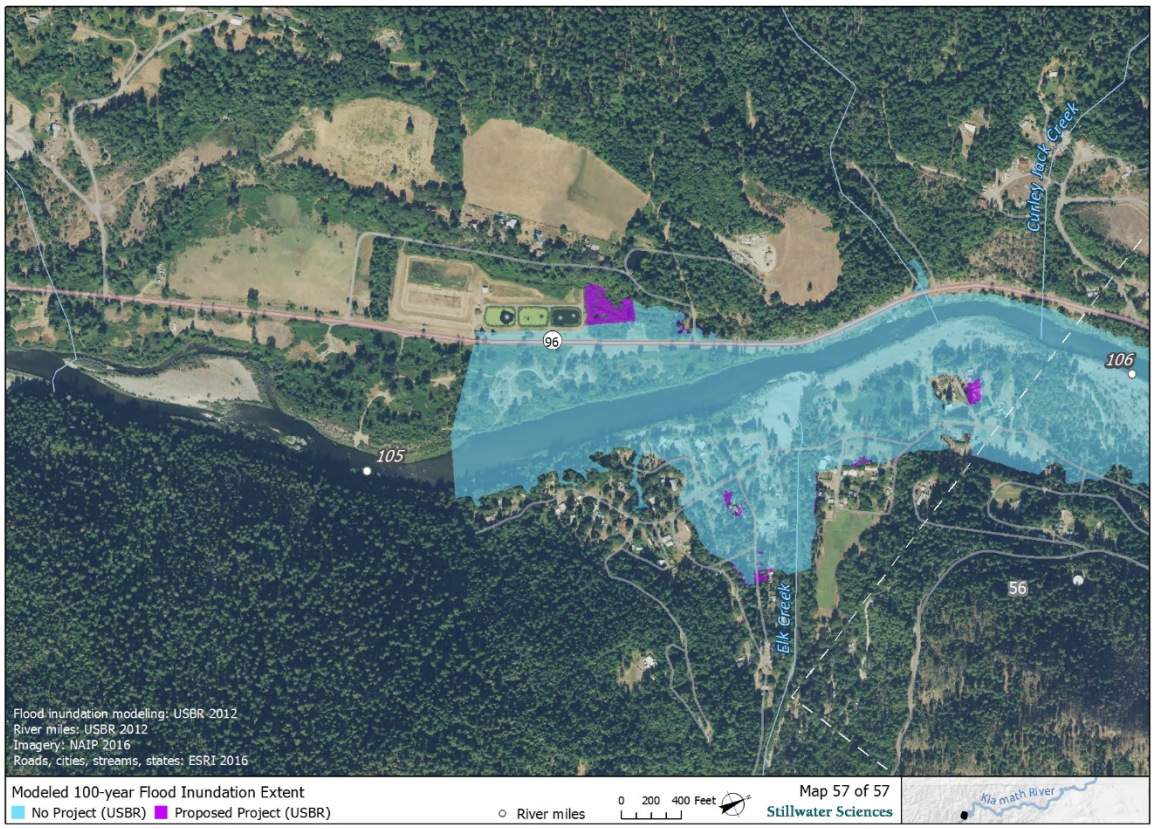

53
51
114
115
Horse Creek
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 52 of 57
Stillwater Sciences
Klamath River


112
54
111
113
52
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 53 of 57
Stillwater Sciences
Klamath River


51
96
110
53
55
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 54 of 57
Stillwater Sciences
Klamath River


96
109
108
56
54
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 55 of 57
Stillwater Sciences
Klamath River


Indian Creek Rd
HAPPY CAMP
96
106
Indian Creek
55
107
57
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 56 of 57
Stillwater Sciences
Klamath River


Curley Jack Creek
96
106
105
56
Elk Creek
Flood inundation modeling: USBR 2012
River miles: USBR 2012
Imagery: NAIP 2016
Roads, cities, streams, states: ESRI 2016
Modeled 100-year Flood Inundation Extent
No Project (USBR)
Proposed Project (USBR)
River miles
0 200 400 Feet
Map 57 of 57
Stillwater Sciences
Klamath River

Appendix L

Groundwater

Table L-1. Abbreviations used to Characterize Geologic Units in Well Logs.

Material	SDST	Sandstone
	CLST	Claystone
	BRNST	Brownstone
	GRST	Graystone
	SH	Shale
	CGLT	Conglomerate
	BDRK	Bedrock
	SPTN	Serpentine
	SLT	Silt
	MDST	Mudstone
Color	Brn	Brown
	Lt	Light
	Grn	Green
	Dk	Dark
	Brnsh	Brownish
	Grnsh	Greenish
	Blk	Black
Other	decomp'd	Decomposed
	fract'd	Fractured
	interm't	Intermittent
	Crs	Coarse
	am't	Amount
	Med	Medium
	Lgr	Large
	Sm	Small
	comp'd	Compacted
	N/R	No recovery, no log, or illegible log

Copco 1 and Copco 2 Reservoirs

Table L-2. Well Construction information for Wells Identified within 2.5 Miles of Copco 1 and Copco 2 Reservoirs.

Well ID	70943	555722	406066	512954	555712	113378	93347	406065	713255	1075453	750784	406993	126312	1075456	781717	1089469	824871	50076	784332	784331	783919	1075033
Ground Surface Elevation (ft)	2623.5	2624.8	2686.4	2613.4	2642.7	2637.3	2655.4	2657.6	2624.9	2690.4	2676.3	2657.6	2636.1	2657.6	2700.1	2727.8	2775.5	2667.5	2672.6	2688	2866.8	2995.9
Nearest Reservoir	Copco	Copco	Copco	Copco	Copco	Copco	Copco	Copco	Copco	Copco	Copco	Copco	Copco	Copco	Copco	Copco	Copco	Copco	Copco	Copco	Copco	Copco
Distance to Nearest – Reservoir (ft)	39.4	55.8	85.3	98.4	154.2	160.8	183.7	196.9	196.9	239.5	242.8	259.2	272.3	420	429.8	547.9	1148.4	1335.4	2004.7	2142.5	5325.1	6276.6
Reservoir Elevation (ft)	2602	2602	2602	2602	2602	2602	2602	2602	2602	2602	2602	2602	2602	2602	2602	2602	2602	2602	2602	2602	2602	2602
Reservoir Bed, Upstream End (ft)	2598	2598	2598	2598	2598	2598	2598	2598	2598	2598	2598	2598	2598	2598	2598	2598	2598	2598	2598	2598	2598	2598

Well ID	70943	555722	406066	512954	555712	113378	93347	406065	713255	1075453	750784	406993	126312	1075456	781717	1089469	824871	50076	784332	784331	783919	1075033
Reservoir Bed, Downstream End (ft)	2493	2493	2493	2493	2493	2493	2493	2493	2493	2493	2493	2493	2493	2493	2493	2493	2493	2493	2493	2493	2493	2493
Top of Perforated Interval, Depth (ft bgs)	70	23	49	75	100	16	15	200	104	50	460	152	63	50	40	28	140	44	130	95	140	31
Top of Perforated Interval, Elevation (ft)	2553.5	2601.8	2637.4	2538.4	2542.7	2621.3	2640.4	2457.6	2520.9	2640.4	2216.3	2505.6	2573.1	2607.6	2660.1	2699.8	2635.5	2623.5	2542.6	2593	2726.8	2964.9
Bottom of Perforated Interval, Depth (ft bgs)	84	184	300	225	120	75	110	200	124	200	500	172	83	425	512	350	204	60	150	110	180	128
Bottom of Perforated Interval, Elevation (ft)	2539.5	2440.8	2386.4	2388.4	2522.7	2562.3	2545.4	2457.6	2500.9	2490.4	2176.3	2485.6	2553.1	2232.6	2188.1	2377.8	2571.5	2607.5	2522.6	2578	2686.8	2867.9
Depth (ft bgs)	90	184	300	384	220	75	110	200	124	200	510	172	83	425	512	350	250	60	150	110	184	128

Well ID	70943	555722	406066	512954	555712	113378	93347	406065	713255	1075453	750784	406993	126312	1075456	781717	1089469	824871	50076	784332	784331	783919	1075033
Well Bottom Elevation (ft)	2533.5	2440.8	2386.4	2229.4	2422.7	2562.3	2545.4	2457.6	2500.9	2490.4	2166.3	2485.6	2553.1	2232.6	2188.1	2377.8	2525.5	2607.5	2522.6	2578	2682.8	2867.9
1st Water, Depth (ft bgs)	32		180			49		150		80				125	118	250	140	52	146	22		50
1st Water Elevation (ft)	2591.5		2506.4			2588.3		2507.6		2610.4				2532.6	2582.1	2477.8	2635.5	2615.5	2526.6	2666		2945.9
Water Bearing Zone, Depth (ft bgs)																		52				
Water Bearing Zone, Elevation (ft)																		2615.5				
Pumping Rate (gpm)		13	0.1	2	15	25	20	0.8	30	17	40	10	10	15	100	10	42	12	25	25	30	8

Well ID	70943	555722	406066	512954	555712	113378	93347	406065	713255	1075453	750784	406993	126312	1075456	781717	1089469	824871	50076	784332	784331	783919	1075033
Static Water Level, Depth (ft bgs)	15	40		50	80	40	15	60	60	35	60	150	40	50	261	90	45	32	13	10	20	18
Static Water Level, Elevation (ft bgs)	2608.5	2584.8		2563.4	2562.7	2597.3	2640.4	2597.6	2564.9	2655.4	2616.3	2507.6	2596.1	2607.6	2439.1	2637.8	2730.5	2635.5	2659.6	2678	2846.8	2977.9
Lithologic Unit 1	0–32 ft bgs; clay w/	0–10 ft bgs; clay, tan	0–21 ft bgs; clay, blk	0–18 ft bgs; SH, gray	0–40 ft bgs; clay, brn	0–20 ft bgs; adobe w/	0–15 ft bgs; clay, brn	0–18 ft bgs; clay, blk	0–22 ft bgs; adobe, brn	0–6 ft bgs; clay, blk	0–384 ft bgs; No Log	0–150 ft bgs; rock, tan	0–6 ft bgs; clay, brn	0–6 ft bgs; clay, blk	0–1 ft bgs; soil, blk	0–25 ft bgs; rock, brn,	0–9 ft bgs; clay, blk	0–5 ft bgs; clay, sticky	0–70 ft bgs; clay, brn w/	0–22 ft bgs; topsoil w/	0–10 ft bgs; adobe	0–3 ft bgs; clay, blk
Lithologic Unit 2	32–33 ft bgs; gravel w/ water	10–184 ft bgs; rock, blue-grn w/ qtz	21–25 ft bgs; clay, yellow	18–97 ft bgs; SH, brn	40–75 ft bgs; clay, tan	20–49 ft bgs; soil w/ rock	15–30 ft bgs; soil, diatomaceous earth	18–21 ft bgs; clay, white	22–75 ft bgs; adobe, gray	6–25 ft bgs; clay, yellow	384–390 ft bgs; rock, brn, fract'd	150–172 ft bgs; granite, broken,	6–35 ft bgs; clay, lt brn, sticky	6–20 ft bgs; clay, yellow	1–15 ft bgs; SDST, brn	25–250 ft bgs; rock, gray, hard	9–16 ft bgs; clay, brn w/ cobbles	5–15 ft bgs; clay, brn & red	70–75 ft bgs; boulders, blue & gray	22–40 ft bgs; clay, blk w/ water	10–18 ft bgs; rock, grn, harder	3–12 ft bgs; clay, brn

Well ID	Lithologic Unit 3	Lithologic Unit 4	Lithologic Unit 5
70943	33–60 ft bgs; clay w/ boulders	60–75 ft bgs; clay, blk	75–90 ft bgs; rock
555722			
406066	25–44 ft bgs; sand & gravel w/ clay, brn	44–180 ft bgs; SDST, gray	180–181 ft bgs; SDST, gray, broken
512954	97–130 ft bgs; rock, reddish-tan	130–225 ft bgs; rock, lt tan w/ minor rock, gray w/	225–338 ft bgs; rock, white
555712	75–220 ft bgs; rock, blk & grn w/ qtz		
113378	49–60 ft bgs; boulders, sm w/ water		
93347	30–45 ft bgs; clay, brn	45–110 ft bgs; rock, brn	
406065	21–32 ft bgs; ash, red	32–47 ft bgs; CLST, blue, caving	47–98 ft bgs; CLST, blue
713255	75–95 ft bgs; gravel, gray-blk, cobbly	95–104 ft bgs; SH, brn	104–124 ft bgs; SH, grn, hard w/ rock, blk
1075453	25–45 ft bgs; CLST, white	45–47 ft bgs; sand & gravel	47–80 ft bgs; basalt, blk
750784	390–500 ft bgs; rock, gray, decomp'd	500–510 ft bgs; rock, gray, hard, fract'd	
406993			
126312	35–65 ft bgs; clay, blue, sticky	65–70 ft bgs; sand, blue, cemented	70–80 ft bgs; rock, brn, decomp'd
1075456	20–35 ft bgs; CLST, white	35–95 ft bgs; basalt, blk	95–125 ft bgs; SDST, blue w/ qtz
781717	15–30 ft bgs; CLST, yellow	30–58 ft bgs; SPTN, blue	58–60 ft bgs; SDST, brn
1089469	250–251 ft bgs; rock, gray, fract'd w/ water	251–310 ft bgs; rock, gray, hard	310–312 ft bgs; rock, gray, hard, fract'd
824871	16–26 ft bgs; basalt	26–35 ft bgs; gravel & cobbles	35–70 ft bgs; SH, brn w/ gravel
50076	15–17.5 ft bgs; clay, brn & red, hard	17.5–40 ft bgs; clay, white & gray	40–53 ft bgs; mud, blue w/ water
784332	75–146 ft bgs; clay, brn w/ rock	146–150 ft bgs; rock, broken w/ water	
784331	40–63 ft bgs; clay, brn w/ rock, sm	63–74 ft bgs; cinders, blk & brn & red	74–77 ft bgs; rock, brn broken
783919	18–45 ft bgs; SH, brn	45–80 ft bgs; rock, grn, harder	80–85 ft bgs; rock, blk w/ red color
1075033	12–32 ft bgs; boulders w/ sand & gravel	32–42 ft bgs; clay, blue	42–50 ft bgs; rock, blue

Well ID	70943	555722	406066	512954	555712	113378	93347	406065	713255	1075453	750784	406993	126312	1075456	781717	1089469	824871	50076	784332	784331	783919	1075033
Lithologic Unit 6			181–300 ft bgs; SDST, gray	338–384 ft bgs; rock, reddish-tan				98–99 ft bgs; CLST, blue, broken		80–82 ft bgs; SDST, blue, w/ qtz w/ water			80–83 ft bgs; rock, brn, hard w/rock, blk	125–127 ft bgs; SDST, blue, fract'd	60–118 ft bgs; basalt, blue, hard	312–350 ft bgs; rock, gray, hard	70–95 ft bgs; SH, brn w/ qtz	53–60 ft bgs; rock		77–102 ft bgs; rock, brn, hard	85–90 ft bgs; rock, lt grn	50–52 ft bgs; rock, brn w/ water
Lithologic Unit 7								99–150 ft bgs; clay, blue		82–95 ft bgs; SDST, blue				127–345 ft bgs; basalt, blk	118–119 ft bgs; basalt, brn, fract'd w/ water		95–135 ft bgs; rock, blue-gray w/ qtz			102–110 ft bgs; clay, blue	90–110 ft bgs; rock, blk & red, interbedded	52–85 ft bgs; rock, blue
Lithologic Unit 8								150–151 ft bgs; CLST, blue, broken		95–140 ft bgs; basalt, blk				345–347 ft bgs; QTZ, fract'd w/ water	119–120 ft bgs; basalt, brn		135–150 ft bgs; SH w/ rock, blue-gray w/ qtz				110–180 ft bgs; rock, lt grn	85–87 ft bgs; rock, blue, fract'd w/ water

Well ID	70943	555722	406066	512954	555712	113378	93347	406065	713255	1075453	750784	406993	126312	1075456	781717	1089469	824871	50076	784332	784331	783919	1075033
Lithologic Unit 9								151–200 ft bgs; clay, blue		140–142 ft bgs; SDST, blue, fract'd				347–408 ft bgs; basalt, blk	120–135 ft bgs; basalt, blue		150–163 ft bgs; SH, purple				180–182 ft bgs; rock, brn, soft	87–128 ft bgs; rock, blue
Lithologic Unit 10										142–180 ft bgs; basalt, blk				408–410 ft bgs; basalt, blk, fract'd w/ qtz w/ water	135–140 ft bgs; basalt, brn, fract'd w/ water		163–171 ft bgs; rock, blue-gray				182–184 ft bgs; rock, grn, hard	
Lithologic Unit 11										180–182 ft bgs; SDST, blue, fract'd w/ water				410–425 ft bgs; basalt, blk	140–348 ft bgs; lava, blk, hard		171–260 ft bgs; SH, gray & blk					

Well ID	70943	555722	406066	512954	555712	113378	93347	406065	713255	1075453	750784	406993	126312	1075456	781717	1089469	824871	50076	784332	784331	783919	1075033
Lithologic Unit 12										182–200 ft bgs; SDST, blue					348–350 ft bgs; lava, blk w/ water							
Lithologic Unit 13															350–376 ft bgs; ash, red							
Lithologic Unit 14															376–378 ft bgs; lava, red w/ qtz w/ water							
Lithologic Unit 15															378–400 ft bgs; lava, blk, hard							

Well ID	70943	555722	406066	512954	555712	113378	93347	406065	713255	1075453	750784	406993	126312	1075456	781717	1089469	824871	50076	784332	784331	783919	1075033
Lithologic Unit 16															400–440 ft bgs; SPTN, grn							
Lithologic Unit 17															440–510 ft bgs; basalt, blk							
Lithologic Unit 18															510–512 ft bgs; basalt, blk, q/ qtz w/ water							

Key:
bgs: below ground surface
ft: feet
gpm: gallons per minute

Iron Gate Reservoir

Table L-3. Well Construction Information for Wells Identified within 2.5 Miles of Iron Gate Reservoir.

Well ID	311084	14918	78652	4355	334387	184187	311078	333890	99852	1087529	781723	369526	414209	99834	1075044	781725	781726	1075458	1087565	134222	134223	134224	14912	14911	958105
Ground Surface Elevation (ft)	2712.9	2329.4	2409	2467.7	2508.8	2712.9	2465.9	2371.7	2712.9	2712.8	2171	2571.2	2624.8	2323.7	2815.2	2696.6	2460.8	2672.5	2696.1	2481.5	2481.5	2481.5	2389.6	2389.6	2767.5
Nearest Reservoir	Iron Gate	Iron Gate	Iron Gate	Iron Gate	Iron Gate	Iron Gate	Iron Gate	Iron Gate	Iron Gate	Iron Gate	Iron Gate	Iron Gate	Iron Gate	Iron Gate	Iron Gate	Iron Gate	Iron Gate	Iron Gate	Iron Gate	Iron Gate	Iron Gate	Iron Gate	Iron Gate	Iron Gate	Iron Gate
Dist to Nearest – Reservoir (ft)	544.6	554.5	620.1	712	866.2	987.6	1095.9	1683.2	1735.6	2073.6	3025.1	3376.1	3507.4	3776.4	5049.5	5262.7	5331.6	5479.3	6942.6	7585.7	8199.2	8271.4	8904.6	9649.4	10499.2
Reservoir Elevation (ft)	2328	2328	2328	2328	2328	2328	2328	2328	2328	2328	2328	2328	2328	2328	2328	2328	2328	2328	2328	2328	2328	2328	2328	2328	2328
Reservoir Bed, Upstream End (ft)	2320	2320	2320	2320	2320	2320	2320	2320	2320	2320	2320	2320	2320	2320	2320	2320	2320	2320	2320	2320	2320	2320	2320	2320	2320

Well ID	311084	14918	78652	4355	334387	184187	311078	333890	99852	1087529	781723	369526	414209	99834	1075044	781725	781726	1075458	1087565	134222	134223	134224	14912	14911	958105
Reservoir Bed, Downstream End (ft)	2165	2165	2165	2165	2165	2165	2165	2165	2165	2165	2165	2165	2165	2165	2165	2165	2165	2165	2165	2165	2165	2165	2165	2165	2165
Top of Perforated Interval, Depth (ft bgs)	20	40	80	20	25	271	22	23	20	100	35	25		20	52	54	55	40	140	120	20	80	40	100	30
Top of Perforated Interval, Elevation (ft)	2692.9	2289.4	2329	2447.7	2483.8	2441.9	2443.9	2348.7	2692.9	2612.8	2136	2546.2		2303.7	2763.2	2642.6	2405.8	2632.5	2556.1	2361.5	2461.5	2401.5	2349.6	2289.6	2737.5
Bottom of Perforated Interval, Depth (ft bgs)	270	160	140	70	420	291	246	271	500	200	90	200		200	260	265	530	125	300	160	530	120	60	120	247
Bottom of Perforated Interval, Elevation (ft)	2442.9	2169.4	2269	2397.7	2088.8	2421.9	2219.9	2100.7	2212.9	2512.8	2081	2371.2		2123.7	2555.2	2431.6	1930.8	2547.5	2396.1	2321.5	1951.5	2361.5	2329.6	2269.6	2520.5
Depth (ft bgs)	270	160	140	100	420	291	246	271	500	200	90	200		200	268	275	625	125	300	160	530	120	60	120	250

Well ID	311084	14918	78652	4355	334387	184187	311078	333890	99852	1087529	781723	369526	414209	99834	1075044	781725	781726	1075458	1087565	134222	134223	134224	14912	14911	958105
Well Bottom Elevation (ft)	2442.9	2169.4	2269	2367.7	2088.8	2421.9	2219.9	2100.7	2212.9	2512.8	2081	2371.2	2624.8	2123.7	2547.2	2421.6	1835.8	2547.5	2396.1	2321.5	1951.5	2361.5	2329.6	2269.6	2517.5
1st Water, Depth (ft bgs)	168	20	25	30		50	128	46	191	180	62	105		25	185	120	180	65	120	100		80	25	60	140
1st Water Elevation (ft)	2544.9	2309.4	2384	2437.7		2662.9	2337.9	2325.7	2521.9	2532.8	2109	2466.2		2298.7	2630.2	2576.6	2280.8	2607.5	2576.1	2381.5		2401.5	2364.6	2329.6	2627.5
Water Bearing Zone, Depth (ft bgs)	250	20	25	50		280	128	210			35	105		156	185	120	180	65	140	100		80	25	60	140
Water Bearing Zone, Elevation (ft)	2462.9	2309.4	2384	2417.7		2432.9	2337.9	2161.7			2136	2466.2		2167.7	2630.2	2576.6	2280.8	2607.5	2556.1	2381.5		2401.5	2364.6	2329.6	2627.5
Pumping Rate (gpm)	25	40	6	10	0.1	15	12	12	5	25	75	20		25	30	7	12	100	20	20	1	15	50	50	

Lithologic Unit 3	Lithologic Unit 2	Lithologic Unit 1	Static Water Level, Elevation (ft bgs)	Static Water Level, Depth (ft bgs)	Well ID
106–168 ft bgs; clay, gray w/ rock,	32–106 ft bgs; clay, gray w/ rock,	0–32 ft bgs; rock-dirt			**311084**
40–100 ft bgs; rock, grn, hard	20–40 ft bgs; rock, brn, soft w/	0–20 ft bgs; clay, brn, rocky	2334.4	-5	**14918**
40–50 ft bgs; rock, gray	20–40 ft bgs; rock, brn, soft	0–20 ft bgs; clay, brn w/ rock	2384	25	**78652**
30–70 ft bgs; gravel, volcanic	2–30 ft bgs; adobe, gray	0–2 ft bgs; hardpan	2417.7	50	**4355**
395–420 ft bgs; lava ash, red	350–395 ft bgs; CLST, blue	0–350 ft bgs; N/R	2218.8	290	**334387**
291–291 ft bgs; lava, lt gray	45–281 ft bgs; lava, lt gray w/	0–45 ft bgs; topsoil, clays			**184187**
46–87 ft bgs; rock w/ clay, gray	25–46 ft bgs; clay, lt brn, sticky	0–25 ft bgs; clay, adobe			**311078**
46–148 ft bgs; clay, redish-brn w/	23–46 ft bgs; clay, gray	0–23 ft bgs; clay, red			**333890**
12–26 ft bgs; CLST, brn	1–12 ft bgs; clay, brn	0–1 ft bgs; soil, brn	2562.9	150	**99852**
	160–200 ft bgs; rock, brn	0–160 ft bgs; clay, adobe			**1087529**
18–24 ft bgs; sand & boulders	3–18 ft bgs; clay, brn	0–3 ft bgs; clay, blk	2141	30	**781723**
12–35 ft bgs; CLST, red	2–12 ft bgs; clay, brn	0–2 ft bgs; clay, blk	2541.2	30	**369526**
		N/R			**414209**
16–37 ft bgs; basalt, brn, broken	1–16 ft bgs; clay, brn	0–1 ft bgs; soil, brn	2313.7	10	**99834**
18–28 ft bgs; ash,red	2–18 ft bgs; clay, brn	0–2 ft bgs; clay, blk w/ cobbles	2785.2	30	**1075044**
20–46 ft bgs; CLST, red	4–20 ft bgs; clay, brn	0–4 ft bgs; clay, blk	2644.6	52	**781725**
30–120 ft bgs; SDST, blue, hard	1–30 ft bgs; clay, brn	0–1 ft bgs; clay, blk	2330.8	130	**781726**
38–55 ft bgs; basalt, blue, hard	9–38 ft bgs; SDST, brn	0–9 ft bgs; clay, blk	2637.5	35	**1075458**
20–120 ft bgs; SH, gray	4–20 ft bgs; clay	0–4 ft bgs; topsoil	2576.1	120	**1087565**
40–140 ft bgs; rock, gray	10–40 ft bgs; rock, brn, soft	0–10 ft bgs; clay, brn	2431.5	50	**134222**
40–95 ft bgs; clay, red, hard	10–40 ft bgs; rock, brn, soft	0–10 ft bgs; clay, brn	2421.5	60	**134223**
20–40 ft bgs; rock, brn, soft	5–20 ft bgs; rock, red, soft	0–5 ft bgs; clay, brn	2451.5	30	**134224**
	20–60 ft bgs; rock, blk w/ water	0–20 ft bgs; clay, brn w/ gravel	2379.6	10	**14912**
40–80 ft bgs; rock, gray w/ water	20–40 ft bgs; rock, lt gray	0–20 ft bgs; clay, brn w/ rock	2361.6	28	**14911**
17–18 ft bgs; clay, brn	2–17 ft bgs; boulders	0–2 ft bgs; soil, brn	2772.5	-5	**958105**

Well ID	Lithologic Unit 4	Lithologic Unit 5	Lithologic Unit 6
311084	168–209 ft bgs; rock, brn-gray	209–229 ft bgs; rock, brn	229–270 ft bgs; rock, brnsh-gray w/water
14918	100–140 ft bgs; rock, gray	140–160 ft bgs; rock, grn	
78652	50–60 ft bgs; rock, brn	60–70 ft bgs; rock, gray	70–140 ft bgs; rock, brn
4355	70–100 ft bgs; gravel, volcanic w/		
334387			
184187			
311078	87–128 ft bgs; clay, reddish-gray	128–246 ft bgs; clay, grayish-brn	
333890	148–210 ft bgs; gravel, brn w/	210–271 ft bgs; rock, gray–brnsh-	
99852	26–160 ft bgs; SDST, blue	160–195 ft bgs; CLST, red	195–250 ft bgs; SDST, blue
1087529			
781723	24–30 ft bgs; SDST, brn	30–62 ft bgs; SPTN, blue	62–63 ft bgs; SPTN, blue w/ qtz w/ water
369526	35–105 ft bgs; CLST, blue	105–108 ft bgs; CLST, red, broken	108–170 ft bgs; CLST, red
414209			
99834	37–100 ft bgs; basalt, blue	100–112 ft bgs; CLST, purple	112–156 ft bgs; basalt, blue
1075044	28–45 ft bgs; rock, brn, soft	45–120 ft bgs; rock, blue, hard	120–185 ft bgs; rock, blue
781725	46–85 ft bgs; SPTN, blue, hard	85–120 ft bgs; ash, red	120–121 ft bgs; SPTN, blue w/ qtz w/ water
781726	120–150 ft bgs; CLST, blue	150–180 ft bgs; SDST, blue	180–182 ft bgs; SDST, blue, fract'd w/ water
1075458	55–60 ft bgs; CLST, purple	60–65 ft bgs; basalt, blue	65–78 ft bgs; basalt, blue, fract'd w/ qtz w/ water
1087565	120–260 ft bgs; SH, dk gray	260–300 ft bgs; SH, gray, fract'd	
134222	140–160 ft bgs; rock, gray,hard		
134223	95–120 ft bgs; rock, blk	120–530 ft bgs; rock, dk brn	
134224	40–120 ft bgs; rock, brn w/ water		
14912			
14911	80–120 ft bgs; rock, blk		
958105	18–27 ft bgs; rock, blue, broken	27–140 ft bgs; rock, gray, hard	140–141 ft bgs; rock, gray, fract'd w/ water

Well ID	311084	14918	78652	4355	334387	184187	311078	333890	99852	1087529	781723	369526	414209	99834	1075044	781725	781726	1075458	1087565	134222	134223	134224	14912	14911	958105
Lithologic Unit 7									250–268 ft bgs; CLST, red		63–90 ft bgs; SPTN, blue	170–175 ft bgs; CLST, blue, broken w/ water		156–157 ft bgs; basalt, blue, broken w/ water	185–186 ft bgs; rock, blue, fract'd w/w water	121–160 ft bgs; SPTN, blue, hard	182–360 ft bgs; SDST,blue	78–107 ft bgs; basalt, blue, hard							141–180 ft bgs; rock, gray, hard
Lithologic Unit 8									268–290 ft bgs; SDST, blue			175–200 ft bgs; SDST, blue		157–180 ft bgs; basalt, blue	186–240 ft bgs; rock, blue, hard	160–220 ft bgs; ash, red	360–361 ft bgs; SDST, blue, fract'd w/ water	107–110 ft bgs; basalt, blue, fract'd w/ water							180–200 ft bgs; rock, red, hard
Lithologic Unit 9									290–291 ft bgs; SDST, blue, broken					180–182 ft bgs; basalt, blue, broken	240–242 ft bgs; rock, blue, fract'd	220–235 ft bgs; SPTN,blue, hard	361–410 ft bgs; SDST, blue	110–118 ft bgs; basalt, blue, hard							200–210 ft bgs; rock, gray, hard

Well ID	311084	14918	78652	4355	334387	184187	311078	333890	99852	1087529	781723	369526	414209	99834	1075044	781725	781726	1075458	1087565	134222	134223	134224	14912	14911	958105
Lithologic Unit 10									291–312 ft bgs; CLST, red					182–200 ft bgs; basalt, blue	242–268 ft bgs; rock, blue, hard	235–236 ft bgs; SPTN, blue, fract'd w/ water	410–430 ft bgs; basalt, blue	118–125 ft bgs; CLST, purple							210–211 ft bgs; rock, gray, fract'd w/ water
Lithologic Unit 11									312–367 ft bgs; SDST, grn							236–275 ft bgs; SPTN,blue, hard	430–431 ft bgs; basalt, blue, fract'd w/ water								211–250 ft bgs; rock, gray, hard
Lithologic Unit 12									367–382 ft bgs; CLST, red								431–530 ft bgs; basalt, blue								

Well ID	311084	14918	78652	4355	334387	184187	311078	333890	99852	1087529	781723	369526	414209	99834	1075044	781725	781726	1075458	1087565	134222	134223	134224	14912	14911	958105
Lithologic Unit 13									382–383 ft bgs; SDST, blue, broken								530–625 ft bgs; ash, red, caving								
Lithologic Unit 14									383–448 ft bgs; CLST, blue																

Key:
bgs: below ground surface
ft: feet
gpm: gallons per minute

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Appendix M

Water Supply/Water Rights

Upstream of Iron Gate Dam, the mainstem Klamath River is controlled by several dams operated by PacifiCorp for hydropower generation. Downstream from Iron Gate Dam, the mainstem Klamath River flows freely for approximately 190 miles through Siskiyou, Humboldt, and Del Norte Counties to the Pacific Ocean. A query on California's Electronic Water Rights Information Management System (eWRIMS) provided six water rights listings upstream of Iron Gate Dam and 42 water right listings downstream from Iron Gate Dam with the Klamath River or a California Lower Klamath Project reservoir (i.e. Iron Gate, Copco No 1, and Copco No. 2 Reservoirs) as the water source. Four water right listings have Fall Creek as their water source. This appendix contains the query results and maps displaying the locations.

Table M-1. Water Rights on Klamath River: Upstream from Iron Gate Dam.

Application ID	Source	County	Direct Diversion Amount	Diversion Units	Diversion Status	Water Right Type	Water Right Status	Entity Type	Holder Name	Additional Information
Downstream from Oregon-California State Line										
S015377	Klamath River	Siskiyou	10	Cubic Feet per Second	Active	Statement of Div and Use	Claimed	Corporation	PacifiCorp	2,200 acre-feet per year to irrigate 43 acres and stock watering between April and October.
S015737	Klamath River	Siskiyou	0	Gallons per Day	Active	Statement of Div and Use	Claimed	Corporation	PacifiCorp	2,700 acre-feet per year to irrigate 58.3 acres and stock watering between April and October.
S015378	Klamath River	Siskiyou	5	Cubic Feet per Second	Active	Statement of Div and Use	Claimed	Corporation	PacifiCorp	575 acre-feet per year to irrigate 8 acres and stock watering between April and October.
Copco Lake										
S015375	Copco Lake	Siskiyou	3200	Cubic Feet per Second	Active	Statement of Div and Use	Claimed	Corporation	PacifiCorp	Average diversion of approximately 1,400 to 1,900 cfs per month for hydropower and impoundment at Copco 1 Powerhouse, non-consumptive use and Copco Lake. In conjunction with S015364.

Application ID	Source	County	Direct Diversion Amount	Diversion Units	Diversion Status	Water Right Type	Water Right Status	Entity Type	Holder Name	Additional Information
S015374	Copco Lake	Siskiyou	3200	Cubic Feet per Second	Active	Statement of Div and Use	Claimed	Corporation	PacifiCorp	Water is stored in Copco Lake. Average use approximately 1,000 to 1,200 cfs per month for impoundment of water and generation of electric power, non-consumptive use. FERC license #2082. In conjunction with S013375.
S015376	Copco Lake	Siskiyou	3200	Cubic Feet per Second	Active	Statement of Div and Use	Claimed	Corporation	PacifiCorp	Average diversion of approximately 1,300 to 1,900 cfs per month for hydropower and impoundment at Copco 2 Powerhouse and Copco Lake.

Source: California Electronic Water Rights Information Management System (eWRIMS) (State Water Board 2017)
Notes:

[1] Status Definitions:

Active Claims (Claimed): Riparian and pre-1914 appropriative rights predate the Water Commission Act that established the water rights permitting system, and the precursor to the State Water Board. Riparian rights exist due to ownership of parcels abutting a watercourse. Entities that hold either of these rights are not required to obtain a permit from the State Water Board.

[2] cfs = cubic feet per second, gpm = gallons per minute, gpd = gallons per day

Table M-2. Water Rights on Klamath River: Downstream from Iron Gate Dam.

Application ID	Source	County	Direct Diversion Amount	Diversion Units	Diversion Status	Water Right Type	Water Right Status	Entity Type	Holder Name	Additional Information
Downstream from Iron Gate Dam										
A017527	Klamath River	Siskiyou	3300	Cubic Feet per Second	Active	Approp.	Licensed	Government (State/ Municipal)	PacifiCorp	1,800 cfs for power generation, 50 cfs for fish propagation facilities, 3,300 cfs to refill regulatory storage space in Iron Gate Reservoir. Direct diversion amount not to exceed 3,300 cfs. Permit for January 1–December 31. Other previsions include maximum diversion not to exceed 120,000 acre-feet in a water year, maximum flow rate not to exceed 300 cfs May 16–September 15, and not to exceed 100 cfs September 16–May 15.
A016958	Klamath River	Siskiyou	0	Acre-feet per Year	Active	Approp.	State Filing	Government (State/ Municipal)	SWRCB	Diversion storage amount 60,000 acre-feet

Application ID	Source	County	Direct Diversion Amount	Diversion Units	Diversion Status	Water Right Type	Water Right Status	Entity Type	Holder Name	Additional Information
A016957	Klamath River	Siskiyou	0	Gallons per Day	Active	Approp.	State Filing	Government (State/ Municipal)	SWRCB	Diversion storage amount 60,000 acre-feet
S012968	Klamath River	Siskiyou	48	Cubic Feet per Second	Active	Statement of Div and Use	Claimed	Corporation	PacifiCorp	Direct diversion amount 48 cfs
A019478	Klamath River	Siskiyou	0.1	Cubic Feet per Second	Active	Approp.	Licensed	Government (State/ Municipal)	Klamath River Country Estates Owners Association Inc	Direct diversion amount 0.1 cfs, May 1–October 31 for irrigation of 8 acres. Can increase diversion rate, but must not interfere with other vested water rights or go over flow allowance in a 30-day period.
S016524	Klamath River	Siskiyou	126.8	Acre-feet per Year	Active	Statement of Div and Use	Claimed	Corporation	R- Ranch POA	Direct diversion amount 126.8 acre-feet per year

Application ID	Source	County	Direct Diversion Amount	Diversion Units	Diversion Status	Water Right Type	Water Right Status	Entity Type	Holder Name	Additional Information
S000708	Klamath River	Siskiyou	0	Gallons per Day	Active	Statement of Div and Use	Claimed	Corporation	Klamath River Country Estates Owners Association Inc	Irrigation of 8 acres. The Statement of Water Diversion and Use includes use during May 1–October 31; maximum flow rate of 25 gallons per minute (gpm) but flow volume used per month changes. There is an approximate total use of 1.6 million gallons annually
D031134R	Klamath River	Siskiyou	4500	Gallons per Day	Active	Registration Domestic	Registered	Individual	-	Direct diversion amount shall not exceed 4,500 gallons per day (gpd) during January 1–December 31 for domestic use. Max diversion not to exceed 5 acre-feet per year.
S011340	Klamath River	Siskiyou	9000	Gallons per Day	Inactive	Statement of Div and Use	Inactive	-	-	Direct diversion amount 9,000 gpd, no name of file since 2007.
S023523	Klamath River	Siskiyou	2.67	Cubic Feet per Second	Active	Statement of Div and Use	Claimed	Individual	-	-

Application ID	Source	County	Direct Diversion Amount	Diversion Units	Diversion Status	Water Right Type	Water Right Status	Entity Type	Holder Name	Additional Information
S017637	Klamath River	Siskiyou	2.673	Cubic Feet per Second	Inactive	Statement of Div and Use	Inactive	Individual	-	-
S021731	Klamath River	Siskiyou	0.11	Cubic Feet per Second	Active	Statement of Div and Use	Claimed	Individual	-	-
S001040	Klamath River	Siskiyou	8.91	Cubic Feet per Second	Inactive	Statement of Div and Use	Inactive	Individual	-	Direct diversion amount 8.9 cfs
S009616	Klamath River	Siskiyou	1.1	Cubic Feet per Second	Inactive	Statement of Div and Use	Inactive	Corporation	E M ROSTON & SONS	Direct diversion amount 1.1 cfs
S009617	Klamath River	Siskiyou	3.56	Cubic Feet per Second	Inactive	Statement of Div and Use	Inactive	Corporation	E M ROSTON & SONS	Direct diversion amount 3.56 cfs, no updated address on file, status is inactive.
Downstream from Cottonwood Creek										
S009618	Klamath River	Siskiyou	0.45	Cubic Feet per Second	Inactive	Statement of Div and Use	Inactive	Corporation	E M ROSTON & SONS	Direct diversion amount 0.45 cfs, no updated address on file, status is inactive.
S022031	Klamath River	Siskiyou	0.38	Cubic Feet per Second	Active	Statement of Div and Use	Claimed	Individual	-	-
S013204	Klamath River	Siskiyou	0.134	Cubic Feet per Second	Inactive	Statement of Div and Use	Inactive	Individual	-	Direct diversion amount 0.134 cfs
S014586	Klamath River	Siskiyou	0.11	Cubic Feet per Second	Active	Statement of Div and Use	Claimed	Individual	-	Direct diversion amount 0.11 cfs, Diversion 1.4 acre-feet

Application ID	Source	County	Direct Diversion Amount	Diversion Units	Diversion Status	Water Right Type	Water Right Status	Entity Type	Holder Name	Additional Information
S014788	Klamath River	Siskiyou	1.1	Cubic Feet per Second	Active	Statement of Div and Use	Claimed	Individual	-	Direct diversion amount 1.1 cfs, Diversion 1,000 acre-feet
S021741	Klamath River	Siskiyou	0	Cubic Feet per Second	Active	Statement of Div and Use	Claimed	Individual	-	-
S021740	Klamath River	Siskiyou	0	Cubic Feet per Second	Active	Statement of Div and Use	Claimed	Individual	-	-
S016753	Klamath River	Siskiyou	0	Acre-feet per Year	Active	Statement of Div and Use	Claimed	Individual	-	Direct diversion amount 0 acre-feet/yr
S025997	Klamath River	Siskiyou			Active	Statement of Div and Use	Claimed	Individual	-	-
S020130	Klamath River	Siskiyou	0	Cubic Feet per Second	Active	Statement of Div and Use	Claimed	Individual	-	-
S013405	Klamath River	Siskiyou	14400	Gallons per Day	Inactive	Statement of Div and Use	Inactive	Corporation	The Rea Family Trust	Direct diversion amount 14,400 gpd
S010021	Klamath River	Siskiyou	100	Gallons per Day	Active	Statement of Div and Use	Claimed	Individual	-	Direct diversion amount 100 gpd for irrigation and stock watering.
S013406	Klamath River	Siskiyou	7200	Gallons per Day	Active	Statement of Div and Use	Claimed	Individual	-	Direct diversion amount 7,200 gpd
D032742	Klamath River	Siskiyou			Active	Registration Domestic	Pending	Individual	-	-

Application ID	Source	County	Direct Diversion Amount	Diversion Units	Diversion Status	Water Right Type	Water Right Status	Entity Type	Holder Name	Additional Information
S025885	Klamath River	Siskiyou	14	Gallons per Minute	Active	Statement of Div and Use	Claimed	Individual	-	-
S014172	Klamath River	Siskiyou	0.33	Cubic Feet per Second	Active	Statement of Div and Use	Claimed	Individual	-	Direct diversion amount 0.33 cfs, Diversion 30 acre-feet
A017036	Klamath River	Siskiyou	0	Gallons per Day	Active	Approp.	State Filing	Government (State/Municipal)	SWRCB	Diversion storage amount 1,850,000 acre-feet
A017035	Klamath River	Siskiyou	0	Gallons per Day	Active	Approp.	State Filing	Government (State/Municipal)	SWRCB	Diversion storage amount 1,850,000 acre-feet
Downstream from Seiad Valley										
S023407	Klamath River	Siskiyou	0.004	Cubic Feet per Second	Inactive	Statement of Div and Use	Inactive	Individual	-	-
A017034	Klamath River	Siskiyou	0	Gallons per Day	Active	Approp.	State Filing	Government (State/ Municipal)	SWRCB	Diversion storage amount 1,850,000 acre-feet
A017033	Klamath River	Siskiyou	0	Gallons per Day	Active	Approp.	State Filing	Government (State/ Municipal)	SWRCB	Diversion storage amount 4,120,000 acre-feet

Application ID	Source	County	Direct Diversion Amount	Diversion Units	Diversion Status	Water Right Type	Water Right Status	Entity Type	Holder Name	Additional Information
A021640	Klamath River	Humboldt	0.13	Cubic Feet per Second	Active	Approp.	Licensed	Individual	-	Direct diversion amount 0.13 cfs, max 0.15 cfs as long as not to exceed 7.8 acre-feet in 30 days. Maximum amount allowed in a year 39 acre-feet. Use is for irrigation purposes for 19 acres; use May 1–December 1.
A017032	Klamath River	Humboldt	0	Gallons per Day	Active	Approp.	State Filing	Government (State/ Municipal)	SWRCB	Diversion storage amount 5,480,000 acre-feet
A017031	Klamath River	Humboldt	0	Gallons per Day	Active	Approp.	State Filing	Government (State/ Municipal)	SWRCB	Diversion storage amount 5,480,000 acre-feet
A017038	Klamath River	Humboldt	0	Gallons per Day	Active	Approp.	State Filing	Government (State/ Municipal)	SWRCB	Diversion storage amount 1,940,000 acre-feet
A017037	Klamath River	Humboldt	0	Gallons per Day	Active	Approp.	State Filing	Government (State/ Municipal)	SWRCB	Diversion storage amount 1,940,000 acre-feet

Application ID	Source	County	Direct Diversion Amount	Diversion Units	Diversion Status	Water Right Type	Water Right Status	Entity Type	Holder Name	Additional Information
A023121	Klamath River	Del Norte	0.5	Cubic Feet per Second	Active	Approp.	Permitted	Government (State/ Municipal)	Klamath Comm. Services Dist.	Direct diversion amount 0.5 cfs, Diversion 210 acre-feet per year

Source: California Electronic Water Rights Information Management System (eWRIMS) (State Water Board 2017)
Notes:
[1] Status Definitions:

Active Claims (Claimed): Riparian and pre-1914 appropriative rights predate the Water Commission Act that established the water rights permitting system, and the precursor to the State Water Board. Riparian rights exist due to ownership of parcels abutting a watercourse. Entities that hold either of these rights are not required to obtain a permit from the State Water Board.
Inactive: Claimed riparian or pre-1914 right that are currently unexercised.
Licensed: A license indicates that the conditions of development of the project is complete and diversion and use has occurred, as contemplated under the permit.
Permitted: A permit is an authorization that allows for the development of a project to divert and use water with due diligence, under permitted conditions.
Registered: Entities can register to divert and use a small amount of water from a stream for domestic purposes or the use of a small amount of water for livestock. In such cases, the use is registered with the State Water Board and must follow conditions set by the CDFW to protect fish and wildlife.
State filing: State filing applications are made by the State Water Board in trust for the people of California, in order to preserve water for future use and development consistent with a coordinated plan such as the State's Water Plan or a County General Plan. If "assignment" of the state filing application is requested and approved, an applicant to develop a water right may use the water right priority of the state filing, allowing the new project to be senior to certain existing diverters.

[2] cfs = cubic feet per second, gpm = gallons per minute, gpd = gallons per day

Table M-3. Water Rights on Fall Creek.

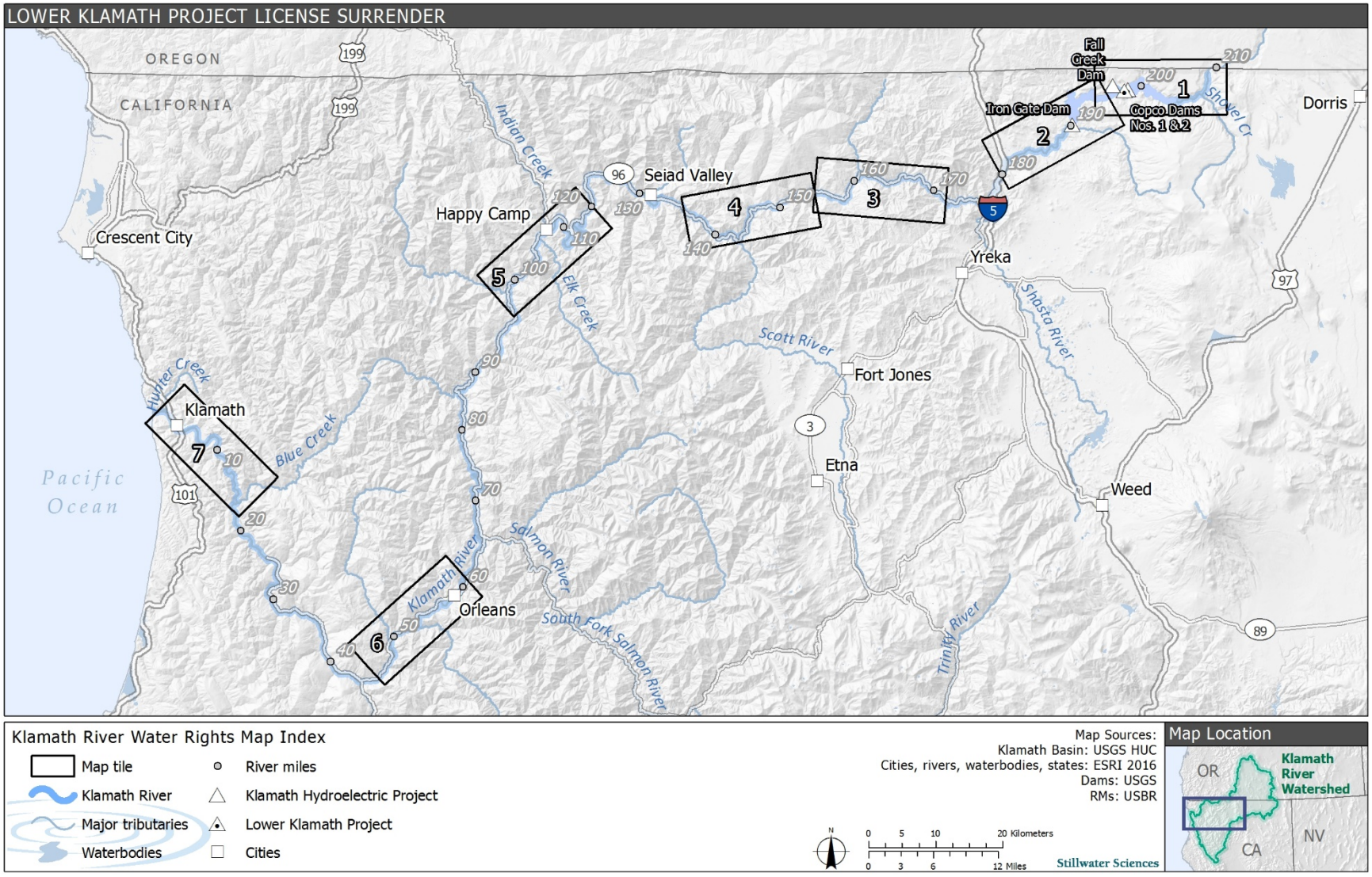
Application ID	Source	County	Direct Diversion Amount	Diversion Units	Diversion Status	Water Right Type	Water Right Status	Entity Type	Holder Name	Additional Information
S015373	Fall Creek	Siskiyou	-	-	Active	Statement of Div and Use	Claimed	Corporation	PacifiCorp	Hydropower generation
S015372	Fall Creek	Siskiyou	-	-	Active	Statement of Div and Use	Claimed	Corporation	PacifiCorp	Hydropower generation
A022551	Fall Creek	Siskiyou	6,300	Acre-feet per year	Active	Approp.	Permitted	Government (State/Municipal)	City of Yreka	Municipal water supply
A025896	Fall Creek	Siskiyou	5,465	Acre-feet per year	Active	Approp.	Licensed	Government (State/Municipal)	CA Dept. of Fish and Wildlife	Fish propagation

Source: California Electronic Water Rights Information Management System (eWRIMS) (State Water Board 2017)
Notes:
[1] Status Definitions:

Active Claims (Claimed): Riparian and pre-1914 appropriative rights predate the Water Commission Act that established the water rights permitting system, and the precursor to the State Water Board. Riparian rights exist due to ownership of parcels abutting a watercourse. Entities that hold either of these rights are not required to obtain a permit from the State Water Board.

Licensed: A license indicates that the conditions of development of the project is complete and diversion and use has occurred, as contemplated under the permit.

Permitted: A permit is an authorization that allows for the development of a project to divert and use water with due diligence, under permitted conditions.


LOWER KLAMATH PROJECT LICENSE SURRENDER
OREGON
CALIFORNIA
Crescent City
Happy Camp
Seiad Valley
Indian Creek
Elk Creek
Scott River
Shasta River
Yreka
Fort Jones
Etna
Weed
Dorris
Fall Creek Dam
Iron Gate Dam
Copco Dams Nos. 1 &2
Shovel Cr
Hunter Creek
Blue Creek
Klamath
Salmon River
Klamath River
Orleans
South Fork Salmon River
Trinity River
Pacific Ocean
1
2
3
4
5
6
7
Klamath River Water Rights Map Index
Map tile
Klamath River
Major tributaries
Waterbodies
River miles
Klamath Hydroelectric Project
Lower Klamath Project
Cities
Map Sources:
Klamath Basin: USGS HUC
Cities, rivers, waterbodies, states: ESRI 2016
Dams: USGS
RMs: USBR
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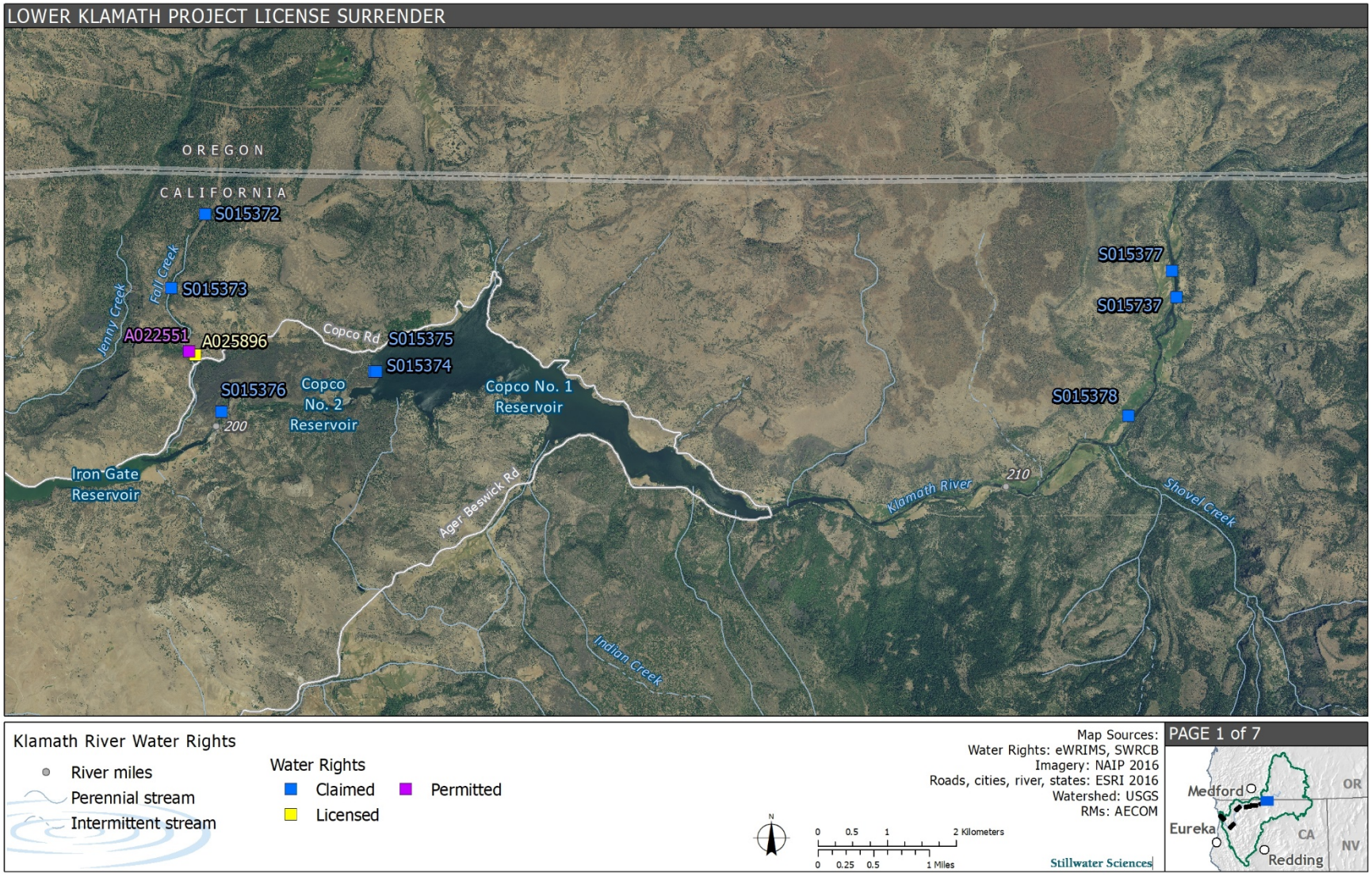
0 3 6 12 Miles
Stillwater Sciences
Map Location
OR
CA
NV
Klamath River Watershed


LOWER KLAMATH PROJECT LICENSE SURRENDER
OREGON
CALIFORNIA
S015372
S015373
S015377
S015737
S015378
A022551
A025896
S015375
S015374
S015376
Copco No. 2 Reservoir
Copco No. 1 Reservoir
Iron Gate Reservoir
Copco Rd
Jenny Creek
Fall Creek
Ager Beswick Rd
Klamath River
Shovel Creek
Indian Creek
200
210
Klamath River Water Rights
River miles
Perennial stream
Intermittent stream
Water Rights
Claimed
Permitted
Licensed
Map Sources:
Water Rights: eWRIMS, SWRCB
Imagery: NAIP 2016
Roads, cities, river, states: ESRI 2016
Watershed: USGS
RMs: AECOM
Stillwater Sciences
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0 0.25 0.5 1 Miles
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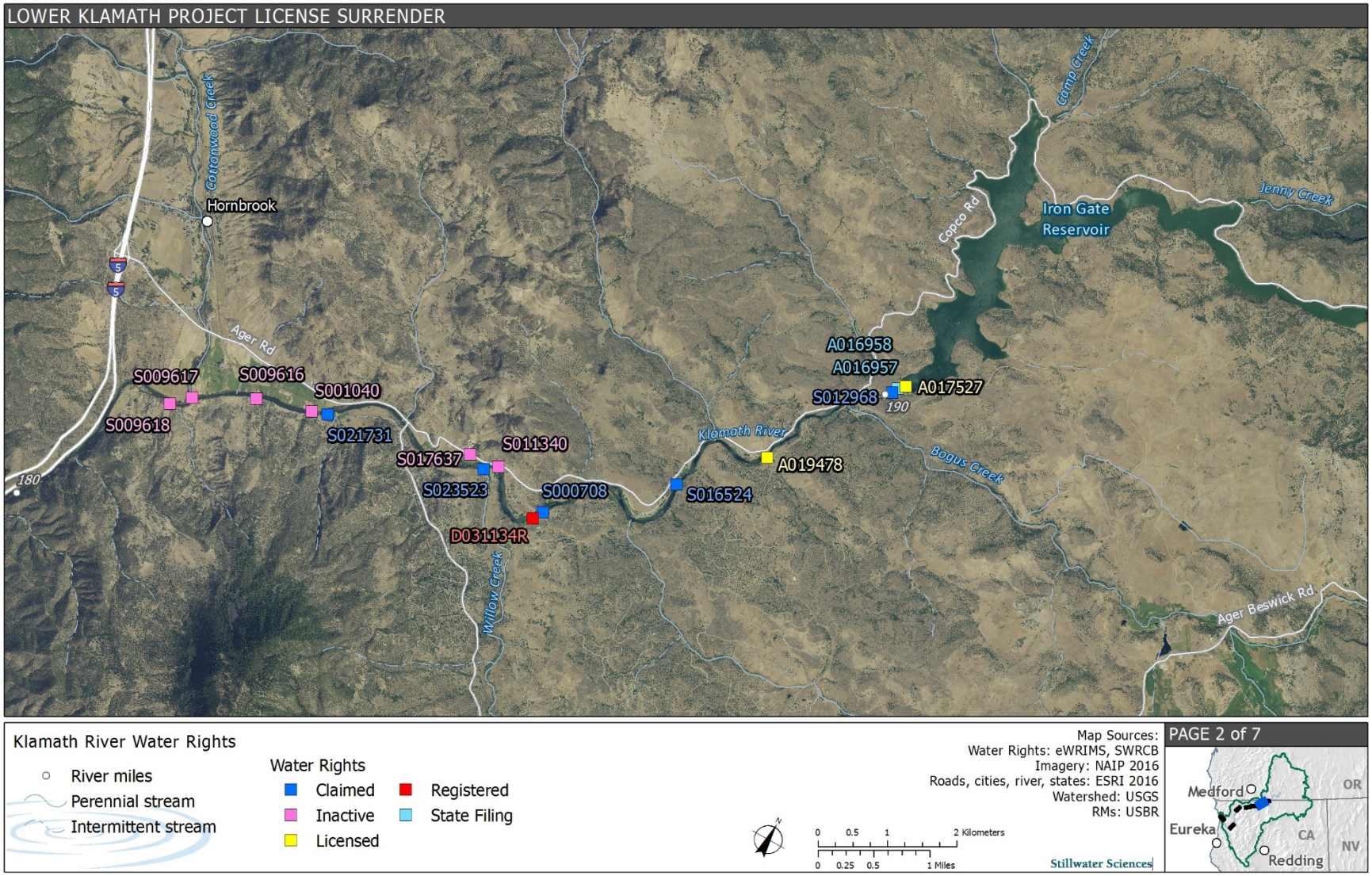
Medford
Eureka
Redding
OR
CA
NV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Cottonwood Creek
Hornbrook
Ager Rd
S009617
S009616
S001040
S009618
S021731
S011340
S017637
S023523
S000708
D031134R
Willow Creek
Camp Creek
Jenny Creek
Copco Rd
Iron Gate Reservoir
A016958
A016957
A017527
S012968
190
Klamath River
A019478
Bogus Creek
S016524
Ager Beswick Rd
180
Klamath River Water Rights
River miles
Perennial stream
Intermittent stream
Water Rights
Claimed
Registered
Inactive
State Filing
Licensed
Map Sources:
Water Rights: eWRIMS, SWRCB
Imagery: NAIP 2016
Roads, cities, river, states: ESRI 2016
Watershed: USGS
RMs: USBR
0 0.5 1 2 Kilometers
0 0.25 0.5 1 Miles
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LOWER KLAMATH PROJECT LICENSE SURRENDER
S014586
S013204
96
Klamath River
160
Klamath River
170
S022031
S025997
S021740
S016753
S021741
S014788
Humbug Creek
Klamath River Water Rights
River miles
Perennial stream
Intermittent stream
Water Rights
Claimed
Inactive
Map Sources:
Water Rights: eWRIMS, SWRCB
Imagery: NAIP 2016
Roads, cities, river, states: ESRI 2016
Watershed: USGS
RMs: USBR
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0 0.25 0.5 1 Miles
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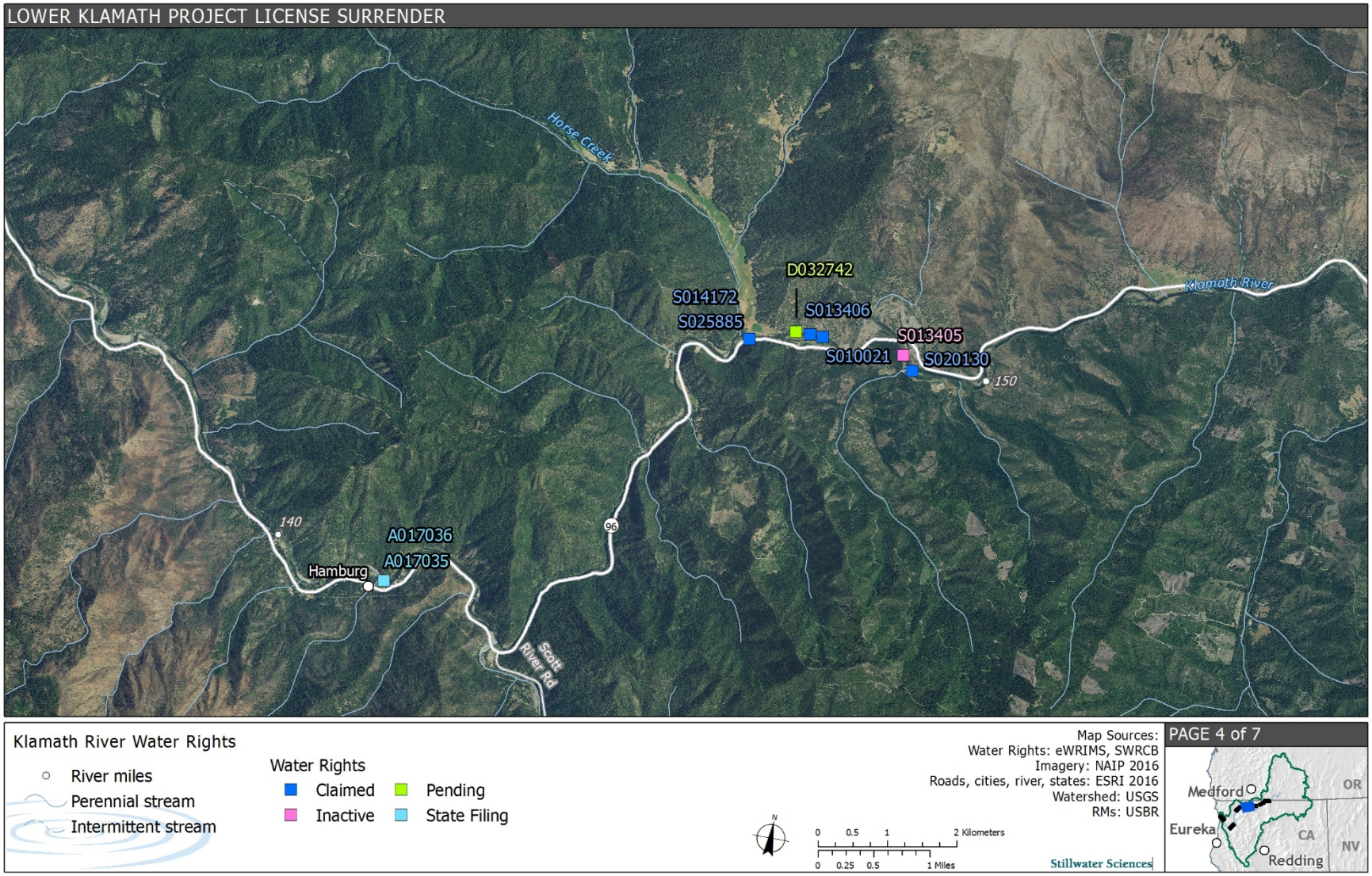
LOWER KLAMATH PROJECT LICENSE SURRENDER
Horse Creek
Klamath River
D032742
S014172
S025885
S013406
S013405
S010021
S020130
150
140
A017036
A017035
Hamburg
96
Scott River Rd
Klamath River Water Rights
River miles
Perennial stream
Intermittent stream
Water Rights
Claimed
Pending
Inactive
State Filing
Map Sources:
Water Rights: eWRIMS, SWRCB
Imagery: NAIP 2016
Roads, cities, river, states: ESRI 2016
Watershed: USGS
RMs: USBR
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0 0.25 0.5 1 Miles
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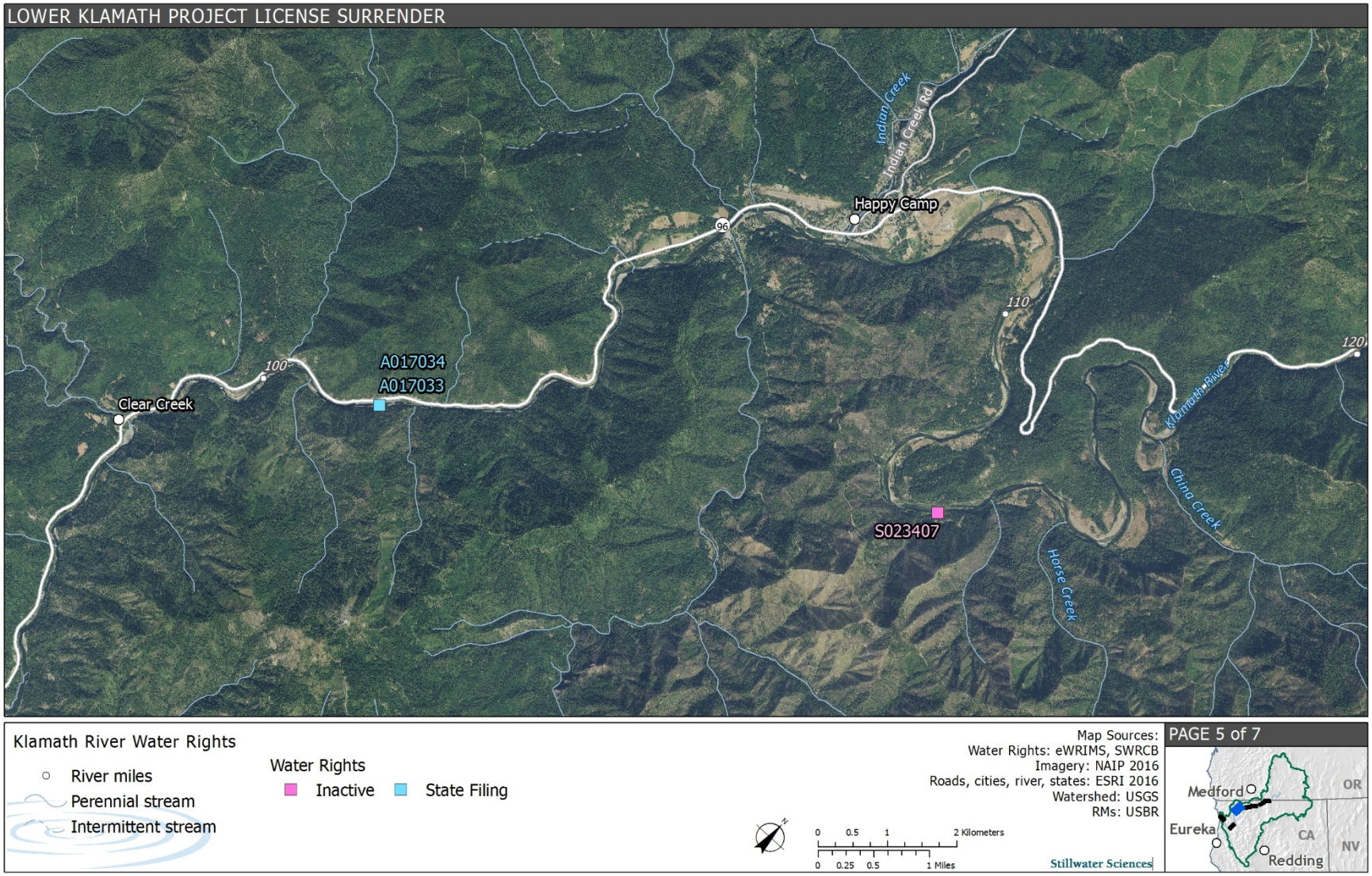
LOWER KLAMATH PROJECT LICENSE SURRENDER
Indian Creek
Indian Creek Rd
Happy Camp
96
110
120
100
A017034
A017033
Clear Creek
Klamath River
China Creek
S023407
Horse Creek
Klamath River Water Rights
River miles
Perennial stream
Intermittent stream
Water Rights
Inactive
State Filing
Map Sources:
Water Rights: eWRIMS, SWRCB
Imagery: NAIP 2016
Roads, cities, river, states: ESRI 2016
Watershed: USGS
RMs: USBR
0 0.5 1 2 Kilometers
0 0.25 0.5 1 Miles
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CA
NV
Redding


LOWER KLAMATH PROJECT LICENSE SURRENDER
Bluff Creek
Camp Creek
50
A017032
A017031
96
Klamath River
A021640
Orleans
60
96
Indian Creek
Klamath River Water Rights
River miles
Perennial stream
Intermittent stream
Water Rights
Licensed
State Filing
Map Sources:
Water Rights: eWRIMS, SWRCB
Imagery: NAIP 2016
Roads, cities, river, states: ESRI 2016
Watershed: USGS
RMs: USBR
0 0.5 1 2 Kilometers
0 0.25 0.5 1 Miles
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Redding


LOWER KLAMATH PROJECT LICENSE SURRENDER
Requa
Klamath River
A023121
Klamath
101
101
10
Blue Creek
A017038
A017037
Klamath River Water Rights
River miles
Perennial stream
Intermittent stream
Water Rights
Permitted
State Filing
Map Sources:
Water Rights: eWRIMS, SWRCB
Imagery: NAIP 2016
Roads, cities, river, states: ESRI 2016
Watershed: USGS
RMs: USBR
0 0.5 1 2 Kilometers
0 0.25 0.5 1 Miles
Stillwater Sciences
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CA
NV
Redding

M.1 References

State Water Board (State Water Resource Control Board). 2017. California Electronic Water Rights Information Management System. Accessed at http://www.swrcb.ca.gov/ewrims/. [Accessed October 24, 2017].

Appendix N

Air Quality Impacts

The air quality impact modeling described in this appendix is reorganized from the 2012 KHSA EIS/EIR analysis. Although there have since been some modifications to the project schedule, the 2011 air quality impact modeling has not been re-run because the construction-related air pollutant-generating activities for the Proposed Project are materially similar to those modeled below. Minor changes in construction activities between the 2012 KHSA EIS/EIR analysis and the Proposed Project are primarily due to the timing associated with removing each dam (Table 2.7-1). The Proposed Project and the data modeled as part of the 2012 KHSA EIS/EIR in this attachment are within the thresholds noted in this EIR Section 3.9.3 *[Air Quality] Significance Criteria* and analyzed in Section 3.9.5 *[Air Quality] Potential Impacts, Impacts, and Mitigation*.

3. Alternative Name Key	
4. 2012 KHSA EIS/EIR Alternative Name	**5. Lower Klamath Project EIR Alternative Name**
6. Alternative 2 Full Facilities Removal	7. Proposed Project
	8. Three Dam Removal (Iron Gate, Copco No. 1, and Copco No. 2)
	9. No Hatchery
10. Alternative 3 Partial Facilities Removal	11. Partial Removal
12. Alternative 4 Fish Passage at Four Dams	13. Continued Operations with Fish Passage
14. Alternative 5 Fish Passage at Two Dams, Remove Copco 1 and Iron Gate	15. Two Dam Removal (Iron Gate and Copco No. 1)

N.1 Existing Emission Sources and Monitoring Data

This section provides estimates of the existing emissions in Siskiyou, California to identify the major sources of emissions. Existing monitoring data is also provided as context for the county's attainment status.

N.1.1 Emission Sources

Table N-1 presents estimates of existing emissions in Siskiyou County for 2015, the latest year for which an inventory is available. Miscellaneous area-wide processes are the major sources of volatile organic compounds (VOC), carbon monoxide (CO), sulfur oxides (SOx), inhalable particulate matter (PM_{10}), and fine particulate matter ($PM_{2.5}$) emissions in Siskiyou County, while on-road motor vehicles are the major sources of nitrogen oxides (NOx) emissions. Managed burning and disposal is the major source of VOC, CO, PM_{10}, and $PM_{2.5}$ emissions within the area-wide sources, and residential fuel combustion is the major driver of NOx and SOx emissions within the area-wide sources.

Table N-1. Siskiyou County (California) 2015 Emission Inventories.

Source Type/Category	Estimated Annual Average Emissions (tons per day)			
	ROG	**NO_X**	**PM_{10}**	**$PM_{2.5}$**
Stationary Sources				
Fuel Combustion	0.09	0.33	0.25	0.24
Waste Disposal	0.00	0.00	0.00	0.00
Cleaning and Surface Coating	0.19	-	-	-
Petroleum Production and Marketing	0.40	-	-	-
Industrial Processes	0.14	-	0.35	0.15
Subtotal (Stationary Sources)	**0.82**	**0.33**	**0.61**	**0.39**
Area wide Sources				
Solvent Evaporation	4.63	-	-	-
Miscellaneous Processes	3.89	0.70	17.05	4.80
Subtotal (Area-wide Sources)	**8.52**	**0.70**	**17.05**	**4.80**
Mobile Sources				
On-Road Motor Vehicles	1.74	4.96	0.24	0.13
Other Mobile Sources	0.90	2.40	0.11	0.10
Subtotal (Mobile Sources)	**2.64**	**7.36**	**0.36**	**0.23**
Grand Total for Siskiyou County	**11.98**	**8.39**	**18.01**	**5.42**

Source: CARB 2015
Notes: "-" = less than 0.1 ton per day
Totals shown in this table are rounded, and therefore may not appear to add exactly.

N.1.2 Monitoring Data

Table N-2 summarizes the air quality data from the monitoring station near the area of analysis in California. Data from the City of Yreka monitoring station was used to characterize ambient air quality, since it is the closest monitoring station to the Proposed Project in the Northeast Plateau Air Basin (NPAB). Because the City of Yreka monitoring station only monitors for ozone (O_3), PM_{10}, and $PM_{2.5}$, other pollutants are not summarized in the table.

Table N-2. Summary of Ambient Air Quality Data (2014–2016).

	2014	2015	2016
Ozone			
Maximum concentration (1-hour/8-hour average, ppm)	0.082/0.065	0.076/0.066	0.092/0.068
Number of days state standard exceeded (1-hour)	0	0	0
Number of days 8-hour standard exceeded (National/California)	0/0	0/0	0/0
Fine Particulate Matter ($PM_{2.5}$)			
Maximum concentration (µg/m^3) (National/California)	71.9/71.9	51.0/51.0	25.1/25.1
Number of days national standard exceeded (estimated/measured)	*/2	*/2	0.0/0
Annual average (µg/m^3) (National/California)	*/*	*/*	4.9/*
Respirable Particulate Matter (PM_{10})			
Maximum concentration (µg/m^3) (National/California)	90.6/82.9	65.5/59.6	*/*
Number of days state standard exceeded (estimated/measured)	*/3	6.1/1	*/0
Number of days national standard exceeded (estimated/measured)	0.0/0	0.0/0	*/0
Annual average (µg/m^3) (California)	*	12.9	*

Source: CARB 2017
Notes:
µg/m3 = micrograms per cubic meter
$PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter
PM_{10} = particulate matter less than or equal to 10 microns in diameter
ppm = parts per million
ppb = parts per billion
* Insufficient data available to determine the value.

Table N-3 shows the attainment status of Siskiyou County with respect to national ambient air quality standards (NAAQS) (CARB 2016) and California ambient air quality standards (CAAQS) (CARB 2016). As indicated in Table N-3, Siskiyou County is designated as attainment or unclassified for all federal and state ambient air quality standards.

Table N-3. Attainment Status Summary, Siskiyou County.

Criteria Pollutant	Federal Designation	State Designation
Ozone (O_3) (1-hour)	(no federal standard)	Attainment
Ozone (O_3) (8-hour)	Unclassified/Attainment*	Attainment
Nitrogen Dioxide (NO_2)	Unclassified/Attainment*	Attainment
Sulfur Dioxide (SO_2)	Unclassified*	Attainment
Carbon Monoxide (CO)	Unclassified/Attainment*	Unclassified*
Particulates (as PM_{10})	Unclassified*	Attainment
Particulates (as $PM_{2.5}$)	Unclassified/Attainment*	Attainment
Lead (Pb)	Unclassified/Attainment*	Attainment
Sulfates (as SO_4)	(no federal standard)	Attainment
Hydrogen Sulfide (H_2S)	(no federal standard)	Unclassified*
Vinyl Chloride (C_2H_3Cl)	(no federal standard)	n/d
Visibility Reducing Particles	(no federal standard)	Unclassified*

Source: CARB 2015
Notes:
* At the time of designation, if the available data does not support a designation of attainment or non-attainment, the area is designated as unclassified.
n/d—no data/information available

N.2 Assessment Methods

This section describes the methodology used to develop the emission inventories and the comparison of the analysis results for the California site activities to the Siskiyou County Air Pollution Control District (SCAPCD) significance thresholds.

N.2.1 Emission Calculation Methodology

In general, the construction emissions were estimated from various emission models and spreadsheet calculations, depending on the source type and data availability. The California Air Resources Board (CARB) Urban Emissions Model (URBEMIS) – Version 9.2.4 was used to estimate fugitive dust emissions from the general movement of the construction equipment on unpaved surfaces and excavation activities (cut/fill). Although URBEMIS is capable of estimating emissions from trucks and construction worker commuting vehicles, it is difficult to modify the model's default settings. Additionally, the model was developed specifically for activities completed in California and the exhaust emission components are not suitable for the construction activities that occur in Oregon. URBEMIS was therefore only used to estimate emissions from fugitive dust, which would be applicable in both states, and other methods were used to estimate emissions from non-dust sources.

Although URBEMIS is suitable for estimating fugitive dust emissions from the operation of the construction equipment and excavation activities, it is not suitable for estimating emissions from unpaved haul roads. Emissions from travel on unpaved roads were estimated using the methodology identified in the *Compilation of Air Pollutant Emission Factors (AP-42)* maintained by the United States Environmental Protection Agency (USEPA). Chapter 13.2.2 (USEPA 2006) was used to estimate the appropriate emission rate for unpaved roads.

Exhaust emissions from the off-road construction equipment operating at each dam site were estimated using the OFFROAD2007 and NONROAD2008a emission factor models for California and Oregon, respectively. Since California is unique amongst other states because it can set its own vehicular emission standards as prescribed in Section 209 of the federal Clean Air Act, it developed its own emissions factor model to estimate emissions from off-road equipment. It was assumed in these calculations that all off-road equipment would be diesel-fueled unless specifically identified as non-diesel fueled (e.g., gasoline) by the project consultants.

In a similar vein, exhaust emissions from on-road vehicles, specifically trucks and construction worker vehicles, were estimated using the EMFAC and MOBILE6.2 emission factor models for California and Oregon, respectively. It was assumed that construction workers would only be operating light-duty passenger cars and trucks; therefore, the emission factor calculations were restricted to only these vehicle classes. A combination of gasoline-fueled (catalyst and non-catalyst) and diesel-fueled engines was also used in the calculations. The default fleet mixes for Siskiyou County, California and Klamath County, Oregon were also used based on information contained in EMFAC for California and provided by the Oregon Department of Environmental Quality for Oregon.

Daily emissions for construction were estimated from appropriate emission factors, number of facilities and features being worked, and the associated schedules that were provided by the project consultants. The following sections provide additional discussion of emission estimation methodologies used for each source group.

N.2.1.1 On-site Building Demolition and Excavation Activities

The URBEMIS model was developed to estimate construction emissions from land development projects. It treats construction in three phases: Phase 1—demolition, Phase 2—site grading, and Phase 3—building construction. For the Proposed Project and alternatives, URBEMIS was used for fugitive particulate matter, or dust, emissions from demolition and grading (earth cut/fill) activities. The earth cut/fill activity is included in URBEMIS Phase 2—Site Grading, which allows the user to select one of four tiers of detail to calculate fugitive dust emissions.

Fugitive (re-entrained) dust emissions would occur from the movement of construction equipment at each of the construction sites. As a result, the default emission factor in URBEMIS for average construction activities (10 pounds per acre per day of PM_{10}) was used to estimate fugitive dust emissions from the equipment at the site. It was assumed in the calculations that fugitive dust emissions could occur from the construction equipment during the entire construction schedule. Table N-4 summarizes the size of the construction footprint for each 2012 KHSA EIS/EIR alternative used in URBEMIS to estimate fugitive dust emissions from the equipment.

Table N-4. Estimated Construction Area (acres).

2012 KHSA EIS/EIR Alternative Name[1]	Lower Klamath Project EIR Alternative Name	Iron Gate[1]	Copco No. 1[1]	Copco No. 2[1]	J.C. Boyle[1]
Full Facilities Removal	Proposed Project	13.1	2.3	2.8	9.7
	Three Dam Removal (Iron Gate, Copco No. 1, and Copco No. 2)				
	No Hatchery				
Partial Facilities Removal	Partial Removal	11.7	1.0	0.6	5.1
Fish Passage at Four Dams	Continued Operations with Fish Passage	5.1	1.5	1.0	2.1
Fish Passage at Two Dams, Remove Copco 1 and Iron Gate	Two Dam Removal (Iron Gate and Copco No. 1)	13.1	2.3	1.0	2.1

[1] Source: S. Wright, River Design Group, Inc., pers. comm., November 2010.

In addition to the re-entrained dust emissions from the movement of equipment at the construction site, emissions could also occur from excavation activities. The next tier in URBEMIS ("Low Level") was used to refine the emissions estimates for any phase or location that involved soil excavation. The construction window for excavation activities was limited to a shorter window than the entire construction schedule during which excavation activities could occur. Table N-5 summarizes the volumes of the excavated earth for each 2012 KHSA EIS/EIR alternative, which is based on the estimated volume of excavated material (spoils/cut material) increased by a factor of 20 percent to account for the bulk volume. This adjustment was made to account for the fact that the excavated material would take up more volume when removed from the ground than when compacted.

Table N-5. Estimated Bulk Waste Volume for Earth Materials (cubic yards).

2012 KHSA EIS/EIR Alternative[1]	Lower Klamath Project EIR Alternative Name	Iron Gate[1,2]	Copco No. 1[1]	Copco No. 2[1,2]	J.C. Boyle[1,2]
Full Facilities Removal	Proposed Project	1,300,000	n/a	1,800	170,000
	Three Dam Removal (Iron Gate, Copco No. 1, and Copco No. 2)				
	No Hatchery				
Partial Facilities Removal	Partial Removal	1,300,000	n/a	1,800	170,000
Fish Passage at Four Dams	Continued Operations with Fish Passage	n/a	n/a	n/a	n/a
Fish Passage at Two Dams, Remove Copco No. 1 and Iron Gate	Two Dam Removal (Iron Gate and Copco No. 1)	1,300,000	n/a	n/a	n/a

[1] Source: Appendix B: *Detailed Plan*.
[2] Volumes increased 20 percent for loose earth materials.

The estimates of earthen material waste that would require on-site disposal has decreased by approximately 80,000 cubic yards under the Proposed Project (Appendix B: *Definite Plan*). As such, there is the potential to generate fewer equipment engine exhaust, haul truck engine exhaust, and fugitive dust emissions during the excavation and on-site disposal of earthen materials from the Lower Klamath Project dams. This issue is discussed further below in Section N.3 *Emissions Inventories*.

In addition to fugitive dust emissions from the construction equipment and cut/fill activities, emissions would also occur from the demolition of existing structures at each of the sites. The quantity of building waste expected to be removed during demolition activities is summarized below.

- Copco No. 1 Dam: 300 cubic yards
- Copco No. 2 Dam: 600 cubic yards
- Iron Gate Dam: 400 cubic yards
- J.C. Boyle Dam: 2,000 cubic yards

Building demolition was only assumed to occur in the alternatives that would involve dam removal (i.e., all but the Continued Operations with Fish Passage Alternative). The building removal at Copco No. 1, however, is required to allow the mobilization of large equipment at the site. As a result, its building demolition is assumed to occur under all alternatives.

The estimates of building waste that would require off-site disposal has increased by approximately 2,600 cubic yards under the Proposed Project (Appendix B: *Definite Plan*). As such, there is the potential to generate greater equipment engine exhaust, haul truck engine exhaust, and fugitive dust emissions during the demolition and off-site disposal of building waste. This issue is discussed further below in Section N.3 *Emissions Inventories*.

N.2.1.2 On-site (Off-road) Equipment Engine Exhaust Emissions

Emissions would also occur from the combustion of fuel during operation of the off-road construction equipment at each of the dams. As was previously stated, separate emission factor models (i.e., OFFROAD and NONROAD) are used to estimate emissions in California and Oregon.

Preliminary estimates of the type, size (horsepower), and quantity of construction proposed to be used at each of the dam locations was provided by the project consultants. Engine load factors are also incorporated into the emission factor models. Emission factors for each piece of equipment were then selected based on the equipment type (e.g., cranes, excavators, loaders, etc.) and the engine size. It was conservatively assumed that all equipment located at a dam site could operate simultaneously for the entire shift. The total hours of operation for each piece of equipment was also provided with the equipment list provided by the project consultants.

In addition to the mobile construction equipment, several stationary generators would be present at each of the dam locations to provide power for electric-operated equipment. Emission factors from Chapter 3.3 (USEPA 1996) of AP-42 were used to estimate emissions from these generators.

Furthermore, speciation profiles were needed in many cases to convert emissions of PM_{10} to $PM_{2.5}$. CARB maintains particulate matter size fractions for various types of equipment (CARB 2010). Profile number 425 (Diesel Vehicle Exhaust) was used to determine the ratio of $PM_{2.5}$ to PM_{10} for equipment located in California. The USEPA also maintains generalized particle size distributions in Appendix B.2 to AP-42 (1996); these size fractions were used to estimate $PM_{2.5}$ emissions from diesel equipment located in Oregon. Finally, the NONROAD model provides emission estimates in terms of total hydrocarbon emissions. The conversion of total hydrocarbons to VOC was estimated from information contained in the USEPA's *Conversion Factors for Hydrocarbon Emission Components* (2003) document.

N.2.1.3 Off-site (On-road) Haul Truck Engine Exhaust Emissions and Paved Road Dust

The haul truck engine exhaust emissions were calculated based on EMFAC and MOBILE6.2 emission factors for heavy-duty diesel trucks in Siskiyou County, California and Klamath County, Oregon, respectively. Information on the peak daily and project total round trips was provided by the project consultants. The total project trips were assumed to occur evenly throughout the project schedule. The total vehicle miles traveled was determined from the number of trips and estimated distance to haul each component (e.g., earth, concrete, metal, etc.) to disposal sites near the Lower Klamath Project facilities and to disposal/recycling facilities in Klamath Falls, Medford, and the City of Yreka depending on the component.

Emission factors vary by year based on changes in the vehicle fleet mix by older engines retiring from service and improved emission control technologies and standards in newer engines joining the fleet. As a result, two different emission factors are provided by location (state) and pollutant to reflect these changes in the fleet mix.

Re-entrained road dust from haul truck travel was estimated for paved roads. Paved road dust was estimated using emission factors developed by the Midwest Research Institute (MRI 1996). Table N-6 presents the paved road dust emission factors. The emission factor for average road conditions and average daily trips (ADT) was used throughout the emission calculations.

Table N-6. Paved Road Re-entrained Dust Emission Factors.

Road Condition	Average Daily Trips (ADT)[1]		
	High	Low	Average[2]
Average conditions[3]	0.37	1.3	0.81
Worst-case conditions[4]	0.64	3.9	2.1

Source: MRI 1996.

Notes:

[1] Arterials" and "major streets" were classified by MRI as high-ADT roads, while "collectors" or "local streets" were classified as low-ADT roads.

[2] Based on 65 percent of high- and 35 percent of low-ADT silt loading values.

[3] Based on median value of MRI sampling data and average vehicle weight of 2.4 tons.

[4] Based on 90th percentile of MRI sampling data and average vehicle weight of 2.4 tons.

Key:

PM_{10} = inhalable particulate matter

Additionally, since the MRI emission factors are specific to PM_{10}, CARB size fraction profile number 471 (Paved Road Dust, 97 and after) was used to estimate emissions of $PM_{2.5}$.

N.2.1.4 Construction Worker Commuting

Emissions associated with construction workers commuting to and from the various dam locations were also estimated for each alternative. It was assumed that construction worker vehicles would consist of a mix of passenger cars and light-duty trucks. The combination of diesel and gasoline (catalyst and non-catalyst) vehicles from the various emission factor models was retained in the emission factor estimates. As explained in Section N.2.1.2 for trucks, the EMFAC and MOBILE6.2[12] emission factor models were used to estimate emissions. Re-entrained road dust was estimated using the emission factors provided in Table N-6 for average road conditions and average ADT.

N.2.1.5 Unpaved Road Dust

Fugitive dust emissions would also occur from unpaved roads that are used to haul waste materials. The methodology documented in Section 13.2.2 (USEPA 2006) of AP-42 was used to estimate fugitive dust emissions from the trucks operating on these roads.

The unpaved roads section of AP-42 requires an emission factor to be calculated using variables like the surface material silt content and mean vehicle weight on the roads. Two different equations are provided in AP-42 depending on whether the road is located at an industrial site or a publicly accessible road. The latter equation for publicly accessible roads assumes that the road will be dominated by light-duty vehicles; since trucks will be the primary equipment on the various haul roads, the equation for industrial sites (shown below) was used to estimate emissions.

$$E = k(s/12)^a (W/3)^b$$

Where:
E = size-specific emission factor, pounds per vehicle mile traveled (lb/vehicle miles traveled [VMT])
k, a, and b = empirical constants (see Table N-8)
s = surface material silt content, %
W = mean vehicle weight, tons

A silt content of 0.1 percent was used for all haul roads, which is the lowest silt content estimated for gravel roads by the USEPA (2006). The vehicular weight was estimated at 36.5 tons for empty trucks and 80 tons for loaded trucks (Caterpillar 2018). Table N-7 summarizes the empirical constants used in the preceding equation and the calculated emission factors for empty and loaded trucks.

[12] In 2010, the USEPA approved the use of the Motor Vehicle Emissions Simulator (MOVES) model for official State implementation air quality plan submissions to the USEPA and for transportation conformity analyses outside of California (75 FR 9411). The approval also started a two-year grace period that ends on March 2, 2012; the use of MOVES is not required during this timeframe. Since this analysis was completed during the grace period and project-level data was not available for MOVES, MOBILE6.2 was used for the analysis.

Table N-7. Empirical Constants and Emission Factors for Unpaved Roads.

Constant	$PM_{2.5}$	PM_{10}
k (lb/VMT)	0.15	1.5
a	0.9	0.9
b	0.45	0.45
E, Empty (lb/VMT)	0.0062	0.062
E, Loaded (lb/VMT)	0.0088	0.088

Source: USEPA 2006.
Key:
lb/VMT = pounds per vehicle mile traveled
$PM_{2.5}$ = fine particulate matter
PM_{10} = inhalable particulate matter

The emission factors provided in Table N-7 are for uncontrolled fugitive dust emissions. Natural mitigation occurs from annual precipitation, the control efficiency of which can be estimated from the following equation.

$$E_{ext} = E\left[\left(365 - P\right)/365\right]$$

Where:
E_{ext} = annual size-specific emission factor extrapolated for natural mitigation, lb/VMT
E = unpaved road dust emission factor (see Table N-8)
P = number of days in a year with at least 0.254 mm (0.01 in) of precipitation

The number of days of precipitation was estimated at approximately 88 days for Klamath County and 84 days for Siskiyou County. The control efficiency of natural mitigation was therefore estimated as 76 percent and 77 percent, respectively, for Klamath and Siskiyou Counties.

N.2.1.6 Restoration Activities

Restoration activities may use, in part, helicopters or other small aircraft and barges for reseeding. A combination of techniques was used to estimate emissions from the restoration activities. The Federal Aviation Administration's Emissions and Dispersion Modeling System was used to simulate emissions that could occur from landing and takeoff operations associated with aerial seed application. Barges would also be used during reseeding activities. Emission factors for propulsion engines were derived from the USEPA's *Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data* (2000), while generator emissions for the seed sprayer were estimated from the USEPA's *Compilation of Air Pollutant Emission Factors* for diesel engines (1996).

N.2.1.7 City of Yreka Water Supply Pipeline Construction

Fugitive dust and exhaust emission factors associated with constructing the City of Yreka pipeline were estimated using the Sacramento Metropolitan Air Quality Management District's Road Construction Emissions Model, Version 6.3.2 (2009). Although this model is used by a different air district than the Siskiyou County Air Pollution Control District, this model is recommended to estimate emissions for linear projects like the pipeline construction (USBR and CDFG 2012).

N.2.1.8 Recreation Facility Removal

The California Emissions Estimator Model (CalEEMod) was used to estimate exhaust emissions that would occur from grading activities associated with restoring parking lots associated with recreational facilities proposed for relocation and demolition. CalEEMod makes general assumptions about the quantity and types of construction equipment needed to grade a site based on its size (acreage).

N.3 Emission Inventories

Emission inventories were completed for each of the dam locations and alternatives as described in the previous sections. Table N-8 provides a summary of the peak daily emissions by alternative.

For the purposes of the Lower Klamath Project air quality analysis, the emissions from the Three Dam Removal (Iron Gate, Copco No. 1, and Copco No. 2) Alternative are considered substantially similar to the emissions from the Proposed Project. Instead of including a duplicate of the emissions inventory for the Proposed Project, the discussion below refers to the Proposed Project and Three Dam Removal (Iron Gate, Copco No. 1, and Copco No. 2) together.

Table N-8. Summary of Peak Daily Emissions by Alternative.

2012 KHSA EIS/EIR Alternative Name[1]	Lower Klamath Project EIR Alternative Name	Peak Daily Emissions (pounds per day)[1,2]					
		VOC	CO	NOx	SOx	PM_{10}	$PM_{2.5}$
Full Facilities Removal	Proposed Project	165	739	**921**	29	**523**	**261**
	Three Dam Removal (Iron Gate, Copco No. 1, and Copco No. 2)						
	No Hatchery						
Partial Facilities Removal	Partial Removal	162	725	**896**	29	**514**	**257**
Fish Passage at Four Dams	Continued Operations with Fish Passage	11	63	59	4	11	6
Fish Passage at Two Dams	Two Dam Removal (Iron Gate and Copco No. 1)	146	673	**857**	27	**425**	237
Threshold of Significance[2]	Proposed Project	250	2,500	250	250	250	250

Notes:
[1] Data from 2012 KHSA EIS/EIR.
[2] Values shown in **bold** exceed the Siskiyou County Air Pollution Control District's (SCAPCD) thresholds of significance in Rule 6.1 (Construction Permit Standards for Criteria Air Pollutants).

As shown in Table N-8, with the exception of the Continued Operations with Fish Passage Alternative, the project alternatives would exceed the significance thresholds for NOx and PM_{10}. In addition, the Proposed Project, Three Dam Removal (Iron Gate, Copco No. 1, and Copco No. 2) Alternative, and Partial Removal Alternative would exceed the significance thresholds for $PM_{2.5}$. As such, the construction emissions from these alternatives would be significant.

As noted above in Section N.2.1.1 *On-Site Building Demolition and Excavation Activities*, the estimates of earthen material waste that would require on-site disposal has decreased by approximately 80,000 cubic yards under the Proposed Project (Appendix B: *Definite Plan*). As such, there is the potential to generate fewer equipment engine exhaust, haul truck engine exhaust, and fugitive dust emissions during the excavation and on-site disposal of earthen materials from the dams. However, the estimates of building waste that would require off-site disposal has increased by approximately 2,600 cubic yards under the Proposed Project (Appendix B: *Definite Plan*). As such, there is the potential to generate greater equipment engine exhaust, haul truck engine exhaust, and fugitive dust emissions during the demolition and off-site disposal of building waste.

The decrease in emissions from the excavation and hauling of earthen material waste would partially off-set the increase in emissions from the demolition and hauling of building waste. However, the building waste would require disposal at off-site locations that range from 22 to 28 miles (44 to 56 miles round-trip) from the dams. The earthen material waste would be disposed of at on-site locations that range from 0.25 to 4 miles (0.5 to 8 miles round-trip) from the dams. As such, it is anticipated that the emissions from dam removal activities under the current proposal (Appendix B: *Definite Plan*) would be greater than the emissions estimates calculated for the 2012 KHSA EIS/EIR. This increase would primarily be due to haul truck engine exhaust because of the hauling distance required for the off-site disposal of building waste. As applicable, this issue is addressed further under the discussion of emissions from the alternatives.

The discussion below provides more detailed information about the emissions from the Proposed Project and the alternatives.

N.3.1 Emissions from the Proposed Project and Three Dam Removal (Iron Gate, Copco No. 1, and Copco No. 2) Alternative

A summary of the total daily emissions associated with the Proposed Project and Three Dam Removal (Iron Gate, Copco No. 1, and Copco No. 2) Alternative is provided in Table N-9. As described in the previous sections, construction emissions were calculated for various project activities including dam and powerhouse deconstruction, restoration activities, relocation and demolition of recreational facilities, and the Yreka supply pipeline relocation.

Table N-9. Total Uncontrolled Daily Emissions from the Proposed Project and Three Dam Removal (Iron Gate, Copco No. 1, and Copco No. 2) Alternative.[1]

Project Activity	Daily Emissions (pounds per day)[2]					
	VOC	CO	NOx	SOx	PM_{10}	$PM_{2.5}$
Dam and Powerhouse Deconstruction	131	584	650	9	503	248
Restoration Activities	19	62	168	20	3	3
Recreation Facilities	12	77	85	0	17	7
Yreka Water Supply Pipeline Relocation	3	16	18	0	10	3
Total	165	739	**921**	29	**523**	**261**
Significance Criterion[2]	250	2,500	250	250	250	250

[1] Data from 2012 KHSA EIS/EIR.

[2] Values shown in **bold** exceed the Siskiyou County Air Pollution Control District's (SCAPCD) thresholds of significance in Rule 6.1 (Construction Permit Standards for Criteria Air Pollutants).

As shown in Table N-9, total daily emissions from the Proposed Project and Three Dam Removal Alternative (Iron Gate, Copco No. 1, and Copco No. 2) Alternative are estimated to exceed the SCAPCD's significance thresholds for NOx, PM_{10}, and $PM_{2.5}$. As such, the construction emissions from the Proposed Project and Three Dam Removal Alternative (Iron Gate, Copco No. 1, and Copco No. 2) Alternative would be significant. Since the Yreka water pipeline relocation will occur prior to initiating drawdown of the Iron Gate Reservoir, the construction emissions from this project activity do not have the potential to occur at the same time as the other activities and should be analyzed separately.

As discussed above, it is anticipated that the emissions from dam removal activities under the current proposal (Appendix B: *Definite Plan*) would be greater than the emissions estimates calculated for the 2012 KHSA EIS/EIR. This increase would primarily be due to haul truck engine exhaust because of the hauling distance required for the off-site disposal of building waste. As such, it is anticipated that these additional emissions would contribute to the finding of significant impacts for the emissions of NOx, PM_{10}, and $PM_{2.5}$ from the Proposed Project. It is not anticipated that these additional emissions would cause the Proposed Project to exceed the significance thresholds for VOC, CO, or SOx for the following reasons: 1) the emissions of these criteria air pollutants from the Proposed Project are well below the SCAPCD's significance thresholds (Table N-9); and 2) the hauling of waste from dam removal activities only constitutes a small portion of the emissions of these criteria air pollutants (Table N-10).

The discussion below provides more detailed information about the emissions from the various project activities that would occur under the Proposed Project and Three Dam Removal Alternative (Iron Gate, Copco No. 1, and Copco No. 2) Alternative.

N.3.1.2 Emissions from Dam and Powerhouse Deconstruction

A breakdown of peak daily emissions associated with dam and powerhouse deconstruction under the Proposed Project and Three Dam Removal Alternative (Iron Gate, Copco No. 1, and Copco No. 2) Alternative is provided in Table N-10. Emissions are identified for each of the major components of construction, including off-road construction equipment, on-road trucks, construction worker commuting vehicles, and

fugitive dust from vehicle re-entrainment on unpaved roads and excavation/grading activities.

Table N-10. Peak Daily Emissions from Dam and Powerhouse Deconstruction.[1]

Source	Peak Daily Emissions (pounds per day)[2]					
	VOC	CO	NOx	SOx	PM_{10}	$PM_{2.5}$
Iron Gate						
Construction Equipment	63	248	**313**	2	12	11
Haul Trucks	3	12	34	0	5	2
Employee Commuting Vehicles	1	11	1	0	4	1
Unpaved Roads	--	--	--	--	31	3
Excavation/Grading	--	--	--	--	157	33
Iron Gate Subtotal	67	272	**348**	2	210	50
Copco No. 1						
Construction Equipment	26	159	117	1	6	5
Haul Trucks	1	4	11	0	2	1
Employee Commuting Vehicles	1	13	1	0	3	1
Unpaved Roads	--	--	--	--	2	<1
Excavation/Grading	--	--	--	--	161	159
Copco No. 1 Subtotal	27	176	129	1	174	165
Copco No. 2						
Construction Equipment	19	56	80	1	4	3
Haul Trucks	3	12	32	0	5	2
Employee Commuting Vehicles	1	16	2	0	2	<1
Unpaved Roads	--	--	--	--	4	<1
Excavation/Grading	--	--	--	--	3	1
Copco No. 2 Subtotal	19	56	80	1	4	3
J.C. Boyle						
Construction Equipment	13	22	54	5	9	8
Haul Trucks	1	1	4	0	2	<1
Employee Commuting Vehicles	2	31	1	0	2	<1
Unpaved Roads	--	--	--	--	5	1
Excavation/Grading	--	--	--	--	84	17
J.C. Boyle Subtotal	15	54	60	5	103	27
Total Emissions	131	584	**650**	9	**503**	248
California Emissions	116	531	**590**	4	**401**	221
Oregon Emissions	15	54	60	5	103	27
Significance Criterion[2]	250	2,500	250	250	250	250

[1] Data from 2012 KHSA EIS/EIR.

[2] Values shown in **bold** exceed the Siskiyou County Air Pollution Control District's (SCAPCD) thresholds of significance in Rule 6.1 (Construction Permit Standards for Criteria Air Pollutants).

N.3.1.3 Emissions from Restoration Activities

A summary of peak daily emissions associated with restoration activities is provided in Table N-11.

Table N-11. Peak Daily Emissions from Restoration Activities.[1]

Phase	Peak Daily Emissions (pounds per day)					
	VOC	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$
Ground Equipment	3	8	15	2	0	0
Barges	16	54	153	18	3	3
Aircraft	15	39	3	1	0	0
Maximum Daily[2]	19	62	168	20	3	3

[1] Data from 2012 KHSA EIS/EIR.
[2] Barge and aerial application would not happen simultaneously; therefore, maximum daily emissions summarize the peak day tha consists of ground equipment and barges operating at the same time.

N.3.1.4 Emissions from Recreation Facilities

A summary of peak daily emissions associated with the relocation and demolition of recreation facilities is provided in Table N-12.

Table N-12. Peak Daily Emissions from Recreation Facilities.[1]

Location	Peak Daily Emissions (pounds per day)					
	VOC	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$
J.C. Boyle	4	32	31	0	4	1
Copco No. 1 Reservoir	2	13	16	0	4	2
Iron Gate Reservoir	6	32	38	0	9	4
Total Emissions	12	77	85	0	17	7

[1] Data from 2012 KHSA EIS/EIR.

N.3.1.5 Emissions from Yreka Water Supply Pipeline Relocation

A summary of peak daily emissions associated with the relocation of the Yreka water supply pipeline is provided in Table N-13.

Table N-13. Peak Daily Emissions from Yreka Water Supply Pipeline Relocation.[1]

Location	Peak Daily Emissions (pounds per day)					
	VOC	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$
J.C. Boyle	4	32	31	0	3	1
Copco No. 1 Reservoir	2	13	16	0	2	1
Iron Gate Reservoir	6	32	38	0	5	3
Total Emissions	12	77	85	0	11	5
Significance Criterion	250	2,500	250	250	250	250

[1] Data from 2012 KHSA EIS/EIR.

As noted above, the Yreka water pipeline relocation will occur prior to initiating drawdown of the Iron Gate Reservoir and the construction emissions from this project activity do not have the potential to occur at the same time as the other activities. Therefore, this project activity is analyzed separately from the other project activities. As

shown in Table N-13, emissions from the relocation of the Yreka water supply pipeline are below the significance criteria.

N.3.2 Emissions from the Partial Removal Alternative

A summary of the total daily emissions associated with the Partial Removal Alternative is provided in Table N-14. As described in the previous sections, construction emissions were calculated for various project activities including dam and powerhouse deconstruction, restoration activities, relocation and demolition of recreational facilities, and the Yreka supply pipeline relocation.

Table N-14. Total Uncontrolled Daily Emissions from the Partial Removal Alternative.[1]

Project Activity	Daily Emissions (pounds per day)[2]					
	VOC	CO	NOx	SOx	PM_{10}	$PM_{2.5}$
Dam and Powerhouse Deconstruction	128	570	625	9	484	244
Restoration Activities	19	62	168	20	3	3
Recreation Facilities	12	77	85	0	17	7
Yreka Water Supply Pipeline Relocation	3	16	18	0	10	3
Total	162	725	**896**	29	**514**	**257**
Significance Criterion[2]	250	2,500	250	250	250	250

[1] Data from 2012 KHSA EIS/EIR.
[2] Values shown in **bold** exceed the Siskiyou County Air Pollution Control District's (SCAPCD) thresholds of significance in Rule 6.1 (Construction Permit Standards for Criteria Air Pollutants).

As shown in Table N-14, total daily emissions from the Partial Removal Alternative are estimated to exceed the SCAPCD's significance thresholds for NOx, PM_{10}, and $PM_{2.5}$. As such, the construction emissions from the Partial Removal Alternative would be significant. Since the Yreka water pipeline relocation will occur prior to initiating drawdown of the Iron Gate Reservoir, the construction emissions from this project activity do not have the potential to occur at the same time as the other activities and should be analyzed separately. As shown in Table N-14, the emissions from the relocation of the Yreka water supply pipeline are below the significance criteria.

Compared to the Proposed Project, this alternative generally results in fewer NOx, PM_{10}, and $PM_{2.5}$ emissions associated with excavation and cut/fill activities because the footprint on which equipment would be operating is smaller than the Proposed Project. Emissions associated with the other components are relatively unaffected because the peak number of truck trips, construction equipment, or employees does not substantially change between the Proposed Project and this alternative. An exception occurs at J.C. Boyle, which requires fewer workers and less construction equipment under the Partial Removal Alternative compared to the Proposed Project.

As discussed above, it is anticipated that the emissions from dam removal activities under the current proposal (Appendix B: *Definite Plan*) would be greater than the emissions estimates calculated for the 2012 KHSA EIS/EIR. This increase would primarily be due to haul truck engine exhaust because of the hauling distance required for the off-site disposal of building waste. As such, it is anticipated that these additional emissions would contribute to the finding of significant impacts for the emissions of NOx,

PM_{10}, and $PM_{2.5}$ from the Partial Removal Alternative. It is not anticipated that these additional emissions would cause the Partial Removal Alternative to exceed the significance thresholds for VOC, CO, or SOx for the following reasons: (1) the emissions of these criteria air pollutants from the Partial Removal Alternative are well below the SCAPCD's significance thresholds (Table N-14); and (2) the hauling of waste from dam removal activities only constitutes a small portion of the emissions of these criteria air pollutants (Table N-15).

A breakdown of peak daily emissions associated with dam removal activities that would occur under the Partial Removal Alternative is provided in Table N-15.

Table N-15. Peak Daily Emissions for Dam Removal Activities for the Partial Removal Alternative.[1]

Source	Peak Daily Emissions (pounds per day)[2]					
	VOC	CO	NOx	SOx	PM_{10}	$PM_{2.5}$
Iron Gate						
Construction Equipment	63	248	**313**	2	12	11
Haul Trucks	2	11	30	<1	5	1
Employee Commuting	1	11	1	<1	4	1
Unpaved Roads	--	--	--	--	31	3
Excavation/Grading	--	--	--	--	156	33
Iron Gate Subtotal	66	**270**	**344**	2	208	49
Copco No. 1						
Construction Equipment	26	159	117	1	6	5
Haul Trucks	1	2	6	<1	1	<1
Employee Commuting	1	11	1	<1	3	1
Unpaved Roads	--	--	--	--	2	<1
Excavation/Grading	--	--	--	--	159	158
Copco No. 1 Subtotal	27	173	124	1	171	165
Copco No. 2						
Construction Equipment	19	56	80	1	4	3
Haul Trucks	2	8	22	<1	3	1
Employee Commuting	1	16	2	<1	2	<1
Unpaved Roads	--	--	--	--	2	<1
Excavation/Grading	--	--	--	--	1	<1
Copco No. 2 Subtotal	21	80	103	1	12	5
J.C. Boyle						
Construction Equipment	12	19	49	5	8	7
Haul Trucks	<1	1	3	<1	1	<1
Employee Commuting	1	28	1	<1	2	<1
Unpaved Roads	--	--	--	--	5	1
Excavation/Grading	--	--	--	--	77	16
J.C. Boyle Subtotal	14	48	53	5	94	25
Total Emissions	128	570	**625**	9	**484**	244
California Emissions	115	522	**571**	4	**390**	219
Oregon Emissions	14	48	53	5	94	25
Significance Criteria[1]	250	2,500	250	250	250	250

[1] Data from 2012 KHSA EIS/EIR.
[2] Values shown in **bold** exceed the Siskiyou County Air Pollution Control District's (SCAPCD) thresholds of significance in Rule 6.1 (Construction Permit Standards for Criteria Air Pollutants).

N.3.3 Emissions from the Continued Operations with Fish Passage Alternative

A breakdown of peak daily emissions associated with construction activities under the Continued Operation with Fish Passage Alternative is provided in Table N-16. Emissions estimates for this alternative only include construction activities related to the construction of fish passage since this alternative does not include the other project activities that would occur under the other alternatives.

Table N-16. Peak Daily Emissions for Construction Activities for the Continued Operations with Fish Passage Alternative.[1]

Source	Peak Daily Emissions (pounds per day)[2]					
	VOC	CO	NOx	SOx	PM_{10}	$PM_{2.5}$
Iron Gate						
Construction Equipment	10	54	52	<1	2	2
Haul Trucks	1	3	7	<1	1	<1
Employee Commuting	1	6	1	<1	2	<1
Unpaved Roads	--	--	--	--	--	--
Excavation/Grading	--	--	--	--	2	<1
Iron Gate Subtotal	11	63	59	<1	8	3
Copco No. 1						
Construction Equipment	9	51	37	<1	2	1
Haul Trucks	1	3	7	<1	2	<1
Employee Commuting	1	4	<1	<1	1	<1
Unpaved Roads	--	--	--	--	--	--
Excavation/Grading	--	--	--	--	1	<1
Copco No. 1 Subtotal	9	51	37	<1	2	1
Copco No. 2						
Construction Equipment	9	51	42	<1	2	2
Haul Trucks	1	3	8	<1	2	<1
Employee Commuting	<1	3	<1	<1	1	<1
Unpaved Roads	--	--	--	--	--	--
Excavation/Grading	--	--	--	--	<1	<1
Copco No. 2 Subtotal	10	58	50	<1	5	2
J.C. Boyle						
Construction Equipment	8	14	45	3	6	5
Haul Trucks	1	1	5	<1	3	1
Employee Commuting	<1	<1	<1	<1	1	<1
Unpaved Roads	--	--	--	--	--	--
Excavation/Grading	--	--	--	--	1	<1
J.C. Boyle Subtotal	9	16	50	4	11	6
Maximum Daily Emissions	11	63	59	4	11	6
Significance Criterion	250	2,500	250	250	250	250

[1] Data from 2012 KHSA EIS/EIR.

[2] Values shown in **bold** exceed the Siskiyou County Air Pollution Control District's (SCAPCD) thresholds of significance in Rule 6.1 (Construction Permit Standards for Criteria Air Pollutants).

As shown in Table N-16, emissions from the Continued Operations with Fish Passage Alternative are below the significance criteria. Peak daily emissions of each pollutant would be substantially lower than emissions under the Proposed Project. This is largely based on the fact that the dams will remain in place and fugitive dust emissions will be minimal. The reduced level of construction activities compared to that under the

Proposed Project also results in fewer emissions from the components (i.e., construction equipment, trucks, and construction worker commuting vehicles).

N.3.4 Emissions from the Two Dam Removal (Iron Gate and Copco No. 1) Alternative

A summary of the total daily emissions associated with the Two Dam Removal (Iron Gate and Copco No. 1) Alternative is provided in Table N-17. As described in the previous sections, construction emissions were calculated for various project activities including dam and powerhouse deconstruction, restoration activities, relocation and demolition of recreational facilities, and the Yreka supply pipeline relocation.

Table N-17. Total Uncontrolled Daily Emissions from the Two Dam Removal (Iron Gate and Copco No. 1) Alternative.[1]

Project Activity	Daily Emissions (pounds per day)[2]					
	VOC	CO	NOx	Sox	PM_{10}	$PM_{2.5}$
Dam and Powerhouse Deconstruction	117	552	620	7	399	225
Restoration Activities	18	60	165	20	3	3
Recreation Facilities	8	45	54	0	13	6
Yreka Water Supply Pipeline Relocation	3	16	18	0	10	3
Total	146	673	**857**	27	**425**	237
Significance Criterion[2]	250	2,500	250	250	250	250

[1] Data from 2012 KHSA EIS/EIR.
[2] Values shown in **bold** exceed the Siskiyou County Air Pollution Control District's (SCAPCD) thresholds of significance in Rule 6.1 (Construction Permit Standards for Criteria Air Pollutants).

As shown in Table N-17, total daily emissions from the Two Dam Removal (Iron Gate and Copco No. 1) Alternative are estimated to exceed the SCAPCD's significance thresholds for NOx and PM_{10}. As such, the construction emissions from the Two Dam Removal (Iron Gate and Copco No. 1) Alternative would be significant. Since the Yreka water pipeline relocation will occur prior to initiating drawdown of the Iron Gate Reservoir, the construction emissions from this project activity do not have the potential to occur at the same time as the other activities and should be analyzed separately. As shown in Table N-17, the emissions from the relocation of the Yreka water supply pipeline are below the significance criteria.

Peak daily emissions of each pollutant under this alternative are substantially less than emissions from the Proposed Project. This is largely based on the fact that two dams will remain in place and fugitive dust emissions will be substantially reduced. The reduced level of construction activities compared to that under the Proposed Project also results in fewer emissions from the components (i.e., construction equipment, trucks, and construction worker commuting vehicles).

As discussed above, it is anticipated that the emissions from dam removal activities under the current proposal (Appendix B: *Definite Plan*) would be greater than the emissions estimates calculated for the 2012 KHSA EIS/EIR. This increase would primarily be due to haul truck engine exhaust because of the hauling distance required for the off-site disposal of building waste. As such, it is anticipated that these additional

emissions would contribute to the finding of significant impacts for the emissions of NOx and PM_{10} from the Two Dam Removal (Iron Gate and Copco No. 1) Alternative. Since the emissions of $PM_{2.5}$ under this alternative are just below the SCAPCD's significance threshold, it is conservatively assumed that these additional emissions would cause this alternative to exceed the significance threshold for $PM_{2.5}$. It is not anticipated that these additional emissions would cause the Two Dam Removal (Iron Gate and Copco No. 1) Alternative to exceed the significance thresholds for VOC, CO, or SOx for the following reasons: 1) the emissions of these criteria air pollutants from the Two Dam Removal (Iron Gate and Copco No. 1) Alternative are well below the SCAPCD's significance thresholds (Table N-17); and 2) the hauling of waste from dam removal activities only constitutes a small portion of the emissions of these criteria air pollutants (Table N-18).

A breakdown of peak daily emissions associated with dam removal activities under the Two Dam Removal (Iron Gate and Copco No. 1) Alternative is provided in Table N-18.

Table N-18. Peak Daily Emissions for Dam Removal Activities for the Two Dam Removal (Iron Gate and Copco No. 1) Alternative.[1]

Source	Peak Daily Emissions (pounds per day)[2]					
	VOC	CO	NOx	SOx	PM_{10}	$PM_{2.5}$
Iron Gate						
Construction Equipment	63	248	**313**	2	12	11
Haul Trucks	2	11	30	0	5	1
Employee Commuting	1	22	2	0	5	1
Unpaved Roads	--	--	--	--	31	3
Excavation/Grading	--	--	--	--	157	33
Iron Gate Subtotal	67	**282**	**345**	2	209	49
Copco No. 1						
Construction Equipment	26	159	117	1	6	5
Haul Trucks	1	4	11	0	2	1
Employee Commuting	1	16	2	0	3	1
Unpaved Roads	--	--	--	--	2	0
Excavation/Grading	--	--	--	--	160	159
Copco No. 1 Subtotal	28	179	129	1	173	165
Copco No. 2						
Construction Equipment	11	52	70	0	3	3
Haul Trucks	1	4	12	0	2	1
Employee Commuting	0	4	0	0	1	0
Unpaved Roads	--	--	--	--	--	--
Excavation/Grading	--	--	--	--	0	0
Copco No. 2 Subtotal	12	61	82	0	6	4

Source	Peak Daily Emissions (pounds per day)[2]					
	VOC	CO	NOx	SOx	PM_{10}	$PM_{2.5}$
J.C. Boyle						
Construction Equipment	8	18	56	4	6	6
Haul Trucks	1	2	6	0	3	1
Employee Commuting	1	12	0	0	1	0
Unpaved Roads	--	--	--	--	--	--
Excavation/Grading	--	--	--	--	1	0
J.C. Boyle Subtotal	10	32	63	4	11	7
Total Emissions	117	552	**620**	7	**399**	225
California Emissions	107	521	**557**	3	**388**	218
Oregon Emissions	10	32	63	4	11	7
Significance Criterion[1]	250	2,500	250	250	250	250

[1] Data from 2012 KHSA EIS/EIR.
[2] Values shown in **bold** exceed the Siskiyou County Air Pollution Control District's (SCAPCD) thresholds of significance in Rule 6.1 (Construction Permit Standards for Criteria Air Pollutants).

N.4 Mitigation Measures

Several mitigation measures were proposed as part of the analysis in the 2012 KSHA EIS/EIR to reduce emissions of NOx, PM_{10}, and $PM_{2.5}$. The mitigation measures included the following:

- AQ-1 – Any off-road construction equipment (e.g., loaders, excavators, etc.) must be equipped with engines that meet the model year (MY) 2015 emission standards for off-road compression-ignition (diesel) engines (13 CCR 2420-2425.1). Older model year engines may also be used if they are retrofit with control devices to reduce emissions to the applicable emission standards.
- AQ-2 – Any on-road construction equipment (e.g., pick-up trucks at the construction sites) must be equipped with engines that meet the MY 2000 or on-road emission standards.
- AQ-3 – Any trucks used to transport materials to or from the construction sites must be equipped with engines that meet the MY 2010 or later emission standards for on-road heavy-duty engines and vehicles (13 CCR 1956.8). Older model engines may also be used if they are retrofit with control devices to reduce emissions to the applicable emission standards.
- AQ-4 – Dust control measures will be incorporated to the maximum extent feasible during blasting operations at Copco No. 1 Dam. The following control measures will be used during blasting activities:
    - Conduct blasting on calm days to the extent feasible. Wind direction with respect to nearby residences must be considered.
    - Design blast stemming to minimize dust and to control fly rock.
    - Install wind fence for control of windblown dust

Below is a discussion of the mitigated emissions by alternative for dam removal activities and the mitigated emissions by alternative with all project activities combined. As noted above, the other project activities for which emissions were estimated include restoration activities, relocation and demolition of recreational facilities, and replacement of the Yreka water supply pipeline.

N.4.1 Mitigated Emissions by Alternative for Dam Removal Activities

The mitigated emissions for each of the dam locations and alternatives were calculated as described in the previous sections. Table N-19 summarizes the mitigated emissions by alternative for dam removal activities.

Table N-19. Summary of Mitigated Emissions by Alternative for Dam Removal Activities.[1]

Alternative[2]	Peak Daily Emissions (lbs/day)[3]					
	VOC	CO	NOx	SOx	PM_{10}	$PM_{2.5}$
Proposed Project and Three Dam Removal (Iron Gate, Copco No. 1, and Copco No. 2) Alternative	66	405	146	3	**309**	74
Partial Removal	64	394	137	3	**294**	60
Two Dam Removal (Iron Gate and Copco No. 1)	54	372	156	3	209	44
Significance Criterion[3]	250	2,500	250	250	250	250

[1] Data from 2012 KHSA EIS/EIR.
[2] The Continued Operations with Fish Passage Alternative not included in the table because mitigation would not be required for this alternative.
[3] Values shown in **bold** exceed the Siskiyou County Air Pollution Control District's (SCAPCD) thresholds of significance in Rule 6.1 (Construction Permit Standards for Criteria Air Pollutants).

As shown in Table N-19, emissions of PM_{10} would remain significant for the Proposed Project, Three Dam Removal (Iron Gate, Copco No. 1, and Copco No. 2) Alternative, and Partial Removal Alternative.

N.5 Mitigated Emissions by Alternative with All Project Activities

In addition to criteria pollutant emissions that would occur from dam removal activities, emissions would also occur from restoration activities, relocation and demolition of recreation facilities, and replacement of the Yreka water supply pipeline. Table N-20 summarizes the total mitigated daily emissions that would occur when all of these components are considered together. Mitigated emissions estimates are not provided for the Continued Operations with Fish Passage Alternative because mitigation would not be required and the other project activities would not occur under this alternative.

Table N-20. Total Mitigated Daily Emissions by Alternative with All Project Activities.[1]

Alternative/Project Activity	Daily Emissions (pounds per day)[2]					
	VOC	CO	NOx	SOx	PM_{10}	$PM_{2.5}$
Proposed Project and Three Dam Removal (Iron Gate, Copco No. 1, and Copco No. 2) Alternative						
Dam and Powerhouse Deconstruction	66	405	146	3	**309**	74
Restoration Activities	19	62	168	20	3	3
Recreation Facilities	12	77	85	<1	11	5
Yreka Water Supply Pipeline	3	16	18	<1	10	3
Total	100	560	**418**	24	**332**	84
Partial Removal Alternative						
Dam and Powerhouse Deconstruction	64	394	137	3	**294**	60
Restoration Activities	19	62	168	20	3	3
Recreation Facilities	12	77	85	<1	11	5
Yreka Water Supply Pipeline	3	16	18	<1	10	3
Total	98	549	**409**	24	**317**	71
Two Dam Removal (Iron Gate and Copco No. 1) Alternative						
Dam and Powerhouse Deconstruction	54	372	156	3	209	44
Restoration Activities	18	60	165	20	3	3
Recreation Facilities	8	45	54	<1	7	4
Yreka Water Supply Pipeline	3	16	18	<1	10	3
Total	83	494	**393**	22	230	53
Significance Criterion[1]	250	2,500	250	250	250	250

[1] Data from 2012 KHSA EIS/EIR.

[2] Values shown in **bold** exceed the Siskiyou County Air Pollution Control District's (SCAPCD) thresholds of significance in Rule 6.1 (Construction Permit Standards for Criteria Air Pollutants).

As shown in Table N-20, emissions of NOx would remain significant for the Proposed Project, Three Dam Removal (Iron Gate, Copco No. 1, and Copco No. 2) Alternative, Partial Removal Alternative, and Two Dam Removal (Iron Gate and Copco No. 1) Alternative. In addition, emissions of PM_{10} would remain significant for the Proposed Project, Three Dam Removal (Iron Gate, Copco No. 1, and Copco No. 2) Alternative, and Partial Removal Alternative.

As indicated in Table N-20, the mitigation measures result in the greatest reductions in emissions for construction activity related to dam and powerhouse deconstruction. Due to the proposed construction techniques and equipment (e.g., aircraft, barges, etc.), the mitigated emissions for the other project activities (i.e., restoration activities, relocation and demolition of recreation facilities, and relocation of the Yreka water supply pipeline) would be similar or slightly reduced as compared to the unmitigated emissions.

The current proposal for the Proposed Project (Appendix B: *Detailed Plan*) lacks sufficient detail concerning construction activities and it is too speculative to determine whether the mitigation measures proposed in the 2012 KHSA EIS/EIR are feasible and enforceable. Since similar minimization measures may be implemented during project construction, it is assumed that the emissions generated by the Proposed Project and the project alternatives would fall somewhere in the range between the uncontrolled and mitigated emissions estimates.

Due to this uncertainty, the emissions of NOx, PM_{10}, and $PM_{2.5}$ from the Proposed Project, Three Dam Removal (Iron Gate, Copco No. 1, and Copco No. 2) Alternative, Partial Removal Alternative, and Two Dam Removal (Iron Gate and Copco No. 1) Alternative are found to be significant.

N.6 References

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Appendix O

Greenhouse Gases

The greenhouse gases impact modeling described in this appendix is reproduced from the 2012 EIS/EIR analysis. Although there have since been some modifications to the project schedule, the 2011 greenhouse gases impact modeling is reproduced herein because the construction-related emissions-generating activities for the Proposed Project are materially similar to those modeled below. Minor changes in construction activities between the 2012 EIS/EIR analysis and the Proposed Project are primarily due to the timing of the peak construction period associated with removing each dam (Table 2.6-13). The Proposed Project and the data modeled as part of the 2012 EIS/EIR in this attachment are within the thresholds noted in Lower Klamath Project EIR Section 3.10.3 *[Greenhouse Gases] Significance Criteria* and analyzed in Section 3.9.5 *[Greenhouse Gases] Potential Impacts, Impacts, and Mitigation*.

Alternative Name Key	
2012 EIS/EIR Alternative Name	**Lower Klamath Project EIR Alternative Name**
Proposed Action	Proposed Project
	Three Dam Removal (Iron Gate, Copco No. 1, and Copco No. 2)
	No Hatchery
Partial Facilities Removal	Partial Removal
Remove Two Dams (Iron Gate and Copco No. 1)	Two Dam Removal (Iron Gate and Copco No. 1)
Fish Passage at Four Dams	Continued Operations with Fish Passage

O.1 Assessment Methods

This section describes the methodology used to calculate greenhouse gas (GHG) emissions from construction activity related to the decommissioning of the Lower Klamath Project dam developments.

Since the project proposes construction activity related to the decommissioning of the Lower Klamath Project dam developments that would be completed at the end of 2021, it does not include long-term operational emissions. Direct GHG emissions associated with the reduced operation of Iron Gate Fish Hatchery combined with the re-instated operation of Fall Creek Hatchery were assumed to be the same as existing operation conditions at Iron Gate Hatchery for eight years following dam removal. This is due to the fact that the existing functions at the Iron Gate Hatchery that will be eliminated as part of dam removal activities, will be replaced by the reopening and operation of the Fall Creek Hatchery and by making improvements to the Iron Gate Hatchery Section 2.7.6 *Hatchery Operations*).

Emissions of carbon dioxide (CO_2), CH_4, and nitrous oxide (N_2O) were estimated for construction activity to evaluate GHG impacts. The other two pollutants commonly evaluated in various mandatory and voluntary reporting protocols, hydrofluorocarbons and perfluorocarbons, are not expected to be emitted in large quantities and were not estimated for the proposed project. It is likely that sulfur hexafluoride (SF_6) would be released during deconstruction because the circuit breakers from the power facilities would be emptied. Although SF_6 has a relatively high GWP, sufficient data is not available to quantify the emissions.

Non-CO_2 pollutants have global warming potential (GWP) factors that reflect the degree to which these pollutants affect climate change, as compared to CO_2. The product of each GHG emissions and its GWP is known as Carbon Dioxide equivalent (CO_2e). The value of GWPs is continually being modified by the Intergovernmental Panel on Climate Change (IPCC) as climate change science is refined. Although the IPCC is currently working on the Fifth Assessment Report, most mandatory and voluntary reporting registries require the use of the GWPs published in the Second Assessment Report (IPCC 1996); therefore, the GWPs from the Second Assessment Report were used to maintain consistency with the international standard.

O.1.1 Emission Calculation Methodology for Dam Removal Activities

The GHG emission sources from dam and powerhouse deconstruction activities that were estimated as part of this analysis include the following:

- Exhaust from off-road (onsite) mobile construction equipment and stationary sources (e.g., generators)
- Exhaust from on-road (offsite) mobile vehicles, including haul trucks and construction worker commuting

Emissions from dam removal construction activities were estimated from appropriate emission factors, number of facilities, and features being worked, and the associated schedules that were provided by the project consultants. The following sections provide additional discussion of emission estimation methodologies used for each source group.

O.1.1.1 On-site (Off-Road) Equipment Engine Exhaust Emissions

Emissions would occur from the combustion of fuel during operation of the off-road construction equipment at each of the dams. As was previously stated, separate emission factor models (i.e., OFFROAD2007 and NONROAD2008a) are used to estimate emissions in California and Oregon.

Preliminary estimates of the type, size (horsepower), and quantity of construction proposed to be used at each of the dam locations was provided by the project consultants. Engine load factors are also incorporated into the emission factor models. Emission factors for each piece of equipment were then selected based on the equipment type (e.g., cranes, excavators, loaders, etc.) and the engine size. It was conservatively assumed that all equipment located at a dam site could operate simultaneously for the entire shift. The total hours of operation for each piece of equipment was also provided with the equipment list provided by the project consultants. Annual emissions were then calculated from the total hours of operation.

In addition to the mobile construction equipment, several stationary generators would be present at each of the dam locations to provide power for electric-operated equipment. Emission factors from Chapter 3.3 (U.S. Environmental Protection Agency 1995) of AP-42 were used to estimate emissions from these generators.

O.1.1.2 Off-site (On-Road) Haul Truck Engine Exhaust Emissions and Paved Road Dust

The haul truck engine exhaust emissions were calculated based on EMFAC2007 and MOBILE6.2 emission factors for heavy-duty diesel trucks in Siskiyou County, California and Klamath County, Oregon, respectively. Information on the project total round trips was provided by the project consultants. The total project trips were assumed to occur evenly throughout the project schedule. The total vehicle miles traveled was determined from the number of trips and estimated distance to haul each component (e.g., earth, concrete, metal, etc.).

Emission factors vary by year based on changes in the vehicle fleet mix by older engines retiring from service and improved emission control technologies and standards in newer engines joining the fleet. As a result, two different emission factors are provided by location (state) and pollutant to reflect these changes in the fleet mix.

O.1.1.3 Construction Worker Commuting

Emissions associated with construction workers commuting to and from the various dam locations were also estimated. It was assumed that construction worker vehicles would consist of a mix of passenger cars and light-duty trucks. The combination of diesel and gasoline (catalyst and non-catalyst) vehicles from the various emission factor models was retained in the emission factor estimates. As explained in Section O.1.1.2 for trucks, the EMFAC2007 and MOBILE6.2 emission factor models were used to estimate emissions.

O.1.2 Emission Calculation Methodology for Other Project Activities

As part of this analysis, GHG emissions were estimated for the other project activities, which include the following:

- Restoration Activities
- Relocation and Demolition of Recreation Facilities
- Yreka Water Supply Pipeline Relocation

O.1.2.1 Restoration Activities

Restoration activities may use, in part, helicopters or other small aircraft and barges for reseeding. A combination of techniques was used to estimate emissions from the restoration activities. Emissions from landing and takeoff operations associated with aerial seed application were estimated using the Federal Aviation Administration's Emissions and Dispersion Modeling System. Emissions from hydroseeding barges were estimated using the following sources listed below.

- Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data (USEPA 2000)
- AP-42, Compilation of Air Pollutant Emission Factors, Chapter 3.3: Gasoline and Diesel Industrial Emissions (USEPA 1996)
- Title 17 California Code of Regulations, Section 93115.7: Air Toxic Control Measure for Stationary Compression Ignition Engines – Stationary Prime Diesel-Fueled Compression Ignition Engine (>50 bhp) Emission Standards
- Title 13 California Code of Regulations, Section 2423: Exhaust Emission Standards and Test Procedures—Off-Road Compression-Ignition Engine

O.1.2.2 Relocation and Demolition of Recreation Facilities

The California Emissions Estimator Model (CalEEMod), Version 2011.1.1, was used to estimate exhaust emissions that would occur from grading activities associated with restoring parking lots associated with recreational facilities proposed for relocation and demolition. CalEEMod makes general assumptions about the quantity and types of construction equipment needed to grade a site based on its size (acreage).

O.1.2.3 Yreka Water Supply Pipeline Relocation

The Sacramento Metropolitan Air Quality Management District's Road Construction Emissions Model, Version 6.3.2 (2009), was used to estimate exhaust emission factors associated with relocation of the Yreka water supply pipeline (USBR and CDFG 2012). The Siskiyou County Air Pollution Control District does not have a comparable model to estimate emissions from linear projects like the proposed pipeline relocation action.

O.1.3 Emission Calculation Methodology for Methane Emissions from Reservoirs

The Karuk Tribe (2006) estimated the total amount of CH_4 released from Keno, J.C. Boyle, Copco, and Iron Gate reservoirs in its comments on the Draft Environmental Impact Statement (EIS) for relicensing and/or decommissioning of the Klamath

Hydroelectric Project. The emissions estimation method presented by the Karuk Tribe was adapted for this analysis to estimate CH_4 emissions from impounded water. Emissions were estimated by multiplying the reservoirs' area by areal emissions rates from reservoirs around the world with similar characteristics (poor water quality). Using this methodology, it was determined that the methane produced by the reservoirs associated with the Lower Klamath Project dam developments ranges from 4,000 to 14,000 metric tons of CO_2e annually. With the removal of the Lower Klamath Project reservoirs, this source of methane emissions would be eliminated.

O.2 Emission Inventories

As described in the previous sections, construction emissions were calculated for various project activities including dam and powerhouse deconstruction, restoration activities, relocation and demolition of recreational facilities, and the Yreka supply pipeline relocation. Table O-1 summarizes the total uncontrolled emissions associated with the Proposed Project activities.

Table O-1. Uncontrolled GHG Emissions from the Proposed Project.

Project Activity	Project Emissions ($MTCO_2e$)
Dam and Powerhouse Deconstruction	8,558
Restoration Activities	704
Recreation Facilities	160
Yreka Supply Pipeline Relocation	33
Total Emissions	**9,455**

Source: Appendix N

As shown in Table O-1, total uncontrolled GHG emissions from the Proposed Project are estimated to be approximately 9,455 $MTCO_2e$. The sections below provide more detailed information about the emissions from the various project activities.

O.2.1 Emissions from Dam and Powerhouse Deconstruction

Table O-2 summarizes the uncontrolled emissions associated with the dam and powerhouse deconstruction activities.

Table O-2. Uncontrolled GHG Emissions from Dam and Powerhouse Deconstruction.

Location	Project Emissions ($MTCO_2e$)			
	CO_2	CH_4	N_2O	Total
Iron Gate	4,106	4	0	4,110
Copco No. 1	1,459	1	0	1,461
Copco No. 2	970	1	0	971
J.C. Boyle	2,016	<1	0	2,016
Total Emissions	**8,551**	**6**	**0**	**8,558**
California Total	6,535	6	0	6,542
Oregon Total	2,016	n/a	0	2,016

Source: Appendix N

As Table O-2 shows, deconstruction of the dams would contribute approximately 8,558 $MTCO_2e$ of GHG emissions during the deconstruction period.

O.2.2 Emissions from Restoration Activities

Table O-3 summarizes the uncontrolled emissions associated with the restoration activities.

Table O-3. Uncontrolled GHG Emissions from Restoration Activities.

Location	Project Emissions ($MTCO_2e$/)			
	Ground Equipment	Barges	Aerial	Total
Iron Gate	29	88	149	266
Copco No. 1 and Copco No. 2	32	88	298	419
J.C. Boyle	19	n/a	n/a	19
Total Emissions	**80**	**177**	**447**	**704**

Source: Appendix N

As Table O-3 shows, the GHG emissions from restoration activities would result in approximately 704 $MTCO_2e$ of GHG emissions.

O.2.3 Emissions from Recreation Facilities

Table O-4 summarizes the uncontrolled emissions associated with the relocation and demolition of recreation facilities.

Table O-4. Uncontrolled GHG Emissions from Recreation Facilities.

Location	Project Emissions ($MTCO_2e$)			
	CO_2	CH_4	N_2O	Total
Siskiyou County	153.51	0	0	153.71
Klamath County	5.94	0.01	0	5.95
Total Emissions	**159.5**	**0.01**	**0**	**159.7**

As Table O-4 shows, the GHG emissions from the relocation and demolition of recreation facilities would result in approximately 160 $MTCO_2e$ of GHG emissions (Appendix N).

O.2.4 Emissions from Yreka Water Supply Pipeline Relocation

According to the modeling results, approximately 33 $MTCO_2e$ of GHG emissions would be emitted during relocation of the Yreka water supply pipeline (USBR and CDFG 2012).

Detailed emission inventories for the Proposed Project are included as attachments to Appendix N (Air Quality Supplemental Methodology Information and Detailed Impact Analyses).

O.3 References

FERC (Federal Energy Regulatory Commission). 2007. Final Environmental Impact Statement for Hydropower License. Volume I. Klamath Hydroelectric FERC Project No. 2082-0278. November.

IPCC (Intergovernmental Panel on Climate Change). 1996. Climate Change 1995: The Science of Climate Change. Contribution of Working Group I to the Second Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, Great Britain: Press Syndicate of the University of Cambridge.

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Appendix P

Shasta Nation Confidential Tribal Cultural Appendix

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Appendix Q

Shasta Indian Nation Confidential Tribal Cultural Appendix

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Appendix R

Aesthetics

R.1 Comparison of 2010 and 2002/2003 to Existing Conditions

This EIR applies the results of the *Land Use, Visual, and Aesthetic Resources Final Technical Report* (PacifiCorp 2004) and the analysis in the 2012 KHSA EIS/EIR (USBR and CDFG 2012) to establish the existing environmental setting for the aesthetics Area of Analysis. To verify that conditions were similar to those of 2003 and that the conclusions made using these 2002/2003 photographs were still applicable to the 2012 KHSA EIS/EIR, photographs taken from selected locations in October 2010, referenced as CDM 2010, were compared to the 2003 photographs. Similarly, for this EIR, photos from similar locations that were available in the 2017 Technical Support Document (Appendix B) and the 2018 Definite Plan (Appendix B) were compared to the 2003 and 2010 photos.

R.1.1 J.C. Boyle Dam and Facilities



R.1.1-1: J.C. Boyle Dam 5 (CDM 2010)



R.1.1-2: J.C. Boyle Dam (FERC 2004)



R.1.1-3: Outflow From J.C. Boyle Dam—View From Access Road (FERC 2004)



R.1.1-4: Outflow From J.C. Boyle Dam—View From Access Road (Appendix B: *Technical Support Document*)

R.1.2 Downstream of J.C. Boyle Dam



R.1.2-1: J.C. Boyle Dam looking Downstream (CDM 2010)



R.1.2-2: Klamath River From Bridge Below J. C. Boyle Dam Downstream (FERC 2004)



R.1.2-3: J.C. Boyle Power Canal (left) and Klamath River Bypass Reach (right) (Appendix B: *Technical Support Document*)

R.1.3 Copco Cove Rec Area 2



R.1.3-1: Copco Cove Rec Area 2 (CDM 2010)



R.1.3-2: Copco Cove (FERC 2004)



R.1.3-3: Copco Cove (Appendix B: *Technical Support Document*)

R.1.4 Long Gulch



R.1.4-1: Long Gulch (CDM 2010)



R.1.4-2: Long Gulch (FERC 2004)



R.1.4-3: Long Gulch (Appendix B: *Technical Support Document*)

R.1.5 Iron Gate Boat Launch



R.1.5-1: Iron Gate Boat Launch (CDM 2010)



R.1.5-2: Iron Gate Access Boat Launch (FERC 2004)



R.1.5-3: Iron Gate Access (FERC 2004)



R.1.5-4: Iron Gate Recreation Site (Appendix B: *Technical Support Document*)

R.1.6 Klamath River From Fishing Access #5



Ager-Beswick Fishing Access point_South of Klamath River (CDM 2010)



HC8: Klamath River From Fishing Access #5 (Topsy Grade Road) Downstream (FERC 2004)

R.2 Typical Scenic/Landscape Character along the Klamath River

The following photographs from the *Land Use, Visual, and Aesthetic Resources Final Technical Report* (PacifiCorp 2004) identify typical scenic/landscape character along the Klamath River, including its elements of canyon-walled enframement, channel configuration, water clarity, bank and riparian appearance.

R.2.1 BB2: Klamath River from Bridge Below J. C. Boyle Dam



Upstream (low flow= 100 cfs)



Downstream (low flow = 100 cfs)

R.2.2 BB4: J.C. Boyle Bypass Reach View #1 from Access Road



Upstream (low flow= 325 cfs)



Downstream (low flow = 325 cfs)

R.2.3 BB5: J.C. Boyle Bypass Reach View #2 from Access Road



Upstream (low flow= 325 cfs)

R.2.4 BB6: J. C. Boyle Bypass Reach View #3 from Access Road



Upstream (low flow= 325 cfs)



Downstream (low flow = 325 cfs)

R.2.5 BB7: J. C. Boyle Bypass Reach View #4 from Access Road



Upstream (low flow= 325 cfs)



Downstream (low flow = 325 cfs)

R2.6 HC5: Klamath River from Frain Ranch Boater Access



Upstream (low flow= 350 cfs)



Downstream (low flow = 350 cfs)

R.2.7 HC6: Klamath River (Caldera Rapids) from Frain Ranch



Upstream (low flow= 350 cfs)



Downstream (low flow = 350 cfs)

R.2.8 HC7: Klamath River from Stateline Takeout


Looking Upstream (low flow= 350 cfs)


Looking Downstream (low flow= 350 cfs)

R.2.9 HC8: Klamath River from Fishing Access #5 (Topsy Grade Road)


Upstream (low flow= 350 cfs)


Downstream (low flow = 350 cfs)

R.2.10 HC3: Topsy Grade Road Potential Overlook #2


Looking Upstream


Looking Downstream

R.2.11 HC4: Topsy Grade Road Potential Overlook #3

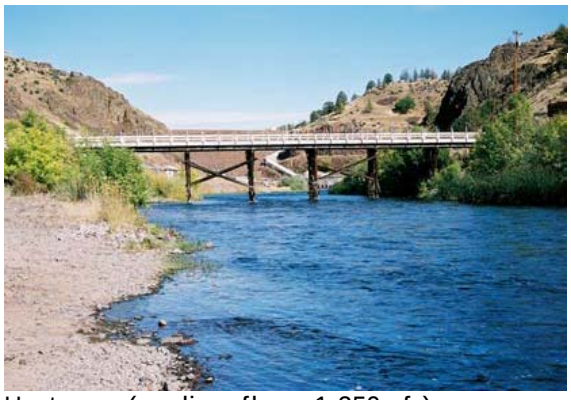


Looking Upstream



Looking Downstream

R.2.12 IG12: Klamath River from Iron Gate Hatchery River Access



Upstream (medium flow= 1,350 cfs)



Downstream (medium flow = 1,350 cfs)

R.3 References

PacifiCorp. 2004. Land Use, Visual, and Aesthetic Resources Final Technical Report. Klamath Hydroelectric Project, No. 2082.

USBR and CDFG (U.S. Bureau of Reclamation and California Department of Fish and Game). 2012. Klamath Facilities Removal Public Draft Environmental Impact Statement/Environmental Impact Report. State Clearinghouse #2010062060.

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Appendix S

Recreation Supporting Technical Information

As part of the 2012 KHSA EIS/EIR, potential changes in recreation opportunities were modeled by evaluating flow variations between the No Project ("dams in" scenario using the 2010 BiOp Flows) and the Proposed Project ("dams out" scenario using the KBRA Flows), since river flows influence when certain recreational activities could occur. The 2012 KHSA EIS/EIR modeling estimated the flows in multiple reaches of the Klamath River and the analysis compared those modeled flows with the acceptable range of flows for whitewater boating and fishing by reach to estimate the average number of days when those recreational activities could occur under each scenario. The analysis of potential changes in recreation opportunities from the 2012 KHSA EIS/EIR is reproduced in this appendix in Sections S.1 and S.2.

However, flow requirements in the Klamath River have changed since the modeling for the 2012 KHSA EIS/EIR was performed. Separate and independent of the Proposed Project, the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) issued a Joint Biological Opinion for the Klamath Irrigation Project in 2013 specifying the current hydrology requirements for the Klamath River (2013 BiOp Flows) and the standard to which the USBR Klamath Irrigation Project operates (NMFS and USFWS 2013). As detailed in Section 3.1.6 *Summary of Available Hydrology Information for the Proposed Project*, the range of 2013 BiOp Flows are overall similar to the range of KBRA Flows. Hydrologic model outputs previously developed using the KBRA Flows for the 2012 KHSA EIS/EIR are sufficiently accurate that they can be used to estimate the *range* of conditions under 2013 BiOp Flows, but the hydrologic model results using the KBRA Flows would not always be applicable when evaluating the duration (i.e., number of days) of specific flow ranges during individual months. Monthly variations between ranges of 2013 BiOp and KBRA Flows cause in variations in the exact number of days within the range of acceptable flows for flow-dependent recreational activities, especially in the reaches between Keno and Iron Gate dams. Section S.3 presents the changes in the 2012 KHSA EIS/EIR flow-dependent recreational opportunities due to differences between the 2013 BiOp and KBRA Flows.

The Proposed Project, the data modeled as part of the 2012 KHSA EIS/EIR, and the recreational opportunities under the current 2013 BiOp Flows are further evaluated in Section 3.20.5 *[Recreation] Potential Impacts, Impacts, and Mitigation*.

S.1 Potential Flow Changes That May Alter Flow-Dependent Recreation

Flow-dependent recreational activities on the Klamath River include whitewater boating and fishing. River flows may change based on the various future management scenarios (i.e., "dams in" versus "dams out") and could subsequently affect the availability and the quality of the recreation experience. Optimal and acceptable flows for various recreation opportunities along reaches of the Klamath River were developed as a part of technical studies completed during the relicensing process (FERC 2007). Optimal and acceptable flow levels can be compared with existing or proposed levels to assess the effect on various recreation activities. River flows under both No Project and Proposed Project alternatives have been modeled by U.S. Bureau of Reclamation (USBR); results of the models are used to project the effects on recreation activities within the various river reaches.

The following tables summarize flows acceptable for fishing and whitewater boating opportunities in the various reaches of the Klamath River. Table S-1 provides a

summary for each of the major river reaches where whitewater boating and fishing currently take place. Table S-2 summarizes monthly changes in flows for the Hells Corner Reach specifically for two sets of flow conditions (1,000 to 3,500 cfs and 1,300 to 3,500 cfs) that may be deemed acceptable for different types of whitewater boating. Tables S-3 through S-8 include the number of days per month with acceptable flows for each activity under the No Project Alternative and the Proposed Project. This data is also presented graphically in Section 3.20 *Recreation*. In Tables S-3 through S-8, it is assumed that flows less than 1,300 cfs are not acceptable for whitewater boating in order not to understate the potential impact of the Proposed Project on whitewater boating. However, the impact of dam removal on whitewater boating could be smaller if acceptable flows for some types of whitewater boating occur between 1,000 and 1,300 cfs.

Table S-1. Summary of Acceptable Flow Data for Whitewater Boating and Fishing.

River Reach	Activity	Acceptable Flows		Total Avg. Annual No Days with Acceptable Flows		Percent Difference
		Low Value (cfs)	High Value (cfs)	Dams In	Dams Out	
Keno Reach	Whitewater Boating	1,000	4,000	151.29	139.30	-7.93%
	Fishing	200	1,500	246.10	237.53	-3.48%
J.C. Boyle Bypass Reach	Whitewater Boating	1,300	1,800	4.63	41.35	793.56%
	Fishing	200	1,000	106.96	141.86	32.63%
Hells Corner Reach	Whitewater Boating/Kayaking	1,000	3,500	331.61	187.67	- 43%
	Whitewater Boating/Rafting	1,300	3,500	277.98	119.33	-57.07%
	Fishing	200	1,500	234.37	228.07	-2.69%
Copco No. 2 Bypass Reach	Whitewater Boating	600	1,500	10.22	223.09	2083.83%
	Fishing	50	600	13.75	2.84	-79.36%
Iron Gate to Scott River	Whitewater Boating/Fishing	800	4,000	278.04	280.86	1.01%
Scott River to Salmon River	Boating	800	7,000	242.96	246.26	1.36%
	Fishing	800	4,000	174.92	182.23	4.18%
Salmon River to Trinity River	Whitewater Boating/Fishing	800	10,000	207.00	210.67	1.78%
Trinity River to Ocean	Whitewater Boating/Fishing	1,800	18,000	238.86	238.33	-0.22%

Source: USBR 2012b,c; PacifiCorp 2004; FERC 2007; Greimann 2012.

Table S-2. Hells Corner – Whitewater Boating Recreation Days from two Different Criteria for "Acceptable Flows."

Month	1,000–3,500 cfs			1,300–3,500 cfs		
	Dams In	Dams Out Days	% Change Days	Dams In Days	Dams Out Days	% Change Days
January	26.27	16.00	39%	20.88	13.4	36%
February	21.94	11.65	47%	17.80	10.3	42%
March	22.59	18.23	19%	21.78	15.7	28%
April	21.80	18.81	14%	20.27	15.4	24%
May	26.88	22.37	17%	25.90	19.5	25%
June	29.96	25.14	16%	28.78	20.3	29%
July	30.41	15.40	49%	17.27	11.0	36%
August	31.00	13.09	58%	19.45	2.3	88%
September	30.00	19.47	35%	17.04	4.1	76%
October	31.00	10.48	66%	31.00	0	100%
November	30.00	6.79	77%	29.43	1	97%
December	29.76	10.24	66%	28.35	4.3	85%
Total	331.61	187.67	43%	277.95	117.3	58%

Source: Greimann 2012.

S.2 Recreational Flow Analysis

The recreation analysis evaluated and estimated the effect of potential future river flows on different recreation activities along various reaches of the Klamath River. High and low flow values for the recreation activities along the various reaches are provided in the following tables. Flow values that fall within these ranges are considered necessary for the various activities to occur. The Klamath Project Simulation Model (KPSIM) coupled to a daily operations model of the Klamath River below Link Dam for the No Project and the Proposed Project alternatives estimated the duration of recreational flows by reach. For additional information on the KPSIM model please refer to the USBR (2012a) report, "Hydrology, Hydraulics and Sediment Transport Studies for the Secretary's Determination on Klamath River Dam Removal and Basin Restoration, Technical Report No. SRH-2011-02."

The average, the maximum, and minimum number of days by month that the river is expected to be within the high and low value are listed on each row of Tables S-3 through S-8. The results are provided for wet, average, and dry start years under both the No Project and Proposed Project alternatives. The data provided for the Proposed Project are only for the years following dam removal (post-2019).

The Hells Corner Reach is a peaking reach and daily averages do not adequately capture conditions. Therefore, the following conditions must be met in order to be considered within range:

Whitewater Boating: Flows are within the desirable range between 10:00 a.m. and 2:00 p.m.

Fishing: Flows are within the desirable range for at least 4 hours either between 5 a.m. and 11 a.m., or between 3 p.m. and 9 p.m.

Table S-3. Analysis for Proposed Project, All Years, Average Number of Days.

River Reach	Activity	Low Value (cfs)	High Value (cfs)	Average Number of Days within Flow Range												
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	WY Total
Keno Reach	Whitewater Boating—Standard	1,000	4,000	15.7	12.0	20.5	19.3	23.2	20.9	12.3	2.9	4.2	0.0	2.0	6.5	139.3
	Play Boating	1,100	1,800	6.4	1.9	4.5	5.4	5.7	5.6	6.4	1.4	2.8	0.0	0.8	3.3	44.1
	Fishing	200	1,500	14.9	13.2	6.9	6.3	10.0	14.0	24.4	31.0	30.0	31.0	28.6	27.1	237.5
J.C. Boyle Bypass Reach	Whitewater Boating—Standard	1,300	1,800	3.8	1.9	4.4	3.7	5.8	5.7	7.2	2.3	4.1	0.0	0.0	2.4	41.3
	Fishing	200	1,000	11.6	11.1	3.0	1.4	4.9	4.8	15.6	17.9	10.5	20.5	22.8	19.1	141.9
Hells Corner Reach	Whitewater Boating	1,200	3,500	13.8	10.3	16.1	16.0	21.5	21.6	13.8	3.7	5.5	0.1	1.0	5.2	130.9
	Fishing	200	1,500	14.2	13.1	6.1	5.6	8.6	12.5	22.1	30.2	30.0	31.0	28.6	26.0	228.1
Copco No. 2 Bypass Reach	Whitewater Boating	600	1,500	13.5	12.4	6.1	5.6	8.6	12.5	22.1	30.2	30.0	31.0	28.6	24.5	223.1
	Fishing	50	600	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	2.8
Iron Gate to Scott River	Whitewater Boating	800	4,000	21.1	16.6	12.7	13.8	19.2	24.3	29.6	31.0	30.0	29.7	26.9	25.8	280.9
	Fishing	800	2,500	12.7	9.9	5.1	5.5	6.4	14.3	24.8	31.0	30.0	29.7	24.7	20.7	215.1
Scott River to Salmon River	Boating	800	7,000	14.6	9.5	7.5	8.8	14.2	23.7	30.2	31.0	30.0	31.0	26.3	19.3	246.3
	Fishing	800	4,000	5.5	3.9	2.0	2.6	4.7	12.7	26.7	31.0	30.0	30.9	21.8	10.9	182.2
Salmon River to Trinity River	Whitewater Boating/Fishing	800	10,000	8.7	5.0	3.4	4.7	9.6	20.4	30.5	31.0	30.0	30.9	23.8	13.0	210.7
Trinity River to Ocean	Whitewater Boating/Fishing	1,800	18,000	11.8	6.9	5.6	10.1	16.0	25.0	30.5	30.3	30.0	30.8	25.3	16.2	238.3

Source: USBR 2012b,c; PacifiCorp 2004; FERC 2007; Greimann 2012.

Table S-4. Analysis for Proposed Project, All Years, Maximum Number of Days.

River Reach	Activity	Low Value (cfs)	High Value (cfs)	Maximum Number of Days within Flow Range												
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	WY Total
Keno Reach	Whitewater Boating—Standard	1,000	4,000	31	29	31	30	31	30	31	31	30	0	30	31	271
	Play Boating	1,100	1,800	31	28	31	30	31	30	31	31	30	0	30	31	180
	Fishing	200	1,500	31	29	31	30	31	30	31	31	30	31	30	31	366
J.C. Boyle Bypass Reach	Whitewater Boating—Standard	1,300	1,800	31	28	31	30	31	30	31	31	30	0	1	24	117
	Fishing	200	1,000	31	29	31	30	31	30	31	31	30	31	30	31	365
Hells Corner Reach	Whitewater Boating	1,200	3,500	31	29	31	30	31	30	31	31	30	1	30	31	242
	Fishing	200	1,500	31	29	31	30	31	30	31	31	30	31	30	31	366
Copco No. 2 Bypass Reach	Whitewater Boating	600	1,500	31	29	31	30	31	30	31	31	30	31	30	31	366
	Fishing	50	600	29	29	0	0	0	0	0	0	0	0	0	31	89
Iron Gate to Scott River	Whitewater Boating	800	4,000	31	29	31	30	31	30	31	31	30	31	30	31	366
	Fishing	800	2,500	31	29	31	30	31	30	31	31	30	31	30	31	366
Scott River to Salmon River	Boating	800	7,000	31	29	31	30	31	30	31	31	30	31	30	31	366
	Fishing	800	4,000	31	29	31	30	31	30	31	31	30	31	30	31	366
Salmon River to Trinity River	Whitewater Boating/Fishing	800	10,000	31	29	31	30	31	30	31	31	30	31	30	31	366
Trinity River to Ocean	Whitewater Boating/Fishing	1,800	18,000	31	29	31	30	31	30	31	31	30	31	30	31	366

Source: USBR 2012b,c; PacifiCorp 2004; FERC 2007; Greimann 2012.

Table S-5. Analysis for Proposed Project, All Years, Minimum Number of Days.

River Reach	Activity	Low Value (cfs)	High Value (cfs)	Minimum Number of Days within Flow Range												
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	WY Total
Keno Reach	Whitewater Boating—Standard	1,000	4,000	0	0	0	0	0	0	0	0	0	0	0	0	0
	Play Boating	1,100	1,800	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fishing	200	1,500	0	0	0	0	0	0	0	30	30	31	0	0	92
J.C. Boyle Bypass Reach	Whitewater Boating—Standard	1,300	1,800	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fishing	200	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0
Hells Corner Reach	Whitewater Boating	1,200	3,500	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fishing	200	1,500	0	0	0	0	0	0	0	0	30	31	0	0	91
Copco No. 2 Bypass Reach	Whitewater Boating	600	1,500	0	0	0	0	0	0	0	0	30	31	0	0	91
	Fishing	50	600	0	0	0	0	0	0	0	0	0	0	0	0	0
Iron Gate to Scott River	Whitewater Boating	800	4,000	0	0	0	0	0	0	1	30	30	3	2	0	152
	Fishing	800	2,500	0	0	0	0	0	0	0	30	30	3	0	0	99
Scott River to Salmon River	Boating	800	7,000	0	0	0	0	0	0	4	31	30	31	0	0	137
	Fishing	800	4,000	0	0	0	0	0	0	0	30	30	28	0	0	104
Salmon River to Trinity River	Whitewater Boating/Fishing	800	10,000	0	0	0	0	0	0	16	30	30	29	0	0	124
Trinity River to Ocean	Whitewater Boating/Fishing	1,800	18,000	0	0	0	0	0	0	17	1	30	24	0	0	136

Source: USBR 2012b,c; PacifiCorp 2004; FERC 2007; Greimann 2012.

Table S-6. Analysis for No Project, All Years, Average Number of Days.

River Reach	Activity	Low Value (cfs)	High Value (cfs)	Average Number of Days within Flow Range												
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	WY Total
Keno Reach	Whitewater Boating—Standard	1,000	4,000	16.1	13.7	19.6	18.0	24.5	22.9	1.8	0.0	0.0	7.9	11.8	14.9	151.3
	Play Boating	1,100	1,800	2.7	0.0	3.6	3.6	7.3	11.2	0.0	0.0	0.0	0.6	5.3	2.5	36.8
	Fishing	200	1,500	16.4	12.2	7.9	13.5	11.6	21.0	30.9	31.0	30.0	31.0	22.9	17.7	246.1
J.C. Boyle Bypass Reach	Whitewater Boating—Standard	1,300	1,800	0.1	1.3	1.7	0.8	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.4	4.6
	Fishing	200	1,000	12.5	6.7	10.5	12.1	12.8	9.5	1.2	0.0	6.5	18.9	7.6	8.6	107.0
Hells Corner Reach	Whitewater Boating	1,200	3,500	23.4	18.7	22.6	21.6	26.3	29.9	24.4	26.7	27.1	31.0	30.0	29.2	310.9
	Fishing	200	1,500	15.0	12.2	7.3	13.4	9.7	15.2	30.8	31.0	30.0	31.0	21.2	17.5	234.4
Copco No. 2 Bypass Reach	Whitewater Boating	600	1,500	0.9	2.5	3.2	2.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.7	10.2
	Fishing	50	600	2.1	2.5	2.8	2.7	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.7
Iron Gate to Scott River	Whitewater Boating	800	4,000	20.3	13.8	12.2	15.0	17.3	24.4	30.9	31.0	30.0	31.0	29.1	23.0	278.0
	Fishing	800	2,500	10.8	7.0	5.4	7.4	6.4	17.5	30.1	31.0	30.0	30.5	23.5	14.3	214.0
Scott River to Salmon River	Boating	800	7,000	13.7	8.3	7.1	10.2	13.2	24.0	30.9	31.0	30.0	30.8	26.0	17.8	243.0
	Fishing	800	4,000	4.1	2.5	1.2	2.2	3.9	13.0	29.4	31.0	30.0	30.3	19.6	7.6	174.9
Salmon River to Trinity River	Whitewater Boating/Fishing	800	10,000	8.7	4.1	2.8	4.5	9.0	21.0	30.7	31.0	30.0	30.5	23.2	11.6	207.0
Trinity River to Ocean	Whitewater Boating/Fishing	1,800	18,000	11.7	6.2	6.1	10.1	16.2	25.5	30.7	30.4	30.0	30.7	25.3	15.9	238.9

Source: USBR 2012b,c; PacifiCorp 2004; FERC 2007; Greimann 2012.

Table S-7. Analysis for No Project, All Years, Maximum Number of Days.

River Reach	Activity	Low Value (cfs)	High Value (cfs)	Maximum Number of Days within Flow Range												
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	WY Total
Keno Reach	Whitewater Boating—Standard	1,000	4,000	31	29	31	30	31	30	31	0	0	31	30	31	245
	Play Boating	1,100	1,800	31	0	31	30	31	30	0	0	0	31	30	31	142
	Fishing	200	1,500	31	29	31	30	31	30	31	31	30	31	30	31	366
J.C. Boyle Bypass Reach	Whitewater Boating—Standard	1,300	1,800	2	20	29	8	11	0	0	0	0	0	0	19	48
	Fishing	200	1,000	31	29	31	30	31	30	31	0	30	31	30	31	245
Hells Corner Reach	Whitewater Boating	1,200	3,500	31	29	31	30	31	30	31	31	30	31	30	31	366
	Fishing	200	1,500	31	29	31	30	31	30	31	31	30	31	30	31	366
Copco No. 2 Bypass Reach	Whitewater Boating	600	1,500	31	28	31	20	18	1	0	0	0	0	0	20	83
	Fishing	50	600	29	25	31	29	30	1	0	0	0	0	0	1	59
Iron Gate to Scott River	Whitewater Boating	800	4,000	31	29	31	30	31	30	31	31	30	31	30	31	366
	Fishing	800	2,500	31	29	31	30	31	30	31	31	30	31	30	31	366
Scott River to Salmon River	Boating	800	7,000	31	29	31	30	31	30	31	31	30	31	30	31	366
	Fishing	800	4,000	31	29	31	30	31	30	31	31	30	31	30	31	366
Salmon River to Trinity River	Whitewater Boating/Fishing	800	10,000	31	29	31	30	31	30	31	31	30	31	30	31	366
Trinity River to Ocean	Whitewater Boating/Fishing	1,800	18,000	31	29	31	30	31	30	31	31	30	31	30	31	366

Source: USBR 2012b,c; PacifiCorp 2004; FERC 2007; Greimann 2012.

Table S-8. Analysis for No Project, All Years, Minimum Number of Days.

River Reach	Activity	Low Value (cfs)	High Value (cfs)	Minimum Number of Days within Flow Range												
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	WY Total
Keno Reach	Whitewater Boating—Standard	1,000	4,000	0	0	0	0	0	0	0	0	0	0	0	0	0
	Play Boating	1,100	1,800	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fishing	200	1,500	0	0	0	0	0	0	30	31	30	31	0	0	122
J.C. Boyle Bypass Reach	Whitewater Boating—Standard	1,300	1,800	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fishing	200	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0
Hells Corner Reach	Whitewater Boating	1,200	3,500	0	0	0	0	0	29	0	0	0	31	30	0	183
	Fishing	200	1,500	0	0	0	0	0	0	30	31	30	30	0	0	122
Copco No. 2 Bypass Reach	Whitewater Boating	600	1,500	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fishing	50	600	0	0	0	0	0	0	0	0	0	0	0	0	0
Iron Gate to Scott River	Whitewater Boating	800	4,000	0	0	0	0	0	0	29	31	30	31	20	0	144
	Fishing	800	2,500	0	0	0	0	0	0	15	31	30	3	0	0	121
Scott River to Salmon River	Boating	800	7,000	0	0	0	0	0	0	28	31	30	19	0	0	133
	Fishing	800	4,000	0	0	0	0	0	0	12	31	30	1	0	0	101
Salmon River to Trinity River	Whitewater Boating/Fishing	800	10,000	0	0	0	0	0	0	22	30	30	9	0	0	128
Trinity River to Ocean	Whitewater Boating/Fishing	1,800	18,000	0	0	0	0	0	0	22	1	30	18	0	0	138

Source: USBR 2012b,c; PacifiCorp 2004; FERC 2007; Greimann 2012.

S.3 Changes in 2012 KHSA EIS/EIR Model Results Due to Variations Between KBRA Flows and 2013 BiOp Flows

As previously introduced, the 2013 BiOp Flows are the current hydrology requirement to which the USBR Klamath Irrigation Project operates. The 2013 BiOp Flows are sufficiently different from the previously modeled KBRA Flows that the projected duration (i.e., number of days) for which flows would be within the range of acceptable flows for whitewater boating and fishing would vary between the 2013 BiOp and KBRA Flows. While the 2013 BiOp Flows have a similar annual range as the KBRA Flows, the monthly range varies between the 2013 BiOp and the KBRA Flows. The most prominent difference is that 2013 BiOp Flows generally result in higher flows in the fall months (October through December) and lower flows in the summer months (June through August) when compared to KBRA Flows. Changes in the monthly range of flows could result in more or less flow-dependent recreational opportunities (i.e., whitewater boating and fishing) during certain months and a net change in the total average annual number of days for these recreational activities.

As explained in Section 3.1.6 *Summary of Available Hydrology Information for the Proposed Project,* monthly flow exceedance curve plots are useful for comparing the flow differences by month under 2013 BiOp and KBRA Flows, since they show the entire potential range of flows that would occur during different water year types (i.e., wet, median, and dry year types). Variations between exceedance flow curves for the 2013 BiOp Flows and the KBRA Flows were evaluated to qualitatively determine how monthly variations between the 2013 BiOp and KBRA Flows would alter the estimated number of days within the acceptable flow range for recreational activities under the previous analysis using the KBRA Flows. Monthly flow exceedance curves for the 2013 BiOp and the KBRA Flows exist at Keno Dam (see Figure S-1) and at Iron Gate Dam (see Figure S-2). Accordingly, Klamath River reaches between Keno Dam and Iron Gate Dam are assessed using the exceedance curves at Keno Dam and the reaches downstream of Iron Gate Dam are assessed using the exceedance curves at Iron Gate Dam. This evaluation focuses on exceedance flow curves during July, August, and September, because those are the highest demand months for recreational activities on the Klamath River, but it also considers the exceedance flow curves for the entire year.

Differences between the 2013 BiOp and KBRA Flows, as shown by the monthly flow exceedance curves at Keno Dam (see Figure S-1), are anticipated to produce a net decrease in the number of days that flows are within the acceptable range for whitewater boating between Keno Dam and Iron Gate Dam. Whitewater boating requires a minimum flow of 1,000 cfs to 1,300 cfs in the Keno, J.C. Boyle Bypass, and Hell's Corner reaches (see Table S.1). Much of the variations between the 2013 BiOp and KBRA Flows during winter and spring occur within the acceptable range of flows for whitewater boating and these variations would not alter the number of days whitewater boating could occur during this time period. However, during summer and fall months, variations between the 2013 BiOp and KBRA Flows would alter the number of days available for whitewater boating, since they would change the frequency that flows would be within the acceptable range. In July through September, KBRA Flows would exceed 1,000 cfs during wet water years (represented by flow exceedances of 10% or less) and KBRA Flows would even exceed 1,300 cfs during wet water years in July. Under the KBRA Flows, the projected average number of days of whitewater boating for all water year types between July and September would range from 2.3 days in August in the J.C. Boyle Bypass Reach to 13.8 days in July in the Hell's Corner Reach (Table S-3).

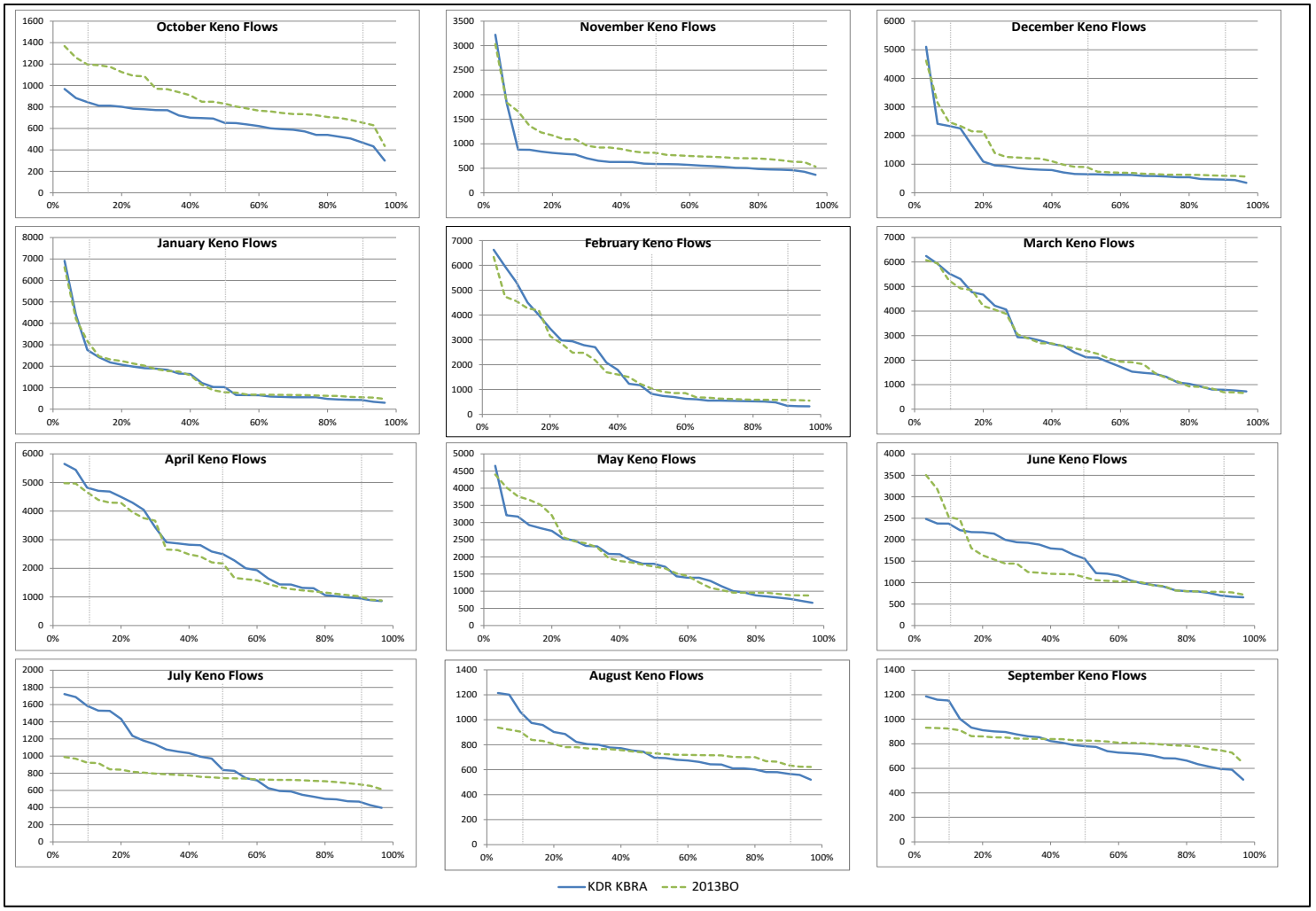

Figure S-1. Monthly Flow Exceedance Curves at Keno Dam for the KBRA Flows (KDR KBRA) and 2013 Joint Biological Opinion Flows (2013 BO). Source: USBR 2016. Note: The scale on the y-axis (flow in cfs) varies significantly between months. Vertical grey dotted lines indicate the 10% (wet year), 50% (median year), and 90% (dry year) flow exceedances.

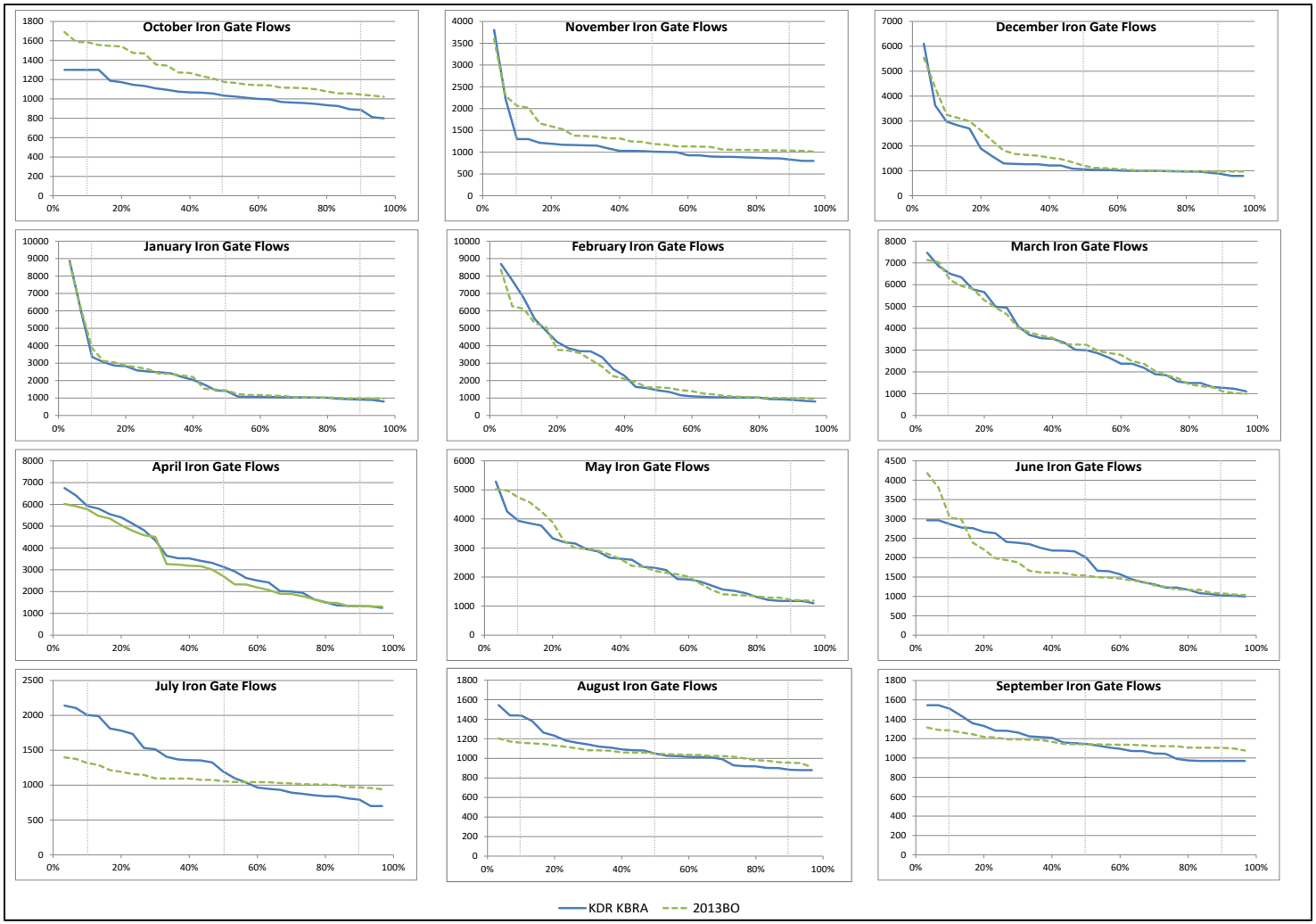

Figure S-2. Monthly Flow Exceedance Curves at Iron Gate Dam for the KBRA Flows (KDR KBRA) and 2013 Joint Biological Opinion Flows (2013 BO). Source: USBR 2016. Note: The scale on the y-axis (flow in cfs) varies significantly between months. Vertical grey dotted lines indicate the 10% (wet year), 50% (median year), and 90% (dry year) flow exceedances.

However, the 2013 BiOp Flows would remain below 1,000 cfs during all water year types between July through September, so the number of days whitewater boating could occur between July and September in the Keno, J.C. Boyle Bypass, and Hell's Corner reaches of the Klamath River would be zero under the 2013 BiOp Flows.

Conversely, in October the projected number of days of whitewater boating would increase under the 2013 BiOp Flows relative to the KBRA Flows. The exceedances curves at Keno Dam in October show that the 2013 BiOp Flows exceed 1,000 cfs in 30 percent of years, with the flows reaching a maximum of approximately 1,400 cfs, but the KBRA Flows are always below 1,000 cfs. Klamath River flows between Keno and Iron Gate dams would be within the range of acceptable flows for whitewater boating under 2013 BiOp Flows in October under some water year types, especially wet water years, but acceptable whitewater boating flows would not occur under KBRA Flows. Thus, the projected average number of days of whitewater boating for all water year types in October between Keno Dam and Iron Gate Dam would be greater under 2013 BiOp Flows than under the KBRA Flows.

Overall, the projected average number of days that would support whitewater boating for all water year types between Keno Dam and Iron Gate Dam would decrease under the 2013 BiOp Flows compared to those modeled in the 2012 KHSA EIS/EIR under the KBRA Flows, since the decreases in July through September are expected to be greater than the increase in October.

The average number of days that fishing could occur between Keno and Iron Gate dams would increase under the 2013 BiOp compared to the KBRA Flows. In addition to detailing the percent of time that flows would be exceeded, the monthly flow exceedance curves also indicate the percent of years when the flows would occur. The percent of years within the acceptable flow range for fishing (i.e., 200 cfs to 1,500 cfs in the Keno, J.C. Boyle Bypass, and Hell's Corner reaches) can be estimated by subtracting the percent exceedance from one hundred percent, if the minimum flow is always greater than the minimum acceptable fishing flow (i.e., 200 cfs). Under the 2013 BiOp and KBRA Flows, the percent of years within the acceptable fishing flow range is similar and the average number of days available for fishing would also remain similar for all months except June and July. In those two months, the 2013 BiOp Flows would be within the acceptable fishing flow range more frequently (approximately 70 percent of years in June; 100 percent of years in July) than the KBRA Flows (approximately 50 percent of years in June; approximately 80 percent of years in July). As a result, there would be a net increase in the projected average number of days with acceptable fishing flows under the 2013 BiOp Flows compared to under the KBRA Flows between Keno Dam and Iron Gate Dam.

A comparison of the monthly exceedance curves for the 2013 BiOp and KBRA Flows at Iron Gate Dam (see Figure S-2) indicates that the number of days flows are within the acceptable range for flow-dependent recreational activities would be generally similar under 2013 BiOp and KBRA Flows downstream of Iron Gate Dam. Most of the variations between the 2013 BiOp and KBRA Flows at Iron Gate Dam occur within the acceptable range of flows for whitewater boating, boating, or fishing and those variations would not alter the number of days flow-dependent recreational activities could occur. Differences between the 2013 BiOp and KBRA Flows outside of the acceptable range of flows downstream of Iron Gate Dam occur infrequently and primarily for either dry (represented by a 90 percent exceedance) or wet (represented by a 10 percent

exceedance) water year types. In May, KBRA Flows would exceed 4,000 cfs in approximately 10 percent of years, but 2013 BiOp Flows would exceed 4,000 cfs in approximately 20 percent of years. This variation between the KBRA and 2013 BiOp Flows would decrease the average number of days within the acceptable flow range for whitewater boating and fishing in the Klamath River from Iron Gate to its confluence with the Salmon River under the 2013 BiOp Flows. In July, KBRA Flows would not exceed 800 cfs in approximately 30 percent of years, but 2013 BiOp Flows would always exceed 800 cfs. The result would be an increase the average number of days within the acceptable flow range for whitewater boating and fishing in the Klamath River downstream of Iron Gate Dam under the 2013 BiOp Flows. The overall net change in the average number of days within the acceptable flow range for recreational activities between the 2013 BiOp and KBRA Flows would be minimal downstream of Iron Gate Dam, but the exact number of days under 2013 BiOp Flows would vary slightly from those modeled in the 2012 KHSA EIS/EIR analysis under the KBRA Flows. This suggests that the average number of days for flow-dependent recreational activities estimated in the 2012 KHSA EIS/EIR analysis downstream of Iron Gate Dam is generally representative of trends and conditions under the 2013 BiOp Flows.

S.4 References

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USBR. 2012c. Model runs of the Klamath Project Simulation Model (KPSIM) for Recreational Flows with 'Dams In' (No Action). Updated May 16, 2012.

Appendix T

Noise and Vibration Impact Analysis

This appendix describes basic noise and vibration concepts and the methods used to assess the potential construction and vehicle noise impacts. Attachment 1 presents the results of the construction noise impact analysis. Attachment 2 includes the vibration impact analysis. Traffic noise modeling inputs and outputs are presented in Attachment 3.

T.1 Noise Concepts

Sound is mechanical energy characterized by the rate of oscillation of sound waves (frequency), the speed of propagation, and the pressure level (amplitude). The human brain perceives pressure on the ear as sound. The sound pressure level is the logarithmic ratio of that perceived pressure to a reference pressure, and it is expressed in decibels (dB). Approximately zero dB corresponds to the threshold of human hearing.

Environmental sounds are measured with the A-weighted scale of a sound level meter. The A-weighting approximates the frequency response of the average young ear when listening to most everyday sounds. When people make relative judgments of the loudness or annoyance of a sound, their judgments correlate well with the A- weighting sound levels of those sounds (California Department of Transportation [Caltrans] 2013). A-weighted sound levels are designated as dBA. Table T-1 shows the sound levels (dBA) of and human response to common indoor and outdoor noise sources.

As sounds in the environment usually vary with time, they cannot be described with a single number. The equivalent noise level (L_{eq}) is the constant sound level that, in a given period, has the same sound energy level as the actual time-varying sound pressure level. L_{eq} allows noise from various sources to be combined into a measure of cumulative noise exposure. It is commonly used by regulatory agencies to evaluate noise impacts.

In addition to evaluating noise impacts based on compliance with noise standards, project noise impacts are also assessed by annoyance criteria, or the incremental increase in the existing noise level. The impact of increasing or decreasing noise levels is presented in Table T-2. For example, Table T-2 shows that a change of 3 dBA is barely perceptible but that a 10 dBA increase or decrease would be perceived by a person to be a doubling or halving of the loudness.

Table T-1. Sound Levels and Human Response.

Sound Source	Noise Level	Response	Hearing Effects	Conversational Relationships
Carrier deck Jet operation	150 140	Painfully loud	Contribution to hearing impairment begins	
	130	Limit amplified speech		
Jet takeoff (200 feet)	120	Maximum vocal effort		Shouting in ear
Auto horn Riveting machine Jet takeoff (2,000 feet) Garbage truck	110			
	100	Very annoying Hearing damage (8 hours)		
NY subway station Heavy truck (50 feet)				Shouting (2 feet)
	90	Annoying		
Pneumatic drill (50 feet) Alarm clock				Very loud conversation (4 feet)
	80			Loud conversation (2 feet)
Freight Train (50 feet) Freeway traffic (50 feet)	70	Telephone use difficult		
Air conditioning unit (20 feet)	60	Intrusive		Loud conversation (4 feet)
Light auto traffic (100 feet)	50	Quiet		Normal conversation (12 feet)
Living room Bedroom	40			
Library Soft whisper (15 feet)	30	Very quiet		
Broadcasting studio	20			
		Just audible		
	10			
	0	Threshold of hearing		

Source: Siskiyou County 1978

Table T-2. Decibel Changes, Loudness, and Energy Loss.

Sound Level Change (dBA)	Relative Loudness	Acoustical Energy Loss (%)
0	Reference	0
-3	Barely perceptible change	50
-5	Readily perceptible change	67
-10	Half as loud	90
-20	1/4 as loud	99
-30	1/8 as loud	99.9

Source: Federal Highway Administration (FHWA) 2011

The following general guideline was used to assess daily on-site construction noise impacts, as compared to existing ambient levels:

- A less than 3 dBA increase in sound level is considered no impact;
- A 3 to 5 dBA increase in sound level is considered a slight impact;
- A 6 to 10 dBA increase in sound level is considered a moderate impact; and
- A greater than 10 dBA increase in sound level is considered a severe impact.

This analysis assumed that an increase greater than 10 dBA would be significant and would require evaluating construction noise mitigation measures.

T.2 Construction Noise Impact Assessment Method

Methods described in FHWA's Roadway Construction Noise Model User's Guide (2006) were used to estimate noise impacts associated with construction equipment, blasting, and waste hauling that are expected to be used in the action alternatives. Table T-3 presents noise levels of common construction equipment operating at full power (L_{max}) measured 50 feet from the source, the percent of time the equipment would be operated at full power (usage factor), and the equivalent noise level over a construction shift (FHWA 2006). To comply with the Siskiyou County General Plan (1978), , the maximum allowable noise level in the General Plan (1978) was used for equipment whose L_{max} in the Roadway Construction Noise Model exceeds the Siskiyou County regulation. The L_{eq} noise levels were calculated for each construction equipment using Equation 1.

Equation 1: $$L_{eq\_equipment} = 10 \log_{10} [10^{(Lmax\_equipment/10)} \times UF_{equipment}]$$

Where:

- Lmax is the maximum sound level for each type of equipment (dBA); and
- UF is the daily usage fraction of time that equipment is used at full power (%).

Table T-3. Construction Operations, Equipment Types, and Their Noise Levels.

Equipment Types	Usage Factor (%)	L_{max} at 50 feet (dBA)	L_{eq} at 50 feet (dBA)
Air compressor	40	78	74
Backhoe	40	78	74
Blasting	1	94	74
Compactor	20	83	76
Concrete mixer truck	40	79	75
Concrete pump truck[1]	20	81	74
Crane	16	81	73
Dozers[1]	40	81	77
Dump truck	40	77	73
Excavator	40	81	77
Front end loader	40	80	76
Generator	50	81	78
Generator (<25 kVA)	50	73	70
Grader	40	85	81

Equipment Types	Usage Factor (%)	L_{max} at 50 feet (dBA)	L_{eq} at 50 feet (dBA)
Jackhammer[1]	20	81	74
Mounted impact hammer (hoe)	20	90	83
Pickup truck	40	75	71
Pumps	50	77	74
Scraper	40	84	80
Tractor[1]	40	81	77

Source: FHWA 2006, Siskiyou County 1978

[1] Maximum allowable noise levels from construction equipment at 100 feet from Siskiyou County's General Plan converted to noise levels at 50 feet.

Noise levels were calculated for all equipment expected to be used during peak deconstruction or construction day at each dam, including blasting. Detailed equipment usage for non-peak days was not available at the time of the analysis. The individual L_{eq} of each piece of equipment was combined to obtain the total L_{eq} noise level at each construction site using Equation 2.

Equation 2: $$L_{eq\_total\ source} = 10 \log_{10} [\Sigma\ 10^{(Leq\_equipment/10)}]$$

Natural noise attenuation resulting from distance between the construction sites and receptors, atmospheric absorption, and terrain were subtracted from the total L_{eq} of all equipment. The equivalent L_{eq} noise levels at each noise-sensitive receptor were calculated using Equation 3:

Equation 3: $$L_{eq\_receptor} = L_{eq\_total\ source} - A_{div} - A_{ground} - A_{air} - IL_{barrier}$$

Where:

- L_{eq}_total source is the estimated total L_{eq} noise level at 50 feet (dBA) calculated using Equation 2;
- Adiv is the geometrical divergence, or the distance attenuation (dBA) calculated using Equation 4;
- Aground is the attenuation caused by interference between direct and ground-reflected sound (dBA) calculated using Equation 5;
- Aair is the attenuation due to atmospheric absorption (dBA); and
- ILbarrier is the attenuation due to barrier, including natural terrain, (dBA) calculated with Equations 5 through 7.

Equation 4: $$A_{div} = 20 \log_{10} (d/50)$$

Where:

- d is the distance from the construction site to the noise-sensitive receptor (feet).

This formula results in a six dBA loss for each doubling of distance due to spherical divergence. The distances were measured from the construction site to the closest noise-sensitive receptor.

Ground attenuation is dependent on the ground surface characteristics, distance, and source and receptor heights. Constants in Equation 5 are based on a typical construction equipment noise frequency of 500 hertz (Hz) and noise source and receptor heights (h_s = source height [feet] and h_r = receptor height [feet]) of approximately five feet. The first term is the ground attenuation in the source zone, which extends from the source to 30 hs toward the receptor. The second term is the ground attenuation in the receptor zone, which extends from the receptor to 30 hr toward the source. The third term is the ground attenuation in the zone between the source and receptor zones. The ground factor (G) for each zone is zero if the ground surface consists of asphalt or concrete pavement, water, or any hard ground with low porosity. The ground factor for soft ground, or porous ground that is covered by vegetation or loose materials such as snow and pine needles, is zero. For zones with a mixture of soft and hard ground surface areas, the ground factor is the fraction of the ground that is soft.

Equation 5: $A_{ground} = (6.5G_s - 1.5) + (6.5G_r - 1.5) - 3\{1-[30(h_s + h_r)/d]\}(1-G_m)$

Where:

- G_s is the ground factor for the source zone (source to 30 hs toward the receptor);
- G_r is the ground factor for the receptor zone (receptor to 30 hr toward the source);
- h_s is the source height (feet);
- h_r is the receptor height (feet);
- d is the distance between the source and the receptor; and
- G_m is the ground factor for the middle zone (between source and receptor zones).

Terrain attenuation was calculated using the Equations 6 through 8. Aground in Equation 8 cancels out the term in Equation 3.

Equations 6 through 8:

Equation 6: $N = (2 / \lambda)(d_1 + d_2 - d)$

Equation 7: $K = \exp\{-0.0005 \sqrt{[(d_1 d_2 d) / (N\lambda)]}\}$

Equation 8: $IL_{barrier} = 10 \log_{10}(3 + 10NK) - A_{ground}$

Where:

- λ is the wavelength of the sound wave (feet);
- d_1 is the distance between the top of the hill and the noise source (feet);
- d_2 is the distance between the top of the hill and the noise receptor (feet);
- d is the distance between the source and the receptor (feet);
- N is called the Fresnel number (a dimensionless number used in predicting the attenuation of a noise barrier located between a noise source and receiver) (Caltrans 2013);
- K is the atmospheric correction factor for d > 100 meters; and
- A_{ground} is the ground attenuation, which eliminates the A_{ground} term in Equation 3.

Attenuation associated with atmospheric absorption is dependent on temperature, relative humidity, and frequency of the sound waves. It should be noted that as humidity decreases, the atmospheric attenuation increases because dry air is a poor conductor of sound compared to humid air. Based on an average air temperature of 50ºFarenheit and 50 percent humidity sound attenuates at 1.9 dB per kilometer (0.0006 dB per feet) at 500 Hz (Harris 1998).

The construction noise level calculated with the above equations must be added to the existing noise levels at the receptor to determine the noise level at the receptor resulting from construction activities. The basic concept of Equation 2 was used to add construction noise impact to existing noise levels at the receptor, as shown in Equation 8. Average daytime L_{eq} and nighttime L_{eq} noise levels for rural residential areas found in the *U.S. EPA Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety* (USEPA 1974) were used to estimate ambient noise levels at selected receptor locations. These levels are 40 dBA during the day (7 a.m. to 10 p.m.) and 30 dBA at night (10 p.m. to 7a.m.). Nighttime existing level is used at Iron Gate Dam and Copco No. 1 Dam receptors, where there is possible impact from nighttime construction activities.

Equation 8: $L_{eq\_receptor} = 10 \log_{10} [10^{(Leq\_total\ equipment/10)} + 10^{(Leq\_existing/10)}]$

Where:

- L_{eq}_total equipment is the equivalent total L_{eq} noise level at the receptor due to construction activities after distance, terrain, and atmospheric attenuation are taken (dBA); and
- L_{eq}_existing is 40 dBA for daytime noise analysis and 30 dBA for nighttime noise analysis (dBA).

The existing L_{eq} was subtracted from the resulting total L_{eq} at the receptor to calculate the increase in noise levels due to construction activity. This impact was compared against the criteria of 10 dBA to determine significance.

Attachment 1 presents the results of the construction noise impact analysis.

T.3 Construction-Related Traffic Noise Impact Assessment Methodology

Peak hour traffic noise levels for the Existing, No Action, and Action Alternatives were estimated for construction workers' commuting vehicles, delivery trucks, and trucks hauling waste materials using the FHWA Traffic Noise Model, Version 2.5 (TNM2.5). TNM2.5 is capable of modeling noise impacts from automobiles, medium trucks (two axles), heavy trucks (three or more axles), buses, and motorcycles by factoring in vehicle volume, vehicle speed, roadway configuration, distance to the noise-sensitive receptors, atmospheric absorption, and ground attenuation characteristics (FHWA 1998a, 2004a). The model is based on measurements collected by the Volpe National Transportation Systems Center Acoustics Facility and is generally considered to be accurate within +/- 3 dB (FHWA 1998b).

To simplify the analysis, bus and motorcycle volumes were assumed to be negligible and attenuation from the natural terrain and vegetation were not included. It was assumed that there would be equal volumes of traffic on each direction of a roadway and peak hour traffic coincides with the worst one-hour L_{eq}. Peak hour noise levels were modeled for generic receptors 50 and 500 feet from the edge of the road. 50 feet represents the minimum possible distance for a receptor along any roadway, and 500 feet is the maximum recommended receptor distance for traffic noise models (Caltrans, 2006). The modeled roadway segment should be longer than eight times the maximum source to receptor distance (FHWA 2004b). The maximum distance between the source and receptor is 500 feet; therefore, an approximately 5,000 feet road segment was modeled.

Average daily traffic counts published by Caltrans (2010) provided the basis for estimating the existing noise levels on US Interstate 5. Existing one-hour L_{eq} for Topsy Grade Road and Copco Road and vehicle distributions were provided by the transportation engineers (J. Key, pers. comm., December 13, 2010). Based on a review of published ODOT and Caltrans traffic counts, peak hour traffic volume was typically 10 to 20 percent of the average daily traffic volume. Changes in noise levels would be greater when the baseline traffic counts are lower; therefore, for a conservative analysis, the analysis assumed that peak hour traffic is 10 percent of average daily traffic. As free-flow speeds were not available, posted speed limits were entered in the model to be conservative. As measured traffic counts on U.S. Interstate 5 between Yreka and Anderson, California, are generally higher than those north of Yreka, significance for the Yreka-Anderson segment was based on the significance of the segment north of Yreka, California. Traffic counts and characteristics of Topsy Grade Road were used to model noise levels on Ager-Beswick Road because they have a similar level of service (LOS). It was assumed that there would be no increase in regional traffic between Existing Conditions and No-Action Alternative.

Under the Proposed Project, trucks would haul recyclable metal waste to Weed, California for waste originating in California[13]. Wood waste from Copco No. 2 Dam would likely be hauled to a hazardous waste landfill in Anderson, California. For the alternatives requiring fish passage construction, rebar and wood would be supplied from Medford, Oregon, and concrete would be transported from the Yreka, California. The haul routes would likely be U.S. Interstate 5, US 97, OR 66, Copco Road, Topsy Grade Road, and Ager-Beswick Road. Details regarding the roadways affected by this Proposed Action are presented in the Transportation Section (Section 3.22 *Traffic and Transportation*). The greater number of trucks available for each material or the peak daily haul truck volumes divided by eight was used as the hourly truck volume. The estimated construction work shift length is eight hours. The hourly truck volumes were added to the existing/no-action peak hour traffic volumes. This analysis assumes that off-site hauling to suppliers and disposal areas would only occur during the daytime. All new truck trips are assumed to consist of heavy trucks, those with three axles or greater for use in the TNM2.5 model.

[13] This assumption from the 2011 noise modeling is no longer accurate. Actually, the recyclable metal waste would be taken to the Yreka Transfer Station in Yreka California. The trip to Yreka follows the same route as the trip to Weed except it is shorter. Therefore, the analysis is still valid.

Construction workers would likely commute from Yreka, California, or Medford, Oregon, to Iron Gate, Copco No. 1, and Copco No. 2 sites and from Keno or Klamath Falls, Oregon to the J.C. Boyle site according to the Population and Housing Section (Section 3.17 *Population and Housing*). The maximum number of construction workers for J.C. Boyle was added to automobile traffic on US 97, OR 66, and Topsy Grade Road. Maximum total construction workers for Iron Gate, Copco No. 1, and Copco No. 2 were added to automobile traffic volume on Copco Road and U.S. Interstate 5. As the distribution of workers from Medford, Oregon, and Yreka, California, on U.S. Interstate 5 are unknown, the maximum number of workers commuting to the California dams were added to both segments of US Interstate 5 for a conservative analysis.

For Alternatives 2, 3, and 5, truck and commute trips for all dams using the same road were combined. For Alternative 4, the maximum number of trucks and passenger vehicles traveling each road was used because construction is scheduled to occur one dam at a time.

Significance is defined as an increase of 12 dBA in California (Caltrans 2006) or more above existing one-hour L_{eq} for traffic-induced noise.

The results of the traffic noise modeling analysis are presented in Attachment 3.

T.4 Vibration Concepts

Vibration is caused by oscillatory waves that propagate through the ground. Ground-borne vibration can cause building floors to shake, windows to rattle, hanging pictures to fall off walls, and in some cases damage buildings.

Like noise, vibration from a single source may consist of a range of frequencies. The magnitude of vibration is commonly denoted as the peak particle velocity (PPV) and is expressed in inches per second (in/sec). The PPV is the maximum velocity experienced by any point in a structure during a vibration event and indicates the magnitude of energy transmitted through vibration. PPV is an indicator often used in determining potential damage to buildings from vibration associated with blasting and other construction activities.

Table T-4 summarizes the levels of vibration from construction equipment and the typical effects on people and buildings based on a review of published vibration levels and effects (Caltrans 2004). Although blasting is considered a transient source, human response may vary widely depending on the event duration, frequency of occurrence, startle factor, level of personal activity at the time of the event, health of the individual, time of day, orientation of the individual (standing up or lying down), and political and economic perception of the blasting operation. Ground vibration as low as 0.1 in/sec due to a blasting operation may be considered distinctly to strongly perceptible by a person.

Table T-4. Summary of Construction Equipment Vibration Levels and Effects on Humans and Buildings.

Effects	Peak Particle Velocity (in/sec)	
	Transient	**Continuous/Frequent Intermittent Sources**
Potentially Damaged Structure Type		
Extremely fragile historic buildings, ruins, ancient monuments	0.12	0.08
Fragile buildings	0.2	0.1
Historic and some old buildings	0.5	0.25
Older residential structures	0.5	0.3
New residential structures	1.0	0.5
Modern industrial/commercial buildings	2.0	0.5
Human Response		
Barely perceptible	0.04	0.01
Distinctly perceptible	0.25	0.04
Strongly perceptible	0.9	0.10
Severe	2.0	0.4

Source: Caltrans 2004
Notes:
[1] Transient sources create a single isolated vibration event, such as blasting and drop balls.
[2] Continuous/frequent intermittent sources include impact pile drivers, vibratory pile drivers, and vibratory compaction equipment.

Vibration from construction and traffic typically does not contribute to building damage, with the occasional exception of blasting and pile-driving during construction.

U.S. Bureau of Mines and Office of Surface Mining Reclamation and Enforcement have developed a blast vibration limit ranging from 0.5 to 2.0 in/sec depending on vibration frequency and distances to protect buildings with various structure type and condition. Studies have shown that blast vibration typically does not damage residential structures even at levels exceeding U.S. Bureau of Mines and Office of Surface Mining Reclamation and Enforcement blast vibration limits (Caltrans 2004).

Average vibration amplitude is a more appropriate measure for human response as it takes time for the human body to respond. Average particle velocity over time is zero so the root-mean-square amplitude called the vibration velocity level (L_v) in vibration decibels (VdB) is used to quantify annoyance. For a person in their residence, the low threshold for annoyance is 72 VdB. The L_v equivalent of the 0.12 in/sec damage criteria for fragile historic buildings is 90 VdB, a much higher value than what a person may perceive as “annoying” (Federal Transit Administration [FTA] 2006).

Vibration impacts from the project were considered significant if the peak particle velocity exceeded 0.3 in/sec based on the damage level for older residential structures. Vibration velocity level was considered significant if it exceeded the 72 VdB annoyance level.

T.5 Construction Vibration Impact Assessment Method

Vibration from construction projects is caused by general equipment operations, and is usually highest during pile driving, soil compacting, jack hammering, demolition, and blasting activities. Although it is conceivable for ground-borne vibration from construction projects to cause building damage, the vibration from construction activities is almost never of sufficient amplitude to cause even minor cosmetic damage to buildings. The primary concern is that the vibration can be intrusive and annoying to people nearby. Table T-5 presents the vibration levels for typical construction equipment published in FTA Transit Noise and Vibration Impact Assessment (2006).

Table T-5. Vibration Levels for Construction Equipment.

Equipment Types	PPV at 25 feet (in/sec)	L_V at 25 feet (VdB)
Clam shovel drop	0.20	94
Vibratory roller	0.21	94
Large bulldozer/Hoe ram	0.08	87
Caisson drilling	0.08	87
Loaded trucks	0.07	86
Jackhammer	0.03	79

Source: FTA 2006

Total PPV at each construction site is the sum of PPV for all equipment at the construction site. Equation 9 was used to calculate the construction equipment vibration levels at the receiver, based on a reference vibration at 25 feet.

Equation 9: $PPV_{receptor} = PPV_{source} (25/d)^{1.5}$

Where:

- PPVsource is the total vibration level at 25 feet (in/sec); and
- d is the distance from the equipment to the receptor (ft).

Vibration levels expressed as VdB are treated similarly to noise levels. Equation 10 was used to calculate the total L_v from all construction equipment. The equivalent L_v at the receptor was calculated using Equation 11.

Equation 10: $L_{v\_total} = 20 \log_{10} \Sigma\, 10^{(Lv\_equipment/20)}$

Equation 11: $L_{v\_receptor} = L_{v\_source} - 30 \log_{10} (d/25)$

Where:

- d is the distance from the construction site to the noise-sensitive receptor (feet).

Vibration levels associated with blasting are site-specific and are dependent on the amount of explosive used, soil conditions between the blast site and the receptor, and the elevation where blasting would take place (specifically, the below surface elevation where bedrock would be encountered). Blasting below the surface would produce lower vibration levels at a receptor due to additional attenuation provided by distance and

transmission through soil and rock. Vibration from blasting was estimated using the Blast Vibration Prediction Curves published by L. L. Oriard in 1999 and 2000 (Caltrans 2004). One can estimate the PPV of blasting based on the square root scaled distance (Equation 12). The estimated PPV was converted to L_v using Equation 13. Actual blasting procedures would be dictated by site-specific conditions as determined by the construction contractor prior to construction and through monitoring during construction.

Equation 12: $D_S = d / \sqrt[3]{W}$

Where:

- d is the distance from the construction site to the noise-sensitive receptor (feet); and
- W is the charge weight (pounds).

Equation 13: $L_V = 20 \text{ Log}_{10}(PPV/10^6) – 12$ (assuming a crest factor of 4)

Calculated PPV and L_v were compared against the criteria of 0.3 in/sec and 72 VdB, respectively, to determine significance.

T.6 References

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Attachment 1

Construction Noise Impact Analysis

The noise and vibration impact modeling described in this attachment is reproduced from the 2012 EIS/EIR analysis. Although there have since been some modifications to the project schedule, the 2011 noise and vibration impact modeling is reproduced herein because the construction-related noise and vibration-generating activities for the Proposed Project would be similar to those modeled below. Minor changes in construction activities between the 2012 EIS/EIR analysis and the Proposed Project are primarily due to the timing associated with removing Iron Gate Dam, Copco No. 1 Dam, and Copco No. 2 Dam. The Proposed Project and the data modeled as part of the 2012 EIS/EIR in this attachment are within the thresholds noted in Lower Klamath Project EIR Section 3.23.3 *[Noise] Significance Criteria* and analyzed in Section 3.23.5 [Noise] *Impacts and Mitigation*.

Alternative Name Key	
2012 EIS/EIR Alternative Name	**Lower Klamath Project EIR Alternative Name**
Proposed Action	Proposed Project
	Three Dam Removal (Iron Gate, Copco No. 1, Copco No. 2)
	No Hatchery
Partial Facilities Removal	Partial Removal
Remove Two Dams (Iron Gate and Copco No. 1)	Two Dam Removal (Iron Gate, Copco No. 1)
Fish Passage at Four Dams	Continued Operations with Fish Passage

Attachment 2

Construction Vibration Impact Analysis

The noise and vibration impact modeling described in this attachment is reproduced from the 2012 EIS/EIR analysis. Although there have since been some modifications to the project schedule, the 2011 noise and vibration impact modeling is reproduced herein because the construction-related noise- and vibration-generating activities for the Proposed Project would be similar to those modeled below. Minor changes in construction activities between the 2012 EIS/EIR analysis and the Proposed Project are primarily due to the timing associated with removing Iron Gate Dam, Copco No. 1 Dam, and Copco No. 2 Dam. The Proposed Project and the data modeled as part of the 2012 EIS/EIR in this attachment are within the thresholds noted in Lower Klamath Project EIR Section 3.23.3 *[Noise] Significance Criteria* and analyzed in Section 3.23.5 [Noise] *Impacts and Mitigation*.

Alternative Name Key	
2012 EIS/EIR Alternative Name	**Lower Klamath Project EIR Alternative Name**
Proposed Action	Proposed Project
	Three Dam Removal (Iron Gate, Copco No. 1, Copco No. 2)
	No Hatchery
Partial Facilities Removal	Partial Removal
Remove Two Dams (Iron Gate and Copco No. 1)	Two Dam Removal (Iron Gate, Copco No. 1)
Fish Passage at Four Dams	Continued Operations with Fish Passage

Attachment 3

Traffic Noise Impact Analysis

The noise and vibration impact modeling described in this attachment is reproduced from the 2012 EIS/EIR analysis. Although there have since been some modifications to the project schedule, the 2011 noise and vibration impact modeling is reproduced herein because the construction-related noise- and vibration-generating activities for the Proposed Project would be similar to those modeled below. Minor changes in construction activities between the 2012 EIS/EIR analysis and the Proposed Project are primarily due to the timing associated with removing Iron Gate Dam, Copco No. 1 Dam, and Copco No. 2 Dam. The Proposed Project and the data modeled as part of the 2012 EIS/EIR in this attachment are within the thresholds noted in Lower Klamath Project EIR Section 3.23.3 *[Noise] Significance Criteria* and analyzed in Section 3.23.5 [Noise] *Impacts and Mitigation*.

Alternative Name Key	
2012 EIS/EIR Alternative Name	**Lower Klamath Project EIR Alternative Name**
Proposed Action	Proposed Project
	Three Dam Removal (Iron Gate, Copco No. 1, Copco No. 2)
	No Hatchery
Partial Facilities Removal	Partial Removal
Remove Two Dams (Iron Gate and Copco No. 1)	Two Dam Removal (Iron Gate, Copco No. 1)
Fish Passage at Four Dams	Continued Operations with Fish Passage

Appendix U

Alternatives

2.4.4.6 Recreation Facilities

Changes to the recreation facilities surrounding the existing reservoirs would be the same as those in the Proposed Action (see Table 2-14).

2.4.4.7 Keno Transfer

The Partial Facilities Removal of Four Dams Alternative would include the transfer of Keno Dam as a connected action in the same fashion as for the Proposed Action. The description of the transfer presented in Section 2.4.3.7 characterizes how the transfer would be executed under the Partial Facilities Removal of Four Dams Alternative.

2.4.4.8 East and Westside Facilities – Programmatic Measure

The Partial Facilities Removal of Four Dams Alternative would include decommissioning the East Side and Westside Facilities in the same fashion as the Proposed Action. The description of the facility decommissioning presented in Section 2.4.3.8 characterizes how decommissioning would be completed under the Partial Facilities Removal of Four Dams Alternative.

2.4.4.9 City of Yreka Water Supply Pipeline Relocation – Programmatic Measure

The Partial Facilities Removal of Four Dams Alternative would include the relocation of the City of Yreka Water Supply Pipeline in the same fashion as the Proposed Action. The description of the relocation presented in 2.4.3.9 characterizes how the relocation would be completed under the Partial Facilities Removal of Four Dams Alternative.

2.4.4.10 KBRA – Programmatic Measures

The Partial Facilities Removal Alternative would include implementation of the KBRA in the same fashion as the Proposed Action. The description of the KBRA presented in Section 2.4.3.10 characterizes the plans, programs, and actions that would be pursued under the Partial Facilities Removal of Four Dams Alternative.

2.4.5 Alternative 4: Fish Passage at Four Dams

Alternative 4 would provide upstream and downstream fish passage at the Four Facilities. The Fish Passage at Four Dams Alternative would not satisfy the KHSA; consequently, the KBRA would not be implemented (although ongoing restoration activities in the No Action/No Project Alternative may continue). For the purposes of this analysis, alternatives that would not result in full implementation of the KHSA do not include the KBRA as a connected action to the alternative. Additionally, the transfer of Keno Dam to DOI would not move forward as a connected action.

The description of Alternative 4 uses information from the *United States Department of the Interior's Filing of Modified Terms, Conditions, and Prescriptions (Klamath Hydroelectric Project, No. 2082)* (DOI 2007) and from the *National Marine Fisheries Service Modified Prescriptions for Fishways and Alternatives Analysis for the Klamath Hydroelectric Project (FERC Project No. 2082)* (NOAA Fisheries Service 2007). These fishway prescriptions and mandatory conditions were developed during the FERC

relicensing process. Issues of Material Fact associated with the prescriptions and mandatory conditions were challenged; the resulting Administrative Law Judge decision found that PacifiCorp failed to meet its burden of proof on most factual issues in dispute. Attachment B of Appendix A includes the full list of prescriptions and mandatory conditions; several of the prescriptions include studies to determine if features are necessary (such as spillway and tailrace modification).

For the purposes of analysis in this EIS/EIR, however, Alternative 4 has been developed with some assumptions regarding details and feature designs for purposes of this analysis that are not included or not yet determined for the fishway prescriptions and do not reflect any final decision by NOAA Fisheries Service or USFWS regarding any differences from the express text of the fishway prescriptions or how any decision may be made under the terms of the fishway prescriptions. Alternative 4 thus includes some specific fishway facility design and construction details beyond what are specifically required in the prescriptions and are based on designs of similar fishway facilities used at other hydroelectric facilities. For example, the prescriptions include spillway modification at Copco 1 Reservoir; Alternative 4 includes a fish screen at the power intake and a fish collection device to divert fish from the spillway. Prior to advancing to feasibility-level of design, the Hydropower Licensee must obtain concurrence from NOAA Fisheries Service and USFWS related to proposed modifications for each independent facility, or any major feature of a facility (DOI 2007; NOAA Fisheries Service 2007).

Flows within the Hydroelectric Reach would change compared to the No Action/No Project Alternative because of the mandatory conditions related to releases from J.C. Boyle Dam and Powerplant. A key 4(e) condition requires at least 40 percent of J.C. Boyle inflow to be released into the Bypass Reach. Under this alternative, the J.C. Boyle Powerhouse would produce peaking power only one day a week to coincide with recreation releases. This alternative would generate less power than current production because of the change in peaking operations and the flow requirements for the J.C. Boyle Bypass Reach. Flows downstream from Iron Gate Dam, however, would be similar to those in the No Action/No Project Alternative (see Figure 2-7).

This alternative would be implemented through FERC licensure including 401 certifications to an entity that would operate the Four Facilities (the “Hydropower Licensee”). Inflows to Upper Klamath Lake, and outflows from Iron Gate Dam are assumed to be the same under the Fish Passage at Four Dams Alternative as described above for the No Action/No Project Alternative. The ongoing resource management activities, TMDLs, biological opinions, and other regulatory conditions described under the No Action/No Project Alternative would also occur under this alternative.

This section describes general information about the fish passage facilities that would be constructed, and the following sections discuss aspects unique to each facility. Typical upstream fish passage facilities at each dam would consist of pool and weir type fish ladders to provide the safe, timely, and effective upstream passage of Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout. This type of fish ladder is

generally constructed from reinforced concrete and occasionally uses metal or wood hardware for adjustable components. In order to meet the prescribed fish passage criteria (DOI 2007; NOAA Fisheries Service 2007), the fish ladders would use 6-inch steps between each weir that would result in an overall structure slope of 4 and 6 percent. At a minimum, each ladder bay would measure 8 feet long by 6 feet wide by 5 feet deep to meet the minimum pool requirements (NOAA Fisheries Service 2008), which would drive the structure slope of 4 to 6 percent. The FERC Final EIS identified a 10 percent slope, but that slope would not meet current requirements for fish ladders. Figure 2-22 shows an example of a cast-in-place pool and weir fish ladder that is similar to that proposed for upstream fish passage at the Four Facilities under this alternative. Final design of these structures would likely exceed this minimum pool dimension by 50 to 100 percent in order to meet all regulatory criteria and minimize turbulence in the ladder bays. Table 2-24 provides a minimum footprint for each upstream fish ladder.



Figure 2-22. Example of cast-in-place pool and weir fish ladder.

Table 2-24. Minimum Structure Footprint and Dimensions for Fish Ladders at Each Dam

Dam	Vertical Drop (feet)	Min. Number of Pools	Min. Structure Length (feet)	Min. Structure Footprint (square feet)
J.C. Boyle	61	122	1,089	8,712
Copco 1	124	249	2,241	17,928
Copco 2	22	44	396	3,168
Iron Gate	157	314	2,826	22,608

Vertical Drop Source: CH2M Hill 2003

The J.C. Boyle and Copco 2 fish ladders are well within typical pool and weir fish ladders being designed today to meet fish passage criteria for the vertical drop. The Copco 1 and Iron Gate fish ladders are substantially longer and have a bigger elevation differential; however, there are two successful examples in Oregon where bigger elevation differentials have been overcome with pool and weir fish ladders for upstream fish passage. The two examples are the Faraday/North Fork ladder on the Clackamas River (196 feet tall, 1.9 miles long) and the Pelton ladder on the Deschutes River (230 feet tall, 2.8 miles long) (Ratliff et. al. 1999). The Pelton ladder was shut down in 1968 primarily due to downstream juvenile passage and not upstream passage.

Fishway prescriptions require two downstream entrances and associated entrance pools for each fish ladder (DOI 2007; NOAA Fisheries Service 2007). All fish ladders would require an auxiliary water supply (AWS) to ensure adequate attraction flows at the downstream and to draw fish into the fish ladder and moderate water temperatures. The AWS would consist of a pipeline or intake that draws water from the reservoir and releases it in the fish ladder and near the fishway entrance pools. To accommodate increased flows, the downstream bays of the fish ladder would be larger than upstream bays in the fish ladder.

Downstream fish passage facilities would vary at each dam. Generally, the facilities would include fish screens and collection facilities to screen the fish away from the intake structures for the power generation facilities and the spillways (if they are unsuitable for downstream passage). Table 2-25 summarizes the fish passage facilities that would be required at each dam under this alternative.

Table 2-25. Fish Passage Improvements under the Fish Passage at Four Dams Alternative

Dam	Upstream Fish Passage	Spillway Modifications[1]	Tailrace Barrier[1]	Fish Screens & Bypass
J.C. Boyle	New fish ladder over dam with auxiliary water supply (AWS) for attraction	Spillway modification to provide smooth transition	Extend river bank and install cutoff screen	New fish screen with bypass
Copco 1	New fish ladder over dam with AWS	Collection device	Extend river bank and install cutoff screen	New fish screen with bypass
Copco 2	New fish ladder over dam with AWS	Spillway modification to provide smooth transition	Extend river bank and install cutoff screen	New fish screen with bypass
Iron Gate	New fish ladder over dam with AWS, observation and sorting station in fish ladder	Spillway modification to provide smooth transition		New fish screen with bypass

Notes:

1. For the purposes of analysis in this EIS/EIR, Alternative 4 includes some specific fishway facility design and construction details that are beyond those required in the prescriptions. The modified prescriptions provide that the applicant is allowed to perform site-specific studies to determine if spillway modifications and tailrace barriers are necessary at the developments where these are prescribed. However, the modified prescriptions provide that spillway modifications and tailrace barriers shall be constructed and operated unless and until USFWS and NOAA Fisheries Service determine based on any such site-specific studies that any prescribed spillway modifications or tailrace barriers are unnecessary.

2.4.5.1 Construction Details

Construction of fish ladders represents the bulk of the work under this alternative. The Hydropower Licensee would construct the ladders from reinforced concrete using construction methods typical for civil infrastructure work.

Table 2-26 shows estimated quantities of concrete for each facility.

Table 2-26. Estimated Minimum Amount of Reinforced Concrete Necessary for Fish Ladder at Each Dam

Dam	Reinforced Concrete (yd^3)
J.C. Boyle	2,800
Copco 1	5,800
Copco 2	1,000
Iron Gate	7,000

The Hydropower Licensee would need to control water and isolate the work area from flowing water and aquatic organisms throughout the duration of construction. Control mechanisms would be installed prior to starting work for each dam removal. The Hydropower Licensee could control water in most areas using gravity diversions; however, pumps could be required to dewater isolated ponding. Dewatering would require electric, gasoline, or diesel powered pumps, along with flexible hosing to convey water. Pumps would discharge water away from the river into upland areas to prevent discharge of fine sediments to waterways.

The Hydropower Licensee would work in wet conditions in areas that cannot be dried. For in-water work, the Hydropower Licensee would use physical barriers of a type and in a manner similar to that used under the dam removal alternatives.

The following sections provide a detailed description of necessary fish passage facilities for each dam under the Fish Passage at Four Dams Alternative.

2.4.5.1.1 J.C. Boyle Fish Passage Facilities[6]

The J.C. Boyle site has the best access for construction equipment and staging for construction. Equipment and materials could be brought into the site on existing gravel access roads and temporary access roads where necessary.

Upstream Passage

J.C. Boyle Dam has an existing pool and weir concrete fish ladder on the north side of the spillway, but it does not meet current design criteria and must be replaced because of its

[6] Feature design has been provided in this EIS/EIR to support effects analysis. If the Klamath Hydroelectric Project is relicensed, the licensee would be required to obtain concurrence from USFWS and NOAA Fisheries Service regarding fishway design and construction plans for each facility prior to advancing to feasibility-level of design (NOAA Fisheries Service 2007; DOI 2007).

configuration and poor structural condition. The Fish Passage at Four Dams Alternative would include removal of the existing fish ladder structure and construction of a new pool, weir, and reinforced concrete fish ladder on the north side of the dam spillway, at or near the same location as the existing fish ladder (see Figure 2-23).



Figure 2-23. Conceptual Layout of J.C. Boyle Fish Passage Facilities.

The overall difference in water levels from the downstream river to J.C. Boyle Reservoir ranges from 55 to 61 feet, depending on reservoir pool elevation. The new fish passage facilities would have multiple openings into the reservoir to accommodate the reservoir pool fluctuation while maintaining continual upstream passage. The new ladder would have two entrances to accommodate low flow and high flow conditions.

An AWS would be necessary for temperature and attraction flow mitigation. The AWS would draw water from the reservoir through a screened inlet and variable height intake structure to provide water temperature control. The AWS would pipe water into the fish ladder at two locations.

Construction of these facilities would begin with demolition and removal of the existing fish ladder using mechanical means (such as hydraulic shears or hoe-ram). The Hydropower Licensee would then install the new reinforced concrete fish ladder by constructing concrete forms, laying the reinforcement, and pouring concrete. The Hydropower Licensee would construct a cofferdam around the area where the fish ladder enters the reservoir to allow construction in dry conditions.

Downstream Fish Passage – Water Intake

The existing water intake has a design flow of 3,000 cfs, which requires a minimum fish screen of 7,500 square feet based on an approach velocity of 0.4 feet per second (ft/s). The Fish Passage at Four Dams Alternative would include a conventional fish screen at the J.C. Boyle water intake. The fish screen would terminate in a 36 inch diameter fish bypass pipe (approximately 40 cfs) that would run from the water intake to a bypass facility for recording downstream migrating fish and then continuing on to a controlled outfall in the river downstream from the dam. The fish screen would be stainless steel and the fish return pipe would be standard steel with concrete and steel support structures along the length of the pipe.

The fish screen would be fabricated offsite and installed by a crew of skilled workers using light equipment. This phase of construction would require extensive dewatering and work isolation effort in order to provide a dry or partially isolated work area. Dewatering could require reservoir water level manipulation or construction of coffer barriers with pumps to dewater the work area around the water intakes.

Downstream Fish Passage – Spillway

Radial gates regulate discharge over the J.C. Boyle Dam's concrete spillway section that terminates in an abrupt drop onto bedrock. Modifications to the spillway would likely include removing the drop at the downstream end of the spillway by building a cast-in-place concrete transition and minor channel modifications. This design would likely reduce fish mortality on the rock outcrop below the spillway and provide a smooth transition for downstream passage. Construction would involve a small amount of demolition and concrete placement; methods would be similar to the work on the new fish ladder.

Tailrace Barrier

The power generation turbines at J.C. Boyle Powerhouse are several miles downstream from the dam with a large outlet bay, or tailrace area, that flows into the Klamath River (see Figure 2-2). This tailrace has the potential for false attraction waters and needs a barrier. The Fish Passage at Four Dams Alternative would include extension of the bank of the Klamath River and installation of a stainless steel, wedge-wire cutoff screen.

2.4.5.1.2 Copco 1 Fish Passage Facilities[7]

The Copco 1 Dam site has difficult site access because of steep canyon terrain. The Fish Passage at Four Dams Alternative would include construction of temporary roads for site access and other special provisions to move materials, such as a tower crane or aerial tramway.

Upstream Passage

Fish Passage at Four Dams Alternative would include a new pool and weir fish ladder on the right side of Copco 1 Dam for upstream fish passage. The fish ladder would have an AWS plumbed into it at two locations to moderate water temperatures, flow in the fishway, and attraction flows at the downstream end of the fishway. The downstream entrance of the fish ladder would have two entrances for low water and high water conditions, as shown in Figure 2-24. The upstream end of the fish ladder that enters the reservoir area would also have multiple openings to accommodate water level fluctuations. Construction would require installation of the cast-in place concrete ladder and isolation of the area where the ladder connects to the reservoir.



Figure 2-24. Copco 1 Fish Ladder Configuration, Fish Screen, and Collection Device.

[7] Feature design has been provided in this EIS/EIR to support effects analysis. If the Klamath Hydroelectric Project is relicensed, the licensee would be required to obtain concurrence from USFWS and NOAA Fisheries Service regarding fishway design and construction plans for each facility prior to advancing to feasibility-level of design (NOAA Fisheries Service 2007; DOI 2007).

Downstream Fish Passage

The existing facilities at Copco 1 Dam are not conducive to downstream fish passage because the juvenile salmonids travelling downstream would flow through the intake to the power generation facility or over the dam spillway during high flows. The Fish Passage at Four Dams Alternative would include a fish screen as the primary measure to ensure safe downstream passage (DOI 2007; NOAA Fisheries Service 2007).

Depending on the frequency of spill, a collection facility may also be necessary to prevent fish from moving toward the spillway area. For the purposes of this analysis, the Fish Passage at Four Dams Alternative includes construction of a collection facility that is integrated with the fish screen for Copco 1 Reservoir. The collection facility would protect the entire spillway area. The collection device would be fabricated off-site and shipped to the site using standard flatbed trucks. The Hydropower Licensee would assemble the pieces on-site. Once the structure was assembled, it would be put in place near the water intake area and secured.

The fish screen would be a steel structure using a typical fish screen configuration. The existing power generation water intake has a design flow of 3,200 cfs, which requires a minimum fish screen of 8,000 square feet based on an approach velocity of 0.4 ft/s. The fish screen would be at the intake structure on the right side of the dam. The fish screen would be anchored to the existing rock and concrete dam structure to ensure stability. The screen would direct fish to an approximately 36 inch diameter bypass pipe with a capacity of more than 60 cfs.

Tailrace Barrier

The Copco 1 Powerhouse tailrace configuration is similar to the Iron Gate facility. For the purposes of analysis, this analysis of Alternative 4 includes a tailrace barrier.[8]

2.4.5.1.3 Copco 2 Fish Passage Facilities[9]

The Copco 2 site has difficult access because of the narrow canyon and relatively steep road access into the site. The existing access road would require upgrades such as gravel surfacing and grading.

Upstream Fish Passage

The Fish Passage at Four Dams Alternative includes a concrete pool and weir fish ladder with 6-inch drops to provide volitional fish passage at Copco 2 Dam. The overall difference in water levels from the downstream river to Copco 2 Reservoir is about 20 to

[8] The modified prescriptions provide that the applicant is allowed to perform site-specific studies to determine if spillway modifications and tailrace barriers are necessary at the developments where these are prescribed. However, the modified prescriptions provide that spillway modifications and tailrace barriers shall be constructed and operated unless and until USFWS and NOAA Fisheries Service determine based on any such site-specific studies that any prescribed spillway modifications or tailrace barriers are unnecessary.

[9] Feature design has been provided in this EIS/EIR to support effects analysis. If the Klamath Hydroelectric Project is relicensed, the licensee would be required to obtain concurrence from USFWS and NOAA Fisheries Service regarding fishway design and construction plans for each facility prior to advancing to feasibility-level of design (NOAA Fisheries Service 2007; DOI 2007).

25 feet, depending on reservoir pool elevations. The new fish passage facilities would accommodate the reservoir pool fluctuation while maintaining continual upstream passage. Construction would require installation of the cast-in place concrete ladder and isolation of the area where the ladder connects to the reservoir.

The pool and weir fish ladder would be on the right side of the concrete spillway structure in the earth embankment. An AWS would be necessary for temperature and attraction flow mitigation. The AWS would draw water from the reservoir through a screened inlet. Figure 2-25 shows a conceptual layout for a fish ladder at Copco 2 Dam.

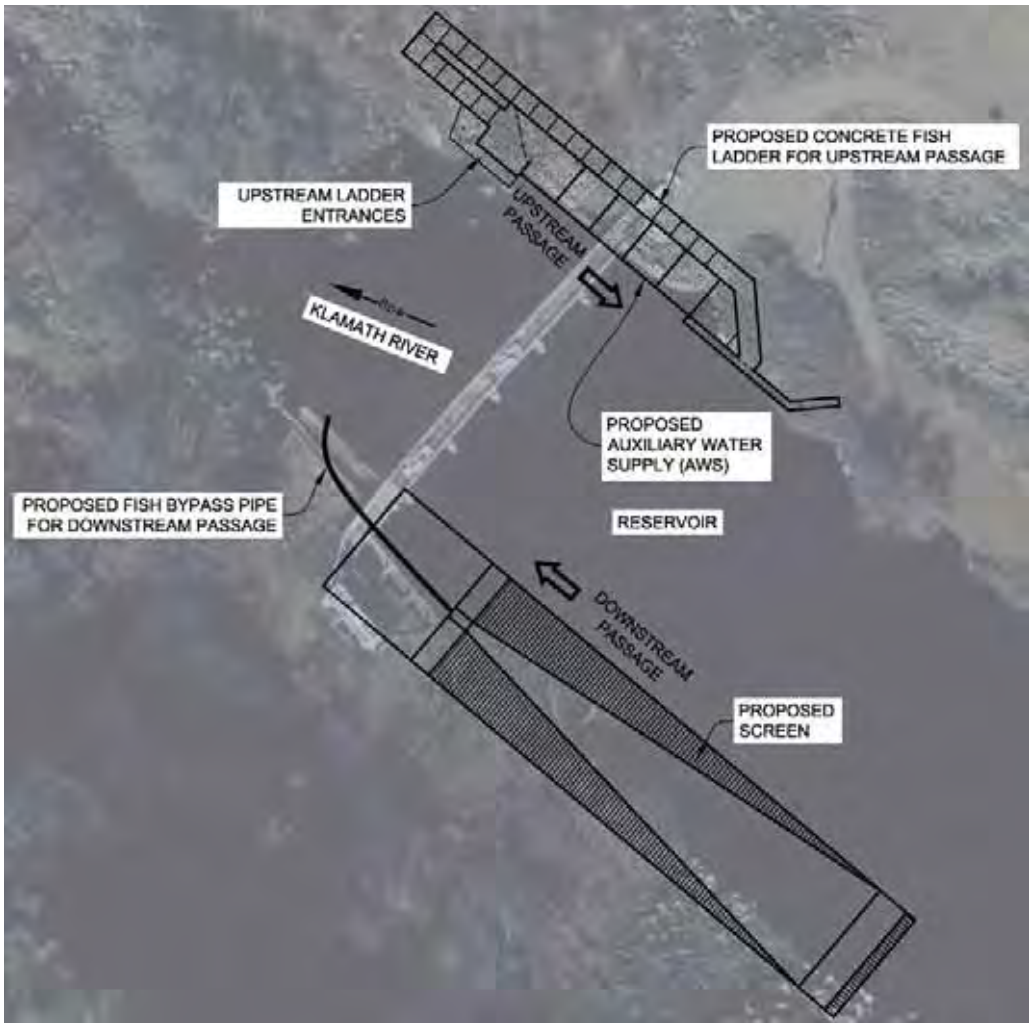

Figure 2-25. Copco 2 Fish Ladder and Fish Screen, along the left side of the river, for power water diversion.

In addition to the fish ladder, a transverse bedrock sill approximately 0.5 miles upstream of the Copco 2 Powerhouse in the Bypass Reach could create a fish passage barrier. A new FERC license would likely increase flows in the Bypass Reach and this barrier would not likely exist. As part of the license renewal process, a study would determine whether corrective measures would be needed at this barrier to provide fish passage.[10] According to the mandatory prescriptions, sufficient flow would need to be released into the Bypass Reach to attract upstream-migrating fish into the fishway entrance pools and ensure that flows are sufficient to attract fish at the point of confluence between the Bypass Reach and the downstream powerhouse discharges. The prescriptions do not specify a flow rate in the Bypass Reach, but modeling the recommendations indicates that minimum flows would be approximately 438 cfs.

Downstream Fish Passage – Water Intake

The existing power generation water intake at Copco 2 Dam is on the left side of the concrete spillway structure. The water diversion capacity is 3,200 cfs, which would require a minimum 8,000 square feet of screen. A conventional fish screen for the water intake would minimize the length of the screen. The fish screen would terminate in an approximately 36-inch fish bypass pipe that would flow over the dam and into the downstream river area. As with the fish screen for the J.C. Boyle Development, the screen would be fabricated off-site and installation would require dewatering and isolation to provide a dry or partially isolated work area.

Downstream Fish Passage – Spillway

The Copco 2 spillway is controlled with radial gates that regulate discharge over the concrete spillway section. The existing elevation difference between the spillway crest and water level on the downstream side of the dam is approximately 13 feet. Modifications to the concrete apron and spillway would minimize or eliminate rapid changes in direction and abrupt velocity changes at the spillway apron for downstream moving fish. A transitional ramp would be installed at the midpoint of the spillway to transition flows smoothly into the water conditions downstream from the concrete apron. The transitional ramp would be formed using cast-in-place concrete similar to the existing spillway construction.

Tailrace Barrier

The power generation turbines for Copco 2 are 1.4 miles downstream from the dam with a large tailrace area that flows back into the Klamath River. The water flowing out through this tailrace has the potential to attract fish to a false pathway. Alternative 4 includes a tailrace barrier extending the bank line of the Klamath River and installing a cutoff screen to prevent fish from straying into the tailrace area (see Figure 2-26).

[10] The prescriptions require modifications to the bedrock sill unless the licensee demonstrates through an evaluation approved by USFWS and NOAA Fisheries Service that indicates that it will not be a "barrier to fish passage under normal operating flows specified for the Copco 2 bypassed reach in the new license" (USFWS 2007; NOAA Fisheries Service 2007).

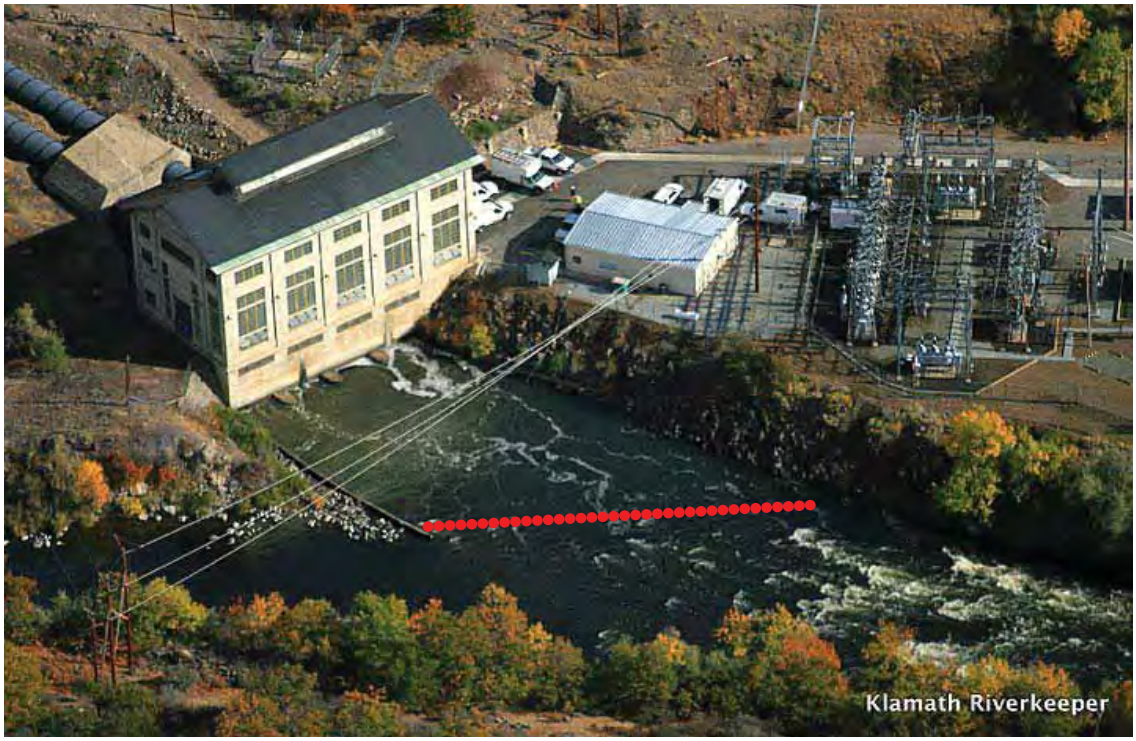

Figure 2-26. Modifications at the tailrace of the Copco 2 Powerplant would extend the bank and install a tailrace barrier screen (red dots).
(Source: Klamath Riverkeeper)

2.4.5.1.4 Iron Gate Dam Fish Passage Facilities[11]

The Iron Gate Development has difficult site access because of steep canyon terrain. It would require construction of temporary roads for site access and a tower crane or aerial tramway to move construction materials.

Upstream Fish Passage

The Fish Passage at Four Dams Alternative would include installation of a fish ladder on the left side of Iron Gate Dam near the existing penstock pipe, as shown in Figure 2-27. The fish ladder would have two entrances with entrance pools at the downstream end of the fish ladder. An AWS would feed water into the fish ladder at two locations to help with attraction flows and water temperatures. Multiple openings would be necessary where the fish ladder connects to the reservoir to allow for water level fluctuation. Construction would require installation of the cast-in place concrete ladder and isolation of the area where the ladder connects to the reservoir.

[11] Feature design has been provided in this EIS/EIR to support effects analysis. If the Klamath Hydroelectric Project is relicensed, the licensee would be required to obtain concurrence from USFWS and NOAA Fisheries Service regarding fishway design and construction plans for each facility prior to advancing to feasibility-level of design (NOAA Fisheries Service 2007; DOI 2007).



Figure 2-27. Conceptual fish passage facilities layout for Iron Gate Dam showing fish ladder, water intake screen, and spillway transition modifications.

Downstream Fish Passage – Water Intake

The existing power generation water intake structure at Iron Gate Dam is on the left side of the embankment dam. The water intake design flow is 1,735 cfs and would require a minimum fish screen of 4,340 square feet based on an approach velocity of 0.4 ft/s. A conventional fish screen would be the best option for screening the water intake to address the substantial size of the screen. The fish screen would terminate in a 36-inch-diameter fish bypass pipe (approximately 40 cfs) that would run from the water intake to a fish bypass facility for identification of downstream migrating juveniles and then continue downstream to the river below the dam. The fish screen would be stainless steel and the fish return pipe would be standard steel with concrete and steel support structures along the length of the pipe. As with the fish screen for the J.C. Boyle facility, the fish screen would be fabricated off-site and installation would require dewatering and isolation to provide a dry or partially isolated work area.

Downstream Fish Passage – Spillway

The Iron Gate spillway is an unregulated, free overflow from the reservoir area. Likely modifications to the spillway would include building a smoother transition at the downstream end using cast-in-place concrete to form an ogee-type drop structure that would connect the downstream river levels to the free flowing spill conditions. This modification would reduce fish mortality on the rock outcrop below the spillway. In addition, the Hydropower Licensee would use concrete to fill the area just upstream of the free outfall at the downstream end of the spillway to make a consistent hydraulic transition and reduce potential harm during downstream passage of primarily juvenile fish.[12]

2.4.5.2 Schedule

The schedule would likely follow the schedule prescribed in the FERC relicensing process. The prescriptions include a schedule for implementation and recommend that downstream facilities be installed prior to upstream passage facilities (DOI 2007; NOAA Fisheries 2007). Table 2-27 shows the schedule for implementation (including design, permitting, and construction) of the fish passage facilities at each dam, based on these constraints.

Table 2-27. Timetable for Implementation of Fish Passage Improvements at each Dam from Date of FERC License Renewal

Dam	Upstream Fish Passage	Spillway Modifications	Tailrace Barrier	Screens & Bypass
J.C. Boyle	4 years	4 years	4 years	4 years
Copco 1	6 years	6 years	8 years	6 years
Copco 2	6 years	6 years	8 years	6 years
Iron Gate	5 years	5 years	N/A	5 years

Key:
N/A: Not Applicable

2.4.5.3 Workforce

Table 2-28 shows the estimated workforce necessary for construction at each facility. Each facility would also have 5 to 10 on-site construction administrative personnel (e.g., inspectors, field engineers) for the duration of the project.

[12] The modified prescriptions provide that the applicant is allowed to perform site-specific studies to determine if spillway modifications and tailrace barriers are necessary at the developments where these are prescribed. However, the modified prescriptions provide that spillway modifications and tailrace barriers shall be constructed and operated unless and until USFWS and NOAA Fisheries Service determine based on any such site-specific studies that any prescribed spillway modifications or tailrace barriers are unnecessary.

Table 2-28. Estimated Average Construction Workforce for Fish Passage at Four Dams

Facility	Estimated Construction Workforce	Duration
J.C. Boyle	10 to 20 people	4-6 months
Copco 1	15 to 25 people	9 months
Copco 2	10 to 20 people	4-6 months
Iron Gate	15 to 30 people	12 months

2.4.5.4 Environmental Measures

The Fish Passage at Four Dams Alternative would incorporate standard measures to reduce environmental effects. These measures would be the same as those included in the Proposed Action (see Section 2.4.3).

2.4.5.5 Trap and Haul around Keno Impoundment – Programmatic Measure

NOAA Fisheries Service and DOI prescriptions include a measure to trap and haul fall-run Chinook salmon upstream and downstream around Keno Impoundment. The prescriptions call for seasonal trap and haul operations from June 15 to November 15 when water quality conditions are not suitable for fish (dissolved oxygen concentration less than 6 mg/l or temperature above 20 degrees Celsius) (DOI 2007; NOAA Fisheries Service 2007). Upstream operations would include construction of a collection and handling facility downstream from Keno Dam; these fish would be released upstream of Link River Dam. Downstream operations would include construction of a collection and handling facility at or adjacent to Link River Dam that would collect downstream migrating fish. These fish would be released downstream from Keno Dam. The exact details of the collection facilities, haul routes, or necessary road improvements are not yet defined; therefore, this measure is analyzed in this EIS/EIR at a programmatic level.

2.4.6 Alternative 5: Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate

The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative consists of the full removal of Iron Gate and Copco 1 facilities and installation of upstream and downstream fish passage facilities at both the J.C. Boyle and Copco 2 Dams. On Copco 2 and J.C. Boyle Dams, ladders would be less complex to construct and provide volitional fish passage because of dam height and reservoir length. Iron Gate and Copco 1 Dams also provide less power; therefore, removal would have less effect on power generation. Removing Iron Gate and Copco 1 Reservoirs, the two largest impoundments in the Hydroelectric Reach, would also address water quality problems driven by reservoir size, such as increased water temperature, low dissolved oxygen, and toxic algal blooms in the summer and fall.

In order to meet current criteria for volitional fish passage, J.C. Boyle and Copco 2 Dams would require new upstream and downstream fish passage facilities. The fish passage facilities at J.C. Boyle and Copco 2 Dams would be the same as in the Fish Passage at Four Dams Alternative; Section 2.4.5 describes these facilities in detail. Similar to the

Fish Passage at Four Dams Alternative, the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would incorporate most of the prescriptions from the FERC relicensing process related to fish passage at J.C. Boyle and Copco 2 Dams (see Attachment B of Appendix A for a list of prescriptions). Alternative 5 would not incorporate the prescriptions related to peaking power at J.C. Boyle and recreation releases. In Alternative 5, Copco 2 Dam would be the only dam remaining downstream from J.C. Boyle Dam. Copco 2 Reservoir is very small, and does not have adequate capacity to reregulate flows associated with peaking operations so that they are suitable for fish downstream. Therefore, Alternative 5 would not include peaking operations or recreation releases on any days at J.C. Boyle Dam.

Alternative 5 flows would be driven by releases from J.C. Boyle Dam because of the lack of downstream reregulation. The prescriptions would require 40 percent of J.C. Boyle releases to enter the Bypass Reach; therefore, these flows would be greater than the No Action/No Project Alternative. Flows at the Iron Gate Gauge would be generally similar to the No Action/No Project Alternative to maintain suitable flows for fish, although they may experience small variations because Iron Gate and Copco 1 Dams would not be in place to control flow patterns.

Removal of Iron Gate and Copco 1 Dams would be the same as in the Proposed Action; Section 2.4.3 describes the removal plans in more detail. Inflows to Upper Klamath Lake, and outflows from Copco 2 Dam and fish ladder and the Copco 2 Powerhouse are assumed to be nearly the same under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative as described above for the No Action/No Project Alternative.

A Hydropower Licensee would implement this alternative through licensure by FERC and would be responsible for its long term operation and maintenance. Implementation of the KBRA is not included in the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative. The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would not satisfy the KHSA; consequently, the KBRA would not be implemented (although ongoing restoration activities in the No Action/No Project Alternative may continue). For the purposes of this analysis, alternatives that would not result in full implementation of the KHSA do not include the KBRA as a connected action to the alternative. Additionally, the transfer Keno Dam to DOI would not move forward as a connected action. The ongoing resource management activities, TMDLs, biological opinions, and other regulatory conditions described under the No Action/No Project Alternative would also occur under this alternative.

2.4.6.1 Schedule

This alternative would follow a schedule similar to that of the Proposed Action, because two of the dams are being removed and fish passage would be necessary as soon as possible after dam removal. Similar to Alternative 4, downstream fishways at each site would be completed before upstream fishways. Figure 2-28 shows the schedule for construction of the fish passage facilities at two dams and for removal of the remaining two dams, based on these constraints.

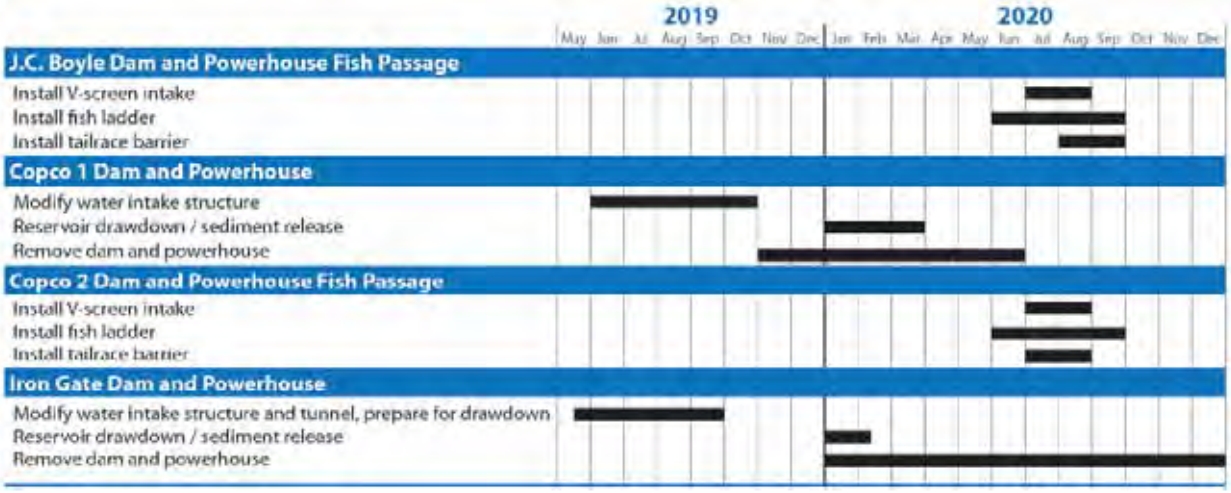

Figure 2-28. Anticipated schedule for Fish Passage at J.C. Boyle and Copco 2 Dams with Removal of Copco 1 and Iron Gate Dams.

2.4.6.2 Workforce

Table 2-29 shows the estimated workforce necessary for each facility under this alternative. In addition to the average construction workforce, there would be 5 to 10 on-site construction management staff (e.g., inspectors, field engineers) at each site for the duration of the project. The deconstruction efforts at Copco 1 and Iron Gate Dams would constitute the bulk of the efforts in this alternative.

Table 2-29. Estimated Construction Workforce for Full Removal of Iron Gate and Copco 1 Dams with Fish Passage at Copco 2 and J.C. Boyle Dams

Facility	Estimated Average Construction Workforce	Duration	Estimated Peak Workforce	Peak Period
J.C. Boyle	10 to 15 people	4 to 6 months	15–20	Jul 2020–Sep 2020
Copco 1	30 to 35 people	12 months	50–55	Nov 2019–Apr 2020
Copco 2	10 to 15 people	4 to 6 months	15–20	Jul 2020–Sep 2020
Iron Gate	35 to 40 people	18 months	75–80	Jun 2020–Sep 2020

2.4.6.3 Environmental Measures

The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would incorporate standard measures to reduce environmental effects. These measures would be the same as those included in the Proposed Action (see Section 2.4.3).

2.4.6.4 Recreation Facilities

Recreation facilities near J.C. Boyle Reservoir would stay intact, and the Copco 2 area does not have any developed recreation facilities. Recreation facilities at Iron Gate and Copco 1 (see Table 2-30) would be removed.

Table 2-30. Recreation Facilities under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative

Site Name	Existing Facilities	Facilities Following Dam Removal
Sites at J.C. Boyle Reservoir (Oregon)		
Pioneer Park	Two day-use areas with picnic tables, fire rings, and portable toilets	This site would remain, there would be no improvements or changes
Topsy Campground	Campground, day-use area, boat launch	This site would remain, there would be no improvements or changes
Sites at Copco 1 Reservoir (California)		
Mallard Cove	Day-use picnic area and boat launch	All facilities would be removed. Parking area would be regraded, seeded, and planted
Copco Cove	Picnic area and boat launch	All facilities would be removed. Parking area would be regraded, seeded, and planted
Sites at Iron Gate Reservoir (California)		
Fall Creek Trail	Day-use area and trail	This site would remain, there would be no improvements or changes
Jenny Creek	Day-use area and campground	This site would remain, there would be no improvements or changes
Wanaka Springs	Day-use area, campground, boat launch	All facilities would be removed. Parking area would be regraded, seeded, and planted
Camp Creek	Day-use area, campground, boat launch	All facilities would be removed. Parking area would be regraded, seeded, and planted
Juniper Point	Primitive campground and boat dock	All facilities would be removed. Parking area would be regraded, seeded, and planted
Mirror Cove	Campground and boat launch	All facilities would be removed. Parking area would be regraded, seeded, and planted
Overlook Point	Day-use area	All facilities would be removed. Parking area would be regraded, seeded, and planted
Long Gulch	Picnic area and boat launch	All facilities would be removed. Parking area would be regraded, seeded, and planted
Dutch Creek	Day-use area	All facilities would be removed. Parking area would be regraded, seeded, and planted
Iron Gate Fish Hatchery Public Use Area	Day-use area and boat launch	This site would remain, there would be no improvements or changes

Source: Reclamation 2011

2.4.6.5 Trap and Haul around Keno Impoundment – Programmatic Measure

The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would include trap and haul measures to move fish around Keno Impoundment when

water quality is not suitable for fish. The measures would be the same as those described in the Fish Passage at Four Dams Alternative (see Section 2.4.5). The exact details of the collection facilities, haul routes, or necessary road improvements are not yet defined; therefore, this measure is analyzed in this EIS/EIR at a programmatic level.

2.4.6.6 City of Yreka Water Supply Pipeline Relocation – Programmatic Measure

The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would include the relocation of the City of Yreka Water Supply Pipeline in the same fashion as the Proposed Action. The description of the relocation presented in 2.4.3.9 characterizes how the relocation would be completed under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative.

2.5 Preferred Alternative

Both Alternative 2 and Alternative 3 include removal of the Four Facilities and implementation of KBRA and both alternatives more fully meet the Purpose and Need (Sections ES.3 and 1.5.2.1). Some key benefits provided by implementation of Alternative 2 and Alternative 3 include (for a full discussion of the Alternatives, see Chapter 3):

- Provides optimal anadromous fish passage to and from at least 420 miles of historical habitat above Iron Gate Dam by creating a free flowing river in the Hydroelectric Reach in 2020
- Anadromous fish would access low gradient historical habitat of critical importance to spawning and rearing under Copco 1 and Iron Gate Reservoirs
- Provides for natural recruitment of spawning gravel and river processes within and below the Hydroelectric Reach through dam removal
- Largely eliminates in 2020 elevated late summer/fall water temperatures in and below the Hydroelectric Reach by removing the largest reservoirs
- Largely eliminates 2020 dissolved oxygen and pH problems produced in reservoirs in the Hydroelectric Reach and transported downstream
- Largely eliminates in 2020 algal toxins produced in the Hydroelectric Reach and transported downstream
- Reduces concentration of myxospores associated with carcasses accumulating below hatchery facilities, thus reducing disease

Removal of the Four Facilities and implementation of KBRA are important components of a durable, long-term solution for local communities and tribes regarding the development, administration, allocation, and advancement of water and native fishery resources of the Klamath Basins. Alternative 2 and Alternative 3 provide a greater opportunity for expanding restoration of salmonids, which, over time would improve

Appendix V

KHSA 2012 EIS/EIR Section 3.12 Tribal Trust

3.12 Tribal Trust

Indian trust resources consist of certain real property, natural resources and related rights, held in trust by the Federal Government for federally recognized Indian Tribes or individual Indians. Trust resources and rights cannot be sold, leased, or otherwise encumbered without approval of the United States. Trust resources attributed to tribes are called "tribal" trust resources, and trust resources attributed to individual Indians (usually called "allottees") are called "individual" trust resources. Some tribes have the trust right to use resources that are transitory or migratory in nature and that move beyond the reach of Federal or tribal management (e.g., fish and water). In such cases, it is a tribe's ability to access, use, and obtain sufficient quantities of those resources that is the trust resource. This right to obtain trust resources does not necessarily exclude other users from access to the resource. For additional information on Water Rights/Water Supply related to Tribal Trust, see Section 3.8.

In the case of the Klamath Basin Indian Tribes, the Federal Government has the responsibility to safeguard the fishery to ensure that tribes with fishing rights are able to practice those rights. Water quality and quantity are essential for success of a safeguarded fishery, with some Klamath Basin tribes also maintaining federally recognized water rights. Tribes of the Klamath Basin also use resources that may not meet the legal definition of trust resources. These resources are referred to as resources traditionally used by tribes. Resources traditionally used by tribes are those that are related to tribal cultural values associated with a tribal way of life that may not meet the definition of a trust resource, but which may or may not be entitled to legal protection under statute, regulation, or other law or regulation. Although the tribes of the Klamath Basin share many cultural values, their histories and practices are not necessarily the same. Thus, each of the six tribes may have its own set of resources that it considers important to the formation and maintenance of its culture but that the United States does not currently regard as a trust resource.

In addition to trust responsibility associated with trust resources, the Federal Government has a government-to-government relationship with federally recognized tribes based on, or otherwise arising from, treaties, statutes, executive orders and the historical relationship between the United States and Indian tribes. Cultural values related to a tribal way of life centered on rivers and lakes are composed of myriad values, styles, practices, resources, and items transmitted and evolving through time that together define the unique identities of the Yurok, Hupa, Karuk, Shasta, Klamath, Modoc, and Yahooskin (a band of Snake) cultures. Cultural values more specifically can be described as the unique manner in which tribal people access, take, prepare, administer, consider and otherwise use natural resources in unique tribal ways. To the extent that such resources and related values are diminished by ecosystem degradation, related cultures are also degraded and cultural transmissions become inhibited, which can contribute to the detriment of the mental, spiritual, and physical health of the Indians of the Klamath Basin.

This section provides a history of the Indian Tribes of the Klamath Basin, their salmon based economy and barter system, their trust resources, other resources traditionally used by the tribes, and traditional cultural practices associated with these resources. This section also documents the effects of the Klamath Hydroelectric Project dams on these resources and values and also reflects the replacement of a salmon based economy (cyclic based upon nature and natural occurring events) with that of an industrial economy (dams). The information presented in this section is primarily drawn from two 2011 United States Department of the Interior (DOI) reports: 1) Current Effects of Implementing the Klamath Hydroelectric Settlement Agreement (KHSA) and Klamath Basin Restoration Agreement (KBRA) on Indian Trust Resources and Cultural Values (2012); and 2) Potential Effects of Implementing the KHSA and KBRA on Trust Resources and Cultural Values[1] (2011).

As part of the studies, government-to-government consultations were conducted with the six basin tribes to solicit input from the tribal governments regarding their assessment of effects on Indian trust resources, tribal rights to take those resources, other resources traditionally used by tribes, and cultural values related to those resources and rights within the study area resulting from the current operations of the Klamath River. The reader should note that inclusion of any claims and assertions put forth by these tribes does not necessarily imply that the U.S. government endorses those views.

Three rounds of consultation meetings were held between the DOI and each of the six tribal governments The purpose of the first consultation meetings (Round 1) was for DOI to describe the study process of the elicit information about the histories and backgrounds of the tribes, and discuss how the dams might be currently affecting their resources and rights and related cultural values. In response, the Yurok, Resighini, Karuk, and The Klamath Tribes provided comprehensive background documents (DOI 2012 appendix X, Y and Z). The Round 2 meetings were conducted to collect comments from the tribes concerning the two technical reports and the potential effects of the Dams In Scenario and the Dams Out Scenario on their trust and other resources and rights. In Round 3, DOI sought comments from the tribes on the first draft of the Potential Effects of Implementing KHSA and KBRA on Trust Resources and Cultural Values Reports. For additional details on government to government meetings between DOI and the Klamath Basin Tribes, please see Chapter 7 Consultation and Coordination.

3.12.1 Area of Analysis

The area of analysis for Indian trust resources and other traditional resources includes the entire 263 miles of the Klamath River and the Klamath Basin.

[1] Unless otherwise cited the information in this section is drawn from these reports.

3.12.2 Regulatory Framework

Tribal Trust, within the area of analysis are regulated by several Federal laws and policies, which are listed below.

3.12.2.1 Federal Authorities and Regulations

- American Indian Religious Freedom Act
- Federal Power Act
- Executive Order 13007
- Executive Order 13084

3.12.3 Existing Conditions/Affected Environment

The information presented in this section is primarily drawn from the 2011 and 2012 DOI reports on Indian trust resources and cultural values in the study area. These reports identify Indian trust resources in the study area and document the effects of the Klamath River dams on those resources. Where no citations appear in Section 3.12.3, the information and discussion presented is based on the 2011 and 2012 DOI reports. Section 3.13, Cultural and Historical Resources, presents additional information regarding the Indian Tribes in the area of analysis.

This section presents individual histories of the six tribal governments in the study area. The federally recognized tribes in the study area include The Klamath Tribes, Quartz Valley Community, Karuk Tribe, Hoopa Valley Tribe, Yurok Tribe, and Resighini Rancheria. These tribes live along different reaches of the Klamath River and in different areas of the Klamath Basin. Each tribe has a unique history of its long-term occupation and use of the study area and establishment of its tribal government, reservations, rancherias, or other tribal lands. The section is organized by tribe to highlight the tribes' individual histories and to identify the specific Indian trust resources of each tribe and the impacts of the Klamath Hydroelectric Project on those trust resources.

3.12.3.1 The Klamath Tribes

3.12.3.1.1 The Klamath Tribes History

The Klamath Tribes are composed of three historically separate tribes: the Klamath Tribe, the Modoc Tribe, and the Yahooskin band of Snake Indians. The current membership is about 3,400 and the current total land base is approximately 600 acres[2].

The Klamath Tribes Treaty of 1864 (16 Stat. 707) (Treaty) was signed in the Wood River subbasin on October 14 near modern-day Fort Klamath. The Klamath Tribes signed the treaty, ceding more than 22 million acres of their traditional territories to the United States. These ceded lands included much of south-central Oregon as well as portions of north-central California. Based on the language in the Treaty, from the date the Treaty was signed the Klamath, Modoc, and Yahookskin became known as The Klamath Tribes.

[2] As discussed below, the land base of the Klamath Tribes was substantially eliminated as the result of the United States' Termination Policies of the 1950s.

Under the Treaty, approximately 1.9 million acres, primarily Klamath ancestral lands, were retained for the Klamath Indian Reservation. As a result, the Klamath Reservation was the largest reservation in the State of Oregon. Under the Treaty, The Klamath Tribes also reserved the rights to hunt, fish, trap, and gather plants throughout the reservation in perpetuity.

In 1887, Congress passed the General Allotment Act, which fundamentally changed the nature of land ownership on the Klamath Reservation. Under the allotment system, approximately 25 percent of the original Klamath Reservation passed from tribal to individual Indian ownership over a number of decades. Subsequently, many of these individual Indian-owned allotments passed into the hands of non-Indians.

The construction of Copco 1 Dam in 1918 and the resulting loss of anadromous fish had disastrous effects on The Klamath Tribes; however, The Klamath Tribes continued to harvest staple fish, game, and plant materials both on and off-reservation.

In 1954, as part of a nationwide effort to assimilate Indian Tribes into the cultural and economic mainstream, the Federal Government chose The Klamath Tribes for the experiment of "termination," and enacted the Klamath Termination Act (25 USC §564, et seq.). The Klamath Tribes were chosen in part because of their self-sufficiency, which was due, in part, to the resource harvest; however, termination ultimately resulted in separating the Tribes from the factors that had enabled their self-sufficiency.

Throughout the termination process, the United States divided the reservation into large timber tracts, intending to sell them to private timber companies; however, for various reasons, only one such tract was actually sold, and the government found it impossible to dispose of the others. In 1961, the United States itself purchased large forested portions of the former Klamath Reservation. This forestland became part of the Winema National Forest under the jurisdiction of the United States Forest Service. The balance of the reservation was placed in a private trust for the "remaining" tribal members who had opted to retain an interest in the tribal lands. In 1973, these remaining Indian lands were condemned and purchased by the government, and added to the Winema National Forest.

Termination ended The Klamath Tribes' status as a federally recognized Indian Tribe, dissolved the Federal recognition of the tribal government, and nullified some Federal fiduciary responsibilities to the tribal community. It did not, however, dissolve the Tribes' own government and social organization, and did not convert Indians into non-Indians... The social, economic, and cultural consequences of termination were both significant and complex and are generally viewed as dire by Klamath Tribes' members.

Reservation employment and benefits disappeared, and access to traditional lands and resources quickly eroded. Control over irrigation water supporting tribal farms diminished as well, as government-owned irrigation infrastructure was privatized and fell into non-Indian control. Under this Termination Act, tribal members were encouraged to give up their interest in tribal property in return for cash. A large majority of the tribe chose to do this. A provision of this Act continued the Indians' right to hunt, fish, trap,

and gather on the former reservation land. Cash payments for liquidated tribal assets were distributed irregularly within the tribal community, and those lands retained by tribal members were often lost to taxes and acquired by non-Indians. In addition, some non-Indian merchants, lawyers, and business people took advantage of the situation to engage in unscrupulous practices that hastened the transfer of this wealth away from tribal members. Once a model of economic self-sufficiency, the former members of The Klamath Tribes now had poverty levels that were three times those of their non-Indian neighbors.

Over the next three decades, tribal members and their families continued to reside principally on former reservation lands. Despite the loss of tribal lands, most continued to practice traditional subsistence harvests of game, plants, and fish, especially within the former reservation boundaries. Today The Klamath Tribes have re-acquired about 600 acres of their former reservation. The United States holds title to approximately 70 percent of the former reservation lands.

On August 26, 1986 The Klamath Tribes officially regained Federal recognition under the Klamath Restoration Act (25 USC §566, et seq.). However, the Restoration Act did not restore The Klamath Tribes' former reservation lands and tribal efforts to regain a tribal land base continue.

The Tribes are now acquiring lands in the former reservation as they can and are placing them in Federal trust. Significantly, for the present discussion, restoration did not restore to the Tribes the anadromous fisheries lost due to the construction of Copco 1 Dam and the other Klamath River dams. The tribal members continue to practice their cultural traditions, including traditional subsistence practices and related ceremonies. The Tribes maintain active natural and cultural resources departments.

3.12.3.1.2 The Klamath Tribes' Cultural Practices

Fishing

The Federal courts have confirmed that The Klamath Tribes' hunting, fishing, gathering, trapping, and water rights survived Termination. These resources, especially fish, have played a central role in the physical, social, and spiritual well-being of the Klamath people for millennia. The Klamath Basin from Link River to the headwaters of the Wood, Williamson, Sprague, and Sycan River subbasins once had an almost continuous geographical distribution of traditional sites and activities including resource harvest areas, ceremonial sites, and burials areas, which surrounded the major population centers.

The Klamath Tribes relied heavily on upland game (e.g., deer, elk, and pronghorn antelope) and plant foods (e.g., yampah, wild plum, and many other fruits and berries), but riverine and especially marsh resources were of equal importance. Salmon and multiple species of sucker, trout, eel, lamprey, mussels, and other fish were dietary staples, while marsh and riparian plants, such as the yellow pond lily (Wocus or Wokus), tule, cattail, and willow provided staple foods and materials for essential tools and crafts. The Klamath, Modoc, and Yahooskin traditionally recognized all of the plants and animals of their traditional territory as possessing their own spiritual powers; tribal

members took active steps from ceremonial activities to active management techniques to maintain respectful relationships with the species on which they most depended to ensure that the species would return abundantly in future years. These ritual activities were an essential part of the ceremonial tradition of the historical Klamath Tribes, and they have continued into the modern day.

The confluence of Spencer Creek and the Klamath River was a particularly important salmon fishing site for the Modoc tribe. The site also afforded fishing opportunities that were rare downstream from the Link River because of natural shallows that obstructed the salmon during low-water years until levels began to rise from springtime snowmelt. Salmon were speared there in large numbers. In the 19th century, Modocs still gathered there and "pulled salmon out with pitchforks" just downstream from this shallows. Captain Jack, leader of the Modocs during the Modoc War, was said to have fished the Klamath Canyon extensively and most commonly fished Spencer Creek. Following the Modoc War, some Modoc families maintained ties to the area. For example, Indian women married to white men stayed in the area, providing a lasting foothold in the Klamath River corridor.

Klamath Canyon, particularly the zone from Spencer Creek downstream, was a major historic center of settlement, salmon procurement, and trade for the Klamath and Modoc Indians. During salmon fishing time, Klamaths, Shastas, and Modocs occupied separate groups of structures within larger, multi-tribal communities. The communities along the Klamath Canyon floor were important centers of social, ceremonial, economic, and political activity timed to coincide with the peak salmon harvest. The presence of fish at sites downriver from the Upper Klamath Basin drew some Modocs and Klamaths downstream into the canyon; but since some fish worked their way into the Upper Basin, Klamaths and Modocs did not have to go to the canyon to fish.

Salmon were numerous throughout much of The Klamath Tribes' traditional territory, including the Upper Basin. The fish were commonly said to arrive in runs so large that "it looked like you could walk across their backs;" and the fish were packed so tightly in shallow river channels that they could be speared with ease. Klamath men used spears to catch fish, and, during the 19th and early 20th centuries, it was common knowledge that the large numbers of salmon thrashing in the Sprague, Williamson, Link, and Wood River basins would "spook the horses" and people understood not to ride close to the rivers during salmon runs to avoid being thrown. Because salmon were numerous and relatively ubiquitous, the location of fishing stations reflected not wholly the extent of fish distribution, but rather areas convenient for fishing, such as naturally available shallows where fish could be easily speared, natural barriers that caused the fish to become "bunched up," nearby settlements and secondary resources, springs and spawning grounds, and other factors that influenced the locations of salmon fishing within the Klamath and Modoc territories.

Historically, The Klamath Tribes fished not only for salmon and steelhead, but also for mullet, suckers, trout, sturgeon, eels, and lamprey. Anadromous lampreys were harvested in large numbers during salmon season, often being gigged or speared. Most

large-scale fishing within the Upper Klamath Basin was timed to coincide with salmon runs, but all species were taken at these times and places. Salmon and mullet appeared at roughly the same times and at the same places. Trout also appeared with these fish to consume the spawn of both species. Together, these fish provided a tremendous, dependable food resource for the Klamath and Modoc people.

Detailed environmental knowledge once guided tribal member movements to and between salmon fishing sites, and some of this knowledge persists today. They knew which fishing stations and which riffles would provide the right conditions for salmon fishing based on the level of the water in front of their home village. Today, experienced Klamath fishermen still possess the knowledge of how water levels near their home relate to the exposure or submersion of riffles as well as general fishing conditions at trout-fishing sites.

Salmon-fishing sites were usually accompanied by settlements or seasonal encampments. Many of the largest Klamath and Modoc winter villages were close to large salmon fishing stations. The Indians said, "where the fish were, we were." Springtime salmon fishing marked the end of the lean winter months, and the proximity of winter villages to salmon fishing sites ensured that salmon would be detected and thus available from the onset of each year's spring migration. Although late spring and summer involved other subsistence activities far from these villages, the fall Chinook salmon run was said to draw people back to many of these villages. The success of fall fishing had major implications for a community's food supplies when alternative resources were limited, and a poor fall salmon run indicated a potentially difficult winter ahead. Salmon thus occupied a crucial position within the seasonal round, with salmon runs marking both the beginning and the end of annual resource procurement.

Multi-village and multi-tribal gatherings centering on the salmon harvest were important social and ceremonial events. The movement of the tribes associated with the salmon runs shaped much of Klamath and Modoc social life: "Early spring finds them leaving for favorable fishing stations where there are successive fish runs," one local reported. Salmon fishing at certain productive fishing stations, such as those on the Klamath Canyon, Link River, and Beatty Springs, were "where you met the person you were going to marry." Gambling contests, races, and group dances were facilitated by these large gatherings of families from different villages. Dried salmon was used in trade, particularly with interior populations such as Paiutes and interior Pit River bands, providing the Klamath and Modoc with access to trade goods from these interior locations. Mobility and social diversity of the population participating in the salmon harvest fostered multi-tribal gatherings even at sites quite distant from salmon-fishing stations. For example, Tule Lake villages, including those at the Lava Beds, served as a stopover point for Modocs, Paiutes, and other tribes traveling to and from the Klamath Canyon to catch or barter for salmon.

Salmon was also typically shared within the community. Tribal members typically caught surplus salmon to feed the elderly, children, and those with disabilities who were unable to participate in the salmon harvest. This practice also appears in classic

ethnographic studies of The Klamath Tribes and is an ongoing one today. This redistribution of the salmon catch cemented social bonds within and between communities, in addition to ensuring food security in the community as a whole. These practices are still a source of pride among many tribal members today. Young people still share the catch of other fish species, especially trout and mullet, in the traditional manner. "You always give away fish to the elders…you always give away the first deer you kill…our grandparents taught us that and young people still need to listen to that," a tribal member described. Young men who go on salmon fishing trips outside of the Upper Klamath Basin also redistribute modest quantities of salmon among tribal members, and such salmon is highly prized. Young people "always drop by to drop off fish" after these long-distance fishing trips, said one tribal member. Access to fishing sites and fishing gear is viewed as essential to a family's security; some tribal members mentioned that they have inherited fishing gear from their elders, which is understood as a sign of one's obligation to continue fishing for the extended family in the elder's absence.

Affidavits of tribal members compiled in the early 1940s suggest that between one-half and one-sixth of the aboriginal diet consisted of salmonid fish. Rates of salmon consumption likely varied over time and between individual communities and households, but a review of both written accounts and contemporary oral histories suggests that salmonid fish were consumed in large quantities by most Klamaths and many Modocs as a dietary staple.

Salmon was an essential part of the Klamath Basin ecology, with salmon carcasses in particular providing food for many species of animals and nutrients that facilitate the health of marsh plant communities. Tribal members identified the following effects associated with a reduction in salmon:

> "When the salmon leave, everything else falls apart."
> "A lot of other fish started to disappear as soon as the salmon were gone."
> "Trout fed on the salmon spawn…once the salmon were gone, they went after the sucker spawn more…and then there weren't as many trout and suckers."

The Klamath Tribes' members also report that their ancestors used to manage fish populations. Staple fish, such as salmon, trout, mullet, and suckers were harvested according to a rule that "you should never take more than you needed…you take what you need, then quit" and this rule still guides the actions of tribal members today. Chub and other species were known to eat salmon and trout eggs, and increases in chub populations corresponded with subsequent decreases in salmon and trout populations. For this reason, when fish populations were thought to be out of balance, men sometimes intentionally caught large numbers of chub and tossed them onto the banks to be eaten by birds and other creatures. This practice is said to have continued into the 20th century.

Religious Practices

Salmon played an important ceremonial and religious role in Klamath and Modoc culture. The tribes have creation stories that relate to salmon fishing and salmon fishing

sites, and most of the large salmon fishing dams were historically viewed as the handiwork of the Creator, *Gmukampc*. "…the special creation of [*Gmukampc*] was man, and whatsoever stands in direct connection with his existence, welfare, and customs, as fishing places…," noted ethnographer Gatschet (1890). Gatschet further notes that events in Klamath oral tradition were sometimes said to center on *tsiäls-hä'mi*, ("salmon time") that is part of the Klamath seasonal round.

It is understood by The Klamath Tribes that salmon possess a spirit and that this spirit must be respected and honored in order to ensure the return of the fish. Salmon fishing was guided by certain protocols, which acknowledged the belief that the fish possessed a spirit and sentient qualities. For example, unused portions of fish carcasses were put back in the water "so that they will come back" in following years. Tribal members also conducted first salmon ceremonies at the beginning of each year's run to ritually distribute salmon flesh and honor the salmon. These ceremonies could last two or three days, and involved large salmon feasts celebrating the return of the salmon and the end of winter hunger. Currently, traditional ritual activity continues by The Klamath Tribes' members to ritually ensure the return or resuscitation of salmon, mullet, and other important species and to influence water levels and water quality for the benefit of fish.

Oral Traditions

The Klamath Tribes' oral traditions, including the "*Gmukampc* tears down the fish dam" story, are said to impart teachings that still guide tribal members in dealing with moral or ethical dilemmas. These stories are tied to particular landscape features that are prominent in the vicinity of traditional salmon fishing sites. In some cases, certain landscape features of religious significance distant from salmon fishing sites also possess ceremonial associations with salmon fishing. These oral teachings relate to salmon fishing and impart lessons from *Gmukampc*, the Creator, regarding fundamental moral and ethical principles. One principal story reflects The Klamath Tribes' sentiments regarding the Klamath Hydroelectric Project and its effects on fish populations and their ability to acquire fish:

> The people who lived there [below the Chiloquin forks] had a big fish dam. They got greedy and kept building it higher, catching all the fish until no fish could get past them…the people upstream couldn't catch anything and were starving. They said the Creator got angry…and he asked the animals to help him tear down the dam….After the dam was gone, the people were all turned into rocks…they got punished. People fishing there could always see those rocks…it reminded them. (Spier 1930)

3.12.3.1.3 The Klamath Tribes' Potentially Affected Trust Resources

A government-to-government consultation meeting concerning the effects of current Klamath River dam operations on The Klamath Tribes' trust resources and other resources traditionally used by The Klamath Tribes was held on October 4, 2010. A variety of trust resources have been affected by current dam operations; however, the

meeting focused on The Klamath Tribes' fish resources and water conditions that relate to the health of the fishery. Table 13.12-1 identifies trust resources and rights associated with The Klamath Tribes.

Table 3.12-1. Effects of Current Dam Operations on Klamath Tribes Trust Resources and Rights

Trust Resource/Right	Effects
Water resources	Poor flow management (e.g., peaking regimes, flow pulses, flow homogenization, aquatic ecosystem functionality)
	Altered water temperature regime
	Reduced bedload sediment transfer in the Project Reach (JC Boyle to Iron Gate Dam) until about the Shasta River.
	Degraded water quality caused by nutrient input, dissolved oxygen, pH, algal toxins and other contaminants
Aquatic resources	Loss of habitat
	Less suitable water temperature regime
	Reduced bedload transfer
	Increased potential for disease/parasites
	Reduced population size
Terrestrial resources	Reduced food availability
	Loss of riparian habitat

Source: DOI 2011, DOI 2012

Among the anadromous fish The Klamath Tribes used as staple foods are fall and spring Chinook salmon, steelhead, Pacific lamprey, and possibly coho and sockeye salmon. These fish entered the Klamath Reservation along the drainages of the Sprague, Williamson, and Wood Rivers and were also found in the open waters of Upper Klamath Lake. Historically, The Klamath Tribes also depended on a variety of other resident fish species, primarily the adfluvial and resident rainbow trout, *c'waam* or Lost River sucker, and *koptu* or shortnose sucker, cutthroat trout, Klamath smallscale sucker, Klamath largescale sucker, Pit-Klamath brook lamprey, blue chub, tui chub, and speckled dace. Although the exact quantity of fish historically consumed by The Klamath Tribes is difficult to establish, anadromous salmonids were staple foods. Anadromous salmonids were the focus of extended multifamily fishing operations often lasting weeks or months, and were an important source of wealth and stability to The Klamath Tribes prior to the construction of Copco 1 Dam in 1918.

The construction of Copco 1 Dam blocked anadromous fish runs into the Upper Klamath Basin and abruptly ended The Klamath Tribes' access to all anadromous fish. Two other major fisheries, adfluvial and resident salmonids (trout) and Catostomids (suckers), could still be used by The Klamath Tribes after the demise of the anadromous fisheries. The catostomid fishery consisted primarily of *c'waam* (Lost River sucker) and *koptu* (shortnose sucker) until the Tribes closed their fishery in 1986 to protect it in the face

of severe population declines. This move by the Tribes in turn prompted the Federal Government to list these fish as endangered in 1988 under the Endangered Species Act. As the only surviving tribal fishery, adfluvial and resident salmonids today represent an invaluable resource to tribal members.

Water quality and flows in the Klamath River and its tributaries associated with current dam operations are an important issue to The Klamath Tribes. Water conditions affect the ability of anadromous fish species to survive. The Klamath Tribes retain a right to instream water quantities in on-reservation and off-reservation locations at levels that are sufficient to support fishing and other harvest rights on former reservation lands, as affirmed in 1984 with the 9th Circuit Court of Appeals' decision in United States v. Adair, 723 F.2d 1394. A number of ritual traditions of The Klamath Tribes depend on access to clean water from natural sources, which is used in ritual purification of people, places, and objects, as well as in rituals associated with drought abatement and other environmentally restorative activities. However, the water of the Klamath River is widely viewed as inappropriate for these ritual uses because of the effects of the dams on water temperature, algae development, and other variables of water quality.

The current operations of the Klamath River dams have had a range of secondary effects on The Klamath Tribes. Among these effects are the decline of fish and wildlife in addition to the loss of cultural and social practices, diminished economic opportunity, and negative health effects resulting from dietary changes that became necessary with the loss of traditional food sources.

Tribal oral tradition suggests that the timing of catostomid (sucker) and trout population declined following the extirpation of anadromous salmonids, reflecting partial dependence of these resident fish on marine protein from salmonid sources. In recent interviews, numerous tribal members noted that the once-abundant numbers of these other culturally significant species have diminished, attributing this change in part to the absence of anadromous fish within the Upper Klamath Basin. Recent studies have confirmed that no fewer than 137 other wildlife species depend on salmon consumption for some portion of their life cycle, drawing sustenance from smolts, adult salmon, or salmon carcasses. Subsistence fish and wildlife species affected by the absence of salmon include, but are not limited to, black bear, mule deer, and a large number of waterfowl species. Several salmon-dependent wildlife species are of traditional cultural significance to members of The Klamath Tribes beyond their subsistence value, including but not limited to the Bald and Golden eagles, coyote, cougar, American marten, weasel, bobcat, red and gray foxes, northern river otter, various bat species, raven, crow, red-tail hawk, blue jay, and a variety of songbirds.

Many non-salmon species and ecologically linked plants are significant for the cultural and economic well-being of The Klamath Tribes. The Klamath Tribes traditionally used pelts, feathers, and other body parts from some of these animals in ceremonial regalia, traditional crafts, and for other purposes. In a few cases, tribal members relied on the sale of pelts from some of these species for supplemental income. In ethnographic interviews, tribal members referred to a number of culturally preferred riparian and marsh

plant species that are said to have declined in population in the last century. Foremost among these is the yellow pond lily (Wocus), a source of edible seeds that has served as one of the most important staple plant foods of The Klamath Tribes. The decline in some riparian plant species may correlate with declines in the fish population of the Upper Klamath Basin and may reflect the reduction in nutrient loading to marsh plant procurement areas.

Prior to the extirpation of anadromous salmonids from the Upper Klamath Basin, salmon were the focus of a complex of cultural traditions, including distinctive fish harvesting and processing technologies; traditional ecological knowledge relating to fish habitats and behavior; and ritual traditions centering significantly on the maintenance of harvestable fish populations through ceremonial displays of respect for the fish, the Creator, and other spiritual forces said to influence the return of the fish. Through such practices, The Klamath Tribes have always played an active role in the stewardship of anadromous fish resources, and contemporary tribal members perceive this role as a cultural right and responsibility.

The absence of the fish has compromised the ability of members of The Klamath Tribes to pass knowledge from generation to generation relating to the fish and their harvest. The importance of salmon harvest is further reflected in The Klamath Tribes' languages, place names, songs, stories, and the moral teachings provided to children. Large gatherings associated with the fish harvest once served as a venue for economic exchanges, reunion with kin from other communities, and the forging and maintenance of intercommunity ties within the larger tribal population. The demise of the fish populations has interrupted the performance of these important social and cultural functions.

Although The Klamath Tribes have the most direct interest in resources upstream of the four Klamath River hydroelectric dams, the current operations of the Klamath Hydroelectric Project have affected The Klamath Tribes' resource interests in the footprint of the dams and impoundments, and downstream from the dams in lands ceded by The Klamath Tribes. In the Klamath River corridor, for example, harvest activities historically focused on riparian resources. Plants, animals, soil, and rocks are all of concern to Klamath Tribes members, both economically and environmentally. The Indians commonly gathered riparian vegetation, including but not limited to willows for basketry and drying racks; tree species such as cottonwood for firewood; sedges, rushes, cattails, and tule for basketry mats and bedding; and a variety of berries and medicinal plants uniquely concentrated in the riparian corridor. Game in the riparian corridor, such as white- and black-tail deer, rabbit, groundhog, and birds, were also taken.

Various forms of evidence suggest that The Klamath Tribes' gathering activities were concentrated in relatively recent alluvial deposits consisting of gravel bars and fresh deposits of silt, loam, and sand-sized particles. At these sites, culturally prized early successional vegetation was abundant and desirable. For example, roots used in basketry

were unusually long, straight, and easy to dig. Additionally, tribal members gathered rocks for use as cooking stones along the riparian corridor, especially basalt cobbles and other dense, nonporous stones.

3.12.3.1.4 The Klamath Tribes' Health Impacts

Because salmon was the first dietary staple to be lost to The Klamath Tribes, its depletion was said to have initiated dramatic dietary shifts among tribal members. For a time, this fostered increased consumption of deer, mullet, and sucker, which some tribal members believe resulted in localized overuse of these resources, particularly in the light of game management practices of the State of Oregon. For some, the loss of the salmon was the catalyst for a dietary transition that led to the ultimate dependence of The Klamath Tribes on the purchase of processed foods and the use of supplementary commodity foods.

Tribal members attributed a number of historical health problems to the loss of salmon. A 1920s tuberculosis epidemic was said to have been worsened by the rapid impoverishment of the diet in preceding years. Recent Indian Health Service studies endorsed by The Klamath Tribes concluded that a host of physical ailments plaguing members of The Klamath Tribes have been linked to the demise of the aboriginal diet. Diabetes, hypertension, obesity, and related cardiovascular ailments are particularly widespread, reflecting dramatic changes in food consumption and procurement patterns. A number of tribal members expressed the view that the loss of salmon was among the most significant components of this dietary shift.

3.12.3.1.5 Alternative 1: No Action/No Project Alternative - The Klamath Tribes and Damming of the River

Continued impoundment of water could affect tribal trust resources. The current Klamath River dam operations have measurable consequences on the exercise of The Klamath Tribes' Treaty harvest rights on the former Klamath Reservation; consequences which would continue under the No Action/No Project Alternative. In response to the loss of the Klamath Reservation as a result of the 1954 Klamath Termination Act and the absence of provisions for the reservation's return in the 1986 Klamath Restoration Act, The Klamath Tribes have been actively acquiring lands within the boundaries of the former reservation and placing them in trust status. Existing and pending trust lands include properties that are transected by waters formerly housing populations of anadromous fish. These trust lands are entirely in the Upper Klamath Basin and affected by the same environmental variables that apply to that region...

Salmon have not been sighted in the areas upstream of the dams in about 100 years. However, in 1907, before the dams went into service, Barrett (1910) reports that "Fish were abundant in the lakes, salmon and salmon trout being especially esteemed by the Indians." Other firsthand observations confirm the presence of salmon before the dams were built. In the 1940s, in preparation for a lawsuit against Copco for blocking the anadromous fish runs, Bureau of Indian Affairs (BIA) Superintendent B.G. Courtright interviewed 50 older members of the Klamath Tribe and non-Indian settlers in the area about salmon in the Klamath Basin. These unpublished affidavits unanimously report there were salmon in fisheries as far upstream of Klamath Lake as the Sprague and

Williamson rivers, Upper Klamath Lake, and Spencer Creek. Spier (1930) reported that salmon in the Klamath Basin "…ascend all the rivers leading from Klamath Lake...going as far up Sprague River as Yainax, but are stopped by the falls downstream from the outlet of Klamath marsh." A tribal elder in the 1940s also stated that he had observed salmon as far up the Sprague River as Bly.

Salmon continue to be symbolically and culturally important to members of The Klamath Tribes. Moreover, tribal members insist that traditional salmon fishing stations are still being used today, whether for subsistence purposes, ceremonial activities, or instruction of children on tribal history and culture. Resources that were once harvested secondarily to the salmon harvest have now become the focus of subsistence activity at these stations, and tribal members still use certain historic campsites at these stations during subsistence, social, and ceremonial activities. Tribal members continue to participate in ritual activities "to bring back the salmon," while The Klamath Tribes government continues to explore legal and administrative options to achieve the same goal.

Many historic and current factors, such as mining, timber extraction, agricultural production, and cattle grazing, affect the environmental integrity of the Klamath Basin, as noted above. However, the current operations of the four Klamath River dams adversely affect the trust resources of The Klamath Tribes and other resources traditionally used by the tribes, and, by extension, their cultural values (Table 3.12-1), and their continued operation under the No Action/No Project Alternative would result in no change from existing adverse conditions.

3.12.3.1.6 Alternative 2: Full Facilities Removal of Four Dams Alternative (the Proposed Action)

Removal of the Four Facilities could affect tribal trust resources.[3] Under the Proposed Action, four dams and their associated hydroelectric facilities along the Klamath River would be removed. Keno Dam would be transferred to the DOI, the East and Westside Facilities would be decommissioned, the KBRA would be implemented, and the City of Yreka Water Supply Pipeline would be installed. Implementation of the Proposed Action, including the KHSA and KBRA, would, in the long term, benefit the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by The Klamath Tribes (Table 3.12-1). Actions addressing these issues are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this Environmental Impact Statement/Environmental Impact Report (EIS/EIR).

KBRA – Programmatic Measures

The KBRA has several programs that could result in impacts/effects to trust resources and other traditional resources used by The Klamath Tribes. Specific KBRA programs potentially affecting trust resources and other traditional resources include:

[3] Tribal Trust Resources and other traditionally used resources are also discussed in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

- Tribal Fisheries and Conservation Management Program
- Klamath Tribes Interim Fishing Site
- Mazama Forest Project

Other KBRA programs would have effects on trust resources of aquatic resources, water quality, and terrestrial resources; these programs' effects are discussed in Sections 3.2, 3.3, and 3.5 of this EIS/EIR.

Implementation of the Tribal Fisheries and Conservation Management Program could result in impacts/effects to Trust Resources and other traditionally used resources. As the original stewards of the natural resources of the Klamath Basin, The Klamath Tribes hold special positions in the Basin and have interests in and a traditional relationship to the Basin ecosystem and its fisheries. Implementation of the Tribal Fisheries and Conservation Management Program would provide funding to assist the tribe in developing their capacity to participate in resource management activities within the Basin, particularly relating to tribal fishing and revitalization of tribal subsistence and other economic activities. The timing of and specific locations where these resource management actions could be undertaken is not certain but the improvements they are anticipated to support in trust resources would contribute to the positive effects of hydroelectric facility removal. Implementation of the Tribal Fisheries and Conservation Management Program would generate beneficial effects to trust resources and other traditionally used resources. Implementation of specific plans and projects associated with the Tribal Fisheries and Conservation Management Program will require future environmental compliance as appropriate.

Establishment of The Klamath Tribes Interim Fishing Site could result in impacts/effects to Trust Resources and other traditionally used resources. Actions associated with The Klamath Tribes Interim Fishing Site include establishment of an interim fishing site for Klamath Tribal members between Iron Gate Dam and Interstate -5. The improvement in salmon fishery access generated by development of The Klamath Tribes Interim Fishing Site would contribute to the positive effects of hydroelectric facility removal. Establishment of The Klamath Tribes Interim Fishing Site would generate beneficial effects to trust resources by providing tribal members with access to the salmon fishery prior to hydroelectric facility removal.

Implementation of the Mazama Forest Project could result in impacts/effects to Trust Resources and other traditionally used resources. Actions associated with the Mazama Forest Project include the purchase and management of 90,000 acres of timberland on former reservation land owned by the Klamath Tribe (Chui 2008; Kerr 2012). The improvement in trust resources and other traditionally used resources generated by the Mazama Forest Project would contribute to the effects of hydroelectric facility removal. Implementation of the Mazama Forest Project would generate beneficial effects to trust resources and other traditionally used resources because of the implementation of appropriate forest management plans. Implementation of specific plans and projects associated with the Mazama Forest Project will require future environmental compliance as appropriate.

3.12.3.1.7 Alternative 3: Partial Facilities Removal of Four Dams

Partial facilities removal could affect tribal trust resources. Under the Partial Facilities Removal of Four Dams Alternative, four dams and their associated hydroelectric facilities would be partially removed to provide for fish passage. Keno Dam would be transferred to the DOI, The East and Westside Facilities would be decommissioned, the KBRA would be implemented, and the City of Yreka Water Supply Pipeline would be installed. Implementation of the Partial Facilities Removal of Four Dams Alternative, including the KHSA and KBRA, would, in the long term, benefit water, aquatic, and terrestrial resources issues related to trust resources and rights identified by The Klamath Tribes (Table 3.12-1). Actions addressing these issues are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

3.12.3.1.8 Alternative 4: Fish Passage at Four Dams

Fish passage at four dams could affect tribal trust resources. Under the Fish Passage at Four Dams Alternative, operation of the existing dams and hydroelectric facilities would continue along the Klamath River and fish passage facilities would be constructed at the four dams. Keno Dam would not be transferred to DOI and the KBRA would not be implemented. Implementation of the Fish Passage at Four Dams Alternative would benefit fish populations. However, implementation of this alternative would not fully resolve the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by The Klamath Tribes (Table 3.12-1). Under the Fish Passage at Four Dams Alternative issues related to water, aquatic, and terrestrial resources related to trust resources and rights would persist.

3.12.3.1.9 Alternative 5: Fish Passage at Two Dams, Remove Copco 1 and Iron Gate

Fish passage at two dams and facilities removal of two dams could affect tribal trust resources. Under the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative, two dams, their associated hydroelectric facilities, and fish hatchery facilities along the Klamath River would be removed and fish passage facilities would be constructed at two dams. Under this alternative, Keno Dam would not be transferred to the DOI and the KBRA would not be implemented. Implementation of the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative would address the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by The Klamath Tribes (Table 3.12-1), but not to the same degree as the Proposed Action or Partial Facilities Removal of Four Dams Alternatives. Actions addressing issues related to water, aquatic, and terrestrial resources are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

3.12.3.2 Quartz Valley Community

3.12.3.2.1 Quartz Valley Community History

Most of the Quartz Valley Community's tribal members are descendants of people of Karuk ancestry, although a few tribal members are also of Shasta ancestry. Therefore, their cultural traditions are similar to those described in the Karuk section of this report.

The Quartz Valley Community is a federally recognized tribe representing people of middle Klamath (Karuk) and Shasta Indian ancestry. The Quartz Valley Indian Reservation is in Siskiyou County near the community of Fort Jones. The population is around 126, with a tribal enrollment of about 150. Total reservation size is 174 acres. Some tribal members are descendants of the same tribal leaders that signed the unratified 1851 Treaty R negotiated between Indian Agent Redick McKee and Indian inhabitants of Scott Valley and the upper Trinity and Klamath Rivers. The original Quartz Valley Indian Reservation, once near the present-day reservation, was abolished in the 1960s.

The current Tribal mission is stated as:

> While on earth we must practice stewardship, protection, and enhancement of the air we breathe, the water we drink, the soil that supports us, and the lives we cherish. It is our duty to protect and enhance these resources for the continued prosperity of the Quartz Valley Indian Tribe and our fellow brothers and sisters we share this earth with.
>
> In partial fulfillment of the mission statement, the tribe employs several full-time and part-time positions to operate the Tribal Environmental Protection Department. Current achievements are creek restoration projects, salmon surveys, water quality monitoring, establishment of a native garden, and the recent opening of a microbiology lab for testing the Tribe's ground water.

3.12.3.2.2 Quartz Valley Community Cultural Practices Fishing, Trade and Barter, Religious Practices, and Oral Traditions

The Quartz Valley Community are of Karuk and Shasta Decent. Cultural practices and values or the Karuk people are described in Section 3.12.3.3.

3.12.3.2.3 Quartz Valley Community Potentially Affected Trust Resources

The Quartz Valley Community does not have a reserved right to the Klamath River fishery. The tribe is not reliant on Klamath River water, nor does it retain Klamath River reserved water rights. The tribe's land base is not along the Klamath River but on a tributary to the Scott River, which is a tributary to the Klamath. Therefore, there are no primary effects on Quartz Valley trust resources although there are effects on Quartz Valley resources traditionally used by the tribe, health, and cultural values and well-being.

Traditionally used fish resources of the Scott River include Chinook salmon, coho salmon, steelhead and Pacific lamprey. The Quartz Valley Indian Reservation relies on these fish for sustenance and their spiritual well being. These fish need to survive their migration through the Klamath River to and from the ocean. Therefore, the tribe has an interest in Klamath River health.

Any fishing and concomitant water rights to which the Quartz Valley Community may be entitled have not yet been determined. However, Quartz Valley tribal members have historically fished for salmon, steelhead and eels (Pacific lamprey) in the Scott River and Shackleford Creek.

Despite the lack of a recognized right by the United States or the State of California many members of tribe fish on the Klamath River, often with Karuk Tribe members to whom they are related, and have done so in an unbroken tradition dating back to time immemorial. Table 13.12-2 identifies resources traditionally used by the Quartz Valley Tribe.

Table 3.12-2. Effects of Current Dam Operations on Resources Traditionally Used by the Quartz Valley Tribe

Other Resources Traditionally Used By The Tribe	Effects
Water resources	Altered flows
	Altered water temperature regime
	Reduced bedload sediment transfer in the Project Reach (JC Boyle to Iron Gate Dam) until about the Shasta River.
	Degraded water quality caused by nutrient input, dissolved oxygen, pH, algal toxins and other contaminants
	Diminished aesthetics
	Human exposure to toxic water while conducting cultural activities
	Diminished opportunity for traditional bathing
Aquatic resources	Loss of habitat
	Less suitable water temperature regime
	Reduced bedload transfer
	Increased potential for disease/parasites
	Reduced population size
	Loss of traditional salmon diet and increased risk of heart disease, strokes, diabetes, and obesity
	Depression, alienation, and possible suicide
	Tribal members leaving ancestral territory
	Lost opportunities for transmitting traditional knowledge
Terrestrial resources	Reduced food availability
	Loss of riparian habitat
	Diminished plant availability for cultural practices and related benefits
	Loss of opportunity for inter-generational traditional knowledge transmission

3.12.3.2.4 Quartz Valley Community Health Impacts

The members of the Quartz Valley Community refrained from making any comments.

3.12.3.2.5 Effects Determinations

Alternative 1: No Action/No Project – Quartz Valley Community and Damming of the River

Continued impoundment of water could affect traditionally used resources. The dams are responsible for a drastic reduction in spawning habitat and a major component of many other changes in the river system, such as water quality and water temperature. All of these changes have created an environment in which it is difficult or impossible for many species to flourish. In addition to environmental effects, the changes in the river secondarily have resulted in diminished physical, mental and social health. For thousands of years the Indians who depend on the river have been part of a functioning social, economic, and cultural health system that is currently dying.

Many historic and current factors, such as mining, timber extraction, agricultural production, and cattle grazing, affect the environmental integrity of the Klamath Basin. Mining activities in the Klamath Basin have significantly decreased over the last several decades, and timber extraction in the basin is more regulated at the Federal and State levels than in past decades.

However, the current management of the Klamath River adversely affects the resources traditionally used by the Quartz Valley Community and, by extension, their cultural values, and their continued operation under the No Action/No Project Alternative would result in no change from existing conditions.

Alternative 2: Full Facilities Removal of Four Dams Alternative (the Proposed Action)

Removal of the Four Facilities could affect traditionally used resources. Under the Proposed Action, four dams and their associated hydroelectric facilities along the Klamath River would be removed. Keno Dam would be transferred to the DOI, the East and Westside Facilities would be decommissioned, the KBRA would be implemented, and the City of Yreka Water Supply Pipeline would be installed. Implementation of the Proposed Action, including the KHSA and KBRA, would, in the long term, benefit the water, aquatic, and terrestrial resources traditionally used by the Quartz Valley Tribe. Actions addressing these issues are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

KBRA

The KBRA has several programs that could result in impacts/effects to traditional resources used by the Quartz Valley Community. Specific KBRA programs potentially affecting traditional resources include the Tribal Fisheries and Conservation Management Program. Other KBRA programs would have effects on aquatic resources, water quality, and terrestrial resources; these programs' effects are discussed in Sections 3.2, 3.3, and 3.5 of this EIS/EIR.

3.12.3.2.6 Alternative 3: Partial Facilities Removal of Four Dams Alternative

Partial facilities removal could affect traditionally used resources. Under the Partial Facilities Removal of Four Dams Alternative, four dams and their associated hydroelectric facilities would be partially removed to provide for volitional fish passage. Keno Dam would be transferred to the DOI, the East and Westside Facilities would be decommissioned, the KBRA would be implemented, and the City of Yreka Water Supply Pipeline would be installed. Implementation of the Partial Facilities Removal of Four Dams Alternative, including the KHSA and KBRA, would, in the long term, benefit the water, aquatic, and terrestrial resources traditionally used by the Quartz Valley Community. Actions addressing these issues are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

3.12.3.2.7 Alternative 4: Fish Passage at Four Dams

Fish passage at four dams could affect traditionally used resources. Under the Fish Passage at Four Dams Alternative operation of the existing dams and hydroelectric facilities would continue along the Klamath River and fish passage facilities would be constructed at the four dams. Keno Dam would not be transferred to DOI and the KBRA would not be implemented. Implementation of the Fish Passage at Four Dams Alternative would benefit fish populations. However, implementation of this alternative would not fully resolve the water, aquatic, and terrestrial resources issues related to traditionally used resources identified by the Quartz Valley Community. Under the Fish Passage at Four Dams Alternative issues related to water, aquatic, and terrestrial resources related to traditionally use resources would persist.

3.12.3.2.8 Alternative 5: Fish Passage at Two Dams, Remove Copco 1 and Iron Gate

Fish passage at two dams and facilities removal of two dams could affect traditionally used resources. Under the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative, two dams, their associated hydroelectric facilities, and fish hatchery facilities along the Klamath River would be removed and fish passage facilities would be constructed at two dams. Under this alternative, Keno Dam would not be transferred to the DOI and the KBRA would not be implemented. Implementation of the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative would address issues associated with the water, aquatic, and terrestrial resources traditionally used by the Quartz Valley Tribe but not to the same degree as the Proposed Action or Partial Facilities Removal of Four Dams Alternatives. Actions addressing issues related to water, aquatic, and terrestrial resources are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

3.12.3.3 Karuk Tribe

3.12.3.3.1 Karuk History

The Karuk Tribe has been federally recognized since 1979 and occupies territory along the middle section of the Klamath River. The 2000 United States Census reported tribal membership to be 2,702 individuals. In 2004, the California Department of Housing and Community Development reported tribal membership to be 3,164 individuals. Currently,

Karuk are one of the largest tribes in California with approximately 4,800 members. The Karuk maintain offices in Orleans, Humboldt County; Happy Camp, Siskiyou County; and the City of Yreka, Siskiyou County, all in California.

The tribe's ancestral territory was about 1.4 million acres. Currently, the Karuk own 652 acres in trust status. The Karuk Tribe is a Self-Governance Tribe under Indian Self-Determination Act of 1975 (California Department of Housing and Community Development, California Indian Assistance Program 2004, as cited in DOI 2011 and DOI 2012). The tribe has a constitution that was initiated in April 1985 and the Karuk maintain a robust Natural Resources Department.

3.12.3.3.2 Karuk Cultural Practices

The Karuk Tribe has effectively maintained its cultural identity and traditional practices. Tribal members still engage in traditional hunting, gathering, and resource management activities. This includes preservation and use of the Karuk language, basket-making, fabrication of regalia, practice of traditional religious ceremonies, and stewardship of natural resources through use of fire and harvest management techniques.

Fishing

The Klamath and Salmon River fishery and other resources supported more than 100 ancestral Karuk villages along the Klamath and Salmon Rivers. Karuk established villages on beaches, river bends, benches, and near fishing sites to exploit riverine resources. Indeed, Karuk incorporate ritual, spiritual, and technical elements of their culture to facilitate management and enrichment of local ecosystems. These culturally based natural resource management practices are articulated in the Karuk Tribe's Eco-cultural Resources Management Plan.

The Karuk diet traditionally consisted mostly of salmon, deer, and acorns. Fish, especially salmon, have always been a major food resource and the focus of ceremonies for the tribe. Karuk use several methods, both traditional and contemporary, to catch fish. Fish important to the Karuk include spring-run Chinook or king salmon, fall-run Chinook, out-migrating Chinook smolt, coho or silver salmon steelhead, trout, sucker, bullhead, sturgeon, and Pacific lamprey. Freshwater mussels also have cultural significance for the Karuk not only as food, but also as important tools. For example, a mussel tool, an *íshuvar*, is used in traditional basket-making.

Religious Practices

Ceremonies provide insight into the cultural life and underlying values of the Karuk. These ritualistic celebrations also demonstrate the interrelationship of Karuk and other tribes along the Klamath River. In one respect, the ceremonies are reenactments of stories involving the *ikxareeyavsa*, or immortal ones. However, these ceremonies go beyond symbolism to teach important practical lessons about careful management of resources, hard work, and the importance of observing rituals.

The Karuk are known among tribes in the Klamath Basin as "The Fix-the-World People" because of their role in the annual *Piky'avish*, or World Renewal Ceremonies. *Piky'avish*

starts with the First Salmon Ceremony in early spring and continues throughout late summer into early fall. The scheduling of the dance cycle is determined each year by a ceremonial leader, who also appoints a *fataveenaan* (medicine man or priest) each year. This appointment is both a source of honor and a great deal of work because the *fataveenaan* is required to undergo a lengthy ordeal of fasting, praying, and walking the medicine trails.

The First Salmon Ceremony marks the passing of the first spring Chinook salmon up the Klamath River. This migrating salmon was allowed to pass all the way up the Klamath River to its spawning ground. Indians believed that the first spring Chinook migrating upstream would leave its scales at each spawning location for the rest of the salmon run to follow. Eating this first migrating salmon of the year was considered taboo; if eaten, it was believed to cause convulsions and death. Permitting this fish to pass safely upstream lifted the taboo and allowed the people to fish for salmon in the river. The dramatic decline in the spring Chinook run has made it impossible for the Klamath Basin tribes to conduct the First Salmon Ceremony.

The Karuk and Yurok Tribes coordinate the performance of their First Salmon Ceremonies based on the appearance of fish in the Klamath River. Chinook historically spawned as far north as the Williamson River, an area that was available as spawning grounds prior to the damming of the Klamath River and the reconstruction of Klamath Lake in its present form. The First Salmon Ceremony is typically conducted around April when the fish first breech the sandbar at the mouth of the river, marking their transition from the Pacific Ocean back to the fresh water of the Klamath River.

The most important of Karuk ceremony is *Piky'avish*, or literally "fix the world." Called by different names in by different tribes, many tribes of the Klamath as well as the Pacific Northwest practice a similar ceremony. In Kroeber and Gifford's *Karok Myths* (1980), tribal member Georgia Orcutt captured the emotional nature of the *Piky'avish* as follows: "At the beginning of the *Piky'avish*, it looks like everything down, nobody happy. *Piky'avish* means 'making the world right.' *Fatawanun* [*fataveenan*] fixed it so everything is coming up nice."

According to Kroeber and Gifford (1980), the Karuk ceremony has three major aspects:

> The first is a period of usually not more than ten days during which the priest remains much in the sweathouse, fasts, and prays for abundance of food, the elimination of sickness and the stability of the world. He also visits sacred spots; and young men engage in archery contests. The second part is the climax of the ceremony, when the priest keeps an all-night vigil by a sand pile called *yuxpit*. This vigil is accompanied and followed the next day, by the Deerskin Dance, or its surrogate, an imitation affair employing branches instead of deerskins; at *Inam* [*Inaam*] and *Katamin* [*ka'tim'iin*] the War Dance is part of the dance ritual. The third part is the anticlimactic retreat of the priest and other officials.

The ceremonies feature a variety of ritual dances. The Jumping Dance (or Jump Dance) is held in the spring during the first salmon run. The Deerskin Dance is held in the fall in association with the acorn harvest and the second salmon run. It is performed in alternating years with the Medicine Dance, during which other decorated skins including martin and otter are displayed rather than the famous white deerskins. Both dances feature displays of wealth, along with dancing and singing.

According to Karuk creation stories, fishing weirs were created by one of the immortals. The fishing harpoon also appears in one of a series of creation stories that present accounts of the origins of humans, institutions, and tools. In the story, the Blue Heron develops the two-pointed harpoon so that even people without rights or nets could still catch fish. According to the story, *Chukchuk* took a long stick and fastened two smaller sticks to the end of it. He thought, "I will spear salmon. Let me make that kind. Let me make it so that if a man has no fishing place and he sees salmon he can catch them. If he has no net he will kill them in this way" (Kroeber 1925a).

3.12.3.3.3 Karuk Potentially Affected Trust Resources

In a government-to-government consultation meeting concerning Karuk Tribe trust resources affected by current dam operations held on September 30, 2010, the Karuk Tribe asserted the following as tribal trust resources: water, fish, mollusks, riparian plants, wetlands, and all other plants and wildlife dependent on a healthy river and playing a role in Karuk ceremonies. This assertion was coupled with the assertion that the United States has a trust responsibility to protect such resources and ensure that such resources are managed for the beneficial use of the Tribe and its membership. In addition, the Karuk assert that Federal Government has responsibilities to the Tribe in the areas of social welfare, education, and health and a responsibility to uphold certain Federal laws, such as the National Historic Preservation Act and the American Indian Religious Freedom Act. The United States does not necessarily agree that all of the above resources are in trust but the resources are important to the Karuk (and thus to the United States) for their traditional ceremonial use. Table 3.12-3 identifies Karuk traditionally used resources that are affected by the four Klamath River dams.

Unlike The Klamath Tribes, Congress never formally ratified the treaty negotiated between the United States and the Karuk Tribe in 1851, and no statute or executive order otherwise set aside reservation lands for the Tribe. The Karuk Tribe began efforts in 1978 to receive Federal recognition. In November 1978, the Bureau of Indian Affairs Central Office (BIA) staff conducted a field trip to Northern California. The BIA determined that the aboriginal subentities of the tribe consisted of three communities located in Happy Camp, Orleans, and Siskiyou (Yreka). See 13 IBIA 76, 78; 1985 WL 69127 (I.B.I.A.). The Assistant Secretary for Indian Affairs, in a memorandum entitled "Revitalization of the Government-to-Government Relationship Between the Karok (sic) Tribe of California and the Federal Government," notified the local offices of the Bureau of Indian Affairs on January 15, 1979, that: Based on the findings collected . . ., the continued existence of the Karoks as a federally recognized tribe of Indians has been

Table 3.12-3. Effects of Current Dam Operations on Resources Traditionally Used by the Karuk Tribe

Other Resources Traditionally Used By The Tribe	Effects
Water resources	Altered flows
	Altered water temperature regime
	Reduced bedload sediment transfer in the Project Reach (JC Boyle to Iron Gate Dam) until about the Shasta River.
	Degraded water quality caused by nutrient input, dissolved oxygen, pH, algal toxins and other contaminants
	Diminished aesthetics
	Human exposure to toxic water while conducting cultural activities
	Diminished opportunity for traditional bathing
Aquatic resources	Loss of habitat
	Less suitable water temperature regime
	Reduced bedload transfer
	Increased potential for disease/parasites
	Reduced population size
	Loss of traditional salmon diet and increased risk of heart disease, strokes, diabetes, and obesity
	Depression, alienation, and possible suicide
	Tribal members leaving ancestral territory
	Lost opportunities for transmitting traditional knowledge
Terrestrial resources	Reduced food availability
	Loss of riparian habitat
	Diminished plant availability for cultural practices and related benefits
	Loss of opportunity for inter-generational traditional knowledge transmission

Source: DOI 2011, DOI 2012

substantiated. In light of this finding, I am directing that the government-to-government relationship, with attendant Bureau services within available resources, be re-established."

The United States has more recently taken lands into trust for the benefit of the Karuk Tribe, including over 810 acres in Siskiyou County and approximately 40 acres in Humboldt County. Most of the Tribe's aboriginal lands along the Klamath River, above the Klamath Trinity Confluence, now form part of the Klamath National Forest. Any fishing and concomitant water rights to which the Karuk Tribe may be entitled have not yet been determined. Regardless, the Karuk assert that an inability to use traditional resources affects their general health and well being and cultural values.

In the consultation meeting, only effects on fish and water were discussed in detail. Nonetheless, the lack of fish in the local economy has secondary effects on general tribal

health and cultural well being. The Karuk Tribe, when asked if such resources were affected by the current dam operations, emphatically responded, "Yes." Tribal representatives at the meeting stated that water quality and fish returns have diminished, and, being a tribe that lives along the river, their aesthetic quality of life has also diminished. They rarely bathe in the river, as they did historically, and in an area with fewer available fish, tribal members are likely to consume less of the traditional food base and pay less attention to the culturally inherited management traditions of a "Salmon People." This situation has exacerbated related impacts on tribal health, such as higher rates of obesity, diabetes, heart disease, stroke, and mental diseases such as depression.

Since the construction of the dams on the Klamath River, the numbers of a variety of river species have plummeted. Some of these fish had traditionally been a source of food and cultural ceremonies and practices for the Karuk Tribe, as well as a means of trade and income. Not only salmon, but also steelhead, sturgeon, suckers, lampreys, clams, mussels and other aquatic species appear to have declining populations as a result of the dams effects on water flow, temperature, and on the river environment.

Karuk believe one of the most significant impacts of the Klamath River dams is the way that the natural process of seasonal warming and cooling trends in the river is altered by the presence of reservoirs. In effect, the reservoirs appear to create a "thermal lag" in both the spring and the fall. This means that the river warms more slowly in the spring and cools more slowly in the fall than it would without the dams. The result of these thermal effects is a delay in timing of runs for the migration of fall Chinook salmon. For Karuk, this translates into a shorter fishing season in the fall. Before construction of Iron Gate Dam, Karuk fishermen report that fishing at Katimiin started in late July. Since construction of Iron Gate Dam, fish do not typically arrive at Ishi Pishi Falls until early September. In addition to limiting the number of fishing days available in the fall, the opportunity to harvest spring Chinook salmon has been completely lost to the Karuk since construction of Iron Gate Dam.

Water quality plays a very significant role in Karuk tribal culture because of its effect on culturally relevant aquatic species. Water quality also affects the ability of *Fataveenan*, or World Renewal priests, to conduct ceremonies. *Pikiavish* starts with the Spring Salmon Ceremony in early spring and continues throughout late summer into early fall. Key ceremonial participants bathe multiple times a day in the Klamath River for 10 days in a row. This is the time of year when the blooms of the toxic algae, *Microcystis aeruginosa*, are at their peak.

To avoid interfering with cultural and religious ceremonies and practices, the water conditions in the Klamath River must allow for specific species to be present in adequate supplies. This includes species that are consumed by participants, such as salmon and lamprey as well as species used in ceremonies, such as crayfish and willows. Water conditions must also be safe for what is usually termed "recreational contact" as well as human consumption.

Degraded water quality in the Klamath Basin, including the seasonal presence of algal toxins in the Klamath River and reservoirs, has impaired the ability of Karuk to use the water for cultural purposes. Known and/or perceived health risks associated with degraded water quality have resulted in the alteration of cultural ceremonies to exclude or limit ingestion of river water. Additionally, known or perceived risk of exposure to degraded water quality conditions during ceremonial bathing and traditional cultural activities, such as gathering and preparing basket materials and plants for other purposes, has resulted in an impairment of cultural use.

According to Karuk cultural biologist Ron Reed, the World Renewal Ceremony is held on the Klamath River at Clear Creek, Somes Bar, and Orleans during July, August, and September of each year. The medicine man, who leads the ceremony, walks 14 miles through the ridges and hills along the Klamath River and is joined halfway through his journey by children and adults of the tribe who follow him the rest of the way for good luck. Traditionally, when the medicine man reached the Klamath River at the end of this walk, he drank water from the river to complete the ceremony. Currently, this does not occur very often because blooms of *Microcystis aeruginosa* have led to health warnings along the river. However, children are still known to jump in the river and drink the water.

Bathing in the river is an important part of most Karuk ceremonies. For example, bathing in the Klamath River and its tributaries is a requirement for participants in the Brush Dance Ceremony. Bathing is also associated with funeral services, subsistence practices, recreational swimming, courtship, and individual hygiene. Bathing associated with funeral rituals occurs year around and includes preparation for burial and purification after burial.

Karuk tribal member collect willow roots, wild grape, cottonwood, and willow in the riparian zone along the Klamath River and use these materials to make baskets. Traditional collection of these basketry materials often involved wading in the water, and washing and cleaning the materials in the river. Willows are peeled by mouth following cleaning with river water, and plants are also collected for food, medicine, and other cultural functions. Given current degraded water quality conditions, ingestion of water as a result of traditional cultural activities or use of materials harvested from the river may pose a potential health risk.

Prior to construction of dams on the Klamath River, steelhead spawned freely not only in the Klamath River and its tributaries, but in Upper Klamath Lake and beyond. An estimated 650 miles of salmon habitat were lost with the construction of four dams in the Klamath River (unpublished report prepared for The Klamath Tribes and Yurok Tribe). This is a significant amount of habitat no longer available for spawning and rearing. In interviews with Karuk tribal members, they refer to loss of steelhead runs that were once vigorous, supplying fish even at times of the year when salmon runs were no longer taking place. Furthermore, steelhead eat juvenile salmon; therefore, without a healthy salmon run, there will not be a healthy steelhead run.

Steelhead can be a resident fish or they can be anadromous. One prevalent theory about the loss of migratory steelhead is that steelhead produced in the hatchery at Iron Gate Dam comprises a resident population. They are released from the hatchery into a nutrient-rich system immediately downstream from Iron Gate Dam, where there are no triggers to force them to migrate. They have enough food to keep them there; and no other steelhead are coming from downriver to compete with them, increase the densities, and compel them to move. The result is a resident population of non-migratory steelhead.

This lack of migratory steelhead affects the local economy and the well-being of the Karuk. Steelhead fishermen from outside the area used to pay for the privilege of fishing for the Klamath steelhead, bringing money into the local economy to the benefit of the Karuk. In the late 1960s and early 1970s, steelhead fishermen lined the banks of the Klamath River. Today, the numbers of steelhead are so low that the sport is no longer viable.

Karuk tribal members who harvest lamprey eels report an extreme decline in their numbers. Lamprey has traditionally been an important food source for the Karuk and has augmented salmon in their diet, particularly as salmon have become scarce.

Freshwater mussels have also been both an important food source for the Karuk and other groups and an essential part of tribal ceremonies. During the early 20th century, mussels were gathered for food and for use in rituals late in the season when the river flows were low. These low flow periods are unfortunately the time of year when the mussels are most contaminated. Even though there are few to be found, people continue to use freshwater mussels as a food source, but their use in ceremonies has been greatly reduced. Historically, women also used the mussel shells for spoons, tools, and jewelry.

3.12.3.3.4 Karuk Health Impacts

The Karuk have been denied traditional food sources such as salmon over the last 150 years, and have increasingly adopted western foods. The decrease in the availability of traditional foods, including salmon, trout, eel (various species of lamprey), mussels, and sturgeon, is responsible for many diet-related illnesses among Indians, including diabetes, obesity, heart disease, tuberculosis, hypertension, kidney problems, and strokes (Karuk Department of Natural Resources 2007). These conditions result from the lack of proper nutrient content in foods consumed in place of the traditional foods, as well as from the decrease in exercise associated with fishing and gathering food.

The health of many people, including the Karuk, is closely linked to the health of the river. The three largest tribes in California eat fish from the Klamath River, and the declining river system is directly related to the inability of tribal members to continue eating traditional diets. Although early anthropologists described the Klamath River tribes as some of the wealthiest people in California, since European contact, they have become some of the poorest. One result is that the Klamath corridor has some of the lowest incomes and the highest rates of hunger in California. Local populations have traditionally had much of their food supplied by the Klamath River. This continues to be

the case, but with the decline in river health this becomes increasingly difficult. Given the economic impoverishment of the region, there is no general access to healthy alternative foods without subsistence fishing and gathering (See also Section 3.16, Environmental Justice). As a result, hunger is significantly related to the presence and effects of the dams, and these effects are directly connected to the traditional subsistence economy.

The estimated diabetes rate for the Karuk Tribe is 21 percent, nearly four times the U.S. average, and the estimated rate of heart disease for the Karuk is 39.6 percent, three times the U.S. average. Spring Chinook salmon represented a large volume of healthy food for the Karuk people until the 1960s and 1970s. Diabetes is a recent occurrence in the Karuk population. In the 2005 Karuk Health and Fish Consumption Survey, Karuk families were asked when diabetes first appeared in their family and when spring salmon stopped playing a significant role in their family diet. Over 90 percent of reporting families say that before 1950 spring salmon played a significant role in the family diet and less than 15 percent reported occurrence of diabetes. By 2005, no families claimed that spring salmon played a significant role in the family diet and nearly 100 percent reported occurrence of diabetes (Norgaard 2005).

Historically, consumption of fish by the Karuk Tribe was estimated at 450 pounds per person per year, whereas in 2003, the Karuk people consumed fewer than 5 pounds of salmon per person. In 2005, more than 80 percent of Karuk households surveyed reported that they were unable to harvest adequate amounts of eel, salmon, or sturgeon to fulfill their family needs. Furthermore, 40 percent of Karuk households reported that there are fish species that their family historically caught that are no longer harvested.

Difficulty in meeting basic needs can result in overwhelming physical and psychological stress. Traditionally, fishing is done by Karuk men. With the loss of the salmon comes a loss of a man's sense of pride in being able to provide food for his family and tribe. For a tribe that has called itself The People of the Fish, there is an indisputable loss of identity when there are no fish. For a people whose belief system includes their specific role on earth, that they have a predefined relationship with nature that needs to be honored, there is a sense of failure when they are unable to fulfill that role.

The changes that have caused wildlife to becoming scarce and the rivers polluted, may make it hard for young people to understand the ways of their parents and grandparents. They wonder why the tribe focuses on ceremonies that revolve around periodic fish runs and ritual eating of salmon when the availability of fish is so erratic. Never having seen it themselves, they do not understand that in the past there could be eight yearly runs of salmon in the Klamath when all they see is one-half of a fall run. Without tradition as an anchor, young people are sometimes drawn to gangs to establish a feeling of belonging, and leave Karuk territory for cities (DOI 2011; DOI 2012).

The act of eating salmon from the Klamath River affirms sense of place, identity, connection, and community. This orientation draws individuals into relationships of responsibility to care for the fish. Such a world view and set of relationships are in stark

contrast to the separate, individualistic modality of the dominant culture in which plants and animals are "resources" and people are expected to watch out for their individual interests. Relationships between Karuk people and plants and animals fulfill profound mental, emotional, and spiritual functions. In the absence of these food species, traditional activities such as dip net-fishing, eeling, or berry picking have come to an end.

The destruction of the Klamath River fishery has led to both poverty and hunger. As described above, prior to contact with Europeans and the destruction of the fisheries, the Karuk, Hoopa, and Yurok Tribes were the wealthiest people in what is now known as California, and now they are amongst the poorest. The devastation of the resources, especially the fisheries, is directly linked to the disproportionate unemployment and low socioeconomic status of Karuk people today. This dramatic reversal is directly linked to the destruction of the fisheries resource base. Poverty and hunger rates for the Karuk Tribe are among the highest in the State and nation. Median income for Karuk families is $13,000. The poverty rate for Karuk tribal members in Siskiyou County is 88.4 to 91.9 percent. Section 3.16, Environmental Justice, offers more information regarding poverty and employment levels among populations in the area of analysis.

3.12.3.3.5 Effects Determinations

Alternative 1: No Action/No Project - Karuk and Damming of the River

Continued impoundment of water could affect traditionally used resources. The dams are responsible for a drastic reduction in spawning habitat and many other changes in the river system, such as water quality, water temperature, and flow regimes. All of these changes have created an environment in which it is difficult or impossible for many species to flourish. In addition to environmental effects, the changes in the river caused by the dams secondarily have resulted in diminished physical, mental and social health. For thousands of years the Indians who depend on the river have been part of a functioning social, economic, and cultural health system that is currently dying.

Many historic and current factors, such as mining, timber extraction, agricultural production, and cattle grazing, affect the environmental integrity of the Klamath Basin. Mining activities in the Klamath Basin have significantly decreased over the last several decades, and timber extraction in the basin has slowly become controlled by better regulations at the Federal and State levels.

However, the current operations of the four Klamath River dams adversely affect the resources traditionally used by the Karuk and, by extension, their cultural values, and their continued operation under the No Action/No Project Alternative would result in no change from existing adverse conditions.

Alternative 2: Full Facilities Removal of Four Dams Alternative (the Proposed Action)

Removal of the Four Facilities could affect traditionally used resources. Under the Proposed Action, four dams and their associated hydroelectric facilities along the Klamath River would be removed. Keno Dam would be transferred to the DOI, the East and Westside Facilities would be decommissioned, the KBRA would be implemented,

and the City of Yreka Water Supply Pipeline would be installed. Implementation of the Proposed Action, including the KHSA and KBRA, would, in the long term, benefit the water, aquatic, and terrestrial resources traditionally used by the Karuk (Table 3.12-2). Actions addressing these issues are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

KBRA – Programmatic Measures

The KBRA has several programs that could result in impacts/effects to traditional resources used by the Karuk. Specific KBRA programs potentially affecting traditional resources include the Tribal Fisheries and Conservation Management Program. Other KBRA programs would have effects on trust resources of aquatic resources, water quality, and terrestrial resources; these programs' effects are discussed in Sections 3.2, 3.3, and 3.5 of this EIS/EIR.

Implementation of the Tribal Fisheries and Conservation Management Program could result in impacts/effects to traditionally used resources. As the original stewards of the natural resources of the Klamath Basin the Karuk hold a special position in the Basin and have interests in and a traditional relationship to the Basin ecosystem and its fisheries. Implementation of the Tribal Fisheries and Conservation Management Program would provide funding to assist the tribe in developing their capacity to participate in resource management activities within the Basin, particularly relating to tribal fishing and revitalization of tribal subsistence and other economic activities. The timing of and specific locations where these resource management actions could be undertaken is not certain but the improvements they are anticipated to support in trust resources would contribute to the effects of hydroelectric facility removal. Implementation of the Tribal Fisheries and Conservation Management Program would generate beneficial effects to traditionally used resources. Implementation of specific plans and projects associated with the Tribal Fisheries and Conservation Management Program will require future environmental compliance as appropriate.

3.12.3.3.6 Alternative 3: Partial Facilities Removal of Four Dams Alternative

Partial facilities removal could affect traditionally used resources. Under the Partial Facilities Removal of Four Dams Alternative, four dams and their associated hydroelectric facilities would be partially removed to provide for volitional fish passage. Keno Dam would be transferred to the DOI, the East and Westside Facilities would be decommissioned, the KBRA would be implemented, and the City of Yreka Water Supply Pipeline would be installed. Implementation of the Partial Facilities Removal of Four Dams Alternative, including the KHSA and KBRA, would, in the long term, benefit the water, aquatic, and terrestrial resources traditionally used by the Karuk (Table 3.12-2). Actions addressing these issues are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

3.12.3.3.7 Alternative 4: Fish Passage at Four Dams

Fish passage at four dams could affect traditionally used resources. Under the Fish Passage at Four Dams Alternative operation of the existing dams and hydroelectric facilities would continue along the Klamath River and fish passage facilities would be

constructed at the four dams. Keno Dam would not be transferred to DOI and the KBRA would not be implemented. Implementation of the Fish Passage at Four Dams Alternative would benefit fish populations. However, implementation of this alternative would not fully resolve the water, aquatic, and terrestrial resources issues related to traditionally used resources identified by the Karuk Tribe (Table 3.12-2). Under the Fish Passage at Four Dams Alternative issues related to water, aquatic, and terrestrial resources related to traditionally use resources would persist.

3.12.3.3.8 Alternative 5: Fish Passage at Two Dams, Remove Copco 1 and Iron Gate

Fish passage at two dams and facilities removal of two dams could affect traditionally used resources. Under the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative, two dams, their associated hydroelectric facilities, and fish hatchery facilities along the Klamath River would be removed and fish passage facilities would be constructed at two dams. Under this alternative, Keno Dam would not be transferred to the DOI and the KBRA would not be implemented. Implementation of the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative would address issues associated with the water, aquatic, and terrestrial resources traditionally used by the Karuk (Table 3.12-2), but not to the same degree as the Proposed Action or Partial Facilities Removal of Four Dams Alternatives. Actions addressing issues related to water, aquatic, and terrestrial resources are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

3.12.3.4 Hoopa Valley Indian Tribe

3.12.3.4.1 Hoopa Valley Indian Tribe History

The Hoopa Valley Indian Reservation is in the northeastern corner of Humboldt County in northern California, approximately 50 miles inland from the Pacific Ocean, and encompasses roughly 20 percent of Hupa aboriginal territory. The reservation, known as "the 12-mile square," is laid out geometrically with sides approximately 12 miles in length for a total of a little less than 144 square miles. At close to 90,000 acres, the reservation is the largest in California.

The northern portion of the reservation is in Yurok ancestral territory. The Trinity River bisects the reservation. A small length of the northern border of the reservation includes about a quarter mile reach of the Klamath River called Saints Rest Bar several miles upriver from Weitchpec, California. The 2000 U.S. Census counted 2,633 people on the reservation, and the tribe listed an enrollment of 2,130 in 2004.

The word Hupa is from the Yurok name for the Hoopa Valley. Hoopa is used when referring to the name of the tribe, and Hupa is used when referring to the people, place, or culture. The Hupa called themselves *Natinook-wa*, meaning "people of the place where the trails return." The Hupa are culturally related to the Yurok and also the Karuk.

Currently, the Hoopa Valley Tribe employs hundreds of people and has established a wide array of industries that support numerous business enterprises. Timber extraction,

gravel extraction, modular house manufacturing, a hotel, a restaurant, and a small casino are the major economic enterprises of the Hoopa Valley Tribe. The Hoopa Valley Tribe also maintains a modest fishery program.

3.12.3.4.2 Hoopa Valley Indian Tribe Cultural Practices

Fishing

The Trinity River is of prime importance to the Hoopa Valley Tribe because it is the river that runs through the Hoopa Valley Indian Reservation. Fish destined for the Trinity River must pass through the lower Klamath River and are therefore affected by Klamath River conditions. Poor conditions in the Klamath River could affect fish populations available to the Hoopa Valley Tribe.

The Trinity River is of unique and irreplaceable value to the Hupa. It is a vital natural resource that is the foundation of their social and cultural way of life. At its most basic level, the river has always been a source for food and other necessities of daily Hupa life. The river also provides basket materials, fish net materials, and a means of transportation. Even rocks from the river are used by Hupa people in their traditional cultural practices. Uses of the Trinity River by the Hupa people are highlighted by maintenance of fisheries and religious ceremonies (e.g., ceremonies that involve prayers offered by people trained to make medicine).

Many natural foods were available to the Hupa, with salmon and acorns providing the bulk of the native diet. When the salmon entered the Trinity River each spring and fall, the year's supply of fish was taken by Hupa using a variety of efficient devices. Other important fish include steelhead, sturgeon, and lamprey eels. Surplus stocks of fish were preserved for future consumption by drying in the smoke of fires.

Religious Practices

Religious beliefs and practices played an important role in everyday life for the Hupa people. An almost endless series of taboos had to be scrupulously observed, daily supplications were made for health and wealth, and acts were performed to ensure luck. In addition, each person was supposed to maintain a devout frame of mind throughout the day, particularly during important group rituals when reverent thoughts by participants and onlookers were considered essential for their success.

The religion of the Hupa is based on individual effort through ritual cleanliness as well as ceremonies that bring the entire tribe together. The tribes of the region, including the Hoopa, practice the annual World Renewal Ceremonies, which involve songs and dances that have been preserved for generations. The Hoopa and Yurok tribes also practice the White Deerskin Dance. These rituals are associated with the river as well as with medicine to cure sickness, but also roots, herbs, and bark used to promote spiritual health. The Brush Dance, for example, is a social event as well as a healing ceremony in which certain tribal members dance, sing, make medicine, and pray to bless a particular sick child or infant.

The Hoopa Valley Indians continue to conduct many of their traditional religious ceremonies, and the cultural significance of the Trinity River is captured in many of these ceremonies. Ancient religious sites on the river were believed to be designated by spiritual deities at a time beyond living memory are still used in current tribal rituals. Prayers conducted at the dances are directed toward the well-being of everyone, and food, particularly fish, is shared with all who attend the ceremonies.

The greatest divinity for the Hupa people is *Yimantuwingyai*, "the one lost (to us) across (the ocean)," also known as *Yimankyuwinghoiyan*, "old man over across," who establishes the order and condition of the world and is the leader of the *kihunai*, or ancestors. *Yimantuwingyai* seems to be a combination of the tricky and erotic *Wohpekumeu* and the more heroic *Pulekukwerek* of the Yurok, who is also similar to the Hupa *Yidetuwingyai*, "the one lost downstream" (Kroeber 1925b:134). A traditional story concerning *Yidetuywingyai* tells of the time when the sun and earth alone existed. From the sun and earth were born twins, *Yidetuywingyai* and the ground on which men live. This particular cosmogony has not been found among the Yurok or Karuk and may have reached the Hupa through the influence of more southerly tribes (Kroeber 1925b:134).

The White Deerskin and Jump Dances, the Flower Dance, and the Brush Dance all demonstrate the importance of the river flows to the Hupa people and how vital the rivers are to Hupa familial and tribal material well-being and self-esteem. Unfortunately, the Hupa report that, although these dances and other religious ceremonies have continued in modern times, the decline of the Trinity River's health has made their practice increasingly difficult for Hupa medicine people, dancers, and others. Thus, the adverse impacts of an unhealthy river extend beyond the fisheries to religious ceremonies.

The Hupa honor the Earth and the Creator for providing sustenance and for allowing the continuance of the tribe in two major ceremonies celebrating world renewal, the White Deerskin Dance and the Jump Dance. Both ceremonies are closely tied to the river. A Hupa name for the White Deerskin dance is *hun'q'ehch'idilye*, "along the river religious dance." This important ceremony is conducted at village sites and resting places near the Trinity River and involves travel on the river. The exact timing of the dances depends on the river and its waters. The White Deerskin Dance is held from late August into September. The Jump Dance follows 10 days after the conclusion of the White Deerskin Dance. Both dances are elaborate ceremonies that take place over a period of 10 days. As part of the rituals, the Hupa offer salmon they have caught at their fishing sites for the ceremony and to share with the participants and attendees.

The Jump Dance takes place along the river and has its own dance steps, songs, and regalia, and is dedicated to the good of the world. The completion of the Jump Dance signals a blessing for the year to come, with the hope that all people may be satisfied with small quantities and have their needs met. Both the White Deerskin Dance and the Jump Dance depend on a healthy river for fish, basket materials, bathing, and ambiance. The flows of the river are also a central element of these dances as they influence the dancers'

ability to travel the river in the manner of their ancestors. The Hupa claim that as the river's flows have declined, so has the Hupa's ability to practice these ceremonies.

The Boat Dance is a spectacular segment of the White Deerskin Dance involving dancing and singing while crossing the Trinity River. As the Boat Dance proceeds, the camps follow the dancers from the east side of the river to the west side. In this way, the dance echoes the river's flows and their connotation of river health. The next day, as the dance continues, the camps move to different sites until the dance concludes.

The Brush Dance is held for the purpose of curing a sick baby or child. Hupa people traditionally bathe in the Trinity River each morning of the dance, and they use baskets made with willows growing along the river in the ceremony. The dance is called the Brush Dance because part of the ceremony requires the participants to fill their quivers with willow brush. Operations along the Trinity River are thought to have reduced the abundance of willow brush and other basket-making materials vital to this dance.

The Flower Dance is held at various Hupa towns along the river. The purpose of this dance is to train a girl who has just reached adolescence to lead a good life as an adult woman. The girl for whom the dance is held traditionally bathes at seven sacred places in the river during training in the Flower Dance ceremony.

3.12.3.4.3 Hoopa Valley Indian Tribe Potentially Affected Trust Resources

A government-to-government consultation meeting concerning the effects of current dam operations on Hoopa Valley Indian Tribe trust resources was held on November 8, 2010. Although current operations of the four Klamath dams are more likely to affect resources of the Klamath River, Klamath water quality affects resources traditionally used by the Hoopa and their fishing rights by adversely affecting fish destined for the Trinity River, which must pass through approximately 42 miles of the Klamath River before turning up the Trinity River and through the Hoopa Valley, where Hoopa Tribal members participate in a tribal subsistence fishery. Table 13.12-4 identifies Trust Resources and rights associated with the Hoopa Valley Indian Tribe.

Table 13.12-4. Effects of Current Dam Operations on Hoopa Valley Indian Tribe Trust Resources and Rights

Trust Resource/Right	Effects
Water resources	Altered flows
	Altered water temperature regime
	Degraded water quality caused by nutrient input, dissolved oxygen, pH, algal toxins and other contaminants
Aquatic resources	Loss of habitat
	Less suitable water temperature regime
	Reduced bedload transfer
	Increased potential for disease/parasites
	Reduced population size
Terrestrial resources	Reduced food availability
	Loss of riparian habitat

Source: DOI 2011, 2012

The Hoopa Valley Tribe also provided information suggesting that no mitigation was historically required for the reduction of miles of salmonid fishery habitat upriver of Copco 1 and Copco 2 Dams because such mitigation was not required when the dams were completed[4]. When other dams were constructed, mitigation was required for the loss of fish habitat, but only for the several miles between Iron Gate Dam and Copco No. 2 Dam, (i.e., the Iron Gate Fish Hatchery was built to mitigate for the loss 16 miles of habitat and not for the loss of all upriver habitat). The hatchery does not manage spring Chinook salmon because these fish were primarily affected by previous dam construction, and to a lesser extent than Iron Gate Dam.

3.12.3.4.4 Hoopa Valley Indian Tribe Health Impacts

The secondary effects of the Klamath River dams on the people of the Hoopa Valley Tribe include emotional and physical health effects such as increased obesity, diabetes, heart disease due to loss of the traditional salmon diet, and depression, alienation, and suicide. Additionally, the tribal members experience a loss of opportunity for intergenerational transmission of traditional knowledge. These conditions result in tribal members, especially young people, leaving the reservation for opportunity elsewhere (DOI 2011; DOI 2012).

3.12.3.4.5 Effects Determinations

Alternative 1: No Action/No Project - Hoopa Valley Indian Tribe and Damming of the River

Continued impoundment of water could affect tribal trust resources. Members of the Hoopa Valley Tribe have offered firsthand accounts of the decline of the river and its effects on the people.

Byron Nelson, a Hupa elder, stated:

> Though many Hupa and Yurok still hold to traditional beliefs and engage in certain time-honored practices such as shamanism and basketry, the decline of the rivers' health, the center of their culture and spirituality, has led to a loss of self-esteem, an increase in cynicism, and has greatly hurt the cohesiveness and health of these tribal communities. The rivers are the focalizing element of the society; with their loss, it seems much of the hope has also been lost.

According to Nelson, cultural stress related to an unhealthy Klamath and Trinity rivers has resulted in a broad spectrum of social and educational problems, including the

[4] In this instance, the EIS/EIR is reporting the views of a Hoopa Valley Tribal member. However the now inoperable Fall Creek Hatchery was built by the California Oregon Power Company in 1919 in lieu of a fish ladder over Copco 1 Dam. The 110 feet high dam was considered too high for salmon and steelhead to pass over successfully. Furthermore, no provision could be made for safe passage of young downstream migrants. Chinook salmon eggs for the facility were collected at the Klamathon Egg taking station while steelhead eggs were obtained at Fall Creek and Bogus Creek collecting stations (Leitrtz 1970).

According to Leitrtz, the stakeholders at that time knew that anadromous fish went at least as far as Spencer Creek. While some believed they went all the way to the Sprague and Williamson, many others did not. This may explain why only minimal attempts to mitigate Copco 1 occurred.

disruption of traditional occupations and the loss of opportunities for religious practice and community participation in tribal culture. Limitations in the tribes' access to resources has restricted the practice of some of their most important traditions, including freely fishing the once prolific seasonal salmon runs and participating in the concurrent cycle of ceremonies. It appears that the access to resources may also be a cause of younger tribal members leaving the area.

The damming of the river has wide-ranging effects on the culture of the Hoopa Valley people. Despite significant degradation of the river ecosystem of the Klamath/Trinity region through the end of the 19th century and the first half of the 20th century, the Hupa persisted in their traditional reliance on the rivers and their resources. Although they found it increasingly difficult, the tribes continued to practice their ceremonies and religions; gathered vegetation for baskets, food, medicines, and other purposes; and met and ate together along the riverbanks. Fish caught by the tribes, as much as possible, continued to be an important component of their diets. Many of the current tribal members grew up with a strong physical connection to the rivers and great appreciation for the traditions and ways of life of their ancestors.

A reason for the ability of the tribes to maintain some of their traditional relationship to the rivers was that the rivers' flows remained relatively unimpeded. This all changed with the building of the dams. The dams, along with other diversions and impoundments in the Klamath/Trinity Basin, have dramatically altered the region's rivers. Fishing and traditional-use sites have become clogged with debris, and declines in fish population persist.

In the past, Federal regulations governing fishing on the Hoopa Valley Indian Reservation have permitted the taking of fish for ceremonial purposes even when the fisheries were closed to harvest. This fact is evidence that the Federal Government recognizes that fishing and fish are an integral and indispensable part of the religious and ceremonial life of the tribe. Unfortunately, the poor condition of the fishery in recent times has in some instances forced the Hupa to purchase fish from sources off their reservations to provide for all who attend their ceremonies. Tribal elder Byron Nelson stated:

> A lack of fish has resulted in the scaling down or even cancellation of ceremonies. The continual practice of ceremonies represents an important means for keeping tribal members who live off the reservations connected to their culture and families. However, without enough salmon, many do not come back; and the planning of ceremonies, once a time to appreciate nature's abundance and of spiritual celebration, often brings significant anxiety to the region's native peoples.

According to a report by the California Department of Fish and Game, the fish kill of 2002 affected all of the tribes along the Klamath River; however, the Trinity River in the Hoopa territory was also affected. Although a larger number of Klamath River fall-run Chinook died, a greater proportion of the Trinity River run was affected by the fish kill.

This is because the Trinity run is substantially smaller than the Klamath run on an annual basis, and the Trinity run was at its peak during the height of the fish kill. The effects were more pronounced in the Trinity River than the Klamath River because the fish kill occurred downstream from the confluence of the Trinity and the Klamath, and thus eliminated much of the fishing opportunity on the Trinity River.

Many historic and current factors, such as mining, timber extraction, agricultural production, and cattle grazing, affect the environmental integrity of the Klamath Basin, as noted above. However, the current operations of the four Klamath River dams significantly affect the trust resources of the Hoopa Valley Tribe and other resources traditionally used by the Hoopa, by extension, their cultural values, and their continued operation under the No Action/No Project Alternative would result in no change from existing conditions.

3.12.3.4.5 Alternative 2: Full Facilities Removal of Four Dams Alternative (the Proposed Action)

Removal of the Four Facilities could affect tribal trust resources and other traditionally used resources. Under the Proposed Action, four dams and their associated hydroelectric facilities along the Klamath River would be removed. Keno Dam would be transferred to the DOI, The East and Westside Facilities would be decommissioned, the KBRA would be implemented, and the City of Yreka Water Supply Pipeline would be installed. Implementation of the Proposed Action, including the KHSA and KBRA, would, in the long term, benefit the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by the Hoopa Valley Indian Tribe (Table 3.12-3). Actions addressing these issues are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

KBRA – Programmatic Measures

Upon becoming a Party to the KBRA in accordance with Section 38, the Hoopa Valley Tribe will be eligible for funding to implement programs under the KBRA. The KBRA has several programs that could result in impacts/effects to Trust Resources and other traditional resources used by the Hoopa Valley Tribe. Specific KBRA programs potentially affecting Trust Resources and other traditional resources include the Tribal Fisheries and Conservation Management Program. Other KBRA programs would have effects on trust resources of aquatic resources, water quality, and terrestrial resources; these programs' effects are discussed in Sections 3.2, 3.3, and 3.5 of this EIS/EIR.

Implementation of the Tribal Fisheries and Conservation Management Program could result in impacts/effects to Trust Resources and other traditionally used resources. As the original stewards of the natural resources of the Klamath Basin the Hoopa Valley Tribe holds a special position in the Basin and has interests in and a traditional relationship to the Basin ecosystem and its fisheries. Implementation of the Tribal Fisheries and Conservation Management Program would provide funding to assist the tribe in developing their capacity to participate in resource management activities within the Basin, particularly relating to tribal fishing and revitalization of tribal subsistence and other economic activities. The timing of and specific locations where these resource management actions could be undertaken is not certain but the improvements they are

anticipated to support in trust resources would contribute to the effects of hydroelectric facility removal analyzed above. Implementation of the Tribal Fisheries and Conservation Management Program would generate beneficial effects to Trust Resources and other traditionally used resources. Implementation of specific plans and projects associated with the Tribal Fisheries and Conservation Management Program will require future environmental compliance as appropriate.

3.12.3.4.6 Alternative 3: Partial Facilities Removal of Four Dams

Partial facilities removal could affect tribal trust resources and other traditionally used resources. Under the Partial Facilities Removal of Four Dams Alternative, four dams and their associated hydroelectric facilities would be partially removed to provide for volitional fish passage. Keno Dam would be transferred to the DOI, the East and Westside Facilities would be decommissioned, the KBRA would be implemented, and the City of Yreka Water Supply Pipeline would be installed. Implementation of the Partial Facilities Removal of Four Dams Alternative, including the KHSA and KBRA, would, in the long term, benefit the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by the Hoopa Valley Indian Tribe (Table 3.12-3). Actions addressing these issues are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

3.12.3.4.7 Alternative 4: Fish Passage at Four Dams

Fish passage at four dams could affect tribal trust resources and other traditionally used resources. Under the Fish Passage at Four Dams Alternative operation of the existing dams and hydroelectric facilities would continue along the Klamath River and fish passage facilities would be constructed at the four dams. Keno Dam would not be transferred to DOI and the KBRA would not be implemented. Implementation of the Fish Passage at Four Dams Alternative would benefit fish populations. However, implementation of this alternative would not fully resolve the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by the Hoopa Valley Indian Tribe (Table 3.12-3). Under the Fish Passage at Four Dams Alternative issues related to water, aquatic, and terrestrial resources related to trust resources and rights would persist.

3.12.3.4.8 Alternative 5: Fish Passage at Two Dams, Remove Copco 1 and Iron Gate

Fish passage at two dams and facilities removal of two dams could affect tribal trust resources and other traditionally used resources. Under the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative, two dams, their associated hydroelectric facilities, and fish hatchery facilities along the Klamath River would be removed and fish passage facilities would be constructed at two dams. Under this alternative, Keno Dam would not be transferred to the DOI and the KBRA would not be implemented. Implementation of the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative would address the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by the Hoopa Valley Indian Tribe (Table 3.12-3), but

not to the same degree as the Proposed Action or Partial Facilities Removal of Four Dams Alternatives. Actions addressing issues related to water, aquatic, and terrestrial resources are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

3.12.3.5 Yurok Tribe

3.12.3.5.1 Yurok Tribe History[5]

With more than 5,000 members, the Yurok Tribe is the largest tribe in California. The tribe's ancestral territory covers approximately 350,000 acres and includes approximately 50 miles of Pacific coastline. Today, the tribe's reservation, located in Del Norte and Humboldt Counties, California, encompasses approximately 57,000 acres, and consists of a strip of land beginning at the Pacific Ocean and extending a mile along each side of the Klamath River a distance of about 45 miles upriver, to just above the confluence of the Klamath and Trinity rivers. This reservation configuration came about through a complex series of Federal reports and legislative acts.

Today the Yurok Tribe, headquartered in Klamath, California, with an upriver office located in Weitchpec, California, employs more than 200 people, boasts one of the most substantial fishery programs on the entire Klamath River, and self-regulates its subsistence and commercial fishery. The tribe actively participates in the in-river and upslope restoration of its ancestral lands and has signed a collaborative management agreement with the DOI that memorializes the prime role that the Yurok Tribe maintains in managing its resource base (DOI 2011; DOI 2012).

In summary, Sloan (2011:55) states:

> The inseparable relationship of the Yurok people with the environment and resources provided by the rivers of the Klamath-Trinity Basin cannot be overemphasized. The Klamath River is a vital natural resource which is the foundation of Yurok social and cultural way of life. At its most basic level, the River has always been a source for food and other necessities of daily life…Even rocks from the river are used by Yurok people to practice their cultural ways. The Yurok River is traveled during religious ceremonies and in recreational activities, it is integral to the Yurok language and its oral tradition and truly represents the binding force of their community. Yurok use of the River developed over a long period of time as evidenced by the complexity of their religious ceremonies and practices. In aboriginal times, religious practices were integrated with fisheries management.
>
> The Yurok have many traditional dances and ceremonies which they have long practiced along the banks of the Klamath and Trinity Rivers. The Yurok's ceremonial way-of-life has greatly suffered with the deterioration of the region's rivers. The Yurok have always depended on the Klamath

[5] A detailed report documenting the history and culture of the Yurok prepared by Sloan (2011) is included in Appendix B of the DOI (2012) report.

> and Trinity Rivers and the sustenance that their flows provide, they name themselves after the rivers and much of their universe is defined in terms of their physical relation to rivers. Residency, natural and cultural resource sites, ceremonial practices, oral history, transportation routes, economic and sociological resources, indeed the Yurok identity, are all intricately woven into the ecosystems of the Klamath and Trinity Rivers. Yurok continue to live upon some of the forty-four village sites that line the Klamath and lower Trinity Rivers. These are places where Yurok have lived, fished, gathered, prayed and have been buried for countless centuries.

3.12.3.5.2 Yurok Cultural Practices

Fishing

The Yurok have long practiced their traditional dances and ceremonies along the banks of the Klamath River. Consequently, deterioration of the Klamath River affects Yurok ceremonial and traditional practices. The lives of the Yurok people have always been intricately tied to the river. Historically, they depended on the river for sustenance, and much of their world was defined in terms of their physical relation to the river. Natural and cultural sites, daily and seasonal ceremonial practices, oral traditions, transportation routes, economic resources, social relationships, and the Yurok identity were all drawn from the river.

The Yurok base time and direction on the flows of the Klamath River as much as on the rising and setting of the sun, which can be obscured by the steep terrain, deep forests, and rainy conditions of the Klamath Basin. As one Yurok elder said, “Without this river we would not know who we are, where we’re from, or where we’re going.” Under natural conditions, the rates and sounds of the river’s flow tell the Yurok both the season and the time of day. The skill of the Yurok fisherman has always been measured by his ability to navigate the Klamath River in the dark, not by the stars or landmarks, but by correlating the location and swiftness of the current and back eddies of the river with the sounds that are unique to each bend and riffle. Moreover, the Yurok people are so attuned to the river that they have a name for each characteristic of the water’s movement. Even when Yuroks are away from the river, they remain acutely aware of their location in relation to it, always measuring direction by the river’s flow. For example, it is not uncommon to refer to the burners on a kitchen stove as upriver or downriver, depending on their position. One Yurok elder said, “The river flows like our blood. It is our veins and arteries.”

Many of the Yurok cultural sites on the Klamath and lower Trinity Rivers are traditional fishing spots owned by families. Fishing spots are locations where there are deep holes, significant back eddies, and ideal spots to set a net or erect a platform out over the river. Fishing spots can be given, inherited, loaned, leased, and bought and sold, and are central to the Yurok economy. Over time, as the rivers’ flows have changed, so have the locations of these cultural sites. To this day the Yurok continue to live in some of the

village sites that line the Klamath and lower Trinity Rivers, where they still practice many of their traditions in places where the Yurok have lived, fished, gathered, prayed, and buried their dead for centuries.

The Yurok Tribe conducted subsistence fishing in 1987 through 1989. Since 1990, tribal commercial harvests have been marginal and have not provided a comfortable standard of livelihood as originally envisioned for the Yurok in the Hoopa Yurok Settlement Act. At the same time, subsistence fishing has been severely limited. The decreased harvests have had a significant adverse impact on the tribe's economies and health, as described below.

Trade and Barter

Fish are the Yurok Tribe's most valuable asset and a mainstay of their economy. Abundant fish allow Yurok to feed themselves and their families and to acquire products from outside their territory through trade. Fish was a trading commodity available to any enterprising man. A young man who diligently fished and successfully traded fish for other items could amass sufficient wealth to buy a boat, travel to collect all of the necessary items to fashion intricate ceremonial regalia, and to allow him to marry. Fish were the baseline resource that facilitated the acquisition of wealth and upward social mobility in Yurok culture.

Religious Practices

First Salmon Ceremonies were initiated around April when fish first breeched the sandbar at the mouth of the Klamath River. The ceremony was conducted to celebrate the harvesting of fish and to pray for continuing prosperity and access to subsistence resources. Written and oral tradition indicates that prior to impacts on the fishery beginning with miners who arrived during the Gold Rush, salmon were entering the river in distinguishable waves throughout the year. The major run was traditionally that of the spring salmon. George R. Field, supervisor of the cannery of the Klamath Packers Association at the mouth of the Klamath, described the runs in 1930:

> As the run of winter steelheads ceases, about March 30, spring Salmon begin to come. A few enter the Klamath in the later part of February, but the run really starts in March and slackens or almost entirely passes by the last of May. These fish average about 11 pounds in weight and are indistinguishable from those which come later, except that the eggs are always immature. These spring salmon may be caught in the smaller streams fed by melting snow at the headwaters of Salmon River during the month of May.

In early spring the first salmon to enter the Klamath River was traditionally speared and ritually eaten by Yurok medicine men, which signified the beginning of the fishing season. The beginning of fishing season also marked the construction of the fish dam at Cappell, located 33 miles from the mouth of the Klamath River. The fish dam that has not been constructed since 1913 was built by Yurok men under the supervision of a

Yurok medicine man. Dam construction sanctified the taking, distribution, and consumption of salmon. All other ceremonies were scheduled only after the fish dam ceremony took place.

Salmon are ritually managed to ensure that Yurok are provided with fish and that enough fish spawn to maintain the fishery. Yurok maintain a general reverence for salmon; however, a strong belief prevails that without proper ceremony the salmon will not return in sufficient numbers. Regardless, the river is central to most Yurok ceremonies. There are several rocks along the river etched with petroglyphs that provide instructions from the Creator to the Yurok people. One message is a warning that when the rivers stop flowing that will mark the end of the Yurok world. Accordingly, some elders have prophesied that the manipulation of flows by damming represents the beginning of the end for the Yurok.

The Brush Dance, intended as a communal focus around an ailing child, is held in many of the traditional village sites along the Klamath River. The ceremony requires the proper river setting and the availability of river resources. As a Brush Dance unfolds over a four-day period, the participants celebrate the wealth that the riverine environment provides. Baskets made of plant materials collected at the water's edge are used to hold food and ceremonial medicine. Acorns are cooked in the baskets and converted into a nourishing mush using hot rocks gathered from specific river bars. Regalia used by dancers is constructed from various plant and animal products that the riverine environment provides. Ceremonial hosts are expected to feed visitors salmon, and to fail in providing such traditional food to guests is considered an insult.

Beginning with the California Gold Rush and the appearance of large numbers of EuroAmericans in traditional Yurok territory, Yurok traditional cultural practices began to decline; however, during the 1970s and 1980s Yurok cultural practices were revitalized. Tribal elders began to teach young people traditional Yurok practices and ceremonies. The Jump Dance was conducted in Pecwan in 1984, a War Dance was held in the late 1980s, communities came together to support the revival of Brush Dances, and in 2000 the White Deerskin Dance was held for the first time in many years at Weitchpec (DOI 2011; DOI 2012).

Oral Traditions

The anthropologist Alfred Kroeber traveled throughout Yurok territory in the early 1900s interviewing Yurok people and documenting the tribe's riverine way of life. Kroeber (1976) presents 169 Yurok stories, of which 77 make direct reference to the Klamath River. Among the stories are tales and information regarding construction of fish dams, locations and origins of ceremonies held along the river, bad places in the river, locations where the first salmon was created, what one must do with salmon caught at certain locations, how the river came to flow the way it does, and death passage on the river. It is evident from transcriptions of Yurok stories that the Klamath River is an integral part of their way of life and a basis of their tradition and culture. These stories highlight a healthy and vibrant river ecosystem.

The use of the Yurok language dramatically decreased when non-Indians settled in the Yurok territory, and by the early 1980s it was near extinction. When the Yurok Tribe began to operate as a formal tribal government in 1988, the Yurok created a language revitalization program. The use of old records helped new language learners, but hearing fluent speakers was the most effective way for young people to acquire the language (DOI 2011; DOI 2012).

3.12.3.5.3 Yurok Potentially Affected Trust Resources

In a government-to-government consultation meeting concerning Yurok trust resources affected by current dam operations held on September 28, 2010, the Yurok Tribe asserted the following as Yurok trust resources: water, fish, land, wildlife, minerals, and timber. The Yurok Tribe asserted that the United States has a trust responsibility to protect such resources and ensure that such resources are managed for the beneficial use of the Tribe and its membership. The Yurok further assert that the Federal Government has other trust responsibilities to the Yurok in the areas of social welfare, education, and health. For example, Yurok believe that limited access to water, aquatic, and terrestrial resources has restricted the ability of Yurok to practice of some of their most important traditions. This includes freely fishing the once-prolific semi-annual salmon runs and participating in the cycle of ceremonies initiated concurrently. In the past, the Yurok were not inclined to leave their territory; currently, several factors, including an inability to meet subsistence needs from the fishery and a perception that the rivers are dirty, prompt younger tribal members to leave the area to find work (DOI 2011; DOI 2012).

The Yurok tribal chairperson, when asked if such trust resources were affected by the current dam operations, responded “Yes” and went on to relate that the Yurok understand that their resources are intricately interconnected to multiple ecosystems. The Yurok World Renewal Ceremonies, recently completed at the time of the meeting, were provided as an example of how Yurok understand and pray for the integrity of such ecosystems. Table 13.12-5 identifies trust resources and rights associated with the Yurok Tribe. The United States does not necessarily agree that all of the above resources are in trust (and therefore form the basis of a trust relationship), but the resources are important to the Yurok (and thus to the United States) for their traditional and ceremonial use.

3.12.3.5.4 Yurok Health Impacts

Secondary effects of the Klamath River dams on the Yurok Tribe include emotional and physical conditions such as increased obesity, diabetes, and heart disease due to loss of traditional salmon diet, and depression and alienation that can result in suicide (DOI 2011; DOI 2012).

3.12.3.5.5 Effects Determinations

Alternative 1: No Action/No Project - Yurok and Damming of the River

Continued impoundment of water could affect tribal trust resources and other traditionally used resources. The damming of the river has resulted in changes in the

Table 13.12-5. Effects of Current Dam Operations on Yurok Tribe Trust Resources and Rights

Trust Resource/Right	Effects
Water resources	Altered flows
	Altered water temperature regime
	Degraded water quality caused by nutrient input, dissolved oxygen, pH, algal toxins and other contaminants
	Diminished aesthetics
	Algae clogged fishing nets
	Human exposure to toxic water while conducting cultural activities
	Diminished opportunity for traditional bathing
Aquatic resources	Loss of habitat
	Less suitable water temperature regime
	Reduced bedload transfer
	Increased potential for disease/parasites
	Reduced population size
	Diminished livelihood
	Loss of traditional salmon diet and increased risk of heart disease, strokes, diabetes, and obesity among tribal members
	Depression, alienation, and possible suicide
	Tribal members leaving ancestral territory
	Lost opportunities for transmitting traditional knowledge
Terrestrial resources	Reduced food availability
	Loss of riparian habitat
	Diminished plant availability for cultural practices and related benefits
	Loss of opportunity for inter-generational traditional knowledge transmission

Source: DOI 2011; DOI 2012

flows of the water and the resources it offers to the tribe, along with myriad losses to tradition and culture (USFWS et al. 1999). Despite significant degradation of the river ecosystem of the Klamath region through the latter 19th and first half of the 20th centuries, the Yurok persisted in their traditional reliance on the river and its resources. Although it became increasingly difficult, the tribe continued to practice its ceremonies and religions and gathered vegetation for baskets, food, medicines, and other purposes. As much as possible, Klamath River fish caught by the Yurok tribal membership continued to be an important component of the tribe's diets. Indeed, many of today's older Yurok grew up with a strong physical connection to the river and a great appreciation for the traditions and ways of life of their ancestors.

The presence of the dams on the upper reaches of the Klamath River has brought about changes in Yurok culture. Sites for fishing and traditional use have become clogged with

debris and algae, and fish populations have declined. Observers report that when tribal members try to use their traditional fishing nets, they fill with algae, which is a sign of an unhealthy river.

Many historic and current factors, such as mining, timber extraction, agricultural production, and cattle grazing, affect the environmental integrity of the Klamath Basin. Mining activities in the Klamath basin have significantly decreased over the last several decades. Timber extraction in the basin has slowly become controlled by better regulations at the Federal and State levels to the point where timber extraction is now better characterized as forest management.

However, the current operations of the four Klamath River dams significantly affect the trust resources of, and other resources traditionally used by the Yurok Tribe and, by extension, their cultural values, and their continued operation under the No Action/No Project Alternative would result in no change from existing conditions.

3.12.3.5.6 Alternative 2: Full Facilities Removal of Four Dams Alternative (the Proposed Action)

Removal of the Four Facilities could affect tribal trust resources and other traditionally used resources. Under the Proposed Action, four dams and their associated hydroelectric facilities along the Klamath River would be removed. Keno Dam would be transferred to the DOI, the KBRA would be implemented, the East and Westside Facilities would be decommissioned, and the City of Yreka Water Supply Pipeline would be installed. Implementation of the Proposed Action, including the KHSA and KBRA, would, in the long term, benefit the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by the Yurok Tribe (Table 3.12-4). Actions addressing these issues are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

KBRA – Programmatic Measures

The KBRA has several programs that could result in impacts/effects to trust resources and other traditional resources used by the Yurok. Specific KBRA programs potentially affecting trust resources and other traditional resources include the Tribal Fisheries and Conservation Management Program. Other KBRA programs would have effects on trust resources of aquatic resources, water quality, and terrestrial resources; these programs' effects are discussed in Sections 3.2, 3.3, and 3.5 of this EIS/EIR.

Implementation of the Tribal Fisheries and Conservation Management Program could result in impacts/effects to Trust Resources and other traditionally used resources. As the original stewards of the natural resources of the Klamath Basin the Yurok hold a special position in the Basin and have interests in and a traditional relationship to the Basin ecosystem and its fisheries. Implementation of the Tribal Fisheries and Conservation Management Program would provide funding to assist the tribe in developing their capacity to participate in resource management activities within the Basin, particularly relating to tribal fishing and revitalization of tribal subsistence and other economic activities. The timing of and specific locations where these resource management actions could be undertaken is not certain but the improvements they are

anticipated to support in trust resources would contribute to the effects of hydroelectric facility removal. Implementation of the Tribal Fisheries and Conservation Management Program would generate beneficial effects to trust resources and other traditionally used resources. Implementation of specific plans and projects associated with the Tribal Fisheries and Conservation Management Program will require future environmental compliance as appropriate.

3.12.3.5.7 Alternative 3: Partial Facilities Removal of Four Dams

Partial facilities removal could affect tribal trust resources and other traditionally used resources. Under the Partial Facilities Removal of Four Dams Alternative, four dams and their associated hydroelectric facilities would be partially removed to provide for volitional fish passage. Keno Dam would be transferred to the DOI, the East and Westside Facilities would be decommissioned, the KBRA would be implemented, and the City of Yreka Water Supply Pipeline would be installed. Implementation of the Partial Facilities Removal of Four Dams Alternative, including the KHSA and KBRA, would, in the long term, benefit the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by the Yurok Tribe (Table 3.12-4). Actions addressing these issues are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

3.12.3.5.8 Alternative 4: Fish Passage at Four Dams

Fish passage at four dams could affect tribal trust resources and other traditionally used resources. Under the Fish Passage at Four Dams Alternative operation of the existing dams and hydroelectric facilities would continue along the Klamath River and fish passage facilities would be constructed at the four dams. Keno Dam would not be transferred to DOI and the KBRA would not be implemented. Implementation of the Fish Passage at Four Dams Alternative would benefit fish populations. However, implementation of this alternative would not fully resolve the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by the Yurok Tribe (Table 3.12-4). Under the Fish Passage at Four Dams Alternative issues related to water, aquatic, and terrestrial resources related to trust resources and rights would persist.

3.12.3.5.9 Alternative 5: Fish Passage at Two Dams, Remove Copco 1 and Iron Gate

Fish passage at two dams and facilities removal of two dams could affect tribal trust resources and other traditionally used resources. Under the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative, two dams, their associated hydroelectric facilities, and fish hatchery facilities along the Klamath River would be removed and fish passage facilities would be constructed at two dams. Under this alternative, Keno Dam would not be transferred to the DOI and the KBRA would not be implemented. Implementation of the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative would address the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by the Yurok Tribe (Table 3.12-4), but not to the same degree as the Proposed Action or Partial Facilities Removal of Four Dams Alternatives. Actions addressing issues related to water, aquatic, and terrestrial resources are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

3.12.3.6 Resighini Rancheria

3.12.3.6.1 Resighini Rancheria History

The Resighini Rancheria was originally thought to consist of 228 acres. A resurvey in 1974 determined the size of the Rancheria to be 238.78 acres. It is located in Del Norte County, California. It is primarily settled by Yurok Indians affiliated with the Yurok Coast Indian Community. (Davis, R. B., Letter to Acting Superintendent of Indian Affairs. (July 27, 1973)) The Resighini Rancheria has 132 enrolled members. A population of 36 was reported to live on Rancheria lands in the 2000 U.S. Census. The Resighini Rancheria is located several miles inland from the mouth of the Klamath River and rests on the southern banks of the river, completely surrounded by the Yurok Reservation.

The land for the Rancheria was purchased from ranch owner Augustus (Gus) Resighini by the Secretary of the Interior in 1938 under the authority of the Indian Reorganization Act. The Secretarial proclamation, deeming the land "reservation," proclaimed the purchase was to "provide for the protection of the soil, the proper development of the land, and the equitable distribution of benefits from the land."(*Secretarial Proclamation proclaiming the purchased lands a reservation. (October 21, 1939))* The lands, although located mostly in the floodplain of the Klamath River, were productive hay fields and supported a substantial dairy farm. Additional letters between various Indian Agents and the central office of the Secretary, justifying the purchase, commented on the possibility of Rancheria members continuing to operate the dairy farm, produce hay, grow vegetable gardens, and perhaps receive jobs as fishing guides for the burgeoning recreational fishery that the Klamath River was, at that time, known for providing.

The original proposal to create the Resighini Rancheria described the "228-acre" tract of land as "agricultural" with conditions that are "ideal for farming or dairying."(*Merin (December 28, 1937))* However, the value of the land as agricultural was directly connected to the loss of the traditional fisheries. During the settlement of this land, disastrous flooding periodically occurred, with a 100-year flood washing through in 1964. This natural disaster led to the removal and evacuation of Indian families to other local areas.

In 1975, a band of Yurok Indians stood together and formally created a non-traditional form of government with a constitution and bylaws, which were approved and ratified by Indian commissioner Bruce Thompson from the Department of the Interior. In 1979, the Indian people who chose to return to the Resighini Rancheria began the challenge of rebuilding.

In past years, commercial and subsistence fishing was a primary means of economic and subsistence support for the Yurok along the Klamath River. However, with the closure and restrictions on tribal fishing, the Yurok people lost this means of support.

Today the Resighini Rancheria employs a dozen people and operates a campground. A former casino and cafe received flood damage in the 1990s and are no longer operational. The tribe also operates a gravel-extraction enterprise along the course of a secondary

channel to the Klamath River that runs through rancheria boundaries. Ground water wells have been assessed and are slated for improvements that will lead to better water distribution throughout the rancheria in support of several residences and the campground and for irrigating agricultural lands. The tribe recently purchased off-rancheria and adjacent fee lands totaling 196 acres. This additional acreage is mostly riparian habitat along the mainstem of the Klamath River and includes the old Waukel Flat Indian Agent site.

The Rancheria has a reserved water right per the reserved water rights doctrine. The reserved rights doctrine provides that when lands are set aside as Indian or other Federal reservations, sufficient water to fulfill the purpose of the reservation is reserved as well. Federal reserved water rights arise expressly or by implication from Federal treaties, statutes, and executive orders, and vest no later than the date the reservation was established. Unlike State appropriative rights, Federal reserved water rights are for present and future uses and may be exercised at any time and are not lost through non-use. While Federal reserved water rights may be quantified and administered by States in the context of comprehensive State water adjudication, they are otherwise governed by Federal, not State, law.

3.12.3.6.2 Resighini Rancheria Cultural Practices
Fishing, Trade and Barter, Religious Practices, and Oral Traditions

The Indians of the Resighini Rancheria are Yurok people; consequently they share their cultural practices and values with the general culture described for the Yurok Tribe. Resighini tribal members recently participated in the Weitchpec Jump and Deerskin ceremonies.

The original "Merin" proposal to create the Resighini Rancheria described the tract of land as "agricultural" with conditions that are "ideal for farming or dairying." However, the value of the land as agricultural was directly connected to the loss of the traditional fisheries. In past years, commercial and subsistence fishing was a primary means of economic and subsistence support for the Yurok along the Klamath River. However, with the closure and restrictions on tribal fishing, the Yurok lost this means of support. Under the Hoopa-Yurok Settlement Act of 1988, 25 U.S.C. §§ 1300i, et seq., (The Settlement Act) the extended strip of land along the Klamath River was cleaved from the original Hoopa Valley Reservation and designated the Yurok reservation. Section §1300i- 1(e) then vested in the Yurok Tribe the authority to govern the Yurok Reservation and to administer the unalloted trust land and assets – including the fisheries – of the Yurok Reservation.

Pursuant to The Settlement Act, members of the Resighini Rancheria with Yurok heritage were given an opportunity to join the Yurok Tribe. The Settlement Act also provided qualified Indians of the original Hoopa Valley Reservation, which included allottees or their descendants, the opportunity to elect membership in the Yurok Tribe. 25 U.S.C. 1300i-5(c)(1). An Indian who chose not to affiliate with the Yurok Tribe (or

the Hoopa Valley Tribe) received a lump sum payment, but lost any "interest or right whatsoever in the … resources within or appertaining to… the Yurok Reservation." 25 U.S.C. 1300i-5(d)(3).

The Settlement Act also provided an opportunity for the Resighini Rancheria (along with others) to merge its lands and membership with the Yurok Reservation if a majority of the Rancheria's adult members voted in favor of such merger. 25 U.S.C. sec. 1300i-10(b). The Resighini Rancheria members did not exercise this option, the Rancheria remains a separate sovereign tribal government, and the Tribe and its lands were not extinguished through merger with the Yurok Reservation as would have occurred had its members exercised the merger option under The Settlement Act.

3.12.3.6.3 Resighini Rancheria Potentially Affected Trust Resources

In a government-to-government consultation meeting concerning Resighini Rancheria trust resources affected by current dam operations held on September 29, 2010, the Resighini Rancheria asserted the following as Rancheria trust resources: gravel (minerals); water as it relates to ground water for domestic, agricultural, and recreational (campground) uses; riparian plants; wetlands; fish; land; and wildlife. The Resighini Rancheria asserted that the United States has a trust responsibility to protect such resources and ensure that such resources are managed for the beneficial use of the Rancheria and its membership. The Rancheria further asserted that the Federal Government has trust responsibilities to the Rancheria in the areas of social welfare, education, and health. The United States does not necessarily agree that all of the above resources are trust resources but the resources are important to the Rancheria (and thus to the United States) for their traditional ceremonial use. Table 3.12-6 identifies Resighini Rancheria Trust Resources and rights and resources traditionally used by Rancheria members.

Any Klamath River salmonid fishing rights and concomitant water rights to which the Resighini Rancheria may be entitled have not yet been determined [Solicitor's Opinion M-36979 October 4, 1993]. Regardless, the general health and well being and cultural values of the members of the Rancheria are affected by a lack of fish in the local economy and overall water quality. The lack of fish in the local economy also has secondary effects on general tribal health and cultural well being. The Rancheria tribal council person, when asked during consultation if such resources were affected by the current dam operations, responded, "Yes" and went on to relate that water quality has declined, erosion of lands occurs at a higher rate, replenishment of gravel extraction beds has diminished, and fish returns are low. In addition, as a tribe that lives alongside the river, their aesthetic quality of life has diminished. The Rancheria people are at risk when they bathe in the river, tourists are less interested in visiting the Klamath River and staying in the campground, and in an area with fewer available fish, tribal members are likely to consume fewer traditional food resources. This has led to related impacts on tribal health such as higher rates of obesity, diabetes, heart disease, and stroke (DOI 2011; DOI 2012).

Table 3.12-6. Effects of Current Dam Operations on Trust Resources and Rights and Resources Traditionally Used by the Resighini Rancheria

Trust Resource/Right	Other Resources Traditionally Used By The Tribes	Effects
Water resources (ground water)		Indeterminate ground water quality
	Water resources (instream)	Altered flows
		Altered water temperature regime
		Degraded water quality caused by nutrient input, dissolved oxygen, pH, algal toxins and other contaminants
		Diminished aesthetics
		Algae clogged fishnets
		Human exposure to toxic water while conducting cultural activities
		Diminished opportunity for traditional bathing
	Aquatic resources	Loss of habitat
		Less suitable water temperature regime
		Reduced bedload transfer
		Increased potential for disease/parasites
		Reduced population size
		Less traditional salmon diet and increased risk of heart disease, strokes, diabetes, and obesity
		Tribal members leaving reservation
		Fewer opportunities for transmitting traditional knowledge
		Increase in invasive species (Asian clams)
Terrestrial Resources		Real property: erosion and flooding
		Mineral: less gravel replacement
	Terrestrial resources	Reduced food availability
		Reduced riparian habitat
		Diminished plant availability for cultural practices and related benefits
		Loss of opportunity for inter-generational traditional knowledge transmission

Source: DOI 2011; DOI 2012

The Yurok of the Resighini Rancheria bathe in the river and use its water for daily and ritualistic purposes. Because of their reliance on the river for so many aspects of their lives, they are concerned about the quality of its water. The Klamath Hydroelectric Project has effects on water quality and related environmental issues, such as watershed health, riparian habitats, erosion, sediment, turbidity, sources of pollution and temperature changes, algae blooms, low dissolved oxygen, high pH, and un-ionized

ammonia. The cumulative effects may result in health problems, not just for the people who live on the Rancheria, but also for the tourists who come and camp in the area every year, and for people who use the water for business purposes or who work for those businesses.

A 1975 Resighini Rancheria Water Resources Investigation Report states that samples were not taken of the water in the abandoned well. It also states that coliform was found in a sample taken from a stream running through the Rancheria. A second report completed by the Bureau of Reclamation (Reclamation) in 2010 to document an Environmental Assessment of the Resighini Rancheria's Water Resources states: "The Rancheria is in need of an additional source of dependable drinking water to reduce potential health risks associated with their current operation." Later, the same document states: "Hydrogeologic information is currently not available for water-bearing formation, ground water level trends, and ground water storage for the Lower Klamath River Valley ground water basin."

3.12.3.6.4 Resighini Rancheria Health Impacts

Secondary effects of the Klamath River dams on the people of the Resighini Rancheria include emotional and physical health effects such as increased obesity, diabetes, heart disease due to loss of the traditional salmon diet, and depression, alienation, and suicide. Additionally, the tribal members experience a loss of opportunity for inter-generational transmission of traditional knowledge. These conditions result in tribal members, especially young people, leaving the reservation for opportunities elsewhere (DOI 2011; DOI 2012).

3.12.3.6.5 Effects Determinations

Alternative 1: No Action/No Project - Resighini Rancheria and Damming of the River

Continued impoundment of water could affect tribal trust resources and other traditionally used resources. The Klamath River dams have significantly reduced the ability of tribal members to engage in traditional and contemporary subsistence and religious practices. The availability and rights to traditional foods and basket-making materials have been affected by the presence of the dams. The dams have altered the natural flows of the river, which has affected the formation of the sand spit in terms of sand buildup and the ability of the river to clear a path through the spit to the ocean. As a result of altered functions, including increased sand build up coupled with seasonal low flows, the Rancheria has experienced more fall flooding of its lands.

The Rancheria members have noticed an invasion of clams (identified generally as "Asian clams") and wonder how that might alter the ecosystem. The tribe is not sure whether invasive species can be directly attributed to the dams, but does know that the clams have migrated from upriver to downriver. Although new species are introduced into the ecosystem with unknown consequences to Rancheria members, the Rancheria has also witnessed the demise of traditional species such as the spring run of Chinook and

the near extinction of the Klamath population of eulachon. The demise of these populations is generally attributed to poor Klamath River water quality (DOI 2011; DOI 2012).

Many historic and current factors, such as mining, timber extraction, agricultural production, and cattle grazing, affect the environmental integrity of the Klamath Basin. Mining activities in the Klamath basin have significantly decreased over the last several decades. Timber extraction in the basin has slowly become controlled by better regulations at the Federal and State levels to the point where timber extraction is now better characterized as forest management, as noted above.

However, the current operations of the four Klamath River dams significantly affect the trust resources of the Resighini Rancheria and, by extension, their cultural values, and their continued operation under the No Action/No Project Alternative would result in no change from existing conditions.

3.12.3.6.6 Alternative 2: Full Facilities Removal of Four Dams Alternative (the Proposed Action)

Removal of the Four Facilities could affect tribal trust resources and other traditionally used resources. Under the Proposed Action, four dams and their associated hydroelectric facilities along the Klamath River would be removed. Keno Dam would be transferred to the DOI, the East and Westside Facilities would be decommissioned, the City of Yreka Water Supply Pipeline would be installed, and the KBRA would be implemented. KBRA programs would have effects on trust resources of aquatic resources, water quality, and terrestrial resources, which are discussed Sections 3.2, 3.3, and 3.5 of this EIS/EIR. Implementation of the Proposed Action, including the KHSA and KBRA, would, in the long term, benefit the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by the Resighini Rancheria (Table 3.12-5).

3.12.3.6.7 Alternative 3: Partial Facilities Removal of Four Dams

Partial facilities removal could affect tribal trust resources and other traditionally used resources. Under the Partial Facilities Removal of Four Dams Alternative, four dams and their associated hydroelectric facilities would be partially removed to provide for volitional fish passage. Keno Dam would be transferred to the DOI, the East and Westside Facilities would be decommissioned, the KBRA would be implemented, and the City of Yreka Water Supply Pipeline would be installed. Implementation of the Partial Facilities Removal of Four Dams Alternative, including the KHSA and KBRA, would, in the long term, benefit the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by the Resighini Rancheria (Table 3.12-5). Actions addressing these issues are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

3.12.3.6.8 Alternative 4: Fish Passage at Four Dams

Fish passage at four dams could affect tribal trust resources and other traditionally used resources. Under the Fish Passage at Four Dams Alternative operation of the existing dams and hydroelectric facilities would continue along the Klamath River and fish

passage facilities would be constructed at the four dams. Keno Dam would not be transferred to DOI and the KBRA would not be implemented. Implementation of the Fish Passage at Four Dams Alternative would benefit fish populations. However, implementation of this alternative would not resolve the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by the Resighini Rancheria (Table 3.12-5). Under the Fish Passage at Four Dams Alternative issues related to water, aquatic, and terrestrial resources related to trust resources and rights would persist.

3.12.3.6.9 Alternative 5: Fish Passage at Two Dams, Remove Copco 1 and Iron Gate

Fish passage at two dams and facilities removal of two dams could affect tribal trust resources and other traditionally used resources. Under the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative, two dams, their associated hydroelectric facilities, and fish hatchery facilities along the Klamath River would be removed and fish passage facilities would be constructed at two dams. Under this alternative, Keno Dam would not be transferred to the DOI and the KBRA would not be implemented. Implementation of the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative would address the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by the Resighini Rancheria (Table 3.12-5), but not to the same degree as the Proposed Action or Partial Facilities Removal of Four Dams Alternatives. Actions addressing issues related to water, aquatic, and terrestrial resources are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

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Appendix W

Additional Information Incorporated by Reference

Table B-6. Human Health Water Quality Criteria for the Secretarial Determination Klamath River Sediment Study

Chemical	Units	California Department of Public Health CCR		California Basin Plan					National RWQC Priority		National RWQC Non-priority		California Ocean Plan		Oregon DEQ HH		Oregon DEQ WQ Criteria	
		MCL	Primary MCL	Secondary MCL	Agriculture	Human Health CTR	Human Health NTR	Human Water and Organism	Human Organism	Human Water and Organism	Human Organism	Human Health NCAR	Human Health CAR	Human Water and Organism	Human Organism	Human Water and Organism	Human Organism	Human Drinking Water
Conventionals																		
Chloride	µg/L	250,000		250,000	106,000													
Metals and AVS																		
Aluminum	µg/L	1,000	1,000	200	5,000													
Antimony	µg/L	6	6			14		5.6	640			1,200		146	45,000	146	45,000	
Arsenic	µg/L	10	50		100			0.018	0.14					0.0022	0.0175	0.0022	0.0175	50
Cadmium	µg/L	5	5		10											10		10
Chromium	µg/L	50	50		100							190,000				170,000	3,433,000	50
Copper	µg/L	1,000	1,300	1,000	200	1,300		1,300						1,300				
Iron	µg/L	300		300	5,000					300				300		300		
Lead	µg/L		15		5,000											50		50
Mercury	µg/L	2	2			0.05										0.144	0.146	2
Nickel	µg/L	100	100		200	610		610	4,600					13.4	100	13.4	100	
Selenium	µg/L	50	50		20			170	4,200					10		10		10
Silver	µg/L	100		100												50		50
Zinc	µg/L	5,000		5,000	2,000			7,400	26,000									
Organics PAHs																		
Acenaphthene	µg/L					1,200		670	990									
Acenaphthylene	µg/L																	
Anthracene	µg/L					9,600		8,300	40,000									
Benz(a)anthracene	µg/L					0.0044		0.0038	0.018									
Benzo(a)pyrene	µg/L	0.2	0.2			0.0044		0.0038	0.018									
Benzo(b)fluoranthene	µg/L					0.0044		0.0038	0.018									
Benzo(g,h,i)perylene	µg/L																	
Benzo(k)fluoranthene	µg/L					0.0044		0.0038	0.018									
Chrysene	µg/L					0.0044		0.0038	0.018									
Dibenz(a,h)anthracene	µg/L					0.0044		0.0038	0.018									
Fluoranthene	µg/L					300		130	140			15		42	54	42	54	
Fluorene	µg/L					1,300		1,100	5,300									
Indeno(1,2,3-cd)pyrene	µg/L					0.0044		0.0038	0.018									
Naphthalene	µg/L																	
Phenanthrene	µg/L																	
Pyrene	µg/L					960		830	4,000									
Organics PCBs																		
Aroclor 1016	µg/L	0.5																
Aroclor 1221	µg/L	0.5																
Aroclor 1232	µg/L	0.5																

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Chemical	Units	California Department of Public Health CCR		California Basin Plan					National RWQC Priority		National RWQC Non-priority		California Ocean Plan		Oregon DEQ HH		Oregon DEQ WQ Criteria	
		MCL	Primary MCL	Secondary MCL	Agriculture	Human Health CTR	Human Health NTR	Human Water and Organism	Human Organism	Human Water and Organism	Human Organism	Human Health NCAR	Human Health CAR	Human Water and Organism	Human Organism	Human Water and Organism	Human Organism	Human Drinking Water
Aroclor 1242	µg/L	0.5																
Aroclor 1248	µg/L	0.5																
Aroclor 1254	µg/L	0.5																
Aroclor 1260	µg/L	0.5																
Total PCBs	µg/L	0.5	0.5			0.00017		0.000064	0.000064					0.000079	0.000079	0.000079	0.000079	
Organics Carbamate Pesticides																		
3-Hydroxycarbofuran	µg/L																	
4,4'-DDD	µg/L					0.00083		0.00031	0.00031				0.00017	0.000024	0.000024	0.000024	0.000024	
4,4'-DDE	µg/L					0.00059		0.00022	0.00022									
4,4'-DDT	µg/L							0.00022	0.00022									
Alachlor	µg/L	2	2															
Aldicarb	µg/L																	
Aldicarb sulfone	µg/L																	
Aldicarb sulfoxide	µg/L																	
Aldrin	µg/L					0.00013		0.000049	0.00005				0.000022	0.000074	0.000079	0.000074	0.000079	
Atrazine	µg/L	1	1															
BHC-alpha (HCH-alpha)	µg/L					0.0039		0.0026	0.0049					0.0092	0.031	0.0092	0.031	
BHC-beta (HCH-beta)	µg/L					0.014		0.0091	0.017					0.0163	0.0547	0.0163	0.0547	
BHC-delta (HCH-delta)	µg/L																	
BHC-gamma (HCH-gamma, Lindane)	µg/L	2	0.2			0.019		0.98	1.8					0.0186	0.0625	0.0186	0.0625	4
Bromacil	µg/L																	
Butachlor	µg/L																	
Carbaryl	µg/L																	
Carbofuran	µg/L	18																
Chlordane	µg/L	0.1	0.1			0.00057		0.0008	0.00081				0.000023	0.00046	0.00048	0.00046	0.00048	
Chlorothalonil	µg/L																	
Dieldrin	µg/L					0.00014		0.000052	0.000054				0.00004	0.000071	0.000076	0.000071	0.000076	
Endosulfan I	µg/L					110		62	89					74	159	74	159	
Endosulfan II	µg/L							62	89									
Endosulfan sulfate	µg/L							62	89									
Endrin	µg/L	2	2			0.76		0.059	0.06					1		1		0.2
Endrin aldehyde	µg/L							0.29	0.3									
Heptachlor	µg/L	0.01	0.01			0.00021		0.000079	0.000079				0.00005	0.00028	0.00029	0.00028	0.00029	
Heptachlor epoxide	µg/L	0.01						0.000039	0.000039				0.00002					
Methomyl	µg/L																	
Methoxychlor	µg/L	30	30							100				100		100		100
Molinate	µg/L	20																

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		MCL	Primary MCL	Secondary MCL	Agriculture	Human Health CTR	Human Health NTR	Human Water and Organism	Human Organism	Human Water and Organism	Human Organism	Human Health NCAR	Human Health CAR	Human Water and Organism	Human Organism	Human Water and Organism	Human Organism	Human Drinking Water
Oxamyl	µg/L	50																
Propachlor	µg/L																	
Simazine	µg/L	4	4															
Thiobencarb	µg/L	70																
Toxaphene	µg/L	3	3			0.00073		0.00028	0.00028				0.00021	0.00071	0.00073	0.00071	0.00073	5
Organics Phthalates																		
Bis(2-ethylhexyl) phthalate	µg/L							1.2	2.2									
Butyl benzyl phthalate	µg/L							1,500	1,900									
Diethyl phthalate	µg/L							17,000	44,000			33,000		350,000	1,800,000	350,000	1,800,000	
Dimethyl phthalate	µg/L							270,000	1,100,000			820,000		313,000	2,900,000	313,000	2,900,000	
Di-N-butyl phthalate	µg/L							2,000	4,500			3,500						
Organics VOCs																		
1,2-Dibromoethane	µg/L		0.05															
1,3,5-Trimethylbenzene	µg/L																	
2,4-Dinitrotoluene	µg/L							0.11	3.4				2.6	0.11	9.1	0.11	9.1	
2,6-Dinitrotoluene	µg/L																	
Benzene	µg/L	1	1			1.2		2.2	51				5.9	0.66	40	0.66	40	
Bromobenzene	µg/L																	
Bromochloromethane	µg/L																	
Bromodichloromethane	µg/L		100			0.56												
Bromoform	µg/L		100			4.3		4.3	140									
Carbon disulfide	µg/L																	
Carbon tetrachloride	µg/L	0.5	0.5				0.25	0.23	1.6				0.9	0.4	6.94	0.4	6.94	
Chlorobenzene	µg/L	70	70				680	130	1,600			570						
Chloroethane	µg/L																	
Chloroform	µg/L		100					5.7	470				130	0.19	15.7	0.19	15.7	
Chloromethane	µg/L																	
Cis-1,2-Dichloroethene	µg/L	6	6															
Dibromochloromethane	µg/L		100			0.41		0.4	13				6.2					
Dibromomethane	µg/L																	
Dichlorodifluoromethane	µg/L																	
Ethylbenzene	µg/L	300	300				3,100	530	2,100			4,100		1,400	3,280	1,400	3,280	
Isopropylbenzene	µg/L																	
Methylene chloride	µg/L							4.6	590									
MTBE	µg/L	13																
N-butylbenzene	µg/L																	
N-propylbenzene	µg/L																	

Table B-6. Human Health Water Quality Criteria for the Secretarial Determination Klamath River Sediment Study

Chemical	Units	California Department of Public Health CCR		California Basin Plan					National RWQC Priority		National RWQC Non-priority		California Ocean Plan		Oregon DEQ HH		Oregon DEQ WQ Criteria	
		MCL	Primary MCL	Secondary MCL	Agriculture	Human Health CTR	Human Health NTR	Human Water and Organism	Human Organism	Human Water and Organism	Human Organism	Human Health NCAR	Human Health CAR	Human Water and Organism	Human Organism	Human Water and Organism	Human Organism	Human Drinking Water
Pentachloroethane	µg/L																	
Sec-butylbenzene	µg/L																	
Styrene	µg/L	100																
Tert-butylbenzene	µg/L																	
Tetrachloroethene	µg/L	5	5				0.8	0.69	3.3				2	0.8	8.85	0.8	8.85	
Toluene	µg/L	150	150			6,800		1,300	15,000			85,000		14,300	424,000	14,300	424,000	
Vinyl chloride	µg/L	0.5	0.5				2	0.025	2.4				36	2	525	2	525	
Organics SVOCs: Phenols																		
2,4,5-Trichlorophenol	µg/L									1,800	3,600			2,600		2,600		
2,4,6-Trichlorophenol	µg/L							1.4	2.4				0.29	1.2	3.6	1.2	3.6	
2,4-Dichlorophenol	µg/L							77	290					3,090		3,090		
2,4-Dimethylphenol	µg/L							380	850									
2,4-Dinitrophenol	µg/L							69	5,300			4						
2-Chlorophenol	µg/L							81	150									
2-Nitrophenol	µg/L																	
4,6-Dinitro-2-methylphenol	µg/L							13	280									
4-Chloro-3-methylphenol	µg/L																	
4-Nitrophenol	µg/L																	
Pentachlorophenol	µg/L	1	1			0.28		0.27	3					1,010		1,010		
Phenol	µg/L							10,000	860,000					3,500		3,500		
Organics SVOCs: Chlorinated Hydrocarbons																		
1,1,1,2-Tetrachloroethane	µg/L																	
1,1,1-Trichloroethane	µg/L	200	200									540,000				18,400	1,030,000	
1,1,2,2-Tetrachloroethane	µg/L	1	1				0.17	0.17	4				2.3	0.17	10.7	0.17	10.7	
1,1,2-Trichloroethane	µg/L	5	5				0.6	0.59	16				9.4	0.6	41.8	0.6	41.8	
1,1-Dichloroethane	µg/L	5	5															
1,1-Dichloroethene	µg/L	6	6				0.057	330	7,100				0.9					
1,1-Dichloropropene	µg/L																	
1,2,3-Trichlorobenzene	µg/L																	
1,2,3-Trichloropropane	µg/L																	
1,2,4-Trichlorobenzene	µg/L	5	5					35	70									
1,2-Dibromo-3-chloropropane	µg/L		0.2															
1,2-Dichlorobenzene	µg/L	600	600			2,700		420	1,300									
1,2-Dichloroethane	µg/L	0.5	0.5				0.38	0.38	37				28	0.94	243	0.94	243	
1,2-Dichloropropane	µg/L	5	5			0.52		0.5	15									
1,3-Dichlorobenzene	µg/L					400		320	960									
1,3-Dichloropropane	µg/L																	

Table B-6. Human Health Water Quality Criteria for the Secretarial Determination Klamath River Sediment Study

Chemical	Units	California Department of Public Health CCR		California Basin Plan					National RWQC Priority		National RWQC Non-priority		California Ocean Plan		Oregon DEQ HH		Oregon DEQ WQ Criteria	
		MCL	Primary MCL	Secondary MCL	Agriculture	Human Health CTR	Human Health NTR	Human Water and Organism	Human Organism	Human Water and Organism	Human Organism	Human Health NCAR	Human Health CAR	Human Water and Organism	Human Organism	Human Water and Organism	Human Organism	Human Drinking Water
1,4-Dichlorobenzene	µg/L	5	5			400		63	190				18					
2,2-Dichloropropane	µg/L																	
2-Chloronaphthalene	µg/L							1,000	1,600									
2-Chlorotoluene	µg/L																	
3,3'-Dichlorobenzidine	µg/L							0.021	0.028				0.0081					
4-Chlorophenyl phenyl ether	µg/L																	
4-Chlorotoluene	µg/L																	
Bis(2-Chloroethoxy)methane	µg/L																	
Bis(2-Chloroethyl) ether	µg/L							0.03	0.53				0.045	0.03	1.36	0.03	1.36	
Bis(2-Chloroisopropyl) ether	µg/L							1,400	65,000					34.7	4,360	34.7	4,360	
Hexachlorobenzene	µg/L	1						0.00028	0.00029				0.00021	0.00072	0.00074	0.00072	0.00074	
Hexachlorobutadiene	µg/L							0.44	18				14	0.45	50	0.45	50	
Hexachlorocyclopentadiene	µg/L	50						40	1,100			58		206		206		
Hexachloroethane	µg/L							1.4	3.3				2.5	1.9	8.74	1.9	8.74	
Trans-1,2-dichloroethene	µg/L	10	10			700		140	10,000									
Trichloroethene	µg/L	5	5			2.7		2.5	30				27	2.7	80.7	2.7	80.7	
Trichlorofluoromethane	µg/L	150	150															
Organics Other SVOCs																		
Isophorone	µg/L							35	960				730	5,200	520,000	5,200	520,000	
Nitrobenzene	µg/L							17	690			4.9		19,800		19,800		
N-nitrosodi-n-propylamine	µg/L							0.005	0.51									
N-nitrosodiphenylamine	µg/L							3.3	6				2.5	4.9	16.1	4.9	16.1	
Organics Polychlorinated Dioxins and Furans																		
2,3,7,8-TCDD	µg/L	0.00003	0.00003			1.3E-08		5E-09	5.1E-09					1.3E-08	1.4E-08	1.3E-08	1.4E-08	
Organics PBDEs																		
4-Bromophenyl phenyl ether	µg/L																	

Water Quality Criteria Key:

CCR= California Code of Regulations
MCL= Maximum Contaminant Level
RWQC= Recommended Water Quality Criteria
DEQ= Department of Environmental Quality
CTR= California Toxics Rule
NTR = National Toxics Rule
NCAR= Non-carcinogenic
CAR= Carcinogenic

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Chemical	Units	California Department of Public Health CCR		California Basin Plan					National RWQC Priority		National RWQC Non-priority		California Ocean Plan		Oregon DEQ HH		Oregon DEQ WQ Criteria	
		MCL	Primary MCL	Secondary MCL	Agriculture	Human Health CTR	Human Health NTR	Human Water and Organism	Human Organism	Human Water and Organism	Human Organism	Human Health NCAR	Human Health CAR	Human Water and Organism	Human Organism	Human Water and Organism	Human Organism	Human Drinking Water

Units Key:

µg= microgram (10^{-6} gram)

L= liter

Table 3.5-3 Previously Recorded Archaeological Sites and Built Environment Resources

Primary No.	State Trinomial	Component Age	Site Type	Year(s) Recorded or Updated	NRHP Eligibility*
P-47-000016	CA-SIS-16/H	Multiple	Prehistoric Village/Rockshelter with Historic Artifact Scatter	1953, 1995, 2002	3B
P-47-000017	CA-SIS-17/H	Multiple	Prehistoric Village, Cemetery, and Historic Ranch	1953, 1988	7
P-47-000155	CA-SIS-155	Prehistoric	Village	1952	7
P-47-000156	CA-SIS-156	Prehistoric	Campsite	1952	7
P-47-000157	CA-SIS-157	Prehistoric	Lithic Scatter and Features	1952	7
P-47-000158	CA-SIS-158	Prehistoric	Lithic Scatter	1952, 2007	7
P-47-000159	CA-SIS-159	Prehistoric	Lithic Scatter	1952	7
P-47-000161	CA-SIS-161	Prehistoric	Village	1952	7
P-47-000264	CA-SIS-264	Prehistoric	Burial	1957	7
P-47-000326	CA-SIS-326	Prehistoric	Village	1960, 1961, 1969, 1973	7
P-47-000328	CA-SIS-328	Prehistoric	Lithic Scatter	1965, 2007	7
P-47-000329	CA-SIS-329/H	Multiple	Prehistoric Lithic Scatter, Burial, and Historic Artifact Scatter	1965, 2000	7
P-47-000498	CA-SIS-498-H	Historic	Pokegama Log Chute	1970s, 1997, 2002, 2003	1B
P-47-000513	CA-SIS-513-H	Historic	Klamath Hot Springs/Beswick	1970s, 2004	7
P-47-000522	CA-SIS-522-H	Historic	Empire Quartz Mine	1976	7
P-47-000536	CA-SIS-536-H/ CA-SIS-1315-H	Historic	Klamathon Town Site and Lumber Mill	1970s, 1986, 1987, 2011	7
P-47-000630	CA-SIS-630	Prehistoric	Village	1977	7
P-47-000632	CA-SIS-632/H	Multiple	Prehistoric Village; Mine and Historic Artifact Scatter	1977, 2004	7
P-47-000873	CA-SIS-873	Prehistoric	Lithic Scatter	1982	7
P-47-001066	CA-SIS-1066/H	Multiple	Midden with Lithic Scatter and Features; Mine with	1981, 1983, 1999	2

Primary No.	State Trinomial	Component Age	Site Type	Year(s) Recorded or Updated	NRHP Eligibility*
			Features		
P-47-001198	CA-SIS-1198/H	Multiple	Prehistoric Village; Historic Feature with Artifact Scatter	1984, 1992, 1993, 1995	2D1
P-47-001314	CA-SIS-1314-H	Historic	Dump	1987	7
P-47-001670	CA-SIS-1670	Prehistoric	Lithic Scatter and Features	1993, 1996, 2000	3S
P-47-001671	CA-SIS-1671-H	Historic	Klamath Lake Railroad Grade	1993, 2004	7
P-47-001672	CA-SIS-1672-H	Historic	Structures, Ditch, and Artifact Scatter	1992	7
P-47-001721	CA-SIS-1721	Prehistoric	Village	1996	2D1
P-47-001776	N/A	Prehistoric	Lithic Scatter	1995	7
P-47-001838	CA-SIS-1838/H	Multiple	Prehistoric Village; Historic Ranch with Structures	1994, 1999	3S
P-47-001839	CA-SIS-1839/H	Multiple	Prehistoric Lithic Scatter; James Whalen Saloon	1994, 2002	7
P-47-001840	CA-SIS-1840	Prehistoric	Village	1994, 2002	3S
P-47-002117	CA-SIS-2117-H	Historic	Features	1996	6Z
P-47-002126	CA-SIS-2126-H	Historic	Large Refuse Dump	1996	7
P-47-002127	CA-SIS-2127-H	Historic	Habitation with Artifact Scatter	1996	7
P-47-002128	N/A	Ethnographic	Traditional Cultural Property (TCP)	1996	3
P-47-002129	CA-SIS-2129-H	Historic	Grieve-Miller-DeSoza Ditch	1996	3
P-47-002130	N/A	Historic	Rock Wall	1996	6Z
P-47-002131	CA-SIS-2131	Prehistoric	Features	1996	7
P-47-002132	CA-SIS-2132	Prehistoric	Lithic Scatter	1996	7
P-47-002237	CA-SIS-2237-H	Historic	Copco Mutual Flume	1995	3S
P-47-002238	CA-SIS-2238-H	Historic	Greek Ovens	1995	3S
P-47-002239	CA-SIS-2239-	Historic	COPCO II Ranch	1996	4S2

Primary No.	State Trinomial	Component Age	Site Type	Year(s) Recorded or Updated	NRHP Eligibility*
	H		Features		
P-47-002241	CA-SIS-2241/H	Multiple	Prehistoric Village and Features; Historic Irrigation Ditch	1980, 1995, 2002	3S
P-47-002263	CA-SIS-2263	Prehistoric	Lithic Scatter and Features	1997, 2000, 2002	7
P-47-002264	CA-SIS-2264	Prehistoric	Village	1997	3S
P-47-002266	N/A	Historic	COPCO II Powerhouse	1997	3S
P-47-002267	N/A	Historic	COPCO I Powerhouse	1997, 2003	3S
P-47-002268	N/A	Historic	Fall Creek Powerhouse	1997	3S
P-47-002400	CA-SIS-2400/H	Multiple	Prehistoric Village; Historic Cabin and Artifact Scatter	1997, 2002	3S
P-47-002401	CA-SIS-2401	Prehistoric	Lithic Scatter	1997, 2002	3S
P-47-002402	CA-SIS-2402/H	Multiple	Lithic Scatter and Features; Historic Foundation	1997, 2002	7
P-47-002403	CA-SIS-2403/H	Multiple	Prehistoric Village; Historic Rock Wall and Artifact Scatter	1997, 2003	3S
P-47-002566	CA-SIS-2566	Prehistoric	Lithic Scatter and Features	1999, 2004	3S
P-47-002567	CA-SIS-2567/H	Multiple	Prehistoric Village; Historic Refuse	1999, 2001, 2004	3S
P-47-002568	CA-SIS-2568	Prehistoric	Lithic Scatter, Features, and Burial Site	1999	3S
P-47-002569	CA-SIS-2569	Prehistoric	Village and Features	1999, 2002	3S
P-47-002570	CA-SIS-2570	Prehistoric	Village	1999, 2002	3S
P-47-002571	CA-SIS-2571-H	Historic	Burial Cairns	1999	4S2
P-47-002572	CA-SIS-2572	Prehistoric	Lithic Scatter and Features	1998, 2002	3S
P-47-002573	CA-SIS-2573	Prehistoric	Lithic Scatter and Features	1998, 2003	7
P-47-002574	CA-SIS-2574	Prehistoric	Lithic Scatter	1998, 2002	3S

Primary No.	State Trinomial	Component Age	Site Type	Year(s) Recorded or Updated	NRHP Eligibility*
P-47-002575	CA-SIS-2575/H	Multiple	Prehistoric Lithic Scatter; Historic Feature	1998, 2002	3S
P-47-002276	CA-SIS-2576	Prehistoric	Village	1998, 2002	3S
P-47-002577	CA-SIS-2577/H	Multiple	Village; Ranch Complex	1998, 2002, 2004	3S
P-47-002578	CA-SIS-2578/H Locus 1	Multiple	Prehistoric Village and TCP; Historic Barn	1998, 1999, 2002, 2004	3S
P-47-002579	CA-SIS-2579	Prehistoric	Lithic Scatter and Feature	1998	3S
P-47-002591	CA-SIS-2591/H	Multiple	Prehistoric Lithic Scatter and Rock Art; Historic Feature	1999	7
P-47-002646	CA-SIS-2646	Prehistoric	Habitation and Features	1999, 2001	2D1
P-47-002823	CA-SIS-2823-H	Historic	COPCO II Wooden Stave Penstock	2000	3S
P-47-002824	CA-SIS-2824-H	Historic	COPCO Guest House	2000	3S
P-47-002825	CA-SIS-2825/H	Multiple	Lithic Scatter; Historic Dam Vista Homestead	2003	7
P-47-002826	N/A	Historic	Frank Wood Cabin	2000	3S
P-47-002827	CA-SIS-2827	Prehistoric	Village	2000, 2002	3S
P-47-002990	CA-SIS-2990-H	Historic	Irrigation Ditch	1996	6Z
P-47-003192	N/A	Historic	Artifact Scatter	2002	7
P-47-003913	CA-SIS-3913	Prehistoric	Lithic Scatter and Features	2003	7
P-47-003914	CA-SIS-3914	Prehistoric	Lithic Scatter	2003	7
P-47-003915	CA-SIS-3915	Prehistoric	Lithic Scatter	2003	7
P-47-003916	CA-SIS-3916-H	Historic	Wooden Trestle	2003	7
P-47-003917	CA-SIS-3917-H	Historic	Refuse Scatter	2003	7
P-47-003918	CA-SIS-3918-H	Historic	Refuse Scatter	2003	7
P-47-003919	CA-SIS-3919	Prehistoric	Lithic Scatter	2003	7
P-47-003920	CA-SIS-3920	Prehistoric	Lithic Scatter	2003	7

Primary No.	State Trinomial	Component Age	Site Type	Year(s) Recorded or Updated	NRHP Eligibility*
P-47-003921	CA-SIS-3921	Prehistoric	Village	2003	7
P-47-003922	CA-SIS-3922-H	Historic	Copco Village Dump	2003	7
P-47-003923	CA-SIS-3923	Prehistoric	Village and Rockshelter	2003	3S
P-47-003924	CA-SIS-3924	Prehistoric	Lithic Scatter	2003	7
P-47-003925	CA-SIS-3925	Prehistoric	Lithic Scatter	2003	7
P-47-003926	CA-SIS-3926	Prehistoric	Village	2003	7
P-47-003927	CA-SIS-3927-H	Historic	Refuse Scatter and Feature	2003	7
P-47-003928	CA-SIS-3928-H	Historic	Rock Wall	2003	7
P-47-003929	CA-SIS-3929/H	Multiple	Prehistoric Village; Historic Artifact Scatter	2003	7
P-47-003930	CA-SIS-3930	Prehistoric	Lithic Scatter	2003	7
P-47-003931	CA-SIS-3931	Prehistoric	Lithic Scatter and Midden	2002	7
P-47-003932	CA-SIS-3932-H	Historic	Habitation with Artifact Scatter and Features	2002	7
P-47-003933	CA-SIS-3933	Prehistoric	Lithic Scatter and Features	2003	3S
P-47-003934	CA-SIS-3934-H	Historic	Rock Piles	2003	7
P-47-003935	CA-SIS-3935	Prehistoric	Lithic Scatter	2003	7
P-47-003936	CA-SIS-3936-H	Historic	Rock Piles and Rock Alignments	2003	7
P-47-003937	CA-SIS-3937-H	Historic	Rock Wall	2003	7
P-47-003938	CA-SIS-3938	Prehistoric	Lithic Scatter	2003	7
P-47-003939	CA-SIS-3939/H	Multiple	Prehistoric Rockshelter; Historic Artifact Scatter	2003	7
P-47-003940	CA-SIS-3940-H	Historic	Habitation with Artifact Scatter and Features	2003	7
P-47-003941	CA-SIS-3941-H	Historic	Ditch	2002	7
P-47-003942	CA-SIS-3942-	Historic	Rock Wall	2003	7

Primary No.	State Trinomial	Component Age	Site Type	Year(s) Recorded or Updated	NRHP Eligibility*
	H				
P-47-003943	CA-SIS-3943-H	Historic	Rock Wall	2003	7
P-47-003944	CA-SIS-3944-H	Historic	Rock Wall	2003	7
P-47-003945	CA-SIS-3945-H	Historic	Rock Piles	2003	7
P-47-003946	CA-SIS-3946	Prehistoric	Lithic Scatter and Feature	2003	7
P-47-004089	CA-SIS-4089-H	Historic	Road	2002	7
P-47-004212	N/A	Historic	Bridge	2004	2
P-47-004134	CA-SIS-4134/H	Multiple	Prehistoric Lithic Scatter; American Bar Mine	2003, 2004, 2008, 2009	7
P-47-004303	N/A	Historic	Hilt Mine with Artifact Scatter	2007	7
P-47-004304	CA-SIS-4304/H	Multiple	Prehistoric Quarry; Historic Artifact Scatter and Features	2007	7
P-47-004305	N/A	Historic	Rock Wall	2007	7
P-47-004315	CA-SIS-4315-H	Historic	Mine and Ditch	2007	7
P-47-004321	CA-SIS-4321	Prehistoric	Quarry and Feature	2007	7
P-47-004322	CA-SIS-4322	Prehistoric	Quarry	2007	7
P-47-004323	CA-SIS-4323	Prehistoric	Quarry	2007	7
P-47-004326	CA-SIS-4326-H	Historic	Mine	2007	7
P-47-004414	N/A	Historic	Ash Creek Bridge	2000	2
P-47-004427	N/A	Historic	Habitation with Artifact Scatter and Features	2000	7
P-47-004945	CA-SIS-4945-H	Historic	Garvey Gulch Arrastra and Mine	2008	7
P-47-004999	N/A	Historic	Mine	2000	7
P-47-005000	N/A	Historic	Rock Wall	2000	7
P-47-005255	CA-SIS-5255-H	Historic	California Oregon Stage Road	2015	3S
P-47-005256	CA-SIS-5256-H	Historic	Anderson Ditch	2015	6Z

Primary No.	State Trinomial	Component Age	Site Type	Year(s) Recorded or Updated	NRHP Eligibility*
P-47-005346	CA-SIS-5346-H	Historic	Topsy Road	2015	7
N/A	N/A	Unknown	Pollock Site 3	Unknown	7
N/A	N/A	Unknown	Pollock Site 4	Unknown	7
N/A	N/A	Unknown	Pollock Site 5	Unknown	7
N/A	N/A	Unknown	Pollock Site 6	Unknown	7
N/A	N/A	Unknown	Pollock Site 7	Unknown	7
N/A	N/A	Unknown	Pollock Site 10	Unknown	7
N/A	N/A	Unknown	Pollock Site 13	Unknown	7
N/A	N/A	Historic	Habitation with Artifact Scatter and Features	2013, 2016	7
N/A	N/A	Prehistoric	Lithic Scatter	1992	7
N/A	N/A	Prehistoric	Lithic Scatter	1992	7
N/A	N/A	Historic	Klamath Kamp Service Station and Habitation	2015	6Z
N/A	N/A	Historic	Habitation	2015	6Z

*NRHP Eligibility from Cardno ENTRIX (2012) and/or NEIC site records:

- 1B Listed in the National Register as a contributor to a district and separately;
- 2 Determined eligible for listing in the National Register;
- 2D1 Contributor to a district determined eligible by the Keeper;
- 3 Appears eligible for listing in the National Register;
- 3S Appears eligible for separate listing;
- 3B Appears eligible for separate listing and contributor to a district that has been fully documented according to OHP instructions and appears eligible for listing;
- 4S2 May become eligible for separate listing in the National Register when more historical or architectural research is performed on the property;
- 6Z Found ineligible for listing in the National Register;
- 7 Not evaluated.

Isolated Finds

The KRRC records search identified 68 isolated finds, including 65 prehistoric resources, 2 historic-period isolates, and 1 isolated feature of unknown age (Table 3.5-4). Prehistoric isolates include one small rock cairn, one bedrock milling feature, one location with two possible cupule boulders, one incised cobble, one piece of possible ground stone, one unifacial mano, one cobble mortar, one basalt maul, three obsidian biface fragments, one chert biface fragment, one basalt core, nine chert cores, one jasper core, two chert flake tools, one chert barbed projectile point, one chert projectile point midsection, one chert scraper, and four obsidian unifaces. Forty-one isolate locations were found to contain debitage,